**INTRODUCTION**

The use of cranial endoscope was started in the early 20th century by Dandy and others to treat hydrocephalus by cauterizing the choroid plexus. But due to high morbidity and mortality it was not encouraged. Moreover, in 1950's and 60's CSF shunt was popularized due to its simplicity in use. However, it has not solved all the aspects of the disease maintaining long-term favourable results. To overcome the complications of shunt system; like over or under drainage, shunt infections, shunt dependency and foreign body reaction to the silicon catheter; endoscopic third ventriculostomy is really the solution of these problems and is the preferred option as an alternative to ventriculo-peritoneal and ventriculoatrial shunting. Furthermore, because of high rate of complications after shunt use and further advancement in the endoscopic system, cranial endoscopy showed its safety and superiority in the field of neurosurgery; not only can we treat hydrocephalus but a variety of other procedures can also be performed with safety and excellent results. Endoscopic third ventriculostomy is a surgical procedure that allows the CSF to flow directly from the third ventricle to the basal cistern and subarachnoid spaces thus bypassing the aqueduct and the posterior fossa. The procedure is in fact a ventriculocisternostomy which is considered to be a simple internal shunt, creating CSF diversion providing physiological restoration of CSF pathway and CSF dynamics requiring patent subarachnoid spaces and adequate re-absorption into venous system.

The use of cranial endoscope for performing third ventriculostomy is now universally accepted especially for treating obstructive hydrocephalus. The success rate is variable considering different anatomical, etiological and technical factors and selecting cases of hydrocephalus. Furthermore, ETV success score (Table I) that predicts long-term outcome, has become a standard score of consideration in this group of patients. In experienced hands the procedure is safe with minor complications reported in literature. One must consider 5 Ps, i.e. pre-operative assessment, position during anaesthesia, portal (exposure), procedure and post-operative care.

The purpose of this study was to determine the success rate of endoscopic third ventriculostomy for treating obstructive hydrocephalus.

**METHODOLOGY**

The study was conducted at the Department of Neurosurgery, PGMI, Lady Reading Hospital, Peshawar, from May 2010 to November 2011. The sampling technique was consecutive non-probability sampling. Patients with triventricular hydrocephalus secondary to meningitis were excluded. Endoscopic third ventriculostomy was performed. Success, complications and mortality was noted. Data was analyzed by descriptive statistics using SPSS software version 17.
posterior fossa lesion, brain stem glioma, CP angle tumour, pineal tumour, aqueductal stenosis and patients with blocked shunt previously treated for triventricular hydrocephalus were included. Patients with post-tuberculous meningitis hydrocephalus, post-subarachnoid haemorrhage, hydrocephalus with Dandy Walker syndrome, congenital hydrocephalus, age less than 6 months were excluded.

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.

The success rate and complications in relation to the underlying pathology and age of the patients were analyzed. ETV was considered successful in clinically improved patient with and without radiological improvement. ETV was considered failed in patient who did not improve clinically even with patent stoma. Ventriculoperitoneal shunt was considered in failed cases and no repeat ETV was attempted.

A database was compiled using inpatients and outpatients medical records by an independent observer who was not part of the operative team and/or inpatient care. Data variables included age, gender, number and nature of complications after surgery. Data was analyzed by descriptive statistics using Statistical Package for Social Sciences (SPSS) software version 17.

**RESULTS**

A total of 155 patients with hydrocephalus were subjected to endoscopic procedure. There were 72 males and 83 females with age ranging from 6 months to 60 years and a mean age of 15 years. The causes of hydrocephalus are outlined in Table II. Successful outcome results (Table III) were seen in almost 71% of cases. Complications were seen in 18 (11.61%) patients. These included CSF leak in 8 cases (5.16%); haemiparesis, seizures and meningitis in 2 cases each (1.29%), and subdural hematoma in one case. Three patients (1.93%) died.

**DISCUSSION**

Now-a-days ETV is an alternative treatment to CSF shunt therapy in patients with obstructive hydrocephalus due to its better long-term benefits and infrequent complications as compared to shunt insertion. The procedure is considered to be highly safe and fast in experienced hands. The success rate of the procedure is based on different variables. These variables can be independent; which are not related with the procedure or after procedure like age, sex, race, cause and type of hydrocephalus, history of previous surgery and procedure performed and the dependent variables including ETV failure and complications, which needs additional treatment protocols to treat hydrocephalus.

The success rate varies from 30 – 90% among different studies. The difference in results depend on difference in patient age, cause of hydrocephalus, previous shunt status or other confounders accounted through variance. The pre-operative assessment score predicts the success rate hypothesized by Kulkarni et al., which is based on analysis of 15 published ETV studies. This score predict the failure within 2 months to 6 months, late failure can occur later or rarely. Any patient where ETV remain successful after 6 months is usually cured. Intra-operative

### Table II: Causes of hydrocephalus in patients undergoing endoscopic third ventriculostomy (n = 155).

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posterior fossa tumour</td>
<td>83</td>
<td>53.54</td>
</tr>
<tr>
<td>Aqueductal stenosis</td>
<td>37</td>
<td>23.87</td>
</tr>
<tr>
<td>Already shunted</td>
<td>8</td>
<td>5.16</td>
</tr>
<tr>
<td>Non-tectal tumour</td>
<td>8</td>
<td>5.16</td>
</tr>
<tr>
<td>CP angle tumour</td>
<td>7</td>
<td>4.51</td>
</tr>
<tr>
<td>Tectal tumour</td>
<td>7</td>
<td>4.51</td>
</tr>
<tr>
<td>Posterior fossa abscess</td>
<td>3</td>
<td>1.93</td>
</tr>
<tr>
<td>Posterior fossa hematoma</td>
<td>2</td>
<td>1.29</td>
</tr>
</tbody>
</table>

### Table III: Successful outcome results (n = 155).

<table>
<thead>
<tr>
<th>Clinical / Radiological outcome</th>
<th>Number of patients</th>
<th>Out of total cases (n = 155)</th>
<th>Out of successful cases (n = 110)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical + radiological improvement</td>
<td>92</td>
<td>59.35%</td>
<td>83.63%</td>
</tr>
<tr>
<td>Clinical improvement only</td>
<td>18</td>
<td>11.61%</td>
<td>16.36%</td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Procedure was abandoned in 4 cases, while clinically insignificant bleeding occurred in 11 cases.

Complications were seen in 18 (11.61%) patients. These included CSF leak in 8 cases (5.16%); haemiparesis, seizures and meningitis in 2 cases each (1.29%), and subdural hematoma in one case. Three patients (1.93%) died.
variations like thickness of the floor of the third ventricle and mean stoma size during surgical procedure and postoperative complications like CSF leak, infection, vascular and neuronal injury, seizure and abandoned procedure can contribute in the form of dependent variables for its failure.15-17

Change in the ventricular size is not believed to be immediate and at least 3 months radiological follow-up is needed for the change in the ventricle size. The improvement in the clinical status of the patient has great value rather than change in ventricle size. Radiological change in the ventricle size may be correlated correctly with ETV success.18

Expected postoperative complications also included abandoned procedure. Haemorrhage has both clinical significant and clinically non-significant, CSF leakage, vascular and neuronal injury, infection and seizures, rare complications like sub-dural hygroma/hematoma may contribute.18 All the complications add significantly to morbidity and mortality of the patients. The success rate of ETV, therefore, needs proper clinical and radiological diagnosis and proper selection of patient before including to surgical indication for better outcome.

Patients aged greater than 2 years, aqueductal stenosis and obstructive hydrocephalus due to tectal and nontectal tumours, like brain stem, pineal, posterior fossa and CP angle tumour showed excellent results. Successful results were seen in 110 cases out of 155, with success rate of 70.96%. In those with previous shunt therapy only 5 had a shunt free life. The success rate in aqueductal stenosis with hydrocephalus with previous shunt showed success in 3 cases only. Successful results were obtained in posterior fossa abscess and hematoma in 3 and one case respectively, while clinical failure was noted in one patient due to poor GCS status before surgery.

Mortality was recorded in 3 cases as due to bad chest in one child below one year, significant intraventricular haemorrhage secondary to probably anaesthesia complications was noted in one child and very high uncontrollable blood pressure during procedure and reverse herniation syndrome in one patient with the posterior fossa tumour. These factors were not related with surgical technique.

CSF leakage was noted in 8 cases; only one of those patients developed meningitis and rest of the cases responded well with spinal tap, while one needed VP shunt. Seizure was significantly seen in 14 cases postoperatively, while contralateral hemiparesis seen in 2 cases due to wrong Burr hole position by junior faculty member during procedure. Bleeding, seizures, subdural hygromas, wound infection, CSF leakage, ventriculitis and even table death from ruptured basilar artery has been reported in the literature.19-22 Procedure was abandoned in 3 cases due to haemorrhagic CSF, as a clear CSF media is a prerequisite for endoscopic procedure, with the cloudy/blood stained CSF, endoscopic procedure loses its validity. The complications in this series are somewhat comparable with two international researchers.5,18 All these factors affected the outcome.

There were few limitations of this study. Firstly there was a selection bias, like operating surgeon/team selected those cases more often which would have better post-operative results, based upon pre-operative confounders as mentioned in Table I. Furthermore, these were the results of a single centre; randomized controlled trials from different centres are required to comment on the validity/acceptance of ETV success score.

CONCLUSION

From this study, we can conclude that ETV is an alternative second surgical procedure which is safe, fast and effective for treating obstructive hydrocephalus, peroperative success outcome based on ETV success score. The procedure is successful in 71% of cases. Based on age, cause of hydrocephalus and any history of previous shunt surgery, failure of procedure can be assessed in 3 – 6 months. Postoperative complications can be minimized in experienced hands by considering both dependent and independent variables during procedure.

REFERENCES


