

Problem based review: Pleuritic Chest Pain

RW Lee, LE Hodgson, MB Jackson & N Adams

Abstract

Pleuritic pain, a sharp discomfort near the chest wall exacerbated by inspiration is associated with a number of pathologies. Pulmonary embolus and infection are two common causes but diagnosis can often be challenging, both for experienced physicians and trainees. The underlying anatomy and pathophysiology of such pain and the most common aetiologies are presented. Clinical symptoms and signs that may arise alongside pleuritic pain are then discussed, followed by an introduction to the diagnostic tools such as the Wells' score and current guidelines that can help to select the most appropriate investigation(s).

Management of pulmonary embolism and other common causes of pleuritic pain are also discussed and highlighted by a clinical vignette.

Keywords

Pleuritic pain, pulmonary embolus, pleurisy, chest pain

Key Points

1. Pleuritic chest pain is a common reason for presentation to hospital.
2. Pulmonary embolism is a common, potentially life-threatening cause but can be difficult to diagnose, with clear overlap between typical presentations.
3. Excluding other differential diagnoses can be difficult without definitive investigation e.g. CT Pulmonary Angiography (CTPA).
4. Clinical probability and scoring systems (e.g. Wells' score) can assist the physician in further management.
5. Several key guidelines from the thoracic and cardiological societies provide useful algorithms for investigation and further reading.

Richard William Lee
MBBS, MRCP, MA
(Cantab.)
Respiratory Registrar,
Darent Valley Hospital

Luke Eliot Hodgson
MBBS, MRCP, MSc
Respiratory Registrar,
Brighton & Sussex
University Hospitals NHS
Trust.

Mark Basil Jackson
MBBS, FRCP
Respiratory Consultant,
Brighton & Sussex
University Hospitals NHS
Trust

Nick Adams
MD, FRCP
Respiratory Consultant,
Western Sussex Hospitals
NHS Trust

Correspondence:
Dr Mark Jackson
Royal Sussex County
Hospital,
Brighton and University
Hospitals NHS Trust,
Eastern Road,
Brighton
Email: Mark.Jackson@bsuh.
nhs.uk

Introduction

Pleuritic pain is a sharp, 'catching' pain perceived deep to the chest wall, exacerbated by inspiration. In Greek, pleura translates as *rib* or *side* and indeed pain of a pleuritic nature has been described at least as early as the time of Hippocrates "when pain seizes at the side, either at the commencement or at a later stage, it will not be improper to try to dissolve the pain by hot applications".¹

A pulmonary embolus is a relatively common and potentially life-threatening cause of pleuritic pain. Similar pain however complicates a number of other common respiratory pathologies. This review will focus on the differential diagnosis; the decision making process that surrounds this and the literature that supports the investigation and treatment modalities available. Discussions of chest pain associated with acute coronary syndromes can be found elsewhere.²

2. What anatomical structures give rise to pleuritic pain?

The lung and chest wall are lined by visceral and parietal pleura respectively, providing a frictionless

Case History

A 37 year-old male smoker, with no previous medical history presented to his GP with acute right-sided chest pain that had developed acutely overnight and was worse on inspiration. He was noted to be tachycardic with a heart rate (HR) of 140 beats per minute (bpm), hypoxaemic with oxygen saturations of 90% on room air and a low grade fever (37.9°C). The patient was sent into hospital for further assessment.

Initial assessment in the emergency department revealed oxygen saturations of 96% on room air, HR 100 and a respiratory rate of 22 breaths per minute. Coarse crepitations were heard at the right base with dullness to percussion. ECG demonstrated a sinus tachycardia. A chest infection was diagnosed and antibiotics were commenced and a referral to the medical team made.

surface over which the lungs can slide within the thoracic cavity. Movement of these membranes with inspiration and expiration can become impaired when the pleura or underlying structures are damaged.

Inflammation, infiltration or other injury of the parietal pleural can give rise to pleuritic pain. This is somatic, transmitted by fast-conducting A-delta fibres and typically perceived as sharp in nature and well localised. The pain characteristically worsens with inspiration. Referred pain from the pleura may also be felt in the thoracic wall in the areas of skin innervated by the intercostal nerves.³ It is important to distinguish this from visceral pain from internal organs, transmitted by slow-conducting C fibres, poorly localised and typically dull or aching in character as well as neuropathic pain which may also affect the chest wall.

3. What are the causes of pleuritic pain and the clinical features that differentiate them?

Although pleuritic pain is often well defined in location and can be reproduced by asking the patient to make an inspiratory effort, chest pain experienced by patients presenting to general practice or the emergency department with pleural pathology can be difficult to relate to classical descriptions of pleuritic pain. In addition, patients presenting with other non-pleural causes of chest pain can describe pain that at times has an apparently pleuritic nature.

The literature suggests that up to 15% of hospital admissions for chest pain are attributable to pulmonary disease.⁴⁻⁶ The most important factor in making an accurate diagnosis of pleuritic chest pain is to establish whether the pain is truly pleuritic in nature and not, for example, the 'typical' dull, crushing sensation of cardiac ischaemia or the tearing pain that radiates to the back of aortic dissection. Other symptoms suggestive of infection or trauma are then useful discriminators. In the Manchester Investigation Of Pulmonary Embolism (MIOPE) study of pleuritic chest pain presentations to an emergency department, only 5.4% were ultimately diagnosed as having a pulmonary embolus.⁷

3a. Pleuropulmonary Pathology

Pulmonary Embolism

Pulmonary emboli are fragments of thrombi that usually form in the deep venous system of the lower limbs or pelvis as a result of an alteration in one or more components of "Virchow's Triad" (see figure 1): blood flow, coagulability and vessel wall function. These pass through the right heart and lodge at a position downstream of the right ventricle. A large embolus may lodge either side of the main pulmonary trunk as a "saddle embolus", whereas smaller emboli can occlude varying sized vessels. The significance of emboli occluding the smallest of these vessels is unclear.

The high mortality rate and nonspecific symptoms of pulmonary embolism (PE) lead us into the undesirable position of simultaneously over-testing for⁹⁻¹⁰ and under-diagnosing the disease.¹¹⁻¹² Whilst the clinical diagnosis of acute PE is challenging,¹³

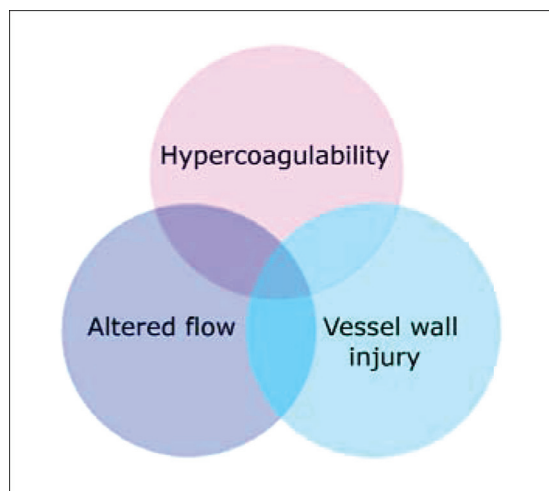


Figure 1. Virchow's Triad (adapted from⁸).

a high index of suspicion should prompt investigation at an appropriate emergency facility.

The literature suggests an incidence of PE of 70/100,000 population per year,¹⁴ 50% of which occur when subjects are inpatients of hospitals and other institutions.¹⁵ It is a diagnosis to be considered in any patient with chest pain, and suspicion is increased where there is a previous history of venous thromboembolism (VTE), immobilisation or malignancy or where there is dyspnoea not fully explained by the clinical evaluation, chest radiograph, or electrocardiogram.¹⁶⁻¹⁷ Isolated symptoms and signs are often not helpful diagnostically, because their frequency is similar among patients with and without PE.¹⁸

The most frequently occurring symptoms in the Prospective Investigation of Pulmonary Embolism Diagnosis (PIOPED 1) study were dyspnoea (73%), pleuritic chest pain (66%), cough (37%), and haemoptysis (13%).¹⁹ The subsequent PIOPED 2 study further elucidated that dyspnoea may be absent or occur only on exertion.¹⁸ When present, the onset of dyspnoea is usually rapid. Other common symptoms may also be absent or mild, even with severe PE.

Clinical examination findings in suspected PE are poorly specific – the commonest physical signs in the PIOPED 2 study were tachypnoea (70%) and crepitations (51%). A tachycardia was present in 30% of subjects but is also common to a number of alternative diagnoses.¹⁸ The PIOPED 2 study showed that combined symptoms or signs had improved sensitivity: 92% of patients found to have a PE had pleuritic pain, dyspnoea or tachypnoea; whilst one or more of these signs and symptoms or signs of deep venous thrombosis were present in 98% of patients with PE. In the PIOPED 1 study, a chest radiograph abnormality was seen in 84% and 50% had non-specific electrocardiographic abnormalities.¹⁹ More specific clinical signs e.g. an audible fourth heart sound (25%) or an accentuated second heart sound

Problem based review: *Pleuritic Chest Pain*

(23%) in addition to other signs of right heart failure can be useful but may not be present at onset.

It is often a combination of all key clinical data including risk factors for PE that enables a diagnosis to be made (**see section 4 – What are the risk factors for pulmonary embolism? below and Table 5**).

Pneumonia

Pneumonia is an inflammatory process of the lung parenchyma (airways or alveoli) usually associated with bacterial infection. The patient with community acquired pneumonia (CAP) classically presents with acute onset of rigors followed by fever, pleuritic chest pain and cough productive of purulent sputum. In one series, chest pain occurred in 30% of cases, chills in 40-50% and rigors in 15%.²⁰

Pleural “parapneumonic” effusions are a common complication – it was described in up to 29.8% of patients with CAP in a meta-analysis by Fine *et al*²¹ and may progress to an empyema where organisms invade the pleural space. A pus laden effusion may result in spiking fevers. Empyema should always be considered in any patient presenting with a pleural effusion and non-resolving pneumonia or fever.²²

Pleural effusion

Pleural effusion can complicate any pathology of the pleura and is not limited to bacterial pneumonia – for example it may occur secondary to tuberculosis, malignancy or a pulmonary embolus. Pleuritic chest pain may occur as a result of an effusion, although a patient with a large pleural effusion may as readily present with dyspnoea or non-specific chest discomfort. “Stony” dullness to percussion with diminished breath sounds would suggest the presence of pleural fluid.

Pneumothorax

Sudden onset pleuritic pain and respiratory distress may also signal spontaneous pneumothorax. This accounts for approximately 20 admissions per 100,000 population per year.²³ A primary spontaneous pneumothorax occurs without a precipitating event in a person with no overt lung disease – young, tall, adult male smokers are at increased risk. Secondary pneumothoraces occur in patients with underlying lung disease including pulmonary fibrosis and emphysema and may be more refractory to treatment.

Pleurisy

Pleurisy is an inflammation of the parietal and serous pleura of the lung usually precipitated by infection. Viral pleurisy is a common cause of pleuritic chest pain in young adults and is associated with coxsackie virus infection (“Bornholm’s syndrome”). Bacterial causes are also well recognised. Tuberculosis should be considered where there is suggestion of immunocompromise or close contact with a known

case of active tuberculosis. Pleurisy as a result of a more generalised serositis can also be seen in a number of connective tissue diseases such as systemic lupus erythematosus or rheumatoid arthritis. Uraemia complicating advanced renal failure is also a recognised cause of pleural irritation.

Cancer

Isolated chest pain is reported as a relatively rare presentation of lung cancer.²⁴ However, patients with known lung cancer may present with dyspnoea in the context of pleuritic chest pain that may not have been as severe or not have been recognised previously. Neuropathic or bone pain may be described by the patient to have a similar character to pleuritic pain, particularly in peripheral tumours or mesothelioma with invasion of chest wall structures. In such cases, duration of onset, relation to other symptoms and distinguishing the pain from a more persistent or gnawing pain may help to differentiate this from pulmonary embolism.

3b. Extra-Pulmonary causes

Pericarditis

Acute pericarditis causes chest pain over the anterior chest, typically sudden in onset. This can be pleuritic in nature but diminution of pain when the patient sits forward together with radiation, especially to the trapezius ridge can help pinpoint the diagnosis. An accompanying pericardial friction rub and widespread ST segment elevation on the electrocardiogram is also typical.²⁵

Musculoskeletal Pathology

Chest wall pathology is a common cause of chest pain seen by primary care clinicians, accounting for 36% of episodes in one report.²⁴ The patient may describe a history of repetitive or unaccustomed activity involving the upper trunk or arms – it is common however, for the patient to be unable to recall any such event. Musculoskeletal chest pain is often insidious and persistent, lasting for hours to weeks. This is frequently sharp and localised to a specific area (such as the xiphoid), but may be diffuse and poorly localised. The pain may be positional or exacerbated by deep breathing, turning, or arm movement. Three of the commonest musculoskeletal causes of pain mimicking pleuritic pain are:

- **Costochondritis** – multiple areas of tenderness at the costochondral or costosternal junctions that reproduce the described pain, usually at the upper costal cartilages. Chest wall palpation can also reproduce the discomfort of true pleurisy and does not rule out pleural pathology.
- **Tietze’s syndrome** – also causes costosternal, sternoclavicular, or costochondral tenderness but is associated with localised swelling of the

Problem based review: Pleuritic Chest Pain

joints and is less common, primarily affecting young adults.²⁶⁻²⁷

- **Vertebral pathology** - particularly involving the articulations of the posterior ribs. Neuropathic pain or focal neurological signs may localise spinal pathology.

Musculoskeletal chest wall pain is common in rheumatological conditions such as rheumatoid arthritis, ankylosing spondylitis, psoriatic arthritis, and fibromyalgia. Co-existence of pleural effusion suggests serositis and a clear history of joint inflammation, skin rashes or mucous membrane irritation suggests a systemic auto-immune process.

Skin and sensory nerves

Chest pain may be the presenting symptom of herpes zoster (shingles), and often precedes the characteristic rash. A well localised band of burning pain will be more typical than that usually described for pleuritic pain.

Psychogenic/Psychosomatic

A report of patients evaluated in an emergency department for chest pain found that 20% had panic disorder as the cause.²⁸ It is reported that approximately one-third of patients presenting to the emergency department for chest pain have a psychiatric disorder, while approximately 50% of patients with non-cardiac chest pain have various psychiatric diagnoses.²⁹⁻³⁰ Careful discussion of the presenting complaints is required to exclude a serious pathology.

Abdominal pathology

Pylonephritis, cholecystitis, ovarian pathology or appendicitis may present with upper abdominal pain that can occasionally be difficult to distinguish from lower chest wall pain. The presence of "shoulder tip" pain suggesting diaphragmatic irritation should not be missed.

4. What are the risk factors for pulmonary embolism?

Identifying and documenting risk factors (see Tables 1 & 2 below) for VTE to establish a "pre-test probability" of pulmonary embolus is key to most recent recommendations concerning diagnosis (British Thoracic Society (BTS) Guidelines, 2003; European Society Cardiology (ESC) Guidelines, 2008).^{15,31} Patients can be categorised as low, intermediate, or high probability for PE.³²⁻³³

Virchow's triad (see Figure 1) also provides a useful *aide memoire* for PE risk factors: venous stasis (abnormal flow) may be precipitated by immobility; hypercoagulability may be the result of malignancy (especially advanced or metastatic abdominal and pelvic tumours), thrombophilia or other haematological abnormality; vessel wall injury may be traumatic or secondary to

Table 1. Summary of VTE Risk Factors.

Inherited risk factors

Antithrombin deficiency
Factor V Leiden
Protein C deficiency
Protein S deficiency
Prothrombin G20210A

Acquired risk factors

Advancing age
Inflammatory bowel disease
Leg paresis or paralysis
Lupus anticoagulant
Malignancy
Myeloproliferative neoplasms
Nephrotic syndrome
Obesity
Paroxysmal nocturnal haemoglobinuria
Prior superficial vein thrombosis
Wegener granulomatosis

Triggering factors

Oestrogens (hormone therapy, oral contraceptives)
Pregnancy and post-partum period
Prolonged air travel
Surgery
Temporary immobilisation
Trauma or major fracture

(**Others:** Elevated homocysteine; elevated factors V111, 1X, X1; thrombin activatable fibrinolysis inhibitor; decreased tissue factor pathway inhibitor; decreased fibrinolytic activity; activated protein C resistance without factor V Leiden)

Table 2. Major and Minor risk factors for VTE (from¹⁵).

Major risk factors (relative risk 5–20):

- Surgery (where appropriate prophylaxis is used, relative risk is much lower) - Major abdominal/pelvic surgery: Hip/knee replacement: Postoperative intensive care
- Obstetrics - Late pregnancy, Caesarian section, Puerperium
- Lower limb problems - Fracture, Varicose veins
- Malignancy - Abdominal/pelvic, Advanced/metastatic
- Reduced mobility - Hospitalisation, Institutional care
- Miscellaneous - Previous proven Venous Thromboembolism (VTE)

Minor risk factors (relative risk 2–4):

- Cardiovascular - Congenital heart disease, Congestive cardiac failure, Hypertension, Superficial venous thrombosis, Indwelling central vein catheter
- Oestrogens - Oral contraceptive, Hormone replacement therapy
- Miscellaneous - COPD, Neurological disability, Occult malignancy, Thrombotic disorders, Long distance sedentary travel, Obesity, Other[†]

[†] Inflammatory bowel disease, nephrotic syndrome, chronic dialysis, myeloproliferative disorders, paroxysmal nocturnal haemoglobinuria, Behçet's disease.

Problem based review: *Pleuritic Chest Pain*

circulating irritants. Previous thrombosis should be identified in the history. The post-operative patient is at particular risk, even as far as three months post surgery, particularly after major abdominal or orthopaedic surgery - including fractures. Obstetric factors are also associated with

an increased risk – particularly in the late stages of pregnancy. There is however an increased risk throughout pregnancy, including the immediate post natal period.³⁴ Identifying whether thromboprophylaxis has been prescribed is a key part of the drug history in any in-patient.

Case Update 1

The Acute Medical Consultant reviewed the patient and noted a history of a cough productive of green sputum for 3 days. An arterial blood gas (ABG) on air showed a PaO_2 of 8.7kPa and a PaCO_2 5.2 kPa. The patient had a white blood cell count of 18 with a neutrophilia and a C-reactive protein (CRP) of 223. A chest radiograph was performed.

What does the chest radiograph show? (answers on p175)

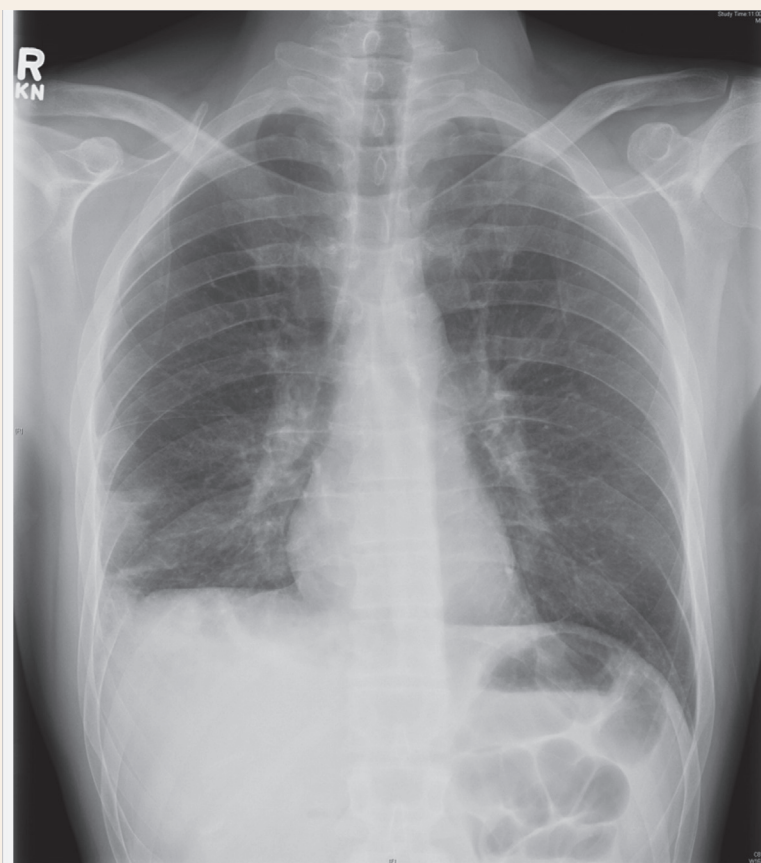


Figure 2. Chest radiograph on admission.

He was diagnosed with pneumonia and discharged later the same day with a course of antibiotics.

The patient re-presented three days later complaining of bilateral, pleuritic chest pain, with a few episodes of small volume haemoptysis and fevers at night. Observations revealed oxygen saturations of 97% on room air, HR 152bpm, BP 107/78, respiratory rate 22 and a temperature of 37.2°C. ABG showed a PaO_2 of 8.3kPa and a PaCO_2 5.1kPa. Chest examination was unremarkable. A rising CRP (236) was noted, with no risk factors identified for venous thromboembolism (VTE). The impression remained pneumonia but with a differential of pulmonary embolism. Chest radiography was repeated.

Problem based review: Pleuritic Chest Pain

What does the repeat chest radiograph show? (answers on p175)

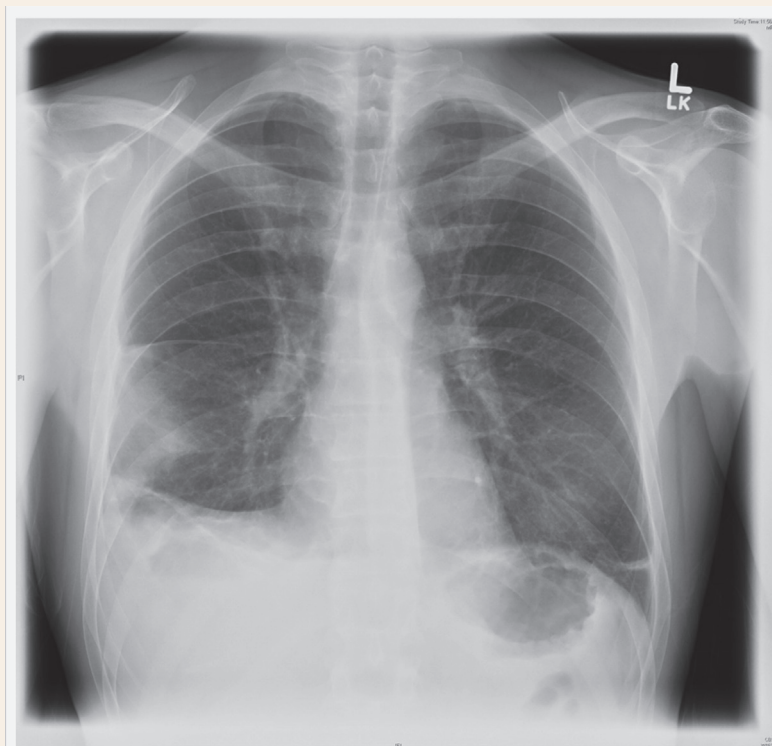


Figure 3. Repeat chest radiograph on re-admission.

Table 3. Summary of Key Investigations.

Arterial Blood Gas (ABG) Analysis quantifies the degree of hypoxaemia if present. For example, marked hypoxaemia in the presence of a normal chest radiograph and normal clinical examination on the chest may indicate an underlying pulmonary vascular cause. An ABG also provides objectivity when considering whether a patient will require care in a critical care environment.

Chest Radiograph may identify another focal pathology to account for a pleuritic process or more likely alternative pathology – e.g. a pleural effusion or consolidation; PE can be masked by any of the above, but classic chest radiograph features of PE would include oligoemic lung fields or a wedge-shaped infarct corresponding to the location of the embolus.

D-dimers have a strong negative predictive value. When a sensitive, quantitative assay is used in low or intermediate probability group subjects it can reliably exclude the presence of VTE. It should not be used when a high clinical suspicion of PE exists. It is also most appropriately used at point of admission, since it has a tendency to increase following admission (e.g. due to cannulation or development of other pathology, yielding false positive results).

CT-Pulmonary Angiography (CTPA) is diagnostically highly sensitive and specific for identifying pulmonary emboli. It is the recommended initial investigation in “non-massive PE”¹⁵ and where a good quality scan is negative, PE can usually be excluded.

Ventilation:Perfusion (V:Q) scan

Ventilation Perfusion imaging with contrast scintigraphy will compare defects in perfusion relative to ventilation which, in the absence of chest pathology on a radiograph can provide a reasonable first line investigation where there is familiarity with its use. A non-diagnostic scan does, however, require further investigation with CTPA.

Problem based review: Pleuritic Chest Pain

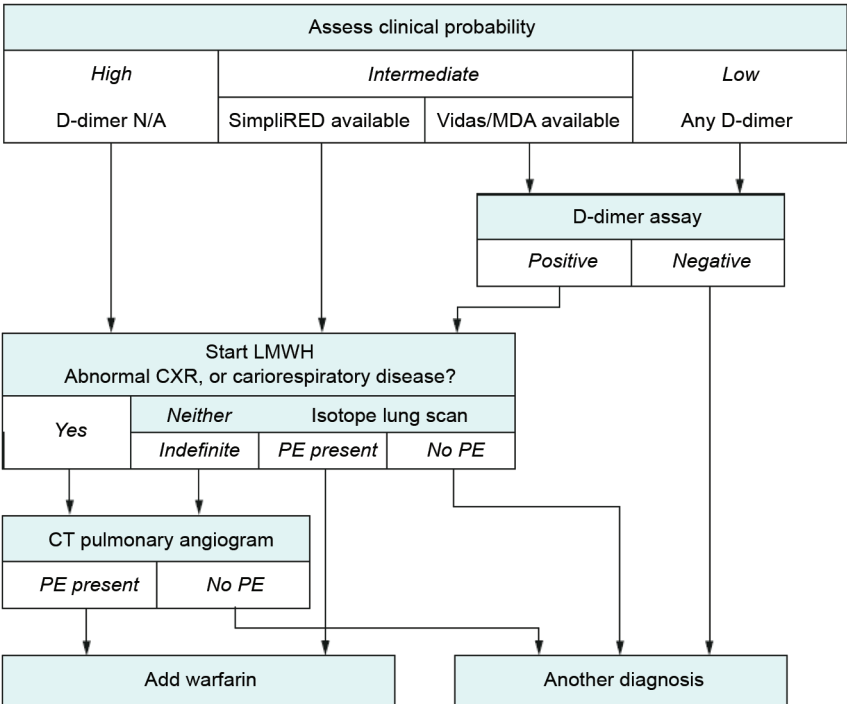


Figure 4. British Thoracic Society Pulmonary Embolus Guideline.¹⁵

Table 4. Supplementary Investigations.

Transthoracic Echocardiography (TTE) In suspected massive (or high risk) PE, severe right heart strain on TTE may be sufficient to make the diagnosis and in the compromised patient is often safer to perform at the bedside. This may also be useful in addition to CTPA in high risk PE when considering thrombolysis. Ultrasound venous doppler of the lower limbs may identify the presence of a deep venous thrombosis (DVT) and may be useful when CTPA is contra-indicated (or undesirable, such as in pregnancy). Ultrasonography of the chest wall is not routinely employed in investigation of PE but may be useful in identifying another pathology and is advised when an effusion requires diagnostic aspiration or drainage. Pleural aspiration (diagnostic +/- therapeutic) can distinguish an exudative from a transudative effusion by the demonstration of increased protein (>30g/L) content. In borderline cases, application of Light's criteria³⁵ can increase the sensitivity and specificity by also measuring lactate dehydrogenase (LDH). Light's Criteria³⁵ - presence of one or more criteria indicates an exudate: • Ratio of pleural fluid to serum protein greater than 0.5 • Ratio of pleural fluid to serum LDH greater than 0.6 • Pleural fluid LDH greater than two thirds of the upper limits of normal serum value Sending pleural fluid for microscopy and culture to identify the causative organism of an infection is crucial and the pH should be recorded using an ABG analyser. A pH < 7.2 suggests a complicated parapneumonic effusion or empyema. Magnetic resonance imaging (MRI) Thorax is not widely utilised due to difficulties with thoracic movement in inspiration but there is limited evidence to suggest that MRI may have a role in identification of PE where contrast induced nephropathy is a particular risk. Other investigations may become necessary once the diagnosis is established but are not necessarily as helpful in differentiating PE from other pathologies. For example in selected patients measuring antiphospholipid antibodies, antithrombin III levels, Factor V Leiden and protein C and S levels in patients with an apparently unprovoked PE.
--

Case Update 2

The patient was recorded as having a Wells score of 1 (haemoptysis). The heart rate of 80 at this time was felt to be reassuring and in view of the history of fever and productive sputum it was decided that VTE was a less likely diagnosis.

However due to persisting symptoms and lack of improvement, the following day a CTPA was performed.

What does the CTPA show? (answers on p175)

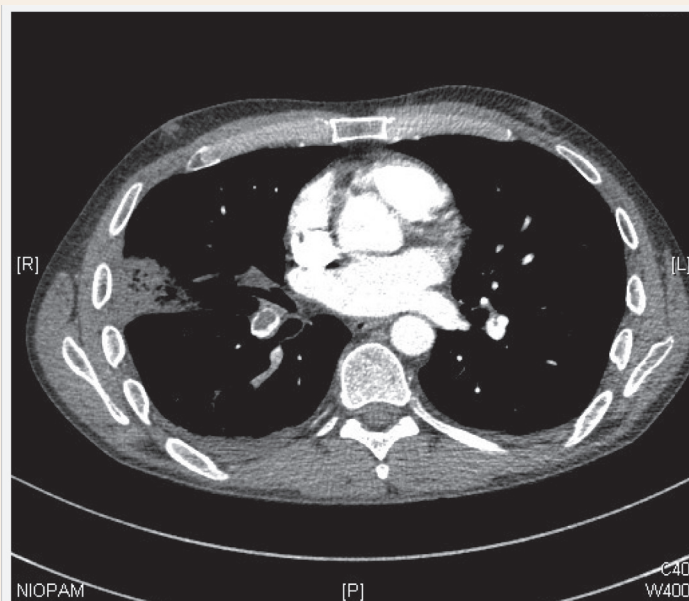


Figure 5. CT Pulmonary Angiogram.

5. How do you investigate pleuritic pain?

The BTS¹⁵ and ESC³¹ provide comprehensive guidelines for the investigation and management of PE and similar guidelines are available from such organisations for investigation and management of the most common differential diagnoses. Local hospital guidelines and protocols are also often a useful resource. The list below (Tables 3 & 4) give an overview of the relative merits of the most commonly used diagnostic investigations and any important discussions in the literature that surrounds their use.

Which patients require investigation for pulmonary embolism?

Several validated tools are available to the physician to aid risk stratification, to guide appropriate investigations and ultimately the confirmation or safe exclusion of pulmonary embolism. Using Well's modified score (Table 5, Above), a low score (<4) along with a negative D-Dimer test gives a less than 2% risk of PE.³⁶

The Geneva score is a widely employed alternative to the Wells score and does not include the most subjective and criticised component of the Wells score: "alternative diagnosis more likely" (see ³⁷⁻³⁸). However this is considered by some to be the most diagnostically useful feature of the Wells

Table 5. Modified Wells Score for Pulmonary embolus.³⁶

Simplified Wells rule: low, (0-1); intermediate, (2); high (3-5) probability.

Risk factor	Score
Signs & symptoms of DVT	3
Alternative diagnosis less likely than PE	3
HR >100	1.5
Immobilisation or surgery	1.5
Previous DVT/PE	1.5
Haemoptysis	1
Malignancy	1

score.³⁹ More recently, abbreviated versions of these scoring systems have been developed which can be used to simplify risk stratification.⁴⁰

However, these rules are intended to guide diagnostic testing and low-probability objective clinical assessment cannot exclude the diagnosis. Moreover it has been argued that subjective clinical gestalt, particularly when involving a senior clinician, may be equally accurate.⁴¹

Are there any special circumstances when PE is investigated differently?

Pulmonary embolus in pregnancy is common with increased susceptibility (7-10 fold greater than the

Problem based review: Pleuritic Chest Pain

baseline) and carries a high mortality. Mechanical obstruction from the gravid uterus can increase venous stasis but the VTE risk is the same in all trimesters, irrespective of uterine size, except in the post partum period where the frequency may be even higher. Diagnosis can be difficult for a number of reasons. Dyspnoea is a normal finding in pregnancy, however, an elevated respiratory rate and hypoxaemia are not typical.⁴² D-dimer levels are often raised in a normal pregnancy, limiting their utility – although its negative predictive utility may be preserved.⁴³ Ultrasound venous doppler of the lower limbs can be employed as an initial investigation to avoid the need for radiation exposure. Further investigation with VQ (if the chest radiograph is normal) or CTPA should be discussed with a specialist when indicated.

PE in severe chronic kidney disease can present a further diagnostic difficulty. A careful clinical consideration needs to be made as to the perceived probability of VTE since contrast induced nephropathy as a result of a poorly considered CTPA can result in lifelong dependence on dialysis. Such cases should be discussed with a nephrologist.

Radiography Answers:

Chest radiograph 1 shows increased density in the periphery of the right lower lobe with underlying pleural reaction. This commonly reflects infective change but as discussed above has a differential diagnosis.

Chest radiograph 2 shows a further increase in shadowing in the right lower zone, most likely to represent infective change but once again the clinical history can be important in suggesting an alternative differential.

These radiographs demonstrate “**Hampton’s hump**” - a wedge shaped hump in the lung periphery which in this case obscures the right costophrenic angle is one of the classic radiographic findings of pulmonary embolism.⁴⁴

The CTPA demonstrates this wedge shaped infarct with reduced contrast in the first division of the right pulmonary artery giving also the “**doughnut sign**” confirming a diagnosis of pulmonary embolism.

6. How is pleuritic pain managed?

Management of pleuritic pain is dependent on identification of the correct aetiology whilst alleviating symptoms with appropriate analgesia and supporting essential organs as necessary in an appropriate clinical environment.

Pulmonary Embolism

An exception to the above is when an intermediate or high clinical suspicion of PE exists and empirical treatment should be commenced without delaying for diagnostic imaging. Low molecular weight heparins (LMWH) as per local protocols are the mainstay of therapy, with subsequent warfarinisation (or alternative). A target INR of 2.0 – 3.0 would usually be appropriate.^{15,45} The

need for anticoagulation and risk of further VTE must be balanced against the risk of bleeding. The duration of recommended anticoagulation should be carefully considered. The American College of Chest Physicians (ACCP) Guidelines⁴⁵ recommend patients suffering provoked events should receive 3 months treatment. Those suffering unprovoked events or who have irreversible risk factors should be evaluated at 3 months for the risk-benefit ratio of long-term therapy. For patients in whom risk factors for bleeding are absent and for whom good anticoagulant monitoring is achievable, the ACCP recommend long-term treatment.

The high mortality associated with massive PE – more correctly labelled as “high risk PE”³¹ highlights the need for increased vigilance against sudden cardiac collapse and the critical care team may need to be informed of such admissions. Early thrombolysis is recommended in patients with massive PE that causes either cardiac arrest or severe deterioration after excluding contra-indications.

Prevention is a key topic in venous thromboembolic disease. Patients admitted with a medical complaint who have reduced mobility should be risk assessed for VTE and where appropriate prophylaxis should be instituted.⁴⁶ Conflicting literature surrounds the use of IVC filters in scenarios where anticoagulation has failed or is contra-indicated but may be useful in patients who require surgery despite recurrent PE.

Pleural effusions

Pleural effusions should be drained when there is evidence of complicated para-pneumonic effusion or empyema due to the risk of non-resolution and high mortality associated with an untreated source of sepsis. In addition, when a pleural effusion causes respiratory compromise this can be improved by drainage but should be discussed with a respiratory physician to ensure that the most appropriate initial therapy is instituted and any necessary investigations performed at the same time. In some cases a therapeutic aspirate should precede admission for drainage. Medical or surgical pleurodesis and long-term tunnelled pleural catheters may be considered in the context of recurrent pleural effusions, particularly in those associated with thoracic malignancy.

Pneumothorax

BTS guidelines provide evidence based recommendations for the management of primary and secondary pneumothorax.²³ In summary, a large primary pneumothorax may initially be managed by aspiration; if aspiration is unsuccessful a chest drain should be inserted. A secondary pneumothorax of sufficient size should be managed by the placement of a chest drain. Smoking cessation advice should be given with explanation of the increased risk of recurrence with non-cessation.²³

Problem based review: Pleuritic Chest Pain

Malignancy

Pleuritic pain associated with malignancy may be amenable to palliative radiotherapy to the chest wall and this should be discussed with an oncologist promptly. Specialist palliative care services can often help to optimise analgesia and offer psychological support.

General Principles of treatment

NSAIDs, where not contraindicated, are appropriate as short-term analgesics since they also reduce pleuritic inflammation. Paracetamol and opioids, if required, may also be useful. Effective analgesia is important to minimise atelectasis and risk of pneumonia as a result of decreased chest wall movement. In malignant disease, palliative radiotherapy may be useful for treating pain not controlled by medications. Musculoskeletal pain would usually be managed with analgesia and physiotherapy depending on the aetiology.

Which patients to discuss with the respiratory team?

A number of respiratory diseases that require early specialist input present with pleuritic pain. These include patients admitted as a result of lung cancer, mesothelioma, suspected TB or pneumothorax.⁴⁷ Specialist outpatient assessment of VTE may be considered at 6-12 weeks and again at 3-6 months depending on local service provision, to assess response to therapy and underlying pathology.

When to discharge?

From the perspective of VTE, a negative D-dimer or, when appropriate to perform, a negative/low probability VQ or CTPA allow discharge from hospital where no other features exist to suggest clinical instability. Selected cases of PE without haemodynamic compromise or substantial comorbidities can also be managed safely in an ambulatory care setting if available.⁴⁸ This would usually involve interaction with an outpatient anticoagulation service. PE severity can be quantified by indices such as the PE severity index⁴⁹ which may offer guidance as to patient fitness for discharge.

Pneumonia and pleurisy can be followed up by primary care services to check for the resolution of abnormal signs or symptoms. Older patients at higher risk of cancer (particularly those with a significant smoking history) may be seen by the respiratory team where particular concern exists. The BTS pneumonia guidelines dictate that smokers and those over 50 years of age with an abnormal chest radiograph should be followed up with a 6 week interval chest radiograph to ensure resolution and absence of an underlying obstructing lesion.⁵⁰ Patients with primary pneumothorax can be discharged when treated successfully. Secondary pneumothorax requires resolution of underlying

pathology to a stable state and follow-up with the appropriate medical or surgical team. Smoking cessation advice should be given to all patients as per NICE guidance.⁵¹

What are the outcomes following pleuritic chest pain?

Untreated pulmonary embolism is associated with a high mortality. This is greatest in massive PE and patients who develop acute right heart failure. Untreated PE can also result in chronic hypoxaemia and pulmonary hypertension. Up to 5% of patients who have suffered a PE go on to develop thromboembolic pulmonary hypertension and in such instances pulmonary endarterectomy may be indicated.⁵²

Non PE causes of pleuritic chest pain can also be life-threatening or have severe consequences. In one large meta-analysis pneumonia was associated with a 13.7% mortality.²¹ In addition, 40% of parapneumonic effusions may progress to complicated effusions or empyema, 15% of which require surgery and 22% die.²² Recurrence of pneumothorax is common and many patients will go on to require an additional attempt at drainage or a surgical procedure to correct the defective segment of lung.

7. Summary

This case highlights how acute pleuritic chest pain can present a number of challenges to the physician. The differential diagnosis is broad, ranging from minor musculoskeletal inflammation to PE, with potential risk to the patient varying considerably. A detailed history and examination can narrow the initial differential diagnosis but can be difficult to use alone confidently. Clinical risk assessment is crucial in this setting and a number of well validated risk stratification tools can then help to identify those patients at greatest risk of PE in whom further investigation is needed.

Potentially life-threatening causes should be considered early and, where significant clinical suspicion arises, treatment instigated without delay – in the case of suspected PE, this will be prior to a confirmation of the diagnosis. Where the diagnosis of PE is made, anti-coagulation is needed and the treating physician needs to take care in considering the risk of recurrence that will influence a recommended duration of treatment and at the same time consider the potential presence of underlying disease processes that are causally related.

Further reading: Clear guidelines surrounding pulmonary embolus investigation and pre-clinical probability as well as investigation and management of pleural diseases are available from the BTS (<http://www.brit-thoracic.org.uk/>) and ESC (<http://www.escardio.org>) websites.

Problem based review: Pleuritic Chest Pain

References

- Hippocrates Corpus, On Regimen in Acute Diseases Part 7, in <http://classics.mit.edu/Hippocrates/acutedis.mb.txt> (Accessed October, 2011).
- Amsterdam EA, Kirk JD, Bluemke DA, *et al.* Testing of low-risk patients presenting to the Emergency Department with chest pain – a scientific statement from the American Heart Association. *Circulation* 2010; **122**: 1756–76.
- Moore KL (1985) Clinically Oriented Anatomy, 2nd edition. Williams and Wilkins, Baltimore, 46.
- Fothergill NJ, Hunt MT, Touquet R. Audit of patients with chest pain presenting to an accident and emergency department over a 6-month period. *Arch Emerg Med* 1993; **10**: 155–60.
- Buntinx F, Knockaert D, Bruyninckx R, *et al.* Chest pain in general practice and in the hospital emergency department: is it the same? *Family practice* 2001; **18**: 586–9.
- Martínez-Sellés M, Bueno H, Sacristán A, *et al.* Chest pain in the emergency department: incidence, clinical characteristics and risk stratification. *Rev Esp Cardiol* 2008; **61**: 953–9.
- Hogg K, Dawson D, Mackway-Jones K. Outpatient diagnosis of pulmonary embolism: the MIOPED (Manchester Investigation Of Pulmonary Embolism Diagnosis) study. *Emerg Med J* 2006; **23**: 123–7.
- Beevers G, Lip GYH, O'Brien E. The pathophysiology of hypertension. *BMJ* 2001; **322**: 912–16. (Figure 1 – Virchow's triad).
- Trowbridge RL, Araoz PA, Gotway MB, *et al.* The effect of helical computed tomography on diagnostic and treatment strategies in patients with suspected pulmonary embolism. *Am J Med* 2004; **116**: 84–90.
- Hainaut P, Elamly A, Dessomme B, *et al.* ELISA d-dimer measurement for the clinical suspicion of pulmonary embolism in the emergency department: one-year observational study of the safety profile and physician's prescription. *Acta Clin Belg* 2003; **58**: 233–240.
- Lindblad B, Sternby NH, Bergqvist D. Incidence of venous thromboembolism verified by necropsy over 30 years. *BMJ* 1991; **302**: 709–711.
- Ryu JH, Olson EJ, Pellikka PA. Clinical recognition of pulmonary embolism: problem of unrecognized and asymptomatic cases. *Mayo Clin Proc* 1998; **73**: 873–879.
- Hyers TM. Venous thromboembolism. *Am J Respir Crit Care Med* 1999; **159**: 1–14.
- White RH. The epidemiology of venous thromboembolism. *Circulation* 2003; **107**: 4–8.
- British Thoracic Society guidelines for the management of suspected acute pulmonary embolism. *Thorax* 2003; **58**: 470–83.
- Palla A, Petruzzelli S, Donnamaria V, *et al.* The role of suspicion in the diagnosis of pulmonary embolism. *Chest* 1995; **107**: 21S–24S.
- Yu DR, Miller R, Bray PF. Clinical problem-solving. Through thick and thin. *N Engl J Med* 1998; **338**: 1684–7.
- Stein PD, Beemath A, Matta F, *et al.* Clinical Characteristics of patients with Acute Pulmonary Embolism: Data from PIOPED 2. *Am J Med* 2007; **120**: 871–79.
- Stein PD, Terrin ML, Hales CA, *et al.* Clinical, laboratory, roentgenographic, and electrocardiographic findings in patients with acute pulmonary embolism and no pre-existing cardiac or pulmonary disease. *Chest* 1991; **100**: 598–603.
- Marrie TJ. Community-acquired pneumonia. *Clin Infect Dis* 1994; **18**: 501–13.
- Fine MJ, Smith MA, Carson CA, *et al.* Prognosis and outcomes of patients with community-acquired pneumonia. A meta-analysis. *JAMA* 1996; **275**: 134–41.
- Wrightson J, Davies R. The Approach to the Patient with a Parapneumonic Effusion. *Semin Respir Crit Care Med* 2010; **31**: 706–715.
- MacDuff A, Arnold A, Harvey J. Management of spontaneous pneumothorax: British Thoracic Society pleural disease guideline, 2010 <http://www.brit-thoracic.org.uk/Portals/0/Clinical%20Information/Pleural%20Disease/Pleural%20Guideline%202010/Pleural%20disease%202010%20pneumothorax.pdf> (Accessed October, 2011).
- Klinkman MS, Stevens D, Gorenflo DW. Episodes of care for chest pain: a preliminary report from MIRNET. *J Fam Pract* 1994; **38**: 345–52.
- Lange RA, Hillis LD. Clinical practice. Acute pericarditis. *N Engl J Med* 2004; **351**: 2195–202.
- Wise CM. Chest wall syndromes. *Curr Opin Rheumatol* 1994; **6**: 197–202.
- Brown CW, Deffer PA, Akmakjian J, *et al.* The natural history of thoracic disc herniation. *Spine* 1992; **17**: S97–102.
- Worthington JJ, Pollack MH, Otto MW, *et al.* Panic disorder in emergency ward patients with chest pain. *J Nerv Ment Dis* 1997; **185**: 274.
- Wulsin LR, Yingling K. Psychiatric aspects of chest pain in the emergency department. *Med Clin North Am* 1991; **75**: 1175–88.
- Fleet RP, Dupuis G, Marchand A, *et al.* Panic disorder, chest pain and coronary artery disease: literature review. *Can J Cardiol* 1994; **10**: 827–34.
- ESC Guidelines on the diagnosis and management of acute pulmonary embolism. *Eur Heart J* 2008; **29**: 2276–2315.
- Wells PS, Anderson DR, Rodger M, *et al.* Excluding pulmonary embolism at the bedside without diagnostic imaging: Management of patients with suspected pulmonary embolism presenting to the emergency department by using a simple clinical model and d-dimer. *Ann Intern Med* 2001; **135**: 98–107.
- Wicki J, Perneger TV, Junod AF, *et al.* Assessing Clinical Probability of Pulmonary Embolism in tge Emergency ward: A Simple Score. *Arch Intern Med* 2001; **161**: 92–97.
- Royal College of Obstetricians and Gynaecologists. Green-Top Guideline 37. Reducing the risk of thrombosis and embolism during pregnancy and the puerperium. London: Royal College of Obstetricians and Gynaecologists, 2009. <http://www.rcog.org.uk/files/rcog-corp/GTG37aReducingRiskThrombosis.pdf> (Accessed October, 2011).
- Light RW, Macgregor MI, Luchsinger PC, *et al.* Pleural effusions: the diagnostic separation of transudates and exudates. *Ann Intern Med* 1972; **77**: 507–13.
- Wells PS, Anderson DR, Rodger M, *et al.* Derivation of a simple clinical model to categorize patients probability of pulmonary embolism: increasing the models utility with the SimpliRED D-dimer. *Thromb Haemost* 2000; **83**: 416–20.
- Le Gal G, Righini M, Roy PM, *et al.* Prediction of Pulmonary Embolism in the Emergency Department: The revised Geneva Score. *Ann Intern Med*. 2006; **144**: 165–71.
- Klok FA, Kruisman E, Spaan J, *et al.* Comparison of the revised Geneva score with the Wells rule for assessing clinical probability of pulmonary embolism. *J Thromb Haemost* 2008; **6**: 40–44.
- Klok FA, Karami Djurabi R, Nijkeuter M, *et al.* Alternative diagnosis other than pulmonary embolism as a subjective variable in the Wells clinical decision rule: not so bad after all. *J Thromb Haemost* 2007; **5**: 1079–80.
- Douma RA, Gibson NS, Gerdes VEA, *et al.* Validity and clinical utility of the simplified Wells rule for assessing clinical probability for the exclusion of pulmonary embolism. *Thromb Haemost* 2009; **101**: 197–200.
- Kabrhel C, Camargo CA Jr, Goldhaber SZ. Clinical gestalt and the diagnosis of pulmonary embolism: does experience matter? *Chest* 2005; **127**: 1627–1630.
- Bourjeily G, Paidas M, Khalil H, *et al.* Pulmonary embolism in pregnancy. *Lancet* 2010; **375**: 500–12.
- Chan W-S, Chunilal S, Lee A, *et al.* A Red Blood Cell Agglutination D-Dimer Test to Exclude Deep Venous Thrombosis in Pregnancy. *Ann Intern Med* 2007; **147**: 165–170.
- Kirkpatrick IDC. Images of a pulmonary embolus: classic and contemporary. *CMAJ* 2002; **167**: 511–512.
- Kearon C, Kahn SR, Agnelli G, *et al.* Antithrombotic therapy for venous thromboembolic disease: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th edition). *Chest* 2008; **133**: 454S–545S.
- Venous thromboembolism: reducing the risk. NICE, 2010. <http://www.nice.org.uk/nicemedia/live/12695/47195/47195.pdf> (Accessed October, 2011).
- Pantin CFA. BTS statement on criteria for specialist referral, admission, discharge and follow-up for adults with respiratory disease. *Thorax* 2008; **63**: 1–16.
- Ambulatory emergency care protocols, NHS Institute for Innovation and Improvement, 2010. http://www.institute.nhs.uk/images//documents/Quality_and_value/HighVolumeCare/Ambulatory%20care%20pathway%20for%20P%20E.pdf (Accessed October, 2011).
- Donze J, Le Gal G, Fine MJ, *et al.* Prospective validation of the Pulmonary Embolism Severity Index. A clinical prognostic model for pulmonary embolism. *Thromb Haemost* 2008; **100**: 943–8.
- BTS Guidelines for the management of community acquired pneumonia in adults: update 2009. <http://www.brit-thoracic.org.uk/Portals/0/Clinical%20Information/Pneumonia/Guidelines/CAPGuideline-full.pdf> (Accessed October, 2011).
- NICE. Brief Interventions and referral for smoking cessation: guidance, 2006. <http://www.nice.org.uk/nicemedia/live/11375/31864/31864.pdf> (Accessed October, 2011).
- Pengo V, Lensing AW, Prins MH, *et al.* Incidence of chronic thromboembolic pulmonary hypertension after pulmonary embolism. *N Engl J Med* 2004; **350**: 2257–64.