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Comparative Outcomes of Endoscopic Third Ventriculostomy vs. Ventriculoperitoneal Shunt in Treating Obstructive Hydrocephalus

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ABSTRACT

Background: Obstructive hydrocephalus, characterized by cerebrospinal fluid (CSF) accumulation due to flow obstruction, requires effective management to prevent neurological damage.

Objective: This study aimed to compare the clinical outcomes of Endoscopic Third Ventriculostomy (ETV) and Ventriculoperitoneal Shunt (VPS) in treating obstructive hydrocephalus.

Methodology: A prospective, comparative observational study was conducted at the Mardan Medical Complex Mardan, KPK, Pakistan from January 2023 to December 2023. There were sixty patients getting VPS and sixty undergoing ETV. Data were gathered on follow-up, clinical outcomes, surgical complications, etiology of hydrocephalus, and demographics. Chi-square tests were used to compare categorical data, whereas descriptive statistics were used to describe patient features. To evaluate differences in continuous variables like the length of hospital stay, independent t-tests were used. P-values less than 0.05 were regarded as statistically significant.

Results: ETV achieved a higher success rate with 45 patients (75%) experiencing successful outcomes compared to 40 patients (66.67%) in the VPS group, though this difference was not statistically significant (p=0.30). The ETV group had fewer postoperative complications, with 2 infections (3.33%) and 1 CSF leak (1.67%), while the VPS group had 5 infections (8.33%) and 3 CSF leaks (5.00%). ETV also resulted in a significantly shorter hospital stay (mean 5.52 days) compared to VPS (mean 7.29 days, p=0.001). The number of revision surgeries was lower in the ETV group (mean 0.13) compared to the VPS group (mean 0.33, p=0.02). Long-term outcomes showed better results for ETV in terms of quality of life improvement and fewer recurrent symptoms.

Conclusion: In terms of success rates, complications, and length of hospital stay, ETV often provides better results than VPS for obstructive hydrocephalus; nevertheless, the decision of therapy should be based on the unique circumstances of each patient.

Keywords: Obstructive Hydrocephalus, Endoscopic Third Ventriculostomy, Ventriculoperitoneal Shunt, Clinical Outcomes, Postoperative Complications

INTRODUCTION

Cerebrospinal fluid (CSF) abnormally accumulates in the brain's ventricles due to obstruction of CSF flow, a neurological disorder known as obstructive hydrocephalus [1,2]. If treatment is not received, this accumulation may lead to increasing intracranial pressure and brain injury [3]. Obstructive hydrocephalus is most often caused by brain tumors, cysts, aqueductal stenosis, and post-hemorrhagic consequences, among other congenital anomalies [4]. It is a disorder that affects people of all ages, and maintaining brain function and general quality of life depends on adequate care [5].

Ventriculoperitoneal shunt (VPS) and endoscopic third ventriculostomy (ETV) are the two basic treatments for obstructive hydrocephalus [6]. Though via distinct processes, the goal of both therapies is to restore normal CSF dynamics [7]. By bypassing the barrier and creating a hole in the third ventricle's floor, endoscopic total ventriculation (EVT) is a minimally invasive treatment that enables CSF to flow directly to the subarachnoid space, where it may be reabsorbed [8]. On the other hand, VPS entails the surgical installation of a shunt device that allows extra cerebral spinal fluid to be drained from the brain's ventricles and absorbed into the peritoneal cavity [9].

Although obstructive hydrocephalus may be effectively treated with both ETV and VPS, there is continuous discussion on whether treatment method produces superior long-term results [10]. The benefit of ETV is that it is a shunt-free surgery, which lowers the risks of infection and dysfunction that come with shunt reliance. However, because of their still-developing CSF dynamics, it may not be beneficial for all patients, especially for newborns under the age of one [11]. Conversely, VPS is very effective and broadly applicable, but it also requires regular modifications due to long-term problems such infection and shunt failure [12]. The decision-making process often relies on patient-specific characteristics, such as age, the origin of hydrocephalus, and general health state, since both methods have advantages and disadvantages.

Research Objective

The objective of study was to compare the clinical outcomes of ETV and VPS in the management of obstructive hydrocephalus.

MATERIAL AND METHODS

Study Design and Setting

This was a prospective, comparative observational study conducted at the Mardan Medical Complex, Mardan, KPK, Pakistan. The study was carried out over a period of one year, from January 2023 to December 2023.

Inclusion and Exclusion Criteria

The research's inclusion criteria were patients aged 1 to 15 years, those receiving either VPS or ETV during the study period, and those with a confirmed diagnosis of obstructive hydrocephalus based on neuroimaging. Patients with non-obstructive hydrocephalus, those who had previously had both ETV and VPS, those with severe comorbidities that could have an impact on neurological outcomes or survival, and infants younger than one-year-old who

were not yet ready for ETV due to potential development of CSF dynamics were among the exclusion criteria.

Sample Size

The World Health Organization (WHO) method for comparing two proportions was used to calculate the sample size, which has a 5% margin of error and a 95% confidence range. The research had 120 patients in total, which ensured a sufficient number of participants for statistically significant comparisons between the results of VPS and ETV surgeries.

Data Collection

Patients receiving either VPS or ETV for the treatment of obstructive hydrocephalus provided prospective data. A variety of data were gathered, such as follow-up information, clinical results, postoperative complications, surgical therapy (VPS or ETV), the etiology of hydrocephalus, and demographic information (age, sex). Reduction of symptoms, need for revision surgery, and complications including infection, shunt failure, or malfunction were the main end measures. Following surgery, patients were monitored for at least six months in order to evaluate long-term results.

Statistical Analysis

SPSS version 25 was used to analyze the data. Patient characteristics were summed up using descriptive statistics, and categorical factors like success rates and complications were compared between the two groups using chi-square testing. Hospital stay time and other continuous variables were compared using independent t-tests. P-values less than 0.05 were regarded as statistically significant.

Ethical Approval

Ethical approval for the study was obtained from the Institutional Review Board (IRB) of MMC, Mardan. The study was conducted in accordance with the Declaration of Helsinki, ensuring ethical standards were upheld throughout. Informed consent was obtained from all participants, and patient confidentiality was strictly maintained, with all identifying information anonymized during data collection and analysis.

RESULTS

There were sixty patients in each of the study's two groups: VPS and ETV (table 1). Twenty patients (33.33%) in the ETV group were 1–5 years old, 22 (36.67%) were 6–10 years old, and 18 (30%) were 11–15 years old. Thirteen patients (30%), ages one to five, ten patients (35%), and fifteen patients (35%) were in the VPS group. There were 35 men (58.33%) and 25 women (41.67%) in the ETV group and 33 men (55%) and 27 women (45%) in the VPS group. In the ETV group, aqueductal stenosis accounted for 25 cases (41.67%), brain tumors for 15, 25%, cysts for 11, 18.33%), and post-hemorrhagic hydrocephalus for 9 patients (15%) as the cause of hydrocephalus. In the VPS group, the distributions were similar: 22 patients (36.67%) had post-hemorrhagic hydrocephalus (15%), 17 patients (28.33%) had brain tumors, 12 patients (20%) had cysts, and 9 patients (15%) had aqueductal stenosis.

Table 1: Demographic Details and Causes of Hydrocephalus

Characteristic		ETV Group (n=60)	VPS Group (n=60)
Age (years)	1-5 years	20 (33.33%)	18 (30.00%)
	6-10 years	22 (36.67%)	21 (35.00%)
	11-15 years	18 (30.00%)	21 (35.00%)
	Mean ± SD	5.20 ± 3.80	6.10 ± 4.20
Sex	Male	35 (58.33%)	33 (55.00%)
	Female	25 (41.67%)	27 (45.00%)
Cause of Hydrocephalus	Aqueductal Stenosis	25 (41.67%)	22 (36.67%)
	Brain Tumors	15 (25.00%)	17 (28.33%)
	Cysts	11 (18.33%)	12 (20.00%)
	Post-Hemorrhagic	9 (15.00%)	9 (15.00%)

In the trial, 48 patients (80%) in the ETV group and 45 patients (75%) in the VPS group had symptom relief (table 2). Eight patients (13.33%) in the ETV group and twenty patients (33.33%) in the VPS group needed revision surgery. Two patients (3.33%) in the ETV group and five patients (8.33%) in the VPS group had postoperative problems related to infection. One patient (1.67%) in the ETV group and three patients (5%) in the VPS group had CSF leaks, while seven patients (11.67%) in the VPS group experienced shunt malfunctions. In the ETV group, one patient (1.67%) and in the VPS group, two patients (3.33%) had additional problems. For the ETV group, the average hospital stay was 5.52 days (±2.13), but for the VPS group, it was 7.29 days (±3.08). For the ETV group, the mean follow-up period was 8.38 months (±2.16), whereas for the VPS group, it was 7.83 months (±2.47).

Table 2: Clinical Outcomes, Postoperative Complications, and Follow-Up Data

Outcome		ETV Group (n=60)	VPS Group (n=60)
Symptom Resolution	Resolved	48 (80.00%)	45 (75.00%)
	Not Resolved	12 (20.00%)	15 (25.00%)
Revision Surgery	Required	8 (13.33%)	20 (33.33%)
	Not Required	52 (86.67%)	40 (66.67%)
Postoperative Complications	Infection	2 (3.33%)	5 (8.33%)
	CSF Leak	1 (1.67%)	3 (5.00%)
	Shunt Malfunction	N/A	7 (11.67%)
	Other Complications	1 (1.67%)	2 (3.33%)
Hospital Stay Duration (days)	Mean ± SD	5.52 ± 2.13	7.29 ± 3.08
Follow-Up Duration (months)	Mean ± SD	8.38 ± 2.16	7.83 ± 2.47

The long-term results for the ETV and VPS groups were as follows, after at least six months of follow-up. Table 3 shows that the total success rate for ETV was 75% (45 patients) and for

VPS it was 66.67% (40 patients). Ten patients (16.67%) from the ETV group and fourteen patients (23.33%) from the VPS group experienced recurrent symptoms; six patients (10%) from the ETV group and eleven patients (18.33%) from the VPS group experienced additional surgeries; and three patients (5%) from the ETV group and five patients (8.33%) from the VPS group experienced cognitive or developmental problems. These were some of the long-term complications. In terms of improvement in quality of life, 39 patients (65%) in the ETV group and 35 patients (58.33%) in the VPS group reported considerable improvements. While 6 patients (10%) in the ETV group and 8 patients (13.34%) in the VPS group showed no improvement, 15 patients (25%) in the ETV group and 17 patients (28.33%) in the VPS group reported little improvement.

Table 3: Long-Term Outcomes after Minimum 6 Months Follow-Up

Outcome		**ETV Group (n=60)**	**VPS Group (n=60)**
Overall Success Rate	Success	45 (75.00%)	40 (66.67%)
	Failure	15 (25.00%)	20 (33.33%)
Long-Term Complications	Recurrent Symptoms	10 (16.67%)	14 (23.33%)
	Additional Surgeries	6 (10.00%)	11 (18.33%)
	Cognitive or Developmental Issues	3 (5.00%)	5 (8.33%)
Quality of Life Improvement	Significant Improvement	39 (65.00%)	35 (58.33%)
	Minimal Improvement	15 (25.00%)	17 (28.33%)
	No Improvement	6 (10.00%)	8 (13.34%)

The VPS and ETV groups' success rates and problems are contrasted in Table 4. With 45 patients (75%) in the ETV group and 40 patients (66.67%) in the VPS group, the success rate was greater in the ETV group; however, the difference was not statistically significant (p=0.30). Ten patients (16.67%) in the ETV group and fourteen patients (23.33%) in the VPS group had recurrent symptoms (p=0.28). Six patients (10%) in the ETV group and eleven patients (18.33%) in the VPS group needed further procedures (p=0.23). Three patients (5%) in the ETV group and five patients (8.33%) in the VPS group had cognitive or developmental problems (p=0.43).

Table 4: Comparison of Success Rates and Complications between ETV and VPS Groups

Outcome		**ETV Group (n=60)**	**VPS Group (n=60)**	**p-value**
Success Rate	Successful Outcome	45 (75.00%)	40 (66.67%)	0.30

	Unsuccessful Outcome	15 (25.00%)	20 (33.33%)	
Recurrent Symptoms	Present	10 (16.67%)	14 (23.33%)	0.28
	Absent	50 (83.33%)	46 (76.67%)	
Additional Surgeries	Required	6 (10.00%)	11 (18.33%)	0.23
	Not Required	54 (90.00%)	49 (81.67%)	
Cognitive or Developmental Issues	Present	3 (5.00%)	5 (8.33%)	0.43
	Absent	57 (95.00%)	55 (91.67%)	

A comparison of continuous variables between the VPS and ETV groups is shown in Table 5. With a mean of 5.52 days (±2.13) compared to 7.29 days (±3.08) for the VPS group, the ETV group's average hospital stay length was considerably lower, with a mean difference of -1.7 days (p=0.001). While the ETV group's follow-up period was 8.38 months (±2.16) longer than the VPS group's (7.83 months, ±2.47), the difference was not statistically significant (p=0.35). With a mean of 0.13 (±0.34) against 0.33 (±0.47) in the VPS group, the ETV group had fewer revision procedures than the VPS group, indicating a mean difference of -0.20 (p=0.02).

Table 5: Comparison of Continuous Variables between ETV and VPS Groups Using Independent t-tests

Variable	ETV Group (n=60)	VPS Group (n=60)	Mean Difference	p-value
Hospital Stay Duration (days)	5.52 ± 2.13	7.29 ± 3.08	-1.7	0.001
Follow-Up Duration (months)	8.38 ± 2.16	7.83 ± 2.47	0.5	0.35
Number of Revision Surgeries	0.13 ± 0.34	0.33 ± 0.47	-0.20	0.02

DISCUSSION

The purpose of this research was to assess the clinical effectiveness, complications, and long-term outcomes of VPS and ETV in the treatment of obstructive hydrocephalus.

Despite not being statistically significant, the success rate of ETV was 75% (45 patients) as opposed to 66.67% (40 patients) for VPS (p=0.30). This result is in line with other studies that found comparable success rates for ETV and VPS, highlighting the fact that while ETV may have a greater initial success rate, variations in patient reactions and procedural details may eventually cause the differences in overall efficacy to disappear [13, 14]. On the other hand, the research conducted by Sunderland et al. [15] revealed a greater success rate for VPS, indicating that the benefits of VPS may be more noticeable in certain patient groups, especially in babies and those with complicated hydrocephalus.

In terms of postoperative complications, the ETV group had lower rates of CSF leaks (1.67%) and infections (3.33%) than the VPS group, which had higher rates of CSF leaks (5.00%) and infections (8.33%). These findings support earlier studies that found that since ETVs don't have a permanent external device, they are often less susceptible to infections and mechanical issues

than VPSs [16]. In contrast, ETV resulted in a shorter average hospital stay of 5.52 days compared to 7.29 days for VPS (p=0.001). This finding supports earlier research findings that noted similar issues with shunt dependency and malfunction [17]. However, in 11.67% of cases, VPS was associated with shunt malfunctions, a complication that was not applicable to ETV. Previous research indicates that since ETV is a less intrusive technique, patients often recover more quickly and remain in hospitals for shorter periods of time [18]. This shorter hospital stay is consistent with these results. It was also shown in a research by Talamonti et al. [19] that follow-up time is mostly reliant on individual patient recovery and not substantially impacted by the kind of surgery. Nevertheless, our investigation did not find any significant difference in follow-up duration between the two groups.

As expected, the ETV group had fewer revision procedures (mean of 0.13) than the VPS group (mean of 0.33) (p=0.02). This is consistent with the findings of the prior research, which indicated that ETV usually required fewer revisions than VPS, especially in patients with congenital causes of hydrocephalus [20]. This lends credence to the idea that a decreased incidence of follow-up surgical procedures might be attributed to the shunt-free aspect of ETV. The success of either surgery may vary depending on individual patient variables, so although our research supports the benefits of ETV in terms of fewer problems and shorter hospital stays, it also highlights the need for careful patient selection and individualized treatment regimens.

Study Limitations

The single-center design of this research is one of its many drawbacks, which could restrict how broadly the results can be applied. Furthermore, the very brief 6-month follow-up period could have missed long-term consequences or issues, which might have an impact on determining the therapies' actual efficacy. Moreover, differences in surgical technique and postoperative care were not taken into consideration in this investigation, which may have affected the results. Lastly, the research was limited by the inclusion criteria to patients between the ages of 1 and 15, excluding any possible variations in treatment effectiveness in younger or older groups.

CONCLUSION

According to our research, ETV offers superior results in terms of success rates, fewer problems, and shorter hospital stays when compared to VPS. In comparison to VPS, ETV showed a decreased incidence of infections and revision procedures, which helped to provide a more favorable recovery profile. Despite these benefits, the decision between ETV and VPS should be based on the requirements of the particular patient, taking into account things like age, the cause of the hydrocephalus, and unique clinical situations. For many individuals with obstructive hydrocephalus, ETV seems to provide a more successful and efficient course of therapy overall.

REFERENCES

1. Leinonen V, Vanninen R, Rauramaa T. Cerebrospinal fluid circulation and hydrocephalus. Handbook of clinical neurology. 2018 ;145:39-50. https://doi.org/10.1016/B978-0-12-802395-2.00005-5
2. Krishnamurthy S, Li J. New concepts in the pathogenesis of hydrocephalus. Translational pediatrics. 2014 ;3(3):185. doi: 10.3978/j.issn.2224-4336.2014.07.02.

3. Di Curzio DL. Neuropathological changes in hydrocephalus—a comprehensive review. Open Journal of Modern Neurosurgery. 2017 ;8(01):1. https://doi.org/10.4236/ojmn.2018.81001.
4. Azzam AM, Yehia A, Abd El-Bary TH, El-Sharkawy AM. Pathophysiology and Classification of hydrocephalus. Tobacco Regulatory Science (TRS). 2023 :3381-403. DOI: doi.org/10.18001/TRS.9.1.238.
5. Hochstetler A, Raskin J, Blazer-Yost BL. Hydrocephalus: historical analysis and considerations for treatment. European journal of medical research. 2022 ;27(1):168. https://doi.org/10.1186/s40001-022-00798-6.
6. Shakeel NA, Aziz A, Farooq MF, Usmani F, Salahuddin T. OBSTRUCTIVE HYDROCEPHALUS;: SHORT TERM COMPLICATIONS OF ENDOSCOPIC THIRD VENTRICULOSTOMY IN OBSTRUCTIVE HYDROCEPHALUS. The Professional Medical Journal. 2019 ;26(02):318-23. DOI: 10.29309/TPMJ/2019.26.02.3115.
7. Gholampour S, Bahmani M, Shariati A. Comparing the efficiency of two treatment methods of hydrocephalus: shunt implantation and endoscopic third ventriculostomy. Basic and Clinical Neuroscience. 2019 ;10(3):185. doi: 10.32598/bcn.9.10.285.
8. Salvador SF, Oliveira J, Pereira J, Barros H, Vaz R. Endoscopic third ventriculostomy in the management of hydrocephalus: Outcome analysis of 168 consecutive procedures. Clinical Neurology and Neurosurgery. 2014 ;126:130-6. https://doi.org/10.1016/j.clineuro.2014.08.037.
9. Furtado LM, Val Filho JA, Faleiro RM, Vieira JA, Dos Santos AK. Abdominal complications related to ventriculoperitoneal shunt placement: a comprehensive review of literature. Cureus. 2021 ;13(2). doi: 10.7759/cureus.13230.
10. Greuter L, Schenker T, Guzman R, Soleman J. Endoscopic third ventriculostomy compared to ventriculoperitoneal shunt as treatment for idiopathic normal pressure hydrocephalus: a systematic review and meta-analysis. British Journal of Neurosurgery. 2022 :1-7. https://doi.org/10.1080/02688697.2022.2149697.
11. Sacko O, Boetto S, Lauwers-Cances V, Dupuy M, Roux FE. Endoscopic third ventriculostomy: outcome analysis in 368 procedures. Journal of Neurosurgery: Pediatrics. 2010 ;5(1):68-74. https://doi.org/10.3171/2009.8.PEDS08108.
12. Dewan MC, Lim J, Shannon CN, Wellons JC. The durability of endoscopic third ventriculostomy and ventriculoperitoneal shunts in children with hydrocephalus following posterior fossa tumor resection: a systematic review and time-to-failure analysis. Journal of Neurosurgery: Pediatrics. 2017 ;19(5):578-84.
13. Lu L, Chen H, Weng S, Xu Y. Endoscopic third ventriculostomy versus ventriculoperitoneal shunt in patients with obstructive hydrocephalus: meta-analysis of randomized controlled trials. World neurosurgery. 2019 ;129:334-40. https://doi.org/10.1016/j.wneu.2019.04.255.
14. Pande A, Lamba N, Mammi M, Gebrehiwet P, Trenary A, Doucette J, Papatheodorou S, Bunevicius A, Smith TR, Mekary RA. Endoscopic third ventriculostomy versus ventriculoperitoneal shunt in pediatric and adult population: a systematic review and meta-analysis. Neurosurgical Review. 2021 ;44:1227-41. https://doi.org/10.1007/s10143-020-01320-4.

15. Sunderland GJ, Conroy EJ, Nelson A, Gamble C, Jenkinson MD, Griffiths MJ, Mallucci CL. Factors affecting ventriculoperitoneal shunt revision: a post hoc analysis of the British Antibiotic and Silver Impregnated Catheter Shunt multicenter randomized controlled trial. Journal of Neurosurgery. 2022 ;138(2):483-93. https://doi.org/10.3171/2022.4.JNS22572.
16. Minta KJ, Kannan S, Kaliaperumal C. Outcomes of endoscopic third ventriculostomy (ETV) and ventriculoperitoneal shunt (VPS) in the treatment of paediatric hydrocephalus: Systematic review and meta-analysis. Child's Nervous System. 2024 ;40(4):1045-52. https://doi.org/10.1007/s00381-023-06225-3.
17. Roytowski D, Semple P, Padayachy L, Carara H. Intracranial pressure monitoring as an early predictor of third ventriculostomy outcome. World Neurosurgery. 2013;80(5):605-11. https://doi.org/10.1016/j.wneu.2013.01.129.
18. Obaid S, Weil AG, Rahme R, Bojanowski MW. Endoscopic third ventriculostomy for obstructive hydrocephalus due to intraventricular hemorrhage. Journal of Neurological Surgery Part A: Central European Neurosurgery. 2015 ;76(02):99-111. DOI: 10.1055/s-0034-1382778.
19. Talamonti G, Nichelatti M, Picano M, Marcati E, D'Aliberti G, Cenzato M. Endoscopic third ventriculostomy in cases of ventriculoperitoneal shunt malfunction: does shunt duration play a role?. World Neurosurgery. 2019 ;127:e799-808. https://doi.org/10.1016/j.wneu.2019.03.268.
20. Shinde S, Kotecha N, Ansari I, Patel S. Study of endoscopic third ventriculostomy (ETV) versus ventriculoperitoneal shunt (VP shunt) in patients with hydrocephalus at a tertiary hospital. https://jcdronline.org/admin/Uploads/Files/647d883826c754.29137319.pdf.