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ORIGINAL ARTICLE

CAUSES OF HYDROCEPHALUS AND COMPLICATIONS OF VP SHUNT IN PEDIATRIC POPULATION

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ABSTRACT

Background: Ventriculoperitoneal (VP) shunt is a common procedure for treatment of hydrocephalus. The objectives of the study were to determine the causes of hydrocephalus and complications of VP shunt in our pediatric population.

Materials & Methods: This descriptive, cross-sectional study was conducted in the Department of Neurosurgery, Gomal Medical College, D.I.Khan, Pakistan from January 2018 to January 2019. The sample size was 97 selected through consecutive, non-probability sampling technique using online sample size calculator, the Raosoft. The inclusion criteria were all pediatric patients with hydrocephalus. All those post-operative patient operated for other pathologies of brain and spine without VP shunt were excluded from the study. CT or MRI of brain with and without contrast were done. Post operatively all the patients were followed up till 6 months and any complication which occurred were documented. Demographic variable were sex and age in years. Research variables were causes of hydrocephalus and post-operative complications of VP shunt. All variables except age in years being categorical were analyzed through frequency and percentages. Age was calculated by mean and SD using SPSS version 20.

Results: Out of 97 patients, boys were 59(60.82%) and girls were 38(39.17%). The mean age of the sample was 4.5 ±5 ranging from 5 months to 13 years. The most common cause was aqueductal stenosis having 58(59.7 %), myelo-meningocele were 17(17.7%), post meningitis were 12(12.3%) and remaining 10(10.3%) were associated with brain tumors. Out of 21 patients 12(57.2%) developed shunt obstruction, 5(23.8%) shunt infection, 2(9.5%) developed post-operative seizures, 2(9.5%) had exteriorization of lower end of shunt through abdominal incision.

Conclusion: The most common cause of hydrocephalus is acqueductal stenosis. The most common complication of VP shunt is shunt obstruction in pediatric population, having pre-school boys as modal group.

KEY WORDS: Complications; Ventriculoperitoneal shunt; Pediatric population; 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 cerebrospinal fluid (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.[1,2]

Still most common and effective treatment of hydrocephalus involves a surgical placement of a Ventriculoperitoneal (VP) shunt. VP Shunt comprises ventricular catheter, peritoneal catheter and reservoir with pressure control chamber. The shunt allows excess 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. VP Shunt was first introduced specifically for the treatment of

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hydrocephalus.[3] 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 nowadays 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; infection, mechanical failure, functional failure and displacement. These above complications put patients at increased risk for intellectual impairment and even death. The management of these complications may require revision of VP Shunt and an additional surgery with all its risks. Finally, from an economical point of view, each malfunction doubles the cost of the treatment.[4]

Rationale of the current study was to know about the causes and complications of different types of VP shunt. This study was 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 insertionnd and so this will be a step for patient betterment and care. The objectives of the study were to determine the causes of hydrocephalus and complications of VP shunt in our pediatric population.

MATERIALS AND METHODS

This descriptive, cross-sectional study was conducted in the Department of Neurosurgery, Gomal Medical College, D.I.Khan, Pakistan from January 2018 to January 2019. The sample size was 97 selected through consecutive, non-probability sampling technique using online sample size calculator, the Raosoft.[16] The inclusion criteria were all pediatric patients with hydrocephalus. All those post-operative patient operated for other pathologies of brain and spine without VP shunt were excluded from the study.

After taking consent from the hospital ethical research committee, a proforma was designed for data collection. All those patients who were planned to be operated for hydrocephalus with VP 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 from all the patients. Post operatively all the patients were followed up till 6 months and any complication which occurred were documented.

Demographic variable were sex and age in years. Research variables were causes of hydrocephalus (aqueductal stenosis, myelomeningocele, post meningitis, brain tumors) and post-operative complications of VP shunt (shunt obstruction, shunt infection, post shunt seizures, exteriorization of lower end of shunt). All variables except age in years being categorical were analyzed through frequency and percentages. Age was calculated as mean and SD using SPSS version 20.

RESULTS

Out of 97 patients, boys were 59 (60.82%) and girls were 38 (39.17%). The mean age of the sample was 4.5 ±5 ranging from 5 months to 13 years. The most common cause was aqueductal stenosis having 58 (59.7 %), myelo-meningocele were 17 (17.7%), cases followed by meningitis were 12 (12.3%) and remaining 10 (10.3%) were associated with brain tumors. (Table no 1)

Table 1: Causes of hydrocephalus in pediatric population of D.I.Khan, Pakistan (n=97)

S. No.	Cause	Frequency	Percentage	95% CI of Proportion
1	Aqueductal stenosis	58	59.7	50.0 - 69.5
2	Myelo-meningocele	17	17.7	9.9 - 25.0
3	Post meningitis	12	12.3	5.8 - 18.9
4	Brain tumors	10	10.3	4.2 - 16.3
Total		97	100.0	--

Table 2: Complications of VP shunt in pediatric population of D.I.Khan, Pakistan (n=97)

S. No.	Names of complications	Frequency	Percentage	95% CI of Proportion
1	Shunt obstruction	12	57.2	47.3 - 67.0
2	Shunt infection	5	23.8	15.3 - 32.2
3	Post shunt seizures	2	09.5	3.6 - 15.3
4	Exteriorization of lower end of shunt	2	09.5	3.6 - 15.3
Total		21	100.0	--

Total 21 patients suffered from different form of shunt complications. Out of 21 patients 12 (57.2%) were due to shunt obstruction, 5 (23.8%) of shunt infection, 2 (9.5%) developed post-operative seizures, 2 (9.5%) had exteriorization of lower end of shunt through abdominal incision. (Table no 2)

DISCUSSION

Ventriculoperitoneal (VP) shunt placement remains the mainstay treatment for pediatric hydrocephalus. These devices have a relatively high complication and failure rate, often requiring multiple revision. Jonathon J et al 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 a total of 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.[5]

In current study also the most common cause is aqueductal stenosis having 58 (59.79%) cases. The most common shunt complication was shunt obstruction which occurred in 12 (12.37%) followed by shunt infection with 5 (5.15%). Ventriculoperitoneal 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.[6-10] So in our pediatric population the rate of ventriculoperitoneal shunt infection is within internationally quoted range.

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 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. [11-15] 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. 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 prolong duration.

CONCLUSION

The most common cause of hydrocephalus is acqueductal stenosis. The most common complication of VP shunt is shunt obstruction in pediatric population, having pre-school boys as modal group.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	SN, FH
Acquisition, Analysis or Interpretation of Data:	SN, FH, SK, SR, NS, SA
Manuscript Writing & Approval:	SN, FH, SK, SR, NS, SA

All the 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.