

Who Should Undergo TAVR?

The role of transcatheter aortic valve replacement as a new paradigm for treating aortic stenosis.

BY PAUL J. PEARSON, MD, PhD

Trascatheter aortic valve replacement (TAVR) has revolutionized the treatment of calcific aortic stenosis. TAVR enables physicians to replace dysfunctional aortic valves in the beating heart using a minimally invasive method that does not require a large incision or the use of cardiopulmonary bypass.¹ However, this introduces the question of who the ideal candidate is for this groundbreaking technology.

Calcific aortic stenosis is the most common cardiac valve pathology in the United States, affecting up to 4% of the population older than 75 years.² Conventional surgical aortic valve replacement (SAVR) using cardiopulmonary bypass in the arrested heart provides a historically effective and durable treatment for this condition.^{3,4} However, even when performed in a minimally invasive manner, operative morbidity and mortality can be significant, particularly in the elderly.^{5,6} Thus, we are faced with a paradoxical situation in which the group with the highest prevalence of aortic stenosis has the least positive outcome with the conventional surgical treatment of this condition.

The higher morbidity and mortality associated with SAVR in the elderly might, in part, account for what has historically been expressed as the “undertreatment of aortic stenosis in the United States.”⁷ In one United States study, up to 75% of elderly patients with severe, symptomatic aortic stenosis were not offered SAVR.⁸ In addition, patients older than 80 years were significantly less likely to be offered surgical therapy.

This is important because the population of the United States is obviously aging. The US Census Bureau projects that the number of Americans aged 65 years and older will more than double between 2010 and 2050.⁹ The percentage of Americans 65 years and older will grow from 13% to more than 20% of the total

population by 2030, and the fastest growing segment of this group (individuals 85 years and older) is expected to triple in number during the next 4 decades. These changes in the age demographic of the United States population are largely due to people living longer and the baby boomer generation crossing into the age-65-and-older age bracket in 2011. This translates into a dramatic increase in the number of elderly patients with severe, symptomatic aortic stenosis who will potentially be candidates for therapy.

WEIGHING BENEFITS VERSUS RISKS

The minimally invasive benefit of TAVR must be balanced by increased incremental risks associated with use of the technology and unknowns related to the device itself. For TAVR, the incremental risk is the possibility of a higher stroke risk that has been associated with catheter-based valve deployment. Although the PARTNER trial demonstrated a stroke risk double that in the surgically treated cohort, other studies have shown a relatively low stroke risk using the two commercially available TAVR systems.^{10,11} As for durability of the prostheses, excellent 5-year durability data are now available in a large cohort of patients.¹² However, moderate or severe paravalvular leakage is estimated to occur in approximately 12% of patients after TAVR, which is significantly higher than after SAVR.¹³ This moderate or severe aortic regurgitation is associated with decreased survival and an increased incidence of heart failure in post-TAVR patients.^{13,14}

CURRENT INDICATIONS FOR TAVR

Clearly, for patients with severe, symptomatic aortic stenosis and no surgical options, TAVR should be con-

sidered as the definitive treatment of choice. Patients in this group include those who cannot undergo SAVR due to technical anatomic reasons (such as an aorta completely encased in calcium [ie, porcelain aorta], previous chest wall radiation, etc.) or patients who are deemed inoperable because of multiple comorbidities (such as renal failure, lung disease, frailty, etc.). In the landmark PARTNER trial, a subgroup of patients who were not candidates for SAVR and instead underwent TAVR had a 20% improvement in 1-year survival and significant relief of symptoms.¹⁵ Additionally, in another subgroup of the PARTNER trial, patients who were considered high risk for SAVR had similar rates of survival at 1 year (although they expressed different periprocedural risks) whether treated with SAVR or TAVR.¹⁰ Based on the published findings of these two important subgroups, in addition to similar excellent outcomes reported in Canada and Europe,^{16,17} various scientific affiliations developed consensus guidelines for the use of TAVR.

Even though they were produced by groups with geographic and cultural detachment, the guidelines are strikingly similar. For example, the 2012 ACCF/AAT/SCAI/STS Expert Consensus document on TAVR recommends TAVR for inoperable aortic valve patients and patients who have a prohibitive surgical risk (> 50% mortality or irreversible morbidity at 30 days).¹⁸ In addition, the guidelines state that TAVR is a reasonable alternative to SAVR in high-surgical-risk patients ($\geq$ 8% mortality risk for SAVR). In general, the 2012 ESC/EACTS guidelines mirror these recommendations.¹⁹

THE EVOLVING APPLICATION OF TAVR

Although the indications for TAVR in patients with no surgical options or for those who are at very high risk for surgical intervention are well accepted, the use of TAVR in intermediate-risk patients (those with a Society of Thoracic Surgery [STS] predicted mortality between 4% and 8%) is not without controversy. The results of the PARTNER II trial will give us important guidance on this indication, but our current uncertainty is exacerbated by the imprecise tools we have available to accurately predict surgical outcomes in a given patient. This is particularly apparent when dealing with frail patients or those with cognitive dysfunction.

For example, a cornerstone of the current risk assessment is the STS Risk Calculator.²⁰ However, one must understand what the STS Risk Calculator represents and what it does not. More than 90% of the adult cardiac surgical programs in the United States participate in the STS database. Since its inception in 1989, more than 5 million patient records have been submitted. These data include outcomes of cardiac surgical cases with 30-day

follow-up. However, the STS database only represents a select group of patients. The outcomes data (the basis of the STS Risk Calculator) represent patients whose family physicians, cardiologists, and cardiac surgeons deemed good candidates for a cardiac surgical procedure. Patients who were potentially turned down for surgical intervention, based upon intangibles such as frailty or cognitive dysfunction, are not represented in the database. However, because TAVR is perceived as being less invasive and less systemically traumatic than SAVR, patients who would not have previously been referred for surgical intervention are now populating our valve clinic waiting rooms. Thus, when evaluating such patients for TAVR, we need to understand that the STS Risk Calculator was based on a different patient population. In our “new” patient population, an individual with an STS-predicted mortality of 4% might be the ideal TAVR candidate.

FRAILITY, COGNITION, AND SURGICAL RISK

The complexity of predicting therapeutic outcomes is most apparent when adding the confounding patient factors of frailty or cognitive dysfunction to the calculated surgical risk. These factors are not measured in the STS Risk Calculator, but they do have a dramatic impact on surgical outcomes. For example, patients with a slow preoperative gait speed ($\geq$ 6 seconds to walk 5 meters is a good surrogate of frailty) have a two- to threefold increased risk of mortality and major morbidity for any given level of STS-predicted risk of mortality compared to patients with normal speed.²¹ In addition, cognitive impairment, which is estimated to affect 22.2% of patients aged 71 years and older in the United States, is associated with increased perioperative mortality and postoperative functional decline.²²⁻²⁴ Thus, factors not typically accounted for in preoperative evaluations would potentially change the therapeutic trajectory of many patients in favor of the less-invasive TAVR.

The take-home message is that when evaluating this new group of primarily elderly patients for the treatment of aortic stenosis, the interventionist can trust a high STS-calculated risk of mortality and morbidity but should not be fooled by a low score alone. Currently, there are multiple tools available to assist the heart team in quantifying a patient's frailty and cognitive dysfunction. In the future, calculators of surgical morbidity and mortality will most likely be enhanced to include metrics in these critical areas.

VALVE-IN-VALVE APPLICATIONS

A final arena where TAVR has exciting applications is in high-operative-risk or elderly patients with failed

TAKE-HOME POINTS

- Calcific aortic stenosis is the most common cardiac valve pathology in the United States, and with the number of elderly Americans projected to increase faster than ever before, a huge increase in the number of high-surgical-risk patients with aortic stenosis is expected.
- TAVR is indicated in patients with severe, symptomatic aortic stenosis who are not suitable for SAVR, as assessed by a heart team, and who are likely to gain improvement in quality of life and have a life expectancy of more than 1 year after consideration of their comorbidities.
- TAVR is a reasonable alternative to SAVR in patients at high surgical risk (PARTNER trial criteria: STS $\geq$ 8%).
- TAVR can currently be considered a reasonable alternative to SAVR in patients with lower surgical risk (STS between 4%–8%) in the presence of factors such as frailty and cognitive dysfunction, as the STS Risk Calculator does not account for these outcome-altering variables.

bioprosthetic heart valves. In the United States, the surgical implantation of bioprosthetic valves has eclipsed the use of mechanical valves because of a desire to avoid the need for lifelong anticoagulation with warfarin and the recognition of improved durability with the current generation of surgical tissue valves. However, tissue valves eventually fail and require reoperation. As pointed out by Webb et al, the STS Risk Calculator predicts that an 80-year-old man with no comorbidities has an approximate mortality risk of 5% for aortic reoperation and 10% for mitral reoperation, and a major morbidity risk of 20% to 23%.²⁵ These risks dramatically increase in the presence of comorbidities.²⁶ Recent reports demonstrate the feasibility and excellent short-term outcomes of transcatheter “valve-in-valve” replacement for failed bioprosthetic heart valves in high-risk cohorts.^{25,27}

THE FUTURE OF TAVR

The question of who is a viable candidate for TAVR has an answer that is evolving and ever expanding. As one “reads the tea leaves” as to the future of TAVR, one can envision the potential application exceeding surgically implanted aortic valves. New imaging technology and analysis algorithms will remove the guesswork of valve sizing and placement during deployment. A decrease in the size of delivery systems will relegate major vascular injuries to a historical footnote, embolization protection

systems will dramatically reduce periprocedural neurologic events, and modification of prosthetics will all but eliminate perivalvular leakage. The question at that time will not be, “Who is a candidate for TAVR?” but, “Who is not a candidate?” ■

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