

PROGNOSTIC SIGNIFICANCE OF PRE AND POST-RESECTION HYDROCEPHALOUS MANAGEMENT IN PAEDIATRIC POSTERIOR FOSSA TUMOURS; A TWO YEARS PROSPECTIVE SERIE

Muhammad Ali Nouman, Ayaz Ahmed, Muhammad Mukhtar Khan, Muhammad Nasir, Atif Aman, Muhammad Tariq

ABSTRACT

Background: Posterior fossa tumours are one of the commonest malignancies of childhood. Most of them presents with concomitant hydrocephalous and majority require pre-resection CSF diversion procedures such as VP shunt, EVD or ETV.

Methods: This study was conducted in a prospective manner from January 2013 to December 2014 at the department of Neurosurgery, Hayatabad Medical Complex Peshawar. The clinical effectiveness of CSF diversion procedures was assessed in terms of Glasgow outcome score.

Results: A total of 25 patients were included with a male to female ratio of 1:3. The majority of patients presented with concomitant hydrocephalous and most (72%) of them underwent VP shunt or ETV procedures preoperatively. 28% of patients underwent CSF diversion post-resection. There was a significant correlation between pre-resection CSF diversion and functional outcome with an Odds ratio of 2.722 (95% CI .822-9.011) and .311 (95% CI .116-.832) for favourable and unfavourable outcome groups, respectively.

Conclusion: CSF diversion before definitive resection of posterior fossa tumours in paediatric patients is a simple and effective procedure. This study has highlighted the positive role which this intervention can play in improving the final outcome. Larger and long term studies are however needed in order to fully elucidate the role of these procedures.

Keywords: Posterior fossa tumours, CSF diversion, VP shunt, ETV, Outcome, Paediatric

Abbreviations: CSF: Cerebrospinal fluid, VP Shunt: Ventriculoperitoneal shunt, ETV: Endoscopic third ventriculostomy, PFT: Posterior fossa tumour

INTRODUCTION

Hydrocephalous is a serious condition which has diverse range of causes and affect all groups. In various clinical series it has been noted to occur from 30% to 70% of children with posterior fossa tumours (PFTs).^{1,2} There is a considerable debate whether cerebrospinal fluid (CSF) diversion be performed pre-resection, post-resection or intraoperative simultaneously.^{3,4,5} However, strictly randomised data is lacking and studies show a variable results for CSF diversion in pre-resection as well as post-resection groups. Various studies have also compared the role of extent of tumour resection, histopathology of the tumour, neurologic status at presentation and various other factors.^{3,6,7,8,9} Following research into the factors predicting postoperative resolution or progression of

hydrocephalous the Canadian Preoperative Predictive Rule for Hydrocephalous (CPPRH) was developed.^{3,10,11}

Over the last two decades the prognostic role of intraoperative usage of external ventricular drainage (EVD) has been validated and its significance described in these children.^{2,5,12} More recently ventriculoperitoneal (VP) shunt and endoscopic third ventriculostomy (ETV) have been studied and their role validated in pre- and post-operative hydrocephalous in children with posterior fossa tumours.^{1,4,13,14,15,16} Variable results have been reported in all the studies with respect to progression or resolution of hydrocephalous.^{4,17,18}

EVD as a means of temporarily diverting the CSF in PFT resected patients, has been rejected by several authors due to the high incidence of infective complications.^{2,7,12} Similarly VP shunt and ETV also has its demerits.^{13,14,15} Clinical effectiveness and practice of a particular procedure for bypassing the CSF in these patients will continuously be evaluated unless data from randomised trials are available which proves the effectiveness of one procedure over another.

We studied the prognostic significance of CSF diversion procedures in both pre-resection and post-re-

Department of Neurosurgery, Hayatabad Medical Complex Peshawar - Pakistan.

Address for correspondence:

Dr. Muhammad Ali Nouman

Department of Neurosurgery, Hayatabad Medical Complex Peshawar - Pakistan.

E-mail: drmalinuman@gmail.com

section groups with the aim of evaluating the superiority of the former procedure over the later. We believed that if pre- or post-resection timing is proved to be of significance will change the clinical practice as well as result in better patient outcomes and less complications.

METHODS

The study was conducted in a prospective manner at the Department of Neurosurgery Hayatabad Medical Complex (HMC) Peshawar from January 2013 to December 2014. Approval of this research study from ethical committee of the hospital was obtained. Paediatric patients presenting with the diagnosis of posterior fossa tumours were included after informed consent of the parents/guardians. Detailed history and physical examination of patients were performed and data was recorded on pre designed pro forma. The primary diagnosis and concomitant hydrocephalous was confirmed on imaging studies.

Those patients who had significant hydrocephalous were listed for pre-resection VP shunt or ETV while others were listed for earlier resection of the tumour. Postoperative course was followed and complications were recorded. Those patients who developed clinically symptomatic hydrocephalous were listed for either VP shunt or ETV and they were also followed postoperatively. Three main outcome variables were defined, namely; postoperative complications, Glasgow outcome score (GOS) at discharge to one month postoperatively and early postresection mortality. The CSF diversion was stratified into pre- or post-resection while the outcome in GOS was stratified as either favourable (GOS 4,5) or unfavourable (GOS 1,2,3).

Demographic variables, clinical features, histopathological diagnoses, preresection or postresection shunt or ETV frequencies, complications, GOS and mortality were calculated. Chi square test was performed for the clinical variables and outcome parameters and their significance noted. Odds ratios (OR) were calculated for the cohort of patients with pre-resection CSF diversion and their outcome in terms of GOS and mortality. Similarly bivariate analysis was performed for pre- and post-resection CSF diversion versus outcome in terms of GOS and mortality and their significance noted.

Data analysis was done using SPSS v 20.0. The data was displayed using graphs and charts. A p-value equal to or less than 0.05 was considered significant in all statistical tests.

RESULTS

A total of 25 patients were included with 7 (28%) males and 18 (72%) females. (Table 2) The mean age was found to be 6.6 years $\pm$ 2.6 SD. The mean GCS on admission was found to be 13.4 $\pm$ 2.1 SD. The mean GOS on discharge was 3.2 $\pm$ 1.2 SD while mean GOS at 1 month postoperatively was 3.8 $\pm$ 1.5 SD. (Table 1)

Clinical features were found as follows; headache in 18 (72%), Vomiting in 21 (84%), fits in 3 (12%), cranial nerves dysfunction in 8 (32%), nystagmus in 11 (44%) while focal deficits were found in 3 (12%) of patients. The frequencies of histopathologically confirmed tumours was as follows; Medulloblastoma 10 (40%), Ependymoma 6 (24%), Pilocytic astrocytoma 4 (16%) while 1 (4%) case each of Haemangioblastoma, Tuberculoma, Brainstem glioma, Choroid papilloma and Atypical Rhabdoid tumour. (Table 2)

Significant hydrocephalous was present in 22 (88%) patients with the rest of 3 (12%) developing it postoperatively. Pre-resection diversion of CSF was done in 18 (72%) while post-resection CSF diversion was done in 7 (28%) patients. 14 (56%) patients were operated for pre-resection CSF diversion with a VP shunt while pre-resection ETV was performed 4 (16%) patients. Post-resection VP shunt was done in 3 (12%) while post-resection ETV was performed in 2 (8%) of patients. (Table 2)

The following complications were found postoperatively; Progressive neurologic deterioration in 6 (24%), wound infection in 2 (8%) and CSF leak in 1 (4%) of patients. (Table 2)

Overall a favourable outcome was recorded in 16 (64%) patients while in 4 (16%) patients the outcome was unfavourable. Overall mortality was 16% (4 cases). (Table 2) and (Table 3)

The Chi squared test for pre-resection CSF diversion vs outcome as favourable or unfavourable GOS showed a significance ($p = 0.021$) in terms of lower mortality and good functional outcomes. (Table 4) The risk estimates produced odds ratios of 0.367 (95% CI 0.111-1.216) and 3.214 (95% CI 1.203-8.591) for favourable and unfavourable outcome groups, respectively. (Figure 1) Similarly, the post-resection CSF diversion risk estimates showed odds ratio of 2.722 (95% CI .822-9.011) and .311 (95% CI .116-.832) for favourable and unfavourable outcome groups, respectively. (Figure 2)

The bivariate correlation test showed a p value of 0.02 for the pre-resection CSF diversion group which meant that the pre-resection CSF diversion confers more benefit in terms of functional outcome and mortality.

DISCUSSION

Posterior fossa tumours comprise the most common central nervous system malignancies and are frequently associated with gross hydrocephalous.² The management of this class of hydrocephalous has remained a controversy among the neurosurgical community.^{5,10,11} Although all of the neurosurgeons agree absolutely as to promptly manage the progressively increasing hydrocephalous, the timing of the various diversion procedures is a matter of debate and various studies have shown variable results.⁵ Some authors

Table 1: Descriptive statistics for quantitative variables

Clinical Variable	Minimum	Maximum	Mean	Std. Deviation
Patients' Age	2	11	6.68	2.641
Admission GCS	7	15	13.44	2.142
GOS on Discharge	1	5	3.24	1.234
GOS at 1 month Postop	1	5	3.88	1.509

Table 2: Qualitative Variables & their frequencies

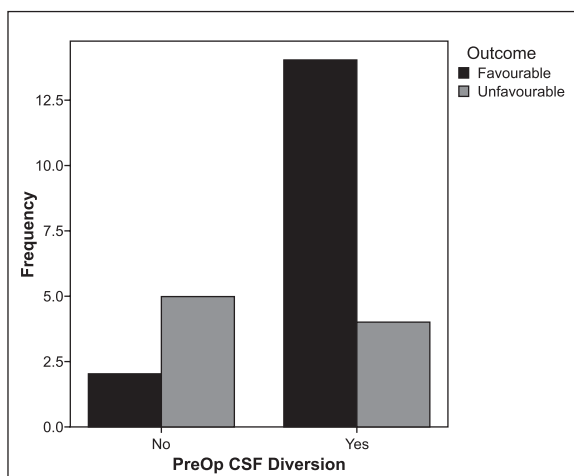
Clinical Variable	Frequency (n)	Percentage (%)
Gender		
Male	7	28%
Female	18	72%
Headache	18	72%
Vomiting	21	84%
Fits	3	12%
Cranial Nerves Dysfunction	8	32%
Ataxia	21	84%
Nystagmus	11	44%
Focal Deficit	3	12%
Histopathological Diagnosis		
Medulloblastoma	10	40%
Ependymoma	6	24%
Pilocytic Astrocytoma	4	16%
Haemangioblastoma	1	4%
Tuberculoma	1	4%
Brainstem Glioma	1	4%
Choroid Papilloma	1	4%
Atypical Rhabdoid Tumour	1	4%
Concomitant Hydrocephalous	22	88%
Pre-resection Shunt	14	56%
Post-resection Shunt	3	12%
Pre-resection ETV	4	16%
Post-resection ETV	2	8%
Pre-resection CSF Diversion	18	72%
Post-resection CSF Diversion	7	28%
Complications		
Progressive Neurologic Deterioration	6	24%
Wound Infection	2	8%
CSF Leak	1	4%
Outcome		
Favourable	16	64%
Unfavourable	9	36%
Mortality	4	16%

Table 3: GOS distribution at discharge

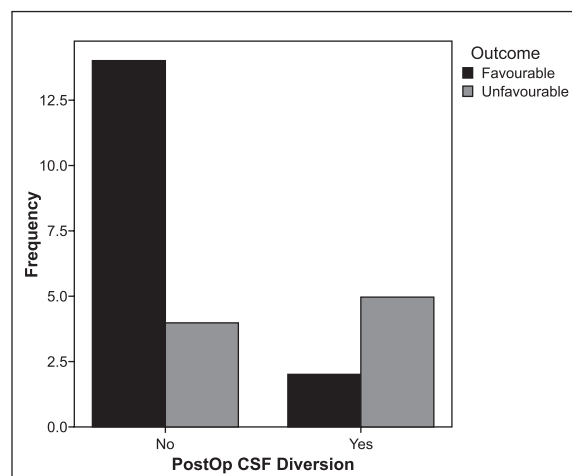
GOS	Number of cases	Percentage
1	4	16.0
2	2	8.0
3	5	20.0
4	12	48.0
5	2	8.0

Table 4: Cross tabulations for Pre-resection CSF diversion vs Outcome

			Outcome Groups	
			Favourable	Unfavourable
PreOp CSF Diversion	No	Frequency	2	5
		% within PreOp CSF Diversion	28.6%	71.4%
	Yes	Frequency	14	4
		% within PreOp CSF Diversion	77.8%	22.2%
Preoperative CSF diversion		P-value = 0.021		

**Figure 1: Pre-resection CSF diversion and Outcome**

report good outcomes with intraoperative or post-resection diversion procedures while others maintain that the hydrocephalous should be diverted prior to resection of the tumour.¹⁷ The proponents of intraoperative or post-resection diversion are of the view that the hydrocephalous is effectively treated if the tumour resection is promptly done as this opens the blocked pathways for CSF circulation. However, the authors who practice hydrocephalous surgery prior to resection of the tumour maintain that hydrocephalous is a rapidly life threatening situation and it should managed first. Moreover, it is also advised that total resection of the tumours is not always possible and there develops postoperative oedema which could worsen the situation for the patients.^{4,14} Research into this matter will

**Figure 2: Post-resection CSF diversion vs Outcome**

continue unless data from randomised trials and large cohorts is available.

We conducted this study to see the prognostic significance of pre- or post-resection management of hydrocephalous and to test which class will have the benefit of good functional outcome. Another view in our study was from the perspective of the developing countries where diagnosis is late, operative care sub-optimal, resections are frequently subtotal, post-operative care is inadequate and follow up is inconsistent.

Our study is not the only one to be conducted for assessment of CSF diversion timing in paediatric PFTs. Azab et al¹⁷ performed study into the clinical effectiveness of ETV in paediatric patients with PFTs.

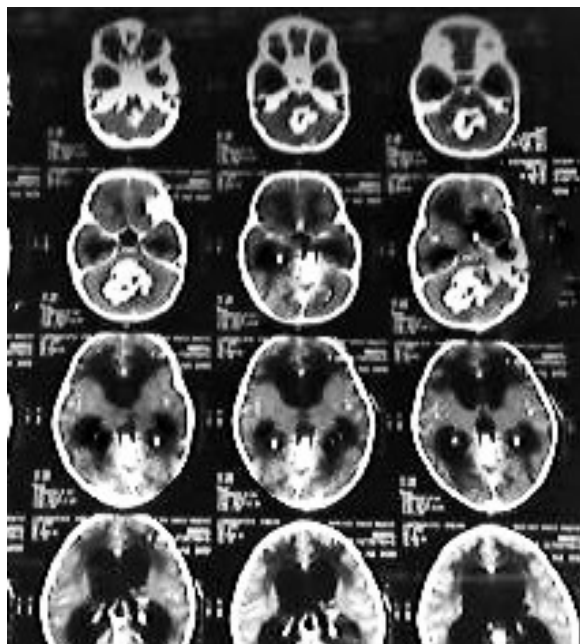


Figure 3: A posterior fossa Cerebellar tumour with dilated temporal horns and 3rd Ventricle

Mean age in this study was 6 years $\pm$ 3.8 SD with a majority of male (64.70%) patients contrary to our study. The clinical aim and rationale of Azab et al was different though, as it was only to assess the effectiveness of ETV as presumably there are more complications associated with VP shunt and EVD than with ETV. Ependymoma was the predominant tumour type in their series while mean follow up period was 13.9 months. They showed that ETV performed before performing resection of the tumour was successful in 88.2% cases. Azab et al noted headache in 64.7%, vomiting 64.7%, nystagmus 64.7%, cranial nerve dysfunction 52.9%, ataxia 41.1% and focal deficits in 11.7% of patients. The distribution of clinical features was also closely related to our series.

Steinbok et al¹⁸ has noted a 33.33% CSF related complications such as pseudomeningocele and CSF leaks while noting that CSF diversion has little or no association to the occurrence of these complications. This finding was similar to our study as we did not find an association between pre- or post-resection CSF diversion procedure and incidence of complications. In our study however, complications related to general neurologic deterioration were more prominent, though statistically non-significant.

El Beltagy¹⁹ et al has assessed the use of pre-resection ETV versus VP shunt and found a significant resolution of hydrocephalous for the ETV group in 65% of patients. However, the success of ETV in these patients was dependent upon the histopathological nature of the tumour with 100% success in glioma, 50% in ependymoma and 47.6% in medulloblastoma. The ETV in their series failed to completely resolve hydrocephalous in 35% of patients. In our series,

however, due to the short term follow up we could not assess the success or failure of either procedure in either subset of patients. We, however, successfully demonstrated that management of hydrocephalous prior to resection do confer positive results in terms of postoperative functional recovery and mortality. Bhatia et al²⁰ has reported a success rate of 87.1% in terms of improved symptomatology for pre-resection ETV and a high association of significant hydrocephalous with increased complications. The same study has concluded that pre-resectional CSF diversion is of more benefit in resolving the symptoms and improving outcome as compared to post-resection VP shunt or ETV. These conclusions are in positive agreement to our study where bivariate correlation have shown a significant ($p = 0.02$) association between pre-resection CSF diversion and good functional outcome. (Figure 1 & 2)

The limitations of our study are the lower number of patients. It prevents definitive conclusions to be made with certainty. Another limitation is the shorter duration of only one month post-operative success of CSF diversion. The neurologic consequences needs to be studied for longer duration in order to fully elucidate the results.

CONCLUSION

Management of hydrocephalous associated with posterior fossa tumours in children is a long term controversy. Our study is a preliminary attempt at proving the good prognostic role of pre-resection CSF diversion. Studies with longer duration of follow up and larger number of patients are required to further elucidate the above impression.

REFERENCES:

1. P Kamalo. Exit ventriculoperitoneal shunt; enter endoscopic third ventriculostomy (ETV): contemporary views on hydrocephalus and their implications on management. *Malawi Med J.* 2013 Sep; 25(3): 78-82.
2. El-Gaidi MA, El-Nasr AH, Eissa EM. Infratentorial complications following preresection CSF diversion in children with posterior fossa tumors. *J Neurosurg Pediatr.* 2015 Jan;15(1):4-11.
3. Schneider C, Ramaswamy V, Kulkarni AV, Rutka JT, Remke M, Tabori U, et al. Clinical implications of medulloblastoma subgroups: incidence of CSF diversion surgery. *J Neurosurg Pediatr.* 2015 Mar;15(3):236-42.
4. Takahashi Y. Long-term outcome and neurologic development after endoscopic third ventriculostomy versus shunting during infancy. *Childs Nerv Syst.* 2006 Dec;22(12):1591-602.
5. Taylor WA, Todd NV, Leighton SE. CSF drainage in patients with posterior fossa tumours. *Acta Neurochir (Wien).* 1992;117(1-2):1-6.
6. Gopalakrishnan CV, Dhakoji A, Menon G, Nair S. Factors predicting the need for cerebrospinal fluid

- diversion following posterior fossa tumor surgery in children. *Pediatr Neurosurg*. 2012;48(2):93-101.
7. Hosainey SA, Lassen B, Helseth E, Meling TR. Cerebrospinal fluid disturbances after 381 consecutive craniotomies for intracranial tumors in pediatric patients. *J Neurosurg Pediatr*. 2014 Dec;14(6):604-14.
 8. Santos de Oliveira R, Barros Jucá CE, Valera ET, Machado HR. Hydrocephalus in posterior fossa tumors in children. Are there factors that determine a need for permanent cerebrospinal fluid diversion? *Childs Nerv Syst*. 2008 Dec;24(12):1397-403.
 9. Rahman MH, Ahamed SU, Sayed MA, Rashid MH, Sarkar S. Is gross total removal necessary for paediatric posterior fossa tumour? *Mymensingh Med J*. 2010 Apr;19(2):239-43.
 10. Riva-Cambrin J, Detsky AS, Lamberti-Pasculli M, Sargent MA, Armstrong D, Moineddin R, et al. Predicting postresection hydrocephalus in pediatric patients with posterior fossa tumors. *J Neurosurg Pediatr*. 2009 May;3(5):378-85.
 11. Foreman P, McClugage S 3rd, Naftel R, Griessenauer CJ, Ditty BJ, Agee BS, et al. Validation and modification of a predictive model of postresection hydrocephalus in pediatric patients with posterior fossa tumors. *J Neurosurg Pediatr*. 2013 Sep;12(3):220-6.
 12. Ghani E, Zaidi GI, Nadeem M, Rehman L, Noman MA, Zaman KU. Role of cerebrospinal fluid diversion in posterior fossa tumor surgery. *J Coll Physicians Surg Pak*. 2003 Jun;13(6):333-6.
 13. Ruggiero C, Cinalli G, Spennato P, Aliberti F, Cianciulli E, Trischitta V, et al. Endoscopic third ventriculostomy in the treatment of hydrocephalus in posterior fossa tumors in children. *Childs Nerv Syst*. 2004 Nov;20(11-12):828-33.
 14. Tamburrini G, Pettorini BL, Massimi L, Caldarelli M, Di Rocco C. Endoscopic third ventriculostomy: the best option in the treatment of persistent hydrocephalus after posterior cranial fossa tumour removal? *Childs Nerv Syst*. 2008 Dec;24(12):1405-12.
 15. Sainte-Rose C, Cinalli G, Roux FE, Maixner R, Chumas PD, Mansour M, et al. Management of hydrocephalus in pediatric patients with posterior fossa tumors: the role of endoscopic third ventriculostomy. *J Neurosurg*. 2001 Nov;95(5):791-7.
 16. Di Rocco F, Jucá CE, Zerah M, Sainte-Rose C. Endoscopic third ventriculostomy and posterior fossa tumors. *World Neurosurg*. 2013 Feb;79(2 Suppl):S18.e15-9.
 17. Azab W, Al-Sheikh T, Yahia A. Preoperative endoscopic third ventriculostomy in children with posterior fossa tumors: an institution experience. *Turk Neurosurg*. 2013;23(3):359-65.
 18. Steinbok P, Singhal A, Mills J, Cochrane DD, Price AV. Cerebrospinal fluid (CSF) leak and pseudomeningocele formation after posterior fossa tumor resection in children: a retrospective analysis. *Childs Nerv Syst*. 2007 Feb;23(2):171-4; discussion 175.
 19. El Beltagy MA, Kamal HM, Taha H, Awad M, El Khateeb N. Endoscopic third ventriculostomy before tumor surgery in children with posterior fossa tumors, CCHE experience. *Childs Nerv Syst*. 2010 Dec;26(12):1699-704.
 20. Bhatia R, Tahir M, Chandler CL. The management of hydrocephalus in children with posterior fossa tumours: the role of pre-resectional endoscopic third ventriculostomy. *Pediatr Neurosurg*. 2009;45(3):186-91.

ONLINE SUBMISSION OF MANUSCRIPT

It is mandatory to submit the manuscripts at the following website of KJMS. It is quick, convenient, cheap, requirement of HEC and Paperless.

Website: www.kjms.com.pk

The intending writers are expected to first register themselves on the website and follow the instructions on the website. Author agreement can be easily downloaded from our website. A duly signed author agreement must accompany initial submission of the manuscript.