Ventriculo-Peritoneal Shunt Infections in Infants and Children

Bokhary MM Aly[1] and Kamal HM[2]

1 Department of Neurosurgery
2 Department of Pediatrics. King Fahad Hofuf Hospital, Hofuf, Saudi Arabia.

Abstract

Objective: To determine the rate and the type of ventriculoperitoneal (VP) shunt infections in infants and children admitted to King Fahad Hofuf hospital of Al-Ahsaa area at the Eastern Province of Saudi Arabia. **Methods**: From mid 2003 to end of 2006; VP shunt infection episodes were reviewed. Once infection was suspected, a cerebrospinal fluid (CSF) sample was taken and empirical antibiotics were recommended. Once infection was confirmed, VP shunt was removed and external ventricular drainage (EVD) was inserted until CSF became sterile after which a new shunt was inserted. **Results:** 25.9% of patients with VP shunts had infections which represents 29.3% of the procedures. 40% of infected patients had recurrent episodes. 59.1% of infections occurred throughout the first two months following insertion. Single pathogen was isolated in each episode. Pseudomonas auerginosa represented 50% of isolated pathogens compared with 18.2% with Staphylococcus epidermidis. **Conclusions:** There is a high incidence of VP shunt infections in King Fahad Hofuf hospital when compared with other international centres. Gram negative organisms are the most common cause of the infection.

Key words: shunt, infections, CSF, ventriculoperitoneal, infants, children

Introduction

Infection is a common complication of ventriculoperitoneal shunt (VP) placement [1]. It occurs in nearly 10% of patients [2,3,4]. Shunt infections generally occur within the first two months after surgery and Staphylococcus epidermidis is the most common cause [5]. When a shunt infection is suspected, percutaneous needle aspiration of the shunt reservoir is usually diagnostic [6]. The preferred treatment of CSF shunt infections involves intravenous antimicrobial therapy, surgical removal of the infected shunt, installation of an external ventricular drainage (EVD) device, and insertion of a new shunt once the CSF is sterile [5.[

The aim of this retrospective study is to determine the rate and the type of VP shunt infections in infants and children admitted to Neurosurgical and Paediatric Departments at King Fahad Hofuf Hospital (KFHH) of Al-Ahsaa area in the Eastern Province of Saudi Arabia. This hospital is the only referral centre for pediatric neurosurgical cases in this area.

Patients and methods

Over a three-and-a-half year period from mid 2003 till the end of 2006, 58 infants and children with hydrocephalus (30 girls and 28 boys) were subjected to 75 VP shunt procedures. VP shunt infection was suspected by two or more of the following clinical findings: fever, recurrent vomiting, poor feeding, depressed consciousness, irritability, seizures, and bulging tense anterior fontanel. Once infection was suspected, CSF (from shunt reservoir or from ventricular tapping), blood, and urine samples were taken in addition to other sepsis work up (full blood count, estimation sedimentation rate, C- reactive protein, full blood biochemistry, arterial blood gases, and chest x-ray.(

Empirical antibiotics were then commenced pending culture and sensitivity results. Computerized tomography (CT) scanning of the brain was also considered. Once CSF infection had been confirmed, VP shunt was removed and EVD inserted until 3 CSF successive samples became sterile and its protein content got back to normal. A new shunt was then inserted. Ethical approval was gained before collection of patient data.

Results

Fifteen patients (25.9%), 8 girls and 7 boys, had 22 shunt infection episodes (29.3%). Table (1) shows ages of procedures and times of infections.

Table 1 Ages of procedures and time of infections

Age of 1st procedure		Times of infection (after procedure)	
1d-1m	7	1st 2 m	13
1m-6m	6	2m-1y	6
>6m	2	>1y	3
Total	15	Total	22

Table 2 Original causes of hydrocephalus. Six patients (40%) had more than one episode of shunt infections within one month after shunt insertion.

Original cause of hydrocephalus	
IVH	6 (40%)
Isolated aquiduct stenosis	4 (26.7%)
Postmeningitic	3 (20%)
Aquiduct stenosis and spina bifida	2 (13.3%)
Total	15 (100%)

Table 3 A single pathogen was found in each episode of infection. Gram negative bacteria (GNB) represented the vast majority of pathogens (17 episodes, 77.3%) while S. epidermidis was isolated in only 4 episodes (18.2%). Concomitant blood and urine cultures showed no growth in all patients.

Type of organism	No and %
Pseudomonas Auerginosa	11 (50%)
Enterococcus faecalis	4 (18.2%)
Staphylococcus Epidermidis	4 (18.2%)
Serratia Merescens	1 (4.5%)
Haemophilus influenza	1 (4.5%)
Candida Albicans	1 (4.5%)
Total	22 (100%)

The usual empirical antibiotics used were Ceftazidime plus Cloxacillin or Vancomycin plus Ceftazidime. With established sensitivity, Ceftriaxone was used in 1 episode of infection (Haemophilus influenza), Piperacillin plus Gentamicin in 1 episode (Pseudomonas), Amphotericin B in 1 episode (Candida), Ceftazidime in 4 episodes (Pseudomonas), Meropenam in 6 episodes (4 with Enterococci, 1 with Serratia and one with Pseudomonas) and Vancomycin in 9 episodes (4 episodes with S. epidermidis and 5 episodes with Pseudomonas).

The median duration of intravenous antibiotics treatment was 10 days after CSF being culture negative as well as clinical improvement (usually between 14 - 21 days). The patient with candidal infection was given Amphotericin B therapy for a total of 25mg/kg for 30 days; followed by oral fluconazole for one month.

Intraventricular antibiotics with Gentamicin or Vancomycin for 5 days was tried in 7 episodes (3 with Serratia, 2 with Enterococcus faecalis and 2 patients with S. epidermidis). One episode of P. auerginosa ended with death from septic shock 5 days after commencing conventional plus intraventricular therapy.

Two patients, one with candidal infection and another with Enterococcus infection, were treated with anticonvulsant medication (phenobarbitone). Beside the above mentioned; short term morbidity (3 months after recovery from infection) particularly neurological disability was not significantly different from age-and-sex matched patients with VP shunts and did not develop CSF infections.

Discussion

It was suggested that the real incidence of infected shunts might be higher than what had previously been suspected in cases of malfunctioning shunts because shunts, when removed, frequently showed microbial growth [7]. In our study, infected removed shunt tubes (in case of malfunction) were not considered as clues for shunt infection. That if was not associated with positive CSF culture and clinical features suggestive of VP shunt infection; because of high possibility of contamination of these tubes. This is in agreement with opinions expressed in pervious studies [8].

The incidence of VP shunt infections in our study was relatively high (25.9%) compared to many other studies where the rate of infection varies from 3.2-17% [6,9-13]. GNB represented 81.3% of pathogens in our study compared to 7-20% in other studies [9,11,14]. In contrast, gram positive bacteria (all were S. epidermidis) were isolated in 12.5% in our study compared to 47-80% in other studies [9,10,11,13,14]. Patients with hydrocephalus secondary to IVH or meningitis were the most infected with GNB (8 patients, 13 infection episodes) or Candida (1 patient). This might be explained by impaired local resistance resulting from past infection or hemorrhage. Though GNB infections can be associated with poor prognosis, there was one case death in our study. Other patients did not show neurological damage after 6 months of the onset of infection. These results are compatible with a previous study by Stamos et al. [15] who concluded that patients with GNB CSF shunt infections often present relatively well clinically and they can be successfully treated. In this study, the high prevalence of GNB infections was not only noticed in patients with VP shunts, but also in the majority of cases with postoperative sepsis particularly related to intestinal and urologic diseases. Despite the strict anti-infectious protocols followed in all hospital areas particularly within the operating rooms and intensive care units, resistant strains of GNB particularly P. auerginosa and Klebsiella have been emerging. Empirical abuse of antibiotics, particularly second and third generation cephalosporins, within most of the medical centres in the area is likely to be the main cause of the high rate of GNB infection.

It was known that incomplete shunt removal is associated with an unacceptably high failure rate [14]. Therefore, removal of the infected shunt in addition to optimal antibiotic coverage were the cornerstones in the management of VP shunt infections in our patients. The empirical antibiotic treatment always considered coverage of Pseudomonas and Staphylococcus infections. Vancomycin was the most used antibiotic (40.9%) followed by Meropenam (27.3%). It could be suggested that initial empirical combination of Ceftazidime and Vancomycin is a proper choice considering the types of infecting pathogens and patterns of microbial resistance. Previous studies had nearly the same suggestions as ours, third generation Cephalosporins and Vancomycin in one study, [10] Vancomycin and flucloxacillin in another [16].

Intraventricular antibiotic therapy for VP shunt infections was addressed in several reports. Swayne et al., [16] reported good results in using intraventricular Vancomycin in patients who had gram positive cocci in CSF cultures. Forwards et al. [14] used intraventricular antibiotics in 4 patients with success. Fan-Harvard and Nataha [5] recommended the use of intraventricular antimicrobial therapy if the risks associated with surgery are high or if ventriculitis is persistent and refractory to systemic antimicrobial therapy. However, in our study, the impact of intraventricular antibiotic therapy was unclear regarding the time for clinical improvement and duration of the therapy.

It could be concluded that King Fahad Hofuf hospital has a high incidence of VP shunt infections compared with other international centres, with an unexpectedly higher prevalence of gram negative infections particularly P. auerginosa infections. Removal of shunt is mandatory in all patients with infected VP shunts. The combination of Vancomycin and Ceftazidime as empirical treatment could be useful in the majority of infections.

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