Critical limb ischemia: case presentation of retrograde endovascular approach

Tratamiento de isquemia crítica en miembros inferiores: presentación de un caso con resolución endovascular por vía retrógrada

Deysi Vanessa Cuadros Morales[1]

ABSTRACT

Critical lower limb ischemia is a serious medical condition with a high risk of major amputation, disability, and death. Treatment of choice is percutaneous due to its low rate of complications. However, it poses a challenge when performing antegrade (femoral) revascularization in chronic total coronary occlusions with technical failure rates between 10% and 40%. For this reason, the retrograde approach ofinfrapopliteal vessels arises as an alternative with successful results, and a low risk associated with the puncture site.
This is the case of a patient with critical ischemia who required unconventional access to achieve revascularization.

Keywords: *critical ischemia, lower limbs, occlusive lesions, angioplasty retrograde.*

RESUMEN

La isquemia crítica de miembros inferiores genera una condición médica grave con alto riesgo de amputación mayor, incapacidad y muerte. El tratamiento percutáneo es de elección por su baja tasa de complicaciones. Sin embargo, presenta un reto cuando se realiza revascularización por vía anterógrada (femoral) en oclusiones crónicas, con fracaso técnico entre un 10 y un 40%. Por ello surge como alternativa el abordaje retrógrado sobre los vasos infrapoplíteos, con resultado exitoso y bajo riesgo asociado al sitio de punción.
Reportamos un caso de paciente con isquemia crítica que requirió de acceso no convencional para lograr la revascularización.

Palabras clave: *isquemia crítica, miembros inferiores, lesiones oclusivas, angioplastia retrógrada.*

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INTRODUCTION

Lower limb critical ischemia is a serious manifestation of lower limb peripheral arterial disease. It poses a high risk of amputation or complications associated with tissue loss, gangrene, sepsis or multiple organ failure.[1] This ischemia is characterized by the coexistence of pain at rest or foot or toes ulceration or gangrene. It often presents as a chronic total coronary occlusion (CTO) in the femoropopliteal segment (FP).[2]

Endovascular treatment is the therapy of choice to revascularize patients with critical limb ischemia thanks to its results and low morbidity and mortality rates reported.[3] Technical success is defined as the arrival of direct flow towards the foot through, at least, 1 patent infrapopliteal blood vessel.

Access via femoral approach—antegrade—is the common access route to perform an angioplasty of lower limb arteries. The rate of technical failure regarding revascularization is somewhere between 10% and 40%. Retrograde approach techniques via the accesses opened in anterior and posterior tibial, feet, fibular, and metatarsal arteries respond to the goal of reducing the rate of technical failure.

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CASE REPORT

This is the case of a 92-year-old woman with a positive cardiovascular risk factor for arterial hypertension. Her past medical history included non-anticoagulated atrial fibrillation, and peripheral arteriopathy with intermittent claudication at 54 yards. Also, the patient's medical history included hip fracture with metal prosthesis in right lower limb. She is referred from a different center with lower limb critical ischemia of 20-day evolution with necrotic ulcer of right hallux up to the third ipsilateral phalange (Rutherford V).[4]

The physical examination confirmed the presence of palpable femoral pulse grade 2/2 with reduced popliteal pulse and absence of anterior tibial artery with slightly reduced temperature, paleness, delayed capillary pulse, and right foot hyperalgesia. The ankle-brachial index (ABI) before treatment was 0.5.

Other additional tests:

- Laboratory tests: RBC, 39%: WBC, 9.7 million/mm^3; platelets, 200 million/mm^3 creatinine levels, 1.4 mg/dL; urea levels, 57 mg/dL.
- Arterial Doppler ultrasound: occlusion of right superficial femoral artery.

Procedure is performed under sedoanalgesia and systemic heparinization through antegrade puncture and insertion of a 6-Fr introducer sheath (Avanti Plus; Cordis Corporation, Miami Likes, FL, United States) into the right common femoral artery. The diagnostic arteriography performed reveals a total chronic coronary occlusion at superficial femoral artery (SFA) level from the ostium towards the distal third with recanalization at popliteal level due to collateral circulation (**Figures 1 A-B**). An occlusion of the anterior tibial artery is revealed at infrapopliteal level with distal recanalization. Afterwards, a 5-Fr diagnostic

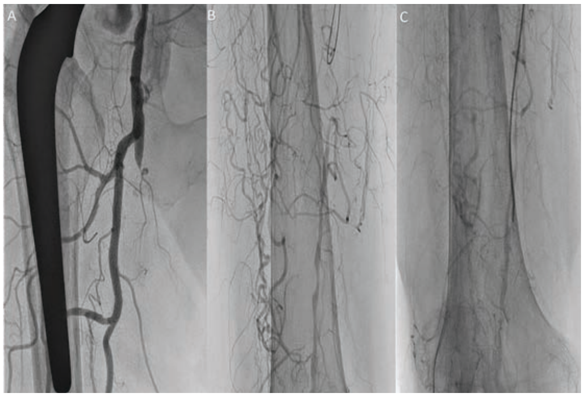

Figure 1. *A. and B. Angiography reveals the occlusion of the superficial femoral artery from the ostium towards the distal third. C. Failed angioplasty via antegrade access of SFA.*

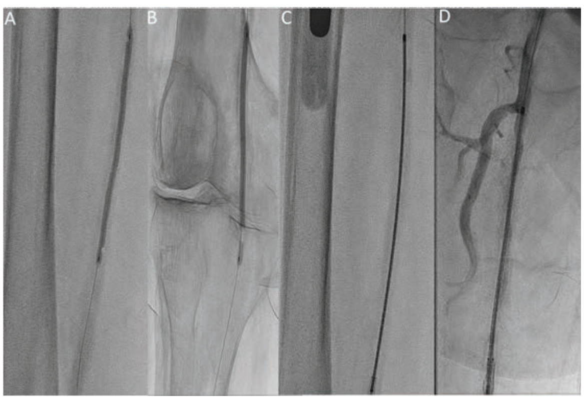

Figure 3. *A. and B. Balloon angioplasty of SFA and popliteal artery. C. and D. Positioning and implantation of self-expanding stents into the SFA.*

catheter (Impulse™ MPA2, Boston Scientific, MA, United States) is mounted on a 150 cm 0.035 in J-tip hydrophilic guidewire (Radiofocus™ Guide Wire M, Terumo Corporation, Tokyo, Japan) that is advanced towards the mid third of the SFA. Then, it is exchanged for a 4-Fr hydrophilic vertebral catheter (Radiofocus™ Glidecath™, Terumo Corporation, Tokyo, Japan) in an attempt to recanalize the crossing. Procedure is difficult due to the presence of severe calcification with failing antegrade revascularization **(Figure 1C).**

The posterior tibial artery is treated with retrograde puncture at distal third level with a 21G needle (Cook Medical Inc. Bloomington, IN, United States) with fluoroscopy guidance. Afterwards, a 5-Fr radial introducer sheath is inserted (Terumo Corporation, Tokyo, Japan) followed by a 0.014 in guidewire (Cross-IT 300 XT, Abbott Vascular, Santa Clara, CA, United States) mounted over a 2.0 mm x 20 mm OTW balloon (Ryujin Plus, Terumo Corporation, Tokyo, Japan) until reaching the inside of the vertebral catheter placed via antegrade access at the SFA mid third level to eventually connect the retrograde and antegrade accesses (SAFARI technique)[5] **(Figures 2 A-C)**. Afterwards, access is reversed and angioplasty is completed with a 3 mm x 80 mm balloon (RapidCross, Medtronic, Minneapolis, MN, United States), a 5 mm x 120 mm OTW balloon (Admiral Xtreme, Medtronic, Minneapolis, MN, United States) **(Figures 3 A-B)**, and implantation of three 6 mm x 120 mm self-expanding stents (Everflex™, Medtronic, Minneapolis, MN, United States) covering the ostium until the distal third of the right SFA **(Figures 3 C-D)**.

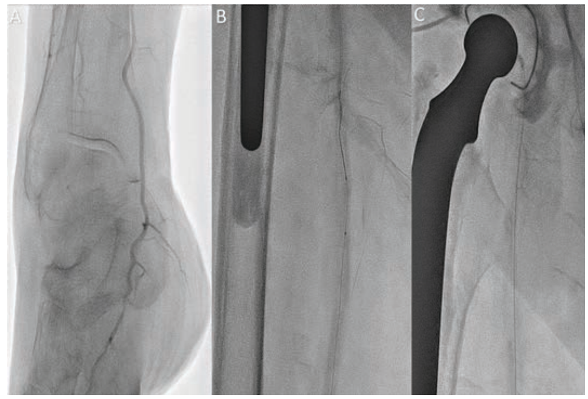

Figure 2. *A. Scarce blood supply at foot dorsal level where the patent posterior tibial artery can be seen. B. and C. Using the posterior tibial access, insertion of the guidewire into the catheter inserted via femoral access and use of the SAFARI technique.*

Control angiography shows patency in the entire territory of the right superficial femoral artery, and in the popliteal and right posterior tibial arteries with increased infrapatellar flow. These arteries had been hypoperfused before the procedure **(Figures 4 A-F)**. Homeostasis was performed with compressive bandage at the posterior tibial puncture site without further complications.

Technical success facilitated the revascularization of the previously occluded superficial femoral artery that had caused the problem, and increased flow while keeping patent, at least, 1 infrapopliteal vessel. In the immediate postoperative period, the foot artery recovered pulse with an ABI (angle-brachial index) of 1 with better color, capillary refill, and with normal temperature.

At the outpatient follow-up, a control Doppler echocardiography was performed at 6 months with preserved right posterior femoral and tibial flow that progressed into the healing of the lesion and no pain at rest while on ASA, clopidogrel, cilostazol, and statins.

DISCUSSION

The presence of critical ischemia (pain at rest or trophic lesions) requires early revascularization treatment due to the high risk of losing the limb in an elevated number of patients causing functional disability, and social and economic losses. The rate or primary amputation at 1 year is 25%.[1]

Over the last decade, the arrival and perfectioning of new percutaneous technologies has turned into a significant growth of endovascular strategies.[6] However, in complex cases of extensive occlusions, the rate of failure is somewhere between 10% and 40% when performed via antegrade femoral access. Even in reference centers, the rate of technical failure associated with long chronic total coronary occlusions can be up to 17.8%.[7] When this happens, an option that should be taken into consideration is retrograde access[8] that is associated with higher chances of technical success (of up to 85%) in cases with failing conventional antegrade access.[9] This approach should be performed with extreme caution and, on many occasions, it is the only patent infrapatellar vessel responsible for keeping the limb viable.

Good angiographic results were reported when proper flow was reestablished in the ulcer region, which facilitated the healing of the lesion, and prevented amputations.

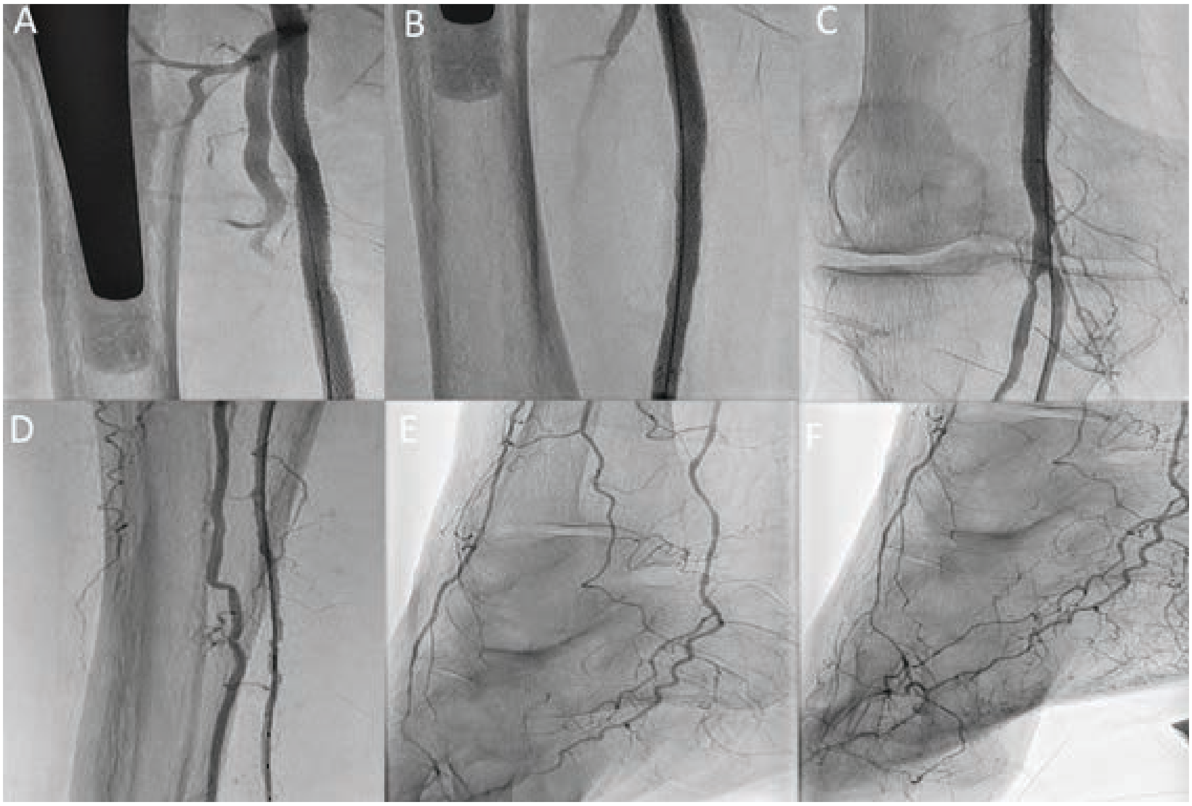

Figure 4. *A-C. Angiography after treatment showing patency from the ostium until the distal third of the previously occluded SFA. D-F. Patency of posterior tibial and plantar arteries with significant flow improvement in the fibular and foot arteries, both of which were hypoperfused before treatment.*

CONCLUSION

Peripheral angioplasty via retrograde access in long occlusive lesions is a viable therapeutic option.This new therapeutic strategy allows the endovascular revascularization of most patients with successful results, which improves the viability of the limb with lower rates of amputation, morbidity, and mortality associated with this condition.

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Transcatheter aortic valve replacement for failing homograft

Reemplazo valvular aórtico transcatéter en fallo de homoinjerto

José María Milanesi[1], Martín Oscos[2], Diego Grinfeld[2], Raúl Solernó[3], Ricardo Aquiles Sarmiento[4]

ABSTRACT

Aortic valve replacement with homograft is a rarely used option due to the risk of late degeneration involved. Reoperation in patients with aortic valve replacement with homograft represents a high risk. Transcatheter aortic valve replacement is an established therapy for patients with severe aortic stenosis. However, its use in aortic homograft failure has been reported in very few publications. This is the case of transcatheter aortic valve replacement for failing homograft.

Keywords: *aortic valve stenosis, transcatheter aortic valve replacement, homograft, allograft.*

RESUMEN

El reemplazo valvular aórtico con homoinjerto es una opción poco utilizada debido al riesgo de degeneración tardía. La reintervención quirúrgica en pacientes con reemplazo valvular aórtico con homoinjerto representa un riesgo elevado. El reemplazo valvular aórtico transcatéter es un tratamiento reconocido para pacientes con estenosis aórtica severa, pero su uso en fallo de homoinjerto en posición aórtica ha sido reportado en escasas publicaciones. Presentamos un caso de reemplazo valvular aórtico transcatéter en fallo de homoinjerto.

Palabras clave: *estenosis valvular aórtica, reemplazo valvular aórtico transcatéter, homoinjerto, aloinjerto.*

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INTRODUCTION

Surgical aortic valve replacement (SAVR) with homograft is prone to late degeneration as it is associated with severe calcification and vascular dysfunction. Surgical reintervention in patients treated with SAVR with homograft can be associated with a significantly high risk.[2] Transcatheter aortic valve implantation (TAVI) has become a known therapy for patients with severe aortic stenosis (AoS) with high risk for conventional surgery. This is the case of a failing aortic homograft on which TAVI was performed.

CASE REPORT

This is the case of a 65-year-old man, former smoker, and with a past medical history of high digestive bleeding due to duodenal ulcer treated with endoscopic therapy. He showed severe aortic valvular disease that was treated with SAVR back in 2003 with homograft placement, chronic atrial fibrillation on anticoagulant therapy, recent transient ischemic attack, and VVI pacemaker implantation due to sinus node disease. The patient presented with NYHA functional class (FC) II-IV progressive dyspnea of 14-day evolution.

The transthoracic echocardiography performed revealed the presence of a homograft with sclerocalcification in the aortic position conditioning a moderate-to-severe restriction in its opening. Mean gradient was 41 mmHg, the continuity equation area, 1.02 cm^2, and the patient showed moderate aortic regurgitation with an eccentric jet. The presence of mild tricuspid regurgitation allowed us to estimate pulmonary systolic pressure in 64 mmHg. The left ventricle was slightly dilated with preserved systolic function, same as the right ventricle. The cine coronary arteriography performed found no coronary lesions. The cardiac examination was completed with a coronary computed tomography angiography that confirmed the presence of severe calcification of the aortic homograft and ascending aorta. Size of the valvular annulus was 29.3 mm, the left main coronary artery-valvular plane distance was estimated at 15 mm, and the right coronary artery-valvular plane distance at 14.7 mm.

Following the findings made in the additional methods used, the clinical signs were interpreted as failing homograft after 17 years. EuroScore II risk score was 11.33%, and the STS risk score, 5.1%. The case was brought to the heart team to assess the therapeutic strategy that should be followed and, considering the risks associated with reinterventions, it was decided to go with TAVI.

Procedure was performed by puncturing the right femoral artery using a minimally invasive technique.[6] An Avanti+® 7-Fr femoral introducer sheath was used (Cordis, CA, United States). Valvular plane was crossed using a 0.035 in straight Starter™ guidewire (Boston Scientific, MA, United States) and a 6-Fr Impulse™ AL2 catheter (Boston Scientific, MA, United States). The system was changed for a Confida™ guidewire (Medtronic, Minneapolis, MN, United States), and a no. 29 CoreValve™ Evolut R™ system was advanced

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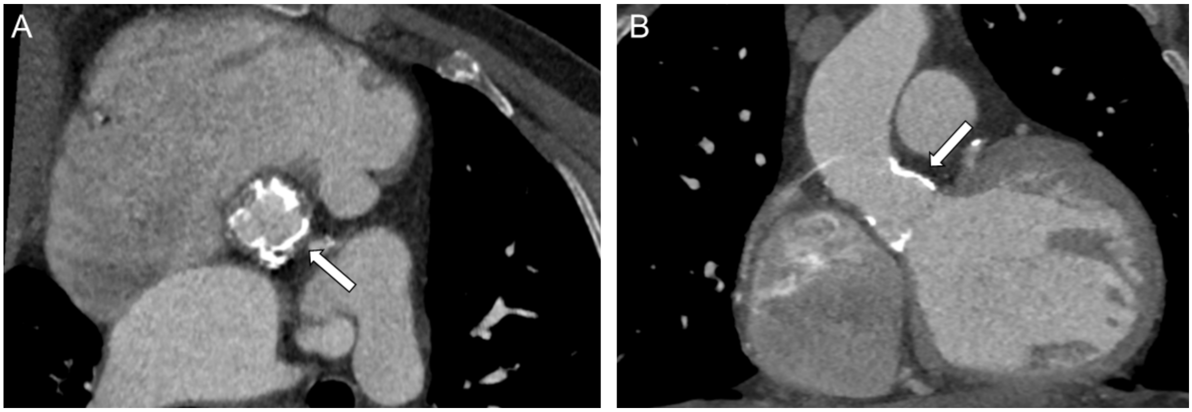

Figure 1. *Axial view (A), and long axis of left ventricle (B) on cardiac computed tomography scan. Severe calcification of aortic homograft (white arrows).*

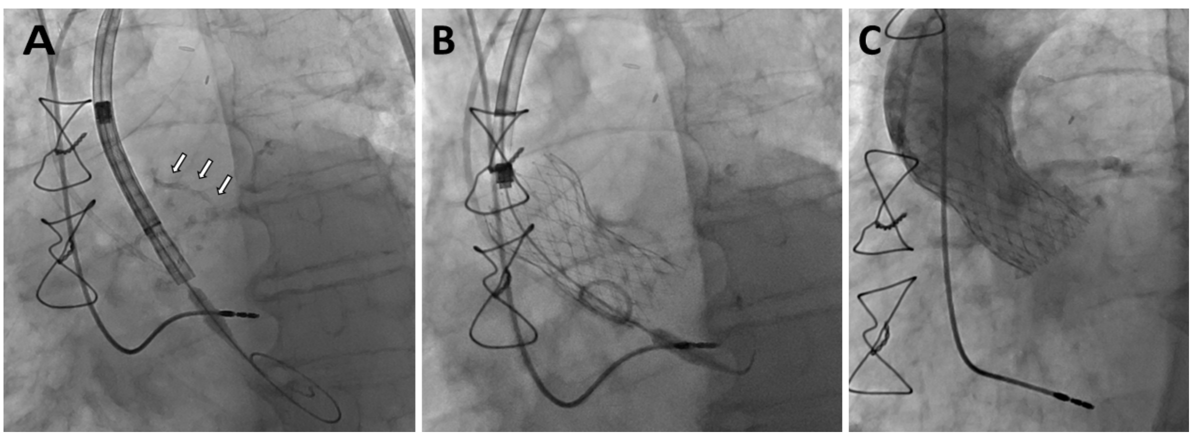

Figure 2. *Fluoroscopic images in LAO and caudal angulation (CAU) projection angles (A and B) and cranial LAO view (C) during transcatheter aortic valve implantation. Image A shows the severe calcification of the aortic homograft (white arrows). Image B shows the CoreValve™ Evolut R™ system successfully implanted. Image C corresponds to the thoracic aortogram after TAVI with no paravalvular leaks or residual AR findings.*

(Medtronic, Minneapolis, MN, United States) that was placed in the valvular plane and released successfully. Angiographic and echocardiographic control confirmed the right position of the system without paravalvular regurgitation. Peak-to-peak aortic gradient was estimated at 5 mmHg. Femoral percutaneous closure was performed using a Proglide™ device (Abbott Laboratories, IL, United States). The patient was discharged from the hospital 72 hours after the procedure and once in a normal range of anticoagulation.

DISCUSSION

This is the case of a patient with a severe aortic valvular homograft dysfunction considered of high surgical risk for reintervention. Although the medical literature available does not establish any specific recommendations on how to treat this type of patients we decided to go with TAVI with favorable hemodynamic, echocardiographic, and clinical outcomes.

Aortic root homografts are rarely used for SAVR. They are often spared for very complex repairs where a tissue engineered valve is required, as well as for cases when the bioprosthetic valve is not good enough due to infections or other factors.[1] The advantages of valvular replacement with homograft are its excellent hemodynamic profile and good homeostasis, as well as the low risk of thromboembolism and infection of the prosthetic valve. The setback is its durability due to the destruction and degeneration of the valve. Also, because it is not available everywhere.[2] However, several studies suggest that homografts rarely deteriorate after 5 years, and that the need for reintervention appears, on average, after 12 years (RI, 8 to 13 years).[2,3]

Conventional surgical reintervention is technically challenging because it requires coronary artery reimplantation, often in elderly patients with comorbidities and worsening ventricular function.[2] High surgical risk determines whether reintervention will be an alternative or not. The experience published in the medical literature comparing therapeutic options regarding failing homografts in the aortic position is scarce. Sedeek et al. compared conventional surgical reintervention vs TAVI only to find a higher rate of bleeding in the surgical option (58% vs 0% P = < .001), and more vascular access complications in the percutaneous option (36% vs 15% P = .193). Morbidity and mortality risk was high regardless of the replacement technique used. Avoiding vascular complications may lead to better results in the TAVI group.[3]

When considering percutaneous treatment in this type of cases there are different questions that should be studied prior to the procedure and that are often complex issues. The anatomy of the aortic root is often distorted, which complicates the measurement of the annulus and the placement of the prosthetic valve. Multislice computed tomography provides clear images of the anatomy and geometry of the aortic root, the distribution of coronary calcium, and most important of all, accurate measurements of annular size.[2] Although there is a higher risk of paravalvular leak due to the stent asymmetrical dilatation and patient-prosthesis mismatch, overinflating balloons of balloon-expandable valves or postdilatation can tear both the root and the annulus of the heavily calcified aortic homograft.[4] Another variable that should be taken into consideration is the possibility of coronary ostia obstruction as it is the case with valve-in-valve procedures. Precise measurements of valvular annulus and coronary ostia are essential to prevent this potential complication.[4,5]

CONCLUSION

In our case, SAVR with TAVI turned out to be a safe option to treat a failing homograft in the aortic position. We should mention the importance of planning and taking previous measurements of the anatomy of valvular apparatus and ascending aorta through computed tomography scans since the usual geometry is often distorted. The minimally invasive technique promotes early hospital discharges.

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