

COMPLICATION OF VENTRICULOPERITONEAL (VP) SHUNT IN DEVELOPING COUNTRIES - OUR OBSERVATION**Dr. Sukriti Das^{*1}, Dr. Rathin Halder², Dr. Shamsul Islam Khan³, Dr. Sharbari Dey⁴, Dr. Uzzal Kumar Shadhu Khan⁵, Dr. Saiful Hoque⁶, Dr. Kaniz Fatema Ishrat Zahan⁷, Dr. Mahmudul Haque Morshed⁸**¹Associate Professor, Department of Neurosurgery, Bangabandhu Sheikh Mujib Medical University.²Resident, Department of Neurosurgery, Bangabandhu Sheikh Mujib Medical University.³Assistant Professor, Department of Neurosurgery, Dhaka Medical College & Hospital.⁴Consultant, Bangabandhu Sheikh Mujib Medical University.⁵Assistant Professor, Department of Neurosurgery, Dhaka Medical College & Hospital.⁶Registrar, Department of Neurosurgery, Dhaka Medical College & Hospital.⁷Assistant Professor, Department of Neurosurgery, Dhaka Medical College & Hospital.⁸Assistant Professor, Department of Neurosurgery, Shaheed Suhrawardy Medical Hospital.***Corresponding Author: Dr. Sukriti Das. FCPS, FRCS, MS (Neurosurgery)**

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ABSTRACT

Objective: Ventriculoperitoneal (VP) shunt is very commonly performed neurosurgical operation in developing countries. Complications due to shunt infection and obstruction are associated with high morbidity and mortality. This observational study was performed by collecting data from multiple institutes in Bangladesh. **Materials and Methods:** It is a clinical retrospective observational study. This study was conducted on 150 patients of both genders with different ages who presented with signs and symptoms of shunt malfunction between 2018 and 2020. A complete clinical assessment was done, a final diagnosis was made, and a treatment of individual patients was planned accordingly. Patients were followed up within 1 week and 1 month post-operatively. Data was analyzed using the SPSS (version 22.0). **Results:** VP shunt surgery was done in 150 patients. Among them twenty-five (16.6%) patients had various forms of complications. Fifteen (60%) patients had complications related to the proximal catheter and the reservoir while 10 (40%) patients had complications related to distal catheter. The most common complications were exposed proximal shunt reservoir 16% and exposed distal catheter 8%, followed by proximal shunt obstruction 8% and distal obstruction 4%. The most common cause of Hydrocephalus was Congenital about 86.66 %, in which 16.1 % patients faced complications after surgery. Twenty-three (92%) patients were managed surgically, 21 (91%) patients of them showed marked improvement at the end of the first month postoperatively, while two (8%) patients needed another surgical intervention. **Conclusion:** During VP shunt surgery utmost care should be taken during procedure of the shunt surgery starting from scrubbing to closure of skin to avoid complications. Despite complications, the VP shunt insertion remains the main surgical option used for hydrocephalus management.

KEYWORDS: Hydrocephalus, Cerebrospinal Fluid (CSF), Ventriculoperitoneal Shunt, Ventriculoperitoneal shunt complications.

INTRODUCTION

Hydrocephalus (HCP) is a common neurosurgical disorder in children. The prevalence and incidence of HCP is 0.9–1.2/1000 and 0.2–0.6/1000, respectively, in developed world.^[1] Although a reliable estimate is not available, the incidence is likely to be higher in developing countries.^[2] Cerebrospinal fluid (CSF) diversion procedures have dramatically reduced morbidity and mortality of children with HCP. But this procedure has potential complications that may need multiple surgical procedures during a patient's life span. The reasons of Ventriculoperitoneal (VP) shunt failure include obstruction (proximal part and distal part),

infection, mechanical disconnection or breakage, shunt migration, etc. Earlier studies evaluated shunt-associated complications and shunt survival predominantly in the pediatric hydrocephalus population; only limited data are published in adult patients. In pediatric surgical series, shunt failures occur in 14% of patients just within the 1st month after shunt placement^[3] and 40%–50% of the shunts will fail within the 1st year.^[4,5] Shunt revision surgeries account for 48% of all shunt-related procedures performed in the United States.^[6] Lately, Endoscopic Third Ventriculostomy (ETV) had emerged as an alternative to Ventriculoperitoneal (VP) shunt for HCP. Absence of hardware makes ETV a viable alternative to

shunting to reduce the complications of VP shunt. Furthermore, due to less availability of expertise, technology, infrastructure, and cost-related issues, VP shunt is still the most commonly performed and only available option to treat HCP in low-resource setting like Bangladesh. Early identification and management of risk factors may help in improving patient outcome. Here, we report our 2-year experience of management of HCP with VP shunts, their complications, and management of shunt failure.

METHODS

This is a retrospective observational study that was conducted at the Department of Neurosurgery, BSMMU for a period of 2 years from January 2018 to December 2020. An informed signed consent was taken from the parents and guardians of patients before enrolling them into the study after the approval of the IRB, BSMMU. During the study period, a complete clinical assessment including a detailed history and examination with a particular emphasis on neurological examination was done for all patients after admission. A medium-pressure shunt system was inserted for all patients. Patients with

VP shunt complications operated at multiple institutes were included while patients operated before the study period were excluded. The investigations performed for all patients were complete blood count (CBC), Erythrocyte Sedimentation Rate (ESR), complete urine analysis, X-Ray chest, and brain computed tomography (CT) scan or MRI. Specific investigations such as CSF analysis, CSF culture and sensitivity; blood culture and sensitivity; urine culture and sensitivity; pus culture and sensitivity; ultrasound of abdomen, shunt series X-rays, and MRI of the brain were also performed when indicated. A final diagnosis was made on the basis of clinical findings, and investigations and treatment of individual patients were planned accordingly. All patients with VP shunts who had one or more complications were included in the study.

Statistical analysis

Data was recorded and analyzed using the Statistical package of Social Sciences (SPSS) version 22.0. Descriptive statistics were presented as frequencies, percentages, means, and standard deviations.

Table 1: Age and sex distribution of shunt complications (n=25).

Item	Frequency	Percentage
Age groups		
Infant	12	48
Child	10	40
Adult	3	12
Sex		
Female	9	36
Male	16	64

Table 2: Clinical presentations of shunt complications(n=25).

Item	Frequency	Percentage
Clinical presentations		
Bulged anterior fontanelle	12	48
Sleepiness	16	64
Frequent vomiting	18	72
Enlarged head	15	60
Tense anterior fontanelle	8	32
Agitation and irritability	11	44
Inflammation around distal tube	3	12
Fever	8	32
Headache	8	32
Exposure of shunt reservoir	4	16
CSF leak from distal wound	3	12
Swelling around reservoir	2	8
Swelling around distal tube	2	8

Table 3 (A): Complications related to proximal end(n=25).

Item	Frequency	Percentage
Complication related to proximal end	15	60
Exposure of the reservoir	4	16
Misplaced catheter	3	12
Meningitis	1	4
Proximal obstruction by debris	2	8
CSF collection around reservoir	2	8

CSF over drainage (CSDH)	1	4
Nonfunctioning shunt	2	8

Table 3(B): Complications related to distal end(n=25).

Item	Frequency	Percentage
Related to distal catheter	10	40
Exposure in the abdominal end	2	8
Infection around the tube	2	8
CSF collection around distal tube	1	4
Fracture of the tube	1	4
Extrusion through anus	1	4
Obstruction by pseudocyst with CSF leak	1	4
Extra peritoneal placement with CSF leak	1	4
CSF or pus discharge through abdominal end	1	4



Figure 1: Exposure of the reservoir.

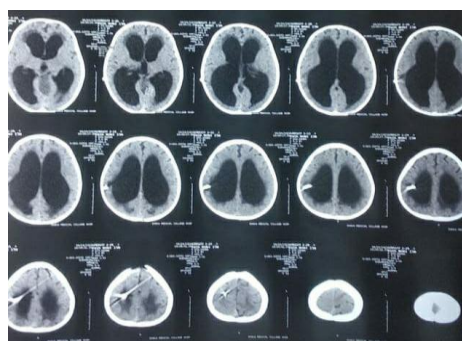


Figure 2: Misplaced catheter.



Figure 3: CSF collection around reservoir.



Figure 4: Nonfunctioning shunt.



Figure 5: Extrusion through anus.

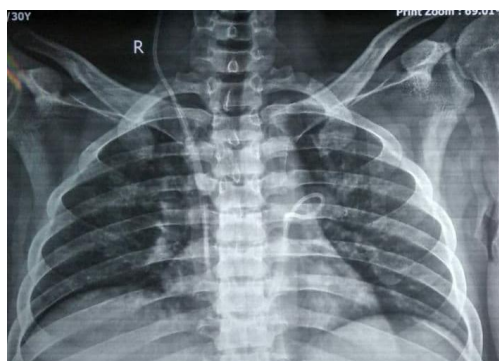


Figure 6: Extra peritoneal (Mediastinal) placement.



Figure 7: CSF or pus discharge through abdominal end.

RESULTS

One fifty patients for whom VP shunt was inserted by consultant and senior neurosurgeons, 25 patient (16.6%) patients had complications. Both genders were included 16 (64%) males and 9 (36%) females. All ages were also included 12 (48%) infants, 10 (40%) children, and 3 (12%) adults with a mean age (3.4 ± 6.64) as shown in **Table 1**.

Clinically, 12 (48%) patients presented with bulged anterior fontanelle, 16 (64%) with sleepiness, 18 (72%) patients with frequent vomiting, 15 (60%) patients with enlarged head, 8 (32%) patients with tense anterior fontanelle, 11(44%) patients with agitations and irritability, 3 (12%) patients with inflammation around distal tube, 8 (32 %) patients with headache, 8 (32%) patients with fever, 6 (24%) patients with exposure of the shunt reservoir, 3 (12%) patients with CSF leak from the distal wound, 2(8%) patients with swelling around the reservoir and 2 (8%) patients with swelling around distal tube, as shown in and **Table 2**.

The documented complications were classified according to site into two categories, complications related to proximal end in **Table 3(A)** and complications related to distal end as presented in **Table 3 (B)**. Concerning proximal catheter and reservoir complications, skin erosion over the shunt reservoir was the most common complication which was documented in 4 (16%) patients as shown in **Figure 1**. Misplaced catheter was noted in 3

(12%) patients as shown in **Figure 2**; meningitis was presented in 1 (4%) patient. Obstruction of proximal catheter by debris was noted in 2 (8%) patients, and CSF leak making collection around the reservoir was documented in 2 (8%) patients as shown in **Figure 3**. Over drainage of the ventricles may lead to unilateral or bilateral chronic subdural hematoma (CSDH), and this was presented in 1 (4%) patient and 2 (8%) patients nonfunctioning shunt as shown in **Figure 4**.

Regarding distal end complications, exposure in abdominal end occurred in 2 (8%) patients (hyperemia with superficial ulceration or complete exposure). Infection around the distal catheter was reported in 2 (8%) patients. 1 (4%) patient showed poor peritoneal absorption which led to distal failure and CSF collection under the skin surrounding the distal catheter. Fracture can occur at any site along the course of the distal tube especially near bony prominences. In our study, 1(4%) patient were documented to have a fracture and, hence, distal tube migration. Extrusion of the distal end of distal catheter through anus was also reported in 1 (4%) patient as shown in **Figure 5** one (4%) patients had a distal end failure due to obstruction by pseudocyst with CSF leak Other complications were noted as extraperitoneal (mediastinal) placement as shown in **Figure 6** and CSF/pus through abdominal wound, each of them noted in only one patient for each (4%) as shown in **Figure 7**.

Table 5: Incidence of VP shunt complications in relation to site and etiology (n=150).

Etiology	No of patient shunt(n=150)	No. of complications	Percentage
Congenital HCP	130	21	16.1
Post Meningitic HCP	10	2	20
Post subarachnoid HCP	4	2	50
Tumor	6	0	0

Table 6: Management of complicated patient (n=25).

Management	Frequency	Percentage
Surgical Management	23	92
Conservative management	2	8
3 rd surgery needed	2	8

VP shunts were inserted for treatment of hydrocephalus caused by any etiology such as congenital, post

meningitic, post subarachnoid hemorrhage, and tumor obstructing CSF pathway. In the current study, out of

150 patients operated with VP shunt, 130 patients were congenital, 10 patients were post meningitic, four patients were post subarachnoid hemorrhage, and six patients were tumor-induced hydrocephalus (Table 5). Out of 25 patients who had various types of VP shunt complications, 21 (84%) patients complained of congenital hydrocephalus, two (8%) patient complained of post meningitic hydrocephalus, and two (8%) patients complained of post subarachnoid hydrocephalus. No patient who had tumor induced hydrocephalus complained of shunt complications (Table 5).

Patients were followed up after 1 week and 1 month postoperatively. Two (8%) patients were managed conservatively while 23 (92%) patients were managed surgically as shown in Table 6. Surgeries included proximal revision, distal revision, debridement, redirection of misdirected catheter, repositioning of the distal catheter, new VP shunt on the other side.

DISCUSSION

Although VP shunt is an effective treatment of hydrocephalus, it is plagued by shunt-related complications.^[7] As VP shunt is lifelong commitment, multiple surgical procedures may be required during life time.^[8] The incidence of VP shunt complications was reported by most studies to be slightly higher in males than females^[9], which was consistent with the current study as males represent 64%. Among 25 patients who were operated by ventriculoperitoneal shunt, infants and children represented 88% whereas adults represented 12% in our study. This is consistent with Abdul Munam et al. who conducted their study on 40 VP shunt complicated patients where children represented 85%.^[10] In neonates, scalp wound is actually a common complication associated with VP shunts which is due to the inherent skin fragility and the superficial nature of the shunt.^[11,12] In our study scalp wound exposure (reservoir exposure) was presented in 4 (16%) patients. Lee et al. found shunt blockage in 12.2% of 246 shunt procedures in Seoul, Korea, and their infection rate was 4.1%. Shunt infection was found together with blockage in most instances in their series indicating that shunt malfunction could have been caused by infection in these patients.^[13] In our study shunt infection (both proximal and distal end) 8 (32%) patients. Hamada and Abou Zeid found that misdirection of proximal catheter was founded in two (7.1%) patients of their shunt malfunction series which is approximately near to the result of this study as proximal catheter misdirection was founded in three (12%) patients.^[14] Vanaclocha et al. observed that shunt malfunction occurred in infected shunts where some of which were clinically undetectable. They argued that the incidence of shunt infection might be higher than generally reported and that negative cultures of CSF taps did not exclude shunt infection in malfunctioning shunts.^[15] Peacock and Curren found shunt blockage to be 20% in their series of 440 patients.^[16] Mwan'gombe and Omulo reported an infection rate of 24.6% among children operated for non-tumor hydrocephalus in

Nairobi.^[17] In the current study, shunt obstruction was reported in 4 (16%) of patients (proximal obstruction by debris 2 cases, distal obstruction by pseudo cyst 1 case and extraperitoneal placement 1 case). Aldrich and Harmann found that shunt disconnection and fracture accounted for 15% of their shunt malfunctions.^[18] In agreement with this study, Shunt fracture was noted in 4% of shunt complication Abdominal complications of VP shunt are not rare and the main causes of distal catheter failure are related to extra peritoneal retraction of the catheter and subcutaneous or intra-abdominal cerebrospinal fluid (CSF) collections.^[20] In the current study, intra-abdominal pseudo cyst was reported in one (4%) patients and extra peritoneal catheter in one (4%) patient. Sathyanarayana et al. documented a protrusion of distal catheter per anus without any complications such as obstruction or peritonitis.^[21] This agrees with the current study where one patient was reported with a VP shunt distal catheter per rectum without any complications in the form of obstruction or peritonitis. Previous studies reported that age and principal diagnosis (etiology) are independent contributors to the risk of initial shunt failure.^[22-24] In agreement with these studies, our study demonstrated that age and etiology were significantly associated with shunt revision where 21 (84%) patients with VP shunt complications were congenital. Accordingly, there was a higher rate of complications related to congenital etiology.

CONCLUSION

VP shunt surgery is a Common surgical procedure in hydrocephalus. Utmost care should be taken during procedure of the shunt surgery starting from scrubbing to closure of skin to avoid complications. Despite complications, the VP shunt insertion remains the main surgical option used for hydrocephalus management.

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