Chest Injury Guidelines

Contents:

WMAS Clinical Guidelines

CG-CLI-009 I Version - 1

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Version	Version 2			
Title	**Chest Injury**			
Approved by	**Immediate Care Governance Group**			
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Directorate	**Immediate Care Governance Group**			
Authorised Staff For main guideline	**Emergency Care Assistant**		**Consultant paramedics**	X
	Technician		**HEMS CCPs**	X
	Advanced Technician	**X**	**Advanced practitioner approved by ICGG**	X
	Student Paramedic	**X**	**Doctor**	X
	Paramedic	**X**		
Clinical Category	**Green – Deviation permissible for registered healthcare professionals with application of clinical judgement**			

1. Scope

1.1. These guidelines are written to support clinicians' management of patients with chest injuries whilst being treated by West Midlands Ambulance Service NHS Foundation Trust responders.

2. Background

2.1. Chest injuries are significant contributors to major morbidity and mortality. Assessment of thoracic conditions is often difficult within the Prehospital environment and patients may not display classical signs of injury which may delay timely management.

3. Guidelines

3.1. Assessment

3.1.1. In accordance with JRCALC Guidelines; Thoracic Trauma, Trauma Emergencies

3.1.2. The following signs must be actively assessed and/or excluded:

- Respiratory rate & pattern
- Presence of penetrating chest wound, bruising
- Asymmetrical chest expansion; flail chest, relative hyperexpansion, splinting – May not be seen with bilateral tension pneumothoraces or other chest injuries
- Neck wounds, surgical emphysema, swelling, laryngeal crepitus

- Venous engorgement - may not be evident with hypovolaemia / neck collar in-situ
- Haemoptysis – Indicating tracheobronchial injury / lung contusion / Max-Fax injury
- Chest wall swelling
- Chest wall crepitus
- Chest wall tenderness
- Tracheal deviation (late sign of tension pneumothorax if at all present!)
- Cardiovascular compromise

3.1.3. It is important to attempt full examination of the chest (including back, sides, axillae and shoulders) to avoid missing posterior or lateral injuries. Avoid prolonged exposure for patient dignity and avoidance of cooling.

3.1.4. Strongly consider chest percussion and auscultation where ambient noise permits. The lateral chest and anterior armpit should be auscultated to avoid transmitted sounds from the contralateral chest.

3.1.5. Consider the assessment of injury and symptoms described in the context of the mechanism of injury.

3.2. Minimum Recordings for PRF in Chest Trauma

- Respiratory rate
- Radial Pulse
- Conscious level; (GCS)
- Pulse oximetry
- ECG Monitoring
- Blood Pressure
- Capnography (if LMA/ETT in situ)

3.3. Paediatrics

3.3.1 Rib fractures indicate a significant mechanism of injury and serious injury should be suspected. Isolated chest injury is rare.

3.3.2 Chest drain insertion is rarely indicated prehospital, requires special expertise and equipment and the need would generally suggest immediate departure to a paediatric trauma centre.

3.4 Interventions

3.4.1 All patients with evidence of thoracic injury require high flow oxygen through a non re-breathe mask (15L/min)

3.4.2 Adequate analgesia

3.4.3 The majority of patients can be adequately managed with the above measures with timely transfer to hospital.

3.5 Splinting / Positioning

3.5.1 The ideal position for managing chest injuries is in a sitting position. However, the need to simultaneously manage the cervical spine may preclude this position and result in respiratory embarrassment when laid supine. Assessment of the severity of the injury and the need to assist ventilation may mandate the need for rapid sequence induction and assisted ventilation prior to transfer in the supine, fully spinal immobilised position.

3.5.2 Splinting a flail segment options may include:

- Direct pressure applied by hand
- 500ml bag of fluid taped over the flail segment
- Lie the patient with the flail segment downwards

3.6 Chest Seal

3.6.1 Indications

- Open pneumothorax

3.6.2 Advantages

- Quick

3.6.3 Disadvantages

- Lack of adhesion to surrounding skin
- Does not re - expand collapsed lung
- Latex components
- No collection of blood if accompanied by haemothorax

3.6.4 Technique

3.6.4.1 Skin may need to be dried & shaved to facilitate adequate adhesion

3.6.4.2 An adhesive dressing with a central hole placed over the wound with a chest seal placed over it is an alternative

3.7 Needle Thoracocentesis (Needle Chest Decompression)

3.7.1 Tension pneumothorax is a rare prehospital event in blunt trauma. There is extensive evidence that tension pneumothorax presents differently dependent on whether the patient is spontaneously breathing or is intubated & ventilated. Positive pressure ventilation increases the risk of tension pneumothorax substantially.

3.7.2 Indications

- Suspicion of a compromising pneumothorax in a ventilated patient
- Worsening respiratory distress in a trapped patient breathing spontaneously with symptoms consistent with a tension pneumothorax

3.7.3 Advantages

- Quick
- Potential resolution of obstructive shock

3.7.4 Disadvantages

- High failure rate (immediately or soon after intervention)
  - Cannula rapidly tracks back out of pleural space and ceases to function
  - A number of people have soft tissues greater than the length of a 14G cannula in the 2nd intercostal space mid-clavicular line and this technique may fail to decompress the pneumothorax
  - Recurrence of tension pneumothorax secondary to obstruction by blood, tissue or kinking
- Does not facilitate complete (if any) lung re-expansion
- A large air leak can collect in the pleural space quicker than can be drained by the cannula

3.7.5 Technique

3.7.5.1 Avoid thick muscle, breast tissue or areas with surgical emphysema

3.7.5.2 The 1st choice of site is the 2nd intercostal space in the mid clavicular line using a 14G cannula

3.7.5.3 The cannula should be inserted into the chest attached to a syringe and flushed with 2ml of air if there is no obvious air release on insertion

3.7.5.4 If an anterior approach fails due to suspected depth of chest wall, a lateral approach should be attempted in the 5th intercostal space, anterior to the mid axillary line

3.7.5.5 A thoracostomy is preferred as definitive treatment (see appendix 1)

Appendix 1

Authorised staff for this appendix:

HEMS CCP + Consultant paramedic	**X**
Advanced practitioners approved by ICGG	**X**
Doctor	**X**

4 Simple Thoracostomy Without Drain Insertion

4.1 Indications

- Any pneumothorax in a patient undergoing positive pressure ventilation
- Actual or near traumatic cardiac arrest
- Shocked state with chest injuries and no apparent primary cardiovascular cause

4.2 Performing simple thoracostomy:

4.2.1 The incision is usually made with the patient on the floor and with the ipsilateral arm abducted to 90 degrees. Skin incision is performed followed by blunt dissection that should be directed inferiorly over the top of the 4th or 5th rib.

4.2.2 The presence of surgical emphysema and flail segments can make placement of the incision over the 4th or 5th intercostal space difficult. The incision should always be above the nipple line (in males).

4.2.3 Bleeding from the subcutaneous tissues in the axilla would normally be compressed by the drain and sutures. This effect is not present in simple thoracostomy. Blunt dissection can limit the extent of any bleeding.

4.2.4 The hole through intercostal muscles should allow free insertion of a finger without pushing. This may require some of the intercostal muscle being “stripped” off the rib.

4.2.5 Thoracostomy should be performed as soon as possible (i.e. a minute or two) after endotracheal intubation has been secured, if indicated (e.g. simple pneumothorax diagnosed pre-RISK). In a peri-arrest situation needle chest decompression should be considered and bilateral thoracostomies performed while intubation is taking place.

4.2.6 Bilateral thoracostomies should never be performed unless the patient is intubated.

4.3 Technique

4.3.1 With the patient supine abduct the arm to approximately 90 degrees

4.3.2 Clean the skin with chlorhexidine spray

4.3.3 Use sterile gloves

4.3.4 If awake infiltrate the skin, subcutaneous skin and pleura with 1% Lidocaine (max 3mg/Kg)

4.3.5 Make a 5cm incision along the line of the ribs in the 4/5th intercostal space in the mid-axillary line

4.3.6 Use a scalpel for the skin only. Thereafter use blunt dissection to pass through the intercostal muscles and pleura

4.3.7 Make a hole sufficient to push 1 finger into the pleural cavity and finger sweep through 360 degrees. Be careful when you push, as there may be fractures ribs that are sharp.

4.3.8 Confirm the lung is felt up and expanded

4.3.9 Leave the soft tissues to fall back over the wound, which will act as a flap valve

4.3.10 Re-spray the wound with chlorhexidine

4.4 Advantages

- The lung can be felt / seen to re-expand
- If the patient persists in a shocked state during transport the thoracostomy can be “refingered” to ensure the lung is up and working thus excluding one cause of obstructive shock
- Avoids intubation of the chest in a non-clinical area
- Avoids risk of re-tension caused by blockage and kinking of drainage systems

4.5 Disadvantages

- Bleeding more likely than needle decompression (reduced with use of blunt dissection)

- Damage to lung tissue (reduced with use of blunt dissection)
- Occlusion of thoracostomy during patient packaging (e.g. by patient's arm)

Appendix 2

Authorised staff for this appendix:

HEMS CCP + Consultant paramedic	**X (not autonomously)**
Advanced practitioners approved by ICGG	**X**
Doctor	**X**

5. Thoracotomy

5.1 Introduction

5.1.1 A resuscitative thoracotomy is a surgical incision made usually across the anterior chest wall to allow access to the chest cavity and structures

5.1.2 Patients who suffer a cardiac arrest through penetrating trauma have a universally fatal outcome without surgical intervention. In selected groups, survival may be as high as 40%, although all resuscitative thoracotomies demonstrate a lower survival.

5.1.3 Transportation to hospital whilst administering CPR is futile and exposes the public and crew to risk. Blood flow through the heart has ceased through obstruction to filling, or hypovolaemia. Only immediate surgical intervention will offer a chance of survival.

5.1.4 Pre-hospital thoracotomy will address one specific lesion – namely a simple penetrating cardiac wound leading to tamponade and arrest. Blunt injury, or massive chest injury will not be treatable on scene and so in these cases thoracotomy will not be indicated.

5.2 Scope

5.2.1 This appendix is intended to provide guidance to appropriately skilled practitioners (approved by the immediate care governance group) working with West Midlands Ambulance Service in the technique of simple resuscitative thoracotomy (clamshell), and to provide MERIT/Critical Care paramedics the information to assist in the preparation, procedure and management of thoracotomy.

5.2.2 As with all clinical procedures, strict adherence to guidelines is recommended, but the techniques described within them should only be performed if within the practitioner's scope of practice

5.3 Indications

5.3.1 The indications for resuscitative thoracotomy in Penetrating chest injury are;

i. Penetrating chest/epigastric trauma
   Tension pneumothorax excluded
ii. Window of opportunity
   < 15 minutes loss of vital signs ("to hand on heart")
   Vital signs = palpable blood pressure/carotid pulse, respiratory effort, papillary, gag or corneal reflexes or spontaneous movement
iii. Fixable injury
   Penetrating, usually knife or other sharp object, usually unilateral, usually single, tamponade suspected
iv. Chain of trauma survival
   Where-to next? (the management and transfer of the patient post thoracotomy permits potentially successful management)

5.4 Contraindications

5.4.1 The contra-indications for resuscitative thoracotomy are;

i. Pre-hospital cardiac arrest secondary to blunt trauma
ii. Cardiac arrest secondary to gunshot wound (relative)
iii. Associated very severe head injury
iv. Loss of vital signs >15mins ("to hand on heart")
   Ultrasound is still unproven particularly prehospital. (Evidence around efficacy of ultrasound usage in chest trauma should be collated and reviewed.) Also consider low-flow output state – capnography may aid this decision making
v. No basic life support in progress since loss of signs of life
vi. Unskilled practitioner
vii. Short journey time to MTC where an immediate thoracotomy can be performed <15 minutes from time of loss of vital signs

5.5 Intent of resuscitative thoracotomy

5.5.1. The desired intents of resuscitative thoracotomy are;

i. Release of cardiac tamponade
ii. Control of intrathoracic vascular, pulmonary or cardiac haemorrhage (note: not definitive management of

bleeding/injury)
iii. Permit open cardiac massage
iv. Occlusion of descending aorta (cross clamping / compression)

5.6. Equipment

5.6.1. The essential equipment required for thoracotomy is:
i. Scalpel
ii. Tuff-cut scissors
iii. Spencer Wells forceps
iv. 1 and 2/0 silk sutures on large curved needles
v. Powered suction with yankeur catheter
vi. Bright torch
vii. Skin preparation solution
viii. Absorbent swabs

5.6.2. Additional equipment that may be needed is:
i. Gigli saw
ii. Foley catheter
iii. Artery clips
iv. Skin stapler

5.7. Technique

5.7.1 The decision to undertake thoracotomy should be made within the first minute of arriving on scene and establishing a positive mechanism with absent signs of life. If the patient is alive but rapidly deteriorating, consider an emergent RSI with immediate thoracotomy. This is however usually a clinical diagnosis, and time should not be spent undertaking monitoring.

5.7.2. Incision

5.7.2.1. Ensure immediate 360-degree access, and scene safety.

5.7.2.2. The paramedic should commence attempts at intubation, followed by effective IV/IO access. In cardiac tamponade, the neck veins may be distended and would be a suitable site for cannulation following intubation.

5.7.2.3. The doctor should abduct both arms to 90 degrees. Chest preparation with betadine should be used if possible. Bilateral

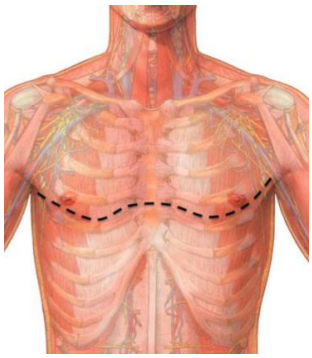
thoracostomies should be made in the posterior axillary line in the 4th/5th intercostal space using a scalpel and Spencer Wells forceps. Pause and check for clinical improvement. If no immediate resolution occurs continue as follows:

5.7.2.4. A broad smooth incision should be made from the one thoracostomy to the other thoracostomy along the lines of the diagram shown (following the rib space):

5.7.2.5. This incision should cut the chest wall skin and subcutaneous fat. It is important to ensure that the incisions are extended to the posterior axillary line to allow good access once open.

5.7.2.6. Extend each thoracostomy to the sternum using tuff-cut scissors following the rib space. Sterile scissors should be used if possible. The operator's fingers may follow underneath the scissors lifting the chest wall away from underlying structures.

5.7.2.7. Depending upon the patient the sternum may be breached with the tuff- cut scissors, or with a Gigli saw. If the tuff-cut scissors cannot breach the sternum, pass a pair of Spencer Wells forceps under the sternum, grasp one end of the Gigli saw, and retract. Attach the wire to the handles and saw briskly. (if rib-spaces are off-set cut across the sternum obliquely)



5.7.3. <u>Access</u>

5.7.3.1. Lift the anterior chest away. This can be delegated to an assistant who must be wearing clinical gloves. If possible, this should not be the MERIT paramedic who will be needed to directly assist in the procedure.

5.7.3.2. This opening of the chest may require the division of fibrous tissue behind the sternum to allow the full lift to occur. If the chest will not open enough, consider extending the incision more posteriorly.

5.7.3.3. Use suction to clear the field and identify anatomy. Maximum illumination should be achieved using whatever means possible.

5.7.3.4. Always open the pericardium as below (5.7.3.)

5.7.4. Tamponade

5.7.4.1. Identify the heart, and if tamponade is present the pericardium may look tense and deep purple/black in colour.

5.7.4.2. Use an artery clip to raise a small fold of pericardium on the anterior surface of the heart and cut a small hole with a scalpel. Extend this incision vertically with the scalpel and horizontally at the bottom (an inverted T shape) and evacuate any clotted blood with fingers and/or suction.

5.7.4.3. As this occurs, the heart may beat spontaneously, fibrillate or remain motionless.

5.7.5. Bimanual Cardiac Massage

5.7.5.1. If the heart makes no spontaneous movement, begin internal cardiac massage.

5.7.5.2. Place the right hand behind the heart with the apex in the palm. Ensure the heart is not reflected too anteriorly in order to maintain patency of the great vessels.

5.7.5.3. Place the left hand over the anterior surface of the heart, again with the apex in the palm.

5.7.5.4. Squeeze hands together, starting at the heel of the hand and 'milking' towards the fingers. Avoid direct fingertip pressure, and keep the hands flat. A rate of 80-100bpm should be aimed for, and an assessment of cardiac filling should be made.

5.7.5.3. By this time 2 x IV/IO access points should be secured. If required a bolus of warmed fluids should be delivered, along with adrenaline until myocardial activity is seen.

5.7.5.4. If ventricular fibrillation is seen, close the chest, apply defibrillation pads in the normal positions and defibrillate as normal.

5.7.4. Cardiac Wounds

5.7.4.1. Small wounds <1cm can be left if there is minimal bleeding.

5.7.4.2. If there is significant bleeding, they may be sutured (use 2/0 silk on a hand needle (do not overtighten), stapled (skin stapler), occluded with direct pressure, using a foley catheter or pack with haemostatic gauze.

5.7.4.3 Sutures should be broad with minimum tension to prevent tearing the muscle. Avoid catching surface vessels under a suture wherever possible.

5.7.4.4. A finger should not be inserted into a hole as this will ultimately extend the defect

5.7.4.5. A foley catheter should be inflated and gentle traction applied with counter pressure outside the heart. The open end of the catheter can be occluded with an artery clip.

5.7.5 Pulmonary Wounds

5.7.6.1. If there is an obvious wound it can be stitched, or twisted and occluded with a clip.

5.8. Transport

5.8.1. Return of cardiac activity:

5.8.1.1. All patients undergoing thoracotomy should be triaged to the nearest Major Trauma Centre with clear request for cardiothoracic surgeons and major transfusion protocol available in ED on arrival.

5.8.1.2. The alert should include that the patient has had a thoracotomy.

5.8.2. No return of cardiac activity:

5.8.2.1. If there is no return of cardiac activity following thoracotomy, pericardial opening, and internal cardiac massage with fluid and adrenaline then life may be pronounced extinct on scene as nothing else will be achieved during and subsequent to transfer to hospital.

5.8.2.2. This will be outside the experience of all personnel on scene and an immediate hot-debrief should be followed up using existing support procedures. Ensure adequate time is set aside for dealing with team members involved in this procedure.

Appendix 3

Authorised staff for this appendix:

HEMS CCP + Consultant paramedic	**X**
Advanced practitioners approved by ICGG	**X**
Doctor	**X**

Evaluation of Pneumofix needle decompression device by CCPs

1 Introduction

1.1 Unrelieved tension pneumothorax continues to be a major cause of serious morbidity and mortality. Needle thoracocentesis can be live-saving when a patient has a tension pneumothorax as it allows decompression, to restore circulation and improve ventilation. There are a number of commercially available products for treating tension pneumothorax. Significant evidence is available that indicates using an inappropriate or improvised product to perform this procedure may lead to complications or may be inadequate. Commonly used devices may not be long enough, the catheters kink and occlude.

1.2 Within West Midlands Ambulance Service and Midlands Air Ambulance Charity the current guidelines advices to use a large bore intravenous cannula for thoracocentesis. However significant evidence is available that indicates using an inappropriate or improvised product to perform this procedure may lead to complications or may be inadequate. A standard IV cannula may not be long enough to penetrate the chest wall, it can also kink and occlude.

1.3 The PneumoFix™ was designed to address many of the clinical deficiencies seen in other products. The one- way valve in the device ensures that no air can pass back into the pleural cavity through it and thus cause harm. This is particularly important if a needle decompression device is incorrectly used or no pneumothorax is present. Cadaveric testing has shown good skin penetration and successful permeation of the pleural cavity as well as a number of other observations. Controlled skin penetration of the cadavers was observed with the device even in embalmed cadavers without the need for scalpel use to pre-nick the skin. No kinking of the catheter was observed and in all cases the device reached the pleural cavity successfully.

1.4 Midlands Air Ambulance Critical Care Paramedics (CCPs) and HEMS Paramedics have been asked to evaluate the effectiveness of the PneumoFix™ device with the possibility of its rollout to all WMAS paramedics if the it proves effective and reliable. The evaluation will consist of 20 insertions of the device, supported by a controlled punch incision of the skin prior to placement.

1.5 The purpose of this SOP is to provide instruction for its use, outline the evaluation process and document the procedure for reporting any serious untoward incidents.

1.6 Training on safe use of the device will be initially provided by the device supplier and then cascade delivered by appropriately trained CCP trainers. A record of this training and subsequent sign off to use the device and participate in the evaluation will be kept on file by the Clinical Lead for MAAC/MERIT (appendix 3.1).

2 Features of the PneumoFix™

2.1 Veress tip and indicator device to assist safe insertion with minimal risk of injuring underlying lung.

2.2 Low pressure release valve to permit release of tension pneumothorax, with minimal potential of subsequent air re-entry.

2.3 11cm catheter designed to have minimal risk of kinking.

2.4 12-Gauge for rapid venting.

2.5 Depth markings printed on surface.

2.6 Radio-opaque to be seen on X-ray imaging.

2.7 Catheter tip holes to maximise drainage ability and minimise tip occlusion.

3 Indications

3.1 Suspected life threating tension pneumothorax in spontaneously breathing patients.

3.2 In traumatic cardiac arrest where tension pneumothorax is strongly suspected

4 Contraindications

4.1 Patients without evidence of tension pneumothorax, simple pneumothorax or pleural effusion

4.2 Patients known to have pleural adhesion (i.e. of visceral and parietal pleurae).

4.3 Patients known to have a chest wall thickness of greater than 11cm.

5 Precautions

These precautions for use should be fully understood before using the device:

5.1 Do not use the PneumoFix® if it has reached or passed its use by date.

5.2 Do not use the PneumoFix® if it is found to be damaged on removal from its packaging.

5.3 Use of the PneumoFix® should be restricted to medical personnel who have appropriate training and an understanding of the technical principles, clinical applications and risks associated with treating tension pneumothorax.

5.4 The different components of the PneumoFix® and their uses should be properly understood before using the device.

5.5 Care is advised when using on patients under 50kg and those with thin chest walls to take care that the needle is not advanced so as to cause harm to underlying tissues.

5.6 The PneumoFix® is a single-use device.

5.7 Careless technique or insertion to excessive depth may lead to serious harm or death to the patient.

6 Conditions of Storage

6.1 The PneumoFix® should be stored and transported in a normal environment, i.e. away from extreme temperatures and humidity. Do not use if the sterile barrier is damaged and/or deteriorated. This product is for single use only. Do not reuse, reprocess or re-sterilise. Reuse, reprocessing of re-sterilisation may compromise the integrity of the set and/or lead to failure, which may result in patient injury, illness or death.

7 Assessment

7.1 In accordance with JRCALC Guidelines; Thoracic Trauma, Trauma Emergencies

7.2 A rapid trauma assessment should take place and the following signs searched for:

- Increased respiratory rate & abnormal respiratory pattern, rapidly deteriorating respiratory distress, cyanosis.

- Greatly reduced or absent breath sounds and hype resonance on the effected side.
- Presence of penetrating chest wound, bruising.
- Asymmetrical chest expansion; flail chest, relative hyper expansion, splinting – May not be seen with bilateral tension pneumothoraces or other chest injuries.
- Neck wounds, surgical emphysema, swelling.
- Venous engorgement – (may not be evident with hypovolaemia/neck collar in-situ).
- Chest wall swelling, crepitus, tenderness.
- Tracheal deviation (late sign of tension pneumothorax if at all present!).
- Cardiovascular compromise.

7.3 Patients who are receiving positive pressure ventilation are far more likely to develop life threating tension pneumothorax. Forcing air into the lungs under positive pressure can rapidly expand simple pneumothorax into a tension pneumothorax. These patients should be continually monitored for signs of increased intrathoracic pressure and a high suspicion of suspicion of tension pneumothorax should be maintained. Where the skill is available and appropriate thoracostomy should be undertaken.

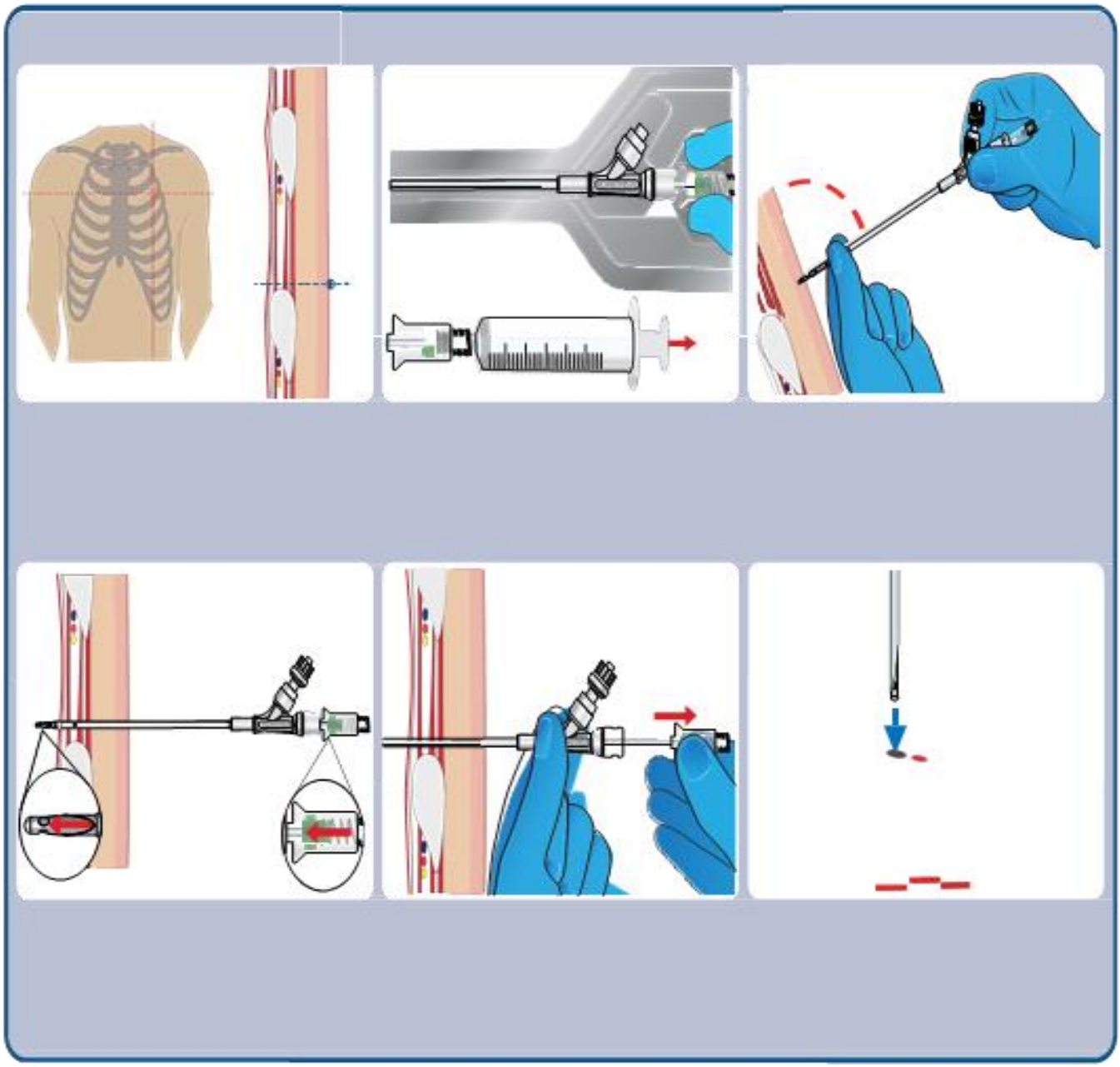
7.4 Tension pneumothorax is a rare prehospital event in blunt trauma. There is extensive evidence that tension pneumothorax presents differently dependent on whether the patient is spontaneously breathing or is intubated & ventilated. Positive pressure ventilation increases the risk of tension pneumothorax substantially.

7.5 Consider the assessment of injury and symptoms described in the context of the mechanism of injury.

8 Instructions for use

8.1 All patients with evidence of thoracic injury require high flow oxygen through a non-rebreathe mask (15L/min).

8.2 Establish the diagnosis of tension pneumothorax, and identify which side of the chest the tension pneumothorax exists: this is the side where the procedure should be carried out



8.3 The insertion site should be just above the upper border of the third rib (i.e. into the second intercostal space) in the anterior mid-clavicular line, to avoid the intercostal neurovascular bundle.

8.4 Clean the skin with chlorhexidine spray.

8.5 A small skin incision should be made using a size 15 blade to aid the placement of the Veress needle. This incision should be no greater than1cm in length or

depth

8.6 Open the PneumoFix® and remove from its packaging by holding the hub of the Veress Needle.

8.7 Grip the PneumoFix® at the catheter hub marked 'Prometheus' for greatest stability. Insert the needle end into the intercostal space at a 90-degree angle to the chest wall. NOTE: do not insert the needle medial to the mid-clavicular line and avoid directing towards the heart. Preferably the user should aseptically grasp the needle assembly during insertion with their other hand in order to stabilise it and control depth of insertion.

8.8 Insert into the pleural space and note the sudden movement of the green indicator towards the patient: this suggests that the needle tip is in the intra-pleural space. Push the whole device approximately 1cm further into the patient. The movement of the green indicator may not always occur. Extreme care should be exercised as the needle advances past the expected chest wall thickness.

8.9 Fix the depth of the catheter and fully withdraw the Veress needle, leaving the catheter in place.

8.10 Dispose of the needle by inserting it into a suitable sharps box.

8.11 If considered necessary, secure the catheter with medical tape to the patient's chest.

8.12 A thoracostomy is preferred as definitive treatment in positively pressure ventilated patients.

9 Documentation and Evaluation

9.1 The use of the PneumoFix® should be recorded on the Patient Record. Including the indication, location, technique, any complications and effectiveness.

9.2 The use of the PneumoFix® should be documented on the monthly mortality and morbidity governance review form under the advanced procedures section.

9.3 The PneumoFix® Evaluation form (appendix 3.2) should be completed and stored in the base folder.

9.4 If any adverse or serious events occur a member of MAAC management team should be informed immediately, an online ER 54 should also be completed as

soon as possible.

10 References

Brown, S. N., Kumar, D., Millins, M., & Mark, J. (Eds.). (2016). *UK ambulance services clinical practice guidelines 2016*. Bridgwater: Class Professional.

West Midlands Ambulance Service MERIT CLI SOP 009 Chest Injury

Prometheus Russell PneumoFix® Instructions

Lee C, Revell M, Porter K et al The prehospital management of chest injuries: a consensus statement. The faculty of pre-hospital care, Royal College of Surgeons Edinburgh Emerg Med J 2007;**24: 220-224**

Appendix 3.1

CCPs who have successfully undertaken training in the use of Pneumofix

First Name	Surname	Date trained

Appendix 3.2

PneumoFix® Evaluation Form

Date: Name:

1. What was the number of Russell PneumoFix® used in this patient?

2. Please indicate the type of incident where the PneumoFix® was used:
□ RTC (Road Traffic Collision)
□ Assault
□ Domestic Accident
□ Industrial Accident
□ Leisure Activity Accident (Horse Riding, Mountain Biking etc.)
□ Other:

3. Length of time the PneumoFix® took to use minutes

4. Using a scale of 1 – 5 where "5" equals excellent and "1" equals not acceptable please score the following:
- Packaging robustness _____
- Packaging ease of opening _____
- Product ease of use _____
- Needle disposal _____
- Fixation to patient _____
- Overall performance _____

5. Can the PneumoFix® be readily used while wearing the appropriate PPE?
□ Yes □ No, because

6. What did you LIKE about the PneumoFix®?

7. What did you NOT LIKE about the PneumoFix®?

11. Did the PneumoFix® fit into the sharps box? Yes No

Appendix 4

Authorised staff for this appendix:

HEMS CCP + Consultant paramedic	**X**
Advanced practitioner approved by ICGG	**X**
Doctor	**X**

The use of ultrasound

1 Introduction

Focused echocardiography/ lung ultrasound (FE/LU) has been shown to improve outcomes in the critically ill patient. However, it is important that FE/LU is introduced and maintained in a properly governed manner to ensure patient safety.

2 Training

Independent practice in FE/LU requires satisfactory completion of the training pathway.

The training pathway consists of completion of a training course (FEEL – Focused Echocardiography in Emergency Life Support) or equivalent (FICE/ED level 2), followed by training scans, with the aim of achieving full FEEL accreditation (or equivalent).

Each training scan should be saved, reported and reviewed by a mentor.

The training scans should not impede or delay clinical care.

Practitioners with ultrasound experience but without formal qualifications will be assessed on an individual basis and may be granted the equivalent of full or selective accreditation, or may be required to undertake the full training pathway

2.1 The training pathway and details of accreditation.

Stage 1 - All staff following the MAA/MERIT pathway should undertake 10 scans following their FEEL course of which at least 5 should be directly observed by a mentor. These scans may be on healthy volunteers or patients. If the patient has capacity, verbal consent for the training scan should be sought prior to undertaking the scan.

Stage 2 – staff start collecting type specific scans within their logbook as follows;

- 10 lung scans of potential pneumothorax demonstrating slide sign (at least 2 of proven pneumothorax). These scans should include the 4 views of the heart as well as the lungs if possible
- 15 heart scans in critically ill patients (including arrest and peri-arrest). At least 5 scans should demonstrate one of the following – asystole, hypovolaemia, tamponade, dilated right ventricle, poor left ventricular contractility
- At least 5 of these stage 2 scans should be directly supervised, and at least one scan of each group (lung or heart) should be directly supervised

Stage 3 - selective sign off can then occur as each type specific target is reached i.e. once 10 Lung scans are achieved and reviewed, practitioners can start using this Lung scans to change management.

Stage 4 – Practitioners continue to collect heart and lung scans and apply for full FEEL accreditation as laid down by the ERC (Total of 50 scans, 15 of which are directly supervised).

CCPs and PHEM trainees may only use the scan results to alter management directly if they have had the selective sign off. They should document that the USS was used to **affect** the clinical decision made.

Consultants may use the pre-sign off scans to support their clinical decisions if they feel confident to, but take clinical responsibility for this action. They should document that USS was used to **support** the clinical decisions made.

A register will be kept of all those who are authorised to use the USS machine and to what level as laid out in Appendix 4.1. This register will be maintained by the Clinical Lead. Sign off for the different stages will be by the approved MAA/MERIT mentors as listed in Appendix 4.2.

Any of the scans required for stages 1-4 may be undertaken on suitable volunteers/patients in the hospital environment, provided the appropriate permission has been granted, and with same requirements of consent.

A detailed record should be maintained of all scans undertaken. The recommended FEEL logbook is found below (appendix 4.3).

3 Practice

The current indications for scans are

3.1) Lung scanning
– at least 3 positions on each side

To aid diagnosis of pneumothorax

3.2) Heart scanning
– attempt Parasternal short and long axis/apical/subcostal

To aid diagnosis of cause of hypotension/respiratory failure/chest pain/cardiac arrest

- pericardial effusion = tamponade
- failing Left and Right ventricular function = heart failure
- dilated Right ventricle = Pulmonary embolus
- Hyper dynamic Left ventricle = hypovolaemia

Diagnosis should be based on the overall clinical picture, and not based on scan findings alone, especially when scan findings do not correlate with the rest of the clinical picture.

Treatment of the above conditions is detailed in the appropriate clinical guidelines.

In the event of poor quality scans, excessive time should not be utilised trying to improve the quality of the scan picture.

4 Equipment maintenance

When not on a mission, the ultrasound unit should be on charge.

Care for screen as per manufacturer's instruction manual.

Do not use anything containing alcohol (or any other strong solvent) on the probe. This will erode the plastic seals and ultimately destroy the probe.

Following use, wipe any excess coupling gel from the probe using a dry tissue. Then wipe the probe and cable with the approved cleaning wipes provided. In a hospital environment, non-alcohol cleaning wipes will be OK.

If the probe is grossly contaminated (e.g. with dried blood) then a wet soapy cloth can be used to clean it before disinfection.

Ensure the batteries are charged and maintained according to the manufacturer's instructions

Appendix 4.1

MAAC/MERIT staff approved to use USS independently

First name	Surname	Basic course	Basic first 10 scans	Heart Scans (15)	Lung Scans (10)	Full accreditation (specify)

Appendix 4.2

Approved Mentors for MAAC/MERIT USS sign off:

- Any FEEL/ FICE mentor as listed on each organisations' website
- MAAC/MERIT mentors

First Name	Surname	Contact email	Approving organisation

Appendix 4.3

Evaluation of USS machines for use by MAA/MERIT

Any USS that is to be evaluated by MAA/MERIT will initially be carried on either the HMED03 or Night MERIT platform as this will generate the most number of uses across both the CCP and doctor staffing model.

Any member of staff who has undertaken a FEEL course or is accredited via another approved organisation may use the machine during the evaluation period.

Each time the machine is used the evaluation form below should be completed and returned to the nominated coordinator for this particular evaluation.

MAA Ultrasound Evaluation Form – Please circle where required

1) Date

2) Doc/CCP

3) Indication ?Respiratory failure

?Hypotension

?Chest pain

?Cardiac arrest

4) Findings Pneumothorax

Pericardial effusion/tamponade

Failing left/right ventricular function

Dilated right ventricle/ pulmonary embolus

Hyper dynamic left ventricle/hypovolaemia

NAD

5) Machine size

Too small / ok / too big

6) Machine weight

Too light / ok / too heavy

7) Picture quality

v.poor / poor / ok / good / v.good

8) Ease of use of controls

v.difficult / difficult / ok / easy / v.easy

9) Ease of picture optimisation (depth/gain etc)

v.difficult / difficult / ok / easy / v.easy

10) Ease of storage

v.difficult / difficult / ok / easy / v.easy

11) Ease of replay/review

v.difficult / difficult / ok / easy / v.easy

12) Other comments, and Thank you!

Appendix 4.4 **FEEL logbook**

Appendices

Appendix 1

Focused Echocardiography Training Log

For training purposes only. NOT FOR ADDITION TO PATIENT NOTES
When reporting echo studies you must report in line with local governance

Patient Details				
Age	years	**Sex**	M ☐	F ☐
Clinical indication:				
Cardiac arrest with CPR ☐	**Peri-Arrest** ☐	**Other** ☐		
Study details				
Date performed		**Performed by**		
Quality of images		**(2-optimal, 1-suboptimal, 0-inadequate)**		
Windows used	**Subcostal** ☐	**PLAX** ☐	**PSAX** ☐	**Apical 4 chamber** ☐
Findings / Results				
Rhythm				
ECG complexes with cardiac motion on echo	**Yes** ☐	**No** ☐		
ECG complexes with no cardiac motion on echo	**Yes** ☐	**No** ☐		
Cardiac standstill	**Yes** ☐	**No** ☐		
VF?	**Yes** ☐	**No** ☐		
Left Heart				
LV severely dilated	**Yes** ☐	**No** ☐		
LV severely impaired	**Yes** ☐	**No** ☐		
LV severely underfilled	**Yes** ☐	**No** ☐		
Right Heart				
RV severely dilated	**Yes** ☐	**No** ☐		
RV severely impaired	**Yes** ☐	**No** ☐		
Paradoxical septal motion?	**Yes** ☐	**No** ☐		
Pericardium				
Large pericardial collection?	**Yes** ☐	**No** ☐		
Free text /additional comments				
Outcome/management				
Signatures				
Echocardiographer				
Supervisor				
Supervisor comments:				

Appendix 2

Front page of logbook

Name	
Institution(s)	
Date of your course	
Venue	
Course Director	
Mentor's name	
Echo qualification	
Institution	
Mentor's name	
Echo qualification	
Institution	
Mentor's name	
Echo qualification	
Institution	

FEEL-UK competency statement
I/We confirm that I/we have mentored and reviewed the focused echo studies performed by the above-named candidate and that they are of an adequate standard.

_____ _____

Candidate **Mentor**

Notes:

- Studies should be recorded and reported on the standard reporting sheet, and copies of these reports should be included in the trainee's personal logbook.
- Each echocardiographic study completed by the trainee should be reviewed with the mentor, who will countersign the report. If the study and interpretation are satisfactory, the mentor should countersign the logbook summary.
- Once the mentor considers the trainee has achieved competency in peri-resuscitation echocardiography, this summary should be signed and dated (by both the supervisor and the trainee) and returned to the course director.
- The total number of studies performed at the time of achieving competency should also be recorded, and must be a **minimum of 50.**

Appendix 3

Logbook

Study Number	Date of echo	Comment	Trainee signature	Supervisor signature
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

Logbook (continued)

Study Number	Date of echo	Comment	Trainee signature	Supervisor signature
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

Appendix 5

Authorised staff for this appendix:

HEMS CCP + Consultant paramedic	**X**
Advanced Practitioners as approved by ICGG	**X**

Competency based process for autonomous finger thoracostomy

Introduction

This appendix describes the governance processes involved to train, approve (sign off) and maintain competence to undertake autonomous finger thoracostomy.

Eligible staff

- Advanced paramedics approved by Immediate Care Governance Group (ICGG)
    - Senior Trauma Paramedics
    - Consultant Paramedics
- Advanced Practitioners as approved by ICGG.

Initial training requirements

- Completion of a suitable post-graduate course involving advanced trauma management as approved by the ICGG
- Attendance at a surgical skills study day as approved by the ICGG.

Experience requirements

- Documented observation of at least 2 finger thoracostomies by 2 different PHEM doctors as approved by the ICGG (appendix 5.1).
- Documented performance of at least 2 finger thoracostomies under direct supervision by 2 different PHEM doctors (appendix 5.1).

Assessment

- A knowledge and skills assessment (appendix 5.2) by a PHEM consultant approved by the ICGG.
- Feedback from the 2 supervising PHEM doctors above.

Sign off process

- All documents related to the above process reviewed by consultant lead for the process, as approved by the ICGG.
- Advanced practitioner issued with sign off certificate (appendix 5.3)

- Details of sign off process entered onto a competency log (appendix 5.4) which will be held by the consultant lead for the process on behalf of WMAS.

Post sign off requirements

- For at least the first 2 autonomously performed finger thoracostomies, a reflective summary of the case should be written and forwarded to the consultant lead for review
- All procedures performed must be recorded in a suitable personal logbook.
- All procedures must be registered on a suitable way to allow peer review.
- All signed off advanced practitioners must engage in a annual review process of their whole practice.
- All signed off practitioners must attend one surgical skills study day per year.
- If more than 6 months has elapsed between performing the procedure, the advanced practitioner must undertake a local revision session which should include the use of a suitable manikin. This revision process should be recorded in the practitioner's logbook and will be assessed at the yearly review process.

Appendix 5.1 – Autonomous finger thoracostomy experience record

Name:		**HPC Number**	

PART A – record of initial surgical skills training

Date of training: Location:

Trainer name (print): Signed:

GMC number:

PART B – Procedure Observation

- Directly observe at least 2 finger thoracostomies being performed by a PHEM doctor
- **TWO** procedures should be observed on **TWO** different patients

Patient	Date	WMAS Case Number	Assessor Name	Assessor Signature	GMC Number
1					
2					
3					

PART C – Observed practice

- Perform under direct supervision at least 2 finger thoracostomies observed by a PHEM doctor
- **TWO** procedures should be observed on **TWO** different patients

Patient	Date	WMAS Case Number	Assessor Name	Assessor Signature	GMC Number
1					
2					
3					

Appendix 5.2 – Knowledge and skills assessment

Name:		**HPC Number**	

To be completed by an approved PHEM consultant

- Candidate directly questioned on indications / complications / anatomy / challenges
- Candidate demonstrates the procedure on a chest model with commentary.

	Performance Criteria	Date	Sign
1	Lists the Advanced Paramedic/Practitioner indications of pre-hospital simple thoracostomy. • Traumatic Cardiac Arrest (bilateral simple thoracostomy) • Suspected tension pneumothorax in patient undergoing positive pressure ventilation		
2	List the potential complications of pre-hospital simple thoracostomy. • Procedural failure • Re-occlusion • Nerve damage • Damage to deep structure (heart/lung) • Bleeding • Infection • Scarring (inc. keloid)		
3	Describes the relevant chest wall anatomy (to include chest wall layers and neurovascular bundle). Awareness of structures deep to incision site.		
4	Demonstrates the correct positioning (supine / arm abducted) and site for performing finger thoracostomy (4-5th ICS Anterior to MAL) on the assessor.		
5	Demonstrates awareness of potential challenges: • Paediatric: tough intercostals / finger sweep may be impossible • Bariatric: challenge getting through chest wall / risk of occlusion • Trauma: risk of injury from bone ends (consider double glove) • Transport: Risk of re-occlusion when packaged with arms at side.		

Demonstrate procedure on chest manikin			
6	Prepares equipment: Scalpel, Forceps, Sharps bin		
7	Universal precautions followed - Gloves (ideally sterile) and eye protection minimum.		
8	Identifies correct site and preps insertion site with skin prep.		
9	Describes correct position (supine / arm abducted) and approach (at level of chest and at 90 degrees) – prompt with question if required		
10	Makes a 4-5cm incision through the skin along the line of the intercostal space (incision over rib acceptable to prevent over penetration).		
11	Blunt dissects through the subcutaneous tissue and intercostal muscles over the top of the lower rib (to avoid neurovascular bundle).		
12	Puts a gloved finger into the incision and performs a finger sweep Notes - air or blood release / lung up or down / adhesions		
13	Aware of need to keep thoracostomy uncovered (skin acts as flap valve) for re-fingering if required.		
PHEM Consultant Name (PRINT)			

Appendix 5.3 – autonomous finger thoracostomy sign off certificate

This certificate confirms that

Has undertaken training, observation, practical experience and a skills/knowledge assessment and has been deemed competent to undertake finger thoracostomies autonomously providing they adhere to the post sign-off requirements stipulated in this document.

Name: Signature:

Date: GMC number:

Approved Consultant Lead

Appendix 5.4 – competency log

Name	Date of sign off	Date 2 reflective cases reviewed	Date of year 1 review	Date of year 2 review	Date of year 3 review	Date of year 4 review

Change Control:

Document Number	ICGG-CLI-SOP- 005
Document	**Standard Operating Procedure 'Chest Injury Clinical Guidelines'**
Version	
Owner	WMAS Medical Director
Distribution list	All staff and relevant partner agencies
Issue Date	February 2017
Next Review Date	February 2019
File Reference	
Impact assessment	
Author	ICGG West Midlands

Change History:

Date	**Change**	**Completed by**
Feb 2017	V1 New Policy	ICGG
Mar 2017	New clinical guideline format	M Nash MAA/MERIT clinical lead
May 2017	V2 - Addition of ICGG approved appendix 5 – autonomous finger thoracosotomy competency process	M Nash MAA/MERIT clinical lead