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INCIDENCE OF EARLY SEIZURE IN NON-TRAUMATIC POSTERIOR FOSSA SURGERIES: A MULTI-CENTERS EXPERIENCES

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Abstract

The posterior fossa runs from the tentorial incisura where it communicates with the supratentorial space to the foramen magnum where it communicates with the spinal canal. Seizure: Abnormal paroxysmal discharge from the cerebral neurons causing changes in sensation, motor function, behavior or consciousness. The 89 patients who underwent posterior fossa surgery between July 2022 and January 2023 at Neurosurgical teaching hospital, Ghazi ALhariri hospital for surgical specialties, ALkadhmiya teaching hospital and Doctor Saad Al witry teaching hospital for Neuroscience form the basis of this study. patients with supratentorial lesions were excluded. Those patients with a preoperative history of seizure or with posterior fossa lesions due to head injury were also excluded. In this department, no anticonvulsant drugs are administered to patients unless there is evidence of seizure. Included in this study were 89 patients who underwent a total of 89 posterior fossa operations. The youngest patient was 3 years old and the oldest 66 years old. The male-to- female ratio was 1: 1.06. Eleven (12%) of the patients developed seizures within 2 weeks after the operation. The highest incidence was among patients with metastasis (33%) and cerebellopontine angle meningioma (33%), followed by those with astrocytoma (19%), cerebellopontine angle vestibular shwannoma (12.5), ependymoma (6.6%), medulloblastoma (4.7%). Spontaneous cerebellar hemorrhage and cerebellar abscess were not associated with early postoperative seizure. Early seizures after non-traumatic posterior fossa surgery are uncommon and are mainly associated with secondary supratentorial complications and systemic metabolic disturbances rather than the posterior fossa pathology itself. Prompt identification and correction of these factors may reduce seizure risk and improve outcomes.

Key Words: Posterior Fossa Tumors, Early Postoperative Seizure in Posterior Fossa Surgeries, Non-Traumatic Post-Operative Complications In Posterior Fossa Surgeries

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1. Introduction

The posterior fossa is a complex anatomical compartment located between the tentorium cerebelli and the foramen magnum, containing critical structures such as the cerebellum, brainstem, cranial nerves, and major vascular networks. Owing to the confined nature of this space and the vital neurological functions of its contents, pathological lesions arising within the posterior fossa often present significant diagnostic and therapeutic challenges [1,2]. Surgical intervention is frequently required for a wide spectrum of posterior fossa disorders, including neoplasms, vascular malformations, inflammatory lesions, congenital abnormalities, and traumatic conditions [2].

Seizures are defined as transient episodes of abnormal, excessive, or synchronous neuronal activity in the brain that may manifest as alterations in consciousness, behavior, sensation, or motor function. Epilepsy is a chronic neurological disorder characterized by a persistent predisposition to generate recurrent unprovoked seizures and their associated neurobiological, cognitive, psychological, and social consequences [3]. Although seizures are commonly associated with supratentorial pathologies due to the presence of cortical epileptogenic foci, they may also occur following neurosurgical procedures involving the posterior fossa, despite the absence of direct cortical involvement.

The incidence of postoperative seizures after posterior fossa surgery has received relatively limited attention compared with supratentorial procedures. Previous studies have suggested that seizures occurring after posterior fossa operations are rarely attributable to the primary infratentorial pathology itself. Instead, they are more frequently associated with secondary complications affecting supratentorial structures or systemic physiological disturbances [4, 5]. Such complications include hydrocephalus, cortical injury related to ventricular catheter insertion, tension pneumocephalus, postoperative intracranial hemorrhage, and central nervous system infections. Additionally, metabolic and electrolyte abnormalities, including hyponatremia, hypernatremia, hypocalcemia, hypomagnesemia, metabolic acidosis, and hypoglycemia, may significantly lower the seizure threshold and contribute to postoperative seizure development [2, 4, 6].

Early postoperative seizures represent a clinically significant complication because they may lead to neurological deterioration, prolonged intensive care and hospital stay, increased healthcare costs, and unfavorable functional outcomes [7]. Furthermore, the occurrence of seizures may complicate postoperative management, necessitate additional diagnostic investigations, and require long-term antiepileptic therapy in selected patients. Identifying patients at increased risk of postoperative seizures is therefore essential for optimizing perioperative management and improving patient outcomes [8].

Despite advances in neurosurgical techniques, neuroimaging, perioperative monitoring, and critical care, the reported incidence and etiological factors of early seizures following posterior fossa surgery remain variable across studies. Moreover, the relative contribution of primary posterior fossa pathology compared with secondary intracranial or systemic factors remains incompletely understood. Therefore, this multicenter study was conducted to evaluate the incidence of early seizures following non-traumatic posterior fossa surgeries and to identify the major risk factors and underlying etiologies associated with their occurrence.

2. Material and Methods

The 89 patients who underwent posterior fossa surgery between July 2022 and January 2023 at Neurosurgical teaching hospital, Ghazi ALhariri hospital for surgical specialities, ALkadhmiya teaching hospital and Saad Al witry teaching hospital for Neuroscience form the basis of this study.

Patients with supratentorial lesions were excluded. Those patients with apreoperative history of seizure or with posterior fossa lesions due to head injury were also excluded. In this department, no anticonvulsant drugs are given to patients before or after the surgery of the posterior fossa unless there is evidence of a seizure. Each patient was placed in one of three operating positions (sitting, prone or lateral) and general anesthesia was induced through endotracheal intubation and administered balanced technique

with propofol and ketamine for induction, muscle relaxants (rocrunium and atracurium) and maintained with sevoflurane and isoflurane.

All patients were observed in an intensive care unit for first (1-5) days after the operation, or longer if necessary. Immediate post operative and daily blood sugar, serum electrolyte complete blood count, C-reactive protein values were obtained routinely during the intensive or respiratory

care units or during the ward admission. For patients who developed early postoperative seizures, blood sugar,serum electrolyte and c-reactive protein levels were measured immediately, and a follow-up computerized tomography (CT) scan was performed in order to exclude the possibility of a surgically correctable etiology.

MRI and EEG were not done post operatively in this study. Phenytoin or others antiepliptic drugs were used for controlling the seizures.

Data were collected prospectively and analyzed using the Statistical Package for the Social Sciences (SPSS), version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were presented as mean ± standard deviation (SD), whereas categorical variables were expressed as frequencies and percentages.

3. Results

Table 1 provides a summary of the condition requiring posterior fossa surgery and the operative position of the patient. All operations involved a suboccipital craniectomy or retrosigmoid approach with extra or intra dural procedures (see Table 1). There were 26 astrocytomas, 21

medulloblastomas,15 ependymomas, 8 cerebellopontine angle (c.p.) shwannoma, 7 cerebellar haemorrahage(spontaneous), 6 metastasis, 3 c.p. meningiomas and 3 cerebellar abcess. Ventriculoperitoneal (V.P.) shunt placement was performed before posterior fossa surgery in 35% of the procedures where there was preexisting hydrocephalus.

Table 1. Summary of 89 Patients Undergoing Posterior Fossa Surgery

Pathological Condition	Total Procedures (n)	Pre-operative VP Shunt (n)	Patient Position Intraoperatively
Astrocytoma	26	7	15 Prone, 11 Sitting
Medulloblastoma	21	9	5 Prone, 16 Sitting
Ependymoma	15	11	12 Prone, 3 Sitting
Cerebellopontine (CP) Vestibular Schwannoma	8	1	Lateral
Cerebellopontine (CP) Meningioma	3	1	Lateral
Metastasis	6	3	2 Prone, 4 Sitting
Spontaneous Cerebellar Hemorrhage	7	0	Prone
Cerebellar Abscess	3	0	Prone
Total	**89**	**32**	—

For different posterior fossa lesions, the incidence of early postoperative seizures was quite variable (Table 2)

Table 2. Incidence of Early Postoperative Seizures According to Posterior Fossa Pathology

Pathological Condition	No. of Cases (n)	Seizure Cases (n)	Seizure Percentage (%)
Astrocytoma	26	5	19.2
Medulloblastoma	21	1	4.8
Ependymoma	15	1	6.7
Cerebellopontine Angle (CPA) Vestibular Schwannoma	8	1	12.5
Cerebellopontine Angle (CPA) Meningioma	3	1	33.3
Metastasis	6	2	33.3
Spontaneous Cerebellar Hemorrhage	7	0	0.0
Cerebellar Abscess	3	0	0.0
Total	89	11	12.4

Eleven (12%) of the patients developed seizures within 2 weeks after the operation. Of the eleven patients (12%) with postoperative seizures, three patients (27%) exhibited postoperative electrolyte disturbance before and after the seizure attack. Two patients with hyponatremia, one of them had a serum sodium level of 115 mEq/ml and the other had serum sodium level 118 mEq/ml.

The last one of three patients with electrolyte disturbances had hypocalcemia with serum calcium level 6 mg/dL. One patient who suffered seizure proved to have meningitis. In these four patients, no postoperative hydrocephalus or hematoma or other surgical cause was found. Of eleven patients with seizure during the day zero to the fourteenth day after the operation, five patients (45%) developed early postoperative hydrocephalus and two (18%) developed tension pneumocephallus remote from the operation site (Table 3).

Table 3. Clinical summary of 11 patients with early postoperative seizure

No.	Age/ Sex	Pathology	Position	Pre-op VP Shunt	Time to Seizure	Seizure Type	Seizure Frequency	Postoperative CT Findings	Laboratory Findings
1	36 y/F	CPA Vestibular Schwannoma	Lateral	Yes	10 days	Generalized	3/day	Postoperative changes	Elevated WBC and CRP; positive CSF culture (Staphylococcus aureus)

2	7 y/M	Ependymoma	Prone	No	3 hours	Generalized	2/day	Hydrocephalus	Normal
3	32 y/M	Astrocytoma	Sitting	No	1 hour	Generalized	4/day	Tension pneumocephalus	Normal
4	28 y/M	Astrocytoma	Prone	No	2 days	Generalized	2/day	Hydrocephalus	Normal
5	46 y/F	Metastasis	Sitting	Yes	3 hours	Generalized	1/day	Tension pneumocephalus	Normal
6	3 y/M	Astrocytoma	Sitting	No	2 hours	Generalized	5/day	Hydrocephalus	Normal
7	43 y/M	CPA Meningioma	Lateral	No	4 days	Generalized	2/day	Postoperative changes	Hypocalcemia (Ca^{2+} = 6 mg/dL)
8	48 y/M	Metastasis	Prone	No	12 days	Partial Complex	3/day	Postoperative changes	Hyponatremia (Na^{+} = 115 mEq/L)
9	3 y/M	Astrocytoma	Prone	No	3 days	Generalized	4/day	Hydrocephalus	Normal
10	37 y/F	Medulloblastoma	Prone	No	10 days	Generalized	2/day	Postoperative changes	Hyponatremia (Na^{+} = 118 mEq/L)
11	26 y/F	Astrocytoma	Prone	No	5 hours	Generalized	3/day	Hydrocephalus	Normal

Five patients (5%) suffered aseizure within 24 hours after surgery. In 10 (90.9%) of the 11 patients the seizures were of generalized tonic-clonic type; the other one patient (9%) had partial complex seizure with motor symptoms.

The highest incidence were among patients with metastasis(33%) and cerebellopontine angle meningioma(33%), followed by those with astrocytoma (19%), cerebellopontine angle vestibular shwannoma (12.5), ependymoma (6.6%), medulloblastoma (4.7%). Spontaneous cerebellar haemorrhage and cerebellar abcess were not associated with early postoperative seizure.

The incidence of early postoperative seizure was lower in patients with preoperative v.p. shunt placement than in patient who did not undergo those procedures (Table 4).

Table 4. Early postoperative seizure correlated with or without preoperative V.P. shunt□

Seizure Status	With VP Shunt (n=35)	Without VP Shunt (n=54)	Total (n=89)
Seizures	2	9	11
Seizure-Free	33	45	78
Total	**35**	**54**	**89**

- V.P. =ventriculoperitoneal

4. Discussion

The study reported eight of thirteen patients with postoperative seizure developed it within first week after the operation while None of the patients with posterior fossa surgery reported by Matthew et al. 14 had seizures during the first postoperative week. Standefer et al. 15 reported no

postoperative seizures in a series of 234 suboccipital craniectomies. Although postoperative seizures might be uncommon, Fukamachi et al. [9] found three patients with posterior fossa tumors who had seizures within 48 hours of operation. While in our study we had six patients developed seizures within 48 hours.

The incidence of immediate or early postoperative seizures in our study is much lower than the incidence in Boarini,Carbral and Calliauw series of supratentorial surgery [10-12].

This prospective study suggests the possibility of seizures in the early postoperative period after sub-occipital craniectomy and retrosigmoid approach for a posterior fossa lesion, Seizures occurred in 12% of operated cases while Seizures occurred in 5.9% of operated cases according to A. SURI et al Seizures following posterior fossa surgery study [13]. The risk factors were age, sitting position, absence of ventricular peritoneal shunt in mildly enlarged ventricles, astrocytoma, medulloblastoma, ependymoma, cerebellopontine angle pathology, metastasis, intraoperative air embolism, pre or postoperative electrolyte disturbances and infection. A. Suri, A. K. Mahapatra & P. Bithal found Sixty-six 20 percent of seizures occurred within 3 h of surgery while in our study four (36%) of eleven patients postoperative seizures occurred within first 3 hour of surgery. Copeland et al. [14] found that postoperative seizures developed in 4.3% of patients who were with ventricular shunting surgery. In our series, the early postoperative seizures in patients with shunt were (18%). Shih-Tseng Lee et al [15]. The highest incidence was in cases of medulloblastoma (7.2 %), astrocytoma (2.3 %), meningioma (2.2 %), hypertensive hematoma (2.1 %), microvascular compression syndrome (1.8 %) and cranial nerve neurinoma (1.1 %). Early postoperative seizures were not associated with cerebellar abscess, arteriovenous malformation, aneurysm or cerebellar tumor (including ependymoma, hemangioblastoma, metastatic tumor, epidermoid cyst, or lymphoma). While in our study. The highest incidence was among patients with metastasis (33%) and cerebellopontine angle meningioma (33%), followed by those with astrocytoma (19%), cerebellopontine angle vestibular shwannoma (12.5), ependymoma (6.6%), medulloblastoma (4.7%). Spontaneous cerebellar haemorrhage and cerebellar abcess were not associated with early postoperative seizure.

Electrolyte imbalance, hypoxia, hypoglycemia, acidosis, or intracranial hematoma may cause seizures in the early postoperative period. Of the five patients who developed seizures postoperatively within 24 hours in this study, three (60%) had hydrocephallus and two (40%) had tension pneumocephallus while Shih-Tseng Lee [15] and his colleagues found of

the five patients who developed seizures postoperatively within 24 hours in our study, four (80%) had preictal metabolic acidosis and one (20%) had hyponatremia due to inappropriate secretion of antidiuretic hormone although Fukamachi, et al, [9] found that about half of the immediate postoperative seizures were precipitated by local organic lesions

Shih-Tseng Lee [15] and his colleagues found eight patients who experienced seizures between the 2nd and 14th postoperative day had significant CT findings: hydrocephalus (75%) or hemorrhage remote from the operative site (25%). All of these patients needed further VP shunting or supratentorial craniotomy

while in our study the six patients who experienced seizures between the 2nd and 14th postoperative day had: hydrocephalus (33%), electrolyte disturbance (50%) [hyponatremia (33%) and hypocalcemia (16%)] and Meningitis (16%).

Although three different operative positions were used, there was no evidence of air embolism during surgery in our patients with early postoperative seizure as Shih-Tseng Lee study.

5. Conclusion

This prospective study suggests the possibility of seizures in the early postoperative period after suboccipital craniectomy or retrosigmoid approaches for a posterior fossa lesion. In those seizures developing within 24 hours, hydrocephalus or tension pneumocephallus were more likely the cause. In seizures developing more than 24 hours after the operation, hydrocephalus, central nervous system infections, electrolytes disturbance and a focal organic supratentorial lesion should be excluded.

In general no primary causes were identified from posterior fossa pathology that had direct cause of seizure or epilepsy, the main reasons come from secondary etiologies that either in supratentorial compartment like hydrocephalus, cortical injury,tension pneumothorax, central nervous system infection or from general systemic impairment like metabolic acidosis, hyponatremia,hypernatremia, hypocalcemia, hypomagnesemia, systemic infection other than CNS, hypoglycemia and others.

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