Queensland Health

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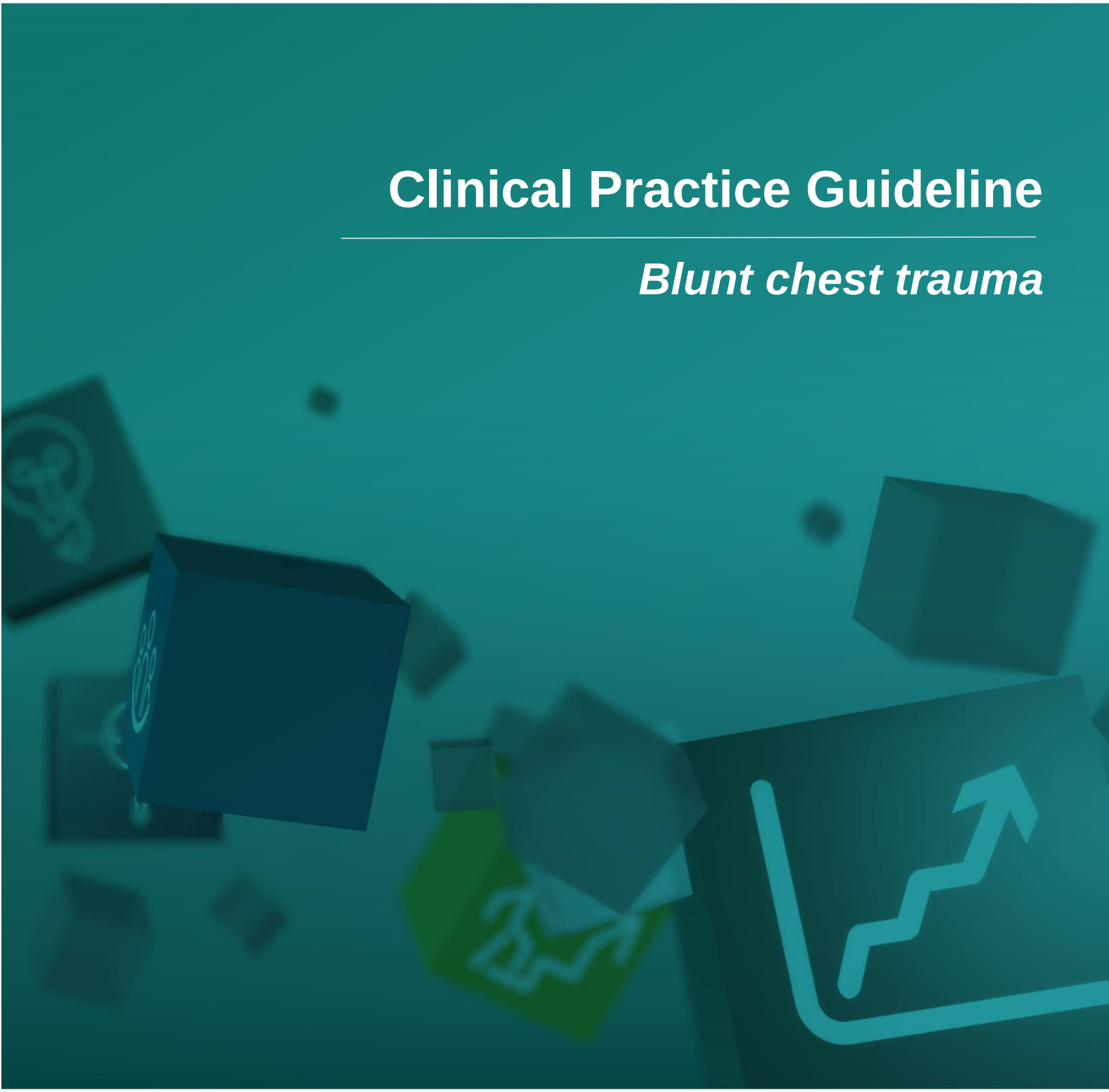
Clinical Practice Guideline

Blunt chest trauma



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Queensland Government

Blunt chest trauma

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An electronic version of this document is available on the intranet, at
https://qheps.health.qld.gov.au/caru/networks/trauma

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The guideline is not a substitute for clinical judgement, knowledge and expertise, or medical advice. Variation from the guideline, taking into account individual circumstances, may be appropriate.
This guideline does not address all elements of standard practice and accepts that individual clinicians are responsible for:

- Providing care within the context of locally available resources, expertise, and scope of practice
- Supporting consumer rights and informed decision making, including the right to decline intervention or ongoing management
- Advising consumers of their choices in an environment that is culturally appropriate and which enables comfortable and confidential discussion. This includes the use of interpreter services where necessary
- Ensuring informed consent is obtained prior to delivering care
- Meeting all legislative requirements and professional standards
- Applying standard precautions, and additional precautions as necessary, when delivering care
- Documenting all care in accordance with mandatory and local requirements

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Flowchart: Blunt Chest Trauma

Follow ATLS/EMST guidelines for initial assessment and management of all trauma patients

For specific blunt chest trauma: Assessment and Management
If the patient is unable to cough, take a deep breath or mobilise – an inpatient admission is required.
Consider an ICU review when any clinical deterioration is detected (e.g.↑ 02 or flow demand, ↑WOB, ↑ADDS score, ↓SpO2 or multiple red flags present). Escalate care as per local guidelines.
Arrange a review by the appropriate clinical team
Consider transfer to a major trauma centre and ensure early activation of the retrieval process[35] through **RSQ (1300 799 127)** where applicable

Red flags for potential deterioration
Age >55years
Uncontrolled pain

Previous lung disease:
Smoker, COPD, asthma
Morbid obesity

Respiratory compromise:
↑WOB, ↑RR, ↓SpO2
≥3 fractured ribs
Shallow breathing
Inability to cough

Associated injuries:
Pneumothorax or haemothorax
Pulmonary contusion
Flail chest

Admission
Intensive Care/High Dependency Unit:
Respiratory management above ward-level care
Haemodynamic monitoring requirement
Inotrope requirement
And/or other injuries requiring ICU management

Ward Admission
Admission to either a surgical or medical ward bed will be dependent on local patient admission procedures. The patient management should be supported by the appropriate treating team/s.

Telemetry Bed
If there is clinical concern for cardiac contusion or a new ECG change and/or elevated troponin:
Continuous cardiac monitoring (telemetry) is indicated for 24 to 48hrs[1,2]
Cardiology review/admission for consideration of echo

Transfer to Major Trauma Centre
Consider transfer to a major trauma centre for the following patients, as per local guidelines.
Ensure early activation of retrieval with RSQ
Significant major trauma involving more than one body region
Patients requiring ventilatory support
Haemothorax with significant ICC drainage
Large tracheobronchial injury, cardiac tamponade, clinical flail chest
Sternal fracture with cardiac contusion
Mediastinal or great vessel injury[3]
Consideration of surgical rib fixation[4]

Ward-based Care
Consider respiratory adjuncts, analgesia requirements, and prevention of complications

Respiratory Adjuncts
Incentive Spirometry
Hourly deep breathing
Supported cough
Daily review by Physiotherapist
Consider HFNP (Flow/Fi02 and target SpO2 to be documented in the patients' medical record)

Analgesia
Referral to the Acute Pain Management Service (or equivalent if available) once a decision is made to admit the patient. If any RED FLAG risk factors are present, also refer for consideration of a Regional Block or PCA.
Ensure regular oral analgesia is available
Simple analgesia - paracetamol (age/weight appropriate dose)
NSAID - if clinically appropriate, review every 3 days
Oral Opioids - immediate or slow release or PRN
Patient Controlled Analgesia (PCA) - Opioid
Regional blocks - Erector Spinae Plane (ESP), Serratus Anterior Plane (SAP) , Intercostal Nerve (ICN), paravertebral
Epidural
Other - Ketamine - continuous infusion, Gabapentinoids

Complication Prevention
Early documented clearance to mobilise
Encourage sitting out of the bed
Elevate bedhead
Daily chest physiotherapy
Early nutrition
Regular aperients
VTE prophylaxis (chemical and/or mechanical)

Discharge Planning
Wean HFNP and analgesia as clinically indicated
Liaise with multidisciplinary team on any barriers to discharge such as mobility, carer support, home environment, return to work/activity limitations
Discharge home when pain well controlled on oral analgesics and respiratory function optimised

- Provide prescriptions for oral analgesia and aperients if required
- Ensure opioid weaning plan is documented in the Discharge Summary for the GP
- Arrange all follow up appointments including GP follow up within 3 days of discharge
- Provide patient with an information leaflet or relevant handout
- Arrange all follow up appointments including GP follow up within 3 days of discharge

Consideration for special patient groups
Elderly frail patients aged >65 - Early recognition, low threshold for CT, GP/Geriatrician/medical input, and opioid sparing analgesia strategies i.e. regional blocks.
Obstetric trauma patients Refer to Maternity and Neonatal Clinical Guideline *Trauma in Pregnancy*[5]
Paediatric trauma patients Refer to Paediatric Trauma Service: *Trauma Guidelines 11th Edition*[6]

Abbreviations

ABC	Airway/breathing/circulation
ABG	Arterial blood gases
ADDS	Adult deterioration detection system
AMPLE	Allergies/medications/past history/pregnancy/last meal/events
ATLS	Advanced trauma life support
COPD	Chronic obstructive pulmonary disease
CPAP	Continuous positive airway pressure
CT/CTA	Computed tomography/computed tomography angiography
CXR	Chest x-ray
ECG	Electrocardiograph
ECHO	Echocardiography
ECMO	Extra-corporeal membrane oxygenation
EFAST	Extended focused assessment with sonography in trauma
EMST	Early management of severe trauma
FAST	Focused assessment with sonography in trauma
FBC	Full blood count
GCS	Glasgow coma scale
HFNP	High flow nasal prongs
ICC	Intercostal catheter
ICU	Intensive care unit
ISS	Injury severity score
IV	Intravenous
LOS	Length of stay
MDT	Multidisciplinary team
MI	Myocardial Infarction
MRI	Magnetic resonance imaging
MVA	Motor vehicle accident
NIV	Non invasive ventilation
NSAID	Non-steroidal anti-inflammatory drug
PCA	Patient controlled analgesia
PEEP	Positive end expiratory pressure
PRN	Pro re nata (as needed)
PTA	Post traumatic amnesia
QAS	Queensland Ambulance Service
ROTEM	Rotational thromboelastometry
RSQ	Retrieval services Queensland
SpO2	Peripheral capillary oxygen saturation
SSRF	Surgical stabilisation of rib fixation
TBI	Traumatic brain injury
TEG	Thromboelastometry
TEMSU	Telehealth emergency management support unit
UEC	Urea, electrolytes and creatinine
VBG	Venous blood gas
VTE	Venous thromboembolism
WOB	Work of breathing

Contents

Summary

Blunt chest trauma refers to any injury of the chest wall or within the thoracic cavity arising from a blunt mechanism or force. It may present as an isolated injury or as part of a multitude of injuries and has the potential to cause life threatening damage to the chest wall, internal organs, vasculature and mediastinal structures. A rapid and thorough assessment and management of blunt chest trauma is critical for preservation of essential body functions. The following evidence based clinical guideline is intended for reference by health practitioners that provide care to patients with isolated blunt chest trauma, who present to a Queensland Health hospital or health service.

1. Background

Blunt chest trauma is often associated with significant morbidity and mortality and is the third highest cause of death after head trauma and abdominal trauma.[7–10] Blunt chest trauma resulting in rib fractures account for the largest group of thoracic injury. Pneumothorax, hemothorax and pulmonary contusions are among the most common associated thoracic injuries.[11] Complications from chest trauma include pneumonia, respiratory failure, atelectasis, severe pain, and admission to an intensive care unit (ICU), which often results in an increased hospital length of stay (LOS).[8,9] The elderly population, aged over 65, are more likely to develop life-threatening complications and have a higher incidence of mortality.[12] Careful consideration is still required for patients who present with less severe, non-life-threatening blunt chest injury or delayed presentation, as they can deteriorate within 24–72 hours, and up to a week after admission. [9,13]

1.1 Anatomical Structures

The chest contains many structures that contribute to sustaining life. The internal structures such as the heart, aorta, lungs, trachea, oesophagus, diaphragm and other major vasculature all serve vital functions and when injured can be life-threatening. The chest wall surrounds the internal structures and serves the two important functions of protecting the internal organs as well as assisting in respiration. Given the superficial nature of the chest wall, it is quite vulnerable to injury and this can lead to accompanying internal organ damage. The anatomical structures in the chest wall include the skin, bones, musculature, cartilage, neurovascular bundles and the pleura, which line the internal wall of the chest.

1.2 Physiological Considerations

Hypoxia, hypercarbia and acidosis are some of the major physiological changes that may occur as a result of blunt chest trauma. Due to the high volume of blood that passes through the heart and lungs, there is a very high risk of contusion, clotting or hemorrhage if a major organ or vessel sustains a laceration or rupture. This may lead to blood filling other areas of the chest, into the lungs, or external bleeding. Movement of air or fluid into or around the lungs can disrupt the intrathoracic pressure and lead to difficulty with ventilation, depriving the body of vital oxygen.

1.3 Epidemiology

Motor vehicle accidents (MVAs) account for 70–80% of all blunt chest trauma cases.[14] The sudden high-speed deceleration and compression of the thorax can cause significant injuries, of which may be exacerbated if the patient is unrestrained in the vehicle. Other common causes of blunt chest trauma include assaults and falls. Blunt chest trauma in patients aged over 65 is commonly caused by a fall from standing height and is associated with significant mortality and

morbidity. [15] Falls in the elderly aged over 65 represents 80% of injury requiring hospitalisation in Queensland. [16,17] Increased morbidity and mortality of trauma patients has been shown to be correlated to the number of rib fractures present. [18,19]

2. Assessment

2.1 Clinical Examination

The immediate assessment of the patient should be prioritised according to the Early Management of Severe Trauma (EMST) or Advanced Trauma Life Support (ATLS) principles.[20,21]

Primary Survey – this should be conducted as soon as possible to detect serious lift threatening injuries that require immediate intervention, as outlined in section 3.2. This may be required to be reassessed multiple times.

Secondary survey – this is completed following the primary survey and after the patient has been stabilised. It includes a thorough review of the patient history and a full head-to-toe clinical examination to determine if any further assessment such as additional imaging and pathology is required.[22]

Tertiary survey – this should be completed within 24 hours of admission or as soon as practicably appropriate, to find any undetected or progressively evolving injuries.[23] This would include a complete physical re-examination of the patient, along with re-evaluation of laboratory and radiological findings. If the patient is intubated when the tertiary survey is undertaken, it is repeated after the patient is extubated.

2.2 Diagnostic Imaging

Imaging is essential for the early diagnosis of all blunt chest trauma, which can in turn assist clinicians to provide rapid life-saving therapy. A chest x-ray (CXR), computed tomography (CT) and ultrasound are all imaging modalities that can provide valuable diagnostic information in the early stages of presentation. [24] The chest xray is essential on presentation of any suspected chest trauma and may rapidly diagnose a pneumothorax, mediastinal deviation, abnormal fluid presence and bony fractures. A CT scan of the chest with contrast is recommended if there are any abnormalities detected on the chest xray, or in the case of a high-speed deceleration mechanism or suspicion of an aortic injury. An extended Focused Assessment with Sonography in Trauma (eFAST) scan is used to identify the presence of free fluid in the thoracic or perioneal cavities and has the highest sensitivity in the unstable trauma patient. Although it can assist in the diagnosis of trauma to the heart and great vessels, [25–27] it is not sensitive enough to delineate myocardial or great vessel injuries. A 12 lead electrocardiogram (ECG) should be performed early on patients who are at high risk for myocardial contusion, as abnormalities such as arrhythmias, conduction delay or ST segment changes necessitate futher investigation and monitoring.

2.3 Pathology

Pathology tests should be taken for a full blood count (FBC) and a chem-20 (electrolytes, renal and liver function as well as glucose levels). Venous blood gas (VBG) assessment of pH and lactate levels provide good monitoring of tissue oxygenation, circulatory status and response to resuscitation. Coagulation studies, group and hold and crossmatch are recommended when

there is a high index of suspicion for major injuries requiring further care. Beta HCG should be taken where indicated. Isolated results from single blood tests may be misleading and results should be considered in the context of the whole patient and trended results utilised when available.[28] ROTEM or TEG if available for point-of-care diagnostic testing is useful to measure, monitor and support coagulation, should be initiated as early as possible and used to guide a goal-directed treatment strategy for blood product transfusions and resuscitation endpoints.[29] Troponin testing is recommended when any ECG changes may indicate the presence of blunt cardiac injury, and serial testing should follow abnormal results, however optimal timing for this lacks clear evidence.[1]

3. Management

The immediate management of injuries arising from blunt chest trauma may be in the form of respiratory interventions, medications, fluid resuscitation including blood products, bedside procedures (e.g. intercostal catheter insertion), haemorrhage control, surgical intervention, or a combination of these. Minor injuries also require effective management, to prevent them from evolving into more serious injury.[30,31] A multi-disciplinary approach to care including nursing, medical, allied health, and surgical intervention are superior, and should be included in a clinical pathway.[32]

The position statement for prehospital thoracostomy management in the hospital environment recommends: [33–35]

- in most cases a prehospital thoracostomy can be used for chest tube insertion in the management of a pneumothorax or haemothorax in preference to new incisions.
- prehospital thoracostomy not requiring chest tube insertion can be sutured closed.
- prophylactic antibiotics are not routinely administered for tube placement in chest trauma for prehospital or hospital thoracostomy.

3.1 Minor Chest Injuries

Bone and muscle contusions – A patient may be suitable for discharge if there are no accompanying signs of significant injury, however they should be given appropriate advice of warning signs and when to seek medical advice or return to the Emergency Department.

Clavicle, sternum and scapular fractures – Clavicle fractures may be managed conservatively in a sling if there is minimal displacement and the patient is showing no signs of respiratory or neurovascular compromise. The main aim is to reduce swelling, ensure adequate pain control, and restrict shoulder range of motion until clinical union is attained. Sternal fractures with minimal or no displacement usually heal without any intervention, however the patient should adhere to limited lifting precautions during the healing phase. Scapular fractures are commonly managed non-operatively and heal well with conservative management in a shoulder immobiliser sling. All patients with these fractures should have a follow up review after discharge.

Haemothorax – All haemothoracies should be considered for drainage regardless of size. Drainage should be via a large bore intercostal catheter.[36] Small haemothoracies could be managed without drainage initially in a stable patient with a repeat CXR to monitor progression.

Pneumothoracies – small and occult pneumothoracies may not require tube management, however moderate to large pneumothoracies require ICC placement, or a pigtail catheter could be considered.

Rib fractures/cartilaginous injury – When greater than 3 ribs are fractured, consideration should be given to hospital admission due to the high risk of hypoventilation, atelectasis and pneumonia. Surgical rib fixation may be considered in some cases (refer to section 3.5 below), however conservative management is relatively common. Cartilage and soft tissue injuries are more likely to be detected with an MRI, however CT and ultrasound are also useful in diagnostics. These injuries need to be carefully managed, as any major disruption in soft tissue structures can cause an unstable rib cage, decreasing the body's ability to protect the vital organs.

3.2 Major Chest Injuries

Diaphragm injury – This can present as a minor or major injury, depending on the location and severity. It can lead to disruption of respiratory function, as well as injury to the peritoneal contents. A gastric tube may be inserted to deflate the stomach; however, a diaphragm rupture will likely require an either an open or minimally invasive surgical procedure.

Sternoclavicular dislocation – A direct and high velocity impact can cause dislocation in an anterior or posterior direction. Whilst a posterior dislocation is uncommon, it can result in significant internal injury e.g. tracheal compression, laceration or occlusion of the subclavian or brachiocephalic vessels, damage the lung parenchyma causing a pneumothorax, or injury the laryngeal nerve. A contrast CT will assist to identify the bony or vascular injury. Posterior dislocations can be difficult to relocate after 24hrs, therefore early diagnosis and treatment are important for management.

Large tracheobronchial Injuries – A leak from the large airway can occur from disruption to the tracheobronchial wall, causing large amounts of air under the skin that rises and falls with ventilation. This subcutaneous emphysema can vary in severity and lead to further complications, so it is important to detect early, monitor closely, and consider a chest tube if any positive pressure ventilation is indicated. A flexible bronchoscopy may assist to detect the location of the air leak; however, a large injury may require a rapid thoracotomy and surgical repair.

Tension pneumothorax – When air tracks into the pleural space, there is an increase in the intrathoracic pressure, which may cause lung collapse. Haemodynamic instability can then rapidly occur due to compression of the superior and inferior vena cava. Chest decompression via finger thoracostomy or needle thoracostomy are vital to restore pressures and allow venous return. Decision making around finger thoracostomy vs needle thoracostomy will be dependent on local skills and expertise in the procedures. Insertion of an intercostal catheter is required for definitive management for any ongoing drainage of air or fluids.

Open pneumothorax – Open wounds to the chest wall that allow air to flow into the chest cavity from outside the body and disrupt the intrathoracic pressure gradient lead to an open pneumothorax. A sterile, occlusive dressing sealed on three sides should be placed to create a one-way valve until ICC placement and wound closure is complete.

Massive haemothorax – A rapid blood loss greater than 1500mLs into the chest cavity, causes impaired ventilation and oxygenation, along with hypotension and shock. An immediate chest decompression and restoration of blood volume are vital. A chest tube can assist; however, a thoracotomy may still be indicated in the case of large and ongoing blood loss.

Flail chest – A flail chest occurs when three or more ribs are fractured in more than one place, causing a segment of the rib cage to detach from the chest wall. Flail chest can be identified radiologically or clinically. Clinical flail chest is represented by paradoxical movement of the chest wall, and the patient will typically report extreme pain and shortness of breath. Invasive or non-invasive ventilation may be required, and surgical fixation may be indicated, dependent on pain, chest wall deformity and non-union.

Pulmonary contusion – This injury to the lung tissue is often seen in moderate to severe blunt chest injury and is best detected by a CT scan. With haemorrhage into the interstitial space, complications including decreased lung compliance, ventilation-perfusion mismatch/shunt and hypoxia ma lead to respiratory distress and failure. Strategies to support oxygenation and ventilation including escalation from mask and high flow oxygen therapy to NIV, or intubation, and if still unable to maintain oxygenation, extra-corporeal membrane oxygenation (ECMO) may be considered.

Great vessel injury – damage and subsequent haemorrhage of the aorta and its branches, pulmonary arteries and veins, superior/inferior vena cava and the innominate and thoracic veins needs to be recognised and managed promptly due to the high risk of mortality. The patient may present with hypotension, diminished pulses, unequal blood pressures of the upper and lower limbs, pulsating haematoma, intrascapular murmur, left flail chest, neurological deficits, or palpable thoracic or sternal fractures. Mediastinal widening on a plain CXR is common in great vessel injury, although CTA is the imaging modality of choice. Surgical specialists should be consulted, and treatment may consist of non operative management, endovascular stent-grafting or open repair.

Cardiac tamponade – An eFAST is used at the bedside for identification of free fluid in the pericardial sac, causing compression of the heart. A FAST scan has been demonstrated to be 90–95% accurate [20] (operator dependent) and will not detect small or focal collections causing tamponade physiology. A formal ECHO will provide greater diagnostic ability as the haemodynamic effects are considered in addition to the presence of a pericardial effusion. Surgically, a pericardial window can be used to clinically detect and manage important traumatic pericardial effusions. Cardiac tamponade is a life-threatening emergency that may require an emergency thoracotomy.

Blunt cardiac injury – This may include myocardial contusion, cardiac rupture or herniation, valvular injury or septal tears. An ECG should be performed in all cases where blunt cardiac injury is suspected and if any abnormality is present, the patient should be admitted for 24 hour cardiac monitoring. Blunt cardiac injury may be ruled out when both the ECG and troponin are normal,[1] however troponin testing may not be required in the presence of a normal ECG. Cardiothoracic specialists should be consulted to advise on any intervention that may be required for structural repair.

3.3 Admission

Patients presenting with any red flags for deterioration following blunt chest injury should undergo a period of observation as a hospital inpatient. This will allow for regular clinical observation, titration of multimodal pain relief, management of coexisting injuries, as well as access to physiotherapy and other allied health disciplines as required. The admission pathway will depend on the patient age and comorbidities, severity of injury, services required and local admission

policies. Admitting teams may include surgical, general medical, cardiothoracics or intensive care, with the potential of a shared-care arrangement between more than one team.

3.4 Retrievals and Interhospital Transfers

Early recognition of clinical severity is vital to ensure a timely and safe transfer between facilities. A Consultant led discussion should occur prior to any transfer, and an appropriate handover given to the receiving service.

If a patient requires an emergency trauma road transfer, contact the Queensland Ambulance Service (QAS) on triple zero (000). If a patient requires an emergency aeromedical interhospital transfer, contact Retrieval Services Queensland (RSQ) on 1300 799 127. Refer to the RSQ criteria *for Early Notification of Trauma for Interfacility Transfer*. [37] Always follow local hospital guidelines for any facility-specific escalation pathways.

3.5 Surgical Rib Fixation

The indications for surgical stabilisation of rib fractures (SSRF) have evolved over the last decade and its use has increased with modern techniques and hardware. The most widely studied indication is chest wall instability.[38] This has been shown in multiple studies to potentially reduce length of stay, intensive care unit length of stay, duration of mechanical ventilation, rates of pneumonia, and the need for tracheostomy placement. [4,41]

The Chest Wall Injury Society Guideline[4] recommends chest wall stabilisation in patients with:

- respiratory failure with unstable fracture patterns e.g. flail chest, offset rib fractures
- ≥ 3 severely displaced acute rib fractures in ribs 3-10, with ≥ 2 pulmonary physiologic derangements despite adequate anesthesia
- RR>20, <50% predicted volumes on incentive spirometry, pain score >5/10, inability to cough
- Failure to wean from the ventilator

Contraindications for surgical stabilisation of rib fractures include:

- shock or ongoing resuscitation
- fractures outside of ribs 3–10
- severe traumatic brain injury (TBI) or intracranial hypertension
- acute myocardial infarction (MI)

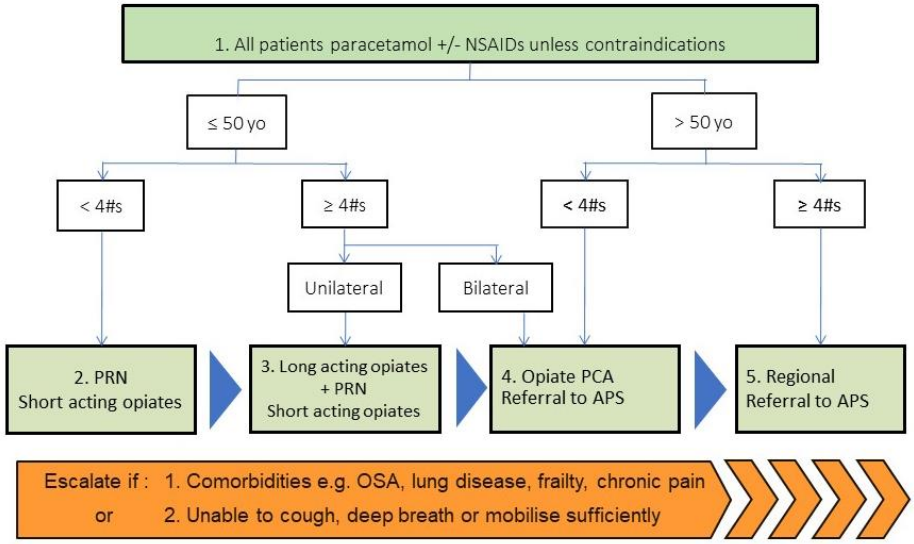
3.6 Analgesia

Analgesia is an essential component of preventing secondary complications in blunt chest trauma and needs to be considered as soon as practical. If a patient is having difficulty managing a deep breath or cough, they are at a very high risk of secondary pulmonary complications such as atelectasis, sputum retention, hypoventilation and pneumonia. A referral to an acute pain service or equivalent (if available) would be recommended for all patients presenting with blunt chest trauma involving multiple rib fractures. The side effects of many analgesics will include impaired bowel motions, which may be further exacerbated by the changing intrathoracic and abdominal pressures due to pain. Early consideration of aperients whilst on pain relief is recommended.

A multi-modal approach to pain management is always required and is essential to reduce morbidity and mortality.[40] A pain management strategy may begin with incorporating simple and

oral opioid analgesia, then potentially IV opioids, ketamine and regional analgesia adjuncts. The flowchart below in *Figure 1* is an example of multi-modal pain relief in the management of rib fractures.

Figure 1 Example of an analgesia pathway for multiple rib fractures [41]



Simple Analgesia

Simple analgesics are used to relieve mild to moderate pain and are less potent than opioids. They are an ideal first line of care medication in blunt chest trauma.

Paracetamol
Caution in chronic hepatic disease or impairment (may need consideration of a reduced dose).

Non-Steroidal Anti-Inflammatory Drugs
These may be utilised in conjunction with Paracetamol and are designed to decrease inflammatory effects that may be associated with injury, therefore acting to reduce mild to moderate pain. They are contraindicated in renal impairment, cardiovascular disease, gastric ulcer disease, asthma sensitive to aspirin/NSAIDs.

Opioids

Opioid medications act on the central nervous system and are used to treat moderate to severe pain. They should be considered with care, as long-term use can lead to dependence and tolerance. Consider a PRN opiate, then add slow release (SR) or controlled release (CR) opiates as needed. A PCA can be utilised as a mode of administration for medications such as Oxycodone, Morphine, Fentanyl, Hydromorphone or Buprenorphine.

Adjunctive Therapy

Additional options for pain management may include a continuous Ketamine infusion, or the use of Gabapentinoids.

Regional Blocks

Regional blocks utilise anaesthetic agents to block pain and sensation in a specific or targeted area of the body and have a good effect on moderate to severe pain. A serratus anterior plane block targets the anterolateral thorax, an erector spinae plane block targets the whole thorax

unilaterally, a paravertebral block targets the whole thorax unilaterally and an intercostal nerve block provides analgesia in patients with rib fracture pain. The patient should be monitored for potential complications, particularly delayed pneumothorax, local anaesthetic toxicity, hematoma, and occurrence of spinal anaesthesia (rare). Regional blocks should be used with caution in disorders of coagulation, or when anticoagulants are utilised. These patients should be discussed with the local pain service or Anaesthetic department.

Epidural

An epidural utilises medication that is delivered into the epidural space of the spine and may be utilised for ongoing severe pain. This mode of pain relief is contraindicated in disorders of coagulation, when anticoagulants are utilised, or in the presence of sepsis. These patients should also be discussed with the local pain service or Anaesthetic department.

3.7 Supportive Therapies

Adjunct therapies have an important role in supporting patients' presenting with blunt chest trauma. Respiratory modalities may be utilised such as high flow oxygen devices, non-invasive ventilation and airway clearance devices. These have been included in prior chest injury protocols[32] and should be implemented in the earliest phase of admission. Referrals to allied health clinicians should be made at the earliest appropriate time. A physiotherapist can assist with decreasing the risk of sputum retention, atelectasis and assisting with equipment prescription, brace/splint/sling fitting, and return to mobility as soon as able. An occupational therapist may be able to assist with testing for post traumatic amnesia (PTA), cognitive retraining, return to work guidance, activities of daily living and personal care tasks. A social worker should be engaged to provide support in the initial phase of injury, give some direction with the management of health and financial matters, and work with the patient and family members throughout the inpatient admission. A psychologist may be of benefit in the early stages of admission to assist with mood, adjustment and ongoing support. A dietician can aid in ensuring adequate nutrition is provided to the patient whilst they are recovering from multiple injuries.

3.8 Discharge Planning

Discharge planning should begin at the earliest part of the patient admission as practical. The multidisciplinary team need to work closely together with the patient, family and carer (with the patients consent). Factors such as the patients' geographic location, physical home environment, mobility, ongoing care needs, and social supports all play an important part of determining where, when and how a patient may be safely transferred out of the hospital environment. Follow up appointments should be clearly communicated to the patient, to ensure that any ongoing care requirements are met.

3.9 Repatriation

When a major trauma centre has completed the required specialist intervention/s, patients' may be suitable for transfer back to the referring hospital, and closer to their residential location. If an aeromedical transfer is required, RSQ can be contacted to facilitate the transfer, however appropriate preparations and follow up must be arranged by the major trauma centre. The telehealth emergency management support unit (TEMSU) is available to assist in connecting clinicians for the purposes of clinical handover and planning of ongoing care requirements. QAS may be contacted for assistance with hospital to hospital road transfers.

4. Special Patient Groups

4.1 Elderly Trauma

Minor forces (e.g. fall from standing height) to the chest wall in the elderly patient can result in to severe isolated chest injuries, and have a high associated mortality and morbidity.[12,19]

Key objectives in elderly blunt chest trauma management: [15,42]

- low threshold for CT
- early recognition of frailty
- opioid sparing analgesia strategies i.e. regional anaesthesia
- include General Physician/Geriatricians input early

These can be achieved by:

Early identification with contrast CT scan as the investigation of choice to define chest and chest wall injuries is recommended in elderly trauma. This is predominantly due to the poor recognition of fractures and lung contusions with X-ray and their prognostic influence on ensuring the correct treatment strategy.[15,42]

Analgesia must be included promptly in the ED, to enable deep breathing, adequate coughing and early mobilisation to reduce the risk of chest specific complications such as atelectasis, pneumonia and respiratory failure. Elderly patients often receive inadequate analgesia due to fear of causing side effects, such as sedation and respiratory depression. Opioid sparing analgesia strategies in the elderly may be an effective way to help reduce the risk of delirium and central nervous system effects. A combination of analgesics and techniques to reduce the adverse effects of drugs such as opioids would be a much more desirable option for these patients.[15,42]

There is high prevalence of cognitive impairment and polypharmacy among older patients, and complications such a delirium and acute kidney injury are common. In older patients with recognised frailty, there is robust evidence that early comprehensive geriatric assessment improves outcomes from inpatient hospital stays. A decision for a medical or surgical admission will depend on individual institution models of care, as well as the patients' clinical requirements i.e. intercostal catheter in situ. If a medical admission is appropriate, it is recommended that the elderly blunt chest trauma patient is admitted to a ward that is experienced in managing significant analgesia requirements with ongoing input from a surgical team.[15,42]

4.2 Spinal Cord Trauma

Patients presenting with blunt chest trauma may have concomitant spinal cord injury, particularly at thoracic level. Spinal injury is usually identified on CT, but in patients too unstable for early CT, the trauma series plain films should be assessed for vertebral injury which is easily overlooked in the acute phase. Concomitant injury to the chest and spine requires early transfer to a tertiary spinal unit, typically to an Intensive Care Unit. Impairment of respiratory muscles in the presence of a spinal cord injury compounds the inability to take a deep breath or cough effectively in blunt chest trauma. This patient group has an increased frequency of respiratory failure, failed extubation and requirement for tracheostomy.Pneumothorax can often be managed without an intercostal catheter, including with positive pressure ventilation. However patients undergoing

prolonged spinal fixation, particularly prone, warrant a lower threshold for pre-emptive ICC placement.Spinal injury may complicate operative positioning for chest wall fixation and should be discussed between specialty teams where there are competing priorities.

4.3 Obstetric Trauma

Please refer to the Maternity and Neonatal Clinical Guideline: Trauma in Pregnancy.[5]

4.4 Paediatric Trauma

Please refer to the Queensland Children's Hospital Paediatric Trauma Service Guidelines *11th Edition*.[6]

5. Complications

There are various rapid clinical changes and complications of the respiratory and cardiac systems that may occur in the first 72 hours after presentation, which will need close monitoring and detection to ensure appropriate treatment is given.[42] Repeat investigations are indicated when any concerning clinical change is detected. Risk factors for clinical deterioration include age >65, three or more rib fractures, a smoking history, and cardiorespiratory compromise.[12,43,44] Complications to consider are listed below:

Localised:

- respiratory compromise
- pneumonia
- empyema
- hypoventilation and atelectasis
- re-accumulation of haemothorax
- non-union of bony fractures

Other:

- pressure injuries
- exacerbation of comorbidities
- fluid accumulation and rebleeding
- analgesia side effects, e.g. drowsiness
- decreased function and mobility
- infection
- wound dehiscence
- venous thromboembolism*

* The Queensland Health statewide guideline for the prevention of VTE in adult hospitalised patients describes all major trauma patients being at immediate high VTE risk and provides recommendations for both pharmacological and mechanical VTE prophylaxis from the point of admission.[45]

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