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Transcarotid access for transaortic valve implantation

Background

Aortic stenosis is the most common valvulopathy in more economically developed countries, where its prevalence is growing due to an ageing population. Transcatheter aortic valve implantation (TAVI) has been developed as an effective alternative to open heart surgery in both inoperable patients and patients considered intermediate-to-high-risk.¹⁻⁵ These patient subgroups often have multiple comorbidities that preclude the use of the classical and less morbid pathway for TAVI – transfemoral access. These comorbidities include lower limb obliterative arterial disease with severe stenosis, vessel diameter <6 mm, heavily calcified vessels, tortuosity and significant descending aortic disease.^{6,7} Since its first description in 2010,⁸ minimally-invasive surgery of the transcarotid pathway has been reported to have similar outcomes to transfemoral access in terms of mortality and morbidity.^{6,7,9,10} Additionally, it carries multiple advantages when compared to other alternative pathways. Patients who have previously undergone a coronary artery bypass may be unsuitable for the transaortic pathway if they received venous grafts, or unsuitable for the transaxillary pathway if they received mammal artery grafts. General anaesthesia for transapical or transaortic access may be contraindicated in patients with chronic respiratory insufficiency, and the transaxillary pathway may be limited by vascular anatomy, such as tortuosity, stenosis or angulation. Amzoun *et al.*, reported acceptable safety and efficacy for transcarotid TAVI under local anaesthesia in a small cohort.¹⁰ To date, there have been no randomised comparative studies that have compared these different pathways for TAVI. The left carotid access for TAVI was initially favoured⁸ because it provides superior coaxial alignment between the ascending aorta, optimal positioning for the transcatheter valve during the device deployment and simple operating room configuration. However, right carotid access has also been used, with success,^{6,10} and some teams use a femoro-carotid shunt to optimise neurological outcomes.⁷

CoreValve® (Medtronic, Minneapolis, MN, USA) has been the most frequently used TAVI system for transcarotid approach in published studies.^{7,10} This was probably due to a smaller sheath size of 18 Fr, compared to 20–24 Fr for Edwards SAPIEN XT Transcatheter Heart Valve (Edwards Lifesciences, Irvine, CA, USA),¹¹ which lowers the risk of local complications. The new-generation Corevalve® Evolut® R system comes with a smaller sheath size of 14 Fr and is indicated for vessel diameters of ≥5 mm. It also has a recapturable system that helps to optimise valve deployment and reduce the risk of complications.

Case presentation

An 89-year-old male was admitted for severe symptomatic aortic stenosis with a mean gradient of 45 mmHg, as found on transthoracic echocardiography performed for acute pulmonary oedema. He also suffered from chronic obstructive pulmonary disease and moderate chronic renal insufficiency (creatinine clearance with Modification of Diet in Renal Disease [MDRD] formula: 55 ml/min). The preoperative coronary angiography showed no lesion; however, the aortic computed tomography showed significant tortuosity with heavily calcified abdominal and thoracic aorta that precluded the transfemoral access. The mortality risk calculated with the Society of Thoracic Surgeons (STS) score was 24%.

Management

The optimal treatment chosen for this patient was TAVI via left transcarotid access – a technique that has been described previously.^{7,12} After a vertical incision 2 cm above the left clavicle, the common carotid artery was carefully dissected to avoid lesion of the vagus nerve. Vascular clamps were used to achieve proximal and distal control of the carotid artery. Secondary percutaneous arterial right femoral access was achieved by insertion of a 5 Fr vascular access sheath to insert the pigtail catheter, and an electrosystolic stimulation probe then inserted through the right femoral vein into the right ventricle. The stenotic aortic valve was

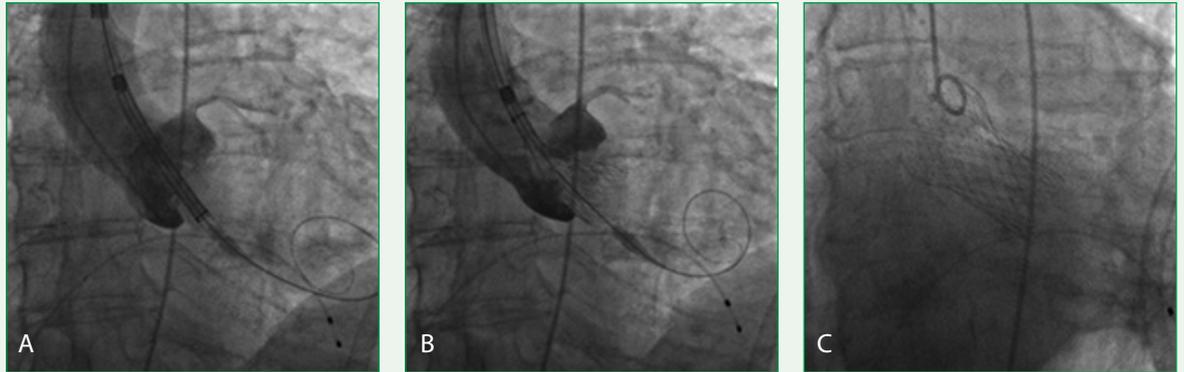
fig. 1

Fluoroscopy image of the transcatheter Corevalve® Evolut® R self-expandable valve positioning in the aortic annulus during contrast injection through the pig tail.

A) Non-deployed valve in the catheter.

B) Deployment under fluoroscopy control with contrast injection.

C) Deployed valve.



crossed in the usual fashion. The Corevalve® Evolut® R 29 mm valve was deployed in the aortic annulus through an 18 Fr catheter, being careful of optimal positioning. The control contrast injection showed a mild periprosthetic leak, but this was expected to be spontaneously resolved with the self-expandable Corevalve®

Evolut® R valve. The carotid arterial access was then surgically repaired with PROLENE® Sutures 6-0. The transthoracic echocardiographic control showed a mild periprosthetic leak, and the carotid Doppler-echocardiography control showed no local complication. Functional improvement was reported during follow-up.

Quiz Questions

1. Are there more neurological complications associated with the transcarotid approach for TAVI compared with transfemoral access?

The available literature does not show an increased rate of stroke. Some teams use a femoro-carotid shunt to maximise neurological safety, although this technique has not been shown to be effective.

2. What type of valve system can be used to perform a transcarotid TAVI?

Both the self-expanding (CoreValve® Evolut® R, Medtronic) and balloon-expandable (Edwards SAPIEN 3, Edwards Life Sciences) valves can be used. So far, Evolut® R has been used for a larger number of patients in the available literature and has demonstrated improved safety data when compared to Edwards SAPIEN 3. This is most likely due to the smaller sheath of Evolut® R, as sheath size is associated with local carotid complications, which could lead to unacceptable brain damage.

3. What factors typically indicate a preference for treatment with TAVI via the transcarotid pathway?

A patient of 80 years or older, suffering from severe symptomatic aortic stenosis and unsuitable for the transfemoral pathway due to unsuitable iliofemoral arteries (occlusion criteria: small arteries <6 mm, tortuosity, significant calcification) or descending aortic anatomy.

4. Should one side be favoured over another for transcarotid access TAVI?

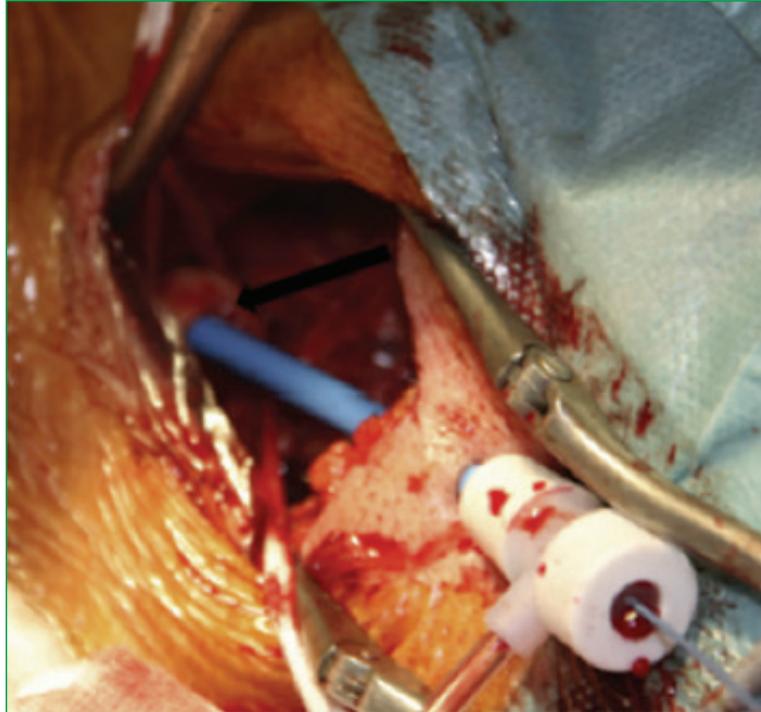
Both sides seem to have similar outcomes, although no randomised comparative study has been reported so far. The left common carotid artery provides superior coaxial alignment between the aorta and the transcatheter valve during the device deployment, as well as simpler operating room configuration.

5. What should operators be aware of when performing a transcarotid approach?

The transcarotid approach has to be performed by an experienced vascular surgeon due to the presence of important local structures, such as the vagus nerve and the respiratory tract. There are additional risk factors that require a highly-skilled operator, whereby a lesion on the recurrent laryngeal nerve could cause dysphonia, or insufficient haemostasis could lead to major post-operative complications such as a compressive haematoma and subsequent asphyxia. If a patient develops signs of compressive haematoma – dysphonia, dysphagia, dyspnoea – an emergency oro-tracheal intubation is warranted to provide time for a surgical revision.

fig. 2

Minimally-invasive transcarotid access surgery with Corevalve® Evolut® R and a 18 Fr sheath inserted in the left common carotid.⁷



Take-home messages

Patients suffering from severe symptomatic aortic stenosis who are not eligible for open heart surgery, or considered high-risk, should be treated with TAVI. When a transfemoral approach is unsuitable – due to iliofemoral vascular anatomy, lower limb obliterative arteriopathy or unsuitable descending aorta anatomy – the minimally-invasive transcarotid surgical pathway can be used to perform the procedure. So far, results have proven more effective with the CoreValve® system, than with the Edwards SAPIEN XT.⁷

The transcarotid pathway is still an experimental approach that needs to be validated in larger, randomised, comparative studies and compared with the other possible TAVI pathways. However, in patients unsuitable for the transfemoral approach, it can sometimes provide a vital solution for aortic valve replacement.

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