

How can the long-term tumor control be improved in meningiomas treated by Simpson grade IV resection?:The impact of detachment from the affected dura on retreatment-free survival

Soichi Oya MD PhD; Yuta Fukushima; Hirofumi Nakatomi MD PhD; Shunya Hanakita; Shota Tanaka MD; Masahiro Shin;

Kensuke Kawai; Nobuhito Saito MD, PhD

The University of Tokyo Hospital, Tokyo ,Japan

Introduction

The aim of this study is to investigate the factors related to necessity of retreatment and to find any possible surgical nuances surgeons can add with the aid of modern neurosurgical techniques for meningiomas treated by Simpson grade IV resection.

Methods

This retrospective analysis included patients with World Health Organization grade I meningiomas treated by Simpson grade IV resection as their initial therapy at the University of Tokyo Hospital between January 1995 and April 2010.

Results

A total of 38 patients were included in this study. Regrowth of residual tumor was observed in 22 patients in a mean follow-up period of 6.1 years (Table 1).

Table1					
All Tumors	No Retreatment	Retreatment	p Value		
38	18	20			
53.7 ± 15.6	59.0 ± 14.4	49.0 ± 15.4	0.045		
(57.0)	(49.5)	(59.5)			
8:30	3:15	5:15	0.70		
18:20	10:8	8:12	0.52		
22.2 ± 20.9	18.8 ± 13.6	25.3 ± 25.8	0.53		
(17.0)	(18.4)	(15.5)			
5.37 ± 6.86	3.24 ± 3.47	7.29 ± 8.52	0.037		
(3.09)	(4.72)	(2.27)			
75.0 ± 18.4	81.4 ± 14.6	69.3 ± 19.8	0.042		
(76.9)	(71.4)	(81.0)			
1.2 ± 0.9	1.1 ± 0.7	1.4 ± 1.0	0.50		
(1.1)	(1.1)	(1.1)			
12 / 38	10 / 18	2 / 20	0.005		
31/38	12 / 18	19 / 20	0.038		
15 / 38	6/18	9 / 20	0.52		
	All Tumors 38 53.7 ± 15.6 (57.0) 8 : 30 18 : 20 22.2 ± 20.9 (17.0) 5.37 ± 6.86 (3.09) 75.0 ± 18.4 (76.9) 1.2 ± 0.9 (1.1) 12 / 38 31 / 38 15 / 38	All Tumors No Retreatment 38 18 53.7 ± 15.6 59.0 ± 14.4 (57.0) (49.5) 8 : 30 3 : 15 18 : 20 10 : 8 22.2 ± 20.9 18.8 ± 13.6 (17.0) (18.4) 5.37 ± 6.86 3.24 ± 3.47 (3.09) (4.72) 75.0 ± 18.4 81.4 ± 14.6 (76.9) (71.4) 1.2 ± 0.9 1.1 ± 0.7 1.2 ± 0.9 1.1 ± 0.7 1.2 ± 38 10 / 18 31 / 38 12 / 18 32 / 38 6 / 18	All Tumors No Retreatment Retreatment 38 18 20 53.7 ± 15.6 59.0 ± 14.4 49.0 ± 15.4 (57.0) (49.5) (59.5) 8:30 3:15 5:15 18:20 10:8 8:12 22.2 ± 20.9 18.8 ± 13.6 25.3 ± 25.8 (17.0) (18.4) (15.5) 5.37 ± 6.86 3.24 ± 3.47 7.29 ± 8.52 (3.09) (4.72) (2.27) 75.0 ± 18.4 81.4 ± 14.6 69.3 ± 19.8 (76.9) (71.4) (81.0) 1.2 ± 0.9 1.1 ± 0.7 1.4 ± 1.0.1 (11.1) (1.1) (1.1) 12/38 10 / 18 2 / 20 31 / 38 12 / 18 19 / 20		

Characteristics of 38 partially resected meningiomas

Retreatment including re-resection or stereotactic radiosurgery due to regrowth of residual mass was performed for 20 of 22 tumors with regrowth.

Risk factors related to significantly shorter retreatment-free survival (RFS) were age younger than 50 years (p = 0.006), postresection tumor volume of 4 cm3 or more (p = 0.016), no dural detachment (p = 0.001), and skull base location (p = 0.016). (Figure 1)



Time-to-retreatment curves stratified by age (A), sex (B), pre-resection volume (C), post-resection volume (D), resection rate (E), laterality (F), MIB-1 LI (G), management of dural attachment (H), skull base location (I), and peri-tumor edema (J).

Multivariate analysis revealed that no dural detachment (hazard ratio 6.42, 95% confidence interval 1.41-45.0, p = 0.02) and skull base location (hazard ratio 11.6, 95% confidence interval 2.18-218, p = 0.002) were independent risk factors for early necessity of retreatment while post-resection tumor volume of 4 cm3 or more was not a statistically significant risk factor. (Table 2)

TABLE 2			
Variable	HR (95% CI)	p Value	
age <50 years	1.77 (0.60 - 5.63)	0.3	
post-resection volume >4 cm ³	1.27 (0.41 - 4.30)	0.68	
no dural detachment	6.42 (1.41 - 45.0)	0.02	
skull base location	11.6 (2.18 - 218)	0.002	

Multivariate analysis for 38 partially resected meningiomas

Discussion

1. Implications of Simpson Grade IV Resection Slight postoperative growth of the residual mass over years would be expected rather than considered a simple treatment failure when Simpson grade IV resection is strategically planned. In our opinion, recurrence-free survival is appropriate to evaluate the outcomes for meningiomas treated by Simpson grade I, II, or III resection, because "no recurrence" is the primary goal of surgery for such treatment. In contrast, the aim of Simpson grade IV resection in most cases is to achieve long-term tumor control without retreatment and protect the quality of life.

2.Factors Influencing the RFS of Meningiomas Treated by Simpson Grade IV Resection

Four factors were associated with shorter RFS, including age younger than 50 years, postresection volume of 4 cm3 or more, absence of dural detachment, and skull base locations. Multivariate analysis also raised an interesting finding that dural detachment was another important modifiable factor related to surgical strategy. Detaching the tumor from the affected dura might contribute to significant additional improvement in surgical outcomes if Simpson grade IV resection was strategically planed or chosen based on the intraoperative findings for high-risk meningiomas. One possible explanation for this result is the effect of eradication of feeding arteries in the dura.[1] Patients with Simpson grade IV resection who underwent preoperative embolization were reported to have statistically insignificant but slightly lower recurrence rate.[2]



THE UNIVERSITY OF TOKYO

(A) Preoperative coronal T1-weighted MR
image with contrast medium demonstrating a tuberculum sellae meningioma. (B)
Postoperative MR image performed immediately after Simpson grade IV
resection with dural detachment. (C)
Coronal MR image performed 7 years after surgery showing no tumor growth. (D)
Preoperative axial T1-weighted MR image with contrast medium demonstrating a paraclinoid meningioma. (E) Postoperative MR image performed immediately after
Simpson grade IV resection without dural detachment. (F) Axial MR image performed 2 years after surgery showing tumor

growth.

Conclusions

No dural detachment and skull base location were independent risk factors for the necessity of retreatment. If Simpson grade IV resection is strategically planned before surgery or tactically chosen during surgery, dural detachment, if possible, might contribute to better long-term tumor control.

References

1. Ichinose T,Goto T, Ishibashi K, et al. J Neurosurg 113:1072-1078, 2010 2.Sughrue ME, Kane AJ, Shangari G, et al: J Neurosurg 113:1029-1035, 2010