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Bilateral aneurysms of the cavernous internal carotid arteries following yttrium-90 implantation

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Abstract. We present a case of bilateral aneurysms of the cavernous internal carotid arteries probably caused by radiation damage due to yttrium-90 implantation for a pituitary adenoma. Other possible aetiological factors are discussed.

Key words: Radiation – Yttrium – Aneurysm – Carotid artery

The effects of radiation on small and large arteries are well known [1–13]. However, there are only a few reports of aneurysm formation due to radiation damage and four cases of unilateral internal carotid artery (ICA) aneurysm associated with yttrium-90 implantation [14, 15]. We report the first case of this type with bilateral cavernous internal carotid aneurysms.

Case report

A 51-year-old woman presented with a history of several episodes of pain in her right eye and diplopia. On examination, she was found to have a partial third nerve palsy and mild optic atrophy. Seventeen years previously, she had trans-sphenoidal implantation of yttrium-90 seeds for treatment of a pituitary adenoma causing acromegaly. CT of the brain failed to reveal any abnormality other than the seeds. She declined further investigation and returned abroad to work. She returned 3 years later with a complete but painless third nerve palsy and was otherwise well. CT revealed a mass in the right cavernous sinus which enhanced strongly with intravenous contrast medium. Carotid angiography demonstrated a giant aneurysm arising from an ectatic right cavernous internal carotid artery (ICA) and a smaller aneurysm of the left cavernous ICA. The right ICA was ligated in the neck. The giant aneurysm was found to extend beyond the cavernous sinus; the ectasia of the ICA included the origin of the opthalmic artery and a clip was placed distal to the ectatic segment. She made a satisfactory recovery from this procedure. Temporal artery biopsy taken at the time of craniotomy was normal.

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Discussion

Presentation of radiation-induced injury to large arteries usually follows one of two patterns [9]: arterial disruption, which occurs early (within 20 weeks) or stenosis or occlusion, which is relatively delayed (several months to many years). Complications of irradiation in large cerebral vessels are predominantly occlusive in nature [2–11, 13]; aneurysm formation has been described only rarely.

A number of reports concern the development of cerebral aneurysms from 3 months to 19 years following irradiation for a variety of head and neck tumours. One patient described by McCready et al. [9] developed an aneurysm of the extracranial carotid artery 3 months after irradiation of the neck. Azzarelli et al. [16] described four intracranial aneurysms occurring within 4 years of irradiation for a suprasellar germinoma, while Scodary et al. [17] report a patient in whom three intracranial aneurysms were detected 12 years after whole brain irradiation for a temporoparietal astrocytoma. Gomori et al. [18] described a basilar artery aneurysm seen 3 years after irradiation for nasopharyngeal carcinoma. Three cases of intracranial aneurysms developing 9–19 years after combined external irradiation and intrathecal gold-198 therapy were reported by Benson and Sung [19].

Multiple intracranial aneurysms occurring one year after radiotherapy for pituitary adenoma were described by Moriyama et al. [20] and after 9 years by Nishi et al. [21]. However, we are aware of only four reports of intracranial ICA aneurysms associated with yttrium-90 implants, none of which had bilateral lesions. Thun and Lanfermann [15] described two cases of giant aneurysm of the ICA probably caused by radiation damage; they were on the cavernous and supraclinoid segments and presented 8 and 11 years after preoperative angiograms had shown no vascular abnormality. Jakubowski and Kendall [14] in their review of angiographic studies of patients with tumours of pituitary origin, included 2 cases of cavernous ICA aneurysm associated with previous yttrium-90 implantation; they were

Fig. 1. Contrast-enhanced CT demonstrates part of a right ICA aneurysm

Fig. 2. Right internal carotid arteriogram shows the giant intracavernous aneurysm arising from an ectatic artery

Fig. 3. Lateral projection of left internal carotid arteriogram shows a small aneurysm in intimate relation to an yttrium-90 seed *(arrow)*

not sure whether these were incidental, post-traumatic or the result of radiation.

Irradiation more commonly causes small vessel occlusion, but human and animal studies have shown that therapeutic irradiation can damage large arteries and lead to adventitial fibrosis and accelerated development of atherosclerosis [10]. Although the pathogenesis of large vessel postirradiation disease is poorly understood, it is possible that injury to the vasa vasorum is an important factor [5]. Hyperlipidaemia and hypertension may also play a role [9, 13].

Giant aneurysms comprise about 5 % of intracranial aneurysms. Of these, 21 % arise from the cavernous ICA and there is a strong female preponderence. A giant ICA aneurysm in combination with a further ICA aneurysm accounts for only 5.5 % of all giant aneurysm cases in adults [22]. Coincidental aneurysms have been reported with tumours of pituitary origin but it is not known whether this is simply a chance association or is related to growth-producing factors, flow patterns in the tumour or hormonal effects on vessel walls. Jakubowski and Kendall [14] found 11 incidental silent aneurysms (including four on the intracavernous ICA) in 188 such patients. Wakai et al. [23] found 7 (including 2 intracavernous aneurysms) in 95 patients. None was bilateral.

Another possible aetiological factor to be considered is direct mechanical trauma to the ICA during insertion of the yttrium-90 seeds, due to misplacement or a medial course of the artery. There have been five reports of iatrogenic intracavernous aneurysms following transnasal, transethmoidal or trans-sphenoidal surgery [22]. The aneurysms tend to develop rapidly and none followed yttrium-90 implantation, which therefore seems an unlikely cause of delayed presentation of bilateral lesions, as in our case.

Without performing angiography prior to yttrium-90 implantation, it is impossible to entirely exclude the occurrence of coincidental aneurysms. However, in our case, the rare combination of aneurysms and their intimate relation to the seeds, the absence of other known aetiologies and the recognised association of intracranial aneurysms with irradiation lead us to believe that radiation damage to the ICA was the most likely causal factor.

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References

1. Aarnoudse MW, Lamberts HB (1977) Arterial wall damage by x-rays and fast neutrons. Int J Radiat Biol 31: 87–94
2. Brant-Zawadzki M, Anderson M, DeArmond SJ, Conley FK, Jahnke RW (1980) Radiation-induced large vessel occlusive vasculopathy. AJR 134: 51–55
3. Conomy JP, Kellermeyer RW (1975) Delayed cerebrovascular consequences of therapeutic radiation. Cancer 36: 1702–1708
4. Darmody WR, Thomas LM, Gurdjian ES (1967) Postirradiation vascular insufficiency syndrome. Neurology 17: 1190–1192
5. Fonkalsrud EW, Sánchez M, Zerubavel R, Mahoney A (1977) Serial changes in arterial structure following radiation therapy. Surg Gynecol Obstet 145: 395–400
6. Glick MAJB (1972) Bilateral carotid occlusive disease following irradiation for carcinoma of the vocal cords. Arch Pathol 93: 352–355
7. Hayward RH (1972) Arteriosclerosis induced by radiation. Surg Clin North Am 52: 359–366
8. Loftus CM, Biller J, Hart MN, Cornell SH, Hiratzka LF (1987) Management of radiation-induced accelerated carotid atherosclerosis. Arch Neurol 44: 711–714
9. McCready RA, Hyde GL, Bivins BA, Mattingly SS, Griffen WO (1983) Radiation-induced arterial injuries. Surgery 93: 306–312
10. Murros KE, Toole JF (1989) The effect of radiation on carotid arteries. Arch Neurol 46: 449–455
11. Painter MJ, Chutorian AM, Hilal SK (1975) Cerebrovasculopathy following irradiation in childhood. Neurology 25: 189–194
12. Rheinhold HS, Keyeux A, Dunjic A, Jovanovic D, Maisin JR (1974) The influence of radiation on blood vessels and circulation. Curr Top Radiat Res 10: 185–198
13. Silverberg GD, Britt RH, Goffinet DR (1978) Radiation-induced carotid artery disease. Cancer 41: 130–137

14. Jakubowski J, Kendall B (1978) Coincidental aneurysms with tumours of pituitary origin. J Neurol Neurosurg Psychiatry 41: 972–979
15. Thun F, Lanfermann H (1991) Intracranial giant aneurysm due to the effects of radiation. Radiologe 31: 244–246
16. Azzarelli B, Moore J, Gilmor R, Muller J, Edwards M, Mealey J (1984) Multiple fusiform intracranial aneurysms following curative radiation therapy for suprasellar germinoma. J Neurosurg 61: 1141–1145
17. Scodary DJ, Tew JM, Thomas GM, Tomsick T, Liwnicz BH (1990) Radiation-induced cerebral aneurysms. Acta Neurochir (Wien) 102: 141–144
18. Gomori JM, Levy P, Weshler Z (1987) Radiation-induced aneurysm of the basilar artery – a case report. Angiology 38: 147–150
19. Benson PJ, Sung JH (1989) Cerebral aneurysms following radiotherapy for medulloblastoma. J Neurosurg 70: 545–550
20. Moriyama T, Shigemori M, Hirohata Y, Konishi J, Tokunaga T, Kuramoto S (1992) Multiple intracranial aneurysms following radiation therapy for pituitary adenoma: a case report. No Shinkei Geka 20: 487–492
21. Nishi T, Matsukado Y, Kodama T, Hiraki T (1987) Multiple intracranial aneurysms following radiation therapy for pituitary adenoma. Neurol Med Chir (Tokyo) 27: 224–228
22. Fox JL (1983) Intracranial aneurysms. Springer-Verlag, New York, pp 54, 424–425
23. Wakai S, Fukushima T, Furihata T, Sano K (1979) Association of cerebral aneurysm with pituitary adenoma. Surg Neurol 12: 503–507