Endoscopic third ventriculostomy in secondary hydrocephalus

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Abstract

Introduction:

Since the introduction of neuro endoscope in the last century, it was the mainstay treatment of hydrocephalus secondary to third ventricular cysts and tumors as craniopharyngiomas, pineal body tumors, and posterior fossa tumors. Preoperative MRI & MRA brain are mandatory to know the course of the posterior communicating arteries and to know the presence or absence of Liliequest membrane.

Proper case selection and post-operative care including monitoring of ICP are crucial to reduce the hazardous complications after the procedure. The presentation in pediatric patients is different to manifestations in the adult. While visual defect and altered mental state were the main complaints in adults, children may manifest with repeated seizures and repeated vomiting.

Our aim of the study is to report our experience in the cases with secondary hydrocephalus that are treated by ETV (endoscopic third ventriculostomy).

Patients and method:

A prospective randomized study was conducted to thirty-two patients who have secondary hydrocephalus. They were 18 males and 14 females with age range from 5 to 52 years. They were collected from January 2011 to December 2013. All of them were subjected to brain CT and MRI to confirm the diagnosis and to detect the critical anatomical landmarks before surgery.

Preoperative investigations were carried out including CBC, prothrombin time and concentration. Surgical fitness was done for them. Patients were classified into two main groups according to the age at time of presentation. Group A: childhood group from age 5 to 18 years, Group B: Adult group (above 18 years). They are followed for one year after the procedure.

Results:

The mean age was 37.3 ± 21.4 years with male predominance. Twenty-four patients (75%) improved significantly postoperatively. Five patients (15.6%) required second revision of the ETV, Two of those five showed failure of ETV due to the closure of the subarachnoid space and VP shunt was applied. One case showed memory disorders and another case showed postoperative CSF leak. Another case (3.2%) died 5 days after the operation due to intraventricular hemorrhage.

Conclusion:

The results were better in pediatric patients in comparison to the adult group. Early diagnosis, good selection of the patients and surgeons' experience play a fundamental role in the prognosis of those patients. Endoscopic third ventriculostomy aids a step in preparation for tumor excision.

Keywords:

IVH (intraventricular hemorrhage) – CSF (Cerebrospinal fluid) – ETV (Endoscopic third ventriculostomy) – VP shunt: (Ventriculoperitoneal shunt) –CPA (Cerebello- Pontine angle).

Introduction:

Endoscopic interventions had occupied the place of the traditional operations in treating different neurosurgical problems (1-3). Endoscopic third ventriculostomy nowadays is the cornerstone management of the secondary hydrocephalus to different lesions (4,5). Although the results of ETV in post-hemorrhagic and post-infective hydrocephalus is disappointing, the outcome in hydrocephalus secondary to intracranial tumors is promising especially in youngs (6).

Regarding history, ETV was firstly carried out in 1923 by William Mixter, he utilized the urethroscopy in treating obstructive hydrocephalus in a child (7). A further amendment was done by Tracy J. Putnam to coagulate the choroid plexus. The introduction of the shunt system caused delay in the development of ETV technique for the following three decades (8).

Proper patient selection and advanced imaging gives better results of ETV, which leads to a decline in figures of shunts placement. The best prognosis is achieved with obstructive hydrocephalus with preserved subarachnoid space, especially in pediatrics (9).

Our aim in this study is to evaluate the results of ETV to hydrocephalus secondary to brain tumors, to detect both morbidity and mortality and to detect the prognostic factors for improvement.

Patients and method:

Over 3 years (from January 2011 to December 2013), a prospective study was carried out. Thirty-two patients with secondary hydrocephalus were involved in the study after a written confirmed consent taken from the patients or their parents. All of them were diagnosed with a CT brain. MRI brain was done to all patients. A full history was taken, full clinical and radiological information were recorded. Complete general and neurological examination were done. MRI with sagittal and coronal cuts data including the size of the lateral and third ventricle, the distance between clivus and the basilar artery were gathered. Patient selection depends on these data.

Operative technique: The approach depends on the demonstration of (Kocher's point) 2.5 cm lateral to the midline and 1 cm anterior to coronal suture. This is the trajectory of choice to the floor of the third ventricle. Under general anesthesia, with the supine position of the patient, the head is slightly flexed 15 degrees and fixed with three points Mayfield. A burr hole was done in the Kocher's point with coagulation of the dura. Karl-Storz rigid endoscopy with zero degrees lens after white balance on the monitor with 35 mm and 65 mm sheath was used. The Cushing tube was used to measure the CSF pressure then the sheath was applied with the trocar using the same trajectory. Proceeding downward to the foramen of Monroe following the choroid plexus descending to the third ventricle united with the thalamostriate vein in its way to unite the septal vein. Opening the floor of the third ventricle between mammillary bodies and the infundibular recess using the forceps (Figure 10), dilatation was carried out using French Fogarty catheter size 3. Enough floor opening was ensured by free CSF flow and visible pulsation of arachnoid membranes transmitted from basilar artery. Some bleeding may occur which was overcom by repeated irrigation using Ringer lactate.

Postoperative CT brain was done for all patients after 2 days, 1 month and six months. Results were evaluated by clinical and radiological follow-up. The clinical improvement included amelioration of the conscious level, improvement of manifestations of increased intracranial tension and improvement in gait and sphincteric functions. While the radiological improvement included a decline in the width of the lateral and third ventricles, the disappearance of periventricular edema and reappearance of normal sulci.

Inclusion criteria:

1- Obstructive hydrocephalus secondary to brain tumors (CPA, brain stem tumors and third ventricular tumors).
2- Radiological signs of increased intracranial tension including periventricular edema and absence of sulci and gyri.

Exclusion criteria:

1- Communicating hydrocephalus.
2- Non-communicating hydrocephalus secondary to lesions other than tumors (intraventricular hemorrhage, post infection or idiopathic aqueductal stenosis).
3- Congenital hydrocephalus.

Results:

Thirty-two patients with secondary hydrocephalus to posterior fossa tumors were involved in the study. The clinical symptoms of these patients were summarized in table 1.

Table 1: Clinical symptoms in candidate patients

Type of symptoms	Number of patients
Symptoms of intracranial hypertension	32
Disturbed conscious level	18
Ataxia	20
Urine incontinence	9
Bulbar manifestations	12
Cranial nerve palsy	18
Hemiparesis	8
Decreased visual acuity	11

In about one fourth of the patients (8 patients), CT brain showed periventricular edema. Ten patients had CPA tumors causing secondary hydrocephalus, while eight patients had third ventricular tumors (Table 2).

Table (2): Causes of secondary hydrocephalus

Cause of hydrocephalus	Number of patients
Cerebellopontine angle tumors	10
Tumor of posterior portion of the third ventricle	8
Cerebellar tumors	7
Brain stem lesion	7
Total	32

Clinical improvement occurred in 24 patients (75%), while radiological improvement with reduction of the width of the ventricular system was achieved in 17 patients (53%). Manifestations of increased intracranial tension relieved in the early postoperative period with marked betterment in both cognitive and sphincteric manifestations. Regarding the causative tumors, we fenestrated third ventricular cyst and excise the third ventricular tumors in the same session, took a biopsy from the brain stem lesion while we prepared patients for CPA tumors for excision. There was non-significant relation between the cause of hydrocephalus and clinical improvement (table 3).

In 5 patients there was a failure of the ETV due to re-closure of the arachnoid membranes that required repeated ETV. Three of them were successful in the second time, while the other two cases needed VP shunt as the manifestations of increased intracranial tension recurred, Figure (1).

In one case (3.2%) there were memory problems may be due to forniceal injury. One case had postoperative CSF leak that required wound re-suturing. One patient died on the third postoperative day due to extensive intraventricular hemorrhage even with use of external drain, the patient did not improve.

Table (3): clinical improvement according to the cause

Cause of hydrocephalus	Clinical improvement	No clinical improvement	P value
Cerebellopontine angle tumors	7(70%)	3(30%)	1.000* (NS)
Tumor of posterior portion of the third ventricle	6(75%)	2(25%)	1.000 (NS)
Cerebellar tumors	6(85.7%)	1(14.3%)	0.805* (NS)
Brain stem lesion	5(71.4%)	2(28.6%)	0.805* (NS)
Total	24(75%)	8(25%)	

* Fisher exact test was used instead of Chi square test

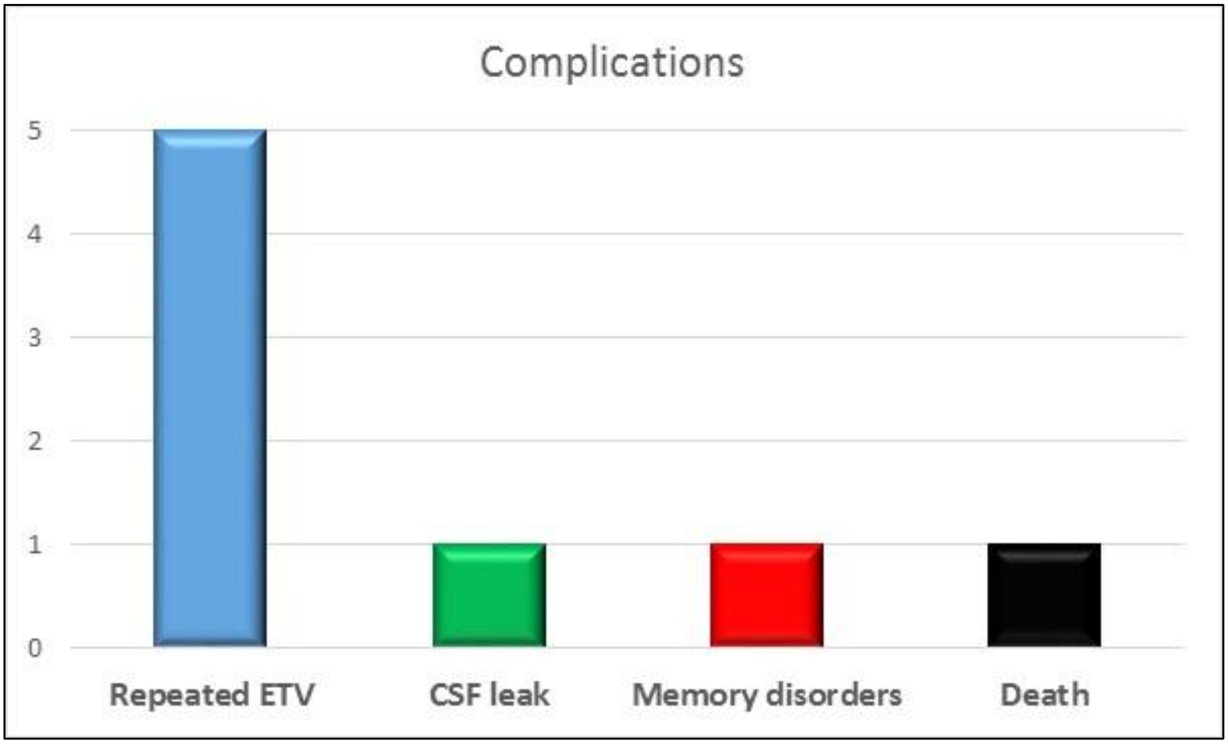

Figure (1): Complications after ETV

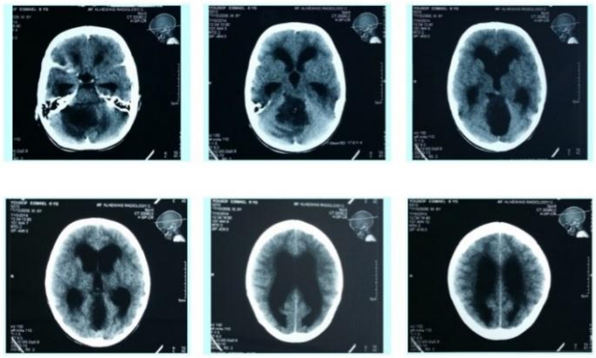

Figure (2): Preoperative CT brain shows a hydrocephalus secondary to cerebellar tumor.

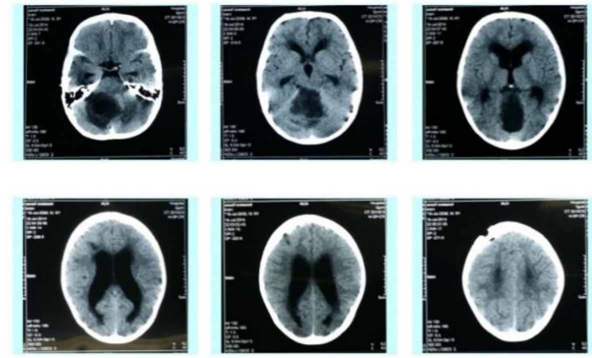

Figure (3): Postoperative CT to the same patient after ETV.

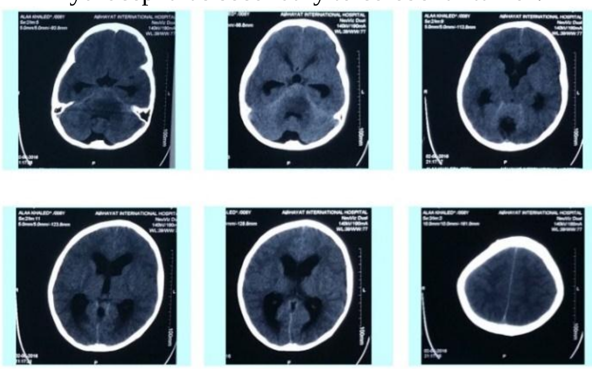

Figure (4): CT brain Shows obstructive hydrocephalus secondary to brain stem lesion

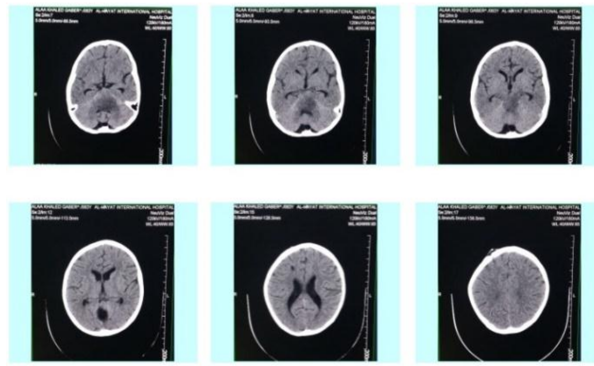

Figure (5): shows postoperative CT to the same patient after ETV

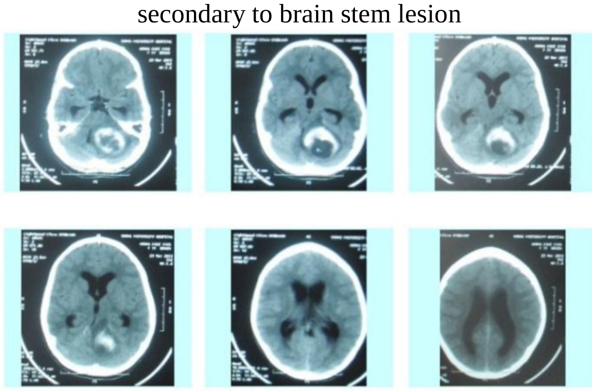

Figure (6): preoperative CT brain shows hydrocephalus secondary to CPA tumor

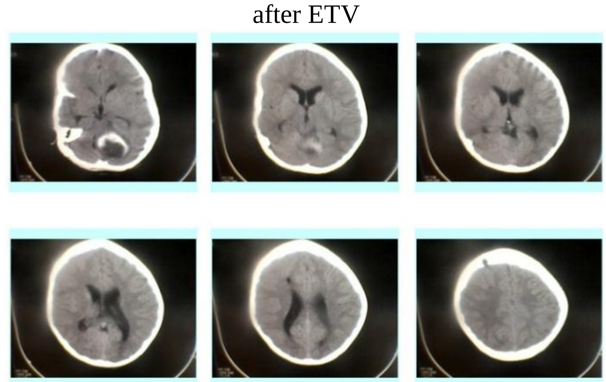

Figure (7): postoperative Ct brain of the same patient after ETV.

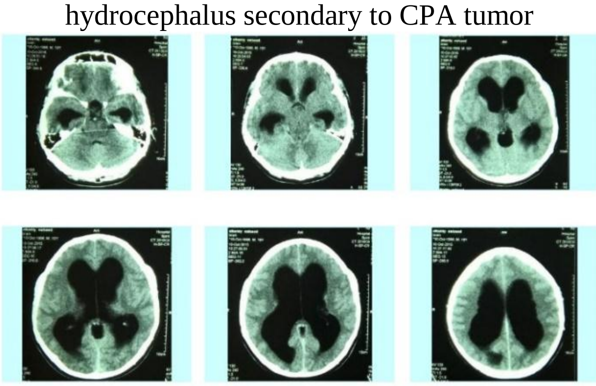

Figure (8): Ct brain shows a hydrocephalus secondary to third ventricular tumor.

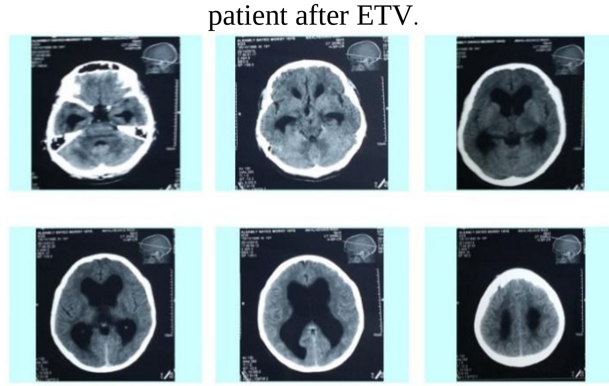

Figure (9): shows postoperative CT brain to the same patient after ETV

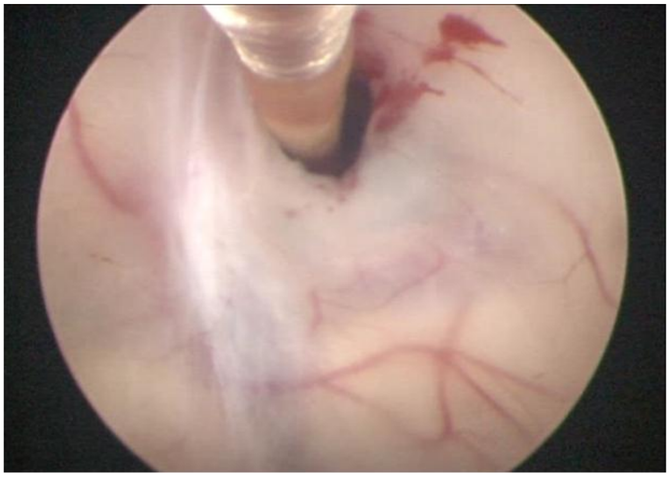

Figure (10): opening the floor of the third ventricle

Discussion:

Endoscopic surgeries are becoming widely used as they carry more advantages than the traditional shunts. They are more physiological with avoidance of all complications of the shunts. Our target in endoscopic ETV is to divert CSF optimally and safely.

In our study, we selected patients with hydrocephalus secondary to brain tumors. The mean age was 37.3 ± 21.4 years with male predominance 56.2% (n = 18) which is comparable to other studies (10). Childhood group with 20 cases (62.5%) was larger than the adult group with 12 cases (37.5%). In our study, the results were more favorable in 90% of the childhood group (n = 18) than the adult group 50% (n = 6) which is similar to some authors (9). The mean period of follow-up was 1 year. Preoperative evaluation by radiological tools is crucial to ensure patency of the subarachnoid space. This selection was in line with other studies (10,11).

MRI brain is mandatory for patients selected for ETV with measuring the width of the third ventricle. The minimal allowed width of the third ventricle is 1 cm. The sagittal plane of MRI scans detects the distance between the basilar tip and the infundibular process. In our study, we used the rigid endoscopy; while other studies, the fiberoptic endoscopy was the tool of choice due to its smaller diameter (12). In comparison to our study which depended on direct vision, another study carried out stereotactic ETV under fluoroscopy (13). However, direct vision reduces the risk of direct nervous and vascular injuries. Navigation system was used in other systems (14).

According to literature, if the floor of the third ventricle is thick, dark and rigid, discontinuation of the procedure and shifting to shunt is the best choice (15). However, in our study, all cases had the thin bluish transparent floor. The optimum tool to perform ETV is Fogarty catheter while using diathermy and sharp instruments should be used cautiously. Another study used the laser beam to perforate the floor of the third ventricle. To avoid basilar artery injury, doppler microprobe could be used prior to ETV. The perforation should involve all layers of the floor and should be at least 5 mm width to prevent reclosure of the ventriculostomy(16).

Regarding prognosis, no sharp prognostic factors for the ETV success, however, there are some clinical and radiological data that may help in decision making. In our study, young patients, an obstructive hydrocephalus secondary to brain stem tumors, thin bluish membrane, and post- procedural pulsations of the arachnoid membrane had the best favorable outcome. In the literature, the patient’s age, the causative factor, and previously inserted shunt were the most determinant factors (16).

In some studies with long follow-up period, they reported ETV failure. The mean time of the second ETV is six to eight months post ETV (17). Authors classified the causes of failure to early (within 3 months) or late (after 3 months). Early ETV failure is due to the insufficient opening in the floor of the third ventricle or due to CSF malabsorption. While the late failure is due to re-closure of the fenestration, and in this case, repeating ETV is considered. However, in children, VP shunt is preferred (18).

Conclusion:

ETV is the treatment of choice in cases of hydrocephalus secondary to brain tumors specially brain stem neoplasms. The success rate was 75% of patients. However, complications are reported and the shifting to shunt system may occur. Young patients would get benefit more than old patients. The highly valuable benefit of avoiding shunt systems with all its complications in obstructive hydrocephalus deserves trying with ETV at the first place. Furthermore, image guidance may help to find the ideal entry point and avoid fornix contusion, but it is hard to believe that it has an impact on the effectiveness of ETV.

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Disclosure of interest:

The authors declare that they have no conflicts of interest concerning this article

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الملخص العربي

استعمال المنظار الجراحي في حالات الاستسقاء الثانوي بالمخ

مقدمة البحث:

منذ تقديم مناظير المخ في بدايات القرن العشرين فقد صارت هي الاداة الرئيسية لعلاج حالات الاستسقاء المخي الثانوي الناتج عن اورام بطينات المخ وأورام جذع المخ وأورام المخيخ. ولكي يتم اختيار المريض بشكل جيد فان عمل اشعة رنين مغناطيسي على المخ وشرايين المخ اصبح مهما لمعرفة طرق مسارات الشرايين كما أنه يساعدنا في اتخاذ القرار السليم في المكان المحدد لاجراء العملية. إن الاختيار الصحيح للمريض قبل العملية ومتابعته بشكل دقيق بعد اجراء العملية ضروري لنجاح التدخل الجراحي وسلامة المريض.

طريقة البحث:

تم اجراء البحث على ٣٢ مريض من الاطفال والبالغين كان أكثرهم من الذكور (١٨ مريض) و١٤ من الاناث على مدى ثلاث سنوات ما بين يناير ٢٠١١ وديسمبر ٢٠١٣. تم اجراء الفحوصات اللازمة قبل اجراء العملية مثل صورة الدم ونسبة السيولة بالدم كما أنه تم عمل أشعة الرنين المغناطيسي للمخ.

نتائج البحث:

كان المتوسط العمري للمرضى ٣٧.٣ سنة وكان أغلبهم من الذكور بنسبة ٦٢.٥%. تم التحسن بشكل كامل في ٢٤ مريض بنسبة ٧٥%. خمس مرضى احتاجوا لاعادة التدخل الجراحي واثنين منهم احتاجوا لتركيب صمام بالمخ لفشل العملية. مريض واحد اشتكى من مشاكل بالذاكرة ومريض اخر عانى من تسريب بالسائل المخي. مريض واحد قد مات في اليوم الخامس بعد اجراء العملية وذلك لحدوث نزيف في بطينات المخ.

ملخص البحث:

النتائج كانت أفضل بشكل عام في الاطفال عنها في البالغين. استخدام منظار المخ مهم في علاج حالات استسقاء المخ ويساعد أيضا في تحضير العملية للمريض المصاب باورام المخ.