PAKISTAN JOURNAL OF NEUROLOGICAL SURGERY (QUARTERLY) – OFFICIAL JOURNAL OF PAKISTAN SOCIETY OF NEUROSURGEONS

Original Research

Effectiveness of Endoscopic Third Ventriculostomy Versus Ventriculo-Peritoneal Shunt in Obstructive Hydrocephalus

Mushtaq[1], Muhammad Usman[2], Naseer Hassan[3], Zahid Khan[4], Seema Sharafat[4]

[1]Department of Neurosurgery, Hayatabad Medical Complex, Khyber Girls Medical College, Peshawar

[2]Department of Neurosurgery, PAF Hospital, Fazaia Medical College, Islamabad

[3]Department of Neurosurgery, Qazi Hussain Ahmad Medical Complex, Nowshera Medical College, Nowshera

[4]Department of Neurosurgery, Lady Reading Hospital, MTI, Peshawar – Pakistan

ABSTRACT

Objective: To analyze the effectiveness of endoscopic third ventriculostomy (ETV) versus ventriculo-peritoneal (VP) shunt for the surgical management of obstructive hydrocephalus.

Material and Methods: The comparative cross-sectional study was conducted in the Neurosurgery department of Lady Reading Hospital, MTI Peshawar. The duration of the study was 4 years, i.e.; August 2019 to July 2023. All the patients diagnosed as obstructive hydrocephalus because of posterior fossa tumor, aqueductal stenosis, already shunted, and tectal and non-tectal tumors were in the inclusion criteria, while patients with post-infectious hydrocephalus, congenital hydrocephalus including intra-ventricular hemorrhage and with acute hydrocephalus presenting to the emergency department were in the exclusion criteria. Analysis of the data was done by using statistical software SPSS.

Results: There were a total of 302 patients in the study, which were divided into 2 groups; 155 patients had undergone ETY, while 147 patients had VP shunt. Successful results in the case of ETV were 71%, while in VP shunt was 66%. The complication rate was 10.32% in ETV, while 14.96% in the VP shunt group.

Conclusion: ETV is the better substitute for VP shunt as it's effective, with less complication rate, an economical, safe, and successful procedure in the surgical management of patients suffering from obstructive hydrocephalus.

Keywords: Obstructive hydrocephalus, Endoscopic third ventriculostomy, Ventriculo-peritoneal shunt, Posterior fossa tumor, Complications.

Corresponding Author: Muhammad Usman
Department of Neurosurgery, PAF Hospital, Fazaia Medical College, Islamabad – Pakistan
Email: drusman387@yahoo.com

Date of Submission: 01-05-2024

Date of Revision: 10-05-2024
Date of Acceptance: 12-08-2024
Date of Online Publishing: 30-9-2024
Date of Print: 30-9-2024

DOI: 10.36552/pjns.v28i3.998

INTRODUCTION

The disproportionate amount of Cerebro-spinal fluid in the ventricles of the brain, which has been or is under high pressure is termed Hydrocephalus. Various neurological manifestations are associated with hydrocephalus, like; brain atrophy, raised intracranial pressure, headache, blurring of vision, and even mortality.[1,2]

This very common entity has up to 1.5% of prevalence worldwide. The challenging nature of this disease, because of the optimum management dilemma, has staggered neurosurgeons throughout medicine's history.[3] The treatment of hydrocephalus is usually diversion of the CSF either extra or intra-cranially.[4] Traditionally hydrocephalus has been treated with CSF diversion intra-cranially, by implanting some types of shunt. But all these systems are associated with complications like; infection, blockage, multiple revisions, erratic cognitive outcomes, and malfunction.[5-9] Therefore, there was always a struggle to look for alternate options.[10]

The intervention and addition of a neuroendoscope in the surgical armamentarium of neurosurgeons resulted in significant improvement in the surgical treatment of obstructive hydrocephalus.[3,11] ETV, the neuroendoscopic management of obstructive hydrocephalus is being widely practiced and considered successful for both children and adults.[10] Because of the multiple advantages of ETV over VP shunt; like minimal invasiveness and other benefits, it is becoming the treatment modality of choice to treat obstructive hydrocephalus.[3] In this surgical approach CSF flow is bypassed by making a stoma in the third ventricular floor, thus CSF flows through the third ventricle to the pre-pontine cistern.[12] In the national and international studies, the rate of success of ETV ranged from 42% - 90%.[4,9,13]

In the developed world, ETV has been practiced as a surgical treatment of choice for obstructive hydrocephalus.[14] As the data is scarce on the effectiveness and comparison of ETV with VP shunt in our part of the world. This study will not only provide regional statistics but also guide the health personnel to opt for this surgical procedure in obstructive hydrocephalus and if the results go in favor of this very procedure, patients would be prevented from unnecessary complications of permanently implanted foreign bodies.

MATERIAL AND METHODS

Study Setting and Design

The comparative cross-sectional study was conducted in the Neurosurgery department of Lady Reading Hospital, MTI Peshawar. The duration of the study was 4 years, i.e.; August 2019 to July 2023. Written informed consent was sought from patients or their relatives. As well as ethical approval was also taken from the hospital's ethical review board.

Inclusion Criteria

All the patients diagnosed as obstructive hydrocephalus because of posterior fossa tumor, aqueductal stenosis, already shunted, and tectal and non-tectal tumors were in the inclusion criteria.

Exclusion Criteria

Patients with post-infectious hydrocephalus, congenital hydrocephalus including intra-ventricular hemorrhage, and acute hydrocephalus presenting to the emergency department were in the exclusion criteria.

Data Collection

Data was collected on a pre-designed proforma, which includes patient age, gender, demographic distribution, and cause of hydrocephalus. The clinical status of the patient including pre-operative GCS and post-operative GCS, the

success of the procedure, and complications of the procedure were also recorded.

Data Analysis

Random allocation of the surgical procedure, either (Group A) ETV or (Group B) VP shunt of all the included study participants was done. Outcome variables and other details like clinical outcomes, management, and other relevant clinical details were taken into account and measured. The effectiveness of either procedure (ETV or VP shunt) was considered when there was an improvement of GCS of 3 or more grades post-operatively. All the patients were followed up for at least 6 months. Data analysis was done through descriptive statistics in SPSS version 26. Statistical tests, such as the chi-square test were used to calculate the p-value for qualitative data. The p-value less than 0.05 was considered statistically significant.

RESULTS

There was a total of 302 patients, of which 155 patients underwent ETV, while 147 VP shunt.

Gender Incidence

There were 72 males, and 83 females in the ETV group 68 males, and 79 females in the VP shunt group.

Age Distribution

The majority of the patients in the ETV group were in their first decade of life, i.e., under 10 years of age, while in the VP shunt group, most of the patients were less than 5 years of age. In the ETV group, 34 patients were under 1 year, 58 in the age range of 1-5 years, 44 patients were between 6-10 years, 8 between 11-15 years, and 11 patients more than 15 years. On the other hand, in the VP shunt group, 52 patients were under 1 year, 29 were in the age range of 1-5 years, 21 patients were between 6-10 years, 11 were between 11-15 years, and 34 patients were more than 15 years. The age distribution is shown in Figure 1.

Demographic Distribution

Almost one-third of the patients of both groups belong to Peshawar (33.11%), followed by Mardan, Nowshera, Swabi, Charsadda (16.55%), agencies (15.56%), Karak, DI Khan, Kohat, Bannu (13.9%), Dir, Swat, Boner, Shangla, Malakand (12.58%) and Afghanistan (8.27%) (Figure 2).

Cause of Hydrocephalus

The most common causes of hydrocephalus were posterior fossa tumor in 90 patients, followed by aqueductal stenosis in 37 patients, patients with already shunt, which is blocked and non-tectal tumors in 7 patients each, CP angle tumor and tectal tumors in 6 patients each and posterior fossa hematoma 2 patients in endoscopic third ventriculostomy group. On the other hand, in ventriculo-peritoneal shunt group most common cause of obstructive hydrocephalus was posterior fossa tumor in 88 patients, followed by aqueductal stenosis in 38 patients, non-tectal tumors in 8 patients, CP angle tumor in 6 patients, tectal tumor 5 patients and posterior fossa hematoma 2 patients (Table 1). In posterior fossa tumor patients, the CSF diversion procedure (ETV or VP shunt) was done before the surgery of tumor excision.

Success Rate

The overall pre-operative mean GCS was 7.49 ± 1.71, while post-operative it was 10.27 ± 2.18. In the ETV group, it was 7.48 ± 1.7 pre-operatively, while 10.49 ± 2.26 post-operatively. On the other hand, in the VP shunt group, the mean pre-operative GCS was 7.49 ± 1.72, while 10.05 ± 2.08 post-operatively. The success rate was 70.96% (110/155 patients) in the ETV group, while it was

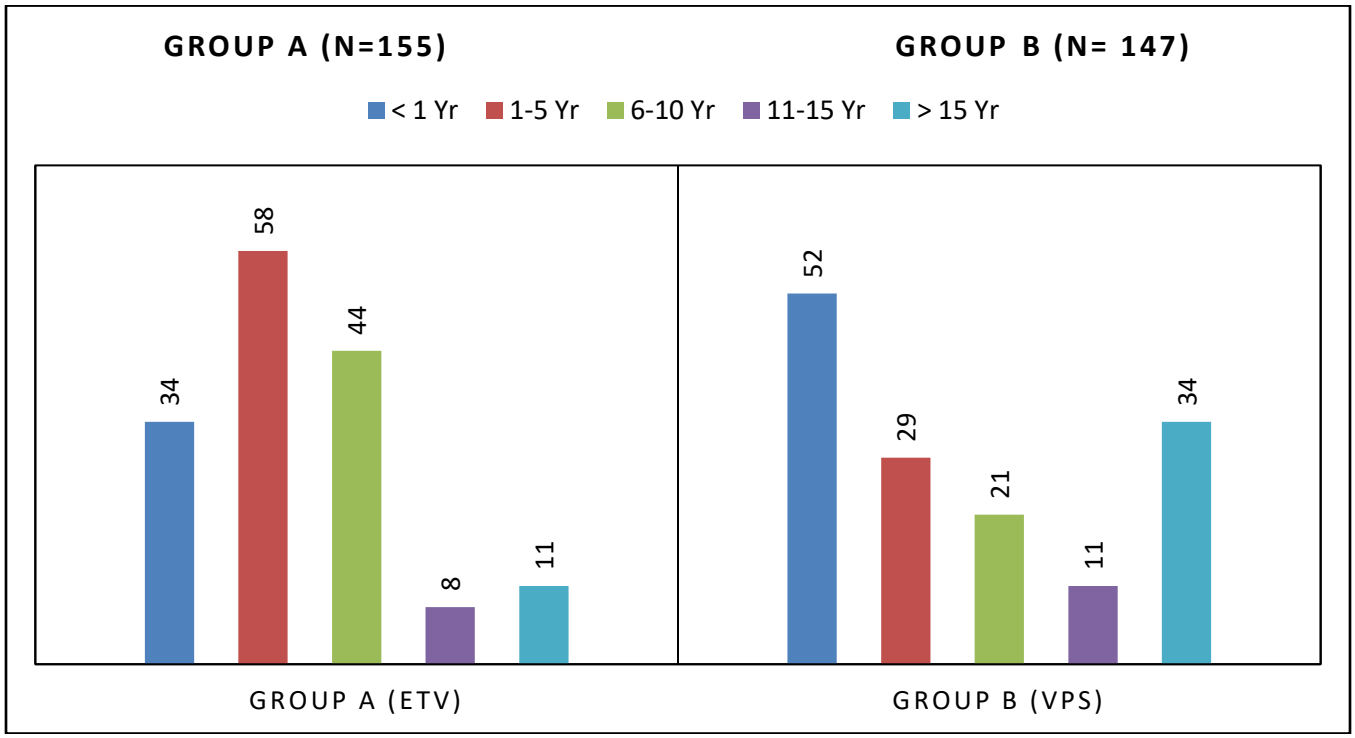

Figure 1: Age distribution in both groups.

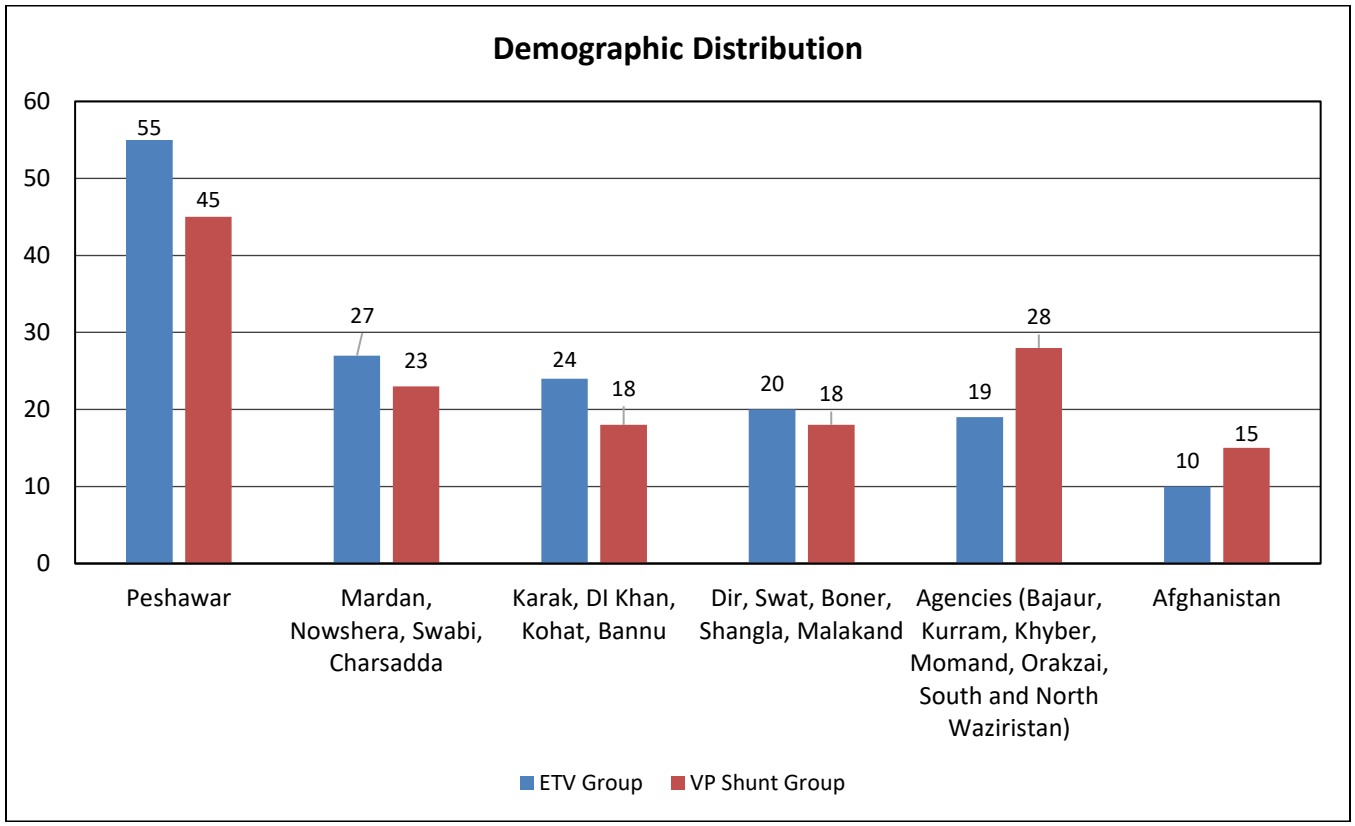

Figure 2: Demographic distribution of patients.

66.66% (98/147 patients) in the VP shunt group. The p-value between the success rates of the two procedures is shown in Table 5.

Table 1: Cause of Hydrocephalus.

Cause of Hydrocephalus	ETV Group No. of Patients (%age)	ETV Group No. of Patients (%age)
Posterior fossa tumor	90 (58.06%)	88 (59.86%)
Aqueductal stenosis	37 (23.87%)	38 (25.85%)
Patients with blocked shunt	7 (4.51%)	0 (0%)
Non-tectal tumors	7 (4.51%)	8 (5.44%)
CP angle tumor	6 (3.87%)	6 (4.08%)
Tectal tumor	6 (3.87%)	5 (3.4%)
Posterior fossa hematoma	2 (1.29%)	2 (1.36%)
TOTAL	**155 (100%)**	**147 (100%)**

Stratification of Cause of Hydrocephalus with Effectiveness of Procedure

In the ETV group, the procedure is more effective in posterior fossa tumors (79%) and aqueductal stenosis (70%), moderately effective in CP angle tumors (50%), tectal tumors (50%), and posterior fossa hematoma (50%), while moderate to less effective in already shunted (43%) and non-tectal tumors (43%). The procedure is more effective in the VP shunt group in posterior fossa tumor (73%) and aqueductal stenosis (65%), moderately effective in CP angle tumor (50%) and posterior fossa hematoma (50%), while moderate to less effective in tectal tumor (40%) and non-tectal tumor (37.5%) (Table 2).

Post-operative Complications

The most common complications in ETV were CSF leak, followed by seizures and meningitis and the complication rate was 9.67% (15/155 patients) (Table III), while in the case of VP shunt the common complications were blocked shunt and infected shunt and the complication rate was 14.96% (22/147 patients) (Table IV). The p-value between the complication rates of the two procedures is shown in Table 5.

Table 2: Stratification of Cause of Hydrocephalus with Effectiveness of Procedure.

	ETV Group Effectiveness		VP Shunt Group Effectiveness	
Cause of Hydrocephalus	**Yes No. of Patients (%age)**	**No No. of Patients (%age)**	**Yes No. of Patients (%age)**	**No No. of Patients (%age)**
Posterior fossa tumor	71 (78.88%)	19 (21.11%)	64 (72.72%)	24 (27.27%)
Aqueductal stenosis	26 (70.27%)	11 (29.72%)	25 (65.78%)	13 (34.21%)
Patients with blocked shunt	3 (42.85%)	4 (57.14%)	0 (0%)	0 (0%)
Non-tectal tumors	3 (42.85%)	4 (57.14%)	3 (37.5%)	5 (62.5%)
CP angle tumor	3 (50%)	3 (50%)	3 (50%)	3 (50%)
Tectal tumor	3 (50%)	3 (50%)	2 (40%)	3 (60%)
Posterior fossa hematoma	1 (50%)	1 (50%)	1 (50%)	1 (50%)
TOTAL	**110 (70.96%)**	**45 (29.03%)**	**98 (66.66%)**	**49 (33.33%)**

Table 3: Complications in the ETV group.

Complications	No. of Patients	% age
CSF Leak	8	5.16
Seizures	2	1.29
Meningitis	2	1.29
Hemiparesis	1	0.64
SDH	1	0.64
Mortality	1	0.64
TOTAL	**15**	**9.67**

Table 4: Complications in VP shunt group.

Complications	No. of Patients	% age
Blocked shunt	11	7.48
Infected shunt	8	5.44
Eroded shunt	2	1.36
Displaced shunt	1	0.68
TOTAL	**22**	**14.96**

Table 5: Comparison of Complication and Success Rate of ETV and VP Shunt.

Procedure	ETV Percentage (No. of Patients)	VP Shunt Percentage (No. of Patients)	Chi-square test p Value
Complication rate	9.67% (15/155)	14.96% (22/147)	P value: 0.166
Success rate	70.96% (110/155)	66.66% (98/147)	$\chi 2 = 1.9$

DISCUSSION

ETV is becoming a contemporary surgical treatment for managing all the patients of obstructive hydrocephalus.[3] There is a lot of debate on the successful criteria or effectiveness of ETV in the literature. In our study we considered the procedure to be effective when there is improvement post-operatively in the GCS status of the patient of ≥ 3 grades.

In our study, the ETV was successful in 70.96%, which is compatible with the literature. The literature reported in some studies the effectiveness in up to 90% of the cases.[4,9,13] The studies with higher success rates, included only selected cases, while in our study we also included the cases with blocked shunts. The other possible reason for a comparatively lower success rate in our study is that most of the patients present late when there is developed cerebral atrophy due to decreased cerebral mental because of long-standing hydrocephalus. The success rate in VP shunt cases in our study is 66.66%, which is also comparable with the literature, which mentioned a success rate in the range of 61-70%.[15] Although the difference in the success rate of ETV versus VP shunt in our study is not statistically significant, as the p-value is 0.713, overall ETV is superior as compared to VP shunt.

The complication rate in our study was 9.67% and 14.96% in ETV and VP shunt respectively. Overall, there is less complication rate in ETV, but the difference in complication rate between the two procedures is statistically not significant, as the p-value is 0.286. The documented complication rate in the literature of ETV is 5-15%,[16] with debilitating morbidity of 2.1% and mortality of up to 0.22%.[13] The common complications of ETV mentioned in the literature are fever, decreased level of consciousness, visual symptoms, motor weakness, impaired memory, weight gain, and hemorrhage.[17,18] In our study the complications were CSF leak, fever, meningitis, hemiparesis, subdural hematoma, and mortality. The literature reported the same complications with the addition of subdural hygroma and headache.[18] The comparative lower complication rate in VP shunt in our study, as compared to the literature,[3,8] is because of two main possible reasons, firstly, strict adherence to SOPs laid down by our "Hospital Infection Prevention and Control Committee" and secondly, we excluded patients of post-infectious etiology in our study.

In the surgical management of obstructive hydrocephalus, when we compare ETV with VP shunt, the ETV has the benefits of physiological shunt, decreased operative time, good patient

compliance, early recovery, economical and good to excellent long-term results with lower complication rates. On the other hand, VP shunt is inferior to ETV, because of foreign bodies, increased complication rate, increased operative time, delayed recovery, needs often revision surgery and patients complain a lot.[3,6,8,19,20] Our study also advocated the superiority of ETV over VP shunt in the surgical management of obstructive hydrocephalus. The lower complication and high success rate make ETV the procedure of choice for treating obstructive hydrocephalus.

The limitations of our study were short follow-up and single-center trial. But it paves the way for future research in this very field.

CONCLUSION

In obstructive hydrocephalus, ETV is the better substitute than the VP shunt, as it's effective, with less complication rate, economical, and safe. ETV is an internal, physiological shunt, with no permanent implant or foreign body and no abdominal complications as in the case of VP shunt. ETV has also added the benefits of less operative time, early recovery, and reduced hospitalizations.

REFERENCES

1. Garne E, Loane M, Addor MC, Boyd PA, Barisi I, Dolk H. Congenital hydrocephalus – prevalence, prenatal diagnosis and outcome of pregnancy in three European regions. Eu J Pediatr Neurol. 2010; 14 (2): 150-5. https://doi.org/10.1016/j.ejpn.2009.03.005
2. Grogorean VT, Popescu M, Sandu AM, Toader S. Ventriculoepiploic Shunt, a new surgical procedure for the treatment of hydrocephalus. J Experimental Med Surg Res. 2010; 1: 55-63.
3. Haq NU, Ishaq M, Jalal A. Outcome comparison of endoscopic third ventriculostomy versus ventriculoperitoneal shunt in obstructive hydrocephalus. Pakistan Journal of Medical & Health Sciences. 2022;16(02):956-58. Doi: https://doi.org/10.53350/pjmhs22162956.
4. Brohi SR, Brohi AR, Siddiqui MA, Mughal SA, Saeed S. Outcome of endoscopic third ventriculostomy in hydrocephalus. J Surg Pak. 2010; 15 (1): 25-8. https://www.researchgate.net/profile/Ali-Brohi/publication/228650029_Outcome_of_endoscopic_third_ventriculostomy_in_hydrocephalus/links/59a5264845851570311b2e72/Outcome-of-endoscopic-third-ventriculostomy-in-hydrocephalus.pdf
5. Sufianov AA, Sufianova GZ, Iakimov IA. Endoscopic third ventriculostomy in patients younger than 2 years, outcome analysis of 41 hydrocephallous cases. J Neurosurg Pediatr. 2010; 5: 392-401. https://doi.org/10.3171/2009.11.peds09197
6. Sheikh F, Safdar S, Malik M, Rauf MA, Saleem R. Endoscopic Third Ventriculostomy: A Comparable Alternative to Ventriculoperitoneal Shunt for Obstructive Hydrocephalus Secondary to Infratentorial Tumors. Pak. J. of Neurol. Surg. 2021;25(4):610-8. https://doi.org/10.36552/pjns.v25i3.583
7. Reddy GK, Bollam P, Caldito G. Long-term outcomes of ventriculoperitoneal shunt surgery in patients with hydrocephalus. World Neurosurg. 2014; 81 (2): 404-410. https://doi.org/10.1016/j.wneu.2013.01.096
8. Texakalidis P, Tora MS, Wetzel JS, Chern JJ. Endoscopic third ventriculostomy versus shunt for pediatric hydrocephalus: a systematic literature review and meta-analysis. Childs Nerv Syst. 2019;35:1283-93. https://doi.org/10.1007/s00381-019-04203-2
9. Khan HM, Haq N, Usman M, Hussain R. Audit of Endoscopic Third Ventriculostomy in the Treatment of Obstructive Hydrocephalus. Pak J Neurological Sci 2015; 10(3):27-30. https://ecommons.aku.edu/pjns/vol10/iss3/7/
10. Khan HM, Usman M, Ali M, Hussain R, Naeem-Ul-Haq. Effectiveness of Endoscopic Third Ventriculostomy in The Treatment of Obstructive Hydrocephalus. Pak. J. of Neurol. Surg 2014;18(1):44-48. https://pakjns.org/index.php/pjns/article/view/36
11. Ali M, Usman M, Khan Z, Khan KM, Hussain R, Khanzada K. Endoscopic Third Ventriculostomy for

Obstructive Hydrocephalus. J Coll Physicians Surg Pak 2013; 23(5): 338-41. https://www.jcpsp.pk/archive/2013/May2013/08.pdf
12. Kulkarni AV, Riva-Cambrin J, Browd SR. Use of the ETV Success Score to explain the variation in reported endoscopic third ventriculostomy success rates among published case series of childhood hydrocephalus. J Neurosurg Ped. 2011; 7 (2): 143-6. https://doi.org/10.3171/2010.11.peds10296
13. Dixon HZ, Hamandi YM, Mahmmoud AM, Hoz SS, Al-Sharshahi ZF. Endoscopic third ventriculostomy for obstructive hydrocephalus. Romanian Neurosurgery, 2020; 34 (2): 269–274. https://doi.org/10.33962/roneuro-2020-039
14. Rahmayani DD, Gunawan PI, Utomo B. Profil klinis dan faktor risiko hidrosefalus komunikans dan non komunikans pada anak di RSUD dr. Soetomo. Sari Pediatri. 2017;19(1):25-31. https://doi.org/10.14238/sp19.1.2017.25-31
15. Di-Rocco C, Massimi L, Tamburrini G. Shunts vs endoscopic third ventriculostomy in infants: are there different types and/or rates of complications? A review. Childs Nerv Syst 2006;22(12):1573-89. https://doi.org/10.1007/s00381-006-0194-4
16. Bouras T, Sgouros S. Complications of endoscopic third ventriculostomy. World Neurosurg. 2013;79(2):S22-e9. https://doi.org/10.1016/j.wneu.2012.02.014
17. Ullah MA, Khan FU, Usman M, Ishaq M, Khan Z. Frequency and Pattern of Early Complications after Endoscopic Third Ventriculostomy in Obstructive Hydrocephalus. Pak. J. of Neurol. Surg. 2020; 24(3):237-42. https://doi.org/10.36552/pjns.v24i3.466
18. Sokal P, Birski M, Rusinek M, Paczkowski D, Zieliński P, Harat A. Endoscopic third ventriculostomy in treatment of hydrocephalus. Videosurg Other Miniinvasive Tech. 2012;7(4):280. https://doi.org/10.5114/wiitm.2011.30810
19. Jiang L, Gao G, Zhou Y. Endoscopic third ventriculostomy and ventriculoperitoneal shunt for patients with noncommunicating hydrocephalus: A PRISMA-compliant meta-analysis. Medicine (Baltimore), 2018;97(42):e12139. https://doi.org/10.1097/md.0000000000012139
20. Uche EO, Okorie C, Iloabachie I, Amuta DS, Uche NJ. Endoscopic third ventriculostomy (ETV) and ventriculoperitoneal shunt (VPS) in non-communicating hydrocephalus (NCH): comparison of outcome profiles in Nigerian children. Child's Nerv Syst. 2018;34:1683-9. https://doi.org/10.1007/s00381-018-3848-0

Additional Information

Disclosures: Authors report no conflict of interest.
Ethical Review Board Approval: The research was a retrospective study.
Human Subjects: Consent was obtained by all patients/participants in this study.
Conflicts of Interest:
In compliance with the ICMJE uniform disclosure form, all authors declare the following:
Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.
Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.
Data Availability Statement: Data will be made available upon genuine request by the corresponding author MU (email: drusman387@yahoo.com).
Funding: None

AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Mushtaq & Muhammad Usman	1. Study design and methodology.
2.	Muhammad Usman & Naseer Hassan	2. Paper writing.
3.	Naseer Hassan & Muhammad Usman	3. Data collection and calculations.
4.	Zahid Khan & Mushtaq & Seema Sharafat	4. Analysis of data and interpretation of results.
5.	Seema Sharafat & Zahid Khan	5. Literature review and referencing.
6.	Muhammad Usman & Mushtaq	6. Editing and quality insurer.