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LECTURE II.

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Circulation of Blood through the Heart—Location of the Heart—Space over which Normal Dullness is found—Sounds of the Normal Heart—Sounds of the Abnormal Heart.

GENTLEMEN : Before I proceed to describe the Diseases of the Heart, it is proper that we inquire into the method of the circulation of the blood in and through that organ.

The *venous* blood which is returned by the ascending and descending vena cava, enters the *right* auricle during its diastole.

Part of it flows on into the right ventricle during the earlier part of its diastole; but the auricle being filled before the ventricle, then contracts, and discharges its contents through the *tricuspid valves* into the ventricle, which it thus completely distends.

The reflux of blood into the veins during the auricular systole, is impeded by the contraction of their own walls, and by the valves with which they are furnished; but these valves are so formed as not to close accurately, especially when the tubes are distended; so that a small amount of reflux usually takes place, and this is much increased when there is any obstruction to the pulmonary circulation.

Whilst the *right* ventricle is contracting upon the blood that has entered it, the *earneae columnae,* which contract simultaneously with its proper walls, put the *chordae tendinae* upon the stretch, and these draw the flaps of the *tricuspid valve* into the auriculo-ventricular axis.

The blood then getting behind them, and then being compressed by the contraction of the ventricle, forces the flaps together in such a manner as to close the orifice; but they do not fall suddenly against each other, as is the case with the semi-lunar valves, since they are restrained by the chordae tendinae, whence it is that no sound is produced by their closure.

The blood is expelled by the ventricular systole into the pulmonary artery, which it distends, passing freely through its *semi-lunar valves;* but as soon as the *vis a tergo* ceases, a reflux might take place by the contraction of the arterial walls. The valves are filled out by the backward tendency of the blood, and completely check the return of any portion of it into the ventricle.

The blood after having circulated through the lungs, returns as arterial blood by the *pulmonary veins* to the *left* auricle; whence it passes through the *mitral* valve into the left ventricle, and thence into the *aorta* through its semilunar valves, in the same manner as that on the other side.

We will now proceed to describe and determine the

LOCATION OF THE HEART,

and *the space in which normal dulness is found.*

The heart is situated between the cartilages of the third and sixth ribs. The upper extremity, or base, is defined with sufficient precision by the upper margin of the third rib. The point or apex generally extends to the fifth intercostal space, near the junction of the rib to its cartilage. The organ is situated obliquely within the chest, a line passing through the longitudinal axis, intersects obliquely the clavicle near its acromial extremity. The medial line and the linea mammalis, are convenient landmarks for indicating the space which the heart occupies transversely. The median line divides the heart, leaving about one-third on the right, and two-thirds on the left side. The left margin of the heart, in the male, extends to a point just within the nipple, which is situated on the fourth rib, near the junction of its rib with the cartilage. The apex is about three inches to the left of the median line, and about an inch within the linea mammalis. The right margin extends from half an inch to an inch beyond the sternum, on the right side. Viewing the several portions of the heart in relation to the median line, on the right are situated the right auricle, and about a third of the right ventricle; on the left of this line are situated two-thirds of the right ventricle and the left auricle.

The relations of the heart to the adjacent organs are important with reference to the signs furnished by percussion, also by the other methods of exploration. At the base are the large arteries connected with the ventricles, viz., the aorta and pulmonary artery, which extend up beneath the sternum —the latter to the level of the upper margin of the second, and the former nearly as high as the first rib. The portion of the heart situated on the *right* of the median line is *covered* by the right lung. The lower border of the heart, to the left of the median line, lies on the diaphragm which separates it from the left lobe of the liver, and, towards the apex, from the stomach. The portion of the heart lying to the *left* of the median line, is only partially covered by the left lung—a part is in contact (the pericardium only intervening) with the thoracic walls.

The space on the chest within which the heart is not covered by lung, is called the *superficial cardiac region.*

The praecordial space within which the heart is covered by lung is called the deep *cardiac region.*

These names should be remembered, for they will frequently occur.

The boundaries of the *superficial cardiac region* are thus given: It is bounded on its sides by lung, and on the greater part of one side, viz., the lower, by the liver and stomach, with the diaphragm intervening. The portion of the heart's surface exposed, is an irregular quadrangle. This space may be embraced within a right angled triangle delineated as follows : The oblique line, or hypothenuse, is drawn by connecting a point at the centre of the sternum on a level with the junction of the fourth costal cartilage, with the point where the apex of the heart comes in contact with the thoracic walls, the latter being usually in the fifth intercostal space, about an inch within the linea mammalis, or about three inches to the left of the median line. The median line extending from the same point on the sternum, and a line extending transversely from the point of the apex-beat to meet the median line, will form the two other sides of the triangle.

The limits to which the *deep cardiac region* extends have been already defined in giving the boundaries of the space which the heart occupies within the chest.

The dulness over the *superficial cardiac region* is more decided than over the *deep-seated cardiac region,* owing to the fact that it is not covered by lung. This dulness can be recognized by *light* percussion. It requires *forcible* percussion to mark out the dulness over the *deep cardiac region.*

[For full and minute directions to examine by percussion, consult 'Walshe or Flint on Diseases of the Heart.]

If the *dulness,* found on examination of a patient, exceeds the limits given above, we may conclude that some kind of enlargement exists. The heart, in proportion to its increase in volume, pushes aside the anterior border of the left lung, leaving a large portion of its anterior surface uncovered and in contact with the thoracic walls. The degree of dulness within the superficial cardiac region is greater than in health in proportion to the enlargement. Increased extent and degree of superficial dulness are signs of enlargement of the heart, provided the adjacent organs are healthy. The presence of phthisis, chronic pleurisy, enlargement of the liver, dilatation of the stomach, aneurism of the aorta,

enlarged spleen, ascites, pregnancy, may cause difficulty in making a correct diagnosis by means of percussion.

The limits of this work will not permit us to go further into this subject. For full and exact knowledge relating to the physical diagnosis of abnormal conditions discernable by percussion, reference must be had to the works previously alluded to.

THE SOUNDS OF THE NORMAL HEART.

When the ear is applied over the cardiac region, during the natural movements of the heart, two successive sounds are heard, each pair of which corresponds with one pulsation ; there is also an interval of silence between each recurrence, and the sound that immediately follows this interval is known as the *first* sound, the other as the *second.*

The *first* sound of the heart is caused by the contraction or *systole,* of the ventricles, and is called the *systolic* sound. The *second* sound is caused by the dilation or *diastole* of the ventricles, and is called the *diastolic* sound.

The *first* sound is heard plain, over the *apex* of the heart, or where the apex-beat is felt.

The *second* sound is best heard just above the base of the heart, in the intercostal space between the second and third ribs, close to the sternum.

The *first* sound, over the apex, is longer, lower, and has a "blowing"quality.

The *second* sound, in the second intercostal space on either side, is shorter, more acute, and has a clicking or valvular quality.

In order to get a clear idea of the heart-sounds, the stethescope should be used. The bin-aural stethescope is considered superior to all others for this purpose.

If the *ear* is applied to the praecordia, the sounds from different sources are commingled, and they cannot be so well studied separately.

The *second* sound of the heart varies, as we study it on different sides of the sternum, in the space between the second and third ribs. .

On the *right* side the sound is more acute, more abrupt, louder, and apparently nearer the ear, and is said to be caused by the movements of the semi-lunar valves of the *aorta.*

On the *left* side the sound is less acute, and emanates from the valves of the pulmonary artery, and due to their expansion succeeding the ventricular systole.

This *second* sound of the heart consists of a single element only— a *valvular* element—in this respect differing from the first sound.

The *first* sound of the heart, as heard over the apex of the organ, is a *mixed* sound. It is composed chiefly of two distinct elements. One of these elements consists of a clicking sound, emanating from the mitral and tricuspid valves; the other proceeds from the movements of the apex of the heart against the thoracic walls. The latter is called the element of impulse, or the impulse-sound; the former, the valvular element, or valvular sound.

THE ABNORMAL SOUNDS OF THE HEART.

There are certain morbid sounds or murmurs of the heart which occur in disordered conditions of that organ. They mingle with, follow, or quite supersede the healthy sounds.

These “murmurs,”as they are generally called, with one or two exceptions may be considered as modifications of the *bellows murmur,* or *bruit de souffle.*

This, in its purest form, is a smooth, blowing sound, named from its resemblance to that made by a pair of bellows. It may be single or double, soft or loud, of a low or high key; short, so as to merely prolong one of the natural sounds, or continuous, so as to fill up more or less completely the space between the impulses. Sometimes it wholly supersedes the healthy sound, and nothing is heard but one continuous bellows-murmur; but such cases are rare.

Not unfrequently it becomes, in various degrees, rough or broken; and attempts have been made to designate the modifications thus produced by the terms filing, rasping, sawing, etc. The *sawing* sound being a *double* sound, should only be applied to the "double murmurs produced by the alternate motion of the heart. In some instances the murmur is of a musical or whistling character, and has been compared to the chirping of young birds.

The pure *bellows murmur* may exist without any organic disease of the heart. It may be produced artificially, by alterations in the diameter of one of the larger arteries, even in health, as by the pressure of the stethescope upon the artery. The most frequent cause.of the sound is probably an abrupt contraction at one of the orifices, or in one of the tubes through which the blood passes. It will be readily understood that the fluid, as it emerges from the stricture, and spreads out to fill the larger space beyond it, breaks into currents, which set against the sides of the tube, and, being thence reflected, occasion vibrations which result in sound. Thus the sound may result from contraction of any of the orifices of the heart, or the expansion of one of the great arteries immediately beyond them, 'and, in the former case, may be produced either by organic or by functional disease or spasmodic contraction. The *bellows murmur* is not always produced by changes in the heart and arteries. It may be produced by a *watery state of the blood,* such as occurs in chlorosis or anaemia. The liquid in these states being more movable, currents are more easily formed by whatever affects the regular movements of the blood. In such conditions, anything which excites the circulation will generate the murmur. It may also be induced by bleeding, and arises from any profuse haemorrhage.

The *rough murmurs,* as they are called, to distinguish them from *smooth* murmurs, may be produced by *inequalities* in the surface over which the blood flows, especially in the orifices of the great vessels, produced by depositions of lymph, excrescences of various kinds, osseous or cartilagenous productions, etc. These rough sounds, like *rasping, filing,* and the like, are supposed to indicate organic disease in the valves or the valvular openings.

Another species of murmur is called the *regurgitant.* These regurgitant murmurs are caused by some defect in the valves—either loss of substance, irregular thickening, dilatation of the orifice, or something else which prevents their accurate closure, and thus allows a regurgitation of the blood. It may be supposed that in these cases the sound is ascribable not only to the irregularity given to its backward movement through the insufficient valve, but also in some measure to the conflict of the reverted with the regular » current of blood; as, for example, when the blood of the contracting ventricle is sent through the insufficient auriculo ventricular valve against the current entering the auricle.

All these murmurs are heard most distinctly when the heart is in an excited condition. They are influenced by the less or greater force of the moving cause. The *systolic* ventricular murmurs are louder than the diastolic, because the former is caused by the more powerful contraction

of the ventricles; the latter, on the feebler elastic pressure of the great arteries.

Roughness of sound is proportionate to irregularity in the surface producing it, and it most frequently attends regurgitation.

The *tone* of the murmur depends somewhat on the depth at which the sound is generated.

By close examination, the following two important points can be ascertained:

I. *In which of the valvular orifices the murmur originated.*

II. *Whether it depends on obstructions, or upon deficiency of the valves, and consequent regurgitation.*

When the sound is loudest on the sternum immediately below the insertion of the third rib, and thence extends upwards for about two inches along the course of the great vessels, it may be considered as having its source in the *semi-lunar* valves.

If the sound be perceived most distinctly along the course of the ascending aorta, upon the right, it is probably seated in the *aortic* valves; if along the pulmonary artery, on the left, it is in the *pulmonic* valves.

When the murmur is most distinct over that part of the chest on which percussion is dull—that is, where the ventricles are in contact with the walls—it may be inferred that it is generated either in the *mitral* or *tricuspid* valve; in the Former, when the point of greatest loudness is a little to the right of the left nipple, and an inch or so below it; in the latter, when the analagous point is on or near the sternum, in the same horizontal line.

There are other *morbid sounds,* resembling murmurs, which have nothing to do with the valves of the heart. « Among these are the *anarmic murmurs,* mentioned above. They do not follow the course of the large vessels so fully or frequently as do valvular murmurs. They occur only during the systole of the ventricles—are not generally heard below the left nipple, as they do not arise from regurgitation through the mitral valve. They are almost always accompanied by a smart, smacking impulse. They disappear during mental or physical quiet. They are always diminished, and generally disappear under appropriate medical treatment, which is not ordinarily the case with true valvular murmurs.

Venous murmurs (nun's murmur, top murmur,) are heard in many young persons, in the anterior triangular space, in which the external jugular vein descends. It is a continuous murmur, and is generally more audible on the right than on the left side. This murmur disappears when the current of blood is interrupted by pressure upon the jugular vein, or by any position of the body in which the head lies lower than the thorax. It is heard loudest in an erect position, and during inspiration. It was thought to be connected with anaemia, but has been found as often in young and healthy persons.

Pericardial murmurs. The inner surface of the pericardium is normally smooth, and the heart moves within it without causing any sound. But when this surface becomes roughened in consequence of inflammation and exudation, we hear *friction-sound,* which may closely resemble an endocardial murmur. We can generally distinguish between these murmurs, for the *internal* murmurs correspond almost exactly to the rhythm and the natural sounds of the heart, whilst the *friction-sounds* seem to *follow* upon the movements of the heart. Should the friction-sound be short, we cannot distinguish it from an endocardial murmur.

There is another *friction-sound,* caused by a roughened condition of that portion of the *pleura* which covers the unattached portion of the pericardium. It is produced by the rubbing of this portion of the pleura against the lungs or thoracic walls. Being caused by the action of the heart, it exactly coincides with its rhythm, and cannot be distinguished from endocardial murmurs. The previous history of the disease and the result of appropriate treatment can only settle the question.