

CT Guided Pleural Biopsy

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INTRODUCTION

Pleural disease is a common problem worldwide with an estimated incidence of pleural effusion of 1 million cases per year in the USA (1). The recommended sequence of investigations in pleural effusion includes history, clinical examination, chest radiography and pleural aspiration (2). Unfortunately, these investigations may not allow for a confident diagnosis of the cause of pleural effusion in all cases. In the case of an undiagnosed exudative effusion with pleural thickening, pleural biopsy may be necessary for diagnosis. Biopsy can be performed as a blind biopsy with an Abram's or Cope needle; under direct visualisation with medical thoracoscopy or video-assisted thoracoscopic surgery (VATS); as an open surgical biopsy or under image guidance. Image-guided biopsy is a technique with high sensitivity and specificity which can be performed as a day case procedure under local anaesthesia. A randomised trial has shown that it is more accurate than blind biopsy (3). The main alternative is medical thoracoscopy, which allows direct visualisation of the pleura, drain insertion and pleurodesis but requires se-

dition or general anaesthesia. In a small but significant proportion of patients, it may not be possible to enter the pleural space, either due to rib crowding or a small or multi-septated effusion.

INDICATIONS

1. Suspected Malignant Pleural Effusion

Studies have demonstrated that approximately 60% of malignant pleural effusions can be diagnosed by aspiration and cytological examination alone (4-7). This drops to approximately 30% in mesothelioma. A second diagnostic aspirate is of limited benefit and a third aspirate is rarely helpful (7) and, as such, image-guided biopsy may be needed for diagnosis. CT guided biopsy has a reported sensitivity of 76-88% and specificity of up to 100% for diagnosis of malignant pleural thickening including a sensitivity of 83-86% and specificity of up to 100 % for diagnosis of mesothelioma (8-11).

2. Undiagnosed Pleural Thickening in the Absence of an Effusion

Pleural thickening may be present in the absence of pleural fluid. This may be benign or malignant.

Benign causes include benign asbestos related pleural thickening, rheumatoid arthritis, tuberculosis and previous pleural infection (empyema) or haemothorax. The clinical history may be helpful in determining the cause but, where there is diagnostic doubt, image guided pleural biopsy can be helpful. Image guided biopsy is as effective in the absence of an effusion as reported in section 1.

3. Pleural Masses

Pleural masses may be seen without an associated effusion. Pleural masses may be benign or malignant, discrete or multiple. Malignant pleural masses may be due to primary pleural malignancy (mesothelioma) or metastatic disease, commonly from breast cancer, lung cancer or thymoma. Benign pleural masses include pleural fibroma although this does not usually require biopsy since its characteristic CT appearance usually allows a confident diagnosis.

Contraindications

There are few absolute contraindications to CT-guided pleural biopsy. However, the following points should be considered.

Prior to biopsy;

- Coagulation parameters should be measured. If the patient has been on warfarin, the international normalised ratio (INR) should be measured. Any coagulopathy should be corrected. An uncorrectable coagulopathy is a contraindication to biopsy. A full blood count should also be performed.
- Since one of the main complications of pleural biopsy is pneumothorax, the patient's respiratory reserve and therefore ability to tolerate a pneumothorax should be considered. Lung function tests should be performed prior to biopsy. Biopsy is not usually performed if the FEV1 is less than 1 litre. The risk of pneumothorax is increased when there is little or no pleural effusion.

- The patient should be able to give informed consent. If not, consent may need to be given by relatives or carers. A confused patient is unlikely to be able to co-operate with the procedure and it should not be performed in this instance.

During the biopsy;

- Biopsy should not be performed at a site of overlying skin abnormality such as tumour invasion or infection. In most cases, another site can be chosen to perform the biopsy but if not the biopsy should be postponed or avoided.
- The patient needs to be able to tolerate lying flat for at least 15-30 minutes to allow the procedure to be performed under imaging guidance.

Technique

The exact technique used will depend on local availability of equipment and expertise. The biopsy can be performed with or without a co-axial needle, depending on the individual case. The technique described below assumes that there are no special facilities for CT intervention, such as CT fluoroscopy, and describes a non co-axial technique

1. A sterile trolley should be prepared with the necessary equipment (see figure 1).
2. The patient is scanned in an appropriate position (supine, prone etc) according to the results of prior imaging with the best location chosen for biopsy. It is important that the patient is comfortable enough to tolerate this position for the duration of the position. Many patients are uncomfortable lying prone and the 'nephrostomy position' (patient prone, target side tilted slightly up, one arm by the head, the other by the patients side) may be better tolerated.
3. Bearing in mind the findings of previous imaging, a limited scan is first performed of the abnormal area to select an appropriate site for biopsy. Depending on the findings of the original CT scan, intravenous contrast may be administered to help visualise the abnormal pleura. If an appropriate intercostal space to insert the biopsy ne-

edle is not apparent, the patient may be rescanned with the arms in a different position in order to alter the relative position of the ribs and pleural abnormality.

4. A CT section should be identified which allows the biopsy needle to be inserted immediately above the rib to minimise the risk of damaging the neurovascular bundle, and marked on the skin surface.

5. The skin should be thoroughly cleared with anti-septic solution eg chlorhexidine and sterile drapes placed around the biopsy site.

6. Local anaesthetic should be infiltrated into the skin, the subcutaneous tissue and down to the pleura to be biopsied.

7. Limited scans (generally 1 to 7 slices depending on the set-up of the scanner) should be performed to confirm that the needle is advanced at the correct angle. When there is minimal pleural thickening, the biopsy should be performed in the plane of the thickening to minimise the chance of sampling adjacent lung and to maximise sample size.

8. A small incision is made in the skin with a scalpel at the entry point for the biopsy needle.

9. The biopsy needle can then be inserted, using the same technique of using repetitive limited CT scanning to confirm the needle position. The needle is first advanced to the pleura. During the biopsy procedure, the patient may either be allowed to breathe gently or be asked to hold their breath on gentle inspiration.

10. The closed biopsy needle can then be advanced into the area of pleural thickening.

11. A repeat limited scan should be performed to confirm the needle position before taking the biopsy.

12. If necessary, for example in very minor pleural thickening, the needle can be opened before taking the sample and the position of the opened needle confirmed with CT (Figure 2).

13. After opening, the needle may be rotated through 90 degrees, and is then fired and removed, in one smooth sequence of movements.

14. An assistant should apply gentle pressure at the site of skin entry whilst the biopsy sample is exposed and placed in formaldehyde for histological analysis. If tuberculosis is considered a sample should also be sent for microbiological analysis.

15. A limited post biopsy scan can be performed to exclude a post biopsy haemorrhage or pneumothorax.

Complications

There are few reported complications post image guided biopsy. In a series of 85 CT guided pleural biopsies performed in a single UK centre (8) there was a 4.7% incidence of pneumothorax visible on post biopsy chest x-ray and a 7.5% incidence of bleeding although none of these had significant cardiovascular compromise. Other studies have shown a 5-10% complication rate (9-11).

Post Biopsy Care

The patient should be instructed to move as little as possible and avoid talking until the first post-biopsy chest x-ray. This is particularly important if a small pneumothorax was identified on the post procedure CT.

The patient should be transferred to an observation area for 4-6 hours post-biopsy.

Regular observations including blood pressure, pulse, respiratory rate and oxygen saturation should be performed and any alterations in the observations reported to the attending doctor.

Simple Analgesia May Be Prescribed

Chest radiographs should be performed at agreed intervals, for example at 2 and 4 hours. If the 2 hour radiograph shows no complication, the patient may talk, eat and drink and mobilise.

If the patient is well after 4-6 hours with no significant chest x-ray abnormality they may be discharged home. Aftercare advice should be provided for the patient.



Figure 1: Equipment for CT guided pleural biopsy.



Figure 2: CT of pleural biopsy-needle in open position crossing the pleura.

Summary

CT guided pleural biopsy is a relatively safe procedure that can usually be performed as a day case procedure. It has high sensitivity and specificity for identifying the cause of unexplained pleural effusion and pleural thickening and is preferred to blind pleural biopsy. The exact technique depends upon local equipment and expertise. Following the general principles detailed above should ensure that the procedure is as safe as possible and provides a high diagnostic yield.

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