



4-2009

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Recommended Citation

Hayat, Ansar; Rodrigues, Desi; Crawford, Peter; and Mendelow, David (2009) "External Ventricular Drains — Can Morbidity be Reduced," *Pakistan Journal of Neurological Sciences (PJNS)*: Vol. 4 : Iss. 1 , Article 2.

Available at: <https://ecommons.aku.edu/pjns/vol4/iss1/2>

EXTERNAL VENTRICULAR DRAINS - CAN MORBIDITY BE REDUCED

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Pak J Neurol Sci 2009; 4(1):1-3

ABSTRACT

Objectives: External ventricular drain (EVD) catheters are of major importance in the treatment of patients with head trauma, subarachnoid haemorrhage (SAH), and other causes of increased intracranial pressure (ICP). Although these catheters are used frequently they are not without complications which can at times be life-threatening. Although CSF infection is a considered a major cause of EVD-related morbidity, we have identified other factors contributing to the morbidity of these patients and we propose ways to minimize these problems. **Methods:** Patients who underwent EVD insertion between 1st May 2006 and 30th Oct 2006 were included. Treatment records of 50 patients were reviewed - 35 retrospectively and 15 prospectively. Indications for placement of EVDs were recorded. The main use of the drain was to monitor ICP and prevent secondary hydrocephalus in SAH, IVH, posterior fossa bleed, head trauma, shunt blockage, and administration of intrathecal antibiotics. **Results:** Ages of patients ranged from 1.5 years to 85 years; 27 (54%) were females and 23 (46%) were males. Prophylactic antibiotics were used in 70 % of cases. Average duration of drain was 5.9 days. Image guidance equipment was used in one case only. The ventricles were reached with first pass in 48 %, 2% with 2nd pass and 2% with 4th pass, while this information was not available for the remaining cases. In the 42 (84%) cases where post operative images were available, 9(21%) had the EVD in a suboptimal position. Where CSF analysis was available, WBC count was >100 in 21 (50%) and the organism was isolated in 13 (30%). Overall 20 different incidents of minor or major complications were identified and the common ones included EVD blockage in 7, leak of CSF from EVD site in 4, infection in 6, and EVD-related hemorrhage in 3 cases. **Conclusion:** A written protocol for EVD insertion, nursing and surveillance should be implemented. Regular CSF specimens should be sent for analysis while the EVD is in place. If image guidance is not used during the procedure, at least one post-operative scan should be obtained within 24 hours of insertion of the drain. Malposition of EVD is not uncommon (21%) and image guidance should improve this.

External ventricular drain (EVD) catheters are of major importance in the treatment of patients with head trauma, subarachnoid haemorrhage (SAH), and other causes of increased intracranial pressure (ICP). These catheters provide reliable means of monitoring ICP and controlling elevated pressure by draining cerebrospinal fluid (CSF). Benefits derived from placement of an EVD catheter, however, can be offset by catheter-related complications, the frequency of which remains unclear. Common complications include infections, CSF leak, EVD-related hemorrhage, and malposition.^{1,2,3} They are associated with significant morbidity and mortality.

Various suggestions have been made for inserting and managing EVDs, but to our knowledge there is no standard protocol in common use. We carried a retrospective review of all cases that underwent EVD catheter placement over a six-month period in order to establish the current practice, identify complications, and make changes so as to improve outcomes.

METHODS

Hospital records of all patients having EVDs for a period of 6 months from May 2006 to October 2006 were

reviewed. Details of indication, procedure documentation, duration of EVD, sampling and antibiotic prophylaxis were collected.

RESULTS

A total of 50 patients with available records had EVD insertion during this period, of which 27 (54%) were females and 23 (46%) were males. Median age was 56.5 years (2-85 years). Prophylactic antibiotics were used in 70 % of cases, including those already on antibiotics for some other reason. However, in 30% there was no record of the prophylactic antibiotics used. In most cases, cefuroxime was the agent of choice.

Common indications for EVD insertion were monitoring of ICP in hydrocephalus secondary to subarachnoid hemorrhage or intraventricular hemorrhage, space occupying lesions, traumatic brain injury, posterior fossa bleed or surgery, and shunt blockage or infection. In 8 (16%) cases it was also used for intrathecal antibiotic administration.

Average duration of drainage was 5.9 days (2 - 13). Image guidance in the form of stereotaxy was used in only one case. The procedure was performed in 86% cases by registrars, 6% by consultants, and 8% by senior house officers. The number of attempts to hit the ventricle was documented in only 52 % of cases. Most of the time (92%), the ventricles were accessed at first pass, while multiple passes were needed in 8% cases. Although it was the protocol to tunnel all drains subcutaneously for at least 5 cm, details about tunnelling were not available in 22 (44%). The drain was secured with stitches in 70% cases (in the remaining 30% this information was not recorded). Post-EVD imaging was performed in 84% and in 16 % there was not a single post-operative image available. Post-operative scans were not necessarily performed to check the position of the EVD. However, where available, imaging revealed that in 21% drain placement was suboptimal. EVD-related hemorrhage was identified in 20% of patients. Forty-two (84%) cases had at least one CSF analysis of which 21 (50%) had an elevated white cell count; a positive CSF culture was found in 13 (30%).

Almost 20 incidents of some kind of complication related to the EVD were noted. Most of these complications were minor, including EVD blockage in 7 and CSF leakage from the EVD site in 4; however, some were serious such as evidence of infection in 6 and evidence of EVD-related hemorrhage in 3 cases. It should be noted that CSF leakage and infection were inter-related and similarly hemorrhage could lead to blockage of the drain. The duration of EVD in these patients ranged from 4 to 9 days.



Figure 1: A post-operative CT scan documenting drain position.

DISCUSSION

External ventricular drain catheters are of major importance in the treatment of patients with head trauma, subarachnoid hemorrhage, and other causes of increased intracranial pressure. They are also considered a gold standard for ICP monitoring. However, although a minor procedure, it is not without complications, which to a certain extent are avoidable.

Our study revealed a significant number of complications related to this procedure, which could be reduced if a proper standard protocol of EVD insertion and management is adhered to. Proper technique and detailed note-keeping is mandatory for any study being conducted retrospectively. This was lacking, as noted in our observations, especially with reference to tunnelling, drain fixation, and frequency of sampling.

Blockage of the EVD was the commonest complication noted in our series and this was mainly attributed to blood load in the CSF or malpositioning of the drain. To our knowledge, no study has so far acknowledged this as a major problem. We presume that studies have usually concentrated on complications such as CSF infection and drain duration.^{4,5} To overcome this problem we recommend image-guided placement of the catheter (either brainlab, ultrasound, or stereotaxy) which should help placement of the catheter in the optimum position.

Should there be blood load, one can use saline irrigation to clear the blood, although thrombolytics have also been used to disintegrate clots.⁶

Although laboratory parameters suggested the possibility of infection in almost 30% (based on CSF cell count and inflammatory markers), clinical evidence of infection was confirmed on cultures and the clinical condition of the patient in only 12% of cases. This could not be attributed to the duration of the EVD, but a clear link was seen with infection and leak of CSF. Other authors have also found that longer duration of EVD does not increase the incidence of EVD-related infection.⁴ However, tunneling and prophylactic antibiotic usage may reduce the infection rate.^{1,7} In our series, 70% patients had prophylactic antibiotics. Prophylactic antibiotics should be used in all cases unless they are already on board for some other reason.^{8,9} The use of antimicrobial-impregnated EVD catheters can significantly reduce the risk of catheter-related infections.¹⁰ The EVD should be tunneled at least 5 cm away from the wound as suggested by some ongoing trials.⁷ We too followed this standard, but no documentation was made in the patient's case notes in 44% cases.

There is a correlation between positive CSF cultures with the increased CSF cell count. Increasing CSF cell count should lead to the suspicion of bacteriological drainage contamination.¹¹ CSF sampling should be undertaken using strict aseptic precautions and should be repeated no shorter than every 72 hours unless clinically indicated.¹¹

Although the clinical evidence of hemorrhagic complications due to EVD placement is present in only a few cases, radiological evidence showed that the incidence is more common than expected (20%). If image guidance is not used during the procedure one would recommend at least one post-operative scan in the 24 hours following the insertion of the drain. Catheter gauge has an effect on the size of hematoma.²

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