Endoscopic Third Ventriculostomy: Analysis of 41 Cases

Prabin Shrestha, MD, PhD; Anish M Singh, MBBS, MS; Manish Kolakshyapati, MD, PhD
Unit of Neurosurgery, Department of Neuroscience, B & B Hospital, Gwarko, Lalitpur, Nepal

Address for Correspondence:
Prabin Shrestha, MD, PhD
Unit of Neurosurgery, Department of Neuroscience, B & B Hospital, Gwarko, Lalitpur, Nepal
Email: prabinshrestha@hotmail.com

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Neuroendoscopy is one of the vital fields of neurosurgery. Different types of surgery can be performed with endoscopy like endoscopic surgery of pituitary adenoma, endoscopic surgery of intraventricular tumors, endoscopic spinal surgery etc.
Endoscopic third ventriculostomy (ETV) is one the most common endoscopic procedures of brain and is performed mainly for obstructive hydrocephalus. It can be performed by expert hands in any age group except for small children less than few months of age.
We have performed endoscopic intraventricular exploratory procedures in 41 cases in last 10 years out of which ETV was performed in 24 cases, ETV with Ventriculo Peritoenal shunt (VPS) was done in 9 cases and exploration of intraventricular cavity was done in 8 cases.
Males and females were almost equal in number. Of 41, 35 cases were adults and only 6 were children of about 10 years age.
All the cases with ETV improved significantly after surgery. Cases with ETV and VPS also did well. There was not a single case of significant morbidity and mortality after the procedure. Mild bleeding was noted during procedure which was controlled with irrigation. Hospital stay was 3-7 days.
Keywords: ETV, endoscope, neurosurgery, VP shunt.

Hydrocephalus can be treated by different surgical procedures like VP shunting, ETV, Choroid Plexus Cauterization (ETV/CPC) etc. However, appropriate cases have to be selected for each above mentioned procedures. VP shunting is helpful in all types of hydrocephalus whereas ETV is helpful for obstructive type not for communicating type. Whatever the surgical procedure may be, the success rate depends upon patient factors such as age, associated medical co-morbidities, cause of hydrocephalus, skill of surgeon etc.

ETV is one of the effective procedures for obstructive or non-communicating hydrocephalus in adults and/or children though it is technically demanding as compared to VP shunt.[1] ETV is sometimes followed by choroid plexus cauterization in infants in selected cases. Most of the time it is safe, however, at times it can cause complications like intraventricular hemorrhage. In long term, closure of the opening or pathway made surgically by ventriculostomy may cause recurrent hydrocephalus.[2]

Here, we present our experience of ETV that we have performed so far and analyze critically on its outcome and complications.

Materials and Methods

This is a retrospective case series analytical study. Total cases of hydrocephalus that were treated from 2008 till 2017 by our team were analyzed and studied. Out of more than 100 case of hydrocephalus that underwent different treatment, 41 cases underwent endoscopic procedure.

The endoscopic system that was used was Wolf Endoscpic system, USA and Karl Storz endoscopic system, Germany **(Figure 1)**. Rigid endoscope was used in all the cases and scopes of 0 and 30 degrees were used in most of the cases.

Most of the cases, except few, of normal pressure hydrocephalus (NPH), hydrocephalus secondary to head injury, subarachnoid hemorrhage or intraventricular hemorrhage were excluded and only the cases of obstructive hydrocephalus were considered for the endoscopic procedure. Endoscopic procedure was performed for intraventricular exploration and ETV. Of 41, ETV was performed in 24 cases and only intraventricular exploration was done in 8 cases. The cases of endoscopic intraventricular exploration were of both communicating and obstructive type of hydrocephalus with abnormal shape and loculation of ventricles as found in MRI.

Figure 1: Endoscopic system that we used, A) Wolf Endoscopes, USA, B) Storz Endoscopes, Germany, C) Sheath and endoscopes of different degrees

Gross adhesion and arachnoid bands were found in those cases and biopsy was also taken which showed arachnoiditis. Intraopertive procedure, complications, outcome etc were analyzed.

Results

Of 41, 24 cases underwent ETV. All of them were cases of obstructive hydrocephalus. Lateral ventricles and third ventricle were well explored. There was no obvious intraventricular pathology. Floor of the third ventricle was normal. It was a thin layer of arachnoid with good pulsating movement in most of the cases. Floor or tuber cinerium was punctured with a guide wire or at times with biopsy probe and then further dilated with 6.0 f fogarty balloon **(Figure 2)**. Pre-pontine cistern was also observed and few bands of nearby liliequist membrane were removed. Slight bleeding was observed during the procedure which was well controlled with continuous irrigation.

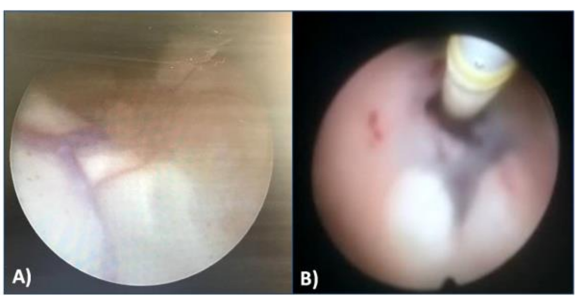

Figure 2: Intra-operative intraventricular endoscopic pictures showing A) foramen monro, choroid plexus and thalamostriate veins, B) floor of 3rd ventricle showing mamillary bodies and tuber cinerium being perforated and dilated with fogarty balloon

Of 41, 8 cases underwent only intraventricular exploration without ETV due to technical difficulties In those cases of intraventricular exploration the whole anatomy of the intraventricular space was distorted, as was noted in pre-operative MRI, and there were multiple bands of arachnoid and blood vessels. VP shunting was done in these cases. Few bands were taken and sent for biopsy which showed arachnoiditis. One of the cases was a case of tubercular meningitis with communicating hydrocephalus. His endoscopic intraventricular exploration was done which showed thick and inflamed ependymal layer and looked like a snow field **(Figure 3)**.

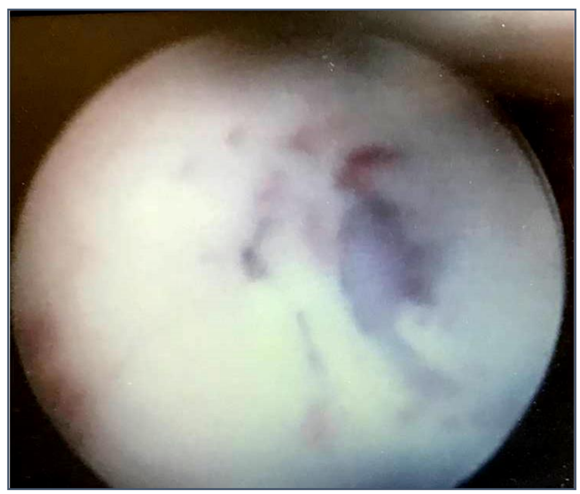

Figure 3: Intraventricular picture of a patient with TB meningitis showing markedly inflammed and thickened ependymal layer looking like snowfield

Of 41, in 9 cases VP shunting was done in addition to ETV as ventriculostomy was not satisfactory. There was no to and fro movement of tuber cinerium after ventriculstomy, lots of arachnoid bands, liliequist membrane, were present in pre-pontine cistern. In such situation, both VP shunting and ETV was performed.

Males and females were almost equal in number. Of 41, 35 cases were adults and only 6 were children of about 10 years age.

Discussion

Endoscopic procedure has been widely used for hydrocephalus. It is safe and convenient for both surgeon and patient. It is a faster procedure, less invasive with small skin incision, no need of an implant, there is minimal brain injury etc. It is indicated in hydrocephalus secondary to wide range of conditions like 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.[2] It is also indicated in block shunt or slit ventricle syndrome.

Proper Pre-operative assessment of imaging is required to confirm whether ETV is going to be helpful in that particular case or not. For example presence or absence of Liliequist membrane or other membranes in the prepontine cistern can predict the possible outcome of ETV.[2]

In case of obstructive hydrocephalus due to mass in posterior fossa, VP shunt may cause upward herniation of brain and further complicate the condition as suggested by Bracksick et al.[3] In such condition also ETV can be more helpful to prevent upward herniation. However in real clinical picture, upward migration is much rarer than what was thought earlier.[3]

Most common indication of ETV in children is congenital aqueduct stenosis. Besides it can also be done in many cases of obstructive hydrocephalus which is caused by different intracranial pathologies. ETV has also been routinely used in cases which have previous VP shunt malfunction.[4] ETV has also been found helpful in such situation mainly in obstructive type. Similarly posterior fossa tumor also causes hydrocephalus due to blockage of 4th ventricle which usually opens up if tumor is completely removed. If not ETV can be done after tumor removal if there is persistent hydrocephalus.[5] However incidence of persistent hydrocephalus after posterior fossa tumor removal is mush low. One of the rare cases where ETV can be of help is AVM located in the brain stem compressing the aqueduct.[6]

In our experience, the indication of ETV was mainly obstructive hydrocephalus due to different intracranial pathologies and number of adults was much higher than children. Due to unavailability of appropriate size of endoscope, we avoided too small children due to possible complications.

ETV used to be less commonly done in the past. However, with the growing experience, it is being done more and more these days in both adult and children, even in children of up to 6 months of age.[7,8] In children it's been found that higher is the age better is the success rate due to well development of prepontine cistern. It has also been found that ETV is less successful in high risk cases like brain tumors or intracerebral cystic lesions.

Similarly, treatment of hydrocephalus by VP shunt and ETV has been compared in children. Perdaens O et al have shown that ETV is safer than VP shunt in terms of post operative complications.[9] Obstructive hydrocephalus showed better outcome than that caused by infective cause like meningitis or encephalitis. ETV has also been found to be quite effective in post traumatic hydrocephalus and post hemorrhagic hydrocephalus. However massive subarachnoid hemorrhage and blocked cisterns indicated higher possibility of ETV failure.[10,11]

Even though ETV is a technically simple procedure, it may at times create complications during or after the procedures. Thompson et al studied the possibility of infection in ETV and external ventriculostomy and found that there is definitely risk of infection in case of repeated sampling through the open ventriculostomy. However in our cases of ETV, we didn't find any significant secondary infection.[12]

Failure of ventriculostomy at times happens with ETV. It has been established that age of the child is one of the major factors as in small age the skull is distensible and grows with age. It will cause less pressure gradient between the intraventricular and extraventricular space.[13]

At times it may also create unexpected and disastrous complication like venous air embolism.[14]

In our series, we haven't encountered any significant complications. Failure of ventriculostomy was also not evident in our experience, also may be because we used VP shunt in doubtful cases.

Patency of ventriculostomy after ETV can be assessed by higher Tesla cine MRI which shows not only the size of third ventricle but also flow of CSF through the aqueduct and ventriculostomy to the pre-pontine cistern. Cine MRI can also measure the velocity of CSF flow.[15]

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