Alternate Vascular Access of TAVR

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I have no relevant financial relationships
Alternate Access for TAVI

- Transcarotid
- Transaortic
- Transseptal
- Transcaval
- Transapical
- Iliac artery
- Transfemoral
Evolution in TAVI Access

First-in-man TAVI Transseptal Anterograde

Transapical
Transsubclavian Surgical
Transcarotid
Transcaval

Transfemoral retrograde
Transaortic
Transsubclavian Percutaneous

Experience

TAVI = transcatheter aortic valve implantation.

Transfemoral access

• Percutaneous approach
  • Prostar XL 10F
  • Perclose/Proglide

• Perfect femoral artery puncture:
• Common femoral artery
• Central vessel (fluoro guided, echo guided)
• Wire placement from the contra-lateral for managing complication
  • balloon artery occlusion
  • covered stent placement
Difficult transfemoral tavr
The 15% of patients were unsuitable for Transfemoral access
Apical access
**Transapical access**

Fig 4 Forest plot for relative risk of stroke at longest follow-up for transcatheter aortic valve implantation (TAVI) compared with surgical aortic valve replacement (SAVR) for severe aortic stenosis, by valve approach.

<table>
<thead>
<tr>
<th>Study</th>
<th>No of events/total</th>
<th>Relative risk (95% CI)</th>
<th>Weight (%)</th>
<th>Relative risk (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transapical TAVI</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STACCATO</td>
<td>3/34</td>
<td>1/36</td>
<td>6</td>
<td>3.18 (0.35 to 29.07)</td>
</tr>
<tr>
<td>PARTNER 2A – transapical subgroup</td>
<td>29/239</td>
<td>18/237</td>
<td>94</td>
<td>1.60 (0.91 to 2.60)</td>
</tr>
<tr>
<td>Subtotal (heterogeneity: P=0.56, I²=0%)</td>
<td>32/273</td>
<td>19/273</td>
<td>100</td>
<td>1.67 (0.97 to 2.87)</td>
</tr>
<tr>
<td><strong>Transfemoral TAVI</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOTION</td>
<td>5/136</td>
<td>7/128</td>
<td>5</td>
<td>0.67 (0.22 to 2.06)</td>
</tr>
<tr>
<td>US Pivotal</td>
<td>45/378</td>
<td>58/329</td>
<td>44</td>
<td>0.68 (0.47 to 0.97)</td>
</tr>
<tr>
<td>PARTNER 2A – transfemoral subgroup</td>
<td>62/753</td>
<td>67/758</td>
<td>52</td>
<td>0.93 (0.67 to 1.30)</td>
</tr>
<tr>
<td>Subtotal (heterogeneity: P=0.42, I²=0%)</td>
<td>112/1272</td>
<td>132/1215</td>
<td>100</td>
<td>0.80 (0.63 to 1.01)</td>
</tr>
</tbody>
</table>

Reed A Siemieniuk et al. BMJ 2016;354:bmj.i5130
- The first case of TA TAVI without cardiopulmonary bypass was performed in 2005
- TA approach rapidly emerged as the alternative access route to TF
- Its use has clearly declined owing to the high proportion of patients amenable to a TF approach, complications related to the TA access site, and the advent of a variety of alternative access strategies.
Trans-subclavian/axillary Access
Table 5. Actuarial freedom from events at 6 months.

<table>
<thead>
<tr>
<th></th>
<th>Total (n=514)</th>
<th>Femoral (n=460)</th>
<th>Subclavian (n=54)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death, %</td>
<td>89.1±1.5</td>
<td>88.6±1.6</td>
<td>93.3±3.8</td>
<td>&gt;0.2</td>
</tr>
<tr>
<td>Cardiac death, %</td>
<td>95.8±0.9</td>
<td>95.5±1.0</td>
<td>97.9±2.1</td>
<td>&gt;0.2</td>
</tr>
<tr>
<td>MACCEs, %</td>
<td>86.3±1.6</td>
<td>85.5±1.7</td>
<td>93.9±3.4</td>
<td>&gt;0.2</td>
</tr>
<tr>
<td>MAVREs, %</td>
<td>87.9±1.5</td>
<td>87.9±1.6</td>
<td>88.5±4.5</td>
<td>&gt;0.2</td>
</tr>
</tbody>
</table>
Trans subclavian / axillary access

- The surgical cutdown is performed through an infra clavicular incision
- Percutaneous approach have been described with the insertion of a wire in the ipsilateral brachial artery externalised through the femoral artery or contralateral brachial artery for balloon occlusion or covered stent implantation in case of failure of the percutaneous closure system
- 3 to 5.8% of patients in the FRANCE 2 registry (2010-2012)
Subclavian/axillary Access

**Advantages**
- No groin access, early mobilization
- Shorter route to the valve - more control
- Less manipulation in the arch
- Feasible under local anesthesia in most patients
- Option for concomitant PM implant

**Disadvantages**
- Requires surgical exposure
- Subclavian artery lesions
- Open LIMA
- Neurologic embolic events
- Potential dramatic vessel complication (intra-thoracique)
- Nerve lesions
- Postoperative hematoma

Vessel diameter > 6.5 mm for 18F delivery system

Retract 18F vascular sheath proximal to LIMA

Subclavian is free of vascular disease proximal to LIMA

Side of permanent pacemaker should be avoided
Distal axillary artery Access
Transsubclavian versus transfemoral

Meta-analysis of six studies including 4,504 patients (3,886 TF and 618 TSc)

1-YEAR mortality

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Femoral Access</th>
<th>Subclavian Access</th>
<th>Odds Ratio IV, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frohlich Am J. Car 2015</td>
<td>388</td>
<td>2828</td>
<td>188</td>
</tr>
<tr>
<td>Gleason TCT 2016 (US Pivotal)</td>
<td>50</td>
<td>202</td>
<td>47</td>
</tr>
<tr>
<td>Muensterer. Clin Res Card 2013</td>
<td>56</td>
<td>301</td>
<td>9</td>
</tr>
</tbody>
</table>

TSc resulted comparable to TF approach in terms of 30-day and 1-year mortality, vascular complications, and major bleeding despite a much higher rate of PAD.

Early all-cause mortality was lower after TSc/TAx than TAp or TAo.

Early PM implantation was more frequent after TSc/TAx than TAp or TAo.

Midterm all-cause mortality was higher after TSc/TAx than TF.
FIGURE 1 Temporal Trends in the Volume of Each Nonfemoral Access Route

Percentage of transcatheter aortic valve replacement procedures using nontransfemoral access sites according to quarterly TVT (Transcatheter Valve Therapy) Registry data. Q = quarter; TA = transapical; TAo = transaortic; TAx = transaxillary.
Direct aortic access
Direct aortic access

• Familiar & easy to learn for surgeons
• No LV puncture
  ▪ Reduced risk of bleeding
  ▪ No risk of apical aneurysm/decline in LV function
• No pleural separation
  ▪ Less painful
• Allows large bore access
• Controlled valve deployment

• Requires sternotomy or lateral thoracotomy
• Requires general anaesthesia
• Still pretty invasive
• Still pretty painful
Direct aortic access

Mini-Thoracotomy or Mini-Sternotomy

Selection criteria confirmed with mandatory pre-operative CT scan:

- Aortic root angulation criteria (see table below)
- Basal plane to aortic access site distance ≥ 6 cm (see figure to right)
- Soft tissue depth allows for digital palpation of aortic access site
- Aortic access site free of calcification

Access site and delivery trajectory free of RIMA or patent RIMA graft

<table>
<thead>
<tr>
<th>Approach</th>
<th>Direct Aortic</th>
<th>Left Subclavian / Axillary</th>
<th>Right Subclavian / Axillary</th>
<th>Iliofemoral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable Aortic Root Angle*</td>
<td>Any angle</td>
<td>&lt;70°</td>
<td>&lt;30°</td>
<td>&lt;70°</td>
</tr>
</tbody>
</table>

R anterior mini-thoracotomy

Upper mini-sternotomy
TAVR: Direct aortic access vs Femoral

- 394 matched pairs of IF and DA patients

- The all-cause mortality rate was significantly higher in the DA group than in the IF group at 30 days (10.9% vs 4.1%, P<0.001), but this difference was reduced at 1 year (28.1% vs 23.2%, P=0.063). When femoral access is not feasible, DA access allows effective delivery of the valve but incurs an increased risk of death and adverse events, potentially the result of procedural differences.
Trans-Carotid Access
Trans Carotid access

- First reported 2009
- Experience with carotid access
- Presence of the vagus nerve and the respiratory tract.
- Left carotid access more coaxial with the ascending aorta
- FRANCE TAVI registry showed that up to 5.5% of patients are now treated with the TC

<table>
<thead>
<tr>
<th>Anatomical constraints &amp; limiting conditions</th>
<th>Mode of access &amp; anaesthesia</th>
<th>Advantages</th>
<th>Disadvantages/specific complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transcarotid (TC)</td>
<td>Surgical</td>
<td>No interaction with descending &amp; abdominal aorta</td>
<td>Complications of access preparation (nerve injury)</td>
</tr>
<tr>
<td>Min. vessel diameter &lt;6 mm</td>
<td>General anaesthesia OR</td>
<td>No myocardial injury</td>
<td>Monitoring of cerebral perfusion required</td>
</tr>
<tr>
<td>Calcification and tortuosity</td>
<td>Local anaesthesia with</td>
<td>No chest wall injury, no entry in pleural cavity</td>
<td>Right-side: unfavourable alignment if steep angle between annular plane and horizontal axis</td>
</tr>
<tr>
<td>Short neck</td>
<td>conscious sedation</td>
<td>No restrictions in presence of prior cardiac surgery</td>
<td></td>
</tr>
<tr>
<td>Prior ipsilateral carotid artery intervention</td>
<td></td>
<td>Rapid recovery</td>
<td></td>
</tr>
<tr>
<td>Stenosis or occlusion of contralateral carotid artery or vertebral arteries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticipated difficult airway</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PATIENT FOCUSED EVIDENCE-BASED APPROACH
### TABLE 3 Clinical Outcomes of Transcarotid TAVR Patients (N = 96)

<table>
<thead>
<tr>
<th>Event</th>
<th>Mortality</th>
<th>Bleeding</th>
<th>Vascular complications</th>
<th>Composite endpoints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>3 (3.1)</td>
<td>34 (37.4)</td>
<td>4 (4.2)</td>
<td>86 (89.9)</td>
</tr>
<tr>
<td>Procedural</td>
<td>3 (3.1)</td>
<td>4 (4.2)</td>
<td>4 (4.2)</td>
<td>89 (92.7)</td>
</tr>
<tr>
<td>30-day</td>
<td>6 (6.3)</td>
<td>11 (9.9)</td>
<td>11 (26.5)</td>
<td></td>
</tr>
<tr>
<td>1-year</td>
<td>16 (16.7)</td>
<td>22 (23.2)</td>
<td>11 (9.9)</td>
<td></td>
</tr>
<tr>
<td>Major</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life-threatening</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>1 (1.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute kidney injury (grade 3)</td>
<td>7 (7.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New pacemaker*</td>
<td>22 (26.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital stay, days</td>
<td>11 (9-15)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 4 Stroke and TIA in Transcarotid TAVR Patients (N = 96)

<table>
<thead>
<tr>
<th>Event</th>
<th>3 (3.1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-hospital stroke or TIA</td>
<td>3 (3.1)</td>
</tr>
<tr>
<td>TIA</td>
<td>3 (3.1)</td>
</tr>
<tr>
<td>Stroke</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Ipsilateral localization</td>
<td>1 (33)</td>
</tr>
<tr>
<td>Hemorrhagic stroke</td>
<td>0 (0)</td>
</tr>
<tr>
<td>In-hospital atrial fibrillation</td>
<td>1 (33)</td>
</tr>
<tr>
<td>CHA2DS2-VASc score*</td>
<td>3.8 ± 0.8</td>
</tr>
<tr>
<td>Aortic valve pre-dilation</td>
<td>3 (100)</td>
</tr>
<tr>
<td>THV post-dilation</td>
<td>1 (33)</td>
</tr>
<tr>
<td>30-day stroke or TIA</td>
<td>6 (6.3)</td>
</tr>
<tr>
<td>TIA</td>
<td>6 (100)</td>
</tr>
<tr>
<td>Stroke</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Ipsilateral localization</td>
<td>2 (33)</td>
</tr>
<tr>
<td>Hemorrhagic stroke</td>
<td>0 (0)</td>
</tr>
<tr>
<td>In-hospital atrial fibrillation</td>
<td>4 (67)</td>
</tr>
<tr>
<td>Discharge anticoagulation</td>
<td>4 (67)</td>
</tr>
<tr>
<td>Discharge dual antiplatelet therapy</td>
<td>2 (33)</td>
</tr>
</tbody>
</table>
Transcarotid vascular access for TAVR is safe, feasible, and associated with encouraging short-term clinical outcomes in terms of mortality, stroke, and major vascular complications in pts who are not candidates to transfemoral TAVR.
Trans-caval Access
Schematic description of Caval-Aortic Access

A. A catheter directs a transfemoral vein guidewire from the inferior vena cava towards a snare target positioned in the adjoining abdominal aorta.

B. A catheter is advanced over the guidewire into the aorta and used to introduce a more rigid guidewire.

C. The valve introducer sheath is advanced from the vena cava into the aorta.

D. After completion of transcatheter aortic valve replacement, the aortocaval access tract is closed with a nitinol occluder.
• 100 patients

• 29% of 12-month mortality.

• No vascular complications after discharge.

• 93% of fistulas were proven occluded

• Fistula patency was not associated with overall survival nor with heart failure admissions.

• No cases of occluder fracture or migration or visceral injury.

(A) Overall survival after transcaval TAVR. (B) Cardiovascular versus noncardiovascular mortality. (C) Survival by high- versus low-volume enrolling centers. Survival was lower at 30 days at low-volume centers but was not different after 1 year. (D) Survival by fistula patency status at the conclusion of the transcaval TAVR procedure. Survival was not different whether the fistula was occluded or patent.

TAVR = transcatheter aortic valve replacement.

n-FP and FP TAVR provided similar results and a similar safety profile, except for a 2-fold lower rate of major vascular complications or unplanned vascular repairs in the n-FP TAVR group.
Comparative 30-day all-cause mortality, stroke and life-threatening bleeding rates in high-risk patients treated with the different transcatheter aortic valve implantation approaches.

![Graph showing mortality, stroke, and life-threatening bleeding rates](chart.png)

- **Mortality**
  - Transfemoral (Adams et al): Blue bar
  - Transapical (Börgermann et al): Purple bar
  - Transsubclavian (Schäfer et al): Green bar
  - Transaortic (Bapat et al): Pink bar
  - Transcarotid (Mylotte et al): Blue bar

- **Stroke**
  - Transfemoral (Adams et al): Blue bar
  - Transapical (Börgermann et al): Purple bar
  - Transsubclavian (Schäfer et al): Green bar
  - Transaortic (Bapat et al): Pink bar

- **Life-threatening bleeding**
  - Transfemoral (Adams et al): Blue bar
  - Transapical (Börgermann et al): Purple bar
  - Transsubclavian (Schäfer et al): Green bar
  - Transaortic (Bapat et al): Pink bar
  - Transcarotid (Mylotte et al): Blue bar

References:
Algorithm for alternative approach selection

Alternate Access for TAVI: Stay Clear of the Chest

Pavel Overtchouck and Thomas Modine

AT = ACURATE TA; JV = JenaValve; ER = Evolut R; S3 = SAPIEN 3; TA = transapical; TAo = transaortic; TC = transcarotid; TF = transfemoral; TS = trans-subclavian.
Take home message

• Select the best valve for the patient
• Select the best access
• Select the best access taking in consideration the surgical expertise available
• Perform the procedure in the best and safest way for the patient
• Probably in the future less need of alternate vascular access to femoral artery
• Peripheral hostile access are more prevalent in high risk patient population
• The intermediate or low risk usually has more favourable anatomies
Thank You