

New Insights From the STS/ACC TVT Registry

What these ongoing data tell us about TAVR and future areas of interest.

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After the approval of the first transcatheter aortic valve prostheses by the US Food and Drug Administration (FDA) in November 2011, a National Coverage Decision (NCD) for transcatheter aortic valve replacement (TAVR) was developed by the Centers for Medicare & Medicaid Services (CMS). This NCD mandated that all hospitals and their heart teams performing the procedures must participate in a prospective database that enrolls these patients and collects data on their postprocedure outcomes as part of postmarket surveillance in association with the FDA.¹ Subsequent devices and modifications of these devices that have been approved by the FDA for TAVR, including transcatheter mitral valve clipping (TMVC) for mitral regurgitation, transcatheter aortic valve-in-valve (TAViV), transcatheter mitral valve-in-valve (TMViV), and transcatheter mitral valve-in-ring (TMViR) are all entered in this database for all nationally approved programs. Data from these reports are generated quarterly and distributed to the performing hospitals, as well as to the Society of Thoracic Surgeons (STS)/American College of Cardiology (ACC) Transcatheter Valve Therapy (TVT) Registry Steering Committee, the FDA, and CMS, and aggregated data are distributed to the Stakeholders Advisory Committee.

Each year, the Steering Committee produces an annual report for joint publication in *Journal of the American College of Cardiology* and *The Annals of Thoracic Surgery*. In this article, we review the results of the annual report that was recently published in both journals.^{2,3} In addition, we review several important in-depth reports generated with TVT Registry data.

DATA REVIEW

The published annual report reviews TVT Registry data for the transcatheter valve but cannot, due to manuscript length limitations, cover all procedures in detail. The most recent annual report reviewed data from all patients entered in the TVT Registry since its inception

at the end of 2011 through December 31, 2015. Data from procedures performed in 2016 will be added to the next annual report.

From 2012 through the end of 2015, 418 hospitals had established TAVR programs and 54,782 procedures had been performed. There was a rapid increase every year for each of these procedures. In 2015, the self-expanding valve was approved by the FDA, and balloon-expandable valves were utilized in 66.4% of TAVR procedures versus 32.6% for self-expanding valves. New models of these valves that could be delivered through smaller sheaths led to an increase in femoral artery access site use, increasing from 75.9% in 2012 to 86.6% in 2015.

In-hospital deaths associated with TAVR have progressively decreased from 5.7% in 2012 to 2.9% in 2015, and 30-day mortality has similarly decreased from 7.5% to 4.6%. However, the 1-year mortality rate still remains relatively high, although there was a decrease from 25.8% in 2012 to 21.6% in 2014. The overall stroke rate was 2.1%. Major bleeding decreased significantly and transfusions were reduced by 50% during this period. At discharge or 30 days after the procedure, aortic regurgitation was none or trace in 64% of patients, mild in 29%, and moderate to severe in only 6.9%, improving over time. There was a progressive decrease in postprocedure aortic valve gradients at 30 days, with the gradient being ≥ 20 mm Hg in only 6.3% of patients in 2015.

There was some decrease in the preoperative risk of TAVR patients going from inoperable to high risk in the time period being studied based on FDA-approved risk populations. This, coupled with improvements in the TAVR devices and greater experience among those doing the procedures, all likely contributed to the improvements in outcomes, which were quite significant.

Since its inception, the TVT Registry has collected quality-of-life outcomes, stemming from a belief that quality of life is, in addition to operative mortality and morbidity, very important in these older higher-risk patients. The Kansas City Cardiomyopathy Questionnaire (KCCQ) has been the instru-

ment used for the measurement of quality of life. Arnold and colleagues studied quality-of-life outcomes after TAVR in the TVT Registry noting that the baseline KCCQ scores indicated “substantial health status impairment.”⁴ However, surviving patients had significant improvements in health status at 30 days persisting to 1 year. They noted that overall, 62.3% of these patients had a favorable outcome at 1 year, defined as alive with a reasonable quality-of-life score and, very importantly, identified baseline patient characteristics that were associated with worse quality of life at 1 year, which informs patients of the relative risks versus benefits of a procedure. They concluded, however, that “although the health status results were favorable for most patients, approximately one in three still had a poor outcome 1 year after TAVR,” noting that future efforts need to occur to improve these results. Alexander noted that, “Nowhere is a scientific approach to symptom assessment more relevant than for those in their mid-80s with severe aortic stenosis who report symptoms severely limiting their enjoyment of life.”⁵

From 2013 through 2015, there were 176 sites that performed 3,745 TMVC procedures. This was reviewed in the annual report for only 2014 and 2015 since a major article by Sorajja et al recently reviewed TVT-R mitral clip procedures performed prior to 2014.⁶ TMVC procedures are approved for commercial use only for patients with severe mitral regurgitation who are at prohibitive risk for a surgical mitral valve repair—this group tends to be quite ill, as the median age is 81 years and > 50% are frail. The STS Predicted Risk for Operative Mortality (PROM) score for mitral valve repair was 6.1% during 2014 and 2015, and 14.5% of patients were on home oxygen. TMVC procedures are fairly low risk, with an overall 30-day mortality rate of 5% during this period and only a 0.7% incidence of stroke at 30 days. Mitral valve reintervention was extremely low at 0.6%, and mitral valve regurgitation at discharge or 30 days was none, trace, mild, or moderate (grade ≤ 2) in 86% of patients, with very low mitral valve gradients of ≤ 5 mm Hg in 74% of patients.

Sorajja and colleagues noted very similar results compared to the findings of the past 2 years, with an overall procedure success rate of 90.6% in patients who were at high risk for a surgical mitral valve repair with a predicted STS PROM score of 7.9%, 57% of whom were frail. Mortality was similarly low and mitral valve regurgitation was reduced to grade ≤ 2 in 93% of their patient population.

TMViV and TMViR procedures were performed for humanitarian reasons in 349 patients and entered into the TVT Registry from 2013 through 2015. The procedures involved insertion of a transcatheter aortic valve into a degenerated surgical mitral valve bioprosthesis or a mitral ring with recurrent mitral regurgitation. Of

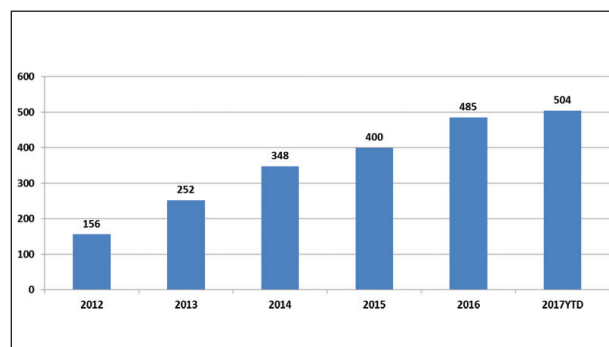


Figure 1. Sites enrolled in the TVT Registry. Note the progressive annual increase in sites from 2012 through 2017 year-to-date.

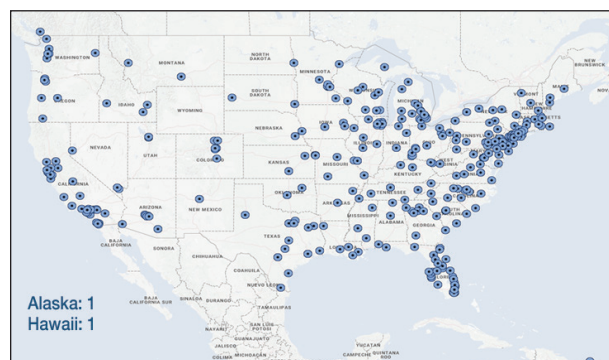


Figure 2. TAVR centers in North America. The distribution of sites is widespread, with the greatest concentration of sites primarily in densely populated areas.

these 349 procedures, 76% were TMViV, and 24% were TMViR. The median STS PROM score was 11% overall and consistent over the years, a hostile chest was present in 13% of patients, and home oxygen was needed in 15%. Seventy percent of patients had transapical access and 24% underwent transseptal access. In-hospital mortality was 7.2% and 30-day mortality was 8.5%, both of which were less than the STS PROM score of 11%. Postprocedure morbidity was low considering the complexity of these patients, and valve performance was quite good, with no mitral insufficiency being seen on echocardiography in 48% of patients; trace, trivial, or mild mitral insufficiency was observed in 33%; and moderate, moderate to severe, or severe was seen in only 2.6%. In addition, the median mitral valve gradient was ≤ 6 mm Hg, and left ventricular outflow obstruction developed in only 1.4% of patients.

LIMITATIONS

In the early stages of a newly developed registry, there are frequently issues with the data completion of certain data elements and some misinterpretation of data element definitions, which must be closely monitored and

corrected. The TVT Registry was not an exception, and for that reason, the percent of missing data for specific variables was listed in the tables of the annual report. Due to diligent efforts by TVT Registry staff in terms of daily education, annual face-to-face educational meetings with data managers, and electronic data checks, data completeness has significantly improved. For example, baseline KCCQ completeness rates have increased from 74% in 2013 to 90% in 2015, from 74% to 85% for 30 days postprocedure, and from 66% to 73% at 1 year postprocedure.

In regard to accuracy, an independent audit was performed in 2016, which showed 85% accuracy overall, being highest at baseline (preprocedure). In 2017, and annually thereafter, random audits will occur at 10% of programs. The TVT Registry also utilizes a link with CMS data to augment 1-year data capture.

DATA IMPACT

Thus far, 20 publications have resulted from the TVT Registry. There has been and continues to be considerable interest in identifying patients who are ideal candidates for transcatheter valve therapy, not only those who are good candidates, but also those in whom risks may outweigh the benefits resulting in questionable benefits of the procedure. One such publication from the TVT Registry by Arsalan and colleagues explored this and illustrates the complexity of this issue.⁷ In a study of TAVR procedures performed between November 2011 and September 2014, there were 3,773 (15.7%) patients who were 90 years of age or older. The 30-day and 1-year mortality rates were significantly higher in patients 90 years and older compared with those younger than 90 years (8.8% vs 5.9%; and 24.8% vs 22%; respectively). Major complications were fairly similar in nonagenarians. Nonagenarians had lower median KCCQ scores at 30 days after the procedure. However, at 1 year, there was no difference in these scores between them and the younger patients.

The authors noted that patients who were 90 years and older had statistically higher mortality rates, but the differences in mortality were clinically modest, and at 1 year, there appeared to be the same improvement in quality of life as in the younger patients. The authors, therefore, concluded that it is reasonable to perform TAVR in these patients, unless they have other comorbidities that would put them at a much higher risk than the rest of their age group, emphasizing the importance of individualizing patient care.

Along the same lines, a study has been proposed and funded by the Patient-Centered Outcomes Research Institute to help optimize health outcomes in patients with symptomatic aortic valve disease. This study will use the existing STS/ACC TVT Registry plus the Society

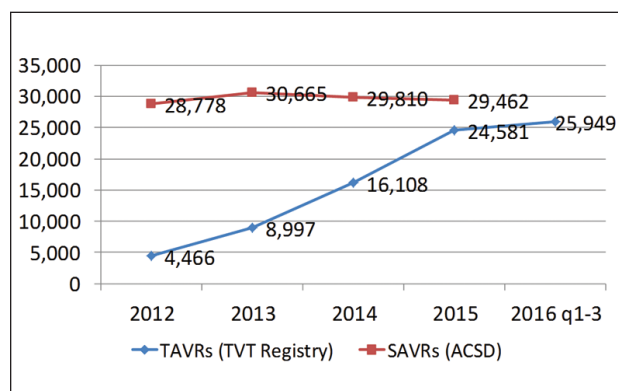


Figure 3. TAVR and surgical AVR procedures in the TVT Registry and STS Adult Cardiac Surgery Database. Note the rapid annual growth of TAVR procedures compared to the relatively static number of surgical AVRs with almost equal numbers in 2016.

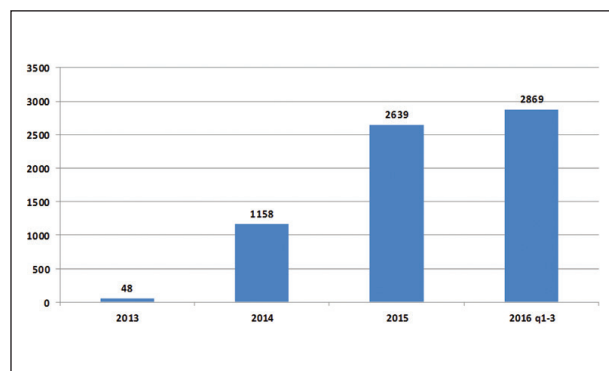


Figure 4. Commercial mitral leaflet clip procedures. There has been a considerable increase in the number of TMVC procedures performed annually with a total of 6,741 at 212 sites.

of Thoracic Surgeons Adult Cardiac Surgery Database data to develop decision assistance tools to help patients and their families evaluate their expected outcomes, and involve them in the care planning process.

Fadahunsi et al reviewed the incidence, patient and treatment characteristics, and outcomes of those requiring permanent pacemakers after TAVR.⁸ They noted that in patients operated on from November 2011 through September 2014, the need for a permanent pacemaker occurred more frequently in patients who had a higher STS PROM score, were older, and who had a previous conduction defect. It also occurred more frequently in those who received self-expanding TAVR devices versus those who had balloon-expandable devices, was associated with longer hospital and intensive care unit stays, and an increased 1-year mortality and composite of 1-year mortality or heart failure

readmission. Most of these pacemaker procedures were required in the first week after the TAVR procedure, but a small number continued beyond that. One question that arises is whether unrecognized heart block after discharge could be associated with long-term mortality after TAVR.

Three manuscripts have also been submitted for publication: one involving the relationship between learning curves and procedure volume over time on outcomes for TAVR in United States clinical practice, and another evaluating TAVR function by echocardiography looking specifically for development of aortic gradients and/or insufficiency. The third study (TAVR in degenerated surgical AVR or TAVR bio-prosthesis) is an investigation of the indications and results of TAViV procedures, which has recently been completed and was presented at the annual meeting of the ACC in March 2017.

CURRENT ACTIVITY

A TAVR 30-day operative mortality risk model is currently being developed, and eventually risk models will be developed for 1-year mortality and other outcomes. A stroke risk model is in the final stages of development, and in the near future the TVT Registry hopes to have a composite model including mortality and various morbidities. A dataset work group has been formed and will add pertinent variables for tricuspid valve evaluation, appropriate use criteria, and eventually transcatheter mitral valve replacement. In addition, data variables that are judged not valuable for the mission will be eliminated to ease the burden of data collection. Consideration is also being given to initiating voluntary public reporting.

It is important to provide an update as to where the TVT Registry stands as of January 18, 2017, in terms of volume of centers and procedures. There are now 485 TVT Registry sites and more than 80,000 patients (Figure 1) in the United States who have undergone FDA-approved TAVR therapy as compared with 418 sites and 54,782 patients at the end of 2015. The centers are dispersed as shown in Figure 2. As of September 30, 2016, the number of surgical AVRs and TAVRs performed in the United States is very similar and growing closer (Figure 3). Also, as of September 30, 2016, a total of 6,714 TMVC procedures have been performed at 212 sites as compared with 3,745 procedures at 176 sites at the end of 2015 (Figure 4). A total of 720 TMViV and TMViR procedures have been performed at (approximately 100) sites through the third quarter of 2016 as compared to the 349 procedures through the end of 2015.

CONCLUSION

The TVT Registry has continued to mature since its inception in 2011 and serves as an important source of information for these novel new structural heart devices during the early postmarket approval period. It also serves as a source for numerous research projects, quality improvement, and patient safety. Like many databases early in their development, missing data still present challenges, but many mechanisms are being utilized to improve this and there has been significant improvement in data acquisition in each year of the study. To be absolutely certain that the data are high quality, the TVT Registry has contracted for random audits of 10% of centers each year by an independent group that also audits the STS databases and this, with the continued education of the data managers and the health care teams that are involved, has resulted in improved quality and completeness of data. ■

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