Mapping Procedural Data in Transcatheter Aortic Valve Implantation to Predict Patient Recovery & Functional Outcome

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Background

Transcatheter Aortic Valve Implantation (TAVI) is a multifaceted procedure wherein critical stages and actions including sheath access, pacing wire placement and valve deployment influences patient outcomes. Current interventional cardiac practices rely heavily on operator expertise, with studies showing significant interobserver variability1. However, the precise relationship between these procedural steps and metrics of outcomes remains an understudied aspect of TAVI.

The involvement of Artificial Intelligence (AI) in imaging modalities for cardiac procedures has been recognised and researched and shows potential for the implementation of AI in TAVI procedures 2. Using the data capture in our proceduralist platform we can capture, retain and analyse the proceedings.

Methodology

This is a prospective quantitative cohort study of 112 TAVI cases that were selected by stratified random sampling strategy from our interventional unit over the 14month period February 2024-May 2025 at our University Clinic. Procedural capture and data analysis of TAVI interventions Data collection involved procedural tagging, time-stamping and chaptering of 20 steps. Images and videos of each step were recorded and documented for visual representation. The type of device, valve and deployment were also documented.

These steps are mapped to post-operative outcomes in the periprocedural and 6-12 weeks follow up including; NYHA class, Quality of Life scores (QoL), echocardiographic parameters (para-valvular leakage (PVL) severity, mean aortic gradient changes) and pacemaker / Left Bundle Branch Block (LBBB) incidence. Correlation analysis was conducted between procedural timing and recovery outcomes to assess efficiency and inform future benchmarking.

Objective

To investigate how intraoperative procedural TAVI data correlates with post-operative outcomes and influences complication rates and recovery trajectories using the SXR platform.

Results – Aortic Gradient, NYHA class & complications

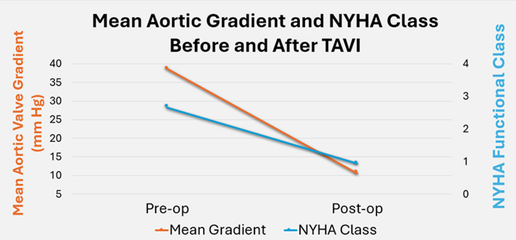

Figure 1: *Significant reduction in both aortic gradient and NYHA class observed across the cohort following TAVI.*

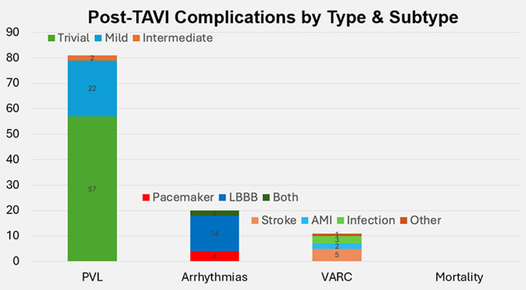

Figure 2: *Mild PVL and LBBB were the most frequent post-operative complications. No patient mortality was recorded*

Results

This study demonstrates the potential of using the Surgical XR® platform to capture and analyse intraoperative data in a structured way. We have previously published our findings in other uses of the SXR-PPE platform to improve education, compliance and remediation in real-time3. While our current data presented is limited, our early findings suggest that procedural variability may influence post-operative outcomes such as aortic gradient, arrhythmias and NYHA class 4.

More importantly, this methodology provides a framework for benchmarking operator performance and identifying modifiable steps that could impact recovery. By enabling detailed post-hoc review, the platform supports consistency, procedural education, and future integration with decision support tools even before real-time guidance is fully implemented5.

Results – End state images (ESI) of TAVI Deployment

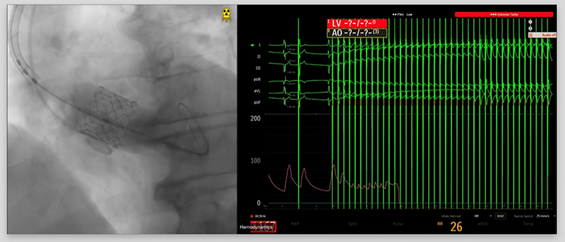

Figure 3:
End-state imaging of TAVI deployment showing balloon inflation under fluoroscopy with concurrent haemodynamic trace. This critical capture enables post-operative assessment of valve positioning, pacing effectiveness, and residual aortic regurgitation, forming a benchmark for procedural review and AI training.

Discussion

Mapping procedural data to outcomes allows for objective benchmarking in TAVI. By linking intraoperative metrics with post operative measures of success (including echocardiography parameters), NYHA improvement, and complication rates, this methodology can support consistent performance and better recovery. Current directions include validating these models against multi-center datasets to ensure generalizability and robustness.

The Surgical XR® platform enables data-driven feedback and lays the foundation for real-time support and AI integration5 moving TAVI toward more standardised, high-quality delivery.

For more information scan the QR code

References

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