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COMPARISON OF ENDOSCOPIC THIRD VENTRICULOSTOMY AND VENTRICULOPERITONEAL SHUNT FOR OBSTRUCTIVE HYDROCEPHALUS: A RECENT SYSTEMATIC REVIEW AND META-ANALYSIS

Naeem ul Haq[1], Warda Naeem[2]*
[1]Associate Professor, Neurosurgery Unit, Mardan Medical Complex, KP, Pakistan
[2]*Anaesthesia Department MMC. Mardan medical Complex, KP, Pakistan

***Corresponding Author: Warda Naeem**
*Email: warda_naeem@hotmail.com

Abstract
Increased intracranial pressure and dilated ventricles are characteristics of hydrocephalus, a medical disorder caused by problems with the increased level of cerebrospinal fluid. This research meta-analyses previous studies to determine whether or not a shunt placed in the abdominal cavity is more successful than an ETV in treating obstructive hydrocephalus. Results Our examined cases for operational cases are operative cases. Postoperative infection, haemorrhage, blockage rate, cerebrospinal fluid leakage, and death from five randomised clinical trials including 88 patients. The risks of infection, obstruction, death, haemorrhage, and cerebrospinal fluid leakage were all decreased by 81%, 56%, 35%, and 56%, respectively, with ETV compared to VPS. However, the need for individual randomizedlised treatment decisions is emphasised by the diversity in outcome criteria and patient characteristics. While the findings from this study are helpful, further in-depth studies and age-specific analysis are required to adequately advise treatment recommendations. Aiming for standardized criteria in future research will help decrease result heterogeneity.
Study design: Meta-analyses-Study
Palace and duration of study: Department Of Neurosurgery Mmc Hospital Mardan, Pakistan From Jan 2022 To Jan 2023

Keywords: Hydrocephalus, endoscopic third ventricular ostomy (ETV), ventricular peritoneal shunt (VPS), systematic review, meta-analysis, comparative efficacy.

Introduction

Hydrocephalus is a medical condition distinguished by an enlargement of the ventricles inside the brain and an elevation in intracranial pressure (ICP). This condition is caused by an anomaly in the generation, circulation, or removal of cerebrospinal fluid (CSF). 1 It is crucial to consider that certain individuals diagnosed with hydrocephalus may not exhibit elevated intracranial pressure (ICP). 2 Hydrocephalus may be classified into two primary classifications, namely communicative and noncommunicative, which are determined by the underlying pathophysiological mechanisms involved. 3 Various factors, including infections, tumors, haemorrhages, and previous surgical interventions, have the potential to interfere with the regular flow of cerebrospinal fluid (CSF). Noncommunicating hydrocephalus, a condition that will be elaborated upon further, may arise as a consequence of these disruptions. 4 The surgical procedure known as ventriculoperitoneal shunt

(VPS) implantation has been widely accepted as the preferred method for managing obstructive hydrocephalus. This technique involves the creation of a conduit that allows cerebrospinal fluid to be diverted from the ventricles of the brain to the abdominal cavity. 5 While the efficacy of vagus nerve stimulation (VNS) in mitigating hydrocephalus symptoms has been demonstrated, it is important to acknowledge the potential hazards associated with this intervention. Potential risks associated with ventriculoperitoneal shunts (VPS) are shunt obstruction and infection, both of which may necessitate further surgical intervention. The user's text is not sufficient to rewrite in an academic manner. 1
The comparative advantages of VPS and ETV have been extensively debated and disputed in contemporary discourse. 3 ETV has garnered attention due to its capacity to decrease the occurrence of infections, a prevalent outcome of VPS, as previously corroborated by a prior meta-analysis. 1 The main objective of this updated meta-analysis and systematic review is to examine and compare the effectiveness of these two treatment options in managing obstructive hydrocephalus. In order to get a more comprehensive understanding of the comparative advantages and possible drawbacks associated with each strategy in addressing this complex medical disease, we will do a thorough assessment of clinical outcomes, rates of complications, and mortality rates pertaining to VPS and ETV.

Methods

This study was conducted in the department of neurosurgery MMC Hospital Mardan, Pakistan from Jan 2022 to Jan 2023. The present review adhered to the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement. 6 The identification of randomized clinical trials (RCTs) was conducted by a thorough and systematic search across many databases, such as PubMed, the Cochrane Central Register of Controlled Trials, and Scopus. To further ensure a thorough literature search, we also reviewed the cited works of included studies, meta-analyses, and systematic reviews.

Selection Criteria and Endpoints

The studies used in this analysis adhered to the following criteria: (1) they were RCTs, (2) they examined the comparative effectiveness of ETV and VPS as treatment methods, (3) they included patients who had been diagnosed with obstructive hydrocephalus, and (4) they reported at least one clinically significant outcome. Exclusion criteria were applied to studies that satisfied any of the following conditions: (1) inclusion of overlapping populations, (2) inclusion of research groups that were deemed irrelevant, or (3) use of an RCT study design. The key outcome measures examined in this research comprised: (1) surgical success, (2) occurrence of CSF leakage after surgery, (3) incidence of postoperative infection, (4) occurrence of postoperative or intraoperative bleeding, (5) rate of obstruction, and (6) death.

Data Analysis

In order to conduct a comparison of binary endpoints, we employed risk ratios (RR) in conjunction with 95% confidence intervals (CI). The assessment of heterogeneity was conducted utilising the Cochrane Q-test and I^2 statistics. In this analysis, substantial heterogeneity was determined by observing values of $p > 0.10$ and $I^2 > 25\%$. 7 The researchers utilised a fixed-effect model for endpoints exhibiting an I^2 value below 25%. In cases where the I^2 value exceeded 25%, a DerSimonian and Laird random-effect model was applied. The statistical analyses were conducted using R Studio software, specifically version 4.2.1 provided by the R Foundation for Statistical Computing.

Quality Assessment and Sensitivity Analysis

The assessment of possible bias was carried out following the guidelines outlined in the Cochrane Handbook for Systematic Reviews of Interventions, with the Rob-2 instrument developed by the Cochrane Collaboration. The tool encompasses five distinct aspects, specifically choosing, efficiency, identification, attrition, and reporting, as shown by previous research. 6,7 To evaluate the reliability of the evidence randomized controlled trials (RCTs) were categorized into several levels of quality,

including extremely low, low, moderate, or high-quality evidence. The categorization was established after a comprehensive assessment of many aspects, encompassing the likelihood of bias, the coherence of outcomes, the accuracy of findings, the existence of publication bias, and the magnitude of treatment effects. The evaluation adhered to the standards delineated in the Grading of Recommendation Evaluation, Development, and Assessment (GRADE) methodology.

Figure 1: Ventriculostomy stoma in tuber cineruim

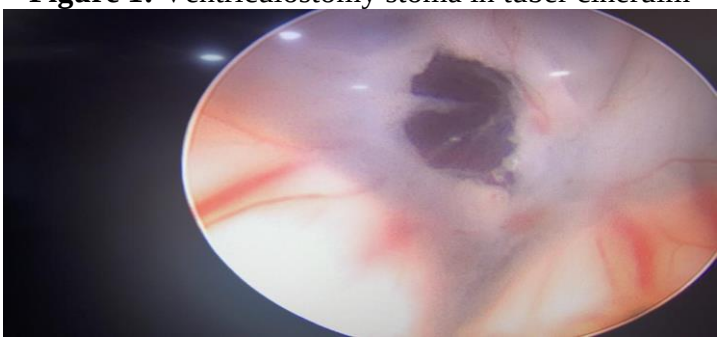

Figure 2: Pre pontine cistern

Table 1: Study Selection and Characteristics

Selection and Characteristics	
Initial Search Results	2,353
Duplicate Records Removed	14
Studies Included in Analysis	5 (RCTs)
Total Patients	88 (ETV: 23, VPS: 65)
Age Range in VPS Group	3.6 months - 32.3 years
Age Range in ETV Group	3.91 months - 31.5 years
Male-to-Female Ratio Reported	Yes (in most studies)
Follow-up Period in ETV Group	1 - 27.5 months
Follow-up Period in VPS Group	1 - 26 months
Outcomes Analysed	Operative Success, Postoperative
	Infection, Postoperative or
	Intraoperative Bleeding, Blockage
	Rate, Postoperative CSF Leakage
	Mortality

Table 2: Summary of Outcomes

Outcome	**ETV (Events/Total)**	**VPS (Events/Total)**	**Risk Ratio (RR)**	**95% CI**	**p-value**	**I^2 (%)**
Operative Success	30/40	32/40	1.18	0.77–1.82	0.44	84
Postoperative Infection	6/23	24/103	0.11	0.04–0.33	<0.0001	0
Postoperative or Intraoperative Bleeding	4/40	6/40	0.44	0.17–1.15	0.09	0
Blockage Rate	2/24	24/29	0.15	0.03–0.75	0.02	53
Postoperative CSF Leakage	5/15	6/15	0.65	0.22–1.92	0.44	18
Mortality	0/20	6/20	0.19	0.03–1.09	0.06	0

Table 3: Quality Assessment

Study	Randomization Method	Allocation Concealment	Risk of Bias	GRADE Evidence Quality
Study 1	Yes	Unclear	Low	Very Low
Study 2	Yes	Unclear	Low	Very Low
Study 3	Yes	Unclear	Low	Very Low
Study 4	Yes	Unclear	High	Very Low
Study 5	Yes	Unclear	Low	Very Low

Discussion

The present meta-analysis comprised a sample of 88 individuals diagnosed with obstructive hydrocephalus who had undergone either ETV or VPS surgeries. This study was undertaken following a rigorous systematic review of the available literature. Our investigation has yielded some significant findings that offer valuable insights into the comparative effectiveness of various therapeutic approaches. In comparison to VPS, ETV demonstrated a reduced likelihood of postoperative infections and a lower incidence of obstruction. When conducting a comparison between ETV and VPS, it was observed that the relative risk of mortality was significantly reduced by 81% for ETV compared to VPS. Additionally, the in relation threat of postoperative or intraoperative bleeding was found to be 56% lower for ETV, while the risk of CSF leakage was 35% lower. Furthermore, the likelihood of achieving operative success was found to be 18% higher with VPS compared to ETV.

Cerebral aqueduct occlusion, colloid cysts, and tumours are typical causes of obstructive hydrocephalus, which is characterised by the obstruction of cerebrospinal fluid (CSF) flow inside the ventricles. Hydrocephalus can manifest in a broad variety of ways with no consistent clinical hallmarks. In addition to papilledema, adults may also experience headaches, nausea, delayed development, sleepiness, lethargy, and behavioural problems in children. The treatment of CSF diversion in hydrocephalus is difficult despite the development of endoscopic procedures and VPS hardware. After multiple postoperative difficulties with early endoscopic treatments, shunt techniques, popular in the 1960s, became the preferred treatment. 8 However, ETV and other endoscopic procedures have advanced and become the gold standard for treating hydrocephalus in the brain that is not communicated to the patient. 9

Both VPS and ETV surgeries aim to lower the pressure inside the skull, helping the brain perform better. on ETV, a tiny hole is drilled in the floor of the third ventricle to redirect cerebrospinal fluid (CSF) around the blocked area. In order for ETV to be considered successful, the patient's symptoms must improve without further shunt installation. Lower complication rates and quicker recoveries are the results of improvements in endoscopic technology that have made the treatment safer and more

effective. In contrast, VPS is a surgical operation in which a catheter is inserted into a vein in the femoral vein to drain CSF from the ventricles of the brain into the peritoneal cavity, where it is reabsorbed. 10 Long-term care of hydrocephalus remains a major concern due to multiple complications related to shunt dysfunction and infection, despite technical advancements. Despite advances in technology and the expertise of surgeons, a large majority of shunts fail after a few years. 11

Postoperative infection, haemorrhage, shunt obstruction, and CSF leaking are the most common VPS complications. Our meta-analysis confirmed the results of a prior meta-analysis, showing that ETV significantly reduced the risks of postoperative infection and shunt obstruction. Since the RCTs we included in our study did not include data on mortality, the outcome was consistent with the existing literature. The restricted patient group in the RCTs makes it difficult to draw firm conclusions on the trend favouring ETV for postoperative or intraoperative haemorrhage and death. Still, these findings are encouraging since they point to enhanced success rates for ETV treatments. However, it is important to note that patients who underwent VPS experienced more severe bleeding events, such as subdural and epidural hematomas, requiring additional interventions and, in one case, resulting in death, despite the fact that our meta-analysis found no significant differences between ETV and VPS in terms of postoperative or intraoperative bleeding.

The different ways in which the included RCTs define operative success is a significant obstacle when attempting to draw parallels between ETV and VPS. Operative success has low statistical significance and large observed variability, both of which may be attributed to the lack of unanimity in defining this outcome. When comparing the ETV group (5%) to the VPS group (8%), we found that both had similar rates of CSF leakage. 12 These rates are in line with other meta-analyses that compared ETV with VPS and are comparable with data in paediatric patients with posterior fossa tumours. 13,14 Our study has several limitations that should be taken into account when interpreting its findings. These include the relatively small number of randomised controlled trials (RCTs), the possibility of bias, the lack of information regarding the causes of obstructive hydrocephalus, the use of different criteria for evaluating outcomes, and the inclusion of patients across a wide age range.

Conclusion

We have effectively explained the relative benefits of ETV and VPS in the treatment of obstructive hydrocephalus by conducting a thorough systematic review and an updated meta-analysis. Hydrocephalus is a pathological illness described by an abnormal accumulation of cerebrospinal fluid and increased pressure within the skull, and its management presents a significant challenge to the medical community. The primary objective of this research was to increase knowledge of the aftereffects, complication rates, and mortality threats of ETV and VPS procedures. The goal was to provide healthcare providers and patients with a wider variety of data to use in making educated decisions. Five randomized clinical studies with a total of 88 participants were analyzed, and the results revealed a number of statistically significant findings. The emergence of ETV as a possible alternative to VPS is attributed to its reduced risk of postoperative infections and lower incidence of blockages. Upon comparing ETV with VPS, it was seen that the former exhibited a relative chance of operational success that was 18% higher, a risk of postoperative or intraoperative bleeding that was 56% lower, a danger of cerebrospinal fluid leakage that was 35% lower, and a risk of death that was 81% lower. It is crucial to bear in mind, nonetheless, that instances of obstructive hydrocephalus exhibit significant variability, hence rendering a standardised strategy potentially ineffective. The optimal therapy approach may be contingent upon several factors, including the root reason, the patient's age, and additional individual attributes. Hence, it is crucial to give precedence to the patient's needs and preferences while making a decision between ETV and VPS. Although the findings of the study provide valuable insights, it is crucial to acknowledge the limitations inherent in the research. Concerns have been raised about the small sample sizes of the available randomised clinical trials, as well as possible biases, differences in outcome definitions, and a broad age range of patients included in the study. Considering specific patient groupings and clinical circumstances, more rigorous

research is needed to give stronger evidence favouring ETV over VPS or vice versa. In conclusion, our meta-analysis and systematic review add to the continuing conversation about how best to treat obstructive hydrocephalus. While both ETV and VPS are viable therapy choices, the former may have less side effects. However, specific patient characteristics and clinical context should inform therapy selection. To further comprehend these therapy methods and to revise clinical recommendations for the best management of obstructive hydrocephalus, more research and randomised clinical trials are required.

Limitations

It is important to note that our study has some limitations, despite the fact that our systematic review and meta-analysis of the literature on the topic of the relative efficacy of ETV and VPS for the treatment of obstructive hydrocephalus is very helpful. First and foremost, the number of RCTs available for inclusion in our analysis was relatively limited. This constraint may influence the generalizability of our findings, emphasizing the need for future investigations with more extensive participant cohorts to strengthen the evidence base. Additionally, although the risk of bias in the RCTs we examined was generally low or unclear, there may still be unaccounted sources of bias that could impact the validity of our results. Consequently, further studies employing robust methodologies are crucial to minimize potential bias. We also observed significant heterogeneity in some outcomes, such as operative success, possibly due to variations in the criteria used to define success in different studies. To address this issue, future research should strive for standardized criteria to reduce heterogeneity. Lastly, our meta-analysis encompassed patients spanning a broad age range, and as the management of obstructive hydrocephalus can differ between pediatric and adult populations, future studies should consider age-specific analyses to gain more comprehensive insights into treatment outcomes.

Recommendations for Future Studies

In light of the findings and limitations identified in our systematic review and meta-analysis, we offer recommendations for future research in the field of obstructive hydrocephalus treatment. Firstly, it is imperative to conduct a greater number of well-designed randomized clinical trials (RCTs) with larger and more diverse patient cohorts. These trials should encompass various age groups, from pediatric to adult populations, to provide a comprehensive assessment of the comparative effectiveness of ETV and VPS. Furthermore, to enhance the comparability of outcomes, future studies should aim for standardized criteria when defining critical endpoints such as operative success. This standardization will reduce heterogeneity and allow for more accurate comparisons between treatment modalities.

Author's contribution

Naeem ul Haq: Concepts and Design of the study, Drafting, Data Analysis
Warda Naeem: Critical Analysis and Final Version

References

1. Texakalidis P, Tora MS, Wetzel JS, Chern JJ. Endoscopic third ventriculostomy versus shunt for pediatric hydrocephalus: A systematic literature review and meta-analysis. Child's Nervous System. 2019 Aug 1;35:1283-93.
2. 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 Jun;44:1227-41.
3. Li C, Gui S, Zhang Y. Compare the safety and efficacy of endoscopic third ventriculostomy and ventriculoperitoneal shunt placement in infants and children with hydrocephalus: a systematic review and meta-analysis. International Journal of Neuroscience. 2017 Jun 1(just-accepted):1-30.

4. 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 Sep 1;129:334-40.
5. Pasqualotto, E., Schmidt, P.H.S., Ferreira, R.O.M., Chavez, M.P. and da Silva, F.F.S., 2023. Endoscopic Third Ventriculostomy versus Ventriculoperitoneal Shunt in Patients with Obstructive Hydrocephalus: An Updated Systematic Review and Meta-Analysis. *Asian Journal of Neurosurgery*.
6. Rasul, F.T., Marcus, H.J., Toma, A.K., Thorne, L. and Watkins, L.D., 2013. Is endoscopic third ventriculostomy superior to shunts in patients with non-communicating hydrocephalus? A systematic review and meta-analysis of the evidence. *Acta neurochirurgica*, *155*, pp.883-889.
7. Jesuyajolu, D.A., Zubair, A., Nicholas, A.K., Moti, T., Osarobomwen, O.E., Anyahaebizi, I., Okeke, C. and Davis, S.O., 2022. Endoscopic third ventriculostomy versus ventriculoperitoneal shunt insertion for the management of pediatric hydrocephalus in African centers–A systematic review and meta-analysis. *Surgical Neurology International*, *13*.
8. Gillespie CS, Fang WY, Lee KS, Clynch AL, Alam AM, McMahon CJ. Long standing overt ventriculomegaly in adults (LOVA): a systematic review and meta-analysis of endoscopic third ventriculostomy vs ventriculoperitoneal shunt as first line treatment. World neurosurgery. 2023 Mar 21.
9. Legaspi, G.D., Espiritu, A.I. and Omar, A.T., 2021. Success and complication rates of endoscopic third ventriculostomy for tuberculous meningitis: a systematic review and meta-analysis. *Neurosurgical Review*, *44*, pp.2201-2209.
10. Jiang L, Gao G, Zhou Y. Endoscopic third ventriculostomy and ventriculoperitoneal shunt for patients with noncommunicating hydrocephalus: A PRISMA-compliant meta-analysis. Medicine. 2018 Oct;97(42).
11. de Ribaupierre S, Rilliet B, Vernet O, Regli L, Villemure JG. Third ventriculostomy vs ventriculoperitoneal shunt in pediatric obstructive hydrocephalus: results from a Swiss series and literature review. Child's Nervous System. 2007 May;23:527-33.
12. Zaben M, Manivannan S, Sharouf F, Hammad A, Patel C, Bhatti I, Leach P. The efficacy of endoscopic third ventriculostomy in children 1 year of age or younger: A systematic review and meta-analysis. European Journal of Paediatric Neurology. 2020 May 1;26:7-14.
13. Giordan E, Palandri G, Lanzino G, Murad MH, Elder BD. Outcomes and complications of different surgical treatments for idiopathic normal pressure hydrocephalus: a systematic review and meta-analysis. Journal of neurosurgery. 2018 Nov 23;131(4):1024-36.
14. Montemurro, N., 2023. Clinical and surgical outcome of endoscopic third ventriculostomy (ETV) and ventriculoperitoneal shunt (VPS) in patients with Long-Standing Overt Ventriculomegaly in Adults (LOVA): a systematic review. *Neurological Research*, pp.1-8.