

# COMPLICATIONS OF VENTRICULO-PERITONEAL SHUNT IN PEDIATRIC POPULATION

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## ABSTRACT

**BACKGROUND:** Disorders of the central nervous system can be very distressing at any time of life, particularly in children. Hydrocephalus is the most common problem encountered by pediatric neurosurgeons and is a disorder for which there is no absolute cure. Still most common and effective treatment of hydrocephalus in practice is a surgical placement of a ventriculo-peritoneal shunt. This study was conducted to determine frequency of different types of ventriculo-peritoneal shunt complications in pediatric population

**METHODS:** This cross sectional study was conducted at DHQ Teaching Hospital Gomal Medical College D.I.Khan, Pakistan from 20-11-2014 to 20-11-2015. All those patients who were operated for hydrocephalus with ventriculo peritoneal shunt inserted, aged 5 months to 12 years, were included. While patients operated for other pathologies with no ventriculoperitoneal shunts were excluded. Patient's particulars and any complication of shunt were documented on a predesigned proforma. Patients were followed till 6 months post operatively. Spss version 20 was used for data analysis and represented in the form of graphs and charts.

**RESULTS:** Total 97 patients were included in the study in which males to females ratio was 1.55:1. Patients were in the age range of 5 months to 12 years and mean age was  $4.5 \pm 5SD$ . The most common etiology of hydrocephalus was aqueductal stenosis having 58(59.79 %) followed by the myelomeningocele related in 17(17.52%) cases. Complications upto 6 months post operatively were 12(12.37 %) cases of shunt obstruction, 5(5.15 %) patients developed shunt infection while seizures and exteriorization of lower end of shunt occurred in 2(2.06%) of cases.

**CONCLUSION:** The leading cause of hydrocephalus in pediatric population is aqueductal stenosis while post operative patients of ventriculo-peritoneal shunts mostly deteriorate due to shunt obstruction.

**KEY WORDS:** Complications, Ventriculo-Peritoneal Shunt, Shunt Obstruction, Shunt Infection.

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## INTRODUCTION

Disorders of the central nervous system can be very distressing at any time of life, particularly in children. Hydrocephalus is the most common problem encountered by pediatric neurosurgeons and is a disorder for

which there is no absolute cure. Hydrocephalus is derived from a Greek word literally meaning "watery head." Hydrocephalus is a condition not a disease. Regardless of the cause, the result is an abnormal or excessive accumulation of CSF within the brain. It

is also defined as "Abnormality in formation, Flow and Absorption of the CSF resulting into raised Intracranial Pressure" (Northfield Neurosurgery). The natural history of untreated hydrocephalus is disabling disfigurement and retardation that heralds a bleak future for a great majority of patients with hydrocephalus<sup>1,2</sup>.

Still most common and effective treatment of hydrocephalus involves a surgical placement of a V.P. shunt. V.P. Shunt comprises ventricular catheter, peritoneal catheter and reservoir with pressure control chamber. The shunt allows excess to the obstructed CSF to be drained from the brain to the peritoneum. This modified drainage of CSF prevents the dangerous accumulation of CSF, the continual rise in intracranial pressure, and subsequently, brain injury. V.P. Shunt was first introduced specifically for the treatment of hydrocephalus<sup>3</sup>. Other surgical procedure which are recommended in obstructive hydrocephalus are Third Ventriculostomy and Ventriculo-atrial shunt and others. It has been over a century, when the first cerebrospinal fluid (CSF) shunt surgery, and ventriculoperitoneal (VP) shunt insertion for the treatment of hydrocephalus was performed and since then it has been performed routinely. Although the condition in the past had invariably led to the patient's death or severe clinical deterioration. But now a days its quite safe and has greater benefit upon the quality of survival in patients with hydrocephalus.

Shunt complications can be categorized into four major groups: (1) infection (2) mechanical failure (3) functional failure (4) displacement. These above complications put patients at increased risk for intellectual impairment and even death. The management of these complications may require revision of V.P. Shunt and an additional surgery with all its risks. Finally, from an economical point of view, each malfunction doubles the cost of the treatment<sup>4</sup>.

Objective of the current study is to know about the frequency of different types of ventriculoperitoneal shunt complications. This study is important on this aspect that it will create a base

for future research. By comparing the results of our study with both local and international studies it will show any drawback in our set up in terms of sterilization and technique of insertion and so this will be a step for patient betterment and care.

**MATERIAL & METHODS**

After taking consent from the hospital ethical research committee this study was started on the postoperative patients of ventriculoperitoneal shunt of both gender and age in range from 5 months to 12 years. All those post operative patients operated for other pathologies of brain and spine without ventriculoperitoneal shunt were excluded from the study. Before starting study, proforma was made for data collection containing patient particulars and post operative complications of ventriculoperitoneal shunt. Data collection was done according to the proforma. All data analysis was done by spss version 20 and represented in graphs and charts.

All those patients who were planned to be operated for hydrocephalus with ventriculoperitoneal shunt insertion were evaluated by history and physical examination. Necessary radiological investigations like CT brain or MRI of brain with and without contrast were done. Blood work like complete blood count, Hepatitis B and C serology, RFTs, LFTs, PT/APTT were done. CSF analysis was also done. An informed consent was taken along with explaining the possible complications after procedure was taken. Then ventriculoperitoneal shunting was done.

Post operatively all the patients were followed up till 6 months and any complication which occurred was documented. At the end of 6 months, frequency of different types of complications of ventriculoperitoneal shunt in pediatric population was determined.

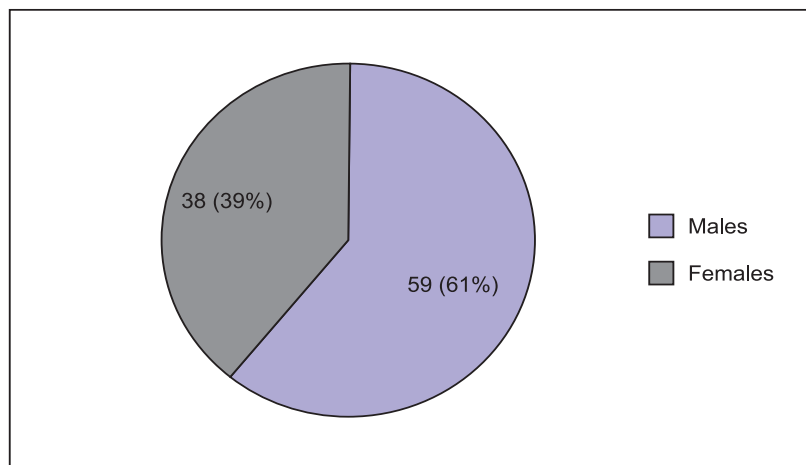
**RESULTS**

Total 97 patients were included in our study in which males were 59(60.82%) and females were 38(39.17%)(Figure no 1). All the patients were in the age range of

5 months to 13 years with a mean of 4.5 ±5 SD. Regarding etiology of hydrocephalus, the most common cause was aqueductal stenosis having 58(59.79%), associated with myelomeningocele were 17(17.52%), cases followed by meningitis were 12(12.37%) and remaining 10(10.30%) were associated with brain tu-

mors( Table no 1). Total 21(21.64%) patients suffered from different form of shunt complications. Out of 21 patients 12(57.14%) were due to shunt obstruction, 5(23.80%) of shunt infection, 2(9.52%) developed post operative seizures, 2(9.5%) had exteriorization of lower end of shunt through abdominal incision (Table no 2).

**FIG 1: GENDERWISE DISTRIBUTION OF PATIENTS (n=97)**



**TABLE 1: ETIOLOGY OF HYDROCEPHALUS (n=97)**

Etiology of HCP	No of patients	Percentage of patients
Due to aqueductal stenosis	58	(59.79%)
Associated with MMC	17	(17.52%)
Post meningitis HCP	12	(12.37%)
Associated with brain tumors	10	(10.30%)

**TABLE 2: COMPLICATIONS OF VENTRICULO-PERITONEAL SHUNT (n=97)**

Names of complications	No of patients	Percentage of patients
Shunt obstruction	12	12.37%
Shunt infection	5	5.15%
Post shunt seizures	2	2.06%
Exteriorization of lower end of shunt	2	2.06%

**DISCUSSION**

Ventriculo-Peritoneal (VP) shunt placement remains the mainstay treatment for pediatric hydrocephalus. These devices have a relatively high complication and failure rate, often requiring multiple revision. Jonathan J et al<sup>5</sup> conducted retrospective

study based on chart review on all pediatric patients who underwent VP shunt placement from January 1990 through November 1996 at the University of Rochester Medical Center. They documented that total 234 procedures were performed on 64 patients, with a mean follow-up of 19.9 years. Patients ranged from a

few days to 17.2 years old when they received their original shunt, with a median age of 4 months; 84.5% of the patients required 1 or more shunt revisions and 4.7% required 10 or more. Congenital defects, Chiari Type II malformations, tumors, and intraventricular hemorrhage were the most common causes of hydrocephalus. Overall, patients averaged 2.66 revisions, with proximal (27%) and distal (15%) catheter occlusion, disconnection (11%), and infection (9%) comprising the most common reasons for shunt malfunction. Notably, 12.5% of patients did not require their first shunt revision until more than 10 years after initial device placement, a previously undescribed finding due to the short follow-up duration in previous studies<sup>5</sup>. In current study also the most common cause is aqueductal stenosis having 58(59.79%) cases. The most commonly shunt complication was shunt obstruction which occurred in 12(12.37%) followed by shunt infection with 5(5.15%). Ventriculoperitoneal (VP) shunt is one of the commonest procedures in neurosurgical practice. A significant problem encountered in shunt procedures is infection, with infection rate ranging from 2 to 27%, often with poor outcome<sup>6,7,8,9,10</sup>. So in our pediatric population the rate of ventriculoperitoneal shunt infection is within internationally quoted range. A VP shunt complication is a major obstacle in the management of hydrocephalus. Further, it is conceivable that the features of VP shunt complication can differ according to a patient's age and the etiology of the hydrocephalus. The incidence of complications following VP shunt placement is reported to be around 20 to 40%. However, Stone et al. reported 84.5% of their patients had required shunt revision on 15 year follow up of pediatric shunt surgeries. Stein and Guo reported the 5 year

shunt survival rates in children and adults, estimated using mathematical model, were 49.4 and 60.2%, respectively. Even though patient deaths are greater in adults with shunt insertions, shunts in adults fail more slowly and tend to survive longer than those in children. The incidence of shunt failure is higher in the first six months following the VP shunt. The cause of shunt malfunction is different according to the time interval following VP shunt placement<sup>11,12,13,14,15</sup>. In our study total 21(21.64%) patients developed complications but our post operative follow up duration is for 6 six months and this is why our complications of ventriculoperitoneal shunt are less as compared to the above mentioned studies.

### CONCLUSION

Ventriculoperitoneal shunt is a common procedure which is performed in day to day life for treatment of hydrocephalus. The most common complication in pediatric population is shunt obstruction. The more the time passes after procedure, the more complications develop mainly due to shunt hardware failure. Therefore it is suggested that post operative patients should be followed for prolonged duration.

### REFERENCES

1. Sherman C, Guo W. Have we made progress in preventing shunt failure? A critical analysis. *Neurosurg.*: Pediatrics / Volume 1 / January 2008
2. Cindy Julius Simpkins. *Pediatric Nursing*. November-December 2005/Vol. 31
3. Schreffler R, Schreffler A, Wittler R. Treatment of cerebrospinal fluid shunt infections: a decision analysis. *Pediatric Infectious Disease Journal*. 2002;21(7):632-636.
4. Mc Girt M, Wellons J, Nimjee S, Bulsara K, Fuchs H, George, T. Comparison of total versus partial revision of initial ventriculoperitoneal shunt failures.

*Pediatric Neurosurg*. 2003;38:34-40.

5. Jonathan J, Walker CT, Jacobson M, Phillips V, Silberstein HJ. Revision rate of pediatric ventriculoperitoneal shunts after 15 years. *JNS*. Jan 2013;11(1):15-19.
6. Kaufman BA, Mc Lone DG. Infection of cerebrospinal fluid shunts, In : Infection of the central nervous system, Scheld WM, Whitley RJ, Durack DT (Editors). Raven press: New York; 1991. p. 561-85.
7. Morrice JJ, Young DG. Bacterial colonization of holter valves; a ten-year survey. *Dev Med Child Neurol*. 1974;16:85-90.
8. Olsen L, Fryberg T. Complications in the treatment of hydrocephalus in children. *Acta Paediatr Scand*. 1983;72:385-90.
9. Schoenbaum SC, Gardener P, Shillito J. Infections of the cerebrospinal fluid shunts; epidemiology, clinical manifestation and therapy. *J Infect Dis* 1975;131:543-52.
10. Sells CJ, Shurtleff DB, Loeser JD. Gram negative cerebrospinal fluid shunt associated infections. *Pediatr* 1977;59:614-8.
11. Al-Tamimi YZ, Sinha P, Chumas PD, Crimmins D, Drake J, Kestle J, et al. Ventriculoperitoneal shunt 30-day failure rate : a retrospective international cohort study. *Neurosurgery*. 2014;74:29-34.
12. Farahmand D, Hilmarsson H, Högfeldt M, Tisell M. Perioperative risk factors for short term shunt revisions in adult hydrocephalus patients. *J Neurol Neurosurg Psychiatry*. 2009;80:1248-1253.
13. Reddy GK, Bollam P, Caldito G. Long-term outcomes of ventriculoperitoneal shunt surgery in patients with hydrocephalus. *World Neurosurg*. 2014;81:404-410.
14. Stein SC, Guo W. A mathematical model of survival in a newly inserted ventricular shunt. *J Neurosurg*. 2007;107(6 Suppl):448-454.
15. Stone JJ, Walker CT, Jacobson M, Phillips V, Silberstein HJ. Revision rate of pediatric ventriculoperitoneal shunts after 15 years. *J Neurosurg Pediatr*. 2013;11:15-19.

#### CONFLICT OF INTEREST

None declared.

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NIL

**Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.**