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CASE REPORT

Successful surgical treatment of a giant right coronary artery aneurysm with a patent left internal thoracic artery graft

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Abstract We report a rare case of a giant right coronary artery aneurysm 13 years after coronary artery bypass grafting. Coronary angiography at the time of primary surgery demonstrated irregular aneurysmal dilatation in the mid-right coronary artery that expanded greatly over a 13-year period to a maximum diameter of 80 mm. The patient underwent aneurysmectomy and interposition using a saphenous vein graft through a right lateral thoracotomy. The patient did not undergo dissection or clamping of the left internal thoracic artery graft, and myocardial protection was obtained using systemic hypothermia and hyperkalaemia in addition to continuous antegrade cardioplegia. Postoperatively, coronary computed tomography showed a lack of residual aneurysm and good flow in the saphenous vein graft. The patient made an uneventful recovery.

Keywords Coronary artery aneurysm · Coronary artery bypass grafting · Reoperation

Introduction

Coronary artery aneurysm (CAA) is a rare condition for which the clinical course remains unclear. Currently, no standardised treatment protocol exists, and surgical treatment includes aneurysmectomy and coronary artery bypass grafting (CABG). Most surgical treatment is primary surgery via median sternotomy, although a few cases of redo surgery for saphenous vein graft aneurysm performed though re-sternotomy have been reported. Re-sternotomy and dissection in patients who have a patent internal thoracic artery graft may result in a greater risk of injury. We present a case of giant right coronary artery aneurysm after CABG in which the patient underwent aneurysmectomy and interposition without dissection and clamping of the left internal thoracic artery (LITA) graft through a right lateral thoracotomy.

Case

A 77-year-old man was referred to our hospital after chest radiographic abnormalities were noted. He had a history of hypertension, dyslipidaemia, diabetes mellitus, and angina pectoris; he had undergone CABG involving the LITA to the left anterior descending artery (LAD), radial artery to the distal left circumflex artery, and right gastroepiploic artery (GEA) to the distal right coronary artery (RCA) 13 years earlier. Coronary angiography performed at the time of primary surgery demonstrated an irregular aneurysmal dilatation in the mid-RCA (maximum diameter 7.9 mm; Fig. 1a). Upon admission, physical examination revealed normal S1 and S2 heart sounds without murmur. Coronary angiography revealed that all grafts were patent and the RCA was aneurysmal (Fig. 1b), and computed tomography revealed a giant aneurysm originating from the mid-RCA (maximum diameter 80 mm; Fig. 1c).

Surgery was performed through a right lateral thoracotomy along the fifth intercostal space under a cardiopulmonary bypass established via cannulation of the right axillary artery and right common femoral vein. A giant right CAA was observed in the lateral surface of the heart (Fig. 2a). Access was obtained for antegrade cardioplegia.

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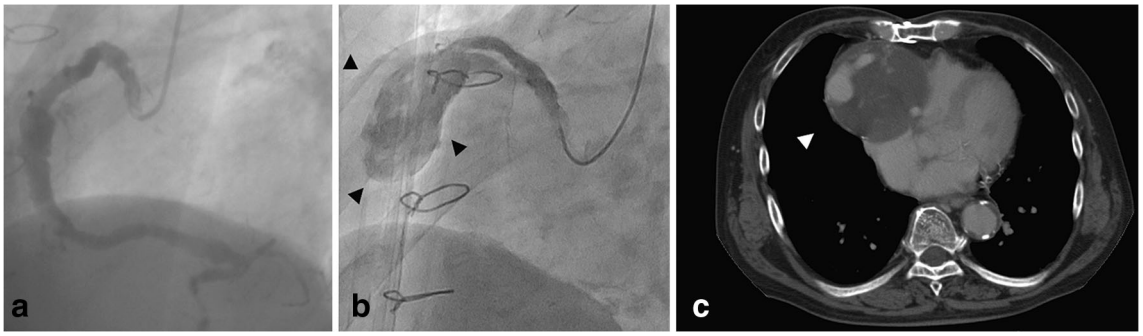

Fig. 1 Coronary angiography findings of the right coronary artery obtained 13 years previously (**a**) and preoperatively (**b**). A computed tomography scan showing a giant aneurysm (*arrowheads*) (**c**). *Arrowheads* aneurysm

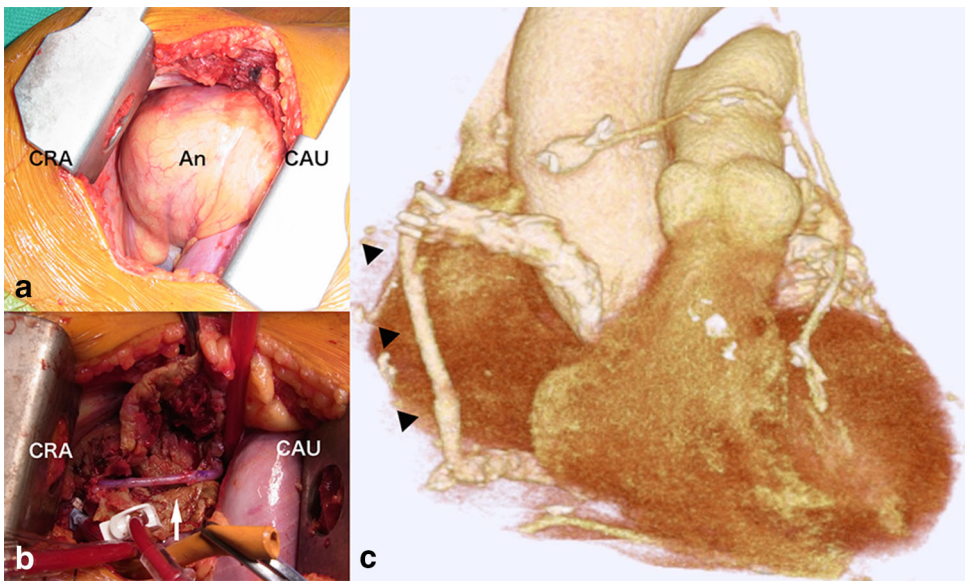

Fig. 2 Operative photographs showing a giant aneurysm of the right coronary artery (**a**) and interposition using a saphenous vein graft (**b**). A computed tomography scan showing no residual aneurysm and good flow through the saphenous vein graft (*arrowheads*) (**c**). *An* aneurysm, *CRA* cranial, *CAU* caudal, *arrow* saphenous vein graft

Preoperative computed tomography showed the LITA graft running along the left side of the main pulmonary artery, and the distance between the LITA graft and the ascending aorta was sufficient to clamp the aorta safely. The patient did not undergo dissection or clamping of the LITA graft. Aortic clamping was performed, and subsequent cardioplegic arrest was obtained. Myocardial protection was obtained using systemic mild hypothermia (30 °C) and hyperkalaemia (6–7 mEq/L) in addition to continuous antegrade cardioplegia; cardiac activity was not seen. Aneurysmectomy and interposition were performed under cardioplegic arrest. The GEA was grafted to the chronic, totally occluded distal RCA; the graft did not supply perfusion to the whole RCA territory. Therefore, this patient underwent interposition in addition to aneurysmectomy. The aneurysm was incised longitudinally and was found to contain a large thrombus. The proximal and distal aneurysmal lumens were identified, and the aneurysmal segment of the RCA was resected. The saphenous vein was anastomosed to the proximal and distal openings of the aneurysm (Fig. 2b). Ventricular fibrillation occurred during terminal warm cardioplegia; however, the patient underwent defibrillation soon and his cardiac function did not decrease significantly after the release of aortic cross-clamping. Hence, the cardiopulmonary bypass could be easily discontinued. The total operative time was 255 min, with the cardiopulmonary bypass time being 105 min and the aortic-cross clamp time being 52 min. Histopathological examination showed hyperplasia of the fibrous tissues of the arterial wall with hyaline degeneration and calcification including thrombosis. There were no significant postoperative changes on the electrocardiogram, and the peak creatine kinase-myocardial band value was 32 U/L at 16 h postoperatively. The patient made an uneventful recovery. At 7 days postoperatively, coronary computed tomography showed a lack of residual aneurysm and good flow in the saphenous vein graft (Fig. 2c). At the 4-week regular follow-up examination, the patient was

asymptomatic. One year after the resection, the patient presented at our hospital for follow-up coronary computed tomography showing good flow in the conduit and no residual aneurysm. The patient was in excellent physical condition.

Discussion

The clinical course of this patient suggests two important clinical issues. First, re-operative surgical correction of a right CAA with a patent LITA to LAD graft can be performed safely via a right lateral thoracotomy. Second, CAAs can expand greatly over the long term even if the initial diameter is small.

Right lateral thoracotomy is safe and effective for re-operative surgical correction of a right CAA with a patent LITA to LAD graft. The surgical technique for CAA is still controversial, and there is no consensus regarding the optimal surgical strategy. Previously, surgical resection for right CAA via median sternotomy has been reported [1–4]. However, we selected right lateral thoracotomy along the fifth intercostal space because of the patent LITA-LAD graft and right lateral location of this aneurysm. The potential benefits of this approach are the avoidance of sternal re-entry and limited dissection of adhesions. This approach enables easy access to the right CAA, regardless of an adhesion. Then, we induced mild hypothermia (30 °C) and systemic hyperkalaemia (6–7 mEq/L), in addition to continuous antegrade cardioplegia, for myocardial protection. Cardiac activity was not seen. Postoperatively, there were no significant changes on the electrocardiogram and no elevated cardiac enzyme levels. Thus, we believe that this technique could provide sufficient myocardial protection. Furthermore, bleeding from the proximal openings of the aneurysm was minimised by cardiac arrest and a bloodless field was obtained. It should be noted that aortic cross-clamping might be dangerous for patent LITA grafts, and it is important to evaluate the course of the LITA graft carefully and its proximity to the ascending aorta preoperatively by using computed tomography. This approach, which leaves the patent LITA graft open during aortic cross-clamping, has been reported to reduce patent graft injury and bleeding and minimise cardiac dissection and exposure with no effect on mortality [5]. In this case, right lateral thoracotomy without LITA graft dissection enabled easy access to the right CAA and avoided LITA graft injury.

Secondly, CAAs can expand greatly over the long term, even if the initial diameter is small. Coronary artery aneurysm is defined as "coronary dilatation with a diameter of $\geq$1.5 times the normal coronary artery" [6]. Dilatation of the coronary diameter relative to a normal adjacent segment, regardless of the absolute diameter, is an important definitive criterion of a CAA. The present case satisfied this criterion of CAA at the time of primary CABG. When a patient with a coexisting CAA of any diameter undergoes cardiac surgery, concomitant surgery or careful follow-up should be considered.

Causative factors of CAA include atherosclerosis, Takayasu arteritis, congenital disorders, Kawasaki disease, and percutaneous coronary intervention [7]. Saphenous vein graft aneurysm after CABG has also been reported; such cases include true aneurysms that occur during the late postoperative period or previously present pseudo-aneurysms [8]. Dissection can be due to procedural trauma during percutaneous intervention or surgery, and pseudo-aneurysms often occur as a result [9]. In this case, the patient had no obvious significant past medical history. The histopathological examination showed thrombosis and atherosclerosis inside the aneurysm. We believe the reason for aneurysmal change is atherosclerosis, independent of anastomosis or trauma. Atherosclerotic CAA, as well as aneurysms at other sites, can be reasonably expected to undergo dilatation over the long term, necessitating careful follow-up.

In conclusion, right lateral thoracotomy is safe and effective for re-operative surgical correction of a right CAA with a patent LITA to LAD graft. Furthermore, CAA can expand greatly over the long term, despite a small initial diameter. Based on the present case, we believe that patients with CAA should be carefully followed up, and indications for concomitant surgical correction should be considered in patients with CAA who may undergo cardiac surgery.

Compliance with ethical standards

Conflict of interest The authors have declared that no conflict of interest exists.

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