Temporary symptomatic swelling of meningiomas following gamma knife surgery

Report of two cases

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In two patients in whom gamma knife surgery was performed for meningiomas clinically significant volume increases were observed in the first 3 months after treatment. Clinical examination and various imaging studies form the basis of the report in these patients. In each case, the volume increase was temporary.

KEY WORDS • meningioma • complication • tumor swelling • dexamethasone

PITUITARY apoplexy, in which hemorrhage or infarction causes a sudden swelling of a pituitary tumor, is a well-known condition. A similar spontaneous occurrence in meningiomas is very rare indeed. There are four reports of related conditions. A peritumoral hemorrhage occurring 3 years after GKS has been reported in the literature. A meningioma near the sella mimicking pituitary apoplexy has also been reported in two papers. One paper describes the acute presentation of a meningioma due to central necrosis.

We describe the case histories of two patients with parasellar tumors in whom a phenomenon similar to pituitary apoplexy occurred 3 to 6 months after GKS. The clinical picture is described and its significance discussed.

Case Reports

Case 1

This 45-year-old woman had an 8-month history of visual disturbance, beginning with difficulty in seeing the TV properly with her right eye. A right-sided medial sphenoidal ridge meningioma was found. This tumor was intimately adjacent to the right optic nerve and chiasm as shown in Fig. 1. There was no papilledema and no optic atrophy. This 14.2-cm³ tumor received 12 Gy to the 45% isodose with 86% cover (low to preserve vision) and a conformity index

Abbreviations used in this paper: GKS = gamma knife surgery; MR = magnetic resonance.
of 1.19 (the conformity index is described as PIV/TVPIV, where PIV = the volume of the prescription isodose, and TVPIV = the volume of the prescription isodose covering the target). Nine gray was delivered to 3.5-mm³ visual pathways. Three months after treatment she suffered a fever for a week. After that she developed a severe headache and right-sided ocular pain. This was associated with a deterioration of vision as confirmed by the visual field testing that showed a blind right eye and a new left-sided temporal field defect. There was also a marked peritumoral edema as shown in Fig. 2. She was started on dexamethasone 2 mg four times daily for approximately 4 weeks, then reduced to 1.5 mg twice daily for 8 weeks, and gradually tapered and ceased completely. The dose was adjusted in keeping with the clinical development. We were concerned with the speed of deterioration, fearing that the lesion might be malignant; however, an MR spectroscopy suggested that this was necrotic tissue not active tumor.

After 4 weeks on dexamethasone, her headache improved and there was a minor improvement in the visual field. After 2 months her vision had subjectively and objectively improved, but the headache remained. The headache was periorbital and radiated posteriorly. The MR imaging studies revealed reduction in tumor volume and a marked reduction in peritumoral edema. From then to the most recent examination 10 months after treatment, there has been steady improvement. Visual field status at that time was better than before treatment. The tumor had shrunk to a size much smaller than before treatment. All these changes have taken place in less than 1 year.

Case 2

This patient presented with a grand mal epileptic seizure after going to bed. She was unconscious for 2 hours. After the attack she suffered amnesia, which improved over a month. She was taking epanutin 100 mg twice daily. She
Meningioma swelling after radiosurgery

![Image](https://example.com/image.png)

**Fig. 3. Case 2. Neuroimages demonstrating various stages of the tumor: pretreatment; the expansion with central loss of contrast enhancement and marked edema at 6 months; and resolution of edema and marked shrinkage of the tumor at 12 months after treatment.**

had no other symptoms. A left medial sphenoidal wing meningioma was observed (Fig. 3) to enfold the middle cerebral artery. It was not in contact with the visual pathways but close to them. Visual field examination was essentially normal.

This 9.7-cm³ tumor was treated with 12 Gy to the 50% isodose with 91% cover and a conformity index of 1.2. The maximum dose to the visual pathway was 8.3 Gy and only 2.6 mm³ received more than 8 GY. The patient did not attend early follow up despite being told of its necessity should her symptoms worsen. At the 6-month follow up she claimed that for 2 months her longstanding headache had progressively worsened; the headache predated radiosurgery and yet she had never mentioned this symptom before. The headache had apparently improved after treatment but had now returned to pretreatment levels. She had some problems with memory that started with the headache deterioration and was maintained. She was still taking epanutin 100 mg twice daily. The MR imaging studies demonstrated some swelling of the tumor (Fig. 3) and a marked peritumoral edema. There was also loss of central contrast enhancement. She maintained that the headache and amnesia were actually slightly better than previously. For this reason no changes were made to her treatment. Although she thought her vision had suffered there was no evidence for this on visual field examination.

At 12-month follow up the headaches had disappeared and she considered her amnesia to be improved by 80%. Her vision was subjectively better. Magnetic resonance imaging revealed a remarkable reduction in tumor volume so that the tumor was now smaller than before treatment, as shown in Fig. 3. The marked perilesional edema had almost resolved. The visual fields were normal.

**Discussion**

The course in these patients is unusual. We found no previous report of the phenomena observed in our two cases. In both cases the complication appears to resemble a pituitary apoplexy. An infarct seems to have been followed by tumor collapse much in the same fashion as occurs with pituitary apoplexy.

The issues highlighted by these cases are as follows. First, because the image changes in the brain were reversible, they were likely not the result of direct radiation damage to component cells of the cerebral tissue. This argument is strengthened by what developed in Case 1: the patient suffered a very severe visual deterioration from which she recovered; in fact visual performance improved overall. It is widely believed that radiation-induced visual function loss is irreversible. This course is also similar to that reported by others.³

One patient had a severe, deteriorating clinical condition, steroid therapy was instituted. The other patient was already improving so the steroid treatment was deferred and in the end not used. A third patient also underwent steroid therapy for deteriorating condition.³ The decision to use steroid agents will depend on the clinical situation in a given patient. However, in the patient reported here and in our other paper the response was speedy and useful.

The course with these two tumors was dramatic. They both swelled and for approximately 4 weeks were cause for serious concern; however, they underwent a more rapid shrinkage than is usual for meningiomas. The phenomena described here have not been reported. Our two patients and a third³ constitute 3.6% of all meningiomas treated at our center. It is suggested that this condition is underreported at present.

The visual field findings in the first patient would lend support to the dosimetry practiced. At this center with very rare exceptions all meningiomas, schwannomas, and non-functioning pituitary adenomas receive 12 Gy to the margin irrespective of their volume. Great attention is paid to the technique of dose planning so that the conformity index is kept below 1.25 (or 0.75 according to the preferences on how it should be recorded). Every attempt is made to achieve 90% or more target coverage with the prescription dose, and this was sacrificed in this case because of the very...
intimate relationship between the tumor and the visual pathway. However, after the statistics are deemed to be satisfactory, the images are inspected and the dose adjusted to ensure that the conformity placed properly. Thus, the unavoidable dose outside the target is not in a place of significance. In Case 1 in which vision was crucial, the desired tumor coverage of 90% or more was sacrificed to protect visual function. The dose to the visual pathways was carefully controlled. This dosimetry technique would seem to be justified at least in Case 1. She suffered a considerable pressure to her visual pathway and even with the low margin dose and low percentage coverage of the tumor, the latter shrank and the visual function improved over baseline status.

Conclusions

It would seem that some meningiomas can undergo a swelling followed by collapse following GKS. The clinical picture can be alarming but may be controlled by steroid therapy. The findings reported here are based on a highly conformal dosimetry with a prescription dose of 12 Gy. Not all changes seen on MR imaging in a patient with new symptoms after GKS may be due to radiation-induced brain damage; rather, they may be related to a circulatory disturbance resulting from tumor swelling.

References


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