The Clinical Determination of Mitral Insufficiency when Associated with Mitral Stenosis

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A review of 200 consecutive operated cases of pure mitral stenosis and 47 consecutive operated cases of mitral stenosis with an associated mitral insufficiency indicates that careful evaluation of the history, auscultatory findings, electrocardiogram and fluoroscopy permits a correct diagnosis of associated insufficiency in a majority of instances. History and auscultation remain the internists' most valuable tools despite a large array of as yet incompletely evaluated mechanical measures.

It has been observed that the presence of severer degrees of mitral insufficiency associated with mitral stenosis increase operative mortality and morbidity and decrease the number of worthwhile operative results. The detection of this associated lesion is at times difficult and frequently not made except by the surgeon's exploring finger in the left atrium.

This study is a review of 247 consecutive case histories taken from our first 500 patients who have undergone mitral commissurotomy. It is an attempt to determine clinical features which might aid in the detection of an associated mitral insufficiency.

Methods and Materials

Two hundred consecutive operated cases of pure mitral stenosis and 47 consecutive operated cases of mitral stenosis with associated mitral insufficiency are included in this series.

The presence or absence of insufficiency was determined in every case by finger palpation of the mitral valve and subjectively grading the regurgitant jet of blood from 0 to grade 4. We are aware of the crudeness of using the palpating finger of the surgeon in the left atrium for the diagnosis of mitral regurgitation. However, the many variable mitral valve configurations prevent precise quantitative determination of the degree of regurgitation by any method available today. Only patients with a regurgitant jet of grade 2 or more as determined by this method were included in the category of associated insufficiency.

Thirty-two of the 47 patients with mitral stenosis and insufficiency had a jet of grade 2 intensity; 11 were of grade 3; only four were of grade 4 intensity. No cases of pure mitral insufficiency were encountered in this series.

The transverse diameter of the orifice of the mitral valve bore no apparent close correlation to the severity of the regurgitant stream striking the palpating finger. The orifical opening in these 47 patients varied from one cigarette in diameter to three fingers. A combination of factors such as flexibility of valve leaflet and of chordae tendineae, papillary muscle contractility and the position of the mitral valve orifice relative to the left ventricular outflow tract probably are as significant as the cross sectional area of the mitral inlet.

This paper will be primarily concerned with the evaluation of those procedures available to the average clinician, namely, the history, auscultatory findings, the electrocardiogram and x-ray.

Clinical Features

Natural History. The clinical course of the average patient with pure mitral insufficiency differs strikingly from that of the patient with pure mitral stenosis. In mitral insufficiency the history is one of relative benignity. Dyspnea, an early disabling symptom of mitral stenosis, occurs later and is overshadowed by the primary complaint of easy fatigability in mitral insufficiency. Chronic disability is often postponed until the fifth or sixth decade in pure insufficiency unless subacute bacterial endocarditis or episodes of acute rheumatic fever supervene. This is probably due to the fact that
there is little or no sustained pulmonary hypertension until late in the course of this disease. Other reports have noted a dominance of males and a lessened incidence of a positive rheumatic fever history in patients with mitral insufficiency as compared with patients who have mitral stenosis.

However, as will be noted throughout this report, these apparently clear-cut differences vanish under the influence of an associated mitral insufficiency and stenosis. As the two lesions relinquish their purity and combine, the more dynamic pathophysiology of mitral stenosis usually dominates the clinical picture and thereby complicates the clinical differentiation.

There was no appreciable age difference in our two groups of patients, although 40 per cent of those with associated insufficiency were males as compared with 25 per cent with pure stenosis. A positive rheumatic fever history was obtained in 40 per cent of the patients with pure mitral stenosis, and in 70 per cent of those with an accompanying insufficiency. This is contrary to the reported findings in pure mitral insufficiency.

Fatigue played a more dominant role than did exertional dyspnea when the severer grades of incompetence were present. This was true both early and late in the symptomatic course of such patients.

Strikingly, systemic arterial embolization occurred much less frequently when mitral regurgitation is associated with mitral stenosis. It occurred in 23.5 per cent of those patients with pure stenosis but in only 6.4 per cent of those in whom regurgitation was also present. Apparently, the regurgitant jet prevents stagnation of blood, and hence thrombus formation in the left atrium. It is usual at operation to find a left atrium free of thrombi if significant regurgitation is associated with mitral stenosis, and this was noted in 43 of the 47 cases. This was also true even in the presence of atrial fibrillation (19 of 24 patients). In pure mitral stenosis, however, a thrombus was found in the left atrium in 86 of 200 patients. Subacute bacterial endocarditis may be the source of arterial emboli in some of those patients who had no thrombi in the left atrium but had a positive history of systemic arterial embolization. It has often been noted that the incompetent mitral valve is more susceptible to the ravages of endocarditis than the purely stenotic one.

**Auscultation.** The characteristic murmur of dynamically significant pure mitral insufficiency is usually best heard at the mitral area. It is usually rough, grade 3 or 4 in intensity and holosystolic (less frequently late systolic) in time. It begins with the first heart sound and frequently dampens or obscures it. The murmur extends up to and includes the second sound or the aortic component of a split second sound. Its transmission is usually laterally to the axilla and back but less well to base of the heart. The pulmonic second sound may be accentuated. A third heart sound easily mistaken for the opening snap of mitral stenosis is often heard in pure mitral insufficiency. Systolic murmurs which originate at the aortic valve may occasionally be heard only at the mitral area. Differential auscultatory features are: (1) these aortic murmurs start later in systole and therefore do not include the first sound, (2) they are accentuated in mid-systole, and (3) they rarely include the second sound.

A systolic murmur of varying intensity at the mitral area was heard in 30 per cent of patients who had only a pure mitral stenosis. Thus, we see that the clinician is frequently challenged as to the significance of a mitral systolic bruit. The greater the similarity between the murmur heard and the characteristic murmur of pure mitral insufficiency the more likely that it is indicative of a dynamically significant associated mitral incompetence. The intensity of the murmur is the most important single factor.

None of the patients with pure mitral stenosis had a mitral systolic murmur of grade 4 intensity, although six of the 200 had one of grade 3. Contrastingly, a grade 3 or 4 murmur was heard in 13 of 15 patients who had a regurgitant jet of grade 3 or 4 associated with stenosis.

Scarring and calcification of the anterior leaf of the mitral valve is a common cause of mitral systolic murmurs in pure stenosis. Turbulence is created by the irregular surface as the blood is ejected along the left ventricular
outflow tract, striking the scarred anterior mitral valve leaf and passing through the aortic valve. Fifteen of 25 patients with pure stenosis who had a systolic murmur of grade 2 or more demonstrated a calcified anterior mitral valve leaf at surgery.

**X-ray Examination.** X-ray films offers only limited aid in the differentiation of pure and impure mitral stenosis. The great difficulty of detecting left ventricular enlargement by x-ray, especially in the presence of a marked right ventricular enlargement, has been generally realized. Mitral insufficiency exerts relatively minor dynamic effects upon the left ventricle and enlargements of this chamber are usually minimal, if present at all. The left ventricle was found to be minimally (1+) enlarged at operation in only 7 of the 15 patients with an associated regurgitation of grade 3 or 4.

Massive (aneurysmal) dilatation of the left atrium is usually considered to be caused by mitral stenosis with an associated insufficiency, although it is felt by some to be more characteristic of pure mitral stenosis. Thirteen massively dilated left atria were found at surgery in this series. Eleven of these had an associated regurgitation (nine of grade 3 or 4). However, two exhibited only pure stenosis.

Systolic expansion of the left atrium as seen upon fluoroscopy in multiple views has been thought to be caused by systolic regurgitation of blood into the left atrium. It has been extensively studied by many authors but unfortunately this phenomenon has proved to be of little clinical value because it is frequently seen in pure mitral stenosis.

Calcification of the mitral valve was demonstrated at operation in 65 per cent of our 47 patients with associated regurgitation, and in 32 per cent of those with pure stenosis.

**Electrocardiogram.** A pattern of left ventricular hypertrophy is seldom seen in patients with mitral stenosis and associated mitral insufficiency. Only one patient with associated regurgitation demonstrated this pattern as an isolated finding and it was combined with right ventricular hypertrophy in only two other patients. Nor is the absence of a right ventricular hypertrophy pattern on the electrocardiogram in the presence of a clinically evident mitral stenosis suggestive of associated mitral insufficiency. The absence of right or left ventricular hypertrophy was noted in 98 of our 200 patients with pure stenosis. Also, 9 of the 15 patients with severe associated insufficiency had right ventricular hypertrophy upon their electrocardiograms.

**Summary of Additional Graphic Aids in the Diagnosis of Mitral Insufficiency Associated with Stenosis**

Numerous mechanical measures have been utilized in attempting to diagnose mitral insufficiency associated with mitral stenosis. These are not readily available to the average clinician and consequently will be discussed only briefly. In general, these procedures have proven of only limited value, even in experienced hands, as compared with the clinical stand-bys of auscultation and natural history. There is great need for more extensive correlation with surgical findings before these procedures can be properly evaluated.

**Cardiac Catheterization.** It was hoped that pressure curves obtained by "wedging" the catheter tip into the smaller capillary branches of the pulmonary artery would accurately reflect the pressures of the pulmonary venous system and the left atrium. If this were true it would be of great aid in detecting the systolic surge of blood into the left atrium which is present in mitral insufficiency. There is, however, a great deal of dispute among investigators as to whether these "wedge pressure curves" actually reflect pressure changes in the left atrium. Some authors feel that they do not.

**Auricular Esophagogram.** Luciani first noted the existence of cardiac pulsations when an inflated balloon was placed in the esophagus at the level of the left atrium. Minkowski and Rautenberg described a positive plateau curve obtained in systole in cases of mitral insufficiency. However, recent work, notably that of Abelmann and others, has shown the poor correlation of these curves with the surgical findings.

**Left Auricular Electrokymograms.** Electrokymography of the heart was introduced by
Boone, Henny and Chamberlain\textsuperscript{21} in 1947. It was applied to the left atrial border by Luisada and Fleischner\textsuperscript{22} in 1948 and a positive systolic plateau was obtained in the presence of mitral insufficiency. But the same authors found similar tracings in cases of clinically pure mitral stenosis. Soloff\textsuperscript{23} reported detailed observations of the findings of electrokymography in mitral regurgitation. It was his conclusion that this laboratory aid was not as useful as detailed fluoroscopy of the heart in skilled hands. In addition, he stresses that the normal heart can and frequently does produce records identical to those seen in mitral insufficiency. Recently curves of like nature were found in persons with normal hearts and in those with pure mitral stenosis, proved at operation.\textsuperscript{16}

Phonocardiograms. Margolies and Wolferth\textsuperscript{24} showed that in mitral stenosis the time interval between the second heart sound and the opening snap of the mitral valve in the presence of atrial fibrillation varied with the preceding cycle length. Messer and co-workers\textsuperscript{25} and Weiss and Joachim\textsuperscript{26} noted a varying time interval between the onset of electrical systole and the first heart sound in similar patients again depending on the previous cycle length. Recently an interesting and perhaps quite important observation was made by Kuo and Schnabel.\textsuperscript{27} They observed that these two intervals remained fixed when there was an associated mitral or aortic insufficiency. Their observations up to this time have been limited to only a small number of cases.

Ballistocardiogram. The ballistocardiogram has only recently been used as a possible aid in the diagnosis of mitral insufficiency. It has been reported that a consistent headward ballistic wave occurs preceding the J wave when mitral insufficiency is present.\textsuperscript{28} There has again been too little clinical correlation to justify any conclusions as to its value.

Direct Left Atrial Pressure. An ingenious method of obtaining direct pressure readings from the left atrium by bronchoscopic passage of a needle through the right main bronchus has recently been reported.\textsuperscript{29} Further correlation is again needed.

Conclusions and Summary

Although pure mitral insufficiency and pure mitral stenosis appear to be two separate clinical entities, their apparently clear-cut dissimilarities are quickly lost when the two are combined. Mitral stenosis is the dynamic dominant and soon governs the clinical picture. However, certain dissimilarities remain to varying degrees in the individual patient and are useful in their clinical evaluation. Preoperative detection of severer grades of mitral insufficiency associated with mitral stenosis is important. It has been observed that these patients have an increased operative morbidity and mortality as well as a lessened degree of worthwhile postoperative results as compared with patients with only pure mitral stenosis.

It has been observed upon reviewing 200 consecutive operated cases of pure mitral stenosis and 47 consecutive operated cases of mitral stenosis with an associated mitral insufficiency that careful evaluation of the natural history, auscultatory findings, electrocardiogram and fluoroscopy permits a correct diagnosis of associated insufficiency a majority of the time. History and auscultation remain the internists' most valuable tools despite a large array of as yet incompletely evaluated mechanical measures.

Thirty per cent of 200 patients with a pure mitral stenosis had a mitral systolic murmur in addition to a diastolic murmur. It is in this group that the question of significant associated insufficiency arises. The intensity of the mitral systolic murmur is the most useful differential feature of auscultation. Thirteen of 15 patients with a regurgitant jet of grade 3 or 4 as determined by the palpating finger in the left atrium had a systolic murmur of grade 3 or 4 intensity. No grade 4 systolic murmurs were heard in pure mitral stenosis although 6 of these 200 patients did have a murmur of grade 3 intensity. In addition, it can be generally stated that the greater the similarity to the characteristic murmur of pure mitral insufficiency the more likely that such a systolic murmur is indicative of a dynamically significant regurgitation.

Further clinical aid can be gained by obtain-
ing a chronologic and complete history of the disease. Systemic arterial embolization occurs much less frequently when insufficiency is associated with mitral stenosis than when stenosis exists alone. It occurred in 23.5 per cent of the 200 patients with pure stenosis but only 6.4 per cent when regurgitation was also present. This decided difference was also noted when auricular fibrillation accompanied mitral insufficiency and stenosis. Apparently, the regurgitant stream prevents stagnation of blood and thrombus formation in the left atrium.

Fatigue rather than dyspnea usually plays the early dominant role in the symptomatology of those patients with severe associated insufficiency. Apparently, sustained pulmonary hypertension with its deleterious effects on the right heart and upon the lungs occurs later in such individuals than in those with pure stenosis and thereby delays the onset of dyspnea.

The only value of the electrocardiogram in the differentiation of the predominance of mitral stenosis versus mitral insufficiency is the presence of left ventricular hypertrophy when insufficiency is predominant. In such cases in our experience mitral valve commissurotomy has failed to produce beneficial results; in fact, such patients developed a significant mitral regurgitation after surgery, which inevitably results in death from congestive heart failure. About one-half of all patients with pure mitral stenosis showed no electrocardiographic evidence of right ventricular preponderance, at the time of surgery. The relatively small dynamic effect of mitral insufficiency upon the left ventricle is reflected not only in the electrocardiogram, but also by noting a normal-sized left ventricle demonstrated fluoroscopically and directly observed at operation.

In our experience massive dilatation of the left atrium with mitral stenosis and insufficiency indicates that the insufficiency is of dynamic significance. Of eleven patients in whom preoperative clinical diagnoses of massively dilated left atria were confirmed at operation, 9 had a regurgitant jet of grade 3 or 4. It was interesting that the two other patients with massively dilated left atria were found in the 200 cases with pure mitral stenosis.

It is evident from the foregoing that there is no single clinical or laboratory procedure that will predict the predominance of mitral insufficiency over mitral stenosis. Rather, it is a matter of integrating the historical and laboratory features of each patient.

**SUMARIO ESPAÑOL**

Un repaso de 200 casos consecutivos operados de estenosis mitral pura y 47 casos operados consecutivos de estenosis mitral asociada con insuficiencia mitral indica que la evaluación cuidadosa del historial, los hallazgos auscultatorios, electrocardiograma y fluoroscopía permiten el diagnóstico correcto de insuficiencia asociada en la mayoría de los casos. La historia y la auscultación persisten como los medios más valiosos para el internista no obstante el gran número de aún poco evaluadas medidas mecánicas.

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