

amounts to more than $2\frac{1}{2}$ ctm., and which thus passes beyond the mammillary line to the left or the parasternal line to the right,—provided there be no displacement of the organ as a whole,—invariably indicates hypertrophy of the heart.

The heart's impulse in hypertrophy may be distinctly appreciable, both to the eye and hand, in two or even three intercostal spaces at once; when the enlargement is considerable and limited to the left heart the pulsation may manifest itself in these spaces with greater or less intensity as far outwards as the axillary line, or when the right half of the organ is affected it may extend in the other direction to near the right mammillary line.

It is to be borne in mind, however, that the heart may pulsate in at least two intercostal spaces and yet show no trace of hypertrophy, as when it lies in immediate contact with a larger part of the chest-wall than usual, from retraction of the anterior border of the left lung as the result of atrophy. But never, in such cases, is the apex-beat felt to the outside of the mammillary line to the left or beyond the parasternal line to the right, a fact which, apart from other points brought out by further examination, renders it impossible to mistake this condition for a genuine hypertrophy of the heart.—Hypertrophy, especially in children and young persons, announces itself not only in the character of the impulse, but also by giving rise to a certain degree of *prominence* of the præcordial region; in older patients, whose chest-walls are more rigid, this prominence is more seldom observed.

The various signs which have been discussed in this section always enable us to recognise whether the heart is normal with regard to position, whether it is hypertrophied and dilated, whether the increase in size is limited to the left or right ventricle or affects both; and the diagnosis so arrived at is almost invariably a sound one, particularly when the examination of the impulse by inspection and palpation is followed up by the inspection of the arteries (see p. 223); but a moderate amount of hypertrophy of the *right* ventricle may escape notice by inspection when the heart is covered by emphysematous lung.

SYSTOLIC PULSATIONS,

(proceeding partly from the heart and partly from the great vessels).

1. *Systolic Pulsation in the Epigastrium.*

This may be synchronous with the apex-beat in the normal situation, or may exist alone, when no other impulse is perceptible in the præcordial region.—The first condition is very frequently observed when the heart is acting with increased energy, and is then simply owing to the transmission of the normal impulse to that part; it disappears when the heart again begins to act quietly.—In another class of cases the *epigastric pulsation* accompanying the normal apex-beat is merely the transmitted *pulse of the abdominal aorta*. In such circumstances it depends on the presence of conditions which either strengthen the pulse of the abdominal aorta or which facilitate its conduction to a distance; the force with which that vessel expands is increased in hypertrophy of the left ventricle from whatever cause arising (excepting only that connected with stenosis of the aortic orifice), and the impulse is more readily conveyed through thin and lax abdominal coverings (as in women after several pregnancies) and through an enlarged and depressed left lobe of the liver.—Epigastric pulsation propagated from the abdominal aorta appears an instant later than the heart's impulse, and is also not strictly confined to the epigastrium, but extends over a considerable part of the abdominal surface; in cases of aneurism of the abdominal aorta and of the celiac artery the greater part of the abdominal wall may be caused to pulsate.—The recognition of epigastric pulsation conducted from the abdominal aorta is thus comparatively easy, as that vessel may be directly examined by the hand, provided the tension of the recti muscles do not interfere to any great extent with the proper performance of palpation. By compressing the abdominal aorta at a more distant point the epigastric pulsation may be increased in force.

The second variety of *systolic pulsation in the epigastrium*, that in which the heart's impulse is either entirely wanting in the normal situation or is weak and diffuse, occurs when the *diaphragm* is *depressed*, particularly when at the same time

the *right ventricle is hypertrophied*. Both factors are present in the severer forms of vesicular emphysema of the lungs: here the heart is drawn downwards and to the right, so that each contraction of the enlarged right ventricle gives rise to an impulse in the epigastrium.

The objection that the epigastric pulsation in emphysema can have no connection with the right ventricle, as the latter does not move towards the epigastrium during the systole (Friedreich), but that it is due rather to the expansion of the abdominal aorta, is disposed of by the observation that in emaciated subjects the heart may be felt as a pulsating body through the tissues in the epigastrium; the results also of the dissection of the dead body previously frozen, show that in pulmonary emphysema the heart is displaced laterally, towards the sternum.—In those cases in which besides the epigastric wave there is also an apex-beat, the latter is always feeble and appears at a lower level and nearer the inner border of the costal arch than normally.

(For some remarks on the systolic wave seen in the upper part of the abdomen, occurring in certain rather rare cases and caused by *pulsation of the hepatic veins*, see p. 232.)

2. Systolic Pulsation in the Great Vessels.

To this category belong the pulsations of the aorta and the subclavian artery, and the pulsating *aneurisms of the aorta* (aneurisms of the ascending, transverse, and descending portions of the arch of the aorta).

The pulsations of the aorta and subclavian artery are seen externally when the left ventricle undergoes any considerable degree of thickening; they are most distinctly visible, and perceptible also to the finger, at those parts at which these vessels approach most closely to the chest-wall,—in the case of the aorta, in the second right intercostal space at the sternal insertion of the third rib, and also a little below that point, and in the case of the subclavian artery, the region immediately above, and more especially that immediately below, the clavicle, towards its acromial end.

The stroke is still more energetic when the aorta (rarely the subclavian artery) is the seat of aneurismal dilatation. *Aneurism of the ascending aorta* (the most common variety of aneurism) forms a pulsating tumour in the second right intercostal space near the sternum; that of the transverse part of the *aortic arch* is situated at the level of the manubrium sterni, but reaches to

a variable distance to the left of that bone according to the size of the aneurismal swelling; that of the *descending aorta* renders prominent a part of the left posterior surface of the thorax, in the neighbourhood of the lower dorsal vertebræ.

The foregoing statement of the anatomical relations of thoracic aneurisms is applicable only to such as are of but moderate size, not to those which exceed ordinary dimensions. Very large aneurisms (of the arch, for instance), which cause a certain bulging outwards of the surface of the chest, form large pulsating tumours in the left half of the thorax; and the external appearances, with respect to the situation and extent of the pulsation, are found to vary according as the aneurismal swelling springs from one or other part of the arch, its convexity or its concavity.—The same remarks apply to aneurisms of the descending aorta.—The seat of the pulsation in aneurism of the ascending aorta is almost invariably that indicated above, though I have seen one case in which an aneurism limited to this portion of the vessel showed itself as a pulsating tumour to the *outside* of the left border of the sternum.—The rarely-occurring aneurisms of the abdominal aorta cause a visible and rhythmical undulation of the surface in the upper part of the *abdomen*. Their diagnosis may usually be effected by direct examination, as both the saccular variety and the cylindrically dilated abdominal aorta are easily accessible to *palpation*; nevertheless, if the tumour be situated at a high point in the course of the vessel, behind the liver, it is obviously beyond the reach of examination by the finger.

All these pulsations are either exactly synchronous with the heart's beat or take place immediately after it. Before an aneurism has become sufficiently large to produce any bulging of the surface, the diagnosis between aneurismal pulsation and that due to the transmission of the cardiac impulse or an abnormally forcible arterial pulse, is based partly on the circumstance that between the two centres of pulsation, the aneurism and the heart, intervenes a region in which there is *no* pulsation. Other differential signs are obtained by palpation (see p. 238), percussion (the aneurismal swelling is dull to percussion), and auscultation.

Concerning the *diastolic pulsation* often seen (but much more clearly perceptible to the touch) in the second left intercostal space and produced by the closure of the valves of the pulmonary artery, and with reference to a similar, though somewhat rarer, pulsation in the second right intercostal space, caused by the closure of the aortic valves, see p. 239.

Instead of systolic pulsation *systolic retraction* of certain points in the præcordial region is sometimes observed, either *accompanying the apex-beat or occurring in its absence*.

1. Those systolic retractions which accompany the normal apex-beat appear in the third and fourth intercostal spaces; the heart is sometimes in these cases in all respects normal, generally it is acting unusually energetically, most commonly it is hypertrophied, and in contact with a correspondingly large portion of the chest-wall, the margin of the left lung being pushed back; such depressions are more frequent in young persons, particularly in children, whose thoracic parietes are thin, than among adults, whose thorax is less yielding and is protected by thicker coverings. In these circumstances, when the heart acts with undue force each systole is attended by an exceedingly rapid undulatory movement passing over the præcordial region from above downwards, and a slight recession of the surface in the third and fourth intercostal spaces. The explanation of these phenomena is very probably this, that with the systolic locomotion of the apex to the left, downwards and forwards, is combined a movement of the base of the heart backwards and to the right; this creates an empty space between the base of the heart and the chest-wall, to fill up which the superficial soft parts are dragged inwards. These depressions have no diagnostic importance.

This explanation of the occurrence of systolic recession in the intercostal spaces at a point situated above that at which the apex-beat is seen, is, however, not perfectly satisfactory; the objection to it which has most weight is one suggested by Friedreich, that during the systolic movement of the apex downwards the space left vacant by the contracting portion of the heart, to occupy which the tissues immediately over it are said to be retracted, is at once taken up by another part of the heart in a similar state of contraction. It is nevertheless quite conceivable that the upper segment of the cardiac muscle is less considerably enlarged, particularly in the direction of its antero-posterior diameter, than the lower portion, and that in that way the depression of the intercostal spaces may be brought about.

2. The less common form of systolic retraction is also the more important of the two, that in which the apex-beat is completely wanting. In these cases the soft parts in the fifth intercostal space recede, are not elevated as they should be, on each contraction of the heart; this change may either be limited to the area usually occupied by the normal apex-beat or may extend over nearly the whole of the præcordia, so that even the sternal ends of the ribs and the lower end of the sternum are drawn inwards. This phenomenon is pathognomonic of adhesion of the

heart to the pericardium (Skoda) or of the pericardium to the substernal connective tissue and the diaphragm. The degree and extent of the adhesion may be inferred from the depth and area of the depression: thus, if the heart be adherent to the pericardium and the vertebral column on one side, and to the sternum on the other, its movement downwards and forwards on contraction is prevented, and as all the diameters of the heart are shortened during the systole, and as the spinal column is a fixed point, the lower end of the sternum is retracted; if adhesions have also been formed with the connective tissue investing the ribs, the latter also are similarly acted upon; and finally, if the heart be completely adherent to the tissues round it on every side, the systolic depression involves a large part of the surface of the left lower segment of the thorax. To overcome all these difficulties in the way of the proper performance of its functions, the heart necessarily acts with increased energy.—It is nevertheless sometimes observed that depressions limited to the region in which the apex-beat usually manifests itself, may be dependent on adhesions of very trifling extent.*—When the contractile power of the heart is greatly diminished, the systolic retractions disappear, notwithstanding the existence of extensive and intimate adhesions.†

The parts of the thorax which, on account of the adhesions formed by the heart, are at each systole dragged inwards towards the vertebral column spring back again during the diastole to their former position; if the systolic retraction is confined to the spot at which, in normal circumstances, the apex-beat is felt, this region becomes markedly prominent during the diastole, constituting a diastolic cardiac impulse or apex-beat,—the only exception to the general rule that the apex-beat is systolic in rhythm.

INSPECTION OF THE ARTERIES.

The increased pulsation of the aorta in hypertrophy of the left

* Traube has described one case of distinct systolic retraction, in which there was no adhesion of the heart to the pericardium. The retraction was found, on *post mortem* examination, to be caused by the presence of a congenital fold on the posterior surface of the heart, passing from the upper end of the pulmonary artery to the left auricle, so situated that the systolic movement of the heart to the left and downwards was prevented, or at least limited.

† A case of this kind has come under my own notice: on examining the body of a patient who had died in the stage of asphyxia in cholera, the heart was discovered to be adherent at nearly every point to the surrounding tissues, yet during life no trace of retraction was seen (the cardiac impulse was not perceptible).

heart and in cases of aneurism has already been under consideration. In the same way the force of the pulsation in the further ramifications of the aorta,—the carotid and subclavian arteries, &c., may be taken as a measure of the degree of power being exercised by the heart.

While the heart is acting quietly the arteries in the neck pulsate feebly, the carotid wave appearing only in the fossa between the sternomastoid muscles, and that of the brachial and radial arteries only when the arms are held in a suitable position. When the heart acts more powerfully, but still within physiological bounds, arterial pulsation is to a corresponding degree increased, and is particularly noticeable over the larger vessels. In hypertrophy of the left ventricle the pulse becomes still more forcible, that of the carotid being clearly seen through the soft tissues of the neck; and smaller vessels which at other times are scarcely visible, such as the temporal arteries and the smaller branches of the brachial and femoral arteries, pulsate prominently and appear *dilated* and *tortuous*.—The phenomena attendant on hypertrophy of the *right* side of the heart are characteristically different from those in the domain of the systemic vessels in enlargement of the left ventricle. Here the arterial pulse is not only not rendered stronger, but it is frequently feebler than usual, as, from the engorged condition of the pulmonary circulation, of which the hypertrophy of the right ventricle is but another of the results, the aortic system of vessels contains a smaller volume of blood than normally. Enlargements of the right and left ventricles are therefore often distinguishable from each other at the first glance by simple inspection of the arteries. And further, as any considerable degree of hypertrophy of the *left* ventricle, if the strongly pulsating arteries are at the same time dilated and tortuous, is generally due to insufficiency of the *aortic* valves, and as, on the other hand, hypertrophy of the right ventricle is most commonly caused by *mitral* lesion, a careful inspection of the arteries often enables us to come to at least a *general* conclusion regarding the seat of the impediment to the circulation.

INSPECTION OF THE VEINS.

The pathological phenomena observed on inspection of the veins are

1. *Engorgement* of the venous system, and therefore visible dilatation of the superficial veins;
2. Certain *movements*, seen almost exclusively in the jugular veins, the result either of the respiratory expansion and contraction of the thorax (*undulatory* movements) or of the movements of the heart (*venous pulsation*).

VENOUS CONGESTION.

Of all the superficial vessels near the heart the cervical veins show the greatest differences with regard to the amount of blood they contain at different times in health and disease; they are therefore well adapted for examination by inspection. Even in normal conditions the external jugular vein as it crosses the sternomastoid muscle may, by simply turning the head to one side, be made to stand out prominently on the skin as a thin, somewhat bluish-coloured cord; the internal jugular vein, on the contrary, placed deeply as it is between the two lower divisions of the same muscle, never comes into view.—The reason for this is found in the fact that the vertical course of the cervical veins promotes a rapid flow of blood from the head towards the heart; this tendency is still further favoured by the act of inspiration, which lessens the pressure within the innominate veins and the superior vena cava (into which the jugular veins empty themselves), and in that way, by a kind of aspiratory action, quickens the current through these vessels.

As a pathological phenomenon congestion of *all* the veins of the body, particularly of those of the neck, is met with under the following circumstances:

1. When the contractile power of the right ventricle is diminished: the latter is then unable to discharge itself of the whole of its contents, and so fails to accommodate all the blood which should enter it from the right auricle, and the auricle itself, and eventually also the venous trunks and the whole venous system, become unduly distended with blood.—Of all the changes in the organs of circulation, mitral insufficiency and constriction of the left auriculo-ventricular orifice, and of the affections of the respiratory apparatus those which lead to persistent congestion of the pulmonary circulation, and so to hypertrophy of the right heart, and at a later stage to fatty degeneration of the cardiac muscular fibre, are the diseases which most commonly give rise