Procedures in Practice

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PLEURAL ASPIRATION AND BIOPSY

Indications

To aid diagnosis
Treatment

Pleural aspiration may be needed for diagnosis or treatment.

Diagnosis—To confirm that there is effusion (rather than consolidation or collapse); to diagnose empyema and haemothorax; to distinguish transudate from exudate by the protein content; and to identify malignancy and infection by cytological examination and culture.

Treatment—To relieve dyspnoea; to remove blood or pus; and to instil antibiotics for empyema.

Aspiration procedure

Fluid analysis

Microscopy: blood-cell type,
tumour cells, organisms

Bacteriological culture including
Mycobacterium tuberculosis

Biochemical measurement:
protein + glucose concentrations

It is important that the patient is as comfortable and relaxed as possible; some explanation of what he will feel during the procedure should be given. The best site for pleural aspiration is decided by locating the fluid by percussion and from posteroanterior and lateral radiographs. A common error in cases of difficulty is to insert the needle too low down or too far forward. When the fluid is not loculated the easiest site for puncture is on the posterior chest wall medial to the angle of the scapula. The patient should be positioned leaning slightly forwards with his arms folded comfortably before him and resting on a pillow. He may be either seated facing the side of his bed with his arms on it or in bed with a bed table as support for his arms.

The operator should scrub up and be gloved and gowned as for any surgical procedure. The patient's skin is prepared with a suitable antiseptic and sterile towels. The skin overlying an intercostal space at the chosen level is infiltrated with 1% or 2% lignocaine using a 25-gauge (orange-hub) needle. This is then changed for a 21-gauge needle (green hub) to infiltrate the chest wall down to the pleura. When the needle penetrates the pleura fluid should appear in the syringe as the plunger is withdrawn. To avoid damaging the intercostal neurovascular bundle the inferior border of the upper rib is avoided. Care must be taken to ensure that air does not enter the pleural space at any stage of the procedure.

When the tap is for diagnosis only, 20-50 ml fluid is aspirated into a fresh sterile syringe and put into sterile plastic or glass containers. These are labelled and sent for microscopy for blood cells, cytology, and organisms; for bacterial culture (including acid-fast bacilli); and for estimations of protein, fat (if chylous), and glucose content (low in rheumatoid disease).

To remove a large quantity of fluid use a needle with attached three-way tap or a ready-prepared pack consisting of needle, three-way tap, connecting plastic tubing, syringe, and collecting bag. Aspirating large volumes of fluid in this manner may be protracted and uncomfortable for the patient, and it is sometimes easier to insert a catheter such as the 12- or 14-gauge E-Z Cath intravenous placement unit and, after withdrawing the central needle and stylet, to connect a three-way tap and syringe to the Luer fitting on the end. When the needle or catheter is removed a small adhesive dressing is adequate for the puncture site.

Patients with empyema and haemothorax—Difficulties may arise in patients with empyema and haemothorax when the fluid is thick or loculated. Aspiration may be possible only with a large-bore needle, and exploratory aspiration at several different sites may be necessary. The finding of pus is an indication for instilling antibiotics while the needle is in the empyema space; it may be difficult to locate the space at a later attempt. If the empyema is a complication of a bacterial pneumonia then laboratory information on the organism and its antibiotic sensitivities may already be available to guide the choice of antibiotic. If this guidance is not available then ampicillin (500-1000 mg) in 10-20 ml of water for injection or a cephalosporin should be instilled. Foul-smelling pus usually indicates an anaerobic infection, for which metronidazole is appropriate. Repeated aspiration and intrapleural instillation of antibiotic should be continued until pus is no longer obtainable. If there is then still evidence of continuing infection insertion of an intercostal drainage tube is indicated, followed, if necessary, by rib resection with evacuation of the empyema cavity.

Biopsy equipment

Needle biopsy of the pleura should be performed at the time of a diagnostic pleural aspiration if the cause of the effusion is not then apparent. If mesothelioma is strongly suspected, however, it is better to avoid a needle biopsy because of the risk of seeding mesothelioma cells in the needle track. Fluid cytology without biopsy is sometimes sufficient for diagnosing this condition.

The Abrams needle is the one most widely used in Britain for pleural biopsy. The blunt-type Cope needle may be more suitable when little or no pleural fluid is present. The Abrams needle consists of outer and inner tubes, the outer acting as a trocar. Behind the tip of the outer tube is an opening into which a fold of pleura is to be impacted. This opening is closed completely when the cutting edge of the inner tube is advanced by twisting its hexagonal grip clockwise. This rotation moves a pin in the hilt of the inner tube forwards along a spiral slot in the hilt of the outer tube. The biopsy specimen is cut by the advancing edge of the inner tube and is retained within the instrument. It can then be retrieved by using the accompanying blunt obturator.

Biopsy procedure

Position and prepare the patient as for a pleural tap, and infiltrate the intercostal tissues at the chosen site with lignocaine. Make a short incision (3-5 mm) through the skin and deeper tissues with a sharp, pointed scalpel blade; the closed Abrams needle is then introduced through the tissues and parietal pleura with a slight rotary movement. Connect a three-way tap and syringe to the Luer fitting on the needle, rotate the hexagonal hub of the inner tube anticlockwise to open the notch, and aspirate pleural fluid in the usual manner. The needle is airtight when the notch is closed, but a syringe or closed three-way tap must be attached when the notch is open to prevent air entering the pleural cavity.

When taking a biopsy specimen it is convenient to have a small (2 ml) syringe attached to the needle. Rotate the grip to open the notch, which faces the same direction as the spherical marker on one facet of the hexagonal base of the outer tube. With this marker (and therefore the notch) facing along the line of the intercostal space (to the left if the operator is right-handed), apply lateral pressure towards the notch with the forefinger and slowly withdraw the needle until resistance is felt owing to pleura catching in the notch. If the needle is withdrawn too far only intercostal muscle will be obtained. Hold the needle firmly and sharply twist the grip of the inner tube clockwise to take the specimen. Withdraw the needle with a slight rotary action when the patient exhales. To avoid damage to the intercostal neurovascular bundle the notch should never be directed upwards. The specimen will be found either within the inner tube or in the tip of the needle and should be put in 10% formol saline. If tuberculous pleurisy is suspected a second pleural biopsy specimen should be taken and placed in a dry sterile container for bacteriological culture.

Complications of pleural aspiration and biopsy

If fluid is removed too quickly or in too great a quantity oedema may develop in the re-expanded lung tissue. It is usually recommended that not more than 1.0-1.5 l is aspirated at one time. If the lung is unable to re-expand freely a high negative intrapleural pressure may develop as fluid is aspirated. This will be felt by the operator as an increased pull on the syringe plunger and by the patient as chest tightness accompanied by coughing. Both of these complications can be relieved by letting air into the pleural space to lower the negative pressure, but this delays re-expansion of the lung and may permit loculation of the fluid.

In the absence of a clotting defect pleural aspiration rarely leads to serious haemoptysis or haemothorax. The former may occur if pleural biopsy is attempted without first obtaining fluid and the latter if the vessels at the lower border of the rib are damaged. Pneumothorax can result if the needle tip penetrates the visceral pleura or if air is inadvertently allowed to enter via the needle. If the pneumothorax is large an intercostal drain with underwater seal may be required. If the aspiration needle tears the visceral pleura and a superficial vein, air may be sucked into the pulmonary veins from the needle itself or from the adjacent lung. The air may enter any systemic artery, most often the cerebral vessels, and produce transient neurological symptoms and signs. The customary emergency treatment is to tilt the patient head down and with his right side uppermost to reduce the chance of air entering these arteries. Many deaths previously certified as "pleural shock" were probably due to air embolus, but vagal inhibition can also occur. Empyema after a non-sterile aspirating technique is rare, but nevertheless infection may be introduced and convert a sterile pleural effusion into a difficult empyema. Possible complications in cases of mesothelioma have already been mentioned.

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