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Clinical Study

External ventricular drain infections at the Canberra Hospital: A retrospective study

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ABSTRACT

External ventricular drains (EVD) are crucial for the emergency management of hydrocephalus and raised intracranial pressure. Infection is the most morbid and costly cause of EVD malfunction and can cost up to $50,000 US to treat per case. In 2007, Canberra Hospital changed EVD management protocols requiring set-up of EVD transducer systems in theatre, cessation of prophylactic antibiotics after 24 hours, cerebrospinal fluid (CSF) samples second or third daily and discontinuation of elective EVD changes. The current study aimed to retrospectively audit EVD inserted between 2006 and 2010 in order to determine the impact of these changes. There was a non-significant downward trend in infection rates from 20.93% to 11.50% (p = 0.343) after the protocol changes. Patient age (OR = 1.032, p = 0.064, confidence interval (CI): 0.998–1.067) and sex (OR = 1.405, p = 0.595, CI: 0.401–4.917) were not significantly associated with infection. However, multiple drains were associated with a significant increase in infections rates (OR = 21.96, p = 0.001, CI: 6.103–79.023) and systemic perioperative antibiotic prophylaxis was associated with decreased rates of infections (OR = 0.269, p = 0.044, CI: 0.075–0.964). Our study showed a non-significant downwards trend in infections with introduction of changes to hospital protocol and illustrated some risk factors for infection in the Australian setting.

1. Introduction

External ventricular drains (EVD) are a fundamental aspect of the emergency management of increased intracranial pressure and hydrocephalus. They are a mainstay of treatment for a variety of intracranial pathologies in the paediatric and adult settings and 40,000 EVD are estimated to be inserted annually in the US [1]. There are several causes of EVD malfunction including haemorrhage, malposition and infection. EVD infection is the most morbid and financially costly aetiology of EVD malfunction [2]. Observed rates of EVD infection have been extremely variable in the literature, with studies observing infection rates ranging from 0% to 22% in adults [3] and 5% to 15% in children [4]. Recent studies in adults estimate a narrower range of 1% to 12% [1,4–7] worldwide with recent Australian data showing an infection rate of approximately 11% [6]. EVD infections are associated with increased morbidity and mortality as well as increased length of hospital admission, returns to theatre and a consequent increase in the cost of treatment [4]. In children, EVD infection has been linked to reduced intelligence quotient (IQ), seizures, psychomotor impairment and subsequent shunt failure [4]. The cost of treating EVD related infections has been estimated to be as high as $50,000 US per infection [4,8]. Attenello et al. [4] found that the cost to treat 38 shunt infections in the paediatric setting over a 5.5 year period was $1,841,256 US. This makes EVD associated infections the most expensive implant related infection to treat per patient [2].

Due to their economic cost, morbidity and mortality, there has been a concerted effort to identify and minimise risk factors for EVD infection and to implement strategies to combat EVD associated infections. This includes the introduction of antibiotic impregnated EVDs [9], systemic antibiotic prophylaxis [10–12], and the introduction of protocols designed to curb infections [13]. There is conflicting evidence on the relationship between drain duration and infections. Lo et al. [6] found that monitoring duration was not related to infections per day, which discourages elective revision. Holloway et al. [14] observed the risk of infection to increase daily, initially peaking at 10 days, after which infection became very unlikely with the exception of a smaller population of patients who remained at risk. Ratilal et al. [10] undertook a Cochrane

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systematic review and found the use of systemic antibiotic prophylaxis and the use of antibiotic-impregnated catheters were associated with a decrease in shunt infection and found no benefit to elective shunt revision. Fried et al. [13] recommended that whether EVDs are placed in theatres or at the bedside should be dictated by patient and clinical factors, given there is very little evidence to suggest that placing an EVD outside of theatres leads to increased rates of infection. However, they note that the existing evidence is low-quality [15,16] and there is a lack of conclusive evidence comparing EVD insertion in theatre and by the bedside.

In 2007, changes to the EVD management protocol at Canberra Hospital were made, including connection and setting up of an EVD transducer system in theatre, cessation of prophylactic antibiotics after 24 hours, taking cerebrospinal fluid (CSF) samples second or third daily and no longer routinely changing of EVD. The current study aimed to audit all EVD inserted between 2006 and 2010, prior to and after the introduction of changes to EVD management, in order to compare the EVD infection rate pre and post introduction of changes. In addition, we assessed modifiable factors that can affect infection rate.

2. Methods

Institutional ethics approval was granted from the Australian Capital Territory (ACT) Health Human Research Ethics Committee to undertake a retrospective descriptive study. Individual patient consent was not sought given that this would be impractical due to the retrospective nature of the study and that contacting the families of deceased patients could cause unnecessary psychological distress.

The study included all patients with EVDs inserted between 2006 and 2010 at Canberra Hospital, a 672 bed tertiary-level centre that caters to a population of approximately 550,000. Data was collected on patient age, sex, indication for EVD, EVD duration, any EVD changes and the indications for those changes. We also collected data on perioperative antibiotic usage, EVD infections and the causative organism where one was identified. EVD infection was defined as positive microbial growth from a CSF sample. This was chosen as fever, inflammatory markers and CSF cell counts may be unreliable in intensive care unit patients and are not specific for shunt infections [3,17].

Data was collected and linked from local records, including the Clinical Information Record System, Concerto Portal, ACT Pathology Clinical Integration System and Neurosurgical Audit Database. Data were entered into and analysed with Microsoft Excel (Microsoft Corporation, Redmond, WA, USA). Univariate analysis was performed using chi-squared tests for equal proportion and student t-tests.

3. Results

153 patients were retrospectively identified as having undergone at least one EVD insertion between 2006 and 2010. The patient population was divided into two groups, 2006 to 2007, corresponding to the pre protocol change period, and 2007 to 2010, corresponding to the post protocol change period. Table 1 shows the demographic data of the two groups.

Across the 43 patients treated pre protocol change and the 110 patients treated post protocol change there were 69 and 141 EVD inserted, respectively. This consisted of 28 and 88 patients with a single EVD, six and 21 patients with two EVD and nine and three patients with three or more EVD respectively. Figure 1 shows the indications for EVD insertion in the two groups and Figure 2 shows the indications for EVD changes.

Table 1
Demographic data on patients who received external ventricular drains in Canberra Hospital in 2006 to 2007 and 2007 to 2010

Demographics	2006–2007	2007–2010
Number of patients	43	110
Median age (range)	56 (19–87)	53 (12–81)
Sex		
Male (%)	14 (32.6)	74 (67.2)
Female (%)	29 (67.4)	36 (32.8)

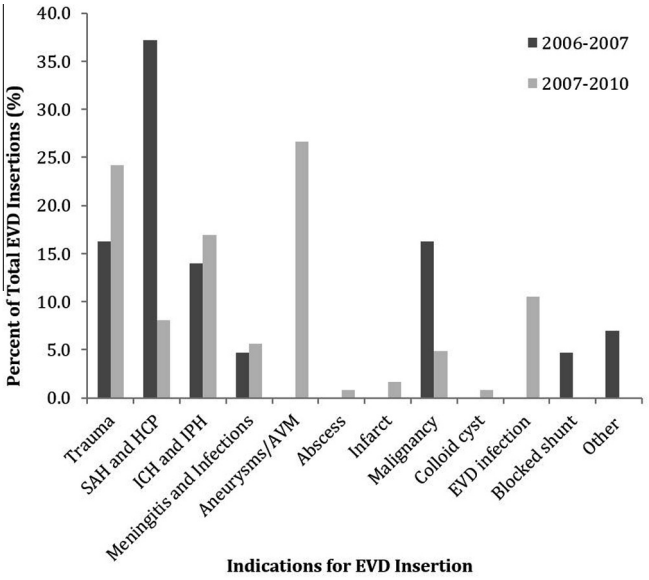

Fig. 1. Indications for initial external ventricular drain (EVD) insertion in 2006 to 2007 and 2007 to 2010. AVM = arteriovenous malformation, HCP = hydrocephalus, ICH = intracerebral haemorrhage, IPH = intraparenchymal haemorrhage, SAH = subarachnoid haemorrhage.

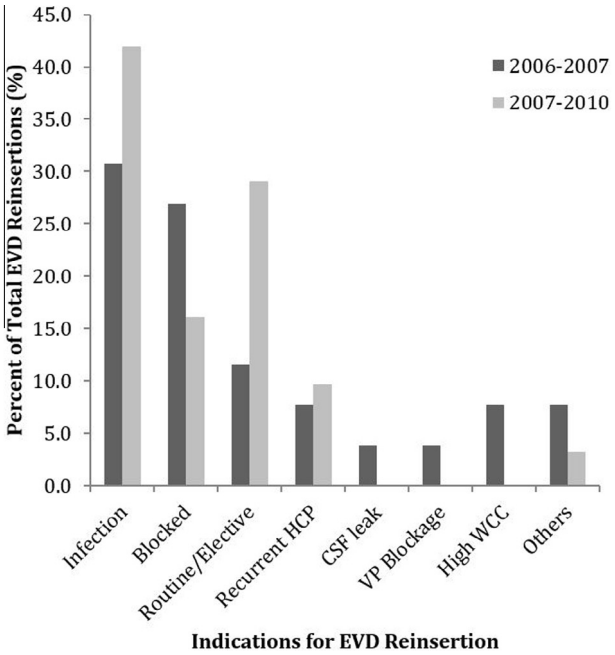

Fig. 2. Indications for subsequent external ventricular drain (EVD) changes in 2006 to 2007 and in 2007 to 2010. CSF = cerebrospinal fluid, HCP = hydrocephalus, VP = ventriculoperitoneal, WCC = white cell count.