Minimally invasive root surgery: a Bentall procedure through a J-ministernotomy

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Clinical vignette

A 43-year-old woman was referred to our hospital with a diagnosis of severe aortic regurgitation and ascending aorta aneurysm (*Video 1*). The patient was classified as New York Heart Association (NYHA) II. Upon admission, a transthoracic echocardiogram showed a bicuspid aortic valve associated with severe aortic regurgitation and normal left ventricular function [left ventricular ejection fraction (LVEF) =65%]. The computed tomography (CT) angiogram confirmed dilatation of the sinuses of Valsalva (42 mm) and ascending aorta (45 mm). Coronary angiography ruled out any significant coronary artery disease. The patient was scheduled for a Bentall procedure through an upper J-ministernotomy (1).

Surgical techniques

General anesthesia was applied according to the standard protocol used for minimally invasive aortic valve surgery. External defibrillator pads were placed and a transesophageal echocardiogram (TEE) probe was set up for intraoperative evaluation of the anatomy and function of the aortic root. Prior to skin incision, the sternal notch and the xiphoid were marked. The skin was next covered from the neck to the knees leaving exposure of femoral vessels. Following a 5 cm skin incision, an upper J-ministernotomy extended to the right fourth intercostal space was performed with a Stryker sternal saw. After pericardiotomy and placement pericardial traction sutures, the ascending aorta, the proximal arch, the right atrium and the right superior pulmonary vein were adequately exposed. The patient was fully heparinized (activated clotting time ≥480 s) and cardiopulmonary bypass (CPB) was instituted by means of standard central cannulation. Aortic cannulation (EZ Glide Aortic Perfusion Cannula, Edwards Lifesciences Irvine, CA, USA) was made in the proximal arch, and a dual-stage venous cannula (VC2™ Atrial Caval Venous Cannulae, Medtronic, Germany) was placed via the right atrial appendage. The right superior pulmonary vein was cannulated (DLP® Medtronic, Germany) for left ventricle venting. A Jackson-Pratt drain was placed from the jugular notch to continuously inflate carbon dioxide into the pericardial cavity. The same drain was used as a pericardial drain at the end of the procedure. At 32 °C internal temperature, the ascending aorta was gently clamped using a specifically designed clamp for minimally invasive interventions (Cygnet® Flexible Clamps, Vitalitec, Plymouth, MA, USA) and opened. Cardioplegic arrest was achieved by means of antegrade selective intracoronary infusion of cold crystalloid cardioplegia (Custodiol, Koehler Chemie, Alsbach-Haenlein, Germany).

The modified 'button technique' Bentall procedure was performed, in the same manner of standard sternotomy approach. In particular, the aortic root was extensively freed from surrounding tissue and the coronary buttons were prepared and fully mobilized for the following re-attachment. The bicuspid aortic valve was removed and a mechanical valved conduit was selected based on the measured size of the aortic annulus (Carbomedics Carbo-Seal 23 mm, Sorin, Milano, Italy). The sewing ring of the composite graft was sutured to the annulus with 2-0 pledgeted Tycron "U" sutures. A 4-0 running

polypropylene suture was used to approximate the aortic remnant to the sewing ring to improve hemostasis. With a cautery, appropriate holes for the re-implantation of the coronary arteries were made in the Dacron graft. First the left, and then the right coronary buttons, were attached using 6-0 polypropylene running sutures. An additional dose of 200 cc of cardioplegia was administered into the composite graft to rule out leaks at the coronary buttons. A fibrin sealant (TISSEEL, Baxter, USA) was used to improve hemostasis. The distal anastomosis was then performed with a continuous 4-0 polypropylene suture after distal aortic preparation with a double internal and external felt strips. The graft was vented with two needles and the left ventricle accurately de-aired. Before aortic declamping, a ventricular pacing wire was positioned on the anterior surface of the right-ventricular and a chest drain tube was inserted from sub-xiphoid place. After CPB was weaned off, TEE documented a well-functioning prosthetic valve and good left ventricle contractility. Protamine was administered to contrast heparinization, and after hemostasis, the pericardium was closed above the valved conduit and sternum closed using four single steel wires. Operative times were as follows: CPB time 123 minutes, and myocardial ischemic time 105 minutes. After 5 hours of mechanical ventilation, the patient was extubated with satisfactory blood gases, blood loss in the first 24 hours was 300 cc, and no transfusion of blood components was necessary. The patient was uneventfully discharged 5 days after surgery.

Comments

The Bentall procedure represents standard treatment for patients with root pathologies. The classic approach for root replacement interventions involves a longitudinal median sternotomy to expose the heart and the aorta, and cannulation of the distal ascending aorta (or aortic arch) and right atrium to establish CPB. However, despite meticulous standardization of the Bentall procedure and its excellent current outcomes, an increasing number of surgeons, experienced in aortic root surgery and well trained to perform minimally invasive aortic valve replacement operations (2,3), initially treat root pathologies through reduced chest incisions aiming to both reducing surgical trauma and improving clinical and cosmetic outcomes (4,5).

Here we presented our Bentall technique through a J-ministernotomy at the 4th intercostal space. This approach provides excellent visualization of fundamental anatomical structures (the aortic root, ascending and aortic arch, main pulmonary artery, superior vena cava, right superior pulmonary vein and the right atrial appendage) and allows the operating surgeons keeping their standard Bentall techniques straightforward and uncomplicated, in every single step of the surgical procedure, with a valuable sense of comfort and safety. In fact, as long as experience in both minimally invasive aortic valve and standard root surgery has been accumulated by the operating team, the learning curve for surgeons, anesthesiologists and scrub nurses does not represent a concern, with techniques and equipment not different from those used in standard interventions.

While cannulation of the femoral vessels is frequently used during minimally invasive valvular interventions to enhance visibility and maneuverability within a reduced working space, central cannulation of the distal ascending aorta (or arch) and right atrium represents our first-choice technique. While this approach may make the preferred operative field appear to be more cumbersome, the main advantages are that it avoids additional skin incisions and infrequent but not impossible severe vascular and embolic complications related to the cannulation of the groin vessels. Central cannulation has been always possible in our experience, both in aortic valve and root surgery. However, very large aneurysms that virtually occupy the entire pericardial space may hamper a safe and well controllable access to the cannulation sites. Under such conditions, we would not hesitate to switch to peripheral femoral or axillary cannulation.

Whether less invasive approaches translate into clinically measurable improved outcomes after Bentall surgery has to be determined. Pending good studies comparing minimally invasive versus standard Bentall interventions, few studies have already demonstrated feasibility and safety of the former ones. As long as minimally invasive Bentall interventions are thoughtfully indicated and safely performed by experienced surgeons, and taking into consideration the patients' appreciation of these minimally invasive procedures, we believe it is worth offering them. For those like us who are at the beginning of their experience with minimally invasive root surgeries, we suggest carefully selecting their initial cases favoring low-risk women with ascending aortic aneurysms <6 cm.

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References

1. Cohn LH, Adams DH, Couper GS, et al. Minimally invasive aortic valve replacement. Semin Thorac Cardiovasc Surg 1997;9:331-6.
2. Cosgrove DM 3rd, Sabik JF. Minimally invasive approach for aortic valve operations. Ann Thorac Surg 1996;62:596-7.
3. Murtuza B, Pepper JR, Stanbridge RD, et al. Minimal access aortic valve replacement: is it worth it? Ann Thorac Surg 2008;85:1121-31.
4. Sun L, Zheng J, Chang Q, et al. Aortic root replacement by ministernotomy: technique and potential benefit. Ann Thorac Surg 2000;70:1958-61.
5. Perrotta S, Lentini S, Rinaldi M, et al. Treatment of ascending aorta disease with Bentall-De Bono operation using a mini-invasive approach. J Cardiovasc Med (Hagerstown) 2008;9:1016-22.

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