Worcestershire NHS
Acute Hospitals NHS Trust

Acute Pain Management for Rib Fractures

This guidance does not override the individual responsibility of health professionals to make appropriate decision according to the circumstances of the individual patient in consultation with the patient and /or carer. Health care professionals must be prepared to justify any deviation from this guidance.

Lead Clinician(s)

Dr Alexander Midgley-Hunt — ST7 Anaesthetics
Dr Hannah Williams — Consultant Anaesthetist
Dept of Anaesthesia

Approved by TACCS on: 04/08/21

Approved by Medicines Safety Committee on: Add date
Where medicines included in guideline

This guideline should not be used after end of: January 2024

Key amendments to this guideline

Date	Amendment	Approved by:

1. Introduction

This guideline for use in all patients presenting with multiple rib fractures. It is designed to optimise early acute pain management and prevent complications of under treated pain. It also outlines criterial for referral for specialist advice regarding rib fixation.

2. Scope

This guideline is suitable for use by the following staff groups:

- Doctors
- Qualified nursing staff
- Students and unqualified staff under the direct supervision of qualified Registered staff

This guideline should be used in conjunction with WHAT-KD-004 – Acute Pain Control for Adult Patients

3. Background

Rib fractures are common injuries occurring in 10% of patients following significant trauma (1). Patterns of injury differ between age groups, with younger patients sustaining high impact blows, whereas rib fractures in the elderly are generally secondary to fragility (2). Both injury patterns result in significant morbidity and mortality due to pain-related hypoventilation, impaired gas exchange in contused underlying lung and altered breathing mechanics.

Pain associated with rib movement reduces the tidal volume and predisposes to significant atelectasis and pneumonia. Even in the context of isolated minor rib fractures, pneumonia is a significant risk: occurring in approximately 1.6% of cases (3). Complication rates rise with increasing numbers of rib fractures and a significant proportion of these patients will require level 2 or 3 care.

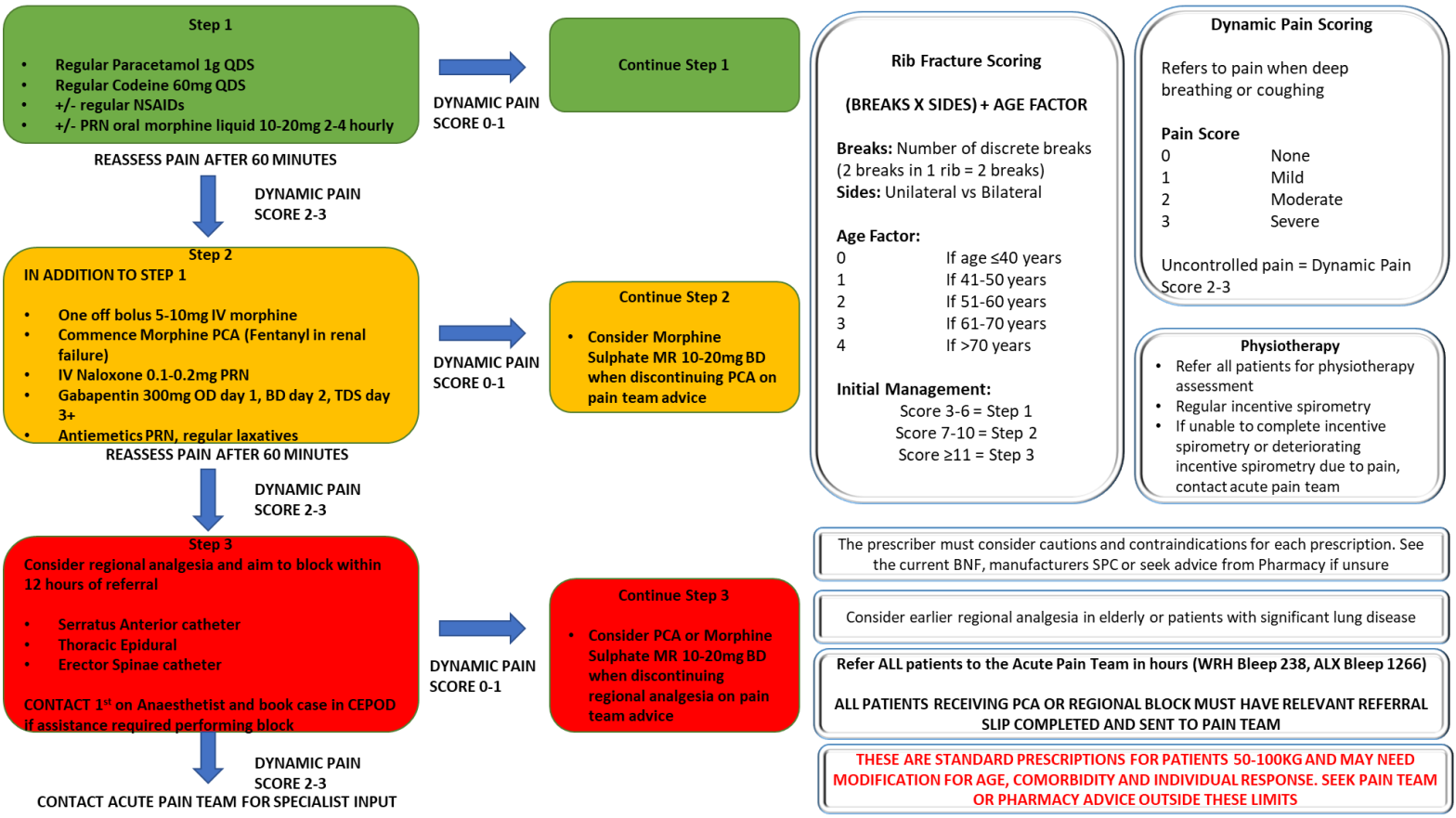
Good analgesia is essential for both patient experience and to prevent atelectasis and allow secretion clearance. In preventing these complications, analgesia may work to reduce the incidence of pneumonia and contribute to reducing rib fracture mortality and ITU admission

rates (4). The use of multi-modal strategies has become more common and includes enteral, parenteral and regional analgesic approaches.

4. Assessment and Management of Rib Fractures

4.1 Rib Fracture Algorithm

The following algorithm delineates an evidence-based approach to the management of rib fractures. The rib fracture pathway documentation should be used to aid management **(WAHT-TBC)**



4.2 Pain Assessment

Assess pain following rib fractures using a dynamic pain assessment. This is the pain experienced when moving, deep breathing or coughing. A dynamic pain score of 2 or more indicated uncontrolled pain. Alternatively, an inability to engage with physiotherapy may indicate uncontrolled pain.

Uncontrolled pain despite step 2 is an indicator for consideration of regional analgesia, ideally within 12 hours. Catheter based techniques have been shown to confer superior analgesia compared with systemic opioids and should be considered in preference to single shot blocks (5).

Pain must be recorded regularly on a **RIB FRACTURE PAIN ASSESSMENT AND MANAGEMENT PATHWAY (WHAT-TBC).**

4.3 Referral for consideration for fixation of rib fractures

The only indication for rib fixation with good quality evidence is flail chest with resultant respiratory failure (5,6,7,8,9,10). Fixation in these cases results in a reduction in duration of ventilation, a reduction in ITU length of stay and reduced incidence of pneumonia.
However, the following are generally accepted criteria for operative rib fixation and are in line with the Chest Wall Injury Society Guidelines(11):

Non-ventilated patients

1. Impending/ established respiratory failure defined as 2 or more of
    a. Respiratory rate >20
    b. Measured volumes on incentive spirometry ≤50% predicted
    c. Pain score ≥2 despite optimal analgesia
    d. Poor cough

PLUS

2. Chest wall instability (defined as any of)
    a. Three rib flail chest
    b. Three bi-cortically displaced/ offset ribs
    c. Clinical finding of paradoxical motion
    d. Instability or ‘clicking’ on palpation

Ventilated Patients

1. Chest wall instability (as defined above)

OR

2. Failure to wean from mechanical ventilation

Consider discussing patients meeting these criteria with the thoracic team at the Queen Elizabeth Hospital Birmingham

5. Serratus Plane Block

A regional anaesthetic technique first described in 2013 by Blanco and colleagues (12) for surgery performed on the anterolateral chest wall, serratus plane blocks aim to provide anaesthesia of the hemithorax. It has been used in patients with rib fractures as an alternative to thoracic paravertebral blocks and thoracic epidurals.(13,14).

5.1 Anatomy

The serratus anterior muscle originates on the anterior surface of ribs 1–8 and inserts on the medial border of the scapula. A potential space exists both superficial and deep to the serratus anterior muscle. The latissimus dorsi muscle lies superficial to serratus anterior, with the ribs and thoracic intercostal nerves lying deep to, but also piercing the serratus muscle. This therefore enables the thoracic intercostal nerves to be blocked when injecting local anaesthetic in the potential space around the serratus muscle, providing analgesia to the anterolateral part of the thorax, with paraesthesia from T2 to T9.(12). Local anaesthetic can be infiltrated either superficial or deep to serratus anterior, but Blanco and colleagues found a greater duration of action from superficial placement.

5.2 Approved locations for use

All sites – ITU, HDU, main theatres, main recovery, obstetric suite, obstetric theatre, obstetric recovery

Alexandra Hospital – All surgical wards

Worcestershire Royal Hospital – All surgical wards

5.3 Contraindications

Absolute

Lack of appropriately trained staff

Lack of consent

Local sepsis near insertion site

Allergy to the local anaesthetic agent

Relative

Systemic sepsis/bacteraemia

Untreated hypovolaemia

Significant coagulopathy (pathological or iatrogenic)

Distorted anatomy obscuring landmarks

Surgical emphysema

Intercostal drain insertion

Previous surgery at insertion site

5.4 Side effects

Hypotension

Itching

Nausea and vomiting

5.5 Insertion Technique

Insertion uses an in-plane technique, aiming to deposit local anaesthetic between the latissimus dorsi and the serratus anterior (as demonstrated below). Good spread should be observed with tracking of the local anaesthetic through the fascial plane. The trust policy is that local anaesthetic should **NOT** be infiltrated below the serratus anterior owing to the much greater risk of pneumothorax without evidence of benefit.

The procedure should be conducted as follows

1. Informed consent – (complete a written consent if this is a standalone procedure not linked to anaesthesia for surgery)

2. Intravenous access for resuscitation purposes should be established and maintained throughout the period of local anaesthetic block.

3. AAGBI minimum standards of monitoring apply – NIBP, ECG, SpO_2

4. Full sterile PPE with probe cover and window drape over site (it is helpful to do a preliminary scan to optimize approach & identify surface landmark before prepping and positioning the sticky window drape).

5. Use a high frequency linear probe with the long axis in AP orientation. Mid-axillary line. Nipple level (ribs 4-5).

5. Slide probe posteriorly until wedge of Latissimus appears over serratus (see ultrasound image).

6. Angle/rotate probe to optimise image as required.

7. 1% lignocaine to skin and subcutaneous tissues.

8. Nerve block catheter needle/ tuohy in plane: Anterior to Posterior insertion

9. Insert needle between latissimus dorsae & serratus muscles (carefully avoid any vessels, such as the lateral thoracic artery; they often accompany nerves i.e. Long thoracic).

10. Hydro-dissect and locate the plane with small boluses of 0.9% sodium chloride – use the minimum amount required to open the space and allow advancement of the catheter to avoid dilution of local anaesthetic.

11. Insert catheter. Aim to leave at least 5 – 10cm inside the space (this can be a loose & mobile area of anatomy).

12. Visualise catheter and check position with 5ml 0.9% sodium chloride bolus, taking adequate care to ensure intravascular placement is avoided.

13. Secure, ideally with locking dressing and cover with a clear dressing allowing easy visualisation of the catheter insertion site. An antibacterial filter and bung must be attached to each catheter.

14. Administer local anaesthetic as per the table below

Ultrasound image of Needle Placement for Serratus Anterior Block

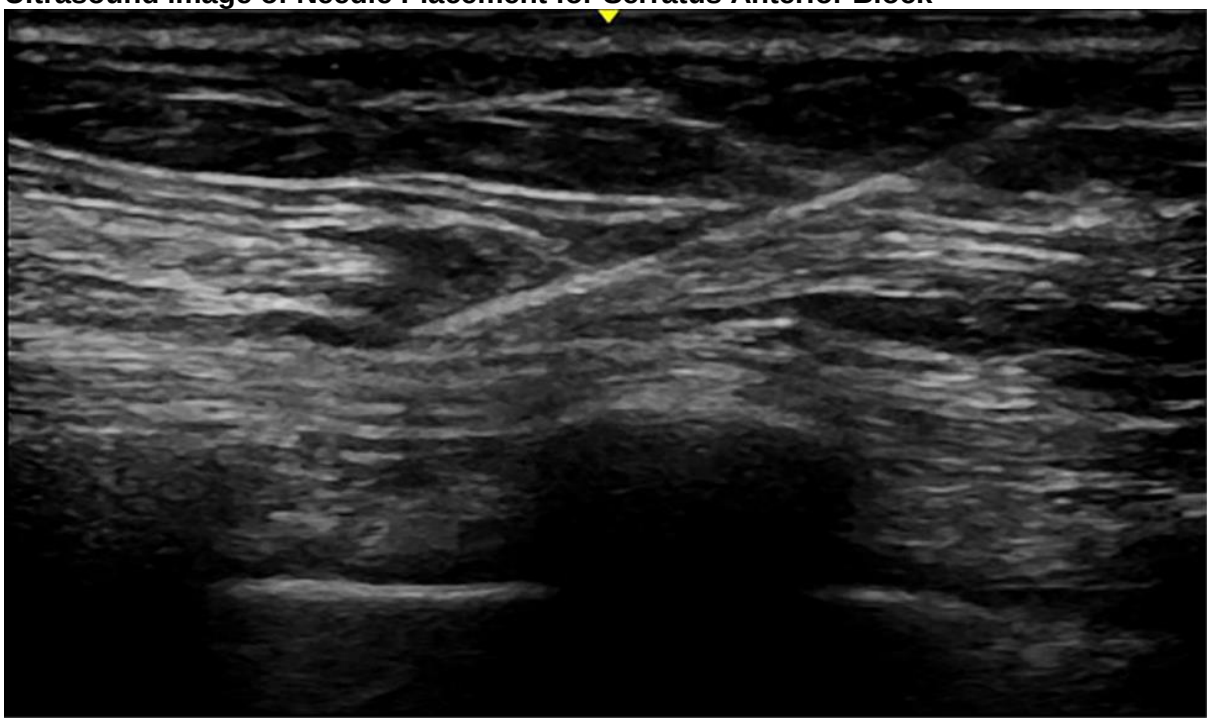
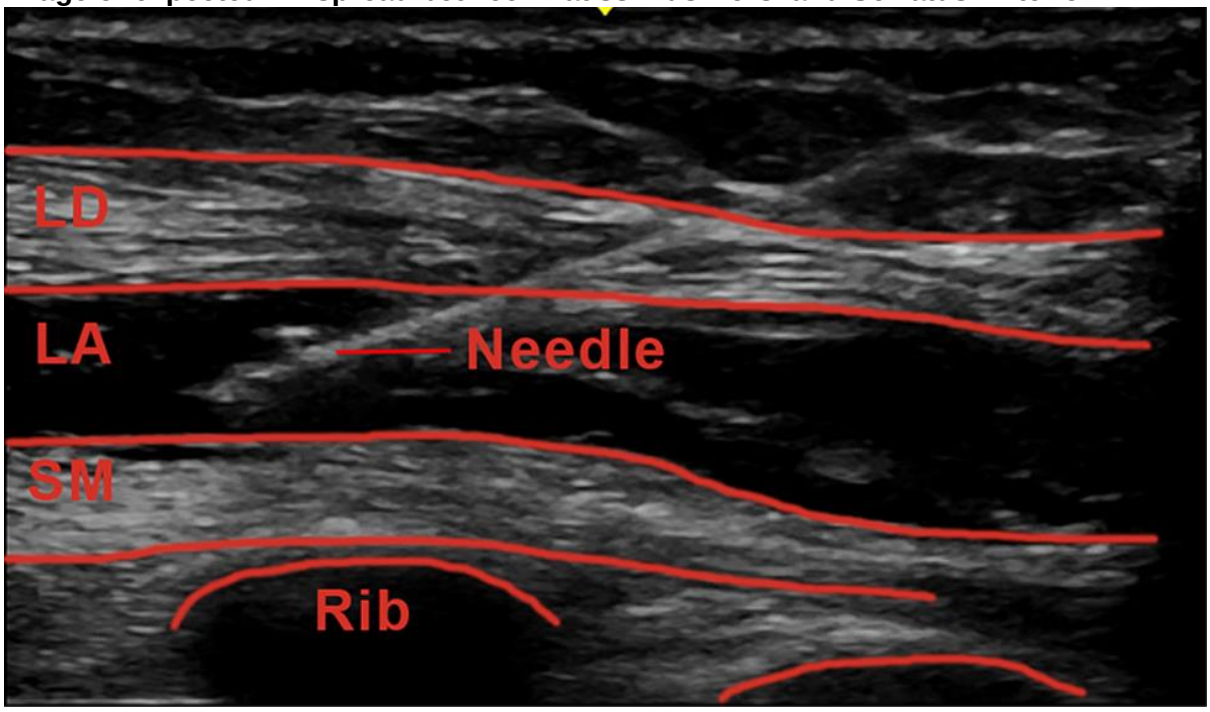


Image of expected LA spread between Latissimus Dorsi and Serratus Anterior



5.6 Drugs and Dosages

Drugs

Bolus administration – Bupivacaine 0.25% (2.5mg/ml)

Catheter infusion – Ropivacaine 0.2% (2mg/ml, 400mg in 200ml bags)

Maximum Doses

Bupivacaine – 2mg/kg (Max 150mg) 6 hourly

Ropivacaine – 3mg/kg 6 hourly

If using an initial bolus followed by an infusion, the dose of bupivacaine should not exceed 1mg/kg and the initial infusion rate for ropivacaine should not exceed 0.25mg/kg/h (1.5mg/kg over 6h) to minimise risk of local anaesthetic toxicity. The infusion rate can be escalated more than 6 hours post-bolus dose if the patient is experiencing pain

5.6.1 Standard Prescription (50-90kg male, 50-70kg female)

Drug and concentration	Supplied as	Administration
Unilateral Block – Intermittent bolus		
Bupivacaine 0.25% (2.5mg/ml)	**10ml ampoules**	**20ml (equivalent to max. 1mg/kg) 6 hourly**
Bilateral Block – Intermittent bolus		
Bupivacaine 0.25% (2.5mg/ml)	**10ml ampoules**	**20ml to each catheter (equivalent to total max 2mg/kg) 6 hourly**
Unilateral Block – Infusion		
Bupivacaine 0.25% (2.5mg.ml) **(Initial Bolus)**	**10ml ampoules**	**20ml (equivalent to max 1mg/kg)**
Ropivacaine 0.2% (2mg/ml)	**400mg in 200ml bag**	**Infusion after initial bolus dose as per table below**
Bilateral Block – Infusion		
Bupivacaine 0.25% (2.5mg/ml) **(Initial Bolus)**	**10ml ampoules**	**10ml per catheter diluted to 20ml with 0.9% sodium chloride (equivalent to total max 1mg/kg)**
Ropivacaine 0.2% (2mg/ml)	**400mg in 200ml bag**	**Infusion after initial bolus dose as per table below**

5.6.2 Patients Under 50kg

Drug and concentration	Supplied as	Administration
Unilateral Block – Intermittent bolus		
Bupivacaine 0.25% (2.5mg/ml)	**10ml ampoules**	**0.4ml/kg (1mg/kg) diluted to 20ml with 0.9% sodium chloride 6 hourly**
Bilateral Block – Intermittent bolus		
Bupivacaine 0.25% (2.5mg/ml)	**10ml ampoules**	**0.4ml/kg per catheter (total 2mg/kg) diluted to 20ml with 0.9% sodium chloride 6 hourly**
Unilateral Block – Infusion		
Bupivacaine 0.25% (2.5mg/ml) **(Initial Bolus)**	**10ml ampoules**	**0.4ml/kg (1mg/kg) diluted to 20ml with 0.9% sodium chloride**
Ropivacaine 0.2% (2mg/ml)	**400mg in 200ml bag**	**Infusion after initial bolus dose as per table below**
Bilateral Block – Infusion		
Bupivacaine 0.25% (2.5mg.ml) **(Initial Bolus)**	**10ml ampoules**	**0.2ml per catheter diluted to 20ml with 0.9% sodium chloride (equivalent to total 1mg/kg)**
Ropivacaine 0.2% (2mg/ml)	**400mg in 200ml bag**	**Infusion after initial bolus dose as per table below**

5.6.3 Ropivacaine 0.2% (2mg/ml) Infusion Rates

Within 6h of initial bolus dose		Max infusion rate (More than 6h after initial bolus dose)	
Unilateral Catheter	**Bilateral Catheter**	**Unilateral Catheter**	**Bilateral Catheter**
5ml/hour	**2.5ml/hour each side**	**10ml/hour**	**5ml/hour each side**

5.6.4 Dose Adjustment for males >90kg and females >70kg

Use Lean Body Weight (LBW) which is calculated using the Janmahasatian Formula as described by the Society for Obesity and Bariatric Anaesthesia (SOBA) whose guidelines have been adopted by the Trust.

The Janmahasatian Formula calculates the patient's lean body weight (LBW) excluding fat using one of the following formulae: Males LBW = 9270 x ABW / 6680 + (216 x BMI) Females LBW = 9270 x ABW / 8780 + (244 x BMI)

To Calculate **Lean Body Weight (LBW)** you need to know the patients actual body weight (ABW) and their height in metres (H).

Male

$$LBW = 9270 \times (\frac{ABW}{6680}) + (216 \times \frac{ABW}{H^2})$$

Female

$$LBW = 9270 \times (\frac{ABW}{8780}) + (244 \times \frac{ABW}{H^2})$$

5.7 Bolus dose administration

Boluses must only be administered by doctors competent in the administration of local anaesthetic agents or a qualified Registered nurse who has attained intravenous drug competency AND who has received additional training and been assessed as competent in bolusing local anaesthetic catheters. (Training is provided by the Acute Pain Team).

Local anaesthetic boluses should be prescribed on the patient's drug chart making it very clear that these should be given through the catheter and not intravenously.

1. Ensure the patient has patent intravenous access

2. Check the catheter for signs of infection, leakage, or migration

3. Use standard personal protection (apron and gloves)

4. Using an aseptic non-touch technique

- Remove the bung from the catheter filter and aspirate gently for blood
- If no blood is aspirated, administer 5ml of the local anaesthetic solution

5. Wait for 2 minutes. During this time, ask the patient to report any tinnitus, double vision, numbness or tingling of the mouth, change in taste or dizziness. If any symptoms develop, do not administer any further bolus of local anaesthetic.

6. If no symptoms then gently aspirate again and if no blood then administer a second 5ml bolus

7. Do this for the remaining dose (in 5ml aliquots)

8. Then re-attach a new sterile bung to the filter and sign the prescription chart.

9. If present, repeat for the second catheter

All patients with local anaesthetic regimens must be referred to the Acute Pain Service for on-going care and follow up, using the referral forms attached to the prescription charts. Local anaesthetic boluses will vary in the extent to which they cause loss of sensation in the affected area, with some patients experiencing very little to others experiencing significant sensory block.

5.8 Local Anaesthetic Infusion Administration

Setup

1. Ensure that consent has been obtained from the patient

2. The continuous infusion requires a dedicated epidural pump for each catheter and an epidural giving set

3. Connect the ropivacaine 0.2% (400mg/200ml) bag to the giving set and load into the epidural pump

4. Set the infusion rate as per the table above and the VTBI to 190ml to prevent air in the line

5. Prime the line using the pump's preset 'Prime' function

6. Affix a grey local anaesthetic drug label close to the filter end of the catheter

7. Connect the catheter of the pump to the wound infusion catheter.

8. Do not forget to prescribe the infusion. This will be done using the infusion prescription chart. Ensure that the prescription is clearly identified as being for local anaesthetic agent for wound infiltration

9. Regular monitoring should be performed to ensure that not only is pain relief effective but that early signs of toxicity are not missed.

5.9 Rescue Techniques

Although often highly effective, there will be a subset of patients for whom the Serratus Anterior block fails to provide adequate analgesia. There are a variety of potential reasons for this including inadequate volume of local anaesthetic in the plane or technical issues with the catheter or delivery system. This group of patients will benefit from an urgent anaesthetic or pain team review for further management of their analgesia.
Modifications to the Serratus Anterior local anaesthetic prescription should only be undertaken by the acute pain team (in hours) or the on-call anaesthetist (out of hours).

5.9.1 Rescuing a Serratus Anterior Infusion

Administration of Serratus Anterior block by infusion has several benefits over an intermittent bolus regime. Continuous and reliable analgesia is provided to the patient through the continuous infusion of anaesthetic. This removes the need for clinician involvement to maintain analgesia and therefore reduces the risk of delayed administration owing to competing clinical commitments. However, owing to the slower delivery of volume, the block may be less extensive than that gained through intermittent boluses.

In the event that the block in insufficient, in the first instance the catheter site should be checked for slippage or leakage. If the catheter appears appropriately sited with minimal leakage, the rate of the infusion can be increased to a maximum of 0.25ml/kg/h (0.5mg/kg/h) in a unilateral catheter, or 0.125ml/kg/h (0.25mg/kg/h per side) in the case of bilateral catheters. This should not be done if a bolus dose has been administered within the last 6 hours.

Alternatively, the patient may be transitioned to an intermittent bolus regime. The total local anaesthetic dose administered over the preceding 6 hours should be calculated and any boluses administered should not exceed the patients combined local anaesthetic maximum dose (eg. If the patient has received a total of 1.5mg/kg ropivacaine over the last 6 hours (50% of their maximum dose), then a bupivacaine top up should not exceed 1mg/kg total (50% of the patients maximum bupivacaine dose). Boluses should be made up to 20ml with 0.9% sodium chloride to ensure adequate coverage of the tissue plane.

If these measures are inadequate then consideration should be given to resiting the block or alternative forms of regional analgesia (eg epidural or erector spinae block)

5.9.2 Rescuing a Serratus Anterior Intermittent Bolus

Patients on a bolus regime may experience pain for different reasons and it is important to assess the nature of the pain. Pain that occurs close to the time that the next bolus dose is due may be due to leakage around the catheter and this should be investigated, or ma benefit from conversion to a continuous infusion. In this instance, alternative analgesia should be given until the next bolus dose is due, at which time an initial bolus followed by an infusion should be administered as per tables 5.6.1 to 5.6.3.
Patients who are experiencing ongoing pain, despite a bolus, are unlikely to benefit from an infusion. In this instance the catheter site should be inspected for leakage or displacement and consideration should be given to resiting the catheter or alternative analgesic techniques (eg epidural or erector spinae block)

5.10 Additional requirements

All patients with rectus sheath and would infiltration catheters must have patent intravenous access and oxygen prescribed.

5.9.1 Resuscitation equipment

Oxygen and appropriate drugs must be readily available wherever local anaesthetic boluses are administered. Intralipid® is stored in main theatres in recovery, also in the obstetric unit, A&E resuscitation, ITU, Beech High Care and Ward 14.

For management of local anaesthetic toxicity please refer to the 2010 AAGBI guidelines "Management of Severe Local Anaesthetic Toxicity" (kept with the Intralipid® and also at https://www.aagbi.org/sites/default/files/la_toxicity_2010_0.pdf

5.10.2 Observations

Document blood pressure, pulse rate, respiratory rate, oxygen saturation, pain score and AVPU score for each set of observations at the frequency indicated below. These must be documented on the NEWS (PF WR5044 NEWS National Early Warning Score), at the following time intervals:

Timing	Frequency
After each bolus	At 15 minutes and 30 minutes
Greater than 30 minutes after last bolus	Standard as per NEWS

Inspect the insertion site of the catheter at least once every nursing shift for leakage, signs of inflammation or catheter migration. Seek advice from APS or on call anaesthetists if concerned. The site should be check for a further 24 hours after the catheter has been removed.

5.11 Duration

Serratus Anterior sheath catheters can be continued for up to 7 days. The epidural filters are licensed for 96 hours use. The requirement for the catheter should be reviewed on a daily basis. If the catheter is required for longer than 96 hours then the giving set and filter (but not the catheter) must be changed. Infection control must be assured. The open end of the epidural catheter must not become contaminated during the brief time between removing the

old filter and attaching the new filter. If in doubt seek help from the Acute Pain Team (on call anaesthetist/intensivist out of hours).

5.10.1 Discontinuation of the Serratus Anterior infiltration

Prior to removal, a period of 6 hours should elapse after the last bolus dose or the infusion is discontinues and pain must continue to be assessed to confirm the adequacy of the alternative analgesia provided.

Catheter removal is an aseptic procedure. After removing the dressing and fixation device, apply gentle traction to the catheter and ensure it is intact. Look for presence of blue tip on catheter. If there are any signs of infection, send tip for MC+S. Apply a clean dressing for 24 hours.

5.10.2 Precautions

1. Ensure that there are no contraindications to the administration of ropivacaine

2. Only use the epidural pumps for this purpose

3. Ensure intravenous access is maintained throughout the duration of the infusion

4. Ensure that serratus anterior catheter infusion lines are clearly labelled to prevent IV connection

Local Anaesthetic Toxicity

Toxic effects usually result from excessive plasma concentrations, which may occur because of inadvertent intravascular administration or overdose.

Signs and symptoms of local anaesthetic toxicity:

- Light headedness
- Numbness and tingling around the mouth and numbness of tongue
- Tinnitus
- Visual disturbance
- Muscular twitching
- Drowsiness
- Unconsciousness
- Convulsions
- Coma
- Respiratory / Cardiac arrest

Resuscitation equipment, oxygen and appropriate drugs must be readily available wherever local anaesthetic boluses are administered. Immediate management is to stop the administration of local anaesthetic. Treatment of severe local anaesthetic toxicity includes

the infusion of lipid, also known as 'lipid rescue' Intralipid® and administration details are kept in:

- Theatres recovery (countywide)
- Obstetric Theatre
- A&E resuscitation
- Intensive Critical Care Units
- Beech High Care
- Ward 10.

Full details on the management of local anaesthetic toxicity are the 2010 AAGBI guidelines "Management of Severe Local Anaesthetic Toxicity" (kept with the Intralipid® and also at https://www.aagbi.org/sites/default/files/la_toxicity_2010_0.pdf

Appendix 1 – RIB FRACTURE PAIN ASSESSMENT AND MANAGEMENT PATHWAY

Affix Patient Label here or record:

Name: .....

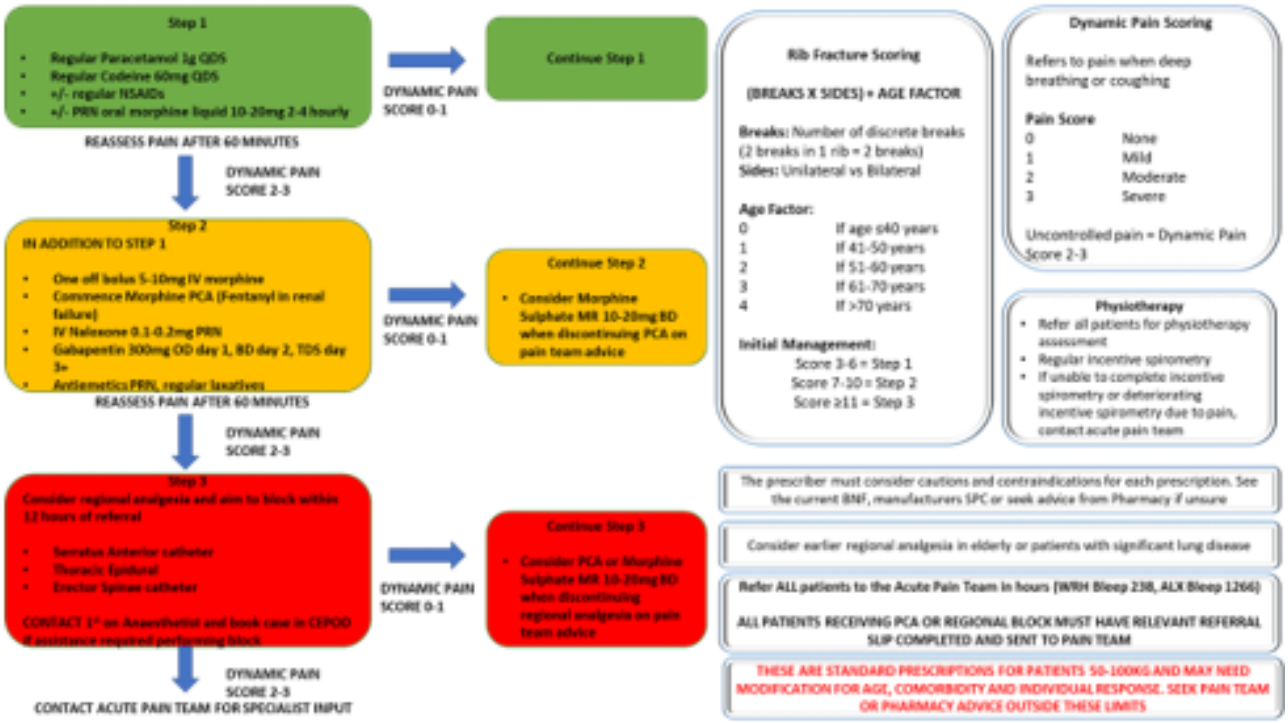
NHS No: | | | | | | | | | | |

Hosp No: | | | | | | | | | | |

D.O.B: D D / M M / Y Y Y Y Male ☐ Female ☐

Ward:..... Cons.....

RIB FRACTURE PAIN ASSESSMENT AND MANAGEMENT PATHWAY



(BREAKS X SIDES) + AGE FACTOR = RIB FRACTURE SCORE

(_____ X _____) + _____ = _____

INITIAL MANAGEMENT STEP = _____

Guidance

Calculate the patients rib fracture score using the tool above and then commence the patient on the corresponding stage of the pathway

Document pain scores (overleaf) hourly until pain is stable and then 4 ~~hourly~~ at least, along with other observations. Frequency of observations must be increased if escalation occurs.

Please use the Abbey Pain tool (overleaf) for patients with dementia/ learning difficulties

Please record **DYNAMIC (pain on movement/coughing)** scores (0-3) in the chart overleaf and follow instructions in the pathway above and overleaf regarding escalation

Document actions taken in the space provided in this document

Affix Patient Label here or record:

Name: .....

NHS No: | | | | | | | | | | |

Hosp No: | | | | | | | | | | |

D.O.B: D D / M M / Y Y Y Y Male ☐ Female ☐

Ward: ..... Cons. .....

PAIN ASSESSMENT CHART

Date																		
Time																		
Rib Fracture Pathway Stage (1/2/3)																		
3																		
2																		
1																		
0																		
Escalated & documented in pathway	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N
Initials																		

Please continue overleaf

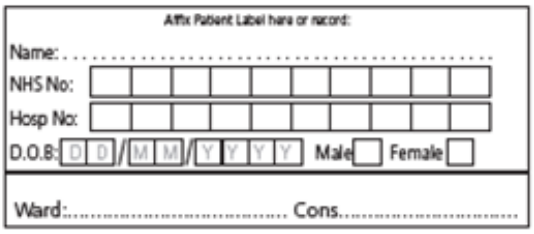
Nursing Escalation Guidance

0 / 1 (No/Mild pain) = Continue with current analgesia; offer reassurance; review environment

2 / 3 (Moderate/Severe Pain) = Contact Parent Team for medical review and escalation of management if on step 1 or step 2 of the management pathway. Increase frequency of observations to 1 hourly until pain stable. Document actions taken in the space provided in this document

If no improvement following medical review or the patient is on step 3 of the pathway please contact Acute Pain Team (bleep 238 (WRH)/ 1266 (ALX)) 8am-4pm or 1st on call Anaesthetist (bleep 700 (WRH)/ 1907 (ALX))

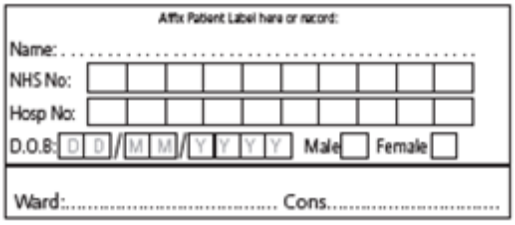
See over for escalation documentation and further pain score charts



Date																		
Time																		
Rib Fracture Pathway Stage (1/2/3)																		
3																		
2																		
1																		
0																		
Escalated & documented in pathway	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N
Initials																		

Escalation Documentation

Date	Time	Pain Score	Action Taken	Signature and Pin



Date	Time	Pain Score	Action Taken	Signature and Pin

Appendix 2

Monitoring Tool

Key control:	Checks to be carried out to confirm compliance with the policy:	How often the check will be carried out:	Responsible for carrying out the check:	Results of check reported to: *(Responsible for also ensuring actions are developed to address any areas of non-compliance)*	Frequency of reporting:
WHAT?	**HOW?**	**WHEN?**	**WHO?**	**WHERE?**	**WHEN?**
Patients with rib fractures should all be commenced on the rib fracture pathway. Patients should be analgesed according to their rib fracture score as per pathway.	Regular audit of use of and compliance with the rib fracture guidelines and pathway	12 to 24 monthly	Dr Hannah Williams	Anaesthetic Department	12-24 monthly.

References

1. Ziegler DW, Agarwaal NN. (1994). The morbidity and mortality of rib fractures. The Journal of Trauma. 37(6):975-9
2. Williams A, Bigham C, Marchbank A. (2020). Anaesthetic and surgical management of rib fractures. BJA Ed. 20(10):332-40

3. Ho S-W, Teng Y-H, Yang S-F, Yeh H-W, Wang Y-H et al. (2017). Risk of pneumonia in patients with isolated minor rib fractures: a nationwide cohort study. BMJ Open. 7:e013029
4. Witt CE, Bulger EM. (2017). Comprehensive approach to the management of the patient with multiple rib fractures: a review and introduction of a bundled rib fracture management protocol.Trauma Surgery & Acute Care Open. 2:e000064
5. Peek J, Smeeing DPJ, Hietbrink F et al. (2019). Comparison of analgesic interventions for traumatic rib fractures: a systematic review and meta-analysis. Eur J Trauma Emerg Surg. 45:597-622
6. Tanaka H, Yukioka T, Yamaguti Y et al. (2002). Surgical stabilization or internal pneumatic stabilization? A prospective randomized study of management of severe flail chest patients. J Trauma. 57:727
7. Granetzny A, Abd El-Aal M, Emam E et al. (2005). Surgical versus conservative treatment of flail chest. Evaluation of the pulmonary status. Interact Cardiovasc Thorax Surg. 4:583
8. Marasco SF, Davies AR, Cooper J et al. (2013). Prospective randomized controlled trial of operative rib fixation in traumatic flail chest. J Am Coll Surg. 216:924
9. Liu T, Liu P, Chen J, et al. (2019) A Randomized Controlled Trial of Surgical Rib Fixation in Polytrauma Patients With Flail Chest. J Surg Res. 242:223.
10. Coughlin TA, Ng JW, Rollins KE, et al. (2016) Management of rib fractures in traumatic flail chest: a meta-analysis of randomised controlled trials. Bone Joint J. 98-B:1119
11. Chest Wall Injury Society. (2020). Chest Wall Injury Societyhttps://cwisociety.org/ (Accessed on September 6th 2021)
12. Blanco, R., Parras, T., McDonnell, J. G., & Prats-Galino, A. (2013). Serratus plane block: a novel ultrasound-guided thoracic wall nerve block. Anaesthesia. 68(11): 1107–1113.
13. Camacho, F., & Segura-Grau, E. (2019). Continuous serratus anterior plane block provides analgesia in multiple rib fractures: a case report. Brazilian journal of anesthesiology. 69(1): 87–90.
14. López-Matamala, B., Fajardo, M., Estébanez-Montiel, B., Blancas, R., Alfaro, P., & Chana, M. (2014). A new thoracic interfascial plane block as anesthesia for difficult weaning due to ribcage pain in critically ill patients. Medicina intensive. 38(7): 463–465.

Contribution List

This key document has been circulated to the following individuals for consultation;

Designation

This key document has been circulated to the chair(s) of the following committee's / groups for comments;

Committee
TACCS
MCS

Supporting Document 1 - Equality Impact Assessment Tool

To be completed by the key document author and attached to key document when submitted to the appropriate committee for consideration and approval.

		Yes/No	Comments
1.	**Does the policy/guidance affect one group less or more favourably than another on the basis of:**		
	• Race	NO	
	• Ethnic origins (including gypsies and travellers)	NO	
	• Nationality	NO	
	• Gender	NO	
	• Culture	NO	
	• Religion or belief	NO	
	• Sexual orientation including lesbian, gay and bisexual people	NO	
	• Age	NO	
2.	**Is there any evidence that some groups are affected differently?**	NO	
3.	**If you have identified potential discrimination, are any exceptions valid, legal and/or justifiable?**	N/A	
4.	**Is the impact of the policy/guidance likely to be negative?**	NO	
5.	**If so can the impact be avoided?**	N/A	
6.	**What alternatives are there to achieving the policy/guidance without the impact?**	N/A	
7.	**Can we reduce the impact by taking different action?**	N/A	

If you have identified a potential discriminatory impact of this key document, please refer it to Human Resources, together with any suggestions as to the action required to avoid/reduce this impact.

For advice in respect of answering the above questions, please contact Human Resources.

Supporting Document 2 – Financial Impact Assessment

To be completed by the key document author and attached to key document when submitted to the appropriate committee for consideration and approval.

	Title of document:	Yes/No
1.	Does the implementation of this document require any additional Capital resources	NO
2.	Does the implementation of this document require additional revenue	NO
3.	Does the implementation of this document require additional manpower	NO
4.	Does the implementation of this document release any manpower costs through a change in practice	NO
5.	Are there additional staff training costs associated with implementing this document which cannot be delivered through current training programmes or allocated training times for staff	NO
	Other comments:	

If the response to any of the above is yes, please complete a business case and which is signed by your Finance Manager and Directorate Manager for consideration by the Accountable Director before progressing to the relevant committee for approval.