

Queensland  
Trauma Education

**CHEST TRAUMA**

# Penetrating chest trauma

## Immersive scenario

Facilitator resource kit

**CSDS**



Clinical Skills Development Service

Metro North  
Health



Queensland  
Government

**Developed by**

Dr Frances Williamson  
Emergency Staff Specialist - Metro North Hospital and Health Service

Tracey McLean  
Simulation Educator - Clinical Skills Development Service

**Reviewed by**

Kimberly Ballinger  
Simulation Educator - Clinical Skills Development Service

Education Working Group, Statewide Trauma Clinical Network - Clinical Excellence Queensland

**Designed by**

Rebecca Launder  
Product Designer - Clinical Skills Development Service

**Queensland Trauma Education****Chest trauma - Penetrating chest trauma: Immersive scenario - Facilitator resource kit  
Version 1.0**

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[csds.qld.edu.au/qte](https://csds.qld.edu.au/qte)  
Phone +61 7 3646 6500  
Email [CSDS-Courses@health.qld.gov.au](mailto:CSDS-Courses@health.qld.gov.au)

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## Queensland Trauma Education

The resources developed for Queensland Trauma Education are designed for use in any Queensland Health facility that cares for patients who have been injured as a result of trauma. Each resource can be modified by the facilitator and scaled to the learners needs as well as the environment in which the education is being delivered, from tertiary to rural and remote facilities.

## National Safety and Quality Health Service (NSQHS) Standards



## About this training resource kit

This resource kit provides healthcare workers with the skills to assess and manage low velocity penetrating chest wall trauma.

The scenario encompasses the decision making and procedural skill for insertion of an intercostal catheter to manage a traumatic haemo-pneumothorax.

### Target audience

Emergency department medical and nursing staff.

### Duration

45-60 minutes (set up, scenario and debrief).

### Group size

4-6 participants (or team composition applicable to local area).

### Learning objectives

By the end of this session the participant will be able to:

- Demonstrate the assessment of a trauma patient with penetrating chest injuries.
- Identify the need for escalation of decompression strategy in penetrating chest wall trauma.
- Recognise and effectively manage a patient with immediately life-threatening penetrating chest trauma.

## Facilitator guide

1. Facilitator to provide participant resource kit to the learner.
2. Facilitator to discuss the pre-simulation briefing and deliver the immersive scenario on penetrating chest trauma.
3. Utilise the supporting documents to maximise the learning throughout immersive scenario.
4. Utilise the debriefing guide to evaluate participant performance and provide feedback.

## Participant resource kit

- Learning objectives.
- Overview of penetrating chest trauma.
- Further reading.
- Supporting resources:
  - Structured assessment in trauma - infographic poster.

## Supporting resources

- Structured assessment in trauma - infographic poster.

# Overview of penetrating chest trauma

Chest trauma is the second most common traumatic injury in non-intentional trauma.<sup>1</sup> Trauma to the chest is associated with the highest mortality; in some studies, up to 60% depending on the mechanism of injury.<sup>2</sup> While penetrating chest trauma is less common than blunt trauma, it can be more deadly. Penetrating chest trauma admissions account for 1-13% of all trauma admissions.<sup>3</sup>

Knowledge of likely sequelae of injury patterns are key factors for assessment, management and patient survival.

## Further reading

Ludwig, C., & Koryllos, A. (2017). Management of chest trauma. *Journal of thoracic disease*, 9(Suppl 3), S172–S177. <https://doi.org/10.21037/jtd.2017.03.52>

Mumtaz, U., Zahur, Z., Raza, M. A., & Mumtaz, M. (2017). Ultrasound And Supine Chest Radiograph In Road Traffic Accident Patients: A Reliable And Convenient Way To Diagnose Pleural Effusion. *Journal of Ayub Medical College, Abbottabad : JAMC*, 29(4), 587–590.

Karmy-Jones, R., Namias, N., Coimbra, R., Moore, E. E., Schreiber, M., McIntyre, R., Jr, Croce, M., Livingston, D. H., Sperry, J. L., Malhotra, A. K., & Biffi, W. L. (2014). Western Trauma Association critical decisions in trauma: penetrating chest trauma. *The journal of trauma and acute care surgery*, 77(6), 994–1002. <https://doi.org/10.1097/TA.0000000000000426>

QAS Clinical Practice Guidelines: Trauma/chest injuries  
[https://www.ambulance.qld.gov.au/docs/clinical/cpg/CPG\\_Chest%20injuries.pdf](https://www.ambulance.qld.gov.au/docs/clinical/cpg/CPG_Chest%20injuries.pdf)

Primary Clinical Care Manual, 10th edition 2019, Section 3: Emergency – Chest, p. 171  
<https://www.publications.qld.gov.au/dataset/primary-clinical-care-manual-10th-edition>

ANZCOR Guideline 11.10.1- Management of Cardiac Arrest due to Trauma  
<https://resus.org.au/guidelines/>

## CHEST TRAUMA

# Structured assessment in trauma

## Primary survey

- A Airway/C-spine**  
Rapidly assess, maintain or secure airway and C-spine.  
**Life threats**  
Airway obstruction, Blunt/penetrating neck injury.
- B Breathing/Ventilation**  
Rapidly assess, support ventilation/oxygenation.  
**Life threats**  
Tension pneumothorax, Massive haemothorax, Open pneumothorax  
Flail chest, Ruptured diaphragm.
- C Circulation with Haemorrhage control**  
Rapidly control, assess and support haemodynamics.  
**Life threats**  
Exsanguinating external haemorrhage, Cardiac tamponade,  
Penetrating cardiac injury.
- D Disability**  
Rapidly assess and protect neurological status.  
**Life threats**  
Catastrophic cerebral haemorrhage.
- E Exposure**  
Expose patient, assess for further injuries,  
maintain normothermia.

## Simulation event

### **This section contains the following:**

1. Pre-simulation briefing poster.
2. Immersive scenario.
3. Resource requirements.
4. Handover card.
5. Scenario progression.
6. Supporting documents.
7. Debriefing guide.

# Pre-simulation Briefing

Establishing a safe container for learning in simulation.



## 1 Clarify objectives, roles and expectations

- Introductions.
- Learning objectives.
- Assessment (formative vs summative).
- Facilitators and learners' roles.
- Active participants vs observers.

## 2 Maintain confidentiality and respect

- Transparency on who will observe.
- Individual performances.
- Maintain curiosity.

## 3 Establish a fiction contract

- Seek a voluntary commitment between the learner and facilitator.
- Ask for buy-in.
  - Acknowledge limitations.

## 4 Conduct a familiarisation

- Manikin/simulated patient.
- Simulated environment.
- Calling for help.

## 5 Address simulation safety

- Identify risks.
- Medications and equipment.
  - Electrical or physical hazards.
  - Simulated and real patients.

**Note:** Adjust the pre-simulation briefing to match the demands of the simulation event, contexts or the changing of participant composition.

Adapted from Rudolph, J., Raemer, D. and Simon, R. (2014). Establishing a Safe Container for Learning in Simulation. *Simulation in Healthcare: Journal of the Society for Simulation in Healthcare*, 9(6), pp.339-349.





## Immersive scenario

<b>Type</b>	Immersive scenario
<b>Target audience</b>	Emergency department medical and nursing staff.
<b>Overview</b>	<p>32yr old male patient. Allegedly assaulted 1 hour ago. He has sustained a single stab wound to L posterior chest wall.</p> <p>The patient is brought to the emergency department by ambulance complaining of difficulty taking a deep breath. His vital signs with the ambulance are HR 100, BP 90/60, sats 88% RA, and RR 28. He has a single stab wound to his left posterior chest wall.</p> <p>He is agitated and breathless despite 10mg IV morphine prehospital.</p>
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>• Demonstrate the assessment of a trauma patient with penetrating chest injuries.</li> <li>• Identify the need for escalation of decompression strategy in penetrating chest wall trauma.</li> <li>• Recognition and management of circulation life threats.</li> </ul>
<b>Duration</b>	45 minutes including debrief.

## Resource requirements

### Physical resources

<b>Room setup</b>	Resus bay in emergency.
<b>Simulator/s</b>	1 manikin – SimMan3G / ALS Simulator.
<b>Simulator/s set up</b>	<ul style="list-style-type: none"> <li>• Street clothes, sitting up at 45 degrees.</li> <li>• Moulage: single stab wound to L posterior chest (no exit wound).</li> </ul>
<b>Clinical equipment</b>	<ul style="list-style-type: none"> <li>• Large bore ICCs (24-32F), sterile insertion pack, ICC drain set (Under Water Seal Drain/Dry Seal Drain), suture kit.</li> <li>• PPE – gown, sterile gloves, goggles, surgical mask.</li> <li>• Medications – local anaesthetic, +/-sedatives, analgesia.</li> </ul>
<b>Access</b>	2 IVC setups, with 1 'NO IV' sticker attached.
<b>Other</b>	ED chart and relevant paperwork.

### Human resources

<b>Faculty</b>	2 facilitators (Dr/Nurse with debriefing experience) to take on roles of scenario commander and primary debrief.
<b>Simulation coordinators</b>	1 SimCo or Faculty for manikin set up and control.
<b>Confederates</b>	QAS officer for handover.
<b>Other</b>	Initially 1 nurse and 1 doctor in room. Additional staff to be called into room when further help requested to constitute full trauma team (as applicable to your area).

## Handover card

### Handover from QAS officer

This is Joel. He is a normally well 32-year-old man who was involved in an altercation with another person one hour ago. He has sustained a stab wound to the L posterior chest wall with a knife - unsure of the length. We had to help him out of his location as he complained of feeling short of breath and light-headed with movement. His has become more breathless in the last 5 minutes and we have just noticed his sats have dropped from 95% to 88% RA as we were unloading.

His vital signs currently are: GCS 15, HR 100, BP 90/60mmHg, sats 88% RA and respiratory rate 28.

He has had 10mg IV morphine with minimal relief.

Joel has no past medical history, does not take medications and has no known allergies.  
Thanks for looking after him.

## Scenario progression

STATE 1: INITIAL ASSESSMENT			
Vital signs	Script	Details	Expected actions
ECG: ST	<b>Joel</b> I'm having trouble breathing (labored respirations).	<b>Primary survey results</b> <b>A</b> Maintaining own, anterior neck normal, no wounds/lacerations, trachea midline. <b>B</b> Single stab wound to L posterior chest over 4/5th ICS, no subcutaneous emphysema, laboured breathing. Reduced air entry L lung. <b>C</b> Cool peripherally, cap refill 3 secs. <b>D</b> GCS 15, no neurological deficits. <b>E</b> Nil abnormality.  <b>Manikin: 50% blocked left lung.</b>	<b>Commence primary survey</b> <input type="checkbox"/> Assess airway including anterior neck. <input type="checkbox"/> Assess breathing. <ul style="list-style-type: none"> <li>Identify stab wound to L posterior chest.</li> <li>Examine for unequal chest wall movement and tracheal position.</li> <li>Feel for subcutaneous emphysema.</li> <li>Auscultate breath sounds.</li> </ul> <input type="checkbox"/> Assess circulation. <ul style="list-style-type: none"> <li>Feel peripheral pulses.</li> <li>Assess for JVP.</li> <li>Auscultate for heart sounds.</li> </ul> <input type="checkbox"/> Assess disability. <input type="checkbox"/> Expose patient. <input type="checkbox"/> Recognise hypoxaemia and respiratory distress and apply high concentration oxygen (via NRB mask).
HR: 100			
SpO2: 88% RA			
BP/ART: 90/60			
RR: 28			
Temp: 36.7°C			
BGL: 5			
GCS: 15/15			

STATE 2: ONGOING MANAGEMENT / SECONDARY ASSESSMENT			
Vital signs	Script	Details	Expected actions
ECG: ST	<p><b>Joel</b> Can someone please help me? My chest hurts so bad and it's hard to breathe (labored breathing, short sentences).</p>	<p>Improvement in saturations to 93% if oxygen is applied.</p> <p>Continue to reduce saturations if failure to apply O2.</p> <p><b>Secondary survey results</b></p> <p>Head – nil abnormalities.</p> <p>Abdomen – soft, no other wounds.</p> <p>Pelvis – aligned, non-tender to palpation.</p> <p>Long bones and limbs – nil injury.</p> <p>Back – single stab wound, no exit wound, not actively bleeding.</p> <p><b>Results</b></p> <p>CXR – L Pneumothorax.</p> <p>EFAST scan – nil free fluid in abdomen or pericardium, L pleural fluid and lack of lung sliding LHS.</p> <p><b>Manikin: 100% blocked left lung.</b></p>	<p><b>Secondary survey</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Top to toe assessment.</li> <li><input type="checkbox"/> Arrange further analgesia.</li> <li><input type="checkbox"/> Ensure adequate oxygenation.</li> <li><input type="checkbox"/> Provide IV fluid bolus.</li> </ul> <p><b>Investigations (as applicable)</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Bloods: Trauma panel - FBE, chem20, Group and hold, lipase, coags.</li> <li><input type="checkbox"/> EFAST.</li> <li><input type="checkbox"/> CXR.</li> <li><input type="checkbox"/> Venous bloods gas.</li> </ul> <p><b>Management</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Recognition of penetrating L chest wall trauma.</li> <li><input type="checkbox"/> Recognition of need for decompression of pleural space (perform needle decompression if applicable to your area and team composition).</li> <li><input type="checkbox"/> Recognise possibility of cardiac involvement.</li> <li><input type="checkbox"/> Analgesia plan.</li> </ul>
HR: 120			
SpO2: 93% with NRB			
BP/ART: 80/60			
RR: 28			
Temp: 36.7°C			
BGL: 5.0			
GCS: 15/15			

STATE 3: IDENTIFICATION OF NEED FOR ICC INSERTION			
Vital signs	Script	Details	Expected actions
ECG: ST	<p><b>Joel</b> It is even harder to breathe now... (gaspings, one-word responses).</p>	<p>Increasing respiratory distress and haemodynamic instability.</p> <p><b>Assessment results</b></p> <ul style="list-style-type: none"> <li>Decreased BS L hemithorax.</li> <li>Respiratory distress with single word responses.</li> </ul> <p><b>Manikin: 50% blocked left lung (if ICC inserted or finger thoracostomy performed).</b></p>	<p><b>Assessment</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Repeat primary survey.</li> <li><input type="checkbox"/> Escalate management to decompression L chest.</li> <li><input type="checkbox"/> Prepare for ICC insertion:                             <ul style="list-style-type: none"> <li>Equipment.</li> <li>Sedation plan.</li> <li>Team roles.</li> <li>Pre-brief.</li> </ul> </li> </ul> <p><b>Management</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Insertion of ICC - as per procedural skills station.</li> </ul>
HR: 120			
SpO2: 93% NRB			
BP/ART: 80/60			
RR: 28			
Temp: 36.7°C			
BGL: 5			
GCS: 15/15			

STATE 4: POST ICC INSERTION			
Vital signs	Script	Details	Expected actions
<b>ECG:</b> ST <b>HR:</b> 104 <b>SpO2:</b> 100% NRB <b>BP/ART:</b> 100/70 <b>RR:</b> 22 <b>Temp:</b> 36.1°C <b>BGL:</b> 5 <b>GCS:</b> 15/15	<b>Joel</b> The tube is painful, but I can breathe better now.	Respiratory status improved post ICC insertion. Remains tachycardic.	<b>Assessment</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Repeat primary survey.</li> <li><input type="checkbox"/> Check ICC function:                             <ul style="list-style-type: none"> <li>• Swing, bubble, drain.</li> <li>• CXR position.</li> <li>• Improvement in clinical symptoms.</li> </ul> </li> </ul> <b>Management</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Disposition and ongoing analgesia.</li> <li><input type="checkbox"/> Documentation.</li> <li><input type="checkbox"/> Notification to surgeons/RSQ for consultation.</li> </ul>

**STATE 5: DETERIORATION POST ICC (For senior participants only)**

Vital signs	Script	Details	Expected actions
<p><b>ECG:</b> ST</p> <p><b>HR:</b> 120</p> <p><b>SpO2:</b> 90% NRB</p> <p><b>BP/ART:</b> 70/40</p> <p><b>RR:</b> 32</p> <p><b>Temp:</b> 35.8°C</p> <p><b>BGL:</b> 5</p> <p><b>GCS:</b> 12/15</p>	<p><b>Joel</b> Moaning.</p>	<p>Deterioration of GCS and haemodynamic state. Increasing respiratory distress.</p> <p><b>Primary survey results</b></p> <p><b>A</b> Maintaining own, midline trachea. <b>B</b> Tachypnoea, increasing respiratory distress, ICC swinging, bubbling – drained 1000ml blood. <b>C</b> Pale, diaphoretic, thready brachial pulse. <b>D</b> Reduced consciousness. E3V3M6.</p> <p><b>Imaging results</b></p> <p>EFAST – Positive subxiphoid/cardiac.</p>	<p><b>For senior participants</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Recognition of deterioration.</li> <li><input type="checkbox"/> Reassess primary survey.</li> <li><input type="checkbox"/> Recognise circulatory compromise and initiate treatment and investigations.</li> <li><input type="checkbox"/> Initiate repeat EFAST.</li> </ul> <p><b>Management</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Progress to OT or ED thoracotomy as per participant level/environment and location.</li> <li><input type="checkbox"/> Failure to recognise abnormal vital signs results in further deterioration in observations necessitating +/- thoracotomy (can be discussion or part task trainer if available).</li> <li><input type="checkbox"/> If team recognise the requirement for operative management scenario ends with summary by facilitator of surgical management.</li> </ul>

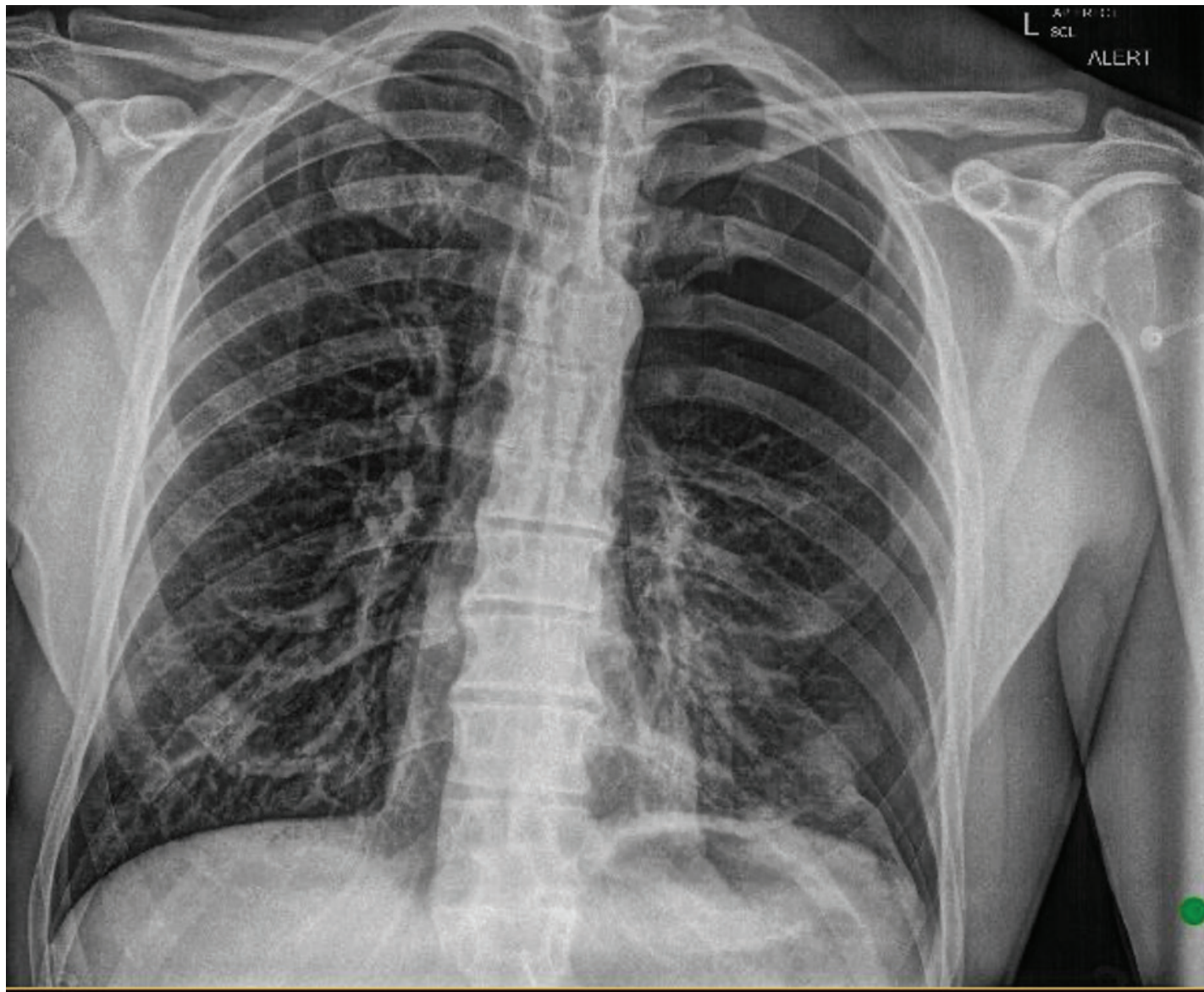


## Supporting documents

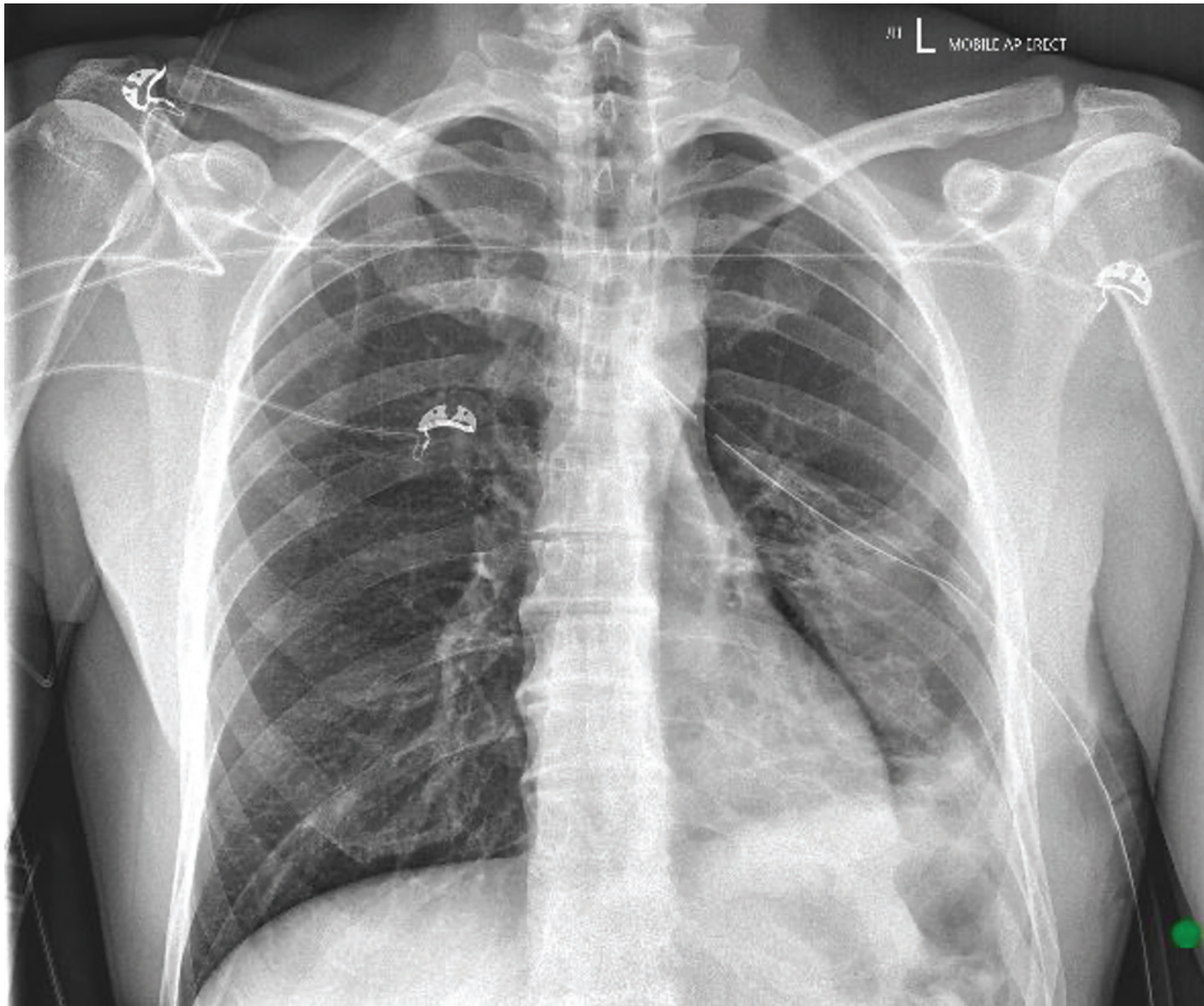
The following supporting documents are provided for this immersive scenario:

1. Chest X-ray 1: Pre-ICC insertion: L Pneumothorax
2. Chest X-ray 2: Post-ICC insertion: L ICC insitu
3. EFAST: Subxiphoid/cardiac: negative
4. EFAST: Morrison's/RUQ: negative
5. EFAST: Splenorenal/LUQ: negative
6. EFAST: (lung US m-mode) L lung: negative pneumothorax
7. EFAST: (lung US m-mode) R lung: positive pneumothorax
8. EFAST: Pelvic: negative
9. Repeat EFAST: Parasternal long view/cardiac: positive pericardial free fluid
10. Lab result: Group and hold
11. Lab result: Coagulation
12. Lab result: Biochemistry
13. Lab result: Venous blood gas

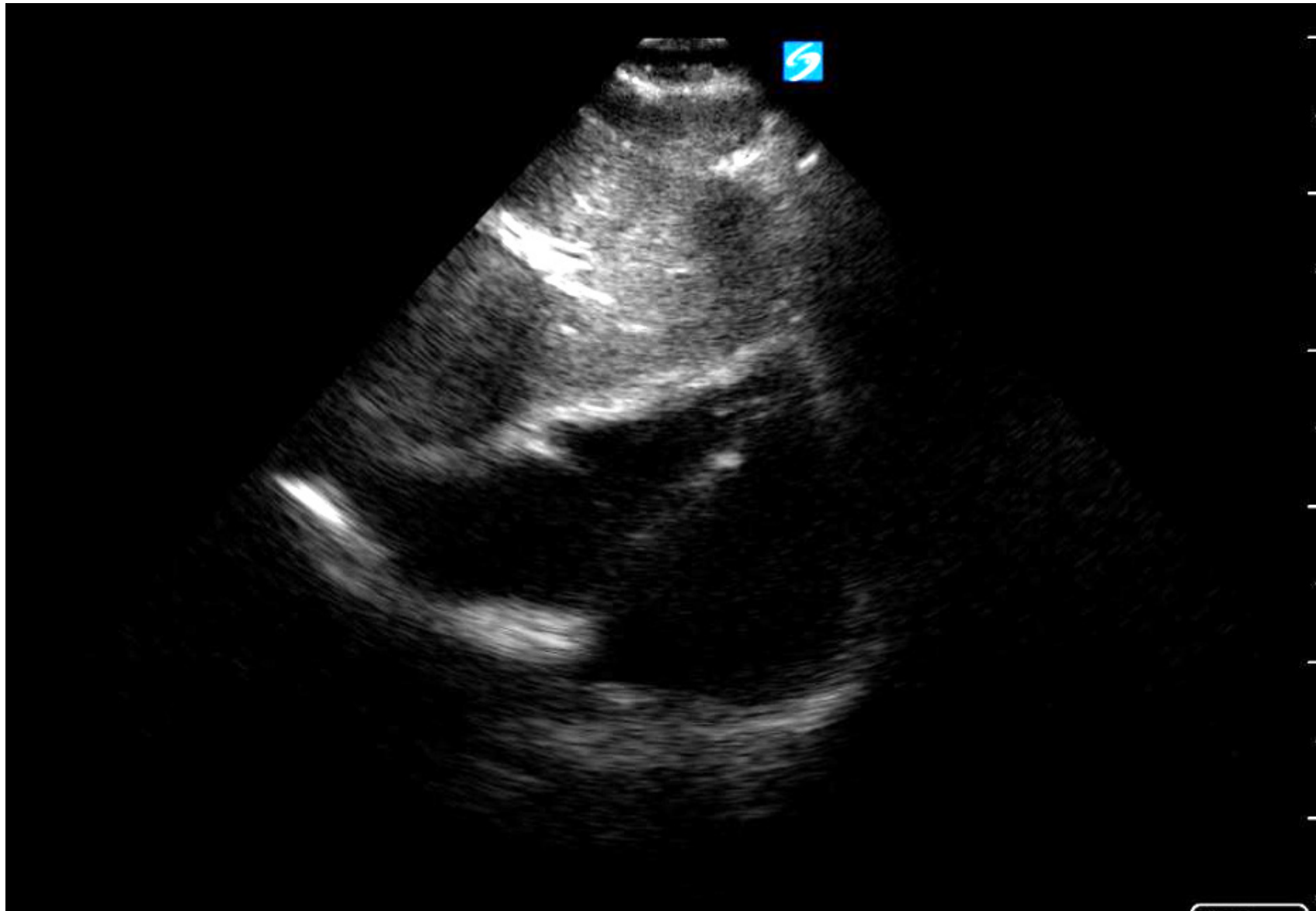
### Chest X-ray 1: L) Pneumothorax (Pre ICC insertion)



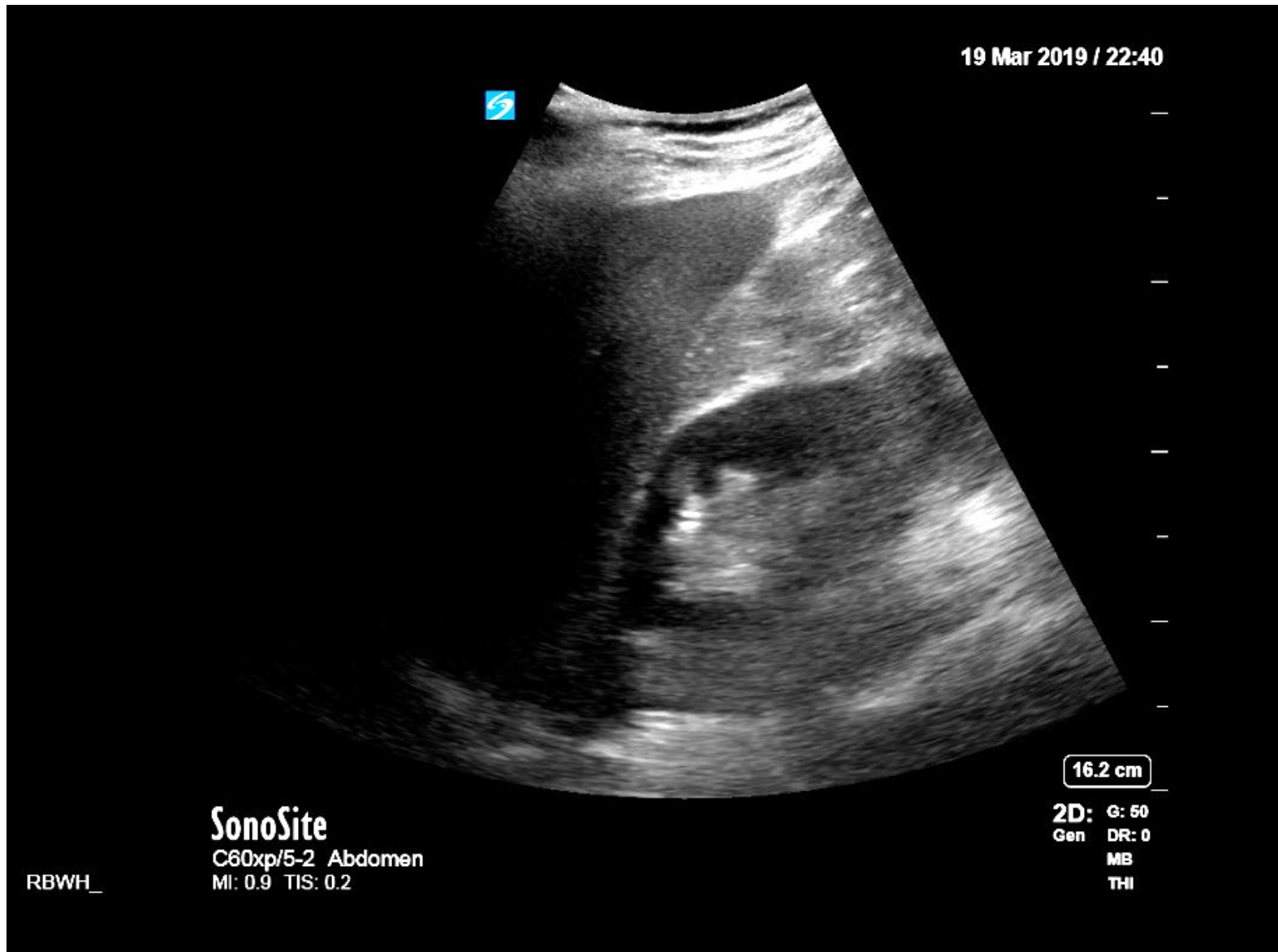
## Chest X-ray 2



## EFAST: Subxiphoid/cardiac



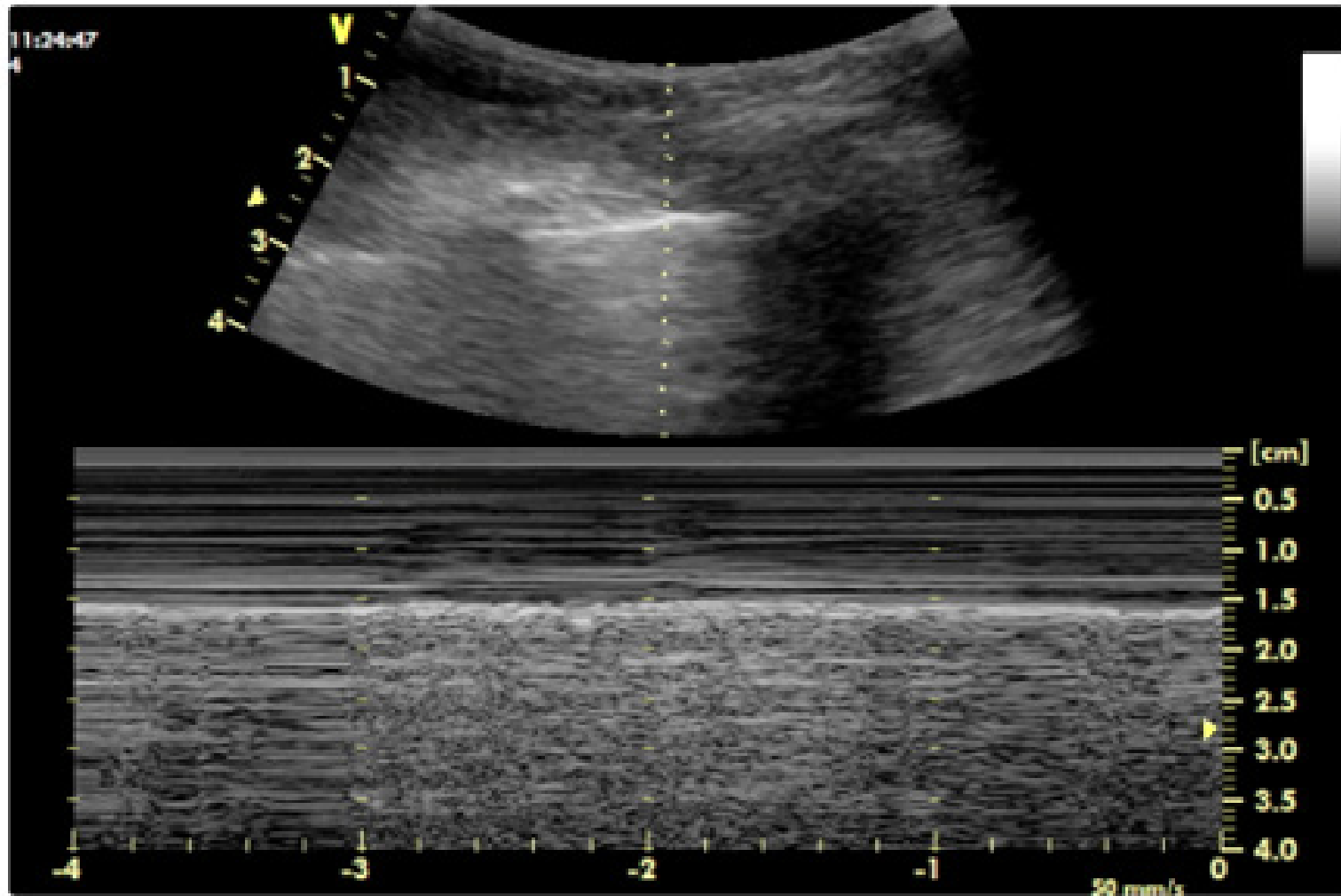
## EFAST: Morrison's/RUQ



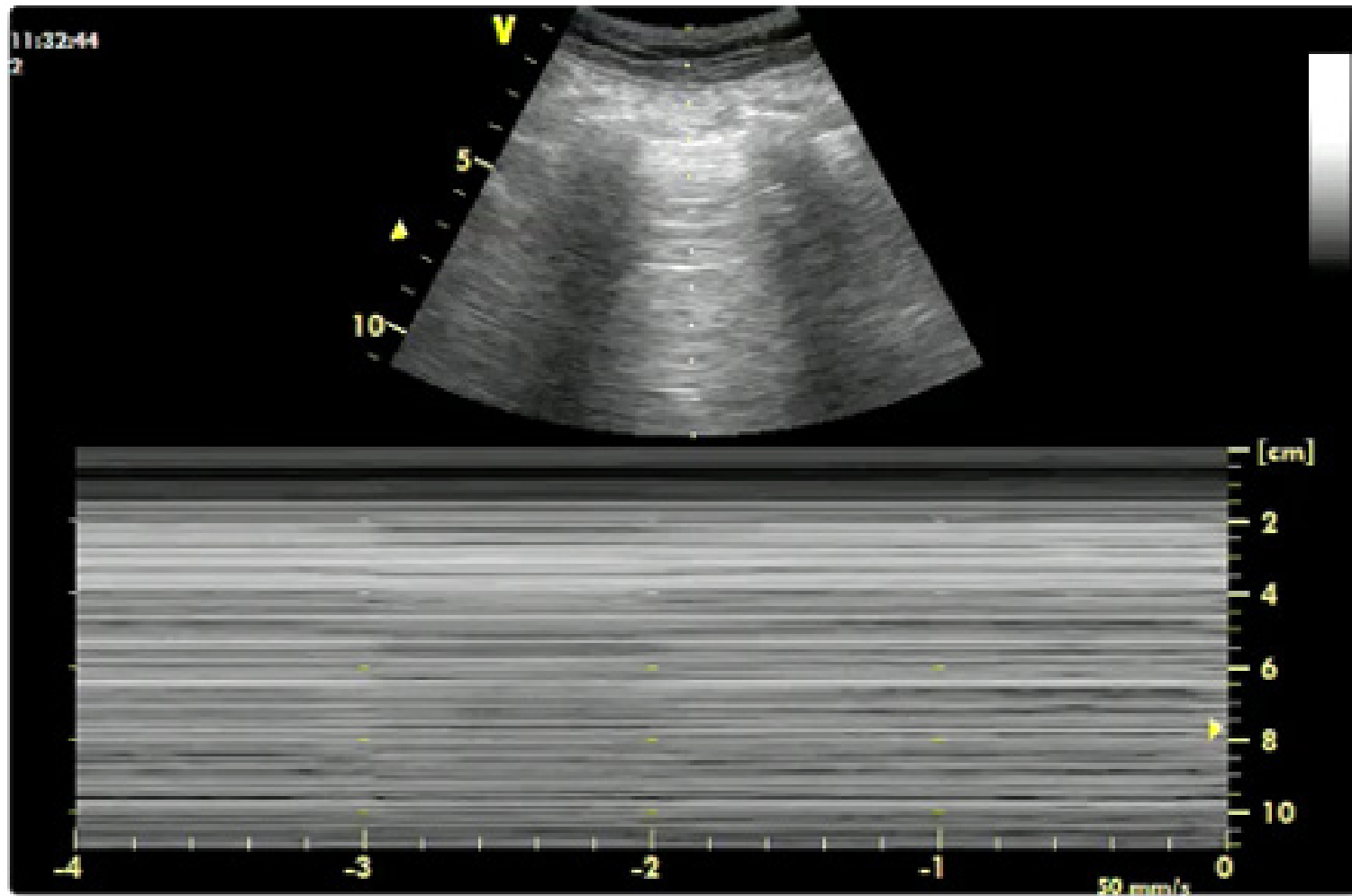
## EFAST: Splenorenal/LUQ



**EFAST: (lung US m-mode) R lung**

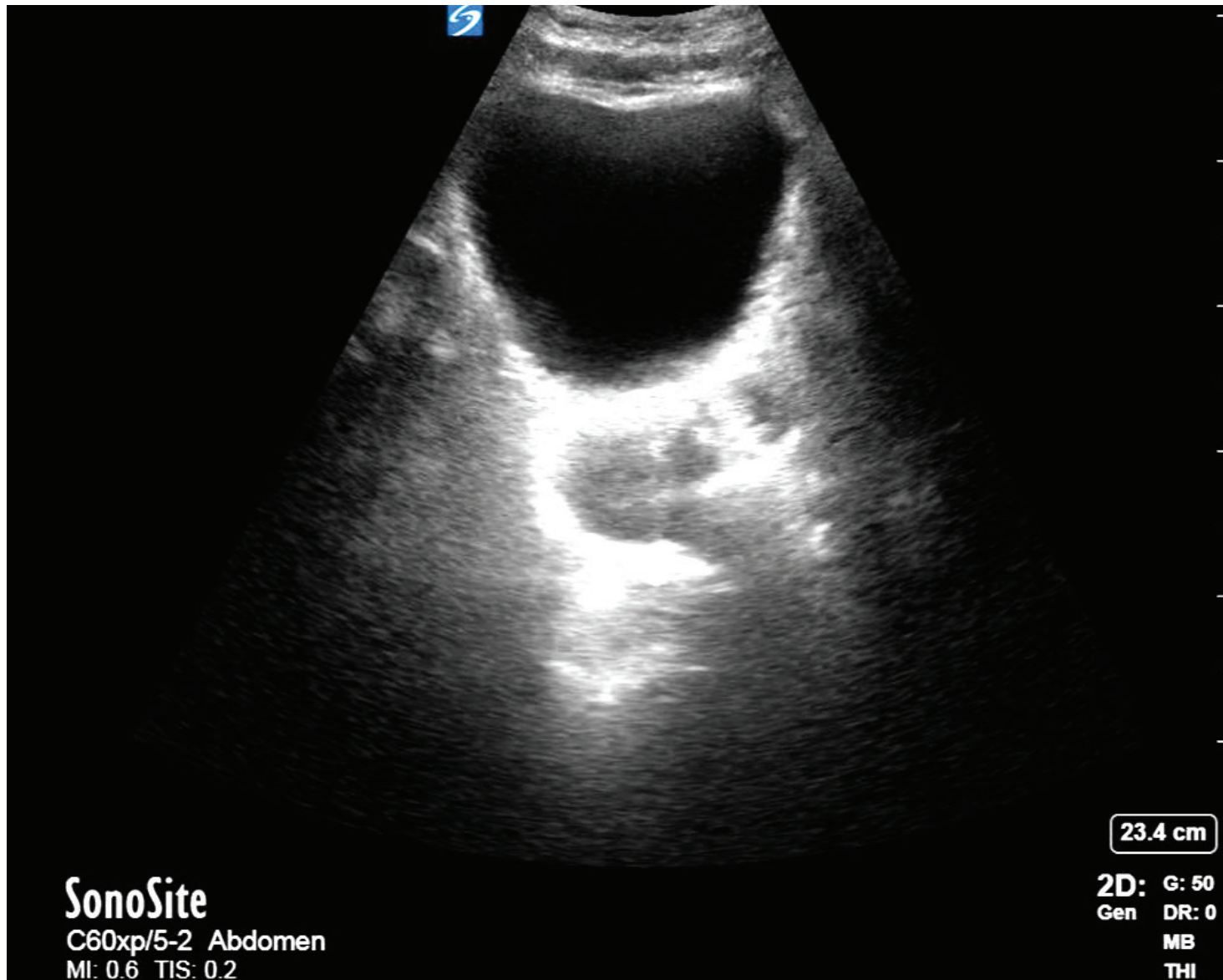


**EFAST: (lung US m-mode) L lung**

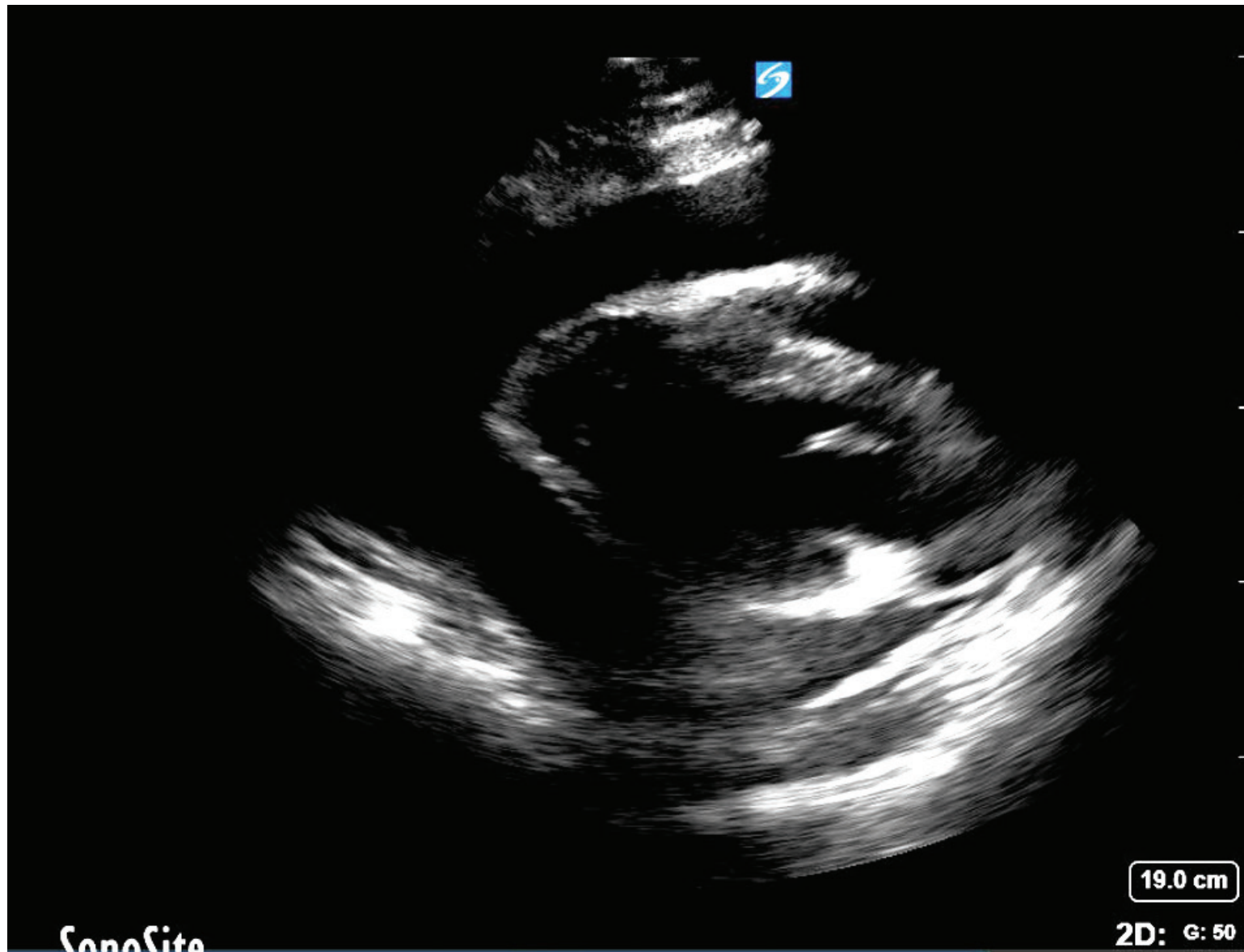




## EFAST: Pelvic



**Repeat EFAST: Parasternal long view/cardiac**

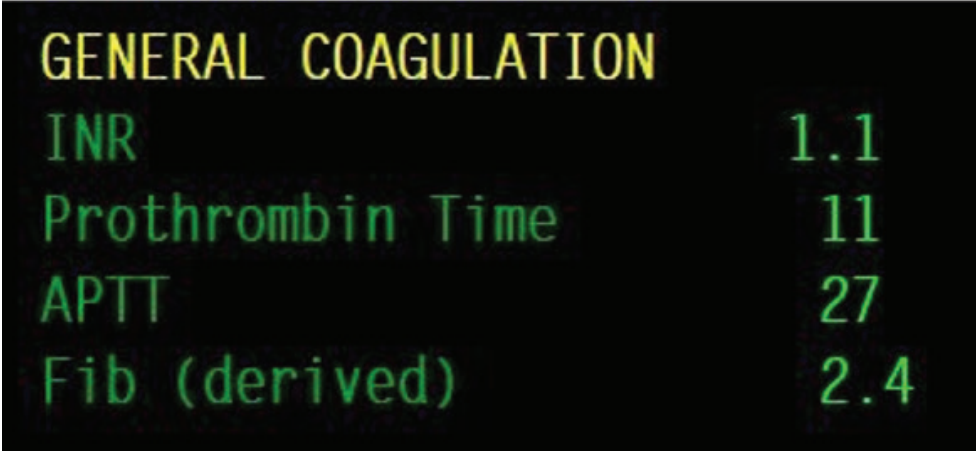


**Group and hold.**

Transfusion Medicine - Group and Antibody Screen

Blood Group: O Rh(D) POSITIVE

Antibody Screen: Negative

**Coagulation.**

GENERAL COAGULATION	
INR	1.1
Prothrombin Time	11
APTT	27
Fib (derived)	2.4

**Biochemistry.**

Specimen type	Blood	Urate	0.28	mmol/L	(0.15 - 0.50)
Sample Appearance	Clear	Protein	62	g/L	(60 - 80)
Sodium	137	Albumin	42	g/L	(35 - 50)
Potassium	4.3	Globulin	20	L g/L	(25 - 45)
Chloride	106	Bilirubin	31	H umol/L	(< 20)
Bicarb.	26	Bili(Conj)	5	H umol/L	(< 4)
Anion Gap	5	ALP	47	U/L	(30 - 110)
Glucose	5.1	Gamma GT	11	U/L	(< 55)
Fasting RR	-->	ALT	12	U/L	(< 45)
Urea	7.2	AST	12	U/L	(< 35)
Creatinine	76	LD	205	U/L	(120 - 250)
Urea/Creat.	95	CK	87	U/L	(46 - 171)
eGFR	>90				mL/min/(> 60)
					1.73m <sup>2</sup>

## Venous blood gas

<b>RADIOMETER ABL800 FLEX</b>			
ABL837 RH~RB PATIENT REPORT	Syringe – S 250uL		Sample # 16538
<b>Identifications</b>			
Patient ID	SDC 240195		
Patient Last Name	HELLIER		
Patient First Name	Joel		
Sample type	Venous		
T	35.8		
FO2(l)	1.0		
Operator	C.D. Henderson		
<b>Blood Gas Values</b>			
pH	7.28		[ 7.350 – 7.450 ]
pCO2	51	mmHg	[ 35.0 – 45.0 ]
pO2	41	mmHg	[ 75.0 – 100 ]
cHCO3~(P)c	25	mmol/L	[ 21.0 – 27.0 ]
cBase(B)c	-10	mmol/L	[ -3.0 – 3.0 ]
P50c		mmHg	
Baro.		mmHg	
<b>Oximetry Values</b>			
aO2		%	
ctHb	110	g/L	[ 105 – 135 ]
Hct		%	
FO2Hb		%	[ 94.0 – 98.0 ]
FCOHb		%	[ 0.0 – 1.5 ]
FMetHb		%	
FHHb		%	[ - ]
<b>Electrolyte Values</b>			
cNa+	134	mmol/L	[ 135 – 145 ]
cK+	4.1	mmol/L	[ 3.2 – 4.5 ]
cCl-	109	mmol/L	[ 100 – 110 ]
cCa2+	1.12	mmol/L	[ 1.15 – 1.35 ]
AnionGap,K+c		mmol/L	[ - ]
<b>Metabolite Values</b>			
cGlu	5.0	µmol/L	[ 3.0 – 7.8 ]
cLac	4.0	µmol/L	[ 0.7 – 2.5 ]
cCrea	72	µmol/L	[ 36 – 62 ]
ctBll		µmol/L	[ - ]
<b>Temperature Corrected Values</b>			
pH(T)			
pCO2(T)		mmHg	
pO2(T)		mmHg	
<b>Notes</b>			

## Debriefing guide

### Scenario objectives

- Understand the injury pattern from low velocity penetrating trauma.
- Perform a primary and secondary survey assessment.
- Recognise major penetrating chest trauma.
- Understand management principles of penetrating chest trauma.

### Example questions

#### Exploring diagnosis

- Explain your thought process in assessing a trauma patient for life threatening injuries.
- Do you have a system for rapid assessment following trauma?

#### Discussing management

- What are your strategies to manage this patient's pain?
- What are your options to manage his hypoxaemia?
- What is the role a Chest Xray in penetrating trauma? Can the EFAST help in diagnosis?
- How do you decide the timing of intercostal catheter insertion?
- Are there any factors that would make you change your approach to the ICC insertion (consideration of diaphragmatic injury/location of stab wound)?
- What criteria indicate the need for an emergency thoracotomy?
- Where is this best performed?
- Describe the steps in performing an ED thoracotomy.

#### Discussing teamwork / crisis resource management

- How do you prioritise the team to manage the penetrating chest wall injury?
- What would you do with your team to provide optimal conditions to place the ICC?
- Where would that ideally occur in your department?
- How do you encourage all team members to voice their concerns/recognition of the deteriorating patient?

### Key moments

- Systematic assessment of trauma presentation.
- Recognition of differences in management of penetrating chest wall injury.
- Decision making for ICC insertion timing and procedure.
- Analgesia/sedation or intubation strategy to facilitate ICC placement.

## Acronyms and abbreviations

<b>EFAST</b>	Extended Focussed Assessment with Sonography in Trauma
<b>FBE</b>	full blood examination
<b>ICC</b>	intercostal catheter
<b>ICS</b>	intercostal space
<b>JVP</b>	jugular venous pressure
<b>LHS</b>	left hand side
<b>NRB</b>	non-rebreather mask
<b>PCO2</b>	partial pressure of carbon dioxide
<b>PO2</b>	partial pressure of oxygen

## References

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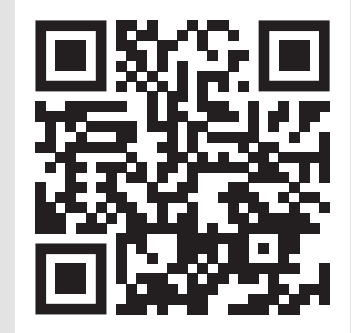
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