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Epidemiology of ventriculoperitoneal shunt complications in pediatric age group in medina region: Observational study

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Abstract

Background: Complications of VP shunt are presented elsewhere. Worldwide centers competitively published their incidence, type, and severity of VP shunt complication

Purpose: The aim of this study is to review the rate, nature, and distribution of complications in pediatric patients with VP shunt.

Study design: Retrospective analysis.

Methods: This study was a retrospective analysis of children registry between 2011 and 2019. Hydrocephalus (HCP) was then divided into congenital, post-meningitis, post-intraventricular (IVH) and syndromic HCP. The patient's registry data were retrieved including demographics, symptomatology, investigations, complications, and finally necessity to revision surgery.

Results: There was 65 (43.62%) patients developed shunt complications. All data described are for complication nest rather than the total population. In general, there were 42 males and 23 females in this study. The mean age at shunt insertion was 18.7±4.2 months, the mean and SD of age at emergence of complication was 27.6±2.1 months. The frequency of obstruction and infection was 25/65 (38.46%) and 8/65 (12.3%) respectively. Revision of ventricular end was done 14 times, revision of peritoneal end was done 10 times, and the entire shunt system revision was done 8 times while shunt removal and new shunt insertion were done 4 times. The mortality was found to be 12.3% (8 cases out of 65).

Conclusions: The development of shunt complication is variable universally and depends on the etiology of hydrocephalus itself. Age and gender were found to offer no effects on the incidence, type, and severity of complication.

Introduction

Hydrocephalus is a serious complication that involves cumulative enlargement of the ventricular system with subsequent increment of intracranial pressure [1-4]. Congenital hydrocephalus incidence is 3-4 per 1000 births. The cerebrospinal fluid diversion was a sole strategy working for management of hydrocephalus [5-7]. Ventriculoperitoneal (VP) shunt is a method of CSF diversion from ventricular system to peritoneal organ to be absorbed there [8-10]. The operation itself is not technically demanding, however complications due to this surgery are frequent and mentioned many times in literatures. These complications may be as easy to be dealt with while others are hazardous and life-threatening [11,12].

In general, complications of VP shunt are divided into (1) mechanical and (2) infective complications [9,13]. Mechanical complications are obstruction, disconnection or migration of either end from its target. Infective complications are shunt tract abscess, ventriculitis, and over-valve skin necrosis [4,14]. There are group of complications can be listed under the name of rare complications. These complications are perforation of a viscus, inguinal hernia, hydrocele, pseudocyst formation, and subdural collection [6].

The aim of this study is to review the rate, nature, and distribution of complications in pediatric patients with VP shunt.

Methods

This study was a retrospective analysis of children registry between 2011 and 2019. Hydrocephalus (HCP) was then divided into congenital, post-meningitis, post-intraventricular (IVH) and syndromic HCP. The patient's registry data were retrieved including demographics, symptomatology, investigations, complications, and finally necessity to revision surgery.

Causes of revision surgery were subdivided into infection, malposition, obstruction, distal problems. The causes of shunt revision were divided according to age, time interval of first surgery and revision. All cases received VP shunt using medium pressure slit valve (pediatric size). Complications were analyzed according to time interval between surgery and appearance of complications; those occurred prior to 6 months were regarded as early complication and those who occurred thereafter were regarded as late complications.

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Results

Hydrocephalic patients' registry data were retrieved. The study retrieved 149 patients who underwent VP shunt. There was 65 (43.62%) patients developed shunt complications. All data described are for complication nest rather than the total population. In general, there were 42 males and 23 females in this study. The mean age at shunt insertion was 18.7±4.2 months, the mean and SD of age at emergence of complication was 27.6±2.1 months. In Table 1, etiologies of HCP in sample of complications are illustrated.

Revisions for complicated cases were not done for all cases. Forty-nine cases (75.38%) require surgical intervention either single or multiple times thereafter while 16 (24.62%) cases developed complications require no surgical intervention by neurosurgeons. Table 2 illustrates revision times for complicated cases.

Distribution of shunt revision according to etiology and time of revision is illustrated in Table 3. Obstruction and infection were the most common complication in our series. The frequency of obstruction and infection was 25/65 (38.46%) and 8/65 (12.3%) respectively. Revision of ventricular end was done 14 times, revision of peritoneal end was done 10 times, and entire shunt system revision was done 8 times while shunt removal and new shunt insertion were done 4 times. The mortality was found to be 12.3% (8 cases out of 65).

Non-surgical complications are those complications that not require shunt revision treatment and best illustrated in Table 4.

Discussion

Hydrocephalus is a common neurological complication for many diseases (vascular, neoplastic and post-inflammatory) at pediatric age groups(1). The traditional classification of hydrocephalus is based on the site of occlusion of CSF flow into obstructive and communicating HCP [15]. For either type, at the beginning of life, increase head circumference (74%) is the commonest observation made by parents as well as bulging of anterior fontanel and cranial suture splay (67%) [14,16]. Closed head HCP is manifested as headache (12%), vomiting (11%), lethargy (7%) and a refusal to feed (9%) [1,17]. Eye signs are also presented like papilledema (6.5%) and sunset sign (5%)(2,5).

Table 1. Distribution of HCP etiologies in complication samples

Etiology	Number	Age
Congenital	15	1.4-8 months
Post-Meningitis	22	3.5-7.8 months
Post-IVH	13	2.1-8 months
Syndromic	15	4-8 months

Table 2. Revision times frequency

Revision	Number	%
1st-time revision	27	41.53
2nd-time revision	15	23.07
3rd-time revision	7	10.76

Table 3. Cause of revision and time interval

Etiology	<6	6-12	12-24	>24
Obstruction	13	10	2	0
Infection	2	2	4	0
Disconnection	5	2	3	0
Under drainage	4	0	0	0
Extrusion	0	1	1	0

Table 4. Non-surgical complications

Complications	Number	%
Subdural collection	3	4.6
Wound infection	5	7.7
Hernia/hydrocele	6	9.23
Ascites	2	3

The incidence of complications as stated from our registry was about 43%. The worldwide incidence of complications is variable from 20-45% [6-11]. In rural areas, incidence reached up to 80%.

Either infection or obstruction of shunt, shunt malfunction term is now the end-result [18]. Both causes are common predisposing factors to shunt malfunction. The reason for the presence of high rate of obstruction is in the high viscid contents of the CSF (full of debris and clotted proteinaceous contents) leading to blocked passage either at proximal or at valve itself [19]. In contrast to proximal blockage, distal blockage is happened by collection of the tissues with wrapped omentum. In certain situations, insertion of the distal end may be done by assistance of laparoscopy [20].

Infection was the second cause of shunt malfunction. The reported series showed that infection was ranging from 5-15% [19,21]. Contamination of the shunt system during placement is the primary cause of organism contamination. Seventy percent of shunt infection is manifesting in the first 3 months. The most common organisms responsible for shunt infection are coagulase-negative staphylococci, *Staphylococcus epidermidis* and *aureus* [10,22].

The infection rate is proportionally related to the impact of disease-causing HCP, sepsis, and acquired nosocomial infection [15,20]. These factors mandates decrease hospital stay, enhance patient's immunity and surgical wound care. Infection is more prevalent in younger children than older ones. Regression analyses done by certain reports found a correlation between young age and incidence of infection [16,17,19,21,23,24].

Once infection diagnosed, the shunt is best to be removed and start broad-spectrum IV antibiotics until culture and sensitivity analyses pointing out the causative organism [8,11].

In this study, disconnection was found in 10/65 patients. The usual sites for disconnections are mobile sites (valve and neck). All disconnection cases happened between the valve and proximal shunt [25,26]. The explanation for this is formation of fibrosis around shunt valve prevents its mobility while skull is growing.

Over drainage is manifesting as collapsing skull bones and subdural hematoma. Collapsing bones are manifested as craniosynostosis. Underdrainage may be manifesting as the persistence of symptoms. This may be due to blockage or using incompatible pressure valves with patient cases [10,22,24,25].

Shunt related epilepsy is a well-known phenomenon [9,27]. Its incidence may reach up to 48% of the case. It is not believed due to shunt placement itself but to the pathophysiology of the underlying causative illness [23,28]. Presence of seizure mandates exclusion of shunt malfunction first. Antiepileptic medications are not required unless patient had persistent fits after shunt placement [27].

On literature review, event-freesurvival at 1 year ranged from 62% to 80% and at 10 years from 35% to 48%. In this study, we found 56.12% and 37.7% event-free at 1 year and 5 years respectively. The shunt-related mortality reported being 8.6%–13.7%. In our series, it was 8 (12.3%) [19,20].

In conclusion, the development of shunt complication is variable universally and depends on the etiology of hydrocephalus itself. Age and gender were found to offer no effects on the incidence, type, and severity of complication.

Conflict of interest

There was no conflict of interest.

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