International Journal of Advances in Medicine
Nayak MT et al. Int J Adv Med. 2015 May;2(2):94-99
http://www.ijmedicine.com
pISSN 2349-3925 | eISSN 2349-3933

DOI: 10.5455/2349-3933.ijam20150502

Research Article

Outcome of endoscopic third ventriculostomy: analysis of first 23 cases

Madhukar T. Nayak[1]*, Vidyashri Kamath[2]

[1]Department of Neurosurgery, [2]Department of Obstetrics and Gynaecology, Father Muller Medical College, Mangalore, Karnataka, India

Received: 28 February 2015
Accepted: 05 March 2015

***Correspondence:**
Dr. Madhukar T. Nayak,
E-mail: madhukar1978@gmail.com

ABSTRACT

Background: Surgical treatment of hydrocephalus has been in the form of CSF diversion procedures since centuries. The introduction of Neuroendoscope added to the improved optics in the form of advanced lens – rod system and better illumination using xenon cold light source has provided greater impetus to Endoscopic third ventriculostomy (ETV) as a viable and effective treatment modality.
Methods: This retrospective study analyses the clinical and radiological outcome of ETV in the first 23 patients of varied age groups and etiologies operated over a period of 24 months. The follow up duration ranged from 5 months to 30 months. A successful outcome was considered if there was resolution of clinical symptoms and improvement in radiological features of hydrocephalus and no requirement of alternative CSF diversion procedure (V P Shunt). A failure was indicated by either lack of clinical improvement or radiological features of partial or complete resolution of hydrocephalus and need for an alternative CSF diversion procedure (V P Shunt).
Results: The predominant age group was 6-60 years. The age ranged from 1 month to 67 years. The Male: Female ratio was 14:9. The common etiologies were congenital, post infective and intracranial bleed in 26.1% (n=6) each. Favorable outcome was seen in 82.6% of cases. The failure rate was 17.4%. Most no of cases with favorable outcome was seen in 6-60 years age group, whereas >60 years age group had the most no of cases with poor outcome. The overall mortality rate was 21.6 % (n=5). Wound related complication was seen in 1 patient (4.3%). Two (8.7%) patients required VP shunt post ETV. The cause of mortality was aspiration pneumonitis in 3 cases, CSF metastasis and wound infection in 1 cases each.
Conclusions: ETV is a safe viable and effective alternative for VP shunt as a CSF diversion procedure in the treatment of Hydrocephalus. It provides long lasting and virtually permanent solution due to its non-dependence on hardware and implants. Cost of equipment and availability of surgical expertise are the only impediments to this promising treatment modality.

Keywords: Endoscopic Third Ventriculostomy, Hydrocephalus, V P Shunt, Neuroendoscopy, CSF Diversion Procedure, ETV

INTRODUCTION

Hydrocephalus is one of the major neurological ailments drawing the attention of the neurosurgeon. The estimated incidence of congenital hydrocephalus in developed countries is 0.7 per 1000 live births.[1] Surgical options for diverting the CSF flow across the obstructive pathology has been a time tested method of treating this pathology. The modalities of CSF diversion have seen major refinements over decades. VP shunt has been a time tested treatment modality for decades, for various etiologies leading to obstruction to CSF pathways. Congenital aqueduct stenosis, Dandy walker malformations, post meningitic hydrocephalus, primary intraventricular bleed, intracranial tumors with obstructive hydrocephalus and aneurysmal bleed with Sub arachnoid hemorrhage leading to hydrocephalus have been the various etiological factors. The overwhelming reliance on shunt hardware has demonstrated many instances of clinical deterioration due to shunt malfunctions either due to hardware related issues like tube disconnection or tube breaking on the one hand while a whole set of shunt malfunctions due to tube blockage by CSF debris in the form of blood products or increased protein content in CSF due to infection. Endoscopic third ventriculostomy (ETV) addresses the hardware related issues and provides reliable and long lasting treatment to patients with hydrocephalus. Technological refinements in magnification, image resolution and lighting have resulted in projecting neuroendoscopic procedures like ETV as a safe, attractive and viable option to the traditional shunting procedures.[2,3]

METHODS

The study was a retrospective analysis of first 23 consecutive cases operated by the first author between July 2012 and July 2014. All patients were preoperatively evaluated clinically and radiologically. In infants and children, increasing head circumference, tense and bulging anterior fontanelle, Sun set sign (downward fixed gaze), failure to thrive, poor feeding and delayed/ regression of milestones were considered as the positive clinical findings. Altered sensorium, progressive neurological deficits, late onset seizures, features of raised intracranial pressure with or without headache and vomiting were considered as positive findings in adults.

All patients with positive clinical findings were further evaluated clinically by performing CT scan brain (with or without contrast enhancement), MRI brain (with or without contrast enhancement). Data was collected and analyzed using Microsoft Excel and SPSS version 17. A Pre-coronal burr hole was performed on the side of the larger lateral ventricle or preferably on right (non-dominant) side. The lateral ventricle was tapped using a Brain Cannula and a 0 degree neuroendosope (MINOP®; Aesculap, Tuttlingen, Germany), 18 cm long, which was introduced with an outer sheath of 4.6mm (13 Fr) with a working channel and 2 way irrigation ports. The Neuroendoscope was connected to a 3 CHIP / FULL HD camera. Warm Ringer lactate was used as an irrigating fluid. A no 5 Fr Fogarty catheter was introduced through the working channel of the Neuroendoscope sheath, across the foramen of Monroe to identify the thinned out floor of third ventricle, which was fenestrated. The landmark for fenestration was, just anterior to the mammillary bodies and posterior to the tuber cinereum (Figure 1). In cases with a thick and opaque floor of third ventricle, the Fogarty catheter tip was used to feel the dorsum sellae and indirect observation of the presence of basilar artery was made by seeing for the pulsations transmitted through the third ventricle floor and fenestration made on the side away from the pulsations, just posterior to the dorsum sellae. The stoma was inspected by advancing the Neuroendoscope close to the 3rd ventricle floor to "PEEP IN" and look for any vital structures close to the third ventricle floor. Advancing the scope tip close to the floor helps in pushing away any vital structure like small brain stem perforators, because of the jet flow of the irrigation fluid, thereby making dilating the stoma by inflating the Fogarty balloon much safer. The balloon is inflated using 1 ml of air. It is ensured that the lilliquist membrane is also perforated well and there is good flapping of the edges of the stoma. After ensuring good hemostasis, watertight galeal closure is performed and compression dressing given. We have found virtually no wound related complications like CSF leak as we use a "Double breasting closure" technique whereby the pericranial flap is raised based medially which is closed separately followed by the galea+skin semicircular flap based laterally. Closure is done using a monofilament non-absorbable suture (no 3-0 polypropylene). In infants and children skin closure is done using Cyanoacrylate glue (DERMABOND, Ethicon Inc). Sutures are removed on the 14th postoperative day till which time compression dressings are given. Drainage Lumbar puncture was done in patients with persistent tense pseudomeningocele at the operative site, as ETV would have converted an Obstructive Hydrocephalus to a Communicating hydrocephalus. Data were analyzed using Microsoft Excel and SPSS version 17 software. The patients were clinically evaluated at regular intervals postoperatively. Radiological evaluation was done using MRI brain (T2 and FLAIR sequences) to demonstrate flow void across the floor of third ventricle (Figure 2), which is an indicator of patency of the 3rd ventriculostomy stoma and a functional ETV. Reduction in size of ventricles was also noted as a sign of successful ETV. The follow up duration ranged from 5 to 24 months. Non improvement or worsening of clinical features, lack of flow void across floor of third ventricle on MRI Brain, increase in size of ventricles and need for VP Shunt were considered signs of failure of ETV.

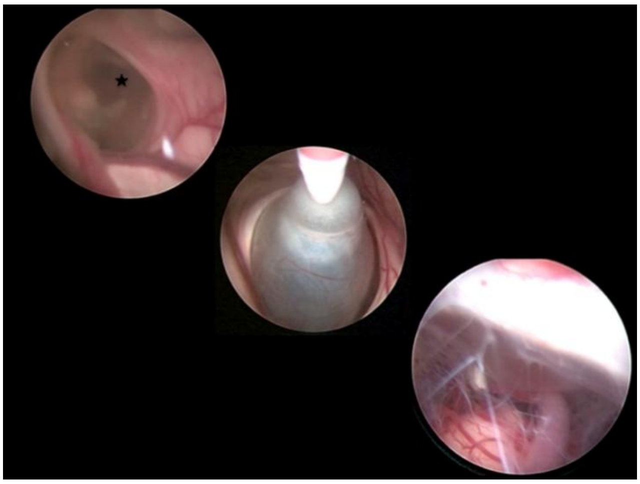

Figure 1: Showing intraoperative view of floor of third ventricle and the site of fenestration for ETV (depicted by a star), the dilatation of stoma by inflating a fogarty balloon and the final appearance of prepontine space showing the Basilar artery, pons and the brain stem perforators.

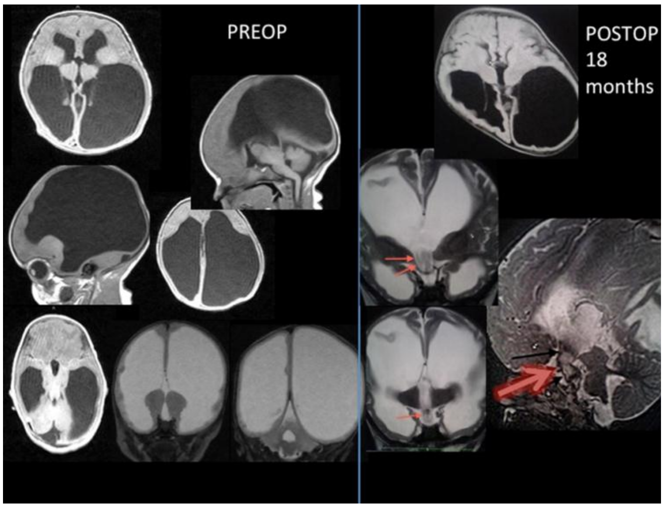

Figure 2: Showing a representative case of a neonate with congenital hydrocephalus. Postoperatively at 18 months follow up, the ventricle size has significantly reduced and note the flow voids (arrows pointing) across the floor of third ventricle indicating patent and functioning ETV stoma.

RESULTS

The patients were divided into 0-5 years, 6-60years and > 60 years age groups (Table 1). The predominant age group was 6-60 years. The age ranged from 1 month to 67 years. The Male: Female ratio was 14:9. The common etiologies were congenital, post infective and intracranial bleed in 26.1% (n=6) each. Most no of cases with favorable outcome was seen in 6-60 years age group, whereas >60 years age group had the most no of cases with poor outcome. The average hospital stay was 8.9 days. Various parameters like etiology, sex, need for postoperative shunt, radiological outcome, wound complications, hospital stay, age group and year of surgery were statistically compared for association with good clinical outcome. None of the parameters had a statistically significant p- value to prove a strong association. All patients had good radiological outcome postoperatively. However, clinically favorable outcome was seen in 82.6% of cases. The failure rate was 17.4%. The overall mortality rate was 21.6 % (n=5). Wound related complication was seen in 1 patient (4.3%). Two (8.7%) patients required VP shunt post ETV. The cause of mortality (Table 2) was aspiration pneumonitis in 3 cases, CSF metastasis and wound infection in 1 cases each.

Analysis of Mortality cases:

1. Wound related complication: This was a 3-year-old child with congenital aqueduct stenosis. Post ETV, child had wound gaping and CSF leak from operated site. Even after Lumbar CSF drainage for 1 week the leak did not subside. Postoperative MRI brain showed mild reduction in size of ventricles and flow void in the floor of 3rd ventricle suggestive of patent and functioning ETV stoma. After ruling out CSF infection, V-P shunt was performed. Child had partial clinical improvement. The skin overlying the shunt tube gave way over the scalp and abdomen leading to wound infection and sepsis due to which child succumbed. As child was emaciated and had hypoalbuminemia, we attribute the poor outcome to malnourishment as a primary cause.

2. Aspiration pneumonitis: Out of the 3 patients, 1 patient had active TB Meningitis on anti-tubercular treatment and intra operatively there were tubercular nodules on the ventricular wall, which was confirmed histopathologically. One patient had hypertensive intraventricular bleed with hydrocephalus. One patient had post-infective hydrocephalus. All these patients had radiological evidence of improvement, but succumbed due to secondary systemic complications.

3. CSF Metastasis: This was a 43 year old lady, a known case of Carcinoma breast who had clearance of primary disease post Modified Radical Mastectomy, chemotherapy and local radiation 5 years prior to presentation. She presented with features of raised ICP and imaging revealed a large posterior fossa metastatic lesion in the cerebellar hemisphere. She underwent posterior fossa craniectomy and gross total tumor excision followed by whole brain radiation. During the course of Radiotherapy, she developed hydrocephalus due to secondary aqueduct stenosis for which Endoscopic third ventriculostomy was done. She had a good postoperative recovery and was discharged with a modified Rankin score of 0 (asymptomatic and fully independent). After 11 months since the above event, she presented with altered sensorium and imaging revealed moderate ventriculomegaly. There was evidence of patency and functioning of ETV stoma on MRI. She underwent V-P shunt and the CSF that was collected intraoperatively was teeming with malignant cells. She did not show any significant improvement and succumbed to the disease.

DISCUSSION

Analysis of outcome

In our series, the success rate was 83.3% in cases congenital (aqueduct stenosis), intracranial bleed and post-infective etiologies. Whereas, the success rate was 100% in patients with shunt malfunction, tumor and posterior fossa lesions. Those patients who required postoperative shunting had good outcome in only 50% cases. Only 1 patient had wound related complication that led to a bad outcome. It is a well-established fact that there might not be a dramatic reduction in size of ventricles postoperatively in ETV, compared to those seen in post shunting. Hence we considered status quo or even small reduction in size of ventricles, resolution of

CSF seepage findings (periventricular lucencies) and presence of flow voids at the floor of 3rd ventricles on T2 weighted and FLAIR sequences (evidence of patent and functioning ETV stoma) as features of good radiological outcome. The clinical outcome was favorable in only 82.6% cases (Table 3). There was no statistically significant correlation found between clinical and radiological good outcome. This finding reiterates the fact that, the overall clinical outcome is multifactorial and radiological feature is just one of the attributes influencing the overall outcome. Pediatric age group (0-5 years) had a good outcome in 88.8 %. In our study, the mortality rate was 17.4%. The need for VP shunt was seen in 8.7 % in our series. The good outcome in patients with <7days hospital stay was 91.6% compared to 80% good outcome in those with 7-14 days hospital stay and 0% in those with >14 days hospital stay. The outcome was compared among patients operated in the first year (2012), second year (2013) and third year (2014) to evaluate role of learning curve on the clinical outcome. The good outcome was 87.5% in the 1st year, 50% in the 2nd year and 80% in the 3rd year. This clearly depicts that there is no strong association between good outcome and the role of learning curve. This is probably due to the fact that, procedures and steps in ETV are fairly standardized and reproducible.

Incidence of shunt related complications have been found in literature to be between 20-80%. This finding translates into added morbidity to the patient in the form of surgical re-exploration and the emotional turmoil involved with each such event.[4]

Added to this is the incidence and impact of shunt related infection and the problems associated with a foreign body inside the cranium.[5] With so much baggage attached to the "conventional and time tested" treatment modality (V P shunt), there has been an earnest longing for a treatment modality which can eliminate all the hardware related complications, is safe, effective and reliable. ETV for hydrocephalus has emerged as a promising treatment modality.

Table 1: Showing comparison of various parameters and their outcome.

Sr. No.	Parameters	Outcome	%	n	Bad outcome	Good outcome	Fishers exact test p-value
1.	**Etiology**						
a.	Bleed		26.1	1	1	5	0.712
b.	Congenital		26.1	1	1	5	
c.	Post infective		26.1	2	2	3	
d.	Posterior fossa mass lesion		8.7	0	0	2	
e.	Shunt failure		4.3	0	0	1	
f.	Tumor		8.7	0	0	2	
2.	**ETV**		95.7	4	4	18	
3.	**ETV+ Biopsy**		4.3	0	0	1	
4.	**Postop shunt**	Yes	8.7	2	1	1	0.324
		No	91.3	21	3	18	
5.	**Radiological Outcome**	Bad	0	0	0	0	
		Good	100	23	4	19	
6.	**Wound complication**	Yes	4.3	1	1	0	0.174
		No	95.7	22	3	19	
7.	**Hospital stay**						
a.	< 7 days		52.2	12	1	11	0.181
b.	8-14 days						
c.	> 14 days		43.5	10	2	8	
8.	**Age group**						
	0-5 years		39.1	9	1	8	0.181
	6-60 years		43.5	10	2	8	
	> 60 years		17.4	4	2	2	
9.	**Year of surgery**						
a.	1st yr. (2012)		69.6	16	2	14	0.489
b.	2nd yr. (2013)		8.7	2	1	1	
c.	3rd yr. (2014)		21.7	5	1	4	
10.	Sex						
a.	Male		60.9	14	2	12	0.517
b.	Female		39.1	9	2	7	

P value >0.05 Not significant

Table 2: Showing the causes of death.

Sr. No	Cause of death	No.	%
1.	Aspiration pneumonitis	3	13
2.	CSF metastasis	1	4.3
3.	Wound sepsis	1	4.3

Table 3: Showing the overall outcome of patients.

Outcome	No.	%
Bad	4	17.4
Good	19	82.6
Total	23	100.0

When we analyze the success rates of ETV done for various etiologies, aqueduct stenosis seems to have a higher success rate.[6,7] Whereas in other etiologies like post intracranial bleed, post infectious and post shunt failure, the outcome have been less encouraging.[6,7] Hopf et al., in their study found good outcome in aqueduct stenosis (83%) and benign lesions (95%).[7,8]

ETV in children has been a topic of controversy since long. More so, involving infants (below 1 year age).[9-13] One of the largest studies on ETV and its outcome in the infant (below 1 year) population has been the study involving 153 children at Uganda. In their study the good outcome was documented in only 53% cases.[14] Similar study was conducted in Canada in which they compiled and studied data from 9 centers across Canada where in cases operated by 22 Neurosurgeons between January 1989 and December 2004. They found higher failure rates among neonates and younger children.[15,16] This may be due to reduced absorption capacity, formation of newer arachnoid membranes and development of scar around the stoma.[17] Another mechanism postulated is that, with open fontanelle, the pressure gradient across the ETV stoma is inadequate to drive the CSF into the subarachnoid space.

In our study, there were 9 cases in the 0-5 years age group. The good outcome was seen in 8(88.8%). Out of these, 7 cases were below 1-year age (infants). There was good outcome in all the patients. The follow-up duration ranged from 5 to 30 months (mean 15.5 months).

The mechanism of hydrocephalus is both obstruction as well as reduced absorption, sometimes to variable proportions. Over a period of time, there occurs a change in fluid dynamics, wherein there is increase in absorption and more accommodative CSF spaces.[7]

CONCLUSIONS

ETV is a safe viable and effective alternative for VP shunt as a CSF diversion procedure in the treatment of Hydrocephalus. It provides long lasting and virtually permanent solution due to its non-dependence on hardware and implants. Cost of equipment and availability of surgical expertise are the only impediments to this promising treatment modality.

ACKNOWLEDGEMENTS

The authors would like to acknowledge statistician Mrs. Sucharita Suresh for her invaluable contribution.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Pereira J, Lamas R, Ayres-Basto M, Seixas ML, Vaz R. Neuroendoscopy in the treatment of obstructive hydrocephaly. Acta Médica Portuguesa. 2002;15(5):355-64.
2. Li KW, Nelson C, Suk I, Jallo GI. Neuroendoscopy: past, present, and future. Neurosurg Focus. 2005;19(6):E1.
3. Walker ML. History of ventriculostomy. Neurosurg Clin N Am. 2001;12(1):101-10.
4. Guzelbag E, Ersahin Y, Mutluer S. Cerebrospinal fluid shunt complications. Turk J Pediatr. 1997;39(3):363-71.
5. Piatt JH, Jr. Cerebrospinal fluid shunt failure: late is different from early. Pediatr Neurosurg. 1995;23(3):133-9.
6. Kadrian D, van Gelder J, Florida D, Jones R, Vonau M, Teo C, et al. Long-term reliability of endoscopic third ventriculostomy. Neurosurgery. 2005;56(6):1271-8.
7. Hopf NJ, Grunert P, Fries G, Resch KD, Perneczky A. Endoscopic third ventriculostomy: outcome analysis of 100 consecutive procedures. Neurosurgery. 1999;44(4):795-804.
8. Siomin V, Cinalli G, Grotenhuis A, Golash A, Oi S, Kothbauer K, et al. Endoscopic third ventriculostomy in patients with cerebrospinal fluid infection and/or hemorrhage. J Neurosurg. 2002;97(3):519-24.
9. Beems T, Grotenhuis JA. Is the success rate of endoscopic third ventriculostomy age-dependent? An analysis of the results of endoscopic third ventriculostomy in young children. Childs Nerv Syst. 2002;18(11):605-8.
10. Vinchon M, Rekate H, Kulkarni AV. Pediatric hydrocephalus outcomes: a review. Fluids Barriers CNS. 2012;9(1):18.
11. Drake JM, Kulkarni AV, Kestle J. Endoscopic third ventriculostomy versus ventriculoperitoneal shunt in pediatric patients: a decision analysis. Childs Nerv Syst. 2009;25(4):467-72.
12. Sandberg DI. Endoscopic management of hydrocephalus in pediatric patients: a review of indications, techniques, and outcomes. J Child Neurol. 2008;23(5):550-60.

13. Tambo FF, Djientcheu V, Chiabi A, Mbarnjuk SA, Walburga YJ, Mbonda E, et al. Our experience in the management of infantile hydrocephalus: a study on thirty-five regrouped cases in Yaounde, Cameroon. Afr J Paediatr Surg. 2011;8(2):199-202.
14. Warf BC. Hydrocephalus in Uganda: the predominance of infectious origin and primary management with endoscopic third ventriculostomy. J Neurosurg. 2005;102(1 Suppl):1-15.
15. Drake JM. Endoscopic third ventriculostomy in pediatric patients: the Canadian experience. Neurosurgery. 2007;60(5):881-6.
16. Drake JM. The surgical management of pediatric hydrocephalus. Neurosurgery. 2008;62 Suppl 2:633-42.
17. Mohanty A, Vasudev MK, Sampath S, Radhesh S, Sastry Kolluri VR. Failed endoscopic third ventriculostomy in children: management options. Pediatr Neurosurg. 2002;37(6):304-9.

DOI: 10.5455/2349-3933.ijam20150502
Cite this article as: Nayak MT, Kamath V. Outcome of endoscopic third ventriculostomy: analysis of first 23 cases. Int J Adv Med 2015;2:94-9.