CLINICAL ASSESSMENT OF MITRAL ORIFICE IN PATIENTS WITH REGURGITATION

BY*

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Mitral regurgitation may take place through orifices which are severely narrowed and through orifices which are so large as to offer negligible obstruction. In disabled patients the size of the mitral lumen chiefly determines whether surgical treatment should relieve stenosis or correct incompetence.

A study of 20 patients suffering from mitral regurgitation has suggested that the size of the mitral orifice may be predicted with reasonable accuracy from the cardiac impulse and heart sounds.

Material and Methods

Twenty patients with signs of mitral incompetence and auricular fibrillation were selected for study on the grounds of their freedom from evidence of hypertensive, ischaemic, or aortic valvular disease. At valvotomy or open-heart operation the presence of regurgitation was confirmed and the long diameter of the mitral orifice measured by palpation (G. H. W.).

Pre-operatively, the patients were examined with special reference to the nature of the cardiac impulse, the mitral diastolic murmur, and the third heart sound of rapid left ventricular early diastolic filling. In every patient a crystal microphone and an oscillographic phonocardiograph were used to record the heart sounds at a paper speed of 80 mm./sec. Simultaneous tracings were taken from the pulmonary area (high frequency) and apex (high or medium frequency: Leatham, 1952). Care was taken to avoid filtering or attenuating out the third heart sound and the onset of the mitral diastolic murmur. From the tracings two varieties of passive mitral diastolic murmur were recognized: those with a loud abrupt onset and short duration, and those which were quiet in onset and long in duration.

A third heart sound was regarded as present when vibrations twice the size of the first variety of passive diastolic murmur occurred shortly after its beginning. The identification severally of aortic and pulmonary-valve closure and mitral opening snap vibrations, and the configuration and time relationships of the third sound, distinguished it from other transients. The third heart sound was not commonly present in every cardiac cycle, and its occurrence was noted as being frequent or infrequent. In several patients the third sound was loudest towards the end of expiration. The apical thrust of a palpable left ventricle was recorded as being present or absent.

In 13 patients left atrial pressure pulses were obtained by the method of Allison and Linden (1955) or Ross (1959) at a time when the heart rate was slow enough for diastasis to be demonstrable. Patients with sinus rhythm were excluded from this study.

Results

The important findings are shown in the accompanying Table.

In five cases with orifices measuring 1.2 cm. or less the mitral diastolic murmur began quietly and there was no third sound. Two patients with orifices of 1.5 cm.

Case	Left Ventricle Palpable	Mitral Diastolic Murmur		Third Heart Sound		Long Diameter of Mitral Orifice (cm.)	Diastasis
		Quiet Onset	Loud Onset	Infrequent	Frequent		
1	+	+	0	0	0	0.5	0
2	+	+	0	0	0	1.0	0
3	0	+	0	0	0	1.0	0
4	0	+	0	0	0	1.0	0
5	0	+	0	0	0	1.2	0
6	+	+	0	0	0	1.5	0
7	0	+	0	0	0	1.5	0
8	+	0	+	+	0	1.5	0
9	+	0	+	+	0	1.8	+
10	+	0	+	0	+	2.0	+
11	+	0	+	0	+	2.25	+
12	+	0	+	0	+	2.25	+
13	+	0	+	0	+	2.5	+
14	+	0	+	0	+	2.5	+
15	+	0	+	0	+	3.0	+
16	+	0	+	0	+	3.0	+
17	+	0	+	0	+	3.5	+
18	+	0	+	0	+	3.5	+
19	+	0	+	0	+	3.5	+
20	+	0	+	0	+	4.0	+

The symbols + and 0 represent the presence or absence of the physical sign.

Diastasis is the phase of diastole immediately preceding systole during which the atrial pressure normally rises. The absence of an entry indicates either that the left atrial pressure pulse was not recorded or that tachycardia prevented the possible appearance of this feature.

showed similar features. The mitral diastolic murmur began loudly and a third sound was present occasionally in the third patient with a 1.5-cm. orifice and in the patient with a 1.8-cm. orifice. With orifices of 2 cm. or more the mitral diastolic murmur began very loudly and a third heart sound occurred in the majority of cardiac cycles. The left ventricle was palpable in half the patients with orifices of 1.5 cm. or less and in all the patients with larger orifices. The absence of a late diastolic rise in left atrial pressure indicated severe mitral obstruction in five patients with orifices of 1.5 cm. or less. The presence of such a rise indicated ease of flow from left atrium to ventricle in eight patients with orifices measuring 1.8 cm. or more.

Discussion

The borderline between predominant obstruction and predominant incompetence seems to lie with orifices measuring 1.5–1.8 cm. in diameter. With this order of lumen the left ventricle may or may not be palpable, a third heart sound may appear occasionally or not, the passive diastolic murmur may have a quiet or a loud beginning, and diastasis may or may not be present. With smaller orifices it appears that the mitral diastolic murmur begins quietly, and the third sound does not occur. The absence of a late diastolic rise in left atrial pressure indicates severe obstruction. With orifices measuring 2 cm. or more the left ventricle is invariably palpable, the diastolic murmur has an explosive onset, a third sound is present in most cardiac cycles, and the rise of left atrial pressure in diastasis is a reliable sign that atrium and ventricle can fill together as a common chamber.

The brevity of the mitral diastolic murmur in incompetence contrasted with its length in stenosis has been described by Wood (1956). McKusick (1958)

observed that the passive murmur of mitral stenosis may not fill diastole if the disease is trivial and if heart rate or cardiac output is low. Brandenburg and Burchell (1958) rarely found the passive murmur confined to early diastole in cases of advanced mitral obstruction. McDonald *et al.* (1957) considered that a long diastolic murmur indicated severe stenosis and that a short diastolic murmur was typical of mitral incompetence. Turner and Fraser (1956) thought that the duration of the diastolic murmur was principally determined by the rigidity of the mitral valve. We believe that while the diastolic murmur is generally long in severe mitral stenosis, it may be short in mild mitral stenosis, in mitral regurgitation, and in moderately severe mitral stenosis when the cardiac output and heart rate are low. Furthermore, it may be difficult to measure the length of the diastolic murmur in a patient with a low cardiac output and a thick chest wall.

Hultgren and Leo (1959) and Nixon *et al.* (1959) observed the explosively loud onset of the short mitral diastolic murmur in patients with severe regurgitation (Fig. 1). The third heart sound occurs early in this

FIG. 1.—Simultaneous high-frequency pulmonary and mitral phonocardiograms, left atrial pressure, and electrocardiogram from a patient with a 2.5 cm. mitral orifice. Diastasis indicates the period in late diastole during which left atrial pressure rises as the left atrium and ventricle fill together as a common chamber.

P.A.=Pulmonary area. M.A.=Mitral area. A.P.=Aortic and pulmonary valve closure. O=Opening snap of mitral valve. 3=Third heart sound of rapid left ventricular filling. S.M.=Pan-systolic mitral murmur. D.M.=Mitral diastolic murmur with a loud beginning. H.F.=High frequency.

FIG. 2.—Simultaneous medium-frequency mitral phonocardiogram, left atrial pressure, and electrocardiogram from a patient with a mitral orifice measuring 1 cm.

T.M.=Tricuspid followed by mitral valve closure. S.M.=Pan-systolic mitral murmur. D.M.=Mitral diastolic murmur with a quiet beginning. M.A.=Mitral area. M.F.=Medium frequency.

murmur. It may be difficult to decide whether large vibrations are part of the murmur or whether they form a third sound. The decision is probably of no importance, since each appears to indicate that the orifice is not severely obstructed. This murmur of dominant regurgitation is distinguished more easily from the quietly beginning long-drawn-out murmur of dominant obstruction (Fig. 2) by its loud onset than by its short duration. There may be advantage in naming the former the *high-flow* mitral diastolic murmur, and the latter the *low-flow* mitral diastolic murmur.

Right and left heart pressure pulses and indicator-dilution curves have been obtained in 50 patients disabled from mitral-valve disease, using the method described by Nixon (1960a). This experience has supported the view that the onset of the mitral diastolic murmur is the single feature of greatest value in predicting when regurgitation is too severe for valvotomy to be offered to a patient with atrial fibrillation.

The loudness of the first sound and systolic murmur are not reported in this communication because they appeared to have little value in diagnosing the size of the mitral orifice.

A loud mitral opening snap occurred in 13 of the patients reported here, and in every one the main part of the aortic cusp was supple and capable of ballooning. In one case a faint opening snap was just visible on the phonocardiograph, and the aortic cusp was found to be thickened and moving poorly. There was no opening snap in the remaining six patients in whom the aortic cusp proved to be rigid and immobile. The presence of an opening snap was not related in any way to the size of the mitral lumen. Similar findings have been reported previously (Nixon *et al.*, 1959; Nixon, 1960b).

If future experience supports the observations made in this small group of patients with mitral regurgitation it may become possible to diagnose the size of the mitral orifice and the state of the aortic cusp from the onset of the diastolic murmur and the opening snap.

Summary

A clinical and surgical study of 20 patients with mitral regurgitation and atrial fibrillation suggests that a quietly beginning diastolic murmur identifies a mitral orifice measuring less than 1.5 cm. in diameter. With orifices of 2 cm. or more the diastolic murmur begins loudly and a third heart sound appears frequently.

It is suggested that the former murmur should be named the *low-flow* mitral diastolic murmur, and the latter the *high-flow* mitral diastolic murmur.

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