

How to perform a lumbar puncture with the patient in the seated position

Introduction

The main advantage of performing lumbar puncture with the patient seated is that it is technically easier since the anatomical landmarks are less ambiguous. The main disadvantage is that the opening pressure can not be accurately measured (Table 1).

When the patient is curled in the lateral position the spine must accommodate both the pelvis and shoulder girdle by lateral flexion and rotation. This can present a challenge to even the skilled operator, especially when faced with wide-girdled women. With the patient in the seated position there is less ambiguity since the spine is symmetrical about the sagittal plane. The seated position produces less tension in the paravertebral musculature than the standard approach. Furthermore, flexion of the spine – to open the intervertebral space – is aided by gravity when the patient rests forward as shown in Figure 1.

This method should not be used if the opening pressure is required nor should it be used for intrathecal infusions. It is recommended for fully conscious patients in whom a diagnostic spinal tap is required.

Before the procedure

'First hit' successful lumbar puncture is best achieved with the patient relaxed. Reassure the patient. Relaxation of the paraspinal muscles aids needle penetration.

Table 1. Advantages and disadvantages of 'seated approach'

Advantages	Technically simpler
	Full lumbar flexion of spine aided by gravity
	Well tolerated
Disadvantages	Cannot measure opening pressure
	Requires patient cooperation
	Cannot use for intrathecal infusions

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Although longer, the black (22G) spinal needle is similar in gauge to a green (21G) venepuncture needle. Even so the patient should receive sufficient local anaesthetic that no pain is felt during the procedure. The patient should be aware that he/she may feel some pressure as the operator palpates the spine.

Explain the procedure and show the patient the sitting position – they should be relaxed and bent forward, lying with the head in their arms on a pillow (Figure 1). The shoulders should remain square to the hips. The patient should be told to sit still during the procedure and breathe normally.

Give premedication (Table 2) and prepare the procedure trolley – this usually takes 5–10 minutes. Allow 5 minutes to print off request forms and label specimen bottles. By the time the trolley is ready and the forms and specimen bottles prepared, the premedication should be taking effect.

Figure 1. Patient position for seated lumbar puncture. Height of bed can be adjusted to suit the operator. It helps if the patient's feet are raised slightly.



Table 2. Premedication

Diazepam 2 mg (PO)	Give 15 minutes before procedure Repeat if necessary Avoid if patient on anti-retrovirals Alternative: midazolam 5 mg (PO)
Pethidine 50 mg (IM)	Avoid in pregnancy or history of previous reaction Alternative: dihydrocodeine 60 mg (PO)
Metoclopramide 10 mg (PO)	Alternative: cyclizine 25 mg (IM)

IM = intramuscular; PO = by mouth

Diazepam is a good muscle relaxant with both analgesic and amnesic properties, and 2 mg (by mouth; PO) is sufficient to mildly sedate most adult patients before the procedure.

Give pethidine 25–50 mg (intramuscular; IM) plus metoclopramide 25 mg (PO). Ideally the patient should feel no pain during the procedure, and minimal discomfort afterwards. Any pain felt during the procedure will cause reflex tension in the paraspinal muscles and cause a rise in CSF and blood pressures.

The lumbar spine should be exposed (an surgical gown worn by the patient is ideal) and the bed and undergarments should be protected from the stain of the disinfectant by inserting an inco-pad.

Anatomical landmarks are key to performing successful lumbar puncture. Before proceeding, define the plane of the posterior superior iliac crests. This marks the level of L3–L4. The spinal cord ends at L1–L2. Palpate and mark the spinous processes above and below the level you wish to enter. These should feel bony hard under the skin and subcutaneous fat. Mark the anatomical landmarks and limits of the operating field with a marker pen (Figure 2).

Double check that the procedure trolley is set up correctly and that the lidocaine vials (equivalent to 10 ml) are open ready for use (Figure 3). Snap open the vials by bending towards the indicator dot.

Procedure

Prepare the skin with disinfectant, wiping away from the L3–L4 space you wish to enter. Disinfect the bony landmarks of the

Figure 2. Surface anatomy of the lumbar spine for lumbar puncture; X = posterior superior iliac spine; V = position of the spinous processes of L3 and L4.



posterior superior iliac crests and spinous processes to save replacing your gloves if you need to palpate the surface landmarks later.

Draw up 10 ml of 2% lidocaine using the larger bore (21G) green needle. (Note: 2 x 5 ml vials are easier and cheaper than 5 x 2 ml.) Switch to an orange (25G) needle and infiltrate the skin. Pain fibres are mainly at the level of the dermis and ligamentum flavum. Infiltrate 2–5 ml of lidocaine widely around the point of entry under the skin and massage the area for 30 seconds using aseptic method. Allow several minutes for the local anaesthetic to take effect.

Switch back to the green needle once the skin has been anaesthetized and give a further 5 ml lidocaine directed at the ligamentum flavum. The ligamentum flavum lies about 4–6 cm below the surface of the skin and will usually entail penetration of the green needle up to the hilt. If you hit bone adjust the trajectory of the needle in the sagittal plane (Table 2). Allow a further 2 minutes for the anaesthetic to work.

The spinal needle should be held between the fingers with one thumb over the stylet. Use the other hand to direct the angle of penetration. Slight resistance is felt as the needle passes through the skin. Ensure that the needle remains in the sagittal plane. Slight deviations to the right or left will result in the end hitting bone. Advance the spinal needle towards the umbilicus with the bevel uppermost. The entrance to the vertebral foramen is bordered by the inferior articular and spinous processes that form bony arches above and below the level of entry (Figure 2).

Figure 3. Lumbar puncture kit. Sterile pack containing: sterile gloves; 10 x lidocaine 2%; disinfectant; 1 x 22G (black) spinal needle; 4 x gauze swabs, 3 x specimen pots for CSF sample; 2 x 10 ml sterile syringe; 1 x glucose bottle (oxalate-grey top); 2 x 21G (green) needle; 1 x sterile towel; 2 x 25G (orange) needle; 1 x inco-pad.



Table 2. Trouble shooting

You hit bone	Withdraw the needle. Recheck the patient's position and bony landmarks. Adjust the needle's pitch ensuring that it is in the sagittal plane and repeat. If still unsuccessful, withdraw and repeat a space higher at L2–L3
You obtain blood-stained fluid	Fresh blood obtained as slow ooze via the lumbar puncture needle suggests penetration of the posterior venous plexus. This may result in bruising of the space and haematoma. Try another space remembering to flush or replace the spinal needle before repeating Streaky blood staining of the CSF, becoming clear later, indicates a traumatic tap with blood in the needle. Discard initial CSF and collect a later specimen for analysis Uniform blood-staining of CSF indicates possible subarachnoid haemorrhage confirmed by red cell count in successive samples. Xanthochromia of supernatant is often present
Patient complains of tingling feet	Provided the correct landmarks have been defined the most likely cause is patient anxiety. Reassure patient and ensure they are comfortable. Consider further diazepam
Operator despair	Repeat attempts become increasingly difficult – and less well tolerated – as the intra-spinous muscles become bruised Previous surgery, spinal fusion and previous traumatic lumbar puncture may make the procedure tricky. Computed tomography (CT)-guided lumbar puncture may be required If bacterial meningitis is suspected take blood cultures and commence antibiotic therapy

dered by the inferior articular and spinous processes that form bony arches above and below the level of entry (Figure 2).

Increased resistance will be felt as the needle enters the ligamentum flavum. Firm resistance indicates bone in which case one should withdraw and try again. There is usually an obvious 'give' as the spinal needle penetrates this tough ligament. The dura mater and the spinal canal lie immediately deep to this.

Remove the stylet. Clear CSF should drip slowly from the end of the needle. If the initial drop shows streaky blood staining wait for a few seconds for this to clear. Asking the patient to count aloud slowly to thirty is a useful distraction method and allows enough time to collect the sample.

At L3–L4 the cauda equina will not be compromised by the presence of the spinal needle. If CSF flow is poor, rotate the needle in case a nerve root is lying against it.

After the procedure

Remove the spinal needle and apply firm pressure with a sterile swab for 30 seconds over the exit site. Clean the site with disinfectant and dress with a sterile dressing.

Pulse, blood pressure and neurological observations should be performed quarter-hourly for 1 hour with the patient lying supine for at least 1 hour following a lumbar puncture. For patients in casualty departments and for outpatient procedures this should allow for preliminary results to be available. In the event of a traumatic tap,

or repeated attempt, bed rest should be longer: a further hour for each repeat attempt is suggested, up to 4 hours. Patients should not drive for the rest of the day because of the effects of the premedication.

Ensure that the sample reaches the lab and that the technician knows who to bleep with the result. (It is best for the operator or one of the team to take the specimen directly by hand, to avoid delays.)

After the procedure, send bottles 1 and 3 for cell count to differentiate a bloody tap from blood in the CSF. Send bottle 2 for biochemistry and xanthochromia. **BJHM**

Conflict of interest: none.

KEY POINTS

- Explain the procedure and demonstrate the sitting position to the patient.
- Give premedication. Prepare trolley and request forms and bottles.
- Prepare the patient, prepare the sterile field and clean the skin.
- Give local anaesthetic, concentrating on skin and deep tissues of the ligamentum flavum.
- Enter with the spinal needle horizontal to the ground aiming for the umbilicus. Ensure the needle does not deviate to the side.
- Once in the spinal canal remove the stylet and collect CSF.
- Remove needle and apply firm pressure with a sterile gauze. Cover with a clean dressing.
- Lie the patient on their back for 1 hour, with observations performed every 15 minutes.