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Tuberculum Sellae Meningiomas: Nuances in Treatment

Mohamed Khallaf

Department of Neurosurgery, Faculty of Medicine, Assiut University, Assiut, Egypt
Email: khallaf_1973@yahoo.com

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Abstract

Tuberculum sellae meningiomas (TSMs) represent special surgical challenge for neurosurgeons. In this review, we summarize the most common clinical manifestations, diagnostic images, surgical approaches and prognostic factors for outcome at single tertiary care teaching hospitals. **Material and Methods:** Prospective study was done between January 2010 and January 2017 (Minimum 24-month follow-up). Imaging and clinical data of 31 consecutive patients with TSMs were collected and analyzed. There were no exclusion criteria. **Result:** The majority of patients were >40 years old (22 patients; 71%). There was a female preponderance 74%: 23 cases (M/F ratio was 1:3). The most common clinical presentation was visual impairment (24; 77%). The mean tumor size was 3.3 cm. Thirty-one patients underwent surgical excision by different approaches. The overall visual improvement was 29% (9 of 31 patients) however visual deterioration occurred in 6.4% (2 of 31 patients). Favorable prognosis was found in patients with short preoperative visual affection (less than 6 months). This finding was statistically significant ($P \leq 0.05$). Also, visual outcome had significant correlations with edema surrounded tumor: arterial encasement by the tumor and brain-tumor interface. Two patients died 3 weeks postoperatively from brain stem infarction (overall incidence of mortality 6%) while the overall incidence of morbidity was 19% (6 of 31 patients). **Conclusion:** The most common symptom of Tuberculum sellae meningioma is visual affection. The favorable prognosis was found in patients with short preoperative visual affection (less than 6 months). Also; visual prognosis had significant correlations with peritumoral edema, arterial encasement by the tumor, and brain-tumor interface.

Keywords

Tuberculum Sellae, Meningiomas, Optic Nerve, Visual Outcome, Surgical Approaches

1. Introduction

Tuberculum sellae meningiomas (TSMs) are not uncommon variety among the intracranial meningiomas. They originate from the dura mater of Tuberculum sellae, planum sphenoidale, and chiasmatic sulcus and comprise 5% to 10% of all intracranial meningiomas [1]. Optic chiasm was displayed posteriorly and superiorly while the optic nerves were displayed laterally [2].

The most common clinical presentation for Tuberculum sellae meningiomas was gradual visual compromise. The term "chiasmal syndrome," coined by Holmes and Sargeant in 1927, refers to a primary optic atrophy with a bitemporal field defect due to compression on optic pathway [3].

The duration of preoperative visual affection has a strong correlation on visual outcome. Thus, early diagnosis is desirable for successful management with a better chance of favorable postoperative visual outcome.

Complete tumor excision with preservation or improvement of visual function is the goal of Tuberculum sellae meningioma (TSM) treatment. Tuberculum sella meningiomas represent a surgical challenging due to their relationship with surrounding vital structure especially the optic pathway, internal carotid arteries, anterior cerebral artery and the pituitary stalk. Several transcranial approaches have been used; however the subfrontal and pterional approaches are the most common and traditionally used. There have been several recent studies on an extended endoscopic transsphenoidal approach as an alternative approach, but its long-term outcome has yet to be determined. They concluded also the larger tumors with lateral or optic canal extension or vascular encasement should be approached via a craniotomy.

This is a prospective study analyzing 31 patients with Tuberculum sellae meningiomas operated at the department of neurosurgical, Assiut University over 7 years period. This study summarizes the most common clinical manifestations, diagnostic images, surgical approaches and prognostic factors for outcome of the surgical treatment of Tuberculum sellae meningiomas at single tertiary care teaching hospitals.

2. Materials and Methods

A total of 31 consecutive patients with Tuberculum sellae meningiomas operated by the author during the period from January 2010 till January 2017 (Minimum 24-months follow-up) with no exclusion criteria. The basic demographic data include age, sex, clinical presentations, radiological findings, management and outcome. The neuro-ophthalmological evaluations include assessment of visual acuity (VA); visual field (VF) and fundscopy. Oculomotor function was assessed throughout neurological examination.

All patients underwent assessment by neuroimaging study (CT scanning and MR imaging). CT showed bony reaction of the planum sphenoidale and Tuberculum sellae (hyperostosis) or tumoral calcification. MRI findings were analyzed regarding tumor size, edema surrounded tumor, arterial encasement, optic canal

extension, brain-tumor interface etc. MRA- or CTA- can be valuable in detecting feeding vessels and surrounding blood vessels (internal carotid arteries, anterior cerebral artery). Endocrinological hormonal tests for pituitary function were done preoperatively and on follow up postoperatively in case of pituitary insufficiency.

2.1. Surgical Procedure

Several microscopic surgical approaches have been used. It included extended bifrontal, unilateral frontal, perional, and fronto-temporo-orbito-zygomatic. Choosing the side of the craniotomy is a cardinal issue when using the unilateral subfrontal approach. The extent of tumor resection was based on Simpson grading [4]. All surgical procedures were done by single author neurosurgeon.

2.2. Follow-Up

Follow-up examinations were doneduring 24 months postoperatively, to evaluate visual function and imaging studies (CT and MRI). Endocrinological hormonal tests for pituitary function were followed up in patients with pituitary insufficiency.

2.3. Ethical Consideration

The study was approved by the ethical committee of Assiut University Teaching Hospital. Informed consent had to be obtained in writing before surgery.

2.4. Statistical Analysis

SPSS version 22 (SPSS, Inc., Chicago, IL) was used for statistical analyses. The results were expressed as frequency and percent in qualitative data and mean ± SD for quantitative data. Comparison of categorical variables between the two was performed using chi-square test and a P value of ≤0.05 was considered significant.

3. Results

3.1. Patient Demography

The study group comprised of 23 women and 8 men with mean age ± SD (range) 44.97 ± 8.577. The most common clinical presentation was visual impairment (24; 77%) with mean duration ± SD of preoperative visual symptoms (range) 10.3 ± 5.046. Other relatively common symptoms were headache 4 patients (13%) and pituitary insufficiency 3 patients (10%). Mean tumor size was 3.3 cm. Optic canal was involved in 3 patients (10%); edema surrounded tumor was detected in 9 patients (29%); arterial encasement in 8 patients (26%) and brain tumor interface was clear in 24 patients (77%) (**Table 1**).

3.2. Surgical Approaches

The Tuberculum sellae meningioma is a challenge for neurosurgeons. Due to the

complex anatomy of the Tuberculum sellae region, decision making is very difficult. When choosing an approach, neurosurgeons must carefully analyze which is the best alternative for each case, because these are among the most challenging surgeries in the neurosurgical field. Thirty-one patients underwent craniotomy for tumor resection: 12 bifrontal, 9 pterional, 8 unilateral frontals and 2 fronto-orbito-zygomatic approach (Figure 1).

3.3. Follow-Up

The overall visual preservation was 93.6%; vision improved in 29% (9 of 31 patients). Visual compromise occurred in 6.4% (2 of 31 patients). There was a strong significant correlation between the duration of symptoms prior to treatment and visual prognosis. The best prognosis was found in patients with short preoperative visual affection (less than 6 months). This finding was statistically significant ($P \leq 0.05$). Also; visual outcome had significant correlations with edema surrounded tumor ($P \leq 0.04$), arterial encasement by the tumor ($P \leq 0.04$), and brain-tumor interface ($P \leq 0.05$) (Table 2).

Two patients died 3 weeks postoperatively due to brain stem infarction (overall incidence of mortality 6%). Postoperative neurological complications were as follows: Two patients had more visual deterioration post operatively (2 patients; 6.4%). Two patients developed a postoperatively CSF leak. Both of them had aseptic meningitis and recovered completely with antibiotic. One patient developed postoperative epilepsy that was controlled with antiepileptic treatment. One patient had atransient diabetes insipidus. The overall incidence of morbidity was 19% (6 of 31 patients).

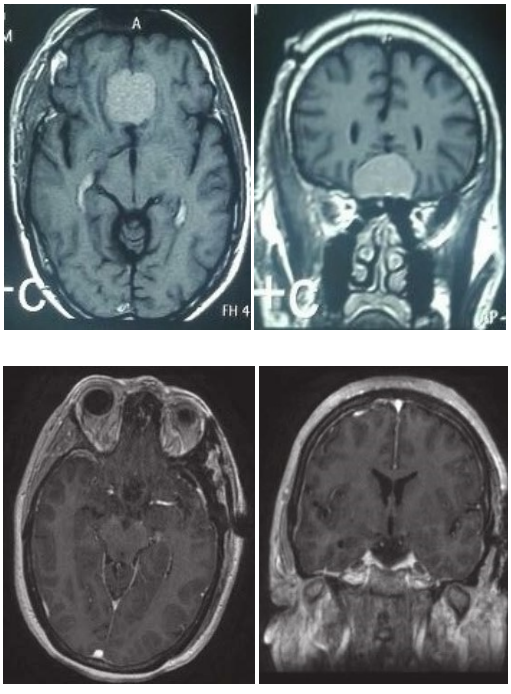

Figure 1. A pre and post-operative MRI axial and coronal cuts of a case of Tuberculum sellae meningioma showing complete excision.

Table 1. Demographic data of patients with Tuberculum sellae meningiomas in the studied period (2010-2017).

Variable	Number	Percent
Age		
○ ≤40	9	29%
○ >40	22	71%
mean age ± SD (range) 44.97 ± 8.577		
Sex		
○ Male	8	26%
○ Female	23	74%
clinical presentation		
○ Visual impairment	24	77%
○ Headache	4	13%
○ Pituitary insufficiency	3	10%
Visual disturbance		
○ Both eye	19	61%
○ Rt eye	7	23%
○ Lt eye	5	16%
Duration of visual symptoms		
○ ≤6 months	10	32%
○ >6 months	21	68%
mean duration ± SD (range) 10.3 ± 5.046		
Radiological findings		
○ Size		
○ <3	21	68%
○ 3 - 6	6	19%
○ >6	4	13%
mean size ± SD (range) 3.3 ± 2.205		
○ Attached Tuberculum Sella		
○ With optic canal involvement	3	10%
○ Without optic canal involvement	28	90%
○ Peritumoral edema		
○ Present	9	29%
○ Absent	21	71%
○ Arterial encasement		
○ Present	8	26%
○ Absent	23	74%
• Brain tumor interface		
○ Clear	24	77%
○ Not clear	7	23%

Table 2. Factors affecting visual outcome.

Variables	Visual outcome		P value
	Not improved	Improved	
Duration of visual symptoms			
○ <6 months	3 (30%)	7 (70%)	0.05
○ >6 months	19 (90%)	2 (10%)	
Peritumoral edema			
○ Present	8 (89%)	1 (11%)	0.04
Absent	14 (64%)	8 (36%)	
Arterial encasement			
○ Present	7 (87.5%)	1 (12.5%)	0.04
○ Absent	15 (65%)	8 (35%)	
Brain-tumor interface			
○ Clear	22 (92%)	2 (8%)	0.05
○ Not clear	0 (0%)	7 (100%)	

4. Discussion

4.1. Incidence

Tuberculum sellae meningiomas represent 5% to 10% of all intracranial meningiomas. Many studies on their manifestation and surgical management have been published over the years [5] [6]. Women are commonly affected more often than men. the mean age at diagnosis is between 40 and 50 years [7] which is consistent with the patients in this study; The greatest number of the patients had >40 years old (22; 71%) and the mean age was ±SD (range) 44.97 ± 8.577. There was an overwhelming female preponderance 74%; 23 cases (M/F ratio was 1:3) (**Table 1**).

4.2. Pathogenesis

There is different pathogenesis for preoperative optic nerve affection: ischaemia, compression, demyelination, and tumors invasion. Optic nerve compression leads to small vessel demyelination, especially in patients with a long history of visual compromise before surgery. Preservation of the optic pathway and its appropriate decompression is essential and main aim of operation [8].

4.3. Clinical Presentations

The main clinical presentation of a Tuberculum sellae meningioma is visual affection. In most patients with TS meningioma, visual loss starts insidiously and slowly progresses. The majority of the patients in this study presented with visual compromise (24; 77%) consistent with other reports [9] [10]. Other relatively common symptoms were headache 4 patients (13%) and pituitary insufficiency 3 patients (10%) (**Table 1**).

4.4. Surgical Technique

Surgery for TSMs is challenging due to unique set of vital anatomic surrounding that affect outcomes and decision-making. Different surgical approaches were used traditionally for Tuberculum Sellae Meningiomas; each has its prons and cons. The are many factors must be considered in decision-making and choosing of the approach like anatomical characteristics of the tumor, relationship with neurovascular structures; and the experience of the neurosurgeon.

The bifrontal approach provides the widest surgical view and is considered as the most suitable for very large tumors. Also, the frontotemporal, the pterional, and the unilateral subfrontal approaches are thought to provide a sufficient surgical view. The orbitozygomatic approach provides an excellent access to lesions in the skull base, however it is rarely used in patients with TS meningiomas. [11] [12] [13]. More recently, keyhole craniotomies, such as the transciliary or transpalpebral supraorbital craniotomy, have been described. They provide more cosmetic advantages however their application in TSM are limited due to insufficient ability to deal with bilateral optic canal extension or extensive vascular encasement [14] [15] [16]. Thirty-one patients were operated for TSMs through

different approaches: 12 bifrontal, 9 pterional, 8 unilateral frontals and 2 fronto-orbito-zygomatic approach in presenting study.

As result of the evolution of endoscopic surgery for pituitary adenomas, these meningiomas have been increasingly excised using an endonasal endoscopic approach, however a meta-analysis by Ivo *et al.* [17] indicates that the endoscopic transsphenoidal approach has not been shown to be superior to the microscopic surgery for Tuberculum sellae meningiomas. Moreover, it was associated a higher rate of vascular injury and more CSFleakthan microscopic approach.

4.5. Prognostic Factors

Several studies [8] [13] [18] [19] have described various factors affecting visual outcome. The proposed factor was symptom duration; preoperative visual function, vascular encasement, arachnoid membrane intactness and peritumoral edema. They concluded that the prognosis and visual outcome is excellent in patients with short preoperative visual affection; intact arachnoid membrane; absence of arterial encasement and peritumoral edema. The results in presenting study are in accordance with previous investigations. The Favorable prognosis was found in patients with short preoperative visual affection (less than 6 months). This finding was statistically significant ($P \leq 0.05$). Also; visual outcome had significant correlations with edema surrounded tumor ($P \leq 0.04$), arterial encasement by the tumor ($P \leq 0.04$), and brain-tumor interface ($P \leq 0.05$) (**Table 2**).

The extent of tumor excision has improved due to the advent of microsurgery, It was 35% to 76% in macrosurgical series, compared with 58% to 100% in microsurgical series [20]. The study by Pamir *et al.* [19] postulated that the visual prognosis was better in totally excised tumors; however Zevgaridis *et al.* [8] found no significance correlation.

Outcome

Following the advent of microsurgery, mortality rates have fallen to less than 10%. Mortality in the earlier series was often directly related to the surgical intervention. In contrast, in recent microsurgical era; Themortality is usually related to nonsurgical problems, such cardio-embolic complication, pulmonary complications as pneumonia, and sepsis [12] [13]. In the presenting study; Two patients died 3 weeks postoperatively due to brain stem infarction (overall incidence of mortality 6%).

Postoperative neurological complications were as follows: Two patients had more visual deterioration post operatively (6.4%). Postoperative visual loss is a dreaded complication following transcranial excision of Tuberculum Sella meningioma. It is linked to multiple reasons including intraoperative manipulation of the nerve, thermal injury due to use of cautery and drills and any obvious vascular injury. The key to preserving visual function is to avoid a direct trauma to the optic pathway or its blood supply. In previous reports, visual acuity improved in 28% to 80% of patients, the same in 9% to 64%, and deteriorated in

7% to 33% [10] [11] [13] [21] [22] [23]. In this study, vision improved in 29% of the patients, the same in 64.6%, and deteriorated in 6.4%.

Two patients developed a post-optatively CSF leak. Both of them had aseptic meningitis and recovered completely with antibiotic. One patient developed postoperative epilepsy that was controlled with antiepileptic treatment. One patient had atransient diabetes insipidus. The overall incidence of morbidity was 19% (6 of 31 patients).

There were several important study limitations. The sample size was not large enough to provide strong evidence for clinical practice. Duration of follow up may be needed to be extended to assess prognostic factors that affect outcome efficiently. The strength of the study is that it was based on a defined population without selection based on examined, operated and followed up by single neurosurgeon neither neurosurgical treatment nor neurosurgical intensive care was available in other institutions in our area.

5. Conclusion

The most common clinical presentation of a TSM is visual affection and the main aim of surgery is complete tumor excision with maintaining or improvement of visual function. The prognosis and visual outcome are excellent in patients with short preoperative visual affection; intact arachnoid membrane; absence of arterial encasement and peritumoral edema.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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