Surgical Management and Short-Term Outcome of Patients with Posterior Fossa Tumor in All Age Groups: Our Perspective

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Abstract

Background:
Different types of brain tumor can occur in the region of posterior fossa. Ependymoma, medulloblastoma and pilocytic astrocytoma occur mostly in children and rarely in adults. Brain metastases in adults are the most common malignancies at this site. Other tumors that occur in the posterior fossa are meningioma, schwannoma, hemangioblastoma, brain stem glioma and epidermoid tumors. Posterior fossa tumor has different treatment approaches and prognosis. So, an accurate diagnosis, surgical approaches, complication analysis and outcome assessment are mandatory.

Objective:
To evaluate the clinical aspects, surgical approach, role of preoperative shunt, post-operative complications, and short-term outcome of patients with posterior fossa tumor in different age groups.

Methods:
This cross-sectional observational study included 36 patients with posterior fossa tumors that were admitted and operated in the Neurosurgery Department of Rangpur Medical College Hospital between the period of November 2018 and June 2022. In each patient clinically diagnosis was confirmed by MRI of Brain with contrast followed by histopathology.

Results:
Out of 36 patients, 23(63.9%) patients were male and 13(36.1%) were female. Mean age was 18.01±13.95 SD years (minimum 6 months and maximum 45 years), more common in pediatric age group (36.1% <10 years and 25% between 11-20 years). Common presentations were headache (91.6%), vomiting (83.3%) and ataxia (72.2%). Medulloblastoma (27.8%) and ependymoma (25%) were common histological types. Surgical outcome was excellent in 17 cases (47.2%), while poor in 5.6% and 19.4% patients died. There was no statistically significant association of surgical outcome with age (p=0.148) and sex (p=0.170). Suboccipital craniotomy was superior to other surgical procedures in terms of patient's outcome (p=0.031). Ependymomas and Astrocytomas had better outcome (p=0.014).

Conclusions:
Surgical outcome is related to the operative approach and histology of the tumor in this study, but no significant association of patient's outcome with age, sex and preoperative procedure.

Keywords: Posterior fossa tumor, Ventriculoperitoneal shunt, Craniotomy, Tumour histology, Surgical outcome

Introduction:

The posterior fossa of the cranial cavity, also called infratentorial space, limited by the tentorium above, has much smaller space than the rest of the cranial cavity. However, the contents of such a comparably small space are several types of motor and sensory tracts and several vital nuclei and reticular formation for the systemic body functions and consciousness in the form of midbrain, pons, and medulla. Also packed with cranial nerves, vascular network with large venous sinuses, changing volume of cerebrospinal fluid (CSF) in the ventricle and cisterns, and prominently visible cerebellar parenchyma with nuclei and peduncles. Most of the time, the posterior fossa tumors (PFTs) present themselves as an acute emergency following the compression of the brainstem either due to the increase in tumor size, edema, bleed, or

obstruction to CSF pathways and herniation.[1]

Prevalence of posterior fossa tumors in children is more common than in adults. 44-70% of all brain tumors in children are present in the posterior fossa but 15–20% in adults. These tumors occur in males than females.[2]

Medulloblastoma, ependymomas and pilocytic astrocytoma occur more frequently in childhood. Tumors such as metastatic lesions, lymphomas and hemangioblastoma are more common in adulthood.[3] Intracranial dermoid tumors have a rare percentage of all intracranial tumors, about 0.1–0.7%.[4]

The clinical presentation varies according to the tumor site, its biological behavior and aggressiveness, and its growth rate. Symptoms may be due to focal compression on the cerebellum or brain stem, or from increased intracranial tension.[5]

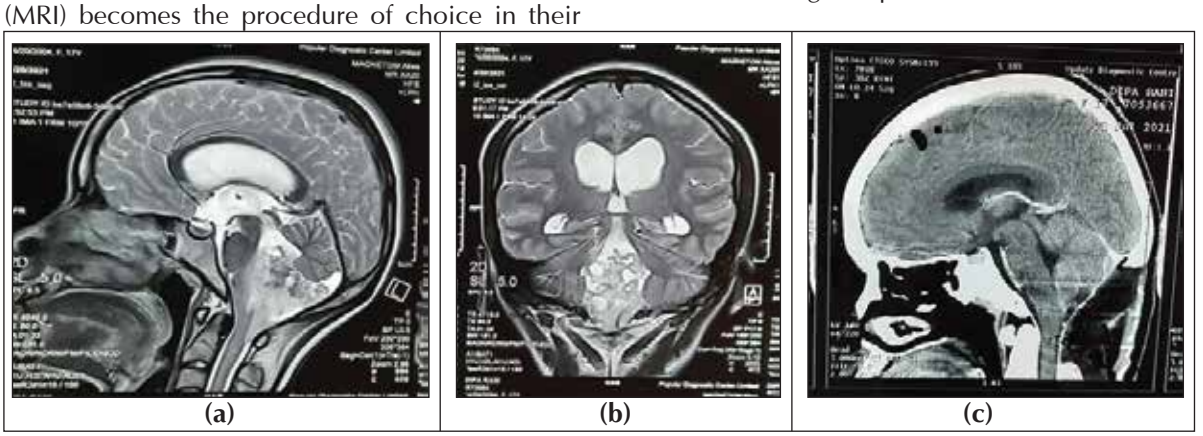
The modern neuroimaging modalities lead to their diagnoses at earlier stages of the disease. Computed tomography (CT) delineates the presence of posterior fossa tumors in more than 95% of cases, but magnetic resonance imaging (MRI) becomes the procedure of choice in their diagnosis.[6]

Surgical debulking, to relieve the pressure on the brainstem, though full of risks, is an indispensable mode of management. However, in such a small space, the intraoperative complications and postoperative disease progression owing to residual, or recurrence of the lesion worsen the surgical outcome. In 1930, an account of 61 patients of PFTs was published by the most cherished neurosurgeon of the world, Cushing H, claiming fatal outcome in almost all.[7]

The aim of our study was to determine the clinical aspects of patients, histopathological variety of tumor, analysis of post-operative complications and surgical short-term outcome of patients with posterior fossa tumor in all age groups.

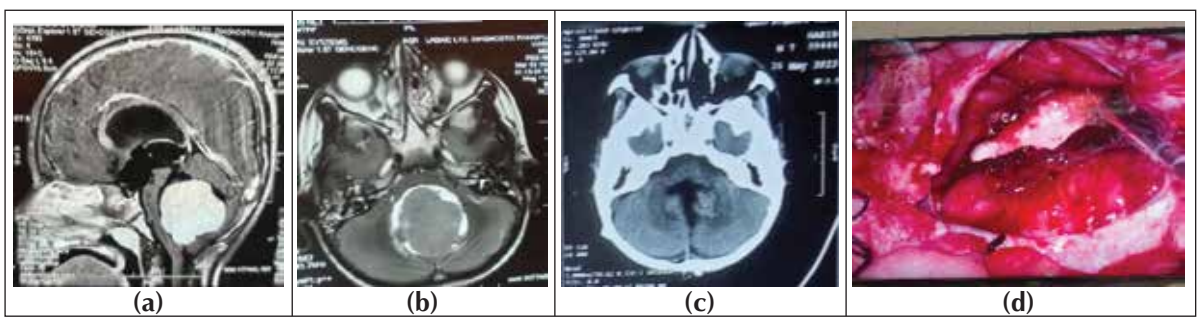
Methods:

The cross-sectional study was conducted between a period of November 2018 and June 2022 at the Neurosurgery department of Rangpur Medical College Hospital. 36 patients of all age groups that were admitted during this period and given consent for surgical procedure were included.



(a) (b) (c)

Figure-1: Preoperative radiological image in a 17-year-old lady showing posterior fossa mass lesion (heterogeneous lesion occupying fourth ventricle) a. sagittal T2W image b. Axial T2W image. Histopathology was Ependymoma Gr II, c) Postoperative CT scan showing complete removal of tumor.



(a) (b) (c) (d)

Figure-2: (a) Preoperative radiological image with IV contrast in a 7yrs old boy showing posterior fossa tumor (solid contrast enhancing), (b) axialT2W tumor occupying 4th ventricle, (c) postoperative CT scan showing complete removal of tumor (d) floor of fourth ventricle after complete removal of tumor.

After through clinical evaluation CT scan of Brain as well as MRI with contrast enhancement was done for all cases before surgery followed by investigations for operative fitness.

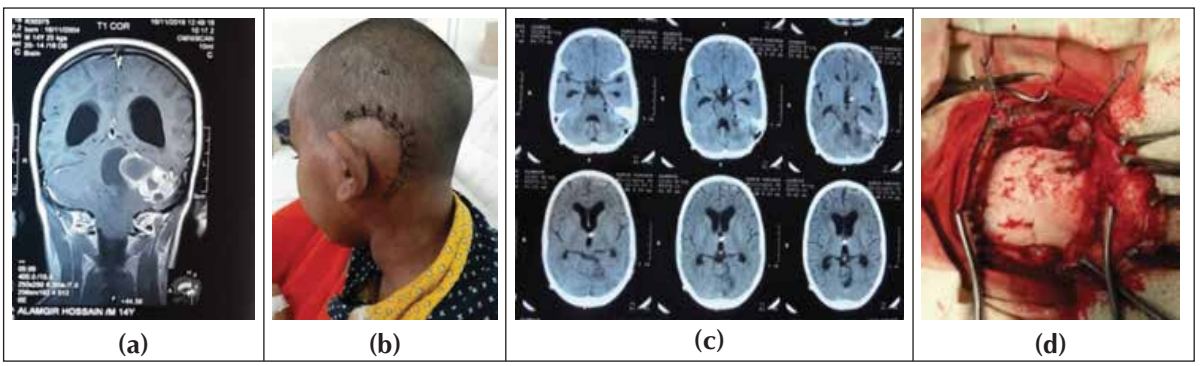
Pre-operative Shunt:

VP shunt/ ETV was done in patients with obstructive hydrocephalus with gross ventriculomegaly and features of raised intracranial pressure. Those having mild to moderate ventriculomegaly, and not symptomatic, single stage surgery was done.

Operation notes:

The surgery was performed under general anesthesia. Midline suboccipital craniotomy/ craniectomy was done according to the size and extension of tumor. In cases where there is caudal extension of tumor, foramen magnum decompression was done, and posterior arch of Atlas was removed. In the case of suboccipital craniotomy bone flap was replaced during closure. Approach was either telovelar or trans-vermian according to the accessibility of the tumor. In cerebellar tumor, transverse folial incision was given. Retro-mastoid retro-sigmoid approach done in "park bench" position with an incision shaped like the pinna of the ear, 3 finger breaths behind the external auditory canal.

Goal of Surgery was complete microsurgical excision of the tumor unless that tumor was invading the brain stem or attached to important vessels or nervous tissue. The extent of tumor removal was to avoid possible risk of complications, if adherent to the floor a small portion was left behind.



(a) (b) (c) (d)

Fig 3: Coronal contrast image of a 14-year-old boy showing a) Posterior fossa tumor (in left CP angle location), b) incision used in retro sigmoid approach c) Post op CT scan d) Exposure of asterion.

Post operative follow up:

Post –operative follow up CT scan of Brain done from POD-0 to 3rd post-operative day to rule out any complications. Patient was followed up after one- and three-months interval, for any recurrence or residual tumor by contrast CT scan of Brain. Outcome was categorized as excellent, good and poor after 3 months of follow up.[5]

- Excellent: total tumor excision with no neurological deficit
- Good: subtotal excision with no or reversible neurological deficit or total excision with reversible neurological deficit
- Poor: subtotal or total excision with irreversible neurological deficit

Patient was sent to oncologist for further radiotherapy or chemotherapy according to tumor histology.

The program used in our study was IBM SPSS 25. Quantitative data were analyzed using mean and standard deviation, while frequency and percentage were used with qualitative data. Pearson chi-square test was used to analyze qualitative data. A p-value <0.05 was considered statistically significant.

Results:

The mean age of the participants was 18.01±13.95 years with minimum age 6 months and maximum 45years and more frequently occur in younger age group, 36.1% of patients were below age 10 years and 25% were within 11- 20 years of age. Majority of the patients were male (63.9%). Headache was the most common presentation in all age group (91.6%), followed by vomiting (83.3%) and ataxia

Table-I: Sociodemographic characteristics and clinical presentations of the respondents (n=36)

Sociodemographic characteristics	no. (%)
Age group	
0-10 ears	13(36.1)
11-20 years	9(25.0)
21-30 years	6(16.7)
31-40 years	6(16.7)
41-50 years	2(5.6)
Sex	
Female	13(36.1)
Male	23(63.9)
Clinical presentation	
Headache	33(91.6)
Vomiting	30(83.3)
Cranial nerve palsy	7(19.4)
Ataxia/imbalance	26(72.2)
Enlargement of head	5(13.8)

(72.2%). Progressive enlargement of head with head lag was present in 5(13.8%) of patients below 3 years of age. (Table-I)

Obstructive hydrocephalus was present in 80.6%(29) of patients, among them 21(58.3%) patients underwent preoperative VP shunt. Most of the patients underwent suboccipital craniectomy (66.7%) followed by suboccipital craniotomy (27.8%), and retro-sigmoid approach (5.6%). Post-operative hematoma occurs in 11.1% patients, hematoma was resolved spontaneously in one patient one month later. But three patients expired on day after surgery. CSF leakage with pseudo-meningocele formation occurs in 4 patients (11.1%). In three patients it stopped spontaneously, but one patient of 15 months age, it continued, later meningitis developed, and the child expired 14 days later. Posterior fossa syndrome develops in one (2.8%) patient that was completely recovered. Residual tumor was found in 3(8.3%) cases, in one patient revision surgery done with good outcome. But two patients expired on 5th post-operative day. Epidermoid was done in 2 cases (5.6%), in one patient developed chemical meningitis and wound infection, later the patient expired on 8th post-operative day. Common histological types were medull-

Table-II: Surgery related characteristics and outcome of the patients (n=36)

	no. (%)
Preoperative procedure	
VP shunt	21(58.3)
ETV	1(2.8)
Combined	2(5.6)
No procedure	12(33.3)
Type of surgery	
Retrosigmoid	2(5.6)
Suboccipital craniectomy	24(66.7)
Suboccipital craniotomy	10(27.8)
Post-operative complication	
Post-operative hematoma	4(11.1)
Psedomeningocele with CSF leakage	4(11.1)
Wound infection	3(8.3)
Posterior fossa syndrome	1(2.8)
Cranial Nerve palsy	1(2.8)
None	17(47.2)
shunt malfunction	3(8.3)
Residual tumor	3(8.3)
Histology of tumour	
Medulloblastoma	10(27.8)
Ependymoma	9(25.0)
Cerebellar astrocytoma	7(19.4)
Epidermoid	2(5.6)
Pilocytic astrocytoma	3(8.3)
Haemangioblastoma	3(8.3)
Vestibular schwannoma	1(2.8)
Arachnoid cyst	1(2.8)
Surgical outcome	
Excellent	17(47.2)
Expired	7(19.4)
Good	10(27.8)
Poor	2(5.6)

oblastoma (27.8%) and ependymoma (25%). Surgical outcome was excellent in 17 cases (47.2%), while poor in 5.6% and 19.4% patients died. (Table-II)

Table-III showed the association of sociodemographic and surgery related variables with patient's. There was no significant association of patient's outcome with age, sex and preoperative procedure (VP shunt/ ETV) (p-value>0.05). Rather higher mortality occurs in

Table-III: Association of different variables with patient's outcome

	Outcome of patent				Total	p-value
	Excellent	Good	Poor	Expired		
Age group						
0-10 years	6	4	0	3	13	
11-20 years	5	4	0	0	9	
21-30 years	2	2	0	2	6	0.148 ns
31-40 years	3	0	1	2	6	
41-50 years	1	0	1	0	2	
Sex						
Male	10	8	0	5	23	0.170 ns
Female	7	2	2	2	13	
Pre-operative procedure						
VP shunt	7	6	2	6	21	
ETV	1	0	0	0	1	0.182 ns
Combined	0	2	0	0	2	
No pre-op procedure	9	2	0	1	12	
Type of surgery						
Retro-sigmoid	0	1	1	0	2	
Suboccipital craniectomy	10	6	1	7	24	0.031 S
Suboccipital craniotomy	7	3	0	0	10	
Histopathology						
Medulloblastoma	4	3	0	3	10	
Ependymoma	6	2	0	1	9	
Cerebellar astrocytoma	4	3	0	0	7	
Epidermoid	0	0	1	1	2	0.014 s
Pilocytic astrocytoma	2	1	0	0	3	
Hemangioblastoma	1	1	0	1	3	
Vestibular schwannoma	0	0	1	0	1	
Arachnoid cyst	0	0	0	1	1	

ns=not significant, s=significant

VP shunt group. Suboccipital craniotomy was superior to other surgical procedure in terms of patient's outcome (P-value <0.05). Ependymomas and Astrocytoma had better outcome (p-value <0.05).

Discussion:

An understanding of the clinical presentation, differential diagnosis, work–up, and treatment of these lesions will assist all physicians in the care of a patient with this medical condition.[12]

The treatment options that exist for posterior fossa masses include observation, microsurgery, and stereotactic radiotherapy. Treatment decision is based on the type, size, and location of the lesion, whether there are related symptoms or signs, and to a large degree patient's preference. Treatment decisions should be made with the goal of tumor control with maximal patient benefit without creating morbidity.[13]

In this study, the mean age was 18.01±13.95 SD years. The minimum age was 6 months and maximum 45 years; 36.1% patients were below the age of 10 years and 25% patients within 11- 20 years of age, reflecting posterior fossa tumor are frequent in younger age group in this study. Out of 36 patients, male was more frequent [23(63.89%)]. There was no statistically significant correlation of surgical outcome with age (p=0.148) and sex (p=0.170) of the patients.

Hamid Akbar Shaikh et al revealed among 66 patients, the mean age was 31.21±18.49 years (95% CI: 26.66 to 35.75). The minimum age of the patient was 11 months and maximum 75 years. There were 41(62%) males and 25(38%) females. Good surgical outcome was observed in the group of 11 to 30 and 41 to 50 years. Good surgical outcome was similar in male and female patients in their study.[8]

Headache (91.6%) and vomiting (83.3%) were the predominant symptoms which coincided with the study conducted by Emara et al,[9] who found that headache and vomiting as primary presenting symptoms in 90.9% and 77.3%, respectively.

In our study post-operative hematoma occur in 4 patients (11.1%), of them in one patient hematoma was resolved spontaneously that was evidenced by follow up CT scan one month later. Preoperatively lower cranial nerve palsy was present in 19.4% partially improved in six patients, in one patient remain.

Emara et al found that surgical complications were hemorrhage in 13.6% of cases which was resolved spontaneously without need for surgery, and lower cranial nerve palsy (bulbar) occurred in 9.1% of cases (three improved partially and the fourth need tracheotomy).[9]

The present study revealed that excellent outcome in 17 patients (47.23%) with no post-operative complications. Good outcome with mild neurological deficit in 10(27.7%), poor outcome in 5.6% of patients.

Study conducted by Shaikh et al study concluded the surgical outcome was good in 77% of their studied group while poor outcome (moderately disable, not to perform daily activities independently or have neurological deficit) in 23%.[8]

In this study preoperative VP shunt was given in 21(58.3%), ETV in 1(2.8%) patient, combined procedure (VP shunt plus ETV) done in 2(5.6%) patients and in 12(33.3%) patients single stage surgery was done. Comparison done with outcome of patients that show no variation, rather mortality is higher in VP shunt group (p=0.182).

Robert et al. found that permanent cerebrospinal fluid diversion was needed in 33% of patients.[10] In another study, V-P shunt was inserted in 53% of patients.[11] Goel et al reviewed the data of 59 PFT patients with evidence of increased ICP presenting at their center and concluded that pre-resection CSF diversion procedures were not always indicated. Twenty-six patients underwent pre-operative shunt surgeries, and one patient required a post-operative shunt. Complications were seen in 15 patients, with 5 developing shunt infections, 2 developing shunt blockage warranting revision surgery, and 2 patients developing post-operative tension pneumoce phalus, requiring an additional burr-hole: a rather unusual statistic. The author also noticed increased difficulty in tumor removal due to the proximity of tumor to the brainstem following shunt insertion.[14]

Regarding surgical approach, suboccipital craniotomy was done in 10(27.8%), suboccipital craniectomy in 24(66.7%) and retro-sigmoid approach in 2(5.6%) of patients in this study. In this study CSF leak with pseudo meningocele formation occur in 4(11.1%) and wound infection 3(8.3%) in craniectomy but no such complication in craniotomy group. Suboccipital craniotomy was superior to other surgical procedures in terms of patient's outcome (p=0.031).

FG Legnani et al (2013) conducted a study in 152 patients, craniotomy done in 100 patients and craniectomy in 52 patients. In the study they detected no dural damage after bone removal in both groups. The total complication rate related to the technique itself was 7% for the craniotomy group and 32.6% for the craniectomy group (<0.0001). Pseudomeningocele occurred in 4% vs. 19.2%, CSF leak in 2% vs. 11.5% and wound infection in 1% vs. 1.9%, respectively. They concluded that suboccipital craniotomy and craniectomy are two widely adopted techniques to access the posterior fossa and craniotomy is associated with fewer postoperative complications.[15]

Our study showed medulloblastoma in 27.8%, ependymoma in 25% and cerebellar astrocytoma in 19.4% of cases. Ependymomas and Astrocytoma had better outcome (p=0.014). In a previous on 66 patients, medulloblastoma (29.26%) and pilocytic astrocytoma (29.26%) were the common posterior fossa brain tumors.[8]

Conclusion:

The surgical management of posterior fossa tumor still represents a challenge for Neurosurgeons. Surgical outcome is related to the operative approach and histology of the tumor in this study, but no variation is seen according to the age of the patient and pre-operative procedure as VP shunt/ETV, in comparison to single stage surgery.

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