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Application of Cerebral Protection System in Open Mitral Replacement with Extensive Calcified Left Atrial Thrombus

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Abstract

Neurological complications remain a major burden in cardiac surgery, despite various intraoperative measures attempting to reduce its occurrence. Advancement of percutaneous approach in valve replacement has brought focus to the use of cerebral protection system (CPS). We reported a novel application of percutaneous CPS in open heart surgery for a patient with an extensive calcified left atrial thrombus to reduce risk of embolic stroke. Although, there is no evidence to advocate routine use of CPS in all open cardiac surgical patients, we believe it is a technically feasible and probably safe approach for neurological protection in high-risk patients.

Keywords

cardiac surgery, cerebral vascular disease, stroke, endovascular

Introduction

Neurological complications remain a major burden in cardiac surgery, despite various intraoperative measures attempting to reduce its occurrence. Advancement of percutaneous approach in valve replacement has brought focus to the use of cerebral protection system (CPS). We report a successful application of the Sentinel™ device (Claret Medical, Santa Rosa, CA, USA) in a patient who had severe mitral stenosis with concomitant extensive calcified thrombus in the left atrium. Under the setting of hybrid operating theater, the Sentinel™ system was placed under fluoroscopic guidance and followed by open transseptal mitral valve replacement and tricuspid annuloplasty.

Case Report

A 66-year-old female with history of atrial fibrillation on appropriate dose of warfarin for 2 years presented with shortness of breath on minimum exertion. Initial chest X-ray showed cardiomegaly and calcified left atrium (Fig. 1). Echocardiogram showed severe mitral stenosis and moderate tricuspid regurgitation, left ventricular ejection fraction of 61%, and right ventricular systolic pressure of 77 mmHg. Left atrium was dilated to 55 mm with thrombus and calcification. Coronary angiogram demonstrated normal coronary anatomy. Computed tomography (CT) of thorax demonstrated focally and heavily calcified left atrium with thrombus and mediastinal lymph nodes, and there was no significant aortic calcification. Mediastinal lymph nodes were confirmed tuberculosis and treated with 6 months of antituberculosis treatment. Progression CT thorax demonstrated the resolved mediastinal lymph nodes and persistent calcified left atrium with thrombus despite appropriate preoperative anticoagulation (Fig. 2a).

Elective mitral valve replacement and tricuspid annuloplasty were offered for her after treatment of tuberculosis. In view of the densely calcified left atrium with heavy load of thrombus, there is significant discernible perioperative risk of embolic cerebrovascular event. Given the safety and efficacy from the SENTINEL (Cerebral Protection in Transcatheter Aortic Valve Replacement) trial for transcatheter aortic valve replacement patients,[1] we decided and offered the use of CPS to reduce the risk of cerebral embolic event in her open-heart surgery. In addition, to minimize manipulation of the heart chambers, transseptal approach was planned. Preoperative CT was reviewed with the heart team of

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Fig. 1. Preoperative chest X-ray with arrow pointing at the calcified left atrial edge.

our institute to confirm anatomical feasibility of the Sentinel™ device deployment.

In the hybrid operative theater, right radial artery and right femoral artery access was established with Fr 6 arterial sheaths under ultrasound guidance, and 3,000 U of heparin was given intravenously. Aortogram for road mapping guiding the device deployment was performed with pigtail catheter via femoral access and the percutaneous Sentinel™ device was deployed through the radial arterial access. The pigtail catheter at the aortic arch was removed after positions of the baskets were confirmed with aortogram and secured at the brachiocephalic and left common carotid artery respectively.

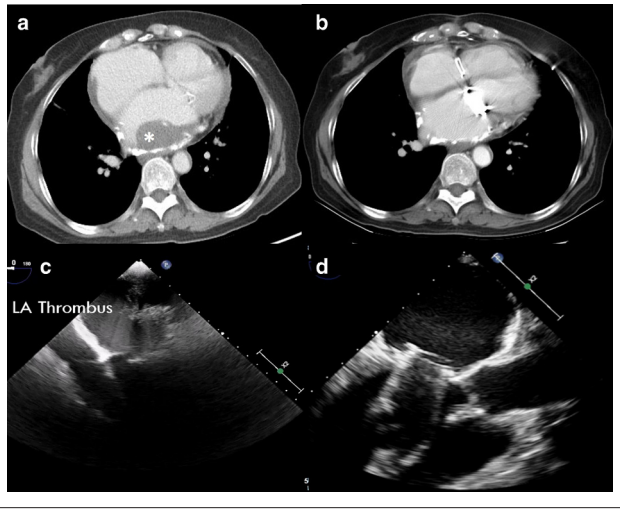

Fig. 2. (a) Preoperative CT of thorax, * denotes the LA thrombus on the calcified atrial wall. (b) Follow-up CT thorax showing the left atrium with minimal atrial thrombus. Intraoperative transesophageal echocardiogram (c) before and (d) after thrombectomy. (c) LA thrombus and (d) left atrium largely free of thrombus. CT, computed tomography; LA, left atrial.

Median sternotomy was performed, and full-dose systemic heparin was loaded according to body weight to achieve activated clotting time of more than 400 seconds. The patient was cannulated routinely with arterial cannulation through the ascending aorta and venous bicaval cannulation. Right atriotomy and transseptal left atrial exposure were followed (Fig. 3a).

The left atrium was thickened and heavily calcified over the roof and posterior wall, and the contractility was limited by the intramural calcification shown on the perioperative transesophageal echocardiogram (TEE) (Fig. 2c). There was extensive thrombus within the left atrium extending into the left atrial appendage and was partially obstructing the exposure to the mitral valve. The thrombus was in "mud-like" consistency, fragile, and scattered with minimal manipulation (Fig. 3b). Meticulous thrombectomy was performed under thoracoscopic assistance to improve visualization; repeated lung inflation with saline flushing to aspirate small thrombus within pulmonary veins was done until there was no gross thrombus fragment seen. There was infiltrative calcification into the left atrial wall, and further decalcification might lead to perforation of the left atrium; therefore, we decided not to completely remove.

The mitral valve was calcified with calcification extending from leaflets to subvalvular apparatus while mitral annulus was relatively spared. After excision of calcified mitral leaflets, a mechanical prosthesis (St Jude Medical MHP Size 25 [St Jude Medical, Inc, St Paul, MN, USA]) was placed supra-annularly. The interatrial septal incision was closed and tricuspid valve annuloplasty (Carpentier-Edwards Physio Annuloplasty Ring size 30 [Edwards Lifesciences LLC; Irvine, CA, USA]) was performed. The patient was weaned from cardiopulmonary bypass without problem and the operation was completed in the usual manner. TEE showed functioning of mechanical mitral prosthesis and trivial tricuspid regurgitation. The left atrial wall was thickened but there was no gross mobile thrombus noted (Fig. 2d).

The Sentinel™ device was then retrieved under fluoroscopy and heparin reversal with protamine was given while the aortic cannula was removed last. The baskets of the Sentinel™ device were examined and revealed pieces of captured thrombus (Fig. 3c). Total cardiopulmonary bypass time was 183 minutes and cardiac ischemic time 138 minutes.

Postoperative course was uneventful with full neurological function assessed by neurologist and the patient was discharged on day 17. Follow-up CT brain with no major infarct and CT thorax showed largely resolved thrombus (Fig. 2b). The pathological assessment of collected debris was diagnosed as debris with blood clot.

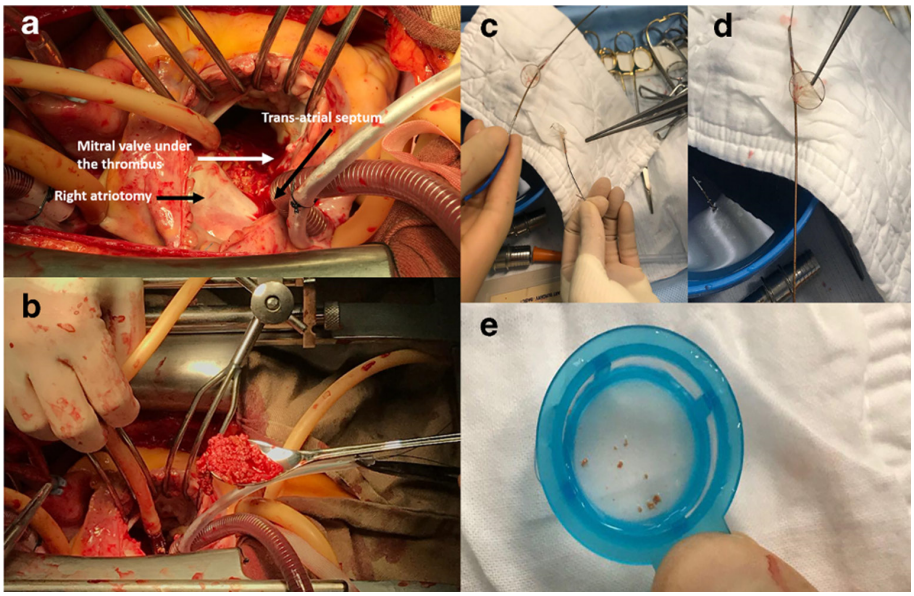

Fig. 3. (a) Transseptal approach of the left atrium through right atriotomy, mitral valve was obstructed by the left atrial thrombus. (b) Left atrial thrombectomy with "mud-like" thrombus. (c–e) Retrieved cerebral protection device with the captured thrombus.

Discussion

We reported a novel and hybrid application of percutaneous CPS in open heart surgery for a patient with an extensive calcified left atrial thrombus to reduce risk of embolic stroke. It is well established that aortic atheroma is a risk factor for cerebral embolization in cardiac surgery.[2] However, with the extensive calcification in this patient and the need for mitral valve replacement, the risk of neurological complication was considered substantial. We believe an integrated approach with CPS and concomitant open mitral valve replacement is the best solution for her condition. Furthermore, the decision of transseptal approach for mitral and tricuspid valve surgery was made to minimize the manipulation of heart,[3] avoiding the possible dislodgement of thrombus or left atrial rupture. The use of mechanical valve was based on discussion with the patient and the left atrial appendage was rigid with egg-shell calcification, and direct ligation or excision was considered not feasible. We believe the multiple measures on the perioperative planning and monitoring facilitated the encouraging outcome for this patient.

This case had brought on the evolving collaboration of the heart team in terms of importance of the integrational application of transcatheter techniques by cardiac surgeons. Our approach presented a feasible application of Sentinel™ CPS in open cardiac surgical patient.

There is no conclusive evidence to advocate routine use of CPS in all open cardiac surgical patients, in addition to that the Sentinel™ CPS does not offer a full anatomical cerebral protection[1] and the evidence on the clinical effect from other CPS devices was not convergent. Some devices have been shown to reduce lesion volume and extraction of emboli;[4] however, a recent randomized control trial did not show a reduction of neurological infarction.[5] Nevertheless, given the substantial thrombus load and multivalvular procedures from this case, we believe such integrated approach is technically feasible and probably safe for neurological protection in this high-risk group of patients.

Declaration of Conflicting Interests

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