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Original Research

Complications following Pediatric Posterior Fossa Tumors Surgery

Muhammad Tariq[1], Faiqa Filza[1], Mustafa Qazi[2], Salman Zahir[2], Muhammad Bilal[3]

[1]Department of Neurosurgery, Northwest General Hospital & Research Center, Peshawar

[2]Department of Medicine and Surgery, Northwest General Hospital & Research Center, Peshawar

[3]Department of Medicine and Surgery, Khyber Teaching Hospital, Peshawar – Pakistan

ABSTRACT

Objective: Addressing posterior cranial fossa tumors in children is a complicated endeavor in the field of pediatric neurosurgery. While surgical procedures provide hope, they also carry substantial risks. The goal of this study was to identify complications postoperatively occurring after posterior fossa tumor surgery in the pediatric population.

Materials and Methods: A retrospective review of cases of children under 15 years who underwent surgery for Posterior fossa tumors was conducted. Documented complications arising in the postoperative phase, in-hospital mortality rates, their management, and the patient's general well-being were tracked till discharge. Complications were categorized based on a contracted version of the original Clavien-Dindo system, a system that was specifically designed for ranking the severity of surgical complications.

Results: 64.5% of males and 35.4% of females have a mean age of 9.22 ± 1.7 years. Between the onset of symptoms and the diagnosis, the average duration of time was 42.3 ± 12.8 days. The number of medulloblastoma cases was 19 and 11 cases each of ependymoma and pilocytic astrocytoma. Overall, the mean duration of stay was 8.1 ± 3.9 days. Hydrocephalous and CSF leaks from incision sites were the most frequent postop compilations, accounting for 58.3% of all the complications. Other complications reported were wound site infections in 12.5% of cases, peri-tumor edema in 16.6%, cerebellar mutism in 10.41%, tumor bed bleeds in 6.2%, and hospital-acquired pneumonia in 5.3% of cases.

Conclusion: The development of hydrocephalus and cerebrospinal fluid leaks were the most frequent complications, followed by peri-tumor edema, tumor bed hematoma, cerebellar mutism, oropharyngeal apraxia, also systemic complications including sepsis, postoperative pneumonia, and meningitis.

Keywords: Pediatric neurosurgery, Posterior fossa, Tumor, Complications, Tertiary care center, Pakistan.

Corresponding Author: Faiqa Filza
Department of Neurosurgery,
Northwest General Hospital & Research Center, Peshawar
Email: Faiqa.filza@gmail.com

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INTRODUCTION

Central nervous system tumors are the second most prevalent solid neoplasm in children and are responsible for about 60-70% of all CNS tumors that occur in the juvenile population.[1,2] Based on histology, the majority of CNS malignancies are categorized; among the three most prevalent infratentorial tumor types in children, ependymoma, medulloblastoma, and astrocytoma account for 10%, 40%, and 20-35% respectively.[1,3] in the last several decades, there has been a significant improvement in the 5-year survival rates of children with posterior fossa tumors. Currently, the rates are 90% for Astrocytomas, 60-80% for medulloblastoma, and 60% for ependymomas that are detected in childhood.[2]

Vomiting, headache, ataxia, and motor signs are some of the presenting complaints of patients with posterior fossa tumors, they can be diagnosed clinically or through imaging such as MRI brain and CT scan, with MRI being the investigation of choice. The treatment options for such tumors are ~~S~~urgical removal, chemotherapy, radiotherapy, and also shunting.[4] ~~P~~osterior ~~F~~ossa tumors can cause complications affecting the ocular afferent and efferent systems. The afferent systems can be affected by blockage of CSF flow, which can result in Obstructive hydrocephalus and Papilledema. The efferent system can be affected through injury to the abducent and trochlear nerves, altogether resulting in nystagmus, impaired gaze-stabilization mechanism, diplopia, optic nerve atrophy, and complete vision loss. One other known complication that occurs after resection of the midline posterior fossa tumor is cerebellar mutism characterized by ataxia, hypotonia, and impaired speech.[5,6] Studies have reported that 11-29% of the children undergoing Posterior fossa tumor resection would develop ~~C~~erebellar ~~M~~utism.[7] In 33-73% of the cases dysphagia is also a prominent complication of posterior fossa tumor.[8] Advancements in surgical techniques are promising for reducing complications in pediatric posterior cranial tumor surgery. Endoscopic procedures that require little to no incision have shown promise in reducing discomfort and infection at the surgical site. Additionally, surgical accuracy and safety have been increased by intraoperative imaging technologies including intraoperative MRI and neuronavigational devices.

The postoperative complications of posterior fossa tumor (PFT) surgery are mainly unknown, like uncharted territory waiting to be discovered. The available data for Pakistan is very scanty. The situation appears encouraging in Western countries, where surgical theaters have cutting-edge equipment and perioperative care is a fine art.[9,10] However, in developing countries, such as Pakistan, we face a different landscape.

Here, PFT procedures are commonly performed under less-than-ideal conditions. While anesthesiologists are undoubtedly dedicated, they may find themselves in foreign territory when it comes to neuro-anesthesia. Essential tools such as magnification, which play a critical role in improving surgical precision, can be apparent by their absence in these critical moments.[11] Furthermore, intraoperative monitoring technology, the guardian angel of surgical accuracy, is frequently unavailable in these operating rooms.[10] The restricted availability of intensive care beds during the critical postoperative period and scarcity of nursing and clinical personnel further worsen the situation.[12-14]

In light of the foregoing, we conducted this study with the primary objective of looking into the postoperative complications that children with PFT surgery experience and secondarily looking over their management. In the long run, this study will affect patient care and treatment and lead to improved outcomes.

MATERIALS AND METHODS

Study Design and Setting

A retrospective patient chart and operation theater notes review was conducted, after obtaining ethical approval from the concerned board, of the

records from December 2022 to March 2023 at Northwest General Hospital and Research Center II, Peshawar. The study design of Khan MM et al, was employed for our study after minor modifications to better suit our study aim.

Sample Size and Sampling

After screening the data of 76 patients who had undergone posterior fossa tumor excision within the allotted time, 28 of them were eliminated according to the exclusion criteria, resulting in a convenient sampling sample size of 48 cases.

Inclusion Criteria

The inclusion criteria encompassed patients of both genders who fell under the age threshold of 15 years and had been definitively diagnosed and operated for PFTs by a craniectomy.

Exclusion Criteria

Patients with primary brainstem tumors, patients who had undergone solely hydrocephalous, and patients with recurrent diseases were excluded.

Data Collection

Documented complications arising in the postoperative phase, in-hospital mortality rates, their management, and the patient's general well-being were tracked till discharge. Complications were categorized based on a contracted version of the original Clavien-Dindo system. Multiple complications in a single patient were reported as distinct cases. All patients had been operated on in the prone position by a consultant under general anesthesia, no intraoperative electrophysiological monitoring was performed, and magnification was attained with high magnification (3x-6x) binocular loupes.

Data Analysis

After the data was inputted, SPSS version 26.0 was used to produce descriptive statistics including mean, standard deviations, and frequencies.

RESULTS

Age, Gender-wise Distribution

A total of 76 individuals who had posterior fossa craniectomy surgery throughout the study period were screened; 28 of them were eliminated because they fell under the exclusion criteria. The remaining 48 patients ranged in age from 2 years to 15 years, with 31 (64.5%) male patients and 17 (35.4%) female patients.

Length of Hospital Stay

The overall mean length of stay (LOS) of the patients was 8.1 ± 3.9 days with a minimum duration of 2 days and a maximum duration of 21 days in the facility.

Clinical Manifestation and Diagnosis

The mean duration between symptoms onset and diagnosis was 42.3 ± 12.8 days. The most repeated document-presenting symptoms were headaches in 39 (81.2%) patients, nausea and vomiting in 31 (64.5%) patients followed by double vision occurring in 14 (29.1%) patients. There was a total of 29 (60.4%) patients with more than one of the above symptoms along/or with other deficits or focal symptoms.

Histological Classification of Tumors

In total, there were 19 cases of medulloblastoma, accounting for 39.5% of all cases. Ependymoma and pilocytic astrocytoma had the same occurrence, with 11 instances each, accounting for 22.9% of the total occurrences for these tumor categories. Brainstem gliomas accounted for 6 instances, accounting for 12.5% of the total. Atypical teratoid/rhabdoid tumor was the least common, accounting for only one case, or 2% of all cases. The histological subtypes of the tumors

and grades of complications are given in Table 1.

Post-operative Complications

Hydrocephalous and CSF leaks from incision sites were the most frequent postop compilations, each occurring in 14 cases and accounting for 58.3% of all the complications. Of the patients of hydrocephalus, a ventriculoperitoneal (VP) shunt was placed in 9 while an endoscopic third ventriculostomy was carried out in 5 (35.7%) patients. Of the patients of CSF leak, 11 were re-operated and the dural rent was closed followed by fibrin glue application. The remaining 3 patients benefited from lumbar drainage and conservative management.

Other complications reported were wound site infections in 6 (12.5%) cases, peri-tumor edema in 8 (16.6%), cerebellar mutism in 5 (10.41%), tumor bed bleed in 3 (6.2%) and hospital-acquired pneumonia in 7 (5.3%) cases. For the wound site infections, swabs for sent for culture and sensitivity (C/S) meanwhile starting them on empirical therapy with cefoperazone and sulbactam (2g IV BD) along with the application of airtight antiseptic dressing. C/S reports yielded Methicllin-resistant streptococcus aureus (MRSA) in 2 and S. epidermidis in 4 patients, sensitive to linezolid and ceftazidime respectively. All patients responded to the antibiotics leading to infection resolution in an average of 5 days ± 1.7 days.

Out of all the 8 patients with peri-tumor edema treated with IV steroids, oxygen therapy, and mannitol, 7 made a complete recovery. Of the 3 patients with tumor bed bleed diagnosed on non-contrast CT, only one required emergency surgery for hematoma evacuation and hemostasis. In the intensive care unit, patients suffering from hospital-acquired pneumonia were treated with broad-spectrum antibiotics, oxygen treatment, and ventilation if required. The complications are stratified against the histological subtype of the tumors in Table 2.

Table 1: Clavien-Dindo grade-based complications and tumor subtypes.

	Histological subtype of Tumor					
Grades	**Medulloblastoma n = 19 (%)**	**Ependymoma n = 11 (%)**	**Pilocytic Astrocytoma n = 11 (%)**	**Brainstem Glioma n = 6 (%)**	**AT/RT* n = 1 (%)**	**Complications n = 48 (%)**
Grade 1	4 (21.05%)	1 (9.09%)	3 (27.27%)	2 (33.3%)	-	10 (20.8%)
Grade 2	5 (26.3%)	4 (36.3%)	1 (9.09%)	-	-	10 (20.8%)
Grade 3	3 (15.7%)	2 (18.1%)	5 (45.4%)	1 (16.6%)	-	11 (22.9%)
Grade 4	5 (26.3%)	3 (27.2%)	2 (18.1%)	2 (33.3%)	1 (100%)	13 (27.08%)
Grade 5	2 (10.5%)	1 (9.09%)	-	1 (16.6%)	-	4 (8.3%)

*AT/RT stands for Atypical Teratoid/Rhabdoid Tumor.

Table 2: Particular complications in tumor subtypes.

	Histological subtype of Tumor				
Variable	**Medulloblastoma n = 27 (%)**	**Ependymoma n = 15 (%)**	**Pilocytic Astrocytoma n = 13 (%)**	**Brainstem Glioma n = 10 (%)**	**AT/RT* n = 1 (%)**
Hydrocephalus	6 (26.08%)	3 (21.4%)	4 (30.7.1%)	1	-
CSF leak	3 (13.6%)	4 (28.5%)	3 (23.07%)	4	-
Wound infection	2 (9.09%)	1 (7.1%)	1 (7.6%)	2	-
Peri tumor edema	3 (13.6%)	3 (21.4%)	2 (15.3%)	-	-
Cerebellar mutism	2 (9.09%)	2 (14.2%)	1 (7.6%)	1	-

Tumor bed bleed	1 (4.5%)	1 (7.1%)	-	-	1 (100%)
Hospital Acquired Pneumonia	3 (13.6%)	-	2 (15.3%)	2	-
Meningitis	2 (9.09%)	1 (7.1%)	-	-	-

*AT/RT stands for Atypical Teratoid/Rhabdoid Tumor.

DISCUSSION

One of the deadliest illnesses that can affect individuals is a brain tumor, particularly when it affects the brainstem and develops in the posterior fossa. Because of the restricted space in the posterior fossa and the possibility that important brainstem nuclei may be involved, tumors in this region are regarded as some of the most serious brain lesions. CNS tumors are the most frequent solid pediatric tumors, accounting for 40–50% of all cancers, and are the second most prevalent childhood tumors (20%). Between 54% and 70% of brain tumors in children are posterior fossa tumors, whereas only 15% to 20% of brain tumors in adults are of this type.[18] Before the age of three, one-third of CNS malignancies are diagnosed. Based on the kind of tumor and the patient's age, more boys than girls are affected.[19] Felice D'Arco et al, state that medulloblastoma is the most prevalent malignant pediatric brain tumor, forming nearly 40% of all posterior fossa tumors. Our study supports this claim, finding that 19 cases (39.5%) out of a total of 48 cases were of medulloblastoma.[20] In contrast, pilocytic astrocytoma, which affected 40.62% of the patients in another Middle Eastern study,[21] was the most prevalent, followed by medulloblastoma, which affected 35.93% of the patients, and Picarriello S. et al,[22] reported atypical teratoid/rhabdoid tumor as the most prevalent (27%). Medulloblastoma was reported to be 31%, ependymoma to be 26%, and pilocytic Astrocytoma to be 24% in a study from Pakistan.[23] Emara M et al, found that 90.9% of patients in their study reported headaches, and 77.3% reported vomiting. These findings were replicated in our study, where 81.2% of patients first reported headaches as their presenting symptom, followed by nausea and vomiting in 64.5% of patients.[24] Kozyrev DA et al, also noted similar results, observing that headaches were the most common reason for imaging.[25] Regarding postoperative complications, among our 48 patients, 29.1% experienced hydrocephalus, and 29.1% had CSF leakage. These were followed by 16.6% with peri-tumor edema and 14.5% with hospital-acquired pneumonia. In their investigation, Anetsberger S. et al, found that the rates of hydrocephalus were 10.5%, CSF leaks were 7.5%, and systemic infections were 1.5%. New neurological deficits, including ataxia, paralysis, dysmetria, internuclear ophthalmoplegia, and pseudobulbar palsy, accounted for the majority of complications that they reported (32.8%).[26] Although the study by Sáenz A et al, had a longer study duration and a larger number of participants than ours, the surgical site infections recorded in that study were 11.06%, which is comparable to the 12.5% observed in our study.[27] In another Pakistani study, of 40 pediatric patients, 30 (75%) needed VP shunting; of these, 22 (73.3%) were pre-operative and 8 (26.7%) were post-operative. We came across 14 individuals with hydrocephalus; 9 of them had VP shunts placed, and 5 had endoscopic third ventriculoplasty.[28]

This needs further studies to evaluate the cases of different complications and to find better ways of treatment to minimize complications in the future.

CONCLUSION

We infer from this study that of all the posterior fossa tumors, medulloblastoma was the most common, followed by ependymomas and pilocytic astrocytoma, which had the same occurrence. The most common problems were hydrocephalus and

leaks of cerebrospinal fluid; these were followed by peri-tumor edema, tumor bed hematoma, cerebellar mutism, oropharyngeal apraxia, also systemic complications including sepsis, postoperative pneumonia and meningitis. According to the Clavien-Dindo criteria for classifying surgical complications, the majority of the patients fell into Grade 4.

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Additional Information

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AUTHORS CONTRIBUTION

S. No.	Authors Full Name	Intellectual Contributions to Paper
1.	Muhammad Tariq	Study Design, Methodology, Analysis, Manuscript Writing and Approval
2.	Faiqa Filza, Mustafa Qazi Salman Zahir & Muhammad Bilal	Methodology, Analysis, Manuscript Writing and Approval