Risk of Recurrence in Operated Parasagittal Meningiomas: A Logistic Binary Regression Model

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■ BACKGROUND: **Parasagittal meningiomas arise from the arachnoid cells of the angle formed between the superior sagittal sinus (SSS) and the brain convexity. In this retrospective study, we focused on factors that predict early recurrence and recurrence times.**

■ METHODS: **We reviewed 125 patients with parasagittal meningiomas operated from 1985 to 2014. We studied the following variables: age, sex, location, laterality, histology, surgeons, invasion of the SSS, Simpson removal grade, follow-up time, angiography, embolization, radiotherapy, recurrence and recurrence time, reoperation, neurologic deficit, degree of dependency, and patient status at the end of follow-up.**

■ RESULTS: **Patients ranged in age from 26 to 81 years (mean 57.86 years; median 60 years). There were 44 men (35.2%) and 81 women (64.8%). There were 57 patients with neurologic deficits (45.2%). The most common presenting symptom was motor deficit. World Health Organization grade I tumors were identified in 104 patients (84.6%), and the majority were the meningothelial type. Recurrence was detected in 34 cases. Time of recurrence was 9 to 336 months (mean: 84.4 months; median: 79.5 months). Male sex was identified as an independent risk for recurrence with relative risk 2.7 (95% confidence interval 1.21–6.15), $P = 0.014$. Kaplan–Meier curves for recurrence had statistically significant differences depending on sex, age, histologic type, and World Health Organization histologic grade. A binary logistic regression was made with the Hosmer–Lemeshow test with $P > 0.05$; sex, tumor size, and histologic type were used in this model.**

■ CONCLUSIONS: **Male sex is an independent risk factor for recurrence that, associated with other factors such tumor size and histologic type, explains 74.5% of all cases in a binary regression model.**

INTRODUCTION

Parasagittal meningiomas arise from the arachnoid cells of the angle formed between the superior sagittal sinus (SSS) and the brain convexity. They comprise 20%–30% of all intracranial meningiomas. Considering the symptoms and the surgical aspects, we divide these tumors into anterior, middle, and posterior thirds of the SSS. The sinus can be partially or completely occluded by the tumor's growth. Sometimes only the lateral wall of the sinus is involved.[1]

Angiography or angio-magnetic resonance imaging (angio-MRI) usually is needed to assess the status of the SSS and the relationship of the meningioma with the cortical veins, this information is vital, particularly in middle and posterior-third lesions to decide what to do with the SSS during surgery. Many authors have carefully approached this aspect, and they all agree

Key words
- Operated meningiomas
- Parasagittal meningiomas
- Parasagittal meningiomas recurrence
- Superior sagittal sinus

Abbreviations and Acronyms
Angio-MRI: Angio-magnetic resonance imaging
CI: Confidence interval
CT: Computed tomography
MRI: Magnetic resonance imaging
PR: Progesterone receptor
RR: Relative risk
RS: Radiosurgery
RT: Radiotherapy
SSS: Superior sagittal sinus
WHO: World Health Organization

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that it is vital to conserve the cortical drainage veins to avoid a venous stroke.

In cases in which occlusion of the sinus is total, it is possible to bind the sinus if blood flow is absent when demonstrated by angiography. Some authors have proposed as a valid method reconstruction of the SSS if permeability still exists, its invasion makes a tumor progression very predictable despite a subtotal resection of the meningioma.

All these considerations are important because a subtotal resection typically is associated with a greater rate of tumor recurrence. A subtotal resection is accepted by the scientific community as a risk factor but nowadays some studies put in fabric of judgment this affirmation, with a large number of cases and no statistical significance between Simpson Grade of resection and rate of recurrence. Other risk factors for recurrence have been described in published studies such as age, tumor size, sex, World Health Organization (WHO) grading, and histologic type.[2,3] In this retrospective study, we focused on aspects relating to factors that predict an early recurrence of this type of meningioma and progression time.

MATERIALS AND METHODS

We have researched all parasagittal meningiomas operated from 1985 to 2014. We studied in our hospital data base (Hospital Torrecárdenas, Almería) the following variables: age, sex, location (anterior, middle, or posterior third of the SSS), laterality (right, left, or bilateral), date of surgery, histology, surgeons, degree of invasion of the SSS (total, partial, or no invasion), Simpson removal grade, follow-up time, angiography, previous tumor embolization, radiotherapy (RT) after surgery, recurrence, recurrence time, reoperation, neurologic deficit at diagnosis, and level of dependence as measured by the functional independence measure before, after surgery, and at the end of the patient follow-up, which evaluates the patient according to the areas of feeding, locomotion, expression, transfer mobility, and social interaction. Scores are comprise the following groups: 1 (complete dependence), 2 (modified dependence), 3 (modified independence), and 4 (complete independence).[4] Also studied was the status of the patients at the end of the follow-up: living free of disease, alive with recurrence, perioperative death, death due to tumor progression, death due to another reason, and death due to age.

There were 125 patients with parasagittal meningiomas who underwent operation. All were studied with a previous contrast computed tomography (CT) scan and magnetic resonance imaging (MRI). Angiography was performed in 75 cases and 10 were previously embolized, and 50 were studied only with angio-MRI. Since 2007, tumor location is determined intraoperatively with a neuronavigation system. A standardized technical process is performed in our department: great craniotomy, dura opening in a C-shape fashion with its base toward the SSS, an initial debulking of the tumor with bipolar and ultrasonic suction, dissection of the tumor's lateral walls with cottoned and water jet dissection, middle wall coagulation, and removal of tumor implantation around the sinus (SSS) area.

The degree of resection was evaluated 24 hours after surgery with a contrast CT scan and 2 months after surgery with a gadolinium-contrast MRI. Statistical analysis was performed with SSPS 22.0 Statistical Software (IBM Corp., Armonk, New York, USA). We made an analysis of frequency of variables. A comparison between qualitative variables was made with the χ^2 test, and Kaplan–Meier curves with a long-rank test (Mantel-Cox) have been done to see the influence of diverse variables and the recurrence of the tumor or patient's survival. Using the same software, we made a binary logistic regression model with the Hosmer–Lemeshow test to accept it.

RESULTS

Patient Characteristics

The age range of patients was 26–81 years (mean: 57.86 years; median: 60 years). There were 44 men (35.2%) and 81 women (64.8%). Time to follow-up ranged from 13 to 340 months (mean: 105.79 months; median: 96 months).

Clinical Presentation

There were neurologic deficits in 57 patients (46.2%). The most common presenting symptoms were motor deficit (41 patients; 32.8%), followed by headache (34 patients; 27.2%), seizures (25 patients; 20%), mental symptoms (16 patients; 12.8%), dysphasia (6 patients; 4.8%), visual loss (4 patients; 3.2%), and head tumescence (2 patients; 1.6%). Diagnosis was incidental in 7 patients (5.6%).

Histology

Tumors were classified and divided into histologic subtypes according to the WHO criteria. WHO grade I tumors were identified in 104 patients (84.6%) the majority were the meningothelial type, followed by transitional and fibroblastic; "atypical" meningiomas (WHO grade II) were diagnosed in 16 patients (13%), and malignant meningiomas (WHO grade III) were diagnosed in 3 patients (2.4%).

Tumors Characteristics

Tumor size ranged from 2 to 8.6 cm (mean: 4.86 cm; median: 5 cm). Table 1 lists the patients depending on tumor laterality (right, left, or bilateral), sinus invasion, histologic grade (WHO grades I, II, or III), Simpson removal grade (Grades I, II, III, or IV), functional outcome before, after surgery, and at the end of follow-up (functional independence measure grades I, II, III, or IV), and final status of the patients according to the tumor location along the SSS (anterior, middle, and posterior third).

In the majority of cases (68 patients; 54.4%) the location of the tumors was in the middle third of SSS, the others cases were in the anterior third (37 patients; 29,6%) and in the posterior third (20 patients; 16%). There were 55 patients (44%) with tumors on the right side, 51 patients (40.8%) with tumors on the left side, and 19 (15.4%) patients with bilateral tumor extension. After we evaluated the preoperative images (MRI, CT scan, angio-MRI, and angiography) and after confirming it intraoperatively, the SSS was