Management of Ventriculo-Peritoneal Shunt Infections

Miraj us Siraj, Samina Iltaf, Roohina Saeed

ABSTRACT

Objective — *To analyze etiology, clinical features, pathogens, mortality and morbidity, and modalities of treatment for ventriculo-peritoneal (VP) shunt infections.*

Study design — *Descriptive case series.*

Place & Duration of study — *Study was carried out in the department of Neurosurgery, Foundation University Medical College Rawalpindi, from June 2003 to June 2008.*

Methodology — *The record of 5 year period was reviewed. The data were evaluated for etiology of hydrocephalus, age, clinical features, microbiological parameters, management and clinical outcome of VP shunt infections.*

Results — *A total of 149 patients were operated for ventriculo-peritoneal shunt. Majority (n 128 – 86%) were below the age of 5 years. Twenty-one (14 %) of the operated patients were admitted with symptoms of shunt infection. Four (19%) of the infected patients had throat infection/gastroenteritis rather than shunt infection. Six (29%) patients were treated conservatively with intravenous antibiotics. Eleven (52%) of the infected patients had removal of shunt and insertion of external ventricular drain (EVD) with periodic CSF sampling and culture sensitivity (CS) and delayed shunt replacement. Five (3.3%) of VP shunt patients died with shunt infection and septicemia. Commonest causative microorganism identified were staphylococcus epidermidis, staphylococcus aureus and gram negative bacilli.*

Conclusions: — *The most common bacteria isolated were gram positive organisms. In cases with VP shunt infection it is essential to remove VP shunt and start systemic antibiotics.*

Key words — *Hydrocephalus, Ventriculo-peritoneal shunt, VP shunt infection.*

INTRODUCTION:

Many techniques have been used for decades to treat hydrocephalus by diverting CSF from brain to various body cavities for permanent drainage and absorption. VP shunting has dramatically changed the outlook of patients with hydrocephalus, with many of them having normal life expectancy and attaining normal intelligence. Key and Retzius in 1875 first demonstrated the CSF pathways and ventricles.[1] Dandy and Blackfan in 1914 demonstrated the CSF production within the ventricles by choroid plexus and divided hydrocephalus into communicating and non communicating types.[1, 2] The modern shunting era began with Nulson and Spitz in 1968 by creating a one way pressure regulated valve which they placed in the atrium via the jugular vein. John Holter was the father of a hydrocephalic child who worked on the early development of the shunt valve. Becker and Nulson set a new standard in hydrocephalus treatment, due to improved biomaterials such as silicone, and led the way for ventriculoperitoneal shunts as today's standard.[3]

The placement and revision of ventriculo peritoneal shunts remains a mainstay in the surgical treatment of hydrocephalus worldwide[4,5] Among the complications of VP shunt, obstruction and infection rank highest.[6,7,8] The incidence of CSF infection after shunt insertions has been reported between 2.2% and 39 %.[5, 9- 11] Many factors have been reported to be associated with increased risk of infection,

Correspondence:
Dr. Miraj us Siraj
Department of Neurosurgery
Foundation University Medical College
Rawalpindi.
Email: musiraj@hotmail.com

including the age and general condition of the patient, etiology of hydrocephalus, type of shunt implanted, and the surgeon's experience and technique of performance of the procedure and post operative care.[12] The aim of present study was to evaluate clinical features, management, and outcomes of patients with cerebrospinal fluid (CSF) shunt infections.

METHODOLOGY:

The study was conducted in the Department of Neurosurgery, Foundation University Medical College Rawalpindi. The clinical notes of 149 consecutive patients having VP shunt placement operation for various etiologies between the periods of June 2003-June 2008 were reviewed. Etiology of hydrocephalus for which VP shunt was inserted were: congenital hydrocephalus 76% (n 114), post-meningitis hydrocephalus 13% (n19), hydrocephalus secondary to intracranial mass 11% (n 16). The type of the shunt used was medium pressure shunt in 92% (n138) and low pressure in 8% (n 11) of the patients. Burr-hole valve shunt, from Medtronics California, USA was used in all patients. Loading dose of second generation cephalosporin - cefuroxime (Zinacef) 750 mg was given (50mg/kg/day in pediatric patients) in all cases as prophylaxis one hour before the surgery and continued for 48 hours post operatively. Patients were given antibiotics in the ward before moving to operation theatre to avoid delay in administering antibiotics inside operation theatre.

VP Shunt patient were placed first on the operation theatre list. Only one operating surgeon and one experienced theatre nurse scrubbed for surgery. Opsite adhesive film was used to cover whole operative field prior to incision. Shunt hardware was not opened from sterile packing till the tunneling performed and head and abdominal wounds were connected. Gloves changed before opening the hardware. Peritoneal catheter was wrapped in sterile towel while awaiting insertion in peritoneal cavity. Head wound was closed immediately after securing the burr hole valve to avoid air contamination. Sterile gauze padding and crepe bandage applied to head after surgery to avoid wound exposure and to keep homogenous pressure on the flap to avoid serous fluid accumulation which can cause infection. Abdominal wound was also securely covered with Mepore dressing. Dressing was changed on 5th day post operative unless there was discharge from the wound and then changed on alternate days. Stitches were removed on 8th-10th post operative day . Printed instructions in Urdu were given to patients/parents at the time of discharge regarding expected shunt complications and their symptoms especially shunt infection.

The patients who presented with possible shunt infections were analyzed according to timings of presentation at our hospital, age, symptoms, etiology of hydrocephalus, clinical features and clinical outcome. Hematological, biochemical and microbiological parameters were also evaluated. Shunt infection was suspected with following clinical findings: fever, recurrent vomiting, decreasing level of consciousness, irritability, seizures, tense fontanellae, and neck stiffness. Once infection was suspected, blood samples for full blood count (CP), ESR, C reactive protein (CRP) and blood cultures were taken. CSF sample was also taken by aseptically tapping the reservoir and sent for routine analysis, gram staining and culture sensitivity. Empirical intravenous antibiotics (vancomycin and third generation cephalosporin) were commenced pending culture and sensitivity results. CT brain with contrast was also performed and compared with previous CT scan, if available. Once CSF infection had been confirmed, VP shunt was removed and improvised external ventricular drain inserted as original EVD system was not available. Patients with stitch abscess, partial wound dehiscence were treated with antibiotics and dressing without removal of VP shunt. Excluded from the study were patients with open neural tube defects.

RESULTS:

A total of 149 patients were operated for ventriculo-peritoneal shunt. Of these 86 % (n 128) were below the age of 5 years and 14 % (n 21) were between the age of 5-47 years. Fourteen (67%) patients presented within 6 months of surgery while 33% (n 7) presented between 6 month to 3 years. Twenty-one (14%) of the operated patients were admitted with symptoms of shunt infection. Four (19%) of these showed negative CSF and biochemical studies and were referred for treatment of throat infection and gastroenteritis. Six (29%) of the infected patients presented with wound infection, partial wound dehiscence, stitch abscess and were treated with intravenous antibiotics, wound debridement, re-stitching and dressing without removal of VP shunt. Eleven (52%) of the infected patients had removal of shunt and insertion of improvised external ventricular drain with periodic CSF sampling and culture sensitivity and delayed shunt replacement after 3 negative culture results.

In 4 of our cases culture sensitivity results showed no growth. Five (3.3%) patients died with shunt infection and septicemia. Causative microorganism identified was staphylococcus epidermidis in 9 cases,

Staphylococcus aureus in 3, gram negative bacilli in 5 cases. No growth of organism was found in 4 cases.

DISCUSSION:

VP shunt infections remained an important issue world over. Nationwide data of VP shunt infection is not available from Pakistan. There is no general agreement on etiology, prevention and treatment.[13] VP shunt infection is a relatively frequent complication with most authorities quoting a figure of approximately 7-10% per procedure.[6,8,14] In another published series infection rate was nearly 30%.[15] In our patient population, the majority of VP shunts were placed for congenital hydrocephalus. Many studies suggest that the etiology of hydrocephalus was correlated with infections however, in our study it was age of the patient which was a major factor of predisposing shunt infection.[12] Most of the children operated belonged to poor socio-economic group had anemia and malnutrition. Other factors contributing to infection in this age group are long hospital stay, higher skin bacterial concentrations, immature immune system, and more resistant strains of bacteria.[16] Higher incidence of shunt infections had also been found in the geriatric population in some studies.[12]

Fever is the most common manifestation of CNS shunt infections in our study as reported by others.[8,17] Presentation with other non-specific symptoms such as nausea, vomiting, malaise, headache and meningismus are variable.[10,17,18] Examination of CSF is mandatory in all patients with suspected shunt infection by aseptically tapping the shunt. Bacterial and fungal cultures of CSF, in addition to blood culture, should be obtained from these patients before starting antibiotics. Administration of antibiotics to a patient with suspected shunt infection before obtaining CSF culture reduces the likelihood of obtaining a positive culture.[16] The bacteria responsible for most shunt infections are skin commensal organisms. Intraoperative contamination by skin flora or airborne skin organisms are the most important mechanism of infection of CSF shunts, and efforts should be directed at improving intraoperative asepsis and reducing contamination of the operative field.[10]

The organisms most frequently causing VP shunt infections are the staphylococcus epidermidis. The second most frequent pathogen is staphylococcus. aureus.[7,8,10,15,16] Gram negative enteric bacteria and pseudomonas spp. are associated with greater morbidity and mortality.[10] In some studies the rate of gram negative and positive microorganisms was approximately equal.[18] In our study the management of established VP shunt infection was surgical removal of the shunt, temporary external CSF drainage, parenteral antimicrobial therapy with shunt replacement after the infection had been eradicated. This approach is similar to other authors.[10,19,20] Intrathecal administration of antibiotics is a challenge in developing countries. Drugs available are extremely expensive and most hospitals in Pakistan are not equipped with preparation and administration of intrathecal antibiotics. Fan-Harvard and Nataha 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.[21] In our study prophylactic antibiotics were given for a period of 48-72 hours for all VP shunt operations. Although the shunt infection is potentially avoidable, only Choux et al has succeeded in preventing infection completely in a series of 274 new shunt operations.[22]

CONCLUSIONS:

Etiology of shunt infections was predominantly gram positive organisms. In case of established VP shunt infection, it is essential to remove VP shunt and commence systemic antibiotic treatment and replace it with new hardware after having 3 negative cultures and when patient is clinically stable. VP shunt should be inserted under strict aseptic techniques. Timely usage of empirical antibiotic at the time of admission and appropriate antibiotics according to antimicrobial susceptibility testing afterwards, are essential for successful treatment.

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