Case Reports

Aortic Hemiarch Replacement

through a J-Shaped Lower Partial Sternotomy

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Minimally invasive cardiac surgical techniques include the use of partial sternotomy for aortic valve and mitral valve replacement. Partial sternotomy is associated with less pain, better chest and upper-sternal stability, shorter hospital stays, and faster recoveries. However, aortic arch operations are still typically performed through median sternotomies.

We describe the case of a 77-year-old woman who underwent elective hemiarch replacement because of an asymptomatic ascending aortic aneurysm. She requested a minimal incision. Our J-shaped partial lower sternotomy adequately exposed the proximal aorta and enabled all cannulations to be performed through the sternotomy. The patient had an uncomplicated postoperative course. We think that a partial sternotomy for ascending aortic and hemiarch replacement can be considered in selected patients for whom the procedure's benefits are important. ***(Tex Heart Inst J 2015;42(6):582-4)***

Aortic hemiarch replacement is typically performed through a median sternotomy, to enable optimal access to the supra-aortic vessels. We describe our use of a less invasive incision for ascending aortic and hemiarch replacement: a lower partial sternotomy in an active, elderly patient.

Case Report

In August 2013, a 77-year-old woman with hypertension and dyslipidemia presented at our hospital with an asymptomatic ascending aortic aneurysm, detected incidentally on magnetic resonance images of the thoracic spine. A computed tomographic angiogram revealed a dilated ascending aorta (diameter, 5.5 cm) and proximal aortic arch (diameter, 4.3 cm) (Fig. 1). An echocardiogram showed a normal left ventricular ejection fraction, a sclerotic aortic valve, mild-to-moderate aortic insufficiency caused by noncoronary-cusp prolapse, and a dilated aortic root. The patient requested elective hemiarch replacement through a minimal incision.

Through a 10-cm skin incision, we made a J-shaped lower partial sternotomy into the right 3rd intercostal space through a lower pectus excavatum deformity (Fig. 2). The pectus deformity was minor: the heart was not displaced into the left hemithorax. Use of an Estech sternal retractor (AtriCure, Inc.; West Chester, Ohio) provided operative-field exposure (Fig. 3A). Through this incision, the ascending aorta was accessible with no additional cephalad retraction, and the supra-aortic trunks were reached without difficulty after cephalad retraction on the superior aspect of the incision (Fig. 3B). The dilated aortic root was approximately 5 cm in diameter. Heparin was administered. We placed a cavoatrial venous cannula and ascending aortic arterial cannula, a retrograde cardioplegia line, and a left ventricular vent (all Medtronic, Inc.; Minneapolis, Minn) through the right superior pulmonary vein. We placed the ascending aortic cannula on the inner curve of the ascending aorta, 3 cm proximal to the aortic arch—our standard position. Carbon dioxide was used to flood the field. The patient was placed on a heart-lung machine and was cooled to a temperature of 22 °C before hypothermic circulatory arrest was initiated.

To facilitate the view of the hemiarch anastomosis, we left the posterior wall of the distal ascending aorta intact and used it to retract the entire aorta caudally (Fig. 3B). A 26-mm-diameter branched Vascutek® Gelweave™ Ante-Flo graft (Terumo Cardiovascular Group; Ann Arbor, Mich), consisting of a tube-graft with an 8-mm-diameter side branch, was inverted and introduced into the aortic arch in preparation for anastomosis. In this inverted-graft technique, the graft was invaginated so that it

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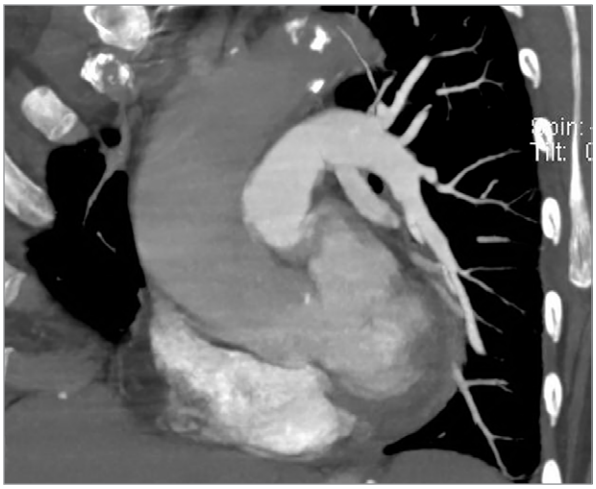

Fig. 1 *Computed tomographic angiogram shows a dilated ascending aorta.*

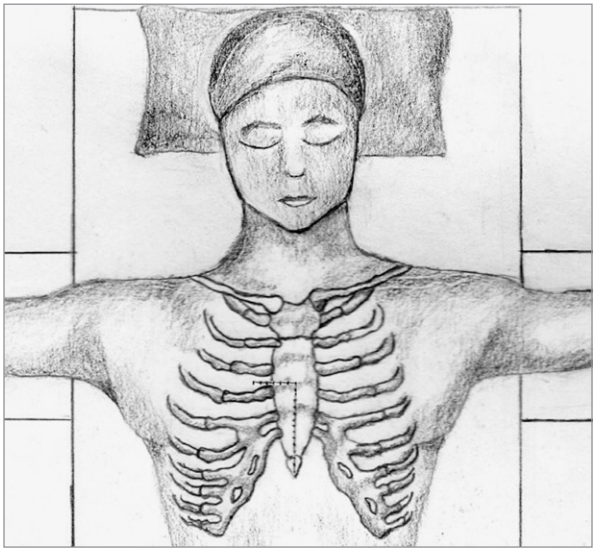

Fig. 2 *Drawing shows the lower partial sternotomy incision for hemiarch replacement (artist: Viviana Juan).*

could be placed entirely in the aortic arch, to improve visibility during the distal anastomosis.

The anastomosis was performed with use of a running 4-0 Prolene suture. The distal anastomosis was achieved by means of the inclusion technique within the posterior wall and with a single running anastomosis in the remainder of the aorta. The invagination was then reduced, and the graft was everted into the surgical field for completion of the proximal anastomosis—similar to the process in an elephant-trunk operation. A side branch was connected to the arterial cannula (Fig. 3C), and reperfusion was initiated after complete deairing of the arch. The circulatory arrest time was 20 min. During rewarming of the patient, we performed Schäfers' aortic valve repair of the noncoronary cusp,[1] plicating the prolapsing leaflet with 6-0 Prolene suture. The plication did not need reinforcement. This maneuver brought the 3 cusps to equal height. Next was annuloplasty of the sinotubular junction with 3 running 5-0 Prolene sutures and bovine pericardial strips. The ascending aortic anastomosis was to the newly reduced sinotubular junction (Fig. 4).

The patient was weaned from cardiopulmonary bypass after 168 total minutes, in sinus rhythm and without inotropic support. The aortic cross-clamp time was 71 min. Five sternal wires were used to close the partial sternotomy. The patient's uneventful postoperative recovery involved extubation within 8 hours, one day in the intensive care unit, and 5 more days of hospital stay. Postoperative echocardiograms showed normal left ventricular function and no segmental wall-motion abnormalities. The patient's aortic regurgitation decreased to trace levels, a finding that was confirmed on an echocardiogram one year later.

Discussion

The benefits of less invasive incisions for cardiac surgery are improved pain control, maintained stability of the chest and upper sternum, and a potential reduction in complications,[2] meaning faster postoperative recoveries and faster returns to full activity. Typically, partial upper sternotomy (ministernotomy) is chosen as a less invasive approach to aortic valve replacement (AVR); the authors of a systematic review reported that patients thus treated had shorter hospital stays, less blood loss, and less dependence on ventilators.[2] A right parasternal incision for AVR has reduced operative morbidity.[3] Upper partial sternotomy has been used in ascending aortic and aortic arch operations, including hemiarch and total arch replacement.[4] A T-shaped partial lower sternotomy beginning at the 2nd intercostal space was used for aortic root and partial arch replacement in a patient with a prior tracheostomy.[5]

Partial lower sternotomy has been reported in 28 patients[6] who underwent mitral valve replacement or repair, tricuspid valve repair, or AVR; 2 of the patients also underwent left internal mammary artery-to-left anterior descending coronary artery anastomosis. Some of the patients needed femoral artery cannulation when their aortic exposure was inadequate.[6] Partial lower sternotomy has also been used for valve replacement in patients who had infectious endocarditis and tracheostomies.[7] The 2 main limitations of partial lower sternotomy are inadequate access to the supra-aortic vessels and the need for femoral cannulation, this last with its own intrinsic limitations.

We contemplated a bilateral transverse submammary incision and total median sternotomy in our patient. However, this would have necessitated removing both of her breast implants and mobilizing more soft tissue,

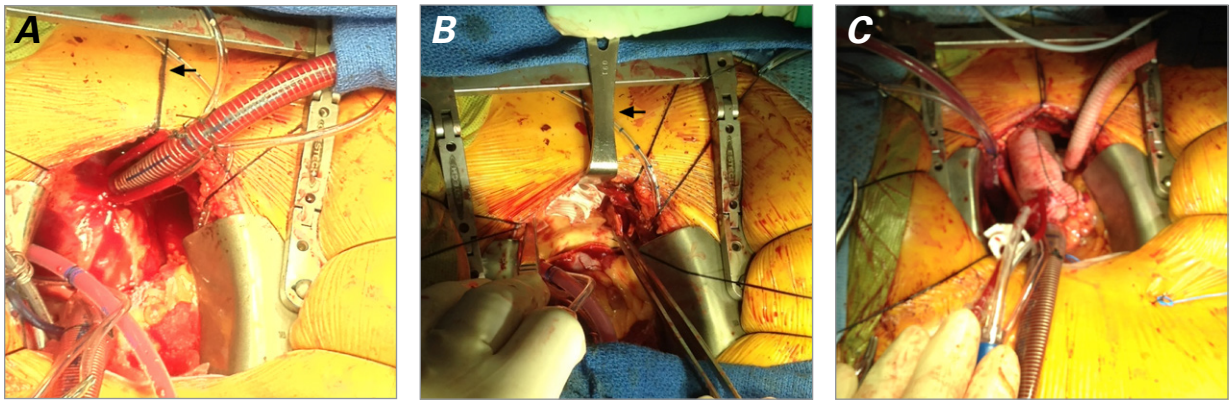

Fig. 3 *Intraoperative photographs show hemiarch replacement through a lower partial sternotomy.* ***A****) Cardiopulmonary bypass is initiated with use of ascending aortic arterial and cavoatrial venous cannulas. The arrow indicates the undivided upper sternum.* ***B****) Exposure for aneurysm resection is facilitated with use of an Army-Navy retractor (arrow). The forceps points to the wall of the aneurysm.* ***C****) Hemiarch replacement is completed with use of a branched-vessel graft.*

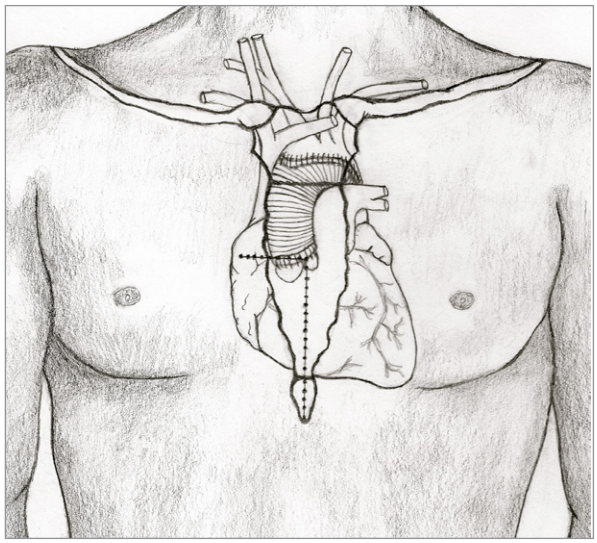

Fig. 4 *Drawing shows completed hemiarch replacement (artist: Viviana Juan).*

with more scarring. Our 10-cm lower skin incision and J-shaped lower partial sternotomy enabled adequate exposure for safe surgery, and all cannulations were performed through the sternal incision. A minimal incision such as this entails additional challenges—among them prolonged time of exposure and more technical difficulty—so it is not appropriate for all patients. However, in experienced hands, lower partial sternotomy can be feasible in anatomically suitable patients who need proximal aortic surgery. We think that a J-shaped partial sternotomy for ascending aortic and hemiarch replacement can be considered in selected patients for whom the procedure's benefits are important.

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