SPINAL DRAINS AND THORACO-ABDOMINAL ANEURYSM REPAIR (TAAR)

INDICATION

CSF drainage during and after open or endovascular Thoraco-Abdominal Aneurysm Repair (TAAR) reduces the risk of paraplegia when combined with other measures of spinal cord protection (1, 2).

CONTRAINDICATIONS

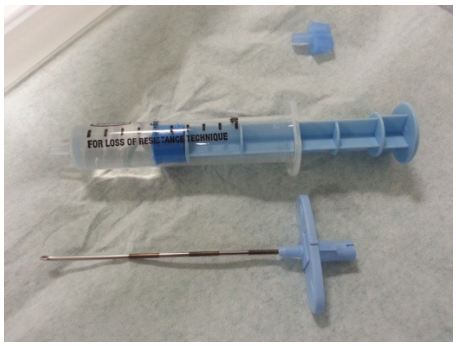
1) Active infection (systemic or local)
2) Unstable patient
3) Raised ICP
4) Abnormal coagulation (PLT $<100 \times 10^9$/L; INR >1.3; APTTR>1.4; abnormal TEG)
5) Anticoagulant therapy:
   - Unfractionated iv/sc heparin within 4h
   - Prophylactic dose LMWH within 12h
   - Therapeutic dose LMWH within 24h
   - Tirofiban or Eptifibatide within 8h
   - Rivaroxiban within 18h
   - Abciximab within 48h
   - Fondaparinux within 36h
   - Clopidogrel within 7 days
   - Dabigatran within 7 days
   - Prasugrel within 10 days
   - Ticlopidine within14 days

RISKS (3, 4)

1) Post-dural puncture headache (0.2%)
2) Neuraxial haematoma
3) Intracranial haemorrhage (SAH, SDH) (0.45%)
4) Catheter fracture (0.1%)
5) Fistulation and CSF leak (0.55%)
6) Spinal cord/nerve root injuries
7) Meningitis (0.2%)
8) Neuraxial abscess
9) Cerebral Herniation

HOW TO INSERT A SPINAL DRAIN

1) Get your equipment ready (from the cupboard next to the fridge in anaesthetic room 9)
   - Standard epidural kit with 16G Tuohy needle
   - External drainage set
   - Single pressure monitoring set with yellow tabs



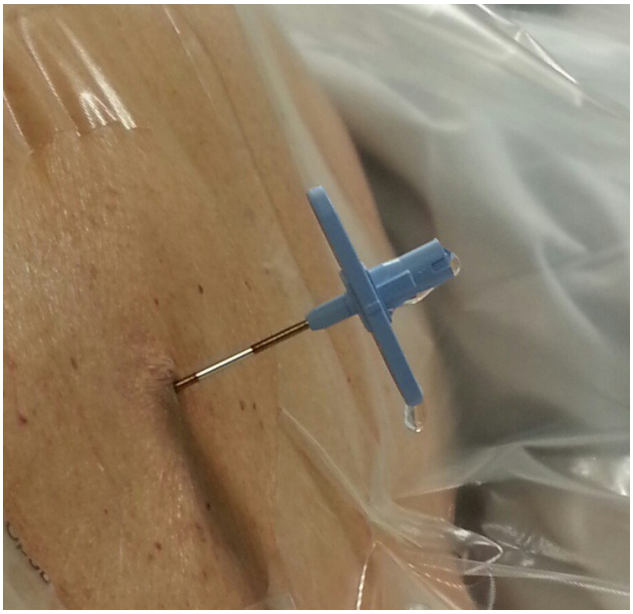
Drip chamber

Collection bag

Collection tubing

2) Full aseptic technique
3) Patient awake or under general anaesthesia
4) Sitting or lateral decubitus position
5) At or below the L3/L4 interspace use LOR to saline to identify the epidural space

6) Remove the LOR syringe and slowly advance the Tuohy needle until CSF flows freely (usually 0.5-1cm beyond the epidural space)



7) Advance the epidural catheter into the subarachnoid space, leaving 5-7cm in situ

8) Confirm free drainage of CSF through the catheter

9) Secure the catheter with a “Lockit” device and fix on the right of the spine with a clear dressing

10) Confirm that CSF flows freely through the catheter after securing it AND after patient positioning on the operating table

11) Do not use a filter on the catheter as this can obstruct CSF flow

12) Label the system very clearly “Spinal drain: NOT for injection”
13) Carefully consider whether an epidural for analgesia is indicated
    - It may mask the early signs of neurological deficit
    - It may be confused with the spinal drain

PITFALLS AND TROUBLESHOOTING

If a bloody tap occurs:

- Attempt insertion at a different interspace
- Wait 60 minutes before systemic anticoagulation
- Have a higher index of suspicion for post-operative neuraxial haematoma
- Document it clearly on the anaesthetic chart and “Spinal Drain Checklist“

If two bloody taps occur:

- Discuss with the surgical team
- Consider postponing surgery

SETTING UP THE DRAINAGE SYSTEM

1) Use an Aseptic Non-Touch Technique (ANTT)
2) Attach the collection tubing of the External Drainage Set to the spinal drain catheter
3) Use a dedicated spinal drain pressure monitoring set labelled with yellow tabs and a dedicated pressurised flush system
4) Prime the spinal drain pressure monitoring set with normal saline then connect it to the External Drainage Set via the three-way tap
5) The roller clamp on the line that delivers flush to the spinal drain pressure monitoring set should be taped closed and labelled “SPINAL DRAIN: DO NOT FLUSH”

Replace this picture for on with spinal drain not for injection labelled

Spinal drain catheter

Collection tubing of External Drai

Pressure Monitoring Set

Collection tubing to drip chamber

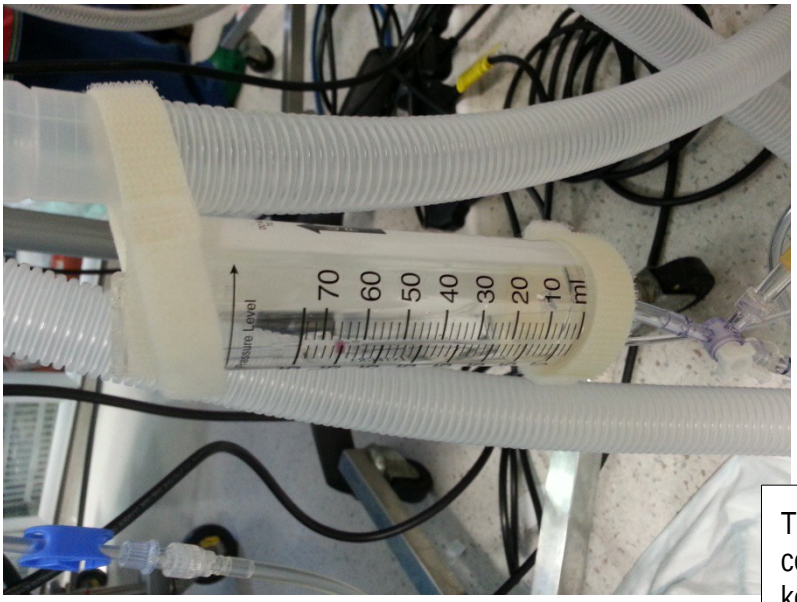
Three-way Tap of External Drainage Set

6) Zero the spinal drain pressure transducer at the level of the elbow
7) Label the spinal CSF pressure “ICP” on the display monitor
8) Plug connections should be double checked to ensure that spinal CSF pressure and other pressure monitoring (e.g. CVP) is not confused

Roller clamp taped and marked “DO NOT FLUSH”

9) Hang the drip chamber using the Velcro straps
10) Close the three-way tap to the collection bag

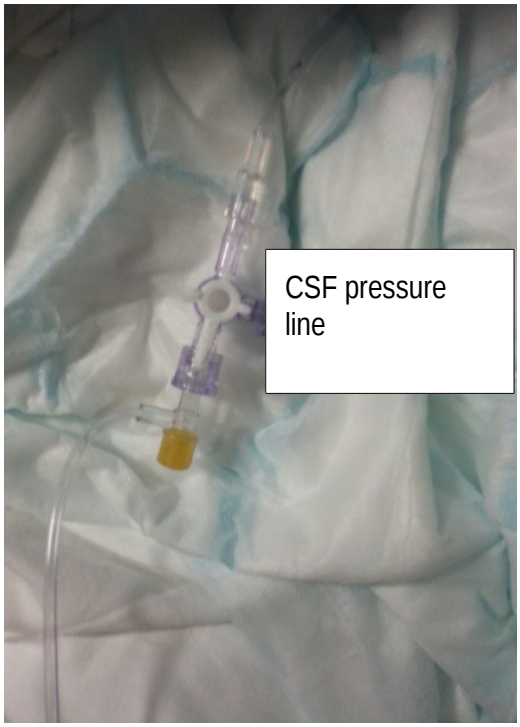
11) The speed of CSF drainage depends on the height of the drip chamber off the ground. At first, position the drip chamber 30cm below the level of the elbow.



Three way tap to collection bag – to be kept closed

12) A three-way tap controls whether CSF pressure is measured or CSF is drained into the drip chamber

Three way tap open to pressure measurement



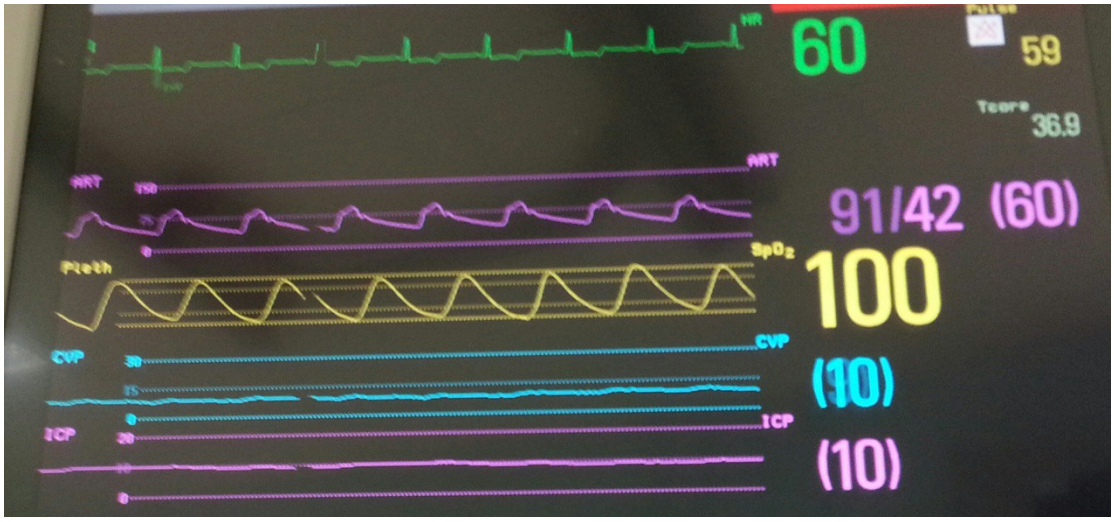
CSF pressure line

CSF drainage line

INTRAOPERATIVE MANAGEMENT OF THE DRAIN

1) Ensure the CSF pressure transducer is **zeroed** at the **level of the elbow**
2) The target CSF pressure (CSFP) during TAAR is 10 mmHg
3) Start CSF drainage at the beginning of the case in order to slowly reach the target by the time the spinal cord is at risk (during aortic cross clamping or stenting)
4) Rapid drainage of CSF increases the risk of an intracranial haemorrhage
5) If the CSFP is in excess of 10mmHg, open the three way tap to the drip chamber and slowly drain 5-10mls of CSF

6) As long as the CSF remains clear (not blood-stained) continue to drain 5-10ml aliquots until the target CSFP is reached
7) CSFP should be monitored continuously except whilst draining CSF



8) Closely monitor and record the colour and volume of drained CSF
9) Maintain MAP >85mmHg with fluids +/- noradrenaline once the stent graft has been deployed or after aortic unclamping
10) If the spinal cord CSFP is >15mmHg (e.g. due to restricted CSF drainage) increase the MAP until the Spinal Cord Perfusion Pressure (MAP-CSFP) is > 70mmHg
11) Other intra-operative targets are:
    - Haemaglobin >100 g/L
    - PO_2 >7.3-10.6kPa
    - O_2 saturation > 95%
12) Do not give any intrathecal injections via the spinal drain
13) Maintain good communication with the surgical team

PITFALLS AND TROUBLESHOOTING

If CSF becomes blood-stained:

- Stop drainage and reassess in 30 minutes
- If CSF becomes clear, continue to drain CSF as normal
- If CSF is still blood-stained, do not drain CSF
- Be alert to the possibility of an intracranial haemorrhage and document this on the handover form.

If the amplitude of sensory/motor evoked potentials in the lower limbs decreases:

- Reduce the target CSF pressure to 5mmHg and drain without limit (assuming the CSF remains clear)
- Ensure oxygen saturations > 95%
- Aim Hb >120g/L
- Aim MAP > 90mmHg and SCPP > 80mmHg (if surgically feasible)

POST- OPERATIVE HDU & ITU CARE

Handover

1) The spinal drain device must be set up by the anaesthetist before leaving the patient
2) The anaesthetist must complete the "Spinal Drain Checklist" with the ITU/HDU nurse AND the ITU/HDU Registrar (the on call Vascular Registrar covers the Zacchary Cope HDU)

Setting up the spinal drainage device

1) The sterility and integrity of the closed spinal drainage system must be maintained at all times
2) The spinal drain must be clearly labelled "Spinal drain: NOT for injection"
3) The roller clamp on the line that delivers continuous flush to the transducer should be taped closed and labelled "DO NOT FLUSH"
4) The CSF pressure transducer should be zeroed at the level of the elbow
5) Label CSF pressure "ICP" on the monitor
6) Double check connections to ensure that CSF pressure and other pressure lines are not confused
7) Don't secure drain tubing to the bed as the catheter may dislodge if the patient moves

Managing the spinal drainage device

1) The spinal drain usually remains in situ for 48-72 hrs postoperatively
2) Drain CSF in 5ml aliquots to maintain a target CSF pressure of <15 mmHg
3) Do not drain more than 15mls/hr CSF
4) Record hourly observations including:
    a. Motor power and sensation in the lower limbs
    b. GCS and pupil size/reactivity
    c. Volume and colour of drained CSF
    d. CSF Pressure
5) Usual targets are:
    a. Spinal Cord CSF Pressure (CSFP) <15mmHg
    b. MAP >85-90 mmHg
    c. Haemoglobin >10 g/dl
    d. PO_2 7.3 – 10.6 kPa
    e. O2 saturation >95%
6) There should usually be a sedation hold within 12 hours of surgery to allow neurological assessment
7) Repeat the sedation hold every 12 hours
8) Assess the insertion site every 12 hours for evidence of infection or CSF leak
9) The drain may be clamped briefly (< 5 minutes) for care activities
10) Prophylactic LMWH can be given daily
11) Do not give any intrathecal injections via the spinal drain
12) Be aware that CPAP increases CSF pressure and may cause paraplegia. Commencing CPAP is a consultant decision.

Spinal drain problems

1) Alert the ITU/HDU Registrar IMMEDIATELY if:
    a. New neurological deficit occurs
    b. The patient's level of consciousness falls
    c. The patient complains of a new onset severe headache
    d. Turbid//blood stained CSF is observed

2) Get an urgent ITU/HDU Registrar review if:
    a. The spinal drain malfunctions
    b. There is a spinal drain disconnection
    c. There is a CSF leak

New neurological deficit

This is an EMERGENCY. If motor power or sensation in the lower limbs becomes impaired, the vascular registrar, vascular consultant and on call anaesthetist (blp 1201) must be alerted IMMEDIATELY. Adopt the modified COPS protocol (see below).

The patient's level of consciousness falls

If the patient's level of consciousness falls unexpectedly, stop CSF drainage and arrange an immediate CT head to assess for intracranial haemorrhage.

The patient complains of a new onset severe headache

Be alert to the possibility of an intracranial haemorrhage or meningitis

Turbid CSF

Be alert to the possibility of meningitis

Blood stained CSF

If CSF becomes blood stained, stop CSF drainage, correct coagulopathy and reassess to see if the CSF clears. If it does not clear, replace the drain. If CSF is still blood stained, do not use the drain and be alert to the possibility of an intracranial haemorrhage or neuraxial haematoma. Consider imaging the head and spine.

Spinal drain malfunction

If the drain malfunctions within the first 48hrs post-operatively, it should be replaced.
If the COPS protocol has been adopted and the drain malfunctions within 7 days, it should be replaced

Spinal drain disconnection

Consider the system no longer sterile if leakage or disconnection occurs. Turn off the three-way tap closest to the patient if the disconnection is distal to this point. Otherwise, clamp the spinal drain proximal to the disconnection. It may be possible to repair/reconnect the spinal drainage system with a full aseptic technique

CSF leak +/- postural headache

Treatment of a CSF leak or postural headache includes conservative measures (bed rest, hydration, <30° head-up tilt, analgesia) for 24hrs followed by consideration of an epidural blood patch (contact the on call anaesthetist on blp 1201)

Removing the spinal drain

1) The Vascular Team decide when to remove the spinal drain (usually 48-72 hours post-operatively).
2) Before removal, check the patient's clotting and correct if necessary
3) Remove the spinal drain 12h hrs after the last LMW heparin dose. Withhold heparin for 4 hrs after drain removal
4) Do not cap the spinal drain before removal as this can increase CSF pressure and CSF leak
5) The vascular registrar/ITU registrar should remove the spinal drain with the nurse
6) Apply a transparent occlusive dressing once the catheter is removed and Inspect the insertion site every 2 hours for 24 hours, looking for CSF leak
7) Bed rest is mandatory for 2 hours after spinal drain removal
8) Continue to monitor motor power and sensation in the lower limbs every hour for 24 hours after spinal drain removal. If neurological deficit occurs after drain removal, re-insert the spinal drain and adopt the modified COPS protocol.

CHECKLIST & HANDOVER FOR POST OPERATIVE CARE OF THE SPINAL DRAIN

Insertion and Intra-operative management

Bloody tap during insertion ☐

Intra-operative blood stained CSF ☐

Intra-operative loss of motor/sensory EPs ☐

Epidural for analgesia in situ ☐

HDU/ITU Management of spinal drain

Position patient head up (max 30^0) ☐

Hang CSF drip chamber 30cm below the level of the elbow ☐

Pressure bag:

Roller clamp OFF and taped closed ☐

Marked “DO NOT FLUSH” ☐

Transducer:

Positioned and zeroed at the level of the elbow ☐

Spinal drain:

Ensure drain is patent ☐

Marked “Spinal drain: NOT for injection” ☐

Open three-way tap to “pressure measurement” ☐

Monitor CSF pressure continuously (labeled ICP on monitor) ☐

Ensure connections checked by two members of staff ☐

Close the three-way tap to the collection bag ☐

Target parameters recorded and discussed (see below) ☐

Prophylactic dose LWMH prescribed ☐

Post extubation CPAP must be d/w a consultant ☐

First sedation hold to occur at …….hrs ☐

Usual Target Parameters

MAP > 85 mmHg: maintain with fluids +/- noradrenaline

CSFP < 15 mmHg:

Intermittent drainage of 5 -10 ml aliquots of CSF

Maximum drainage 15 ml/h

If CSFP still > 15mmHg increase MAP until Spinal Cord Perfusion (MAP-CSFP) >70 mmHg

$Sa0_2$ > 95%

PO_2 7.3-10.6kPa

Hb >100g/L

Observations and Monitoring

Hourly:

Motor power/sensation lower limbs

GCS

Pupils

Volume/colour drained CSF

CSFP

Every shift change:

Sedation hold to assess neurology

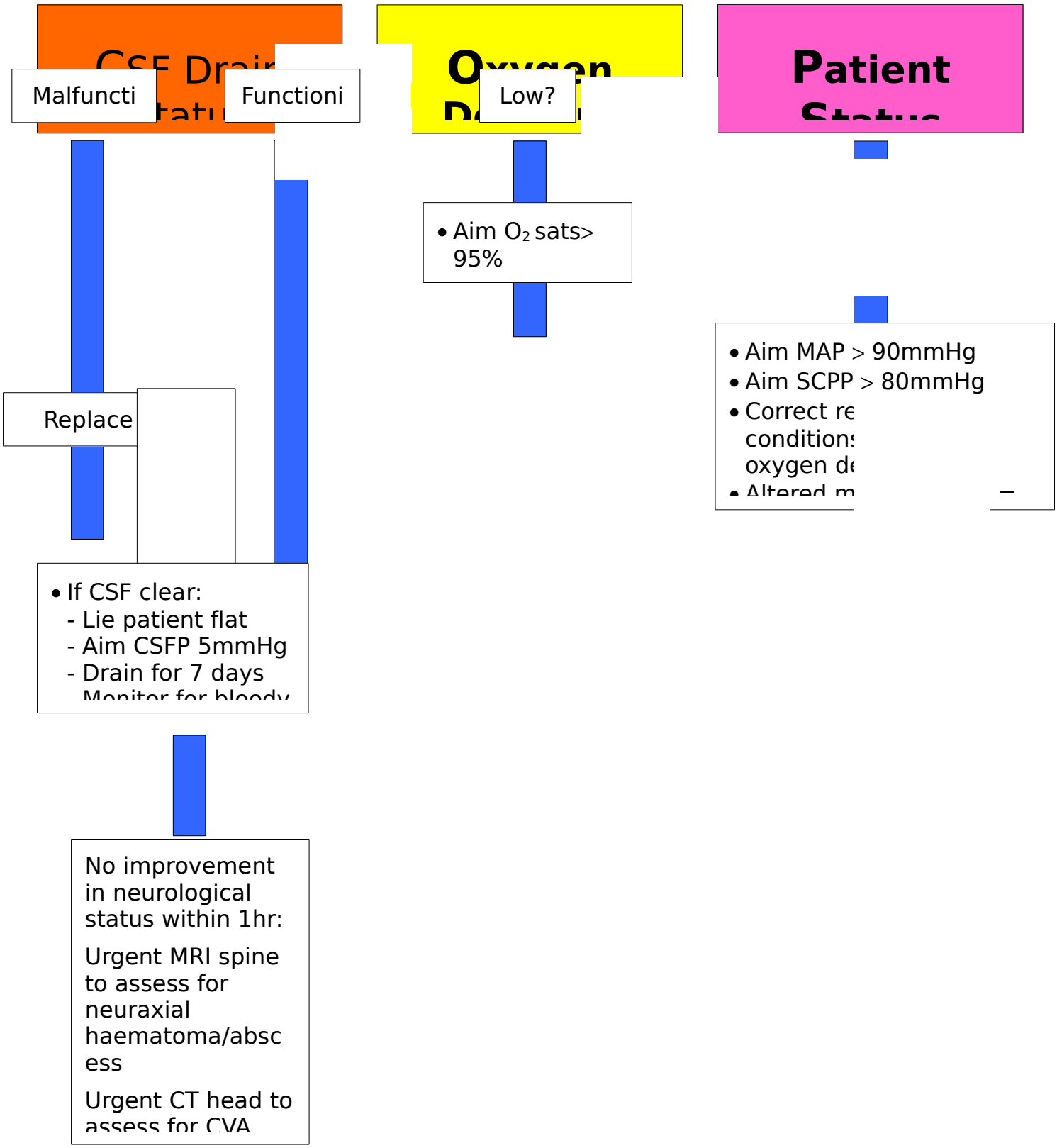
Inspect spinal drain insertion site

Spinal drain emergencies

Contact the ITU/HDU Registrar +/- on call anaesthetist IMMEDIATELY if:

New neurological deficit occurs
The patient's level of consciousness falls unexpectedly
The patient complains of a new onset severe headache
Turbid/blood stained CSF

COPS PROTOCOL: MANAGING NEW NEUROLOGICAL DEFICIT IN THE LOWER LIMBS (adapted from 3)



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