The Newcastle upon Tyne Hospitals NHS Foundation Trust

Guidelines for Management of EVDs in Adults at the Regional Neurosciences Centreat the Regional Neuroscience Centre (v1)

1 Introduction

An External Ventricular Drain is a device that diverts cerebro-spinal fluid (CSF) from the chambers of the brain into a closed drainage system. Access is via a ventriculostomy via a catheter placed into the the llateral ventricle normally gained through a frontal burr hole (a ventriculostomy.) This is a formal surgical procedure carried out as an aseptic procedure. It is deemed necessaryused when there CSF pathways are obstructed or at risk of obstruction or to treat raised intracranial pressure. is a build up of fluid within the CSF pathway in the brain, which causes a rise in intra-cranial pressure and a subsequent deterioration in the patient's coma score An EVD is a gravity drain with a zero reference point and a pressure level therefore the positioning of the EVD will determine the amount of CSF drained.

This guideline will cover the following key areas:-

1. Insertion Procedures.
2. The Medtronic "Duet" EVD set.
2.3. Management/Care Plan.
4. Transducing EVDs.
3.5. Removal of EVDsCSF Sampling.
6. Weaning from an EVD.
7. Removal of an EVD.
3.Complications of EVDs.
4.8. CSF sampling.
5.9. Investigation and management of ventriculostomy related infection.
10. Administration of Intrathecal Antibiotics.
6.Removal of EVDs
7.11. Appendices.

2 Guideline Scope

This guideline should be used as reference for all healthcare staff caring for an adult patient with an external ventricular drain in the RVI.

3 Main body of the Guideline

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3.1 Insertion Procedures

Location
All EVDs should be inserted in theatre unless there are specific situations that prevent transfer there.

Prophylactic Antibiotics

All patients should receive prophylactic antibiotics prior to the procedure. If the EVD is to be placed de novo then use flucloxacillin 2gcefuroxime 1.5g single dose. Gentamicin 3

9mg/kg should be used for penicillin allergic patients. If the EVD is being changed or the patient is MRSA colonised then discuss with microbiology. (My understanding is that we are trying to prevent skin and soft tissue infection - fluclox at 1g single dose half an hour prior to op should suffice as plasma/skin levels are at least 10 -15 times higher , if not more, than MIC of bacteria at this dose and higher if the patient has been fasting. Similarly Clindamycin at 600mg should be sufficient. Higher doses are required to prevent deep tissue colonisation/infection e.g. heart valves.)

Peri-operatively

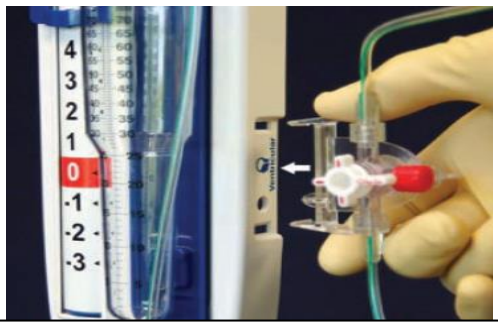
The EVD should be connected to the drainage system in an aseptic fashionusing a strict surgical ANTT in theatre before the sterile field is broken.
If infection is suspected Procedure

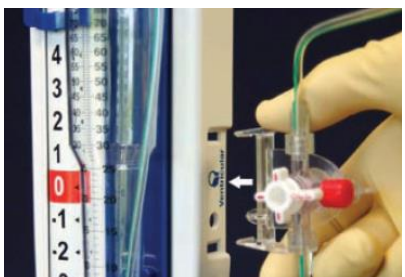
1. Silver impregnated catheters should be selected unless contraindicated[12].
2. The area for insertion and catheter exit should be shaved. Skin should be cleaned with aqueous betadine prior to draping.
3. The wound is cleaned with 2% chlorhexidine and the patient draped.
4. The surgeon double gloves & creates a burr hole.
5. The surgeon should then change their outer gloves.
6. The EVD is inserted and tunnelled at least 5cm from the burr hole wound.
7. The wound is closed and the EVD connected to a drainage system. A dressing should be applied to cover the wound.
8. Aa baselineinitial/base line CCSF sample should be sent immediately after insertion to microbiology and biochemistry for routine analysisgramstain, microscopy, culture and sensitivity, protein and glucose.

The catheter and connecting tubing should be clearly labelled as an EVD or containing CSF to prevent accidental intrathecal injection.

It is the responsibility of the **neurosurgeon** to give instructions on the level at which the drain is to be set **or** the amount of drainage required each hour and to document this in the patient's medical records.

Attach the system 3 way tap to the lower position on the side of the drainage system and rotate the pressure scale to cm H_2O.





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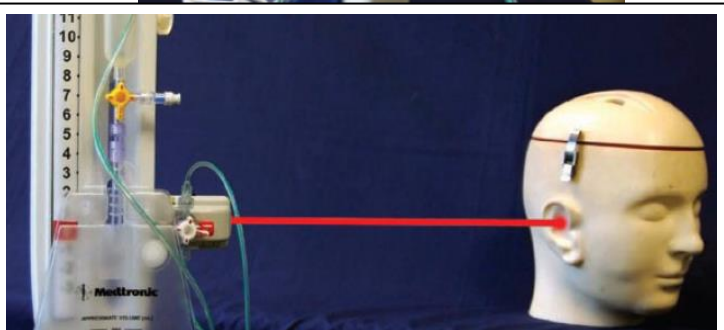

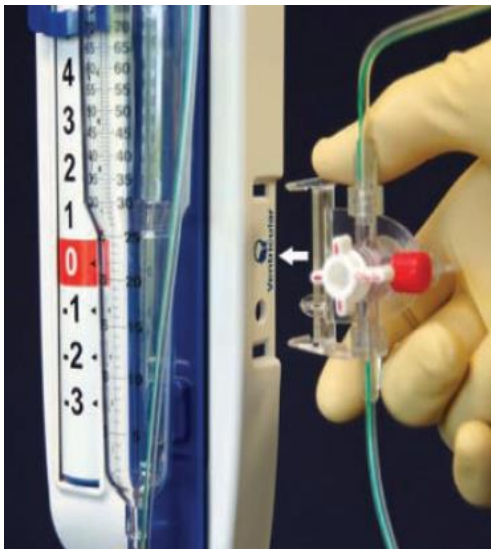
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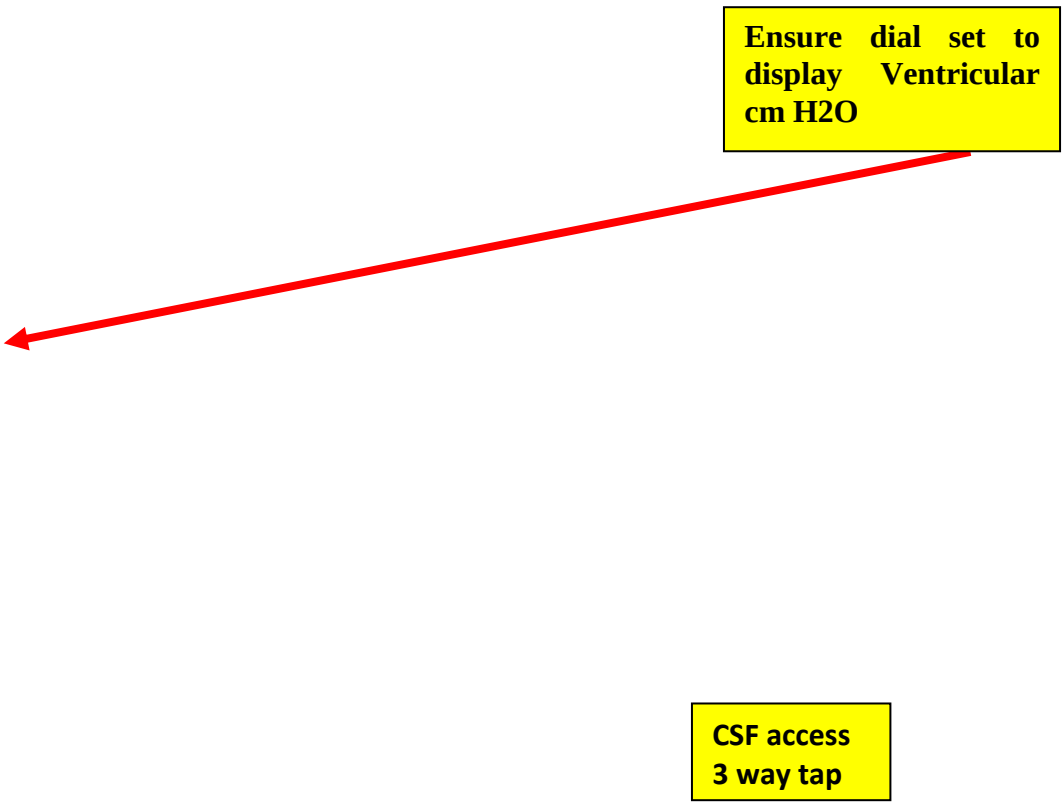
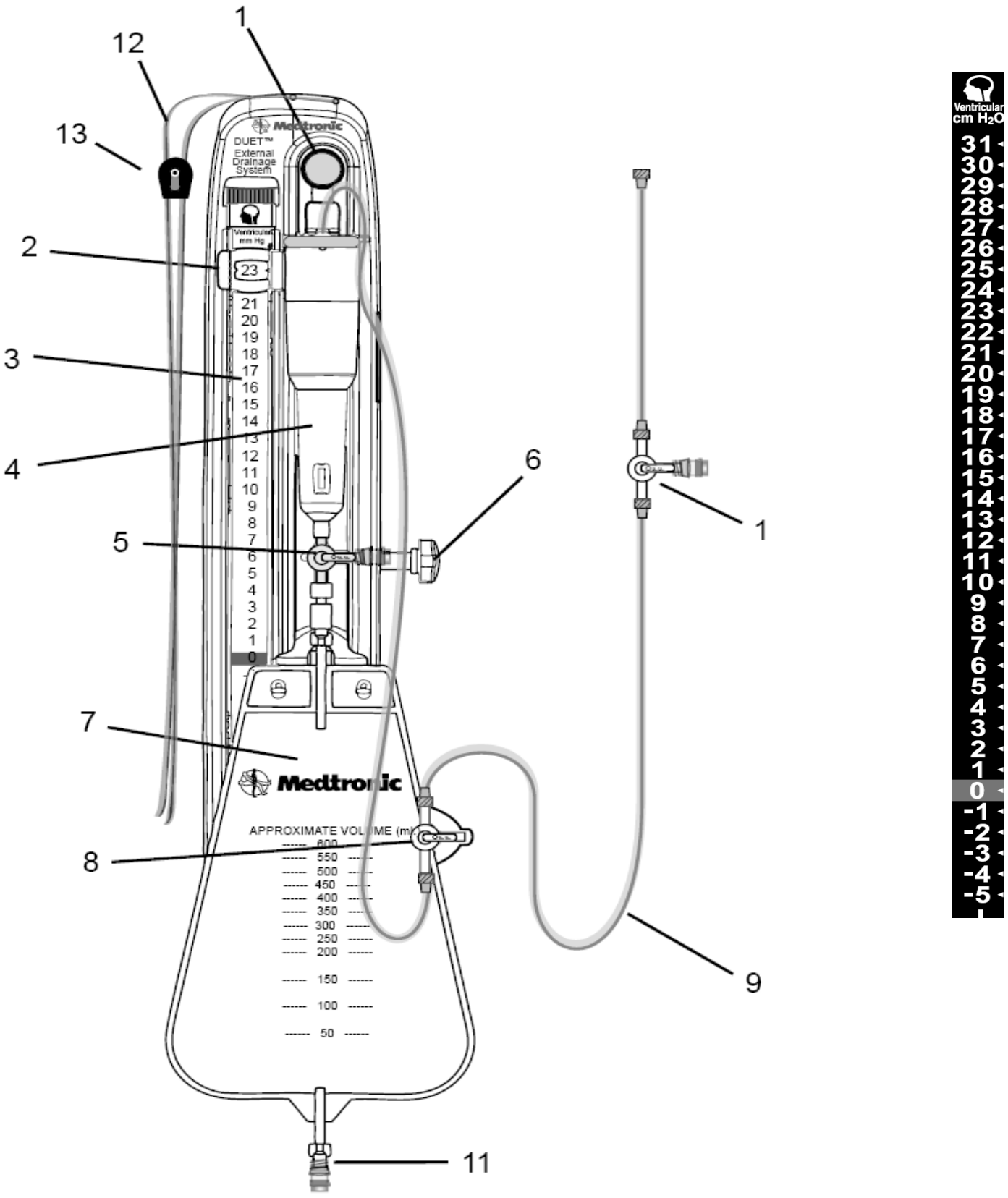

Ensure dial set to display Ventricular cm H2O
Sampling Port 3 way tap
CSF access 3 way tap
System 3 way tap

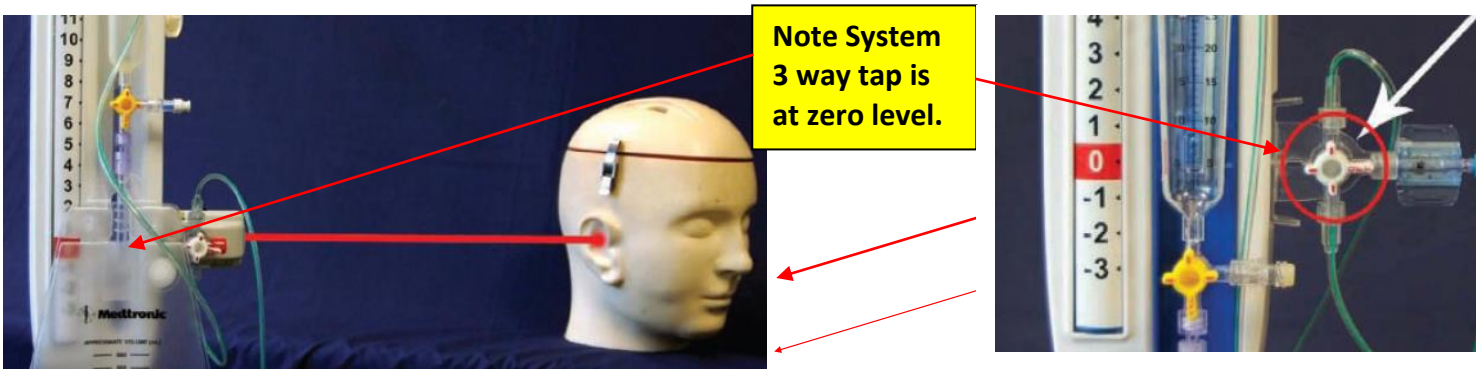
The Medtronic “Duet” Drainage System



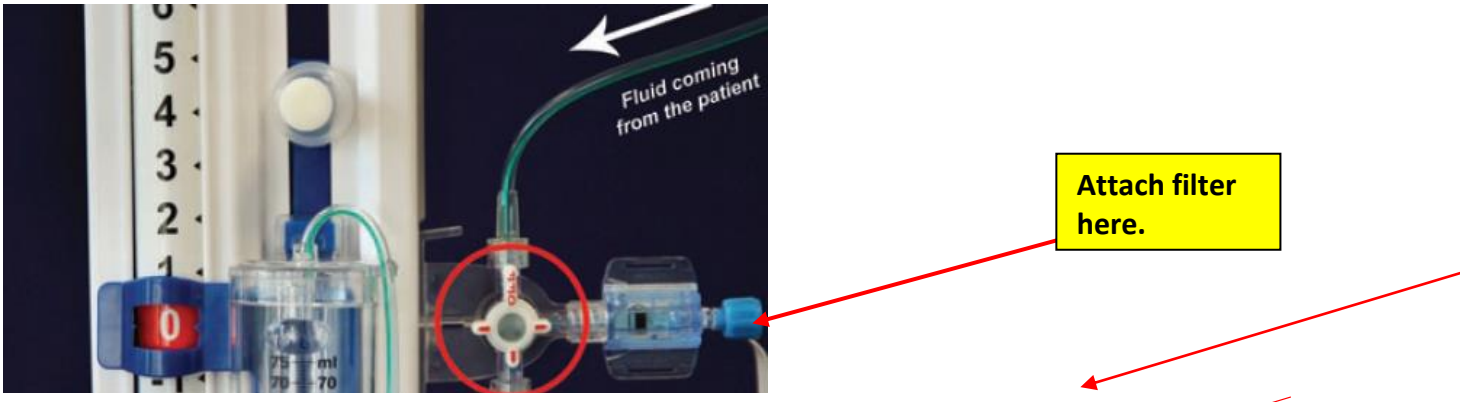
3.2 Management/ Care Plan

1. The unitEVD set must hang from a separate dedicated intra-venous pole.

2. The drain is set by the medical staff at a predetermined level usually 10-15cms above the zero anatomical reference markers. This reference point is the iIntraventricular fForamen of Monro (IFM) the nearest external marker correlating with this is the external auditory meatus (earhole). Measurement is to be achieved with the use of a spirit level or laser dependent upon the drainage system used.



3. If a pressure transducer is used it should be attached and zeroed as below. A filter should be attached to the pressure transducer.



33. Re-zero the drain when the patient's head position is altered, which may affect the drainage.

44. Maintain a closed system at all times. Ensure that only essential breaches occur (i.e. when the system is changed or taking CSF samples.)

55. All patients must be monitored using the Glasgow Coma sScale. The frequency of the observations will be dependent upon their clinical condition of the patient but at least 42 hourly.

66. Drainage is recorded according to the patient's clinical condition on the fluid balance area of the observation chart. and the External vVentricular dDrainage record chart.

Recording the following:

- Amount
- Colour of the CSF
- Opacity

Inform the medical staff /nurse –in charge of any significant changes in the drainage amount: i.e.

- An increase in the hourly rate by more than 10mls

- An increase of volume by 30mls in one hour
- Sudden drainage of frank new blood or new blood staining

77. Observe the system for patency if no drainage occurs. Llook for swinging in the fluid level in the line. Observe for blockage, kinks or closed 3 way taps. If the drain is blocked contact the medical staff immediately.

88. When transporting the patient, the EVD system must remain switched on and at the prescribed level and **not** laid in the bed. With medical staff agreement, drain can be switched off and laid in the bed , but **drip chamber must be emptied first** to avoid backflow into the ventricle.

99. The entry site must be dressed with an aseptic occlusive dressing at all times. The dressing should be changed when soiled and/or becomes loose using a surgical ANTT. Any wetness of the dressing must be reported to the medical staff. Observe for signs of infection; redness, swelling, discharge around the entry site.
Record the patient's temperature at least **4 hrly.** Rreport any pyrexia to the medical staff.

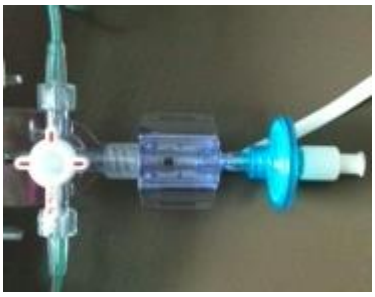
100. Drains should remain in situ as long as the patient remains drain dependant. There is no evidence that elective change is beneficial but as with other indwelling devices the cumulative risk of infection increases with time rising markedly between days 5-11. If the patient remains drain dependent consideration should be given to whether they need a permanent CSF diversion procedure or whether a lumbar drain may suffice.

3.3 Transducing an EVD

Equipment
Dressing trolley
Sterile Dressing pack with sterile gloves
One 10ml syringe
One green needle
Sterile Saline ampoule
Transducer
EVD Filter
1x Bung
0.5% Chlorhexidine Gluconate w/v in 70% Isopropyl Alcohol spray.

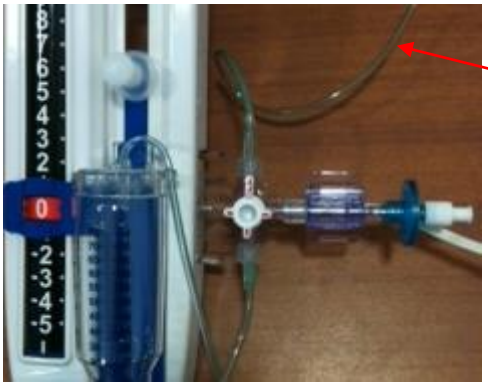
1. Wash hands, don apron and gloves.
2. Clean trolley with a universal sanitising wipe and allow to air dry.
3. Remove apron and gloves and wash hands.
4. Don apron and gel hands.
5. Ensure 3 way tap is off to the port on the EVD, remove bung and spray with 0.5% Chlorhexaidine Gluconate w/v in 70% alcohol and allow to dry.
   surgical
6. Using a surgical ANTT open sterile pack and equipment protecting key parts.
7. Gel hands and don sterile gloves.
8. on the EVD On sterile field, Ddraw up 5 mls of normal saline into the 10ml syringe, attach to transducer and prime the transducer until saline drips from opposite end.

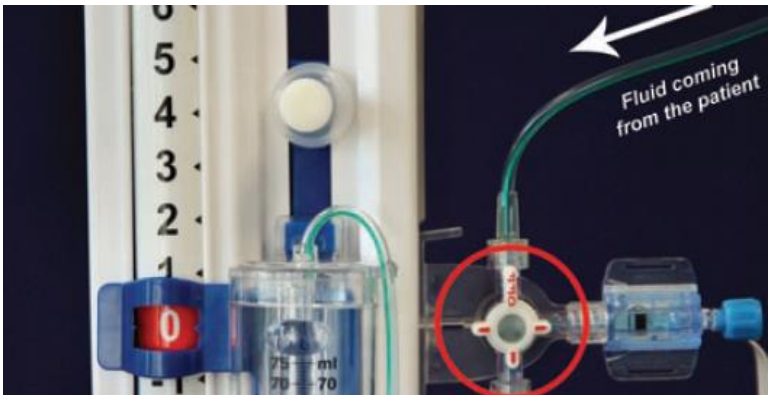
9. Connect open end of transducer to open port of EVD set.
10. Remove syringe from transducer.
11. Attach filter then white bung.
12. Dispose of waste as per trust policy.
13. Wash hands.
14. Connect transducer cable to transducer and monitor.



3.4 Zeroing Transducer

1. Ensure zero and transducer are level with the external auditory meatus of the patient.
2. Ensure 3 way tap next to transducer is off to the patient.
3. Lower chamber to zero position.
4. Remove bung using standard ANTT leaving filter connected to EVD port ensuring key parts are protected.
5. Press zero on monitor ensure monitor display is reading is zero. Replace bung and raise EVD to prescribed height.
7. Ensure EVD is reopened at the closed 3 way tap.





cribed level.

ing ‘off’ label faces the drain chamber.
open ports of 3 way tap are open to the
v).

3.5 CSF Sampling

The decision to take a sample should be made in conjunction with a consultant.

Indications

1. Suspected infection
1.2. Turbid CSF
2.3. Prior to insertion of a permanent drainage system (eg VP shunt)

These samples should be discussed with the laboratory technician to be analysed urgently. The sample should be sent to the Freeman microbiology laboratory by taxi ASAP.

Please note that routine CSF sampling from an EVD is no longer recommended.

Sampling Technique (Nursing Staff)

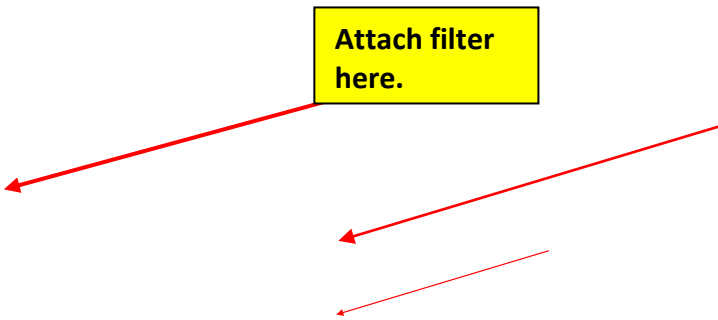
2 competent members of staff. (One “sterile sampler”, one “clean assistant”)
Dressing trolley
Sterile Dressing pack
One 10ml syringe
Sterile universal container x2
Grey topped vacutainer bottle.
Sterile gloves x 2 pairs (if not in dressing pack)
0.5% Chlorhexidine Gluconate w/v in 70% Alcohol spray.
New sterile bung for injection port

1. Clean trolley with universal sanitising wipe and allow to air dry.
2. A surgical ANTT must be adhered to at all times.
3. Sample must be taken from the “sampling” port below the drain chamber.
4. Assistant opens outer wrapping of dressing pack.
5. Sampler opens inner sterile wrapping to expose contents of pack and create key part.
6. Assistant provides equipment required for procedure using principles of ANTT.
7. Sampler applies sterile gloves from dressing pack.
8. Assistant removes bung using a standard ANTT, sprays sampling port at 3 way tap with 0.5% Chlorhexidine Gluconate w/v in 70% Alcohol and allows to dry (The exposed, open port of the patient line 3 way tap is a 'key-part' in this procedure.)
9. Attach 10 ml syringe to port and turn 3 way tap off to the drainage bag and aspirate CSF. Return sampling port 3 way tap to off position facing drainage chamber.
10. Apply sterile bung
11. Place 2mls of CSF in each of 3 containers. One universal container should be sent for microscopy, gram stain and C&S. A universal container and a grey topped vacutainer bottle should also be sent to biochemistry for protein and glucose.
12. Dispose of equipment inline with trust waste management policy.

3.6 Weaning from EVD

Although there is little evidence of superiority over abrupt/intermittent calmping, current practice is to wait for clinical stability then to sequentially raise the EVD over several days (eg 5cm/day) then after managing at 25cm to clamp and transduce the EVD for 24 hours prior to removal.
Weaning failure is suggested by neurological deterioration associated with an ICP >20mmHg or a CT scan showing hydrocephalus – these patients need an ongoing period of CSF diversion and may require a VP shunt.

3.7



Removal of an EVD

1. The decision to remove the drain is a medical one. It is likely to be successful when:
   - The patient has tolerated a challenge & the volume of CSF drainage has been within acceptable limits.
   - The CSF drainage pathways are free of obstruction.
   - The CSF is clear of infection.
   - The CSF is not heavily blood stained.

2.T The drain may be clamped and transduced for a predetermined length of time i.e. 12 –24 hours prior to removal.

Equipment

Trolley
Dressing Pack
Sterile gloves if not in pack
Stitch cutter
Apron
Dressing
Stitch
Suture Pack
Gauze

1. Clean trolley with universal sanitising wipe and allow to dry.
2. Don apron and wash hands.
3. Assistant opens dressing pack.
4. Doctor applies sterile gloves, and assistant opens other sterile equipment.

5. Using surgical ANTT take waste bag from the dressing pack, place hand inside bag and using bag remove EVD dressing, once removed, invert bag.
6. Using forceps and stitch cutter remove stitch.
7. Take 2 pieces of sterile gauze, one over the EVD entry site and one to hold the EVD with slow and steady traction remove the catheter; as the tip emerges there may be a spurt of CSF this can be stopped by applying direct pressure with a sterile gauze swab for a few seconds.
8. A stitch is required to ensure skin closure and prevent ongoing leakage of CSF.
9. Apply occlusive dressing to site.
10. Dispose of waste as per trust policy.
11. Document procedure in patient notes.

3.8 3.Using a strict surgical ANTT, Rremove the dressing and the sutures.

4. With a slow and steady traction remove the catheter as the tip emerges there may be a spurt of CSF this can be stopped by applying direct pressure with a sterile gauze swab for a few seconds. A stitch is required to ensure skin closure and prevent ongoing leakage of CSF. Apply a sterile occlusive dressing.

CComplications of External Ventricular Drains

1. Infection

   - As the catheter has direct passage to the brain there is an increased risk of infection/meningitis. Studies demonstrate an incidence of about 8-10%s between 2-25% (Average of 10 % .. See attached ref).
   -
   - Infection should be considered where there is pyrexia, neurological deterioration, neck stiffness, photophobia or raised inflammatory markers. None of these signs are specific and may be attributable to causes other than CNS infection. Infection may also be relatively asymptomatic.

   For diagnosis/management – see below

2. Haemorrhage related to insertion
   - Often asymptomatic but tract haematoma is reported to occur in approx. 3.5%
   - Extra-axial or IVH in 1.5%
   - Coagulopathy should be corrected prior to insertion of EVD/LD.

3. Blockage

   - Blockage of the catheter is indicated by a lack of drainage of CSF or a lack of oscillation of the CSF meniscus in the drainage system with respiration
   - If there is no swinging in the system then the EVD is blocked and hydrocephalus may develop.
   - The neurosurgical registrar should be contacted to review urgently to decide on flushing or replacement.
   - If the line requires flushing this should be performed by a trained competent health care practitioner. This procedure is requires an surgical aseptic techniqueANTT.

4. Leakage around wound/skin exit site

   - Leakage is a significant risk factor for infection. The neurosurgical registrar should be informed.
   - A plan to If the patient is drain dependant and the leakage persists then the EVD should be remove or changed the EVD within the next 24-48 hours should be made within the next 24-48 hours.

5. Overdrainage

   - Excessive drainage (>30ml/hour) may collapse the ventricles pulling the brain away from the dura, which , may rupture bridging blood vessels and result in a sub dural haemorrhage or ingress of air through any breach in the skull.
   - The neurosurgical registrar should be contacted to review urgently and consideration given to elevating the level of the drain.

6. Accidental cutting of the catheter

   - Clamp the catheter that remains attached to the patient with non traumatic clamps (forceps) to prevent uncontrolled free drainage CSF from the patient.
   - Wrap the cut area of the catheter that remains attached to the patient in a sterile towel.

- Inform the neurosurgical team **immediately.**

7. Accidental removal of the catheter

   - Inform the neurosurgical team **immediately.**
   - Cover site with an occlusive dressing.

3.9

CSF Sampling

Routine Surveillance Sampling

The aim of this is to detect drain colonisation which may be a precursor to developing an infection.

A baseline sample should be sent off from theatre immediately after insertion. Thereafter routine samples should be sent off onon day 4 and every 48 hours thereafter.

Efforts should be made to dispatch all routine samples together by 10am on the hopper to the Freeman. This will ensure we get the results back by 3pm the same day.

Urgent Sampling

Indications

1. Suspected infection
2. Turbid CSF

These samples should be discussed with the laboratory technician to be analysed urgently. The sample should sent to the Freeman microbiology laboratory by taxi ASAP.

Sampling Technique

2 competent members of staff. (One “sterile sampler”, one “clean assistant”)
Dressing trolley
Sterile Dressing pack
Two 5-mlOne 2ml and one 10ml syringe (2)s

Sterile universal container x2
Grey topped vacutainer
Sterile gloves x 2 pairs (if not in dressing pack)
0.5% Chlorhexidine Gluconate w/v in 70% Alcohol spray.
20.5% Chlorhexidine spray
NNew sterile cap for injection port

ClClean whole trolley with general purpose detergentuniversal sanitising wipe. and aDry. well and follow with a 70% alcohol wipe over the entire surface.

1. A strict aseptic no touch sterile technique (ANTT) must be adhered to at all times.
2. Sampling must be carried out by health care professionals who are trained and assessed to be competent in the procedure.
3. Samplinge must be taken from the most proximal “sampling” bung (under the drain chamberclosest to the patients head.)

"Clean aAssistant" opens outer wrapping of dressing pack and exposes inner sterile wrapping in order that "sterile sampler" can remove it aseptically.

"Sterile sSampler" opens inner sterile wrapping to expose contents of pack and create sterile fieldkey part.

Assistant provides equipment required for procedure using principles of ANTT.

Sampler applies sterile gloves from dressing pack.

Assistant removes bung using a standard ANTT, sprays sampling port at 3 way tap with 0.5% Chlorhexidine Gluconate w/v in 70% Alcohol and allows to dry (The exposed, open port of the patient line 3 way tapstopcock is a 'key-part' in this procedure.)

Attach 10 ml syringe to port and turn 3 way tap off to the drainage bag and aspirate CSF.

Return sampling port 3 way tap to off position facing drainage chamber.

Apply sterile bung

Place 2mls of CSF in each of 3 containers. One universal container should be sent for microscopy, gram stain and C&S. A universal container and a grey topped vacutainer bottle should also be sent to biochemistry for protein and glucose.

Dispose of equipment inline with trust waste management policy.

4.

"Clean assistant" provides equipment required for procedure in aseptic manner

"Sterile sampler" applies sterile gloves from dressing pack (double glove for cleaning)

4. Spray bung with 2% chlorhexidine spray and allow to dry.

5.Open sterile pack, 1 green needle and 5 ml syringe.

6.Put on apron and wash hands. Dry hands and put on sterile gloves.

"Sterile sampler" cleans sampling port 3 way tap with 0.5% chlorhexidine for 20 seconds and allows to dry for 2030 seconds minimum (The exposed, open port of the patient line stopcock is main 'key-part' in this procedure. The only time it should be touched directly is when being cleaned. Adopt non-touch technique at all other times.)

"Sterile sampler" removes and discards outer pair of sterile gloves.

Use 2ml syringe to SLOWLY aspirate 2ml of CSF and discard.

Use 10ml syringe to SLOWLY aspirate 6ml of CSF. Return sampling port 3 way tap to 'onoff' position.

Place new sterile cap over port.

12. Place 2ml CSF in each of the 3 containers. One universal container should be sent for microscopy and gram stain,C&S. A universal container and a grey topped vacutainer should also be sent to biochemistry for protein & glucose. Using a sterile gauze swab open first clamp under the drain chamber.

Assistant returns main system stopcock to 'on' position to allow CSF drainage

8.Using the needle and syringe aspirate CSF through the bung under the drain chamber carefully draw off 5 ml of CSF and discard. Carefully draw off another 5ml.

9.Remove needle and put CSF into a universal containers and replace the lids.

10.Replace clamp on EVD, dispose of sterile field and wash hands.

11.Samples should be sent for wet microscopy and gram stainM,C&S, protein & glucose.

Record telephonic results from the lab in the patient's notes /results' sheet and inform the ITU doctor

Investigation & Management of VentriculostomyDrain Related Infection **(should this be EVD catheter related infections ?) (I sthere a ref for using DRI ?)**

Refer to appendices I-IV: Appendix 1 for routine surveillance sample
Appendix 2 for urgent sample/suspected infection
Appendix 3 for surveillance definitions for drain related infections

Explanatory notes:

Clinical signs such as fever, headache, meningism, reduced conscious level, cranial nerve signs or irritability are non-specific but alert to the possibility of a problem. In the event of neurological deterioration patients should have a CT with contrast to identify whether there is any meningeal or ventricular enhancement which may support a diagnosis of drainventriculostomy related infection.

CSF microbiological evaluation is the most important investigation. No single parameter can reliably predict or exclude drainventriculostomy-related infection (VDRI.) Gram's staining has a high specificity but a low sensitivity in comparison to culture. Because the results of the CSF white cell count may be confounded by intraventricular hemorrhage, the "cell index" was introduced as a new parameter for the diagnosis of EVD-related infection. This is based on the hypothesis that intraventricular hemorrhage simply leads to dilution of CSF with blood.

The results of the CSF white cell count is frequently confounded by intraventricular haemorrhage. For a lumbar puncture CSF specimen Aa rough guide is 1 WBC: 500 RBC. and a CSF WCC > 5 10/mm3 would be considered abnormal in the absence of haemorrhagic contamination. (This applies to CSF from LPs only ??). One off values of samples from EVDs are non specific as the WBC population varies over time and may adhere to the EVD itself. One off values of samples from EVDs however are non specific as the WBC population varies over time and may adhere to the EVD itself. The "cell index" was introduced as a new parameter for the diagnosis of EVD-related infection. This is based on the hypothesis that intraventricular hemorrhagehaemorrhage simply leads to dilution of CSF with blood. A rise in cell index > 5 may precede positive cultures.
(Ref ?)

If there is a strong clinical suspicion of DVRI then empirical broad spectrum antibiotic therapy should be commenced as soon as appropriate cultures have been taken (CSF, blood, urine, respiratory.) Consideration should be given to stopping at 72 hours if the results of CSF culture are negative.

Empirical therapy for DVRI is: mMeropenem 2g tds and lLinezolid 600mg bd.
Discuss with microbiologist. Reviewed at 72 hours with the results of cultures.

3.10 Microbiological Definitions

A steadily rising cell index in the context of clinical deterioration and/or an abnormal biochemical profile may be supportive of a "**suspected VDRI**."

A positive Gram's stain should prompt an immediate repeat sample. If repeat sampling is considered essential between 12 midnight and 6 am then this can be discussed with the oncallon call microbiologist as the benefit of plating out ahead of 9am can be controversial. In the context of routine surveillance if the repeat sample is negative, the cell index is normal and cultures are negative at 48h the initial findings likely represented a **contaminant.**..

A persistently positive Gram's stain indicates either drain colonisation or drain related infection. These can be differentiated by the results of the ancillary investigations.

Drain colonisation usually precedes drain related infection by 24-48 hours.

DrainDrain colonisation is best treated by removal of the colonised drain. Drain colonisation can be “contained” for a limited period of time with intrathecalintraventricular thecal (I feel ‘thecal’ site needs to be specified – can this be IVT ?) antibiotics alone but efforts should be made to ascertain the patients dependence on the drain as removal is not always possible in those that remain drain dependant. A decision should be made by the patient’s neurosurgical consultant to remove/change the drain within 2448 hours of identifying colonisation.

VentriculostomyDrain related infection (ventriculo-meningitis) requires intravenous antibiotic therapy usually for 10-14 days. The drain will also be colonised so treatment is unlikely to be successful whilst the drain remains in situ. Drain dependant patients should receive additional intra ventricular thecal (IVT ?) t hecal antimicrobial therapy and a decision regarding timing of EVD change made. The duration of intraaventricular thecal (IVT)thecal therapy and the timing of definitive CSF diversion is dictated by the response of the infection to treatment & discussion with the microbiologists.

3.11

Administration of Intraventricular tthecal (IVT)thecal Antibiotics

The administration of intraventricular antibiotics is primarily the responsibility of the neurosurgical SpR or SHO once competencies have been completed. It is the responsibility of nursing staff to assist with this procedure once competencies have been completed

Administering intraventricular antibiotics is a high risk procedure and if not carried out correctly has the potential to introduce additional infection. Therefore only personnel trained and deemed competent to perform and assist in this procedure may do so. Doctors must not attempt to do this procedure alone – an assistant is necessary to preserve the sterile fieldprotect key parts, key sites and micro-critical aseptic fields and this procedure must be carried out using a strict surgical aseptic non-touch technique.

Technique

- Intraventricular thecal (IVT) antibiotics need to be given a competent healthcare professional
Ensure vancomycin and/or aminoglycoside pre-filled syringes have been ordered from pharmacy
Dressing trolley. Clean whole trolley with general purpose detergent (GPD)Clinell wipe and allow to dry.
- Intrathecal antibiotics need to be given by a competent healthcare professional.
- Ensure vancomycin and/or aminoglycoside pre-filled syringes have been ordered from pharmacy
- Sterile dressing pack.
- 1 x 2ml, 1 x 5ml & 1 x 10ml syringes and 1 x green needle.
- 0.5% Chlorhexidine 0.5% sprayChlorhexidine Gluconate w/v in 70% Alcohol wipespray.
- 1 pair of sterile gloves and 2 aprons (1 for doctor and 1 for assistant)PPE for Doctor, assistant uses standard ANTT equipment.
- Sterile saline for injection ampoule for flush.
- New sterile capbung for injection port.

1. Don apron and gloves.
2. Clean trolley with universal sanitising wipe and allow to air dry.

Dressing pack
Two 5-ml syringes
Sterile gloves (if not in dressing pack)
2% Chlorhexidine spray
3 x green needles

3. Take prepared trolley to bedside.
4. Remove gloves and apron and wash hands. Don new apron, gel hands.
5. Check correct patient, correct drug, expiry date, dose, route against prescription.
6. Inspect antibiotic - check no crystallisation or precipitation of drug in syringe.

7. Assistant opens outer wrapping of dressing pack and exposes inner sterile wrapping. in order that doctor can remove it aseptically.
8. Doctor opens inner sterile wrapping to expose contents of pack and create sterile field protecting key parts.
9. Doctor applies apron and sterile gloves assistant ties apron.

10. Assistant provides equipment required for procedure in aseptic manner – sterile gloves, syringes and needle, chlorhexidine, new sterile capbung, antibiotic in pre-filled syringe adhering to surgicalprinciples of ANTT.
    Doctor applies sterile gloves
11. Doctor draws up appropriate volume of sterile saline in 5ml syringe for flush (see table over – aim for discarded 2ml + 6ml sample = antibiotic + flush) and purges air from flush syringe.
12. Assistant washes hands and applies gloves.
    Doctor applies sterile gloves from dressing pack (double glove for cleaning)
13. AssistantDoctorAssistant turns off EVD at main system 3 way tap (see diagram on drainage set page 2),.
14. Doctor removes and discards cap from CSF access 3 way tap and holds EVD system firmly on either side of CSF access 3 way tap.
15. Doctor cleansAssistant sprays CSF access 3 way tap port – firstly the exposed, open port, then the tap and then at least 5cm either side of 3 way tap with 0.5% chlorhexidine gluconate w/v in 70% alcohol wipe for 20 seconds and allows to dry for 230 seconds minimum..
16. Assistant holds line at the maximum distance able from the port to prevent contamination from environment.
    Doctor removes and discards outer pair of sterile gloves.
17. Doctor positions sterile towel from dressing pack under sampling 3 way tap.
18. Use 2ml syringe to SLOWLY aspirate 2ml of CSF and discard.
19. Use 10ml syringe to SLOWLY aspirate 6ml CSF, use for sampling if necessary.
20. Attach antibiotic syringe to sampling 3 way tap and SLOWLY inject antibiotic via port.
21. SLOWLY flush through with saline from 2nd syringe.
22. Leave CSF access stopcock in 'off' position for one hour.
23. Place new sterile cap over port / injection site.
24. Discard equipmentwaste as per trust policy appropriately.
25. Document administration on prescription chart and in medical notes.

1. 21. Ensure nurseassistant notes that drain must remain 'off' for one hour. NurseAssistant returns sampling 3 way tap to 'on' position after one hour to allow EVD to drain (open sooner if neurological deterioration.)

1. Check correct patient, correct drug, expiry date, dose, route.
2. Check no crystallisation or precipitation of drug in syringe
3. Wash hands and prepare sterile field
4. Spray EVD port nearest patient with 2% chlorhexidine spray.
5. Turn off the 3 way tap to the drainage system
6. With sterile syringe and green needle withdraw CSF from port through the bung. The CSF volume should equal the volume of drug and flush to be instilled.
7. Attach green needle onto drug syringe and inject drug slowly (over 2 minutes) into the EVD via bung, withdraw a similar volume as in (6) mid way through then return to patient (Barbotage)
8. Follow with a flush of saline.
9. Clamp EVD at 3 way tap nearest to patient for one hour & observe patient.
10. Dispose of equipment.
11. Wash hands.
12. Remember to unclamp the drain after 1 hour (sooner if neurological deterioration.)

Observe for any adverse reactions during the procedure, e.g. seizure, rigor,, vomiting, drop in GCS - should any of these occur stop the procedure immediately and seek senior help.

If **two** intraventricular antibiotics are prescribed an interval of **two hours** is required **between the two antibiotics**

1) Take CSF specimens
2) Administer 1st antibiotic
3) Leave drain 'off' for 1 hour
4) Allow EVD to drain for 1 hour
5) Give 2nd antibiotic

Aim for CSF removed to = antibiotic + flush

Intraventricular thecal (IVT) Antibiotic Therapy

Seek advice from a microbiologist.

Table 7. Recommended dosages of antimicrobial agents administered by the intraventricular route (A-III).

Antimicrobial agent	Daily intraventricular dose, mg
Vancomycin	5–20[a]
Gentamicin	1–8[b]
Tobramycin	5–20
Amikacin	5–50[c]
Polymyxin B	5[d]
Colistin	10
Quinupristin/dalfopristin	2–5
Teicoplanin	5–40[e]

NOTE. There are no specific data that define the exact dose of an antimicrobial agent that should be administered by the intraventricular route.

[a] Most studies have used a 10-mg or 20-mg dose.
[b] Usual daily dose is 1–2 mg for infants and children and 4–8 mg for adults.
[c] The usual daily intraventricular dose is 30 mg.
[d] Dosage in children is 2 mg daily.
[e] Dosage of 5–10 mg every 48–72 h in one study [112].

Amphotericin B variable

Miconazole 5-6mg/day

ıl) - do we ever check ? (Ref ?)

Dosages have been determined empirically with adjustments made on the basis of the concentration of the agent in the cerebrospinal fluid.

Subsequent doses can be determined by measuring the trough concentration in a sample of cerebrospinal fluid obtained immediately before the infusion of the next dose.

The trough concentration divided by the minimal inhibitory concentration of the agent for the isolated bacterial pathogen should generally exceed 10 to 20 for consistent sterilization of the cerebrospinal

4 Training, implementation, resource implications

If two intraventricular antibiotics are prescribed an interval of two hours is required between the two antibiotics

Take CSF specimens
Administer 1st antibiotic
Leave drain 'off' for 1 hour
Allow EVD to drain for 1 hour
Give 2nd antibiotic

Aim for CSF removed to = antibiotic + flush

Training will predominantly be delivered by the nurse educator on ward 18 and senior medical staff within ward 18 and neurosurgery. Patients with an external ventricular drain will usually be managed on ward 18.

5 Monitoring

Regular audit should be carried out on EVD care bundle adherence and complication rates.

6 Evidence Review

The evidence reviewed can be found in the reference section below

7 References

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Removal of an EVD

1. The decision to remove the drain is a medical one. It is likely to be successful when:
- The patient has tolerated a challenge & the volume of CSF drainage has been minimal.
- The CSF drainage pathways are free of obstruction.
- The CSF is clear of infection
- The CSF is not heavily blood stained. (some criteria here might be useful ?).

2. The drain may be clamped for a predetermined length of time i.e. 12 –24 hours prior to removal.

3. Remove the dressing and the sutures

4. 4. With a slow and steady traction remove the catheter as the tip emerges there may be a spurt of CSF this can be stopped by applying direct pressure with a sterile gauze swab for a few seconds. A stitch is required to ensure skin closure and prevent ongoing leakage of CSF. Apply a sterile occlusive dressing.

CSF Analysis Results

Cerebrospinal fluid findings in central nervous system infections

	Cell count (cells/mm^3)	Glucose	Protein
Bacterial meningitis	Elevated (100–5000) PMNs predominate	Decreased	Elevated
Viral meningitis	Elevated (10–500) Lymphocytes predominate	Normal	Elevated
Fungal meningitis	Normal to elevated (0–500) Lymphocytes predominate	Normal to decreased	Elevated
Tuberculous meningitis	Normal to elevated (0–1000) Lymphocytes predominate	Decreased	Elevated
Brain abscess	Normal to elevated (0–500) Mixed differential	Normal	Elevated
Ventriculitis	Elevated (100–5000)* PMNs predominate	Decreased	Elevated

Abbreviation: PMNs, Polymorphonuclear leukocytes.

* In postneurosurgical patients or patients with a ventriculostomy, the cerebrospinal fluid (CSF) cell count may be elevated as a result of surgical manipulation and inflammation. Reduction in CSF glucose may be a more sensitive indicator of infection.

Data from Lewin JJ, LaPointe M, Ziai WC. Central nervous system infections in the critically ill. Journal of Pharmacy Practice 2005;18(1):25–41.

CS

$$\text{Cell index} = \frac{\text{WBC}_{\text{CSF}}\,[\text{mm}^3] \div \text{RBC}_{\text{CSF}}\,[\text{mm}^3]}{\text{WBC}_{\text{blood}}\,[\text{mm}^3] \div \text{RBC}_{\text{blood}}\,[\text{mm}^3]}$$

Fig. 1 Calculation of the cell index [31] in patients with hemorrhagic CSF

[1] Har Keong, Nicole Chwee; Bulters, Diederik O.; Richards, Hugh; Farrington, Mark; Sparrow, Owen; Hutchinson, Peter J., Pickard, John Douglas; Kirkpatrick, Peter J. The SILVER Trial. Neurosurgery 2010;67(2): 549

Vincent – Comments on Appendices

- Both flow charts rely on an early Gm stain result – something we don't always get reliably. Are all CSF samples treated as urgent specimens by microbiology
- The guideline does not state who has responsibility for ensuring results are looked at on a surveillance day
- A negative Gm stain but raised WC/ protein is common on surveillance specimens when there may be minimal clinical suspicion at that time. There is no path to follow on the surveillance flowchart – i guess action depend on degree of clinical suspicion
- There is nowhere on the guideline a reference to actual WCC values. Was this deliberate to confine to the terms "elevated/ rising" I personally think that some comment on actual values may be useful and to draw attention to difference between this a clean LP sample taken in a different setting.

Manju – comments on appendices

Appendix 2 – need to decide either EVD infection (at the top) or DRI – can't be both terminologies.

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