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Case Report

Minimally Invasive Aortic Root Replacement Through Right Anterior Mini-Thoracotomy: Mini Bentall

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Abstract

Minimally invasive procedures, which are increasingly used in heart surgery, are also becoming more widespread in aortic root surgery. The right anterior mini-thoracotomy technique, which is used in aortic valve replacements, also seems applicable for aortic root and proximal aortic surgery in suitable patients. A 55-year-old male patient underwent aortic root replacement through the right anterior mini-thoracotomy approach. The cardiopulmonary bypass time was 152 min, and the cross-clamp time was 127 min. The patient was extubated at the 5th h post-operation. The patient was transferred out of the intensive care unit the following day and was discharged on the 5th day. No blood products were used. The 6-month follow-up was completed without any issues. Aortic root surgery can be safely performed in suitable patients using this technique. It allows for an early return to normal life for the patient without the limitations associated with sternotomy.

Keywords: Aortic root; aortic valve; bentall; mini thoracotomy; minimally invasive cardiac surgery.

Sağ Anterior Mini Torakotomi ile Minimal İnvaziv Aort Kök Replasmanı: Mini Bentall

Özet

Kalp cerrahisindeki kullanım alanı gün geçtikçe artan minimal invaziv girişimler, aort kök cerrahisinde de yaygınlaşmaktadır. Aort kapak replasmanlarında kullanılmakta olan sağ anterior mini torakotomi (RAT) tekniği, uygun hastalarda aort kökü ve proksimal aort cerrahisinde kullanılabilir görünmektedir. 55 yaşında erkek hastaya, sağ anterior mini torakotomi yöntemi ile aort kök replasmanı uygulandı. Kardiyopulmoner bypass süresi 152 dakika, kros klemp süresi ise 127 dakika olarak kaydedildi. Operasyon sonrası beşinci saatte ekstübe edildi. Bir gün sonra yoğun bakımdan çıkarılan hasta, beşinci günde taburcu edildi. Ameliyat süresince ve postoperatif dönemde kan ürünü kullanılmadı. 6. ay kontrolü sorunsuz olarak gerçekleşti. Sağ anterior mini torakotomi yöntemiyle, uygun hastalarda aort kök cerrahisi güvenle uygulanabilir. Sternotominin yol açtığı kısıtlılıklar olmaksızın, hastanın normal yaşantısına erken dönmesini sağlayabilir.

Anahtar sözcükler: Aort kök; aort kapak; bentall; mini torakotomi; minimal invaziv kardiyak cerrahi.

Introduction

Operations for aortic root pathologies are most commonly performed through median sternotomy. Since the Bentall De Bono procedure was described in 1968, it has been applied using this method.[1] To avoid the physical limitations and the risk of deep wound infections associated with the median sternotomy approach in the early post-operative period, as well as to reduce blood usage, enable early extubation and decrease intensive care and hospital stay durations, minimally invasive techniques are becoming more widespread. As an alternative to sternotomy for aortic root surgery, the upper mini-sternotomy approach is often preferred and is safely applied.[2]

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The right anterior mini-thoracotomy approach is also a preferred method, especially for suitable patients planned for aortic valve replacement. This technique is considered applicable when most of the aorta's section at the level of the pulmonary bifurcation is positioned on the right half of the sternum.[3] The advantages of this method over sternotomy have led to its potential applicability in proximal aortic surgery. LaPietra et al.[4] were the first to perform aortic valve replacement combined with ascending aortic replacement. We also evaluated its applicability in aortic surgery while using the right anterior mini-thoracotomy for aortic valve replacements. We wanted to present our technique, which we believe may enhance exposure through direct visualization, to the literature. An informed consent has been obtained from the patient for the presentation of the case.

Case Report

A 55-year-old male patient presented to the cardiology clinic with complaints of effort-related dyspnea. Transthoracic echocardiography revealed severe insufficiency of the aortic valve. The ejection fraction was calculated as 55%. Mild insufficiency was observed in the mitral and tricuspid valves, but structurally they appeared normal. An aneurysmal dilation was detected in the ascending aorta. Computed Tomography angiography showed an aneurysmal proximal segment of the ascending aorta, with a measured diameter of 57 mm. The patient was informed that an aortic root surgery was planned. Taking the patient's preferences into account, it was decided to proceed with aortic root replacement using a mechanical prosthesis.

An incision was made in the supine position in the right-third intercostal space. The right internal mammary artery and vein were clamped and divided. As shown in Figure 1, the third and fourth ribs were separated in a puzzle-like fashion from the point where they joined the sternum and retracted to both sides. Following femoral arterial and venous cannulation, cardiopulmonary bypass was initiated. Exposure was achieved with a soft tissue retractor and a mini-thoracotomy retractor. The pericardium was suspended with four or five sutures at the skin margins. The aorta was slung with a tape. The left ventricle was vented through the right upper pulmonary vein. After placing an aortic cross-clamp through the same incision, an aortotomy was performed. Myocardial protection was achieved with modified Del Nido cardioplegia through the coronary ostia. While resecting the aortic leaflets, suspensory sutures were placed at the commissural regions to bring the aortic root closer to the incision line. The coronary ostia were prepared in a button shape, and the aortic valve was resected. The surgical exposure provided by the suspensory sutures is shown in Figure 2. The aortic annulus was measured, and a 23-size On-X mechanical aortic valve (Artivion Inc.) and a 28-size tubular graft (InterGard Dacron® grafts, MAQUET Holding GmbH & Co. KG., Rastatt, Germany) were sutured together before implantation. The created graft was implanted into the aortic annulus with pledgeted sutures, passing through both the valve suture line and the graft simultaneously. The coronary buttons were sewn onto the graft with continuous 5–0 Prolene sutures. The distal anastomosis was supported with pledgeted sutures and performed using a continuous 4–0 Prolene suture technique. An epicardial pacemaker was placed on the anterior surface of the right ventricle without removing the cross-clamp. After de-airing, the cross-clamp was removed.

The heart started beating spontaneously. After the body temperature returned to normal, the patient was weaned off cardiopulmonary bypass without the need for inotropic support. To ensure easy visualization and intervention in case of any bleeding, the suspensory sutures placed at the commissures were kept in place until bleeding control was achieved (Fig. 3). The pericardium was loosely approximated. The separated third and fourth ribs were fixed to the sternum with a single wire, such as pieces of a puzzle, in the same way, they were removed. The muscle and skin layers were approximated, and the skin was closed.

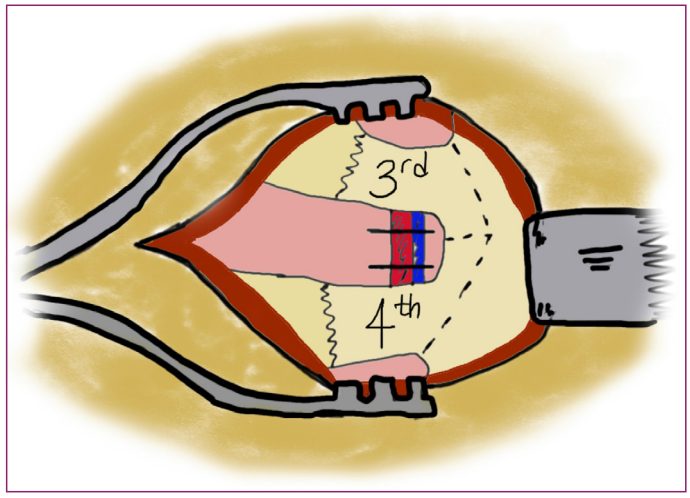

Figure 1. Mobilization of the third and fourth ribs in a puzzle-like manner: Schematic drawing.

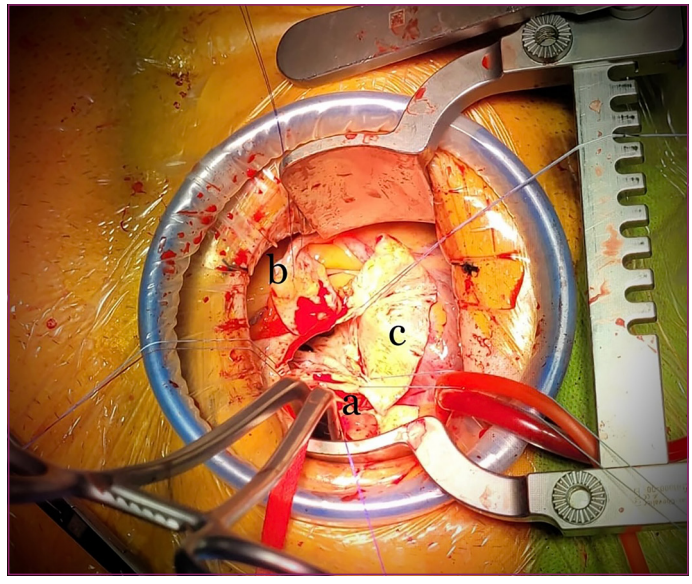

Figure 2. Exposure of the aortic root with commissural suspension sutures: (a) Left coronary button, (b) right coronary button, (c) non-coronary portion of sinus valsalva.

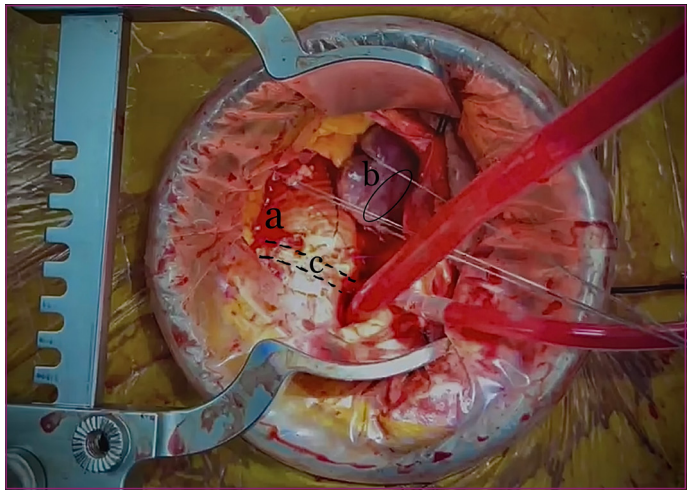

Figure 3. Final appearance: (a) Ascending aortic graft, (b) commissural suspension sutures, (c) distal anastomosis line.

The patient was transferred to the intensive care unit and extubated on the 5th post-operative h. The patient was transferred to the ward for follow-up on the 1st post-operative day and discharged on the 5th post-operative day. Follow-up visits were scheduled on the 10th day, 1st month, and 6th month after discharge. The patient was monitored without any issues.

Discussion

The right anterior mini-thoracotomy approach, used for aortic valve replacement in suitable patients, can also be applied in proximal aortic surgery in selected patients. Johnson et al.[5] have stated that the Bentall procedure can be safely performed in selected patients using mini-thoracotomy. In contrast to our technique, the surgery is performed with the assistance of a camera and total circulatory arrest (TCA) is applied during the distal anastomosis. In their series of seven patients, the median extubation time was 10 h, intensive care unit stay was 1 day and total hospital stay was reported as 4 days. In our patient, extubation was performed within 5 h. The main reason for this difference is the early extubation protocols are applied in our hospital. The durations of intensive care and total hospital stay are similar. Karadzha et al.[6] performed the Bentall procedure with hemiarch replacement using a right anterior mini-thoracotomy incision, entering antegrade selective cerebral perfusion. In our technique, proper mobilization of the third and fourth ribs ensures exposure of the ascending aorta up to the brachiocephalic trunk. This allows access to the distal ascending aorta without the need for TCA or antegrade selective cerebral perfusion. The thoracotomy incision provides exposure that makes all interventions on the aortic root possible. Tsaroev et al.[7] have also performed aortic valve-sparing root reimplantation using this approach. Interventions on the annular or subannular region are easier compared to aortic valve replacement. Since the sinus of Valsalva and proximal aortic tissue are completely resected, the annular region becomes more accessible.

Conclusion

Right anterior mini-thoracotomy for aortic root pathologies can be safely performed in selected patients. This method eliminates post-operative limitations, enabling patients to be discharged early and facilitating a faster adaptation to normal life.

Disclosures

Informed Consent: Written informed consent was obtained from the patient for the publication of the case report and the accompanying images.

Conflict of Interest: All authors declared no conflict of interest.

Use of AI for Writing Assistance: No AI technologies utilized.

Financial Disclosure: The authors declared that this study received no financial support.

Peer-review: Externally peer-reviewed.

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