

Tips and tricks in transaxillary aortic root surgery: the Bentall procedure

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Clinical vignette

A 74-year-old woman with obesity and arterial hypertension was admitted with acute cardiac decompensation, dyspnea, and bilateral pleural effusions. Echocardiography showed severe aortic regurgitation with a dilated left ventricle. Coronary angiography revealed a small right coronary artery and a very short left main stem with almost separate origins of the left anterior descending and circumflex arteries. Computed tomography (CT) demonstrated a root-dominant aneurysm with an annulus of 25 mm, sinus of Valsalva of 46 mm, sinotubular junction of 50 mm, ascending aorta of 52 mm with a maximum of 54 mm, and 36 mm at the level of the innominate artery. The remaining aorta was free of thrombus, and the common femoral artery measured 9 mm. Aortic root replacement with a valved conduit was indicated (1,2). Three-dimensional planning on the CT dataset identified the fourth intercostal space, directly at the lower border of the pectoralis major, as the access exposing both the aortic root and the distal ascending aorta for a transaxillary Bentall procedure.

Surgical techniques

Preparation

The patient is intubated with a double-lumen tube to allow one-lung ventilation and placed in the left lateral decubitus position with the right arm above the head. The femoral artery and vein are punctured, and 5-French sheaths are inserted before the incision.

Exposition

The skin is incised along the anterior axillary line, the pectoralis major is mobilized and preserved, and the fourth intercostal space is opened while protecting the lung. After systemic heparinization, the sheaths are exchanged over ProGlide closure systems for arterial and venous cannulas, temporary pacing wires are placed, and a soft-tissue

retractor is inserted. The pericardium is opened anterior to the phrenic nerve and suspended with six retraction sutures. Left single-lung ventilation with positive end-expiratory pressure on the left lung shifts the heart toward the incision and further improves exposure.

Operation

The aortic arch is mobilized during brief periods of controlled hypotension. A left ventricular vent and an aortic root vent for cardioplegia are inserted; the aorta is mobilized caudally and, after initiation of root cardioplegia, cross-clamped through the same intercostal space. Cardioplegia is then continued as selective coronary perfusion (*Video 1*).

The distal ascending aorta is mobilized and resected first, followed by proximal mobilization at the sinotubular junction. The three commissures are suspended and the valve inspected. In this case, it was resected rather than repaired because of the patient's age, her decompensated status, and the significant calcification. After debridement, the annulus is sized for the valved conduit. Exposure is then improved by stay sutures that retract the pulmonary artery posteriorly toward the pericardium and the fat pad over the right coronary artery upward and downward against the pericardium with a further stay suture, secured with tourniquets or COR-KNOT fasteners. This maneuver is the key to comfortable root surgery through the limited access.

The coronary buttons are mobilized, right first, then left. Annular sutures are placed as in conventional aortic valve replacement, passed through the soft sewing cuff of the Bentall conduit and secured with the COR-KNOT device after removal of the valve holder. The left coronary button is reimplanted first. The standard graft cautery tip is too short for this approach, so its electrical contact must be extended to create the neo-ostium at the required depth. The anastomosis is performed with continuous 5-0 polypropylene. At the roof, the suture is passed from inside out, and each stitch is tightened individually with a small suture hook to ensure hemostasis. The right button is reimplanted in the same manner.

The distal anastomosis is reinforced with a Teflon felt strip. It is started at a distance with a parachute technique. The graft is then brought into position and the anastomosis completed as a continuous suture with individual tightening of each stitch. A root vent is reinserted into the conduit and the cross-clamp released after meticulous de-airing.

Completion

Vents are removed, temporary pacing wires and drains are positioned, and the pericardial retraction sutures are released. The patient is then weaned from cardiopulmonary bypass under ventilation of both lungs, followed by a systematic assessment of hemostasis. The intercostal space is closed without excessive narrowing, a catheter for continuous ropivacaine infusion is inserted, and the wound is closed in layers.

Comments

Clinical results

A 25-mm KONECT RESILIA valved conduit was implanted. Cross-clamp time was 129 minutes, and the mean transvalvular gradient was 7 mmHg. The patient was extubated after 6 hours, transferred to the ward on the first postoperative day, and discharged on day 8. Postoperative CT showed widely patent, correctly positioned coronary ostia, including the left double ostium, a distal anastomosis close to the brachiocephalic trunk, and no caliber mismatch between graft and native aorta.

Advantages

The approach avoids any sternal or costal division and leaves a scar hidden in the axilla (3). Compared with partial sternotomy, it preserves the entire thoracic cage, which supports early extubation, mobilization, and fast-track pathways (4). Through a single intercostal space, the root, the coronary buttons, and a distal anastomosis close to the brachiocephalic trunk can be reached, so the extent of the repair is not compromised by the access.

Caveats

Patient selection is decisive. CT-based three-dimensional simulation of the intercostal space is mandatory to confirm that both the root and the distal anastomotic site are reachable, and the distal extent of the repair must never be dictated by the access. A calcification-free clamping zone, suitable iliofemoral access, and coronary anatomy that allows safe button mobilization complete the assessment. Venous drainage deserves particular attention, because the pericardial retraction sutures can compress the superior vena cava, which is only kept open by the venous cannula. The cannula must therefore be placed securely in the superior vena cava under transesophageal echocardiographic guidance and, in case of doubt, supplemented by an additional jugular cannula for adequate drainage. For the same reason, the retraction sutures must be released before weaning from cardiopulmonary bypass. Inside-out roof stitches, individual tightening with a suture hook, and a systematic hemostasis check before closure are essential. Cardiopulmonary bypass times are longer than in sternotomy.

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Footnote

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Ethical Statement: Written informed consent was obtained from the patient for the publication of this article and the accompanying video.

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