Clinical Outcomes with Transcranial Resection of the Tuberculum Sellae Meningioma

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■ BACKGROUND: **The tuberculum sellae is a relatively common location for meningiomas. We assessed our experience with the use of transcranial resection, which, although criticized for its more invasive nature compared with endonasal approaches, may be the ideal approach in selected patients with tuberculum sellae meningiomas (TSMs).**

■ METHODS: **We retrospectively reviewed the charts of patients with TSMs treated by frontotemporal or bifrontal open cranial resection. Clinical, radiographic, and surgical variables were analyzed.**

■ RESULTS: **Forty-nine patients with a TSM treated by frontotemporal or bifrontal open cranial resection were identified. The mean patient age was 53.2 $\pm$ 14.0 years, and the mean duration of follow-up was 42.3 $\pm$ 45.4 months. The mean tumor volume was 12.4 $\pm$ 18.0 cm^3. Optic canal invasion was seen in 46.9% of the patients, and 91.8% presented with visual deficits. Gross total resection (GTR) was achieved in 42 patients (85.7%), and near-total resection was performed in 7 patients (14.3%). Postoperatively, visual outcomes improved in 17 patients (34.7%), remained stable in 22 (44.9%), were intact in 6 (12.2%), and worsened in 1 (2.0%). Good outcome (Glasgow Outcome Scale [GOS] ≥4) was achieved by 46 of 49 patients (93%) at discharge and by 39 of 41 patients (95.1%) at 6 months. A total of 16 manageable and self-limiting complications occurred in 16 patients.**

■ CONCLUSIONS: **In most patients undergoing a frontotemporal approach, a GTR/Simpson grade I resection with manageable and self-limiting surgical complications, a good 6-month GOS in most patients, and improved to stable vision were seen at follow-up. Various treatment approaches can be considered for TSM resection, but the ability to decompress the optic canal and achieve a GTR makes the frontotemporal approach attractive in many cases.**

INTRODUCTION

Approximately 5%–10% of intracranial meningiomas are tuberculum sellae meningiomas (TSMs), which most commonly present with visual disturbances because of their position displacing the optic nerve superolaterally.[1] Resection of meningiomas in the anterior cranial fossa is complicated by complex anatomy, including the olfactory groove, planum ethmoidalis, planum sphenoidalis, and tuberculum sellae. TSMs arise from the limbus sphenoidale, chiasmatic sulcus, and tuberculum in a suprasellar, subchiasmal midline, or paramidline position.[2,3] Often the tumor can be difficult to separate from surrounding anatomic structures.

Multiple recent studies have compared transcranial resection (TCR) with endoscopic transsphenoidal approaches (ETAs) for TSMs.[1,4-15] Other suggested approaches include supraorbital endoscopic[16] and endoscopic-assisted microsurgical[4] techniques. Various clinical features support one surgical approach over another, but our understanding of the factors affecting the long-term clinical outcomes associated with these approaches remains limited. Although the TCR approach has been cited as

Key words
- Cranial resection
- Endoscopic resection
- Tuberculum sellae meningioma
- Visual outcomes

Abbreviations and Acronyms
CSF: Cerebrospinal fluid
EBL: Estimated blood loss
ETA: Endoscopic transsphenoidal approach
GOS: Glasgow Outcome Scale
GTR: Gross total resection
MRI: Magnetic resonance imaging
TCR: Transcranial resection
TSM: Tuberculum sellae meningioma

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conferring a greater risk of optic pathway injury compared with ETAs, in previous studies for various TSM tumors, treatment approaches have been selected a priori. The results of recent studies have led some to disfavor the TCR approach.[5,17,18] Our objective in the present study was to evaluate the radiologic, surgical, and clinical outcomes of a modern series of patients treated for TSM by a TCR approach.

METHODS

Patient Cohort and Clinical Variables

After receiving Institutional Review Board approval with waiver of consent, we undertook a retrospective chart review from the electronic medical record of patients with TSMs who underwent surgical resection. Such patients treated between April 1, 2002, and April 13, 2017, who had at least 1 month of follow-up were reviewed. Patients with meningiomas arising from the clinoid process or olfactory groove and cribriform plate area were excluded, as were patients with missing clinical or radiographic information. Clinical and demographic parameters were evaluated, along with duration of follow-up, tumor grade, and incidence of tumor recurrence. Presenting clinical signs and symptoms and postoperative symptoms and disposition were recorded. Surgical parameters, including surgical approach, estimated blood loss (EBL), and surgery-related complications, were also reviewed. Gross total resection (GTR) was defined by absent residual disease on postoperative magnetic resonance imaging (MRI), whereas near-total resection resulted in residual disease or otherwise questionable enhancing masses. Both the image and the radiology report were reviewed to identify the extent of resection. Radiographic measures, including tumor and sinus volume (length × width × height × 0.5), vessel encasement (defined as >270° of surrounding by tumor), optic nerve infiltration, and MRI fluid-attenuated inversion recovery signal changes were assessed. Ophthalmologic variables and follow-up were evaluated. Glasgow Outcome Scale (GOS) was evaluated for each patient at discharge and 6-month follow-up.

Means and standard deviations are reported where applicable. Continuous variables were analyzed using the t test, and discrete variables were analyzed using the χ^2 test. A P value of <0.05 was considered statistically significant. Statistical analyses were performed using SPSS version 20.0 (IBM, Armonk, New York, USA).

TCR

TCR approaches can involve unilateral frontotemporal/pterional or bifrontal methods, depending on lesion size. In most cases in this series, we used a frontotemporal surgical approach as described previously.[5] A bifrontal approach, with a bicoronal incision and frontal-based craniotomy, was used in 2 patients. For the frontotemporal craniotomy, the side of approach was the side of the most involved eye. A right-sided approach was favored in patients with equal eye involvement.

For the TCR procedure, the patient is positioned supine with the head turned away from the operative site and slightly extended to allow gravity-assisted frontal lobe retraction. A frontotemporal incision is made behind the hairline, and myocutaneous dissection is performed, followed by burr hole placement at the pterion and the temporal squamous bone. The sphenoid ridge is drilled to the region of the superior orbital fissure. The dura is opened in a curvilinear fashion based on the drilled lesser wing of the sphenoid. The frontal lobe is slightly retracted. The roof of the optic canal medial to the sphenoid wing is dissected from lateral to medial, and the tumor is resected, with care taken to avoid vessel injury. The olfactory tracts are left undisturbed whenever possible.

The tumor is first devascularized from the skull base in a lateral-to-medial direction. Next, tumor debulking is performed with microscissors or ultrasonic surgical aspiration, starting within the tumor. The optic nerve and carotid artery on the ipsilateral side are identified early during dissection. The arachnoid is dissected between the tumor and optic nerve after removal of sufficient tumor medially to enable tumor dissection from the medial aspect of the optic nerve. The contralateral optic nerve is identified by following the optic chiasm contralaterally or by identifying the contralateral sphenoid ridge and following it toward the anterior clinoid. Any tumor involving the lateral wall of the cavernous sinus is removed as described previously.[19] The dura over the anterior clinoid is dissected and removed, and the anterior clinoid is drilled, with unroofing of the optic canal. All hyperostotic bone is removed, and tumor within the canal is resected away. The dural attachment of the tumor is removed. A pericranial flap and fat graft are laid over the tuberculum sellae and planum sphenoidale if the sphenoid sinus is opened, and fibrin glue is applied.

RESULTS

Forty-nine patients who met the inclusion criteria were identified. Their mean age was 53.2 ± 14.0 years, and 12 (24.5%) were males (Table 1). The mean tumor volume was 12.4 ± 18.0 cm^3, and the maximum tumor diameter was 3.0 ± 1.3 cm. On radiographic examination, 26 tumors (53.1%) showed cavernous sinus enhancement; 27 (55.1%) showed encasement of major vessels, such as the anterior cerebral or middle cerebral arteries; 23 (46.9%) showed optic canal invasion (30.6% left, 10.2% right, 6.1% bilateral); and 15 (30.6%) showed MRI fluid-attenuated inversion recovery signal changes. The mean length of hospital stay was 5.7 ± 3.5 days, and the mean duration of follow-up was 42.3 ± 45.4 months. One patient (2.0%) died.

Six patients (12.2%) had undergone previous surgical treatment before the index surgical resection (Table 2), including 3 (6.1%) with transsphenoidal resection, 1 (2.0%) with transsphenoidal biopsy, and 2 (4.1%) with unknown approaches. No patient had received radiotherapy or chemotherapy before the index surgical case. After the index case, 2 patients (4.1%) underwent repeat surgery for residual or recurrent disease, 6 (12.2%) received radiotherapy, and 2 (4.1%) received combined radiotherapy with chemotherapy. Visual acuity at the time of treatment is reported in Table 1. Among the patients with complete ophthalmologic follow-up, color vision deficit was observed in 30.0%, stereoscopic vision was absent in 22.2%, an afferent pupillary defect was observed in 81.3%, and visual field defects were seen in 60.0%.

The rates of presenting symptoms were similar to the rates of postoperative deficits (Table 2). Rates of visual symptoms (91.8% vs. 85.7%; $P = 0.48$), headache (10.2 vs. 10.2%; $P = 1.0$), cranial nerve deficits (0 vs. 4.1%; $P = 0.15$), cognitive deficits (6.1% vs. 8.2%; $P = 0.69$), and anosmia (2.0% vs. 2.0%; $P = 1.0$) were similar in preoperative and immediate postoperative evaluations (Table 2).