The Royal Wolverhampton NHS Trust

CP60
Management of Pleural Diseases

Contents

1.0 Policy Statement (Purpose / Objectives of the policy)

To support the delivery of the highest standards of medical care to and for patients with pleural diseases within the Trust safely and effectively.

2.0 Definitions

Pleural diseases – diseases affecting the pleural membranes (covering the inner chest wall, the diaphragm, the lung and mediastinum) and the pleural cavity

Unilateral pleural effusion – a collection of fluid within the pleural cavity of one hemithorax

Malignant pleural effusion – a collection of fluid in the pleural space due to a malignant process

Spontaneous pneumothorax – a collection of air in the pleural space

Tension pneumothorax – a pneumothorax where the pressure of air within the pleural space leads to haemodynamic instability

Pleural infection - an infective process within the pleural space

Thoracic ultrasound - indirect imaging of the pleural space using ultrasound technology

Intercostal chest drain (ICD) - a tube placed within the pleural space for drainage of fluid or air

3.0 Accountabilities

3.1 The Pleural Services Group (PSG)

The Group is charged with ensuring that the highest standards of medical care are provided for patients with pleural diseases within the Royal Wolverhampton NHS Trust. The Group will report quarterly to the Patient Safety Improvement Group on activity relating to incident reporting, root cause analysis undertaken as a result of any serious incidents identified and any on-going clinical audit work. The Pleural Services Group will also undertake an annual policy review and ensure implementation of the policy takes place across the Trust and carry out appropriate monitoring of the pleural service.

3.2 Patient Safety Improvement Group (PSIG)

The PSIG and Pleural Services Group will monitor incidents relating to pleural diseases. The PSIG will receive reports from the Pleural Services Group including clinical audit results and action plans.

3.3 Divisional Management Teams

The Divisional management teams and relevant Directorates will be responsible for ensuring that the pleural diseases policy is implemented across the Trust.

3.4 Departments

Individual Departments who wish to carry out pleural procedures will be identified. Those departments that wish to carry out pleural procedures must nominate a Consultant who will be responsible for ensuring that individuals carrying out pleural procedures in their department are competent to do so. A register of individuals who are carrying out pleural procedures must be established within each department.

Nominated departmental leads will be responsible for ensuring that pleural procedures are carried out in an appropriate environment with all necessary equipment being available. The nominated lead will be required to ensure appropriate after care of patients is provided, that responsible medical staff undergo appropriate training and are proven to be competent.

Records of competency will be held by the nominated departmental lead and the competent doctors and nurses in their personal files or portfolios.

The nominated Departmental lead will also be responsible for auditing all pleural procedures and reporting any incidents to Datix and the Pleural Services Group. They will be tasked with providing an annual report of their activities to the Pleural Services Committee.

3.5 Doctors/nurses/allied health professionals

This policy is intended for use by all healthcare professionals who are involved in managing patients with pleural disease. It is the responsibility of the healthcare professional to ensure that their practice is in line with the policy.

4.0 Policy Detail

This policy and supporting guidelines are in line with the British Thoracic Society (BTS) Pleural Disease Guideline 2023. Implementation of this policy will ensure that patients with pleural diseases will be managed appropriately, safely and within acceptable timescales to get satisfactory clinical outcomes.

Scope of Policy

Chest drain insertion in neonates and children are outside the scope of this policy. However, a policy for the use of chest drains in neonates agreed by the Neonatal Collaborative Group is available on the Trust intranet site. (http://trustnet.xrwh.nhs.uk/departments-services/o/obstetrics-gynaecology-and-neonatal-services/neonatal-guidelines/)

Children requiring non urgent chest drains will be referred to the Birmingham Children's Hospital. In the case of emergencies, the oncall Consultant Paediatrician will liaise with the thoracic surgical team for help and advice.

This policy is supported by the following comprehensive guidelines and are available on the RWT intranet site:

Appendix 1: Investigation of unilateral pleural effusion
Appendix 2: Malignant pleural effusion
Appendix 3: Management of pleural infection
Appendix 4: Management of spontaneous pneumothorax
Appendix 5: Guidelines on pleural procedures
Appendix 6: Guidelines on anticoagulation and antiplatelets for pleural procedures
Appendix 7: Guidelines on intrapleural fibrinolysis for pleural infection
Appendix 8: Ambulatory pathway for new/recurrent pleural effusion

5.0 Financial Risk Assessment

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

6.0 Equality Impact Assessment

Equality Impact and Assessment form has been completed and forwarded to Equality and Diversity department. No adverse effects have been identified affecting personal protective characteristics.

7.0 Maintenance

The policy will be monitored regularly via the Pleural Diseases Group with a maximum review period of three years. The policy will be subject to review should any new or updated guidance become available in the intervening period.
The policy is subject to regular programmed clinical audit to establish levels of compliance and to plan for improvement where necessary.

8.0 Communication and Training

This policy and supporting guidelines will be available on the hospital intranet site. Medical staff who wish to perform pleural procedures must undertake the relevant procedural training including thoracic ultrasound to gain competence.

9.0 Audit Process

Criterion	Lead	Monitoring method	Frequency	Committee
Annual report	Chair Pleural Services Group	Quality Assurance Audit. Reports from Departmental leads.	Annual	Patient Safety Improvement Group
Clinical Audit Project	Chair Pleural Services Group	Clinical Audit Project	Annual	Pleural Services Group

10.0 References

British Thoracic Society (BTS) Pleural Disease Guideline, July 2023 www.brit-thoracic.org.uk

National Patient Safety Agency (NPSA) Rapid Response Report: Risks of chest drain insertion reference 1065 (CAS reference NPSA/208/RRR03), May 2008 http://www.npsa.nhs.uk/

The Royal Marsden Manual Online http://www.rmmonline.co.uk/

Document Control

Policy number and Policy version: CP60 Version 4.0	**Policy Title** **Management of Pleural Diseases**	**Status:** Final		**Author: Consultant Respiratory Physician** **Director Sponsor: Chief Medical Officer**
Version / Amendment History	Version	Date	Author	Reason
	1.0	October 2012	Dr J Mann	Improve governance of pleural procedures
	2.0	January 2016	Dr J Mann	To ensure continuing governance of pleural procedures
	2.1	October 2016	Dr J Mann	Update on use of ultrasound scan / guidance unless an emergency
	3.0	September 2019	Dr M Ahmed	In line with policy review
	3.1	October 2022	Dr M Ahmed	Extension
	3.2	June 2023	Dr M Ahmed	Extension
	3.3	July 2023	Dr M Ahmed	Hyperlink updated for Appendix 11
	3.4	April 2024	Dr M Ahmed	Extension
	4.0	December 2024	Consultant Respiratory Physician	Full review
Intended Recipients: All trust employees involved with the care of patients with pleural diseases.				
Consultation Group / Role Titles and Date: **Respiratory Directorate Governance Meeting 25/6/24**				
Name and date of Trust level group where reviewed		Trust Policy Group – December 2024		
Name and date of final approval committee		Trust Management Committee – January 2025		
Date of Policy issue		January 2025		

Review Date and Frequency (standard review frequency is 3 yearly unless otherwise indicated)	December 2027
Training and Dissemination: Trust intranet website. Adult medical guidelines.	
To be read in conjunction with: BTS Pleural Disease Guideline July 2023; supporting medical guidelines on pleural procedures available on the Trust intranet.	
Initial Equality Impact Assessment (all policies): Completed Yes **Impact assessment (as required): Completed Yes** If you require this document in an alternative format e.g. larger print please contact the Policy Administrator 8904.	
Monitoring arrangements and Committee	Pleural Services Group to monitor all clinical incidents relating to pleural procedures and ensure relevant governance procedures are in place. The Pleural Services Group is to have oversight of clinical audit projects and action plans developed as a result of audit projects.
Document summary/key issues covered. This policy supports clinicians involved with managing pleural diseases to deliver high standards of care. It is expected that implementation of this policy will ensure that patients diagnosed with pleural diseases are managed appropriately, safely and within acceptable timescales, to result in satisfactory clinical outcomes.	
Key words for intranet searching purposes	Pleural disease, Pleural effusion, Pneumothorax, Pleural infection, Pleural procedures, Chest drain

INVESTIGATION OF A UNILATERAL PLEURAL EFFUSION

Pleural effusions are a common medical problem with many underlying causes. They occur due to increased pleural fluid formation and/or reduced absorption.

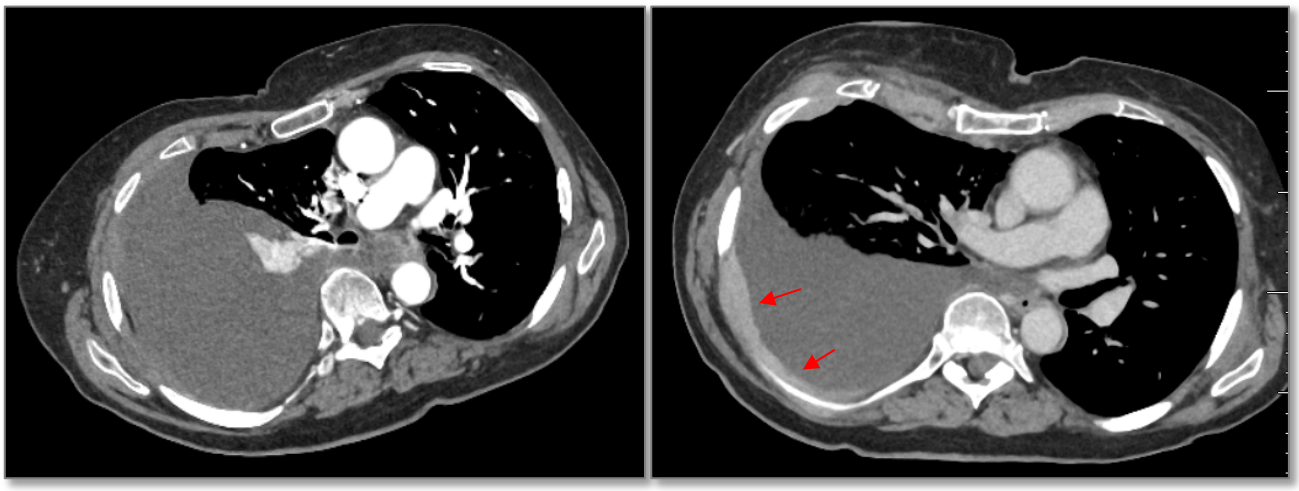
A systematic approach to investigation is important, due to the wide differential diagnoses. A thorough clinical history including medication, occupation and travel history should be taken as part of the initial assessment. The table on page 5 lists some of the common causes of pleural effusions but this is by no means an exhaustive list.

❖ Radiological assessment

A chest x-ray should be followed by thoracic ultrasound. Ultrasound will provide relevant information on the size and characteristics of the pleural effusion, including whether it is amenable to safe pleural intervention. There may be obvious features to suggest pleural malignancy on the ultrasound such as pleural or diaphragmatic nodularity.

Unless the clinical picture and thoracic ultrasound appearances of the pleural fluid is suggestive of pleural infection, a contrast enhanced CT thorax/abdomen/pelvis in portal venous phase should be performed. A scan done in portal venous phase enables better delineation of pleural abnormalities than a CT scan performed in arterial phase.

A CT scan may or may not demonstrate definitive features of malignancy. Where there is clear evidence of malignancy, this may guide further investigation to obtain tissue e.g. image guided biopsy. However, it is important to note that a normal CT scan without definitive malignant features does not exclude malignancy as a cause of the pleural effusion.



Left: *Arterial phase CT image.* ***Right:*** *Portal venous phase CT image.*
Note the pleural abnormalities (red arrows) appear more prominent on the portal venous phase image

❖ Pleural fluid analysis

A pleural aspiration under ultrasound guidance should be performed if safe. Pleural fluid should be sent for biochemical, microbiological and cytological analysis. Serum protein and LDH should also be sent which allows the use of Light's criteria to characterise the effusion as an exudate or transudate accurately. If pleural infection is suspected, pleural fluid should also be sent in blood culture bottles which increases the diagnostic yield.

The diagnostic sensitivity of pleural fluid cytology varies by tumour subtype, with a higher sensitivity in breast, gynaecological malignancies and lung adenocarcinoma. This should be considered in the investigation pathway and an alternative method to obtain tissue should be used early where the cytological yield is potentially low. At least 50mL of pleural fluid should be sent for cytology.

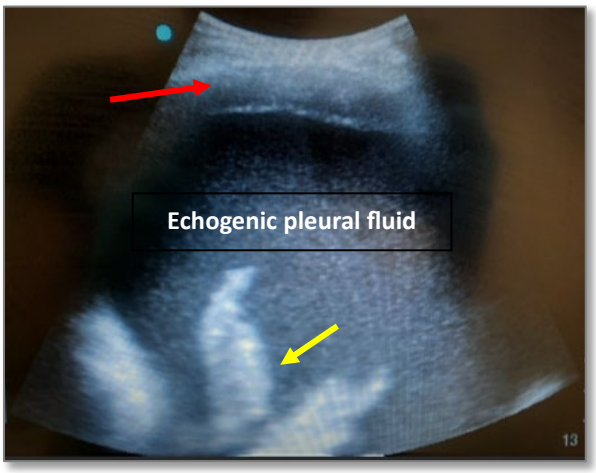
The diagnosis and management of pleural infection is covered in a separate guidance. The pleural fluid biochemistry in this group plays an important role in guiding management, particularly the decision to insert an intercostal chest drain.

Pleural fluid should be analysed for cholesterol and triglycerides in cases of suspected chylothorax and pseudo-chylothorax but these tests are not routinely required.

❖ Pleural biopsy

In patients where the suspicion for malignancy is high and the pleural fluid cytology is negative, a pleural biopsy may be indicated. This can be done under radiological guidance (using ultrasound or CT imaging) or direct biopsy through surgical or local anaesthetic thoracoscopy.

Patients with a high suspicion for mesothelioma can be considered for a pleural biopsy directly, as the diagnostic yield from pleural fluid is very low in this group and often non-contributary. A pleural biopsy should also be considered where tuberculosis is suspected, due to the low positive yield from pleural fluid alone.



Thoracic ultrasound image demonstrating parietal pleural thickening (red arrow). An echogenic pleural effusion is also present surrounding the underlying atelectatic lung (yellow arrow)

A summary of the investigation pathway is shown on page 4.

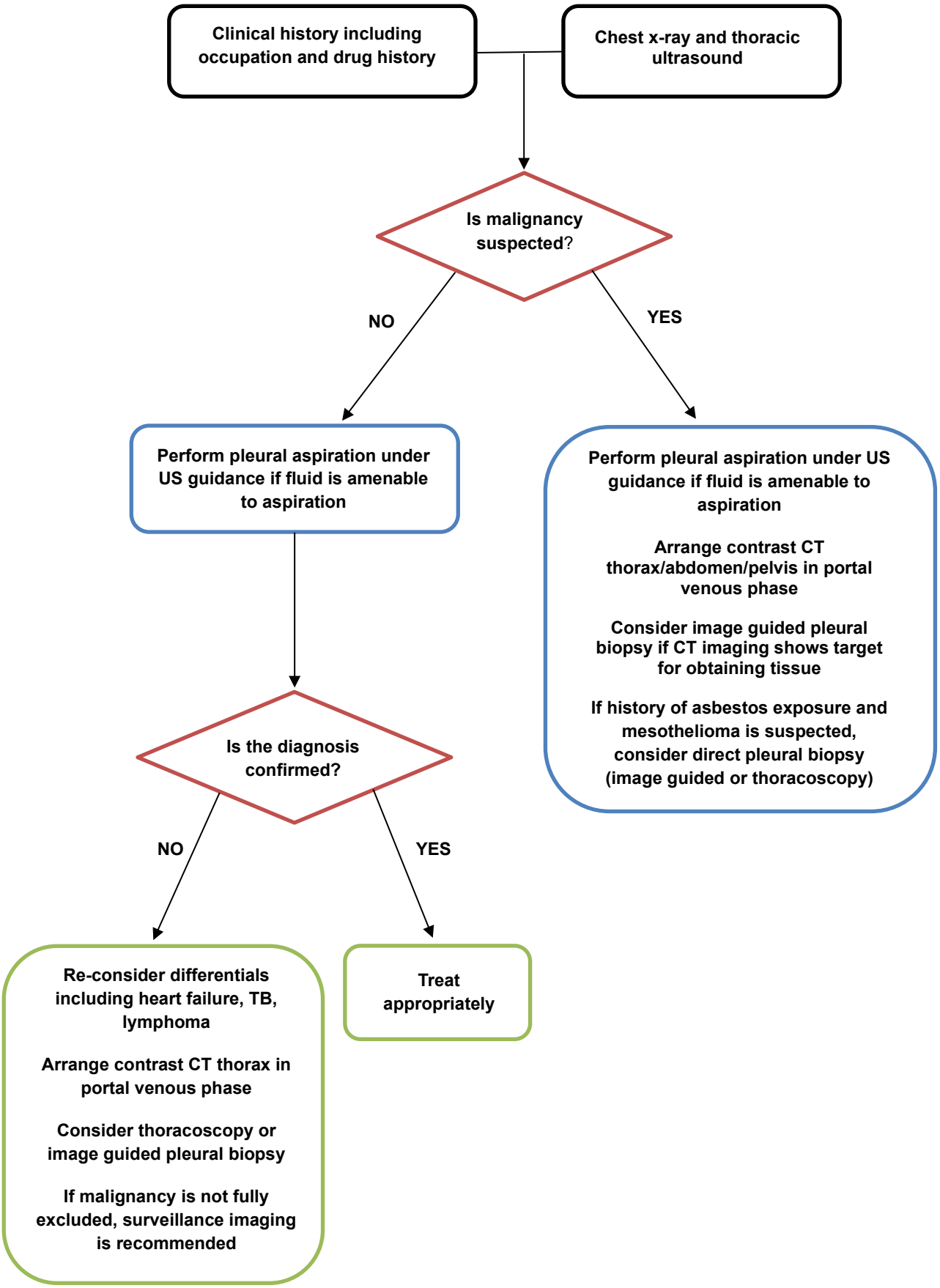
In all cases of a new effusion, interpretation of imaging and pleural fluid results needs to take the clinical context into account. Consider other causes of benign effusions such as autoimmune pleuritis, rheumatoid arthritis and drugs.

In patients where the cause of the effusion is thought to be benign but malignancy is not fully excluded, surveillance interval imaging should be considered.

Summary of key points

- ✓ Thoracic ultrasound should be performed at presentation for all patients presenting with a pleural effusion.
- ✓ Pleural fluid should be sampled for diagnostic purposes if it is amenable to safe aspiration.
- ✓ At least 25 – 80mL of fluid should be sent for cytology where possible.
- ✓ A contrast CT in **portal venous phase** should be performed where the suspicion for malignancy is high.
- ✓ A normal CT scan **does not** exclude malignancy and further investigations must be considered where appropriate.
- ✓ Pleural biopsy under image guidance or at thoracoscopy is useful in cases of suspected malignancy and should be considered early in the diagnostic pathway.
- ✓ In suspected cases of TB pleuritis, pleural biopsy should be considered if the diagnosis is not confirmed by other tests.

DIAGNOSTIC PATHWAY FOR THE INVESTIGATION OF A NEW UNILATERAL PLEURAL EFFUSION



DIFFERENTIAL DIAGNOSES FOR PLEURAL EFFUSION

Exudate ○ Malignancy ○ Pleural infection ○ Pulmonary embolism ○ Autoimmune pleuritis ○ Benign asbestos related pleural effusion ○ Drugs ○ Post coronary artery bypass graft surgery	**Transudate** ○ Heart failure ○ Liver disease ○ Nephrotic syndrome ○ Hypoalbuminaemia ○ Peritoneal dialysis
Lymphocytic pleural effusion ○ Malignancy ○ Tuberculosis ○ Lymphoma ○ Heart failure ○ Rheumatoid arthritis ○ Chylothorax ○ Post coronary artery bypass graft surgery	
Bilateral pleural effusions ○ Heart failure ○ Renal failure ○ Nephrotic syndrome ○ Liver failure ○ Hypoalbuminaemia ○ Malignancy ○ Autoimmune pleuritis	
Chylothorax ○ Idiopathic ○ Thoracic surgery ○ Thoracic injuries ○ Malignancy including lymphoma ○ Others: tuberculosis; lymphatic disorders e.g. LAM; chyloascites	**Pseudo-chylothorax** ○ Rheumatoid arthritis ○ Tuberculosis

Light's criteria

An exudate is defined if one or more of the following is present:

- Pleural fluid protein to serum protein ratio >0.5
- Pleural fluid LDH to serum LDH ratio >0.6
- Pleural fluid LDH > 2/3 the upper limit of normal serum LDH value

PLEURAL FLUID DIAGNOSTIC TESTS AND SAMPLE COLLECTION

Biochemistry

- Protein and LDH: 2 – 5 mL in serum gel bottle (gold top)
- Glucose: 1 – 2 mL in fluoride oxalate bottle (grey top)

- pH: send in capped blood gas syringe to avoid exposure to air
  Process on ward blood gas machine or send to the lab promptly
  The pH on purulent fluid does not need to be tested (can cause damage to blood gas machine)

- Send serum total protein and LDH simultaneously so that Light's criteria can be applied to characterise the effusion accurately

Microbiology

- Microscopy and culture: 5mL in universal container
- If pleural infection is suspected, also send fluid in blood culture bottles (5mL in each aerobic and anaerobic bottle)

- AAFB: 5mL in universal container if TB suspected

Cytology

- At least 25mL in universal container
- If malignancy is suspected, send 60 – 80mL if there is sufficient volume fluid

Other tests to be sent in selected cases:

Triglycerides and cholesterol

- To distinguish between chylothorax and pseudo-chylothorax
  Send 5mL in universal container

	Chylothorax	*Pseudo-chylothorax*
Triglycerides	*>1.24 mmol/L (110 mg/dL)*	*Low*
Cholesterol	*Low*	*>5.18 mmol/L (200mg/dL)*
Cholesterol crystals	*Absent*	*Present*
Chylomicrons	*Present*	*Absent*

Flow cytometry and cytogenetics

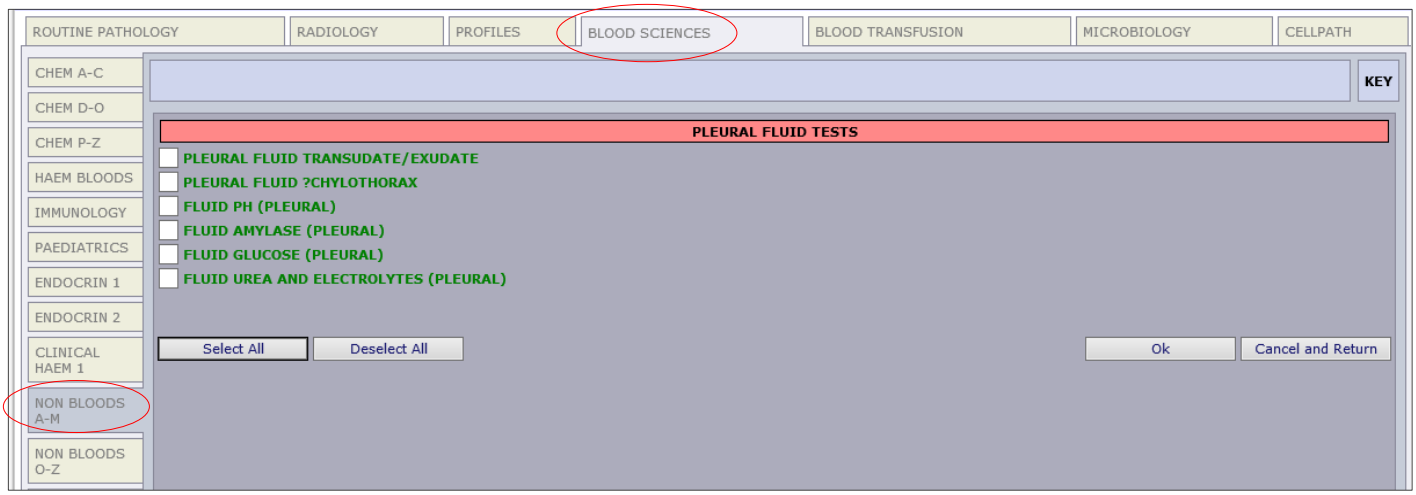
- In suspected haematological malignancy, standard cytology is often non-diagnostic
  Send 10mL fluid in a universal container with request from (available from the haematology department)

Haematocrit

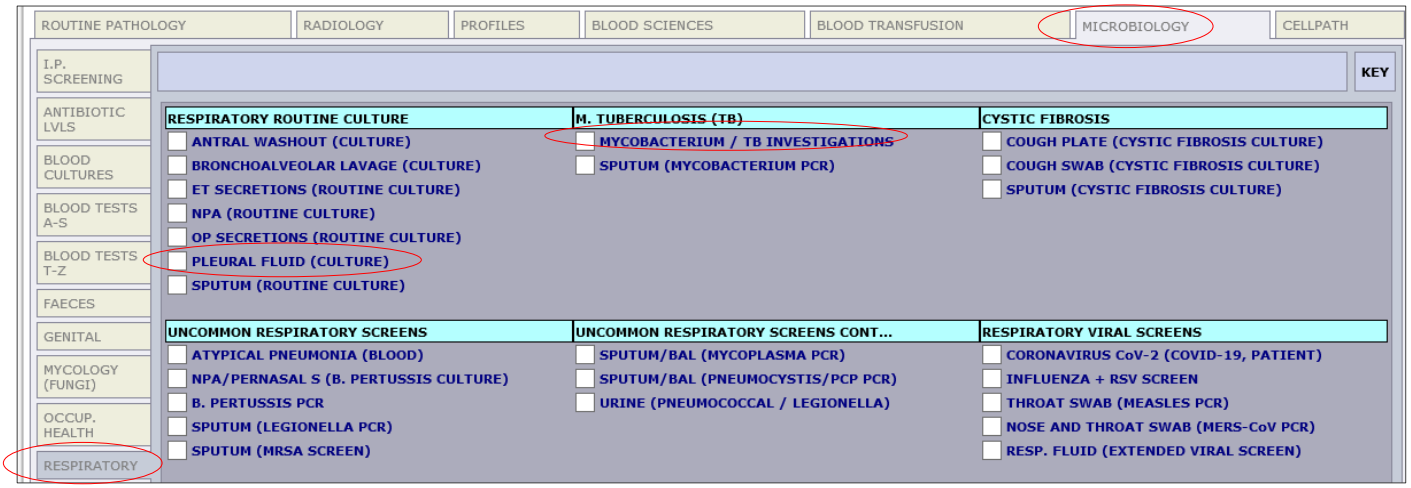
- In suspected cases of haemothorax, >50% of serum haematocrit supports the diagnosis
  Send 1 – 2mL fluid in EDTA bottle (purple top)

REQUESTING PLEURAL FLUID TESTS ON RWT ICE PATHOLOGY SYSTEM

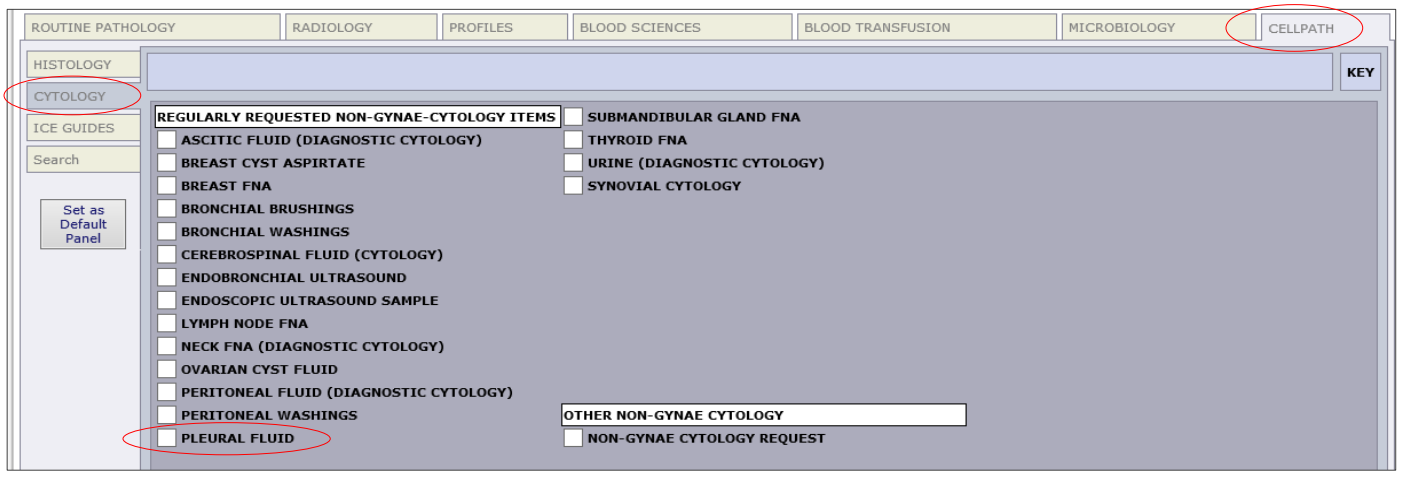
Biochemistry requests: Blood sciences ⇨ Non-bloods (A-M) ⇨ Fluids ⇨ Pleural



Microbiology requests: Microbiology ⇨ Respiratory ⇨ Pleural fluid culture / Mycobacterium for TB



Cytology: Cell path ⇨ Cytology ⇨ Pleural fluid



References

1. Roberts ME Rahman NM, Maskell NA et al. British thoracic Society Guideline for pleural disease. Thorax 2023; 78 (Suppl 3): 1-42.

2. Davies HE, Davies RJ, Davies CW, on behalf of the BTS Pleural Guideline Group. Management of pleural infection in adults: British Thoracic Society Pleural Disease Guideline 2010. Thorax. 2010;65(Suppl 2):ii41-53.

3. Rahman NM, Ali NJ, Brown G, Chapman SJ, Davies RJ, Downer NJ, et al. Local anaesthetic 1956 thoracoscopy: British Thoracic Society Pleural Disease Guideline 2010. Thorax. 2010;65(Suppl) 2:ii54-60.

4. Havelock T, Teoh R, Laws D, Gleeson F, on behalf of the BTS Pleural Guideline Group. Pleural procedures and thoracic ultrasound: British Thoracic Society Pleural Disease Guideline 2010. Thorax. 2010;65(Suppl 2):ii61-76.

5. Woolhouse I, Bishop L, Darlison L, De Fonseka D, Edey A, Edwards J, et al. British Thoracic Society Guideline for the investigation and management of malignant pleural mesothelioma. Thorax. 2018;73(Suppl 1):i1-i30.

DIAGNOSIS AND MANAGEMENT OF MALIGNANT PLEURAL EFFUSION

Malignant pleural effusion (MPE) is a common problem with an increasing incidence and is associated with significant morbidity and mortality.

The most common causes of secondary pleural malignancy are lung and breast cancer but several other malignancies may be complicated by MPE including lymphoma. Mesothelioma is a primary pleural malignancy commonly presenting with pleural thickening and effusion.

The management of MPE has developed significantly over recent years due to outcomes from several high-quality clinical trials. The aim of treatment in this group of patients remains symptom palliation and improving quality of life. Several evidence-based treatments are now available to patients and clinicians, including ambulatory pathways to avoid hospital admission. This is especially relevant in this group of patients where life expectancy is short.

❖ Diagnosis

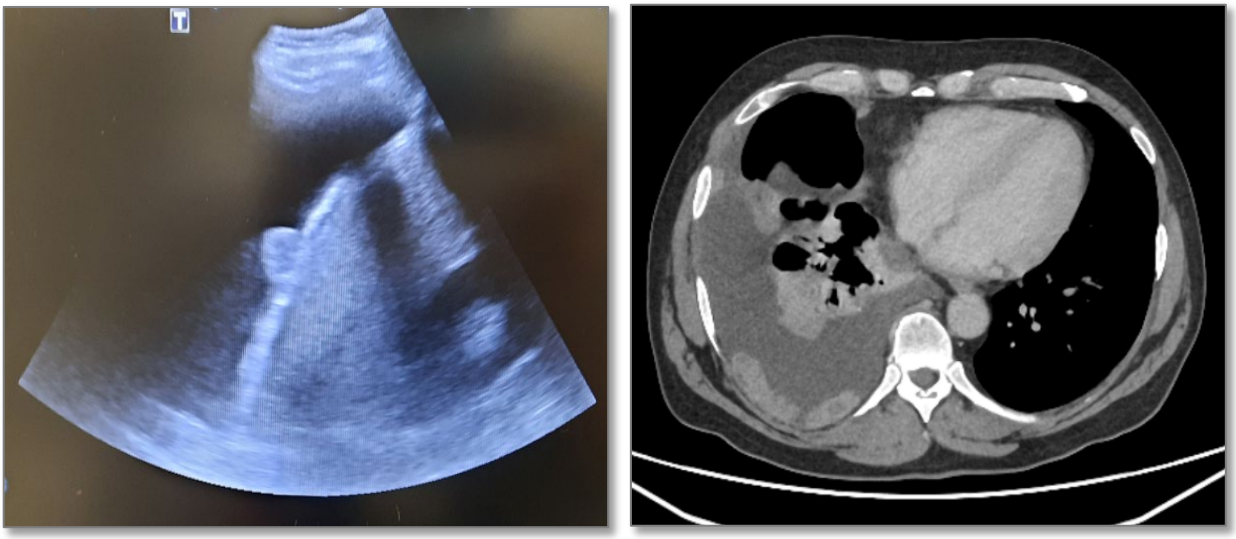
Thoracic ultrasound is a useful tool at presentation to support a diagnosis of pleural malignancy where appropriate sonographic skills are present. Pleural nodules or thickening have a high sensitivity for pleural malignancy.

CT appearances can also support a diagnosis of pleural malignancy. However, a normal CT does not exclude malignancy and further investigation such as biopsy should be considered where the clinical suspicion for malignancy is high. PET-CT can be useful where there are suspicious clinical and/or CT features but negative histological results, or where invasive sampling is not possible.

Pleural aspiration under ultrasound guidance remains an important first intervention and may lead to a diagnosis in many cases. At least 50mL of pleural fluid should be sent for cytology where possible.

The sensitivity of pleural fluid cytology is about 60% and this needs to be taken into consideration when planning diagnostic investigations. The tumour subtype is an important determinant of pleural fluid diagnostic yield, with the yield being much higher in some malignancies. It is, therefore, important to consider alternative means of obtaining tissue in cases where the suspected primary is likely to have a low diagnostic yield from pleural fluid cytology.

A pleural biopsy can be performed under image guidance or during thoracoscopy, both video assisted thoracoscopic surgery (VATS) and local anaesthetic thoracoscopy (LAT). An image guided pleural biopsy may be useful where there is significant volume of disease and only a small amount of pleural fluid or where thoracoscopy is not available. Where thoracoscopy is available, it should be considered early in the diagnostic pathway as it is enables diagnostic and therapeutic intervention in one procedure, thereby significantly shortening the diagnostic pathway for patients.



***Left**: Diaphragmatic pleural nodule seen on thoracic ultrasound. **Right:** Pleural nodules on CT thorax in a patient with metastatic renal cancer*

❖ Procedural intervention

The presence of a malignant effusion signifies incurable disease and the primary focus of treatment is on palliation of symptoms, with an aim to improve and maintain quality of life. There are now several management options for patients with MPE, including ambulatory interventions.

Patient choice plays an important role in deciding how best to approach the treatment for MPE. The advantages and disadvantages of treatment options should be discussed with patients to allow them to make an informed decision. The final decision should be made with the clinician and patient based on the patient's preference, performance status, underlying malignancy, probability of response to cancer therapy, home support and availability of local services. Where possible, patients should be offered definitive pleural intervention in the form of talc pleurodesis or an indwelling pleural catheter to avoid unnecessary interventions.

○ *Therapeutic pleural aspiration*

This involves draining up to 1.5 litres of pleural fluid at a time and can be done as a day case procedure. It can help determine whether fluid drainage relieves symptoms and assess for non-expandable lung post drainage. Up to 25% of patients may not gain any symptom benefit from fluid drainage and fluid reaccumulation occurs in about 80% of cases. Repeated therapeutic aspirations may be appropriate in a select group of patients where other options are considered inappropriate.

○ *Talc pleurodesis*

Sterile talc is instilled into the pleural space to cause fusion of the parietal and visceral pleural surfaces, thereby preventing reaccumulation of pleural fluid. For pleurodesis to be successful, there

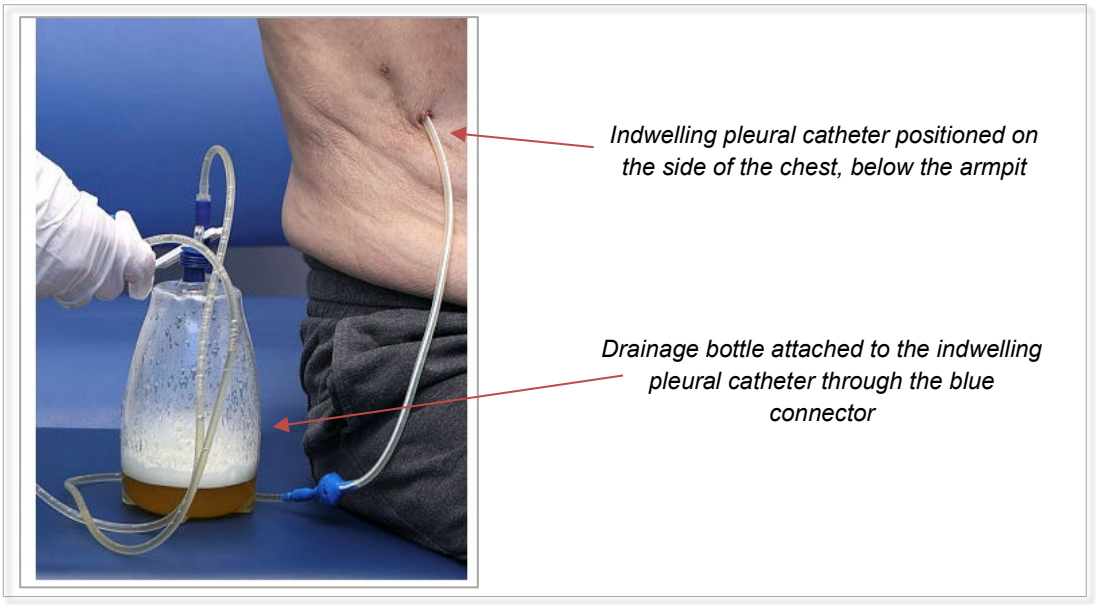
needs to be adequate apposition of the visceral and parietal pleurae, therefore making it unsuitable if there is non-expandable lung. The success rate from trial evidence is 60 – 70% and patients should be informed of this.

Pleurodesis can be performed through a chest drain (slurry) or at thoracoscopy (poudrage). Trial evidence has shown that there is no significant difference in success rates between the two methods.

- *Indwelling pleural catheter (IPC)*

An indwelling pleural catheter (IPC) is a tunnelled catheter that allows regular drainage of pleural fluid in the patient's home to manage breathlessness. It is performed under local anaesthetic, often as a day case procedure, and can remain in the pleural space for months. Drainage can be done by patient relatives or district nurses. It is the recommended intervention in cases of non-expendable lung. Patients can also continue with systemic cancer treatment with no significant risk of infection to the IPC.

About 25% of patients will achieve autopleurodesis with regular IPC drainages. Trial evidence has also shown that instilling sterile talc into an IPC in an outpatient setting can increase the pleurodesis rate to 45% (IPC plus trial). The IPC can usually be removed when less than 50mL of fluid is drained on three occasions and there is no significant residual effusion on imaging.



- *Thoracoscopy*

Both local anaesthetic thoracoscopy (also referred to as 'medical' thoracoscopy) and surgical VATS allow diagnostic and therapeutic intervention in one procedure. Pleural biopsies are performed and if deemed appropriate, talc poudrage can be performed at the same time to facilitate pleurodesis.

An IPC can also be inserted at the time of thoracoscopy, thereby offering a means to manage fluid reaccumulation without a further procedure. Patients presenting with MPE with a good performance status can be considered for a 'direct to thoracoscopy' approach which shortens the diagnostic pathway, especially in those with a high suspicion for mesothelioma.

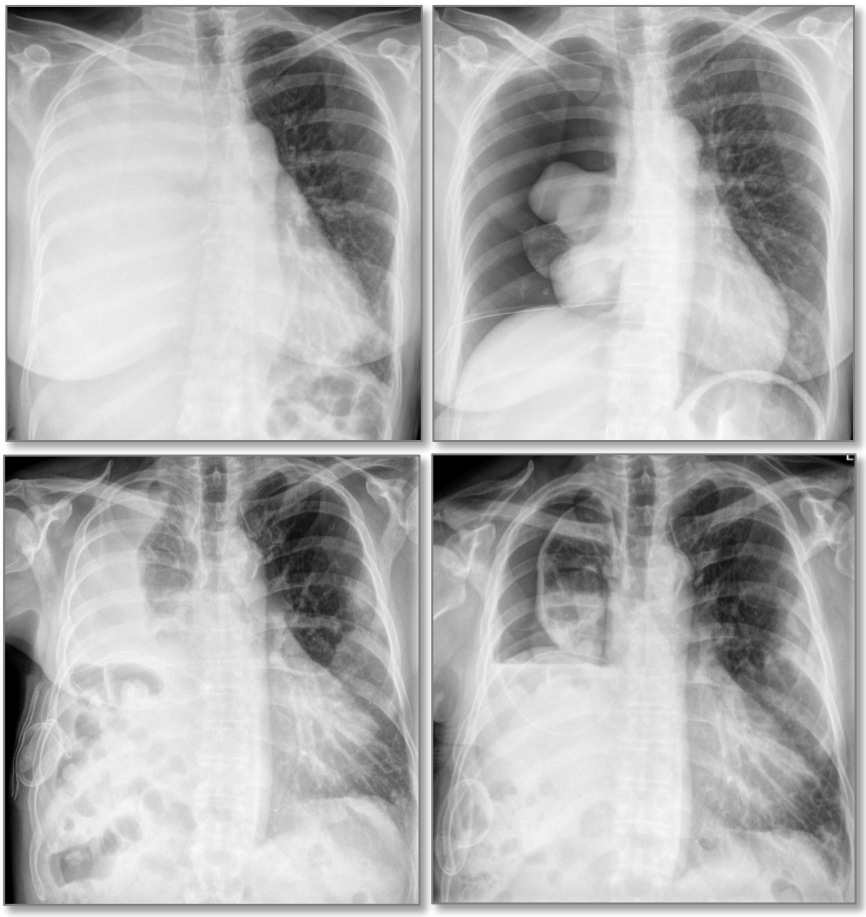
Table 1: Summary of procedural treatments for managing malignant pleural effusion

Treatment	Advantages	Disadvantages
Therapeutic pleural aspiration	• Day case procedure • Enables rapid relief of symptoms • Helpful in assessing for non-expandable lung	• Offers temporary symptom relief • Likely to need further procedures when the fluid reaccumulates
Chest drain and talc pleurodesis	• Allows complete drainage of fluid and relief of breathlessness • Stops fluid reaccumulation in about 60 -70% of cases	• Needs hospital admission (3 -5 days on average) • Cannot be done if there is non-expandable lung • Further procedures required if unsuccessful
Indwelling pleural catheter	• Day case procedure • Offers longer term solution to manage the fluid • Procedure of choice in non-expandable lung • Pleurodesis is achieved in about 25% of cases • Can also have talc administered to increase the probability of pleurodesis	• Catheter may need to stay in for several months • Needs intensive aftercare and hospital visits to address problems • Risk of complications – infection, blockage, septated effusion
Thoracoscopy (local anaesthetic or surgical VATS)	• Offers diagnostic and therapeutic intervention in one procedure (talc poudrage or IPC insertion can be performed at the time of thoracoscopy)	• Longer procedure • Requires hospital admission (usually 2 – 3 days) • If pleurodesis is unsuccessful, likely to need further procedures

❖ Challenges in management

Non-expandable lung (NEL; sometimes referred to as 'trapped lung') occurs due to visceral pleural thickening or metastatic nodularity that prevents the lung from re-expanding. It affects more than 30% of patients with MPE and poses a challenge to management. It usually becomes evident after draining the effusion. An IPC is the recommended definitive intervention in patients with NEL, as pleurodesis would not be effective due to absence of pleural apposition. Some patients with NEL who have an IPC can achieve autopleurodesis, particularly with a daily drainage regime. In select patients, there may a be a role for VATS pleurectomy and decortication to manage NEL.

Septations within a malignant effusion result in reduced fluid drainage, either through a chest drain or an IPC. Patients may become symptomatic with breathlessness but this largely depends on the volume of residual fluid. A septated effusion also limits opportunities for pleurodesis. There is a role for intrapleural fibrinolysis in these cases but trial evidence is limited in this area so treatment should be considered on an individual case basis. If the residual septated effusion is small, the risks of fibrinolysis may outweigh the benefits and it is important to discuss this with patients.



Chest x-rays demonstrating non-expandable lung following insertion of a chest drain (top images) and indwelling pleural catheter (bottom images). The appearance can be mistaken for a pneumothorax but note the air fluid level and prominent visceral pleural thickening on the bottom right image

❖ Prognosis

MPE is associated with poor survival and signifies advanced malignant disease. Two scores have been externally validated for prognostication in malignant effusion: the LENT score and the PROMISE score. However, their impact on clinical decision making and outcomes other than survival have not been evaluated. They may have a role in planning treatments or discussions with patients regarding prognosis. It is important that all patients with malignant pleural effusion are managed with multidisciplinary team input including specialist palliative care services, which have a pivotal role in caring for this group of patients.

Table 2: The LENT score

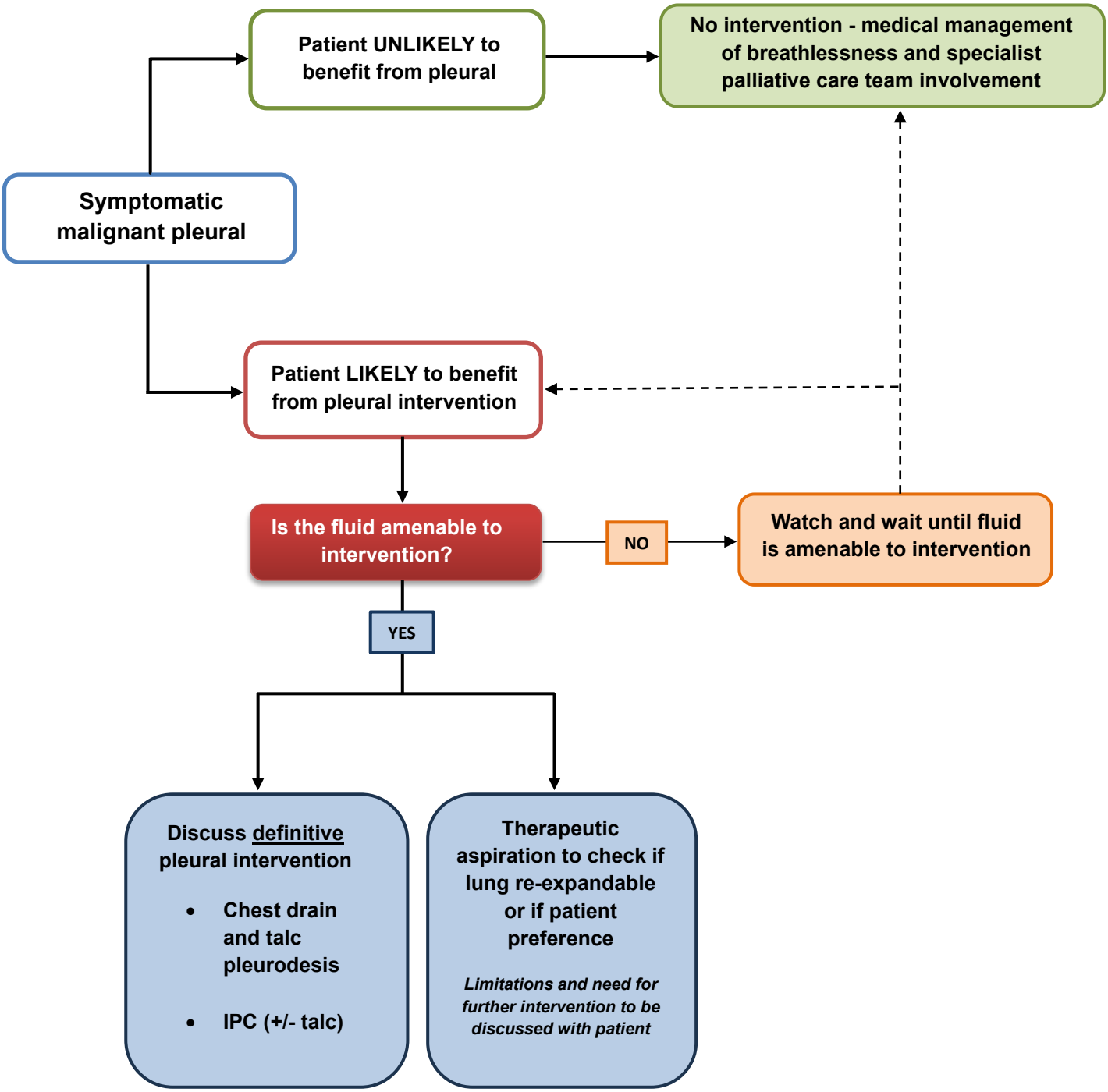
	Variable	Score
L LDH in pleural fluid (IU/L)	<1500 >1500	0 1
E ECOG Performance status	0 1 2 3-4	0 1 2 3
N Neutrophil/lymphocyte ratio	<9 >9	0 1
T Tumour type	*Lowest risk* Mesothelioma Haematological malignancy *Moderate risk* Breast cancer Gynaecological cancer Renal cell carcinoma *Highest risk* Lung cancer Other tumours	 0 1 2

Score	Mortality risk category
0 – 1	**LOW RISK**
2 – 4	**MODERATE RISK**
5 – 7	**HIGH RISK**

Summary of key points

- ✓ Thoracic ultrasound and CT imaging provide useful information in diagnosing MPE.
- ✓ Pleural fluid cytology has a sensitivity of about 60%, but this is higher in certain tumour subtypes.
- ✓ Pleural biopsy or an alternative tissue biopsy should be considered early in the diagnostic pathway.
- ✓ Patients with a good performance status can be considered for a “direct to thoracoscopy” approach which offers diagnostic and therapeutic intervention in one procedure.
- ✓ Patient choice plays a vital role in the decision-making process for offering therapeutic intervention, including ambulatory pathways that avoid hospital admission.

TREATMENT PATHWAY FOR MALIGNANT PLEURAL EFFUSION



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DIAGNOSIS AND MANAGEMENT OF PLEURAL INFECTION

Pleural infection is defined as the presence of bacteria in the pleural space. It remains a common medical presentation, and it is associated with significant morbidity and mortality. The incidence of pleural infection is increasing across the Western world, particularly in the elderly population, but the cause of this remains unclear.

Between 20 and 60% of patients with pneumonia present with a pleural effusion, of which up to 7% progress to develop pleural infection. Although commonly associated with pneumonia, about 30% of pleural infection cases occur as a primary infection in the absence of pneumonia.

Empyema refers to the presence of purulent pleural fluid in the pleural space. The term pleural infection encompasses all forms of pleural infection including complicated parapneumonic effusion and empyema and is now the preferred term to use.

❖ Clinical features

Patients may present with symptoms of an acute respiratory illness with fevers and rigors, and/or a non-resolving pneumonia. Chronic infection can present with constitutional symptoms such as anorexia and weight loss, and sometimes mimics malignancy, particularly in the elderly population.

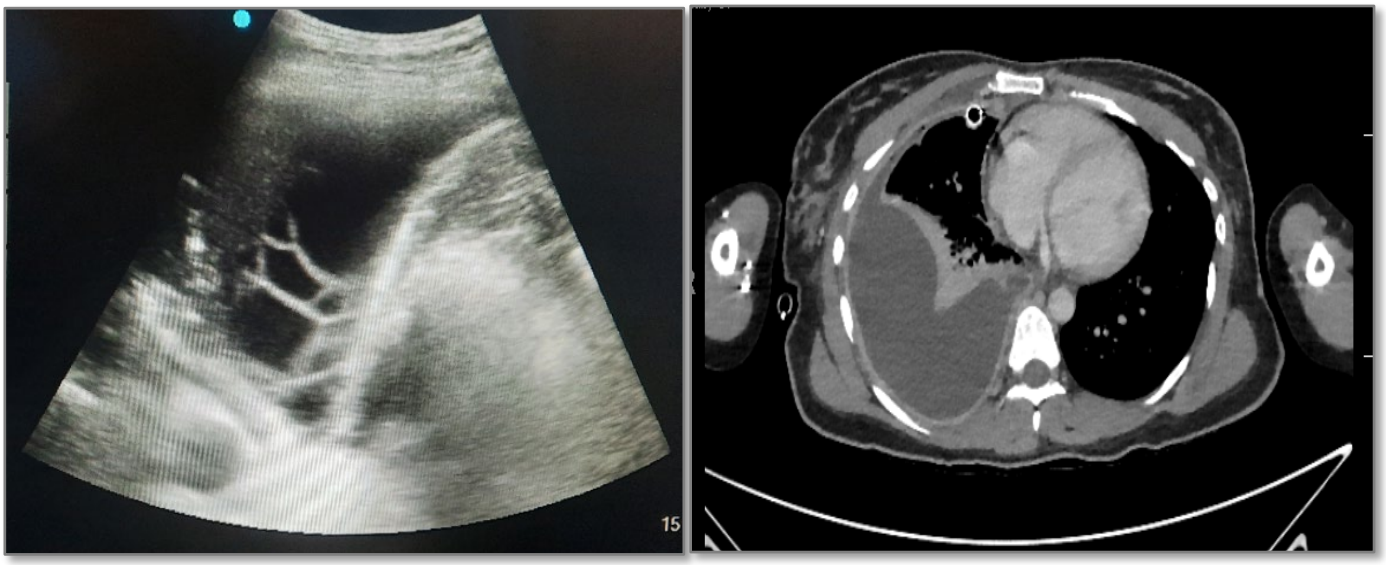
Risk factors for developing pleural infection include immunosuppression, diabetes, gastro-oesophageal reflux, poor dentition/oral hygiene, alcohol excess and intravenous drug use. These factors are known to independently increase the pneumonia progressing to pleural infection and should be considered when assessing patients presenting with pleural infection.

❖ Imaging

A chest x-ray is the first line investigation in suspected pleural infection which can detect a pleural effusion, consolidation and other parenchymal abnormalities that could be contributing to the clinical picture. However, x-rays have poor sensitivity for pleural effusion and can miss significant parapneumonic effusions, particularly in the presence of lower lobe consolidation.

Thoracic ultrasound is used to guide safe sampling of pleural fluid. It is also useful in detecting features that may support a diagnosis of pleural infection prior to sampling e.g. septations, loculations, echogenic swirling.

CT imaging is useful for assessing pleural abnormalities and other lung pathology, although it is not as specific as ultrasound in diagnosing pleural infection. Some features on CT including pleural thickening/enhancement and the ‘split pleura’ sign have been shown to predict pleural infection.



Left: *Thoracic ultrasound image showing a septated pleural collection.* ***Right:*** *CT thorax image demonstrating enhancement of the parietal and visceral pleural surfaces, separated by a fluid collection (known as the 'split pleura' sign)*

CT features commonly associated with pleural infection
• Visceral pleural thickening • Associated pulmonary consolidation • Lentiform appearance of pleural fluid • Hypertrophy of extra-pleural fat (>2mm) • Increased density of the extra-pleural fat

❖ Pleural fluid sampling

This is the gold standard for diagnosing pleural infection. Pleural fluid should be sampled at the earliest opportunity if it is safe to access based on thoracic ultrasound imaging. Samples should be analysed for biochemistry (pH, protein, LDH, glucose) and culture. If pus is aspirated, this is diagnostic of empyema and does not require biochemical analysis.

Sending pleural fluid in blood culture bottles increases the culture yield from 30-40% to about 60%. 5-10mL of fluid should be sent in both aerobic and anaerobic blood culture bottles.

In cases of suspected TB, the yield from pleural fluid culture is typically low so a pleural biopsy should be considered.

The microbiology of pleural infection differs from that of pneumonia. The incidence of polymicrobial pleural space infections is estimated at about 60% in primary pleural infection, compared to 25% of pneumonia-associated pleural infections. This adds to the challenges in treatment, often because cultures do not yield a causative organism.

❖ Management

The latest national guidance by the British Thoracic Society published in July 2023 made some key changes to treatment of pleural infection that differ significantly from previous guidelines. It is hoped that these changes will improve outcomes in this patient group with a high morbidity and mortality.

There are several aspects to managing pleural infection:

- Early identification and diagnosis
- Prompt initiation of appropriate antibiotic therapy
- Drainage of infected pleural collection
- Nutrition management
- Prophylaxis of thromboembolism

○ *Antibiotic therapy*

Prompt initiation of antibiotic therapy is of critical importance in treating pleural infection. The choice of antibiotic is determined by local guidelines, the infection setting (community or hospital acquired) and local resistance patterns.

Treatment for community acquired infection should cover both gram positive aerobes and anaerobes whilst gram negative cover needs to be included for hospital acquired infections. Antibiotic therapy should be narrowed once positive cultures are available.

A minimum of 4 weeks treatment in total is recommended, which includes both intravenous and oral treatment. This can be extended to 6 weeks in patients where resolution of infection and clinical improvement has taken a slower course. Intravenous therapy can be changed to oral when there is adequate clinical improvement in terms of resolution of pyrexia, reduction in inflammatory markers and radiological improvement.

Please refer to the trust antimicrobial guide when initiating antibiotics for pleural infection. Patients who do not respond to initial therapy should be discussed with the microbiology team.

○ *Drainage of infected pleural fluid*

The infected pleural collection should be drained once pleural infection has been confirmed, providing the fluid is amenable to intervention. The decision on insertion of a chest drain is guided by the pleural fluid biochemistry – pH, LDH, glucose as summarised in Table 1.

In patients with fluid pH ≤ 7.2, a chest drain should be inserted immediately.

In patients with an intermediate fluid pH 7.21 to 7.39 and LDH >900, a chest drain should be considered especially if there is a large volume of fluid, septations on ultrasound, or pleural contrast enhancement on CT.

In patients with an intermediate pH and LDH <900, a therapeutic pleural aspiration can be performed if there is a reasonable volume of fluid.

If the decision has been made to insert a chest drain, the recommendation locally is to use size 16F or 18F Seldinger drain. A large bore drain may be appropriate in some patients e.g. where a Seldinger drain has been ineffective and there is a large residual pleural collection. It is important to consider regular chest drain flushes, particularly in patients with frank empyema to maintain the patency of the drain and reduce the risk of drain blockage.

- *Thoracic surgery*

Surgical intervention plays an important role in patients with pleural infection that do not improve with standard therapy.

Early referral to the thoracic surgeons is key and should be done after 48 to 72 hours of treatment if there is evidence of ongoing sepsis and a persistent fluid collection on imaging.

A VATS approach is used for most patients who undergo surgery for pleural infection but a proportion may require open thoracotomy, depending on the stage of pleural infection. VATS is associated with a shorter length of stay and fewer post operative complications compared to thoracotomy.

Table 1: British Thoracic Society guidelines on drainage in pleural infection

Pleural fluid pH	Likelihood of pleural infection	Recommended action
≤7.2	**HIGH**	Intercostal chest drain insertion if the fluid is accessible on ultrasound
7.21 – 7.39	**INTERMEDIATE**	Chest drain insertion if LDH ≥900 and any of: • Large volume of pleural fluid • Low fluid glucose ≤ 4mmol/L • Septations on ultrasound • Pleural contrast enhancement on CT If LDH <900, monitor clinically and consider repeat diagnostic aspiration if not improving. Therapeutic aspiration is an option if large fluid volume and symptom relief required.
≥7.4	**LOW**	No need for urgent chest drain • Monitor progress clinically • Consider therapeutic aspiration if large volume of fluid • Conservative management if small effusion ± repeat diagnostic aspiration if lack of clinical improvement

- *Intrapleural fibrinolytic therapy*

There is good trial evidence to support use of intrapleural enzymes for fibrinolysis in pleural infection. Large quantities of inflammatory mediators in the infected pleural fluid leads to deposition of fibrin membranes and clots. This increases fluid viscosity and formation of septations within the pleural cavity, thereby making pleural fluid drainage difficult.

The combination of Alteplase (tPA) and Dornase alpha (DNase) improves fluid drainage, reduces the need for surgical intervention and shortens hospital stay.

In patients with pleural infection who do not improve after 48 hours of treatment (persistent radiological shadowing and static or worsening inflammatory markers) and are not suitable for thoracic surgery, intrapleural fibrinolysis should be considered.

The risk of bleeding from fibrinolysis is about 4% which must be discussed with the patient. Factors associated with a higher bleeding risk include renal failure, concurrent use of anticoagulants and platelets <100. The risks and benefits must be carefully considered in these patients before administering treatment. Please refer to the guidance on intrapleural fibrinolysis for details on the local protocol and administration. It is recommended that these patients are discussed with the pleural team prior to administering treatment.

- *Nutrition and thromboprophylaxis*

All patients with pleural infection should be offered nutrition support from a dietician. Poor nutritional states and low albumin are associated with a higher risk of mortality. Supplementary nasogastric feeding should be considered in patients at risk of deterioration and those with slow clinical improvement.

Patients with pleural infection are at high risk of thromboembolic events. Unless contraindicated, all patients should receive chemical prophylaxis in line with the trust guidance.

❖ Prognosis and risk stratification

Pleural infection remains a disease of high morbidity and mortality. Delaying drainage of the infected pleural fluid or surgical referral is associated with a higher mortality risk. Several factors have also been associated with a poorer prognosis.

The RAPID score has been derived from baseline parameters to determine mortality at 3 months (Table 2). A poorer outcome is associated with increasing age, non-purulent fluid, hospital acquired infection, low albumin and high urea. Although it's role in clinical practice and decision making is yet to be defined, it is a useful tool to risk stratify patients early in the course of their illness and may help guide discussions with patients and their relatives. It may also have a role in defining treatment strategies in the future but further research into this is needed.

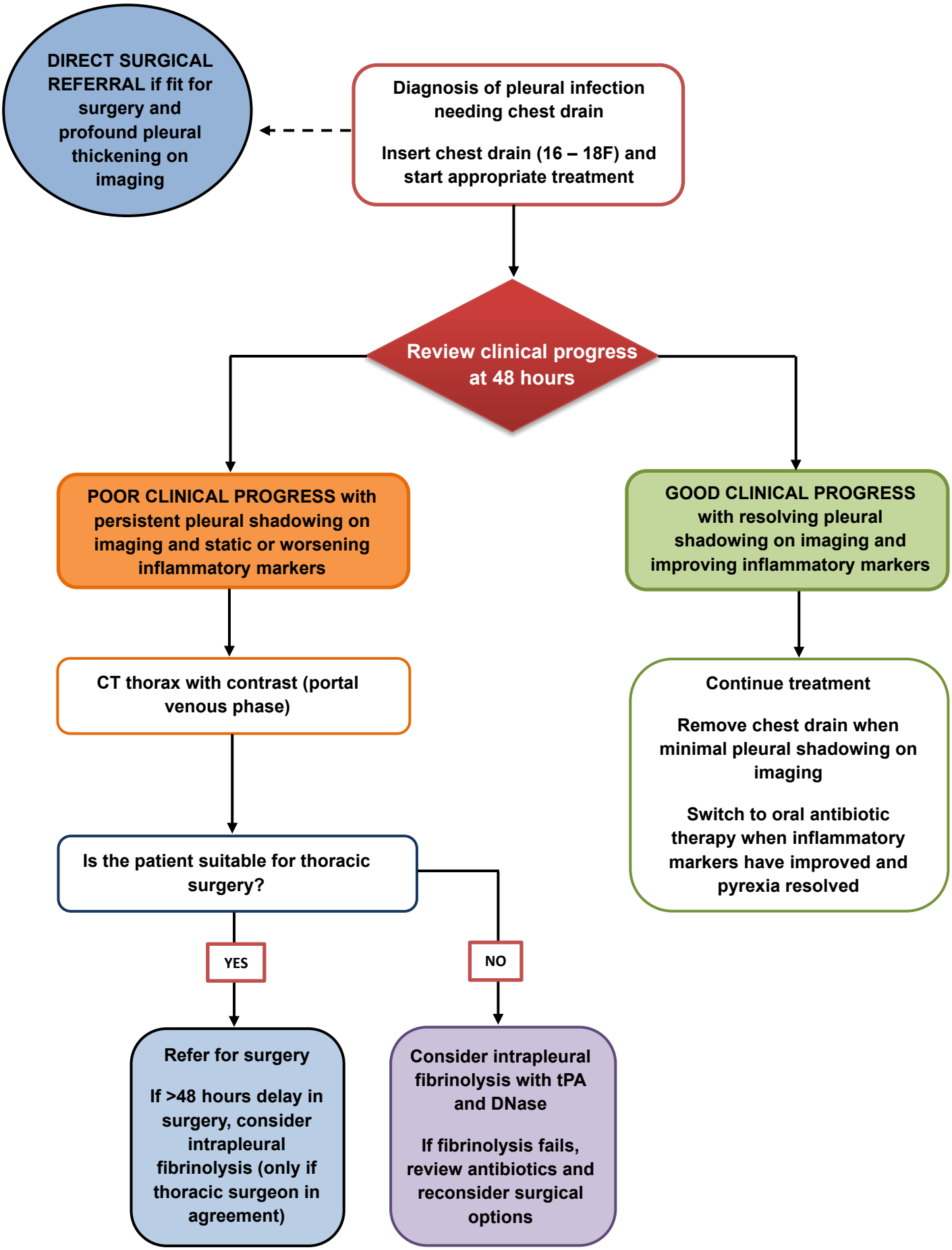
Table 2: The RAPID score for risk stratification in pleural infection

Parameter	Measure	Score	Risk categories for mortality at 3 months
RENAL: Urea	<5 5 – 8 >8	0 1 2	• **0 – 2: LOW RISK** • **3 – 4: MODERATE RISK** • **5 – 7: HIGH RISK**
AGE	<50 50 -70 >70	0 1 2	
PURULENCE of fluid	Purulent Non-purulent	0 1	
INFECTION source	Community acquired Hospital acquired	0 1	
DIETARY: Albumin	>27 <27	0 1	

Summary of key points

- ✓ Pleural infection is associated with a high morbidity and mortality**.**
- ✓ Diagnostic pleural aspiration should be performed in **all** cases of suspected pleural infection.
- ✓ Sending pleural fluid in **blood culture bottles** increases the diagnostic yield by about 20%.
- ✓ Management involves various aspects including antibiotic therapy, drainage of the pleural collection, thoracic surgery and intra-pleural fibrinolysis.
- ✓ If a chest drain is required, size 16F or 18F is recommended (local guidance).
- ✓ Consider the need for thoracic surgery referral if no clinical improvement after 48 to 72 hours.
- ✓ The RAPID score is a useful clinical tool for predicating mortality at 3 months in patients with pleural infection.

TREATMENT PATHWAY FOR PLEURAL INFECTION



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MANAGEMENT OF SPONTANEOUS PNEUMOTHORAX

Spontaneous pneumothorax occurs when air accumulates within the pleural space in the absence of trauma or iatrogenic intervention (such as lung biopsy). It is a common medical problem with increasing hospital admissions over the last 50 years. Several high-quality clinical trials have been conducted over recent years that have shaped the current guidelines for managing this group of patients.

❖ Definitions

Primary spontaneous pneumothorax (PSP):

- Age < 50 years
- Minimal smoking history
- No known significant underlying lung disease

Secondary spontaneous pneumothorax (SSP):

- Age > 50 years
- Significant smoking history (>20 pack year history or significant cannabis use)
- Underlying lung disease such as COPD/emphysema, chronic severe asthma, pulmonary fibrosis, bronchiectasis

❖ Clinical features

Clinical presentation is usually of acute onset breathlessness and/or pain (chest, back or shoulder tip). Features suggestive of tension include severe or disproportionate breathlessness, significant hypoxia or haemodynamic compromise (tachycardia, hypotension).

❖ Investigations

A chest x-ray is the first investigation that can easily identify a pneumothorax. A CT thorax may be required in patients presenting with a complex pneumothorax on chest x-ray or where there is uncertainty e.g. differentiating between pneumothorax and large bulla.

❖ Management

Following publication of the British Thoracic Society Guidelines in July 2023, management of spontaneous pneumothorax is now determined primarily by the presence of symptoms and high-risk characteristics. The previous emphasis on size as the main guide for intervention no longer features in the treatment pathway. There is greater emphasis on patient preference and priority between rapid symptom relief and procedure avoidance. However, it is also recognised that treatment options and outcomes differ between primary and secondary pneumothorax.

The main approaches to management are:

- Conservative approach
- Needle aspiration
- Intercostal chest drain
- Thoracic surgery
- Ambulatory devices e.g. pleural vent, flutter valve

Primary spontaneous pneumothorax

For patients with PSP, the presence of any high-risk characteristics necessitates treatment with a chest drain if it is safe to intervene. Sufficient size for intervention is deemed to be >2cm interpleural distance when measured at the level of the hilum or any size deemed safely accessible by CT guided intervention in complex cases.

In symptomatic patients who do not require immediate intervention, treatment options largely depend on the patient's priorities. If the patient is keen to avoid intervention, conservative management is recommended with early outpatient follow up.

For patients who want to gain rapid relief of symptoms, needle aspiration of up to 1.5L is recommended. However, if there is a significant residual pneumothorax after the aspiration with persisting symptoms, then a chest drain should be placed. Locally at RWT, the recommendation is to insert a 16F or 18F drain to avoid complications that often arise from 12F chest drains.

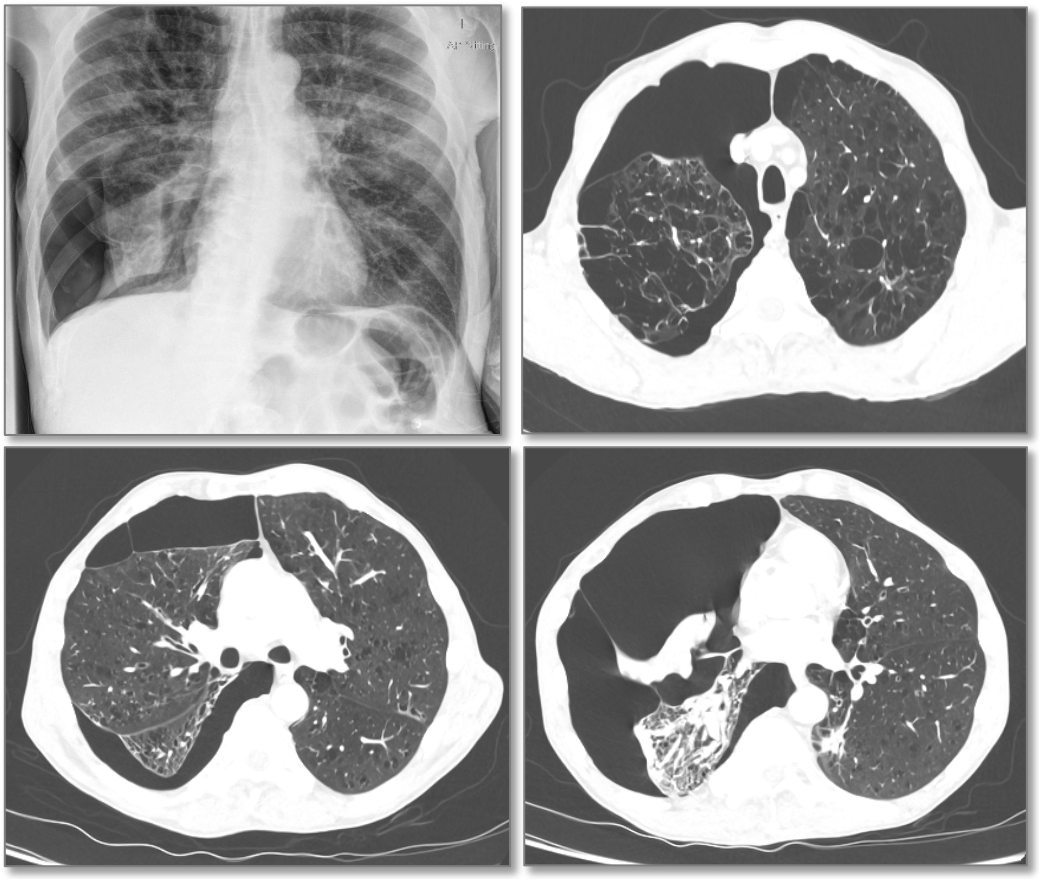
Ambulatory pleural devices also form part of the treatment pathway in specific cases but these should only be used at the discretion of the pleural or cardiothoracic surgical team.

Secondary spontaneous pneumothorax

In contrast to PSP, the mainstay of management in patients with SSP is insertion of a chest drain if the pneumothorax is large enough and safe to intervene on. Patients with SSP are more likely to be symptomatic and hypoxic and are also at higher risk of developing a prolonged air leak. Needle aspiration is not routinely used in SSP due to concerns about efficacy and a lack of robust evidence.

If the pneumothorax is not large enough for intervention, a period of inpatient observation is recommended before discharge with close follow up in clinic.

Ambulatory devices are not recommended in patients with PSP as evidence so far suggests a higher rate of treatment failure when they are used.



Images demonstrating a complex right sided secondary pneumothorax. CT imaging demonstrated a large enough size that was safe for intervention and a chest drain was inserted. The patient developed a persistent air leak which was successfully manged with autologous blood patch pleurodesis

❖ Management of persistent air leak

Most cases of pneumothorax will resolve spontaneously once the cause of the air leak has healed. In some cases, however, a persistent air leak (PAL) may develop, usually defined after 48 hours of intervention. This can be challenging to manage and often results in a prolonged hospital stay. There is a lack of robust evidence to guide management in this group. For patients with primary spontaneous pneumothorax, early discussion with thoracic surgeons is recommended as these patients tend be fit for surgical intervention.

Patients with secondary spontaneous pneumothorax are more challenging to manage. Thoracic suction can be used which may help to speed up lung expansion and appose the pleural surfaces, thereby sealing the defect causing the leak. Although there is little evidence around its use, it is usually well tolerated by patients. The recommended pressures are between -10 to -20cm H_20 (equivalent to -1 to -2kPa).

Autologous blood patch pleurodesis should also be considered to treat PAL. This involves taking 50mL to 100mL of the patient's own blood and instilling it into the chest drain. It is thought to cause

a pleurodesis reaction and formation of a clot over the visceral defect. There is some evidence that it shortens the time to resolution of the air leak. However, it must not be performed through a small bore chest drain due to the risk of blockage and potential tension pneumothorax (size 16F or larger recommended).

Other options for managing PAL include ambulatory devices and endobronchial valves but these need to be considered on a case-by-case basis, usually when other options have failed to resolve the persistent air leak.

❖ Monitoring and follow-up

Patients with SSP where the pneumothorax is not safe for intervention should be admitted for observation and a repeat chest x-ray after 24 hours.

Those with PSP opting for conservative management may be discharged if observations remain stable at 4 hours.

All patients discharged following a pneumothorax should be reviewed in the respiratory outpatient clinic within 2-4 weeks post discharge with a repeat chest x-ray. They should also be given verbal and written advice to return to the emergency department should their symptoms worsen or recur, and advice on activity post discharge.

❖ Prevention of recurrence

Recurrence of primary spontaneous pneumothorax occurs in up to 30% after the first episode. For secondary spontaneous pneumothorax, this ranges between 13 to 39%. It is important to consider the various strategies that can reduce the risk of recurrence in every patient that presents with a pneumothorax.

- *Lifestyle advice*

Smoking (including cannabis) cessation should be strongly advised as this increases the risk of recurrence in all-cause spontaneous pneumothorax.

- *Talc pleurodesis*

This can be considered on the first episode for patients with secondary spontaneous pneumothorax treated with a chest drain, if there is concern recurrence could result in significant deterioration. This group of patients are often unfit for surgical intervention, so preventing recurrence is an important consideration.

- *Thoracic surgery*

Elective referral after initial pneumothorax may be considered if the risk of recurrent pneumothorax will have major impact on occupation (such as professional divers, airline pilots, military personnel), or where the initial presentation was extreme e.g. tension pneumothorax.

Elective surgical referral should also be considered in patients with a second ipsilateral or first contralateral pneumothorax.

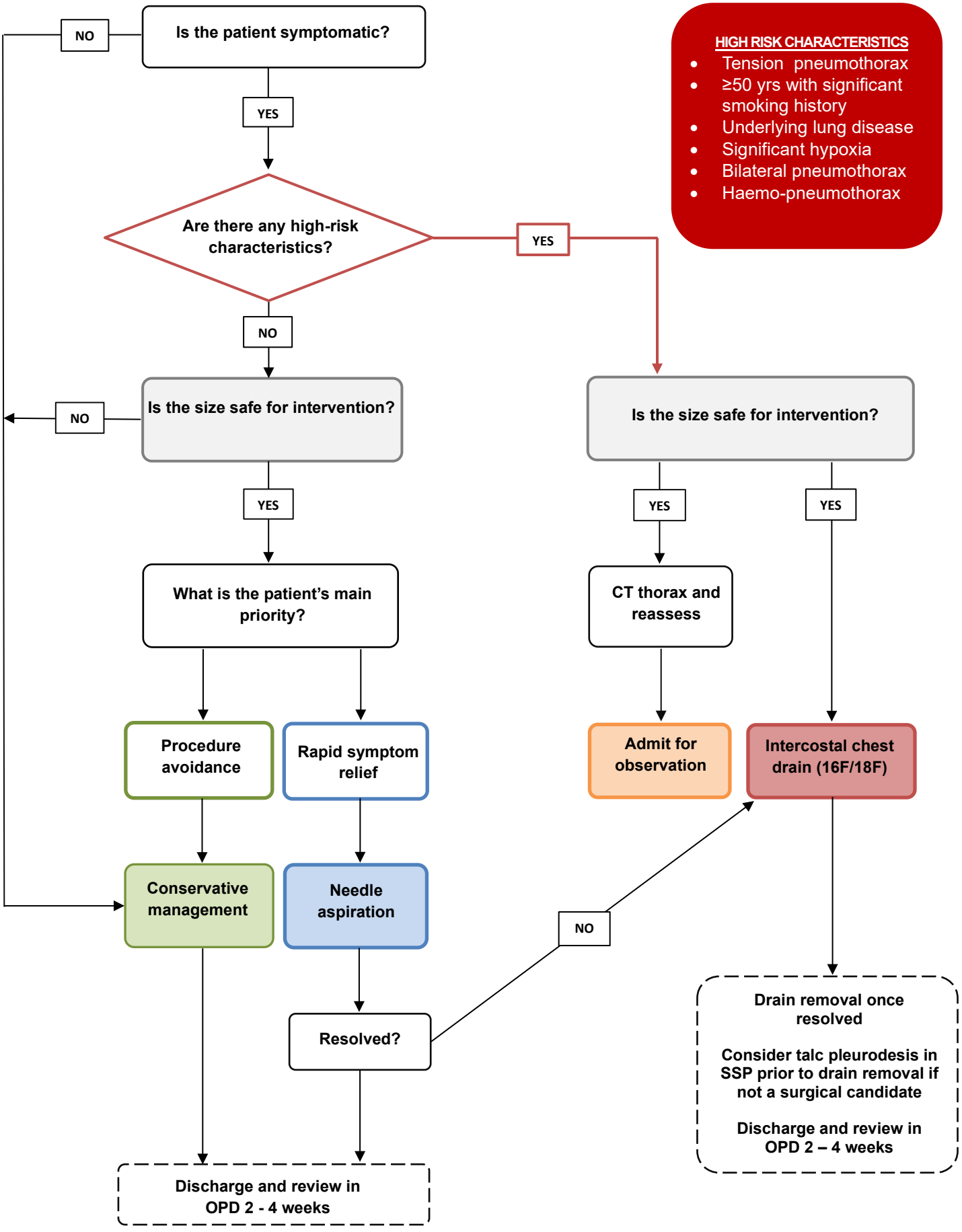
❖ Advice for patients

All patients should be advised not to fly until the pneumothorax has fully resolved radiologically. Patients can fly after seven days following confirmation of radiological resolution. They should be advised not scuba-dive at all unless they have undergone definitive surgical treatment such as surgical pleurectomy.

Summary of key points

- ✓ Management of PSP does not always require intervention. Consider symptoms and patient preference when deciding on the need for intervention.
- ✓ Conservative management can be offered to patients with minimal symptoms.
- ✓ If intervention is required, needle aspiration or a chest drain should be performed.
- ✓ SSP usually requires intervention due to a higher risk of deterioration. Intercostal chest drain is the first line treatment if intervention is required.
- ✓ Talc pleurodesis can be considered after a first episode of SSP in patients unfit for surgical intervention.
- ✓ Autologous blood patch pleurodesis can be used to manage persistent air leak in patients unfit for surgical intervention. The drain should be 16F or larger to reduce the risk of blockage and tension pneumothorax.

DECISION PATHWAY FOR SPONTANEOUS PNEUMOTHORAX



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GUIDELINES ON PLEURAL PROCEDURES

This guidance focuses on areas of safe clinical practice relating to pleural interventions. It is not a guide on how to perform pleural procedures but is aimed at standardising the processes around pleural interventions to ensure safe and consistent practice. The following areas are covered:

- Safety and preparation
- Pleural aspiration (diagnostic and therapeutic)
- Intercostal chest drain
- Indwelling pleural catheter
- Talc slurry pleurodesis
- Blood pleurodesis

PREPARATION AND SAFETY

- Where possible, pleural procedures should be performed in a clean and dedicated procedure room.

- Pleural intervention should be performed during **daytime hours between 9am and 4pm**. Procedures should only be taken outside these hours in cases of emergency.

- **Patients with intercostal chest drains must be managed on a Respiratory ward (C14/C26), Cardiothoracic ward or ITU.** Patients who have chest drains inserted in the emergency department must be prioritised for transfer to a Respiratory or Cardiothoracic ward.

- **Imaging must be reviewed** before any pleural procedure to confirm the side of intervention.

- **Thoracic ultrasound is mandatory for all pleural fluid procedures** and must be performed immediately before the procedure. The patient must be in the position that the procedure is to be undertaken. An approach of marking a site then delaying the procedure must not be used. Ultrasound is generally not required for pneumothorax procedures but can be used in some cases to guide the intervention site e.g. in a loculated pneumothorax.

- **Thoracic ultrasound must be performed by a competent operator** who can safely identify a site for intervention. In patients with a large body habitus or where the imaging is unclear, specialist input must be sought e.g. from a pleural consultant or formal imaging in radiology.

- **The operator performing the pleural procedure must be fully competent to undertake the procedure.** Operators who are learning must be supervised by a trained operator.

- **Medications must be reviewed, specifically anticoagulants and antiplatelets.** These need to be suspended prior to intervention (refer to "Guidelines on anticoagulation for pleural procedures"). Specialist advice should be sought from the Haematology team for patients at high risk of thromboembolism.

- **Bloods must be checked and reviewed** before any pleural procedure – FBC, platelets and INR. This should be done within 72 hours for inpatients and 1 to 2 weeks for elective outpatient procedures.

- **INR ≤1.5 and platelets ≥50** are satisfactory for pleural intervention. A point of care test (POCT) INR can be performed at the time of the procedure if available.

- **Informed written consent** must be obtained for pleural aspiration (diagnostic and therapeutic), intercostal chest drain and indwelling pleural catheter insertion. This should be documented clearly in line with GMC recommendations and the Trust consent policy. Verbal consent is acceptable for talc pleurodesis.

- The **pleural procedure safety checklist** must be completed prior to all pleural procedures.

- The **details of the procedure** should be recorded in the medical records to include the following details: procedure performed; medications administered; any immediate complications; recovery plan including post procedure observations; plan for restarting anticoagulant/antiplatelet if applicable.

- **Local anaesthesia** should be administered using **Lidocaine 1%** which can be given at a dose of up to 3mg/kg (maximum 250mg). Lidocaine with adrenaline 1:200 000 can be given up to 7mg/kg (maximum 500mg).

- **Observations** following pleural procedures should be measured and recorded as summarised below.

PROCEDURE	OBSERVATIONS FREQUENCY	MONITORING
Pleural aspiration	Immediately after the procedure	Routine observations in accordance with NEWS score if done as an inpatient
Intercostal chest drain	Immediately after the procedure and at 15 minutes	Every 30 minutes for 1 hour then monitor in accordance with NEWS score if clinically stable
Indwelling pleural catheter	Immediately after the procedure and at 30 minutes	Routine observations in accordance with NEWS score if done as an inpatient
Talc/blood pleurodesis	Immediately after the procedure	Routine observations in accordance with NEWS score
Intrapleural fibrinolysis (after each dose)	Immediately after the procedure and at 15 minutes	Every 30 minutes for 1 hour then monitor in accordance with NEWS score if clinically stable

PLEURAL ASPIRATION

- Diagnostic pleural aspiration involves taking 50mL of pleural fluid using a small bore needle for diagnostic purposes.
- Therapeutic pleural aspiration involves aspirating 500mL to 1500mL using an aspiration catheter for therapeutic purposes.

❖ Indications

- Diagnosis of unexplained pleural effusion
- Relief of breathlessness
- Assess for non-expandable lung in patients with malignant pleural effusion to guide fluid management
- Treatment for spontaneous pneumothorax

❖ Contraindications

- No safe site for aspiration identified on thoracic ultrasound
- Uncorrected coagulopathy
- Uncooperative patient
- Local infection/cutaneous disease at procedure site
- Mechanical ventilation which may increase the risk of tension pneumothorax or bronchopleural fistula (chest drain may be more appropriate in these cases)

❖ Consent

- Pain
- Infection
- Bleeding
- Pneumothorax
- Organ damage
- Failed procedure
- Re-expansion pulmonary oedema (therapeutic aspiration)

Therapeutic aspiration should be performed using a 6F or 8F aspiration catheter. A maximum of 1.5L fluid should be drained at a time. Where relevant, pleural fluid samples should be sent for the relevant analyses (refer to “Investigation of a unilateral pleural effusion” guidance).

Observations should be performed immediately after the procedure but no period of monitoring is required unless there is clinical concern or complications occurred during the procedure.

A post procedure chest x-ray should be performed after a therapeutic aspiration. However, an x-ray is not routinely required following a diagnostic aspiration providing the procedure was straightforward and uncomplicated.

INTERCOSTAL CHEST DRAIN

- Small bore chest drains are inserted using Seldinger technique with the aid of a guidewire.
- Large bore chest drains (>20F) are inserted using a blunt dissection technique.

❖ Indications

- Malignant pleural effusion
- Pleural infection
- Talc pleurodesis
- Drainage of pneumothorax
- Traumatic haemothorax / haemo-pneumothorax
- Post thoracic cavity procedures e.g. thoracoscopy, thoracic or cardiac surgery

❖ Contraindications

- No safe site for aspiration identified on thoracic ultrasound or other appropriate imaging
- Uncorrected coagulopathy
- Unco-operative patient
- Local infection/cutaneous disease at procedure site

❖ Consent

- Pain
- Infection
- Bleeding
- Organ damage
- Failed procedure
- Drain blockage
- Drain displacement
- Subcutaneous emphysema
- Re-expansion pulmonary oedema

Thoracic ultrasound must be performed if a drain is being inserted for a pleural effusion, by an operator competent in ultrasound. Ultrasound is not required for a pneumothorax but can be useful for complex cases e.g. loculated pneumothorax.

The type of drain inserted depends on the indication and expertise of the operator. Seldinger chest drains are usually inserted by Respiratory and Medical teams. Large bore drains are inserted by the Cardiothoracic surgical team who should be contacted if the clinical situation requires a large bore drain.

In cases where a Seldinger chest drain is being inserted, size 16F or 18F is recommended regardless of the indication. 12F drains are more likely to block and become mispositioned so should be avoided.

All Seldinger chest drains must have a 3-way tap attached. They should also be secured with a suture and additional fixation method e.g. drain fix or alternative adhesive dressing to ensure that the drain is well secured post insertion.

- **If required, Seldinger chest drains for patients on the Cardiothoracic ward should be performed by the Respiratory team.**
- **If a chest drain needs to be placed out of hours and there is no competent operator on the medical team, the on-call Cardiothoracic registrar must be contacted to perform the procedure.**

❖ Chest drain aftercare

Observations should be performed immediately after procedure, 15 minutes later then every 30 minutes for 1 hour. Following this, monitoring can be done in accordance with the NEWS score if the patient is clinically stable or more frequently in a clinically unstable patient.

Documentation of the procedure notes should include the thoracic ultrasound findings if performed, medication administered, size of drain inserted, distance at which the drain is fixed, pleural fluid appearance and instructions for drainage. A post procedure chest x-ray should be performed within a few hours of insertion to ensure appropriate position of the drain and to exclude immediate complications.

All chest drains must have a monitoring chart by the bedside which should be maintained until the drain is removed. For an effusion, the rate of fluid drainage must be regulated to avoid re-expansion pulmonary oedema. A maximum of 1000mL can be drained in the first hour if the patient tolerates it (reduce to 500mL in patients with excessive coughing or chest discomfort). The drain should then be clamped for 2 hours followed by draining 500mL every 2 hours clamping the drain in between. The drain can be left on free drainage when the fluid output is less than 500mL per hour. A bubbling chest drain must never be clamped except in occasional circumstances on advice of a specialist. The patient must be closely monitored in this situation.

CONTROLLED DRAINAGE OF PLEURAL FLUID
• Drain 1000mL after drain insertion (500mL if patient unable to tolerate) • Clamp the drain for 2 hours • Drain 500mL every 2 hours clamping the drain in between (1000mL can be drained in some cases if the patient tolerates it) • Keep on free drainage when output slows down to less than 500mL/hr
If the patient develops chest pain, persistent cough, breathlessness or vagal symptoms, clamp the drain immediately and assess the patient.

❖ Trouble shooting

○ *Non-functioning drain*

A drain that stops swinging indicates it is not functioning, usually due to blockage within the tube. Inspect the entire length of the chest drain from the skin to the drainage bottle to check for kinks and twists. The drain can be flushed with 20mL saline using sterile precautions to see if this resolves the problem. If flushing does not result in the drain swinging, a chest x-ray should be performed to check the drain position. If the x-ray shows a kink in the section of drain within the chest, consider withdrawing the drain partially. If that does not help, a CT scan should be considered to check the position. The drain may have to be replaced if it still does not work despite the measures discussed.

○ *Malposition on chest x-ray*

If a drain is placed very far into the chest such that it is causing symptoms suggestive of pleural irritation, it can be withdrawn to a degree, ensuring that it is not withdrawn out of the pleural space. If a drain is too far out such that any of the drainage holes are outside the pleural space, the drain must not be pushed into the pleural space, as this carries risk of introducing infection into the pleural space. In such cases, the drain should be removed and another drain should be placed using a different site if needed.

○ *Subcutaneous emphysema*

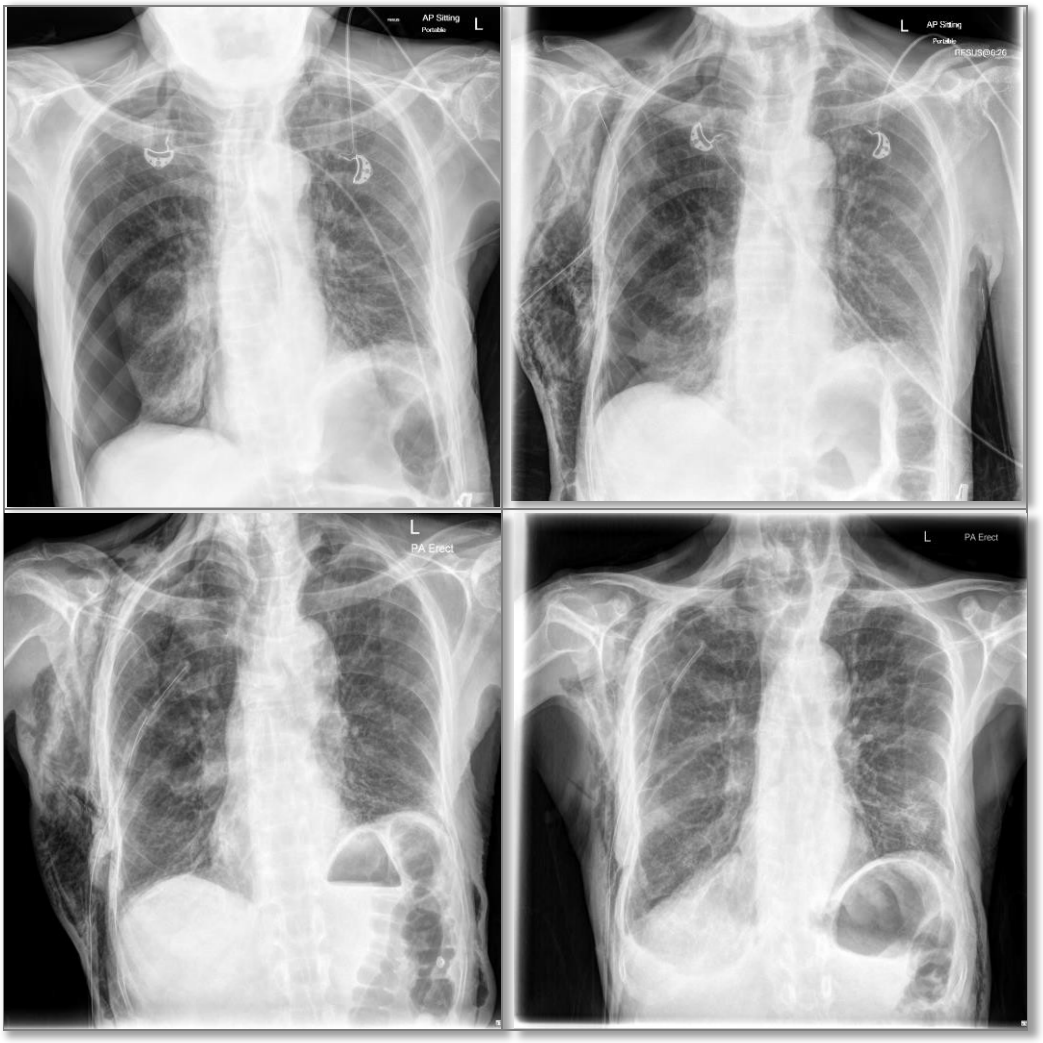
It is not uncommon for subcutaneous (surgical) emphysema to develop following insertion of a chest drain for a pneumothorax or following thoracoscopic procedures. This is not usually significant and resolves with time. However, significant subcutaneous emphysema can develop in some situations that requires management. This is usually in the case of a poorly placed or secured drain and drain blockage, leading to the drainage holes sitting subcutaneously, in the context of a large air leak. Consideration should be given to insertion of a new drain, which may need to be a large bore drain especially in cases where there is a large air leak.

MANAGING SIGNIFICANT SUBCUTANEOUS EMPHYSEMA	
1.	Administer high flow oxygen (titrate to target saturations)
2.	Flush drain to check it is patent and functioning
3.	Arrange chest x-ray to check drain position. Are any of the drainage holes sitting outside the pleural cavity? If so and the lung has not expanded, then a new drain is likely to be required
4.	If the drain is adequately positioned with no drainage holes outside the pleural space and the lung has not re-expanded, consider thoracic suction or replacing it with a large bore drain
5.	If the subcutaneous emphysema continues to worsen despite the measures above, liaise with the thoracic surgeons
6.	In most patients, the emphysema gradually resolves with time but the drain needs to be adequately positioned and functioning to deal with the air leak. Patients and relatives should be given some reassurance that it will resolve with time

MANAGING RE-EXPANSION PULMONARY OEDEMA

A rare but potentially life-threatening complication defined by hypoxia and new infiltrates on chest x-ray, caused by rapid lung re-expansion. It can also occur following drain insertion for a pneumothorax.

1. Clamp the chest drain or therapeutic aspiration catheter
2. Apply high flow oxygen and titrate to target oxygen saturations
3. Arrange an urgent chest x-ray to check the drain position and exclude other complications
4. Opiates e.g. Morphine and diuretics can be given but there is no strong evidence base for this
5. Most patients improve with time but consider referral to ITU if not improving with significant hypoxia



Images demonstrating subcutaneous emphysema following insertion of right sided chest drain for a secondary spontaneous pneumothorax

Note the malpositioned drain in the top right image. The drain was replaced with a large bore drain resulting in resolution of the pneumothorax and subcutaneous emphysema after a few

❖ Drain removal

For a pneumothorax, the drain can be removed when the lung has re-expanded and the air leak has stopped. There may be a small residual pneumothorax in some cases. These patients should have appropriate clinic follow up and chest x-ray to confirm resolution.

Following talc pleurodesis, the drain can be removed when the fluid output is less than 150mL in 24 hours post pleurodesis or there is evidence of pleurodesis on thoracic ultrasound (performed by a trained operator).

For other indications, it is the clinician's decision to decide when it is appropriate to remove the drain. This may not always coincide with the intended clinical outcome but the risks of a drain staying in for a prolonged period need to be considered.

There is no consensus on the timing of removing a drain i.e. whether it is done at the end of inspiration or expiration. Either can be used if a Valsalva manoeuvre is performed at the time.

Chest drains should only be removed by trained operators (this includes nurses and nurse practitioners who have been appropriately trained). A suture is not required to close the wound for small bore drains (12F – 18F). For large bore drains, a holding suture is usually in place and should be tied after removing the drain.

A chest x-ray is not always required after drain removal (e.g. if one was taken shortly before it is removed) but should be considered depending on the clinical context, such as to check that a pneumothorax has not worsened.

❖ Flushing chest drains

Chest drains can be flushed to check their patency. This is important in cases of pleural infection or haemothorax where the drain output can be thick, thereby increasing the risk of drain blockage. **The procedure must be done using aseptic technique and should only be performed by those who have been appropriately trained.** 0.9% saline should be used when flushing chest drains.

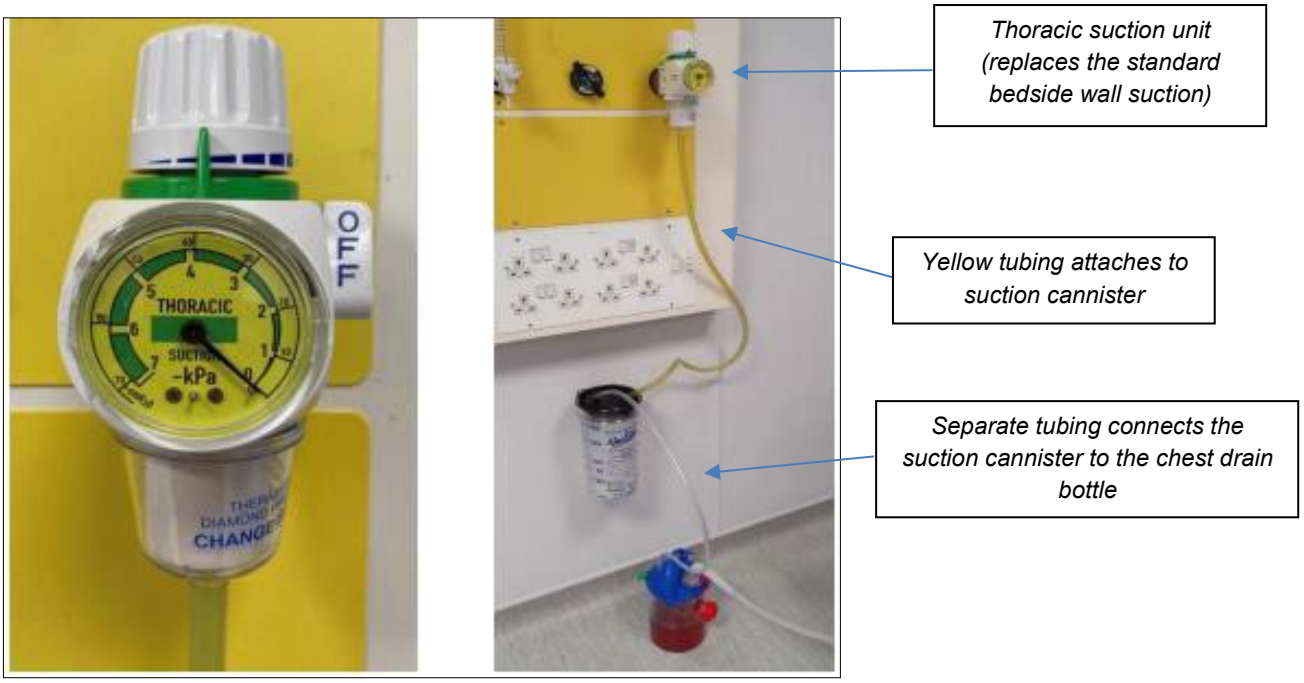
❖ Thoracic suction

Suction can be applied to chest drains to apply negative pressure to the pleural cavity, which can facilitate lung re-expansion or accelerate the removal of air or fluid from the pleural cavity. However, there is lack of robust data demonstrating its efficacy in clinical practice. For this reason, there is no recommendation for using it routinely but it may be considered in some cases.

The most common use for thoracic suction is in managing pneumothorax with a persistent air leak. Suction should NOT be used soon after drain insertion to minimise the risk of re-expansion pulmonary oedema.

Low pressure high volume thoracic suction should be used. The suction should be applied to a separate cannister and then connected via tubing to the chest drain bottle connected to the patient. Suction should start at a low pressure and can be increased if the patient tolerates it. The recommended starting pressure is -1kPa (=-10cmH20) and the maximum is -2kPa (=-20cmH20).

Digital suction devices such as the Thopaz device deliver suction and also measure the air leak. They also offer the advantage ambulation for patients. At RWT currently, they are only used on the Cardiothoracic ward and should only be used by staff trained to use them.



FLUSHING A CHEST DRAIN

- Use sterile precautions and ANTT
- Check that a 3-way tap is attached (Seldinger drains). For large bore drains, use an appropriate adapter or ensure that a drain clamp is available to use for the procedure
- Draw 40mL 0.9% saline into a 50mL Leur lock syringe
- Clean the side port on the 3-way tap with Chlorhexidine wipes
- Flush the drain with 20mL saline. Flush the remaining 20mL into the chest drain tubing to the drain bottle
- Check the drain site to ensure there is no leakage following the flush which could indicate drain malposition

- For large bore drains, clamp the drain above the connection with the tubing. Disconnect the tubing and clean the end of the drain well using Chlorhexidine wipes. Attach a bladder syringe to the end of the drain then unclamp the drain. Flush the drain with 30mL 0.9% saline. Clamp the drain again and reconnect the tubing. It is important to ensure that the tubing does not get contaminated (otherwise attach new tubing). Unclamp the drain once the tubing is reconnected.

INDWELLING PLEURAL CATHETER

An indwelling pleural catheter (IPC) is a tunnelled drain designed to act as a longterm solution for recurrent pleural effusions.

It enables patients to manage their effusion at home and is commonly inserted as a day case procedure under local anaesthetic, thereby avoiding hospital admission.

The IPC is made of silicone with drainage holes at one end and a one-way valve at the other. The valve connects to a vacuum bottle thereby allowing drainage of fluid. A polyester cuff on the catheter placed subcutaneously stimulates formation of scar tissue which secures the drain for the duration it is in situ. When it is not being drained, the catheter is covered with a waterproof dressing.

Drainage can be performed by patients' relatives or community district nurses. There is no limit to how long the catheters can remain in place, which varies from weeks to months, or even years (although less likely in practice). Regular drainage can eventually result in auto-pleurodesis, following which the catheter can be removed. It is hoped that patients live a normal life with the catheter whilst managing their symptoms.

Images demonstrating a patient with a right sided indwelling pleural catheter for a malignant pleural effusion

Left: *The catheter is covered with a waterproof dressing when it is not being drained*
Middle: *The dressing has been removed to expose the catheter*
Right: *Catheter attached to a drainage bottle*

[Patient consent obtained for use of these photographs]

- **Indications**
  - First line for recurrent malignant effusion according to patient choice
  - First line for malignant pleural effusion with non-expandable lung
  - Second line after failed talc pleurodesis
  - Selected cases of recurrent benign pleural effusion

- **Contraindications**
  - No safe site for insertion identified on thoracic ultrasound
  - Uncorrected coagulopathy
  - Uncooperative patient or inability to lie in lateral decubitus position
  - Local infection or malignant skin infiltration at procedure site
  - Pleural infection with evidence of ongoing sepsis
  - Lack of services to support outpatient management of the IPC

- **Consent**
  - Pain
  - Bleeding
  - Infection – skin cellulitis and pleural infection
  - Failed procedure
  - Drain blockage
  - Drain falling out dislodgement
  - Non-draining septated effusion

- **IPC aftercare**

An IPC must only be accessed by appropriately trained staff. There is significant risk associated with poor catheter care which must be avoided.

The recommended volume of fluid drainage from the IPC is 500mL at each drainage session. However, up to 1000mL can be drained in some cases, depending on the indication and patient's symptoms. This should be decided by the clinician responsible for the patient, in agreement with the patient.

For most patients, the initial drainage frequency is usually alternate days but this can be changed to match the patient's symptoms and the volume of fluid being drained. There is some evidence that daily drainage shortens the time to pleurodesis so this can be considered in patients with expandable lung where the priority is to remove the drain at the earliest opportunity. As fluid volume reduces over time, the drainage frequency can also be reduced.

It is important to educate patients about looking after the drain, particularly the signs that could indicate infection e.g. pain/redness at the drain site, exudate or change in pleural fluid colour. Patients should be provided with a contact number to report any problems they encounter with the drain or consumables.

Patients can shower and bath with an IPC, usually after 7 days post insertion. They should be advised to ensure that the waterproof dressing that covers the catheter is intact to avoid it getting wet.

Systemic anti-cancer therapy is not a contraindication to IPC insertion, as there is no robust evidence to suggest an increased risk of infection in these patients. However, the timing of the procedure should be considered and avoided during the high risk post chemotherapy period.

When output from the IPC is less than 50mL on three consecutive occasions, auto-pleurodesis is likely to have been achieved providing there is no significant residual fluid on imaging. The pleurodesis rate is about 25% with standard drainage protocols but has been shown to increase to about 45% if sterile talc is instilled into the IPC which can be done in the outpatient setting.

- **IPC related complications**

  - Pain / discomfort

Pain or discomfort at the drain insertion site is not uncommon and can last a few days. This can usually be managed with simple analgesia. Severe or persistent pain rarely occurs but could indicate intercostal nerve irritation. IPC removal may need to be considered in these cases. Pain can also be experienced towards the end of drainage in patients with non-expandable lung. This is common and can be managed with use of analgesia before drainage sessions or modifying the drainage protocol e.g. drain smaller volumes frequently or reduce frequency of drainage.

  - Air within the pleural cavity

It is common for air to enter the pleural cavity during catheter insertion and appear as a pneumothorax on chest x-ray. However, this usually resolves spontaneously or gets removed from the pleural space during the IPC drainages. However, if a large amount is present and associated with pain, this could be due to visceral injury and patients may require a period of inpatient observation.

Non-expandable lung can also look like a pneumothorax on chest x-ray and usually persists after a reasonable volume of fluid is drained. Subcutaneous emphysema can also occur after IPC insertion but this tends to be when the IPC has been inserted post VATS and usually resolves with time.

  - *Infection*

IPC related infection occurs in about 5% of cases and takes the form of cellulitis in the skin around the catheter exit site, or pleural infection. The mortality rate from IPC related pleural infection is low (<1%) and majority respond to antibiotics which may need to be administered intravenously in

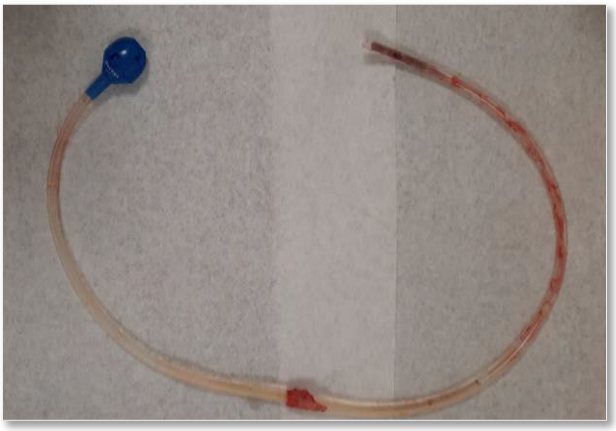
some cases. The IPC may also need to be attached to an underwater seal to drain the infected pleural space if a moderate or large fluid collection is present. In some cases, the catheter must be removed but this is uncommon and tends be in severe cases where antibiotic therapy fails. A swab from the exit site and pleural fluid should be sent for culture if IPC related infection is suspected.

- *Catheter blockage*

There is a 4% rate of IPC blockage, which usually occurs due to deposition of fibrinous debris within the tube. Flushing the catheter with sterile saline can clear the blockage.

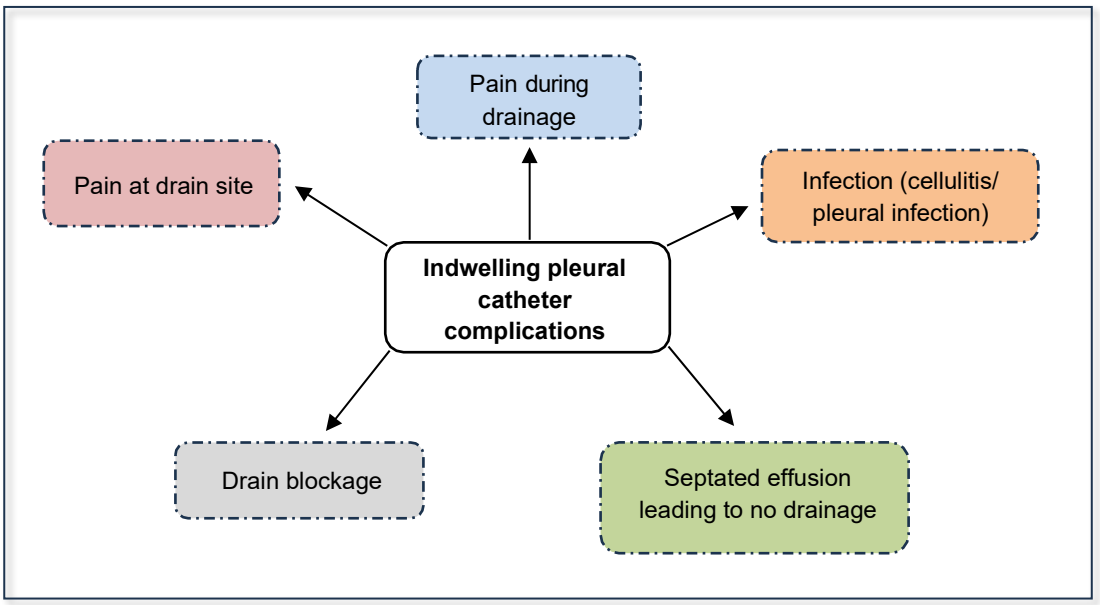
Fibrinolytic therapy can be considered but it is worth noting that this has a variable success rate.

The image on the right demonstrates a catheter that was removed due to blockage.



- Septated effusion

Drainage from the IPC can reduce or stop in cases where the effusion becomes septated. Intrapleural fibrinolytic therapy can be used to break down the septations and improve drainage. However, this carries a risk of bleeding (3%) so should be considered on an individual case basis weighing up the risks against the benefits.



PLEURODESIS

Pleurodesis is performed to obliterate the pleural space by causing inflammation and adhesion of the visceral and parietal pleural surfaces. This process enables control of pleural fluid re-accumulation and recurrence of pneumothorax.

❖ Talc pleurodesis

Talc pleurodesis can be performed through a chest drain (talc 'slurry') or at the time of thoracoscopic surgery (talc 'poudrage').

Sterile talc is used to perform pleurodesis and evidence has demonstrated it to be most effective and safe agent. Trial evidence has also shown that there is no difference in efficacy between the two methods when performed for management of malignant effusion.

Indications for talc pleurodesis

- Malignant pleural effusion
- Recurrent pneumothorax in patients unfit for surgical intervention
- Some non-malignant exudative effusions e.g. chylothorax

When to perform talc pleurodesis

For malignant effusion, pleurodesis can be performed when the pleural space has been evacuated or when there is at least 50% pleural apposition on the chest x-ray and fluid drainage is less than 250mL per hour in the preceding 24 hours. For a pneumothorax, the lung needs to be fully re-expanded with no air leak prior to pleurodesis.

Consent (written or verbal) should be obtained to include the following risks: pain, fever, infection, failed procedure, reaction to talc.

Pre-medication with an opiate should be administered about half an hour before the procedure e.g. Oramorph. The inflammatory response caused by the talc may result in significant pain and fever. Regular analgesia should also be prescribed for administration after the procedure.

How to perform talc pleurodesis

The steps of the procedure are shown on page 15. It is important to maintain aseptic precautions throughout the procedure to reduce the risk of introducing infection into the pleural space.

TALC SLURRY PLEURODESIS
○ Review chest x-ray to ensure >50% pleural apposition and the chest drain is within the pleural cavity ○ Check fluid output is ≤250mL/hr in the preceding 24hours ○ Check a 3-way tap is attached to the drain (Seldinger drains)
○ Obtain informed consent: pain, fever, infection, reaction to talc, unsuccessful procedure ○ Give premedication 15 – 30 minutes before the procedure e.g. Oramorph 5mg ○ Ensure regular analgesia is prescribed to be given post pleurodesis. NSAIDs are safe to use in the absence of contraindications
○ Use sterile precautions and ANTT ○ Flush the drain with 20mL 0.9% saline. For large bore chest drains, place a clamp on the drain and flush with 30mL 0.9% saline using a bladder syringe ○ Instil Lidocaine 1% at dose of 3mg/kg (max dose 250mg) into the drain ○ Make talc slurry using 4g sterile talc and 40mL 0.9% saline and instil into the drain ○ Flush the drain with 20mL 0.9% saline ○ Clamp the drain for 2 hours ○ If done for a pneumothorax, suspend the chest drain tubing above the level of the patient for 1 hour, to stop the talc from draining out e.g. using a drip stand. Do NOT clamp the drain
○ When the drain is unclamped, leave on free drainage ○ Remove the drain when ≤150mL fluid has drained in 24 hours after the pleurodesis or thoracic ultrasound demonstrates evidence of pleurodesis

❖ Autologous blood ‘patch’ pleurodesis

Autologous blood pleurodesis can be performed in patients with a persistent air leak (more than 5 days) who are not suitable for thoracic surgery.

It is performed by instilling the patient’s own blood through the chest drain. Blood is thought to cause a pleurodesis reaction and formation of a clot over the visceral defect, thereby stopping the air leak. Evidence has shown success rates of up to 80% and reduction in sealing time by about 50%.

Blood pleurodesis must not be done through a small bore chest drain due to the risk of blockage (size 16F or larger recommended). Any patient having blood pleurodesis should have been discussed with the thoracic surgeons and should also be discussed with the pleural team.

AUTOLOGOUS BLOOD PATCH PLEURODESIS
○ Check that the patient has had a persistent air leak for more than 5 days and is not suitable for surgical intervention ○ Review chest x-ray to check that the drain is adequately positioned ○ Check that the drain is an adequate size (16F or larger) and a 3-way tap is attached (Seldinger drains) ○ Ensure another drain is available and ready for insertion in case of blockage and need for immediate replacement
○ Obtain informed consent: pain, fever, drain blockage which can worsen air leak, pleural infection, unsuccessful procedure.
○ Use sterile precautions and ANTT ○ Flush the drain with 20mL 0.9% saline to confirm patency. For large bore chest drains, place a clamp on the drain and flush with 30mL 0.9% saline using a bladder syringe ○ Take 50 – 100mL of venous blood from the patient ○ Instil the blood through the chest drain followed by a flush with 30mL 0.9% saline ○ Suspend the chest drain tubing above the level of the patient for 1 hour to stop the blood from draining out e.g. using a drip stand ○ Do NOT clamp the drain as there is risk of causing a tension pneumothorax ○ Check observations immediately post procedure and after 30 minutes ○ Observe the patient closely for signs of worsening pneumothorax or tension and arrange an urgent chest x-ray if there are any signs of deterioration
○ Remove the chest drain when the air leak stops (this may not occur for a few days post pleurodesis)

GUIDELINES ON ANTICOAGULATION AND ANTIPLATELET THERAPY FOR PLEURAL PROCEDURES

All patients undergoing pleural procedures must have their medications reviewed.

Blood tests including FBC and INR should be checked within 72 hours of the procedure for inpatients and 1 to 2 weeks for elective outpatient procedures. A point of care test (POCT) INR can be performed at the time of the procedure if available.

INR ≤1.5 and platelet count ≥50 are safe for pleural procedures.

The following points need to be considered in patients on anticoagulation/antiplatelet therapy prior to pleural procedures:

- Indication for anticoagulation/antiplatelet therapy
- Bleeding risk of the procedure
- Risk of thromboembolism
- Timing of the procedure (elective or emergency)
- Renal function

❖ Elective and planned pleural procedures

The risk and benefits of suspending medication before the procedure must be discussed with the patient. In patients with a high risk of thrombosis, it is important to discuss with the relevant specialty teams (e.g. Cardiology, Haematology) before stopping therapy. Bridging therapy may be required in some patients e.g. metallic heart valve.

- Aspirin and prophylactic dose LMWH can be continued. For patients on twice daily prophylactic LMWH, allow 4 hours from the last dose.

- Clopidogrel and Prasugrel should be stopped 5 days before a planned procedure. Ticagrelor should be stopped for 7 days.

- Therapeutic low molecular weight heparin should be stopped 24 hours before the procedure.

- Warfarin should be stopped for at least 5 days before the procedure and the INR pre procedure should be ≤1.5. Consider the need for bridging therapy with low molecular weight heparin pre and post procedure in patients at high risk of thromboembolism.

- DOACs should stopped 24 to 48 hours before the procedure depending on the drug, procedure bleeding risk and patient's renal function.

❖ Emergency pleural procedures

It may not be possible to discontinue antiplatelets or anticoagulants in patients requiring an emergency pleural procedure. The risk and benefits of the procedure must be considered and discussed with the patient. Any bleeding risk should be corrected where possible and advice should be sought from the Haematology team.

Table 1: Summary of timing to discontinue antiplatelets/anticoagulation prior to pleural procedures

Drug	When to stop	When to restart	Duration off treatment
Aspirin	No need to stop	No need to stop	None
Clopidogrel/Ticagrelor	Stop for 5 days	Day after procedure	5 days
Prasugrel	Stop for 7 days	Day after procedure	7 days
Prophylactic LMWH	No need to stop *(allow 4 hours from last dose in patients on twice daily dosing)*	No need to stop	None
Therapeutic LMWH	Stop for 24 hours	Day after procedure *(consider prophylactic dose on day of procedure in high risk patients)*	48 hours
Warfarin	Stop for 5 – 7 days until INR ≤1.5	Day after procedure	5 – 7 days
DOAC			
CrCl >50mL/min			
Low bleeding risk procedure	Stop day before and day of procedure	Day after procedure	2 days
High bleeding risk procedure	Stop 2 days before and day of procedure	2nd day after procedure	4 days
CrCl <50mL/min			
Low bleeding risk procedure	Stop 2 days before and day of procedure	Day after procedure	3 days
High bleeding risk procedure	Stop 3 days before and day of procedure	2nd day after procedure	5 days
DABIGATRAN			
CrCl >50mL/min			
Low bleeding risk procedure	Stop day before and day of procedure	Day after procedure	2 days
High bleeding risk procedure	Stop for 2 days before and day of procedure	2nd day after procedure	4 days
CrCl <50mL/min			
Low bleeding risk procedure	Stop 2 days before and day of procedure	Day after procedure	3 days
High bleeding risk procedure	Stop 4 days before and day of procedure	2nd day after procedure	6 days

Table 2: Summary of timing to discontinue DOAC and Dabigatran

	Number of days in relation to pleural procedure										
	Procedure bleeding risk	**-5**	**-4**	**-3**	**-2**	**-1**	**0 Day of procedure**	**+1**	**+2**	**+3**	**+4**
DOAC (CrCl >50)	*Low*	✓	✓	✓	✓	x	x	✓	✓	✓	✓
	High	✓	✓	✓	x	x	x	x	✓	✓	✓
DOAC (CrCl<50)	*Low*	✓	✓	✓	x	x	x	✓	✓	✓	✓
	High	✓	✓	x	x	x	x	x	✓	✓	✓
Dabigatran (CrCl >50)	*Low*	✓	✓	✓	✓	x	x	✓	✓	✓	✓
	High	✓	✓	✓	x	x	x	x	✓	✓	✓
Dabigatran (CrCl <50)	*Low*	✓	✓	✓	x	x	x	✓	✓	✓	✓
	High	✓	x	x	x	x	x	x	✓	✓	✓

✓ - DOAC can be taken
x - **DOAC to be omitted**

Table 3: Bleeding risk for pleural procedures

Pleural procedure	**Bleeding risk**	
Pleural aspiration	Low	Both diagnostic and therapeutic aspiration
Intercostal chest drain insertion	Low	
Indwelling pleural catheter	Low	
Pleural vent device	Low	
Talc slurry pleurodesis	Very low	No need to stop anticoagulation/antiplatelet therapy
Intrapleural fibrinolytic therapy	High	Consider risk vs benefit especially in patients with high thrombotic risk. Discuss with pleural consultant
Local anaesthetic thoracoscopy	High	

Anticoagulants and antiplatelets must NOT be discontinued without a definitive plan for pleural intervention, to reduce the risk of complications and harm from prolonged interruption.

The clinician responsible for the pleural procedure must document a clear plan for withholding and restarting therapy in the patient's records.

References

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GUIDLELINES ON INTRAPLEURAL FIBRINOLYSIS FOR TREATMENT OF PLEURAL INFECTION

Pleural infection is associated with significant morbidity and mortality. Alongside antimicrobial therapy, drainage of infected pleural fluid is one of the key elements of managing pleural infection. It is not unusual for the pleural collection to become septated, which makes drainage more challenging.

In patients fit to undergo surgery, pleural decortication through video assisted thoracoscopic surgery (VATS) is recommended to clear the septated infected fluid from the pleural space. However, in those who are not fit for surgery, intrapleural fibrinolysis using Alteplase (tissue Plasminogen Activator, tPA) and Dornase alpha (DNase) can be effective at breaking down septations within the pleural collection to improve fluid drainage. This is based on evidence from the MIST 2 trial and has been supported by the British Thoracic Society Guideline for pleural disease published in July 2023.

This guideline covers the indications and contraindications for fibrinolysis, risks and complications, administration and monitoring post fibrinolysis.

Indications

- Clinical presentation in keeping with pleural infection
- Treatment failure of chest tube drainage and antibiotics after 48 hours
    - ongoing sepsis
    - persisting significant pleural collection
    - moderate to severe septations on thoracic ultrasound
- Thoracic surgery deemed unsuitable (either due to patient fitness or patient not willing to undergo surgery)

Absolute contraindications

- Age <18 years
- Pregnant or breastfeeding
- Significant coagulopathy, platelets <100 or INR >1.5
- Known sensitivity to tPA or DNase
- Acute or recent stroke
- Recent major haemorrhage or trauma
- Major surgery in the preceding 5 days
- Significantly haemorrhagic pleural fluid
- Bronchopleural fistula or significant trauma/inflammation at chest drain site

Relative contraindications

- Recent treatment dose anticoagulation (may consider half dose fibrinolysis in selected cases)
- End stage renal disease or hepatic impairment
- Severe pleural pain
- High RAPID score
- Significant frailty
- Hydropneumothorax with ongoing air leak

Intrapleural fibrinolysis can only performed by an appropriately trained respiratory specialist:

- Consultant respiratory physician
- ST4+ Respiratory trainee or Senior Clinical Fellow
- Pleural specialist nurse

Patients must be admitted and managed on a Respiratory ward (C14/C26), Cardiothoracic ward or ITU. It is recommended that patients are discussed with the pleural team prior to administering intrapleural fibrinolysis.

Risks and complications

Informed written consent must be obtained prior to treatment and should include the risks and complications listed above.

- Pain
- Bleeding
- Introduction of infection
- Failure of procedure
- Need for further intervention

Patients may experience significant pain following fibrinolysis. Each treatment dose stimulates production of approximately 500mL of pleural fluid in addition to breakdown of septations which causes pain. About 4% of patients require opiates to manage their pain. It is important to ensure that adequate analgesia is prescribed.

Bleeding is the main risk associated with intrapleural fibrinolysis, estimated at 4.2% from trial evidence. If bleeding occurs, majority can be managed conservatively with blood transfusion and blood products. Factors independently associated with a higher bleeding risk include a high RAPID score, use of concurrent anticoagulation, renal failure and a low platelet count (<100). There is evidence that using half dose Alteplase and once daily dosing is effective and safe. This regime can be considered in patients with a higher risk of bleeding deemed likely to benefit from fibrinolysis.

Anticoagulants and antiplatelets should be suspended prior to administration of fibrinolysis as summarised below, taking into consideration the risk of stopping treatment against the benefit to be gained from fibrinolysis.

- Aspirin - 24 hours
- Clopidogrel/Prasugrel - 5 to 7 days
- DOAC - 48 to 72 hours
- Therapeutic LMWH - 48 hours

The administration protocol and post treatment monitoring are summarised on pages 4 and 5.

Malignant pleural effusions

Malignant pleural effusions can also become heavily septated, resulting in challenges when managing this patient group with a high symptom burden. There is limited evidence to suggest optimal management in these patients, so no formal recommendations were made in the BTS guidelines. However, it recommended that *"intrapleural fibrinolytics can be considered in highly selected symptomatic patients with septated malignant pleural effusion to try and improve breathlessness".*

Fibrinolysis should not be used routinely in these patients but it may be considered in patients with the following criteria:

- Significant septations with persisting breathlessness impairing quality of life but with otherwise good performance status (WHO PS 0-2)
- Not responded to initial standard chest tube or indwelling pleural catheter drainage
- Not fit for surgical intervention

The decision to offer treatment is at the discretion of the responsible pleural consultant.

Administration protocol for intrapleural fibrinolysis

Equipment
○ Alteplase 10mg (or 5mg if using half dose) ○ DNAse 5mg ○ 100mL 0.9% saline ○ 2x 50mL Luer lock syringes ○ 2x 20mL Luer lock syringes ○ Drawing up needles ○ Dressing pack ○ Sterile gloves ○ Chlorhexadine cleaning wipes x 4

Administration
○ Ensure adequate supply of tPA and DNase is ordered from pharmacy and in stock on the ward ○ Doses must be prescribed on EPMA and signed for at each administration ○ Ensure regular analgesia is prescribed to be given post treatment
○ Ensure that the chest drain is adequately positioned within the pleural space and a 3-way tap is attached
○ Use sterile precautions and ANTT ○ In a sterile field, draw up the drugs immediately before procedure: - 2x 20mL syringes 0.9% saline - Alteplase (tPA) 10mg drawn up with 30mL 0.9% saline into 50mL syringe (5mg if using half dose) - DNase 5mg drawn up with 30mL 0.9% saline into 50mL syringe ○ Clean side port on 3 way-tap with chlorhexidine wipe ○ Flush drain with 20mL 0.9% saline ○ Instil tPA followed by DNase (clamp the drain in between doses) ○ Flush drain with 20mL 0.9% saline ○ Clamp drain for 1 hour then unclamp and leave on free drainage (suction should NOT be used)
○ Repeat this process twice daily for 3 days with an interval of 8 to 12 hours between doses [maximum dosage is a total of 6 administrations over 3 days]
Notes: If using half dose Alteplase, the product characteristics suggest that it is safe to store the remainder of the 10mg vial in the fridge for up to but no more than 24hrs once opened. If Alteplase is unavailable, Urokinase 100,000 units made up with 30mL 0.9% saline may be used in combination with DNase 5mg. NONE of the drugs should be used as monotherapy as it is not effective but still carries bleeding risk.

Post treatment monitoring
○ Observations: prior to dose administration; immediately after dose administration; at 15 minutes then every 30 minutes for 1 hour. Continue to monitor as per NEWS score if clinically stable ○ Daily monitoring of volume and appearance of pleural fluid ○ Daily thoracic imaging (chest x-ray +/- thoracic ultrasound) to assess response to treatment and successful drainage ○ Daily monitoring of inflammatory response - fever, WCC and CRP ○ Daily monitoring of haemoglobin to detect potential haemorrhage into the pleural space ○ Monitoring can be discontinued after 3 to 5 days once there is evidence of treatment success and the patient is clinically stable

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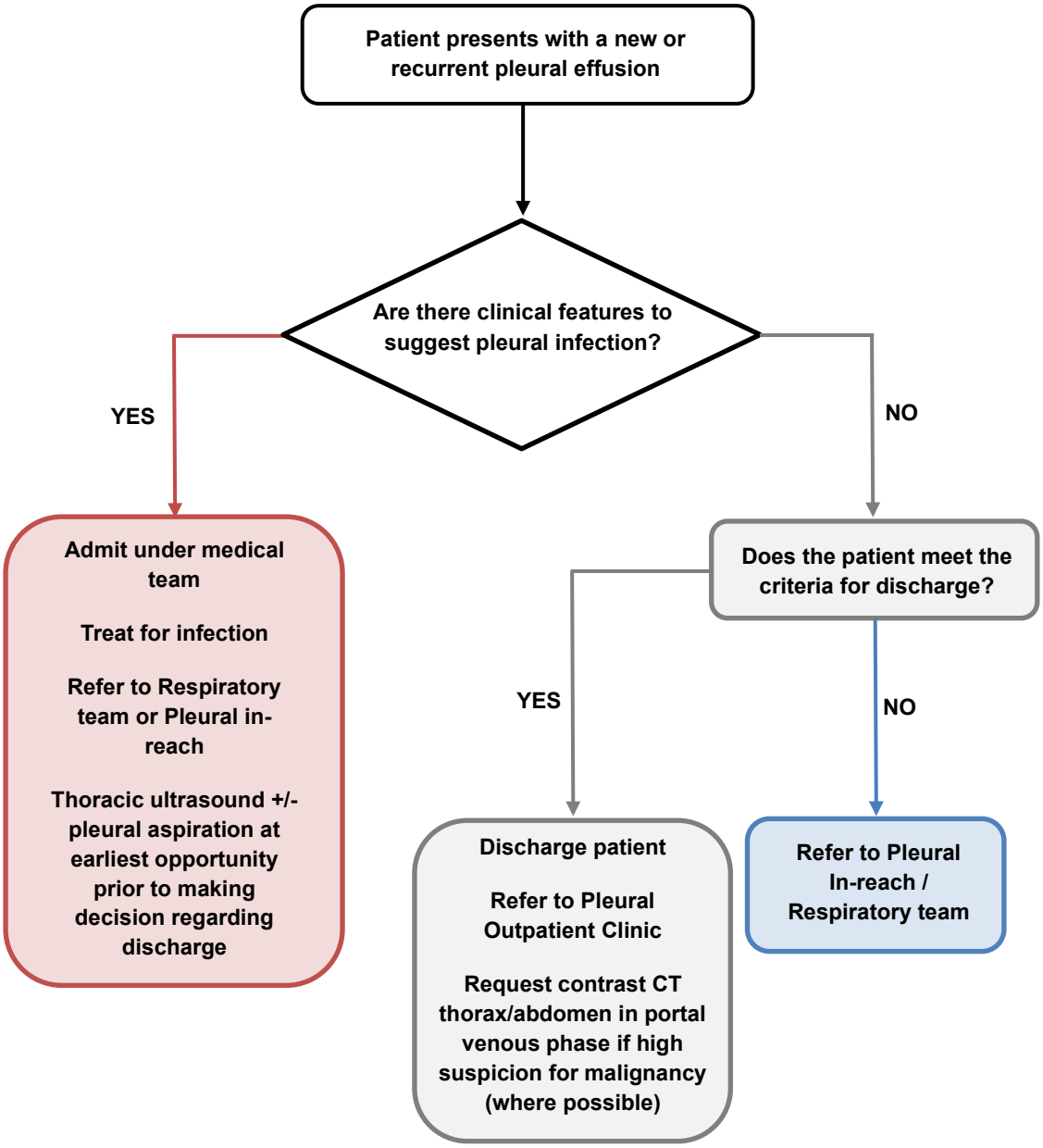
AMBULATORY PATHWAY FOR PATIENTS PRESENTING TO AMU/ED WITH A NEW OR RECURRENT PLEURAL EFFUSION



Criteria for discharge:

- SpO2 > 92% on air (or within target range specific to the patient)
- No haemodynamic compromise
- No evidence of tension on chest x-ray
- Able to cope with symptoms until seen in clinic
- No other clinical or social reason to require inpatient admission

Referral details:

- Pleural in-reach: rwh-tr.pleuralinreach@nhs.net
- Pleural clinic: rwh-tr.pleuraloutpatientclinic@nhs.net

Pleural team:

- Dr Maryam Ahmed – Consultant/Service lead
- Dr Alison Stockbridge – Consultant
- Lisa Sammons – Pleural Nurse Specialist

Guidance notes for the Ambulatory pathway

- Where possible, patients with a new or recurrent pleural effusion should be managed on an ambulatory pathway.

- If a patient has features suggestive of pleural infection (infective symptoms, fever, high inflammatory markers) and a moderate or large pleural effusion, they should not be discharged on the ambulatory pathway unless they have been discussed with the Pleural/Respiratory team. Where possible, these patients should have an ultrasound +/- diagnostic aspiration to decide on the need for admission.

- If a patient has a large effusion but no other reason to need admission, discuss with the Pleural/Respiratory team prior to discharge. They may be appropriate to have a therapeutic pleural aspiration prior to discharge whilst they wait for investigations and an outpatient clinic appointment.

- Where possible, request a staging CT thorax/abdomen in portal venous phase prior to discharge for patients suspected to have malignancy (62 day target).

- Referrals to Pleural clinic will be triaged and offered an appointment depending on the clinical urgency and working diagnosis. If an appointment is not offered, correspondence will be sent to the referrer and/or GP.

- **Information to include in referrals to Pleural clinic:**
  - All relevant background history
  - Reason for referral and working diagnosis
  - Anticoagulant/antiplatelet medication
  - Relevant bloods (including INR) and imaging results
  - Other relevant details e.g. if an interpreter is required

- **Pleural in-reach service**
  Operates Monday to Friday between 9am and 3pm aiming to provide early specialist review of patients with presenting to AMU/ED/Durnall with pleural pathology. The ambulatory pathway may be used for straightforward cases that meet the criteria to be managed on the pathway without review by the Pleural team. During weekend hours, contact the Respiratory Consultant on-call if urgent advice is required.