ON THE MURMURS IN DILATED HEARTS AND THEIR EXPLANATIONS.

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DILATATION of the heart is a common condition, easily recognized by physical signs.

Murmurs are frequently associated with dilatation and are due to it, for they come and go with it. They may be therefore very properly described as "dilatation murmurs." How they are produced is a problem upon which opinions differ, and it is to some points connected with this problem that I propose to address myself.

I. It may simplify the question if we consider first the conditions under which murmurs occur in dilated vessels, arteries, and veins.

Murmurs are "audible eddies." The most marked murmurs are often said to be due to a "jet," but the jet only causes violent eddies. It is very extraordinary that the blood circulates through the normal vessels and heart without producing murmurs. Eddies represent loss of power. The absence of murmurs shows the wonderful physiological adjustment of the vessels to the blood which passes through them, so that, in spite of all the twists and turns the blood has to make, no eddies are produced.

It is no wonder that alterations in the vessels should cause eddies and murmurs. The wonder is that they are not more common.

The conditions under which eddies form fall into two groups according as the blood is passing: (A) Into or out of a dilatation of the vessel, or (B) through a constriction in it. For the eddies to be audible they must be sufficiently forcible, so that they will depend upon the force of the circulation. This explains why these murmurs vary in intensity at different times, why they come and go, and sometimes even disappear.

A. (a) Of the forms in which dilatation is the prominent change the simplest is that known as *mimic aneurysm*.

Fig. 1.

The name was, I believe, invented by Paget, although the condition was certainly known to Laënnec. I wrote on the subject many years ago, but, though the condition is by no means uncommon, it seems to have fallen out of recent literature and to be hardly referred to now. The name "mimic aneurysm" is an excellent one. It describes exactly what it is—namely, a fusiform dilatation of a part of a large artery which, however, is not permanent but transient. The subclavian is the common artery to be affected. Then under the clavicle a distinct pulsating swelling is found, over which the veins may be distended and a systolic murmur heard. It is a transient

condition. It comes and goes, lasting only, it may be, a few minutes, and with it goes the murmur too. I have seen the same condition also in the carotid at the root of the neck. In its most familiar form it is known as "the pulsating aorta," or what Laënnec described as abdominal pulsation. In these cases not only is the pulsation marked but a swelling may be obvious sufficient to suggest an actual aneurysm. Indeed, it is not rare in hospital practice to have such cases sent in with that diagnosis. The pulsation and the signs come and go.

In these cases of simple dilatation murmurs are not always present; this depends partly upon the abruptness of the dilatation and partly upon the force of the circulation, but as an attack of abdominal pulsation is usually associated with palpitation, the action of the heart being rapid and forcible, the murmur is generally well marked so long as the attack lasts.

Cases of abdominal pulsation are certainly rarer in the wards than they used to be. I can hardly suppose that the condition is actually less common, but I presume that it is more generally recognized, and being regarded as a neurosis does not excite sufficient interest for the case to be admitted into the hospital.

(b) A true fusiform aneurysm presents exactly the same condition, except that the dilatation is permanent. Over it a systolic murmur is common.

(c) With *saccular aneurysms* murmurs are common though not constant. In other words every saccular

Fig. 2.

aneurysm is not so placed that the circulation causes eddies in it sufficient to produce a murmur. The reason of this may be either (1) that the sac lies at the side of the vessel, and out of the direct current of blood, so that the blood passes over its mouth rather than into the sac; or, (2) that the sac itself is not distensible enough to allow sufficient blood to enter for the eddies to form; this may be due to rigid walls or to the cavity being filled with clot, but even large thin-walled aneurysms may present no murmur, just as sometimes they may not even pulsate.

B. The second group of conditions which may cause the eddies necessary for the murmur is that in which the vessel is constricted, the blood having then to pass through a constriction, and having thus a dilatation, relative or absolute, both above and below, conditions the most favourable of all for the eddies required.

(a) This constriction may be produced by *external pressure*—by the stethoscope, for instance, or by a tumour or bony prominence pressing on the vessel.

(b) An allied condition is that which occurs at the root of the neck, where the external jugular vein passes through the fibrous membrane, closing the thorax in the supraclavicular fossa. If this vein dilate, the fibrous ring through which it passes being rigid, a relative constriction is produced and a murmur ensues. This is the explanation usually given of the venous murmur audible above the clavicle in chlorosis. Indeed, it is in chlorosis especially that the conditions requisite for the production of these murmurs can be best demonstrated. Thus the murmur can easily be produced or exaggerated by pressure and made to vary with the force or rate of the circulation, being loudest in the erect position, on inspiration, and during diastole.

(c) Constriction of a vessel is, however, more commonly produced by *disease of its walls*. In this case the lumen is narrowed, and eddies are the necessary result.

II. Similar conditions in the heart will be capable of producing murmurs. If it be difficult to explain the absence of murmurs in healthy vessels, it is still more difficult in the case of the heart, where the blood has to pass through so many orifices and to turn so many corners.

Where there is organic disease, especially of the orifices, the occurrence of murmurs is easy to comprehend; but it is with the murmurs which occur where there is no gross structural lesion that I have to deal—that is, those in which there is only one abnormal condition present, namely, dilatation.

In the dilated heart the normal relation between the orifices and the cavities is changed so that the blood no longer passes in the usual uniform stream, but is driven here and there through the dilated cavities and so produces the requisite eddies.

Dilatation murmurs in the heart fall into two groups, according as they occur at the base of the heart or over the body of it, and may be described as (A) *basic* or (B) *ventricular* respectively. Whether basic or ventricular they may be present on the right or left sides, in the aortic and pulmonary areas in the one case, and over the right or left ventricles or auricles in the other.

Wherever they occur they are almost invariably systolic in time and soft or blowing in character, while the heart sounds, though they may be somewhat modified, are almost without exception present and distinct.

(A) The *basic murmurs* are often called "haemic" and referred to some altered condition of the blood, but what this altered condition is, except that there is anaemia in some form, is not explained. Moreover, these murmurs vary from time to time while the blood condition remains unchanged. Anaemia of any kind causing, as it must, defective nutrition and, therefore, weakness of the cardiac muscle, will lead to dilatation, and this is easy of demonstration. If "haemic" is a bad term, so is

Fig. 3.

"functional," which merely means absence of gross structural lesion.

(a) Murmurs of this kind at the left base are usually called *pulmonary* and are assumed to be produced in the pulmonary artery. If so they may be due to the eddies produced by the blood as it passes through the normal orifices into a dilated artery above or more probably out of the dilated right ventricle below. It is also possible that they are sometimes due to a dilated left auricle pressing on the pulmonary artery from without.

(b) Of the basic murmurs at the right base—that is, in the aortic area—I only wish to refer to one group, which is not as well recognized as it deserves to be.

A perfectly healthy man, for example, may present himself for examination for life insurance. Everything may be normal, except that over the aortic area a very distinct blowing systolic murmur may be audible. A short rest may lead to its disappearance, and it may not be present at all on another day. It seems to be due to the nervous excitement of the examination and to the fear that something may be found wrong. Men are often more nervous on examination for life insurance than when they consult the doctor for reasons of ill-health. At any rate, these murmurs are transient, and last, it may be, for a few minutes only. I have no doubt that many applicants for insurance have been rejected or rated up because the true condition has not been recognized, and the diagnosis has been made of organic disease of the aortic valves.

Though the recognition of this group of murmurs is therefore of great practical importance, their explanation is not simple. I believe these, too, are murmurs of dilatation, on account of their transient character; but whether the dilatation is in the aorta itself at its root or in the left ventricle I do not know; at any rate, I have not seen any evidence of dilatation of the ventricle, though the action of the heart is often hurried and palpitating as the result of the nervous excitement, so that I think it very likely that the condition is the same as that of the mimic aneurysms referred to, and that the murmur is due to a transient dilatation of the root of the aortic arch.

(B) It is to the ventricular group of the dilatation murmurs that I wish more especially to address myself. These may also be on the right or left side respectively. These murmurs are almost always systolic in time, soft and blowing in character, limited to the precordial area, and rarely propagated as organic valvular murmurs are.

They are commonly stated to be due to regurgitation through the auriculo-ventricular orifices. This explanation I believe to be wrong, as I shall endeavour to show.

The muscle-bundles run round the heart in figure-of-eight fashion, and lap round the auriculo-ventricular rings. The effect of this, according to Ludwig and Hasse's experiments, is that when the heart contracts the auriculo-ventricular rings are also constricted, so that the orifices are narrowed. This would appear to be a special provision for doubly ensuring competency of the valves during health, and it might be that it would be sufficient to prevent incompetency, even when the valves were to some extent diseased.

Ludwig and Hasse, however, went further, and drew the conclusion that even in health this contraction was essential, and that without it even perfectly healthy valves were not competent to close the orifices; in other words, that muscular weakness even in slight degree would render the valves incompetent, and thus allow regurgitation. This is an astounding conclusion to arrive at. *A priori* it is in the highest degree improbable, for all the important organs of the body have a large margin over what is the minimum required for health. Thus two-thirds of the liver, kidneys, and lungs can be destroyed before life becomes impossible, and small defects are almost unnoticeable. Can it be that the heart alone has so little to spare that muscular weakness, of only slight degree and of a temporary nature, can lead at once to such a serious defect as valvular incompetency? Ludwig and Hasse's experiment consisted in plunging the freshly excised heart into a saturated solution of potassium bichromate. This caused extreme contraction of the heart muscle, and of the auriculo-ventricular orifices also. It was a violent experiment, but it showed that contraction of the heart muscle narrowed the auriculo-ventricular orifices; it could not, however, prove that without this contraction healthy valves would be incompetent.

Post-mortem observation is against such a conclusion, for in relaxed condition of the heart *post mortem* the valves are generally competent at least to hold water, even when the orifices can be shown by measurement to be stretched a good deal beyond their normal size.

But the theory that these dilatation murmurs are due to regurgitation through the valvular orifices must stand the test of clinical observation before it can be accepted.

Of course this theory cannot apply to the basic group of dilatation murmurs at all, though it actually has been extended also to them. It can apply only to the ventricular group. The obvious test is to compare these dilatation murmurs with the regurgitant murmurs of organic disease. If they agree the theory is established; if they do not agree the theory must fall.

I. The Ventricular Dilatation Murmurs of the Left Side.

(a) The characters of the murmurs of mitral regurgitation resulting from organic disease are well known. These murmurs are systolic in time, audible at the apex and outside it, transmitted to the axilla and to the angle of the scapula, where they may be heard louder than elsewhere. The heart sounds are greatly altered. Sometimes it may be these murmurs are not so definitely propagated. They may vary in many particulars, and may at times even be absent. These variations may depend upon varying conditions in the force of the circulation or heart's action, but as the general rule the regurgitant murmurs are propagated as stated.

The left ventricle dilatation murmurs, however, differ. They are systolic in time, as a rule softer and more blowing in character. They are definitely limited to the precordium, heard more widely over it, and are not propagated to the axilla and back, while the heart sounds are little if at all changed.

If there are, then, these differences, the same explanation can hardly fit both, and it follows that the murmurs of dilatation cannot be due to regurgitation.

But there is another important fact to be borne in mind—namely, that it sometimes happens, though rarely, that when the dilatation of the heart is extreme the murmurs are propagated as they would and ought to be if they were regurgitant. If, then, in some rare cases we have evidence that the dilatation murmur is regurgitant, while in the majority of cases the evidence is to the contrary, there must be for this majority some other explanation found. If not regurgitant they can only be intraventricular, that is, produced by eddies set up in the dilated ventricle.

In actual organic disease of the valves of the left side dilatation often increases the difficulties of exact diagnosis. So much so that it is often impossible to be certain of the exact condition until the dilatation has more or less passed off, when the diagnosis, which at the time was difficult or impossible, becomes easy and simple.

(b) The apex murmurs associated with aortic regurgitation are instructive. The murmur of aortic regurgitation is characteristic enough even when transmitted to the apex, so long as the ventricle is hypertrophied only and not dilated; but so soon as dilatation occurs and becomes

marked, new apex murmurs of an entirely different kind develop, which often raise the question whether there is mitral incompetency as well as aortic regurgitation. There is then audible at the apex, and over an area within it, a general churning, which is more or less continuous throughout the whole heart cycle—that is, during diastole as well as systolic. It is so peculiar and characteristic that on putting the ear to the apex the diagnosis of aortic

regurgitation is at once suggested, and as a rule no part of this churning is transmitted as regurgitant mitral murmurs are. These murmurs vary a good deal in different cases. One of them has been described as Flint's murmur, though known and recognized long before it became connected with Flint's name. Flint's murmur has been described as the murmur of mitral stenosis without mitral disease, but it is not in the least like the true presystolic murmur, nor is it really presystolic in time. It is nothing more than a special form of the

Fig. 4.

general churning I have described, and like it is endoventricular and due to dilatation.

(c) As with aortic regurgitation the dilatation of the ventricle often raises the question of mitral disease, so with mitral regurgitation murmurs are sometimes heard at the base which raise the question of aortic regurgitation. In a case of undoubted mitral regurgitation there may be heard in the left third intercostal space, about an inch or so from the sternum, a double or continuous murmur. Although many aortic regurgitant murmurs are heard best, and sometimes only, in the left third intercostal space near the sternum, this murmur is continuous and double and not diastolic only,

so that careful auscultation will soon show that aortic regurgitation alone will not explain it. Occurring as it does further from the sternum and over a larger area, there is nothing left for it but the left auricle, and it must be, I consider, a dilatation murmur produced in the dilated left auricle or appendix.

Fig. 5.

II. The Ventricular Dilatation Murmurs of the Right Side.

These are much more easy to deal with than those of the left side, for they are more superficial and the dilatation of the right side of the heart is more easily demonstrated.

Tricuspid regurgitation due to organic disease, though a very rare condition, yields very characteristic physical signs. The systolic murmur is well marked, and is propagated in a definite direction from the lower part of the sternum transversely outwards to the right, where the auricle can be shown clearly by percussion to be greatly dilated.

Tricuspid regurgitation is a very favourite diagnosis with some clinicians, but then on theoretical grounds and not on physical signs. The right side of the heart is greatly dilated as shown by percussion; there is epigastric pulsation; distension, and pulsation of the jugular veins. These physical signs are considered sufficient for the diagnosis even without any murmur whatever, but they may all be present without regurgitation.

Murmurs over a dilated right heart are by no means common, yet dilatation is an everyday phenomenon.

I do not know that I have ever seen the characteristic murmurs of tricuspid regurgitation without organic disease, and have in many cases confirmed the diagnosis by *post-mortem* examination. When murmurs over a dilated right heart do occur they are soft and blowing, heard over the ventricle especially and not over the auricle, and are not propagated as those of organic disease are across the sternum towards the right side. Therefore I maintain that on the right side, as on the left, they are not due to regurgitation through the auriculo-ventricular orifices, but are produced within the dilated chamber.

The considerations I have brought forward thus justify the conclusion I desire to establish—namely, that these ventricular-dilatation murmurs are not regurgitant, but are due to eddies set up within the dilated cavities; in other words, that they are not valvular but intra-ventricular. They are, of course, connected with defective muscular action, but only so far as this leads to dilatation. Varying degrees of dilatation associated with variations in the force of muscular contractions are adequate to explain all the phenomena met with.

Fig. 6.

COMMON ERRORS IN DIAGNOSIS AND TREATMENT OF CARDIAC DISEASES.*

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It is obviously impossible for me, in the short time at my disposal, to deal with all the common errors in the diagnosis and treatment of cardiac diseases. I shall only deal with those which are most common and of the greatest practical importance.

The Rheumatic Infection in Childhood.

I think we cannot do better than commence with the rheumatic infection of the heart in childhood—a subject of the utmost importance, for by far the larger number of cases of heart disease under 30 years of age, and a considerable proportion of those of later life, are a direct result of this infection.

Notwithstanding the fact that this subject has received a great deal of attention, it is still not sufficiently realized that it is very easy to overlook a rheumatic infection in children, and even when we are especially on the look-out for it it is not infrequently very difficult to come to a definite conclusion as to whether the heart is affected or not. This is very unfortunate, because the future welfare of the patient in large measure depends upon the medical attendant adopting sufficiently prolonged, careful, and adequate treatment during the stage of infection.

Now, in my view, the reason why the practitioner so frequently overlooks infection of the heart by the rheumatic poison is that the clinical picture of acute and subacute rheumatism was originally exclusively drawn from the disease as it appears in adult life, and the result is that many practitioners do not realize that rheumatism as it appears in childhood presents many and important points of difference. It is important to recognize the following facts: In adult life arthritis is the chief manifestation of the rheumatic infection, and is looked upon as constituting a typical attack, while cardiac involvement is regarded as a complication. In children, on the other hand, arthritis is usually slight, and may be even entirely absent, while affections of other organs and parts are more frequent, and constitute a more prominent part in the disease. Thus endocarditis, myocarditis, and pericarditis are much more frequent, and should not be looked upon as "complications"; they are just as much part of the disease as is affection of the joints. Subcutaneous nodules, certain exudative erythemata, and purpura rheumatica are also more frequent manifestations of the rheumatic infection; chorea is common in connexion with the rheumatism of childhood; and tonsillitis is perhaps more common in connexion with the rheumatic state in youth than in adult life.

Endocarditis, myocarditis, or pericarditis may accompany the slightest affection of the joints. There is often a little pain, stiffness, and tenderness, with no perceptible swelling; acid perspirations are usually very slight, and the pyrexia is in most instances moderate. Sometimes the affection is confined to the tendons of the fascia in the neighbourhood of the joint, as, for example, the tendons of the hamstring muscles under the knee, causing the child to walk on the tips of the toes, with the knees bent. This may be mistaken for incipient talipes equinus or paresis. On the other hand, we should be careful to exclude infantile scurvy, acute anterior poliomyelitis in its early stages, syphilitic disease of the ends of the long bones, and other affections of the joints in children. Involvement of the heart may also be associated with subcutaneous nodules, certain exudative erythemata, chorea, or merely with an indeterminate febrile attack. Indeed, carditis may occur alone, that is, it may be the only manifestation of rheumatism at the time.

While endocarditis may occur acutely in children as it does in adults, it often occurs in a subacute and insidious form, and therefore its existence is frequently not known or suspected until the heart is examined because of some other rheumatic manifestation. There is frequently an

THE Harben lectures of the Royal Institute of Public Health will be delivered on July 1st, 3rd, and 6th, by Dr. L. Vaillard, President of the Health Committee of the French army. The first lecture will deal with caries, the second with tetanus, and the third with house-flies. The lectures will be delivered at the Institute, 37, Russell Square, W.C., at 5 p.m. on each day, and are open to the public.

* The substance of a lecture given at the Medical Graduates' College and Polyclinic, February, 1914.