



COMPARATIVE STUDY BETWEEN ENDOSCOPIC THIRD VENTRICULOSTOMY AND VENTRICULO-PERITONEAL SHUNT FOR HYDROCEPHALUS IN CHILDREN BETWEEN SIX TO TWELVE MONTHS OF AGE

Neurosurgery

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ABSTRACT

Introduction - Hydrocephalus can affect humans even before birth. Many causes have been identified and it has been classified accordingly. Treatment involves shunt surgery, which is plagued by complications such as shunt malfunction and infections. Of late endoscopic third ventriculostomy has come into vogue. The success rate of ETV in infants varies from series to series. This study compares the outcomes of Shunt surgery versus ETV in the age group of 6 to 12 months.

Materials and Methods- This was a prospective study carried out at Dr. B.R.A.M. Hospital, Raipur from March 2015 to September 2016. It comprised of 112 cases of children in the age group of 6 months to 1 year having hydrocephalus. They were treated with either shunt or ETV surgery. Results and complications of each of two modalities were compared. They were followed up after surgery upto their discharge & at one month after that.

Results- Of 112 patients, 57 underwent ETV surgery & 55 underwent VP shunt surgery. The incidence of infective complications in ETV was found to be 8% while it was 26% in cases of VP shunts, which was significantly higher. Malfunctioning of VP shunt was seen in 5 patients (9.1%) before discharge & in 9 patients (16.4%) at one month follow up i.e. total 14 patients out of 55 (25.4%) showed sign/ symptoms of shunt malfunction. Total 57 patients underwent ETV for management of hydrocephalus, out of which 5 patients (8.8%), before discharge & 6 patients (10.5%) at one month follow up showed sign/ symptoms of ETV failure i.e. total 11 patients (19.29%). Difference was statistically significant. ETV was found to be significantly better in case of obstructive type of hydrocephalus, especially aqueductal stenosis ($p=0.020$).

Conclusion - In the age group of 6 months to one year, ETV has excellent outcomes and lesser complications for obstructive type of hydrocephalus.

KEYWORDS

ETV, VP shunt, hydrocephalus, ETV failures, VP shunt failures

INTRODUCTION

Hydrocephalus is defined as dilatation of ventricles. It was described by Hippocrates as early as in 466-377 BC, who described symptoms of headache, vomiting, visual disturbance, and diplopia, and explained the illness as a "liquefaction of the brain caused by epileptic seizures"¹ and also referred to this condition as hydrocephalus, which is constructed from the Greek words 'hydro', meaning water and 'kefalé' meaning head. Since then a lot of publications have been made and the pathophysiology of CSF flow has been studied, allowing a scientific approach to classifying this entity on the basis of its aetiology and formulating treatment strategies. The management is mainly surgical. Shunt surgery has been the mainstay of treatment for such patients.

For years, the management of hydrocephalus has been the most common problem encountered in neurosurgical practice. Hydrocephalus is responsible for 40% to 50% of the surgical interventions and clinic visits². The purpose of this study was to evaluate the effectiveness of ETV in the age group of 6 months to year for hydrocephalus, which is a well established modality of treatment in children older than year.

MATERIALS AND METHODS

This was a prospective study carried out from March 2015 to September 2016 (duration 18 months). All patients in the age group of 6-12 months, with hydrocephalus defined by Evan's ratio, were included in the study. Patients with hydrocephalus as sequelae of bacterial meningitis were excluded. Radiological assessments were done with either CT scan or MRI where appropriate. Infants below 6 months of age were also excluded, as lack of subarachnoid space

development and high failure rate of ETV in this group is described in literature. Total of 112 cases of hydrocephalus in infants (6 months to 1 year of age) qualified for inclusion in this study. Fifty-seven patients underwent ETV surgery & 55 underwent VP shunt surgery. The choice of procedure was on surgeon's preference. Post operative surgical outcome and complications were noted. Patients were followed up in OPDs.

RESULTS

Out of 112 cases in the cohort, 71 (68.4%) were males and 41 (36.6%) were females. ETV was done in 57 (50.8%) and VP shunt was done in 55 (49.1%). The mean age of the patients who underwent ETV was 10.12 months and that of patients in the shunt group was 9.98 months. The presenting features were macrocephaly in all, vomiting in 45.5%, irritability in 42.9%, delayed development was present in 80.4%, fullness of fontanelle and engorged scalp veins in 79.9%, sunset sign in 55.4%, 6th nerve palsy in 17%. There were 80 (71.4%) patients with obstructive hydrocephalus and 32 (28.6%) with communicating hydrocephalus. Of the patients who underwent ETV, 40 had obstructive hydrocephalus and 17 communicating. Of the patients who underwent VP shunt, 40 had obstructive hydrocephalus and 15 communicating. At the end of 1 month 42 (73.68%) were relieved of their symptoms in the ETV group and 47 (85.45%) were relieved of symptoms in the VP shunt group. In our study the incidence of infective complications in ETV was found to be 8% while it was 26% in cases of VP shunts, which was significantly higher.

In our study, total 55 patients underwent VP-shunting, out of which 28 (50.9%) in immediate post-operative phase & 30 (54.5%) at one month follow up, were without any complication. But we noted

malfunctioning of VP shunt in 5 patients (9.1%) in post operative period & in 9 patients (16.4%) at one month follow up i.e. total 14 patients out of 55 (25.4%) showed sign/symptoms of shunt malfunction. Later they required revision of shunt.

There were total 57 patients in our study who underwent ETV, out of which 5 patients (8.8%) in post operative period & in 6 patients (10.5%) at one month follow up showed sign/symptoms of ETV failure i.e. total 11 patients (19.29%) required shunting later. Thirty-five out of 40 cases (87.5%) of obstructive type of hydrocephalus in our study responded well to ETV surgery while only 11 out of 17 cases (64.7%) of communicating type of hydrocephalus, who underwent ETV, showed effective results.

		ETV	SHUNT
Total		57(50.8%)	55(49.1%)
Obstructive hydrocephalus		40	40
Communicating hydrocephalus		17	15
Infection		8%	26%
Failure		11(19.29%)	14 (25.45%)
Success	Obstructive hydrocephalus	35/40 (87.5%)	33/40 (82.5%)
	Communicating hydrocephalus	11/17 (64.7%)	8/15 (53.3%)

DISCUSSION

Hydrocephalus was termed so and described by Hippocrates as early as in 466-377 BC¹. It has been functionally classified into obstructive, where there is a block to CSF flow proximal to arachnoid granulations and communicating where the block is at the level of arachnoid granulations³. Infants with hydrocephalus present with large heads, excessive crying and irritability, fullness of fontanelles, engorgement of scalp veins, Macewen's sign (cracked pot sound on percussing over dilated ventricles), 6th nerve palsy, sun-setting sign (upgaze palsy), irregular respiration and widening of sutures³.

Hydrocephalus may develop either due to decreased CSF absorption or due to excessive production. They may be congenital or acquired. Congenital causes include Chiari 2 malformations associated with meningomyelocele, Chiari-type 1 malformations due to 4th ventricular outlet obstruction; primary aqueductal stenosis; secondary aqueductal gliosis or Dandy-Walker malformations. Acquired causes include – Infectious- post meningitis, cysticercosis; post-haemorrhagic; secondary to masses -vascular malformations or neoplastic; or may be associated with spinal tumours^{4,5,6}.

Early hydrocephalus sometimes may be difficult to identify on MRI/CT scan and therefore certain criteria have been laid down. Most commonly used parameters are temporal horns ≥ 2 mm; ratio of distance between frontal horns and inner diameter between tables at this level > 5 ; Evan's ratio, which is the ratio of distance between frontal horns and maximum biparietal diameter > 0.3 ; upward bowing of corpus callosum; ballooning of frontal horn (mickey-mouse sign) and third ventricle; periventricular hypo density on CT or hyperintensity on T2WI on MRI⁷. It should be differentiated from – hydrocephalus ex vacuo, agenesis of corpus callosum, septo-optic dysplasia.

Management of hydrocephalus once established is primarily surgical, medical management being limited to diuretic therapy to buy time for surgery. Surgery should aim at maximizing neurological improvement rather than trying to obtain normal sized ventricles³. Dandy had described Choroid plexectomy in 1918 for communicating hydrocephalus, which was associated with high mortality⁸. Eliminating the obstruction-vascular malformation, neoplasm or cyst, has led to resolution of hydrocephalus. Various shunts- ventriculo-atrial, ventriculo-pleural have been tried, but by far the most commonly performed procedure is ventriculo-peritoneal shunt. Endoscopic third ventriculostomy has found success in relieving certain kinds of hydrocephalus and has the advantage of not leaving any hardware in situ.

The failure rates of ETV have been found to be higher in infants less than 90 days and in those with meningomyelocele⁹. ETV success rates have been found to vary from 20% to 70% in infants less than 1 year of age^{10,11,12,13}. Formation of new arachnoid adhesions and complete closure of ETV stoma has been found in redo surgeries¹⁴.

In our study, 11 patients (19.29%) showed signs of ETV failure and had to be taken up for shunt surgery. Kulkarni et al found lower risk of ETV failure right from the early postoperative period, which became even more favourable with time¹⁵. Mohanty et al reported 6–15% ETV failures due to re-closure of the stoma from gliosis. They reported ETV failure in 13, of which 8 were infants 16. The high rate of re-closure in infants has been ascribed to impeded CSF absorption leading to a greater tendency of new arachnoid membrane formation and growth of gliotic, ependymal, and scar tissue. Stoma size and Lilliequist membrane perforation are also equally important. ETV depends upon pressure difference between third ventricular and subarachnoid spaces, which is present before surgery, but is lost with time as ETV starts functioning and leads to stoma closure and ETV failure. In infants with open fontanelles, gradient development fails to occur between two compartments, leading to low success rate of ETV as compared to adults.

In our study malfunctioning of VP shunt was noted in a total of 14/55 patients (25.4%) and shunt revision was done for them. Tuli et al. (1999) in their prospective cohort study found 45% failure rate for VP shunt¹⁷. De Ribaupierre et al. in their retrospective study of 55 procedures (24 ETV and 31 VP shunt placements) found lower failure rates in the ETV group (26%) as compared to VP shunt group (42%)¹⁸. Garton et al. in their retrospective study found no significant differences in the treatment success rate or in cost-effectiveness parameters between ETV and VP shunt¹⁹.

In our study intraoperative complications were found in 5 of 57 (8.8%) and 2/55 (3.6%) of ETV and VP shunt respectively, mainly bleeding. Erşahin et al have found low intraoperative complication rates in both ETV and VP shunt²⁰.

In our study the incidence of infective complications in ETV group was found to be 8% while it was 26% in VP-shunt group, which was significantly higher. CSF leaks were seen in 6 (10.5%) and none in VP shunt group. All infective complications of ETV were after CSF leak through scalp incision, which developed due to ETV failure. All these patients had very thin cortical mantle to seal the ETV entry site in cortex. Same applies to VP shunts as well, chance of CSF leak or subgaleal collections are more in patients with inadequate cortical mantle. Erşahin et al have also reported a significantly lower infection rates in ETV (1-5%) as compared to VP shunt (1-20%). It was also noted that, infections in children with ETV have a more benign course and tend to subside with antibiotic treatment alone. Drake JM et al have found shunt infections to form the major bulk of shunt complications²¹. Other complications found in Shunt population were intraventricular haemorrhage in 2 (3.6%), seizure in 1 (1.8%), peritonitis in 2 (3.6%), abdominal pseudocyst formation in 1 (1.8%). Patients who underwent VP shunt were found to be having significantly longer duration of hospital stay compared to those who underwent ETV (8.09 Vs 9.81 days). The study by Garton et al did not find any difference in postoperative hospital stay between the two groups¹⁹. In our study, complications were found to be significantly higher in VP shunt subjects, both immediate after surgery & at one month follow up. A study conducted at Netherlands suggested that ETV should be the initial choice, as it has a lower risk profile in infants and postponing shunt implantation while the immune system is still immature²².

In our study ETV was found to be significantly better in case of obstructive type of hydrocephalus especially aqueductal stenosis (p=0.020). Thirty five out of 40 cases (87.5%) of obstructive type of hydrocephalus in our study respond well to ETV, while only 11 out of 17 cases (64.5%) of communicating type of hydrocephalus who underwent ETV surgery show effective results. In our study, there were total 55 cases of VP-shunting out of which 15 were communicating type of hydrocephalus & 40 were obstructive type of hydrocephalus. No significant association was found in outcomes with regards to the two variables (p=0.118). Javadvpour et al. found success in 33% of ETV cases emphasizing on the aetiology as a causative factor²³. Baldauf et al in their study on ETV in children less than 2 years of age with non-communicating hydrocephalus found success to be determined by both age and cause, and found success in 43%. ETV was more effective in patients with aqueductal stenosis²⁴. The study conducted by Warf et al, of ETV outcomes in 153 infants, found overall success rate of 53% including 40% in patients with myelomeningocele and 70% in aqueductal obstruction²⁵.

CONCLUSIONS

In infants between 6 months to one year age, ETV has acceptable chance of success and lower complication rate as compared to VP shunt surgery. ETV works excellent in obstructive type of hydrocephalus. Even in communicating type of hydrocephalus, surgeon should perform ETV to avoid shunt related complications and decision should be individualised. Presently there is a trend towards ETV for management of hydrocephalus. VP shunts should be reserved for cases where ETV is not feasible or has failed.

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