Endoscopic third Ventriculostomy (ETV) in infants. Is it contraindicated?

Hamdy Behairy, Islam Alaghory, Mohammed Hassan, Adel Ragab, Mohammed Barania, Mohammed Ellabbad

Department of Neurosurgery, Al-azhar University Hospitals, Egypt
i_aghory@hotmail.com

Abstract: Background: Endoscopic third ventriculostomy (ETV) is a recent surgical option for hydrocephalus which if succeeded, avoids shunt insertion which possesses multiple not uncommon complications. There are multiple different opinions ranging from indication to contraindication depending on different results of managing hydrocephalus in infants through ETV. We are therefore presenting the results of ETV in 50 infants in a trial to delineate more favorable opinion. **Materials and Methods:** A prospective study which included 50 infants suffering from obstructive hydrocephalus (40 infants with congenital hydrocephalus due to aqueductal stenosis and 10 infants with post meningitic hydrocephalus). All infants were planned for undergoing ETV in Alazhar University hospitals along the last 3 years followed by an average follow up period of 18 months. **Results**: There was 56% (28 cases) clinical success rate in our study. Infection, persistent cerebro-spinal fluid (CSF) leak and bleeding occurred in 4 (8%) cases, while blockage of stoma was observed in 8 (16%) patients. ETV stoma closure (4 out of total 8) occurred following infection (2) or bleeding during surgery (2). Overall failure rate in our study was 44% (8 stoma blocks and 1 procedure abandoned). Low birth weight pre mature infants had higher failure rate (4 out of 4 infants100%). Success rates were significantly different in patients with aqueductal stenosis and those post meningitic hydrocephalus. **Conclusion**: ETV can be the definitive treatment for obstructive hydrocephalus in infants less than one year of age. Many different etiologies of hydrocephalus may be treated; however, congenital aqueductal stenosis carries the best prognosis for success. Success rate of ETV depends not only on the age but mainly on the cause of hydrocephalus, maturity of the infant, preoperative MRI findings and surgeon endoscopic experience.

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1. Introduction

Shunting remains the most common treatment option for hydrocephalus, but is associated with several short and long-term complications. Endoscopic third ventriculostomy (ETV) as an alternative option to shunting for treating hydrocephalus through establishing an alternative natural CSF pathway has become an accepted treatment option.(1)

The debate of choice of endoscopic third ventriculostomy (ETV) versus CSF shunting for the treatment of childhood hydrocephalus remains largely unresolved. The indications for ETV in infants less than one year of age are still evolving. According to published data from several groups, infants younger than one year of age have a higher failure rate for ETVs compared with older children (2).

In this study we present our 3 years experience of ETV management of hydrocephalic infants less than one year of age to further define the indications and results of ETV in this population.

Many studies report that patients younger than one year of age are not candidates for ETV and should undergo placement of a V-P shunt instead (3).

2. Materials and Methods

This is a prospective study of 50 infants who underwent ETV in our institution (Al-Azhar university hospitals, Cairo, Egypt) during the period of July 2010 to June 2013. A detailed history and physical examination were done in all cases. CT scan was also done for all infants. MRI was done in 21 patients. All infants had newly diagnosed hydrocephalus. No patient had a previous shunt. ETV was done in all cases. Forty cases (n=40) had congenital hydrocephalus with aqueductal stenosis and ten cases (n=10) had post-meningitic hydrocephalus.

Inclusion criteria

i. Age of 12 months or less.
ii. Obstructive hydrocephalus (Aqueductal stenosis).
iii. Post- meningitic hydrocephalus.

Exclusion criteria

i. Associated congenital anomalies e.g. cardiac.
ii. History of intracranial hemorrhage..
iii. History of previous CSF diversion procedure.
iv. Associated myelomeningocele (Chiari malformation type II).

Endoscopic third ventriculostomy was performed in a standardized fashion. The patient was placed under general anesthesia and positioned supine, brow up. Localization was used to optimize an entry site,

and a bur hole was placed just medial to the midpupillary line and immediately in front of the coronal suture. The lateral ventricle—usually on the right side—was cannulated with a rigid endoscope sheath, and CSF was collected for routine laboratory studies and, when applicable, for additional cytology and tumor markers. Under visual guidance, the endoscope was advanced through the foramen of Monro into the third ventricle. Fenestration of the third ventricle floor was made in front of the mammillary bodies as anteriorly as possible, most commonly using a 4-F Fogarty balloon catheter that was repeatedly inflated and deflated to create an opening of approximately 5 mm in diameter.

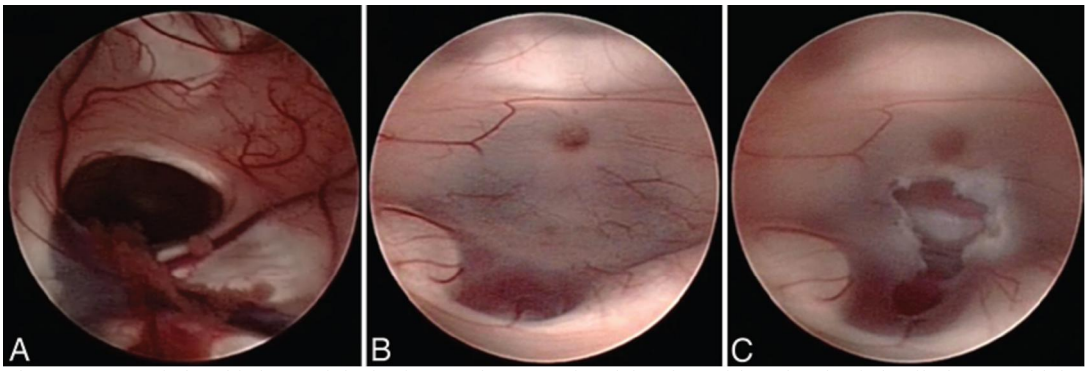


Fig. 1. The anatomy of the third ventricle is frequently appreciated in situ with a level of detail that would leave early neuroendoscopists envious. After passing the device through the foramen of Monro **(A)**, the surgeon will encounter the interior of the third ventricle, where he or she will identify the infundibular recess and mammillary bodies **(B)**, and thus may safely perform the fenestration **(C)**.

All post operative complications like infections, CSF leak and failure of the procedure were evaluated. Post operative CT scan and MRI were done in 22 patients who did not improve, deteriorated or had evidence of failure of ETV such as a bulging fontanel or CSF leak from the operative site. ETV was considered clinically successful when anterior fontanel becomes depressed or flush to the adjoining scalp and the patient improved clinically and the absence of need for additional surgery for hydrocephalus. Follow up ranged from 9 to 32 months with an average of 18 months.

Case presentation

Female patient 7 month old with large head and tens bulge anterior fontanel.

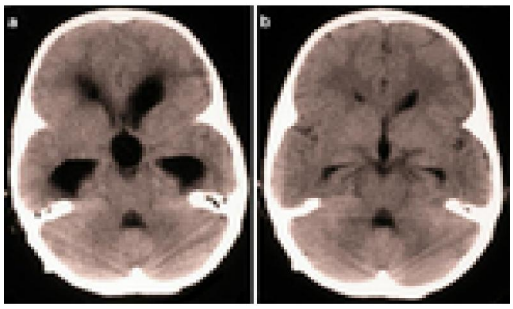


Fig 2: pre operative image show obstructive hydrocephalus

Procedure

ETV

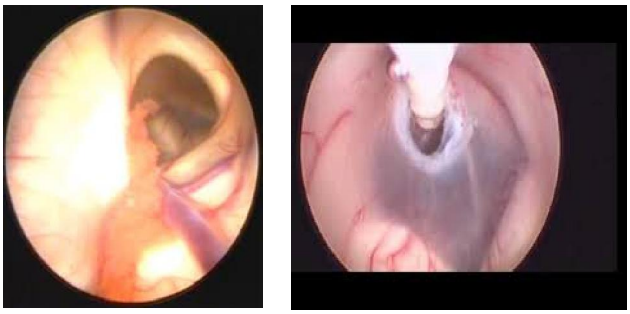


Fig 3 intraoperative foramen of monro and floor of third ventricle

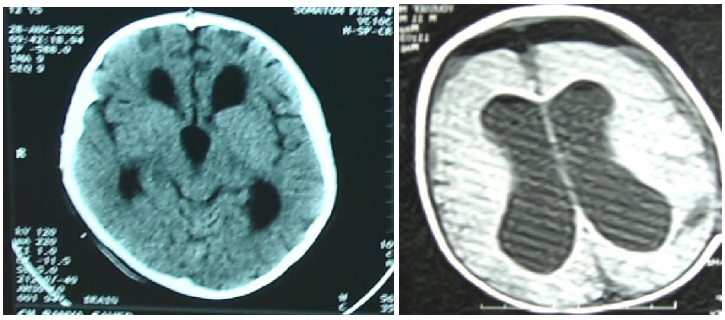
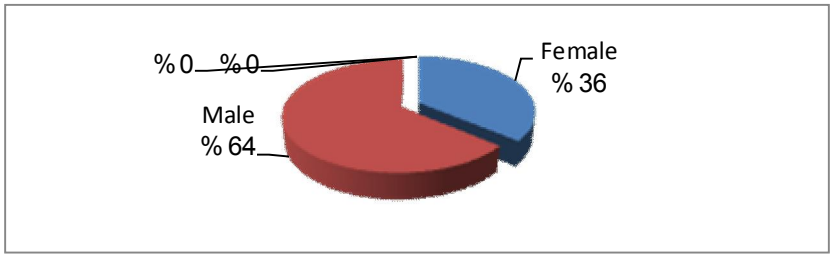


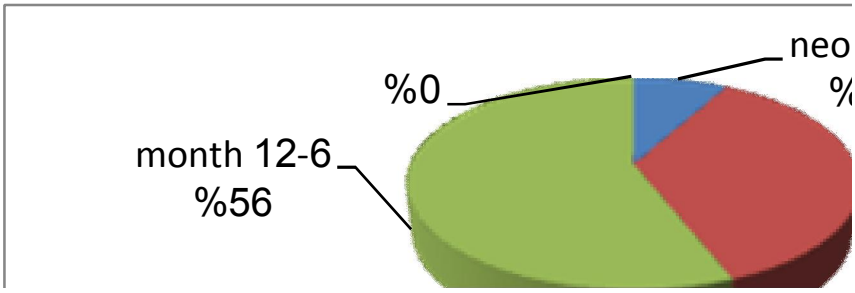
Fig 4:Postoperative CT scan and MRI

3. Results

The study included 50 infants (32 males and 18 females). The age in 4 cases was less than 1 month, and in 18 cases was below 6 months and in 28 cases was from 6 to 12 months.

Only 2 pre mature low birth weight neonates out of 4 cases and 2 from 1 to 6 months.





Symptoms and signs included; Large head in all cases (n=50), vomitting (n=6), history of fever (n=10) and fits (n=12).

Symptom or sign	No. of Cases	Percentage %
Large head	**50**	**100**
Vomiting	**6**	**12**
History of fever	**10**	**20**
Fits	**12**	**24**

Overall clinical improvement

Age/Success	Success		Failure		Total	
	No.	%	No.	%	No.	%
Neonate	0	0 %	4	100%	4	8%
1 to 6 months	8		10		18	36%
6-12 Months	20		8		28	56%

Complications

Postoperative leakage of CSF from the burr hole developed in 8 patients which stopped in 5 days in 4 patients while continued for 10 days in 4. MRI without flow study was suggestive of stoma closure in these cases.

An evidence of infection was found in 5 patients.

Postoperative seizures occurred in 1 patient.

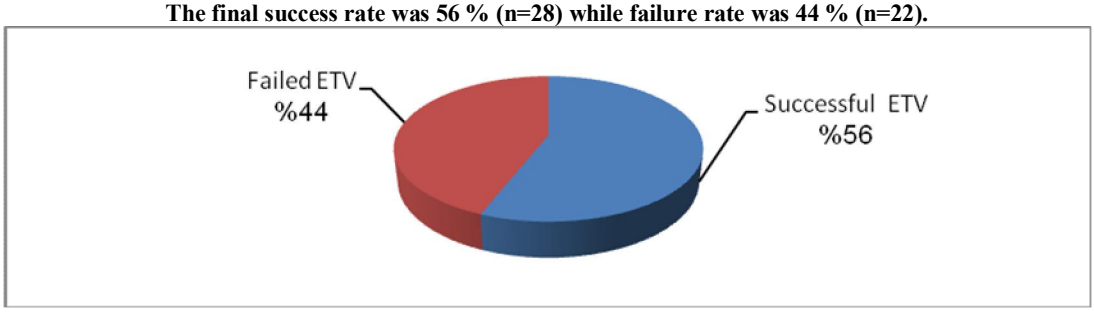
Mild intraoperative bleeding which stopped after continuous irrigation occurred in 4 patients.

Procedure had to be abandoned in 1 patient due to poor visualization of floor of the third ventricle.

In 7 cases out of 8 where the stoma closed, this closure occurred within 6 weeks (n=7) while in the remaining case (n=1) this complication was seen within 3 months. When we analyzed stoma closure cases, we found that 4 out of 8 stoma closures were in low birth weight pre mature infants.

Final failure occurred in the all low birth weight pre mature infants (100%).

The final success rate was 56 % (n=28) while failure rate was 44 % (n=22).



4. Discussion

In this study endoscopic third ventriculostomy was done for all cases of hydrocephalus however success rate was higher in cases of congenital than post infectious cases.

The clinical success rate of ETV in our study was 56%.These results are comparable to other studies. Success rate of 61%, 64%and 55%was observed in other studies done in infants while the success rate in other age group patients varied from 76%to91.5%.[4]

Failure of ETV was 44% in our study, including one procedure which was abandoned (2%) due to poor visualization of the floor of the third ventricle. This was a case of TBM hydrocephalus in which we could not see the mamillary bodies and the infundibular recess. Most of the stoma blockage (4 out of a total of 8) occurred following infection (4) and bleeding during surgery. Failure rate of ETV in low birth weight pre mature infants (n=4) was (100%) [5-6].

Table 1: Calculation of the ETVSS*

0	<1 mo postinfectious previous shunt
10	1 mo to <6 mos no previous shunt
20	myelomeningocele, IVH, nontectal brain tumor
30	6 mos to <1 yr aqueductal stenosis, tectal tumor, other
40	1 yr to <10 yrs
50	≥10 yrs

* The ETVSS is calculated as: Age Score + Etiology Score + PreviousShunt Score(7).

CSF leak occurred in 8 (16%) patients which stopped in 4 cases spontaneously. The cause of persistent leak in 4 patients (8%) was closure of the stoma and consequently rise of intracranial pressure. Causes of temporary CSF leak could be due to failure of closure of dura, thinned out scalp and thin cortical mantle. Incidence of CSF leak after ETV have varied between 2% [8] to 7%.[9]

Bleeding occurred in 4 patients (8%) during surgery which stopped after persistent irrigation. Two out of these 4 patients developed closure of stoma resulting in failure of ETV. Bleeding was also seen in about 5%[10] and 3%[11] of cases in other series. Aspiration of clots and thorough irrigation of ventricular cavity should be done after bleeding stops; this measure can reduce chances of stoma closure.

George *et al.* (2007) stated that age, cause of hydrocephalus, previous shunt placement, or meningitis have been used by some to exclude patients from treatment with third ventriculostomy, but these are all relative contraindications.(12)

Nishikawa (2007) stated that endoscopic aspiration of intraventricular hematomas and ETV was successful in 30% of patients.ETV is a safe procedure, which in carefully selected children with etiologies of hydrocephalus thought to be 'communicating' in nature carries a satisfyingly high success rate. (13)

Matthew *et al.* (2003) considered success rate of endoscopic third ventriculostomy in cases of hydrocephalus due to infection to be60% while it is 71% in cases due to hematoma.(14)

In this study success rate in cases of post meningitic hydrocephalus is 10 % which is less than Nishikawa's study and this may be due to the fact that it is the first [13] reported long term successful results with ETV in both their cases with hydrocephalus secondary to infection. study to us in endoscopic third ventriculostomy for communicating hydrocephalus and lack of experience in dealing with such cases of hydrocephalus may be less than obstructive type.

Clinical success in post meningetic hydrocephalus was 10% while it was65% in congenital hydrocephalus with aqueductal stenosis.

5. Conclusions

Endoscopic third ventriculostomy (ETV) appears to be an effective method for treating selected patients with hydrocephalus and freeing them from the long-term complications of implanted ventricular shunts. ETV can be the definitive treatment for obstructive hydrocephalus in infants less than one year of age. Many different etiologies of hydrocephalus may be treated; however, congenital aqueductal stenosis carries the best prognosis for success. Age should not be a deterrent to performing ETV. We observed 3 factors to get best outcome that make the case candidate for ETV: (1) Non-communicating hydrocephalus. (2) No history of preoperative CNS infection and (3)Good surgeon experience.

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