Clinical Validation of a Rib Fractures Disposition Protocol

Using the Trauma Quality Improvement Program (TQIP) Database.

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Background

Rib fractures are the most prevalent type of chest injury caused by a wide range of mostly blunt injury mechanisms. Rib fracture pain and underlying pulmonary disease lead to decreased gas exchange and an increased risk of pneumonia and respiratory failure.

Patients with rib fractures should be closely monitored for respiratory decompensation (in ICU vs floor setting). There are various studies that help identify patients at increased risk of pulmonary complications and death. But none provided an evidence-based algorithm or sensitivity/specificity analyses.

Hypothesis: The triage of rib fracture patients to the appropriate monitoring level could influence overall outcomes.

Aim of the Study: Determine sensitivity and specificity of previously proposed triage criteria in identifying patients at risk for respiratory complications or mortality, in a nationwide sample.

Methods

Data source - Trauma Quality Improvement Program Database. Inclusion criteria: Patients 18-year-old or older with a diagnosis of a traumatic rib fracture.

Exclusion criteria: **(1)** penetrating trauma, **(2)** severe injury affecting a body part other than the thorax (AIS severity ≥ 3), **(3)** patient discharged from ED with less than 6 hours of observation, AMA, expired in ED or transferred from ED to OR or to other facility, **(4)** hospitals without an ACS Trauma Center designation of Level I or II.

Primary outcome: Pulmonary complications occurring in-hospital (ARDS, pneumonia, unplanned ICU transfer, unplanned intubation).

Secondary outcomes: Overall complications, prolonged hospital stay, transferred to ICU, hospital discharge disposition, length of stay and in-hospital mortality.

Results

- 132,391 adult patients met the inclusion and exclusion criteria.
- After evaluation in the ED, 32.8% were admitted to the ICU, 62.5% to Floor/Telemetry, and 4.7% were placed in observation.
- Those admitted to the ICU had the highest mean age which was 60 years (SD = 18; vs mean of 58 overall, $p < 0.001$), had highest frequency of frailty (9.5% vs 8.8% overall, $p < 0.001$) and comorbid conditions.
- Fall was the most common mechanism of injury overall (41.1%), while MVC was the most common mechanism for patient admitted to the ICU (38.5%).
- Associated intrathoracic injuries were more prevalent in the ICU with severe injuries being present in 17.4% of patient admitted to the ICU vs 9.8% overall ($p < 0.001$).
- The primary endpoint, pulmonary complications, was significantly higher in ICU patients (n = 4,323, 10.0%) as compared to overall (n = 6,519, 4.9%, $p < 0.001$).
- In patients admitted to the floor, pulmonary complications occurred in 5.8% of patients with ICU criteria vs 1.9% of patients without those criteria.
- After adjusting for age, ISS and operative management, the odds ratios of pulmonary complications, overall complications and prolonged length of stay were 2.54 [2.28-2.83], 2.22 [2.00-2.45] and 1.99 [1.89-2.09], respectively ($p < 0.001$).

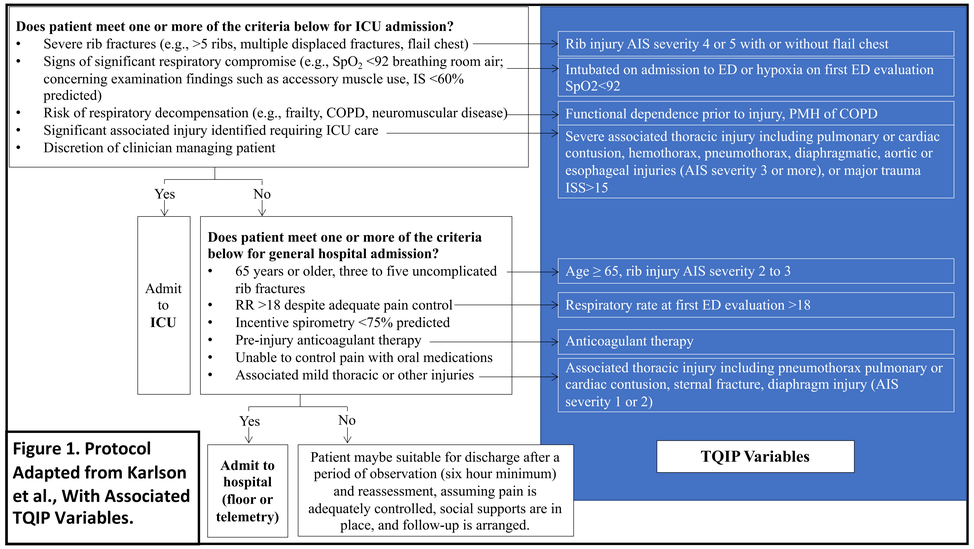


Figure 1. Protocol Adapted from Karlson et al., With Associated TQIP Variables.

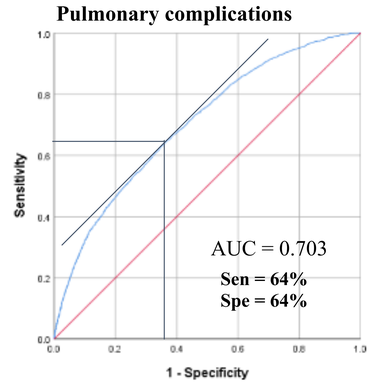


Figure 2. The combined measure of sensitivity and specificity of the models which is the Area Under the Curve was highest for prediction of pulmonary complications in floor patients using ICU criteria (AUC = 0.703).

Conclusions

Within the narrow definition of isolated rib fractures, we identified significantly worse outcomes in under-triage vs per protocol groups.

Specifically, under-triage of patients with ICU criteria to the floor was associated with three-fold higher odds of in-hospital respiratory and overall complications.

The standardized ICU admission criteria examined in this study may improve clinical outcomes.

Limitation

Retrospective study with short follow-up (30-day).

Unadjusted confounders linked to higher or lower triage of patients, such as incentive spirometry, poor cough, uncontrolled pain, accessory muscle use, and hospital/provider-specific protocols.

Future Directions

Future prospective studies should examine whether the application of the algorithm in conjunction with clinical factors (e.g. PIC score) improves outcomes of patients presenting with rib fractures. Future studies should also perform a cost-benefit analysis.

References

- Karlson K, French A, Eiff P, Moreira M, Ganetsky M. Initial evaluation and management of rib fractures. UpToDate wwwuptodatecom © 2022
- Battle CE, Hutchings H, Evans PA. Risk factors that predict mortality in patients with blunt chest wall trauma: a systematic review and meta-analysis. Injury. 2012;43(1):8-17.