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Mitral Valve Repair with Autologous Pericardial Ring: An Early Result

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Abstract **Mitral valve annuloplasty has an important role for a long-term stability of mitral valve repair. Several techniques have been used for this purpose. In this study, we would like to review our result of using autologous pericardial ring for posterior annuloplasty in mitral valve repair.**

Between October 1997 and August 1998, a total of 39 patients underwent mitral valve repair using autologous pericardial ring for posterior annuloplasty at Central Chest Hospital. There were 26 males and 13 females. Their ages ranged from 17 to 71 years old with a mean age of 44.3 years. Follow-ups ranged from 1-11 months with a mean of 5.1 months. The majority of them were caused by rheumatic disease (19). Other causes included degenerative disease (11), infective endocarditis (3), ischemic heart disease (4) and congenital disease (2). Isolated mitral valve repair was done on 20 patients, one as a redo-mitral valve repair. Other associated operations were aortic valve replacement with autologous pericardium (4), aortic valve replacement (2), aortic valve repair (2), aortic valve replacement with pulmonary autograft (1), tricuspid valve repair (5), coronary artery bypass grafting (4), and closure of ventricular septal defects (1). The most commonly used surgical procedures were posterior annuloplasty, resection of secondary chordae, and suture annuloplasty. The average mitral valve repair procedures per patient in this study were 4.43. There was one hospital mortality due to acute respiratory tract problem. There was no thromboembolic complication or reoperation. The functional status as well as the degree of mitral regurgitation improved substantially after the operation. In conclusion, the use of autologous pericardial ring for posterior annuloplasty can be done safely as an alternative technique for mitral valve annuloplasty. Long-term follow-up is mandatory to assess the safety and durability of the technique.

Mitral valve repair has now become a preferred operation for patients with mitral valvular heart disease due to its several advantages over mitral valve replacement. To achieve this, mitral annuloplasty has an important role for a long-term stability of mitral valve repair. Several techniques have been used with good long-term results. In this study, we would like to review our early experience of using autologous pericardial ring for posterior annuloplasty in our patients with mitral valve repair at Central Chest Hospital.

Materials and Methods

Between October 1997 and August 1998, a total of 39 patients underwent mitral valve repair using autologous pericardial ring for posterior annuloplasty at our institution. Of these patients, 26 were males and

Table 1 Preoperative diagnosis in 39 patients underwent mitral valve repair with autologous pericardial ring.

Diagnosis	No.
MR	15
MS	2
MR + AR	5
MR + IHD	4
MR + TR	2
MS + MR	3
MS, MR + AR	2
Restenosis MS + MR	2
MR + AS	1
MR + VSD	1
MS + AS	1
MS, MR + TR	1
Total	**39**

MS = Mitral stenosis
MR = Mitral Regurgitation
AS = Aortic Stensosi
AR = Aortic Regurgitation
TR = Tricuspid Regurgitation
VSD = Ventricular Septal Defect
IHD = Ischmic Heart Disease

Table 2 Surgical findings of the pathology involving mitral valve

Prolapse of AML	14
Prolapse of PML	8
Prolapse of AML + PML	3
Elongation of chordae	22
Leaflet thickening	17
Shortened chordae	13
Chordal fusion	14
Ruptured chordac	14
Annular dilatation	14
Commissural fusion	11
Calcification of leaflet	6
PML Cleft	4
Vegetation	3
Miscellaneous	2

AML = Anterior Mitral Leaflet
PML = Posterior mitral Leaflet

13 females. Their ages ranged from 17 to 71 years old with the mean age of 44.3 years. Follow-up was completed in every patient with the mean of 5.1 months (range from 1 to 11 months). The majority of the cases were caused by rheumatic disease which accounted for 19 patients. Other causes included degenerative disease (11), infective endocarditis (3), ischemic heart disease (4) and congenital heart disease (2). Preoperative diagnoses of the paitents were shown in Table 1. Preoperatively, 15 of the patients were in New York Heart Association (NYHA) functional class II, 20 in class III and 4 in class IV. All of the patients had echocardiographic evaluation by cardiologists during preoperative and post-operative periods at intervals.

Surgical Techniques

A median sternotomy was performed on all patients, and cardiopulmonary bypass was instituted with moderate hypothermia (28°-30°C) and cold blood cardioplegia. Warm blood terminal reperfusion was given prior to aortic declamping. Myocardial protection was achieved by moderate hypothermia, cooling down to 28°-30 °C, and cold blood cardioplegia given either antegradely or retrogradely every 25-30 minutes. The mitral valve was approached by using combined superior-transeptal approach.

Abnormal surgical findings of the mitral valve were mostly those of rheumatic disease, i.e. leafelt thickening (17), chordal fusion (14), shortened chordae (13). In addition to these, other pathological findings that caused valve incompetency were prolapse of anterior mitral leaflet (14), prolapse of posterior leaflet (18) and of both leaflets (3). The details of the surgical findings were shown in Table 2. Operations included isolated mitral valve repair (19), mitral valve repair and aortic valve replacement with autologous pericardium (4), combined mitral and tricuspid valve repair (5) and other operations as shown in Table 3. All of the patients needed multiple surgical procedures to accomplish the valve repair. The average numbers of surgical procedures used in our series were 4.2 per patient. The details of surgical procedures used were depicted in Table 4. The average bypass and aortic clamp time were 156.8 minutes and 116.9 minutes respectively.

The technique to create a pericardial ring was started by using Carpentier's valve ring sizer to measure the size of the valve ring to be made. The length of the posterior aspect of the sizer between the two

Table 3 Operations performed in 39 patients.

Operation	No.
MV	19
MV repair + AVR	2
MV repair + AVR with autologous pericardium	4
MV repair + AV repair	2
MV repair + TV repair	5
MV repair + CABG	4
MV repair + closure of VSD	1
Redo MV repair	1
MV repair + AVR with pulmonary autograft	1
Total	**39**

MV repair = Mitral Valve Repair
AV repair = Aortic Valve Repair
AVR = Aortic valve Replacement
TV repair = Tricuspid Valve Repair
CABG = Coronary Artery Bypass Grafting
Closure of VSD = Closure of Ventricular Septal Defect

Table 4 Surgical procedures required in operation.

Posterior annuloplasty with autologous pericardial ring	39
Suture annuloplasty	20
Resection of secondary chordae	9
Commissurotomy	11
Papillotomy	11
Chordal splitting	9
Neochordal implantation with PTFE	8
Quadrangular resection of MPL	12
Chordal transfer	6
Sliding plasty	8
Commissuroplasty	11
Flip over technique	4
Chordae shortening (cusp level)	4
Miscellaneous	16

PTFE = Polytetrafluoroethylene Suture
PML = Posterior Mitral Leafet

notches were carefully measured. A piece of autologous pericardium, about 0.8 cm wide, was cut according to this length. It was then treated briefly with 0.65% glutaraldehyde solution for 10 minutes and rinsed in 0.9% normal saline solution three times for five minutes each. Posterior annuloplasty was carried out with this pericardial ring with # 2-0 Ethibond using interrupted mattress suture technique. Mitral valve competency was tested periodically by flushing normal saline solution through the mitral valve. Trans-esophageal echocardiography was used routinely to assess the result of valve repair during the operation.

Results

There was one hospital death during this study due to the problem of respiratory failure which resulted in hospital mortality rate of 2.5 per cent. All of the survived patients improved substantially. Twenty-six of them were in NYHA functional class I and the other 12 patients were in class II, compared to the fact that 24 of the patients were in functional class III and IV before operation. The degree of mitral regurgitation (MR) also improved remarkably after surgery. Of the 35 patients who had a significant degree of MR during the preoperative period, only one patient was left with a moderate degree of regurgitation after the operation. The rest of the patients showed no regurgitation in 21 patients and mild degree (+1) of residual MR in the other 13 patients. This is in contrast to the preoperative period when 11 of the patients had +2 degree, 19 had +3 degree and 5 had +4 degree of MR. The mean mitral valve area (MVA) after valve repair was 2.31 cm^2. Assessment of the left ventricular end-diastolic and end-systolic diameter (LVEDD and LVESD) also showed improvement after operation. The average LVEDD and LVESD decreased from the average 62.26 cm to 53.8 cm and 42.58 cm to 39.26 cm after the surgery respectively. There was no thromboembolic or bleeding complication during this study. No patient required reoperation from the problem of valve repair or valve ring failure. However, complications occurred in 3 patients, i.e., wound infection (1), pericardial effusion (1) and pleural effusion (1). All of them responded well to conservative treatment.

Discussion

Mitral valve repair has now become a preferred operation for patients with mitral valvular heart disease. Its several advantages over mitral valve replacement has been confirmed by several studies[1-4]. To achieve this, the techniques used to correct the mitral valve defect must be precise and stable. Mitral annuloplasty has an important role for the long-term stability of the valve repair. Several techniques have

been developed for this purpose.[1,5,6] Our technique of using autologous pericardial ring for posterior annuloplasty in mitral valve repair is based on certain facts. First, it is usually the posterior part of the mitral annulus that dilates during the disease process, while the anterior aspect is stable. To correct only the diseased part is rational and allows surgeons to avoid the potential risk of damaging the aortic valve which lies in close proximity to the anterior part of the annulus. Second, the mitral annulus is a dynamic structure that changes its shape and size throughout the cardiac cycle.[7] Maintaining this dynamics is important for good left ventricular function as is clearly shown by the study of David et al.[8] The use of autologous pericardial ring for posterior annuloplasty is attractive because it provides correction of posterior annular dilatation while maintaining the flexibility of the annulus which has an important impact on left ventricular function. Good long-term result of mitral valve repair using posterior pericardial annuloplasty has been confirmed by the study of Scofani R, et al.[9] In order to ensure excellent results from the use of the pericardial ring, the end point of posterior annuloplasty must be accurate to optimize the valve coaptation without jeopardizing the mitral valve orifice. In addition to this, the reduction of the posterior annulus must be symmetrical so that the annulus will not be distorted after the repair. To reach for these goals, we carefully measure the length of the posterior aspect of the valve ring sizer between the commissures. This will be equal to the length of the pericardial ring to be made and will be the end point for the posterior annuloplasty. Symmetrical reduction is achieved by carefully placing the sutures along the posterior annulus. We usually start from both commissures first and follow by suture at the mid-point between both commissures. Additional sutures will be done symmetrically between these two halves. By doing so, based on our experience, symmetrical reduction of the posterior annulus can be ensured. We must also pay attention to prevent uncontrolled plication of the pericardial ring during tying the surgical knots, otherwise we will not be able to have accurate posterior annular reduction. Our technique is simple: by pulling the commissural suture and mid-point suture tightly when tying the knots, uncontrolled plication can usually be prevented. The use of this type of ring in our patients who underwent mitral valve repair had proved to be safe, effective and reproducible. Our early result is very encouraging with low hospital mortality rate, substantial improvement of functional status, stable valve repair and no thromboembolic and bleeding complication. In addition to these, because the valve ring is made up of autologous pericardium, it is cheap and readily available in almost all situations when it is needed.

In conclusion, the use of autologous pericardial ring for posterior annuloplasty should be considered as an alternative method of mitral annuloplasty in patients with mitral valve repair. However, because the number of patients and duration of follow-up in our series are limited, long-term follow-up is mandatory to assess the safety and durability of the technique.

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