

Factors Predicting the Need of Permanent CSF Diversion Surgery in Children Presenting with Hydrocephalus Due to Posterior Fossa Tumours

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Abstract

Introduction: Tumours arising in posterior fossa are of special concern because it is a small and closed space near critical brain structures including the brainstem and cranial nerves. The percentage of pre operative shunting in hydrocephalic posterior fossa tumours has been quite variable in different studies. The aim of this study is to check the factors that will help in prediction and thus isolate the patient group which will require postoperative VP shunting.

Materials and Methods: One hundred children of posterior fossa tumour were included in the study and out of these sixty were associated with hydrocephalus external ventricular drain (Surgiview shunt and drain systems) was put just prior to surgery in all patients with established clinical and radiological signs of raised intracranial pressure. CSF was drained as required and the EVD was removed on fifth postoperative day. Postexternal ventricular drain removal, patients were reassessed in terms of clinical and radiological signs of raised intra cranial pressure and a VP shunt (Surgiview's Chhabra slit n spring system shunt) was put in the presence of the same. Various parameters like age, sex, type and location of tumour, type of surgery and extent of resection were recorded, data was compiled and results were tabulated.

Results: Out of total of 18 children who required postoperative VP shunting, age less than 3 years, midline location of tumours and residual lesion were found to be the properties in the shunted group which showed statistically significant results. On the other hand, type of tumour (intra/extra axial) and sex of the patient proved to be insignificant for predicting the need of a postoperative VP shunting in patients of posterior fossa tumour.

Discussion: Treatment of hydrocephalus in posterior cranial fossa tumours is still a matter of controversy and the incidence of this association is still quite unclear and the factors determining the need of VP shunt in this study, i.e. age <3 years, midline location of tumour and subtotal resection are also validated by other authors.

Conclusion: Children with posterior fossa tumours with hydrocephalus are particularly at risk of a permanent VP shunt if age of the patient is < 3years, tumour is located in midline and residual tumour postoperatively.

Keywords: Hydrocephalus; Posterior fossa tumour; CSF Diversion Surgery.

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Introduction

Tumours arising in posterior fossa are of special concern because it is a small and closed space near critical brain structures, including the brainstem and cranial nerves. The proximity of fourth ventricle, and therefore CSF pathways, predisposes patients with posterior fossa tumours to the development of obstructive hydrocephalus.¹ The patient with hydrocephalus in a primary brain tumor may be considered to have two distinctly different diseases

which complicate one another and contribute to the complex picture of increasing intracranial pressure.² Various CSF diversion procedures, both temporary and permanent, are available to tackle to problem of hydrocephalus but a significant controversy still exists about the nature and timing of such surgery. The percentage of pre operative shunting in hydrocephalic posterior fossa tumours has been quite variable in different studies and depends on the policy of the centre where study is done: 79%^{3,4}, 10%⁵ and 91%.⁶ Furthermore, some studies suggest that insertion of a cerebrospinal fluid diverting shunt pre operatively makes the subsequent tumour excision more difficult and hazardous and is not frequently indicated.⁷ The aim of this study is to check the factors that will help in prediction and thus isolate the patient group which will require postoperative VP shunting.

Materials and Methods

One hundred children of posterior fossa tumour were included in the study and out of these sixty were associated with hydrocephalus. Diagnosis was confirmed on imaging modalities, i.e. contrast enhanced CT scan (Philips 128 slice) and MRI (Siemens 1.5T). External ventricular drain (Surgiview shunt and drain systems) was put just prior to surgery in all patients with established clinical and radiological signs of raised intracranial pressure. CSF was drained as required and the EVD was removed on fifth postoperative day. All patients were administered a dose of dexamethasone dose adjusted according to weight i.v tds which was tapered to stop during postoperative course. Postexternal ventricular drain removal, patients were reassessed in terms of clinical and radiological signs of raised intra cranial pressure and residual tumour which was defined as more than 1.5cm² of tumour. A VP shunt (Surgiview's Chhabra slit

n spring system shunt) was put in the presence of clinical and radiological signs of raised intracranial pressure. Various parameters like age, sex, type and location of tumour, type of surgery and extent of resection were recorded, data was compiled and results were tabulated. Chi-square test was used to evaluate the statistical significance of each parameter and significance was established. All patients were followed up for three months for outcome.

Results

Characteristics of all 100 children were tabulated and subjected to statistical analysis. Results were tabulated and Table 1 shows the various factors which proved to be significant or otherwise.

A total of 18 children required postoperative VP shunt and 10 out of these 18 were aged less than 3 years and 8 were aged more than 3 years. 10 male patients and 8 female patients required postoperative shunting with no statistical significance for the gender involved

Of the 18 patients requiring a VP shunt postoperatively, 11 had a midline placed tumour and 7 had a tumour in paramedian location. Thus, location of tumours proved to be a statistically significant variable for predicting the need of the same.

A total of 14 patients had residual tumour postoperatively and all required VP shunting. Out of total of 18 children who required postoperative VP shunting, age less than 3 years, midline location of tumours and residual lesion were found to be the properties in the shunted group which showed statistically significant results. On the other hand, type of tumour (intra/extra axial) and sex of the patient proved to be insignificant for predicting the need of a postoperative VP Shunting in patients of posterior fossa tumour.

Table 1:

Parameters		Post op VP shunt		Chi-square	p-value
		Yes (n=18)	No. (n=82)		
Age (yrs)	<3	10 (55.56)	10 (12.2)	FET	<0.0001
	>3	8 (44.44)	72 (87.80)		
Sex	Male	10 (55.56)	46 (56.1)	FET	1
	Female	8 (44.44)	36 (43.9)		
Location	Midline	11 (61.11)	12 (14.63)	12.77	<0.0001
	Paramedian	7 (39.9)	70 (85.37)		
Type	Medulloblastoma	10 (20.4)	39 (79.6)	FET	0.005
	Astrocytoma	3 (11.5)	23 (88.5)		
	Ependymoma	5 (20)	20 (80)		
Follow up at 3 months	Residual SOL	14 (77.78)	0	13.45	<0.0001

Discussion

Treatment of hydrocephalus in posterior cranial fossa tumours is still a matter of controversy and the incidence of this association is still quite unclear. A review article on infratentorial complications following preresectional CSF diversion in children with posterior fossa tumours stated that 301 out of 437 (68%) patients underwent CSF diversion before surgery.⁸ A study on Cerebellar astrocytomas suggested presence of hydrocephalus in 50% of patients with midline tumour and in 20% with hemispheric location⁹. Studies in developing countries show a very high incidence of hydrocephalus in posterior fossa tumour patients that may be due to delay in diagnosis of the disease.¹⁰

In our study, 18% patients required VP shunting postoperatively. Chi-Ta lin and associates in their study of management of posterior fossa tumours and hydrocephalus in children concluded that around 10–40% patients demonstrate persistent hydrocephalus after posterior fossa tumour resection.¹¹

Age less than 3 years proved to be a significant predicting factor for shunt placement postresection. This was in accordance with Chi-Ta lin's study wherein it was concluded that young age on presentation would predict post resection or persistent hydrocephalus. Lazlo Bogнар and associates in their study on analysis of CSF shunting procedure requirement in children with posterior fossa tumours concluded that factors such as young age of patient which showed statistically significant association with postoperative shunt requirement, should be considered when the decision regarding treatment is made.¹² Another study predicting postresection hydrocephalus in pediatric patients with posterior fossa tumours identified age less than 2 years as a significant variable in predicting post resection hydrocephalus.¹³

Age as a significant factor can also be attributed to the unfavourable histologies of tumours usually present at this age. Bagnasco *et al.* in their study of medulloblastoma variants and their age dependent occurrence and relation identified a very clear pattern of age related distribution of particular histological variants with a statistically significant difference in age at diagnosis between Extensive Nodularity Medulloblastoma (MBEN) and Desmoplastic Medulloblastoma (DMB) on one hand and Classic Medulloblastoma (CMB) on the other which suggested that there is an age related susceptibility to the development of these tumors, and that each variant has its peculiar interval of appearance.¹⁴

Also, Packer and Vezina in their review article on management of and prognosis with medulloblastoma stated that in younger children, especially infants, the likelihood of disseminated disease is higher and even with aggressive treatments, therapy remains suboptimal.¹⁵ This further points to the need of pre operative VP shunting in this subset of children.

Fourteen patients (14%) in our study underwent subtotal resection of tumour which was determined based on postoperative scanning. All 14 required postoperative VP shunting. Bagnasco *et al.*¹⁴ reported a 28% residual tumour rate in their study which was double than that of our study. Kazan *et al.*² in their study of factors required for VP shunting in children with posterior fossa tumours concluded that residual tumour is a significant factor which predicts postoperative shunt insertion following posterior fossa tumour surgery. They based it on their observation that more than 85% of patients with gross total removal of tumours didn't require postoperative shunting.² They further stated that subarachnoid adhesions and existence of abnormal fibrin at the level of Pachchioni bodies causing resistance to CSF flow as the two physiopathologic mechanisms for hydrocephalus inspite of total tumour removal. The same causes can also be rendered true for patients with subtotal resection apart from the obstructive cause.

Due Tonnessen and Helseth E in their study on role of tumour surgery in management of hydrocephalus in children with posterior fossa tumours stated a 87% cure rate of hydrocephalus by tumour resection alone which was in concordance to our study wherein 82% patients did not require VP shunting.¹⁶ They further reported a cure rate of 83% in astrocytoma, 54% in ependymoma and 47% in medulloblastoma the trend of which is in concordance with our study wherein highest cure rate was for astrocytoma (93%) followed by ependymoma (80%) and medulloblastoma (61%). The increase in rate can be attributed to advances in technologies that helps increase skill and expertise of the surgeon.

Midline location of tumour in the posterior fossa was determined to be a significant factor for predicting the need of a postoperative VP shunt in our study. This was in accordance with a similar study done by Oliveira *et al.* on hydrocephalus in posterior fossa tumours in children where they ascertained the factors for determining the need for a permanent csf diversion wherein they concluded that age at surgery and location of tumour were significantly associated with definitive postoperative csf diversion and young children with midline tumour should be considered at

risk when preoperative decisions are made in this regard.¹⁷ Bateman and Fiorentino in their article titled "Childhood hydrocephalus secondary to posterior fossa tumour is both an intra- and extra axial process" stated that even after tumour surgery, up to 30% of children will have residual hydrocephalus requiring a shunt postoperatively and the risk factors associated are age (<3 yrs.), midline tumour location, subtotal resection and pseudomeningocele formation.¹⁸ They further stated that despite the overall success of surgery in unblocking the CSF pathways, the resolution of CSF absorption abnormality is not always immediate and this delay in improvement is called adaptation period. In children with obstructed hydrocephalus caused by tumour, there is secondary compression of the venous outflow, which appears to be due to direct compression of the sinuses between the cerebellum and the skull. Thus, the hydrocephalus is both an intra- and extra axial process.

Conclusion

Children with posterior fossa tumours with hydrocephalus are particularly at risk of a permanent VP shunt if age of the patient is <3 years, tumour is located in midline and residual tumour postoperatively and thus preoperative treatment decisions should be made keeping the above said factors in mind.

Conflicts of Interest: None

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