

Case report

Radiation-induced temporary alopecia after embolization of cerebral arteriovenous malformations

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Abstract

Alopecia after endovascular embolization of cerebral arteriovenous malformations (AVMs) is uncommon. In this report, we present a 33-year-old man who developed temporary alopecia after staged embolization of a cerebral AVM. Four days after the last procedure, this patient had hair loss over his right temporoparietal and occipital areas. No scalp erythema or other sign of dermatitis was noted. The hair regrew 2 months later. The alopecia was considered to be related to repeated exposure to radiation during embolization. The experience in this case and review of the literature suggest that interventional neuroradiological procedures may cause substantial radiation exposure to the patient. Therefore, radiation use should be limited to the least amount necessary to complete the endovascular procedure to prevent radiation-induced biological changes and morbidity. Patients should be well informed of adverse effects such as alopecia.

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1. Introduction

In recent years, endovascular procedures have become widely used for the treatment of vascular disorders such as arteriovenous malformation (AVM), arteriovenous fistula, carotid artery stenosis, and others [1]. The main complications of the endovascular procedures can be categorized as local (related to the puncture site), systemic (hypersensitivity or reactions to the contrast agent), or cerebral (ischemia, infarction, hemorrhage) [2]. Radiation-induced adverse effects of endovascular procedures are seldom mentioned in the literature [3–7]. However, the number of patients with complicated vascular anomalies who are being treated with endovascular procedures continues to increase, and these patients might be subjected to doses higher and radia-

tion exposures longer than those used to treat simple lesions [3–7]. Thus, prolonged fluoroscopic imaging during interventional therapeutic procedures might cause serious radiation injuries to the skin, such as dermatitis or alopecia [5,7–11]. In the English-language literature, nine cases of temporary alopecia have been reported to occur after therapeutic embolization, although this complication is uncommon [3,4,6,7,11,12]. In this report, we present a patient with cerebral AVM, who received three courses of embolization and thereafter developed alopecia.

2. Case report

This 33-year-old man had severe headache and dizziness 1 week prior to his admission to the hospital. No associated seizure, nausea, vomiting, blurred vision, or motor weakness was observed. On admission, the patient was alert and oriented and without neurologic

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deficit. His hair appeared normal. The complete blood cell count and serum biochemistry results were all within normal limits. Magnetic resonance imaging revealed multiple signal-void lesions over the hypothalamus and basal ganglia. Bilateral carotid and left vertebral angiograms showed a large AVM at the anterior frontal region, with feeding arteries from the bilateral anterior cerebral arteries, the right medial and lateral lenticulostriate arteries, the right insular arteries, and the left recurrent artery. Three nidus venous aneurysms were noted as well. The venous drainage was through the middle cerebral vein, the basal vein of Rosenthal, and the cortical veins. The patient underwent three courses of embolization of the AVM with an interval of 1 week between courses, and the patient tolerated these embolization procedures well. No neurologic deficits occurred after these procedures. The size of the AVM was estimated to have been reduced to about one-half its original size.

The patient was discharged; however, hair loss over his right temporoparietal and occipital areas (Fig. 1A) was noted 24 days after the initial angiographic examination, 18 days after the first embolization, and 4 days after the last embolization. On examination, the contour of the alopecia in this patient appeared as two overlapping circles (Fig. 1B). His bilateral occipital and superficial temporal arteries had good pulses. Results of pull tests on the hair were abnormal over the areas of hair loss. No scalp erythema or other sign of dermatitis was noted. The total radiation exposure time during the angiographic examination and the embolization procedures was estimated to be 110 min, and the total irradiation dose was estimated to be more than 3 Gy. The hair regrew 2 months after the occurrence of hair loss.

3. Discussion

In this report, the presented patient underwent one angiographic examination and three courses of embolization, and alopecia appeared soon after the last embolization. Such hair loss is usually caused by inadvertent embolization of the branches of the external carotid artery or radiation injury [5,7–11,13]. Because the patient's superficial temporal and occipital arteries had good pulses and because rich collateral arteries supply the scalp [9,14], hair loss due to arterial occlusion was considered unlikely. Another possibility was radiation-induced hair loss [5,7–11]. Usually the radiation dose absorbed by patients undergoing endovascular procedures is considered low, and it rarely causes significant tissue injury [3–7]. However, this patient underwent a total of 84 digital subtraction angiographic studies with 110 min of radiation exposure time. The estimated radiation exposure dose was more than 3 Gy, although accurate retrospective estimates of the skin dose are considered impossible to achieve [3]. The radiation dosage had reached a level that caused temporary alopecia, which typically occurs after a single short-term exposure to 3–6 Gy of radiation [7]. Furthermore, the contour of the alopecia in this patient appeared as two overlapping circles (Fig. 1B). This effect was most likely due to prolonged exposure to radiation in the same area of skin, as with an interventional procedure using a single dose fraction of low-energy X-rays and limited variation in the direction of application. Therefore, the alopecia in this patient was considered to be radiation-induced.

The occurrence of alopecia is considered to be related to the dose of radiation delivered during embolization, and a deterministic threshold exists, above which the

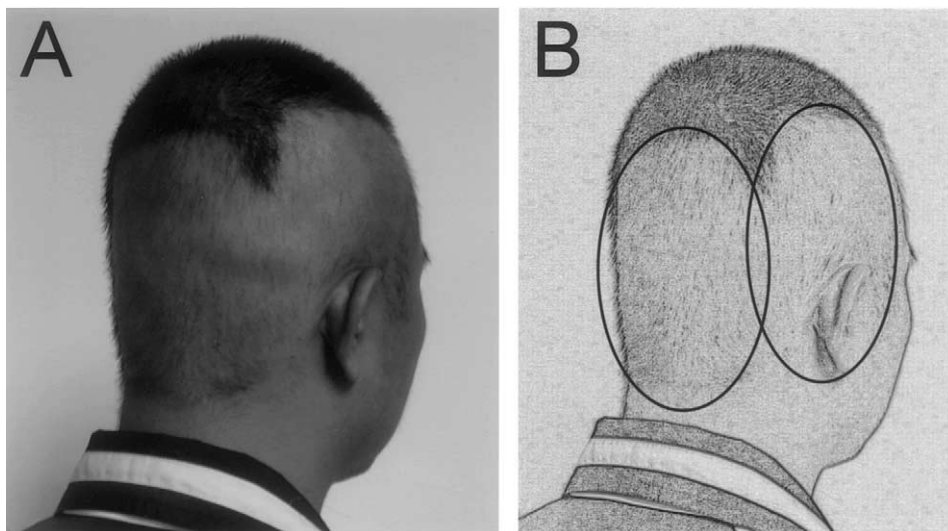


Fig. 1. Photograph of the patient's head shows hair loss over the right temporoparietal and occipital areas (A), with the contour of the hair-loss area appearing like two overlapping circles (B).

probability of the occurrence of skin lesions (such as dermatitis and hair loss) increases rapidly [3–7]. Because the number of patients with complicated vascular anomalies who are undergoing prolonged multiple endovascular procedures is increasing, radiation injuries such as alopecia might be happening more frequently than previously thought [4]. Furthermore, hair is important to a person's self-image, although temporary alopecia is not likely to be detrimental to the patient's health, and the hairs usually regrow 12–14 weeks after irradiation, as in this patient [3–7]. Therefore, knowing the exact radiation dose given to the patient is important, and the dose can be determined only by measuring the definite dose value during the procedure. However, such measurements are seldom used in routine practice [15–17].

In summary, we report a patient with radiation-induced alopecia after a prolonged interventional neuroradiologic procedure for a complicated AVM. Because no good therapy for radiation-induced temporary alopecia exists and because this complication is not negligible in the daily practice of interventional neuroradiology, knowing how to prevent this adverse effect is important. Awareness of this unwanted effect, online monitoring of the patient's exposure, and limitation of radiation use to the least amount necessary to complete the procedure are all important measures in preventing radiation-induced biological changes and morbidity.

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