

# **A Protocol for CSF (Lumbar Spinal) Drainage for Thoracic Aortic Aneurysm Repair**

Date of writing: 2/2009  
Date of review: 2/2012  
Date of second review: 10/2017

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## **Medical Check List**

### **Patient Identifier Label:**

### **Indication for Lumbar spinal drain (circle):**

1. Previous AAA repair (open or EVAR)
2. Long stent graft / distance of aorta covered (>20cm)
3. Left subclavian artery coverage, without prior revascularisation, or a dominant left vertebral artery
4. Emergency case
5. Patients who will require prolonged ventilation
6. Open thoracoabdominal repair

### **Inserted by including time and date:**

### **Presence of oscillations (circle):**

1. Yes
2. No

### **Zero Reference point (circle):**

1. Lumbar drain insertion site
2. Other \_\_\_\_\_

### **Height of manometer setting and chamber level from zero reference (circle):**

1. 10cm/H<sub>2</sub>O
2. Other \_\_\_\_\_

### **Maximum CSF volume per hour (circle):**

1. 20ml/hr
2. Other \_\_\_\_\_

## **Nursing Check List**

### **Initial checks**

1. Is the drain securely attached to a drip stand?
2. Is the drain labelled at all access points?
3. Is the drain kept physically distinct from intravenous lines (ideally on opposite sides of the bed)?
4. Is the drain zeroed to the level of the insertion site?
5. Is CSF draining, or at least swinging/oscillating in the line?
6. Is the drip chamber set at the right height and documented?

### **Moving the patient**

1. Clamp the drain
2. Move the patient
3. Level the drain with the insertion site
4. Unclamp the drain and return to protocol

**OPEN THE DRAIN IMMEDIATELY IF PATIENT DEVELOPS LOWER LIMBS  
NEUROLOGICAL SYMPTOMS & SIGNS.**

### **Hourly checks**

1. Turn the drain off, measure the CSF drainage in the drip chamber and drain it into the bag
2. Record the volume drained each hour
3. Report if:
  - a. Less than 3ml/hr or not swinging
  - b. More than 30ml/hr
  - c. Discoloured or cloudy (yellow for infection, red for blood)
  - d. Patient complains of headache or nausea, pyrexia or lowered level of consciousness

### **Removing the drain**

1. Aseptic technique
2. Remove the dressing
3. Clean the site
4. Pull out the drain:
  - It will stretch a bit and may need a firm pull
  - If it feels really stuck, STOP and get help
  - After removal, check that the tip of the catheter is intact (a smooth rounded tip with small perforations on the distal shaft of the catheter)
5. Pressure dressing and flat for 2 hours

## **Background**

This protocol has been modified from previous documents created following morbidity and mortality meetings involving senior members of the St George's Vascular Institute and the Intensive Care Department.

Paraplegia due to spinal cord ischaemia is a recognised complication of thoracic aortic surgery that occurs in 2-20% of patients depending on the presence of certain risk factors shown in Table 1. It usually occurs immediately following surgery, however, presentation can be delayed by 3-5 days particularly following periods of hypotension.

<b>Risk factors</b>
Long aortic lesions/long aortic coverage (>20 cm)
Prior aortic surgery (e. g., abdominal aortic repair)
Stent placement at the level of the visceral segment Th9–Th12 (origin of the arteria radicularis magna [artery of Adamkiewicz])
Coverage of the left subclavian artery
Occlusion of the internal iliac arteries
Chronic renal insufficiency
Perioperative hypotension
Female gender
Long procedure time

**Table 1. Risk factors associated with the occurrence of spinal cord ischaemia**

A number of pre and perioperative strategies have been developed to reduce the incidence of symptomatic spinal cord ischemia and patients are evaluated on a case-by-case basis to see how these parameters may be optimised pre-operatively (Table 2).

The rationale for the use of cerebrospinal fluid drainage is to decrease postoperative spinal cord oedema. There are, however, limited data to suggest that it should be used routinely in all patients undergoing endovascular repair, as insertion is not without risk. In the absence of strict guidelines, current recommendations (Class II) from the European Society of Cardiology, the European Association for Cardiothoracic Surgery together with several American societies suggest that perioperative drainage should be considered only in those patients considered high risk (Table 1). We have therefore adopted a policy of selective use of lumbar drains, which is in keeping with national and international practice.

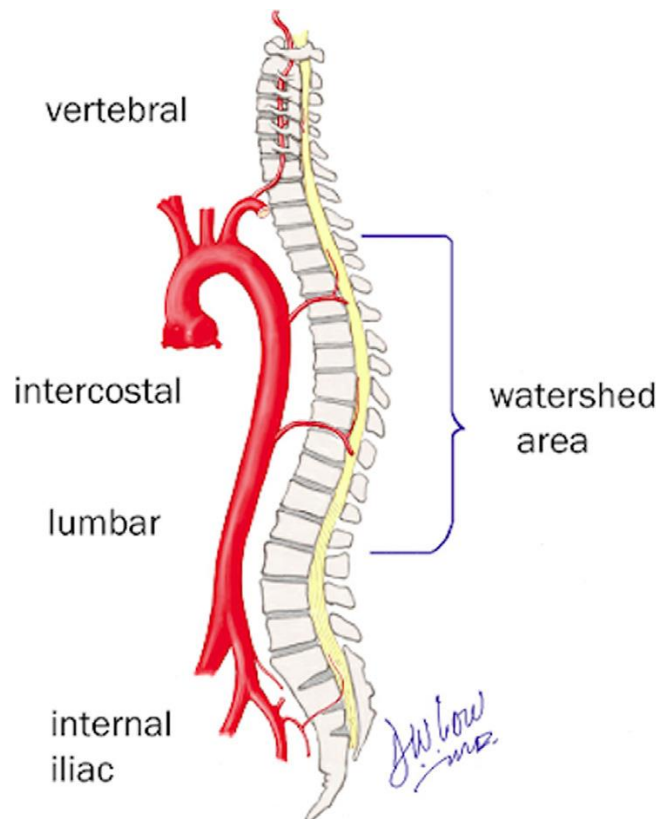
Measures to prevent and treat spinal ischemia
Prevention of hypotensive phases (mean arterial pressure >90 mm Hg)
Shortest possible treatment duration
Staged approach in complex endovascular procedures
Preservation of perfusion to the subclavian artery; where necessary, revascularization if stent coverage is planned
Preservation of perfusion to the internal iliac arteries
Drainage of cerebrospinal fluid
Local or systemic hypothermia
Optimization of hemoglobin levels
Preoperative coiling of lumbar arteries
Neurophysiological monitoring
Drug therapy (e. g., intrathecal papaverine)

**Table 2. Possible measures to reduce the spinal cord ischaemia**

**Importantly, post-operative paraplegia can be transient if identified early and treated aggressively. This includes MAP > 100mmHg using vasopressors and the placement of a lumbar drain if required.**

### Rationale

The arterial blood supply to the spinal cord relies on the anterior spinal artery which arises from the vertebral artery, branches from the intercostal arteries (including the artery of Adamkiewicz), which arise from the thoracic aorta, lumbar arteries that come off the abdominal aorta and branches from the internal iliac vessels (Figure 1). Perfusion of the spinal cord is derived from the difference between the mean arterial blood pressure (MAP) and CSF pressure. The MAP dictates the perfusion pressure and should be maintained above 90mmHg.



**Figure 1. Blood supply to the spinal cord**

Clamping or stenting the aorta reduces the blood pressure to the spinal cord, potentially leading to arterial thrombosis, and can increase the blood pressure in the head and neck markedly. This increases the amount of CSF production and subsequent spinal cord pressure. The combination of a low spinal blood pressure, or thrombosis, and high CSF pressure put the distal spinal cord at high risk of ischaemic damage.

Ischaemia causes oedema of the spinal cord, which swells within the confined space of the spinal canal. The pressure inside the spinal cord may be beneficially reduced by a combination of maintaining a MAP >90mmHg and the increasing drainage of CSF, allowing the spinal cord to swell while increasing spinal perfusion pressure.

### What is a CSF drain?

This comprises of a silicone catheter, collection bag and a ruler (manometer). The catheter is placed below the level of the termination of the cord (L2-L3 or below) and within the CSF. The catheter is taped securely to the skin to prevent dislodgement, and connected to a **manometer, which should be set at 10cm/H<sub>2</sub>O, measured from the lumbar drain insertion site**. This means that the height of the manometer may need adjusting if the patient moves from a supine to seated position.

### Complications

Complications occur in up to 5% of patients with a CSF drain and include spinal headache, subdural haematoma, infection (meningitis or spinal abscess) and persistent CSF leak. **A common and often fatal complication is the inadvertent administration of medication through the CSF drain. Marking the drain and 3-way tap as "CSF" at the time of insertion can prevent this.**

#### 1. Pre-operative considerations: patient selection

The decision to place a lumbar spinal drain pre-operatively depends on a number of patient factors and the operation planned, with specific combinations leaving the patient at higher risk of spinal cord oedema and ultimately paraplegia. Drains should be placed in the anaesthetic room prior to surgery under aseptic conditions. The drain should remain on free drainage for the duration of the surgery.

The operating consultant and anaesthetist will make a decision regarding the administration of routine anti-hypertensive medication pre-operatively. Point of care coagulation testing, such as platelet mapping, activated clotting time and thromboelastography are available and could prove useful in the decision making process specifically in patients suspected to have a coagulopathy.

Indications for pre-operative spinal drain placement:

- Open Thoracoabdominal Aneurysm Repair
  - All patients
- Endovascular Thoracic stent grafts
  - Previous AAA repair (open or EVAR)
  - Long stent graft / distance of aorta covered (>20cm)
  - Left subclavian artery coverage, without prior revascularisation, or a dominant left vertebral artery
  - Emergency thoracic cases
  - Patients who will require prolonged ventilation that may prevent recognition of deficit

#### 2. Intra-operative management of patients undergoing TEVAR

Due diligence must be given to blood pressure control during the procedure. Prior to stent graft placement a mean arterial pressure (MAP) of > 90mmHg should be achieved.

If a spinal drain has been placed, this should be left on free drainage for the duration of the operation. The manometer should be set to 10 cm/H<sub>2</sub>O measured with the zero point on the drain being level with the lumbar insertion site. The height of the drip chamber above the zero point determines the pressure (i.e. the drain should be set at 10cm).

The 3-way tap on the lumbar drain **MUST** be clearly labelled as ventricular drainage or CSF access at the time of drain insertion. This helps prevent inadvertent drug administration through the drain.

If during, or at the end, of the procedure the anaesthetist reports that there has been difficulty maintaining a MAP > 90mmHg, then the following action should be taken. If a drain is already in

situ and open, vasopressor agents should be used to maintain the MAP. If there is no drain in situ, then one should be placed immediately after the procedure and vasopressors commenced.

### 3. Post-operative management of spinal drains

Due to the risks associated with thoracic vascular procedure, all patients should be admitted in cardiac intensive care following their procedure for the first 48 hours following surgery. The decision to return a patient to the ward should be in direct discussion with the vascular team.

The highest-risk period is the first 72-hours post graft placement. In this period it is critical that the MAP is kept > 90mmHg, even if this requires vasopressor support. Patients should continue to receive their normal medication, including post-operative antibiotics (2 doses) and DVT prophylaxis.

There is a theoretical risk of subdural haematomas and coning (pathological herniation of the brainstem through the foramen magnum) if CSF is drained too quickly. A maximum of 20ml/hr of CSF should be drained, after which the drain should be clamped for the remaining of that hour and the vascular team made aware. Patients developing new neurology with spinal drain in situ, should be considered an emergency and early investigations with CT aortogram, CT Head and/or MRI spine considered.



## **Post-drain insertion protocol**

### **a) Spinal drain in situ, no post-operative complication**

#### **Day of surgery**

The manometer should be placed at 10cm/H<sub>2</sub>O with the height measured from the lumbar drain insertion site. MAP > 90mmHg.

#### **Post-operative Day 1**

If no neurological deficit is detected and MAP is >90mmHG without vasopressors on day 1 post-operatively, then the patient should have the spinal drain clamped. The patient should remain in bed, but may sit-up. They should receive all their normal medications, eat and drink.

#### **Day 2**

If there is no neurological deficit detected after 24-hours of spinal drain clamping and the patient is stable, then the drain should be removed. This should occur at least 12-hours after the previous dose of LMWH, but no less than 2-hours prior to the next dose.

### **b) Spinal drain in situ, post-operative complications detected**

If adverse neurological signs are detected (i.e. paraplegia or new paraesthesia) then the drain should be left on free drainage at 10cm/H<sub>2</sub>O and the patient kept lying in a supine position. Hypotension should be managed aggressively with fluids resuscitation and vasopressors to maintain a MAP of >100mmHg and consider maintaining Hb >100g/L.

The drain should be removed or changed under aseptic conditions at 72-hours post drain placement to reduce the risk of a central infection. This must be in discussion with the vascular team.

The vascular surgical team must be informed as soon as adverse neurology is detected. Patients must be managed in the ITU setting. The neuro-physiotherapists should be involved at the ITU stage for all patients with a neurological deficit post-thoracic aneurysm repair. Imaging including CT angiogram, CT Head and MRI spine should be considered.

### **c. Late neurological complications (Figure 2)**

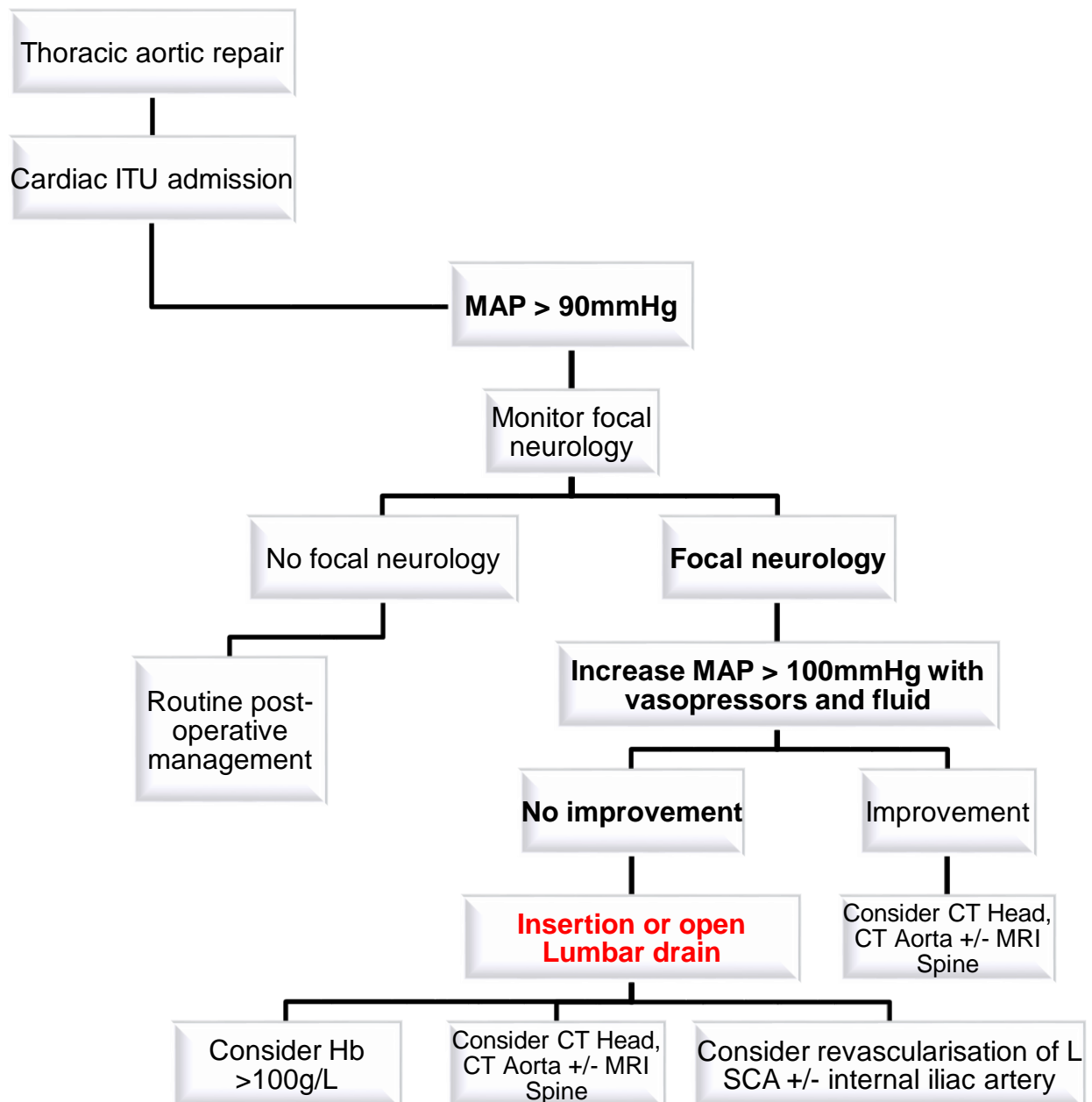
Patients may develop late neurological symptoms following thoracic aneurysm repair. If detected the immediate priority should be to ensure an adequate BP (MAP > 100mm/Hg), Hb >100g/L and spinal drain placement. The ITU should be contacted in the first instance for assistance with BP management, and if a bed is immediately available, transfer should be discussed prior to CSF drainage. If there is delay in transfer, the patient should have a CSF drain inserted in the anaesthetic room of an emergency theatre by an appropriately qualified person. The patient should be transferred from here to an appropriate higher dependency unit for vasopressor support and neuro-physiotherapy (MAP > 100mmHg). The manometer should be placed on free drainage at a level of 10 cm/H<sub>2</sub>O measured from the level of the drain insertion site.

### **d. What happens if the drain blocks / falls out?**

Unfortunately, for a variety of reasons, spinal drains can fall out or become blocked. If the drain is blocked then a single attempt should be made to flush it using an aseptic technique and 5ml of normal saline.

If this fails to stimulate drainage or the drain falls out on the day of / first night after surgery then the drain should be replaced immediately under aseptic conditions. The vascular team should be informed of this situation. If the drain blocks later than the first night following surgery, then the vascular team should be consulted. If there is no evidence of neurological deficit, the patient has a MAP >90mmHg and is otherwise stable, then the usual management will be not to replace the drain. If there are clinical concerns for any of the above reasons, then it is likely that the drain will need to be re-sited.

**Figure 2: Flow diagram of management of patients following thoracic aortic surgery without placement of a lumbar drain**



### **General Principals – Nursing guidance**

The following guidance is adapted from the British Association of Neuroscience Nurses Guidelines – CSF Management (2<sup>nd</sup> Edition).

### **KEY POINTS**

- **Always establish correct zero reference to ensure consistency and accuracy in all readings. Measurement is to be achieved using a spirit level or laser device. The zero level is at the lumbar drain insertion site.**
- **Ensure all connections and tubing are secured and clearly labelled to avoid accidental removal, leakage and/or usage.**
- **The lumbar drain insertion site must be monitored twice daily for signs of infection (leaking CSF, erythema, purulence).**
- **Medical staff must prescribe the height or pressure level that the drain is to be set at. This is routinely set at 10cm/H<sub>2</sub>O, but any change from protocol must be documented in the notes.**
- **The nursing staff must monitor and promptly report any deviations (e.g. over or under drainage) to the medical staff.**
- **Neurological observations and vital signs must be recorded in order to ensure early detection of infection within the CSF or raised ICP (i.e. headache, nausea, neck stiffness, pyrexia).**
- **Respiratory oscillations of CSF, volume drained and appearance (colour and clarity) must be recorded hourly.**
- **If the system becomes disconnected, clamp the line, stay with the patient and call for assistance.**
- **Asepsis must be maintained at all times when handling the drainage system**
- **Ensure patient and their relatives/carers are informed of the rationale for the lumbar drain and the possible risks and side effects.**

## **Statements of Best Practice**

**Staff should have read and be familiar with the protocol**

### **Insertion**

1. The drain must be clearly labelled in order to differentiate it from other invasive lines

### **Management**

1. The system is primed by a trained and competent practitioner in accordance with the local policy.
2. The insertion site has a transparent adhesive dressing to enable visualisation of the entry site. Observe for signs of infection (leaking CSF, erythema, induration and purulence).
3. The CSF drainage system should be attached to an appropriate fixed stand, which must be clearly identifiable.
4. An appropriate levelling device should be always available at the bedside.
5. On insertion medical staff must prescribe the height and pressure level that the drain is to be set at. This must only be adjusted following instructions by a member of the medical team.
6. If the system becomes disconnected, the line must be clamped and urgent medical attention sought.
7. The nursing staff must monitor and promptly report any deviations (over or under drainage) to the medical staff

### **Clamping the drain**

1. Clamping the drain should be discouraged due to the risk of permanent blockage or inadvertent failure to re-open the drain.
2. Clamping must only be undertaken when a patient is being transferred (e.g. bed to chair) or if the drain needs to be laid on the bed (e.g. transfer to CT scan or theatre).
3. The drain will need to be re-zeroed to meet the patient's new position from the insertion site.
4. Medical staff must document in the patient's records the amount of drainage/hour, with a default maximum of 20ml/hr.
5. Clamping of the drain is to be monitored extremely closely by the nursing staff with deviations reported to the medical staff.

### **Changing of the drainage bags**

1. Bags are changed under strict aseptic technique observing infection control measures as in accordance with manufacturer's guidelines and local policy
2. Changing of the bag is minimised to reduce the risk of introducing infection into a closed circuit system.
3. The bag is changed when 75% full as overfilling of the drainage bag impairs drainage.

### **Removal**

1. The lumbar drain is to be removed as soon as clinically indicated by the medical team.
2. Catheters should be removed or changed at 72hrs following insertion.

### **Transferring of patients**

1. Clamping of the drain is only undertaken when a patient is being transferred from bed to chair or if the drain needs to be laid flat on the bed. However, the drain should remain upright whenever possible.
2. If the drain is moved from the prescribed reference point in order to facilitate transport, the CSF drainage system must be:
  - a. Clamped for the minimal amount of time and is re-zeroed and unclamped as soon as possible.
  - b. The drip chamber is emptied and the drainage system is clamped, prior to laying the CSF drainage system down to prevent blocking the hydrophobic filter.

## **Documentation**

Following assessment, an individualised care plan is implemented and evaluated specific to all aspects of care relating to the post-operative management of patients having surgery to their thoracic aorta. This should support daily multi-disciplinary input and review of the management plan and care delivered.

### **Accurate documentation includes:**

1. **The recognised zero reference point - usually the lumbar drain insertion site**
2. **CSF drainage – hourly volume**
3. **Height of the manometer setting and chamber level**
4. **CSF description – colour and clarity**
5. **Presence of oscillation**

Physiological and neurological observations should be recorded hourly in the first 24hrs following surgery. Neurological deterioration or evidence of infection (neck stiffness, headache, nausea) must be immediately reported to the medical team.

All nurses involved in the management of the lumbar drain should be provided with a structured competency based training and education programme.

Protocol and guidance and all relevant documentation are easily accessible and visible in the appropriate clinical area.

## **Patient Information**

Written information should be available for patients & carers with alternative methods of communication available

Patient/family/carers has access to the following information:

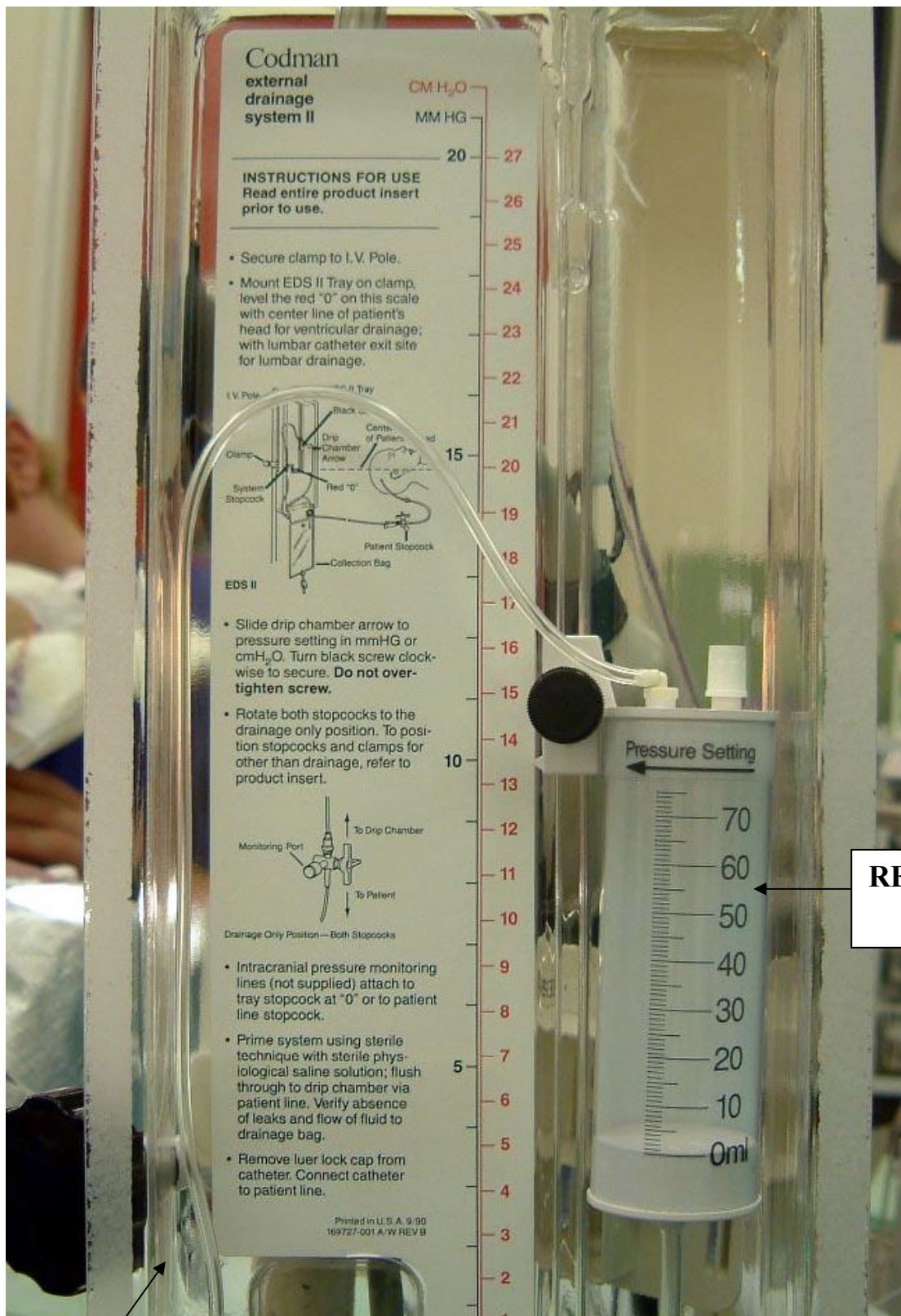
1. Details of the CSF drainage system and how it works
2. Details of any associated equipment that they are likely to encounter.
3. Likely duration of treatment.
4. Explanation of the importance of continual assessment.
5. The importance of checking with healthcare professionals prior to any change in the patients' position.
6. The importance of reporting any changes in the patient's neurology to a healthcare professional.

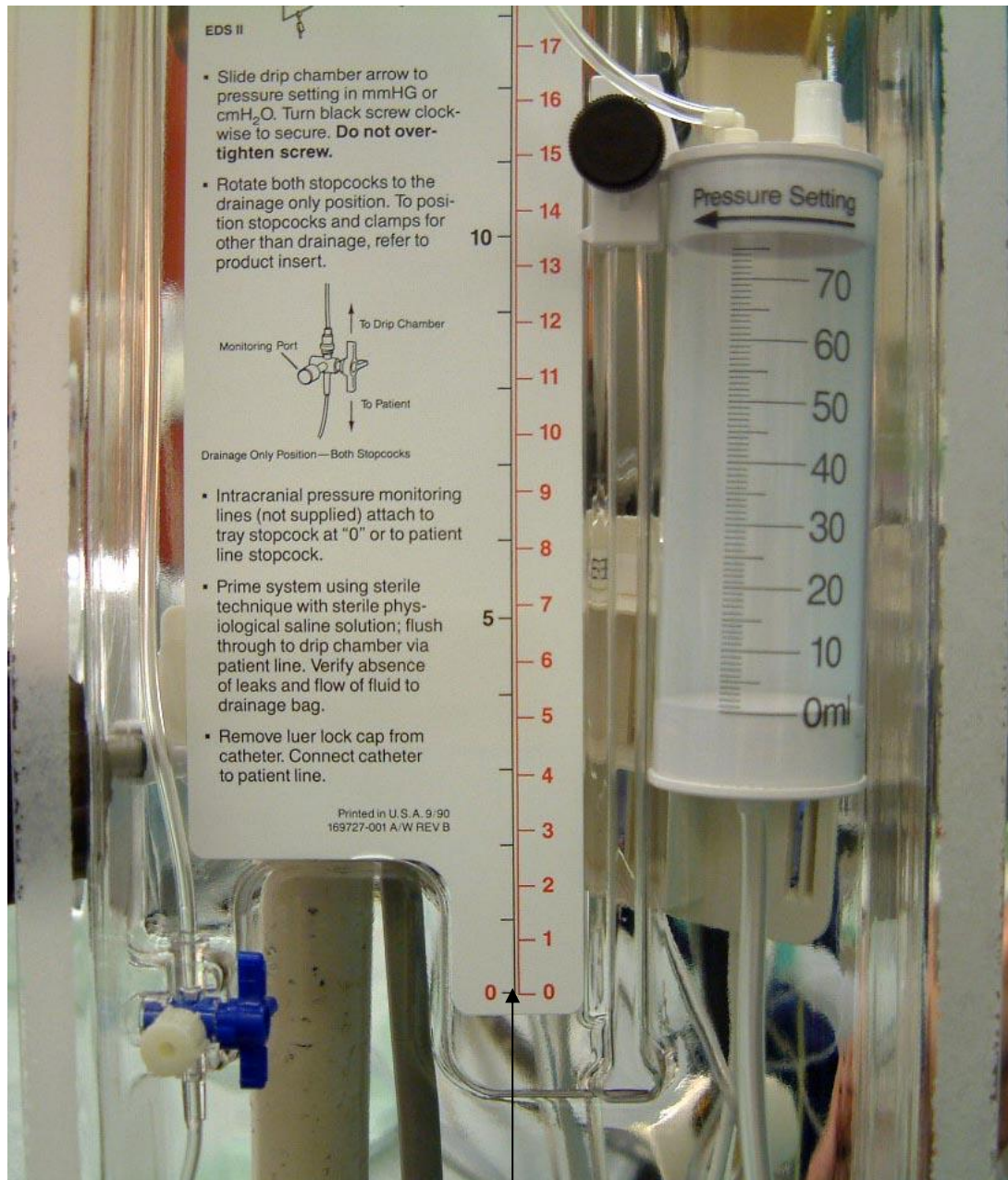
Any information verbal/written that is given to the patient/carers is documented in the patient's records.

The information that is given to the patient is current, evidence based and in accordance with local policy.

Patient information is reviewed in accordance with local policy.







**POSITION THE 'ZERO' AT  
THE LEVEL OF THE  
INSERTION SITE**



**CSF DRAINAGE CATHETER**

