CHAPTER IX.

AUSCULTATION OF THE HEART: CONTINUED.

Cardiac Murmurs.

(*a*) *Terminology.*

The word "*murmur*" is one of the most unfortunate of all the terms used in the description of physical signs. No one of the various blowing, whistling, rolling, rumbling, or piping noises to which the term refers, sounds anything like a "murmur" in the ordinary sense of the word. Nevertheless, it does not seem best to try to replace it by any other term. The French word "*souffle*" is much more accurate and has become to some extent Anglicized. Under the head of cardiac murmurs are included all abnormal sounds produced within the heart itself. Pericardial friction sounds and those produced in that portion of the lung or pleura which overlies the heart are not considered "murmurs."

(*b*) *Mode of Production.*

With rare exceptions all cardiac murmurs are produced at or near one of the valve orifices, either by disease of the valves themselves resulting in shrivelling, thickening, stiffening, and narrowing of the valve curtains, or by a stretching of the orifice into which the valves are inserted.

Diseases of the valves themselves may lead to the production of murmurs:

(*a*) When the valves fail to close at the proper time (incompetence, insufficiency, or regurgitation).

(*b*) When the valves fail to open at the proper time (stenosis or obstruction).

(*c*) When the surfaces of the valves or of the parts immediately adjacent are roughened so as to prevent the smooth flow of the blood over them.

(*d*) When the orifice which the valves are meant to close is dilated as a result of dilatation of the heart chamber of which it forms

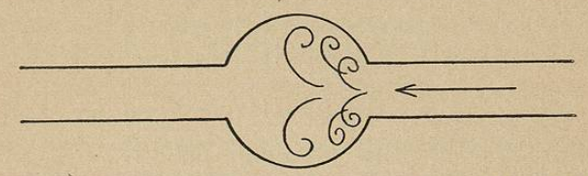

Fig. 112.—Diagram to Illustrate the Production of a Cardiac Murmur Through Regurgitation from the Aorta or in an Aneurismal Sac. The arrow shows the direction of the blood current and the curled lines the audible blood eddies.

the entrance or exit. The valves themselves cannot enlarge to keep pace with the enlargement of the orifice, and hence no longer suffice to reach across it.

The presence of any one of these lesions gives rise to eddies in the blood current and thereby to the abnormal sounds to which we give the name murmurs.[1] (See Figs. 112, 113 and 114.) When

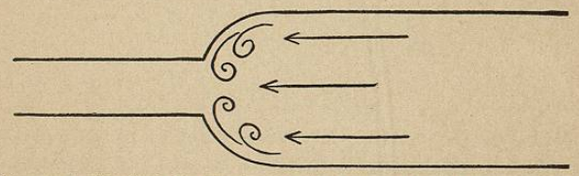

Fig. 113.—Diagram to Illustrate the Production of a Cardiac Murmur Through Stenosis of a Valve-Orifice.

valves fail to close and so allow the blood to pass back through them, we speak of the lesion as *regurgitation, insufficiency, or incompetence;* if, for example, the aortic valves fail to close after the left ventricle has thrown a column of blood into the aorta, some of this blood regurgitates through these valves into the ven-

[1] The method by which functional murmurs are produced will be discussed later. (See page 194.)

tricle from which it has just been expelled, and we speak of the lesion as "*aortic regurgitation*," and of the murmur so produced as an *aortic regurgitant murmur* or a murmur of aortic regurgitation. A similar regurgitation from the left ventricle into the left auricle takes place in case the mitral valve fails to close at the beginning of systole. If, on the other hand, the mitral valve fails to open properly to admit the blood which should flow during diastole from the left auricle into the left ventricle, we speak of the condition as *mitral stenosis* or *mitral obstruction*. A similar narrowing of the aortic valves such as to hinder the egress of blood during the systole of the left ventricle is known as *aortic stenosis* or obstruction. Valvular lesions of the right side of the heart (tricuspid and pulmonic valves) are comparatively rare, but are produced and named in a way similar to those just described.

FIG. 114.—Diagram to Illustrate the Production of Cardiac Murmurs Through Roughening of a Valve.

The facts most important to know about a murmur are:

(1) Its place in the cardiac cycle.
(2) Its point of maximum intensity.
(3) The area over which it can be heard.
(4) The effects of exertion, respiration, or position upon it.

Less important than the above are:

(5) Its intensity.
(6) Its quality.
(7) Its length.
(8) Its relation to the normal sounds of the heart.

Each of these points will now be taken up in detail:

(1) *Time of Murmurs.*—The first and most important thing to ascertain regarding a murmur is its relation to the normal cardiac cycle; that is, whether it occurs during systole or during diastole, or in case it does not fill the whole of one of those periods, in what

part of systole or diastole it occurs. It must be borne in mind that the period of systole is considered as lasting from the beginning of the first sound of the heart up to the occurrence of the second sound, while diastole lasts from the beginning of the second sound until the beginning of the first sound in the next cycle. Any murmur occurring with the first sound of the heart, or at the time when the first sound should take place, or in any part of the period intervening between the first sound and the second, is held to be *systolic*. Murmurs which distinctly follow the first sound or do not begin until the first sound is ended are known as *late systolic* murmurs.

On the other hand, it seems best, for reasons to be discussed more in detail later on, not to give the name of *diastolic* to all murmurs which occur within the diastolic period as above defined. Murmurs which occur during the last part of diastole and which run up to the first sound of the next cycle are usually known as "*presystolic*" murmurs. All other murmurs occurring during diastole are known as *diastolic*.

The commonest of all the errors in the diagnosis of disease of the heart is to mistake systole for diastole, and thereby to misinterpret the significance of a murmur heard during those periods. This mistake would never happen if we were always careful to make sure, by means of sight or touch, just when the systole of the heart occurs. This may be done by keeping one finger upon the apex impulse of the heart or upon the carotid artery while listening for murmurs, or, in case the apex impulse or the pulsations of the carotid are better seen than felt, we can control by the eye the impressions gained by listening. It is never safe to trust our appreciation of the cardiac rhythm to tell us which is the first heart sound and which the second. The proof of this statement is given by the numberless mistakes made through disregarding it. Equally untrustworthy as a guide to the time of systole and diastole is the radial pulse, which follows the cardiac systole at an interval just long enough to mar our calculations.

(2) *Localizations of Murmurs.*—To localize a murmur is to find its point of maximum intensity, and this is of the greatest importance in diagnosis. Long experience has shown that murmurs

heard loudest in the region of the apex beat (whether this is in the normal situation or displaced), are in the vast majority of cases produced at the mitral valve. In about five per cent of the cases mitral murmurs may be best heard at a point midway between the position of the normal cardiac impulse and the ensiform cartilage, or (very rarely) an inch or two above this situation.

Murmurs heard most loudly in the second left intercostal space are almost invariably produced at the pulmonic orifice or just above it in the conus arteriosus.

Murmurs whose maximum intensity is at the root of the ensiform cartilage or within a radius of an inch and a half from this point are usually produced at the tricuspid orifice. Murmurs produced at the aortic orifice may be heard best in the aortic area, but in a large proportion of cases are loudest on the other side of the sternum at or about the situation of the fourth left costal cartilage. Occasionally they are best heard at the apex of the heart or over the lower part of the sternum (see below, Fig. 137).

(3) *Transmission of Murmurs.*—If a murmur is audible over several valve areas, the questions naturally arise: "How are we to know whether we are dealing with a single valve lesion or with several? Is this one murmur or two or three murmurs?" Obviously the question can be asked only in case the murmur which we find audible in various places occupies everywhere the same time in the cardiac cycle. It must, for example, be everywhere systolic or everywhere diastolic. A systolic murmur at the apex cannot be supposed to point to the same lesion as a diastolic murmur, no matter where the latter is heard. But if we hear a systolic murmur in various parts of the chest, say over the aortic, mitral, and tricuspid regions, how are we to know whether the sound is simple or compound, whether produced at one valve orifice or at several?

This question is sometimes difficult to answer, and in a given case skilled observers may differ in their verdict, but, as a rule, the difficulty may be overcome as follows:

(1) Experience and post-mortem examination have shown that the murmur produced by each of the valvular lesions has its own characteristic area of propagation, over which it is heard with an intensity which regularly diminishes as we recede from a *maximum* whose seat corresponds with some one of the valve areas just described. These areas of propagation are shown in Figs. 125, 126, 129, and 134. Any murmur whose distribution does not extend beyond one of these areas, and which steadily and progressively diminishes in intensity as we move away from the valve area over which it is loudest, may be assumed to be due to a single valve lesion and no more. Provided but one valve is diseased, this course of procedure gives satisfactory results.

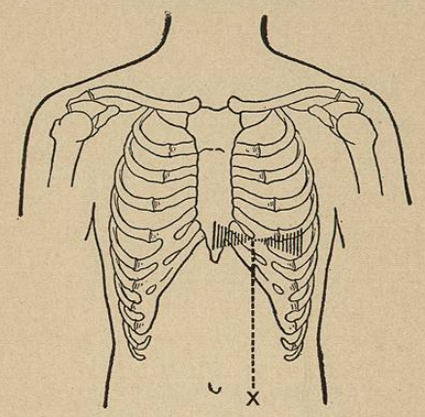

FIG. 115.—Mitral and Tricuspid Regurgitation. The intensity of the systolic murmur is least at the "waist" of the shaded area and increases as one approaches either end of it.

(2) When several valves are diseased and several murmurs may be expected, it is best to start at some one valve area, say in the mitral or apex region, and move the stethoscope one-half an inch at a time toward one of the other valve areas, noting the intensity of any murmur we may hear at each of the different points passed over. As we move toward the tricuspid area, we may get an impression best expressed by Fig. 115. That is, a systolic murmur heard loudly at the apex may fade away as we move toward the ensiform, until at the point x (Fig. 115) it is almost inaudible. But as we go on in the same direction the murmur may begin to grow

louder (and perhaps to change in pitch and quality as well) until a maximum is reached at the tricuspid area, beyond which the murmur again fades out.

These facts justify us in *suspecting* that we are dealing with two murmurs, one produced at the tricuspid and one at the mitral orifice. The suspicion is more likely to be correct if there has been a change in the pitch and quality of the murmur as we neared the tricuspid orifice, and may be confirmed by the discovery of other evidences of a double lesion. *No diagnosis is satisfactory which rests on the evidence of murmurs alone.* Changes in the size of the heart's chambers or in the pulmonary or peripheral circulations are the most important facts in the case. Nevertheless the effort to ascertain and graphically to represent the intensity of cardiac murmurs as one listens along the line connecting the valve areas has its value. An "hour-glass" murmur, such as that represented in Fig. 115), generally means *two-valve* lesions. A similar "hour-glass" may be found to represent the auditory facts as we move from the mitral to the pulmonic or to the aortic areas (see Fig. 116) and, as in the previous case, arouses our suspicion that more than one valve is diseased.

It must not be forgotten, however, that "a murmur may travel some distance underground and emerge with a change of quality" (Allbutt). This is especially true of aortic murmurs, which are often heard well at the apex and at the aortic area, and faintly in the intervening space, probably owing to the interposition of the right ventricle.

In such cases we must fall back upon the condition of the heart itself, as shown by inspection, palpation, and percussion, and upon the condition of the pulmonary and peripheral circulation, as shown in the other symptoms and signs of the cases (dropsy, cough, etc.).

(4) *Intensity of Murmurs.*—Sometimes murmurs are so loud that they are audible to the patient himself or even at some distance from the chest. In one case I was able to hear a murmur eight feet from the patient. Such cases are rare and usually not serious, for the gravity of the lesion is not at all proportional to

the loudness of the murmur; indeed, other things being equal, loud murmurs are less serious than faint ones, provided we are sure we are dealing with organic lesions. (On the distinction between the organic and functional murmurs, see below, p. 196.)

A loud murmur means a powerful heart driving the blood strongly over the diseased valve. When the heart begins to fail, the intensity of the murmur proportionately decreases because the blood does not flow swiftly enough over the diseased valve to pro-

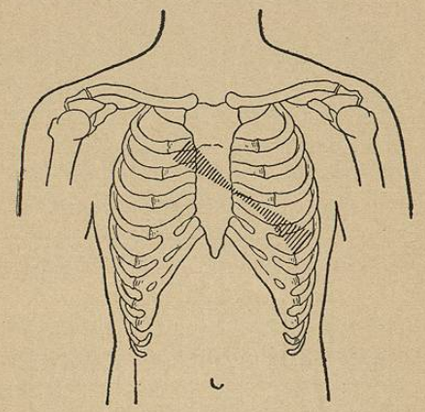

FIG. 116.—Mitral Regurgitation and Aortic Stenosis. The systolic murmur is loudest at the extremities of the shaded area and faintest at its "waist."

duce as loud a sound as formerly. The gradual disappearance of a murmur known to be due to a valvular lesion is, therefore, a very grave sign, and its reappearance revives hope. Patients are not infrequently admitted to a hospital with valvular heart trouble which has gone on so long that the muscle of the heart is no longer strong enough to produce a murmur as it pumps the blood over the diseased valve. In such a case, under the influence of rest and cardiac tonics, one may observe the development of a murmur as the heart wall regains its power, and the louder the murmur becomes the better the condition of the patient. On the other hand, when the existence of a valvular lesion has been definitely deter-

mined, and yet the compensation remains perfectly good (for example, in the endocarditis occurring in children in connection with chorea), an increase in the loudness of the murmur may run parallel with the advance in the valvular lesion.

In general the most important point about the intensity of a murmur is its *increase or decrease while under observation*, and not its loudness at any one time.

(5) *Quality of Heart Murmurs.*—It has been already mentioned that the quality of a heart murmur is never anything like the sound which we ordinarily designate by the word "murmur." The commonest type of heart murmur has a blowing quality, whence the old name of "*bellows sound.*" The sound of the letter "f" prolonged is not unlike the quality of certain murmurs. *Blowing murmurs* may be low-pitched like the sound of air passing through a large tube, or high-pitched approaching the sound of a whistle. This last type merges into that known as the *musical* murmur, in which there is a definite musical sound whose pitch can be identified. *Rasping* or tearing sounds often characterize the louder varieties of murmurs.

Finally, there is one type of sound which, though included under the general name murmur, differs entirely from any of the other sounds just described. This is the "*presystolic roll,*" which has a *rumbling* or *blubbering* quality or may remind one of a short drum-roll. This murmur is always presystolic in time and usually associated with obstruction at the mitral or tricuspid valves. Not infrequently some part of a cardiac murmur will have a musical quality while the rest is simply blowing or rasping in character. Musical murmurs do not give us evidence either of an especially serious or especially mild type of disease. Their chief importance consists in the fact that they rarely exist without some valve lesion,[1] and are, therefore, of use in excluding the type of murmur known as "*functional,*" presently to be discussed, and not due to valve disease. Very often rasping murmurs are associated either with the calcareous deposit upon a valve or very marked narrowing of the valve orifice.

[1] Rosenbach holds that they may be produced by adhesive pericarditis.

Murmurs may be accented at the beginning or the end; that is, they may be of the crescendo type, growing louder toward the end, or of the decrescendo type with their maximum intensity at the beginning. Almost all murmurs are of the latter type except those associated with mitral or tricuspid obstruction.

(6) *Length of Murmurs.*—Murmurs may occupy the whole of systole, the whole of diastole, or only a portion of one of these periods, but no conclusions can be drawn as to the severity of the valve lesion from the length of the murmur. A short murmur, especially if diastolic, may be of very serious prognostic import.

(7) *Relations to the Normal Sounds of the Heart.*—Cardiac murmurs may or may not replace the normal heart sounds. They may occur simultaneously with one or both sounds or between the sounds. These facts have a certain amount of significance in prognosis. Murmurs which entirely replace cardiac sounds usually mean a severer disease of the affected valve than murmurs which accompany, but do not replace, the normal heart sounds. Late systolic murmurs, which occur between the first and the second sound, are usually associated with a relatively slight degree of valvular disease. Late diastolic murmurs, on the other hand, have no such favorable significance.

(8) *Effects of Position, Exercise, and Respiration upon Cardiac Murmurs.*—Almost all cardiac murmurs are affected to a greater or less extent by the position which the patient assumes while he is examined. Systolic murmurs which are inaudible while the patient is in a sitting or standing position may be quite easily heard when the patient lies down. On the other hand, a presystolic roll which is easily heard when the patient is sitting up may entirely disappear when he lies down. Diastolic murmurs are relatively little affected by the position of the patient, but in the majority of cases are somewhat louder in the upright position.

The effects of exercise may perhaps be fitly mentioned here. Feeble murmurs may altogether disappear when the patient is at rest, and under such circumstances may be made easily audible by