Superior Sagittal Sinus Obstruction by Giant Meningiomas: Is Total Removal Feasible?

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OBJECTIVE: **To present our experience with microsurgical technique for patients with giant meningiomas (maximum diameter ≥7 cm) that obstruct the superior sagittal sinus (SSS).**

METHODS: **All patients who were preoperatively diagnosed (between 2010 and 2014) with giant meningiomas involving the SSS in Ward 10 at the Neurosurgery Department of Beijing Tiantan Hospital were enrolled in this study. Patient charts, imaging findings, and outcomes were examined.**

RESULTS: **The study included 6 male and 4 female patients with a mean age of 46.8 ± 10.7 years. The tumor sizes varied from 7 to 12 cm (mean, 8.8 ± 2.0 cm). All patients underwent customized craniotomies, and aggressive surgery for resection of the invaded SSS was performed. Simpson grade I removals were achieved in all cases. No cases of perioperative mortality occurred. Three patients required cranioplasty as a result of a decompressive craniectomy that was performed during the primary surgery. Histologic examinations showed 1 malignant and 9 benign meningiomas. During the follow-up period (mean, 29.0 ± 9.7 months), recurrence/progression occurred in 1 patient, and 1 patient was lost to follow-up. The recent Karnofsky Performance Score was 80 ± 32.3 and was improved in 5 patients and stabilized in 3 patients. In addition, 7 patients lived independently.**

CONCLUSIONS: **The rigorous preservation of cortical veins, draining veins, and eloquent areas should be implemented during the resection of large tumors that obstruct the SSS. Suitable individualized approaches associated with full exposure and low cerebral perfusion pressure levels after surgery are critical for favorable results, and the reconstruction of the SSS may not be necessary.**

INTRODUCTION

Meningioma is a well-recognized type of intracranial tumor that accounts for 24%–30% of all central nervous system neoplasms.[1] Large intracranial meningiomas require extended operating times and are associated with probable increased perioperative complications. If the tumor location is close to the bridging veins and eloquent areas, radical surgery without permanent deficits may not be easy to achieve.[2] Radical surgery is even more dangerous when the posterior two thirds of the sinus are involved.[3] These challenging lesions present additional obstacles for complete resection and leave the surrounding structures intact. Thus, surgical excision is associated with high morbidity, and tumor recurrence occurs frequently after subtotal resection. However, giant meningiomas that obstruct the superior sagittal sinus (SSS) have rarely been studied. Only a few case reports can be found in the literature,[4] and the management for these patients was not consistent. No definitive guidelines exist for the management of these complex cases. Complete resection of the encased portion of the sinus with the giant tumor was the mainstream treatment for many decades [5,6]; however, it is difficult to achieve because of technical difficulties, with high rates of postoperative morbidity and mortality. It is proposed that radical tumor removal should be balanced by the increasing surgical risk during the excision of the sinus,[2,7] even if the sinus appears occluded.[8]

Because of ongoing improvements in surgical techniques and the increasing availability of neuronavigation systems, many

Key words
- Giant Meningiomas
- Microsurgery
- Superior sagittal sinus

Abbreviations and Acronyms
CE-MRV: Contrast-enhanced magnetic resonance vein imaging
GTR: Gross total resection
KPS: Karnofsky Performance Score
MRI: Magnetic resonance imaging
SSS: Superior sagittal sinus

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investigators still recommend Simpson grade I resection (gross total resection [GTR]) as the first-line treatment option. GTR provides the most favorable long-term outcomes, especially if performed by experienced neurosurgeons. We have successfully resected 10 giant meningiomas that obstructed the SSS, and the patients experienced subsequent favorable prognoses. Here, we present the clinical features of patients with giant meningiomas and our surgical experience with these patients.

PATIENTS AND METHODS

This study was a retrospective analysis of 10 patients (6 men and 4 women) with giant meningiomas. These patients underwent surgery at a single institution and by a single surgeon between 2010 and 2014.

The following information was recorded for all patients: sex, age, tumor location, preoperative symptoms, tumor size, surgical approach, extent of tumor removal, pathology, postoperative complications, and Karnofsky Performance Score (KPS) (Table 1).

Three patients had undergone surgery previously at other hospitals. All patients had undergone preoperative magnetic resonance imaging (MRI) and contrast-enhanced magnetic resonance vein imaging (CE-MRV). Both the preoperative diagnosis and subsequent surgery indicated that the SSS was obstructed. In all cases, radical surgeries were performed, and the patients were discharged when their conditions were stable after surgery.

RESULTS

The study included 6 male and 4 female patients, and the mean age was 46.8 ± 10.7 years. The tumor sizes varied from 7 to 12 cm (mean, 8.8 ± 2.0 cm). The patients underwent customized craniotomies. Two patients underwent bifrontal craniotomies. Five patients underwent bifrontal-parietal craniotomies. One patient underwent a parietal-occipital craniotomy. Two patients underwent bifrontal-parieto-occipital craniotomies. Simpson grade I removal of the tumor was achieved in all patients. No perioperative mortality occurred. Histologic examinations revealed 1 malignant and 9 benign meningiomas. Four patients experienced transient postoperative hemiparesis, and 1 patient experienced an epileptic attack. One patient experienced local postoperative hematomas with no positive neurologic signs, and 3 patients required cranioplasty as a result of decompressive craniectomies that were performed during the primary surgery.

The follow-up period ranged from 17 to 43 months (mean, 29.0 ± 9.7 months). At the last follow-up, 1 patient was lost to follow-up, and 1 patient had died as a result of malignant meningioma progression. One patient presented with paralysis involving both lower limbs, and the other patients returned to their social lives with satisfactory KPS (≥80).

REPRESENTATIVE CASE REPORTS

Case 1

A 34-year-old male patient presented with progressive enlargement of a biparietal mass for more than 7 years. The patient reported occasional weakness in the right leg for 4 years. During the previous month, the symptoms had worsened and were accompanied by head and neck pain. The myodynamia of the right leg was grade IV, and there were no other abnormal signs according to a neurologic examination. Brain MRI showed a huge, well-enhanced mass with ill-defined margins along the last third of the SSS; the tumor size was 110 × 66 × 70 mm. The

Table 1. All Patients' Clinical Features

Sex/Age (Years)	Location	Symptoms	Size (cm)	Operation	Simpson Grade	Pathology	Complication	Karnofsky Performance Score			Craniectomy	Follow-Up (Months)	TH Times (Days)
								Pre	Post	Recent			
F/45	1/3A	Poor memory	8	BFP	I	Transitional	None	80	100	100	No	42	No
M/34	1/3A	RLLW	12	BFPO	I	Atypical	TH	80	80	100	Yes	34	10
M/58	1/3A	Seizure	9	BFP	I	Xantomatous	TH, epilepsy	90	90	100	No	36	11
M/41	1/3Mi	Recurrence	7	Bifrontal	I	Meningothelial	None	90	90	100	No	27	No
F/52	1/3Mi	Glossolalia	9	BFP	I	Transitional	TH	90	90	100	Yes	22	8
M/45	1/3Mi	Bone neoplasm	12	BFPO	I	Transitional	Hematoma	90	50	80	Yes	17	No
F/49	1/3Mi	Seizure	7	BFP	I	Transitional	TH	90	80	90	No	18	22
M/27	1/3P	Poor memory	7	BFP	I	Meningothelial	None	90	100	NA*	No	31	No
F/59	1/3P	Recurrence	10	Bifrontal	I	Meningothelial	PTLL	50	40	50	No	43	No
M/58	1/3Mi	Recurrence	7	PO	I	Malignant	Recurrence	70	80	Died	No	20	No

M, male; A, anterior; BFP, bifrontal-parieto; RLLW, right lower leg weakness; TH, transient hemiparesis; Mi, middle; F, female; BFPO, bifrontal-parieto-occipital; PTLL, paralysis of 2 lower limbs; P, posterior; PO, parietal-occipital; NA, not available.
*Lost to follow-up.