

CLINICAL GUIDELINE TITLE

Rib Fractures in Major Trauma: a guideline for management

1) SUMMARY

This guideline provides a framework for the assessment and management of adult patients with rib fractures.

2) INTRODUCTION

Blunt chest-wall trauma, causing rib fractures, accounts for >15% of all trauma admissions to Emergency Departments (EDs) globally¹. Rib fractures may complicate up to two thirds of these injuries². St Mary's Hospital admits, at a conservative approximation, at least 8-10 patients per month with multiple rib fractures.

Mortality associated with such injuries is variably estimated as 4-77%³ whilst 94% have associated injuries. Complications include pneumothorax, haemothorax, haemopneumothorax, lung contusion, flail segment, hypoventilation, lacerations of the liver, kidneys and spleen³. Pain from rib fractures causes impaired coughing, voluntary splinting and muscle spasms and, in combination with lung contusion, impairs ventilatory function resulting in atelectasis, hypoxaemia and pneumonia (in 30% of cases²). Eventually these result in respiratory failure with a requirement for mechanical ventilation. Patient age, number of rib fractures, presence of chronic lung disease, pre-injury anticoagulant use and oxygen saturation levels have been identified as risk factors that may predict complications after blunt chest-wall trauma¹. The incremental costs associated with rib fractures have not been evaluated, but can be considered in terms of 'ICU bed days', 'ventilator days' and 'Major Trauma Ward days', and are likely to be significant.

Gold standard pain relief for patients with multiple rib fractures at St Mary's is achieved with thoracic epidural analgesia (TEA). Expertise in our hospital allows for timely epidural insertion by senior anaesthetists and appropriate management once sited. This approach is supported by evidence demonstrating clear benefit of thoracic epidurals over intravenous (IV) or intramuscular (IM) opioids. A recent meta-analysis⁴ found that although patients receiving TEA had more rib fractures, greater injury severity scores and greater physiological disturbance, they had better outcomes than less severely injured patients who received IV or IM opioid analgesia. Additionally the TEA group spent less time on mechanical ventilation, had greater improvement in tidal volumes in the first 24 hours and had a lower incidence of pneumonia and other pulmonary complications. Despite this, TEA has a low but significant complication rate and in some patients may be contra-indicated; there is also an inevitable failure rate. There are several alternatives to TEA including intercostal, interpleural and paravertebral blocks. Paravertebral analgesia is the most frequently cited alternative, but has disadvantages when compared with our gold standard at St Mary's Hospital. These include:

- Difficulty instituting before rib fixation surgery.
- Risk of pneumothorax and haemothorax.
- Unreliable spread of analgesia: usually a segmental block is achieved and multiple level blocks are required.
- Finite duration of analgesia unless a catheter is sited and a local anaesthetic infusion is administered.
- Better efficacy when sited under direct vision during surgery rather than using a blind technique.

Surgical fixation and stabilisation of flail chest injuries is associated with reductions in duration of mechanical ventilation, ICU stay, total hospital stay, hospital acquired pneumonia and mortality rates⁵⁻⁹. In the long term patients return to work sooner and have a reduced incidence of chronic pain and analgesic dependence⁷⁻⁹. Studies have also shown similar beneficial outcomes in patients with multiple rib fractures¹⁰. A multidisciplinary approach to patient selection for surgery is essential. The National Institute of Clinical Health and Excellence has approved and issued guidance on surgical fixation of flail chest injuries¹¹.

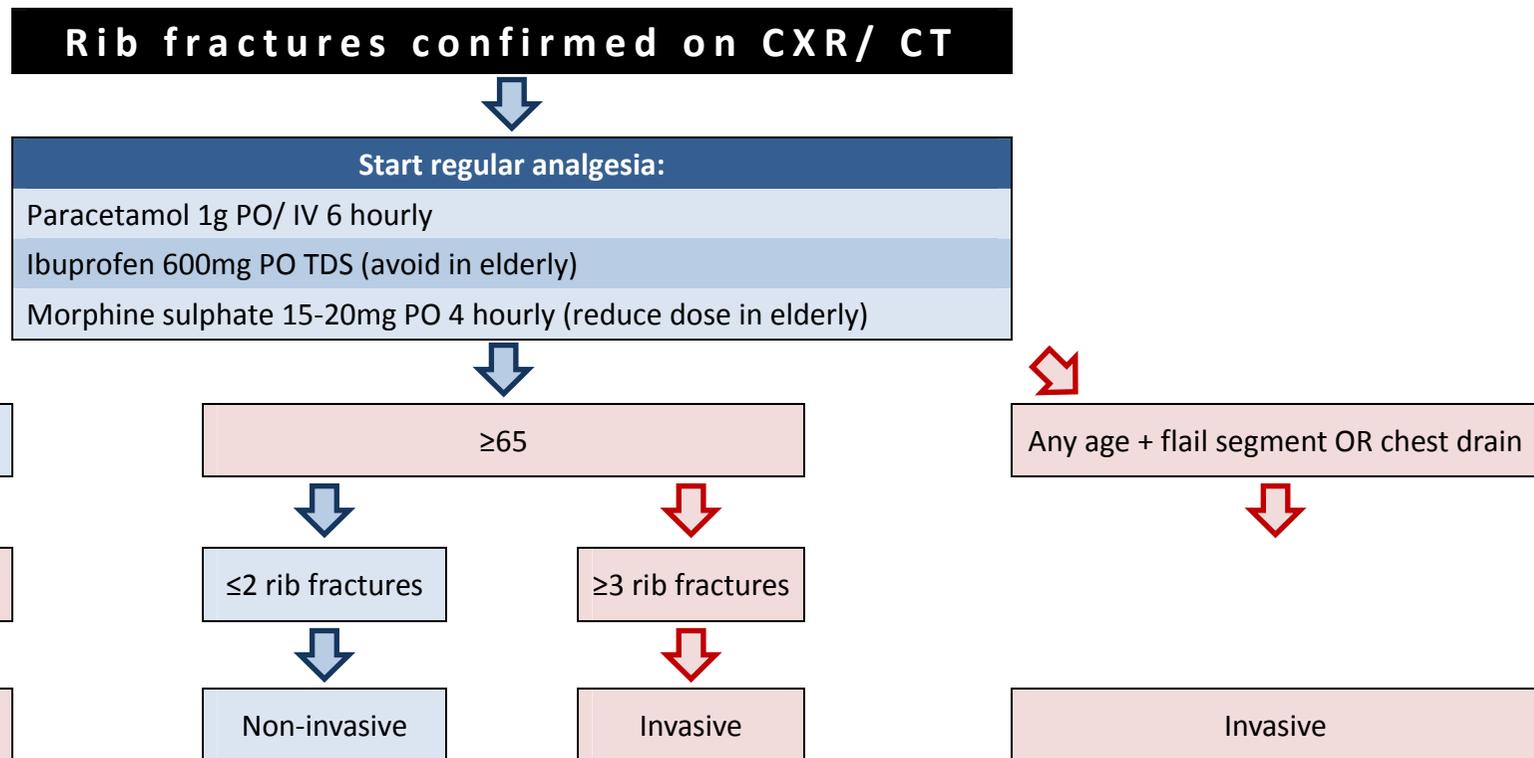
3) DEFINITIONS

- Rib fracture: a break in a bone making up the rib cage.
- Thoracic Epidural (TE): a fine catheter placed into the thoracic epidural space which is used to give analgesic drugs.
- Paravertebral block (PVB): regional anaesthetic technique providing analgesia to a segment of one hemithorax.
- Patient Controlled Analgesia (PCA): a method of allowing a patient to administer their own analgesia intravenously, usually opioid based.
- Visual Analogue Score (VAS): a method for assessing pain on a scale of 0-10.
- Sustained Maximal Inspiration (SMI): deep breathing exercises assessed with incentive spirometry.
- Non-invasive ventilation (NIV): facial Continuous Positive Airways Pressure (CPAP) or Bi-level Positive Airways Pressure (BIPAP) ventilation

4) SCOPE

These guidelines are for all staff involved in the care of adult trauma patients with rib fractures but are of particular relevance to those working in the Emergency Department, Theatres, Anaesthesia, Major Trauma Ward and other wards receiving trauma patients.

5) FULL GUIDELINE



Risk factors for morbidity
Chronic respiratory disease
Pulmonary contusion
Cardiovascular disease
Smoker
Low SpO ₂
Diabetes
Presence of ≥2 distant injuries
Obesity
Sleep apnoea
If present in <65yo, consider invasive path

Early review for surgical rib fixation (<24hrs)
Flail chest
≥3 displaced rib fractures
≥65 years old
Chest wall deformity
CXR: ≥25% lung volume loss
NIV/ ventilator dependent

All admissions will be seen within 48hrs.
To refer to the service please e-mail:
ribfracture@imperial.nhs.uk

Contraindications to epidural analgesia	
Absolute	Relative
Patient refusal	Unable to position patient
Spinal cord injury or haematoma	TBI with uncontrolled ICP
Epidural haematoma	Anatomical abnormalities
Thoracic vertebral body fracture	Previous thoracic spinal surgery
Clopidogrel within 7 days	Incomplete spinal evaluation
	Platelets <80 x 10 ⁹ /L
	Extubation not anticipated within 5 days
	INR >1.4
	Prophylactic dose LMWH within 12hrs
	Treatment dose LMWH within 24hrs

Figure 1: overview of the rib fracture pathway

Non – Invasive Pathway



Within 1 hour of diagnosis aim to:

- Start incentive spirometry
- Monitor oxygen saturation (SpO₂)
- Provide supplemental O₂ if needed
- Pain score using verbal rating scale



Prescribe regular analgesics:

- Paracetamol 1g PO/ IV 6 hourly
- Ibuprofen 600mg PO TDS
- Regular PO morphine or opioid PCA
- Consider lidocaine 5% patches



- SpO₂ reducing
- O₂ needs increasing
- SMI decreasing
- Pain score increasing

- SMI improving
- Pain score improving



Invasive pathway

- Sit in chair
- Ambulate ASAP (spine & other injuries permitting)
- Continue incentive spirometry 4 hourly

Figure 2: non-invasive pathway for rib fracture management

Invasive Pathway

(requires Major Trauma Ward admission)



Within 1 hour of diagnosis aim to:

- Start incentive spirometry
- Monitor oxygen saturation (SpO₂)
- Provide supplemental O₂ if needed
- Pain score using verbal rating scale



Anaesthetic review for Thoracic Epidural (TE)



No contraindications

TE contraindicated

TE within 6 hours (must be booked on Cerner)



Regular follow up



Respiratory deterioration?

- SMI decreased
- SpO₂ reduced
- O₂ needs increased
- ABG deteriorating



Pain score worse

Pain controlled



Call anaesthetist for epidural trouble shooting. Re-site if necessary.

MTW HDU bed
Contact ICU/ outreach
Consider NIV/ IPPV



Candidate for surgical rib fixation

Prescribe regular analgesics:

- Paracetamol 1g PO/IV 6 hourly
- Ibuprofen 600mg PO TDS
- Regular PO morphine or opioid PCA
- Consider lidocaine 5% patches



**Pain worse?
Respiratory decline?**

Pain & SMI improved



Sit in chair
Ambulate ASAP (spine & other injuries permitting)
Continue incentive spirometry 4 hourly

Figure 3: invasive pathway for rib fracture management

Surgical Rib Fixation Pathway

(see Early Review for Surgical Rib Fixation candidates on page 2)

Decision making for potential candidates

Review by member of rib fracture fixation team.

Discussion & Decisions

- MDT may include: rib fracture fixation team, MTW consultant, anaesthetist, intensive care consultant, physiotherapist, occupational therapy & nursing staff.
- Decision for surgery made by 2 consultants.

Liaise with thoracic/ trauma surgeons if suspicion of large air leak or visceral injury.

If ipsilateral clavicle fractured, have low threshold for ORIF clavicle.

Pre-operative

Book Half day theatre session.

Drugs Give LMWH ≥ 12 hours before planned surgery.

Equipment MatrixRib fixation kit is sterile and available.

Imaging 3D CT reconstruction thorax complete.

Blood results FBC, renal profile (U&E & creatinine), clotting screen/ TEG.

Blood products 2 units of packed red blood cells cross matched.

Intra-operative

Anaesthetic team

1. Insert thoracic epidural prior to anaesthetic induction if not already in situ OR ensure the dressings are distant to the operative site.
2. Use single lumen EViewVivaSight™ single lumen (video) endotracheal tube.
3. Ensure bronchial blocker available in theatre.
4. Insert arterial line if anticipating NIV or inability to extubate.

All theatre team Position patient laterally with rib fractures 'up'.

Surgical team

1. Plan surgical incision(s) by identifying fractures clinically or with ultrasound.
2. If thoracic epidural not possible or contraindicated, insert paravertebral block/ catheter under direct vision at the end of the procedure.

Chest drains

1. Replace any pre-existing chest drains prior to operative fixation.
2. Insert a minimum of 1 chest drain per operated hemi-thorax at the end of the procedure and connect it to an underwater seal.

Mobile Chest X Ray at end of procedure (prior to de-sterilising).

Postoperative

Post theatre destination

1. Aim to extubate at end of procedure. Arrange Major Trauma Ward/ Level 2 bed.
2. If intubated pre-op or significant respiratory compromise, to remain intubated and transfer back to ICU.

Analgesia

1. Administer epidural/ paravertebral levobupivacaine/ fentanyl mixture at 15mls/hr.
2. Remove epidural 5 days after insertion (7 days max, at discretion of anaesthetist & pain team).

Rehabilitate

1. Incentive spirometry four hourly.
2. Sit up and ambulate ASAP.

Discharge planning

1. Continue incentive spirometry at home 4 hourly.
2. Wound review at 2 weeks.
3. Clinic review at 6 weeks.

Figure 4: rib fixation pathway

NORTH WEST LONDON TRAUMA NETWORK RIB FRACTURE TERTIARY REFERRAL FORM

It is the policy of the North West London Major Trauma Centre to repatriate patients within 72 hours of rib fracture surgery if deemed medically fit

Referral details

Referring clinician	Responsible Consultant:
	Contact telephone (mobile):
	Contact e-mail address:
	Hospital
	Ward
	Name:
Patient	Date of birth:
	NHS number:
	Home address:
	General Practitioner:

Injury

Mechanism:

Rib fractures:

Pneumothorax? YesNo Haemothorax? YesNo Pulmonary contusion? YesNo

Associated injuries:

Interventions

Intercostal drain? YesNo Date of insertion: / / Persistent air leak? YesNo

Chest XR + CT chest (including 3D reconstruction rendered images) transferred by IEP: YesNo

Thoracic epidural in situ: YesNo

Ventilation: Self-ventilating Non-invasive ventilation Intubated

Details of any other treatment/surgery received:

Pre-morbid state

Co-morbidities:

Previous thoracic/
cardiac/thoracic spinal
surgery:

Anticoagulant history:

Current VTE prophylaxis
(medication/dose/

frequency):

Please e-mail referral to ribfracture@imperial.nhs.uk

Figure 5: rib fracture tertiary referral form

6) IMPLEMENTATION

Training required for staff	<input type="checkbox"/> Yes <input type="checkbox"/> No
If yes, who will provide training:	N/A
When will training be provided?	N/A
Date for implementation of guideline:	1/9/2015

7) MONITORING / AUDIT

When will this guideline be audited?	Ongoing currently (clinical governance reference number 1850)
Who will be responsible for auditing this guideline?	Mr Ian Sinha, Consultant Orthopaedic Surgeon Dr Sabeena Qureshi, Consultant Anaesthetist
Are there any other specific recommendations for audit?	None

8) REVIEW

Frequency of review	Please indicate frequency of review: 3-5 years Person and post responsible for the review: Mr Ian Sinha, Consultant Orthopaedic Surgeon Surgeon Commander Mansoor Khan, Consultant Trauma Surgeon Dr Sabeena Qureshi, Consultant Anaesthetist
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9) REFERENCES

1. Battle et al. Predicting outcomes after blunt chest wall trauma: development and external validation of a new prognostic model. *Crit Care* 2014, **18**:R98
2. Sirmali M. A comprehensive analysis of traumatic rib fractures: morbidity, mortality and management. *Eur J of Cardio-thoracic Surg* 2003; **24**: 133–138
3. EAST Practice Management Guidelines Work Group. Pain management in Blunt Thoracic Trauma. *J Trauma* 2005; **59(5)**:1256-1267.
4. Jarvis AM, Cook CH, Lindsey DE, Reilley TE, Steinberg SM, Beery RM, Whitmill ML, Papadimos TJ, Stawicki SP. Comparison of epidural versus parenteral analgesia for traumatic rib fractures: A meta-analysis. *OPUS 12 Scientist* 2009 3(3): 50-57.
5. Marasco SF, Davies AR, Cooper J, Varma D, Bennett V, Nevill R, Lee G, Bailey M, Fitzgerald M. Prospective randomised controlled trial of operative rib fixation in traumatic flail chest. *J Am CollSurg* 2013 May 13;216(5):924-32.
6. Ahmed Z, Mohyuddin Z. Management of flail chest injury: internal fixation versus endotracheal intubation and ventilation. *J ThoracCardiovasc Surg.* 1995;110:1676-80.
7. Tanaka H, Yukioka T, Yamaguti Y, et al. Surgical stabilization or internal pneumatic stabilization? A prospective randomized study of management of severe flail chest patients. *J Trauma.* 2002;52:727–732.
8. Lafferty PM, Anavian J, Will RE, et al. Operative treatment of chest wall injuries: indications, technique, and outcomes. *J Bone Joint Surg Am.* 2011; 93:97–110.
9. Marasco SF, Davies AR, Cooper J, Varma D, Bennett V, Nevill R, Lee G, Bailey M & Fitzgerald M. Prospective Randomized Controlled Trial of Operative Rib Fixation in Traumatic Flail Chest. *J Am CollSurg* 2013;**216**:924-932.

10. Bottlang M, Walleser S, Noll M, et al. (2010) Biomechanical rationale and evaluation of an implant system for rib fracture fixation. *European Journal of Trauma and Emergency Surgery* 36(5): 417–426.
11. National Institute for Health and Care Excellence (NICE). *Interventional procedure guidance 361: Insertion of metal rib reinforcements to stabilise a flail chest wall*. 2010. NICE: London. Available from: <https://www.nice.org.uk/guidance/ipg361>

10) GUIDELINE DETAIL

Start Date:	Approved by Major Trauma Board January 2015
Approval Dates	Name of Divisional group: Anaesthetics and Major Trauma Date of ratification: January 2015
	Name of Directorate group: Surgery, Cardiovascular and Cancer Date of ratification:
Has all relevant legislation, national guidance, recommendations, alerts and Trust action plans been considered, and included as appropriate in the development of this guideline?	Please list ALL guidance considered: National Institute for Health and Care Excellence (NICE). <i>Interventional procedure guidance 361: Insertion of metal rib reinforcements to stabilise a flail chest wall</i> . 2010. NICE: London.
Have all relevant stakeholders been included in the development of this guideline?	Please list all (name and role): Mr Chris Aylwin, Consultant trauma and vascular surgeon Mr Shehan Hettiaratchy, Consultant plastic surgeon Surg Commander Mansoor Khan, Consultant trauma and vascular surgeon Mr Graham Lawton, Consultant plastic surgeon Mr Ian Sinha, Consultant Orthopaedic surgeon Dr Sabeena Qureshi, Consultant Anaesthetist Matron Michelle Elliott, Major Trauma Ward Matron Miss Nicola Batrick, Consulant Emergency Physician Dr Vanesa Garnelo Rey Consultant Intensivist & Trauma Lead Mr Simon Cunniffe, Theatre Manager Sister Ursula Garrett, Anaesthetics Clinical Co-ordinator Dr William Harrop-Griffiths, Consultant Anaesthetist & Service Director Theatres
Who will you be notifying of the existence of this guidance?	All clinical staff groups who are involved with the care of adult inpatients with rib fractures.
Related documents	Epidural Management Guideline for Anaesthetists
Author/further information	Name: Dr A Wickham, Mr I Sinha, Dr S Qureshi Title: Senior Clinical Fellow in Anaesthesia, Consultant Surgeon, Consultant Anaesthetist Division: Surgery, Cancer & Cardiovascular Site: St Mary's Hospital Telephone/Bleep: 26162 Trust email address: Alexander.Wickham@imperial.nhs.uk, Ian.Sinha@imperial.nhs.uk, Sabeena.Qureshi@imperial.nhs.uk
Document review history	Next review due: 22/1/2018
THIS GUIDELINE REPLACES:	Nil

11) INTRANET HOUSEKEEPING

Key words	Major Trauma, Rib Fracture, Epidural, Rib fixation	
Which Division/Directorate category does this belong to?	Surgery, Cancer & Cardiovascular	
Which specialty should this belong to when appearing on the Source?	Major Trauma	

12) EQUALITY IMPACT OF GUIDELINE

Is this guideline anticipated to have any significant equality-related impact on patients, carers or staff?

Yes

No