Early Neurological Complications After Stereotactic Radiosurgery / Radiotherapy

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Abstract

Objective : To evaluate the neurological complications after stereotactic radiosurgery (SRS) and stereotactic radiotherapy (SRT).

Material and Method : The Ramathibodi Radiosurgery Unit started its service in August 1997, using the linear-accelerator based system. There were 144 patients treated from August 1997 to October 1999. Single fraction SRS was performed in 56 cases consisting of 46 arteriovenous malformations (AVMs), 4 cranial nerve (CN) schwannomas, 3 pituitary adenomas, 2 meningiomas, and 1 multiple hemangioblastomas. Eighty eight patients received multifractionated SRT, including 27 meningiomas, 17 pituitary adenomas, 13 benign and malignant gliomas, 8 brain metastasi(e)s, 5 CA nasopharynx, 5 craniopharyngiomas, 5 CN schwannomas, 2 AVMs, 2 chordomas, and 4 others. After treatment the patients were clinically evaluated every 1-6 months and MRI was scheduled at 6 or 12-month interval or when there were abnormal clinical signs/symptoms. The complications included any new neurological complaints or findings during and after treatment.

Results : Median follow-up time was 9.5 (0-20) months. Of 138 patients with available follow-up data, there were 23 (13 SRS and 10 SRT) cases who experienced new neurological symptoms at 3 weeks - 20 months (median = 3 months) from the time treatment started. Symptoms included headache, seizure, weakness, decreased vision, vertigo with/without ataxia, diplopia, dizziness, impaired memory, hemifacial spasm, decreased sensation and facial palsy. Three AVM patients had intraventricular hemorrhage from the patent nidi. After symptomatic treatment there were 15 cases with complete recovery (including seizure control) and 6 with partial recovery. There were 2 deaths from ruptured AVM and progressive metastatic brain lesion. There were 79 patients who had at least 1 follow-up MRI, and changes were detected in T2-weighted images in 19 cases at 3-18 months after treatment. Ten cases had symptoms corresponding to the image changes, the other 9 patients were asymptomatic.

Conclusions : Longer follow-up time is needed to fully evaluate the complications after SRS/SRT, however, preliminary results showed that most of the complications were mild and transient. There was a tendency of a higher complication rate in the SRS group. Not all patients with post treatment image changes developed symptoms.

Key word : Stereotactic Radiosurgery, Stereotactic Radiotherapy, Complication

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Stereotactic radiosurgery (SRS) is an irradiation technique to deliver a large single dose of radiation with high precision to a small region within the brain, with rapid dose fall-off at the target boundary. Originally it was developed to treat small primary benign conditions, but lately it has increasingly been applied to treat metastatic and primary malignant brain tumors. There are different stereotactic systems using photons (Gamma knife and linear-accelerator (LINAC) based system) or charged particles (eg. protons, Helium 4, Carbon 12)[1]. Recently, with the availability of the relocatable stereotactic frame, multifractionated stereotactic radiotherapy (SRT) has been possible which is probably more suitable for the dividing tumors[2]. Larger lesions may also gain benefit from SRT in terms of the possibility of fewer radiation complications[3].

Although being a non-invasive method, certain risks of treatment complications exist[4-9]. Side effects were reported to occur from during or immediately after the radiation course until many years later. Most reports paid attention to the symptomatic neurological sequelae, which varied among diagnoses. With the currently used SRS techniques, permanent neurological damage is thought to occur in 2-3 per cent of patients with arteriovenous malformation (AVM)[10]. There have been less experiences and shorter follow-up time for other diagnoses, but decreasing SRS dose or using SRT instead of SRS in certain conditions tended to show lower complication rates[11-17]. Because the radiosurgery system, treatment planning and techniques vary widely among institutes, treatment results in terms of tumor control and complication rates cannot be simply predicted from the experience of others. Since the Radiosurgery Unit in Ramathibodi Hospital was started in August 1997, it would be interesting to explore the preliminary results. The objective of this study was to evaluate the neurological complications after SRS/SRT.

MATERIAL AND METHOD

The Ramathibodi Radiosurgery Unit uses the LINAC system (6 MV dedicated LINAC, Varian, Palo Alto, CA; with XKNIFE planning system version 3&4, Radionics, Boston, MA). Before treatment all patients were evaluated in the weekly conference attended by neurosurgeons, radiation oncologists, and neuroradiologists. Eligibility criteria for SRS/SRT were patients with intracranial or skull base lesions 5 cm or less in greatest dimension which were surgically or medically inoperable, residual or recurrent lesions after conventional treatment, or those who refused conventional treatment. Patients with brain metastasi(e)s who had 4 lesions or less, good performance status (Karnofsky Performance Status 60 or more), and controlled primary disease were also eligible for SRT boost after whole brain irradiation (30-50 Gy/10-25 fractions). SRS was selected for patients with AVMs or other benign lesions (except vestibular schwannoma patients who retained useful hearing) whose maximum lesion dia-

meter was 3 cm or less and located 5 mm or more from the brainstem or optic nerve/chiasm. Written informed consent had to be obtained before the treatment.

From August 1997 to October 1999 there were 144 patients, 75 female and 69 male. Median age was 36 years (5-82 years). SRS was used in 56 patients (46 arteriovenous malformations (AVMs), 4 cranial nerve (CN) schwannomas, 3 pituitary adenomas, 2 meningiomas, and 1 multiple hemangioblastomas). SRT was used in 88 patients (27 meningiomas, 17 pituitary adenomas, 13 benign and malignant gliomas, 8 brain metastasi(e)s, 5 CA nasopharynx, 5 craniopharyngiomas, 5 CN schwannomas, 2 AVMs, 2 chordomas, 1 choroidal malignant melanoma, 1 malignant peripheral nerve sheath tumor, 1 orbital alveolar soft part sarcoma, and 1 paranasal sinus osteosarcoma). Table 1 shows details of the treatment the patients received before SRS/SRT. The dose and lesion volume of SRS/SRT treatment, classified by diagnosis, are shown in Table 2.

After treatment, the patients were clinically evaluated every 1-6 months and MRI was scheduled at 6 or 12-month interval or when there were abnormal clinical signs/symptoms. The treatment complications included any new neurological complaints or findings during and after treatment.

RESULTS

Median follow-up time was 9.5 (0-26) months. There were 5 patients who were lost to follow-up at 0, 2, 9, 10, and 13 months, with no complication detected at the time of their last follow-up. One patient with a large cerebellar AVM died 6 months after treatment from an unrelated cause (aspirated pneumomia). Of the remaining 138 patients, there were 23 (13 SRS and 10 SRT) cases who experienced new neurological symptoms. Median time from the date treatment started to onset of symptoms was 3 months (3 weeks - 20 months). Symptoms included headache (5 cases), seizures (4 cases), weakness (3 cases), decreased vision (2

Table 1. Details of the treatment the patients received before SRS/SRT at Ramathibodi Hospital.

Diagnosis	Number	Previous treatment	Number
AVM	48	None	13
		Surgery (1 time)	2
		Embolization (1-7 times)	32
		Radiosurgery + embolization (2 times) *	1
Meningioma	29	None	4
		Surgery (1-4 times)	22
		Surgery (1-3 times) + radiation (50-55.4 Gy / 25-28 fx)	3
Pituitary adenoma	20	None	3
		Surgery (1-5 times)	12
		Surgery (1-2 times) + radiation (45-50.2 Gy / 25-28 fx)	5
Glioma	13	Surgery	2
		Surgery+ radiation (50-60 Gy / 25-30 fx)	11
CN schwannoma	9	None	5
		Surgery (1-3 times)	4
Brain metastasi(e)s	8	Surgery (1-2 times) + radiation (31.5-49 Gy / 12-25 fx)	3
		Radiation (30-39 Gy / 10-20 fx)	5
CA nasopharynx	5	Radiation (65-72 Gy / 36-40 fx) ± chemotherapy (cis-platinum based)	5
Craniopharyngioma	5	Surgery (1-4 times)	5
Chordoma	2	Surgery (1 time)	1
		Surgery (1 time) + radiation (61.2 Gy / 34 fx)	1
Hemangioblastomas	1	Surgery (1 time)	1
Malignant peripheral nerve sheath tumor	1	Surgery (4 times)	1
Malignant choroidal melanoma	1	None	1
Alveolar soft part sarcoma right eye	1	Surgery (1 time) + radiation (40 Gy / 20 fx)	1
PNS osteosarcoma	1	Surgery (6 times) + radiation (60 Gy / 30 fx) + chemotherapy + PDT (2 times)	1

* A boy, aged 10, had a ruptured choroidal AVM and received gamma knife radiosurgery (dose 18 Gy at 45% isodose line) in 1993. He experienced repeated AVM ruptures in 1997 and embolization was performed before the second course of radiosurgery.

fx = fraction(s), PNS = paranasal sinus, PDT = photodynamic therapy

Table 2. Details of volume of the lesions and SRS/SRT doses according to diagnosis.

Diagnosis	SRS			SRT		
	Number	Dose (Gy) (median)	Vol. (ml) (median)	Number	Dose (Gy)	Vol. (ml) (median)
AVM	46	8-20 (15)	0.3-40.1 (2.4)	2	5,6 Gy x 6 fx / 2 wk	17.7, 48.6
Meningioma	2	10,13 (11.5)	5, 13.2 (9.1)	27	1.8, 2 Gy x 22-28 fx / 4.5-5 wk (21 cases) 5.5,6 Gy x 5-6 fx / 1-2 wk (4 cases) 2 Gy x 5 fx / 1 wk (2cases)*	3.6-39.7 (11.6)
Pituitary adenoma	3	10-13 (10)	0.7-8.1 (2.5)	17	1.8, 2 Gy x 22-31 fx 4.5-6 wk (14 cases) 6 Gy x 5 fx / 1 wk (1 case) 2 Gy x 6,8 fx / 1-1.5 wk (2cases)*	0.5-28 (8.3)
CN schwannoma	4	12-13 (12)	0.2-7.8 (0.6)	5	1.8, 2 Gy x 25-28 fx / 5-5.5 wk (4 cases) 4.5 Gy x 6 fx / 2 wk (1 case)	2.2-22.6 (3.1)
Hemangioblastomas	1	10-12 (10)	0.2-6.1 (0.3)			
Glioma (benign & malignant)				13	1.8 Gy x 28 fx / 5.5 wk (1 case) 2.5-5 Gy x 5-10 fx / 1-2 wk (2 cases) 1.5-4 Gy x 4-8 fx / 1-2 wk (10 cases)*	1.8-120 (22)
Brain metastasi(e)s				8	3-6 Gy x 4-6 fx / 1-2 wk **	0.04-11.5 (4.5)
Craniopharyngioma				5	1.8 Gy x 26-28 fx / 5-5.5 wk	2.6-13.5 (7.7)
CA nasopharynx				5	4-5 Gy x 4-5 fx / 1 wk (3 cases)* 1.8 Gy x 28 fx / 5.5 wk (1 case)*** 5 Gy x 5 fx / 1 wk (1 case)***	3.6-85 (14.3)
Chordoma				2	5 Gy x 6 fx / 2 wk 2.3 Gy x 5 fx / 1 wk*	3.9, 64.3 (34.1)
Malignant peripheral nerve sheath tumor				1	4.3 Gy x 8 fx / 2 wk	5.2
Malignant choroidal melanoma				1	2.5 Gy x 20 fx / 4 wk	0.3
Alveolar soft part sarcoma right eye				1	1.8 Gy x 8 fx / 2 wk*	7.6
PNS osteosarcoma				1	3 Gy x 8 fx / 2 wk	2

* Booster dose after conventional radiotherapy
** Booster dose after whole brain radiotherapy
*** Recurrent CA nasopharynx
Vol. = volume, fx = fraction(s), wk = week(s), PNS = paranasal sinus

cases), vertigo with/without ataxia (2 cases), diplopia (1 case), dizziness (1 case), impaired memory (1 case), and hemifacial spasm (1 case). Three AVM patients had intraventricular hemorrrhage from the patent nidi, one of them also had dizziness and confusion attributable to phenytoin intoxication. One patient with left-sided weakness also had decreased sensation and facial palsy on the same side.

After symptomatic treatment (steroid and/or anticonvulsant drugs, 1 case with cystic tumor aspiration) all seizures were controlled. For the rest there was complete recovery in 11 and partial recovery in 6 cases. There were 2 deaths, 1 case from ruptured AVM at 7 months after SRS, 1 case from progressive metastatic brain lesion 3 months after SRT. Table 3 shows details of the patients who developed complications after the treatment.

There were 79 patients who had at least 1 follow-up MRI (32 AVMs, 18 meningiomas, 8 gliomas, 7 CN schwannomas, 6 pituitary adenomas, 3 brain metastasi(e)s, 2 craniopharyngiomas, 1 CA nasopharynx, 1 chordoma, and 1 multiple hemangioblastomas). Changes were detected in T2-weighted images in 19 cases (12 AVMs, 3 gliomas, 2 brain metastasi(e)s, 1 meningioma, 1 CN schwannoma) at 3-18 months after treatment. Ten cases (52.6%; 5 AVMs, 2 gliomas, 1 brain metastases, 1 meningioma, 1 CN schwannoma) had symptoms corresponding to the image changes and the other 9 cases were asymptomatic.

DISCUSSION

Post SRS/SRT morbidity previously reported has been low. Complications can occur from immediate to more than 10 years after treatment. Werner-Wasik et al[5] reported immediate side effects (during and up to 2 weeks after the radiation course) in 28/78 (35%) patients with intracranial lesions including AVMs and tumors, most were mild or moderate and self-limited. In patients with intracranial metastases, Loeffler and Alexander[18] reported 22/196 (11.2%) episodes of nausea and 12/196 (6.1%) seizures within 24 hours and transient motor weakness in 4 patients (2%) within 36 hours. Ten of the patients with seizures had a history of seizure disorder and, in retrospect, had subtherapeutic levels of anticonvulsants. Later changes were reported to occur from 1-24 months post treatment. In 1992 Flickinger et al[19] reported that postradiosurgery imaging changes (PRI) were detected more frequently in the AVM cases (31%) compared to the meningioma and acoustic tumor cases (8%), and suggested that the AVMs and tumors should be studied separately. Their AVM experience later (1997) showed that only one-third of the patients with PRI changes were symptomatic, and the 3-year cumulative actuarial rate for resolution of PRI changes was 81 per cent with median time to the resolution of 12 months[20]. The suggestion (1998) was that some of the PRI changes might not be radiation injury responses but could represent parenchymal hemodynamic changes or signals from the injured abnormal arteriovenous shunting vessels that result from successful AVM obliteration[21]. Very late complications occurring more than 4-5 years after treatment were reported with low incidence (~1%), including cyst formation, late delayed radiation necrosis, and secondary tumor[9,22].

Theoretically, SRT may have advantages compared to SRS in treating malignant lesions, it also may decrease normal brain complications when the treatment volume is large or near the critical region. Hakim et al[11] reported complications in 6/127 meningioma patients treated by SRS, 4 nonfatal complications included monoocular blindness, unilateral hearing loss, leg weakness and hypesthesia, and hemiparesis. They recommended that SRT should be considered if the maximum diameter of the tumor was more than 3 cm or the tumor was abutting or involving the critical structures such as optic nerve/chiasm or brainstem. Efforts to preserve hearing and decrease cranial nerves complications in patients with vestibular schwannoma led to a decreased SRS dose and more studies of the use of SRT[12,13].

In this series new neurological complaints occurred in 16.7 per cent of the patients, most symptoms were mild and reversible. There were 3 patients who developed complications during the course of SRT, 2 patients with left cavernous sinus meningioma and suprasellar craniopharyngioma had decreased visual acuity which fully recovered after steroid therapy. The other patient with craniopharyngioma had impaired memory due to enlargement of the cystic tumor, the condition improved after cystic aspiration and SRT could be continued. There was no immediate seizure after treatment. Complications tended to occur more in patients receiving SRS compared to SRT (23.2% *vs* 11.4%). Considering AVM cases, one limitation of SRS was the long latency period before the nidus could be obliterated, most series reported obliteration rate at 2 years after

Table 3. Details of the patients who developed complications after SRS / SRT.

	Diagnosis	Sex	Age (yr)	Location	Volume (ml)	Dose (%isodose line)	Signs & Symptoms	Timing after SRS / SRT (mo)	Status after treatment
	SRS								
1	AVM	M	34	Rt. parietal	15	16 Gy (80%)	Seizure	2	Seizure controlled
2	AVM	F	16	Rt. frontal	2.4	17 Gy (80%)	Headache (ruptured AVM)	2	Complete recovery
3	AVM	M	41	Lt. frontal	2.8	20 Gy (80%)	Headache (ruptured AVM), dizziness (dilantin intoxication)	3	Complete recovery
4	AVM	M	39	Rt. corpus callosum	1.1	20 Gy (80%)	Dizziness	3	Complete recovery
5	AVM	F	16	Rt. thalamus	27	14 Gy (80%)	Lt. sided weakness gr IV with decreased sensation	5	Partial recovery
6	AVM	F	46	Rt. parietal	13	13 Gy (80%)	Unconciousness (ruptured AVM)	7	Dead
7	AVM	M	35	Lt. temporal	1.7	18 Gy (80%)	Headache	12	Complete recovery
8	AVM	F	27	Lt. parietal	1.3	18 Gy (80%)	Headache	14	Complete recovery
9	AVM	F	35	Rt. corpus callosum	0.8	20 Gy (80%)	Seizure	17	Seizure controlled
10	AVM	F	15	Lt. corpus callosum	5.4	17 Gy (80%)	Seizure	17	Seizure controlled
11	Meningioma	M	56	Parasagittal	13	13 Gy (80%)	Seizure	1	Seizure controlled
12	CN schwannoma	F	29	Lt. jugular foramen	7.8	12 Gy (80%)	Lt. leg weakness gr IV	1	Complete recovery
13	Vestibular schwannoma	F	61	Rt. acoustic canal	0.5	12 Gy (80%)	Vertigo	1	Complete recovery
	SRT								
1	Meningioma	F	52	Lt. cavernous sinus	29	1.8 Gy x 22 fx / 4.5 wk (80%)	Decreased visual acuity left side	After 34.2 Gy	Complete recovery
2	Meningioma	F	59	Lt. cavernous sinus	5.3	6 Gy x 5 fx / 5 d (80%)	Headache	4	Partial recovery
3	Meningioma	F	70	Rt. cavernous sinus	17	6 Gy x 6 fx / 2 wk (85%)	Headache	4	Complete recovery
4	GBM	F	52	Rt. parietal	62	2 Gy x 4 fx / 4 d (80%)*	Progressive lt. sided weakness	5	Partial recovery
5	Astrocytoma grII	F	32	Rt. thalamus	10	1.6 Gy x5 fx / 5 d (95%)*	Diplopia	6	Partial recovery
6	Vestibular schwannoma	F	53	Rt. acoustic canal	3.1	2 Gy x 25 fx / 5 wk (95%)	Lt. hemifacial spasm	16	Partial recovery
7	Brain metastases	F	58	Lt. cerebellum	0.7, 0.04	4.3 Gy x 5 fx / 5 d (90%)	Vertigo with mild ataxia	2	Complete recovery
8	Brain metastases	M	70	Lt. temporal	10	3.5 Gy x 5 fx / 5 d (80%)	Headache	3	Dead (progressive disease)
9	Craniopharyngioma	M	49	Pituitary fossa	7.7	1.8 Gy x 28 fx / 5.5 wk (90%)	Impaired memory (cystic part of tumor enlargment)	After 37.8 Gy	Partial recovery
10	Craniopharyngioma	F	46	Pituitary fossa	3.8	1.8 Gy x 28 fx / 5.5 wk (90%)	Decreased visual acuity left side	After 41.4 Gy	Complete recovery

* booster dose after wide field radiotherapy 50 Gy / 25 fractions.

treatment, 90-100 per cent and 50-70 per cent for small and large lesions respectively[23]. In large AVM sometimes it was necessary to wait 3-5 years before complete obliteration was achieved. In this study, there were 3 patients who had new symptoms after treatment from ruptured AVM, not from the direct radiation effect. Excluding these patients would result in the crude complication rate of 14.5 per cent. One possible reason for our low complication rates might be the conservative dose used in SRS and more use of SRT. With short follow-up time and long nature of the radiation effects further follow-up is necessary to assess whether the complication rates would increase. Because of the small number of patients and the difference in complications among various diagnoses, only crude complication rates of the whole patient group were reported here. The actuarial complication rates and the influencing factors according to each disease will be further analysed after longer follow-up and more patients accrued.

Not all patients with new clinical complaints underwent follow-up MRI, so it was difficult to correlate the imaging changes with clinical findings. However, in accordance with previous reports, changes in T2 weighted images were detected more in the AVM group (12/32, 37.5%) than the tumor group (7/47, 14.5%). Only 41.7 per cent (5/12) of the AVM patients experienced symptoms corresponding to the image changes. In the malignant lesions, nevertheless, T2 changes were more difficult to interpret as they might have resulted from radiation injury to the brain or progressive tumors. So management in this group of patients should be considered individually along with the clinical features and other available confirmation tests such as biopsy. Magnetic Resonance Spectroscopy or Positron Emission Tomography, if available, may provide additional useful information.

SUMMARY

Longer follow-up time is needed to fully evaluate complications after SRS/SRT, but preliminary results showed that most of the complications were mild and transient. There was a tendency of a higher complication rate in the SRS group. Not all patients with post treatment image changes developed symptoms.

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ผลข้างเคียงทางระบบประสาทหลังการรักษาด้วยรังสีศัลยกรรม

มัณฑนา ธนะไชย, พ.บ., วีระศักดิ์ ธีระพันธ์เจริญ, พ.บ.**, จิรพร เหล่าธรรมทัศน์, พ.บ.*, ศิรินธรา พงษ์เพชร, พ.บ.*, พวงทอง ไกรพิบูลย์, พ.บ.*, ทวีศักดิ์ จันทร์วิทยานุชิต, พ.บ.**, ลักษณา โพชนุกูล, พ.บ.*, สมใจ แดงประเสริฐ, พ.บ.*, ประเสริฐ ศัลย์วิวรรธน์, พ.บ.**, วีระ สินพรชัย, พ.บ.**, วีระพันธ์ ควรทรงธรรม, พ.บ.**, รัตนา พีระบูล, วท.ม.*, พรพรรณ ยงวิทิตสถิต, วท.ม.**

วัตถุประสงค์ : เพื่อประเมินผลข้างเคียงทางระบบประสาทหลังการรักษาด้วยรังสีศัลยกรรม

กลุ่มผู้ป่วยและวิธีการ : หน่วยรังสีศัลยกรรม โรงพยาบาลรามาธิบดีเริ่มเปิดดำเนินการในเดือนสิงหาคม 2540 ใช้เครื่องฉายรังสีชนิดเครื่องเร่งอนุภาค มีผู้ป่วยได้รับการรักษา 144 ราย ในช่วงสิงหาคม 2540 – ตุลาคม 2542 ผู้ป่วย 56 ราย ได้รับรังสีขนาดสูงครั้งเดียว ประกอบด้วยผู้ป่วย arteriovenous malformation (AVM) 46 ราย cranial nerve (CN) schwannoma 4 ราย pituitary adenoma 3 ราย meningioma 2 ราย และ multiple hemangioblastomas 1 ราย ผู้ป่วย 88 รายได้รับรังสีแบบแบ่งฉายหลายครั้ง ประกอบด้วยผู้ป่วย meningioma 27 ราย pituitary adenoma 17 ราย benign และ malignant glioma 13 ราย brain metastasi(e)s 8 ราย CA nasopharynx 5 ราย craniopharyngioma 5 ราย CN schwannoma 5 ราย AVM 2 ราย chordoma 2 ราย และอื่น ๆ อีก 4 ราย หลังการฉายรังสีผู้ป่วยได้รับการตรวจทุก 1–6 เดือนและทำ MRI ทุก 6–12 เดือนหรือเมื่อมีอาการผิดปกติ ผลข้างเคียงจากการรักษาในที่นี้รวมอาการทางระบบประสาทที่เกิดขึ้นใหม่จากทุกสาเหตุตั้งแต่วันที่เริ่มการรักษา

ผลการศึกษา : ระยะเวลาการติดตามผลข้างเคียงเฉลี่ย 9.5 (0–20) เดือน จากผู้ป่วย 138 รายที่มาติดตามผลการรักษาพบ 23 ราย (13 รายจากกลุ่มที่ได้รับรังสีขนาดสูงครั้งเดียวและ 10 รายจากกลุ่มที่ได้รับรังสีแบบแบ่งฉายหลายครั้ง) ที่มีอาการทางระบบประสาทที่เกิดขึ้นใหม่ที่ 3 สัปดาห์ – 20 เดือน (เฉลี่ย 3 เดือน) หลังจากวันที่เริ่มรักษา อาการประกอบด้วยการปวดศีรษะ ชัก กล้ามเนื้ออ่อนแรง การมองเห็นลดลง อาการรู้สึกหมุนซึ่งอาจร่วมกับ ataxia เห็นภาพซ้อน เวียนศีรษะ ความจำแย่ลง ใบหน้ากระตุกครึ่งซีก ชา และ อัมพาตใบหน้าครึ่งซีก ผู้ป่วย 3 รายมีอาการเลือดออกในสมองจากการแตกของ AVM หลังการรักษาผู้ป่วย 15 รายอาการกลับคืนสู่ปกติ (รวมถึงอาการชักที่ควบคุมได้) และ 6 รายอาการดีขึ้นบางส่วน มีผู้ป่วยเสียชีวิต 2 รายจากการแตกของ AVM และการโตของ brain metastasis ผู้ป่วย 79 รายได้ทำ MRI อย่างน้อย 1 ครั้งหลังการรักษา พบการเปลี่ยนแปลงใน T2–weighted image 19 รายที่ 3–18 เดือนหลังวันที่เริ่มรักษา 10 รายมีอาการผิดปกติสัมพันธ์กับการเปลี่ยนแปลงใน MRI อีก 9 รายไม่มีอาการ

บทสรุป : การประเมินผลข้างเคียงทางระบบประสาทหลังการรักษาด้วยรังสีศัลยกรรมควรติดตามผู้ป่วยเป็นเวลานาน อย่างไรก็ดีจากการประเมินเบื้องต้นพบว่าผลข้างเคียงส่วนใหญ่ไม่รุนแรงและรักษาได้ กลุ่มที่ได้รับรังสีขนาดสูงครั้งเดียวมีแนวโน้มการเกิดผลข้างเคียงสูงกว่า และผู้ป่วยที่พบการเปลี่ยนแปลงจาก MRI อาจไม่ได้มีอาการทุกราย

คำสำคัญ : รังสีศัลยกรรม, ผลข้างเคียง

มัณฑนา ธนะไชย, วีระศักดิ์ ธีระพันธ์เจริญ, จิรพร เหล่าธรรมทัศน์, และคณะ
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