Re-operative aortic valve replacement via upper partial re-sternotomy in a patient with patent internal thoracic artery after coronary artery bypass grafting: A case report

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Abstract

A 71-year-old man who had undergone coronary artery bypass grafting with left internal thoracic artery (LITA) and saphenous vein graft (SVG) 7 years previously was referred to our hospital for dyspnea on exertion. Transthoracic echocardiography (TTE) showed severe aortic stenosis and regurgitation. Contrast-enhanced computed tomography revealed patent LITA anastomosed to the left anterior descending (LAD) coronary artery and SVG to the left circumflex artery near the ascending aorta. Re-operative aortic valve replacement (AVR) was performed via upper partial re-sternotomy through an inverted T-shaped incision. The patent LITA was dissected and clamped successfully with minimal adhesion detachment. Postoperative TTE revealed a patent LITA anastomosed to LAD. No complications occurred, and the patient was discharged on postoperative day 17.

Introduction

With the aging of the population and improvement in survival rates, the incidence of re-operative cardiac surgery is increasing. Re-operative aortic valve replacement (AVR) with a patent internal thoracic artery (ITA) previously anastomosed to the left anterior descending (LAD) is challenging. Adequate myocardial protection is required while cross-clamping the aorta to dissect and clamp the ITA and prevent cardioplegia washout. However, several fatal complications, such as ITA graft injury, catastrophic bleeding, and myocardial damage, can occur. Conventional re-operative cardiac surgery with patent ITA anastomosed to the coronary artery involves re-sternotomy, adequate tissue detachment, and ITA clamping during aortic cross-clamping. Herein, we report a case of re-operative AVR in a patient with a patent left ITA (LITA) flow to LAD after coronary artery bypass grafting (CABG).

Case Report

A 71-year-old man was referred to our hospital for dyspnea on exertion. His medical history included type 2 diabetes mellitus, chronic renal failure, right femoropopliteal bypass due to arteriosclerosis obliterans (ASO), and CABG with LITA to LAD and saphenous vein graft (SVG) to the left circumflex artery anastomoses 7 years previously. Cardiac examination revealed a grade 3/4 systolic murmur in the auscultation area of the aortic valve. The ankle–brachial pressure index in the right and left leg was 0.87 and 0.70, respectively. Transthoracic echocardiography (TTE) revealed a left ventricular ejection fraction of 70%, severe aortic stenosis with an aortic valve effective orifice area of 0.9 cm^2, transvalvular peak pressure gradient of 63 mmHg, and peak velocity of 4.0 m/s. Moreover, moderate aortic valve regurgitation was observed. Hematological examination revealed creatinine and blood urea nitrogen levels of 3.43 mg/dL and 71.0 mg/dL, respectively. Contrast-enhanced computed tomography revealed patency of the LITA to LAD and SVG to left circumflex artery anastomoses (Fig.1A), calcification of the ascending aorta (Fig.1B), and that the ITA graft was near the ascending aorta (Fig.2). Because of severe ASO, we decided to cannulate the ascending aorta.

Surgery was performed via an upper partial re-sternotomy through an approximately 8-cm inverted T-shaped incision in the fourth intercostal space. After careful adhesiotomy around the right side of heart and ascending aorta, LITA and SVG were secured without damage. Cardiopulmonary bypass was established with cannulation of the ascending aorta, superior vena cava and right atrium. An antegrade cardioplegia line was inserted into the ascending aorta and a left ventricular vent was placed through the right superior pulmonary vein. After aortic cross-clamping and ITA and SVG clamping, cardiac arrest was achieved using antegrade crystalloid cardioplegia. Additional cardioplegia was selectively administered to the left coronary artery via a transverse aortotomy. Next, the aortic valve leaflet with advanced calcification was excised and a 19-mm Carpentier-Edwards Perimount Magna bioprosthesis (Edwards Lifesciences, Irvine, California, United States of America) was implanted in the supra- every noun.annular position (Fig 3). The total bypass time, aorta cross-clamp time, and total operation time was 135 min, 90 min, and 310 min, respectively. The postoperative bleeding was 500 mL. The patient was weaned from the ventilator on the operative day and discharged from the ICU on postoperative day 3. No complications occurred, and the patient was discharged on postoperative day 17. Postoperative TTE revealed a well-functioning prosthetic aortic valve and LITA flow to LAD.

Discussion

A previous study reported an in-hospital mortality of re-operative AVR after CABG of 6.4-17%[1]. Byrne et al. reported that the incidence of perioperative myocardial infarction, stroke, and ITA injury in re-operative AVR after CABG with single ITA is 7%, 11% and 6.8%, respectively[2].

Full re-sternotomy and tissue detachment can increase the incidence of cardiac structural damage, bleeding, ITA injury, prolonged operative time, and massive transfusion and prolongs intensive care unit stay. ITA injury is associated with a mortality rate of 50% and perioperative myocardial infarction rate of 40%[3].

Minimally invasive re-operative AVR (MIrAVR), via a partial sternotomy (upper, lower, or inverted T-shaped) and right mini thoracotomy is an alternative approach to the conventional strategy. Since minimally invasive access to the aortic valve was first reported in 1996, it has become the standard approach for aortic valve surgery[4]. The smaller surgical scar achieves early ventilator weaning, lesser wound pain, lesser bleeding, and shorter hospital stay compared with a full sternotomy[5]. Moreover, in patients with a high risk of postoperative mediastinitis, such as those with diabetes, chronic renal failure, frailty, and chronic obstructive pulmonary disease, the risk may be reduced by making the sternotomy as small as possible. For successfully achieving MIrAVR, preoperative evaluation of the graft routes, positional relationship between grafts and mediastinal structures, and extent of tissue adhesion using computed tomography is important. In this case, the ITA was located near the aorta; thus, it was determined that ITA identification was possible with minimal dissection of adhesions through a partial upper sternal incision. However, if graft dissection is difficult, surgery under hypothermic ventricular fibrillation, balloon occlusion of the ITA graft, or securing the ITA via a left axillary approach should be considered. However, hypothermia may increase bleeding due to prolonged extracorporeal circulation time, and the balloon may cause ITA injury [2,6,7].

Transcatheter aortic valve implantation (TAVI) is aggressively performed in high-risk patients, such as very elderly or frail patients, and those with hepatic cirrhosis, chronic obstructive pulmonary disease, and bleeding tendency[8]. A study comparing the outcomes of re-operative AVR after CABG and TAVI suggested that when transfemoral TAVI is not possible, it may be not the best option on behalf of re-operative AVR[9]. In this case, it was considered that TAVI would have worse outcomes than re-operative AVR due to ASO.

CONCLUSIONS

In re-operative AVR via upper partial re-sternotomy after CABG with patent bypass grafts, MIrAVR may prevent fatal complications, such as graft injury, by minimizing tissue detachment. Although further development of the TAVI technology is expected to change treatment methods in the future, MIrAVR after

CABG is currently a viable treatment option.

References

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Figure legends

Fig 1A. Contrast-enhanced computed tomography shows patent anastomoses of LITA to LAD (white arrow) and SVG to Lcx (black arrow).

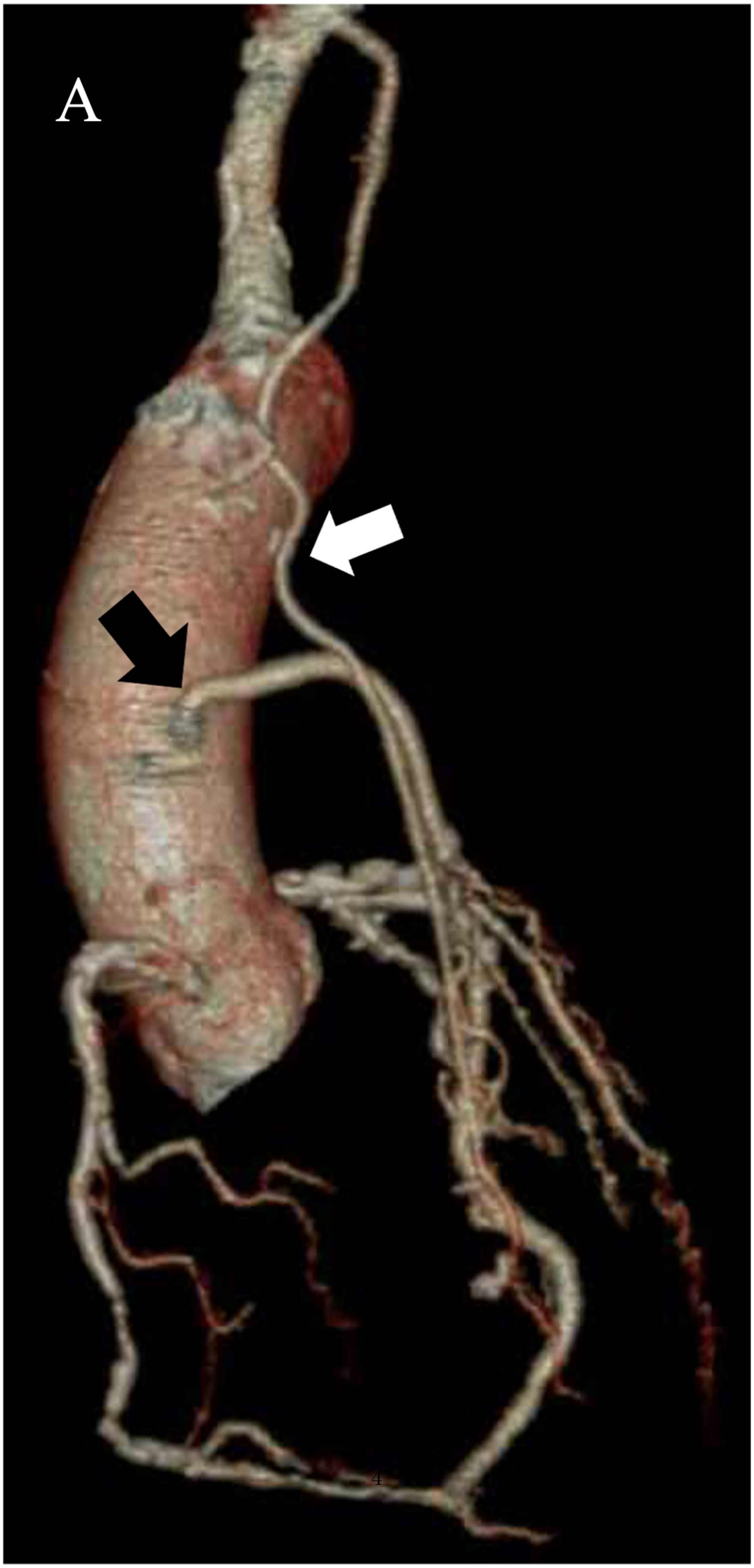
Fig 1B. Contrast-enhanced computed tomography shows calcification of the ascending aorta.

LITA, left internal thoracic artery; Lcx, left circumflex artery

Fig 2. Contrast-enhanced computed tomography scan shows the ITA graft near the ascending aorta (white arrow).

ITA, internal thoracic artery

Fig 3. Re-operative aortic valve replacement is performed via upper partial re-sternotomy with an inverted T-shaped incision. Grafts are secured without damage (white arrow).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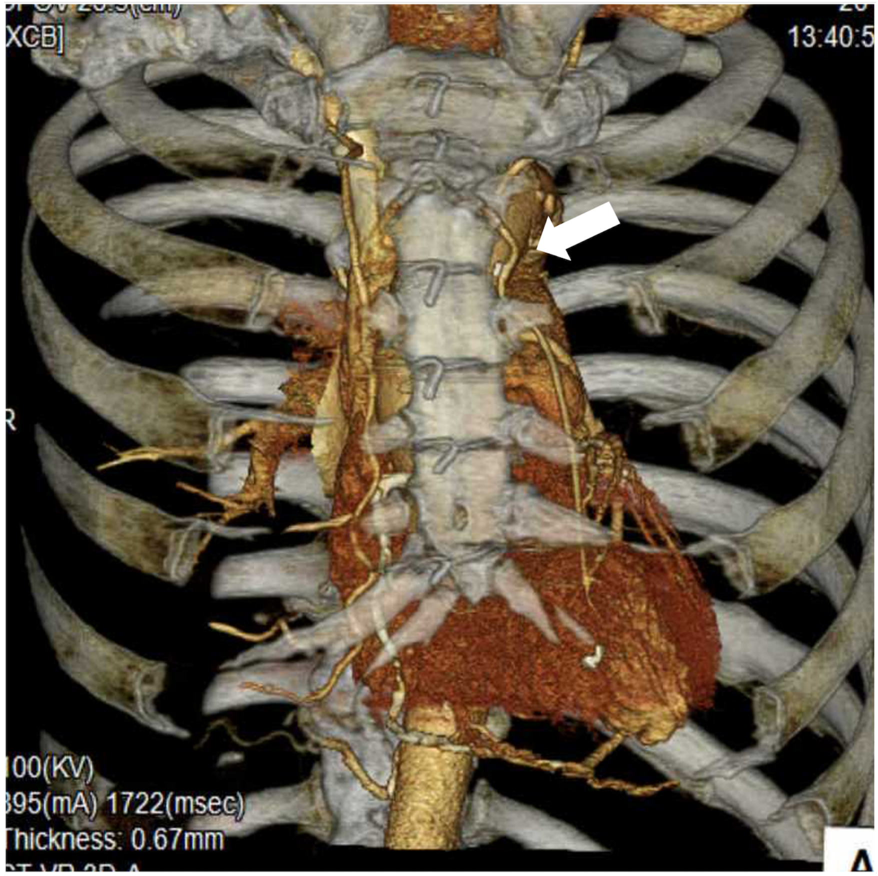
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