

Operative Stabilization of Unstable Flail Chest Injuries Reduces Mortality to that of Stable Chest Wall Injuries

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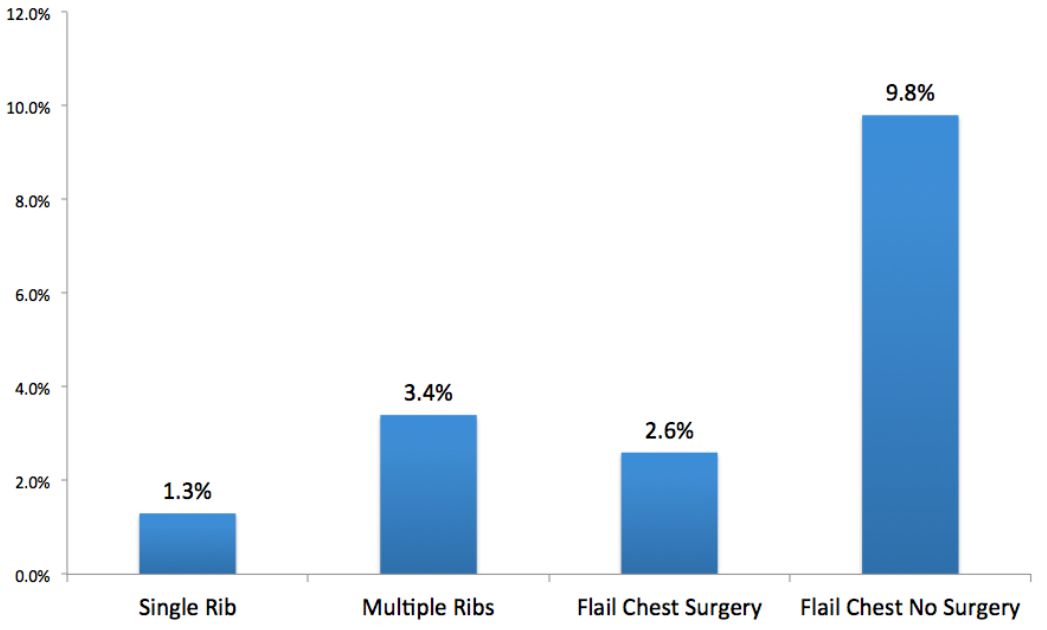
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Purpose: A flail chest injury is defined as an unstable chest wall injury, which has high rates of short-term mortality and long-term morbidity. Patients with multiple rib fractures without an unstable (or flail) segment have a better prognosis, and single rib injuries are typically considered innocuous with little long-term deficit. Surgical fixation of flail chest injuries, while rare, has become more popular in recent years with the rationale being that such repair may reduce the mortality and morbidity of this injury. We sought to define the injury patterns, management, and clinical outcomes associated with these three chest wall injury patterns in the last decade.

Methods: This study is a retrospective cohort study (Level III), utilizing administrative health-care data, and residents over the age of 16 who were admitted to hospital with rib fractures from March 2003 to March 2013 were included for analysis. Patients were divided into three specific groups based on injury: (1) flail chest (with an unstable chest wall segment), (2) multiple rib fractures (without an unstable chest wall segment), and (3) single rib/sternum fractures. Outcomes included rate of surgical repair, days on mechanical ventilation, days in ICU, days in hospital, rate of chest tube placement, and rates of complication, including pneumonia, tracheostomy, readmission, and death.

Results: In total 117,204 patients with fractures of the chest wall were identified: flail chest 1.5% (1708 patients), multiple rib fractures 41% (47,611 patients), and single rib fractures 58% (67,884 patients). Flail chest patients had significantly worse outcomes compared to multiple rib fracture patients in all categories ($P < 0.0001$): cardiac arrest requiring CPR (cardiopulmonary resuscitation) 5% versus 1%; pneumonia 39% versus 13%; mechanical ventilation >48 hours 46% versus 7%; ICU admission 65% versus 14%; chest tube insertion 56% versus 11%; tracheostomy 12% versus 1%; ventilator-associated pneumonia 7% versus 1%; length of stay 16.7 days versus 5.7 days, 30-day readmission to hospital 26% versus 16%; 30-day mortality 9.5% versus 3.4%; and 1-year mortality 14% versus 9%. Similarly, multiple rib fracture patients had significantly worse outcomes compared to single rib fracture patients ($P < 0.0001$ for all outcomes). Of the 1708 patients with flail chest injury, only 4.5% (77 patients) were treated surgically. While patients undergoing surgical fixation of flail chest injury had significantly more complications compared to those treated nonoperatively (ie, pneumonia, mechanical ventilation, and tracheostomy), they had a significantly lower death rate acutely at 30 days (2.6% vs 9.8%, $P = 0.035$), and long term at 2 years (8% vs 17%, $P = 0.038$). When adjusting for age, pneumonia, mechanical ventilation, ICU admission, and length of stay, flail chest patients treated with surgical fixation had significantly lower 30-day mortality (odds ratio [OR] 0.16, $P = 0.02$), compared to those treated nonoperatively. Surgery decreased the 30-day mortality rate of flail chest patients (2.6%) to that of multiple rib fracture patients (3.4%). In addition, the number of patients undergoing surgical fixation dramatically increased from 1% prior to 2010 to 10% after 2010 ($P < 0.0001$).

30 Day Mortality Rates of Patients with Chest Wall Injuries



Conclusion: To our knowledge, this is the largest study of chest wall injuries to date, and defines the landscape of current treatment. From it we conclude: (1) Stability of the chest wall is critical: patients with flail chest injuries had an early 9.5% mortality rate, over three times higher than multiple rib fracture patients at 3.4% ($P < 0.001$). The stability of the chest wall, rather than the number of ribs fractures, may be the most important prognostic factor. (2) Surgical stabilization of an unstable chest wall (flail chest patients) decreased early mortality (2.6%) to that of patients with multiple rib fractures and a stable chest wall (3.4%). (3) Surgical fixation of flail chest injuries has increased significantly from 1% to 10% after 2010. Although there are some drawbacks of our study, it does provide preliminary evidence that the increasing rate of surgical fixation of flail chest injuries may be warranted by reducing mortality. Prospective randomized controlled trials in this area are required to better assess the potential benefits of surgical fixation of patients with rib fractures and flail chest injuries.