

Operative Outcomes with Myxomatous Mitral Valve Repair: Experience with 586 Patients



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Introduction

American Heart Association (AHA) guidelines recommend mitral valve repair for myxomatous mitral regurgitation whenever possible to prevent LV dysfunction and early mortality. Here we review our early operative outcomes with mitral valve repair for myxomatous mitral regurgitation.

Methods

We collected data from 586 consecutive patients that underwent mitral repair for myxomatous disease at the Prince Henry and Prince of Wales Hospitals Sydney between 1997 and 2012. All patients had pre- and postoperative transthoracic echocardiograms.

Results

In the first 30 days postoperatively there were five deaths (0.9%), four strokes (0.7%) and five transient ischaemic attacks (TIAs) (0.9%). Repair involved resection in 55.5%, neochordal reconstruction in 41.6%, and in 2.9% a combination of both. There was increasing use of neochordae since 2006. At discharge 99% had mitral regurgitation (MR) \leq mild and \leq trivial in 79.5%. For posterior leaflet disease neochordae had improved MR at discharge compared with resection (85% vs 78%, $P < 0.05$). Preoperative tricuspid regurgitation (TR) and pulmonary hypertension $>$ mild were associated with a greater degree of MR at discharge ($P < 0.05$) for reasons that are unclear.

Conclusion

We have shown excellent early results for mitral repair with very low operative mortality and excellent freedom from significant MR. Successful mitral repairs with low morbidity have resulted in a pattern of early referral in keeping with the current guidelines.

Keywords

Mitral valve • Valve repair • Cardiac Surgery

Introduction

Myxomatous or degenerative mitral valve disease is the leading cause of leaflet prolapse and surgically correctable mitral regurgitation (MR) in the developed world [1,2]. The aetiology of this disease can be acquired, or congenital with inheritable

connective tissues disorders (Marfans, Ehlers-Danlos IV, Osteogenesis Imperfecta). The surgical description of the myxomatous valve describes a continuum of leaflet and chordal disease from Fibroelastic Deficiency, with thin leaflets and chordal rupture, to Barlow's Disease with grossly excessive and large leaflets causing bileaflet prolapse.

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Chronic severe MR causes volume overload of the left ventricle (LV) and if uncorrected results in LV dilatation and eventually systolic dysfunction. The regurgitant flow causes left atrial (LA) dilatation, atrial fibrillation (AF), and eventually pulmonary hypertension and right heart failure. If severe MR is left untreated it results in significant morbidity and early mortality [3].

Mitral valve repair techniques were pioneered by Alain Carpentier with a rigid annuloplasty ring in his publication the 'French Correction' [4], as well as the work by Carlos Duran [5]. The fundamental concepts of repair include: thorough valve analysis, leaflet reconstruction, remodelling annuloplasty, and assessment of repair. There are many techniques to correct the prolapsing leaflet, and in the last 10 years there has been a move away from the traditional posterior leaflet resection (quadrangular/slide) to leaflet preservation techniques with Gore-Tex neochordae.

Early referral for surgery has been associated with better outcomes for severe MR. The 2014 American Heart Association recommended mitral surgery for asymptomatic severe MR if the LV ejection fraction (LVEF) is less than 60% or the LV end-systolic diameter (LVESD) is over 40 mm (Class I recommendation) [6].

Mitral valve repair has been performed at the Prince Henry and now Prince of Wales Hospitals since the 1980's, initially by Dr David Newman using techniques pioneered by Carlos Duran. With reliable results obtained from repair, patients were then referred earlier, before the onset of LV dysfunction. The surgical team was supported by a busy echocardiography department, with early use of routine preoperative transoesophageal echocardiography (TOE) to ascertain the aetiology and reparability of the lesion.

We reviewed our early results with mitral valve repair over the last 15 years during the transition from resection to leaflet sparing techniques.

Methods

Following institutional ethics board approval we conducted a retrospective review of prospectively collected data using the Prince of Wales database, as well as operation reports, and echocardiograms. This review included all patients that underwent mitral valve repair for myxomatous disease at the Prince Henry and Prince of Wales Public and Private Hospitals from January 1997 to March 2012. All patients had a preoperative and pre-discharge transthoracic echocardiogram (TTE).

Statistics

Results are presented as the mean \pm standard deviation. Comparison between two groups of non-parametric data was obtained using the Chi-square test. Significance was set at $P < 0.05$.

Results

There were 586 consecutive patients that underwent mitral valve repair for myxomatous degeneration between 1997 and

2012 by five surgeons. Mean age was 65.9 ± 12.5 years and 422 were male (72%). Sternotomy was used in 97.1% and a small right anterior thoracotomy with femoral-femoral bypass in 2.9%. Mean cardiopulmonary bypass (CPB) and aortic cross clamp times were 121.1 ± 36.9 and 92.6 ± 0.1 minutes respectively. For isolated mitral valve surgery, CPB and aortic cross clamp times were 105.9 ± 31.5 and 82.1 ± 25.1 minutes respectively. Concomitant operations performed were: coronary artery bypass grafting (CABG) in 133 (22.7%), aortic valve replacement (AVR) in 30 (5.1%), AF ablation in 78 (13.3%), tricuspid valve repair (TVr) in 44 (7.5%), and mitral annular calcification (MAC) resection in 14 (2.4%). Forty patients (6.8%) had previously undergone cardiac surgery via sternotomy of which 20 (3.4%) had a previous failed mitral valve repair.

Preoperative TOE, as reported by an echocardiologist, identified the prolapse to be isolated to the posterior mitral leaflet (PML) in 69.1%, to the anterior mitral leaflet (AML) in 10.1% and bileaflet prolapse in 20.8%. The leaflet repair involved resection in 55.5%, neochordal reconstruction in 41.6% with some patients having a combination of both leaflet resection and neochords implanted. Figure 1 describes the predominant repair technique for isolated PML disease during the study timeframe with a shift from resection to neochords starting in 2006. In the last three years of the study neochordal reconstruction was the predominant technique. Other repair techniques used included commissural suture in 2% and cleft closure in 2.2%. An annuloplasty alone was used in 5.4% to correct the MR of which 50% were for PML prolapse and 47% for bileaflet prolapse.

Overall, 92.2% of patients had an annuloplasty performed and in the last five years this has reached 99% of all mitral repairs. Partial bands were used in 95.4% of which 87% were flexible and 13% semi-rigid, and complete rings were used in 4.6%. In the last three years there has been a trend towards the use of semi-rigid bands.

Adverse Outcomes

In the first 30 days postoperatively there were five deaths (0.9%): two had concomitant AVR and one had extensive MAC with debridement and pericardial patch reconstruction. The other two deaths were isolated mitral valve repairs in

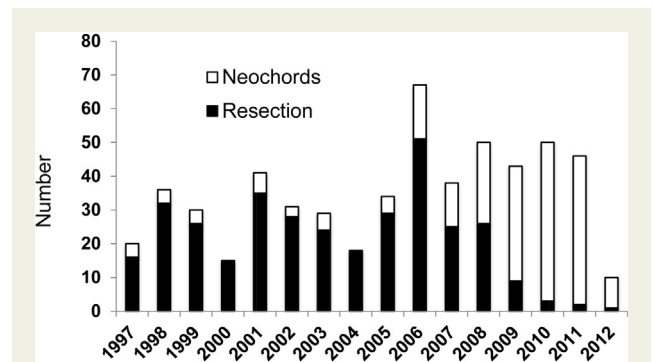


Figure 1 Repair technique for isolated posterior leaflet prolapse by year.

1998 and 1999, with no deaths from isolated repair since then. Four (0.7%) patients suffered a permanent stroke and five (0.9%) a transient ischaemic attack (TIA).

Echocardiographic Results

Table 1 shows the preoperative and immediate postoperative LV and mitral valve values from TTE. The majority of patients had normal or hyperdynamic LV function with a dilated LV. There were significant improvements in LV size, degree of TR and pulmonary hypertension. The discharge MR was \leq mild in 99% and \leq trivial in 79.5%.

We then looked at factors that contributed to the degree of MR at discharge. Figure 2 describes the factors in achieving a repair with nil or trivial MR at discharge. Neochordal reconstruction showed better early results than resection with discharge MR \leq trivial in 85% vs 78% ($p < 0.01$). Significant preoperative TR and pulmonary hypertension (pulmonary artery systolic pressure ≥ 40 mm Hg) were both associated with increased MR at discharge ($P < 0.001$). Left ventricular function, size, and preoperative AF were not significant factors in the early freedom from significant MR.

Table 1 Pre- and Postoperative Echocardiography

	Preop	Postop
LV function		
Normal/hyperdynamic	89.0%	78.4%
Mild impairment	8.9%	13.6%
Moderate or severe impairment	2.1%	8.0%
LV size		
Normal	31.2%	68.1%
TR \geq moderate	10.7%	3.2%
Pulm HTN \geq moderate	30.5%	8.8%
MR \leq mild		99.0%
MR \leq trivial		79.5%

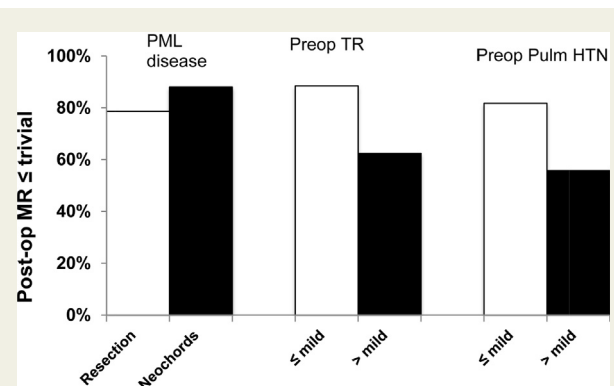


Figure 2 Significant factors ($P < 0.05$) in achieving an optimal mitral valve repair result as determined by nil/trivial MR at hospital discharge.

Discussion

Mitral valve repair for myxomatous disease aims to prevent regurgitation by creating a coaptation zone between the leaflets of about 10 mm. This can be done by correcting chordal abnormalities, controlling/removing excess posterior leaflet height, and maintaining the size and shape of the annulus with an annuloplasty ring.

Many techniques have been used since the original works of Carpentier [4] and Duran [5]. They involve variable degrees of leaflet resection, chordal reconstruction, and annuloplasty. Mitral valve repair has been performed at our institution since 1980, treating posterior leaflet disease with a quadrangular wedge resection and flexible annuloplasty band, as per Duran. Anterior leaflet repairs were initially done with chordal shortening techniques, with variable results, before changing to Gore-Tex neochords as established by David in 1989 [7].

Whilst results in our hands were good, even with extensive resections, there was concern about leaving insufficient leaflet tissue at times or that leaflet scarring occasionally caused haemolysis from an MR jet hitting the annuloplasty ring. Neochordal techniques to repair the posterior leaflet have gradually been adopted since 2006 with the shift in thinking from 'resect' to 'respect'. We initially used neochords to the posterior leaflet in Barlow's type valves to avoid extensive resections and sliding plasties. With improved confidence and good results we then used Gore-Tex neochordae in more limited posterior leaflet disease. We currently use a range of neochord techniques including preformed measured loops described by Mohr [8] as well as simple interrupted Gore-Tex neochords.

It is unclear from the literature as to which technique, resective or neochordal, offers the best long-term result. Carpentier's results with resection showed a 92% freedom from reoperation at 20 years in the initial phase of his repair series (1970–1984) [9]. David's large series of neochordal reconstruction had similar results with a 90% freedom from reoperation on the mitral valve at 18 years [10]. Mohr's group published a randomised trial leaflet resection vs neochords in 129 patients undergoing minimally invasive mitral repair for posterior leaflet prolapse [11]. At one year there was no significant difference in outcomes, however the neochord group had a significantly large area of coaptation (7.6 vs 5.9 mm) suggesting that neochords may be more durable in the long-term.

Our excellent early results reflect a number of factors: Early referral for surgery before the onset of significant LV dysfunction, routine preoperative TOE, frequent cardiologist support with intraoperative TOE, and confirmatory pre discharge TTE. The importance of preoperative assessment of valve morphology by TOE, particularly for the more complex pathologies, is critical for planning surgery and fully informing patients. Reliable intraoperative TOE is essential to assess repair, particularly if there is any residual MR, as precise identification of any leak enables a second pump-run to correct residual MR to ensure the patient leaves the operating room with a reliable result.

We found that there was a significant improvement in LV size, pulmonary hypertension and TR at discharge reflecting our group of patients with predominantly preserved LV function. Interestingly, we have shown that preoperative TR and pulmonary hypertension were better predictors of a poor repair result than LV size or function, however, the basis for this remains unclear. Isolated posterior leaflet disease neochords were more likely to achieve an excellent result than resection, however we await the long-term results of these two very different techniques.

Conclusion

We have shown excellent early results for mitral valve repair in the current era with very low operative mortality and excellent freedom from significant MR. This was a broad patient group reflecting the referral patterns in the Australian community. This review forms the basis for our long-term follow-up which is currently under way. A high repair rate with low mortality or morbidity has resulted in a pattern of early referral in keeping with the current guidelines.

Disclosures

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