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Surgical Treatment of Tentorial Meningiomas — Based on Our Classification Related to Venous Sinuses —

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Summary:

We report our experience and long-term results in the surgical treatment of 27 tentorial meningiomas (TMs). These cases were operated on between 1980 to 2000.5 and represented 9.8% of all 275 surgically treated intracranial meningiomas in that period. Of the total 29 TMs (additional 2 non-surgically treated TMs), 25 were women and 4 were men ranging in age from 26 to 75 years (mean 55.2 years). According to the site of tumor attachment and the venous sinuses, these 29 TMs were divided into 6 subgroups: central (C; 3), anterolateral (AL; 3), posterolateral (PL; 6), free edge (FE; 6), anteromedial (AM; 3), and posteromedial (PM; 8). Various surgical approaches were selected on the tumor location and extension, however, these are divided into 2 approaches. One is anterior or posterior petrosal approach, selected in AL and FE cases and the other is combined occipital-suboccipital approach, selected in C, PL, AM, and PM cases. In 17 patients, total removal (Simpson Grade I:8, II:9) was achieved, subtotal removal (SG III) in 4, and partial removal (SG IV) in 6. Four patients had surgical complications. Gamma knife radiosurgery was performed in 4 residual and 3 recurrent meningiomas. In all these 7 meningiomas, tumor sizes have been well controlled. With a mean follow-up of 70 months (2 to 157 months), recurrences occurred in 5 patients (21.7%), which were subtotal and partial removal cases. Glasgow Outcome Scale scores were GR in 21 patients (77.8%), MD in 3 (11.1%), VS in 1 (3.7%), and D in 2 (7.4%).

Key words: cerebellar tentorium, meningioma, surgery, Gamma knife radiosurgery

Introduction

Tentorial meningiomas (TMs) are uncommon and account for 2 to 3% of all intracranial meningiomas[1),2),3),5),6),7),8)]. Because TMs originate along the cerebellar tentorium, multiple classification systems have been introduced in the literature until now. The cerebellar tentorium is enclosed by superior petrosal sinus, transvers sinus, straight sinus, and free edge, so TMs mostly grow associated with these venous sinuses. And due to the close relationship with the brain stem, important arteries and veins, and cranial nerves, there are many cases which cannot be removed totally, as a result.

We review our experience and long-term results in the surgical treatment of TMs during the past 20 years, based on our classification system related to venous sinuses.

Clinical materials and methods

Between January 1980 and May 2000, 27 TMs were treated

surgically at Nakamura Memorial Hospital, representing 9.8% of all 275 intracranial meningiomas. Of the total 29 TMs, 25 were women (86.2%) and 4 were men (13.8%) ranging in age from 26 to 75 years (mean 55.2 years).

(1) Classification of TMs (Fig. 1)

According to the site of tumor attachment and the venous sinuses, these 29 TMs were divided into 6 subgroups: central (C; 3 cases), anterolateral (AL; 3 cases), posterolateral (PL; 6 cases), free edge (FE; 6 cases), anteromedial (AM; 3 cases), and posteromedial (PM; 8 cases).

(2) Location and extension of TMs (Table 1)

In our series, infratentorial extension was most often in 19 cases.

(3) Involvement of venous sinuses (Table 2)

Angiographically, venous sinuses seemed to be involved in 16 cases (55.2%). Transvers sinus was most frequently involved in 10 cases, and Torcular Herophili and straight sinus were involved in 5, sigmoid sinus and superior petrosal sinus in 2, and vein of Galen in 1.

In all of AM and PM cases, venous sinuses seemed to be involved.

(4) Tumor location and surgical approaches (Table 3)

Various surgical approaches were used on the tumor location and extension, however, these are divided into 2 approaches. One is anterior or posterior petrosal approach, selected in AL and FE cases and the other is combined occipital-suboccipital approach, selected in C, PL, AM, and PM cases.

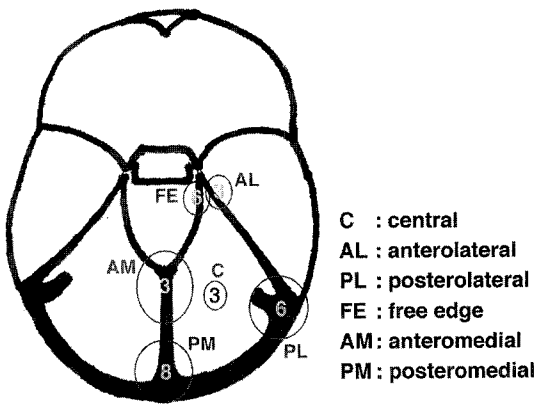

Fig.1: Classification of TMs

In the first place, our strategy of TMs is try to remove totally. However, if tumor adhered tightly to the brain stem or cranial nerves, intentional subtotal removal followed by Gamma knife radiosurgery (GKRS) was considered.

Results

(1) Surgical results (Table 4, 5)

The extent of tumor removal was evaluated according to Simpson Grade (SG) by post operative MRI. In 17 patients (63.0%), total removal (SG I: 8, II: 9) was achieved, subtotal removal (SG III) in 4 patients (14.8%), and partial removal (SG IV) in 6 patients (22.2%) (Table 4).

Glasgow Outcome Scale scores were GR in 21 patients (77.8%), MD in 3 patients (11.1%), VS in 1 patient (3.7%), and D in 2 (7.4%) (Table 5).

GKRS was performed in 4 residual and 3 recurrent

Table 1: Location and extension of TMs (n=29)

Location and extension of TMs (n=29)

Location	Extension S	Extension S+I	Extension I	Total
Central			3	3 (10.3%)
Anterolateral		1	2	3 (10.3%)
Posterolateral	1		5	6 (20.7%)
Free edge		2	4	6 (20.7%)
Anteromedial	1	1	1	3 (10.3%)
Posteromedial	1	3	4	8 (27.7%)
	3 (10.3%)	7 (24.2%)	19 (65.5%)	29

Table 2: Involvement of venous sinuses (n=29)

Involvement of venous sinuses (n=29)

Involvement of major venous sinuses 16 / 29 cases (55.2%)	
Transverse sinus	10
Torcular Herophili	5
Straight sinus	5
Sigmoid sinus	2
Superior petrosal sinus	2
Vein of Galen	1

Location and involved venous sinuses	
Location	involved venous sinuses
C	0 / 3 (0.0%)
AL	2 / 3 (66.7%)
PL	3 / 6 (50.0%)
FE	0 / 6 (0.0%)
AM	3 / 3 (100.0%)
PM	8 / 8 (100.0%)

Table 3: Location and surgical approaches to TMs (n=27)

Location and surgical approaches to TMs (n=27)

Location	Approach	n
C (3)	OTT	2
	SO	1
AL (3)	ST + LSO	1
	PP	1
	ST	1
PL (5)	SO	1
	O	1
	LSO	3
FE (6)	ST	2
	EMF + LSO	1
	AP	3
AM (2)	O	1
	OTT	1
PM (7)	SO	2
	O	1
	SO + O	5

O: occipital, ST: subtemporal, SO: suboccipital, LSO: lateral SO, EMF: extended middle fossa, PP: posterior petrosal, AP: anterior petrosal, OTT: occipital transtentorial

Table 4: Location and Simpson Grade (n=27)

Location and Simpson Grade (n=27)

Location	Simpson Grade I	II	III	IV	Total
C	3				3
AL	1			2	3
PL	2	3			5
FE	2	2		2	6
AM				2	2
PM		4	4		8
	8 (29.6%)	9 (33.4%)	4 (14.8%)	6 (22.2%)	27

Table 5: Location and GOS (n=27)

Location and GOS (n=27)

Location	GOS GR	MD	SD	VS	D	Total
C	3					3
AL	2	1				3
PL	5					5
FE	5	1				6
AM	1				1	2
PM	5	1		1	1	8
	21 (77.8%)	3 (11.1%)		1 (3.7%)	2 (7.4%)	27

meningiomas. In all these 7 meningiomas, tumor sizes have been well controlled.

(2) Complications

Postoperative complications were found in 4 patients (14.8%) at the first operation: that is, trochlear nerve palsy in 3 FE patients, hemiparesis due to mid brain infarction in 1 FE patient, and visual field deficit due to venous infarction in 1 PM patient.

In one patient with PM type meningioma, brain herniation occurred due to pre-operative embolization and this patient was died.

(3) Recurrences

With a mean follow-up of 5y10m, recurrences occurred in 5 patients (21.7%), which were subtotal removal cases in 2 and partial removal cases in 3. Histopathologically, all of these 5 recurrent cases were benign at the first operation.

Illustrative cases

Case 1 (Fig. 2-A)

This case is 71-year-old woman, C type meningioma. Using infratentorial supra-cerebellar approach, total removal was achieved.

Case 2 (Fig. 2-B)

This case is 37-year-old woman, FE type meningioma. Using anterior petrosal approach, total removal was achieved.

Case 3 (Fig. 2-C)

This case is 67-year-old woman, AM type meningioma. Using occipital transtentorial approach, partial removal followed by GKRS was performed.

Case 4 (Fig. 2-D)

This case is 26-year-old woman, PM type meningioma. Using combined occipital-suboccipital approach, subtotal removal was achieved.

Discussion

Tentorial meningiomas (TMs) are uncommon and account for 2 to 3% of all intracranial meningiomas[1),2),3),5),6),7),8)]. Due to the close relationship of the cerebellar tentorium to the brain stem, important arteries and veins, and cranial nerves, total removal of the TMs is still difficult. However, a review of the literature shows that mortality and morbidity rates have decreased in recent years, because of the skillful microsurgical techniques and the development of diagnostic tools[1),2),3),5),6),7),8)].

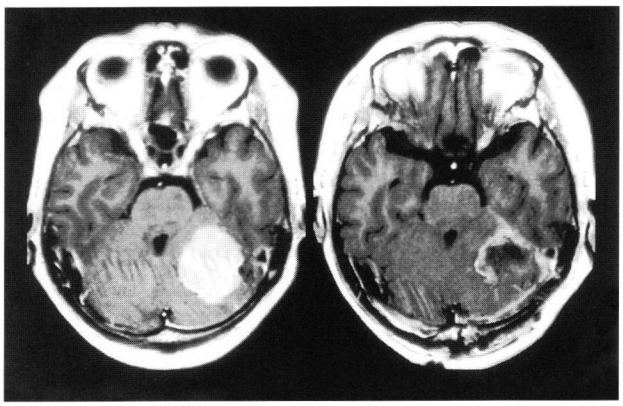

Fig.2-A: C type meningioma; Using infratentorial supracerebellar approach, total removal was achieved.

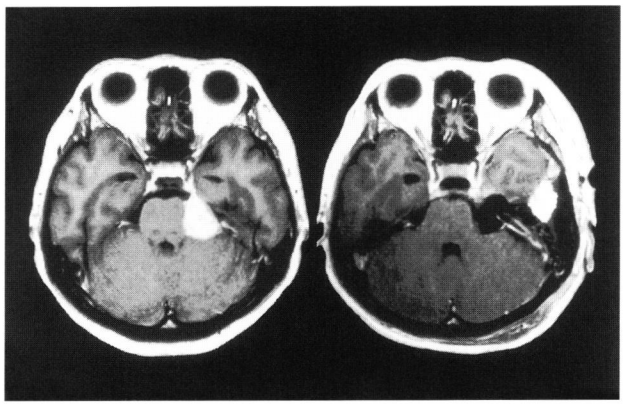

Fig.2-B: FE type meningioma; Using anterior petrosal approach, total removal was achieved.

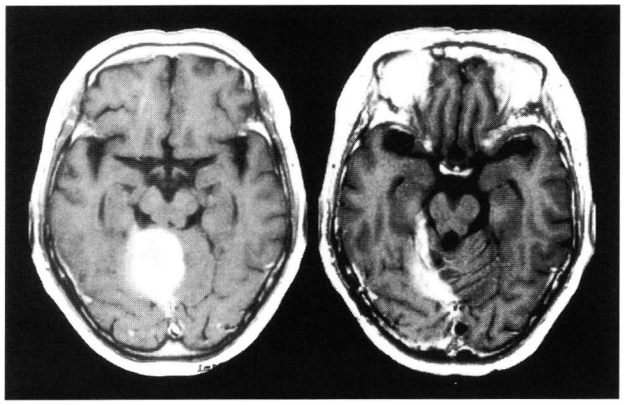

Fig.2-C: AM type meningioma; Using occipital transtentorial approach, partial removal followed by GKRS was performed.

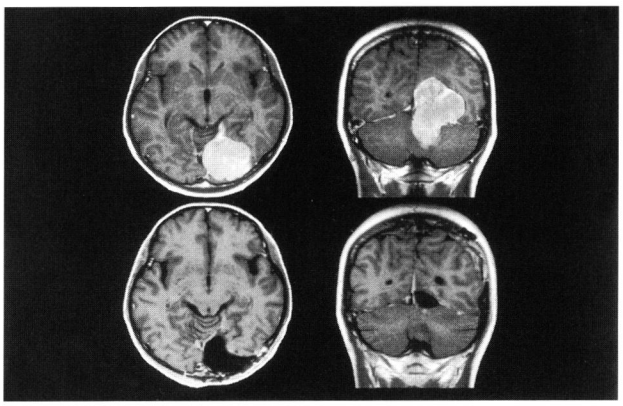

Fig.2-D: PM type meningioma; Using combined occipital-suboccipital approach, subtotal removal was achieved.

TMs are classified by many authors according to the site of dural attachment, and different types determine the appropriate surgical approach to these tumors[1),2),3),5),6),7),8),9)]. Sekhar, et al.[7)] classified 27 surgically treated TMs as 2 groups, that is, 13 tumors as lateral group and 14 tumors as medial group. Guidetti et al.[3)] reviewed the surgical experiences of 61 TMs and classified into 5 subgroups: free edge, anterolateral, posterolateral, posteromedial, and central. Yasargil[9)] described TMs as arising from the inner ring, intermediate ring, and outer ring. Tumors are further categorized by their location along their respective ring: anterior, lateral, and posterior. Based on these classification systems, we divided them into 6 subgroups: central, anterolateral, posterolateral, free edge, anteromedial, and posteromedial.

TMs mostly grow associated with venous sinuses. In our series, venous sinuses seemed to be involved in 16 cases (55.2%). Transvers sinus was most frequently involved in 10 cases, followed by Torcular Herophili and straight sinus in 5. In these cases, it was impossible to resect tumors totally.

In TMs, the choice of surgical approach depended on tumor site, extension above and below the tentorium, feeding arteries, and the relationship with major venous sinuses[3)]. As a result, we selected various surgical approaches. However, these are divided into 2 approaches. One is anterior or posterior petrosal approach, selected in AL and FE cases and the other is combined occipital-suboccipital approach, selected in C, PL, AM, and PM cases.

The incidence of recurrence for skull base meningiomas has been reported in the literature to be as high as 50%[4]. However, with a mean follow-up of 70 months, recurrences occurred in only 5 patients (21.7%).

The goal of the surgical treatment of TMs is their total and safe resection. But, in some cases which adhere tightly to the brain stem and cranial nerves, and in high age groups, we think that intentional subtotal removal followed by GKRS should be performed. In our series, GKRS was performed in 4 residual and 3 recurrent meningiomas. In all 7 cases, tumor sizes have been well controlled.

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