Caring for neurosurgical patients with external ventricular drains

Hydrocephalus is a medical emergency and its treatment involves inserting an external ventricular drain (EVD) into one of the lateral ventricles of the brain to remove excess cerebrospinal fluid (CSF). This article explains how the drains work and discusses key nursing considerations for their management.

Key points
- Hydrocephalus, an excess of cerebrospinal fluid, is a medical emergency as it raises intracranial pressure
- Excess fluid can be removed from the brain by an external ventricular drain
- Patients with EVDs need to have cerebrospinal output monitored hourly
- EVDs carry a high risk of infection, so nurses need to maintain asepsis and regularly assess patients
- Assessing patients’ consciousness is crucial to identify neurological deterioration early

Author Emily Humphrey is staff nurse (mental health), neurosciences department, surgical division, Nottingham University Hospitals Trust.

Abstract External ventricular drains are life-saving devices used in neurosurgical patients with hydrocephalus (excessive amounts of cerebrospinal fluid). The fluid is produced in the brain ventricles and circulates around the brain and spinal cord, protecting them from injury and supplying brain cells with nutrients. Hydrocephalus can occur due to impaired circulation or malabsorption and is a medical emergency, which can lead to raised intracranial pressure. Nurses are responsible for the care of patients who have external ventricular drains. This article explains how the drains work and discusses key nursing considerations for their management.

Citation Humphrey E (2018) Caring for neurosurgical patients with external ventricular drains. Nursing Times [online]; 114: 4, 52-56.
Tumours of the choroid plexus, which are rare, can cause overproduction of CSF (Woodward and Mestecky, 2011).

A medical emergency
Hydrocephalus, from any cause, needs to be treated urgently as it can cause increased pressure in the ventricles (either by build-up of CSF around an obstruction or by blood increasing the overall circulating volume in the ventricles and subarachnoid space). Increased ventricular pressure equates to increased intracranial pressure (ICP) in the skull overall (Sakka et al, 2011).

Raised ICP is critical because it reduces blood flow to the brain, starving it of oxygen, glucose and other vital substances. Due to the limited space in the skull, untreated ICP will eventually lead to brain herniation, a medical emergency in which the brain shifts into any available space – usually downwards. It descends into the opening at the base of the skull, crushing the structures of the brain stem and impeding the vital functions they control, such as respiration and heart rate (Woodward and Mestecky, 2011).

EVD insertion
Hydrocephalus is temporarily treated by insertion of an EVD. Also known as an external ventriculostomy (Hammer et al,
The collection chamber and pressure scale hang side by side. Pressure is measured in millimetres of water pressure (cmH₂O). The scale includes both positive and negative measurements; zero corresponds to the pressure where the catheter enters the ventricle, and should always be horizontally level with the tragus of the patient’s ear (Fig 4) (Woodward and Waterhouse, 2009).

When the patient is lying on one side, this anatomical reference point becomes the bridge of the nose (Woodward and Mestecky, 2011). It is a key nursing responsibility to ensure that zero on the pressure scale is level with the patient’s tragus at all times (Woodward et al, 2002).

The number above (or below) the zero point is the prescribed pressure level of the EVD determined by the neurosurgical team (Woodward et al, 2002). In the patient’s brain, this pressure level corresponds to the amount of pressure that must be inside the ventricles before the CSF drains into the catheter. In the external drainage system, it corresponds to the height at which the collection chamber hangs.

If the collection chamber hangs from a higher point, it will drain CSF from a higher pressure in the ventricles than one hanging from a lower point. The prescribed pressure level must be documented, and the collection chamber must be checked frequently to ensure it is neither too high (which would cause under-drainage of CSF) nor too low (which would cause over-drainage) (Woodward and Waterhouse, 2009).

“External ventricular drains can appear daunting, but they are a rewarding aspect of patient care”

Problems associated with EVDs

Infection

The insertion of an EVD is a highly invasive procedure and carries a significant risk of infection (Muralidharan, 2015; Chatzi et al, 2014; Wong, 2011); this risk increases the more frequently it is accessed by health professionals to obtain CSF samples (Jamjoom et al, 2017), and the longer the EVD is kept in situ (Camacho et al, 2010). Touching EVD components, such as the stopcock or drainage bag, must be an aseptic procedure and handling must be kept to a minimum (Woodward and Waterhouse, 2009).

A sterile, closed drainage system should be maintained and the entry site dressing...
Over- and under-drainage

It is crucial to monitor EVDs meticulously, ensuring the zero point on the scale is horizontally level with the patient’s tragus and that the prescribed pressure level is correct. If CSF drains at a higher pressure it will cause under-drainage and lead to raised ICP, signs of which include:

- Reduced level of consciousness indicated by a decline in Glasgow Coma Scale score;
- New weakness in any of the limbs;
- Headache;
- Changes in pupil size and equality;
- Vision changes (including double or blurred vision);
- Oedema of the optic disc (papilloedema);
- Changes in vital signs (Woodward and Mestecky, 2011).

Neurological and vital signs should be observed at least every four hours as above and CSF output documented hourly on a fluid balance chart (Woodward et al, 2002). Signs of under-drainage should be reported immediately to the neurosurgical team.

Equally damaging for the patient is over-drainage, which can collapse the ventricle, pulling the brain tissue away from the dura, tearing cortical veins and leading to subdural haematoma (Woodward and Waterhouse, 2009). Over-drainage can be prevented by ensuring that the CSF is not draining at a lower pressure than that set by the neurosurgeon.

Over-drainage of CSF can be caused by increased pressure inside the ventricles. Straining to pass faeces can increase intraventricular pressure, so it is important to ensure patients with EVDs maintain regular bowel habits using stool softeners.

Drainage should be turned off at the collection chamber before any intervention involving patient movement, such as suctioning, walking, physiotherapy and repositioning in bed – all of which can increase intraventricular pressure.

Drainage at the collection chamber is turned off by turning the stopcock so that it points ‘north’ (upwards). It can be helpful to visualise the stopcock as obstructing CSF flow into the drainage bag when it is pointing north and associate ‘off’ with the stopcock pointing north. As soon as the intervention is finished, the stopcock should be turned to point ‘west’, turning the drainage system back on again (Fig 3). Drainage should not be turned off for longer than needed, as this can cause the catheter to block.

Early signs of over-drainage include headaches, and the neurosurgical team should be notified urgently if the rate of drainage exceeds 10ml per hour or a total
of more than 30ml drains in one hour (Woodward et al, 2002).

When the patient is being transferred, the EVD system must remain in an upright position and not be left lying flat on the bed, as this will impair drainage (Woodward et al, 2002).

Trauma and haemorrhage
Although they are life-saving devices, EVDs are not without risk. Lewis et al (2015) suggest there is a link between EVDs and delayed hydrocephalus in patients with subarachnoid haemorrhage, arguing that the drain may interrupt CSF flow and slow down clearance of debris from bleeding, which can impair CSF absorption by the arachnoid villi.

EVDs themselves can cause trauma and therefore lead to haemorrhage in the ventricles (intraventricular haemorrhage), or in functioning brain tissue (parenchymal haemorrhage) (Dash et al, 2016), as well as to aneurysm rupture (when a weakened part of a cerebral blood vessel bursts) (Muralidharan, 2015).

Placement of the drain can cause the dura mater to pull away from the overlapping skull bones and Dash et al (2016) report the case of a patient developing a haematoma above the dura (epidural haematoma) after EVD placement. Grandhi et al (2015) report a case of EVD placement causing a pseudoaneurysm (where blood collects between the two outer layers of an artery) of a major cerebral artery; they also cite evidence that EVDs can cause arteriovenous malformations (AVMs), which are abnormal connections between arteries and veins. Aneurysms and AVMs carry a major risk of rupture and bleeding.

Nurses need to be vigilant for signs of trauma, which is another reason why neurological and vital observations should be performed frequently. They also need to:

- Alert the neurosurgical team immediately if previously clear CSF is blood-stained;
- Cohort or provide one-to-one care to confused or agitated patients to prevent accidental removal of the EVD;
- Regularly check that the catheter is swinging: a patent catheter will gently swing but a catheter that is not swinging at all could indicate that it is blocked by clotted blood or tissue debris;
- Regularly check that the catheter is not kinked: this can cause a blockage.

A blocked catheter needs immediate medical attention; the neurosurgical team may need to irrigate it, remove any haematoma or remove the EVD altogether.

Due to the risks of intracranial haemorrhage (haemorrhage anywhere in the brain), prophylactic anticoagulants prescribed for deep vein thrombosis may be contraindicated in patients with an EVD in situ. Nurses must check the local policy and raise any concerns with the neurosurgical team.

Conclusion
Box 2 lists what to monitor and document, while Box 3 features a range of competencies relating to the safe care and management of patients with an EVD in situ. Although these drains can appear daunting, with an understanding of their key elements and function they are a rewarding aspect of patient care.

References