

Surgeon volume and outcomes following thoracic endovascular aortic repair for blunt thoracic aortic injury

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Introduction

- Thoracic endovascular aortic repair (TEVAR) for blunt thoracic aortic injury (BTAI) at high-volume hospitals has previously been shown to be associated with lower perioperative mortality
- But the impact of annual surgeon volume on outcomes following TEVAR for BTAI remains unknown

Methods

Study Design

- We identified patients undergoing TEVAR for BTAI in the VQI from 2013-2023
 - Annual TEVAR (proximal zone 0-5) volume for surgeons and centers: 1 year before index procedure
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 graph TD
 A[Annual case volume] --> B[Lowest quintile]
 A --> C[Middle quintiles]
 A --> D[Highest quintile]
 B --> E[Low volume]
 C --> F[Medium volume]
 D --> G[High volume]
 H[1 year before index procedure] --> I[Index procedure]

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- We excluded cases performed by surgeons who did not enter the VQI TEVAR/EVAR modules at least one year before index procedure

### Outcomes and analysis

- Perioperative mortality and postoperative complications → Chi-square test and Kruskal-Wallis test
- Adjusted outcomes → multilevel logistic regression models accounted for the nested clustering of patients and surgeons within the same center + adjusted for confounders
- Sensitivity analysis excluding Grade IV BTAI patients was performed

## Results

1,321 patients that underwent TEVAR for BTAI stratified by annual surgeon volume

**Table 1a. SVS aortic injury grades and co-existing injury characteristics**

|                                         | Low-volume surgeon (n = 370) | Medium-volume (n = 688) | High-volume (n = 263) | P-value     |
|-----------------------------------------|------------------------------|-------------------------|-----------------------|-------------|
| <b>SVS aortic injury grade</b>          |                              |                         |                       | <b>.003</b> |
| Grade I                                 | 7.6%                         | 6.8%                    | 7.6%                  |             |
| Grade II                                | 20%                          | 18%                     | 17%                   |             |
| Grade III                               | 51%                          | 60%                     | 65%                   |             |
| Grade IV                                | <b>22%</b>                   | <b>16%</b>              | <b>10%</b>            |             |
| <b>Sensitivity analysis</b>             |                              |                         |                       | <b>.261</b> |
| Grade I                                 | 9.5%                         | 8.6%                    | 8.4%                  |             |
| Grade II                                | 25%                          | 21%                     | 18%                   |             |
| Grade III                               | 65%                          | 70%                     | 74%                   |             |
| <b>Injury severity score categories</b> |                              |                         |                       | <b>.021</b> |
| Moderate (ISS 9-15)                     | 13%                          | 8.4%                    | 9.1%                  |             |
| Severe (ISS 16-24)                      | 13%                          | 17%                     | 18%                   |             |

### 1b. Procedural/intraoperative characteristics

|                            | Low-volume surgeon (n = 370) | Medium-volume (n = 688) | High-volume (n = 263) | P-value          |
|----------------------------|------------------------------|-------------------------|-----------------------|------------------|
| <b>Procedure time, min</b> | 50-120                       | 48-104                  | 43-90                 | <b>&lt; .001</b> |
| <b>Contrast volume, ml</b> | 45-110                       | 45-100                  | 40-94                 | <b>.011</b>      |
| <b>Heparin use</b>         | 80%                          | 81%                     | 87%                   | <b>.007</b>      |
| Grade I-III alone          | 80%                          | 82%                     | 91%                   | <b>&lt; .001</b> |
| <b>Urgency</b>             |                              |                         |                       | <b>&lt; .001</b> |
| Elective                   | 5.1%                         | 8.9%                    | 14%                   |                  |
| Urgent (<24 hours)         | 27%                          | 37%                     | 41%                   |                  |
| Emergency (<4 hours)       | 68%                          | 54%                     | 46%                   |                  |
| <b>Grade I-III alone</b>   |                              |                         |                       | <b>&lt; .001</b> |
| Elective                   | 6.2%                         | 10%                     | 14%                   |                  |
| Urgent (<24 hours)         | 31%                          | 42%                     | 42%                   |                  |
| Emergency (<4 hours)       | 63%                          | 48%                     | 43%                   |                  |

## Results

**Table 2. Perioperative outcomes stratified by annual surgeon volume: unadjusted rates and adjusted odds ratios [confidence intervals]**

|                                                             | Low-volume surgeon (n = 370) | Medium-volume (n = 688) | High-volume (n = 263)   | P-value         |
|-------------------------------------------------------------|------------------------------|-------------------------|-------------------------|-----------------|
| <b>Perioperative mortality</b>                              | 11%                          | 7.3%                    | 6.5%                    | <b>.095</b>     |
| <b>Ischemic/hemorrhagic stroke</b>                          | 6.5%                         | 3.6%                    | 1.5%                    | <b>.006</b>     |
| <b>Ischemic stroke</b>                                      | 4.7%                         | 2.8%                    | 1.1%                    | <b>.034</b>     |
| <b>Reintervention during index admission (BTAI related)</b> | 4.7%                         | 1.8%                    | 1.9%                    | <b>&lt;.001</b> |
| <b>Adjusted outcomes*</b>                                   |                              |                         |                         |                 |
| <b>Perioperative mortality</b>                              | Ref.                         | <b>0.49 [0.25-0.97]</b> | 0.45 [0.16-1.22]        |                 |
| <b>Ischemic/hemorrhagic stroke</b>                          | Ref.                         | <b>0.38 [0.18-0.81]</b> | <b>0.16 [0.04-0.61]</b> |                 |
| <b>Ischemic stroke</b>                                      | Ref.                         | 0.42 [0.17-1.00]        | <b>0.19 [0.05-0.76]</b> |                 |
| <b>Reintervention during index admission (BTAI related)</b> | Ref.                         | <b>0.31 [0.12-0.77]</b> | <b>0.17 [0.03-0.89]</b> |                 |

\*Adjusted for age, sex, anemia, renal dysfunction, Injury Severity Score, Traumatic Brain Injury, SVS aortic injury grade, TEVAR center volume, left subclavian revascularization

- Sensitivity analysis showed directionally consistent results

## Conclusions

- In patients undergoing TEVAR for BTAI, higher surgeon volume is independently associated with lower rates of elective repairs, higher rates of heparin use, lower perioperative mortality and postoperative stroke, regardless of center volume.
- Future studies should elucidate if TEVAR for non-ruptured BTAI, when feasible, may be delayed to allow stabilization, heparinization, and involvement of a higher TEVAR volume surgeon

