

Outcome Analysis and Prediction of Recurrence in Surgery of Skull Base Meningiomas

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Introduction

The identification of risk factors of recurrence of skull base meningiomas remains an important goal in neurosurgery. The purpose of the research is outcome analysis of surgical treatment and reliable prognosis scale designing.

Methods

A total of 325 patients with skull base meningiomas were studied. Each patient underwent surgery between 1996 and 2015. The mean patient age was 51.8 years. Clinical data, MRI studies, angiographic data, operative reports, histological findings were examined in patients. Mean follow-up was 76 months (6-18 months). Functional outcomes were determined using the KPS.

Results

Total removal was obtained in 271 patients (83.4%); subtotal was achieved in 31 patients (9.5%). In the 325 patients, mean preoperative and follow-up KPS scores were 75.9±7 and 83±5 respectively. The median MIB-1 index was 2.7% (range: 0-41.6%). 31 patients (9.5%) had tumor regrowth. As predictors of meningiomas regrowth we define the following: earlier radiation therapy, tumor localization, tumor size, cranial nerve affection, brain invasion, grade of tumor removal, histological structure of tumor and MIB-1 index. As a result we offer numerical recurrence rate (RR) scale of meningiomas: low recurrence rate – 0-3 score, moderate – 4-6 score, high – more than 7.

Complications

Mortality (total)	1 (0.43%)
Cerebrospinal fluid leak	5 (2.1%)
Stroke	1 (0.43%)
Diabetes insipidus	2 (0.9%)
Total:	8 (3.43%)

Clinicopathological data of 19 patients with recurrent meningiomas

Case N	Age/ Sex	Previous RT	Location	Tumor size	Vessel encasement	CN palsies	Brain surface invasion	Simpson Grade	MIB I
1	63F	Y	Midline	≥3 cm	+	+	Invasive	III	>3%
2	54M	N	Midline	≥3 cm	-	-	Smooth	I	<3%
3	35F	N	Multiple	≥3 cm	+	-	Invasive	III	>3%
4	28M	N	Midline	≥3 cm	+	+	Intermediate	II	<3%
5	67M	Y	Lateral	≥3 cm	-	-	Invasive	III	>3%
6	38F	Y	Midline	≥3 cm	+	+	Invasive	III	>3%
7	47F	N	Midline	≥3 cm	-	-	Intermediate	II	<3%
8	40M	Y	Multiple	≥3 cm	+	+	Invasive	III	>3%
9	46F	N	Midline	≥3 cm	-	-	Intermediate	I	<3%
10	36M	N	Midline	≥3 cm	+	+	Intermediate	II	<3%
11	28F	N	Lateral	≥3 cm	-	-	Intermediate	III	>3%
12	44F	Y	Midline	≥3 cm	+	+	Invasive	III	>3%
13	38M	N	Midline	≥3 cm	+	-	Intermediate	II	<3%
14	50M	N	Lateral	≥3 cm	-	+	Invasive	III	>3%
15	45M	Y	Multiple	≥3 cm	+	+	Invasive	III	>3%
16	52F	N	Midline	≥3 cm	+	+	Smooth	I	<3%
17	48F	N	Midline	≥3 cm	-	-	Intermediate	II	<3%
18	53M	Y	Multiple	≥3 cm	+	-	Invasive	III	>3%
19	65F	N	Midline	≥3 cm	+	+	Invasive	III	>3%

Grading system to predict the recurrence of meningiomas

Preoperative characteristics	Previous RT	No-0	Yes-1
Localization	Midline	1	0
	Lateral	0	1
	Multiple fossa involvement	No-0	Yes-1
Tumor size	≤3 cm	0	1
	≥3 cm	1	0
	Vessel encasement	No-0	Yes-1
Intraoperative characteristics	CN palsies	No-0	Yes-1
	Brain surface invasion	No-0	Yes-1
Tumor removal grade	Simpson I	0	1
	Simpson II	1	0
	Simpson III or higher	2	0
	Grade I (benign)	0	1
Postoperative characteristics	Grade II (aggressive)	1	0
	Grade III (malignant)	2	0

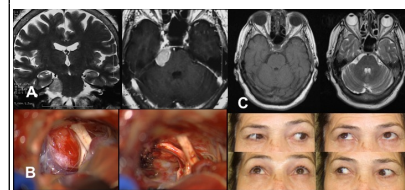
Recurrence prevention strategy.

Low RR – 0-3 score - clinical and radiological exam every 6-12 month

Moderate RR – 4-6 score - clinical and radiological exam every 1-3 month

High RR – more than 7 - Radiosurgery + clinical and radiological exam every 3 month

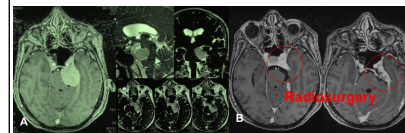
Case 1



A 62-year-old female with petroclival meningioma. Preoperative MRI (A) with axial and coronal views. The patient underwent a retrosigmoid approach. Intraoperative photographs (B) showing complete removal of the tumor. According to the assessment of the recurrence rate we received Moderate risk in this case. Postoperative MRI after 3 years (C).

Previous RT	No-0
Midline	1
Multiple fossa involvement	No-0
≥3 cm	1
Vessel encasement	No-0
CN VII palsy	Yes-1
Brain surface invasion	No-0
Simpson II	1
Grade I (benign)	0
Total	4
RR II – Moderate risk	

Case 2



A 63-year-old female with petroclival meningioma. Preoperative MRI (A) with axial and coronal views. The patient underwent a retrosigmoid approach with opening the tentorium. Resection grade - Simpson III. Summing up all the predictors we get the RR III which shows High risk. Postoperative MRI after 3 months (B). The rest of the tumor underwent radiosurgery.

Previous RT	No-0
Midline	1
Multiple fossa involvement	Yes-1
≥3 cm	1
Vessel encasement	Yes-1
Trigeminal sensory loss, Hearing loss	Yes-1
Brain surface invasion	No-0
Simpson III	2
Grade I (benign)	0
Total	7
RR III – High risk	

Conclusions

The identification of predictors and predicting the probability of recurrence of skull base meningiomas allows choosing the correct combination of treatment options. Combined therapy is indicated for patients with high recurrence rate: microsurgery with following radiosurgery.

Location of skull base meningiomas

Material n=231

Midline cranial base 132 (57.1%)		Lateral cranial base 99 (42.9%)	
Olfactory groove	22 (9.5%)	Orbital roof	9 (3.9%)
Planum sphenoidale	12 (5.2%)	Cranioorbital	17 (7.4%)
Tuberculum sellae	19 (8.2%)	Middle ridge sphenoid wing	22 (9.5%)
Optic canal (sheath)	7 (3.0%)	Middle fossa, petrous ridge	7 (3.0%)
Anterior clinoidal	11 (4.8%)	CPA	35 (15.1%)
Cavernous sinus	18 (7.8%)	Lateral petrous ridge	9 (3.9%)
Petroclival	14 (6.1%)		
Clivus	15 (6.5%)		
Foramen magnum	14 (6.1%)		