

# Peculiar Geometric Alopecia and Trigeminal Nerve Dysfunction in a Patient After Guglielmi Detachable Coil Embolization of a Ruptured Aneurysm

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Neuroendovascular treatment is increasingly being used for treatment of intracranial aneurysms. Postradiation alopecia, commonly seen weeks after radiation for other diseases such as brain tumors, is rarely reported after neuroendovascular procedures for benign lesions because of their delayed manifestations. Although the morbidity and mortality is less compared with surgery, adverse effects related to radiation are probably understated, underreported, and/or often attributed to prolonged bed rest, heparinization, or poor nutrition. We present a case with a delayed onset of a graphic but peculiar geometric alopecia associated with trigeminal nerve pattern dysfunction, which was related to the fluoroscopic radiation for coil embolization of an anterior communicating artery aneurysm. **Key Words:** Radiation injury—trigeminal nerve dysfunction—alopecia—fluoroscopy—interventional radiology—coil embolization.

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## Case Report

A 34-year-old man, who was right-handed, a non-smoker, and a nonalcoholic, presented with acute headache and vertiginous giddiness for a day. He had no history of trauma or any other constitutional symptoms. Results of his general physical examinations were normal but with mild neck rigidity. His cranial nerves were normal and he had no neurologic deficit. He had no history of radiation, alopecia, or dermatitis, or any family history of male pattern baldness.

### Investigations

A plain computed tomography scan was promptly performed, revealing diffuse basal and anterior inter-

hemispheric subarachnoid hemorrhage Hunt and Hess grade 1 without intraventricular extension.

### Intervention

Four-vessel digital subtraction angiography, carried out the same evening, displayed a 2.5-mm diameter anterior communicating artery aneurysm measuring 4 mm in length, on a dominant left anterior cerebral artery (Fig 1). The patient underwent Guglielmi detachable coiling (Target Therapeutics, Fremont, CA) under general anesthesia an hour later. A shielded right anterior oblique (RAO) view, acquired by 33-degree caudal tilt with a 13-degree rotation to the right side, best delineated the aneurysm (Fig 1). The aneurysm ruptured, for which a second coil was inserted with successful occlusion of the aneurysm. This total procedure lasted 150 minutes with the specific RAO view accounting for approximately 105 minutes. There were a total of 80 acquisitions for RAO view alone. An external ventricular drain was inserted postoperatively. A check angiography, on the next day, confirmed complete aneurysm occlusion. At 7 days post-coiling, the patient recovered without any neurologic sequelae and was discharged on nimodipine for a week and phenytoin for a month.

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**Figure 1.** RAO view (caudal 33 degrees and RAO tilt of 13 degrees) with Guglielmi detachable coil in partially occluded sac.

At 6-week follow-up he presented with sharply delineated rectangular alopecia over the left parieto-occipital region (Fig 2). The capillary telangiectasia of the thinned out skin were visible. The size and rectangular shape ( $8 \times 10$  cm) were congruent to the RAO window used for coil embolization. The epilation had started 2 weeks after discharge. There was diminished sensation in the patch of alopecia but no redness. The patient also had burning pain in the left jaw and numbness in the left infraorbital region that, on clinical examination, revealed mild sensory loss in distribution of the second and third divisions of the trigeminal nerve. The patient had no other neurologic deficits. At 6 months, alopecia and trigeminal paresthesias persisted.

## Discussion

Alopecia after head and neck radiotherapy has been well reported, but there are few reports after neuroendovascular treatment.<sup>1,2</sup> However, none of these had described the peculiar shape and extent as in our case. Temporary hair loss is a peculiar form of radiodermatitis occurring postglue embolization of arteriovenous malformations and some after coil embolization.<sup>3,4</sup> Huda and Peters<sup>5</sup> reported epilation in the right occipital region of a 34-year-old woman, approximately 5 weeks after embolization of a left paraorbital arteriovenous malformation guided with a biplane radiograph system (in two

sessions separated by 3 days). Imaging had included 110 minutes of fluoroscopy and 46 digital subtraction angiography acquisitions. Wen et al,<sup>3</sup> who had reported temporary alopecia after embolization of cerebral arteriovenous malformations, also identified other factors affecting the skin besides radiation dose, such as dose rate, fractionation, size of exposed area and its site, and biological factors (age, oxygen status, capillary density, hormonal status, genetic factors, and ethnic differences). Lee et al<sup>6</sup> also reported alopecia in 5 patients after Guglielmi detachable coiling and theorized that it was probably caused by both pressure effect and radiation induced. Their cases were characterized by an unusual distribution of alopecia (temporal scalp and the occipital scalp), short duration of procedure (total time of anesthesia was relatively short, 2-3 hours), and radiation exposure (ionizing radiation ( $>2$  Gy)). Jung et al<sup>7</sup> reported 9 cases (6.7%) with alopecia (temporoparietal or occipital regions) in 135 patients treated for 161 aneurysm by coiling. Our patient has similarities to these reports in that the fluoroscopy time was prolonged because of intraoperative rupture. However, in our case, the shape was peculiar and was associated with trigeminal nerve area dysfunction. Although pulsed fluoroscopy was used, only one predominant view was used for the procedure. The temporary hyperoxia, possibly induced from the patient being ventilated under anaesthesia for the procedure, may have



**Figure 2.** Sharply defined left paramedian parieto-occipital rectangular complete alopecia.

compounded the radiation damage by sensitizing the vascular scalp.<sup>3</sup> The third factor highlighted by our patient is the onset of paresthesias possibly caused by ipsilateral trigeminal nerve damage within the radiation field. The site and size of alopecia and subsequent trigeminal nerve dysfunction was consistent with use of collimated radiation beam during fluoroscopy.

Radiation side effects suddenly rise with increase in dose and duration beyond a certain threshold.<sup>8</sup> The estimated skin entrance dose in our patient was approximately 2 Gy. Some have reported transient skin injury to occur at higher threshold levels of peak entrance skin doses.<sup>9</sup> On September 15, 1995, the Food and Drug Administration (FDA)<sup>10</sup> recommended that the facility record in the patient's medical record information regarding absorbed dose to the skin for any procedure with the potential for a skin dose approaching or exceeding some threshold dose for injury. The FDA suggests a threshold absorbed dose in skin of 1 Gy.<sup>10</sup> Certain equipment-related factors such as radiation leak, defective radiograph collimation, and insufficient filtration should be looked for and prevented by a regular quality check, which, in our institution, is done daily and was ruled out as a cause. The radiation damage to the DNA of hair follicular cells may also suggest likelihood of damage to neuronal elements, making a case for much needed long-term follow-up for radiation side effects.

Although, at our institute, use of lead goggles and thyroid protection device is routine, exposure risks to limbs cannot be neglected.<sup>11</sup> The radiation exposure to the operator (especially left side) may also be significant in such cases and may exceed the limits set by The International Commission on Radiological Protection. This aspect deserves special attention from female operators of childbearing age.<sup>11</sup> Newer units now include timers that buzz at 5-minute intervals and have limits on radiation output.<sup>12</sup> Dose reduction is possible with real-time dose monitoring, techniques of extra beam filtering, selection of lower frame rates, pulse progressive fluoroscopy with freeze frame imaging, and use of different gantry settings to distribute dose over a different area.<sup>13</sup>

### Conclusions

Prolonged exposure in any single view during neuroendovascular procedures can lead to significant radiation-related side effects and risks increases with intraoperative rupture and prolonged procedure time. Radiation effects on follow-up should be looked for and their reporting is encouraged. Where procedures are likely to be

prolonged or complex, dose-reducing techniques described above should be used and operators should routinely wear full protective gear.

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