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Surgical Repair of Mitral Valve in Children at Soavinandriana Hospital: First Cases Series

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Abstract

Surgical repair of the mitral valve is an alternative to mitral valve replacement surgery in children. Advantages include lower cost, the possibility of avoiding long-term anticoagulant therapy, and preservation of native valve function. This case series reported on four cases of surgical repair for mitral regurgitation in Malagasy children, performed at the Soavinandriana Hospital in Antananarivo, during the 26-month period in which open-heart surgery was practised at the hospital (from 1 May 2024 to 30 June 2026). Patients were 2 boys and 2 girls, aged between 7 and 16 years-old. The mitral valve lesions were caused by rheumatic disease in 3 patients. The main symptom was exertional dyspnoea accompanied by other signs of left heart failure. Echocardiography confirmed the diagnosis and of mitral regurgitation. Surgical repair of the mitral valves was performed during open-heart surgery missions at Cenhosoa. Surgical procedures consisted to repair the mitral valve associated with mitral annuloplasty for 3 children by using cardiopulmonary bypass. The postoperative success rate was 100%. Surgical repair of the mitral valve is the treatment for mitral regurgitation in children at Cenhosoa. The immediate postoperative results of the four surgical repair cases were satisfactory. There is no long-term follow-up.

Keywords

Echocardiography, Mitral Regurgitation, Paediatrics, Systolic Murmur, Surgery

1. Introduction

Mitral regurgitation is the most common acquired valvular heart disease in children in sub-Saharan African countries, accounting for around 71% of cases [1]. Surgical treatment for mitral regurgitation in children and young adults primarily involves repairing the mitral valve rather than replacing it. The advantages of mitral valvuloplasty include the absence of the need for anticoagulant therapy and improved valve function [2]. In addition, mitral valve repair has the advantage of preserving native valve function, allowing for somatic growth, and resulting in fewer complications and reoperations [3]. The open-heart surgery at Soavinandriana Hospital started in May 2024 as part of a periodic mission supported by the Chain of Hope non-governmental organisation. The surgical programme focuses on congenital and acquired valvular heart disease in children and young adults. This study aims to report the first case series of surgical repair of mitral valve performed at Soavinandriana Hospital in Antananarivo.

2. Observation

Case 1

The patient was a seven-year-old boy who presented with acute dyspnea. The child had undergone long-term antibiotic treatment for acute infective endocarditis, as diagnosed by echocardiography. He weighed 23 kg and had a 4/6 systolic murmur of mitral regurgitation upon auscultation. Echocardiography revealed severe mitral regurgitation, likely post-endocarditic, classified as Carpentier II, with a left ventricular ejection fraction (LVEF) of 75%. A chest X-ray showed cardiomegaly with a cardiothoracic ratio of 82%. Preoperative evaluation and ultrasound examination show no evidence of an active infectious endocarditis process. Mitral valve repair was performed using cardiopulmonary bypass. Intraoperative exploration revealed a dilated mitral valve annulus. The posterior leaflet (P1 and P2) prolapsed, accompanied by ruptured mitral chordae tendinae of P1 - P2, elongated P3 and A3 chordae (**Figure 1**), and a cleft between the P1 and P2 leaflets. The surgical procedure consisted of implanting neochordae in the posterior mitral valve pillar (**Figure 2**) and closing the tear in the mitral valve between P1 and P2. Postoperative echocardiography showed a good result with minimal mitral regurgigation.

Case 2

The patient was an eight-year-old girl with a history of hospitalisation for dyspnea, diagnosed as mitral regurgitation, and a history of rheumatic disease. On examination, she weighed 21 kg and had a 3/6 systolic murmur at the mitral auscul-

tation site. Echocardiography revealed severe mitral regurgitation with a lack of coaptation of the valve leaflets during systole, as well as a dilated left atrium and left ventricle, with an LVEF of 70%. Chest X-ray showed cardiomegaly, with a CT ratio of 73%. During surgery, the following was found: a dilated mitral annulus; thickening of the leaflets (Figure 3); a lack of coaptation of the valve leaflets, with the posterior leaflet retracted; prolapse of the anterior leaflets A2 and A3; and elongation of the A2 and A3 chordae. The surgical procedures included mitral valvuloplasty, followed by the insertion of two neochordae in A2 and A3, and then annuloplasty using a Carpentier-Edwards Physio II ring, size 24. The saline distension test was satisfactory. The postoperative course was uneventful. Postoperative echocardiography was performed. This revealed that the repaired mitral valve was functioning properly. There was also minimal residual regurgitation.

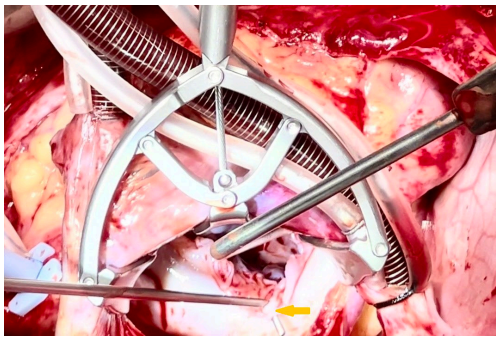


Figure 1. Peroperative image showing an elongated of mitral chordae.

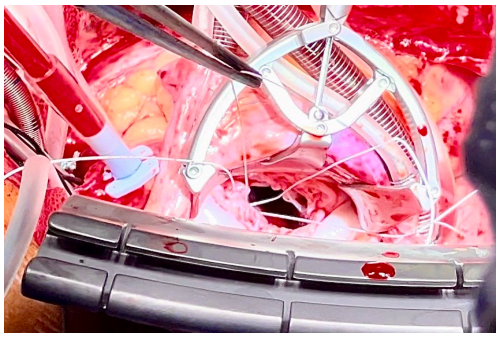


Figure 2. Peroperative implantation of neochordae for the mitral valve.

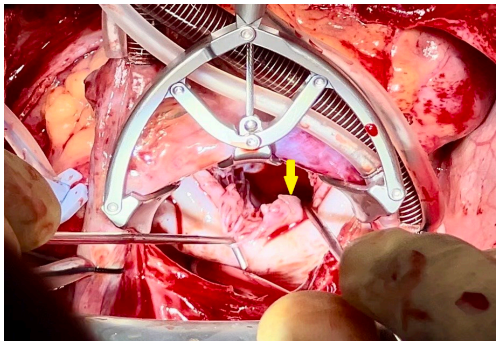


Figure 3. Peroperative image showing thickening of the mitral valve leaflet.

Case 3

The patient was a nine-year-old boy who had experienced dyspnea and chest pain since childhood, without any limitation of physical exertion. He had a history of rheumatic disease. On examination, he was in good general condition and weighed 23 kg. He had a systolic murmur of mitral regurgitation, graded at 3/6. There were no symptoms of left ventricular failure. Echocardiography revealed severe mitral regurgitation due to a lack of coaptation of the mitral leaflets associated with severe aortic regurgitation. Chest X-ray showed cardiomegaly with a CT ratio of 62%, as well as increased pulmonary hypervascularity. Intraoperative exploration revealed a dilated left atrium, thickened mitral leaflets, significant dilatation of the mitral annulus, and elongated chordae. There was aortic regurgitation, accompanied by thickening of the aortic valve leaflets and prolapse of the right coronary cusp. The surgical procedures included mitral valvuloplasty, followed by aortic valvuloplasty. The procedure known as mitral valvuloplasty involved the implantation of a neochordae along with mitral annuloplasty, which was performed using a Carpentier-Edwards Physio II ring in size 28. (Figure 4). Aortic valvuloplasty involved extending the right coronary cusp by adding a pericardial autologous patch, which was sutured with Prolene 6-0. Figure 5 showed the postoperative chest X-ray with image of mitral annulus. Postoperative echocardiography showed that the repaired mitral valve was functioning well with no regurgitation.

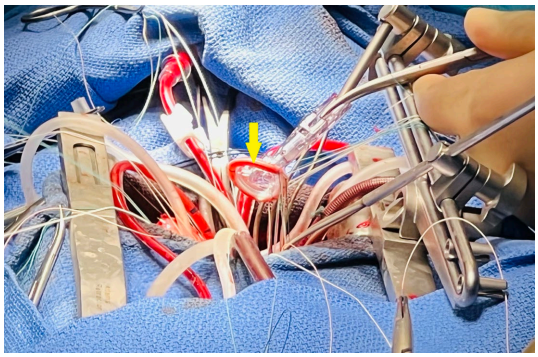


Figure 4. Peroperative image of mitral annulus before implantation.

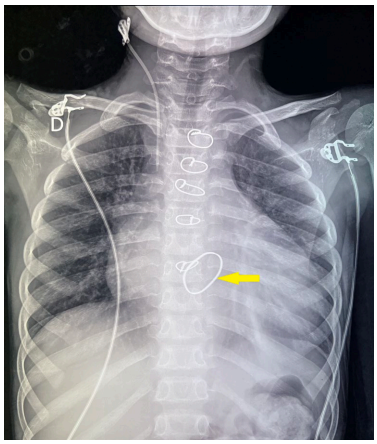


Figure 5. Postoperative chest x-ray showing mitral annulus.

Case 4

The patient was a 16-year-old girl who had experienced dyspnea since the age of 12, without limitation of physical exertion. She had a history of rheumatic disease and had received regular monthly injections of Extencillin since 2024. On physical examination, she was in good general condition and weighed 47 kg. A systolic cardiac murmur was heard at the mitral auscultation site. Echocardiography revealed rheumatic polyvalvular disease, presenting with severe mitral regurgitation (Carpentier class IIIa) and moderate aortic regurgitation, due to low mobility of the non-coronary cusp of the aortic valve. There was also dilatation of the atrium and left ventricle. Intraoperative exploration revealed dilatation of the left atrium, thickening of the mitral valve leaflets with commissural fusion, and dilatation of the mitral annulus. There was also thickening and retraction of the primary chordae of the mitral valve. There was also thickening of the leaflets and fusion of the commissures of the aortic valve. The surgical procedures involved repairing the mitral and aortic valves. Mitral valvuloplasty involved shaving the anterior leaflet and the primary chordae, followed by annuloplasty using a size 30 Carpentier-Edwards Physio II ring. The saline distension testing was satisfactory. Aortic valvuloplasty involved extending the aortic leaflets using an autologous pericardial patch sutured with Prolene 6-0. The Fratter stitch was effective. The saline test of the aortic leaflets was satisfactory. Postoperative echocardiography revealed that the repaired mitral valve was functioning properly, with minimal residual regurgitation.

3. Discussion

Access to cardiac surgery remains low and complicated in low-income countries such as those in sub-Saharan Africa and Madagascar, despite a higher prevalence of rheumatic disease [4]. This limitation in access to cardiac surgery could be explained by the influence of poverty on most of the African population. In Antananarivo, approximately 20% of cases of cardiac heart failure in young patients were due to valvular heart disease [5]. However, the surgical management of valvulopathy in children and young adults remains challenging in Madagascar, as most families cannot afford the cost of cardiac surgery. In addition, most patients found it difficult to adhere to their medical treatment, particularly anticoagulation therapy. With the support of the non-governmental organisation Chain of Hope, which covered the costs of the surgery, Malagasy children were given the opportunity to undergo mitral valve repair surgery.

In sub-Saharan African countries, the population most affected by rheumatic heart disease is young adults, with an average age of 29 years, according to the study by Kingué *et al.* [6]. In our study, however, the patients were children aged between 7 and 16. The Senegalese study by Diop *et al.* showed similar results to our study, with an average age of 12 years [7]. The political strategy of the Chain of Hope to support paediatric cardiac surgery in Madagascar could explain the predominance of children and childhood cases in our study. Most African studies

have shown a female predominance in the population of patients who underwent surgery for mitral valve disease, as in the studies by Femi-Lawal *et al.* (55%) [8], Nwafor *et al.* (53%) [9] and Diop *et al.* (61%) [7]. However, the proportion of females (50%) was equal to that of males (50%) in our study.

Rheumatic heart disease is the most common cause of mitral valve disease in children in sub-Saharan Africa, accounting for 71% of cases of cardiac valve disease [9]. The impact of unfavourable socioeconomic conditions on patients following treatment for rheumatic disease increases the risk of developing rheumatic mitral disease in children and young adults in Madagascar. In our study, three out of four cases (75%) reported mitral valvulopathy following rheumatic disease. Some African authors found a similar result in terms of the prevalence of rheumatic disease as the cause of mitral valvulopathy, such as Bori Bata *et al.* (85%) [10]. Additionally, the majority of cases of mitral valvulopathy reported in sub-Saharan African literature were due to rheumatic disease, as in the studies by Ferratini M *et al.* [11] and Lacour-Gayet F *et al.* [12].

Diagnosis of mitral regurgitation is often delayed in our patients because most Malagasy children with mitral valvulopathy live far from Antananarivo. In addition, there are no cardiologists available to treat heart disease in most rural regions of Madagascar. Mitral regurgitation is usually suspected when symptoms of left heart failure are present. In our study, dyspnea associated with a systolic murmur at the mitral valve auscultation site was the current symptom of mitral regurgitation. According to the study by Nkoke *et al.*, the most common reasons for requesting an echocardiographic examination in a sub-Saharan African paediatric population were clinical symptoms of heart failure (24%) and heart murmurs (21%) [13]. The Senegalese study by Diop *et al.* showed that all children (100%) with mitral regurgitation who underwent surgery presented with a mitral insufficiency murmur [7]. A chest X-ray was performed to confirm the diagnosis of advanced mitral regurgitation, which was supported by the presence of cardiomegaly. A high prevalence of cardiomegaly was observed in Sub-Saharan African studies, such as those by Diop MS *et al.* (86%) [7] and Bori Bata AK *et al.* (92%) [10].

Echocardiography is the gold-standard medical imaging technique for confirming the diagnosis and determining the aetiology and mechanism of regurgitation, as well as evaluating the severity of mitral regurgitation [14]. Our study revealed a high prevalence of severe mitral regurgitation (100%). Some African authors found similar results, such as Diop MS *et al.* (62%) [7] and Nkoke C *et al.* (63%) [13], who also found a predominance of severe mitral regurgitation. The prevalence of severe mitral regurgitation in a population of African patients who underwent surgical repair for mitral regurgitation could be explained by delayed diagnosis and longer waiting times for surgery. The mechanism of mitral valve regurgitation depends on the etiology of valvulopathy. Rheumatic mitral regurgitation is characterised by typical lesions such as leaflet thickening or retraction, chordae thickening or retraction, chordae fusion, commissural fusion, and calcification [15]. These lesions were observed in three patients with rheumatic mitral

disease. However, echocardiography for mitral regurgitation following endocarditis may reveal elongated or ruptured chordae, elongated or ruptured papillary muscles, and leaflet perforation [16].

The choice between replacement and valvuloplasty to treat mitral regurgitation in infants depends on multiple factors, such as the patient's age, the availability of a mitral valve prosthesis, and the possibility to take anticoagulant therapy after the surgery. Mitral valve repair is often preferred to replacement because it preserves native valve function [3]. In our study, all cases of mitral regurgitation were treated with surgical repair of mitral valve due to the difficulty experienced by patients and their families in following anticoagulation therapy. In addition, the possibility of replacing a mitral mechanical prosthesis at the age of adult for these patients remains uncertain because the Chain of Hope only supports the treatment of children with congenital or acquired disease. However, the African study by Bori Bata AK *et al.* showed a predominance of mitral valve replacement with a mechanical prosthesis (74%), and a low rate of mitral valve repair (24%) [10]. In our study, three cases of mitral valvuloplasty were associated with annuloplasty (75%). Fu H's study showed that 94% of annuloplasties were performed alongside mitral valvuloplasty in children with moderate to severe mitral valve regurgitation [17].

Surgical repair of mitral valve produced low mortality rates and positive long-term results in paediatric patients with mitral valve regurgitation [17]. This early result of mitral valve repair showed 100% of success.

4. Conclusion

This case series describes four Malagasy children with severe mitral regurgitation who underwent mitral valve repair at Soavinandriana Hospital. Surgical repair of the mitral valve is feasible in this initial four-patient experience.

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Consent

All parents were informed and gave their consent for these cases series and any related images to be published. The patient's identity is protected.

Author Contributions

Randimbinirina ZL: conceptualization, methodology, data collection and writing—original draft;

Vita OA, Ravaoavy H, Miandrisoa RM: writing—review and editing;

Rajaonanahary TMA, Rakotoarisoa AJC: supervision, validation and writing—review and editing;

All authors have read and approved the final version of manuscript.

Conflicts of Interest

The authors declare no competing interests in the submitted work.

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