MASTERY SKILLS PATHWAY

LUMBAR PUNCTURE

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The NHS Education Scotland Mastery Skills Pathway has been developed to enhance the technical and non-technical skills of clinicians undertaking complex clinical procedures.
Welcome to the NHS Education Scotland Mastery Skills Pathway Lumbar Puncture Reading Pack. We hope you find this pack a valuable learning resource to complement your simulated practice sessions.

The Mastery Skills Pathway is an educational, quality assurance and patient safety initiative to promote high-quality training and safe, effective patient care for high-risk procedural skills.

Your Pre-Learning (Videos and Reading pack), Deliberate Practise and Simulation-Based Assessment sessions will optimally prepare you for real-life procedural performance, under direct supervision.

Below is some additional information about Mastery methodology.

METHODS

GAINING COMPETENCY
We recognise that the traditional model of “see one, do one, teach one” is no longer acceptable. Our new approach allows development of fundamental skills, in a completely safe manner before real-life practice.

In addition, this novel approach allows refreshment of old skills, minimising the effects of potentially harmful skill decay.

The path to procedural competency for clinicians is supported by the following:

A trained faculty.

Knowledge packs containing a combination of written and video educational resources for each procedural skill, with a consistent emphasis on patient safety.

Self-Directed Deliberate Practice where you can spend as much time as you like familiarising yourself with the technical aspects of the procedure.

A supervised simulated checklist-based assessment session where you will receive feedback on your performance from your tutor.

Real-life practice under direct supervision until you are independently competent.
PROCEDURAL PHASES

Complex procedural skills can be daunting prospects initially. It is not uncommon for novices to become overwhelmed when performing such procedures, resulting in avoidable error or harm. It can be helpful to fragment the task into discrete, manageable parts, ensuring one is complete before moving onto the next.

Our “Mastery Procedural Phases” is one method of approaching any complex skill. Six Procedural Phases have evolved to help break down skills into more manageable components. These can be more broadly grouped into domains of Pre-procedure, Procedure and Post-procedure (as shown across). This will be discussed more in the videos and simulation skills sessions.

Phase 1
Preparation, assistance and positioning
Consider whether a procedure is indicated, that no contraindications exist and that informed consent has been given. An appropriately trained assistant should be available to assist you with preparing equipment and in positioning the patient correctly to make the procedure as easy as possible.

Phase 2
A three point procedural pause
The procedural pause is an opportunity for all those involved in the procedure, including the patient, to acknowledge that they are content and happy to proceed.
1. Ensure that the patient is comfortable and that they are happy to proceed.
2. Your assistant should have the opportunity now to voice any concerns, identify any problems or anything else that needs addressed.
3. The clinician should ensure that the equipment is all present, checked and laid out in the order of use. Once this is completed the insertion can begin.

Phase 3
Asepsis and local anaesthetic infiltration
Asepsis should be strictly observed to prevent potentially life altering infective sequelae. Local anaesthetic should be used to minimise any discomfort experienced by the patient.

Phase 4
Insertion
This phase will be covered in a later section of this pack and during the video demonstration.

Phase 5
Anchor & dress
All indwelling devices must be secured & dressed to minimise risk of movement, failure and contamination. Each procedure has specific requirements.

Phase 6
Completion
You should communicate with the patient and the team looking after them, particularly with regard to symptoms to report and observations required. Document the procedure, in detail, including any difficulties encountered and immediate complications.
Each skill covered in the NHS Education Scotland Mastery Skills Pathway has been assigned learning outcomes for you to achieve.
LEARNING OUTCOMES

After reading and viewing the content contained within this pack the trainee should gain the following:

1. An understanding of the indications for performing a lumbar puncture and its use in clinical practice.
2. An understanding of risk assessment, patient safety concerns and contraindications to lumbar puncture.
3. An understanding of the potential complications of the procedure and the basic principles of their management.
4. An understanding of the practicalities of performing a lumbar puncture in a safe and structured fashion.
5. An awareness of your own personal limitations and when to obtain help from a senior clinician.
03 INDICATIONS & RISK ASSESSMENT
INDICATIONS

DIAGNOSIS OF LIFE-THREATENING CONDITIONS
- Subarachnoid haemorrhage
- Acute CNS infections (meningitis/encephalitis)

AID IN DIAGNOSIS OF NEUROLOGICAL CONDITIONS
- Other meningitides e.g. tuberculosis, carcinomatous
- Demyelination/inflammatory conditions e.g. Guillain Barre Syndrome, Multiple Sclerosis, Vasculitis
- Raised intracranial pressure e.g. Idiopathic intracranial hypertension, cerebral venous sinus thrombosis
- Cognitive decline e.g. Creutzfeldt-Jakob Disease

CONTRAINDICATIONS

Absolute contraindications to lumbar puncture include raised intracranial pressure with significant risk of cerebral herniation, and significant bleeding risk. All other contraindications should be assessed in each case and a decision made about the risk versus benefit for each individual patient. If there is concern regarding any of the issues below, senior advice must be obtained. To aid you in understanding these risks, a discussion of each contraindication is included below:

• RAISED INTRACRANIAL PRESSURE (ICP)
• BLEEDING RISK
• RESPIRATORY COMPROMISE
• SKIN
• AGITATED OR CONFUSED PATIENT

RAISED INTRACRANIAL PRESSURE (ICP)
Although the presence of raised ICP may be an indication for a diagnostic and therapeutic lumbar puncture, it is vital to know whether the patient is at risk of cerebral herniation secondary to the procedure. This can occur if there are unequal pressures between the CSF compartment into which the puncture is introduced and the rostral (cranial) compartment - in most cases the infratentorial and supratentorial compartments. The sudden drop in the lower compartment pressure increases the downward pressure on the brain and can lead to cerebral herniation.

Cerebral herniation or 'coning' in practice almost always occurs in patients with neurological findings of impending herniation, such as reduced Glasgow Coma Scale (GCS) or brainstem signs.

(The 95% reference interval for normal pressure is 10-25cmCSF)

Radiological imaging with CT or MRI Brain is mandatory if there is any concern of possible raised ICP, as suggested by the signs below:
• Altered GCS
• Focal neurological signs (including cranial nerves)
• Recent seizures (within 1 week)
• Papilloedema

Note - Patients with impaired immunity may not present with familiar symptoms and signs of raised ICP and therefore should have imaging.

The imaging must be reviewed by a radiologist before starting the procedure.

RESPIRATORY COMPROMISE
Patients with any form of respiratory compromise (especially respiratory muscle weakness) present significant risk in the context of invasive procedures. Particular attention must be paid to positioning, ventilatory and physical support of such patients. If the patient is deemed fit enough, by senior clinicians, to undergo such a procedure, it should ideally be performed in the upright position.

If any concerns, delay procedure and obtain help.

SKIN
Skin infection, cellulitis or suspected epidural abscess at the site of the LP can potentially introduce infection into the CSF space.

If any concerns, delay procedure and seek help.

AGITATED OR CONFUSED PATIENT
There is a higher chance of failure, trauma and infection if the patient is unable to remain still. A senior, experienced clinician should attempt the LP for an agitated patient. The patient may require mild sedation and discussion with anaesthetists.
Patients with a congenital or acquired abnormality of clotting should be carefully considered prior to making a decision on the safety of lumbar puncture.

If there is concern regarding any of the issues below, senior advice from the haematology team must be obtained (1,2). Note that combinations of any of the below drugs confer additional bleeding risk and must be discussed with the haematology team. The table included below is adapted from the AAGBI publication "Regional Anaesthesia and Patients with Abnormalities of Coagulation".

<table>
<thead>
<tr>
<th>BLEEDING RISK</th>
<th>ACCEPTABLE TIME AFTER DRUG FOR LUMBAR PUNCTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thrombocytopenia</td>
<td>Do not perform LP if platelet count &lt;75 x 10^9/L. Take advice from haematology team before proceeding</td>
</tr>
<tr>
<td>Warfarin</td>
<td>Discontinue chronic warfarin therapy 4-5 days before spinal procedure and check INR. INR should be 1.4 or less at the time of the procedure.</td>
</tr>
<tr>
<td>Direct oral anticoagulants</td>
<td>Please consult relevant literature and discuss with haematology regarding patients on newer oral anticoagulants. Advise new oral agents should be stopped for at least 48 hours prior to spinal procedure.</td>
</tr>
<tr>
<td>Rivaroxaban prophylaxis (CrCl &gt; 30ml/min)</td>
<td>18 hours</td>
</tr>
<tr>
<td>Rivaroxaban treatment (CrCl &lt; 30ml/min)</td>
<td>48 hours</td>
</tr>
<tr>
<td>Dabigatran prophylaxis or treatment (CrCl &gt; 80ml/min)</td>
<td>48 hours</td>
</tr>
<tr>
<td>Dabigatran prophylaxis or treatment (CrCl 50-80 ml/min)</td>
<td>72 hours</td>
</tr>
<tr>
<td>Dabigatran prophylaxis or treatment (CrCl 30-50ml/min)</td>
<td>96 hours</td>
</tr>
<tr>
<td>Apixaban prophylaxis</td>
<td>24-48 hours</td>
</tr>
<tr>
<td>Antiplatelet medications</td>
<td></td>
</tr>
<tr>
<td>NSAIDs</td>
<td>No additional precaution</td>
</tr>
<tr>
<td>Aspirin</td>
<td>No additional precaution</td>
</tr>
<tr>
<td>Clopidogrel</td>
<td>7 days</td>
</tr>
<tr>
<td>Prasugrel</td>
<td>7 days</td>
</tr>
<tr>
<td>Ticagrelor</td>
<td>5 days</td>
</tr>
<tr>
<td>Tirofiban</td>
<td>8 hours</td>
</tr>
<tr>
<td>Eptifibatide</td>
<td>8 hours</td>
</tr>
<tr>
<td>Abciximab</td>
<td>48 hours</td>
</tr>
<tr>
<td>Dipyridamole</td>
<td>No additional precaution</td>
</tr>
<tr>
<td>Thrombolytics/ fibrinolytics</td>
<td>10 days</td>
</tr>
<tr>
<td>Alteplase, anstreplase, reteplase, streptokinase</td>
<td></td>
</tr>
<tr>
<td>Heparin</td>
<td></td>
</tr>
<tr>
<td>UFH SC prophylaxis</td>
<td>4 hours or normal APTTr</td>
</tr>
<tr>
<td>UFH IV treatment</td>
<td>4 hours or normal APTTr</td>
</tr>
<tr>
<td>LMWH SC prophylaxis</td>
<td>12 hours</td>
</tr>
<tr>
<td>LMWH SC treatment</td>
<td>24 hours</td>
</tr>
<tr>
<td>Heparin alternatives</td>
<td></td>
</tr>
<tr>
<td>Danaparoid prophylaxis</td>
<td>Avoid (consider anti-Xa levels)</td>
</tr>
<tr>
<td>Danaparoid treatment</td>
<td>Avoid (consider anti-Xa levels)</td>
</tr>
<tr>
<td>Bivalirudin</td>
<td>10 hours or normal APTTr</td>
</tr>
<tr>
<td>Argatroban</td>
<td>4 hours or normal APTTr</td>
</tr>
<tr>
<td>Fondaparinux prophylaxis</td>
<td>36-42 hours (consider anti-Xa levels)</td>
</tr>
<tr>
<td>Fondaparinux treatment</td>
<td>Avoid (consider anti-Xa levels)</td>
</tr>
</tbody>
</table>

UFH unfractionated heparin; SC subcutaneous; APTTr activated partial thromboplastin time ratio; IV intravenous; LMWH low molecular weight heparin; NSAIDs non-steroidal anti-inflammatory drugs; INR international normalised ration; CrCl creatinine clearance
With all skills, time should be taken to consider patient safety and how any potential risk factors can be mitigated.
SAFETY

SPECIFIC CONSIDERATIONS
When performing lumbar puncture, the goal is to safely obtain diagnostic information having removed or minimised any potential risk factors.

If there is any concern that significant risk of harm may compromise patient safety, delay the procedure and seek senior advice.

Specific safety considerations are listed below:

<table>
<thead>
<tr>
<th>MANDATORY COMPONENT</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCESS TO FULL RESUSCITATION EQUIPMENT</td>
<td>• Location of resuscitation trolley should be known</td>
</tr>
<tr>
<td></td>
<td>• Ensure access to airway and suction equipment</td>
</tr>
<tr>
<td></td>
<td>• Consider establishing IV access pre-procedure</td>
</tr>
<tr>
<td>COMPETENT PRACTITIONIAN</td>
<td>• Supervisor for trainee</td>
</tr>
<tr>
<td>APPROPRIATE ASSISTANT</td>
<td>• Must be present throughout the procedure</td>
</tr>
<tr>
<td></td>
<td>• Competent to contribute to equipment checking and ensure patient comfort etc.</td>
</tr>
</tbody>
</table>

QUESTIONS TO CONSIDER

ALWAYS CONSIDER THE FOLLOWING
- Does it need to be done?
- Does it need to be done now?
- Am I competent to do this?
- Is supervision/assistance available?
- Am I familiar with the equipment?
- Does the patient have capacity to consent to the procedure?

NOTE TIMING OF PROCEDURE
- If bacterial meningitis is suspected and risk factors for raised ICP are not present, imaging is not required and the LP should be performed as soon as possible. Blood cultures and EDTA blood for ‘meningitis profile’ should also be collected at this time.
- If SAH is suspected and imaging is normal, it is suggested to delay the LP until at least 12 hours from the onset of the headache (3). This allows in vivo transformation of blood to bilirubin breakdown products that can be detected by spectrophotometry (4).

PATIENT EDUCATION

ALWAYS TALK WITH THE PATIENT
Communicating and informing the patient of exactly what the procedure involves can reduce anxiety and facilitate better positioning for the procedure.

The patient should be made aware why they are having the procedure, the benefits, the potential risks/complications and the alternatives to the procedure.

Once this has been done, informed consent should be sought and documented. There is a consent form available in NHS Lothian which can be used for written consent for lumbar puncture.

If the patient does not have capacity to give informed consent, and the procedure is deemed clinically necessary, ensure an Adults with Incapacity form is completed.

Always establish whether the patient has any known allergies prior to the procedure - they may have an allergic reaction to local anaesthetic or antiseptic skin preparation.

IN SUMMARY
- Tell the patient:
  - Why there is a need for the procedure
  - How the procedure will be performed
  - What the potential risks/ complications are
  - What the alternatives are

Gain consent.

Always offer the patient the opportunity to ask questions.
There are several complications associated with lumbar puncture, some of which, although rare, are extremely serious. It is your responsibility to explain these risks so that the patient may make an informed decision about their care.
## COMPLICATIONS

<table>
<thead>
<tr>
<th>COMPLICATION</th>
<th>CLINICAL PRESENTATION</th>
<th>RECOMMENDED ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>POST DURAL PUNCTURE HEADACHE</strong></td>
<td>Postdural puncture headache, worse on sitting or standing, improves with lying down. May have associated nausea, vomiting, tinnitus, cranial nerve palsies.</td>
<td>Hydration Simple analgesia Supine position Caffeine (oral or IV infusion) If significant persistent headache or associated symptoms, discuss with anaesthetics for consideration of blood patch.</td>
</tr>
<tr>
<td><strong>BACKACHE</strong></td>
<td>Mild localised pain at puncture site or mild generalised lumbar pain.</td>
<td>Simple analgesia Reassurance</td>
</tr>
<tr>
<td><strong>INFECTION • CELLULITIS</strong></td>
<td>Spreading cutaneous inflammatory changes. No evidence of CNS infection.</td>
<td>Antibiotics appropriate to severity of infection (see local antimicrobial guidelines)</td>
</tr>
<tr>
<td><strong>INFECTION • MENINGITIS/ MENINGOENCEPHALITIS</strong></td>
<td>Features include pyrexia, photophobia, neck stiffness, confusion, rash, altered consciousness.</td>
<td>Immediate IV antibiotics. May require repeat LP Urgent assessment by neurology or infectious diseases team</td>
</tr>
<tr>
<td><strong>INFECTION • DISCITIS/ VERTEBRAL BODY OSTEOMYELITIS</strong></td>
<td>Persistent or worsening lumbar back pain Possible pyrexia</td>
<td>Lumbar spine XR +/- MRI Urgent assessment by infectious diseases team</td>
</tr>
<tr>
<td><strong>SPINAL OR EXTRADURAL HAEMATOMA</strong></td>
<td>Persistent or severe back pain and tenderness. Lower limb neurological deficit (leg weakness, decreased perianal or leg sensation, sphincter disturbance)</td>
<td>Urgent MRI Contact neurosurgical team</td>
</tr>
<tr>
<td><strong>CEREBRAL HERNIATION</strong></td>
<td>Reduced consciousness and coma Pupil(s) dilate and fix Respiration can become periodic or stertorous Bradycardia and hypertension (Cushing’s reflex)</td>
<td>Call resuscitation, ICU and neurosurgical teams Bag &amp; mask; hyperventilate with high concentration oxygen Will need intubation and ventilation IV access 200mls 20% Mannitol IV (immediately)</td>
</tr>
<tr>
<td><strong>UNSUCCESSFUL ATTEMPTS</strong></td>
<td>Failure to obtain CSF</td>
<td>See Failed LP Protocol</td>
</tr>
</tbody>
</table>
A sound understanding of the relevant anatomy and physiology related to lumbar puncture will allow you to improve your practice and predict problems.
CEREBROSPINAL FLUID (CSF)

The CSF is contained in the brain ventricles and the cranial and spinal subarachnoid spaces. CSF provides hydromechanical protection of the central nervous system and plays a prominent role in brain development and regulation of brain interstitial fluid homeostasis, influencing neuronal functioning.

The mean CSF volume is 150ml, with 25ml in the ventricles and 125ml in subarachnoid spaces. CSF is predominantly secreted by the choroid plexuses.

Approximately 500-600mls of CSF is produced over 24 hours i.e. the entire volume is renewed about four times every day.

The CSF space is a dynamic pressure system that changes from childhood to adulthood. The normal range for adult CSF opening pressure (measured with the patient in a lateral position) is 10-25cmCSF (14-16).

### Normal adult CSF

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening pressure</td>
<td>10-25cm CSF</td>
</tr>
<tr>
<td>Red cells</td>
<td>Nil</td>
</tr>
<tr>
<td>Lymphocytes</td>
<td>&lt;6x 10^6/l</td>
</tr>
<tr>
<td>Neutrophils</td>
<td>Nil</td>
</tr>
<tr>
<td>Protein</td>
<td>&lt;450mg/l</td>
</tr>
<tr>
<td>Glucose</td>
<td>2.5-4.0mmol/l (2/3 of blood glucose)</td>
</tr>
<tr>
<td>IgG</td>
<td>5-45mg/l</td>
</tr>
</tbody>
</table>

Note - CSF pressure may be increased with anxiety, SAH, infection, SOL, idiopathic intracranial hypertension, congestive cardiac failure. One white cell is permitted for every 500 red cells in the CSF cell count in a traumatic/ bloody tap.

### CSF Parameters in disease

<table>
<thead>
<tr>
<th>Pathology</th>
<th>Appearance</th>
<th>Protein</th>
<th>Glucose (CSF:Blood)</th>
<th>Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial meningitis</td>
<td>Turbid</td>
<td>High</td>
<td>Low</td>
<td>Neutrophils</td>
</tr>
<tr>
<td>Viral meningitis</td>
<td>Clear</td>
<td>Normal/ high</td>
<td>Normal</td>
<td>Lymphocytes</td>
</tr>
<tr>
<td>Viral encephalitis</td>
<td>Clear</td>
<td>Normal/ high</td>
<td>Low</td>
<td>Lymphocytes</td>
</tr>
<tr>
<td>TB meningitis</td>
<td>Fibrin webs</td>
<td>High</td>
<td>Low</td>
<td>Lymphocytes/ Neutrophils</td>
</tr>
<tr>
<td>Fungal meningitis</td>
<td>Clear/ turbid</td>
<td>Normal or high</td>
<td>Normal or low</td>
<td>Lymphocytes</td>
</tr>
<tr>
<td>Subarachnoid haemorrhage</td>
<td>Xanthochromia</td>
<td>Normal/ high</td>
<td>High</td>
<td>Red cells</td>
</tr>
<tr>
<td>Multiple sclerosis</td>
<td>Clear</td>
<td>Normal/ high</td>
<td>Normal/ high</td>
<td>Lymphocytes</td>
</tr>
<tr>
<td>Guillain Barre syndrome</td>
<td>Clear</td>
<td>High</td>
<td>Normal/ high</td>
<td>Nil</td>
</tr>
<tr>
<td>Malignancy</td>
<td>Clear</td>
<td>High</td>
<td>Normal or low</td>
<td>Malignant</td>
</tr>
</tbody>
</table>
SURFACE ANATOMY
An imaginary line connecting iliac crests at the level of the L4 vertebral body in most patients. Sometimes called Tuffier’s line.

INTERNAL ANATOMY
An interactive 3D model showing the layers of the spine has been made which you can view, rotate and move online. Click the buttons below to visit the website:

Animated needle:  
[Click here!]

Annotated model:  
[Click here!]

NB: works best on a computer or tablet
Taking time to ensure you have the equipment and resources you require will ultimately make your task easier, allow you to consider eventualities and how you will deal with them.
CHECKLIST

EQUIPMENT & RESOURCES
The following should be available before commencing the procedure.

- EXPERIENCED AND SKILLED ASSISTANT +/- COMPETENT SUPERVISOR
- STOOL FOR CLINICIAN TO SIT ON DURING PROCEDURE
- PILLOWS (X2)
- INCO-PADS (FOR PROTECTION OF BED SHEETS)
- SHARPS BIN
- SURGICAL GOWN, STERILE GLOVES, FACE MASK AND SURGICAL HAT
- PROCEDURAL TROLLEY
- STERILE PACK INCLUDING STERILE COTTON SWABS AND SMALL LIQUID CONTAINER
- SURGICAL DRAPE (IDEALLY A WINDOW DRAPE WITH ADHESIVE EDGES)
- ADHESIVE TAPE (MAY BE USED TO KEEP DRAPE IN POSITION)
- ANTISEPTIC SOLUTION:
  0.5% chlorhexidine topical spray or
  0.5% chlorhexidine with alcohol solution
  Do not use 2% Chlorprep sponge applicators due to neurotoxicity risk (17,18)
- LIGNOCAINE 1% OR 2% - 5ML AMPouLE
- 5ML SYRINGE
- 1 WHITE OR 1 GREEN NEEDLE FOR DRAWING UP LIGNOCAINE
- 1 ORANGE +/- 1 GREEN NEEDLE FOR INJECTION OF LOCAL ANAESTHETIC TO SKIN
- SPINAL NEEDLES (PENCIL POINT NEEDLE 22G OR 24G - INTRODUCER WILL BE IN PACK)
- MANOMETER WITH THREE WAY TAP
- 4 UNIVERSAL CONTAINERS - IF SENDING FOR ADDITIONAL TESTS MAY REQUIRE MORE
- BLACK BAG/ TIN FOIL (TO PROTECT SAMPLE FROM LIGHT)
- EQUIPMENT TO TAKE PAIRED VENOUS BLOOD
Insertion Procedure

Phase 1 - Preparation & Positioning
Phase 2 - Procedural Pause
Phase 3 - Asepsis & Anaesthesia
Phase 4 - Insertion
Phase 5 - Anchoring & Dressing
Phase 6 - Completion & Documentation
PREPARATION, ASSISTANCE & POSITIONING

OBTAIN INFORMED CONSENT FOR PROCEDURE
- Explain the procedure + provide patient information leaflet if possible
- Explain the alternatives to the procedure
- Discuss potential complications and their management
- Written informed consent is the gold standard
- Adults with Incapacity form if appropriate

EXCLUDE CONTRAINDICATIONS
- Review CT if performed and rule out evidence of raised ICP
- Check for anticoagulant or antiplatelet medications
- Review platelet count and coagulation screen
- Exclude anatomical abnormalities of the spine

PATIENT AND CLINICIAN PREPARATION
- The patient may wish to visit the bathroom prior to positioning
- Ensure bed height is appropriate and seat available if required.
- Remove pager and/or phone
- Ensure your assistant is prepared
- Reassure the patient

PATIENT POSITIONING:

LATERAL POSITION
- Can be either left or right lateral position. Left lateral is standard in most medical units
- Neck and legs should be flexed as much as possible.
- Patient must be comfortable and steady
- A pillow can be placed under the patient’s head for comfort. Ensure spine is as horizontal as possible.
- 1 pillow between the patient’s knees to minimise axial rotation at the hips
- CSF opening pressure normal reference range (10-25cmCSF) is traditionally measured and quoted for the lateral position

SITTING POSITION
- Sitting position is an appropriate alternative, although this is not encouraged to be first line.
- Sitting erect with legs over the side of the bed
- Use chair for legs to rest on. This tends to roll the inferior pelvis anteriorly and help promote an outward curvature of the lumbar vertebrae.
- Use a pillow and ask patient to hug it. This will promote the patient leaning forward and again increase the outward curvature of the lumbar vertebrae.
- CSF opening pressure can also be measured in the sitting position but the upper limit of normality is unclear

ARRANGE EQUIPMENT
- Put on head-cap and face-mask prior to opening sterile equipment. (In the rare cases of epidural abscess most reports identify bacteria that are found to have come from the operator’s oral flora.)
- Open sterile pack onto procedural trolley
- Open procedural equipment onto the trolley
- Ensure trolley on correct side for clinician

IDENTIFY LANDMARKS
- Most lumbar punctures are inserted at the L3/4 interspace. One space above or below would also be acceptable. Tuffier’s line, a line drawn between the posterior iliac crests, corresponds with the body of the L4 vertebra.
- If the space immediately above Tuffier’s line feels appropriate (i.e. a good space between the spinous processes) mark the space with an indentation or a marker pen.
ASEPSIS & ANAESTHESIA

ASEPSIS
Ensure that the patient is sitting on absorbent pads and that clothing has been moved out of the way.
Wash hands and dry with sterile hand towels.
Put on sterile gown and gloves.
Apply antiseptic skin wash. If using 0.5% Chlorhexidine, ensure that your equipment is not at risk of exposure to antiseptic spray/liquid drops. Allow the chlorhexidine to dry whilst you prepare yourself and your equipment. Be vigilant that nothing contaminates the area whilst the chlorhexidine is drying.
Ask assistant to open and hold vial of lignocaine and draw it up.

DRAPE THE PATIENT
Remove the adhesive strips from the drape and, without contaminating the field, apply the drape to the patient with the circular cut-out centred on the intended vertebral interspace

LOCAL ANAESTHETIC
Infiltrate skin with lignocaine. Depending upon the amount of subcutaneous tissue up to 3-4ml of lignocaine 1 or 2% may be appropriate. Advancing the needle only just into the intervertebral ligaments will characteristically make injection very difficult and give you confirmatory feedback that you chosen angle and direction of insertion is in the midline.
INSERTION

INSERTION OF SPINAL NEEDLE
Confirm your landmarks and the spinal interspace. Note that an introducer is required for the pencil point needle you will use; this will be included with the spinal needle in its sterile pack.
Watch the associated video for more details about needle technique.

OPENING PRESSURE
Use the manometer and measure the opening pressure for every patient (95% reference interval for normal pressure is 10-25 cmCSF).

CSF COLLECTION
Aim for 2mls (around 10 drops) of CSF per standard sample.
If sample bottles are not externally sterile, the assistant should hold sample collection bottles under LP needle, taking care not to touch anything sterile.
If sample bottles are externally sterile, clinician can collect samples, taking care to steady needle throughout.
Ensure the tops are secure. Make telephone contact with labs and arrange transport.

IN CASE OF FAILURE TO OBTAIN CSF
Remove needle in a controlled manner and apply a small piece of sterile gauze to puncture site until no bleeding present.
Follow trouble shooting algorithm in appendix below.
ANCHORING & DRESSING

Apply simple dressing to insertion site.
Ensure no ongoing bleeding.

COMPLETION & DOCUMENTATION

COMPLETION
Dispose of waste and sharps appropriately
Provide advice to the patient about follow up/ symptoms etc.
Lable and send CSF samples (discuss with local laboratories if unclear)

- **biochemistry**
  - protein, glucose (volume 0.2ml)
  - requests for spectrophotometry to exclude SAH should be made on the last sample of CSF collected (min volume 0.2ml)
  - samples for spectrophotometry need to be protected from light using an envelope or tin foil

- **microbiology**
  - microscopy, culture and sensitivity
  - virology on all possible meningitis/ encephalitis
  - if TB considered, at least 7ml (discuss with local laboratory)

- **pathology**
  - at least 5ml if malignancy considered

- **paired venous blood**
  - serum glucose essential
  - serum protein if testing for oligoclonal bands

DOCUMENTATION
Including appropriate results
Ideally use an electronic menu to prompt high standard documentation.
An appendix is included with suggested documentation content.
09 APPENDICES

Failed lumbar puncture algorithm
Procedural documentation template
Lumbar Puncture Mastery Assessment
References
Plan A: Initial Plan
Lateral
22-24G pencil point needle with introducer
L4-5 or L3-4 interspace

Follow and double check all steps in guideline
- If introducer contacts bone, needle will not enter CSF
  - re-evaluate landmark anatomy
  - Identify source of error (commonly depth; horizontal angle; midline)
  - Re-position patient +/- clinician
  - Ensure seating and bed height correct
  - Retract introducer almost to the skin or completely out and re-insert correctly until it anchors in the interspinous ligament
  - (most commonly the introducer needs to enter more cephalad or towards the midline)

No more than 3 attempts +
Ensure patient comfort

If procedure performed in lateral position, consider procedure in sitting position
NEVER re-position the patient with a needle in their back

Unsuccessful LP – proceed to Plan B

Plan B: Secondary Plan
Lateral or sitting upright
24G pencil point needle with introducer
L3-4 interspace

Re-evaluate landmark anatomy prior to starting
- Troubleshoot as above
- If procedure performed in lateral position, consider procedure in sitting position
NEVER re-position the patient with a needle in their back

Success
Measure opening pressure
Collect samples
Remove introducer and needle together

Success
As above

Unsuccessful
Ask: Do I need this sample now?

Still unsuccessful LP – Get HELP from a senior or anaesthetist
LUMBAR PUNCTURE

Primary Clinician + Grade
Supervising Clinician + Grade
Assistant + Grade

Risks + Alternatives explained: Y/N
(headache, bleeding, infection, nerve damage, failure)
Patient’s questions answered: Y/N
Written consent obtained: Y/N
AWIA: Y/N

Indication:

Contraindications excluded: Y/N
PT: INR: Platelet count:
Signs of raised ICP: Y/N
CT Brain: Y/N

Patient position:

Asepsis:
Hat + Mask + Gloves + Gown: Y/N
Drape: Y/N
0.5% chlorhexidine/ iodine: Y/N

Local anaesthetic used:

Needle type + gauge:
Interspace:
Number of attempts:

CSF appearance:
Opening pressure:

Samples sent for:
Cell count: Y/N
Gram stain: Y/N
Bacterial culture: Y/N
Viral PCR: Y/N
Biochemistry (protein, glucose): Y/N
Oxyhaemoglobin: Y/N
Pathology/ cytology: Y/N
Other (please specify): Y/N

Serum glucose: Y/N

Any difficulties/ complications: Y/N
# Lumbar Puncture

## Procedural Checklist

### 1 Pre - Procedure

<table>
<thead>
<tr>
<th>ATTEMPT</th>
<th>ATTEMPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Identifies correct patient and ensures consent has been obtained</td>
<td></td>
</tr>
<tr>
<td>Considers indications and lists contra-indications</td>
<td></td>
</tr>
<tr>
<td>Lists correct equipment and ensures trained assistant present</td>
<td></td>
</tr>
<tr>
<td>Describes optimal patient and operator position</td>
<td></td>
</tr>
<tr>
<td>Identifies and marks insertion point</td>
<td></td>
</tr>
<tr>
<td>Surgical scrub (hat/mask, wash hands, sterile gown/sterile gloves)</td>
<td></td>
</tr>
<tr>
<td>Procedural PAUSE. Performs 3 person check and verbal rehearsal with assistant</td>
<td></td>
</tr>
<tr>
<td>Applies antiseptic skin wash and allows to dry</td>
<td></td>
</tr>
<tr>
<td>Avoids contamination of equipment and gloves by the cleaning solution</td>
<td></td>
</tr>
<tr>
<td>Applies drape using a non-touch technique</td>
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</tr>
<tr>
<td>Confirms insertion point</td>
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</tr>
</tbody>
</table>

### 2 Procedure

- Performs final equipment check (and assembles manometer)
- Infiltrates local anaesthetic
- Inserts introducer
- Carefully inserts pencil point spinal needle
- Obtains CSF within 3 attempts
- Obtains opening pressure and collects samples
- Removes introducer and needle

### 3 Post - Procedure

- Describes sample processing and documentation of procedure

### 4 Throughout

- Maintains aseptic technique
- Demonstrates effective communication (incl. instructions to patient + nursing staff)
- Maintains control of introducer and needle throughout
- Demonstrates safe sharps management

## Comments
REFERENCES

1. Association of Anaesthetists of Great Britain and Ireland, Obstetric Anaesthetists’ Association and Regional Anaesthesia UK. Regional anaesthesia and patients with abnormalities of coagulation. Anaesthesia 2013; 68: 966-72
18. Malhotra S et al. One vs two applications of chlorhexidine/ethanol for disinfecting the skin: implications for regional anaesthesia. Anaesthesia 2011; 66; 574-578