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Case Report

Endoconduit for Transcatheter Aortic Valve Implantation

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Access challenges are sometimes encountered in patients who require transcatheter aortic valve implantation (TAVI). Transapical (TA) access is a well-established alternative, but it is more invasive than the standard transfemoral (TF) access techniques. We adopted the iliac endoconduit technique to perform TF TAVI in a patient with small-caliber, heavily calcified iliac arteries. This technique could provide an adequate access route for TAVI that is minimally invasive, even for patients with prohibitory iliac anatomy.

Keywords: endoconduit, aortic valve stenosis, transcatheter aortic valve implantation

Introduction

Transcatheter aortic valve implantation (TAVI) has been successfully introduced as a less invasive treatment modality for aortic stenosis. The primary access route is transfemoral (TF). However, TAVI is associated with access challenges, and alternative access techniques can be used when standard TF access is not feasible. Although transapical (TA) access is a well-established alternative approach, it may result in higher short-term and long-term morbidity and mortality compared to TF access.[1,2] The endoconduit technique consists of the deployment of an iliac stent graft across the prohibitory area and angioplasty with controlled rupture of the iliac artery, allowing for safe passage of the delivery sheath using a standard femoral approach.[3,4] We present the use of the iliac endoconduit technique for a patient with aortic stenosis and small-caliber, heavily calcified iliac arteries treated with TAVI.

Case Report

An 86-year-old man was referred to Osaka City University Hospital for the treatment of severe aortic stenosis. Because he had multiple comorbidities, including hepatocellular carcinoma, recent surgery for colon cancer, previous myocardial infarction, history of percutaneous coronary angioplasty, mild chronic kidney disease, advanced age, and frailty, with a Society of Thoracic Surgeons risk score of 9.4%, TAVI was indicated. Computed tomography (CT) angiography revealed that both external iliac arteries (EIAs) were small and heavily calcified; the smallest diameters were 3.95 mm on the right and 3.8 mm on the left (**Fig. 1**). Angioplasty alone is associated with a high risk of rupturing the iliac arteries. To achieve the theoretical benefit of the TF endoconduit approach compared to the conventional alternative (TA access), we obtained permission from the institutional review board to use this approach and an off-label use of

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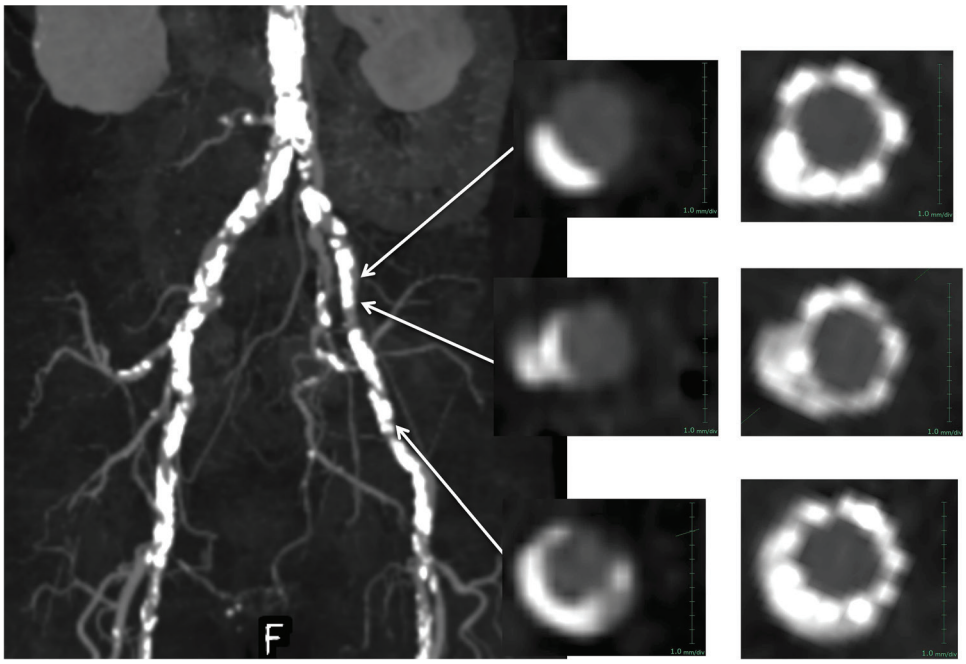

Fig. 1 CT angiogram of the access arteries. Left: MIP of the preoperative CT angiogram reveals heavily calcified iliac arteries. Middle: Images of reconstructed cross sections perpendicular to the center line of the left iliac artery in the preoperative CT angiography; corresponding locations of the images are projected onto the MIP CT image. Right: Images of postoperative cross sections of the respective portions showed marked dilatation, which most likely indicated rupture of the native iliac artery after stent graft deployment and balloon angioplasty. CT: computed tomography; MIP: maximum-intensity projection

a stent graft. Written informed consent was obtained from the patient. Our institute's heart team engaged in a detailed discussion before performing the procedure.

The procedure was performed in a fully equipped hybrid operating room. The patient was maintained under general anesthesia and ordinary ventilation. A 3-cm left inguinal incision was made, and the left common femoral artery was exposed. Two pieces of stent graft, a 10-mm iliac extension of the Endurant II AAA stent graft system (Medtronic Vascular, Inc. Santa Rosa, CA, USA) and an 8-mm Fluency Plus vascular stent graft (CR Bard, Inc. Murray Hill, NJ, USA), were deployed from the origin of the left EIA and covered most of the EIA. Then, controlled rupture of the left EIA was performed with an 8-mm balloon. Angiography did not reveal any hemorrhage. The TAVI procedure was performed through this stent graft or endoconduit. Insertion of a 15-Fr introducer sheath was smooth; however, a passage of the 26-mm valve Edwards Sapien 3 prosthesis (Edwards Lifesciences, Irvine, CA, USA) was tight but possible. Valve implantation was completed successfully, and the retrieval of the sheath was uneventful. Angiography showed no hemorrhage of the iliac arteries and that the stent graft was patent; however, it also revealed a small external iliac dissection distal to the edge of the stent graft (**Fig. 2**). Because this dissection was not flow-limiting, it was left untouched. Postoperative CT angiography confirmed the patency of the stent graft.

Discussion

The iliac endoconduit has been introduced in the field of thoracic endovascular aortic repair as an important alternative to retroperitoneal open iliac conduits.[3,4] It is a reliable and safe approach with a lower incidence of iliofemoral complications compared to the retroperitoneal open iliac conduit technique.[4] The results of endovascular aortic repair allowed us to consider adopting this technique for TAVI instead of transiliac access.

The most common alternative to conventional TF access for Sapien 3 implantation is TA. A comparative study between these two techniques showed better results in terms of morbidity and mortality for the TF approach.[1,2] This difference is likely due to patient selection bias; however, it could also be attributed to the more invasive nature of TA access, which necessitates left

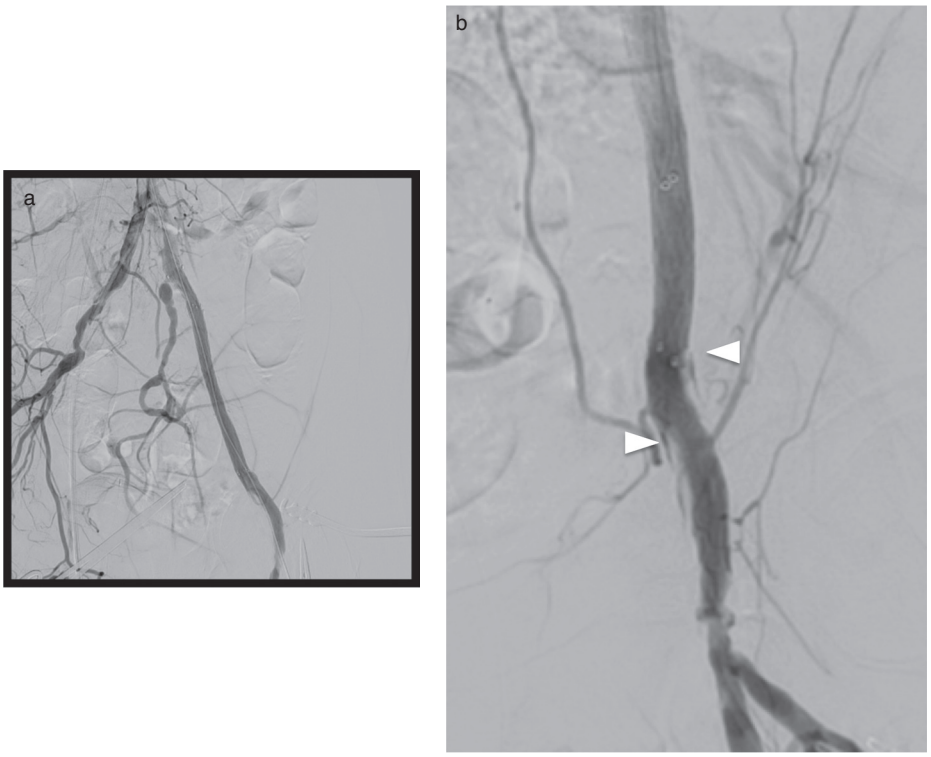

Fig. 2 Intraoperative angiogram. (**a**) Angiogram after retrieval of the transcatheter aortic valve implantation delivery system showed straight and widely patent EIAs with the stent graft. (**b**) Minor dissection was revealed distal to the edge of the stent graft, which was left untouched (white arrows). EIAs: external iliac arteries

thoracotomy. The endoconduit approach requires only a small inguinal incision, which is same as required for the conventional TF approach. Better outcomes could be expected compared to those for TA access although larger series are needed to obtain definitive conclusions regarding the safety of this technique.

More recently, other alternative access procedures have been evaluated, including transubclavian, transcarotid, transaortic, and trans-caval approaches. A comparative study of TF, transaortic, and TA TAVI showed higher but non-significant 30-day and 1-year mortality rates for the TA group, and it was concluded that transaortic access could be an alternative option for cases not suitable for TF access.[5] However, transaortic access requires opening of thoracic cavity or mediastinum, leading to more invasiveness. Transubclavian and transcarotid access are feasible alternative pathways with good initial results when TF access is not suitable.[6] However, they are yet not routinely used. A higher incidence of stroke was reported in some studies of transcarotid access.[7,8] Trans-caval aortic access is a relatively new technique intended for TAVI candidates not suitable for other arterial approaches. The abdominal aorta is accessed from the femoral vein through the inferior vena cava. After prosthesis insertion, the caval-aortic tract is closed using an occluder.[9] Further studies comparing the outcomes of this procedure with those of the existing surgical approaches are needed to elucidate the real benefits of this technique. All of these alternative access methods have their own benefits and risks. When an inhibitory iliac artery is the only reason for considering an alternative, the endoconduit technique might be warranted because of its simplicity and similarity to the most commonly used TF access.

The CoreValve Evolute R (Medtronic, Minneapolis, MN, USA) can be inserted through a smaller-diameter InLine Sheath (6.5 mm) compared to the delivery system of the 26-mm Sapien 3 prosthesis (4.7-mm outer diameter of the eSheath and 7.64-mm diameter during the passage of the 26-mm Sapien 3 with dynamic expansion mechanism).[10] Smaller-diameter devices are advantageous when advancing the device through the sclerotic and stenotic iliac arteries. In our case, even with the use of the CoreValve Evolute R, the device could not be advanced through the narrowest part of the EIA, where the diameter is 3.8 mm, with 75% of the circumference heavily calcified. However, a low profile with better

passing properties is definitely an important factor that should be considered when selecting the device for this type of situation. One of the benefits of selecting the Sapien 3 prosthesis is the unique character of the e-sheath, which can be dilated with a balloon from inside, when the Sapien 3 prosthesis could not be advanced because of insufficient dilatation of the conduit. One can retrieve the prosthesis and re-dilate the endoconduit with the larger balloon from inside the e-sheath.

In this case, early patency of the iliac stent graft was confirmed by postoperative CT angiography. Limb occlusion after endovascular aortic repair for abdominal aortic aneurysm is a rare complication. Furthermore, the use of the endoconduit for thoracic endovascular aortic repair has been reported to be associated with low rates of late iliofemoral complications.[4] However, long-term follow-up is necessary to evaluate the durability of the 8-mm stent graft used for the external iliac endoconduit.

Indications for the endoconduit technique should be limited to severe stenotic and sclerotic iliac arteries that balloon angioplasty alone could not gain enough access to pass the device, or when the possibility of iliac rupture is deemed high. The limitation of this case report is the lack of evidence showing the benefits of this technique over the alternative access methods and ad hoc treatment of the ruptured iliac artery with GORE VIABAHN (WL Gore & Associates, Flagstaff, AZ, USA), which has been recently approved for clinical use in Japan. Comparative studies of large series of cases are needed to justify this technique and examine the safety, long-term patency of the conduit, cost, procedure time, contrast medium volume, radiation time, and bleeding.

In conclusion, the use of the iliac endoconduit was adopted for a patient with restricted femoral access undergoing TAVI. This technique may be a useful alternative to TA access during TAVI.

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Disclosure Statement

Takashi Murakami, Yosuke Takahashi, Shinsuke Nishimura, Shinichi Iwata, Tokuhiro Yamada, Minoru Yoshiyama, and Toshihiko Shibata have no conflicts of interest.

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