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Transcaval Transcatheter Aortic Valve Implantation Using the Self-Expanding Heart Valve Symetis ACURATE Neo (First European Experience)

C Pellegrini[1], C Hengstenberg[1,2,3]*, J Michel[1], AM Kasel[1]

[1]*Department of Cardiovascular Diseases, Technical University Munich, Germany*

[2]*German Center for Cardiovascular Research (DZHK), Partner Center Munich Heart Alliance, Germany*

[3]*Department of Internal Medicine II, Medical University of Vienna, Austria*

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***Corresponding author:** Christian Hengstenberg, Department of Cardiovascular Diseases, German Heart Center Munich, Technical University Munich, Lazarettstrasse 36, 80636 Munich, Germany, Tel: +49 89 1218 4025; Fax: +49 89 1218 4083, Email: christian.hengstenberg@gmail.com

Abstract

We report the first case of transcaval aortic valve implantation using the self-expanding Symetis ACURATE neo in Europe. An 80-year-old female patient with severe aortic stenosis was referred for endovascular transcatheter aortic valve implantation (TAVI). MS-CT showed suitable aortic anatomy for TAVI, a porcelain aorta, and severe iliofemoral calcification and stenosis. In an interdisciplinary discussion with cardiac surgeons and cardiologists, the patient was deemed suitable for transcaval approach. A calcium-free window in the distal abdominal aorta was identified and, via the right femoral vein, puncture was achieved using electrocautery and a 0.014" wire.

The wire was snared, advanced into the aorta, and exchanged for a stiff 0.035" wire using a microcatheter. An 18F sheath was passed into the aorta and TAVI was performed using the Symetis ACURATE neo with excellent final result. Closure of the cavoaortic shunt was performed using an Amplatzer Duct Occluder (St. Jude Medical) with single aortic balloon inflation to optimize the occluder´s position. Angiography showed no residual shunting or retroperitoneal bleeding. A transcaval approach with use of Symetis ACURATE neo proved feasible and can be considered as an alternative technique for patients in whom femoral arterial access is not possible.

Abbreviations: TAVI: Transcatheter Aortic Valve Implantation; MS-CT: Multi-Slice Computed Tomography; CTO: Chronic Total Occlusion; RCB: Right Coronary Bypass

Introduction

Transcatheter aortic valve implantation (TAVI) is considered standard-of-care for the treatment of severe aortic valve stenosis in elderly patients with high surgical risk and is widely applied in intermediate risk patients. The transfemoral access route is associated with lower morbidity and mortality, as well as faster recovery, and is preferred for a minimally-invasive approach compared to transthoracic access routes [1]. A novel transcaval approach is feasible and safe for patients suffering excessive calcification or stenosis of the iliofemoral arteries [2,3].

Case report

An 80-year-old, female patient presented with severe aortic valve stenosis. The patient was highly symptomatic with dyspnea NYHA class III. Transthoracic echocardiography showed a good left ventricular function and a severe aortic stenosis with mean transvalvular gradient of 34mmHg and aortic valve area of 0.94 cm^2. Preoperative angiography showed diffuse, non-obstructive coronary artery disease. Cardiovascular risk factors included arterial hypertension, non-insulin-dependent diabetes mellitus, and hypercholesterolemia. Relevant comorbidities were peripheral arterial disease, stage III chronic renal impairment and idiopathic connective tissue disease. Overall preoperative risk by logistic EuroSCORE was 27.82%. Due to porcelain aorta, the patient was not eligible for surgery.

Multi-Slice Computed Tomography (MS-CT) showed tortuous, heavily-calcified femoral vessels with minimal diameters <5 mm. In an interdisciplinary discussion with cardiac surgeons and cardiologists, the patient was deemed suitable for transcaval approach. A calcium-free window in the distal aorta below the renal arteries was identified. After obtaining informed written consent, the procedure was carried out under general anesthesia in a hybrid-operating suite. A 7-French sheath was inserted into the right femoral vein and a 55cm RCB renal guide catheter positioned at the planned inferior vena cava puncture site. Simultaneous venous and arterial angiography enabled identification of the appropriate puncture height at approximately the level of the 3rd lumbar vertebra (Figure 1).

A 0.014" x 300cm coronary chronic total occlusion (CTO) wire (Confianza Pro, Asahi Intecc), with the distal 10mm removed, was placed within a 0.035" x 145cm wire-converter (Piggyback Wire Converter, Vascular Solutions). The coronary wire and wire-converter were advanced within a 90cm microcatheter and orientated toward the wall of the inferior vena cava using the RCB renal guide catheter. A gooseneck snare (Amplatz Goose-Neck, Medtronic plc) was positioned on the right inner surface of the distal abdominal aorta, encircling the planned puncture site. Aortic puncture was performed by advancement of the wire and simultaneous electrocautery (Figure 1, Panel A). The CTO wire was pushed into the descending aorta using the snare and the microcatheter (Figure 1, Panel B). A stiff 0.035" wire (Back-up Maier, Boston Scientific) was then exchanged into the aorta. A 18F x 40cm sheath (Check-Flo Introducer, Cook Medical) was passed via the femoral vein into the distal aorta (Figure 1, Panel C).

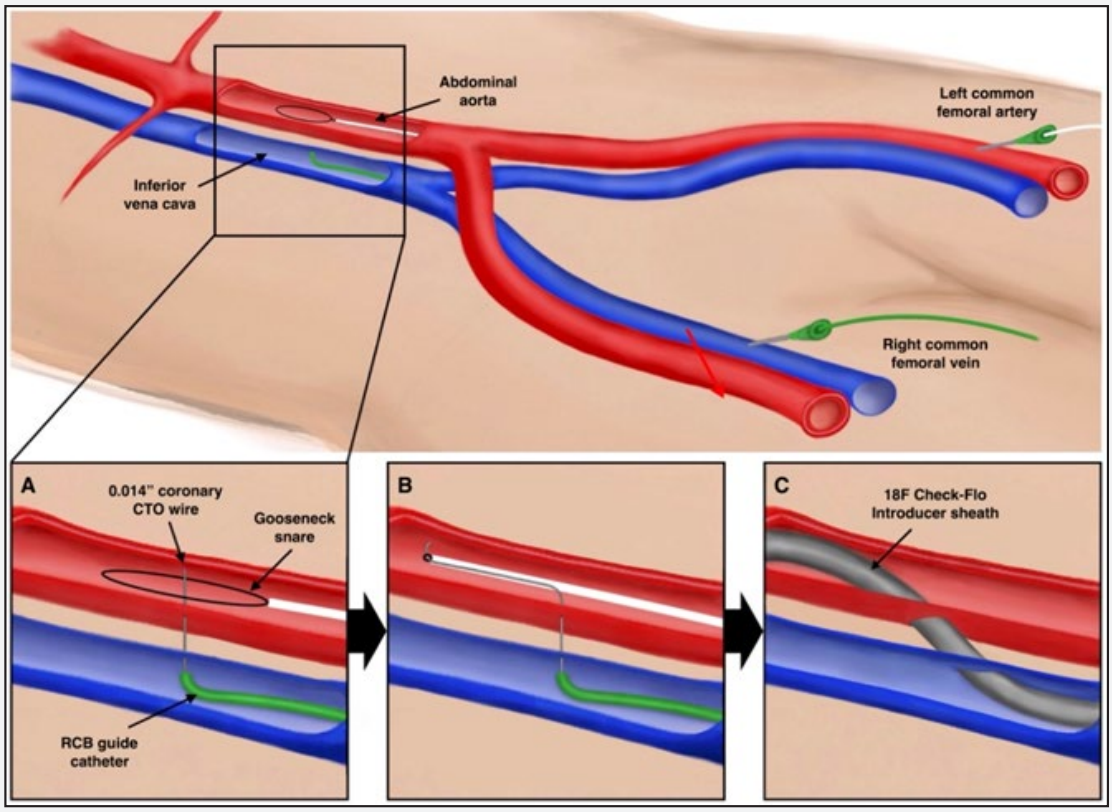

Figure 1: Transcaval puncture and sheath positioning (A-C).
A right coronary bypass (RCB) guide catheter is positioned in the inferior vena cava, and a Gooseneck snare in the abdominal aorta, at approximately the level of the 3rd lumbar vertebra (Upper panel).

1. Panel A: An 0.014" coronary chronic total occlusion wire and diathermy are used to puncture the vena cava and aortic walls.
2. Panel B: The wire is snared in the aorta and advanced proximally.
3. Panel C: A wire converter and microcatheter allow placement of a stiff 0.035" wire and introduction of an 18F sheath. The aortic puncture site is sealed with an Amplatzer Duct Occluder after removal of the sheath.

TAVI with the Symetis ACURATE neo was performed as previously described [4]. In brief, balloon valvuloplasty was performed with a 20mm Loma Vista TRUE Dilatation balloon under rapid pacing, the self-expanding system was released at the appropriate position and post-dilated with a 22 mm balloon (Loma Vista TRUE Dilatation) to achieve optimal expansion. Final angiography showed minimal residual paravalvular leak (Figure 2, Panel A). The sheath could then be removed leaving a standard 0.035", and backup 0.014", wire in situ. Haemostasis was achieved through closure of the cavoaortic shunt using an Amplatzer Duct Occluder (6mm, St. Jude Medical) (Figure 2, Panel B). A single aortic 18mm balloon angioplasty was performed to optimize the occluder´s position (Figure 2, Panel C). Final angiography showed no sign of retroperitoneal bleeding or residual aorto-caval shunting (Figure 2, Panel D). Femoral vein closure was achieved with a Perclose device (Abbott). The patient was monitored on the Intensive Care Unit for 24 hours, then transferred to the ward and mobilized on postoperative day one. The patient was discharged on postoperative day four after an uneventful recovery. At routine 30-day-follow-up the patient described NYHA class I exercise tolerance and echocardiographic parameters were excellent.

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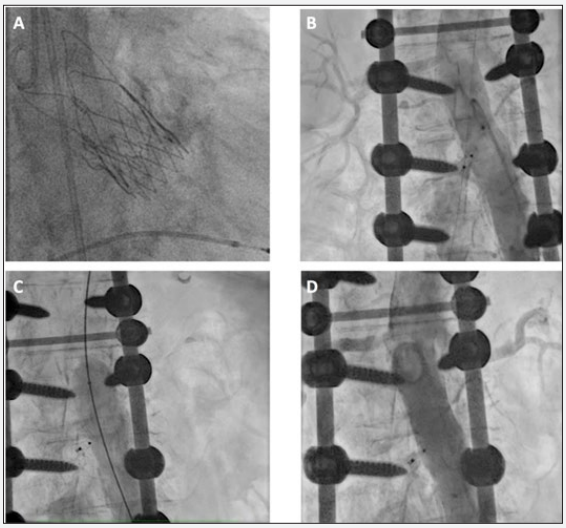

Figure 2: Valve deployment and occlusion of the abdominal aorta (A-D).

1. Panel A: Positioning of the Symetis ACURATE neo valve.
2. Panel B: Closure of the cavoaortic shunt using an Amplatzer Duct Occluder (6mm, St. Jude Medical).
3. Panel C: Single balloon angioplasty to optimize the occluder´s position.
4. Panel D: No sign of residual aorto-caval shunting in the final angiography.

Discussion

Femoral arterial access is the preferred choice access route for TAVI and is consistently associated with improved clinical outcomes compared to the most commonly used alternative strategy, i.e. the transapical approach [1]. The transcaval approach represents a novel technique that facilitates a transfemoral TAVI despite the presence of prohibitive arterial disease. Recently, data from a prospective, multicenter, single arm trial analyzing transcaval access has been published by Greenbaum et al. [5] consolidating initial experience with this novel technique. Out of 100 enrolled patients, 99 were successfully treated through a transcaval access with a device success rate of 99%. Life-threatening bleeding occurred in 12% of patients, which is higher than the 6.7% rate reported in the transfemoral group of the PARTNER-II trial [5].

However, a difference in preoperative risk between the two studies with a mean STS score of 9.6% for the transcaval group and mean STS score of 5.8% for the femoral group must be accounted for. Despite fear of dramatic complications such as retroperitoneal bleeding, no conversion to surgery was required and no patient died as a direct consequence of transcaval approach. 8% of patients required aortic covered stenting due to significant residual arteriovenous shunt after positioning of the occluder device or extravasation. Retroperitoneal hematoma was found in ¼ of patients before discharge on core lab CT scan, however most of them were small or moderate and managed conservatively. In our case, final angiography showed no residual shunt after positioning of the closure device and balloon dilatation and a follow up CT scan was not clinically indicated.

The transcaval approach presents an alternative treatment option for patients otherwise treated with medical therapy or higher-risk transthoracic approach; the safety and feasibility of this technique has been established in a prospective non-randomized trial [3]. Due to improvements in delivery catheter and sheath technology, some clinicians questioned the need for transcaval access. However, due to an estimated TAVI market growth of 16.9% per year over the next 4 years, the extension to intermediate-risk patients, and the inclusion of patient populations with smaller anatomies, there may well be an increased need for alternative access. Furthermore, operator experience with increasingly challenging anatomy is likely to propel the development of transvascular approaches forward, and reduce the requirement for transthoracic procedures.

Conclusion

Our case supports the use of the transcaval approach for patients with peripheral arterial disease preventing standard transfemoral access. In addition, we describe the first European case of Symetis ACURATE neo implanted via the transcaval route and illustrate with it the broad spectrum of transcatheter heart valves that may be implanted using this technique. Transcaval TAVI has the potential to improve outcomes for a cohort of patients whose only alternative options would be medical management or higher-risk alternative TAVI access.

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