

# Effectiveness of Endoscopic Third Ventriculostomy in the Treatment of Obstructive Hydrocephalus

HAYAT MOHAMMAD KHAN, MUHAMMAD USMAN, MUMTAZ ALI

*Ramzan Hussain, Naeem-ul-Haq*

*Department of Neurosurgery, Lady Reading Hospital, Peshawar – Pakistan*

## ABSTRACT

**Introduction:** Hydrocephalus is an abnormal accumulation of cerebrospinal fluid in the ventricles of the brain that is or has been under high pressure. It results in raised intracranial pressure and compressive effects of vital brain structures that can be lethal if not treated in time. Various treatment options had been tried over the years but ventriculoperitoneal shunt has been the most common treatment option. As ventriculoperitoneal shunt is associated with obstruction, infection and over drainage, endoscopic third ventriculostomy has been used to avoid these complications.

**Objective:** To determine the effectiveness of endoscopic third ventriculostomy in the treatment of obstructive hydrocephalus.

**Material and Methods:** This is a descriptive study that was conducted in the Department of Neurosurgery Lady Reading Hospital Peshawar from October 2010 to October 2011. In this study all patients who underwent endoscopic third ventriculostomy of more than six months were included. Total of 94 patients were included in the study. Effectiveness of the procedure was measured in terms of improvement in clinical condition i.e. GCS, headache, vomiting.

**Results:** Total of 94 patients were included of which 58 were male and 36 were female. Age ranged from one to 70 years, with 50% of the patients were below 10 years of age. Majority of the patients had hydrocephalus due to space occupying lesion making 71.9% of the whole. In 75.5% of the patients the procedure was effective. Effectiveness had no statistically significant difference in different age groups, however procedure is more effective in hydrocephalus due to space occupying lesion.

**Conclusion:** Endoscopic third ventriculostomy is a very effective procedure for the treatment of obstructive hydrocephalus. It is effective irrespective of the age of the patient and cause of obstruction.

**Key words:** Endoscopic third ventriculostomy, obstructive hydrocephalus.

## INTRODUCTION

Hydrocephalus is abnormal accumulation of cerebrospinal fluid in the ventricular system of brain that is or has been under high pressure. It results in dilatation of ventricles, increase intracranial pressure, brain atrophy, neurological impairment and even death.<sup>1,2</sup>

Hydrocephalus is common problem with an estimated prevalence of 1 – 1.5%. It has amazed and challenged clinicians throughout the history of medicine.<sup>3</sup> The management of hydrocephalus needs diversion,

either intracranial or extracranial.<sup>4</sup> The traditional treatment for all kinds of hydrocephalus has been the implantation of ventricular shunt system. However these systems have inherent tendency towards complications such as malfunction and infection.<sup>5</sup> Despite great progress in shunt technology during past decades the treatment of hydrocephalus remain a challenge. Hence there has always been a search for alternative options.<sup>3</sup>

The advent of neuroendoscopy has resulted in the

significant modification of the approach to and surgical treatment of hydrocephalus in the last fifteen years.<sup>6</sup>

Endoscopic third ventriculostomy has been accepted as the procedure of choice for the treatment of obstructed hydrocephalus in adults and children.<sup>7,8</sup> It has become the preferred method to treat obstructive hydrocephalus because of the minimally invasive nature.<sup>9</sup> It is a surgical procedure that allows the cerebrospinal fluid flow directly from the third ventricle to the basal cistern and thus bypassing the aqueduct and the posterior fossa.<sup>4</sup>

Various studies have shown different success rates of endoscopic third ventriculostomy i.e. 42%,<sup>10</sup> 68.4%,<sup>4</sup> 87%.<sup>11</sup>

Endoscopic third ventriculostomy is practiced in developed population as a treatment of choice for obstructive hydrocephalus. Our study also confirmed its effectiveness. This procedure can be used safely and with full confidence for the treatment of obstructive hydrocephalus.

## MATERIAL AND METHODS

This is a descriptive study that was conducted in Department of Neurosurgery Lady Reading Hospital Peshawar from October 2010 to October 2011. In this study all patients who underwent endoscopic third ventriculostomy of more than six months were included. While patients with co-morbid condition and recurrent cases were excluded from the study. Total of 94 patients were included in the study. CT and / or MRI brain was performed in all the cases. An informed consent was taken pre-operatively, explaining the prognosis. The ethical approval was taken from the hospital ethical committee. All the patients received a prophylactic third generation cephalosporin intravenously, Injection Ceftriaxone sodium before the induction of anaesthesia and remained for 24 hours on this and then changed to oral antibiotics. For ETV and septum pellucidotomy, a more sophisticated universal GAAB Endoscopic system by Karl Storz GmbH & Co (Tuttlingen, Germany) was used which included rigid rod, lens optics 0-degree.

Effectiveness of the procedure was measured in terms of improvement in clinical condition i.e. GCS, headache, vomiting.

## RESULTS

A total number of 94 patients with obstructive hydrocephalus (diagnosed by CT scan) were included in this

study. Out of 94 patients presented, there were 58 (61.7%) males and 36 (38.3%) females' patients with male to female ratio of 1.61:1.

The age of patients ranged from 1 to 70 years. In this study the overall mean age was 22.56 years  $\pm$  9.46 SD, minimum age was 1 years and maximum was 70 years. Majority of patients 47 (50%) were in the age range of 1 to 10 years, followed by 16 (17%) patients in age group of 11 – 20 years, 14 (14.9%) patients were in the age range of 21 – 30 years, 10 (10.6%) cases were in the age range of more than 70 years, 07 (7.4%) patients were in the age ranges of 31 – 40 years.

Geographical status of the patients showed that majority 43 (45.8%) belonged to central areas of the province, followed by 29 (30.8%) who belonged to FATA / Afghanistan, 17 (18.1%) from northern areas and 5 (5.3%) patients belonged to southern areas of Khyber Pukhtoonkhwa (Table 1).

In majority of the patients the cause of obstructive hydrocephalus was space occupying lesion i.e. 66 (70.2%) followed by patients with aqueductal stenosis 28 (28.8%). Among the space occupying lesions posterior fossa tumor were the dominant lesion comprising 48 (51.1%) of the patients followed by CP angle 9 (9.6%) and pineal lesion, thalamic lesion and brain-stem lesion comprised 3 (3.2%) (Figure 1).

Out of 94 patients included in the study the procedure was effective in 71 (75.5%) patients.

The procedure was most effective in age range 11-20 years 100% followed by 1 – 10 years 72.3%, 21 – 30 years 71%, > 40 years 70%, 31 – 40 years 57.1% (Table 2).

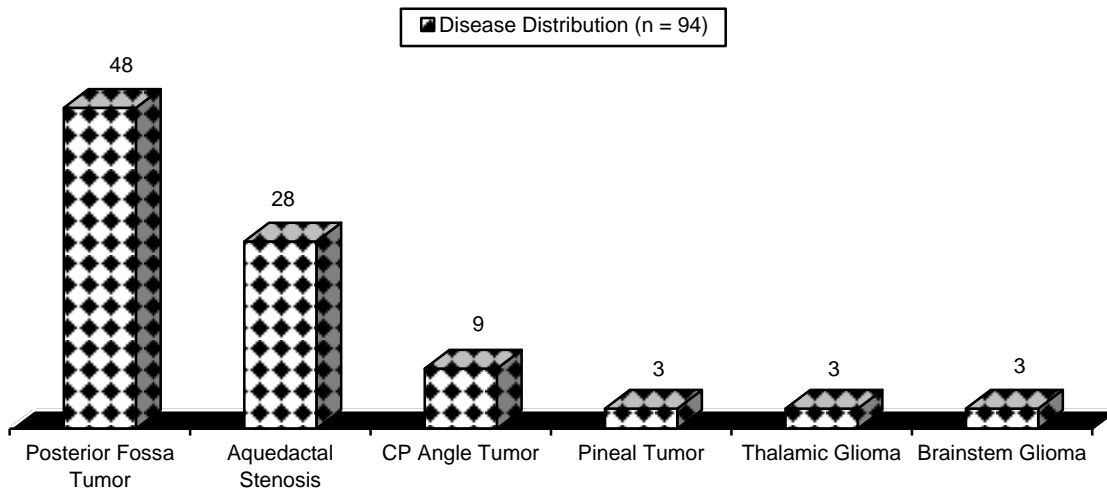
CPA tumor gave the best result 88.95% followed by posterior fossa tumor 81.3%, aqueductal stenosis 71.4%, pineal tumors 66.7% and brain stem and thalamic tumors had 33.3% effectiveness each (Table 3).

## DISCUSSION

Endoscopic third ventriculostomy is a surgical procedure that allows the cerebrospinal fluid to flow directly from the third ventricle to the basal cisterns and sub-arachnoid spaces, thus by-passing the aqueduct and the cerebrospinal fluid pathways of the posterior fossa. Its indications and the interpretation of its significance in different forms of hydrocephalus have changed since the introduction of this technique into neurosurgical practice over the last twenty years. While earlier understanding considered endoscopic third ventriculostomy as a simple internal shunt which created a

**Table 1: Demographic Distribution.**

|       |                                     | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|-------------------------------------|-----------|---------|---------------|--------------------|
| Valid | Peshawar                            | 23        | 24.5    | 24.5          | 24.5               |
|       | Nowshera, Mardan, Charsadda, Swabi  | 20        | 21.3    | 21.3          | 45.7               |
|       | Swat, Dir, Boner, Malakand, Shangla | 17        | 18.1    | 18.1          | 63.8               |
|       | Kohat, Karak, Bannu, DI Khan        | 5         | 5.3     | 5.3           | 69.1               |
|       | Agencies                            | 13        | 13.8    | 13.8          | 83.0               |
|       | Afghanistan                         | 16        | 17.0    | 17.0          | 100.0              |
|       | Total                               | 94        | 100.0   | 100.0         |                    |



**Figure 1: Disease Distribution.**

**Table 2: Effectiveness in Different Age Groups.**

|           |               | Effective |    | Total |
|-----------|---------------|-----------|----|-------|
|           |               | Yes       | No |       |
| Age Range | 1 – 10 years  | 34        | 13 | 47    |
|           | 11 – 20 years | 16        | 0  | 16    |
|           | 21 – 30 years | 10        | 4  | 14    |
|           | 31 – 40 years | 4         | 3  | 7     |
|           | > 40 years    | 7         | 3  | 10    |
|           | Total         | 71        | 23 | 94    |

**Table 3: Effectiveness in Different Diseases.**

|         |                       | Effective |    | Total |
|---------|-----------------------|-----------|----|-------|
|         |                       | Yes       | No |       |
| Disease | Posterior fossa tumor | 39        | 9  | 48    |
|         | Aqueductal Stenosis   | 20        | 8  | 28    |
|         | CP angle tumor        | 8         | 1  | 9     |
|         | Pineal tumor          | 2         | 1  | 3     |
|         | Thalamic glioma       | 1         | 2  | 3     |
|         | Brain stem glioma     | 1         | 2  | 3     |
|         | Total                 | 71        | 23 | 94    |

cerebrospinal fluid diversion requiring patent sub-arachnoid spaces and adequate resorption to ensure benefit to the patient, recent successful applications in forms of so-called non-obstructive hydrocephalus (i.e. post-infection and hemorrhage), demand new interpretations for the mechanisms by which this procedure works.

Endoscopic third ventriculostomy has been established as a safe treatment for obstructive hydrocephalus in selected patients, with fewer overall complications than shunt insertion. The most common problems for endoscopic third ventriculostomy are poor intra-operative vision because of technique (blood leaks), cerebrospinal fluid leaks, subdural fluid collection, ventriculitis or meningitis. Some patients fail to improve and a range of studies has demonstrated variable success rates of 50 – 90%.

In addition, there are many serious, but less common complications such as herniation, arrhythmia, and injury to brain structures especially important structures in the third ventricle, haemorrhage, ischaemic stroke, and infections. Of upmost concern is sudden death, which may occur in acute as well as in the later follow-up stages, e.g. late death after sudden closure of stoma after successful procedure.

Previously shunted patients have been treated with endoscopic third ventriculostomy after shunt malfunction, and a proportion (38–84%) become shunt free as a result, with variable complication rates. Shunt-related over drainage can be successfully treated with endoscopic third ventriculostomy followed by removal of the shunt. Nowadays, the long – held dogma 'once a shunt always a shunt' is definitely no longer valid.

Endoscopic third ventriculostomy has become the treatment of choice for the treatment of obstructive hydrocephalus. It has changed neurosurgical treatment in many ways.<sup>10-13</sup> Different opinions exist about the effectiveness of endoscopic third ventriculostomy. Most authors consider clinical improvement as criteria for obstructive hydrocephalus. In our study improvement in conscious level has been considered as criteria for effectiveness of endoscopic third ventriculostomy.

Effectiveness of endoscopic third ventriculostomy ranges from 51% to 100%<sup>14</sup>, however most studies have shown effectiveness ranges from 65 – 85% overall. In our study the overall effectiveness is 75.5% which is comparable to most international studies. Brohi et al<sup>14</sup> showed 68% effectiveness which is slightly lower than our study but no statistically significant difference exist. Long follow up period is probably the reason for slightly lower success rate in series

of Brohi et al. Other studies like Sufianove et al<sup>15</sup> resulted 71.4% effectiveness which is much closer to overall effectiveness in our study.

Buxton et al, Gagne et al<sup>16</sup>, Pastrana et al<sup>17</sup> gave 80 – 90% success rate in their studies. While others like Michel et al<sup>6</sup> described 83% effectiveness however their studies contained only adults that is why has got slightly higher success rate than our studies.

Effectiveness of endoscopic third ventriculostomy varies with the cause of hydrocephalus. Overall space occupying lesion has 77.27% effectiveness according to our study which is comparable with Jinkenson et al.<sup>18</sup> However in Jinkenson et al<sup>18</sup> endoscopic third ventriculostomy was most effective in patients with aqueductal stenosis i.e. 88%, which is higher than our study. The reason for the difference is that in our study only those patients with impaired conscious level were included which in aqueductal stenosis occur after prolonged period of obstruction when most of the cerebral mental has been atropied and the damage is very difficult to reverse. Even then the difference is not statistically significant.

It shows that endoscopic third ventriculostomy although has different effectiveness in different diseases but overall effective in obstructive hydrocephalus due to any cause. Among the space occupying lesion the best effectiveness were observed in patients with cerebellopontine angle lesion i.e. 88.9% followed by lesion of posterior fossa, which was 81.3%. The lowest success rate observed in our study was for brain stem lesion i.e. 33.6%. This is in contrast with the 85% success rate in the series of Oumar Sako and colleagues<sup>4</sup>. This contradiction is seen because of two reasons. First there were only three patients included in the study who had hydrocephalus due to brain stem lesion. Out of these three patients probably one patient had impaired conscious level due irreversible damage to the brain stem while other had intra operative bleeding that resulted in table abundance of the procedure.

Effectiveness of the procedure also varied with preoperative status of the patient. Patients with poor glassgow coma scale and moribund condition had poor outcome while those with good preoperative status had better results. In our study 95% of the patients with GCS more than ten had effective procedure while in patients with GCS less than ten had 67% effectiveness.

## **CONCLUSION**

Endoscopic third ventriculostomy is a very effective procedure for the treatment of obstructive hydroce-

phalus. Effectiveness varies with age of the patient and cause of hydrocephalus but the difference is not statistically significant. The procedure can be performed safely and adopted in place of other procedure for CSF diversion.

*Address for Correspondence:*

*Dr. Hayat Mohammad Khan*

*Department of Neurosurgery*

*PGMI / Lady Reading Hospital Peshawar – Pakistan*

*Email: dr\_hayatmkhan@yahoo.com*

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