Surgical Management of Tentorial Meningiomas: Analysis of 14 Cases Experience

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ABSTRACT

Background: Tentorial meningiomas (TM) are relatively uncommon tumors; they represent about 5% of reported intracranial meningiomas. Depending on their site of origin, direction of growth and size, tentorial meningiomas differ in their mode of presentation, surgical difficulties and morbidity. To discuss the proper surgical management of tentorial meningiomas it must be based on their site of origin.

Objective: To study the clinical and radiological features, surgical management, complications, and final outcome of tentorial meningiomas patients.

Methods: This is a retrospective study of 14 patients with tentorial meningiomas (TM). The clinical data were reviewed from the medical records. Preoperative diagnostic tests included brain CT scan and MRI brain in all patients and digital subtraction angiography (DSA) in 5 patients. The operative approaches were infratentorial in 10 patients and supratentorial in 4. Data regarding surgery, histopathology and postoperative course were analyzed and reviewed. Evaluation of tumor resection was done using Simpson's grade and final outcome using Glasgow outcome score (GOS).

Results: 9 patients were females and 5 were males. Mean age was 53.5 years (44-71). The average duration of the presenting symptoms was 24 months. Headache was the most frequent presenting symptom. Complete surgical resection (Simpson I-II) was achieved in 12 cases. Final outcome was good recovery in 12 cases, severe disability in 1 case and death of 1 case.

Conclusion: Despite the advances in neuro-radiology and microsurgery tentorial meningiomas represent a challenge for the neurosurgeons. In most cases, complete surgical resection should be the objective in order to minimize the recurrence risk. Subtotal tumor resection should be considered in TMs which have close relationship to critical structures as the brain stem or important vascular channels.

INTRODUCTION

Tentorial meningiomas (TM) are relatively uncommon tumors; they represent about 5% of reported intracranial meningiomas. They are more common in females, 70% to 80% of cases. Tentorial meningiomas can grow in both directions, with equal incidence of supra- and infra-tentorial types. 52% of these meningiomas invade the transverse sinus1. The first report of a tentorial meningioma was in 1833 by Andaal. The old attempts of tentorial meningioma removal resulted in high rates of mortality and morbidity. In series published up to 1990, the mortality rate ranged from 14% to 44%. By development of modern diagnostic imaging and neurosurgical techniques, mortality rates dropped, reaching rates of around 10% in most series published over the last two decades. In spite of that, tentorial meningiomas still represent complex surgical entities associated with significant morbidity and mortality due to their attachment to critical vascular and neural structures. Postoperative morbidity is still high, ranging from 18.9% to 77% among different series.4,5,7

Depending on their site of origin, direction of growth and size, tentorial meningiomas differ in their mode of presentation, surgical difficulties and morbidity. The tentorium seems to have a simple structural design; however, its edges are close to the brainstem. Moreover, its role in venous drainage of the brain and cerebellum makes surgical approach a challenge, even for experienced neurosurgical teams. Signs and symptoms of cranial hypertension are the most common findings, followed by cerebellar ataxia, psychiatric disturbances and cranial nerve dysfunction.11,2

To discuss the proper surgical management of tentorial meningiomas we must be based on their site of origin. With the advent of CT in the early 1970s, many authors proposed different classifications of the
posterior fossa meningiomas. According with Harrison and Almefty, the scheme proposed by Yasargil is the one of the most beneficial. The choice of operative approach depends mainly on the site of the lesion as well as size of the lesion. 8,13,9,14

PATIENTS & METHODS

Between 2008 and 2012, 14 cases with tentorial meningiomas were surgically treated. Only those with a radiologically or surgically documented predominant attachment to the tentorium cerebelli were included in this study. Cases arising from other dural territories and showing minimal tentorial attachment were excluded (as petroclival, cerebellopontine angle, and cavernous sinus meningiomas).

All cases were operated upon in Kasr El-Aini Hospitals, Cairo University. The mean follow-up period was 14 months (range 2-48 months). A full clinical history was taken for the cases. Full preoperative and postoperative neurological examination was also done. The extent of tumor removal was evaluated by the Simpson’s grading system for tumor removal. The Glasgow outcome score (GOS) was utilized for post-operative outcome.

Routine preoperative laboratory investigations, MRI brain with gadolinium including MR angiography were done for all cases preoperatively. Some cases presented with CT brain. 5 cases performed digital subtraction angiography preoperatively. Preoperative embolization was not attempted for any of our cases.

Surgical approaches: Pre-operative cross matched blood was prepared for all cases. Standard Neuroanesthesia were applied for all cases including invasive arterial blood pressure monitoring, non-invasive carbon dioxide monitoring, positive end expiratory pressure monitoring, and catheterization of the right atrium to detect and treat any air embolism. Cases presenting with preoperative hydrocephalus were managed initially by insertion of ventriculoperitoneal shunt 1 week prior to tumor attack. Surgical approach to the tumor was chosen according to the site and size of the lesion. Supratentorial tumors were attacked either through occipital approach or sub temporal approach. In all infratentorial cases sitting position was utilized, and the tumor was attacked through either midline infratentorial supracerebellar route, or paramedian infratentorial retrosigmoid route, according to the tumor site and size.

Immediate post-operative clinical and radiological follow-up was performed for all cases. Latter on follow-up was performed every three months for the first year, then annually afterwards.

The medical records of the 14 patients were retrospectively reviewed for clinical presentation, neuroradiological evaluation, surgical intervention and outcome.

RESULTS

Patient population: there were 9 female and 5 male patients, their age ranged from 44 to 71 years; mean age in our study was 53.5 years (Fig.1).

Clinical picture: The duration of the presenting symptoms ranged from 2 to 13 months (mean 6 months). Headache was the most common presenting feature (in 78% of cases), followed by gait ataxia (43%), memory disturbances (21%), nausea and vomiting (21%), and seizures (14% of cases). On physical examination, cerebellar deficits were the most common finding, in 43% of cases, followed by signs of increased intracranial pressure in 36% of patients.

The anatomical configuration of the tumors, as well as involvement of the adjacent vasculature and of cerebrospinal fluid pathways were analyzed on the basis of imaging studies. The following results were obtained:

- Hydrocephalus was present in 6 cases (43%)
- Average tumor diameter was 43mm (ranging from 25 to 65 mm)
- Topographical classification: The site of tentorial attachment was established by means of both imaging studies and retrospective analyses of operative records. Patients were divided into 5 subgroups derived from the Yasargil’s classification TMs according to their relationship to the free tentorial edge 13.
  - Group I: Anteromedial TMs from the apex of tentorial margin (3 cases)
  - Group II: Anterolateral TMs arising the internal aspect of tentorial margin (1 case)
  - Group III: TMs arising from the intermediate aspect of the tentorium (3 cases).
  - Group IV: TMs arising from the posteroscleral arcuate part of the sellar bone in the cranial suture line (3 cases).
– Group V: TMs arising from the posterolateral aspect of tentorium close to the sigmoid sinus (4 cases).
• In 9 cases (64%), the tumors were projecting infratentorially, 3 cases (21%) projected supratentorially, while the remaining 2 cases projected both supra and infratentorially (Table 1).

Table 1: Anatomical location of 14 tentorial meningiomas (according to Yasargil classification and the tumor projection).

<table>
<thead>
<tr>
<th>Direction of projection</th>
<th>Anatomical location (Yasargil's groups)</th>
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<tbody>
<tr>
<td></td>
<td>Group I</td>
</tr>
<tr>
<td>Infratentorially</td>
<td>1</td>
</tr>
<tr>
<td>Supratentorially</td>
<td>1</td>
</tr>
<tr>
<td>Supra- and infratentorially</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>3 (21.4%)</td>
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• Blood Supply: Among 5 patients who underwent DSA, a tumor blush was visualized in 3 patients. The tumor staining was from the tentorial branches of the cavernous internal carotid artery in 2 patients and from the posterior cerebral artery in 1 patient (fig. 2). The transverse or sigmoid sinuses were seen unilaterally stenotic in 2 patients. There was obliteration of the sigmoid sinus in 1 patient belonging to group V.

Surgical treatment:
Among 6 patients showing ventricular dilatation, 4 underwent a ventriculoperitoneal shunting procedure, it was planned to be 1 week before surgical excision of the tumor.

Blood Supply: Among 5 patients who underwent DSA, a tumor blush was visualized in 3 patients. The tumor staining was from the tentorial branches of the cavernous internal carotid artery in 2 patients and from the posterior cerebral artery in 1 patient (fig. 2). The transverse or sigmoid sinuses were seen unilaterally stenotic in 2 patients. There was obliteration of the sigmoid sinus in 1 patient belonging to group V.

Surgical approaches: 3 different surgical approaches were utilized in our study; the choice of the surgical route was guided mainly by the location of the tumor. (Table 2)
A- Infratentorial tumors: In 10 cases the tumor was mainly infratentorial.
i. Median infratentorial supracerbellar approach involved osteoplastic lozenge-shaped bone flap flush with dural sinuses with its lower margin 2 cm above the foramen magnum.
ii. Paramedian infratentorial retrosigmoid approach combining the supracerbellar and retrosigmoid approaches to the posterior fossa, providing access to both the CPA and the inferior aspect of the tentorium.
B- Supratentorial tumors: In 4 cases the tumor was mainly supratentorial.
Occipital approach: An occipital craniotomy was performed exposing the superior sagittal and transverse sinuses. The occipital lobe was gently elevated away from the falx and the tentorium.

Table 2: Surgical approach in 14 cases

<table>
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<tr>
<th>Tumor location</th>
<th>Surgical approach</th>
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<tr>
<td></td>
<td>Mainly Infratentorial (n = 10)</td>
</tr>
<tr>
<td></td>
<td>Median</td>
</tr>
<tr>
<td>Group I</td>
<td>1</td>
</tr>
<tr>
<td>Group II</td>
<td>-</td>
</tr>
<tr>
<td>Group III</td>
<td>-</td>
</tr>
<tr>
<td>Group IV</td>
<td>3</td>
</tr>
<tr>
<td>Group V</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>4</td>
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Tumor removal: The extent of tumor removal was determined in each case using the operative records and analysis of the postoperative imaging studies and graded according to Simpson's grading for tumor removal. (Table 3)
Post-operative course: There were no intraoperative mortalities. 8 of our cases (57%) experienced 12 postoperative complications including: 8 new or exacerbated neurological deficits (which resolved in 6), 1 postsurgical ventricular dilatation required ventricular peritoneal shunt, 2 septic complications (1 osteomyelitis requiring removal of bone flap and 1 wound sepsis) and 1 systemic complication in the form of pneumonia.

We had a single mortality in our study (7.1%), which died few days post-operatively due to venous infarction. The remaining 13 patients were monitored during the follow-up period with clinical and imaging evaluation.

The final Glasgow outcome score for all cases was: GOS 1 in 1 case (7.1%), GOS 3 in 1 case (7.1%), GOS 4 in 2 cases (14.2%), and GOS 5 in 10 cases (71.4%). Pathologic documentation of meningioma was achieved in all cases. 13 cases (92.8%) were WHO grade I; one case (7.14%) was WHO grade II. No malignancy was detected in our cases.

**Table 3: Simpson’s grade of removal in 14 cases**

<table>
<thead>
<tr>
<th>Tumor location</th>
<th>Simpson’s grade of removal</th>
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<tr>
<td></td>
<td>Grade I</td>
</tr>
<tr>
<td>Group I</td>
<td>3</td>
</tr>
<tr>
<td>Group II</td>
<td>-</td>
</tr>
<tr>
<td>Group III</td>
<td>2</td>
</tr>
<tr>
<td>Group IV</td>
<td>-</td>
</tr>
<tr>
<td>Group V</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>5 (35.7%)</td>
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Fig. 3: **Left & middle:** Gadolinium enhanced MRI illustrating an intermediate aspect (group iii) tentorial meningioma with a supratentorial extension. **Right:** post-operative CT showing total excision via an occipital approach.

Fig. 4: **Left:** MRI showing a huge intermediate aspect (group iii) tentorial meningioma with a supratentorial extension. **Right:** post-operative MRI showing tumor excision via an occipital approach. Pathology: WHO grade II.
DISCUSSION

Tentorial meningiomas are relatively uncommon tumors accounting for less than 5% of intracranial meningiomas in most series of the literature. Our 14 cases account for 4% of 350 intracranial meningiomas operated upon during the same period. The incidence of TMs in women in our series was 64%, consistent with other studies showing a female predominance of 65 to 80%. No signs and symptoms of increased intracranial pressure were the most common finding followed by cerebellar ataxia. Several contributions have mentioned the occurrence of psychiatric disorders, bladder incontinence and gait difficulties in patients with TMs but none has clearly linked such symptomatology to the associated hydrocephalus.

Preoperative evaluation of TMs is employed using CT & MRI. Data obtained from these facilities included tumor volume, extension, mass effect to the brain stem and associated hydrocephalus. Classification followed in this present series was derived from that of Yasargil established according to the tumor location in relation to the inner and outer tentorial rings. This was identified from CT & MRI imaging data. MRV studies, which were done in 7 cases of this study, have proved to be a valuable tool for non-invasive assessment of the patency of dural venous sinuses and of deep venous system.

The choice of a surgical approach raises variable difficulties. For TMs located apart from the tentorial edge, e.g. (TM group III to V in this study), the choice of surgical approach is somewhat easy. Eight of 10 patients in this series belonging to group III-V and showing infratentorial extensions were operated upon via an infratentorial approach while the remaining 2 were operated upon via a supratentorial approach. Those TM located at the tentorial edge (TM group I and II), the choice of surgical approach is extremely difficult due to their deep location and vicinity to critical eloquent areas of the brain.

Conventional Approaches to the tentorial incisura include infratentorial supracerebellar approach, occipital transtentorial approach, occipital supra- and infratentorial approach, occipital supratentorial, infratemporal retrosigmoid, and subtotal approaches.

Transbasal approaches to the tentorial incisura represent sophisticated, recently developed alternatives to conventional approaches and include: presigmoid supra-infratentorial approach, pre and retrosigmoid trans labyrinthine approach and transpetrosal approach. Most of these approaches aim at more tumor exposure by drilling the mastoid process and the petrous bone anterior to the sigmoid sinus, followed by transection of the sigmoid and of the tentorium, with preservation of the vein of Labbé and hence minimizing brain retraction. Removal of TMs comprises various difficulties according to tumor site and volume. The main goal is total tumor resection but all attempts should be at preservation of brain stem, cranial nerves, critical arteries and deep venous system. It was said that "insistence to complete removal is not always necessarily the best judgment".

In this study, total tumor resection was achieved in 12 (85.7%) of 14 patients with Simpson's grade 1 in 5 patients and grade 2 in 7 patients. The 2 patients with subtotal removal were grade 3 and grade 4. The subtotal resection of TMs is not always associated with poor long term prognosis or recurrence: with a follow up period of 4 years, none of these 2 patients with subtotal resection showed tumor progression on repeated neuroimaging studies with no further surgery considered as consistent with other studies showing a low rate of recurrence. This low rate of recurrence is difficult to explain. However, different theories were proposed: 1) extenstentorial cauterization leads to dural devascularization, 2) residual tumors which are completely separated from their dural attachment show minimal growth abilities.

Early attempts at removal of TMs have been associated with high mortality and morbidity rates. Series published before 1980 reported a postoperative death rate ranging from 14% to 44%. Following the emergence of modern imaging techniques, advances in microsurgery, mortality has been dramatically decreased below 10% in most series of the last 25 years. However, the postoperative morbidity rate still remains a problem even in good hands with fig. ranging from 18-77%. Our clinical results compare with those of literature. Our postoperative morbidity included 12 complications in 8 patients (57%) which resolved in the majority of cases. At their latest follow up, 12 of our patients had resumed their previous activities (GOS of 5 or 4 = 85.7%). The vast majority of presenting symptoms had resolved at the long term follow up. We had one mortality in our study representing 7.1% of our cases.

CONCLUSION

Tentorial meningiomas remain a challenging surgical category in spite of advances in neuro-imaging, anesthetic protocols, and microsurgical techniques. They are associated with significant morbidity related to the nervous and vascular structures surrounding the tumor. Complete surgical resection should be the goal. However, this rule can be applied safely in peripheral TMs in respect to TMs located at the tentorial edge which carry worse prognosis. Subtotal tumor resection should be considered in TMs which have close relationship to critical structures in the form of brain stem or important vascular channels. Incomplete tumor removal does not always necessarily result in poor outcome or tumor recurrences.
REFERENCES