Lumbar Puncture

Introduction

Lumbar Puncture is a common diagnostic investigation which is performed in the emergency department. Unlike many investigations it is rather invasive and has many potential complications. The purpose of this clinical procedure is help you perform a safe and successful lumbar puncture in the emergency department. This is a guide only and does not replace supervision from senior medical staff if you are unfamiliar with the technique.

Indications

Emergency Department lumbar puncture may be necessary to investigate suspected:

- Meningitis
- Encephalitis
- Subarachnoid haemorrhage (> 12 hrs after symptoms)
- Guillain Barre Syndrome
- Multiple Sclerosis
- Benign intracranial hypertension

Contra-indications

Lumbar Puncture should not be performed on a patient demonstrating:

- Clinical signs of raised intra cranial pressure
  - altered level of consciousness
  - focal neurology
  - recent seizure
  - brain stem signs (pupillary changes / posturing / irregular respiration)
- Abnormal CT head, including Arnold Chiari malformation
- Cardio respiratory compromise; which will be further compromised by positioning
- Focal infection over puncture site
- Bleeding tendency:
  - systemic anticoagulation,
  - bleeding diathesis,
  - thrombocytopenia with platelets < 100 ×10^9/L
Patient consent

Informed consent should be obtained and clearly documented in the chart. Explain the reasons why you are performing the procedure and what the patient should expect.

Risks to be explained should include:

Commonly
• Backache, particularly during procedure

Uncommonly
• Headache
• Failure to obtain a specimen

Rarely
• Lower limb weakness
• Epidural haematoma
• Epidural abscess
• Brain herniation
• Death

Consent forms can be located and printed from PAH intranet site (see Appendix)

Procedure

CT head prior to LP:

CT should be performed prior to lumbar puncture when there is suspicion of an intracranial lesion contributing to the presentation. This includes suspected intracranial haemorrhage, encephalitis or brain abscess.

It is important to recognise that a normal CT does not exclude raised intracranial pressure.

Subsequently you should not perform an LP on any patient with

• An altered level of consciousness
• Focal neurology
• Localising signs (papillary abnormalities, posturing)

Following anecdotal cases of brain herniation following LP in patients with unrecognised Arnold Chiari malformations, a CT head is typically performed prior to LP at the Princess Alexandra Hospital Emergency Department. However there is no evidence to support this practice.

Prepare patient:

• Screen for contra-indications as above
• Check results of relevant investigations performed (i.e platelet count and INR)
• Gain IV access
• Mark anatomical landmarks: a line traversing the iliac crests corresponds with the L4 spinous process, it's useful to mark the location of the spinous processes with a pen.

• Position patient: Left lateral position or sitting upright on bed with feet on support. Flex spine by drawing shoulders forward and bring thighs to abdomen.

• Consider IV sedation and analgesia

Prepare Equipment & Environment:

• Pre-packed LP pack can be found in the Procedure Suite cupboard which contain:
  • 1 x disposable manometer
  • Pencil Point spinal needles - 22g or 25g
  • CSF containers X 4
  • 5ml syringe
  • 19g, 21g, and 23g needles
  • Sterile window drapes
  • Sterile occlusive dressing

• You will also need to obtain
  • 2 x ampoules of local anaesthetic (eg. Lignocaine 1% with adrenaline)
  • Skin cleaning solution (Betadine or pink chlorhexidine)
  • Sterile gown / sterile gloves / sterile cloth hand towel
  • Skin marking pen

• This procedure should ideally be performed in the Procedure Suite with full non-invasive monitoring should sedation be required.

• A dedicated nurse to monitor patient and assist is preferable.
Technique

- Operator to don a mask, sterile gown and gloves after washing hands.

- Prepare skin with chlorhexidine solution.

- Drape to create sterile field.

- Anaesthetise the skin with a generous amount of 1% lignocaine with adrenaline.

- Insert, bevel up, the introducer followed by the spinal needle, midline in the L4-5 interspace in a cephalad direction aiming toward the navel. A drop in resistance will be felt as the needle enters the epidural space. A 2nd loss of resistance felt on entering the subarachnoid space.
• Remove the stylet and confirm CSF flow.

• To measure opening pressure the patient must be in the lateral position. Attach a small volume manometer to the end of the spinal needle via a 3 way tap. Allow the column of CSF to climb up the manometer until a peak is reached. Sometimes minor fluctuations in pressure associated with respirations can be observed. A high pressure is present if the reading > 25mmHg.

• Collect 0.5mls =10 drops in each of the sequentially numbered spinal tubes. Remember the CSF used to measure the opening pressure should be used to this effect and can be directed into the tubes via the 3 way valve.

• Reinsert stylet and remove needle

• Apply sterile dressing

• Correctly label all 4 tubes and send for:
  • microscopy, culture and sensitivity
  • protein
  • glucose
  • xanthochromia (as indicated)
  • viral serology (can be added on if indicated by the cell count)

• Notify microbiology laboratory that samples are on their way.

• Document the procedure and the results in the patients notes

• The patient can ambulate as desired after procedure once any sedation has resolved. There is no evidence to support immobilisation of patient post LP – bed rest does not reduce incidence of post LP headache.

• Follow up the results and inform patient of same.

Complications

Headache

Risk of headache is 1-4%. The risk is reduced by using a small calibre (20-22 gauge) pencil point needle. The onset is usually within 24-48 hours and lasts 4-8 days. It is often suboccipital in location and improved with lying flat. There can be associated nausea, vomiting & vertigo. It is thought to be secondary to ongoing seepage of CSF.

Management:

• Rest in bed, fluids, analgesia, and caffeine.
• An Epidural patch involves injection of 20mls of patient’s blood into epidural space. The clotting of blood is then thought to reduce rate of
CSF leak. It is contraindicated if there is any possibility of bacteraemia.

**Backache**

Pain is very common at the time of procedure and can be limited by adequate local anaesthesia and sedation. 10% of patients experience shooting pain down the legs at the time of the procedure. This usually settles on removal of the needle. 35% of patients have back pain for several days post procedure. This typically responds to simple analgesia.

**Dermoid formation**

Occasionally implantation of skin cells during lumbar puncture can cause the formation of dermoid tumours. They are usually benign, but may need surgical removal.

**Infection**

Infection is uncommon if sterile precautions are undertaken. It can occur at the puncture site or rarely involve the CSF or bone.

**Lower limb weakness**

Lower limb weakness is exceedingly rare (< 0.01%) and usually transient but can be permanent. It may be secondary to direct trauma, epidural infection or haematoma.

**Brain Herniation**

Brain herniation occurs very rarely, but can lead to death or permanent disability. It is more likely to occur in the setting of raised intracranial pressure or anatomical anomalies such as Arnold Chiari malformations.

**Additional information**

**Normal CSF parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Normal Range for CSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Clear &amp; colourless</td>
</tr>
<tr>
<td>White Cells</td>
<td>0 - 5 x 10⁶ per litre (all lymphocytes with no neutrophils)</td>
</tr>
<tr>
<td>Red Cells</td>
<td>0 - 10 x 10⁶ per litre</td>
</tr>
<tr>
<td>Protein</td>
<td>0.2 - 0.4 g/L (or less than 1% of the serum protein concentration)</td>
</tr>
<tr>
<td>Glucose</td>
<td>3.3 - 4.4 mmol/L (or ≥ 60% of a simultaneous plasma glucose)</td>
</tr>
<tr>
<td>pH</td>
<td>7.31</td>
</tr>
</tbody>
</table>
Pressure

<table>
<thead>
<tr>
<th>Condition</th>
<th>Appearance</th>
<th>White Cells</th>
<th>Red Cells</th>
<th>Protein</th>
<th>Glucose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial Meningitis</td>
<td>Cloudy &amp; Turbid</td>
<td>Raised neutrophils</td>
<td>N</td>
<td>H or VH</td>
<td>VL</td>
</tr>
<tr>
<td>Viral Meningitis</td>
<td>N</td>
<td>Raised lymphocytes</td>
<td>N</td>
<td>N or H</td>
<td>N or L</td>
</tr>
<tr>
<td>Tuberculous Meningitis</td>
<td>N or slightly cloudy</td>
<td>Raised lymphocytes</td>
<td>N</td>
<td>H or VH</td>
<td>VL</td>
</tr>
<tr>
<td>Subarachnoid Haemorrhage</td>
<td>Usually blood stained</td>
<td>N</td>
<td>VH</td>
<td>N or H</td>
<td>N or L</td>
</tr>
<tr>
<td>Guillain-Barré Syndrome</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>H (after 1/52)</td>
<td>N or L</td>
</tr>
<tr>
<td>Multiple Sclerosis</td>
<td>N</td>
<td>Raised lymphocytes</td>
<td>N</td>
<td>H</td>
<td>N</td>
</tr>
</tbody>
</table>

**Further Reading**

An instructional video on LP is available PA intranet. Follow the links from the Intranet home page to the Intensive Care website. Training videos are available through the Medical Education Link.


**References**