

Original Article

Short-term complications of ventriculoperitoneal shunt in children suffering from hydrocephalus

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Abstract. To assess various complications in children with hydrocephalus after ventriculoperitoneal shunt surgery. This descriptive study was conducted in the Department of Neurosurgery, Lady Reading Hospital and Al-Ibrahimi Hospital, Peshawar, Pakistan, from September 2005 to April 2007. A total of 86 children, 48 male and 38 female patients, with male to female ratio of 1:1.3 were included. Age range of patients was from 2 months to 13 years with mean age of 4.3 years. Seventy-nine cases were operated electively while seven cases operated in emergency due to poor clinical condition. Shunt malfunctioning due to obstruction of upper end was noted eight cases (9.3%), shunt infection in seven (8.1%) cases, seizure four (4.7%) cases, paralytic ileus in five (5.8%) cases, shunt extrusion per rectum in two (2.3%) cases, bilateral subdural hematoma in three (3.5%) cases, hydrocele and shunt erosion in two (2.3%) cases each. Two (2.3%) deaths were recorded in the study, which was not related with the surgery or with shunt complication. It is concluded that various complications may develop during and after ventriculoperitoneal shunt surgery. Shunt malfunction and infection are main causes for its failure and poor prognosis, although a list of other rare possible complications can also be expected.

Keywords: Ventriculoperitoneal shunt, hydrocephalus, complication

1. Introduction

The goal of treating hydrocephalic child is manifold. For instance, to achieve a decrease in intracranial pressure to optimum level, and to increase the cerebral mantle thickness to improve intellectual, emotional and motor development. At times, these can only be achieved by cerebrospinal fluid (CSF) diversion [1].

Non-surgical treatment of hydrocephalus is by use of acetazolamid, glycerol, isosorbide nitrates, etc. [2]. Serial head warps as well as serial lumbar and ventricular puncture is no more effective. Non-shunting procedure like resection of tumor in CSF pathway, endoscopic third ventriculostomy and aqueductoplasty has limited indication and success rate.

Shunting is a purely mechanical treatment, which is simple but is regarded as a lifetime commitment from surgeon to the patient [3]. Since 1970, placement of a ventriculoperitoneal (VP) shunt has become the most popular procedure for hydrocephalus. Due to great

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progress in shunt technology and modification in surgical technique, complications have been tremendously decreased [2]. Hydrocephalus is arguably the most common disorder in Pediatric Neurosurgery and CSF diversion is the only surgical procedure for it. VP shunt is of treatment for hydrocephalic child in neurosurgical practice. Although, endoscopic third ventriculostomy is now replacing this procedure where endoscopic facilities are available [4].

Mechanical failures of the device, functional failure because of too much or too little flow of CSF and infection of CSF, or device are common complications observed post operatively with devastating results. There is no doubt, that proper selection of patients, shunt devices, and aseptic working environment can decrease these complications. However, such ideal situation rarely exists in our set up due to a number of reasons [5]. Accordingly, the present study was designed as to assess the variety of complications in children with hydrocephalous after VP shunt surgery.

2. Materials and methods

This study was conducted in the Department of Neurosurgery Lady Reading Hospital Peshawar and Al-Ibrahimi Surgical Hospital Peshawar, Pakistan from September 2005 to April 2007. Both hospitals provide neurosurgical cover to large group of patients of North West Frontier Province of Pakistan and a major part of Afghanistan. Both emergency and elective surgical theatre is in working round the clock. The department of neurosurgery Lady Reading Hospital Peshawar is 50-bed unit with all basic neurosurgical infrastructure facilities, which is also a recognized unit for Post-graduate Neurosurgery training. A total of 86 patients underwent preoperative clinical assessment; most of these patients were referred from periphery hospitals to our outpatient as well as to private clinics. Clinical findings along with demographic data were recorded. Computerized tomography, routine hematological and biochemical investigations, including serological screening for hepatitis B virus surface antigen, anti-hepatitis C virus and human immunodeficiency virus were carried out. All neurologic signs of hydrocephalus, vision loss, headache etc. were also recorded. All patients of pediatric age group from first day of life until 15 years of age were included in this study irrespective of etiology.

Proper soap bath was given to all patients annoyed before surgery and, injectable antibiotic were given in

Table 1
Sex wise distribution of patients

Sex	n (%)
Males	48 (55.81)
Females	38 (44.18)

pre-operative period and continued for 5 days post-operatively. Patient with ventriculitis, loculated hydrocephalus and having CSF infected were excluded in this study.

Types of shunt were commonly used based on patient's affordability and availability of shunt in hospital and pharmacy. In majority of the cases (20 out of 21 cases) median pressure shunt were used only in two cases low pressure shunt were used where already CSF pressure an measured manually was very low. Post-operative abdominal X-ray was performed to exclude extra peritoneal placement.

All patients were discharged on fifth post operation days except five cases that were sent after their abdominal distension settled down on the seventh postoperative day. Mothers were educated about the correct head positioning to avoid pressure on the cranial wound and shunt chamber as well as about potential shunt complication. Follow up visits for examinations were made for 2 weeks and for 3 months following discharge.

3. Results

A total of 86 patients were included in this study there were 48 male and 38 female patients with male to female ratio of 1:1.3 (Table 1). The age range was from 2 months to 13 years with the mean age of 3.4 years. The only indication for putting VP shunt was hydrocephalus irrespective of its cause.

Seventy-nine (93.3%) cases were operated as elective cases and seven (8.1%) cases were emergent due to the patients' poor clinical condition. Different types of shunts were used according to availability and affordability of patients. Only in two cases, low-pressure shunts were used and medium pressure shunts was used in 84 cases.

The most common complication was obstruction of the shunt's proximal end, which was seen in eight cases in first 2 months period due to various reasons. These cases were re-operated for revision. The second most common complication was shunt infection. Commonly shunt tract was infected with pyogenic organisms proximal end infection in five cases was noted. In these cases shunts system was removed in three cases and externalization of lower end in two cases. Peritoneal

Table 2
Complications of shunt

Complications of shunt	n (%)
Obstruction of upper end	8 (9.30)
Shunt infection	7 (8.13)
Paralytic ileus	5 (5.81)
Peritoneal adhesions	1 (1.16)
Pseudocyst formation	1 (1.16)
Seizures	4 (4.65)
Total migration of shunt in the ventricle	1 (1.16)
Subdural hematoma	3 (3.48)
Slit ventricular syndrome	1 (1.16)
Hydrocele	2 (2.32)
Shunt erosion per rectum	2 (2.32) (Fig. 1)
No complications	51 (59.30)

adhesion and pseudo-cyst formation at lower end was seen in one child only (Table 2).

Parents in four cases noticed seizures. These patients were given anticonvulsants [Epival (sodium valproate) 250 mg twice a day or 10–15 mg/kg] with instruction that should be continued for at least 6 months to prevent post-surgical seizures. Other rare complications such as total migration of shunt in ventricle in one case and subdural hematoma in three cases and slit-ventricle syndrome in one patient respectively. Two patients developed hydrocele and five developed paralytic ileus in five cases. Representative images are shown in the Fig. 1.

4. Discussion

For the past few decades, common neurosurgical procedure for treating hydrocephalus has been the VP shunt. VP shunt is a foreign silicon material and possible complications are expected. The complications associated with VP shunts are malfunction and infection of shunt device. Over-drainage, inadequate drainage syndrome, seizures, subdural hygroma and hematoma, shunt disconnection and migration shunt fracture, hemiparesis, peritoneal perforation of gut, per-rectal extrusion [6]. Hernia and hydrocele as well as pseudocyst formation in abdomen other not uncommon complications [7]. Modification and surgical techniques, advances in shunt design and surgical experience have contributed a lot to an overall decrease in shunt-related complication.

The most common complication in pediatric group is shunt obstruction [8]. As long as shunt operations are performed, shunt malfunction will occur. Among the reasons are an increase cell and protein constituents on CSF, debris in CSF and choroids plexus growth [9]. Shunt failure can be a more dangerous condition. The



Fig. 1. Extrusions of ventriculoperitoneal shunt per rectum.

incidence of mechanical shunt malfunction is 79% in the 1st year and 53% in the second year after shunt placement. Failure rate is more common in very young infants and children and in the initial 2 months and may reach 50% of all shunts complications [10]. After 6 months occlusion are usually related to the type of shunt system. Both proximal and distal ends can be occluded. However, common is proximal end [11]. The different reason on intra-ventricular hog during connection of ventricles, distension produced by infection, continuous growth of choroids plexuses and in appropriate length of ventricular catheter during insertion [9]. Distal end occludes by pseudo cyst formation and rarely by omentum and abdomen cavity and extra peritoneal placement [11].

McGirt et al. [12] reported coinciding (similar) obstructions ratio in their study. Shunt infections occur secondary to entry of microorganisms at the time of surgery that may proceed to infection with in the 1st 6 months post operatively. The infection rate usually cited in literature is about 10% but it varies with factors such as age, type of hydrocele, institution and shunt variety, route of shunt, insertion facilities and patient health status [13].

Poor hygiene and poor immunocompetency leads to poor skin condition and early wound brake down.

Younger age and prolonged duration of surgery are other factors responsible for increasing of shunt infection rate [14]. Notably, despite factors, which may predispose to infection in developing countries, we observed infection rate of 13% in our study, which is comparable to the incidence of shunt infection found by Nabika et al. [15], and slightly higher than the rate described by Tuli et al. [16] who reported infection in 10.9% of cases. The reason for acceptable percentage of infection in under-developed countries may be prolonged use of antibiotic good, surgical technique and short follow up period after procedure.

Short terms paralytic ileus and seizures were other complications noticed. Seizures were also seen in our patients 4.65% patients. Reported seizures incidence was matching that of Morioka et al. [17] findings. Post-VP shunt seizures incidence increased with number of revision or multiple cannulation of ventricle doing placement of the ventricular catheter. Single puncture ventricle catheterization was successful in 79 patients with in three and four times in four cases. This may be a contributory factor for increased seizures.

Paralytic ileus was observed in five cases with massive CSF flow into the peritoneal cavity. If the CSF is allowed to flow out side before putting peritoneal catheter in peritoneal cavity, then this complication can be reduced and hospital stay minimized [18]. Hematoma, hydrocele, loculated cyst were rare complications. Total intracranial migration of VP shunt was seen after 1 week in one patient. These may be due to negative pulsation forces in cranial cavity CSF drainage or coiled style memory of shunt during manufacture. Spinal chronic subdural hematoma should be considered in the diagnosis of progressive spinal compression, especially in the patients with VP shunt after minor trauma [19].

Four patients (4.7%) died due to various factors not related to shunt surgery itself. Death after VP shunt surgery is uncommon, and therefore it has been difficult to study. Pediatric shunt procedures performed at high-volume hospitals or by high-volume, surgeons were associated with lower in-hospital mortality rates. Nationwide inpatient sample (1998–2000, age 90 days-18 years) that underwent VP shunt placement or shunt revision as the principal procedure was included. The mortality rate reported was 0.8% [20].

In conclusion, VP shunt is a common neurosurgical procedure with accepted range of complication but still a life saving procedure. Shunt dysfunction and infection account for large number of complications. Paralytic ileuses, seizures, subdural hematoma, are other possible complication. Advancement in surgical tech-

nique, shunt technique, condition of patient and proper selection of patient can play important rule in its prevention of complications

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