# Lumbar Puncture- NSLHD

<table>
<thead>
<tr>
<th><strong>Document Number</strong></th>
<th>PR2013_065</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Publication Date</strong></td>
<td>9 October 2013</td>
</tr>
<tr>
<td><strong>Intranet location/s</strong></td>
<td>Clinical – Neurosciences, Neurology</td>
</tr>
<tr>
<td><strong>Summary</strong></td>
<td>Adult Lumbar Puncture</td>
</tr>
<tr>
<td><strong>Author Department</strong></td>
<td>Neuroscience Clinical Nurse Consultant Neurology/Neurosurgery RNSH</td>
</tr>
</tbody>
</table>
| **Contact (Details)** | Jeanne Barr RNSH  
Phone 9463 2745 |
| **Endorsed By** | NSLHD P&PIC |
| **Sector/Service** | Northern Sydney Local Health District |
| **Audience** | Medical Officers/ Registered Nurses/Endorsed Enrolled Nurse |
| **Date Created** | June 2013 |
| **Review date** | October 2017 |
| **Previous Reference No.** | Nil |
| **Related Policy/s** | Correct Patient, Correct Procedure, Correct Site Policy Identification of Patient  
Patient Information and Consent to Medical Treatment: |
| **Key Words** | Lumbar puncture, spinal tap, cerebrospinal fluid, CSF |
| **Status** | Active |
Title: Lumbar Puncture- NSLHD

1. Scope of Practice
   a) Medical Officers (proceduralist or assistant)
   b) Registered Nurses (assistant)
   c) Enrolled Nurses (assistant)

2. Expected Outcome
   That the patient will have a lumbar puncture performed safely for the purpose of diagnosis or therapeutic intervention.

3. Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumbar puncture</td>
<td>The introduction of a hollow needle with a stylet into the lumbar subarachnoid space of the spinal canal using strict aseptic technique (1)</td>
</tr>
<tr>
<td>Cerebrospinal fluid (CSF):</td>
<td>The fluid surrounding the brain and spinal column that acts as a shock absorber cushioning the brain and spinal cord. CSF is normally clear, colourless and odourless and is made primarily in choroid plexus. It is a closed system where adults generally have approximately 125-150mls. CSF is reabsorbed through the arachnoid villi. (2)</td>
</tr>
<tr>
<td>Post dural puncture headache</td>
<td>A complication of diagnostic spinal puncture, spinal anaesthesia or epidural anaesthesia is a post dural puncture headache (PDPH). It occurs in 10-30 % of patients post lumbar puncture.</td>
</tr>
</tbody>
</table>

4. Procedure

4.1 Policy Statement/Rationale
   Lumbar puncture is an invasive procedure, undertaken by a medical officer for either diagnostic purposes (e.g. meningitis, prion disease, normal pressure hydrocephalus (NPH), Guillain-Barre Syndrome, Multiple Sclerosis, subarachnoid haemorrhage) or therapeutic purposes (intrathecal) drug administration or removal of CSF in certain conditions such as idiopathic intracranial hypertension (pseudotumour cerebri)(3). Lumbar puncture may be contraindicated in some patients. The relative risk of the procedure must be balanced against the benefits of CSF analysis. Therefore the contraindications are divided into absolute and relative contraindications.

   Absolute contraindications:
   - The presence of infected skin over the needle entry site
   - CT findings or papilloedema indicating the presence of increased intracranial pressure e.g. mass lesion, compressed ventricles, midline shift, occlusive hydrocephalus, posterior fossa mass, loss of basilar cisterns, etc.

   Relative contraindications for lumbar puncture include the following:
   - Decreased platelet count or raised INR (>1.40) N.B. anticoagulation (antiplatelet agents, clexane and warfarin)
   - Brain abscess

   Indications for performing brain CT scanning before lumbar puncture in patients with suspected meningitis include the following (3).
- Decreased level of consciousness (N.B. LP may still be done in the emergency situation to determine correct diagnosis)
- Focal neurologic findings
- Papilloedema seen on physical examination
- Clinical suspicion of an elevated ICP.

Antibiotics should not be withheld until after the LP is performed if bacterial meningitis is suspected:

If CSF spectrophotometry is required for the assessment of possible subarachnoid haemorrhage, the LP should be delayed until 12 hours after the onset of headache.


Standard Precautions will be implemented, including sharps handling and disposal of waste.

Latex allergy risk will be assessed and recommended precautions utilised to prevent exposure to latex in known or suspected latex allergy patients and staff.

Ergonomic and manual handling principles will be implemented.

**N. B. INFECTION CONTROL IMPLICATIONS FOR PATIENTS WITH KNOWN OR SUSPECTED PRION DISEASE**


**GENERAL INFORMATION**

A 21G atraumatic (“pencil point”) Sprotte needle is the preferred needle although technically more challenging [3, 5, 6]. Smaller gauges are used in anaesthetics but are not suitable for CSF collection and pressure monitoring. The atraumatic (e.g. Sprotte) needle is not standard in the LP pack but should be available on ward (refer to nursing staff).

(See Figure 1 & 2).

The stylet must be re-inserted prior to withdrawal of needle as this reduces the incidence of post LP headache [7].
Figure 1 - Atraumatic (e.g. Sprotte or Whitcare) needle and Traumatic or standard (Quincke) Needles

The bevelled or cutting needle such as the Quincke comes in the prepared LP pack. It is technically easier but generally not recommended due to the increased incidence of PDPH.

4.2 Requirements

Disposable lumbar puncture set (Figure 4) containing: 3 way stop cock Luer lock, 3 ml syringe, 25 g needle x 1, spinal manometer, 20 gauge Quincke (traumatic spinal needle – not recommended).

Figure 4: Disposable Lumbar puncture set

Sterile pack (Figure 5) containing: sterile field, 1 tray, 1 half petri-dish, 3 x 10 ml spec tube, woven balls, non woven swab, 2 forceps, 1 impervious fenestrated drape
Figure 5: Sterile pack within lumbar puncture set

**ALERT**

NB: Ward stock must include the recommended atraumatic needles (e.g. 21 gauge Sprotte) and introducer.

### Additional equipment
- Local anaesthetic ampoules of lignocaine 1%
- Additional needles to draw up and administer the local anaesthetic
- 5 mL syringe
- Gloves and goggles for assistant
- Angle poise or similar light source lamp
- 2% chlorhexidine in 70% Alcohol 100mL
- Sterile gown and gloves for proceduralist
- Eye protection for proceduralist
- Fluid repellent surgical mask for proceduralist
- Disposable under pad
- Sterile impermeable adhesive dressing
- Tape to secure drape if not self adhesive
- Pen to label specimens/marker to delineate insertion site

### 4.3 Actions

**Pre procedure**
1. Explain the procedure, benefits, risks, complications, and alternative options to the patient and obtain a signed informed consent.
2. Ensure Correct Patient and Procedure Check List completed.
3. Ensure patient is well hydrated and voids if necessary prior to the procedure.
4. Sedation may be needed (inhaled or intravenous) and if so appropriate monitoring and personnel should be available.
5. If the procedure is planned skin anaesthesia can be induced to reduce the discomfort of local anaesthetic infiltration with an Emla patch (45min) or angel cream (20 min) in the area of likely needle insertion.
6. Perform baseline measure of neurological observations, temperature, blood pressure, respirations, pulse and saturations.
7. Blood glucose should be drawn just prior to or after lumbar puncture.

**Procedure**
1. Prepare the patient and equipment before the procedure according to general instructions.
2. Take the trolley to the bedside.
3 Perform hand hygiene and don PPE – gloves, surgical mask\(^{(10)}\) and goggles/protective eyewear.

4 Position patient laterally with knees flexed and head forward on edge of bed as illustrated or sitting upright (Figure 6). The decision will be guided by the medical officer performing the procedure. If upright the patient will require the use of a table to support them in that position\(^{(9)}\). **Opening pressure can only be measured with the patient lying in the lateral position with legs extended at the hips as flexed legs will falsely elevate CSF pressures.**

5 Locate the L4-5 interspace, which will be even with the iliac crests. The L3-4 interspace can also be used if the L4-5 interspace is not available. The spinal cord ends at the L1-2 interspace in adults. Mark needle introducer needle entry site with the pen. Have the patient bend forward and if lying, also maximally flex knees at the hips.

6 Remove lumbar puncture set from bottom shelf, open plastic envelope and slide pack onto top shelf of trolley.

7 Proceduralist to don face mask then perform procedural hand wash using antimicrobial soap and water. Once completed assist MO to gown and glove. Proceduralist may now fold back sterile cover.

8 Add syringe and pour solutions into sterile bowls.

9 Assist the patient to maintain the required position and not to move during the course of the procedure.

10 Position angle poise lamp.

11 Reassure the patient during the procedure.

12 Prep and anaesthesia: (after sterile gloves and gown are on).

13 Prep the area with 2% Chlorhexidine with 70% alcohol. Allow to dry for a minute or two and place the fenestrated drape over the area.

14 Draw up a few mLs of 1% lidocaine and make a wheal in the skin over the L4-5 interspace.

15 If CSF pressure is to be measured, assemble manometer and attach to threeway tap (optional), and turn off to port which will be connected to the spinal needle when it is in situ) putting aside. Manometry can only be performed in the lateral decubitus position with legs extended at the hips to ensure correct CSF pressure measure. NB: CSF pressures can be falsely elevated when patients remain with their hips tightly flexed.

16 Open tubes and stand upright for easy access. Make sure they are in order of correct number.
Look at and adjust three-way tap to become familiar with its use.

Introducer Needle: Due to its "non-cutting" point geometry, the Sprotte needle does not puncture the skin as freely as does a conventional Quincke needle. Therefore it is advised to puncture the skin prior to inserting the Sprotte needle. An introducer needle is offered as one option in performing this task— the introducer needle is placed first, followed by the Sprotte needle which is placed through (inside) the introducer needle. See Introducer needle below:

Aiming towards the umbilicus, gradually advance needle, bevel up (facing flank) to spread, not cut, dural fibres. Occasionally remove stylet to look for fluid once you've gone 3-4 cm, depending on size of patient. Always replace the stylet prior to advancement. When the dura is entered, you may feel a small pop, or notice diminished resistance. Often times nothing different is felt. If you hit bone, back out a bit and re-aim the needle. If you are unable to get to the dura try one level up or down. Also consider changing to a seated position if recumbent.

Once the dural space is entered, attach the three-way tap and manometer; carefully ask the patient, with help from an assistant if necessary to extend the lower limbs at the hips; then measure the pressure. CSF pressures can be falsely elevated when patients remain with their hips tightly flexed.

Assist the proceduralist as required e.g. to support the manometer. After reading is taken, turn the three-way tap so the lever faces toward you; this will release the CSF into the tube. Then remove manometer and three-way tap from needle. Assistant receives specimens from the proceduralist. Place in an upright position and label each container as per lab requirements. Routinely 3 tubes are collected and marked as tubes 1, 2 & 3 in order of collection, each requiring 2 ml/tube.

Re-insert the stylet prior to withdrawal of needle as this reduces the incidence of post LP headache (7).

Basic tests for CSF include protein, glucose, lactate, cell count and differential. Oligoclonal bands are ordered as part of the diagnostic workup for multiple sclerosis plus gram stain and culture if indicated.

**ALERT: A plasma sample should be collected, (10 ml in clotted blood tube) to be taken by venepuncture, at the same time or shortly after for protein, glucose, lactate and protein electrophoresis (if oligoclonal bands are to be requested).**

For many viral pathogens (enterovirus, herpes simplex and varicella zoster) PCR testing is the most appropriate modality for detection. If bacterial meningitis is suspected but cultures are sterile (e.g. patient given antibiotic therapy pre-LP) PCR testing may still make the diagnosis.

For some tests larger volumes may be required (especially for mycobacterial or fungal culture). If testing for organisms causing chronic meningitis is required (tuberculosis, cryptococcus or other fungi) then a separate large volume collection is needed (10ml). The volume of CSF removed is not a risk factor for post-dural puncture headache (11). In the future multiplex PCR will be available for screening abnormal CSF for pathogens.
26 Specimens for assessment of xanthochromia by CSF spectrophotometry should be protected from light at all stages of collection and handling.
27 Detection of free Hb with urinalysis test sticks in the emergency department will provide immediate crude screening of presence of subarachnoid blood in CSF if xanthochromia by spectrophotometry is not available.
28 If specimen is from traumatic tap with low volume and clots then no count is possible. Lactate requests must have been delivered on ice.
29 Ensure signed request form and specimens of CSF are dispatched to the laboratory immediately.

Testing for 14-3-3 (CJD): Follow instructions as per PalMS link: PalMS LabInfo Test Directory - Test Information

30 Check puncture site to ensure there is no leakage of CSF. Apply sterile impermeable adhesive dressing.

Education Alert:
Educate the patient to report headache, chills, fever, swelling, redness or pain at the puncture site, to avoid immersion in water to prevent infection at the site, avoid aspirin containing products to prevent bleeding and to report if there is any leakage from the puncture site. Any changes in level of consciousness, irritability, numbness or tingling in lower extremities must also be reported.

31 Proceduralist to dispose of equipment appropriately.
32 Perform hand hygiene.
33 Document procedure in the patient health record: position of patient, needle size, number of attempts, pressure and requirements as above re patient management post procedure and recommendations regarding bed rest.

Post procedure:
34 There is no evidence that longer bed rest after lumbar puncture is better than immediate mobilisation or short bed rest (30 min) in reducing the occurrence of headache. However, seated patients with high intracranial pressures often experience immediate headache secondary to the dynamic shifts in CSF pressure following lumbar puncture. The patient can mobilise as tolerated in an uncomplicated procedure.
35 A complication of diagnostic spinal puncture, spinal anaesthesia or epidural anaesthesia is a post dural puncture headache (PDPH). It typically occurs hours to days after puncture. The patient presents with headache and nausea that typically worsen when assuming an upright posture. The incidence of PDPH is higher in younger patients, complicated or repeated puncture and use of large diameter needles. Modern, atraumatic needles such as the Sprotte spinal needle cause a smaller dural perforation and reduce the risk of PDPH (5, 6, 7). If a patient develops a PDPH, bed rest does provide symptomatic relief (3, 12).
36 Assess patient for headache after the procedure and monitor LP site for evidence of CSF leak.
38 If a post dural puncture headache occurs the following interventions should be implemented:
   a. Ensure that the headache is not due to another cause. Generally a PDPH will disappear or greatly ease within 30 minutes of the patient lying flat.
   b. Administer analgesia as required.
c. There is no evidence that increasing fluid intake decreases the incidence of post lumbar puncture headache.\(^{13}\)
d. Assess need for continuing neurological observations after the procedure.
e. Observe puncture site for leakage.
f. If no headache or only mild headache is present the patient may be discharged within two hours post procedure on the medical officer’s advice. Ensure the patient is educated as per the education alert.

### Alert
An epidural blood patch (see procedural guidelines below) may be performed if a post dural puncture headache (PDPH) lasts more than 7 days. It increases CSF pressure and is believed to provide a gelatinous plug over the dural puncture to lessen CSF leakage.

### Epidural Blood Patch for PDPH
Epidural blood patch as a form of treatment for prolonged PDPH should be conducted by an experienced anaesthetist or neurologist under strict surgical aseptic conditions\(^{14}\).
Appendix: CSF studies \(^{(15)}\)

<table>
<thead>
<tr>
<th>Test</th>
<th>Normal values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polymorphonuclear cells</td>
<td>Nil</td>
</tr>
<tr>
<td>Mononuclear cells:</td>
<td>0 - 5 \times 10^6/L</td>
</tr>
<tr>
<td>Red cell count</td>
<td>0 cells/mm(^3)</td>
</tr>
<tr>
<td>Protein</td>
<td>0.15-0.4 g/L</td>
</tr>
<tr>
<td>Glucose</td>
<td>60% of serum level*</td>
</tr>
<tr>
<td>Lactate</td>
<td>1.2 – 2.1 mmol/L</td>
</tr>
<tr>
<td>Opening Pressure</td>
<td>76-200 mmHg</td>
</tr>
</tbody>
</table>

* Depending on blood glucose CSF glucose should be approximately 60% of blood glucose. Relationship between Cerebrospinal Fluid Glucose and Serum Glucose N Engl J Med 2012; 366:576-578. February 9, 2012

### Bacterial Meningitis

| Polymorphonuclear cells       | 500 - >20,000 \times 10^6/L |
| Mononuclear cells:            | 0 - 5 \times 10^6/L         |
| Red cell count                | 0 cells/mm\(^3\)           |
| Protein                       | 0.5 - >10 g/L              |
| Glucose                       | < 2.5 mmol/L               |
| Lactate                       | 4 - 10 mmol/L              |

Organisms are in smears and/or culture. *Bacterial meningitis is unlikely if negative cultures after two days in a patient who has not been treated with antibiotics prior to LP.*

### Viral Meningitis

| Polymorphonuclear cells & Mononuclear cells: | 0 - >2000 \times 10^6/L |
| Protein                                      | Normal                  |
| Glucose                                      | Normal                  |
| Lactate                                      | 4 - 10 mmol/L           |

A virus may be isolated or there may be a titre rise in paired sera.

### Fungal Meningitis

| Monocytes (mostly) | 10 - >10,000 \times 10^6/L |
| Protein            | 0.40 – 5g/L                |
| Glucose            | < 2.0 mmol/L               |

Organisms may be seen in smear or culture.

### TB Meningitis

| Lymphocytes (mostly) | 10 - >10,000 |
| Protein              | Increased    |
| Glucose              | Low          |
| Culture              | Positive for AFB |
5. References

9. Cook, T; Fischer, B; Bogod, D; Wildsmith, J; Counsell, D; Christie, I; Damien, M. Antiseptic solutions for central neuraxial blockade: which concentration of chlorhexidine in alcohol should we use?. *British Journal of Anaesthesia* 103 (3): 456–62. 2009.
6. Revision & Approval History

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision No.</th>
<th>Author and Approval</th>
</tr>
</thead>
</table>

Procedure Name | Lumbar Puncture- NSLHD
Document ID | PR2013_065
Version No. | 1
Date Published | 9/10/2013
Page No. | 12 of 12