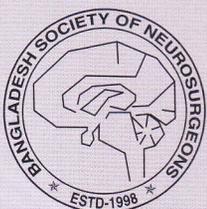


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Comparison between Early Surgical Outcome of Posterior Fossa Midline Tumors Causing Hydrocephalus in Children with and without Preoperative Insertion of Ventriculoperitoneal Shunt (VPS)

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Abstract:

Background: No consensus exists regarding the management of hydrocephalus with posterior fossa tumors before, during or after surgery. This study aims to prove this disparity in literature.

Objectives: The aim of the study was to assess the clinical outcome of surgically treated patients with posterior fossa midline tumors with hydrocephalus with raised intracranial pressure (ICP) which might need cerebrospinal fluid (CSF) diversion procedure by comparing two groups (Group I with preoperative ventriculo peritoneal shunt (VPS) placement and Group II undergoing definite surgery without preoperative VPS) in respect to complications, duration of hospital stay and functional outcome at 10th postoperative day.

Materials and Methods: A multicenter clinical trial comprising 30 patients under age 18 with posterior fossa midline tumor was divided into 2 groups as mentioned above and they underwent definite surgery (tumor resection), group I without pre-operative VPS and group II with VPS placement. The study was conducted over a period of one and half years in various tertiary care centers with well-equipped neurosurgical care. Collected data was processed using SPSS software version 22.0. Statistical analysis was performed using Chi-square and unpaired student t-tests.

Result: In group I, maximum patients were in age groups 6-10 years and 11-15 years (80% combined) as in group II, maximum patients were ≤ 10 years (86.7%). There was statistical significant difference in age group 11-15 years between these two groups (p value 0.03). Headache as a symptom was present in all patients in both groups and cerebellar dysfunction was the most common sign in both groups. There was no statistically significant difference between the 2 groups when symptoms and signs were compared. There were no CSF leak and pseudomeningocele in group II in contrast to meningitis and shunt complications found in only in group II. No statistically significant difference in function outcome of 2 groups as measured by Karnofsky Performance Score (KPS) was found on the 10th post-operative day when divided into 3 categories (0-40, 50-70 and 80-100). Mean duration of hospital stay was 33.93 ± 17.25 days in group I and 53.13 ± 18.50 days in group II (p value 0.75). Group II patient had 4 patients (26.7%) with ependymoma which all required pre-operative VPS placement, while none had in Group I had ependymoma, which proved to be statistically significant (p value 0.03).

Conclusion: We could not conclude from this study that one form of treatment has particular benefit over the other while comparing Group I and Group II whether in terms of pre-operative symptoms and signs, mean duration of hospital stay or functional outcome after definite surgery as measured by Karnofsky Performance Score.

Key Words: Posterior fossa midline tumor, children, pre-operative ventriculoperitoneal shunt, Karnofsky Performance Score.

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Introduction:

Posterior fossa tumors are the most frequent primary neoplasms in children. Tumors in the posterior fossa

are considered critical brain lesions, due to the risks involved like brainstem compression, herniation and death. They constitute 54-70% of childhood brain

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tumors and 15-20% of adult brain tumors. The factors contributing to high morbidity and mortality of these tumors include late presentation when the tumor has locally infiltrated and metastasized outside the cranial cavity and the tumor morphology¹. The majority of posterior fossa tumors in children cause marked intracranial hypertension by causing obstructive hydrocephalus. Removal of the tumor changes the volume parameters and the cerebrospinal fluid distribution². A proportion of patients will require a cerebrospinal fluid (CSF) diversion procedure at some time during the course of their illness. However the management of hydrocephalus in children with resectable posterior fossa tumors is controversial³. The initial enthusiasm for the routine use of a preoperative shunt procedure has gradually waned with the passage of time. There have been various reports in favour of a preoperative shunt and also against its use⁴. To date, no consensus exists regarding the management of hydrocephalus (HCP) in children with posterior fossa tumors before, during or after tumor surgery⁵. The main controversies whether to treat the HCP with endoscopic third ventriculostomy (ETV) or not, before primary tumor resection. Siomin *et al.* 2001, report that when ETV is performed prior to tumor resection in patients with posterior fossa tumors the incidence of postoperative HCP is reduced from 27% to 6%⁶. Persistent or progressive HCP after primary tumor resection and no preoperative cerebrospinal fluid (CSF) diversion is reported to occur in 10%–62% of cases³. In Bangladesh, patients with posterior fossa tumors are usually diagnosed in the later stage with features of raised ICP and rationality in their management can reduce morbidity and mortality. In developing countries, where the disease is usually diagnosed in the later stages and the increase in intracranial pressure is more severe at the time of diagnosis with a very high incidence of hydrocephalus, so preoperative shunting is advisable. In the perspective of our institute, usually patient has to wait for at least 1-1½ month before definitive surgery. During the last two decades, main strategy for the treatment of hydrocephalus caused by a posterior fossa tumor has been primary tumor resection with no routine preoperative or perioperative cerebrospinal fluid diversion procedure. This type of study has been done several years ago but controversy is still remaining whether preoperative CSF diversion surgery is necessary or not⁵. Abdollahzadeh-Hosseini

et al. 2006 said that preoperative shunt is mandatory⁵, but Goel *et al.* 1993⁴ and Bogner *et al.* 2003³ said that tumor surgery should be the first priority. So, this study will be done to compare postoperative outcome in case of posterior fossa midline tumors with obstructive hydrocephalous patients with or without placement of shunt prior to tumor resection. This study will help the surgeons for preoperative counselling, education of the patients and assess postoperative complications and overall cost effectiveness.

Materials and Methods:

The primary objective of the current study is to compare early surgical outcome of posterior fossa midline tumor causing hydrocephalus in children with or without preoperative insertion of ventriculo-peritoneal shunt. The secondary objectives are to compare functional outcome as measured by KPS, post-operative complications and duration of the hospital stay for the same on the 10th post-operative day after definitive surgery. This clinical trial involved two groups. Group I- children with posterior fossa midline tumor without pre-operative VPS placement, followed by definitive surgery (tumor resection) and Group II- children with posterior fossa midline tumor with pre-operative VPS placement, followed by definitive surgery. It is multicenter study, performed from October 2014 to April 2016 in tertiary care centers in Dhaka, Bangladesh with well-equipped neurosurgical care, primarily in Department of Neurosurgery, Bangabandhu Sheikh Mujib Medical University, Dhaka. Ethical clearance was obtained from each institutes ethical committee board. All consecutive children with posterior fossa midline tumor causing obstructive hydrocephalous was admitted in various centers, with sample size of 30 patients. Inclusion criteria: All the patients between 1 to 18 years and both sex groups with the diagnosis of posterior fossa midline tumor causing obstructive hydrocephalus. Exclusion criteria: Patients with previous surgery for posterior fossa midline tumor. Patients with posterior fossa tumor without hydrocephalus. Failure of children's legal guardian to participate in the study or sign written informed consent were excluded. Detailed history, neurological examination was performed and a pre-set questionnaire was designed to collect pertinent data. Following definitive surgery in patients with or without VPS placement, they were followed till 10th postoperative day. In postoperative period all the

patients were evaluated clinically daily for development of features of raised ICP. Postoperatively CT scan was done for evaluation, along with look out for post-operative complications. SPSS software version 22.0 was used to analyze the data. Level of significance

was measured using Chi-square and unpaired T-test. A modified KPS score is mentioned in the appendix section of this article.

Results:

Table-I
Distribution of respondents according to age in groups(n=30)

Age (years)	Group		Total	p value
	Group I (%)	Group II (%)		
≤ 5	3 (20.0)	6 (40.0)	9	0.232
6 - 10	6 (40.0)	7 (46.7)	13	0.713
11 - 15	6 (40.0)	1 (6.7)	7	0.031
>15	0 (0.0)	1 (6.7)	1	0.309
Total	15 (100)	15 (100.0)	30	
Mean ± SD	9.05 ± 3.70	7.40 ± 3.99		0.250
Range (Min – Max)	4.25 – 15.00	3.00 – 17.00		

Unpaired t test was done to measure the level of significance

Table-II
Distribution of respondents according to gender in groups (n=30)

Gender	Group		Total	p value
	Group I (%)	Group II (%)		
Male	8 (53.3)	9 (60.0)	17	0.713
Female	7 (46.7)	6 (40.0)	13	
Total	15 (100)	15 (100.0)	30	

Chi-square test was done to measure the level of significance.

Table-III
Distribution of respondents according to preoperative clinical features in groups (n=30)

Preoperative clinical features	Group		Total	p value
	Group I (%)	Group II (%)		
Headache [n (%)]	15 (100)	15 (100.0)	30	
Vomiting [n (%)]	14 (93.3)	12 (80.0)	26	0.283 [#]
Seizure [n (%)]	0 (0.0)	0 (0.0)	00	
Feature of cerebellar lesion [n(%)]	10 (66.7)	12 (80.0)	22	0.409 [#]
Fundoscopy findings				
Normal [n (%)]	3 (20.0)	1 (6.7)	4	0.283 [#]
Papilloedema [n (%)]	10 (66.7)	8 (53.3)	18	0.456 [#]
Secondary optic atrophy [number (%)]	2 (13.3)	6 (40.0)	8	0.099 [#]
GCS				
14	1 (6.7)	0 (0.0)	1	0.309
15	14 (93.3)	15 (100.0)	29	

[#]Chi-square test was done to measure the level of significance

Table-IV*Distribution of respondents according to postoperative complications in groups (n=30)*

Postoperative complications	Group		Total	p value
	Group I (%)	Group II (%)		
CSF leak	2 (13.3)	0 (0.0)	2	0.143
Pseudomeningocele	3 (20.0)	0 (0.0)	3	0.068
Seizure	1 (6.7)	3 (20.0)	4	0.283
Meningitis	0 (0.0)	1 (6.7)	1	0.309
Shunt complications	0 (0.0)	1 (6.7)	1	0.309
Total	6	5	11	

Chi-square test was done to measure the level of significance

Table-V*Distribution of respondents according to Functional outcome at 10th POD as per modified Karnofsky performance status scale in groups (n=30)*

Functional outcome (modified Karnofsky performance status scale)	Group		Total	p value
	Group I (%)	Group II (%)		
1	1 (6.7)	0 (0.0)	1	0.580
2	5 (33.3)	6 (40.0)	11	
3	9 (60.0)	9 (60.0)	18	
Total	15 (100.0)	15 (100.0)	30	

Unpaired t test was done to measure the level of significance

Table-VI*Distribution of respondents according to histopathological findings in groups (n=30)*

Histopathological findings	Group		Total	p value
	Group I (%)	Group II (%)		
Pilocytic astrocytoma	9 (60.0)	7 (46.7)	16	0.464
Medulloblastoma	4 (26.7)	4 (26.7)	8	1.000
Ependymoma	0 (0.0)	4 (26.7)	4	0.032
Endodermal cyst	1 (6.7)	0 (0.0)	1	0.309
Fibrillary astrocytoma	1 (6.7)	0 (0.0)	1	0.309
Total	15 (100)	15 (100.0)	30	

Chi-square test was done to measure the level of significance

Table-VII*Distribution of respondents according to duration of hospital stay (days) in groups (n=30)*

Duration of hospital stay (days)	Group		p value
	Group I (%)	Group II (%)	
	33.93 ± 17.25	53.13 ± 18.50	0.007

Unpaired t test was done to measure the level of significance

Discussion:

Due-Tonnessen *et al.* 2007 found that significant number of patients was aged between 0.2-19.7 years and the mean age at presentation was 7.3 years⁷. In the study by Gopalakrishnan *et al.* 2012 found the ages ranged from 1.5 to 18 years and mean age 8 years at the time of diagnosis⁸. We have found that (Table I) in group I, maximum patients were in age group 6-10 years and 11-15 years whereas in group II maximum patients were in age group 6-10 years. There was statistically significant difference in age group 11-15 years between these two groups. It indicates that preoperative V-P shunt was less required in 11-15 years age groups. Our findings are similar to the findings of other authors and in close agreement with Santos de Oliveira *et al.* 2008. It can be interpreted that elderly children with preoperative hydrocephalus due to posterior fossa midline tumor have less chance of requirement of V-P shunt. Though most of the literature pointed toward male predominance⁹; Habib and colleagues found in his study that 29 (69%) were males and 13 (31%) were females, with a male to female ratio of 2.2:1¹⁰. Our study (Table II) shows that in both groups, male were predominant. Male to female ratio was 1.14:1 and 1.5:1 in group I and group II respectively. Our study has similarity with the study of Santos de Oliveira *et al.* 2008⁹ and Habib *et al.* 2014¹⁰. A number of clinical features were identified in all patients during their admission in hospital. Among those, nausea, vomiting, headache, abnormal gait and coordination were high in both groups of patients¹¹. Oliveira and his colleagues in 2008 found some typical signs and symptoms in patients namely headaches (89%), ataxia (61%), papilloedema (41%), vomiting (77%), cranial nerve palsy (28%), motor deficits (11%), full anterior fontanelle in infants, and torticollis (27%)⁹. We have found (Table III) headache was present in all patients in both groups. Maximum patients had vomiting in both groups (group I – 93.3%; group II- 80.0%). 66.7% of patients in group I and 80.0% of patients in group II had features of cerebellar lesion. According to fundoscopy findings, 66.7% of patients in group I and 53.3% of patients in group II had papilloedema and 13.3% of patients in group I and 40.0% of patients in group II had secondary optic atrophy. Preoperative clinical features of our study patient have more or less similarity with the studies above. Prusseit and his colleagues in 2009 reviewed studies in patients with VP shunt infections such as

fever (96%), shunt malfunction (50%), local tenderness (25%), vomiting (0%), meningism (21%) and abdominal pain (36%)¹². V-P shunt group suffered added shunt related complications including shunt blockage that was absent in without shunt group that delay the definitive operative procedure. In our study (Table IV), total number of patients was 30. Among them 11 patients developed postoperative complications, 6 in group I and 5 in group II. CSF leak was found in 13.3% of patients, pseudomeningocele was found in 20.0% of patients and seizure was found in 6.7% of patients in group I. There were no CSF leak and pseudomeningocele in group II but there was seizure in 20.0% of patients, meningitis in 6.7% of patients and shunt complications in 6.7% of patients. There was no statistically significant difference between these groups. It is less similar with the study above. Functional outcome at 10th POD as per Karnofsky performance status score in group I and group II (Table V) were observed¹³. In both groups, Karnofsky performance status score was 80-100 in 60.0% of patients¹³. Karnofsky performance status score was 50-70 in 33.3% of and 40.0% of patients in group I and group II respectively. Only one patient in group I had Karnofsky performance status score 0-40. There was no statistically significant difference between these two groups. Such observation was not performed previously in regards to the functional outcome. Santos de Oliveira *et al.* 2008 also found in their study that shunt requirement was highest among ependymoma cases followed by medulloblastoma, lowest was among patients with astrocytomas⁹. Abdollahzadeh-Hosseini *et al.* in 2006 described in their study among 108 patients cerebellar astrocytoma was highest in 48 patients, medulloblastoma was in 39 patients, 14 patients had brainstem glioma, ependymoma was in 12 patients and others were in five patients⁵. Bhatia and his colleagues in 2009 found medulloblastoma in 25 patients, pilocytic astrocytoma was in 24 patients, and only 4 cases had ependymoma¹¹. Different types of tumors were found in our study, among them (Table VI) in group I, maximum 60.0% of patients had pilocytic astrocytoma followed by 26.7%, 6.7% and 6.7% of patients had medulloblastoma, endodermal cyst and fibrillary astrocytoma respectively. In group II, maximum 46.7% of patients had pilocytic astrocytoma followed by 26.7% and 26.7% of patients had medulloblastoma and ependymoma respectively.

There was statistically significant difference in ependymoma subset of patients between these two groups. It means that shunt requirement was highest in ependymoma cases. It was also observed that mean duration of hospital stay following definitive surgery (Table VII) was 17.86 ± 6.82 days in group I and 17.13 ± 5.69 days in group II. There was no statistically significant difference in mean duration of hospital stay between these two groups. The present study has shown that the rate of shunt related complications were higher in VP shunt performed patients. Whereas the rate is low in patients who didn't receive VP shunt. Other study also mentioned about higher complications in VP shunt performed patients¹⁴. Our study is agreement with the study above.

Conclusion:

We could not conclude from this study that one form of treatment has particular benefit over the other while comparing Group I and Group II whether in terms of pre-operative symptoms and signs, mean duration of hospital stay or functional outcome after definite surgery as measured by KPS. Despite no significant difference between children who had posterior fossa midline tumor resected with or without VPS placement in terms of clinical outcome, VPS is strongly recommended by the authors of the current study for below mentioned reasons. In the case of acute hydrocephalus, as a life-saving operation, when definitive procedure is delayed for co-morbid diseases or other reason, when there is persisting raised ICP after tumor removal.

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