Transcatheter aortic valve implantation through carotid artery access under local anaesthesia†

Alexandre Azmoun*, Nicolas Amabile, Ramzi Ramadan, Said Ghostine, Christophe Caussin, Sahbi Fradi, François Raoux, Philippe Brenot, Remi Nottin and Philippe Deleuze

Centre Chirurgical Marie Lannelongue, Le Plessis Robinson, France

* Corresponding author. Centre Chirurgical Marie Lannelongue, 133 Avenue de la Resistance, 92350 Le Plessis Robinson, France. Tel: +33-140948542; fax: +33-140948544; e-mail: azmoun@yahoo.com (A. Azmoun).

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Abstract

OBJECTIVES: Trans-femoral and transapical are the most commonly used accesses for transcatheter aortic valve implantation (TAVI). However, when these approaches are unsuitable, alternative accesses are needed. We report a series of 19 patients undergoing TAVI through common carotid artery (CCA) access under local anaesthesia in order to assess its feasibility and safety.

METHODS: From November 2008 to September 2013, 361 patients underwent TAVI at our institution. Nineteen of them (14 men) with mean age 82.2 ± 6.2 years, EuroSCORE 25.2 ± 15.7, Society of Thoracic Surgeons score 11.9 ± 5.1 and with severe peripheral arteriopathy were unsuitable for usual approaches and underwent TAVI through CCA access under local anaesthesia. Preoperative computed tomography assessed suitable carotid artery anatomy. Common carotid cross-clamping test allowed verifying patient’s neurological status stability. An 18-Fr or 20-Fr sheath inserted into the CCA down into the ascending aorta was used for the delivery catheter. Valve implantation procedures were as usual. After sheath removal, the CCA was surgically purged and repaired. Feasibility and safety end points (V ARC-2) were collected up to 30 days.

RESULTS: Transcarotid insertion of the delivery sheath was successful in all cases (8 right, 11 left) and accurate deployment of the device was achieved in 18 patients (4 Edwards SAPIEN XT® and 14 Medtronic CoreValve®). There was 1 intraoperative death by annulus rupture during preimplant balloon valvuloplasty, and 1 in-hospital death due to multisystem organ failure. There was no myocardial infarction, stroke or major bleeding. Third-degree atrioventricular block requiring pacemaker implantation occurred in 3 patients. No vascular access-site, access-related or other TAVI-related complication occurred. Echocardiography revealed good prosthesis functioning with none, mild and moderate paravalvular leak in, respectively, 8, 9 and 1 patients. Patient ambulation was immediate after TAVI and hospital stay was 4.6 ± 2.3 days.

CONCLUSIONS: TAVI through the CCA approach under local anaesthesia is feasible and safe. It allows continuous clinical neurological status monitoring with low risk of stroke, bleeding events, vascular access-site and access-related complications and immediate patient ambulation. It appears to be a valuable alternative access for patients who cannot undergo trans-femoral TAVI.

Keywords: Transcatheter aortic valve implantation • Transcarotid access • Local anaesthesia

INTRODUCTION

Transcatheter aortic valve implantation (TAVI) has been proposed as a valuable alternative to standard medical therapy and conventional surgical aortic valve replacement for patients with symptomatic severe aortic valve stenosis considered to be at high operative risk [1–7]. Trans-femoral approach is the most commonly used access for TAVI [2, 3, 6, 8, 9]. However, in some patients iliofemoral previous surgery or severe arteriopathy may render this access unfeasible or entail a high risk of bleeding, severe vascular complications and mortality. The need for TAVI in these high-vascular-risk patients has led to the development of other alternative access routes such as transapical, transaortic and transaxillary approaches. Each one of them presents specific advantages and drawbacks. Transapical approach is currently the second available pathway and is routinely used in many centres [2, 3, 6, 9, 10]. However, it involves some specific complications [9, 11–13], and requires general anaesthesia, orotracheal intubation and thoracotomy and remains a relatively invasive access in some frail patients with severe pulmonary or ventricular dysfunction. Similarly, transaortic approach requires general anaesthesia, orotracheal intubation and ministernotomy, and remains also a relatively invasive access for TAVI in patients with severe respiratory disease or having previously undergone coronary artery bypass grafting (CABG) procedure. Finally, in some patients the axillary/subclavian artery could be subject to severe calcification or tortuosity, thereby rendering transaxillary TAVI unfeasible or highly

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risky, particularly in patients having previously undergone CABG surgery with patent internal thoracic artery grafts. That said, in candidates for TAVI with unfavourable femoral access due to severe peripheral arteriopathy and for whom other access routes are unsuitable, the common carotid artery (CCA) could represent another transarterial access route. We report here our series of 19 consecutive patients undergoing TAVI through the CCA approach under local anaesthesia with clinical neurological status monitoring. The purpose of this investigation was to report our initial clinical experience of transcarotid TAVI and to assess its feasibility and safety.

**MATERIALS AND METHODS**

**Patient selection**

From November 2008 to September 2013, 361 patients (188 men, mean age of 83.3 ± 4.2 years) underwent TAVI at our institution using Edwards SAPIEN® (Edwards Lifesciences, Irvine, CA, USA) \(n = 256\) patients and Medtronic CoreValve® (Medtronic, Inc., Minneapolis, MN, USA) \(n = 105\) patients) devices. All of these patients with severe symptomatic aortic valve stenosis (indexed aortic valve area ≤ 0.6 cm²/m²) were no reasonable surgical option due to multiple comorbidities leading to excessive operative risk (EuroSCORE 24.5 ± 16.2, Society of Thoracic Surgeons (STS) score 12.4 ± 7.8) and were selected for TAVI after multidisciplinary heart team discussion. All gave written informed consent and the procedures were approved by the institutional ethics committee. All patients underwent routine preoperative coronary angiography, transthoracic echocardiography, pulmonary function testing and contrast-enhanced electrocardiogram gated computed tomography (CT). When trans-femoral approach was not suitable (iliofemoral previous surgery, severe arteriopathy or major tortuosity), other approaches were used to perform TAVI (Fig. 1).

In March 2012, TAVI through the CCA approach under local anaesthesia was first introduced in our institution initially for patients with unsuitable trans-femoral access and who had undergone previous CABG with patent internal thoracic artery grafts and severe respiratory dysfunction. Since then, 19 patients (14 men, mean age 82.2 ± 5.9 years) with severe peripheral vascular disease and contra indicated for trans-femoral TAVI have undergone TAVI through this approach (Fig. 1).

The contraindications for trans-femoral approach were occlusion or severe tight stenosis in iliofemoral arteries in all these patients. Moreover, there were large abdominal aortic aneurysm (diameter > 50 mm) in \(n = 1\) patient, previous abdominal aortic endoprosthesis in \(n = 2\) patients, previous aortobifemoral bypass surgery in \(n = 3\) patients and previous axillo-bifemoral bypass surgery in \(n = 1\) patient. Baseline clinical, biological and imaging characteristics of these patients are summarized in Table 1.

Suitable CCA anatomy was assessed by preoperative contrast-enhanced CT. Both CCA diameters were measured and the largest and most suitable (diameter > 6 mm, without stenosis, calcification or major tortuosity) was chosen.

**Procedure**

Procedures were performed in a hybrid operative theatre with an available heart–lung machine, by a multidisciplinary team including anaesthesiologists, interventional cardiologists and cardiac surgeons. They were conducted under local anaesthesia, thereby allowing the physicians to control the patients’ clinical neurological status after a transient CCA cross-clamping test. Aspirin 75 mg was given the day before the procedure and continued once daily afterwards with additional clopidogrel or warfarin treatment if required for other indications (stent placement or chronic atrial fibrillation). Patients received cefazolin (1.5 g intravenous injection) immediately before incision. Systolic blood pressure was continuously maintained above 120 mmHg throughout the procedure. No transoesophageal echocardiography was used in these patients. Exposure of the right or left CCA according to the pathway chosen on the preoperative CT studies was performed through a small latero-cervical incision under local anaesthesia. In all cases, the CCA were at good size (>6 mm) and without calcification as assessed by preoperative CT and by palpation examination by surgeons during operation. Heparin 70-100 UI/kg was given intravenously (target activated clotting time of 180–200 s) and cross-clamping test of the proximal CCA was performed for 3 min.

![Figure 1](https://academic.oup.com/ejcts/article-abstract/46/4/693/517993/694)

**Figure 1**: Evolution of TAVI procedure accesses in our institution from November 2008 to February 2012 (left panel) and since March 2012 (right panel). Tfem: trans-femoral access; Tap: transapical access; Tao: transaortic access; Tcar: transcatheter access.
Once the procedure was completed, the CCA was surgically purged and repaired using a 6-0 polypropylene running suture, following delivery sheath retrieval. After rigorous surgical haemostasis, a drain was inserted and the incision was closed in layers. Patients were transferred to the intensive care unit (ICU) with immediate ambulation. Prosthetic valve function was assessed by transthoracic echocardiography by the end of the procedure, on day 1 after implantation, before discharge and at postoperative month 1. Doppler imaging of the carotid artery was performed before discharge to control CCA repair.

### Clinical end points

Feasibility and safety end points including all-cause mortality, cardiovascular and non-cardiovascular mortality, stroke, bleeding, acute kidney injury, respiratory complications, conduction disturbances and arrhythmias, vascular access-site and access-related complications and all other TAVI-related complications were prospectively collected up to 30 days and classified according to the valve academic research consortium-2 (VARC-2) criteria [14].

### RESULTS

#### Feasibility

Transthoracic introduction of the delivery sheath was successful in all cases (8 right, 11 left) and accurate deployment of the device was achieved in 18 (94.7%) patients. Four Edwards SAPIEN XT® and 14 Medtronic CoreValve® devices were implanted (Table 2).

In 2 patients, loss of consciousness occurred during the initial CCA cross-clamping test. Immediate removal of the clamp allowed complete recovery of consciousness within a few seconds. To ensure cerebral perfusion during the procedure a passive antegrade carotid perfusion through a temporary femoro-carotid shunt was used. An 8-Fr sheath (Radifocus®, Terumo, Tokyo, Japan) was inserted into the ipsilateral femoral artery. It was connected to a carotid shunt (POLYSHUNT®, Perouse Medical, Ivry le Temple, France) and introduced in the distal CCA after a small arteriotomy. A new CCA cross-clamping test showed no change in consciousness and stability of the patient's clinical neurological status. The delivery sheath was then inserted in the CCA down into the ascending aorta and the procedure could be performed as usual.

#### Mortality

Overall 30-day mortality was 2 deaths (10.5%). One intraoperative death occurred by aortic annulus rupture during preimplant balloon aortic valvuloplasty. Control angiogram showed major extravasation of the contrast product in the pericardium. Transthoracic echocardiography confirmed the pericardial effusion. Resuscitation manoeuvres were immediately undertaken with percutaneous pericardial drainage and sternotomy but the patient could not be stabilized and no valve was implanted. The second death occurred on postoperative day 6 in an 83-year-old patient in poor preoperative condition (EuroSCORE 32, STS score 15.6, left ventricular ejection fraction 25%) and was due to low cardiac output syndrome with multisystem organ failure.

### Table 1: Baseline characteristics of transcatheter patients

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<tbody>
<tr>
<td>Age, year</td>
<td>82.2 ± 5.9</td>
<td>Male gender, n (%)</td>
<td>14 (73.7)</td>
<td></td>
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<tr>
<td>NYHA functional class III/IV, n (%)</td>
<td>15 (78.9)</td>
<td>Preoperative pacemaker, n (%)</td>
<td>3 (15.8)</td>
<td></td>
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<tr>
<td>Body mass index, kg/m²</td>
<td>24.5 ± 3.3</td>
<td>Coronary artery disease, n (%)</td>
<td>13 (68.4)</td>
<td></td>
<td></td>
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<tr>
<td>Previous PCI, n (%)</td>
<td>7 (36.8)</td>
<td>Previous CABG, n (%)</td>
<td>6 (31.6)</td>
<td></td>
<td></td>
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<tr>
<td>Renal dysfunction, n (%)</td>
<td>8 (42.1)</td>
<td>COPD, n (%)</td>
<td>7 (36.8)</td>
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<tr>
<td>Diabetes, n (%)</td>
<td>7 (36.8)</td>
<td>Atrial fibrillation, n (%)</td>
<td>12 (63.2)</td>
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</tr>
<tr>
<td>Peripheral arterial disease, n (%)</td>
<td>19 (100)</td>
<td>Creatinine, µmol/L</td>
<td>122.6 ± 60.3</td>
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<tr>
<td>Haemoglobin level, g/l</td>
<td>10.9 ± 2.2</td>
<td>Mean aortic transvalvular pressure gradient, mmHg</td>
<td>42.3 ± 15.9</td>
<td></td>
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<tr>
<td>Indexed AVA, cm²/m²</td>
<td>0.43 ± 0.15</td>
<td>Moderate/severe mitral valve regurgitation, n (%)</td>
<td>2 (10.5)</td>
<td></td>
<td></td>
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<tr>
<td>Pulmonary hypertension, n (%)</td>
<td>10 (52.6)</td>
<td>Left ventricular ejection fraction, %</td>
<td>49 ± 16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EuroSCORE, %</td>
<td>25.2 ± 15.7</td>
<td>STS score, %</td>
<td>11.9 ± 5.1</td>
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</tbody>
</table>

### Table 2: Prosthesis characteristics

<table>
<thead>
<tr>
<th>Device</th>
<th>Prosthesis diameter (mm)</th>
<th>Sheath diameter (mm)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edwards Sapien XT®</td>
<td>26</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Medtronic CoreValve®</td>
<td>26</td>
<td>18</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>18</td>
<td>6</td>
</tr>
</tbody>
</table>

During this test, complete clinical awareness with no change in consciousness and stable clinical neurological status of patients were assessed by physicians. An 18-Fr or 20-Fr sheath (Table 2) was inserted after the artery puncture into the CCA down to the ascending aorta and used for introduction of the delivery catheter. The tip of the sheath was positioned in the upper part of the ascending aorta. An arterial (femoral or radial) 5-Fr sheath was inserted and an aortic root pigtail catheter for angiographic visualization was placed. A temporary pacemaker lead was inserted through a 5-Fr sheath in the femoral vein and used for rapid ventricular pacing. A manually preshaped extra stiff wire was placed in the left ventricle. Routine preimplant balloon aortic valvuloplasty was performed under rapid ventricular pacing. The prosthetic valve was introduced and advanced under fluoroscopic control. Aortic root angiographies were performed to assess prosthesis well positioning during deployment and afterwards to assess the valve function. Rapid ventricular pacing was used for Edwards SAPIEN XT® prosthesis deployment only. Once the procedure was completed, the CCA was surgically purged and repaired using a 6–0 polypropylene running suture, following delivery sheath retrieval. After rigorous surgical haemostasis, a drain was inserted and the incision was closed in layers. Patients were transferred to the intensive care unit (ICU) with immediate ambulation. Prosthetic valve function was assessed by transthoracic echocardiography by the end of the procedure, on day 1 after implantation, before discharge and at postoperative month 1. Doppler imaging of the carotid artery was performed before discharge to control CCA repair.
Morbidity

There was no coronary complication or myocardial infarction, assessed by periprocedural cardiac biomarker measurements, electrocardiogram and ventricular wall motion echocardiography analyses.

There was no stroke or transient ischaemic attack assessed by clinical criteria in our series.

No major bleeding complication occurred. During hospitalization, 4 patients with low baseline haemoglobin level (≤10 g/dl) required transfusion of ≥2 units of red blood cells in the absence of overt bleeding.

There was no acute kidney injury assessed by the absence of postoperative elevation of serum creatinine level or urine output drop.

No vascular access-site or access-related complication (injury or infection) occurred.

Third-degree atrioventricular block requiring a permanent dual chamber pacemaker implant occurred in 3 patients with Medtronic CoreValve® devices. There was no new onset of atrial fibrillation or ventricular arrhythmia elsewhere. No prosthesis malpositioning, thrombosis, endocarditis or other prosthesis valve association complication was observed in implanted patients. No respiratory complication occurred.

Transesophageal echocardiography was performed postoperatively, at day 1, before discharge and at 1 postoperative month to assess prosthesis function. There was no prosthetic valve stenosis or prosthesis-patient mismatch. Paravalvular leak was absent or mild in, respectively, 8 and 9 patients, and moderate in 1 patient. At 30 days of follow-up, the mean paravalvular leak remained stable. Patient ambulation was immediate after patients returned to ICU and hospital stay was 4.6 ± 2.3 days. All survivors were discharged from our institution in good condition. Table 3 summarizes the 30-day safety end points as recommended by the VARC-2 criteria.

**DISCUSSION**

More than 10 years after the first successful human case reported by Cribier and associates in 2002 [15], TAVI has emerged as a current new evidence-based treatment alternative for patients with symptomatic severe aortic valve stenosis and multiple comorbidities leading to a high operative risk [1–7]. TAVI results depend largely on device-related complications (such as eventual paravalvular leak) and procedural complications (including myocardial infarction, aortic annulus rupture, myocardial injury, stroke onset, bleeding events, acute kidney injury, respiratory, vascular access-site or access-related complications).

Trans-femoral access is nowadays considered the least invasive access and is therefore the most widely used access in TAVI [2, 3, 6, 8, 9]. With the currently used 18-Fr sheaths, the majority of patients can undergo TAVI through this approach. Furthermore, subsequent percutaneous femoral artery closure techniques allow of less invasive and fully percutaneous procedures. However, given the high burden of vascular disease in TAVI candidates, some patients do not have adequate iliofemoral artery access (previous surgery, severe arteriopathy or tortuosity) and consequently require an alternative access route. In this cohort, alternative access routes such as transapical, transaxillary or transaortic are commonly preferred.

Transapical approach has been proposed initially as the second pathway option for Edwards SAPIEN® devices and is considered by many centres an interesting TAVI access with good short- and mid-term results [10]. However, some authors have reported 30-day mortality rate between 11 and 13%. Moreover, some bleeding complications, subsequent latero-apical hypokinesia or akinsia and ventricular aneurysm formation have been reported to impair outcomes [9, 11–13] significantly. Furthermore, as the transapical approach requires general anaesthesia, otrachial intubation, thoracotomy and left ventricular cannulation, it may not be suitable for some frail patients, especially in cases of severe respiratory disease or left ventricular dysfunction.

Transaortic approach constitutes another effective TAVI access route [16, 17]. However, as it requires general anaesthesia, orotracheal intubation and ministernotomy, it remains also a relatively invasive access, especially in patients with severe respiratory dysfunction or having previously undergone CABG procedure with patent venous grafts. Furthermore, it is not suitable for patients with heavily diffused calcified ascending aorta (porcelain aorta).

Transaxillary access, although efficient and safe [18, 19], is unfeasible under local anaesthesia and remains unsuitable for some patients with severe axillary/subclavian artery calcification or tortuosity. Furthermore, despite some encouraging reports [20], it may be unsuitable for patients having previously undergone CABG intervention with patent internal thoracic artery grafts.

Little by little, as we routinely carry out internal carotid artery endarterectomy under local anaesthesia, TAVI through the CCA approach came to represent a suitable access for TAVI when the trans-femoral approach was unfeasible. Other authors have also reported their experience of TAVI through the left CCA under general anaesthesia with excellent short-term results [21]. In this approach, careful patient selection is mandatory. The proximal segment of the CCA diameter should be of good size (>6 mm) and without calcification, stenosis or severe tortuosity.

Moreover, local anaesthesia has been proved to be safe and efficient in internal carotid artery endarterectomy [22, 23]. As physicians can monitor the clinical neurological status of the aware patient, it allows of rapid detection of any changes in consciousness or onset of unstable neurological status (attesting to cerebral malperfusion) during a transient carotid artery cross-clamping test. Even if many techniques are available for cerebral monitoring (cerebral oxymetry), none of them is superior to clinical

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**Table 3**: Early safety end points (at 30 days)

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
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<tbody>
<tr>
<td>All-cause mortality, n (%)</td>
<td>2 (10.5)</td>
</tr>
<tr>
<td>Intraoperative death (aortic annulus rupture), n (%)</td>
<td>1 (5.3)</td>
</tr>
<tr>
<td>Cardiovascular death (MOF), n (%)</td>
<td>1 (5.3)</td>
</tr>
<tr>
<td>Stroke</td>
<td>0</td>
</tr>
<tr>
<td>Life-threatening, disabling or major bleeding</td>
<td>0</td>
</tr>
<tr>
<td>Acute kidney injury</td>
<td>0</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>0</td>
</tr>
<tr>
<td>Vascular access-site complication</td>
<td>0</td>
</tr>
<tr>
<td>Valve-related complication</td>
<td>0</td>
</tr>
<tr>
<td>Permanent pacemaker implantation, n (%)</td>
<td>3 (15.8)</td>
</tr>
<tr>
<td>Sepsis</td>
<td>0</td>
</tr>
<tr>
<td>Mean aortic transvalvular pressure gradient, mmHg</td>
<td>8 ± 4</td>
</tr>
<tr>
<td>Moderate paravalvular leak, n (%)</td>
<td>1 (5.3)</td>
</tr>
</tbody>
</table>

MOF: multisystem organ failure.
monitoring of the patient’s neurological status (awake testing) while performing the procedure under local anaesthesia. If the patient cannot tolerate transient CCA cross-clamping test, passive antegrade carotid perfusion through a temporary carotid shunt ensures adequate cerebral perfusion during the procedure.

One of the matters of concern in TAVI in general, and through CCA approach in particular, is the risk of stroke. Stroke remains a significant problem in TAVI procedures compared with standard surgical aortic valve replacement [24]. Major mechanisms of stroke during and after TAVI are cerebral embolic events from valvular calcifications or instrumentation of the aortic arch atheroma. Since there is no instrumentation of the aortic arch during transcarotid TAVI and since one CCA is temporarily occluded by the introducing sheath and surgically purged after sheath retrieval, cerebral embolization events may be reduced.

Moreover, direct surgical control of bleeding during and by the end of the procedure allows of only a minimal amount of haemorrhage. Bleeding has been reported as a predictive independent end of the procedure allows of only a minimal amount of haemorrhage. Bleeding has been reported as a predictive independent factor for morbi-mortality in TAVI [25]. No disabling or major bleeding occurred in our series. Four patients with low baseline haemoglobin level (≤10 g/dl) required transfusion of ≤2 units of red blood cells in the absence of overt bleeding during hospitalization.

No vascular access-site or access-related complication (injury or infection) occurred and transcarotid introduction of the delivery sheath was successful in all cases in our series. The proximal part of the CCA can be exposed routinely through a small incision in the neck, thereby reducing the risk of infection, and subsequently easily purged and repaired surgically. Surgical control of the access site through this approach reduces the risk of some immediate or delayed vascular complications as sometimes observed in the trans-femoral approach for TAVI.

The absence of general anaesthesia and orotracheal intubation (and thoracotomy) reduces the risk of respiratory complications in elderly and frail patients. Along with the fact that access is localized in the neck, this allows of immediate patient ambulation and complete freedom of movement soon after the end of the procedure.

CCA approach exposes a direct route to the aortic valve with a shorter distance separating the arterial entry point and the aortic annulus. Similar to transapical and transaortic accesses, this enhances sheath and delivery catheter stability and improves movement precision. Compared with trans-femoral access, it renders the prosthesis positioning more accurate.

In our series, there were two in-hospital deaths unrelated to the CCA access. One intraoperative death occurred by aortic annulus rupture during preimplant balloon aortic valvuloplasty and another death occurred on postoperative day 6 due to low cardiac output syndrome with multisystem organ failure in a poor preoperative condition patient (EuroSCORE 32, STS score 15.6, left ventricular ejection fraction 25%).

Limitations of the study

The present study is limited by the very small size of the cohort. These preliminary data do not allow us to draw any definitive conclusion regarding the safety and the risk of complications of this approach but highlight the interest to be confirmed in a larger, multicentric observational study.

In summary, in a cohort of aged and high-risk surgical patients with unsuitable trans-femoral access and favourable CCA anatomy, transcarotid TAVI under local anaesthesia appears feasible and safe. At our institution, in cases where the trans-femoral approach is unfeasible, the transcarotid approach has become our second option for TAVI. It allows of satisfactory control over delivery catheter positioning and prosthesis deployment, with only low risk of stroke, bleeding, respiratory complications, vascular access-site or access-related complications and immediate post-procedural patient ambulation.

Conflict of interest: none declared.

REFERENCES

APPENDIX. CONFERENCE DISCUSSION

Dr T. Walther (Bad Nauheim, Germany): I would call this a brave approach, actually, because I have learned in cardiac surgery over the years that when we don’t touch the aorta and the supra-aortic vessels, we have the least rate of stroke. Maybe you are very good in having zero strokes, or you are just lucky, or the numbers are just too small to prove that. So I would be interested to see a larger series, but I am not sure whether this is the right way to go.

I have some comments on some other things. For example, your risk profiles: an STS of 24 with a logistic EuroSCORE of 25. This cannot be. So I would like to ask the reviewers of this manuscript to correct this, because this should not be printed. This cannot be if you ask some Americans.

Then, in the end, it is really too small an experience to draw any conclusions. What I don’t know, I’m a bit puzzled about our surgical thinking, especially the colleague before, and it’s a similar thing. We surgeons should strive for one good approach. Now we are splitting: some do transaortic, some do transapical, some do transcarotid. We are fighting each other, which is ridiculous. The cardiologists are fighting us. You should go home and tell your cardiologist “my approach is better; this should be our favoured approach.” Instead, you’re standing here on the stage and accept TF as the favoured approach, and you do the same. Hundreds of patients have been done by TF in your centre, and you have a very small experience only with your surgical approaches. And you left the TA approach before you came above the learning curve. You have done fewer than 50 cases with TA, you left it, and now you have done fewer than 50 cases of transcarotid.

So my assumption would be you haven’t reached the end of the learning curve with both, and I am not sure whether that’s a good surgical strategy. I think surgeons should go the straightforward, easy way to bring our profession forward.

Dr Azmoun: Regarding the last remark, I agree with you; surgeons should have one strategy. As I said before, our access was transapical until 2012, we were surprised by the ease and the simple outcome after TAVI through the carotid artery. And actually currently in our hospital we do not use the transapical approach anymore. Our first choice when transfemoral access is not possible, has become carotid artery access.

I think nobody can really get the truth. But, you are right about the second point: this is a really limited series; we have only 19 patients. That’s true. That doesn’t allow us to draw any definitive conclusion regarding the safety of this approach. But, really, you agree with me, this highlights the interest in confirming this data in a larger study. So this would be another paper to discuss later. I don’t know if you had a third point.

Dr T. Modine (Lille, France): You have to correct the STS score.

Dr Azmoun: Yes. Of course, we were also surprised by seeing this, and I will show you the calculation. The STS scores, of course, are really high in our series.

Dr Modine: Dr Walther, this is good for discussion. We were the first to start this carotid access, and that was based on a critical need, because in some patients we didn’t want to go transapical, in some others we didn’t want to go direct aortic. We have done more than 100 cases so far. We had only six transist Stokes, four of which were on the lateral side, which means emboli, and two of them were bilateral. So there is definitely no high stroke risk. The results are very good in terms of quality of implantation. The protection of irradiation: we have divided by two the dose of irradiation; this is important for me and for you. And the length of the procedure itself.

I like something that you wrote, not a very long time ago, in the last paper you had published in the Annals where you state that the femoral approach is better than the transapical approach and that it is only based on belief. So, please, don’t use your belief to say that the other alternatives are not good.

And one last thing: I’m very happy to hear that surgeons like you are defending the position of cardiac surgeons for TAVI. There is not only one patient, there is not only one indication, and I think we have the chance as surgeons to try to master many options to treat the patients and not have only one transfemoral approach like cardiologists do. In some centres you are lucky enough to have sufficient patients to be able to learn or improve your quality of surgery regarding the transapical approach. In some others it’s much easier to do it under local anaesthesia and use the subclavian or direct aortic approach. Is it bad? I don’t think so.

I think the objective should be how to optimize implantation, achieve very good results in terms of paravalvular leak, in terms of reducing the risk of stroke, in terms of reducing the risk of pacemaker implantation, and then the access is here to serve this. This is my conclusion. And surgeons also should learn sometimes to do transfemoral. If we can do it from here, we can do it from anywhere.

Dr Walther: I’m very much with you that surgeons should do transfemoral. However, all retrograde approaches only pave the way for transfemoral. Once you have smaller devices, transaortic and transcatheter are not required. On the other hand, you pointed out nicely the short distance, some advantages of the transapical, and I think this will stay because it’s the logical way. And I would just remind every one of us to really stand up for what is best for our patients.

Dr Modine: Exactly.

Dr Walther: And I believe the easiest, safest and simplest way should be the way forward. Of course, we should be involved with transfemoral as well, but there is a risk that this will take place in cardiology cath labs somewhere and we have no control, and as long as we can claim that the integrated approach has some advantages, this will be helpful.

Dr J. Kempfert (Bad Nauheim, Germany): We are running out of time. Sorry. We have heard a very wise final comment. We should as surgeons do more transfemoral implants, but this does not mean that this is against the alternative access.