Simultaneously Successful Transfemoral Aortic Valve Implantation and Endovascular Repair of Thoracic Aortic Saccular Aneurysm

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Summary

The prevalence of aortic stenosis (AS) increases in the elderly. They present high surgical risk due to comorbid factors that increase with age. Transcatheter aortic valve implantation (TAVI) is an effective method in patients who present with severe aortic stenosis with a higher surgical risk or who cannot undergo surgical aortic valve replacement (s-AVR). In our case, the presence of saccular thoracic aortic aneurysm with severe AS, which is a vital co-morbidity, requires the treatment of both. The rise in systolic pressure following the TAVI procedure increases the saccular thoracic aneurysm rupture risk and this is why the timing and method of the two treatments become crucial. In this case, which is as far as we know the first and only report in the literature, both TAVI and endovascular thoracic aortic saccular aneurysm repair were applied simultaneously and successfully to the patient via the same transfemoral route. After 1 month, the patient had good functional capacity and there were no complications in control tomography and echocardiography. In this way, we attempted to emphasize with a multidisciplinary study that the patients be assessed carefully before the procedure, and found that even in patients with common peripheral vascular diseases, a transfemoral route could be used together with the proper methods, and that both procedures could be performed simultaneously. (Int Heart J 2014; 55: 459-462)

Key words: Transcatheter aortic valve implantation, TEVAR, Aortic aneurysm

The prevalence of aortic stenosis (AS) has increased with the increase in life expectancy. As a result, severe comorbid factors can occur in advanced ages. The surgical replacement of a stenotic aortic valve (s-AVR) can be performed with low operative mortality rates in the absence of serious comorbid conditions. The patients undergoing s-AVR tend to have greater life expectancy and progress in their symptoms. However, 30% of the patients cannot undergo s-AVR due to left ventricular dysfunction, advanced age, and co-morbid conditions.1,2) Performed for the first time on a patient in 2002, transcatheter aortic valve implantation (TAVI) has become the leading treatment option for high risk and inoperable patient groups. One of the comorbid factors that increases the risk in patients is aortic aneurysm. The rupture risk will be increased with the increase in systolic pressure due to the aortic stenosis being treated. Hence, the timing and method of both treatments are of great importance in our high-risk case which was complicated by a thoracic aortic saccular aneurysm and serious aortic stenosis. In this study, thanks to our unique case in the literature, we managed to show that transfemoral aortic valve implantation and endovascular aneurysm repair could be performed simultaneously and successfully using the same femoral route by evaluating them in a detailed multidisciplinary way.

Case Report

An 83 year-old male patient with a history of coronary artery bypass grafting (CABG) and a permanent pacemaker (VVI-R type) following myocardial infarction 6 years previously was admitted to our clinic due to a recent increase in dyspnea. He was being treated with medications for hypertension (HT), moderate chronic obstructive pulmonary disease (COPD), and heart failure. The estimated glomerular filtration rate was calculated as 44 mL/minute according to the Cockcroft and Gault formula.3) In a physical examination of the patient, who was class 3 according to New York Heart Association (NYHA) classification, we detected a 4/6 intensity systolic ejection murmur, audible in all focuses but best in the aortic focus, spreading longitudinally, and a 3/6 pansystolic murmur in the apex, S3 and S4. The pace rhythm was 70/minute in an electrocardiogram. Following transsthoracic echocardiography (TTE), aortic stenosis (mean gradient: 27 mmHg), moderate to severe mitral regurgitation, and moderate tricuspid regurgitation were detected and the pulmonary artery systolic pressure...
was 50 mmHg while left ventricular ejection fraction (EF) was 35%. In dobutamine stress TTE, the mean aortic gradient was found to be 40 mmHg and the aortic valve area (AVA) was calculated to be 0.7 cm² (according to the continuity equation). Transesophageal echocardiography (TEE), which was performed to obtain greater detail, revealed the aortic valve was calcified in the tricuspid valve area and the AVA was 0.5 cm². In light of the data obtained, the patient was assessed as having low-flow low-gradient severe aortic stenosis. The Society of Thoracic Surgeons (STS) score was 10.5, and the logistic EuroSCORE was 52.8 and high risk according to SURTAVI. Due to the high risk associated with concomitant conditions and diseases such as advanced age, heart failure and having CABG accompanying AS, we decided the patient should undergo TAVI by the heart team.

Native 3 vessel disease was seen in the coronary angiography (CAG) performed on the left brachial artery and in the sequential saphenous graft performed on the right coronary artery as well as the circumflex and diagonal arteries and in the internal mammarian grafts performed on the left anterior descending artery, open and peripheral iliofemoral arteries that were calcified and had moderate tortuosity were observed (Figure 1). Following multi-slice computed tomography (MSCT), calcification and tortuosity were found particularly in the right iliofemoral artery and noncritical atherosclerotic stenosis was detected in the left common iliac artery (Figure 2). Also, a 20 × 18 mm saccular aneurysm in the thoracic aorta just after the left subclavian artery was detected by means of a detailed review (Figure 3). In the patients who initially had chronic kidney disease, acute kidney injury (stage 1 according to VARC-2 AKIN) emerged following CAG and MSCT. Progression was achieved through intravenous hydration and acetlycysteine treatment. As a result of a multidisciplinary assessment together with cardiovascular surgery, interventional radiology and anesthesia, we decided to simultaneously perform TAVI and endovascular aneurysm repair due to the high risk of aneurysm rupture after the TAVI procedure. The patient and his relatives were informed and their consents were obtained.

Under general anesthesia, the patient was taken to the catheterization laboratory where he underwent surgical cut-down from the left femoral route first, followed by balloon valvuloplasty accompanied by TEE and then Edwards Sapien XT (Edwards Lifesciences, Irvine, CA, USA) 26 mm valve implantation under fast pacing through an 18 Fr sheath (Figure 4). Through TEE following the procedure, the aortic valve was seen to be in the appropriate position, the mean gradient was 7 mmHg, and mild paravalvular aortic regurgitation (AR) was observed. The procedure was evaluated as successful. The guide catheter was then implanted over the stiff wire implanted for TAVI. A 0.035 inch extra-stiff wire through the guiding catheter (Lunderquist, Cook, Inc.) was advanced as to the ascending aorta proximal gently enough so as to not touch the bioprosthesis aortic valve. Next, over the extra-stiff wire, a 36 × 130 mm Zenith® (Cook, Inc., Bloomington, IN) thoracic stent-graft was placed just distal to the left subclavian artery (Figure 5). As the minimal proximal type 1 was endoleak in the control digital subtraction angiography (DSA), dilatation was performed with a 40 mm diameter Coda® (Cook, Inc.) aortic balloon. The process was finalized without complication with an excellent final angiographic image which did not have endoleak (Figure 6). Notable improvements in functional capacity were observed in the patient who was discharged 1 week following the procedure and then followed-up. After 1 month, the patient had good functional capacity and there were no complications in the control TTE and MSCT (Figure 7).
The increase in the incidence of aortic stenosis in patients with age brings many comorbid risk factors. This hinders them from benefiting from s-AVR which allows a longer life expectancy and symptomatic relief. TA VI developing rapidly for the last decade has become an important treatment option for surgically inoperable or high-risk patients. The PARTNER study, which is the only randomized clinical trial in the field, suggested that TA VI could be an important alternative for s-AVR for high-risk patients and that it is superior to medical therapy in inoperable patients.5,6) Another important risk factor whose incidence increases with advancing age is comorbid aortic aneurysms. Although there is no data concerning the incidence of aortic stenosis with aortic aneurysms in the literature, the abdominal aortic aneurysm rate can reach up to 5% in patients over 50 years of age.7) The most common cause of thoracic aortic aneurysms is degenerative and its incidence is increasing and is 10.4 cases/100,000 person-years.8) Despite the fact that rupture risk of an aneurysm is in direct proportion to the increase in the size of the aneurysm, the rupture risk in saccular aneurysms is independent from the size of the aneurysm. Both in the studies conducted and in European and American cardiology and cardiovascular surgery, thoracic, and aortic disease guidelines, endovascular repair is strongly recommended when descendent saccular aortic aneurysm is appropriate.9-12) That is to say, saccular aneurysms require immediate treatment. Aortic aneurysms make TAVI difficult because of the rupture risk both during and after the process and access path. That the wires used are tough and sheaths are big can be an obstacle for the transfemoral route which is a very important access path for TAVI especially in abdominal aortic aneurysms. Also, it can lead to an increased rupture risk and aneurysm dilatation with growing systolic and mean pressure after TAVI and the increase in wall stress.13,14) Likewise, an aneurysm operation in a patient with severe aortic stenosis presents high-risk. Surgical aneurysm repair had a high-risk because of the very severe aortic stenosis in our case as well. Accordingly, both the timing of treatment and management of disease have become important due to the high rupture risk of the aneurysm after the TAVI.

**DISCUSSION**

The increase in the incidence of aortic stenosis in patients with age brings many comorbid risk factors. This hinders them from benefiting from s-AVR which allows a longer life expectancy and symptomatic relief. TA VI developing rapidly for the last decade has become an important treatment option for surgically inoperable or high-risk patients. The PARTNER study, which is the only randomized clinical trial in the field, suggested that TA VI could be an important alternative for s-AVR for high-risk patients and that it is superior to medical therapy in inoperable patients.5,6) Another important risk factor whose incidence increases with advancing age is comorbid aortic aneurysms. Although there is no data concerning the incidence of aortic stenosis with aortic aneurysms in the literature, the abdominal aortic aneurysm rate can reach up to 5% in patients over 50 years of age.7) The most common cause of thoracic aortic aneurysms is degenerative and its incidence is increasing and is 10.4 cases/100,000 person-years.8) Despite the fact that rupture risk of an aneurysm is in direct proportion to the increase in the size of the aneurysm, the rupture risk in saccular aneurysms is independent from the size of the aneurysm. Both in the studies conducted and in European and American cardiology and cardiovascular surgery, thoracic, and aortic disease guidelines, endovascular repair is strongly recommended when descendent saccular aortic aneurysm is appropriate.9-12) That is to say, saccular aneurysms require immediate treatment. Aortic aneurysms make TAVI difficult because of the rupture risk both during and after the process and access path. That the wires used are tough and sheaths are big can be an obstacle for the transfemoral route which is a very important access path for TAVI especially in abdominal aortic aneurysms. Also, it can lead to an increased rupture risk and aneurysm dilatation with growing systolic and mean pressure after TAVI and the increase in wall stress.13,14) Likewise, an aneurysm operation in a patient with severe aortic stenosis presents high-risk. Surgical aneurysm repair had a high-risk because of the very severe aortic stenosis in our case as well. Accordingly, both the timing of treatment and management of disease have become important due to the high rupture risk of the aneurysm after the TAVI.
that the patient undergoes. This issue has not been made clear either in guidelines or the literature. Thoracic endovascular aortic repair (TEVAR) has recently become a safe option in which fewer complications are noted compared to open surgery. TEVAR is strongly recommended by European and American cardiology and cardiovascular surgery guidelines, particularly in thoracic aortic aneurysms which are 5.5 cm and more and regardless of diameter in thoracic aortic saccular aneurysms.\(^1\)\(^2\) Our patient also presented with severe aortic stenosis accompanied by thoracic aortic saccular aneurysms. As far as we are concerned, there is no single case in the literature or data concerning the method of both treatments. There are case reports in the literature concerning the procedures performed by Drury-Smith, et al, who first performed transfemoral TAVI and EVAR. These case reports successful transcatheter aortic valve implantation, followed 3 weeks later by transcatheter EVAR.\(^3\)\(^4\) Ghosh-Dastidar, et al reported a case in which they performed transapical TAVI first and then EVAR for infrarenal abdominal aneurysm 3 months later.\(^5\) In our case, the peripheral iliofemoral arteries were calcified and had significant tortuosity. Also, an open left internal mammarian artery according to CABG made the left subclavian intervention for TAVI risky. Using multidisciplinary assessment, it was concluded that both TAVI and TEVAR could be performed from the same transfemoral route and the process was conducted successfully.

**Conclusion:** We have described the first and only case in the literature and conclude that the patient should be evaluated carefully before TAVI, the transfemoral route should not necessarily be immediately considered wrong, and that with careful and appropriate methods it is a good access route and that these cases could be combined successfully with a multidisciplinary study.

**References**