Endoscopic third ventricolustomy as treatment option for normal pressure hydrocephalus

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Abstract

This descriptive cross-sectional study was performed on 24 patients with normal pressure hydrocephalus who underwent endoscopic third ventriculostomy. The patients were selected by the available sampling method, and the data was collected through a researcher-made checklist. Data were analyzed using SPSS-26 software. Among 24 patients, 62.5% were male and the mean age was 70.85 ± 9.1 years. The results showed that there was no statistically significant relationship between age (p value = 0.43) and sex (p value = 0.37) with the success and failure rate of the surgical method. There was a significant difference between movement disorders (p value = 0.00) and dementia (p value = 0.00) before and after surgery, while there was no statistically significant difference between urinary disorders before and after surgery. (p value = 0.22). Endoscopic third ventriculostomy is an effective surgical method in the treatment of patients with normal pressure hydrocephalus and it improves the symptoms of movement disorder and dementia.

Key Words: Ventriculostomy; disorder; dementia, endoscopy.

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Hydrocephalus (HCP) can be defined as an abnormal accumulation of cerebrospinal fluid (CSF) in the ventricles of the brain resulting in increased intracranial pressure (ICP), and if the onset occurs during childhood, it can lead to an abnormal increase in head circumference of the newborn.[1] The disease is characterized by three clinical signs; gait and balance disorders are the most important symptoms, while with the progression of the disease, cognitive decline and urinary incontinence appear.[2] Gait and balance disorders are a combination of movement disorders, loss of correct postural reflexes, abnormal pursuit, and failure to suppress vestibulo-ocular reflexes.[3] Normal-pressure hydrocephalus (NPH) is a chronic disease observed in adults. The disease manifests as Adams-Hakim syndrome with a triad of urinary incontinence, cognitive impairment, and gait imbalance. In these patients, imaging findings show that the ventricles of the brain are dilated, but according to lumbar puncture, the cerebrospinal fluid pressure is normal.[4] Ventriculoperitoneal shunting is the first option for the treatment of normal pressure hydrocephalus, however, it has several complications, including shunt infection, excessive drainage, and shunt dysfunction such as obstruction, which may require surgical intervention or drug treatment.[5] The rate of shunt retention for 1 and 2 years was reported to be 61% and 47%, respectively. On the other hand, since ventriculoperitoneal shunting reduces the size of dilated ventricles, it may lead to ventricular rupture syndrome, which is associated with more complications if re-shunting is required.[4] Endoscopic third ventriculostomy (ETV) is a new method for the treatment of hydrocephalus in which, in addition to the fact that the patient does not need an implant, the risk of infection is low and the long-term treatment outcomes are observed to be excellent.[6] Numerous studies indicate the predominant effect of ETV in pediatric and adult patients, but considering the importance of treatment outcomes in these patients and the limited information on the treatment outcomes in the country, evaluation of the possibility of failure and response to treatment in normal-pressure hydrocephalus patients undergoing ETV is essential.[7]

Thus, the present study aimed to investigate the results of response to treatment in patients with normal pressure hydrocephalus undergoing endoscopic third ventriculostomy surgery.

Materials and Methods

Study Design

The present study is a retrospective descriptive cross-sectional study with practical objectives that was conducted from 2017 to 2021 in Imam Hossein Hospital, affiliated with Shahid Beheshti University of Medical Sciences in Tehran. The study population in this research included all patients with normal pressure hydrocephalus who were referred to Imam Hossein Hospital in Tehran between 2017 and 2021 and underwent endoscopic third ventriculostomy. A total of 24 patients, who met the inclusion criteria, were entered into the study after receiving informed consent.

After submitting the proposal to the Research Committee and the Ethics Committee of the Medical School of Shahid Beheshti University of Medical Sciences in Tehran and obtaining the necessary permits to collect the required information and data, the questionnaires were completed by patients. Patients were assured that all their information would remain strictly confidential. After completing the questionnaires, the collected information was analyzed using statistical methods.

Inclusion and exclusion criteria

Inclusion criteria included patients older than 50 years of age with normal-pressure hydrocephalus who underwent endoscopic third ventriculostomy. Exclusion criteria included patients who had conflicting information or lack of communication, patients who were unwilling to cooperate and participate in the study, and the cases that were less than 50 years old.

Data collection

The data collection tool was a researcher-made checklist that included questions related to demographic characteristics, symptoms of patients, such as hydrocephalus triad which included gait disorders, memory and dementia disorders, and urinary disorders before and after surgery, and the outcomes of treatment of patients. The content validation method was used to evaluate the validity of the data collection tool. In this way, by studying books, magazines, domestic and foreign publications, using electronic databases, using the opinions of physicians and nurses of the neurosurgery department, and supervisors and consultants, a research checklist was prepared and then based on the views of 10 neurology professors and surgeons of Shahid Beheshti University of Medical Sciences, the necessary corrections were made to the checklist, and thus the data collection tool was confirmed in terms of validity.

Sampling and volume of the statistical population studied

All patients who underwent endoscopic third ventriculostomy surgery were included in the study. In this study, the sample size was estimated to be equal to 24 people.

Statistical analysis

Mean and standard deviation of numerical variables and quantity and percentage of qualitative variables were reported in each group, and these data were analyzed and compared using paired *t*-test and Pearson's chi-squared test, respectively. SPSS 26 software for Windows was used to analyze the data. (Statistical Package for the

Table 1. *Frequency distribution of samples based on the studied variables, before and after surgery*

Variable	Before surgery	Frequency (percentage)	After surgery	Frequency (percentage)
Memory and dementia disorders	no	3 (12.5)	No recovery	13 (61.9)
	yes	21 (87.5)	Partial recovery	6 (28.6)
			Full recovery	2 (9.5)
Movement disorders	no	1 (4.2)	No recovery	8 (34.8)
	yes	23 (95.8)	Partial recovery	10 (43.5)
			Full recovery	5 (21.7)
Urinary disorders	no	16 (66.7)	No recovery	6 (75)
	yes	8 (33.3)	Partial recovery	1 (12.5)
			Full recovery	1 (12.5)
Final response to treatment after surgery			No recovery	9 (29.2)
			Partial recovery	12 (50)
			Full recovery	5 (20.8)

Table 2. *Evaluation between the age of patients and the studied variables, before and after surgery*

First variable	Second variable	Chi-Square	DF	p value
Age	dementia disorders before surgery	17.9	17	0.39
	dementia disorders after surgery	29.8	32	0.57
	Movement disorders before surgery	7.3	17	0.97
	Movement disorders after surgery	33.9	34	0.47
	Urinary disorders before surgery	21	17	0.22
	Urinary disorders after surgery	16	10	0.10
	Final response to treatment	34.6	34	0.43
*p ≤ 0.05				

DF, Degrees of freedom

Social Sciences). The p ≤ 0.05 were considered statistically significant.

Results

The results showed that among the 24 patients studied, 15 were male (62.5%) and 9 (37.5%) were female. The mean age of patients was 70.58 years with a standard deviation of 9.1 years. The minimum age was 54 and the maximum age was 84 years. Also, among the patients, 21 patients had symptoms of cognitive impairment and dementia before surgery and 3 patients did not have these symptoms. Also, 23 patients had symptoms of gait disorder before surgery and 1 person did not show these symptoms. Among the subjects, 8 patients had symptoms of urinary disorders before surgery and 16 patients did not have these symptoms (Table 1).

According to Table 1, among the 21 patients in the study who had symptoms of memory impairment and dementia before surgery, 2 patients recovered completely and 6 patients recovered partially after surgery, while 13 patients were not significantly improved. Also, out of 23 patients with movement disorders, 2 patients have fully recovered and 6 patients had partial recovery after surgery, while 13 patients were not significantly improved. On the other hand, among the 8 patients participating in the study who had symptoms of urinary disorders before surgery, 1 patient completely recovered after surgery and 1 patient partially recovered, while 6

Table 3. *Evaluation between the gender of patients and the studied variables, before and after surgery*

First variable	Second variable	Chi-Square	DF	p value
Gender	dementia disorders before surgery	0.02	1	0.87
	dementia disorders after surgery	4.4	2	0.11
	Movement disorders before surgery	1.73	1	0.18
	Movement disorders after surgery	0.18	2	0.91
	Urinary disorders before surgery	0.8	1	0.37
	Urinary disorders after surgery	2	2	0.36
	Final response to treatment	1.96	2	0.37

**p ≤ 0.05*

DF, Degrees of freedom

patients were not significantly improved. Out of 24 patients participating in the study, 4 patients (16.7%) required re-shunting after surgery and 20 patients (83.3%) did not require re-shunting. The results also showed that among the 4 patients who needed re-shunting after surgery, in 2 patients this need was observed after 3 months, for 1 patient it was found after 6 months, and in 1 patient, the need for re-shunting was observed more than 1 year after surgery. The mean of this duration was 9 months with a standard deviation of 10 months. The minimum time was 3 months and the maximum time was 24 months after surgery.

Data analysis using the Chi-square test showed no statistically significant relationship between the age of patients with the variables of memory and dementia disorders, movement disorders, and urinary disorders, before and after surgery. It was also shown that there was no statistically significant relationship between the age of patients and the rate of response to treatment (Table 2).

The analysis of data using the Chi-square test demonstrated that there was no statistically significant relationship between the gender of patients with the variables of memory and dementia disorders, movement disorders, and urinary disorders, before and after surgery. It was also shown that there was no statistically significant relationship between the gender of patients and the rate of response to treatment (Table 3).

Data analysis using paired t-test showed that there was a significant difference between memory and dementia disorders, as well as movement disorders, before and after surgery, while there was no statistically significant difference between urinary disorders before and after surgery (Table 4).

Discussion

Despite significant advances in neurosurgery techniques, deciding on the most effective treatment for hydrocephalus, especially first-line surgical intervention, is still controversial given the failure rate and complications of each approach.[8] Endoscopic third ventriculostomy is an alternative method to ventriculoperitoneal shunting, and the use of this method raises the question of which patients would benefit most from this procedure.[9] In 2017, a study was conducted by Marsha et al. in Addis Ababa, Ethiopia. In this research, the use of endoscopic third ventriculostomy in children with obstructive hydrocephalus was evaluated in comparison with ventriculoperitoneal shunting. 25.9% (67 people) of the patients underwent surgery with endoscopic third ventriculostomy and 74.1% (192 people) of the patients underwent ventriculoperitoneal shunting.[10] In this study, the rate of postoperative infection in patients undergoing ventriculoperitoneal shunting was significantly higher than in patients undergoing ETV (27% vs. 6.1%). Also, the rate of complications following the ETV method was 12%, and in patients who underwent ventriculoperitoneal shunting, this rate was 27%, and the difference was statistically significant.[10] The rate of treatment failure one year after surgery was 45.3% in the ventriculoperitoneal shunting group, and 38.8% in the ETV group, but the difference was not statistically significant. In 2014, another study was conducted by Linnea Torsnes et al. in Norway,[11] and the efficacy of different therapeutic methods for patients with normal pressure hydrocephalus was investigated. The findings demonstrated that endoscopic third ventriculostomy was less successful than shunting, and ETV was not the preferred method of treatment for hydrocephalus patients.[12] In contrast, the results of the present study show that the symptoms of hydrocephalus triad, including dementia and memory disorders were present in 87.5% of patients, movement disorders were present in 95.8% of patients, and urinary disorders were observed in 33.3% of patients. The results of our study are instead in agreement with Larsson et al.,[13] reporting that total percentage of hydrocephalus triad symptoms were 50 to 75%, movement disorders between 80 to 95%, and urinary disorders 50 to 75%. Furthermore in 2013 Neils et al.[14] showed that the success rate of endoscopic third ventriculostomy surgery varies between 67 and 80%. They also showed that most failures of this procedure occur within 30 days after surgery, which are usually associated with cerebrospinal fluid leaks from the wounds.[14] In addition, in a study by Sand Lam et al.,[15] it was stated that in 76% of patients who underwent unsuccessful ETV, ventriculoperitoneal shunting was

Table 4. *Data analysis using paired t-test*

Variable	Mean difference before and after surgery	T	DF	p value
Dementia disorders	0.47	3.2	20	0.00*
Movement disorders	0.86	5.5	22	0.00*
Urinary disorders	0.50	1.3	7	0.22
***p ≤ 0.05**				

DF, Degrees of freedom

used again, and in our study, this rate was equal to 57%. The results of our study showed that the failure rate of endoscopic third ventriculostomy was 29.2%, a percentage in line with the findings of HB Mersha (2017),[10] who reported a failure rate of 38.8%. In agreement with the study by Marsha et al.,[10] in the present study the analysis of the data did not show that age and gender of patients have a significant relationship with the failure rate of ETV surgery. However, a study by Drake et al., report a significant relationship between age of patients and success rate of ETV surgery.[16]
In conclusion, endoscopic third ventriculostomy is an effective surgical procedure for treatment of adult patients with normal pressure hydrocephalus that can improve their movement disorders and dementia..

List of acronyms

CSF - cerebrospinal fluid
DF - Degrees of freedom
ETV - Endoscopic third ventriculostomy
HCP - hydrocephalus
ICP - increased intracranial pressure
NPH - Normal-pressure hydrocephalus

Contributions of Authors

All authors contributed to the design and implementation of the research, to the analysis of the results, and to the writing of the manuscript. All Auhthors approved the final edited typescript.

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Conflict of Interest

The authors declare no conflict of interests.

Ethical Publication Statement

We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

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