

Lumbar punctures and cerebrospinal fluid analysis

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Abstract

Lumbar puncture is an essential neurological investigation. The anatomy of the spinal canal allows cerebrospinal fluid (CSF) to be sampled from the lumbar region. We describe how, with adequate preparation and correct patient positioning, the procedure can be performed quickly and safely. The range of investigations that can be performed on the CSF and their interpretation are discussed.

Keywords Cerebrospinal fluid; diagnostic techniques; lumbar puncture

Introduction

Lumbar puncture (LP) and analysis of cerebrospinal fluid (CSF) provides essential clinical information in acute medical admissions and in the routine investigation of neurological diseases. LP is a safe procedure if clinicians are aware of the risks and contraindications (see below). It is usually performed to aid the diagnosis of central nervous system infections, subarachnoid haemorrhage (SAH), multiple sclerosis, malignancy and idiopathic intracranial hypertension.

Anatomy and physiology

Three layers of meninges cover the brain and spinal cord: the dura, arachnoid and pia. CSF is contained within the subarachnoid space. It is produced mostly by the choroid plexuses in the ventricles. It flows from the lateral ventricles, through the third and fourth ventricles, into the subarachnoid cistern around the medulla and over the surface of the brain and spinal cord, where it is reabsorbed by the arachnoid villi.

Within the spinal canal, the spinal cord ends at approximately the level of the first lumbar vertebra. Below this level, the nerve

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Key points

- Cerebrospinal fluid (CSF) analysis is an essential part of investigation of neurological disease
- Lumbar puncture is a safe routine procedure
- Adequate preparation and correct patient positioning are essential for successful completion of a lumbar puncture
- Accurate diagnosis depends on requesting the appropriate CSF tests and interpreting the results in the clinical context

roots of the cauda equina float in the CSF. A needle can therefore be passed between the spinous processes of two adjacent lower lumbar vertebrae to enter the spinal canal by puncturing the dura (Figure 1).

Procedure

The indications and contraindications for LP are given in Tables 1 and 2, respectively. The most important contraindication to LP is the presence of an intracranial mass lesion. In this situation, LP can result in cerebral herniation and death. In patients who present with seizures or have impaired consciousness, focal neurological signs or papilloedema, brain imaging should be performed first. Other important contraindications are anti-coagulation and thrombocytopenia (because of the risk of haemorrhage) and sepsis in the skin overlying the lumbar spine (because of the risk of introducing infection). A simple LP pack can reduce major errors in CSF collection.¹

Consent

Informed consent should be obtained and should include a description of the potential benefits of the procedure, the nature of the procedure and potential complications. You may want to tell patients about discomfort during the procedure (often pain in the back or shooting down the legs), and inform them that it is possible you will fail to obtain CSF and someone else may do the procedure. Patients should be warned about the potential complications of headache and backache.

'Low-pressure' headaches are characteristic: these are generalized and markedly postural, worse on sitting up and eased by lying flat. They can require treatment with an autologous blood patch, but most are self-limiting. The frequency of post-LP headache has been reduced from 32% to 6% by using a 22G pencil-point needle instead of the traditional 20G bevelled needle.² More serious, although very rare, complications include epidural haematoma or infection.

Preparation

A well-lit room with a firm, height-adjustable couch and an assistant should be arranged. The equipment, which should be prepared on a sterile field, includes an appropriate LP needle. A

Spinal anatomy and needle positioning

Diagrammatic illustration of the spinal anatomy that allows lumbar puncture seen in axial and sagittal planes.

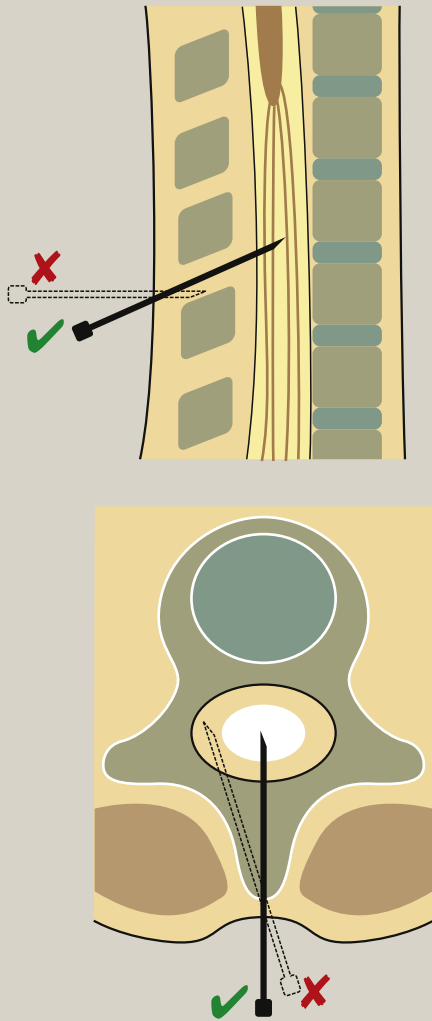


Figure 1

pencil-point needle is preferred, except when the LP is being performed to reduce CSF pressure, for example in idiopathic intracranial hypertension; in this situation, a bevelled needle can be used.

Indications for lumbar puncture

Cerebrospinal fluid examination is often useful in the diagnosis of:

- Subarachnoid haemorrhage
- Meningitis/encephalitis
- Inflammatory neurological disorders including multiple sclerosis and Guillain–Barré syndrome
- Carcinomatous or lymphomatous meningitis
- Prion disease
- Idiopathic intracranial hypertension

Table 1

Contraindications to lumbar puncture

- Symptoms and signs of focal intracranial neurological disease or raised intracranial pressure, including confusion (unless safety has been determined by neuroimaging)
- Neuroimaging evidence of obstruction to cerebrospinal fluid flow
- Coagulopathy – international normalized ratio >1.3 and/or thrombocytopenia
- Signs of local infection at the site of skin puncture

Table 2

Correct patient positioning is the key to success. The patient should be asked to lie in the left lateral position (for the right-handed operator), with the back along the edge of the couch, and adopt the fetal position with the neck, hips and knees flexed. A single pillow should be placed under the patient’s head, and one between the knees. Check that the hips lie vertically above each other, and likewise the shoulders.

The operator should then examine the patient’s back to identify the anatomical landmarks (Figure 2). First locate the iliac crest, and then palpate the spinous processes. The level vertically below the iliac crest should be between L3 and L4. This should be identified by careful palpation as visible surface landmarks can be misleading.

Technique

A sufficiently large area of surrounding skin should be sterilized to maintain a sterile field. Lidocaine (2%) can then be infiltrated into the skin overlying the intervertebral space as far as the

Anatomical landmarks

Illustration of patient position and anatomical landmarks shown from the operator’s point of view.

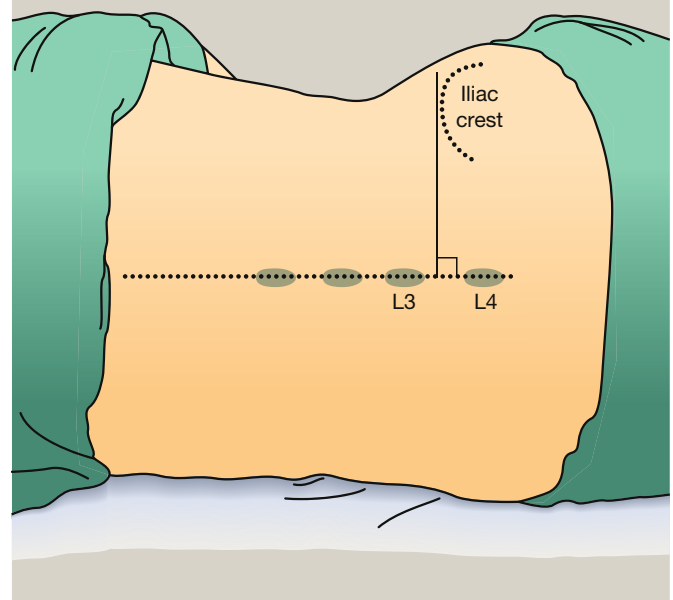


Figure 2

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