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Sheathless Transcaval Transcatheter Aortic Valve Implantation Through an Abdominal Aortic Graft

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Abstract

An 82-year-old patient presented with severe symptomatic aortic stenosis, a high surgical risk profile, and a history of abdominal aortic replacement. Arterial access vessel conditions precluded transarterial transcatheter aortic valve implantation (TAVI). Transcaval access through the aortic graft was achieved; however, tortuosity and resistance at the graft entry site hampered insertion of the introducer sheath and delivery system. Transcaval TAVI without a sheath was contemplated with the expectation of aortocaval fistulous decompression of blood around the TAVI catheter. Hemodynamic measures remained stable, and the valve was successfully implanted. This case illustrates the feasibility of sheathless transcaval TAVI without relevant hemodynamic compromise.

RÉSUMÉ

Un patient âgé de 82 ans présentait une sténose aortique sévère symptomatique, un profil de risque chirurgical élevé et des antécédents de remplacement de l'aorte abdominale. L'état des vaisseaux utilisés pour l'abord artériel excluait toute possibilité d'implantation de valve aortique transcatheéter (IVAT) par voie transartérielle. La voie transcave a été utilisée à travers la greffe aortique; toutefois, la tortuosité et la résistance au point d'insertion au niveau de la greffe nuisaient à l'insertion de la gaine et du système de déploiement. Une IVAT par voie transcave sans gaine d'insertion a alors été envisagée, en anticipant une décompression fistuleuse aorto-cave du sang autour du cathéteur d'IVAT. Les paramètres hémodynamiques sont demeurés stables, et l'implantation de la valve a réussi. Ce cas illustre la faisabilité d'une IVAT par voie transcave sans gaine d'insertion et sans compromettre les paramètres hémodynamiques pertinents.

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Supplementary Material

To access the supplementary material accompanying this article, visit the online version of the Canadian Journal of Cardiology at www.onlinecjc.ca and at <https://doi.org/10.1016/j.cjca.2018.10.003>.

Transfemoral transcatheter aortic valve implantation (TAVI) is an established therapy for patients with severe symptomatic aortic stenosis deemed at increased risk for surgical aortic valve replacement. Although technical refinements allowed considerable downsizing of delivery systems and minimal access diameters required, a small subgroup of patients remains unsuitable for transfemoral or alternative arterial approaches. Transcaval access appears a safe and reliable alternative for these patients.¹ Pressurization of the retroperitoneal space and consecutive drainage of aortic blood via shunting into the vena cava constitutes the pathophysiological concept underlying the feasibility of this approach.^{1,2} No cases of transcatheter valve delivery via transcaval access without placing any sheath across the retroperitoneal space have been reported so far.

Case

An 82-year-old patient recently suffered recurrent hospitalizations due to decompensated heart failure. Echocardiography revealed severe stenosis of his bicuspid aortic valve (type 0) and severely depressed left ventricular ejection fraction (30%). His past medical history is notable for surgical replacement of the abdominal aorta with a Dacron Y-graft (Vascutek Ltd, Inchinnan, Renfrewshire, Scotland). In view of the patient's age and risk profile, the heart team recommended TAVI.

A transfemoral arterial approach was attempted but failed owing to extensive tortuosity of the calcified vessels and kinking of the abdominal aortic graft at the aorto-iliac junction (Fig. 1A). Calibers of alternative peripheral arterial access sites were insufficient and transapical approach declined in the setting of poor left-ventricular function. Multislice computed tomography (MSCT) showed favourable preconditions for a transcaval approach through the aortic graft.^{2,3}

A 7F 55-cm renal-length IMA catheter was inserted over a right venous access and the coaxial crossing system consisting of an Astato XS 20 coronary wire (Asahi Intecc, Aichi, Japan) inside a 150-cm Finecross microcatheter (Terumo, Tokyo, Japan) inside a Navicross support catheter (Terumo) advanced into the vena cava. A 25-mm snare was introduced into the right femoral artery and oriented in the abdominal aortic prosthesis to obtain an *en-face* view orthogonal to the cav- oaortic crossing trajectory predicted by the MSCT. The crossing system was directed toward the aortic target entry site and advanced from the vena cava into the abdominal aortic graft while delivering energy at the wire tip by means of an electrosurgery pencil attached to the distal wire end (70 Watts cutting mode, Erbe VIO 300D; Erbe Elektromedizin GmbH, Tübingen, Germany). After snaring the coronary wire tip and advancing it to the proximal descending aorta, the microcatheters were advanced through the aortic graft. A 190-cm long stiff 0.035" wire (E-wire, Jotec, Hechingen, Germany) was inserted followed by a 16 French eSheath with the intent to implant an Edwards Sapien 3 29-mm bioprosthesis (Edwards Lifesciences, Irvine, CA). Despite an anticipated distance of 28 cm between the femoral venous access and the aortic target entry site, only the dilator, but not the sheath, reached the lumen of the aortic graft (Fig. 1B). The procedural strategy was changed, and a 40-cm long 20 French Extra Large Check-Flo Cook introducer sheath (Cook Medical, Bloomington, IN) inserted to allow delivery of a CoreValve Evolut R 34mm (Medtronic Inc, Minneapolis, MN). However, the sheath

repeatedly kinked after removal of the dilator because of tortuosity and the rigid graft material, despite the use of a stiff guidewire (Fig. 1C). Except for an initial drop in blood pressure, hemodynamic measures remained stable after removal of the sheath (Fig. 1D). Hence, sheathless implantation of a 34-mm CoreValve Evolut R bioprosthesis was undertaken. The delivery system was introduced and advanced across the retroperitoneal space through the aortic graft without a sheath (Fig. 1E; Video 1 view video online), and the valve was successfully implanted. No hemodynamic compromise was observed during these procedural steps that lasted 10 minutes. Subsequently, a sheath was reintroduced and a 10/8-mm Amplatzer Duct Occluder Type 1 (St Jude Medical, St Paul, MN) implanted in the aortic graft wall leaving a residual type I (“simple tubular”) aortocaval fistula (Fig. 1F).

In the post-interventional course, a pseudoaneurysm of the right femoral artery related to the primary transfemoral arterial access attempt was detected and required surgical treatment. At 6 months, echocardiography showed flawless function of the aortic bioprosthesis and abdominal ultrasound closure of the aortocaval fistula.

Discussion

Thorough anatomical pre-evaluation by means of a MSCT and a well-coordinated, experienced team are crucial for the planning of transcaval access and management of potential complications.

In this patient, severe aortic valve stenosis severe vessel tortuosity, fixed by perivascular scar tissue originating from previous vascular surgery and resistance at the entry of the abdominal aortic graft, precluded transcatheter valve insertion via an introducer sheath; however, sheathless delivery was successful. Continuous aortocaval fistulous decompression of blood around the delivery system catheter likely explains the hemodynamic stability observed during sheathless transcaval TAVI.

In the absence of pre-existing right heart failure, a residual aortocaval fistula after closure device implantation is generally well tolerated. Follow-up MSCT suggests nearly all fistulas close spontaneously. Although there were early concerns about left-to-right shunt and hemolysis, contemporary experience has identified no late vascular complications.

Conclusion

Sheathless transcaval implantation of a transcatheter aortic valve is feasible and can be considered as a bailout option in patients for whom introducer sheath insertion fails and aortocaval fistula is hemodynamically well tolerated.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Disclosures

Dr Pilgrim received research grants to the institution from Biotronik, Symetis, and Edwards Lifesciences and speaker fees from Boston Scientific and Biotonik. Dr Greenbaum is a proctor for Edwards Lifesciences and Medtronic and has pending patents on equipment related to the transcaval access and closure that have been assigned to his former employer, the Henry Ford Hospital, Detroit, Michigan. Dr Lederman is an inventor of transcaval closure devices, assigned to his employer. Dr Windecker received research grants to the institution from Abbott, Amgen, Biotronik, Boston Scientific, St Jude Medical, Terumo, and Bayer.

References

1. Greenbaum AB, Babaliaros VC, Chen MY, et al. Transcaval access and closure for transcatheter aortic valve replacement: a prospective investigation. *J Am Coll Cardiol* 2017;69:511–21. [PubMed: 27989885]
2. Lederman RJ, Babaliaros VC, Greenbaum AB. How to perform transcaval access and closure for transcatheter aortic valve implantation. *Cathet Cardiovasc Interv* 2015;86:1242–54.
3. Lederman RJ, O’neill WW, Greenbaum AB. Transcaval access for TAVR across a polyester aortic graft. *Cathet Cardiovasc Interv* 2015;85:1270–3.

Figure 1.

(A) Calcified tortuous iliac arteries with kinking of the aorto-bi-iliac Y graft at the aorto-iliac junction precluding transfemoral valve delivery. Aortic graft target entry site marked by asterisk. (B) Transcaval aortic access across the graft. The inserted Edwards 16F eSheath (Edwards Lifesciences, Irvine, CA) lacked working length (**arrowhead**) and did not reach the aortic graft lumen (AO), because of tortuosity of ilio-femoral veins and resistance at the abdominal aortic graft entry site. (C) Kinking (**arrow**) of the 40-cm 20F Extra Large Cook sheath (Cook Medical, Bloomington, IN) during insertion of the CoreValve Evolut R delivery system (Medtronic Inc, Minneapolis, MN). (D) Initial drop in blood pressure after sheath removal due to aorto-caval shunting but stable hemodynamics thereafter. (E) Sheathless insertion of the CoreValve Evolut R 34-mm transcatheter valve delivery system (**small arrow** marks pigtail catheter in aorta). (F) Final procedural result after implantation of a 10/8-mm Amplatzer Duct Occluder I (St Jude Medical, St Paul, MN) with a residual type I aortocaval fistula.