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Original Article

Outcome of Ventriculoperitoneal Shunt Done in Early Neonates with Congenital Obstructive Hydrocephalus: A Prospective Observational Study

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Abstract

Introduction: Hydrocephalus is a neurological condition that arises from any disorder in normal hydrodynamics of cerebrospinal fluid. Ventriculoperitoneal shunt (VPS) is one of the treatment options for treating hydrocephalus, both obstructive and communicating. It is also one of the most commonly performed neurosurgical procedures, both on the elective and emergency basis.

Materials and Methods: This Prospective observational study was conducted in the Department of Paediatric Surgery, Medical College and Hospital, Kolkata during August 2016 - February 2018. Patients attending Paediatric surgery outpatient department (OPD) and admitted in Paediatric surgery department, Medical College and Hospital, Kolkata and previous operated patients attending OPD. The sample size was 20 in numbers

Results: The cardinal effort of present study was to explore any post-operative complication due to VPS and outcome of shunt thereof done in early neonatal period. Seizure was observed as immediate complication in 1 case. Under drainage and subdural collection observed in three cases. Shunt malfunction was the commonest complication, observed in 3 cases in 1 year follow-up period. Shunt displacement was noted in 1 case. Skull deformity was noted in 3 cases. Migration of shunt observed in 1 case. Shunt tube came out per rectally in 1 case at 1 year of age. Cognitive delay and poor coordination were observed in three cases in 1 year follow-up.

Conclusion: VPS can safely done for hydrocephalus at the early neonatal period with acceptable rate of complications and shunt malfunction. Further studies and follow-up for longer duration to be tailored to minimise the complications, best shunt survival and outcome of the patients.

Key words: Hydrocephalus, Neonatal, Shunt

INTRODUCTION

Hydrocephalus is a neurological condition that arises from any disorder in normal hydrodynamics of cerebrospinal fluid (CSF).[1] This may result from any disorder in process of CSF formation, disorder of CSF flow between the ventricular systems, or disorder in CSF absorption, all of which lead to accumulation of excessive amount of CSF in the brain. This increased CSF volume causes dilatation of ventricles of the brain and may cause increase in intracranial pressure. Communicating hydrocephalus is defined as the condition in which there is full communication between all the ventricles of the brain and subarachnoid space. Non-communicating hydrocephalus is defined as the condition in which there is obstruction in the flow of CSF.[1] The most common cause of congenital hydrocephalus is congenital obstruction of cerebral aqueduct of Sylvius. Other common causes of hydrocephalus in newborn include congenital

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malformations such as Arnold-Chiari malformation or Dandy-Walker malformation. Ventriculoperitoneal shunt (VPS) is one of the treatment options for treating hydrocephalus, both obstructive and communicating. It is also one of the most commonly performed neurosurgical procedures, both on the elective and emergency basis.[2] It works on the principle to drain excess accumulated CSF into the peritoneal cavity thus relieving the CSF pressure in brain.[3] With the advent of shunt surgeries, these neonates can be assured of a near normal neurological development.

The technique of using the peritoneal cavity for CSF absorption in VPS was developed by Kausch.[4] Neonates demonstrated a higher rate of shunt complications than did adults at 5 years.[5] There is a lack of reports and study regarding outcome and complications of VPS surgery in the neonatal age group.

The present study is a prospective observational study on outcome of VPS done in early neonates with congenital hydrocephalus with regard to the aetiology, clinical profile and outcome of VPS surgery.

MATERIALS AND METHODS

Study Area

Department of Paediatric Surgery, Medical College and Hospital, Kolkata.

Study Population

Patients attending Paediatric surgery outpatient department (OPD) and admitted in Paediatric surgery department, Medical College and Hospital, Kolkata and previous operated patients attending OPD.

Study Period

August 2016 - February 2018.

Sample Size

20 in numbers.

Sample Design

Prospective observational study.

Inclusion Criteria

All neonates with obstructive congenital hydrocephalus.

Exclusion Criteria

- Beyond neonatal period
- Acquired hydrocephalus.

Parameters to be Studied

- Informed consent from guardian of neonates
- Proforma for relevant history and Clinical Examination
- Weighing Machine, BP Machine, Stethoscope and light source
- Predetermined Proforma for tabulation of data:
  - Head circumference
  - Condition of Fontanelle and skull
  - Condition of eye/papilloedema
  - Motor function and deep tendon reflexes
  - Presence of any other obvious neurological disease like spinal dysraphism.
- Subsequent follow-up
  - 4 weeks
  - 8 week
  - 12 week
  - 6 months
  - 1 year.

Study Technique

Patients who had came in OPD in post-operative period with VPS in Paediatric Surgery OPD, MCH or admitted with VPS related complication are evaluated Clinically and by investigation.

It included newborn with hydrocephalus due to congenital causes with a minimum follow-up period of 12 months. A detailed record was maintained with regard to name, age, sex, aetiology, clinical features, investigations including imaging and treatment. All newborns underwent an initial ultrasonography of the brain (n = 20) through the window of anterior fontanelle to assess ventricular dilatation and ventricular: parenchyma thickness ratio followed by computed tomography (CT) scan. Magnetic resonance imaging was performed in cases where there was a structural lesion causing hydrocephalus. The device used was medium pressure slit valve shunt (Chhabra's Shunt). CSF flow in this type of shunt is pressure regulated and flow rate type. The whole shunt is radio-opaque. It is an economically viable shunt used extensively in India.[2] Details of complications necessitating shunt revisions and outcome were maintained in the follow-up.

RESULTS AND OBSERVATIONS

Out of 20 patient 11 (55%), 5 (25%), 4 (20%) patients were in 0–7, 8–14, and 15–28 days of age group, respectively [Table 1].

Table 1: Age distribution

Age Group	No of Cases	Percentage of cases
0–7 days	11	55
8–14 days	5	25
15–28 days	4	20
Total	20	100

The sex distribution of the patients male versus female were 7 (35%) and 4 (20%) in 0–7 days, 3 (15%) and 2 (10%) in 8–14 days, and 3 (15%) and 1 (5%) in 15–28 days, respectively [Table 2].

Enlarged head circumference was observed in 18 (90%) cases, bulged fontanelle, in 20 (100%), papilloedema in 3 (15%), impaired motor function in 2 (10%) and spinal dysraphism in 1 (5%) cases, respectively [Table 3].

The predominant cause of hydrocephalus was aqueductal stenosis in all 20 (100%) [Table 4].

Chhabra's medium pressure shunt was used in all neonatal cases with hydrocephalus in Ventriculoperitoneal (VP) shunt surgery [Table 5].

The peri and post-operatively broad-spectrum antibiotic vancomycin, menopenim, tazobactum for 2 weeks was prescribed after shunt implantation [Table 6].

Following Surgery the Schedule of Follow-Up was as Follow

Immediate (0–72 h): The following observations were noted during immediate period. Seizure was observed in 1 (5%) cases and under drainage of shunt was seen in 2 (10%) cases [Table 7].

Subsequent Follow Up

4 week – infection, malfunction of shunt, shunt blockage and shunt displacement was seen in 1 (5%) case each [Table 8].

8 weeks: Shunt malfunction, skull deformity, and seizure was noted in 1 (5%), 3 (15%), and 1 (5%) cases, respectively [Table 9].

12 weeks: Shunt malfunction was noted in 1 (5%) case [Table 10].

6 months: Infection was seen only in one 1 (5%) cases, shunt malfunction in 2 (10%) cases, and migration of shunt was noted in 1 (5%) cases, respectively [Table 11].

1 year: Shunt tube came out per rectum and migration of shunt was observed in 1 (5%) case each. Cognitive delay or regression, poor coordination was seen in 2 (10%) cases each. Whereas infection, seizure, ascitis, paraplegia was seen in none [Table 12].

Table 2: Sex distribution

Age group	No. of cases		Percentage of cases	
	Male	Female	Male	Female
0–7 days	7	4	35	20
8–14 days	3	2	15	10
15–28 days	3	1	15	5
Total	13	7	65	35

Table 3: Clinical features

Clinical features	No. of cases (%)
Enlarged head circumference	18 (90)
Condition of fontanelle (bulged)	20 (100)
Condition of eye (papilloedema)	3 (15)
Impaired motor function	2 (10)
Presence of any other obvious neurological disease like spinal dysraphism	1 (5)

Table 4: Aetiological distribution

Aetiology	No of Cases		Percentage	
	Congenital	Acquired	Congenital	Acquired
Aqueductal stenosis	20	0	100	0
Total	20	0	100	0

Table 5: Type of shunt used

Type of shunt	No of cases	Percentage
Chhabra's medium pressure shunt	20	100

Table 6: Management

Aetiology	No. of cases	Percentage in congenital group
Cases treated with shunt and broad-spectrum antibiotics	20	100%

Table 7: Immediate complications

Clinical parameters	No of cases (%)
Seizure	1 (5)
Under drainage	1 (5)
Subdural collection	1 (5)

Table 8: Complications at 4 weeks

Clinical parameters	No of cases (%)
Infection	1 (5)
Malfunction	1 (5)
Shunt block	1 (5)
Shunt displacement	1 (5)

Table 9: Complications at 8 weeks

Clinical parameters	No of cases (%)
Infection	0 (0)
Malfunction	1 (5)
Skull deformity	3 (15)
Seizure	1 (5)

Table 10: Complication at 12 weeks

Clinical parameters	No of cases (%)
Malfunction of shunt	1 (5)
Skull deformity	0 (0)

The seizure was seen in two cases (1 case during immediate period and 1 case at 8th week), under drainage in one case as an immediate complication, subdural collection in 1 case, infection in two cases (at 4th week and 6th month), shunt malfunction in 6 cases (1 during immediate period, 1 at 4th week, 8th week, 12th week, and at 6th month), shunt block was observed in 1 case (at 4 weeks), shunt displacement in 1 case (at 4th week), skull deformity in 3 cases (at 8th week), shunt migration in two cases (1 at 6th month and 1 at 1st year), perforation of gut/shunt tube come out per rectally in 1 case (at 1st year), cognitive delay in 2 cases (at 1st year), and poor coordination in 2 cases (at 1st year), respectively [Tables 13 and 14].

DISCUSSION

Enlarged head circumference with bulged fontanelle was the commonest presentation of hydrocephalus in the neonatal period. All patients included in this study underwent VP shunt during early neonatal period. Congenital aqueductal stenosis accounted for about 100% of all hydrocephalus cases in our study and in one case there was associated spinal dysraphism. Ahmed *et al.*[6] also reported aqueductal stenosis as the most common cause in a case series of 50 cases of hydrocephalus of different aetiology. All the cases taken in this study were with aqueductal stenosis.

Chhabra's medium pressure shunt was used in all neonatal cases with hydrocephalus in VPS surgery and judicious use of broad antibiotic post-operatively.[7,8]

There were 2 (8%) cases of infection noted in follow up period of 1 year, 1 (5%) as early complication and at the 8th week of follow-up period. However, this was controlled by judicious use of broad antibiotic antibiotics. There are earlier reports that the majority of shunt infection occur within the first few months after VPS surgery which is corroborative to our findings.[9,10] Jaykar *et al.*[11] reported that infection in 6 (10%) cases in a follow up of 60 patients and Christina *et al.*[8] observed shunt infection in 6 (12%) cases in 1 year follow up in a patient undergone VPS surgery. Our incidence of infection is slightly lower than these studies and this can be explained by the fact that our sample size was smaller (n = 20). While Romeo *et al.*[12] who reported 4.25% infection rate in VPS surgery in post haemorrhagic hydrocephalus.

Another hypothesis to explain the cause of shunt obstruction is that debris, such as blood and prtoteinacious fluid may gradually accumulate within and eventually occlude the thin catheter tubing. In fact, many surgeons have been worried about implanting a shunt in a patient with a high protein or red blood cells CSF content for the fear of early obstruction. This hypothesis may appear to be supported by the findings of some studies that suggest that shunt malfunction may be slightly more frequent among patients with intracranial haemorrhage as the aetiology of hydrocephalus.[6]

Table 11: Complications at 6 months

Clinical parameters	No of cases (%)
Infection	1 (5)
Shunt malfunction	2 (10)
Migration of shunt	1 (5)
Relative shortening of shunt.	0 (0)

Table 12: Complications at 1 year

Clinical parameters	No of cases (%)
Infection	0 (0%)
Seizure	0 (0)
Ascites	0 (0)
Shunt tube came out per rectally	1 (5)
Migration of shunt	1 (5)
Cognitive delay or regression	2 (10)
Poor coordination	2 (10)

Table 13: Overall complications at 1 year

Complications	Immediate 0–72 h	4 weeks	8 weeks	12 weeks	6 months	1 year	Total
Seizure	1		1				2
Under drainage	1						1
Subdural collection	1						1
Infection		1			1		2
Shunt Malfunction	1	1	1	1	2		6
Shunt block		1					1
Shunt displacement		1					1
Skull deformity			3				3
Shunt Migration					1	1	2
Ascites							0
Shunt tube came out per rectally						1	1
Cognitive delay						2	2
Poor coordination						2	2

Table 14: Mortality chart

Causes of Mortality	No of cases	Percentage
Shunt failure and increased Intracranial pressure	1	(5)
Shunt Infection and meningitis	1	(5)
Total	2	(10)

Perforation of the gut was noted 1 year of this can be explained by the allergy of silicone. Although allergy of silicone is rare, patients with such an allergy also receive a VP shunt may develop perforation through the bowel as well as through the abdominal wall and other skin erosions around distal catheter.[10-13]

Migration of shunt was observed in 1 (5%) of case. Ahmed *et al*.[7] also reported shunt migration in 5 (10%) cases in follow-up in 50 cases of VPS surgery. This increased incidence of migration of shunt can be explained by the fact that the sample size is 50 while in our study it was 20.

In our study developmental milestones like cognitive delay and poor coordination was seen in 2 (10%) cases each and altogether in 4 (20%) cases. Ahmed *et al*.[7] reported similar findings of delayed developmental milestone in 10 (20%) cases in 1 year of follow up study of outcome of VPS surgery in a series of 50 cases. There was mortality in 2 (10%) cases at 1 year. Christina *et al*.[8] death in 4 (1.6%) cases in a post-operative follow-up study of VPS surgery of 253 patients. Pal *et al*.[7] reported deaths in 14 (8.97%) cases among 60 adults most of which occurred within 1st month of surgery.

Hydrocephalus is a common disorder of the central nervous system in infant and children principally caused by congenital aqueductal stenosis. Early Surgical interaction by VPS represents the partially amenable improvement of quality of life.

CONCLUSION

VPS can be safely done for hydrocephalus at the early neonatal period with acceptable rate of complications and shunt malfunction. Further studies and follow-up for longer duration to be tailored to minimise the complications, best shunt survival and outcome of the patients.

Limitations

- Because of the short time frame of this study, and nature of the study population, the sample size was small
- The study group was conducted purely on Indian (mostly patients from eastern India) ethnic background
- There is a single centre study and we cannot say with certainty whether these results are applicable to other settings or populations.

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