

Mitral Valve Replacement on a Beating Heart for a Patient with Porcelain Aorta; Case Report

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Abstract

This report aims to emphasize the importance of preoperative assessment for cardiac surgery planning. A 40-year-old female diagnosed with severe mitral and tricuspid valves regurgitation. CT chest showed a porcelain aorta. She underwent MV replacement and tricuspid valve repair on a beating heart without an aortic cross-clamp.

Introduction:

The concept of performing cardiac surgery on a beating heart is a viable rationale these days. In some cases, surgeons are forced to perform surgery on a beating heart because it is the only option available. The most common approach for standard MV replacement is median sternotomy, aorti-bicaval bypass at 32^oC and antegrade cardioplegia to arrest the heart⁽¹⁾. In addition, cardiac reperfusion injury is a well-recognized complication that occurs after ischemia or cardioplegia. As a result, various strategies have been developed to prevent ischemic reperfusion injury such as surgery on a beating heart ⁽²⁾. This case report emphasizes the importance of preoperative assessment for cardiac surgery planning.

Patient Information:

A 40-year-old female presented with shortness of breath (New York Heart Association class III), orthopnoea and bilateral lower limb oedema for one year. Her symptoms affected her quality of life (American Association of Anesthesia class IV). She was diagnosed with severe MV regurgitation, pulmonary hypertension, and secondary severe tricuspid valve (TV) regurgitation with normal left and right ventricular function. She is hypertensive and suffers from chronic atrial fibrillation. She takes warfarin.

Clinical Findings:

A slim lady (weight 54 kg, height 157 cm), has chronic AF (PR 98 beat per minute), her BP is 120/77 mmHg and SPO₂ 99% on room air, with moderate bilateral lower limb oedema. On chest examination, she has a normal chest contour, moves with respiration and visible apex beats. On auscultation, there is a loud systolic murmur at the apex of the heart radiating to the left axilla.

Diagnostic Assessment:

Echocardiography revealed severe mitral and tricuspid regurgitation, ejection fraction 70% and pulmonary artery systolic pressure 55 mmHg. X-ray and CT chest showed features of circumferential calcification of the entire thoracic aorta (**Figure 1**) .

Surgical Technique:

Under general anesthesia, two incisions; median sternotomy and right groin for arterial cannulation were made. Porcelain aorta was confirmed. Right femoral arterial and bicaval cannulae were indwelled. Cardiopulmonary bypass (CPB) was performed. The mean arterial pressure was maintained between 65 and 80 mmHg. The aorta was not cross-clamped, no cardioplegia was used during the procedure, and the heart was allowed to beat. To prevent any possible air embolism, the patient was kept in the Trendelenburg position throughout the procedure. Patient was cooled down to 28⁰C to control heart racing .MV approached directly through the left atrium (LA), access very difficult, due to abnormal annulus (facing upward rather than upward and laterally to the right), the MV was found very thickened and myxomatous, as a result, it was replaced using size 25mm mechanical prosthesis with preserving the basal chordate of the posterior mitral leaflet. No obvious leak (on a beating heart). LA was closed in a single layer using 4/0 Prolene. The right atrium (RA) was entered directly and the TV was repaired using the De Vaga technique, however, minimal TR. RA was closed in one layer with 4/0 Prolene. De-airing maneuvers were performed prior to the cessation of CPB. Easy off bypass on Milrinone. The total CPB time was 90 minutes.

Two ventricular pacing wires and two mediastinal drains were left in. Sternum is closed using routine figure of 8 wire closure.

Follow-up and Outcomes:

The patient was transferred to the recovery room on minimal inotropic support, where ventilator support was readjusted, intravenous fluids and electrolytes were replaced guided by frequent ABGs. No bleeding is a concern. Thus, she was extubated within three hours. Post operatively, echocardiogram was done and showed well seated MV prosthesis and no paravalvular leak.

Our patient has been discharged to home on fifth day postoperative in good health, on warfarin. Two months later she returned to work.

Discussion:

In patients with a porcelain ascending aorta, cardiac surgery is challenging. The manipulation of the thoracic aorta during cardiac surgery, such as cross-clamping, incisions or cannulations, increases the risk of perioperative embolic stroke in these patients⁽³⁾ and more importantly damage or incisions to porcelain aorta are not repairable and can risk patients live on table. As an alternative to hypothermic fibrillatory arrest, deep hypothermic total circulatory arrest techniques are most commonly used for mitral valve surgery⁽⁴⁾. As an alternative to conventional mitral valve surgery, beating heart mitral valve surgery without cross-clamping the aorta has been successfully performed with acceptable clinical outcomes⁽⁵⁻⁷⁾.

Arterial perfusion via the common femoral artery is a classic approach to cardiac surgery in patients with calcification of the ascending aorta. In spite of its ease of use, this method carries the risk of embolization by atherosclerotic plaque or thrombus from the thoracic and abdominal aortas due to retrograde perfusion⁽⁸⁾. However, Grossi et al ⁽⁹⁾. demonstrated that retrograde perfusion had no significant impact on stroke incidence in patients <50 years of age, (as in our patient 40 year old with low risk of atherosclerosis) but had a significant effect on neurological events in high-risk patients with aortic disease. Nevertheless, several reports have described positive results of axillary artery cannulation, which has become increasingly popular⁽¹⁰⁻¹²⁾.

Axillary artery perfusion is associated with a lower risk of cerebral atheroembolism because it is less affected by atherosclerosis than the femoral artery. It can be used for selective antegrade cerebral perfusion to avoid cannulation in patients with severe atheroma of the brachiocephalic artery. The axillary vessels also have abundant collaterals, which reduces the risk of severe distal ischemia-reperfusion injury or embolization following cannulation⁽¹³⁾.

Patients with severe porcelain aortas may benefit from cannulation of the brachiocephalic artery. It is possible to avoid the difficulties associated with a second incision (axillary artery cannulation) or the problems

associated with retrograde perfusion (femoral artery cannulation) by utilizing the brachiocephalic artery⁽¹⁴⁾. Transapical aortic cannulation is an alternative method of central cannulation but its clinical impact in patients with porcelain aorta is unclear⁽¹⁵⁾.

One of the most feared complications of mitral valve replacement in a beating heart is air embolism. A patient's position (head down), strict application of routine de-airing maneuvers, intraoperative use of transesophageal echocardiography for the detection of bubbles, and a competent aortic valve reduce the risk of air embolism⁽¹⁶⁾.

Conclusion: It is critical to diagnose patients with porcelain aorta preoperatively so that appropriate surgical methods can be prepared. Furthermore, peripheral arteries assessment is mandatory to select excellent site for cannulation. Although severe calcification of the ascending aorta can easily be detected on a chest X-ray film or by cine angiography, these modalities are not able to determine whether there is nearly or completely circumferential calcification. It is possible to demonstrate calcification in the aorta with a simple chest CT, but it does not provide a satisfactory assessment of the three-dimensional distribution of calcification. Furthermore, multidetector-row CT images with maximum intensity projections and volume-rendered images can be used to evaluate calcification in three dimensions. A beating heart mitral valve surgery without aortic cross clamp can be performed safely as long as all precautions are taken to prevent the most feared complication: an air embolism and adequate arterial cannulation.

Ethical approval and consent to publish

Obtained

Conflict of Interest

Non

Written consent from the patient

Obtained

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Availability of data and materials

All the data used in the study are available from the first and corresponding author on reasonable request.

Authors' contributions

All authors made a significant contribution to this work, whether that is in the study design, acquisition of data, conception, execution, data analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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