

On-Pump Beating Heart Surgery without Aortic Cross-Clamping for Ischemic Cardiomyopathy Complicated by Porcelain Aorta

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Abstract

A 73-year-old man was admitted to our hospital because of advanced ischemic cardiomyopathy complicated by porcelain aorta. We performed left ventricular reconstruction combined with coronary artery bypass grafting and mitral valve repair with on-pump beating heart technique without aortic cross-clamping. The postoperative course was uneventful. The on-pump beating heart technique without aortic cross-clamping is useful for the management of ischemic cardiomyopathy complicated by porcelain aorta.

Keywords

On-pump beating heart surgery, Ischemic cardiomyopathy, Porcelain aorta, Left ventricular reconstruction

Abbreviations

LVR: Left Ventricular Reconstruction; CABG: Coronary Artery Bypass Grafting; MVR: Mitral Valve Repair; OPBH: On-Pump Beating Heart; AXC: Aortic cross-Clamping; ICM: Ischemic Cardiomyopathy; MI: Myocardial Infarction; BNP: Brain Natriuretic Peptide; LAD: Left Anterior Descending artery; LV: Left Ventricular; LVESVI: LV end-systolic volume index; EF: Ejection Fraction; IABP: Intra-Aortic Balloon Pump; SVG: Saphenous Vein Graft; CPB: Cardiopulmonary Bypass; NYHA: New York Heart Association.

Introduction

An extensively calcified ascending aorta (porcelain aorta) is recognized as an important risk factor in patients undergoing cardiac surgery [1]. In patients with porcelain aorta, the standard surgical procedures are modified according to the severity of the condition [1]. Here, we report a patient who underwent left ventricular reconstruction (LVR) combined with coronary artery bypass grafting (CABG) and mitral valve repair (MVR) by using the on-pump beating heart (OPBH) technique without aortic cross-clamping (AXC) for ischemic cardiomyopathy (ICM) complicated by porcelain aorta.

Case Presentation

A 73-year-old man was admitted to our hospital with a chief complaint of paroxysmal nocturnal dyspnea. The patient experienced acute anterior myocardial infarction (MI) 26 years ago. At admission, blood chemistry measurements revealed a brain natriuretic peptide (BNP) level of 446 pg/mL, and chest radiography showed a cardiothoracic ratio of 60%. Coronary angiography demonstrated triple vessel disease with total occlusion of the proximal left anterior descending artery (LAD). Cardiac catheterization showed left ventricular (LV) dilatation with an akinetic apical area and moderate mitral valve regurgitation. The LV end-systolic volume index (LVESVI) was 136 mL/m², LV ejection fraction (EF) was 30%, and LV end-diastolic pressure was 40 mmHg. These findings were consistent with ICM. Moreover, chest computed tomography demonstrated a porcelain aorta and apical mural thrombus (Figure 1, 2).

An intra-aortic balloon pump (IABP) was placed before the operation. At surgery, the ascending aorta was found to be severely calcified, as expected. After the ascending aorta was evaluated by epiaortic echocardiography, an area in the distal anterior segment was found to be disease free, and this area was used for aortic cannulation and proximal anastomosis of saphenous vein grafts (SVGs). Cardiopulmonary bypass (CPB) was established by cannulation to the disease-free area of the ascending aorta, superior vena cava, and inferior vena cava with a perfusion flow index of 2.4 L/min/m² and a mean pressure of >60 mmHg. To prevent air embolism, aortic root and LV vents were used, the operative field was flooded with carbon dioxide, and the patient was positioned in a head-down tilt position until de-airing of the left heart was achieved. The following procedures were performed using the OPBH technique without AXC. First, the left ventricle was opened at the center of the scar on the anterior wall, and the mural thrombus was removed. Next, we performed CABG with the left internal mammary artery grafted to the LAD, an SVG sequentially grafted to the obtuse marginal branch and posterior lateral branch, and another SVG to the posterior descending artery. We used the PAS-Port II system (Cardica, Redwood City, CA, USA) for proximal anastomosis of an SVG to the circumflex arteries, and the proximal end of another SVG was anastomosed in an end-to-side fashion to the proximal site of the SVG anastomosed to the circumflex arteries. We then performed MVR. The mitral valve was approached through a right-side left atriotomy and repaired using a 27-mm St. Jude Medical Tailor partial flexible ring (St. Jude Medical, St. Paul, MN, USA), because of poor visualization of the anterior mitral annulus. We then performed LVR using the Dor procedure. The patient was weaned from CPB without difficulty. The lowest core temperature during the operation was 32 °C in the rectum. The CPB time was 231 min, and the operation time was 376 min.

The IABP was removed on the first postoperative day. Rest of the patient's postoperative course was uneventful, and he was discharged on postoperative day 22. At 1 year after the operation, his functional status was New York Heart Association (NYHA) class II. Blood chemistry measurements revealed that the BNP level reduced to 124 pg/mL. Coronary angiography confirmed the patency of all the grafts, and cardiac catheterization showed improved cardiac function. The LVESVI decreased to 75 mL/m², LVEF increased to 45%, and LV end-diastolic pressure decreased to 12 mmHg.

Discussion

LV dilatation is a powerful predictor of survival in patients after MI [2]. If the left ventricle dilates

progressively, all the diseased components that contribute to LV dilatation should be corrected by CABG, MVR, and LVR in combination rather than separately [3]. Although such procedures have been performed safely [3], they are sometimes indicated for high-risk patients with medical comorbidities, such as whole-body atherosclerotic disease, and must be planned carefully because complications can occur.

Our patient experienced advanced ICM complicated by porcelain aorta. Prolonged myocardial ischemia needed for several reconstructive procedures is very risky from the point of view of myocardial protection [4], and AXC should be avoided to reduce the risk of aortic injury and atheroembolism[1]. Therefore, we performed OPBH surgery without AXC. This surgery is reportedly performed not only in patients with severe aortic atherosclerosis [5] but also in those with poor LV function [4]. Athanasuleas et al [6] in their RESTORE study evaluating the outcomes of surgical ventricular restoration in postinfarction patients reported that the beating heart method was used more frequently than cardioplegic arrest method in those with lower EF (EF \leq 30%:73% vs 27%, $p<0.05$), larger ventricular volume (LVESVI \geq 80ml/m²: 50% vs 37%, $p<0.05$), and more advanced heart failure (NYHA class III and IV: 81% vs 57%, $p<0.05$) as well as poorer hemodynamic status, and that the beating heart method showed survival rates comparable to those of the cardioplegic arrest method (30-day hospital survival: 95.1% vs 94.5%, $p=0.68$). They also reported that the beating heart method provided more endocardial flow than cardioplegic delivery during ventricular exposure for LVR (subendocardial flow: 0.78 ml/ (min gm) vs 0.59 ml/ (min gm) [6]. However, AXC is generally applied in MVR and/or CABG before LVR [3]. To our knowledge, ours is the first report of a patient who had ICM complicated by porcelain aorta and underwent OPBH surgery without AXC.

Although we believe that the procedure presented in this study is useful in the management of such problematic cases, this technique may have some limitations. One is the possibility of air embolism. However, we believe that this can be avoided by carefully performing the abovementioned technique. Another possibility is poor visualization due to the beating of the heart. Although we performed MVR using a partial ring because of poor visualization in this case, some studies have suggested that complete remodeling annuloplasty is superior to partial annuloplasty [7]. Moreover, this technique could be performed more easily by using the transeptal [4] or superior mitral approach [5].

Conclusion

We reported a case of surgery for ICM complicated by porcelain aorta. We believe that OPBH surgery without AXC is useful in the management of such problematic cases.

Figures

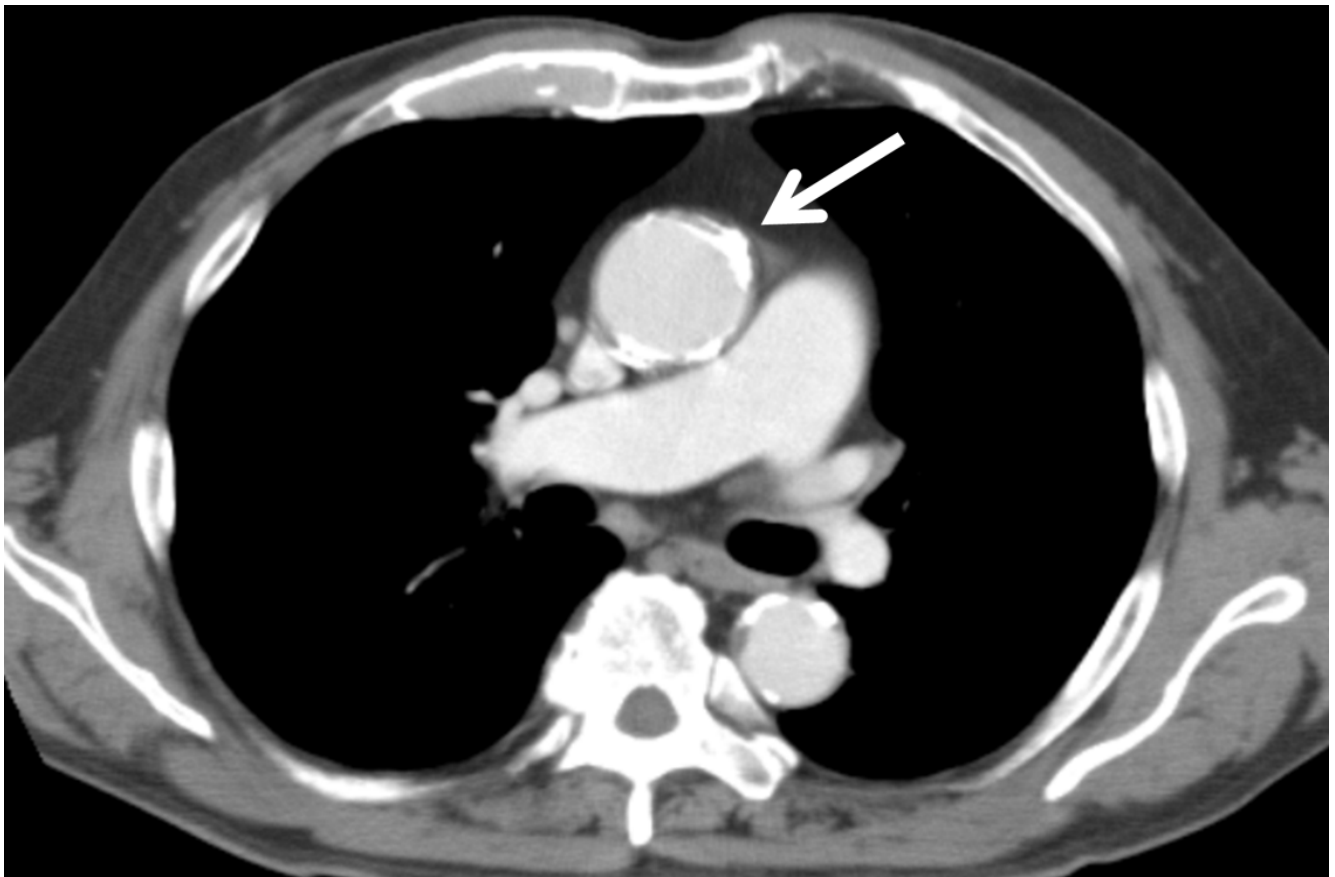


Figure 1: Preoperative chest computed tomography showing a porcelain aorta (arrow)

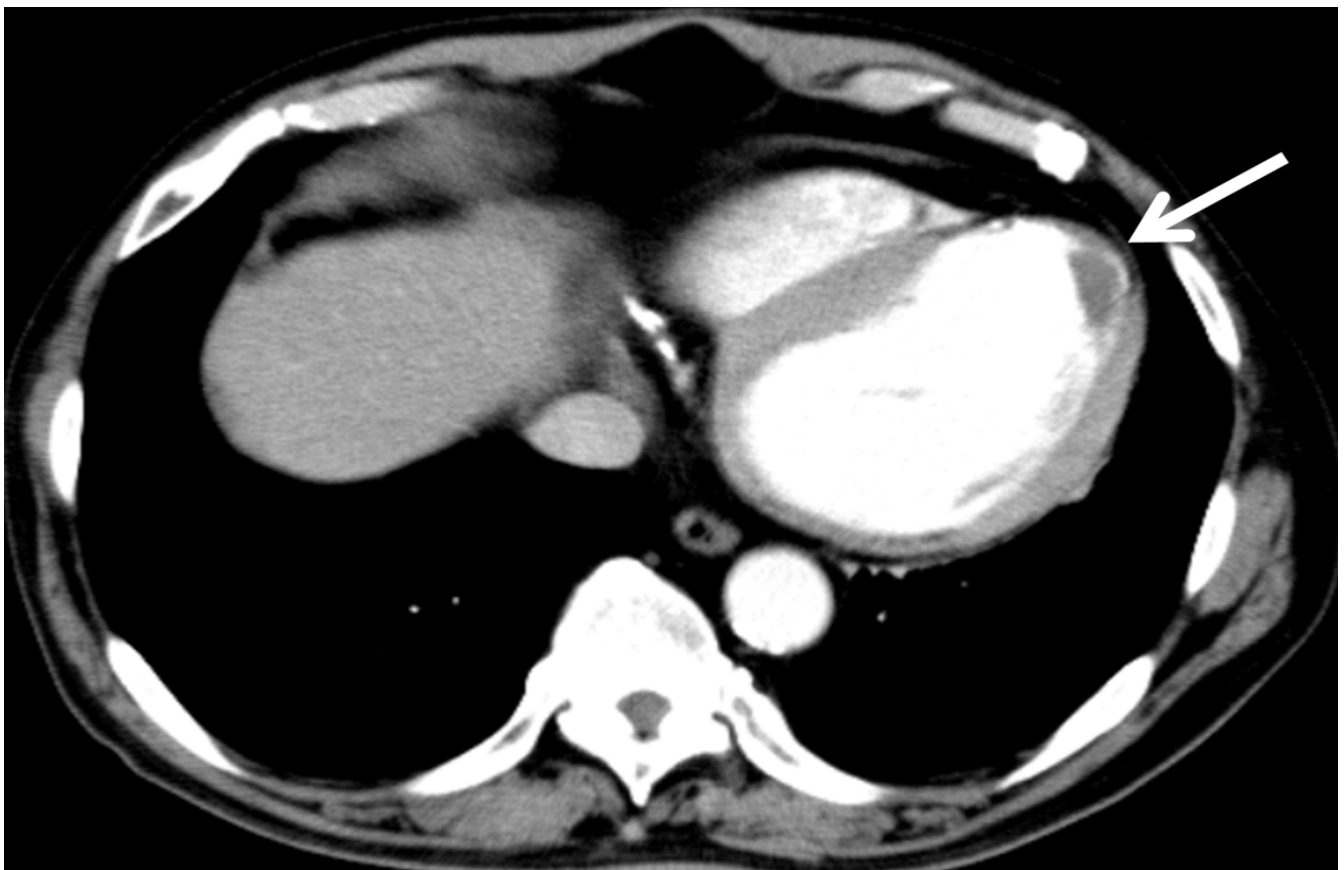


Figure 2: Preoperative chest computed tomography showing apical mural thrombus (arrow)

References

1. Fukuda I, Daitoku K, Minakawa M, Fukuda W. Shaggy and calcified aorta: surgical implications. *Gen Thorac Cardiovasc Surg*. 2013; 61:301-313
2. White HD, Norris RM, Brown MA, Brandt PW, Whitlock RM, Wild CJ. Left ventricular end-systolic volume as the major determinant of survival after recovery from myocardial infarction. *Circulation*. 1987; 76:44-51
3. Suma H, Tanabe H, Uejima T, Isomura T, Horii T. Surgical ventricular restoration combined with mitral valve procedure for endstage ischemic cardiomyopathy. *Eur J Cardiothorac Surg*. 2009; 36:280-285
4. Ghosh S, Jutley RS, Wraighte P, Shajar M, Naik SK. Beating-heart mitral valve surgery in patients with poor left ventricular function. *J Heart Valve Dis*. 2004; 13:622-629
5. Ogino H, Ueda Y, Morioka K, Matsubayashi K, Nomoto T. Mitral valve repair in a patient with severe porcelain aorta. *Ann Thorac Surg*. 1997; 64:1179-1181
6. Athanasuleas C, Siler W, Buckberg G. Myocardial protection during surgical ventricular restoration. *Eur J Cardiothorac Surg*. 2006; 29:S231-237
7. Kwon MH, Lee LS, Cevasco M, Couper GS, Shekar PS, Cohn LH, et al. Recurrence of mitral regurgitation after partial versus complete mitral valve ring annuloplasty for functional mitral regurgitation. *J Thorac Cardiovasc Surg*. 2013; 146:616-622

Manuscript Information: Received: July 18, 2015; Accepted: September 10, 2015; Published: September 14, 2015

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Citation: Furukawa K, Sakaguchi S, Nakamura E, Yano M, Nakamura K. On-pump beating heart surgery without aortic cross-clamping for ischemic cardiomyopathy complicated by porcelain aorta. *Open J Clin Med Case Rep*. 2015; 1035

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