Aortic stenosis (AS) is now the most commonly acquired valvular heart disease in the Western world (2–7% of the population aged >65 years) and the mortality for untreated symptomatic severe AS is up to 50–60% at 2 years in high-risk patients. This review summarizes laboratory and recent clinical investigations concerning AS and current best treatment. Particular emphasis will be placed on pathophysiology and on the concept of afterload mismatch and preload reserve in which left ventricular function is proportionately matched to level of left ventricular pressure, mainly because such studies carry important implications for both treatment with transcatheter aortic valve implantation (TAVI) and prognosis. Surgical aortic valve replacement is currently the gold-standard treatment for patients with severe symptomatic AS. Without surgery, the prognosis is extremely poor, with a 3-year survival rate <30%. However, 33% of all patients aged ≥75 years with severe AS are declined for surgery. TAVI was recently introduced as a new therapeutic option for patients with AS, so the current indications, the technical differences between 2 different transcatheter aortic valves and the clinical available data will be also examined in detail. (Circ J 2011; 75: 11–19)

Key Words: Aortic stenosis; Elderly; Percutaneous valve implantation; Transcatheter aortic valve implantation (TAVI)

Implications of Aortic Anatomy for Percutaneous Valve Implantation

The aortic root is the direct continuation of the left ventricular outflow tract (LVOT). Its components are the sinuses of Valsalva, the fibrous interleaflet triangles, and the valvular leaflets themselves. When defined literally, an “annulus” is no more than a little ring.

Aortic Valvar Leaflets

The normal aortic valve is trifoliate, and proper functioning of the valve depends on the proper relationship between the leaflets within the aortic root.

In the majority of cases, the orifices of the coronary arteries arise within the 2 anterior sinuses of Valsalva, usually positioned just below the sinotubular junction. Knowledge of the location of the coronary arteries, of course, is essential for appropriate percutaneous replacement of the aortic valve. The combination of a relatively low-lying coronary artery ostium and a large native aortic valvular leaflet can therefore obstruct the flow into the coronary arteries during valvular deployment. The presence of a significant subaortic bulge or a hypertrophied septum has been considered a relative contraindication to implantation, mainly for the CoreValve aortic prosthesis. The atrioventricular node is located just inferior to the apex of the triangle adjacent to the membranous septum, and therefore the atrioventricular node is in fact in close proximity to the subaortic region and the membranous septum of the LVOT.

Pathophysiology of AS

The aortic valve stenosis is defined as an obstacle to the flow of blood through the aortic valve during left ventricular (LV) ejection. This LV outflow obstruction due to increased systolic blood pressure, prolonged ejection time, increased blood pressure and decreased diastolic aortic pressure is established as a trans-valvular gradient. These alterations are established...
Figure 1. 33% of all patients aged >75 years with severe aortic stenosis (AS) are declined for surgery. The mortality for untreated symptomatic severe AS is up to 50–60% at 2 years in high-risk patients (red line). Of these patients, among those who ultimately undergo surgical valve replacement, a proportion is at high risk of morbidity/mortality from the procedure. AVR, aortic valve replacement. (Modified from Varadarajan P et al.3)

Figure 2. Symptoms in patients with aortic stenosis begin around the 6th decade of life, after a long latency period, and are characterized by progressive thickening and calcification of the aortic valve or progressive myocardial dysfunction, or both. Without aortic valve replacement or transcatheter aortic valve implantation the prognosis of patients with aortic stenosis after the onset of severe symptoms is extremely poor. (Modified from Ross J and Branwald E.6)
when the valve area is reduced by at least 50%. The pressure overload is initially compensated by the development of myocardial hypertrophy without dilatation of the LV chamber (concentric hypertrophy) that is able to maintain for many years normal systolic function. The increases in systolic blood pressure, ventricular mass and ejection time lead to increased consumption of oxygen by the myocardium. The increase in oxygen consumption and its contributing to decreased myocardial ischemia cause further deterioration of LV function.

In more advanced disease, the disappearance of effective compensatory mechanisms is associated with an imbalance between pump function and LV afterload (afterload mismatch). At this stage, the ventricular chamber dilates, the ejection fraction (EF) is reduced and both the ventricular filling pressure and pulmonary pressure increase. This stage usually coincides with the occurrence of severe stenosis and the onset of symptoms. Usually, the symptoms in patients with AS appear around the 6th decade of life after a long latency period, characterized by progressive thickening and calcification of the aortic valve or progressive myocardial dysfunction, or both (Figure 2). In patients in whom symptomatic severe AS is not treated, the prognosis is poor. For this reason, the ACC/AHA guidelines recommend valve replacement in patients with severe symptomatic AS (Class I: aortic valve replacement (AVR) is indicated for symptomatic patients with severe AS, with level B of evidence).

Concept of Preload Reserve and Afterload Mismatch in AS and in Transcatheter Aortic Valve Implantation (TAVI)

The first study that demonstrated the enhanced sensitivity of the failing human LV to increased afterload was published in 1964 by Ross and Braunwald. Studies of the sudden changes in afterload alone allowed demonstration in the normal heart of the striking effect of increasing the afterload to decrease the stroke volume (SV), and vice versa. Other experimental studies in the normal heart confirmed the inverse relation between afterload and SV when the preload was fixed: when the preload was allowed to vary, the SV could be maintained as the afterload was increased while the preload increase compensated for the augmented afterload. The afterload in that acute study was represented by the systolic LV pressure. When the limit of preload reserve was reached by volume loading to a very high ventricular filling pressure, even in the normal heart, this further increased afterload, resulting in a decrease in the SV. These initial clinical and laboratory observations led to the concept of “afterload mismatch with limited preload reserve”, afterload mismatch indicating the inability of a ventricle to maintain SV or wall shortening at the prevailing level of systolic arterial pressure.

The framework of afterload mismatch and limited preload reserve has proved useful for explaining some phenomena in valvular aortic disease. In the case of AS, when the EF begins to decrease, the preload reserve of the LV is often limited by cardiac hypertrophy and increased myocardial stiffness. As the valve narrowing progresses, LV afterload increases further, and the LVEF can become markedly reduced, primarily because of afterload mismatch without preload reserve (Figure 3). In this setting the EF often can be substantially restored (eg, from 33% to 52% in Figure 3) by reducing the afterload with replacement of the aortic valve.

Of course, the favorable effect on LV function after AVR can occur only if preoperative myocardial degeneration is not too severe.
Classification of the Severity of AS and Clinical Strategies in Affected Patients

Although AS is best described as a disease continuum, its severity can be graded.

- **Mild**: area 1.5 cm², mean gradient <25 mmHg, or jet velocity <3 m/s.
- **Moderate**: area 1–1.5 cm², mean gradient 25–40 mmHg, or jet velocity 3–4 m/s.
- **Severe**: area <1.0 cm² (0.6 cm²/m²), mean gradient >40 mmHg, or jet velocity >4 m/s.

When in AS patients the symptoms of angina, syncope, or heart failure develop after a long latent period, the prognosis changes dramatically. The development of symptoms is a critical point in the natural history of AS. Management decisions are based largely on these findings; most clinicians treat asymptomatic patients conservatively, whereas corrective surgery is generally recommended for patients with symptoms thought to be due to AS. According to the latest update of the ACC/AHA guidelines 2008 the indications for AVR are as follows.

**Class I**
1. AVR is indicated for symptomatic patients with severe AS (level of evidence: B).
2. AVR is indicated for patients with severe AS undergoing coronary artery bypass graft surgery (CABG) (level of evidence: C).
3. AVR is indicated for patients with severe AS undergoing surgery on the aorta or other heart valves (level of evidence: C).
4. AVR is recommended for patients with severe AS and LV systolic dysfunction (EF <0.50) (level of evidence: C).

**Asymptomatic Patients With Severe AS**
Asymptomatic patients with AS have outcomes similar to age-matched normal adults. However, disease progression with symptom onset is common. There is a high probability that these patients will need to undergo surgery within the 5 years after symptom onset. The assessment should only be done by a high-quality cardiology group and the procedure by a high-quality surgical group where the risk is 1% or less. According to the latest update of the guidelines ACC/AHA 2008, the indications for AVR in asymptomatic patients are as follows.

**Class IIb**
1. AVR may be considered for asymptomatic patients with severe AS and abnormal response to exercise (eg, development of symptoms or asymptomatic hypotension) (level of evidence: C).
2. AVR may be considered for adults with severe asymptomatic AS if there is a high likelihood of rapid progression (age, calcification, and coronary artery disease) or if surgery might be delayed at the time of symptom onset (level of evidence: C).
AVR may be considered in patients undergoing CABG who have mild AS when there is evidence, such as moderate to severe valve calcification, that progression may be rapid (level of evidence: C).

AVR may be considered for asymptomatic patients with extremely severe AS (aortic valve area <0.6 cm$^2$, mean gradient >60mmHg, and jet velocity >5.0 m/s) when the patient’s expected operative mortality is 1.0% or less (level of evidence: C).

Figure 4 is a treatment algorithm of patients with severe AS.

In asymptomatic patients, symptoms such as heavy calcification or very severe AS are important. A recent study by Rosenhek et al pointed out that patients with a valve peak velocity greater than 4 m/s have a high likelihood of requiring surgery over the course of the next 3–4 years. If the velocity is greater than 4.5 or greater than 5, the attrition rate is even more important, so a very severe degree of AS may be enough to consider surgery as long as it is performed by a high-quality surgical group. The European guidelines recommend surgery in asymptomatic patients with AS as follows.

Class I  Asymptomatic patients with severe AS and abnormal exercise test showing symptoms on exercise (level of evidence: C).

Class Ia  Asymptomatic patients with severe AS and abnormal exercise test showing a fall in blood pressure below baseline (level of evidence: C).

Asymptomatic patients with severe AS and moderate-to-severe valvular calcification, and a rate of peak velocity progression ≥0.3 m·s$^{-1}$·year$^{-1}$.

A study by Pai et al reveals how complex asymptomatic patients with AS can be. Patients with no symptoms can still have a high mortality rate, especially the older group. In addition, it can sometimes be difficult to establish the presence of symptoms, for a variety of reasons. A study by Otto et al showed that patients with a peak velocity >4 m/s, which is how severe AS is being defined, either underwent surgery or had a bad outcome over the course of the subsequent 5 years.

Patients With Low-Flow/Low-Gradient AS

Patients with severe AS (<1 cm$^2$) and low cardiac output often present with a relatively low transvalvular pressure gradient (ie, mean gradient <30mmHg). Such patients can be difficult to distinguish from those with low cardiac output and only mild to moderate AS. In the former (true, anatomic severely), the stenotic lesion contributes to an elevated afterload, decreased EF, and low SV. In the latter, primary contractile dysfunction is responsible for the decreased EF and low SV. The problem is further complicated by a reduction in the valvular opening forces that contribute to limited valve mobility and apparent stenosis.

Therefore, it may be useful to determine the transvalvular pressure gradient and to calculate valvular area during a baseline state and again during exercise or low-dose pharmacological (ie, dobutamine infusion) stress, with the goal of determining whether the stenosis is severe or only moderate. Thus, if a dobutamine infusion produces an increment in SV and an increase in valve area greater than 0.2 cm$^2$ and little change in gradient, it is likely that the baseline evaluation overestimated the severity of the stenosis. In contrast, patients with true severe AS will have a fixed valvular area with an increase in SV and an increase in gradient during dobutamine infusion. These patients are likely to respond favorably to surgery and perhaps to TAVI.

Approach to the Therapy of AS With TAVI

For several decades, sAVR has been established as the optimal treatment for severe AS and has been associated with increased survival of patients. However, in the huge Euro Heart multi-institutional multinational registry in Europe, 33% of symptomatic patients over the age of 65 years were not referred for surgery. The reasons for not sending them to surgery were not always the comorbidities. David Bach’s series showed the same issue: 33% of symptomatic patients were not referred for surgery, even with a low EuroScore risk. Therefore, a substantial percentage of patients with severe AS are not candidates to surgery due to the high surgical risk. Now there is a new breakthrough technique for these patients: TAVI, which is a novel and rapidly evolving technique. It was first introduced in 2002 and is currently available as an alternative to conventional AVR for patients with severe symptomatic AS who are deemed as having a too high risk for open heart surgery. In order to establish the indication...
for TAVI, the EuroScore can be used to stratify surgical risk in octogenarians undergoing aortic surgery, although the limitations of the score index are well known.

At the present time, 2 devices with substantial clinical data are available are: the CoreValve and the Sapien valve (Figure 5).

The CoreValve ReValving System

The CoreValve ReValving System (Medtronic, Minneapolis, MN, USA) consists of a self-expandable, trileaflet frame composed of nitinol to which is attached a trifoliate, porcine pericardium heart valve (Figure 5). The upper third of the frame (ie, the outflow portion) exerts a low radial force and sits within the ascending aorta, its function being to orient the prosthesis in the direction of the aortic root and blood flow. Although the prosthesis is anchored within the annulus, its function is supra-annular. This valve is currently available in 2 sizes: 1 for aortic rings from 20–23 mm in diameter (small prosthesis: the portion inserted into the native ring measures 26 mm) and another for 24–27 mm rings (large prosthesis: the portion inserted in the native ring measures 29 mm).

Eligibility for TAVI (CoreValve) include the criteria described by Grube et al: 1. Severe native AS with an area <1 cm² or <0.6 cm²/m², with or without aortic valve regurgitation and age ≥75 years or logistic EuroScore ≥15% for the 18F group, or age ≥65 years and at least one of the following complications: liver cirrhosis, pulmonary insufficiency (forced expiratory volume in 1 s <1), previous cardiac surgery, pulmonary hypertension >60 mmHg, porcelain aorta, recurrent pulmonary embolus, right ventricular insufficiency, thoracic burning sequelae with contraindication for open chest surgery, history of mediastinal radiotherapy, severe connective tissue disease with contraindication for surgery, or cachexia (body mass index ≤18 kg/m²).

2. Echocardiographic aortic valve annulus diameter ≥20 and ≤27 mm.

3. Diameter of the ascending aorta ≤45 mm at the sinotubular junction.

The femoral approach is contraindicated in patients with small femoral arteries (<6 mm or <7 mm in hemodialysis patients), excessive atherosclerosis, calcification, or tortuosity of the common femoral arteries or iliac arteries and should be considered cautiously in patients with an aneurysm of the thoracic or abdominal aorta. Recently, a few cases of CoreValve implantation through the subclavian/axillary artery with the standard retrograde delivery system have been described in patients with contraindications to the femoral approach. Petronio et al report their initial experience of CoreValve implantation through the subclavian/axillary approach in 54 consecutive patients from the Italian CoreValve Registry. Procedural success was obtained in 100% of the patients, with no perioperative deaths.

Clinical Data on CoreValve There are many non-randomized clinical registries regarding the use of CoreValve: some have not finished recruitment (Australia–New Zealand Advance Study), 2 have submitted long-term follow-up data (2 years: 18Fr Safety and Efficacy (S&E) Trial, the UK Registry) and other studies have presented their 1-year results (Table 1). The majority of these registries have been presented at international meetings; however, the main randomized trial of CoreValve vs. Surgery or vs. optimal medical management is the US-Pivotal Trial High Risk Surgical Cohort is still ongoing.

Baseline characteristics of patients in the registries are homogeneous across all studies: average age >80 years (except the Spanish Registry, which has a median age of 78.6±6.7 years), high EuroScore logistic (on average >20, except for the Australia–New Zealand Study, which shows an average 18.7±12.9) and the Spanish Registry, which shows an average 16±13.9), and most of patients in a high NYHA class (III or IV).

Recently, partial results of a German Registry of 697 patients (81.4±6.3 years, 44.2% males and logistic EuroScore 20.5±13.2%) who underwent TAVI were reported. Pre-operative aortic valve area was 0.6±0.2 cm², with a mean transvalvular gradient of 48.7±17.2 mmHg. TAVI was performed percutaneously in the majority of patients (95.6%).

Complications with CoreValve in all studies were:
- Death, including all cause and cardiovascular mortality. The procedural success is approximately 98% in all registries and mortality at 30 days for any reason ranges from 5.5% (English Registry) to 15.1% (French Registry).
- Myocardial infarction, including coronary occlusion. The reported incidence of myocardial infarction associated with TAVI is extremely variable across series, ranging from 0.2% to 17.5%.
- Stroke, including permanent stroke and transient ischemic attack. The reported stroke rate has consistently been <5% in most series.
- Re-intervention including sAVR and repeat valve placement. TAVI procedures can be associated with severe hemodynamic deterioration needing hemodynamic support (femoral–femoral bypass or counterpulsation balloon).
- Aortic regurgitation. Mild residual regurgitation is common and not hemodynamic relief: it is considered essentially

<table>
<thead>
<tr>
<th>Registry</th>
<th>Follow-up</th>
<th>Age (years)</th>
<th>Logistic Euro SCORE (%)</th>
<th>LVEF (%)</th>
<th>Mean pressure gradient (mmHg)</th>
<th>Procedural success (%)</th>
<th>All-cause mortality (30 day) (%)</th>
<th>Pacemaker implantation (%)</th>
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<tbody>
<tr>
<td>18Fr Safety and Efficacy Trial</td>
<td>2 years</td>
<td>81.9±6.4</td>
<td>23.4±13.8</td>
<td>51.6±13.1</td>
<td>46.8±15.9</td>
<td>83.1</td>
<td>15.2</td>
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<td>Australia-New Zeland Study</td>
<td>6 months</td>
<td>81.9±6.4</td>
<td>18.7±12.9</td>
<td>58.7±9.14</td>
<td>46.4±15.9</td>
<td>96.8</td>
<td>3.2</td>
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<td>Italian Registry</td>
<td>1 year</td>
<td>82±6</td>
<td>22.9±13.5</td>
<td>51±13</td>
<td>52±17</td>
<td>98.1</td>
<td>7.2</td>
<td>18.5</td>
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<tr>
<td>Belgian Registry</td>
<td>1 year</td>
<td>82±6</td>
<td>25±15</td>
<td>59±13</td>
<td>49±16</td>
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<td>9.0</td>
<td>26.9</td>
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<tr>
<td>Spanish Registry</td>
<td>6 months</td>
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<td>55±14.3</td>
<td>98.1</td>
<td>7.4</td>
<td>35.2</td>
</tr>
<tr>
<td>French Registry</td>
<td>6 months</td>
<td>82.5±5.9</td>
<td>24.7±11.2</td>
<td>51±15</td>
<td>46±15</td>
<td>97.0</td>
<td>15.1</td>
<td>23</td>
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<tr>
<td>UK Registry</td>
<td>2 years</td>
<td>83</td>
<td>20±3</td>
<td>–</td>
<td>–</td>
<td>99.0</td>
<td>5.5</td>
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<tr>
<td>German Registry</td>
<td>30 days</td>
<td>81.4±6.4</td>
<td>20.8±13.3</td>
<td>52.1±15</td>
<td>48.7±17.2</td>
<td>98.7</td>
<td>12.4</td>
<td>42.5</td>
</tr>
</tbody>
</table>

LVEF, left ventricular ejection fraction; TAVI, transcatheter aortic valve implantation.
a periprosthetic leak that has an irrelevant clinical impact. Severe regurgitation is described in 5% of cases of implantation.

- Permanent pacemaker placement (10–25%). The implantation of pacemakers is the most common complication after placement of the CoreValve. Procedural variability, anatomical differences, and clinical practice variation have an impact on pacemaker implant rates.\textsuperscript{31,32}

- Pericardial tamponade (wire perforations) is between 0% and 7%. The rupture of the LV is usually due to guidewire or maneuvering thrusts to bring the prosthesis into the LV. It is essential that the guide has a large loop that ensures the distribution of thrust over a wide area. It is also possible that perforation of the RV is due to the catheter of the temporary pacemaker.

- Vascular and bleeding complications (6–15%). The experience with the CoreValve ReValving system suggests that reducing the catheter size can have a major effect on the incidence of vascular complications (>20% incidence in initial series vs. <5% in recent registries).\textsuperscript{31}

- Valve migration or fracture. The incidence of valve malposition or embolization has decreased markedly from the initial first-in-human and feasibility series (=6%) compared with the most recent studies (=2%).\textsuperscript{31}

- Acute kidney injury—need for hemodialysis. TAVI procedures have a potential risk for acute kidney injury.

### The Edwards Sapien Prosthesis

The Edwards Sapien prosthesis (Edwards Lifesciences LLC, Irvine, CA, USA) consists of a balloon-expandable cylindrical frame composed of stainless steel to which is attached a trifoliate, equine pericardium heart valve (Figure 5). A fabric skirt is sewn to the frame and functions to mitigate paravalvular aortic regurgitation. The anchoring of the prosthesis and function of the valve are both intra-annular. This valve is currently available in 2 sizes: 23 and 26 mm.

The SOURCE\textsuperscript{31} trial is a registry that enrolled patients at high risk for traditional AVR or who were considered inoperable. Generally, these patients have a EuroScore >20. Patients being treated by the transfemoral approach must have femoral or iliac vessel diameter ≥7 mm.

In contrast, the Partner trial is the only published randomized study of TAVI. In the PARTNER\textsuperscript{31} trial, patients had severe AS and cardiac symptoms for which conventional surgery to replace the aortic valve was associated with high risk. Severe AS was defined as an aortic valvular area <0.8 cm\textsuperscript{2}, a mean aortic valvular gradient ≥40 mmHg, or a peak aortic jet velocity >4 m/s. All the patients had NYHA class II, III, or IV symptoms. Patients were divided into 2 cohorts: those who were considered to be candidates for surgery despite having high surgical risk, a logistic EuroScore >25% or having coexisting conditions that would be associated with a predicted risk of death by 30 days after surgery of ≥15% (Table 2); and those who were not considered to be suitable candidates for surgery because they had coexisting conditions that would be associated with a predicted probability of ≥50% of either death within 30 days after surgery or a serious irreversible condition. Baseline demographics and risk factors in the PARTNER and SOURCE trials are shown in Table 2.

### Clinical Data on the Edwards SAPIEN Bioprosthesis

The Edwards SAPIEN Aortic Bioprosthesis European Outcome (SOURCE) Registry comprises 463 transfemoral patients and 575 transapical patients. The resultant logistic EuroScore was 25.7% for the transfemoral and 29.1% for the transapical groups (P<0.001), indicating that the transapical cohort represented a higher risk patient population.

Complications with the Edwards SAPIEN in the SOURCE Registry were:

- Overall 30-day mortality of 8.5% in total, comprising 6.3% for the transfemoral cohort and 10.3% for the transapical group.
- Incidence of permanent pacemaker implantation of 7% in both groups.
- Overall incidence of stroke of 2.5% (transfemoral, 2.4%; transapical, 2.6%).
- Significantly higher incidence of preprocedural carotid artery disease in the transapical group (17.1% vs. 7.6%; P<0.001).

The Placement of Aortic Transcatheter Valve Trial Edwards SAPIEN Transcatheter Heart Valve (PARTNER US) randomized trial incorporated 2 parallel prospective, multicenter, randomized active-treatment-controlled clinical trials. In that study, the results of the patients with AS who were not considered to be suitable candidates for surgery have been reported. It is the only available randomized trial of TAVI involving patients at high surgical risk, who were nevertheless considered to be candidates for surgery, that is ongoing. Thirty days after randomization, the rate of death from any cause was 5.0% in the TAVI group as compared with 2.8% in the standard-therapy group (P=0.41). At 1-year follow-up, the rate of death from any cause (the primary endpoint), as calculated by Kaplan-Meier analysis, was 30.7% in the TAVI group as compared with 50.7% in the standard-therapy group (Figure 6). Repeated hospitalization at 1-year follow-up (Kaplan-Meier analysis) was 42.5% with TAVI as compared with 71.6% with standard therapy. Major strokes occurred more frequently in the TAVI group than in the standard-therapy group at 30 days (5.0% vs. 1.1%, P=0.06) and at 1 year (7.8% vs. 3.9%, P=0.18). However, the rate of the composite of major stroke or death from any cause (Kaplan-Meier analysis) was still significantly lower in the TAVI group than in the standard-therapy group (33.0% vs. 51.3% at 1 year; hazard ratio, 0.58; 95% CI, 0.43–0.78; P<0.001). Major vas-

### Table 2. Clinical Characteristics and Results of the PARTNER and SOURCE Trials

<table>
<thead>
<tr>
<th>Source</th>
<th>Age (years)</th>
<th>Logistic EuroSCORE (%)</th>
<th>LVEF (%)</th>
<th>Mean pressure gradient (mmHg)</th>
<th>Procedural success (%)</th>
<th>All-cause mortality (30 day) (%)</th>
<th>All-cause mortality (1 year) (%)</th>
<th>Pacemaker implantation (%)</th>
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<tbody>
<tr>
<td>SOURCE (transfemoral)</td>
<td>81.7±6.7</td>
<td>25.7±14.5</td>
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<td>95.2</td>
<td>6.3</td>
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<td>6.7</td>
</tr>
<tr>
<td>SOURCE (transapical)</td>
<td>80.6±7.0</td>
<td>29.1±16.3</td>
<td>–</td>
<td>–</td>
<td>92.7</td>
<td>10.3</td>
<td>–</td>
<td>7.3</td>
</tr>
<tr>
<td>PARTNER (TAVI)</td>
<td>83.1±8.6</td>
<td>26.4±17.2</td>
<td>53.9±13.1</td>
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<td>PARTNER (standard therapy)</td>
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<td>43.0±15.3</td>
<td>–</td>
<td>2.8</td>
<td>49.7</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Abbreviations see in Table 1.
cicular complications and major bleeding events were more frequent in the TAVI group than in the standard-therapy group.

Conclusions

Degenerative-calcific AS is now the most common valvular disease, with an incidence of 2–7%, in the human population aged over 65 years. AS is defined as severe if the valvular area is less than 1 cm², the transvalvular gradient is greater than 40 mmHg, or peak velocity exceeds 4 m/s. LV outflow obstruction causes increased pressure inside the LV chamber, affecting the entire pathophysiology of AS. AS causes an afterload mismatch and preload reserve depletion associated with progressive deterioration of LV function. Aortic valve implantation, which eliminates the obstruction of blood outflow and thus eliminates afterload mismatch and preload reserve normalizes the EF (if the myocardium is not irreversibly damaged).

The onset of symptoms is a crucial point in the natural history of the disease, causing a sudden and dramatic deterioration in prognosis. Symptoms of AS are the indication for surgery, because all studies have shown a relationship between the onset of symptoms and adverse events. However, asymptomatic patients with AS and a peak velocity greater than 4.5 m/s also have a poor prognosis.

In clinical practice, at least 30% of patients with severe symptomatic AS do not undergo surgery for replacement of the aortic valve, because of advanced age, LV dysfunction, or the presence of multiple comorbidities. For those patients, who are at high surgical risk, a less invasive treatment may be a worthwhile alternative. TAVI is a new procedure, in which a bioprosthesis valve is inserted through a catheter and implanted within the diseased native aortic valve. TAVI is a novel effective strategy in patients with severe AS who are not candidates for surgery.

References

Aortic Stenosis and TAVI


