



# Pleuritic chest pain

## a systematic approach to investigation

In this series, we present authoritative advice on the investigation of a common clinical problem, specially commissioned for family doctors by the Board of Continuing Medical Education of the Royal Australasian College of Physicians.

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Pleuritic chest pain refers to pain in the chest that is made worse with inspiration and coughing, and possibly with movement of the trunk.

A patient complaining of pleuritic chest pain may have an acute serious condition like pulmonary embolism that requires immediate attention, a more chronic serious condition like lung cancer, or a benign problem like inflammation of the costal cartilages. To avoid missing a serious diagnosis, all patients with pleuritic chest pain need to be assessed carefully. The range of possible diagnoses is listed in Table 1.

When obtaining the history, it is important to determine the time course of the pain. An acute presentation may signal a serious condition that needs urgent treatment. If there is an abrupt onset of the pain, check for pulmonary embolism and pneumothorax. More chronic pain can also be caused by serious conditions, like lung cancer, but there is less urgency in establishing the diagnosis.

Other features associated with the pain may or may not be helpful for making the diagnosis. Dyspnoea is too nonspecific to be diagnostic, particularly as some patients may have difficulty

with breathing simply due to the pain itself. However, if the patient is short of breath, it does raise the likelihood of a serious condition that may require rapid intervention. If the dyspnoea is acute, the oxygen saturation and/or blood gases should be measured to see if the patient is in respiratory failure, which would then need urgent management, including supplemental oxygen.

Fever and cough, particularly if there is purulent sputum, make infection likely. A chest x-ray should be obtained to check for pneumonia. If there is pleural fluid, this always needs to be drained and the fluid sent for microbiology and cytology as well as measurement of protein, glucose and pH levels. If there is pus or bacteria in the pleural fluid, or if the pH is less than 7, the patient has an empyema and thoracic surgical management is required.

### Pulmonary embolism

Ten per cent of deep venous thromboses will produce a pulmonary embolism (PE) that will be clinically obvious, and 50% will produce a silent embolus. If left untreated, 30% of PEs will be fatal;

#### IN SUMMARY

- Establish a diagnosis when a patient presents with pleuritic chest pain – do not just treat with analgesics.
- The diagnosis of pulmonary embolism is important but can be difficult to make, so investigations such as CT pulmonary angiography and nuclear medicine V/Q scans are usually necessary. These tests need to be interpreted in the context of the clinical situation.
- If the patient is also short of breath, assess his or her oxygen requirements.
- Consider a CT scan if there is a suspicion of cancer in the chest.
- The sudden onset of pleuritic chest pain may be caused by a pneumothorax; a chest x-ray with expiratory views is needed to make this diagnosis.

**Table 1. Causes of pleuritic pain****Pericardium**

Pericarditis

- postviral
- postinfarction
- connective tissue disease
- malignancy
- trauma

**Lung**

Pulmonary embolism

Pneumonia

Cancer

- primary lung cancer
- metastatic cancer

**Airways**

Tracheobronchitis

- viral
- bacterial

**Pleural space**

Pneumothorax

**Parietal pleura**

Cancer

- mesothelioma
- metastatic cancer

Infection

- empyema
- pleuritis/pleurisy

**Ribs**

Trauma

Cancer

Costochondritis

**Intercostal muscles**

Coughing

Trauma

**Nerves**

Post-thoracotomy or other procedure

**Skin**

Shingles

Trauma

**Abdomen**

Subphrenic abscess

however, if treated, less than 5% will be fatal. Thus it is important to consider PE not only when there is sudden onset of pleuritic chest pain, but also if there is dyspnoea or haemoptysis, or if the patient is unwell without an obvious cause as many emboli will not be associated with chest pain. The risk factors shown in Table 2 should also raise suspicion for PE.

A diagnostic approach for PE is outlined in the flowcharts on pages 55, 56 and 59.

**Simple investigations**

The chest x-ray may be normal in the presence of PE, but one still should be obtained to see if there is another condition like a pneumothorax or pneumonia producing a patient's symptoms (Figure). Hypoperfusion or vascular pruning may be seen with PE, and some patients will have a wedge-shaped opacity.

The ECG is normal in about 30% of PE cases, but again one should be obtained to look for ischaemic and pericarditic changes. The common changes seen on the ECG with PE are not specific enough to be diagnostic. S1Q3T3 and a new right bundle branch block are more specific for PE, but they are not commonly seen.

Arterial blood gases can be normal or show hypocapnia or hypoxaemia in PE.

**Table 2. Risk factors for pulmonary embolism**

- |                  |                          |
|------------------|--------------------------|
| • Prolonged rest | • Obesity                |
| • Surgery        | • Oedema                 |
| • Pregnancy      | • Phlebitis              |
| • Trauma         | • Smoking                |
| • Past clots     | • Hypercoagulable states |
| • Cancer         | • Family history         |

Again, they are not diagnostic but should be performed, particularly if the patient is unwell, to see if supplemental oxygen is required.

**Imaging**

In most cases the clinical findings and simple tests are not specific or sensitive enough to diagnose or exclude PE, and a nuclear medicine ventilation-perfusion scan (V/Q scan) and/or CT pulmonary angiogram (CTPA) is required. Most radiology departments do not perform conventional pulmonary angiograms, so these will not be discussed further.

The diagnosis of PE can sometimes be made in a patient with the appropriate clinical features and risk factors. However, the treatment of anticoagulation involves risk and inconvenience for several months at least, so it is usually expected that a firm diagnosis be made with a CTPA or V/Q scan. The exception would be for patients in a remote centre without easy access to scans: a decision to treat could then be made without a firm diagnosis because leaving PE untreated is also risky. This decision needs to be made on an individual basis, balancing the risk of treating against the risk of not treating.

**V/Q scans**

The interpretation of V/Q scans is dependent on the clinical probability of a PE. This concept is discussed in the box on page 60. Of note:

- if the clinical probability of a patient having PE is low, then a PE is most

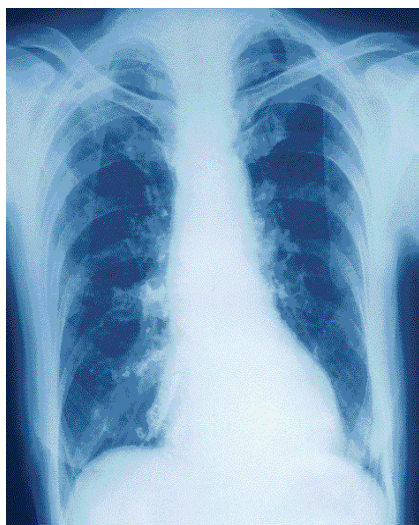


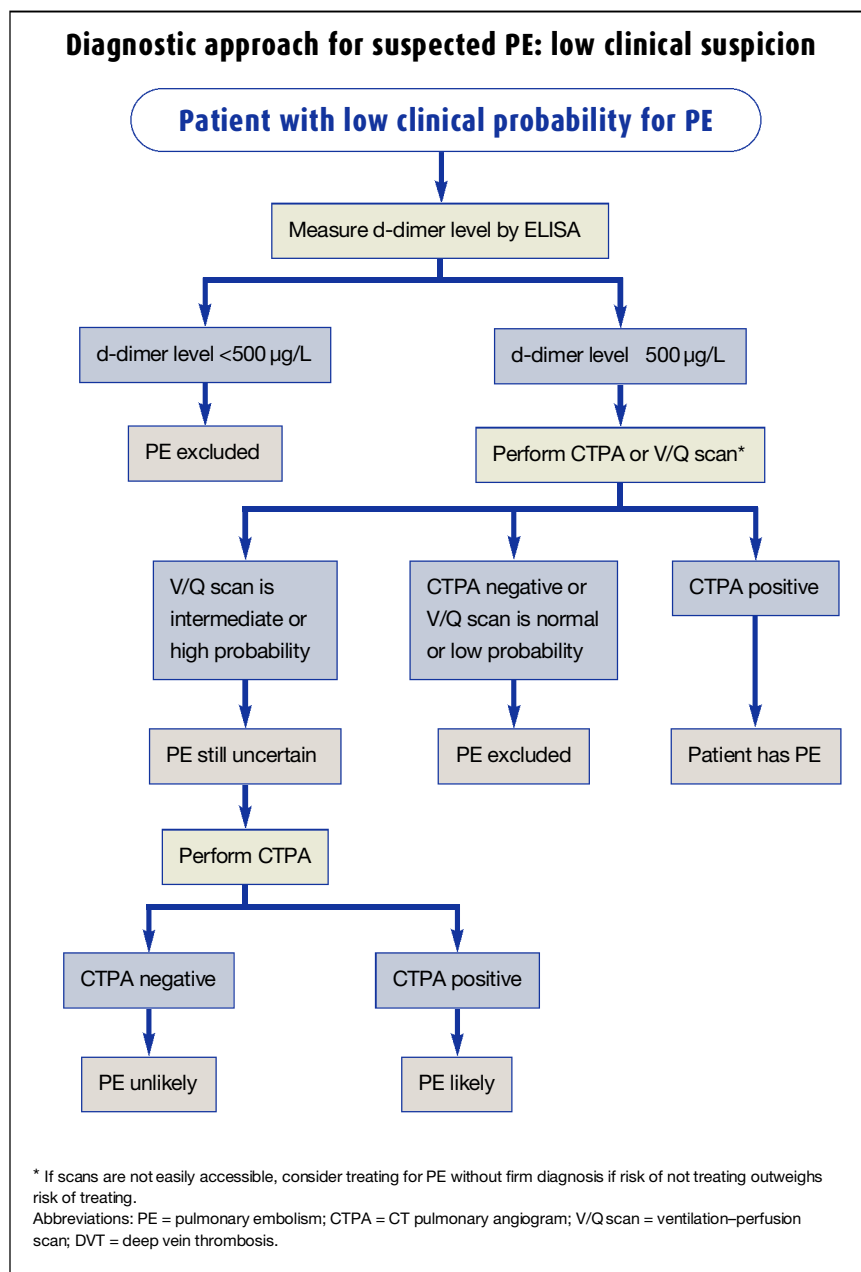
Figure. X-ray showing pneumonia. Pleuritic chest pain is not usually a feature of pneumonia, but may be present if pneumonia also involves the pleura.

unlikely if the scan result is also normal or low probability

- if the clinical probability is high, a normal or low probability scan does not exclude a PE, but a high probability scan result confirms the diagnosis
- further investigation is usually needed for patients with scans with an indeterminate probability
- a normal V/Q scan generally excludes a PE except when the clinical suspicion is high.

### CT pulmonary angiogram

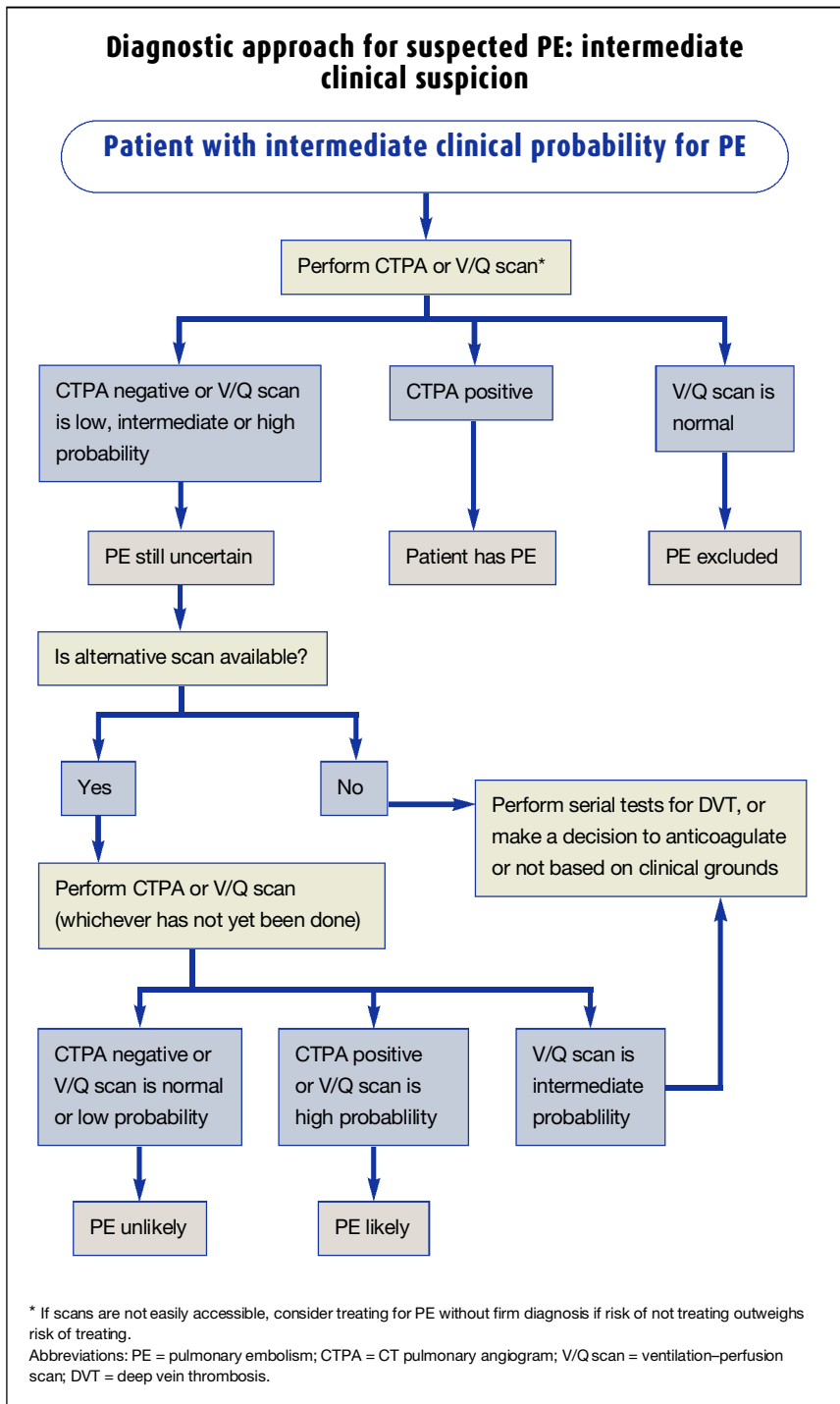
The other commonly used diagnostic test for PE is CTPA. This has a sensitivity of around 95% and a similar specificity for lobar and segmental emboli. It has been criticised for not reliably detecting subsegmental PE, but only 6% of all PEs in the Prospective Investigation of Pulmonary Embolism Diagnosis (PIOPED) study (see the box on page 60) were of this type.<sup>1</sup> Despite these limitations, only 5% of patients with a negative CTPA will develop thromboembolic disease over the next three months. However,



this test is not very sensitive for detection of chronic emboli as the vessels can disappear.

A CTPA has the advantage that other disease processes can be detected with the CT images; this occurs in 30 to 40% of patients. Initially, the choice between a V/Q scan or CTPA is usually determined by the availability of these tests. However,

if there is chronic heart or lung disease it is preferable to get a CTPA. To look for other pulmonary disease as well as PE, consider requesting a CTPA with a full chest CT scan. Also, there is concern about the radiation dose with CTPA to the breasts of young women, so it is preferable for women under 40 years of age to have a V/Q scan.



but it has a role in assessing patients with severe PE to see if thrombolysis is indicated.

**D-dimer levels**

The sensitivity of d-dimer levels measured with the ELISA technique, using a less than 500 µg/L cut-off, is close to 100%. However, it is not specific. This means that a d-dimer level below 500 µg/L excludes PE, but a level equal to or above 500 µg/L does not tell you whether or not the patient has a PE. So if the clinical suspicion for PE is low, it is worth measuring the d-dimer level to exclude PE, but if your clinical suspicion is moderate or high, go straight to a V/Q scan or CTPA. Most hospital patients have levels above 500 µg/L, so it is not a useful test in this group.

The latex test for d-dimer is not sensitive enough to be useful in excluding PE.

**DVT**

If the diagnosis is still not clear after a V/Q scan and/or CTPA, look for DVT. If a DVT is present, anticoagulation will be needed and the diagnosis of PE is then not essential. If the first test is negative for DVT, it should be repeated a few days later to see if any clot is extending. This is based on the fact that 95% of PEs come from a clot in popliteal and/or proximal thigh and pelvic veins. These proximal clots usually extend from calf veins and about 25% of untreated clots in calf veins will extend proximally, usually within 48 hours.

**Pneumothorax**

Pneumothorax needs to be considered if there is sudden onset of pleuritic chest pain. Sometimes the patient will also feel short of breath, but not always. A chest x-ray with expiratory views is the simplest way to detect a pneumothorax. In patients with emphysema, care needs to be taken to distinguish between a pneumothorax and a large bulla. Attempting to drain a bulla can lead to a persistent air leak and be dangerous for the patient.

**Echocardiography**

Right ventricular abnormalities are seen on echocardiography in 80% of patients with PE, but these changes are not specific

for PE because other conditions, such as COPD, may also cause right ventricular dysfunction. Thus echocardiography is generally not used to diagnose PE initially,

Very small pneumothoraces may be missed on chest x-ray but be able to be seen on a CT scan. If they are this small, they are not usually clinically relevant, so CT scans are not usually used to look for a pneumothorax.

If the patient is in respiratory failure with hypoxaemia and/or is hypotensive, consider a tension pneumothorax, in which the air in the pleural space is continuing to expand. This is a medical emergency and requires urgent insertion of an intercostal drain.

### Pericarditis

The pain of pericarditis is due to irritation of the adjacent pleura and so is usually in the centre of the chest, and may radiate to the shoulders or neck. It tends to be sharp, severe, persistent, worse with lying down, and eased with leaning forward.

Pericarditis may occur:

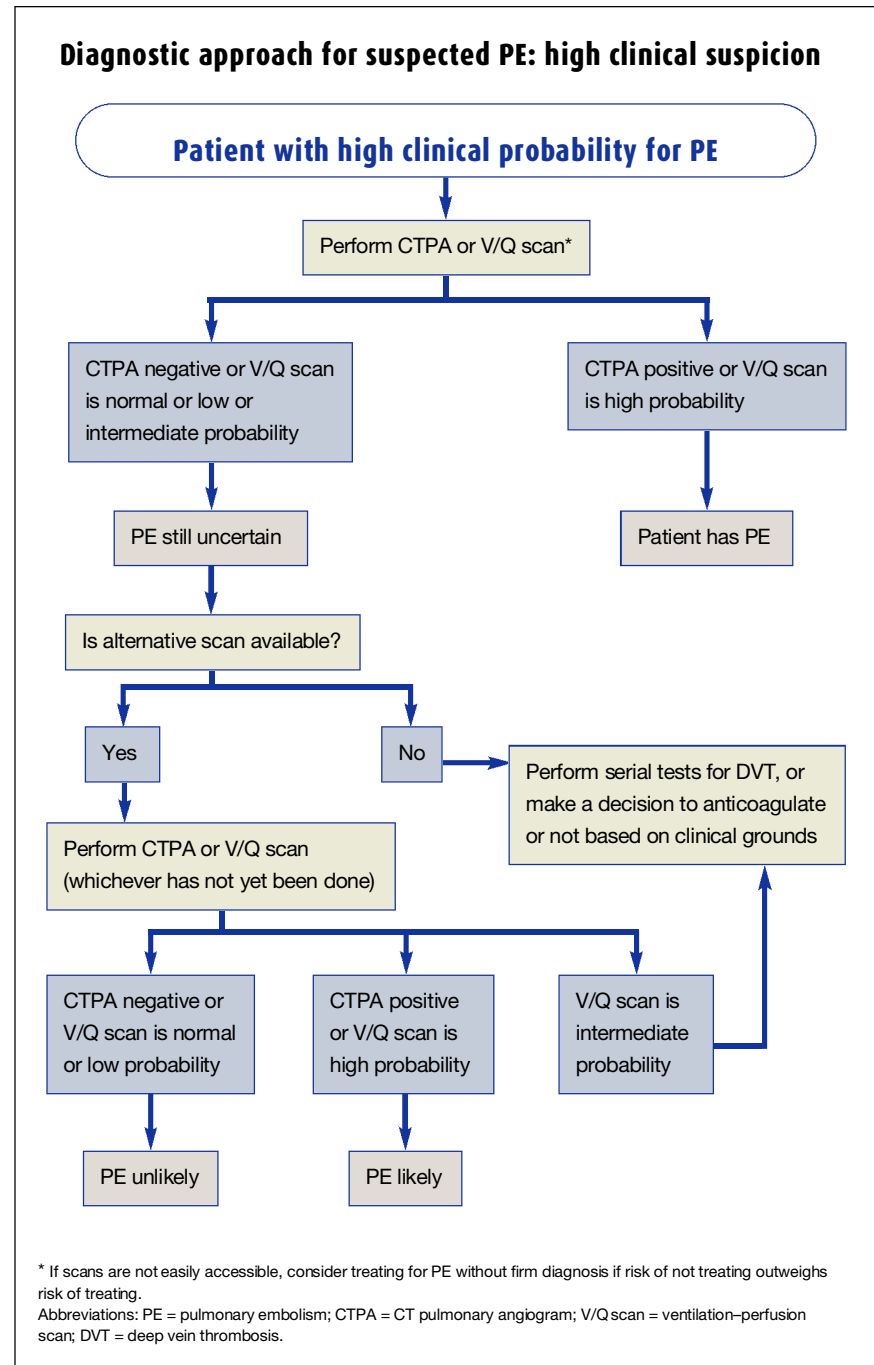
- after myocardial infarction, viral infections or trauma
- in association with connective tissue diseases like rheumatoid arthritis and systemic lupus erythematosus
- as a result of metastatic cancer deposits.

Dressler's syndrome is pericarditis that occurs two to four weeks after myocardial infarction. Sometimes a rub may be heard, but pericarditis is not excluded if there is no rub.

In patients with pericarditis an ECG usually shows ST elevation in all leads except aVR. If the jugular venous pressure is raised, the apex beat is difficult to feel or the heart sounds are indistinct, look for a pericardial effusion with an echocardiogram. Sometimes a friction rub may be heard with pericarditis.

### Lower respiratory tract infection and pleurisy

Lower respiratory tract infections include both infective bronchitis and pneumonia (see Figure). Pleuritic chest pain is not usually a feature of these infections, but it may be present if pneumonia also involves the pleura, or if there is direct



infection of the pleura itself, most commonly with respiratory viruses. Excessive coughing can cause diaphragm or intercostal muscle pain, and in people with osteoporosis it may produce rib fractures.

### Costochondritis

The pain of costochondritis is localised over the costal cartilages, which are tender when pressed. The tenderness is usually at the costochondral junction, and the cause is unknown. In 80% of cases only

## Interpreting V/Q scan results

### The PIOPED study

The Prospective Investigation of Pulmonary Embolism Diagnosis (PIOPED) study assessed the diagnostic value of V/Q scans compared with catheter pulmonary angiograms.<sup>1</sup> Based on these data, V/Q scan results are now usually classified as being normal or being low, intermediate or high probability for pulmonary embolism (PE). In the study:

- 88% of patients with a high probability V/Q scan had a PE, but only 44% with PE had a high probability scan. In other words, a scan result that is not high probability for PE does not exclude a PE
- about 66% of scans were indeterminate. This proportion is higher in patients with lung or heart disease, which limits the usefulness of V/Q scans in this group
- only 2% of patients with a normal or low probability result on a V/Q scan had a PE, so a normal or low result nearly (but not quite) excludes a PE.

However, it should be remembered that V/Q scans performed in Australia are of a better quality than those in the PIOPED study (conducted in the USA), as Technegas is used here. Thus, the applicability of the study results in Australia today has been questioned.

### The clinical setting

A patient's V/Q scan result needs to be interpreted in the light of his or her clinical probability for a PE. The probabilities of a PE using both the V/Q result and the clinical probability are shown in the Table below. These probabilities are based on PIOPED data.

**Table. Determining PE probability**

V/Q scan result	Clinical probability for PE		
	High	Intermediate	Low
High	96%	88%	56%
Intermediate	66%	28%	16%
Low	40%	16%	4%
Normal	10%	6%	2%

one cartilage (usually the second or third) is involved. The onset and duration of the pain are quite variable. There are no specific diagnostic tests for costochondritis. Tietze's syndrome is costochondritis with firm lumps in the involved cartilages.

### Chest wall pain

Rib pain is localised to the ribs involved, and these may also have localised tenderness. There may be an obvious story of trauma; if so, fractured ribs may – but not always – be detected with a chest x-ray with specific rib views. Look for a pneumothorax, haemothorax and underlying

lung contusion on the chest x-ray.

Minimal trauma, and even simple coughing, may produce fractures in older patients with osteoporosis. A bone scan is a more sensitive way of detecting rib fractures than x-rays if the diagnosis is in doubt.

Localised chest pain may also be caused by pain in the intercostal muscles. However, there is also the worry of metastatic cancer with painful ribs, which may be missed with x-rays. Again, a bone scan will be more useful in detecting metastases; suspicion will be raised if there are multiple hot spots on the bone scan. In

this situation, a search for the primary cancer will be needed, including:

- examining the breasts and mammograms in women
- checking the prostate and prostatic specific antigen in men
- performing a CT scan of the chest in smokers, including the upper abdomen to look for renal masses.

Chest wall pain can also be caused by cancer invading the pleura or arising in the pleura, and by mesothelioma.

Consideration should be given to obtaining a CT scan of the chest if there is persistent pain of unknown cause – particularly if there are risk factors for cancer such as smoking or asbestos exposure.

### Subphrenic disease

The differential diagnosis of pleuritic chest pain also includes intra-abdominal pathology such as a subphrenic abscess, an infected gallbladder or hepatitis. In such cases, the patient will usually have signs of infection and have abdominal tenderness and guarding.

### Shingles

Infection of the skin with herpes zoster virus (shingles) can produce pain in the chest before the characteristic rash appears. However, the pain is usually constant rather than pleuritic, and confined to a dermatomal distribution over the skin.

### Conclusion

Pleuritic chest pain can be caused by serious conditions. For this reason, it is important to make a diagnosis and not just to treat the symptoms. **MT**

### Reference

1. The PIOPED Investigators. Value of the ventilation/perfusion scan in acute pulmonary embolism. Results of the Prospective Investigation Of Pulmonary Embolism Diagnosis (PIOPED). JAMA 1990; 263: 2753-2759.

**DECLARATION OF INTEREST: None.**