Perioperative Neurological Injury in Intermediate-Risk Patients Undergoing Transcatheter Aortic Valve Implantation (TAVI)

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Background

TAVI has substantially expanded the therapeutic options for high-risk and inoperable patients with severe aortic stenosis. Success in this setting, and the prospect of a less-invasive technique than open-heart aortic valve replacement has fuelled enthusiasm for expanding the indication to lower-risk patients. However, the procedure is associated with one of the highest incidences of perioperative neurological injury primarily due to cardiogenic emboli (Figure 1). While the attendant risk may be acceptable to those considered of inoperable/high-risk, this may not be so for lower-risk patients who have both more time for neurological sequelae to manifest and alternate management options available to them.

Aims

This study provides the first ‘real-world’ assessment of perioperative neurological injury associated with TAVI undertaken in intermediate-risk patients. Specifically, the primary aim was to characterise the incidence of cerebrovascular events defined by diffusion-weighted imaging (DWI). The secondary aim was to describe clinically apparent neurological injuries, including major/minor stroke, transient ischemic attack, post-operative cognitive dysfunction (POCD), and post-operative delirium (POD).

Methodology

Forty patients undergoing TAVI with the SAPIEN-XT™ (Edwards Lifesciences) under general anaesthetic at The Prince Charles Hospital, Australia, provided written consent (HREC/12/QPCH/291) and were prospectively studied. In addition to routine TAVI work-up, participants underwent: 1) brain magnetic resonance imaging (MRI) with DWI sequences, <24hr pre- and 3-days post-procedure; 2) serial neurological (National Institute of Health Stroke Scale [NIHSS]) and cognitive (Montreal Cognitive Assessment tool [MoCA]) and delirium assessments (Cognitive Assessment Method [CAM]); 3) pre-procedural carotid Doppler ultrasonography and non-contrast computed tomography scan of the chest; 4) health-related quality of life assessment (EQ-5D and Kansas City Cardiomyopathy Questionnaire [KCCQ]); and, 5) functional assessment (6-minute walk distance [6MWD] and 5-meter walk time [5MWT]) at baseline and 6 months.

Results

Baseline characteristics of study subjects and radiological and clinical outcomes are summarised in Tables 1, 2 and 3, respectively.

Table 1. Baseline characteristics

<table>
<thead>
<tr>
<th>Baseline characteristic</th>
<th>Measure</th>
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<tr>
<td>Age (years)</td>
<td>84 ± 19</td>
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<tr>
<td>Frax index</td>
<td>81.7 ± 6.9</td>
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<tr>
<td>Overall event</td>
<td>60%</td>
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<td>MRI-detected injury</td>
<td>83 (15%)</td>
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<tr>
<td>Total</td>
<td>24 ± 19</td>
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Topographical distribution: Anatomical characterisation of lesions identified 80% of infarcts as cortical, 90% (p<0.0001) in the posterior circulation and 81% (p<0.0001) in the right hemisphere (Figure 2).

Cognition: When patients were stratified based on the occurrence of DWI lesions (Figure 3) in those who suffered lesions demonstrated significantly reduced cognitive performance compared to those who did not on the early postoperative MoCA assessments (p<0.001). There was moderate correlation between the degree of early cognitive dysfunction and DWI lesion burden (r = 0.45). However, cognitive performance had resolved by the 6 week follow-up time point.

Functional outcomes: There was no statistically significant difference noted between the 6 month and baseline assessment results for the 6MWD or 5MWT. Longitudinal regression analysis identified time, gender, frailty and TAVI procedure duration as potential predictors of reduced 6MWD and frailty index for reduced 5MWT.

Quality of life outcomes: A statistically significant improvement was identified in the disease-specific KCCQ overall score at 6 months compared with baseline (63 ± 19 vs. 50 ± 13; p = 0.002). Using pre-specified categorical levels 8% of patients had a poor outcome, 17% were unchanged, and 75% showed improvement (21% slight, 29% moderate and 25% substantial). However, improvement in quality of life was not statistically significant when evaluated with the generic EQ-5D. There was no difference in either assessment measured when stratified according to the presence or absence of DWI positive lesions.

Multiple variable analysis: Logistic regression failed to identify any significant association between the occurrence of DWI positive lesions (by number or volume) and any of the potential predictors. A post hoc power calculation confirmed the study was adequately powered to detect important changes (>1.5) in the odds ratio.

Conclusions

The incidence of objectively measured cerebrovascular events remains a concern in intermediate-risk patients. Topographical distribution of MRI-defined infarction suggests vulnerability of the cortical grey matter, posterior circulation and right hemisphere. Although lesion occurrence was associated with reduced early cognition, no other implications for health could be identified, including for longer-term cognition.