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ENDOSCOPIC THIRD VENTRICULOSTOMY-EXPERIENCE OF 16 CASES

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Abstract

Now-a-days endoscopic third ventriculostomy (ETV) is the treatment of choice for obstructive hydrocephalus in pediatric and adult populations. The purpose of this study is to evaluate the safety and efficacy of, and outcome of endoscopic third ventriculostomy (ETV).

Between June 2006 and December 2007, 16 ETVs were performed in 16 patients. All patients were discharged after 48 hours of procedure performed. Patients were followed up at 15 days, one month, three months, six months and 12 months postoperatively. One patient is died on 4th postoperative day. Two patients were excluded from the follow-up analysis due to rapid deterioration of their condition from tumor progression.

At the time of analysis 12 (92%) of the 13 patients remain shunt independent. ETV is failed in one patient (7.7%).

ETV is the minimal invasive, safe and most effective means of treatment of obstructive hydrocephalus rather than ventriculoperitoneal (VP) shunt

KEY WORDS: endoscopic third ventriculostomy; obstructive hydrocephalus

Introduction

The traditional treatment for all forms of hydrocephalus has been the implantation of ventricular shunt systems. However, ventricular shunt systems have inherent tendencies toward complications such as shunt malfunction and infection. The recent (1970s and 1980s) technological improvement in endoscopic equipment combined with the ability of MRI to visualize actual brain anatomy prior to the procedure have led to a new enthusiasm for ETV - as the treatment of choice for obstructive hydrocephalus.

ETV for treatment of hydrocephalus is not a new concept at all-rather it is almost 100 years old concept. ETV is a most effective treatment in cases of obstructive hydrocephalus that is caused by aqueductal stenosis and space-occupying lesions [1].

We started practicing ETV for the management of obstructive hydrocephalus for the last two years. In this study we analyzed outcome of ETV in our set- up.

Materials and methods

Data were collected prospectively on 16 patients (9 male and 7 female) with 12 newly diagnosed hydrocephalus and four previously shunted (ventriculoperitoneal shunt) patients between June 2006 and December 2007. Criteria for selection of patients include age more than one year and obstructive hydrocephalus due to any cause evidenced by preoperative MRI. Of the 16 patients 8 (50%) patients had congenital aqueduct stenosis. Six patients presented with adult onset of symptoms and two of them had previously shunted with shunt malfunction. Two patients with congenital aqueduct stenosis presented at early age (2.5 years and 4 years) and had not received shunt. Five (31.25%) patients presented with acquired obstructive hydrocephalus secondary to a midbrain tumor, pineal region cyst/tumor, thalamic lesions, intraventricular cysts and intraventricular tumor. Two of them had nonfunctioning VP shunt. One (6.25%) patient had posterior fossa tumor with obstructive hydrocephalus. Two (12.50%) patients had spontaneous intraventricular hematoma with ventriculomegaly. Under general anesthesia ETV is done in all patients by using 30-degree rigid telescope manufactured by Karl Storz [2-6].

ETV is done by using the standard surgical technique described in literatures [30-34]. The procedure is done under general anesthesia with a supine position of the patient. The neuroendoscope is introduced into the lateral ventricle of the brain through an entry burr hole placed at or just anterior to the coronal suture (2.5–3 cm lateral to the midline). In most cases, this will provide a direct trajectory from the entry site through the foramen of Monro into the third ventricle. The foramen of Monro is located where the thalamostriate and septal

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veins, as well as the choroid plexus of the lateral ventricle, converge (Fig.1).

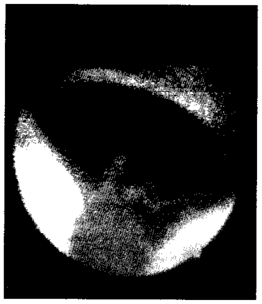

Fig 1: Endoscopic view of the right Foramen of Monro. The choroids plexus at 6 o'clock position; thalamostraite vein at 3 o'clock position and septal vein at 10 o'clock position is seen. Choroid plexus is indicated by black arrow.

After entering into the third ventricle-through foramen of monro, structures in the floor of the third ventricle is identified. In the ideal situation, the basilar artery complex lies at the posterior edge of the third ventricle floor at the level of the mammillary bodies (Fig 2). A fenestration is made at third ventricular floor bluntly via fogarty catheter tip, using a slight back-and-forth twisting motion anterior to the mamillary bodies (Fig 2). The initial fenestration is then dilated up to approximately a 4-5 mm opening by using a numbered 2 or 3 French Fogarty balloon catheter.

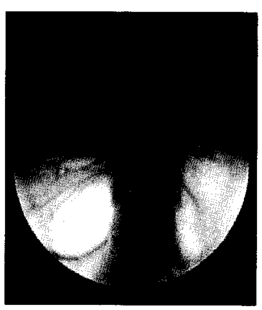

Fig 2: Endoscopic view of the floor of the third ventricle. Two adjacent mamillary bodies (black arrows) with a transparent membrane in front – the site of fenestration (white arrow)

Patients were discharged from hospital after 48 hours of operation and were followed up at 15 days, one month, three months, six months and 12 months postoperatively. The success of the procedure was determined by the improvement of the symptoms of hydrocephalus.

Results

No major complications occurred during the procedures. 15 patients improved their symptoms (seizure, headache, vomiting, visual dimness, ataxia) immediately after ETV. One patient died on 4th postoperative day due to unknown cause. We encountered one case of CSF leak through ventriculostomy wound and managed successfully. One patient with obstructive hydrocephalus due to congenital aqueduct stenosis has developed recurrence of symptoms after 25 days of initial ETV although redo ventriculoscopy has shown patent stoma and patient required VP shunt. Two patients were excluded from the follow-up analysis due to rapid deterioration of their condition from tumor progression. Three months after ETV an overall clinical improvement was observed in 12 (92 %) of 13 patients.

Discussion

Hydrocephalus means excess water in the brain with dilatation of the ventricular system with raised intracranial pressure in most situations. According to aetiology hydrocephalus may be classified as communicating and obstructive variety. Communicating hydrocephalus is characterized by failure of absorption of CSF in the subarachnoid space- because of loss of patency of subarachnoid space due to postinfectious fibrosis of arachnoid vili and granulations –although normal CSF pathway from cerebral ventricles to subarachnoid space is patent. On the other hand in obstructive hydrocephalus patency of subarachnoid space remains intact but communications between cerebral ventricles is disrupted so that CSF cannot drain into the subarachnoid space for its absorption. The common causes of this obstruction are congenital or acquired aqueduct stenosis, intraventricular tumors, and intraventricular hemorrhage (Fig 3).

Fig 3: MRI of the brain showing triventriculomegaly due to aqueduct stenosis; and due to tumor at the midbrain obstructing cerebral aqueduct c & d.

Whatever the types of hydrocephalus-the only effective treatment of hydrocephalus is CSF diversion surgery. Prior to the availability of ventriculoperitoneal (VP) shunts, third ventriculostomy was the most favored treatment of hydrocephalus although these were "open" procedures where the sites for the openings were

a b

c d

directly visualized (i.e., major brain operations). The mortality rates with these procedures were too high to sustain interest in them, however, once shunting materials became available. Also in the early 19th century due to lack of technical improvement of endoscopy-this procedure has failed to gain its much popularity at the earliest period of ETV.

Before last two to three decades ventriculoperitoneal (VP) shunt system was the mainstay of treatment for both communicating and obstructive hydrocephalus. However, VP shunt systems have inherent tendencies toward complications such as shunt malfunction and infection. One recent large prospective multi-institutional study found that 40% of patients required a shunt revision within 2 years of initial shunt placement. Given a lifetime of shunt dependency, these problems are especially dangerous when access to competent care is difficult.

An alternative treatment of obstructive hydrocephalus is endoscopic third ventriculostomy (ETV). Today, ETV is a common practice in tertiary care neurosurgical facilities, and the list of indications for this procedure has grown. Currently ETV is used for :

1. Primary aqueduct stenosis [7, 8]

2. Hydrocephalus caused by mass effect from intraventricular tumors pineal and tectal tumors posterior fossa tumors suprasellar arachnoid cysts pineal cysts or quadrigeminal cistern cysts [9-13].

3. Idiopathic stenosis of the foramina of Magendie and Luschka [14]

4. Dandy-Walker malformation [15]

5. Hydrocephalus due to intraventricular hematoma in combination with aspiration of the hematoma.[16]

6. Some cases of postinfectious/posthemorrhagic hydrocephalus slit ventricle syndrome and communicating and normal-pressure hydrocephalus. [17-19]

Although some believe that congenital aqueduct stenosis should not be treated with ETV because of the insufficiently developed subarachnoid space others have successfully treated congenital hydrocephalus with this procedure. Age does not present a contraindication for ETV, nor does it increase the perioperative risk. The success of ETV is determined by the cause of the hydrocephalus. Fritsch MJ et. al. found that Infants with obstructive hydrocephalus had a 100% success rate.[20]

Many factors have contributed to the attractiveness and popularity of ETV. This treatment is minimally invasive and so patients need short hospital stay. Improvement of symptoms of hydrocephalus (seizure, headache, vomiting, visual dimness, ataxia) occurs immediately after ETV. However many complications of ETV has been reported in literature. Common intraoperative complications include bleeding from the choroid plexus, ventricular wall, ventriculostomy, or interpeduncular cistern. Injury to basilar artery complex is most dangerous and reported in some study. In our series we did not encounter procedure related complications except some hemorrhage which we managed efficiently by warm saline irrigation. Injury to the fornix leads to postoperative cognitive problems. Injury can also occur to the caudate, the thalamus, or the thalamostriate venous complex, especially if the endoscope is blindly over inserted into the ventricle. Excessive CSF loss during the procedure may cause subdural hemorrhage. Intraparenchymal bleeding and infection are less common complications of ETV [3]. Postoperative CSF leakage through entering burr hole may occur. The mortality rate has been reported as high as 1% [8, 21].

A postoperative follow up CT scan or MRI is required usually after two months of ETV to see the ventricular size although in some adult patients with chronic compensated hydrocephalus, the ventricle size may decrease only minimally compared with its preoperative size [22].

The overall shunt-free success rate of ETV has been reported to be between 50 and 90%. Fritsch MJ, et al. reported overall success rate around 75% [20]. O'Brien DF, et. al. reported long-term success rate of 68% for single ETV as a treatment for obstructive hydrocephalus secondary to midline tumors [23]. Beems and Grotenhuis 2 reported a complication rate of 7.7% and a success rate of 76% in a large series of 339 pediatric patients. Hopf, et al.[24] reported that their success rate with ETV was 76% and concluded that ETV is most successful in occlusive hydrocephalus (series of adult and pediatric patients). Gangemi, et al.[8] presented follow-up results in 125 adult and pediatric patients who underwent ETV for obstructive hydrocephalus. They reported overall shunt independence rates of 86.4%. High success rate of ETV in patients with chronic compensated hydrocephalus and tectal plate glioma, is reported by some other study. Feng H, Huang G et. al. found that the aqueductal stenosis subgroup had the highest proportion of functioning ETV (89%) in a comparison of results 1 year after ETV [1]. Canadian pediatric neurosurgery study group have found 1 and 5-year success rates of ETV is 65 and 52%, respectively in a 368 ETV cases 22% of whose had been previously shunted [25]. ETV works well for post infectious hydrocephalus. Success rate for ETVs in cases involving a mechanical shunt malfunction alone is 67% compared with 79% in those cases involving an infected shunt [20]. Patients with a history of intraventricular hemorrhage (IVH) and meningitis as a cause for hydrocephalus had a poor rate of success after the ETV. With regards to "congenital" hydrocephalus (occurring at or close to birth) due to aqueductal stenosis, several authors have reported poor outcomes when treating the condition with third ventriculostomies postulating that there had been a congenital failure of the normal fluid pathways outside of the brain to develop. An Australian physician, on the other hand, favors an attempt to treat the condition with a third ventriculostomy reporting a 60% success rate, a rate of success identical to that of his late onset obstructive hydrocephalics treated with third ventriculostomies. Some authors suggested that success of ETV is aetiology, not age dependent. Infants with obstructive hydrocephalus had a 100% success rate [20].

In our series, 50% of the patients had congenital AS, and of this subgroup 75% had not received a shunt previously and 25% had malfunctioning shunt. 87.5% patients had a successful outcome after an ETV and did not require shunt placement. Previously shunted patients (25%) became shunt free after ETV. One patient (12.5%) need placement of VP shunt due to ETV failure. In other cases ETV was successful except two patients who were excluded from the follow-up analysis due to rapid deterioration of their condition from tumor progression and one young patient of 5 years old having posterior fossa tumor with hydrocephalus died on 4th postoperative day. Three months after ETV an overall clinical improvement was observed in 12 (92 %) of 13 patients.

More than 95% of failures were evident within one month of the ETV. Seventy-five percent of ETV failures occur within 6 months after surgery. The time to failure after the procedure was a mean of 3.4 months (median 2 months, range 0-8 months) [1]. The risk of failure increases with intracerebral infection, likely because of obliteration of cerebrospinal fluid pathways. The group with the single highest failure rate was that of patients with non-post infectious hydrocephalus and a large IVth ventricle. In this series ETV is failed in one patient (7.7%) and the time to failure was 25 days after the procedure [20,26].

Conclusion

Endoscopic third ventriculostomy is a safe, effective, and durable means of surgical option in cases of obstructive hydrocephalus that is caused by aqueductal stenosis and space-occupying lesions. Successful ETV can lead to a reduction in the shunted population. ETV also works well for post infectious hydrocephalus and in mechanical shunt malfunction. Most ETV failures occur within six months after surgery. Initial successful ETV may remain at risk of reclosure of the stroma (fenestration), and so regular follow-up care is needed. Finally, to do this sophisticated surgery a full endoscopic set up and competent neuroendoscopic surgical team is mandatory.

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