DENVER HEALTH TRAUMA
LEVEL ONE ADULT & LEVEL TWO PEDIATRIC
ERNEST E. MOORE SHOCK TRAUMA CENTER

DHMC TRAUMA ADULT RIB FRACTURE PRACTICE MANAGEMENT GUIDELINE

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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].

PURPOSE

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

GUIDELINE

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 ≥ 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. ≥ 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 ≥ 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 O2 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. ≥ 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. ≥ 3 severely (bicortically) displaced fractures (not necessarily contagious)
   iii. ≥ 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 sparring 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 in 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 ≥ 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 ≥ 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.

EXTERNAL REFERENCES

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DHHA RELATED DOCUMENTS

None

ATTACHMENTS

A. Rib Fracture PMG Tables and Figures