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Efficacy and Safety of Endoscopic Third Ventriculostomy in Obstructive Hydrocephalus

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Endoscopic third ventriculostomy is the procedure of choice to treat obstructive hydrocephalus now a days. Published case series of endoscopic third ventriculostomy (ETV) for childhood hydrocephalus have reported widely varying success rates. The purpose of this study is to determine the success rate and complications of ETV for treating obstructive hydrocephalus.

Patients with obstructive hydrocephalus and already shunted patients for obstructive hydrocephalus presented with blocked shunt were included in the study. The exclusion criteria consisted ofrecurrent tumor or intra ventricular hemorrhage. Endoscopic third ventriculostomy was performed. Patients were followed up for one year and Clinical and Radiological improvement, complications and mortality was noted. This study was conducted in Neurosurgery Department, Govt. Medical College, Kota between 2015-2016

There were 56 patients including 36 males and 20females. Success rate in the form of clinical and/ or radiological improvement was seen in 88.8% 0f patients. Complications were seen in 6 patients including ETV failure and ventricular hemorrhage. There was no mortality during follow up period of 1 year.

ETV is cost effective and safe procedure in patients with obstructive hydrocephalus with good outcome. It may be used as replacement procedure of ventriculo-peritoneal shunt as initial line of management in selected patients based on ETV score.

Key Words: ETV, obstructive hydrocephalus, posterior fossa tumor

Endoscopic third ventriculostomy (ETV) is considered as a treatment of choice for obstructive hydrocephalus. It is indicated in hydrocephalus secondary to congenital aqueductal stenosis, posterior third ventricle tumor, cerebellar infarct, Dandy-Walker malformation, vein of Galen aneurism, syringomyelia with or without Chiari malformation type I, intraventricular hematoma, post infective, normal pressure hydrocephalus,

myelomeningocele, multiloculated hydrocephalus, encephalocele, posterior fossa tumor and craniosynostosis. It is also indicated in block shunt or slit ventricle syndrome[11]. Proper Pre-operative imaging for detailed assessment of the posterior communicating arteries distance from mid line[9], presence or absence of Liliequist membrane[1] or other membranes located in the prepontine cistern is useful.

Endoscopic third ventricolostomy is a surgical procedure that allows the CSF to flow directly from the third ventricle to the basal cistern and subarachnoid spaces thus bypassing the aqueduct and the posterior fossa. The success rate is variable considering different anatomical, etiological and technical factors and selecting cases of hydrocephalus.

The purpose of this study was to determine the success rate and complications of endoscopic third ventriculostomy for treating obstructive hydrocephalus.

Materials and Methods

The study was conducted at the Department of Neurosurgery, Govt. medical college and Hospital, Kota from 2015 to 2016. Patients with obstructive hydrocephalus secondary to posterior fossa lesion, brain stem glioma, CP angle tumor, pineal tumor, aqueductal stenosis and patients with blocked shunt previously treated for obstructive hydrocephalus were included. The exclusion criteria consisted of previous history of ETV, recurrent tumor, or intra ventricular hemorrhage. CT and/or MRI brain was done in all the cases to confirm hydrocephalus and its cause. An informed consent was taken pre-operatively, explaining the prognosis. ETV score was calculated in all patients. All the patients received a prophylactic third generation cephalosporin intravenously pre-operatively and post operatively for 7 days. Endoscopic Third Ventriculostomy was performed in all patients. Patients were followed up for period of 1 year. On follow up clinical assessment was done at 1month,3 month, 6 months and 1 year. CT and/or MRI brain was done in all the cases at 6 months to look for clinical and radiological improvement. Patients success, complications and mortality was noted in all patients. Clinical improvement was divided into early and late improvement. Early clinical improvement was defined as improvement in Glasgow Coma Scale (GCS) score of at least 2 from baseline within 72 hours post-operatively. Late clinical improvement was defined as improvement in GCS score of atleast 2 from baseline or improvement in Mini–Mental State Examination (MMSE) score of atleast4 or improvement in modified Rankin Scale (mRS) of atleast 1 after 72 hours post-operatively. Radiological improvement was defined as decreased in maximum size ventriclesby atleast 0.2 cm as compared to baseline done 6 months post-operatively.

Results

A total of 56 patients with hydrocephalus were subjected to endoscopic procedure. There were 36(64.2%) males and 20 (35.7%) females with age ranging from 6 weeks to 60 years. The causes of hydrocephalus are outlined in **Table 1**.

Cause	Number of patients	Percentage
Posterior fossa tumour	38	67.8%
Aqueductal stenosis	16	28.5%
Already shunted	2	3.5%

Table 1: Causes of hydrocephalus in patients undergoing ETV (n= 56)

The ETV score ranged from 40 to 90 in the studied population. ETV score is given in **Table 2.**

ETV Score	Number of patients
40	3
50	2
60	4
70	7
80	14
90	26

Table 2: ETV scores of patients

Out of 56 patients undergoing ETV, 2 patients lost to follow-up. Out of remaining 54 patients Clinical and/or radiological improvement seen in 48 patients (successful outcome rate 88.8%), out of which 42 patients (77.7%) had both clinical and radiological improvement whereas 6 patients (11.1 %) had only clinical improvement. Out of 48 patients with clinical improvement 31 had early clinical improvement whereas 17 had late clinical improvement **(Table 3)**.

Clinical / Radiological improvement	Number of-patients	Percentage
Clinical + radiological improvement	42	77.7 %
Clinical improvement only	6	11.1 %
Total	48	88.8 %

Table 3: Successful outcome results (n = 54)

Complications were seen in 8 patients (14.8%), in which 2 patients had inadequate Ventriculostomyor ETV failure, 2 patients had Ventricular bleed and 4 patients had post ETV fever. Out of 4 ETV failure cases 2 were subjected to VP shunt and in 2 patients repeat successful ETV was done. No mortality was seen in patients undergoing ETV within 6 months of follow up. Patients with ETV failure had low baseline ETV score **(Table 4)**.

Complication	Number
Inadequate Ventriculostomy	2
Ventricular bleed	2
Fever	4
Total	8

Table 4: Complications of ETV

Discussion

Hydrocephalus can be classified as purely obstructive, purely communicating or due to combinations of pathologies (obstruction in addition to defective absorption).

Non-communicating hydrocephalus, or obstructive hydrocephalus, is caused by a CSF – flow obstruction ultimately preventing CSF from flowing into the subarachnoid space (either due to external compression or intraventricular mass lesions. Hydrocephalus treatment is surgical, generally utilizing various types of cerebral shunts. Extra cranial approach involves the placement of a ventricular catheterEndoscopic or intracranial approachthird Ventriculostomy (ETV), in which a perforation is made to connect the third ventricle to the subarachnoid space. ETV is considered to be highly safe and fast in experienced hands.The success rate of the procedure is based on different variables. These variables can be independent; which are not related with the procedure or after procedure like age, sex, race, cause and type of hydrocephalus, history of previous surgery and procedure performed and the dependent variables

including ETV failure and complications, which needs additional treatment protocols to treat hydrocephalus.[5,6]

There are controversies regarding the success of ETV in infants. Some authors found that the ETV success do not depend on an age of the patient.[8,10] Others reported poor results, especially in neonates and in infants, younger than 2 months.[3,4] Overall success rate varies from 30 – 90% among different studies.The pre-operative assessment score predicts the success rate hypothesized by Kulkarni *et al*.[7]

Score	Age	Etiology	Previous shunt
0	< 1 month	Postinfectious	Yes
10	1 to < 6 months	-	No
20	-	Myelomeningocele, intraventricular haemorrhage, non-tectaltumour	-
30	6 months to < 1 year	Aqueductal stenosis, tectaltumour, other	-
40	1 to < 10 years	-	-
50	> 10 years	-	-

Table 5: ETV success score

ETV success with scores ranges from 0 (extremely poor chance of ETV success) to 90 (extremely high chance of ETV success) **(Table 5)**.

Over all complication rate after ETV is about 2% - 15%, but the permanent complications are few. However, complications such as fever, bleeding, hemiparesis, gaze palsy, memory disorders, altered consciousness, diabetes insipidus, weight gain and precocious puberty are reported.[11]

In our study, ETV was performed successfully with good outcome in 48/54 (88.8 %) patients with obstructive hydrocephalus. There was no mortality related to ETV. This success rate is comparable to previous studies (30-90%). In our study group, complication rate were observed in 8 (14.8%) cases including inadequate Ventriculostomy and ventricular hemorrhage. Complications rate were comparable to Bouras T et al, who conducted a review on complications of ETV, the overall complication rate was (8.8%).[2] Complications were more common in patients with low ETV score and may be related to high proteineceous content of CSF in congenital hydrocephalus decreasing visibility and leading to Ventriculostomy failure.

There were few limitations of this study. Firstly there was a selection bias, like operating surgeon/team selected those cases more often which would have better post-operative results, based upon pre-operative confounders as mentioned in **Table 5**. Furthermore, sample size of study population was small and it was single center non randomized study; randomized controlled trials from different centers are required to comment on the validity/acceptance of ETV success score.

Conclusion

From this study, we can conclude that ETV is an safe, fast and cost effective alternative to shunt procedure for treatment of obstructive hydrocephalus with good outcome and fewer complications. Based on age, cause of hydrocephalus and any history of previous shunt surgery, failure of procedure can be assessed in 3-6 months with the help of ETV score. Postoperative complications can be minimized in experienced hands by considering both dependent and independent variables during procedure.

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