DEPARTMENT OF CLINICAL NEUROSCIENCES

WESTERN GENERAL HOSPITAL

EXTERNAL VENTRICULAR DRAINAGE WORKBOOK AND COMPETENCIES

External Ventricular Drainage Education and Competencies

External Ventricular Drainage (EVD) is used as a temporary measure to manage acute hydrocephalus.

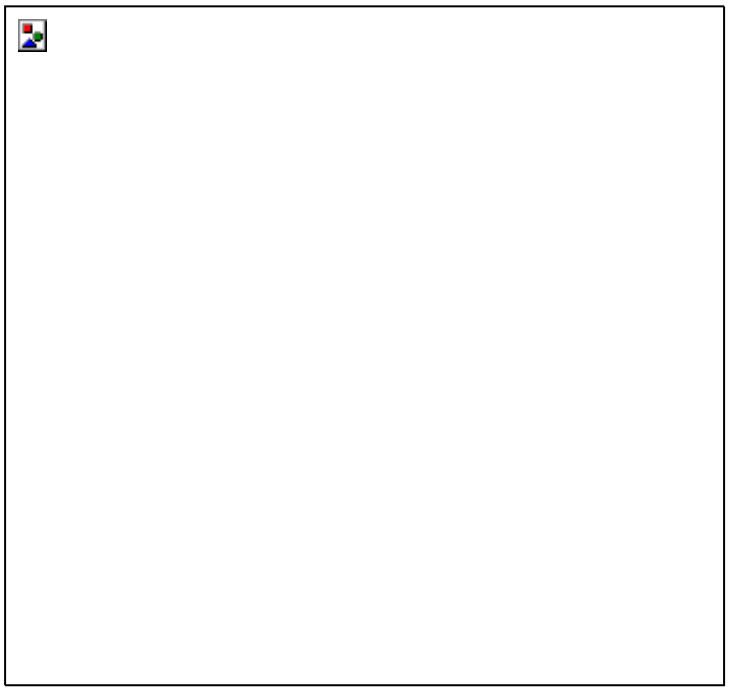
This work book has been written to explain what an EVD is, why is it used and how to care for it.

To understand why EVD is used we need to understand about normal anatomy and physiology.

Anatomy and Physiology

Cerebrospinal fluid (CSF) is a protein-poor serous plasma filtrate that is secreted by choroid plexus cells in each of the four ventricles of the brain and circulates through the ventricles, the central canal of the spinal cord, and the subarachnoid space, then returns to the blood stream at the arachnoid villi. It functions as a shock absorption fluid cushion for the brain and spinal cord as well as a secondary circulatory fluid delivering oxygen and nutrients to the nervous tissue.

Subarachnoid space the space in the meninges covering the brain and the spinal cord located beneath the arachnoid membrane and above the pia mater which contains the cerebral-spinal fluid.



The **ventricles** are a series of four interconnecting cavities of the brain.

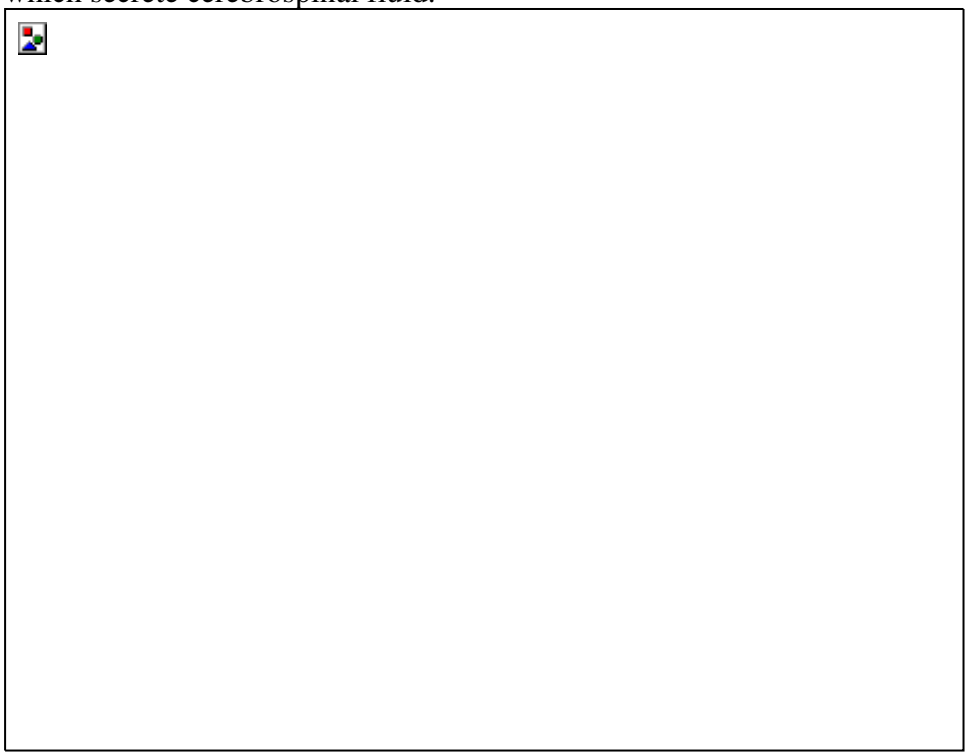
Lateral ventricles are the largest pair (right and left) of ventricles of the brain they are irregular in shape and have projecting horns. They are located in the interior of the cerebral hemispheres they contain choroid plexus which secretes CSF which then circulates through them and passes to the third ventricle. The CSF passes through the **foramen of Monro** to reach the third ventricle.

Third ventricle of the brain is a narrow and vertical space within the thalamus of the diencephalon that receives CSF from the lateral ventricles and passes CSF on via the cerebral aqueduct to the fourth ventricle; contains choroid plexus which secretes CSF.

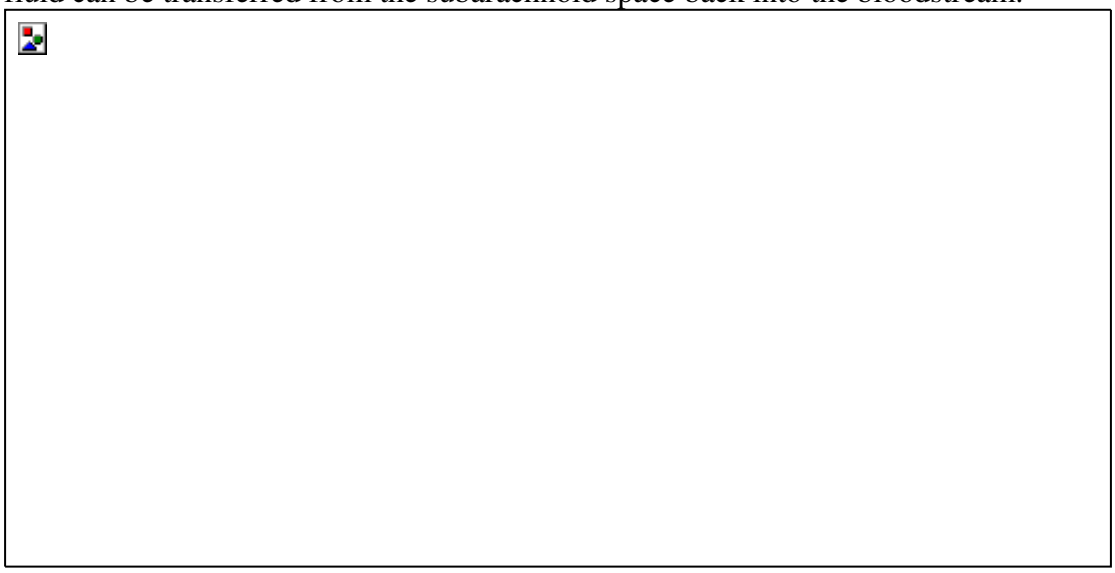
Aqueduct of Sylvius the canal connecting and transporting CSF from the third to the fourth ventricle which is located in the midbrain.

Fourth ventricle once the CSF is in the fourth ventricle it then flows through the two **foramen of Luschka** which allows the CSF to flow around the brain and the single **foramen of Magendie** which directs the CSF to the spinal cord.

Choroid plexus are delicate leaf like processes that float but are attached to the inside of the ventricles. They consist almost entirely of blood vessels, which project into each of the four ventricles of the brain they are lined by specialized ependymal cells which secrete cerebrospinal fluid.



Arachnoid villi are finger-like projections of the arachnoid membrane which project into the cranial venous sinuses within the dura mater along the major fissures of the brain where they are in close proximity to the venous blood and where cerebrospinal fluid can be transferred from the subarachnoid space back into the bloodstream.



Dural sinuses (veins) a series of large, somewhat irregular, blood-filled venous spaces with roughly triangular cross-sections which are located within the dura mater where the dura follows the contours of the major fissures of the brain; typically there are four major dural sinuses, the superior sagittal, straight, and two transverse sinuses; these venous spaces are the locations for the arachnoid villi through which CSF is reabsorbed to be returned to the venous blood supply of the brain.

Blood-brain barrier a physiological mechanism that alters the permeability of brain capillaries, so that some substances, such as certain toxins and drugs are prevented from entering the brain, while other substances are allowed to enter freely.

The **Monro-Kellie hypothesis** states that the skull is a rigid compartment filled to capacity with non-compressible substances – blood, brain and CSF. If one or more of the substances increases a rise in the pressure within the skull will occur unless another component decreases in volume.
Intra-cranial pressure (ICP) is thus affected directly by any changes in volume of CSF within the brain. These changes in volume may be the result of:

(a) Change in the rate of production of CSF
(b) Obstruction to the flow of CSF within the ventricular system
(c) Change in rate of absorption of CSF.

Problems associated with production, flow or absorption of CSF can cause increased ICP and may be an indication for setting up of External Ventricular Drainage (EVD).

Ventricular Access Devices (VAD's) and ventricular catheters are inserted by a Neurosurgeon in the operating theatre under sterile conditions and then attached to the EVD. Generally the site chosen will be 1cm anterior to the coronal suture, 2-3cm from the midline over the non-dominant hemisphere.

The site is shaved and following an initial incision a drill is used to create a small burr hole opening the skull. The dura is opened and the arachnoid and pia membranes are cauterised. A stylet is used to introduce the ventricular catheter into the frontal horn of the lateral ventricle. The stylet is removed once the catheter is in place and this may then be sutured at the insertion site or tunnelled beneath the galea for 4-5 cm and exit at a separate scalp site. In DCN, Ventricular Access Devices (VADs) are more commonly used than ventricular catheters (the principal is exactly the same). Advantages of this are that the VAD can stay in place under the skin of the patient and be used again if required in the future. This is especially useful in patients who have had shunts inserted and may require pressure monitoring if shunt failure or CSF sampling if infection is suspected.

Nursing care and management of patients with EVD

The nursing care and management of patients with EVD is predominantly aimed at preventing the occurrence of complications. It is essential that the medical staff give prescribed parameters based on patient assessment and these parameters are documented clearly.

The EVD system is suspended by an adjustable cord from an IV drip stand placed at the head of the bed, this drip stand should be labelled for EVD use only, and IV fluids **should not** be hung from this drip stand, EVD should not be hung from wall mounted drip stands.
The height of the EVD is prescribed by the medical staff in cm's of H20.
The drainage of CSF depends upon gravity; the level of the chamber will determine the amount of CSF drained. The zero point for the EVD system is the location of the foramen of Monro, which is equal to the external auditory meatus. It is important that this zero point is measured with a spirit level and not by eye – laser levels are available in the ward areas. Next the nurse must adjust the height of the drip chamber until it is set at the prescribed level. It is the difference in the height between the patient's ventricles and the drip chamber that creates both a pressure gradient and a safety valve. The height of the drip chamber equates to the ICP. This pressure must be reached before any CSF will drain into the drip chamber. The nurse must regularly check the level of the drain, referring back to the zero point, to ensure that the patient has not altered position. In the event of the patient moving or needing to be moved for care purposes the drain should **ALWAYS** be switched off and re-zeroed before recommencing drainage. Where possible it is essential to educate the patient and visitors about the importance of not moving without the drain being clamped.

The drains are changed on Monday, Wednesday and Fridays by the Clinical Nurse Practitioners' or the medical staff, the band 6 staff nurses are all competent in resiting the EVD if they become dislodged or accidentally pulled out by the patient. The bag may be emptied or changed (when ¾ full) using a strict aseptic technique if required.

Complications Associated with EVD

Inadequate drainage of CSF may cause the ventricles to enlarge with subsequent rises in ICP, this may occur if the EVD system is placed too high above the level of the foramen of Monro thus minimising CSF drainage or if CSF drainage is obstructed, this may occur if tubing is kinked or inadvertently clamped. Excessive drainage of CSF may also occur if the system is placed too far below the level of the foramen of Monro. This excessive drainage may cause the ventricles to collapse and pull the brain tissue away from the dura. This can result in subdural haemorrhage.

Infection is also a complication of EVD. Maintenance of a closed system is essential only those who have been trained to do so and passed competent should change the drainage system. Ward staff should report any signs of infection to the medical staff so as CSF sampling can take place and anti-biotic prescribed if required.

Observations

Vital signs and neurological observations including the GCS must be recorded at least hourly for patients with EVD in the acute phase of their illness (NHDU). On the ward 4 hourly vital signs, (temperature is essential) and neuro obs are required for patients with an EVD in situ and the EVD should be checked hourly to ensure that it is patent and draining, this should be recorded on the fluid balance chart. The amount of CSF drained should be recorded on the fluid balance chart with a running total for the day, significant changes in the amount of CSF drained (increasing or decreasing) should be reported to the medical staff. Normal CSF is crystal clear, often due to haemorrhage CSF is blood stained and if infected can be straw coloured if there are changes to the colour of CSF medical staff need to be informed.

Lumbar Drains

Lumbar drains work on the same principal as the EVD drain and are set in cm's of H20 as well. The zero point may vary depending on the CSF drainage required and the patient's position in bed. The medical staff must be consulted to determine the zero point and it should be clearly documented in the notes. The same hourly checks of the drain are required as well as the same 4 hourly observations especially temperature.

References:
(The following images and documents have been used in the compilation of this document)

Image for Arachnoid Villi taken from
http://vanat.cvm.umn.edu/neurHistAtls/pages/men3.html#top
(Accessed 29 December 2011)

Image for Choroid Plexus taken from
http://www.southalabama.edu/alliedhealth/biomedical/311Anatomy/Chapter13.pdf
(Accessed 21 December 2011)

Image for Human Ventricular System taken from
http://science.howstuffworks.com/environmental/life/human-biology/brain9.htm
(Accessed 29 December 2011)

External Ventricular Drains – Guidelines for Nursing Care Neuro Intensive Care Unit Leeds (2002).

Critical Care Competency Framework NHS Lothian

SUPERVISED PRACTICES AND FINAL OBSERVED ASSESSMENT OF COMPETENCE

Management of External Ventricular Drainage

		Supervised practices				
Criteria No.	**ASSESSMENT CRITERIA** Assessor to initial achievement for each criterion.	**1**	**2**	**3**	**4**	**Final Assessment**
1	Explain the rationale for insertion of EVD.					
2	Explain the main functions of EVD.					
3	Describe the importance of rationale/observation/checking of:					
	(i) Zero point					
	(ii) Height of drain chamber					
	(iii) Observation of CSF (i) amount (ii) colour					
	(iv) Cessation of drainage					
	(v) Increase in drainage					
	(vi)Observation of signs of infection					
4	Wash hands and put on PPE					
5	Explain to patient what you are going to do					
6	Does the patient display/complain of any symptoms of poor drainage or infection					
7	Observe drain is it swinging?					
8	Is the drain zeroed correctly?					
9	Switch drain off					
10	Observe CSF in chamber – using criteria above					
11	Empty CSF from chamber					
12	Record on Fluid Balance Chart – patency of drain, & volume of CSF					
13	Switch drain back on					
14	Dispose of PPE and ensure comfort of patient					

For **Supervised Practices only**, please could assessors date & initial on completion				

NHS LOTHIAN COMPETENCY STATEMENT

External Ventricular Drainage

ASSESSOR statement:

I confirm that ……..has achieved the required competence for the Management of External Ventricular Drainage
Signature of assessor:……..

Name (print):…….. Position:……..

Date of completion……..

I will maintain my competency in this area of practice in accordance with the NMC Code (2008) and will demonstrate my ongoing competence to a clinical work-based assessor as required by NHS Lothian.

Signature……Print Name:……

Title/Grade
……

Clinical area
……....

Date of completion……..
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MANAGER statement:
I confirm that the above participant has met the required standard of competence for the Management of External Ventricular Drain and therefore can undertake the role of Management of External Ventricular Drainage in practice.

Signature of manager/charge nurse:…….

Print:……Position……
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Date…….
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