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Endoscopic third ventriculostomy versus ventriculoperitoneal shunt in the treatment of obstructive hydrocephalus in children

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Background

This study compares endoscopic third ventriculostomy (ETV) and ventriculo-peritoneal shunt (VPS) in the treatment of paediatric patients with obstructive hydrocephalus

Material&Methods:

Eighty five pediatric patients with obstructive hydrocephalus were studied. Patients were divided into two groups: group A (47 patients) operated by ETV with and group B (38 patients) operated by VPS with a mean follow-up of 9 months.

RESULTS:

Both procedures proved to be effective clinically and radiologically. In group A, spontaneous closure of stoma was the most common complication,intraoperative bleeding occurred in two cases (4.25%) and cerebrospinal fluid leakage in two case (4.25%), two cases died 4.5 months postoperatively from ventriculitis. In group B, shunt infection occurred in four cases (10.52%), Subdural collection occurred in two cases (5.26%),shunt exposure in 2 cases(5.26%), three cases died within a week postoperatively,. Endoscopic third ventriculostomy proved to be superior due to shorter duration of surgery (25 min versus 45 min), lower incidence of morbidity (10.63% versus 29%), less mortality (4.25% versus 10%), and lower incidence of procedure failure (28% versus 40%).

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I. INTRODUCTION

Hydrocephalus, as defined in pathophysiologic terms, may be regarded as an imbalance of CSF formation and absorption of sufficient magnitude to produce a net accumulation of fluid with in the ventricles of brain[(1)] . Hydrocephalus can be classified as communicating and non-communicating hydrocephalus. Etiologies of aqueductal stenosis congenital like Chiari malformation and acquired due to inflammation, hemorrhage or infection, neoplasm. It is unknown in some cases of AqS remain occult,and manifest only in adults[(3)]

Surgical treatment of hydrocephalus:

Goals of therapy: Normal sized ventricles is not the goal of therapy, Goals are optimum neurological function.
Options include: Shunting: ventriculoperitoneal shunt, ventriculo-atrial shunt [(8)] and Third ventriculostomy[(4)]

Ventriculoperitoneal shunt:

(V-P)shunting is the most popular technique for CSF diversion. It is relatively simple, it is suitable for patients of all ages with hydrocephalus from any cause and complications are easy to manage[(9).] Complications can occur in V-P shunt like obstruction most commonly is that of the upper end of the catheter, infection, disconnection, hardware erosion through the skin, intra-ventricular hemorrhage, sub-dural hematomas or hygroma, over drainage syndrome and other complications like tip migration, perforation of viscus , intestinal stangulation, CSF ascites[(11)].

Endoscopic third ventriculostomy (ETV)

The past decade has witnessed the resurgence of endoscopic third ventriculostomy in neurosurgery. The classic indication for ETV is non-communicating hydrocephalus, in which the patient typically presents with dilated lateral and third ventricles, and a normal fourth ventricle . A coronal burr hole is placed 2 cm lateral to the midline and just anterior to the coronal
suture. The burr hole, which is 8 to 12 mm in diameter, is created on the right side. . The endoscope is passed through the sheath and the lateral ventricle is visualized. A grasper is used bluntly to puncture the floor of the

third ventricle midway between the mammillary bodies and the infundibular recess. Then Fogarty balloon catheter(4F) is advanced through the opening in the floor, and inflating it, to widen the newly created aperture[12,13]. Complications can occur in ETV and the most serious one is basilar artery injury. Although very rare, this can lead to pseudoaneurysm or even death. Injuries that occur during floor puncture are more common. These include damage to the pons, hypothalamus, 3rd cranial nerve, and cerebral peduncle.

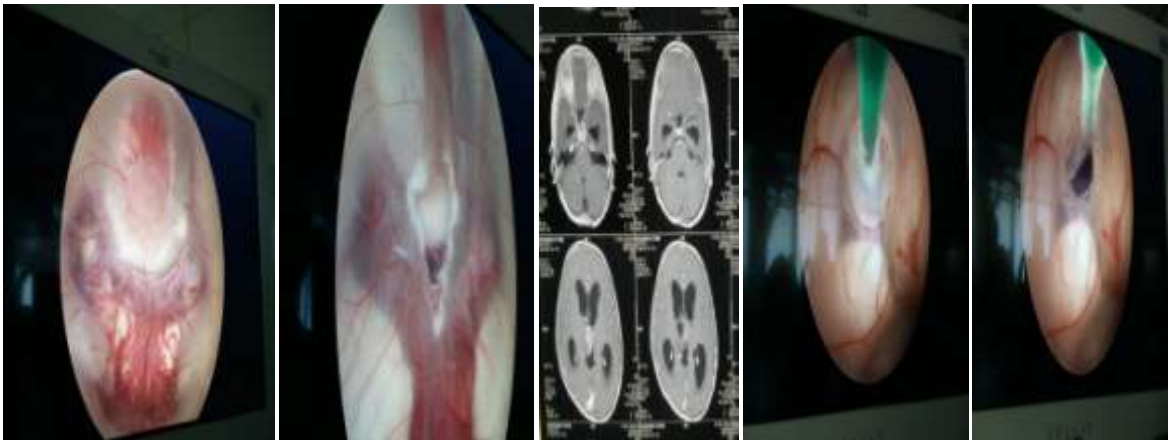
The most frequent surgical complication in ETV is bleeding, and this usually occurs due to injury of the vessels or choroid plexus[14].

II. MATERIAL AND METHODS

This is a prospective study conducted at Rajendra Institue Of Medical Sciences(RIMS) , Ranchi, Jharkhand between the October 2013 to September 2015. 85 operations (47 ETV and 38 V-P shunt) for various aetiologies were performed. All patients of age up to 18 years are with obstructive hydrocephalus and in need for shunting were included in this study with no exclusion. Patients with communicating hydrocephalus were excluded from the study .

The patients age range from 2 months to 18 years of both sexes,with a median of 4 years. In this prospective study a details history had been taken from the patient or their family in infant and children. Proper examination of patient were done including general and nervous system examination especaily fundoscopic examination, cranial nerves examination. Investigation were performed preoperatively and include, complete blood picture, CSF analysis was done in cases suspected of having infection. CT-scan brain to all our patients and finding of scanning is analysed according to the size of the lateral ventricle and whether or not the fourth ventricular dilatation, MRI is done in all patients who were arranged for ETV to assess the size of 3rd ventricle and the aqueduct.

Our patients were divided into two groups. First group include 47 patients who were treated by Endoscopic third ventriculostomy. Second group include 38 patients, who were treated by V-P shunt. Both groups received prophylactic antibiotics during induction, and post operatively all patients received the available antibiotics intravenously for five days and oral antibiotics for next three days. The patients were followed during the period of study. Any new complications or complaint from patients were recorded. Then all the data were collected according to the data collecting proforma, analyzed and plotted in tables. Then the results were compared with the literature of the other studies.



RESULTS:

Table 1: The age of the patients is ranging between 2 months and 18 years old with a median of 4 years with male :female is 3:2

		Numbers (N= 85)	Percentage (%)
Age (Years)	< 1 year	24	28.33
	1- 5 years	30	35.29
	5- 10 years	14	16.47
	10- 18 years	17	20
Sex	Male	50	59
	Female	35	41

Table 2: The most common cause of obstructive hydrocephalus is primary aqueductal stenosis followed by posterior fossa tumors in our study.

Etiology	Number	%
Aqueductal stenosis	37	43.52
Posterior fossa tumors	30	35.29
Post infectious	4	4.70
Colloid cyst	3	3.52
Craniopharyngeoma	4	4.70
Pineal tumors	4	4.70
Pituitary tumors	3	3.52

Table 3: 85 patients were included in our study, in 38 of them V-P shunts were used in treatment of hydrocephalus while 47 of them were treated by ETV

Group	Number (N=85)
ETV	47
V-P Shunt	38

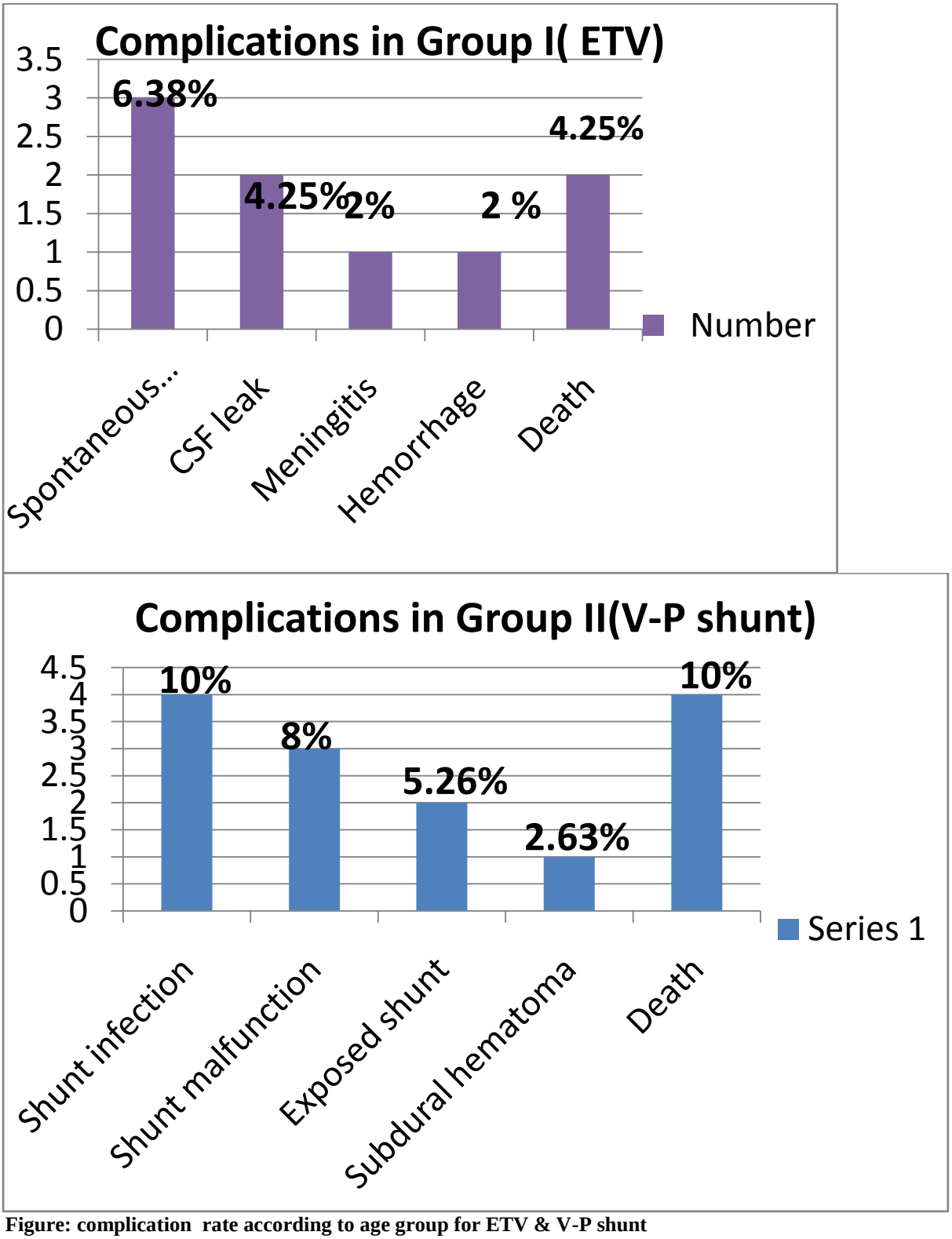


Figure: complication rate according to age group for ETV & V-P shunt

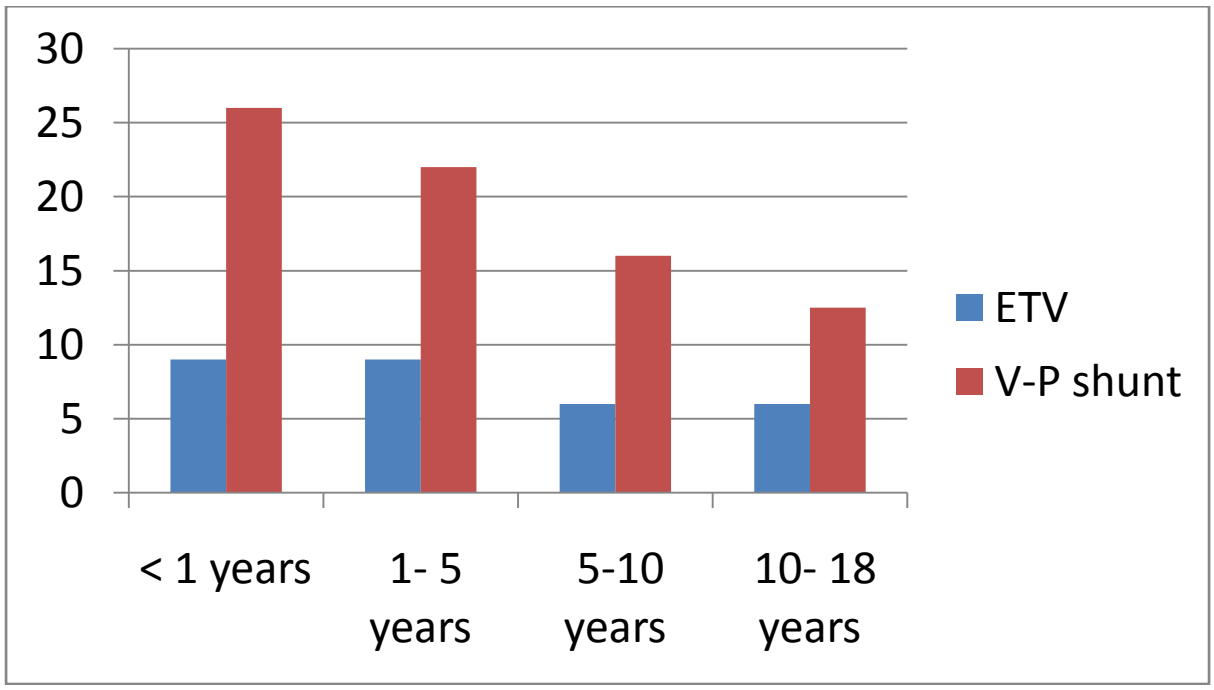


Table : No. of patients treated in both procedure and in relation to the age with the resultant P- value

Age (Years)	Number (N= 47)	Percentage (%)
< 1 year	9	19.14
1 – 5 years	21	44.68
5 – 10 years	8	17.02
10 – 18 years	9	19.14

Age (years)	Number (N = 38)	Percentage (%)
< 1 year	15	39.47%
1 – 5 years	9	23.68%
5 – 10years	6	15.78%
10 – 18 years	8	21.08%

P –value = 0.124

Figure:One-year complication-free survival for ETV and V-P shunt as a function of age group

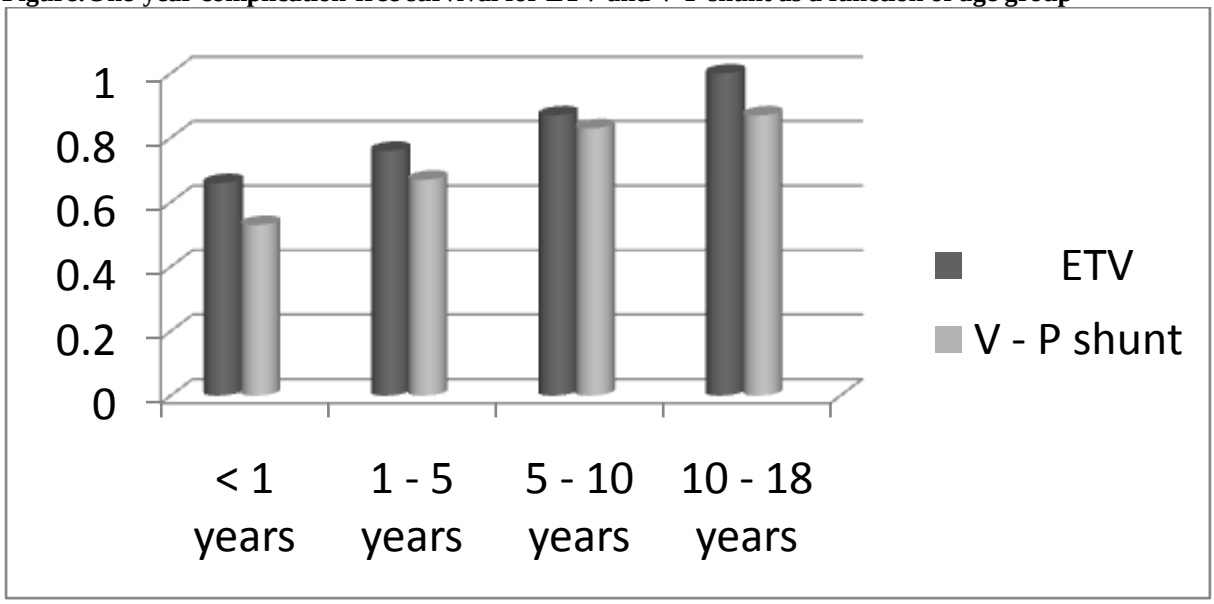


Table : Number of patients treated in both procedures and number of the successful operations and the failed ones and their percentages with the resultant P value.

Procedure	successful	unsuccessful
ETV	34 (72%)	13 (18%)
V-P shunt	23 (60%)	15 (40%)

P- value = 0.186

Table : No. of patients treated in both procedures and in relation to etiology and resultant P-value

Etiology	ETV (N = 47)	V-P shunt(N=38)
Aqueductal stenosis	24	13
Post. Fossa tumor	16	14
Infectious	2	2
Ventricular tumor	2	4
Pineal tumor	2	2
Pituitary tumor	1	3

P- Value = 0.43

Table : Comparison of patients demographics and outcomes in ETV and V-P shunt

Category	ETV group	V-P shunt group
No of patients	47	38
Median age	5 years	2 years
Male	60 %	46%
Mean f/u	14 months	9 months
Failure overall	28 %	40%

III. DISCUSSION

In our study, age of the patients ranged from 2 months to 18 years with the median age of 4 years. There were 59% male and 41% female patients, with the male to female ratio 3:2. 47 patients were treated by endoscopic third ventriculostomy and 38 patients were treated by ventriculo- peritoneal shunt. The ETV patients had a higher average age and slightly higher male preponderance.

Aqueductal stenosis is the most common cause of congenital obstructive hydrocephalus which was found in 44 % of patients in this study. The most common cause of mass lesion with secondary hydrocephalus are posterior fossa tumors.In our study posterior fossa tumors with secondry hydrocephalus were found in 35.29%. Infection is a common cause of shunt blockage (by inflammatory debris or by increase protein in CSF) as stated by Micheal scott et al. In this study it was 10 %[(8).]

The overall revision rate of V-P shunt - 32%, Borgbjerg-BM, et al(retrospective study of 884 patients) revision rate was 38.5%. Of those treated with ETV 72% success rate, Fritsch et. al reported an overall success rate of 75%, Beem's and Grotenhuis reported 76% an overall success[(25)]. Fritsch et. al founded that infants with obstructive hydrocephalus had 100% success rate[(24)] while in our study it is 60%. The risk of intraoperative complications is slightly higher with ETV than with a shunt but in long term, shunts have a higher rate of malfunction and infection.

Determining the best form of CSF diversion in paediatric patients is difficult, particularly in very young patients. Success rates are worse in younger children treated with both ETV (60%) and V-P shunts (53%) This outcome is partially accounted for by an increase in infection rate in younger children, Infection rate increases with younger age following V-P shunt insertion in comparison to overall average infection rate is almost equal in all four age groups for ETV

IV. CONCLUSION

Uncertainty persists on the best treatment for patients with obstructive hydrocephalus: endoscopic third ventriculostomy (ETV) or shunt, particularly in the younger age groups. Shunt surgery is an important operation with a lot of complications, and costly to the patient. Shunt infection is more frequent complication in V-P shunt than other complications. Endoscopic third ventriculostomy is an alternative procedure in treatment of non-communicating hydrocephalus . If performed correctly, ETV is a safe, simple, and effective treatment option with an acceptable level of complications. As observed in this study, the introduction of ETV in a neurosurgical department can also decrease the total hospital stay and currently this factor is important in the health care domain.

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