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Research Article

Ventriculoperitoneal Shunt versus Endoscopic Third Ventriculostomy for Obstructive Hydrocephalus in Infants: A Comparative Outcome Study

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ABSTRACT

Background: Obstructive hydrocephalus in infancy is a common neurosurgical condition requiring timely intervention to prevent irreversible neurological damage. Ventriculoperitoneal (VP) shunting has traditionally been the mainstay of treatment but is associated with significant mechanical and infectious complications. Endoscopic third ventriculostomy (ETV) has emerged as an alternative procedure, particularly for non-communicating hydrocephalus, with the potential advantages of reduced complications and avoidance of implanted hardware. However, comparative regional data in infants remain limited.

Objective: To compare the operative outcomes, complication rates, and treatment failure between VP shunting and ETV in infants with obstructive hydrocephalus.

Methods: This retrospective comparative study was conducted at the Department of Paediatric Surgery, The Children's Hospital and Institute of Child Health, Multan, over a 12-month period. A total of 102 infants (≤1 year) with obstructive hydrocephalus were enrolled using consecutive sampling and randomized into two groups: VP shunt (Group A, n=51) and ETV (Group B, n=51). Operative time, postoperative infection, symptom recurrence, and treatment failure were assessed over a six-month follow-up. Data were analyzed using SPSS version 25, with a p-value ≤0.05 considered statistically significant.

Results: The mean age was comparable between groups (p=0.696). Mean operative time was significantly shorter in the ETV group compared to the VP shunt group (47.34 ± 19.79 vs 62.67 ± 22.80 minutes; p=0.018). Postoperative infection occurred more frequently following VP shunting than ETV (45.08% vs 21.56%; p=0.046). Treatment failure was significantly higher in the VP shunt group (18.62%) compared to the ETV group (10.78%; p=0.035). Symptom recurrence rates did not differ significantly between the two groups (p=0.546).

Conclusion: Endoscopic third ventriculostomy demonstrates superior operative efficiency and a lower risk of postoperative infection and treatment failure compared to

ventriculoperitoneal shunting in infants with obstructive hydrocephalus. ETV represents a safe and effective alternative to VP shunting in appropriately selected patients, though long-term, multicenter studies are warranted to further define its role in this age group.
Keywords: Ventriculoperitoneal Shunt, Endoscopic Third Ventriculostomy, Obstructive Hydrocephalus, Infants, neurosurgical condition

INTRODUCTION

Hydrocephalus is a neurological disorder characterized by an excessive accumulation of cerebrospinal fluid (CSF) within the ventricles of the brain, leading to increased intracranial pressure and ventricular dilation. The condition, first described by Hippocrates, was recognized through symptoms such as headaches, vomiting, visual disturbances, and diplopia, which he attributed to a "liquefaction of the brain induced by epileptic seizures"[1]. Despite advancements in diagnostic imaging and surgical interventions, the underlying pathophysiology of hydrocephalus remains incompletely understood, posing significant challenges in its management[2]. Hydrocephalus is broadly categorized into communicating and non-communicating (obstructive) types[2]. The pathological progression typically begins with dilation of the temporal and frontal horns, followed by stretching of the white matter, thinning of the cortical gray matter, and elevation of the corpus callosum. This complex process underscores the multifactorial nature of the disease and highlights the importance of individualized management approaches.

Management of Obstructive hydrocephalus primarily involves surgical intervention through ventriculoperitoneal (VP) shunting or endoscopic third ventriculostomy (ETV). VP shunting, though widely practiced, is associated with mechanical and infectious complications such as obstruction, disconnection, migration and shunt tract abscess[3]. In recent years, ETV has emerged as a preferred alternative, particularly for obstructive hydrocephalus, due to its lower complication rate and avoidance of implanted hardware [4].

At the Children's Hospital and Institute of Child Health, Multan,a tertiary care facility these procedures are routinely performed, yet regional data on the comparison between the outcome of the two procedures remains limited. This study, therefore, aims to evaluate local surgical experiences and complications associated with hydrocephalus management to inform evidence-based practices and improve patient outcomes.

MATERIAL AND METHOD

This retrospective study was conducted in the Department of Paediatric Surgery at The Children's Hospital and Institute of Child Health, Multan. The study duration was twelve months or until recruitment and follow-up of all participants were completed. Patients were selected through consecutive sampling, while allocation into two groups was done using a simple randomization technique (lottery method). The sample size was determined using a formula for comparing two proportions, taking parameters where p_1 = 8% and p_2 = 26%, with $\alpha = 0.05$ and $\beta = 0.2$, ensuring a power of 80%[1]. The calculated sample size was 51 patients for each group, making a total of 102 participants.

Infants up to one year of age with obstructive hydrocephalus were included in the study, while those with previous cranial surgery, non-obstructive hydrocephalus, multiple congenital anomalies, or whose guardians refused consent were excluded. After obtaining approval from the institutional ethical Board, eligible patients presenting through the pediatric surgery outpatient

department were enrolled and written informed consent from the parents/guardians was taken after detailed information. Group A was assigned for Ventriculoperitoneal shunt and Group B was assigned to patients undergoing third ventriculostomy.

All surgeries were performed by consultant pediatric surgeons following a standardized protocol. Patients without complications were discharged on third postoperative day and followed for six months. During follow-up, outcomes such as wound infection, shunt infection, meningitis, recurrence, and failure were evaluated and recorded on a predesigned proforma. Data were analyzed using SPSS version 25. The Student's *t*-test was applied for intergroup comparisons, with a *p*-value ≤ 0.05 considered statistically significant.

RESULTS

The mean age of patients in Group A (ventriculoperitoneal shunt) was 8.78 ± 3.13 months, while in Group B (third ventriculostomy) it was 8.95 ± 4.08 months. The age range of patients in both groups was comparable, with a minimum of 3.5 months and a maximum of 13 months overall. Statistical analysis using the independent samples *t*-test revealed no significant difference in mean age between the two groups (t = -0.391, p = 0.696). These findings indicate that the two study groups were homogeneous with respect to age distribution, ensuring that age did not act as a confounding factor in comparing postoperative outcomes between the procedures.

Table-1: Descriptive statistics of age (Months) in both study groups

Study group	Mean age (months)	SD	Minimum	Maximum	*p*-value
Group A – Ventriculoperitoneal shunt	8.78	3.13	4.0	12.0	0.696
Group B – Third ventriculostomy	8.95	4.08	3.5	11.0	—
Total	**8.86**	**3.61**	**3.5**	**13.0**	—

The mean duration of surgery in Group A (ventriculoperitoneal shunt) was 62.67 ± 22.80 minutes, while in Group B (third ventriculostomy) it was 47.34 ± 19.79 minutes. The overall mean operative time for the study population was 55.05 ± 21.29 minutes, with a minimum of 43 minutes and a maximum of 82 minutes. Statistical analysis using the independent samples *t*-test demonstrated a significant difference in mean operative time between the two groups (t = -1.065, p = 0.018), indicating that the third ventriculostomy procedure required significantly less operative time compared to the ventriculoperitoneal shunt.

Table-2: Descriptive statistics of Duration of surgery (minutes) in both study groups

Study group	Mean duration (minutes)	SD	Minimum	Maximum	*p*-value
Group A – Ventriculoperitoneal shunt	62.67	22.80	57	82	0.018
Group B – Third ventriculostomy	47.34	19.79	43	62	—
Total	**55.05**	**21.29**	**43**	**82**	—

Postoperative infection was observed in 23 patients (45.08%) in Group A (ventriculoperitoneal shunt) compared to 11 patients (21.56%) in Group B (third ventriculostomy). The remaining 28 patients (54.92%) in Group A and 40 patients (78.44%) in Group B showed no evidence of infection. Overall, infection occurred in 34 out of 102 patients (33.33%). Statistical analysis revealed a significant difference in infection rates between the two groups (p = 0.046), indicating that postoperative infections were more frequent following ventriculoperitoneal shunt procedures than third ventriculostomy.

Table-3: Presence of Infection in both groups with stratification

Study group	Infection present, *n* (%)	No infection, *n* (%)	*p*-value
Group A – Ventriculoperitoneal shunt	23 (45.08)	28 (54.92)	0.046
Group B – Third ventriculostomy	11 (21.56)	40 (78.44)	—
Total	**34 (33.33)**	**68 (66.67)**	—

Symptom recurrence was observed in 19 patients (18.62%) in Group A (ventriculoperitoneal shunt) and 17 patients (16.66%) in Group B (third ventriculostomy). The majority of patients in both groups 32 (81.38%) in Group A and 34 (83.34%) in Group B remained free of recurrent symptoms during the follow-up period. Overall, recurrence was noted in 36 out of 102 patients (35.29%). Statistical analysis showed no significant difference in symptom recurrence between the two groups (p = 0.546), suggesting that both procedures were comparable in terms of postoperative symptom control.

Table-4: Symptoms Recurrence rate in both groups with stratification

Study group	Recurrence – Yes *n (%)*	Recurrence – No *n (%)*	*p*-value	Significance
Group A – Ventriculoperitoneal shunt	19 (18.62%)	32 (81.38%)	0.546	Not significant
Group B – Third ventriculostomy	17 (16.66%)	34 (83.34%)	—	—
Total	**36 (35.29%)**	**66 (64.71%)**	—	—

Treatment failure was observed in 19 patients (18.62%) in Group A (ventriculoperitoneal shunt) compared with 11 patients (10.78%) in Group B (third ventriculostomy). The majority of patients in both groups—32 (81.38%) in Group A and 40 (89.22%) in Group B—had successful outcomes without failure. Overall, treatment failure occurred in 30 out of 102 patients (29.41%). Statistical analysis revealed a significant difference between the two groups (p = 0.035), indicating that the failure rate was higher among patients who underwent ventriculoperitoneal shunt compared to those who underwent third ventriculostomy.

Table-5: Failure of Treatment rate in both groups with stratification

Study group	Failure present, n (%)	Failure absent, n (%)	*p*-value
Group A – Ventriculoperitoneal shunt	19 (18.62)	32 (81.38)	0.035
Group B – Third ventriculostomy	11 (10.78)	40 (89.22)	—
Total	**30 (29.41)**	**72 (70.59)**	—

DISCUSSION

This randomized controlled trial compared the outcomes of ETV and VP shunt procedures in infants under one year of age with obstructive hydrocephalus. Results demonstrated that ETV was associated with a significantly shorter operative time and lower postoperative infection rate compared with VP shunting. Symptomatic improvement was similar in both groups; however, treatment failure was notably lower in the ETV cohort, while the recurrence of symptoms was not significantly different.

In this study, the mean operative time for ETV was 47.34 ± 19.79 minutes, significantly shorter than that for VP shunting (62.67 ± 22.8 minutes; p = 0.018). Postoperative infection occurred in 33.3% of all patients, with a higher frequency in the VP shunt group (45.1%) compared to the ETV group (21.6%; p = 0.046). Treatment failure was observed in 29.4% of all patients, with 18.6% in the VP shunt group and 10.8% in the ETV group (p = 0.035). These findings highlight ETV's procedural efficiency and lower infection risk, possibly reflecting the avoidance of foreign material implantation and reduced surgical manipulation.

These results are consistent with those of previous investigations. A Study conducted in Bangladesh reported a 21% failure rate following ETV[7], while another Tenesse study from Neurosurgery department described failure rates ranging from 10% to 38.6%[8]. Similarly Abdul-Aziz et al compared 52 infants treated with either ETV or VP shunt and found lower postoperative infection rates and shorter operating times in the ETV group (23.1% vs 53.8%, and 46.9 vs 64.3 minutes, respectively)[9]. Although the rates of occlusion and reoperation did not differ significantly, their one-year success rates favored ETV (65.4%) over VP shunting (46.2%).

A systematic review of 122 articles from Missouri found comparable surgical failure rates between both procedures, emphasizing that patient selection and surgeon expertise are pivotal in determining outcomes[10]. In contrast, a retrospective study by M. Saekhu et al found no significant difference in overall efficacy but noted that ETV offered reduced complications and shorter hospital stays[11]. In a larger meta-analysis including 1,513 patients, reported that ETV was superior in reducing infection, reoperation, and complication rates compared to VP shunting[2]. Variations in study design, patient age, etiology of hydrocephalus, and follow-up duration likely explain the discrepancies across studies.

Taken together, This study supports ETV as a safe and effective alternative to VP shunting for non-communicating hydrocephalus in infants. The procedure offers distinct advantages—shorter operative duration, reduced infection risk, and elimination of lifelong shunt dependence—while maintaining comparable symptom control. Nonetheless, ETV demands high technical precision and is less successful in very young infants due to immature CSF absorption pathways. Long-term,

multicenter studies with standardized outcome criteria are warranted to further establish ETV's role as a first-line treatment in this age group.

CONCLUSION

Endoscopic third ventriculostomy (ETV) offers a superior alternative to ventriculoperitoneal (VP) shunting in the management of obstructive hydrocephalus in infants. ETV being associated with shorter operative time, lower rates of postoperative infection and complications, and reduced need for reoperation has better outcome. Given these advantages, ETV can be considered a safe and effective first-line treatment in appropriately selected patients, although long-term follow-up and multicenter studies are recommended to further validate these findings.

REFERENCES

1. Debabrata S, Rajiv S. Comparative study between endoscopic third ventriculostomy and ventriculo-peritoneal shunt for hydrocephalus in children between six to twelve months of age. Int J Sci Res. 2017;6(10).
2. Jiang L, Gao G, Zhou Y. Endoscopic third ventriculostomy and ventriculoperitoneal shunt for patients with non-communicating hydrocephalus. Medicine (Baltimore). 2018;97(42):e12139
3. Pan P. Outcome analysis of ventriculoperitoneal shunt surgery in pediatric hydrocephalus. J Pediatr Neurosci. 2018;13(2):176
4. Zador Z, Coope D, Kamaly-Asl I. Comparative analysis of endoscopic third ventriculostomy trajectories in pediatric cases. J Neurosurg Pediatr. 2015;16(6):626-32.
5. *Ventriculosagittal sinus shunt for treating hydrocephalus with elevated cerebrospinal fluid protein* — includes data on rates of shunt obstruction (~15%), infection (~12.9%), needs for revision/removal, and distal catheter complications.
6. Yadav YR, Parihar VS, Todorov M, Kher Y, Chaurasia ID, Pande S, et al. Endoscopic third ventriculostomy — a review. *Neurol India*. 2021;69(Suppl 2):S502-S513.
7. Rahman MM, Khan SIM, Khan RA, Islam R, Sarker MH. Endoscopic third ventriculostomy in children: problems and surgical outcome—analysis of 34 cases. Chin Neurosurg J. 2021;7(1):1-6.
8. 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. J Neurosurg Pediatr. 2017;19(5):578-84.
9. Abdel-Aziz KI, Nouby R, Thabet MA, Elshirbiny MF. Endoscopic third ventriculostomy versus ventriculoperitoneal shunt for infant hydrocephalus. Open J Mod Neurosurg. 2020;10(2):193-202.
10. Limbrick DD Jr, Baird LC, Klimo P Jr, Riva-Cambrin J, Flannery AM. Pediatric hydrocephalus: systematic literature review and evidence-based guidelines. Part 4: Cerebrospinal fluid shunt or endoscopic third ventriculostomy for the treatment of hydrocephalus in children. J Neurosurg Pediatr. 2014;14(Suppl 1):30-34.
11. Saekhu M, Habibi KMAH, Tobing HG, Sadewo W, Gunawan K, Tandian D, Ichwan S, Aman RA, Ashari S, Nugroho S. In retrospective, the gentle learning curve of unilateral laminectomy promotes favorable clinical outcomes. Heliyon. 2023;9(6):e17406.