Surgical Management and Evaluation of Prognostic Factors Influencing Postoperative Visual Outcome of Suprasellar Meningiomas

Chuan-Wei Wang[1], Ying-Yu Li[2], Shu-Gan Zhu[1], Yang Yang[1], Hong-Wei Wang[1], Jie Gong[1], Yu-Guang Liu[1]

Key words
- Meningioma
- Microsurgery
- Multivariate analysis
- Suprasellar tumor
- Visual outcome

Abbreviations and Acronyms
ACPM: Anterior clinoid process meningioma
DSM: Diaphragma sellae meningioma
MRI: Magnetic resonance imaging
OC: Optic chiasma
ON: Optic nerve
PSM: Planum sphenoidale meningioma
SM: Suprasellar meningioma
TSM: Tuberculum sellae meningioma
VA: Visual acuity
VF: Visual field

From the [1]Department of Neurosurgery, Qilu Hospital of Shandong University, Jinan, P.R. China; and [2]Department of Neurosurgery, Xintai Second People's Hospital of Shandong Province, P.R. China

To whom correspondence should be addressed: Yu-Guang Liu, M.D. [E-mail: NS3000@126.com]

Citation: World Neurosurg. (2011) 75, 2:294-302.
DOI: 10.1016/j.wneu.2010.08.021
Journal homepage: www.WORLDNEUROSURGERY.org
Available online: www.sciencedirect.com

OBJECTIVE: **To study the microsurgical technique and the prognostic factors influencing postoperative visual outcome in patients with suprasellar meningiomas (SMs).**

METHOD: **The clinical materials of 45 patients with SMs treated microsurgically between January 2002 and October 2008 were analyzed retrospectively. Patients received ophthalmologic and radiologic assessment before and after operation. Follow-up ranged from 12 to 93 months (median, 39 months). As far as monocular vision was concerned, univariate and multivariate statistical analysis was performed among factors that might influence postoperative visual outcome.**

RESULTS: **In this group, the mean age of the patients was 51 years. Median tumor size was 3.5 cm. The duration of symptoms ranged from 10 days to 35 years (median, 18 months). Total tumor resection was achieved in 40 cases (88.9%) and subtotal in 5 cases (11.1%). With respect to visual outcome of the 90 eyes, 54 eyes (60%) improved, 24 (26.7%) remained unchanged, and 12 (13.3%) had worsened. It has been illustrated that the postoperative visual improvement was determined by various factors, including age, recurrence, duration and severity of visual disturbance, preoperative condition of optic disc, tumor size, location, peritumoral edema, involvement with optic canal, arachnoid membrane interface, and extent of tumor removal. However, the multivariate analysis showed that recurrence, preoperative condition of optic disc, duration of impaired vision, and peritumoral edema are the most influential factors.**

CONCLUSIONS: **Skillful microsurgical techniques are key to resect SMs while getting the desired visual outcome. The recurrence, preoperative condition of optic disc, duration of impaired vision, and peritumoral edema might be the most important factors influencing postoperative visual outcome.**

INTRODUCTION

Suprasellar meningiomas (SMs) account for 5%–10% of all intracranial meningiomas, including meningiomas arising from the dura of tuberculum sellae, anterior clinoid process, diaphragma sellae and planum sphenoidale. The impaired vision is the most common symptom because of tumor compression of the optic nerve (ON) and optic chiasma (OC), or the extension of tumor tissue into optic canals and fossa orbitalis. Tuberculum sellae meningioma (TSM) was first described by Stirling and Edin in 1897 (35), and the first complete removal was performed in 1916 by Cushing and Eisenhardt (9). Although many studies on SMs show lower mortality and higher complete excision rate (3, 11, 22), the factors influencing visual improvement are still in dispute.

So far, there have been few reports of multivariate analysis of the factors influencing postoperative visual outcome, except that of Zevgaridis et al. (41), who concluded that intact brain–tumor interface and absence of severe (<0.2) preoperative visual loss were the two significant influential factors. This study focuses on a group of SM patients with visual impairments. Many clinical variables were analyzed through statistical methods.

MATERIAL AND METHODS

Inclusion and Exclusion Criteria

Between January 2002 and October 2008, a total of 47 patients with SMs were treated in Qilu Hospital of Shandong University. In consideration of visual outcome analysis, two cases were excluded because of obvious confounding factors. One had measles when he was age 7 years, which had made him binocular blind preoperatively, and the other died soon after surgery and the visual result could not be tested. Clinical data of the remaining 45 patients were reviewed retrospectively.

Radiologic Examination and Follow-up

All patients were given computed tomography (CT) and/ or magnetic resonance imaging (MRI) scans. MRI was performed in 41 patients preoperatively and 31 postoperatively. After the discharge from hospital, pa-

tients were followed up from 12 to 93 months (median, 39 months). Forty-one patients received CT whereas 21 patients received MRI during follow-up.

Ophthalmologic Examination and Evaluation

Ophthalmologic examination consisted of testing the patient's visual acuity (VA) with Snellen E decimal chart, Humphrey visual Field Analyser (HFA‖) perimetry for visual field (VF), and ophthalmoscope examination of optic disc condition for every single eye. A total of 90 eyes in the 45 patients were evaluated. Improvement in VA was defined as a change of ≥1 line. Improvement in VF was considered significant if VF improved with five or more points of $P < 5\%$ or with a cluster of three or more points of $P < 5\%$ (17). Improvement in visual outcome was defined by two conditions: both in VA and VF or improvement in one of the two items and no change in the other. The situation that one of the two items improved but the other deteriorated was not counted. As far as monocular vision was concerned, univariate and multivariate statistical analysis were performed among factors that might influence postoperative visual outcome.

Surgical Techniques

All operations were carried out under general anaesthesia using microsurgery technique. Unilateral subfrontal approach was performed in 12 patients, bilateral subfrontal approach in 8, frontal-interhemispheric approach in 4, pterional approach in 16, frontal–pterional approach in 4, and transsphenoidal approach in 1. The choice of surgical strategies depended on several factors, including the tumor size, location, direction of tumor growth, relationships among tumor and the adjoining structures, dural attachment of the tumor, etc. The side of marked visual deterioration was selected for incision, whereas the nondominant hemispheric side was preferred in bilateral involvement. Prophylactic treatment with steroids and anticonvulsants was used in the cases in which seizures occurred preoperatively or obvious peritumoral edema was found. Mannitol, nimodipine, and papaverine were administered perioperatively. After the tumor was exposed, the ON and internal carotid artery should be identified. Generally, the base and the feeding artery of the tumor were coagulated with bipolar coagulation first. After the tumor feeding artery was blocked, the shriveled tumor could be coped with under exsanguinate operative field, and en bloc resection of tumor could be achieved. However, sometimes the tumor was too large and pervasive to get its real base confirmed and the major feeding arteries could not be interrupted immediately. In this situation, we preferred to first coagulate the tumor capsule and the abnormal arteries creeping on it, simultaneously dissecting the tumor tissue nearby the base progressively. After tumor debulking was managed in piecemeal removal, the base of tumor could be determined and the major feeding artery be blocked. In most cases, the dura where tumor attached was coagulated or incised. If the optic canal was involved, the fibrous ligament would be opened and the bone canal be drilled with continuous irrigation to avoid heat damage to the optic apparatus. If the tumor invaded into orbit, the paries superior orbitae and lateral wall of orbit should be opened for resecting the tumor.

There are some surgical key points for visual improvement. Arachnoid membranes in subarachnoid cistern that cover above the surface of the tumor, the optic apparatus, and surface of cerebral lobe should be preserved. Excessively radical manipulation should be avoided and a little remnant tumor on the optic apparatus and arteries will be permitted if tumor tissue adhere closely to the neighboring vital structures. Arterial branches should be protected carefully, such as the posterior ethmoidal, ophthalmic, superior hypophysial, and anterior communicating artery (40). When close to the ON and OC, tumor resection should be done with low-power bipolar coagulation or just be performed by Cavitron ultrasonic aspiration.

Pathologic Studies

According to WHO classification (2007) of tumors of the central nervous system (21), meningothelial meningioma was confirmed in 24 cases, fibrous (fibroblastic) in 7, transitional in 7, angiomatous in 2, psammomatous in 1, metaplastic in 2, and atypical in 2. The former six groups corresponded to WHO grade 0, while the last "atypical" group corresponded to WHO grade I.

Statistical Analysis

Univariate and multivariate statistical analysis were done among factors that might influence postoperative visual outcome. Statistical analysis was performed with the use of χ^2 test, Fisher's exact test and logistic regression. SPSS 13.0 statistical software was used to deal with data and make 0.05 the boundary of statistical significance. For logistic statistical analysis, entry and removal probability values for stepwise were 0.10 and 0.10.

RESULTS

Symptoms and Signs

This group was composed of 36 women and 9 men. The mean age of the patients was 51 years (ranging from 23 to 75 years). Duration of symptoms was from 10 days to 35 years (median, 18 months). Visual impairment was the most common initial symptom. Forty-two patients (93.3%) complained of visual problems, but the ophthalmologic findings showed visual problems in all patients. The clinical symptoms and signs are shown in **Table 1**.

Radiologic Features

The tumor appeared as mass-like shadow, hyperdense on 31 (68.9%) of 45 CT scans, hypodense on 14 (31.1%), and enhanced with contrast administration on 35 scans (77.8%). Mean tumor diameter was 3.6 cm (range 1.2–8 cm). Calcification was present in 6 (13.3%), peritumoral edema in 17 (37.8%), shift of midline structure in 12 (26.7%), and compression to cerebral ventricle in 10 (22.2%). Most tumors showed sharply demarcated margin, a dural tail and generally isointensity to the grey matter on T1 WI and mild hyperintensity on T2 WI, with strong contrast enhancement on MRI scans. The shape of the tumors was roundish (22 cases), lobulated (3), or irregular (11). Invasion into the unilateral cavernous sinus was present in 5 patients, optical canal involvement in 17 eyes with 5 further extended into the orbital wall or orbital compartment, and involvement with accessory nasal cavity in 5 patients. Hyperostosis of the sellar base of the skull bone was present in 13 patients.