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ENDOSCOPIC THIRD VENTRICULOSTOMY (ETV) IS A BETTER ALTERNATIVE FOR VP SHUNT FAILURE IN NON-COMMUNICATING HYDROCEPHALUS

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ABSTRACT **CONTEXT:** VP Shunt is most commonly used procedure for hydrocephalus but shunt failure is also the common complication in many patients. Endoscopic third ventriculostomy (ETV) is an accepted procedure for the treatment of obstructive hydrocephalus. **AIM AND OBJECTIVE -** The aim of our study is to evaluate the success rate of ETV in patients of obstructive hydrocephalus formerly treated by ventriculo-peritoneal (VP shunt) shunt. The failure VP shunt was removed before ETV. **MATERIALS AND METHOD:** This study was conducted between June 2015 and December 2019 in single unit of our department. Twenty one (n=21) patients were enrolled for this study. All patients were admitted with failure of VP shunt. They were known case of non-communicating hydrocephalus previously operated for VP shunt. Six patients were excluded for ETV because CT/MRI show grossly distorted anatomy of ventricles. Endoscopic third ventriculostomy was attempted in 15 patients, but ventriculostomy was done successfully in 10 patients, rests were treated with revision of VP shunt. **RESULTS:** All patients in this study were radiologically diagnosed case of hydrocephalus due to aqueduct stenosis. They were experienced VP shunt insertion but there were failure of shunt due to any reason. ETV procedures were done successfully in 10 patients. Out of 10 patients one patient needed shunt insertion due ineffective ETV. Shunt revision was done in 11 patients. There was no serious complication during and after ETV procedures. The follow-up period of patients with successful ETV was 6–60 months. This follow-up was uneventful and peaceful for their parents. **CONCLUSION:** ETV can be considered as an alternative treatment for the patients with VP shunt failure with an acceptable success rate of 80%, although long-term follow-up is needed for these patients.

KEYWORDS : Aqueduct stenosis, Endoscopic third ventriculostomy, ETV, Hydrocephalus, Non-communicating hydrocephalus, VP shunt, Ventricles.

INTRODUCTION -

Hydrocephalus is one of the most common pediatric neurological diseases [1]. The estimated incidence of congenital hydrocephalus range between 0.5 to 1 case per 1000 births and acquired hydrocephalus is 3 to 5 cases per 1000 births [2]. Hydrocephalus can result from obstruction of CSF flow (obstructive hydrocephalus) and impaired absorption of CSF (communicating hydrocephalus).The main surgical treatment of hydrocephalus is the diversion of cerebrospinal fluid (CSF). Many diversion techniques developed including shunting techniques through ventriculo-peritoneal (VP) shunt, ventriculo-atrial (VA), lumbo-peritoneal shunt, Ventriculo-pleural shunt and endoscopic third ventriculostomy (ETV) [3]. Ventriculo-peritoneal (VP) shunt is most commonly used surgery worldwide. Though VP shunt is well-established time tested, easy and safe procedure but it has its own problems or complications like infection, blockage, over drainage, peri-catheter leak, shunt fracture, extrusion of shunt, pseudo cyst formation [4].

The risk of shunt malfunction is relatively high. It is 25 to 40% in the first year after shunt insertion, 4 to 5% per year thereafter, and 81% of shunt in situ patients require revision after 12 years. So, shunt complications are commonly faced by patients of hydrocephalus frequently during their life [5,6]. Most patients with shunt malfunction or failure are treated with repeated shunting procedure, but ETV can be used as an alternative treatment in some of these patients. There are several studies which have considered ETV as the main treatment of hydrocephalus in patients with shunt failure [7,8]. Here, we retrospectively studied our patients with shunt failure which were treated with ETV. We evaluated the result of ETV by means of clinical improvement, USG brain and MRI brain if possible.

MATERIAL AND METHODS –

Here we enrolled twenty one (n=21) patients of non-communicating hydrocephalus in which VP shunt was done once or twice time. But shunt became failed. This study was conducted between June 2015 and December 2019 in single unit of our department.

Risk, benefit, side effect, failure or success of procedure explained to parents/caretaker and proper written consent of procedure was taken. Shunt was removed and 5-7 day antibiotics therapy given prior to ETV in patients with infected shunt. Endoscopy done with all aseptic precautions through the burr hole, made at 2 to 2.5cm lateral and 0.5 cm anterior(preferably right side) to the crossing point of sagittal suture and coronal suture (Fig.2). Warm ringer lactate was used as an irrigating fluid (at body temperature). Anatomical land marks were identified. Within the lateral ventricle foramen of Monro was identified using standard landmarks of choroid plexus, thalamostriate and septal veins. Once the third ventricle was entered, the mammillary bodies and infundibular recess were identified (Fig.1 b). Infundibular recess was identified as bright red spot along the anterior limit of the floor of the third ventricle. Floor of the third ventricle was carefully inspected for probable site of the ETV. The site of ostomy was planned at mid way between mammillary bodies and infundibular recess. In most cases, a thin floor could be observed, and the ventriculostomy was performed at the standard location between infundibular recess and mammillary bodies by using blunt tip forceps or Bugbee (ball electrode). In two cases, we found relatively thick floor of third ventricle. A second membrane, the membrane of Lilliquest also present in the pre-pontine space, this membrane must be fenestrated for the free flow of CSF. Confirmation of completion of third ventriculostomy was done by to and fro movements of the margins of the fenestrated site. Endoscope was removed safely. Dura closed, surgicel applied over it and scalp

closed in single layer.

Patients kept on antibiotics for 5-7 days and observe for seizures, fever and other sign and symptoms of raised intracranial tension. Regular follow-up was done with clinical examination, USG brain, and MRI brain with CSF flow study if possible.

INCLUSION CRITERIA –

1. Diagnosed non-communicating hydrocephalus in MRI or CT Brain.
2. Patients with normal anatomy of ventricles.
3. All VP shunt failure patients with non-communicating hydrocephalus.

EXCLUSION CRITERIA –

1. Communicating hydrocephalus.
2. Patients whose CT/MRI show grossly distorted anatomy of ventricles.
3. Patients whose brain CT/MRI not possible.
4. Patients in moribund state.

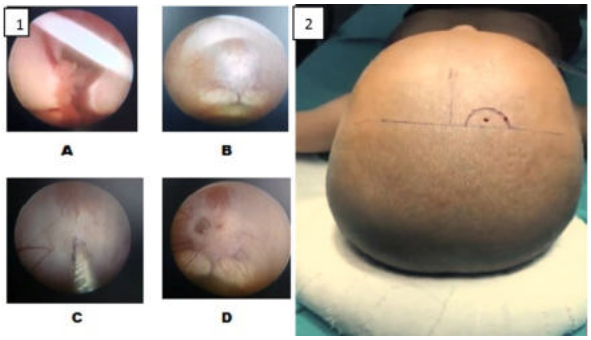

Fig. 1. A-showed endoscopic view of lateral ventricle contains cranial end of VP shunt.
B-showed endoscopic view of floor of third ventricle.
C-showed fenestration of floor of third ventricle.
D-showed floor of third ventricle after successful ventriculostomy.
Fig. 2. Showed presentation for site of burr hole and endoscope insertion by drawing line and semicircle.

RESULT: -

There were 15 male and 6 female children, with their age ranging between 5 months to 3.5 years at the time of admission for shunt failure. All these (n=21) patients were known case of obstructive hydrocephalus confirmed by their brain MRI or CT reports. Time interval between the first shunt surgery and the first shunt failure was between 2 months to 3 years. Out of 21 cases; there were 9 children with shunt failure secondary to shunt infection and 12 cases due to shunt malfunction. In 5 cases ventricular anatomy found abnormally distorted and anatomical landmarks could not identified during endoscopy so the procedure abandoned without taking risk. VP shunt insertion was done in these 5 cases in same sitting. Successful ventriculostomy was done in 10 cases.

Intra operative complication like major bleeding did not occurred in any patient. The seizure was seen in one case post operative period which was managed conservatively. One patient died on 3rd post operative day. In one patient there was CSF leak from suture line; fontanelle was tense so VP shunt insertion was done on 14th postoperative day of ETV. Post ETV Longest follow-up was 5 years in a patient without any event.

Table1: Showing The Characteristics Of Patients Who Were Underwent For Etv In This Study

S. No.	Age	Sex	Previous shunt	Final procedure	Follow up
1	5m	M	Removed	ETV	Uneventful
2	10m	M	Removed	ETV	Uneventful
3	11m	M	Removed	Endoscopy→ VP shunt	Shunt functioning
4	4m	M	Removed	Endoscopy→ VP shunt	Shunt functioning
5	10m	M	Removed	Endoscopy→ VP shunt	Shunt functioning
6	10 m	M	Removed	ETV	ETV Failed→ VP Shunt
7	8 m	F	Removed	ETV	Uneventful
8	5m	M	Removed	ETV	Uneventful
9	6m	M	Present	Endoscopy→ VP shunt	Shunt functioning
10	11m	M	Removed	ETV	Uneventful
11	5m	M	Removed	ETV	Expired on post-op day three
12	6m	M	Removed	ETV	Uneventful
13	2y6m	F	Present	Endoscopy→ VP shunt	Shunt functioning
14	10m	M	Removed	ETV	Uneventful
15	3y6m	F	Present	ETV	Uneventful

Table 2: Summarized result of this study

No. of patient of Non-communicating hydrocephalus with shunt failure enrolled in this study	21
No. of patient excluded due to gross anatomical distortion seen in MRI/CT	6
Endoscopy done	15
Procedure abandoned due to failure to identify anatomical landmark in endoscopy	5
ETV done successfully	10
Intra operative complication/major bleed	Nil
ETV failure and revision of shunt surgery	1

DISCUSSION -

Vesalius is the person who gave the first description that ventricles are the place of excessive fluid collection in brain. This description was given in 16th century [9]. Hydrocephalus was classified by Walter E. Dandy and Kenneth D. Blackfan in following two groups non-communicating (obstructive) and communicating (Dandy and Blackfan classification) [10].

Ventriculo-peritoneal shunt is the well-established treatment of hydrocephalus. First ventriculo-peritoneal shunt insertion was done by Kausch, a German neurosurgeon in 1905 [11]. With time and advancement in technology and to avoid the complication of VP shunt, in 1910 neuroendoscopy was introduced to treat obstructive hydrocephalus. Victor Lespinasse (1878 –1946) an urologist attempted first neuroendoscopy to treat hydrocephalus by destroying the choroid plexus in two young patients with the help of cystoscope [12]. Later on in 1922 Walter Dandy also uses cystoscope and did ventriculoscopy. He identified the lateral ventricle, the foramen of Monro, the choroid plexus and blood vessels in the wall of the ventricles. He attempted to treat the hydrocephalus but success was not gain [13,14].

First successful endoscopic third ventriculostomy was done by William Jason Mixter for non-communicating hydrocephalus in 1923 [15,16]. ETV is the treatment of choice in non-communicating hydrocephalus even in patients previously operated with VP shunt [17]. Indication of ETV congenital aqueductal stenosis, acquired aqueductal narrowing by tectal gliomas and cysts. Other relative indications are ventriculoperitoneal shunt malfunction, posterior fossa tumors, and normal pressure hydrocephalus [18,19,20,21].

ETV was successfully done in ten (n=10) patients at our study. Out of one patient expired on post-operative day three and one another needed VP shunt insertion after ETV procedure. Overall success rate of ETV in this study was 80% (8 out of 10). Similar success rate was found in study of Eva Brichtova et al. 2013. They did ETV in fifteen patients of congenital aqueduct stenosis and twelve patients were remaining uneventful in follow-up. So, their success rate of ETV in cases of congenital aqueduct stenosis was 80% (12 of 15 patients, 80%) [17].

Burcak Bilginer et al. did ETV in their study. There were 23 male and 23 female patients. Overall success rate was 80% which is similar to our study. They also concluded that ETV is a safe, cheap, and effective procedure for shunt malfunction. As per their opinion ETV should be the first line treatment. We also favoured this opinion [22].

Common complication which may occurs due to ETV are permanent neurological complications like hemiparesis, gaze palsy, memory disorders, altered consciousness, permanent hormonal morbidity like diabetes insipidus, weight gain, precocious puberty, intraoperative hemorrhage, intraoperative neural injury like thalamic, forniceal, hypothalamic, and midbrain injuries, Central nervous system

infections, CSF leak, postoperative intracranial hematomas, delayed sudden death, acute hydrocephalus due to stoma occlusion [23]. In our study CSF leak was present in one patient than VP shunt was inserted to manage the leak. One more patient was expired on post-operative day three due to uncontrolled seizures.

CONCLUSION -

ETV is a better alternative in previously operated VP shunt patients which were presenting with shunt malfunction. The success rate is around 80% in pediatric patients of our series which is similar to other reported series. So, In experienced and skilled hand ETV become a treatment of choice for non-communicating hydrocephalus.

Abbreviations -

ETV – Endoscopic third ventriculostomy
VP shunt – Ventriculoperitoneal shunt
MRI – Magnetic resonance imaging
CSF – Cerebrospinal fluid

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Conflicts of interest - There are no conflicts of interest.

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