Mural Leaflet Advancement for Free Mitral Valve Regurgitation Resulting from Dilatation of the Annulus*

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There is a wide variance in the destructive pathologic changes in the human mitral valve resulting from the ravages of rheumatic valvulitis. This study deals with the management of free mitral regurgitation in those patients in whom the size of the annulus of the valve is increased beyond the point where the septal leaflet can coapt with the mural leaflet in systole. Often elongation of the chordae tendinae of the septal leaflet results in overriding of this relatively redundant leaflet over the mural leaflet.

A review of 400 patients with heart disease who were subjected to total cardiopulmonary bypass at the University of Alberta Hospital in Edmonton since 1956 disclosed 75 patients operated on for disease of the mitral valve. Of these, 17 with pure mitral regurgitation resulting from dilatation of the annulus form the basis of this report. In the course of management of these patients, a technique of advancement of the mural leaflet by measurable points of suture placement, with predictable results in mitral valve function, has evolved.

Technique of Repair

Total cardiopulmonary bypass in all patients in this group was by means of gravity flow to a Kay-Cross oxygenator and return to the femoral artery by means of modified DeBakey Roller Pumps.** Caval venous cannulation was carried out through the right atrium in eight patients and from the outflow tract of the right ventricle in the last nine patients in the group. Flow rates were calculated at 2.4 liters/M² body surface and hypothermia to between 28 to 30° C. was used in 15 of the 17 patients. In four patients, elective cardiac arrest by aortic cross clamping was used for periods between 27 and 41 minutes. This has not been found necessary in the last 13 patients.

The pump was primed with heparinized blood in nine patients and with standard acid citrate glucose bank blood in the other eight cases. Total bypass time varied between 34 and 108 minutes, with an average of 61 minutes. An apical left ventricular vent attached to a Y tube for spill-over was used in the last 13 cases in this group.

The right-sided approach was employed in the first two, a midline sternotomy in six and a left anterior thoracotomy in the last nine patients in the series. In these last patients, the left shoulder was raised 15 to 20 degrees forward and in three of these patients an associated midline sternotomy up to the level of the sternal attachment of the first rib provided an increase in exposure needed because of marked cardiomegaly.

In Fig. 1 the details of the approach and the suture placement are depicted. Mural leaflet advancement with absolutely no encroachment on either the septal leaflet or its annulus is the basic feature of this repair.

Following a detailed anatomic study† in 13 normal hearts of the relations of the anterior and posterior commissures, certain measured limits of suture placement were developed. The left circumflex coronary
artery was found to be an average of 11.8 mm. above the anterior commissure and never nearer than 7 mm. However, the annulus averaged 4.4 mm. below the artery and occasionally as close as 2.0 mm. The horizontal distance of the left circumflex artery from the anterior commissure averaged 5.9 mm. and was occasionally as close as 3 mm. Since the attachment of the left coronary aortic leaflet was an average of 5.4 mm. to the septal leaflet side of the anterior commissure it was never in danger because of the strict avoidance of any stitch that encroached on this leaflet or its annulus. This stitch was found routinely to be safe if the needle entered tissue exactly at the anterior commissure and passed in an anterior direction and slightly to the left at a distance never greater than 2.0 mm. beyond the annulus itself. This resulted in a bite of tissue usually 6 mm. deep, which was adequate for strength.

The stitch in the region of the posterior commissure also has certain important anatomic considerations. In this area, the coronary sinus is an average of 11.0 mm. above the commissure and never closer than 6.0 mm. The stitch into the annulus here should not go beyond it as the coronary sinus is occasionally very closely associated, but is usually at least 3.0 mm. away. This stitch then should enter tissue at the posterior commissure and pass upward medially and slightly forward, grasping safely up to 6.0 mm. of tissue including the annulus.

As far as the bite into the mural leaflet is concerned, the distance between the sutures is of importance, but not their exact position on the circumference of the annulus. A distance of 2.5 cm. between them routinely results in an adequate mitral opening in diastole and in complete correction of the regurgitation when the stitches are tied down. For safety, each of these sutures of No. 1 strength silk is duplicated with a second suture of similar material.

**LEFT ATRIAL WALL EXCISION**

At the completion of the repair of the valve, as much of the left atrial wall as possible is resected. This varied from an area of 2.5 by 4.0 cm. to one of 9.0 by 6.0 cm.

**RESULTS**

Sixteen of the 17 patients survived operation, or a mortality rate of 5.9 per cent.
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Figure 2: Comparison of simultaneous left atrial and left ventricular pressure curves in two patients at the time of repair and at the completion of the placement of the stitches.

Fifteen of these patients were classified as having good to excellent anatomic correction and had similar clinical results. In one patient, a Grade II systolic murmur occurred in the first 24 hours, indicating disruption of one group of sutures, but the early clinical result was good, with marked decrease in the hyperdynamic left ventricular activity which had been present preoperatively.

Since all but one of these patients has been operated on in the past two years, it is too early to judge their final result. Excluding the one death in the series (Case 3), the first eight patients have maintained their improved status found at the six month follow-up examination.

Three of these patients have been catheterized at a follow-up examination and the wedge pressure has fallen in all three from the preoperative values. The mean values have fallen, respectively, from 23 to 11 mm., 27 to 12 mm. and 19 to 5 mm. Hg six months after repair.

The resulting orifice in the last nine cases was carefully assessed and varied between 2.8 by 2.0 cm. to 3.5 by 1.5 cm. in diastole after the repair, and in none did an important gradient appear across the valve at the time of pressure studies. Figure 2 demonstrates the hemodynamic status resulting from this repair in two patients.

Radiographic changes indicated diminution in cardiac silhouette in all cases varying from slight but definite to dramatic changes as shown in Fig. 3 (Case 14) 24 hours after surgery and Fig. 4 (Case 8) six months after surgery. Figure 5 shows comparison films taken slightly more than one year after repair.

DISCUSSION

It is appreciated that dilatation of the annulus represents probably the purest deformity of the mitral valve brought to the attention of the cardiac surgeon. Because of its curability, a planned and measurable technical approach to suture replacement is important.

Many different concepts in the repair of this lesion have been described in the literature.

A left-sided approach somewhat modified from that described by Clowes et al. has been employed in the last half of the series and this has so far proved quite satisfactory.

The pioneer work of Scott et al., Merendino et al., and Lillehei has opened the door to the management of this lesion. However, with the simple cross plication described in these reports, the resulting orifice in the hands of this author, in an
earlier series, was often stenotic or the regurgitation was incompletely corrected. This also resulted with the subvalvular roll described by Lillehei, and this form of repair was abandoned. Occasionally an excellent result was obtained with each of these above described techniques, as well as with the Teflon ring repair of Kay et al. J. H. Kay et al. described similar suture placement and adhered to the principle of

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**Figure 3:** Comparison between preoperative roentgenogram of a 44-year-old patient subjected to mural leaflet advancement with the roentgenogram 24 hours following surgery. A large amount of left atrium was removed at the time of surgery which contributed to the early diminution in cardiac silhouette.

**Figure 4:** Comparison between preoperative film in a 40-year-old patient subjected to mural leaflet advancement for ruptured chordus tendinum compared with the six month followup film is demonstrated. The patient is symptom-free and is engaged in a busy life as a carpenter.
Figure 5: One-year postoperative followup film of a 44-year-old woman subjected to mural leaflet advancement compared to preoperative film. The patient was moribund at the time of surgery, requiring preoperative tracheostomy because of severe ventilatory change. At the present time, the patient is approaching the second anniversary of her operation and is maintaining dramatic clinical improvement.

Avoidance of encroachment on the annulus of the septal leaflet of the mitral valve. Morris et al. support the safer placement of stitches in the mitral annulus in the region of the commissures.

Summary

A technique of suture placement has been described for the advancement of the mural leaflet of the mitral valve in free regurgitation, resulting from dilatation of the annulus.

The anatomy of the commissures providing safe suture placement has been described.

Sixteen of 17 patients operated on in this series have survived, yielding a mortality rate of 5.9 per cent.

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References


