Rheumatic Mitral Valve Repair : Experience of 221 Cases from Central Chest Institute of Thailand

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Rheumatic heart disease is a major problem in Thailand and this region. Surgical management is still a dilemma and problematic. Current understanding of mitral valve complex and its dynamics in combination with improvement of surgical techniques allow surgeon to repair rheumatic mitral valve disease better. Several innovative approaches have been introduced recently and greatly enhances the success of mitral valve repair in this clinical entity. This case report reviews the authors' current approaches and results in the repair of rheumatic mitral valve at Central Chest Institute of Thailand.

Keywords: *Rheumatic heart disease mitral valve repair*

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Rheumatic heart disease remains a major problem in Thailand and most countries in this region. During the last four decades, mitral valve repair has become the preferred operation over mitral valve replacement[1]. However, in rheumatic mitral disease, its role is still doubtful. This is due to the fact that rheumatic mitral pathology is usually complex from extensive involvement of mitral valve by rheumatic process. This, in one hand, renders mitral valve more difficult to repair. On the other hand, however, rheumatic patients are frequently young, female and live in rural areas. Many of them are from a poor socioeconomic class with significant problem of compliance to medication, a key problems for optimal anticoagulation therapy in cases with mechanical valve replacement. All of these factors make surgical treatment of rheumatic mitral disease a dilemma as well as problematic for cardiac surgeons.

The present case report aimed to review the authors' current approaches and techniques in dealing with rheumatic mitral valve repair at our institution.

Material and Method

Surgical cases of rheumatic mitral valve repair of a single surgeon, the author, were reviewed retrospectively through patients' record. Data collection was done to include pertinent information of pre-operative status, diagnosis and echocardiography findings. Details of operative findings and surgical procedures were carefully delineated for analysis of the present study. Intra-operative transesophageal echocardiography was routinely done by a single anesthesiologist. Post-operative echocardiography was usually assessed before discharge, 3 months and 6 months after discharge from hospital by cardiologists. Follow-up was done by the same group of cardiac surgeons at intervals. Date was summarized and presented in the form frequency (%) tables. Descriptive statistics in terms of mean, standard deviation, frequency and percentage.

Results

Based on the authors' current approaches, rheumatic mitral valve repair has been successfully performed in a total of 221 cases between March 2003 to June 2011 at Central Chest Institute of Thailand. There were 80 males and 141 females with the average age of 44.52 years. Mean follow-up was 35.9 months. Details of operations and surgical techniques are shown in Table 1 and 2 respectively. The type of valve ring used for annuloplasty is depicted in Table 3. There were 6 hospital mortalities (2.71%). Re-operation was required in 4 patients, 2 from technical errors with rupture of suture. Re-repair was carried out successfully without incidence. The other 2 needed mitral valve replacement due to progression of disease. No hospital

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Table 1. Operations (n = 221 Cases)

	n (%)
MV repair	96 (43.4)
MV repair + TV repair	48 (21.7)
MV repair + Maze	33 (14.9)
MV repair + TV repair + Maze	22 (10.0)
MV repair + AVR	8 (3.6)
MV repair + CABG	4 (1.8)
MV repair + AVR + TV repair	3 (1.4)
MV repair + AVR + TV repair + Maze	2 (0.9)
MV repair + other	5 (2.3)
Average bypass time	119.54 minutes
Average clamp time	96.93 minutes

Table 2. Surgical techniques (n = 221)

	n (%)
21 Mitral annuloplasty	218 (98.6)
14 Resection of 2^0 Chordae	143 (54.7)
18 Papillotomy	110 (49.8)
17 Commissurotomy	99 (44.8)
01 Goretex to AML,PML	96 (43.4)
22 Other	89 (40.3)
15 Chordae splitting	79 (35.7)
06 Commisuroplasty	60 (27.1)
08 Clordae Transfer	26 (11.8)
07 Plication of Leaflet (AML,PML)	25 (11.3)
10 Leaflet reconstruction with autologous pericardium to AML	24 (10.8)
05 Sliding plasty	23 (10.4)
11 Leaflet reconstruction with autologous pericardium to PML	17 (7.7)
16 Chordae shortening	16 (7.2)
09 Chordae Transfer	9 (4.0)
12 Leaflef extension with autologous pericardium to AML	9 (4.0)
Other	16 (7.2)

mortality occurred among these patients. Re-admission was required in 38 patients mostly from post-cardiotomy syndrome (n = 18) which responded well with medical therapy. Other causes were congestive heart failure (n = 11), coumadin overdose (n = 6), severe mitral regurgitation (n = 1), transient cerebrovascular accident (n = 1) that was fully recovered with conservative treatment and pleural effusion (n = 1). Postoperatively, the functional status of the successfully repaired patients improved substantially. The severity of mitral regurgitation as well as mitral valve function all markedly improved as shown by postoperative echocardiography (Table 4). So, with current approach , rheumatic mitral valve repair offered an gratifying midterm results.

Table 3. Types of prosthetic ring

	(n %)
Classic Carpentier-Edwards ring	188 (85.4)
Physio ring	11 (5.0)
Cosgrove band	7 (3.2)
Geoform ring	4 (1.8)
Autologous pericardium	4 (1.8)
Profile 3-D	3 (1.4)
Other	3 (1.4)

Table 4. Preoperative and postoperative echocardiography and NYHA Functional Class

	Preoperative	Postoperative
LVEDD	53.66 $\pm$ 10.430 mm	49.64 $\pm$ 11.310 mm
LVESD	36.73 $\pm$ 7.997 mm	35.19 $\pm$ 11.201 mm
EF	58.14 $\pm$ 10.101 %	57.29 $\pm$ 12.844 %
MR	2.34 $\pm$ 1.190	0.2 $\pm$ 0.594
MVA	1.77 $\pm$ 0.977 Cm^2	1.99 $\pm$ 0.867 Cm^2
Annulus	3.38 $\pm$ 0597 Cm	2.28 $\pm$ 0.325 Cm
TR	1.31 $\pm$ 1.113	0.2 $\pm$ 0.597
NYHA Class	2.4 $\pm$ 0.615	1.17 $\pm$ 0.410

Discussion

Excellent long term results of rheumatic mitral valve repair in 951 patients using Carpentier's techniques was reported by Chauvaud et al[2] with a maximal follow-up of 29 years (mean 12 years). The study showed a low hospital mortality (2%), actuarial survival at 10 and 20 years of 89 $\pm$ 19% and 82 $\pm$ 18% respectively with low rate of thromboembolic complication (0.4%/patient/year). Freedom from reoperation at 10 and 20 years was 82 $\pm$ 19% and 55 $\pm$ 5% respectively. The mean delay between surgery and time of reoperation was 9.3 years. Progression of mitral valve fibrosis was the most common cause of reoperation (83%). Kumar et al also reported his results in 898 rheumatic mitral valve repair patients[3]. Leaflet thinning was used (36%) along with other techniques. Excellent long term results were achieved with low rate of hospital mortality (2.4%). At 10 years, actuarial survival and reoperation free survival were 92 $\pm$ 1.1% and 81 $\pm$ 5.2% respectively. Freedom from moderate to severe mitral regurgitation was 32 $\pm$ 3.9%. The authors' results follows these studies with encouraging midterm results and can be summarized in details as the following :-

Current approaches of rheumatic mitral valve repair

Recent advances in rheumatic mitral valve repair stems from a better understanding of mitral valve and improvement of surgical techniques. Mitral valve is now better viewed as a complex that comprises of at least 6 components. These are atrium, annulus, leaflets, chords, papillary muscles and left ventricle. All of these structures work synchronously to achieve a maximal and least stressful function of mitral valve and thus make the valve most durable. Optimal mitral valve repair must be based on these fundamental to attain the most physiologic and excellent long-term function of the valve.

Although the principle of mitral valve repair is the same for both rheumatic and non-rheumatic valve disease. However, the valve pathology is significantly different and unique from the others. This demands different approaches and techniques to restore normality of the valve which can be described in detail as the following.

Mitral leaflets

In rheumatic heart disease, usually mitral leaflets are thickened, fibrosed or calcified from inflammatory process. The mobility and pliability of leaflets are greatly impaired and need to be corrected by appropriate measures. Leaflet thinning and augmentation with biological tissue, preferably autologous pericardium, will restore the normality of mitral leaflets. This is especially important in anterior leaflet which plays a vital role in normal mitral valve function. When calcification occurs due to prolonged dysfunction, it must be removed with or without repair by valve substitute depending on the size of the defect. It is of utmost importance that valve tissue must be adequate with good quality to assure optimal coaptation, a key for excellent long term results of mitral valve. Several studies have proved the effectiveness of this approach[4,5].

Subvalvular apparatus

The most common subvalvular pathology in rheumatic valvular heart disease is chordal shortening and fusion. The chords may be elongated or shortened and resulted in either type II or type III malfunction of leaflet motion. Elongated chords can be corrected by chordal shortening or chordal transfer, techniques deliberately described by Carpentier[1]. Shortened chords can be resected and replaced if necessary with normal native chords. It is quite often, however, that there is no appropriate native chords available. In this particular situation, neochordal replacement with polytetrafluoroethylene suture (PTFE) is advocated as a viable option that has yielded excellent results in various mitral valve pathologies[6-9]. Several techniques have proved to provide the correct length of the neochords which is crucial in this operation[10,11]. Recent studies have confirmed excellent long term structural and functional outlook of these synthetic chords[7,12].

Annulus

The annulus in rheumatic disease may be dilated, fibrosed and deformed or both. Mitral annuloplasty with prosthetic ring has become an integral part of mitral valve repair. The ring will provide better long term results compared to those cases without the ring. Although annular dynamics is correlated closely to left ventricular function and surgeons should try their best to preserve this dynamics. However, it is not uncommon that rheumatic patients arrive at the late state of disease with severely deformed and fixed annulus. It is obvious that the annular dynamics has long been badly disturbed and the main purpose of the ring is to restore normal physiologic framework of the mitral valve so that leaflets can function normally. Rigid complete ring has its role in this situation. A complete semi-rigid ring that preserves mobility of posterior annulus is an alternative option. The use of flexible posterior prosthetic or pericardial band are infrequently used in rheumatic heart patients. Role of a biological degradable ring has been advocated in children to comply with their potential growth of the annulus. However, this still needs close follow-up in long term[3,13].

Associated problems

Tricuspid regurgitation

Management of associated tricuspid regurgitation in patients with mitral valve disease is often controversial. Many believe that this is secondary to the left sided mitral problem, so called functional tricuspid regurgitation and will resolve spontaneously after correction of the left sided problem. Dreyfus[14], on the other hand, suggested that once the tricuspid is dilated to a certain extent it becomes pathologic and will not resolve spontaneously unless surgical measures with tricuspid annuloplasty are performed. He advocated an annular diameter of 7 cm under cardioplegia as an indicator for tricuspid valve repair, whereas, others advised 4cm. measured by echocardiography as a cut-off point. Recent several long term

studies[15-17] have demonstrated that tricuspid annuloplasty with prosthetic ring offers a better long term outcome compared to those without the ring.

Aortic valve disease

Despite good results in isolated mitral valve disease, the role of mitral valve repair in the setting of double valve disease of aortic and mitral valve is still questionable. Gillinov et al[18] has shown better 15 years survival in all subsets of patients (rheumatic, non rheumatic and including severe mitral stenosis). Freedom from valve replacement in rheumatic mitral valve repair group was 75% at 15 years. It was advocated that mitral valve repair in this situation is feasible and offers a better long term survival. This is supported further by a study from Ho et al[19]. Mitral valve repair is thus a preferred operation when it is feasible in patients with combined aortic and mitral valve disease.

Valvular atrial fibrillation

Atrial fibrillation is a common associated problem in patients with rheumatic mitral valve disease. Preoperative persistence of atrial fibrillation has been shown to be associated with increased late cardiac event and stroke[20]. Concomitant atrial fibrillation surgery is thus advised to reduce these risks. Cox[21] advocated "cut and sew" approaches to treat this problem in the early days. Although it was effective, this approach poses several limitations, namely, its complexity and potential risk of complications *e.g.* bleeding, heart block or sinus arrest etc. This makes surgeons reluctant to add this form of surgery as a routine in patients associated with atrial fibrillation[22]. Advances in development of alternative energy sources, *i.e.*, radiofrequency, cryosurgery or microwave have made this operation more user friendly and appealing in terms of safety and efficacy[23,24].

Surgical techniques

Although most of rheumatic mitral valve lesion can be treated using classical mitral valve repair techniques, however, several innovative approaches have been introduced to cope with more challenging pathologies in recent years with gratifying results. These techniques will be discussed in detail.

Leaflet problem

Most common leaflet problems in rheumatic mitral disease are thickening, retraction and calcification. All of these lesions impair leaflets' pliability and restrict mitral valve opening. Several techniques have been introduced to solve this malfunction.

Leaflet thinning

Kumar[25] advocated peeling of the thickened layer of mitral leaflets in rheumatic heart disease. The aim is to restore pliability of the leaflets and allow them to function better. The technique usually starts by blunt dissection at the annular leaflet junction. Once the cleavage plane is found, the thickened layer can be peeled to the leaflet margin and cut. If the cleavage plane appears to be densed and fused, more severe fibrosis can be anticipated and different approaches like leaflet augmentation or replacement with pericardium may be neccessary. Several studies confirmed the efficacy of this approach[26,27].

Leaflet augmentation and reconstruction

When mitral leaflets are severely affected by firbrosis, retraction or calcification, the valve function will be jeopardized unless these lesions are handled properly. The authors'current approach is to add or reconstruct leaflets to restore leaflet anatomy as well as quality of the leaflets with valve substitute. The authors' preferred valve substitutes are autologous pericardiumfor valve reconstruction and PTFE suture for chordal replacement. Khoury[26] advocated autologous tricuspid valve tissue as leaflet substitute. The authors'preference for autologous pericardium is based on its readily availability and absence of negative physiologic consequences. The pericardium usually is treated briefly with 0.65% glutaraldehyde solution for 10 minues and rinsed in normal saline solution 2 minutes for 3 times. Augmentation of leaflet is usually advocated when leaflet is retracted and reduced in size. When leaflet is more severely affected with fibrosis or calcification, total leaflet reconstruction to restore both normal size and quality of leaflet is necessary for optimal mitral valve repair. The authors reserve this aggressive approach for those patients who are young, females who need pregnancy, poor drug compliance and anyone who is contraindicated for long term anticoagulation therapy. Otherwise, mitral valve replacement with appropriate prosthetic valve will be an acceptable alternative treatment.

Subvalvular problem

The most common subvalvular pathology in rheumatic mitral valve disease is chordal thickening and fusion. The thickened chords may be shortened or elongated. This means the pathology in rheumatic

disease can be varied and complex. It may result in type II or II or combined in any area of the valve. Surgeons must have a clear picture of this situation and pay utmost attention in valve analysis to gain thorough understanding of valve problem.

When the valve is restrictive from subvalvular problem, this malfunction usually can be treated by classical techniques of resection of shortened chords, chordal splitting, papillotomy or fenestration. The aim is to render the valve apparatus more mobile and move freely. Surgeons should not be reluctant to cut even a shortened primary chord if necessary. The leaflet motion can be restored back to normal either by native chordal transfer or PTFE chordal replacement. When the valve motion is type II from elongated chords, chordal shortening, chordal transfer or PTFE chordal replacement usually will resolve the problem depending on the real situation intraoperatively.

Annular problem

Common annular pathology in rheumatic mitral disease are either posterior dilation, severe fibrosis and deformity or combined lesions. Mitral annuloplasty with prosthetic ring has become an integral part of mitral valve repair and provide better long term results when compared to those cases without using the ring. Because most of the annulus in rheumatic cases are thickened, rigid and deformed, a rigid ring has its role in remodeling the annulus back to its physiologic shape and allow the leaflet to open and close effectively. The mobility of annulus in such cases, in fact, have long been lost and as such there is no negative effect on left ventricular function as far as annular dynamic are concerned. Partial flexible band or pericardial strip are seldom used in rheumatic disease except for young patients or small annulus. The role of biodegradable ring advocated by Kalangos[3,13] in young rheumatic patients,although attractive, remains uncertain and needs long term follow-up.

Based on these evidences, rheumatic mitral valve repair provides a viable option for the treatment of rheumatic mitral valve disease especially in our region and many countries where patients' factor and health care system are still suboptimal. Long term follow-up and better refinement of the techniques are mandatory to answer the definite role of this approach in rheumatic mitral valve repair.

Conclusion

Rheumatic mitral valve disease is still a major health problem in this region and many parts of the world. Although the valve pathologies are complex and more difficult to repair, recent advances in surgical techniques and better understanding of mitral valve allow surgeons to achieve a higher rate of repair with excellent results. Despite concern of reoperation, the long term advantages of repair offset the need for secondary operation.

Potential conflicts of interest

None.

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การผ่าตัดซ่อมลิ้นหัวใจไมตรัลจากโรครูมาติก: ประสบการณ์คนไข้ 221 ราย จากสถาบันโรคทรวงอก

ทวีศักดิ์ โชติวัฒนพงษ์, ปิยะวัชร เลิศสมบูรณ์, วิพรรณ สังคหะพงศ์

โรคลิ้นหัวใจรูมาติก เป็นโรคหัวใจที่มีความสำคัญของประเทศไทยและในภูมิภาคนี้ การรักษาโดยการผ่าตัดยังคงเป็นปัญหาที่สำคัญ ในเรื่องของการใช้วิธีไหนซึ่งจะได้ผลดีที่สุด ความเข้าใจในปัจจุบันเกี่ยวกับลิ้นหัวใจไมตรัลและการทำงานของลิ้นหัวใจตลอดจนความก้าวหน้าของเทคนิคในการผ่าตัดได้มีส่วนช่วยทำให้ศัลยแพทย์สามารถทำการผ่าตัดซ่อมลิ้นหัวใจไมตรัลจากโรครูมาติกได้มากขึ้น แนวการสมัยใหม่ในการจัดการโรคนี้ได้มีส่วนอย่างมากคือการผ่าตัดซ่อมแซมลิ้นหัวใจไมตรัลในผู้ป่วยจากโรคนี้ บทรายงานสรุปนี้ได้สรุปและวิเคราะห์ผลการรักษาคนไข้จำนวน 221 ราย ที่ได้อาศัยแนวทางและเทคนิคของการผ่าตัดใหม่ในการผ่าตัดลิ้นหัวใจไมตรัลในสถาบันโรคทรวงอก