Clinical Features, Radiologic Findings, and Surgical Outcomes of 65 Intracranial Psammomatous Meningiomas

Zhiqin Lin[1], Meng Zhao[1], Xiaohui Ren[1], Junmei Wang[2], Zongze Li[1], Xiaolin Chen[1], Yongzhi Wang[1], Xiangrong Li[1], Chengjun Wang[1], Zhongli Jiang[1]

■ OBJECTIVE: **Intracranial psammomatous meningiomas (PMs) are rarely reported due to their extremely low incidence. Knowledge about intracranial PMs is therefore poor. This study aimed to analyze the incidence, clinical features, radiologic findings, and surgical outcomes of intracranial PMs.**

■ METHODS: **Approximately 5651 intracranial meningiomas were surgically treated at Beijing Tiantan Hospital between November 2011 and December 2015. The authors identified all cases in which patients underwent resection of an intracranial tumor that was found to be a PM on pathologic examination and analyzed the data from these cases.**

■ RESULTS: **PMs accounted for 1.15% of the entire series of intracranial meningiomas. Sixty-two (95.4%) of these 65 intracranial PMs were female. The median maximal tumor diameter was 2.8 cm (range, 1.4–8.4 cm). On computed tomography scan, all PMs (23/23) showed various calcification. Gross total resection was achieved in 56 cases, near total resection in 5, subtotal resection in 3, and partial resection in 1. Seventeen (26.2%) of the patients experienced new or exacerbated deficits immediately after operation. Three patients (17.6%, 3/17) got alleviation when assessed at last follow-up. Eleven patients (16.9%) experienced additional surgical complications. At the time of discharge, Karnofsky Performance Scale (KPS) score and neurologic function showed improvement in 50 cases (76.9%) and worsening in 15 cases (23.1%). At a median follow-up of 37 months (range, 7–56 months), 1 patient had experienced tumor regrowth 50 months after surgery and the 4-year progression-free survival rates were 100.0%. No patient died of recurrence. At the latest follow-up, the KPS score showed improvement in 56 cases (86.2%) and worsening in 9 cases (13.8%). Tumor located in the skull base is significantly associated with an increased risk of worsened long-term outcomes. Preoperative KPS score <90, peritumoral brain edema (PTBE), and hypointensity on T2-weighted imaging had a statistically significant effect on the extent of tumor resection.**

■ CONCLUSIONS: **Intracranial PM is a rare subtype of meningioma with marked female predominance and low tendency toward growth and recurrence. Most intracranial PMs exhibit highly calcified imaging characteristics, particularly as seen by computed tomography. Microsurgical treatment of skull base PM remains a formidable challenge due to the hard tumor consistency and critical neurovascular structure encasement. It is unnecessary for radical tumor resection at the cost of severe neurologic deficits.**

INTRODUCTION

Meningiomas represent the most common primary intracranial tumors, accounting for 26%–35% of all primary brain tumors.[1,2] They originate from the

Key words
- Clinical features
- Intracranial
- Psammomatous meningioma
- Radiology
- Surgical outcomes

Abbreviations and Acronyms
CT: Computed tomography
GTR: Gross total resection
IDMs: Incidentally discovered meningiomas
KPS: Karnofsky Performance Scale
MRI: Magnetic resonance imaging
PFS: Progression-free survival
PM: Psammomatous meningioma
T2WI: T2-weighted imaging
WHO: World Health Organization

From the Departments of [1]Neurosurgery, Beijing Tiantan Hospital, Capital Medical University; and [2]Neuropathology, Beijing Neurosurgical Institute, Beijing, China

To whom correspondence should be addressed: Zhongli Jiang, M.D. [E-mail: jiangzhongli5@aliyun.com]

Zhiqin Lin and Meng Zhao contributed equally to the study.

Citation: World Neurosurg. (2017) 100:395-406.
http://dx.doi.org/10.1016/j.wneu.2017.01.056

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

arachnoidal cap cells of the meninges and are classified into 15 different variants according to the 2007 World Health Organization (WHO) classification for brain tumors, with 80% being benign and the remaining 20% being atypical and malignant meningiomas.[3]

Psammomatous meningioma (PM) is a rare benign subtype of meningioma. Histopathologically, PM is characterized by the presence of large numbers of psammoma bodies. Calcification foci can be frequently found in meningiomas containing abundant psammoma bodies. Intraspinal PMs are more common than intracranial PMs. According to the present study, the existence of calcification of intraspinal PM complicates the operative procedure, makes surgical removal difficult, and carries an increased risk of poor neurologic outcome as a result of adhesions to the spinal cord and additional manipulations required to dissect the tumor.[4-8]

The incidence of intracranial PM is approximately 1.05%–3.84% of all intracranial meningiomas.[9,10] Accordingly, intracranial PM has rarely been discussed as a separate entity in the literature, and data focusing on its clinical characteristics and surgical outcomes are limited. In this study, we aimed to investigate the clinical features, radiologic findings, and postoperative outcomes in a consecutive cohort of 65 patients who had undergone resection of intracranial PMs in a large neurosurgical center in China.

MATERIALS AND METHODS

Patients

This study was approved by the Research Ethics Board of Beijing Tiantan Hospital. A consecutive series of 65 patients with intracranial PM from 10 different subdivisions of the Neurosurgery Center in Beijing Tiantan Hospital (Beijing, China) were surgically treated and pathologically confirmed between November 2011 and December 2015. The operations were performed by 14 senior neurosurgeons. The histologic diagnosis was based on the 2007 WHO classification criteria.[11] The clinical data, surgical records, and follow-up clinical records for cases of intracranial PM were reviewed retrospectively. The following information was recorded: patient age, sex, clinical manifestation, duration from onset to admission, lesion size, location, computed tomography (CT) and magnetic resonance imaging (MRI) features, extent of resection, and surgical outcomes. Tumor size was recorded as the measurement of maximal diameter based on radiology. The extent of tumor resection was recorded as gross total, near total, subtotal, or partial according to the surgical record and postoperative MRI.

Surgical Outcome and Postoperative Follow-Up

All patients with intracranial PM were followed up after surgery. Postoperative complications and progression-free and overall survival were recorded. Short-term outcome was assessed by Karnofsky Performance Scale (KPS) score at discharge. Long-term outcome was assessed by KPS score at latest follow-up. Progression of PM was defined according to the radiologic findings after tumor removal. Progression-free survival (PFS) was defined as the time between initial surgery and tumor progression on radiology. Overall survival was defined as the time between initial surgery and death.

Statistical Analysis

IBM SPSS statistics for Windows version 19.0 (IBM Corporation, Armonk, New York, USA) was used for all statistical analyses. Univariate analysis were performed by using the chi-square test to assess potential risk factors for short-term and long-term surgical outcomes and extent of tumor resection. Characteristics identified as potential risk factors according to univariate analysis underwent multivariate logistic regression analyses. To ensure selection of the best combination of explanatory variables, the variables with a P value of <0.20 were included in the model, and they remained in the model only if they were significantly related to the response variable ($P < 0.10$). $P < 0.05$ (2-sided) was considered statistically significant.

RESULTS

Incidence and Clinical Features of Intracranial PM

The incidence of intracranial PM among intracranial meningioma was 1.15% (65 of 5651 cases). Patient demographics and baseline characteristics are summarized in **Table 1**. The age at diagnosis ranged from 10–69 years; the mean age was 52.5 ± 11.2 years (all means are expressed ± standard deviation). These patients included 3 males and 62 females. Histologic examination revealed 64 WHO grade I meningiomas (98.5%) and 1 grade II meningioma (1.5%) with brain invasion. The duration from onset to admission ranged from 10 days to 10 years (median 6 months). The chief complaints included headache or raised intracranial hypertension in 29 patients, dizziness in 15, blurred vision in 9, numbness in 3, limb weakness in 3, seizures in 3, ataxia in 3, hyposmia in 3, memory loss in 2, drinking cough in 1, and hoarseness in 1. Sixteen patients (24.6%) were asymptomatic; their tumors were found incidentally on neuroimaging, such as CT and MRI. Of the 65 PMs, 63 were primary lesions and 2 were recurrent lesions. Neurofibromatosis type 2 was confirmed in 1 case. One PM was associated with an anterior communicating artery aneurysm. The median preoperative KPS score was 90 (range, 40–100). Three patients had received radiotherapy before operation, whereas 62 patients had not. The 1 patient with WHO grade II meningioma received postoperative radiotherapy. Patients were evaluated clinically and by serial imaging (CT or MR) for a median follow-up period of 37 months (range, 7–56 months).

Radiologic Findings of Intracranial PMs

Radiologic data are summarized in **Table 2**. Non–skull base locations included the convexity, parasagittal, falx, tentorium, ventricle, and cerebellar convexity. The lesion was located in the parasagittal in 13 cases, in the convexity in 11 cases, in the falx in 5 cases, in the tentorial in 3 cases, in the lateral ventricle in 1 case, and in the posterior fossa convexity in 1 case. The skull base PMs were frontobasal in 8 cases, in the tuberculum sellae or parasellar in 7 cases, in the sphenoid ridge in 7 cases, in the foramen magnum in 4 cases, in the lateral petrous in 3 cases, and in the jugular foramen in 2 cases. The tumor was located on the left side in 26 cases and on the right side in 27 cases; it was bilateral in 12 cases. Multiple lesions were revealed in 8 cases, whereas a single lesion was revealed in the other 57 cases. Regarding tumor shape, 39 tumors were spherical, 24