Stereotactic Radiation Therapy for Optic Nerve Sheath Meningioma; An Experience at Ramathibodi Hospital

Chomporn Sitathanee MD*,
Mantana Dhanachai MD*, Anuchit Poonyathalang MD***,
Lojana Tuntiyatorn MD**, Veerasak Theerapancharoen MD****

** Division of Radiation Oncology, Faculty of Medicine Ramathibodi Hospital, Mahidol University*
*** Division of Diagnostic Radiology, Faculty of Medicine Ramathibodi Hospital, Mahidol University*
**** Department of Ophthalmology, Faculty of Medicine Ramathibodi Hospital, Mahidol University*
***** Division of Neurosurgery, Faculty of Medicine Ramathibodi Hospital, Mahidol University*

Objective: *To evaluate results of stereotactic radiotherapy for the treatment of optic nerve sheath meningioma (OM) at Ramathibodi Hospital.*
Material and Method: *Twelve patients with primary OM were treated with stereotactic radiation between 1998 and 2005. Five patients underwent surgery and had no light perception before radiation. All patients except one were treated with fractionated stereotactic radiotherapy (FSRT). Mean average dose of FSRT was 55.7 Gy; 180 cGy/fraction. One patient was treated with 15-Gy stereotactic radiosurgery.*
Results: *With a median follow-up of 34 months, there was no visual improvement in the five patients who were completely blind before radiation. Visual acuity improved in four patients and remained stable in two patients. Four of six patients had improved visual field, and five of six decreased in proptosis. Follow-up images were available in six patients, showing minimal tumor regression in five and stable in one. No serious acute side effect was observed. Vision became worse in one patient, who developed vitreous hemorrhage two years after FSRT.*
Conclusion: *Stereotactic radiotherapy is an effective treatment for primary OM. It provides tumor control and visual preservation with low risk of complications. However, more patients and further follow-up are needed for long-term outcomes.*

Keywords: *Stereotactic radiotherapy, Optic nerve, Optic nerve sheath, Meningioma*

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Optic nerve sheath meningiomas (OM) are rare slow-growing tumors, which originate from the arachnoid meninges. They represent only 1-2% of all meningiomas diagnosed in the general population[1]. These tumors are divided into primary OM, which arise intraorbitally or intracanalicularly from the meninges of the optic nerve, and secondary OM, which arise intracranially and subsequently invades the optic canal and the orbit. These tumors can cause extrinsic compression of the optic nerve. Gradual progressive loss of vision, proptosis, motility disturbance, lid edema, and pain are the leading symptoms. The optimal management remains controversial, ranging from observation to surgery and radiotherapy. OM usually arises between the arachnoid and dura mater so that total surgical excision without damaging the optic nerve is virtually impossible. This results in visual deterioration or total visual loss after surgical resection[2]. Furthermore, a substantial rate of local recurrence after surgery has been reported[3-6]. To preserve vision, radiotherapy is now becoming a treatment option. The purpose of the present study was to evaluate results of stereotactic radiotherapy for the treatment of primary OM at the presented institute, in terms of visual outcome, tumor control, and treatment complications.

Correspondence to : *Sitathanee C, Radiation Oncology Division, Ramathibodi Hospital, Rama 6 Rd, Bangkok, 10400, Thailand.Phone: 0 2201 1140, 02 201 1149 Fax: 02201 1191 Email: racsi@mahidol.ac.th*

Material and Method

The authors conducted a retrospective review of twelve patients (10 females and 2 males) with primary OM, each with one eye involved, who were treated with stereotactic radiation at the presented institute between 1998 and 2005. The patients' age ranged from 25 to 67 years (median 41). Presenting symptoms included progressive visual loss (10 patients), proptosis (6 patients), facial numbness (2 patients), and impaired eye movement (1 patient). Five patients underwent surgical removal of the tumors and a histological diagnosis of meningioma was confirmed. After surgery, all of them had no light perception. Indications for radiotherapy in these patients were residual tumors or tumor progression after surgery. Intervals between surgery and initiation of radiation ranged from 3 to 27 months. In the other seven patients, diagnosis was based mainly on imaging and ophthalomologic examination. Indications for radiotherapy in these patients were visual deterioration and proptosis with or without radiologically documented tumor growth. Visual acuities (VA) of these patients before starting radiation ranged from 20/20 to 20/100 (Table1), six of them had impaired visual fields (VF).

Stereotactic radiation technique

Stereotactic radiation was delivered using a dedicated 6-MV linear accelerator. Stereotactic radiosurgery (SRS) was used in one patient with a small tumor (tumor volume = 1.12 cc) and had no vision after surgery. The dose of SRS was 15 Gy prescribed at 80% isodose. Eleven patients were treated with fractionated stereotactic radiotherapy (FSRT). Patients were immobilized and scanned in a relocatable Gill-Thomas-Cosman frame. Target localization and treatment planning was performed based on a CT scan and MRI fused with CT images. The number of isocenters used ranged from 1-5 isocenters. The mean average dose for FSRT was 55.7 Gy (range 51.6-59.1 Gy), prescribed at 90% isodose, delivered in 180 cGy/fraction within 5-6 weeks. Tumor volumes ranged from 2.00-14.8 cc. The average doses to the ipsilateral eyes, contralateral optic nerves, and optic chiasms did not exceed 33, 31, and 30 Gy, respectively. No prophylactic steroids were given before or during the treatment.

Follow-up

Patients were followed at one month after completion of radiotherapy and then every 3 to 6 months thereafter. Ophthalmologic examination including measurement of VA (by Snellen lines) and VF (by perimetry) was performed. Follow-up MRIs were obtained at least once a year. Response to treatment was defined clinically by improvement of vision or presenting symptoms.

Results

Vision and symptoms

After a median follow-up of 34 months (range 7-66 months), there was no visual improvement in the

Table 1. Patient follow-up and treatment outcomes

Pt #	FU (mo)	VA		VF		Other symptoms		FU imaging
		Pre-RT	Post-RT	Pre-RT	Post-RT	Pre-RT	Post-RT	
1.	61	No PL	No PL	-	-	-	-	↓ size
2.	66	No PL	No PL	-	-	Proptosis	Improved	↓ size
3.	49	No PL	No PL	-	-	-	-	↓ size
4.	7	No PL	No PL	-	-	Facial numbness	↔	NA
5.	6	No PL	No PL	-	-	Facial numbness	↔	NA
6.	63	20/70	20/40	↓	↔	-	-	↓ size
7.	52	20/50	20/25	↓	↔	Proptosis	Improved	NA
8.	35	20/25	20/20	↓	↑	Proptosis	↔	↓ size
9.	32	20/100	CF	Good	-	Proptosis	Improved	NA
10.	14	20/32	20/20	↓	↑	-	-	NA
11.	13	20/80	20/20	↓	↑	Proptosis	Improved	NA
12.	9	20/20	20/20	↓	↑	Proptosis, ↓ eye movement	Improved	↔

FU = follow-up in month, VA = visual acuity, VF = visual field, RT = radiation treatment, no PL = no perception of light, CF = count finger, NA= not assessable, ↓ = decreased, ↔ = stable, ↑ = improved

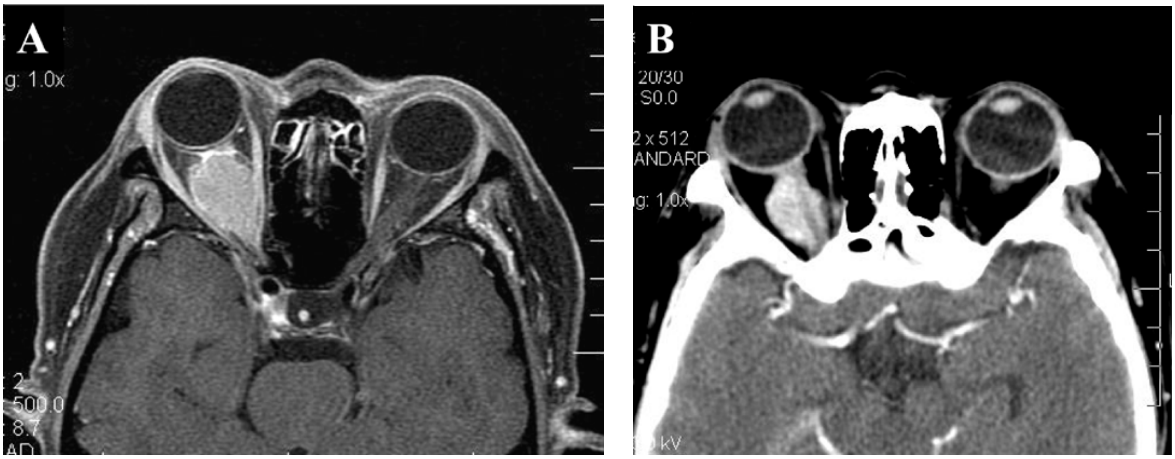

Fig. 1 (A) Example of magnetic resonance imaging (MRI) scan showing a right-sided intraorbital optic meningioma before radiation; (B) a computed tomography (CT) image of the same patient performed at 2 years after 54-Gy stereotactic radiotherapy showing minimal tumor regression and decreased proptosis

five patients who had no light perception before radiation. Among the others, four patients had improved VA. Vision remained stable in two patients who had pretreatment VA of 20/20 and 20/25. Four of six patients had improved VF, and five of six decreased in proptosis. Facial numbness remained stable in two patients. Follow-up images were available in six patients, showing minimal tumor regression in five and stable in one (Fig. 1). No tumor progression was observed. Patient follow-up and treatment outcomes are summarized in Table1.

Treatment complications

With oral steroid given in some patients, no serious acute side effect was observed. One patient had headache and temporary decreased vision four months after radiation and was fully recovered after steroid treatment. Her VA improved from 20/50 before FSRT to 20/25 at 52-month follow-up. One patient with uncontrolled diabetes and hypertension developed vitreous hemorrhage two years after radiation. Her VA dropped from 20/100 to finger count and was not improved after vitrectomy. No visual deterioration of the contralateral eyes was observed.

Discussion

Due to high rates of visual loss after surgery, radiotherapy has become a treatment option for OM, with hope to control the tumor and to preserve or improve vision. Impressive outcomes with conventional radiotherapy were reported [3, 7-9]. Since stereotactic radiotherapy facility was available at the presented institute in 1997, there were only 12 patients with primary OM from 740 patients treated. Due to rarity of the disease, reported results of primary OM treated with stereotactic radiotherapy included a small number of patients. Becker et al[10] reported the effectiveness of FSRT in 15 patients with primary OM. After a median follow-up of 35-month, tumor control was achieved in all patients. VF and VA were improved in 6/15 and 1/16 eyes, and stable in 8/14 and 15/16 eyes, respectively. No serious complications were observed. The authors concluded that SFRT is very effective and may become the standard treatment in selected patients with OM. Baumert et al[11] reported on the results of 23 patients treated with SFRT. After a median follow-up of 20 months, visual control was demonstrated in 21/22 patients (16 improved, 5 stable). Improvement of pain and proptosis was also noted. On follow-up imaging, the tumors remained stable in almost all patients. Radiation retinopathy occurred in one patient. The authors concluded that SFRT improved vision in patients with OM. Landert et al[12] compared seven eyes treated with SFRT to six untreated eyes. Six of seven treated eyes experienced improvement of visual function. By contrast, 3/6 untreated eyes had profound visual loss. No complications of treatment were observed. The results indicate that SFRT is superior to observation in preserving visual function. The authors support early initiation of SFRT in the patients with progressive optic neuropathy before severe visual loss has occurred.

Results from the presented study are consistent with the others showing that stereotactic radiotherapy has an impact on visual preservation, tumor

control, with low risk of complication. Four of five patients (80%) had improved VA, four of six (66%) had improved VF, and five of six (83%) had decreased proptosis. Visual deterioration from vitreous hemorrhage after SFRT was observed in only one patient who has uncontrolled diabetes and hypertension. Although stereotactic radiation did not result in visual improvement of the treated eyes in those who were completely blind after surgery, tumor control was achieved. If left untreated, tumor progression can cause damage to the optic chiasm and visual impairment of the contralateral eye will occur. To minimize late complication to the optic chiasm, the authors used FSRT 1.8 Gy/fraction in four of five patients who had no vision before starting radiation. Only one patient with a small tumor located away from the chiasm was treated with SRS. At the end of the presented study, the authors have not seen any complications to the contralateral eyes.

Conclusion

The early results have shown that stereotactic radiotherapy is an effective treatment for primary OM. Its advantages include an ability to control tumor and preserve visual function with a low risk of complications. Visual improvement was achieved only in patients who still had vision before radiation. However, more patients and further follow-up is needed for long-term outcomes.

References

1. Sibony PA, Krauss HR, Kennerdell JS, Maroon JC, Slamovits TL. Optic nerve sheath meningiomas. Clinical manifestations. Ophthalmology 1984; 91: 1313-26.
2. Richards JC, Roden D, Harper CS. Management of sight-threatening optic nerve sheath meningioma with fractionated stereotactic radiotherapy. Clin Experiment Ophthalmol 2005; 33: 137-41.
3. Kennerdell JS, Maroon JC, Malton M, Warren FA. The management of optic nerve sheath meningiomas. Am J Ophthalmol 1988; 106: 450-7.
4. Alper MG. Management of primary optic nerve meningiomas. Current status - therapy in controversy. J Clin Neuroophthalmol 1981; 1: 101-17.
5. Wright JE, Call NB, Liaricos S. Primary optic nerve meningioma. Br J Ophthalmol 1980; 64: 553-8.
6. Gabibov GA, Blinkov SM, Tcherekayev VA. The management of optic nerve meningiomas and gliomas. J Neurosurg 1988; 68: 889-93.
7. Smith JL, Vuksanovic MM, Yates BM, Bienfang DC. Radiation therapy for primary optic nerve meningiomas. J Clin Neuroophthalmol 1981; 1: 85-99.
8. Turbin RE, Thompson CR, Kennerdell JS, Cockerham KP, Kupersmith MJ. A long-term visual outcome comparison in patients with optic nerve sheath meningioma managed with observation, surgery, radiotherapy, or surgery and radiotherapy. Ophthalmology 2002; 109: 890-9.
9. Ito M, Ishizawa A, Miyaoka M, Sato K, Ishii S. Intraorbital meningiomas. Surgical management and role of radiation therapy. Surg Neurol 1988; 29: 448-53.
10. Becker G, Jeremic B, Pitz S, Buchgeister M, Wilhelm H, Schiefer U, et al. Stereotactic fractionated radiotherapy in patients with optic nerve sheath meningioma. Int J Radiat Oncol Biol Phys 2002; 54: 1422-9.
11. Baumert BG, Villa S, Studer G, Mirimanoff RO, Davis JB, Landau K, et al. Early improvements in vision after fractionated stereotactic radiotherapy for primary optic nerve sheath meningioma. Radiother Oncol 2004; 72: 169-74.
12. Landert M, Baumert BG, Bosch MM, Lutolf UM, Landau K. The visual impact of fractionated stereotactic conformal radiotherapy on seven eyes with optic nerve sheath meningiomas. J Neuroophthalmol 2005; 25: 86-91.

ผลการรักษา Optic nerve sheath meningioma โดยการฉายแสงด้วยรังสีศัลยกรรม ในโรงพยาบาลรามาธิบดี

ชมพร สีตะธนี, มัณฑนา ธนะไชย, อนุชิต ปุญญทลังศ์, โลจนา ตันติยาทร, วีรศักดิ์ ธีระพันธ์เจริญ

วัตถุประสงค์: เพื่อศึกษาผลการฉายแสงด้วยรังสีศัลยกรรมในผู้ป่วย Primary optic nerve sheath meningioma ณ โรงพยาบาลรามาธิบดี

วัสดุและวิธีการ: ทำการศึกษาข้อมูลย้อนหลังของผู้ป่วย Primary optic nerve sheath meningioma จำนวน 12 ราย ที่ได้รับการรักษาโดยการฉายแสงด้วยรังสีศัลยกรรม ตั้งแต่ปี พ.ศ. 2541 ถึง พ.ศ. 2548 ในจำนวนนี้ ผู้ป่วย 5 ราย ได้รับการผ่าตัดมาก่อนและตามองไม่เห็นแล้วก่อนการฉายแสง ผู้ป่วย 11 ราย ได้รับการฉายรังสีศัลยกรรมแบบแบ่งฉายหลายครั้ง ปริมาณรังสีเฉลี่ย 55.7 Gy ฉายครั้งละ 180 cGy ผู้ป่วย 1 ราย ได้รับการฉายรังสีศัลยกรรมแบบฉายครั้งเดียว ปริมาณรังสี 15 Gy

ผลการศึกษา: หลังจากติดตามผลการรักษานาน 7-66 เดือน (mean 34 เดือน) ผู้ป่วย 5 ราย ที่ตาบอดสนิทก่อนการฉายแสง ตายังคงมองไม่เห็นเหมือนเดิม ที่เหลือ การมองเห็นดีขึ้นในผู้ป่วย 4 ราย และคงที่ในผู้ป่วย 2 ราย ผู้ป่วย 4 ใน 6 ราย มีลานสายตาดีขึ้น ผู้ป่วย 5 ใน 6 ราย มีอาการตาโปนลดลง จากการติดตามผลโดยภาพถ่ายรังสีในผู้ป่วย 6 ราย พบว่า ก้อนเนื้องอกมีขนาดเล็กลง 5 ราย ส่วนอีก 1 ราย มีขนาดคงที่ ไม่พบผลข้างเคียงระยะเฉียบพลันที่รุนแรงจากการฉายแสงภายหลังจากการฉายแสง 2 ปี ผู้ป่วย 1 ราย มี vitreous hemorrhage ซึ่งทำให้การมองเห็นเลวลง

สรุป: การฉายแสงด้วยรังสีศัลยกรรมเป็นการรักษา Optic nerve sheath meningioma ที่ได้ผลดีทั้งในด้านการควบคุมโรคและการรักษาการมองเห็นของผู้ป่วย รวมทั้งมีผลข้างเคียงต่ำในระยะแรก อย่างไรก็ตาม ควรมีการติดตามผู้ป่วยเพื่อประเมินผลการรักษาในระยะยาวต่อไป