D:\Nsurg\Vol. 22, No. 4, Oct. – Dec., 2018\Nsurg-3.Doc (A) P. 177 – 182 II

ORIGINAL ARTICLE

Complications Following Posterior Fossa Tumour Surgery in Children: Experience from a Tertiary Care Neurosurgical Facility in a Developing Country

ZIA-UR-REHMAN, MUHAMMAD MUKHTAR KHAN, MIAN IFTIKHAR-UL-HAQ
Department of Neurosurgery, Hayatabad Medical Complex Peshawar

ABSTRACT

Background: *Posterior fossa tumours are the commonest childhood brain tumours with diverse clinical presentations, treatment modalities and postoperative outcomes. The literature has limited description of postoperative complications following surgery for these tumours.*

Objective: *The aim of this study is to analyse the postoperative complications, which occur after PFT surgery in children. A brief overview of the in-hospital mortality and management of these complications presented.*

Materials and Methods: *This is a retrospective chart review of children who were operated for PFTs. The occurrence of complications during the postoperative period was noted. Complications management, in-hospital mortality and overall survival was also recorded until the time of discharge. The complications are divided according to the modified Clavien-Dindo classification and outcome was stratified accordingly.*

Results: *79 (60.3%) males and 52 (39.7%) females with a mean age of 8.15 ± 3.3 years. The mean duration between symptoms onset and diagnosis was 35.3 ± 16.6 days. Overall, there were 53 (40.5%) cases of medulloblastoma, 40 (30.5%) cases of ependymoma, 34 (26.0%) cases of pilocytic astrocytoma and only 4 (3.1%) cases of atypical teratoid/rhabdoid tumours. Twenty-five (19.1%) patients developed hydrocephalous postoperatively. The most common complication was postoperative incisional CSF leak, which occurred in 17 (13.0%) patients. Wound infection was noted in 8 (6.1%) patients, eight (6.1%) of patients presented with cerebellar mutism, five (3.8%) patients had bleed in tumour bed, five (3.8%) patients had aspiration pneumonia and 7 (5.3%) patients developed hospital acquired pneumonia. The overall mean length of stay (LOS) was 5.4 ± 2.2 days (range: 3 – 12 days). The overall mortality rate was 9.9% (n = 13).*

Conclusion: *The most common complication is the development of hydrocephalous, followed by cerebrospinal fluid leaks, cerebellar mutism, peri-tumour oedema, tumour bed haematoma and systemic complications such as meningitis, sepsis and postoperative pneumonia.*

Keywords: *Posterior cranial fossa, tumour surgery, complications.*

INTRODUCTION

Posterior fossa tumours (PFTs) are one of the commonest solid tumours in children and the most common location in central nervous system (CNS) malignancies in children.[1] These tumours are diverse in their clinicopathological behaviour as well as their short and long-term outcomes. The primary mode of treatment for PFTs is complete and safe surgical resection without causing additional neurological deficits.[2] Other options include radiotherapy and chemotherapy, delivered after surgical removal of the tumour.[3] However, neurosurgeons have always feared surgery for PFTs, because of risk of injury to the brainstem and surrounding structures in the floor of the fourth ventricle as well as cerebellum.[4] Moreover, the postoperative swelling of the tumour bed and the risk of haemorrhage in this tight space can also result in life threatening complications.[5]

Date of Submission: 16-10-2018
Date of Printing: 15-12-2018

Postoperative complications after PFTs surgery are of three major types; a) neurological, b) regional and c) systemic complications. Most reports indicate a complication rate after PFTs surgery in the range of 30% to 40%.[6] However, large data on postoperative complication after PFTs surgery is scant, limited to case reports, small case series, journal editorials or expert opinions.[7] Moreover, the complication rates in the developed countries, where perioperative facilities are adequate as well as modern surgical tools are easily available, same cannot be said about developing countries like Pakistan.[8] Most of the time, these surgeries are performed under suboptimal operative conditions like anaesthesiologists who are inexperienced in neuro-anaesthesiology, non-availability of intraoperative magnification, no electrophysiological monitoring equipment and shortage of monitored intensive care (ICU) beds for effective postoperative care.[9] All of these deficiencies are superimposed on the overall shortage of both nursing and clinical staff availability.

In the light of the above, we therefore felt the need to investigate the incidence rates for postoperative complications in children undergoing PFTs surgery and the management strategies adopted at our centre. It will eventually affect patient care and improve patient outcomes.

METHODS

This is a retrospective patient chart and operating theatre chart review of the last five years (July 2011 and June 2018) at the departments of Neurosurgery, Hayatabad Medical Complex Peshawar and lady Reading Hospital Peshawar. The study commenced after obtaining approval of the hospital ethical committee. We included all patients under the age of 15 years, from both genders, with a confirmed diagnosis of PFTs who underwent posterior fossa craniectomy during the study period. Patients with primary brainstem tumours, those who were operated only for hydrocephalous management, or those with recurrent disease were excluded.

All patients underwent posterior fossa craniectomy, which were performed by one of our three senior surgeons. All patients were operated under general anaesthesia in a prone position. No electrophysiological monitoring was used during surgery and magnification was achieved using high magnification (3x-6x) binocular loupes.

Postoperative complication was defined as an event that is unexpected, appearing after surgery and that may either prolong stay at the hospital or may change the postoperative course of the recovery of the patient by warranting intervention in the form of additional medications or surgical procedure.

Favourable outcome was defined as clinical course without the incidence of complications or death or both. Unfavourable outcome include appearance of complications or death that altered the postoperative recovery or if that changed the course of management (additional medical or surgical intervention) and resulted in a delay in recovery.

All charts were screened for patient demographics, pre- and postoperative imaging findings, laboratory findings, histopathologic diagnosis, complications and their management with in-hospital mortality and overall stay at the hospital. We classified the postoperative complications according to the modified Clavien & Dindo classification for postoperative complications[10,11], which classifies postoperative complications according to the need for additional medical or surgical treatment as well as those, which may directly affect survival or result in death of the patient **Table 1**.

The data was entered and analysed using SPSS version 22.0. All descriptive variables are presented as mean ± standard deviation while categorical variables are mentioned as frequency and percentages. Univariate and multivariate analyses were performed to determine the relation between various risk factors and final outcome.

RESULTS

Two hundred and twenty patients operated during the study period with posterior fossa craniectomy were screened; out of these, 89 were excluded due to various reasons. Out of the remaining 131 patients, there were 79 (60.3%) males and 52 (39.7%) females with a mean age of 8.15 ± 3.3 years (range: 2 – 15 years).

Table 1: *Clavien et al classification of surgical complications[10, 11].*

Clavien Grade	Explanation
Grade 1	Deviation from expected course that does not require specific treatment
Grade 2	Complications requiring drug therapy, blood transfusion or nutritional

	support
Grade 3	Postoperative changes that require invasive treatment
Grade 4	Complications with imminent risk of death and need for intensive care
Grade 5	Postoperative death

The mean duration between symptoms onset and diagnosis was 35.3 ± 16.6 days (range: 10 – 75 days). The most common presenting complaints were headache and vomiting, which occurred in nearly 86.3% (n = 113) patients. This was followed by cranial nerve deficits in 69 (52.7%) and other focal neurologic deficits in 51 (38.9%).

Table 2: *Complications grading according to Clavien-Dindo classification.*

Complication Grade	Frequency (%)
Grade 1	6 (4.6%)
Grade 2	13 (9.9%)
Grade 3	41 (31.3%)
Grade 4	8 (6.1%)
Grade 5	13 (9.9%)

Overall, there were 53 (40.5%) cases of medulloblastoma, 40 (30.5%) cases of ependymoma, 34 (26.0%) cases of pilocytic astrocytoma and only 4 (3.1%) cases of atypical teratoid/rhabdoid histological variants. Hydrocephalous was identified in 35 (26.7%) patients preoperatively.Shunt was performed in 17 (13%) patients and endoscopic third ventriculostomy (ETV) was performed in 8 (6.1%) preoperatively.

Twenty-five (19.1%) patients developed hydrocephalous postoperatively; 22 (16.8%) patients of these underwent ventriculoperitoneal (VP) shunt insertion and three patients underwent postoperative ETV. Seven additional patient underwent postoperative ETV due to shunt malfunction in preoperatively shunted patients.

The most common complication was postoperative incisional CSF leak, which occurred in 17 (13.0%) patients. Eight (47.1%) of these patients underwent reoperation, where we opened the wound and closed the dural rent followed by application of fibrin glue application. Four (23.5%) of the remaining five patients were relieved with lumbar drainage and conservative measures. One patient died due to severe meningitis and concomitant sepsis **Table 3**.

Wound infection was noted in 8 (6.1%) patients. Culture swabs were taken from the wounds and empirical antibiotics (ceftazidime 30-50 mg/kg, 8 hourly) were started as well as local wound cleaning with 2% pyodine solution followed by application of airtight dressing. In 6 of these patients, S. epidermidis was identified as the causative agent and all were sensitive to ceftazidime. All of these patients responded to antibiotic therapy and the infection was resolved within an average of 6 days **Table 3**.

Eight (6.1%) of patients presented with cerebellar mutism. Histologically, 5 (62.5%) patients had medulloblastoma, 2 (25%) had ependymoma and 1 (12.5%) had pilocytic astrocytoma. All of these patients were managed expectantly.

Five (3.8%) patients had postoperative worsening of neurological status and were found to have a bleed in the tumour beds on a non-enhanced CT scan of brain. Histologically, three (60%) of these cases were from the pilocytic astrocytoma, and one (20%) each for medulloblastoma and ependymoma. Four (80%) of these patients required urgent reoperation, evacuation of haematoma and securing haemostasis. None of these patients had derangement of their coagulation profile or platelet counts **Table 4**.

Six (4.6%) patients showed neurological worsening due to parenchymal oedema around the tumour bed. All of these patients were treated with intravenous steroids, head elevation, oxygen inhalation and mannitol administration. One (16.7%) patient died in ICU due to worsening of neurological status.

Five (3.8%) patients had aspiration pneumonia; four (80%) of these patients progressed to respiratory failure and eventually died despite best possible ICU care. Similarly, 7 (5.3%) patients developed hospital acquired pneumonia and were managed in ICU setting with broad spectrum antibiotics, oxygen therapy and ventilation if required. Four (57.1%) of these patients eventually died within their admission. There were 3 (2.3%) cases of acute meningitis and 2 (66.7%) of these patients died within hospital despite best medical care. Stratification of postoperative complications is shown in table according to modified Clavien and Dindo classification of postoperative classification **Table 4**.

The overall mean length of stay (LOS) was 5.4 ± 2.2 days (range: 3 – 12 days). The overall mortality rate was 9.9% (n = 13).

Table 3: *Clavien grades of postoperative complications classified for tumour subtypes.*

		Histological Tumour Subtypes			
		Medulloblastoma	**Ependymoma**	**Pilocytic astrocytoma**	**AT/RT**
Clavien grade 1	n	4	1	1	-
	%	3.1%	0.8%	0.8%	-
Clavien grade 2	n	5	6	2	-
	%	3.8%	4.6%	1.5%	-
Clavien grade 3	n	18	8	14	1
	%	13.7%	6.1%	10.7%	0.8%
Clavien grade 4	n	3	3	2	-
	%	2.3%	2.3%	1.5%	-
Clavien grade 5	n	3	6	3	1
	%	2.3%	4.6%	2.3%	0.8%

Table 4: *Complications classified for tumour subtypes.*

Complications		Histological subtypes			
		Medulloblastoma	**Ependymoma**	**Pilocytic Astrocytoma**	**AT/RT**
Postop Hydrocephalus	n	11	5	9	-
	%	8.4%	3.8%	6.9%	-
Wound infection	n	3	3	2	-
	%	2.3%	2.3%	1.5%	-
Cerebellar mutism	n	5	2	1	-
	%	3.8%	1.5%	0.8%	-
CSF leak	n	11	5	1	-
	%	8.4%	3.8%	0.8%	-
Tumour bed bleed	n	1	1	3	-
	%	0.8%	0.8%	2.3%	-
Peri-tumour oedema	n	1	3	2	-
	%	0.8%	2.3%	1.5%	-
Aspiration pneumonia	n	2	2	-	1
	%	1.5%	1.5%	-	0.8%
Nosocomial pneumonia	n	2	4	1	-
	%	1.5%	3.1%	0.8%	-
Meningitis	n	2	-	-	1
	%	1.5%	-	-	0.8%

DISCUSSION

As stated above, complications after cranial surgery were classified by Sawaya et al[12] into three main categories; neurological, regional and systemic. This classification has provided good categorisation for neurosurgical complications. In addition to this classification, Clavien et al[10,11] presented their complication classification according to the level of medical or surgical intervention and the impact of a particular complication on patients health and life. We recorded both kinds, but represented mainly the Clavien and Dindo classification.[10,11]

In our study, a total of 30.5% (n = 40) patients were affected by immediate postoperative complication and these included all types of regional, neurological and systemic complications, like CSF leaks, wound infection, peri-tumour bleed, meningitis, sepsis, aspiration and nosocomial pneumonia and cerebellar mutism. The postoperative wound infections range from superficial wound infection to deep-seated osteomyelitis of the skull, parenchymal abscess formation and meningitis. In supratentorial surgeries, the risk of wound infection is cited around 1% to 2%.[13,14] This is comparable to our study where close to 6% rate of wound infection was noted. For infratentorial surgery, the higher incidence of CSF leaks increase infection rates according to some studies;[14,15] however, we did not find such association in our study. Since these patients are already on immunosuppressive therapy such as intravenous steroids, the infection rates usually go higher in brain tumour patients. Another reason for increase in this rate is wound contamination during and after surgery.[14]

Postoperative CSF leaks are common in posterior fossa surgery and the reasons are many. Tight dural closure always leave some stitches to give up, dural shrinkage during the long procedure, size of the tumour, dural invasion by the tumour, abnormal CSF hydrodynamics and aggressive drilling may also lead to laceration of the dura and hence difficulty in closure.[8,14,16] We observed CSF leak in 13% patients, which is equal to the range cited by most large studies. Majority of CSF leaks necessitate the need for reoperation and careful closure of the leak cite. Use of fibrin glue is effective in such situations, as well as the use of myofascial flaps also provide effective watertight barriers. In addition, wound resuturing, pressure bandage, bed rest and head of bed elevation also helps. Lumbar drainage also provides relief by lower intracranial CSF pressure and hence, provide time for dural healing. Preventive techniques such as application of Valsalva manoeuvre after dural closure provides immediate clue to the leak site.[16]

Bleed in the tumour bed, peri-tumour oedema, hydrocephalous, cerebellar mutism are common in posterior fossa surgery patients.[4, 12]The cited incidence range from 1.2% to 5%. Our findings closely follow these rates. Incomplete tumour resection, incomplete haemostasis, poor lighting and vascular tumours are all risks for tumour bed haematoma. These present early during postoperative period and may present with signs of worsening neurological status, headache, vomiting and in some cases collapse due to pressure on the brainstem. CT scan effectively diagnose these cases and in most cases, reoperation is the procedure of choice.[6] In our study, 80% of patients were shift to operation theatre immediately and the evacuation of haematoma resulted in rapid reversal of neurological symptoms. One patient had sudden respiratory failure, aspiration pneumonia and later died in intensive care.

Oedema in the cerebellum and in brain parenchyma around tumour is also common in posterior fossa surgery.[14] The most common reason is careless retraction, venous outflow restriction due to injury and coagulation of large venous channels.[1] Good patient positioning, minimal use of brain retraction, hyperventilation, intravenous steroids and avoidance of ischaemia may also improve its incidence.[5,6]

Postoperative hydrocephalous is very common in posterior fossa surgery patients and its incidence is cited in the range of 10% to 30%.[17,18] In our study, 19% patients developed postoperative hydrocephalous and all required reoperation with insertion of a VP shunt or ETV.

This study provides detailed outlook of complications associated with posterior fossa tumour surgery in children. However, no definitive conclusions can be made due to its retrospective nature and the very tight exclusion criteria. We suggest that a large, multicentre, prospective study be conducted in order to better study the effects of various preoperative clinical factors on complication development.

CONCLUSION

The most common complication is the development of hydrocephalous, followed by cerebrospinal fluid leaks, cerebellar mutism, peri-tumour oedema, tumour bed

haematoma and systemic complications such as meningitis, sepsis and postoperative pneumonia.

Address for Correspondence:
Dr MianI ftikhar-ul-Haq
Department of Neurosurgery
Lady Reading Hospital, MTI, Peshawar
Email: drmiulhaq@gmail.com
Cell: 0321-9032948

REFERENCES

1. Gnanalingham KK, 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 (4): 821-6.
2. Albright L. Posterior fossa tumors. Neurosurg Clin N Am. 1992; 3 (4): 881-91.
3. Bronstein KS. Epidemiology and classification of brain tumors. Crit Care Nurs Clin North Am. 1995; 7 (1): 79-89.
4. Sen C, L S. Complications of cranial base surgery. In: Post K, Friedman E, P M, editors. Postoperative complications in intracranial neurosurgery. New York: Thieme; 1993: p. 111-33.
5. Hojer C, Hildebrandt G, Lanfermann H, Schroder R, Haupt WF. Pilocytic astrocytomas of the posterior fossa. A follow-up study in 33 patients. Acta Neurochir (Wien). 1994; 129 (3-4): 131-9.
6. Rath GP, Bithal PK, Chaturvedi A, Dash HH. Complications related to positioning in posterior fossa craniectomy. J Clin Neurosci. 2007; 14 (6): 520-5.
7. Heiskanen O, Lehtosalo J. Surgery of cerebellar astrocytomas, ependymomas and medulloblastomas in children. Acta Neurochir. 1985; 78 (1-2): 1-3.
8. Elhassan MMA, Osman HHM, Parkes J. Posterior cranial fossa tumours in children at National Cancer Institute, Sudan: a single institution experience. Childs Nerv Syst. 2017.
9. Rosemberg S, Fujiwara D. Epidemiology of pediatric tumors of the nervous system according to the WHO 2000 classification: a report of 1,195 cases from a single institution. Childs Nerv Syst. 2005; 21 (11): 940-4.
10. Clavien PA, Barkun J, De Oliveira ML, Vauthey JN, Dindo D, Schulick RD, et al. The Clavien-Dindo classification of surgical complications: five-year experience. Ann Surg. 2009; 250 (2): 187-96.
11. Dindo D, Demartines N, Clavien P-A. Classification of Surgical Complications: A New Proposal With Evaluation in a Cohort of 6336 Patients and Results of a Survey. Ann Surg. 2004; 240 (2): 205-13.
12. Sawaya R, Hammoud M, Schoppa D, Hess KR, Wu SZ, Shi WM, et al. Neurosurgical outcomes in a modern series of 400 craniotomies for treatment of parenchymal tumors. Neurosurgery, 1998; 42 (5): 1044-55; Discussion 55-6.
13. Cao Y, Pu K, Li G, Yan X, Ma Y, Xue K, et al. The Role of Antibiotic Prophylaxis in Clean Neurosurgery. World Neurosurg. 2017; 100: 305-10.
14. Dubey A, Sung WS, Shaya M, Patwardhan R, Willis B, Smith D, et al. Complications of posterior cranial fossa surgery--an institutional experience of 500 patients. Surg Neurol. 2009; 72 (4): 369-75.
15. Selesnick SH, Liu JC, Jen A, Carew JF. Management options for cerebrospinal fluid leak after vestibular schwannoma surgery and introduction of an innovative treatment. Otol Neurotol. 2004; 25 (4): 580-6.
16. 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; 23 (2): 171-4; Discussion 5.
17. Due-Tonnessen BJ, Helseth E. Management of hydrocephalus in children with posterior fossa tumors: role of tumor surgery. Pediatr Neurosurg. 2007; 43 (2): 92-6.
18. 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; 34 (3): 402-7; Discussion 7-8.

AUTHORS DATA

Name	Post	Institution	E-mail	Role of Authors
Dr. Zia-ur-Rehman	Registrar	Department of Neurosurgery, Hayatabad Medical Complex Peshawar		Paper Typing
Dr. Muhammad Mukhtar Khan	Registrar			Literature Review
Dr. Mian Iftikhar-ul-Haq			drmiulhaq@gmail.com	Paper Writing

Date of Submission: 16-10-2018 Date of Printing: 15-12-2018