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# Posterior fossa meningioma (surgical experiences)

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**KEYWORDS**

Meningioma;
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**Abstract** *Introduction:* Meningioma is a common tumor that represents about 30% of all intracranial tumors. Posterior fossa location of the tumor is uncommon. It can be classified according to the location in the posterior fossa into cerebellopontine angle, clival, petroclival, convexity, tentorial and foramen magnum. Different surgical approaches are used to excise these tumors.
*Aim of the study:* Was to study different aspects of posterior fossa meningioma regarding location, histology, surgical approaches and outcome.
*Methods:* Retrospective study including 20 patients diagnosed with posterior fossa meningioma was included in the study. Data were obtained from the files of the patients and were analyzed. All patients had preoperative complete general and neurological examination, MRI of the brain with and without Gadolinium. Different surgical approaches were utilized in the study depending on the tumor location and the surgeon's preference. Postoperatively, all patients had a postoperative CT scan of the brain with contrast. Some patients had also MRI of the brain with and without Gadolinium.
*Results:* Fifteen of the patients were females and 5 were males. The age ranged from 35 to 69. Symptoms included headache (75%), cerebellar manifestations (60%), cranial nerve affection (40%) and hearing disturbances (15%). Most of the cases (50%) were cerebellopontine angle meningioma while the least (5%) were foramen magnum meningioma. Surgical approaches used included retrosigmoid approach (50%), transpetrosal approach (30%) and transcondylar approach (20%). Tumor removal was total in 60% of cases and partial in 40%. Postoperative mortality was present in 5% of cases. Morbidity included decreased level of consciousness, cranial nerve palsy and wound infection.
*Conclusion:* Retrosigmoid approach is effectively and safely used for cerebellopontine angle meningioma, convexity menigioma and lateral tentorial meningioma extending inferiorly to the posterior fossa. Suboccipital approach can be used safely for posterior foramen magnum meningioma. Clival and petroclival meningioma carry a high morbidity incidence.


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## 1. Introduction

Meningioma is a diverse set of tumors arising from the meninges, the membranous layers surrounding the central nervous system. They are the second most common primary neoplasm of the CNS, representing about a third of brain tumors. They arise from the arachnoid ''cap'' cells of the arachnoid villi in the meninges. Meningiomas are usually benign but they can be malignant. The term of ''meningioma'' was first used by Harvey Cushing in 1922. Charles Oberling then separated these into subtypes based on cell structure.[1–4] In 1979, the World Health Organization (WHO) classified seven subtypes, upgraded in 2000 to a classification system with nine low-grade variants (grade I tumors) and three variants each of grade II and grade III meningiomas.[5–7] The most common subtypes of meningiomas are Meningotheliomatous (63%), transitional or mixed-type (19%), fibrous (13%), and psammomatous (2%).[8,9]

Meningiomas are classified based on the WHO classification system.[10]

- Benign (Grade I) – (90%) – meningothelial, fibrous, transitional, psammomatous, angioblastic (most aggressive).
- Atypical (Grade II) – (7%) – chordoid, clear cell, atypical (includes brain invasion).
- Anaplastic/malignant (Grade III) – (2%) – papillary, rhabdoid, anaplastic.

In the posterior fossa, most meningiomas are found in the cerebellopontine angle.[11–13] Women are affected twice as often as men. Meningiomas are encapsulated lesions that indent the brain as they enlarge. They grow slowly and may be present for many years before producing symptoms. They often have high vascularity, receiving their blood supply predominantly from dural vessels. Posterior fossa meningioma was classified according to their location in the posterior fossa into cerebellopontine angle, convexity, clival, petroclival, tentorial and foramen magnum.[14–16] Clinical manifestations of posterior fossa meningioma vary according to their location. Different surgical approaches were used to excise these tumors including retrosigmoid, transpetrosal, translabyrinthine and transcondylar approaches.[17–19]

## 2. Aim of the study

The aim of this study was to study different aspects of posterior fossa meningioma regarding location, histology, surgical approaches and outcome.

## 3. Patients and methods

A retrospective study including 40 patients diagnosed with posterior fossa meningioma was included in the study. Data were obtained from the files of the patients and were analyzed. All patients had preoperative complete general and neurological examination, MRI of the brain with and without Gadolinium. Some of the patients had CT scan of the brain with contrast. Different surgical approaches were utilized in the study depending on the tumor location and the surgeon's preference. These approaches included retrosigmoid approach, different transpetrosal approaches, suboccipital approach and transcondylar approach. Postoperatively, all patients had a postoperative CT scan done for the brain with contrast. Some patients had also MRI of the brain with and without Gadolinium. All patients had tumor biopsy sent for pathological analysis.

### 3.1. Statistical analysis

Numbers and percentages were used to describe the results.

## 4. Results

Table 1 shows that females were much more predominant than males (62.5% versus 37.5% respectively).

The age of the patients ranged from 35 to 69 with a mean age of 51 years. Table 2 shows that the age category of 55 to less than 65 years represented the majority of cases (40%) while the least was the age category of 65 years and more.

Table 3 shows that the most common clinical manifestation of the patients was headache (75% of cases), while the least was hearing disturbances (15%).

Table 4 shows the tumor location in cases under study. Cerebellopontine angle meningioma was the most common (40%) followed by petroclival meningioma (25%), while the least meningioma location was the clival and foramen magnum meningioma (5% of cases each), (Figs. 1–3,5 and 6, ).

Table 5 shows the histological subtypes of meningioma cases under study. It shows that fibrous type represented the most predominant type (25%), followed by psamommatous and meningothelial types (20% of cases each) and the least was the malignant type (5% of cases).

Table 6 shows the surgical approaches used in the study. In the majority of patients (75%), the retrosigmoid approach was used, followed by the transpetrosal approach (20%). The least used approach was the transcondylar approach (5% of cases), (Fig. 4).

Table 7 shows the extent of tumor excision related to the location of the tumor. Tumors that had partial removal were equal to those that had complete excision (50% each). All petroclival meningioma cases were only partially removed, while all tentorial, convexity and foramen magnum meningioma were totally excised.

Table 8 shows the postoperative complications. The most common postoperative morbidity was decreased level of consciousness in 25% of cases, followed by cranial nerve palsy (15% of cases) and infection in 10% of cases. Death occurred only in two patients (5% of cases).

Table 9 shows the relationship between the tumor location and the postoperative morbidity and mortality. Cerebellopontine angle meningioma as well as petroclival meningioma had postoperative cranial nerve palsy as a complication which was not present in other tumor location. Petroclival meningioma

**Table 1** Shows the gender of patients under study.

| Gender | Number of patients | % |
|---|---|---|
| Males | 5 | 25 |
| Females | 15 | 75 |
| Total | 20 | |

**Table 2** Shows the age category of patients.

| Age category (years) | Number of patients | % |
|---|---|---|
| 35 to less than 45 | 5 | 25 |
| 45 to less than 55 | 6 | 30 |
| 55 to less than 65 | 8 | 40 |
| 65 and more | 1 | 5 |
| Total | 20 | |

**Table 3** Shows the clinical manifestations of patients under study.

| Clinical manifestations | Number of patients | % |
|---|---|---|
| Headache | 15 | 75 |
| Cerebellar manifestations | 12 | 60 |
| Cranial nerve affection | 8 | 40 |
| Hearing disturbances | 3 | 15 |

**Table 4** Shows the tumor location in patients under study.

| Tumor location | Number of cases | % |
|---|---|---|
| Cerebellopontine angle | 8 | 40 |
| Petroclival | 5 | 25 |
| Tentorial | 3 | 15 |
| Convexity | 2 | 10 |
| Clival | 1 | 5 |
| Foramen magnum | 1 | 5 |
| Total | 20 | 100 |

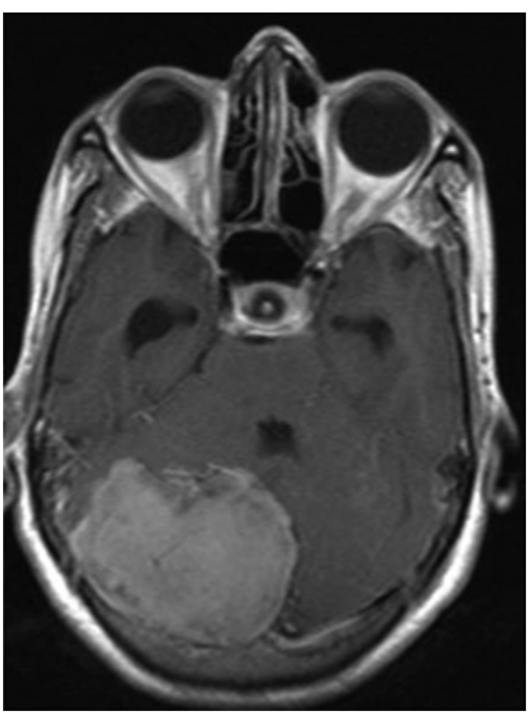

**Figure 1** MRI of the brain, T1-weighted axial image with Gadolinium enhancement showing posterior fossa right convexity meningioma compressing and displacing the cerebellum and the fourth ventricle.

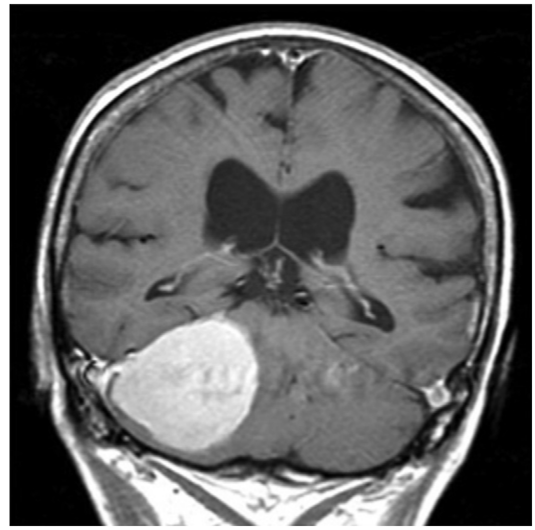

**Figure 2** MRI of the brain, T1-weighted coronal image with Gadolinium enhancement showing right inferior tentorial meningioma.

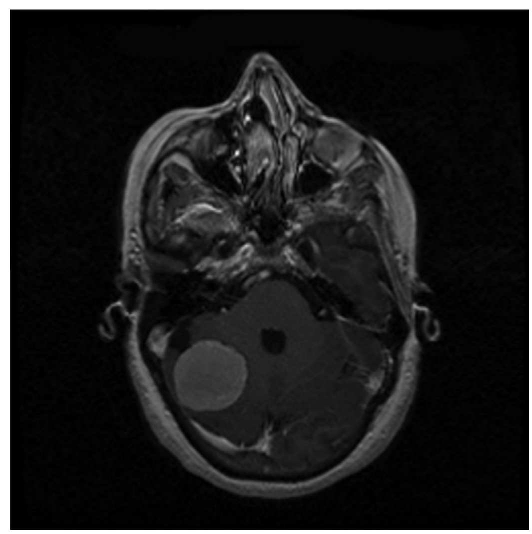

**Figure 3** MRI of the brain, T1-weighted axial image with Gadolinium enhancement showing right inferior tentorial meningioma.

had all postoperative complication items and all the postoperative mortality cases.

## 5. Discussion

Meningioma is a common tumor representing about one third of all intracranial tumors and arises from the arachnoid cap cells.[20–23]The presence of posterior fossa meningioma is relatively uncommon. Here we retrospectively study posterior fossa meningioma cases that were operated and followed up for up to one year. Posterior fossa meningioma can be classified according to their site of origin into cerebellopontine angle (which can be further subclassified into meningioma that arises

**Figure 4** Shows postoperative CT scan of the brain utilizing a retrosigmoid approach to excise right inferior tentorial meningioma.

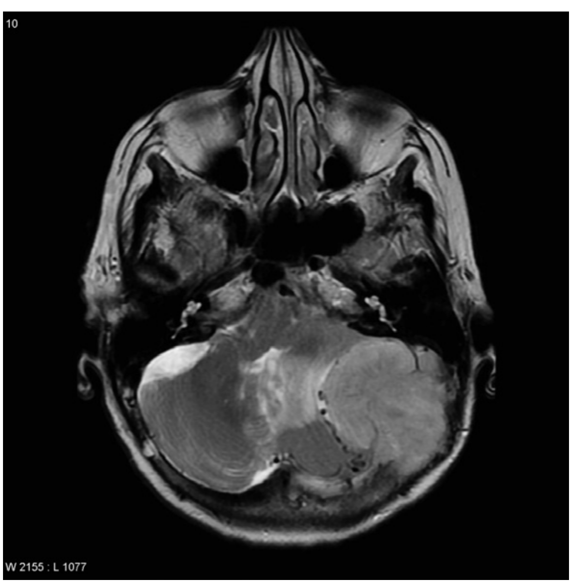


**Figure 5** MRI of the brain, T2-weighted axial image showing left cerebellar meningioma invading the bone that was later found histologically to be malignant.

anterior or posterior to the internal auditory meatus), petroclival, convexity, tentorial, clival and foramen magnum, which can be further subclassified into anterior foramen magnum (essentially a clival meningioma) and posterior foramen magnum meningioma.[24–27] This classification is important for surgical planning and for predicting the clinical outcome and the complications of surgery.[28–30]

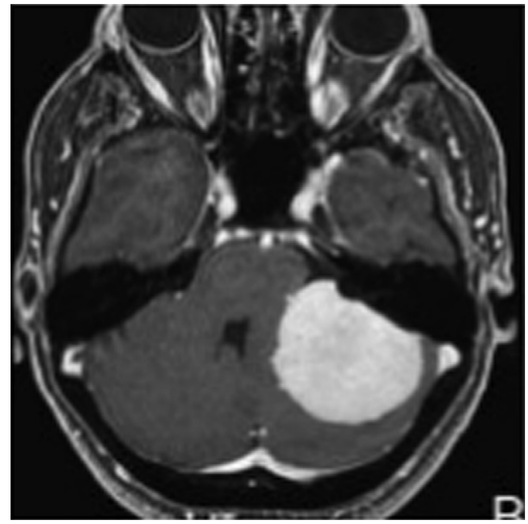

**Figure 6** MRI of the brain, T1-weighted axial image with Gadolinium enhancement showing left cerebellopontine angle meningioma.

**Table 5** Shows the histological subtypes of meningioma under study.

| Histological type of meningioma | Number of patients | % |
|---|---|---|
| Fibrous | 5 | 25 |
| Psammomatous | 4 | 20 |
| Meningothelial | 4 | 20 |
| Angioblastic | 3 | 15 |
| Atypical | 3 | 15 |
| Malignant | 1 | 5 |
| Total | 20 | 100 |

**Table 6** Shows the surgical approaches utilized in patients under study.

| Surgical approach | Number of patients | % |
|---|---|---|
| Retrosigmoid | 15 | 75 |
| Transpetrosal | 4 | 20 |
| Transcondylar | 1 | 5 |
| Total | 20 | 100 |

Forty cases were included in this study; all were diagnosed with posterior fossa meningioma. Twenty five cases (62.5%) were females, while 15 cases (37.5%) were males (Table 1). This makes a female to male ratio of 1.66:1. This goes with the results of other studies in the literature which states a high female to male ratio of meningioma cases and even a higher ratio in posterior fossa meningioma cases. William T. Couldwell in his study about petroclival meningioma reported in his series 40 males and 69 females in a ratio of 1:1.72.[31–33] As regards to the age of patients, it ranges from 35 to 69 years old with a

**Table 7** Shows the extent of tumor excision related to their location.

| Location of the tumor | Partial tumor excision | % | Total tumor excision | % | Number of cases |
|---|---|---|---|---|---|
| Cerebellopontine angle tumor | 4 | 50 | 4 | 50 | 8 |
| Petroclival | 5 | 100 | 0 | 0 | 5 |
| Tentorial | 0 | 0 | 3 | 100 | 3 |
| Convexity | 0 | 0 | 2 | 100 | 2 |
| Clival | 1 | 100 | 0 | 0 | 1 |
| Foramen magnum | 0 | 0 | 1 | 100 | 1 |
| Total | 10 | 50 | 10 | 50 | 20 |

**Table 8** The postoperative complications in patients under study.

| Postoperative complication | Number of cases | % |
|---|---|---|
| Decreased level of consciousness | 10 | 25 |
| Cranial nerve palsy | 6 | 15 |
| Infection | 4 | 10 |
| Postoperative CSF leak | 4 | 10 |
| Death | 2 | 5 |

mean of 51 years old. Most cases (70%) occurred between 45 and less than 65 years, followed by 25% of cases between 35 and less than 45 years. The least proportion of cases occurred at the age of 65 years or older (5%) (Table 2). These results coincide with the results of other studies regarding the age of meningioma patients. William T. Couldwell in his series of 109 cases having petroclival meningioma operated, the age ranged from 25 to 75 years with a mean of 51 years.[34–36] Clinically, most patients (75%) reported having headache as their primary complaint, mostly in the occipital location. This was caused by the sole presence of the tumor in the posterior fossa or due to obstructive hydrocephalus caused by the tumor. Cerebellar manifestations came second in the clinical presentation of posterior fossa meningioma (60%). These included ataxia, nystagmus and dysmetria. These were caused by direct cerebellar compression or compression of the cerebellar pathways in the brain stem. Cranial nerve affection occurred in 16 cases (40%). These included vestibulocochlear nerve compression

**Table 9** The relationship between the tumor location and the postoperative morbidity and mortality.

| Location of posterior fossa meningioma | Postoperative complications | Patients | |
|---|---|---|---|
| | | No. | % |
| Cerebellopontine angle tumor | Decreased level of consciousness | 3 | 19 |
| | Cranial nerve palsy | 4 | 25 |
| | Infection | 2 | 13 |
| | Postoperative CSF leak | 2 | 13 |
| | Death | 0 | 0 |
| Petroclival | Decreased level of consciousness | 3 | 30 |
| | Cranial nerve palsy | 2 | 20 |
| | Infection | 1 | 10 |
| | Postoperative CSF leak | 1 | 10 |
| | Death | 2 | 20 |
| Tentorial | Decreased level of consciousness | 2 | 33 |
| | Cranial nerve palsy | 0 | 0 |
| | Infection | 0 | 0 |
| | Postoperative CSF leak | 0 | 0 |
| | Death | 0 | 0 |
| Convexity | Decreased level of consciousness | 0 | 0 |
| | Cranial nerve palsy | 0 | 0 |
| | Infection | 0 | 0 |
| | Postoperative CSF leak | 0 | 0 |
| | Death | 0 | 0 |
| Clival | Decreased level of consciousness | 2 | 100 |
| | Cranial nerve palsy | 0 | 0 |
| | Infection | 1 | 50 |
| | Postoperative CSF leak | 1 | 50 |
| | Death | 0 | 0 |
| Foramen magnum | Decreased level of consciousness | 0 | 0 |
| | Cranial nerve palsy | 0 | 0 |
| | Infection | 0 | 0 |
| | Postoperative CSF leak | 0 | 0 |
| | Death | 0 | 0 |

(10 cases), trigeminal nerve compression (6 cases), facial nerve compression (8 cases) and lower cranial nerve compression in 6 cases. Hearing disturbances as measured by audiometry occurred in 6 patients (15% of cases) (Table 3). Fabio Robert et al in his study about posterior fossa meningioma reported that headache (50%) and disturbance of gait (44%) were the most common presenting symptoms, and cranial neuropathies the most common neurological signs on admission. These findings were similar to our findings, although in a lower percentage but at a similar importance.[37]

Cerebellopontine angle meningioma occurred in 16 cases (40%). This was the most common location of the posterior fossa meningioma in this study. Petroclival location occurred in 25% of cases, followed by tentorial meningioma (15%), convexity (10%) and lastly by clival and posterior foramen magnum meningioma (5% each) (Table 4). Roberti F. et al. reported his experience in 161 cases of posterior fossa meningioma. The locations of posterior fossa meningioma in his series were petroclival (110 cases), foramen magnum (21 cases), cerebellar hemispheric, lateral tentorial (14 cases), cerebellopontine angle (9 cases), and jugular foramen (7 cases). The difference in the percentages in tumor location between his series and our series could be due to a small size of our series as compared to his series. Mean tumor equivalent diameter ($TED = (X \times Y \times Z)(1/3)$ was 3 cm having a range of 0.98–8. Sekhar LN had a TED of 3.1 cm ranging from 0.53–8.95 in his series of posterior fossa meningioma.[38–40]

A biopsy of the tumor was analyzed pathologically postoperatively. Fibrous type represented the most common subtype (25%) followed by the psammomatous and meningothelial subtypes (20% each). Both angioblastic and atypical subtypes occurred in 6 cases each (15% each). The least common was the malignant type (5%) (Table 5). These results do not coincide with the results of supratentorial meningiomas where the meningothelial type is the most common, but coincide with the results of other series of the posterior fossa meningioma. N. Ianovici et al in his study of posterior fossa meningioma reported that grade I meningioma occurred in 82% of cases, grade II in 11% of cases, while grade III occurred in 5% of cases and the most common histological subtypes were fibrous and psammomatous.[41–44]

In this study, retrosigmoid approach was the most commonly used approach (75% of cases). This was probably because of the familiarity of neurosurgeons with this approach and the presence of many meningioma cases in this study at sites amenable to this approach. Transpetrosal approaches were used in 8 cases. Four of them were translabyrinthine approach for cerebellopontine angle lesions where hearing was non-serviceable. The other four cases were subtemporal anterior transpetrosal approach for petroclival meningioma. Transcondylar approach was used in two patients with low clival meningioma (5% of cases).

The extent of tumor excision varied widely according to the tumor location that, in turn determined the difficulty of tumor access and the fear of injury to the surrounding vital structures. Fifty percent of cerebellopontine angle tumors were removed partially, which were all anterior to the internal auditory meatus, posing difficulty in tumor excision. On the other hand, all the 8 cases posterior to the internal auditory meatus were removed totally (50%). None of the 10 petroclival meningioma cases were removed totally due to the difficult deep location of the tumor and the fear of injury to the surrounding vital structures. All the six tentorial meningioma were removed totally, as well as the four convexity meningioma cases, because of their superficial location. The two clival meningioma cases were removed partially, while the posterior foramen magnum meningioma cases were removed totally (Table 7). From these results, as expected, the more superficial the tumor is, the easier it is to be removed totally. Fabio Robertia in his 161 cases of posterior fossa meningioma had a gross-total resection achieved in 57% of patients, and subtotal/partial in 43%. These percentages are almost similar to ours.[45–48]

As regards to the morbidity, the most commonly encountered one was decreased level of consciousness in 10 cases (25%). This was temporary in 8 cases and permanent in two cases that were shown to have brain stem insult on the magnetic resonance imaging. Cranial nerve palsy was present in 6 cases, four of them were facial nerve injury, two of them improved and two were permanent. The other two cases were lower cranial nerve palsy that improved later on. Infection occurred in four cases both of them were superficial wound infection that responded to antibiotics and frequent dressing. Postoperative CSF leak occurred in 4 cases (10%) that was treated medically and resolved completely. Roberti F had a postoperative CSF leak in 22 cases (13.6%) in his series. Only 2 cases of postoperative mortality were present and were caused by brain stem infarction, mostly due to vascular injury (Table 8). Cudlip SA et al had a postoperative mortality of 11% in his series that included 52 posterior fossa meningioma cases.[49]

Cerebellopontine angle meningioma as well as petroclival meningioma had postoperative cranial nerve palsy as a complication which was not present in other tumor location. This could be explained by the presence of the seventh to twelfth cranial nerves in the surgical trajectory to these tumors that could be easily injured. Petroclival meningioma had all postoperative complication items and all the postoperative mortality cases. Petroclival meningioma is a deep tumor in the posterior fossa lying in front of the brain stem which can be injured either directly or indirectly through vascular injury causing several complications (Table 9).

## 6. Conclusion

Posterior fossa meningioma is mostly a benign tumor with a female preponderance. Retrosigmoid approach is effectively and safely used for cerebellopontine angle meningioma posterior to the internal auditory meatus, convexity menigioma and lateral tentorial meningioma extending inferiorly to the posterior fossa. Suboccipital approach can be used safely for the posterior foramen magnum meningioma. Clival and petroclival meningioma carry a high morbidity incidence.

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