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Case Report

Transcarotid Transcatheter Aortic Valve Replacement in an Octogenarian With Complex Type B Aortic Dissection and Aneurysm: A Case Report

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ABSTRACT

We report the case of an octogenarian with severe aortic valve stenosis, chronic kidney disease (CKD) and heart failure. Due to advanced CKD, we used a 3-dimensional transesophageal echocardiogram for sizing the device before transcatheter aortic valve replacement (TAVR). Noncontrast computed tomography found complex aortic dissection involving the arch, descending thoracic aorta, and abdominal aorta. TAVR was approached via the right carotid artery using a CoreValve. There was no cerebral vascular event. Renal function was well preserved. Transcarotid TAVR can be performed safely with complex type B aortic dissection. Three-dimensional transesophageal echocardiogram provides an alternative sizing solution in advanced CKD.

RÉSUMÉ

Nous décrivons ici le cas d'un octogénaire présentant une sténose sévère de la valve aortique, une néphropathie chronique et une insuffisance cardiaque. En raison de sa néphropathie chronique de stade avancé, nous avons eu recours à l'échocardiographie tridimensionnelle par voie transúsophagienne pour déterminer la taille du dispositif devant être utilisé avant le remplacement valvulaire aortique par cathéter (RVAC). Une tomodensitométrie sans contraste a révélé une dissection aortique complexe touchant l'arc aortique, l'aorte thoracique descendante et l'aorte abdominale. Le RVAC a été effectué par l'artère carotide droite à l'aide du système CoreValve. Il n'y a pas eu d'accident vasculaire cérébral. La fonction rénale a été bien préservée. Le RVAC par voie transcarotidienne peut être réalisé sans danger dans le cas d'une dissection aortique de type B complexe. L'échocardiographie tridimensionnelle par voie transúsophagienne constitue une solution de rechange pour déterminer la taille du dispositif chez les patients atteints de néphropathie chronique à un stade avancé.

Transcatheter aortic valve replacement (TAVR) is recommended for subjects with symptomatic severe aortic valve stenosis who have an intermediate to high level of surgical risk.[1] A transcarotid approach offers a safe alternative access route when approach via the femoral artery is not feasible.[2] The transcarotid approach is also safer compared with the more invasive routes, such as transapical and transaortic TAVR.[3] However, some issues relating to transcarotid TAVR still need to be addressed, including device selection for the self-expandable or balloon-expanded system, device-sizing protocol in patients with advanced chronic kidney disease (CKD),

Novel Teaching Points

- TAVR can be performed safely, with adequate planning, in subjects with complex type B aortic dissection and aneurysm.
- Three-dimensional TEE is a feasible alternative sizing solution in a self-expandable TAVR system for limiting contrast-medium exposure in subjects with advanced CKD.

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Ethics Statement: The authors confirm that written consent for submission and publication of this case report, including images and associated text, was obtained from the patient in line with Committee on Publication Ethics (COPE) guidelines.

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selection of right or left carotid artery access, and cerebral blood flow monitoring and protection during the procedure. Herein, we present an octogenarian with coronary artery disease, advanced CKD with an estimated glomerular filtration rate (eGFR) of 17 mL/min per 1.73m^2, coexistent moderate-severe mitral valve regurgitation, atrial fibrillation, a left ventricular ejection fraction of 43%, and pulmonary hypertension, as well as complex type B aortic dissection involving the arch, descending thoracic aorta, and abdominal aorta with extension to the right iliac artery. TAVR was successfully and safely performed via a right carotid artery approach using a self-expandable valve system without any cerebral vascular issues or worsening of renal function.

Case

An 81-year-old man was referred to our cardiology clinic due to worsening orthopnea and paroxysmal nocturnal dyspnea, with frequent visits to the emergency room and admissions at a local hospital. He had an irregular heart rate with a grade III systolic murmur at the right upper sternal border and apex. A chest X ray revealed bilateral pleural effusion, and an electrocardiogram showed atrial fibrillation and left ventricular hypertrophy with strain. The echocardiogram disclosed severe aortic valve stenosis with a mean pressure gradient of 48 mm Hg, an aortic valve area of 0.8 cm^2, inferior-lateral wall hypokinesia, left ventricular ejection fraction of 43%, moderate-severe mitral valve regurgitation, and pulmonary hypertension (tricuspid valve peak systolic pressure gradient of 94 mm Hg). Due to worsening heart failure, he was soon admitted for treatment. Laboratory data revealed anemia with hemoglobin of 9.6 gram/dL, CKD with an eGFR of 17 mL/min per 1.73 m^2, high-sensitivity troponin T of 123 ng/L, and N-terminal pro-brain natriuretic peptide (NT-pro-BNP) of 28,177 pg/mL. As the echocardiogram showed regional wall motion abnormality and severe aortic valve stenosis, we arranged a pre−aortic replacement cardiac catheterization. The coronary angiogram revealed a distal right coronary artery totally occlusive lesion (Fig. 1A), which was successfully treated by percutaneous coronary intervention with a drug-eluted stent (Fig. 1B), consuming 125 mL of iso-osmolarity contrast medium (VISIPAQUE [iodixanol]; Amersham Health, Princeton, NJ). The calculated Society of Thoracic Surgeons (STS) score was 33%. Pre-TAVR workup began. Renal function remained stable with an eGFR of 21 mL/min per 1.73 m^2. To avoid further contrast-medium exposure with severe CKD, a noncontrast multi-detector computed tomography (MDCT) scan was done. However, an

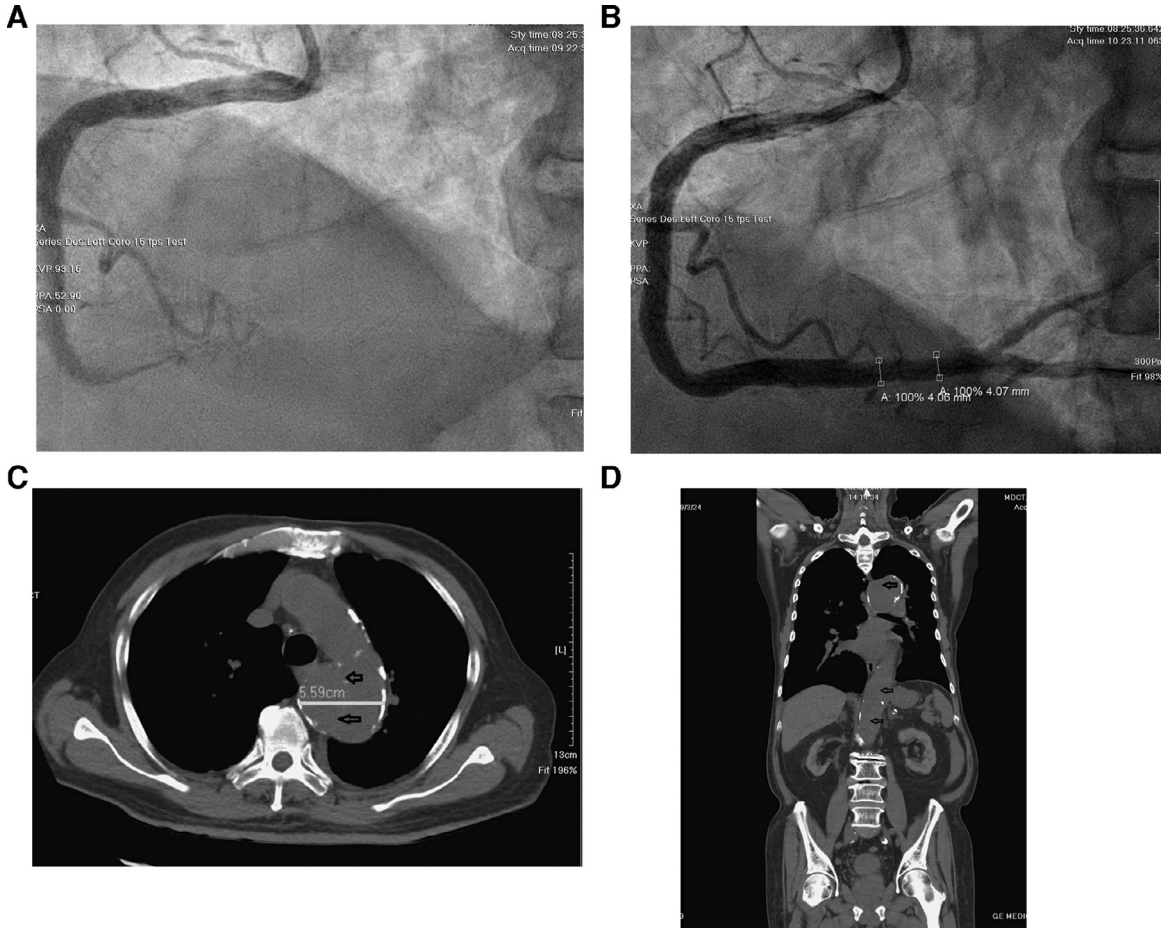

Figure 1. (**A**) Right coronary artery angiogram shows a distal occlusive lesion. (**B**) Right coronary artery revascularization by percutaneous coronary intervention (drug-eluted stenting). (**C**) Noncontrast multi-detector computed tomography shows complex aortic dissection and large aneurysm at the aortic arch; **black arrows** indicate intimal flaps; **green line** indicates largest aortic diameter of 5.6 cm at aortic arch level. (**D**) Noncontrast multi-detector computed tomography shows the descending thoracic and abdominal aorta dissecting aneurysm; **black arrows** indicate intimal flaps.

incidental finding of a complex type B aortic dissection starting from the aortic arch, with extension to the whole descending thoracic, abdominal aorta and into the right common iliac artery was noted (Fig. 1, C and D). For determining the proper device size, we arranged a 3-dimensional (3D) transesophageal echocardiogram (TEE) using analysis software (ACUSON SC 2000 PRIME; Siemens Medical, Erlangen, Germany), which revealed an estimated aortic annulus perimeter of 78 mm (Fig. 2A). The sonogram and Doppler of the carotid artery revealed patent bilateral common and internal carotid arteries with an estimated right common carotid artery diameter of 8.9 mm (Fig. 2B). We decided to perform TAVR with access via the right common carotid artery. The patient underwent general endotracheal anesthesia with brain saturation and electroencephalography (EEG) monitoring. A short sheath was placed via the right radial artery, and a pigtail catheter was inserted into the ascending aorta for imaging. Right femoral venous access was obtained for a transvenous temporary pacemaker. A 6F short sheath was placed at the left femoral artery as a backup site in case an emergent femoral-carotid external shunt was needed. After surgical exposure of the right common carotid artery, test clamping of the proximal right common carotid artery was performed for 3 minutes, during which brain saturation monitoring revealed good oximetry. We then declamped the right carotid artery and inserted a 6F short sheath. The calcified and stenotic aortic valve was crossed with a straight-tip 0.035-inch wire and an Amplatz left (AL) 1 angiographic catheter (6F, Expo; Boston Scientific, Natick, MA) under fluoroscopic guidance. After wiring across the aortic valve, the AL1 catheter was advanced to the left ventricle. A 260-cm J-curved−tip 0.035-inch wire (Glidewire; Terumo, Tokyo, Japan) was introduced to change the AL1 catheter to a 6F pigtail catheter. Via the pigtail catheter, the supporting wire was further replaced with a 0.035-inch 260-cm Confida guide wire (Medtronic, Minneapolis, MN) with a pre-shaped distal round tip. Balloon pre-dilatation was not required, as judged from the pre-procedure TEE and aortagram. Thus, we immediately inserted the transcatheter aortic valve (CoreValve Evolut R 29 mm; Medtronic) via the Confida guide wire and deployed it at the aortic annulus under angiogram and TEE monitoring (Fig. 2C). The carotid artery was sutured and repaired, with the wound closed layer by layer (Fig. 2D). The patient recovered well to functional II symptoms, and the echocardiogram revealed good function of the transcatheter aortic valve, no paravalvular leak, reduced mitral regurgitation and pulmonary hypertension, as well as improved left ventricular ejection fraction. The patient's renal function was well preserved, with no eGFR change (stable at an eGFR of 25 mL/min per 1.73 m^2), and a good daily urine amount maintained during the hospitalization period and at outpatient followups.

Discussion

There have been some algorithms proposed for selecting alternative access sites for TAVR when using the standard femoral artery approach is not feasible.[3] Both the transaortic and transapical approaches are more traumatic and invasive

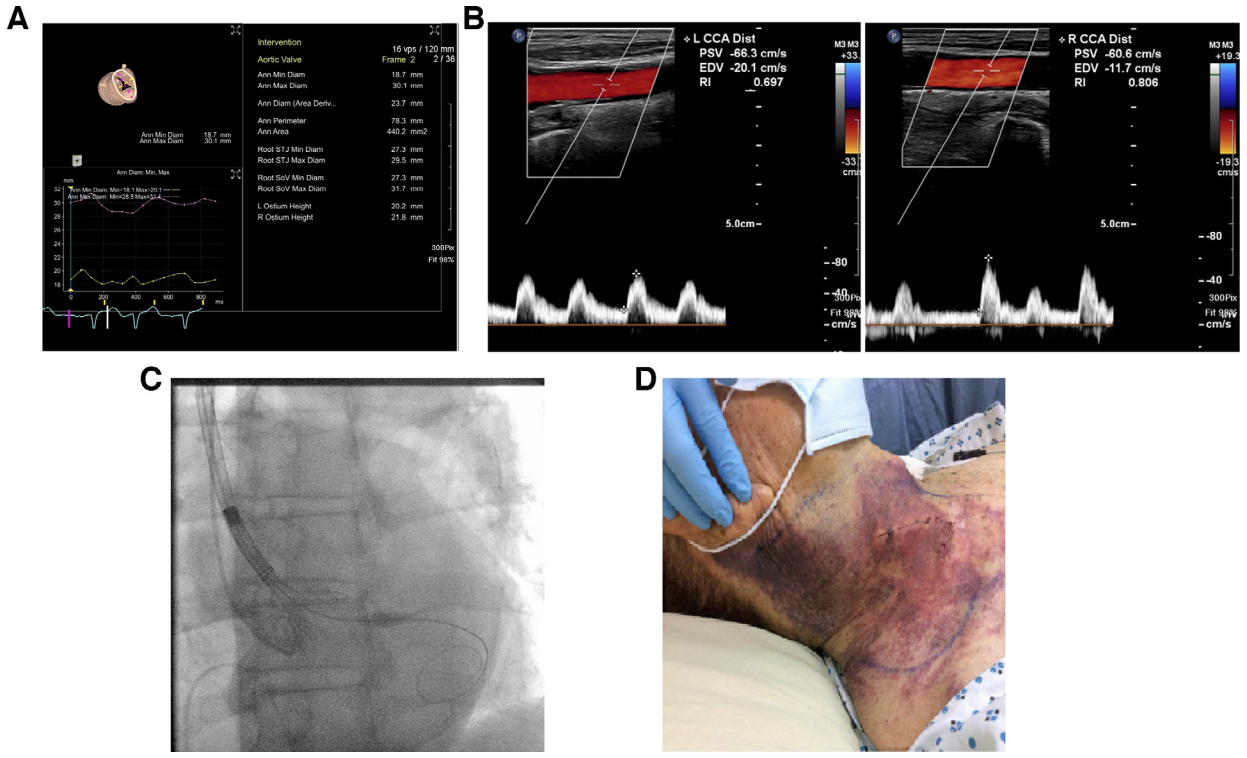

Figure 2. (**A**) Three-dimensional transesophageal echocardiogram using analysis software (ACUSON SC 2000 PRIME, Siemens Medical, Erlangen, Germany) revealing an estimated aortic annulus perimeter of 78 mm. (**B**) Carotid artery sonogram reveals patent bilateral carotid arteries with an estimated right common carotid artery diameter (Diam) of 8.9 mm. (**C**) Deployment of CoreValve Evolut R 29 mm (Medtronic, Minneapolis, MN) to the aortic annulus via the right carotid artery approach. (**D**) Right neck wound 2 days after surgery. Ann, annulus; CCA, common carotid cartery; Dist, distal; EDV, end-diastolic velocity; max, maximum; min, minimum; PSV, peak systolic velocity; RI, Doppler resistive index; STJ, sinus tubular junction.

and should be used only as last choices.[3] Severe left ventricular dysfunction is a contraindication for the transapical approach.[3] Patients with a previous sternotomy or calcified ascending aorta should not undergo the procedure with the transaortic approach.[3] Due to the sharp angulation between the right subclavian artery and the ascending aorta, the transsubclavian approach is usually only possible from the left side and has limitations in subjects with morbid obesity, an internal mammary artery graft, or a left subclavicular implantable device pocket.[4] In a review series of 15 studies, 30-day mortality was significantly higher after the transaortic approach compared with the transcarotid approach.[5] With suitable carotid artery anatomy and good function of the circle of Willis, carotid artery access was deemed to be the first choice for nonfemoral access in some TAVR centers.[2-4,6] In our case, right carotid access was the best option for avoiding the complex type B aortic dissecting aneurysm, involving the arch and the whole descending thoracic and abdominal aorta.

Regarding the selection of either the right or left side of the carotid artery for vascular access in TAVR—each has been advocated by various medical centers. Some centers prefer the left side because it provides superior coaxial alignment between the aortic root and the transcatheter heart valve during deployment.[6] Other centers favor using the right side because they believe it provides a straighter and more direct path to the aortic valve, with the delivery catheter and device orientation being similar to that for the transaortic approach.[3] In our case, left carotid access was not feasible, as it would be via the complex aortic arch dissecting aneurysm, which might disrupt it.

In terms of selection of adequate device size prior to TAVR in subjects with advanced CKD, several protocols have been proposed. Three-dimensional TEE sizing has been used in some medical centers, using different analysis software with good interobserver reproducibility and close correlations with MDCT measurements of the aortic annulus diameter, perimeter, and area.[7] One study used a very low contrast volume of 20 mL of iohexol for MDCT to define aortic annulus and peripheral vascular measurements before TAVR in subjects with an eGFR < 30 mL/min.[8] Another study by Maffeo et al.[9] proposed zero contrast-medium use both in pre-TAVR MDCT and during CoreValve implantation, with the assistance of 2 pigtail catheters for annulus plain estimation in 12 cases with advanced CKD. In our case, noncontrast MDCT helped to incidentally find the complex type B aortic dissection involving the aortic arch, the descending thoracic aorta, and the abdominal aorta with extension to the right common iliac artery. We used 3D TEE to size the aortic annulus perimeter at 78 mm and successfully deployed the 29-mm CoreValve Evolut R without paravalvular leakage.

Conclusion

We adopted right side carotid access for TAVR and successfully avoided the risk of disrupting a large and complex type B aortic dissection and aneurysm. Moreover, sizing the self-expandable TAVR device through use of 3D TEE with limited contrast-medium exposure allowed us to preserve renal function in a patient with advanced CKD.

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Disclosures

The authors have no conflicts of interest to disclose.

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