Lumbar Puncture Procedure and CSF Analysis

Lumbar puncture is a procedure that is often performed to obtain information about the cerebrospinal fluid. Cerebrospinal fluid (CSF) is the fluid that is produced in the choroid plexuses of the ventricles of the brain.

What are the indications of Lumbar Puncture?

This procedure is indicated in:

1. Suspected central nervous infection ie encephalitis, meningitis)
2. Suspected subarachnoid hemorrhage
3. Introducing chemotherapy or contrast
4. Removal of cerebrospinal fluid.

Lumbar puncture is contraindicated in:

Absolute contraindications:

Increased intracranial pressure (ICP).

Relative contraindications are:

- Cardiopulmonary instability
- Soft tissue infection at the puncture site

- Bleeding diathesis:
- Active bleeding
- Platelet count <50,000
- INR > 1.4

Patient Counseling

Your job is to provide a clear explanation of the urgent indications of the procedure, as well as the details of the procedure itself.
In order to obtain informed consent, you must list both risks and benefits.

Risks associated with lumbar puncture are:

- Postspinal headache
- Epidermoid tumor
- Infection
- Cerebral herniation
- Spinal hematoma

Benefits:

The benefit of early diagnosis far outweighs the risk of the procedure if there are no contraindications.

After having looked at all the indications and preparations it's important that we look at the clinical anatomy of lumbar puncture before diving into the procedure itself.

Lumbar Puncture anatomy

In older children, a lumbar puncture can be performed from the level of L2-L3 interspace to the L5-S1 interspace. In children younger than 12 months, LP must be performed below the L2-L3 interspace.

An imaginary line that connects the 2 posterior superior iliac crests intersects the spine at approximately at the level of L4.

Pre-procedure Preparation

Local anesthesia can be provided with either lidocaine and/or EMLA.
The patient must be well-positioned to enable you to see landmarks clearly:

Hips and shoulders should be perpendicular to the exam table
The gluteal crease should align with the spinous processes.

Watch for respiratory function throughout the entire procedure!

Procedure

Lumbar puncture is performed using sterile technique and a sterile field.

Put on sterile gloves and clean the puncture site with betadine. The area should be large, including the posterior superior iliac crest because you will need to use it as a landmark.

Place sterile drapes around the puncture site.

Move on and infiltrate with Lidocaine.

Check your spinal needle- Is the stylet in place? Is it the appropriate diameter and length? Confirm that it a spinal needle.

Are your collection tubes upright and open? CSF samples are collected in four sterile tubes (no preservatives

Find your landmark by marking it with your fingernail.

Advance the spinal needle, bevel up, parallel to the exam table, with the tip of the needle advancing toward the patient's umbilicus. Advance slowly.

In newborns, you may only get the bevel in before you are in the subarachnoid space.

The stylet may be removed as the needle is advanced to look for CSF.

The use of a manometer is optional at this time to measure opening pressure.

Put about 1cc or about 15-20 drops in each of the 4 tubes.

Replace the stylet and remove the needle and dispose of the sharps immediately.

You should label your own CSF tubes with the tube number and what test you want to be ordered, as well as your initials, time, and date. For example:

Tube 1 is used for Chemistry
Tube 2 is used for microbiology testing.
Tube 3 is generally used for cytology.
Tube 4 is generally used for hematology (cell count and differentiation).

What if the procedure doesn't go as expected?

Sometimes when carrying out the procedure you may come across bony resistance:
In this case, increase flexion of the patient, or Withdraw needle to soft tissue and re-palpate to make sure the spine is not rotated.

In case of poor flow, rotate needle by 90 degrees or replace stylet and advance slightly. Pull the needle back and redirect.
If it is not successful still, remove the needle and attempt different sites with a new needle at this

time.

Traumatic Tap occurs when the needle hits venous plexus. CSF typically clears if in subarachnoid space
Remove the needle and reattempt with a new needle if clot forms or fluid doesn't clear.

	Glucose	Protein	# of WBC's	Organism present
Bacterial Meningitis	?	?	>1000 ?neutrophils	Gram stain CSF/bld cx
Viral Meningitis	Nl or slightly?	Nl or slightly?	~10-500 ?lymphocytes	no

When a tap is bloody it may be a traumatic tap, or it could be blood in the CSF. Your CSF analysis will provide a percentage of crenated and uncreated red blood cells.

Crenated means the RBCs have started breaking down, and therefore have likely been in the CSF longer. This may be a sign that you are dealing with Herpes meningitis.

Interpreting CSF can be subjective in many cases. Results will vary based on the timing of the tap in the course of the illness, antibiotics are given, other cultures obtained, and the quality of the tap.

To this point, you may have asked yourself,

What are the characteristics of a normal CSF? here is the answer.

Reference Range

Characteristics of normal spinal fluid are:

Total volume is about 150 mL

Color: Colorless and clear.

The opening pressure is between 90-180 mm H 2O (when the patient lying in lateral position)

Osmolarity is 281 mOsm/L

Specific gravity: 1.006 to 1.008

- pH between 7.28-7.32
- Pco2 of47.9 mm Hg
- HCO3 22.9 mEq/L

Sodium level : 135-150 mmol/L

Potassium level : 2.7-3.9 mmol/L

Chloride: 116-127 mmol/L

Calcium: 2.0-2.5 mEq/L (4.0 to 5.0 mg/dL)

Magnesium: 2.0-2.5 mEq/L (2.4 to 3.1 mg/dL)

- Glucose: 45-80 mg/dL
- Lactate dehydrogenase (LDH) - <2.0-7.2 U/mL

Proteins: 20-40 mg/dL

- At different levels of spinal tap:
    - Lumbar: 20-40 mg/dL
    - Cisternal: 15-25 mg/dL
    - Ventricular: 15-45 mg/dL

Percentage of total protein concentrations)

- Prealbumin: 2-7%
- Albumin: 56-76%
- a1-Globulin: 2-7%
- a 2-Globulin: 3.5-12%
- b-and g-globulin: 8-18%
- g-Globulin: 7-12%
- Immunoglobulins
    - IgG: 10-40 mg/L
    - IgA: 0-0.2 mg/L
    - IgM: 0-0.6 mg/L
    - k/l ratio: 1

Erythrocyte count:

- Newborn: 0-675/mm3
- Adult: 0-10/mm3

Leukocyte count in adult is 0-5/mm 3