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Research Article

Outcome of Midline Posterior Cranial Fossa Tumor Surgery with Preoperative Ventriculo - Peritoneal (V-P) Shunt in Children

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Abstract

Introduction: Pediatric patients with midline posterior cranial fossa tumors present with features of raised intracranial pressure due to development of hydrocephalus. Due to the big size tumour and lack of facility we did Ventriculoperitoneal shunt before definitive surgery for all patients.

Material and Methods: This cross-sectional experimental study was carried out on 55 consecutive patients with midline posterior cranial fossa brain tumors with obstructive hydrocephalus with age ranged from 3 to 15 years got admitted in the Department of Neurosurgery, Bangabandhu Sheikh Mujib Medical University from March 2021 to April 2023. We did preoperative ventriculoperitoneal shunt before definitive surgery but didn't do the Endoscopic third ventriculostomy.

Results: In this study, the age of the patients was 3-15 years, the mean age was 9.47+_3.18 and the peak incidence was 11-15 years which was 20(36.36%). Majority of the patients was male (56%), male female ratio was 1.27:1. Most of the children were presented with headache 51(92.73%) followed by papilloedema 47(85.45%), vomiting 46(83.64%), gait disturbance 37(67.27%), diminution of vision 31(56.36%), swallowing difficulty 12(21.82%), cranial nerve palsy 12(21.82%). 19 patients developed postoperative complications among them 15(27.27%) was meningitis followed by wound infection 7(12.73%), pseudomeningocele 8(14.55%), csf leakage 4(7.27%), hydrocephalous 3(5.45%). Logistic regression analysis was non-significant statistically in my study.

Discussion and Conclusion: In conclusion we found satisfactory outcome of doing pr-operative VP Shunt in posterior fossa midline tumor causing obstructive Hydrocephalus in children, however major postoperative complications were development of hydrocephalus, CSF leak, pseudo meningocele, wound infection and meningitis. Future prospective studies with sufficient sample size are warranted to reach a definitive conclusion.

Keywords: midline posterior fossa tumor; ventriculo-peritoneal shunt; children; obstructive hydrocephalus

Abbreviation

VP Shunt; Ventriculoperitoneal Shunt

CSF: Cerebrospinal Fluid

ETV: Endoscopic Third Ventriculostomy

ICP: Intracranial Pressure

CT: Computer tomography

MRI: Magnetic resonance imaging

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.1

Hydrocephalus and subsequent need for cerebrovascular fluid (CSF) diversion following posterior fossa tumor excision in the pediatric age group is the most common clinical comorbidity. Despite advances in surgical techniques, up to 30% (18%–40%) of patients need CSF diversion as ventriculoperitoneal shunt (VP shunt) or endoscopic third ventriculostomy (ETV) after tumor excision.2

The evolution of surgical technique reflects the maturation of modern neurosurgery. The majority of patients with posterior fossa tumors have hydrocephalus at the time of presentation. The management of hydrocephalus with posterior fossa tumors remains controversial.3

Moreover, postoperative elevations of intracranial pressure (ICP) are reduced with a lower incidence of pseudomeningocele formation and CSF leakage, and hence shortened hospitals stay.4

Ventriculo-peritoneal shunting may decrease operative mortality by affording time to perform diagnostic tests, prepare the patient and schedule a major neurosurgical procedure electively. Reduction in intracranial pressure also permits safer resection.5.

Several complications have been associated with CSF diversion including: supratentorial intracranial hematomas (e.g., extradural, subdural, intracerebral, and intraventricular hemorrhage). Many shunts associated complications such as malfunction, infection, multiple abdominal complications, long-term shunt dependence and infratentorial complications e.g., intratumoral hemorrhage and upward transtentorial herniation.6

Several case reports have been published describing the serious infratentorial complications that may occur because of pre-resectional CSF diversion, either by ventricular shunting or ETV in patients with posterior cranial fossa tumors. Therefore, the actual incidence of such complications is unknown.7

Materials and Methods:

This cross-sectional experimental study was carried out on 55 consecutive patients with midline posterior cranial fossa brain tumors with obstructive hydrocephalus with age 3 to 15 years got admitted in the Department of Neurosurgery, Bangabandhu Sheikh Mujib Medical University from March 2021 to April 2023 who underwent preoperative ventriculoperitoneal shunt before definitive surgery. On admission, a detailed history of the illness was taken from the patient and/or his/her attendant, after that thorough neurological examination was carried out. Preoperative and postoperative clinical features for raised intracranial pressure (ICP) and findings of Computer Tomography (CT) scan and Magnetic Resonance Imaging (MRI) of brain were recorded. A data collection sheet was used to collect the necessary information. Informed written consent was taken from each participant and or guardian. Ventriculoperitoneal shunt was done by using medium pressure Chhabra shunt. Later, definitive surgery was performed. Follow-up of these patients was done up to7 th postoperative day. We assessed the patient in respect to the development of postoperative hydrocephalus, cerebrospinal fluid leakage, pseudomeningocele, wound infection and meningitis within 7th postoperative day after definitive surgery. Datas were processed and analyzed. Demographic data were expressed in number and percentage. Development of postoperative hydrocephalus, cerebrospinal fluid leakage, pseudomeningocele, wound infection and meningitis were expressed in number and percentage. Logistic regression analysis was done to predict the relationship between dependent variable (development of hydrocephalous) and independent variables (age, sex and the extent of tumor removal). Odds ratio (OR) was calculated by using Chi-square test. Chi-square test gave a wald statistic by observing at the 95% CI of the odds ratio. Statistical significance was set to p-value < 0.05.

Results:

The age of the patients was 3-15 years, the mean age was 9.47±3.18, and the peak incidence was 11-15 years which was 20 (36.36%).

Majority of the patient was male (56%), male female ratio was 1.27:1.

Characteristic		**n=55 (%)**
Age (years)		3-15 (Mean 9.47±3.18)
Sex	Male	56 (Ratio was 1.27:1)
	Female	44
Symptoms before surgery	Vomiting	46 (83.64)
	Hydrocephalus	55 (100)
	Headache	51 (92.73)
	Papilloedema	47 (85.45)
	Gait disturbance	37 (67.27)
	Diminution of vision	31 (56.36)
	Cranial nerve disorders (except papilledema)	12 (21.82)
	Decreased level of consciousness	4 (7.27)
Extend of removal (according to CT scan of brain after definitive surgery)	Gross Total	41 (74.55)
	Sub Total	6 (10.91)
	Near Total	8 (14.55)
Post-operative complication	Development of hydrocephalus	3 (5.45%)
	Wound infection	7 (12.73%)
	CSF leakage	4 (7.27%)
	Pseudomeningocele	8 (14.55%)
	Meningitis	15 (27.27)
Tumour Histopathology	Astrocytoma	20 (36.36)

Characteristic		**n=55 (%)**
	Meduloblastoma	16 (29.09)
	Ependymoma	13 (23.64)
	Choroid plexus papilloma	2 (3.64)
	Dermoid	2 (3.64)
	Meningioma	2 (3.64)

Table 1 shows preoperative clinical features of the study subject. Headache 51(92.73%), papilledema 47(85.45%), vomiting 46(83.64%), gait disturbance 37(67.27%), visual 31(56.36%), swallowing 12(21.82%), cranial nerve palsy 12(21.82%).

Table 1: Characteristics of the patient of posterior fossa tumour with hydrocephalus (n=55)

Out of 55 patients 31 patients developed complications, among them hydrocephalus was 3(5.45%), CSF leakage 4(7.27%), pseudomeningocele 11(20%), wound infection 12(21.82%) and meningitis 19(34.55%) (Table 1).

In CT scan of brain after definitive surgery, gross total removal of tumor was done in 41(74.55%) patients, near total removal in 6 (10.91%) patients and subtotal removal in 8(14.55%) patients (Table 1).

In histopathological findings, 20(36.36%) patients were found to have astrocytoma, 16(29.09%) medulloblastoma, 13(23.64%) ependymoma, 2(3.64%) choroid plexus papilloma, 2(3.64%) dermoid and 2(3.64%) meningioma (Table 1).

Outcome	**Gross total removal**		**Near total removal**		**Subtotal removal**	
	n	**%**	**n**	**%**	**n**	**%**
Development of hydrocephalus	3	5.45	0	0.00	0	0.00
CSF leakage	4	7.27	0	0.00	0	0.00
Pseudomeningocele	8	14.55	3	5.45	0	0.00
Wound infection	7	12.73	3	5.45	2	3.64
Meningitis	15	27.27	2	3.64	2	3.64

Table 2: Outcome of the study subject according to the extent of tumor removal during postoperative follow up (n=55)

Development of hydrocephalus was 3 (5.45%) and CSF leakage was 4(7.27%) in gross total removal. Pseudomeningocele was found 8(14.55%) in gross total removal and 3(5.45%) in near total removal. Wound infection was found 7(12.73%) in gross total removal, 3(5.45%) in near total removal and 2(3.64%) in subtotal removal. Meningitis was found 15(27.27%) in gross total removal, 2(3.64%) in near total removal and 2(3.64%) in subtotal removal.

	B	**P value**	**OR**	**95% CI for OR**	
				Lower	**Upper**
Age (11-15 years)	-0.123	0.934	0.886	0.063	10.018
Male	1.831	0.161	6.023	0.489	76.653
Near total removal	-19.088	0.998	0.001	0.000	-
Subtotal removal	-1.254	0.999	0.002	0.000	-

OR=Odds ratio, CI= Confidence interval
Multivariable logistic regression analysis was performed.

Table 3: Logistic regression of development of hydrocephalus

Age (11-15 years) had 0.886 (95% CI 0.063 to 10.018) times increase in odds having development of hydrocephalus. Male had 6.023 (95% CI 0.489 to 76.653) times increase in odds having development of hydrocephalus. Age, male, near total removal and subtotal removal were not significantly associated with development of hydrocephalus.

Discussion:

In this study the age of the patients was 3-15 years, the mean age was 9.47±3.18, and the peak incidence was 11-15 years which was 20 (36.36%). Emara et al.8 reported the mean age was 17.5±14.2 years with an age range from 2 to 30 years. Moussalem et al.9 observed mean age of 6.19±4.42 years. Ghani et al.3 reported mean age was 61.45±30.37 months. Gopalakrishnan et al.10 found the ages ranged from 1.5 to 18 years and mean age 8 years at the time of diagnosis. Helmbold et al.11 found that significant number of patients was between ages 0.4-20.8 years (mean, 8.5; median, 8.2). 15 out of 70 patients (21.4%) required shunt placement over the post-operative course. Patients in the shunt group (n = 15; mean, 5.4 median, 3.0) were younger than in the non – shunt group (n=55; mean, 9.3; median, 9.0). An age < 3 years at surgery was significantly associated with postoperative shunt placement.

Current study observed majority of the patient were male (56%), male female ratio was 1.27:1. Emara et al.8 reported out of 44 patients, 28 (63.6%) patients were males and 16 (36.4%) were females. Moussalem et al.9 observed 59.37% patients were males. Habib13 found in his study that 29 (69%) were males and 13 (31%) were females, with a male to female ratio of 2.2:1. Our study has similarity with the study of de Oliveira et al.12; Habib.13

In this study observed preoperative clinical features of the study subject were headache 51(92.73%), papilloedema 47(85.45%), vomiting 46(83.64%), gait disturbance 37(67.27%), diminution of vision 31(56.36%), swallowing difficulty 12(21.82%) and cranial nerve palsy

12(21.82%). Emara et al.8 reported most common presentation in (90.9%) of cases followed by vomiting (77.3%), then ataxia (22.7%) and cranial nerve palsy (18.2%). Patients with severe hydrocephalus caused by posterior fossa lesions were characterized by headache, nausea, vomiting, diplopia, ventricular collapse, intracranial hypertension, papilloedema and somnolence which has also mentioned by Arriada and Sotelo.14 According to de Oliveira et al.12 preoperative clinical features were headaches 89%, cerebellar ataxia 61%, papilloedema 41%, vomiting 77% and also 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%). Habib13 found in the pediatric group, headache was the most common presentation in 75.7% of patients, followed by vomiting 51.5% and 45.5% with papilledema, diminution of vision and diplopia was noted in 15.1% and 12.1% respectively.

Uddin et al.1 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 de Oliveira et al.12 It can be interpreted that elderly children with preoperative hydrocephalus due to posterior fossa midline tumor have less chance of requirement of VP shunt. Though ETV (endoscpic 3rd ventriculostomy) is an alternative procedure of Ventriculoperitoneal shunt procedure but due to unavailability of the instrument in our centre this procedure can't be done.

Present study observed post-operative complication of the study population CSF leakage 4(7.27%), pseudomeningocele 11(20%), wound infection 12(21.82%) and meningitis 19(34.55%). Emara et al.8 reported the most common complications are as follows: shunt obstruction 8 cases (18.2%), haemorrhage 6 cases (13.6%), cerebrospinal fluid leakage ± pseudomeningocele 6 cases (13.6%), wound infection 4 cases (9.1%), mutism 2 cases (4.55%), cranial nerve palsy 4 cases (9.1%) and seizures 2 cases (4.55%).

EI Molla and Hamza (2016) found their study that failure of V-P shunt was 5 (50%), infection 3 (30 5), CSF leak 2 (20%), upward herniation 1 (10%), subdural collection 2 (20%) and mortality 1 (10%) among 10 patients with pre insertion V-P shunt and 12 patients of direct tumor surgery, 5 (41.6%) showed recurrence of hydrocephalus within two weeks and all were treated with V-P shunt, pseudomeningocele was 3 (25%) and mortality was 2(16.7%) patients15.

A study of Islam et al.16 of 32 patients concluded that cerebrospinal fluid leakage was the most common complication which occurred in 26.7% of cases followed by pseudomeningocele in 23.5% of cases. Charles and Morgan17, complication rate 19% with a single case mortality. An uneventful postoperative period in 31% of cases and only 19% had neurological complications at long-term.18 Moussalem et al.9 reported 12.28 % of the patients developed hydrocephalus postoperatively. In our study postoperative hydrocephalous was in 3(5.45%) patients which was statistically significant with comparison of the study of Helmbold et al. 201911. CSF leak was found in 4 (7.27%) patients of this study which was statistically significant with comparison of the published literature of Sainte-Rose et al.19. Pseudomeningocele was found in 11 (20.0%) patients which was statistically significant in comparison to the study of Gopalakrishnan et al.10; Aljubour et al.20; Marx et al.21. Meningitis was found in 19 (34.55%) patient which was statistically significant with comparison of the published literature of Fritsch et al.22; Abou-Madawi23; Due-Tonnessen and Helseth24; de Oliveria et al.12; Aljubour et al.20; Marx et al.21; Helmbold et al.11.

Current study showed in CT scan of brain after definitive surgery, gross total removal of tumor was done 41(74.55%), near total removal 6(10.91%) and subtotal removal 8(14.55%). Helmbold et al.11 found in their study that within the shunt group, gross total resection was achieved in 9 (60%) and a subtotal resection in 6 patients (40%). There was no significance found between postoperative shunt placement and gross total tumor resection according to the postoperative neuroradiological report.

In histopathological findings, 20(36.36%) patients were astrocytoma, 16 (29.09%) medulloblastoma, 13(23.64%) ependymoma, 2(3.64%) choroid plexus papilloma, 2(3.64%) dermoid and 2(3.64%) meningioma. Emara et al.8 observed the most common is astrocytoma in 16 cases (36.3%) which its variants are pilocytic and anaplastic in 14 and 2 cases of them respectively, then medulloblastoma 12 cases (27.3%), ependymoma 10 cases (22.7%), metastatic tumour 4 cases (9.1%), ganglioglioma one case (2.3%) and dermoid tumour one case (2.3%). A case study was represented a rare intracranial dermoid tumour with its uncommon location in the posterior fossa.26 Moussalem et al.9 reported the most common tumor pathology was pilocytic astrocytoma (40.62 %) followed by medulloblastoma (35.93 %) and ependymoma.

Present study observed 31 patients developed post-operative complications. Development of hydrocephalus was 3 (5.45%) and CSF leakage was 4(7.27%) in gross total removal. Pseudomeningocle was found 8(14.55%) in gross total removal and 3(5.45%) in near total removal. Wound infection was found 7(12.73%) in gross total removal, 3(5.45%) in near total removal and 2(3.64%) in subtotal removal. Meningitis was found 15(27.27%) in gross total removal, 2(3.64%) in near total removal and 2(3.64%) in subtotal removal. Ghani et al.3 reported 81.58% patients were found in gross total and 18.42% in subtotal. Aljubour et al.20 reported patients who had a gross total excision of their tumor have significantly lower risk to need a VP- shunt insertion.

In this study showed age (11-15 years) had 0.886 (95% CI 0.063 to 10.018) times increase in odds having development of hydrocephalus. Male had 6.023 (95% CI 0.489 to 76.653) times increase in odds having development of hydrocephalus. Near total removal and subtotal removal were not significantly associated with development of hydrocephalus. Moussalem et al.9 reported midline tumors were more associated with the development of mutism (OR = 4.632, p = 0.306) and hydrocephalus (OR = 5.056, p = 0.135) postoperatively, a bit not statistically significant. The presence of a preoperative shunt was shown to be protective against the development of CSF leak (OR = 0.636, p = 0.767), as none of the patients that came in with CSF diversion developed a CSF leak after their surgery. Morelli et al.25 found in their study that tumor removal can restore CSF circulation, obstructive hydrocephalus persists or progresses postoperatively in approximately 15 to 30% of cases in which patients need postoperative treatment. Authors of many studies have suggested that a young age and an incomplete tumor resection could be related to a higher incidence of persistent hydrocephalus. de Oliveira et al.12 described that chronic arachnoiditis after posterior fossa surgery, leading to adhesions, may have been responsible for the higher rate of shunt requirements.

Conclusion:

In conclusion we found satisfactory outcome of doing pr-operative VP Shunt in posterior fossa midline tumor causing obstructive Hydrocephalus in children, however major postoperative complications were development of hydrocephalus, CSF leak, pseudo meningocele, wound infection and meningitis. Future prospective studies with sufficient sample size are warranted to reach a definitive conclusion.

Limitations:

1. Sample size was very small.

2. The study was conducted within a short period of time

3. Outcome of the study varies with benign and malignant tumor as well as with different age groups.

4. Postoperative outcome depends on the extent of tumor removal.

Recommendations:

1. Further study should be carried out incorporating large numbers of patients for a better conclusion.

2. Study should be done for a longer period for a better result.

3. A lifesaving operation should be performed in case of acute hydrocephalus.

Declarations:

Authors Contributions:

Conception, Diagnosis and Design, Radiological Diagnosis and Final approval of manuscript:

Dr Md Rezaul Amin, Dr KM Tarikul Islam, Dr ABM Manwar Hossain, Prof. Moududul Haque

Manuscript Preparation, Technical Revision, and Manuscript editing and revision:

Dr Md Rezaul Amin, Dr KM Tarikul Islam, Dr ABM Manwar Hossain

Literature Review: Dr Md Rezaul Amin, Dr KM Tarikul Islam

Ethical Approval:

Not applicable, in our country no ethical committee has been established.

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