

## ORIGINAL ARTICLE

# Complications of Paediatric Ventriculoperitoneal (VP) Shunt: Experience in A Tertiary Care Hospital

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### Abstract

**Background:** Ventriculoperitoneal (VP) shunt is the most commonly used shunt procedure in children because of the capacity of the peritoneum to resorb fluid like Cerebrospinal fluid (CSF). Primary and subsequent peritoneal catheter placement is relatively easy procedure to be done. VP shunt procedures are associated with varieties of complications.

**Methods:** A prospective study was done from July 2017 to June 2021 in Faculty of Paediatric Surgery, Bangladesh Shishu Hospital & Institute. A total number of cases underwent VP shunt surgery were 192. We had analyzed 82(42.71%) patients of VP shunt surgery who had various shunt related complications and analyzed the predisposing risk factors and spectrum of complications.

**Results:** The mean age was 16±14 months and median age was 11.75 months. Out of 82 patients 56 (68.29%) were male and 26(31.71%) were female. Seventy (85.37%) patients had single complication and 12(14.63%) had more than 1 complications. Twenty four (29.27%) patients had infective complication and 58(70.73%) had mechanical complication. Infective complications (24, 29.27%) include shunt tract abscess (41.66%), CSF leak (16.67%) exposure of shunt tube through anus (16.67%), wound infection (16.67%). Mechanical complications were present in 58(70.73%) cases and 40(48.78%) had ventricular end malformation, 24(29.27%) peritoneal end and 18(21.95%) had both end malformation.

**Conclusion:** With this prospective study of complications of VP shunt, age at initial shunt surgery, insertion and important patient-related predictors of shunt failure. The different predominant etiological factors the interval between the age of initial shunt placement and onset of complications were the most responsible for early and late shunt failure were infective and mechanical complications respectively.

**Keywords:** Paediatric hydrocephalous, VP shunt, complication.

### Introduction

Hydrocephalus (HCP) is defined as excessive accumulation of cerebrospinal fluid (CSF) within the ventricular system of brain due to imbalance

between CSF production and absorption or due to obstruction in the CSF pathway.

The complications of VP shunt surgery may be broadly divided into (a) mechanical complication and

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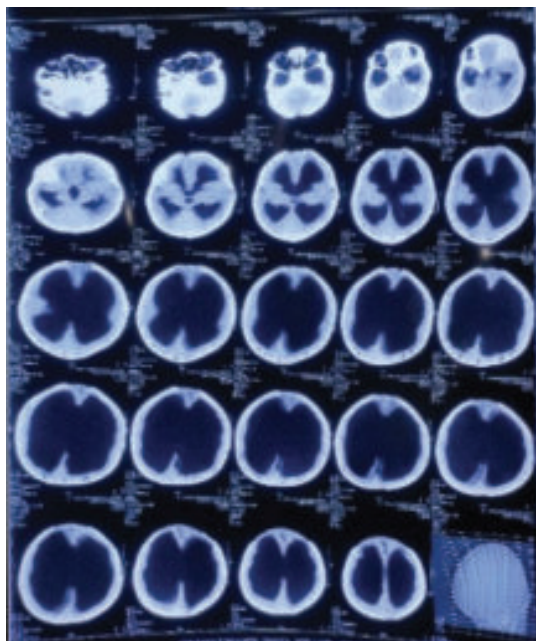
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(b) infective complication. Mechanical complications include obstruction, disconnection or migration of any component of the ventricular or peritoneal catheter.

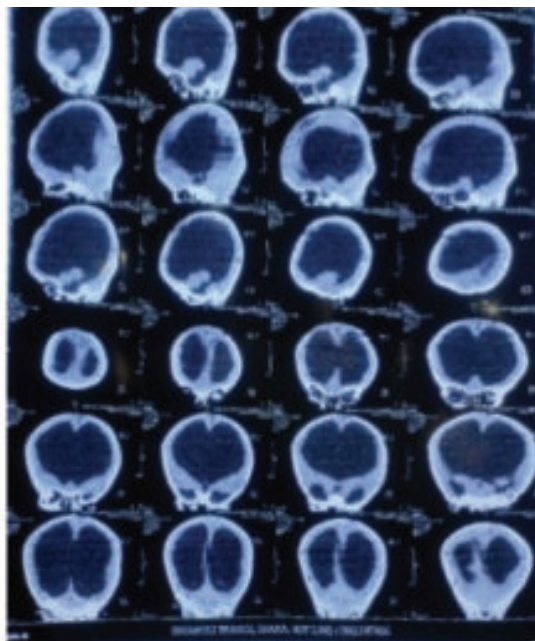
Infective complications include shunt tract abscess, skin necrosis overlying the shunt device and exposure of shunt tube followed by ventriculitis most commonly. Other complications are seizure, subdural effusion, craniosynostosis, inguinal hernia or



**Fig-1:** A baby with hydrocephalous



a) Axial view



b) Sagittal & coronal view

**Fig-2:** CT scan of brain

hydrocele, ascites, CSF pseudocyst formation, perforation of a viscus or gut extrusion or prolapse of shunt through anus, intestinal volvulus and obstruction.<sup>1</sup> We studied 82 patients of VP shunt procedure who presented with various shunt related complications and analyzed the predisposing causes and spectrum of complications.

### Materials and Methods

This study included 82 patients out of 192 patients of hydrocephalus (HCP) who underwent VP shunt placement and had complications. The study was conducted in Faculty of Paediatric Surgery, Bangladesh Shishu Hospital & Institute (BSH&I) from July 2017 to June 2021.

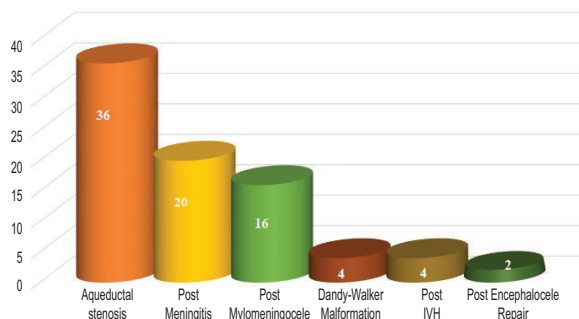
A total number of patients were 192 and all of them underwent VP shunt surgery were evaluated. In all patients medium pressure Chabra's silastic shunt were used for hydrocephalus and 82 patients were presented with various shunt-related complications due to the causes other than intracranial tumour. All patients who presented with complications were recorded and thoroughly analyzed by clinical examinations, laboratory tests and imaging studies like plain x-ray to establish shunt location, computed tomography (CT) scan of brain and ultrasonography (USG) and CT scan of abdomen.

Early and late shunt complications were defined according to the duration between the initial shunt placement and appearance of first complication. Those occurring within 2 years were early and more than 2 years were considered as late complications.<sup>2</sup> The patients whose shunt were completely non-functioning, revision shunt procedure were performed once or more than one occasions whenever applicable.

**Results**

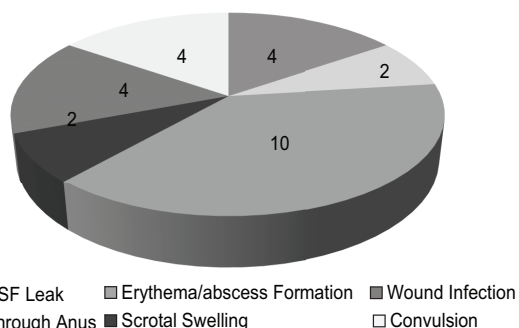
During the study period, a total of 82 (42.7%) patients presented with different patterns of complications were analyzed. The mean age was 16±14 months and range was 2 to 30 months. Median age was 11.75 months sex incidence were male 56(68.29%) and 26 (31.71%) female. Out of 82 patients 70(85.37%) had single complication and the rest 12(14.63%) had multiple complications (Table I).

Parameter	Value	Percentage
Age (month)	Mean ±SD	16±14
	Range	2-30
	Median	11.75
Sex	Male	56 68.29
	Female	25 31.71
VP shunt complication	Single	70 85.37
	Multiple	12 14.63
Mortality		6.17



**Fig.-3: The etiology of HCP**

Aqueductal stenosis (36, 43.90%), post meningitis (20, 24.39%), post myelomeningocele (16, 19.51%), Dandy Walker malformation (4, 4.88%), post IVH (4, 4.88%) and post encephalocele repair (2, 2.44%) were the causes of hydrocephalous (Fig.-3). Infective complications include shunt tract abscess (10, 41.66%), CSF leak (4, 16.67%), exposure of shunt tube through anus (2, 8.33%), seizure (4, 16.67%), wound infection (4, 16.67%), scrotal swelling (2, 8.33%) (Fig.-4).



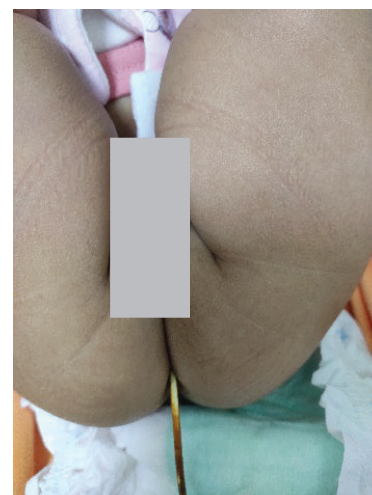
**Fig.-4: Infective implications of VP shunt**



a. CSF leakage from abdominal wound



b. Extrusion of VP shunt through abdominal wound



c. Prolapse of shunt through anus

**Fig.-5: Few complications of VP shunt is shown by photograph**



Patients with meningitis and convulsion had shunt malfunctioning and developed septicemia. The few other follow-up cases of post-encephalocle and post-myelomeningocle repaired HCP developed septicemia and subsequently ventriculitis.

Twenty patients had a history of shunt revision, out of which 14(70%) had undergone revision of shunt once, 2(10%) had undergone revision twice and 4(20%) patients had undergone multiple shunt revision. Fourty (48.78%) patients had ventricular end malfunction and 24 patients had ventricular end malfunction, 18 patients had both ventricular and peritoneal end malfunction. Patient of early

infective complications were 20(24.39%) and late infective complications were 4(4.88%). Moreover, numbers of early and late mechanical complication were 22(26.83%) and 36(43.9%) respectively. On analyzing the nature of complication in respect to infective shunt complication interval, 8(34.14%) of patients with shunt related complication presented within 6 months of initial shunt placement and 16(65.86%) presented within 2 years. Mean shunt complication interval in patients with infective complication was  $15.8\pm 14.35$  (median 18.35) months compared to  $48.55\pm 32.75$  (median 38.6) months in patients with mechanical complication (Table II).

**Table II**  
*Distribution of data of VP shunt complication*

<b>Shunt malfunction</b>	Ventricular end	40	48.78
	Peritoneal end	24	29.27
	Both ventricular & peritoneal end	18	21.95
<b>Shunt complication</b>	<b>Infective</b>	24	29.27
	Early	20	24.39
	Late	4	4.88
	<b>Mechanical</b>	58	70.73
	Early	22	26.83
	Late	36	43.9
<b>Shunt revision</b>	Single	14	70
	Twice	2	10
	>Twice	4	20
<b>Shunt complication interval (month)</b>	<b>Infective</b>		
	Mean $\pm$ SD		15.8 $\pm$ 14.35
	Median		18.35
	Complications within 6 month	8	31.14
	Complications within 2 years	16	65.86
	<b>Mechanical</b>		
	Mean $\pm$ SD		48.55 $\pm$ 32.75
	Median		38.6

## Discussion

VP shunt placement for hydrocephalus is a well known and popular procedure. VP shunt is significantly associated with complications like malfunction and infection.<sup>16</sup> VP shunt malfunction can occur anytime from hours to years after the placement of shunt. Overall shunt infection rate was 5% to 8% in literature.<sup>1</sup> In our study it was 15.63% which was in a higher rate. The role of age at the time of shunt placement has been evaluated previously in several observational studies. DI Rocco et al<sup>2</sup> reported increased shunt failure in patients who had undergone shunt placement at age <6 months. Piatt and Cariso et al<sup>3</sup> had similar results in patients <2 years of age. Similar observation was made by Liptak and McDonaid<sup>4</sup> in children <1year of age. Our present study also revealed that patient age at the time of shunt placement is an important predictor of shunt function and malfunction. In this study, the majority of patients who had shunt failure primary shunt placement were done during initial 2 years of age. On the other hand there was some studies showing no effect of age on the incidence of shunt infection.<sup>5</sup> Brage et al<sup>6</sup> shown a higher incidence of infection in children older than 2 years.

In our series, 33.33% were mechanical, and 15.63% were infective complications. Similar findings were seen in the study done by Kanasha et al were 32% mechanical and 14.6% infective cause, whereas Lee et al shown 12.2% shunt blockage and 4.1% infection.<sup>5,7</sup> Peacock and Career in their study found a shunt blockage rate of 20%.<sup>8</sup>

Lohani et.al shown 12.07% had shunt malfunction and 7.92% had shunt infection.<sup>16</sup>

In our study, 34.14% of patient had shunt related complications presented within 6 months of initial shunt placement and 51.21% presented within 2 years of shunt placement. On several literature reviewed, event free survival at 1 year ranged from 62% to 80%<sup>9,10</sup> and at 10 years from 35% to 48%.<sup>9,11</sup> The most common pathogen isolated in our study from CSF culture sensitivity reports was staphylococcus aureus followed by methicillin-resistant staphylococcus. Staphylococcus aureus was mentioned in literature.<sup>12,13</sup>

The shunt related mortality was 20% in the study by Kalasha et al<sup>5</sup> whereas in our study, it was 4.17%. The different studies available in literature shown a

mortality rate in nontumorous hydrocephalus ranging from 8.6%<sup>14</sup> to 13.7%<sup>15</sup>. The figure varies as per the duration of follow-up in these studies.<sup>14,15</sup> We have a thought from the discussion to decrease the postoperative mortality and morbidity by improving strict technical and sterilization procedure in our setup.

## Conclusion

With this prospective study of complications of VP shunt surgery, age at initial VP shunt placement and the interval between age of primary shunt placement and onset of complications were the most important patient related predictors of shunt failure. The different predominant etiological factors responsible for early and late shunt failure were infective and mechanical complications respectively.

## References

1. Vinchon M, Rekate H, Kulkarni AV. Pediatric hydrocephalus outcomes: A review. *Fluids Barriers CNS* 2012;**9**:18.
2. Di Rocco C, Massimi L, Tamburrani G. Shunts vs endoscopic third ventriculostomy in infants: Are there different types and/or rates of complications? A review. *Childs Nerv Syst* 2006;**22**:1573-89.
3. Piatt JH Jr, Carison CV. A search for determinants of cerebrospinal fluid shunt survival. Retrospective analysis of a 14 year institutional experience. *Pediatr Neurosurg* 1993;**19**:233-41.
4. Li plak GS, McDonald JV. Ventriculopitoneal shunts in children. Factors effecting shunt survival. *Pediatr Neurosci* 1986;**12**:289-93.
5. Kinasha AD, Kahamba JF, Semali IT. Complications of ventriculopentoneal shunts in children in Dar es Salaam. *East Cent Afr J Surg* 2005;**10**:55-59.
6. Braga MH, Carvalho GT, Brandão RA, Lima FB, Costa BS. Early shunt complications in 46 children with hydrocephalus. *Arg Neuropsiquiatr* 2009;**67**:273-77.
7. Lee JY, Wang KC, Cho BK. Functioning periods and complications of 246 cerebrospinal fluid shunting procedures in 208 children. *J Korean Med Sci* 1995; **10**:275-80.
8. Peacock WJ, Curren TH. Hydrocephalus in childhood. A study of 440 cases. *S Afr Med J* 1984;**66**:323-24.
9. Vinchon M, Baroncini M, Delestret I. Adult outcome of pediatric hydrocephalus. *Childs Nerv Syst* 2012; **28**:847-54.

10. Kestle J, Drake J, Milner R, Sainte-Rose C, Cinalli G, Boop F, et al. Long-term follow-up data from the shunt design trial. *Pediatr Neurosurg* 2000;**33**:230-36.
11. Sainte-Rose C, Hoffmann HJ, Hirsch JF. Shunt failure. *Concepts Pediatr Neurosurg* 1989;**9**:7-10.
12. Wong GK, IP M, Poon WS, Mak CW, Ng RY. Antibiotics-impregnated ventricular catheter versus systemic antibiotics for prevention of nosocomial CSF and non-CSF infections: A prospective randomized clinical trial. *J Neurol Neurosurg Psychiatry* 2010;**81**:1064-7.
13. Bayston R. Epidemiology, diagnosis, treatment, and prevention of cerebrospinal fluid shunt, infections. *Neurosurg Clin N An* 2001;**12**:3-8.
14. Tuli S, Tuli J, Dreke J, Spears J. Predictors of death in pediatric patients requiring cerebrospinal fluid shunts. *J Neurosurg* 2004;**100**:442-46.
15. Lumenta CB, Skotarczak U. Long-term follow-up in 233 patients with congenital hydrocephalus. *Childs Nerv Syst* 1995;**11**:173-75.
16. Lohani S, Benaya A. VP shunt complications: 10 years experiences at UDMNINAS. *Nepal Journal of Neurosciences* 2019;**16**:40-42.