

## Lumbar puncture

### Indications

Lumbar puncture (LP) should be performed in babies with suspected meningitis UNLESS:

- There is concern about raised intracranial pressure or a non-communicating hydrocephalus
- There is local infection over the LP site
- Thrombocytopenia  $< 50,000$  or significant coagulopathy (however, if meningitis is highly suspected, consider performing an LP immediately after a platelet transfusion if the baby will tolerate it)
- Unstable babies who will not tolerate LP (most babies, even ventilated ones, will tolerate a slick LP by an experienced operator and nurse). If deferred, the LP should be done as soon as possible after.

LPs should also be performed to look for associated meningitis in all babies with positive blood-cultures (other than coagulase negative staphylococcus) that are not thought to be due to contamination.

Occasionally, LPs are performed to obtain CSF for metabolic investigations instead, or to measure and relieve raised intracranial pressure. All the same precautions below should be observed.

### Consent

We do not currently take formal written consent for an LP, but verbal consent should be sought wherever feasible. Inform the parents of the indication for an LP and how it is performed.

### Potential complications

Failure to obtain a sample, or a blood-stained sample  
 Hypoxic stress  
 Epidural collection of CSF or continuous CSF ooze from skin puncture  
 Post-dural puncture headache (reported in children and adults but not known about in neonates)  
 And rarely: Spinal epidermoid tumour  
 Spinal cord injury/haematoma  
 Spinal abscess  
 Cerebellar tonsillar herniation

### Analgesic considerations

See oral sucrose guideline for procedural analgesia. Non-nutritive sucking and containment can help to alleviate distress.

### Procedure

This is strictly an aseptic procedure. Use sterile equipment and ensure all your equipment is ready before positioning the baby, as they can find it uncomfortable. Make sure the environment is warm and that you have another assistant to catch the CSF drops into sequentially numbered bottles.

- Attach at least a saturation monitor onto the baby to watch for hypoxia and/or bradycardia. Watch the baby's colour and breathing throughout the procedure. Lie the baby on its side.
- Scrub and glove your hands as for a sterile procedure. Clean the baby's back 3 times in a circular motion from the anticipated point of insertion outwards with the appropriate antiseptic solution (see Skin antiseptic guidance) usually 0.5% chlorhexidine in 70% alcohol solution, unless below 27 weeks in the first week of life. Either clean the baby's iliac crest with 0.5% chlorhexidine in 70% alcohol, or apply your drapes so that you can feel for the baby's iliac crest through them whilst remaining sterile.

- Once the back is cleaned, ask the nurse holding the baby to gently curl the baby. Success is highly dependent on having an experienced nurse holding the baby well, whilst simultaneously ensuring good airway control. The lower spine should be flexed but the neck does not need to be excessively flexed.
- Feel for the iliac crest with your finger and drop your thumb to the spinal process in line with it (corresponding to L4). Keep your thumb there to feel for the intervertebral space, whilst slowly introducing the spinal needle just next to your thumb. Always use a needle with a stylet in place, as doing LPs without stylets can cause spinal epidermoid tumours with serious consequences (1).
- When the needle is just through the skin, stop and wait for the baby to stop wriggling. Then continue to slowly advance the needle in the direction of the umbilicus. Also ensure that your needle is in the baby's midline. Stop when you feel a very slight give, and remove the stylet. If no CSF is obtained, replace the stylet and advance the needle by another 1-2mm, and remove the stylet again. Continue this until CSF is obtained. The depth of needle insertion should be between 5-20 mm, depending on the baby's size, but not more than that.
- Collect CSF into 2 universal containers and 1 yellow (fluoride oxalate) glucose tube, 5-10 drops in each depending on the size of the baby. Occasionally, extra samples may be needed for metabolic studies – these should have been determined beforehand. If the first sample is thickly blood-stained but then clears, it may be reasonable to collect a third universal container sample and discard the first. If flow is very slow or insufficient, both protein and glucose can still be done on a universal container sample if sent to the lab within 30 minutes, but protein cannot be done on a fluoride oxalate sample.
- When all samples have been collected, gently withdraw the spinal needle and press over the insertion site with sterile gauze for a few minutes. During this time, the baby can be uncurled. Ensure CSF has stopped oozing before sticking a spot plaster over the insertion site.
- Check a capillary blood glucose within 1 hour of CSF sampling (preferably before, otherwise as soon as possible after the LP) in order to interpret CSF glucose. In a recent local audit, 7 of 9 babies (78%) with culture-proven bacterial meningitis had a CSF:blood glucose ratio of <0.67, yet blood glucose was only checked in 57% of LPs (2).
- Send sample 1 to Biochemistry for protein (together with fluoride oxalate tube for glucose), and sample 2 to Microbiology for microscopy, culture and sensitivity. There is no need to send two bottles to Microbiology here. Call the porters urgently to take the samples straight to the labs, and bleep the lab technicians to inform them that you are sending a CSF sample.
- Virology samples should not be sent routinely, but only on consultant request in specific cases where viral meningitis is strongly suspected. If a sample was not collected specifically for viral studies, Microbiology can sometimes forward their sample on if sufficient CSF was collected. If there is insufficient CSF for Virology testing, then stool, urine or throat swab samples can be informative about systemic infection.

### Post-procedure care

Leave the saturation monitor on for a few hours after the LP. Ensure that results, especially virology ones, if sent, are followed up, and document procedure and cell count/protein/glucose/culture on Badger. Note that a normal cell count does not automatically exclude meningitis. In the same audit as above, 3 of 15 babies with culture-proven bacterial meningitis, and 3 of 8 babies with viral meningitis had a CSF white cell count of <15 (one at 14, one at 6, and the rest at £1). Make sure 0.5% chlorhexidine in 70% alcohol is washed off following procedure.

### Troubleshooting

If the first attempt yields a dry or bloody tap, get a more senior colleague to attempt a second time, unless the baby has been too unstable. Subsequent attempts should always be distal to the first (i.e. L5 or lower) as the spinal cord ends at L3 at its lowest in term and preterm infants, compared to L1-2 in adults (3).

### References

1. Ziv ET, Gordon McComb J, Krieger MD, Skaggs DL. Iatrogenic intraspinal epidermoid tumor: two cases and a review of the literature. *Spine (Phila Pa 1976)*. 2004 Jan 1;29(1):E15-8

2. Elliott E, Gallella S, Wong CM. Lumbar puncture audit. 2010. (Report available from Dr Becher)
3. Rowland Hill CA, Gibson PJ. Ultrasound determination of the normal location of the conus medullaris in neonates. *AJNR* 16:469–472, Mar 1995