Patient with low-flow low-gradient aortic stenosis and ischemic cardiomyopathy
TAVR and possibly percutaneous revascularization

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Disclosures

- Proctor to Edwards Lifesciences, Medtronic
- Consultant to Edwards Lifesciences, Medtronic

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- Abbott Vascular
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- Boston Scientific

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LOW GRADIENT AS
AVA ≤ 1.0 cm² and MG < 40 mmHg

< 50%

LVEF

≥ 50%

≤ 35 ml/m²

SVi > 35 ml/m²

«CLASSICAL» LOW-FLOW LOW-GRADIENT

«PARADOXICAL» LOW-FLOW LOW-GRADIENT

NORMAL-FLOW LOW-GRADIENT
Operative risk stratification and prediction of long term outcomes in LG-LEF AS

LV contractile reserve (CR) during dobutamine infusion was defined by an increase in stroke volume of ≥ 20%

Patient Survival (%)

Operative risk predictors
1. Lack of CR
2. MPG <20mmHg

Kaplan-Meier survival estimates by group and treatment.
TAVI vs. Medical Rx in PARTNER Cohort B
LF-LG and LEF

Log Rank P = 0.039
TAVI vs. Medical Rx in PARTNER Cohort B
LF-LG and LEF

Log Rank P = 0.596
Comparison of LVEF recovery in patients with low LVEF after TAVI and SAVR

LV Ejection Fraction, (%)

Baseline | Discharge | 1 year
---|---|---
30 | 35 | 40
35 | 40 | 45
40 | 45 | 50

p=0.01 (p<0.001)

†: different from baseline
‡: different from discharge
*: different from SAVR
Comparison of LVEF recovery in patients with low LVEF after TAVI and SAVR
TAVI vs SAVR in Classical LF-LG AS

- TAVI has also been proved in LF-LG AS vs. Medical Rx and SAVR

- Some studies suggest better and faster LV function recovery post TAVI

- TAVI is associated with less PPM
Prevalence of Coronary Artery Disease By Age

Prevalence of Valvular Heart Disease By Age

Circulation 2012;125:e2-e220
AHA Heart Disease and Stroke Statistics – 2012 Update

Lancet 2006;386:1005-11
Coronary Artery Disease in TAVR Patients

**Incidence**

In pts. undergoing TAVR the prevalence of significant CAD is reported between 44% - 75%
The prognostic impact of concomitant coronary artery bypass grafting during aortic valve surgery: Implications for revascularization in the transcatheter era

1308 consecutive pts. with significant CAD (>50% stenosis) undergoing AVR with or without CABG between 2001 and 2010

Simultaneous CABG and SAVR reduces risk late mortality
Impact of CAD on clinical outcome post TAVR

The severity of CAD at baseline has prognostic implications among patients with severe AS undergoing TAVR

Baseline SYNTAX score and outcome
Bern TAVI Registry
Impact of incomplete revascularization on clinical outcome post TAVR
Pts. with *incomplete revascularization* with high residual SYNTAX Score (>14) had impaired long-term clinical outcomes post TAVR

**Residual SYNTAX score and outcome**

Bern TAVI Registry
Issues connected to Revascularization in AS patients considered for TAVI

- Assessment of need for revascularization
- Timing of revascularization in relation to TAVI
- Completeness of revascularization
- Coronary protection during TAVI
- Consideration for future revascularization requirements
Exclusion Criteria for CAD in Landmark Trials

**PARTNER** Any therapeutic invasive cardiac procedure performed within 30 days of the index procedure, or 6 months if the procedure was a drug eluting coronary stent implantation

**PARTNER 2** Any therapeutic invasive cardiac procedure resulting in a permanent implant that is performed within 30 days of the index procedure, unless part of planned strategy for treatment of concomitant coronary artery disease

**PARTNER 3** No comment

**Corevalve US High Risk** Significant untreated CAD

**Corevalve Evolut R US** Any untreated significant CAD

**SURTAVI** Any percutaneous coronary or peripheral interventional procedure performed within 30 days prior to randomization. Multivessel coronary artery disease with a Syntax score >22 and/or unprotected left main coronary artery
No Randomized Trial Data to date
Trial Design

Intermediate Surgical Risk
Predicted risk of operative mortality ≥3% and <15%

Heart Team Evaluation
Assess inclusion/exclusion
Risk classification

Screening Committee
Confirmed eligibility

Randomization
Stratified by need for revascularization

Baseline neurological assessments

TAVR
TAVR only
TAVR + PCI

SAVR
SAVR only
SAVR + CABG

N 695 169 633 163
Clinical Outcomes in SURTAVI Based on Revascularization Stratification

Patients with SYNTAX score >22 and/or unprotected left main disease were excluded. In patients randomized to TAVR, PCI could be con-current or staged; coronary artery bypass surgery was to be done concomitantly with SAVR.

The only significant differences between the groups were:

1. STS risk score for mortality 4.8%±1.7% vs 4.4%±1.5% for no revascularization

2. Were more likely to be male (65.1% vs 54.2%)

Søndergaard et al, JACC 2017, TCT 39
Clinical outcomes at 1 year are presented per patients’ randomization stratification

<table>
<thead>
<tr>
<th>1-year K-M rate (%)</th>
<th>Revascularization TAVR (n=169) / SAVR (n=163)</th>
<th>p-value</th>
<th>No revascularization TAVR (n=695) / SAVR (n=633)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-cause mortality or disabling stroke</td>
<td>11.7 / 10.3</td>
<td>0.6870</td>
<td>7.3 / 8.3</td>
<td>0.3774</td>
</tr>
<tr>
<td>All-cause mortality Cardiovascular mortality</td>
<td>9.9 / 10.4 6.8 / 7.1</td>
<td>0.9069 0.9211</td>
<td>6.1 / 5.9 4.3 / 5.1</td>
<td>0.9913 0.5093</td>
</tr>
<tr>
<td>All stroke Disabling stroke</td>
<td>6.8 / 5.0 3.1 / 2.5</td>
<td>0.5528 0.7818</td>
<td>5.0 / 7.1 2.0 / 3.6</td>
<td>0.0651 0.7930</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>3.5 / 1.9</td>
<td>0.5136</td>
<td>1.5 / 1.3</td>
<td>0.7930</td>
</tr>
<tr>
<td>Life-threatening or disabling bleed</td>
<td>9.0 / 11.6</td>
<td>0.4998</td>
<td>6.6 / 6.8</td>
<td>0.8931</td>
</tr>
<tr>
<td>Major vascular complication</td>
<td>9.5 / 0.6</td>
<td><strong>0.0003</strong></td>
<td>5.5 / 1.3</td>
<td>0.7930</td>
</tr>
<tr>
<td>Aortic valve re-intervention</td>
<td>2.5 / 0.7</td>
<td>0.1945</td>
<td>2.0 / 0.4</td>
<td><strong>0.0079</strong></td>
</tr>
<tr>
<td>Aortic valve hospitalization</td>
<td>6.4 / 8.2</td>
<td>0.5808</td>
<td>8.9 / 7.2</td>
<td>0.3177</td>
</tr>
<tr>
<td>Acute kidney injury (stages 2/3)</td>
<td>2.4 / 6.1</td>
<td>0.0865</td>
<td>1.4 / 3.8</td>
<td><strong>0.0068</strong></td>
</tr>
</tbody>
</table>

Søndergaard et al, JACC 2017, TCT 39
Clinical Outcomes in SURTAVI Based on Revascularization Stratification

1 year All cause Mortality

Søndergaard et al, JACC 2017, TCT 39
Clinical Outcomes in SURTAVI Based on Revascularization Stratification

1 year All cause Mortality/Disabling Stroke

Søndergaard et al, JACC 2017, TCT 39
Clinical Outcomes in SURTAVI Based on Revascularization Stratification

1 year Myocardial Infarction

Søndergaard et al, JACC 2017, TCT 39
Clinical Outcomes in SURTAVI Based on Revascularization Stratification

1 year Life threatening/disabling bleed

![Bar Chart]

Søndergaard et al, JACC 2017, TCT 39
Clinical Outcomes in SURTAVI Based on Revascularization Stratification

1 year Major Vascular Complication

![Bar chart showing 1 year major vascular complications for TAVI and SAVR. The chart indicates a higher rate of complications for TAVI compared to SAVR, with a notable difference between those who underwent revascularization (Revasc) and those who did not (No Revasc).]

Søndergaard et al, JACC 2017, TCT 39
Clinical Outcomes in SURTAVI Based on Revascularization Stratification

1 year Acute Kidney Injury (stages 2-3)

Søndergaard et al, JACC 2017, TCT 39
Randomized Controlled Trial; ISRCTN75836930
tests the hypothesis of non-inferiority
of pre-TAVR PCI vs. medical management
of significant coronary lesions

Will provide further insight into
optimal revascularization strategies
in pts. with CAD undergoing TAVR
Coronary Hemodynamics in Patients With Severe Aortic Stenosis and Coronary Artery Disease Undergoing Transcatheter Aortic Valve Replacement
Changes in coronary flow after TAVI
30 vessels, 28 patients

PdPa-flow: resting flow over the whole cardiac cycle

iFR-flow: resting flow during the wave-period of diastole

FFR-flow: hyperemic flow over the whole cardiac cycle

Ahmad et al, JACC Intv 2018;11:2019–31
Changes in systolic coronary flow after TAVI

A) PRE-TAVR

B) POST-TAVR

Ahmad et al, JACC Intv 2018;11:2019–31
Change in fractional flow reserve (FFR) and instantaneous wave-free ratio (iFR) values after TAVI
Receiver Operating Characteristic Curve for iFR Indicating FFR \leq 0.75 and \leq 0.80

116 vessels, 95 patients

(A) The optimal instantaneous wave-free ratio cutoff value for indicating fractional flow reserve \leq 0.75 was 0.82, area under the curve: 0.92.
(B) The optimal instantaneous wave-free ratio cutoff value for indicating fractional flow reserve \leq 0.80 was 0.82, area under the curve: 0.89, p < 0.0001.
(A) The optimal instantaneous wave-free ratio cutoff value for a positive indicating scintigraphy finding was 0.82 (area under the curve: 0.84; p < 0.0001). (B, C) The optimal instantaneous wave-free ratio cutoff value for indicating a positive myocardial ischemia was 0.82 in both left anterior descending artery and non-left anterior descending artery lesions. (B) Area under the curve: 0.82; p < 0.0001. (C) Area under the curve: 0.80; p = 0.0001.
Simultaneous PCI (with Rota) and TAVI
87yo ♂

SOB on exertion last 3m

New symptoms of unstable angina last week

TTE: AVS, AVA 0.8cm², MPG 36mmHg, LVEF 45%

PAVD (LICA 60%), NIDDM

Coroangiography: mLAD 90% calcified

LE I σε 22.44%

STS score 5.57%

STS morbidity & mortality 30.63%
Severely calcified mLAD stenosis
mLAD PTCA (2x20mm balloon)
Rotablation with 1.5mm burr
Rotablation result
mLAD stenting result (2.75x18mm DES)
SAPIEN 3 23mm (+2ml)
TAVI final result
Staged PCI and TAVI
68yo 

SOB on exertion, multiple admissions for APE

CABG 4m ago (LIMA to LAD, RIMA to RCA)

Coro: RIMA occlusion

RCA PCI 1m ago

TTE: AVS, AVA 0.55cm², PG 99/65 mmHg, LVEF 50%

CRF on dialysis last 4y, PAVD (RICA 50%)

LE I 26.4%, STS mortality score 7.4%

STS morbidity and mortality σε 25%
RCA PCI (3.0x18mm DES)
Baseline Aortography
TAVI final result (Evolut R 23mm)
Emergency PCI (LM) and staged TAVI
75yo ♂

SOB on exertion last 1y (NYHA III) and CCS II

Admitted for UA and angiography showed severe LMS disease

Became unstable during angiography and underwent urgent, bail out LMS PCI

TTE: AVS, AVA 0.5cm², PG 85/50 mmHg, LVEF 60%

PAVD (LICA 100%, RICA 50%), HT

LE I σε 13.11%

STS score 3.22%, STS morbidity & mortality 16.32%
Severe LMS disease
Emergency LMS PCI
LMS PCI final result

Left Coronary 15 fps
CORONARY ANGIOPLASTY
KV:74.84
HYGEIA HOSPITAL
Staged TAVI 1 week after BAV 20mm balloon
Threatened LMS occlusion during TAVI Protection and PTCA
80yo ♀

SOB on exertion last 1y, orthopnea and PND lately

Atypical chest pains

2006 AVR for AVS with Biocor #21

TTE: AVS, AVA 0.7cm², PG 76/52 mmHg, LVEF 65%

NIDDM, restless leg syndrome, spine surgery x3

Coroangiography: unremarkable

LE I 19.6%, STS mortality score 12.2%

STS morbidity and mortality σε 43.4%
Estimated LCC leaflet (Red dot) elevation during deployment

NCC estimated elevation projection (Green dot)
TAVI with LMS protection (stent in place)
SAPIEN 3 20mm implantation
Post TAVI aortography
TAVI to STJ PTCA
Challenging future selective coronary ostial engagement
82yo ♂

TAVI 2014 (CoreValve 29mm)

Recent admission for NSTEMI (mild Troponin rise), ECG rate dependent LBBB, biphasic T waves anterior leads

Inf STEMI and Primary PCI in 2013

PAVD, NIDDM, partial nephrectomy for kidney Ca

Coronary angiography
Baseline Aortography
Post TAVI aortography
Difficult selective RCA engagement
Impossible selective LMS engagement
Impossible selective LMS engagement
Timing of PCI in relation to TAVR

Should we intervene before, during or after TAVR?
Algorithm approach to CAD in the TAVR candidate

From the Interventional Section Leadership Council of the ACC
Suggested Clinical Practice till Randomized data becomes available

In patients undergoing TAVI, consider staged pre-procedural PCI if:

1. **Prognostic** disease (>50% LMS or equivalent)

2. >70% stenosis in *major* vessel if > CCS 2 angina present

3. Presentation with undisputable *Acute Coronary Syndrome*
## Timing of PCI and TAVI

<table>
<thead>
<tr>
<th></th>
<th>PCI pre TAVR</th>
<th>PCI during TAVR</th>
<th>PCI post TAVR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pro</strong></td>
<td>Easy coronary access with no prosthesis in place</td>
<td>Reduction of access complications (1 for all)</td>
<td>More stable patient with no AS</td>
</tr>
<tr>
<td></td>
<td>Risk of performing PCI in the presence of Severe AS</td>
<td>Longer procedural time</td>
<td>Potential access / coronary cannulation issues</td>
</tr>
<tr>
<td><strong>Con</strong></td>
<td>Complications not tolerated</td>
<td>Less risk of hemodynamic instability and ischemia during TAVR</td>
<td>More Volume of contrast agent</td>
</tr>
<tr>
<td></td>
<td>Less risk of ischemia during TAVR</td>
<td>More Volume of contrast agent</td>
<td>May be averted in elderly asymptomatic patients</td>
</tr>
<tr>
<td></td>
<td>Less AKI risk</td>
<td>Higher AKI risk</td>
<td>Risk of ischemic MACE in the waiting</td>
</tr>
<tr>
<td></td>
<td>DAPT post PCI may impact post TAVR bleeding</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>