

## **Extradural Approach for Cavernous Hemangioma of the Cavernous Sinus: Experience With 13 Cases**

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### **Abstract**

The clinical, radiological, and surgical issues concerning cavernous hemangiomas located within the dural confines of the cavernous sinus were analyzed on the basis of experience with 13 cases. The feasibility of radical resection by an entirely extradural approach using a basal temporal surgical route to this relatively rare and formidable surgical problem was investigated. Thirteen patients, four males and nine females, with cavernous hemangioma involving the cavernous sinus were treated from 1992 to 2001. The patients were aged from 15 to 55 years. Headaches and deficits of the cranial nerves coursing through the cavernous sinus were the principal symptoms at presentation. Vision was affected in four patients. The radiological features in all patients were similar with a characteristic pattern of extension and encasement of internal carotid artery. The maximum size of the tumor was 28 to 73 mm (mean 44 mm). An entirely extradural route using the basal temporal approach was used successfully in seven cases. Total resection was achieved in 12 patients and partial resection was achieved in one patient. The follow up ranged from 8 months to 9 years (mean 45 months). The outcome of extraocular movements was poor in our series, possibly due to the massive sizes of the tumors encountered. There was no recurrence or growth of the residual tumor and all patients were leading active lives.

Key words: cavernous hemangioma, cavernous sinus, extradural approach

### **Introduction**

Cavernous hemangioma of the cavernous sinus is an uncommon lesion accounting for 2% of all cavernous sinus tumors.<sup>9,12,13,21,24</sup> This benign tumor is a neurosurgical challenge due to the high vascularity, location within the cavernous sinus, and relationship to the intracavernous internal carotid artery and cranial nerves. Histologically, cavernous hemangioma involving the cavernous sinus is similar to intracerebral cavernous angioma but is a distinct clinical entity and the management issues are vastly different from those located within the cerebral parenchyma and other extracerebral locations. Cavernous hemangiomas involving the dural confines of the cavernous sinus, frequently reach giant size before diagnosis. Radiation treatment has been successful,<sup>5,15,17</sup> but the general consensus favors radical surgery as the primary and only modality of therapy for these histologically benign tumors. Here, we analyze our experience with 13

cases of cavernous hemangiomas.

### **Material and Methods**

Thirteen patients with cavernous hemangioma of the cavernous sinus, nine females and four males aged from 15 to 55 years (mean 30 years), were treated in our unit from 1992 to 2001. The duration of symptoms at the time of presentation ranged from 7 days to 2 years (mean 40 days). All patients were treated with radical surgery, and followed up from 8 months to 9 years (mean 45 months). The management issues in these cases were analyzed.

### **Results**

The principal clinical features are shown in Table 1. Ten patients presented with acute symptoms of headache or sudden onset of single or multiple cranial nerve pareses, and the symptoms were progressive in three of these 10 patients. Four patients had visual deficits on the side of the tumor, one of which had visual deficits on both sides, worse on the side of the tumor. The visual deficits were

**Table 1 Presenting clinical symptoms**

Clinical symptoms	No. of patients	Percentage
Headache	13	100
Retroorbital and facial pain	6	46.2
Visual impairment	4	30.8
Impaired corneal reflex	9	69.2
Decreased sensation over face	10	76.9
Wasted temporalis/masseter muscle	8	61.5
Sixth cranial nerve paresis	11	84.6
Third cranial nerve paresis	10	76.9
Seizures	2	15.4

progressive in all patients. Six patients had moderate to severe pain in the face on the side of the tumor. Two patients had no cranial nerve deficit at presentation; one presented with an episode of generalized convulsions and headache and the other had only headache.

All patients were investigated with magnetic resonance (MR) imaging and computed tomography (CT). CT showed the lesions as hypodense with marked enhancement after contrast administration. T<sub>1</sub>-weighted MR imaging showed the lesions as hypointense with marked enhancement after contrast administration. T<sub>2</sub>-weighted MR imaging showed the lesions as highly hyperintense. The size of the tumor ranged from 28 to 73 mm in maximum dimension (mean 44 mm). All tumors irrespective of size were located entirely within the dural confines of the cavernous sinus and had extensions towards the petrous apex, superior orbital fissure, and the sella (Figs. 1-3). All tumors encased the internal carotid artery circumferentially during its course through the cavernous sinus.

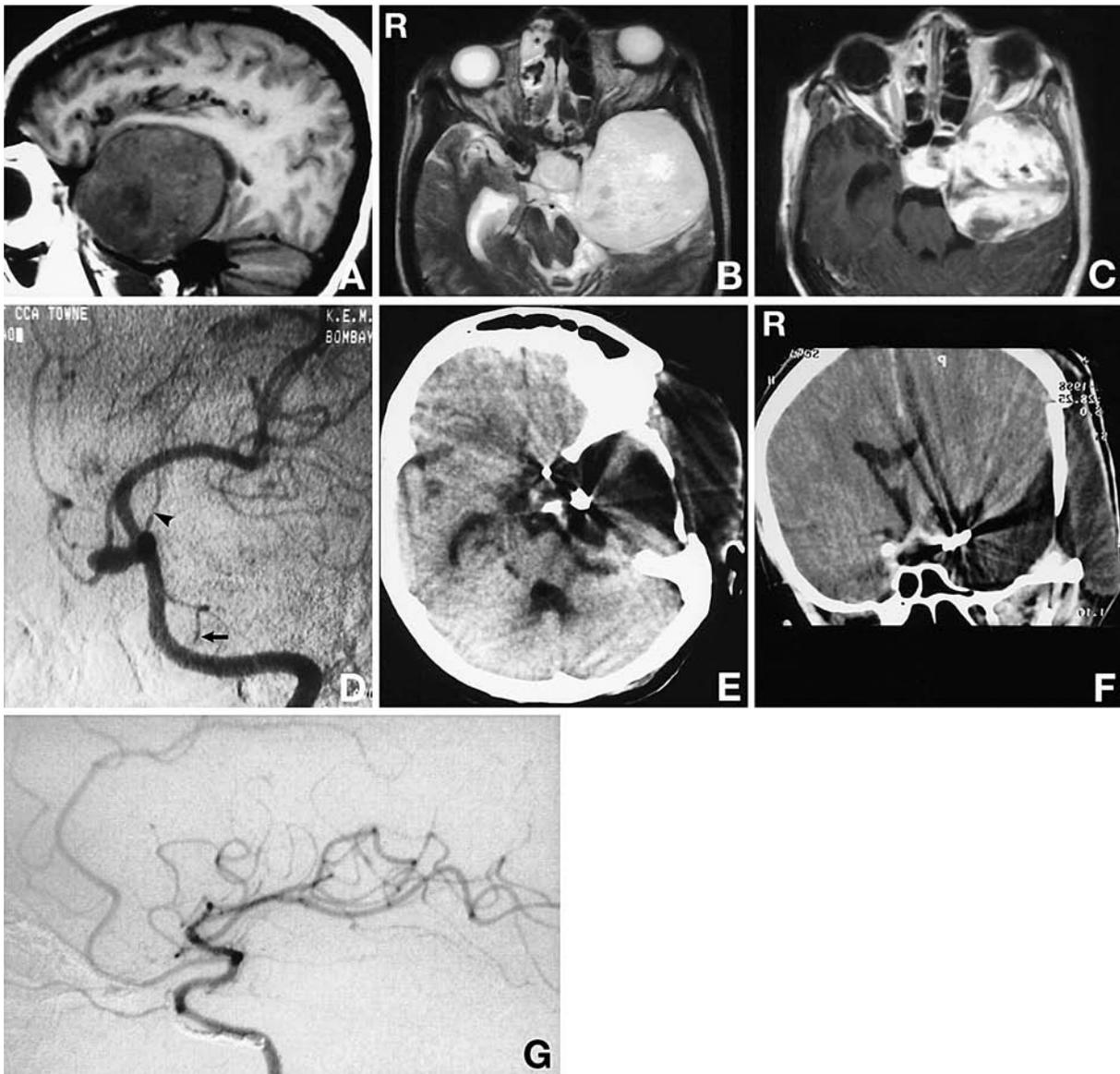
Angiography was performed in five patients. These tumors were angiographically relatively 'occult' despite the intense vascularity encountered during surgery. There was a relatively minor vascular blush in all cases. The tumor was fed by small leashes of vessels arising from the internal carotid artery. The tumor was also fed by larger vessels such as the inferolateral trunk in all five cases, meningo-hypophyseal trunk in four cases, and from the region of McConnell's capsular artery in two cases (Figs. 1 and 2). Preoperative embolization was not possible in any of our cases as the feeding vessels were too small. One case of huge cavernous hemangioma incorporated a large aneurysm in the intracavernous segment of the internal carotid artery associated with evidence of intratumoral bleeding (Fig. 1). There was no evidence of bleeding

in any other tumor. No case showed any calcification or tumor necrosis.

Orbitozygomatic osteotomy, basal pterional craniotomy, and an intradural approach to the lesion were performed in the first case. Intraoperative control of the internal carotid artery in the neck was carried out in this patient. Basal zygomatic bone-based temporal craniotomy was performed with the patient in a lateral position in the other cases. Proximal control of the internal carotid artery in the neck or in the petrous apex was not carried out in these patients. Lumbar drainage of the cerebrospinal fluid was carried out during surgery. Exposure of the lesion extradurally was attempted in the latter 10 cases but was possible only in seven cases, whereas the extradural approach was adopted but an additional intradural approach was used to facilitate tumor resection and to confirm the completeness of tumor removal in the other three cases. A large part of the tumor lateral to the carotid artery was removed en-bloc by careful dissection from the adjoining structures in two cases of relatively small tumors. However, the tumor was large and required piecemeal resection in the other cases.

The surgical strategy was to expose the region by an extradural route from an inferior perspective. The tumor bulk was then exposed by working between the laterally displaced fifth cranial nerve fibers. Most of the tumors were soft and friable and were compressible. Rapid debulking of the tumor using relatively powerful, graded, and controlled suction was carried out to remove the bulk of the tumor, to expose the sixth cranial nerve near the petrous apex, and to coagulate the feeders arising from carotid artery early in the operation. Once the bulk of the tumor was removed and the branches from the major feeding channels were obliterated, the hemostasis was largely spontaneous and relatively simple. Two patients suffered a puncture hole injury in the carotid artery in the region of the inferolateral trunk during the tumor resection. The bleeding could be stopped by local coagulation and gentle pressure for a period in both cases.

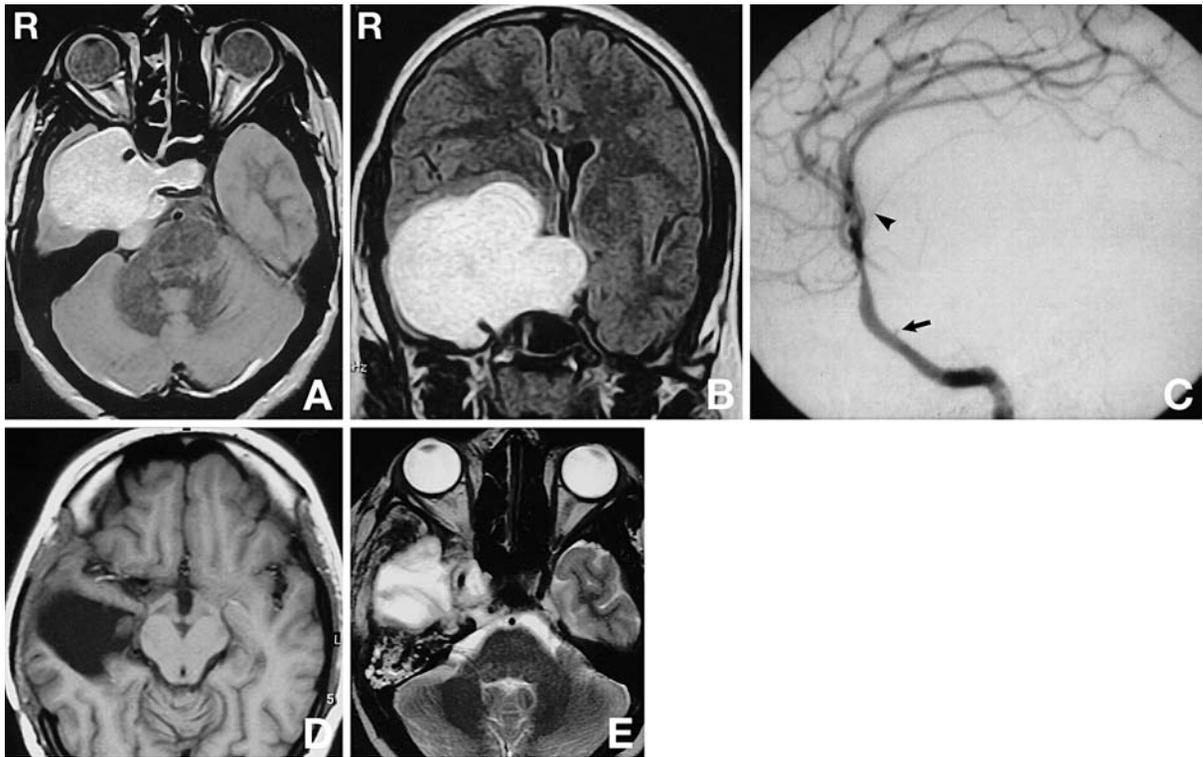
The sixth cranial nerve could not be identified in its course within the cavernous sinus in seven patients. The sixth cranial nerve was identified in six patients and could be completely preserved in three patients. In the immediate postoperative phase, none of the patients showed recovery of function of any cranial nerve. Extraocular movements completely recovered in two patients about 3 months following surgery. One patient who have intact preoperative function of all cranial nerves developed sixth cranial nerve paresis after surgery, but the third cranial nerve remained normal (Fig. 3).



**Fig. 1** A 50-year-old woman presented with sudden onset of ophthalmoplegia 5 days prior to admission. **A:** Sagittal T<sub>1</sub>-weighted magnetic resonance (MR) image showing a large hypointense intracavernous sinus tumor. **B:** Axial T<sub>2</sub>-weighted MR image showing the large hyperintense cavernous sinus tumor encasing the internal carotid artery. **C:** Axial T<sub>1</sub>-weighted MR image with contrast medium showing intense enhancement of the tumor with extensions towards the sella, superior orbital fissure, and Meckel's cave. **D:** Left internal carotid angiogram showing a relatively avascular tumor with mild vascular blush. Arterial feeders from the region of McConnell's capsular artery (arrowhead) and inferolateral trunk (arrow) are seen. A large aneurysm is located on the anterior ascending segment of the artery. The middle cerebral trunk and branches are elevated. **E:** Postoperative axial computed tomography (CT) scan with contrast medium showing complete excision of the tumor. **F:** Coronal CT scan showing complete excision of the tumor, with clip artifacts. **G:** Postoperative left carotid angiogram showing exclusion of the aneurysm from the circulation.

At follow up after 18 months, she showed complete recovery of all extraocular movements. Ten patients had moderate to severe dysfunction of the extraocu-

lar movements and both the third and the sixth cranial nerves were affected. Six patients showed partial recovery of third cranial nerve function. All



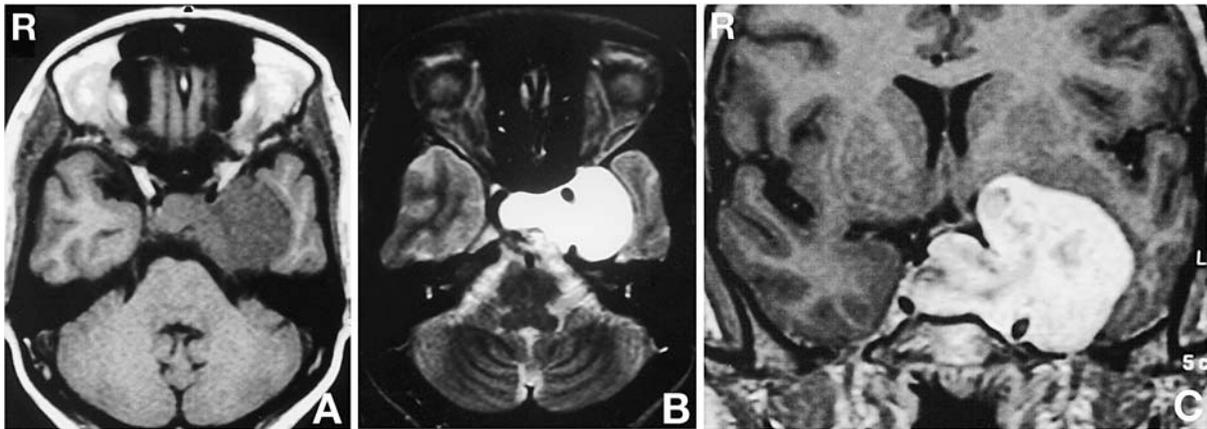
**Fig. 2** A 15-year-old girl presented with progressive worsening of vision in both eyes for 6 months. She had drooping of the right eyelid and diplopia during the last 15 days. On admission her vision allowed only finger counting at the distance of 3 feet in the left eye and only perception of light in the right eye. There was total ophthalmoplegia and numbness in the distribution of the entire right trigeminal nerve. The temporalis and masseter muscles were wasted. **A:** Axial proton density magnetic resonance (MR) image showing a large hyperintense intracavernous sinus tumor. The tumor extends towards the sella, superior orbital fissure, and Meckel's cave. The internal carotid artery is completely encased. **B:** Coronal T<sub>1</sub>-weighted MR image with contrast medium showing the huge intracavernous sinus tumor. The internal carotid artery is encased within the tumor mass. **C:** Right internal carotid angiogram showing no significant tumor blush. Arterial feeders are observed from the region of McConnell's capsular artery (arrowhead) and the inferolateral trunk (arrow). **D:** Postoperative axial T<sub>1</sub>-weighted MR image showing excision of the tumor. **E:** Postoperative axial T<sub>2</sub>-weighted MR image showing excision of the tumor mass.

patients were relieved of the headaches after surgery. During the follow-up period, no recurrence or growth of the residual tumor was found and all patients are leading active lives.

### Discussion

Cavernous hemangiomas are frequently seen in the fourth and fifth decades of life.<sup>3,28)</sup> Nearly half of the reported cases were of Japanese origin.<sup>28)</sup> Ninety-four percent of reported cases occurred in women.<sup>12)</sup> In our series, 69% were females. Considering that females in their youth or middle age are more common victims of this tumor, the origin may be hormonal.<sup>1,8)</sup>

Clinical presentation is usually in the form of symptoms related to the acute or subacute dysfunction of the nerves traversing the cavernous sinus and the optic nerve. Headache, which varied in intensity from moderate to severe, was present in all patients and was the most disabling clinical feature. Two patients had generalized seizures. No other hemisphere-related symptoms occurred in any patient. Pituitary hypofunction has been reported with these tumors,<sup>12,18)</sup> but was not encountered in our series. Hemorrhage within the cerebral cavernous hemangiomas is a common feature, but is relatively uncommon in cavernous hemangiomas located in the cavernous sinus.<sup>26,28)</sup> Despite the acute nature of clinical presentation in 10 cases, only one



**Fig. 3** A 43-year-old woman presented with one episode of generalized seizure, but without any neurological deficit. **A:** Axial T<sub>1</sub>-weighted magnetic resonance (MR) image showing a moderately hypointense intracavernous sinus tumor and extensions. **B:** Axial T<sub>2</sub>-weighted MR image showing the hyperintense intracavernous sinus mass encasing the internal carotid artery. **C:** Coronal T<sub>1</sub>-weighted MR image with contrast medium showing the enhanced tumor occupying the cavernous sinus.

case had evidence of bleeding.<sup>7,18)</sup>

Radiographically, cavernous hemangiomas have a characteristic pattern of extension towards the sella, superior orbital fissure, and Meckel's cave, which was observed in all our cases and in the majority of reported cases with radiography of the lesion.<sup>3,12,28)</sup> Cavernous hemangioma is the only primary intracavernous sinus tumor. Irrespective of the size, the tumor has never been found to protrude out of the anatomical dural confines of the cavernous sinus. The extension towards the sella appears to be through the enlarged intercavernous sinus. Tumor extension into the other tributaries of the cavernous sinus like the superior and inferior petrosal sinuses has not been encountered. Erosion of the bones of the middle fossa floor, sphenoid wing, and the temporal squama and wasting of the temporalis and masseter muscles in some cases suggests the slow growth and progression of these tumors.<sup>15)</sup>

Cavernous hemangioma is hyperdense on CT with brilliant enhancement after contrast administration. The lesion is hypointense on T<sub>1</sub>-weighted MR images and highly hyperintense on T<sub>2</sub>-weighted images. The tumor encased the internal carotid artery during its entire course in the cavernous sinus in all our cases. Cavernous hemangioma is usually angiographically 'occult' despite the extensive vascularity,<sup>15,28)</sup> although mild tumor blush is frequently seen.<sup>6,12,14,16,17,25,28)</sup> As in our cases, the inferolateral trunk,<sup>6,8,11)</sup> meningo-hypophyseal trunk,<sup>15,17,18)</sup> accessory meningeal artery,<sup>18,25)</sup> and middle meningeal artery<sup>5,12,15,17)</sup> have been identified as major feeding vessels. In two of our cases, there was a relatively

large feeder from the region of origin of McConnell's capsular artery. Preoperative embolization of the tumor has been carried out,<sup>3,5,12,18)</sup> but this could not be done in our series due to the small size of the feeding vessels. Aneurysm of the internal carotid artery was seen in one of our cases.<sup>4)</sup>

Surgical excision is the most acceptable therapy considering the benign nature of the lesion and potential curability.<sup>6,12,15,17,23,25)</sup> Smaller lesions and those with mild symptoms can be clinically and radiologically observed. The main difficulty during surgery for cavernous hemangioma is the vascularity of the lesion.<sup>11,12,17)</sup> Surgical resection carries the risk of extensive and uncontrollable bleeding. Surgical misadventures have resulted in high morbidity and mortality.<sup>1,12,18)</sup> Preoperative radiation treatment as a modality to reduce tumor vascularity has also been suggested.<sup>12,16,17,22)</sup> Direct puncture and injection of sclerosing agent (alcohol) in the lesion has produced good results.<sup>19)</sup> Induced hypotension and hypothermia may be useful adjuncts for surgery.<sup>20)</sup>

In our first case, we performed an orbitozygomatic osteotomy and basal frontotemporal approach.<sup>4)</sup> However, we observed that the brain in our cases was lax and the tumor was soft and compressible, so elaborate skull base exposures could be safely avoided. In the later part of our series, we performed a basal temporal craniotomy based over the entire zygomatic bone. The lateral aspect of the lesser wing of the sphenoid bone was removed. Bone work in the extradural space was restricted to prevent avoidable blood loss. We observed that extradural exposure was the most appropriate approach for these

essentially intracavernous sinus tumors. The lateral dural wall of the cavernous sinus could be stripped in a relatively bloodless field from the inner dural layer containing the splayed out cranial nerves.<sup>2)</sup> The incision in the inner layer was taken towards the base to avoid injury to the first division of the fifth cranial nerve. Extradural surgery avoided handling of the temporal brain and reduced the possibility of postoperative seizures.

In our earlier report on this subject,<sup>3)</sup> we recommended en-bloc excision of the tumor. Other authors have also favored an en-bloc tumor excision.<sup>12)</sup> The tumors were very large in our series, so we preferred initial tumor debulking. The red, extensively vascular tumor was soft and contained thin vascular channels, and could be relatively easily stripped off the dura. In our experience, large cavernous hemangiomas can be relatively easily resected by rapid tumor decompression using relatively powerful and controlled suction. Avoiding sharp dissection in the cavernous sinus whilst working in a bloody field was useful to preserve the internal carotid artery and the cranial nerves. We observed that hemostasis was achieved spontaneously after a large part of the tumor was resected and the residual tumor could be resected under vision from the corners. The technique of minor resection and then hemostasis before further tumor resection and maintaining a blood-less field may not be applicable in these cases. Such a procedure is associated with greater overall blood loss than if a relatively quick tumor resection is carried out. Partial or subtotal resections are not recommended and can lead to difficulty in control of bleeding during surgery and could be associated with an increased incidence of postoperative hemorrhage. Radiosurgery is beneficial in the treatment of small cavernous hemangiomas<sup>10)</sup> and could be a useful modality of therapy for smaller residual lesions.

The initial direction of debulking the tumor mass was towards the petrous apex to identify the sixth cranial nerve at the site of its entry into the cavernous sinus. The nerve was then followed distally. The feeding vessels from the intracavernous sinus carotid artery were coagulated as soon as significant tumor debulking was completed and wide exposure of the carotid artery was achieved. The third cranial nerve is located on the dome of the tumor and is securely placed within the dural walls. The dissection of the tumor in the region of the dome was carried out later in the course of the surgery after a large portion of the tumor had been removed from within the cavernous sinus and the bleeding from the tumor was under control.

Radical resection of cavernous hemangiomas

located within the cavernous sinus is possible by an entirely extradural route. Rapid decompression of the tumor after wide exposure can lead to successful resection. The outcome for extraocular movements is poor following surgery in large lesions. However, successful surgical resection can lead to cure of the disease. Recurrence rates after successful resection are extremely low.<sup>27,28)</sup> There was no recurrence or regrowth in any of our patients.

## References

- 1) Finkemeyer VH, Kautzky R: Das Kavernom des Sinus cavernosus. *Zentralbl Neurochir* 29: 23-30, 1968 (Ger)
- 2) Goel A: The extradural approach to lesions involving the cavernous sinus. *Br J Neurosurg* 11: 134-138, 1997
- 3) Goel A, Nadkarni TD: Cavernous haemangioma in the cavernous sinus. *Br J Neurosurg* 9: 77-80, 1995
- 4) Gupta S, Goel A: Cavernous haemangioma of cavernous sinus associated with an internal carotid artery aneurysm. *Br J Neurosurg* 14: 56-59, 2000
- 5) Harada T, Aoyama N, Terada H, Tsujimoto S, Hosogi Y, Iwasaki S: [A case of extracerebral hemangioma of the middle fossa]. *CT Kenkyu* 4: 460-465, 1982 (Jpn)
- 6) Harper DG, Buck DR, Early DO: Visual loss from cavernous hemangiomas of the middle cranial fossa. *Arch Neurol* 39: 252-254, 1984
- 7) Hirata Y, Matsukado Y, Fukumura A: [A case of cavernous hemangioma with acute visual disturbance]. *No Shinkei Geka* 10: 201-206, 1982 (Jpn, with Eng abstract)
- 8) Ito J, Takahashi M, Saito A, Honda H, Yazima K: [Cavernous hemangioma of the middle cranial fossa with an angiographically demonstrated feeding artery and tumor stain]. *Rinsho Hoshasen* 22: 339-344, 1977 (Jpn)
- 9) Kawai K, Fukui M, Tanaka A, Kuramoto S, Kitamura K: Extracerebral cavernous hemangioma of the middle fossa. *Surg Neurol* 8: 19-25, 1978
- 10) Kida Y, Kobayashi T, Mori Y: Radiosurgery of cavernous hemangiomas in the cavernous sinus. *Surg Neurol* 56: 117-122, 2001
- 11) Lechevalier B, Houtteville JP: Cavernomes intracranien. *Rev Neurol (Paris)* 148: 173-179, 1992 (Fre, with Eng abstract)
- 12) Linskey ME, Sekhar LN: Cavernous sinus hemangiomas: a series, a review, and a hypothesis. *Neurosurgery* 30: 101-108, 1992
- 13) Lombardi D, Giovanelli M, de Tribolet N: Sellar and parasellar extra-axial cavernous hemangiomas. *Acta Neurochir (Wien)* 130: 47-54, 1994
- 14) Lu Q: [The neuroimaging of the intracranial hemangiomas]. *Chin J Neurosurg* 3: 137-140, 1987 (Chi)
- 15) Meyer FB, Lombardi D, Scheithauer B, Nichols DA: Extra-axial cavernous hemangiomas involving the dural sinuses. *J Neurosurg* 73: 187-192, 1990
- 16) Moore T, Ganti SR, Mawad ME, Hilal SK: CT and angiography of primary extradural juxtaseellar tumors. *AJR Am J Roentgenol* 145: 491-496, 1985

- 17) Mori K, Handa H, Gi H, Mori K: Cavernomas in the middle fossa. *Surg Neurol* 14: 21-31, 1980
- 18) Namba S: Extracerebral cavernous hemangioma of the middle cranial fossa. *Surg Neurol* 19: 379-388, 1983
- 19) Nepper-Rasmussen HJ, Bjerre PK, Jorgensen KE: [Endovascular neuroradiologic interventions. Embolization of aneurysms and arteriovenous malformations. Sclerotherapy of cavernous hemangiomas]. *Ugeskr Laeger* 155: 3471-3476, 1993 (Dan, with Eng abstract)
- 20) Ohata K, El-Naggar A, Takami T, Morino M, El-Adawy Y, El-Sheik K, Inoue Y, Hakuba A: Efficacy of induced hypotension in the surgical treatment of large cavernous sinus cavernomas. *J Neurosurg* 90: 702-708, 1999
- 21) Penfield W, Ward A: Calcifying epileptogenic lesion: hemangioma calcificans. Report of a case. *Arch Neurol Psychiatry* 60: 20-36, 1948
- 22) Rigamonti D, Pappas CTE, Spetzler RF, Johnson PC: Extracerebral cavernous angiomas of the middle fossa. *Neurosurgery* 27: 306-310, 1990
- 23) Rosenblum B, Rothman AS, Lanzieri C, Song S: A cavernous sinus cavernous hemangioma. Case report. *J Neurosurg* 65: 716-718, 1986
- 24) Russell WJ: Prolonged injection angiography for diagnosing intracranial cavernous hemangiomas. *Radiology* 131: 137-138, 1979
- 25) Sawamura Y, de Tribolet N: Cavernous hemangioma in the cavernous sinus: case report. *Neurosurgery* 26: 126-128, 1990
- 26) Sepehrnia A, Tatagiba M, Brandis A, Samii M, Prawitz RH: Cavernous angioma of the cavernous sinus: case report. *Neurosurgery* 27: 151-155, 1990
- 27) Shi J, Wang H, Hang C, Pan Y, Liu C, Zhang Z: Cavernous hemangiomas in the cavernous sinus. Case reports. *Surg Neurol* 52: 473-479, 1999
- 28) Suzuki Y, Shibuya M, Baskaya MK, Takakura S, Yamamoto M, Saito K, Glazier SS, Sugita K: Extracerebral cavernous angiomas of the cavernous sinus in the middle fossa. *Surg Neurol* 45: 123-132, 1996

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*Commentary on this paper appears on the next page.*

### Commentary

The authors have presented a series of 13 cases of cavernous hemangioma in the parasellar space. According to the data presented, most of these tumors were rather large. They have collected the relevant literature, described the clinical presentation of the disease as well as the diagnostic procedures. The weakest part of their report is the surgical management of demanding parasellar lesions. Since their aim was to report about the extradural approach to cavernous hemangiomas in the parasellar space, they are not convincing in this particular area. The description of the anatomy and, in particular, of the pathological anatomy is unclear and insufficient. The description of the approach and the technique of entering into this parasellar space is at least misleading and confusing. Everybody who has even limited experiences with surgery of cavernous hemangiomas in the region will disagree with "Rapid debulking of the tumor using relatively powerful, graded, and controlled suction was carried out to remove the bulk of the tumor, to expose the sixth cranial nerve near the petrous apex, and to coagulate the feeders arising from carotid artery early in the operation. Once the bulk of the tumor was removed and the branches from the major feeding channels were obliterated, the hemostasis was largely spontaneous and relatively simple." While using this technique the authors encountered injury of the ICA in two cases, and again we must query their description of handling this complication: "The bleeding could be stopped by local coagulation and gentle pressure for a period in both cases." I doubt that surgeons who have experience with arterial bleeding from the ICA in the parasellar space are in agreement with this description. Further, in the description of surgery, the authors state that they were not able to identify nerve VI in seven patients, and they also stated that in six patients nerve VI was identified and was completely preserved in three cases. So, if one adds to the seven patients in whom nerve VI was not found, the other three cases in whom it could not be "completely" preserved, then only in three cases was preservation of nerve VI as it should be. Postoperative cranial nerve deficits were present in too high a proportion of cases. According to the authors' description of the improvement of cranial nerves, it was only partial. In parasellar space cavernous hemangiomas,

what is the most important is the approach and removal of the tumorous lesion without lesioning nerves III through VI. But to achieve this, blind, forced aspiration is not the right way. And at last but not least, the piecemeal technique for removal of the cavernous hemangioma in the parasellar space is not the best technique unless the feeders to the lesion are shut off in a proper way. With the description of surgical procedure as it is in this report the authors are confusing rather than correctly and objectively informing the reader.

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Surgical removal of the hemangioma in the cavernous sinus has been one of the difficult problems for neurosurgeons. During removal, the surgeon has to fight against bleeding from the cavernous sinus opened by tumor decompression, as well as from the hemangioma itself. Operative complications include huge blood loss, temporal lobe seizure and abducens palsy. Modern epidural access and quick tumor removal described by the authors are very important to protect the temporal lobe. Bleeding from hemangioma could be minimized by "en bloc resection," and bleeding from the sinus by head up positioning plus quick packing of surgical. Encasement of the abducens nerve, which courses freely in the cavernous sinus, could not be anticipated before surgery, and preservation of the nerve has been sometimes difficult. Therefore, the discussion points are surgical indication and its timing, because most of the patient's symptoms are mild even in patients with a large tumor. The postoperative risk of abducens palsy might be permissible in patients with visual loss, complete oculomotor palsy or with brain compression syndromes. Surgeons must note that the patient's burden with abducens palsy might be equal to that with visual loss. However, this is an excellent paper describing much experience with modern skull base technique.

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