

A Comparative Study Between Ventriculoperitoneal Shunt and Endoscopic Third Ventriculostomy in the Management of Obstructive Hydrocephalus

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ABSTRACT:

BACKGROUND:

Uncertainty persists on the best treatment for patients with obstructive hydrocephalus: endoscopic third ventriculostomy (ETV) or V-P shunt. Most patients with obstructive hydrocephalus are treated with ventriculo-peritoneal (VP) shunt placement.

OBJECTIVE:

Of this study is to compare between V-P shunt and ETV in the management of obstructive hydrocephalus in relation to the degree of complication.

METHODS:

This is a prospective study of 90 patients with obstructive hydrocephalus of various etiologies operated by V-P shunt or Endoscopic 3rd ventriculostomy in the Department of Neurosurgery in Al-Khdhemia Teaching Hospital, Neurosciences Teaching Hospital and Neurosurgical Teaching Hospital from October 2011 to December 2012. Presenting symptoms and signs, clinical shunt function, operative findings and outcome were recorded.

RESULTS:

Common presenting features were headache, vomiting, irritability and general toxic look of patients. Male to female ratio was 1.14:1. Patients with obstructive hydrocephalus were treated with V-P shunt or with endoscopic third ventriculostomy and followed for 6 months as an average. In patients with V-P shunts, upper end block was a common problem followed by wound dehiscence and valve exposure and other complications such as lower end obstruction, slipped catheter, subdural hematoma, and subcutaneous CSF collection. While in patients with ETV spontaneous closure of the stoma was more frequent than other complications. The complication rate in ETV is lower than that of V-P shunt (30% in V-P shunt and 17% in ETV). However ETV is less successful in patients below 2 years old and in those with normal pressure hydrocephalus.

CONCLUSION:

Endoscopic third ventriculostomy is becoming more popular as an alternative to shunting in the management of obstructive-type hydrocephalus. Obstructive hydrocephalus is the main indication for endoscopic third ventriculostomy. However, in cases where this procedure is indicated, good knowledge of third ventricle anatomy, surgeon preference and experience with endoscopic surgery can yield success rates of up to 80%.

KEYWORDS: obstructive hydrocephalus, ventriculoperitoneal shunt (V-P shunt), endoscopic third ventriculostomy (ETV).

INTRODUCTION:

Hydrocephalus is an abnormal expansion of cavities (ventricles) within the brain caused by the accumulation of CSF⁽¹⁾.

Hydrocephalus, as defined in pathophysiologic terms, may be regarded as an imbalance of CSF formation and absorption of sufficient magnitude to produce a net accumulation of fluid within the cerebral ventricles⁽²⁾.

Hydrocephalus can be classified as communicating and non-communicating hydrocephalus.

1) Communicating hydrocephalus (non-obstructive): caused by lesion that obstruct the subarachnoid space, there is a free flow of fluid out of the ventricles up to the point of obstruction.

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2)Non-communicating hydrocephalus (obstructive):when the ventricles do not communicate through their foramina or aqueducts, CSF backs up and the volume in the ventricle proximal to the blockage increases, e.g obstruction of aquiduct of Sylvius⁽³⁾.

Etiologies of aquiductal stenosis (AqS):

1-A congenital malformation: may be associated with Chiari malformation or neurofibromatosis.

2-Aquired:

-due to inflamation (following hemorrhage or infection)

- neoplasm: especially brain stem astocytomas.

It is unknown why some cases of AqS remain occult, and manifest only in adulthood⁽⁴⁾.

Clinical features of hydrocephalus:

Hydrocephalus causes symptoms and signs by two major mechanism:

- Distortion of normal anatomic relationships between brain structures.
- Increase intracranial pressure.

Signs and symptoms of active hydrocephalus

A- In young children:

Cranium enlarges at a rate more than facial growth, irritability, poor head control,

fontanelle full and bulging, enlargement and engorgement of scalp veins due to reversal of flow from intracerebral sinuses due to increased intracranial pressure, Macewen's sign (cracked pot sound on percussion over dilated ventricles), 6th nerve palsy, setting sun sign (upward gaze palsy, from pressure on region of supra pineal recess), hyper active reflexes, irregular respiration with apneic spells, splaying of cranial sutures (seen on plain skull X-ray), the scalp is often thin and glistening and transillumination of the head is usually positive if the cerebral mantle is less than 1.0 cm in thickness and the patient is under 9 months of age^(2,5).

B- In older children/ adults with rigid cranial vault:

Sudden obstruction of the CSF pathways can be followed within hours by acute dilatation of the ventricles proximal to the blockage. If the cranial sutures are closed, the clinical syndrome is characterized by a rapid and severe rise in intracranial pressure, including: papilloedema, Nausea, vomiting, headache, gait changes, up gaze and/or abducens palsy. Less often, episodes of transient or sustained blindness can occur as a result of transtentorial herniation and entrapment of the posterior cerebral arteries against the free edge

of the tentorium. There is generally a varying degree of decorticate or decerebrate posturing, slowing of the pulse and respirations, and an elevation of the systolic and diastolic pressures. Unless treatment is instituted promptly death ensues^(5,6,7).

Surgical treatment of hydrocephalus:

Goals of therapy: Normal sized ventricles is not the goal of therapy, Goals are optimum neurological function (which usually requires normal intracranial pressure) and a good cosmetic result.

Options include:

1-Choroid plexectomy^(8,9)

2-Third ventriculostomy⁽⁴⁾

3-Shunting: ventriculoperitoneal shunt, ventriculo-atrial shunt, lumboperitoneal, or shunting into various distal projections⁽¹⁰⁾.

Ventriculoperitoneal shunt:

(V-P)shunting is the most popular technique for CSF diversion. It is relatively simple, it is suitable for patients of all ages with hydrocephalus from any cause and complications are easy to manage⁽¹¹⁾. The standard posterior parietal burr hole site is 3 cm from midline and 1 to 2 cm superior to lambdoid suture. Positioning the burr hole slightly too high can be tolerated.

The abdominal incision is a horizontal incision, either just below the rib cage as just lateral to the umbilicus. Abdominal wall is opened in layers until the peritoneum is identified and opened in order to introduce the peritoneal catheter⁽¹²⁾.

Complications can occur in V-P shunt like obstruction most commonly is that of the upper end of the catheter, infection, disconnection at a junction or break at any point, hardware erosion through the skin, intra-ventricular hemorrhage, subdural hematomas or hygroma, over drainage syndrome and other rare complications like hydrocele, tip migration, perforation of (viscus, stomach, bladder...) or migration through the diaphragm, intestinal obstruction, volvulus, intestinal stangulation, CSF ascites and ureter obstruction⁽¹³⁾.

Endoscopic third ventriculostomy (ETV)

The past decade has witnessed the resurgence of endoscopic third ventriculostomy in neurosurgery. The classic indication for ETV is noncommunicating hydrocephalus, in which the patient typically presents with dilated lateral and third ventricles, and a normal fourth ventricle. A coronal burr hole is placed 3 cm lateral to the midline and just anterior to the coronal suture. The burr hole, which is 6 to 10 mm in diameter, is created on the right side. The endoscope is passed

through the sheath and the lateral ventricle is visualized. A Bugbee wire, without electrocoagulation, is used bluntly to puncture the floor of the third ventricle midway between the mammillary bodies and the infundibular recess. Then Fogarty balloon catheter is advanced through the opening in the floor, and inflating it, to widen the newly created aperture^(14,15).

Complications can occur in ETV and the most serious one is basilar artery injury. Although very rare, this can lead to pseudoaneurysm or even death. Injuries that occur during floor puncture are more common. These include damage to the hypothalamus, pons, cerebral peduncle, and third cranial nerve. The most frequent surgical complication in ETV is bleeding, and this usually occurs due to injury of the ependymal vessels or choroid plexus⁽¹⁶⁾.

PATIENTS AND METHODS:

PATIENTS SELECTION:

This is a clinical study conducted at Al-Kadhimia teaching hospital, Neurosciences teaching hospital and Neurosurgical teaching hospital between the October 2011 December 2012.

90 operations (66 V-P shunt and 24 ETV) for various aetiologies were performed. All patients are with obstructive hydrocephalus and in need for shunting were included in this study with no

exclusion. Patients with communicating hydrocephalus were excluded from the study. The patients age range from 2 weeks to 68 years of both sexes, with a mean of 34 years, and from different geographical regions in Iraq and from different occupations. In this prospective study a details

history had been taken from the patient or their family in infant and children. Proper examination of patient were done including general and nervous system examination especially fudoscopic examination, cranial nerves and gait examination. Investigation were performed preoperatively and include, complete blood picture and ESR, blood group and Rh., blood biochemistry, renal function, and ECG to older patients, CSF analysis was done in cases suspected of having infection. Chest X-ray, skull X-ray, brain Ultrasound in some infants, brain CT-scan to all our patients and finding of scanning is analysed according to the size of the lateral ventricle and whether or not the fourth ventricular dilatation (small 4th ventricle in obstructive hydrocephalus), MRI is done in all patients who were arranged for ETV to assess the size of 3rd ventricle and the aqueduct.

Our patients were divided into two groups. First group include 24 patients who were treated by Endoscopic 3rd ventriculostomy. Second group include 66 patients, who were treated by V-P shunt. Both groups received prophylactic antibiotics during induction, and post operatively all patients received the available antibiotics intravenously for one week and oral antibiotics for three days. Stiches removed one week post operatively. The patients were followed during the period of study. Any new events or complaint from patients were recorded. Then all the data were collected according to the data collecting form, analyzed and plotted in tables. Then the results were compared with the literature of the other series.

RESULTS:

Table 1: The age of the patients is ranging between 2 weeks and 68 years old with a mean of 34 years with male predominance with slight male predominance in our study.

		No	%
Age (years)	<1year	16	17.8
	1—4	20	22.2
	5—9	9	10.0
	10—19	10	11.1
	20—29	8	8.9
	30—39	5	5.6
	40—49	10	11.1
	=>50years	12	13.3
Gender	Male	48	53.3
	Female	42	46.7

MANEGMENT OF OBSTRUCTIVE HYDROCEPHALUS

Table 2: The most common cause of obstructive hydrocephalus is primary aqueductal stenosis followed by posterior fossa tumors in our study.

		No	%
Cause	Aq. Stenosis	39	43.3
	Posterior Fossa tumor	32	35.56
	colloid cyst	4	4.4
	Craniopharyngioma	3	3.3
	Intraventricular tumor	3	3.3
	Normal pressure hydro.	2	2.2
	Old IVH	1	1.1
	Pineal body tumor	1	1.1
	Pitutary Tumor	3	3.3
	Suprasellar tumor	2	2.2
	TOTAL	90	100%

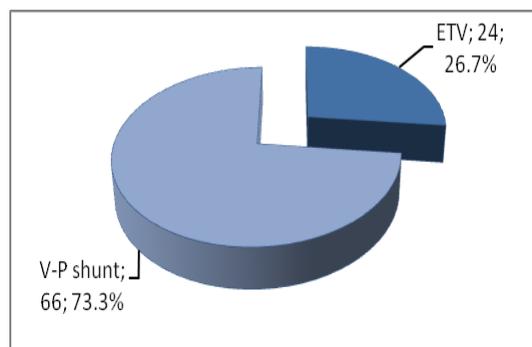


Figure 1: 90 patients were included in our study, in 66 of them V-P shunts were used in treatment of hydrocephalus while 24 of them were treated by E

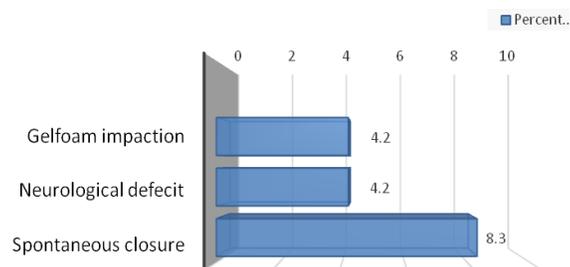


Figure 2: Results of ETV in percentage.

MANEGMENT OF OBSTRUCTIVE HYDROCEPHALUS

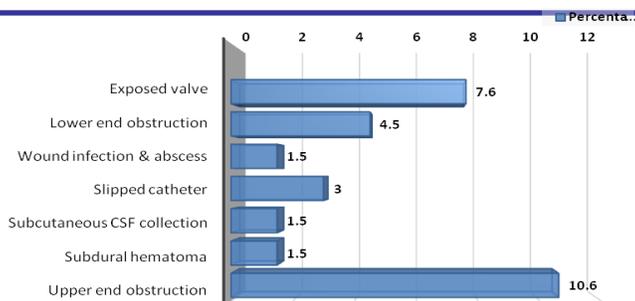


Figure 3: Results of V-P shunt in percentage.

Table 3: Number of patients treated in both procedures and number of the successful operations and the failed ones and their percentages with the resultant P value.

		ETV		V-P shunt		P value
		No	%	No	%	
Result	Succeeded	20	83.3	46	69.7	0.196
	Failed	4	16.7	20	30.3	

Table 4: Number of patients treated in both procedures and in relation to the age with the resultant P value.

		ETV		V-P shunt		P value
		No	%	No	%	
Age (years)	< 1 year	1	4.2	15	22.7	0.020
	1 - 4	6	25.0	14	21.2	
	5 - 9	1	4.2	8	12.1	
	10 - 19	1	4.2	9	13.6	
	20 - 29	3	12.5	5	7.6	
	30 - 39	4	16.7	1	1.5	
	40 - 49	5	20.8	5	7.6	
	=> 50	3	12.5	9	13.6	

DISCUSSION:

In this study, age of the patients ranged from 2 weeks to 68 years with the mean age of 34 years, exhibiting peak incidence below 12 years. There were 53.3% male and 46.7% female patients, with the male to female ratio 1.14:1. Although the true incidence is unknown, the peak age incidence was below 10 years, male are more common than female in a study done by Rubin RC. and Milhorat TH^(2,5).

Aqueductal stenosis is the most common cause of congenital obstructive hydrocephalus which found in 66.7% of patients below 12 years in this study.

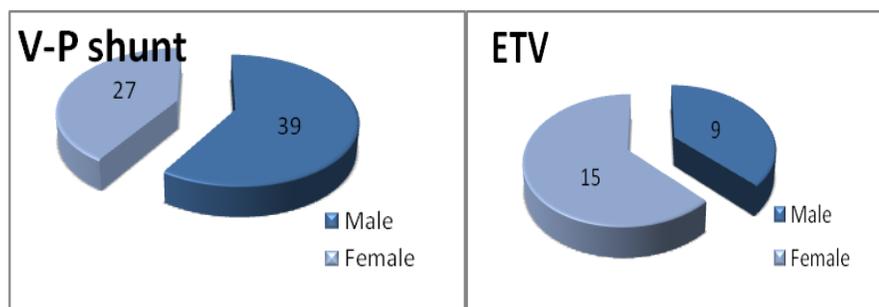
Milhort state that it was found in approximately 2 out of 3 patients with congenital hydrocephalus⁽¹⁷⁾. The most common cause of mass lesion with secondary hydrocephalus are posterior fossa tumors^(3,19). In this study posterior fossa tumor were found in 32 pt. (out of 60 pt. with secondary hydrocephalus) which represent 53.3%.

While 6th cranial nerve palsy was a common signs (50%), slightly below other published series^(2,5,5).. Joseph F. Smith 60% of hydrocephalus patient has cranial nerve palsy⁽¹⁸⁾.

66 patients were treated by V-P shunt with different

sites of burr hole (39 male and 27 female), and 24 patients were treated by Endoscopic 3rd Ventriculostomy (9 male and 15 female) using right

paramedian and in front of the coronal suture, burrhole.



Infection is a common cause of shunt blockage (by pus or inflammatory debris, or by increase protein in CSF) as stated by Micheal scott et al^(10,13,20,21). Distal shunt obstructions are relatively infrequent in ventriculo-peritoneal systems (Holodny AI, George AE, Golomb J, et al)⁽²²⁾. In this study, obstruction to the upper end was 35% and obstruction to the lower end was 15% of complications, which are about the same results found in a study conducted by Dr. Muhammad Usman, (Department of Neurosurgery, Postgraduate Medical Institute, Hospital, Peshawar, Pakistan)⁽²³⁾. However the incidence of shunt infection and exposure is slightly higher in our study (26%) as compared to the previous one (11.1%). The over all revision rate of V-P shunt in our series was 20 patient (30.3%), which is lower than the results of Borghjerg-BM, et al who perform a retrospective study of 884 patient of hydrocephalus of various etiology, the revision rate for ventriculo-peritoneal shunt was 38.5%⁽²⁴⁾. Of those treated with ETV 20 patients(83.3%) were successfully treated as shown by improvement of symptoms in the early post operative period, Fritsch et. al reported an overall success rate of 75%⁽²⁵⁾, Beem's and Grotenhuis reported 76% an overall success rate in a large series⁽²⁵⁾. Fritsch et. al founded that infants with obstructive hydrocephalus had 100% success rate while in this study it is 80%, on the other hand the success rate is independent of age in other study⁽¹⁹⁾.

CONCLUSION:

1. Shunt surgery is an important operation with a lot of complications, and costly to the patient and hospital.
2. Age, sex, and the cause of hydrocephalus were found to have no relation to the development of shunt complication.

3. Upper end obstruction is more frequent complication in V-P shunt than other complications.
4. Endoscopic third ventriculostomy is an alternative procedure in treatment of non-communicating hydrocephalus.
5. The incidence of spontaneous closure of the opening of the floor of the 3rd ventricle is more frequent complication than others.
6. The complications are slightly less in ETV as compared to V-P shunt.
7. The success of ETV procedures depends on the experience and preference of the surgeon and most importantly, the patient who is selected.

RECOMMENDATONS

- 1- With regard to patient selection to undergo ETV it is necessary for all patients to have 3rd ventricle of adequate size (1cm bicoronal diameter).
- 4-During performing ETV the surgeon must explore the prepontine space and open membrane of Lilliequist for successful ETV.

All patients with initially successful ETV should receive follow-up care on a regular basis because patients with successful ETV remain at risk of re-closure of the fenestration, which can lead to a fatal outcome if not promptly recognized and treated.

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