

is due to the fact that a large volume of blood is suddenly and forcibly thrown into the aorta by the hypertrophied and dilated left ventricle, thus causing the characteristically sharp and sudden rise in the peripheral arteries. The arteries then empty themselves *in two directions at once*, forward into the capillaries and backward into the heart through the incompetent aortic valves; hence the sudden collapse in the pulse which, together with its sharp and sudden rise, are its important characteristics. The arteries are large and often elongated so as to be thrown into curves.

Not infrequently one can demonstrate that the radial pulse is delayed or follows the apex impulse after a longer interval than in normal persons. While compensation lasts, the pulse is usually regular in force and rhythm. *Irregularity is therefore an especially grave sign*, much more so than in any other valvular lesion.

Percussion.

Percussion adds but little to the information obtained by inspection and palpation, but verifies the results of these methods of investigation respecting the increased size of the heart, and especially of the left ventricle, which may reach enormous dimensions, especially in cases occurring in young persons. The heart may be increased to *more than four times its normal weight*.

Auscultation.

In rare cases there may be absolutely no murmur and the diagnosis may be impossible during life, though it may be suspected by reason of the above-mentioned signs in the peripheral arteries. But although the murmur is seldom entirely absent, it is often so faint as to be easily overlooked. This is especially true in cases occurring in elderly people, and when the patient has been for a considerable time at rest. The difficulty of recognizing certain cases of aortic regurgitation during life is shown by the fact that out of sixty-five cases of aortic regurgitation demonstrated at autopsy in the Massachusetts General Hospital, only forty-four were recognized during life.

In the majority of cases, however, the characteristic *diastolic murmur* is easily heard if one listens in the right place, and when heard *it is the most distinctive and trustworthy of all cardiac murmurs*. It almost invariably points to aortic regurgitation and to nothing else.

The murmur of aortic regurgitation, as has been already mentioned, is *diastolic* in time.¹ *Its maximum intensity is usually not*

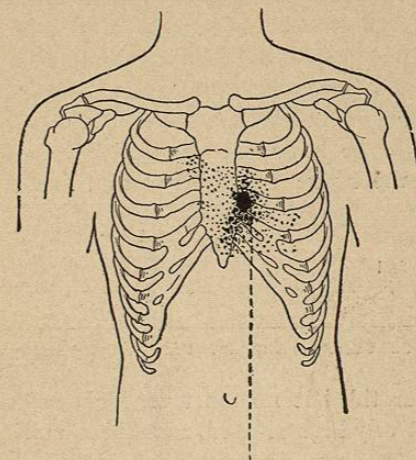


FIG. 137.—Position of the Point of Maximum Intensity of the Murmur of Aortic Regurgitation. The dots are most thickly congregated where the murmur is oftenest heard.

in the conventional aortic area (second right interspace), but on the left side of the sternum about the level of the fourth left costal cartilage. In about one-tenth of the cases, and especially when the aortic arch is much dilated, the murmur is best heard in the conventional aortic area. Occasionally there are two points at which it may be loudly heard—one in the second right interspace and the other at or near the apex of the heart, while between these points

¹ Another murmur, systolic in time, which almost always accompanies the diastolic murmur, is usually due to roughening of the edges of the aortic valves or to dilatation of the aortic arch. This murmur must not be assumed to mean aortic stenosis (see below, p. 243).

the murmur is faint. This is probably due to the fact that the left ventricle, through which the murmur is conducted, approaches the surface of the chest only at the apex, while the intermediate space is occupied by the right ventricle, which often fails readily to transmit murmurs produced at the aortic orifice. Less frequently the murmur of aortic regurgitation is heard with maximum intensity at the second or third left costal cartilage or in the region of the ensiform cartilage (see Fig. 137).

From its seat of maximum intensity (*i.e.*, usually from the fourth left costal cartilage) the murmur is transmitted in all directions, but not often beyond the precordia. In about one-third of the cases it is transmitted to the left axilla or even to the back. It is sometimes to be heard in the subclavian artery and the great vessels of the neck; in other cases two heart sounds are

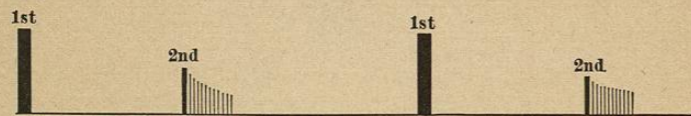


FIG. 138. — Short Diastolic Murmur Not Replacing the Second Sound.

audible in the carotid, but no murmur. The murmur is usually blowing and relatively high pitched, sometimes musical. Its intensity varies much, but is most marked at the beginning of the murmur, giving the impression of an *accent* there. It may occupy the whole of diastole or only a small portion of it—usually the earlier portion (see Fig. 138). Late diastolic murmurs are rare. The murmur may or may not replace the second sound of the heart. Broadbent believes that when it does not obliterate the second sound, the lesion is usually less severe than when only the murmur is to be heard. Allbutt dissents from this opinion.

In listening for the aortic second sound with a view to gauging the severity of the lesion, it is best to apply the stethoscope over the right carotid artery, as here we are less apt to be confused by the murmur or by the pulmonic second sound.

The position of the patient's body has but little effect upon the murmur—less than upon murmurs produced at the mitral orifice.

The first sound at the apex is generally loud and long. There is no accentuation of the pulmonic second.

Over the larger peripheral arteries, especially over the femoral artery, one hears in most cases a sharp, short systolic sound ("pistol-shot sound") due to the sudden filling of the unusually empty artery; this sound is merely an exaggeration of what may be heard in health. Pressure with the stethoscope will usually bring out a systolic murmur (as also in health), and occasionally a *diastolic murmur* as well (Duroziez's sign). This diastolic murmur in the peripheral arteries, obtained on pressure with the stethoscope, is practically never heard except in aortic regurgitation. It is thought by some to be due to the regurgitant current in the great vessels which in very marked cases may extend as far as the femoral artery. Duroziez's sign is a comparatively rare one, not present in most cases of aortic regurgitation, and usually disappears when compensation fails.

Summary and Differential Diagnosis.

A *diastolic murmur* heard with the maximum intensity about the *fourth left costal cartilage* (less often in the second right interspace or at the apex) gives us almost complete assurance of the existence of aortic regurgitation. From pulmonary regurgitation, an exceedingly rare lesion, the disease is distinguished by the presence of predominating hypertrophy of the left ventricle with a heaving apex impulse and by the following arterial phenomena:

- (a) Visible pulsation in the peripheral arteries.
- (b) Capillary pulsation.
- (c) "Corrigan" pulse.
- (d) "Pistol-shot sound" in the femoral artery.
- (e) Duroziez's sign.

Cardiopulmonary murmurs (see page 197) are occasionally diastolic, but are very markedly influenced by position and by respiration, while aortic murmurs are but slightly modified.

The very rare functional diastolic murmur, transmitted from the veins of the neck and heard over the base of the heart in cases of grave anæmia, may be obliterated by pressure over the bulbus jugularis. Such pressure has no effect upon the murmur of aortic regur-

gitation. I have recently reported (*Johns Hopkins Bull.*, May, 1903) three cases of intense anæmia associated with diastolic murmurs exactly like those of aortic regurgitation, but proved post mortem to be independent of any valvular lesion. The arterial phenomena were not marked, but the diagnosis of such cases is very hard. Luckily they are rare. The origin is obscure.

It must be remembered that aortic regurgitant murmurs are often exceedingly faint, and should be listened for with the greatest care and under the most favorable conditions.

Estimation of the Extent and Gravity of the Lesion.

The extent of the lesion is roughly proportional to—

- (a) The amount of hypertrophy of the left ventricle.
- (b) The degree to which the pulse collapses during diastole (provided the radial is not so much calcified as to make collapse impossible).
- (c) The degree to which the murmur replaces the second sound as heard over the right carotid artery (Broadbent).

Irregularity of the pulse is a far more serious sign in this disease than in lesions of the mitral valve, and indicates the beginning of a serious failure of compensation.

Another grave sign is a diminution in the intensity of the murmur.

Complications.

(1) *Dilatation of the Aorta.*—Diffuse dilatation of the aortic arch is usually associated with aortic regurgitation and may produce a characteristic area of dulness to the right of the sternum (see Fig. 134). Not infrequently this dilatation is the cause of a systolic murmur to be heard over the region of the aortic arch and in the great vessels of the neck.

(2) *Roughening of the Aortic Valves.*—In almost all cases of aortic regurgitation the valves are sufficiently roughened to produce a systolic murmur as the blood flows over them. This murmur is heard at or near the conventional aortic area, and may be transmitted into the carotids. (The relation of these murmurs to the diagnosis of aortic stenosis will be considered with the latter lesion.)

(3) The return of arterial blood through the aortic valves into the left ventricle produces in time both hypertrophy and dilatation of this chamber, and results ultimately in a stretching of the mitral orifice which renders the mitral curtains incompetent. The result is a "relative mitral insufficiency," *i.e.*, one in which the mitral valve is intact but too short to reach across the orifice which it is intended to close. Such an insufficiency of the mitral occurs in most well-marked cases; it temporarily relieves the overdistention of the left ventricle and often the accompanying angina, although at the cost of engorging the lungs.¹

(4) *The Austin Flint Murmur.*—The majority of cases of aortic regurgitation are accompanied by a presystolic murmur at the apex, which may be due to a genuine mitral stenosis or may be produced in the manner suggested by Austin Flint. (For a fuller discussion of this murmur see above, p. 227.)

(5) *Aortic stenosis* frequently supervenes in cases of aortic regurgitation, and results in a more or less temporary improvement in the patient's condition. It has the effect of increasing the intensity of the diastolic murmur, since the regurgitating stream has to pass through a smaller opening.

The general visible arterial pulsation becomes much less marked if stenosis supervenes on regurgitation.

AORTIC STENOSIS.

Uncomplicated aortic stenosis is by far the rarest of the valvular lesions of the left side of the heart, as well as the most difficult to recognize. Out of two hundred and fifty-two autopsies made at the Massachusetts General Hospital in cases of valvular disease there was not one of uncomplicated aortic stenosis. Twenty-nine cases occurred in combination with aortic regurgitation. During life the diagnosis of aortic stenosis is frequently made, but often on insufficient evidence—*i.e.*, upon the evidence of a systolic murmur heard with maximum intensity in the second right intercostal space

¹ This relative insufficiency of the mitral valve has been termed its "safety-valve" action, but the safety is but temporary and dearly bought.