Case Report

Combined Aortic Valve Replacement and Coronary Artery Bypass Grafting with in situ Arterial Grafts for Porcelain Aorta

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Patients with porcelain aorta carry a high risk of cerebral as well as systemic embolism during cardiac surgery. Here we describe a case of severe aortic stenosis and coronary artery disease combined with the circumferentially calcified aorta. The patient was a 77-year-old man who successfully received four coronary artery bypass grafts with in situ arterial grafts without clamping the aorta and aortic valve replacement. Aortic valve replacement and two distal coronary artery anastomoses to the left circumflex artery and obtuse marginal branch were performed under cardiac arrest during hypothermic perfusion with endoaortic balloon occlusion, followed by partial endarterectomy and closure of the aorta buttressed with bovine pericardium under deep hypothermic circulatory arrest. While rewarming, the other two distal coronary anastomoses to the left anterior descending artery and diagonal branch were done on the beating heart in order to minimize cardiac arrest time. On-pump beating heart coronary artery bypass grafting (CABG) can be useful especially for combined complex cardiac surgery. (Ann Thorac Cardiovasc Surg 2003; 9: 206–8)

Key words: porcelain aorta, balloon occlusion, aortic stenosis, hypothermic circulatory arrest

Introduction

The operative management of a patient with porcelain aorta for cardiac surgery can be difficult and complex because of the increased risk of perioperative atheroembolism.[1,2] We reported the case of a 77-year-old man who successfully underwent combined cardiac surgery such as aortic valve replacement and partial endarterectomy of the ascending aorta as well as four coronary artery bypass grafting (CABG).

Case Report

A 77-year old man was admitted to National Hospital Kure Medical Center after having suffered from effort angina for six months. Coronary angiography showed severe double vessel disease with stenoses of the left anterior descending artery (LAD) (#7: 75%), the second diagonal branch (D2) (#10: 90%), left circumflex artery (LCX) (#11: 90%), and obtuse marginal branch (OM) (#12: 90%). Echocardiography showed aortic stenosis (AS) with a pressure gradient of 60 mmHg and good contraction (ejection fraction of 55%). Chest computed tomography (CT) demonstrated the circumferentially calcified "porcelain" aorta in the ascending position (Fig. 1).

Operation

He was found to have a heavily calcified ascending aorta. After the ascending aorta and aortic arch were evaluated with epicardial echocardiography, a soft spot on the aortic arch without disease was found and chosen for cannulation. A left ventricular vent and retrograde cardioplegic line were inserted. The patient was cooled down to 18°C. During cooling, the proximal radial artery was connected to the left internal thoracic artery (LITA) in a Y fashion. When the nasopharyngeal temperature reached 24°C, the

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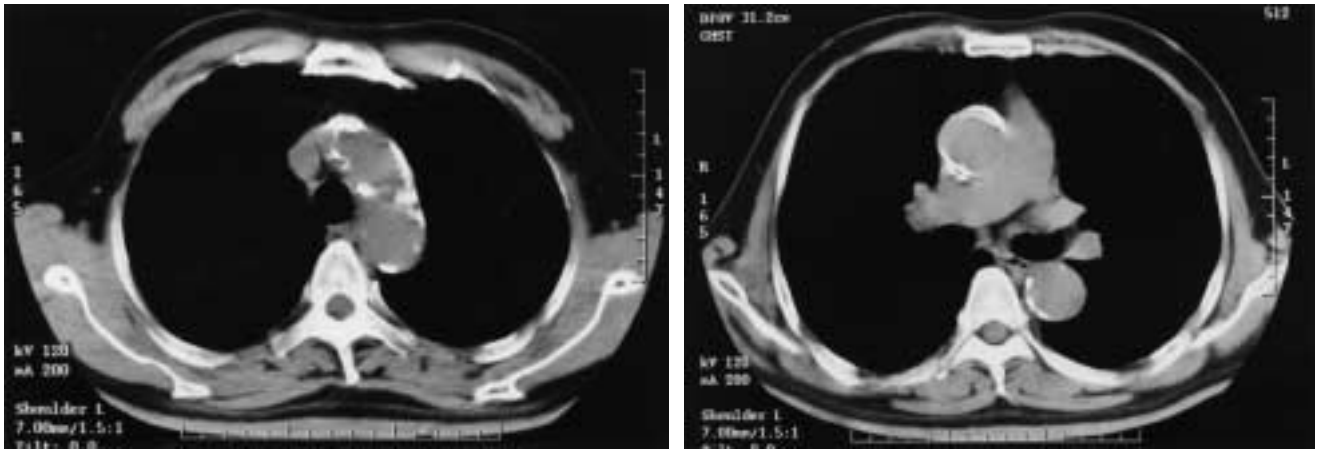

Fig. 1. CT showed a heavily calcified ascending aorta and aortic arch.

A | **B**

aorta was opened at 2 cm above the commissure with a short period of circulatory arrest and an occluding balloon catheter (10F of Sumitomo Bakelite Co., Ltd., Tokyo, Japan) was inserted (Fig. 2A). After balloon inflation, antegrade infusion was reinstituted with half systemic flow. The heart was arrested with selective antegrade infusion of cardioplegia. After a heavily calcified aortic valve was excised, a 25-mm Carpentier-Edwards (Baxter Inc., Irvine, CA, USA) pericardial valve was placed in the standard fashion. Two distal coronary artery anastomoses were constructed with a radial artery graft sequentially to the OM and distal left circumflex. When the nasopharyngeal temperature reached 18°C, circulatory arrest was introduced to debride the calcified intimal plate of both proximal and distal aortic walls of the aortotomy (Fig. 2B). Both the distal and proximal edges of the aortotomy were buttressed with bovine pericardial strips, which were placed both inside and outside of the debrided aortic wall and glued with gelatin-resorcin-formal (GRF) glue especially for the outside (Fig. 2C). After these cuffs were sutured together with 4-0 prolene suture, circulation was reestablished including the heart and the patient was rewarmed. While rewarming, the LITA was anastomosed to D2 and LAD sequentially under a beating heart using a stabilizer. The circulatory arrest time was 45 minutes. The patient was weaned from cardiopulmonary bypass without difficulty.

He was discharged from the hospital on foot without any cerebral complication.

Discussion

Heavily calcified "porcelain" aorta is associated with increased morbidity and mortality during aortic valve replacement because of the increased risk of perioperative atheroembolism.[1,2] The severe atheromatous ascending aorta precludes conventional arterial cannulation or clamping. Digital palpation with a lowered systemic blood pressure was used to find a softer spot in the aortic arch for cannulation, and furthermore, we used epiaortic echocardiography to confirm the diagnosis as well as the sites in the aortic arch for arterial cannulation using a cannula. If the ascending aorta cannot be cannulated safely, then peripheral cannulation (femoral or axillary artery) should be used; however, the axillary artery is more desirable than the femoral artery since retrograde blood flow through a diseased aorta carries a high risk of retrograde thromboemboli. Hypothermic circulatory arrest is a useful adjunct to replace the aortic valve in a patient with a porcelain aorta. Cosgrove[1] suggested placement of a forward occluding balloon in the distal ascending aorta under circulatory arrest and, after balloon inflation, reinstitution of circulation and aortic valve replacement while warming. We modified this technique and performed CABG on the beating heart because deep hypothermic circulatory arrest (a no-touch technique[2]) has a limitation in its safety period without causing ischemic injury to the brain.

Since connecting a graft to the diseased ascending aorta also increased the risk of atheroemboli, all in situ arterial grafts were considered to be optimal in this case. Although saphenous vein grafts anastomosed to the aortic arch branches have been described[3] and when the more accessible innominate or proximal carotid arteries are used, there is still the likelihood of intraluminal disease in these vessels with the possibility of distal embolization into the

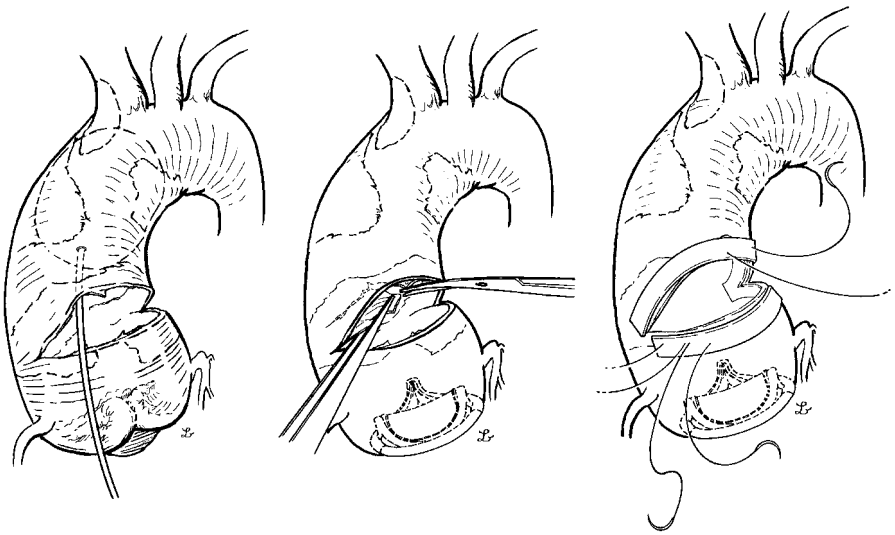

Fig. 2. A: An occluding balloon was inserted during a short period of circulatory arrest instead of using an aortic cross clamp.
B: Endarterectomy of the aortic cuff and aortic valve replacement with pericardial valve were performed during hypothermic half flow perfusion.
C: Reinforcement of the aortic cuff with bovine pericardial strips was carried out during total circulatory arrest.

A | **B** | **C**

cerebral circulation. Arterial revascularization with in situ arterial grafts is useful for the aorta-no-touch technique and using a stabilizer enables total revascularization on the beating heart with a remarkable reduction of cardiac arrest time.

Localized endarterectomy and reinforcement with pericardial strips for these regions is a simple, less invasive technique and is efficient in achieving complete hemostasis of the suture line.[4] We used GRF glue to secure graft anastomosis in an aorta that had become fragile as a result of endarterctomy. On the other hand, Kazui and colleagues[5] reported that aortic root reconstruction using GRF glue was associated with a certain amount of risk of aortic root necrosis. Therefore, care should be taken to ensure proper use of GRF glue, and improvements in the quality of glues and their application technique will be necessary to prevent problems. Other approaches including graft replacement of the ascending aorta[6] or performing complete thromboendarterectomy of the ascending aorta and transverse arch,[7] however, are excessive and should not be necessary.[8] It has not yet been clarified whether aneurysmal dilatation in the endarterectomized aorta occurs over time. Thus, localized endarterectomy and reinforcement with pericardial strips can provide safe and secure suturing of the porcelain aorta, and furthermore, in situ arterial grafts on the beating heart can make the aorta-no-touch technique possible with a remarkable shortening of the cardiac arrest time.

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