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Case Report

Aortic Root Enlargement During Redo Aortic Valve Replacement for Prosthetic Aortic Valve Dysfunction: A Case Report

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Abstract

Introduction

A variety of procedures for enlarging the aortic root have been described. The aim of the current study is to report a case of Redo aortic valve replacement that underwent Aortic root enlargement using a novel method.

Case presentation

A 32-year-old female with a history of severely stenotic aortic valve prothesis developed recurrent attacks of syncope and dyspnea on minimal effort. She had a past surgical history of AVR. Under general anesthesia in supine position re-sternotomy was done. The newly developed technique was done for the aortic root enlargement. There were no significant intra-operative complications. The patient remained two days in the Cardiac intensive care unit (ICU) and 15 days in the ward.

Conclusion

The technique previously described by Yang et al. can be used safely and efficiently to enlarge the aortic root in patients who have had redo aortic valve replacement.

1. Introduction

Aortic valve replacement (AVR) is one of the most common cardiac interventions [1]. It not only relieves symptoms in individuals with aortic valve dysfunction, but it also increases survival [2]. Since patients have a high survival rate, a large number of people are at risk of necessitating a second AVR (redo AVR) over their lifetimes [3]. A small aortic annulus may

be a surgical challenge in this patient population. Inserting a small prosthesis may result in patient prosthesis mismatch (PPM) [1]. In so many studies, PPM has been connected to worse outcomes, such as increased left ventricular work, decreased left ventricular mass regression, and increased death [4]. Aortic root enlargement (ARE) during AVR has been shown to be a useful alternative for patients with a small aortic annulus and the upcoming risk of PPM [5]. The procedure is performed to allow the implantation of a larger sized prosthetic valve in patients undergoing AVR [6]. In the literature, a variety of procedures for enlarging the aortic root have been described [2]. In a recent study, Yang et al. described a novel surgical method to enlarge the aortic annulus by three valve sizes for mechanical AVR without affecting any surrounding aortic root structures [7].

The aim of the current study is to report a case of redo AVR that underwent ARE using Yange et al. method.

2. Case Presentation

2.1. Patient information and Clinical findings

A 32-year-old female with a history of severely stenotic aortic valve prothesis developed recurrent attacks of syncope and dyspnea with minimal effort. She was referred to the department of cardiac surgery for redo AVR. She had a history of two cesarean sections and an AVR but negative past medical history. Her body weight was 55 kg and her height was 161 cm. Electrocardiogram (ECG) showed sinus rhythm with multiple ectopic ventricles.

2.2. Diagnostic assessment

A chest X-ray (AP and Lateral) was done to assess the distance between the sternum and the heart. Echocardiography revealed 50–54% ejection fraction, moderate aortic regurgitation, and severe left ventricular outflow tract obstruction (LVOTO) due to severely stenotic aortic valve prosthesis. A cardiac computed tomography (CT) scan revealed normal coronaries with a suspected stuck prosthetic aortic valve leaflet. According to CT aortography, there is a 6 mm distance between the sternum and the mid ascending aorta and a 3–5 mm distance between the sternum and the proximal arch. The aortic root was 27 x 27 mm in diameter, the ascending aorta was 31.5 x 30.5 mm, the aortic arch was 22 mm, the descending aorta was 20 mm, and the abdominal aorta was 18.5 mm. An abdominal ultrasound was normal other than a scanty amount of pelvic free fluid. Hematological and biochemical lab results were unremarkable. Five days prior to surgery, Warfarin was omitted, and the patient was put on a heparin infusion according to her body weight.

2.3. Therapeutic intervention

Re-sternotomy was performed under general anesthesia in the supine position, with careful dissection to release retrosternal adhesion. The patient was putted on cardiopulmonary bypass (CPB). An aortic cross clamp was placed, and an oblique aortotomy was done. At the non-coronary cusp site, there was significant LVOTO and circumferential fibrous tissue around the stack leaflet of the prosthetic valve. The removal of the stacked prosthetic valve began, followed by aortic annulus sizing using an unsuitable SJM mechanical sizer (size 17). Despite myotomy, excision of all fibrous tissue, and resizing, 17-SJM remains unfit. As a result, the decision to expand the aortic root using the Bo-Yang procedure was made [7]. A Y-incision was created into the Aorto-Mitral barrier through the left non-commissure. The Y-incision was extended under the left and noncoronary aortic annuli to their respective nadirs into the left and right fibrous trigones but did not reach the muscular part on the left or the membranous septum on the right. A rectangular shaped Hemashield Dacron patch was cut to 3.5 cm in width and then stitched to the Aorto-Mitral curtain/mitral annulus from the left to the right fibrous trigone using running 4-0 Prolyne suture. The suture line was moved to the undermined aortic annulus at the nadir of both the left and non-coronary sinuses, and then secured along the patch's longitudinal length up to the level of the transverse aortotomy incision. The non-pledged 2-0 Ethibond sutures were inserted in a non-everting way along the native aortic annulus, starting from the right coronary sinus side and moving inwards to the patch. The mechanical valve was placed with the ends of the two discs facing the left-right commissural post, ensuring that the left and right coronary ostia were on the disc sides. The valve stitches were all pulled through the sewing ring. The patch was cut into a triangular form, similar to a roof, about 2 cm above the mechanical valve. The cross-clump duration was 134 minutes, the bypass time was 169 minutes, and the crystalloid St. Thomas Cardioplegia was used. There were no significant intra-operative complications, and two temporary pacemaker wires were inserted.

2.4. Follow-up

The patient remained two days in the cardiac intensive care unit (ICU) and 15 days in the ward because she developed total atrioventricular (AV) block on the fourth postoperative day and required a continuous pacemaker for the next five days. After that, the patient returned to sinus rhythm.

4. Discussion

Since Rahimtoola developed the concept of PPM in 1978, surgeons have been concerned with placing adequate-size prostheses [8,9]. Pibarot et al. later described PPM as having an index effective orifice area of less than 0.85 cm2/m2 [10]. The main objective of AVR is to reduce LV pressure and/or volume overload since most prostheses are accompanied by some degree of blockage [9]. Aortic root enlargement to allow the insertion of bigger prostheses and, furthermore, avoid the complication of PPM is becoming increasingly acceptable in the surgical community [11]. A potential disadvantage of ARE is the greater technical difficulties associated with prolonged operating time, which may result in a higher incidence of sequelae. Several previous studies, however, have confirmed the procedure's safety and repeatability [11]. Several techniques for increasing the diameter of the aorta with a small annulus and allowing the implantation of bigger prosthetic valves with superior hemodynamic performance have been described in the literature [2].

Nicks et al. published the first report of posterior annular enlargement across the center of the non-coronary sinus [12]. A few years later, Manouguian and Seybold-Epting developed the posterior enlargement via the commissure between the left and non-coronary sinuses [13]. Both techniques are probably the most generally approved and used approaches for ARE [2]. Nicks and colleagues suggested posterior root enlargement. By extending the aortotomy posteriorly via the noncoronary sinus across the aortic ring and inserting a patch to expand the annulus [12]. A similar method was proven by Manouguian et al., who expanded the incision into the commissure between the left and noncoronary sinuses and into the anterior mitral leaflet. The Manouguian approach resulted in root enlargement of 10-25 mm and the feasibility of implanting a valve up to two sizes larger than what the normal annulus could tolerate [13].

To date, relatively few studies have presented the outcomes of ARE in the context of redo AVR [1]. As the population ages, an increasing proportion of individuals are at risk of re-operation. These patients could have a tiny, calcified annulus. As a result, they are at risk of PPM, particularly those who had a small annulus at the time of their initial operation [14]. Kanter et al. presented their experience with 38 redo AVR in children, 27 of them had a simultaneous ARE. They found that these operations could be conducted with acceptable morbidity and mortality. The Konno technique was used for the vast majority of ARE (89%). Adults are most commonly treated with the Manouguian and Nicks procedures [15]. Chauvette et al reported that ARE is viable in the setting of redo AVR and can result in considerable hemodynamic improvements. It efficiently enhances the aortic valve area index and aids in the reduction of gradients across the aortic valve [1].

In the current case, a Y incision and rectangular patch approach were utilized to enlarge the aortic annulus, as previously described by Yang et al. [7]. This procedure did not require the violation of any neighboring aortic root structure, such as the mitral valve or right ventricle. The new approach was easier and safer than the Manouguian and Konno procedures, and it was more effective than the Nicks procedure, which enlarges the annulus by three valve sizes. It can be highly beneficial in young patients, especially teens, who require a larger mechanical valve [7].

5. Conclusion

Planned ARE using Yang et al. approaches can be performed safely and efficiently to enlarge the aortic root in patients who have had redo AVR.

Declarations

Conflicts of interest: The author(s) have no conflicts of interest to disclose.

Ethical approval: Not applicable.

Patient consent (participation and publication)**:** Written informed consent was taken from the patient for the publication of any related information and images or illustrations.

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Authors' contributions: SSA, OFA were a major contributor to the conception of the study, and the surgeons who managed the case. MNH, FHK were involved in the design of the study, literature search and review of studies for the inclusion of related studies, and in the drafting of the manuscript. BAA, ZAZ, DHMS and SHM were involved in the literature review, in the design of the study, the critical revision of the manuscript. BAA and SHM confirm the authenticity of all the raw data. All authors read and approved the final manuscript.

Data availability statement: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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