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## Endoscopic Third Ventriculostomy: a Surgeon's Experience

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**Introduction:** Endoscopic third ventriculostomy (ETV) is considered an alternative treatment for certain types of hydrocephalus. Depending on patient's age and etiology of hydrocephalus, it carries a success rate of around 90%. However, as in any surgical procedure, inherent risks are present and a risk-benefit analysis must be done prior to selecting patients for this intervention.

**Objective:** To evaluate retrospectively the experience of ETV at the University of Puerto Rico and examine the etiological factors, demographic data and symptoms among the Puerto Rico population. This study represents the data of one neurosurgeon and is the first account of endoscopic third ventriculostomy as a mode of treatment in the Caribbean area.

**Methods:** Retrospective analysis was undertaken of

29 patients treated at the University Pediatric Hospital (UPH) and University District Hospital (UDH) in San Juan was undertaken. Different etiologies of hydrocephalus were identified and managed.

**Results:** The most common indication for ETV was aqueductal stenosis (59%) with male predominance (55%). Also, the most common population treated were adults (72%) and the most common symptom presented were headaches (52%) and gait disturbances (43%).

**Conclusions:** Endoscopic third ventriculostomy is a safe and effective way to treat hydrocephalus and should be considered as first choice of treatment for certain patients with hydrocephalus unless otherwise contraindicated.

*Key words:* Endoscopic, Ventriculostomy, Hydrocephalus

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**H**ydrocephalus is defined as an increase of cerebrospinal fluid (CSF) volume in the intracranial cavity. Historically it has been classified either as non-communicating (obstruction of CSF within the ventricular system) or communicating (obstruction of CSF at the arachnoid granulations or CSF overproduction). Various etiological factors for the development of hydrocephalus have been recognized, such as congenital malformations, tumors, normal pressure hydrocephalus (NPH), idiopathic and hemorrhage (1).

The management of hydrocephalus varies depending on age, cause, recurrence rate and surgeon's decision. Ventriculostomy was first introduced during the early twentieth century and Walter E. Dandy was one of the pioneers in its use for hydrocephalus management (2). It was in 1923 that an urologist, William Mixer, using a uteroscope examined and performed the first documented ETV (3). During the following decades third

ventriculostomy through a small open craniotomy was the main treatment modality prior to the development of shunt systems during the 1950s. However, due to the high mortality and morbidity rates and the availability of less traumatic procedures, it was partially abandoned.

Nonetheless, as time elapsed and the limitations of shunt systems and its complications became evident, and with the advent of breakthrough fiberoptic and lens technology a renewed interest in ETV was undertaken (4). Nowadays, many patients with hydrocephalus may benefit with the use of ETV. Among the indications for ETV we include all of the following: obstructive triventricular hydrocephalus due to aqueductal stenosis, isolated lateral ventricular hydrocephalus, Dandy-Walker malformation, intraventricular hemorrhages, posterior fossa masses, pineal tumors and NPH (5-8).

Various controversies have arisen with the increase use of ETV for the management of hydrocephalus in the pediatric and adult population. Still definite indications or guidelines for the use of ETV have not been defined. In this article we retrospectively analyzed twenty-nine patients treated at UDH and UPH in San Juan, Puerto Rico.

### Patients and Methods

A retrospective study including the time frame between September 2005 and May 2007 was conducted. Twenty nine (29) patients underwent ETV for the treatment of

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hydrocephalus at UPH and UDH in San Juan, Puerto Rico and all were treated by one neurosurgeon. Records were reviewed for age, gender, etiological factors, signs, symptoms, use of external ventricular device (EVD), and post-operative hospital stay. The indication for ETV was based on radiological findings and symptoms.

### Surgical Technique

A free-hand procedure was performed in all patients with general anesthesia. Patients were positioned supine with the head slightly flexed (20°). A burr hole was typically placed immediately in front of the coronal suture and 3 cm or more, dependent on etiology, laterally to the midline. The lateral ventricle was cannulated, then a rigid endoscope was advanced and the ventricle was visualized; under direct vision, the endoscope was passed thorough the ipsilateral foramen of Monro into the third ventricle. Anatomical structures such as the choroid plexus, mamillary bodies, and the infundibular recess were identified prior to perforation of the floor of the third ventricle. Perforation of the floor was performed either bluntly with a 30° endoscope, or with a Fogarty catheter Fr. 3 or 4. Upon perforation the prepontine cistern was entered, and the basilar artery complex and adjacent cranial nerve were visualized.

### Results

The mean age of the population was 36 years. Seventy-two percent (72%) were adults and twenty-eight percent (28%) were pediatric. Fifty-five percent (55%) were male and forty-five percent (45%) were female, table 1.

The commonest sign and symptoms in the adult population were: headache (52%), gait disturbance (43%), altered mental status (29%), vomits and nausea (24%). While in the pediatric population, the most common symptom was increased head circumference (38%), table 1.

The etiological factors for hydrocephalus were: aqueductal stenosis (59%), normal pressure hydrocephalus (17%), tumors (10%) and others (14%), table 1.

Procedure-related complications were 3 % and failure rate was 10%. The complication reported in our series was ventriculitis. Despite the complications, the patients did not fail the management and were treated with antibiotics.

In 15 patients (51.7%), an EVD was placed intra operatively and left for a mean time of 2 days to monitor intracranial pressure. EVD were always closely monitored; none of the patients develop increased intracranial pressure.

The average postoperative hospital stay was 7 days. Twenty-three percent (23%) of the patients had a shunt

system prior to ETV. The average postoperative stay for patients with EVD was nine days compared to 4 days for those without EVD.

**Table 1.**

Characteristics	
Sex	
Male	55%
Female	45%
Age	
Mean	36 yrs
Range	0-81 yrs
Mean Age - Males	36 yrs
Mean Age - Females	54 yrs
Pediatric (0-18 yrs) - Male	28%
Pediatric (0-18 yrs) - Female	0%
Adult (18-85 yrs) - Male	72%
Adult (18-85 yrs) - Female	100%
Signs and Symptoms	
Adults	
Headaches	52%
Gait disturbances	43%
Altered mental status	29%
Pediatrics	
Increased head circumference	38%
Etiology	
Aqueductal stenosis	59%
Normal pressure hydrocephalus	17%
Tumors	10%
Others	14%

### Discussion

The management of hydrocephalus remains a complex scenario for the neurosurgeon. Endoscopic third ventriculostomy has been popularized due to the fact that, if successful, a shunt-free period is guaranteed and a life-long dependency on a ventriculo-peritoneal shunt (VPS) could be avoided. However, it must be clearly stated that ETV success does not guarantee a cure for hydrocephalus; it only benefits the patient in the sense that no shunt is better than a perfect shunt. ETV has been established as a reasonable alternative to VPS and ventriculoatrial shunts (VA) or as treatment for VPS/VA failure. The central dogma that “a shunt is always a shunt” has been disfranchised with the experience with ETV (9-10). The main issue related to ETV is whether if it is a safer and better treatment for patients with hydrocephalus as compared to VPS/VA. When comparing success, special mention should be given to complication rate, success rate and cost-benefit analysis.

Results demonstrate that the most common indication for ETV among our population was tri-ventricular

hydrocephalus secondary to benign aqueductal stenosis. It has been shown in the literature that the treatment of choice for benign isolated aqueductal stenosis is ETV due to its good outcome (11-15). Aqueductal stenosis, due to its inherent nature, represented the ideal situation for the implementation of ETV. In the majority of cases, aqueductal stenosis was caused by a mechanical obstruction within the aqueductal lumen such as membranes or by an extrinsic compression such as a tumor in the tectal plate or the pineal gland (16). Thus, by forming a new CSF communication bypass between the third ventricle and the subarachnoid space normal flow can be restored.

The failure rate for ETV has been cited as between 0% and 36% (17-20). At 10% our failure rate was comparable to the literature. Among factors that have been advocated as possible failure scenarios are: age < 1 yr, pre-existing shunt infection, post-operative infection and tumors (21-26). In our experience, 10% of our patients were 1 yr or less and 10% also had tumors, nevertheless, none developed ETV failure. However, due to the small sample of patients, careful interpretation of results must be advocated.

The actual incidence of complication following ETV remains inconclusive, mainly due to the ambiguity in defining what should be considered an adverse complication. The literature describes a number of complications that were not encountered in our series. Such complications include pituitary stalk and hypothalamic damage that usually presents itself as diabetes insipidus (27-28). Cardiac arrhythmias and respiratory arrest could occur due to hypothalamic irritation and manipulation (29-30). The most feared of these complications is damage to vascular structures such as the basilar artery due to the close proximity in the perforation field (31-32). In general, the rate of complications for neuroendoscopic interventions, particularly ETV, is reported to be between 6% and 20% (33-34). However, it must be stated that, as in any surgical procedure, a steep learning curve exists and experience will determine the threshold for minimum complications. Our morbidity rate remained low at 3% and a mortality rate of 0%. The only complication encountered in our experience was the emergence of postoperative ventriculitis.

ETV also has health care cost ramifications. A cost-analysis study of performing ETV as an alternative to VPS, in a 2-year period with 150 VPS was performed (35). After analysis, 23 patients were deemed candidates for ETV. Eight of these required a total of 29 new operations and 230 extra days in the hospital. Assuming a (shunt-free) rate for ETV of 80%, it was calculated

that nine operations and 74 bed-days per year could be saved using this technique.

## Conclusions

ETV remains a safe procedure which, when performed in patients with certain indications, could help control hydrocephalus. Patients with complicated shunt histories and isolated benign aqueductal stenosis remained the group with the highest success rate and less complications. Even though ETV is mainly used for cases with obstructive hydrocephalus, recent data suggest excellent results in cases with non-obstructive hydrocephalus such as normal pressure hydrocephalus (36). It remains to be proven if and when endoscopic third ventriculostomy will be considered the gold standard for patients with hydrocephalus. ETV, when performed correctly by an experienced operator, is a safe, simple and effective treatment for hydrocephalus. A larger sample and further follow up of current patients is needed for better conclusions about ETV's long term benefit and indication profile for our population.

## Resumen

Introducción: La ventriculostomía endoscópica es considerada como una modalidad de tratamiento alterna para un grupo selecto de hidrocefalias. Dependiendo de la edad del paciente y su etiología esta intervención puede tener un éxito de hasta un 90%. Sin embargo, como cualquier procedimiento quirúrgico conlleva unos riesgos inherentes. De esta manera la selección de los pacientes tiene que ser basada en un análisis exhaustivo de riesgo y beneficio. Objetivo: se realizó una evaluación retrospectiva de la ventriculostomía endoscópica en la Universidad de Puerto Rico y se examinó los factores etiológicos, los síntomas y la información demográfica de los pacientes seleccionados para esta intervención. Este estudio representa la recopilación de datos de un neurocirujano y es la primera recopilación acerca de la ventriculostomía endoscópica como modo de tratamiento para hidrocefalia en el área del Caribe. Resultados: La indicación más común para la ventriculostomía endoscópica fue estenosis del acueducto cerebral (59%), con una predominancia de género hacia el varón (55%) y una mayoría en los adultos (72%). La presentación de síntomas más común fue dolor de cabeza (52%) y disturbios del caminar (43%). Conclusión: La ventriculostomía endoscópica es una manera segura y efectiva de tratar un grupo selectivo de hidrocefalias y debe ser

considerado como la primera línea de tratamiento para un grupo de hidrocefalia, siempre y cuando no existan contraindicaciones para ésta.

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