New type A arch dissection stent: restoration of supra-aortic vessel perfusion

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Clinical vignette

A 63-year-old male patient (172 cm, 65 kg, body mass index 22.0 kg/m^2, body surface area 1.77 m^2) suddenly experienced thoracic pain and severe dyspnea, followed by seizures and left-sided hemiparesis. Immediate computed tomography angiography revealed an acute type A/DeBakey type I aortic dissection with a primary entry tear in the ascending aorta. The dissection reached from the aortic root, involving the right and non-coronary sinus, to proximal to the iliac bifurcation. The innominate artery and right common carotid artery were extensively dissected leading to occlusion of the right common carotid artery and consequent cerebral malperfusion with left sided hemiparesis (type-entry-malperfusion classification type A, E1, M2+). On admission, the patient was breathing spontaneously, showing stable hemodynamics and no echocardiographic signs of pericardial tamponade. The corresponding GERAADA score was 22%. Urgent open surgical repair was indicated. The surgical plan was to perform hemiarch replacement in Zone 0 with additional uncovered stenting of the aortic arch using the Ascyrus Medical Dissection Stent (AMDS; Artivion®, Atlanta, GA, USA) to resolve malperfusion and re-establish antegrade flow in the true lumen.

Surgical technique

Preparation

Prior to surgery, two invasive arterial lines were placed in the left radial and left femoral arteries. Near-infrared spectroscopy electrodes were placed bilaterally on the forehead. General anesthesia was initiated using propofol and sufentanil. The patient was placed in a supine position prior to standard sterile draping. Transesophageal echocardiography showed a preserved biventricular function and moderate aortic valve regurgitation.

Exposure

A skin incision was made in the right infraclavicular fossa

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to expose the right axillary artery while preserving the pectoralis muscle and brachial plexus. After systemic heparinization, arterial cannulation using an 18-Fr cannula was performed via the Seldinger technique. Venous cannulation was performed percutaneously via the right femoral vein under ultrasound guidance with a 25-Fr cannula, followed by initiation of cardiopulmonary bypass and careful systemic cooling to approximately 31 ℃ considering the risk of ventricular fibrillation prior to placement of a left ventricular vent. After going on-pump, intraoperative carotid Doppler sonography of the right common carotid artery demonstrated sufficient flow in the true lumen. After median sternotomy, the innominate vein as well as the aortic arch including the brachiocephalic trunk, the left common carotid artery, and the left subclavian artery were carefully exposed. The pericardium was opened, and a left ventricular vent was inserted via the right pulmonary vein and cooling was continued until 28 ℃.

Operation

Retrograde cardioplegia was administered using a balloon-tipped catheter. Upon reaching 28 ℃, the innominate artery and the left common carotid artery were clamped/snared, and flow was reduced to 10 mL/kg/min for unilateral antegrade cerebral perfusion. The ascending aorta was incised and resected down to the sinotubular junction followed by application of selective antegrade cardioplegia. The left subclavian artery was clamped to prevent a steal phenomenon. Distally, the aortic transection was performed carefully in an orthogonal plane to the vessel 1 cm proximal to the innominate artery (Zone 0). The AMDS (tapered; 55 mm/40 mm) was inserted into the true lumen of the aortic arch under direct view. After full insertion in the aortic arch and removal of the sheath, the proximal cuff was fixed to the transected aorta by four cardinal sutures with Prolene 3-0 using a Teflon strip on the outer side. The stent was released, the delivery system removed and a 3-0 Prolene running suture was performed, including the aortic wall layers between the stent cuff and the outer felt stripe utilizing a sandwich technique. The open distal anastomosis was finished by anastomosing the vascular graft with a second 3-0 running suture to the aorta-AMDS complex. The prosthesis was clamped and lower body circulation including rewarming was resumed. After careful inspection of the aortic valve and aortic root, it was decided to preserve the aortic root and aortic valve: the aortic valve was repaired via resuspension of the commissures, the right and noncoronary sinus were readapted using biological glue followed by root reinforcement using an outer Teflon strip. Subsequent water testing indicated a competent aortic valve. Proximal anastomosis was performed in standard fashion.

Completion

After careful de-airing, systemic perfusion was resumed. Reperfusion, de-cannulation, meticulous hemostasis, as well as thorax and wound closure, were uneventful. Due to the malperfusion of the right common carotid artery, the patient was directly transferred to the angiography suite, which found sufficient true lumen perfusion of all supra-aortic vessels. The patient was extubated on the second postoperative day and fully recovered from hemiparesis prior to discharge home. Though no specific anti-platelet or anticoagulant therapy is mandatory for patients who have received the AMDS device, the patient was discharged home on aspirin 100 mg/day due to slight stent flattening phenomenon and status post stroke.

Comments

Open uncovered stenting of the aortic arch using the AMDS hybrid prosthesis may be performed as an adjunct to standard of care hemiarch replacement for the treatment of acute type A/DeBakey type I aortic dissection (1). The unique design reduces the risk of distal anastomotic new entries, restores blood flow of aortic branch vessels and promotes positive aortic remodeling (2). Dissection of supra-aortic vessels is frequently observed in DeBakey type I dissection, carrying the risk of cerebral malperfusion and perioperative stroke. To achieve satisfactory results in terms of AMDS implantation and restoration of true lumen flow of supra-aortic vessels, it is of utmost importance to distinguish between dynamic and static malperfusion, which makes intraoperative carotid ultrasound mandatory. In case of static malperfusion, e.g., caused by false lumen thrombosis, Zone 0 AMDS implantation may not be sufficient to restore supra-aortic vessel perfusion. In these cases, different strategies should be adopted, such as direct cannulation of the affected vessel and debranching. This may also account for combined cases, where false lumen thrombus causes true lumen stenosis without complete occlusion. This underlines the limitations of the AMDS, which does not represent a “one fits all” solution in every scenario. Additionally, aortic arch tears, including re-entries

in the supra-aortic vessels, represent contraindications for this device in case of Zone 0 anastomosis (3). Due to its uncovered design, false lumen flow may not be sufficiently reduced under these circumstances, leading to negative aortic remodeling and consecutive complex reinterventions on the aortic arch (4). This highlights the importance of adequate patient selection for this device to achieve excellent results.

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Footnote

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