

In The Name Of God

Lumbar Puncture

Tabriz University Of Medical Sciences

Faculty of medicine/Skill lab

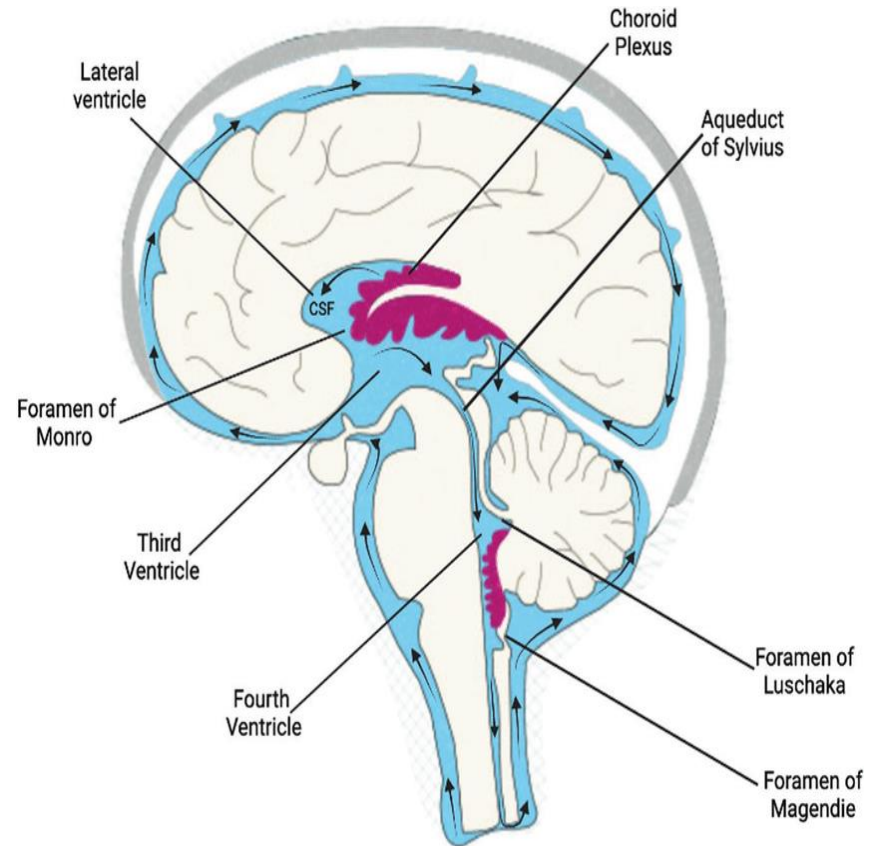
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Anatomy in lumbar puncture (LP)

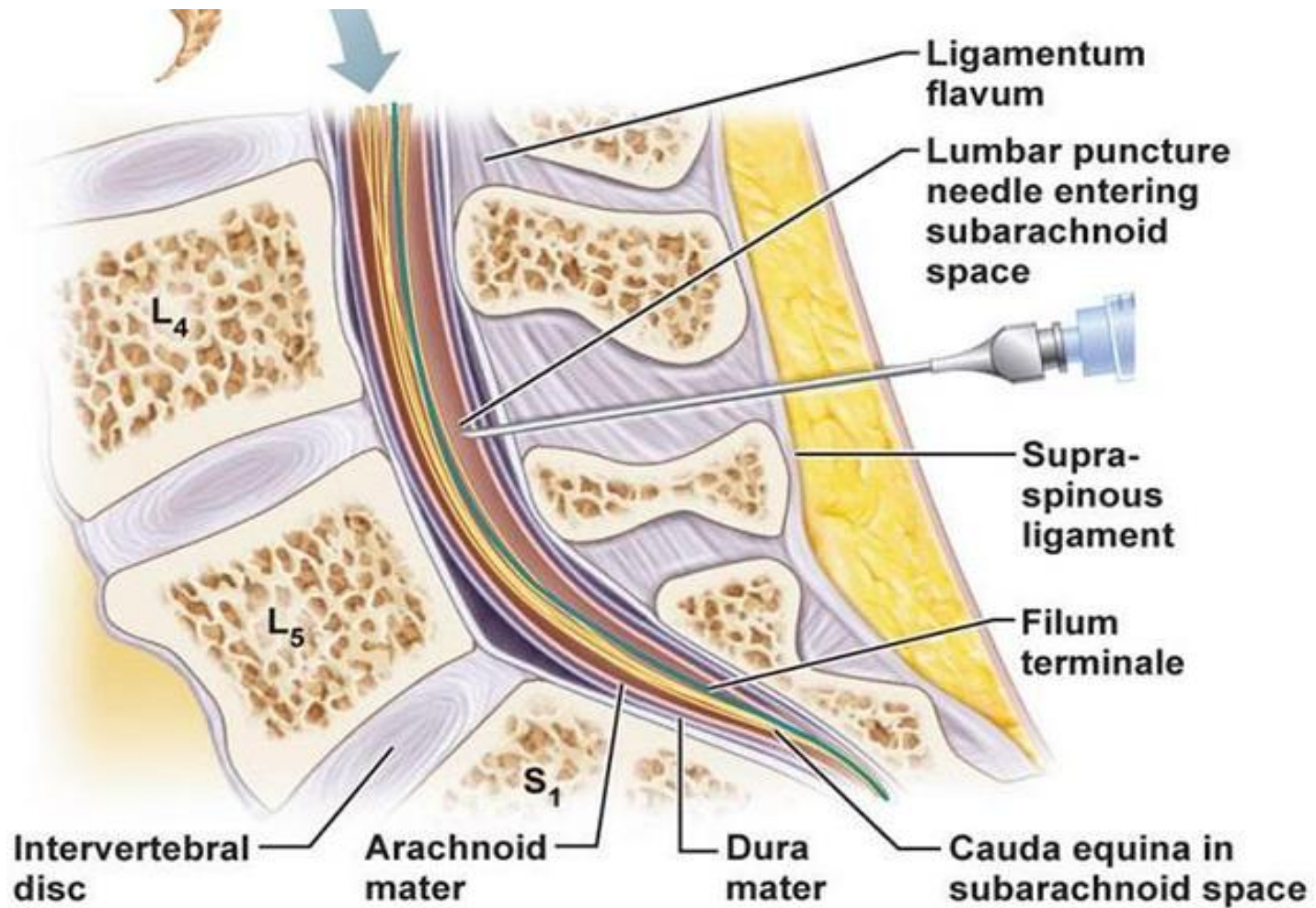
- CSF Produced in choroid plexus in both lateral ventricles
- **20mls/ hour or 500mls/ day**
- Found in subarachnoid space
- Total volume $<1/3$ that of daily production



Spinal anatomy

- Spinal cord ends at distal end of L1
- LP preferentially **performed at L4,5 or L3,4**
- Posterior Superior Iliac Crest (**PSIS**) **located at L4,5**
 - Place palms of hands over PSIS so that superior edge is under your index finger. Your thumbs will connect at, or point to, the approximate location of the L4 vertebrae
- Approximate LP depth(cm) = $1 + 17 \times \text{weight (kg)} / \text{height (cm)}$

- **Layers penetrated by spinal needle**
 - Skin; supraspinous ligaments; interspinous ligaments; ligamentum flavum; epidural space; dura; subarachnoid membrane into subarachnoid space



Indications for lumbar puncture (LP)

- Suspected meningitis
- Suspected subarachnoid hemorrhage
- Fever of unknown origin
- CNS leukemia or lymphoma
- Evaluation of neurological conditions eg. recurrent seizures/ multiple sclerosis
- Diagnosis and treatment (therapeutic pressure reduction) in raised intracranial pressure

Contraindications to lumbar puncture (LP)

- Presence of **infection** at lumbar puncture site
- Papilledema or signs **raised intracranial pressure**
- Severe **thrombocytopenia**(eg, platelet counts **<50,000/microL**), or have an international normalized ratio **(INR) >1.4**
- Uncorrected **bleeding disorders**
- Presence of **cerebral mass lesions** e.g. Abscesses, tumors, intracranial hemorrhage, subdural hematomas

Possible complications of lumbar puncture (LP)

- **Post-LP headache**
- Infection
- Spinal cord injury and bleeding into spinal canal (**very rare**)
- Failure to find subarachnoid space

Pre-procedure

- Assess **risk of raised intracranial pressure**
- Any evidence on imaging?
- Any **false localizing signs** noted (e.g. unexplained third or sixth nerve palsy)?
- Check **platelets and clotting reasonable**
- Ensure **absence of infection or metalwork at lumbar puncture site**
- **Check for allergies** to latex, betadine, lignocaine or other medications
- If doing the LP for **possible subarachnoid hemorrhage, ensure 12 hours have passed** since the onset of symptoms

- **Document informed consent (written if possible)**
 - ✓ Infection
 - ✓ bleeding
 - ✓ failure
 - ✓ pain
 - ✓ Damage to surrounding structures (including nerves and vessels)
 - ✓ Damage to cord incredibly rare.
- Warn patient they may feel a shooting pain down one of their legs as the needle goes in and to tell you if they do so.

- **Headache (in up to one third of patients)** Usually resolves within a couple of hours with simple analgesia.
- ✓ Advice on **hydration**
- ✓ **caffeine intake**
- ✓ and **lying flat for one hour post-procedure** (though no good evidence for this)

Equipment required for lumbar puncture (LP)

- **Dressing trolley & sharps bin**
- **Sterile field**
 - Sterile dressing pack and gloves
 - 2% Chlorhexadine swabs
- **Analgesia**
 - 4mls of 1% or 2% Lidocaine
 - 5ml Syringe (x1)
- **Gauze swabs and small dressing**
- **Spinal needle** (atraumatic needles reduce headache)
- **Manometer**
 - Familiarise yourself with this first and ensure it turns freely
- **Four universal CSF sample containers** (labelled 1-4).

Spinal needles



SINGLE USE HYPODERMIC NEEDLE

COLOUR CODE AND SPECIFICATION

SIZE		COLOUR		LENGTH						
OD (mm)	Gauge	Colour & Code		3/8"	1/2"	5/8"	3/4"	1"	1 1/4"	1 1/2"
0.40	27G	Grey	Grey							
0.45	26G	Brown	Brown							
0.50	25G	Orange	Orange							
0.55	24G	Medium purple	Medium purple							
0.60	23G	Blue	Blue							
0.70	22G	Black	Black							
0.80	21G	Green	Green							
0.90	20G	Yellow	Yellow							
1.10	19G	Creamish	Creamish							
1.20	18G	Pink	Pink							
1.60	16G	Natural	Natural							

Positioning for lumbar puncture (LP)

- A lumbar puncture can be performed in two positions:

- ✓ **Lateral recumbent**

- Patient on his or her side with head propped up on a single pillow to keep spine straight
- Knees & torso flexed to optimise interlaminar foramen of vertebrae
- Ask or use assistant to draw patient's legs up to their chest
- Ensure craniospinal & transverse planes remain stable
- excessive flexion can compromise upper airway

- **Sitting**
- Useful in patients with pulmonary disorders or potential airway compromise
- Seat patient on edge of bed
- Flex trunk by having patient lean forward & rest elbows on table or on knees
- **CSF pressure cannot be reliably measured in this position**

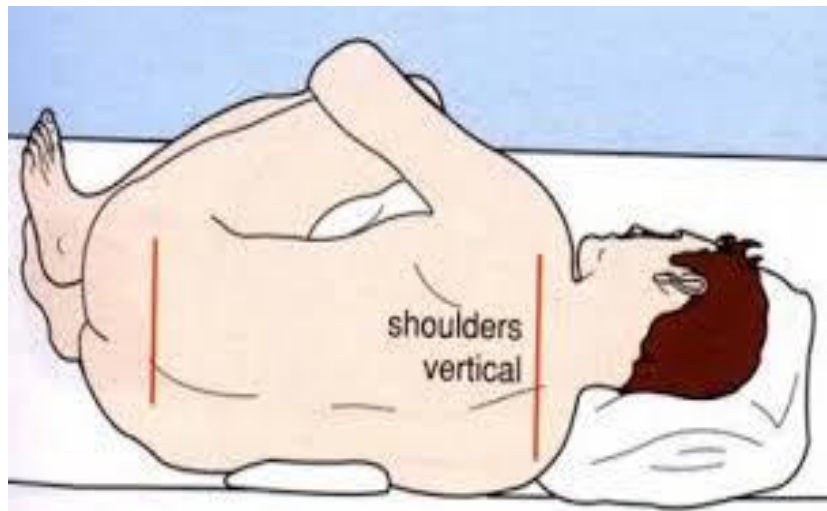
Lumbar Puncture



Lying Position



Sitting Position

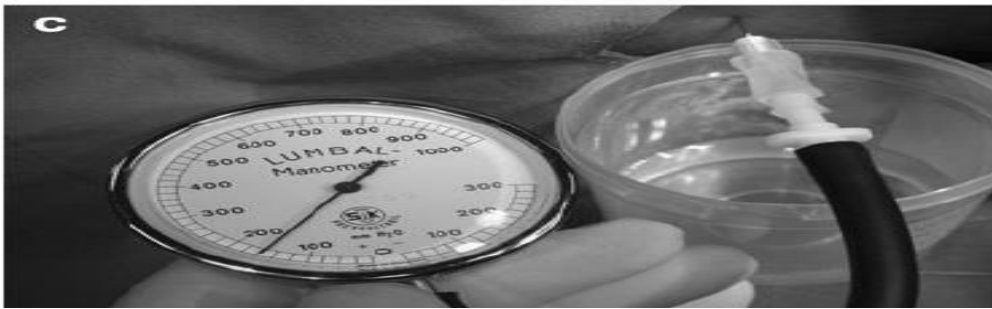
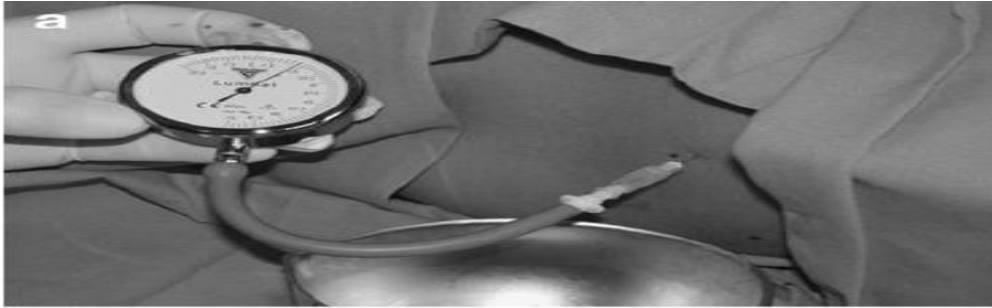


Procedure

- Create your **sterile area** and put on sterile gloves
- Identify & sterilise needle insertion site
- **Mark entry point** with blunt end of needle
- Draw up **lignocaine in 5ml syringe**
- **Always check for entrance to blood vessel prior to injection of lignocaine & never inject into spinal canal**
- **Wait a few minutes** for lignocaine to work.
- During this time do a final **check of your equipment** and make **sure you have an assistant** to help with bottles

- Insert spinal needle
- Make sure stylet in place before advancing needle
- Advance needle slowly in direction of umbilicus with bevel facing upwards (towards the ceiling) if patient in lateral position
- Advance slowly through spinous ligament resistance until you feel some give (sometimes described as a “pop”) with change in resistance as needle enters subarachnoid space
- Remove stylet and check for flow of spinal fluid.
- If no flow, replace stylet, rotate spinal needle a few millimetres & then recheck
- If obstructed, or if needle meets resistance, withdraw the needle with stylet in place, recheck position & re-attempt the procedure

- With flow of CSF, **attach manometer** & 3-way tap to the needle
- Turn the 3-way tap upwards to allow CSF fluid to fill the manometer. Once the CSF has stopped advancing (leaving a swinging meniscus) remember this **CSF pressure**.
- **A normal opening pressure is 12-20 cmh₂O**
- Once pressure read, **collect samples** by placing sterile containers under the 3-way tap and turning it to let the CSF directly out
- Make sure bottles are in the correctly numbered sequence
- **Usually 1-2ml each container**
- If getting **cytology up to 20ml is required** (the more CSF, the higher the sensitivity)



- Once all samples are taken withdraw needle
- There is no need to replace the stylet to do this
- Note that **in cases of doing a lumbar puncture for raised ICP it may be necessary to take a closing pressure as well as an opening pressure**
- **Place bandage** over needle insertion site
- Ensure **samples correctly labelled**,
- phone laboratory staff inform them of urgent sample to be processed
- If necessary take them to the laboratory yourself

Samples usually sent for:

- Cell count
- Gram stain, culture & sensitivity
- Protein, glucose
- Oligoclonal bands (OCB) if indicated
- Virology panel (PCR for HSV, VZV at the very least)
- Cytology (consider spare sample to keep in medical fridge)
- Spectrophotometry if looking for subarachnoid haemorrhage
- **The 'three tube test'** (a decrease in red cells in consecutive tubes on visual inspection) is notoriously unreliable
- Take **blood samples for glucose and oligoclonal bands** (if indicated) immediately post-LP

Normal CSF analysis

Appearance: clear and colourless

White blood cells (WBC): 0 – 5 cells/ μ L, predominantly lymphocytes.

Red blood cells (RBC): 0 – 5/ μ L

Protein: 0.15 – 0.45 g/L (or <1% of the serum protein concentration)

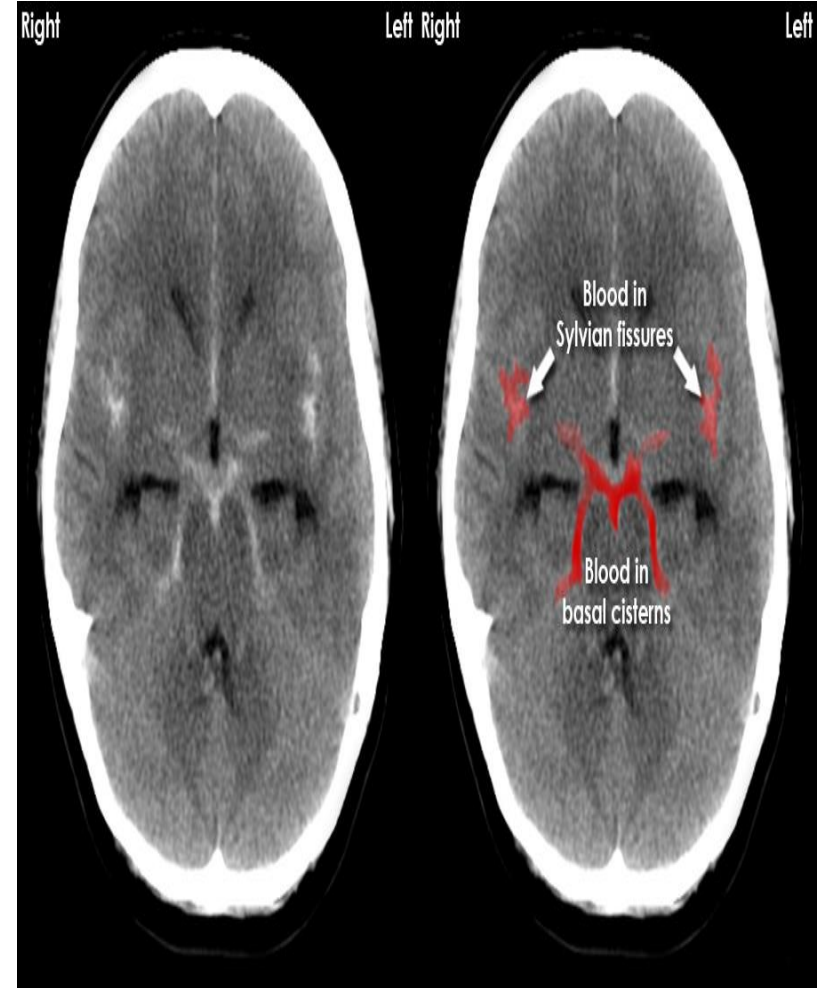
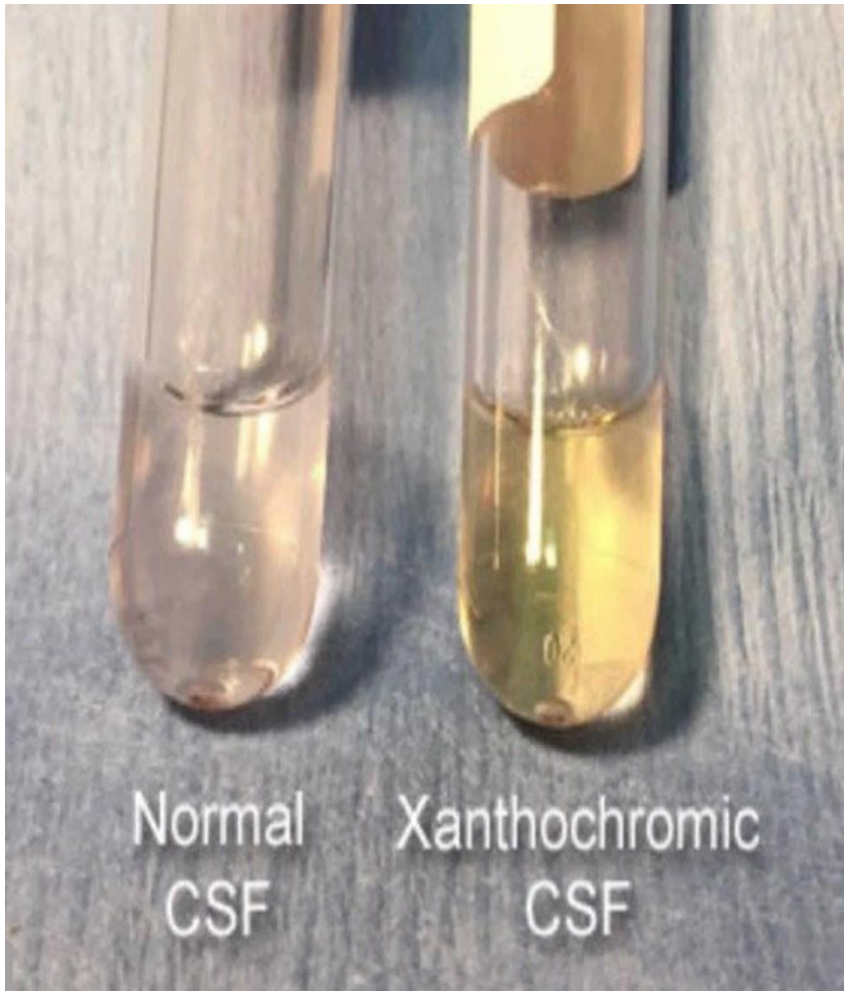
Glucose: 2.8 – 4.2 mmol/L (or \geq 60% serum glucose concentration)

Opening pressure: 10 – 20 cm H₂O

TABLE 32.2 Cerebrospinal Fluid Findings in Various Meningitides

Type	Leukocytes (mm ³)	Protein (mg/dL)	Glucose (mg/dL)
Acute bacterial	>1,000 although ranges from several hundred to >60,000; PMNs predominate.	100-500, occasionally >1,000	5-40; typically a CSF-to-serum glucose ratio of <0.33
Viral	5-1,000; lymphocytes predominate (although early in the disease course, PMNs may predominate).	Frequently normal or slightly elevated; generally <100	Normal (although rarely reduced in cases of LCMV, CMV, paramyxoviruses, HSV)
Tuberculous	25-100; rarely >500; lymphocytes predominate (although early in the disease course, PMNs may predominate).	Elevated; 100-200	Low; <45 in 75% of cases
Cryptococcal	0-800; lymphocytes predominate.	20-500	Often reduced; average 30
Syphilitic	Average 500; primarily lymphocytes	100	Generally normal although may be mildly reduced

CSF In Subarachnoid hemorrhage



Post-procedure

- **Check for headache** and ensure PRN simple analgesia prescribed
- **Advise on good hydration** and taking a caffeine-containing drink to decrease headache
- Conventionally the patient should lie flat for at least one hour post-procedure though there is no good evidence that this reduces headache
- Remember to take blood samples for glucose +/- oligoclonal bands immediately post-LP

**Good
Luck**

