Use of Double Stiff Wire Allows Successful Transfemoral Transcatheter Aortic Valve Implantation Through Extreme Thoracic Aorta Tortuosity

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An 80-year-old man affected by symptomatic (New York Heart Association III) aortic stenosis was referred to our center. Transthoracic echocardiogram showed low-flow low-gradient aortic stenosis (mean gradient 30 mm Hg, valve area 0.6 cm^2, ejection fraction 35%). His past medical history included liver cirrhosis in chronic hepatitis C infection (Child-Pugh A6) and severe osteoporosis with chest deformation and restrictive pulmonary disease. His EuroSCORE was 15.4% and Society of Thoracic Surgeons score was 4.8%.

Preoperative computed tomography revealed significant tortuosity of the descending thoracic aorta, with a double curve (Figure 1A–1C; Movie I in the Data Supplement) and a narrowest lumen diameter of 18 mm. Significant kinking was also present at the level of the right femoro-iliac axis (Figure 1B) with a minimum diameter was 9.1 mm at both sides. His aortic annulus size was calculated at 25×27 mm (area 540 mm2). After Heart Team discussion, in view of his multiple comorbidites, he was submitted to transcathter aortic valve implantation. Transfemoral route was deemed the most suitable access route because of the presence of restrictive pulmonary disease and increased associated risk with transapical access. An Edwards Sapien 3 (Edwards LifeSciences, Irvine, CA) prosthesis was used to minimize the risk of a suboptimal position that would have been difficult to manage in the presence of this aortic anatomy.

After right femoral access and valve crossing, an Amplatz Extra-Stiff wire (Cook Medical, Bjaeverskov, Denmark) was positioned in the left ventricle. After advancement of the device on the wire, the valve would not pass beyond the second curve of the thoracic tortuosity. Every attempt to advance the system further resulted in prolapse of the system and exacerbation of the aortic tortuosity (Figure 2A; Movie II in the Data Supplement); we thus retrieved the entire system.

In an attempt to increase support to aid delivery and make the anatomy more favorable, a Lunderquist wire (Cook Medical, Bjaeverskov, Denmark) within a multipurpose catheter was positioned via the left femoral artery in the ascending aorta. The Extra-Stiff wire was also exchanged with a second Lunderquist, and a new Sapien 3 valve was advanced on this wire. The aortic tortuosity was markedly reduced with the aid of both wires (Figure 2B; Movie III in the Data Supplement), finally allowing successful advancement and deployment of the valve without any complication (Figure 2C; Movie IV in the Data Supplement). The buddy wire was kept in place until delivery system retrival to make it easier and safer. Post-procedural echocardiography demonstrated a well-functioning transcathter aortic valve implantation prosthesis with mild paravalvular regurgitation. The postoperative course was uneventful.

Discussion

The transfemoral route for transcathter aortic valve implantation procedures is usually preferred because of advantages associated with it being less invasive. Unlike small caliber vessels and heavy circumferential calcification, tortuosity of the arterial route has not been clearly associated with increased vascular complications[1] because the arteries usually become less tortuous in the presence of a stiff wire. Tortuosity remains difficult to define, and there are currently no objective parameters or guidelines to define tortuosity that is prohibitive to transfemoral transcathter aortic valve implantation to aid in optimal patient selection.[2,3] Anatomy that was thought to be prohibitive even a few years ago now can be overcome as a result of advances in delivery system technology, improved procedural planning, and operator experience. The double stiff wire approach helped to overcome extreme tortuosity by increasing the support for the valve delivery system and facilitating its advancement without the occurrence of prolapse, which limited the first attempt. Additionally, by changing the arterial anatomy more favorably, the procedure was less traumatic and enabled optimal valve positioning to increase the likelihood of an optimal outcome. Careful preoperative assessment of the access route is mandatory to achieve procedural success in such cases: tortuosity, degree, and

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distribution of calcium and minimal lumen area are all important in determining the suitability of the femoral route. In our case, computed tomography enabled recognition of anatomic difficulties, which operators could therefore be prepared to deal with. Caution should always be taken in such extreme cases because tortuosity can predispose to arterial dissection or rupture that can be a dramatic albeit rare event when the aorta is involved.[4] In particular, the presence of calcification (that was not severe in this case) can increase risks of rupture because of the reduciton in compliance of the aortic wall. By the utilization of a buddy wire, this procedure can be made substantially safer and reduce the likelihood of procedural complication in these high-risk patients.

Disclosures

Dr Colombo is a minor shareholder in DirectFlow Medical Inc (Santa Rosa, CA). The other authors report no conflicts.

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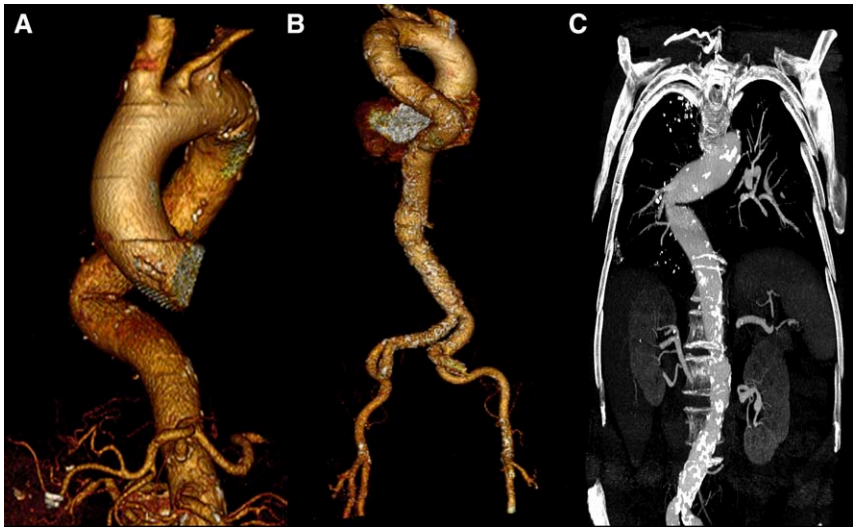

Figure 1. Preoperative computed tomography reconstruction of the arterial tree. **A**, 3D view of the aortic arch and the thoracic descending aorta tortuosities as seen in the exact implantation fluoroscopic projection. **B**, Posterior 3D view of all the arterial kinkings to be overcome from the femoral access to the aortic annulus. **C**, Maximum intensity projection of thoracic aorta showing relationship between aortic tortuosity and calcium distribution.

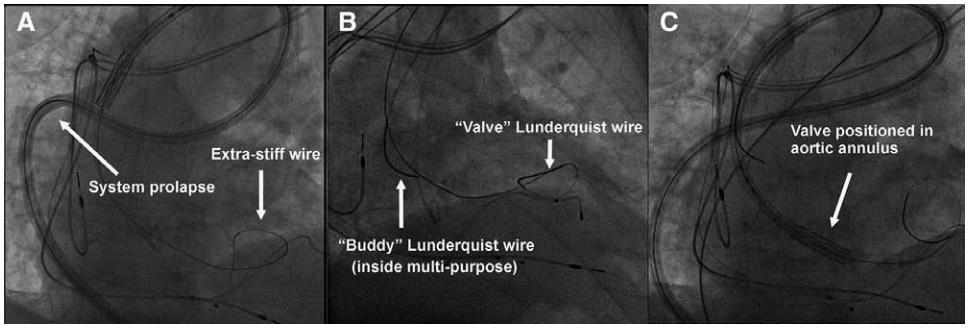

Figure 2. Intraprocedural fluoroscopy steps. **A**, Delivery system prolapse and failure to advance beyond the aortic arch because of the multiple aortic curves. **B**, Two Lunderquist stiff wires in place: the first delivers the valve, whereas the second (inserted into a multipurpose catheter) straightens the aorta and gives enhanced support to the delivery system. **C**, Successful valve delivery in the aortic annulus past the thoracic aorta tortuosities.

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