Posterior Fossa Tumors: Clinical Outcome of Surgery without Cerebrospinal Fluid Diversion

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ABSTRACT

Objective. To present the results of surgery for posterior fossa tumors without CSF diversion and describe the patients who may require permanent CSF diversion post op.

Methods. We analyzed data of 72 patients with posterior fossa tumors and hydrocephalus who were treated surgically through a suboccipital craniotomy/craniectomy and tumor excision without CSF diversion. All of the patients were operated on by the authors and the surgical technique standardized as follows: suboccipital craniotomy/craniectomy, early access of the cisterna magna and evacuation of CSF until the posterior fossa compartment is relaxed, then tumor excision. Data underwent statistical tests for significance for the variables age, tumor type, tumor location, degree of hydrocephalus and extent of tumor excision using Mantel-Haenszel estimates and p values.

Results. The mean age of patients was 36.15 years. The most common tumor type was schwannoma. Eighty-six percent (86%) of patients had moderate to severe hydrocephalus. Eighty-one percent (81%) had total tumor excision. No patient required any other form of CSF drainage or diversion intra-op. The complication rate was 4.2%, with pseudomeningocoele being the most common complication. Four patients required a permanent VP shunt post tumor excision.

Conclusion. The good clinical outcome and low postoperative shunt insertion rate in our series led us to believe that posterior fossa tumor surgery without CSF diversion is a safe and effective treatment plan for posterior fossa tumors with hydrocephalus, and routine CSF diversion for posterior fossa tumor surgery may not be entirely justified. Factors such as age, tumor type, tumor location, degree of hydrocephalus and extent of excision, which showed a statistically significant association with the postoperative shunt requirement in our study, should be considered when the decision regarding CSF diversion is made.

Key Words: Posterior fossa, tumors, CSF diversion

Introduction

Hydrocephalus is found in 40% of patients with posterior fossa tumors.[1,9] Increased intracranial pressure (ICP) from the hydrocephalus poses a large risk to the brain in terms of further injury. Tumor excision is also made more difficult because of a tight, bulging and friable cerebellum. It is therefore mandatory that, prior to any direct tumor treatment, the hydrocephalus is addressed first.

The management of hydrocephalus for posterior fossa tumors has been quite variable in different centers, and depends on surgeon's preference. Most do routine intraoperative external ventricular drains (EVDs) and maintain them postoperatively until the decision for ventriculoperitoneal shunting (VPS) is made. Some do outright VPS one week prior to tumor excision. Still others do endoscopic third ventriculostomy prior to or following tumor excision.[3]

These procedures, however, are not without risk. Ventricular decompression may result in sudden decrease in ICP, and some cases have been reported to develop upward herniation and epidural hematomas,[1,9] which have ominous consequences. Shunt infections and ventriculitis resulting from EVD placement are also inherently associated with cerebrospinal fluid (CSF) diversion procedures for posterior fossa tumor surgery and, therefore, the complications of CSF diversion have raised concern over its frequent use.

A surgical approach to posterior fossa tumors without CSFdiversion is gaining usage and is proving to be useful in most situations. This obviates the need for additional surgery and eliminates its attendant complications. There is also no foreign body left in the patient. In a large tertiary hospital with most patients unable to afford treatment for shunt morbidities or complications, this approach is cost-effective.

However, since this is a relatively new approach, there is paucity of literature on its applicability, indications for greatest benefit, and clinical outcomes.

Objective

The objective of this study is to present the results of our experience in treating posterior fossa tumors with hydrocephalus, without CSF diversion. As a secondary objective, we will describe the characteristics of patients who may not be suitable for such an approach, eventually requiring a VP shunting procedure.

Materials and Methods

This is a retrospective analysis of the charts of patients with posterior fossa tumors admitted at the Philippine General Hospital from January 2006 to November 2007, treated surgically through a suboccipital craniotomy/craniectomy and tumor excision without CSF diversion. Demographic, clinical and radiologic data were extracted from their hospital records. Radiologic data required computerized tomography and magnetic resonance imaging of the posterior fossa tumor and hydrocephalus

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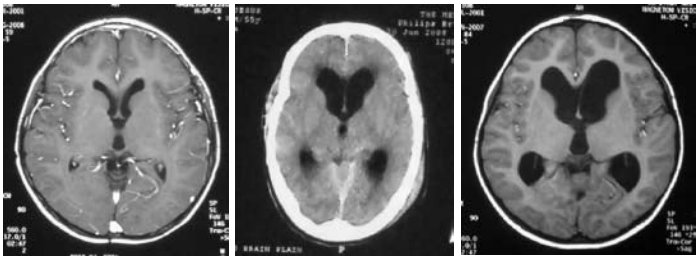
in all patients. Hydrocephalus is defined as an Evan's ratio (ratio of the largest width of the frontal horns to maximal biparietal diameter) of greater than 30%. Mild, moderate, and severe hydrocephalus were assigned to ratios 0.3 to 0.34, 0.35 to 0.4 and >0.4 respectively. All of the patients were operated on by the authors and the surgical technique was standardized. Basic to all the cases was the initial 1.0 to 1.5 cm dural incision at the area of the cistern magna and early drainage of CSF through this opening. The drainage is deemed adequate when there is good pulsation of the cerebellum and tension on its surface has diminished. Standard excision techniques were then carried out. Patient's records were analyzed for the following data: age, tumor type, extent of excision, tumor location, need for post-op VP shunting and complications. Descriptive analysis of the data was performed using measures of central tendency. Analysis of data used Mantel-Haenszel estimates and p values for those who eventually required VP Shunting.



Mild Moderate Severe

Figure 1. Degree of hydrocephalus

Results

A total number of 72 patients who had posterior fossa tumors were included in this study. The mean age of the patients was 36.15 years. (Table 1) The most common posterior fossa tumors encountered were vestibular schwannomas (42%), medulloblastomas (12%) and hemangioblastomas (12%). (Table 2) Most of the tumors were hemispheric. The degree of hydrocephalus was mild in 14%, moderate in 43% and severe in another 43%. (Table 3) Eighty-one percent (81%) underwent total excision of the tumor. None required an intraoperative tube ventriculostomy, the CSF drainage being adequate for all 72 patients.

All patients completed the one-year follow up period. Postoperative morbidity was at 4.2% (3/72), consisting of pseudomeningocoele (2/72) and meningitis (1/72).

Table 1. Number of patients according to age bracket

Age Bracket	Number	Percentage
0 – 10 years	7	9.7
11 – 20 years	6	8.3
21 – 30 years	12	16.6
31 – 40 years	20	27.8
41 – 50 years	10	13.9
51 – 60 years	10	13.9
> 60 years	7	9.7

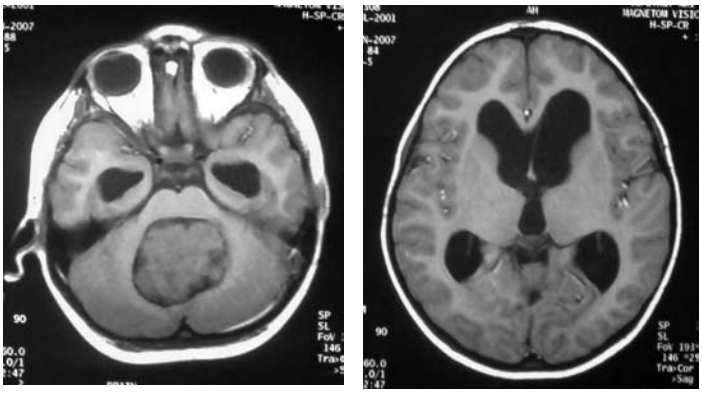


Figure 2. 8/M with medulloblastoma and severe hydrocephalus

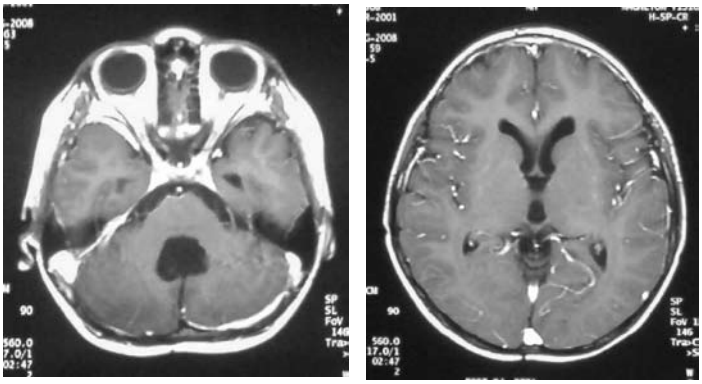


Figure 3. 1 year post-excision without CSF diversion

Table 2. Number of patients according to tumor type

Tumor type	Frequency	Percentage
Vestibular Schwannoma	30	41.8
Medulloblastoma	9	12.5
Hemangioblastoma	9	12.5
PilocyticAstrocytoma	4	5.5
Meningioma	8	11.1
Metastasis	4	5.5
Miscellaneous*	8	11.1

**3 cerebellardermoid cysts, 2 tuberculomas, 1 arachnoid cyst*

Table 3. Number of Patients according to degree of hydrocephalus

Degree of Hydrocephalus	Number	Percentage
Mild	10	14%
Moderate	31	43%
Severe	31	43%

Postoperative persistence of symptomatic hydrocephalus was observed and confirmed by CT scan in 5.6% (4/72). The profile of the patients in whom a postoperative recurrence of the hydrocephalus is summarized in Table 4. These patients eventually underwent VP shunting, one week to 27 days after tumor excision, with unremarkable post-op course.

Among the patients who required postoperative CSF diversion, the following clinical factors showed significant association with the need for postoperative shunting: age < 10 years, midline tumor location, subtotal resection and medulloblastoma type of tumor.

Table 4. Profile of patients with post-operative persistent hydrocephalus

Age/ gender	Tumor location	Tumor Type	Degree of Pre-operative Hydrocephalus	Extent of Resection
2/M	Midline	Medulloblastoma	Severe	Subtotal
5/F	Midline	Medulloblastoma	Severe	Subtotal
8/F	Midline	Medulloblastoma	Severe	Subtotal
37/M	Midline	Hemangioblastoma	Severe	Total

Table 5. CT findings of patient with post-operative persistent hydrocephalus

Patient ID	CT findings
1	Residual tumor on floor of 4th ventricle < 1.5 cm 2
2/M	Moderate hydrocephalus
2	Residual tumor on floor of 4th ventricle < 1.5 cm 2
5/F	Moderate hydrocephalus
3	Residual tumor on floor of 4th ventricle > 1.5 cm 2
8/F	Severe hydrocephalus
4	No residual tumor
37/M	R cerebellar swelling with effacement of 4th ventricle Moderate hydrocephalus

Table 6. Odds Ratios and p Values for the variables tested

Patient ID	Shunted (%)	Odds Ratio	p Value
Age			
<10	50%	65.0	**0.001**
>10	1.5%		
Tumor Location			
Midline	21%	15.5	**0.022**
Hemispheric	1.7%		
Degree of hydrocephalus			
Mild	0%		
Moderate	0%		
Severe	0%		
Extent of Resection			
Total	1.6%	17.4	**0.018**
Subtotal	23%		
Tumor Type			
Vestibular Schwannoma	0%	0.252	0.219
Medulloblastoma	33%	31.0	**0.005**
Hemangioblastoma	11%	2.5	0.451
Meningioma	0%	1.356	0.792
Pilocytic Astrocytoma	0%	2.6	0.422
Metastases	0%	2.6	0.422
Dermoid Cyst	0%	3.3	0.324
Tuberculoma	0%	4.467	0.229
Brainstem Glioma	0%	4.467	0.229
Arachnoid cyst	0%	6.7	0.146

Discussion

Patients in this study showed a demographic profile similar to other series. The tumor type distribution shows a larger than usual proportion of vestibular schwannoma. This is most probably due to referral bias as to the main author's practice.

Eighty-six percent (86%) showed moderate to severe hydrocephalus, emphasizing the clinical significance of this process to the overall treatment of patients with posterior fossa tumors. Despite the severity of the hydrocephalus, all tumors were excised without difficulty pertaining to increased intracranial pressure or cerebellar tension. The maneuver of draining CSF from the cistern magna area afforded adequate release of pressure, as also evidenced by the fact that no patient needed an introperative tube/ external ventricular drainage (EVD). The low complication rate noted post-op, 4.2%, also supports the safety of this technique.

Some advantages have been mentioned for preoperative shunting or intra-op EVD in the literature postoperatively.[4] Hosseini et al. (2005) emphasize that preoperative VP shunts significantly decrease the pressure of the tense posterior fossa and allow a more appropriate approach to tumor removal. Moreover, it significantly reduces the rates of postoperative CSF leak and formation of pseudomeningocele. These adverse effects make the patient prone to septic meningitis and protracted surgical wound healing.[2]

However, EVD and shunt complications such as infections, hemorrhage at entry site, obstruction, upward herniation and epidural hematomas,[1,9] cannot be disregarded. There is still a lack of randomized controlled trials showing better outcomes, fewer complications and acceptable risk:benefit ratios for CSF diversion during posterior fossa surgery.

Sainte-Rose et al. presented good results with endoscopic third ventriculostomy for posterior fossa tumor patients with hydrocephalus.[3] The main criticism to this is that since it was done for all patients preoperatively, there may be a significant number of patients who may not have really needed the procedure after all.

Evacuation of CSF by opening the cistern magna is a faster and equally effective CSF diversion procedure, obviating the possible complications of shunting and EVD insertion and decreasing the number of unnecessary surgeries. However, vigilance for post-op hydrocephalus should still be observed. Knowing the factors which may heighten suspicion to post-op CSF flow problems requiring VP shunting will aid in the timely diagnosis and intervention of this potentially life-threatening condition.

Variables previously found to correlate with postoperative shunting are: age at tumor diagnosis, midline tumors, large tumors, subtotal tumor excision, CSF infections, prolonged EVD, and tumor type.

Young age at tumor diagnosis has been cited as one predictive factor for postoperative CSF shunting. Culley et al.[1]showed that patients requiring postoperative shunts were younger and of those less than three years of age, 68% required postoperative shunts, versus 23% of those over the age of three. These results are similar to those of Papo,[5] who found that children less than 10 years of age had a higher incidence of postoperative shunt placement when compared with older children. The results of the current study showed that for those children less than 10 years of age, half required postoperative shunting. This supports previous studies on young age as a predisposing factor for subsequent shunting. An important aspect of this finding is that these young children all had medulloblastomas, which

are midline lesions and therefore, also inherently with high risk for postoperative shunting as shown by previous studies. Midline tumors in our study had a significant shunt insertion rate of 33%, supporting previous studies of percentages shunted as high as 40%.[1]

Subtotal tumor resection shows a significant trend for subsequent shunting in our series. Literature on extent of excision reveals differences in conclusions as to whether or not subtotal resection is indeed a significant predictor of the need for a postoperative shunt. The study of Stein et al.[20] showing an increased risk of requiring a postoperative shunt with a gross total excision explains that this was due to an increased CSF inflammatory reaction when a large resection cavity was exposed to the CSF spaces. Other investigators have noted a significant increase in postoperative shunt placement for less than complete tumor resection.[21] Culley et al., however, determined that the extent of excision was not a statistically significant predictor for postoperative shunting.

Regarding degree of hydrocephalus, all four patients eventually shunted in our study had severe hydrocephalus at the time of diagnosis. Although previous studies show conflicting conclusions on the correlation of degree of hydrocephalus and postoperative shunting, this parameter should be kept in mind and influence the decision for CSF diversion.

In our study, medulloblastoma was found to have a significant correlation with subsequent need for a shunt, assuming independence for tumor type. However, these were also midline tumors and subtotally resected and giving consideration to interactions within the variables mentioned, it is prudent not to draw conclusions. The numerical observations are too small to analyze possible interactions.

Conclusions

The management of hydrocephalus in posterior fossa tumors without CSF diversion in this series has shown efficacy in terms of intraoperative control of increased intracranial pressure and cerebellar tension. The need for an external ventricular drainage intaoperatively was eliminated. There is a low, acceptable and reversible, complication rate which makes the procedure safe to adopt. The good clinical outcome and low postoperative shunt insertion rate in our series leads us to believe that posterior fossa tumor surgery without CSF diversion is a safe and effective treatment plan for posterior fossa tumors with hydrocephalus, and routine CSF diversion for posterior fossa tumor surgery may not be entirely justified. Factors such as age, tumor type, tumor location, degree of hydrocephalus and extent of excision, which showed a statistically significant association with the postoperative shunt requirement in our study, should be considered when the decision regarding CSF diversion is made.

References

1. Culley DJ, Berger MS, Shaw D, Geyer R. An analysis of factors determining the need for ventriculoperitoneal shunts after posterior fossa tumor surgery in children. Neurosurgery. 1994 Mar;34(3):402-408.
2. Abdollahzadeh-Hosseini SM, Rezaishiraz H and Allahdini F. Management of Hydrocephalus in Posterior Cranial Fossa Tumors. Acta Medica Iranica. 2005 Apr;44(2):89-94.
3. Sainte-Rose C, Cinalli G, Roux FE, et al. Management of hydrocephalus in pediatric patients with posterior fossa tumors: the role of endoscopic third ventriculostomy. J Neurosurg. 2001 Nov;95(5):791-797.
4. Fritsch MJ, Doerner L, Kienke S, Mehdorn HM. Hydrocephalus in children with posterior fossa tumors: role of endoscopic third ventriculostomy. J Neurosurg. 2005 Jul;103(1Suppl):40-2.
5. Papo I, Caruselli G, Luongo A. External ventricular drainage in the management of posterior fossa tumors in children and adolescents. Neurosurgery. 1982 Jan;10(1):13-5.
6. Bognar L, Borgulya G, Benke P, Madarassy G. Analysis of CSF shunting procedure requirement in children with posterior fossa tumors. Child's Nerv Sys. 2003 Jun;19:5-6.
7. Choe IS, Seo DH, Rhee WT, et al. Therapeutic Results of Posterior Fossa Tumors with Hydrocephalus. Korean Neurosurg Soc. 2002 Dec;32(6):535-542.
8. Schijman E, Peter J, Rekate H, Spiros S, Wong T. Management of hydrocephalus in posterior fossa tumors: how, what, when?.Child's Nerv Sys. 2004 Mar;20(3) 1-4.
9. Ehtesham G, Ghalib IZ, Muhammad N, Lal R, Muhammad AN, Khaleeq Z. Role of
Cerebrospinal Fluid Diversion in Posterior Fossa Tumor Surgery. J Coll Physicians Surg Pak. 2003 Jun;13(6):333-6.
10. Vaquero J, Cabezudo JM, de Sola RG, Nombela L. Intratumoral hemorrhage in posterior fossa tumors after ventricular drainage. Report of two cases. J Neurosurg. 1981 Mar;54(3):406-408.
11. Robertson PL, Allen JC, Abbott IR, Miller DC, Fidel J and Epstein FJ. Cervicomedullary tumors in children: A distinct subset of brainstem gliomas. Neurology.1994 Mar;44:1798-1804.
12. Osborn AG, Heaston DK, and Wing SD. Diagnosis of ascending transtentorial herniation by cranial computed tomography. American Journal of Roentgenology. 1978;130(4):755-760.
13. Jallo GI, Freed D, Roonprapunt C and Epstein F. Current Management of Brainstem Gliomas. Annals of Neurosurgery. 2003; 3(1): 1-17.
14. Albright AL, Wisoff JH, Zeltzer PM, et al. Effects of medulloblastoma resections on outcome in children: a report from the Children's Cancer Group. Neurosurgery. 1996;38:265-271.
15. Cohen MD. Treatment strategies for medulloblastoma and primitive neuroectodermal tumors. Neurosurg Focus. 1999;7(2):Article 1.
16. Gnalalingham K, Lafuente J, Thompson D, Harkness W, Hayward R. Surgical procedures for posterior fossa tumors in children: does craniotomy lead to fewer complications than craniectomy?. J Neurosurg. 2002;97:821–826.
17. Conway JE, Chou D, Clatterbuck RE, et al. Hemangioblastomas of the Central Nervous System in von Hippel-Lindau Syndrome and Sporadic Disease. Neurosurgery. 2001 Jan;48(1):55-63.
18. Samii M, Gerganov V, Samii A. Improved preservation of hearing and facial nerve function in vestibular schwannoma surgery via the retrosigmoid approach in a series of 200 patients. J Neurosurg. 2006 Oct;105 (4).
19. Rutka J, Kuo J. Pediatric surgical neuro-oncology: current best care practices and strategies. J Neuro-Oncology. 2004;(69):139–150.
20. Stein BM, Tenner MS, Fraser RAR. Hydrocephalus following removal of cerebellarastrocytomas in children. J Neurosurg. 1972;36:763-768.
21. Dias MS, Albright AL. Management of hydrocephalus complicating childhood posterior fossa tumors. Pediatr Neurosci. 1989;15:283-296.