Dial-in Trauma Education Half Day
20th November 2020

Chest trauma assessment and management update

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UHCW statistics

2019 (January to December) TARN eligible Cases
Seen in ED – 1589
581 with Thoracic Injuries
234 transferred to Cardiothoracic Ward

2020 (January to September) TARN eligible Cases
Seen in ED – 938
399 with Thoracic Injuries
72 transferred to Cardiothoracic Ward (numbers may differ due to COVID-19 pandemic)

Prepared by: Jesse Salvo (TARN Coordinator)

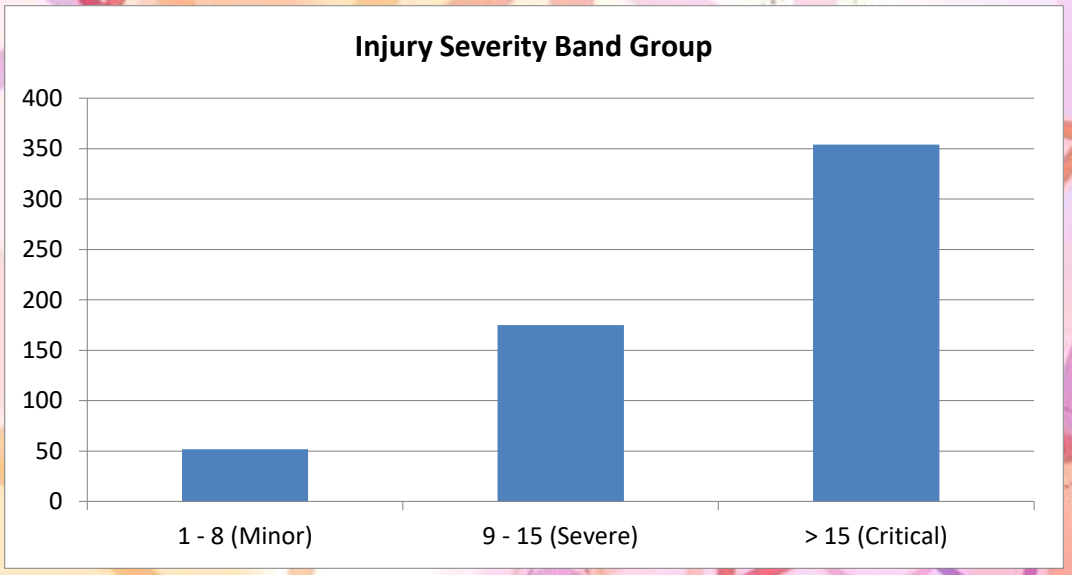
TARN Eligible Inclusion criteria

Inclusion Criteria:

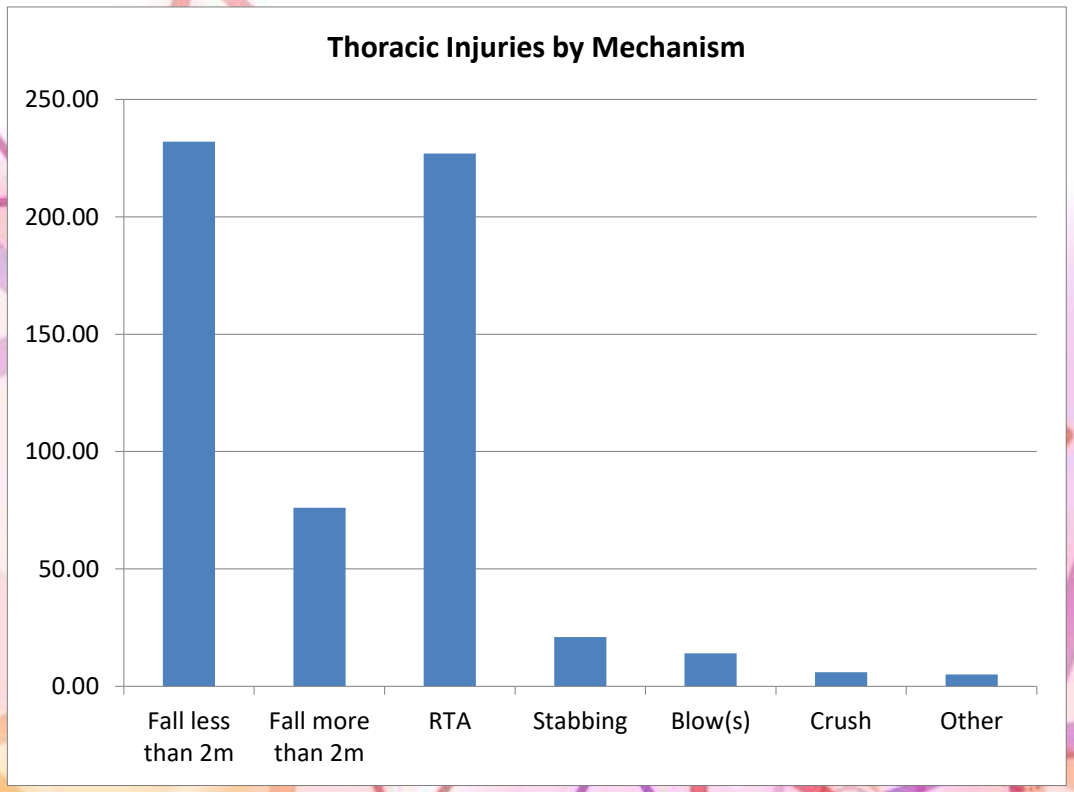
- Trauma Incident such as Road Traffic Accident, Fall, Blows, Shooting, Stabbing, Crush, etc.
- Admitted as Inpatient for at least 3 nights or Died with trauma injuries
- Transferred In and out with combined stay of 3 nights
- General Critical Care Admission, and
- Trauma classified injuries specified in TARN Inclusion. (ICD10 Codes S&T)

TARN Coded each Injuries using AIS (Abbreviated Injury Scale) between 1 to 5 (Minor to Critical)
Injury Severity Score was the product of squared AIS by body Region
Total Injury Severity Score was derived by adding 3 highest Scored per body region. (Head, Face, Chest, Abdomen, Pelvic, Limb, Others)

2019 Thoracic Injuries TARN Cases

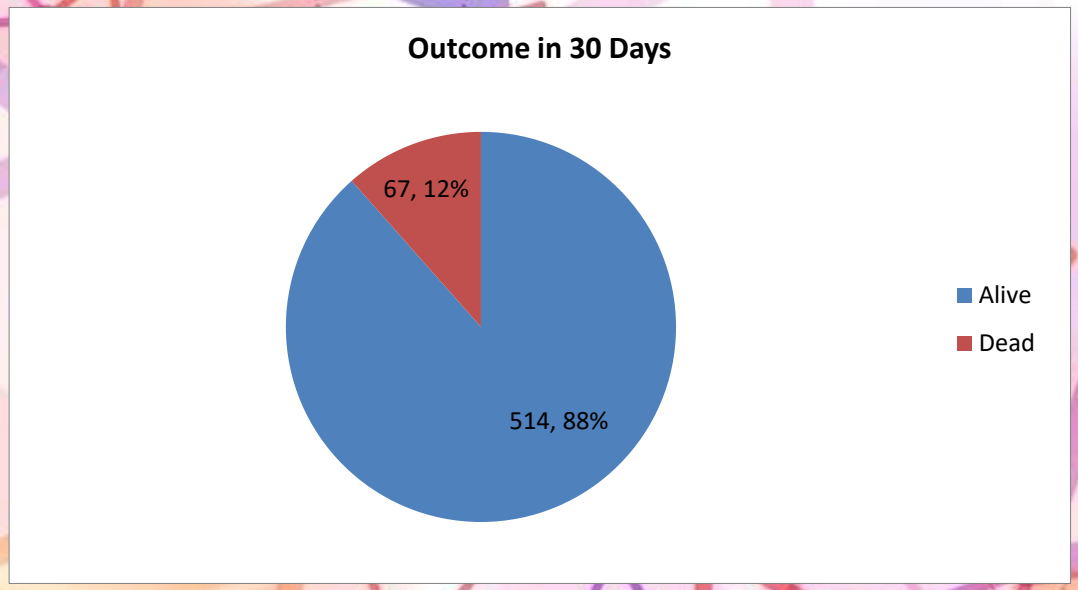


ISS Band	2019 Cases
1 - 8 (Minor)	52
9 - 15 (Severe)	175
> 15 (Critical)	354
Total Cases	581



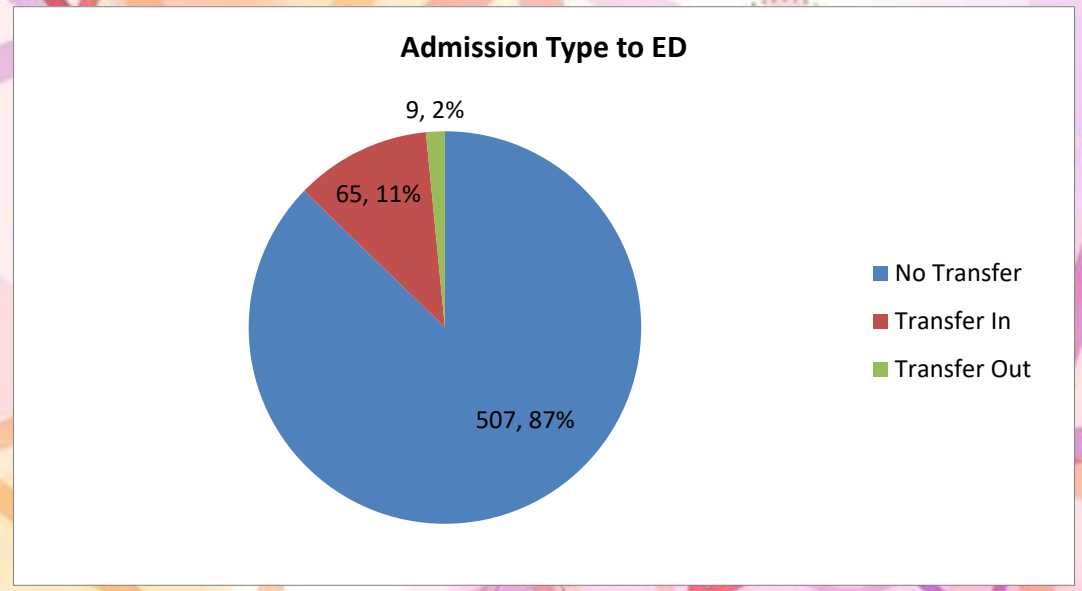
Mechanism	Total
Fall less than 2m	232.00
Fall more than 2m	76.00
RTA	227.00
Stabbing	21.00
Blow(s)	14.00
Crush	6.00
Other	5.00

2019 Cases Outcome in 30 Days



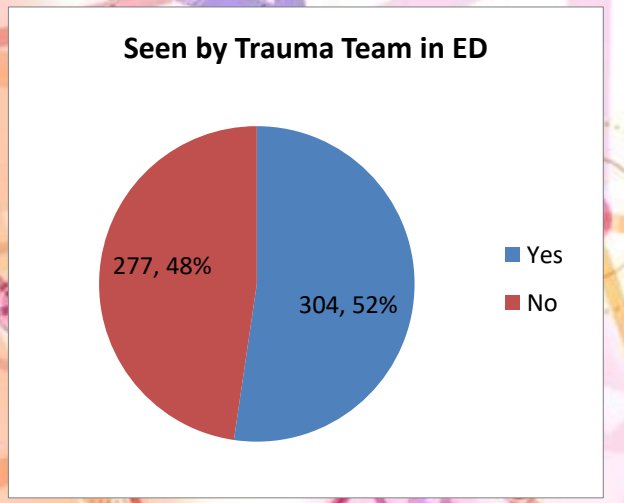
Outcome at 30 Days	2019 Cases
Alive	514
Dead	67
Total Cases	581

Admission Type to ED



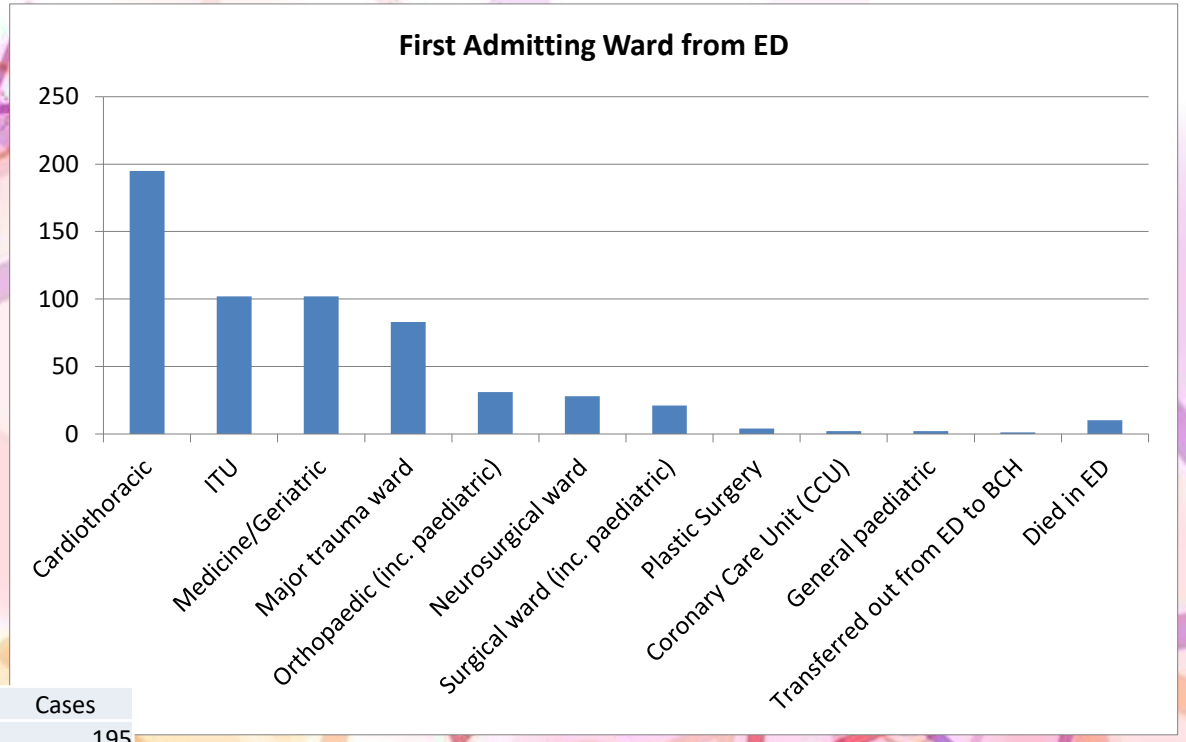
Type of Admission	Total
No Transfer	507
Transfer In	65
Transfer Out	9
	581

Trauma Alerted and Seen by Trauma Team in ED



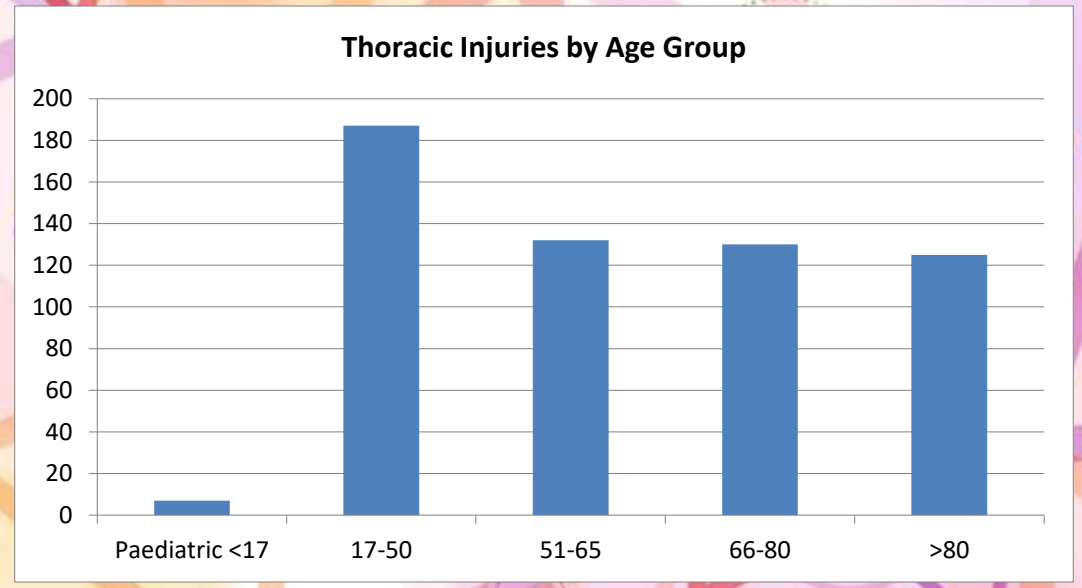
Seen by Trauma Team	Cases
Yes	304
No	277
	581

First Admitting Ward Cases



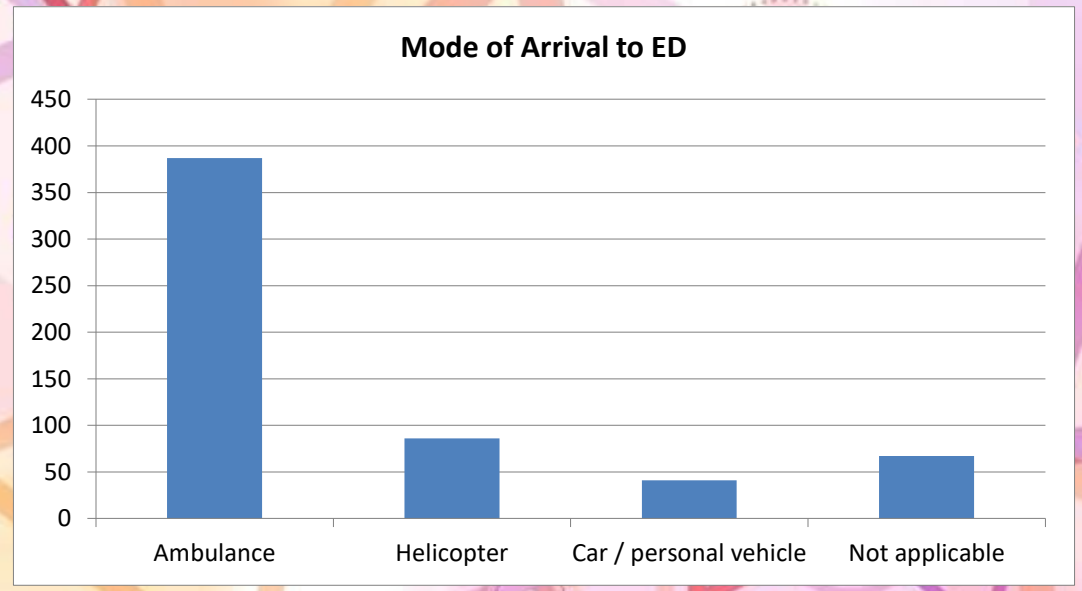
First Admitting Ward	Cases
Cardiothoracic	195
ITU	102
Medicine/Geriatric	102
Major trauma ward	83
Orthopaedic (inc. paediatric)	31
Neurosurgical ward	28
Surgical ward (inc. paediatric)	21
Plastic Surgery	4
Coronary Care Unit (CCU)	2
General paediatric	2
Transferred out from ED to BCH	1

Age Group



Age Group	Cases
Paediatric <17	7
17-50	187
51-65	132
66-80	130
>80	125
	581

Mode of arrival



Mode of arrival	Cases
Ambulance	387
Helicopter	86
Car / personal vehicle (self-presented to ED)	41
Not applicable (transfers from other hospitals)	67
	581

Case Scenario 1

Incident Date-08/02/2019
Incident Description 55 Years old Male
Patient was a motorcyclist travelling at 60mph hit by a car

Patient method of transport- Ambulance
Arrival Time- 14:16
Prehospital observation: 14:33
RR-22
Pulse-66
BP- 135/83
GCS-5 (E-1,V-1,M3)
Pupils size- R4, L-Not applicable
Pre- Alerted to UHCW

Case Scenario 1

- **Interventions:**
- Chest drain insertion
- Added oxygen
- Intubated-15:30
- Pre-hospital blood- 1 unit
- IV Paracetamol
- IV Morphine
- Spinal immobilisation
- MHP Activated

- ED Arrival time-16:26
- Seen by Trauma Team on ED arrival/MHP Activated
- ED observation:
- RR-Intubated
- Pulse-67
- BP- 121/97
- GCS-not applicable as patient was Intubated
- Pupils-Bilateral 2, reactive
- MHP Activated

Case Scenario 1

- Injuries:
- Left anterior pneumothorax,
- Multiple posterior lung contusions
- Left displaced posterolateral fractures 3,4,5,6,7,8 ribs; anterolateral fractures 5-9 ribs
- Communited fracture left scapula
- Left scalp laceration and haematoma, left cheek and nasal laceration

Case Scenario 1

- Operation/s:
- 11/02/2019 – ORIF/Thoracoscopy
- Washout and debridement of left scalp, left cheek and nasal lacerations (Max Fax)

- Critical Care Admission – 08/02/2019 to 13/02/2019 (4 days)
- MTECU Admission – 13/02/2019 to 15/02/2019
- Cardiothoracic Ward Admission- 15/02/2019 to 20/02/2019
- Total Days Inpatient- 12 Days
- Past Medical History- Depression, PE
- GOS- Outcome- Good Recovery
- Discharged Home

- Age- 55
- Gender-Male
- Outcome at Discharge-Alive
- ISS (Injury Severity Score)- 21
- Ps (Probability of Survival)- 58.74%

Case Scenario 2

Incident Date- 22/04/2019
Incident Description:
Crushed whilst working under a car supported by jacks. Car fell on top of him, trapping him under axel. Friend jack the car up and release him.

On arrival of HM53 patient was kneeling against a chair

Patient method of transport- Helimed 53
Prehospital observation: 12:05
RR-36
Pulse-108
BP- 164/108
GCS-15
Pre- Alerted to UHCW

Case Scenario 2

ED Arrival time-12:53
Seen by Trauma Team on ED arrival
ED observation:
RR-21
Pulse-94
BP- 146/91
GCS-15
Pupils-Bilateral 3, reactive

Injuries:
Multiple, bilateral rib fractures:
Right sided fractures in anterior/lateral and posterior ribs 2, 3, 5,6 and 7 in keeping with flail segments.
Left sided fractures in anterlolateral rib and posterior rib 5 in keeping with flail segment.
Posterior left rib fractures in 1,7,5 and 6
Right anterior pneumothorax

Case Scenario 2

Date of Operation: 26/04/2019-09:10

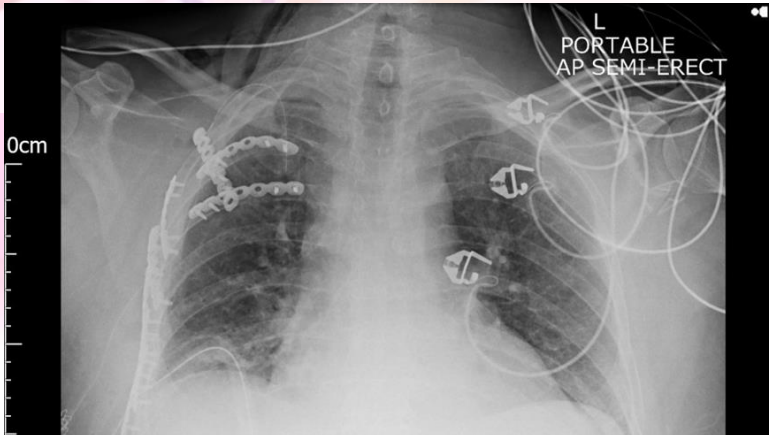
Procedure (including site/side): Right multiple ribs ORIF

2 x incisions. Posterior muscle sparing ORIF 2 x ribs displaced posteriorly with plates and screws. Sutured by layers with redivac under skin flap.

Anterior incision only muscle divided serratus anterior.

6 ribs fixed plates and screws. Upper rib comminuted, 1 x screw each side and reinforced with 2 x ethibonds to splint the rib with the plate. Sutured by layers. 24 F drain

Left chest explored under GA. No obvious deformity or unstable fractures identified on deep palpation. If fracture under scapula trauma to ORIF greater than any possible fracture to be heal by itself, so not proceeded to Left ORIF



Case Scenario 2

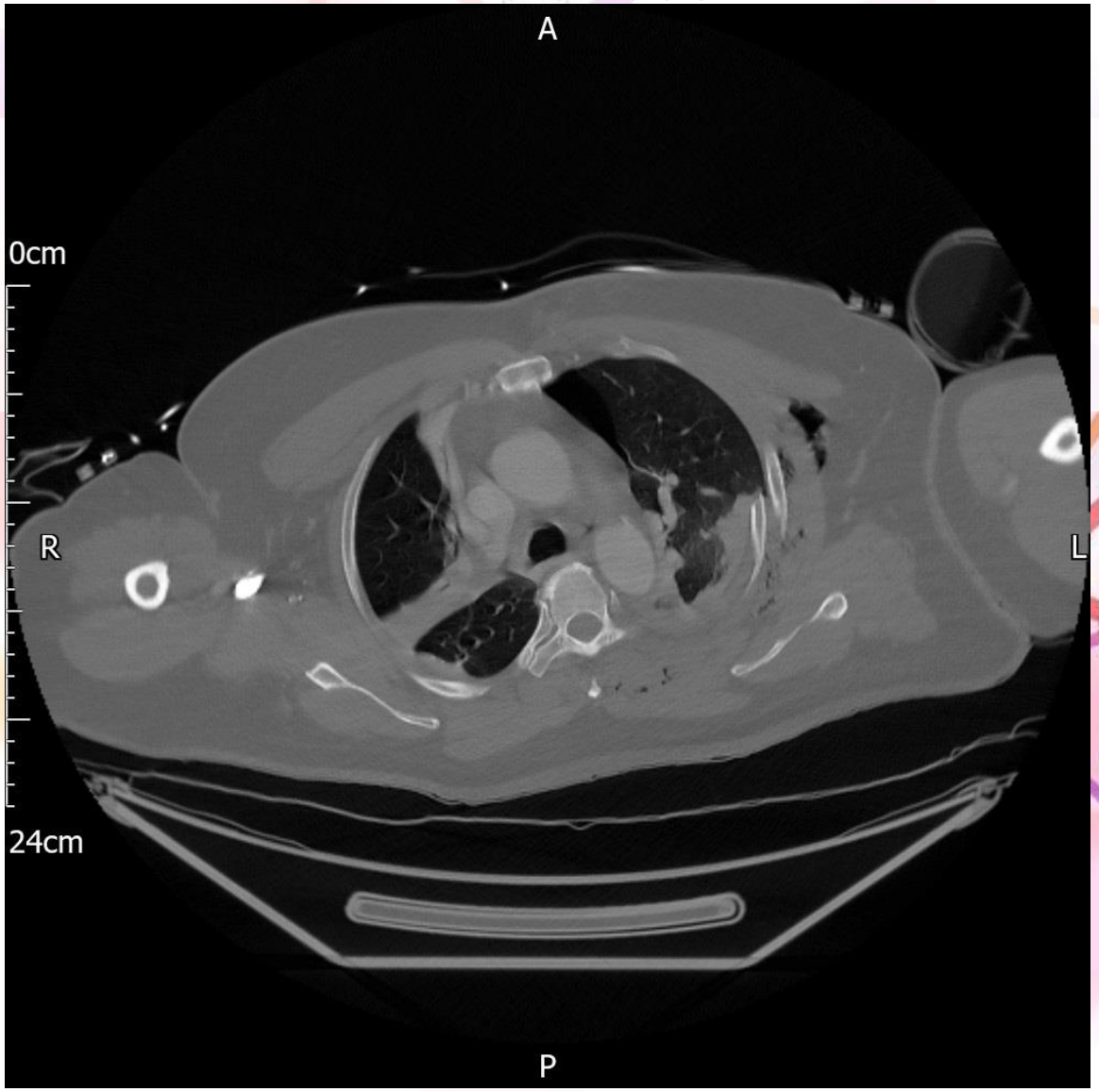
Cardiothoracic Ward Admission- 22/04/2019 to 02/05/2020
Past Medical History- None
GOS- Outcome- Good Recovery

Age-54
Gender-Male
Outcome at Discharge-Alive
ISS (Injury Severity Score)- 25
Ps (Probability of Survival)- 98.96%

Case 1

- 47 yo male, RTC 60 mph vs car and hit a fence 17/10/2019. Intubated and sedated at the scene due to respiratory distress
- CT scan: soft tissue injury left orbit, 2- 9th displaced left rib fractures/ flail chest, surgical emphysema, left pneumothorax, collapse RUL, Left C7- T1 fractures, left humeral fracture
- DM type 2, HTN, asthma, MI 2012
- Admitted to GCC, I&V
- 21/10/2019: Bronchoscopy, Left rib ORIF (5-9), ICD insertion
- Extubated a week later
- 01/11/2019: Left humerus ORIF and radial nerve exploration
- Transferred initially to trauma ward (management of C7-T1 fractures) to cardiothoracic ward
- 06/11/2019: discharged – referred to the peripheral nerve injury department in Birmingham – further exploration of the radial nerve

Case 1



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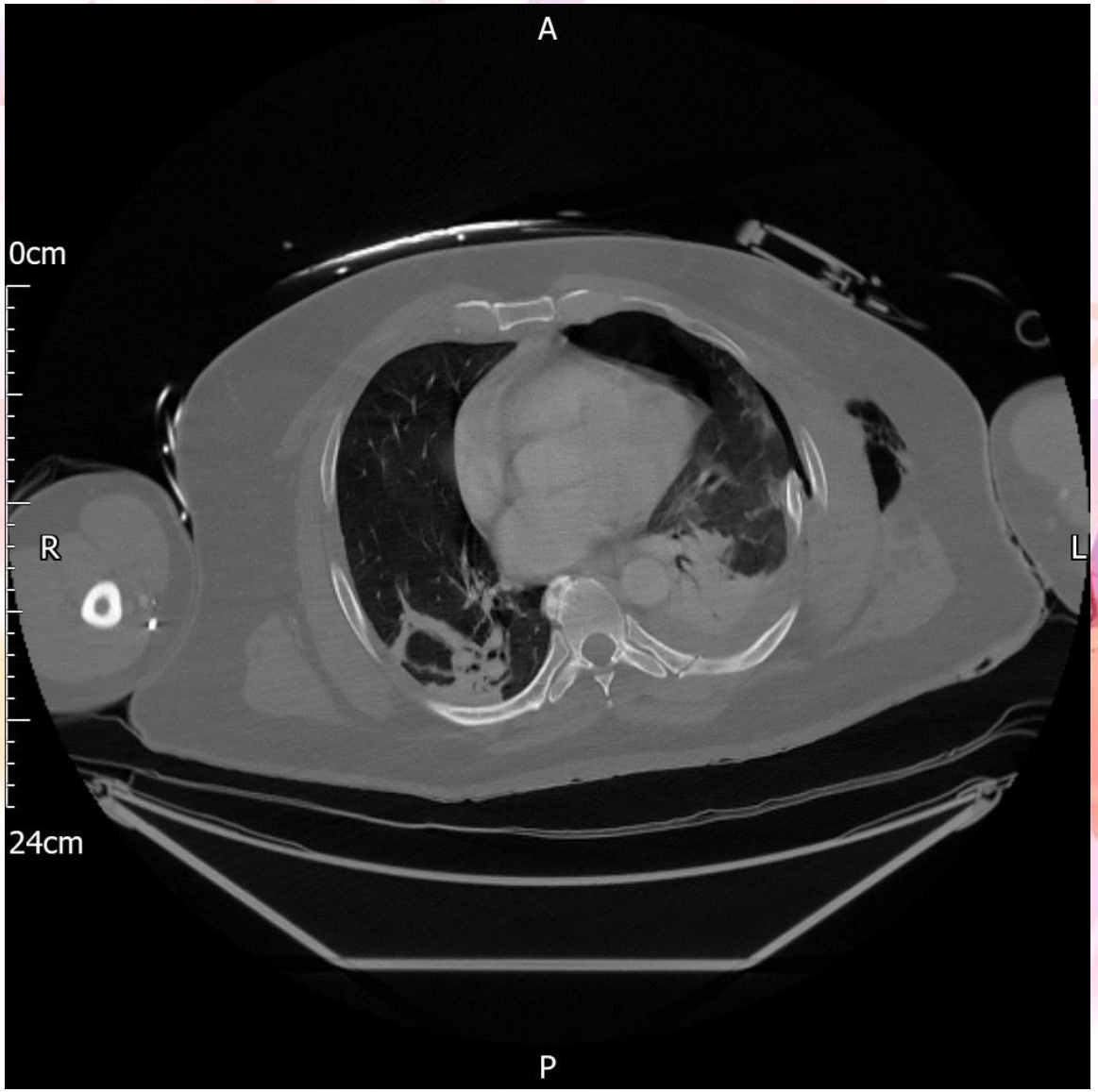
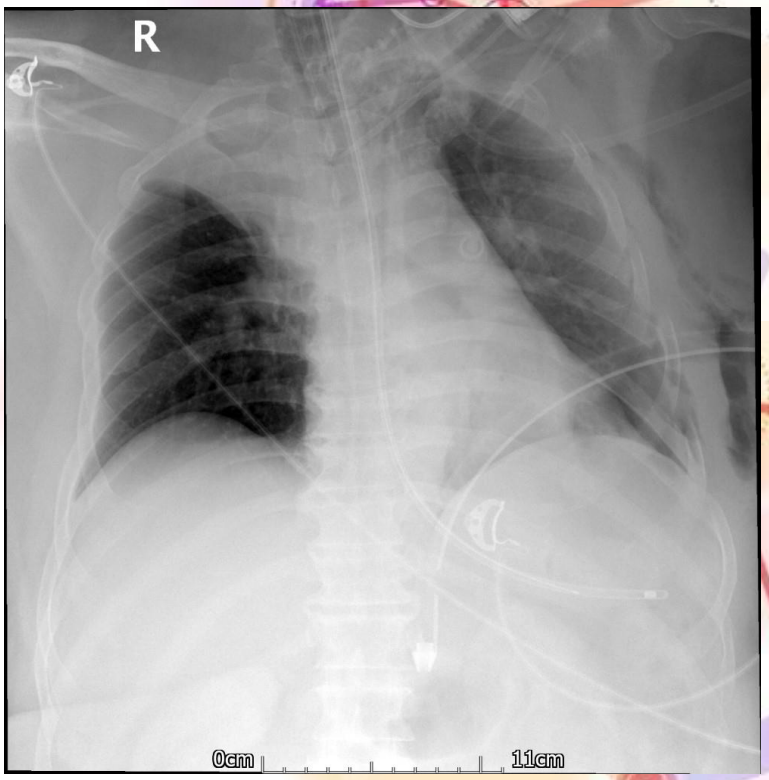
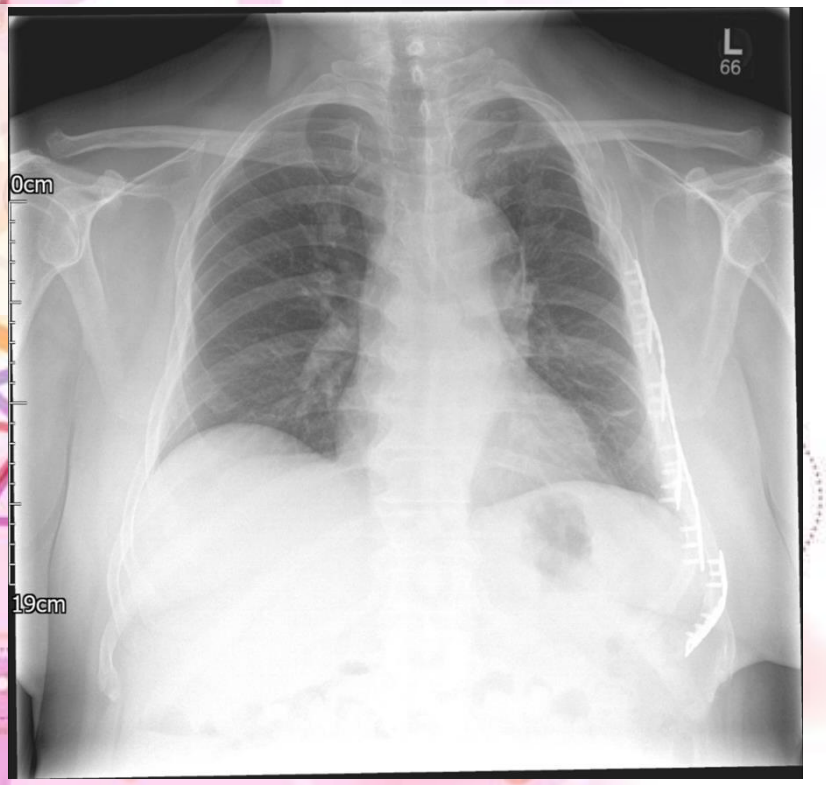


Case 1

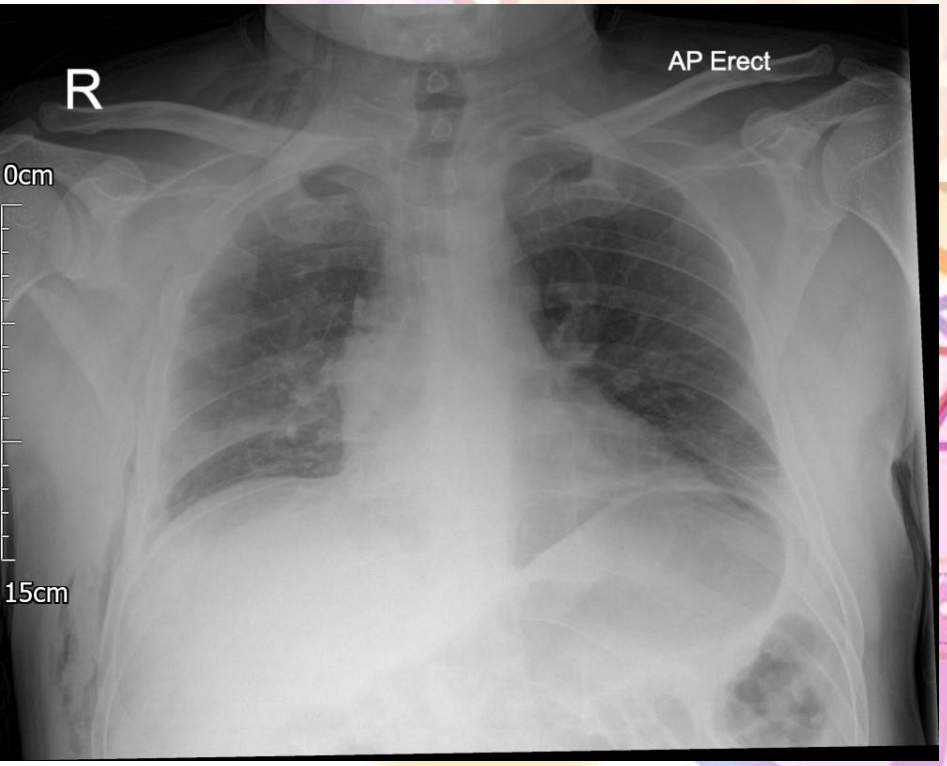


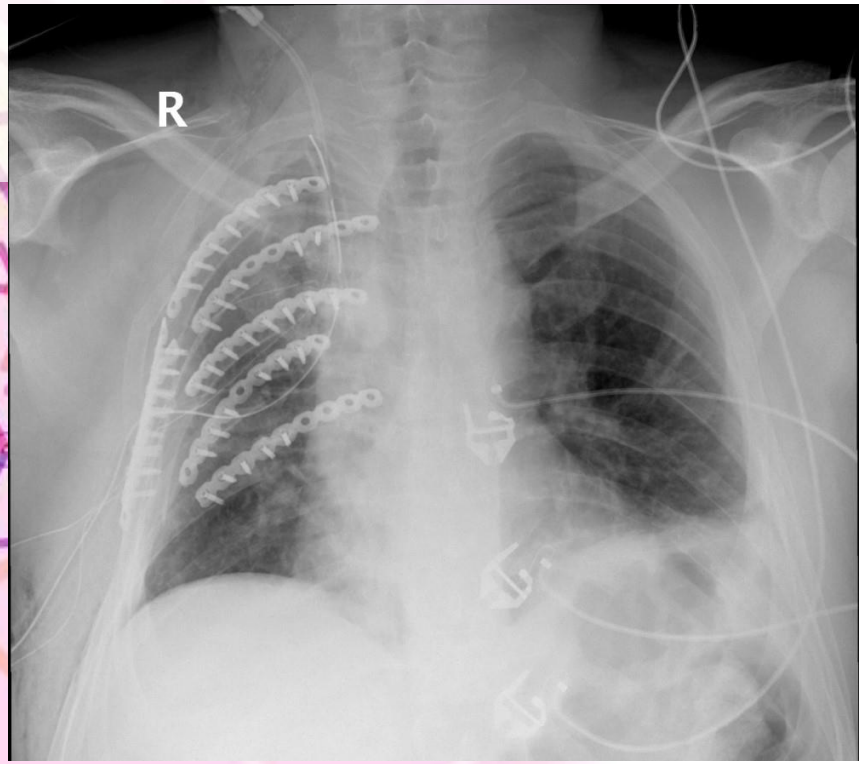


Case 2

- 39 yo male, RTC, cyclist vs bus 25/08/2020
- Right scapula fracture, right ribs 2-10 fractures/ flail segment, surgical emphysema, small haemopneumothorax
- Right ribs ORIF and right VATS 28/08/2020
- Sling for the scapula fracture
- Discharged on 02/09/2020

Case 2





Imaging in chest trauma

CXR: portable, speed of acquisition, image availability, low expense, low radiation exposure. **Can reveal**: Pneumothorax, Haemothorax, Pericardial effusion, subcutaneous emphysema, Possibly mediastinal injury, Pulmonary contusion ,Rib/ clavicle / scapular fractures , Diaphragmatic injury, Pneumoperitoneum, foreign bodies. Does not offer detail

US: portable, fast, easy to use. **Can reveal:** pneumothorax, haemothorax, pericardial effusion (eFAST). Operator dependent; patient's body habitus, subcut emphysema may pose difficulties

CT chest: not portable, speed of acquisition, detailed information.
Gold standard for chest trauma
Pneumothorax, Haemothorax, Pericardial effusion, Mediastinal injury, including specific information about aortic injury, Pulmonary contusion, Fractures, Diaphragmatic injury Pneumoperitoneum. Patient must be stable

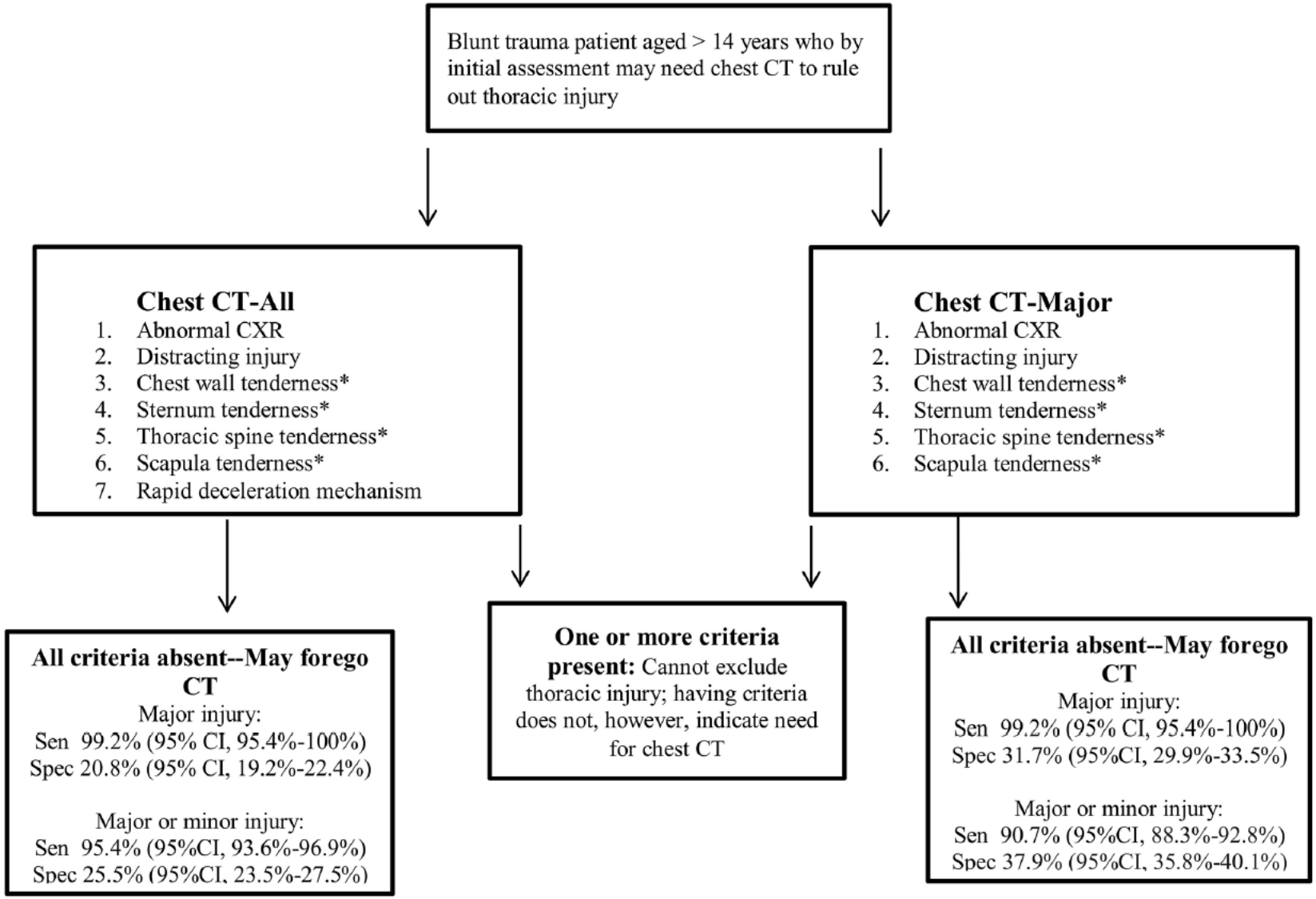


Fig 2. NEXUS Chest CT decision instrument implementation. Abnormal CXR is any thoracic injury (including clavicle fracture) or a widened mediastinum. Rapid deceleration mechanism is a fall from >20 feet (6.1 m) or a motor vehicle accident at >40 miles (64.4 km) per hour with sudden deceleration. Thoracic injury is defined as pneumothorax, hemothorax, aortic or great vessel injury, multiple rib fractures, ruptured diaphragm, sternal fracture, scapular fracture, thoracic spine fracture, esophageal injury, tracheal/bronchial injury, or pulmonary contusion/laceration. *These four criteria may be evaluated together as any thoracic wall, sternal, spine, or scapular tenderness. Sen, sensitivity; Spec, specificity.

Pneumothorax/ Haemothorax

- Chest drain in :
- Clinical suspicion of tension pneumothorax or massive haemothorax
  Penetrating injuries entering the pleural space
- Open pneumothorax (plus secure cover)
- Patient with chest injury with traumatic arrest without cardiac output (to exclude tension pneumothorax)

- Occult pneumothorax (seen on CT but not on CXR) : 15-20% of blunt trauma and up to 17% of penetrating trauma: can be monitored
- Larger, enlarging or symptomatic pneumothoraces should be managed with chest drain insertion

- All haemothoraces should be considered for drainage regardless of the size.
- Consider drainage in respiratory compromise, multiple rib fractures, flail chest, and pneumothorax
- Massive haemothorax= blood drainage>1500 mL and continuous bleeding at 200 mL/hr for at least four hours

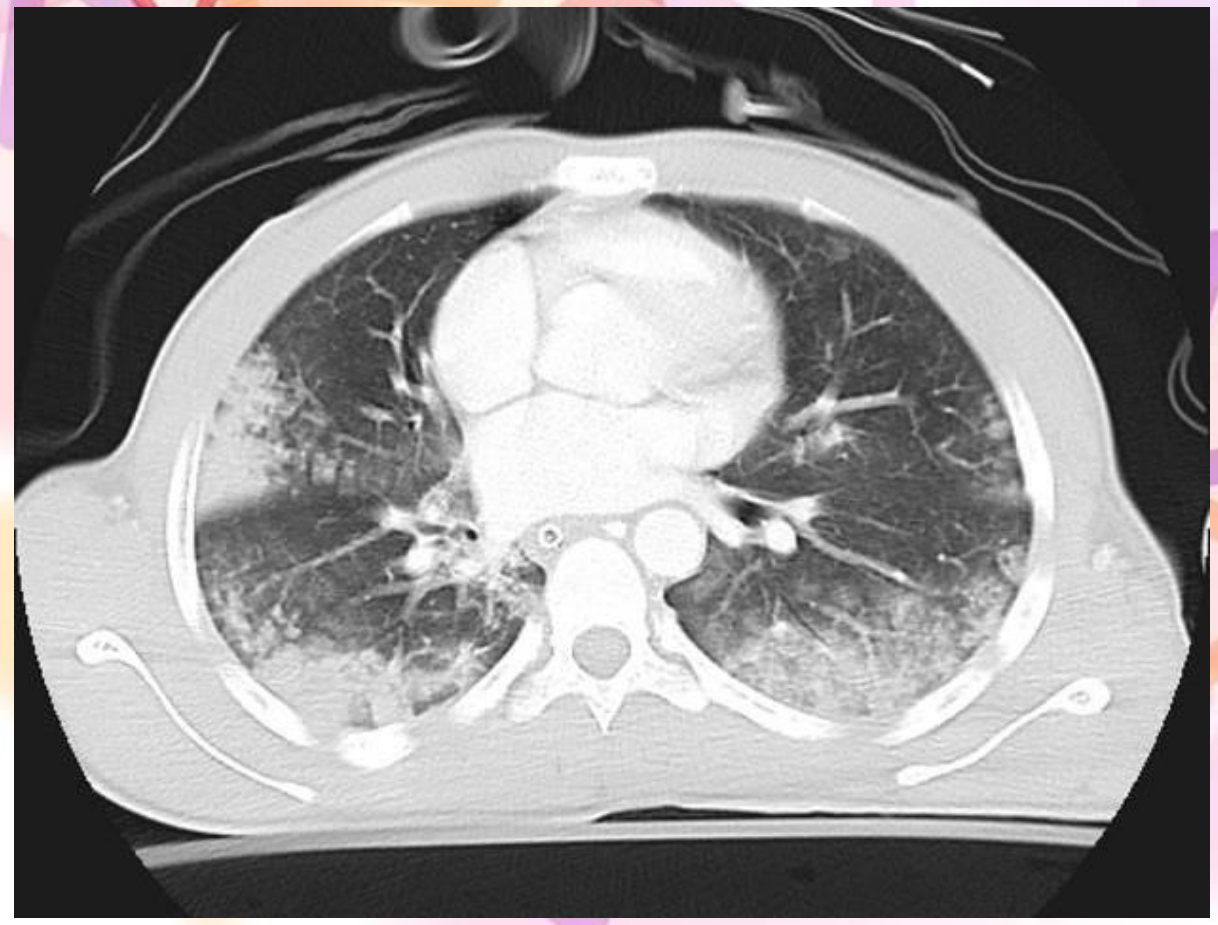
Pneumothorax/ Haemothorax

- 18% to 22% of all injuries involving the thorax require chest drain for pneumo/haemothorax
- Approximately 1 in 10 to 14 initially drained patients has to undergo major thoracic surgery

- A retained haemothorax may result in an empyema (27-33%)

- Regular control of the patency of the system, volume, and quality of evacuated fluid is also mandatory
- 20-24 Fr chest drain for a pneumothorax and 28+ Fr for a haemothorax
- Remove the chest tube when no further air leak is detected. (The swinging fluid in the connecting tube is a sign of cessation of active air leakage from the pleural surface).
- The universally accepted threshold for chest drain removal in trauma is 200 to 300 mL/24-hour

Lung contusions



Lung contusions

- Lung contusion often occurs in conjunction with chest wall injury/ rib fractures, especially in high-speed trauma
- The incidence of lung contusion in patients with blunt chest trauma varies between 17% and 75%

- The contused lung is often damaged and unable to participate in the gas exchange of respiration.
- If large enough in volume, this condition can result in significant respiratory distress. In flail chest, lung contusions are frequently present and contribute to respiratory compromise.
- CXR and CT: The appearance of lung contusion on CXRs often delayed. CT is a more accurate method for diagnosing lung contusions.
- Lung contusions have been identified as an independent risk factor for respiratory complications.
- Mortality varies between 10% and 25%, in conjunction with concomitant injuries.

Lung contusions

- The recovery of a noncomplex lung contusion may be observed on CXR between 48 h and 72 h, but complete recovery may take up to 14
- Clinically, chest pain, dyspnoea and tachypnoea may be present.
- The treatment of pulmonary contusion is supportive. Monitoring of vital signs, oxygen support, pain control, early mobilization and chest physiotherapy, proper fluid balance and, if necessary, diuretics.
- Steroid and empirical antibiotic use are controversial.

- If infection or ARDS does not occur, the clinical condition may slowly correct itself.
- Pulmonary contusion is an independent predictor of complications such as pneumonia, ARDS and multiple organ dysfunction syndrome (MODS).
- For severe contusions, intubation and mechanical ventilation may be necessary. For the most severe injuries, life-threatening hypoxia owing to pulmonary haemorrhage can result. Advanced ventilator modes, including extracorporeal membrane oxygenation, may be necessary.

Rib fixation

- **Pro**: decreases in ICU length of stay, duration of mechanical ventilation, tracheostomy rates, risk of pneumonia, treatment costs. Can facilitate pain management, reduce overall hospital stay and complications and allow earlier return to daily activities.

- **Against**: no improvements in mortality, mixed results in terms of pain control, few long-term outcome data, no studies comparing rib fixation with multimodal analgesia, and questionable indications for operation.

- Different types of fixation systems: wires clamping braces, **external plate and screw fixation**, and intramedullary fixation.

- We use the MatrixRIB (DePuy Synthes™) system

- Accurate early diagnosis by clinical examination and radiological methods can allow for an optimal management plan. Early discussion with thoracic surgeons should be carried out to allow for intervention within the first 72 hours, if deemed appropriate.

Relative indications and contraindications for rib fixation

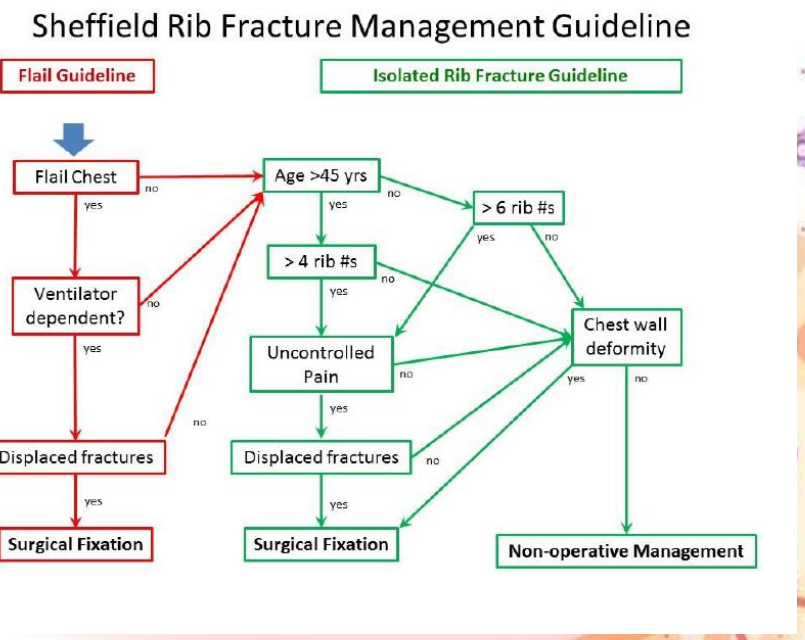
Relative Indications

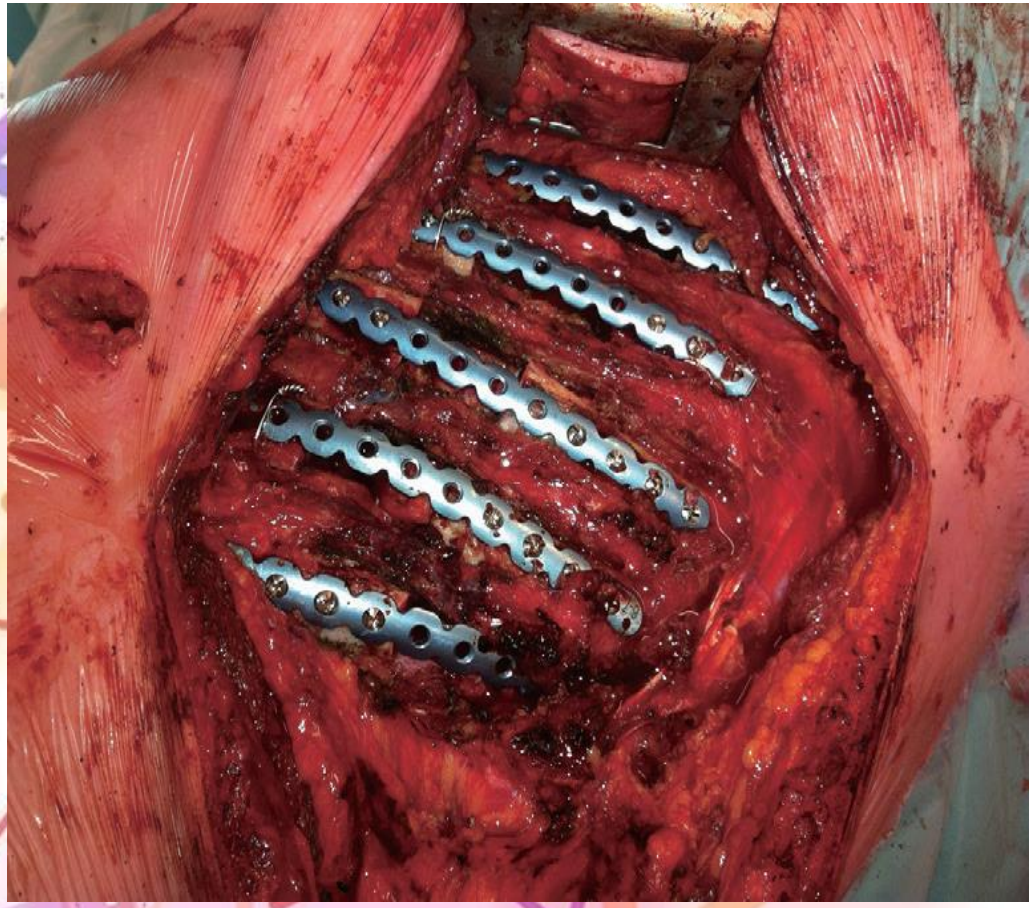
Pain refractory to medical management
Flail chest causing respiratory compromise
Respiratory failure owing to chest wall instability
Rib fractures with fragments impinging on vital structures
Impaired pulmonary function tests owing to chest wall deformity
Symptomatic rib fracture nonunion or malunion

Contraindications

Respiratory failure not related to chest wall injury
Significant pulmonary contusion
Other injuries requiring prolonged intubation
Patients unable to tolerate surgery

Rib fixation





Clinical indications
3 or more rib fractures with rib displacement of more than 1 rib cortical diameter
Flail segment
Pulmonary worsening with progressive volume loss on X-ray
Intubation/mechanical ventilation
Use of IV narcotics
Uncontrolled pain when using analgesia or VAS score >6
Lung impalement
Open chest defect
Stabilization on the retreat of thoracotomy
Pulmonary herniation

Analgesia

- A multidisciplinary approach with 3 primary components: pain management, physiotherapy, and mobility.
- Pain management consists of 3 basic categories: nonregional analgesia, regional anaesthetics, and surgical fixation.
- **Nonregional analgesia**, primarily oral and intravenous analgesics, is often the initial therapy for pain management for mild to moderate chest wall injury.
- Emphasis on **multimodal analgesia**, which is defined as simultaneous use of a combination of analgesics that each have different mechanisms of action: NSAIDs paracetamol, and/or gabapentin and pregabalin with opioids as needed should be attempted for mild to moderate chest wall injury.
- Oral opioids are preferred to IVs when possible., when IV opioids are required, PCA should be used.
- For patients requiring more aggressive pain control, lidocaine or ketamine infusions can be considered.

Analgesia

- **Regional anaesthesia** should be considered to optimize pain control for patients with chest wall injury that are considered at higher risk of respiratory complications.
- In more severe chest wall injury (>4 fractured ribs), over 45 years of age, insufficient respiratory effort (based on incentive spirometry or pulmonary function tests), and/or inadequate pain control with multimodal analgesia.
- Intercostal nerve blocks, paravertebral blocks and thoracic epidural catheters (TEC).
- **Intercostal** nerve block: blocking the intercostal nerves individually with an injection of local anaesthetic, typically bupivacaine.
- Injection at the level of the fractured rib plus 1 rib above and below.
- **Paravertebral** or serratus blocks: placed in an extrathoracic, location using manual palpation or ultrasound guidance. A long infusion catheter is placed and connected to an infusion pump that administers a continuous infusion of local anesthetic for up to 5 days.
- **Epidural** is the regional anaesthetic modality of choice for patients with bilateral chest wall injury, and more than 2 fractured ribs. Risks of dural puncture and spinal cord injury, hypotension, urinary

Analgesia

- **Chest physiotherapy** is arguably the most important component of the management of chest wall injury.
- Necessary to clear airway secretions and prevent atelectasis.
- Lung expansion and secretion clearance are key interventions in preventing pneumonia and respiratory complications.
- Incentive spirometry and positive expiratory pressure therapy devices.
- Secretion clearance is achieved with coughing, and airway suctioning (nasotracheal or tracheal).

- **Mobility** is a key component to the management of trauma patients with chest wall injury, allowing for optimal ventilation and perfusion matching.
- Upright positioning encourages better diaphragm excursion and subsequently higher tidal volumes compared with supine positioning.
- Progressive mobility has been associated with decreased rates of deep venous thrombosis and pulmonary embolism, and lower
- pneumonia rates, less ventilator days, and shorter durations of hospital and ICU stays.

Literature

1. Molnar TF. Thoracic Trauma: Which Chest Tube When and Where? Thorac Surg Clin. 2017 Feb;27(1):13-23. doi: 10.1016/j.thorsurg.2016.08.003. PMID: 27865322.
2. Majercik S, Pieracci FM. Chest Wall Trauma. Thorac Surg Clin. 2017 May;27(2):113-121. doi: 10.1016/j.thorsurg.2017.01.004. PMID: 28363365.
3. Dennis BM, Bellister SA, Guillamondegui OD. Thoracic Trauma. Surg Clin North Am. 2017 Oct;97(5):1047-1064. doi: 10.1016/j.suc.2017.06.009. PMID: 28958357.