How to carry out pericardial aspiration

Introduction

Pericardial effusion is a potentially life-threatening condition. Development of cardiac tamponade is a medical emergency requiring prompt and expert treatment with drainage of the pericardial fluid – pericardiocentesis.

Many clinical conditions lead to the development of pericardial effusions including malignancy, acute myocardial infarction, cardiac surgery or percutaneous cardiac intervention, uraemia, infection, tuberculosis, radiotherapy, aortic dissection, connective tissue disorders and trauma. Consequently pericardial effusion and tamponade may present to doctors in almost any health-care specialty.

The development of symptoms depends on three factors:

1. The absolute volume of fluid produced
2. The rate of accumulation
3. The pericardial elasticity.

The normal pericardium contains 15–50 ml of fluid. Symptomatic pericardial effusion can result from a small but acute amount of fluid of as little as 150–200 ml causing raised intrapericardial pressure and cardiac embarrassment, whereas in chronic conditions such as malignancy or inflammation up to 2 litres of fluid can slowly accumulate with little change in intrapericardial pressure.

Diagnosis

Diagnosis is usually made on the basis of clinical findings and confirmation on echocardiography. A combination of these factors allows an assessment to be made about the necessity and urgency of pericardiocentesis. Clinical parameters suggesting tamponade include hypotension, tachycardia, elevated jugular venous pressure, pulsus paradoxus and oliguria. Echocardiographic findings indicating tamponade include diastolic collapse of right atrium or ventricle (*Figure 1*) or even left atrium, and marked respiratory Doppler variation in transvalvar flows.

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Pericardiocentesis

Pericardial drainage may be necessary for tamponade, symptomatic large effusions or as a diagnostic procedure. Drainage may be done percutaneously or by surgical fashioning of a pericardial window allowing pericardial fluid to drain into the peritoneum. Pericardiocentesis may be done from either a sub-xiphoid (in the vast majority of cases) or apical approach. Echocardiography allows assessment of the likely success of drainage via pericardiocentesis. Echocardiographic features suggesting that a surgical approach may be preferable include posterior effusions, loculation, large amounts of fibrin and clot within the effusion.

Pre-procedure preparation

Ideally, pericardiocentesis should be carried out in a cardiac catheter laboratory by experienced cardiologists with nursing and technical staff support, but clinical urgency may dictate that it is done elsewhere. If sufficient expertise is not available locally, and the patient is stable, transfer to a tertiary cardiac centre may be considered. Intravenous fluid should be given to maintain cardiac filling, but the role of inotropic support in tamponade remains controversial. The patient should have electrocardiographic (ECG) monitoring, oxygen saturation monitoring and invasive or non-invasive blood pressure monitoring. Resuscitation equipment should be available.

Blind pericardiocentesis should only be attempted in an absolute emergency. Routinely, the procedure should be assisted by fluoroscopy, echocardiography or a combination of the two modalities. The patient should receive adequate information about the benefits and risks of the procedure to give informed consent.

Procedure

The patient should be comfortably placed and reclined at 30–45° with adequate support behind them. The sub-xiphoid approach should be used unless contraindicated. The area should be shaved as needed and prepared using a surgical skin cleaner. The procedure should be undertaken in sterile conditions and the area should be surrounded by sterile drapes. Lidocaine 1% should be infiltrated in an area 0.5 cm below and slightly to the left of the xiphoid process. When the skin and subcutaneous tissues are anaesthetized a small nick in the skin should be made with a number 11 blade and subcutaneous tissues divided with mosquito forceps.

A pericardiocentesis needle (18 gauge, 15 cm) should be attached to a syringe containing 1% lidocaine. There was a vogue in the past for attaching an ECG electrode to the needle to look for action potentials that may be generated on contact with the myocardium. This information can be misleading and the practice should be discontinued. The needle should be advanced posteriorly until just behind the bony ribcage. The angle should then be changed to an angle of 15–20° from the abdominal wall and aimed in the direction of the left shoulder tip (*Figure 2*).

Lidocaine should be infiltrated gently as the needle is advanced and aspiration should occur. A feeling of 'give' is usually felt upon accessing the pericardial space and fluid should immediately be aspirated into the syringe. Using echocardiographic guidance or fluoroscopy the needle can be seen to enter the pericardium.

If there is doubt about the placement of the needle tip, further imaging can be performed with either echocardiographic contrast (or even agitated saline) or angiographic contrast media injected down the needle which should delineate between intrapericardial and intracardiac positioning.

The syringe should be removed from the needle and a soft-tip 0.035 guide wire passed through the needle into the pericardium using the Seldinger technique. In this case fluoroscopy is especially useful to see the wire curve around within the pericardial sac. The introducer needle is removed, leaving the guide wire well within the pericardial space. A dilator is then used to make a track into the pericardium. Then a pig-tail drain is passed over the guide wire and placed within the pericardium. The drain should be no less than 7F in size and should have side holes to aid drainage and minimize obstruction. The guide wire can be withdrawn on seeing the pig-tail drain position on fluoroscopy and then drainage of the effusion may occur. This should be done in a slow and controlled fashion, either with a syringe and three-way tap or by leaving the drain on free drainage.

Drainage of the effusion and relief of tamponade should be confirmed with a post-procedure echocardiogram. Pericardial aspirate should be sent immediately to the laboratory for protein and glucose assays, microscopy, culture and sensitivity, acid-fast bacilli and cytology. If the drain is left in situ, it should be secured with stitches and an adhesive dressing and flushed and aspirated regularly. A drain should not be left in for more than 48 hours.

If the sub-xiphoid approach is impossible, the apical approach can be used. Procedural aspects are similar, but the drain is inserted at the site of the apex beat, aiming internally.

Complications

Complications are infrequent in the hands of experienced operators. Complications include pneumothorax, arrhythmias, laceration of ventricles or coronary vessels, and pyopericardium. Sudden onset of pulmonary oedema or circulatory collapse on rapid draining of the effusion have also been reported. In experienced hands with good imaging, the expected complication rate is in the order of 1–2%. BJHM

Conflict of interest: none.

Figure 1 *is reproduced courtesy of Dr RH Swanton.* Figure 2 *is reproduced with permission from Spodick (2003).*

Further reading

Bastian A, Meissner A, Lins M, Siegel EG, Moller F, Simon R (2000) Pericardiocentesis: differential aspects of a common procedure. *Intensive Care Med* **26:** 572–6

Lorell BH (1997) Pericardial disease. In: Braunwald E, ed. *Heart Disease. A Textbook of Cardiovascular Medicine.* WB Saunders, Philadelphia: 1478–535

Spodick DH (2003) Acute cardiac tamponade. *N Engl J Med* **349:** 684–90

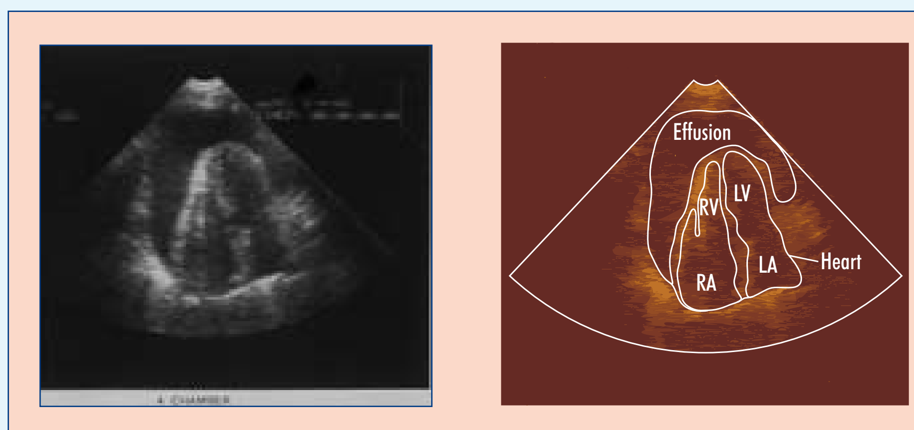

Figure 1. Four-chamber echocardiography showing pericardial effusion and right ventricular (RV) collapse. LA = left atrium; LV = left ventricle; RA = right atrium.

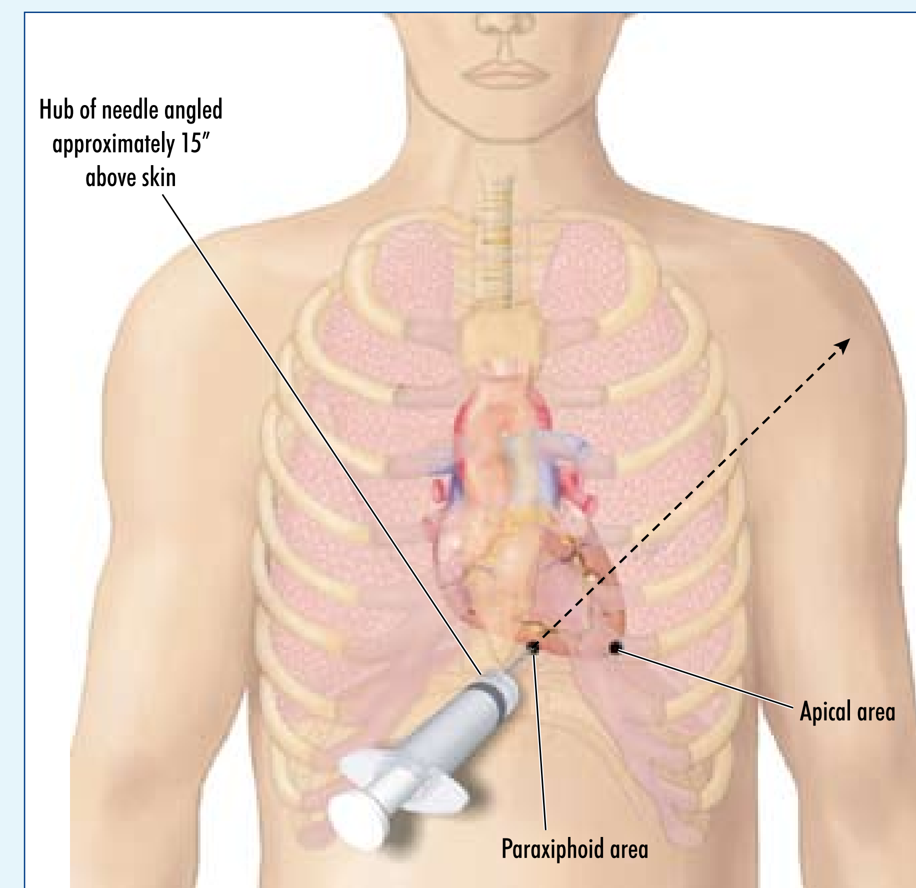

Figure 2. Most common sites of needle insertion for pericardiocentesis.

KEY POINTS

- Pericardial effusion is a life-threatening medical condition.
- It requires experienced urgent clinical and echocardiographic assessment.
- Pericardiocentesis is a safe procedure in expert hands.
- The underlying cause of the pericardial effusion must always be sought.