

Mitral Valve Repair in Children with Mitral Insufficiency Using Single Simple Technique

Ihab Mohamed Salah Eldin Elsharkawy*¹, Hosam Fathy Ali Sayed¹,
Mahmoud M. Elwakeel², Ahmed H. Lamloom¹

Departments of ¹Cardiothoracic Surgery and ²Anesthesia Faculty of Medicine, Cairo University, Egypt
*Corresponding author: Ihab Elsharkawy, Mobile: (+20) 0122222213, E-Mail: bebosharkawy@gmail.com

ABSTRACT

Background: The multifactorial nature of pathologies causing mitral valve insufficiency in children along with the anticipated child's growth make mitral valve repair in such age group a complex procedure. The main cardiac surgeon's consideration in repairing insufficient mitral valve is to restore the valve's geometry and motility using the simplest possible technique.

Objective: This study assessed mid-term feasibility and durability of mitral posterior annuloplasty using pericardial patch in patients aged less than 18 years as a simple technique of mitral valve repair.

Patients and Methods: Data from Cairo University Hospitals on total number of 100 children who underwent successful mitral valve repair (without need for valve replacement) were gathered from their records, including postoperative and follow-up echocardiographic studies.

Results: there were no in-hospital mortalities nor early postoperative significant mitral regurgitation (MR). Follow-up echocardiographic studies revealed moderate mitral regurgitation in 8 patients (8%) and only one patient (1%) required re-operation for severe mitral regurgitation where mitral valve replacement (MVR) was done.

Conclusion: MV repair (MVR) in children using pericardial patch for posterior annuloplasty showed excellent survival, acceptable re-operation rate and satisfactory valve function at short and mid-term follow-up.

Keywords: Mitral valve repair, Posterior annuloplasty, Pericardial Patch and para-valvular leakage.

INTRODUCTION

Mitral valve replacement (MVR) in children has several drawbacks and is linked to a high mortality ranging between 10 to 36% ⁽¹⁾. Additionally, the need for prolonged anticoagulant medications and the likelihood of repeat MVR as the kid gets older are associated with greater morbidity ⁽²⁾. Thus, whenever possible, mitral valve repair is preferred over replacement especially in pediatric populations⁽³⁾.

Over the past two decades, many mid- and long-term publications have reported that pediatric patients can infer the same benefits from mitral valve repair as grown-ups with respect to preserving valvular tissue, sub valvular apparatus, and ventricular geometry, driving to ideal valve and ventricular dynamics ⁽³⁻⁶⁾. For best results of repair in children, cardiac surgeon has to minimize tissue handling and avoid usage of any synthetic materials including mitral rings as mismatches between the native annulus and the mitral prosthesis have been linked to both early and late mortality ^(7,8).

AIM OF THE STUDY

We aim to assess whether the use of a strip of the patient's own pericardium for mitral posterior annuloplasty is feasible and durable as a simple MVR technique in children with leaky mitral valves.

PATIENTS AND METHODS

This descriptive, retrospective, and record analysis study included 100 patients who underwent isolated surgical MVR carried out in the Department of Cardiothoracic Surgery, Faculty of Medicine, Cairo University in the period from January 2015 to December 2021 aimed to assess the effectiveness of posterior mitral annuloplasty using pericardial strip.

Inclusion criteria: Patients between the ages of 1 and 18 years who have a significantly regurgitant mitral valve as shown by a preoperative echocardiographic scan and clinical signs of pulmonary congestion despite maximal drug therapy.

Exclusion criteria: Patients with complex congenital heart anomalies, atrioventricular septal defects, atrioventricular discordance, and those with bad preoperative condition including high inotropic support and mechanical ventilation due to suspected high morbidity and mortality postoperatively were barred from participating.

One hundred consecutive patients meeting the above criteria were entered into the study. Intraoperative Trans-esophageal echocardiography (TEE) and postoperative transthoracic follow-up echocardiography data were analyzed.

All patients underwent routine preoperative investigations including electrocardiogram, chest X-ray, hemoglobin, urea, electrolyte, serum creatinine and echocardiography. MVR was performed trans-septally in 78 patients, while the left atriotomy approach was used in the remaining patients with a sizable left atrium.

Ethical approval:

An approval of the study was obtained from Cairo University Academic and Ethical Committee. Every patient's parent signed an informed written consent for acceptance of the operation. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Surgical Technique:

All patients were approached through standard median sternotomy. After heparinization and initiation of the cardiopulmonary bypass through aorto-bicaval cannulation, the aorta was cross-clamped, and the heart was arrested by administration of antegrade cold blood cardioplegia at moderate hypothermia (range 28 to 32 °C). In 78% of cases, we exposed the mitral valve through an atrial septectomy incision extending from the entrance of the superior vena cava to the front of the coronary sinus. Trans-septal approach was especially practical in patients with small left atrium or where attacking functional tricuspid regurgitation was planned.

After exposure, the mitral valve is assessed for repair feasibility and to detect the exact cause of valve dysfunction through using a pair of hooks or injecting saline into the left ventricular (LV) cavity. In cases with dilated annulus, minimal leaflet prolapses and/or restricted motility, posterior mitral reduction annuloplasty using pericardial strip was initially done.

Repair was considered adequate by good opposition of the two leaflets more towards the posterior annulus and ballooning of the anterior mitral

leaflet after injecting saline into the LV cavity. Otherwise, additional repair techniques may be added or even MVR was carried out and, in such case, patient was excluded from the study. After closure of cardiotomy incisions, rewarming and deairing, TEE operator re-checked for the repair adequacy.

Technique of posterior mitral reduction annuloplasty:

In children with annular enlargement and/or leaflet prolapse, we aimed to reduce the mitral annulus to a size even larger than specified by the BSA, but sufficient to make the valve competent.

After sizing, 8-10 horizontal mattress, non-pledgetted braided sutures (2-0 or 3-0 Ethibond) were placed through the posterior mitral annulus between the fibrous trigones in a clockwise manner [Fig. 1], and then passed through the annuloplasty pericardial strip [Fig. 2]. The strip is then lowered in place and sutures are tied.

After annuloplasty, testing with saline is done [Fig. 3] and sutures can be used to close the gaps or reduce the areas of prolapse in the localized regurgitation area.

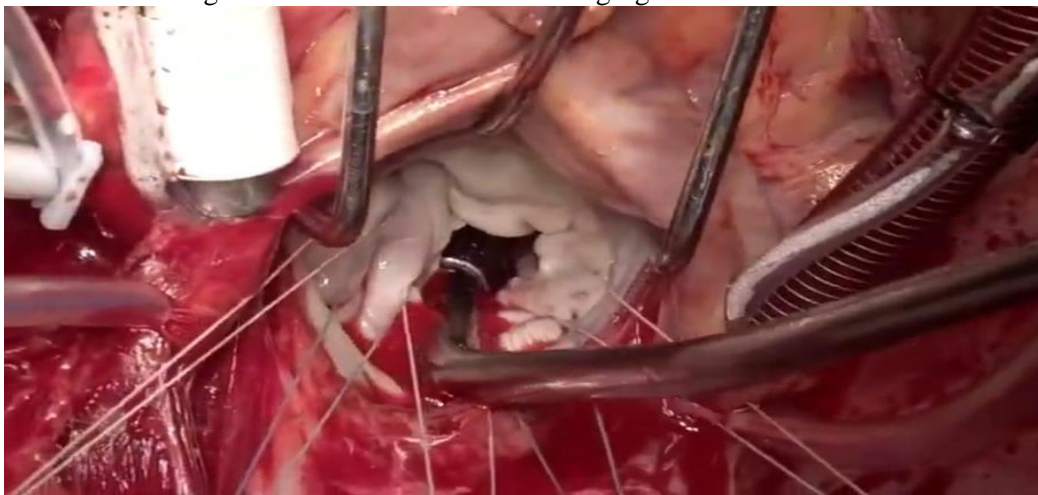


Fig. (1): Taking 8 annular stitches starting and ending 2-3mm beyond both commissures.

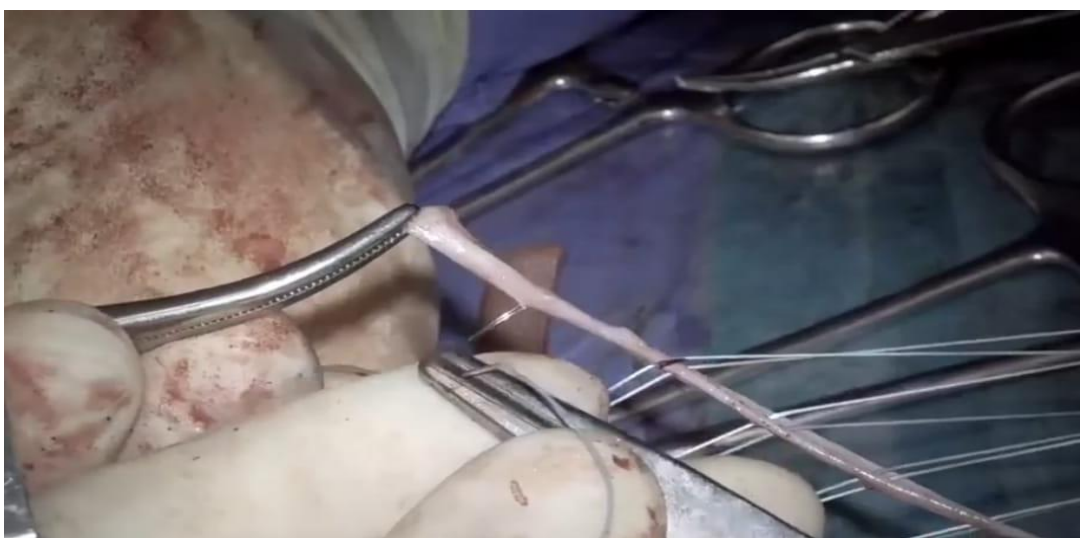


Fig. (2): Arranging the stitches equally within the pericardial strip.

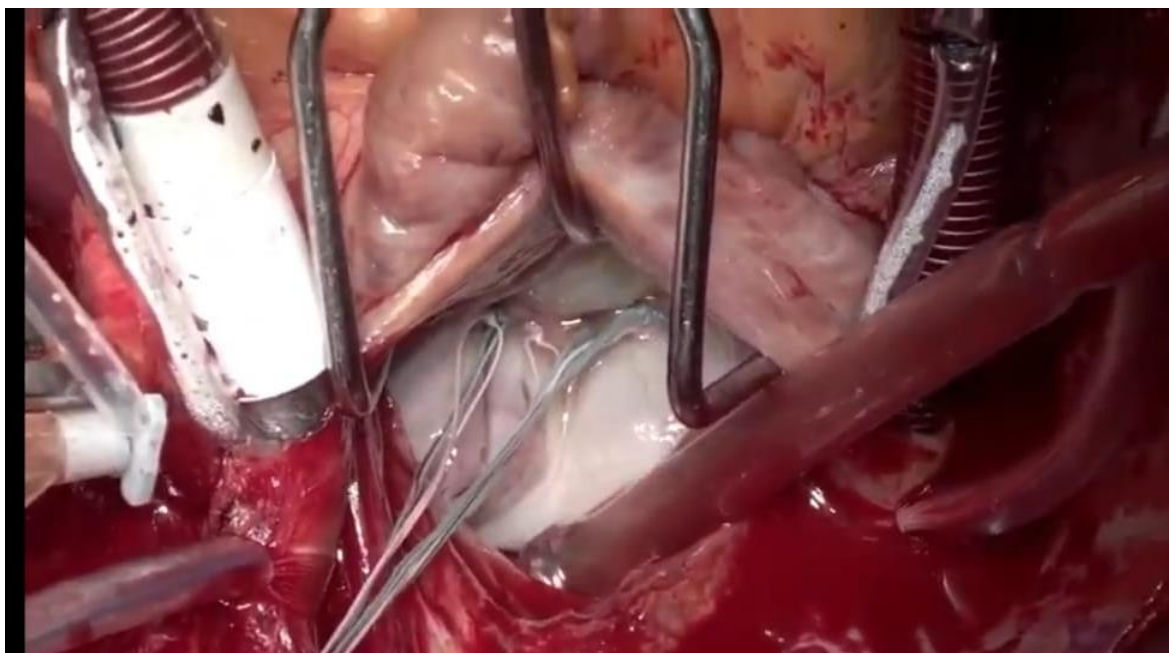


Fig. (3): After tying the 8 stitches and testing with saline.

Statistical analysis

Continuous data were expressed as mean and standard deviation and categorical data as numbers and percentages.

All reported P values were two-sided, and P values of ≤ 0.05 were considered statistically significant. All statistical analyses were performed with SPSS version 22.0 (SPSS, Inc., Chicago, IL, USA). All statistical analyses were done with the help of a Departmental Statistician.

RESULTS

One hundred children between the ages of 1 to 18 years (Mean = 7.86 ± 4.82 years) were included in this study. 75 patients (75%) had rheumatic diseases, 15 (15%) had connective tissue abnormalities, and the final 10 (10%) had congenital mitral disease.

There was no early mortality nor significant mitral regurgitation within 30 days of the operation.

There was no incidence of infective endocarditis nor arrhythmias that dictated initiation of long-term anticoagulant therapy.

Follow-up clinical examination revealed marked improvement in symptoms and NYHA^(Ref) functional class, only 9 patients (9%) were in NYHA functional class III.

Echocardiographic follow-up studies (mean follow-up duration = 1.54 ± 0.32 years) showed moderate mitral regurgitation in 8 patients (8%) who improved clinically with medical treatment and planned for 3-monthly follow-up, while only one patient (1%) came back with manifestations of severe mitral regurgitation 16 months after the primary repair and was managed with mitral valve replacement.

DISCUSSION

The delicate and brittle nature of MV tissue in infants, the broad spectrum of pathology, and the prevalence of co-existing cardiac abnormalities make surgical management of MV disease in children problematic. Both MV repair and MV replacement with mechanical prosthesis are surgical alternatives⁽⁹⁾.

As it preserves the sub-valvar apparatus, ventricular geometry, and function, MV repair is desirable and ought to be tried when possible⁽¹⁰⁾. Many studies have reported satisfactory results with MV repair in children with mid- to long-term survival of 77–94%⁽¹¹⁻¹⁷⁾. This copes well with our results with no mortality along short and mid-term follow-up.

Endemicity of rheumatic heart disease in our country explained rheumatic pathology in 75% of our cases and the exclusive involvement of the mural mitral leaflet besides posterior annular dilatation resulting in increased anteroposterior mitral orifice diameter compared to its transverse diameter. This is comparable to data published by **Lee and his colleagues**⁽⁹⁾ where bileaflet prolapse due to excessive annular dilatation was the main cause of mitral insufficiency in 74% of their cases.

There are various annuloplasty techniques used to repair annulus dilatation. However, each annuloplasty technique fits well with certain pathologies. At 13 to 15 years, **Ohno et al.**⁽¹⁸⁾ and **Sugita et al.**⁽¹⁹⁾ reported that the long-term results of commissure plication annuloplasty (Wooler–Kay type annuloplasty) for congenital MR were 86% and 92%, respectively free of re-operation when bileaflet prolapse aggravates annular dilatation.

For example, **Lee et al.**⁽⁹⁾ suggested posterior annuloplasty with strip or suture plication for younger

children and artificial ring annuloplasty for older children. Resorbable sutures were used in the suture plication posterior annuloplasty procedure by **Prêtre et al.** ⁽²⁰⁾ for young children, with positive short-term outcomes. **Oppido et al.** ⁽¹⁶⁾ used a polytetrafluoroethylene (PTFE) strip in a similar annuloplasty approach and achieved excellent mid-term results.

In our study, we did posterior mitral annuloplasty using patient's own pericardial strip with excellent survival and low incidence for reoperation (1%) over the short and mid-term results.

According to **Authan et al.** ⁽²¹⁾, the incidence of cardiac-device IE has increased by 210% in 15 years even with usage of annuloplasty rings and/or PTFE bands. Our results showed that none of our cases suffered infective endocarditis.

CONCLUSION

We concluded that, at long-term follow-up, MV repair in children demonstrated excellent survival, an acceptable re-operation rate, and satisfactory valve function, and that the less tissue handling and synthetic material used, the better the outcome in terms of incidence of infective endocarditis, the need for reoperation, and the ability of mitral tissue growth for optimum functions.

The described technique is applicable to the majority of pediatric patients with significant MR; it is easily reproducible and allows for effective reconstruction of the mitral valve without affecting valve's geometry, future growth and function especially in the case of concurrent congenital cardiac anomaly.

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