

Case Report

Combined Transapical Aortic Valve Implantation with Coronary Artery Bypass Grafting in a Young Patient with Porcelain Aorta

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The surgical management of porcelain aorta in patients requiring aortic valve replacement or coronary artery surgery carries a high morbidity and mortality and remains controversial. We report a successful transapical aortic valve implantation in combination with on-pump coronary artery bypass grafting in a young patient with severe aortic stenosis, left main coronary artery disease and porcelain aorta. Transapical aortic valve implantation is a minimally invasive surgical alternative that can be safely performed in combination with coronary artery bypass grafting and may become the treatment of choice, even in young patients with porcelain aorta.

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Cardiac surgery involving the ascending aorta becomes a high-risk, challenging procedure — or may even be contraindicated — in the presence of porcelain aorta. Several strategies have been reported regarding the management of these patients. We present a case of on-pump coronary artery bypass grafting with beating heart, combined with transapical aortic valve implantation, in a young man with porcelain aorta, severe aortic stenosis and critical stenosis of the left main coronary artery. Through this hybrid technique we avoided the risk of manipulating the ascending aorta, given that dissection and clamping could not be performed safely. The operation was performed through a median sternotomy and a limited anterior thoracotomy on a beating heart under total cardiopulmonary bypass, using femoral arterial and right atrial venous cannulation. Surgical management was curative and the patient made a full recovery.

Case presentation

A 48-year-old man was admitted to our unit with progressive angina during the previous

year. His medical history included smoking and Hodgkin's lymphoma treated with a combination of radio- and chemotherapy 25 years ago. Physical examination revealed a grade 5/6 holosystolic murmur at the right sternal border. The ECG showed sinus rhythm with left ventricular hypertrophy. Echocardiography revealed an extremely calcified aortic valve with an active valve area of 0.5 cm² and a peak valve gradient of 120 mmHg. There was also moderate left ventricular hypertrophy with normal systolic function (ejection fraction, EF=55%). Selective coronary angiography demonstrated severe ostial stenosis of the left main stem (LM) with normal configuration of the distal tree, and a super dominant right coronary artery (RCA) with haemodynamically insignificant (40%) mid course stenosis. Further investigation with computed tomography (CT) scan demonstrated severe circumferential calcification of the ascending aorta (porcelain aorta) (Figure 1).

Although our patient had a low EuroSCORE (Additive 4, Mortality 2.86%), we considered him as a high-risk case because of his specific co-morbidity and we



Figure 1. Chest computed tomography scan demonstrates severe calcification of the ascending aorta and the aortic root (porcelain aorta).

decided not to proceed with a conventional aortic valve replacement, but instead to perform a transapical aortic valve implantation via a limited left anterior thoracotomy, in combination with a left internal mammary artery (LIMA) to left anterior descending artery (LAD) bypass through a median sternotomy. The operation took place in the cardiac catheterisation laboratory room in cooperation with the interventional cardiologists of our centre.

With the patient placed in supine position and under general anaesthesia median sternotomy was performed. The right femoral artery and the right

atrium were cannulated and cardiopulmonary bypass was initiated. The harvested LIMA was anastomosed on pump, with beating heart, to the LAD artery. The left femoral artery was catheterised in order to perform root angiography during the valve implantation. Subsequently, the apex of the heart was exposed via a left mini anterolateral thoracotomy in the 5th intercostal space. The apex was not accessed through the sternotomy, as we were concerned that the transapical catheter would not align with the aortic valve, but instead with the posteriorly oriented mitral valve. Two 2/0 Prolene purse-string sutures reinforced with pledgets at each myocardial bite were placed lateroapically on the left ventricle, in addition to a bipolar epicardial pacemaker electrode, which was used to provoke ventricular tachycardia during the balloon valvuloplasty and later during the aortic valve release. Following the transapical aortic balloon valvuloplasty, a premanufactured delivery catheter released the prosthesis into the aortic annulus. The exact position of the valve was confirmed simultaneously by aortography and transoesophageal echocardiography. A 23 mm pericardial stented xenograft prosthesis (Edwards Sapien - Edward Lifesciences Inc., Irvine CA, USA) was successfully implanted by balloon inflation (Figure 2), while the patient was paced at a ventricular rate of 200 beats/minute. The operation lasted 360 minutes in total; extracorporeal circulation time was 175 minutes and screening time was 11 minutes.

Postoperatively, the patient was transferred to the intensive care unit, where he was extubated after twenty-six hours. His postoperative echocardiography

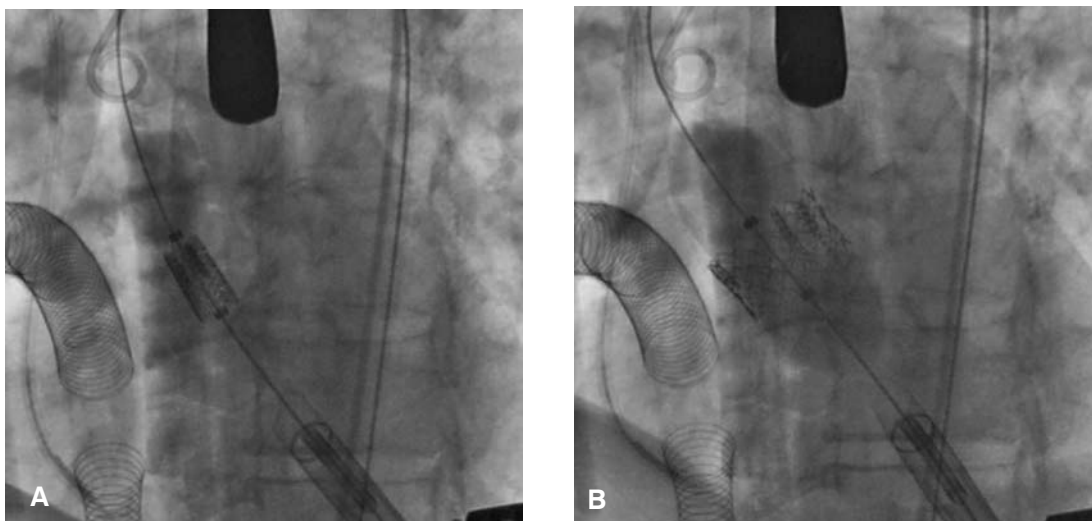


Figure 2. A. The prosthesis is positioned at the aortic root. B. The balloon is inflated and the valve is expanded within the balloon inflation.

revealed mild aortic insufficiency without any paravalvular leak. He was discharged on the 6th postoperative day and his convalescence at home remained uneventful.

Discussion

Aortic valve stenosis is the most frequent acquired heart valve disease and has well defined surgical indications.¹⁻³ Although the technique of median sternotomy, cardiopulmonary bypass and cardioplegic arrest remains the gold standard for conventional aortic valve replacement (AVR), this may prove a high-risk procedure in elderly patients with several co-morbidities or in certain subgroups of patients, such as those with severe calcification of the ascending aorta.^{1,4-5}

It has been reported that approximately 2% of patients referred for cardiac surgery and one third of patients older than 80 years have significant atherosclerosis of the ascending aorta.⁴⁻⁵ One fifth of these patients will have the extreme “porcelain aorta” subtype, with solid, non-ulcerated, plate-like calcification.^{4,6} Several strategies have been described to minimise the risk of cerebral embolisation by avoiding manipulation of the ascending aorta.^{4,6-7} Should a coronary artery bypass graft be required, the use of pedicled internal mammary arteries or free grafts with a proximal connector remains as an option.⁶ The option to perform off-pump LIMA-LAD bypass and transapical aortic valve implantation (TAP-AVI) via the same left thoracotomy was rejected, as it would not be safe for a patient with previous irradiation.⁸ As far as the AVR is concerned, alternative methods include an apicoaortic conduit, endoaortic balloon or Foley catheter occlusion and valve replacement following endarterectomy, and reconstruction of the ascending aorta under deep hypothermic arrest.^{4,6} These are complex surgical procedures with a high perioperative risk, especially in high-risk patients with significant co-morbidities.⁴⁻⁵ Patients who have been treated previously with mediastinal radiation, such as the one we describe, should be considered as high-risk patients, since they carry a higher incidence of postoperative complications.⁸ Moreover, previous mediastinal radiation may contribute to operative difficulties due to retrosternal scarring, making internal mammary harvesting difficult.⁸ Delayed weaning from bypass and prolonged haemodynamic support have also been reported in these patients.⁸

The use of TAP-AVI in patients over 75 years old with porcelain aorta has already been reported.² How-

ever, the combination of the method with concomitant coronary artery bypass grafting has not been previously described. TAP-AVI is a recently introduced, minimally invasive surgical technique designed for elderly high-risk patients with an estimated logistic EuroSCORE >20% and/or STS score >10%. It is performed in a hybrid operating theatre via a mini left anterior thoracotomy, with or without cardiopulmonary bypass using fluoroscopy. Early results have shown good haemodynamic function of the valve. The 30-day survival rate approaches 92%, with a mortality rate one third to one half of that predicted by the EuroSCORE.¹⁻³ Complications of TAP-AVI include paravalvular leak, perforation of the left ventricle, severe aortic incompetence and subsequent conversion to open surgery (if the valve-in-valve strategy fails), stroke, pleural effusion, pericardial effusion, supra-ventricular arrhythmias and cardiac arrest.¹⁻³

Although the method has been described neither in young patients nor in combination with coronary bypass, we believe that by using TAP-AVI in this case we offered a less invasive surgical treatment with lower risk and good postoperative outcome.

Conclusion

TAP-AVI is a minimally invasive surgical technique used in elderly high-risk patients requiring AVR. TAP-AVI is a safe hybrid method that may be the procedure of choice, even in young patients with porcelain aorta. Furthermore, TAP-AVI can be performed in combination with coronary artery bypass grafting in patients with such indications. In our opinion, the median sternotomy and cardiopulmonary bypass contributed towards a safer and more controlled procedure. Further studies are required to investigate the durability and long-term results of the prosthesis, in order to allow wide application in young patients, and to establish it as an alternative in patients with porcelain aorta.

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