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Iatrogenic migration of iliac stent graft that was implanted for the reason of iliac artery perforation at the beginning of TAVI into the ascending aorta during the procedure

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Abstract

Introduction: Vascular complications are one of the substantial complications of transcatheter aortic valve implantation (TAVI). Stent graft implantation is a powerful tool for managing them.

Case presentation : This article describes a case of iliac artery perforation by 10 Fr sheath in an 86-year-old female at the beginning of the TAVI procedure that was solved by stent graft implantation. However, the stent graft was later unintentionally dislocated into the ascending aorta during repeated attempts of sheath and guiding wire introduction. Finally, the migrated stent graft was successfully extracted using a loop snare device.

Conclusions: This article highlights the fact that armamentarium passage through an implanted stent graft, especially when newly deployed, can be tricky and should be done gently and carefully, optimally under fluoroscopic guidance. The permanent multidisciplinary team realizes TAVI can be advantageous for immediate management of difficult clinical situations.

Keywords

Transcatheter Aortic Valve Replacement, Vascular System Injuries, Stent Graft, Migration, Extraction

Rezumat

Introducere: Complicațiile vasculare reprezintă una dintre complicațiile semnificative ale implantării transcateter a valvei aortice (TAVI). Implantarea unui stent graft este un instrument important pentru gestionarea acestora.

Prezentarea cazului: Acest articol descrie un caz de perforare a arterei iliace de către un dispozitiv de introducere de 10 Fr la o pacientă în vârstă, la începutul procedurii TAVI, care a fost rezolvat prin implantarea unui stent graft. Cu toate acestea, stentul graft a fost ulterior dislocat neintenționat în aorta ascendentă, în timpul încercărilor repetate de a introduce dispozitivul și firul de ghidare. În cele din urmă, stentul graft migrat a fost extras cu succes cu ajutorul unui dispozitiv cu buclă.

Concluzie: Acest articol evidențiază faptul că trecerea instrumentarului medical printr-un stent graft implantat, în special printr-un stent graft implantat recent, poate fi dificilă și ar trebui efectuată cu grijă și delicatețe, în mod optim prin ghidare fluoroscopică. O echipă multidisciplinară permanentă care efectuează TAVI poate fi avantajoasă pentru gestionarea imediată a situațiilor clinice complexe.

Cuvinte cheie

Înlocuirea transcateter a valvei aortice, leziuni ale sistemului vascular, stent graft, migrare, extracție

Introduction

Transcatheter aortic valve implantation (TAVI) has become a valuable treatment option for up to one-third of patients with severe symptomatic aortic valve stenosis who are considered ineligible for open surgical valve replacement [1]. The TAVI procedure, despite its minimal invasiveness compared to open surgery, is associated with a broad spectrum of complications. They can be classified as cardiac and non-cardiac at the time of the TAVI procedure. Vascular complications (VCs) are one example of a non-cardiac complication and are defined by the Valve Academic Research Consortium (VARC) 2 guidelines that divide VCs into major and minor [2].

In this article, we describe a case of a TAVI procedure complicated by major VCs, the treatment of which led to new, serious, and unexpected complications, significantly prolonging the TAVI procedure and complicating its management.

Case presentation

An 86-year-old female was admitted to our institution for a TAVI procedure necessitated by severe symptomatic aortic stenosis. Her main complaint was gradually worsening dyspnea leading to total intolerance of physical activity. She also experienced acute decompensation of chronic heart failure two months prior to the TAVI procedure. She was treated for multiple comorbidities: arterial hypertension, chronic heart failure with left ventricle ejection fraction (EF) of 45%, three-vessel ischemic heart partially revascularized by

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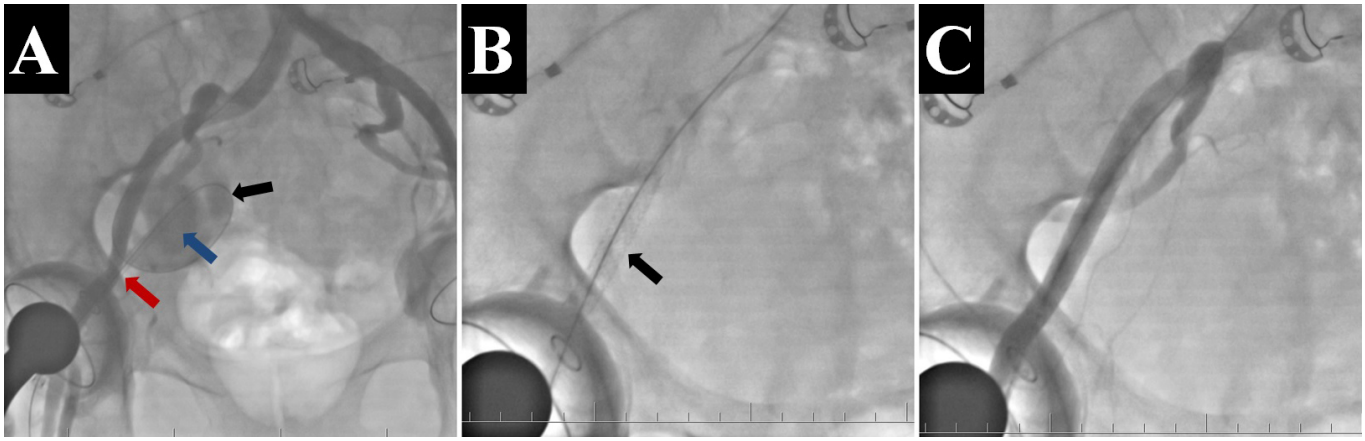

Figure 1 - Angiography of iliac and femoral arteries. Picture (A) shows perforation of right external iliac artery by 10 Fr sheath. Red arrow marks area of perforation, blue shows huge retroperitoneal bleeding, and black indicates guiding wire outside of artery, i.e., in retroperitoneal space. (B) Fluoroscopy of pelvis shows implanted stent graft BeGraft 8x57 mm in right external iliac artery (black arrow). (C) The angiography of right iliac and femoral artery after implantation of stent graft shows no leakage of iodine contrast out of artery into retroperitoneal space.

stent implantation into LAD two months before the TAVI, and third-stage chronic kidney failure according to NKF KDOQI. She had undergone hip joint replacement on both sides 10 years prior.

Echocardiography documented an effective orifice area of 0.55 cm², a peak velocity of 5.2 m/s, a mean gradient of 63 mmHg, and second- to third-degree aortic regurgitation. The EF was reduced to 45%. The CT angiography of the aorta and its main branches was performed prior to the TAVI procedure. The minimal diameter of the common femoral artery (CFA) was 6 mm on the right and 6.2 mm on the left. The variance in minimal diameters on common femoral arteries (CFAs) was negligible between the two sides.

The TAVI procedure was performed in a hybrid operating room. The right CFA was chosen because it could accommodate the larger (i.e., 18 Fr) sheath. The left CFA was chosen for the diagnostic pigtail catheter. The retrograde puncture of both common femoral arteries was performed under fluoroscopic guidance, and a 6 Fr RADIFOCUS™ Introducer II Terumo was introduced into the arteries at the beginning of the procedure. Subsequently, the 6F introducer sheath in the right CFA was removed, and the attempt for 10 Fr RADIFOCUS™ Introducer II Terumo was performed on a soft, standard "J-shaped" guidewire.

However, the clinical condition of the patient worsened dramatically after this. The level of consciousness deteriorated to sopor, and severe arterial hypotension developed with systolic blood pressure at 50 mmHg.

The angiography of the abdominal aorta and iliac and femoral arteries revealed perforation of the right external iliac artery (EIA) by the 10 Fr sheath and massive retroperitoneal bleeding (Figure 1A). The vascular specialist immediately passed from the left to the right common iliac artery (CIA) and inflated the 8x60 mm Ultraverse™ balloon there to stop bleeding. Then, the new retrograde puncture of the right CFA below the previous one was performed, and a new 6 Fr sheath was introduced.

The new puncture was done under fluoroscopic control. The actual position of the 10 Fr sheath and stored image showing the position of the prior puncture of the right CFA (needle) were used for a new one, which was done approximately 5-6 mm below the previous one. After that, a new guiding wire was used for passage through the perforated right EIA. The previous 10 Fr sheath was extracted, and area of the puncture was sealed using ANGIO-SEAL® VIP Vascular Closure Device 8 Fr.

Subsequently, a BeGraft 8x57 mm stent graft was deployed into the right EIA, resulting in complete exclusion of bleeding (Figures 1B and 1C), and concomitantly, the patient's systemic blood pressure normalized. The cardiologists decided to continue the procedure via the right CFA despite major VC. The explanation for this remains unclear. We can only suppose the reasons that would explain this decision. Better handling of the right-sided femoral approach and operator-related lack of experience and knowledge of potential consequences and complications when one passes through a recently deployed stent/stent graft into the peripheral artery could be a potential explanation. The 6 Fr sheath was replaced with a 10 Fr model, and after that, the Vertebral 5 Fr and Lunderquist® guiding wire were introduced into the ascending aorta; however, they were not delivered under fluoroscopy when crossing the stent graft. After that, the dramatic scenario described above suddenly repeated. The patient became soporous and hypotensive. The angiography of iliac arteries and ascending aorta revealed that the stent graft had unintentionally dislocated into the ascending aorta by the Vertebral catheter and Lunderquist® guiding wire (Figure 2A) so that the migration of stent graft was observed only afterwards when the patient became hypotensive.

The balloon was inflated in the right EIA again to stop the bleeding (Figure 3A). After that, a new 10x40mm Fluency™ stent graft was immediately implanted into the right EIA (Figures 3B and 3C), and the dislocated stent graft was caught using the Multi-Snare® pfm medical 30 mm catheter and the proximal grab technique for extraction (Figure 2B).

The stent graft was then pulled out from the ascending aorta into the left CFA, where it was left in situ for subsequent surgical

extraction because it was impossible to pull the destroyed stent graft into the 12 Fr sheath in the left CFA. After this process, the TAVI procedure continued as planned. The 10 Fr sheath in the right groin was replaced with an 18 Fr Sentrant Introducer sheath that was introduced gently and carefully under fluoroscopic control.

Finally, the Evolut™ R 26 mm Medtronic aortic bioprosthesis was successfully implanted. Since the TAVI procedure was performed in a hybrid operating room, the destroyed stent graft left in the left CFA was surgically removed during the same procedure as its last part. The patient was fully heparinized during the whole procedure until the successful surgical extraction of the destroyed stent graft; after that, the heparin was antagonized. The study protocol was approved by an ethics committee.

Discussion

Typical reported VCs of TAVI performed via transfemoral access include arterial dissection, perforation, pseudoaneurysm, rupture, and hematoma [3]. Their incidence varies between 3.5% and 9.3% among newer studies [4, 5]. The presence of major VCs is also associated with worse clinical outcomes, higher morbidity, and higher incidence of all-cause mortality [6, 7].

In view of the above, great efforts have been made to identify VC predictors. These include sheath diameter, sheath to femoral artery ratio (SFAR) ≥ 1.05, early center experience, peripheral artery disease, female sex, learning curves, and left sided femoral approach for the largest sheath insertion [3, 7]. In case of major vascular injuries such as perforation, rupture, or bleeding, the first response option may be the rapid insertion of a dilator or sheath.

Another option is the to inflate the occlusive balloon from the ipsilateral or contralateral femoral approach to ensure hemostasis. However, if the bleeding persists after the balloon is deflated, implantation of a stent graft or surgical revision should be considered.

This article describes a unique case of a major VC during a TAVI procedure. The right EIA was perforated by a 10Fr sheath during its introduction, causing severe bleeding, which was successfully stopped with an immediate stent graft implantation. However, the prior implantation of a stent graft finally dramatically worsened the situation because repeated attempts to insert the sheath and catheter with guiding wire led to unintentional dislocation and migration of the stent graft into the ascending aorta.

Luckily, this clinical situation was successfully managed. The new stent graft was deployed into the right EIA, and the migrated one was extracted using a loop snare device and the proximal grab technique.

The presence of an intravascular foreign body (IFB) – in this case, a dislocated and migrated stent graft – is a serious clinical situation that increases patient morbidity and mortality. It is a feared complication of endovascular procedures and can cause severe adverse events depending on the location of the IFB: infections, thrombosis, ischemia, perforation, and cardiac arrhythmias.

If the IFB is not extracted, the reporting rate for severe adverse events is 71%. Therefore, the extraction should be done as soon as

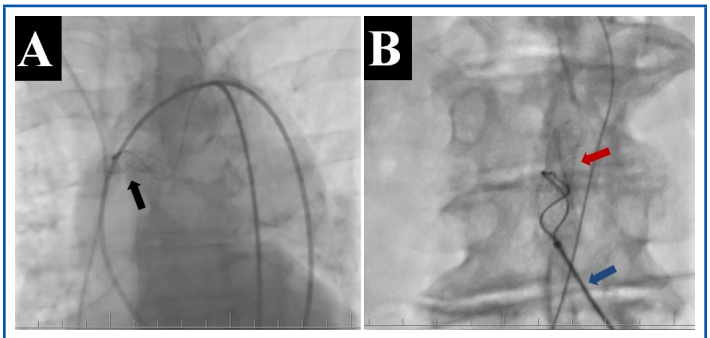

Figure 2 - (A) Fluoroscopy of the chest showing stent graft BeGraft 8x57 dislocated from external iliac artery into ascending aorta (black arrow) due to unintentional entrapment by Lunderquist guiding wire and Vertebral catheter. (B) Fluoroscopy showing stent graft BeGraft 8x57 mm (red arrow) caught by loop snare device Multi-Snare® (blue arrow).

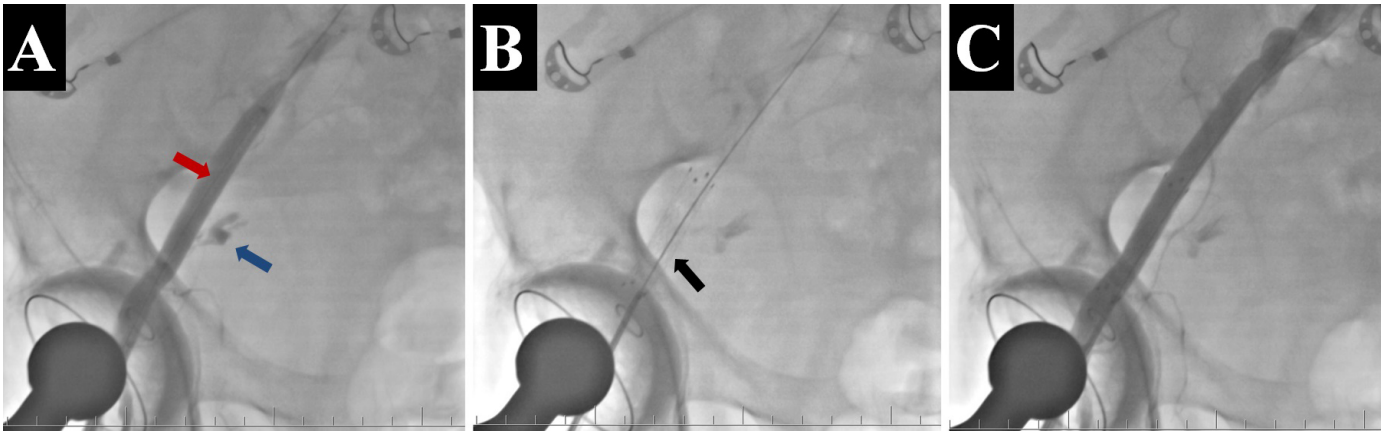

Figure 3 - (A) Angiography of right iliac arteries shows balloon inflated in external iliac artery after dislocation of stent graft BeGraft 8x57 mm (red arrow) in order to stop bleeding. Blue arrow indicates small leakage of iodine contrast from external iliac artery despite inflated balloon, i.e., it marks area of perforation. (B) Fluoroscopy of pelvis shows new stent graft implanted into right external iliac artery (black arrow). (C) Angiography of right iliac artery shows no acute leakage of iodine contrast after stent graft implantation. However, a small amount of iodine contrast is visible near the stent graft that got out from the artery prior to the second stent graft implantation .

possible [8]. Endovascular extraction of the IFB is widely accepted as the first-line retrieval option, while surgical extraction remains a second option for approximately 6-10% of cases when the endovascular extraction is not possible, appropriate, or successful [8].

We identified the following factors as potentially crucial risk factors for VC development in the present case: female sex, calcified femoral artery, the learning curve of the second, and a less experienced TAVI team performing the procedure (the interventional cardiologists are divided into stable teams performing TAVI in our institution). The SFAR for 10 Fr sheath on the right side was 0.73. Since perforation of the EIA happened during introduction of the 10 Fr sheath, the SFAR was not considered a significant risk factor for major VC.

Conclusion

This case underscores the importance of a multidisciplinary model of health care for patients undergoing a TAVI procedure: cardiologists, cardiac surgeons, and vascular specialists should work side by side to perform the TAVI. This article also highlights the fact that passage through implanted stents or stent grafts with an armamentarium can be tricky and should be done gently and carefully, ideally under fluoroscopic guidance.

Author Contributions

All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement

Written informed consent for the procedure and to publish this paper has been obtained from the patient.

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None.

Conflicts of Interest

The authors declare no conflict of interest.

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