DIAGNOSIS AND TREATMENT OF ACUTE MEDICAL DISORDERS

FRANCIS D. MURPHY, M.D., F.A.C.P.

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By

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This book

is affectionately dedicated

to

ANTHONY F. BERENS, S.J.

Preface

THIS book is intended for the general practitioner and medical student. For more than 20 years as Clinical Director of the Milwaukee County General Hospital and the Emergency Unit, as a teacher, and as a practitioner, I have observed that while chronic illnesses are managed very satisfactorily, many difficulties are encountered in the care of the acute disorders. What I have put down here is the result of my experience during active medical practice. It has been my belief that the basis of what one teaches should consist of facts which he has proved to his satisfaction.

This book was written with the aim of passing on to the practitioner diagnostic procedures and methods of treatment which have been found helpful in the management of the acute case. Acute disorders are apt to occur with dramatic suddenness, and the physician, when called, must mobilize at once his store of general knowledge and be prepared to act quickly and with precision. If one is working in a hospital fully equipped for such cases, the task is hard enough; but the one who is called to see the patient in the home, at the factory, or on the street is face to face with a critical problem that taxes his skill and judgment to the utmost, and his decision may mean the life or death of the patient.

The size of this book does not warrant the inclusion of a bibliography and lengthy references, but I am not unaware of the many splendid contributions which have appeared in the medical literature and the helpful suggestions I have gained from them. Diagnostic and therapeutic methods have been brought together into what I believe to be a practical plan for the management of the patient. If I have been successful in presenting a few useful hints in diagnosis and treat-

ment, or have served to remind some reader of information possessed at one time, but now half-forgotten, this book will have fulfilled its purpose.

Finally, I would like to express my cordial thanks to the House Staff of the Milwaukee County Hospital, who have been generous and helpful to me in writing this book, and especially to Miss Audrey Salb for her patience, skillful help, and guidance in the preparation of the manuscript.

FRANCIS D. MURPHY, M.D.

Foreword

THE acute episodes of disease and the emergencies which at times attain life endangering importance must be regarded as among the most disturbing problems that confront the practitioner of medicine. The recognition of this fact led Dr. Murphy to undertake the preparation of a volume which is unique, in that it is devoted entirely to the diagnosis and treatment of those acute conditions which ordinarily come under the observation of the internist and general practitioner.

Few men are so well qualified to write such a book as is Dr. Murphy. By reason of his long years of service in the practice of internal medicine and in the medical wards of large general hospitals, he has been able to embody in his writings, observations and suggestions that not only represent much careful study, but which are based primarily on an extensive practical clinical experience.

The subjects which are discussed in his book have been selected because, over the years, the author has found them to be the acute conditions with which he has been most frequently confronted. When a physician is faced with some acute episode in the course of a disease, he needs precise information in a concise and readily available form. This volume is the only text with which we are familiar that meets these requirements and makes it possible for the hard pressed doctor to obtain urgently needed help without searching numerous comprehensive medical texts.

Dr. Murphy has sought to make this book essentially practical. To that end, long discussions of etiology and pathology have been sacrificed and diagnosis, especially differential diagnosis, and treatment emphasized. The management of patients has been gone into with great detail, so that the reader can obtain exact information as to

how to carry out the suggested therapies. It will be found that the acute situations with which the doctor is ordinarily confronted are all covered in this volume.

Dr. Murphy is to be congratulated upon having produced a work of unusual value and which reflects his own ideas and experience. It should prove of especial interest not only to medical students and young physicians, but also to those of ripe experience who, nevertheless, are only too often puzzled and disturbed by the acute and dramatic manifestations presented by most medical conditions.

GEORGE MORRIS PIERSOL, M.D.

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CHAPTER I

Vascular Disease

HYPERTENSIVE CEREBRAL VASCULAR CRISIS

This important syndrome is more properly termed the acute vascular crisis of hypertension, and corresponds to the "vascular crisis of Pal." Other names which have been erroneously given to this syndrome are the "pseudo-uremia" of Volhard, the "hypertensive encephalopathy" of Oppenheim and Fishberg, and the "pseudo-tumor" of Nonne. The latter three are usually manifestations of malignant hypertension or secondary to the hypertension due to chronic nephritis. The syndrome here described is most generally observed in patients with essential benign hypertension.

Etiology: Pathogenesis of this spectacular complication of hypertension is still rather vague. It would appear as though the sudden onset of symptoms was brought about by an abrupt rise in blood pressure. Some feel that this is due to marked spasm of the cerebral vascular system. Others have attempted to show that the arterioles are not spastic but are dilated, resulting in an increased pressure in both the arterial and venous sides of the capillary network. This latter phenomenon may occur in younger individuals in whom cerebral edema may be the chief factor, while it is very likely that a sudden rise of blood pressure in the older age groups is due to the inability of the cerebral arterioles to relax. At times a definite increase in intracranial pressure is reflected in an increased spinal fluid.

Signs and Symptoms: Clinical evidence of what appears at first to be a cerebral hemorrhage sets in abruptly. In some cases, there is complete hemiplegia; in others only a cloudiness of mentality develops which gradually increases until the patient is in the twilight zone of consciousness. The symptom complex in its milder form is characterized by an increasingly severe headache, mental confusion, and drowsiness. This is followed by dizziness, nausea, vomiting, and visual disturbances. The more severe cases may develop temporary aphasia, paresis, paralysis, convulsions, and even coma. Usually the symptoms subside as rapidly as they appeared. It is not uncommon

to see a patient with a complete paralysis of one side of the face, the leg and arm, only to find several hours later that there is no evidence of paralysis or even a residual paresis. The attacks occur in two definite types of patients: (1) Those with evidence of cerebral edema who are usually under 40 years of age, and (2) those without evidence of cerebral edema, usually over the age of 40.

My own observations of this disorder prompt me to emphasize the importance of keeping an open mind when a hypertensive's behavior verges on the pathological side. Sometimes such patients appear drunk, mentally disordered, or merely vicious and reckless. Final diagnosis should be made slowly and carefully; remember things are not always what they appear to be on the surface.

Pathology: Histologically, examination of the brain fails to reveal vascular changes. This would tend to support the spasm theory or the theory of altered arterial or arteriolar response to an increased blood pressure. Some cases reveal cerebral edema, which may also be explained on the aforementioned basis. There is not much doubt that spasm may be the etiological factor in younger patients, but the physiological vascular response theory is more applicable to the older patients.

Prognosis: Prognosis does not depend on the acute vascular attack but rather on the changes that occur in other vital organs in association with the crisis, the most salient of which are the heart and kidney. Recovery is usually prompt and spontaneous, and thereby the prognosis differs from that of true cerebral hemorrhage, thrombosis, or embolism.

TREATMENT

In general, masterful inactivity is the therapy of choice. An ice bag applied to the head and a hot-water bottle to the feet is usually sufficient, but the following may be instituted:

1. The patient should be kept in a comfortable position.
2. Spinal tap and slow drainage of fluid is indicated if pressure is high.
3. Fifty to 100 cc. of 50 per cent sucrose or glucose may be given intravenously twice a day.
4. Vasodilators, such as nitroglycerin, amyl nitrite, and xanthine derivatives, may be of value.

5. Hormonal therapy has been tried with some success. Testosterone propionate may be given intramuscularly to males. The dosage is four 25 mg. (5/12 grain) injections in the first week; three injections of 25 mg. (5/12 grain) in the second week; 10 mg. (1/6 grain) doses three times a week for the next two weeks; 10 mg. (1/6 grain) twice a week for the next three weeks, and 10 mg. (1/6 grain) once a week up to the twelfth week of therapy. Females are given mixed estrogens and estrones in 10,000 I. U. doses, and estradiol dipropionate in doses of 0.2 mg. (1/300 grain). Four injections are given in the first week; three injections a week are given for the next four weeks; two a week for the following four weeks, and one for another four weeks. This therapy has been said to reduce blood pressure, improve cerebral circulation, and reduce the symptoms of hypertensive encephalopathy.

DISSECTING ANEURYSM

A dissecting aneurysm is an extravasation of blood within the wall of a blood vessel as a result of rupture of the intima. Such an aneurysm of the aorta was first described in 1728 by Nicholls, who in 1761 discovered the condition in an autopsy on the body of King George II of England. The disease was diagnosed uncommonly until 1934 when Shennan's monograph was published. The subject was carefully reviewed by Osgood and co-workers in 1936. Since then reports of accurate diagnoses are no longer rare.

Etiology and Pathology: Most cases of dissecting aneurysm occur in males between the ages of 40 and 60 years. The average frequency of this condition at autopsy is 1 in 630 cases. Antecedent hypertension is usually the cause; syphilis is an infrequent etiological agent.

A dissecting aneurysm results from rupture of the intimal lining of any large blood vessel, but usually the aorta is involved. An arteriosclerotic plaque or a point of rupture of one of the vasa vasorum is the main site of origin. The lesion is associated with arteriosclerotic changes in the elastic tissue of the medial coat of the vessel. Degeneration of the media leads to changes in the wall which pave the way for dissection by the aneurysm. Blood from the lumen is forced through the tear in the intima into the medial coat where dissection begins at once and progresses very rapidly. The rapidity of dissection depends on the height of the systolic blood pressure

and the degree of degeneration of the medial elastic tissue. The sudden rupture of the intima and tearing of the media allows the blood to dissect its way between the layers along the entire course of the aorta or through the media of the subclavian arteries or the iliac arteries. This extravasation of blood under high pressure is thought to be precipitated by emotional excitement or sudden physical exertion.

Impairment of the circulation to and from adjacent viscera results in variable pathology. There may be pressure on the thoracic veins by the aneurysm. Interference with the cerebral circulation may be noted because of involvement of the carotid or innominate arteries. There may be pressure on the esophagus or on the left recurrent laryngeal nerve. Compression of the left lung is fairly frequent. Partial occlusion of the renal arteries is seen at times. Embarrassment of the peripheral circulation in the extremities results from further dissection of the aneurysm downward. Gangrene may thus result and other less severe peripheral vascular changes take place. Interruption of the flow in the intercostal and lumbar arteries at times interferes with the blood supply of the spinal cord and thus causes degenerative changes within the cord. Patchy and bizarre neurological findings may ensue. Rupture of the aneurysm back into the main channel of the aorta may permit recovery to occur with the formation of a so-called double-barreled aorta. The wall of the aneurysmal vessel may rupture into the pericardium, mediastinum, pleural cavities, or further downward.

Signs and Symptoms: The onset is usually abrupt with agonizing pain often followed by the shock syndrome. Occasionally pain passes over and the patient feels well for some weeks or months; then suddenly there is recurrence of the pain. Some of these patients have been called neurotics until subsequent more severe episodes gave convincing evidence of dissecting aneurysm. The location of the pain varies with the site of the aneurysm, but characteristically it exhibits a migratory tendency. It may begin in the precordium or in the epigastrium, pass to the neck or jaw, and later to the back, flanks, and legs, or any one of these areas may be involved. Radiation of the pain to the arms is less common than in myocardial infarction. The pain is usually accompanied by pallor, sweating, prostration, and often by loss of consciousness. Coma is especially likely to occur if

the carotid arteries are involved in the dissection. In the latter case, hemiplegia or other manifestations of central nervous involvement may supervene. The development of neurological signs from ischemia of the spinal cord greatly facilitates the diagnosis. Both motor and sensory changes should be searched for; they may be transitory but are characteristically segmental in distribution. Peripheral neuritis may develop. Fever may be present and vary widely in degree.

When rupture of the intima occurs in the descending thoracic or abdominal aorta, confusion with renal or other abdominal disease is likely. External rupture in this situation may produce extensive extravasation of blood. If such extravasation is detected externally, the acute surgical abdomen may be suspected. The extravasation of blood may also give rise to jaundice from absorption of blood pigment. Pain may be remarkably absent even when the dissection is extensive. Vomiting may be associated with epigastric pain, but usually there is little or no abdominal rigidity. Cyanosis and engorgement of the thoracic veins may be seen. Inequality of the blood pressure may occur from one extremity to another. Left recurrent laryngeal paralysis is not uncommon. Dysphagia has been noted. Dyspnea is fairly common. Left-sided pleural effusion or atelectasis of the left lower lobe may occur. Hematuria and at times anuria are seen. Arterial pulsation may be lost in one or more extremities; palpation of the abdominal aorta may fail to elicit pulsations. There may be progressive failure of motor power in the lower extremities. The legs become cold, cyanotic, and flaccid, and gangrene may be a terminal episode. In the majority of patients, the blood pressure remains elevated throughout the disease, even in the presence of a syndrome that otherwise resembles shock.

Diagnosis: Characteristic electrocardiographic findings distinguish coronary occlusion from dissecting aneurysm. Unilateral hematuria has significance if it can be shown to originate in the side in which the neurological lesions are most extensive. Roentgen examination of the chest frequently shows definite widening of the aorta. Roentgen examination of the abdomen may, by the presence or absence of free air under the diaphragm, aid in differentiating dissecting aneurysm from a ruptured abdominal viscus.

Prognosis: Dissecting aneurysm of the aorta is a common cause of sudden death. The prognosis is poor, and 80 per cent of cases die

within the first day or two. Patients who do recover should have their activity markedly restricted.

TREATMENT

1. Absolute rest should be enforced with opiates and barbiturates.
2. Oxygen may be used to relieve dyspnea and restlessness.
3. External heat may be advisable.
4. Nitrites are recommended for lowering the blood pressure and thus decreasing the degree of dissection. For the latter purpose, venesection has also been advised, but vasodilators are preferable.
5. Surgery to reunite the cavity of the aneurysm with the main channel of the aorta has been conceived and attempted, but a successful outcome must necessarily presuppose very accurate diagnosis, the best of surgical skill, and a happy combination of circumstances.

ACUTE THROMBOPHLEBITIS AND PHLEBOTHROMBOSIS

Acute thrombophlebitis and phlebothrombosis have long been the bane of the surgeon as well as of the physician. They are important for consideration not only because they are in themselves capable of causing pain and disability, but also because they are the precursors of pulmonary embolism with all its suffering and tragic complications. The prophylactic and active treatment of thrombophlebitis and phlebothrombosis go far in reducing the incidence of pulmonary embolism.

Thrombophlebitis is primarily a disease of the veins themselves. For some reason, the intimal lining becomes injured either by toxins, irritants, or bacteria, and particularly when the venous blood flow is slow there is a tendency for a thrombus to form within the injured veins. The superficial veins of the lower extremity are most frequently involved. Once the thrombosis has occurred, the vein becomes cordlike and tender. The skin and tissues about the vein are reddened and the features of an inflammatory reaction are present. The leg may become swollen to twice its normal size, particularly when the deep femoral tributaries are affected. The initial cause of thrombophlebitis is perhaps a diseased vein itself. There is a predisposition for thrombi to develop within these veins because

the blood platelets adhere very readily to the intimal lining. These agglutinated platelets act as a center for the building up of the fibrin clot. This process is encouraged by sluggish venous blood flow and an increase in both the blood platelets and the blood fibrinogen. Infection and varicosities are strong predisposing factors in the development of thrombophlebitis.

Phlebothrombosis, which is a term recently introduced by Ochsner, is reserved for that type of intravenous thrombosis which occurs rather suddenly and produces very few clinical signs. This is the form which is usually seen postoperatively and which gives rise to most of the massive fatal pulmonary emboli. Phlebothrombosis results from the interaction of a number of factors. Perhaps the most important of these arise from changes which go on in the blood to increase its coagulation power. It has been known for some time that patients who are anemic and who have an elevated plasma fibrinogen together with increased numbers of blood platelets are prone to develop a pulmonary embolism. All of these facts together with a slow venous circulation time in the veins of the lower extremities predispose toward the development of a loose noninflammatory thrombus within the vein. Because of the high fibrin content and the strong retracting power of these thrombi, it is easy for them to become dislodged. Pulmonary emboli may of course arise from thrombophlebitis and retraction power. It is in phlebothrombosis that these blood changes are most marked and it is here that we observe most cases of pulmonary embolism.

Thrombophlebitis, as has been indicated, is an acute inflammatory thrombosis usually within a superficial vein of the lower extremity. It is frequently introduced by a rather sharp pain in the lower extremity itself or in the groin. Within a few hours or a day or so, part of the extremity becomes swollen and one is able to palpate tender areas usually along the course of one of the larger venous tributaries. One can elicit pain in the calf and plantar region if there is a thrombosis of the smaller veins in these regions by exerting pressure with the hands. If the thrombophlebitis is superficial, we may notice a reddened warm area of inflammatory reaction along the course of the diseased vein. The patient usually experiences considerable pain if he attempts to bear weight on the extremity. There is frequently an elevation of temperature occasionally accompanied

by a chill. When the process is generalized in the main veins of the extremity, the swelling may become quite extensive and the condition is then called phlegmasia alba dolens.

TREATMENT

The treatment of thrombophlebitis consists of rest and quiet for the involved extremity and heat given either in the form of moist dressings, diathermy, or a cradle heated by electric lights. Vasodilating procedures should be started. Some believe in elevating the affected extremity. If the pain and swelling are very marked, several leeches applied to the skin give prompt relief, although their use may be revolting to both the physician and the patient. If the renal function is normal, fluids and salt should be restricted in the diet; salyrgan, 1 to 2 cc., may be given intravenously every other day for three doses, and it is advisable to give ammonium chloride, 1 Gm. (15 grains), three times a day. Thyroid extract by mouth has been recommended. Heparin is valuable in preventing extension of the process and its use will be discussed later. The treatment of phlebothrombosis is essentially the same as for thrombophlebitis. Bed rest is imperative in order to prevent a dislodging of the clot. However, some advocate the use of tight bandages to the extremity and active or passive exercise in the management of both phlebothrombosis and thrombophlebitis. Paravertebral nerve block and femoral vein ligations are advised by many surgeons. It is considered wise to remove any foci of infection, especially fungous infections; sulfonamide, arsenic, and bismuth therapy may be used for this purpose. Recently there have been reports of excellent results following ultraviolet blood irradiation therapy. Massage, baths, exercise, and vitamin B may be instituted to combat the neuritis when the process is healed.

Hirschboeck and Coffey have recently shown that a rapid clot retraction time is present in cases of pulmonary embolism and phlebothrombosis. In thrombophlebitis, the clot retraction time may be normal or shortened, depending upon the extent of the blood changes. When the clot retraction time is short (below ten minutes), they consider the patient to be a possible candidate for pulmonary embolism and advise prophylactic treatment with heparin.

Heparin, which was discovered by Howell and MacLean, and later purified and made available for clinical use, is the physiological

anticoagulant. Apparently its natural force in the living organism is the granules of tissue mast cells. These granules, together with the granules of the blood basophiles, react to the same chemical tests as heparin. Heparin is most likely an antiprothrombin and an antithrombin. It also inhibits the agglutination of the blood platelets. When heparin is given intravenously, it prolongs both the coagulation time and the clot retraction time. Unfortunately, the intravenous route is the only available one for the introduction of heparin. One must give from 100 to 800 mg. mixed in isotonic saline in more or less continuous infusion over a period of 24 hours. The smaller doses are apparently enough for prophylactic therapy, whereas if a thrombus is already present, it may be better to use the generally advised larger doses in a more or less continuous intravenous drip infusion. However, once a clot has formed, it cannot be dissolved by heparin.

Another anticoagulant, "dicoumarin," the synthetic toxic agent of spoiled sweet clover, is satisfactory in some cases. It is cheaper, may be given orally or intravenously, and has a prolonged effect. Its action is, however, slower than that of heparin. The disodium salt of 3,3'methylenebis (4-hydroxycoumarin) is given by the intravenous route in doses of 4 mg. per kg. body weight ($\frac{1}{16}$ grain per 2.2 lb. body weight). An effect takes place in about 24 hours. The dose for oral treatment is 5 mg. per kg. ($\frac{1}{12}$ grain per 2.2 lb.) at first and daily doses of 1.5 mg. per kg. ($\frac{1}{40}$ grain per 2.2 lb.). Determinations of prothrombin and coagulation time should be made daily. Coagulation time should not be prolonged over 15 to 20 minutes, and prothrombin time should be between 12.5 and 19 seconds.

The anticoagulant effect of dicoumarin may be abolished by stopping the drug, or injection of serum or whole blood. Heparin may be controlled in much the same way. When using anticoagulants, the risk of hemorrhage should always be kept in mind.

ACUTE OCCLUSION IN THE PERIPHERAL ARTERIES

Acute vascular occlusion may occur in an individual whose peripheral vascular tree is normal, but more frequently develops in a patient who has had some disease of the peripheral arteries, as arteriosclerosis. These acute episodes may be classified as follows:

1. Embolic occlusions frequently seen in patients with heart disease.
2. Arteriosclerosis followed by thrombosis, arteritis, or injury.
3. Thromboangiitis obliterans.
4. Syphilitic arteritis.

Chronic diseases of the peripheral arteries, as arteriosclerosis, arteritis, and thromboangiitis obliterans, are comparatively common, and their treatment is well understood. The sudden occlusion of

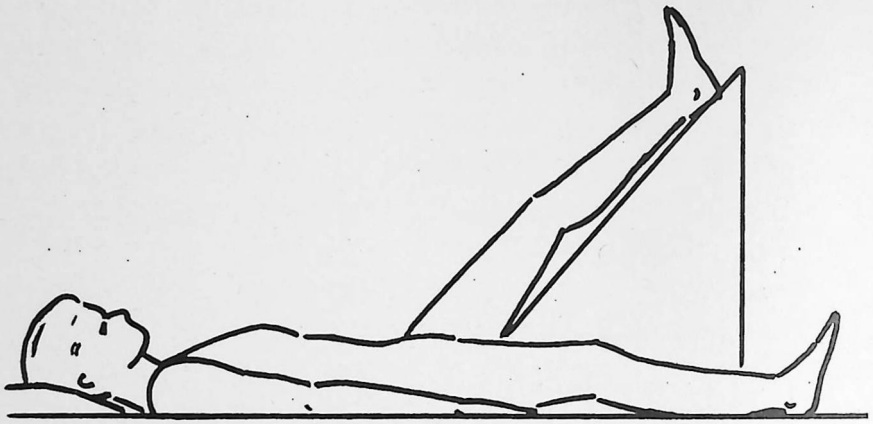

Fig. 1—Acute occlusion in the peripheral arteries. The wrong position of leg when there is an acute arterial obstruction.

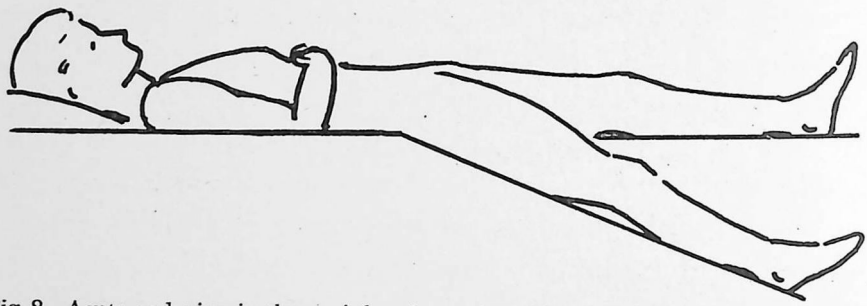

Fig. 2—Acute occlusion in the peripheral arteries. The correct position of leg when there is an acute arterial obstruction.

a peripheral artery as it occurs in a patient with auricular fibrillation or in thromboangiitis obliterans or in an arteriosclerotic person constitutes an acute emergency of great importance. While it is important to determine the exact kind of pathological lesion causing the obstruction to the circulation, it is far more important to realize that the reëstablishment of an adequate blood supply to the involved limb is of much greater concern. The outstanding fact to be remembered is that the blood supply has been cut off; whether the lesion

is embolic, arteriosclerotic, or thrombotic may be determined at a later date. The symptoms that occur with sudden arterial occlusion are pain, paleness of the extremity, coldness, and numbness. Pain and coldness are the chief symptoms and the main indicators of response to treatment.

Examination: The involved limb must be handled gently, as the pain is frequently almost shocking in character. Inspection reveals marked pallor; elevation of the limb accentuates the pallor while lowering of it frequently causes redness. Palpation reveals not only coldness but lack of pulsation in the dorsal pedis and posterior tibial. When there is a venous involvement, as in thromboangiitis obliterans or arterial occlusion, the vascular system of the extremity is overfilled and the foot is puffy and apt to be purple, not pale as in pure arterial occlusion.

The diagnosis of acute occlusion is not at all difficult, though the underlying disease may be hard to recognize. It is obvious that in acute vascular occlusion there is a certain degree of vascular spasm which develops in association with the organic plugging of the vessel. In treatment both conditions must be considered at the same time.

TREATMENT

1. The blood flow to the involved extremity must be improved.
2. Pain must be relieved.
3. The underlying disease must be recognized and treated accordingly.

1. Improving the blood supply to the extremity:

   a. The extremity must not be elevated, but should be lowered in order to augment the blood flow into the obstructed area.

   b. Heat is essential, but must not be too great; otherwise blisters may form and more harm than good done. Most patients do best with 32.2° to 36.7° C. (90° to 98° F.). *Heat higher than body temperature is contraindicated.*

   c. Passive exercises may be helpful.

   d. Codeine and papaverine may be given intravenously in 32 mg. (½ grain) doses two or three times a day; they help dilate the spastic smooth muscles and augment the blood flow to the diseased extremity.

   e. Intravenous injections of 200 cc. of five per cent sodium chloride or sodium citrate solution every day helps at times.

f. Massage is not indicated in the acute phase. After a few days light massage may be helpful.

g. Passive vascular exercise with the suction machine is of great benefit, especially in acute embolic occlusion. Pavex is not so useful in arteriosclerotic disease or in Buerger's disease.

h. Intermittent venous hyperemia is a system of treatment which is based on compression of the return venous flow followed by release of compression. This method of treatment is satisfactory in chronic conditions but not very helpful in acute occlusions.

i. Surgical treatment as paravertebral block of the sympathetic nerve chain is indicated in all cases of acute arterial occlusion to interrupt the reflex vascular spasm, increase the blood flow through the collaterals, and thus check the formation of descending thrombosis distal to the embolus. It should also be done before all embolectomies and after all arterial ligatures.

j. Clot should be removed by embolectomy if less than ten hours have elapsed since the occurrence of the massive obstruction, if the general circulation is fairly well maintained, and if there is no severe peripheral arteriosclerosis. If the patient has been conservatively treated within the first ten hours, without improvement in his condition, embolectomy should be performed.

k. Heparin and heparinlike substances have been used, but their main rôle is in the prevention of the thrombosis which occludes the arteries, rather than in treatment after occlusion has occurred.

l. Repeated intravenous injections of typhoid vaccine are said to be helpful in some cases, but in patients with coronary disease, chronic heart disease, or any debilitating disorder, these vaccines are contraindicated.

2. The relief of pain in the acute phase requires morphine, pantopon, codeine, and papaverine; any one of the four or sometimes nearly all of them are necessary. Papaverine and codeine are the drugs of choice. It is unwise to continue the use of these narcotics after the acute phase is over because of the possibility of the patient becoming addicted to the drug. Luminal, seconal, or bromides had better be substituted for the narcotics after the first several days. Nerve block or parasympathectomy may have to be resorted to for relief of pain at times.

3. If auricular fibrillation or some other form of heart disease is the cause of the embolus, attention must be directed to the underlying disease.

VASCULAR COLLAPSE

.lar collapse is sometimes referred to as peripheral circula-
ıre and is at times erroneously called shock. The syndrome
terized by cold extremities; pallid, mottled lividity; profuse
ion; rapid, feeble, or imperceptible pulse; collapse of the
ıl veins; low blood and venous pressures. Conditions in
ıis symptom complex is found are: (1) Acute infectious
pneumonia; (2) acute diffuse peritonitis; (3) acute pan-
(4) coronary thrombosis with myocardial infarction; (5)
ıry embolism; (6) diabetic acidosis; (7) prolonged vomit-
diarrhea, and (8) terminal stages of heart failure. In addi-
these, there are other conditions which usually produce a
hock syndrome but which at times manifest chiefly a picture
latory failure. These are: (9) Severe trauma; (10) acute
ıage; (11) surgery; (12) severe and extensive burns, and
ldison's disease.

physiology of the circulatory dynamics points towards a
diminution of circulatory blood volume and, as a result of
:eduction in the venous return to the heart. It is believed
:ulatory blood volume has been lost or locked up in a dilated
y bed. Other more detailed features of this syndrome, some
h may be considered as prodromal signs, are excessive thirst,
g, increased respiration, decreased skin temperature, increase
t rate, and a mottling of the skin beginning at the tips of the
and toes. No peripheral venous congestion is noted and pul-
venous congestion is not a feature. The heart is usually of
size except when the syndrome is found in the terminal stages
-standing heart disease.

TREATMENT

: treatment is directed toward increasing the blood volume
ereby the venous return to the heart. Thus, any measure
would facilitate and improve circulation would be indicated
:ondition. The following procedures are usually of some avail:

External heat.

Whole blood or plasma transfusions.

Intravenous administration of glucose, 1000 cc. of five or ten
ıt solution immediately and repeated as often as necessary.

f. Massage is not indicated in the acute phase. After a few days light massage may be helpful.

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3. If auricular fibrillation or some other form of heart disease is the cause of the embolus, attention must be directed to the underlying disease.

VASCULAR COLLAPSE

Vascular collapse is sometimes referred to as peripheral circulatory failure and is at times erroneously called shock. The syndrome is characterized by cold extremities; pallid, mottled lividity; profuse perspiration; rapid, feeble, or imperceptible pulse; collapse of the superficial veins; low blood and venous pressures. Conditions in which this symptom complex is found are: (1) Acute infectious states as pneumonia; (2) acute diffuse peritonitis; (3) acute pancreatitis; (4) coronary thrombosis with myocardial infarction; (5) pulmonary embolism; (6) diabetic acidosis; (7) prolonged vomiting and diarrhea, and (8) terminal stages of heart failure. In addition to these, there are other conditions which usually produce a typical shock syndrome but which at times manifest chiefly a picture of circulatory failure. These are: (9) Severe trauma; (10) acute hemorrhage; (11) surgery; (12) severe and extensive burns, and (13) Addison's disease.

The physiology of the circulatory dynamics points towards a marked diminution of circulatory blood volume and, as a result of this, a reduction in the venous return to the heart. It is believed that circulatory blood volume has been lost or locked up in a dilated capillary bed. Other more detailed features of this syndrome, some of which may be considered as prodromal signs, are excessive thirst, vomiting, increased respiration, decreased skin temperature, increase in heart rate, and a mottling of the skin beginning at the tips of the fingers and toes. No peripheral venous congestion is noted and pulmonary venous congestion is not a feature. The heart is usually of normal size except when the syndrome is found in the terminal stages of long-standing heart disease.

TREATMENT

The treatment is directed toward increasing the blood volume and thereby the venous return to the heart. Thus, any measure which would facilitate and improve circulation would be indicated in this condition. The following procedures are usually of some avail:

1. External heat.
2. Whole blood or plasma transfusions.
3. Intravenous administration of glucose, 1000 cc. of five or ten per cent solution immediately and repeated as often as necessary.

4. Acacia intravenously, a six per cent solution in physiological saline, administering 1 Gm. (15 grains) per kilogram of body weight.

5. Vasoconstrictor drugs as ephedrine, 24 to 46 mg. (⅜ to ¾ grain) immediately and as needed, or ½ to 1 cc. (7½ to 15 minims) of epinephrine hydrochloride, 1:1000 solution subcutaneously.

6. Bandaging of all extremities to improve the circulation to the vital centers.

7. Elevation of the foot of the bed.

8. Sedation as barbital, bromide, or narcotics if necessary to combat the commonly associated apprehension.

SHOCK

There is no unanimity of opinion over the definition of the term "shock." For practical purposes it may be defined as an acute circulatory deficiency, characterized by oligemia, decreased cardiac output, and hemoconcentration. The loose manner in which the term "shock" is commonly employed has contributed to the confusion. Certain common disorders, such as heart failure, pneumonia, hypertensive carotid sinus disorders, and many infectious diseases may cause signs and symptoms which closely simulate shock, and their differentiation from shock is particularly important from the standpoint of therapeutics. Attempts to classify shock by adding a number of adjectives as "neurogenic," "hematogenic," "toxic," "primary," "secondary," and so forth, have not lessened the confusion. It is not the aim of this chapter to solve the problem of shock, but only to point out the chief features of this syndrome, upon which we may expect fair agreement.

Etiology: Injuries, burns, infections as pneumonia, and abdominal operations and emergencies as volvulus, mesenteric thrombosis, pancreatitis, play a prominent rôle in the cause of shock. Obviously, a variety of other conditions may be responsible for the disorder.

Pathology: Within recent years, painstaking investigations have shown that shock is a definite entity and that characteristic clinical and postmortem changes are demonstrable. The pathological changes in shock are featured by capillary and venous congestion involving particularly the internal organs. Congestion is not caused by obstruction to the return flow of blood to the heart but by dilatation of the capillaries. The term "acute venous congestion" is used to indicate

the changes present at autopsy. As yet there is no complete agreement as to the mechanism of production of these pathological changes, but the visceral engorgement that is always present regardless of the primary cause in shock is probably not the result of any one factor but a combination of conditions. Atony and dilatation of the capillaries cause increased permeability and seeping of fluid into the tissue spaces. This leads to diminished blood volume and reduced return flow of blood to the heart, a decreased cardiac output

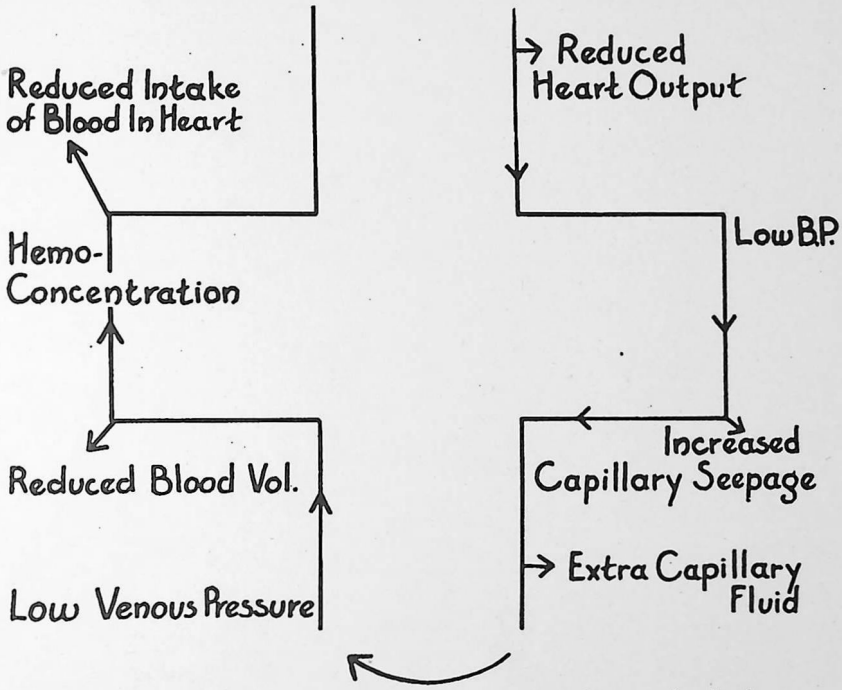


Fig. 3.—Shock. Diagram showing sequence of events in shock.

and hemoconcentration (see diagram). Associated changes of many kinds may be present, such as alterations in the electrolyte pattern, deficiency of adrenal cortical substance, and changes in the nerve cells of the brain and the peripheral nervous system, but these are more apt to be results than participants in the main pathological event.

Signs and Symptoms: The shock syndrome need not have all of the diagnostic features present at the beginning, for there are characteristic features which come in the earlier phases of shock and others which develop later. For our present purpose, all will be dis-

cussed together. Vomiting, pallor, and a cold, clammy skin are the main features in nearly every case. The pulse becomes rapid and thready and sometimes imperceptible. The blood pressure falls to a point where it is difficult to determine, and the temperature is usually subnormal, but not in every case; in burns it may be elevated. Respirations tend to become rapid, shallower than normal, and the external muscles of respiration come into play. The output of urine drops to zero. The pulse becomes weaker and more thready, and finally the patient passes from a semicomatose state into one of complete coma; unless something dramatic is done therapeutically, the patient surely will pass away.

Such a clinical picture as this may be caused by disorders other than genuine shock, but further investigation of the case usually tends to bring out the proper differentiation: (1) The veins of the neck are collapsed and empty, and the heart smaller than normal rather than dilated, in contrast to heart failure; (2) in shock the blood volume is decreased, while in acute heart failure, pneumonia, and other conditions causing a similar clinical picture, there is no decrease in blood volume; (3) the velocity of blood flow is diminished in shock, while it may not be diminished in other conditions or not decidedly so; (4) hematocrit studies in shock usually show increased concentration, while in other clinical entities this occurs much less commonly; (5) venous pressure is decreased in shock. In acute heart failure and other conditions simulating shock the venous pressure is either normal or increased; (6) plasma proteins are definitely reduced in shock, while in heart failure and in other conditions they are positively increased or normal; (7) the mean corpuscular volume is normal in shock or slightly diminished, while it is increased in heart failure; (8) there is a hyperpotassemia in shock, which is absent in other conditions, and the sodium of blood is usually decreased or normal in shock. In other disorders the blood sodium is normal or higher than normal as a rule.

Diagnosis: Heart failure, especially the acute kind, hemorrhage, and shock are confused with one another. As far as hemorrhage is concerned, some believe the differentiation from shock is an unnecessary mental exercise; however, certain points in differential diagnosis will be pointed out.

Heart failure presents a picture of failing circulation characterized by pulmonary congestion, engorgement of the liver, kidneys, spleen, and intestines, and, of most importance, the large veins of the superficial type are engorged. A failing heart is enlarged from hypertrophy and dilatation, and it is usually irregular. As a rule, some evidence of an etiological factor in heart disease is present, as hypertension, coronary disease, valvular leakages, or hyperthyroidism. When the state of shock sets in, the circulatory deficiency is neither cardiac nor vasomotor in origin, and while some features of cardiac collapse may be present, certain clinical features characterize shock. The large veins of the neck, as well as the superficial veins in other parts of the body, are collapsed and empty. The heart is usually very rapid and regular. Enlargement of the heart as seen in heart disease is characteristically lacking in shock, and while the blood pressure may be reduced to a very low point in heart failure, in shock it is extremely low or imperceptible. And, finally, in shock the valvular leakages and other disorders that may cause heart failure are lacking.

In days gone by, the lack of differentiation between shock and heart failure in pneumonia constituted an important error which led to a mistaken idea of therapy. The rapid, regular heart with the thin thready pulse, cold clammy skin, and ashy cyanotic tinge was for a long time considered the toxic effect of pneumonia upon the heart itself. Digitalis and other cardiac stimulants were used almost universally, sometimes in large doses to control the so-called heart failure. However, subsequent studies of the shock syndrome revealed that in pneumonia it was not the heart as a rule that was at fault, but rather that the chief trouble was in the periphery, in the capillaries, and the heart was rapid and appeared weak only because it did not have enough volume of blood to pump effectively.

The clinical evidences of shock may simulate the effects of severe hemorrhage. While they may have certain features in common, the following are points in differential diagnosis; the concentration of the blood in hemorrhage is unchanged at first, but later becomes lower due to the passage of fluid from tissues into the circulation. Nitrogen retention is not present and hyperpotassemia is lacking. The differential diagnosis of these three conditions would be quite unnecessary unless the modes of treatment were affected by the diagnosis. Proper treatment varies in important essentials, depending upon

whether one is dealing with a patient with heart failure, shock, or hemorrhage.

TREATMENT

Treatment may be divided into (1) general measures, and (2) special therapeutic aids.

1. General:
   a. Elevate the foot of the bed.
   b. Apply external heat in the form of hot-water bottles and warm blankets or a heated cage. It is well to remember that warmth is necessary but may be overdone. It has been pointed out that too much warmth is accompanied by vasodilatation and increase in capillary permeability.
   c. Morphine sulfate, 16 mg. (¼ grain), should be administered hypodermically in cases of pain and restlessness, but should not be given when the patient is quiet as there is danger of depressing the respiratory mechanism.
   d. Hot coffee may be administered orally or rectally.
   e. Stimulants as strychnine, 2 mg. (1/30 grain), repeated every two or three hours for several doses have been helpful in cases, especially those following infections. Coramine, 1 to 3 cc. (15 to 45 minims), should be given intramuscularly and repeated every two or three hours.
   f. The use of the vasoconstrictor drugs as epinephrine, ½ to 1 cc. of a 1:1000 solution; pituitrin, ½ to 1 cc., hypodermically, or ephedrine sulfate, 46 mg. (¾ grain), orally is indicated when shock is due to hemorrhage.
2. Special Aids:
   a. As the chief deficiency consists in a low blood volume, augmentation of blood volume is a primary requisite in treatment. This is achieved by an immediate introduction of fluids intravenously, and especially by transfusion of whole blood or in some cases plasma. Whole blood is the ideal method of restoring blood volume, but the procedure involves time and expense and more available measures may be necessary in emergencies. Hypertonic glucose intravenously, 50 cc. of 50 per cent solution, will hasten the return of fluids into the circulation. This injection should be followed by the intravenous administration of two liters of five per cent glucose in physiological saline. Normal saline, 1000 cc., given intravenously may help to make up the loss of fluids in the vascular system. Of course, as the capillary wall is more permeable than normal, such fluids will not be withheld in the circulation and transfusions are better.
   b. Oxygen is of special importance and should be introduced as soon as possible.

c. Adrenal cortical extract, 20 to 30 cc., injected intravenously two or three times a day, in the hands of some observers has proved a very effective remedy, while others have not observed its beneficial effect. It should be used in every case of shock or threatenings of shock.

d. Attempts have been made to improve the venous pressure by applying bandages to the extremities. This type of treatment has been praised by some, condemned by others, and considered of very doubtful value by most investigators.

It may easily be seen that the treatment of shock is quite different from the treatment of conditions simulating it, since introduction of fluids in heart failure is contraindicated and only whole blood transfusions are helpful in making up lost blood in hemorrhage. One should keep in mind that the shock syndrome is characterized chiefly by a diminished blood volume and this volume must be restored, and hemoconcentration which is pronounced must be overcome by more blood dilution.

CRUSH INJURY

"Crush injury" is the name given to kidney damage occurring after crushing injury to the muscle. The condition is closely allied to shock, and has been said to be similar to traumatic injuries, as blast, burns, and trauma of the soft tissues. In all these conditions, there are loss or escape of plasma from the circulating blood stream, and toxemia due to degenerative changes and products liberated from dead or dying cells, plasma, and bacteria.

Etiology: The renal damage has been thought to be due to a variety of etiological factors, among them toxic materials released from the injured muscle, anoxia of the kidney, mechanical obstruction or irritation of the kidney parenchyma by myohemoglobin, hemolysis after injury, muscular ischemia, loss of fluids into the injured limb. It probably cannot be explained by any single mechanism.

Pathology: The kidneys are enlarged, pale, and congested. The capsule strips easily to leave a smooth surface, which may be mottled. The cut surface is wet, shiny, and edematous, and the cortex swollen and everted. The capsular space is filled with granular eosinophilic debris, and the capsular lining cells are changed so that the tubular epithelium appears to extend into the capsule to form a funnel-like

opening. The proximal convoluted tubules are filled with catarrh similar to that in the capsular space. This material may be the remains of necrosed epithelial cells. The ascending limb of Henle's loop and the second convoluted tubule may be completely necrosed in parts and rupture of the tubule may occur. Pigmented casts appear in the second convoluted tubule and are characteristic.

Symptoms and Signs: The patient may be pinned under debris for hours. He appears well except for wounds after release, but soon becomes shocked. This shock may be brought into control in the usual ways, and the patient may appear to progress satisfactorily for a few days.

Then symptoms of urinary insufficiency set in, as bloody, acid urine containing pigmented cells, albumin, and creatine, and oliguria. The limb becomes swollen and hard with petechial hemorrhages, erythematous wheals, and blisters on the skin. Anesthesia and paralysis of the limb and absence of pulsation may set in. Gangrene may occur. The patient is apathetic or anxious at times, and is subject to vomiting. Hypertension occurs, edema increases, and blood becomes dilute. The carbon dioxide combining power drops. Severe loin or abdominal pain may be present. In serious cases, cardiac irregularities may come on, and the electrocardiogram may show changes typical of potassium poisoning. Serum potassium is increased.

Diagnosis: The condition should be differentiated from oliguria from oligemic shock alone, dehydration from vomiting or inadequate fluid intake, blockage from sulfonamide crystals, and transfusion reaction. Examination of the urine, blood, investigation of blood pressure and intake chart will aid the diagnosis. Hematuria from direct injury and hemoglobinuria from cold may be differentiated by examination of the urine and use of a spectroscope. If limb swelling is due to hematoma, wheals are absent, and the muscle is not doughy to the touch.

Prognosis: The duration of the crushing has no particular relation to the result. Prognosis depends on the severity and extent of injury, degree of hemoconcentration, oliguria and blood urea rise.

Treatment: The real problem is not so much the control of the shock as of the oliguria. Surgical procedures, as amputation, incision through the deep fascia to reëstablish circulation cut off by edema, and decapsulation of the kidneys have been tried. To prevent fluid

loss, a pavex apparatus and motor have been used with some success. The use of the elastoplast on the edematous limb has been suggested. Oxygen to relieve the anoxia has also been recommended. Alkalinization has been tried and seems to do good. Investigators, working on the hypothesis that the condition was caused by hemolysis, have treated the condition successfully with intravenous saline followed later by 500 cc. (16 ounces) of three per cent sodium sulfate solution supplemented by generous doses of saline solution by mouth. Potassium citrate is given on the third day coupled with the administration of salt. Some believe that the syndrome may be prevented if 0.53 Gm. (8 grains) of sodium citrate can be injected intravenously before the injured limb has been disturbed.

Bywaters states that in treatment, the renal damage should be treated first, then shock, and then the limb condition. Plenty of alkaline fluid should be given immediately, if possible, while the patient is still crushed. Potassium salts should not be used in alkalinization. Morphine may be needed, and coffee or tea are good. When the kidneys are protected in this way, plasma or serum are given for the shock and circulatory deficiency, and a great deal may be required. Treatment of the limb condition may then be carried out.

CHAPTER II

Diseases of the Blood

Most of the diseases of the blood do not constitute any condition of emergency. Nevertheless, most of the blood dyscrasias may be characterized by acute episodes either at the beginning of the disease or at some time during the long, slow, chronic course. In these pages, attention will be given to those diseases in which the acute phases are encountered.

THE ANEMIAS

Although anemia in its strict sense signifies a lack or want of blood, its clinical usage means reduction in the amount of hemoglobin or red blood cells or both. Within recent years, so much has been achieved in the diagnosis and treatment of the anemias that only the salient features will be considered here. Due to the fact that there are so many groupings and terms used in describing the anemias, I believe that a classification may be given first in order to expedite the following pages. While this outline is not meant to be detailed enough for a hematologist from the practical clinical aspects, it has been found helpful.

1. Loss of blood:
   - *a.* Acute—severe hemorrhage as hematemesis, wounds, hemoptysis, and postpartum hemorrhage.
   - *b.* Chronic—long-continued, slight bleeding as in peptic ulcer, menorrhagia, and hemorrhoids.
2. Hemolytic anemias or blood destruction:
   - *a.* The acute hemolytic anemias:
     - (1) As in streptococcal septicemia or endocarditis.
     - (2) Toxic in origin, as from the sulfonamide drugs.
     - (3) The acute hemolytic anemia of Lederer.
   - *b.* The chronic hemolytic anemias:
     - (1) Acquired type which comes on in later life, characterized by microcytosis, jaundice, splenomegaly, and increased fragility.
     - (2) Familial type commencing during childhood, the patient being more jaundiced than ill throughout a lifetime.

3. Deficiency of blood formation:
   a. Deficiencies due to specific essential factors:
      (1) Lack of the antipernicious anemia factor. (Macrocytic hyperchromic anemia—lack of extrinsic factor in diet as in the pernicious anemias of pregnancy and sprue, as well as deficiency of intrinsic factor as in true addisonian pernicious anemia.)
      (2) Lack of iron. (Microcytic hypochromic anemia as seen particularly in middle-aged women and infants from defective diet and diseases of the gastrointestinal tract.)
      (3) Vitamin deficiencies, particularly lack of vitamin C as in scurvy.
      (4) The deficiency of a specific hormone as thyroxine in myxedema.
   b. Defective formation due to infections and toxic conditions as:
      (1) Bacterial—typhoid fever, rheumatic fever, endocarditis, syphilis, sepsis, nephritis.
      (2) Chemical—arsenic or benzol poisoning, x-rays, radium.
      (3) Neoplasms—cancer.
   c. Disturbances of bone marrow (exhaustion or destruction):
      (1) Primary aplastic anemia.
      (2) Myelophthisic anemia.
      (3) Leukemia and other blood diseases disturbing the erythropoiesis.

From the classification above, the diseases that may require prompt, accurate, and effective diagnosis and immediate treatment will be discussed.

Loss of Blood

When acute hemorrhage occurs, the loss of blood volume is the chief cause of the symptoms. When one approaches an individual who has had sudden serious blood loss, the clinical picture is quite characteristic. The patient's lips, and, in fact, the entire body are pale and almost bloodless, and may be covered with a slight cold sweat. The patient usually appears prostrated and agitated. The pulse is thready, rapid, and weak, and the blood pressure falls. The condition of the pulse and blood pressure, and the rate of breathing, constitute the most important criteria in determining the severity of the hemorrhage. While the blood count itself and even the determination of the plasma and total blood volumes are important in telling us how much blood has been lost, the pulse, blood pressure, and respirations tell us something even more important—that is, how well the patient is tolerating the loss of blood.

The speed with which blood is lost is an important factor because a sudden loss of blood of about one-fourth of the entire volume in certain individuals may cause collapse and even death, while if the loss is gradual, a great deal more may be lost without causing any severe disturbances. It is important to remember that there is great individual variation in the tolerance exhibited by patients to hemorrhage.

Usually the demand made upon the bone marrow by the loss of blood is responded to immediately and the bone marrow starts regenerating the lost blood cells. The speed with which the blood returns to normal depends upon the amount of blood lost, whether the hemorrhage is completely stopped, and the ability of the bone marrow and other centers of formation to respond to the call for action.

Although it is important to make a diagnosis of the cause of the hemorrhage, especially in the acute type, it is more important to take care of the patient first and determine the cause of bleeding afterwards if the cause is not perfectly obvious on superficial examination. Bleeding from the bowel is often the result of an acute painless and undiagnosed peptic ulcer. Other things, as Meckel's diverticulum and bleeding carcinomas, may also be painless. Tarry stools should always be sought for in cases of obscure hemorrhage, and careful blood examination should be made as soon as possible to rule out, as far as practicable, blood disorders that may lead to hemorrhage.

TREATMENT

The treatment of hemorrhage may be dealt with briefly. It is based upon certain physiological principles:

1. An attempt must be made to stop up the hemorrhaging area and to produce a clotting of the blood at the point of hemorrhage. How to accomplish this is a problem that must be decided by the kind of case with which one is dealing.

2. Sometimes thromboplastin in from 20 to 50 cc. doses may be given intravenously to aid the natural processes of coagulation.

3. The patient's blood must be typed as soon as possible, a suitable donor obtained, and provisions made for an immediate transfusion if it is necessary. Blood plasma or serum, 200 to 500 cc., may be given in lieu of a blood transfusion.

4. If the patient is restless and anxious, morphine sulfate, 16 mg. (¼ grain), must be given at once, and the effect continued by the administration of nembutal or sodium amytal by rectum. Usually the contents of two or three nembutal or sodium amytal capsules are dissolved in 15 or 30 cc. (½ or 1 ounce) of water and given as a retention enema. The patient should be kept in a quiet darkened room and maintained in the twilight zone of consciousness until bleeding is under control.

5. Fluids should be given in an attempt to restore the blood volume. Of course, blood transfusion is the best possible method of achieving this, but normal saline or glucose solution or, better still, 1000 cc. of five per cent glucose in saline, may be given intravenously at the rate of 10 to 15 cc. per minute.

6. Blood pressure should be taken every two hours to determine the response of the patient to treatment.

7. The pulse rate and heart tone should be carefully examined every two hours.

Acute Hemolytic Anemia

This clinical entity is one of the rarer hematological states that might be classified as an acute medical emergency. The hemolytic anemias include a rather large number of hematological conditions that represent a more rapid destruction of red blood cells than can be produced by the bone marrow.

Etiology: There are many etiological factors, the commonest of which are severe infections, drugs, chemicals, poisons, hemolysins, and agglutinins. Many cases are familial, while others must be considered idiopathic in origin. The pathogenesis of this type of anemia in most instances is rather vague and presents a great problem to the hematologist. Various theories have been propounded, including (1) a marked increase in fragility in red cells, and (2) hemato-allergic or individual idiosyncrasies which result in the rapid hemolysis of cells. Kracke sets forth in his textbook the belief that hemolysis of red cells occurs in two ways: (1) By the action of toxic agents on the cells in the peripheral blood, and/or (2) by the phagocytic activity of endothelial cells. There has been a general shift in emphasis from the bone marrow and a faulty kind of erythropoiesis to the

spleen and activity of various hemolytic agents on the mature erythrocyte.

Signs and Symptoms: Clinically, the course of this disease is usually characterized by a sudden rise of fever, marked pallor, weakness, general malaise, dyspnea, profound anemia, and slight icterus, usually visible only in the sclerae. The spleen, which is often tender, is usually felt one to three fingerbreadths below the left costal margin. The neck vessels pulsate vigorously and there is marked tachycardia. Some cases develop rapidly, and within a few hours there is extreme weakness, dyspnea, and semicoma. In other instances, the weakness and dyspnea appear insidiously. Gastrointestinal symptoms are common. The peripheral blood reveals reduction of red cells and hemoglobin, leukocytosis, reticulocytosis, and thrombocytosis. At times the leukocytosis may become so marked that there is a resulting leukemoid reaction. Spherocytosis is usually present, associated with increased hypotonic fragility. Bone marrow study reveals an attempt of the erythropoietic series to regenerate the destroyed cells and a markedly active granulocytic series. The icterus index is usually increased with an indirect Van den Bergh, and both stools and urine reveal a definite increase in urobilinogen. Hemoglobinuria has been recognized as a complicating feature, but is not present in every case. When present, it may result in severe kidney damage and thereby produce uremia or even death.

Pathology: Pathological studies of the parenchymal organs in these cases may reveal a marked deposition of hemosiderin. The kidneys show a plugging of the renal tubules and may at times even show tubular degeneration. This type of kidney pathology corresponds very closely to that seen in the kidneys after transfusion with incompatible blood, which suggests the fact that agglutination of red cells may occur prior to red cell hemolysis.

There is an excessive load on the tissues as the result of the destruction of erythrocytes. The reticuloendothelial system becomes congested and hyperplastic with the spleen showing marked engorgement of the pulp with red blood cells.

The clinical picture as described is the one most commonly seen when the anemia is the result of exposure to chemicals, drugs, or poison, more specifically and more commonly seen recently with the advent of sulfonamide therapy. The chief offenders of the latter

group are sulfanilamide, sulfapyridine, and sulfathiazole. It is believed that sulfanilamide may produce this complication in two to three per cent of children and eight to nine per cent of adults treated.

Acute Hemolytic Anemia of Lederer: Another very interesting type of acute hemolytic anemia is that described by Lederer in 1924. This is a rather rare hematological entity which usually develops suddenly in a patient showing evidence of some acute infectious process. The etiology is unknown, but its frequent association with infection suggests this as being the inciting factor. The onset is usually that of a rise of fever, chills, general malaise, headache and generalized muscle aches, diarrhea, and abdominal pain, following which a severe anemia and the above described blood picture are noted. The important practical feature of this disease is that it usually responds very dramatically to single or multiple transfusions.

Prognosis: The prognosis in general for all the acute hemolytic anemias is fairly good if the process is recognized early and treated adequately. If not identified and vigorously treated, death may ensue.

TREATMENT

The treatment is in general very gratifying and consists of the following:

1. Adequate alkalinization, accomplished by giving sodium bicarbonate, 3 to 6 Gm. (45 to 90 grains) orally, or a 6/M solution of sodium lactate intravenously (usually 600 cc. are given). Giving large amounts of fluids rapidly is a dangerous practice.

2. Multiple daily transfusions, 100 to 200 cc. of blood, not only will increase the greatly diminished number of red cells, but may also have an antihemolytic effect. The blood from absolutely compatible donors of the same blood group is important. Transfusions should be given slowly and spaced several hours apart. As few transfusions as possible should be given because of the danger of severe reactions, overtaxing of the heart, and pulmonary edema. If the patient does not respond to three or four transfusions, splenectomy is indicated.

3. Discontinuation of offending drugs such as any of the sulfonamides.

4. Any therapy necessary for the underlying infectious process or for the chemical or poison which may be the etiological agent.

5. At times the addition of liver extract, 3 to 4 cc. intramuscularly, and the administration of ferric ammonium citrate, 1.3 Gm. (20 grains), three times a day is beneficial.

6. Splenectomy: When patients do not respond to transfusion, splenectomy should be performed.

Acute Febrile Anemia

The onset is abrupt with fever of 101° F. to 103° F., chills, headache, vomiting, jaundice, and sometimes peripheral vascular collapse. Hemorrhage from various internal organs may be seen from time to time. The most characteristic feature of course is the change in the blood picture. The rapid falling off of the red blood cells to one million per cubic millimeter or less may occur within a period of a day or two. Nucleated red blood cells are present in the blood smear and the number of reticulocytes increases rapidly. The leukocytes do not seem to be involved, nor do the platelets. Although the disease occurs usually in younger people under 20 years of age, cases have been reported at all ages.

Disturbances of Bone Marrow

Although acute aplastic anemia may be due to such things as benzol, arsenic, radium, and severe infections, there is a kind that is quite commonly known as the idiopathic aplastic anemia in which the cause is unknown. This disease causes aplasia of the red cells, white cells, and platelets of the bone marrow. There is a leukopenia of 1500 white blood cells or less at times and anemia of less than 2,000,000 and the platelet count drops to low figures as 30,000, 20,000 or 10,000 per cubic millimeter. The course of the disease is frequently rapid and death may occur within a period of a few weeks or months. The clinical features of the disease are centered around the anemia but hemorrhages may arise from the thrombocytopenia, and necrotic lesions of the mucous membranes may result from lack of polymorphonuclear leukocytes. This disease must be differentiated from several others that present a somewhat similar picture on the surface. For example:

1. Agranulocytopenia which is characterized by a pronounced diminution of the polymorphonuclear leukocytes, but by fairly nor-

mal red blood cell count and normal platelet count. The response to treatment is quite satisfactory.

2. In certain stages of pernicious anemia, the picture may simulate that of the aplastic form. However, the case history with the characteristic features of pernicious anemia, as glossitis, achlorhydria, neurological changes, and the classical blood and bone marrow picture, serve to identify it.

3. The bone marrow destruction due to certain poisons as x-ray and radium must be remembered. Acute leukemia must always be given consideration in these blood diseases with features of the aplastic type.

TREATMENT

The treatment of any form of aplastic anemia is most discouraging, but the treatment of the idiopathic form is even more hopeless since this is usually a fatal disease. Frequently repeated small transfusions are the greatest aid in treatment. Rest and intelligent feeding are essential. Every effort should be made to find and if possible remove the cause. Pentnucleotide, 10 cc. (0.7 Gm.), diluted to 100 cc. with warm sterile saline may be injected intravenously slowly every day. Yellow bone marrow in doses of 20 to 30 drops three times a day is sometimes efficacious; liver extract, 2 to 4 cc. intramuscularly, daily, and iron and arsenic in the form of iron cacodylate, 32 mg. (½ grain to 1 cc.), may be given intravenously two times a day as adjuncts. Frequently, splenectomy is advisable. While all of these therapeutic measures should be employed, the outlook is nevertheless distinctly unfavorable.

LEUKEMIA AND OTHER DISTURBANCES OF THE WHITE BLOOD CELLS

Although leukemias have been known ever since Virchow first described them in 1850, the outlook and the treatment have changed little since that time. Despite great advances in anatomy, physiology, and pathology, our knowledge of leukemia is limited. From the practical point of view, leukemia may be divided into the acute and chronic forms. The acute forms may be subdivided into the lymphatic, the myelogenous, and the monocytic varieties. The differentiation though is more a manifestation of diagnostic strength than of

any real value as far as the patient is concerned because the treatment and prognosis are about the same in any of the acute forms.

Acute leukemia is most often found in children or adolescents, though many cases have been reported in adults. As a general rule, acute lymphoid leukemia occurs in children, while acute myeloid leukemia and, more often, chronic leukemia, are found in adults. The pathological changes are very much alike, the main difference being that in lymphatic leukemia the lymphatic mechanism is very decidedly enlarged, while in the myeloid variety, this system is not necessarily prominently involved except for splenomegaly.

Etiology: The etiology is practically unknown. Most investigators agree that it is a manifestation of malignant changes in the blood-forming organs. Furth, in 1935, injected an emulsion made of the spleen of a rat with acute leukemia into other rats. In some, malignant tumors of the bone marrow formed, and in others there were definite evidences of leukemic changes. He concluded that leukemia is a malignancy and not due to inflammatory or infectious disorders. We do not know, however, just what trigger factor starts the sudden proliferation of the blood cells which is seen in acute leukemia. There is a hereditary tendency and it has followed trauma, pregnancy, and malaria.

Signs and Symptoms: The onset is similar to that of an acute infection, with continued high fever, chills, weakness, headache, general distress, and a rapidly developing pallor. There is slight enlargement of the spleen and lymph nodes, especially those associated with the mouth, throat, or respiratory system. The lips and gums become thickened and swollen, and there are ulcerations in the tonsillar area. The skin and mucous membranes bleed easily. Hemorrhages are quite common with resulting anemia and retinal changes.

The course is usually stormy and characterized by a rapid progression of the symptoms. It must be remembered that in acute leukemia not only the blood-forming organs and blood are involved, since microscopic examination shows leukocytic infiltration of the heart muscle, kidneys, liver, and digestive system. The urine usually contains albumin and casts as well as leukocytes and red corpuscles. Pleural effusion and dyspnea often appear, and the heart's action may be impaired. Jaundice and heart failure frequently complicate

the clinical picture of acute leukemia. The brain and meninges, too, may become infiltrated and often the patient will have a stiff neck, confusing the picture of leukemia with that of meningococcic meningitis.

The blood picture reveals many immature leukocytes and blast cells and there is a rapid rise or fall of the number of circulating leukocytes.

Diagnosis: Diagnosis of acute leukemia can be made only after numerous disorders have been considered and the various systems of the body carefully analyzed. If the typical blood changes are present, the diagnosis is easy, but frequently we see a case where the white cell count is 8000 rather than 20,000 to 30,000. The differential count may show a normal number of neutrophiles, lymphocytes, and monocytes, and sometimes a careful search fails to uncover a blast cell. This condition is called aleukemic leukemia. The changes in the bone marrow and lymph glands are present, but the blood does not reflect these abnormalities. Repeated examinations, however, usually uncover blast cells of some type.

A clear-cut case of acute leukemia includes a pale skin, hemorrhages, skin lesions, characteristic blood changes of an extremely high white blood count with many blast cells, marked anemia and low platelet count, and enlargement of both the spleen and lymph nodes (particularly in the lymphatic form).

Differential Diagnosis: In differential diagnosis such diseases as infectious mononucleosis, Vincent's angina, typhoid, pneumonia, endocarditis, acute rheumatic fever, diphtheria, meningitis, and a number of other acute infectious disorders must be considered. Perhaps the most confusing condition is acute infectious mononucleosis in which the white cells are greatly increased (20,000 to 40,000). Eighty per cent as a rule are lymphocytes of a youthful variety and the differentiation between these and stem cells is difficult to make. Sore throat, swollen lymph glands, an enlarged spleen, jaundice, fever, and many of the features of acute leukemia are present. However, the lowering of the platelet count does not occur and there is no anemia or prostration. The course is benign and not stormy.

In infectious mononucleosis the diagnosis is verified by the finding of a positive heterophile antibody reaction. The patient with infectious mononucleosis usually recovers and the one with acute

leukemia does not, and therefore the differential diagnosis is of great importance in outlining the course and prognosis.

Course and Prognosis: Prognosis in all types of acute leukemia is gloomy. The course is usually rapid and characterized by weakness, hemorrhage, prostration, fever, collapse, stupor, and coma. Death occurs in from three weeks to two months. If the patient lives longer than that, the disease is likely to be an acute exacerbation of a chronic leukemia rather than the acute form. As a rule, the older the patient the better the chances are for longer life. If there are no other complications and if the leukocyte count is low, the prognosis is comparatively good. In some cases, the symptoms disappear and the patient seems to be quite well, and then in a short time the symptoms reappear, and there are frequent remissions until the patient dies.

TREATMENT

There are three therapeutic measures which are used in acute leukemia: (a) X-ray treatment of the long bones and spleen; (b) blood transfusion; (c) iron and arsenic hypodermically every other day. None of these measures is of any real value. Transfusions sometimes bring the blood count up temporarily, prevent hemorrhages and help prolong the patient's life, but the procedure is questionable at best. The most one can do is to keep the patient as comfortable as possible.

Acute Monocytic Leukemia

The existence of chronic myelogenous and chronic lymphatic leukemia as clinical entities has been recognized since Bennett and Virchow described them in 1845. Subsequently several types of leukemias have been discovered. In 1900, Naegeli added acute myeloblastic leukemia to the blood dyscrasias. Schilling and Reschad gave an account of monocytic leukemia, the third major group of leukemias, in 1913. Naegeli, however, refused to accept monocytic leukemia as a distinct entity, believing instead that monocytic leukemia was merely the monocytic phase of myelogenous leukemia. To complicate matters further, Ewald in 1923 described a leukemia centered in the reticuloendothelial system.

Monocytic leukemia is the center of high controversy because the origin of the monocyte is obscure. At present, it is admitted that most probably the monocyte may be derived from several sources, in which case there is the possibility of several types of monocytic leukemia. Two types are recognized: (1) Naegeli type, and (2) Schilling type.

The Naegeli type is centered in the myeloblast. In this case the monocytic leukemia is a variant of myelogenous leukemia. The monocytic phase usually reverts to the picture of myelogenous leukemia before the course of the disease is run.

The Schilling type is centered in the reticulum cell. There is a hyperplasia of the reticulum cells. These cells round off and become free. In the case of monocytic leukemia, these free cells develop into the monocyte that is found in the peripheral blood stream. It is conceded that this is the same as the leukemic reticuloendotheliosis of Ewald developing toward the monocytic line.

The Naegeli type and the Schilling type of monocytic leukemia can be differentiated by a careful study of the cells intermediate between the stem cell and the mature monocytes. It is usually the Schilling type of leukemia that is referred to as the "acute monocytic leukemia."

The clinical course of monocytic leukemia is relatively acute. The presenting symptoms and the physical findings are similar to those of other acute leukemic states, except that there is a predominance of oral and throat disorders. Symptoms referable to the teeth are particularly prevalent.

Monocytic leukemia manifests a profound, rapidly progressive anemia. It is the normocytic normochromic kind with evidences of normal or pathological regeneration.

The leukocyte count is extremely variable. Total counts from 600 cells to 240,000 cells per cmm. have been recorded.

The platelet count is low with the accompanying manifestations of bleeding.

The blood film reveals varying percentages of monocytes in all stages of development. Care must be exercised not to confuse atypical myeloblasts and even atypical promyelocytes with monocytes. In the Schilling type of leukemia, the monocyte can be traced through inter-

mediate stages to the reticulum. It is the intermediate cells that retain the "reticular" structure in the nucleus.

The course of the Schilling type of monocytic leukemia is rapidly progressive and usually of short duration.

TREATMENT

Monocytic leukemia does not respond to treatment. Deep x-ray therapy may alleviate the pressure symptoms of a leukemic mediastinal tumor, but such treatment will not aid any of the other symptoms and may even lead to increased neutropenia and anemia. Blood transfusions are only palliative, and sometimes harmful.

Acute Aleukemic Leukemia

Aleukemic leukemia is the source of much confusion and misunderstanding. It has many synonyms and several interpretations. It is known as aleukemic myelosis, hypocytic leukemia, leukopenic leukemia, pseudoleukemia, aleukemic lymphadenosis, subleukemic leukemia, and undoubtedly by a few more names. It has been defined on the one hand as a disease with a clinical course and organic changes identical with the leukemic state but in which the peripheral blood shows no leukocytosis nor any immature cells at any time. On the other hand, aleukemic leukemia is considered merely as a leukopenic phase in the leukemic process. The adherents of the latter opinion feel that an accurate knowledge of the morphological appearance of immature cells, particularly the "blast" forms or the stem cells, and a persistent search will reveal varying percentages of these cells at some time or other in the leukemic state which is characterized by a leukopenia.

Etiology: The etiology of aleukemic leukemia, like that of other types of leukemia, is unknown.

Aleukemic leukemia may be chronic, subacute, or acute in its clinical course. It is usually myelogenous or lymphatic in type, the latter occurring the most frequently.

Signs and Symptoms: The chief symptoms are those of a grave anemia, namely, weakness, pallor, fatigue, dyspnea, and palpitation. The physical findings are identical with those of other forms of leukemia. Necrotic lesions of the mouth are a common feature.

Aleukemic leukemia is characterized by a profound, rapidly progressive anemia. The anemia is usually the simple regenerative type showing the presence of anisocytosis, polychromasia, normoblasts, and single Jolly bodies in the red blood corpuscles. It is often toxic with the added features of poikilocytosis, basophilic stippling, and multiple Jolly bodies in the erythrocytes. In rare instances, the erythrocytes are macrocytic and hyperchromic. With the concomitant leukopenia, these cases are often confused with pernicious anemia. The red blood corpuscles are normal in mean volume and hemoglobin except in cases complicated by chronic bleeding.

The total number of leukocytes may be in the normal range, though generally the leukocyte count falls in the leukopenic range. Values as low as 400 cells per cmm. are not infrequent.

A scrupulous morphologic study of the blood smear is imperative. In a case of aleukemic leukemia, a diligent, daily search will reveal at least a few of the stem cells, either myeloblasts or lymphoblasts, and the presence of myelocytes and promyelocytes if the case is myelogenous in type.

The platelet count is usually reduced below the critical level with the accompanying findings of hemorrhage and petechiae. The platelets, however, may be within the normal range.

Differential Diagnosis: Aleukemic leukemia may be confused with other diseases characterized by a leukopenia, among which are agranulocytic angina, severe sepsis, idiopathic aplastic anemia, Banti's disease, pernicious anemia, thrombocytopenic purpura, metastatic carcinoma, and Hodgkin's disease. A bone-marrow biopsy with a careful morphological study of the bone-marrow cells and a scrupulous examination of the peripheral blood will establish the correct diagnosis in the great majority of these cases.

Agranulocytic angina seldom if ever has an anemia or a thrombocytopenia comparable with that usually found in aleukemic leukemia. Likewise, myeloblasts and promyelocytes or lymphoblasts and early lymphocytes are not encountered in the blood films of agranulocytic angina to any significant degree. The majority of cases of agranulocytosis in the hyperplastic phase with a maturation arrest at the myeloblast stage, may cause difficulty in arriving at the correct diagnosis from the bone marrow study alone. The continued study of the peripheral blood will solve the problem.

Severe sepsis can be differentiated from aleukemic leukemia by the absence or only the rare appearance of the "blast" forms and promyelocytes in the peripheral blood stream. There is a shift to the myelocyte and the promyelocyte stage of the granular series in the bone marrow in sepsis, but seldom does the bone marrow show a great predominance of myeloblasts, promyelocytes, or lymphoblasts, as is characteristically encountered in aleukemic leukemia.

Idiopathic aplastic anemia discloses an aplasia of the bone marrow, or at least a marrow with a predominance of the leukemic cells. Aplastic anemia reveals no signs of regeneration in the blood stream. In aleukemic leukemia, signs of normal and pathologic regeneration are usually present.

Banti's disease, pernicious anemia, thrombocytopenic purpura, metastatic carcinoma, and Hodgkin's disease seldom if ever manifest blood cells younger than myelocytes in the peripheral blood. If myelocytes occur in these conditions, they rarely exceed 15 per cent of the total leukocytes.

The characteristic appearance of the erythrocytes, the presence of megalocytes, the distinctive changes in the appearance of the neutrophiles, and the hyperactive, megaloblastic bone marrow of pernicious anemia will distinguish pernicious anemia from aleukemic leukemia in almost every case.

Thrombocytopenic purpura shows an increase of the megakaryoblasts and megakaryocytes in the bone marrow and a normal or slight hyperactivity of the granular series and the normoblastic series which is in no way comparable to the picture found in the leukemic state.

Metastatic carcinoma also may reveal a hyperactive bone marrow, but here again the marrow rarely shows a predominance of the stem cells (myeloblasts or lymphoblasts) and the early promyelocytes.

Hodgkin's disease will be differentiated from aleukemic leukemia by the characteristic tissue changes found in this disease as revealed by histological study.

The course of aleukemic leukemia is the same as that in other leukemic states.

TREATMENT

Acute leukemia is resistant to all treatment. The pressure symptoms of a leukemic mediastinal tumor may be relieved by deep x-ray

therapy. This treatment, however, will not alleviate any of the other symptoms, and even small doses may quickly add to the neutropenia and anemia. Blood transfusions are worthless and may occasionally make the condition worse.

INFECTIOUS MONONUCLEOSIS

Infectious mononucleosis, or glandular fever as it is sometimes called, is an acute and often contagious disease characterized by glandular enlargement and fever, though these need not be present.

Etiology: The cause of the disease is unknown. However, the Listerella monocytogenes has been isolated from the peripheral blood or cerebrospinal fluid in many cases. Infectious mononucleosis occurs most often in childhood and can be acquired through contact. Because many other diseases occur with it, some authors believe it to be an outcome of influenza, leukemia, or streptococcus infections, but proof is lacking. It is probable that infection renders a subject susceptible to other diseases.

Pathology: Examination of lymph nodes reveals a variation in size and shape of the lymphocytes. They have a characteristic pattern which distinguishes them from other lymphocytes. Usually there are general hyperplasia and dense foci of rounded reticulum cells which fill the sinuses. In advanced stages, follicles and germ centers are often absent. There are characteristic changes in the leukocytes.

Signs and Symptoms: Fever, enlargement of the lymphatic glands, sore throat, changes in the blood cells, and enlargement of the spleen usually form the clinical picture of infectious mononucleosis. Since it resembles so many other diseases, it is rather difficult to list the symptoms. The onset varies. The patient may be conscious of a vague constitutional illness for several days, but because it is so mild a physician is not consulted. Then fever and general malaise set in, followed by other symptoms and finally glandular enlargement. Usually the onset is sudden with chill and rapid rise of temperature, and the disease runs an acute course for two to four weeks and then subsides. Headache, dizziness or faintness, irritability, purpuric eruptions and skin rash, fatigue, anorexia, sore throat, malaise, and general weakness are commonly present. Pain in the joints and throughout the body, particularly in the neck, abdomen, and gastrointestinal tract, are occasional symptoms. The leukocyte count may

vary from normal to 30,000; hemoglobin and red blood count are usually within normal limits.

Fever continues for a week or more, commonly rising in the afternoon. The temperature varies from 37.2° to 40° C. (99° to 104° F.). The pulse rate runs parallel with the temperature, as 92 beats per minute with a fever of 39° C. (102° F.). The enlargement of the glands may start before, during, or weeks after the fever sets in, and it may continue for a few days or several months. The enlargement varies in size from 1 to 2 cm. in diameter to that of a small plum. The cervical and inguinal glands are involved most often, though cases have been reported of enlargement of the axillary and mediastinal glands.

There is some question as to whether an attack of infectious mononucleosis may have an effect on the heart; it is generally conceded that acute cardiac failure may result if the heart is in poor condition previous to the attack.

Diagnosis: Pyrexia, splenomegaly, adenopathy, and mononuclear leukocytosis indicate the diagnosis. When the classical picture of glandular enlargement and fever is present, the blood should be examined. If there is a great increase in the mononuclear cells with abnormal lymphocytes varying in size, structure, and staining properties, infectious mononucleosis may be suspected. The Paul-Bunnell test will clinch the diagnosis. This test should always be done in patients with false-positive Wassermann reactions, or with positive agglutination tests without cultural proof.

The differential diagnosis formerly constituted one of the difficult features of the disease. The swollen lymph glands, enlarged spleen, and increased white count with preponderance of lymphocytes often led to a diagnosis of acute lymphatic leukemia. Hodgkin's disease, granulocytopenia, typhoid fever, and tuberculosis have all been confused with infectious mononucleosis. Since the work of Longcope and Downey in 1923, the blood picture has been more widely recognized and the differential diagnosis made easier. In addition to this, the laboratory aid of Paul and Bunnell, described in 1932, is practically diagnostic because the presence of heterophile antibodies in the blood can be noted.

Prognosis in uncomplicated infectious mononucleosis is very good and for this reason correct diagnosis is important.

TREATMENT

1. The treatment is symptomatic and consists primarily in forestalling complications as bronchitis, pneumonia, or any upper respiratory tract infection.

2. Iron, as iron ammonium citrate, 0.66 Gm. (10 grains), three times a day, and alkalinization by the administration of sodium bicarbonate, 1 Gm. (15 grains), three times a day, are recommended as auxiliary measures.

3. Sulfanilamide has given quick and permanent relief in some cases. The initial dose is usually 4 Gm. (60 grains), followed by 1 Gm. (15 grains) every four hours until the optimal level is reached in the blood stream, and then 1 Gm. (15 grains) three or four times a day may be given until the fever subsides. This treatment is especially good when there are complications as hemolytic tonsillitis or respiratory infections.

4. Convalescent serum may help but it is not usually available.

5. Sodium perborate as a mouth gargle, used prophylactically, is indicated because Vincent's infection is often present in conjunction with infectious mononucleosis. If the spirilla and bacilli of Vincent are found, neoarsphenamine (five per cent in glycerin) may be applied locally.

HEMOPHILIA

Hemophilia is a hereditary blood disease occurring only in males, but transmitted by females in whom the tendency to bleed exists as a mendelian sex-linked recessive defect. It is characterized by prolonged coagulation time and repeated hemorrhages throughout life. It has been suggested that since men are subject to the disease and women are not, the latter must have some substance in their bodies which is absent in males. This may be an ovarian or estrogenic element, or a substance in the placenta that may hasten the coagulation time, because young infants bleed rarely or not at all and still grow up to be hemophiliacs.

Etiology: According to mendelian principles, a woman may be a true hemophiliac if she is the daughter of a hemophilic male and a hemophilia-transmitting woman. However, such a union is rare and it is probable that such an inheritance factor would be fatal to the fetus. The transmission of the disease is dependent on the parents.

The marriage of a normal man and a female carrier results in half the sons being bleeders and half the daughters being carriers. There is no way of telling which daughters are carriers until they have children. The transmission of the disease by the union of a hemophilic male and a healthy female results in all daughters being carriers so all male grandchildren of the original union may be bleeders, but the male offspring of the original union will not be bleeders.

It has been noted that the hemophilic families are usually above the average in size. Most hemophiliacs have more daughters than sons, a ratio of about 2 to 1, and those daughters who are carriers have more sons than daughters, thus accounting for the perpetuation of the disease. It rarely occurs in Latins, but it is common in the English and Teutonic races. However, cases are found the world over, especially in young people.

Defect in coagulation apparently lies in the blood platelets. All of the constituents of the blood are normal in appearance, quantity, and chemical content. It is assumed that the platelets are highly resistant to breakdown, and for this reason there is a lack of thromboplastin and coagulation is delayed.

Signs and Symptoms: The disease is not noted at birth, but symptoms usually appear when the child is about two years of age. Repeated and severe hemorrhages, which are either spontaneous or the result of slight trauma, are noted. The bleeding is characterized by its persistence. It is usually more severe during puberty than after. The circumstances of the bleeding vary; the period of bleeding may be slight and short or severe and prolonged, and it may continue for a long time or it may be absent for several months. The how, when, where, and why of these hemorrhages are questions that are unanswerable at present.

Spontaneous hemorrhages may occur in the joint cavities as well as in the muscles and connective tissue. The bleeding into the joints, knee, ankle, elbow, and hip in that order of frequency is often necessary to clinch the diagnosis. Joint bleeding is characterized by diffuse redness, marked swelling, sudden pain, and a varicolored skin over the affected part. The pain may become very severe. Temporary invalidism, transitory or even permanent crippling, restricted movement, and slight or marked bone destruction and deformity may result from these attacks. Anemia arises as a result of the blood loss,

the degree being dependent on the duration and severity of the hemorrhages. Otherwise there are no signs of the disease, and during the periods of remission the patient may appear normal.

Diagnosis: Diagnosis is comparatively easy since a family history is usually obtainable and the disease occurs in the male sex. The bleeding time is normal; the coagulation time is prolonged during attacks but is usually almost normal between them. The prothrombin time is normal, and fibrinogen is abundant. The capillary resistance test is normal.

Prognosis: Because of the severity of bleeding in childhood, and of the greater chance of trauma in that period as from (1) falls, (2) scratches, (3) tooth extraction or loss of teeth, and (4) tonsillectomy, and the inability to control hemorrhages after they start, the prognosis is poor. Most patients die before they reach the age of puberty, but if they live beyond this stage, their chances of long life increase. Since the patient lives in constant fear of attacks and consequent fatal hemorrhage, the mental outlook is poor though he is usually quite well between periods of bleeding. Permanent damage to the joints is common. Sometimes one attack follows another, and the victim remains in a state of invalidism since he is never really able to recover from one siege before another sets in.

TREATMENT

There is no specific therapy for hemophilia. Treatment is directed more at the prevention of hemorrhage than stopping it after it once begins.

1. The individual should be protected from trauma.
2. When hemorrhage starts, the patient should have absolute rest and quiet; small doses of opiates as morphine, 8 to 10 mg. (⅛ to ⅙ grain), or pantopon, 8 to 10 mg. (⅛ to ⅙ grain), hypodermically, should be given.
3. Cephalin should be applied locally to the wound to bring about prompt clotting.
4. Coagulating snake venoms may be applied locally if the bleeding occurs at some easily available site, as the nose, mouth, and rectum. Rabbit thrombin, "globulin" powder, or other sources of tissue thromboplastin may also be used to stop local bleeding.
5. Adrenalin, 1:1000 solution applied locally, may be used.

6. Compression is indicated in external wounds.

7. Fresh cotton wool soaked in fresh normal blood or blood serum should be applied to the wound.

8. Horse serum, 25 to 50 cc., may be injected intramuscularly every 6 to 48 hours in an effort to check the bleeding.

9. An extract of egg white administered parenterally has been used to control hemorrhage.

10. Blood transfusions usually stop the hemorrhage, but the effect is transitory. Consequently, multiple transfusions, 25 to 100 cc. daily or every other day, are necessary. It is probable that they supply thromboplastin which seems to be lacking in the abnormal blood of the hemophiliac, and thus the prothrombin is converted to thrombin more quickly. The coagulation time is normal for about five days after transfusion, and for this reason transfusions should be given before operation.

11. Calcium lactate, 1 Gm. (15 grains) every four hours or one large dose of 4 Gm. (60 grains), should be given to adults, and 1 Gm. (15 grains) in solution is indicated for children.

12. Treatment with estrogenic hormones has been tried with doubtful success.

13. High protein diets, oral administration of placental extracts, and vitamin K have been employed with some good results. Other preparations, as sheep serum and pectin, have been used to reduce coagulation time. Vines demonstrated a marked decrease in coagulation time of capillary blood after intradermal injection of animal serum in hemophiliacs previously sensitized to the serum.

CHAPTER III

Diseases of the Blood

(Continued)

AGRANULOCYTOSIS

Agranulocytosis, or "malignant neutropenia" as it is sometimes called, has been increasing in incidence during the last 15 years. As there is no complete unanimity of opinion regarding the most appropriate term for this disease, the term "agranulocytosis" is used here because it is the original one employed and the one most generally understood. Other names as (1) agranulocytopenia, (2) agranulocytic angina, (3) acute primary granulocytopenia, (4) mucositis necroticans agranulocytica and (5) agranulosis sepsis with granulocytopenia have been substituted for agranulocytosis.

Etiology: Age and sex seem to play little part in the etiology of agranulocytosis, though it is more prevalent among people connected with the medical profession and in middle-aged women of the upper or middle classes. It rarely occurs in Negroes; this has been explained by the fact that they seldom use drugs, depending more on liniment or some kind of self-sacrifice to relieve themselves of pain.

Agranulocytosis may be divided into the primary and secondary types. The cause of primary agranulocytosis is unknown, though it seems to begin as a primary affection of the bone marrow, with a marked diminution of granulocytes in the peripheral blood occurring a few days later, The causes of secondary agranulocytosis are many. Benzene and drugs with the benzene nucleus are known to produce leukopenia. Amidopyrine is closely related to benzene. Madison and Squier observed that in cases of granulocytopenia there was a history of consumption of amidopyrine. Other causes which have been listed are endocrine imbalance, allergy, infections. vitamin deficiency, susceptibility to certain drugs, excessive radiation, use of organic arsenical compounds, sulfonamide drugs, dinitrophenol, and the pyrazalon drug group. Cortical adrenal defi-

ciency and hormonal disorders have been known to accompany agranulocytosis.

The fact that this disease has become more widespread recently has been explained by the greater number of drugs on the market and the increased use of them. More people are taking drugs containing the benzene ring for the relief of pain, and many have substituted these drugs for the salicylates. It should be emphasized that it is not the only element which may cause agranulocytosis and that an overdose of amidopyrine does not produce the same symptoms as those seen in agranulocytosis. The conclusion may be drawn that an idiosyncrasy to the drug determines whether the person will show signs of the disease. Since amidopyrine is known to be a dangerous drug, its use should be omitted or at least restricted to cases of severe pain in which other remedies are ineffective. The action of the drug is so variable that it is almost impossible to determine the amount which will affect a sensitive person and how much is necessary to cause agranulocytosis.

The extraordinary consumption of the sulfonamide compounds has caused many investigators to study carefully their toxic effects upon the blood and bone marrow. Leukopenia, anemia, thrombocytopenia, and agranulocytosis have been reported as occurring after the consumption of one of the sulfonamide drugs. There is no doubt that the sulfonamides have a pernicious influence on the blood and blood-forming organs at times, but their great advantages in the treatment of infections so far outweighs the disadvantages that these toxic side effects do not usually warrant permanent discontinuance of the drug. However, the use of these powerful chemical compounds must always be accompanied by careful and frequent blood studies. These tests will assist the physician in keeping the sulfonamide content of the blood at the proper level.

Signs and Symptoms: The onset of agranulocytosis is usually sudden with high fever, chills, rapid pulse, severe headache, general aching, and occasionally sore throat and spongy tender gums. A sore throat that fails to clear up within a few days should prompt one to study the blood carefully. However, a rather long prodromal period with increasing malaise, lassitude, and easy fatigability usually precedes the illness. The patients are pale, tired and show lack of interest in their surroundings. If treatment is not started at the

onset of the disease, diarrhea and ulcerations or necrosis of the throat and other mucous surfaces, which are coated with yellowish membrane and accompanied by a foul odor, are likely to develop. Nausea, vomiting, epigastric pain, and occasionally a rash may occur. There is tenderness on pressure over the long bones and sternum.

The blood picture tells the entire story of the disease. Severe and progressive leukopenia is the main factor, and as the result of a shortage of leukocytes and consequent lowered physical condition, the patient is subject to infection. Sometimes there is a total absence of neutrophiles in the peripheral blood. Immature white cells are rare. The total white count is seldom above 2500 per cmm. because of the low number of polymorphonuclear cells. The bone marrow may either be depressed or show evidence of maturation arrest. Anemia and thrombocytopenia are rarely present.

Diagnosis: The clinical picture of this disease resembles that of the leukemias, aplastic anemia, infectious mononucleosis, diphtheria, and septic sore throat. However, the leukocyte count in agranulocytosis is usually under 2000 cmm. with few or no neutrophiles, which distinguishes it from the diseases mentioned above. Examination of the sternal marrow also aids in diagnosis. Acute leukemia may be differentiated from agranulocytosis by the predominating immature white cells and frequent hemorrhages, especially in the late stage. Aplastic anemia is characterized by the diminution of platelets and progressive anemia. Serologic tests should be done routinely for syphilis, brucellosis, tularemia, and infectious mononucleosis.

Prognosis: The prognosis of agranulocytosis is always serious. The disease runs a course of from three to ten days, and carries a high mortality unless prompt and vigorous treatment is instituted. However, the chance for recovery today is much better than it was ten years ago because the condition is usually diagnosed earlier and the treatment is more effective. Early diagnosis is important because if the disease is discovered and treated early and there are no other infections, the patient has a 50-50 chance for recovery. It has been noted, however, that if recovery occurs relapses which are as dangerous as the original attack may take place.

TREATMENT

1. All therapy considered to have any bearing on the etiology of the disease should be discontinued.

2. In the acute phase of the disease, the patient should be put at complete bed rest and given a diet with a high caloric and vitamin content. Scrupulous care should be given to the mouth and local lesions. Neoarsphenamine may be applied locally to clear up the inflammation of the mouth and fauces. Spraying the mouth and throat with a saturated solution of potassium chlorate may be beneficial. All abscesses should be drained.

3. Pentnucleotide solution, 40 to 50 cc. daily in divided doses, should be given intramuscularly. Frequently, the injections are very painful and cause quite a rise in temperature. Occasionally, there are also abdominal pain and respiratory distress. Pentnucleotide is not a specific drug and many question its therapeutic value. However, it usually brings about a rise in the white count and in the percentage of polymorphonuclear neutrophiles. The amount of the drug may be decreased and finally eliminated after the white count has been normal for several days. If there is no response within ten days after initiation of the treatment, it is probable that further use of the drug will be of no avail. In severe cases, 10 cc. of pentnucleotide diluted to 100 cc. with warm sterile saline solution may be injected intravenously over a period of 20 minutes. Following this injection, dyspnea, palpitation, and even chills and fever may develop.

4. Desiccated yellow bone marrow, 25 drops three times daily, has been recommended.

5. Transfusions are used by some physicians. At any rate this form of treatment is a good supportive measure and it may keep the patient alive until a specific therapy is put to use.

6. Liver extract may be given intramuscularly, 4 to 8 cc. a day, but its value as a therapeutic measure is debatable. However, it does no harm and it is believed by some to produce increased delivery of granulocytes in 24 to 48 hours.

7. Stimulating doses of x-rays may be used, but the amount of benefit derived is questionable.

8. Sulfonamides should be used in combating the sepsis of agranulocytosis. Going on the premise that patients with agranulo-

cytosis die of the resulting secondary sepsis rather than the reduction of agranulocytes, full doses of sulfathiazole given to patients with severe aminopyrine agranulocytosis after the bone marrow has a chance to recover often produce dramatic results. Since the sulfonamides act by bacteriostasis, they may be given with impunity in conditions with marked leukopenia. It is interesting to note that when a sulfonamide drug causes agranulocytosis, administration of the drug must be stopped immediately, but in all other cases these drugs are valuable therapeutic agents.

PURPURA

Purpura is not a disease *sui generis* but a condition in which there is an alteration of the blood capillaries, of the blood, or of both. The name refers to the extravasation of blood into the subcutaneous tissues which produces petechial hemorrhages or ecchymoses. Both are the result of the same fundamental defect. The variation in appearance of the lesions is merely a matter of a difference in the degree of severity of the disease.

There are so many factors involved in the pathogenesis of purpura, so many diseases which have purpura as a secondary phenomenon, and so much is not known about purpura that it is no wonder a physician is confused when confronted with this symptom complex. Many classifications of the purpuras have been submitted, but few are simple enough and at the same time clear enough to be practical. The following classification has been found workable and clear. For our purposes, purpura may be divided into the primary (idiopathic) and secondary (symptomatic) types. The term "primary," or "idiopathic," refers to those cases in which there is no associated disease that may be the cause of the purpura. The term "secondary" is reserved for those purpuras in which there is another disease that is considered the cause of the purpura. It is important to keep in mind that the differentiation is not always easy, but it is important because the treatment of the two conditions is very different.

Primary Purpura

According to Elliott, only 42 of approximately 700 cases of purpura were classed as primary or idiopathic. Primary purpura

may be called essential thrombocytopenic purpura because in this disease the number of platelets is greatly reduced and changes in the cells of the capillary wall are present. The hemorrhages occur as a result of these factors, and because of the extensiveness of the hemorrhages into the skin and mucous membranes of the lungs, mouth, and rectum, the term "purpura hemorrhagica" was given the condition by Werlhof (1735). Sometimes certain other diseases produce a thrombocytopenia and purpura which may simulate the essential primary or idiopathic purpura. Therefore, when thrombocytopenic purpura occurs in an individual, a careful search must be made for some other disease that may cause the fall of platelets, as leukemia, metastatic carcinoma, and aplastic anemia. Yet these diseases are usually recognized by their attributes other than the thrombocytopenia.

Etiology: The cause of idiopathic (primary) essential thrombocytopenic purpura is unknown, as the name implies. The important point to be remembered is that other diseases, as infections, metabolic disturbances, and poisonings from drugs must be eliminated as causes of the clinical picture.

Pathology: The pathological changes that occur in the spleen and bone marrow are not specific enough to be agreed upon by all authorities. The chief abnormal changes have been found in the spleen where the germinal centers are enlarged and active, and the megakaryocytes are present in the sinuses of the splenic pulp. The megakaryocytes of the bone marrow are usually increased in number.

Signs and Symptoms: The disease may be acute or chronic. The acute condition is much rarer than the chronic and is usually found in young individuals, especially females, under the age of 40 years. The chronic form may occur, too, but it is commoner in adults and is usually recurrent and milder, and may continue intermittently with periods of years between the episodes.

The disease usually comes on abruptly with the attention of the patient focused upon bruise marks or small or large subcutaneous hemorrhages. In the more severe forms, bleeding may arise from the gums or other parts of the body, or a menstrual period may fail to terminate as usual and instead continue for several weeks. Fever is unusual, while rapid heart rate is common. The spleen is com-

monly enlarged, but in the early stages it may not be palpable. The presence of an excessively large spleen with purpura tends to make one believe that the disease is not idiopathic purpura but leukemia with purpuric manifestations. The exact diagnosis depends almost entirely upon a study of the blood picture.

1. The chief feature is a reduction of the platelets from 250,000 or above to 20,000 per cmm. or below.

2. The bleeding time is increased from a normal of three minutes to ten minutes or more.

3. The coagulation time of the blood is normal, but the clot fails to retract and there is no extrusion of serum.

4. The capillary resistance test is positive. This test is performed by placing a tourniquet or cuff of a blood pressure instrument above the elbow and pumping the pressure up above the diastolic level so as to obstruct the venous return, but not the arterial flow, for about five minutes. In purpura, where capillary resistance is decreased, petechial hemorrhages occur over the entire forearm.

5. The white blood cells are normal. A pronounced leukopenia or other abnormalities in the white cells would lead one to think of a secondary rather than a primary purpura.

The course of the disease may be short, for a period of a few months, or for a lifetime. The disease may be self-limited or it may disappear for a while and return at some later date.

Prognosis: This depends upon the adequacy of the treatment. As will be pointed out, most of the patients, that is, 85 to 90 per cent, with thrombocytopenic purpura recover. It must be borne in mind, however, that occasionally a patient with a severe grade of the disease may hemorrhage to death, die of a cerebral hemorrhage or thrombosis, or be the subject of an intercurrent infection.

TREATMENT

1. Great emphasis needs to be placed upon the exactness of the diagnosis of the essential or primary form of thrombocytopenic purpura because in these cases splenectomy is specific. Other forms of nonoperative treatment have been tried but these have not been very successful, and experience shows that most patients had to have splenectomy eventually if cure was to be established. Immediately

following splenectomy, the platelet count rises to 500,000 or above and then falls to normal or well below normal later, but bleeding does not recur. Probably the comparative results of the operative and nonoperative forms of treatment are best shown by Elliott in his Spleen Clinic; he states that splenectomy was satisfactory in 85 per cent of cases, while the nonoperative treatment was effective in only ten per cent of cases. Before splenectomy is done, however, repeated transfusions should be given in order to build up the patient's blood condition so he can withstand the operation.

2. Focal infections, as apical abscesses or sinus infections, are contributory factors and should be cleared up, but a warning must be sounded in regard to these procedures; attempts at removal of these foci may cause disastrous bleeding unless the patient is properly safeguarded by either a previous splenectomy or multiple transfusions.

3. Other measures used have been sesame oil, 1 to 4 cc. (15 to 60 minims) three times a day, large doses of vitamin C as 10 mg. intravenously daily, and ultraviolet radiation.

4. Moccasin snake venom intracutaneously or subcutaneously. 0.2 to 1 cc. of a 1:3000 solution, has been praised by some but has not received very widespread acceptance. It is probably more effective in controlling various hemorrhagic conditions unassociated with blood changes.

Secondary Purpura

In contrast to the purpura of primary essential thrombocytopenia where there is no recognizable cause, secondary purpura embraces those purpuras which are due to some underlying disease. Most purpuras belong to the secondary group. Thrombocytopenia may or may not be present; if it is marked, difficulty may be encountered in differentiating the secondary type from the primary. The important point, however, is to exert every effort to determine the cause if possible, and direct the management of the case at the underlying disease rather than at the thrombocytopenia and purpura directly.

Etiology: Secondary purpura may be divided into two large classes: (1) Secondary thrombocytopenic purpura which is caused by some recognized disease that is associated with lowering of the

blood platelets. Among such diseases are myelophthisic anemia, pernicious anemia, leukemias, aplastic anemia, intoxication from x-rays, radium, or drugs. (2) The secondary purpura without thrombocytopenia forms the second group. In this class, if the platelets are reduced at all, it is very little, and the purpura is predominantly caused by changes in the capillary wall not dependent upon the number of platelets in the blood stream.

1. Secondary purpuras may develop as a sequel to infections as cerebrospinal meningitis, measles, etc.

2. Toxic purpuras may be caused by drugs, as quinine, the barbiturates, mercury, and the sulfonamides.

3. Constitutional debility as seen in chronic glomerulonephritis, cancer, and syphilis may cause purpura. Scurvy and at times other avitaminosis may lead to purpura.

4. Well known is the purpura of subacute bacterial endocarditis, but other endocarditic and septic infections may cause purpura.

The pathogenesis of the secondary type of purpura is frequently obscure. The purpuric eruption is not always brought on by the same mechanism. The factors concerned in the development of petechial hemorrhages are:

1. Defective production of platelets by the bone marrow.

2. It has been postulated that the spleen produces an inhibitory substance which impairs the formation of platelets.

3. A damaged capillary endothelium may be a factor. In most cases of secondary purpura, the chief changes are probably produced by increased permeability of the capillary wall plus thrombocytopenia as an added factor.

4. Aplastic anemia, pernicious anemia, leukemia, and myelophthisic anemia.

Signs and Symptoms: The characteristic clinical picture as seen in purpuras of the essential or primary type is often lacking in the secondary group. While purpuric spots occur in the skin and there may be bleeding from the gums and other parts of the body, the changes in clot retraction time and in the platelet count are not as prominent as in the primary form. The associated underlying disease usually dominates the clinical picture so completely that the purpura seems to play only a minor rôle. Obviously, the manifestations of the purpura are determined by the mechanism that causes

it; for example, if the purpura is due predominantly to capillary damage, the features will be different than if it is produced by defective formation of platelets.

TREATMENT

The treatment of secondary purpura consists in treating the associated disease and cause.

1. During the acute stage, the patient should rest in bed, have good nursing care and an appetizing, well-balanced diet. Good results have been reported following the use of vitamin C, 25 to 50 mg. doses three times a day.

2. Blood transfusions are often important, especially if there is a disturbance of the platelet formation. Small transfusions, repeated every two or three days, are better than large amounts, as platelets are then furnished repeatedly and the life of platelets is very brief. Subcutaneous or intramuscular injections of whole blood, 20 cc. every day or every other day, have been found to be of benefit. The favorable influence of such injections may be due to a foreign protein reaction.

3. Intramuscular injections of liver extract, 3 to 5 cc. weekly, are recommended. Iron, in the form of iron and ammonium citrate, 2 Gm. (30 grains) three times a day, may be given.

4. Calcium lactate, 0.66 Gm. (10 grains) every four hours, or calcium gluconate, 1 Gm. (15 grains) intravenously every day have also been suggested.

5. Vitamin P, which is present in large amounts in the rind of citrus fruits, has been quite effective; the rind of from 6 to 12 oranges ground into a pulp with or without the juice must be given daily.

6. Splenectomy is hardly ever indicated in secondary purpura.

BANTI'S DISEASE

Banti's disease, or splenic anemia, is a chronic disease characterized by splenomegaly, anemia, leukopenia, a tendency toward gastric hemorrhage, and an increase in the formation and destruction of blood cells. In the later stages there is cirrhosis of the liver with ascites and jaundice. The acute episodes in the chronic course constitute emergencies.

Etiology: The cause of Banti's disease is not known. Some investigators question whether it is a distinct entity from the pathological point of view and claim that it is only a phase or period in some form of cirrhosis of the liver. These men believe that some toxin or infection leads to cirrhosis of the liver and also to changes in the spleen. There are, however, some distinguishing characteristics of Banti's disease not found in the average case of liver cirrhosis. Most liver cirrhoses do not develop leukopenia, anemia, hematemesis, and splenomegaly, though it may be that certain types of cirrhoses of the liver are associated with these changes. Banti's disease often comes on in young people, and that is one reason why it should be separated from real cirrhosis of the liver. If all cases of Banti's disease were seen in the cirrhotic period (past 45 years of age) it would seem more likely that cirrhosis and Banti's were one and the same. When it appears in younger individuals, it is often confused with ulcer because of hematemesis, or with other forms of blood dyscrasias because of the anemia and leukopenia.

Pathology: Histologically, Banti described what is known as fibrosis of the malphigian corpuscles in addition to fibrosis of the trabeculae of the spleen. He based the diagnosis of Banti's disease on these peculiar findings. Some investigators believe that the disease is distinguished by these features; others believe that these changes may occur during the course of ordinary cirrhosis of the liver.

Symptoms and Findings: Banti's disease has some very special clinical features. It is a disorder that usually begins in youth and runs a course that covers over one-half the period of an average lifetime. The disease may be divided, as Banti pointed out, into three stages:

1. The first stage begins early in life—in childhood or adolescence. Anemia, weakness, leukopenia, splenomegaly, and frequently hemorrhage from the stomach occur. The hemorrhage from the stomach is not produced by portal obstruction in the early stage. The first stage covers a period of approximately ten years, and is often called splenic anemia.

2. The second stage ensues after ten years, and is a period characterized by enlargement of the liver, pallor, more severe anemia, greater enlargement of the spleen, and frequently hematemesis. This period covers a space of about two or three years.

3. The third stage of this disorder is distinguished particularly by cirrhosis of the liver, portal obstruction, and the other signs and symptoms of Banti's disease—splenomegaly, hematemesis, severe anemia, and leukopenia.

Differential Diagnosis: The diagnosis is decided mainly by exclusion. A half dozen or more disorders may have to be excluded. Carcinoma or ulcers of the stomach must be eliminated first. Next, blood dyscrasias typified by enlargement of the spleen such as Hodgkin's disease, Gaucher's disease, or Osler's disease must be considered. The leukemias must be carefully differentiated from Banti's disease. During certain periods of the leukemic state the patient may have leukopenia. Leukemia is associated with the presence of many pathological young cells—myeloblasts, etc. If one takes a careful history and is able to satisfy the four or five main features of Banti's disease as pointed out above, there should be little or no difficulty in the differential diagnosis.

Prognosis: These patients usually live almost an average lifetime. Hematemesis is the most serious complication that develops. The disease itself does not produce a fatal outcome, but life may be threatened by severe hemorrhage or by intercurrent infections. Spontaneous recovery is unknown.

TREATMENT

The treatment is largely dependent on the stage of the disease in which the patient is seen. In the early stages, when anemia and leukopenia are the characteristic features, splenectomy is said to do good. When gastric disturbances, ascites, and hematemesis predominate, splenectomy is of no avail because these symptoms are produced by the cirrhotic condition of the liver. The problem that often arises is the care of a patient with hematemesis. The treatment should be the same as it is for hematemesis from any other cause:

1. Complete rest.
2. Transfusions.
3. Intravenous glucose in saline.
4. Morphine in order to keep the patient quiet.
5. Finally, it is said that cod liver oil or haliver oil is of value.

GAUCHER'S DISEASE

Gaucher's disease, which was first described by Gaucher in 1882, is a form of splenomegaly accompanied by hepatomegaly, secondary anemia, and leukopenia. The theoretical aspects of this disease are probably more interesting and important than the clinical.

Etiology: There are a familial tendency and a preponderance of Hebrews in the reported cases. The disease is a kind of hyperplasia of the endothelial or reticular cells, and the cause is now believed to be due to a hereditary disturbance of lipoid metabolism.

Symptoms and Findings: Gaucher's disease is characterized by the constant signs of splenomegaly. Hepatomegaly, secondary anemia, and leukopenia are present as the inconstant features of a tendency toward bleeding, brownish-yellow discoloration of the skin and paracorneal wedge-shaped conjunctival thickenings. Occasionally there are gross and radiologic long bone changes consisting of palpable thickening, angular deformity of the spine and pathological fractures. The x-rays show thinning of the cortex, expansion and widening of the medulla, and a mottled appearance of the long bones.

The peripheral blood picture is not striking, but the presence of splenomegaly, hepatomegaly, mild secondary anemia, leukopenia of 3000 to 6000 with reduced polymorphonuclears, relative lymphocytosis and unaltered monocytes, and thrombocytopenia of the order of 125,000 should lead one to suspect the disease.

Diagnosis: Definite and indisputable diagnosis is made by studying smears of aspirations of the spleen or bone marrow, which typically contain the Gaucher cell. These cells are of extreme size, ranging from 40 to 60 micra in diameter; their nuclei stain darkly and are eccentrically placed; the cytoplasm is clear and contains fine fibrillae coursing parallel to the long axis of the cell. It is now known that these cells are elements of the reticuloendothelial system impregnated with a product of disturbed lipoid metabolism in combination with a protein to form a cerebroside.

The condition may have to be differentiated from Banti's disease and hemolytic jaundice. Gaucher's disease may be excluded if portal cirrhosis and ascites are found, as these are not features of Gaucher's disease; early in the disease, however, it may not be possible to distinguish them clinically, unless gastric hemorrhage occurs to clarify the picture. Hemolytic jaundice offers no difficulty if the familial

relationship, the icterus and the blood picture of nucleated red cells, with 10 to 20 per cent reticulocytes and increased red cell fragility, are appreciated.

TREATMENT

Splenectomy is the only known measure that can alter the course of Gaucher's disease. Since this procedure is dangerous and, as a rule, merely slows the process, it should be practiced with reserve. Cure is hardly to be expected, as the disease progressively involves more of the reticuloendothelial elements in the liver, bone marrow, and lymphatic tissue until death ensues during the late twenties or early thirties. However, if the operation is successful, improvement may be expected, and if progress outside the spleen is slow enough, the improvement may be permanent.

POLYCYTHEMIA VERA

Polycythemia vera is a rare disease also known by the synonyms polycythemia rubra vera, erythremia, splenomegalic polycythemia, Vaquez's disease, and Osler's disease. Its origin is unknown. The disease is a chronic condition which progresses slowly, but eventually ends in death. Its acute exacerbations require prompt and skillful medical attention. Polycythemia vera is characterized by excessive formation of erythroblasts by the bone marrow. This results in persistent polycythemia with splenomegaly, which gives a red cyanotic appearance to the skin, and causes erythrosis, increased viscosity and volume to the blood, and distention and engorgement of the capillary vessels.

Etiology: Heredity may have some bearing on the incidence of this disease. Local anoxemia of the bone marrow may play a part, as the level of the red cell count is controlled by the oxygen tension of the bone marrow. However, the cause of polycythemia vera is obscure.

Pathology: The pathological changes consist of hyperplasia of the red cells. This causes an increase in the amount of red bone marrow, which replaces the normal yellow marrow. Most important of all is the decided increase of total blood volume, as well as the increase in number of red cells to over 6,000,000 per cmm.

Symptoms and Findings: The clinical picture is characterized by a most varied number of syndromes. One or another may dominate

the clinical picture for a time, then disappear, and either return at a later date or never return at all. The changes which occur in the different body systems may be summarized as follows:

1. Brain and nervous system:
   a. Dizziness.
   b. Headache.
   c. Lapses of memory.
   d. Complete change of personality. Individuals who have been happy may become irritable; frugal people become spendthrifts; a man who has been happy in his family life may start going about with women.
2. Cardiovascular system:
   a. Palpitation of the heart.
   b. Flushing of the hands and face.
   c. Drumming in the ears.
   d. Pulsation in the wrists.
   e. Cyanosis or redness of face and neck.
3. Respiratory system:
   a. Coughing.
   b. Hemoptysis.
   c. Great dyspnea.
   d. Pain in the chest.
4. Gastrointestinal system:
   a. Nausea and vomiting.
   b. Diarrhea.
   c. Vomiting of blood.
   d. Enlarged spleen.
5. Urinary tract:
   a. Albuminuria.
   b. Blood in the urine.
   c. Frequency of urination.
6. Vascular diseases of the extremities (these are of great importance):
   a. These frequently occur and are characterized by thrombotic lesions in the arteries or by functional occlusion of vessels, with blocking of flow of blood leading to ischemia and gangrene of the feet, simulating Buerger's disease. Operations have sometimes been done when simple treatment would have been all that was necessary.
7. Change in the blood:
   a. This is the greatest change of all. The red blood cell count averages between 7 and 12 million per cmm.; up to six million is not considered polycythemia. The count is usually eight million or more. There are no other pathological lesions. There is great activity of the bone marrow.

Differential Diagnosis: The most important clue to diagnosis is persistent, absolute polycythemia not associated with any obvious cause. The patient's appearance and splenomegaly should be sufficient to decide the diagnosis. Erythrocytosis due to circulatory stasis from chronic cardiac disease and emphysema must be differentiated. The saturation of the arterial blood with oxygen in cardiac or pulmonary polycythemia is less than in polycythemia vera. Diagnosis of polycythemia vera should not be made unless the red blood count is over 6,000,000. If this rule is followed one will not confuse erythremia with an increase of red cells due to living at high altitudes, the administration of certain drugs or poisons, or vasomotor instability. The gastrointestinal symptoms and those referrable to the central nervous system, heart, kidneys, and sense organs must not be confused with symptoms of local primary disease.

Prognosis: Polycythemia is a chronic condition with spontaneous, prolonged remissions and acute episodes. After the onset of the first symptoms, the patient may expect to live from 4 to 20 years. The disease is fatal in the long run, though death may be brought on by other causes. The patient may die during an exacerbation of the disorder from thrombosis or hemorrhage. Modern methods of treatment have improved the prognosis somewhat.

TREATMENT

Venesection is by far the most important method of treatment for polycythemia vera, because there not only is a great increase in blood volume but also in the number of red blood cells. The hematocrit reading is decidedly increased and the hematocrit may be taken as a guide for venesection. At first venesection must be done every week or ten days; then it may gradually be diminished to once every month. In time it has to be done only occasionally as the condition of the patient requires it.

Phenylhydrazine hydrochloride is said to be beneficial. Two-tenths of a gram (3 grains) is given daily for three or four days; then 0.1 Gm. (1½ grains) is administered daily until the leukocytes increase or the hemoglobin falls below 100 per cent. After this happens 0.1 Gm. (1½ grains) is given every second or third day, or medication may be discontinued until the leukocytes begin to fall or the hemoglobin begins to rise. The periods between medication

are gradually lengthened in the hope that the blood hemoglobin and leukocyte count can be stabilized by 0.1 Gm. (1½ grain) doses given once a week.

It has been thought that liver injury may result from this type of therapy, but this has not been proved. The blood should be carefully studied during the course of treatment in order to avoid unfavorable responses. Giffin and Conner feel that the patient should be kept ambulatory as much as possible, that patients confined to bed should not take the drug, and that this drug should be used with extreme caution in the cases of patients over 60 years of age.

Acetylphenylhydrazine is considered superior to phenylhydrazine hydrochloride, since it is less toxic and the dosage easier to regulate. The dose is 0.1 Gm. (1½ grains) given every day for two or three days; then medication is stopped for a few days, a blood count taken and treatment resumed. This procedure is followed for three or four weeks, when the dose may be increased to four, five, or six doses per week, if that is necessary. If there is any drop in hemoglobin or erythrocytes, the drug is stopped at once for a week or longer. Great care must be taken to adapt the dosage to the patient, as individual tolerance varies greatly. Signs of overmedication are drop in red cell count, jaundice, gastrointestinal symptoms. and fever.

Saturation with Fowler's solution in the usual way is helpful. The best result from this treatment is effected if the patients reach a 20-minim dosage three times daily instead of stopping at 10 minims.

Roentgen therapy is sometimes beneficial. Though irradiation of the spleen is harmful, irradiation of the long bones is good. Rather large doses are given to the long bones, sternum, scapula, vertebra, ribs, and pelvis. The effect is temporary and therapy must be withheld if decrease in the leukocytes of the circulating blood indicates impairment of the leukocyte-forming mechanism in the marrow.

CHAPTER IV

The Heart

The routine medical practice is apt to lull one into a sense of self-sufficiency to a degree that the physician fails to be prepared for the acute emergency which is sure to come sooner or later. When this acute episode develops, the judgment and skill of the practitioner are tested to the utmost, for upon proper diagnosis and prompt and skillful management the life of the patient depends.

Of the many kinds of acute emergencies, none is more dramatic or important than that associated with diseases of the cardiovascular system. While the chronic diseases of the heart and circulatory system are usually easily diagnosed and treated, the acute events that develop primarily or in the course of the chronic ailment may find the resourcefulness of the physician lacking. The types of so-called cardiac emergencies met with in both hospital and general practice are those associated with (1) the coronary arteries, (2) right and left ventricular heart failure, (3) the arrhythmias, (4) embolism and thrombosis, and (5) hypertensive cerebral vascular crisis.

DISEASES OF THE CORONARY ARTERIES

There are two main clinical manifestations of coronary artery disease. While these are usually treated as distinct clinical entities, it would be as correct to consider them under one heading and describe the chief events as different stages of the same disease. For the purpose of this chapter, these two conditions will be described separately. They are (a) angina pectoris, and (b) coronary thrombosis. Since diseases of the coronary arteries usually develop on the basis of an arteriosclerotic lesion, it is rare to find this class of heart disease in individuals under the age of 40 years. But, by the same token, most people over the age of 40 years sooner or later develop some sclerosis of the coronary branches.

Angina Pectoris

Angina pectoris is a term over which considerable difficulty has arisen. Many authorities believe it is so inaccurate that it should be

dropped, while others advocate its use. In my opinion, it is a very satisfactory term if one uses it in its proper sense. Angina pectoris is a name indicating a particular kind of pain in the chest due to interference with the proper blood supply to the heart muscle. If one uses the term loosely to designate a variety of chest pains which have nothing to do with the heart or circulatory system, then confusion arises and the term becomes more of a nuisance than a help in diagnosis. The term will be used here strictly for the type of pain that comes when the coronary arteries are involved. If this is done,

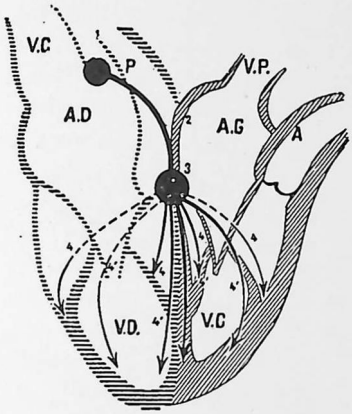


Fig. 1.—Diagram of the bundle which transmits the neuro-myocardial stimuli (bundle of His). V.C., vena cava; V.P., pulmonary vein; P., pulmonary artery; A., aorta; A.D., right auricle; A.G.. left auricle; V.D., right ventricle; V.G., left ventricle; 1 and 2. sinoauricular node; 3. auriculoventricular nucleus; 4. 4'. terminal neuromyocardial ramifications of the bundle.

then as a rule the characteristics of angina pectoris are fairly clear. These will be taken up under Symptoms.

Etiology: The term status anginosus is applied to a clinical condition in which the pain is of greater duration than the pain of angina pectoris, lasting for an hour or two or longer. It is a form of coronary insufficiency, and evidences of myocardial infarction are slight. In the past, many theories have been advanced for the explanation of angina pectoris. The idea that hardening of the coronary arteries was the chief cause of the angina came from Edward Jenner, but this theory was not established as a fact, and such hypotheses as aortitis and coronary spasm were advanced to explain

the pain. Our modern conception of anginal pain is based to a large extent upon the work of Thomas Lewis who showed by analogy with the muscular pain of intermittent claudication to angina pectoris that the pain is due to a relative insufficiency of the blood supply to the heart muscle. He pointed out too that the pain of angina pectoris, where the blood supply to the heart muscle is not completely shut

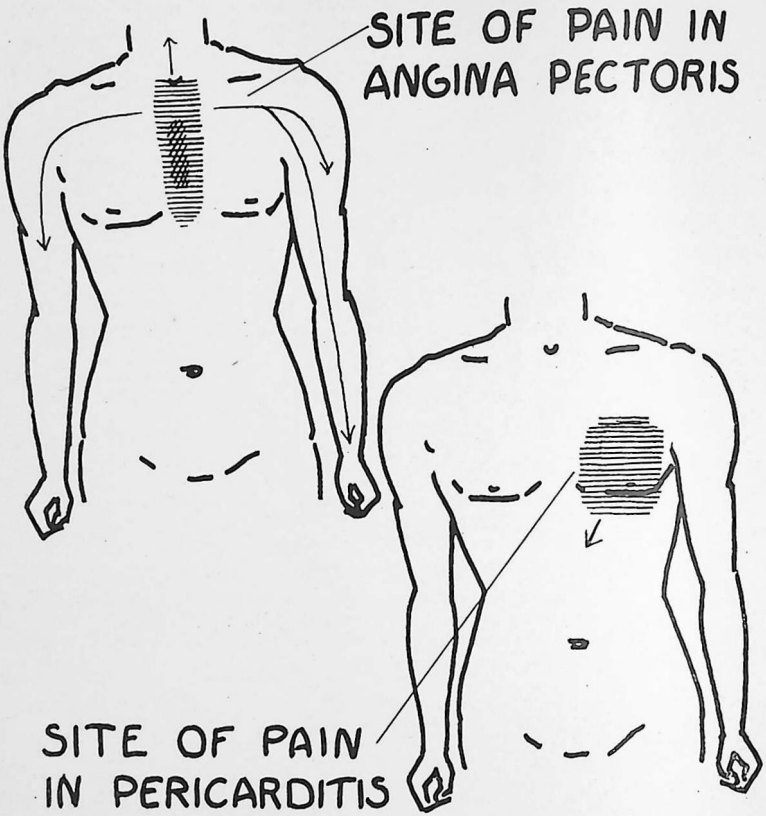


Fig. 2.

off, is the same kind as that in coronary thrombosis where complete occlusion of an arterial branch blocks off the blood supply entirely. The difference is that in the spasmodic type of pain, the insufficiency is partial, while in the other it is complete and the pain is not relieved within a period of from five to ten minutes but continues on with greater severity for hours or sometimes days.

Pathology: Many theories have been advanced to explain angina pectoris. The originator of the term, Heberden, believed that the coronary arteries were hardened and narrowed. Following Heberden's time, this term was used for almost any type of chest pain and the relationship of the coronary system and angina pectoris was lost. Terms as "spurious" angina, "false" angina, angina "notha," and "pseudoangina" pectoris all came into use to describe certain sensations in the chest associated with assumed or genuine lesions of the heart. This state of confusion existed until about 1912 when Herrick first described coronary thrombosis as a separate clinical pathological entity. By a gradual process, angina pectoris and coronary thrombosis were seen to merge as different syndromes in the course of the same disease. Although I must emphasize that certain cases occur apart from organic disease of the coronary system and are explained on the functional basis as a coronary spasm, clinically and at autopsy these are too rare to be of any great consequence in practice.

Signs and Symptoms: Angina pectoris is distinguished by the following three factors:

1. Pain under the upper portion of the sternum.
2. The radiation of the pain down the left arm, up the left side of the neck, and sometimes in both arms.
3. An emotional element is usually an outstanding mark. This consists of a sensation of fear that something disastrous is going to take place.

The painful sensation is often difficult for the patient to describe and more difficult for the physician to interpret. This distressful feature seldom is a sharp lancinating type of pain, but more often consists of a tightness as if a band is about the upper part of the chest. Sometimes the patient feels he is suffocating. This pain is usually most marked over the upper portion of the sternum.

The attack of angina pectoris comes on as a rule following any one of three events: (a) Exercise; (b) emotional strain, or (c) a heavy meal. The attack is usually sudden at onset. It lasts from five to ten minutes, and then disappears promptly and completely without aftermath. There is no evidence of cardiovascular shock, and the heart sounds, force, and rhythm may be as good after the attack as before. Cyanosis, dyspnea, and other evidences of heart failure are lacking. The blood pressure may rise during the attack, but usually

returns to normal following the attack. After the spell is over, the patient feels as well as before and only hopes that a recurrence will never take place. The earlier attacks are usually mild, but as time advances these spells become more frequent and more prolonged. Finally, one comes but does not disappear like the others. It fails to respond to the simple treatment the patient has taken for relief before, and suddenly it dawns on the patient that something more has happened than a mere angina attack. The clutching in his chest is more severe, the tightness is greater, and he is weaker than ever before. He feels his heart thumping and beating irregularly and he falls over in collapse.

It is evident that the coronary system, which for several months to several years has demonstrated its ability to furnish the proper amount of blood to the heart muscle in angina pectoris, has finally suffered from an acute occlusion of one of its main branches by a thrombus. The patient then no longer has simple angina pectoris but a more disastrous kind of coronary disease — namely, coronary thrombosis. But angina pectoris does not always end up with coronary thrombosis. Coronary disease that produces angina pectoris may lead to myocardial degeneration and fibrosis with auricular fibrillation and failure of the heart muscle. And again, the patient may overcome the angina pectoris, and after several years of frequent struggles with these painful attacks may never suffer from them again.

Diagnosis: While the diagnosis of angina pectoris is not always easy, if one keeps in mind the essential features, as the age of the patient, the nature of the onset of the first sign of distress and the periodicity of the course associated with the main causes of the disease, then it becomes comparatively simple. The electrocardiograph is about the only instrument of precision that may aid in diagnosis, and even that is often of little value because the electrocardiographic findings may be negative. The old adage, "Listen carefully to what the patient says and he will tell you the diagnosis" is appropriate here.

The differential diagnosis of angina pectoris is difficult because so many conditions apart from the heart and coronary arteries may produce a pain that in a faint way simulates it, as pleurisy, aortitis, arthritis of the sternocostal joints, intercostal neuralgia, and gallblad-

der disease. The differential diagnosis is made easier if one insists upon a rigid history of the course of events, remembering that angina pectoris is a disease predominantly of men over the age of 40 years, and that the periodic attacks of angina pectoris have a clocklike regularity. And finally, angina pectoris disappears by itself within a short period, or nitroglycerin, amyl nitrite, or other vasodilators usually cause a prompt disappearance of the symptoms. Such treatment will have absolutely no influence on the course of other diseases confused with angina pectoris.

TREATMENT

Angina pectoris is a condition that calls for ambulatory treatment rather than bed rest which is required in coronary thrombosis. The regime of management of angina pectoris is as follows:

1. Avoid any and all events which precipitate attacks! An adjustment of one's mode of living is more important than a prescription for medicine in most cases. Shorter hours, more leisure, and freedom from emotional strain are the main therapeutic factors. The entire intake of food should be cut down and special attention given to the avoidance of any food that may be gas-producing. Tobacco is forbidden. Notwithstanding a variety of opinions upon the benignity or the injuriousness of nicotine in angina pectoris, I have observed that the patients with angina pectoris are better off without tobacco and invariably are made worse by it. While the effect of alcoholic drinks on these patients is somewhat debatable, there is no question that a limited amount of whiskey, brandy, or other strong liquor may be well borne, and, in some cases, may even do good. The abuse of this, however, is to be strongly condemned. In brief, then, the patient with angina pectoris must be educated to live within the rigid boundaries which are set up by his disease. Anything that causes the patient distress should be avoided.

2. The attack may be relieved by 0.65 mg. ($\frac{1}{100}$ grain) of nitroglycerin. This tablet should be placed under the tongue and allowed to melt. An amyl nitrite pearl may be placed in a handkerchief and broken, the inhalation from the pearl usually bringing about prompt relief from the pain.

3. Between periods of severely painful episodes, various sedatives, as elixir of bromide or phenobarbital, one teaspoonful, may be given four or five times a day to control the excitable nervous system.

4. Drugs of the xanthine group are often used effectively over a long period of time. Theobromine, 0.3 Gm. (5 grains), with 0.03 Gm. (½ grain) of phenobarbital may be given three times a day. These drugs are said to increase the blood flow in the coronary system and promote better nourishment of the heart muscle. However, vasodilating drugs may not always do good. When there are rigid ostia or segments in the main coronary vessels, these drugs will not effect coronary vasodilatation. The drugs cause dilatation not only of the coronary vessels, but also of the peripheral vessels, which tends to prevent the return flow to the heart. This may be followed by anoxia or reduced oxygen supply to an already damaged heart. Vasodilating drugs when incorrectly used may cause myocardial infarction.

5. Papaverine hydrochloride may bring about improvement. It should be given in doses of 0.1 Gm. (1½ grains) in tablets four times daily over a period of time. It has been considered good to alternate two weeks of papaverine medication with two weeks of placebo medication. Papaverine may also be given intravenously in large doses with a wide margin of safety. Its action is that of a mild sedative, and a definite and prolonged coronary vasodilator. It is not very toxic, and is not a myocardial depressant. This drug is contraindicated only for intravenous administration in complete auriculoventricular block.

6. The frequency, severity, and duration of attacks may be reduced, and exercise tolerance increased in some individuals by therapy with testosterone propionate, 25 mg. (0.4 grain) every fifth day for a total of 5 to 25 injections. The average number of injections needed is 11. Improvement is not immediate as with nitroglycerin, since about 28 days pass before quantitative improvement is noted, and about 43 days before it is marked. During therapy, blood pressure is usually lowered.

7. Intravenous infusions of nicotinic acid have brought about prolonged subjective and objective betterment, and may reduce both blood pressure and heart rate. It is thought that nicotinic acid causes a rise of pressure to the brain and an increased blood supply to the brain accompanied by inverse changes in the rest of the body.

8. The use of an elastic abdominal support may prevent anginal attacks.

Coronary Occlusion, Thrombosis, and Insufficiency

In discussing diseases of the coronary arteries, confusion has arisen in terminology. In most instances, the names represent not different diseases but different phases of the same disease. Coronary arteriosclerosis is the basis of the disorder which eventuates in myocardial infarction when occlusion occurs. The rate of its progress, the size of the artery involved, and the extent of collateral circulation in the occluded area are factors which modify the clinical picture. Within recent years, various terms, formerly used loosely, have been restricted in their meaning.

Coronary occlusion, coronary thrombosis, and coronary insufficiency have been used interchangeably. While there is not complete unanimity of opinion concerning the preferential use of these terms, the following interpretation seems justified. For practical purposes, the terms coronary thrombosis and coronary occlusion may be used interchangeably, but coronary occlusion is favored. Complete occlusion of a coronary artery may occur without thrombosis, as the partially occluded artery may become completely plugged by hemorrhage into the intima or by conditions other than thrombosis. Myocardial infarction may develop without complete coronary occlusion or thrombosis, and coronary occlusion may occur without myocardial infarction if the development of the process is slow and collateral circulation becomes well established.

The term acute coronary insufficiency should be differentiated from coronary occlusion and thrombosis. It has been shown that most cases can be divided, clinically and electrocardiographically, into acute coronary occlusion and acute coronary insufficiency. One of the chief clinical differences between the two is the abruptness of onset of coronary occlusion and the more insidious development of coronary insufficiency. Another difference is that a number of factors, such as trauma, shock, exertion, and excitement influence the onset of acute insufficiency, while acute thrombosis or occlusion often occur during rest or sleep. The area of infarction in occlusion or thrombosis is frequently large, extending from the endocardium through to the pericardium, and it is more often fatal than an attack of insufficiency, where the area of infarction is apt to be small and not confluent.

Coronary Occlusion and Thrombosis: Acute coronary occlusion is one of the most dramatic and disastrous events encountered in the practice of medicine. Approximately 30 per cent of these patients die within 24 hours after the onset of the attack; 45 per cent recover partially but remain cardiac invalids only to succumb to heart failure, another coronary attack or some other intercurrent disease within a period of five years, and approximately 25 per cent recover completely. Prompt and accurate diagnosis is of first importance, for frequently a surgical condition of the abdomen may be confused with coronary thrombosis. If one operates upon an individual with a coronary attack with the idea of relieving an acute abdominal disease, as perforation of a viscus, which is not present, the patient rarely survives. On the other hand, failure to operate when there is an acute abdominal condition may lead to the patient's death.

Etiology: The cause of coronary occlusion is usually a thrombus on the base of an atherosclerotic plaque. Embolism is seldom the cause of obstruction. The patient with angina pectoris is always a candidate for coronary thrombosis. The fundamental basic lesion, arteriosclerosis, is the same in both conditions. The partially occluded coronary vessel of angina pectoris becomes completely shut off by the development of a coronary artery thrombus. This must not be taken to mean that angina pectoris always precedes an attack of coronary thrombosis, because the thrombostatic episode may occur abruptly without any preceding evidence of any kind of cardiac disturbance.

Signs and Symptoms: As in angina pectoris, exercise, emotional strain, or a heavy meal may precipitate the attack, but it is well known that the attack may come on independent of any one of these conditions. It may develop while the patient is sleeping. It usually begins with a sudden pain in the region of the sternum or in the epigastric area. Because of the location of the pain in the abdomen, so-called acute indigestion or gallstone colic may be suspected. The pain may simulate that of a preceding attack of angina, but it differs in that it fails to be relieved by rest or nitroglycerin within the usual period of about ten minutes. This pain continues and then the associated phenomena characteristic of coronary thrombosis set in with weakness, sweating, nausea and vomiting, palpitation, and irregularity of heart action, and the patient may collapse.

Diagnosis: Differential diagnosis is more important today than ever before because the treatment of coronary disease has become more painstaking, exact, and effective. Furthermore, since coronary thrombosis is simulated by acute abdominal emergencies, it is obvious that certainty in diagnosis may be a matter of the patient's life or death. Coronary disease may be confused with certain surgical emergencies, particularly with acute perforation of peptic ulcer, gallstone colic, acute hemorrhagic pancreatitis, and bowel obstruction.

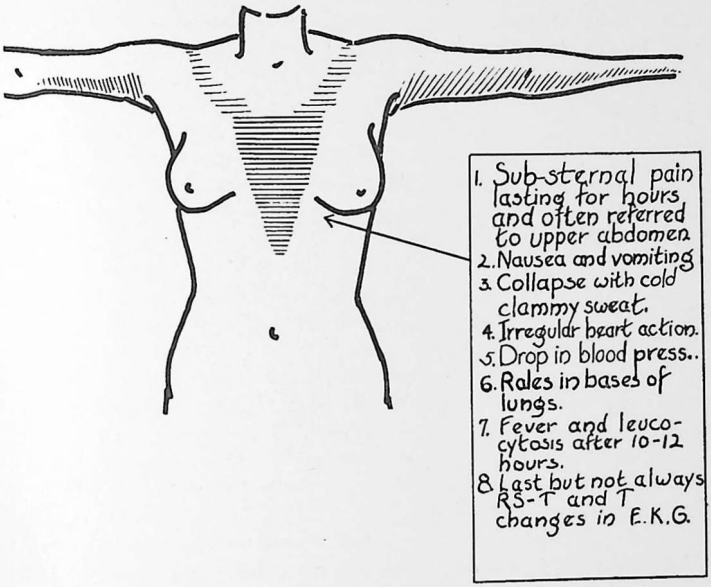


Fig. 3.—Coronary occlusion.

Several important features must be kept in mind for the purpose of differentiation:

1. A primary requisite is an accurate history of just how the attack began and what preceded it. Sometimes it is not possible to obtain this information. The pain may be too severe or the patient may be in shock or a state of collapse, but in most instances this information is available if one tries hard enough to obtain it. A history of former spells of angina-like pain, of hypertension, or of irregular heart action may cause one to concentrate on coronary disease, while a history of pain relieved by food or alkalies may lead one to

think of a peptic ulcer. A story of repeated attacks of pain in the abdomen with vomiting, fear of eating fatty food, cauliflower, or cabbage should lead one to consider gallstones as a likely disease. The sex and age of the patient must be borne in mind, since coronary thrombosis occurs seven times as often in men as in women, and it is a disease of middle life and after.

2. Examination:
   a. *Inspection:* When one is hurriedly called to see a patient who has had a sudden attack of some kind, coronary disease is usually foremost in one's mind. This idea becomes further confirmed if the patient is a man beyond the middle period of life. On inspection, the individual appears to be in great difficulty. He is apt to have a deathlike expression on his face, and the peculiar grayish cyanotic tinge of the skin serves to make suspicion a reality. One's experience will usually tell him that this patient has had a "knockout" blow of some kind, for few if any diseases leave an individual in such a miserable prostrated condition on such short notice. On further inspection, the fingernails are usually found to be cyanotic, breathing is difficult, and the patient is restless. He often assumes first one position, then another, and yet another in an effort to obtain freedom from the cramp, strangling, or oppression which has developed.
   b. *Palpation:* When one takes the radial pulse he finds it weak, rapid, and sometimes intermittent. Palpation further reveals that the patient is covered with a cold, clammy sweat. On placing the hand over the heart area irregular action may be felt. If the blood pressure is taken at this point it is found, though not invariably so, to have dropped well below a normal level.
   c. *Auscultation:* The heart sounds are not clear and normal, but on the contrary are muffled, rapid, and often there is an irregularity. I must emphasize though that there may be no signs of heart disease in the earlier periods of the attack, but they may come hours later. Fever, leukocytosis, and pericardial friction may also appear and help corroborate the diagnosis.

Usually an electrocardiographic examination is unnecessary in outspoken cases. In the less severe forms of the disease, when other conditions may simulate it, the electrocardiogram plays an important part. However, as far as the acute emergency goes, laboratory aids are unnecessary in diagnosis, though they are useful.

Differential Diagnosis: It was stated above that the pain of coronary obstruction may occur in the abdomen and simulate acute abdominal emergencies. There are several diagnostic points to be

remembered when the differentiation between true coronary disease and an abdominal catastrophe is made.

1. The pain of an acute coronary thrombosis may occur in the abdomen, but it does not become localized nor does it correspond to the pain of one of the essential organs. For example, pain of gallbladder disease may be in the epigastric area but tenderness will be localized over the gallbladder area. There is no localized area of tenderness in the referred pain of coronary disease.

2. With coronary disease, there may be marked distention of the abdomen but rigidity of the abdominal wall, as that seen in perforation of an ulcer, is lacking. In abdominal catastrophes, the patient usually is content to lie flat on his back in bed and remain

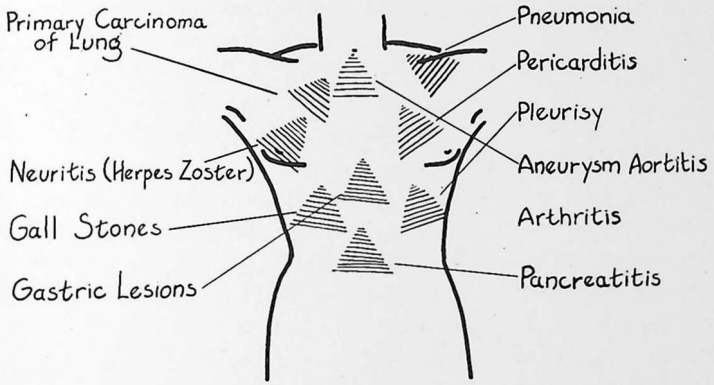


Fig. 4.—Conditions simulating coronary artery disease and the location of most tender area in the respective conditions.

as quiet as possible, while in coronary disease the patient usually tosses and turns and is restless.

3. In coronary disease, the veins of the neck may be full and distended, but in surgical conditions of the abdomen the patient is usually pale, and appears pasty and bloodless.

4. Evidences of impaired circulation as dyspnea, cyanosis, and cough are absent in abdominal emergencies.

5. On auscultation, considerable evidence of great importance is obtained. In the coronary attack, the heart and circulatory system usually show evidences of grave injury, and examination of the bases

of the lungs reveals many râles due to pulmonary congestion. Congestion may be so marked that the patient coughs up a pinkish, frothy, foamy material characteristic of edema of the lungs. But auscultation is too often limited to the chest. If one examines the abdomen with a stethoscope too, valuable information is obtained. In coronary disease, the abdomen is soft and normal intestinal gurgles are usually present, while if the condition is due to intraäbdominal catastrophe, intestinal gurgles are apt to be entirely absent and the wall of the abdomen is firm and rigid.

Other diseases than those of the abdomen must be kept in mind when one is considering the differential diagnosis of coronary thrombosis. Diseases of the chest must be thought of. Of these, the following are most important because they, like coronary disease, may be distinguished chiefly by pain in the anterior chest: Fibrinous pleurisy, early pneumonia, acute pericarditis, aortitis, dissecting aneurysm, arthritis involving the sternocostal joints, neuritis, as herpes zoster, and acute interstitial emphysema. These diseases will be considered in their separate chapters and the features simulating coronary disease will be dwelt upon.

The painful syndrome of coronary disease may be confused with disorders below the diaphragm. The following table emphasizes the chief points to be remembered in differential diagnosis.

The differentiation of coronary thrombosis from a multitude of other diseases, in most instances, requires only the diagnostic ability possessed by almost every practitioner. I wish to emphasize, however, that some cases present problems of great difficulty. For this minority, I have the following advice to offer:

1. Remember that the diagnosis is made as a rule by determining accurately and exactly the very first symptom and analyzing carefully the appearance and course of the associated phenomena. Remember that in coronary disease pain is the first and most outstanding feature in practically all cases.

2. If one keeps in mind that in coronary thrombosis the heart muscle is profoundly injured and that the signs and symptoms will all tend to point towards a disordered cardiovascular system, then usually the diagnosis will be properly made.

3. Finally, when there is any decided difficulty in diagnosing the case and coronary thrombosis is a likely disease, treat the case as

TABLE I

	Angina Pectoris	*Coronary Occlusion*	*Epigastric Crisis*
Age	Over 40	Over 40	Any age after adolescence
Sex	Male	Male	Either
Cause of attack of pain	Effort	At rest	No apparent cause
Onset	Sudden sternal pain	Sudden sternal pain	Without effort
Location of pain	Sternal	Sternal	Usually diffuse over lower chest or upper abdomen. Finally localized over affected organ
Duration of pain	Minutes	Hours	Many hours
Condition between attacks	No distress	Heart trouble	Pain usually persistent
Shock	Absent	Present	Unlikely
Blood pressure	Raised	Lowered	Inclined to be low
Heart sounds	Unchanged	Gallop irregular	Rapid but otherwise normal
Dyspnea	Absent	Present	Absent
Cyanosis	Absent	Present	Absent
Congestion	Absent	Present	Absent
Fever and leukocytosis	Absent	Present	Always some abnormality
Electrocardiogram	Changes often present	Typical changes present	Nothing significant

one of coronary thrombosis because as a rule the treatment will do the patient no harm.

Prognosis: Of many diseases where the future of the patient is unpredictable, coronary thrombosis is the first on the list. The patient with the most severe attack may recover completely, while one with the mildest form may die suddenly. The patient may live for a few minutes, or go on to complete recovery and live a full life. However, the law of averages teaches that there is only one course to follow when the diagnosis is made and that is to set down a rigid set of rules for treatment and to follow them strictly.

Acute Coronary Insufficiency: Acute coronary insufficiency is characterized by coronary arteriosclerosis which causes a progressive narrowing of the artery tree but, at the same time, retains functional capacity until some added factor precipitates functional inadequacy. Added conditions which cause an increase in heart action are followed by an ischemic area in the heart. The clinical picture is less startling than that of coronary occlusion because the onset is more gradual. Angina pectoris, dyspnea on exertion, and distress after meals frequently precede the myocardial infarct by some weeks or months. The infarct is more limited and seldom causes the endocardial and pericardial lesions usually found in occlusion or thrombosis.

Chest pain, which is practically always present in occlusion, is frequently absent, and shock, vomiting, nausea, and a sharp fall in blood pressure are not common in insufficiency. Fever, leukocytosis, and heart failure may come on gradually or never develop at all. There may be a characteristic electrocardiographic pattern in occlusion and insufficiency. In occlusion, the electrocardiogram presents deep Q-waves and RST-elevations progressing into T-wave inversions which persist for some time. In insufficiency, the electrocardiogram shows RST-depressions and T-wave inversions which last several hours or days. Master and his associates found the characteristic electrocardiographic pattern of coronary occlusion associated with occlusion at autopsy in 95 per cent of the cases.

TREATMENT OF CORONARY OCCLUSION, THROMBOSIS, AND INSUFFICIENCY

There are 13 main points to be remembered in the treatment of coronary artery disease:

1. The first thing to do when one is called to see a patient suffering from coronary thrombosis is to place the patient in the position that gives him the most comfort. This is especially important, because the patient may be too weak or sick to assume the posture that he wishes. Except in cases where the patient suggests a different position, one should lift the individual onto a backrest, because most patients feel better when the head and chest are elevated.

2. Since the patient usually is in great distress, morphine or pantopon should be given at once. I do not agree with many authors who advise large doses of morphine immediately, for morphine, although it is a great pain reliever, may cause severe nausea and vomiting. Pantopon, in doses of 0.02 Gm. (⅓ grain), is milder and kinder to the patient. My practice is to give either pantopon, 0.02 Gm. (⅓ grain), or morphine, 0.045 Gm. (¼ grain), with atropine, 0.9 mg. (1/75 grain), immediately, and then if more narcotic is necessary these average doses may be repeated. This seems a better practice than resorting to large doses immediately. It is not necessary to relieve the patient's pain or distress with one bold, therapeutic stroke; it cannot be done and large doses of morphine, as 46 or 64 mg. (¾ or 1 grain), as I have seen given at times, may do more harm than good. Atropine, 0.9 mg. (1/75 grain) may be given subcutaneously every four hours for eight doses.

For the pain, in addition to the drugs now known, metopon, a methyl derivative of dilaudid, and demoral may be helpful. Metopon does not depress the respiratory system as much as morphine; it has greater analgesic power, less tendency to induce addiction, and less emetic properties. Demoral compares favorably with morphine as an analgesic, though its action is of shorter duration; it does not cause respiratory or cerebral depression or addiction.

3. If the patient is pulseless and in shock, coramine, 64 mg. (1 grain), intravenously, is often a lifesaving measure.

4. A patient should not be moved immediately if he is in a state of collapse. He should be treated where he is for a half hour or more before being moved to the hospital.

5. Oxygen must be started and continued until the patient is out of danger.

6. Aminophylline, 0.52 Gm. (8 grains), in 50 cc. of 50 per cent glucose solution, may be administered intravenously twice a day.

Sometimes aminophylline in combination with atropine and phenobarbital is best.

7. Unless vomiting is pronounced, dehydration need not be considered seriously. Small amounts of fluid, as 500 cc. of five per cent glucose solution, may be given intravenously twice a day, but large doses, as 1000 cc. or more, are positively contraindicated, because they throw an added burden on the heart and may cause failure.

8. When food can be taken it should be liquid or semisolid, easily digestible, and given in small quantities. Iced liquids are to be avoided. When food cannot be taken by mouth, or when there is vomiting, 50 cc. of 25 per cent glucose solution may be given intravenously twice a day with 5 to 10 per cent glucose solution given by rectum through a Harris drip. At the end of the second or third week solids may be added to the diet. Vitamins should be provided.

9. Alcohol, given in small doses such as 15 to 30 cc. several times daily, may promote a feeling of well-being, if the patient has been used to taking alcohol before. It should not be given with iced or charged water.

10. Papaverin hydrochloride, 0.064 Gm. (1 grain), may be given intravenously every four hours during the acute episode.

11. Quinidine, 0.3 Gm. (5 grains), every four hours may be used if irregularities develop.

12. Because of the troublesome distention of the abdomen by gas, a combination of magnesium oxide, 0.26 Gm. (4 grains) (heavy), calcium and sodium bicarbonate, 1 Gm. (15 grains) of each, may be given three times a day. It is remarkable how this simple prescription often aids in the control of this condition. Then, too, a prescription for tincture belladonna, 8 cc. (2 drams), with elixir phenobarbital, 120 cc. (4 ounces), in the dosage of one teaspoonful every three or four hours may be very helpful.

13. Narcotics should not be given after the first day or two if they can be avoided. They are apt to depress the patient, make him vomit, and have a harmful reaction. It is better to give small doses of some soporific as phenobarbital, medinal, nembutal, or bromides to control restlessness. Frequently the patient is possessed with an almost ungovernable fear, which is usually worse at night. Most patients will not admit this fear of death, but practically all of them have it. Nurses and residents, as well as the physician in charge,

should develop their knowledge of psychotherapeutics and control many of the disturbances of these patients at night with psychic treatment, rather than a hypodermic injection of a narcotic. The patient feels better the next day if narcotics are restricted.

The patient with coronary thrombosis must be kept strictly in bed for some six weeks to two months. There is no such thing, as far as treatment goes, as a minor attack. If the diagnosis of coronary thrombosis is made, treatment must be directed as if the attack were a major one. Before leaving the subject of treatment I wish to emphasize that it is just as important to know what not to do in these cases as it is to know just what to do. Therefore, the following three medications must be avoided:

1. Digitalis is usually contraindicated, because it may irritate the heart and produce ventricular fibrillation or provoke a rupture of a necrotic area in the heart muscle. If the patient is in congestive heart failure, digitalis may be given.

2. Nitrites must not be given to relieve pain as in angina pectoris. They tend to promote vascular dilatation of the peripheral vessels which is already highly developed.

3. Adrenalin is often used, but it is a dangerous drug in these cases, because of its tendency to cause ventricular fibrillation with sudden death.

ACUTE CORONARY OCCLUSION, THROMBOSIS, AND INSUFFICIENCY: SUMMARY OF TREATMENT

1. Emergency treatment—1st to 14th day:
   - *a.* Permit patient to sit or lie in the position that is most comfortable for him.
   - *b.* Enforce absolute bed rest.
   - *c.* Apply external heat—blankets and hot-water bottle.
   - *d.* Relieve pain by giving:
     (1) Papaverine hydrochloride, 0.06 Gm. (1 grain)
     (2) Atropine sulfate, 0.45 mg. (1/150 grain)
     } Intravenously immediately.

     Followed by:
     (1) Papaverine hydrochloride, 0.03 Gm. (½ grain)
     (2) Atropine sulfate, 0.45 mg. (1/150 grain)
     } Subcutaneously or intravenously every four hours for 48 to 72 hours.

     If these do not relieve give pantopon, 0.02 Gm. (⅓ grain), hypodermically, immediately. (Morphine sulfate, 16 to 30 mg. (¼ to ½ grain), may be administered but pantopon is preferable.)

e. Oxygen is given by nasal catheter, tent, or mask.

f. Administer stimulants, caffeine sodium benzoate, 0.5 Gm. (7½ grains), subcutaneously, or coramine, 2 to 4 cc. (½ to 1 dram), intravenously or intramuscularly if necessary.

Avoid adrenaline and nitrites.

If in profound shock, apply tourniquet or bandage to arms and legs.

g. Give 50 to 100 cc. 50 per cent glucose with aminophylline, 0.52 Gm. (8 grains), intravenously immediately and twice a day as necessary.

h. Feed patient and assist with all movements.

i. Restrict visitors to immediate family.

j. Alkaline powders or citrocarbonate with tincture of belladonna are indicated for gaseous distention.

k. Enemas are contraindicated—give only mild cathartics, as mineral oil, 30 cc. (1 oz.), daily.

l. Quinidine (if tolerated), 0.3 Gm. (5 grains), t.i.d., may be of value for frequent ectopic beats or arrhythmia.

m. Diet—when food can be taken it should be liquid or semisolid, easily digestible, and given in small quantities.

n. Codeine sulfate, 30 to 60 mg. (½ to 1 grain), or codeine phosphate, 30 mg. (½ grain), as necessary for cough.

2. Intermediate treatment—2nd to 8th week:

a. Enforce complete bed rest for six to eight weeks.

b. Xanthine derivative is indicated (use one only):

(1) Aminophylline, 0.19 Gm. (3 grains), t.i.d.

(2) Theobromine, 0.3 Gm. (5 grains), t.i.d.

c. Vasodilatation is obtained by the use of:

(1) Nicotinic acid, 50 mg. (⅚ grain), t.i.d.

(2) Copavin, 60 mg. (1 grain), t.i.d.

d. Digitalis is indicated only if heart failure is present.

e. Institute a light diet; obesity diet is given when indicated.

f. Sedation:

(1) Phenobarbital, 46 mg. (¾ grain), t.i.d.

(2) Sodium bromide, 1 Gm. (15 grains), t.i.d.

(3) Amytal, 0.1 Gm. (1½ grains), t.i.d.

3. Convalescent treatment—two to six months:

a. Restrict activities markedly; mild exercise only.

b. Avoid all types of physical, mental, or emotional strain.

c. Continue hospital drug therapy—xanthine derivative, digitalis as previously indicated.

d. Keep up resistance and avoid infection.

e. Vitamins A, B, C, and D should be administered, especially during the winter months.

f. Restrict diet.

g. Give sedation as necessary.

HEART FAILURE

For the purpose of convenience, heart failure may be classified into left ventricular, right ventricular, and total or congestive heart failure. Usually when the heart fails all chambers participate in the cardiac deficiency. This, however, is not always true, especially not in the earlier stages of failure, when the symptoms of heart exhaustion may be predominantly either right-chamber or the left-sided variety. But if heart failure persists, and particularly left-sided heart failure, the right side of the heart will eventually fail too. Left ventricular failure is considered the commonest cause of right-sided insufficiency. Since incompetency of the left side of the heart occurs more commonly than that of the right, it will be considered first and in more detail than the other kinds.

Left Ventricular Failure

The three outstanding causes of exhaustion of the left side of the heart are (1) persistent hypertension, (2) aortic regurgitation and stenosis, and (3) coronary disease of the left ventricle. In cases of long-standing hypertension, the heart usually bears up well under the strain of the high blood pressure and coronary narrowing with its subsequent malnourishment of heart muscles. However, added exercise, an acute emotional strain, loss of sleep, or an acute upper respiratory infection in these cases will precipitate left ventricular failure.

In the early stage evidence of failure is strictly subjective. The three prominent symptoms which indicate a diminution of the reserve force of the left heart are (*a*) dyspnea of the paroxysmal and usually nocturnal kinds; (*b*) coughing, especially in the morning, caused by mild congestion in the lungs, and (*c*) distressful sensation in the chest in the region of the sternum, described by some as a tightness and by others as actual pain, extending up into the neck and down into the arms. Symptoms of these kinds nearly always develop in the presence of an enlarged left ventricle, which usually precedes the onset of symptoms. When the left ventricle begins to fatigue, the pulmonary circuit becomes turgid with blood. This leads to embarrassment of respiratory activity and acute dyspnea develops, usually at night. The severe attack of paroxysmal dyspnea is attended by tachycardia, cyanosis, and fits of coughing. This added

load on an already overburdened heart produces gallop rhythm. As the heart dilates, a systolic mitral murmur develops, but the murmur disappears as compensation returns. If the lung congestion could be overcome promptly the acute attack would subside, and sometimes this occurs, but at other times the acute episode continues, the gallop rhythm and tachycardia become worse, and the cough more pronounced. The patient begins to cough up frothy sputum, sometimes tinged with small amounts of blood, which is evidence of acute pulmonary edema.

The patient may drown from edema of the lungs unless something is done immediately to relieve the left ventricular failure.

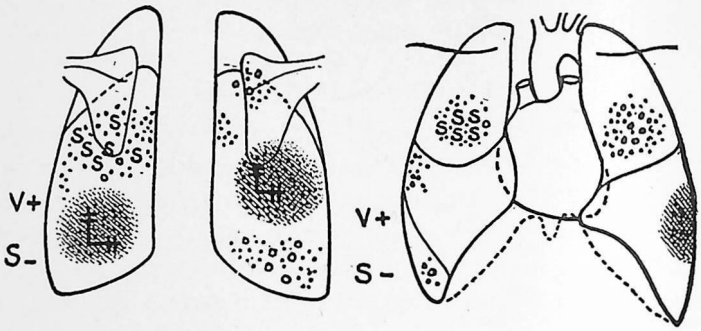


Fig. 5.—Passive congestion the result of cardiac weakness or failure in bronchopneumonia (edema of the bases of the lungs). V+ = increased fremitus. S— = diminished resonance.

Examination of the patient at this stage reveals an individual in great discomfort. He is usually half-sitting up in bed, gasping for air, and harassed to coughing and expectoration of the frothy sputum. He is cyanotic, covered with a cold, clammy sweat, and his pulse is so rapid that it is counted with difficulty.

The symptoms of heart failure of the left ventricular type may be transitory, lasting a few days or a week, or they may be persistent, extending over a period of weeks or months. There may be times when a remission of symptoms occurs, alternating with acute crisis of failure. When left ventricular failure sets in, it is a general rule that complete recovery hardly ever occurs. The reason for this is manifold: The patient usually is in the advanced years of life when degenerative changes have already begun to take their toll; the

primary causes of left failure are conditions that, when they become established, are apt to be progressive in nature. And then finally, for reasons not clearly understood, when the mass of muscle of the left ventricle has its reserve force broken, it is difficult or impossible to restore it to normal. However, this is not the case in right ventricular failure, which is distinctly characterized by short periods of failure followed by long periods, sometimes years, of remission.

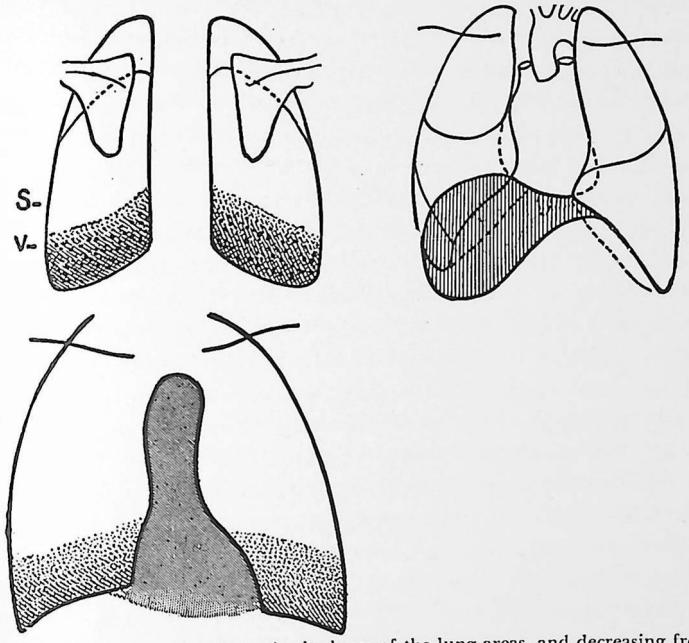


Fig. 6.—Passive congestion. At the bases of the lung areas, and decreasing from below upward, are found relatively dark shadows which show little or no clearing on inspiration and which conceal in a varying measure the diaphragmatic, costo-diaphragmatic, and lower cardiac outlines. S— = diminished resonance. V— = decreased fremitus.

It is evident then that when left ventricular failure becomes firmly established, the outlook for the patient is distinctly bad, and in the course of time the right chambers will be so strained that they too will fail. The patient then has congestive heart failure or an admixture of left and right chamber deficiency. The truest kind of left ventricular failure is seen in aortic stenosis and regurgitation. In these cases, there seems to be a pure forward failure of circula-

tion without any evidence of back pressure in the lungs early in the disease.

Right Ventricular Failure

Heart failure, essentially of the right ventricular kind, occurs almost always in younger individuals under the age of 40. It is caused by lesions, which throw the burden of the strain on the right chambers, as mitral stenosis, pulmonary fibrosis, tricuspid valve insufficiency, and constrictive pericarditis. Emphysema and chronic bronchitis, although they are at times associated with acute right ventricular failure, are usually factors added to an already existing pulmonary disease which constitutes the main cause of the failure. It is a chronic condition that may produce acute right ventricular failure, known as cor pulmonale. Cor pulmonale is the name applied to a syndrome characterized by dilatation, hypertrophy, and failure of the right ventricle caused by chronic pulmonary disease or pulmonary artery stenosis. When an individual in the late teens, 20's, or early 30's has failure, the right-sided type must be considered seriously, just as left ventricular failure is the form that develops in people past 40 or 50 years of age.

The sequence of events in right failure may be given briefly as follows: Rheumatic infection in early life, mitral disease indicated by mitral murmurs in subsequent years, and the presence of a slight enlargement with the murmurs in the most active period of life, but without evidence of failure. In the early 30's a combination of factors, such as natural deterioration of the heart muscle, enhanced by the handicap of a leaky valve, plus some extra strain, as a pregnancy in a woman, contribute to an excessive burden on the heart, especially of the right side. This may be followed by an acute attack of right failure.

The features of acute right ventricular failure are also distinctive. As the right ventricle begins to dilate and fail, the venous pressure rapidly rises. Ordinarily small rises in venous pressure are promptly reduced by the extra activity of the heart's action, but in cases where the right chamber is involved the venous pressure rises higher and higher, as indicated by enlargement and distention of the neck veins and enlargement and tenderness of the liver. A symptom of right failure may be pain in the right upper quadrant

of the abdomen, brought on by exercise and relieved by rest. It is often overlooked, but can be an important clue. It is explained as a manifestation of liver congestion, and is comparable to the dyspnea on effort of early left failure. Turgescence and cyanosis of the tissues about the upper extremities and marked cyanosis of the lips, ascites, and edema of the extremities develop later. Sometimes on percussion and palpation the right auricle and ventricle are greatly distended to the right of the sternum. If they are not found on physical examination, x-rays frequently reveal their presence. Pulsation of the large veins of the neck and liver may occur in right ventricular failure. This usually develops when the tricuspid valve becomes incompetent, due to dilatation or before dilatation comes on. Right ventricular failure does not present as urgent a case of that of the left ventricular type, although the condition may cause a great deal of distress. The patient responds quite satisfactorily and may live on for many years, suffering frequent bouts of acute right failure during this time.

Congestive Heart Failure

The term "congestive heart failure" may easily be misinterpreted. It is seen from the above descriptions that a failing right ventricle may result in a typical picture of congestive failure—that is, swollen legs, enlargement of the liver, ascites, pleural effusion, turgescence of the veins of the neck, cyanosis, and dyspnea. But congestive failure too may develop when the right chambers fail as a sequel to the left ventricular insufficiency. Obviously, the two conditions are very different when prognosis and treatment are considered. The first usually responds satisfactorily to treatment, and the second does so very grudgingly. Symptoms simulating congestive failure may be caused by such conditions as constrictive pericarditis, and removal of the constricting bands may at times result in permanent cure of the congestion in the periphery.

Of course, the main feature of congestive heart failure is the inability of the heart to expel the amount of blood carried to it, and the venous system as a consequence becomes overcrowded with blood. Decreased cardiac output, prolongation of the circulation time, increased venous pressure, and dilatation of all chambers of the heart are characteristics of congestive failure. The prognosis depends

upon the underlying factors as the primary cause of the heart disease, the degree of damage to the heart muscle, and the response of the heart to treatment. This last item is one that is difficult to evaluate at times, but the age of the patient, the size of the heart, and the faithfulness with which treatment is carried out all bear an influence in this regard.

Failure to mention the fact that the shock syndrome may be confused at times with congestive heart failure may be a serious omission. The shock syndrome has some features in common with congestive heart failure, especially the acute kind, but there are differences which may be listed briefly as follows: In the shock syndrome the trouble lies in the periphery and capillaries, which are dilated and congested, and not in the heart itself. In shock the superficial veins, especially those of the neck, are empty, while in failure they are gorged. In shock the heart is very rapid and the pulse thready, but the heart is not enlarged or otherwise diseased. In heart failure, of course, the heart is usually enlarged and may be irregular and there may be valvular disturbances. In shock the patient suffers from an oligemia, while in congestive heart failure hydremic plethora is more apt to prevail. Hemoconcentration is an outstanding evidence of shock, but not of heart failure. The treatment of congestive heart failure is usually pointed at relieving the peripheral vascular system of some of the excess blood, while the prime motive in the treatment of shock is to augment the blood volume so that the heart will have enough blood to pump around the body. Digital preparations are sheet anchors in the treatment of congestive heart failure, but harmful consequences are the result of their administration to patients in shock.

TREATMENT

Left Ventricular Failure: The treatment of left ventricular failure to a large extent is built upon fundamental changes in the pathological physiology of the cardiovascular system. The chief principles may be epitomized as follows:

1. Absolute rest in bed for a number of weeks is imperative. The patient obtains greater relief when allowed to sit up in bed than when lying flat.

2. Oxygen is given, especially if cyanosis or dyspnea persist; it is wise to give it in any case of heart failure.

3. Small doses of morphine, 16 mg. (1/4 grain), or pantopon, 20 mg. (1/3 grain), with atropine sulfate, 0.9 to 0.45 mg. (1/75 to 1/150), hypodermically, are sometimes necessary to quiet the patient and relieve dyspnea, but for a long time I have realized that morphine is a double-edged sword in the therapeutics of heart failure and that it must be used sparingly.

4. Fifty to 100 cc. of 50 per cent glucose solution with 0.5 Gm. (7 1/2 grains) aminophylline may be given intravenously to augment the pulmonary circulation and relieve dyspnea.

5. Digitalis purpura or digitalis lanata, 0.09 Gm. (1 1/2 grains), is usually indicated. If one desires rapid digitalization, strophanthin, 0.65 mg. (1/100 grain), may be given at once and repeated in six hours, providing no digitalis has been given previously. Ouabain, five cat units, may be given intravenously, with six cat units of digitalis administered orally (see chapter on Heart Drugs).

6. The fluid should be limited to 1200 to 1500 cc. (40 to 50 ounces) a day and the salt in the diet kept at a low ebb.

7. Diuretics as diuretin are often too irritating to the stomach; mercupurin in 1 or 2 cc. doses or some like preparation may be given intravenously in the forenoon for a few days in succession. Peripheral edema need not be present before mercupurin is indicated, since the mercurial diuretics often relieve the dyspnea as well as the edema. Anedemin, the "vegetable trochar" of older physicians, may be helpful.

8. Cough is usually relieved when the circulation of the lungs is improved; occasionally codeine phosphate or sulfate, 30 mg. (1/2 grain), may be given with ammonium chloride, 1 Gm. (15 grains), in a proper vehicle three or four times a day.

9. When an acute attack of paroxysmal dyspnea sets in, aminophylline, 0.5 Gm. (7 1/2 grains), intravenously is generally sufficient to relieve the distress. If not a narcotic as pantopon, 20 mg. (1/3 grain), may be resorted to. Often the paroxysmal dyspnea that comes on at night may be prevented if the patient is given 0.19 Gm. (3 grains) of aminophylline by mouth before going to sleep.

10. The diet must be simple and non-gas-producing, and the bowels controlled so distention of the abdomen with gas does not prevail, as this augments the dyspnea already present from heart failure.

11. If the veins of the neck are turgid and swollen when the patient is in a semireclining position and if he is cyanotic, a venesection of 500 cc. of blood is recommended. Frequently this is followed by a prompt relief of the dyspnea.

Right Ventricular Failure: The fundamental principles emphasized in the treatment of left ventricular failure prevail also in right failure, but there are a few important differences which I shall emphasize. The rest, oxygen, aminophylline, digitalis, fluid limitation, diuretics, and diet may be patterned after the rules mentioned above. The employment of diuretics has a special place in right ventricular failure because the symptoms are much more responsive to the mercurial diuretics than those of left failure. Occasionally in right failure, the venous congestion may be so great in the periphery and the venous pressure so high that nothing short of a venesection of one pint or more of blood will serve to relieve the patient. This should be done immediately and repeated once or twice within a period of a week if necessary for the relief of symptoms. In right ventricular failure, an effusion of fluid is often present in the chest cavity, compressing a lung; this naturally is followed by an augmentation of the dyspnea. Thus, the heart failure which results in accumulation of fluid in the chest is in turn made worse by the ensuing reduction of lung volume, and the vicious circle must be broken by the removal of the fluid by thoracentesis. The same principle is applied to the accumulation of fluid in the abdominal sac.

Congestive Heart Failure: The treatment of congestive failure may be divided into (1) the immediate and (2) the remote. The immediate treatment embraces the 11 items listed under the treatment of left failure. The treatment of the so-called remote factors is concerned with the precipitating cause of heart failure as infections, indiscriminations, and associated disorders. Frequently in congestive failure, as in right ventricular failure, the cardiac insufficiency causes pleural effusion and the fluid must be removed to break the vicious circle caused by the effusion.

ACUTE LEFT FAILURE: SUMMARY OF TREATMENT

1. Absolute bed rest is enforced in semireclining position.
2. Sedation (opiates) is indicated:

a. Pantopon 20 mg. (⅓ grain)
b. Morphine, 16 mg. (¼ grain)
c. Dilaudid, 3 mg. (1/20 grain)
} Use one of these immediately and sparingly as needed for three or four days.

Follow with a barbiturate as:

a. Phenobarbital, 46 mg. (¾ grain), t.i.d.
b. Nembutal
c. Seconal
} 0.19 Gm. (3 grains) at night as needed
} Tolerated best by the young and middle-aged group.

Or with a bromide as:

a. Triple bromide, 1 Gm. (15 grains), t.i.d.
b. Penta bromide, 1 Gm. (15 grains), t.i.d.
c. Sodium bromide, 1.3 Gm. (20 grains), t.i.d.
} Tolerated best by the older age group.

3. Oxygen is given by nasal catheter, tent, or mask.
4. Digitalization:
   a. Rapid methods:
      (1) Digilanid (digitalis lanata), 8 cc., intravenously immediately; then one tablet t.i.d. until digitalized.
      (2) Digifortis, 3 cc., intramuscularly or subcutaneously for two days; follow with a maintenance dose of 1 cc. daily.
      (3) Ouabain, 5 cat units, intravenously immediately, with 0.583 Gm. (9 grains) of oral digitalis immediately. Then give maintenance dose of digitalis daily, 0.09 to 0.19 Gm. (1½ to 3 grains).
      (4) Strophanthin, 0.006 Gm. (1/100 grain), intravenously immediately. (NOTE: Do not use strophanthin or ouabain if patient was on digitalis!)
      (5) Digitoxin, 1.26 mg. (3 cat units), for single dose digitalization. The drug may be given orally or intravenously in the same dosage, and results in digitalization within a few hours.
      (6) Lanatoside C, 8 cc., intravenously.
   b. Slow methods:
      (1) Digitalis purpurea leaf, 0.09 Gm. (1½ grains), t.i.d. until digitalized [approximately 21 mg. per kg. (1½ grains per 10 lb.) body weight].
      (2) Digitalis lanata, one tablet t.i.d. until digitalized.
      (3) Digifortis, 1 ampule (1 cc.), intramuscularly t.i.d. until digitalized.
5. Administer 50 to 100 cc. of 50 per cent glucose with 0.5 Gm. (7½ grains) aminophylline intravenously immediately and b.i.d.
6. Mercupurin, 2 cc., intravenously every other day for three times.
7. Cardiac diet is given.
8. Xanthine derivative is indicated; use one only:
   a. Theobromine, 0.3 Gm. (5 grains), t.i.d.
   b. Aminophylline, 0.2 Gm. (3 grains), t.i.d.
   c. Theominal, one tablet, t.i.d.

9. Limit fluids to 1200 cc. (40 oz.) daily.
10. Give patient reassurance (treat the psychic as well as the somatic disturbances).

ACUTE RIGHT FAILURE

1. Enforce absolute bed rest in a semireclining position.
2. Sedation is given as in Acute Left Failure.
3. Digitalis is given as in Acute Left Failure.
4. Oxygen is administered by nasal catheter, tent, or mask.
5. Ammonium chloride, 2 Gm. (30 grains), t.i.d. or
   Ammonium nitrate, 3 Gm. (45 grains), t.i.d. } For three days.
6. Then give mercupurin, 2 cc., intravenously daily for three days.
7. Limit fluids to 1200 cc. (40 oz.) daily (measure intake and output).
8. Remove pleural or ascitic fluid if patient is in distress.
9. Venesection of 400 to 500 cc. of blood may be necessary; this must be done rapidly.
10. Magnesium sulfate, 30 Gm. (1 oz.), daily three or four times.
11. Cardiac diet, consisting of soft, low caloric, and low salt foods, is given.
12. Xanthine derivative is indicated—theobromine or aminophylline as in Acute Left Failure.
13. Codeine phosphate or sulfate are given for cough, as in Acute Coronary Thrombosis.

CHRONIC MYOCARDIAL FAILURE

1. Enforce absolute bed rest in a semireclining position.
2. Digitalize the patient.
3. Ammonium chloride, 2 Gm. (30 grains), t.i.d. } One or the other for three
   Ammonium nitrate, 3 Gm. (45 grains), t.i.d. } days.
4. Then give mercupurin, 2 cc., intravenously every other day for three times.
5. Administer 50 to 100 cc. 50 per cent glucose with 0.5 Gm. (7½ grains) aminophylline intravenously, b. i. d.
6. Sedation as in Acute Left Failure.
7. Xanthine derivative as in Acute Left Failure.
8. Magnesium sulfate, 15 Gm. (½ oz.), daily.
9. Limit fluid to 1200 to 1500 cc. (40 to 50 oz.) daily.
10. Institute cardiac diet—soft, low caloric, low salt.
11. High vitamin intake is important; supplement diet at times with 10,000 units vitamin B intramuscularly daily for one or two weeks.
12. Encourage movement of extremities.
13. Check for complications as infectious processes, uremia, thyrotoxicosis.

CHAPTER V

The Heart

(Continued)

THE ARRHYTHMIAS

Although disorders of cardiac rhythm are not always of grave significance, they may cause the patient considerable distress. Since the electrocardiograph has become more widely used in general practice, many disorders of the heart beat have been described which were formerly diagnosed with difficulty, if at all, at the bedside. However, most irregularities can be diagnosed without the electrocardiograph.

It is desirable to limit my discussion of the arrhythmias to those main types which are recognizable at the bedside. These are:

1. Sinus Arrhythmia.
2. Extrasystoles (ectopic beats).
3. Auricular Fibrillation.
4. Auricular Flutter
5. Paroxysmal Tachycardia.
6. Stokes-Adams Syndrome.

The significance of these irregularities of the heart beat depends upon the condition of the myocardium rather than on the disorder itself. Although all of these arrhythmias do not constitute emergencies, it seems best to describe them.

Sinus Arrhythmia

The simplest form of irregularity is sinus arrhythmia, which frequently occurs in children and in the aged. It is dependent upon a hyperirritability of the sinoauricular node or increased vagal tone. There is variation in the period between the heart beats, but there is no interference with transmission of the impulse that leaves the sinoauricular node. It is recognized clinically by the fact that the heart beat becomes slower on expiration and more rapid on inspiration. The relationship of this kind of irregularity to the act of respiration is usually sufficient to make the diagnosis of sinus irregularity or sinus arrhythmia. This disorder has no pathological significance and

occurs in normal individuals. Its importance lies in the confusion it may cause with other kinds of irregularities, and, of course, the presence of any sort of an irregularity is apt to cause the young patient considerable anxiety. No special treatment is indicated, and the best management consists in advising the patient to forget this disordered action of the heart beat.

Extrasystoles (Ectopic Beats)

Extrasystoles are premature heart beats, caused by a premature contraction of the heart though the rhythm remains normal. They originate independently of the impulses that come from the sino-auricular node. These extra impulses coming from the auricle, the ventricle or the a.v. node itself cause the premature contraction and consequently when the normal regular impulse from the sinus node passes down to the ventricle, it finds the ventricle in the refractory period. The diastolic period which follows the premature ventricular beat is therefore extraordinarily long. This gives the patient a sensation of an unusually large heart beat and naturally causes him to become fearful or alarmed. The beat due to the extrasystole then is a small one, and the next normal beat following it is a large one. These big and little beats may be heard by listening over the heart, but they may not be perceptible at the wrist.

Etiology: Although extrasystoles may occur at any age, they are particularly common after the age of 50. The cause of this type of irregularity is unknown. Functional disorders are apt to provoke these extrasystoles which disappear when the cause is removed. Emotional strains, excessive use of tobacco or alcoholic beverages, and fever associated with infectious diseases have all been suggested as precipitating causes. Extrasystoles may develop in individuals whose hearts are normal in every other respect or they may occur in association with serious cardiac diseases as mitral stenosis, aortic regurgitation, or coronary disease. This is apt to cause considerable confusion in the proper interpretation of the irregularity. While it is often said that premature beats are benign, seldom serious, and often disappear as promptly as they come, leaving no heart disorder, it must be kept in mind that the condition of the heart muscle rather than the presence of the irregularity itself is of first importance. Therefore, the extrasystoles, especially those appearing after the age

of 50, must be investigated thoroughly before the true significance is passed upon.

Diagnosis: The recognition of extrasystoles is usually quite a simple matter. At times, ectopic beats do not cause the patient any disturbance and may pass undiagnosed for a long time. The differentiation between the auricular and the ventricular type of extrasystoles is usually made with certainty by the use of an electrocardiographic tracing. Other times, however, the patient suffers from marked disturbance characterized by palpitation of the heart. Patients with extrasystoles may or may not be inconvenienced or alarmed by their presence; however, it must be emphasized that the extrasystole itself should not be regarded as a serious matter; the gravity of the situation depends entirely upon whether cardiac disease occurs coincidentally with it. Some believe that extrasystoles may cause the heart to be overworked and lead to heart failure, but such an occurrence must be a rare outcome. Although it is thought by many that extrasystoles are to be ignored and that they mean nothing except a mild inconvenience of the heart rhythm, I believe that they must be taken seriously and that a thorough investigation of the entire cardiovascular system is indicated. However, one must guard against passing a serious diagnosis when it is unwarranted, because such an action may lead to cardiac neurosis.

TREATMENT

In the treatment of extrasystole, the following facts must be kept in mind:

1. Digitalis usually makes this irregularity worse.
2. Quinidine in doses of 0.3 Gm. (5 grains) four or five times a day is often effective.
3. Papaverine, 60 to 90 mg. (1 to 1½ grains) intravenously, has been said to be as good as quinidine. The prescribed dose may be repeated in ten minutes if necessary. This drug is most effective in stopping ventricular premature systoles, which may forestall fatal ventricular fibrillation.

Papaverine also is followed by good results when given orally, 0.2 Gm. (3 grains) four or five times daily. This drug is particularly good in cases with coronary insufficiency, as it is a mild sedative and good coronary dilator.

4. Small doses of bromides, 0.3 Gm. (5 grains) three times a day, or phenobarbital, 30 mg. (½ grain) two or three times a day, are used to sedate an overirritable and nervous patient.

5. The arrhythmia does not contraindicate exercise.

6. If an underlying myocardial disturbance is present, then the treatment of the cardiac disease must be considered.

6. When a physical cause for the condition cannot be found, very often a psychological factor can be uncovered.

AURICULAR FIBRILLATION

Auricular fibrillation is the commonest cardiac irregularity with the exception of premature contraction. This disorder results from a disturbance in the mechanism of the heart impulse in which the wave contraction pursues a rapid and irregular continuous course around the auricles. This leads to a fibrillary twitching without systematic regular contractions of the auricles. The a.v. node is bombarded with impulses to which it fails to respond. The effect on the ventricles results in an irregularity of the timing and strength of contractions of the ventricular chambers. The ventricles beat at a rapid rate of 120 to 180 beats per minute. Some of the contractions are too feeble to cause an opening of the aortic valve. This leads to the phenomenon of "pulse deficit" in which the number of ventricular beats of the heart may be greater by 15 or 20 than the number of beats felt at the wrist.

Etiology and Pathology: The main cause of auricular fibrillation is unknown. There is no one specific etiological factor, since many diseases of the heart may provoke it. At times fibrillation exists without heart disease. Histopathological examinations of fibrillating hearts fail to identify any specific tissue change. Certain diseases, however, are known to be commonly associated with the onset of fibrillation. They are coronary disease, rheumatic heart disease, hypertensive heart disease, hyperthyroidism, and sometimes syphilis. White has summarized the analysis of McEachern and Baker of 575 cases of auricular fibrillation as follows: Rheumatic heart disease, 34.4 per cent; coronary disease, 31.1 per cent; hypertension, 16.9 per cent; thyrotoxicosis, 7.5 per cent; emphysema, 5.0 per cent; syphilis, 3.0 per cent, and miscellaneous, 2.1 per cent.

Signs and Symptoms: Auricular fibrillation may begin abruptly and lead to cardiac failure if the heart muscle is badly damaged. Subjectively, there is usually a sense of palpitation associated with shortness of wind, faintness, and exhaustion. Pain is seldom present unless the fibrillation is a part of coronary disease. The discomfort caused by the onset of fibrillation usually causes the patient great mental agony.

Auricular fibrillation may be one of two types from the clinical standpoint: (*a*) Paroxysmal or intermittent, and (*b*) continuous or permanent. The paroxysmal type may last a short time only and cause little or no disturbance of the cardiac function, while the permanent type is bound to cause embarrassment of the heart. The intermittent acute paroxysmal fibrillation usually develops in normal hearts; frequently it is precipitated by excessive drinking or heavy smoking. A day of rest in bed usually is sufficient to restore the cardiac rhythm to normal. If the heart is not enlarged and if no valvular disease, coronary occlusion, or evidences of failure are present, quinidine in doses of 0.3 to 0.6 Gm. (5 to 10 grains) every four hours restores the regular rhythm within a few days. Permanent or continuous auricular fibrillation usually develops in individuals who have an established cardiac defect. The prognosis of this type is much more unfavorable than the intermittent form. The presence of the fibrillation causes the heart reserve to become depleted. However, the arrhythmia in some cases may be present for many months or even years without causing cardiac failure. Whenever fibrillation develops in an older person past 50 years of age and the immediate cause is not perfectly clear, the possibility of a hidden hyperthyroidism should be kept in mind.

Diagnosis: The diagnosis of auricular fibrillation can usually be made by physical examination. The irregular beating of the heart and the presence of pulse deficit are enough to confirm the diagnosis. Occasionally, premature contractions may simulate auricular fibrillation. If possible, one should always have an electrocardiographic tracing done in order to be certain of the diagnosis.

TREATMENT

1. The patient must be confined to bed during the early stages of fibrillation. A vigorous attempt must be made to control this

irregularity as soon as possible in order to forestall complications as heart failure, death from ventricular fibrillation, and the formation of emboli.

2. The type and degree of cardiac damage must be determined at once. This is important because it is obvious that if the cause of the disorder is hyperthyroidism, the treatment will be quite different than if the cause is mitral stenosis or rheumatic heart disease.

3. There are two drugs for auricular fibrillation—quinidine sulfate and digitalis.

a. Quinidine sulfate is a satisfactory drug in the following cases:
(1) Young individuals who have no heart failure.
(2) Where the irregularity has been of short duration.
(3) Patients without advanced valvular damage.

It should be given in small doses at first and then increased gradually to 0.6 Gm. (10 grains) three or four times a day.

According to recent reports the drug may be given intramuscularly. A prescription which is easily prepared and stored and which contains 0.15 Gm. (2¼ grains) quinidine to the cc. may be made as follows:

Quinidine hydrochloride	1 Gm.	(15 grains)
Antipyrine	1 Gm.	(15 grains)
Urea	1.5 Gm.	(20 grains)
Water (distilled) to make.....	100 cc.	(3⅓ oz.)

This should be sterilized in a Berkefeld filter. It can then be stored in ampules or stoppered bottles. This preparation is advocated for intramuscular use in cases where there is delayed absorption from the gastrointestinal tract and when rapidity of action is necessary. It may be used whenever oral administration of quinidine is indicated. The dosage is 0.45 to 0.6 Gm. (6.75 to 9 grains). In from one and one-half to two hours the dose may be repeated. If no favorable response is elicited, the dose may be increased.

Quinidine is contraindicated for patients with long-standing heart failure, advanced valve disease, and older people.

b. When fibrillation accompanies heart disease, especially congestive failure, mitral stenosis, or chronic arteriosclerosis, digitalis is the preferred drug. In mild cases, one cat unit three or four times a day usually is sufficient to control the fibrillation.

4. At times auricular fibrillation with severe myocardial failure may threaten life, and emergency treatment must be instituted.

a. Strophanthin, 0.65 mg. (1/100 grain), may be given intravenously and repeated every 12 hours for three or four doses. It must be emphasized

that strophanthin is contraindicated if the patient has been digitalized within a week of the time of giving strophanthin.

b. Digitalis, 0.5 Gm. (7½ grains), in 10 cc. of solution may be given intravenously every four to six hours for three or four doses. This is followed by one cat unit, 0.1 Gm. (1½ grains), every three or four hours until the irregularity is controlled. Nausea and vomiting may require the discontinuance of digitalis therapy.

c. Digitoxin, 1.26 mg. (three cat units), may be given for single dose digitalization, either orally or intravenously.

d. Ouabain, 0.5 mg. (five cat units), intravenously reduces the ventricular rate and is beneficial in treating arrhythmias of auricular origin. One hour after the first dose of ouabain, four to eight cat units of digitalis leaf should be given orally. Twenty-four hours after the initial dose digitalis is given in maintenance doses of 1 grain or 0.06 Gm. (one cat unit) daily. Ouabain should not be used when digitalis has been used in the preceding week.

e. Sometimes auricular fibrillation and cardiac embarrassment may require oxygen or the intravenous injection of 50 cc. to 100 cc. of 50 per cent glucose solution with the addition of 0.5 Gm. (7½ grains) aminophylline to reduce pulmonary congestion, promote diuresis, and allay the dyspnea brought on by lung congestion.

Auricular Flutter

Auricular flutter is a condition in which the heart beats are normal but very very rapid. Flutter is most apt to occur in individuals who have advanced heart disease. In most cases, the onset is preceded by an attack of failure of the right side of the heart. Valvular disease, especially mitral stenosis, is a common precursor. The rate of the auricular beat may be between 200 and 300 per minute. The ventricles beat at a slower rate, as 100 to 140 per minute. This gives a varying degree of heart block. The pulse is very rapid. The attack of flutter causes the individual to feel a marked palpitation of the heart, dizziness, giddiness, and sometimes fainting and exhaustion occur. However, when flutter develops, the patient usually has heart disease. The disorder is often confused with paroxysmal tachycardia, and an electrocardiographic tracing may be necessary for the differentiation. An attack of auricular flutter may be short in duration, lasting for one-half hour, or it may continue for days, weeks, or even months. The outcome of auricular flutter depends on the condition of the heart muscle itself. The most important phase of our knowl-

edge of flutter consists in our ability to convert the flutter into fibrillation and to control the irregularity.

TREATMENT

The treatment of auricular flutter is usually successful.

1. The drug which produces the best results is strophanthin, 0.65 mg. ($\frac{1}{100}$ grain) intravenously every two or three hours for several doses.

2. Ouabain as used for auricular fibrillation is effective.

3. Digitalis may be given in large doses, 0.5 Gm. (7½ grains) intravenously every two or three hours for several doses, and then one cat unit by mouth every three or four hours for several times may convert the flutter into fibrillation. When the fibrillation replaces flutter, the withdrawal of the digitalis results in the return of the heart rhythm to normal.

4. Digitoxin, 1.26 mg. (3 cat units) given orally or intravenously, promotes rapid digitalization. Another method of achieving rapid digitalization is to give 0.065 Gm. (2 grains) (U.S.P. XI) or 0.1 Gm. (1½ grains) (U.S.P. X) of powdered digitalis per ten pounds of body weight in divided doses. A maintenance dose of about 0.065 Gm. (1 grain) (U.S.P. XI) should be continued. The ventricular rate should not be allowed to go below 60 beats per minute.

5. Quinidine is indicated when attacks are paroxysmal, and when congestive failure, heart damage, and emboli are not part of the picture. During this kind of therapy, the patient must be closely watched, as the doses are large, and toxicity may follow. A test dose of 0.2 Gm. (3 grains) should be given. Then if no unfavorable reaction occurs, 0.4 Gm. (6 grains) may be given orally and repeated every four hours for six or seven doses. If good results do not follow, the dosage may be increased, but the patient must be carefully watched all the time. When rhythm returns to normal, the dose is reduced to 0.2 to 0.4 Gm. (3 to 6 grains) t.i.d. and continued for several weeks at least. This drug is best not given intravenously. Some say that if given with strychnine, 1.5 to 2 mg. ($\frac{1}{40}$ to $\frac{1}{30}$ grain) t.i.d., quinidine therapy is more effective and smaller doses are necessary. Sometimes digitalis and quinidine in combination may prevent or abort attacks.

6. Recurrent attacks of flutter have been observed. They may be controlled by the use of digitalis or strophanthin or the other drugs as indicated above. The regulation of the flutter has a favorable effect upon the accompanying signs and symptoms of heart failure. Edema disappears, dyspnea clears away, and palpitation ceases.

Paroxysmal Tachycardia

Paroxysmal tachycardia is an arrhythmia characterized by the abrupt onset of an extremely rapidly beating heart. This is caused by ectopic beats rising from a single focus in the heart muscle. There is no specific pathological change known to account for it. It may be associated with coronary disease or rheumatic heart disease, but it often develops independent of any organic disorder. The episode of tachycardia begins abruptly and may last for a few minutes or a month, and it may end as quickly as it started. During the attack, the patient suffers from a sense of extreme exhaustion, dyspnea, irritability, and sometimes syncope. Pulsations of the vessels of the neck may be violent. The attack may result in peripheral vascular collapse.

A differentiation must be made between auricular flutter, paroxysmal auricular fibrillation, and paroxysmal tachycardia. In paroxysmal tachycardia, there is less likely to be an organic disease in the background, while in flutter and fibrillation, organic disease is the common rule. Patients with paroxysmal tachycardia are usually young people who are emotionally unstable. A distinction is often made between auricular, ventricular, and nodal paroxysmal tachycardia. In the auricular form, the attack is usually minor, and is controlled by stimulation of the vagus nerve. Ventricular paroxysmal tachycardia is similar but may be associated with organic disease, as coronary occlusion. The exact differentiation requires an electrocardiogram.

TREATMENT

There is no sovereign method of treatment for an attack of paroxysmal tachycardia.

1. The patient should be allowed to rest in the position which he finds most comfortable. This is usually lying supported by pillows, but some prefer to stand or sit.

2. Food should be chosen carefully for its high nutritive value and its capability of being taken easily. It should be given in small quantities.

3. Ice bags may be used to relieve local pain; iced drinks may be given. Occasionally ice over the precordium is all that is necessary to relieve an attack.

4. Morphine may be needed to relieve the dyspnea, and if acute pulmonary edema is present, oxygen is necessary.

5. Sometimes digitalis controls paroxysmal tachycardia, while at other times quinidine is more effective. Some believe that digitalis may bring on an attack, and should be avoided.

6. Frequently ocular pressure, breath holding or pressure on the carotid artery below the angle of the jaw will stop this arrhythmia. It should be emphasized that this pressure on the carotid must be exerted on the carotid sheath for periods of 5, 10, or 15 minutes. Most people attempting compression for the control of the paroxysm exert the pressure for too short a period of time to obtain relief.

7. Mecholyl subcutaneously may be given. The initial dose is 20 mg. (⅓ grain). If necessary, this dosage may be repeated in 20 minutes or half an hour. Before this drug is employed, a syringe containing 0.6 mg. (1/100 grain) atropine sulfate should be ready to counteract any untoward reactions. Mecholyl should not be used in those with bronchial asthma or coronary artery disease.

8. When treatment, such as carotid or ocular pressure, and breath holding, is unsuccessful, magnesium sulfate may be given intravenously in doses of from 10 to 20 cc. of 10 to 20 per cent solution. The stronger doses are apt to be more successful. This form of therapy is not associated with any serious toxic reactions, though transient disturbances of conduction and ventricular extrasystoles may occur.

Occasionally all these measures fail and the attack ceases as spontaneously as it began. In most difficult cases of paroxysmal tachycardia, it is important to remember that administration of any of the above remedies may fail to control the episode but they should be repeated again and again and finally the paroxysm may be eliminated.

Heart Block

Complete heart block is readily recognized in most cases because the heart rate is so slow and regular. An electrocardiogram reveals complete disassociation of the auricular and ventricular activity. Heart block in itself does not cause the patient's death. Patients may be inconvenienced by a more severe grade of block developing where block has existed for some time. Heart failure usually terminates the life of the patient with heart block. Heart block may occur without the development of Stokes-Adams syndrome which consists of the epileptic-like fit. It must be remembered that complete heart block need not be permanent. Sometimes it changes to normal rhythm and back again to complete block within a period of five minutes. Although most patients live for only a few years, I observed a patient with complete block and a rate that ranged from 20 to 35 beats per minute for a period of fifteen years. A colleague had the same patient under observation for ten years previous to my experience with him.

The Stokes-Adams syndrome is distinguished by paroxysmal attacks of bradycardia associated with fainting, dizziness, and sometimes epileptiform convulsions. This disorder most often occurs in individuals past 50 years of age, and is commonly associated with diseases of the coronary arteries, usually arteriosclerotic occlusion of some of the branches. Occasionally the lesion is syphilitic in nature and involves the myocardium.

The paroxysms occur irregularly. There may be a rapid succession of attacks coming on every few days for a period of several months, and then a period of months or years of quiescence. It is the underlying cardiac lesion rather than the bradycardia itself which requires attention. There is usually some degree of chronic heart block. Some patients with the Stokes-Adams syndrome live for from 10 to 25 years after the initial episode, while others die in the first attack. During an attack, the pulse rate drops to 30 or 40 beats a minute. The patient is usually comfortable unless evidences of heart muscle exhaustion set in.

The onset is abrupt and without apparent cause; an attack frequently develops while the patient is at work or occasionally while he is at rest in bed. The seizure is characterized by sudden dizziness

and giddiness, and after a few minutes the patient loses consciousness. There is a tonic followed by a clonic convulsion accompanied by foaming at the mouth. Usually patients recover from such a seizure, though occasionally it is fatal. If the seizure lasts more than two minutes, the patient usually dies.

TREATMENT

The patient with Stokes-Adams disease or chronic bradycardia may have his life prolonged by many years with successful treatment. The ultimate outcome depends not on the seizures, but on the condition of the heart muscle and the lesion producing the bradycardia.

1. During the attack 1 cc. of adrenalin hydrochloride, 1:1000 solution, is given subcutaneously at once, and repeated every two hours for several doses.

2. Ephedrine sulfate, 16 to 32 mg. (¼ to ½ grain) in capsules, may be administered by mouth every three or four hours.

3. After the acute episode is over, the most effective treatment consists of giving thyroid extract, 64 mg. (1 grain) two or three times a day.

4. Barium chloride, 32 to 64 mg. (½ to 1 grain) three or four times a day, has also been recommended.

5. Atropine sulfate, 0.8 mg. ($\frac{1}{75}$ grain) twice a day, or tincture of belladonna, 1 cc. two or three times a day, may be used until evidence of atropinism, such as dryness of the mouth or visual disturbances, occurs.

CHAPTER VI

The Heart

(Continued)

ENDOCARDITIS

Acute Endocarditis

Acute endocarditis may be classified into simple or benign, and the ulcerative, sometimes called malignant, and subacute bacterial endocarditis. The benign or verrucose type is by far the commonest of the three. It is practically always the result of acute rheumatic fever or tonsillitis and is considered to be caused by a mild form of streptococcus. Rheumatic endocarditis is the name usually applied to the benign condition. The malignant form is caused by suppurative organisms as staphylococci, pneumococci, streptococci, and gonococci. The engraftment of Streptococcus viridans on a valve already damaged by rheumatic infection is called subacute bacterial endocarditis.

Acute
- 1. Simple. Benign. Rheumatic.
- 2. Bacterial (malignant).
- 3. Subacute bacterial endocarditis (Endocarditis lenta).

Pathology: The changes in the heart valves in the simple form are characterized by small beadlike nodules in the subendocardial tissue near the edge of the valve. Later, deposits of fibrin and connective tissue result in the warty or verrucose type of vegetation. While all cases of the simple form of endocarditis do not heal, most of them do. As healing occurs, scar tissue in the valve leaflets contracts and insufficiency of the valve develops. The degree of functional impairment occurring in a valve depends, of course, on the severity of the acute endocardial lesion. In those cases in which the inflammatory lesion in the valve fails to heal in the usual period of a few months, an accompanying acute myocarditis and likely pericarditis are present. When healing occurs, the patient remains well for many years until the remote consequences of the defective valve

action cause embarrassment of the heart muscle with beginning failure 20 to 25 years later.

Diagnosis: A history of rheumatic fever is of value in diagnosis. However, the diagnostic identification mark is the presence of a soft blowing murmur over the valve area. As the mitral valve is most commonly involved, a soft systolic mitral murmur is usually present. Unless one has examined the heart carefully every day of the sickness, the presence of a murmur may lose its significance. It may be a new development or it may have been there before the onset of the present illness. A murmur alone must not be taken as positive evidence of endocarditis, because in any acute febrile disease, a systolic murmur may result from the slight cardiac dilatation which develops. However, a murmur occurring with a rise in fever, an increase of the leukocytes and marked or decided increase of heart rate would lead one to believe that it was of endocarditic origin.

TREATMENT

In the treatment of simple endocarditis, it is not the dramatic exhibition of any one specific measure but the judicious use of many different measures that brings about the cure of the patient.

1. Absolute rest in bed is necessary. Sometimes the lesion heals in about one and one-half months, but prolonged rest is advisable. Patients with even the simplest form of acute endocarditis will not recover but will develop other complications unless rest in bed is enforced. A question often asked is, "When should a patient with simple endocarditis be allowed out of bed?" Freedom from fever for a period of one month, a drop of the leukocytes to normal, a normal sedimentation rate, and a normal red cell count with a heart rate under 90 per minute are evidences that the heart lesion has healed completely or almost completely. I have found the sedimentation rate to be of distinct value in determining when the patient should be allowed more freedom. Usually the fever, pulse rate, and leukocyte count return to normal long before the sedimentation rate does, and therefore this test is of particular value.

2. The medical treatment is of less importance than the general measures. Nevertheless, certain drugs appear to have a favorable action in these cases.

a. Sodium salicylate, 1 Gm. (15 grains), with sodium bicarbonate, 0.6 Gm. (10 grains), may be given every three hours with plenty of water, until the patient objects to the untoward reactions of the salicylates, as ringing in the ears and excessive sweating. At times, if tolerated, patients may need larger doses. If not tolerated orally we have found 5 Gm. (75 grains) of sodium salicylate given as a starch retention enema two or three times a day to be of great value. Salicylates may be given *via* the parenteral route, but there is no particular advantage in administering them this way. If they are not tolerated, one may have to resort to the use of amidopyrine, 0.6 Gm. (10 grains), four times a day in order to relieve the patient of pain. If this drug is used one must watch the white count closely.

b. Most patients with acute endocarditis suffer from hypochromic normocytic anemia. This is overcome by administration of citrate iron, as iron ammonium citrate, 2 Gm. (30 grains), three times a day.

c. Since these patients are usually indisposed for a number of weeks or months with fever and other toxic manifestations of the disease the appetite may be very poor and a vitamin deficiency may result. It is wise to supplement the iron with a number of the essential vitamins which have been standardized therapeutically, as concentrated capsules of cod-liver oil and vitamins B and C.

Acute Ulcerative (Bacterial) Endocarditis

Acute bacterial endocarditis is usually caused by hemolytic streptococcus, staphylococcus, gonococcus, or pneumococcus. Rarely some other organism is responsible. Acute bacterial endocarditis, like pericarditis, is seldom a primary disease. It is usually the result of an infection elsewhere in the body as pneumonia, gonorrhea, or general sepsis. The onset of this disease is commonly abrupt, but the endocarditis is usually completely overshadowed by the severity of the constitutional symptoms of the original disease. Therefore, the diagnosis of the heart involvement may be delayed for some time. The rapidity of the progress of bacterial endocarditis has given rise to the term "malignant" for these cases.

The lesion on the valve differs from that of the simple endocarditis probably more in degree than in kind. There is a rapidly growing cauliflowerlike vegetation, which develops from the presence of the organism in the blood stream. While the appearance of the vegetation may differ, depending on the type of organism producing it, the nature of the lesion is practically the same with all organisms.

Signs and Symptoms: The clinical picture of acute bacterial endocarditis varies according to the severity of the infection, but the general pattern of all cases is the same. There are sepsis, high fever, usually leukocytosis, prostration, and sometimes delirium or coma. It has been customary to split this kind of endocarditis into the cardiac, the typhoid, and the so-called septic types, but these terms have reference only to the organs which bear the brunt of the infection. For example, if the symptoms are predominantly referable to the heart, it is said the patient has the cardiac type; if the symptoms are those of long-continued sepsis, it is called the septic type, while the typhoid class refers to those patients with bowel involvement. The fever, tachycardia, pallor, prostration, and murmurs of the heart are the chief signs. The spleen may be considerably enlarged, though this may not develop until later in the course of the disease. Despite the extensive involvement of the heart valves at autopsy, the physical signs, as valvular murmurs, are often not very pronounced. Usually the mitral valve is involved, although right-sided endocarditis may occur also.

Many times the evidences of endocarditis of this type are found outside the heart itself. For example, an embolic particle may break off the cauliflowerlike vegetation and be carried into the brain, causing hemiplegia and secondary abscess, or it may pass on into the large vessels leading to the extremities, resulting in embolic occlusion of the main artery and gangrene. Patients with acute bacterial endocarditis have a very grave prognosis. However, with the development of the sulfonamide group of drugs, the outlook for these patients may be entirely changed.

TREATMENT

1. Vaccines, therapeutic sera, and administration of dyes, as gentian violet and mercurochrome, have failed to alter the downward trend of endocarditis.

2. Sulfanilamide, sulfapyridine, and sulfathiazole have been shown to be of definite value, at times resulting in cures and at other times relieving the patient of drenching sweats, prolonged fever, and associated debilitation. Further reference to the use of these drugs will be made under "Subacute Bacterial Endocarditis."

3. Penicillin may be given intravenously or intramuscularly, in combination with the sulfonamides or alone.

Subacute Bacterial Endocarditis

Any patient with valvular heart disease caused by rheumatic fever is a candidate for one of four complications: (1) Failure of the heart; (2) auricular fibrillation (with failure or embolic phenomena); (3) embolism, or (4) subacute bacterial endocarditis. Subacute bacterial endocarditis is not as acute as the so-called "malignant" form, since it runs a slower course, lasting over a period of several months or even a few years. Nevertheless, it is as likely to cause the patient's death as the short and stormy acute (malignant) bacterial endocarditis. Although subacute bacterial endocarditis is not a common disease, it is important because it may be simulated by so many other disorders, and because of the almost universally fatal prognosis and inadequacy of treatment before the advent of the sulfonamide drugs. A diagnosis of subacute bacterial endocarditis erroneously made or failure to recognize its presence is unfortunate for both patient and physician.

Signs and Symptoms: The term, "subacute bacterial endocarditis," is something of a misnomer applied to a new granulomatous cauliflowerlike vegetative growth engrafted on a heart valve already damaged by rheumatic endocarditis or on a congenital valve defect. There may be a history of rheumatic endocarditis, and usually the valves of the left side of the heart are involved. The organism is most commonly a streptococcus, usually of hemolytic or viridans variety. Less often the pneumococcus, bacillus influenzae, or staphylococcus is involved. Blood cultures are positive in nearly every case, although repeated cultures may have to be made.

The five main characteristics are (1) pallor, (2) fever, (3) asthenia, (4) presence of an old valve lesion, and (5) an enlarged spleen. Other prominent features are weight loss, anemia, slight leukocytosis (occasional leukopenia) with increased stab forms, elevated sedimentation rate, heart murmur, red blood cells in the urine, petechial hemorrhages, Osler's nodes, clubbed fingers, and a positive blood culture.

Practically all the systems of the body may be involved at one time or another during the course of subacute bacterial endocarditis:

1. Nervous system: Symptoms are due to systemic infection or toxemia. Emboli to the brain may result in hemiplegia, convulsions, coma, or retinal hemorrhages (Roth's sign).

2. Cardiorespiratory system: Symptoms of heart failure are not common. Murmurs of an old heart lesion may be changed by the development of vegetations. Vegetations or bacteria may break off, enter the blood stream, and produce pulmonary infarction.

3. Gastrointestinal system: Anorexia, vomiting, and diarrhea which may be bloody due to showers of emboli often occur.

4. Genitourinary system: Focal embolic glomerulonephritis or renal infarction with red blood cells, white blood cells, and albumin in the urine are almost always present.

5. Cutaneous manifestations and extremities: Crops of petechiae in the mucous membranes and skin, splinter hemorrhages under the fingernails, Osler's nodes, clubbed fingers, and gangrene of an extremity from embolism in a peripheral vessel may develop.

6. Hematopoietic system: Secondary anemia and leukocytosis (often 12,000 to 18,000) with shift to the left in the Schilling count are common. The sedimentation rate is increased.

The onset of the disease is characteristically insidious and in the first stages the symptoms are those of a low-grade infection. The most frequent early complaints are weakness, fever, cardiac symptoms, and arthralgia, or, if the onset is sudden, chills, sweats, and emboli may be foremost. In the later phases of the illness embolic manifestations are prominent. The course is typical. It may be stormy and end fatally in a few months, but usually it is characterized by remissions representing semihealing of the heart valve lesions, during which the patient may be afebrile for months. Pallor remains, exacerbations occur, and death comes within a year or two. I have seen patients recover, though they have presented the typical picture of subacute bacterial endocarditis except for the positive blood culture.

Diagnosis: The diagnosis is proved by the presence of a positive blood culture. Without a positive blood culture, I am always loath to make a diagnosis of subacute bacterial endocarditis. The simple forms of endocarditis may recur from time to time and closely simulate subacute bacterial endocarditis, but patients with the latter disease usually die, while those with simple endocarditis nearly

always live. The differentiation here is of more than just academic interest. With few exceptions, I demand a positive blood culture before labeling a patient with a diagnosis of subacute bacterial endocarditis.

This disease is frequently confused with neurasthenia, typhoid fever, undulant fever, tularemia, recurrent rheumatic endocarditis, or pyemia without endocarditis. Malignancy, blood dyscrasias as purpura hemorrhagica, leukemia, and pernicious anemia, Banti's disease, and myxedema must also be considered. Cases of sudden onset may be confused with influenza and malaria.

TREATMENT

The treatment of subacute bacterial endocarditis at the present time falls into three definite categories: (1) Sulfonamide therapy; (2) penicillin therapy; and (3) supportive measures.

1. Sulfonamide therapy: Since sulfanilamide and its associated compounds were first used, there have been some 30 to 35 reported cures of subacute bacterial endocarditis. These cures were obtained either by the use of one of the sulfonamides or by the combination of a sulfonamide with artificial fever therapy or in combination with heparin infusion. There is some question as to the exact value of heparin, especially in view of the risks encountered in its use. However, the administration of any individual sulfonamide is certainly indicated in the diagnosed cases of bacterial endocarditis. If the patient is in relatively good condition, artificial fever therapy is warranted.

The question of which drug to use is still much in debate. We feel that if one can demonstrate a marked suppression of bacterial growth of the etiological organism *in vitro* by one of the sulfonamide drugs, that particular drug is indicated for an *in vivo* response. For example, if sulfapyridine seems to prevent a growth of a certain cultured strain of Streptococcus viridans better than sulfanilamide, sulfathiazole, or sulfadiazine, then sulfapyridine is the drug of choice.

When using sulfanilamide, one should attempt to attain an optimal blood level of 10 to 12 mg. per cent. This is usually accomplished by giving an initial dose of 4 Gm., followed by 1 Gm. every three or four hours day and night. A blood level of 5 to 8 mg. per cent is the ideal when sulfapyridine, sulfathiazole, or sulfadiazine is

used. This is obtained by giving an initial dose of 4 Gm., followed by 1 Gm. of the drug every four hours day and night. While the patient is on these drugs, one must carefully watch the hemoglobin, red, and white counts daily or every other day, and study the urine for the appearance of red cells or an overflow of crystalline drug. If the patient is in too critical condition at the start of therapy to tolerate the drug orally, one is justified in using the parenteral route. Sulfapyridine or sulfathiazole may be given intravenously in 5 Gm. doses as a five per cent solution two or three times a day. Sulfanilamide is best given subcutaneously as a one per cent solution in normal saline.

2. Penicillin therapy has been disappointing in some cases of subacute bacterial endocarditis, but successes have followed combined penicillin and heparin therapy.

3. Supportive measures:

a. The patient should be confined to bed while febrile and while receiving sulfonamide therapy.

b. Occasionally a hypochromic anemia is encountered, both because of the patient's disease and sometimes secondary to the sulfonamide therapy. This is combated by giving iron ammonium citrates, 2 Gm. (30 grains), three times a day.

c. Clinical and in many instances subclinical levels of vitamin deficiency are observed. Therefore, vitamins A, B, C, and D are given in ample quantities.

d. During the early stages of the disease the patient may be very ill generally and can only tolerate a very light or even liquid diet. However, after some response is shown to the therapy instituted a high caloric diet is indicated.

e. Occasionally the patient's anemia is very severe or the patient may be unusually toxic. In these instances, multiple small transfusions may be of great benefit. However, one should remember to alkalinize the subject before giving such a transfusion. This may best be accomplished by giving 400 to 600 cc. of 6/M sodium lactate solution intravenously twice a day for two days prior to transfusion.

f. Triweekly doses of crude liver extract, 2 cc., intragluteally have been found to improve the production of blood by stimulating the hematopoietic centers.

PERICARDITIS

There are three principal forms of acute pericarditis: (1) The rheumatic, which embraces the fibrinous and serofibrinous; (2) the

suppurative, which may be due to rheumatic fever, pneumonia, streptococcal or gonococcal infections, or other diseases, and (3) the terminal form, occurring in patients dying of uremia. These three types of pericarditis are not really separate and distinct diseases, but may be considered as stages of one pathological process. If the patient survives the acute phase, healing takes place and causes connective tissue adhesions between the parietal and visceral pericardial layers, and chronic or constrictive adhesive pericarditis develops.

Etiology: The main cause of acute pericarditis is an infection, particularly rheumatic fever. It may be a direct extension of inflammation from the surrounding organs or through the blood stream in general septic processes. Of the acute forms, the suppurative is the most serious type; it develops as a sequel to conditions as pneumonia, empyema, or septicemia. Often the acute fibrinous or serofibrinous types develop and run a comparatively benign course, terminating with complete resolution without the true condition being recognized or diagnosed. Frequently the general infection of the preëxisting disease may be so severe that the pericardial lesion is completely overlooked. It must be kept in mind that acute coronary thrombosis may be an immediate cause of acute pericarditis, but in this case the true nature of the underlying lesion is usually recognized. Tuberculosis too is a very common cause of pericarditis, but needs no description now because it is a chronic form of the disease.

Signs and Symptoms: The chief symptom of pericarditis is precordial distress. This pain is seldom severe in nature, but usually takes the form of a dull aching sensation over the lower portion of the sternum, which is made worse by pressure on the sternum. Rapid pulse, fever, and an increased respiratory rate are practically always present. After the pain has persisted for a day or two, it often becomes less and less, and finally disappears entirely. Freedom from precordial pain is usually followed by distressful dyspnea. When the pain gives way to shortness of breath, it is usually a sign that the precordial effusion has become great enough to separate parietal from the visceral layers of the pericardial sac which relieves the pain. This effusion may be mild, moderate, or severe, and the degree of dyspnea is usually dependent upon the amount of effusion. Usually dyspnea lasts for a few days and then disappears. However, this does

not mean that the effusion has ceased, since it may persist for a much longer time. Ordinarily the effusion completely vanishes within a period of a week or ten days, although sometimes suppuration may set in, which precipitates a serious complication. With the disappearance of the effusion, the half-forgotten pain of the earlier stage may return to some degree, together with the classical pericardial friction rub.

On inspection one usually finds some characteristic features of acute pericarditis. The patient with an acute rheumatic infection who has been progressing fairly well, let us say, becomes more restless than usual, the temperature rises to a higher point, the pulse increases in rate, and sometimes a dusky cyanotic tinge appears. Palpation of the precordial area may reveal fremitus friction. On percussion in the early stages no abnormality is found. Auscultation brings out the characteristic to-and-fro friction rub that is not synchronous with either the systolic or diastolic phases of the heart rhythm. This friction sound is usually made out first over the base of the heart in the region of the great vessels. The scratching, grating pericardial friction sound differs from an endocardial murmur as follows:

1. It is more superficial and appears to lie directly under the skin.
2. It does not synchronize exactly with either systole or diastole, but as a rule overlaps portions of both.
3. A murmur tends to remain unchanged for comparatively long periods of time, while the pericardial rub varies in intensity, position in the cardiac cycle, and location in the precordium almost from day to day.
4. The friction rub varies with the respiration. It may become louder on inspiration and softer on expiration.

When effusion takes place the friction sound becomes less marked and the heart sounds are muffled. The apex beat may be displaced to the left, and, on percussion, decided increase of the cardiac dullness is made out. This area of dullness takes a conical shape; that is, the apex of the cone is situated at about the level of the second rib and the base is in the region of the fifth or sixth intercostal space. It is during this stage of effusion that the heart muscle may become weaker and fail. The failure is not always due to the pericardial effusion entirely, since there may be an accompanying myocarditis

which weakens the already overburdened heart. Another physical sign of pericarditis is the pulsus paradoxus. Although this is rarely present, sometimes it is an outstanding feature of the examination. A pulse that tends to become faint during inspiration and return to its full bounding quality during expiration is the pulsus paradoxus.

Diagnosis: The diagnosis of acute pericarditis is commonly easy to make. This is especially so when the characteristic friction rub occurs. The concomitant changes as the pulse rate, respiratory rate, and fever are helpful. Of particular value is the sudden change in the appearance of the patient. When in doubt an x-ray examination will serve to confirm or repudiate the tentative diagnosis.

Prognosis: The prognosis as a whole depends to a great extent upon the immediate cause, as the simple pericarditis, with or without effusion of rheumatic variety, usually resolves and the patient recovers. Of course, chronic adhesions may be the result of the acute pericarditis, and they may ultimately be the cause of the patient's premature death. The amount of effusion is a fairly good prognostic guide; the greater the effusion, the worse is the outlook for the patient. Purulent pericarditis is especially dangerous, because it develops in the course of diseases of a serious nature as pneumonia, empyema, and septicemia, but these cases are not always hopeless.

TREATMENT

1. Absolute rest in bed is imperative until the period of fever and complications has passed.
2. The antecedent disease, if recognized, should be treated as vigorously as possible.
3. As pain may be a distressful feature, especially in the early stages, small doses of pantopon, 20 mg. (⅓ grain), or even morphine, 10 mg. (⅙ grain), may be given hypodermically for relief when necessary.
4. Icebags over the precordium give more relief than heat.
5. The irritating, painful cough, which is often a complication, calls for codeine sulfate, 16 mg. (¼ grain), in some vehicle as simple syrup given as needed.
6. The intake of fluid should be limited to about 1000 cc. (1 quart) per day.
7. Diuretics as mercupurin or salyrgan, 1 cc. intravenously every

other day for three doses, or diuretin, 0.6 Gm. (10 grains), three times a day should be given to relieve the pressure of the effusion.

8. As long as the effusion is well borne by the patient, aspiration of the pericardial sac is not necessary. If a massive effusion is present and the patient becomes extremely dyspneic, cyanotic, and weak, the needle should be introduced at the fifth or sixth intercostal space just to the left of the left sternal border or in the sixth intercostal space outside the nipple line. Needling, however, has become a rare event in my experience. The question of paracentesis of the pericardial sac is often brought up but it should be rarely resorted to because the effusion usually absorbs and seldom causes enough embarrassment to warrant the introduction of a needle. When heart failure comes on in the presence of effusion, I am of the opinion that it is due not so much to the effusion as to the myocardial and endocardial involvement.

9. The general management of the patient requires consideration of the proper amount of food and vitamins in the diet.

10. As anemia is often present, good-sized doses of iron ammonium citrate, 2 Gm. (30 grains) three times a day or some other iron preparation should be given daily.

11. If purulent pericarditis is present, a surgical opinion should be sought regarding the removal of pus. Although purulent pericarditis may resolve without surgical drainage, an operation proves to be the most effective measure in the treatment of these cases.

12. Pericarditis, due to pneumococcus or streptococcus infections or bacteria which respond to the sulfonamides or penicillin, requires these therapeutic measures given in the usual manner.

CHAPTER VII

The Heart

(Continued)

RHEUMATIC FEVER

Rheumatic fever is an acute infectious disease of unknown etiology, causing fever and a marked intoxication characterized by the presence of minute focal proliferative lesions in the heart and other tissues and organs.

Etiology: Rheumatic fever is usually found in the temperate climates, particularly in the cold damp areas, during the winter and early spring. It has a tendency to appear in epidemic form at irregular intervals. It occurs most frequently in children between the ages of 5 and 15 years.

The cause of rheumatic fever is unknown. The disease often follows Hemolytic streptococcus infections of the upper respiratory tract, though more than one strain of streptococci may be demonstrated in one patient. The portal of entry is probably the throat. Other suggested etiologic factors are an allergic or a humoral phenomenon. Trauma is believed to play a rôle in the disease, since an injury to a joint may serve as a site of an initial lesion. Pharyngitis, sinusitis, and tonsil infections may also be predisposing factors. Rheumatic fever is usually the result of repeated infections with renewed activity in old foci of infection.

Pathology: The affected joints show edema of the periarticular tissue, and the synovial cavities have a thick yellow fluid which contains relatively large amounts of fibrin. The synovial membrane is thickened and injected, and the cartilage of the joint may be eroded. The body cavities, as the pleural and pericardial cavities, may also contain a serofibrinous fluid. The pericardial epithelium may be destroyed and obliterative pericarditis may ensue with organization of the exudate. Endocarditis or valvulitis in the early stages show minute gray-pink vegetations along the line of approximation of the cusps with some thickening. The mitral valve is most commonly affected. The Aschoff bodies, which are to rheumatic fever what

tubercles are to tuberculosis, occur about the smaller blood vessels as a small necrotic area surrounded by polymorphonuclear leukocytes and cells with a large basophilic cytoplasm with large, frequently multiple, nuclei. These large basophilic cells are found in all the acute lesions.

Signs and Symptoms: The symptoms of sore throat or upper respiratory infection are the most prominent early manifestations of the disease, accompanied by general malaise, fatigue, pallor, anorexia, fleeting pains in the limbs, and persistent loss of weight. A sense of coldness, associated with clammy sweat and exhaustion, is also evident. The temperature rises rapidly, and more than one joint may become painful. Within 24 hours, the fever may range between 39° and 40° C. (102° and 104° F.) and the pulse is rapid. There are marked prostration, profuse sweating, and arthritis. The joints are painful, tender, swollen, hot, and red. The large joints may be involved singularly or more than one at a time. The joints most subject to strain are the first ones to be affected. The joint involvement is transitory and migratory.

The fever lasts 10 to 15 days. There is usually a further rise in temperature with the involvement of more joints. Each joint may be inflamed for a period of one to six days, and relapses may occur. Clinical signs of cardiac involvement are present in more than 50 per cent of cases, and it is probable that the heart is affected in almost every case. The chief signs of myocarditis during the acute period are enlargement of the cardiac area, disturbances of rhythm and rate, and electrocardiographic changes. There is an increase in heart size due to the acute cardiac dilatation and the murmurs which are present may be due to a relative insufficiency of the valve. Precordial pain and hyperesthesia are suggestive of cardiac involvement, and a palpable diffuse apical impulse with a gallop rhythm confirms this suspicion. An accentuated third sound, dropped beats, and premature contractions are frequently noted. The development of pericarditis in a patient with signs of valvular injury signifies pancarditis. Friction rub is diagnostic of pericarditis. With pericarditis there are an effusion in the pericardial sac, tachycardia, and increasing dyspnea and cough.

Subcutaneous nodules in the skin are specific and important signs of a virulent infection. Central nervous symptoms may be those

of chorea in children, while in adults there are usually delirium and coma if this system is involved.

There is a rapidly progressive secondary anemia with a leukocytosis ranging from 10,000 to 25,000 cells with a shift to the left. Erythrocytes and hemoglobin are reduced. The sedimentation rate is always rapid. The urine is scanty, highly concentrated, and may show a trace of albumin and many red and pus cells. Acute nephritis is an unusual but serious complication of acute rheumatic fever.

Diagnosis: The diagnosis is made on the clinical phenomena previously described, and should be strongly suspected in any case of acute migratory polyarthritis. It has been suggested that the following criteria be adhered to in diagnosis: (1) Any combination of the major manifestations, such as arthralgia, carditis, chorea, nodules, and a history of previous rheumatic fever; (2) a combination of at least one of the major manifestations with two minor manifestations, such as fever, abdominal or precordial pain, epistaxis, pulmonary changes, and laboratory abnormalities; (3) the presence of rheumatic heart disease increases the diagnostic significance of the minor manifestations when no other cause for these exists.

Differential Diagnosis:

1. Multiple acute secondary arthritis which is differentiated from acute rheumatic fever by the purulent infection of the joints.
2. Gonorrheal arthritis which is usually quite readily distinguished because of the presence of a genital infection.
3. Acute osteomyelitis and septic arthritis in which cases there are a septic fever, profound intoxication and marked leukocytosis.
4. Gout, in which the history and presence of a high blood uric acid make the diagnosis quite simple.
5. Tuberculosis, brucellosis, and trichinosis may be confused with acute rheumatic fever.

TREATMENT

Treatment for rheumatic fever is still largely symptomatic. Its aim is to control the infection and prevent complications, particularly heart damage. Since serious rheumatic heart disease seldom results from the first attack, but is produced by a succession of relapses and recurrences, treatment is prolonged and the prevention of

further rheumatic activity is of paramount importance. The following regimen has been found to be beneficial.

1. Bed rest, preferably in a hospital, should be instituted in any case with a persistent infection, and the individual should be kept completely at rest until every evidence of infection has subsided, *i. e.*, until the heart rate, white blood count, Schilling count and sedimentation rate have been normal for some time. Some suggest rest flat on the back with only one pillow and no activity whatsoever. Special attention should be paid to temperature, pulse, changes in the size of the heart and development of bruits. As the condition improves, gradual elevation is accomplished, the pulse rate being watched carefully all the while. Such prolonged confinement, which may extend into months, is often hard to achieve, as the acute symptoms may subside and the patient feel well long before the process is cured. However, the fact that heart damage may be prevented or minimized in this manner makes it well worthwhile.

2. Protect the patient from cold and chilling.

3. Liberal fluid intake to combat or prevent dehydration is recommended, except in the presence of edema, when fluid intake should be restricted. The diet should be high in calories and contain easily digestible food.

4. Drugs are useful only in treating passing phases of the disease. However salicylates are indicated to relieve abdominal symptoms, precordial pain, joint pain and temperature. Sulfanilamide has been tried with varying degrees of success. It does not relieve symptoms, but may enhance them. Nevertheless, some feel that when given early before heart damage begins, it will help remove foci of infection and prevent the untoward effects of rheumatic fever. Sulfonamide therapy may be combined effectively with salicylate therapy. The suggested dosage is sulfanilamide or sulfadiazine only, 0.05 Gm. (¾ grain) to the pound, to be given daily for the first two or three days, and then salicylate therapy only.

Recently the use of large doses of sodium salicylate has been advocated. When the disease proves resistant to the usual measures, 10 Gm. (⅓ ounce) of sodium salicylate in 1000 cc. of 0.9 per cent sodium chloride are administered by intravenous drip in four to six hours. This is continued daily for about a week or until a satisfactory response takes place. Oral therapy replaces intravenous

therapy after the first week. The use of such large doses of sodium salicylate intravenously has been praised by some, condemned by others. It would seem that this method is indicated if the disease fails to respond to the usual procedures.

5. Immobilize the joints. Salicylates, 1.0 to 1.3 Gm. (15 to 20 grains) accompanied by equal doses of sodium bicarbonate every two hours in milk, may be given, and a soothing liniment or ointment as methyl salicylate should be applied to the involved joint. The salicylates may be continued until the ears ring. If not tolerated orally, 5 Gm. (75 grains) in a starch retention enema b.i.d. may be given. The effect of salicylates may be increased by magnesium. Magnesium carbonate is the best tolerated form of magnesium and should be given in amounts equal to the dosage of salicylate. Aminopyrine, 0.3 to 0.5 Gm. (5 to 7½ grains) four to six times a day may be used, and is six times as effective as the salicylates. However, it must be used with care as agranulocytosis may follow. If the fluid in the joint space is large in amount, it should be aspirated, using careful technic to prevent the introduction of any infection.

6. Aspirate the fluids in the heart sac and pleural cavities.

7. Morphine sulfate, 10 mg. (⅙ grain) or codeine sulfate, 32 mg. (½ grain) may be necessary for the relief of pain.

8. Digitalis is indicated in cases of heart failure, but should be used carefully. In treating the heart failure of rheumatic fever, it may be more important to promote diuresis than to regulate the heart rate. In congestive failure it has been suggested that the condition be controlled by the xanthines. If they are not effective digitalis may be used, and as a last resort, the mercurial diuretics.

9. Iron therapy is indicated for the anemia later in the course of the disease.

10. Remove all foci of infection when the disease becomes quiescent. In general, it is best to wait six or eight weeks. At the end of this time operation should be performed whether or not healing has occurred, since it is probable that the disease will not disappear until the infection is cleared up.

11. Vitamins A, B, C, and D are useful in building up the general resistance of the patient.

12. Prolonged convalescent care is important in order to ward off relapses and remissions. The child is best treated in a sana-

torium or convalescent home, and it has often been suggested that the Public Health Department establish institutions for the care of those suffering from rheumatic fever, as it has done for tuberculosis. Removal to a warm, tropical climate is both expensive and unnecessary, since rheumatic fever occurs even in the tropics.

The proper balance must be struck between exercise and rest. In general, moderate activity in a good environment and under careful supervision is satisfactory. Plenty of rest and a long afternoon nap are recommended. The patient should not return to school for 6 to 8 months after the disease is quiescent, but may try to keep on with his scholastic activity during convalescence.

13. When the child returns home, the latter should be improved as far as possible, if the situation requires it. It is best for the rheumatic individual to have a separate bedroom, avoid crowds, and observe the other precautions necessary in the prevention of upper respiratory tract infection. If he should develop any infection at all, no matter how slight, he should go to bed. The diet should be adequate with plenty of milk and citrus fruit.

14. In prophylaxis, some have felt that sulfanilamide therapy is valuable. Others have reported favorably on the salicylate prophylaxis of rheumatic fever and immunization with injections of hemolytic streptococcus toxin. While such reports have proved interesting, the value of such measures has been questioned. Since the etiology of rheumatic fever is uncertain, it is difficult to discover any successful specific prophylactic treatment. More and more emphasis has been placed on the public health aspects of the disease, and it is felt that a general improvement in housing, nutrition, and cleanliness would do much to stave off this malady.

COR PULMONALE

Cor pulmonale is a disease of the heart, caused by obstruction to the flow of blood through the pulmonary vessels, which terminates in failure of the right ventricle. There are two forms of cor pulmonale, the acute and the chronic. There is a type of acute cor pulmonale which is the result of embolism from phlebothrombosis in the legs. The recognition of the phlebothrombosis is important because ligation of the thrombosed veins of the leg is likely to be followed by complete recovery. The long course of the chronic

type is punctuated by acute episodes of right-sided heart failure. These attacks at times are preceded by exertion and, at other times, the precipitating factor is obscure. Following the early bouts of acute right-sided failure, the patient may appear quite well for a time, but eventually the heart becomes exhausted from repeated attacks, and fails permanently.

Etiology: The pathogenesis of this type of heart disease is extensive and is characterized by long-standing disease of the lung parenchyma or of the pulmonary vessels or gross deformities of the thoracic cage with consequent obstruction to the flow of blood through the pulmonary vessels and subsequent compensatory hypertension in the lesser circulation. The pulmonary hypertension produces strain on the right ventricle. This, if long-continued, leads to hypertrophy, dilatation and eventual failure of this chamber through a process of fatigue rather than degenerative changes. Such hypertension in the lesser circulation and its effect on the right ventricle are comparable to hypertension in the systemic circulation with its corresponding effect on the left ventricle. Apropos of this, it should be borne in mind that the texture of the right ventricle is more delicate than that of the left.

The etiology of the underlying pulmonary disease may be quite varied. It must be extensive enough to interfere with the free flow of blood through the pulmonary vascular bed and it must be present over a long period of time. Among such causes are (1) silicosis, (2) pulmonary fibrosis due to any chronic inflammation of the lungs, as chronic bronchitis, bronchiectasis and fibroid tuberculosis, (3) asthma and resulting emphysema, (4) long-standing pulmonary atelectasis, (5) marked scoliosis or kyphosis or any gross deformities of the thoracic cage sufficient to diminish the oxygenating capacity of the lung, (6) Ayerza's disease, (7) Pick's disease with extensive adhesions involving the mediastinum, and (8) emphysema from any cause.

Symptoms and Findings: The signs are variable and depend on the nature of the underlying pulmonary disease and the length of time it has been present. Dyspnea, cough, cyanosis, and weakness may have been present for long periods of time as the result of the pulmonary disease. As these same symptoms may represent early cardiac failure, it is frequently difficult to determine where the

cause terminates and the effect begins. This difficulty is made more severe because of the long chronic course of the pulmonary process and the usually insidious onset of cardiac weakness and failure. Such a combination frequently causes the transitional period to be overlooked by both patient and physician. The symptoms become increasingly severe in proportion to what would be expected from the pulmonary process alone. With the onset of definite right heart failure, symptoms and findings produced by congestion of the liver, edema of the lower extremities, and passive congestion of the neck veins become manifest. Râles in the lungs and tachycardia, too, may have been present for a long time previous to the onset of cardiac involvement, but with congestive failure these findings become more marked. The heart may not show definite left-sided enlargement until relatively late, but earlier in the course of the disease accessibility of the right ventricle may be determined. Clubbing of the fingers and toes is frequently seen.

Common findings are elevation of the red blood count and hemoglobin. The electrocardiogram may show right axis deviation and right ventricular strain. Enlargement of the right ventricle may be difficult to show with x-rays as this chamber lies anteriorly, but a prominent pulmonary conus is seen on the left cardiac border. Enlargement of the right auricle is demonstrated with a flat film of the chest or with a barium esophagram. In the later stages, the heart may show generalized enlargement.

Prognosis: The course is variable, but usually follows that of the underlying pathology. As the underlying pathology progresses, more strain is thrown on the lesser circulation and on the right ventricle until failure finally occurs. During the process of the disease, the reserve of the right heart is diminished and the heart becomes less able to withstand added burden that might be imposed upon it. An example of such an added burden is acute respiratory infection to which these patients are subject, particularly during the winter months. Cardiac decompensation is common during such infections. True pneumonia is a burden which few are able to withstand.

TREATMENT

1. Whatever can be done to arrest the course of the underlying pulmonary pathology may be considered fundamental in treatment.

Such a regimen will include a regulated hygiene of living with additional rest, nutritional diet, and satisfactory environmental conditions. Life in a warm dry climate is often of much benefit to such a patient.

2. If cardiac failure supervenes, treatment must include satisfactory bed rest, digitalis, diuretics, limited fluids and, if necessary, venesection and the use of oxygen.

PULMONARY EMBOLISM

Etiology: Pulmonary embolism may arise from thrombosis in the large veins of the leg, pelvis, or abdomen, from vegetations on the valves of the right side of the heart, or from thrombotic masses in the right auricle that develop when heart failure and auricular dilatation occur. Although other causes occasionally are recorded, those noted above account for the majority of cases. Pulmonary embolism from blood clots in the large veins of the leg is most common and develops especially after abdominal or pelvic operations or fracture of the leg.

Signs and Symptoms: The signs and symptoms of pulmonary embolism depend largely on the size of the artery obstructed by the embolus. A small embolus in a small artery of the lung may not produce an infarct large enough to cause any characteristic features. Larger emboli may obstruct larger arteries and cause serious manifestations. Various classifications have been recommended, and the following is acceptable:

Three main types of pulmonary embolism may be observed:

1. In this group are classed those cases in which the embolus is so large that it plugs one of the main branches of the pulmonary artery or even the main artery itself. In these cases, sudden collapse and death usually occur within five minutes.

2. These are cases which result from an embolus that obstructs a medium-sized artery of the pulmonary tree. A large area of infarction develops as a result of this arterial plug and the sudden shock, dyspnea, cyanosis, pain in the chest, and other signs commonly attributed to pulmonary embolism develop. In this type, the embolism may be fatal but resolution and recovery are common.

3. Finally, the third kind of pulmonary embolism is character-

ized by the lodging of numerous small emboli which occlude some of the smaller and smallest branches of the pulmonary arterial tree; small areas of hemorrhagic infarcts varying in size from a pea to a hickory nut develop as a result. This is the kind of pulmonary embolism that is frequently confused with pneumonia.

Obviously the signs and symptoms of pulmonary embolism vary greatly depending upon the size and position of the obstructing mass. Naturally, in cases in Group A death is so sudden that collapse is about the only clinical feature present. In these cases, dramatic results have been reported from quickly opening the pulmonary artery and removing the obstructing embolus. It is rarely, however, that time will permit this operation even though the patient is in a hospital equipped for such an emergency.

In general, it may be said that the characteristic signs of a large pulmonary embolism are the sudden onset of dyspnea, pallor, and pain in the chest. Cyanosis may or may not be present. A point that appears to require emphasis is that pain need not be present.

In other forms of pulmonary embolism, the vessels plugged are of smaller size, and certain physical signs and symptoms are characteristic. Physical signs are usually absent during the first 24 hours, but after infarction takes place, a friction rub, râles, and alterations in breath sounds, as well as impairment of the percussion note, are observed. X-ray examination usually discloses clouding of the costophrenic angle in the lung. From the fourth to the tenth day, pleural changes take place and the area of cloudiness increases and remains for months, but the lung density usually disappears within two weeks.

In cases of partial infarction, there are no obvious physical signs. However, if fever is present and suddenly rises at night with pleuritic pain, dyspnea, cyanosis, and a faster pulse rate, small incomplete infarctions are probably present.

If the physician keeps pulmonary embolism in mind in postoperative cases, fractures, and heart or infectious diseases, diagnosis is not difficult. If the patient acquires a fever when convalescence is otherwise satisfactory, or if he has a chest pain, increased pulse rate and signs of pleurisy, consolidation, or pleural effusion, pulmonary embolism is apt to be present. Bloody sputum and pain are not necessary for diagnosis.

Recently at the Mayo Clinic, Barker and his associates conducted an extensive survey to determine the incidence of postoperative venous thrombosis and pulmonary embolism. Their findings briefly are summarized in the following tables:

TABLE I

POSTOPERATIVE VENOUS THROMBOSIS AND PULMONARY EMBOLISM.

Number of operations	172,888	.....
All thrombosis and embolism	1665	0.96%
Pulmonary embolism	897	0.52%
Fatal pulmonary embolism	343	0.20%
Thrombophlebitis	938	0.54%

TABLE II

PREDISPOSING CONDITIONS.

		None	*Cardiac*	*Peripheral Veins*	*Blood*	*Carcinoma*	*Severe Infections*
Men....	757	276/36.5	126/16.6	77/10.2	163/21.5	224/29.6	223/29.5
Women .	908	303/33.4	93/10.2	172/18.9	307/33.8	190/20.9	156/17.2
Total..	1665	579/34.8	219/13.15	249/14.9	370/28.2	414/24.9	379/22.8

TABLE III

LOCATION OF POSTOPERATIVE VENOUS THROMBOSIS.

Veins lower extremity	1199	85.6
Veins abdominal viscera	116	8.3
Inferior vena cava	39	2.8
Veins upper extremity	24	1.7
Veins head and neck	17	1.2
Superficial veins trunk	6	0.4

Postoperative thrombi were commonest following laparotomy on the female pelvic organs where injury to the iliac veins may occur.

De Takats and his associates made an experimental study to analyze the mechanism by which pulmonary emboli kill patients. They state that two types of fatal pulmonary embolism have been produced experimentally: (1) One plugs the terminal vascular bed and pro-

duces dyspnea and cyanosis; and (2) the other obstructs the main pulmonary branches and causes syncope, pallor, fall in blood pressure and collapse. It is in the latter type that atropine and papaverine produce their best results.

Differential Diagnosis: Pulmonary embolism is especially apt to be confused with coronary thrombosis. The symptoms of the two conditions are similar. However, a patient with pulmonary embolism is usually one who has undergone an operation and develops the acute episode in a period of from five to ten days after. In coronary disease, the patient is often older. Favoring the embolism are dyspnea out of proportion with other signs of chest disease, decided cyanosis and distention of the veins of the neck. The electrocardiographic tracings are often not very helpful in differentiating because characteristic changes are not always present. However, the following evidences are frequently seen on the electrocardiogram in pulmonary embolism:

1. Deep S in lead I giving the picture of right axis deviation.
2. Deep Q_3 with a low voltage throughout.
3. Deep inversion of T_3 and sometimes T_2.
4. The S-T_1 and S-T_2 may show a low takeoff and inversion of T_2 and T_3.

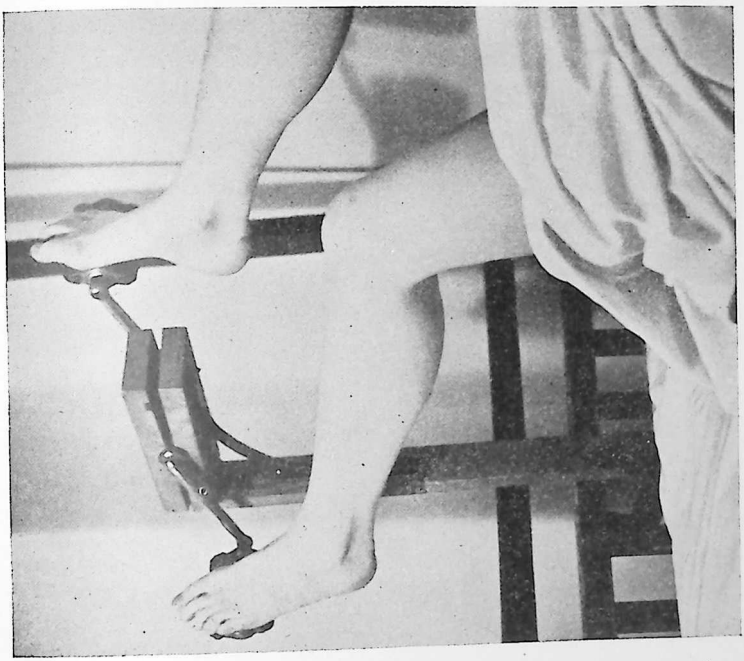
An x-ray examination of the chest may not be very helpful because changes may be lacking. However, it may help in identifying other conditions associated with or confused with embolism. Pneumonia, pneumothorax, massive collapse of the lung, and pulmonary embolism all must be taken into consideration in the differential diagnosis.

TREATMENT

The treatment of pulmonary embolism requires prompt and decisive action. When the patient is first seen, the distress from dyspnea, pain in the chest, and mental anxiety is very pronounced. Usually the patient will be sitting up in a semireclining position, panting for air unless he is too collapsed to do so. In either case, the expression on his face, fear mingled with pain, serves to convince one that a catastrophic event has just occurred. Any emergency treatment must be administered carefully because of the possibility of a mistake in diagnosis.

The treatment then may be outlined briefly as follows:

1. Oxygen of the 100 per cent variety may be used at the beginning of treatment, but after one-half or one hour, better results are obtained by switching to the customary 40 to 60 per cent oxygen. This is best administered with the Boothby type of mask.



Postoperative exercise apparatus to improve venous backflow. The patients pedal on this stationary bicycle for five minutes three times a day, starting on the third postoperative day (de Takats).

2. Morphine, 16 mg. (¼ grain), or pantopon, 20 mg. (⅓ grain), hypodermically may be given immediately to allay mental and physical distress.

3. Atropine, 0.9 mg. (1/75 grain), injected intravenously relieves the vascular spasm of the lung. The atropine counteracts the constriction of the smooth muscles of the coronary system caused by irritation of the vagus, since it blocks the vagal impulse.

4. Papaverine hydrochloride, 32 mg. (½ grain), may be injected intravenously. It is used to release the contracted smooth muscle.

Atropine and papaverine are given three times daily in the above amounts. After the continuation of the intravenous injections of these drugs for two or three days, copavin, 64 mg. (1 grain), may be given three or four times a day by mouth for a week or two in addition to the above.

5. Prophylactic measures should be taken on patients who are candidates for future embolism, as those with phlebothrombosis, thrombophlebitis, or those undergoing operations. Bicycle exercises are helpful, and in suspicious cases, routine ace bandages to the legs, and a cradle of lamps should be used. The thighs should not be flexed on the abdomen. If embolism has occurred before in a patient with phlebothrombosis, and if the patient is over 50, ligation and section of the femoral vein is indicated. Heparin should be started after operations on those likely to develop embolism. Combined therapy with heparin and dicoumarin is advocated, heparin for the immediate effect and dicoumarin later.

CHAPTER VIII

Metabolic Disorders

DIABETIC COMA

The most important factor in diabetes is that diabetic coma may develop and kill the patient. Therefore, the greatest responsibilities of the physician are to safeguard the patient from coma and to save him if coma occurs. Although diabetic coma does not occur as frequently as formerly, it continues to be a significant factor in the treatment of diabetes. Diabetes is a common disease, usually benign, and it is often treated too lightly by the patients themselves and occasionally by the physician in charge. It has long been known as a disease of complications, and until some complication arises, the disease may be almost entirely overlooked since it may cause no distress.

Etiology: Diabetic coma is usually precipitated by (1) an excessive amount of food, and particularly the wrong kind of food, (2) interruption in the use of insulin or too little insulin, and (3) infections. Some diabetic patients deliberately break their diet and consume an excessive amount of carbohydrate food; if the insulin is omitted, coma is almost always the rule. The interruption of insulin is becoming a less common occurrence due to the campaign for education of these patients. One of the common reasons for the omission of insulin is the development of an upper respiratory infection or an acute digestive disturbance which interferes with the patient's eating the regular diet. Frequently, these patients believe that if they do not eat their regular portions of food, the insulin becomes unnecessary. They fail to realize that in case they do not take food by mouth, sugar is called up from the glycogen stores of the body and this glucose must be burned just the same as the glucose from ingested food. Of the three common conditions that precipitate coma, probably infections head the list. It is not necessary that the infection be a very severe one, for a simple type as acute tonsillitis, acute bronchitis, acute gastroenteritis, carbuncle, or boil, which may be a benign condition in a normal person, is serious in a diabetic. It interferes

with the metabolism of the body and disrupts the balance that the diabetic patient has maintained by exercise, diet, and insulin. Any infection must be looked upon as an important matter because it may produce coma in a diabetic.

Signs and Symptoms: One of the difficulties with diabetes is that it appears so gentle and innocuous. Yet it is a disease that is ready to strike when the proper moment arises and unless one is on the alert for its complications, including coma, the patient may lose his life. The development of diabetic coma is frequently rapid and its duration is sometimes difficult to fix. After coma sets in, the patient rarely lives more than a few days and death may take place within a few hours if treatment is not instituted immediately.

The signs and symptoms of diabetic coma have been, for convenience sake, divided into the precoma and coma phases. In the precoma stages, the patient has already begun to suffer from the symptoms of ketosis. It is important to recognize this promptly and to be on the lookout for the clinical features of acid intoxication, which, if left unchecked, produce diabetic coma. It is not enough for the physician to know these evidences of oncoming disaster; the patient must be educated so he too will realize the significance of the early signs and symptoms. They are as follows:

1. Excessive thirst.
2. Vomiting.
3. Headache, nausea, apathy and weakness.
4. A feeling of general malaise with aches and pains in the joints or abdomen.
5. Respiratory distress brought on by slight exertion which previously caused no difficulty.
6. A tendency for the patient to be tired, sleepy, restless or nervous.

Many of these symptoms may develop early in the stage of acid intoxication. The speed with which diabetic coma evolves depends on the severity of the metabolic disturbance which is present. The treatment is the most important factor.

The line of demarcation between the stage of precoma and coma is often difficult to draw. From the practical point of view, the treatment is almost essentially the same in both stages. Whenever a diabetic develops any one of the features mentioned above, the urine

should be carefully checked for sugar, acetone and diacetic acid. The test for diacetic acid is the most important of all and will be discussed under the heading of diagnosis.

The onset of coma is merged gradually with the precomatose symptoms. Vomiting, excessive thirst and somnolence going over into complete unconsciousness are the clinical evidences of coma. As coma becomes more firmly established, the clinical picture is more or less constant. One may say that diabetic coma is made up of two main syndromes, dehydration and ketosis. While both merge to produce a classical clinical picture of coma, the separation may be helpful from the standpoint of treatment.

1. The dehydration syndrome:
   a. The skin is dry and inelastic.
   b. The face is flushed and drawn, but fever is absent.
   c. The tongue and mouth are dry and coated.
   d. The pulse is weak and its volume reduced.
   e. The blood pressure is low, and the heart tones are rapid, distant, and weak.
   f. The eyeballs are soft and sunken back in the sockets.
   g. Oliguria and then anuria develop.
2. The components of the ketosis complex may be enumerated as follows:
   a. The breath has a peculiar fruity odor.
   b. Breathing is deep, though not necessarily rapid, and is known as the Kussmaul type.
   c. The urine contains large amounts of sugar, acetone, and diacetic acid.
   d. The blood sugar is elevated, though the degree of elevation as such is not an index of the severity of the diabetic coma.
   e. The carbon dioxide combining power of the blood drops down to 20 volumes per cent or lower at times.

Diagnosis: The differentiation between diabetic coma and other types of coma is usually easy if the urine is tested for sugar, diacetic acid and acetone. When there is any reason for doubt, a carbon dioxide combining power determination of the blood should be done; this is low in diabetic coma and not ordinarily changed in other kinds.

The commonest disorders that are confused with diabetic coma are:

1. Hypoglycemic reaction from insulin.
2. A cerebral accident in a patient who is also a diabetic.
3. An injury to the brain or skull by accident. If the history re-

TABLE I

	Diabetic Coma	*Insulin Reaction*	*Cerebral Accidents*
Onset	Slow	Rapid (few minutes)	Sudden
Food	Excessive	Too little	No influence
Insulin	Little or none	Excessive	None
Infection	Usually	None	None
History	Mild, if any	Absent as a rule	Arteriosclerotic or hypertensive after the accident
Pain in the abdomen	Frequent	Absent	May be pain in head
Vomiting	Common	Seldom	After the accident
Fever	Frequent	Absent	May be very high
Skin	Dry	Moist	Indifferent
Appearance	Very sick	Pale and weak	Typical features of hemiplegia
Respiration	Air hunger	Normal	Stertorous
Mental state	Unconscious	Delirious	Usually unconscious or nearly so
Urine	Sugar and diacetic acid	No sugar or diacetic acid, but occasionally present on first examination and absent on second	Sugar but no diacetic acid
Blood examination	Hyperglycemia	Hypoglycemia	Normal or slightly elevated
CO_2 combining power	Reduced to 20 volumes per cent or below	Normal	Normal

lates that the patient has had diabetes, and if there is a story of progressive thirst, vomiting, nausea, air hunger, and drowsiness, the diagnosis is simplified. It is always well to remember the rule that the urine should be examined a second time, particularly when the clinical picture and the urinalysis do not seem to fit one another. This is especially true when the problem of insulin reaction arises, because some sugar may be found in the first urine specimen, which in reality is a mixture of residual sugar-containing urine, giving one the false impression of a truly positive urinary sugar.

The table on page 128 may be used in the differentiation between diabetic coma, insulin reaction, and cerebral accident.

TREATMENT

The treatment of diabetic coma may be divided into (1) general, and (2) specific.

1. General:
   - *a.* Warmth is important. External heat is applied by equipping the bed with warm blankets in place of sheets. Electric pads, hot-water bottles, and irons are not used because of the danger of causing burns.
   - *b.* A catheter should be inserted and the bladder drained. The urine should be examined for sugar, acetone, and diacetic acid.
   - *c.* The patient must have a blood sugar determination done immediately, and it is well to ascertain the amount of nonprotein nitrogen and cholesterol in the blood at the same time. Probably the most important factor in the blood work is the determination of the carbon dioxide combining power.
   - *d.* Circulatory stimulants as coramine, 4 to 6 cc., or caffeine, 0.4 Gm. (6 grains), may be given intramuscularly and repeated every four to six hours if necessary.
2. The specific treatment must be aimed at treating the ketosis with large doses of insulin and administering an abundance of fluids to overcome dehydration.
   - *a.* Treatment of ketosis:
     - (1) Insulin: The amount of insulin to be given depends on the depth of coma when the patient arrives for treatment. From time to time various authorities have recommended different methods of determining and administering the insulin, but the chief thing to be remembered in any one form of treatment is that the amount of insulin should be large and the doses repeated every hour or two until acidosis is controlled. Protamine zinc insulin alone is

not the best method for managing patients in coma. Regular insulin should be given in addition to the protamine.

The patient's established dose of protamine zinc insulin should be administered subcutaneously at once; then 40 to 50 units of regular insulin should be given every two hours, the first dose intravenously and the subsequent injections subcutaneously, until the urine shows a decrease in the amount of sugar and a clearing away of acetone and diacetic acid. It may be wise, if possible, to follow the course of treatment with frequent blood sugar estimations. The urine may be examined frequently if one inserts a catheter and leaves it *in situ* while the patient is unconscious. Repeated blood samples may be used as a guide to treatment, especially if the urine specimens cannot be obtained.

In my experience coma has been controlled with about 200 to 250 units of insulin in 24 hours. Fowler, Benson, and Rabinowitz have treated patients by giving 100 units of regular insulin intravenously and 100 units of regular insulin and 200 units of protamine zinc insulin intramuscularly. They believe that these large doses are more effective in the treatment of diabetic coma than the intermittent administration of small doses.

b. Treatment of dehydration:

(1) Intravenous solutions of 1000 cc. of normal saline are indicated; 1000 cc. of saline may be given subcutaneously. These fluids should be given slowly and at slightly above body temperature. The intravenous injections particularly should be administered slowly. Within the first 24 hours one should aim at giving the patient in diabetic coma from 4000 to 6000 cc. of fluid. The response to the administration of fluids is shown by an increased yield of urine. If the patient in coma has been anuric and fails to have a diuresis after administration of fluid the outlook is bad. On the other hand, when diuresis sets in following fluid administration, the prognosis becomes very good.

(2) After a cleansing enema 1000 cc. of tap water may be given per rectum by drip method.

(3) When the blood sugar has dropped, the urine sugar has been reduced, and the patient begins to react favorably, fluid administration may be stopped and doses of insulin spread further and further apart.

(4) As soon as it is convenient the patient who has been brought out of coma should be placed on three or four regular feedings a day, with an appropriate dose of regular insulin accompanying each feeding until the amount of insulin required for controlling the patient is established.

HYPOGLYCEMIA AND HYPERINSULINISM

The terms "hypoglycemia" and "hyperinsulinism" are used interchangeably, but they do not denote exactly the same thing. Hypoglycemia is most commonly an effect of hyperinsulinism, but it may also be produced by other conditions as deficiency of the liver, cholera, and constitutional disorders as Addison's disease, hyperpituitarism, and hemochromatosis. Hyperinsulinism may be caused by hyperplasia, hypertrophy, adenoma, or carcinoma of the islands of Langerhans.

Etiology: The main causes of hypoglycemia are usually found in connection with some functional disturbance, including excess of insulin, endocrine disorders which affect the pituitary, thyroid and suprarenal glands, the central nervous system disorders which affect control of blood sugar, and liver diseases with glycogen deficiency.

Signs and Symptoms: The syndrome of hypoglycemia has become universally recognized. The typical picture is seen after an overdose of insulin is given. The clinical features depend upon the severity of the disease, and mild, moderate, or severe forms occur. In mild types, mental apathy or confusion, a change of personality, psychic exaltation or depression, irritability, and weakness may be the only symptoms. Usually the pulse rate rises, blood pressure increases, pupils dilate, and the patient breaks out in a cold sweat. As the disorder becomes aggravated, delirium, transient loss of consciousness, and visual disturbances may occur in addition to the above. Later on, convulsions, local or general, develop and a state of coma may terminate the clinical course.

Diagnosis: It is often difficult to recognize hypoglycemia in the mild form, but if a patient has lapses of memory, short periods of unconsciousness, excessive hunger which is relieved by food, a desire to sleep, and sweats profusely, the diagnosis should be suspected. Having the condition in mind, when a patient has a chain of symptoms which are hard to account for after the usual diseases have been considered, is half the diagnosis. Obtaining a sample of blood for sugar determination during the acute episode serves to clinch or abjure the diagnosis. Sugar tolerance tests are not very reliable, but if the blood sugar is below 40 mg. per cent during an attack and relief is obtained by the intravenous administration of glucose, the patient has hypoglycemia.

Mild stages of hypoglycemia may be mistaken for alcoholic intoxication, petit mal, hysteria, psychoses, encephalitis, or organic brain lesions. Severe cases are confused particularly with epilepsy (grand mal), hysteria, brain tumor, and sometimes with cerebral injury or hemorrhage. Before making a final diagnosis of hyperinsulinism, other disorders as carcinoma, cirrhosis or subacute atrophy of the liver, and diseases of the adrenals, pituitary, and thyroid must be eliminated. Genuine hyperinsulinism is usually caused by hypertrophy and hyperplasia of the islands of Langerhans and more rarely by carcinoma or adenoma of the islands.

Prognosis: Prognosis is usually favorable, though it depends on the cause. The tendency towards obesity in these cases is not a favorable factor.

TREATMENT

1. The treatment of hypoglycemia is dependent on the cause. If it is due to an adenoma or carcinoma of the islands, surgical exploration should be done and the adenomatous or carcinomatous tissue removed if possible. This usually results in a cure. If symptoms persist, there may be multiple tumors or malignant degeneration. Often an adenoma is too small to be palpated through the abdomen and as a result the area must be explored at operation.

2. Most cases of hypoglycemia are due to other causes which can be remedied by medical treatment.

a. Drugs as epinephrine, ½ to 1 cc. of 1:1000 solution, hypodermically may be used to stimulate the glycogenic breakdown in the liver and keep the blood sugar at a somewhat raised level.

b. The most important principle in treatment is a dietary regimen, with frequent feedings and the use of a high fat, medium carbohydrate, and low protein diet. For the middle-sized adult 180 Gm. of fat, 90 Gm. of carbohydrate, and 70 Gm. of protein may be given, divided into approximately six meals a day. The high fat intake slows the emptying time of the stomach and lets the carbohydrate into the system at a slower rate.

c. The patient suffering from an acute attack of hypoglycemia should be given 50 to 100 cc. of 25 or 50 per cent glucose intravenously. If the patient is conscious orange juice with or without sugar, dextrose, syrup, or dry sugar placed in the mouth will be of benefit. It is a good practice for these patients to carry lump sugar with them at all times so it may be taken when symptoms arise.

d. If the indication is present vitamins should be given freely.

TETANY

Tetany is a systemic disturbance, rather than a disease itself. It is due to abnormal inorganic salt metabolism as illustrated by a low serum calcium level and a high serum phosphorus level. Tetany is characterized by increased neuromuscular irritability.

Etiology: The two main causes of tetany are (1) hypocalcemia, and (2) alkalosis.

1. Hypocalcemia:
   a. Hypoparathyroidism is the most common cause in this group. It is most often noted about 24 hours after radical thyroid operation and it may last for days or years.
   b. Rickets or osteomalacia, inadequate calcium intake, steatorrhea, administration of alkaline phosphates, excessive excretion of calcium, and renal insufficiency with phosphorus retention also cause or lead to tetany.
2. Alkalosis:
   a. Hyperventilation usually due to an emotional disturbance most often causes alkalosis, resulting in tetany.
   b. Alkalosis may also ensue from ingestion of large amounts of alkali, persistent vomiting causing excessive loss of gastric contents, etc.

Signs and Symptoms: Clinically, one may distinguish between active and latent tetany. In the active type, there is tonic spasm of any muscle, in the glottis, and the extremities are affected bilaterally, often with generalized convulsions. The latent form is characterized by neuromuscular excitability, but symptoms may be very mild and diagnosis overlooked.

Three signs are usually present in tetany. Erb's sign is almost always constant and is the most positive clinical sign. Chvostek's and Trousseau's signs are also indicative of tetany. Other features of the condition are carpopedal spasm, laryngeal spasm, and epileptic seizures. All voluntary muscles may undergo clonic or tonic contractions.

The typical tonic muscular spasms of active tetany occur spontaneously. They are usually preceded by a tingling sensation, slight numbness, stiffness and difficulty in moving the extremities. The wrist and elbow are flexed, the hand stiff and arched, and the fingers rigid with the thumb covered by the fingers, which are usually bent only at the metacarpophalangeal joints. When the lower extremities

are affected, the heel is pulled up, the sole arched, and the leg extended. Involvement of the glottis is recognized from the noisy and difficult breathing. Convulsions may cause death in severe tetany. Cataracts and soft, decaying teeth are commonly associated with tetany.

Laboratory examination reveals a low serum calcium (7.5 mg. per cent or less as compared with the normal 10 mg. per cent), a high serum phosphorus (up to 10 mg. per cent or higher), and a prolonged clot retraction time. The normal calcium phosphorus ratio of 2:1 tends to be reversed.

Diagnosis is dependent on the clinical picture and laboratory findings.

Prognosis: Prognosis has become more cheerful with the advent of newer methods of treatment. When the cause is discovered and eliminated, and the proper acid-producing salt administered, tetany usually disappears. Tetany due to alkalosis and chronic tetany offer excellent prognoses.

TREATMENT

Raising the serum calcium level and a simple method of gauging this level are the two important points in treatment.

1. Dihydrotachesterol (AT-10), a photochemical derivative of ergosterol, fills the first need in most cases. Usually about 2 to 3 cc. are given orally per day until calcium appears in the urine, and then the dose is modified to a maintenance level of 1 cc. three to five times a week. Since this is a dangerous drug, it must be used only in conjunction with frequent laboratory tests.

2. In addition to AT-10, 2 to 4 Gm. (30 to 60 grains) of calcium salts should be given.

3. Parathyroid extract daily by intramuscular injection and calcium salts are usually given during the severe acute attack and this is later substituted by moderate doses of AT-10 and calcium salt. Parathyroid extract is effective, but patients often develop a tolerance to it, and injections must be given often.

4. Similarly, slow intravenous injections of calcium chloride, 10 to 20 cc. of a sterile five per cent solution, or calcium gluconate, 10 cc. of a 20 per cent solution, give immediate relief but must be repeated every hour.

5. A high calcium intake is best obtained through milk and calcium lactate or gluconate, 10 to 12 Gm. (150 to 180 grains) daily.

6. Vitamin D, as 5 to 10 cc. of cod-liver oil three times a day or 10 to 15 drops of viosterol three times a day, promotes calcium absorption. However, its action is slower than that of AT-10 and there is less excretion of phosphorus in the urine.

7. The Sulkowitch test gauges the level of calcium in the urine and should be used in connection with AT-10, which is a dangerous drug if not used carefully.

CHAPTER IX

Metabolic Disorders

(Continued)

HYPERTHYROIDISM

I. Acute Hyperthyroid Crisis

The symptoms referable to the cardiovascular system frequently occupy the center of the stage in a case of acute hyperthyroid crisis. The cardiac symptoms accompanying the hyperthyroidism may come on abruptly, take a rapid, stormy course, and terminate either fatally or in prompt recovery, depending to a large extent on the skillfulness manifested in the management of the case. More commonly, though, the cardiac symptoms of hyperthyroidism are of the chronic type, occurring in older individuals who have a long-standing adenomatous goiter with a low grade, often masked, hyperthyroidism. This chronic type comes on insidiously, runs a long, slow course, and terminates in auricular fibrillation with a long-standing chronic heart failure.

Signs and Symptoms: At this time, I am interested only in the acute phase that develops at times in younger people with so-called exophthalmic goiter or the acute stage following thyroidectomy. The cardiac manifestations of the thyroid crisis, which constitute one of the most serious features of this disease, are characterized by the following events:

1. The heart becomes extremely rapid and the blood pressure usually falls. However, sometimes the systolic pressure rises and only the diastolic phase decreases.
2. Auricular fibrillation may develop or the tachycardia may be of the sinoauricular type.
3. The heart may dilate and fail.
4. There may be systolic murmurs over the mitral and aortic areas.
5. Sometimes precordial distress, even anginal pain, is a feature of this stage of the disease.
6. Hepatic enlargement may develop, and edema of the ankles appear.

Other signs and symptoms of hyperthyroid crisis include nausea and vomiting, loss of appetite, marked weakness, weight loss, and sometimes fever and diarrhea. Postoperative crisis is usually ushered in with an unusual rise in temperature. A red, beefy tongue may be a warning of impending crisis in some cases.

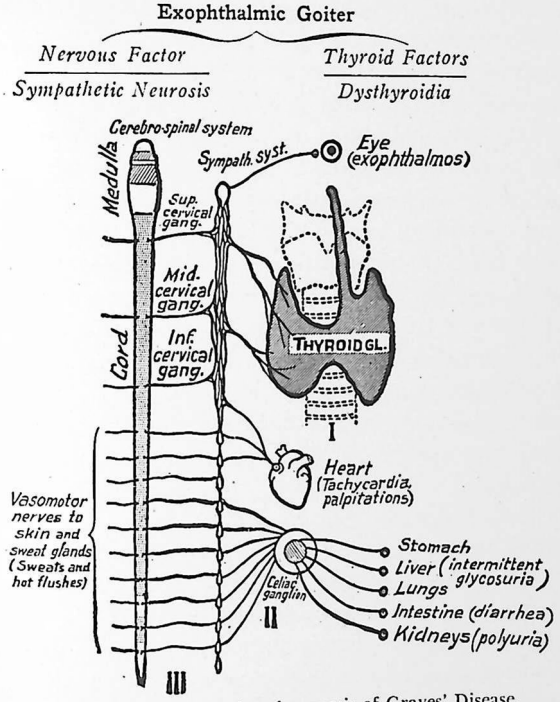


Fig. 1.—Symptoms and pathogenesis of Graves' Disease.

TREATMENT

Treatment of the Crisis: When symptoms of cardiovascular failure develop in the presence of acute hyperthyroidism, there is no time to be lost in instituting proper treatment. Usually it is not the heart alone that is affected, but there is also vascular collapse. What constitutes proper immediate treatment is a question that is answered in more ways than one. Some prefer immediate surgery; others are more conservative and believe that medical treatment alone should

be given a trial period. A course of preliminary treatment, regardless of the seriousness of the case, is the best policy.

The routine for managing such cases is as follows:

1. Ten drops of Lugol's solution may be given by mouth three times a day, or 2 to 4 Gm. (30 to 60 grains) sodium iodide intravenously in divided doses during the day. After the acute crisis is controlled, the dose of Lugol's solution may be decreased to 0.66 to 1 cc. (10 to 15 minims) daily.

2. The precordial area may be packed in ice to reduce the temperature. Another practice is to apply ice bags to the head, neck, and chest, two for each degree of temperature above 101° F.

3. Two to three thousand cubic centimeters of five per cent glucose solution may be given intravenously at the rate of about 5 cc. per minute. If edema occurs, sodium chloride intake should be reduced, but fluids should not be discontinued. Since the glucose is also an aid in combating liver failure, in some cases it may be necessary to increase the glucose concentration from time to time by adding 1 unit of insulin for each 2 Gm. (30 grains) of glucose to restore metabolic equilibrium.

4. Rest is important for the patient, and may be obtained by the use of morphine sulfate, 0.016 Gm. (¼ grain) hypodermically, sodium bromide, 1 Gm. (15 grains), or chloral hydrate, 1 Gm. (15 grains), or sodium amytal, 0.2 Gm. (3 grains), orally.

5. Digitalis appears to be contraindicated in these cases. Frequently it fails to slow the heart rate.

6. On the other hand, quinidine sulfate in 0.33 Gm. (5 grain) doses may be given every three or four hours for six or eight doses. Many physicians are afraid of quinidine, especially if auricular fibrillation is present, because it has been attended by fatal accidents. This risk, however, is not great, especially if the fibrillation or irregularity is of short duration. It must be granted, nevertheless, that quinidine has a depressant action on the heart muscle and when one is giving quinidine, the patient must be watched carefully so that additional strain is not added to the already overburdened heart. The dose is repeated every three hours because the action is of short duration, and the drug is excreted rapidly from the body.

Evidences requiring the discontinuance of quinidine therapy are buzzing in the ears and deafness, increase in the irregularity of the

heart or heart rate, nausea, vomiting, faintness or dizziness. If the desired results have not been obtained after 2.66 Gm. (40 grains) of quinidine has been administered, it is useless to continue the drug.

Prognosis: The prognosis in regard to the heart in acute thyroid crisis depends on the condition of the heart before the crisis sets in and on the age and condition of the patient in general. In younger people whose hearts were in normal condition before the onset of crisis, the chances of complete recovery are very good. On the other hand, if the individual is older and has suffered from chronic cardiac ailments, the additional insult of acute thyroid crisis, either before or after operation, is often more than the heart can withstand.

The treatment outlined above may be used for acute episodes of hyperthyroidism either before or after operation. Needless to say, when the heart has been sufficiently controlled by therapy, thyroidectomy should be performed as soon as possible.

Preoperative Treatment: The most important features in preparing a patient for operation are:

1. *Administration of Iodine.* Since Plummer first began the routine use of Lugol's solution in preparing a patient for thyroidectomy, this procedure has become a standard routine. Lugol's solution is given in doses of 0.33 to 0.66 cc. (5 to 10 minims) three times a day. It is difficult to determine just how long this should be continued, but about two weeks is the usual time. The basal metabolic rate may be used as a guide for the time of operation, but the clinical condition of the patient is more important. Usually the basal metabolic rate is reduced to its lowest level in about ten days, and operation may be done within the next seven or eight days. The psychic condition of the patient, the pulse rate, respiratory rate, and gain in weight are important identification marks of control of the toxicity.

2. *Diet.* The diet should be rich in carbohydrate and 4000 to 5000 Calories a day should be given. Not only must the carbohydrate content of the diet be kept at a high level, but the quantity of protein too must be elevated because of the demands upon the protein stores of the body. Vitamins, especially B, administered orally and parenterally should be employed. Hydration must be kept in mind, and it is better to keep the intake of fluid at a high level a few weeks before operation than to have to administer large volumes intravenously after operation. The risk of the operation is considered

less if the patient is well hydrated and has begun to gain weight before thyroidectomy is attempted.

3. *Rest.* Formerly it was thought best to keep the patients absolutely quiet for a period of two weeks before the operation. However, the best results are obtained today by allowing these patients, providing the heart condition permits, to be up and around the home or hospital every day in order to keep the muscle tone of the body at a proper level. Patients may be kept in bed for part of the day, but absolute bed rest is not a good way to prepare them for operation.

We have spent too much time in the past keeping a patient in bed and overlooking the more important psychic outlook of the patient. A cheerful attitude should be maintained by all those attending a patient being prepared for operation. This is true of any operation, but it is especially true for a patient who is highly unstrung from a long siege of hyperthyroidism. The physician in charge should see that the patient is not disturbed by psychic shocks such as was witnessed in a patient a short time ago. The patient was being prepared with more than average care and had a graduate nurse in attendance to see that all the details of treatment were rigidly carried out. On visiting the patient a few days before operation was scheduled, the writer found the room darkened and the nurse and patient listening to a program of hymns coming over the radio in the midafternoon. The patient was unusually depressed, and closer observation revealed a tear or two flowing out of the corners of the eyes. The tune being played on the radio was, "Oh Lord, Lead Me Gently Home." Protection of a patient from such sad thoughts is an important part of preparation for operation. Psychic, as well as somatic, rest should be insisted upon.

4. *Other Medications:*

   a. Phenobarbital, 0.1 Gm. (1½ grains), two or three times a day is usually well tolerated and does a great deal of good.

   b. Digitalis in doses of 0.1 Gm. (1½ grains) three times a day may be of value if auricular fibrillation and heart failure are present.

   c. If auricular fibrillation alone exists quinidine, 0.33 Gm. (5 grains), every four hours is probably better than digitalis.

   It is best to administer these drugs preoperatively rather than postoperatively, because of the danger of embolism which may follow the initial doses.

5. X-ray treatment of the thyroid gland has been recommended by some as a preoperative measure, especially in cases of unusual severity. If x-ray treatment is given, a period of several weeks should elapse before operation because of the condition of the tissue about the neck.

6. It has been known for a long time that it is dangerous to operate upon a patient who has an upper respiratory infection. It is well to emphasize here that no attempt should be made to remove any focus of infection in a patient with hyperthyroidism. More than one patient has been seen by the writer, one a physician's wife and another a physician, who, regardless of advice to the contrary, had teeth extracted in an attempt to control an active thyroidism. The result was death in the dentist's office in one case, and death within 12 hours after extraction in the other.

Postoperative Treatment: 1. If the patient has been adequately prepared and the operation is skillfully done, the postoperative management is a matter of watching the patient recover. One must always be on guard against upper respiratory infection, bleeding, and an unexpected hyperthyroid crisis. Crisis after operation may be due to continued secretion of toxic thyroid elements into the blood stream from the remaining part of the gland or to careless manipulation of the gland by the surgeon during operation, thus forcing excess secretion into the circulation. If crisis occurs, two things must be done:

a. Three to four thousand cubic centimeters of five per cent glucose in physiological saline solution must be given intravenously at the rate of 5 to 10 cc. per minute.

b. 0.06 Gm. (1 grain) of potassium iodide may be given intravenously and 4 Gm. (1 dram) of Lugol's solution by rectum twice a day for several days.

c. Oxygen too is usually of considerable benefit in these cases.

2. The patient should be given a highly nutritious diet after the first 24 hours.

3. Careful attention must be given to the condition of the atmosphere of the sickroom. Draughts or dry air are apt to pave the way for an upper respiratory infection which is a disagreeable and dangerous complication. Furthermore, anyone with an upper respiratory infection of any kind must be prohibited from the room.

4. The patient may be allowed out of bed about three days after thyroidectomy, as the moving around does not interfere with the healing of the wound in the neck.

5. *Treatment Afterward:* Many physicians believe that after the operation is performed, the disease has been completely cured, but this is not true. The treatment after the first month or two postoperatively is quite important. The patient must be watched for several important complications as

a. Hypothyroidism may gradually set in any time from a few months to a few years after thyroidectomy. Frequently this insidious hypothyroidism is not recognized until a glaring myxedema develops. This can be controlled, of course, by a few grains of thyroid substance every day.

b. Following operation a patient may develop evidences of hypoparathyroidism, which results from injury to the parathyroids at the time of operation. This may be controlled by calcium, parathyroid substance, or dihydrotachysterol.

c. If the patient has had a long-standing hyperthyroidism before operation the danger of chronic heart disease must be kept in mind, and it is wise to make careful examination of the cardiovascular system at frequent intervals for at least a few years after operation.

HYPOPARATHYROID CRISIS

Hypoparathyroidism occurs as a result of the accidental removal of the parathyroid bodies during thyroidectomy, or it may be due to fibrosis, atrophy or cystic degeneration of the parathyroid system. The lack of proper parathyroid hormone supply results in: (a) A fall in the blood calcium; (b) decrease of excretion of calcium in the urine, and (c) a rise in the plasma phosphorus. There are no changes in the bones as a result of the disturbance in calcium metabolism.

Signs and Symptoms: The main clinical evidences of parathyroid deficiency are tetany and symmetrical tonicity, muscular spasms or psychic disturbances bordering on hysteria. Restlessness, mental irritability, and depression may be present, and at times outright psychoses may develop.

Muscular pain, spasms, contractions, and hysterical attacks are particularly associated with parathyroid deficiency. When such a chain of events occurs following thyroidectomy, hypoparathyroidism should be thought of. However, this syndrome may develop 20 years

after operation. The serum calcium is well below normal, that is, below 8 mg. per cent. The serum phosphates are commonly elevated above the usual 2½ to 4 mg. per cent, and sometimes rise to 8 or 10 mg. per cent. Unless the hypoparathyroidism is corrected, the patient becomes progressively weaker and passes from one convulsion into another and finally dies of exhaustion or respiratory paralysis.

Diagnosis: If hypoparathyroid tetany is suspected, the diagnosis is easily clinched by a study of the serum calcium. The characteristic contractures of the hands, so-called obstetric position, phalanges flexed with the middle and the distal contracted down into the palm of the hand present a typical picture. The face muscles may be involved, but more frequently they may escape the contractions. These contractures may persist for a few moments or a few hours or they may continue for weeks, coming and going at frequent intervals. The patient may present no particular complaint between paroxysms except extreme exhaustion and sometimes faintness, especially when he attempts to walk. The heart rate may be considerably increased, and the electrocardiogram is characteristic in many cases. It is featured by an abnormally prolonged S-T period, in some cases as prolonged as 0.40 second.

Hysteria is one condition which is apt to give great difficulty in differential diagnosis. However, remembrance of the fact that the calcium and phosphorus metabolism is disturbed nearly always leads to the proper diagnosis.

The diagnosis of tetany in its latent form may be made by:

1. Demonstration of hyperirritability by testing for Chvostek's or Trousseau's sign.
2. Demonstration of electrical hyperirritability by electrical stimuli (Erb's phenomenon).
3. Chemical changes in the blood—low calcium and high phosphorus.
4. Striking electrocardiographic changes, especially an S-T period of 0.40 second.

TREATMENT

Parathyroid tetany may be either acute or chronic. The patient with the chronic type may live comfortably for many years.

When a patient develops the disturbances of calcium metabolism that go with a deficient parathyroid hormone, it is advisable to

attempt to restore the calcium balance by the simplest measures possible, for example, the administration of large doses of calcium lactate, a low phosphorus diet, and vitamin D in fairly large amounts. The specific parathyroid extract is a treatment to be used more in the acute or critical stages rather than for the continuous management of the case. Sometimes it is impossible to maintain the patient's calcium level without the use of the parathyroid substance. In these cases, every measure must be undertaken to keep the patient in as normal a condition as possible. Most patients, especially younger individuals, may be maintained in comparatively good health for many years by simple therapeutic measures. I must emphasize, however, that there are patients, especially among the older group, who occasionally become refractory to parathyroid substance after a comparatively short period of time. In spite of all therapeutic measures, these patients become worse and finally die in a state of exhaustion, and no present-day method of treatment is capable of controlling the disastrous outcome.

The following treatment is effective in most cases:

1. Large doses of calcium lactate, approximately 2 Gm. (30 grains), should be dissolved in water and administered orally every four hours.

2. The intake of phosphorus in the diet should be strictly limited. This is accomplished by withdrawing to a large extent the meat and eggs from the diet.

3. Ammonium chloride in doses of 3.3 Gm. (50 grains) three times a day liberates calcium from the stores in the body and helps control the tetany.

4. In severe cases, intravenous calcium may be given, as 20 cc. of 10 per cent calcium gluconate, two or three times a day.

5. Vitamin D is given to promote calcium absorption. Large doses are necessary, as 5 to 10 cc. of cod-liver oil three times a day or viosterol, 10 to 15 drops three times a day.

5. Parathyroid extract may be given in doses of 0.006 Gm. (1/10 grain) three times a day. In severe cases parathormone may be injected hypodermically, using from 25 to 50 units every day.

6. Dihydrotachysterol (AT-10) has been used effectively. It simulates parathyroid extract in its action. The dose recommended is about 1 cc. a day. Calcium lactate or calcium gluconate, 2 to 4 Gm.

(30 to 60 grains) four times a day, should be given by mouth in conjunction with this substance. AT-10 should be used only after parathyroid and calcium therapy, diet regulation, and other measures have failed to control the tetany, and the patient should be under close observation while it is employed.

ADDISON'S CRISIS

Addison's disease is a chronic disorder of the adrenal glands, characterized by periods of crisis and remission. In the long course of the average case of Addison's disease, episodes of acute adrenal insufficiency develop at times with explosive suddenness; the reason for these remains a mystery. During the period of remission, the degree of adrenal insufficiency is variable; sometimes it is little and sometimes it is considerable.

As this chapter is concerned with the acute episode, only the phases of Addison's disease which participate in the picture of the crisis will be considered. In the course of Addison's disease, the acute episodes of adrenal insufficiency, known as Addison's crisis, are associated with loss of sodium attended by dehydration, an increase in the potassium of the blood, retention of nonprotein nitrogen, phosphates, sulfates, and other substances that occur in cases of renal failure.

Etiology and Pathology: Although the exact cause of the acute adrenal insufficiency is not known, many factors may help precipitate the acute phase. Physical exhaustion, upper respiratory infection, and trauma, psychic or somatic, are prominent complications that may bring on the crisis.

The crisis is not apparently dependent upon any marked change in the pathological lesion in the adrenal gland. When the critical phase has passed and remission sets in, the clinical features which prevailed before the crisis are reëstablished. Acute hemorrhage in the adrenal gland, commonly known as adrenal apoplexy, produces acute adrenal insufficiency such as that seen in Addison's crisis.

Signs and Symptoms: The clinical features of acute adrenal insufficiency (crisis) may vary as to the mode of onset and progression of the disease, but fundamentally the clinical picture is quite characteristic. The onset is usually abrupt but it may be insidious. It may follow trauma or infection of any kind, or it may come on inde-

pendently. Abdominal pain may usher in the episode, or vomiting, headache, and lassitude may be the initial symptoms. Convulsion followed by coma may occur. The blood pressure, which is usually low in Addison's disease, drops still lower and there is peripheral vascular collapse.

The appearance of the patient is important in the diagnosis. There is a grayish pallor and the skin is cold and clammy. The pulse is feeble or the patient may be pulseless. The lassitude and weakness are so pronounced that the examining physician can see in a moment the patient's state of extreme helplessness.

Differential Diagnosis: This clinical picture may be produced by other diseases associated with shock, and confusion in the diagnosis may occur unless certain fundamentals in the differential diagnosis are kept in mind.

1. The knowledge that the patient had Addison's disease naturally would be of diagnostic importance.

2. A generalized bronzing of the skin with excessive pigmentation in the armpits and groin associated with areas of deep pigmentation on the buccal membrane is significant. Observations of crops of black pigmented freckles may make one think of Addison's disease.

3. The blood sugar is apt to be abnormally low.

4. The blood nonprotein nitrogen is usually abnormally high.

5. The blood sodium chloride usually is below the normal of 420 mg. per cent, and may be as low as 300 mg. per cent.

6. There is a decided elevation of the blood potassium.

7. A remarkably low blood pressure, as low as 80 mm. Hg or less, may be noted.

8. A slight degree of eosinophilia may be found.

TREATMENT

Unless treatment is instituted promptly and is adequate in nature, the patient usually dies. Adequate and prompt treatment, however, saves most patients in crisis. The treatment may be outlined as follows:

1. Specific treatment:
   a. Normal salt solution with ten per cent glucose, 3000 to 4000 cc., must be given intravenously in the first 24 hours.
   b. Adrenal cortical substance, 20 to 50 cc., must be given intravenously at once. In a desperate situation like this there is no point in giving

small doses of the specific hormone, since an overdose will do no harm, while an underdose may be responsible for the patient's death. Then 10 to 20 cc. of this substance should be given twice a day intramuscularly or intravenously, depending upon the urgency of the case. Subsequently smaller doses, as 5 cc. every second or third day, may be sufficient to carry the patient along, but this dose must be judged by individual needs rather than by any rule of the thumb.

c. Desoxycorticosterone acetate has been recommended and used recently as a substitute for the hormone of adrenal cortex. It has been found that 1 mg. (1/60 grain) of this synthetic substance has the equivalent effect of 4 cc. of the genuine extract. There is considerable difference of opinion concerning the efficacy of desoxycorticosterone acetate compared with that of adrenal cortical substance; some say it is more effective and others believe it is less effective. Undoubtedly future experience will show that some synthetic preparation of this kind will be used almost exclusively because of the expense of the genuine hormone.

2. General therapy:

a. Sodium chloride, 15 to 20 Gm. (225 to 300 grains), in a liter of water must be administered orally to the patient daily, since the outpouring of sodium chloride from the tissues during crisis must be replaced.

b. Intravenous glucose solution, 2000 to 3000 cc. of five per cent glucose in physiological saline, must be given every day as the blood sugar is low. The hypoglycemia is a common condition in Addison's crisis and is often responsible for some of the shock symptoms noted.

c. The patient must be kept warm and as comfortable as possible.

d. All physical exertion must be avoided as well as psychic exertion and agitation.

e. Purgations should be avoided.

f. Infections must be prevented because simple infections that are not very damaging to a normal patient are apt to end disastrously for the patient with adrenal insufficiency.

g. The diet should contain large amounts of carbohydrates as orange juice, lemon juice, and tomato juice, while foods high in potassium as potatoes, fish, and meat should be limited.

h. Because the restricted diet of a low potassium nature may be deficient in such things as iron and protective vitamins, it is well to give 0.6 or 1 Gm. (10 or 15 grains) of a potent iron preparation two or three times a day along with vitamins A, B, C, and D.

NIGHT BLINDNESS DUE TO A VITAMIN A DEFICIENCY

Night blindness is a condition of the eyes in which vision is adequate with good illumination, but deficient in a dimmer light. There is impairment of the scotopic mechanism, so that the eye can-

not adapt itself readily to light change and is insensitive to dark. It is not really a substantive disease, but is a symptom of various conditions, among them congenital defects, Oguchi's disease, pathological changes of the liver, overexposure to light, or malnutrition. This discussion will include only the type of night blindness due to vitamin A deficiency in the body.

Etiology: This condition is brought on by lack of vitamin A in the diet, or an inability of the body to assimilate vitamin A from the diet. It occurs commonly during famine, in prisons, poorhouses, and armies, when eating standards are subnormal.

The clinical picture shows as a main feature impairment of the scotopic mechanism. This disorder occurs whenever the rods are prevented from participating adequately in the visual process.

Symptoms and Findings: The chief symptom is inability to see in the dark. This defect in dark adaptation may take various forms: The light threshold may be normal with little or no increase in sensitivity as adaptation progresses, or the light threshold may be high with subsequent adaptation absent or subnormal. Red light causes the least disturbance according to most authors, but Best concluded that long-waved light caused the greatest disturbances.

The sensitivity of the retina to light changes is also affected. Purkinje's phenomenon develops slowly or is reversed and the photochromatic interval is shortened or absent. Purkinje's afterimage is not observed. It has been thought that color vision might be affected, as some cases have been reported to have some blue blindness.

If the condition is chronic, other degenerative changes may follow, for instance, xerophthalmia, keratomalacia, or conjunctival pigmentation. Lack of vitamin A may contribute to myopia, or cause blindness by constriction of the optic nerve associated with stenosis of the optic canal.

Prognosis: The prognosis is good in the type of night blindness caused by vitamin A deficiency, unless the condition has been present long enough to cause serious degeneration.

TREATMENT

Most cases will be cleared up by eating a diet adequate in vitamin A. Cure is hastened by the exclusion of light or the wearing of dark glasses. A diet high in vitamin A should include plenty of butter, cream, eggs, carrots, and cod-liver oil.

ACIDOSIS

Acidosis is a condition in which there is a reduction of the alkaline reserve of the blood below the normal level, and an increase in the pulmonary ventilation.

Etiology: Under usual conditions of activity and food intake, the acid waste products of metabolism exceed the basic. This contingency is combated by: (1) The buffer quality of the blood which maintains a consistent reaction chiefly by combining the acid radicals with the base of the bicarbonate and driving off the liberated carbon dioxide through the lungs; (2) the excretion by the kidney of a urine more acid than blood; (3) the utilization of ammonia combined with acid radicals to be eliminated as neutral salts. When the removal of base occurs through the intake or production of acid in excess of the capacity of the regulatory mechanism, acidosis follows. The commonest cause is the excessive production of betahydroxybutyric and aceto-acetic acids by faulty fat and protein metabolism. Less frequently other organic acids may be produced in amounts sufficient to cause acidosis. The retention of acid radicals may arise because of derangement of regulatory mechanisms. Disease of the kidney may cause retention of phosphoric acid, sulfuric acid, and possibly others, and a reduced capacity to utilize ammonia in the excretion of acid radicals. Removal of base through severe diarrhea may cause acidosis, particularly in children. The commonest specific causes of acidosis are uncontrolled diabetes mellitus, cyclic vomiting of childhood, the terminal stages of chronic nephritis, and, less frequently, acute nephritis, Asiatic cholera, starvation, and dehydration.

Signs and Symptoms: Only marked acidosis is recognized clinically. Headache, weakness, drowsiness, and eventually hyperpnea appear. Nausea, vomiting, abdominal cramps, and pain in the extremities are further signs. A characteristic fruity odor appears on the breath due to the excessive production of ketone acids. The skin and mucous membranes become dry. Unconsciousness eventually supervenes.

Laboratory Aids: The simplest determination of the presence of acidosis is the examination of the urine for the presence of acetone and diacetic acid. The test for acetone may easily be performed by putting 5 to 10 cc. of urine in a test tube, adding a few drops of strong sodium nitroprusside and glacial acetic acid, then overlaying the solu-

tion with ammonia water. If acetone is present a purple color, in direct proportion to the amount of acetone in the urine, appears between the two layers. The test for diacetic acid is made by putting 5 to 10 cc. of urine in a test tube and then adding a ten per cent or stronger solution of ferric chloride slowly. At first a white precipitate of phosphates is formed; more ferric chloride should be added until this dissolves, when the resultant color may be noted. The presence of a burgundy or mahogany red color indicates the presence of diacetic acid. The intensity of the color is of some value in indicating the amount of acid present.

The most reliable test is the determination of the carbon dioxide combining power of the plasma according to the method of Van Slyke. The normal range is from 45 to 60 volumes per cent. The range between 30 and 40 volumes per cent is important because it represents the stage immediately before clinical symptoms appear and is the period when wise therapy may prevent a more serious condition. Coma usually supervenes when the Van Slyke index is between 10 and 20 volumes per cent. A level of 10 is critical.

Prognosis: Acidosis is an abnormal physiological state which may appear in a variety of pathological conditions and is not a disease entity in itself. The prognosis depends principally on the underlying cause. It should be guarded in any case with clinical manifestations. The prognosis becomes especially poor if the urinary output is decreased or if anuria develops.

TREATMENT

1. The patient should be kept warm with blankets or hot water bottles.

2. In nearly all conditions in which acidosis develops in severe forms, there is a depletion of water and base in the body. Rational therapy therefore requires quick restoration of the acid base balance and of the water balance. Large amounts of fluid are often necessary and should be given parenterally if they cannot be taken in sufficient quantities by mouth. In uncomplicated cases of acidosis in coma with a plasma carbon dioxide combining power of 20 volumes per cent or lower, the intravenous injection of 2500 cc. of solution, made up of 2000 cc. of one per cent salt solution to which is added 25 Gm. of soda bicarbonate dissolved in 500 cc. of distilled water should be

given without delay. Thereafter, 1000 cc. of five per cent glucose in one per cent salt solution should be given intravenously every three hours until the condition is improved, that is, until the patient is out of coma, there has been a rise in the plasma carbon dioxide and blood pressure, and he is able to take fluids by mouth. When the acidosis is less severe, soda bicarbonate solution may not be necessary. The venous pressure is the best guide to the propriety of continuing intravenous saline solutions in large amounts. A venous pressure which increases as a result of the infusion is a danger signal. Sodium bicarbonate may also be given in doses of 2 to 3 Gm. (30 to 45 grains) orally, three times daily.

3. Blood transfusions have been recommended for states of acidosis when there is no diuresis within three hours following the first infusion of fluids and the blood pressure remains low.

4. Enemata should be used as indicated for adequate cleansing of the bowel.

5. The urine should be checked frequently for evidence of disappearance of the acetone and diacetic acid.

6. If the acidosis has been induced by uncontrolled diabetes, insulin must be given in large quantities and should be used also to cover whatever amounts of glucose are given. Patients in severe diabetic acidosis often require between 400 and 500 units of regular insulin for adequate control in the first 24 hours. There is no medical emergency where hour-to-hour watching in meeting the occasions as they arise is more important than in severe diabetic acidosis.

ALKALOSIS

Alkalosis is a clinical condition in which the bicarbonate of the blood rises above the normal level or in which there is an abnormal increase in the *p*H of the blood owing to loss of carbonic acid.

Etiology: Ingestion of alkali in amounts which cannot be eliminated by the kidney or bowel at a rate to prevent accumulation in the blood results in alkalosis. Loss of the acid chlorine radical in excessive amounts, as by prolonged vomiting, causes the sodium thus released to combine with carbon dioxide and thereby to increase the bicarbonate in the blood. Carbon dioxide may be lost from the blood by hyperventilation and thus reduce the acid in proportion to bicarbonate. Administration of alkali in the treatment of peptic ulcer or

in combating acidosis at times causes alkalosis. Deaths have been reported following the administration of large quantities of alkali to patients with chronic nephritis. Patients with diabetic acidosis are reported to have developed definite alkalosis after having received sodium bicarbonate in large amounts.

Signs and Symptoms: Mild grades of alkalosis seldom produce symptoms. Increase in the severity of the condition causes restlessness, increased irritability, and excitability. There is decreased pulmonary ventilation at first in volume and then in rate until respirations may be reduced to five to ten per minute. This decreased respiratory function leads to an elevation of carbon dioxide percentage in the alveolar air, but at the same time there is a reduction in the oxygen partial pressure and in extreme instances cyanosis will result.

Tetany may supervene. Erb's sign is the most reliable clinical manifestation of tetany. With the stimulating electrode over the motor nerve, there is a muscular response to far weaker stimuli than the minimal effective stimulus needed in normal individuals. The Chvostek sign is easy to elicit. It is a twitch of the innervated muscles following gentle tapping over the facial nerve at its exit from the stylomastoid foramen anterior to the external auditory meatus. Trousseau's sign, also characteristic, is the ability to precipitate a typical paroxysm of tetany by temporary compression of an extremity, either over a principal nerve trunk or more easily by occluding the arterial blood supply to the extremity. The typical tonic muscular contractions of tetany come spontaneously. The hand becomes stiff and the fingers rigid. The thumb is markedly adducted and partially covered by the stiff fingers which are usually bent only at their metacarpophalangeal joints. The palm of the hand is hollowed while the wrist and elbow are flexed. In the lower limbs, the toes are flexed and the sole becomes arched like the hand. The heel is pulled up and the rest of the leg is fully extended. The muscles all feel very tightly contracted. Any muscles may be involved and especially those of the face, eyes, tongue and larynx. Smooth muscle may also be involved through effect on the sympathetic nervous system. Consciousness usually remains unimpaired, but the spasm may become so severe that breathing is not possible. The contractions after a short time become painful and are described by the

patient as cramps; in severe tetany they may last for minutes or hours.

Laboratory Aids:

1. There is an increase in the carbon dioxide combining power of the plasma.
2. The urine usually becomes alkaline but ketonuria may be present.
3. The blood becomes concentrated through loss of water to the tissues.
4. Return flow to the heart is decreased and cardiac output falls.

TREATMENT

Correction of the disturbed acid base balance and of dehydration, when present, is necessary. Treatment will vary with the underlying condition producing the alkalosis.

1. Alkaline therapy should be discontinued.
2. Forcing fluids by mouth will facilitate the excretion of the excess alkali in the blood. Ammonium or calcium chloride in doses of 1 Gm. (15 grains), three times a day, may be given by mouth, and weak hydrochloric acid 0.66 cc. (10 minims) in a glass of water may be given three times a day.
3. Dehydration and loss of chlorides by vomiting may be corrected by the intravenous injection of 1000 cc. of one per cent sodium chloride solution, repeated every three hours as long as necessary.
4. Overventilation may be relieved by rebreathing of five per cent carbon dioxide-oxygen mixture.
5. If the condition has reached the stage of tetany, calcium gluconate, 10 cc. of 20 per cent solution, may be given intramuscularly or intravenously for immediate relief, or 500 to 1000 cc. of one per cent saline solution, repeated within an hour if necessary, will usually control the situation.

CAISSON DISEASE

Caisson disease is a metabolic malady produced in individuals who, after breathing air under greater than normal atmospheric pressure, are subjected to rapid reduction of air pressure. With the increase in the use of compressed air for deep water diving, and in pier and tunnel construction, the appearance of this disease became

more frequent. In the past it has caused permanent disability or death in many instances.

Etiology: The disease is caused by nitrogen gas. With a sudden change from greater than normal atmospheric pressure to normal pressure, the dissolved nitrogen gas in the blood and body tissues evolves in the form of bubbles which produce blocking of the circulation and tearing of tissues. The reason nitrogen is thus evolved is that it is inert and not utilized by the body, as opposed to oxygen, which is readily metabolized and chemically active. Nitrogen gas emboli have been said to be partly responsible for the phenomenon.

Secondary conditions such as age, systemic disease, obesity, alcoholism, and fatigue predispose an individual to caisson disease. Obese men should not work under raised air pressures because of the great solubility of nitrogen in fat. Acute upper respiratory infections should disqualify men for compressed air labor because such infection frequently involves the eustachian tubes and ostia of the sinuses. On entering the compressed air chamber, the ear drum is stretched, with resultant severe pain known as "ear block." Failure of the eustachian tubes to open and equalize the pressure on either side of the tympanic membrane may mean rupture of the tympanum and infection of the middle ear. Infection of the mucous membrane of the ostia of the sinus causes edema, and the formation of a valve-like action which allows air to enter the sinus but not to escape. Air becomes trapped in the sinus under pressure causing "sinus block."

Pathology: Fatal cases have been separated into a rapidly fatal and a delayed fatal group. In the former, death has been thought to be caused by nitrogen emboli in the vital centers of the brain, in the coronary vessels and in the pulmonary arteries. In the group of delayed deaths, fatalities are supposedly caused by secondary complications following neurologic manifestations of the disease. The significant pathological changes in the group of delayed deaths are found in the spinal cord. The lumbar and thoracic cords show areas of necrosis and softening with degeneration and destruction of the fibers.

Symptoms and Findings: The onset is relatively rapid. The symptoms in 60 per cent of cases appear within the first hour after release from the abnormally high pressure, in 30 per cent of cases

in the second hour, and in five per cent within three hours or more. The outstanding symptom of the disease is pain, which varies in intensity according to the site of the bubble formation and the amount of gas released from the tissues. It may therefore, be mild and transient, or severe and prolonged. The location of the pain may be in the legs, unilaterally or bilaterally, usually about the knees and ankles, or in the arms or abdomen. The abdominal pain may be of such severity that collapse and prostration occur. It is often accompanied by signs of circulatory failure in which the distress is so severe that the patient often bends over to secure relief; for this reason the disease has become popularly known as the "bends." Pain in the extremities may radiate along the course of a peripheral nerve. The appearance of mottled areas of subcutaneous hemorrhage further suggests the presence of free gas in the blood. This mottling is a prodromal sign of coma and collapse.

The second most common symptom is vertigo, known to the workers as the "staggers." The symptoms resemble those of Ménière's syndrome. Vertigo may be so severe as to be accompanied by staggering, nausea, or nystagmus and tinnitus. A worker seen in this condition resembles a man under the influence of an excess of alcohol; he may be thought to be an alcoholic and treated as such, unless his identification is seen. Vertigo and its accompaniments are thought to be caused by the evolution of nitrogen bubbles in the labyrinth, cochlea, and semicircular canals.

Dyspnea is characteristic of another group of patients. Compressed air workers with this symptom resemble asthmatic patients, or those suffering from sudden left ventricular failure. Physical examination reveals bilateral, medium and fine moist and musical râles.

There may be cutaneous manifestations known as the "itch." Erythema, mottling, and pruritus are seen. Pruritus is intense. Cutaneous signs are usually early manifestations of compressed air sickness and signify possible ensuing symptoms of great severity.

Many patients develop neurologic manifestations which are serious, as they may result in permanent damage to the central nervous system if not promptly treated. Nerve tissue is vulnerable to ischemia and pressure from nitrogen bubbles. These nitrogen bubble formations can occur in any part of the brain or spinal cord. The nervous

disorder produced may simulate the signs of any other disease or injury of the brain or spinal cord. There may be collapse and complete unconsciousness, or simply numbness and tingling of the extremities. Paralysis of the bladder and bowels is common in spinal cord cases. Permanent weakness of the lower limbs may result. Hemiplegia, monoplegia, strabismus, nystagmus, diplopia, paresis, and sensory disturbances have been said to follow the disease, as well as bone necrosis and chronic arthritis.

Prognosis: The mortality of caisson disease has dropped to a low figure because of the efficiency of the recompression treatment. In cases of sudden collapse and unconsciousness the prognosis is graver than in those presenting only pain in the extremities. Where paralysis is present, cure is difficult and advice as to the outcome should be guarded.

TREATMENT

1. **Prophylaxis:** There is no immunity to caisson disease. The most important step in prevention is the physical examination with special emphasis on the lungs, circulatory system and cardiac reserve. Age, weight, and habits should not be overlooked. A man who shows symptoms of the disease after one or two trial tests should be rejected from this type of work, though repeated mild attacks of pain and itching should be no cause for rejection.

The ultimate prevention of the disease depends on the proper elimination of nitrogen from the tissues during decompression. Nitrogen must be eliminated through the lungs by the circulation. The value of exercise during the decompression stage to stimulate circulation should be stressed. The necessity of slow decompression should also be kept in mind. The working time under pressure should always be held within safe limits with adequate rest periods between shifts. The inhalation of oxygen and oxygen-helium mixtures during the decompression period to hasten the release of nitrogen is beneficial. Sudden changes in temperature should be avoided.

2. **Active Treatment:** The essential treatment of a patient with active symptoms of caisson disease is return to the compressed air chamber. In the past, men who were seized with an attack voluntarily returned to the compression chamber for the relief of their symptoms.

Today this treatment is administered in a chamber called "the medical air lock." Recompression should be started as soon as possible; the sooner this is done, the sooner the nitrogen bubbles will be redissolved and the pain relieved. It has been noted that if treatment is delayed, a higher pressure is necessary for relief. Observations have proved that a waiting period of 20 to 30 minutes is best before starting decompression.

Exercise of the affected limb during decompression aids materially in obtaining permanent relief. Inhalation of pure oxygen and oxygen-helium mixtures has given encouraging results, as these gases hasten the elimination of dissolved nitrogen from the blood. Strychnine, epinephrine, and caffeine are valuable in cases of circulatory collapse. For respiratory failure, artificial methods should be used. Physical therapy and nursing care should be used as indicated.

HIGH ALTITUDE

A flier going above 12,000 feet without oxygen is in danger of collapse.

Hazards other than oxygen lack are cold, aerembolism, throat irritation, sulfonamide therapy, or headache. At a cockpit temperature of 0° F., there is a 30 per cent loss of efficiency, due to frosted goggles, cold hands and feet, or perhaps even frostbite and clumsiness from heavy clothing, and this percentage increases as the temperature decreases. An adequate oxygen supply is especially necessary if the temperature of the cockpit is low since inadequate oxygenation of the blood results in increased capillary bed which in turn leads to diversion of the blood from less active areas, and the slow blood circulation in the extremities leads to chilling.

Aerembolism may occur at 30,000 feet or above and is due to the formation of air bubbles in tissue or body fluids. It may take a variety of forms. Symptoms include pains in the joints, especially in the lower extremities, as the knee or ankle, and itching. Both usually disappear on descent and leave no aftereffects, though the former, if it has existed for more than an hour, may persist for a while after reaching ground level. The itching may develop into pain with perspiration, pallor, and other symptoms of shock. Headache may occur, and there may be throat irritation and if the pain becomes severe, dyspnea and even collapse may develop.

CHAPTER X

The Nervous System

VERTIGO

Vertigo or dizziness is merely a symptom, and the term "dizziness" is used by the laity to denote a variety of terms, including such sensations as light-headedness to true dizziness or vertigo.

Etiology: One of the best classifications of the causes of vertigo is that given by Simonton, in which he states that vertigo may occur in the course of cardiac, renal, or vascular diseases, in pernicious anemia and severe secondary anemia as a result of anemia or hyperemia of the labyrinth. More severe degrees are seen among patients suffering from leukemia or purpura whenever hemorrhage into the labyrinth occurs. Toxic vertigo is caused by tobacco, alcohol, drugs (principally quinine and the salicylates), constipation, acute infectious diseases, and focal infections. Nitrogen embolism, such as seen in divers or caisson workers and more recently among pilots of fast-climbing fighter airplanes, is a cause of vertigo. Vertigo may also be produced by allergic hypersensitiveness. Ocular vertigo results from a sudden paralysis of the ocular muscles. Expanding lesions of the cerebellum or cerebellopontine angle, such as tumors, cysts or abscesses, or vascular anomalies pressing on the acoustic nerves, induce a constant type of vertigo. Disseminated sclerosis with involvement of the cerebellum or vestibular centers may cause vertigo. Trauma, such as blows on the ear, produces rupture of the tympanic membrane or hemorrhage into the middle ear. Basal skull fractures involving the labyrinth are causes of vertigo. Concussions produce the condition by injury to the vestibular nuclei. Acute closure of the eustachian tube or a sudden closure of the external auditory canal may cause auditory vertigo. Infections of the labyrinth invariably produce vertigo; this type is usually very severe and continues during the acute stage and gradually diminishes as the acute inflammation subsides.

Ménière's disease is characterized by recurring attacks of vertigo associated with tinnitus and deafness of the perceptive type. Hyper-

sensitive carotid sinus may frequently arise through vertigo, which actually is more of a syncope than a true vertigo. In this instance stimulation of the sensitive carotid sinus causes a stimulation of the vagus, which in turn slows the heart, thereby producing cerebral edema.

Signs and Symptoms: Vertigo may vary as to its intensity. It may be nothing more than a transitory feeling that objects are rotating in space, or it may be a sensation of violent rotation to such a degree that the patient may be thrown to the ground because of his inability to orientate himself with his immediate environment. Vertigo of any intensity at all may cause staggering when the individual attempts to walk or if operating a vehicle there may be difficulty in keeping it in its proper line.

Prognosis: Prognosis depends on the underlying cause. Vertigo resulting from sea or car sickness disappears with the elimination of the cause—that is, the uneven motion. Toxic vertigo may be alleviated by the removal of the offending agent. The vertigo due to labyrinthitis, when serous or purulent, is always accompanied by a grave prognosis due to the pathway which is present for the extension of the infection directly to the meninges of the brain. In intracranial lesions, such as cerebral tumors or tumors of the cerebellopontine angle, one usually sees a disappearance of the vertigo following removal of the tumor. The prognosis in Ménière's disease is variable, since the individual patient's response varies in almost each instance.

TREATMENT

The treatment must always be directed toward the removal of the pathological cause. The transient vertigo as that caused by car sickness and toxic vertigo are quite readily relieved with the removal of the offending agent, plus dehydration by means of saline cathartics as magnesium sulfate, 16 Gm. (4 drams), daily for three days, restriction of fluid, and induced sweating. In addition a spinal puncture and the intravenous injection of 50 cc. of 5 per cent glucose solution may bring about a cure. Vertigo due to intracranial lesions is of course treated directly by way of surgery. Vertigo caused by nitrogen embolism is treated by gradual decompression in the chamber or it may be prevented by the individual's inhalation of pure oxygen prior to the sudden lowering of the air pressure. Ocular vertigo,

such as occurs following a sudden paralysis of one of the extraocular muscles, can be immediately corrected by closing or covering one eye.

In general, the treatment of vertigo subsequent to trauma is purely symptomatic. The treatment of infectious labyrinthitis should be conservative during the acute stage and, should extension of the infection beyond the labyrinth occur, an operation on the labyrinth should be done. When the disease has reached the quiescent stage a labyrinthectomy offers the surest protection against recurrence and extension of the inflammation should the infection be a purulent one.

Ménière's disease may be treated by the Furstenberg régime, which includes the elimination of extra salt in the diet plus the substitution of ammonium chloride, 3 Gm. (45 grains) in capsules, with each meal, three days on and two days off, to maintain the chloride level of the body. Nicotinic acid, 50 mg. (⅚ grain), three times a day; thiamin chloride, 3 to 5 mg. (1/20 to 1/12 grain), three times a day, and more recently the intravenous administration of histamine diphosphate have been used in the treatment of this disease. The latter treatment is given as follows: One ampoule, 1 cc., of histamine diphosphate (2.75 mg. per cc.) is added to not less than 250 cc. of sterile physiological saline solution and thoroughly mixed. The solution is then administered intravenously so that 2.8 cc. are given per minute. Occasionally the patient will note a slight sensation of heat in the face, headache, and rapid increase in the pulse rate, but this can be controlled and recurrence avoided by reducing the rate of flow. One of these treatments per day on two, and sometimes three, successive days is suggested. Following this treatment it is recommended that 0.275 mg. (1/240 grain) be administered subcutaneously one to four times weekly for an indefinite period in order to maintain the beneficial results. In the event that flushing of the face or other evidences of histamine reaction occur following the administration of a maintenance dose, the dosage should be reduced 50 per cent, and later an attempt to increase the dosage should be made. This treatment has proved very effective.

Should the carotid sinus be the cause of vertigo, and simple measures as the elimination of high stiff collars and sudden twisting or stretching of the neck are not effective, it may be necessary to do a denervation of the hypersensitive carotid sinus to obtain relief.

COMA

Coma presents one of the most interesting and dramatic episodes in medicine. It may be defined as a loss of consciousness from which the patient cannot be aroused by the application of the most powerful external stimuli. The commonest etiological factors to be considered in the differential diagnosis of coma may be grouped in simple classifications as included in the following table. Cases of diabetic coma, insulin reaction, poisoning, and others require immediate treatment.

Etiology: The causes of coma in patients entering a hospital in order of frequency are:

1. Poisonings:
   a. Alcoholic, which is responsible for 59 per cent of cases in large urban hospitals.
   b. Barbital poisoning, cocaine, opium, carbon monoxide, bromides, lysol, causing three per cent.
2. Cerebral lesions:
   a. Trauma, which causes approximately 13 per cent.
   b. Cerebral vascular lesions, as hemorrhage, thrombosis, and embolism, causing about ten per cent.
   c. Tumors, central nervous system syphilis and inflammations of the brain and encephalitis, causing approximately 2.5 per cent.
3. Constitutional intoxications or metabolic conditions, as diabetes, uremia, eclampsia, and hypoglycemia, responsible for about three per cent.
4. Epilepsy, 2.5 per cent.
5. Toxic conditions, as pneumonia and septicemia of various kinds, causing 1.5 per cent.
6. Cardiac decompensation, Stokes-Adams syndrome, coronary thrombosis, and the like, causing 1.5 per cent.
7. Miscellaneous causes, which include such conditions as cholemia, ruptured ectopic pregnancy, miliary tuberculosis, hysteria, and massive hemorrhages, accounting for four per cent of the causes of coma.

The relative frequency of coma due to each of these varies with one's type of practice. Internists see many cases of coma due to acidosis, diabetic coma, or hypoglycemia. Industrial surgeons may see skull injuries, while a neurologist may see more comas due to epilepsy, cerebral vascular accidents, or brain tumors. There are many causes of coma. They are so varied that all cannot be mentioned. It is not important to carry all of the possibilities in mind,

but one must have the basic causes classified. Age is always of first consideration. In a patient under 40, diseases like epilepsy and infection are common. In older individuals metabolic disorders, cardiovascular disease, and tumors of the brain occur more frequently. Aside from hemorrhage few things frighten the public as much as coma. If a patient is in coma the first step is to determine the cause of the trouble. History is essential. It may be obtained from anyone who has been with the patient or occasionally from the patient himself, if he can be aroused or possibly if he has a lucid period. Trauma, either immediate or remote, must be considered in every case. A patient may suffer injury to the head and not lapse into coma until weeks later when a subdural hematoma develops. In a patient who has been well and is suddenly taken with fever, chills, and rapid pulse, infection with some bacterial agent must be kept in mind. Poliomyelitis, meningitis, or any inflammatory lesion of the brain or its appendages must be considered.

Diagnosis: Diagnosis must be made carefully and accurately. Physical examination frequently establishes the diagnosis. If one uses his five senses an obscure diagnosis may often become very obvious. An odor of alcohol, acetone, gas, or a uriniferous odor may be suggestive. Injury to the skull, bleeding mouth, or a laceration of the tongue may indicate the etiology. Other valuable aids may be found on examination, as needle marks seen in a narcotic addict, the presence of a diabetic regulation card, morphine tablets, lumps of sugar, or syringes. The presence of a dilated pupil on one side or the other, high blood pressure, or neck rigidity may also give one an important clue as to diagnosis.

Fundoscopic examination may reveal the presence of intracranial tumors, albuminuric or diabetic retinitis, which may prove the presence or absence of any of these conditions. One must also look for rigidity of the neck, fractures, muscle and vasomotor tone in the extremities, and enlarged glands. Finally, the examination of the heart and lungs and the evaluation of the temperature, pulse, respiration, and blood pressure must be resorted to. If the above fail, the subsequent clinical course frequently reveals what has been obscure in the initial examination.

The next procedures are the laboratory examinations, which should start with urinalysis and blood counts, followed by gastric

lavage in all cases of suspected poisoning and severe alcoholism. All the contents must be saved for chemical examination. If evidence of infection is present, one must take a blood culture, and when central nervous system syphilis is suspected a blood Wassermann and spinal fluid serology should be done. The nonprotein nitrogen and carbon dioxide combining power of the blood should be determined. Lumbar puncture must be routine in all injuries (except during shock), cerebral vascular accidents, convulsions in the presence of signs of increased intracranial pressure or meningeal irritation, and in all cases where the diagnosis is obscure. The initial pressure, the color of the fluid, red and white blood cell count, spinal fluid protein and serology are considered. Enough fluid should be saved for smear, culture, and pellicle formation. Finally, one must be reminded again that if the above tests fail the clinical course frequently discloses what the tests do not reveal.

In discussing coma further, each of the main groups will be analyzed separately and the outstanding findings on physical examination and clinical course given:

1. *Acute Alcoholic Intoxication:* This type of coma is very common. The patient is sound asleep, but is seldom so comatose that he cannot be aroused sufficiently to answer questions, unless the alcoholism is complicated by another disorder. In the typical case the patient has a flushed face, a florid appearance, an alcoholic odor to his breath, the pupils are dilated, and the conjunctivae are injected. If alcoholism is chronic the typical red nose is prominent. The most commonly associated complications are skull fracture or poisoning by the various impurities, as lead or methyl alcohol, which may have been present in the alcohol consumed.

2. *Cerebral Lesions:* The commonest cause is trauma and the most important factor in the diagnosis is the history of direct injury to the head. Symptoms referable to cerebral concussion, compression, irritation, or paralysis are often the main factors; laboratory findings as x-ray or spinal fluid will aid in making a positive diagnosis. However, it must be remembered that any individual with a head injury may have a skull fracture with or without symptoms. Therefore, it is difficult to determine in trauma whether or not a skull fracture is present. Any patient with an acute head injury

must be considered a potential skull fracture case until it is proved otherwise. As stated above, the symptoms may be latent for several weeks, until pressure due to a subdural hemorrhage occurs.

The patients with cerebral vascular lesions are of various types. The young individual, one under the age of 40, may present himself in coma; he probably has an embolus caused by a fibrillating heart or a rupture of congenital or mycotic aneurysm of the cerebral artery. The individual between 40 and 60 years of age, with high blood pressure and arteriosclerosis, may present himself with a thrombosis or a hemorrhage. The symptoms are characteristic, though they may resemble each other. There may be no history of trauma. There is usually a flaccid paralysis; a Babinski sign may be present, and as the patient breathes the paretic cheek blows out and drops lower than the normal one. There is a deviation of the eyes and the superficial reflexes are lost on the side of the lesion. Finally, the spinal fluid may or may not show the presence of blood.

Brain tumors and central nervous system syphilis are recognized with increased frequency. In brain tumors the onset is usually gradual, with a history of headaches, failing vision, dizziness, and vomiting, and finally the patient passes into coma; he may have choked disks and other localized signs. Increased intracranial pressure may call for spinal puncture, although this must be done with great care in the presence of choked disks. Sudden death due to jamming down of the medulla oblongata into the foramen magnum may follow puncture in such cases.

3. *Intoxications or Metabolic Conditions:* The diagnosis is based on a history of diabetes, nephritis, pregnancy, or use of insulin. The diabetic patient who is in acidosis either knows he has diabetes or gives a suggestive history of diabetes such as polydipsia, polyuria, polyphagia, loss of weight, or a history of frequent infections which resist ordinary treatment. Such information may be obtained from the family or occasionally from the patient himself.

This condition is unlike insulin reaction. Usually a slow pulse, soft eyeballs, Kussmaul air hunger, clammy skin, and the odor of acetone on the breath are evident. However, it must be remembered that the odor of acetone on the breath or the presence of it in the urine may mean dehydration and not necessarily diabetic coma.

The urine may show glycosuria, acetone, and acetoacetic acid. Typical hypoglycemia may be revealed by determination of the blood sugar; at times the eyegrounds show diabetic retinitis. The absence of glycosuria does not necessarily indicate the absence of diabetes, because a recent injection of insulin may have controlled the excretion of sugar, even though a severe acidosis is present. In insulin shock the patient is irritable, sweaty, and the skin is warm. The pulse is rapid, and nervousness, hypotension, and tremor predominate. The pupils are dilated. In the laboratory tests the urine shows no sugar, although it may be found if the urine has been retained in the bladder for several hours. The blood pressure may be elevated.

Uremic coma is the result of renal insufficiency. Renal failure may be due to nephritis, pyelonephritis, renal tuberculosis, or any condition which interferes with the proper secretion of urine. It is customary to classify uremic coma into the (1) genuine, and (2) convulsive types. Although both kinds may occur together in the same patient the causes of these episodes are different. Genuine uremia is the result of renal failure and the accumulation of toxic products in the blood and tissue. Convulsive uremia, on the other hand, is not dependent on renal failure at all, but on hypertension and increased intracranial pressure.

4. *Epilepsy:* This individual may be one who has been known to have had attacks in the past. The history from relatives is very important; it will be that of a typical grand mal attack preceded by an aura, after which the patient cries out, falls, and has tonic and clonic convulsions, together with involuntary passage of urine and feces and then goes into a comatose state. One may find evidence of injury to the tongue or buccal mucous membrane. It must be remembered that these individuals may suffer severe head injuries when they fall.

5. *Toxic Conditions:* The most important point in establishing this as a cause of coma is the history of infection, the presence of high fever and leukocytosis, and the history of chills.

6. *Cardiac Decompensation:* Here again the patient's past history and the physical examination will determine the diagnosis.

7. *Miscellaneous:* This group has to be considered only after all of the above have been ruled out.

TREATMENT

1. *Central nervous system lesions:*
   a. Extracranial lesions:
      (1) When a diagnosis of head injury is made and the extent of the lesion determined, there are several "don'ts" to be observed:
         (*a*) Do not move the patient for x-rays. If it is essential to determine the extent of various compound fractures, portable x-ray apparatus should be used.
         (*b*) Do not operate in shock unless the shock is due to a bleeding meningeal artery or unless the bleeding must be controlled to stop shock.
         (*c*) Do not dehydrate in shock. It is permissible to treat shock with intravenous injections of isotonic solutions of glucose or saline. Hypertonic solutions should not be given in the presence of dural or extradural hemorrhage.
         (*d*) Morphine should not be given as a routine measure, because of the masking of symptoms and signs which may occur, and also because of the respiratory depression.
      (2) The following treatment is indicated:
         (*a*) The patient should be put into a shock bed.
         (*b*) External heat is applied.
         (*c*) The room should be kept dark and quiet and visitors restricted.
         (*d*) All bleeding vessels should be sutured or bleeding controlled by applying pressure dressings.
         (*e*) All fractures should be immobilized by the use of sandbags or temporary splints. In the presence of depressed and compound fractures surgical intervention is necessary.
         (*f*) All wounds should be débrided and sutured as soon as the patient is out of shock.
         (*g*) Extradural and subdural hemorrhage do not require immediate surgery. Surgery may be done when the patient's condition warrants the procedure. It should be delayed as long as it is deemed necessary and depends upon the findings as they arise.
         (*h*) Certain drugs may be used, as atropine sulfate, 0.45 or 0.65 mg. (1/150 or 1/100 grain); strychnine sulfate, 1 or 2 mg. (1/60 or 1/30 grain); pituitrin (surgical), 1/2 to 1 cc., intramuscularly; cortin, 10 cc., intravenously or intramuscularly, repeated at frequent intervals, depending upon the degree of shock.
         (*i*) Hypertonic solutions which are most commonly used are 50 per cent sucrose, 100 to 200 cc., intravenously, or 50 per cent glucose, 50 to 100 cc., intravenously. Sucrose may be repeated in 12 to 24 hours, but it should never be used in the presence of kidney damage. Glucose may be repeated in 6 to 12 hours.

Fluids as normal saline or five per cent glucose, 500 to 1000 cc., should be given intravenously if the patient has lost considerable blood. In some cases, transfusion may be indicated.

(*j*) For sedation the best drugs are chloral hydrate, 2 Gm. (30 grains); sodium phenobarbital, 0.1 Gm. (1½ grains), or sodium amytal, 0.2 Gm. (3 grains). Magnesium sulfate, 30 Gm. (1 oz.), by mouth or 60 Gm. (2 oz.) rectally as a retention enema may be helpful.

(3) Following these procedures the patient must be observed very closely for edema or hemorrhage.

(a) Special attention should be paid to the state of consciousness, restlessness, the occurrence of convulsions, and the patient's use of his arms and legs.

(*b*) Careful neurological examination should be repeated frequently to note any changes. It must be remembered, however, that many abnormal findings may be temporary after convulsions, and they do not necessarily mean that the patient is showing any progression of hemorrhage.

(*c*) Blood pressure readings should be taken every one or two hours. A drop in diastolic pressure below 60 mm. of mercury means shock. Systolic pressure above normal may be a sign of edema of the brain or increased intracranial pressure.

(*d*) The pulse must be watched carefully. Slowing of the pulse to 60 beats or less a minute may mean cerebral edema. A very rapid or irregular pulse is a bad prognostic sign, in that it shows that the patient has difficulty compensating for his injury.

(*e*) The temperature is subnormal in shock and later in severe injuries begins to rise; this is a bad prognostic sign, especially if it reaches 40.5° to 42.2° C. (105° to 108° F.) within a few hours after injury.

(*f*) Rapid, irregular, and stertorous respiration usually accompanies serious injuries.

(*g*) Lucid interval may mean subdural or extradural hemorrhage or cerebral edema. Convulsions and localizing symptoms may occur from cerebral edema and disappear with a few hours if they are due to edema alone.

(*h*) The question of spinal taps has long been a disputed point. They should not be done in subdural or extradural hemorrhage, intracranial hemorrhage, or severe shock. Diagnostic taps may be done to determine pressure and the presence of blood. However, only 1 or 2 cc. of fluid should be removed. If spinal taps are done for treatment, sufficient fluid should

be removed to reduce the spinal fluid pressure to one-half of the original pressure.

(4) Prognosis: Patients with severe injuries should be hospitalized for from two to six weeks, depending upon the symptoms. The length of bed rest can be determined by the patient's condition. The patient is allowed up after he has been symptom-free for a few days. If headaches and dizziness develop after the patient is up and about, he should be put back to bed for a few more days of rest.

b. Intracranial Trauma: A patient who develops a stroke must always be treated quickly and with precision. This emergency may arise at any time, any place, and under almost any circumstances. The patient who has a hemorrhage of the brain is most likely to give the true picture of an apoplectic stroke. This disorder usually occurs in a middle-aged individual, who has had high blood pressure. The onset of hemorrhage is abrupt and is precipitated usually by exercise or straining, particularly by forced expiration with a closed glottis, which increases the pressure in the vascular system of the brain. Occasionally, however, a cerebral hemorrhage occurs while the patient is at rest.

The emergency treatment of a patient with a stroke is simple but very important. At first too energetic treatment may increase the hemorrhage, aggravate the symptoms, and cause death.

If heart failure is present digitalis should be given intramuscularly or intravenously. Thromboplastin, 20 cc., or 2 cc. of the patient's blood may be given intramuscularly. Later, drugs, as theobromine, 0.33 Gm. (5 grains), three times a day, or potassium iodide, 0.6 cc. (10 minims), five times a day, may be given.

c. Cerebral diseases: The treatment of brain tumors, of course, is surgical. Central nervous system syphilis may be treated by fever therapy, malaria treatment, or tryparsamide. When a diagnosis of meningitis is made the patient should be treated with the available specific sera and with the sulfonamides (see page 353). In the treatment of epidemic encephalitis the patient must be kept in bed and restraints applied if necessary. Symptomatic treatment is used as symptoms arise. Opiates should be administered with great caution. The treatment of most value seems to be repeated lumbar punctures to relieve the stupor, headache, and cranial nerve palsies. The sequelae of the disease, as tremor and the parkinsonian syndrome, should be treated with stramonium compounds. The treatment of patients with hysterical attacks is purely psychiatric.

2. *Intoxications of metabolic origin:*

a. Diabetic coma and insulin shock (see Chapter VIII).

b. Uremia.

c. Eclampsia: The treatment of this condition is, of course, the prevention of the disorder by prenatal care and observation. However, if the

clinician is called to see a patient in the last trimester of pregnancy with sharp epigastric pain, disturbed vision, or severe headaches, followed later by twitchings, convulsions, dyspnea, edema, high blood pressure, or albuminuria, then the treatment must be energetic.

(1) The patient is put to bed at absolute rest in a warm, dark room.

(2) Sodium luminal, 0.13 or 0.2 Gm. (2 or 3 grains), or morphine sulfate, 0.016 to 0.032 Gm. (¼ to ½ grain), hypodermically, is given immediately. The administration of the drugs should be repeated in two hours if necessary to control the convulsions.

(3) The patient must be protected against injury and all mucus must be removed from the mouth.

(4) Control of the convulsions may also be secured by the intravenous administration of 20 cc. of ten per cent solution of magnesium sulfate. Four doses are usually enough and up to 8 Gm. (120 grains) as a total dose is sufficient. Magnesium sulfate as an eight per cent solution may also be given intramuscularly up to a total of 2 Gm. (30 grains) per kilogram of body weight or as a slow drop by drop enema 20 Gm. (300 grains) in ½ to 1 liter of water.

(5) Phenobarbital hypertonic solutions, as 50 per cent glucose or sucrose, may be given intravenously for control of convulsions.

(6) To maintain fluid balance and keep the blood pressure down, constant and copious withdrawals from the bowel and bladder are indicated, as well as venesection and bandaging of the extremities.

(7) All foods and fluids by mouth are withheld for 24 hours.

(8) Oxygen inhalations are given after each convulsion until the breathing is normal and the cyanosis disappears.

(9) The circulation should be stimulated by the use of metrazol, 0.2 Gm. (3 grains), hypodermically.

(10) The patient should be given a daily purge with magnesium sulfate, 15 to 30 cc. (½ to 1 oz.), by mouth.

(11) Diuresis should be established. Hypertonic glucose, 300 cc. of 25 per cent solution, should be administered intravenously every four or five hours during the attack. Mercurial diuretics, as salyrgan, 1 cc. by vein, are used.

(12) If acidosis is extreme, as evidenced by a low carbon dioxide combining power, the use of 500 cc. 6/M sodium lactate solution intravenously will counteract this.

(13) As a last resort, surgical decapsulation of the kidney in extreme coma and anuria is indicated.

(14) The method of delivery of the fetus is left to the judgment of the obstetrician. Some authorities favor conservative treatment, allowing the patient to continue to term, while others favor the emptying of the uterine contents as soon as possible without violence through version, forceps, or cesarean section.

3. *Epilepsy:* Epilepsy may be treated in an institution or in the home. The patient's general habits and occupation need supervision. The drugs for chronic use are bromides, phenobarbital, and dilantin sodium. The dosage must be decided for each individual case, but it should be remembered that when bromides are used sodium chlorides should be administered, because bromides and iodides hasten the elimination of chlorides from the body. The patients taking the barbiturates or dilantin are usually more alert than those on the bromides.
4. *Toxic conditions:* The treatment of these causes of coma is directly dependent upon the treatment of the original conditions.
5. *Miscellaneous causes:* Probably the commonest of these are heat exhaustion and sunstroke. Heat exhaustion presents symptoms similar to shock, while patients with sunstroke have a high fever, a rapid full pulse, and high blood pressure. They become restless and excited and later develop delirium. The treatment of this condition is discussed in page 186.

CEREBRAL HEMORRHAGE, EMBOLISM, AND THROMBOSIS

Cerebral hemorrhage, thrombosis, and embolism are vascular accidents involving the arteries of the brain, and are generally grouped together under the term "apoplexy." The differentiation between these kinds of apoplexy is of little importance as far as the treatment of the patient is concerned. Thrombotic lesions are commonest of all; cerebral accidents due to hemorrhage come next. Patients with cerebral hemorrhage are more apt to die in the acute attack, while those with thrombosis survive the acute phase, though they sustain considerable disability, as partial hemiplegia. When a cerebral accident is caused by syphilitic arteritis the patient is usually young and the condition is amenable to proper treatment. Thrombosis may involve almost any of the main cerebral vessels, either those comprising the circle of Willis and its branches or the anterior, middle, and posterior cerebral cortical arteries. Hemorrhage occurs in the lenticulostriate of the middle cerebral so frequently that this vessel has been called "the artery of cerebral hemorrhage."

Etiology: Apoplexy due to cerebral hemorrhage is practically always caused by hypertension. It usually comes on in people past 45 years of age when arterial degeneration accompanies hypertension. The hemorrhage of a mycotic aneurysm may occur at any age and simulate closely apoplexy of hypertension. Mycotic aneurysms have

a predilection for the circle of Willis at the junction with the anterior cerebral. Apoplectic strokes due to hemorrhage are more apt to occur in individuals who indulge in alcoholic excesses and in those who overeat or participate in excessive muscular exercise.

Apoplexy caused by cerebral thrombosis nearly always develops in older persons who have generalized hardening of the arteries. In these cases the onset is less abrupt and several days may pass before the full effects of the thrombotic occlusion are witnessed. The apo-

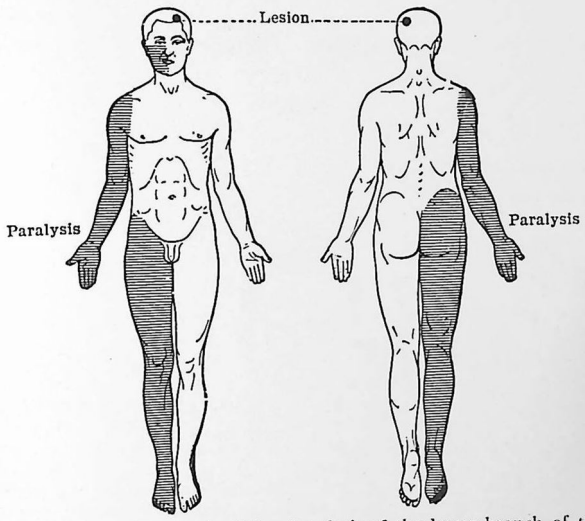


Fig. 1.—Hemiplegia of cerebral origin. Paralysis of the lower branch of the facial and of the extremities on the side opposite the lesion.

plectic stroke of cerebral embolism may occur at any age and is caused by such diseases as vegetative endocarditis, abscess of the lung, bronchiectatic cavitation, or, probably commonest of all, the releasing of a small thrombotic mass from the left auricle during auricular fibrillation and heart failure.

Course and Prognosis: Obviously, there is considerable difference in the chain of events that take place, depending upon the nature and extent of the lesion in the brain. But for practical purposes a general course may be outlined for all apoplectic strokes. In any and all cases there may be a period of unconsciousness or partial lack of consciousness at the beginning, which lasts for a few

hours up to a few days. Hemorrhage is more apt to produce an extensive period of coma. After a variable period of time there may be paralysis of one side of the body, involving the leg, the arm, and the entire side of the face. This is *hemiplegia.* The degree of paralysis depends on the severity of the lesion in the brain, but the extent of the original paralysis is no measuring stick of the completeness of recovery which may take place. Sometimes the patient with the most complete paralysis during the first few weeks eventually makes

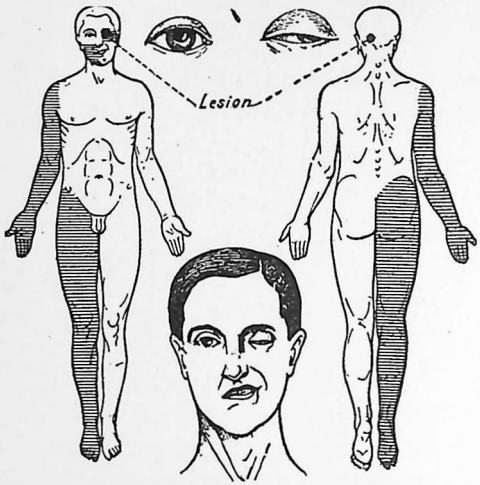


Fig. 2.—1. Paralysis of the extremities on the side opposite the brain lesion. 2. Oculomotor paralysis on the same side as the lesion. (a) Ptosis. (b) Outward deviation of the eye owing to persistence of function of the fourth and sixth cranial nerves.

the best recovery, while the one who suffers only mild paralysis may die. A physician should not attempt to make an accurate prognosis until six to eight weeks have elapsed, for it requires this length of time to determine the degree of recovery that will take place. Generally, the recovery after the two-month period is slight.

Signs and Symptoms: The onset is usually abrupt, during strenuous exercise, while at rest, or sometimes while performing an ordinary duty. Occasionally, there may be premonitory symptoms of headache, numbness or tingling in the limbs, and choreiform movements in the muscles of the opposite side of the body. Sometimes vascular disturbances are described by the patient after recovery.

Transient aphasia or monoplegia may occur occasionally. When the onset is sudden, consciousness is lost and complete relaxation of the extremities occurs. Subsequently, whether the onset is sudden or gradual, the face usually becomes cyanotic or ashen-gray; the pupils vary in size, commonly being dilated and frequently unequal and unresponsive to light. When the lesion is in the pons or in the ventricles, the nucleus of the third nerve is irritated and constriction of the pupils occurs. The respirations are stertorous, slow, and

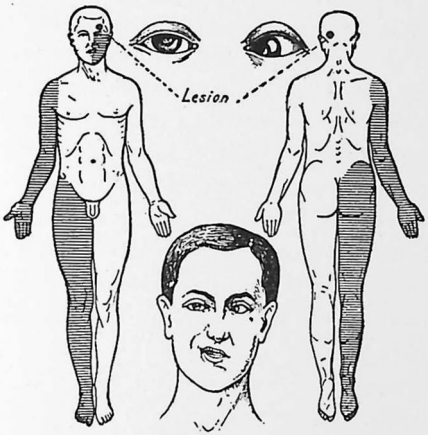


Fig. 3.—1. Paralysis of the extremities on the side opposite the brain lesion. 2. Paralysis of the face on the same side as the lesion. 3. Paralysis of the sixth cranial nerve on the side of the lesion, causing convergent strabismus through deviation of the eye inward and downward.

frequently Cheyne-Stokes in type. The pulse is slow and full. The temperature may be subnormal or normal; in basilar hemorrhage, it may be elevated. Incontinence of urine and feces usually occurs. Physical examination will reveal that the affected side is flaccid; that is, when the limb is raised, it will drop back on the bed as if dead. Conjugate deviation of the eyes also develops in many cases.

When the onset is more gradual the patient may not lose consciousness, but there will be a loss of power or complete paralysis of the affected extremities. In some of these cases unconsciousness will come on later. After the patient has recovered consciousness there may be hemiplegia, either partial or complete. This may persist for a variable period of time and completely clear up or never

clear up at all, depending on the location and extensiveness of the lesion.

Hemiplegia: After the patient regains consciousness a paralysis may be present. The extent of this paralysis depends upon the degree of destruction that has occurred in the motor area, in the pyramidal tract, or in any part of its course. Ordinarily, the face is involved on the same side as the arm and leg, unless the lesion is in the lower part of the pons. The facial paralysis results in difficulty or inability to elevate the eyebrow, close the eye, or move the corner of the mouth. When the hypoglossal nerve is involved, the extension of the tongue will show deviation toward the paralyzed side. In addition, various degrees of aphasia and aphonia may occur, due either to involvement of these areas within the brain itself or the muscles controlling these functions. In most instances a permanent paralysis results and certain groups of muscles are more likely to be affected permanently than others. In the leg the flexors and the dorsal flexors of the foot are most frequently involved, whereas the extensors of the leg and plantar flexors of the foot usually recover. In the arm the muscles which oppose the thumb are usually affected, as well as those which rotate the arm outward.

Crossed hemiplegia occurs when the lesion is in the pons, the crus or the medulla. When the lesion is in the crus the condition produced is known as the syndrome of Weber, and is characterized by paralysis of the arm, face, and leg of the opposite side and the third nerve on the same side. In addition, frequently there will be sensory changes. When the lesion is in the pons or medulla the pyramidal tract will be involved and very likely one or more of the cerebral nerves. Paralysis of the face on the same side and hemiplegia on the opposite side occurs when the lesion is in the lower part of the pons. The external rectus muscle is usually also involved, due to paralysis of the sixth nerve. When the fifth nerve is involved there is loss of sensation on the same side as the lesion and loss of motor activity on the opposite side of the body.

The Reflexes: When the patient is in coma the knee-jerks and abdominal reflexes are frequently absent on both sides and there is a positive Babinski. On the hemiplegic side the lost reflexes may never return or they may come back very gradually.

TABLE 1—DIAGNOSTIC TABLE

	Hemorrhage	*Embolism*	*Thrombosis*
Cause	High blood pressure	Valves	Arteriosclerosis or syphilis
Age	40 to 60	Young	Old—arteriosclerosis Young—syphilis
Onset	Sudden	Sudden	Slow
Paralysis	Hemiplegia	Hemiplegia and aphasia	Partial
Convulsions	Yes	Rare	Yes
Coma	Yes	No	No
Prognosis	Fair	Poor	Poor

TREATMENT

The emergency treatment of the patient with a stroke is simple but important. Too energetic treatment may lead to more hemorrhage, aggravate the symptoms, and cause death. The therapeutic measure called "masterful inactivity" is often the best method of treating the patient with a stroke. The anxiety of the family to have something spectacular done often leads to overtreatment.

1. The first step is to place the patient on a couch or mattress, with his head elevated so foreign material will not be sucked into the trachea and lungs. The breathing is usually better too if the patient is in a semireclining position. It is important to keep the chin from falling onto the chest for this makes breathing difficult, causes congestion in the veins of the neck, increases the cerebrospinal pressure, and promotes the active bleeding in the brain.

2. Do not move the patient immediately after the stroke. It takes half an hour to an hour for the initial shock to subside. During this time small injections of caffeine sodium benzoate, 0.13 to 0.26 Gm. (2 to 4 grains), hypodermically, may be given to keep up the circulation and prevent peripheral vascular collapse.

3. When the time is appropriate, move the patient to bed at home or preferably to a hospital. At this stage the treatment may

determine the outcome. Icebags placed around the head appear to be effective in controlling the hemorrhage in the brain. Be sure that the urinary bladder is not distended. The bowels should be emptied freely because this serves to reduce the blood pressure. An icebag applied to the heart slows circulation.

4. If the blood pressure is very high, the veins of the neck distended, and the face florid and cyanotic, 500 cc. of blood may be withdrawn. If these symptoms are not present venesection should not be done.

5. There has been a tendency to give hypertonic glucose and sucrose solutions in the early stage of apoplexy, but intravenous solutions should not be given during this period.

6. When the patient becomes conscious a small dose of morphine, 0.01 Gm. (⅙ grain), or pantopon, 0.01 Gm. (⅙ grain), hypodermically, will relax him and favor the clotting of blood in the brain.

7. If the blood pressure continues to rise during the early hours of the stroke sodium nitrite, 0.03 Gm. (½ grain), may be given subcutaneously and repeatedly. This reduces the blood pressure, slows circulation, and promotes clotting at the points of hemorrhage.

8. When the patient has recovered from the first stage of the stroke he must be kept quiet. Avoid trying to make him swallow until the process of deglutition is under control, because coughing or choking may aggravate the condition in the brain or a particle of food may be sucked into the lung and cause pneumonia.

9. Massage may be started about the tenth day, followed by passive exercise with gradual encouragement to perform active exercise with the extremities. Contractures are difficult to prevent, but this may be accomplished in many cases by application of casts, extension devices, and other appliances as individually needed.

CHAPTER XI

The Nervous System

(Continued)

HERPES ZOSTER

Herpes zoster, more commonly known as shingles, is an acute dermatological manifestation of a neuritic disease and is characterized by vesicular eruption distributed along the course of one or more peripheral sensory nerves.

Etiology: The cause of the disease is still unknown. A filtrable virus has long been suspected as being the etiological agent. However, it differs definitely from the virus which produces herpes simplex. Other predisposing factors are evident because of its common association and occurrence in patients who have been (1) overworked, (2) affected by certain drugs or poisons, especially the heavy metals, (3) ill from a chronic disease as generalized arteriosclerosis, diabetes, central nervous system syphilis, or (4) exposed to chickenpox.

Signs and Symptoms: The onset is usually acute and is that of general malaise and occasionally gastrointestinal upset. This is followed by a slight fever and the development of a neuralgic pain along the course of the affected nerve. The degree of pain is variable and at this time the underlying skin is found to be hyperesthetic. Shortly thereafter, an erythematous eruption appears. Within three to five days, these lesions develop into papules, vesicles, and vesiculo-papules. They appear in successive crops along the nerve distribution and usually involve one or two nerves. They are most commonly unilateral, but at times a bilateral involvement is noted. The vesicles tend to become confluent and are grouped in small areas, the usual case having 2 to 12 of these groups. The vesicular lesions persist for a week or ten days, when they finally dry up, form crusts, and resolve. Atrophic scarring is the usual remnant after healing is complete. Sequelae may be (1) a persistent postherpetic pain, (2) blindness secondary to fifth nerve involvement, or (3) motor root involvement producing paralysis, especially when cranial nerves five or seven are affected.

Diagnosis: Diagnosis depends upon the appearance of neuralgic pain followed by cutaneous vesicular eruption with the characteristic unilateral nerve distribution.

Pathology: The most salient changes are noted in the posterior spinal ganglia or cranial nerve ganglia which reveals a lymphocytic infiltration perivascularly or hemorrhage and round cell infiltration. At times the posterior gray columns reveal the same process, which would explain the prominent nerve degeneration as is seen in very severe cases. Histological study of the cutaneous lesion shows an inflammatory process at the onset, interepithelial vesiculation and edema during the vesicular stage, and fibrosis and pigmentation with an atrophic epithelial layer during the healing stage.

Prognosis: Prognosis is good. One attack usually results in an immunity, although cases of repeated attacks have been observed, especially in patients with chronic debilitation.

TREATMENT

Treatment for the most part is symptomatic, but certain measures have been instituted in an attempt to treat the patient generally. Various combinations of the following may be tried:

1. Push fluids orally.
2. Proper elimination through the use of cathartics.
3. An intragluteal injection of 10 cc. of patient's own blood may be given daily or 20 cc. may be given every other day, in the acute stage. This treatment is less useful after the acute stage has passed.
4. Surgical pituitrin, 1 cc. intramuscularly daily for four days, for pain.
5. Diphtheria antitoxin, 5000 units intramuscularly immediately and repeated in two days.
6. Ten cubic centimeters of ten per cent solution of sodium iodide intravenously daily.
7. Thiamin chloride, 10,000 units intramuscularly daily.
8. Neoarsphenamine, 0.3 to 0.45 Gm. (4½ to 6¾ grains) intravenously at four-day intervals for four doses.
9. Sodium salicylate and sodium bicarbonate, equal parts of each, 1.33 Gm. (20 grains), every four hours until 8 Gm. (120 grains) have been given.

10. Locally, affected areas may be covered with a salve of equal parts of lanolin and vaseline with one per cent procaine or 0.5 per cent cocaine and be protected by a silk dressing. Calamine lotion with one per cent phenol or anesthetic dusting powders applied locally.

ACUTE NEURITIS

Acute neuritis includes those lesions of the peripheral nerves which are due to inflammatory, toxic, or progressive degenerative processes.

Etiology: Many causative agents are known to produce neuritis. The most salient of these are: (1) Metabolic deficiencies, as diabetes which in turn predisposes to arteriosclerosis; (2) deficiency states, as the various types of vitamin deficiency seen in beri-beri, pellagra, or chronic alcoholism; (3) infections, as a primary process as in acute infectious polyneuritis or as a secondary complication of severe septicemia, for example, diphtheria, and (4) poisons, the chief offenders being lead, arsenic, and alcohol.

Pathology: Pathology varies with the etiological agent, and therefore there may be few if any changes elicited in one case while marked damage is revealed in others. In the latter, there is usually a degeneration of the myelin sheath with proliferation of the sheath cells. In addition, the interstitial connective tissue may show inflammatory and proliferative changes. In very severe cases, the axon of the nerve cell may be completely destroyed.

Signs and Symptoms: The clinical picture depends on: (1) Whether the process involves one or more peripheral nerves; (2) the etiological agent, and (3) the duration of the disease prior to seeing the physician. The constitutional symptoms are usually manifestations of the etiological agent. The neuritic complaints are characterized by pain, diminution of peripheral sensation and impairment of muscular strength along the distribution of the affected nerve. The pain is usually sharp, stabbing, and radiates along the course of the nerve trunk. Neuritic pains, especially those in older patients having arteriosclerosis or diabetes or both, tend to recur at nighttime.

Paresthesias are common, and hyperesthesia is elicited upon deep pressure over the involved nerve. In mild cases, only slight weakness may be noted, but in severe and protracted cases there may be

partial or complete loss of muscular power. Deep sensibility may be partially or completely lost. Reflexes likewise may be greatly impaired and at times absent. If the case is untreated, marked muscular atrophy and contractures may develop. The cutaneous structures supplied by the affected nerve may also show evidence of inflammatory or degenerative change. This is manifested by an increased redness, scaling, and sometimes necrosis of the epithelium.

Prognosis: Prognosis again depends upon the causative factor and the duration of the disease. For example, the neuritic process secondary to arteriosclerosis in the diabetic offers a poor prognosis. In contrast, the neuritic process seen in vitamin deficiency states and that secondary to acute infections offers a good outlook.

TREATMENT

Treatment for the most part is supportive, but the following points are deemed important in the management of the ailment:

1. The etiological agent must be removed.
2. Absolute bed rest is imperative.
3. A high caloric and high vitamin diet should be given.
4. Heat, as hot as it can be borne, with due caution to avoid burning where anesthesia exists, should be applied. Heat not only provides relief, but usually hastens recovery and may be employed for several hours daily; moist heat seems to be preferable to dry heat. Physiotherapeutic measures, as passive exercise, massage, short wave and ultraviolet, should be instituted when the acute phase has passed.
5. Massive doses of vitamin B_1, 6 to 10 mg. ($\frac{1}{10}$ to $\frac{1}{6}$ grain) orally and 10,000 units intramuscularly, should be administered daily. B_1 may also be given intravenously as one ampoule containing 10 mg. daily.
6. Pain may be relieved with analgesics as sodium salicylate, 1.33 Gm. (20 grains), with sodium bicarbonate, 1.33 Gm. (20 grains), four times a day. If not tolerated orally, larger doses of the salicylates may be given rectally in starch retention enemas. As much as 5 Gm. (75 grains) may be given twice a day. In the neuritides due to poisoning with metals, especially arsenic, the intravenous administration of sodium hyposulfite in doses of 1 Gm. (15 grains) daily may be helpful. Strychnine sulfate, beginning with doses of 0.002 Gm. ($\frac{1}{30}$ grain), and gradually increasing the dose to 0.006 Gm. ($\frac{1}{10}$

grain), may be administered three times a day. Potassium iodide, 0.65 Gm. (10 grains), three times a day, each alternate week, may be an aid in the elimination of metallic poisons.

7. Ointments should be applied locally; methyl salicylate ointment U.S.P. commonly gives relief.

8. The patient's general condition may be improved by intragluteal injections of liver extract, 2 to 3 cc. weekly, and the administration of iron in the form of iron and ammonium citrate, 1.33 Gm. (20 grains), three times a day.

9. Injection of the nerve trunk with 20 to 50 cc. of two per cent novocain solution, or 2 to 5 cc. of alcohol, may be resorted to in severe cases.

CONVULSIONS

Generalized convulsions are nearly always associated with loss of consciousness, though there are a few exceptions, as in strychnine poisoning, the early stages of tetanus, and so-called jacksonian epilepsy. In strychnine poisoning, the convulsion is precipitated by such stimulants as loud noises or flashes of light. Convulsions occur in spasms lasting one-half to one and one-half minutes, often with relaxation between attacks. In the early stages of tetanus, the jaws are set, the neck is stiff, the abdomen is rigid, and usually there is a history or evidence of some recent external injury. Serum must be given, and it is emphasized that 10,000 units given at the time of injury is worth more than a greater amount administered after symptoms of tetanus have set in. In the so-called jacksonian epilepsy, convulsions are limited to one part or one side of the body. This condition is due to diseases confined to the cortex of the brain.

Complete loss of consciousness is the general rule with the exception of the instances mentioned above. Both sides of the body, face, arms, and legs are equally involved, though sometimes the attacks are unilateral at first and bilateral later. Convulsions usually commence in the same way, that is, at first there is a tonic spasm followed by clonic convulsions, and then there is a period of coma. Usually convulsions last for a minute or a few minutes, and return at uncertain periods later on; sometimes one convulsion follows another so rapidly that there is no breathing spell between them, and the patient dies of exhaustion, respiratory paralysis, or heart failure. The con-

vulsions of adults are generally of greater seriousness than those of infants since the underlying organic disease is very likely to be of more importance. A convulsion itself is not so dangerous, but the underlying disease that accounts for it is always a grave matter.

A simple classification of the causes of convulsions includes:

1. Cerebral:
   a. Trauma, leading to skull fracture, subdural hematoma, or extradural clots.
   b. Tumors of the brain.
   c. Meningeal irritations, as tuberculous meningitis or other forms of meningitis.
   d. Vascular diseases of the brain, hemorrhage, thrombosis, or embolism.
2. Toxic conditions:
   a. Acute alcoholism: Convulsions may be caused by brain edema. Lumbar puncture, intravenous hypertonic solutions, and sedation are necessary.
   b. Drug poisoning, as strychnine.
3. Constitutional diseases:
   a. Uremia: The convulsion is associated with hypertension, increased cerebrospinal fluid pressure, and certain evidences of kidney disease.
   b. Hypoglycemia: An overdose of insulin is usually the cause, but it may occur in a patient who has a tumor in the islands of Langerhans. Administration of glucose intravenously is the proper treatment until the complete diagnosis is established.
   c. Hypoparathyroidism.
   d. Pheochromocytomas of the adrenals with paroxysmal hypertension.
   e. Epilepsy.
4. Cardiocirculatory diseases: Stokes-Adams disease—The patient has heart block. The attack usually comes on suddenly and the patient falls as in an epileptic fit. The administration of 1 cc. of 1:1000 adrenalin intramuscularly or subcutaneously is usually effective in relieving the attack. Between spells thyroid, 30 mg. (½ grain), three times a day, and ephedrine, 46 mg. (¾ grain), two or three times a day, may be given.
5. Hysteria: The convulsion may simulate an epileptic fit. Other identification marks of hysteria are usually present to confirm the diagnosis.

TREATMENT

A convulsion is a symptom of some underlying disease, and therefore the treatment must be divided into two stages, the immediate and the after treatment.

1. The immediate treatment is important because a convulsion is always an emergency and may lead to respiratory failure, cardiac

exhaustion, and death. Regardless of the cause, measures must be instituted immediately to control the episode.

a. Ether or chloroform inhalations to the point of depression may be given. Sodium amytal, 0.24 to 0.46 Gm. (4 to 7 grains), must be given intravenously

b. Some article, like a tongue depressor or a wooden stick wrapped with gauze, should be inserted between the teeth so the tongue will not be cut.

c. If the irritant has been taken orally, the stomach should be washed out with 1:1000 potassium permanganate solution, and then chloral hydrate and sodium bromide, 1.33 Gm. (20 grains), of each should be given by rectum or mouth.

d. Sedatives, as morphine sulfate, 0.016 Gm. (¼ grain), or pantopon, 0.02 Gm. (⅓ grain), hypodermically, may be administered to control mild convulsive states.

e. If, during the convulsive seizure, respiratory depression becomes so great that the patient stops breathing and turns blue, an immediate injection of some stimulant as caffeine sodium benzoate, 0.33 Gm. (5 grains); coramine, 2 to 4 cc. (½ to 1 dram), or strychnine, 0.002 Gm. (1/30 grain), hypodermically, must be given to preserve life.

f. In order to control repeated convulsions the patient should be removed to a quiet dark room, where the treatment of the immediate emergency may be continued.

g. Edema of the brain may be an important feature in such diseases as chronic alcoholism, uremia, lipoid nephrosis, and acute elevation of chronic hypertension. Removal of spinal fluid is helpful but caution must be exercised. Spinal puncture should be done only after grave consideration is given to the possibility of a brain tumor and to the ill consequences of such an action if a tumor is present. Hypertonic glucose or sucrose, 100 to 300 cc. of 50 per cent solution, may be given intravenously, but sucrose should be avoided in the presence of anuria.

h. In uremia of the convulsive form there may or may not be edema. An elevated blood pressure is more significant than any other sign and is probably the remote cause of the convulsion. Magnesium sulfate, 10 cc. of a 25 per cent solution, may be given intravenously or intramuscularly and repeated every four hours. Results are often remarkable.

2. The after-treatment of a convulsion requires that the underlying cause be uncovered and the condition, whether organic or functional, be remedied. Whenever possible, a urinalysis, blood sugar determination, and simple blood count should be done because fre-

quently the cause of the convulsion lies in a common disorder revealed by such routine tests.

MIGRAINE

Migraine is a symptom complex dependent on unknown factors. It is generally applied to a severe paroxysmal headache affecting only one side of the head. Such headaches are generally preceded by mild aura, associated with vomiting and terminated by sleep. There are, however, headaches classed as migraine which do not present all these symptoms.

Etiology: Migraine occurs more frequently in women than men with a ratio of about 2.5 to 1. It begins early in life, often at puberty, is recurrent, and tends to disappear during pregnancy and after the menopause. The malady often runs in families and may be hereditary. Infectious diseases as influenza, malaria, syphilis, gastrointestinal disturbances, chill, anemia, fatigue, prolonged nervous strain, or mental exhaustion have all been considered as causes. There is considerable evidence that the endocrines, the pituitary gland in particular, have some relation to the disease.

The most plausible explanation to date is that migraine is caused by a vascular spasm due to vasomotor disturbances. Oppenheim's belief that the cause is disturbance of the sympathetic innervation may be correct, though the underlying factors are as yet unknown. The vascular storm is said to produce localized edema in the occipital cortex, resulting in visual phenomena and increased intraventricular pressure, producing headache and vomiting.

Foods may be a contributory factor, as migraine is often found in persons who are allergic.

Symptoms and Findings: Migraine is a periodical or paroxysmal headache with gastric disturbances. The attack is preceded by a feeling of pressure in the head, dullness, moodiness, yawning, somnolence, dizziness, and occasionally by nausea, anorexia, or choking sensations. The headache is as a rule unilateral, but may be frontal, temporal, parietal, or occipital. It is at first dull, but grows in intensity until it is almost unbearable, at times causing the patient to cry out in pain. At the height of the attack there is apt to be vomiting. Migraine headache terminates in sleep.

The headache is often preceded by visual disturbances, such as spots before the eyes, contracted visual field, blind spots, or scotomas. There may also be disturbances of sensation, speech, or motility.

Pallor or redness of the face, dilatation of the pupils, or salivation may appear as a result of migraine. The disorder resembles epilepsy when it is accompanied by symptoms such as tics, cramps, or convulsions. Abdominal pain and gastric hypersecretion have been reported in connection with migraine.

Prognosis: Migraine headache may last from several hours to a day or more. In neurotics the hemicrania may become constant. Migraine may last part or all of one's life, though it usually stops at the menopause or during pregnancy. Prognosis is unfavorable as to cure, but favorable as to life. The ophthalmoplegic type is more serious, as are migraine headaches associated with hysteria.

Diagnosis: Migraine headache is usually easy to recognize. In atypical cases, however, there may be diagnostic difficulty. The diagnosis should not be made too often. Organic disease of the brain, tumor or aneurysm of the cerebral vessels, syphilis, epilepsy, uremic and arteriosclerotic headache, sphenopalatine neuralgia, headaches due to eye conditions or infections of the sinuses should all be ruled out before a diagnosis of migraine is made.

TREATMENT

The treatment for migraine is not entirely satisfactory. Probably the most effective treatment is histamine diphosphate. The strength of the solution used is 0.275 mg. ($\frac{1}{240}$ grain) per cc. One-tenth cc. of this solution is injected subcutaneously every day. The dose is increased 0.1 cc. each day until 1.0 cc. is given. Then 1.0 cc. is continued on an average of one injection every five days for a variable period of time. Sometimes, however, flushing of the face, headaches, nausea, and vomiting develop, making it necessary to stop these injections.

E. E. Hines of the Mayo Clinic at Rochester, Minnesota, advocates the use of potassium thiocyanate in 0.2 Gm. (3 grain) doses three times daily. The blood level of 10 to 12 mg. of cyanate per 100 cc. per cent of blood is considered optimal. It is suggested further that this treatment is to be used in combination with estrogenic therapy in women whose headaches are aggravated around the time

of menstruation. Patients with migraine associated with hypertension are more benefited with potassium thiocyanate than patients whose blood pressure is normal or subnormal.

Phenacetin, antipyrine, amidopyrine, or aspirin may give relief. Amyl nitrite pearls or nitroglycerin sometimes overcome vasomotor spasms. Codeine or morphine can stop the attack, but the danger of addiction is too great. Pituitary gland extract, 0.06 Gm. (1 grain), alone or in combination with 0.016 Gm. (1/4 grain) of thyroid may be used if there is a suspicion that the pituitary gland is involved. Ergotamine tartrate, if given early, may abort the attack. It should be given 0.25 mg. (1/240 grain) subcutaneously and repeated in two to three hours if necessary. Phenobarbital is sometimes good. Cold compresses to the head and hot foot baths are traditional measures. If anemia is present it should be treated with iron, arsenic, or other acceptable therapy.

Focal infections should be attended to, visual defects corrected, and gastrointestinal disorders taken care of. The diet should be watched, and if certain foods bring on an attack they must be avoided. Menstrual disturbances and pelvic abnormalities should be corrected. It is wise to x-ray the sinuses in order to find out whether there is infection there that should be removed. Rest, sufficient sleep, and avoidance of excitement are beneficial.

HEAT EXHAUSTION AND SUNSTROKE

Heat exhaustion is a state of weakness, dizziness, pallor, and profuse perspiration resulting from exposure to high temperatures over a prolonged period of time. Sunstroke (heatstroke) is a disturbance of the heat-regulating mechanism of the body due to the same pathogenesis.

Etiology: The etiology in both conditions is exposure to extreme degrees of heat, usually over a long or relatively long period of time. Association of the extreme heat with high humidity is particularly important in the causation of these states.

The pathology is not distinctive. Cerebral and visceral congestion are the chief changes, and, if death is sudden, there may be no noteworthy lesions.

Signs and Symptoms: Heat exhaustion is distinguished by weakness, dizziness, pallor, and cold clammy sweating. Stupor and rarely

loss of consciousness are seen. Pulse and respiration rates are accelerated and the blood pressure is lowered. The oral temperature may be subnormal or very slightly elevated. The rectal temperature, however, is alleged by tropical experience to be invariably raised to about 38.3° C. (101° F.). The onset is usually sudden and is not always precipitated by exertion. Where the environment is one of sustained heat, there may be a prodromal period of several days of malaise, headache, anorexia, and constipation.

Frequently there is no clear line of demarcation between heat exhaustion and heatstroke, and cases of heat exhaustion may after a time reveal evidence of sunstroke. The onset of the latter may occur with overwhelming suddenness and death may follow shortly. Premonitory cephalalgia, dizziness, nausea, or visual disturbances may precede the prostration. Consciousness is lost early. The face is flushed and the skin dry and hot. The temperature rises at times to 43.3° C. (110° F.) or higher. In the early stages the pulse is full and rapid and the breathing is deep; as the condition advances the pulse grows irregular and feeble, and the respirations more shallow, and of Cheyne-Stokes variety at times.

Heat cramps are another manifestation of prolonged heat exposure due to a concomitant depletion of blood chlorides. The condition is found particularly among stokers, miners, and steel workers. The onset is sudden. Cramps involve the muscles of the extremities or of the abdominal wall. They may occur intermittently for 24 hours and rarely longer.

Prognosis: The death rate from heat in the United States for the period from 1900 to 1932 amounted to 0.39 per 100,000. Deaths from heat are closely correlated with unusually high atmospheric temperatures continuing for several days, and are commoner in men than in women. Death from sunstroke may occur within a few minutes, but if the patient survives the second day recovery is probable. Persistent susceptibility to heat and impairment of memory are noticed after attacks of heat exhaustion and stroke.

TREATMENT

1. The patient with *heat exhaustion* should be brought to lie in a cool place.

a. Clothing should be loosened and water given by mouth.

b. Mild stimulants as aromatic spirits of ammonia, 2 to 4 cc. (½ to 1 dram), in a glass of water, should be given orally if the pulse continues to be rapid and weak.

c. If the situation is one where the temperature falls well below normal external heat must be administered and hot drinks given. Here caution must be exercised to prevent the passing of the condition into sunstroke.

2. The important and essential treatment of sunstroke is to reduce the body temperature to a tolerable level.

a. The patient may be placed in a bath of water, cooled to 10° C. (50° F.) and kept there until the rectal temperature falls to around 39° C. (102° F.). After this level is reached the body in favorable cases will continue to lose heat even after being removed from the water.

b. The skin must be massaged continuously while the patient is in the tub; otherwise, the overheated blood may be driven inward by peripheral vasoconstriction.

c. An ice-water enema, 1000 cc. or more, should be given.

d. The body may be rubbed with ice or placed in sheets wrung out of ice water.

e. Water may be sprayed onto the stripped body from a fine nozzle and accompanied by a current of air from hand or electric fans.

3. The victim of heat cramps must also be removed to a cool place.

a. Frequently rest alone is followed by subsidence of the cramps.

b. Sodium chloride, 1 Gm. (15 grains), every hour should be given until 15 doses have been administered. It may be injected intravenously if necessary.

4. Preventive Treatment: The untoward effects of heat are frequently due in part not only to the excessively high temperature of the environment and to chloride depletion, but to excessive heat production by the body and to insufficient production of sweat. Diet and clothing should therefore be adjusted to the environment.

a. Soft fine clothing or little or no clothing should be worn, so greater amounts of sweat may be produced and absorbed or evaporated.

b. The diet should be bland and easily digestible, consisting of light fruits and vegetables, rather than of calorie-producing meats and fats.

c. People in industry who work in high temperatures require more than the average amount of salt, and may obtain it by adding one level teaspoonful to each quart of water or by taking one 15-grain tablet of sodium chloride with every glass or two of water.

CAROTID SINUS SYNDROME

Hyperactivity of the carotid sinus reflex is strictly a clinical syndrome, which may occur in association with a variety of diseases. It is characterized clinically by episodes of fainting, dizziness with or without convulsions, and usually a decided arterial hypotension.

Etiology: This syndrome is often found in association with coronary heart disease, and whenever the disorder is recognized, a careful study of the cardiac mechanism should follow. However, there are other conditions, such as cerebral vasoconstriction, which if not the cause of the carotid sinus syndrome, are associated with it. An unstable vasomotor system is usually present. There is no unanimity of opinion at present concerning the exact etiology of the hyperactive carotid sinus syndrome.

Pathology: As this is a functional disorder, pathological changes in the tissues are not described.

Signs and Symptoms: Fainting, vertigo, visual disturbances, general weakness, buzzing in the ears, and numbness and tingling in the extremities are the characteristic symptoms. These come on at irregular intervals, and are usually precipitated by constriction of the neck, as occurs with tight collars, psychic trauma, emotional disturbances and upsets, and by continued fatigue.

Patients appear to be in good health, and no evidence of malnutrition is noticed. Pallor, a tendency to clammy skin, lightheadedness, and lack of the usual physical energy are features. Two types of this syndrome may be recognized: Clinically, one is associated with marked hypotension with other evidences of vasodilatation and a slow, weak heartbeat. The other form is distinguished by a blood pressure which does not fall to abnormal levels, but the bradycardia is present.

Diagnosis: Confusion may occur in the diagnosis of the carotid sinus syndrome with such diseases as epilepsy, early Addison's disease, coronary disease of the heart, early tumors of the brain, hysteria, Stokes-Adams disease, and chronic hemorrhagic pachymeningitis interna. The diagnosis of hyperactive carotid sinus reflex is made by applying pressure with the thumb over the carotid artery where the common artery bifurcates and forms the internal and external branches. Pressure over this area will be exerted on the sinus. In the

presence of the disease, pressure on one side or the other usually causes slowing of the heart, pallor, weakness, convulsions, and, as a rule, a marked drop in arterial blood pressure.

TREATMENT

1. All existing associated abnormalities should be corrected, if possible. Emotional upsets or other conditions which might precipitate an attack should be eliminated.

2. One milligram (1/65 grain) atropine sulfate orally three or four times a day or tincture of belladonna, 1 cc. (15 minims) t.i.d., will usually prevent attacks; the least amount of the drug necessary to prevent attacks should be given. If there are distressing effects from the drug, 30 mg. (½ grain) ephedrine sulfate should be given orally three times a day instead of atropine. Phenobarbital, 15 mg. (¼ grain) may be given in conjunction with these drugs if there is excessive nervousness or palpitation of the heart. Thyroid, 60 mg. (1 grain) b.i.d., may do good.

If medication fails to relieve this condition, neurosurgeons may bring about relief by resecting unilaterally the carotid sinus.

SUBARACHNOID HEMORRHAGE

Subarachnoid hemorrhage is bleeding into the subarachnoid space from trauma and other causes.

Etiology: Cases of subarachnoid hemorrhage may be divided according to causes. There are those of unknown or undetermined causes and those of known causes. The known causes of subarachnoid hemorrhage are trauma, intraventricular or massive cerebral hemorrhage, blood dyscrasias, ruptured intracranial aneurysm, septic or infectious embolism, arteriosclerotic degeneration of vessel walls, and ruptured cerebral neoplasm. It may occasionally result from shock therapy.

Signs and Symptoms: The onset is sudden, usually after physical exertion or excitement. Headache, vomiting, and dizziness are the initiating symptoms, caused by the blood escaping into the subarachnoid space and increasing the intracranial pressure. The blood then travels along the sheaths of the optical and cranial nerves. This may result in increased intraocular pressure, retinal hemorrhages, pupillary changes from day to day, hyperemia of the disks, facial paresis

and deviation, extraocular palsies, ringing in the ears, and respiratory and cardiac disturbances. Nuchal rigidity is common. A mild Kernig sign may be present. Usually the consciousness of the patient is impaired in varying degrees.

Mild leukocytosis, elevation of temperature, and slow pulse compared to the temperature are generally characteristic.

Diagnosis: The spinal fluid is uniformly bloody, but varies in intensity of color. On standing, the red blood cells collect at the bottom of the test tube, while the top fluid is yellow or orange.

Subarachnoid hemorrhage may simulate septic meningitis, encephalitis, tumor of the brain, uremia, or sinusitis.

TREATMENT

1. The headache should be relieved immediately by the administration of mild sedatives, as codeine and acetylsalicylic acid. The head of the bed may be elevated.

2. The intracranial pressure may be reduced by hypertonic dextrose or sucrose solutions, intramuscular injections of magnesium sulfate, or caffeine with sodium benzoate. Lumbar puncture should be exercised with care, being used only in those cases due to trauma, arteriosclerosis or unknown causes, or to arrive at a diagnosis. In other cases, repeated punctures may cause the patient's death. Usually only 5 to 10 cc. should be withdrawn at any one time. It may be said that dramatic results in relieving the patient's symptoms have occurred in cases which refused to react to other medications.

3. An adequate amount of nutritious food should be given. Since many of these patients have no appetite, vomit, or are unconscious, tube feeding may have to be resorted to. Fluid intake should be limited to 1200 cc. per day. Salt and vitamins should be given.

4. Paraldehyde, intramuscularly, by mouth or rectum will reduce excitement, or a mild restraint may be employed.

5. Patients should be kept in bed for six weeks and allowed to convalesce for six months. It is important to protect the patient from excitement and physical exertion of any kind.

CHAPTER XII

The Kidneys

ACUTE NEPHRITIS

Acute nephritis is sometimes subdivided into the acute focal, the hemorrhagic, and the diffuse forms. From the clinical standpoint this subdivision is not only unnecessary, but at times may be confusing. As all three classes are merely manifestations of various phases or degrees of intensity of the inflammatory lesion in the kidney, it is considered best to use one term only, and that term is acute nephritis. In the past some writers advocated the use of the term "acute glomerular nephritis," as helpful in differentiating between acute tubular nephritis and acute glomerular nephritis. The same objection holds here as above, since both the glomeruli and the tubules are involved when the kidney is caught in this inflammatory disease.

Etiology: Acute infections practically always precede the onset of acute nephritis. Nearly all writers are unanimous in the opinion that upper respiratory infections constitute the chief cause of acute nephritis. Diphtheria, measles, chickenpox, suppurative lymph glands, chills, appendiceal abscess, or almost any infection in the body may be responsible for nephritis, but tonsillitis, septic sore throat, and otitis media are the main predisposing diseases.

Pathology: Acute glomerular nephritis is not merely a disease of the kidney, but may involve various systems of the body as well as the glomerular tufts. The term "acute glomerular nephritis" is used, because the capillaries of the glomeruli are practically always the site of the initial lesion. While it is known that infection by streptococci plays the predominant rôle in the cause of acute glomerular nephritis, the mechanism by which glomerular inflammation arises is not entirely clear. It is almost universally accepted that the streptococci do not cause glomerular inflammation by direct invasion. The most widely held opinion, but one that lacks positive proof, is that the streptococci call for the production of antibodies in such concentrations that an interaction develops between the formed anti-

bodies and the antigen itself, resulting in the formation of a toxic material which is responsible for the injury of the capillaries of the glomeruli. However, it has always seemed rather paradoxical that Nature in its wise provision for warding off the attack of the streptococci adequately would thereby subject essential organs of the body to such a crippling disease as glomerular nephritis.

The chief changes occurring in acute glomerular nephritis are swelling and disintegration of the endothelial cells which line the capillaries of the tufts. The process is a diffuse one involving all glomeruli in all the tufts. Some glomeruli are more severely involved than others, but practically no glomerulus escapes some injury. The tubules in the very early stages of acute nephritis may remain intact, but in a few days cloudy swelling, granular degeneration, and disintegration of the epithelial cells commences. The proximal and distal types are especially involved. Grossly, the kidney is large and ischemic, and the capsule is usually under greater than normal tension, so that when the capsule is nicked it splits away from the kidney parenchyma by virtue of the intracapsulary tension. Microscopically, the glomerular loops are practically bloodless, due to the fact that the swollen epithelium occludes the lumen of the capillary. The degree of inflammatory change noted under the microscope varies considerably with the intensity of the inflammation. However, the clinical features may be easily explained by the pathologic changes in the kidney, and correlation between the changes in the glomeruli and the tubules and the clinical picture is usually discernible.

Symptoms: Following an acute infection, for example, an upper respiratory infection, the patient may develop the clinical picture of acute nephritis within a period of from two to eight days. The classical textbook picture of hematuria, hypertension, edema, and nitrogen retention is not always present; in fact, it seldom is. Only the rare cases present the typical well-known clinical features. More often the patient has only evidences of renal inflammation as shown by the urine examination. Albuminuria, red blood cells, pus cells, and casts in the urine are frequently the only signs, and are often overlooked if symptoms are absent. A urinary syndrome is the one of greatest importance, because most reliance can be placed on the urinary changes. Edema, hypertension, and nitrogen retention may

be present or absent. Disturbances of urination characterized by a scanty outflow of urine or even complete anuria may be present. In these cases, examination always reveals red blood cells, pus cells, and casts in the urine. Many times the oliguria is not marked enough to be recognized unless it is looked for specifically. The severity or mildness of the kidney disease cannot always be measured by the examination of the urine or any other tests.

Hypertension is present in about 40 per cent of cases of acute nephritis. It is not an obligatory sign, as it was thought to be years ago, yet the onset of hypertension in acute nephritis is always a serious and frequently a disastrous complication. If it is present at the beginning and drops down to normal within the first week or two of the disease when resolution begins to set in, less importance is attached to the hypertension. If, on the other hand, hypertension makes its appearance and the blood pressure keeps rising little by little after the renal disease is in progress, this is a sign of unfavorable prognosis. Sometimes the blood pressure rises rapidly to 200/120 mm. Hg. The eyegrounds in these cases often show evidences of so-called albuminuric retinitis. This is a grave sign, though some of these patients do recover.

Edema is not an important syndrome unless it makes its first appearance after the disease is in progress for a week or two. The onset of edema a little later on in the course of the disease usually indicates an extensive involvement of the kidney and frequently a permanent one. Sometimes the edema is very mild and hardly recognized by the examining physician. Persons of the household, however, are more apt to notice the rounded-out features and the pallorous waxy condition of the face.

The rise in the nonprotein nitrogen is a sign of renal insufficiency. Frequently the rise is rapid in the early stages of acute anuria. Then after four or five days, when urine output is restored to normal, the blood NPN drops to normal. While the initial rise in NPN in the acute episode is not of great importance, it does point out to the physician that he must establish urinary flow as soon as possible. As a rule, if this condition is allowed to go uncorrected for seven or eight days genuine fatal uremia sets in.

Uremia: Uremia is a difficult syndrome to evaluate because it may mean either the genuine or convulsive form. Genuine uremia

is the direct outcome of renal insufficiency and is entirely independent of the convulsive seizures which are associated with and probably caused by hypertension. A rising NPN is the precursor of uremia in most instances. Usually the diastolic pressure of 120 mm. of mercury, edema of the optic discs, fresh hemorrhages, and fluffy white patches go hand in hand with convulsions. The spinal fluid pressure in convulsive uremia is usually increased above the normal 150 mm. of water up to 300 mm. of water pressure. While the patient that develops genuine uremia hardly ever recovers, the outlook is entirely different with the convulsive type of uremia, which frequently clears up and appears to have little or nothing to do with the chances of a rather long life afterwards.

Cerebral Complications: Headache, visual disturbances, vomiting, convulsions, and loss of consciousness occur in the course of acute nephritis. These complications were at one time thought to be the result of edema of the brain, and, although edema of the brain may be present, it is the hypertension that is behind these features which is to blame, as they practically never occur without high blood pressure.

Ophthalmoscopic examination often is a valuable indicator of the degree of cerebral involvement. The retina may be pale and the arteries thin and almost bloodless. The margins of the discs are often blurred and later on genuine choked disc develops. Within a short time hemorrhages may be seen throughout the retina and even fresh white fluffy patches appear. The typical picture of so-called albuminuric retinitis may develop within a period of 12 hours. As the eyeground is looked upon as a mirror of changes in the kidney, this kind of an examination is of utmost importance in following the course of acute nephritis.

Remissions and Relapses: After the first two weeks of acute nephritis patients usually appear to make a complete recovery, and in some cases they do. In others the recovery is more apparent than real. Frequently the patient that seems to have recovered completely is only partly cured, and the cure is more on the surface than underneath. These patients may feel quite well and the parents and others, and occasionally and unfortunately the physician in charge, may be led to a premature assumption that the nephritis has entirely subsided, when only the more acute, severe phase has passed. In some

of these cases a low-grade, smouldering inflammation continues. This may be called the latent stage of acute nephritis, where nothing appears to be wrong unless careful urinary examination is carried out. Then the truth comes to light and it is found that an excessive amount of red blood cells, pus cells, and casts are present in the urine. There may be no high blood pressure, headache, edema, or other disturbances. Sometimes these latent cases go on to recovery, while others continue and finally terminate with chronic glomerular nephritis. Perhaps the greatest problem in the management of acute nephritis is to recognize this latent stage and to deal with it satisfactorily.

TREATMENT

The chief aim in the treatment of acute nephritis is to prevent further deterioration of the inflamed kidney, and at the same time to maintain as well as possible the general health of the body. This is accomplished by using measures which not only are directed at curing the disease of the kidney, but restoring the physiological functions of the body which have deviated from normal.

Treatment consists in shielding the patient from acute infections as much as possible and protecting the kidneys when the patient actually develops acute infection. It seems that this has been quite satisfactory in scarlet fever, but not so effective in cases of simple upper respiratory infection. Complete rest, alkalinization, and regulation of food intake are the chief safeguards in this phase.

Sulfonamides may be beneficial in the treatment of nephritis. Williams, Longcope, and Janeway used sulfanilamide and noted that it increased the incidence of recovery and prevented progression of the condition. I have seen good results follow the use of sodium sulfathiazole and sodium sulfadiazine. Of course, this form of treatment must be used with caution, as severe renal damage may ensue, either as a result of obstruction due to clumps of crystals in the tubules, pelves, or ureters, or as a result of direct nephrotoxic action. As a rule, untoward reactions may be avoided if a few simple precautions are taken. The state of hydration must be carefully watched, and it is a good rule to insist on a daily fluid intake of from 2000 to 3000 cc. The urinary output must also be closely checked, with special emphasis on quantity and appearance on

gross and microscopic examination. If crystals are detected extra care must be exercised in regard to dosage, blood level, and urinary output. Alkalinization of the urine may reduce the incidence of crystalluria. Experimentation shows that if the *p*H of the urine can be kept well above 7 the occurrence of crystalluria is diminished. The sulfonamides should not be given before any renal insufficiency or obstructive uropathies have been carefully evaluated.

The patient must be kept in bed until all signs of renal inflammation have passed. This means more than keeping the patient in bed while hypertension, edema, and hematuria exist. The patient must remain in bed as long as the microscopic examination of the urine shows red cells, casts, and albumin, and until the sedimentation rate becomes normal. Other tests helpful in the detection of unhealed renal lesions are the concentration test and blood urea clearance test. The presence of an unresponsive anemia indicates that the kidney damage is becoming worse. It is generally well to insist on four months of modified bed rest. If the kidney has not cleared up by this time the condition is probably chronic and continued rest will have no effect.

In order to restore the body functions to normal, one must first know the disturbances which have resulted from renal insufficiency. This requires a fundamental knowledge of the water balance, salt and alkali reserve, the plasma protein content, and the amount of nitrogenous substances retained in the blood. To achieve good results one should be prepared to give intravenously glucose and sodium chloride solutions, alkalinization infusions as 1/6 molar sodium lactate, and plasma protein, or better, albumin.

The diet requires special consideration. The optimal quantities of protein, salt, and fluids vary so much with the requirements of each case that it is difficult to lay down precise instructions. However, the following generalizations may be helpful:

Protein increases the work of the kidney, and may augment the inflammation, and retard the healing processes. Usually 1 to 2 Gm. per kilo of body weight are sufficient to meet the body requirements. If there is a deficiency of protein in the diet the kidney may be spared, but the patient suffers as a consequence. Sometimes plasma proteins, especially albumin, are greatly reduced and play a rôle in edema formation. Then it is wise to give more protein to make

up the deficiency. Albumin may be given intravenously in amounts varying from 12 to 25 Gm. every day for three days until plasma albumin rises.

Rarely is there ever a sodium chloride deficiency in acute nephritis, but an excess of salt in the body is common. A diet low in sodium chloride is given to prevent edema. This is satisfactorily accomplished by withholding the addition of salt from food. It is seldom necessary to resort to rendering natural foods salt free. It is wise to watch carefully the sodium and chloride content of the blood in nephritis, for in the presence of renal insufficiency a depletion of sodium chloride may occur. This can be rectified by the addition of 2 to 3 Gm. (30 to 45 grains) of salt daily by mouth, or by giving 500 cc. of normal saline solution intravenously daily for two or three days.

It should be emphasized that hydration is an important feature of treatment. The patient may be edematous and yet be dehydrated, as indicated by plasma volume studies. Fluids are necessary despite the fact that the water balance is disturbed and edema is present. Fluids may be given in amounts from 2000 to 3000 cc. daily in the form of fruit juices, milk, imperial drink, or water. When there is vomiting the same quantity may be given intravenously. A physician is often in doubt as to what kind of fluid to administer to the patient. In general 1000 cc. of ten per cent glucose solution may be given slowly intravenously once or twice a day, depending on the needs of the individual. If there is acidosis or a rapidly rising nonprotein nitrogen, 500 cc. of 1/6 molar solution of sodium lactate may be prescribed in addition. Five hundred cc. of normal saline solution may also be added, if renal insufficiency is associated with a depletion of sodium chloride from the blood.

Resistance of the individual plays an important part in recovery and renal inflammation is less likely to subside in a person who is anemic and whose strength is sapped by the causal infection which usually accompanies the nephritis. Vitamins play an important part in building up the resistance of the individual and should be given daily; A and D may be given in the form of cod or halibut liver oil capsules, B complex in brewer's yeast and supplemented by intramuscular injections of thiamin chloride, 2 to 3 cc., daily. Vitamin C may be given in tablet form. The value of iron has been proved by

careful observers and may be administered in the form of iron ammonium citrate, 0.66 Gm. (10 grains), three times daily.

If diuresis can be established the signs and symptoms of acute nephritis usually subside. Water is the most important of all diuretics, but simple diuretics as potassium citrate, 1.33 Gm. (20 grains), three or four times a day, or a combination of potassium citrate and potassium acetate, each 1.33 Gm. (20 grains) three times a day in liquor ammonium acetate, may be administered to aid in the promotion of diuresis. The stronger diuretics are to be condemned in the treatment of acute nephritis.

Heart Failure: In the course of acute nephritis the heart in certain cases may have to bear the brunt of the blow. This is particularly true if hypertension is present. In this case the heart becomes dilated and the apex beat shifts well to the left. If convulsions set in, the strain on the heart is accentuated and the patient may die of acute dilatation of the heart. More familiar though is the patient with a slowly dilating left ventricle, followed by pulmonary edema, which gradually becomes worse until finally death comes from advanced pulmonary edema. In these cases treatment is largely symptomatic. The hypertension may be controlled by magnesium sulfate. Venesection may be employed with good results. Sometimes digitalis in doses of 0.1 Gm. (1½ grains) three times a day is beneficial. Morphine may be required and oxygen promotes comfort.

Cerebral Complications: The complications pointing to cerebral involvement, such as nausea, vomiting, visual disturbances, headache, and coma, are familiar to every practitioner and are serious emergencies. The treatment of these complications is as follows:

1. An intravenous injection of 15 cc. of 25 per cent magnesium sulfate solution is indicated. This may be repeated three or four times in 12 hours.

2. Sometimes spinal puncture is necessary in order to reduce the pressure of the spinal fluid.

3. Sodium amytal, 0.2 Gm. (3 grains), or some other sedative of light nature must be given to quiet the patient. If convulsions are occurring the sedative should be administered intravenously. Fifty cc. of 50 per cent sucrose solution have been advocated, but it is considered unwise to use the sucrose solution for cerebral complications unless there is a fairly good urinary output.

4. Testosterone propionate or estrogenic hormones given as for hypertensive cerebrovascular crises may benefit the cerebral symptoms.

UREMIA

Uremia is a clinical syndrome caused by retention in the blood and tissues of toxic substances which should have been excreted in the urine.

Until 1870, no differentiation was made between the different forms of uremia. Then Traube stated that convulsive uremia was due to edema of the brain. In 1912, Volhard and Fahr separated uremia into two great classes. The nomenclature identifying these groups varies considerably, but it may be stated that a patient either has (1) genuine uremia or (2) convulsive uremia.

1. Genuine uremia is the direct outcome of renal insufficiency. It comes on when the kidney fails to excrete urine and the toxic materials are retained in the blood stream. There is a rise in the nonprotein nitrogen and creatinine in the blood. This type of uremia is caused by any condition which produces renal insufficiency. It may be due to tuberculous destruction, malignancy, pyelonephritis, or it may be the direct outcome of Bright's disease. Genuine uremia is distinguished clinically by the following features:

a. There may be the cerebral type, in which the patient is maniacal, euphoric, or stuporous. In these cases, the stupor gradually merges into renal coma.

b. The gastrointestinal type is that pointed out by Osler as the typhoid form. There may be diarrhea, tympanites, vomiting, dehydration, and at times hematemesis.

c. The cardiorespiratory type is the form in which there is severe dyspnea, usually without apparent cardiac disablement. Uremic pericarditis develops in this form.

2. Convulsive uremia stands out in direct contrast to genuine uremia since it is not dependent on renal failure, and retention of nitrogen has no connection with the condition. It is distinguished by high blood pressure associated with edema of the brain. It seems that the edema of the brain leads to convulsions. There is a relation between the hypertension and the eyeground changes (albuminuric retinitis). If the diastolic pressure is above 120 or 130, edema of the discs is usually present, and the spinal fluid pressure is usually greatly

increased. The convulsive attack simulates closely epileptic attacks: after the convulsion, there is a clonic convulsion followed by stupor.

Prognosis: The outlook varies with the patient. Convulsive uremia frequently clears up and the patient lives for years in comparative comfort. On the other hand, genuine uremia usually means that the kidneys have failed and the chances of prolonging life are slight.

TREATMENT

The treatment of uremia is not always attended by unsuccessful results. It must be kept in mind that uremia may be produced by a variety of conditions. Some of the diseases that may cause uremia respond fairly well to treatment, as hypertrophy of the prostate, obstructive lesions in the upper urinary tract which are removable, and the uremia which comes on in the hypertensive arteriosclerotic individual who develops some myocardial insufficiency and extensive dehydration. The uremia of the end stage of chronic glomerulonephritis is usually irresponsive to any treatment and only temporary alleviation of symptoms can be anticipated.

The most dramatic results in the treatment of uremia often are obtained in those cases where the uremic condition is caused by a closing down of the kidney in the presence of dehydration and myocardial insufficiency. In such cases, it may appear from the examination that the kidneys' reserves have all been lost, but administration of fluids and other treatment are frequently followed by a complete recovery from the uremia and by years of active existence even though the reserve forces of the kidney are below normal.

While many therapeutic attempts have been made to control uremia, most of them may be summarized in the following rules:

1. By far the most important aid in genuine uremia is the administration of fairly large quantities of fluid. Since the patient usually cannot take or retain very much liquid by mouth, 2000 to 3000 cc. a day should be given intravenously. The output of the toxic products of metabolism is dependent largely on the output of urine; therefore, the urinary output becomes the problem of main concern. Naturally, the way to increase the output of urine is to increase the intake of fluid. It is emphasized that a very accurate record of the intake of fluids must be kept to aid in the management of the patient with uremia.

In convulsive uremia, it is not wise to push fluids because dehydration is desired for the purpose of reducing the edema of the brain and the spinal fluid pressure. There are times, however, when it is necessary to give fluids to increase the output of urine. In these cases, the fluids must be given slowly and cautiously. Magnesium sulfate in 20 per cent solution in amounts of 10 to 20 cc. intravenously two or three times daily has been used to control the convulsions which may occur. Dextrose, 50 to 300 cc. of 30 per cent solution, may be given instead of magnesium sulfate. I have used sucrose, 300 cc. of 50 per cent solution intravenously, to reduce the spinal fluid pressure and edema of the brain. It not only promotes diuresis in a way that cannot be accomplished by other solutions, but the patients seem much improved clinically after these sucrose injections.

In older individuals whose hearts are damaged by a degenerative process, 2000 to 3000 cc. of fluid may be given safely, providing it is administered slowly and cautiously.

The kind and quantity of fluid to be used is not always easy to determine. The rational procedure is based on a consideration of the chemical and physiological disturbances and on the correction of them by administration of fluids. In most cases, the proper use of five and ten per cent glucose solution, sodium chloride solution, plasma, and solutions of albumin, sodium bicarbonate, and lactate will accomplish all that can be accomplished. Diminution in the output of urine which leads to retention of nitrogenous substances in the tissues and blood is the commonest defect, and it may be corrected by the intravenous administration of 1000 cc. of five or ten per cent glucose solution. This may be repeated two or three times a day, depending upon the individual requirements.

Sometimes it is wise to give 1000 cc. of five per cent glucose in isotonic saline because there is a loss of sodium chloride in some patients with uremia, especially if vomiting precedes coma. In nephritis, before uremia sets in, there may be difficulty in excreting sodium chloride. Then, later, when uremia develops, there may be hypochloremia which, if uncorrected by the judicious use of sodium chloride, may in itself cause added kidney damage. Therefore, in some instances, a solution containing both glucose and saline is administered, and in others, glucose alone.

It is always desirable to determine precisely the sodium and

chloride levels of the blood. When in doubt, solutions of five or ten per cent glucose are safe if given at the rate of 5 or 10 cc. per minute. In the presence of an impaired circulation, the rapid intravenous administration of any fluid may lead to further damage. As a general rule, solutions of sodium chloride may be used safely when dehydration is present without a rising nonprotein nitrogen of the blood. An excessive amount of sodium chloride intravenously may cause edema and diminish the output of urine.

A common defect is hypoproteinemia which may be corrected by the use of 200 cc. of plasma daily for several days. Solutions of albumin are also effective when they are available. Whenever a patient develops oliguria or anuria and uremia, one may assume that not only azotemia but acidosis is present. The intravenous administration of 500 cc. of ⅙ molar solution of sodium lactate is given. Five per cent solution of sodium bicarbonate may be given in place of sodium lactate and repeated daily until acidosis is overcome.

2. The use of diuretics. There is a natural tendency for the physician in charge of a patient with anuria and uremia to wish to give something to stimulate the kidneys to further action. The various diuretics naturally come to mind, but those commonly used to make the urine flow in cases of heart failure, as the mercurials and diuretin, are of very little value and may cause actual harm in uremia. Probably the most important diuretic of service in cases of uremia is aminophylline given in 0.53 Gm. (8 gr.) doses intravenously along with 50 cc. of 50 per cent glucose. The aminophylline has a tendency to increase the capillary activity and thereby may be helpful.

3. When the kidneys are functioning insufficiently, it is traditional to attempt to relieve the body of the by-products of metabolism through extrarenal routes. Sweating, for example, the hot pack, is one of the oldest measures in treatment. While it is recognized that the hot pack does not eliminate very much of the waste by the sweating process itself, it has another action which may be of some importance. It may act as a counterirritant and in that way promote renal activity. The hot pack is justified not because of any scientific reason but merely because it appears to do good in certain cases.

4. The diet in uremia assumes rather a small place in treatment because the patient's gastrointestinal tract is usually unable to retain food. After the episode of intoxication passes over, diet assumes some importance; it should be high in carbohydrate, low in protein, and rich in the various essential vitamins. This is easily fulfilled by giving the patient cereals, ice cream, fruit juices, gelatin, and similar types of nourishment. When vomiting, nausea, and abdominal distention become distressful, one's therapeutic ability is usually strained to the utmost. Frequently, however, the following preparation may be of some aid: tincture of belladonna, 16 Gm. (4 drams) and elixir of phenobarbital, 120 Gm. (4 oz.), one teaspoonful three times daily. If this cannot be taken by mouth 15 Gm. (½ oz.) may be given per rectum and repeated every hour or two. Sometimes it is necessary to give atropine, 0.0004 Gm. ($\frac{1}{150}$ grain), hypodermically.

5. Acidosis is usually a part of the syndrome of uremia and the carbon dioxide combining power of the blood may drop to as low as 15 to 20 volumes per cent or lower. This troublesome complication may be warded off by the administration of alkali by mouth in the earlier stages of the disease, or if the patient is unable to take such preparations by mouth, 500 cc. of ⅙ molar sodium lactate solution intravenously is recommended. This may be given every eight hours with good results.

6. The cerebral manifestations such as sleeplessness, delirium, or coma, may be the most prominent features of an early uremia. The treatment of these manifestations requires considerable judgment. A hot bath or warm pack may be satisfactory in relieving the restlessness and delirium. Bromides given alone or in combination with chloral in doses of 1.33 Gm. (20 grains) each are of outstanding help. If the patient is unable to swallow these preparations, they may be given by rectum. If these simple remedies fail, one is justified in administering hypodermically pantopon, 0.02 Gm. (⅓ grain), dilaudid, 0.003 Gm. ($\frac{1}{200}$ grain), or morphine, 0.015 Gm. (¼ grain).

ACUTE SUPPRESSION OF URINE

Acute suppression of urine is a failure of secretion by the kidneys. It must be differentiated from acute retention of urine in which urine is secreted by the kidneys and retained within the bladder.

Etiology and Pathology: Failure of the kidneys to secrete urine is brought about by (1) congestion associated with acute nephritis; (2) mechanical obstruction of the urinary tract by stone in the ureters or renal pelves or by ureteral strictures, neoplastic growths in the ureters, or embolism of main vessels of both kidneys; (3) bilateral necrosis of the cortex of the kidneys as seen occasionally in accidents of the puerperium and debilitating diseases or (4) degenerative nephritis due to poisoning by or from the heavy metals; (5) dehydration; (6) retention of fluid in tissues; (7) low blood pressure simulating shock; and (7) endocrine factors. There are innumerable rare conditions which may be responsible for acute suppression of the urine. Reflex anuria caused by the passing of a catheter has been known to occur rarely. The hydronephrosis which so frequently accompanies partial obstruction of the urinary tract does not usually appear in acute suppression of urine.

Signs and Symptoms: There may be remarkably few symptoms. Headache, dyspnea, vomiting, and lumbar pain are most commonly seen. Convulsions occur rarely and consciousness is not lost until shortly before death. The severity of the symptoms of anuria varies directly with its duration which may be for hours or days. A distinction from retention of urine may be made by examination of the abdomen or by catheterization.

Obviously little if any urine is obtained. What little is found may reveal evidence of acute nephritis or other manifestations of the cause of the anuria. Retention of nitrogen occurs in the blood, frequently in larger amounts than during the terminal stages of long-standing nephritic uremia. Pyelographic visualization of the urinary tract may reveal the cause and avenue of treatment of the condition.

Prognosis: The prognosis in acute suppression of urine must always be guarded. It obviously depends on the cause of the disorder. The earlier diuresis is resumed, the better the outlook. Recovery has been reported, however, after total suppression of urine for 19 days.

TREATMENT

1. Suppression of urine caused by acute nephritis or by degeneration or necrosis of the kidneys requires that large quantities of fluid be offered to the kidneys to aid in opening their channels.

Isotonic fluid, 3000 to 5000 cc. of five per cent glucose in normal saline, administered intravenously and subcutaneously, should be given daily for its hydrating effect, and hypertonic glucose, 300 cc. of a 20 per cent solution, intravenously twice daily for its diuretic effect.

2. Hot packs to the kidney area, vigorous purging, and hot colonic irrigations have demonstrated their value.

3. A spinal tap is indicated at times when an increased intraspinal pressure is associated with the nitrogen retention.

4. Surgery is imperative when the anuria is caused by local obstruction which cannot be removed by retrograde examination of the urinary tract. If the suppression lasts more than a few days, surgery to decapsulate the kidney must be tried, even if there is no local obstruction.

5. Adrenalin, ½ to 1 cc. (7½ to 15 minims) of a 1:1000 solution, subcutaneously has been shown to release the suppression that is brought about by reflex action. A nitroglycerin tablet, 0.0006 Gm. (1/100 grain), placed under the tongue, may also be tried and at times has been effective in relieving the suppression.

RENAL COLIC

Renal colic is an abdominal pain of extremely severe degree caused by the passage of a renal calculus down the ureter.

Etiology: Renal stones are concretions formed from substances normally in solution in the urine. "A urinary stone or calculus is a body resembling a stone in its general characteristics and formed of crystalline urinary salts (exceptionally of other substances) held together by viscid organic matter and showing microscopically or to the naked eye laminated structure" (Keyes). Primary stones develop in an acid urine without antecedent inflammation, while secondary stones form in alkaline urine which is the result of infection. The primary stones are composed usually of uric acid, calcium oxylate, and the urates of sodium, calcium, or potassium. The secondary stones are formed of mixed phosphates of ammonium, magnesium, or calcium. There are various theories why solids ordinarily in solution in the urine are deposited as concretions. Among the causes listed as responsible for stones are absence of non-albuminous colloids, the reaction of the urine, stasis, infection, dietary deficiency, and hyperparathyroidism.

Signs and Symptoms: The pain of renal colic is one of the most severe known and it may resist large doses of morphine. It begins suddenly, often in a person otherwise in the best of health. It radiates across the abdomen, is referred to the region of the kidney and ultimately down the course of the ureter to the bladder, symphysis pubis, genitalia, or the inner side of the thigh. It is often accompanied by retraction of the testicle, the radiation corresponding roughly to the progress of the stone down the ureter. Faintness, nausea, vomiting, cold sweat, and shock accompany the pain. Often there is incipient stimulus to urinate, and urination becomes very painful. The urine is scanty, high-colored, and frequently bloody. The manifestations are related to the size of the calculus. Palpable enlargement of the kidney occurs in 10 to 25 per cent of cases and is presumably due to hydronephrosis or pyelonephrosis. Ten to 20 per cent of cases are bilateral.

Albuminuria, hematuria, and pyuria of varying degrees are present. Calculi may be found in the strained urine. Roentgen examination of the abdomen may reveal the presence of stones with or without pyelography.

Complications include obstruction, ulceration, and infection. Hydronephrosis may be a sequela. The obstruction, if complete, may cause anuria of the affected kidney. Complete anuria ensues when both kidneys are blocked simultaneously. Ulceration is more likely to occur with a larger and less moveable stone and may cause perforation and extravasation of urine. Ureteral stricture may result from an impacted stone. Renal calculi are among the commonest causes of infection of the kidney, particularly with staphylococcus albus.

Prognosis: When anuria persists more than a few hours, the chance of spontaneous recovery is diminished, but removal of the stone by manipulation or operation makes the prognosis better. The conditions responsible for the formation of calculi continue after their removal and in many cases lead to new concretions.

TREATMENT

1. The relief of pain usually requires morphine, 0.016 to 0.032 Gm. (¼ to ½ grain), repeated in the space of an hour to secure relief. Atropine, 0.006 Gm. (1/100 grain), may be given simul-

taneously in an attempt to bring about ureteral relaxation. Nitroglycerin, 0.006 mg. (1/100 grain), is beneficial at times.

2. Local application of heat or a hot bath is comforting and upon occasions this procedure is sufficient to relieve the spasm.

3. Relief of the anuria may be secured by the intravenous injection of 50 to 200 cc. of 50 per cent glucose solution or the administration of 1000 to 2000 cc. of five per cent glucose in physiological saline intravenously. Colonic irrigations and purging may be tried in an effort to relieve the anuria.

5. Glycerin in doses of 60 cc. (2 ounces) three times daily for three days has been recommended as an aid in the passage of renal stones.

6. Acidification of urine by administration of ammonium chloride, 1 Gm. (15 grains) four times daily, and sodium acid phosphate, 0.66 Gm. (10 grains) four times daily, is recommended.

7. Hyperparathyroidism may have to be corrected by surgery.

8. If the stones are phosphatic, they may be dissolved by a solution consisting of citric acid (monohydrated), 32.25 Gm.; magnesium oxide (anhydrous), 3.84 Gm.; sodium carbonate (anhydrous), 4.37 Gm., and water to make 1000 cc. A roentgenogram will help determine whether or not the stone is of a type which will respond to this treatment and an air pyelogram aids in showing its exact position. The apparatus used depends on the case. The pressure in the kidney should be sufficient to force the solution around the stone, but the solution should not be forced around the stone continuously as this may cause a pyelonephritis. If only one ureteral catheter is used a bladder catheter should also be employed to prevent the irritation which may occur as a result of voiding around the ureteral catheter. A soft rubber catheter (Bardam No. 10) may be left in place for weeks or months. The apparatus may be so adjusted that the patient can operate it himself. The progress of the dissolution may be checked by air pyelograms. While this therapy is being used, sulfonamide medication is advised to prevent or combat infection.

PYELONEPHRITIS

Pyelonephritis is an infectious disease of the kidney pelvis and parenchyma.

Etiology: Pyelonephritis is caused most commonly by the Bacil-

lus coli, pyogenic cocci, and at times by the tubercle bacillus. The Bacillus coli and related organisms are present in two-thirds of the cases. They have a tendency to involve the pelvis of the kidney more than the parenchyma. The pyogenic cocci include the Staphylococcus aureus and albus, the streptococcus and pneumococcus, and rarely the gonococcus. At times other infecting agents as the Bacillus proteus, the Bacillus pyocyaneus, the Bacillus influenzae, and the Actinomyces bovis are isolated. The pyogenic cocci tend to affect the parenchyma of the kidney and cause perinephritic abscesses. Bacteria are transported to the kidney by the blood or by extension up the ureter. The latter may be due to reflux of urine with inflammation of the ureter or to obstruction of the lower urinary tract. Other routes of infection are the lymphatic system and more rarely by direct extension from neighboring organs. Bacteria may pass through the kidney without causing any apparent harm, a notable example of which is the typhoid bacillus. Lowered resistance of the kidney to infection is probably brought about by stasis as a result of conditions such as hydronephrosis and calculi. Ascending infection by the colon bacillus is found relatively frequently in young girls, pregnant women, and elderly men.

Pathology: In addition to the inflammatory reaction found in the mucous membrane of the renal pelvis and lower urinary tract, lesions consisting of round cell infiltrations are found early about the tubules. These round cell infiltrations may break down into abscesses. The end result is the formation of scar tissue, and consequently the tubules are distorted or destroyed. In the chronic form of the disease, the pathology resembles grossly that of chronic glomerulonephritis with adherent capsule, loss of normal markings, and a thinned parenchyma. The calyces become dilated, old scars are found in the renal tissue, and the walls of the renal pelvis are hypertrophied and thickened.

Signs and Symptoms: The onset is frequently sudden with chills, fever, pain, and tenderness in the involved kidney area, frequent and painful urination, and the presence of bacteria, pus, and albumin in the urine. The fever varies from a brief rise to a fulminating septic curve. A distinct chill occurs in the more severe cases. Pain in the costovertebral angle is caused by stretching of the kidney capsule in severe cases. In milder cases, only tenderness over the involved

kidney is elicited by pressure. The pain may extend anteriorly to the region of the gallbladder or even as low as the appendix and it may radiate across the abdomen. Hypertension may be a direct result, or it may exist coincidentally. In chronic cases, the damage may be sufficient to cause symptoms of uremia.

Leukocytosis is usually present. Bacteria can nearly always be found in the urine. Albumin and white blood cells, frequently clumped, are always present in the urine unless there is a local obstruction to the urinary flow on the corresponding side as is occasionally found at the beginning of the disease. Casts are more commonly absent. Red blood cells are rarely abundant enough to cause manifest hematuria, but they may be found under the microscope. The urine is scanty and high-colored in the acute cases, but may be increased in amount and of low specific gravity in the more chronic cases in which there is severe renal damage. All grades of functional impairment of the kidney may be encountered as evidenced by lowering of the specific gravity of the urine, increase in the volume of the night urine, poor response to renal function tests, and nitrogen retention in the blood. There may be changes in the pyelographic picture, and exact differentiation between various renal diseases may require ureteral catheterization and pyelography.

Prognosis: The prognosis of pyelonephritis depends upon a variety of factors, including the virulence of the organism, the location of the lesion in regard to drainage and the degree of renal damage. Infections by the pyogenic cocci are more dangerous than those caused by the colon group. The more the lesion is confined to the pelvis and the less it involves the parenchyma, the better will be the chance of resolution. Obstructions must be removed from the urinary tract as soon as possible for a satisfactory outcome to be anticipated. The course of chronic pyelonephritis depends on the extent of the lesion. Repeated infection may lead to septicemia or uremia.

TREATMENT

Essentially, the treatment of pyelonephritis includes relief of any obstruction present, bed rest, diuresis with water, urinary antiseptics, and occasionally drainage.

1. Bed rest is essential in the acute stages with fever, and is recommended for all cases where there is extensive involvement of the kidney.

2. The diet should be nourishing and contain a moderate amount of protein. Three thousand to 5000 cc. of fluid a day are required. The kind of fluid to be used depends on whether or not acidosis is pending. Ten per cent glucose in normal saline is useful, but ⅙ M sodium lactate is needed if the alkali reserve is lowered.

3. Heat applied to the kidney area aids in the relief of pain. If further relief is required, mild measures, as a combination of codeine sulfate, 0.016 Gm. (¼ grain), phenobarbital, 0.06 Gm. (1 grain), and acetylsalicylic acid, 0.33 Gm. (5 grains), should be tried before resorting to heavier opiates.

4. The favored urinary antiseptics at present are the sulfonamide drugs; sulfathiazole has been notably successful. The drug need not be given in as high a dosage as for pneumonia and similar septic states; it is not necessary that a high blood level be maintained, for adequate concentration of the drug is obtained in the urine with low blood levels. Dosages of 0.5 Gm. to 1.0 Gm. (7½ to 15 grains) three to four times a day, have proved sufficient. Precipitation of sulfonamide crystals is thought to be less frequent when coincidental alkaline therapy, as sodium bicarbonate, 0.66 Gm. (10 grains) with each dose, is employed. The urine should be watched carefully for the presence of drug crystals and for evidence of further renal irritation by the drug.

5. Other methods of urinary antisepsis that have been used with notable success are urotropin, 0.33 Gm. (5 grains), and sodium acid phosphate, 0.33 Gm. (5 grains), with ammonium chloride, 0.66 Gm. (10 grains), administered three times a day; or mandelic acid, 3 Gm. (45 grains), with ammonium chloride, 1 Gm. (15 grains), administered four times a day, and the ketogenic diet. In giving mandelic acid, the urine must be kept highly acid, the *p*H not rising above 5.3. Excessive acidification of the urine, however, is undesirable in cases of renal insufficiency, acidosis, or the very acute stages of pyelonephritis.

6. Most subacute or chronic renal infections are caused by stasis, and the obstruction must be removed before further treatment will be efficacious.

7. It has been shown that where there is a tendency to recurrent urinary tract infection, as in cases of irreparable deformities of the urinary tract, or where the necessity of frequent catheterization exists,

very small doses of sulfathiazole as low as 0.13 Gm. (2 grains) five times a day prove an excellent prophylactic remedy.

Renal Damage Due to Sulfonamides

The kidneys may be damaged in the course of sulfonamide therapy. This toxic reaction, its treatment, and prevention will be taken up in Chapter XXIV.

CHAPTER XIII

The Lungs

PNEUMONIA

Pneumonia is an acute inflammation of the lungs, usually caused by the pneumococcus. It may be of the lobar, bronchial, interstitial, or combined forms, but lobar and bronchopneumonia are the commonest types. The pneumococcus causes most cases of lobar pneumonia and more than one-half of the cases of bronchopneumonia. The pneumococci in the blood stream are capable of producing diseases other than those of the lung. However, the chief manifestations are respiratory. Other organisms, as Streptococcus hemolyticus, Friedlander bacillus, Staphylococcus aureus, or nonbacterial agents, may cause pneumonia. The importance of determining the causative agent cannot be overemphasized since effective treatment is dependent on it. Pericarditis, endocarditis, or meningitis may be the sequelae of a general pneumococcal septicemia. So-called atypical pneumonia or virus pneumonia is not caused by the pneumococcus but by one of the numerous viruses. This form will be discussed separately.

Since lobar and bronchopneumonia are the commonest forms, this chapter will be confined to a discussion of these two types.

Lobar Pneumonia

Lobar pneumonia is an acute medical emergency, and the advent of the newer specific therapeutic measures requires that the diagnosis be made as soon as possible so treatment may be commenced early in the disease. While the specific remedies, as serum and chemotherapeutic measures, are sometimes effective when given late in the disease, they are much more beneficial when administered in the earlier periods of the infection. Lobar pneumonia is a specific acute infectious disease which involves an entire lung or part of a lung. Sometimes both lungs are completely involved in the pneumonic process. In contradistinction to bronchopneumonia, lobar pneumonia is always a primary disease. Bronchopneumonia frequently follows an upper respiratory infection or is a complication of some other disease in the body.

Etiology: Lobar pneumonia may occur at any time of the year, but it is most frequent in the months from January until May. It is a disease that spares no age group, though it is most likely to occur before the age of 10 and after the age of 50 years. Exposure to inclement weather, draughts, loss of sleep, and contact with patients who have infections or healthy carriers are the chief predisposing factors. The specific cause of pneumococcic pneumonia, of course, is the

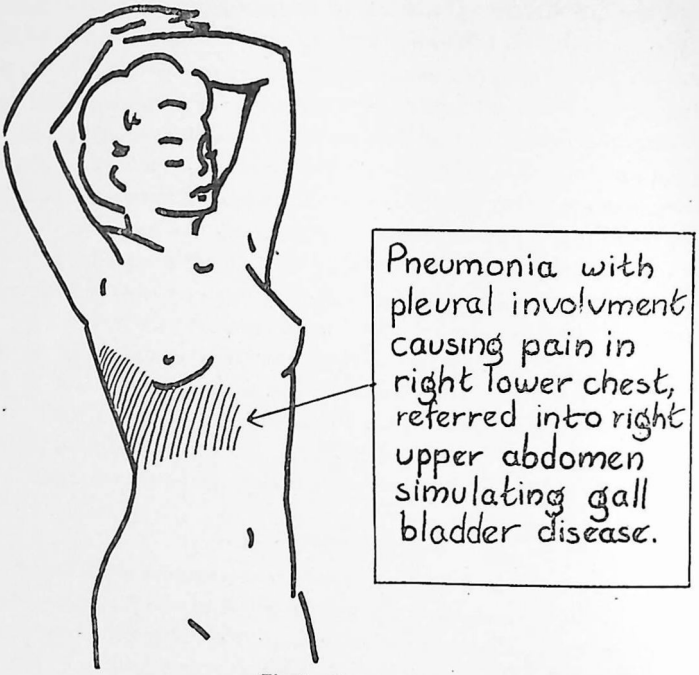


Fig. 1.—Pneumonia.

pneumococcus. Formerly, four main types of pneumococci were recognized, but recently more than 40 kinds have been identified. Types I, II, III, V, VII, VIII, and XIV are responsible for the majority of cases of pneumonia. Sometimes more than one type may be present in the same patient. Types I, II, and V, which are found most often in lobar pneumonia, usually present a fairly typical picture. These types, along with Types VII and VIII, cause about 50 per cent of all cases of lobar pneumonia.

It has been customary to recognize four stages of pneumonia, and in the clinical diagnosis it is very important to have these various phases of the disease in mind:

1. Engorgement of the lung.
2. Early consolidation.
3. Complete consolidation.
4. Resolution.

Signs and Symptoms: Pneumonia does not always begin according to the classical textbook description with chills, fever, pain in the chest, and expectoration of bloody or rusty sputum, but it frequently does. It is well to remember that pneumonia is a disease that sets in abruptly. There may or may not be a preceding upper respiratory infection with a cough. Frequently, the first evidence of pneumonia is a feeling of prostration which is due to the early bacteremia. Then coughing begins, and there may be bloody expectoration. Even at this early stage, the sputum may contain the pneumococcus. When the patient has a chill with a rapid, bounding pulse, fever, and pain in the side of the chest, the diagnosis is easily made.

Although pneumonia may be suspected when pleuritic pain, chill, fever, tachycardia, and bloody sputum occur, the physical signs of pneumonia may not be present for another 24 hours. The early recognition of pneumonia is accomplished by careful attention to the history of onset and by a skillful examination of the chest. Many physicians believe that an x-ray examination is more important in early diagnosis than a physical examination, and that it is a more positive means of diagnosing early pneumonia. This is not always true because proficient clinicians are able to determine the presence of pneumonia and clinch the diagnosis before the evidence is confirmed on the x-ray film.

Inspection usually reveals a patient with an anxious facial expression. Breathing may be rapid and the excursions of the chest may be limited. A cyanotic tinge about the lips or fingertips may help in the identification of the disease. Palpation reveals a hot, dry skin, and the pulse is not only rapid but bounding. There may be no alteration of tactile fremitus. The early diagnosis of pneumonia is established usually by the finding of an impaired percussion note over the diseased lung. The dullness to percussion is usually well marked even in the first stage of the disease.

Auscultation on the involved side of the chest may disclose alteration of the breath sounds. Typical bronchial breathing may not be present, but a muffled tubular breathing is usually noted. The presence of fine crepitant râles, especially if the patient coughs, associated with other signs, is practically always positive evidence of early pneumonia. Two or three days may elapse before the typical features of lobar consolidation appear.

Diagnosis: In those cases in which the area of pneumococcic consolidation begins deep in the lung and findings are not evident for

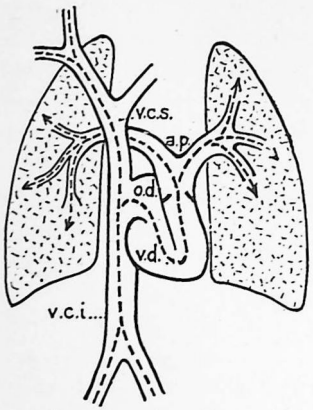


Fig. 2.—Infarction of the lung through sudden occlusion of a pulmonary artery by a blood clot (embolus). The embolus, having become detached at some point in the inferior vena cava (v.c.i.) or its tributaries, or in the superior vena cava (v.c.s.) or its tributaries, passes through the right auricle (o.d.), is discharged into the pulmonary artery (a.p.), and lodges in one of the lobes of the lung, giving rise to an infarct which finds its clinical expression in 1. a sudden sharp pain in the side; 2. blood spitting (hemoptysis); 3. the physical signs shown in Fig. 3. Usual causes, in the order of their frequency: 1. Infectious phlebitis, particularly puerperal; 2. heart disorders in the stage of lost compensation; especially mitral disease in the stage of dilatation of the right heart; 3. after operations, especially abdominal and chiefly appendiceal and pelvic.

several days, percussion note changes and distant or muffled bronchial breathing serve to identify the condition. Sometimes the consolidation involves the lower lobe and the diaphragmatic pleura becomes inflamed. In this case, movement of the involved side of the chest is very limited, and pain may be referred into the abdomen, suggesting an acute abdominal disease. Sometimes the pain may extend as low in the abdomen as the area of the appendix, simulating acute appendicitis. This is commoner in children than in adults.

Pulmonary infarct as a result of an embolus may simulate pneumonia at times. Bloody sputum, chest pain, fever, and signs of consolidation may be very similar to the consolidation of pneumonia. When there is doubt, the treatment for pneumonia should be instituted at once. The presence of pneumococci in the sputum or in the blood stream serves to make the differentiation positive. In older individuals, lobar pneumonia may be confused with coronary thrombosis. Careful attention, however, to the onset may help in diagnosis. Coronary thrombosis is apt to be associated with more evidence of collapse in the beginning than lobar pneumonia. In lobar pneumonia, the blood pressure is less likely to change. In brief, in coronary disease, the cardiovascular features predominate, while in lobar pneumonia, the cardiovascular system is intact, especially in the beginning of the disease. It is only later that cardiovascular collapse is a feature.

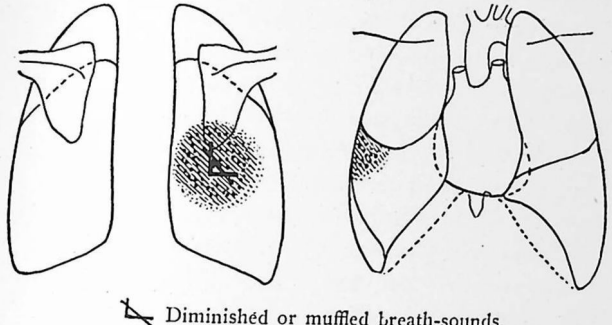


Fig. 3.—Physical signs of infarction of the lung through sudden occlusion of a pulmonary artery by a blood clot (embolus).

Usually the mistakes in diagnosis of pneumonia consist in failure to recognize the presence of the disease in its earlier stages. Diagnoses such as bronchitis, influenza, pleurisy, or grippe are occasionally made instead of pneumonia. Pulmonary tuberculosis, typhoid fever, or pulmonary embolism may simulate pneumonia so closely that a few days may elapse before the true diagnosis is made. Since the early diagnosis of pneumonia is so important in the modern treatment of the disease, it is better to treat the suspected case as one of pneumonia presence of pneumonia in its early stages.
and learn later that it is another disease, than to fail to recognize the

Course: If lobar pneumonia remains uncomplicated, the disease runs its course in from 4 to 12 days. It usually terminates by crisis, when the temperature drops, and the pulse and respiratory rates suddenly approach normal. At other times, the resolution takes place more slowly and recovery is by lysis.

A variety of complications may occur with lobar pneumonia. Empyema is the commonest, and usually develops after the seventh day of the disease. However, it may occur after the primary lobar pneumonia has practically subsided. Whenever a patient with pneumonia appears to be making a satisfactory recovery and then suddenly has a relapse with a higher fever, more rapid pulse rate, and an increase of the respiratory rate, one should always look for empyema. Perspiration, elevated white blood count, and increase in polymorphonuclear leukocytes may be associated with the above signs. Evidence of fluid is usually noted if the effusion is free in the pleural cavity, and diminution or absence of tactile fremitus along with the other signs confirms the diagnosis. If there is a question concerning a definite diagnosis, chest plates and/or thoracocentesis are valuable aids.

Failure of the pneumonia to resolve at the end of the tenth or twelfth day often leads to a diagnosis of unresolved pneumonia. The supposed unresolved pneumonia, however, usually turns out in these cases to be empyema or abscess of the lung. Otitis media and mastoiditis are complications of pneumonia and are usually found in children. Other complications of pneumonia are pericarditis, endocarditis, and meningitis, and any one of these deserves a very guarded prognosis.

Bronchopneumonia

While lobar pneumonia is a term applied to consolidation of an entire lobe, a lung, or both lungs, bronchopneumonia is a term applied to areas of consolidation disseminated throughout both lungs. The isolated small patches of consolidation may at times become confluent, and make the diagnosis difficult.

Bronchopneumonia usually occurs in children under 12 years of age and in older people past 65 years. As a rule it is secondary to other diseases, such as acute bronchitis, measles, scarlet fever, or it

may be a complication of heart disease, malignant disease, or Bright's disease. While lobar pneumonia is almost always produced by the pneumococcus, other organisms, as the streptococcus, may be the cause of bronchopneumonia.

Signs and Symptoms: Bronchopneumonia does not set in abruptly as does lobar pneumonia. It usually comes on gradually in an individual who is ill with some other condition. The disease ends in lysis, not by crisis, as is usually the case in lobar pneumonia. Cough, pain in the chest, shortness of breath, and cyanosis usually mark the beginning of a bronchopneumonic process. The physical signs are not nearly so characteristic as in lobar pneumonia, and areas of consolidation may be completely obscured by an associated bronchitis or heart failure. Usually the breath sounds are decidedly altered on both sides of the chest below the angle of the scapula. The bronchopneumonic breath sounds associated with medium or small-sized mucous râles usually lead to the diagnosis. A characteristic feature of bronchopneumonia is the rapid change of signs from day to day. The course of bronchopneumonia is usually longer than that of lobar pneumonia, running from four to five days to two or three weeks. In this disease, the differential diagnosis assumes great importance, for tuberculous bronchopneumonia may simulate the nontuberculous kind very closely unless sputum is examined frequently for the presence of the tubercle bacilli.

Prognosis: The modern treatment of pneumonia has altered the prognosis so much within recent years that our ideas of a few years ago seem like century-old ones. Formerly, from 25 to 40 per cent of patients with pneumonia died. Now from three to nine per cent die. In general, it is difficult to give any prognostic rules. The following suggestions as to prognosis may be helpful:

1. If the patient with pneumonia shows serious evidences of intoxication by the fourth or fifth day of the disease, the outlook is bad. Such toxic manifestations consist of the relative condition of the heart, the state of the blood pressure, the rate of the pulse, and the general condition of the patient.

2. If the patient's heart, blood pressure, and pulse rate tolerate the infection well until the seventh day, the chances for recovery are good.

3. If the pulse rate per minute rises above the figure for the systolic blood pressure, and continues to rise, the prognosis is bad.

4. A chronic alcoholic bears up poorly.

5. Prognosis is serious in very young children and in adults over 40 years of age.

6. Bacteremia, leukopenia, pregnancy, and septic complications affect the prognosis unfavorably.

7. The type of pneumococcus concerned influences the outcome. Pneumonia due to pneumococcus Type I is more benign, and that due to Types II, V, and VII usually more severe. The seriousness of Type III pneumococcus pneumonia is variable.

8. Some believe it is helpful in treatment and prognosis to determine the number of pneumococci in Wright stained smears of rusty sputum. When the sputum count is 10 or less pneumococci per field, the patient is only mildly ill. If the count is between 11 and 35 per field, the patient is moderately ill, and if the count rises over 35, he is seriously ill.

TREATMENT OF PNEUMONIAS

With the introduction of serum treatment and chemotherapeutic measures, the older and more general measures have been somewhat neglected. The treatment of pneumonia may be divided into two phases: (1) The General Measures, and (2) the Specific Therapeutic Agents.

1. General measures:

   a. Formerly it was thought that a patient with pneumonia should not be moved from his bed at home to a hospital, because the moving was considered to be deleterious to the patient. With the advent of serum treatment and better hospital facilities it became more commonplace to take the patient to the hospital. The administration of serum, oxygen, intravenous solutions, and special nursing care could be furnished so much better that the old fear of moving the patient was almost completely cast aside. At the present time it is difficult to say what the physicians of the future will do, but it is probable that if a patient is in a comfortable home, the treatment can be carried out just as well there as in the hospital. Furthermore, the cost of the treatment for the patient is so much less in the home that there may be a return to the use of specific measures there.

b. The patient should be kept comfortable and placed in a semireclining position if this is most pleasant. Since pneumonia is a communicable disease the patient should be kept in a room by himself.

c. The patient should take at least 1500 to 2000 cc. of fluid a day. Intravenous injections of large amounts of glucose solution should be discouraged, because they are not well tolerated by pneumonia patients. On the other hand, if the patient is vomiting and cannot take fluid by mouth the administration of glucose intravenously may be considered, provided the solution is given at a slow rate of speed (10 cc. or less per minute).

d. A soft liquid diet is best for the patient in the early stages of the disease, but the type of food should be left to the discretion of the patient, rather than to the nurse or physician. It is senseless, for example, to force milk on a pneumonia patient who had always detested milk when he was well. It may be added that a patient who is accustomed to taking tea or coffee is not harmed by a little tea or coffee when he is sick. Fruit juices, charged water, lemon and orangeades, and other fruit ades are usually well borne.

e. The room should be kept at a temperature of about 15.6° to 21.1° C. (60° to 70° F.). Visitors should be excluded, if possible, and precautions taken to protect the people who must come in contact with the patient.

f. The mouth should be kept clean and moist by the use of a mouth antiseptic dissolved in water.

g. The bowels should be kept active, but not particularly loose.

h. Since coughing is apt to be distressful a cough mixture containing 0.016 to 0.032 Gm. (¼ to ½ grain) codeine, in some pleasant vehicle as syrup of wild cherry, may be given three or four times a day. Later on ammonium chloride, 0.66 Gm. (10 grains), three or four times a day may be added to the cough mixture to stimulate the secretion of the bronchial mucous membrane. If the patient is not alert enough to cough up the increased bronchial secretion this addition should not be made. If necessary, chest pain may be relieved by codeine sulfate or morphine. Heat may also be applied to the site of pain.

i. Headache may be controlled by administering a capsule containing 0.032 Gm. (½ grain) codeine sulfate and 0.33 Gm. (5 grains) acetylsalicylic acid.

j. Nausea, vomiting, and abdominal distention often disturb the pneumonia patient. These may be relieved by colonic flushings and therapeutic stupes. For the distention of the abdomen pitressin, 0.5 to 1 cc., hypodermically, three or four times a day may be given.

2. Specific measures of treatment. Specific measures may be enumerated under the headings of:

a. Serum.

b. Chemotherapeutic agents.

c. Oxygen.

Serum Treatment: One of the great stumbling blocks in the use of serum is that the type of pneumococcus present must be known and the corresponding serum administered. Specific anti-sera are rapidly becoming available for most types of pneumococci, and sera for Types I, II, III, IV, V, VII, VIII, and XIV are accepted in the treatment of pneumonia. If the type of pneumococcus is determined, the anti-pneumococcic serum may be given according to the following schedule:

Certain precautions must be taken to prevent reactions due to horse serum sensitivity. The patient should be questioned regarding his allergic background as to the presence of hay fever, asthma, or urticaria in himself or his family. Anti-sera should not be given to patients with congestive heart failure, to those having positive sensitivity tests to animal serum, or a history of allergy to horse or rabbit proteins. An injection of 0.1 cc. into the skin or the administration of a drop or two of the diluted serum into the conjunctival sac may reveal the presence of undue sensitivity. A reaction to these tests will develop within a half hour.

Forty thousand units of the serum may be given intravenously at once, and then 40,000 units every four hours until about 140,000 units have been administered. In most uncomplicated cases in patients under 30 years of age with pneumonia of less than four days' duration, there is a rapid crisis after introduction of 50,000 to 100,000 units of serum. Type II pneumonia requires more than twice this amount. Dosage should be increased with age, when there has been delay in treatment, if the pulmonary process is extensive, and when the patient is pregnant or bacteremic.

Two important considerations must be kept in mind when using anti-sera: (1) The serum should be given as early as possible, that is, within the first three or four days of the onset of the disease, but it may be used during any period when it is seen that the patient is not making satisfactory progress; (2) the amount should be adequate, for small doses have no place in this treatment. Sometimes small doses, as 10,000 to 20,000 units every two hours, are given, but large doses with longer periods between the injections seem preferable. In severe cases, one or two very large doses of 150,000 units are much more effective than smaller doses spread over a period of several days.

Serum sickness occurs in about one-third of all patients treated with serum, but recently, with the advent of refined sera, the intensity and duration of the sickness has been greatly diminished. It usually begins about a week after the introduction of serum therapy and is characterized by fever, urticaria, arthritis, and lymphadenopathy, in combination or alone. The patient should be kept in bed and given analgesics, as acetylsalicylic acid and codeine. Treatment is usually symptomatic and not very effective.

Immediate serum reactions include chill, anaphylaxis, sudden circulatory changes, and miscellaneous reactions. The chill is usually followed by a rise in temperature, though at times the chill phase does not occur. Dyspnea and cyanosis may be associated with these symptoms. Treatment is purely symptomatic with application of heat during the chill phase, and cooling drinks during the fever stage. Usually these symptoms disappear within a few hours, though they may recur later; it is advisable to withhold further serum treatment. Serum therapy may be started again, but it is best to use a different lot of serum.

Anaphylactic reactions include itching, asthma, urticaria, and edema. Circulatory changes may accompany these reactions or occur alone. Circulatory changes include shock; vascular collapse; rapid, thready, or irregular pulse, and epinephrine is the treatment of choice. After these changes are noted, serum therapy should be discontinued and not given again unless absolutely necessary.

Chemotherapy: The value of sulfonamides in the treatment of pneumonia is so well established that it is unnecessary to elaborate on their advantages over other methods of therapy. Due to the current great demand for these chemicals, one may not always be able to procure the kind of sulfonamide one wishes. However, this is not a serious inconvenience, as either sodium sulfathiazole, sulfapyridine, or sulfadiazine may be employed.

Sulfapyridine was developed and used experimentally in pneumococcic infections in mice in 1938. Original experiments proved the drug was effective against intraperitoneal infections in mice with Types I, III, V, VII, and VIII pneumococci. Clinical results that followed sharply on the experimental investigation showed that the drug was effective against practically all types of pneumococci in the human being. In July, 1938, the clinical results of the treatment of

100 cases of lobar pneumonia were reported, and since that time, innumerable papers have appeared from all over the world. The results obtained corresponded to and corroborated those of the earliest workers with sulfapyridine. The dramatic clinical response to sulfapyridine has paved the way for other drugs of about the same chemical nature. Sulfathiazole and sulfadiazine have challenged the place of sulfapyridine in the treatment of pneumonia, and others are being investigated. Whether sulfapyridine is the best drug is a question that has not been finally answered. All have their advantages and disadvantages. However, from the reports of those who have used these drugs, and have collected comparative data, the impression seems to be that sulfathiazole and sulfadiazine, while not so dramatic in their action, are as effective if not more so than sulfapyridine. On the basis of recent experience, many consider sulfadiazine more valuable than other sulfonamide drugs, though sulfathiazole has its adherents. The rash caused by sulfathiazole is one of the conspicuous minor complications, but it does not seem to retard the patient's recovery in any way.

Before any treatment is started, specimens of sputum and blood should be obtained for typing and culture. This is important, because then, if necessary, a switch may be made from drug to serum treatment without any delay. In general, if there are no contraindications, sulfapyridine, sulfathiazole, or sulfadiazine therapy should be started in all cases of pneumonia, since these drugs are effective even if many types of pneumococci are present in the patient. It is impossible to write the final word on the use of sulfonamides in the treatment of pneumonia. First sulfapyridine, then sulfathiazole held the stage, and now sulfadiazine is most widely employed. Before long, another preparation may prove more efficient.

The general impression of chemotherapy may be summarized as follows:

1. Sulfapyridine, sulfathiazole, and sulfadiazine are effective in the treatment of almost any type of pneumococcus pneumonia. The virulence of the pneumococcus and the type of organism seem to have little or no influence on the effect of sulfapyridine. However, it is believed that when pneumonia is due to Staphylococcus aureus, sulfathiazole is the drug of choice. Sulfanilamide is effective in pneumonia due to hemolytic streptococcus, but it is best to use sulfapyri-

dine, sulfathiazole, or sulfadiazine in all acute pneumonic infections which are possibly due to pneumococci unless otherwise indicated.

The sulfonamides are capable of reducing the mortality rate from 30 to 40 per cent to the low figure of from four to five per cent. Undoubtedly these statistics for fatality rates will have to be changed from time to time because of variations that occur from year to year in the severity of the pneumococcus infections. It is only natural that unless the diagnosis of pneumonia is made with great caution, a false and probably too favorable view of the therapeutic effects of the sulfonamides may develop. Nevertheless, when the diagnosis of pneumonia is made, sulfapyridine, sulfathiazole, or sulfadiazine offer the best therapeutic measures we have to combat it.

2. Administration: The method of administering sulfonamides remains about the same as when Evans and Gaisford wrote their first article on the use of Dagenan. The initial dose should be given orally, 30 grain or 2 Gm. or four tablets. Then every three hours 1 Gm. (15 grain) or two tablets should be administered until the temperature drops to normal. This usually occurs within 24 to 36 hours. After the fever has subsided, the drug should be continued in 1 Gm. (15 grains) doses, two or three times a day for two or three days after apparent recovery so the pneumonia may be held under control. If the drug is discontinued too soon, a recrudescence may follow excretion of the drug through the kidneys. If this happens, reinstate drug therapy, starting again with 2 Gm. (30 grains). When the treatment is discontinued, it should be done abruptly to eliminate the possibility of the patient becoming drug-fast.

Higher doses of 6 Gm. (90 grains) at first, followed by 1 Gm. (15 grains) every four hours are attended by slightly more rapid recovery, fewer relapses, and less likelihood of spread of the pneumonia to another lobe, or of delayed resolution. Toxic reactions seem no more numerous with the large than the small doses.

Both sulfonamide and serum therapy may be gauged and controlled by a study of the sputum count. Determination of the number of pneumococci in Wright stained smears of rusty sputum from time to time will also enable one to evaluate the effect of therapy and the course of the pneumonic process.

It is best to determine the level of the sulfonamide preparation in the blood stream by the Marshall method so the concentration

of the free sulfonamide may be learned. It is advised to keep the concentration at the optimal level during the first four or five days of treatment. This level varies with the preparation in use.

At the present time, fairly satisfactory preparations for intravenous use are obtainable for patients who are unable to tolerate the drugs by mouth or when it is inadvisable to give them orally. When there is intractable vomiting or inadequate absorption of the drug after oral dosage, or when it is not advisable to waste precious hours in trying to raise the blood concentration of the drug *via* oral administration, the intravenous route should be used. However, this method should be abandoned as soon as it is possible or safe to give the drug orally. Sodium sulfapyridine, sodium sulfathiazole, and sodium sulfadiazine are used intravenously in 5 Gm. (75 grains) doses two or three times a day, depending upon the nature of the disease and the requirements of the patient. The concentration of the solution may vary from one to five per cent; the latter concentration is most commonly used. This is prepared by dissolving 5 Gm. (75 grains) of the sulfonamide in 100 cc. of sterile, distilled water, and administered slowly—approximately 5 to 10 cc. per minute.

Certain complications which may result from sulfonamide therapy must be kept in mind.

1. Kidney damage may occur as a result of mechanical blockage of the tubules or ureters by sulfonamide crystals or from parenchymal changes due to the nephrotoxic action of these drugs. Hematuria and other evidences of renal irritation have followed the administration of sulfapyridine, sulfathiazole, and sulfadiazine, and fatalities due to oliguria or anuria have occurred. Almost all patients who have received large doses have had crystals of the acetylated form in the urine. These are usually seen without associated hematuria, pus cells, or albumin. These typical boat-shaped, or spear-head-shaped crystals, in most cases, appear during the administration of the drug and quickly pass away when the drug is discontinued. If a patient has nephritis, or any other renal disease causing renal insufficiency, caution should be practiced in the administration of the drug because there may be a rapid accumulation of the drug in the tissues with a toxic reaction. However, sulfonamides may in some

cases cure acute glomerulonephritis, and the kidney lesions instead of being made worse, may disappear.

Renal complications, as hematuria, albuminuria, and anuria from plugging of the renal tubules and ureters with the acetylated compounds, occur frequently after sulfapyridine, less often after sulfathiazole, and rarely after sulfadiazine administration. When any of these unfavorable reactions develop, the drug must be discontinued, an abundance of fluids given to increase the urinary output, and in the case of anuria, the ureters must be washed out with a catheter.

A few safeguards will protect the patient against the renal complications of sulfonamide therapy. The intake of fluid, the hydration of the patient's tissues, and the output of urine are probably the most important factors concerning the kidney impairment. General opinion is that 1500 to 2000 cc. of fluid per day must be given if adequate urinary output is to be assured. During therapy careful observations of the quantity of the urine, and its appearance on gross and microscopic examination should be made. If sulfonamide crystals are present, extra care must be taken in regard to dosage, blood level, and urinary output, but this in itself, is not an indication that therapy must be stopped. When the urine is alkalinized to a *p*H of 7 or higher, there is very little crystalluria. Renal disorders should be carefully evaluated before beginning therapy.

2. Nausea, vomiting, anemia, or skin reactions may occasionally occur. Vomiting, however, is no reason for discontinuance of the drug. The tablet may be crushed and given in milk or fruit juice, and after several doses the patient may tolerate the tablets, even if he could not do so previously.

3. The sulfonamides, especially sulfathiazole, may cause fever. This fever may lead one to believe that the original disease is not yielding to the treatment and the drug therefore is given in even larger doses than before. The point to be remembered is that when the underlying disease seems to have responded to treatment and the fever continues, discontinuance of the drug for a day may be followed by a drop of the temperature to normal.

4. The patient may become resistant to sulfonamides. If a patient who is originally sensitive to sulfonamides later becomes resistant, he may pass this same strain of sulfonamide-resistant-pneumonia to another person, who may develop pneumonia which will not

respond to sulfonamide therapy. However, if an individual does not respond to a particular sulfonamide, a switch to another drug of this group may be followed by good results. Sulfanilamide resistance is most easily acquired, then sulfapyridine and sulfathiazole.

5. These drugs are contraindicated when there is a history of serious toxic reactions from previous medication with the sulfonamide group, renal or hepatic disease, or persistent vomiting, especially in patients where the pneumonia develops after a gastrointestinal operation. However, in some cases it may be best to give the drug if there is a chance of saving life. (See Chapter on the Sulfonamide Drugs).

The Combined Use of Serum and Sulfonamides: Some authors advocate the use of both serum and sulfonamides, especially when the patient is severely ill with pneumonia. Other authorities believe chemotherapy alone is sufficient in average cases, but if the sulfonamide drugs do not bring about improvement in 36 hours, if the patient is over 50 years of age, or has some complication as pregnancy, or when more than one lobe is involved, or the blood culture is positive, specific immune serum should be added to the chemotherapy.

6. In penicillin therapy, 10,000 units are injected intramuscularly every four hours for three or four days. Recovery may follow as few as ten injections, totaling 100,000 units, but in more serious cases, 400,000 to 500,000 units may be necessary. In cases where the pneumonia is severe and the diagnosis is delayed, it is wise to give 80,000 units intravenously the first day, in addition to the routine intramuscular injections. Sometimes, if patients do not respond promptly to sulfa or to penicillin alone, the two drugs may be used simultaneously, both given according to the established methods of administration.

Other Chemotherapeutic Measures: Hydroxyethylapocupreine, 8 Gm. (120 grains) daily for four or five days is reported to be about as effective as sulfonamide therapy in pneumonia. This drug is much less toxic, apparently, than sulfapyridine, sulfathiazole, and sulfadiazine. Untoward reactions are not serious, and visual disturbances do not occur.

Oxygen: Oxygen insufficiency occurs in pneumonia because of the reduction of the tissues responsible for oxygen absorption.

Also, there is a greater than normal demand for oxygen because of the fever and infection. Cyanosis is usually an early evidence of oxygen want, but one should not wait for cyanosis to appear before beginning administration of oxygen in pneumonia, because oxygen therapy seems to have other beneficial actions. When sustained rapid pulse and respiration, cyanosis or delirium occur, alone or in combination, it is wise to start oxygen therapy.

There are several ways of administering oxygen. The older methods of using oxygen chambers or oxygen tents have almost entirely disappeared from practical work. However, the oxygen tent is valuable if the patient cannot tolerate oxygen given by mask or nasal catheter, or if he does not receive adequate amounts by these methods. This tent is more comfortable for the patient, but it is also more expensive and very complicated for home use. A full-time nurse or other person trained in the use of oxygen therapy is necessary. Analysis of tent air must be made every two or three hours to be sure that the patient is receiving enough oxygen. If the patient requires a concentration above 60 per cent, he should be exposed to it for only 24 to 36 hours, or a high concentration may be given for 12 hours, and then a lower concentration for 12 hours, alternating this regime until treatment is no longer necessary.

The Boothby mask for providing 100 per cent oxygen is a satisfactory method of administration. Sometimes the nasal catheter is recommended for its simplicity and inexpensiveness. With almost any method, the patient should receive eight to ten liters of oxygen per minute. Oxygen in the treatment of pneumonia appears to increase the oxygen saturation of the blood, eases the distress caused by the lack of oxygen, causes the patient to breathe more deeply and more effectively, probably increases the circulation of blood in the lung, and it is likely that it enhances the resistance of the patient against the pneumococcal infection. Administration of oxygen should be continuous in a sufficient concentration, 40 to 50 per cent by volume, and discontinued gradually when it is no longer necessary. If symptoms recur after oxygen withdrawal, this treatment should be reinstated.

Certain precautions are necessary in the room where oxygen is used. Fire and highly inflammable materials are prohibited, and lubricating oil must not be used on the equipment since high con-

centrations favor combustion. To prevent irritation of the mucous membranes from the dry gas, a vaporizing bottle should be used.

The administration of positive pressure in conjunction with oxygen or helium-oxygen mixtures, and inhalations of vaporized solutions of neosynephrine and epinephrine may be beneficial. One hundred per cent oxygen or helium-oxygen mixtures given under positive pressure tend to relieve the edema by preventing the exudation of serum into the lung and retarding the entrance of blood. It is contraindicated only in shock. Positive pressure is best administered by the helium-oxygen hood, and pressures of 1 to 6 cm. water are maintained both in inspiration and expiration. A mask in which the exhaled air passes out through a tube immersed in varying degrees of water may also be effective. The flow of oxygen or helium-oxygen should be from 7 to 10 liters a minute.

Neosynephrine has a vasoconstrictor effect on the mucous membrane of the tracheobronchial tree and epinephrine is a bronchodilator. Inhalation of vaporized solutions of neosynephrine and epinephrine is best done by passing five liters of oxygen from a high pressure tank through a nebulizer placed in 1 cc. of one per cent solution of neosynephrine and 0.5 cc. of 1:100 solution of epinephrine.

Prophylaxis: Prophylaxis consists of isolating the patient, and careful disposal of secretions of the mouth and respiratory tract. Contaminated articles must be burned or sterilized. Vaccinating may be a valuable preventive agent. Since many cases of pneumonia are caused by healthy carriers, or individuals convalescing from pneumonia, who still carry the pneumococci in the respiratory tract, carriers should be taught how not to pass the disease. Sulfonamides have not done a great deal to reduce the convalescent carrier rate in pneumococcus pneumonia.

ACUTE FIBRINOUS PLEURISY

Pleurisy is an inflammation of the pleura. Clinically, it is divided into three types: (1) Dry, fibrinous pleurisy, (2) pleurisy with effusion which may be serofibrinous, purulent, or hemorrhagic, and (3) chronic pleurisy with thickening of the membrane.

Etiology: Pleurisy is seldom with certainty a primary disease. It is usually a local manifestation of a systemic infection or a direct extension or complication of another lesion.

The initial lesion is usually dry pleurisy which may or may not be followed by effusion. The most common cause of dry pleurisy is an infection of the respiratory tract or the conditions which contribute to the latter. It may also be caused by any inflammatory or neoplastic disease of the lung, or bronchiectasis.

Pleurisy with serofibrinous effusion is commonly caused by tuberculosis. Other causes are carcinoma, rheumatic fever, trauma, jugular thrombosis, Hodgkin's disease, leukemia, cirrhosis of the liver, actinomycosis, and parasitic infections.

Purulent effusions are the result of infections caused by the pneumococcus and streptococcus, less often by the staphylococcus, hemophilis influenzae, and the Bacillus typhosus. These pyogenic infections may arise in the lung, in the mediastinum, or below the diaphragm. Empyema frequently begins as a simple serous exudate.

Hemorrhagic effusions are caused by carcinoma of the lung or pleura, by trauma, and by streptococcal infections of the pleura.

Chronic pleurisy with thickening of the membrane is the end result of the types described above.

Pathology: The pathology of pleurisy may be divided into several stages:

1. The stage of hyperemia: The membrane loses its luster and becomes dry and injected.

2. Exudation of fibrin which upon coagulation gives a shaggy appearance to the membrane; in dry pleurisy the process terminates here. The fibrin-covered surfaces adhere and the adhesions may obliterate the cavity. Such pleurisy is well localized.

3. Effusion: The exudate is serofibrinous and yellow-green to straw-colored. Floating flakes of fibrin may be seen. The specific gravity varies from 1.010 to 1.020. The albuminous fluid coagulates on boiling. The fluid may be hemorrhagic instead of simply fibrinous.

4. The effusion may become purulent with predominance of polymorphonuclear cells. Pneumococcal pleurisy is frequently purulent from the start.

5. Resolution with variably extensive and variably permanent adhesions. This stage may be accompanied or followed by thickening of the involved pleural membrane.

The effusion if extensive causes marked pressure on the lung tissue and viscera near it. Atelectasis of a portion or sometimes the whole of a lung may ensue. The heart and great vessels may be pushed to the opposite side. The liver and spleen may be displaced downward.

Symptoms: The onset may be insidious or sudden. Dry pleurisy is usually ushered in suddenly with lancinating pain on the affected side. The pain is made worse by breathing or any movement of the involved region. Dyspnea and lassitude are natural consequences of the pain. The pain may be referred to the epigastric or umbilical region. Chill may accompany or precede the appearance of pain. Constitutional disturbances may be present. As effusion takes place, the severe pain is replaced by more marked dyspnea. The patient lies on the affected side to allow more freedom of motion in the sound lung. Respiration and pulse are rapid, and poorly productive cough is present with scanty mucoid sputum. The sputum is never rusty unless pneumonia or other disease of the lung exists simultaneously. Low-grade fever may be present with dry pleurisy or pleurisy with serofibrinous effusion, but when a purulent effusion appears, the temperature usually rises abruptly and assumes a septic curve.

Physical Signs: The physical signs resulting from the fibrinous exudation are usually situated at the bottom of the axilla where the diaphragmatic and costal layers of the pleura are in close apposition. The diagnosis is based upon a single physical sign which is a grating, rubbing friction sound, usually somewhat jerky and interrupted and often audible throughout the entire respiratory act. The sound is described well by the French as the *"bruit de cour neuf."* The pleural friction rub at times is felt as well as heard. The corresponding side of the chest is seen to be less mobile than its mate.

Effusion changes the physical signs. The friction rub disappears and is replaced by depressed, absent or distant tubular breath sounds. The corresponding side of the chest may remain relatively fixed. The intercostal spaces may bulge if the effusion is large. As a similar consequence, the mediastinal structures may be shifted to the oppo-

site side with corresponding change in their physical signs. The area of effusion is flat to percussion. Tactile fremitus is decreased or absent. Shifting dullness at times is demonstrated by altering the position of the patient. An area of hyperresonance may at times be found above the level of the fluid on the corresponding side. The presence of fluid is confirmed by the aspirating needle.

In most of the cases of interlobar empyema so far reported, the pus has been demonstrated in the fissure which runs along the verte-

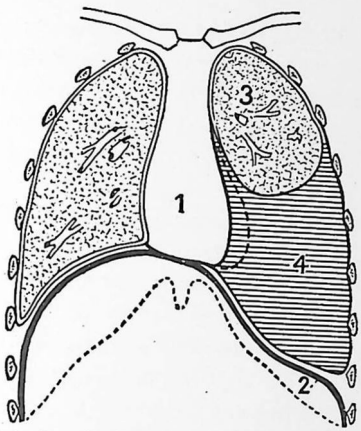


Fig. 4.—Left-sided pleural effusion. 1, Heart pushed over toward the right; 2, diaphragm depressed (suppression of Traube's space); 3, left lung displaced upwards; 4, effusion in pleural cavity.

bral border of the scapula when that bone is pulled as far forward as possible by crossing the arms in front. The signs usually found in this condition are localized flatness on percussion, diminished fremitus, and feeble or absent breath sounds.

The physical signs of pleural thickening are dullness to percussion to a variable degree, diminished breath sounds, diminution or increase of voice sounds, tactile fremitus, and diminution of the normal respiratory excursion of the affected side.

Laboratory Aids: X-rays of the chest usually confirm the presence of fluid in the pleural cavity. Laboratory analysis of the fluid reveals a high lymphocyte count in serofibrinous effusions, particularly those of the tuberculous group, and a high polymorphonuclear count in the purulent effusion, while tumor cells may at times be

found in the fluid caused by neoplasm. If the organism is not demonstrated on microscopic examination, guinea pig inoculation may be necessary to establish the diagnosis. Leukocytosis is usually present and, with empyema, it may be marked. The sedimentation rate is usually elevated.

The prognosis of pleurisy depends entirely upon that of the disease with which it is associated. Prompt and efficient treatment may improve the outlook.

TREATMENT

1. It is very important that during the acute stages of pleurisy the patient rest in bed with plenty of fresh air until the temperature reaches normal, and that later he resumes his active life slowly, returning to bed in case fever recurs. If tuberculosis is present, treatment in a sanatorium is in order.

2. Fixation of the chest usually brings relief. To accomplish this, a binder with shoulder straps is best during the acute stage. In diaphragmatic pleurisy, the binder should immobilize the upper abdomen as well as the thorax. This type of immobilization is preferable, as it can be easily removed and allows proper daily physical examination. Later, strips of adhesive tape about four inches wide, long enough to extend beyond the mid-line in front and back, and applied during forced expiration, are most satisfactory.

3. For local relief of the pleuritic pain, heat in the form of hot-water bottles, the electric pad, or hot compresses may be applied.

4. The above measures may fail to bring relief and if so, the salicylates, acetysalicylic acid or phenylsalicylate in 0.33 Gm. (5 grains) doses every two hours for four doses should be given. In severe cases codeine sulfate, 0.016 to 0.032 Gm. (¼ to ½ grain) every two hours or morphine sulfate, 0.01 to 0.016 Gm. (⅙ to ¼ grain) hypodermically may be necessary.

5. During the acute period while fever is present, the diet should be that for all febrile conditions. Some give six ounces of a liquid diet every two hours, which may be sweet milk, or buttermilk, egg albumen, fruit juices, etc. Perhaps the best guide to the food intake is the appetite of the patient. The diet for months following the illness should be one of a high caloric and high vitamin content.

6. The patient should drink plenty of water.

7. The bowels should be kept open and regulated by use of a mild laxative, as milk of magnesia, 30 Gm. (1 oz.) every other day or cascara sagrada, 4.0 Gm. (1 dram) daily.

In the treatment of serofibrinous pleurisy the binding of the affected side as a measure in an attempt to lessen the volume of effusion which collects, seems to be a mistake, as it may aid in the dislocation of organs and later hinder the absorption of fluid, the latter being favored by deep respiratory movements.

Counterirritation in the form of a mild mustard poultice, application of tincture of benzoin, or radiant light physical therapy seems to relieve the pain in serofibrinous pleurisy.

In addition to medications as above, calcium chloride or calcium gluconate is administered early in the disease in the hope of checking an increase of the effusion. The rationale of this treatment is that fluid exudates can arise only in the presence of the sodium ion, which in some degree the calcium displaces. Frequent doses (6 to 12 per day) of a 6.6 per cent solution of calcium chloride (1 Gm. or 15 grains of calcium chloride dissolved in 15 cc. of water) are administered, or two intravenous injections each week of 10 cc. of a ten per cent calcium gluconate solution are given. It is said this therapy has no effect after the effusion has collected or if the pleurisy is of the purulent type.

Purulent effusions frequently require surgical drainage, but this should not be done until frank pus has formed. Serous effusions, particularly those caused by tuberculosis, are best not removed unless to relieve the dyspnea.

The cause of any of the types of effusions must be sought and treated. Extensive laboratory culture, animal inoculations, and frequent physical examinations may be required to make the diagnosis.

INFLUENZA

Influenza is an acute, highly infectious, and contagious disease which occurs in endemic and epidemic forms with occasional pandemics. It is characterized by an abrupt onset, marked myalgia, headache, fever, chills, and prostration.

Etiology: The etiology has been variously thought to be a filtrable virus, the Bacillus influenzae, or both in symbiosis. The causative organism is easily transmissible through secretions of the respira-

tory passages, and is highly pathogenic. The ages most affected are between 10 and 40 years. Sex seems to possess little influence. One attack of the disease does not appear to confer lasting immunity.

Pathology: Involvement of the respiratory tract is characteristic. Severe inflammatory injection of the upper respiratory mucous membranes is commonly found. Bronchitis, bronchiolitis, tracheitis, laryngitis, and at times pneumonia are seen. A serosanguinous exudate may be found in the air passages and there may be scattered areas of necrosis of the respiratory epithelium. Lung findings indicate peribronchial inflammatory changes. These changes occur early and, if the patient survives, are transformed to a purulent involvement; bronchiectasis and chronic pneumonitis may result. Pleural involvement was not common in the post-World War pandemic. If the central nervous system is involved, there may be hyperemia of the meninges of the brain and cord.

Signs and Symptoms: The incubation period is short, varying from one to five days. The onset is sudden. Fever ranging from 39° to 40.5° C. (102° to 105° F.) appears with chills or chilliness and marked prostration. Usually catarrhal symptoms affecting the eyes, nose, and pharynx appear early. Severe aching of the head, back, and extremities is characteristic. The face, neck, and thorax may be flushed. Tachycardia may be present. Pharyngitis may be marked, and a sense of soreness in the chest frequently accompanies it. Gastrointestinal symptoms appear concomitantly with the respiratory complaints. On the third or fourth day, bronchitis of a purulent type associated with a productive cough manifests itself. Auscultation may reveal many coarse or fine râles scattered through the lungs. The temperature drops at this time to about 38.3° C. (101° F.). The cough is usually persistent; chronic bronchitis frequently follows. Sinusitis is often seen at this period, and in children otitis media may be found.

Pneumonia may accompany the involvement of the upper respiratory passages or be an immediate sequel to it. The pneumonia is generally bilateral and the lower lobes are most often involved. Fever is usually maintained and the tachycardia may continue. Cyanosis and prostration are out of proportion to the pneumonic involvement. Leukopenia is characteristic of the disease. Recovery from such pneumonia is frequently delayed because of pulmonary

complications, as delayed resolution, abscess, chronic bronchitis, or bronchiectasis.

Prognosis: Endemic cases are usually mild and relatively few deaths result. However, in epidemics and pandemics, there is a mortality of between 15 and 60 per cent. The fatality rate rises with the second and third waves.

TREATMENT

1. Isolation should be enforced to protect the patient from secondary bacterial invaders and to shield others from the disease. The disease is usually only reportable during epidemics.

2. Absolute rest in bed is essential until the temperature has been normal for several days and symptoms have disappeared. This should be followed by a full week for convalescence before the usual routine is adopted. Fresh air should be plentifully supplied.

3. The diet should be soft or fluid. Regular diet may be resumed as soon as the patient expresses a desire for food.

4. Fluid intake should be adequate, 3500 to 5000 cc. daily during the febrile period. Fruit juices are essential. The patient should have a glass of fruit juice every hour he is awake.

5. Headache and myalgia are combated by use of the salicylates. Sodium salicylate, acetylsalicylic acid or salol in 0.6 Gm. (10 grains) doses with an equal amount of sodium bicarbonate given every two to three hours for four or five doses will usually bring relief. In some instances small doses of codeine sulfate, 8 to 30 Mg. (⅛ to ½ grain), repeated as often as necessary until the more intense pain subsides, are indicated.

6. At the outset of the disease, a purge is advisable. Magnesium sulfate, 30 Gm. (1 oz.), or citrate of magnesia, 1 bottle (200 cc.) are satisfactory cathartics for this. Afterwards, the bowels should move daily with the aid of a mild cathartic or laxative as fluid extract of cascara sagrada, 4 to 8 cc. (1 or 2 drams) daily, or a small tap water enema. Excessive catharsis in the asthenic or severely prostrated patient should be avoided.

7. Relief for the congested nasal passages is secured by the local application of an ephedrine solution of camphor and menthol. Mouthwashes, irrigations of the throat, and gargles should be regularly employed. Normal saline solution or dilute hydrogen peroxide

is preferable for bathing the inflamed mucous membranes of the throat and mouth.

8. Pain in the chest may be relieved by the application of a mustard plaster (one part mustard and three parts flour, and warm water to make a paste and spread on muslin). The plaster should be left on the area for approximately 15 minutes.

9. Repeated sponging is indicated for extremely high fever.

10. Oxygen is always advised, and if pneumonia supervenes it is necessary.

11. The sulfonamides have not proved successful up to now.

12. Vaccination against the disease has been tried, but the results are still doubtful.

MASSIVE COLLAPSE OF THE LUNG

Etiology: Massive collapse of the lung is usually a complication of some other disease. The conditions which most commonly are followed by complete atelectasis are (1) surgery (especially upper abdominal operations), (2) trauma to the thorax, (3) foreign body in the bronchus or trachea and (4) bronchogenic carcinoma. Massive collapse comes on within a few hours to three days after an injury or operation, especially one requiring general anesthesia. Some other conditions which precede massive collapse are diphtheria, pregnancy, edema of the glottis, influenza, and vagal stimulation causing constriction of the bronchus. Massive collapse occurs when a main bronchus is obstructed; occlusion of a secondary bronchus is followed by lobar atelectasis, and of a smaller bronchus by patchy atelectasis. Incomplete obstruction may bring on emphysema. Predisposing factors in atelectasis are straining respiration and loss of the efficiency of the cough reflex. The most important factor in this disorder is lowering of the tonus of the respiratory muscles which decreases intrathoracic volume and respiratory excursions. This loss of tone may be due to anesthesia or psychic shock.

Signs and Symptoms: The manifestations of this condition begin abruptly and are characterized by dyspnea, weakness, tachycardia, and frequently by collapse. The involved side may be painful but usually is not. Fever rises soon after the onset; however it may be entirely absent. Blood pressure may drop 10 or 15 points on the systolic side. When an entire lung is collapsed, coughing

and bloody sputum are less apt to be present. In cases of partial collapse, the symptoms, as cough and hemoptysis, are more prominent. The leukocyte count varies from 10,000 to 20,000. It must be kept in mind that pneumonia, collapse of the lung, and pulmonary infarct may occur in the same individual.

Massive collapse involving a whole lung may be entirely overlooked because the symptoms may be meager. The chief identification marks may be listed as follows:

1. The sudden onset of dyspnea is characteristic. Sometimes it is mild and brought on by exertion, while at other times it is urgent and present without exertion.
2. Cough and expectoration are usually present.
3. Cyanosis may be mild or severe, depending on the condition of the other lung.
4. On physical examination, the chief sign is the displacement of the heart to the collapsed side. The collapsed side is shrunken and the spaces between the ribs are greatly narrowed.
5. Movement of the collapsed side is hardly present. The tactile fremitus over the collapsed lung is gone.
6. The percussion note is greatly impaired as in a consolidated lung.
7. Auscultation over the collapsed lung usually reveals tubular breathing as found in lobar pneumonia, but breath sounds may be absent.
8. The patient may cough up a large quantity of gelatinous sputum containing blood. This may not occur until the disease has existed for several days and expectoration may be followed by inflation of the lung.
9. X-ray examination will practically always clinch the diagnosis; the displacement of the heart in the direction of the collapsed lung and the elevation of the diaphragm on the collapsed side are almost sufficient to make a final diagnosis of massive collapse.

Diagnosis and Prognosis: In addition to the specific characteristics of massive collapse of the lung, these patients may be suspected of having pneumonia, pulmonary embolism, pneumothorax, or even a pleurisy with effusion. One of the outstanding features in the differential diagnosis is that in massive collapse the signs are out of all proportion to the symptoms. The patient is not very ill from

massive collapse and although he may be short of wind, he usually feels quite well. He is almost always free from pain, but pain is associated with some of the diseases confused with massive collapse.

Usually after massive collapse, the lung becomes inflated within from two to three days to a week or two. Sometimes pneumonia or some other complication sets in.

TREATMENT

1. **Emergency Treatment:** The emergency treatment consists in combating shock and collapse.

   a. It is best to give a stimulant as 0.001 Gm. (1/60 grain) of atropine sulfate and 0.002 Gm. (1/30 grain) of strychnine sulfate, repeated two or three times a day if necessary.

   b. One hundred per cent oxygen should be started immediately. However, some prefer a mixture of five per cent carbon dioxide concentration in oxygen.

   c. For cardiac stimulation 2 or 3 cc. of coramine should be given subcutaneously and repeated every four hours.

   d. Recently the bronchoscope has been used to withdraw obstructing substances from the main bronchial tree.

   e. Sometimes moving the patient from side to side in a rocking sort of motion is sufficient to cause the expectoration of the large hemorrhagic gelatinouslike mucous mass which is followed by inflation of the lung.

2. **Prophylactic Measures:**

   a. Inhalations of five per cent carbon dioxide and oxygen following anesthesia are of value in the prevention of postoperative atelectasis and should be repeated if there is any evidence of bronchitis.

   b. Encourage deep breathing and frequent changes of position following operation. Steam inhalation with tincture of benzoin or menthol to warm and moisten the inflamed mucous membranes is advised.

   c. Excessive use of morphine and hypnotics following operation should be avoided, as they tend to restrict coughing and full respiratory movement and favor the retention of mucous in the bronchial tubes.

   d. Avoid tight binders or appliances which hamper breathing.

   e. Guard against upper respiratory infections.

LUNG ABSCESS

Lung abscess is a localized suppuration in the parenchyma of the lung, and is usually associated with necrosis of pulmonary tissue.

Etiology: Lung abscess is caused by pneumonia or other infections of the lung tissue with suppurative anaerobic microorganisms.

The primary focus of infection may be an oral abscess, tonsillitis, or pyorrhea. Pulmonary abscess is caused by the inhalation of organisms with or without the association of the ordinary pyogenic organisms. Conditions which favor the entrance of these organisms from the upper air passages, especially operations as tonsillectomy or tooth extraction, favor the development of an abscess through the aspiration of infected blood.

Inhalation of foreign bodies is a frequent cause of pulmonary abscess, especially in children. These foreign bodies may cause partial or total occlusion of a bronchus with consequent edema in the area distal to the occlusion and often atelectasis; this latter condition offers a most favorable opportunity for bacterial infection. Oily substances introduced into the nose in the form of nasal drops or sprays occasionally gain entrance into the pulmonary tissue by way of the bronchi and give rise to lung abscess. Lung abscesses may also result from infected emboli which arise in other parts of the body and break down into suppuration after becoming lodged in the lung.

Pathology: The pathological process may be necrotic from the start. The area of suppuration breaks down into a small cavity and is surrounded by a zone of edema and exudate in the neighboring alveoli, which is not encircled by a definite wall in the acute stage. As the suppurative process progresses, the area breaks down until the abscess may become one of very large size with a correspondingly marked increase in the collateral zone of exudate. Sputum is absent during the formative stage of the abscess and foul expectoration occurs only when communication with a bronchus is affected. Usually early in the process, pus breaks through into the bronchus and is discharged through the mouth by cough. If this type of drainage is insufficient, the pathological process continues to extend until a large portion of the lung may be involved. On the other hand, if drainage is effective, the pus is evacuated, the area of exudate surrounding the abscess is absorbed and prompt resolution occurs. If drainage is only partially adequate, the process may become localized; a fibrotic wall forms about the area of infiltration and a chronic abscess results.

Signs and Symptoms: Whenever a patient with pneumonia fails to recover within the usual period of time, abscess of the lung

must be considered. Most cases thought to be unresolved pneumonia are in reality cases of lung abscess. The acute onset with a chill, sudden rise in temperature, and pain in the chest may simulate that of pneumonia. Within several days, foul pus may be expectorated. Fever remains high and the amount of expectoration may be profuse and associated with a distressing paroxysmal cough. In extensive cases, dyspnea and cyanosis may ensue because of insufficient aeration due to the large amount of pulmonary tissue involved. Physical signs are scant in the early stages. There is an impaired percussion note and numerous fine moist râles without alteration in the breath sounds. Tuberculosis with cavitation may be simulated. The right lower lobe is the one most commonly affected because of the relative ease with which the expectorated material reaches it.

Diagnosis: X-ray signs are the most satisfactory diagnostic criteria. Early in the disease, there is an area of increased density with a rarefied center. Later, the rarefied center may show the characteristic dense shadow of a shifting fluid level. However, the area of infiltration may be homogeneous if the cavity is sufficiently large to be detected by x-rays or if it is completely filled with exudate. Chronic cases of pulmonary abscess may show multiple cavities each with a fluid level. The diagnosis should be suspected if the patient expectorates foul pus and runs the clinical course previously described.

Chronic abscess in the upper lobe greatly simulates tuberculosis and the differential diagnosis is made by virtue of persistently negative sputum, the history, onset, and course, which are usually fairly typical for lung abscess. Bronchiectasis has a more difficult differential diagnosis since the two are often associated. The diagnosis is made through the use of x-rays with lipiodol, since in bronchiectasis the bronchiectatic cavities are well outlined by the lipiodol. Bronchogenic carcinoma may simulate a lung abscess after it becomes secondarily affected and breaks down. Both carcinoma and abscess may be found at autopsy.

TREATMENT

1. **Preventive:** Contemplated surgery about the mouth or pharynx, including removal of abscessed teeth and infected tonsils, should be preceded by a preliminary period during which as much oral sepsis is obtained as is possible. Hyperventilation of the lung

and coughing should be encouraged after operation as a means of preventing abscess formation.

2. Strict bed rest is necessary. Fresh air, a moderately high caloric diet rich in vitamins, and ultraviolet radiation are necessary accompaniments of bed rest. Postural drainage continued for five to six minutes several times a day during which time the infected lung always occupies the uppermost position is one of the greatest aids in this disease. Rest in bed for several weeks after purulent expectoration has ceased is always indicated.

3. In the early stages severe pain and lack of sleep may exhaust the patient and morphine sulfate, 0.008 to 0.01 Gm. (⅛ to ⅙ grain), or codeine sulfate 0.033 Gm. (½ grain) administered subcutaneously, may be temporarily employed. Deodorant inhalations in cases with a distressingly malodorous expectoration have some value.

4. A few cases may recover spontaneously within a period of several weeks.

5. Chemotherapy has come to occupy a relatively large position in the treatment of acute lung abscess. There are on record reports of cases which have recovered through the use of sulfapyridine given in large doses, starting with an initial dose of 3 to 4 Gm. (45 to 60 grain), followed by 1 Gm. (15 grains) every four hours until a suitable blood level has been reached. The patient is then placed on a maintenance dose, usually 1 Gm. (15 grains) three or four times a day to help maintain this level. More recently, sulfadiazine and sulfathiazole have been used with similarly encouraging results.

6. Bronchoscopy is indicated in order to create a passageway through the swollen mucous membrane of a bronchus; it is also necessary to remove a foreign body if this is the agent which started the pathological process.

7. Conservative treatment is said to fail in approximately 70 per cent of cases, according to various observers, and then surgical drainage is indicated. Some believe that surgical intervention is the method of choice, and should be done as soon as possible after an abscess cavity can be shown to be present. Surgeons believe that the opening and draining of a lung abscess is as important as the opening of an abscess in another part of the body.

8. Surgical intervention is contraindicated during the acute stage of the disease because it widely disseminates the infective proc-

ess due to lack of protective barriers. Surgery is most satisfactory if instituted after the acute stage is over and before the chronic stage has become well established.

a. Artificial pneumothorax proves an adequate means of instituting drainage when the lung abscess assumes a hilar position. The aim of artificial pneumothorax is to get drainage of the bronchi without kinking and atelectasis. For this only small doses of gas should be given, that is, doses of from 75 to 300 cc. Too much collapse may lead to kinking of the bronchus, atelectasis, and the risk of rupture of the abscess.

b. Abscesses at the periphery rarely drain sufficiently through a bronchus and are more likely to produce empyema by ulceration into the pleural cavity than abscesses located at or near the hilus. Such abscesses must be drained by thoracoplasty and thoracotomy, since with these procedures the infected abscess is allowed to drain through the surgical incision. It is wise always to institute this phase of therapy before the wall about the abscess has become too well organized, since then collapse of the abscess may not be effected as readily as one would desire.

CHAPTER XIV

The Lungs

(Continued)

ACUTE ASTHMA

Asthma is a kind of dyspnea caused by spasmodic constriction of the bronchial muscles. These paroxysmal attacks occur at variable intervals. They are commonly seen in several members of a family or in a family where other members are suffering from allergic diseases. The asthmatic individual is one who frequently has suffered from other allergic conditions. Asthma is a disorder characterized by hypersensitivity to some foreign substances which are taken into the body by eating, inhalation, injections, infections, absorption from chemical or other toxic agents, and sometimes by an autointoxication associated with toxic conditions within the body.

The attacks may be mild, characterized by wheezy breathing for a short period of time, or severe, at times appearing to threaten the life of the patient. The distinguishing feature of such an attack is the difficulty in expiration and the lack of any disturbance of the inspiratory phase of breathing. In heart disease, fibrosis of the lung, laryngismus stridulus, and foreign bodies, the breathing difficulty is of inspiratory kind, rather than expiratory.

Diagnosis: The diagnosis of bronchial asthmatic seizures is not difficult, as the dyspnea is almost always expiratory. Examination reveals the characteristic dry rhonchi sibilant and sonorous over the entire chest. A careful examination of the heart usually is sufficient to rule out heart disease as the cause of dyspnea. In cardiac asthma, the engorgement of the lung is produced by over-distention of the pulmonary vessels and the râles are of the moist type; it is pulmonary edema that characterizes the clinical picture. In bronchial asthma, the lungs are dry. In cardiac asthma the heart is enlarged and irregular, while in bronchial asthma this is seldom the case. The most striking feature of the patient in the seizure of bronchial asthma is the superficial type of respiration of the expiratory variety.

TREATMENT

While an attack of bronchial asthma seldom endangers the life of the patient, it does so occasionally. It always causes the patient distress, and relief is more than welcome.

1. When called to see a patient in an asthmatic seizure, one should administer 0.5 cc. of 1:1000 solution of epinephrine subcutaneously for immediate relief. This dose may be repeated every hour or two or oftener if needed, but it is seldom necessary to repeat it more than once or twice. A nasal spray of a solution of 1:100 epinephrine augments the action of the subcutaneous dose.

2. Ephedrine, 0.05 Gm. (¾ grain), may be given orally four times a day. Ephedrine is not as effective as epinephrine in controlling a severe attack, but is decidedly beneficial in preventing a mild dyspnea from growing worse. When applied locally to the mucous membranes it is less irritating and produces a more lasting constriction than does epinephrine.

2. Nethamine hydrochloride, a new synthetic ephedrine-like drug, given in doses of 0.0078 Gm. ($1\frac{3}{100}$ grain) daily is beneficial. This drug is said to be as effective as ephedrine and not quite as toxic.

3. Adrenalin should not be given to children in injections of more than 0.12 to 0.18 cc. (2 or 3 minims) and the injection should be given subcutaneously only. This dose may be repeated in 20- to 30-minute intervals. If adrenalin does not work in the first few doses, the drug should not be used. Prolonged adrenalin medication is not recommended, as the drug is habit-forming, the dosage cannot always be controlled and abdominal crises may ensue.

4. If adrenalin does not relieve an attack, the asthma is probably due not to bronchiolar spasm, but to bronchial edema with bronchial plugging. Syrup of ipecac should be given in these cases, ½ to 1 teaspoonful for infants and young children and more for older children to induce vomiting. If the ½ to 1 teaspoonful dose does not cause the infant or young child to vomit, two teaspoonfuls may be given. The ipecac should be followed with warm water.

If the attack is prolonged, the ipecac should be followed by the administration of 10 to 15 per cent intravenous glucose given by slow drip infusion (300 cc. for young children and 500 to 1000 cc. for older ones). One one-thousandth of adrenalin may be mixed in

with this infusion to make a dilution of 1:300,000 to 1:1,000,000. This prevents or helps dehydration and may relieve edema.

4. Morphine is contraindicated. If sedation is necessary, it must be obtained by using sodium phenobarbital, 0.033 Gm. (½ grain) subcutaneously, or paraldehyde, 15 to 30 cc. (½ to 1 ounce) per rectum. This is dissolved in 60 cc. (2 ounces) of some oily substance as olive oil. Other acceptable sedatives include bromides, 0.66 to 1 Gm. (10 to 15 grains) and chloral, 0.12 to 0.42 Gm. (2 to 7 grains), which may be given intravenously. Triple bromides, 0.33 to 1 Gm. (5 to 15 grains), amytal, 0.033 Gm. (½ grain), and or acetyl salicylic acid, 0.33 to 0.66 Gm. (5 to 10 grains) may be given orally. This sedation may be repeated in two or more hours.

5. Aminophylline, 0.53 Gm. (8 grains) in 50 cc. of 50 per cent glucose solution, intravenously, often, but not always, controls the seizure. If relief is not afforded, the addition of 0.5 cc. of adrenalin, 1:1000 solution, to the intravenous solution may produce striking effects. When adrenalin, aminophylline, and hypertonic glucose are ineffective, ether, 30 cc. (1 ounce) in 60 cc. (2 ounces) of olive oil, given rectally in useful in controlling status asthmaticus.

6. Sometimes in severe cases intravenous normal salt solution usually containing five per cent glucose is beneficial. The dose should be large, 1500 cc. or more, and given quite rapidly. Solutions of hypertonic glucose, 100 cc. of 50 per cent solution, given daily for two or three days are also recommended.

7. Oxygen and helium, either alone or in combination, when given through a nasal catheter may promote comfort. It is not usually well to give oxygen therapy in a tent, as this may upset the patient. Asthmatics are likely to experience claustrophobia during attacks.

8. The inhalation of fumes from burning asthma powders, which contain stramonium leaves and potassium nitrate, may afford temporary relief in mild attacks.

9. Whenever the attack is prolonged and the above measures have failed, the patient should be moved to different surroundings. Removal to a different room and bed, or to a friend's house near by is often quite effective. Extrinsic causes can usually be avoided by removal to a clean hospital bed.

The general management and prevention of recurrence of attacks consists in the determination and exclusion of the exciting

substance (allergen) which may be discovered experimentally or through cross-examination of the patient. If an offending allergen is found, the simplest and most satisfactory method of treatment is the prevention of contact by the patient with the excitant. If this is impossible, then desensitization therapy through the injections of specific or nonspecific proteins may be instituted. The failure to determine a cause calls for further physical examinations, looking for infected teeth or tonsils, gall-bladder disease, anomalies or diseases of the nasal passages and sinuses, and complete study of the gastrointestinal tract.

The selection of drugs for administration during the free period is difficult, but the iodides, sodium or potassium, in doses of 0.33 Gm. (5 grains) three times a day, is recommended. A ten per cent solution of calcium chloride in doses of 15 cc. (½ ounce) three times a day occasionally has a good effect. Calcium has no place in the treatment of the acute paroxysm, however.

Physical agents, as roentgen-ray therapy, diathermy, actinotherapy, and hydrotherapy have their proponents, but results of this treatment are unreliable and temporary in their benefits.

Surgical measures, as extirpation of sympathetic ganglia or section of the vagus in the cervical region, have been attempted in the belief that the number of constricting stimuli to the bronchi are reduced. Bronchoscopic lavage and local therapy in the bronchi have been found of value in nonsensitive cases with profuse expectoration and a chronic tracheobronchitis. The benefit of surgical procedures, however, is usually transitory.

The administration of endocrine substances such as thyroid, ovarian extracts, and parathormone has proved effective in certain cases. Change of climate is advantageous in many cases. Breathing exercises are recommended. Psychic therapy has its place in certain selected cases. In the case of an asthmatic patient, the physician must be aware that he is treating a constitutional disease and steps must be taken to correct any abnormalities or local or systemic diseases impairing the health of the patient.

SPONTANEOUS PNEUMOTHORAX

Pneumothorax or air in the pleural cavity may be of the spontaneous type which arises from the rupture of emphysematous blebs,

and from perforation of the pleura by carcinomatous, tuberculous, and other destructive lesions, or the artificial form which constitutes the introduction of air into the cavity for therapeutic purposes. Spontaneous pneumothorax is characterized by its abrupt onset in apparently healthy persons, usually young adults. It almost always clears up uneventfully.

Etiology: Kjaergaard has endeavored to explain the rupture of emphysematous blebs or subpleural valve vesicles by: (1) Localized emphysematous changes in the lungs; (2) scar tissue in the lungs, and (3) congenital cystic disease of the lungs. Another suggested cause is rupture of the mediastinal pleura in the presence of mediastinal emphysema. Years ago the cause of spontaneous pneumothorax was believed to be rupture of a tuberculous focus or some other destructive lung process piercing the pleural cavity. Recently, however, it has been noted that pneumothorax occurs most often in people who are free of demonstrable disease, and the cause in these instances is given as rupture of blebs near a pulmonary scar or of an emphysematous bleb. It has been proposed that a congenital pleural defect or a constitutional inferiority of the pleural structure may cause pneumothorax or the formation of pleural blebs. Since emphysema is a disease of later life, pulmonary emphysema may be excluded as an etiological factor as a general rule. Spontaneous pneumothorax occurs most often among young adult males, suggesting a constitutional factor in the causation. It has also been noted that it occurs in families. Chest trauma or mechanical strain are also common causes of the disease. If a pulmonary infarct is septic, it may break down and allow free air to pass into the pleural cavity resulting in pneumothorax.

Signs and Symptoms: The earliest and commonest symptom of spontaneous pneumothorax is sudden pain at the time of rupture, with or without collapse. The pain involves the entire side of the chest, shoulder, back, or substernal area. However, this symptom need not be present, and often the patient is not at all conscious of his condition and it is discovered incidentally. Often the patient is "heart conscious" because of dyspnea of varying degree. Marked pallor is noted. Cyanosis and a sudden rise in temperature is a common finding in children, but usually is lacking in adults. Respirations are shallow and rapid. The pulse is small and fast, and in very

severe cases syncope and collapse may ensue with a subnormal temperature. A dry, unproductive cough is often an accompanying feature of the disease.

Physical findings include increased size of the affected side of the chest, deviated or absent apical heart beat, limited chest movements, and widened and bulging interspaces. Breath sounds are usually absent on auscultation, though tinkling râles may be heard occasionally. Peculiar amphoric sounds with a metallic ring are often detected when the patient coughs. Percussion reveals hyperresonant or tympanitic tone, but this may be dull if pressure within the pleural cavity is high. If the valve-like opening is patent a typical cracked-pot sound is heard. Vocal fremitus is diminished or absent. Palpation reveals an "air-cushion" sensation over the interspaces. There is absence of respiratory mobility of the lower lung margin with dullness in this area. In left-sided pneumothorax, the heart may be displaced to the right or cardiac dullness may even be obliterated. The coin test reveals a peculiar sound.

The course of spontaneous pneumothorax is dependent on the perforation. Usually the pneumothorax becomes stationary when enough air enters the pleural cavity to overcome the negative pressure. Sometimes the opening has little tendency to close and the collapse will remain stationary for a rather long period of time, and then reëxpansion takes place very slowly. In other cases, the opening closes almost immediately and the lung expands in a few days or weeks. Generally speaking, the prognosis is excellent, though attacks often recur.

Diagnosis: This acute type of lung collapse must be distinguished from heart disease as coronary thrombosis and acute pericarditis, and from other lung diseases as massive collapse, pulmonary embolism and infarction, and pleurisy. Sometimes rupture of a large emphysematous bulla in the hilar area may simulate pneumothorax. Pneumonia and diaphragmatic hernia also must be kept in mind.

X-ray examination and aspiration of air after paracentesis help in arriving at the correct diagnosis. Sometimes a pneumothorax and a large peripheral cavity may seem alike on x-ray examination, but usually the pneumothorax is in the lower part of the chest, while the cavity is apical. The chest wall is generally retracted in cavities, but bulging in pneumothorax.

TREATMENT

1. The patient should be put to bed immediately and kept there for at least two weeks. A half-sitting position is preferable. Complete bed rest for patients with partial pneumothorax will prevent a total collapse. All these patients should have restricted activity for a year.

2. The patient should be given a diet rich in Calories and vitamins.

3. Morphine sulfate, 0.01 to 0.016 Gm. (⅙ to ¼ grain), hypodermically, or codeine sulfate, 0.03 to 0.06 Gm. (½ to 1 grain), administered orally or hypodermically, may be given as needed to relieve pain and control the cough.

4. Sedatives, as phenobarbital, 0.03 Gm. (½ grain) three or four times daily, or sodium bromide, 1 Gm. (15 grains), or chloral hydrate 1 Gm. (15 grains), daily are indicated for sleeplessness.

5. Oxygen administration is of value.

6. Some advise that the affected side of the chest be strapped in order to prevent any chance of forced respiratory movements reopening the fistula, and to forestall progressive distention of the affected side.

7. If the heart is displaced, thoracentesis with withdrawal of small amounts of air is advisable.

8. In tension cases, patients should be kept in bed for three or four weeks. Small quantities of air should be removed repeatedly. In most cases, sedation should be continued and no attempt made to lower the intrapleural pressure until the perforation is well sealed. Reëxpansion usually takes place in six to ten weeks; if tuberculosis is suspected, reëxpansion should be delayed by the injection of air.

9. Recurrent attacks may occur, involving either the same side, the opposite side, or alternating. A sterile pleural exudate should be produced in these cases by injecting substances into the pleural sac.

10. Bilateral pneumothorax may occur if the strain of compensating for the involved lung is too great on the opposite one. Emergency aspiration of air and oxygen is necessary.

11. If hemorrhage from the torn lung into the pleural space (hemopneumothorax) takes place, measures to combat shock must be instituted. Sedation, blood transfusions, plasma, parenteral fluids, and oxygen are indicated.

HEMOPTYSIS

Coughing or spitting of blood is always a serious sign. In the strict sense, hemoptysis means expectoration of blood from the lungs or bronchi with the exclusion of blood from the nose or throat. This bleeding from the lungs or bronchi usually results in the spitting of bloody sputum, though conditions associated with bloody sputum do not always cause hemoptysis.

Etiology: Hemoptysis is most commonly produced by pulmonary infarction, pulmonary tuberculosis, and other acute inflammatory lesions, abscess or gangrene of the lung, carcinoma of the lung, bronchiectasis, ulceration of any part of the respiratory tract, or mitral stenosis, though there are many other causes. It is also a symptom in some hemorrhagic or blood diseases and frequently occurs with trauma, as gunshot or stab wounds, foreign bodies and contusions.

Diagnosis: The diagnosis of hemoptysis is not very difficult, though it may be confused with hematemesis. There is usually a history of pulmonary or cardiac disease in hemoptysis, while in hematemesis the history is of a gastric disturbance. In hemoptysis the blood is coughed up, mixed with sputum, and is frothy and bright red and alkaline in reaction; in hematemesis, it is vomited, clotted, and acid in reaction. After the first spell of hemoptysis, the patient usually coughs up dark clots of blood for a day or two.

The bleeding in hemoptysis is seldom extensive or persistent. From rupture of mycotic aneurysm of a lung vessel, a large tuberculous cavity, or perforated aortic aneurysm, hemorrhages may be copious. An opinion prevails that hemorrhage from mitral heart disease is usually small and insignificant. Such hemoptyses may result from a ruptured or distended engorged blood vessel, from rupture of a mycotic aneurysm or from pulmonary infarction. In cases of ruptured aneurysmal sac, bleeding may be copious, prolonged and fatal.

TREATMENT

Hemorrhage due to tuberculosis must be treated carefully so that the tuberculosis is not scattered. Morphine is effective in reducing fear and coughing, but in tuberculosis it must be used cautiously or the infected blood will not be expectorated and the tuberculosis will spread. Profuse and repeated bleeding calls for artificial pneumothorax, but before this can be done the physician must determine

which side is bleeding. Sometimes pleural adhesions are present, and thus pneumothorax is prevented.

Serum injections, pituitary extract, atropine, calcium, and the nitrites have been used in the treatment of pulmonary bleeding. Treatment consists in stopping the hemorrhage and preventing its recurrence. An injection of morphine should be given for profuse bleeding, but care must be taken so it does not stop the coughing and consequently the expectoration, since the patient might suffocate if the bronchial tubes were filled with blood.

The immediate treatment consists of:

1. Absolute rest in bed in a semirecumbent position. The anxiety of the patient should be allayed by assurance that the amount of blood lost is trivial, that the bleeding will soon cease, and that death from hemorrhage is rare.

2. Nothing is given by mouth except ice chips for 36 hours, after which only liquids and semisolids should be given.

3. Cold compresses should be applied to the head, neck, and chest over the heart.

4. If the hemorrhage is profuse, morphine sulfate, 0.01 Gm. to 0.016 Gm. (⅙ to ¼ grain), hypodermically, may be administered as necessary to secure absolute quiet. This drug must be used cautiously in tuberculosis. Sodium amytal, 0.2 Gm. (3 grains), may be used as a sedative and repeated as often as necessary to secure quiet in less severe cases. Atropine sulfate, 0.0003 to 0.0006 Gm. (1/200 to 1/100 grain), given hypodermically every four hours has a beneficial effect. Emetine, 0.05 Gm. (¾ grain), hypodermically, three or four times a day may be given. Calcium chloride (20 cc. of a 15 per cent solution) should be administered intravenously slowly. Sodium chloride (10 cc. of a ten per cent solution) intravenously is of value. Calcium gluconate or calcium chloride may be given later or in cases of small repeated hemorrhages by mouth in amounts ranging from 1 to 3 Gm. (15 to 45 grains) four times a day. Parathormone may be combined with either of these drugs, giving 10 to 30 units every 24 to 48 hours.

5. Small, multiple transfusions (50 to 75 cc.) of citrated blood have proved a valuable aid, but the necessity of securing a suitable donor, cross matching and typing of the blood militate against the use of transfusions during the acute episodes.

6. Blood coagulants, as hemoplastin or fibrinogen, may be given.
7. Inhalation of amyl nitrite may be of value.
8. After the hemoptysis is under control, determination of the cause of the bleeding must be sought.

ACUTE MILIARY TUBERCULOSIS

This disease is commoner in childhood and the adolescent period of life than in after years, but it may occur at any age. The tubercle bacilli, which cause the formation of tubercles diffusely spread throughout the lungs and other organs, arise from a focus in the lung or the abdominal cavity, or from an old tuberculous focus in some bone, joint, or other part of the body. Usually the patient has had a tuberculous lesion which has undergone healing. Then he has an acute infectious disease, and the old focus is relighted and the tubercle bacilli are poured into a vein, carried to the heart, and disseminated throughout the organs.

Acute miliary tuberculosis may be classified into the following forms:

1. Generalized.
2. Pulmonary.
3. Meningeal.

1. **Generalized Miliary Tuberculosis:** The onset of this form may be insidious and the patient may be free from severe symptoms. Grippe, acute bronchitis, or a simple upper respiratory infection may usher in the first phase of the disease. A past illness of tuberculosis should be kept in mind because the simpler kinds of infections may light up an old, apparently healed lesion. Weakness, loss of appetite, and fever characterize the first phase of the disease. Rapid pulse, dry tongue, headache, and an afternoon rise in temperature usually develop. This form of miliary tuberculosis is often called the "typhoid" type because the spleen, liver, mesentery, and intestines are usually studded with tubercles. The focus is usually a broken-down lymph gland which lies adjacent to a vein leading to the main pulmonary vein. The tubercle bacilli flow into the left chambers of the heart and are spread throughout the body.

The most important features of this type of miliary tuberculosis are the irregular fever and the slow insidious onset with gradual but persistent downward trend. Leukocytosis or leukopenia may be pres-

ent. Differential blood count as a rule reveals a very decided rise in the stab forms. Later, lymphocytosis may occur, but it is not seen in the earlier phase. As the kidney may be involved in this process, the tubercle bacillus may be found in the urine. Since this disease may be confused with typhoid, numerous agglutination tests should be done. Other diseases, as undulant fever, certain types of syphilitic infections, and some acute infectious diseases, as acute endocarditis, usually have to be considered in the differential diagnosis. Special blood tests as well as blood cultures must be done to facilitate the diagnosis.

2. **Pulmonary Miliary Tuberculosis:** The tubercle bacilli are poured into the right side of the heart from the bile duct or from blood borne from outside the thoracic cavity. These bacilli are then disseminated throughout the lungs.

The onset is usually sudden with severe cough, dyspnea, and cyanosis. The amount of sputum may be negligible. Fever is a marked feature, rising to 40° C. (104° F.) at times. The physical examination shows very little evidence of pulmonary damage. On auscultation, there may be many râles scattered throughout both lungs. The disease may be simulated by bronchitis, influenza, or bronchopneumonia. The diagnosis is usually clinched by finding tubercle bacilli in the sputum, but x-ray examination of the chest usually is relied upon for correct diagnosis. A diffuse speckling is found throughout both lungs, and the picture is usually characteristic of tuberculosis.

3. **Meningeal Miliary Tuberculosis:** In tuberculous meningitis, the invasion of the meninges by tubercle bacilli gives rise to a typical tuberculous inflammation of the pia mater. The tubercles coalesce and form caseated tuberculous nodules. The exudate practically never becomes purulent but is fibropurulent in character and may be quite clear. One of the chief changes, especially in younger individuals, is the accumulation of fluid in the ventricles of the brain which are usually distended and often lead to what is called "acute hydrocephalus."

The symptoms of acute tuberculous meningitis may be divided into three stages corresponding to practically three weeks of the disease:

(*a*) *The Prodromal Stage:* In this period, the patient is irritable and apathetic, but there is no definite physical sign that identifies the condition. Headache, general malaise, and a rise in fever to 37.8° C. (100° F.) mark the onset of the condition. Loss of appetite, weakness, nausea, and tachycardia are also typical features. This period, characterized by indefinite symptoms, usually lasts a week or ten days.

(*b*) *The Stage of Irritation:* The headache becomes more severe, and rigidity of the neck sets in. The temperature is more intermittent. Vomiting, delirium, and signs of intoxication are more marked. The pulse may be irregular and slow at one period and very rapid and regular at another. This period may also last a week or ten days.

(*c*) *The Paralytic Stage:* The final phase of the disease is ushered in by collapse, convulsions, and paralysis of some of the cranial nerves. Coma may develop at this time and death may take place in from four to six weeks after the very beginning of the disease. Cerebral vomiting, delirium, stupor, and convulsions may come and go during this final phase of the disease.

Although the clinical picture is quite characteristic, one cannot rely on these indefinite findings alone to make a diagnosis. A lumbar puncture reveals cerebrospinal fluid which is under great pressure, usually over 250 mm. of water. This fluid is as a rule fairly clear and not turbid as in septic meningitis. Then, too, there is a lymphocytosis rather than a polymorphonuclear leukocytosis as in other kinds of meningitis. It is always wise to attempt to find the tubercle bacilli in the so-called "veil" that forms in this clear fluid if it is allowed to stand in a test tube overnight. However, it is a difficult and tedious task to isolate the tubercle bacilli from the spinal fluid of these cases. Furthermore, it is not necessary, as the diagnosis is usually revealed by the associated signs and symptoms.

TREATMENT

It is generally conceded that acute miliary tuberculosis, regardless of type, is a fatal disease. Miliary tuberculosis rarely yields to treatment. The main objective of therapy is to control the symptoms in an attempt to make life more comfortable for the patient. This is done by repeated lumbar punctures for the relief of the increased intracranial pressure. While life may be prolonged, it can seldom be

saved. Instead of saying that patients with acute miliary tuberculosis never recover, it may be better to say that they hardly ever recover.

The following general measures may be taken in the care of patients with miliary tuberculosis:

1. A fluid or light diet may be given with careful attention to its digestion, assimilation, and excretion.
2. In typhoidal forms, tepid or cool water or alcohol sponge baths reduce the fever and add greatly to the comfort of the patient.
3. Hydrotherapy in the form of wet packs is also useful.
4. General cardiac and systemic stimuli are necessary in the pneumonic form especially, together with mildly stimulating expectorants.
5. For relief of cerebral symptoms, the ice cap, systemic sedatives, and narcotics are indicated.

EDEMA OF THE LARYNX

Acute edema of the larynx (edema of the glottis) may develop as a complication of a constitutional disorder as in acute or chronic nephritis and heart failure, or it may be a sequel to pressure from tumors of the thyroid or the larynx. It is usually not a serious matter when there is merely an edema of the larynx. Actually, the term "edema of the glottis" should be limited to those cases in which an inflammatory lesion from some infection extends to and involves the entire larynx. In these cases, not only the glottis but the entire larynx is inflamed and swollen, and closure of the larynx endangers the patient's life.

Edema of the larynx is rarely primary, but it may follow a large variety of diseases. The symptoms usually set in abruptly. At first the patient feels some difficulty in breathing or swallowing, and rapidly a sense of suffocation develops. Soon the patient is unable to speak and cyanosis of the neck and face follow. The distressful breathing due to the stenosis of the larynx becomes stridulous. The sense of suffocation makes the patient anxious and this anxiety added to the lack of air causes him to become almost hysterical at times.

The diagnosis of the condition is not usually very difficult. The patient as a rule has been having sore throat, laryngitis, septic pharyngitis, infection of the glands of the neck, erysipelas, or some other infection about the neck or throat. Once a physician sees a patient with edema of the larynx in a paroxysm of stertorous breathing.

cyanosis of the face and neck, paroxysms of coughing in an attempt to dislodge the obstruction, he probably will never forget it. The patient's futile attempts to save himself from strangulation and the anguish of the helpless and terror-stricken onlookers present an unforgettable experience. If there is any doubt about the diagnosis, and one cannot see edema around the epiglottis, one's suspicions may be confirmed by inserting the index finger into the pharynx where he will feel the swollen, tense, and turgid epiglottis.

TREATMENT

There is little time for procrastination in the management of a case of edema of the larynx. Mild cases may pass over quickly, but severe ones require daring procedures. In mild cases, adrenalin solution of 1:1000 may be sprayed into the throat. A sedative, as pantopon, 0.02 to 0.01 Gm. (⅓ to ⅙ grain), should be administered to allay the anxiety of the patient. In the more severe cases, it may be necessary to mechanically raise the epiglottis with a forceps, and if the condition does not subside rapidly, there should be no hesitation in performing a tracheotomy at once.

The emergency tracheotomy may be done in a number of ways, but the following procedure is best:

1. The thyroid cartilage is located and the cricoid cartilage is readily felt. One should paint the area below and around the cricoid cartilage with iodine or alcohol quickly.

2. A sharp scalpel or a razor blade, in an emergency, is quickly disinfected with carbolic acid, alcohol, or any antiseptic solution.

3. A *longitudinal* incision about an inch long is made over the upper part of the trachea below the cricoid cartilage. It should be emphasized that sterile precautions should be observed as fully as possible, but in dire emergencies the main thing is to open up the windpipe so the patient will not suffocate. Then the skin and subcutaneous tissue are retracted. Bleeding must be controlled as fully as possible by pressure, or if one has the instruments, by a clamp or two.

4. The tough cartilagenous trachea is felt and, with the sharp instrument, a longitudinal incision of one-half inch or more is quickly and daringly made. The lips of the incised trachea must be separated with a forceps, if it is available, or with some blunt instru-

ment which has been sterilized, and the aperture in the trachea should be kept open until a regular tracheotomy tube or an improvised one, as a short piece of hard rubber tubing, can be inserted. It must be emphasized that a safety pin must be attached to the tube so it will not slip from the operator's fingers and go down the windpipe.

5. After the emergency is over and the patient is breathing nicely again, the less important phases of the operation, as ligating any bleeding points, obtaining a proper type of tracheotomy tube, stitching up the skin and subcutaneous tissues, and applying antiseptic solutions, should be carried out.

6. Finally, it must be emphasized that an emergency tracheotomy is a lifesaving measure, and when it is indicated, it must be performed promptly without tremor or fear. Every physician and surgeon, whether internist or specialist, should be able to perform this emergency operation.

Minute details of the operation which are necessary and required in an operating room must be, for the most part, forgotten for the moment and attended to later on in an emergency. It is better to have a live patient operated on under conditions where there is lack of sterility and exacting surgical technic than to have the patient dead as the result of waiting for someone to come with the proper implements of precision and the proper surgical training to perform the operation with scientific correctness. Good advice for every physician, general practitioner and all, is to carry an emergency kit which is within easy reach and contains very simple medicines and instruments so that these dire emergencies may be handled and a life saved without too great a delay.

FOREIGN BODY IN THE RESPIRATORY TRACT

If a foreign body enters the respiratory tract below the epiglottis, the patient's life may be in danger. A variety of foreign bodies may block the windpipe. The commonest kind consists of pieces of food which lodge in the windpipe during the act of swallowing when it is suddenly interrupted by laughing, coughing, or crying. At these times, slippery fruit stones or hard particles of food may be sucked into the upper respiratory tract. While these emergencies arise more commonly in children, they may occur in people of any age. Obstruction by foreign bodies in the lower respiratory tract is often

encountered among older individuals and especially in apoplectic patients. If fluids pass down into the respiratory tract, they are often successfully coughed up, but if the reflex mechanism of coughing is abnormal owing to some disease, then aspirated liquids may not be thrown out and they may cause death. If a solid body of any kind becomes lodged below the larynx, death may occur unless something is done immediately.

The effect of foreign bodies may be two-fold: (1) That of obstruction to the passage of air, and (2) that of damage to the mucous membrane of the tube itself. Abscesses, pulmonary edema, and gangrene may develop as remote effects of obstruction.

TREATMENT

The treatment depends upon the grade of obstruction produced by the foreign body.

1. If the obstruction is quite complete, no time is to be lost before obtaining relief. This means an immediate tracheotomy with removal of the foreign body if it can be located.

2. If the condition is not quite so urgent, a bronchoscopist or any one with the ability to insert the bronchoscope should be called and the foreign body removed with this instrument.

PNEUMONITIS
(ATYPICAL PNEUMONIA OR VIRUS PNEUMONIA)

Etiology: This is not a new disease. Many different viruses are held responsible, notably the viruses of psittacosis, variola, measles, influenza, rickettsiae, and many others. The relationship of the various viruses is not yet entirely settled.

This disease may be transmitted from animals and particularly birds to man and by human carriers. The contagiousness is not great in most cases, are instances where the virus passed through several members of one family by personal contact. It occurs most frequently in the winter months and sometimes has the aspects of an epidemic. It may also occur sporadically at any season of the year.

Signs and Symptoms: The onset usually is insidious and the incubation period varies from ten days to two weeks. Constitutional symptoms predominate over the respiratory ones. The patient is usually mildly or moderately ill. An attack may follow exposure to cold, dampness, or upper respiratory infections. A history of expo-

sure to insect bites or contact with birds is not necessary. Symptoms include malaise; severe headache; chilliness without rigor; dry, paroxysmal cough which becomes productive later; high, irregular fever; slow pulse. The sputum may be streaked with blood. Later in the disease, coarse, explosive râles may be heard. In severe cases, dyspnea and asthmatic breathing may increase the discomfort caused by the cough, and the patient may become cyanotic. Coryza, sore throat, substernal pain, photophobia, dizziness, anorexia, nausea, vomiting, abdominal pain, and diarrhea are all seen at times. The duration of this disorder is usually from 4 to 14 days with a period of convalescence. However, there are cases which run for six to eight weeks or even longer.

The cerebrospinal fluid in patients with severe headache has been found to be sterile with normal cell count and protein content. Blood counts and urinalyses are generally normal. The leukocyte count and Schilling index may be decreased. White blood counts vary between 6000 and 9000 but may be as low as 3000 or as high as 15,000.

The x-rays reveal changes which are striking in comparison to the meager physical signs. First the size of the hilar shadow is increased on one or both sides, and then perihilar infiltration develops and the shadow spreads outward. The infiltration is of a soft, patchy or homogenous type and most dense near the hilus. Sometimes, it resembles pneumonia. A whole lobe is not usually involved. Ordinarily a lower lobe is affected, but in about ten per cent of the cases, several lobes may be involved. This picture is variable. Lesions may disappear in a few days, but they usually progress as described, and recede slowly. The x-ray picture does not correlate with physical findings. Roentgenographic changes may not be marked while the symptoms are most pronounced, and often appear and progress while the symptoms are diminishing.

There is a bronchitis resembling atypical pneumonia without the x-ray findings and this may be a mild form of the same disease.

Pathology: The pathological findings are typical of hemorrhagic interstitial bronchopneumonia or acute bronchitis. Adams and his associates in a study of two epidemics among infants found proliferation and sloughing of bronchial epithelium to be the most common finding. The exudate in the bronchial lumen was primarily epithelial; the main infiltrating cell was mononuclear. Edema, atelec-

tasis, and hemorrhage may occur. The diseased epithelial structures of the lung often contain cytoplasmic inclusion bodies. There are areas of deep red, moist solidification in the lung with thickening of the interalveolar septa, exudate in the alveoli, and pus in the bronchi. In some cases there may be enlargement of the spleen and lymph nodes. Microscopically, these changes resemble those of acute follicular splenitis and mesenteric lymphadenitis.

Diagnosis: The main diagnostic features may be epitomized as follows:

1. Grippy sensations.
2. Minimal physical signs.
3. Characteristic x-ray pictures.
4. Normal white blood count or leukopenia.
5. Irregular fever, usually remittent.
6. Sputum negative for pneumococci.
7. No response to sulfonamides.

Recently it has been discovered that cold agglutinins occur regularly in high titer in atypical pneumonia, and usually not in other clinical entities. This fact may be of importance diagnostically. These agglutinins occur in dilutions of serum or plasma from 1:10 to 1:10,000 at 0° C. (32° F.) and the titers are highest at the end of the febrile period. The height of the titers seem to parallel to some extent the severity of the illness.

This condition may be difficult to differentiate from other types of pneumonia. Other diseases which must be considered are tonsillitis, colds, nasopharyngitis, known virus diseases as influenza and psittacosis, fungus diseases, pleurisy with effusion, atelectasis, cancer, bronchiectasis, and infectious mononucleosis. Patients with pneumonia are generally more ill. Laboratory identification of the etiological agent is important in the differential diagnosis.

Prognosis: The prognosis, as a rule, is good unless complications occur, such as abscess formation or superimposition of pneumococcic pneumonia on the virus pneumonia. However, complications are rare.

TREATMENT

Treatment is symptomatic. All the usual supportive measures ordinarily employed in the management of patients with acute respiratory conditions are indicated. Oxygen seems to be the most valuable therapeutic aid in severe cases.

The place of sulfonamides in the therapy of virus pneumonia is disputed. Some claim that they should not be used unless specifically indicated. Others feel that since atypical pneumonia may be of pneumococcic origin, sulfonamides should be given for the first three days. If the patient is not benefited and it is proved that the infection is not pneumococcic, the drug should be stopped at this time. It is agreed that secondary infections must be prevented or combated, and when these infections are susceptible to sulfonamides, these drugs may be used to advantage. Otherwise, sulfonamides are useless, and have no good effects in cases of uncomplicated virus pneumonia.

Convalescent whole blood or serum may be useful. However, since virus pneumonia may be caused by so many different viruses, it is hard to predict what would be the effect of these therapeutic agents in specific cases.

The severe headache may be promptly relieved by lumbar puncture. Or, codein sulfate, ½ grain, and acetysalicylic acid, 5 grains, may be given two or three times a day.

Roentgen therapy in small doses between 35 and 90 r has produced cures in a few days. With this therapy results are best when treatment is started in the early stages, and not so good when started two weeks after the onset. Roentgen therapy is especially effective in controlling the cough. If it is taken in doses larger than those prescribed, untoward results may occur. However, good effects have been obtained with 1 or 2 treatments of 112 r units each.

Care must be taken to prevent the occurrence of secondary infections. Since patients with virus pneumonia do not regain their strength quickly, a long convalescence is recommended. The average hospital stay is 27 to 34 days.

Administration of positive pressure, inhalations of helium-oxygen mixtures, and of vaporized solutions of 1:100 epinephrine and one per cent neosynephrine as for pneumonia, may be beneficial.

Sodium salicylate and sodium bicarbonate have been used for the generalized aches, pains, and fever.

The value of penicillin is questionable, but it should be used in cases which fail to respond to other treatment promptly. It has been used with success in some cases in doses of 10,000 units intramuscularly every four hours for five days in succession.

CHAPTER XV

Acute Abdominal Emergencies

The diagnosis of acute abdominal emergencies is of as much importance to the general practitioner and the internist as it is to the surgeon. The truth of this statement lies in the fact that the patient with acute pain is usually seen by the general practitioner or diagnostician before the surgeon is called, and naturally the diagnosis must be made by the nonsurgical colleagues.

When a patient is taken with acute abdominal pain, the diagnosis is always difficult because the abdominal distress may be only a manifestation of a disease in some other part of the body unrelated to the abdomen itself. For example, a patient with pneumonia may have abdominal pain as an early symptom, and if an operation is performed on such a patient, the fatality rate is quite high; yet, if this patient with the acute abdominal distress has a peptic ulcer which is perforating or which has perforated, a delay in operation might be held responsible for a fatal outcome.

There are so many conditions that may cause abdominal pain that an enumeration of them alone would be a lengthy undertaking. For practical purposes, the diagnosis of the acute abdomen will be taken up in the following manner. The law of averages shows that there are five important diseases in men that may be responsible for the so-called "acute abdominal emergency." They are: (1) Acute appendicitis; (2) acute gallbladder disease with or without stone; (3) perforation of a peptic ulcer; (4) acute bowel obstruction, and (5) acute pancreatitis (Fig. 1). In women, we must add four more diseases to the list: (6) Ruptured ectopic pregnancy; (7) acute salpingitis; (8) twisted ovarian cyst, and (9) rupture of a tuboövarian abscess (Fig. 2).

Before commenting upon these disorders, it should be emphasized that there are five extraäbdominal diseases that commonly cause pain in the abdomen simulating an acute surgical emergency. They are: (1) Pneumonia; (2) coronary disease of the heart; (3) lead colic; (4) tabes dorsalis with gastric crisis, and (5) renal stones. These con-

ditions do not embrace all of the diseases that may cause either a "genuine" or "false" abdominal emergency, but they are the commonest diseases that must be kept first in mind. There are innumerable medical conditions that have to be taken into consideration, as cirrhosis of the liver, acute hepatitis, uremia, diabetic coma, various drug poisonings, abscesses of the liver, vitamin deficiencies, and many other constitutional disorders.

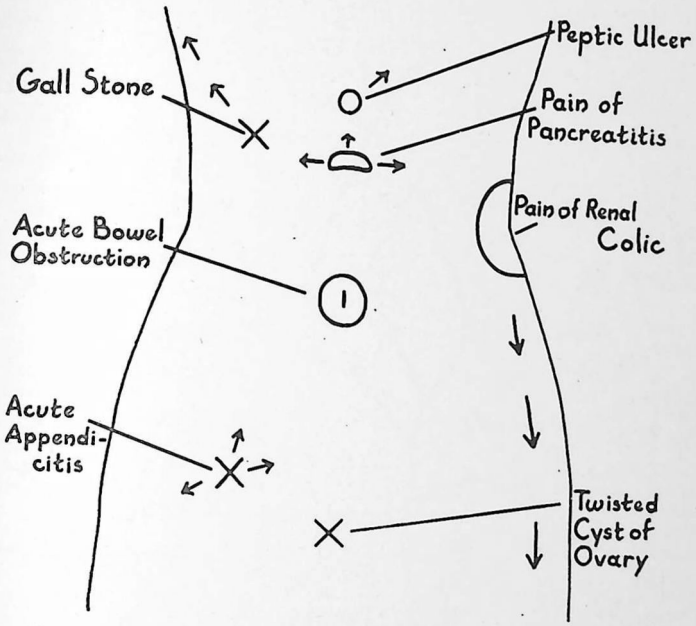


Fig. 1.—The chief points of pain in various acute abdominal disorders.

Diagnosis of Acute Abdominal Pain: The importance of making a prompt and precise diagnosis in a case of acute abdominal pain cannot be overemphasized, for, as stated above, an incorrect diagnosis may lead to an operation which is not only needless but which may be detrimental to the patient and even cause his death; on the other hand, a delay in the presence of an acute abdominal catastrophe may lead to a fatal outcome. This kind of diagnosis requires the mustering of a physician's entire diagnostic acumen and the mobilizing of his past experiences and observations on very short notice. Such cases

do not permit delay entailed by carrying out elaborate laboratory work. While laboratory studies at times are important for diagnosis of acute abdominal conditions, it must be emphasized that the diagnostic ability of the physician himself with only his God-given senses is far more important. Most cases of the acute abdominal type may be diagnosed accurately if the diagnostician takes plenty of time and cross examines the patient skillfully. Many times the diagnosis is made too swiftly to be precise, and one may be greatly embarrassed

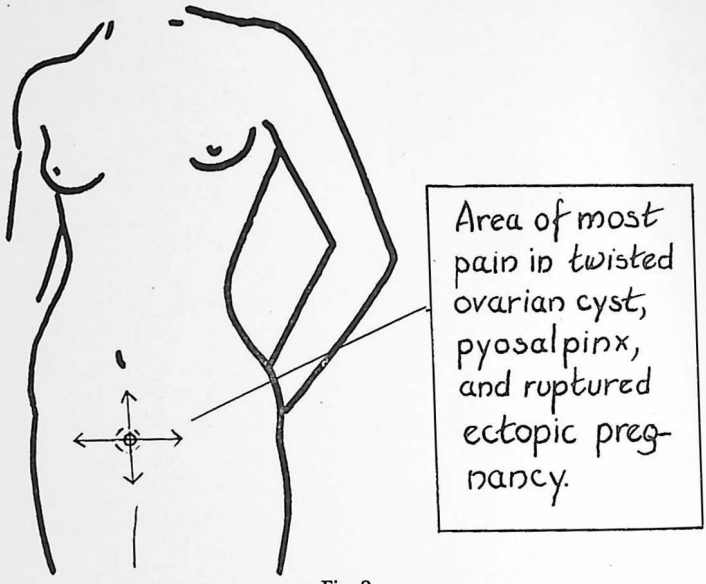


Fig. 2.

when the abdomen is opened and it is found that the dramatic snap diagnosis was far from the correct one. By this it is not implied that one should practice waiting and putting off the diagnosis until another day, for such procrastination is also a serious error.

A careful history and painstaking physical examination of the patient are so important that no apologies for extra emphasis are given. The history a patient gives is usually like a textbook description of the disease. The history-taking requires more than merely asking the patient about the immediate abdominal disturbance; it includes a careful questioning as to past experiences with abdominal

ACUTE ABDOMINAL EMERGENCIES

	Acute Appendicitis	*Acute Cholecystitis*	*Gall Stone Colic*	*Acute Intestinal Obstruction*	*Perforated Peptic Ulcer*	*Acute Pancreatitis*	*Acute Salpingitis*	*Twisted Ovarian Cyst*	*Ruptured Ectopic Pregnancy*
Age and Sex	Any age, Mostly 20 to 40 Either sex	Middle-aged Females	Middle-aged Females	Any age Either sex	20 to 50 Either sex	40 to 60 Mostly females	15 to 30 Females	18 to 50 Females	16 to 36 Females
Onset	Gradual	Gradual	Abrupt	Sudden	Abrupt	Abrupt	Gradual	Sudden	Abrupt
Nature of pain	At first colicky, later localized over area of appendix	Dull, merging into colic	Colicky in epigastrium	Cramp-like pains over entire abdomen	Severe pain in upper abdomen	Continuous pain in upper abdomen	Dull aching pain in both lower quadrants	Sharp pain in lower abdomen	Dull pain in back and lower abdomen
Associated Symptoms	Tenderness over right lower quadrant, nausea and vomiting	Vomiting and jaundice	Jaundice and vomiting	Vomiting	Vomiting, shock	Shock, tenderness and rigidity	History of past G.C. infection	Associated with effort	History of missing periods
Diagnostic features	History of generalized abdominal ache with tenderness, and rigidity over right lower quadrant	Tenderness over gall bladder	Women, fair, fat around 40 with acute pain in epigastrium and jaundice	Pain, vomiting and distention	Pain, shock, rigidity of abdomen. Gurgles gone	Mostly in women who have had gall bladder disturbance	Pain coming on about menstrual time, associated with high fever	Lower abdominal pain in women, coming on after exercise	Uterine bleeding with enlargement of uterus and subnormal temperature

pain, and, in particular, the past history of a similar kind of pain. The sequence of events is always of great importance, as, for example, in the diagnosis of acute appendicitis. In this disease, as has been emphasized down through the years, the following events, though not always in the same sequence, nearly always take place: (a) Generalized abdominal pain; (b) nausea and vomiting; (c) localization of the pain over the right lower quadrant, and (d) a rise in temperature.

The examination must be painstaking, but this does not mean just a careful study of the abdomen alone, because diseases of the chest, the nervous system, and cardiovascular system may be shown to be the cause of the abdominal pain. However, this fact is uncovered only after elaborate observation of the patient.

ACUTE APPENDICITIS

Acute appendicitis heads the list of the acute abdominal emergencies. When one considers that it is the commonest surgical condition found in the abdomen, the importance of this disease in differential diagnosis is readily seen. An early diagnosis and prompt operation are of course primary requisites in the management of this disease. Naturally, the diagnosis is of greater importance because on it the treatment depends. As has been demonstrated time and again, a delay in diagnosis often leads to perforation of the appendix with generalized peritonitis which is associated with a high mortality rate. Thus, the need of an early and careful diagnosis is obvious. The operative mortality of acute non-complicated non-perforated appendicitis is less than one per cent, while the mortality rate of all forms of acute appendicitis is about four per cent.

If the signs and symptoms of early appendicitis were always of the same kind and intensity, the diagnosis would be simple. However, we know that such is not the case, and that many cases of acute appendicitis present atypical features which lead to confusion in diagnosis. Most often the difficulty does not lie in the differentiation between acute appendicitis and some other abdominal emergency requiring surgery, but between acute appendicitis and a disease of no surgical significance. For many years I have been guided by the following axiom when in doubt about the diagnosis of the atypical case:—When confronted with a patient who has an acute disease that simulates acute appendicitis, and after careful history

and physical examination acute appendicitis cannot be eliminated as the cause, then the operation should be done immediately. The opposite stand, that is, when in doubt wait for further developments, has been in my experience not only an erroneous but a disastrous course to follow. An operation performed in doubt, that is a legitimate doubt, will do little harm to the patient even though no appendicitis is found, while failure to operate when appendicitis actually exists may result in perforation and diffuse peritonitis with the subsequent death of the patient.

Signs and Symptoms: Ordinarily the patient with acute appendicitis is stricken suddenly with a pain over the entire abdomen which soon localizes to the right lower quadrant with most tenderness over the so-called McBurney's point. We commonly think of the tenderness in acute appendicitis as being localized to McBurney's point, but this does not always hold true. An inflamed appendix attached to a mobile cecum may give practically no pain upon abdominal palpation, but rectal examination will cause the patient to cry out when the tender inflamed mass in the pelvis is touched by the examining finger. A retrocecal appendix will show marked tenderness in the right flank with relatively little at McBurney's point, and if merely the tip is involved in a gangrenous process, the tenderness may be so high that it simulates gallbladder disease. Occasionally, the appendix lies in a position to the left of the midline, and we must also bear in mind the possibility of a "situs inversus" in left lower quadrant tenderness.

The onset of pain is abrupt and not very severe. Usually there is no history of preceding attacks. The pain in most cases has the superficial aspect of the good old-fashioned "belly-ache" that follows eating green apples. In fact, most patients, after the onset of pain, seem to remember something they ate the day before which disagreed with them. In days gone by, this led to the wrong diagnosis of ptomaine poisoning. The patient usually lies on the flat of his back with the right leg drawn up a little to relieve the tenseness and pain. Vomiting usually follows the pain and does not precede it. The number of times the patient vomits is of some diagnostic importance, for a patient with appendicitis seldom vomits more than a few times. With other diseases, as gall-bladder disease or gastric crisis, the patient may vomit many, many times and lie back

exhausted from the nausea and vomiting. The pulse is usually accelerated and there is a slight fever. Consideration should be given to the old saying, if the fever is above 38.3° C. (101° F.), look out for something besides appendicitis.

Diagnosis: The diagnosis of acute appendicitis is usually easy, but sometimes it is difficult and occasionally impossible. Acute bowel obstruction, especially of the small bowel, and salpingitis and pelvic cellulitis in women, and the gastroenteritis of acute food intoxication are the main diseases of the abdomen which simulate appenditicis. Extra-abdominal disorders, as pneumonia, renal and biliary colic, lead colic, and gastric crisis must be taken into consideration. In these puzzling cases, not the pain in the abdomen nor the tenderness in the right lower quadrant constitute the diagnostic criteria, but the other signs and symptoms which develop along with such pain. As, for example, in acute bowel obstruction there is an abrupt onset of pain, colicky in nature, with innumerable attacks of vomiting. The patient is in greater distress and more on the verge of shock than in acute appendicitis. Then too, the vomiting may come on before the pain of obstruction sets in. A subnormal temperature rather than a fever may be characteristic during the early stages of this disease.

In acute salpingitis, the associated history of trouble in the abdomen, especially of the lower part, is characteristic. Then again the pain of pelvic cellulitis or salpingitis has a different course than that of appendicitis, and the previous history of infection or exposure to infection or of disturbances of the uterus and adnexa is also important in diagnosis. The blood sedimentation study may be helpful; in acute appendicitis the sedimentation rate is almost normal, while it is increased in acute salpingitis.

Biliary colic or biliary disease is usually attended by previous spells of pain and tenderness in the right upper quadrant. These attacks are often precipitated by the same indiscretions of diet, the finding of bile-tinged urine, or slightly jaundiced sclerae. When the urine examination reveals many red blood cells and one is suspicious of renal colic, a flat plate of the abdomen should be taken and every attempt made to eliminate renal stone as the causative factor of the colic. Gastric crisis and lead and other colics are diagnosed by the presence of other changes.

The diagnosis of pneumonia is suspected if the respirations are rapid, and if the patient has an anxious expression about the face and a sharp hacking cough. If one suspects pneumonia, an inquiry should be made about a possible grippal or upper respiratory infection of a day or two before. The diagnosis, of course, is clinched by the physical examination and here percussion is more important than the stethoscope or x-rays. The earliest and most conclusive evidence of pneumonia is the percussion note which is impaired over the area of consolidation.

In children one may frequently see a condition known as acute mesenteric lymphadenitis which is definitely a clinical entity. Usually there is a history of a previous sore throat or upper respiratory infection. The attack begins with right-sided abdominal pain followed by tenderness in the right lower quadrant, due to the presence of inflamed mesenteric lymph nodes. Nausea and vomiting may be present. The fever is higher than in appendicitis in most cases; the leukocyte count is not a diagnostic aid because of its variability. Experience has taught me that when in doubt as to the diagnosis, operation should be done, as it is sometimes impossible to differentiate between this condition and appendicitis.

ACUTE GALLBLADDER DISEASE WITH OR WITHOUT STONE

Inflammatory lesions of the gallbladder top the list of conditions that produce pain and distress in the right upper quadrant of the abdomen. Numerous classifications for the acute diseases of the gallbladder have been suggested, but many of them, while they are based on physiological and pathological features, are too cumbersome or clumsy for clinical application. The condition may be said to be characterized by three types of disease: (1) Acute catarrhal cholecystitis or hydrops of the gallbladder; (2) suppurative cholecystitis, and (3) gangrene of the gallbladder.

Etiology: Gallstones are the most important exciting cause of acute cholecystitis. Pyogenic organisms, the streptococcus, the staphylococcus, and the colon bacillus may be the bacterial factors. While these organisms, especially streptococci when present in the blood stream, may invade the gallbladder without the presence of stones, usually gallstones exist.

Diagnosis: Acute cholecystic disease must be differentiated from duodenal ulcer, acute appendicitis, renal colic, acute pleurisy, or pneumonia of the right lower lobe. When the clinical signs and symptoms are clear-cut, the differential diagnosis may be easy, but at times difficulty may be encountered. The past history, history of onset of the present disease, and careful physical examination often will be sufficient to clinch a diagnosis. When in doubt and when the clinical picture is not complete, an x-ray examination may disclose a stone in the kidney, ureter, or the gallbladder itself. An x-ray examination of the chest may cause one to shift from an impression of cholecystic disease to inflammatory condition of the lung involving

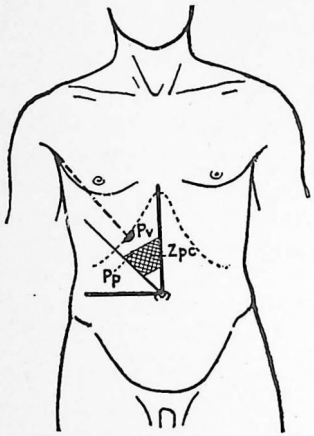


Fig. 3.—Biliary and pancreatic points of tenderness (Chauffard). Pv, gall-bladder point. Pp, Desjardins's pancreatic point. Zpc, pancreatico-choledochian area.

the right leaf of the diaphragm. Great caution must always be exercised in analyzing the case so that an acute appendicitis will not be overlooked and pass untreated into a stage where even an operation may fail to save the patient's life.

Acute Catarrhal or Hydrops of the Gallbladder

The acute catarrhal cholecystitis may or may not be associated with stone. However, stones occur in about 90 per cent of cases. There may be varying degrees of edema of the gallbladder wall and by the same token there may be evidences of mild, moderate, or severe inflammation.

Signs and Symptoms: In acute cholecystitis of the catarrhal type, the individual is often taken suddenly with pain in the right upper quadrant, chills, and fever. When a gallstone is present, the pain may be more colicky in type and the symptoms more severe. As a rule, acute cholecystitis of the inflammatory type occurs in individuals past the age of 40 years. It is three times as common in women as in men. Tenderness over the area of the gallbladder is found in all cases. The gallbladder is distended and palpable in about one-fourth of the cases. Chills or chilly sensations occur in practically all cases and jaundice in approximately one-third of them. When stone is present, the symptoms and signs are more prominent and the course of the disease is longer. Without stone, the acute hydrops of the gallbladder lasts from four to eight days; if stone is present, it continues for one to two weeks. The pain and tenderness over the right upper quadrant is the most characteristic feature of the disease. The pain may be referred into the back or up under the right shoulder. The temperature usually reaches its acme on the first day, rising to 39.5° or 40° C. (103° or 104° F.). Vomiting is present in about three-fourths of the cases. This disease may be confused with acute appendicitis, especially when the pain of appendicitis is referred upward to the right upper quadrant.

Course and Prognosis: The outlook is favorable in this kind of cholecystitis. Most patients resolve promptly within a week unless such complications as suppuration or gangrene set in. If stone is present, the chances of a recurrent attack must always be kept in mind.

TREATMENT

Within recent years, the tendency in the treatment of cholecystitis has been to be more radical than formerly. While it must be admitted that acute cholecystitis does not present the surgical emergency of acute appendicitis, sometimes an operation must be performed to save the patient from suppurative cholecystitis and peritonitis or from perforation of the gallbladder. However, most cases respond favorably to palliative treatment, as:

1. Large hot stupes to the abdomen.

2. Sedatives, as small doses of codeine sulfate, 0.033 Gm. (½ grain), pantopon, 0.011 Gm. (⅙ grain), or morphine sulfate, 0.018

Gm. (¼ grain), given hypodermically for the relief of pain and spasm.

3. Duodenal drainage, advocated by many observers and proved to be effective in many cases.

4. Intravenous solutions as 1000 cc. of ten per cent glucose in normal saline solution every day.

5. Atropine, 0.0003 Gm. (1/200 grain), hypodermically, or phenobarbital, 0.033 Gm. (½ grain), orally, three times daily.

6. Surgical treatment should be considered when the fever, chills, pain, and enlargement of the gallbladder persist for three days or more. If stone is present, then surgical treatment is without doubt the procedure of first choice.

Suppurative Cholecystitis

The difference between acute cholecystitis of the catarrhal form and acute suppurative cholecystitis is more of degree than of kind, for the acute catarrhal type may progress and become a suppurative form. The pathological changes in the gallbladder are more severe in the suppurative type and necrotic lesions occur in the mucosa of the gallbladder. The extensive infiltration of the gallbladder wall may lead to vascular changes, which, if severe enough, develop into areas of infarction with gangrene and perforation.

The tenderness and pain in this form may not be any greater than in the simple catarrhal cholecystitis, and it must be remembered that these symptoms are not exact measuring sticks of the degree of inflammation present in the gallbladder. More reliance may be placed upon the higher fever, more severe and frequent chills, and greater rise in leukocytes with a high percentage of stab forms in the differential count. When these evidences of severe infection last for a few days, the tendency is to give up waiting and depending upon medical or palliative measures and to operate at an early date. The mortality rate in the acute suppurative type increases if surgery is delayed more than five days. Statistics on the mortality rate of patients not operated upon show that the average rate ranges from 10 to 20 per cent.

Gangrene of the Gallbladder

Gangrene and perforation or abscess of the gallbladder are complications that occur when a cholecystitis fails to heal and becomes

progressive. By far the greatest number of gallbladder perforations occur in cases where nature already has built up a cofferdam about the inflamed viscus by means of the omentum, and hence perforation results in the formation of a localized abscess corresponding to that seen in appendicitis. If perforation takes place without walling off by the omentum, the picture is one of sudden onset of generalized abdominal pain with widespread rigidity and it is often confused with the acute perforation of a peptic ulcer.

It is said that a ruptured gallbladder is found at autopsy or operation in about 12 per cent of these cases. While there is a great difference in reports and opinions concerning the incidence of perforation and pericolic abscess, there is no doubt that in general the mortality rate is very high if palliative measures are used persistently. However, one's judgment in the management of these cases must be tempered a good deal by his own experience and immediate observations. If the cholecystitis appears to be mild, early operation may be postponed. On the other hand, when the diagnosis is clear-cut and the general condition of the patient is growing worse with the signs and symptoms indicating a severe inflammatory lesion, early operation seems safe and attended with a lower mortality than late surgery. Those who wait for the acute gallbladder to "cool off" must be ready to shoulder the responsibility of a mortality rate that runs from 15 to 20 per cent, while those who operate before the fourth day of the disease assume responsibility of a five per cent mortality rate. In general, it may be stated that mild cases may be treated palliatively, and severe cases treated more radically and surgically.

Gallstone Colic

Gallstones form in the gallbladder and occasionally in the larger ducts of the biliary tract. They occur more frequently in women than in men, probably due to the difference in cholesterol metabolism in men and women. Gallstones may be divided according to kind into: (1) The pure cholesterol stone; (2) the one composed of cholesterol and bile pigment, and (3) another made up of cholesterol, bile pigment, and salts of magnesium and calcium. Cholesterol stones are usually single; the other kinds are multiple. In the multiple type, there may be several or several hundred stones.

Since at this time it is gallstone colic that is being discussed, the diagnosis of gallstones will be discussed briefly. It must be remembered that gallstones may lie in the gallbladder symptomless for a long time. On the other hand, gastric disturbances as belching, indefinite pain in the abdomen, and abhorrence for certain kinds of food, especially fatty, may be present for many years before the true nature of the disease is exposed. Cholecystography is usually very effective in diagnosing gallstones.

Signs and Symptoms: 1. Pain usually comes on abruptly and is excruciating in type. It commences in the epigastric area in most cases and radiates over the entire upper abdomen into the right chest. It is paroxysmal in type and frequently becomes more severe as time goes on.

2. There is sweating, at times chills, the pulse is weak, and the patient is on the verge of collapse.

3. The patient nearly always vomits not once but several times.

4. Jaundice occurs, but only after several hours as a rule. Sometimes several days elapse before jaundice begins.

5. After the succession of attacks, the pain may stop as abruptly as it began and never return again. This happens when the stone slips out of the duct into the ampulla or the intestine. The stone may plug the cystic duct and cause hydrops of the gallbladder. In this case there is no jaundice, but the gallbladder is tender and distended. Sometimes the stone becomes impacted in the common duct, resulting in a long-continued and occasionally permanent jaundice. A stone may produce partial obstruction and lead to suppuration in the biliary tree. In these cases, jaundice, fever, chills, and paroxysms of pain come and go over a period of years unless the obstruction is relieved by operation.

TREATMENT

1. The patient usually lies in a fixed cramped position and takes exception to being examined.

2. Pain must be relieved at once by giving morphine sulfate, 0.016 Gm. (¼ grain), with atropine sulfate, 0.0008 Gm. (1/75 grain), hypodermically. This must be repeated every two or three hours.

3. Sometimes an intravenous injection of calcium chloride, 10 cc. of a five per cent solution, eases the pain. This injection must be

given slowly, at the rate of 2 cc. per minute, for if given more rapidly severe nausea and vomiting usually occur.

4. A hot wet fomentation placed over the entire abdomen often gives considerable comfort.

5. If the patient is not vomiting too much, a tablet or capsule, containing atropine, 0.0006 Gm. (1/100 grain), and phenobarbital, 0.1 Gm. (1½ grains), given orally, may serve to alleviate the distress.

PERFORATION OF A PEPTIC ULCER

Peptic ulcers may be gastric or duodenal, and either acute or chronic. While the preceding clinical features may vary a good deal depending upon the location, position, and size of the peptic ulcer, the event of most importance is the acute perforation which may occur in any type of ulcer. There are few conditions in which the prompt recognition of this emergency is of greater importance since the patient's condition and chances for recovery become worse with every hour's delay. Therefore, it is of little or no consequence to be able to identify beforehand the exact location and kind of lesion causing the perforation, for while it is always desirable to make as exact a diagnosis as possible, it is imperative to recognize the fact that a perforation has occurred and that an immediate operation is necessary.

Etiology: Certain contributory factors may be mentioned as causes for perforation of a peptic ulcer. Excessive physical activity, direct trauma to the abdomen, and sudden physical effort have been included. However, perforation may occur in the absence of any of the so-called "exciting causes."

Signs and Symptoms: Perforation of a peptic ulcer may occur at almost any age and at any time. It may take place when the stomach is empty, but is more likely to occur when the stomach is filled with food or liquids or both, and the drinking of a large quantity of cold beer preceding the rupture of an ulcer is not at all uncommon. The patient attributes his pain to the cold beer, but careful history and examination will generally reveal the true story.

Duodenal ulcers are approximately four times as common as gastric ulcers and perforated ulcers bear about the same ratio. Usually perforation is preceded by a history of recurrent attacks of ulcer, but this is not always the case. Perforation may occur in an individual

who has never had any symptoms referable to the ulcer, or the patient may be an alcoholic who denies any previous stomach distress. He has had it, but pays little heed to it, thinking that it is due to his use of liquor of uncertain quality. Males are much more prone to ruptured ulcers than females, the proportion being about 25 or 30 to 1.

The symptoms that develop when perforation actually occurs are very definite and need little description. The symptoms may be divided into three stages: (1) There is an abrupt onset of violent pain in the upper abdomen. Usually this pain quickly spreads over the entire abdomen down into the pelvis and both flanks, but at times it is limited to the right side with tenderness in the lower right quadrant as its chief sign. This is due to gravitation of the escaped stomach contents down the gutter formed by the ascending colon and the lateral abdominal wall, and the diagnosis of appendicitis is a natural mistake. Vomiting often occurs along with the pain; bright red blood may be seen in the vomitus, and it is well to remember that every now and then a perforating ulcer bleeds. Conservative treatment in such a case might result in a fatality. The presence of generalized peritoneal irritation in the perforated ulcer should differentiate it from the pure case of bleeding ulcer. Sometimes the pain is so severe that the patient collapses and lies perfectly quiet because any effort to move exaggerates the pain. In this initial stage the pulse becomes rapid, weak, and thready, and the blood pressure falls to well below normal. The patient is pale and cold, and is often covered with a clammy sweat. Palpation at this time usually reveals rigidity of the entire abdominal wall. Although the abdomen is generally tender, there is usually a point of greatest tenderness over the epigastric area. This tender area and the spread of the pain downward toward the pelvis are factors that may be helpful in differentiating the condition from some catastrophe that occurs above the diaphragm but simulates the acute abdomen.

(2) Within one-half to two and one-half hours after the initial shock, a reaction sets in. This is characterized by great improvement in the patient's condition. Color comes to his face; the pulse becomes slower and of better volume. The pain diminishes and vomiting ceases. In this stage, the diagnosis may be more confusing than at any other period of the emergency. *Improvement may develop in all directions, but there is one outstanding sign of perforation which*

occurs at the very beginning and persists throughout—that is, rigidity of the abdominal wall. This rigidity is due to the irritation of the peritoneum by the escaped acid stomach contents which at first cause a chemical peritonitis; the amount of rigidity is an index of the amount of irritation below the peritoneum. The liver dullness is obscured by the presence of air in the abdominal cavity, but this sign is not of much diagnostic value.

(3) If the patient is not operated, the third period develops within 24 hours. This is the period of generalized peritonitis. In this stage, the temperature is no longer subnormal but begins to rise. The heart becomes rapid and weaker. Symptoms of dehydration usually set in and if these are not combated by administration of fluids, the typical Hippocratic facies develops. The patient in this stage appears very ill, and the presence of a generalized peritonitis hardly ever escapes the clinical observer.

Throughout all stages, it must be emphasized again that the chief identification mark of a perforation of a peptic ulcer is the rigidity of the abdominal wall, which at first is associated with retraction and later with distention of the abdomen, but the tenderness and rigidity continue unabated.

Diagnosis: The differentiation of nonsurgical conditions, as pneumonia, the colics, gastric crisis, and other medical diseases, may cause considerable difficulty at times. The awful consequences that may develop from neglecting to operate upon the acute perforation of a peptic ulcer are such that the recognition of this condition constitutes one of the greatest responsibilities that confronts a practicing physician. Gallstone colic, renal stone, acute appendicitis, and gastric crisis seldom present any great difficulty in differential diagnosis.

If one keeps in mind that a perforation of a peptic ulcer is characterized by abrupt onset of intense abdominal pain associated with absolute rigidity of the abdominal wall and a point of localized tenderness in the ulcer-bearing area, I believe the correct diagnosis will usually be made. Acute hemorrhagic pancreatitis or acute mesenteric thrombosis may each cause a violent pain in the abdomen followed by prostration, yet the abdominal rigidity is not as constant and universal as in perforation. It is well to bear in mind that at times one is confronted with referred pain, due to medical conditions above the