The University of Arkansas for Medical Sciences
Trauma Clinical Practice Management Guideline

SUBJECT: Chest Wall Injury Blunt

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PURPOSE: To provide guidelines for the evaluation and management of patients with traumatic chest wall injury, including rib fractures, sternal fractures, hemothorax, and retained hemothorax.

BACKGROUND:
Chest wall injuries, including sternal fractures, rib fractures, and flail chest, pose a significant risk for morbidity and mortality in the trauma patient. Mortality risk for patients with multiple rib fractures increases notably as the number of fractures increases. The inflection point for a substantial increase in older adults (> 65 years old) is three rib fractures. This increased risk is also seen in younger patients, and significant increases in morbidity and mortality can be seen in 45-year-old patients with five rib fractures. This clinical practice management guideline is intended to provide a rational pathway for evaluating and intervening in patients with rib fractures and sternal fractures.

GUIDELINE:

EVALUATION – Rib and Sternal Fractures

Patients presenting with traumatic injuries will have routine chest radiographs in the case of Level 1 and 2 trauma activations. For patients with a Level 3 activation, a chest radiograph should be obtained. A CT scan of the chest should be obtained for the following indications:

1. The presence of or suspicion of multiple (>2) rib fractures
2. Evidence of or concern for sternal fractures
3. Presence of significant chest wall tenderness
4. Presence of bony crepitus
5. Paradoxical motion clinical diagnosis of flail segment
6. Presence of subcutaneous emphysema
7. Widened mediastinum
8. Spine tenderness
9. Other mechanistic or exam findings raising clinical suspicion, which warrant further evaluation

If a chest CT is obtained and there are >2 rib fractures or a sternal fracture noted, a request will be made

for 3D reconstructions of the chest wall bony structures with and without the presence of the scapula. If a sternal fracture is noted, an eFAST exam and EKG will be performed, as well as additional lab work with troponin biomarkers to assess for potential blunt cardiac injury. Please refer to the separate "Cardiac Injury Blunt Management" if there are concerns for blunt cardiac injury.

If a pneumothorax or hemothorax is noted on CXR or CT, consideration for tube thoracostomy on a case-by-case basis is based on patient stability and surgeon discretion. For full guidelines, please see the separate "Tube Thoracostomy Management Guideline."

INITIAL MANAGEMENT – Rib Fractures (see below for sternal fractures)

The hallmark for management of rib and sternal fractures is pain management and aggressive pulmonary toilet. Given the risk for morbidity and mortality associated with rib fractures, especially in the elderly, strong consideration should be given to admission or observation until such time that the patient demonstrates adequate pain control to perform incentive spirometry, coughing, and clearance of secretions. Strong consideration for ICU monitoring if staffing allows, as greater hospital-level ICU use is associated with better outcomes among older patients with isolated rib fractures.

- All patients over the age of 65 with any rib or sternal fractures should be considered for admission or observation.
- Patients under the age of 65 with 3 or more rib fractures should be admitted or observed.
    - Patients under the age of 65 with sternal or < 3 rib fractures can be evaluated for admission on a case-by-case basis.
- Admission location
    - The attending trauma surgeon will have the final discretion on patient disposition, but in general:

<u>Indications for Admission to ICU</u>:

- Any age with multiple rib fractures and/or flail chest and either of the following:
    - Need for mechanical ventilation or >4L/min nasal cannula
    - Incentive spirometry volumes ≤7.5cc/kg IBW
    - Special consideration should be given to those aged> 65 or with pre-existing lung disease for ICU admission

<u>Indications for Admission to Progressive</u>:

- Age > 45 with >3 rib fractures and/or flail chest[1]
- Any age with rib fractures and/or flail chest <u>and</u> any of the following:
    - Poor pain control
    - Incentive spirometer (IS) volumes ≤15cc/kg IBW
    - Oxygen requirement ≥ 2L/min nasal cannula

** When the above indications are no longer met, the patient may be transferred to the floor*

***Patients who warrant admission for monitoring or pain control but do not meet the above criteria can be admitted to floor status, unless ICU or progressive status is needed for other injuries.*

- Patients should be started on non–operative management
    - Multimodal pain therapy (per "Acute Pain Protocol" guideline) beginning in the Emergency Department
    - If analgesia is inadequate on multi-modal therapy, consider an early anesthesia pain management consult, especially in patients > 65 years.
    - See below for the Anesthesia pain service consultation guidelines (Appendix A & B)
- Patients will receive an incentive spirometer and education on its use
- Orders for respiratory care teaching and hourly use of the incentive spirometer should be written
- Serial examination should be performed to determine the efficacy of the current pain management regimen.
    - Pain control should be sufficient to allow the patient to achieve an inspiratory effort of 10mL/kg of ideal body weight on the incentive spirometer.
    - The patient should be able to generate a cough sufficient to clear blood and secretions.
- If the patient is not able to perform these aspects of pulmonary toilet successfully, a consult will be made to the anesthesia pain team for placement of a thoracic epidural or paravertebral blocks.
- Repeat assessments of pain management efficacy should be performed twice daily.
- If the patient is unable to achieve the above pulmonary toilet goals, consideration should be given to surgical chest wall stabilization, as outlined below.
- The decision for operative stabilization or continued non-operative management should be made within 48 hours of injury, with intervention performed in < 72 hours, preferably.

Indications for Surgical Chest Wall Stabilization:

Patients who fail to achieve adequate pulmonary toilet and pain control as described above should undergo a CT scan of the chest (for purposes of rib plating evaluation, this can be performed with a non-contrast scan) with 3D reconstructions, including both with and without the scapula. If a CT scan was performed at the time of admission, these prior images may be reviewed. The CT 3D reformats should be examined to correlate patient symptoms with one of the following indications for surgical stabilization.

Demonstrated to improve outcomes based on Randomized Controlled Trials (RCTs)

1. Clinical Flail Chest - paradoxical motion on exam
2. Respiratory Failure

Supported by prospective or retrospective studies, but ***not shown to improve outcomes in RCTs***

1. Pain
    a. Typically, three or more ribs
    b. Crepitus with movement
    c. Failure of pain control efforts to allow adequate pulmonary toilet.
2. Deformity
    a. Loss of volume
    b. Displaced ribs impede lung expansion
    c. Lung impalement with rib or fracture fragment
    d. Herniation of the lung through the chest wall
3. Non-Union
    a. Focal pain at the site of fracture 2-3 months after injury
    b. Symptomatic fracture movement
4. Need for a thoracotomy for other reasons

Surgical intervention should be performed within 72 hours of injury whenever possible. A relative contraindication to this protocol is patients with a severe traumatic brain injury or unstable spine who are likely to be on the ventilator for a prolonged period and would not benefit from stabilization to expedite the ability to extubate.

Post-stabilization films should be obtained before discharge, including PA and lateral CXRs.

INITIAL MANAGEMENT: Sternal Fractures

Sternal fractures can be a severely debilitating injury with significant pain. Most sternal fractures do not require stabilization, and initial efforts at pain control and non-operative management should follow the same sequence of pain control as rib fractures, with the following differences:

- All patients with a sternal fracture should have a troponin sent and receive an EKG
- An elevated troponin or new arrhythmias, ST changes, heart block, ischemia, and any unexplained EKG changes should warrant concern for possible blunt cardiac injury. Please refer to the separate "Cardiac Injury Blunt Management" guidelines for further evaluation and management.

Indications for Surgical Sternal Stabilization:

- Severe pain
- Respiratory dysfunction attributable to the sternal pain
- Displacement or overlap of the fractured sternum
- Instability with or without flail
- Non-union of previous fracture

- Hunched over posture due to pain
- Limited range of motion of the upper extremities due to sternal pain

CT scans with reformats should be obtained and reviewed as described above for rib fractures. Patients with overlap or displacement greater than the thickness of the sternum are likely to benefit the most from surgical stabilization.

Post-stabilization films should be obtained before discharge with PA and Lateral CXR.

INITIAL MANAGEMENT: Hemothorax and Retained Hemothorax

Patients with a retained hemothorax of greater than 300 mL have a high rate of development of empyema and other complications from the blood in the chest. Patients with persistent or recurrent fluid in the chest warrant further evaluation to determine the volume and nature of the fluid. CXR is a poor indicator of volume and the need for intervention.

- Identification of fluid in the chest on initial CXR during resuscitation warrants intervention or further evaluation with CT.
    - Opacification of the hemithorax or evidence of a hemopneumothorax should be addressed immediately with tube thoracostomy.
    - If a smaller amount of blood is present, which does not require immediate action, a CT scan can be used to evaluate the fluid collection.
    - Drainage with tube thoracostomy should be considered for fluid collections greater than 300 cc.
        - A daily morning CXR should be obtained thereafter to assess for lung expansion and retained hemothorax.

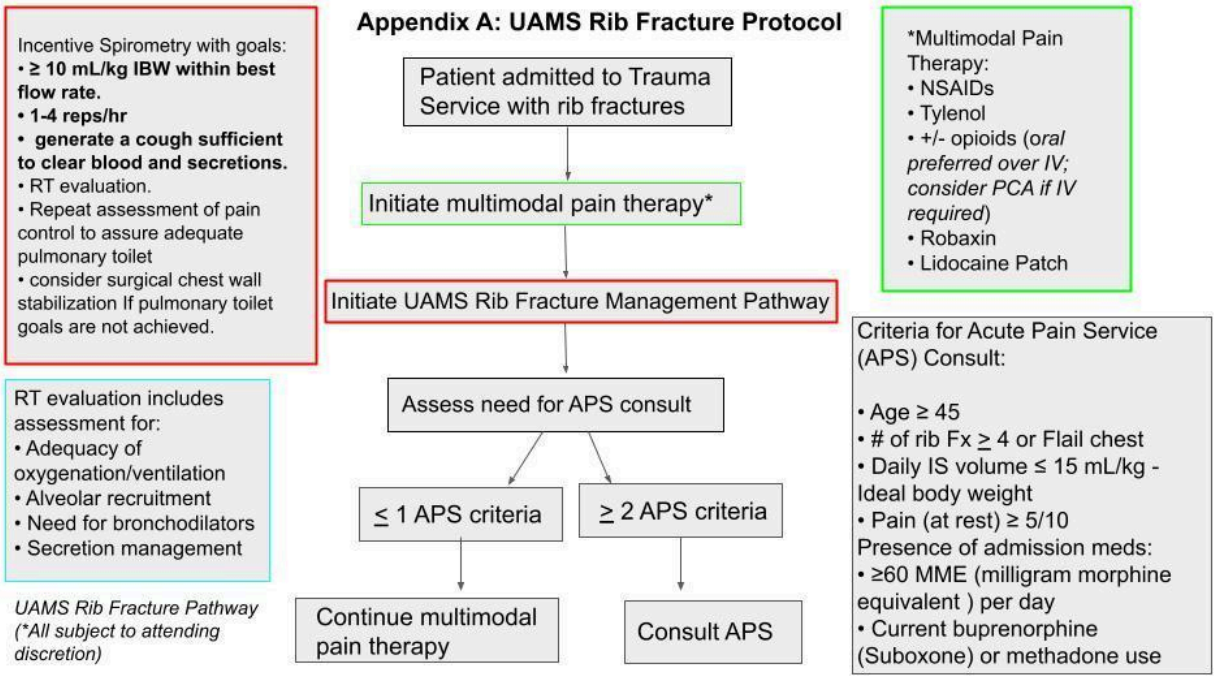
- In patients who previously underwent drainage and have a residual or recurrent fluid collection, further evaluation or drainage may be necessary
    - If the CXR continues to demonstrate the presence of a continued effusion 24 hours after the placement of a tube thoracostomy, a chest CT scan (preferably with IV contrast) of the chest should be obtained to evaluate the adequacy of tube placement and the need for surgical procedure.

- Tube Thoracostomy
    - There is evidence that 28-32 French chest tubes perform similarly to 36-40 French tubes for evacuating blood and air from the hemithorax. Consideration should be given to using smaller tubes to help with post-placement pain management.
    - If patient stability allows, pre-procedural antibiotics and full sterile procedural precautions should be used for placement.

- "Pigtail" catheters are successful in evacuating fluid and air from the chest with less pain than traditional chest tubes; however, they are more challenging to place and have a higher complication rate of malposition than conventional tubes. They may be used at the attending surgeon's discretion.

- Video Assisted Thoracoscopic Surgery (VATS)
  - In circumstances where the fluid is organized within the chest, multiple loculations are present, an enhancing wall around the fluid is present, drainage is not possible, or other evidence of empyema or a complicated fluid collection is present, consideration should be given to early VATS for decortication and evacuation of the chest. This procedure is best performed early to reduce the risk of organization and fibrous reaction, which can occur with delayed intervention. Early intervention reduces the risk of conversion to open thoracotomy, which increases substantially by post-injury day 5.

Appendix A: UAMS Rib Fracture Protocol



Appendix B: APS Consult Guidelines

Acute Pain Service Consult Considerations

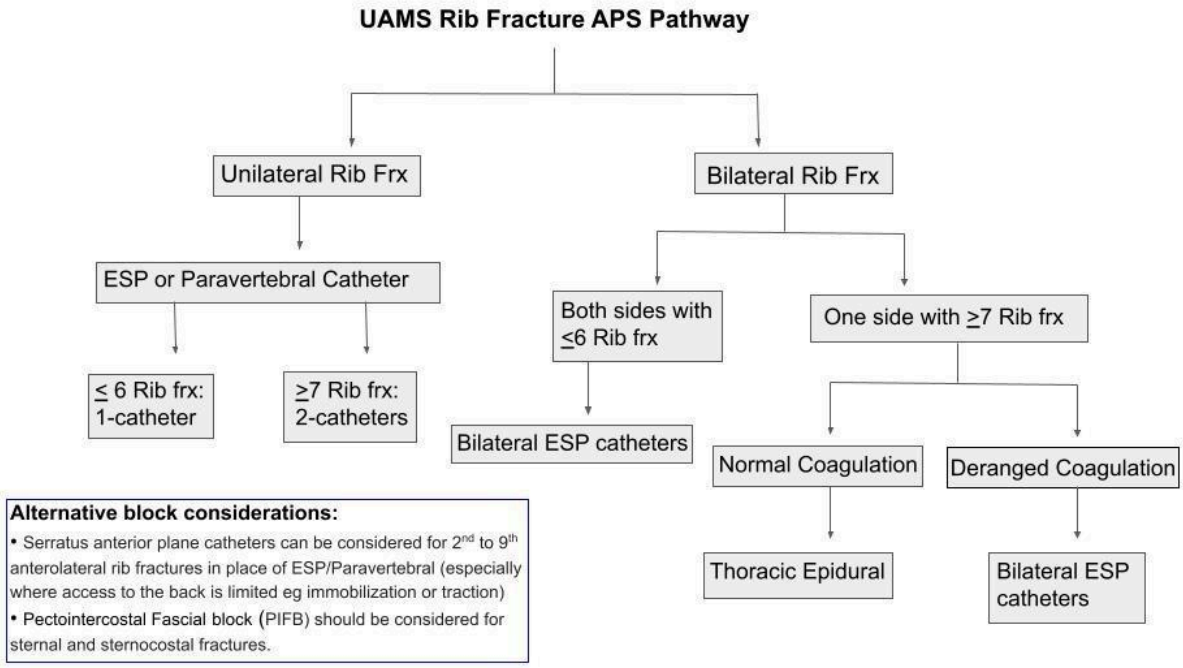
- Evaluate patients within 4 hours of consultation.
- Reassess the patients daily after initial evaluation.
- Place and maintain perineural (ESP) catheters or thoracic epidural in place for 3-7 days.
- Consider ketamine infusions as an adjunct to regional techniques or solo agent if nerve block or epidural contraindicated/suboptimal or unilateral injury. Discuss with primary team prior to starting ketamine.
- Provide daily follow up while perineural catheters or epidural in place or IV infusions running.
- Consider regional techniques for intubated patients (RASS -2 to +1) to aid vent weaning with anticipated extubation in the next 24hrs.
- Discuss with trauma faculty if regional or neuraxial anesthesia is contraindicated.

Barriers to Regional Anesthesia - These are not contraindications but are challenges to providing regional anesthesia :

- Deep sedation: < RASS -3
- Injuries requiring placement in traction
- Patient distant from extubation or ventilator weaning > 24hrs
- Inability to provide consent or identify surrogate decision maker
- Operative spine fractures or pending spine evaluation

Thoracic Epidural Contraindications: *does not preclude other blocks.*

- Labs: Platelets < 80,000, INR ≥ 1.5, elevated PTT, deranged ROTEM
- Medications: anticoagulants, antiplatelet agents, or the inability to rule out the use of these medications (*see AZRA guidelines*)
- Infection: Systemic or insertion site infection
- Certain traumatic injuries: Epidural or spinal cord hematoma, TBI with midline shift, Spinal precautions, Spinal cord injury, Spinal fractures adjacent to insertion site and need for possible surgery
- Positioning Contraindication (spinal precaution, traction etc)
- High BMI (large body habitus not amenable to thoracic epidural)



Performance Monitoring:

1. **Time to chest wall stabilization < 72 hours, if performed**
2. **Time to anesthesia pain procedure < 24 hours, if it meets the criteria**

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