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Epidemiological and complication assessments of patients with ventriculoperitoneal shunts

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Abstract

This study aims to examine patients with ventriculoperitoneal shunts (VPS) used prevalently in the treatment of hydrocephalus epidemiologically, identify complications and present what can be done to reduce complications. Thirty-three patients who underwent ventriculoperitoneal shunt placement surgery between 2019 and 2021 at the neurosurgery department of a university hospital were examined retrospectively in terms of their epidemiology and complications using the hospital data. The most frequently observed complaint at admission was clouding loss of consciousness. There were significant differences between the patients who received revision operations after the first year following their surgery, which is the most frequently encountered period, and those who had revision operations within the first year ($p<0.001$). There were no significant differences between the patients who underwent revision operations and those who did not, in terms of the examined variables ($p>0.001$). In VPS surgery, which has frequent usage in the treatment of hydrocephalus, shunt dysfunction is usually caused by obstruction and infection. Some precautions can be taken to reduce the rates of these complications. Preoperative antibiotic use, the completion of the surgery in the shortest time possible, limiting entries and exits for the operating room, touching parts of the shunt as little as possible, and using neuro-navigation if possible are among the precautions that can be taken to minimize complications. To reduce mortality and morbidity rates, avoid unnecessary economic losses and prevent patients and their relatives from experiencing this stress, it is highly important to comply with these methods.

Keywords: Hydrocephalus, ventriculoperitoneal shunt complication, scrotal migration

Introduction

Hydrocephalus is a condition where cerebrospinal fluid (CSF) accumulates excessively in the ventricles as a result of its excess production and absorption problems in the brain. This situation causes increased intracranial pressure and secondary clinical symptoms. Hydrocephalus. which is seen congenitally at a rate of approximately 1-1.5 in every 1000 births [1] can also develop as an acquired disease and a complication of other acquired diseases. Its mortality and morbidity rates are high when it is not treated. or its treatment is delayed. A ventriculoperitoneal shunt (VPS) is one of the most prevalently used methods in the treatment of hydrocephalus [2].

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In this study. it was aimed to examine patients for whom VPSs were placed at our clinic epidemiologically. reveal their complications and present what can be done to reduce these complications.

Materials and Methods

After receiving the approval of the local ethics committee with the decision dated Apr 18. 2022. and numbered 83116987-264 for conducting the study. the epidemiology and complications of 33 patients with VPSs placed between 2019 and 2021 at the Neurosurgery Department of a University Hospital were retrospectively examined from the information management system of the hospital.

STATISTICAL ANALYSIS

In this study. the quantitative variables are expressed with mean and standard deviation values. whereas the qualitative variables are expressed with frequency and percentage values. The significance of the differences in the mean values of the quantitative variables was tested using independent-samples t-test for comparing two groups and one-way analysis of variance (ANOVA) for comparing

more than two groups when the normality assumptions were met. Cross-tables were created for comparing the qualitative variables. and Chi-Squared analysis was used to identify relationships between variables. Pearson's correlation coefficient was used for the quantitative variables. The calculations were made using a statistical software package (IBM SPSS Statistics 19. SPSS Inc.. an IBM Co.. Somers. NY). and the level of statistical significance was accepted as $p<0.01$.

Results

Thirty-three patients who underwent VPS surgery between 2019 and 2021 were evaluated. While 16 of these patients were female. 17 were male (Figure 1). The mean age was found 34.6 in all patients. 35.3 in the female patients. and 33.9 in the male patients.

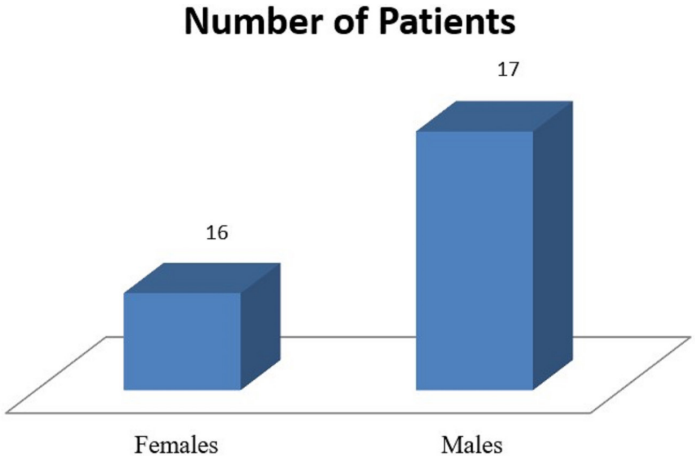

Figure 1. Patient number distribution based on sex

The most frequently encountered complications were obstruction and infection. Most of the CFS culture results of the patients who experienced infections indicated Staphylococcus epidermis. Nineteen patients underwent shunt revision operations. There were significant differences between the patients who received revision operations after the first year following their surgery. which is the most frequently encountered period. and those who had revision operations within the first year ($p<0.001$). The most frequent etiology was found as congenital hydrocephalus in 12 patients. This etiology was followed by tumors. post-traumatic hydrocephalus. and NPH. The most frequently reported complaint at admission was clouding-loss of consciousness. There were no significant differences between the patients who underwent revision operations and those who did not undergo revision in terms of the examined variables ($p>0.001$).

Surgery was performed on 2 patients for hydrocephalus that developed after subarachnoid hemorrhage (SAH). 1 patient for normal-pressure hydrocephalus (NPH). 2 patients for hydrocephalus that developed after tumor surgery. and 2 patients for hydrocephalus that developed after traffic accidents. One patient underwent shunt surgery due to idiopathic intracranial hypertension (İİHT). As their complaints at the time of arrival. 2 of the patients had trauma. 3 had seizures. 7 had a headache. 3 had nausea-vomiting. 8 had clouding of consciousness. 1 had swelling in the scrotum. 1 had visual impairment. 1 had fontanelle tension. 1 had a fever. 1 had slurred speech. 2 had swelling in their shunt traces. and 3 had balance disorders. Thirteen patients underwent revision surgery. The descriptive characteristics of the patients and the information related to the complications are as seen in Table 1.

Table 1. The descriptive characteristics of the patients and the information related to the complications

		n	%
Complication	Obstructıon	9	27.3
	Infectıon	5	15.2
	Malposıtıon	3	9.1
	Shunt rupture	2	6.1
	No complıcatıon	13	39.4
	Migration	1	3.0
Pathogen	No pathogen	29	87.9
	Enterococcus faecalis	0	0.0
	Staphylococcus epidermidis	2	6.1
	Staphylococcus haemolyticus	1	3.0
	Staphylococcus lugdunensis	1	3.0
Gender	Female	16	48.5
	Male	17	51.5
Etiology	Congenital	12	36.4
	Post-traumatic	4	12.1
	After SAH	3	9.1
	After ınfectıon	2	6.1
	NPH	4	12.1
	After tumor surgery	5	15.2
	İİHT	3	9.1
Post operatıve revısıon perıod	0	14	42.4
	1	3	9.1
	2	4	12.1
	3	12	36.4
Number of shunt revisions	0	15	45.5
	1	14	42.4
	2	2	6.1
	3	2	6.1
Hospital admission complaint	Epileptic seizure	3	9.1
	Headache	6	18.2
	Nausea-vomiting	3	9.1
	Trauma	1	3.0
	Fontanel tension	3	9.1
	Fever	2	6.1
	Confusıon	11	33.3
	Swelling in the shunt tracing	3	9.1
	Scrotal swelling	1	3.0
	Defect of vision	0	0.0
Epilepsy	No	29	87.9
	Yes	4	12.1
Headache	No	26	78.8
	Yes	7	21.2
Nausea-vomiting	No	30	90.9
	Yes	3	9.1
Trauma	No	31	93.9
	Yes	2	6.1
Fontanel tension	No	30	90.9
	Yes	3	9.1
Fever	No	29	87.9
	Yes	4	12.1
Confusıon	No	19	57.6
	Yes	14	42.4
Swelling in the shunt tracing	No	30	90.9
	Yes	3	9.1
Scrotal swelling	No	32	97.0
	Yes	1	3.0
Defect of vision	No	30	90.9
	Yes	3	9.1

Discussion

An increased head circumference and fontanelle tension in the pediatric age group are warning signs for hydrocephalus. Trans fontanelle ultrasonography and computed brain tomography (CBT) can be used in the diagnosis. In adults. clinical symptoms are headache. nausea-vomiting. seizures. and clouding of consciousness. The prominence of the temporal horns of the ventricle in CBT and the presence of edema caused by periventricular CSF migration are findings that are indicative of hydrocephalus. In our patients. the diagnosis of hydrocephalus was also made by CBT imaging. VPS is still the most frequently used method for the treatment of hydrocephalus today [3]. With VPS. the intracranial pressure is expected to return to normal. However. some complications may also occur in VPS surgery. as in other surgical procedures. The most frequently encountered complications are the obstruction and the infection of the shunt. Approximately 1/3 of patients with VPSs require revision due to various reasons within 1 year following surgery [4]. Revision operations were performed in 4 of our patients in the first month. Three patients underwent revision in the same week due to the cranial end malposition of the shunt. while 1 patient underwent revision at the 1st month due to shunt infection. It was determined that 8 patients with previous VPSs placement who presented with shunt dysfunction had cranial end obstruction. 1 patient had migration to the scrotum (Image 1). and the shunt was ruptured at different places in 2 patients (Image 2).

In the study conducted by Boran et al.. the most frequent cause of shunt dysfunction development in the pediatric age group was determined as shunt obstruction [5]. In our study. among the patients who underwent revision surgery. the most frequently encountered cause was also cranial end obstruction seen in 8 patients. The most frequently reported complaint at admission in our study was clouding-loss of consciousness. There were no significant differences between the patients who underwent revision operations and those who did not undergo revision in terms of the examined variables ($p>0.001$). There were significant differences between the patients who received revision operations after the first year following their surgery. which is the most frequently encountered period. and those who had revision operations within the first year ($p<0.001$).

Fever and shunt dysfunction in a VPS patient should be a cause of suspicion of shunt infection. In pediatric patients. fever. meningeal irritation signs. infection signs such as redness-swelling on the shunt trace. seizures and altered neurological stage can be observed [6]. In adult patients. fever can be accompanied by symptoms including headache and nausea-vomiting [7]. In our study. signs of infection were detected in 5 patients. The agents of infection were mostly Staphylococcus species. In one patient. the CSF culture taken during the shunt surgery revealed Enterococcus faecalis reproduction. but as there was no infection sign in the patient's follow-up. the shunt was working correctly. and the patient clinically got better. in the assessment made by pediatric doctors. this result was thought to be caused by contamination. No problem was encountered in the follow-ups of the patient.

In the patients who initially presented to the Neurology clinic due to complaints of headache. forgetfulness. and loss of vision. VPS surgery was carried out due to NPH in one and idiopathic intracranial hypertension in the other.

Image 1. Migration to the scrotum in a pediatric VPS patient

Image 2. VPS ruptured from the distal of the pump in the cervical region

VPS is still among the most frequently preferred treatment methods of hydrocephalus. In this surgery that involves the risk of several complications. mainly infection and obstruction. the rates of revision are considerable. To reduce the number of complications in this surgery. a fast surgical operation under maximally sterile conditions is needed. The shunt package should be opened right at the time of its usage. It was reported that antibiotics applied at the appropriate doses before surgery reduce the rate of infections [8]. Especially in cases where the ventricles are relatively small (e.g.. intracranial hypertension). the placement of the shunt under

the guidance of neuro-navigation can lower the rate of shunt malposition.

Conclusion

Consequently. in VPS surgery. which has frequent usage in the treatment of hydrocephalus. shunt dysfunction is usually caused by obstruction and infection. These are relatively preventable causes for reducing dysfunction rates. Some prevention methods may be listed as preoperative antibiotic use. the completion of the surgery in the shortest time possible. limiting entries and exits for the operating room. touching parts of the shunt as little as possible. and using neuro-navigation if possible. For reducing the rates of mortality and morbidity. avoiding unnecessary economic losses and preventing patients and their relatives from experiencing this stress. it is highly important to comply with these methods.

Conflict of interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical approval
Nokat Gaziosmanpaşa University Ethichs Board, Decision No. 83116987-264, Date: Apr 18, 2022

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