Patient Selection and Preparation for TAVI

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Agenda

• Some definitions.
• Indications for intervention in severe AS.
• TAVI vs. SAVR.
• The heart team and clinical evaluation of patients with severe AS.
• Assessment of fitness & procedural planning.
Types of AS

- **High-gradient aortic stenosis**
  (valve area <1 cm², mean gradient >40mmHg).

- **Low-flow, low-gradient AS with reduced EF** [valve area <1cm², mean gradient <40mmHg, EF < 50%, stroke volume index < 35mL/m²]

- **Low-flow, low-gradient AS with preserved EF** (valve area <1cm², mean

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The HEART TEAM

- A multidisciplinary team responsible for taking decisions of treatment in cardiac patients.
- **Main players**: cardiologist, cardiac surgeon, anesthesiologist, intensivist.
- **Other players** join the team when needed: pulmonologist, hepatologist, neurologist, geriatrician, ......
Indications for intervention in aortic stenosis and recommendations for the choice of intervention mode

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a) Symptomatic aortic stenosis</strong></td>
<td></td>
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<tr>
<td>Intervention is indicated in symptomatic patients with severe, high-gradient</td>
<td>I</td>
<td>B</td>
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<tr>
<td>aortic stenosis (mean gradient ≥40 mmHg or peak velocity ≥4.0 m/s).</td>
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<tr>
<td>Intervention is indicated in symptomatic patients with severe low-flow, low-</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>gradient (&lt;40 mmHg) aortic stenosis with reduced ejection fraction, and</td>
<td></td>
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<tr>
<td>evidence of flow (contractile) reserve excluding pseudo-severe aortic stenosis.</td>
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<tr>
<td>Intervention should be considered in symptomatic patients with low flow, low-</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>gradient (&lt;40 mmHg) aortic stenosis with normal ejection fraction after</td>
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<tr>
<td>careful confirmation of severe aortic stenosis.</td>
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</table>

**Indications for intervention in aortic stenosis and recommendations for the choice of intervention mode (continued)**

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>The choice for intervention must be based on careful individual evaluation of</td>
<td>I</td>
<td>C</td>
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<tr>
<td>technical suitability and weighing of risks and benefits of each modality</td>
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<tr>
<td>(aspects to be considered are listed in the according table). In addition,</td>
<td></td>
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<tr>
<td>the local expertise and outcomes data for the given intervention must be</td>
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<tr>
<td>taken into account.</td>
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<tr>
<td>SAVR is recommended in patients at low surgical risk (STS or EuroSCORE II</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>&lt;4% or logistic EuroSCORE I &lt;10% and no other risk factors not included in</td>
<td></td>
<td></td>
</tr>
<tr>
<td>these scores, such as frailty, porcelain aorta, sequelae of chest radiation).</td>
<td></td>
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<tr>
<td>TAVI is recommended in patients who are not suitable for SAVR as assessed by</td>
<td>I</td>
<td>B</td>
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<tr>
<td>the Heart Team.</td>
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</tbody>
</table>
Aspects taken into consideration by the heart team
### Aspects to be considered by the Heart Team for the decision between SAVR and TAVI in patients at increased surgical risk

#### Clinical characteristics

<table>
<thead>
<tr>
<th></th>
<th>Favours TAVI</th>
<th>Favours SAVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>STS/EuroSCORE II &lt; 4% (logistic EuroSCORE I &lt; 10%)</td>
<td>+</td>
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</tr>
<tr>
<td>STS/EuroSCORE II ≥ 4% (logistic EuroSCORE I ≥ 10%)</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Presence of severe comorbidity (not adequately reflected by scores)</td>
<td>+</td>
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<tr>
<td>Age &lt; 75 years</td>
<td></td>
<td>+</td>
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<tr>
<td>Age ≥ 75 years</td>
<td>+</td>
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<tr>
<td>Previous cardiac surgery</td>
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<td>+</td>
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</tbody>
</table>

### Aspects to be considered by the Heart Team for the decision between SAVR and TAVI in patients at increased surgical risk (continued)

#### Clinical characteristics (continued)

<table>
<thead>
<tr>
<th></th>
<th>Favours TAVI</th>
<th>Favours SAVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frailty</td>
<td>+</td>
<td></td>
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<tr>
<td>Restricted mobility and conditions that may affect the rehabilitation process after the procedure</td>
<td>+</td>
<td></td>
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<tr>
<td>Suspicion of endocarditis</td>
<td></td>
<td>+</td>
</tr>
</tbody>
</table>

#### Anatomical and technical aspects

<table>
<thead>
<tr>
<th></th>
<th>Favours TAVI</th>
<th>Favours SAVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Favourable access for transfemoral TAVI</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Unfavourable access (any) for TAVI</td>
<td>+</td>
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</tr>
</tbody>
</table>
Aspects to be considered by the Heart Team for the decision between SAVR and TAVI in patients at increased surgical risk (continued)

<table>
<thead>
<tr>
<th>Anatomical and technical aspects (continued)</th>
<th>Favours TAVI</th>
<th>Favours SAVR</th>
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</thead>
<tbody>
<tr>
<td>Sequelae of chest radiation</td>
<td></td>
<td></td>
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<tr>
<td>Porcelain aorta</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence of intact coronary bypass grafts at risk when sternotomy is performed</td>
<td></td>
<td></td>
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<tr>
<td>Expected patient–prosthesis mismatch</td>
<td></td>
<td></td>
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<tr>
<td>Severe chest deformation or scoliosis</td>
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<td></td>
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<tr>
<td>Short distance between coronary ostia and aortic valve annulus</td>
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</tbody>
</table>

Aspects to be considered by the Heart Team for the decision between SAVR & TAVI in patients at increased surgical risk (continued)

<table>
<thead>
<tr>
<th>Anatomical and technical aspects (continued)</th>
<th>Favours TAVI</th>
<th>Favours SAVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of aortic valve annulus out of range for TAVI</td>
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<tr>
<td>Aortic root morphology unfavourable for TAVI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve morphology (bicuspid, degree of calcification, calcification pattern) unfavourable for TAVI</td>
<td></td>
<td></td>
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<tr>
<td>Presence of thrombi in aorta or LV</td>
<td></td>
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<tr>
<td>Cardiac conditions in addition to aortic stenosis that require consideration for concomitant intervention</td>
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<tr>
<td>Severe CAD requiring revascularization by CABG</td>
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</table>
Evidence

- Available data from randomized controlled trials and large registries in elderly patients at increased surgical risk show that TAVI is:
  - Superior in terms of mortality to medical therapy in **extreme-risk (inoperable)** patients.
  - Non-inferior or superior to surgery in **high-risk** patients
  - Noninferior to surgery and even superior when transfemoral access is possible in **intermediate-risk patients**
So, the heart team decided to perform TAVI......
What’s next??

Assessment of fitness & procedural planning
Why MSCT?
- High spatial resolution.
- Scanning Large volume in a short time.
- Method of choice to assess calcification.
- Widely available.
- Easy to perform & read.
Main role of MSCT

• Assessment of vascular access.
• Assessment of Aorta.
• Assessment chest anatomy
• Assessment of the aortic root & annulus.

I-Vascular access
Good assessment of vascular access by CT helps to decrease vascular complications by evaluation of
1- Minimal luminal diameter

- Across the whole access (iliofemoral or subclavian).
- Accurate MPRs are used to get orthogonal images for accurate assessment.
• Sapien XT:
  - 23 mm → 6 mm
  - 26 mm → 6.5 mm
  - 29 mm → 7 mm
• Sapien 3:
  - 23, 26 mm → 5.5 mm
  - 29 mm → 6 mm
• Corevalve:
  - 26, 29, 31 mm → 6 mm
• Evolut R:
  - 23, 26, 29 mm → 5 mm
2- Calcifications

3- Tortousity
• Not a problem by itself (solved by passage of stiff wire).
• Becomes a problem if calcified.
Calcified vs. non calcified tortuous vessels

4- Additional data

• Site of common femoral bifurcation in relation to femoral head.
• Distance between anterior wall of access vessel and skin.
II-Aorta

- Entire aorta should be screened if transfemoral access is planned.

- Femoral access is contraindicated with aortic:
  - Massive elongation with kinking.
  - Dissection.
  - Thrombi or large plaques protruding to lumen.
• If transaortic approach is planned → must know position of ascending aorta relative to chest wall.

• In cases of previous CABG surgery, the position of grafts & its potential adhesions to chest wall is important in case emergency open heart surgery is needed.
II-Left ventricle & chest wall

- Exclude LV thrombi

- For transapical access:
  - position of apex in relation to chest wall
  - Alignment of LV axis with LVOT orientation.
Why do we need to accurately assess the annulus?

- Too small prosthesis
  - embolization.
  - Paravalvular regurge
- Too large
  - rupture
What is the annulus?

- Not a separate anatomical structure.
- Formed by a plane joining the hinge points of the 3 cusps

It is always oval
2D echo vs. 3D MSCT
How do we get the accurate plane containing the annulus?

By modifications of the axial plane in sagittal & coronal planes.

• Once the accurate annular plane is obtained, a lot of data can be extracted
Prosthesis sizing

The oval shape always (esp. in balloon expandable prosthesis) changes to near circular after valve implantation
\[ D = \frac{D_1 + D_2}{2} \]

\[ D = \text{circumference} / \pi \]
\[ D = 2 \times \sqrt{\frac{\text{area}}{\pi}} \]

- Each manufacturer provides detailed charts for choosing the prosthesis size according to mean diameter, circumference & area of the annulus.
Corevalve®

Height of coronary ostia (more important in Sapien)
Length & calcification of cusps

Sinus of valsalva width & height (for Corevalve)
Recommended SOV measurements for each Corevalve® size

<table>
<thead>
<tr>
<th>Valve Size</th>
<th>Aortic Annulus Measurements</th>
<th>Sinus of Valsalva Diameter</th>
<th>Native Leaflet to Sinotubular Junction Length</th>
<th>Ascending Aorta Diameter*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Diameter</td>
<td>Perimeter</td>
<td>Area Range</td>
<td>≥ 25 mm</td>
</tr>
<tr>
<td>23</td>
<td>18-20 mm</td>
<td>56.5-62.8 mm</td>
<td>354.5-314.2 mm</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>20-23 mm</td>
<td>62.8-72.3 mm</td>
<td>314.2-415.5 mm</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>23-27 mm</td>
<td>72.3-84.8 mm</td>
<td>415.5-572.6 mm</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>26-29 mm</td>
<td>81.7-91.1 mm</td>
<td>530.9-660.5 mm</td>
<td></td>
</tr>
</tbody>
</table>

- There is more risk of coronary occlusion in case of:
  - heavily diffusely calcified cusps.
  - Long cusps.
  - shallow sinuses
Dangerous anatomy (dense calcification at aortomitral continuity) → Regurgete → Rupture

Implantation angle orthogonal to annulus
3D Echo
• **Avoids disadvantages of MSCT:**
  - radiation
  - contrast
  - higher cost
  - motion artefacts
  - accessibility

• However, echocardiography has inferior spatial resolution especially with severe calcifications (which is always there in TAVI candidates).

• No data about other necessary informations (vascular access, sinuses of valsalva, coronary ostia, distribution of calcifications, ....)
• Also, results are not always reproducible even in highly experienced hands.

• Data regarding its accuracy in comparison to MSCT (the gold standard) is still conflicting.
• So, for the time being 3D TEE can be used for annular sizing only if MSCT is not available or contraindicated (which is also a rare situation).

Cardiac MRI
Results

- CMR was found to be a reliable imaging technique for annulus sizing. Its performance stands up to the level of confidence of CCT
Why CMR?

- 3D

- Suitable in patients with CKD.

- Indications of TAVI are extending to include younger patients with lower risk in whom minimizing exposure to ionizing radiation is of great importance.

- If both MSCT & TEE are difficult to do (e.g. elderly with CKD & oesophageal problems or poor airway control.)
- Possible use of gadolinium-based contrast material, which is significantly less nephrotoxic and produces less adverse reactions than CT contrast media, permits assessment of scarring & fibrosis that are associated with worse prognosis in AS.

**But**

- Expensive & has limited availability.

- Contraindicated in case of previous implantation of metallic devices or prosthesis (which is not uncommon in elderly population).

- Its efficiency in assessment of other data needed for the procedure (coronary heights, sinuses, access, …) is not yet well tested.
Coronary anatomy

- Assessment with revascularization if needed better before the procedure

Finally

- Talk to your patient and the family:
  - Why TAVI was decided
  - Procedural steps.
  - Expected postprocedural course.
  - Possible complications.
Looking Forward to see you

THANK YOU