CASE REPORT

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Mini-Bentall procedure for severe aortic regurgitation and root dilation: a case report of rapid recovery, and excellent outcomes

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ABSTRACT

Introduction: The Bentall procedure has long been regarded as the gold standard for addressing combined aortic valve and root pathologies. With advancements in minimally invasive cardiac surgery, the mini-Bentall procedure has emerged as a promising alternative to the traditional approach, offering reduced surgical trauma, shorter hospital stays, and improved postoperative recovery.

Case illustration: This report presents the case of a 66-year-old male with severe aortic regurgitation and aortic root dilatation who underwent a successful mini-Bentall procedure. Preoperative evaluation revealed significant left ventricular dysfunction with an ejection fraction of 30.8%, severe aortic regurgitation, and dilatation of the aortic root. The surgery was performed via a mini-sternotomy approach, with careful resection of the aortic root and valve and replacement with a composite graft. Postoperative recovery was uneventful, with minimal bleeding, no mechanical ventilation required, and a significantly reduced length of hospital stay.

Conclusion: This case highlights the feasibility and benefits of the mini-Bentall procedure as a less invasive yet effective approach to complex aortic surgery, demonstrating excellent outcomes and rapid recovery.

Keywords: mini-bentall procedure, minimally invasive, aortic, surgery, replacement.
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INTRODUCTION

Since its inception, the Bentall technique for aortic root replacement has been established as a safe, effective, and widely regarded "gold standard" for addressing combined aortic valve and root pathologies.[1] Initially detailed by Bentall and De Bono, the traditional method for root replacement involved performing a longitudinal median sternotomy to access the heart and great vessels.[2] In recent years, however, minimally invasive techniques have become increasingly prevalent in cardiac surgery. Specifically, minimally invasive aortic valve replacement (AVR) performed through mini sternotomy (MS) or mini-thoracotomy has emerged as a less traumatic alternative to median sternotomy. It is now the preferred approach in many experienced centers.[3] Advances in mini-AVR techniques, alongside growing patient demand for less invasive options, have encouraged aortic surgeons to extend these approaches to more complex procedures, including aortic root replacement and arch surgery.[4] However, performing ARR through an upper mini-sternotomy (UMS) may offer advantages such as reduced need for blood transfusions, less pain, improved respiratory function, and shorter hospital stays, all without compromising surgical exposure.[4] Previous smaller studies have demonstrated that the UMS Bentall procedure, or "mini-Bentall," is both safe and reproducible.

CASE REPORT

A male patient, 66 years old, came to our emergency room for severe aortic regurgitation and aortic root dilatation. He complained of worsening shortness of breath over the past week, significantly limiting daily activities. The patient reported sleeping in a sitting position over the last three days due to discomfort. There were no signs of pulmonary edema. The jugular venous pressure (JVP) was elevated on physical examination at +5 cm H2O. Cardiac auscultation revealed standard S1 and S2 sounds, with a regular rhythm and a grade III/IV diastolic murmur heard at the second and third intercostal spaces along the left sternal border. Pulmonary examination indicated normal vesicular breath sounds without significant rhonchi or wheezing. The abdomen was non-distended, and the extremities were warm to touch, with bilateral edema noted. During physical exam, the blood pressure was 114/62 mmHg, pulse 130 beats/ min, oxygen saturation 98% on room air, and respiratory rate 18 breaths/ min. Complete blood count and basic biochemical parameters were still in normal range with mild dysfunction on coagulation studies that showed a prolonged international normalized ratio (INR) of 1.41 with a prothrombin time

(PT) of 19.0 seconds and an activated partial thromboplastin time (APTT) of 29.8 seconds. Electrocardiography (ECG) was performed with atrial fibrillation with rapid ventricular response (AF RVR) at a rate of 122 bpm. Echocardiography performed revealed significant structural and functional abnormalities. The left atrium (LA), left ventricle (LV), and right atrium (RA) were dilated, with the LV showing eccentric hypertrophy. The systolic function of the LV was markedly reduced, with an ejection fraction (EF) by biplane measurement of 30.8%. The diastolic function of the LV was also impaired, classified as grade II dysfunction. Right ventricular (RV) contractility was preserved, with a tricuspid annular plane systolic excursion (TAPSE) measurement of 22 mm, although global hypokinesis was noted. Valve assessment showed severe aortic regurgitation (AR) secondary to aortic root dilatation, along with mild mitral regurgitation (MR) and mild tricuspid regurgitation (TR) with an intermediate probability of pulmonary hypertension (PH). Based on these findings, the patient was recommended for a Bentall procedure. The patient was also examined for a transesophageal (TEE) exam with the result severe AR caused by aortic root dilatation, global hypokinesis with severely reduced LV systolic function, LV eccentric hypertrophy, LA, LV, RA dilatation, Mild MR, and normal RV systolic function.

After induction of general anesthesia, the patient was placed in the supine position, and a J-sternotomy incision was made. After aortic cross-clamping, an aortotomy was performed. The aortic valve was found to have three cusps, with dissection of the ascending aorta showing no calcification but significant dilation of the aortic annulus. Direct coronary ostial protection was performed for both the right and left coronary arteries. Resection of the dilated segment of the ascending aorta was completed, and the coronary buttons were preserved. The aortic valve was resected, and proximal anastomosis was performed with a #28 CAVGJ graft, using 15 pledged sutures and three commissural sutures (Figure 1). The left coronary button was anastomosed to the graft. No leaks were detected at the coronary button anastomosis. The distal graft anastomosis was completed using pledgeted sutures made from resected aortic tissue, and the right coronary button was also anastomosed without any leakage. Rewarming was initiated, and the temperature returned to normal. The aortic cross-clamp was removed, and venting was discontinued with de-cannulation of the pulmonary vein. A pacing wire was placed in the right ventricle. CPB was weaned off, with stable hemodynamics, and protamine was administered. Decannulation of the right atrium, femoral vein, and aorta was performed. A 32Fr substernal drain was placed and connected to a water-seal drainage (WSD). The sternum was closed with sternal wires, and the skin was closed in layers. Post-operative wound of J sternotomy incision in good condition during outpatient clinics follow-up (Figure 2).

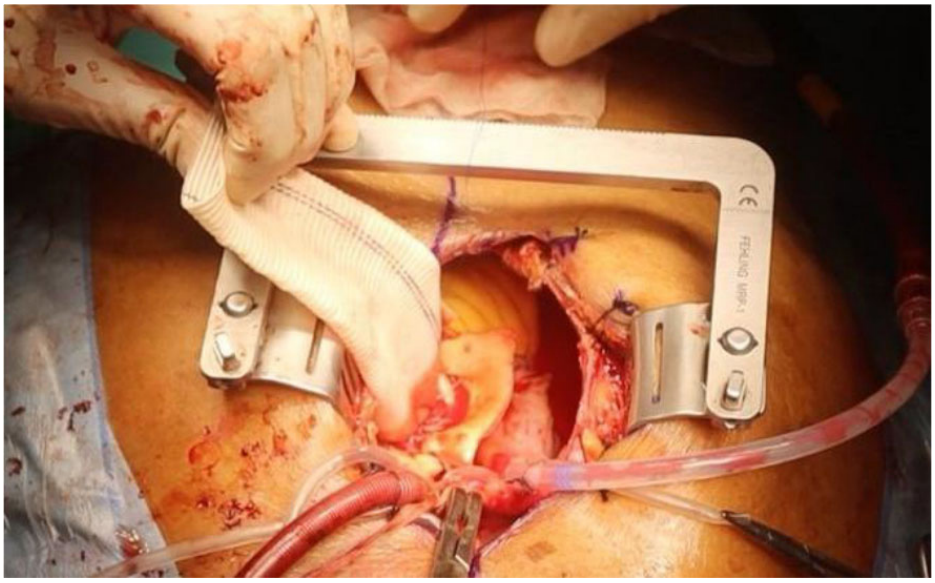

Figure 1. Proximal anastomosis on resected aortic valve with a #28 CAVGJ graft.

Figure 2. J-Sternotomy wound post-operative.

DISCUSSION

Modern cardiovascular and thoracic surgery increasingly prioritizes reducing surgical trauma to promote faster recovery for patients. Minimally invasive surgical techniques are becoming more prevalent, offering clear advantages.[5] With growing expertise in performing aortic valve replacements via upper hemi-sternotomy or right mini-thoracotomy, there is a natural progression towards exploring minimal-access incisions for aortic surgery.

The Bentall procedure is regarded as the standard treatment for patients needing aortic root replacement. Since its inception, advancements in surgical techniques have significantly transformed the procedure. Initially, the procedure had a high rate of complications related to the coronary buttons. Most Bentall procedures involve replacing the aortic root with a mechanical valve conduit, which offers long-term durability but necessitates lifelong anticoagulation, increasing the risk of bleeding. The original Bentall procedure, which involves reimplanting the coronary arteries, has been associated with complications such as difficulties in reattaching the coronary buttons, which may affect coronary circulation. Compared with the Mini-Bentall procedure, which is

a less invasive alternative with a smaller incision, quicker recovery, and potentially less postoperative pain, but might pose more technical challenges and may not be suitable for all cases. Both procedures offer similar long-term results, especially in replacing the aortic root and valve.[6]

Patients undergoing the Mini-Bentall procedure experienced a shorter length of hospital stay (LOS) and significantly reduced ventilator dependency compared to those undergoing the full Bentall procedure.[6] On average, the Mini-Bentall group required 5.5 hours on ventilation versus 17 hours for the full Bentall group, likely due to preserved respiratory mechanics resulting from reduced surgical trauma.[7] Similarly, Mikus and colleagues reported that fewer patients required ventilation for over 96 hours following Mini-Bentall compared to full Bentall.[7] In the Mini-Bentall procedure, there were no reoperations, whereas 4 patients required reoperation for bleeding after complete Bentall procedures.[7] Mini-Bentall had significantly lower drainage than the smaller incision and less tissue dissection, with a smaller surface area amenable to bleeding may explain.[8] There was no difference in stroke, renal failure, or operative mortality between groups.[9]

In this case, we performed a mini-Bentall procedure on a patient diagnosed with severe aortic regurgitation and aortic root dilation. The patient had significant aortic valve insufficiency, leading to chronic volume overload, which contributed to the dilation of the aortic root. The mini Bentall procedure, a less invasive alternative to the traditional Bentall surgery, involved replacing both the aortic valve and the ascending aorta with a composite graft, which allowed for a more precise and efficient treatment of the underlying pathology. Postoperatively, the patient had an excellent prognosis, with a significantly reduced recovery time. The hospital stay was notably short, lasting just one week, a testament to the minimally invasive nature of the procedure and the patient's overall resilience. There was minimal bleeding during and after surgery, and the patient did not require mechanical ventilation, further emphasizing the procedure's success in reducing postoperative complications.

Additionally, the patient's pain levels were well managed, with a noticeable decrease in the Visual Analog Scale (VAS) score. This reduction in pain is attributed to the smaller incision and less trauma to surrounding tissues during the mini-Bentall procedure compared to the traditional approach, leading to improved postoperative comfort and a quicker return to normal activities.

CONCLUSION

Mini Bentall procedure offers a promising alternative to traditional aortic valve and ascending aorta replacement surgeries, particularly for patients with severe aortic regurgitation and aortic root dilation. This minimally invasive approach results in a shorter hospital stay, reduced postoperative pain, and lower complication rate,s such as minimal bleeding and no need for mechanical ventilation. The procedure demonstrates excellent outcomes, with patients experiencing faster recovery and improved overall prognosis. Given these advantages, the mini Bentall procedure can be considered a valuable option for select patients, contributing to enhanced patient comfort and clinical success.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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ETHICAL CONSIDERATION

The patient had received signed written informed consent regarding publication of medical data in a scientific medical journal with confidentiality of personal information.

AUTHOR CONTRIBUTION

All authors had contributed to the manuscript writing and agreed on the final version of the manuscript for publication.

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