Chest Wall Injury Society

Title of Presentation Rib Fixation Still Helps: Surgical Stabilization of Rib Fractures in Traumatic Brain Injury, A TQIP Study

Background

Surgical stabilization of rib fractures (SSRF) improves outcomes in patients with chest trauma, but its benefit in polytrauma patients with concomitant traumatic brain injury (TBI) remains controversial. We hypothesized that TBI phenotype modifies the association between SSRF and clinical outcomes

Methods

We conducted a retrospective cohort study using the TQIP (2017–2023) database. Patients ≥18 years old with concurrent head and thoracic injuries (AIS ≥ 3 for each region) were included; those with any AIS = 6, burns, or who died in the emergency department were excluded. TBI phenotypes were classified as focal, diffuse, mixed, or concussion-only using ICD-10 codes. Patients with ≥2 rib fractures were included. The primary outcome was in-hospital mortality; secondary outcomes were pulmonary complications (composite of ARDS, ventilator-associated pneumonia, or unplanned intubation) and total ventilator support days. Multivariable logistic regression with an interaction term for SSRF × TBI phenotype assessed effect modification, adjusting for age, sex, race, ISS, GCS, flail chest, need for respiratory assistance, early transfusion volume, and shock index. A generalized linear model with the same covariates analyzed ventilator days.

Results

Of 73,965 patients included, 80.4% had focal TBI, 12.5% mixed, 4.6% concussion-only, and 2.5% diffuse TBI. Overall, 3.3% underwent SSRF. Median age was 57 years [40–69]; 72.6% were male; and 12.8% died. A significant interaction was found between TBI phenotype and SSRF with respect to mortality ($p = 0.045$). SSRF was independently associated with lower mortality across all phenotypes, reducing odds of death by 76% in focal TBI, 92% in diffuse, 81% in mixed, and 90% in concussion-only injuries (all $p < 0.001$). SSRF showed no significant difference in pulmonary complications(OR 1.23, 95% CI 0.98–1.53, $p = 0.073$) or total ventilator days ($B = -0.15$, $p = 0.19$), and no significant interaction with TBI phenotype was observed for either outcome.

Conclusion

SSRF was significantly associated with reduced in-hospital mortality across all TBI phenotypes, indicating that TBI does not diminish the survival benefit of rib fixation. TBI phenotype did not modify SSRF's effect on pulmonary complications or ventilator duration. These findings support phenotype-based patient selection for SSRF, favoring intervention even in the presence of TBI

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Table 1. Effect of SSRF on Clinical Outcomes

Outcome	Adjusted Effect of SSRF	Interaction p-value
Mortality (Primary)		0.045
Focal TBI	OR 0.25 (0.20-0.32), p<0.001	
Diffuse TBI	OR 0.08 (0.02-0.34), p<0.001	
Mixed TBI	OR 0.20 (0.12-0.34), p<0.001	
Concussion	OR 0.13 (0.04-0.44), p<0.001	
Pulmonary Complications (Secondary)	OR 1.23 (0.98-1.53), p=0.073	0.882
Ventilator Days (Secondary)	B = -0.15, p=0.19	>0.40

Adjusted for age, sex, ISS, GCS category, and flail chest. OR, Odds Ratio; CI, Confidence Interval. Interaction p-value tests whether SSRF effect differs by TBI phenotype.