Transventricular Mitral Valvotomy

By Frank Gerbode, M.D.

In the rediscovery period of mitral surgery, beginning with the efforts of Harken and associates\(^1\) and Bailey\(^2,3\) it was clearly demonstrated that even a moderate increase in the size of the mitral orifice would improve the physiologic status of the patient considerably. However, as time went on it was apparent that finger fracture alone was not sufficient for many badly scarred and calcified valves. This observation led to the use of various types of knife and other devices to increase the valve orifice and to obtain some degree of mobility. Historically, instrumental means to open the valve were thought an essential approach to the solution of valve stenosis.\(^4,5\) Thus, in 1912, Schepelmann\(^6\) used the transventricular approach to cut the mitral valve in experimental animals. The first successful human operation for the relief of mitral stenosis was performed through the left ventricle by Cutler in 1923, an attempt having been made to incise the valve blindly with a tenotome.\(^7\) A few years later Souttar\(^8\) definitely demonstrated the feasibility and safety of finger fracture valvotomy. The belief that it was necessary to accept a degree of insufficiency in the effort to relieve the stenosis through instrumental means was questioned by Geoffrey Bourne in 1927,\(^9\) who emphasized that, if possible, extending the commissures was preferable to an incision into a valve cusp.

In more recent history, Smithy, in 1948,\(^10\) employed the transventricular approach with success in several patients, although regurgitation was still accepted by him as a necessary aftermath of the operation. DuBost and co-workers\(^11\) introduced instrumental transatrial valvotomy, a blind operation that was done without simultaneous digital control. This definitely established the principle of opening the commissures by applying force in 2 opposite directions in an effort to obtain a good split of both anterior and posterior commissures.

Our own interest in the transventricular approach was stimulated by the work of Andrew Logan, of Edinburgh, and Oswald Tubbs, of London, both of whom have used transventricular valvotomy for some time. Our present approach is to make the conventional left lateral thoracotomy over the upper margin of the fifth rib, entering the fourth interspace. At times it has been necessary to cut the fifth rib anteriorly to gain access to the apex of the left ventricle. The pericardium is opened either anterior or posterior to the phrenic nerve, depending upon the amount of space available. A purse-string suture is placed around the base of the atrial appendage, but is not held with a tourniquet, for we have found that this not infrequently will result in cutting through the atrial wall, causing leakage; the operator usually holds the purse-string suture with his left hand. The valve is first palpated and efforts are made to open it digitally, for if a satisfactory valvotomy can be performed the transventricular approach is not used. However, if it is necessary to open the commissures more forcibly, we place a purse-string suture in the apex of the left ventricle in an area that is not supplied by large coronary arteries (fig. 1). A small rubber bolster is placed over the loop of the purse-string or mattress suture, so that in tightening it a cutting action will not result in the avulsion of ventricular wall. A small wound is made, and the instrument is passed into the chamber, where it is then guided through the orifice of the mitral valve with the right index finger in the left atrium.

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563
The instrument is passed through a small stab wound in the apex of the left ventricle. The small rubber bolster is used to prevent a cutting action from the apical suture. A screw in the handle can be regulated by the thumb to control the amount the blades may be opened.

The instrument* has a screw-lock in a convenient place on the handle, so that it can be opened gradually with the thumb as the blades are widened inside the heart. This is an added safety factor, for it will not allow the blades to spring apart maximally until the surgeon is ready for them to do so. The maximum spread is 5 cm. The instrument then is finally removed from the ventricle and the purse string is held by an assistant while a number of interrupted sutures are placed to close the stab wound, after which the purse string is removed. The purse string in the atrial appendage is simply tied as the index finger is withdrawn from the left atrium. The atrial appendage is oversewn with 000 silk.

The use of this instrument in the majority of the operations since 1955 has not resulted in any severe instances of mitral regurgitation. There are occasional patients who will develop slight mitral regurgitation as a consequence of opening the valve widely, but this has not impaired their recovery, and there is no question in our minds that the more forceful splitting of the commissures has resulted in better mobility of the valve leaflets and a larger aperture.

In the past 200 operations upon the mitral valve with blind technics the operative mortality rate was 12.5 per cent. All the mortality rate can be accounted for by poor-risk patients, all of whom were in group III or IV. There have been no deaths in group-II patients, and very few group-I patients have been operated upon. In the last few years an increasing number of bad-risk patients have come to operation. Many of these had apical systolic murmurs and were formerly thought to have mitral insufficiency, but on more careful study have been shown to have had mainly tricuspid insufficiency associated with marked pulmonary hypertension. There have been 3 deaths from cerebral emboli, and it is an interesting fact that none of these emboli occurred during operation, but rather during the period following operation while the patients were in either the recovery room or ward.

Of special significance in patients with severe mitral stenosis is the anesthesia requirement. The services of an expert anesthesiologist are of primary importance. A technic for minimizing the amount of anesthetic agent has been developed by Bailey and associates in which virtually no drug save Demerol is given during the major part of the operation, the patient meanwhile being maintained on 100 per cent oxygen until closure of the skin is started, when nitrous oxide is used. Such patients are semiconscious and can respond to commands during the cardiac portion of the operation.

Worthy of comment is our experience with operating upon 17 patients who had had a

previous mitral valvotomy in our hospital or by others. There were 2 postoperative deaths among the 17 patients, which is an indication that a second operation upon the mitral valve, done with the blind technic, is no more dangerous than the original one. One other patient has died from a vascular accident 3 years following a second operation. The average elapsed time between operations was 4 years and it is noteworthy that the majority of these procedures were done in the first 2 years following the introduction of mitral surgery. This is an indication that in many instances the operation was an inadequate one because of either severe fibrosis or calcification, or because the operator had not used more forceful means to obtain mobility and an adequate orifice.

The technic employed in second operations was to re-open the wound through the previous thoracotomy incision, which in most instances was a fourth-or-fifth-rib posterolateral or anterior thoracotomy. The incision was converted into a lateral thoracotomy. Only the portion of the lung that was adherent to the wound edges was separated sufficiently to permit the introduction of the rib spreader. Anteriorly the lung was separated from the pericardium, which was then gradually dissected free from the myocardium. In most instances this procedure required sharp dissection, but it was always possible to find a plane between the attached pericardium and the myocardium, and furthermore it was always possible to identify enough surface anatomy to avoid becoming involved with the major coronary circulation. One of the important steps in the dissection of the left atrium that has previously been entered for mitral surgery is the separation of the atrial wall from the inferior margin of the pulmonary artery. This separation must be carried well posteriorly, so that an adequate portion of the atrial wall can be made available for a purse-string suture (fig. 2). Usually the atrial appendage that has been tied is only a fibrous knob and, furthermore, the tissues surrounding it have become foreshortened from scar-

Figure 2

Exposure in second operations upon the mitral valve. A twisted wire is used for the purse string. It may be more advantageous to make a small stab wound through the atrial appendage scar, and follow it into the atrium with the index finger without using a clamp.

ring. It may be necessary to carry the dissection well below the upper margin of the superior pulmonary vein. When this has been done we have employed a twisted stainless-steel wire as a purse-string suture, using a tourniquet to control it. The circle encompassed by the purse string need not be very great, for it is usually possible to make a stab wound in the center of it, directly entering the atrial chamber, and this can then be enlarged with a finger as it passes into the atrium. We have ordinarily placed the purse-string suture in the apex of the left ventricle before entering the atrium, for the transventricular approach has been used in virtually all of the second operations we have done. The same technic for opening the valve as employed with first operations is used (fig. 1). We have, however, been rather determined in opening the valve as adequately as possible, even at the risk of causing some valvular insufficiency in these patients. Suffice it to say that although we
have created mitral insufficiency in some instances it has not been of such degree as to interfere with recovery. After the maximum fracture has been obtained, the index finger is withdrawn from the atrium as the wire purse-string suture is tightened. We then proceed with closure of the ventriculotomy incision and repair the atriotomy incision with a continuous suture of 000 silk. It is possible to remove the wire more easily by having a small suture looped in it as it is being placed, although probably no harm would come from leaving the wire.

It is currently being held by a number of surgeons that second operations on the mitral valve should be done with the aid of extracorporeal circulation. Although we have occasionally performed the open operation upon patients with predominant mitral stenosis complicated by other conditions, it is our impression that the open operation at the present time is not justified unless there is reason to believe that there are extensive thrombi in the atrium or associated mitral insufficiency of a significant degree. There are, of course, occasional patients who have combined tricuspid and mitral stenosis; these might reasonably be operated upon under extracorporeal circulation. Where the predominant lesion is mitral insufficiency we have, in favorable cases, operated with the aid of extracorporeal circulation. We are not convinced that direct vision is of very much aid in opening an extremely scarred and calcified valve. In fact, there are instances in which it is impossible to ascertain exactly where these commissures are, and it is likely that in the circumstances more insufficiency might be created.

The selection of patients for mitral valvotomy is almost entirely done on the basis of clinical findings with the aid of the roentgenogram and the electrocardiogram. Cardiac catheterization is only employed in dubious circumstances where other valvular disease or the degree of pulmonary hypertension seems worthy of evaluation. The operation is still performed ideally on patients in the younger age group, for although brilliant success can be attained from operations in those who are in their fifties or occasionally in their early sixties, the secondary effects of the stenosis will interfere with an outstanding result.

We have continued to use digitalis during the preoperative period in patients, even though it had not been used previously. More recently, in an attempt to convert those patients who have fibrillated before operation or who have fibrillated postoperatively, quinidine sulfate has been given, beginning a week to 10 days following the operation. Many such patients who have had an accurate valvotomy can be converted and will retain sinus rhythm subsequently. If this attempt at conversion is not successful it is tried again several months later.

Summary
In a consecutive series of 200 operations for relief of mitral stenosis, transventricular valvotomy was performed whenever digital valvotomy was found to be ineffective. The operative mortality was 12.5 per cent.

In a series of 17 second operations for mitral stenosis, the transventricular method was similarly used, with 2 operative deaths. A left lateral thoracotomy was employed, with re-entry through the left atrium.

The results of transventricular valvotomy were more satisfactory than when the usual commissurotomy through the left atrium was employed.

Summario in Interlingua
In un serie consecutive de 200 operationes pro le alleviamento de stenosis mitral, le technica del valvotomia transventricular esseva usate quandoocunque valvotomia digital se mostrava inefficace. Le mortalitate operatori in le serie total esseva 12,5 pro cento.

In un serie de 17 secunle operationes pro stenosis mitral, le technica transventricular esseva usate se-cundo le mesme principio. In iste serie il occurreva 2 mortes operatori. Thoracotomia sinistro-lateral esseva emplate, con re-entra in le atrio sinistre.

Le resultatos esseva plus satisfacente in le casos in que valvotomia transventricular esseva usate que in le casos trastate per le metodo usual de commissurotomy via le atrio sinistre.

References
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