

# DHMC TRAUMA ADULT RIB FRACTURE PRACTICE MANAGEMENT GUIDELINE

Author: Fred Pieracci MD

SURGERY

Contributors:

- Ryan Lawless, MD SURGERY
- Barry Platnick, MD SURGERY
- Larissa Fritts, PA SURGERY
- Steve Bourland, MD ANESTHESIOLOGY
- Anna Engeln, MD EMERGENCY MEDICINE
- Candice Preslaski, PharmD PHARMACY
- Megan Mitchell, PT, DPT PHYSICAL THERAPY
- Michael Harris, RRT RESPIRATORY THERAPY
- Jim Haenel RESPIRATORY THERAPY

I. BACKGROUND:

- a. Rib Fractures are one of the most common injuries, found in more than one half of blunt thoracic injuries and 10% of all trauma admissions [1].
- b. In 2017, Denver Health admitted 494 patients with rib fractures, or 1.4 patients per day.
- c. Morbidity and mortality in patients with rib fractures is substantial, and related to certain demographic, radiologic, and physiologic parameters, such as age [2], number of fractures [3], and spirometry [4], respectively.
- d. Protocol-driven management of rib fracture patients has been shown to improve outcomes [5, 6].

II. PURPOSE OF THIS DOCUMENT

- a. The purpose of this document is to delineate a standardized management and follow-up pathway for adult (age  $\geq 15$  years) patients presenting to Denver Health Medical Center with rib fractures.

III. DISCIPLINES INVOLVED

- a. Trauma Surgery
- b. Emergency Medicine
- c. Anesthesiology
- d. Physical Medicine & Rehabilitation
- e. Nursing
- f. Respiratory therapy
- g. Physical therapy
- h. Pharmacy

IV. PATIENT CARE AREAS INVOLVED

- a. Emergency department

- b. Adult Urgent Care Center (AUCC)
- c. Surgical intensive care unit (SICU)
- d. Surgical wards
- e. Outpatient clinics

V. SCORING SYSTEMS

- a. The two scoring systems used herein, both developed at Denver Health, are the RibScore [7] and Sequential Clinical Assessment of Respiratory Function (SCARF) score [8].
- b. The RibScore is a completely radiographic score that ranges from 0-6 (**Figure 1**).
- c. The SCARF score is a completely physiologic score that ranges from 0-4 (**Figure 2**).
- d. Both scores correlate significantly with pulmonary complications, with higher scores being worse.

VI. ADMISSION

- a. The admission algorithm for patients with rib fractures is shown in **Figure 3**.

VII. IMAGING

a. *Initial imaging*

- i. All patients with suspected rib fracture should undergo a chest X-RAY as the *initial* imaging modality.
- ii. Recent data from Denver Health [9] suggest that both disposition and therapeutic decisions are influenced by CT scan results in approximately 1/3 of patients with rib fractures. Thus, a selective approach to CT scan has been chosen to both maximize utility and minimize unnecessary radiation and cost. After CXR, the following patients with either suspected or known rib fractures should undergo CT chest:

1. All patients being considered for admission
  2. Patients in whom CT chest is indicated for the work up of other injuries
  3. Patients aged  $\geq 65$  years
  4. Provider discretion
- iii. Patients aged  $< 21$  years should have extra consideration given before obtaining a CT scan, due to the increased risks of radiation exposure.
- iv. Neither PO nor IV contrast is necessary for the evaluation of rib fractures; however, the use of contrast should be individualized to suspected non-fracture injuries.
- v. In a stable patient for whom the results of the CT will not change admission disposition (e.g., ward vs. SICU, **Figure 3**), obtaining the CT scan (and the radiologist interpretation thereof) should not delay either placement of the admission order or movement of the patient to their final destination.

*b. Subsequent imaging*

- i. Rib fractures may undergo substantial interval displacement over 48 – 72 hours due to changes in lung compliance and larger changes in pleural pressure.
- ii. Patients with rib fractures may develop delayed hemothorax, which may not be present on initial imaging. Retained hemothorax is a frequent reason for re-admission in hospitalized rib fracture patients
- iii. The following patients should undergo repeat imaging of rib fractures, including (at least) on the day of discharge
  1. Respiratory deterioration
  2.  $\geq 6$  rib fractures
  3. Fractures managed surgically

4. Patients on therapeutic anticoagulation, including novel oral anti-coagulants
5. Patients in whom a chest tube was placed and then removed

VIII. ANALGESIA

- a. The analgesia algorithm for inpatients with rib fractures is shown in **Figure 4**.
- b. Response to therapy is gauged using the SCARF score with inadequate response defined as SCARF  $\geq 2$ .

IX. RESPIRATORY THERAPY

- a. All patients admitted with rib fractures should receive an RT consult
- b. Initial management is with incentive spirometry (IS) instruction and administration by bedside RN.
- c. If IS < 60% of predicted, flail chest, > 6 rib fractures, or weak cough
  - i. Hourly IS
  - ii. PEP therapy via mouthpiece/face mask (AccuPAP) every four hours
  - iii. Instruction with PEP device to mobilize secretions
  - iv. Wean to q6H and then PRN with improvement
- d. If worsening CXR, increased O<sub>2</sub> requirement, or secretion management issues
  - i. Naso-tracheal suctioning PRN
  - ii. Cough assist device BID or PRN as tolerated
  - iii. Chest physiotherapy, manual or with vest as tolerated by patient
  - iv. Broncho-dilators PRN for wheezing/secretion clearance
  - v. High flow nasal cannula
  - vi. Continuous positive airway pressure (CPAP) via facemask
- e. Contra-indications to PEP therapy, cough assist device, and CPAP

- i. Inability to tolerate increased work of breathing/nausea
- ii. Intra-cranial pressure > 20 mm Hg
- iii. Recent facial, oral, or esophageal surgery/trauma
- iv. Untreated pneumothorax
- v. Hemodynamic instability
- vi. Sinusitis
- vii. Bullous emphysema
- viii. hemoptysis

X. PHYSICAL THERAPY

- a. Physical therapy is an integral part of the management of patients with severe chest wall injuries.
- b. The following patients should routinely receive an inpatient PT consult:
  - i. Flail chest
  - ii. Bilateral rib fractures
  - iii.  $\geq 3$  severely displaced fractures
  - iv. Inability to wean supplemental oxygen
  - v. Fractures due to a fall
  - vi. Mechanical ventilation at any point during admission
  - vii. Provider discretion.
- c. The following patients should be considered for an inpatient PT consult:
  - i. Baseline mobility issues (use of gait aid or known MSK disorder)
  - ii. Frail adults with > 3 comorbid conditions
  - iii. Questionable cognitive function
  - iv. Limited social supports

v. Provider discretion

d. The Denver Health PT guidelines are shown in **Figure 5**.

XI. INDICATION FOR AND TIMING OF SURGERY

a. Surgical stabilization of rib fractures has been shown to be effective for patients with flail chest [10].

b. Patients with multiple, contiguous, bi-cortically displaced fractures have also realized benefit from surgery [11].

c. General indications for surgery are:

i. Flail chest

ii.  $\geq 3$  severely (bicortically) displaced fractures (not necessarily contiguous)

iii.  $\geq 30\%$  loss of hemithorax volume measured by CT scan.

iv. Any fracture pattern with persistent physiologic/pain derangement despite optimal medical management (see section VIII) as defined as a SCARF score  $> 2$ .

d. The operative technique of rib fixation at Denver Health has been standardized [12], and includes:

i. Intra-operative bronchoscopy with secretion clearance

ii. Muscle sparing incisions

iii. Repair of all accessible fractures of ribs 3-10

iv. Pleural space irrigation and drainage

v. Guided loco-regional anesthesia

e. Denver Health data have shown that, in the absence of competing injuries and hemodynamic or intra-cranial instability, surgery for rib fracture repair should be performed as soon as possible, and ideally within 24 hours of injury [13].

XII. FOLLOW UP

- a. Follow up frequency and destination is dependent upon injury severity (**Figure 6**).
- b. Patients discharged from the ED should follow up with their PCP. The ED will make reasonable attempts to arrange for a PCP in the case that the patient is not empaneled.
- c. Patients admitted to the trauma service and managed non-operatively should follow up once in the TACS clinic two weeks after discharge if they have one or more of the following:
  - i. > 3 rib fractures
  - ii. Inpatient procedural intervention for chest trauma (e.g., chest tube, VATS), exclusive of SSRF (SSRF patients follow up in thoracic surgery clinic).
  - iii. Age  $\geq$  70 years
  - iv. New oxygen requirement upon discharge
  - v. Any additional injury requiring TACS follow up (e.g., splenectomy).
- d. The need for imaging at post-operative TACS visits (e.g., chest XRAY) will be determined on a case-by-case basis.
- e. Patients admitted to the trauma service and managed operatively should follow up in the thoracic surgery clinic at two weeks, one month, and two months post discharge.
  - i. All patients managed operatively and following up in thoracic surgery clinic should have a chest XRAY performed on the day of each scheduled clinic visit.
  - ii. Patients in whom an incidental thoracic pathology is discovered (e.g., pulmonary nodule > 12 mm) can also follow up in thoracic surgery clinic.
- f. Patients admitted to the trauma service and managed operatively should have a referral for outpatient physical therapy
- g. Patients with one or more of the following should have a referral for outpatient cardio-pulmonary rehab clinic:



- i. Age  $\geq$  65 years
- ii. Discharged on supplemental oxygen

### XIII. RESEARCH

- a. There are several ongoing research studies at Denver Health pertaining to rib fractures (**Figure 7**). Please be aware of patients who are potentially eligible for one or more of these studies and contact study personnel prior to initiating therapies.
- b. Research studies should never delay or replace definitive clinical care.

### XIV. REFERENCES

1. Ziegler, D.W. and N.N. Agarwal, *The morbidity and mortality of rib fractures*. J Trauma, 1994. **37**(6): p. 975-9.
2. Bulger, E.M., et al., *Rib fractures in the elderly*. J Trauma, 2000. **48**(6): p. 1040-6; discussion 1046-7.
3. Flagel, B.T., et al., *Half-a-dozen ribs: the breakpoint for mortality*. Surgery, 2005. **138**(4): p. 717-23; discussion 723-5.
4. Butts, C.A., et al., *Do simple bedside lung function tests predict morbidity after rib fractures?* Am J Surg, 2017. **213**(3): p. 473-477.
5. Todd, S.R., 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): p. 806-11.
6. Gonzalez, K.W., et al., *A pilot single-institution predictive model to guide rib fracture management in elderly patients*. J Trauma Acute Care Surg, 2015. **78**(5): p. 970-5.
7. Chapman, B.C., et al., *RibScore: A novel radiographic score based on fracture pattern that predicts pneumonia, respiratory failure, and tracheostomy*. J Trauma Acute Care Surg, 2016. **80**(1): p. 95-101.
8. Hardin, K., et al., *The Sequential Clinical Assessment of Respiratory Function (SCARF) Score: A Dynamic Pulmonary Physiologic Score that Predicts Adverse Outcomes in Critically Ill Rib Fracture Patients*. Presented at the 2019 meeting of the Chest Wall Injury Society, March 28-30, Santa Fe, NM, 2019.
9. Chapman, B., et al., *Does CT Chest Provide Clinically Meaningful Information in Patients with Suspected Rib Fractures*. 2014: p. Oral Presentation at the 2014 Annual Meeting of the Western Surgical Association.
10. Slobogean, G.P., et al., *Surgical fixation vs nonoperative management of flail chest: a meta-analysis*. J Am Coll Surg, 2013. **216**(2): p. 302-11 e1.
11. Pieracci, F.M., et al., *A prospective, controlled clinical evaluation of surgical stabilization of severe rib fractures*. J Trauma Acute Care Surg, 2016. **80**(2): p. 187-94.
12. Pieracci, F.M., et al., *Surgical stabilization of severe rib fractures*. J Trauma Acute Care Surg, 2015. **78**(4): p. 883-7.
13. Pieracci, F.M., et al., *A multicenter evaluation of the optimal timing of surgical stabilization of rib fractures*. J Trauma Acute Care Surg, 2018. **84**(1): p. 1-10.

