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CASE REPORT

Combined Transaortic Valve Implantation and off-pump Coronary Artery Bypass Graft surgery in a patient with aortic stenosis, left main disease and «porcelain» aorta

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ABBREVIATION LIST:
AVR: Aortic Valve Replacement
BAV: Balloon Aortic Valvuloplasty
CABG: Coronary Artery Bypass Graft
CAD: Coronary Artery Disease
CT: Chest Computed Tomography
LVEF: Left Ventricular Ejection Fraction
LAD: Left Anterior Descending artery
LIMA: Left Internal Mammary Artery
LV: Left Ventricle
PAA: Porcelain Aorta
PCI: Percutaneous Intervention
TAVI: Transcatheter Aortic Valve Implantation
TAo-AVI: Trans-Aortical Aortic Valve Implantation
TAp-AVI: Trans-Apical Aortic Valve Implantation
TF: Transfemoral

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ABSTRACT

Conventional aortic valve replacement in patients with porcelain aorta can be technically challenging and is even sometimes seen as contraindication. Trans-aortic valve implantation has been proposed as an alternative to other trancutaneous routes of implantation and is feasible when there is a small healthy area in the right anterolateral aspect of the ascending aorta. Herein we report an interesting case of combined transaortic valve implantation and off-pump coronary artery bypass grafting in a patient with severe aortic stenosis, severe ostial left main coronary artery disease and porcelain aorta.

INTRODUCTION

The surgical AVR or/and CABG surgery in patients with "porcelain" ascending aorta (PAA) is associated with increased morbidity/mortality and remains controversial.[1] TAVI is the procedure of choice for the management of patients with severe symptomatic aortic stenosis at high (class I indication) and intermediate (class IIa indication) operative risk for traditional surgical AVR.[2,3] TAVI using the Edwards SAPIEN XT device (Edwards LifeScience, Irvine, CA) is usually performed via retrograde, or apical approach.[4] TAo-AVI has been also described as a safe and feasible alternative retrograde approach that can avoid complications related to the access route.[5]

Although PAA can be a relative contraindication to TAo-AVI approach, however a small calcification free spot of the aortic wall can be sufficient to achieve secure insertion of the devices. Herein we report an interesting case of combined TAo-AVI with off-pump CABG surgery in a patient with severe aortic stenosis, left main CAD and PA via a median sternotomy.

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CASE REPORT

A 70-year-old female patient with history of severe symptomatic (NYHA-III, CCS II) aortic stenosis (Aortic Valve Area 0.7cm^2 and mean transvalvular pressure gradient 40mmHg) was referred for TAVI. The annulus was measured at 18mm by Transesophageal Echocardiography. Her past medical history included anterior myocardial infarction successfully treated with primary angioplasty, arterial hypertension, dyslipidemia and insulin independent diabetes mellitus. Also, she had a history of breast cancer successfully treated with surgery and radiation. Coronary angiography and aortography revealed a significant ostial left main CAD with no instent restenosis in the Left Anterior Descending artery (LAD) stent, and a PAA, respectively (Figure 1). CT thorax scan confirmed the severe calcification of the ascending aorta, with a calcified free segment at approximately 50mm above the annulus (Figure 2).

Appropriate management of coexistent CAD in TAVI patients is yet to be defined. Calcified aorto-ostial lesions requiring rotational atherectomy may pose a particular challenge for PCI post TAVI, when interaction of the rotablation system and the TAVI frame is possible. The solution of BAV followed with LM PCI could be an option. Atherectomy of aorto- ostial LM CAD in patients with PAA is feasible however is correlated with high rate of complications and low technical success.[6] Since the patient was of low surgical risk (estimated logistic Euroscore-I 4.2% and STS mortality score 2.2%) and there was a calcified free segment at ascending aorta, the "Heart Team" decided to perform CABG via a median sternotomy combined with TAo-AVI in order to avoid the secondary anterior left thoracotomy and the Trans-Apical Aortic Valve Implantation (TAp-AVI) access route associated complications.

The procedure was performed in hybrid room with the patient placed in supine position and under general anesthesia. After median sternotomy the LIMA was dissected in a skeletonized manner. The heart was exposed and positioned for off-pump CABG. The LIMA was grafted in an end-to-side fashion onto the LAD, without complications and with good TIMI flow. Subsequently, a calcification free spot at the right anteroseptal aspect of the ascending aorta (approximately 50mm from the annulus) was chosen for access site, after careful manually and echocardiographic evaluation. Puncturing of the ascending aorta was performed through a 6F catheter. The aortic valve was crossed with a soft wire. An extra stiff wire was introduced into the LV after crossing the aortic valve with an Amplatz Left 2 catheter. The Ascendra 16F sheath was then directly introduced through the purse-string sutures and was kept in the upper part of the ascending aorta. The proximity between the puncture site in the ascending aorta and the aortic valve created a stable straightforward platform for the procedure. Aortic valve orifice area enlargement was performed by BAV, inflating a 20mm balloon for 15 seconds. Then, a 23mm Sapien XT

FIGURE 1. Coronary angiography (spider view) showing significant ostial left main disease.

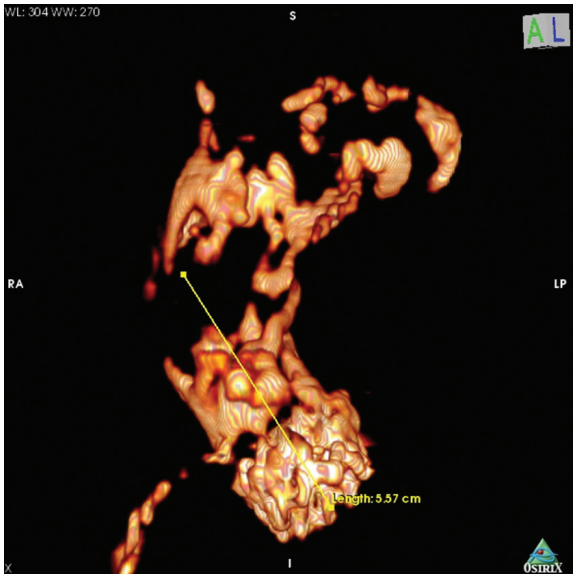

FIGURE 2. CT scan demonstrating the severe calcification of the ascending aorta, "porcelain", with a calcified free segment at the right anteroseptal aspect of the ascending aorta, approximately 50mm above the annulus.

device was successfully implanted under rapid pacing. Both, BAV and TAo-AVI were performed, while the patient was paced at a ventricular rate of 180 beats/minute, (Figure 3A, 3B). An intraoperative Transesophageal Echocardiography confirmed the correct positioning and functioning of the bioprosthetic valve indicating a mild paravalvular leak (Figure 4A, 4B). The Ascendra-2 sheath was withdrawn and hemostasis was achieved. The sternum was closed with 6 steel wires. The operation lasted 180 minutes in total, the fluoroscopy time was 11:29 minutes, the dose-area product (DAP) was 369.592 cGycm^2 and the contrast agent (Visipaque) volume was 150ml.

Postoperatively, the patient was transferred to the intensive care unit, where she was extubated after 16 hours without neurological complications. The patient was transferred to normal station after 32h. The postoperative course of our patient was complicated by atrial fibrillation successfully treated with i.v amiodarone. She was discharged in sinus rhythm on the 8th postoperative day. His convalescence at home remained uneventful.

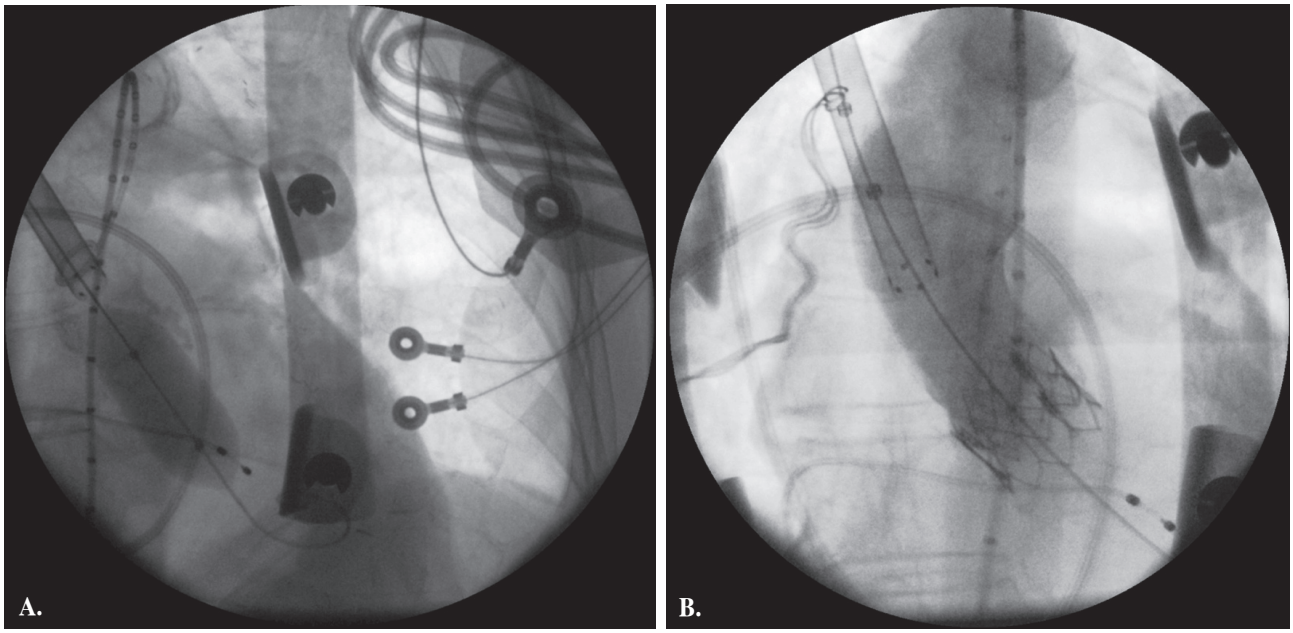

FIGURE 3. A. Aortic valve orifice area enlargement was performed by BAV, inflating a 20mm balloon for 15 seconds. **B.** 23mm Edwards Sapien device (Edwards LifeScience, Irvine, CA) was successfully implanted, by balloon inflation.

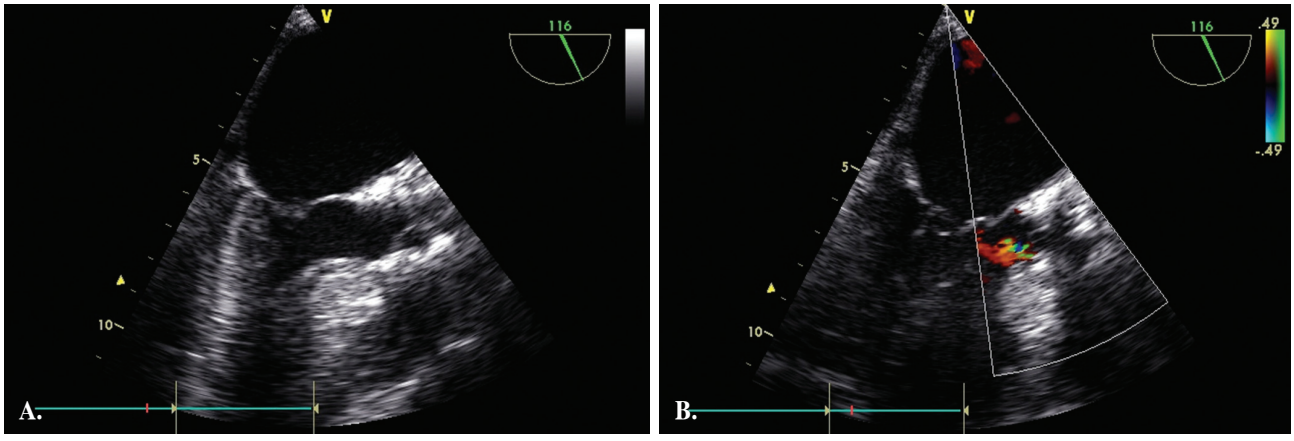

FIGURE 4. A-B. Transesophageal Echocardiography immediately post implantation showing satisfactory valve position and function with mild paravalvular leak.

DISCUSSION

Aortic valve stenosis is the most frequent acquired heart valve disease and has well defined surgical indications.[1] Although the technique of median sternotomy, cardiopulmonary bypass and cardioplegic arrest remains the gold standard for conventional AVR, this may prove a high-risk procedure in patients with PAA.[7] Patients with severe aortic stenosis considered unsuitable for surgical AVR had better outcomes with TAVI compared to medical treatment.[2] TAVI using the Edwards SAPIEN device (Edwards LifeScience, Irvine, CA) is usually performed via retrograde (TF or Subclavian, or Transapical). The SOURCE Registry (Sapien Aortic Bioprosthesis European Outcome) show a 9% 30-day mortality in TAp-AVI patients, mainly due to major access complications.[8] TAo-AVI was described for both most commonly used balloon and self-expandable devices as a new, safe and feasible alternative retrograde approach that can avoid complications related to the access route.[8,9,10]

Combined TAp-AVI with CABG surgery in a patient with PAA has been reported.[11] In our case, the option to perform an off-pump LIMA-LAD bypass via a median sternotomy combined with TAp-AVI via a secondary anterior left thoracotomy was rejected since there was a high risk for prolonged hospitalization and subsequent apical-wall-motion abnormalities. In contrast, TAo-AVI could be accomplished easily sequel after the LIMA-LAD bypass via the existing median sternotomy, thus decreasing the risk of access complications.[5]

TAp-AVI carries specific risks inherent to the access route. Echocardiographic data indicate that after TAp-AVI approximately 33% of the patients developed new apical hypo- or akinesia, affecting the LVEF in 7–13% of the patients.[10] This is significant in patients with a very low LVEF where additional scarring on the apex can adversely affect postoperative prognosis. Also, TAp-AVI carries relative high risk of severe bleeding, postprocedural re-exploration and aneurysm formation, significantly impairing the survival.[12,13] In the above mentioned retrospective study severe apical bleeding requiring extracorporeal bypass and/or complete sternotomy, termination of the procedure without valve implantation, or surgical re-exploration was detected in 7% of the cases.[12] In contrast, after TAo-AVI, hemostasis can be easily completed after withdrawal of catheters, even in fragile aortas.[5]

However, TAo-AVI involves some manipulation of the ascending aorta increasing the risk of periprocedural embolism and cerebrovascular accident. Although PAA can be a contraindication to TAo-AVI approach, however a small calcification-free spot of the anterior aortic wall can be sufficient to achieve secure insertion of the devices.[5] Moreover, in comparison with the TF approach, manipulation of the aortic arch is avoided, which is known to be the primary source of atherosclerotic emboli.[14] Therefore, with a careful manual and imaging examination of the ascending aorta, the subsequent risk of stroke can be minimized.

Although TAp-AVI approach via an anterior minithoracotomy is technically feasible is undesirable in patients with severe chest deformity, poor lung function, previous pulmonary complications and poor LVEF. In contrast, TAo-AVI can be performed through an upper ministernotmy. The upper ministernotomy has advantages with respect to respiratory function, due to preservation of the diaphragm, postoperative bleeding and postoperative pain.[5,15] Also, TAo-AVI avoids opening the left pleura and the subsequent necessity for pleural drainage, compared with the TAp-AVI. In addition, the upper ministernotmoy can be easily converted to full sternotomy in case of catastrophic complications, such as annular rupture, valve migration, coronary ostia obstruction, allowing prompt access for conventional surgery. However, a technical consideration of the upper ministernotomy TAo-AVI approach can be patients with patent vein grafts or with the right internal thoracic artery crossing anteriorly the aorta.

Recently, it was shown that alternate access options that mimic the results of TF-TAVI avoiding morbidity of transthoracic approaches are: [A] the Trans-Carotid approach, which has as a main contraindication the existence of more than 50% stenosis in the common or internal carotids, congenital variants, prior instrumentation, and contralateral carotid occlusion or vertebral stenosis. In addition requires arteries greater than 7mm and evaluation with Brain MRI angiography and transcranial Doppler. Recent propensity match analysis comparing transcarotid with transapical and transaortic access clearly showed that the former is correlated with shorter length of stay, fewer transfusions, more frequent discharge to home, and better 2-year survival,[16] [B] Transcaval approach, the most novel alternative access route for TAVI, requires specialized experience and involves femoral vein access with crossover to the abdominal aorta from the inferior vena cava. Periprocedural CT scanning is of paramount importance to ensure that there is a suitable non-calcified area of abdominal aorta to allow wire crossover from the inferior vena cava. This area of aorta should be free of any important arterial branches, such as the renal artery, renal vein and aorto-iliac bifurcation, as a covered stent may be required as a bailout strategy if there are bleeding complications during the procedure. Recent European data are encouraging with this approach regarding safety and feasibility,[17] and [C] Trans-subclavian or axillary approach requires size of the arteries $\geq$ 6 mm. Although majority of trans-subclavian cases performed via the left subclavian artery in case of LIMA-LAD graft we prefer no to use it avoiding potential ischemia or injury of LIMA graft. Right subclavian artery is used exceptionally due to its inconvenient implantation angle. Recent report showed that the stroke risk with both balloon-expandable and self-expanding valves when delivered transaxillary is relative high (5-6%) [18]. Therefore, although there are other access site options in case of TF-TAVI

contraindication, selection of the approach should be highly individual based on the experience of the "Heart Team", the availability of different valve types, and the anatomy and pathology of the patient's vessels. In addition, ongoing follow-up of patients treated with this approaches and future studies needed to determine the long-term outcomes. In our case the "heart team" was familiar with the transaortic approach and the PAA had a free of calcium spot therefore the decision was to combined TAo-TAVI with CABG.

CONCLUSION

In conclusion, TAo-AVI using Edwards Sapien Valve can be feasible in patients with aortic valve stenosis and PAA undergoing off pump CABG surgery via a median sternotomy. However, the presence of "porcelain" ascending aorta requires careful manual and imaging examination. Furthermore, TAo-AVI through an upper ministernotomy, provides an alternative feasible option especially in patients deemed unsuitable for conventional approaches.

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