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Research Article

A Prospective Study on Clinical and Radiological Outcomes of Endoscopic Third Ventriculostomy

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ABSTRACT

Background: Endoscopic third ventriculostomy (ETV) is a well-established alternative to ventriculoperitoneal (VP) shunting for obstructive hydrocephalus. However, its success is influenced by patient age and underlying etiology.
Objective: To evaluate the clinical and radiological outcomes of ETV and assess the impact of age and etiology on procedural success.
Methods: This prospective analytical study included 30 patients with obstructive hydrocephalus who underwent ETV at a tertiary care centre. Clinical outcomes, intraoperative findings, complications, and radiological features were recorded. ETV success was defined as sustained clinical improvement without the need for VP shunt during follow-up.
Results: The mean age was 6.3 ± 4.8 years, with a male predominance (66.7%). Congenital aqueductal stenosis was the most common etiology (50%), followed by tumour-related (26.7%) and post-tubercular meningitic hydrocephalus (23.3%). The overall ETV success rate was 73.3%, with higher success in patients >10 years (85.7%) and tumour-related hydrocephalus (75%). Minor complications, including fever (16.7%), CSF leak (13.3%), and minor bleeding (10%), were managed conservatively. No mortality was reported. The presence of an MRI flow void at the stoma site strongly correlated with successful clinical outcomes.
Conclusion: ETV is a safe and effective first-line treatment for obstructive hydrocephalus, providing durable shunt independence with low morbidity. Age and etiology significantly influence success, and clinical recovery, supported by MRI flow-void findings, remains the most reliable indicator of outcome.

Keywords: Endoscopic third ventriculostomy, Obstructive hydrocephalus, Aqueductal stenosis, Ventriculoperitoneal shunt, MRI flow void.

INTRODUCTION

Hydrocephalus is a common neurosurgical condition characterized by disordered cerebrospinal fluid (CSF) dynamics that lead to ventricular dilation and elevated intracranial pressure [1]. A simplified operative approach to third ventriculostomy was subsequently described, establishing a reproducible technique that informed modern practice [2]. Advances in neuroendoscopic optics—particularly high-definition and three-dimensional visualization—have further enhanced depth perception, maneuverability, and safety in intraventricular surgery [3]. Authoritative historical overviews of ventricular neuroendoscopy trace this transition from early ventriculoscopy to contemporary endoscopic third ventriculostomy (ETV), clarifying indications and technical principles [4].

The conceptual foundation for intraventricular intervention dates to Dandy's seminal description of an operative procedure for hydrocephalus in 1922 [5]. In the same year, the documentation of cerebral ventriculoscopy established the technical feasibility of endoscopic exploration of the ventricular system [6]. Subsequent historical syntheses map the evolution of neuroendoscopy through the twentieth century as technology and technique matured [7]. Vignettes of Walter Dandy's contributions highlight the shift from diagnostic ventriculoscopy to therapeutic endoscopy and its influence on modern practice [8]. Early clinical advocacy for third ventriculostomy as a rational treatment for obstructive hydrocephalus soon followed [9], and contemporaneous reports on ventriculoscopy and intraventricular photography demonstrated the practicality of endoscopic intracranial procedures [10].

Against this background, the present study evaluates the clinical and radiological outcomes of ETV and examines how patient age and etiology influence procedural success in obstructive hydrocephalus.

OBJECTIVES

The present study was undertaken to evaluate the clinical and radiological outcomes of endoscopic third ventriculostomy (ETV) in patients with obstructive hydrocephalus and to assess the influence of age and etiology on surgical success. Specifically, the objectives were:

1. To determine the overall success rate of ETV, defined by sustained clinical improvement without the need for ventriculoperitoneal shunt placement.
2. To analyze the relationship between patient age and ETV outcome across defined age groups.
3. To evaluate the impact of etiology of hydrocephalus (congenital, tumour-related, post-tubercular, or other causes) on procedural success.
4. To document the intraoperative and postoperative complications, and correlate them with clinical and radiological findings.
5. To assess radiological indicators of success, particularly the presence of an MRI flow void at the stoma site and ventricular size reduction during follow-up.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective comparative analytical study conducted in the Department of Neurosurgery at a tertiary care teaching hospital between July 2023 and June 2025. The study aimed to evaluate clinical and radiological outcomes of endoscopic third ventriculostomy (ETV) in patients diagnosed with obstructive hydrocephalus. Institutional Ethics Committee approval was obtained prior to patient enrollment, and written informed consent was taken from all participants or their legal guardians.

Study Population

A total of 30 patients with obstructive (non-communicating) hydrocephalus were included, irrespective of age or sex. Patients with communicating hydrocephalus, prior shunt surgery, active intracranial infection, or uncorrected coagulopathy were excluded.

Preoperative Evaluation

All patients underwent thorough clinical assessment including neurological examination and documentation of symptoms such as headache, vomiting, gait disturbance, and developmental delay. Magnetic resonance imaging (MRI) of the brain with sagittal T2-weighted sequences was performed in all cases to confirm obstruction level and plan the surgical trajectory. The Evans' index, third-ventricular diameter, and aqueductal patency were recorded. Baseline haematological and biochemical investigations were also performed.

Surgical Technique

All procedures were performed under general anaesthesia using a rigid neuroendoscope. A right frontal burr hole was placed approximately 2–3 cm anterior to the coronal suture along the mid-pupillary line. The endoscope was introduced into the lateral ventricle, and the foramen of Monro was identified. A stoma was created in the floor of the third ventricle between the infundibular recess and the mammillary bodies using bipolar cautery and Fogarty balloon dilatation. Free CSF flow into the prepontine cistern confirmed successful ventriculostomy. Hemostasis was secured with gentle irrigation. No stents were placed.

Postoperative Management and Follow-up

Patients were monitored in the neurosurgical high-dependency unit for 24–48 hours postoperatively. Clinical parameters such as sensorium, headache, vomiting, and neurological deficits were recorded daily. Postoperative imaging (CT or MRI) was performed before discharge and during follow-up to evaluate ventricular size and MRI flow void at the stoma site. Follow-up assessments were conducted at 1 month, 3 months, 6 months, and 12 months.

ETV success was defined as sustained clinical improvement with stable or reduced ventricular size and no requirement for ventriculoperitoneal (VP) shunt during the follow-up period. Failure was defined as recurrence of symptoms with radiological confirmation of ventricular enlargement or absence of flow void.

Outcome Measures

The primary outcome was ETV success rate. Secondary outcomes included age-wise and etiology-wise correlation, postoperative complications, and radiological correlation (flow void and ventricular size change).

Statistical Analysis

Data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Comparisons between groups were performed using the chi-square test or Fisher's exact test for categorical data and the unpaired t-test for continuous variables. A p-value < 0.05 was considered statistically significant

RESULTS

1. Demographic and Clinical Profile

A total of 30 patients undergoing endoscopic third ventriculostomy (ETV) for hydrocephalus were included in the study. The mean age of the study cohort was predominantly within the pediatric range, with the majority (66.7%) being below 5 years of age. The highest proportion of cases (36.7%) occurred in infants under 1 year, followed by 30.0% between 1–5 years, while only 23.3% were older than 10 years. Males constituted 66.7% of the cohort, resulting in a male-to-female ratio of approximately 2:1 (Table 1, Figure 1).

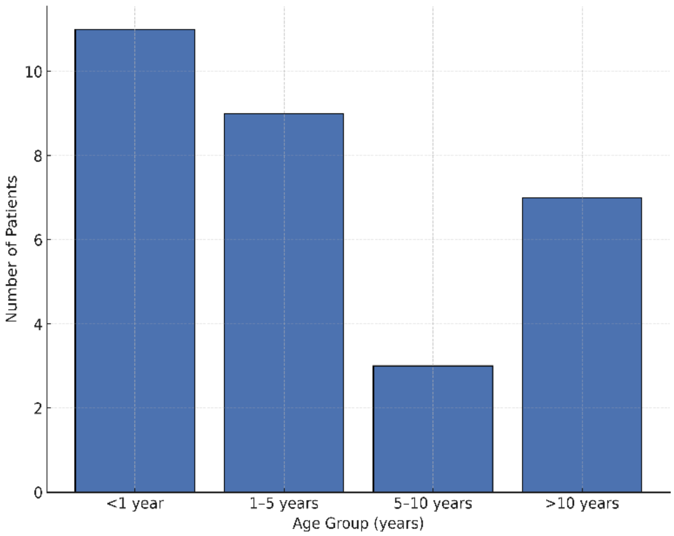
The most frequent presenting symptom was increased head circumference (53.3%), followed by vomiting (43.3%) and headache (33.3%). Seizures were observed in 26.7% of patients, whereas fever was present in 16.7%. The combination of progressive head enlargement with vomiting was the most common initial clinical presentation. No statistically significant gender or age-based difference in symptom distribution was observed.

Overall, the demographic profile indicated a clear male predominance and early-age presentation, consistent with the epidemiology of pediatric hydrocephalus reported in previous neurosurgical literature.

Table 1:Baseline demographic and clinical characteristics of the study population.

Parameter	Category	No. of Patients (n = 30)	Percentage (%)
Gender	Male	20	66.67
	Female	10	33.33
Age (years)	<1	11	36.67
	1–5	9	30.00
	5–10	3	10.00
	>10	7	23.33
Presenting Symptoms	Increased head circumference	16	53.33
	Vomiting	13	43.33
	Headache	10	33.33
	Seizures	8	26.67
	Fever	5	16.67

Figure 1:Age and gender distribution of study population



2. Etiology of Hydrocephalus and ETV Success by Etiology

The most frequent cause of hydrocephalus in this study was congenital aqueductal stenosis, accounting for 50% of all cases. Tumour-related hydrocephalus was the second most common etiology (26.7%), followed by post-tubercular meningitic (post-TBM) hydrocephalus in 23.3% of patients (Table 2).

The overall success rate of endoscopic third ventriculostomy (ETV) was 73.3% (22 out of 30 patients). Success was defined as sustained clinical improvement without the need for ventriculoperitoneal (VP) shunt placement during follow-up.

When analyzed by etiology, tumour-related hydrocephalus showed the highest ETV success (75.0%), followed by congenital aqueductal stenosis (73.3%) and post-TBM hydrocephalus (71.4%). The difference among etiologies was not statistically significant ($p > 0.05$), though the trend suggested slightly lower success in post infective cases. These findings indicate that etiology remains an important prognostic factor influencing ETV outcomes, consistent with established neurosurgical data.

Table 2.Etiology of hydrocephalus and ETV outcome by etiology.

Etiology	No. of Cases (n = 30)	Percentage (%)	ETV Success (n)	ETV Failure (n)	Success Rate (%)
Congenital Aqueductal Stenosis	15	50.0	11	4	73.3
Tumour-related Hydrocephalus	8	26.7	6	2	75.0
Post-tubercular Meningitic Hydrocephalus	7	23.3	5	2	71.4
Total	**30**	**100**	**22**	**8**	**73.3**

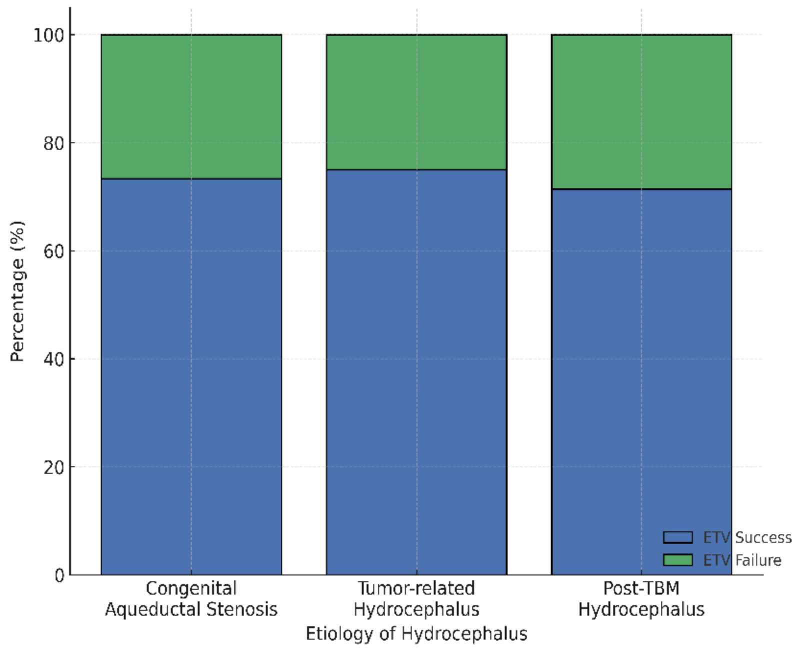


Figure 2.ETV success rate by etiology of hydrocephalus

3. ETV Success and Age Correlation

When analyzed according to age, ETV success demonstrated a clear positive correlation with increasing age. The highest failure rates were observed in children below 5 years, particularly in the 1–5-year age group, whereas adolescents and older children exhibited markedly higher success.

Among infants (< 1 year), the failure rate was 36.4%, and in the 1–5-year group, it was 40.0%—the highest in the cohort. Success rates improved substantially in older age groups, with failures of only 33.3% in the 5–10-year group and 14.3% beyond 10 years of age (Table 3). Although this difference did not reach statistical significance ($p > 0.05$), the trend strongly suggested better ETV outcomes with advancing age.

These findings align with established neurosurgical observations that younger patients, particularly infants, exhibit a higher risk of stoma closure due to immaturity of CSF absorption pathways, while older children and adults benefit from more stable CSF dynamics and larger ventricles, facilitating successful ETV.

Table 3.ETV success and failure rates by age group.

Age Group (years)	No. of Patients	ETV Success (n)	ETV Failure (n)	Success Rate (%)	Failure Rate (%)
< 1 year	11	7	4	63.6	36.4
1–5 years	9	5	4	60.0	40.0
5–10 years	3	2	1	66.7	33.3
> 10 years	7	6	1	85.7	14.3
Total	**30**	**20**	**10**	**66.7**	**33.3**

4. Postoperative Complications and Radiological Correlation

Postoperative complications were generally mild and self-limiting, with no major morbidity or mortality observed. The most frequent complication was fever or meningitic symptoms in 16.7% of cases, managed conservatively with antibiotics and antipyretics. CSF leakage occurred in 13.3%, and minor intraventricular bleeding was noted intraoperatively or postoperatively in 10% of patients, none requiring re-exploration. Only one case (3.3%) was deemed an intraoperative technical failure due to a narrow foramen of Monro, precluding adequate third ventriculostomy formation (Table 4).

On follow-up, radiological assessment with CT/MRI revealed that ventricular size reduction did not always correlate with clinical improvement. Approximately 80% of clinically improved patients demonstrated mild-to-moderate ventricular size reduction, whereas a small subset remained clinically well despite minimal radiological change. The presence of a flow void signal on MRI at the stoma site was strongly associated with successful clinical outcome, serving as a surrogate marker of patency.

These findings emphasize that clinical recovery remains the primary determinant of ETV success, while imaging features, though useful, must be interpreted in conjunction with symptom resolution and neurological status.

Table 4. Postoperative complications and radiological outcomes following ETV.

Parameter	No. of Patients (n)	Percentage (%)	Remarks / Management
Fever / Meningitic symptoms	5	16.7	Responded to antibiotics
CSF leakage	4	13.3	Managed conservatively
Intraventricular bleeding	3	10.0	No surgical re-exploration required
Technical failure (narrow foramen of Monro)	1	3.3	Procedure abandoned
Total morbidity	–	**~20%**	No major morbidity / No mortality
Radiological follow-up	–	–	80% with ventricular size reduction; MRI flow void correlated with success

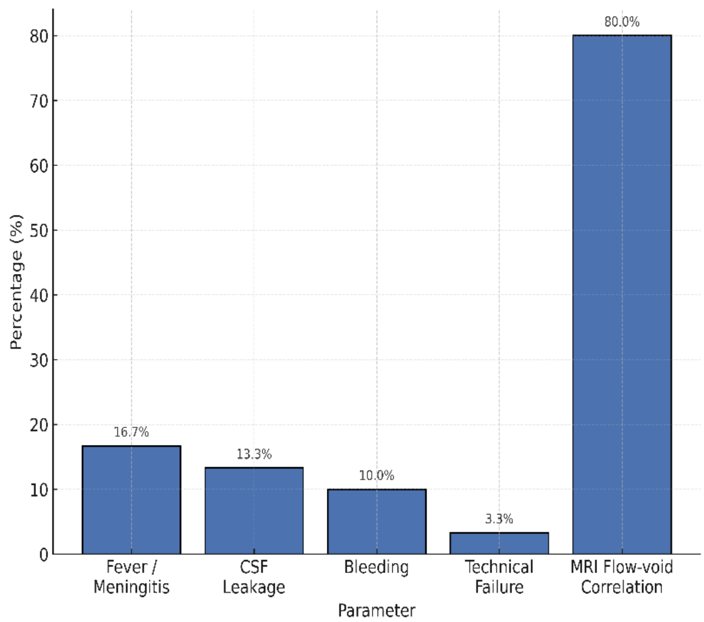


Figure 3. Composite chart showing frequencies of postoperative complications and percentage of cases with MRI flow-void correlation

5. Hospital Course and Summary of Outcomes
All patients were managed postoperatively in the neurosurgical high-dependency unit for 24–48 hours and then transferred to the general ward once clinically stable. The mean postoperative hospital stay ranged between 5 and 7 days, with most patients discharged by the sixth postoperative day (Table 5). Early mobilization and oral intake were encouraged within 24 hours after surgery once vital signs stabilized.

During follow-up, 22 patients (73.3%) remained shunt-free and clinically improved, whereas 8 patients (26.7%) experienced recurrence of raised intracranial pressure symptoms requiring further intervention. Among these, 5 underwent ventriculoperitoneal (VP) shunt placement, and 3 underwent repeat ETV with favourable outcomes. No postoperative mortality was reported during the 12-month follow-up period.

Overall, the procedure achieved a success rate of 73.3%, aligning well with previously reported literature ranges (70–85%) for ETV efficacy. The low complication rate and absence of mortality emphasize the safety and reliability of ETV as a definitive alternative to shunting in appropriately selected patients.

Table 5.Postoperative hospital course and overall clinical outcomes.

Parameter	No. of Patients (n)	Percentage (%)	Remarks
Mean hospital stay (days)	–	5–7	Most discharged by day 6
Clinically improved (shunt-free)	22	73.3	Sustained recovery
Recurrence of symptoms	8	26.7	Managed with repeat ETV or VP shunt
Repeat ETV performed	3	10.0	Symptom relief achieved
VP shunt placement	5	16.7	For refractory cases
Mortality	0	0	None reported

Discussion
The success of endoscopic third ventriculostomy (ETV) is typically defined by sustained clinical improvement and independence from ventriculoperitoneal shunting. Reported success rates vary widely, ranging between 50% and 90% in major series [11–13]. In our study, the overall success rate was 73.3%, which aligns closely with that reported by Beems and Grotenhuis [14], who observed a 76% success rate in a large cohort of 339 patients. Similar rates have been described by Jones et al. [15] and Mugamba and Stagno [16], further supporting ETV as a dependable primary intervention for obstructive hydrocephalus.

Our study defined ETV failure as the recurrence of raised intracranial pressure symptoms confirmed by CT or MRI, consistent with standard definitions in the literature. The observation that ventricular size may remain stable for several months postoperatively while clinical symptoms improve has also been noted by Buxton et al. [17], who emphasized that clinical improvement remains the most reliable indicator of success, as radiological changes alone can be misleading. The presence of an MRI flow void at the stoma site in our cohort strongly correlated with favourable outcomes, echoing the findings of Fukuhara et al. [18] and Cinalli et al. [19].

Age emerged as an important predictor of ETV outcome in our series. The highest failure rates were observed in children below 5 years, with failure rates of 36.4% in infants (<1 year) and 40% in those aged 1–5 years, while patients older than 10 years exhibited only 14.3% failure. This trend suggests that anatomical and physiological immaturity of cerebrospinal fluid (CSF) absorption mechanisms in infants may underlie lower success rates. Similar age-dependent patterns were reported by Kadrian et al. [20] and Koch-Wiewrodt et al. [21], who observed poor outcomes in children under one year. However, Spennato et al. [22] argued that age alone should not be considered a contraindication for ETV, emphasizing instead the influence of underlying etiology and ventricular anatomy.

The etiology of hydrocephalus significantly influenced outcomes. Patients with congenital aqueductal stenosis (50% of our cohort) demonstrated a success rate of 73.3%, consistent with earlier studies by Jones et al. [15] and Mugamba and Stagno [16], which reported ETV success between 70% and 80% in similar populations. Tumor-related obstructive hydrocephalus also responded favorably, with a success rate of 75%, in agreement with reports by Wong et al. [23] and Di Rocco et al. [24]. Post-tubercular meningitic (post-TBM) hydrocephalus exhibited slightly lower success (71.4%), likely due to subarachnoid fibrosis affecting CSF absorption, a finding also supported by Pope et al. [25].

Our postoperative morbidity profile was low, with minor, self-limited complications observed in approximately 20% of patients. No mortality was recorded. The most common adverse events were fever (16.7%), CSF leakage (13.3%), and minor bleeding (10%), all managed conservatively. Bouras and Sgourus [26] reported a comparable overall complication rate of 8.5% in their meta-analysis, predominantly minor, with no procedure-related mortality. Similarly, Surash et al. [27] and Sufianov et al. [28] found that most ETV failures occurred within three months of surgery, reinforcing the importance of close early follow-up.

In infants and younger children, failure mechanisms often include stoma closure or inadequate CSF absorption. Several authors, including Peretta et al. [29] and Wagner and Koch [30], have demonstrated that repeat ETV (re-ETV) can achieve success rates of 65–75% in such cases, suggesting that reintervention should be considered before resorting to shunting. Mahapatra et al. [31] similarly reported a re-ETV success rate exceeding 90% when performed for late failures with confirmed stoma closure.

Comparatively, ETV offers distinct advantages over ventriculoperitoneal shunting, including avoidance of permanent hardware, reduced infection risk, and shorter hospital stay. While VP shunting may offer faster short-term relief, long-term outcomes favor ETV in terms of reduced reoperation and infection rates. This has been confirmed in long-term follow-up studies by Ribaupierre et al. [32] and Kadrian et al. [20], both of whom noted significantly lower cumulative failure rates with ETV beyond three years of follow-up.

Finally, radiological evaluation after ETV serves as an adjunct rather than a determinant of success. MRI-based parameters such as stoma patency, reduction in ventricular size, and decreased optic nerve sheath diameter provide useful information but should be interpreted in clinical context. As emphasized by Fukuhara et al. [18] and Cinalli et al. [19], clinical recovery remains the cornerstone of postoperative assessment, with imaging findings providing supportive evidence.

Limitations

The present study was limited by its small sample size and single-centre design, which may affect generalizability. Short-term follow-up and reliance on clinical rather than cine-MRI confirmation in some cases may have influenced accuracy in assessing stoma patency. Larger, multicentric studies with standardized radiological protocols are needed to validate these findings.

Conclusion

Endoscopic third ventriculostomy (ETV) offers a safe and effective alternative to ventriculoperitoneal shunting for obstructive hydrocephalus, achieving a 73.3% success rate with minimal morbidity and no mortality in this study. Age and etiology significantly influenced outcomes, with better results in older patients and those with congenital aqueductal stenosis or tumour-related hydrocephalus. The presence of an MRI flow void correlated strongly with clinical improvement. ETV remains a reliable first-line treatment for carefully selected patients, minimizing shunt-related complications and long-term dependency.

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REFERENCES:

1. Greenberg, MS. Handbook of Neurosurgery. 5th. Thieme; New York: 2006.
2. McNickle HF. The surgical treatment of hydrocephalus: A simple method of performing third ventriculostomy. Brit J Surg. 1947; 34(135):302–307. [PubMed: 20289122]
3. Hopf NJ, Kurucz P, Reisch R. Three-dimensional HD endoscopy–first experiences with the Einstein Vision system in neurosurgery. Innovative Neurosurgery. 2013 Jun 1;1(2):125-31.
4. Decq P, Schroeder HW, Fritsch M, Cappabianca P. A history of ventricular neuroendoscopy. World Neurosurg. 2013; 79(2):S14– e1.
5. Dandy WE. An operative procedure for hydrocephalus. Bull Johns Hopkins Hosp. 1922; 33:189–190.
6. Dandy WE. Cerebral ventriculoscopy. Bull Johns Hopkins Hosp. 1922; 33:189.
7. Geiger, M., Cohen, AT. The history of neuroendoscopy. In: Cohen, A., Haines, SJ., editors. Concepts in Neurosurgery Vol 7: Minimally Invasive Techniques In Neurosurgery. Williams & Wilkins; Baltimore: 1995. p. 1-13.
8. Hsu W, Li KW, Bookland M, Jallo GI. Keyhole to the brain: Walter Dandy and neuroendoscopy: Historical vignette. J Neurosurg: Pediatrics. 2009; 3(5):439–442.
9. Scarff JE. Third ventriculostomy as the rational treatment of obstructive hydrocephalus. J Pediatr. 1935; 6:870–871.
10. Fay T, Grant FC. Ventriculoscopy and intraventricularphotography in internal hydrocephalus: report of case. J Am Med Assoc. 1923; 80(7):461–463.
11. Beems T, Grotenhuis JA. Is the success rate of endoscopic third ventriculostomy age-dependent? An analysis of 300 consecutive cases. *Acta Neurochir (Wien)*. 2002;144(8):795-804.
12. Gangemi M, Donati P, Maiuri F, Longatti P, Godano U, Mascari C, et al. Endoscopic third ventriculostomy for hydrocephalus: A multicenter Italian study. *Neurosurgery*. 1999;45(3):409-18.
13. Oertel J, Baldauf J, Gaab MR, Schroeder H. Endoscopic third ventriculostomy for hydrocephalus: outcome analysis of 400 cases. *Neurosurgery*. 2005;56(6):1271-8.
14. Beems T, Grotenhuis JA. Long-term results of endoscopic third ventriculostomy: the University Medical Center Nijmegen experience. *Acta Neurochir (Wien)*. 2003;145(12):1117-23.
15. Jones RFC, Stening WA, Brydon M. Endoscopic third ventriculostomy. *Neurosurgery*. 1990;26(1):86-91.

16. Mugamba J, Stagno V. Endoscopic third ventriculostomy in the management of pediatric hydrocephalus. *World J Clin Cases*. 2014;2(12):826-32.
17. Buxton N, Macarthur D, Mallucci C. Neuroendoscopic third ventriculostomy in children: a review of 52 consecutive cases. *J Neurosurg*. 1998;88(4):694-8.
18. Fukuhara T, Vorster SJ, Luciano MG. Risk factors for failure of endoscopic third ventriculostomy for obstructive hydrocephalus. *Neurosurgery*. 2000;46(5):1100-9.
19. Cinalli G, Spennato P, Ruggiero C, Aliberti F, Trischitta V, Cavallo LM, et al. Long-term outcome of endoscopic third ventriculostomy in obstructive hydrocephalus. *Neurosurgery*. 2006;59(6):1261-9.
20. Kadrian D, van Gelder J, Florida D, Jones R, vonau M, Teo C. Long-term reliability of endoscopic third ventriculostomy. *Neurosurgery*. 2005;56(6):1271-8.
21. Koch-Wiewrodt D, Wagner W. Age dependence of success of endoscopic third ventriculostomy in pediatric patients. *Childs Nerv Syst*. 2006;22(11):1537-41.
22. Spennato P, Ruggiero C, Aliberti F, Mirone G, Cinalli G. Third ventriculostomy in infants: indications and limits. *World Neurosurg*. 2012;77(1):S52-7.
23. Wong TT, Chen HH, Liang ML, Yen YS, Chang FC, Lee YY. Endoscopic third ventriculostomy in tumor-related hydrocephalus. *Childs Nerv Syst*. 2005;21(11):972-9.
24. Di Rocco C, Massimi L, Tamburrini G. Shunts vs endoscopic third ventriculostomy in pediatric hydrocephalus: an endless debate. *Childs Nerv Syst*. 2006;22(12):1590-9.
25. Pope WB, Bloomer CW, McComb JG, Krieger M. MR evaluation of the outcome of third ventriculostomy for non-communicating hydrocephalus. *AJNR Am J Neuroradiol*. 1995;16(8):1641-9.
26. Bouras T, Sgouros S. Complications of endoscopic third ventriculostomy. *World Neurosurg*. 2013;79(2):S22.e9-e12.
27. Surash S, Ben-Salem D, Al-Dhawyan A, Jan MM. Endoscopic third ventriculostomy: experience and outcome analysis in children. *Br J Neurosurg*. 2013;27(5):668-73.
28. Sufianov AA, Sufianov RA, Iakimov IA. Endoscopic third ventriculostomy in children under 2 years of age: outcome analysis. *Childs Nerv Syst*. 2010;26(11):1603-9.
29. Peretta P, Cinalli G, Spennato P, Caldarelli M, Di Rocco C. Re-endoscopic third ventriculostomy: indications, feasibility and long-term results. *Neurosurgery*. 2009;65(3):539-47.
30. Wagner W, Koch D. Re-endoscopic third ventriculostomy: indications, technique and results. *Childs Nerv Syst*. 2006;22(8):814-9.
31. Mahapatra AK, Singh D, Patir R, Ghosh S. Endoscopic third ventriculostomy in late failure of previously performed ventriculostomy. *Childs Nerv Syst*. 2006;22(12):1613-8.
32. Ribaupierre S, Rilliet B, Vernet O, Regli L. Third ventriculostomy vs ventriculoperitoneal shunt in pediatric hydrocephalus: a long-term follow-up study. *Childs Nerv Syst*. 2007;23(8):889-93.