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Case report

# Delivery system release during transcatheter aortic valve implantation in extreme thoracoabdominal aorta tortuosity and bicuspid aortic valve: Case report

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## Abstract

A tortuous thoracoabdominal aorta is a rare congenital abnormality with an unknown prevalence due to rarity. A bicuspid aortic valve is the most common congenital cardiac anomaly and is found in 0.5-2% of the population. The coexistence of these two abnormalities together with severe aortic stenosis is much rarer. We report a 78-year-old male who admitted to the Hospital with a history of dyspnea. Following echocardiography and computed tomography scan, the patient was diagnosed with a bicuspid aortic valve, severe aortic stenosis, and severe thoracoabdominal aortic tortuosity. Transcatheter aortic valve implantation was unsuccessful so he underwent aortic valve replacement. The post-operative course was uneventful.

**Keywords:** Arterial tortuosity, Transcatheter aortic valve implantation, Descending aorta

## Introduction

A careful evaluation of the aorta is mandatory since a bicuspid aortic valve (BAV) is often associated with aortic dissection, aortic aneurysm, and aortic tortuosity. Tortuous aortas have rarely been described in the literature. This aortic pathology may necessitate surgical intervention rather than transcatheter aortic valve implantation (TAVI). There are limited reports of TAVI in a tortuous thoracoabdominal aorta (1, 2). The heart team is important in optimizing the outcome of patients undergoing TAVI. In the situation of severe tortuosity of the thoracoabdominal aorta, TAVI procedure should be used with high caution at first and other methods must be considered either.

*Case presentation*

A 78-year-old male was admitted to the Hospital with dyspnea (New York Heart Association classification NYHA III) over a period of 10 months. He reported no previous clinical events. Physical examination was remarkable for a grade 3/6 systolic murmur over the aortic area. Electrocardiography revealed a normal sinus rhythm, left axis deviation, and left ventricular hypertrophy. Transthoracic echocardiography showed a severely calcified aortic stenosis and moderate aortic insufficiency with valve area of 0.7 $cm^2$, maximum gradient of 98 mmHg, mean gradient of 67 mmHg, left ventricular ejection fraction of 55%, aortic annular diameter of 25 mm, aortic annulus of 25mm, and ascending aorta of 39 mm. A pre-operative multi-slice computed tomography scan of the aorta and its branches confirmed the patency of the femoral arteries allowing a transfemoral approach and significant thoracoabdominal aortic tortuosity [Figure1], therefore, the feasibility of transfemoral-TAVI warranted assessment. The distance between left main coronary ostium and aortic annulus was 14mm. Coronary angiography was normal. The patient was evaluated by a heart team and found to be of high risk for aortic valve replacement due to his age and morbid obesity. Accordingly,

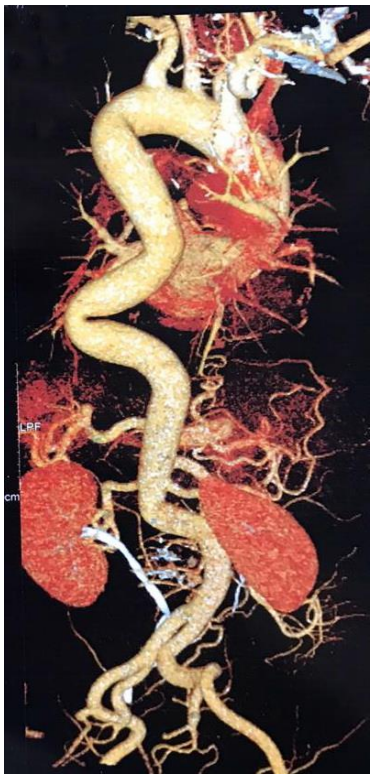

Figure1. Computed tomography 3D reconstruction of the severe tortuous aorta

it was decided to perform TAVI. The details of the TAVI procedure, especially the drawbacks of this technique for patients with BAV, were described to the patient and his family and informed consent was obtained from them. Under local anesthesia plus sedation, a right femoral artery cutdown was performed. A right Amplatz catheter was introduced through to the aortic annulus over a Terumo and Exchange stiff wire despite severe tortuosity. The transcatheter heart valve delivery system with a 26-mm Sapien S3 valve within a 14-Fr eSheath (Edwards Lifesciences) was smoothly advanced. The prosthesis was then advanced to the level of the aortic valve. The valve was separated from the introducer tip with multiple attempts and due to high degree of resistance we could not pulled back the device to the eSheath. Urgent median sternotomy was done under general anesthesia. After standard cannulation for cardiopulmonary bypass, the ascending aorta was cross-clamped. Aortotomy was done revealing the failed transcatheter heart valve delivery system, which was safely resected and removed from the aortic root [Figure2]. The aortic annulus was sized after the aortic valve leaflets were resected following the Edwards 23 mm valve (Carpentier-Edwards Perimount Magna Ease Aortic Heart Valve) implantation in a standard manner. After aortotomy closure, an echocardiography verification of the biological valve function was performed. The patient was discharged from the hospital on the 6$^{th}$ postoperative day without any complications. A 30-day follow-up showed significant improvement in clinical and hemodynamic findings.

## Discussion

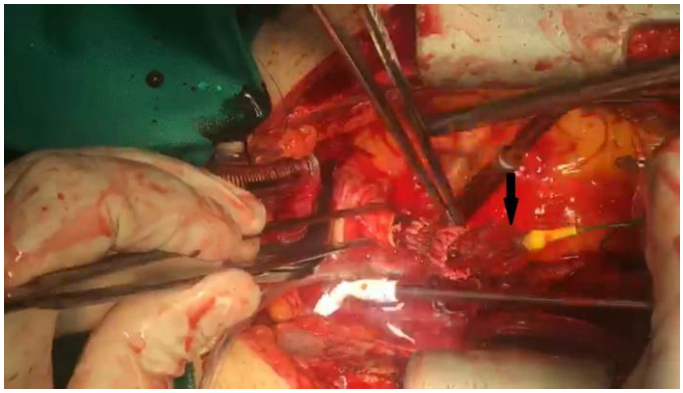

Figure 2. Surgical view of the transcatheter heart valve delivery system (Black arrow)

The first TAVI was performed by Alain Cribier in January 2002 (3). Over 350,000 procedures have been performed in over 70 countries since then (4). Today, it is an alternative to surgical aortic valve replacement in patients with bicuspid aortic valves, aortic insufficiency, low surgical risk, and younger age and fewer comorbidities. In the beginning, TAVI produced unsatisfactory outcomes in patients with a bicuspid aortic valve; however, bicuspid aortic valve is not a contraindication to TAVI any more based on the currently available findings. Transcatheter aortic valve implantation using the Edwards Sapien 3 valve system has been recently reported to be an effective treatment for severe bicuspid aortic valve stenosis (5). An access strategy is crucial for achieving procedural success in TAVI. The choice of the access site depends on three factors. The first factor is the anatomy, for example, tortuosity, or

calcification. The second factor is the clinical condition, and the third factor is the physician's experience. The transfemoral approach is the most preferred access route (6). Historically, vascular anomalies were important limitations to the use of TAVI due to lethal vascular complications. However, due to increased procedural familiarity, technological advances in the devices leading to miniaturization of delivery systems, and increased experience of the clinicians, this procedure is now easy to perform. Tortuosity of the thoracic and abdominal aorta is a very rare entity. The TAVI procedure may be challenging in patients with complex anomalies, such as a bicuspid aortic valve, and associated aortic diseases, such as severe calcification, tortuosity, narrowing, and aneurysm. Pre-operative three-dimensional reconstruction can provide precious guidance for TAVI in patients with complex and unusual anatomy. In patients with a highly tortuous aorta, it is difficult to pass the device through the aorta because of high resistance(2). Before any TAVI procedure, it is essential for the heart team to discuss other options, including the appropriateness of conversion to open heart surgery. This case report highlighted how to cope with complications during the TAVI procedure. Moreover, in case of the tortuosity of the thoracoabdominal aorta, alternative vascular access routes are suggested. The transapical approach is currently the second available access route (7). The common carotid artery, transaxillary, direct aortic, and transcaval approaches are other transarterial access routes. Vascular access was particularly challenging in this case. The transapical route was another choice. We had limited experience in transcaval TAVI; therefore, we selected the transfemoral approach despite severe aortic tortuosity but it was unsuccessful. TAVI can be performed in very challenging cases; however, other options should be considered in cases with severe aortic tortuosity.

This was a report of an unsuccessful case of TAVI in a patient presenting with a combination of two rare abnormalities: a tortuous thoracoabdominal aorta and a bicuspid aortic valve. Descending aorta tortuosity is a predictor of complications in patients undergoing transfemoral TAVI. In situations where TAVI treatment fails or is complicated, the other surgical or endovascular interventions are the preferred choice.

**Author contribution**

All authors contributed equally and approved the final version of manuscript

**Conflict of Interest**

Authors declare no conflicts of interest.

**Ethical declaration**

There was no ethical declaration.

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