

Appendix A: Vanderbilt Rib Fracture Protocol

VUMC Rib Fracture Management Pathway

- Supervised Incentive Spirometry (10 reps/hr, goal ≥ 15 ml/kg IBW within best flow rate)
- RT Evaluation
- PT consult for early mobility
- Maintain euvolemia

RT evaluation includes assessment for:

- Adequacy of oxygenation/ventilation
- Alveolar recruitment
- Need for bronchodilators
- Secretion management

Consult APS if 4+ rib fractures AND any of the following:

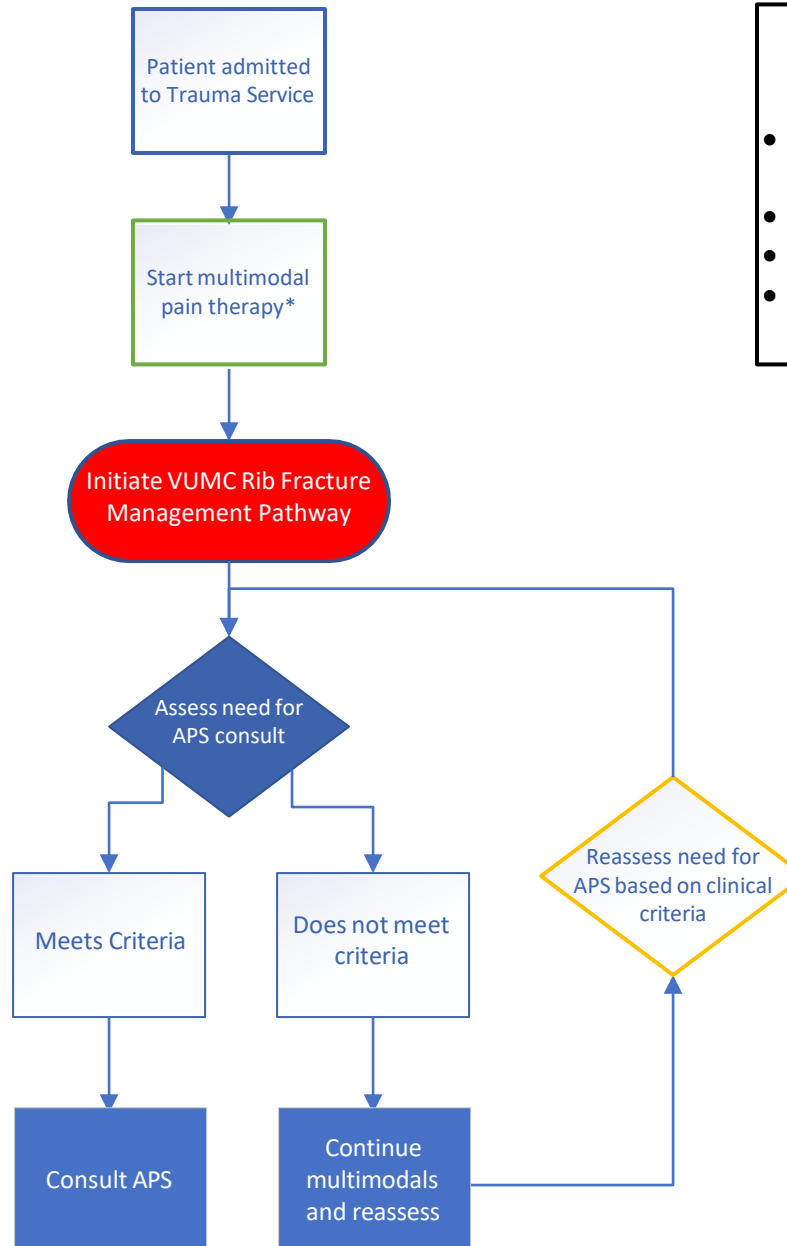
- On home opioids > 60 morphine equivalent dosing, buprenorphine, or methadone
- > 45 years of age
- Planned inpatient admission
- COPD or other pulmonary disease, $> 2L$ O₂ NC at home (https://www.vumc.org/trauma-and-scc/sites/default/files/public_files/Protocols/COPD%20exacerbation.pdf)
- Incentive spirometry < 750 mL or 15ml/kg
- Supplemental O₂ $> 5L$

*Start multi-modal therapy

- Acetaminophen
 - Gabapentin
 - Methocarbamol
 - Ketorolac
 - Oxycodone
- If NPO**
- Ketorolac
 - IV Methocarbamol
 - IV hydromorphone

On re-evaluation consult APS if any of the following:

- Pain $> 6/10$
- Worsening Incentive Spirometry
- Increased O₂ requirement



Appendix B: APS Consult Guidelines

APS Considerations

APS will:

- Evaluate patient within 6 hr of consultation
- Reassess after initiation of interventions and as medically necessary
- Evaluate for epidural vs other nerve block vs analgesic infusions for the management of uncontrolled pain
- Consider epidural appropriateness in intubated patients who could be extubated within 24 hr
- Communicate and collaborate with trauma service in order to improve patient outcomes



If criteria not met and consult still desired secondary to concern for patient's medical condition, then attending-to-attending communication should occur

Thoracic Epidural Contraindications

- Labs: Platelets <80,000, INR>1.4, elevated PTT
- Medications: anticoagulants, antiplatelet agents or the inability to rule out these medications
- Infection: systemic or insertion site infection
- Certain traumatic injuries: epidural or spinal cord hematoma, intracranial bleeding especially with midline shift, spinal cord injury, certain vertebral fractures, planned spine surgery

APS Barriers to Regional Anesthesia

- Deep sedation, RASS -3
- Injuries requiring placement of traction
- Patient not ready to be extubated
- Inability to obtain consent
- Pending spine "clearance"



Barriers to Lidocaine & Ketamine infusions

- Seizure disorder
- Marked liver disease/cirrhosis
- Sedation
- PTSD
- Unstable cardiovascular disease
- Certain arrhythmias or antiarrhythmic medications

VUMC CHEST PROTOCOL FOR BLUNT FORCE THORACIC TRAUMA

Policy Description:

Managing patients with multiple rib fractures or flail chest requires significant health care resources including intensive care unit monitoring, ventilator management [1-3], surveillance and treatment of pneumonia, and pain management protocol. Both acute complications and long-term disabilities occur as a result of this very common pattern of thoracic trauma.

In a retrospective review of 64,750 civilian trauma patients in the National Trauma Databank (NTDB) with 1 or more rib fractures, mortality in the entire cohort was 10%[1]. Mortality increased stepwise with each additional fracture to a maximum of 34.4% with 8 or more fractures. Epidural analgesia was used in only 2.2% of patients but significantly reduced mortality in patients with 2 rib fractures and 4 or more rib fractures. For patients with 8 rib fractures, only 7% received an epidural catheter; however, those who did had a 98% survival as compared to a 65% survival without an epidural. Consideration for single or multiple paravertebral catheters should also be considered when an epidural catheter is contraindicated or technically unsuccessful as there is evidence of efficacy similar to epidurals with fewer contraindications and hypotension [4].

The nationwide opioid abuse epidemic has increased awareness of how acute pain is managed. A joint practice guideline from trauma surgeons and anesthesiologists conditionally recommends use of multimodal analgesia rather than opioids alone in patients with blunt thoracic trauma (10). Emphasis should be on reducing the duration and dosage of opioids as much as possible. Multimodal approaches involving non-steroidal anti-inflammatory drugs (NSAIDs) and GABA-analogs (gabapentin and pregabalin) have been shown to improve perioperative pain control and have been adapted as an initial approach for blunt chest wall injury [5-7].

Use of a rib fracture protocol has recently been shown to reduce ICU length of stay, hospital length of stay, and pneumonia in patients with rib fractures [3,8]. Significantly reduced mortality was demonstrated with a multidisciplinary approach involving the trauma team, anesthesia pain service, advanced care practitioners, use of incentive spirometry, physical therapy, and nutrition.

Long-term outcomes are similarly poor in these patients. Civilian studies indicate that the morbidity and lost productivity in patients suffering thoracic trauma is substantial even in the relatively young and those with minimal injuries. For example, patients with rib fractures are significantly more disabled at 30 days post injury when compared with patients with chronic medical illness and lose an average of 70 days of work or usual activity during their acute recovery [9].

From a functional standpoint, a 2009 study found that for up to 2 years after pulmonary contusion and rib fractures, multiple parameters on pulmonary function testing and exercise tolerance are compromised with VO_{2max} of 60% predicted[10]. In patients with flail chest, over 50% develop permanent morbidity with persistent chest wall pain or deformity being the most common long-term problems [11, 12]. As many as 40% of these patients still had not returned to work one year after their injury.

The challenge, therefore, is to identify treatment strategies that improve both short- and long-term outcomes in patients with severe chest wall trauma. We believe a multidisciplinary approach is warranted at VUH given the frequency of rib fractures in our patient population and the potential benefits to having a treatment protocol for managing acute fractures and a multi-modal approach to avoiding long-term disability (Appendix A).

Policy Statement:

1. This policy applies to trauma patients with rib fractures who are admitted to the Trauma service. Patients who meet the defined criteria will be managed according to this protocol as detailed in Appendix A.
2. The key pain management decisions are: 1) Implementation of basic multimodal analgesia by Trauma service; 2) Need for additional pain adjuncts beyond basic multimodal pain control to be evaluated by and initiated by APS; 3) the need for operative stabilization of dislocated fractures or a flail chest; 4) patient suitability for regional anesthetic procedures; and 5) analgesic requirements at discharge (drug, dose, and duration).
3. If the patient has a flail chest, displaced rib fractures causing significant chest wall deformity, a need for surgical intervention in the chest in the setting of multiple rib fractures, or chronic pain from rib fractures, operative stabilization of the fractures should be considered. This does not replace the need for multimodal pain control.
4. Pain management beyond basic multimodal oral pain regimen will be managed primarily by APS. Management recommendations will be communicated to the Trauma team by the APS service. Regional anesthesia solutions and IV analgesic infusions (including but not limited to lidocaine and ketamine) will be ordered directly by APS. Management decisions such as placement or non-placement of regional anesthetics and the use of IV analgesic infusions will be communicated to the responsible trauma staff.

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References:

1. Fligel BT, Luchette FA, Reed RL, Esposito TJ, Davis KA, Santaniello JM, et al. Half-a-dozen ribs: the breakpoint for mortality. *Surgery*. 2005;138(4):717-23; discussion 23-5. Epub 2005/11/05. doi: S0039-6060(05)00433-2 [pii] 10.1016/j.surg.2005.07.022. PubMed PMID: 16269301.
2. Sharma OP, Oswanski MF, Jolly S, Lauer SK, Dressel R, Stombaugh HA. Perils of rib fractures. *Am Surg*. 2008;74(4):310-4. Epub 2008/05/06. PubMed PMID: 18453294.
3. Todd SR, McNally MM, Holcomb JB, Kozar RA, Kao LS, Gonzalez EA, et al. A multidisciplinary clinical pathway decreases rib fracture-associated infectious morbidity and mortality in high-risk trauma patients. *Am J Surg*. 2006;192(6):806-11. Epub 2006/12/13. doi: S0002-9610(06)00602-7 [pii] 10.1016/j.amjsurg.2006.08.048. PubMed PMID: 17161098.
4. Mohta M, Verma P, Saxena AK, Sethi AK, Tyagi A, Girotra G. Prospective, randomized comparison of continuous thoracic epidural and thoracic paravertebral infusion in patients with unilateral multiple fractured ribs--a pilot study. *J Trauma*. 2009;66(4):1096-101. Epub 2009/04/11. doi: 10.1097/TA.0b013e318166d76d. PubMed PMID: 19359920.
5. Chou R, Gordon DB, de Leon-Casasola OA, Rosenberg JM, Bickler S, Brennan T, et al. Management of Postoperative Pain: A Clinical Practice Guideline From the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council. *J Pain*. 2016;17(2):131-57. Epub 2016/02/02. doi: 10.1016/j.jpain.2015.12.008. PubMed PMID: 26827847.
6. Galvagno SM, Jr., Smith CE, Varon AJ, Hasenboehler EA, Sultan S, Shaefer G, et al. Pain management for blunt thoracic trauma: A joint practice management guideline from the Eastern Association for the Surgery of Trauma and Trauma Anesthesiology Society. *J Trauma Acute Care Surg*. 2016;81(5):936-51. Epub 2016/10/22. doi: 10.1097/TA.0000000000001209. PubMed PMID: 27533913.
7. Dennis BM, Bellister SA, Guillaumondegui OD. Thoracic Trauma. *Surg Clin North Am*. 2017;97(5):1047-64. Epub 2017/09/30. doi: 10.1016/j.suc.2017.06.009. PubMed PMID: 28958357.
8. Sborov KD, Dennis BM, de Oliveira Filho GR, Bellister SA, Statzer N, Stonko DP, Guyer RA, Wanderer JP, Beyene RT, McEvoy MD, Allen BFS. Acute pain consult and management is associated with improved mortality in rib fracture patients. *Reg Anesth Pain Med*. 2022 Jul 26:rapm-2022-103527. doi: 10.1136/rapm-2022-103527. Epub ahead of print. PMID: 35882429.
9. Kerr-Valentic MA, Arthur M, Mullins RJ, Pearson TE, Mayberry JC. Rib fracture pain and disability: can we do better? *J Trauma*. 2003;54(6):1058-63; discussion 63-4. Epub 2003/06/19. doi: 10.1097/01.TA.0000060262.76267.EF. PubMed PMID: 12813323.
10. Amital A, Shitrit D, Fox BD, Raviv Y, Fuks L, Terner I, et al. Long-term pulmonary function after recovery from pulmonary contusion due to blunt chest trauma. *Isr Med Assoc J*. 2009;11(11):673-6. Epub 2010/01/30. PubMed PMID: 20108554.
11. Beal SL, Oreskovich MR. Long-term disability associated with flail chest injury. *Am J Surg*. 1985;150(3):324-6. Epub 1985/09/01. PubMed PMID: 4037191.
12. Landercasper J, Cogbill TH, Lindesmith LA. Long-term disability after flail chest injury. *J Trauma*. 1984;24(5):410-4. Epub 1984/05/01. PubMed PMID: 6716518.