How Do I Perform a Lumbar Puncture and Analyze the Results to Diagnose Bacterial Meningitis?

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Objective

- Review the evidence about diagnostic LP techniques that may decrease the risk of adverse events and the evidence about test accuracy of CSF analysis in adult patients with suspected bacterial meningitis.

Adverse Effect

- Adverse event: post-LP headache (60%) (CSF leakage through dura)
- Back pain (40%)
- Cerebral hernia, SDH, EDH, infection

=>No evidence support universal neuroimaging before LP

=>Overall clinical impression able to identify P't with a contraindication to LP

Contraindication

- In patient susp. meningitis underwent CT
- Absence of : Age>60 y/o, immunocompromised, hx of CNS disease, seizure within 1 wk, abnormal NE

=> reduce the abnormal CT finding (23.8 => 3%)

- Local infection
- Coagulation defects => EDH
- Increased risk of paraparesis

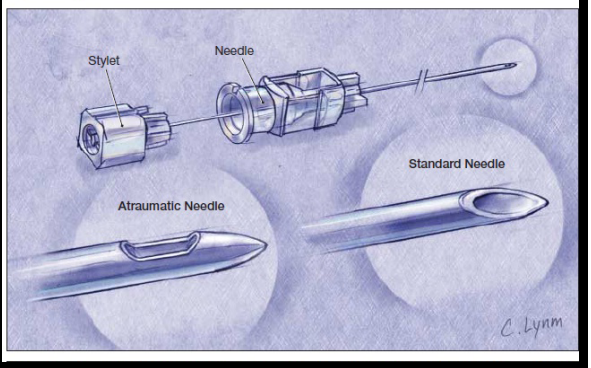
Data Sources

- Cochrane Library, MEDLINE, EMBASE
- Randomized trials of patients aged 18 years or older undergoing interventions to facilitate a successful diagnostic LP or to potentially reduce adverse events
- Studies assessing the accuracy of biochemical analysis of the CSF for possible bacterial meningitis were also identified

RESULTS

- 15 randomized trials
- Experience of Operator: no difference in risk of traumatic LP (no data of required proficiency)
- Positioning of Patient: interspinous distance was greatest when the patient was placed in the sitting position with feet supported
- Needle Choice: Atraumatic needles : nonsignificant decrease in the risk of headache ([ARR], 12.3%)

Figure 1. Types of Lumbar Puncture Needles



- Number of Attempts: There was a nonsignificant increase in the risk of requiring 2 or more attempts in atraumatic needle.
- Guidelines from American Academy of Neurology support the use of atraumatic needles
- The risk of headache was significantly reduced with a smaller needle (ARR, 26%)

- Reinsertion of Stylet: Fewer patients experienced headache (strand of arachnoid could enter the needle along with the out flowing CSF) (ARR, 11%)
- Bed Rest: There was a nonsignificant decrease in the risk of headache in mobilized after LP (ARR 2.9%)

- Supplementary Fluids (drinking 1.5 L vs 3 L) no different
- Interpreting the Results: CSF pressure
- CSF pressure changed little (1.1 mm of water) with flexion of the lower extremities
- Compressing the abdomen or the jugular vein (Queckenstedt's maneuver)
- Obstruction to CSF flow prevents the normal rise => no study

- Laboratory Tests
- Gram stain negative bacterial meningitis cannot be ruled out.

Table 1. Reference Values for Adult Cerebrospinal Fluid[52]

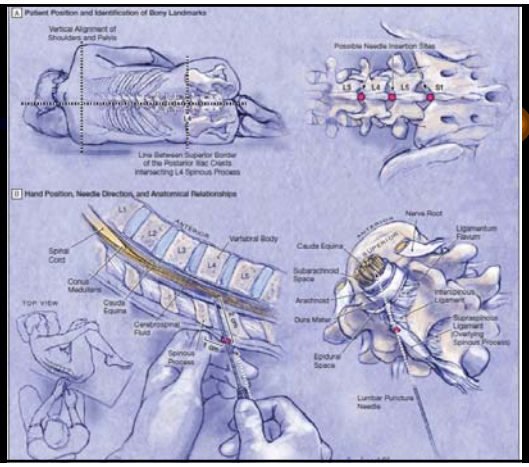
Cerebrospinal Fluid Variable	Value
Pressure	60 to 180 mm H_2O; 6 to 14 mm Hg
Glucose	45-80 mg/dL (2.5-4.4 mmol/L)
Protein	15-45 mg/dL
Blood-glucose ratio	≥0.6
White blood cell count	<5/μL
Gram stain	No organisms
Cytology	No atypical cells

Bacterial meningitis

- CSF–blood glucose ratio < 0.4 (likelihood ratio [LR], 18)
- CSF WBC count > 500/ μ L (LR, 15)
- CSF lactate level > 31.53 mg/dL (3.5 mmol/L) (LR, 21)
- Accurately diagnosed bacterial meningitis.

How Should the Procedure Be Performed?

- Procedure and its risks should be explained
- 6/10 people may develop a transient headache and that up to 4/10 people can experience temporary backache.
- Anxiolytic (eg, lorazepam) may be given prior to the procedure



- Absence of any focal neurological findings => no need of prior CT
- If CT performed => antibiotic therapy should be started immediately
- lateral recumbent position
- back at the edge of the bed
- legs should be flexed toward the chest
- neck should also be slightly flexed

- shoulders and pelvis should be vertical
- Imaginary line connecting the patient's posterior superior iliac crests would cross the L4-L5 interspace
- Lumbar puncture can occur in the L3-L4, L4-L5, or L5-S1 interspace (no evidence to guide)

- Superior spinous process should be palpated.
- Needle should be inserted about 1 cm inferior to the tip of this process
- Atraumatic needle : may use an introducer to puncture the skin
- Advance it horizontally while aiming toward the umbilicus to a depth of about 2 cm

- Continue to advance the needle until a pop
- If no fluid emerges, rotate the needle
- If there is still no fluid, reinsert the stylet and advance the needle slightly
- Pain radiating down either leg indicates that the needle is too lateral and has touched nerve root

- If this process fails, move down 1 interspace and try again.
- If this fails, the procedure should be attempted by another person
- 1st tube labeled for biochemistry
- 2nd tube for bacterial studies
- 3rd tube Cell counts can be done
- 4th tube can be used for cytology or for other tests

- Stylet should be reinserted prior to removal of the needle.
- A bandage may be applied to the puncture site and the patient allowed to ambulate.
- To learn : practice 3 to 5 LPs (6-10)

Conclusions

- These data suggest that small-gauge, atraumatic needles may decrease the risk of headache after diagnostic LP.
- Reinsertion of the stylet before needle removal should occur and patients do not require bed rest after the procedure.
- Future research should focus on evaluating interventions to optimize the success of a diagnostic LP and to enhance training in procedural skills.