

and the patients suffer from restless and sleepless nights. Paraldehyde and amylene hydrate are sometimes serviceable. Urethan, sulphonal, and chloralamide are rarely efficacious, and it is best, after a few trials, particularly if the paraldehyde does not answer, to give morphia. It may be given in combination with atropine.

(g) *Renal Symptoms*.—With ruptured compensation and lowering of the tension in the aorta, the urinary secretion is greatly diminished, and the amount may sink to five or six ounces in the day. Digitalis and strophanthus, when efficient, usually increase the flow. A brisk purge may be followed by augmented secretion. The combination in pill form of digitalis, squill, and the black oxide of mercury, will sometimes prove effective when the infusion or tincture of digitalis alone has failed. Calomel acts well in some cases, given in grs. iij every six hours for three or four days.

The *diet* in chronic valve diseases is often very difficult to regulate. With the dilatation and venous engorgement come nausea and often a great distaste for food. The amount of liquid should be restricted, and milk, beef-juice, or egg albumen given every three hours. When the serious symptoms have passed, eggs, scraped meat, fish, and fowl may be allowed. Starchy foods, and all articles likely to cause flatulency, should be forbidden. Stimulants are usually necessary, either whisky or brandy.

III. HYPERTROPHY AND DILATATION.

Hypertrophy is an enlargement of the heart due to an increased thickness, total or partial, in the muscular walls. Dilatation is an increase in size of one or more of the chambers with or without thickening of the walls. The conditions usually coexist, and could be more correctly described together under the term enlargement of the heart. Simple hypertrophy, in which the cavities remain of a normal size and the walls are increased, occurs, but simple dilatation, in which the cavities are increased and the walls remain of a normal diameter, probably does not, as it is always associated with thinning or with thickening of the coats. Commonly we have the forms of simple hypertrophy, hypertrophy with dilatation, and dilatation with thinning of the coats.

HYPERTROPHY OF THE HEART.

There are two forms—the simple hypertrophy, in which the cavity or cavities are of normal size; and hypertrophy with dilatation (eccentric hypertrophy), in which the cavities are enlarged and the walls increased in thickness. The condition formerly spoken of as concentric hypertrophy, in which there is diminution in the size of the cavity with thickening of the walls, is, as a rule, a post-mortem change.

The enlargement may affect the entire organ, one side, or only one chamber. Naturally, as the left ventricle does the chief work in forcing the blood through the systemic arteries, the change is most frequently found in it.

Etiology.—Hypertrophy of the heart follows the law governing muscles, that within certain limits, if the nutrition is kept up, increased work is followed by increased size—i. e., hypertrophy. Hypertrophy of the left ventricle alone, or with general enlargement of the heart, is brought about by—

Conditions affecting the heart itself: (1) Disease of the aortic valve; (2) mitral insufficiency; (3) general pericardial adhesions; (4) sclerotic myocarditis; (5) disturbed innervation, with overaction, as in exophthalmic goitre, in long-continued nervous palpitation, and as a result of the action of certain articles, such as tea, alcohol, and tobacco. In all of these conditions the work of the heart is increased. In the case of the valve lesions the increase is due to the increased intraventricular pressure; in the case of the adherent pericardium and myocarditis, to direct interference with the symmetrical and orderly contraction of the chambers.

Conditions acting upon the blood-vessels: (1) General arterio-sclerosis, with or without renal disease; (2) all states of increased arterial tension induced by the contraction of the smaller arteries under the influence of certain toxic substances, which act, as Bright suggested, by affecting “the minute capillary circulation, render greater action necessary to send the blood through the distant subdivisions of the vascular system”; (3) prolonged muscular exertion, which enormously increases the blood-pressure in the arteries; (4) narrowing of the aorta, as in the congenital stenosis.

Hypertrophy of the right ventricle is met with under the following conditions—

(1) Lesions of the mitral valve, either incompetence or stenosis, which act by increasing the resistance in the pulmonary vessels. (2) Pulmonary lesions, obliteration of any number of blood-vessels within the lungs, such as occurs in emphysema or cirrhosis, is followed by hypertrophy of the right ventricle. (3) Valvular lesions on the right side occasionally cause hypertrophy in the adult, not infrequently in the foetus. (4) Chronic valvular disease of the left heart and pericardial adhesions are sooner or later associated with hypertrophy of the right ventricle.

In the auricles simple hypertrophy is never seen; it is always dilatation with hypertrophy. In the left auricle the condition develops in lesions at the mitral orifice, particularly stenosis. The right auricle hypertrophies when there is greatly increased blood-pressure in the lesser circulation, whether due to mitral stenosis or pulmonary lesions. Narrowing of the tricuspid orifice is a less frequent cause.

Morbid Anatomy.—The heart of an average-sized man weighs about nine ounces (280 grammes); that of a woman, about eight ounces (250 grammes). In cases of general hypertrophy the heart may weigh

from sixteen to twenty ounces. Weights above twenty-five ounces are rare. So far as I know, the heaviest heart on record is one described by Beverly Robinson, weighing fifty-three ounces. Dulles has reported one weighing forty-eight ounces. The measurement of the thickness of the walls is, next to weighing, the best means of determining the hypertrophy. In extreme dilatation the walls, though actually thickened, may look thin. When *rigor mortis* is present, the cavity may be small and the walls may appear greatly thickened. The measurements should not be made until the heart has been soaked in water and thoroughly relaxed. In the left ventricle a thickness of ten lines, or from twenty to twenty-five millimetres, indicates hypertrophy. The right ventricle is thinner than the left, and has an average diameter of from four to seven millimetres. In hypertrophy it may measure from thirteen to twenty millimetres. The left auricle has a normal thickness of about three millimetres, which may be doubled in hypertrophy. The wall of the right auricle is thinner than that of the left, rarely exceeding two millimetres in diameter. The appendices of the auricles often present marked increase in thickness and the muscoli pectinati are greatly developed.

The shape of the heart is altered in hypertrophy; with great enlargement of the ventricles, the apex is broadened, and the conical shape is lost. In the enormous enlargement of aortic insufficiency this rotundity of the apex is very marked. When the right ventricle is chiefly affected it occupies the largest share of the apex. In mitral stenosis the contrast is very striking between the large, broad right ventricle, reaching to the apex, and the small left chamber.

The hypertrophied muscle has a deep red color, is firm, and is cut with increasing resistance. The right ventricle, as Rokitsky noted, may have a peculiar hard, leathery consistence. In simple hypertrophy of the left ventricle the papillary muscles and the columnæ carneæ may be enlarged, but the former are often much flattened in dilated hypertrophy. The muscular trabeculæ are more developed, as a rule, in the right ventricle than in the left.

The increase in size of the heart is probably due to a definite numerical increase, resulting from development of new fibres.

Symptoms.—Hypertrophy is a conservative process, secondary to some valvular or arterial lesion, and is not necessarily accompanied by symptoms. So admirable is the adjusting power of the heart that, for example, an advancing stenosis of aortic or mitral orifice may for years be perfectly equalized by a progressive hypertrophy, and the subject of the affection be happily unconscious of the existence of heart-trouble. Hypertrophy is in almost all cases an unmixed good; the symptoms which arise are usually to be attributed to its failure, or, as we say, to disturbance of compensation.

Among the most common symptoms are unpleasant feelings about the heart—a sense of fulness and discomfort, rarely amounting to pain. This

may be very noticeable when the patient is recumbent on the left side. Actual pain is rare, except in the irritable heart from tobacco or in neurasthenics. Palpitation may not occur, nor do patients always have sensations from the violent shocks of a greatly hypertrophied organ. There are instances in which very uneasy feelings arise from a moderately exaggerated pulsation. The general condition has much to do with this. In health we are not conscious of the heart's pulsations, but one of the first indications of exhaustion from excesses or overstudy is the consciousness of the heart's action, not necessarily with palpitation. Headaches, flushings of the face, noises in the ears, and flashes of light may be present.

Certain untoward effects of long-continued hypertrophy of the left ventricle must be mentioned, chief among which is the production of arterio-sclerosis. Particularly is this the case when the hypertrophy results from increased peripheral resistance. The heightened blood-pressure (expressed by the word strain) in the arteries gradually induces an endarteritis and a stiff, inelastic state of those vessels most exposed to it—viz., the aorta and its primary divisions. In overcoming the peripheral obstruction the hypertrophy "ruins the arteries as a sequential result" (Fothergill). Prolonged muscular exertion also acts injuriously in this way.

Another danger is rupture of the blood-vessels, particularly those of the brain. In general arterial degeneration associated with contracted kidneys and hypertrophied left heart apoplexy is common. Indeed, in the majority of cases of cerebral hæmorrhage there is sclerosis of the smaller vessels, often with the development of miliary aneurisms, and the rupture may be caused by the forcible action of the heart.

Physical Signs.—*Inspection* may show bulging of the præcordia, producing in children marked asymmetry of the chest. It may occur without pericardial adhesions, which Schroetter thinks are invariably associated with this condition. The intercostal spaces are widened, and the area of visible impulse is much increased. On *palpation* the impulse is forcible and heaving, and with each systole the hand or the ear applied over the heart may be visibly raised. A slow, heaving impulse is one of the best signs of simple hypertrophy. With large dilated hypertrophy the forcible impulse is often more sudden and abrupt. A second, weaker impulse can sometimes be felt, due perhaps to a rebound from the aortic valves (Gowers). The beat may be felt in the sixth, seventh, or eighth interspace from one to three inches outside the nipple. This downward dislocation of the apex is an important sign in hypertrophy of the left ventricle. In moderate grades, such as are seen in chronic Bright's disease, the impulse may be in the sixth interspace in the nipple line, or a little outside of it.

Percussion reveals increased dulness, which in the parasternal line may begin at the third rib or in the second interspace, and transversely may extend from half an inch to two inches beyond the nipple line and an equal distance beyond the middle line of the sternum. The dull area

is more ovoid than in health. When carefully delimited the colossal hypertrophy of aortic valve disease may give an area of dulness from seven to eight inches in transverse extent. In moderate grades a transverse dulness of four inches is not uncommon.

On *auscultation* the sounds, when the valves are healthy, may present no special changes, but the first sound is often prolonged and dull. When there is dilatation as well, it may be very clear and sharp. Reduplication is common in the hypertrophy of renal disease. A peculiar clink—the *tintement métallique* of Bouillaud—may be heard just to the right of the apex beat. The second sound is clear and loud, sometimes ringing in character or reduplicated. With valvular lesions, the sounds, of course, are much altered, and are replaced or accompanied by murmurs.

In simple hypertrophy not dependent on valvular lesions, the pulse is usually regular, full, strong, and of high tension. It may be increased in rapidity, but is often normal. In eccentric hypertrophy the pulse is full, but softer, and usually more rapid. One of the earliest signs of failure and dilatation is irregularity and intermittence of the pulse.

Hypertrophy of the *right ventricle* in the adult very rarely follows valvular disease on the right side, but results from increased resistance in the pulmonary circulation, as in cirrhosis of the lung and emphysema, or in stenosis of the mitral orifice. With perfect compensation, which fully maintains the equilibrium of the circulation, there are no symptoms. Extra exertion, as the ascent of stairs or running, may cause shortness of breath, but in many ways hypertrophy of the right ventricle is the most enduring and salutary form in the whole cycle of cardiac affections. For long periods of years the effects of mitral stenosis may be counterbalanced, and only sudden death by accident or an acute disease reveal the existence of an unsuspected lesion. In the hypertrophy secondary to emphysema or cirrhosis of the lungs, there may be sensations of distress in the cardiac region, with cough and shortness of breath; but as long as the dilatation is moderate the symptoms are not marked. With great dilatation and tricuspid leakage come venous engorgement, oedema, and pulmonary troubles. The increased pressure in the lesser circulation leads to sclerosis of the pulmonary arteries and the constant engorgement of the capillaries leads ultimately to a deposition of pigment and increase in the fibrous elements in the lung—the brown induration. Extreme pulmonary congestion and apoplexy are more often associated with dilatation. Hæmoptysis may result from rupture of vessels during sudden exertion.

Physical Signs.—Bulging of the lower part of the sternum and left cartilages occurs. The apex beat is forced to the left, but is not so often displaced downward. The most marked impulse may be in the angle between the ensiform cartilage and the seventh rib or beneath the cartilages of the sixth and seventh ribs. The pulsation is rather diffuse, not punctuate, particularly if there is much dilatation. In thin-walled chests there may be pulsation in the third and fourth right interspaces.

The cardiac dulness is increased transversely and toward the right; it may extend an inch or more beyond the border of the sternum. On auscultation the first sound at the lower part of the sternum is louder and fuller than normal, but the differences are not very marked unless there is much dilatation, when the sound is clearer and sharper. Accentuation and reduplication of the second sound are heard in the pulmonary artery on account of the increased tension. The pulse at the wrist is usually small. Pulsation occurs in the jugulars when there is tricuspid incompetence.

Hypertrophy of the *auricles* always occurs with dilatation. It is most common in the left chamber, which hypertrophies in mitral stenosis and incompetency and naturally assists in restoring the balance of the circulation. There are no distinctive physical signs, and we usually can infer its presence only by the existence of mitral stenosis and a presystolic murmur. Increased dulness may be determined to the left of the sternum, and there may be a presystolic wave in the second left interspace.

Hypertrophy and dilatation of the right auricle are met with (associated with a similar condition in the right ventricle and incompetency of the tricuspid) in emphysema, cirrhosis of the lung, chronic bronchitis, and mitral disease. In comparison with the left auricle the greater development and hypertrophy of the appendix and its muscoli pectinati is very striking. The latter may be distributed over the anterior wall of the sinus to a greater extent than in health. There are increased dulness in the third and fourth interspaces, pulsation sometimes presystolic in rhythm, signs of venous engorgement, jugular pulsation, and other evidences of dilatation of the right heart.

Diagnosis.—Among conditions to be distinguished are:

(1) Neurotic palpitation, from whatever cause, even when very forcible, has not the heaving impulse of genuine hypertrophy. Enlargement of the organ may, however, follow prolonged overaction, as in the smoker's heart, the irritable heart of neurasthenics, and in exophthalmic goitre, but it is usually slight.

(2) The increased area of dulness may be due to a variety of causes, some of which may closely simulate hypertrophy, such as pericardial effusion, aneurism, mediastinal growths, or displacement of the heart from pressure, or the existence of malformation of the chest. With the exercise of ordinary care, however, the diagnosis can usually be made. There are two opposite conditions which frequently give trouble. With the left lung contracted from pleurisy, phthisis, or cirrhosis, a large surface of the heart is exposed; the pulsation may be extensive and forcible, and may at first sight resemble hypertrophy. In this condition there is dislocation upward and to the left. The existence of pulmonary or pleuritic disease and the fixation of the lung on deep inspiration will suffice to prevent mistakes. A less extensive exposure of the heart may occur without any disease in very narrow-chested persons with ill-developed lungs; here, though the area of dulness may be much increased, the normal position