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Original Article

Long-Term Outcomes of Ventriculoperitoneal Shunt Surgery in Patients with Hydrocephalus

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ABSTRACT

For the treatment of hydrocephalus, VP shunt surgery is considered the most appropriate method of treatment, but this treatment has a number of complications, it needs to be replaced after the failure of the previous shunt. **Objective:** To evaluate the different regulatory factors involved in the failure of Shunt surgery, the initiation point of shunt failure, and the number of shunt surgeries required after first shunt treatment. The time duration required for shunt failure was also considered to evaluate the lifelong experience with this VP shunt surgery. **Methods:** It is a retrospective study with a statistical approach. This study was conducted in Neurosurgery unit, Mardan medical complex / Bacha khan medical college, Mardan for the Duration of One year August 2020 to July 2021. Patients suffering from hydrocephalus undergoing shunt surgery visited the neurosurgery unit of Mardan Medical complex, Bacha Khan Medical College were included in the study. Complete information related to the etiology, imaging results, demographic distribution, surgery reports, and medical follow-ups were analyzed thoroughly. **Results:** About 25 patients having VP shunt surgery were selected; their average age was above 60 years. The median mean of the follow-ups were 6 and 9 respectively. Patients with having age of more than 18 years are considered adult patients and constituted of the 70 % of the total. The rate of shunt failure was estimated, it was about 46.2 %. The pediatric patients are more prone to shunt failure than the adult ones. Different factors are involved in shunt replacement but age and sex have a major role. Shunt replacement time is quite low in young patients. While in case of age, male patients have a greater number of shunt replacements within their lifespan. **Conclusion:** The results inferred that age has a particular role in the triggering of shunt failure, many other factors are also associated independently to increase the rate of shunt failure. There is a need for controlled studies to understand the link between risk factors and shunt failure rate.

INTRODUCTION

The primary treatment for the patients suffering from hydrocephalus is the bypassing of CSF (cerebrospinal fluid) from the ventricles to the peritoneum and this method is thought to be the more effective method for the treatment. In this disease, fluid initiate to build inside the cavities within the brain, Due to excess amount of fluid, the size of ventricles is enhanced and pressurized the cavity inside the brain [1,2]. If the patient does not recover, then secondary treatments are provided to initiate the recovery process. The third method of treatment is ventriculostomy. The first method of treatment is effective by bypassing spinal fluid required a number of surgeries and revisions of these surgeries, this thing makes it quite complicated and expensive. This method also creates a number of other complications and put pressure on social and medical budgets. The failure of different surgeries also took place in distal and proximal regions [3-5]. Apart from all adverse effects of primary treatment of the disease, a number of other methods are also used for the treatment of the disease such as neurosurgery. The primary method of treatment by bypassing the cerebrospinal fluid has been proved useless in a number of patients, there is a need to replace and regularly monitor the shunt. But previous studies support this method of VP shunt, this method

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improves neurological outputs. A number of risk factors play their role in the failure of the shunt treatment such as demographic distribution of patients, etiology, and type of disorder. A number of other regulatory factors play their role in the failure of the VP shunt method [6]. A few recent studies suggest that the etiology of this disease, sex, and age of the patient have no significant effect on the incidence of failure of this shunt treatment, but other factors play their role in the initiation of failure of the disease. However, if a patient has some kind of tumor in some cranial tissues along with hydrocephalus disease, this tumor independently induces the initiation of failure of the VP shunt surgery, and it triggers the need for a new bypass for the Cerebrospinal fluid. About 25 patients with this VP shunt surgery were tested for the failure of surgery and all the factors related to the failure were considered [7-9].

METHODS

This study was conducted in Neurosurgery unit, Mardan medical complex / Bacha khan medical college, Mardan for the Duration of One year August 2020 to July 2021. The selection of patients was already defined within the introduction, demographic distribution, etiology, age, and sex are all considered. By using different databases, patients were diagnosed with hydrocephalus and were previously treated with VP shunt treatment. Patients were selected from December 2020 to December 2021 for the study of VP shunt failure [10]. Patients having VP shunt surgery were completely assessed by using medical charts for their symptom analysis, results of imaging by ultrasonography, reports of their surgery, and follow-up. The protocol of this surgery was also analyzed to find whether it is approved by CDC (Center for disease control) or not. For more accuracy, the authenticity of the results was also confirmed. Information related to the different factors involved in the failure of shunt treatment, date of treatment initiation, date of replacement of shunt, date of all revisions, and malfunctioning zone and failure were also analyzed [11]. The primary purpose of this research work was to find the number of revisions required after first shunt surgery, the rate of shunt replacement, and all the linked factors involved in the initiation of failure of shunt surgery. Shunt replacement or revision means replacing it with a new shunt or bypass after the first insertion within the patient. When patients were diagnosed, about eight different groups of etiology were observed [12-13]. These etiology groups were idiopathic, cysts, hemorrhage in the cerebral, dysraphism of the spinal, post-traumatic, post-craniotomy, and congenital. Some other etiologies were also observed such as stenosis of an aqueduct, meningitis, and many more [14]. For the comparison of shunt failure rates in different groups, the Fisher test was used. The group that has a variable shunt failure rate and is not comparable to the Fisher test, was analyzed by the Wilcoxon test. A regression test was used to find out the shunt revisions. Kaplan Meier test was used for survival prediction of the shunt in different time durations. When the probability value of a particular test came out less than 0.05, it was considered significant statistically [15].

RESULTS

The study had 25 patients that participated and VP shunt surgery was carried out on them. At the time of the surgery the median age in the studied patients was 42 and range was from 0-90. Of the 25 patients that were selected 8 (30%) were patients having pediatric problems. These patients had age less than 17 years. The 17 (70%) of the patients were adults at the time of shunt surgery placement. The highly observed conditions were tumor and cyst in 24% of the patients. 19% had cerebral hemorrhage, 19% were with idiopathic issues, and 10% and 8% had congenital and posttraumatic illness respectively. Among all the types of hydrocephalus that was observed, obstructive hydrocephalus was found in 50% of the patients. There were 28% cases of communicating hydrocephalus and 12% cases of normal pressure hydrocephalus found among the patients. The other types represented 8% of the participants of this study (Table 1).

Variable	Number of participants (n= 25)	Patients with revisions (n=10)	p-value
Sex	12 (49%)	4 (48%)	<0.01
Male	12 (49%)	5(48%)	
Female	13 (51%)	4 (44%)	
Ethnicity			<0.01
White	15 (62%)	4 (41%)	
Black	9 (36%)	5 (50%)	
Other	1 (1%)		
Age group			<0.01
Pediatric less than 17years	8 (30%)	7 (70%)	
Greater than 17 years age	17 (69)	3 (30%)	
Process before insertion of shunt			<0.01
Yes	4 (17%)	3 (30%)	
No	20 (83%)	6 (60%)	
hydrocephalus etiology			<0.01
Tumor	6 (24%)	2 (2%)	
Cerebral hemorrhage	5 (20%)	6 (60%)	
Idiopathic	5 (20%)	2 (20%)	
Congenital	2.5 (10%)	8 (80%)	
Posttraumatic	2 (8%)	4 (40%)	
Spinal dysraphism	2 (8%)	5 (50%)	
Postcraniotomy	1 (4%)	1 (10%)	
Other	2 (8%)	5 (50%)	
Hydrocephalus type			<0.01

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Obstructive	12 (25%)	5 (50%)	
Communicative	7 (28%)	4 (40%)	
Normal pressure hydrocephalus	3 (12%)	1 (10%)	
Other	2 (8%)	7 (70%)	

Table 1: Patients Demographics and Rate of Shunt Revisions

Off the 25 patients that were 4 (17%) had already procedures done before the VP shunt surgery. The follow up time means of the included patients, after the initial surgery was calculated as 9 years (Table 2).

Shunt revisions	Pediatric patients	adults	Total
Total patients	8	17	25
Shunt revisions	5 (70%)	6 (40%)	
Mean number of revisions per patient	2	0.6	

Table 2: Patients suffering from Hydrocephalus

DISCUSSION

Although there are advances in the CSF diversionary treatments, improved shunt hardware and endoscopic techniques still the treatment of hydrocephalus is one of the biggest challenges that scientist face right now. Especially because shunting comes with many shunting failures that's why it's malfunctioning provides the scientists with great challenge while designing its treatment [16]. Most of the patients with shunt treatment face this problem in their life that their shunt stops working and it results in failure. Then they had to carry out shunt revisions. As most of the invasive treatment s involve risks and complications it is very important to identify the risk factors that can adversely affect the treatment procedure. Therefore, here a long term analysis was carried out to look for perioperative complications for shunt survival in a small group of patients [17]. One of the limitation is its retrospective study designs. Retrospective study design make the study biased in a randomized controlled trait. Also the diagnostic and the procedure of treatment has no predefined scheme which makes the interpretation biased. Analyzed way cannot be used to study the factors included in present study [18]. The studies revealed that the occurrence rate of shunt revisions in participated patients is 46%. Infants had a greater rate of shunt revisions as compared to adult patients. (78% vs 32%). The incident rates of shunt revisions that we got in our studies matched with the previous reports. The complication rate of shunt treatment in adults with hydrocephalus was obtained as 20%. Berry et al., reported that in a 5-year duration, the infant patients received 24 shunt revisions. Other studies have shown that 14% of the infant patients experienced shunt blockage just in the first month of their treatment. And 40-50% of the patients had reported the shunt failure after the surgery. The shunt complication if take place early prove to be very problematic for patients. There is need of close monitoring that is required especially during the early few months of the treatment [19]. Studies have reported that type of hydrocephalus, age, etiology, all these factors play important role in causing risk in early shunt failures. Other studies also support these findings that shunt revisions are linked to age, etiological factors, and type of hydrocephalus. Our findings also showed that the age at which the shunt treatment is carried out plays important role in deciding the shunt revisions in multicenter study carried out by Shah et al., it was found that the infants have greatest chances of shunt revisions and the rate of shunt failures increases with each shunt revision. Another study carried out by Tuli et al., demonstrated that the age at which the first shunt is inserted into the patient is most important factor and it plays role in further shunt revisions [20]. Therefore, the multiple shunt revisions need more aggressive clinical follow-up as the shunt failure risk is greater now. However, there are many other risk factors also that plays important role in shunt revisions of the patient. The studies indicate that the complication of shunt revision after the application of initial shunt surgery as well as successive shunt surgeries is time dependent aspect. The Kaplan – Meier survival curve that is drawn to show initial deep slope then it is followed by a steady and balanced slope with the passage of time, which shows that in case of most of the shunt revisions, the revision take place whether it was subsequent or initial shunt surgery [21]. Normally the first steep slope shows the complications that are linked to air-borne contaminations produced during the surgery. Whereas the next slope tells us about the risk and complications those come with the shunt itself. All these studies further support that the deeper steep slope was observed in case of pediatric patients as compared to the non-pediatric patients. Therefore, we can say that these findings show that the shunt revisions percentage incidence is much elevated in infant patients as compared to the adults just after the procedure of initial shunt surgery [22]. In this study we found that the shunt revisions and the associated factors with the failure of shunt procedure in small population. There were multiple risks that were involved in shunt treatment and there were many risks involved after initial shunt application.

CONCLUSION

The retrospective study was carried out top look for the shunt revision rates and the factors that were linked with the failure of suing shunt treatment. There were multiple factors that contributed and it was found that there exists a strong link between the risk factors and shunt survival. Therefore, these complications contribute to decide the shunt survival rates. VP shunt is an effective treatment for

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hydrocephalus however it is associated with infection blockage.

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