Αντιπαράθεση
Ασθενής με αορτική στένωση χαμηλής ροής χαμηλής κλίσης πίεσης και ισχαιμική καρδιοπάθεια
Καρδιοχειρουργική αντιμετώπιση

Χριστόφορος Σ. Κωτούλας
Καρδιοθωρακοχειρουργός
401 ΓΣΝΑ – Metropolitan General Hospital

www.kotoulas.com
Unfortunately, I have nothing to declare
I am just a Cardiac Surgeon
• Carabello et al, 1980 – high perioperative mortality
• deFilippi et al, 1995 – DSE for the diagnosis
• Monin et al, 2001/2003 – flow reserve and perioperative risk
• Hachicha et al, 2007 – paradoxical LF/LG AS
Stages of Valvular Aortic Stenosis

<table>
<thead>
<tr>
<th>Stage</th>
<th>Definition</th>
<th>Valve Anatomy</th>
<th>Valve Hemodynamics</th>
<th>Hemodynamic Consequences</th>
<th>Symptoms</th>
</tr>
</thead>
</table>
| D1     | Symptomatic severe high-gradient AS                                         | • Severe leaflet calcification or congenital stenosis with severely reduced leaflet opening | • Aortic $V_{\text{max}} \geq 4 \text{ m/s}$, or mean $\Delta P \geq 40 \text{ mm Hg}$  | • LV diastolic dysfunction  
• LV hypertrophy  
• Pulmonary hypertension may be present | • Exertional dyspnea or decreased exercise tolerance  
• Exertional angina  
• Exertional syncope or presyncope |
|        |                                                                             |                                                                                | • AVA typically is $\leq 1 \text{ cm}^2$ (or $\text{AVA}_i \leq 0.6 \text{ cm}^2/\text{m}^2$), but may be larger with mixed AS/AR |                                                                                |                                                               |
| D2     | Symptomatic severe low-flow/low-gradient AS with reduced LVEF              | • Severe leaflet calcification with severely reduced leaflet motion            | • AVA $\leq 1 \text{ cm}^2$ with resting aortic $V_{\text{max}} < 4 \text{ m/s}$ or mean $\Delta P < 40 \text{ mm Hg}$  
• Dobutamine stress echo shows AVA $\leq 1 \text{ cm}^2$ with $V_{\text{max}} \geq 4 \text{ m/s}$ at any flow rate | • LV diastolic dysfunction  
• LV hypertrophy  
• LVEF $<50\%$ | • HF,  
• Angina,  
• Syncope or presyncope |
# Stages of Valvular Aortic Stenosis

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Symptomatic severe AS</td>
<td>Severe leaflet calcification with severely reduced leaflet motion</td>
<td>AVA ≤1 cm² with aortic $V_{max}$ &lt;4 m/s, or mean $\Delta P &lt;$40 mm Hg</td>
<td>Increased LV relative wall thickness</td>
<td>HF, Angina, Syncope or presyncope</td>
</tr>
<tr>
<td>D3</td>
<td>Symptomatic severe low-gradient AS with normal LVEF or paradoxical low-flow severe AS</td>
<td>Severe leaflet calcification with severely reduced leaflet motion</td>
<td>Indexed AVA ≤0.6 cm²/m² and Stroke volume index &lt;35 mL/m²</td>
<td>Small LV chamber with low-stroke volume. Restrictive diastolic filling</td>
<td>HF, Angina, Syncope or presyncope</td>
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<td></td>
<td></td>
<td></td>
<td>Measured when the patient is normotensive (systolic BP &lt;140 mm Hg)</td>
<td>LVEF ≥50%</td>
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</tr>
</tbody>
</table>
Figure 1: Different Patterns of Severe AS According to Flow, Gradient, and LV Geometry

The majority (50% to 70%) of patients with severe aortic stenosis (AS) exhibit left ventricular (LV) hypertrophy with normal LV cavity size and ejection fraction (EF), which allow maintenance of normal LV pump function. These patients with severe AS and normal transvalvular flow rate exhibit a high-gradient. Patients with low LV EF, "classical" low-flow, low-gradient (LFLG: AS % 90% to 50% of the AS population) have a diseased LV cavity and a restrictive physiology leading to impaired LV filling, altered myocardial function, and reduced LV outflow. Because of the LV state, patients with classical or paraclastical LV mass present with a LV diastolic pressure of severe stenosis. AHA = aortic valve area in square centimeters; ejection = ejection fraction; aortic valve area at normal flow rate in square centimeters; BSA = body surface area; LFLG = left ventricular function; EF = ejection fraction; LV = left ventricle; aortic valve = surgical aortic valve replacement; SV = stroke volume; TRCM = truncal valve replacement; Figure Illustration by Greg Small.
Low-flow/low-gradient aortic stenosis—Still a diagnostic and therapeutic challenge

Anja Vogelgesang | Gerd Hasenfuss | Claudius Jacobshagen
Low-Flow, Low-Gradient Aortic Stenosis With Normal and Depressed Left Ventricular Ejection Fraction

Philippe Faberot, DVM, PhD, Jean G. Dumesnil, MD
Quebec City, Quebec, Canada

Low-flow, low-gradient (LF-LG) aortic stenosis (AS) may occur with depressed or preserved left ventricular ejection fraction (LVEF), and both situations are among the most challenging encountered in patients with valvular heart disease. In both cases, the decrease in gradient relative to AS severity is due to a reduction in transvalvular flow. The main challenge in patients with depressed LVEF is to distinguish between true severe versus pseudo-severe stenoses and to accurately assess the severity of myocardial impairment. Paradoxical LF-LG severe AS despite a normal LVEF is a recently described entity that is characterized by pronounced LV concentric remodeling, small LV cavity size, and a restrictive physiology leading to impaired LV filling, altered myocardial function, and worse prognosis. Until recently, this entity was often misdiagnosed, thereby causing underestimation of AS severity and inappropriate delays for surgery. Hence, the main challenge in these patients is proper diagnosis, often requiring diagnostic tests other than Doppler echocardiography. The present paper proposes to review the diagnostic and therapeutic management specificities of LF-LG AS with and without depressed LV function. (J Am Coll Cardiol 2012;60:LS45–53) © 2012 by the American College of Cardiology Foundation.
Outcome and Impact of Aortic Valve Replacement in Patients With Preserved LVEF and Low-Gradient Aortic Stenosis

Victor Dayan, MD, PhD,¹ Gustavo Vignolo, MD,² Julien Magné, PhD,³ Marie-Annick Dania Moltry, MD; Philippe Mbarot, BVN, PhD

ABSTRACT

BACKGROUND Low mean transvalvular gradient (<40 mm Hg) and small aortic valve area (<1.0 cm²) in patients with aortic stenosis (AS) and preserved left ventricular ejection fraction raises uncertainty about the actual severity of the stenosis and survival benefit of aortic valve replacement (AVR).

OBJECTIVES This study analyzed studies of mortality and survival impact of AVR in patients with low-gradient (LG) AS and preserved left ventricular ejection fraction, including paradoxical low-flow (i.e., stroke volume index <35 ml/m²), low-gradient (LF-LG) and normal-flow, low-gradient (NF-LG), and those with high-gradient (≥40 mm Hg) AS or moderate AS.

METHODS Studies published between 2005 and 2015 were analyzed. Primary outcome was the survival benefit associated with AVR. Secondary outcome was overall mortality regardless of treatment.

RESULTS Eighteen studies were included in the analysis. Patients with LF-LG AS have increased mortality compared with patients with moderate AS (hazard ratio [HR]: 1.68; 95% confidence interval [CI]: 1.31 to 2.17), NF-LG (HR: 1.80; 95% CI: 1.29 to 2.51), and high-gradient (HR: 1.67; 95% CI: 1.16 to 2.39) AS. AVR was associated with reduced mortality in patients with LF-LG (HR: 0.44; 95% CI: 0.25 to 0.77). Similar benefit occurred with AVR in patients with NF-LG (HR: 0.48; 95% CI: 0.28 to 0.83). Compared with patients with high-gradient AS, those with LF-LG were less likely to be referred to AVR (odds ratio: 0.32; 95% CI: 0.21 to 0.49).

CONCLUSIONS Patients with paradoxical LF-LG AS and NF-LG AS have increased risk of mortality compared with other subtypes of AS with preserved left ventricular ejection fraction, and improved outcome with AVR. (J Am Coll Cardiol 2015;66:2594-603) © 2015 by the American College of Cardiology Foundation.
CENTRAL ILLUSTRATION  Outcome and Impact of Aortic Valve Replacement in the Different Subtypes of Flow/Gradient Aortic Stenosis

Mortality According to Subtypes of Aortic Stenosis

<table>
<thead>
<tr>
<th>Subtype Comparison</th>
<th>Odds Ratio</th>
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<tbody>
<tr>
<td>LF-LG vs HG AS</td>
<td></td>
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<tr>
<td>NF-LG vs HG AS</td>
<td></td>
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<tr>
<td>LF-LG vs NF-LG AS</td>
<td></td>
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<tr>
<td>LF-LG vs MAS</td>
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</tbody>
</table>

Mortality According to Type of Treatment

<table>
<thead>
<tr>
<th>Type of Treatment</th>
<th>Odds Ratio</th>
</tr>
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<tbody>
<tr>
<td>LF-LG AS</td>
<td></td>
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<tr>
<td>NF-LG AS</td>
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<tr>
<td>LG AS</td>
<td></td>
</tr>
<tr>
<td>HG AS</td>
<td></td>
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</tbody>
</table>


Pooled odds ratio for the different groups and modalities of treatment. AS = aortic stenosis; AVR = aortic valve replacement; HG = high-gradient; LF-LG = low-flow, low-gradient; LG = low-gradient; MAS = moderate aortic stenosis; NF-LG = normal-flow, low-gradient.
Low-Flow, Low-Gradient Aortic Stenosis With Normal and Depressed Left Ventricular Ejection Fraction

Philippe Pibarot, DVM, PhD, Jean G. Dumesnil, MD
Québec City, Québec, Canada

Low-flow, low-gradient (LF-LG) aortic stenosis (AS) may occur with depressed or preserved left ventricular ejection fraction (LVEF), and both situations are among the most challenging encountered in patients with valvular heart disease. In both cases, the decrease in gradient relative to AS severity is due to a reduction in transvalvular flow. The main challenge in patients with depressed LVEF is to distinguish between true severe versus pseudosevere stenosis and to accurately assess the severity of myocardial impairment. Paradoxical LF-LG severe AS despite a normal LVEF is a recently described entity that is characterized by pronounced LV concentric remodeling, small LV cavity size, and a restrictive physiology leading to impaired LV filling, altered myocardial function, and worse prognosis. Until recently, this entity was often misdiagnosed, thereby causing underestimation of AS severity and inappropriate delays for surgery. Hence, the main challenge in these patients is proper diagnosis, often requiring diagnostic tests other than Doppler echocardiography. The present paper proposes to review the diagnostic and therapeutic management specificities of LF-LG AS with and without depressed LV function. (J Am Coll Cardiol 2012;60:1845–53) © 2012 by the American College of Cardiology Foundation
Figure 3: Survival of Patients With Low LVEF, LF-LG AS According to Presence of LV Flow Reserve and Type of Treatment

Patients with no LV flow (contractile) reserve (Group II) defined as <20% increase in stroke volume during DSE have markedly reduced survival compared with those with LV flow reserve (Group I), regardless of the type of treatment. Aortic valve replacement is associated with dramatic improvement in survival in patients with LV flow reserve and a trend for better survival in those with no flow reserve. *p = 0.001 versus medical; § p = 0.07 versus medical. Adapted with permission from Monin et al. (7).
Figure 6  Impact of AVR on Survival in Patients With Paradoxical LF-LG AS

The data for the (A) entire cohort (n = 101) and (B) propensity score matched patients (n = 61). AVR = aortic valve replacement; other abbreviations as in Figure 1.

Outcomes of Transcatheter and Surgical Aortic Valve Replacement in High-Risk Patients With Aortic Stenosis and Left Ventricular Dysfunction

Results From the Placement of Aortic Transcatheter Valves (PARTNER) Trial (Cohort A)

Sammy Elmariah, MD, MPH; Igor F. Palacios, MD; Thomas McAndrew, MS;
Irene Hueter, PhD; Ignacio Inglessis, MD; Joshua N. Baker, MD; Susheel Kodali, MD;
Martin B. Leon, MD; Lars Svensson, MD; Philippe Pibarot, DVM, PhD;
Pamela S. Douglas, MD; William F. Fearon, MD; Ajay J. Kirtane, MD, SM;
Hersh S. Maniar, MD; Jonathan J. Passeri, MD; on behalf of the PARTNER Investigators

Background—The Placement of Aortic Transcatheter Valves (PARTNER) trial demonstrated similar survival after transcatheter and surgical aortic valve replacement (TAVR and SAVR, respectively) in high-risk patients with symptomatic, severe aortic stenosis. The aim of this study was to evaluate the effect of left ventricular (LV) dysfunction on clinical outcomes after TAVR and SAVR and the impact of aortic valve replacement technique on LV function.

Methods and Results—The PARTNER trial randomized high-risk patients with severe aortic stenosis to TAVR or SAVR. Patients were stratified by the presence of LV ejection fraction (LVEF) <50%. All-cause mortality was similar for TAVR and SAVR at 30 days and 1 year regardless of baseline LV function and valve replacement technique. In patients with LV dysfunction, mean LVEF increased from 35.7±8.5% to 48.6±11.3% (P<0.0001) 1 year after TAVR and from 38.0±8.0% to 50.1±10.8% after SAVR (P<0.0001). Higher baseline LVEF (odds ratio, 0.90 [95% confidence interval, 0.86, 0.95]; P<0.0001) and previous permanent pacemaker (odds ratio, 0.34 [95% confidence interval, 0.15, 0.81]) were independently associated with reduced likelihood of ≥10% absolute LVEF improvement by 30 days; higher mean aortic valve gradient was associated with increased odds of LVEF improvement (odds ratio, 1.04 per 1 mm Hg [95% confidence interval, 1.01, 1.07]). Failure to improve LVEF by 30 days was associated with adverse 1-year outcomes after TAVR but not SAVR.

Conclusions—In high-risk patients with severe aortic stenosis and LV dysfunction, mortality rates and LV functional recovery were comparable between valve replacement techniques. TAVR is a feasible alternative for patients with symptomatic severe aortic stenosis and LV dysfunction who are at high risk for SAVR.

Clinical Trial Registration—URL: http://www.clinicaltrials.gov. Unique identifier: NCT00530894.

(Key Words: aortic valve replacement • heart failure • surgery • transcatheter aortic valve implantation • ventricular dysfunction, left)
Severe Aortic Stenosis and Coronary Artery Disease—Implications for Management in the Transcatheter Aortic Valve Replacement Era
A Comprehensive Review

Sachin S. Goel, MD,* Mobolaji Ige, MD,† E. Murat Tuzcu, MD,* Stephen G. Ellis, MD,* William J. Stewart, MD,* Lars G. Svensson, MD, PhD,‡ Bruce W. Lytle, MD,‡ Samir R. Kapadia, MD*

Cleveland, Ohio

Management of coronary artery disease (CAD) in patients with severe aortic stenosis (AS) referred for transcatheter aortic valve replacement (TAVR) is posing challenges. Due to limited and heterogeneous data on the prevalence and clinical impact of CAD on the outcomes of TAVR and the management strategies for CAD in patients undergoing TAVR, we performed a comprehensive review of the literature. Significant CAD is present in 40% to 75% of patients undergoing TAVR. The impact of CAD on outcomes after TAVR remains understudied. Based on existing data, not all patients require revascularization before TAVR. Percutaneous coronary intervention (PCI) should be considered for severely stenotic lesions in proximal coronaries that subend a large area of myocardium at risk. Ongoing studies randomizing patients to surgical or percutaneous management strategies for severe AS will help provide valuable data regarding the impact of CAD on TAVR outcomes, the role of PCI, and its timing in relation to TAVR. (J Am Coll Cardiol 2013;62:1–10) © 2013 by the American College of Cardiology Foundation
Prevalence of CAD in Patients With Severe AS

CAD in SAVR patients. At the time of SAVR, the prevalence of significant CAD requiring concomitant CABG has been shown to increase with age. Studies have shown that in the age group of 61 to 70 years, 40% of patients required concomitant CABG, whereas in patients over the age of 80 years, >65% had concomitant CABG (9,10). Several surgical databases have shown that CABG increases operative and short-term mortality with SAVR (11–14). Similarly, concomitant CABG appears to have an adverse effect on long-term outcomes after SAVR (9,15). However, there are no randomized controlled trials of CABG+SAVR compared with SAVR alone in the presence of significant CAD. It is possible that the increase in short- and long-term mortality in patients undergoing concomitant CABG and SAVR compared with SAVR alone might be a reflection of more severe and diffuse atherosclerosis in the former group, which renders this population sicker and direct comparisons with those undergoing SAVR difficult to interpret (16). In a study comparing the outcomes of SAVR patients with severe AS and no CAD versus severe AS and CAD where CABG was not performed, short- and long-term outcomes were not found to be different (17). That study, however, is notable for a small number of patients (n = 55) who did not undergo CABG with SAVR in addition to most patients having single vessel CAD. In other
APPROPRIATE USE CRITERIA

ACC/AATS/AHA/ASE/ASNC/SCAI/SCCT/STS 2017 Appropriate Use Criteria for Coronary Revascularization in Patients With Stable Ischemic Heart Disease

Clinical Outcomes and Revascularization Strategies in Patients With Low-Flow, Low-Gradient Severe Aortic Valve Stenosis According to the Assigned Treatment Modality

Crochan J. O'Sullivan, MD,† Lars Engblom, MD,† Nicola Hosek, MS,§ Dik Heg, PhD,¶ Davide Cao, MD,* Giulio G. Stefanini, MD,λ Stefan Stortecky, MD, φ Steffen Gleckler, MD, Erment Spitzer, MD,‡ David Till, MD,© Christoph Huber, MD,ό Thomas Pilgrim, MD, π Fabien Praz, MD,κ Lutz Buellesfeld, MD, Α Ahmed A. Khatib, MD,τ Thierry Carrel, MD,υ Bernhard Meier, MD, ϕ Stephan Windecker, MD,∫ Peter Wenaus, MD

Patients presenting with low ejection fraction heart failure and severe aortic stenosis (AS) typically exhibit a low mean gradient on hemodynamic evaluation despite the presence of a tight aortic valve orifice (1-5). Patients with this condition, low ejection fraction, low-gradient (LEF-LG) severe AS, present a management challenge because previous studies have shown LEF-LG severe AS patients undergoing conventional surgical aortic valve replacement (SAVR) to have a high perioperative mortality rate (range 6% to 33%), particularly in the absence of flow reserve, but an abysmal outcome when managed conservatively (2-4,6-13).
ABSTRACT

OBJECTIVES This study compared clinical outcomes and revascularization strategies among patients presenting with low ejection fraction, low-gradient (LEF-LG) severe aortic stenosis (AS) according to the assigned treatment modality.

BACKGROUND The optimal treatment modality for patients with LEF-LG severe AS and concomitant coronary artery disease (CAD) requiring revascularization is unknown.

METHODS Of 1,551 patients, 204 with LEF-LG severe AS (aortic valve area <1.0 cm², ejection fraction <50%, and mean gradient <40 mm Hg) were allocated to medical therapy (MT) (n = 44), surgical aortic valve replacement (SAVR) (n = 52), or transcatheter aortic valve replacement (TAVR) (n = 108). CAD complexity was assessed using the SYNTAX score (SS) in 187 of 204 patients (92%). The primary endpoint was mortality at 1 year.

RESULTS LEF-LG severe AS patients undergoing SAVR were more likely to undergo complete revascularization (17 of 52, 35%) compared with TAVR (8 of 108, 8%) and MT (0 of 44, 0%) patients (p < 0.001). Compared with MT, both SAVR (adjusted hazard ratio [adj HR]: 0.16; 95% confidence interval [CI]: 0.07 to 0.38; p < 0.001) and TAVR (adj HR: 0.30; 95% CI: 0.18 to 0.52; p < 0.001) improved survival at 1 year. In TAVR and SAVR patients, CAD severity was associated with higher rates of cardiovascular death (no CAD: 12.2% vs. low SS [0 to 22], 15.3% vs. high SS [>22], 31.5%; p = 0.037) at 1 year. Compared with no CAD-complete revascularization, TAVR and SAVR patients undergoing incomplete revascularization had significantly higher 1-year cardiovascular death rates (adj HR: 2.80; 95% CI: 1.07 to 7.36; p = 0.037).

CONCLUSIONS Among LEF-LG severe AS patients, SAVR and TAVR improved survival compared with MT. CAD severity was associated with worse outcomes and incomplete revascularization predicted 1-year cardiovascular mortality among TAVR and SAVR patients. (J Am Coll Cardiol Intv 2015;8:704-17) © 2015 by the American College of Cardiology Foundation.
The 835 SAVR patients were all 70 years or older without a previous sternotomy undergoing SAVR (with or without coronary artery bypass grafting) without a concomitant valvular intervention between January 2005 and December 2012. LVEF = left ventricular ejection fraction; MT = medical therapy; SAVR = surgical aortic valve replacement; TAVR = transcatheter aortic valve replacement.
Figure 2: Kaplan-Meier Curves for Clinical Outcomes According to Assigned Treatment Modality

A. All-Cause Death (%)
B. Cardiovascular Death (%)

Figure 4: Kaplan-Meier Curves for Clinical Outcomes Stratified by Completeness of Revascularization Among SAVR and TAVR Patients Only

A. All-Cause Death (%)
B. Cardiovascular Death (%)

Figure 3: Kaplan-Meier Curves for Clinical Outcomes Stratified by SYNTAX Score Among TAVR and SAVR Patients Only

A. All-Cause Death (%)
B. Cardiovascular Death (%)

Figure 5: Left Ventricular Ejection Fraction Recovery Over Time

Changes in LVEF over time in patients with low-flow, low-gradient severe aortic stenosis undergoing either conventional SAVR or TAVR. As nonsignificant, other abbreviations as in Figure 1.
Transcatheter Aortic Valve Replacement in Patients With Low-Flow, Low-Gradient Aortic Stenosis
The TOPAS-TAVI Registry

Henrique Barbosa Ribeiro, MD, PhD, Stamatis Lerakis, MD, Martine Gillard, MD, PhD, João L. Cavalcante, MD, Raj Makkar, MD, Howard C. Herrmann, MD, Stephan Windecker, MD, Maurice Enriquez-Sarano, MD, Asim N. Cheema, MD, Luis Nombela-Franco, MD, PhD, Ignacio Amat-Santos, MD, PhD, Antonio J. Muñoz-García, MD, PhD, Bruno García del Blanco, MD, Alan Zajarias, MD, John C. Lisko, MD, Salim Hayek, MD, Vasili Babaliaros, MD, Florent Le Ven, MD, Thomas G. Gleason, MD, Tarun Chakravarty, MD, Wilson Y. Szeto, MD, Marie-Annick Clavel, DVM, PhD, Alberto de Agustín, MD, PhD, Vicenç Serra, MD, John T. Schindler, MD, Abdellaziz Dahou, MD, PhD, Rishi Puri, MBBS, PhD, Emilie Pelletier-Beaumont, MSc, Melanie Côté, MSc, Philippe Pibarot, DVM, PhD, Josep Rodés-Cabau, MD
BACKGROUND Few data exist on patients with low-flow, low-gradient aortic stenosis (LFLG-AS) undergoing transcatheter aortic valve replacement (TAVR). Also, very scarce data exist on the usefulness of dobutamine stress echocardiography (DSE) before TAVR in these patients.

OBJECTIVES The authors sought to evaluate clinical outcomes and changes in left ventricular ejection fraction (LVEF) following TAVR in patients with classical LFLG-AS.

METHODS This multicenter registry included 287 patients with LFLG-AS undergoing TAVR. DSE was performed before TAVR in 234 patients and the presence of contractile reserve was defined as an increase of ≥20% in stroke volume. Transthoracic echocardiography was repeated at hospital discharge and at 1-year follow-up. Clinical follow-up was obtained at 1 and 12 months, and yearly thereafter.

RESULTS The median Society of Thoracic Surgeons score of the study population was 7.7% (interquartile range 5.3% to 12.0%), and the mean LVEF and transvalvular gradient were 30.1 ± 9.7% and 25.4 ± 6.6 mm Hg, respectively. The presence of contractile reserve was observed in 45% of patients at DSE. Mortality rates were 3.8%, 20.1%, and 32.3% at 30 days, 1 year, and 2 years, respectively. On multivariable analysis, chronic obstructive pulmonary disease (p = 0.022) and lower hemoglobin values (p < 0.001) were associated with all-cause mortality. Lower hemoglobin values (p = 0.004) and moderate-to-severe aortic regurgitation post-TAVR (p = 0.016) were predictors of the composite of mortality and rehospitalization due to heart failure. LVEF increased by 8.3% (95% confidence interval: 6% to 11%) at 1-year follow-up, and the lack of prior coronary artery bypass graft (p = 0.004), a lower LVEF at baseline (p < 0.001), and a lower stroke volume index at baseline (p = 0.019) were associated with greater increase in LVEF. The absence of contractile reserve at baseline DSE was not associated with any negative effect on clinical outcomes or LVEF changes at follow-up.

CONCLUSIONS TAVR was associated with good periprocedural outcomes in patients with LFLG-AS. However, approximately one-third of LFLG-AS TAVR recipients died at 2-year follow-up, with pulmonary disease, anemia, and residual paravalvular leaks associated with poorer outcomes. LVEF improved following TAVR, but DSE failed to predict clinical outcomes or LVEF changes over time. (Multicenter Prospective Study of Low-Flow Low-Gradient Aortic Stenosis [TOPAS Study]; NCT01835028) (J Am Coll Cardiol 2018;71:1297-308) © 2018 by the American College of Cardiology Foundation.
Central Illustration: Clinical Outcomes and LV Changes Following TAVR in Patients With LFLG-AS

TAVR in Patients with Low-Flow, Low-Gradient Aortic Stenosis

- LVESV < 40%
- dP/dt > 5,000 mmHg/s
- AHA < 10 cm²
n = 284

- Contractile (Flow) Reserve
  EFV > 200% (45%)

- Dobutamine Stress-Echo
  n = 284

- No Contractile (Flow) Reserve
  EFV > 200% (55%)

Changes in LVEF Over Time

- With Contractile Reserve
- Without Contractile Reserve


[Notes: Increased AP = mean gradient; AHA = aortic valve area; LFLG-AS = low-flow, low-gradient aortic stenosis; LV = left ventricle; SV = stroke volume; EFVR = contractile ventricular ejection fraction replacement.]
Low-Flow, Low-Gradient Aortic Stenosis
TAVR In, Dobutamine Stress Echocardiography Out?*

Philippe Généreux, MD
Comments

• Non-randomized study
• Mix of retrospective and prospective data
• Long term mortality 39%
• Rehospitalization 25%
• 30% of the procedures non transfemoral approach

• Heterogeneous data
• Severe AS was not confirmed by DSE in 50% of the patients
• No information about the presence or absence of concomitant right ventricular dysfunction and tricuspid regurgitation
The percutaneous coronary intervention prior to transcatheater aortic valve implantation (ACTIVATION) trial: study protocol for a randomized controlled trial

Muhammad Zeeshan Khayaja1,2,*, Duobao Wang3, Stuart Pocock4, Simon Robert Redwood1,2,1 and Martyn Rhys Thomas2

Abstract

Background: Current guidelines recommend treatment of significant coronary artery disease by concomitant coronary artery bypass grafting (CABG) in patients undergoing surgical aortic valve replacement. However, there is no consensus on how best to treat coronary disease in high-risk patients requiring transcatheter aortic valve implantation (TAVI).

Methods/Design: The percutaneous coronary intervention prior to transcatheater aortic valve implantation (ACTIVATION) trial is a randomized, controlled open-label trial of 310 patients randomized to treatment of significant coronary artery disease by percutaneous coronary intervention (PCI) – test arm – or no PCI (control arm). Significant coronary disease is defined as 30% lesion in a major epicardial vessel or 50% in a vein graft or protected left main stem lesion. The trial tests the hypothesis that the strategy of performing pre-TAVI PCI is non-inferior to not treating such coronary stenoses with PCI prior to TAVI, with a composite primary outcome of 12-month mortality and hospitalization. Secondary outcomes include efficacy endpoints such as 30 day mortality, safety endpoints including bleeding, burden of symptoms, and quality of life (assessed using the Seattle Angina Questionnaire and the Kansas City Cardiomyopathy Questionnaire).

In conclusion, we hope that using a definition of coronary artery disease severity closer to that used in everyday practice by interventional cardiologists – rather than the 50% severity used in surgical guidelines – will provide robust evidence to direct guidelines regarding TAVI therapy and improve its safety and efficacy profile of this developing technique.


Keywords: Transcatheater aortic valve implantation, Percutaneous coronary intervention, Aortic stenosis, Coronary
Coronary Angiography and Percutaneous Coronary Intervention After Transcatheter Aortic Valve Replacement

Matias B. Yudi, MBBS, Samin K. Sharma, MD, Gilbert H.L. Tang, MD, MSc, MBA, Annapoorna Kini, MD
Factors Impacting Coronary Access

Anatomical
1. Sinotubular junction dimensions
2. Sinus height
3. Leaflet length and bulkiness
4. Sinus of Valsalva width
5. Coronary height

Device and Procedural
1. Commisural tab orientation
2. Sealing skirt height
3. Valve implant depth

Imaging Evaluation

Fluoroscopy
MDCT

Summary of factors impacting coronary access and imaging evaluation after TAVR. MDCT = multidetector computed tomography. TAVR = transcatheter aortic valve replacement.
<table>
<thead>
<tr>
<th>First Author (Ch. 2)</th>
<th>Year Published</th>
<th>No. of Patients</th>
<th>Study Summary on Feasibility of Coronary Angiography and PCI</th>
<th>Catheter Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dehmer et al.</td>
<td>2017</td>
<td>31</td>
<td>Success rate of angiography for PCI</td>
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<td></td>
<td></td>
<td></td>
<td>Some patients required additional procedures</td>
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<td></td>
<td></td>
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<td>Research is ongoing to improve feasibility</td>
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<td>Initial strategies include use of EBD and J-1 catheters</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Further investigation needed</td>
<td></td>
</tr>
<tr>
<td>Buonanno et al.</td>
<td>2017</td>
<td>16</td>
<td>All patients underwent PCI</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Success rate of PCI: 95%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Some patients required additional procedures</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Research is ongoing to improve feasibility</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Initial strategies include use of EBD and J-1 catheters</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Further investigation needed</td>
<td></td>
</tr>
</tbody>
</table>

### Conclusions

Coronary angiography and PCI in patients after TAVR can be challenging. Intricate knowledge of the valve design and its relationship with the coronary ostia, sinus of Valsalva, and STJ anatomies can help predict the difficulty in coronary reaccess and identify a strategy to manage these patients. Proposed algorithms on cardiac catheterization and PCI may aid troubleshooting in the management of these complex clinical scenarios.
Valvular performance and aortic regurgitation following transcatheter aortic valve replacement using Edwards valve versus CoreValve for severe aortic stenosis: A Meta-analysis

Samit Bhatheja, Hemang B. Panchal, Neil Barry, Debabrata Mukherjee, Barry F. Uretsky, Timir Paul

Division of Cardiology, Department of Internal Medicine, East Tennessee State University, 329 N State of Franklin Rd, Johnson City, TN, 37604
Department of Internal Medicine, East Tennessee State University, VA Building #1, Johnson City, TN
Division of Cardiology, Department of Internal Medicine, Texas Tech University, 4800 Alberta, El Paso, TX, 79905
Division of Cardiovascular Medicine, University of Arkansas for Medical Sciences, 4301 West Markham Street, Little Rock, AR, 72205
ABSTRACT

Objectives: To compare incidence of aortic regurgitation (AR), paravalvular AR and valvular performance with Doppler hemodynamic parameters following transcatheter aortic valve replacement (TAVR) with Edwards valve (EV) versus CoreValve (CV). Currently, there are scarce data on post-TAVR echocardiographic outcomes comparing EV and CV.

Methods: PubMed and the Cochrane Center Register of Controlled Trials were searched through May 2015. Twenty studies (n = 11,244) comparing TAVR procedure that used EV (n = 6445) and CV (n = 4799) were included. End points were post-TAVR moderate to severe AR and paravalvular AR, effective orifice area (EOA), mean trans-aortic pressure gradient (MPG), peak trans-aortic pressure gradient (PPG) and left ventricular ejection fraction (LVEF). The mean difference (MD) or relative risk (RR) with 95% confidence interval (CI) was computed and p < 0.05 was considered as a level of significance.

Results: Moderate to severe AR and paravalvular AR were significantly lower in EV group (RR: 0.57, CI: 0.52–0.63, p < 0.00001 and RR: 0.40, CI: 0.25–0.63, p < 0.0001 respectively) compared to CV group. EOA and PPG were not significantly different between EV and CV groups. MPG was significantly lower among patients in CV group (MD: 1.08, CI: 0.05–2.10, p = 0.04). LVEF was significantly higher in patients in EV group (MD: 2.26, CI: 0.77–3.74, p = 0.03).

Conclusions: This study showed CV is associated with higher incidence of post-TAVR moderate to severe paravalvular AR. Echocardiographic valvular performance measures (MPG, LVEF) showed minimal but significant difference, which may not be clinically significant.

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<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>EV Events</th>
<th>Total</th>
<th>CV Events</th>
<th>Total</th>
<th>Weight</th>
<th>Risk Ratio M-H, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chieffo 2013</td>
<td>6</td>
<td>340</td>
<td>9</td>
<td>453</td>
<td>0.8%</td>
<td>0.89 [0.32, 2.47]</td>
</tr>
<tr>
<td>DiMaro 2012</td>
<td>98</td>
<td>1472</td>
<td>130</td>
<td>1050</td>
<td>16.4%</td>
<td>0.54 [0.42, 0.69]</td>
</tr>
<tr>
<td>Dworakowski 2014</td>
<td>96</td>
<td>1287</td>
<td>157</td>
<td>1153</td>
<td>17.9%</td>
<td>0.55 [0.43, 0.70]</td>
</tr>
<tr>
<td>Gilard 2012</td>
<td>174</td>
<td>2107</td>
<td>138</td>
<td>1043</td>
<td>19.9%</td>
<td>0.62 [0.51, 0.77]</td>
</tr>
<tr>
<td>Hayashida 2012</td>
<td>80</td>
<td>347</td>
<td>21</td>
<td>53</td>
<td>3.9%</td>
<td>0.58 [0.40, 0.85]</td>
</tr>
<tr>
<td>Hernandez-Antolin 2011</td>
<td>1</td>
<td>37</td>
<td>0</td>
<td>21</td>
<td>0.1%</td>
<td>1.74 [0.07, 40.83]</td>
</tr>
<tr>
<td>Kasel 2014</td>
<td>3</td>
<td>50</td>
<td>8</td>
<td>50</td>
<td>0.9%</td>
<td>0.38 [0.11, 1.33]</td>
</tr>
<tr>
<td>Nombela-Franco 2013</td>
<td>9</td>
<td>41</td>
<td>16</td>
<td>41</td>
<td>1.7%</td>
<td>0.56 [0.28, 1.12]</td>
</tr>
<tr>
<td>Spargias 2013</td>
<td>10</td>
<td>59</td>
<td>28</td>
<td>67</td>
<td>2.8%</td>
<td>0.41 [0.22, 0.76]</td>
</tr>
<tr>
<td>Spethmann 2012</td>
<td>5</td>
<td>48</td>
<td>27</td>
<td>98</td>
<td>1.9%</td>
<td>0.38 [0.16, 0.92]</td>
</tr>
<tr>
<td>Tchetchet 2010</td>
<td>1</td>
<td>24</td>
<td>3</td>
<td>21</td>
<td>0.3%</td>
<td>0.29 [0.03, 2.60]</td>
</tr>
<tr>
<td>Van Belle 2014</td>
<td>243</td>
<td>1872</td>
<td>193</td>
<td>897</td>
<td>28.2%</td>
<td>0.60 [0.51, 0.72]</td>
</tr>
<tr>
<td>Wantebe 2013</td>
<td>26</td>
<td>170</td>
<td>44</td>
<td>150</td>
<td>5.1%</td>
<td>0.52 [0.34, 0.80]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>7854</strong></td>
<td><strong>5097</strong></td>
<td><strong>100.0%</strong></td>
<td></td>
<td><strong>0.57 [0.52, 0.63]</strong></td>
<td></td>
</tr>
</tbody>
</table>

Total events: 752
Heterogeneity: Chi² = 5.53, df = 12 (P = 0.94); I² = 0%
Test for overall effect: Z = 11.42 (P < 0.00001)

Fig. 2. Meta-analysis comparison of incidence of post-TAVR moderate to severe AR between EV and CV. AR = aortic regurgitation, CV = CoreValve, EV = Edwards Valve, TAVR = transcatheter aortic valve replacement.
Early effects of transcatheter aortic valve implantation and aortic valve replacement on myocardial function and aortic valve hemodynamics: Insights from cardiovascular magnetic resonance imaging

Gareth Crouch, MBBS, 1,2 Jayme Bannett, MBBS, 1,2 Ajay Sinhal, MD, 3 Phillip J. Tall, PhD, 3 Darryl P. Leong, PhD, 4 Craig Bradbrook, MBBS, 5 Amy L. Penhall, BSc, 5 Carmine G. De Pasquale, PhD, 6,7 Adhiraj Chakrabarty, MBBS, 1,2,8 Robert A. Baker, PhD, 4,9 and Joseph B. Selvanayagam, DPhil 1,2,8

Objectives: There remains a paucity of mechanistic data on the effect of transcatheter aortic valve implantation (TAVI) on early left and right ventricular function and quantitative aortic valve regurgitation. We sought to assess and compare the early effects on myocardial function and aortic valve hemodynamics of TAVI and aortic valve replacement (AVR) using serial cardiovascular magnetic resonance (CMR) imaging and echocardiography.

Methods: A prospective comparison study of 47 patients with severe aortic stenosis undergoing either TAVI (n = 26) or high-risk AVR (n = 21). CMR (for left ventricular/right ventricular function, left ventricular mass, left atrial volume, and aortic regurgitation) was carried out before the procedure and early postprocedure (~14 days).

Results: Groups were similar with respect to Society of Thoracic Surgeons score (TAVI, 7.7 vs AVR, 5.9; P = .11). Preoperative left ventricular (TAVI, 69% ± 13% vs AVR, 73% ± 10%; P = .10) and right ventricular (TAVI, 61% ± 11% vs AVR, 59% ± 8%; P = .3) ejection fractions were similar. Postoperative left ventricular ejection fraction was preserved in both groups. In contrast, decline in right ventricular ejection fraction was more significant in the TAVI group (61%±54% vs 59%±58%; P = .01). Postprocedure aortic regurgitant fraction was significantly greater in the TAVI group (15% vs 4%; P < .001), as was left atrial size (110 vs 74 mL; P = .02). Further analysis revealed a significant relationship between the increased aortic regurgitant fraction and greater left atrial size (P = .006), and a trend toward association between the decline in right ventricular dysfunction and increased postprocedure aortic regurgitation (P = .09).

Conclusions: There was no significant difference in early left ventricular systolic function between techniques. Whereas right ventricle systolic function was preserved in the AVR group, it was significantly impaired early after TAVI, possibly reflecting a clinically important pathophysiologic consequence of paravalvular aortic regurgitation. (J Thorac Cardiovasc Surg 2015;149:462-79)
Our results demonstrate for the first time that TAVI is associated with early RV dysfunction. This may reflect the higher incidence of AR with TAVI and explain the recent observation of increased long-term mortality in this setting.
2017 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease
(2014 guideline with 2017 focused update incorporated)
# Management of coronary artery disease

(Adapted from Windecker et al.)

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diagnosis of coronary artery disease</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coronary angiography is recommended before valve surgery in patients with severe VHD and any of the following:</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>- history of cardiovascular disease,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- suspected myocardial ischaemia,</td>
<td></td>
<td></td>
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<tr>
<td>- LV systolic dysfunction,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- in men &gt;40 years and postmenopausal women,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- one or more cardiovascular risk factors.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coronary angiography is recommended in the evaluation of moderate to severe secondary mitral regurgitation.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>CT angiography should be considered as an alternative to coronary angiography before valve surgery in patients with severe VHD and low probability of CAD or in whom conventional coronary angiography is technically not feasible or associated with a high-risk.</td>
<td>Ila</td>
<td>C</td>
</tr>
</tbody>
</table>
### Indications for myocardial revascularization

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>CABG is recommended in patients with a primary indication for aortic/mitral valve surgery and coronary artery diameter stenosis $\geq 70%$.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>CABG should be considered in patients with a primary indication for aortic/mitral valve surgery and coronary artery diameter stenosis $\geq 50%-70%$.</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>PCI should be considered in patients with a primary indication to undergo TAVI and coronary artery diameter stenosis $&gt;70%$ in proximal segments.</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>PCI should be considered in patients with a primary indication to undergo transcatheter mitral valve interventions and coronary artery diameter stenosis $&gt;70%$ in proximal segments.</td>
<td>IIa</td>
<td>C</td>
</tr>
</tbody>
</table>
Requirements of a heart valve centre

(Modified from Chambers et al.)

<table>
<thead>
<tr>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multidisciplinary teams with competencies in valve replacement, aortic root surgery, mitral, tricuspid and aortic valve repair, as well as transcatheter aortic and mitral valve techniques including reoperations and reinterventions. The Heart Teams must meet on a regular basis and work with standard operating procedures.</td>
</tr>
<tr>
<td>Imaging, including 3D and stress echocardiographic techniques, perioperative TOE, cardiac CT, MRI, and positron emission tomography-CT.</td>
</tr>
<tr>
<td>Regular consultation with community, other hospitals, and extracardiac departments, and between non-invasive cardiologists and surgeons and interventional cardiologists.</td>
</tr>
</tbody>
</table>
Stepwise integrated approach for the assessment of aortic stenosis severity (Modified from Baumgartner et al.)

Valve morphology by echocardiography suspicious of AS

Assess velocity/gradient

LOW-GRADIENT AS
Vmax < 4 m/s, ΔPm < 40 mmHg

Assess AVA

AVA ≤ 1.0 cm²

Exclude measurement errors that may cause underestimation of gradient/flow/AVA

Moderate AS

Define flow status (SVi)

AVA > 1.0 cm²

HIGH-GRADIENT AS
Vmax ≥ 4 m/s, ΔPm ≥ 40 mmHg

High flow status excluded

No

Severe high-gradient AS (normal flow/low flow) (normal EF/low EF)

Yes

Define whether high flow status is reversible
Stepwise integrated approach for the assessment of aortic stenosis severity (continued) - (Modified from Baumgartner et al.)

Define flow status (SVi)

- Low flow (SVi ≤ 35 mL/m²)
  - Severe AS Unlikely
  - Assess LVEF
    - LVEF < 50%
      - Dobutamine echo
        - Flow reserve present → Pseudosevere AS or true severe AS
        - No flow reserve
    - LVEF ≥ 50%
      - Integrated approach
        - Calcium score by CT

Define whether high flow status is reversible

- Not reversible
  - Severe AS
- Reversible
  - Re-assess at restored normal flow

- High flow may be reversible in settings such as anaemia, hyperthyroidism, arteriovenous shunts
- Pseudosevere AS is defined by an increase to an AVA > 1.0 cm² with flow normalization
Criteria that increase the likelihood of severe AS in pts. with AVA < 1.0 cm², mean gradient < 40 mmHg and preserved EF (Baumgartner et al)

<table>
<thead>
<tr>
<th>Criteria (continued)</th>
<th></th>
</tr>
</thead>
</table>
| Quantitative imaging data (continued) | • Low flow (SVi <35 mL/m²) confirmed by techniques other than standard Doppler technique (LVOT measurement by 3D TOE or MSCT; CMR, invasive data).
| | • Calcium score by MSCT:
| | - Severe aortic stenosis very likely:
| |  men ≥3000; women ≥1600,
| | - Severe aortic stenosis likely:
| |  men ≥2000; women ≥1200,
| | - Severe aortic stenosis unlikely:
| |  men <1600; women<800.

www.escardio.org/guidelines
## 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>
<td></td>
</tr>
<tr>
<td>Intervention is indicated in symptomatic patients with severe, high-gradient aortic stenosis (mean gradient ≥40 mmHg or peak velocity ≥4.0 m/s).</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Intervention is indicated in symptomatic patients with severe low-flow, low-gradient (&lt;40 mmHg) aortic stenosis with reduced ejection fraction, and evidence of flow (contractile) reserve excluding pseudo-severe aortic stenosis.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Intervention should be considered in symptomatic patients with low flow, low-gradient (&lt;40 mmHg) aortic stenosis with normal ejection fraction after careful confirmation of severe aortic stenosis.</td>
<td>IIa</td>
<td>C</td>
</tr>
</tbody>
</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>Intervention should be considered in symptomatic patients with low-flow, low-gradient aortic stenosis and reduced ejection fraction without flow (contractile) reserve, particularly when CT calcium scoring confirms severe aortic stenosis.</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>Intervention should not be performed in patients with severe comorbidities when the intervention is unlikely to improve quality of life or survival.</td>
<td>III</td>
<td>C</td>
</tr>
</tbody>
</table>

**b) Choice of intervention in symptomatic aortic stenosis**

Aortic valve interventions should only be performed in centres with both departments of cardiology and cardiac surgery on-site, and with structured collaboration between the two, including a Heart Team (heart valve centres). | I     | C     |
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 technical suitability and weighing of risks and benefits of each modality (aspects to be considered are listed in the according table). In addition, the local expertise and outcomes data for the given intervention must be taken into account.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>SAVR is recommended in patients at low surgical risk (STS or EuroSCORE II &lt;4% or logistic EuroSCORE I &lt;10% and no other risk factors not included in these scores, such as frailty, porcelain aorta, sequelae of chest radiation).</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>TAVI is recommended in patients who are not suitable for SAVR as assessed by the Heart Team.</td>
<td>I</td>
<td>B</td>
</tr>
</tbody>
</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>In patients who are at increased surgical risk (STS or EuroSCORE II ≥4% or logistic EuroSCORE I ≥10% or other risk factors not included in these scores such as frailty, porcelain aorta, sequelae of chest radiation), the decision between SAVR and TAVI should be made by the Heart Team according to the individual patient characteristics (see according table), with TAVI being favoured in elderly patients suitable for transfemoral access.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Balloon aortic valvotomy may be considered as a bridge to SAVR or TAVI in haemodynamically unstable patients or in patients with symptomatic severe aortic stenosis who require urgent major non-cardiac surgery.</td>
<td>IIb</td>
<td>C</td>
</tr>
</tbody>
</table>
### Recommendations

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>d) Concomitant aortic valve surgery at the time of other cardiac/ascending aorta surgery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAVR is indicated in patients with severe aortic stenosis undergoing CABG, or surgery of the ascending aorta or of another valve.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>SAVR should be considered in patients with moderate aortic stenosis* undergoing CABG, or surgery of the ascending aorta or of another valve after Heart Team decision.</td>
<td>Ila</td>
<td>C</td>
</tr>
</tbody>
</table>

* Moderate aortic stenosis is defined by a valve area of 1.0-1.5 cm² or a mean gradient of 25-40 mmHg in the presence of normal flow conditions. However, clinical judgement is required.
Indications for Aortic Valve Replacement in Patients With Aortic Stenosis

Abnormal Aortic Valve With Reduced Systolic Opening

Severe AS
$V_{\text{max}} \geq 4 \text{ m/s}$
$\Delta P_{\text{max}} \geq 40 \text{ mm Hg}$

Symptomatic (stage D1)

Asymptomatic (stage C)

LVEF $< 50\%$
(stage C2)

Other cardiac surgery

$V_{\text{max}} \geq 5 \text{ m/s}$
$\Delta P_{\text{max}} \geq 50 \text{ mm Hg}$
Low surgical risk

Abnormal ETT

$\Delta V_{\text{max}} > 0.3 \text{ m/s}$
Low surgical risk

AVR (I)

AVR (IIa)

AVR (IIIb)

Symptomatic

LVEF $< 50\%$

YES

DSE with
$AVA \leq 1 \text{ cm}^2$ and
$V_{\text{max}} \geq 4 \text{ m/s}$
(stage D2)

AS likely cause of symptoms

AVR (IIa)

NO

AVA $\leq 1 \text{ cm}^2$
and
LVEF $\geq 50\%$
(stage D3*)

Asymptomatic (stage B)

Other cardiac surgery

Class I

Class IIa

Class IIIb
# Aortic Stenosis: Choice of Intervention

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Modified:</strong> Surgical AVR is recommended for symptomatic patients with severe AS (Stage D) and symptomatic patients with severe AS (Stage C) who meet an indication for AVR when surgical risk is low or intermediate</td>
<td>I</td>
<td>B-NR</td>
</tr>
<tr>
<td>For patients in whom TAVR or high-risk surgical AVR is being considered, a heart valve team consisting of an integrated, multidisciplinary group of healthcare professionals with expertise in VHD, cardiac imaging, interventional cardiology, cardiac anesthesia, and cardiac surgery should collaborate to provide optimal patient care</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td><strong>Modified:</strong> Surgical AVR or TAVR is recommended for symptomatic patients with severe AS (Stage D) and high risk for surgical AVR, depending on patient-specific procedural risks, values, and preferences</td>
<td>I</td>
<td>A</td>
</tr>
</tbody>
</table>
### Recommendations

<table>
<thead>
<tr>
<th>Modified: TAVR is recommended for symptomatic patients with severe AS (Stage D) and a prohibitive risk for surgical AVR who have a predicted post-TAVR survival greater than 12 months</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>New: TAVR is a reasonable alternative to surgical AVR for symptomatic patients with severe AS (Stage D) and an intermediate surgical risk, depending on patient-specific procedural risks, values, and preferences</th>
<th>COR</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IIa</td>
<td>B-R</td>
</tr>
</tbody>
</table>
TAKE HOME MESSAGE

• HEART TEAM

• Careful preoperative evaluation of aortic valve stenosis severity

• SAVR is the gold standard treatment

• Full Revascularization is essential for long-term survival

• TAVI is a credit alternative for high risk patients