Investigating pleural thickening
As pleural thickening can have a benign or malignant cause, use of the appropriate imaging
techniques is crucial to a correct diagnosis. The authors explore the options

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This series provides an update on the best use of different imaging methods for common or important clinical presentations. The series advisers are Fergus Gleeson, consultant radiologist, Churchill Hospital, Oxford, and Kamini Patel, consultant radiologist, Homerton University Hospital, London. To suggest a topic for this series, please email us at practice@bmj.com.

A 77 year old man presented with left sided chest and back pain that did not respond to simple analgesics. He had a history of atrial fibrillation and was taking warfarin. A retired joiner, he had been exposed to asbestos in the 1960s and '70s. He was a non-smoker. Examination showed reduced air entry on the left and tenderness at the inferior aspect of the scapula. A chest radiograph showed bilateral calcified pleural plaques and pleural thickening on the left hand side (fig 1).

Background and differential diagnosis
Pleural thickening can be focal or diffuse and has various causes (table1). Imaging is used for confirming the presence, nature, and extent of disease and for distinguishing benign from malignant causes. The appearances of some of these benign and malignant diseases are similar, and only the presence of invasion and/or metastatic disease are definite indicators of malignancy. However, some features seen on imaging can help differentiate benign and malignant causes.

Chest radiography
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Pleural plaques
Pleural plaques are benign fibrotic lesions that often calcify,2 and they are most commonly found on the inferior parietal pleura adjacent to ribs and on the diaphragm. They are usually a sign of previous exposure to asbestos, though they can be associated with previous chest trauma (haemothorax), pleural infection, or artificial pneumothoraces used for the treatment of tuberculosis. Pleural plaques are a benign condition and not premalignant; therefore, in the absence of pleural fluid or thickening they do not themselves require regular follow-up. As pleural plaques indicate previous exposure to asbestos, patients are at risk of developing other conditions caused by exposure to asbestos such as mesothelioma and asbestosis. Patients should therefore be advised that if they develop persistent chest pain or breathlessness they should seek medical help. In England and Wales, patients do not receive compensation if pleural plaques alone are detected (although this was the case before 2007); rarely, pleural plaques may be so extensive that they cause restrictive lung function, and in such cases the person may receive compensation.3 In Scotland, however, patients receive compensation if pleural plaques alone are detected.

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What should be the next investigation?

Computed tomography

Intravenous contrast enhanced computed tomography (CT) is the primary imaging modality for assessing pleural disease and thickening. Its main advantage is the ability to show the entire pleura in excellent detail. Newer multidetector CT scanners enable reformating of high resolution images in several planes, which provides additional information about anatomical relations—for example, with the diaphragm—which can aid surgical planning. Disadvantages include a radiation dose to the patient and the need for administration of iodinated contrast material, which is contraindicated in patients with poor renal function and allergy to contrast material. Overt signs of malignancy on CT scans include chest wall and bony invasion as well as metastatic disease. CT features suggestive of malignancy include circumferential pleural thickening (sensitivity 41%, specificity 100%), parietal pleural thickening >1 cm (36%, 94%), nodularity (51%, 94%), and mediastinal pleural involvement (56%, 88%). The British Thoracic Society’s guidelines for the management of mesothelioma suggest consideration of a 60 second delay to scan time after the administration of intravenous contrast material as this may improve the enhancement and demonstration of pleural disease.

Computed tomography (in combination with the pathological findings) is also helpful for the staging of malignant pleural mesothelioma; this is described in detail elsewhere.

Ultrasoundography

Ultrasoundography is an excellent modality for detecting fluid collections in the pleural space. However, it is less sensitive for the detection and characterisation of pleural thickening, for which computed tomography is the best imaging modality. Ultrasoundography may fail to detect pleural thickening that is <1 cm in thickness and is best used for detecting soft tissue when accompanied by fluid. A small study has shown ultrasoundography to have 73% specificity and 100% sensitivity for pleural malignancy when pleural nodules or thickening are seen with pleural fluid.

Magnetic resonance imaging

Pleural malignancy enhances avidly with gadolinium based contrast, and the features used for distinguishing benign and malignant disease are similar to those used in computed tomography. Studies have suggested that magnetic resonance imaging has a sensitivity of 98-100% and a specificity of 92-93% for detecting pleural malignancy when compared with computed tomography. However, it is less available and more expensive compared with computed tomography. It can be used in evaluating local tumour extension where computed tomography is inconclusive and in those patients who cannot have iodinated contrast material. It also has the advantage of not carrying a radiation dose.

How should pleural thickening be biopsied?

Positron emission tomography computed tomography

Positron emission tomography computed tomography (PET-CT) combines the administration of radiolabelled biological molecules, usually glucose, with computed tomography. Metabolically active tissue is demonstrated, and as tumours are generally metabolic, PET-CT has a high sensitivity for detecting pleural malignancy. The technique is not used routinely for investigating patients with pleural thickening, but there is increasing evidence of its efficacy in differentiating benign from malignant disease. A study of 64 patients found a sensitivity of 96.8% and specificity of 88.5% for detection of malignant disease. It may also have a role in determining prognosis and monitoring response to treatment.

Biopsy under ultrasound or CT guidance

Guided biopsy is done under local anaesthesia by radiologists and involves obtaining core biopsies using computed tomography or ultrasonography for guidance. It has 87% sensitivity for malignancy compared with 47% for non-image guided biopsy and <1% mortality rate. The commonest complication of lung biopsy is pneumothorax, which occurs in 20% of cases, of which a chest drain needs to be inserted in only 3%. However, rates are much lower than this for pleural thickening as no aerated lung has to be crossed (fig 2). Other complications such as pulmonary haemorrhage and haemoptysis occur in around 5%. If pleural thickening measures greater than 0.5 cm and is in a suitable position then CT or US guided biopsy would be the first line investigation.

Medical thoracoscopy

Medical thoracoscopy, done under conscious sedation by physicians, allows the pleural surfaces to be visualised and guided biopsies to be taken. It has 90% sensitivity and 96% specificity for malignant disease and low morbidity and mortality rates. In the absence of pleural fluid thoracoscopy can be done but requires an experienced operator to induce a pneumothorax. A thoracoscopy without pleural fluid is usually considered only if the pleural thickening is not suitable for biopsy done under ultrasound or CT guidance.

Surgery

Biopsy under general anaesthesia is usually considered a last resort and carries the highest risk, including a significant risk of a tumour seeding, but may be required if other methods of obtaining tissue are not suitable. Tissue may also be obtained if the patient has surgical resection; however, the MARS study...
(a randomised controlled trial examining the outcomes in patients having extrapleural pneumonectomy and trimodality treatment) did not show a survival benefit in these patients.©

Outcome

The patient had computed tomography, which confirmed the presence of bilateral pleural plaques and pleural thickening on the left hand side, which was thicker than 1 cm, showed evidence of nodularity, and extended on to the mediastinal surface (fig 3⇓). A CT guided pleural biopsy was done (fig 2⇓), and histology testing showed malignant mesothelioma of sarcomatoid type. This was staged as T4N0M0. He subsequently had palliative radiotherapy and chemotherapy.

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Table

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Figures

Fig 1 Frontal chest radiograph demonstrates thickening of the pleura in the left upper zone (white arrow) and bilateral calcified pleural plaques (black arrow). The pleural thickening is best seen at the lung edges—where the x-ray beam passes through it tangentially (white arrow)—as an area of soft tissue density whose medial edge runs parallel with the chest wall.

Fig 2 CT guided biopsy of left sided pleural thickening.
**Fig 3** Axial (left) and coronal (right) computed tomograms of the thorax after administration of intravenous contrast material. These demonstrate pleural thickening (open black arrows), which extends on to the mediastinal surface, and rib destruction (black arrow). Note the presence of incidental pleural plaques (white arrowhead).