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Original Research Article

ENDOSCOPIC THIRD VENTRICULOSTOMY VS VENTRICULOPERITONEAL SHUNT IN OBSTRUCTIVE HYDROCEPHALUS IN TERMS OF POST-OPERATIVE COMPLICATIONS

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Abstract: *Obstructive Hydrocephalus is a condition characterized by increased cerebrospinal fluid (CSF) volume within the brain's ventricular system, leading to clinical deterioration and disability. Without treatment, it can be fatal. Two primary treatment modalities are Ventriculoperitoneal Shunting (VPS) and Endoscopic Third Ventriculostomy (ETV), with ongoing debate over the superiority of one approach over the other.* ***Objective:*** *To compare the complications associated with Ventriculoperitoneal Shunting (VPS) and Endoscopic Third Ventriculostomy (ETV) in patients with obstructive hydrocephalus.* ***Methods:*** *A randomized controlled trial was conducted at a tertiary care hospital from April 15, 2024, to September 15, 2024. A total of 100 patients diagnosed with obstructive hydrocephalus were randomly allocated into two groups: 50 patients received VPS treatment, and 50 received ETV. Complications, including surgical site infection, seizures, hematoma, and CSF leakage, were recorded and analyzed.* ***Results:*** *Complications were observed in 36% (n=18) of patients in the VPS group compared to 16% (n=8) in the ETV group, with a statistically significant difference (p=0.023). Surgical site infections occurred in 8% (n=4) of VPS patients, while no infections were reported in the ETV group. Seizures were significantly more common in the VPS group, affecting 26% (n=13) compared to 8% (n=4) in the ETV group (p=0.017). Hematoma formation was observed in 4% (n=2) of VPS patients and 6% (n=3) of ETV patients. CSF leakage occurred in 4% (n=2) of VPS patients and 2% (n=1) of ETV patients.* ***Conclusion:*** *Endoscopic Third Ventriculostomy (ETV) demonstrated a significantly lower complication rate compared to Ventriculoperitoneal Shunting (VPS) in the management of obstructive hydrocephalus. These findings support ETV as a safer alternative with fewer associated complications.*

Keywords: Ventriculoperitoneal Shunt, Endoscopic Third Ventriculostomy, Obstructive Hydrocephalus, Cerebrospinal Fluid

Introduction

Hydrocephalus (HCP) is a debilitating neurological condition that results from the collection of Cerebrospinal fluid (CSF) in the ventricular system of the brain. (1) Obstructive Hydrocephalus is a subtype that results from a blockage in the normal CSF flow. The global prevalence of HCP is 85 per 100,000 with most cases occurring in the pediatric age group. The former is due to congenital malformations & intraventricular haemorrhages. (2)

The aetiology of obstructive HCP is varied. A spectrum of lesions encompassing congenital, benign & malignant are causative. Chiari-type congenital malformations, vascular malformations, and posterior fossa tumours i.e. medulloblastomas, colloid cysts & pituitary tumours are some of the few etiological lesions. The main symptomatic outcome is a sequela of raised intracranial pressure. Presentation ranges from papilledema, gait changes, frontal bossing, and cognitive impairment to blindness & respiratory arrest. (3)

Untreated the outcome is fatal. Ventriculoperitoneal shunting (VP shunting) is the first line & most widely employed treatment option. It is based on drainage of CSF from the brain to the peritoneal cavity thus normalizing the

CSF pressure. However, it is not without its complications & limitations. Endoscopic third ventriculostomy is a widely studied alternative treatment. Recently, the paradigm has shifted with ETV being reported as the superior option. (4, 5) Other studies report both methods as equivalent. (6) Hence the best method is yet to be discerned.

Compared to VPS, ETV has been reported less associated with major complications & also lower incidence of post-operative infection. (5) Mousa et al reported both procedures to be clinically effective. (7)

Haq et al compared both treatment options in obstructive hydrocephalus. (8) Complications in the VPS group were higher at 33.3% (n= 10) as compared to ETV being 16.7% (n= 5). Of these, there was CSF leak in 16.6% (n=5) in VPS & 6.6% (n=2) in ETV, Infection 6.6% (n=2) in VPS & 3.3% (n=1) in ETV, Seizures 6.6% (n=2) in VPS vs 3.3% (n=1) in ETV & hematoma formation which was equal in both groups being 3.3%. (n=1).

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This study aims to compare the occurrence of postoperative complications between the two methods to guide local treatment options so that the best option can be chosen in patients with Obstructive Hydrocephalus.

Methodology

This randomized controlled trial was conducted at the Neurosurgery Department of a Tertiary Care Hospital in Rawalpindi, Pakistan from April 15, 2024, to September 15, 2024. Ethical approval for the study was obtained from the Institutional Review Board, and written informed consent was secured from all patients meeting the inclusion criteria. The sample size of 100 participants was calculated using the WHO sample size calculator, with a study power of 80% and a confidence interval of 95%. A non-probability, consecutive sampling technique was utilized, and randomization was carried out through the lottery method.
Patients aged between 6 months and 60 years presenting with obstructive hydrocephalus were included in the study. They were admitted to the Neurosurgery Department via the Emergency Department or Outpatient Department (OPD). Patients were excluded if they had communicating hydrocephalus, presented with infection or meningitis at admission, or had severe comorbid conditions such as decompensated liver or cardiac disease.
Participants were divided into two groups. Group A underwent ventriculoperitoneal shunting (VPS), while Group B underwent endoscopic third ventriculostomy (ETV). Postoperative complications were documented using a customized data collection form. Patients were followed up for one-month post-surgery to monitor for any adverse outcomes.
Data was entered into a specifically designed proforma and analyzed using SPSS version 26. Quantitative variables, such as age, were reported as mean and standard deviation, while qualitative variables, including gender, diagnosis, and postoperative complications, were expressed as frequencies and percentages. The primary outcome of the study was assessed by comparing the frequency of postoperative complications between the two groups using the chi-square test. A p-value of ≤ 0.05 was considered statistically significant. Additionally, effect modifiers, such as age and gender, were stratified, and post-stratification chi-square tests were applied to evaluate their influence on the outcomes.

Results

In this study, 100 patients were included. 68 were male & 32 female. The mean age was 25 years ± 19 years. Post-operative complications occurred in 26% of patients (n=26). Patients were divided into two groups, groups A & B, ventriculoperitoneal shunting & endoscopic third ventriculostomy respectively.
In group A, the mean age was 20 ± 21. In Group B, it was 28 ± 17. There were 66% (n=33) males and 34% (n=17) females in group A. There were 70% (n=35 males) & 30% (n=15) females in group B.
Complications were noted in 36% (n=18) in the VPS group as compared to 16% (n=8) in the ETV group. This difference was statistically significant. P-value = 0.023. Table 1.
These included surgical site infection, found in 8% (n=4) of VPS. Seizures were found in 26% (n=13) of the VPS group & 8% (n=4) of the ETV group, the p-value is 0.017.
Hematoma occurred in 4% (n=2) in VPS & 6 %(n=3) in ETV. CSF leak was noted in 4% (n=2) of VPS patients & 2% (n=1) of the ETV group. Table 2.
Stratified by gender 77% (n=14) of males had complications in the VPS group as opposed to 23% (n= 4). In the ETV group, 75% (n=6 males) had complications as opposed to 25% (n=2) females. This difference was statistically insignificant.
In VPS group, 20% of patients (n=10) had aqueductal stenosis, 10% (n=5) had colloid cyst, 2% (n=1) had pituitary SOL, 2% (n=1) had suprasellar sol, 2% (n=1) had posterior fossa SOL, 8% (n=4) had dandy walker malformation, 8% (n=4) had chiari malformation, 6% (n=3) had intraventricular SOL, 8% (n=4) had a previous ventriculoperitoneal shunt. 34% (n=17) had hydrocephalus secondary to space-occupying lesion. (SOL)
In ETV group, 14% of patients (n=7) had aqueductal stenosis, 18% (n=9) had a colloid cyst, 8% (n=4) had suprasellar SOL, 16% (n=8) had posterior fossa SOL, 2% (n=1) had dandy walker malformation, 4% (n=2) had chiari malformation, 16% (n=8) had intraventricular SOL, 8% (n=4) had a previous ventriculoperitoneal shunt. 14% (n=7) had hydrocephalus secondary to space-occupying lesion. (SOL)
The relationship of occurrence of complications to any particular diagnosis in either the VPS or ETV group was not found to be significant. (P-value >0.05) Table 3.
The mean age at which complications were noted in the VPS group is 18 ± 16 & the mean age at which complications occurred in the ETV group is 23 ± 29. However, no statistically significant correlation is present between age & occurrence of complications in either group. (P-value >0.05)

Table 1 - Frequency of Complications

Procedure		Frequency	Per cent
VPS	Complications	18	36.0
ETV	Complications	8	16.0
	P-value	0.023	

Table 2 - Complications in ETV vs VPS

Procedure	Seizure	Hematoma	SSI	CSF leak
VPS	13 (26%)	2 (4%)	4 (8%)	2 (4%)
ETV	4 (8%)	3 (6%)	0	1 (2%)
P-value	0.017	0.64	0.04	0.55

Discussion

Obstructive Hydrocephalus is a neurological condition that results from an increased volume of cerebrospinal fluid in the brain secondary to an obstruction in the normal outflow pathways. First described in 1913, it can result from a myriad of etiologies being either benign or malignant. These include Chiari-type congenital malformations, vascular malformations, medulloblastomas, colloid cysts & pituitary tumours. The obstruction occurs most commonly at

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the foramen of Monro, the aqueduct of Sylvius & the fourth ventricle (1).

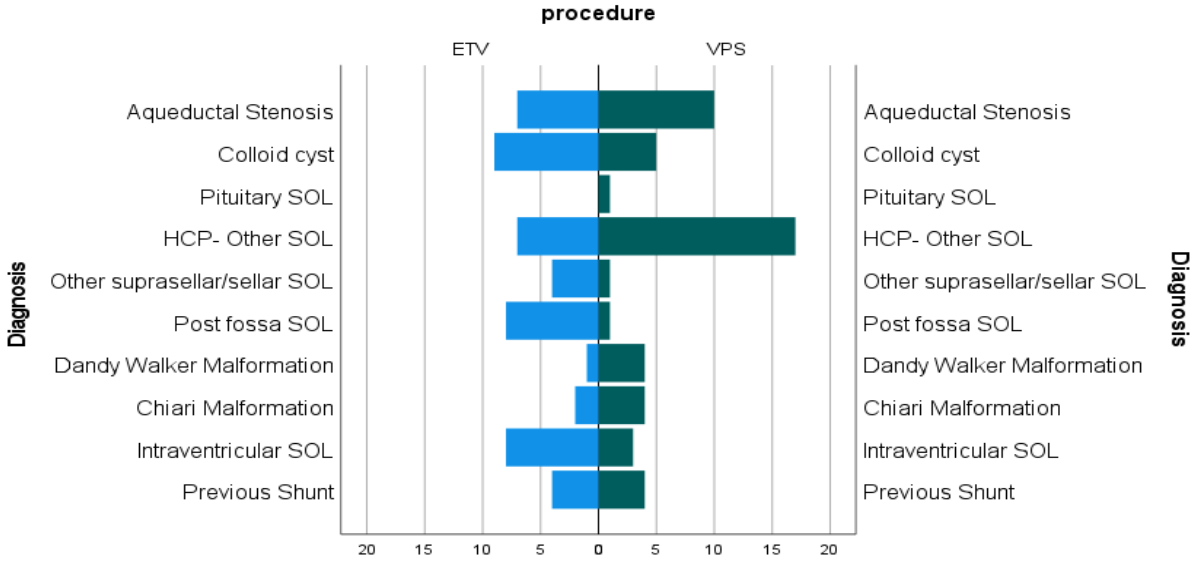

Figure 1 - Distribution of Diagnosis by Procedure

Diagnosis is made through clinical & radiological findings. The latter consists of neuroimaging having the key role. MRI is the study of choice while CT is used in acute cases (3).Timely surgical treatment is key to a favourable outcome as left untreated or delayed, the disease is fatal & any deterioration incurred is irreversible. Three main treatment options are available with Ventriculoperitoneal shunt being the initial & time tested procedure. Increasingly, Endoscopic third ventriculostomy & Choroid plexus cauterization are being explored as alternative treatment options. Both are becoming widely studied with varying results reported & a gold standard yet not established. In our study, we aimed to answer the same query of ETV vs VP Shunting. Ventriculoperitoneal shunting is a procedure whereby a shunt is placed in the lateral ventricle & tunnelled to the peritoneal cavity. A programmable pump & reservoir control the flow rate across the device maintaining normal intracranial pressure. While effective, complications both wound-related & device-related remain a cause of morbidity (9). The latter consists of shunt blockage/malfunction requiring revision surgery & the former of surgical site infection & hematoma formation. Post-op seizures & cerebrospinal fluid leaks also commonly result. Uchi et al studied 55 pediatric patients and reported an incidence of surgical site infection & sepsis of 13% in the VPS group as compared to 4% in the ETV group. Although his results were statistically significant akin to ours, he recommended ETV as the safer option (10).

Endoscopic third ventriculostomy is an increasingly available and relatively novel option. It entails the creation of an opening in the floor of the third ventricle via an endoscope introduced via a burr hole bypassing the causative lesion (3).It offers the prospects of being minimally invasive & cost-effective coupled with all the benefits of minimally invasive surgery i.e. shorter duration of hospital stay, cost-effectiveness, earlier return to a normal routine, reduced access related & wound-based complications. However, complications are present with haemorrhage, infections & cerebrospinal fluid leaks being the most common. Late sudden deterioration leading to patient death has also been reported (11).

In our study, we found ETV to have less frequency of all studied post-op complications.

Mushtaq et al compared the two procedures & found similar outcomes with the VPS group having 14.9% complications & ETV having 10%. He reported CSF leak as most common followed by seizures & meningitis in the latter group. In the former, shunt-related complications predominated being shunt blockage and shunt infection (12). Mousa et al studied the comparison in patients with posterior fossa tumours & reports in the ETV group, CSF leak at 18.7% (n=6), pseudo meningocele in 12.5% (n=4) & pneumocephalus in 34.4% (n=11). In the VPS group, he reports an equal incidence of pneumocephalus & shunt obstruction & infection in 18.7% (n=6) (7).

Mersha et al reported a higher complication rate, 27% (n=37) in the VPS group as compared to 12.2% (n=6) in the ETV group (13). Surgical site infection occurred in 27% (n=37) of VPS vs 6.1% (n=3) in the ETV group. Simair et al reported 20% (n=3) complications in the ETV group in the form of recurrence. (8) In the VP group, 26.7% (n=4) had complications. (9) Sharafat S et al reported in their study reported 9.52% complication rate in ETV group patients (14).

Similar results are reported by Rahman et al & Kamikawa et al. (15,16) Kamikawa et al report that 75% (n=33) of the

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subjects treated with ETV did not require revision with shunting. The rest eventually needed endoscopic guided VP shunting.

Varying success rates are reported for ETV. Sharafat et al report a success rate of only 57% at 6 months (n=12) in treated infants with complications noted in 10% of patients. (14) A meta-analysis conducted by Kong et al based on 6 RCTs concludes that in Comparison to VPS, ETV had lower postoperative infection incidence & postoperative CSF leakage. However, VPS had no mortality as compared to ETV (17).

A meta-analysis by Lu et al reported that ETV was associated with a lower incidence of postoperative infection; postoperative hematoma and blockage rate compared with VPS. Compared with VPS, ETV had no significant effect on the incidence rate of postoperative cerebrospinal fluid leakage mortality rates but there have been no deaths in patients treated with ETV (4).

Thus, varying results are reported with a general trend towards more favourable outcomes in ETV relative to VPS, even when statistically insignificant (18). Our study is also in line with this observed treatment with significant differences noted.

Conclusion

Our study supports the fact that ETV is a new robust procedure option for treatment of the obstructive hydrocephalus. This should be further explored & consolidated in studies free of the limitation of a relatively small sample size as present in ours. VPS should not be trumped over the latter by being time-tested. ETV should be tangibly considered a valuable addition to the neurosurgical treatment inventory.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department Concerned. (IRBEC-032/24)

Consent for publication
Approved

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Conflict of interest

The authors declared an absence of conflict of interest.

Author Contribution

MUHAMMAD MOTSIM SHAH (PGT Neurosurgery). *Conception of study, literature review, data acquisition, Study Design, Manuscript drafting.*
MUNEMA KHAN (Resident General Surgery) *Development of Research Methodology Design, data analysis , Review of manuscript.*
NADEEM AKHTAR (Professor of Neurosurgery) *Manuscript revisions, critical input. Coordination of collaborative efforts.*
ALI TASSADAQ (Consultant Neurosurgeon) *Manuscript drafting, critical input.*
YASIR SHAHZAD (Associate Professor of Neurosurgery) *Manuscript drafting, review of manuscript.*
INAYATULLAH KHAN (Professor of Neurosurgery) *Critical input.*
ZOHAIB MASOOD (Registrar Neurosurgery) *Manuscript revisions, critical input.*
YUMNAH ANWAR (Resident Neurosurgery) *Coordination of collaborative efforts. Data acquisition.*

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