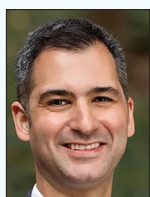


PANEL DISCUSSION

Contemporary Strategies in Minimalist TAVR

How streamlined workflows, selective sedation strategies, and multidisciplinary care models are driving minimalist pathways for transcatheter aortic valve replacement.

With Yousif Ahmad, MBBS, PhD, FACC, FSCAI; Tara L. Jones, MD, PharmD; Dhaval S. Kolte, MD, MPH, PhD, FACC, FSCAI; and John T. Saxon, MD



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How do you define “minimalist” transcatheter aortic valve replacement (TAVR) at your institution? Do you utilize nurse-led sedation or anesthesia?

Dr. Jones: Minimalist TAVR consists of conscious sedation, transthoracic echocardiogram (TTE), and radial arterial access as the secondary access point. Currently, we do still use anesthesia-directed sedation, although we are exploring nurse-led sedation as an option.

For preoperative evaluation, we have moved to requiring only CTA of the chest, abdomen, and pelvis and TTE to fast-track TAVR evaluation and the procedure itself, reserving all other preoperative evaluation (ie, coronary angiography) for specific instances only.

Postprocedurally, patients ambulate after 4 hours of bed rest, and discharge occurs the next morning, barring any outstanding issues like conduction system disease. We have also implemented a relationship with electrophysiology (EP) such that if there are conduction system issues postdeployment that would have previously required a transvenous pacemaker to remain in place, EP will place a temporary-permanent lead before the patient leaves our room to allow for early ambulation.

Dr. Kolte: We consider minimalist TAVR as monitored anesthesia care (MAC) with moderate sedation/analgesia, TTE, transfemoral access, no arterial line, and no Foley catheter. The patient goes to the postanesthesia care unit (PACU) and then to the cardiology floor, with discharge home.

the next day if there are no complications. We use a cardiac anesthesia team because we perform TAVRs in the hybrid operating room, and we have dedicated anesthesia staffing available to us on the designated TAVR days.

Dr. Saxon: We use the minimum-required vascular access and minimum-required sedation for each TAVR. We have an algorithm for nurse-led sedation, and around 15% of our cases are nurse-led sedation only. The remainder are treated with an anesthesiologist, of which the vast majority are monitored anesthesia. Only 5% of our cases involve general anesthesia, and these are usually for another reason (eg, alternate access, leaflet modification).

Dr. Ahmad: We try to use minimalist TAVR for all our patients where possible. This involves conscious sedation delivered by our cardiac anesthesia colleagues, as well as use of the radial artery as the secondary access site and for invasive arterial pressure monitoring for anesthesia, eliminating the need for a separate arterial line. These interventions are all part of our standard approach. We also selectively use left ventricular pacing for appropriate cases.

All of our patients then go to the telemetry floor and do not require intensive care unit admission unless there are any specific extenuating factors during the case. We ambulate patients early and aim to discharge them in the morning of postoperative day 1.

Which patients are ideal candidates for a minimalist TAVR approach?

Dr. Kolte: All patients except alternate (nontransfemoral) access and those with baseline conduction disease who often require > 24 hours of in-hospital stay.

Dr. Ahmad: For us, this would be extreme-risk patients who might require perfusion backup, need for leaflet modification or other extreme risk anatomy where we might prefer to utilize transesophageal echocardiography (TEE) for procedural guidance, or vascular anatomy that mandates alternative access. Outside of these high-risk clinical and anatomic phenotypes, we try to take a minimalist approach for all patients.

Dr. Saxon: Ideal candidates have few comorbidities and are the most likely to tolerate a minimal sedation approach. We have a rigorous screening method for minimalist TAVR to pick up on expected complexities with sedation, hemodynamics, or airway issues.

Dr. Jones: Most of our patients go through our aforementioned “minimalist TAVR” pathway. Alternative access or extreme comorbidities necessitating general anesthesia are really the only exceptions.

What evolutions in the TAVR field have been most impactful in making a minimalist TAVR pathway reality?

Dr. Saxon: As lower-risk categories have been incorporated into management of aortic stenosis, TAVR has become the dominant approach. As with any procedure, increasing volume has a relationship with procedural skill and reducing procedural time and complexity; in minimalist TAVR, we are now comfortable with the less-is-more approach even despite the large-bore access that is required.

Dr. Kolte: Many developments have been instrumental in making the minimalist TAVR pathway a reality, including:

- Patient candidacy: The shift from high to intermediate to low risk, with associated decrease in comorbidity burden (eg, chronic lung disease, chronic kidney disease/dialysis, peripheral artery disease, dementia).
- Technology: The development of hydrophilic, expandable sheaths and improvements in delivery systems, which allow for transfemoral access in the majority of patients and enable safe navigation across tortuous anatomy.
- Technique: The cusp overlap method for self-expanding valves has resulted in more predictable depth of deployment and a reduced need for permanent pacemaker implantation.
- Team structure: Having dedicated implanters (interventional cardiologists/cardiothoracic surgeons), echocardiographers, and cardiac anesthesiologists has been an absolute key, as has cath lab nurses and techs who are familiar with the equipment and workflow.

Dr. Ahmad: The maturity of the procedure as a whole has really aided us here. Standard preprocedural CT imaging and a more sophisticated understanding of favorable versus unfavorable anatomy has allowed us to gain confidence in the anatomies that can be well-treated with TAVR with a low risk of complications. In a similar way, we can identify patients at higher risk of complications and therefore take additional precautions to ensure we can treat these patients safely and successfully. These are the patients we do not necessarily want to adopt a minimalist approach for.

Lower-profile sheaths for vascular access have made severe vascular complications and bleeding much less common than in the early days. Newer valve technology has also reduced the incidence of paravalvular leak, and our implantation techniques have become more nuanced to help minimize conduction disturbance.

Dr. Jones: Certainly, the ability to stay femoral in most cases has made this approach more realistic. This mostly relates to smaller access sheath sizes compared to the early days of TAVR, as well as the ability to use intravascular

lithotripsy in cases where vessel caliber is okay but there is concern for heavy calcification.

Our valve team shares a like-mindedness in favor of safe but expedited care. Transitioning to a preoperative evaluation consisting mostly of CTA only has allowed us to expedite care for our patients. Additionally, early ambulation and eliminating the need for a higher level of care in the case of post-TAVR conduction system issues have led to more expeditious discharge.

In what ways does a minimalist TAVR pathway streamline the overall workflow? What specific benefits and outcomes have been demonstrated in your program?

Dr. Ahmad: A minimalist pathway for TAVR is the rare thing in medicine that benefits all stakeholders—patients, treating clinical teams, and hospital systems. Patients much prefer fewer femoral punctures, earlier ambulation, and rapid discharge. This approach also make us feel comfortable as implanters, and it allows us to treat more patients by improving throughput and efficiency while maintaining safety.

Dr. Jones: Programmatically, minimalist TAVR allows us to achieve our referral time-to-TAVR goal of within 3 weeks in the majority of cases. The major factors in this are the more concise pre-TAVR evaluations, less alternate access, and the use of conscious sedation to allow for more cases to be scheduled on any given day.

Dr. Saxon: Most patients go home the next day, and we have even instituted a same-day discharge program for TAVR, which is possible for 15% of our patients. Specific benefits and outcomes of a minimalist TAVR pathway include improved recovery, quicker ambulation, and a far higher percentage of discharge to home rather than to rehab or skilled nursing facility.

Dr. Kolte: It has given us the ability to do more cases on a given day. We went from two TAVR cases per day with general anesthesia and TEE to four per day with MAC and TTE. This has in turn resulted in reduced wait times from referral/evaluation to TAVR, and increased volume. Furthermore, next-day discharge is beneficial for patients/families and the hospital/health care system.

How would you summarize the primary day-to-day challenges of running a minimalist TAVR pathway? What were the biggest hurdles during early implementation?

Dr. Jones: We are currently in the process of trying to improve our program further with the implementation of nurse-led sedation, and one of the challenges we are facing

is selecting which patients are appropriate. To address this, we have ongoing discussions with our anesthesia colleagues and other members of the valve team to ensure all parties are comfortable.

Dr. Saxon: Patient selection requires a true multidisciplinary approach, including input from anesthesiologists, interventional cardiologists, surgeons, nurses in the cath lab and recovery units, and advanced practice providers, and that can be a challenge. During early implementation, we encountered our biggest hurdles in changing from a model of maximum intervention to minimum, getting comfortable with the new treatment pathways, and nursing getting used to sedating these patients who were previously handled by anesthesiologists. Our route was to find engaged and interested nurses who were open-minded about treatment paradigms and new approaches; this team was the one to spearhead our efforts and get the program going.

Dr. Kolte: Some of the hurdles were, and still are, the variable level of patient sedation, depending on anesthesiologist comfort; accepting the fact that some patients will need to be converted to general anesthesia for various reasons and being prepared to do so when needed; ensuring the anesthesia team has access to the venous sheath for central access and the arterial sheath for continuous invasive blood pressure monitoring; and the PACU hold (ie, time waiting for a bed in the PACU because the procedure is now “too” efficient/quick).

What safeguards are/should be in place to ensure efficiency does not come at the expense of patient safety?

Dr. Saxon: We’ve found that it’s important to have continuous review of outcomes, frequent debriefings, morbidity and mortality conferences, data collection and review, and multidisciplinary input.

Dr. Kolte: Safeguards include continuous hemodynamic and airway monitoring, the ability to quickly convert to general anesthesia when needed, and maintaining standard practices for safe large-bore access (eg, ultrasound guidance, micropuncture, femoral angiogram, use of closure devices per institutional practice).

Dr. Jones: As mentioned, we are exploring patient-specific criteria to allow for safe and effective use of nurse-led sedation.

Dr. Ahmad: The valve team is the cornerstone here. Thorough patient evaluation helps you identify patients who require additional precautions that you cannot skip to ensure that the procedure can be completed safely.

How has your group tracked and/or documented the efficiencies with your minimalist approach?

Dr. Kolte: We initially monitored TAVR wait time, procedure time, time to obtain PACU bed, and room turnover time, and we continue to track procedure volumes.

Dr. Ahmad: We have a quality improvement team as part of our valve team that tracks all our outcomes, including efficiency metrics.

Dr. Jones: We are tracking time from referral to TAVR as the major quality measure. We also have monthly morbidity and mortality meetings where we review any adverse events and discuss whether or not they were related to any of the preoperative, postoperative, or perioperative proceedings.

Dr. Saxon: We specifically have tracked our rates of MAC and nurse-led sedation over time, which have consistently shown increasing adoption over the years.

How have your results with this pathway been received at the division and hospital level?

Dr. Kolte: The minimalist TAVR pathway has been received positively due to the clear benefits of increased volume and throughput.

Dr. Saxon: The pathway has been received favorably.

Dr. Jones: From a hospital and divisional standpoint, this pathway is more cost-effective and allows for more expeditious care for our patients; thus, it has been well received.

What modifications to your process have you made since initial implementation, changes that could help flatten the curve for new adopters?

Dr. Kolte: We share the arterial sheath with anesthesia to eliminate the need for them to place a separate arterial line. We also have the nurses call the PACU for a bed at the start of the case to reduce the time waiting for a bed after the procedure.

Dr. Saxon: The primary modification has been an algorithm for candidacy for nurse-led sedation, and it has been validated with our successful implementation.

Dr. Jones: The best advice I can give is to have representatives from all parties (surgery, interventional cardiology, cath lab nursing, and anesthesia) present when designing pathways so there is buy-in from the entire team.

What does the increase of minimalist TAVR pathways mean for the trajectory of the structural heart field in the years to come? Is there a possibility of extending the minimalist structure to other structural/valvular interventions?

Dr. Saxon: I think we will see increased access to procedural efficiencies as volumes rise and resources (eg, anesthesiologists) become scarcer. We have instituted a nurse-led sedation-only program for transcatheter tricuspid valve replacement (TTVR) with Evoque (Edwards Lifesciences), using intracardiac echocardiography (ICE) for guidance. These patients are sicker, with more comorbidities than a typical TAVR patient; however, they do benefit from less sedation and shorter procedure times as their recovery is quicker. We are always looking for other procedures to streamline sedating practices.

Dr. Jones: As intraprocedural imaging like ICE continues to evolve, I think that minimalist TAVR will serve as an example for how structural interventions can be done in a more expeditious fashion. Mitral and tricuspid interventions rely heavily on TEE guidance for success and thus often require general anesthesia. However, we do follow a similar pathway of early ambulation and next-day discharge for the vast majority of these cases.

Dr. Ahmad: I believe a minimalist approach should be adopted for all our interventions where possible. TAVR has benefited from a tremendous amount of clinical research that has helped shape the field and increase our confidence in being able to adopt these interventions and pathways without sacrificing safety or efficacy.

Dr. Kolte: Overall, it means we'll continue to see increased throughput and procedural volume, with potentially higher margins for the hospital for TAVR. Extending the minimalist structure to mitral/tricuspid valve interventions will be challenging, as these procedures are still predominantly TEE guided. However, I think ICE-guided orthotopic TTVR, as well as heterotopic TTVR, will move the field toward a minimalist pathway for tricuspid valve interventions. ■

Disclosures

Dr. Ahmad: Consultant to Edwards Lifesciences.

Dr. Jones: None.

Dr. Kolte: Receives research funding from the NIH/NHLBI, Medtronic, and Edwards Lifesciences outside of the submitted work; CEC member for Tioga Cardiovascular, Inc.

Dr. Saxon: Consultant to and proctor for Edwards Lifesciences, Medtronic, Abbott Vascular, W.L. Gore, and Johnson & Johnson.