

**UAMS MEDICAL CENTER
TRAUMA SERVICES MANUAL**

SUBJECT: Blunt Chest Wall Injury Clinical Management

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UPDATED: 4/19, 2/23

EFFECTIVE: 3/2/2023

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CONCURRENCE(S): ALL

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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 in patients as the number of fractures increases. The inflection point for substantial increase in the elderly (> 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 the evaluation and intervention 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 I and II activations. For patients activated at a Level III, 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 for 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. Or 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

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for 3D reconstructions of the chest wall bony structures with and without the presence of the scapula.

If a sternal fracture is noted, a FAST 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 separate “Traumatic Cardiac Injury Clinical Management Guideline” 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 based on patient stability and surgeon discretion. For full guidelines, please see 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:

Indications for Admission to ICU:

- 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 ≤ 7.5 cc/kg IBW
 - Special consideration should be given to those age > 65 or with pre-existing lung disease for ICU admission

Indications for Admission to Progressive:

- Age > 45 with >3 rib fractures and/or flail chest¹
- Any age with rib fractures and/or flail chest and any of the following:
 - Poor pain control
 - Incentive spirometer (IS) volumes ≤ 15 cc/kg IBW
 - Oxygen requirement ≥ 2 L/min nasal cannula

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

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***Patients that 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) starting in Emergency Department
 - If analgesia inadequate on multi-modal therapy consider early anesthesia pain management consult, especially in patient with age > 65
 - See below for the Anesthesia pain service consultation guidelines (Appendix A and 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.
 - The pain control should be sufficient to allow the patient achieve 10cc/kg of ideal body weight inspiratory effort 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 anesthesia pain team for placement of a thoracic epidural or paravertebral blocks to be placed.
- Repeat assessment for efficacy of pain management should be performed twice daily.
- If the patient is not able to achieve the above pulmonary toilet goals, consideration should be given to surgical chest wall stabilization based on the indications below.
- The decision for operative stabilization or continued non operative management should be made within 48 hours of injury if possible, 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 have a CT scan of the chest (for purposes of rib plating evaluation, this can be non-contrast) with 3D reconstructions with and without the scapula. If a CT scan was done at the time of admission these previously performed images may be reviewed. The CT 3D reformats should be reviewed to correlate patient symptoms with one of the below indications for surgical stabilization.

1. Flail Chest
 - a. Failure to wean on the vent
 - b. Paradoxical motion
2. Pain
 - a. Typically, three or more ribs
 - b. Crepitus with movement

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

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 of time and would not benefit from stabilization to expedite the ability to extubate.

Post stabilization films should be obtained prior to discharge with PA and Lateral CXR.

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 fractures 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 see separate “Traumatic Cardiac Injury” guidelines for further work up 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

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

Post stabilization films should be obtained prior to discharge with PA and Lateral CXR.

INITIAL MANAGEMENT: Hemothorax and Retained Hemothorax

Patients with a retained hemothorax of greater than 300cc have a high rate of development of empyema and other complications from the blood in the chest. Patients noted to have persistent or recurrent fluid in the chest warrant further evaluation to determine the volume and nature of the fluid. CXR has been shown to be a poor indicator of volume and 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 there is a smaller amount of blood present which does not require immediate action CT scan can be used to further 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 it is clear that the effusion/hemothorax is greater than 300cc or is symptomatic, an additional tube thoracostomy or early VATS evacuation should be considered to drain the retained hemothorax.
 - If the size is difficult to determine or there have been multiple unsuccessful attempts to drain the fluid with tube thoracostomy, a repeat CT scan should be performed to determine the size, character of the fluid and the presence of any loculations.
- Tube Thoracostomy
 - There is evidence that 28-32 French chest tubes perform the same as 36-40 French tubes for the evacuation of blood and air from the hemithorax. Consideration should be given to using smaller tubes for 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 have been shown to be successful in the evacuation of fluid and air from the chest with less pain than a traditional chest tube but are more difficult to place and have a higher complication rate of malposition than traditional tubes. They may be used at attending surgeon discretion.

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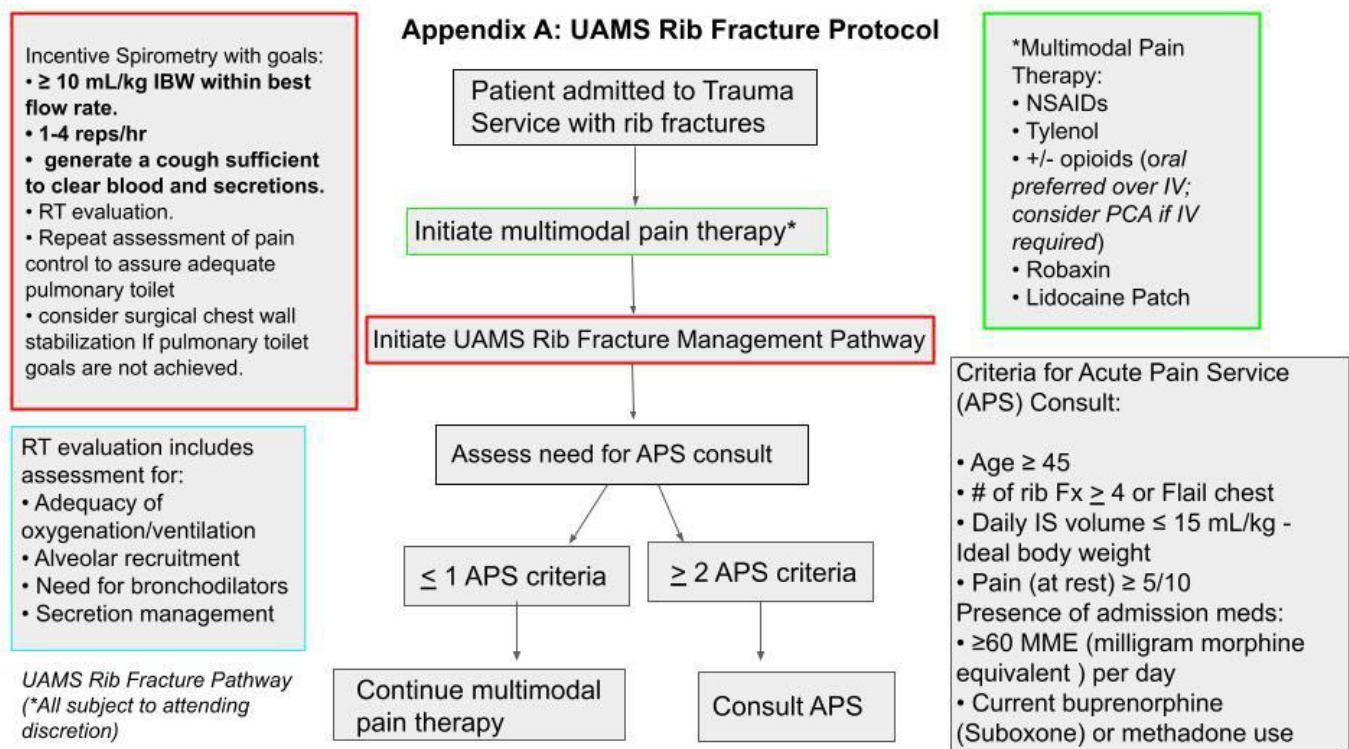
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- Video Assisted Thoracoscopic Surgery (VATS)
 - In circumstances where there is organization of the fluid within the chest, multiple loculations, enhancing wall around the fluid, inability to drain or other evidence of empyema or complicated fluid collection, 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 occurs in the setting of delayed intervention. Early intervention reduces the risk of conversion to open thoracotomy, which increases substantially by post-injury day 5.



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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 (EPS) 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.

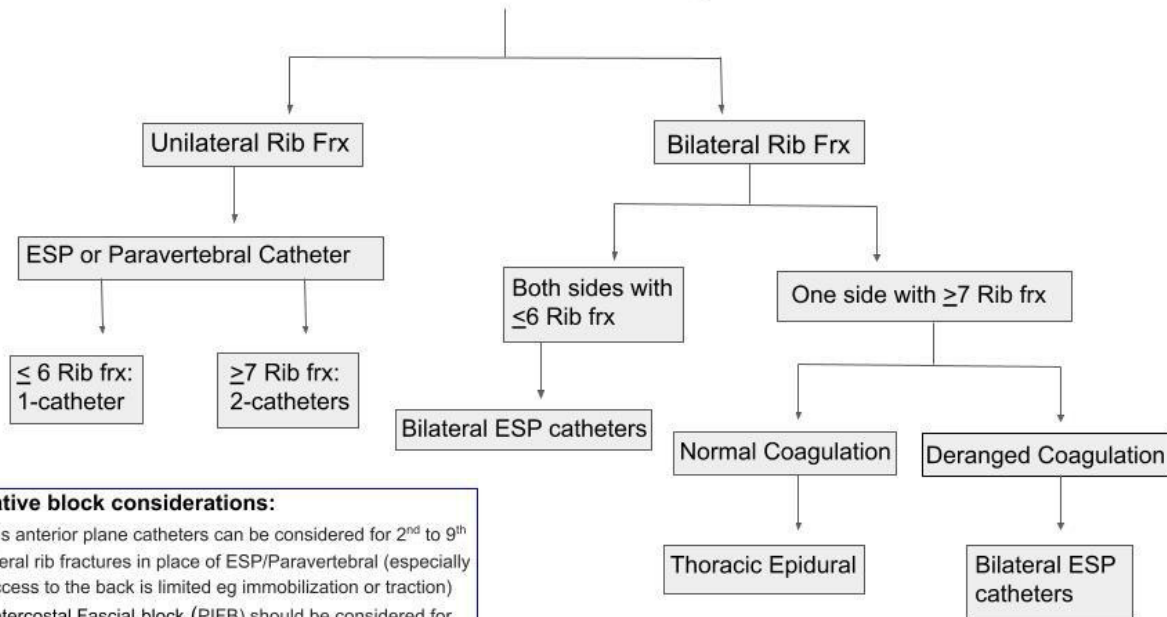
Barriers to Regional Anesthesia - These are not contraindications but are challenges to providing regional anesthesia :

- 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)

UAMS Rib Fracture APS Pathway



Alternative block considerations:

- Serratus anterior plane catheters can be considered for 2nd to 9th anterolateral rib fractures in place of ESP/Paravertebral (especially where access to the back is limited eg immobilization or traction)
- Pectintercostal Fascial block (PIFB) should be considered for sternal and sternocostal fractures.

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Performance Monitoring:

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

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