Case Report

Endarterectomy and Graft Replacement of Severely Calcified (Porcelain) Ascending Aorta with Coronary Ostial Involvement in a Patient Requiring Aortic Valve Replacement

Hitoshi Terada, MD, Teruhisa Kazui, MD, Katsushi Yamashita, MD, Naoki Washiyama, MD, Kazuchika Suzuki, MD, Takayasu Suzuki, MD, and Bashar Abul Hasan Muhammad, MD

We report a successful aortic valve replacement within an extensively calcified (porcelain) aorta, involving the left coronary artery ostium. Clamping such an aorta can result in embolization, dissection, and mural laceration. A 72-year-old female presented with a severely calcified and stenotic aortic valve with a peak pressure gradient of 101 mmHg. Computed tomography demonstrated extensive calcification of the ascending aorta. Coronary angiogram showed a 50% ostial left coronary artery stenosis. Under deep hypothermic circulatory arrest, the aorta was transected at the proximal arch and distal graft anastomosis was performed. This was followed by endarterectomy of the porcelain ascending aorta and the left coronary ostium. Aortic valve replacement, proximal aortic graft anastomosis, and a coronary artery bypass grafting (CABG) with the left internal thoracic artery (LITA) anastomosed to the left anterior descending artery (LAD) were then performed in a sequential manner. (Ann Thorac Cardiovasc Surg 2005; 11: 273–6)

Key words: endarterectomy, porcelain aorta, aortic valve replacement, replacement of the ascending aorta, coronary artery bypass grafting

Introduction

A 72-year-old female, who had been receiving medical management for hypertension and familial hyperlipidemia, presented with increasing symptoms of chest pain on effort. A chest roentgenogram showed calcification of the ascending aorta. An echocardiogram demonstrated trivial aortic regurgitation, a severely calcified and stenotic aortic valve with a peak pressure gradient of 101 mmHg and severe left ventricular hypertrophy. Computed tomography demonstrated extensive calcification of the ascending aorta (Fig. 1) and a small abdominal aortic aneurysm. Coronary arteriogram revealed a 50% ostial left coronary artery stenosis, while the right coronary artery had no significant stenosis (Fig. 2). Aortogram showed 50% stenosis of both common iliac arteries. The body surface area of the patient was 1.30 m^2.

From The First Department of Surgery, Hamamatsu University School of Medicine, Hamamatsu, Japan

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Address reprint requests to Hitoshi Terada, MD: The First Department of Surgery, Hamamatsu University School of Medicine, 1-20-1 Handayama, Hamamatsu 431-3192, Japan.

Operative technique

After a median sternotomy, the ascending aorta, assessed by manual palpation and epiaortic echo scanning, was found to be totally calcified. The posterior wall of the right femoral artery demonstrat a severe plate-like calcification, and the wall of the abdominal aortic aneurysm was also found to be severely atherosclerotic, precluding the use of the femoral arteries as the only arterial cannulation site. Therefore, both the right axillary artery and the right femoral artery were used as arterial inflow, using interposed 8 mm woven Dacron grafts (Boston Scientific Corp., Oakland, NJ). A two-stage cannula was inserted into the right atrium through its appendage as a venous return. The left ventricle was vented through a cannula placed in the right superior pulmonary vein. Rec-

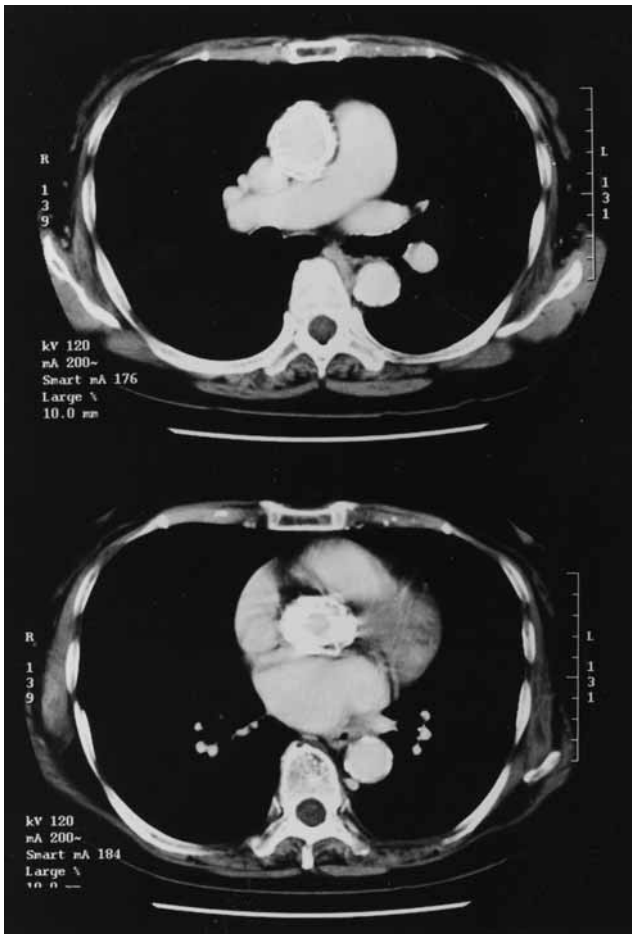

Fig. 1. Computed tomography demonstrated extensive calcification of the ascending aorta.

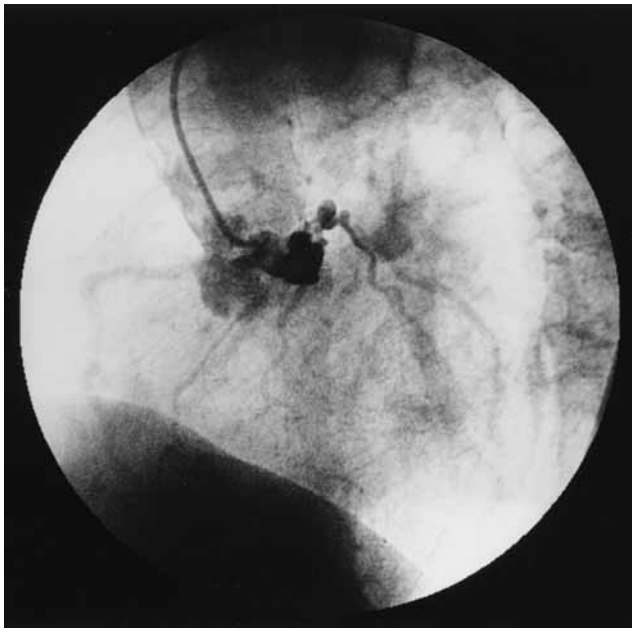

Fig. 2. Coronary arteriogram revealed a 50% ostial left coronary artery stenosis.

tal temperature was lowered to 20℃ by cardiopulmonary bypass (CPB) and cardiac arrest was induced with retrograde cardioplegia following a systemic potassium chloride injection. A unilateral selective cerebral perfusion was initiated through the right axillary artery after clamping the brachiocephalic and left common carotid arteries. Deep systemic hypothermic circulatory arrest was induced to avoid cross-clamping of the aorta, while the proximal aortic arch was transected completely. A 24 mm collagen coated woven Dacron graft (Boston Scientific Corp., Oakland, NJ) was anastomosed distally to the transected proximal aortic arch with a continuous 4-0 monofilament suture reinforced with a Teflon felt strip. After the distal aortic anastomosis was completed, the proximal graft was cross-clamped and systemic perfusion, through both the right axillary and the right femoral arteries, along with rewarming by the CPB, were initiated. The ascending aorta could not be opened with a longitudinal incision because calcification involved its entire circumference and extended into the aortic annulus. Therefore, endarterectomy of the entire ascending aorta, up to the aortic annulus, was performed using scissors. Calcification of both coronary ostia necessitated coronary ostial endarterectomy. The heavily calcified trileaflet aortic valve was excised and replaced with a 19 mm St. Jude Medical (SJM) mechanical valve. After the valve replacement, the remaining media and adventitial layers of the proximal ascending aortic wall were anastomosed to the graft with a continuous 4-0 monofilament suture reinforced with the Teflon felt strip. Both anastomoses were further wrapped with approximately 3 cm wide Teflon felt strip. Finally, the left internal thoracic artery (LITA) was anastomosed to the left anterior descending artery (LAD) (Fig. 3). The patient was weaned from CPB in spite of a slightly compromised right ventricular function and extubated at 5 days after operation with no neurologic dysfunction. Postoperative cardiac catheterization showed a fully patent left coronary artery ostium and the LITA-LAD graft. However, a 99% stenosis was noted in the right coronary artery just distal to its ostium for which coronary angioplasty with stenting was performed. The postoperative course was otherwise uneventful and the patient is doing well one and a half years after operation.

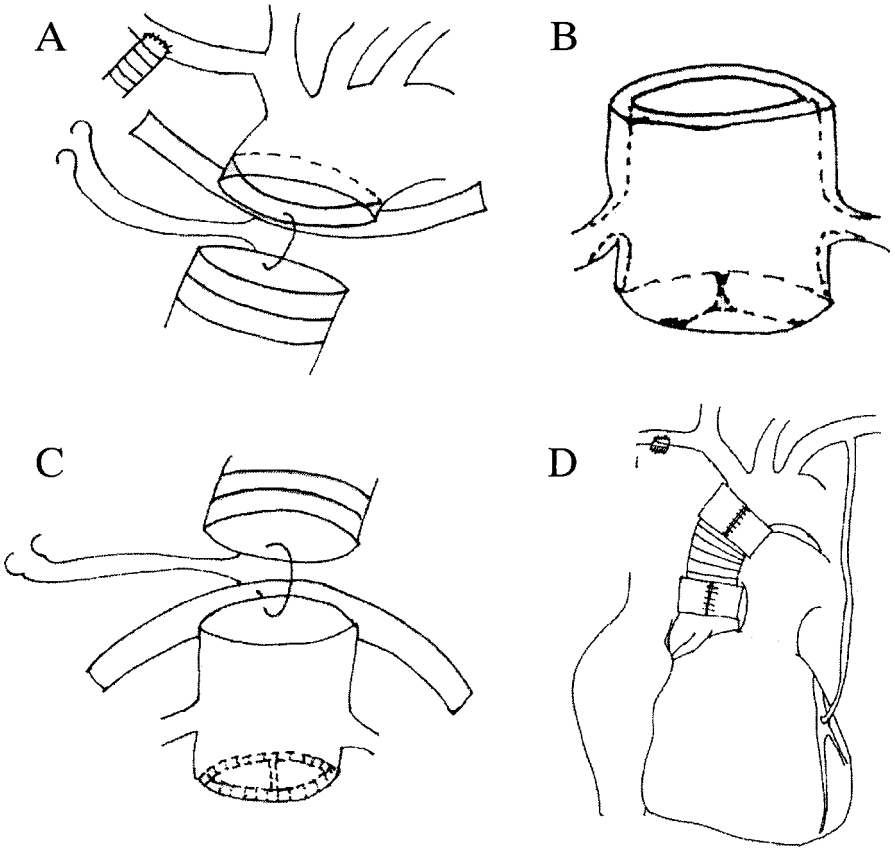

Fig. 3.
A: A woven Dacron graft was anastomosed distally to the transected proximal aortic arch.
B: Circumferential calcification of the ascending aorta extended into the aortic annulus.
C: Endarterectomy of the ascending aorta, up to the aortic annulus and that of the coronary artery ostia, were performed. After aortic valve replacement using a 19 mm SJM valve was performed, the remaining media and adventitial layers of the aortic wall were anastomosed to the graft.
D: Both anastomoses were wrapped with about 3 cm wide Teflon felt strip. Finally, the left internal thoracic artery was anastomosed to the left anterior descending artery.

Comment

Two distinct patterns of atherosclerotic ascending aorta have been identified. The most common type is characterized by diffuse plaques with varying degrees of ulceration, and friable, pedunculated soft atheromatous debris. The second type, a porcelain aorta, is less common, and is characterized by solid, non-ulcerated, plate-like calcification, involving the entire circumference of the aorta rendering it to a rigid tube.[1)]

A porcelain ascending aorta can complicate in a number of ways aortic valve replacement surgery, which unlike coronary artery bypass grafting (CABG), requires both a CPB and aortic manipulation.[2)] Not only that such an ascending aorta can not be used as an arterial cannulation site for the CPB, it is difficult to open, annular sutures and aortic repair sutures are difficult to insert, and the risk of a stroke or myocardial infarction from embolic material is increased.[3)] The axillary artery can serve as an alternative site for cannulation, in such patients, since the right axillary artery perfusion can be used for unilateral cerebral perfusion. Using the femoral artery as the only arterial inflow may incur a significant risk of retrograde embolization and aortic dissection,[4)] particularly when the abdominal aortic region is atherosclerotic. Furthermore, femoral perfusion was thought to be insufficient because the patient had a 50% stenosis of both common iliac arteries.

Several reports describe strategies for the management of aortic valve disease in patients with calcified (porcelain) aorta. The most commonly used strategy has been aortic valve replacement during hypothermic circulatory arrest with a “no-touch” technique.[5,6)] Svensson and coworkers have reported successful aortic endarterectomy to facilitate aortic valve replacement.[3)] However, this procedure may be associated with dislodgement of atherosclerotic debris and the long-term fate of the thinned aorta is unknown.[7)]

A 19 mm SJM valve was slightly small for the patient. However, aortic valve replacement using a 19 mm SJM hemodynamic plus valve or a 21 mm SJM valve under annuloplasty such as Nick’s method were likely to be difficult in this patient, given the rigid nature of the supravalvular and subvalvular apparatus.

Kouchoukos and associates described ascending aortic replacement using a tube graft in patients requiring

aortic valve replacement with severely and diffusely atherosclerotic ascending aorta.[8] Advantages of this technique include absence of manipulation before hypothermic circulatory arrest, resection of the diseased segment of aorta, and a relatively brief period of hypothermic circulatory arrest. A relatively disease-free area for graft anastomosis was fortunately found in the proximal aortic arch in this patient, however, it is usually very difficult to determine the site of distal graft anastomosis when the aortic arch and descending aorta are heavily calcified.

Since endarterectomy alone could not be relied upon as a treatment of the left coronary ostial stenosis in the present patient, additional CABG was performed with LITA to LAD. Potential disadvantage of the endarterectomy technique for coronary ostia includes the risk of coronary injury and stenosis. Therefore, a bypass to the right coronary artery should also be considered, particularly when right ventricular function is found to be compromised after weaning from CPB.

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