Anagen Effluvium after Neurointerventional Radiation: Trichoscopy as a Diagnostic Ally

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Keywords

Anagen effluvium · Trichoscopy · Neurointerventional radiation

Abstract

Minimally invasive procedures for vascular brain lesions are being performed more frequently. Radiation exposure caused by endovascular embolization of cerebral aneurysms may give rise to nonscarring scalp alopecia located in the treated area. Clinical and trichoscopic features of this type of alopecia are similar to alopecia areata (AA). Herein, we performed a comprehensive review to describe the clinical and trichoscopic characteristics of radiation-induced anagen effluvium. Predominant trichoscopic findings include black dots, yellow dots, short vellus hairs, and absence of exclamation marks hairs. It is important to consider this diagnosis in patients who have recently undergone such procedures that can easily be misdiagnosed as AA.

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Introduction

Anagen effluvium is a nonscarring alopecia caused by various insults, most commonly associated with chemotherapeutic agents. Approximately 90% of scalp hairs are anagen follicles, which is the hair growth phase of active division and proliferation that lasts from 2 to 6 years [1]. Anagen follicles are very sensitive to high doses of radiation, which causes damage in the actively dividing cells [1, 2]. Unlike chemotherapy or radiotherapy induced anagen effluvium, intracranial endovascular procedures produce a well-demarcated alopecic patch consistent with the treatment area [3] (Fig. 1).

Radiation-induced anagen effluvium after neurointerventional procedures has been reported with increasing frequency. Nonetheless, its clinical characteristics and trichoscopic features are nonspecific, thus further research could aid in the diagnosis. Since minimally invasive procedures with radiation are performed more frequently in the field of neurointerventional surgery, dermatologists should include radiation-induced temporary alopecia [4] in the differential diagnosis of nonscarring alopecias.

Fig. 1. **a** Four-year-old female patient with rectangular pseudo-alopecic patch in the temporal occipital scalp due to endovascular embolization of carotid-cavernous fistulae secondary to trauma. **b** Nineteen-year-old male patient with rectangular pseudo-alopecic patch in the occipital scalp 2 weeks after second session (2/3) for endovascular stent placement. **c** Forty-nine-year-old male patient with pseudo-alopecic patch on the occipital scalp 2 weeks after undergoing cerebral aneurysm embolization.

Fig. 2. **a** Anagen hair. **b, c** Red arrows: black dots; blue arrows: yellow dots; red circles: short vellus hairs.

Herein, we conducted a comprehensive search of current literature from PubMed and SCOPUS search engines, including case series and case reports that described trichoscopic findings of patients with radiation-induced temporary alopecia. A total of 25 research outputs were found, including textbooks, book chapters, case reports, case series, original articles, and reviews. We then decided to include 8 articles describing neurointerventional radiation procedures, as well as 3 personal cases from our clinic.

Current literature regarding clinical and trichoscopic findings in patients who developed an alopecic patch after neurointerventional radiation exposure, including

our cases is shown in Table 1. A total of 22 cases including our 3 cases have been reported on the literature up to this date. Demographic and clinical characteristics are shown in Table 2. Women represent 63.6% of cases, men 36.4%, with a wide age-group, from 4- to 70-year-old patients, 63.6% between 20 and 50 years, 9% <20 years, and 36% 50-year-old patients or older. The most common trichoscopic findings reported (shown in Table 3; Fig. 2) were yellow dots (50%), black dots (50%), short vellus hairs (41%), and absence of exclamation mark hairs (23%); additional trichoscopic findings were coiled hairs, peripilar sign, lack of terminal hairs, broken hairs, dystrophic hair roots, white dots and blue-gray dots in a tar-

Table 1. Neurointerventional radiation-induced temporary alopecia cases reported in literature including our patients [present study]

Authors	Patient no.	Sex	Age	Neurointerventional procedure	Location	Radiation dose	Onset of alopecia after procedure	Shape of alopecia	Dermoscopic/trichoscopic findings
Tosti et al. [5]	1	F	30	Arteriovenous malformation embolization	Left temporo-occipital scalp	–	2 weeks	13x4 cm oval patch	Absence of exclamation mark hairs
	2	F	44	Arteriovenous malformation embolization	Occipital scalp	–	1 week	–	Dystrophic hair roots
	3	F	35	Supratentorial aneurysms of both internal carotid arteries	Parietal and occipital hairline bilaterally	–	2 weeks	–	Absence of exclamation mark hairs
Marti et al. [6]	1	F	29	Aneurysms of both carotid-ophthalmic arteries	Occipital scalp	–	2 weeks	13x10 cm square patch	Absence of exclamation mark hairs
López et al. [7]	1	F	44	Right occipital arteriovenous malformation embolization	Temporoparietal scalp	3 Gy cumulative dose	3 weeks	18x6 cm patch	Absence of exclamation mark hairs
Podlipnik et al. [8]	1	M	38	Arteriovenous malformation embolization	Occipital scalp	>4 Gy cumulative dose	4 weeks	Alopecic square patch of 5 cm x 5 cm	Absence of exclamation mark hairs
Cho et al. [3]	1	F	70	Cerebral aneurysm angioembolization	Right parietal and occiput scalp (10%)	–	2 weeks	Two rectangular-shaped alopecic patches (70%)	Yellow dots (60%), black dots (60%), short vellus hairs (50%)
	2	F	35	Arteriovenous malformation embolization	Left temporal and occiput scalp (50%)	–	8 weeks	Two rectangular-shaped alopecic patches (70%)	White dots (10%)
	3	M	39	Subarachnoid hemorrhage angioembolization	Occiput scalp (30%)	–	4 weeks	–	Yellow dots (60%), short vellus hairs (50%)
	4	F	48	Cerebral aneurysm angioembolization	Left temporal and occiput scalp (50%)	–	3 weeks	Two rectangular-shaped alopecic patches (70%)	Yellow dots (60%)
	5	M	54	Carotid cavernous fistula angioembolization	Left temporal and occiput scalp (50%)	–	1 week	Two rectangular-shaped alopecic patches (70%)	Yellow dots (60%), peripilar sign (20%)
	6	F	67	Cerebral aneurysm angioembolization	Left temporal and occiput scalp (50%)	–	1 week	Two rectangular-shaped alopecic patches (70%)	Yellow dots (60%), black dots (60%)
	7	F	66	Dural arteriovenous fistula angioembolization	Occiput scalp (30%)	–	1 week	–	Yellow dots (60%), black dots (60%) and coiled hairs (10%).
	8	F	48	Cerebral aneurysm angioembolization	Left temporal and occiput scalp (50%)	–	6 weeks	Two rectangular-shaped alopecic patches (70%)	Black dots (60%), short vellus hairs (50%)
	9	F	58	Cerebral aneurysm angioembolization	Left parietal and occiput scalp (10%)	–	6 weeks	Two rectangular-shaped alopecic patches (70%)	Black dots (60%) and short vellus hairs (50%)
	10	F	65	Subarachnoid hemorrhage angioembolization	Occiput scalp (30%)	–	2 weeks	–	Black dots (60%), short vellus hairs (50%) and broken hairs (10%)
	1	M	26	Ruptured aneurysm embolization (3 sessions)	Right occipital-parietal region	5 Gy cumulative dose	1 week after last embolization	Rectangular bald patch	Lack of terminal hairs, presence of vellus hairs and yellow dots
César et al. [9]	1	M	26	Ruptured aneurysm embolization (3 sessions)	Right occipital-parietal region	5 Gy cumulative dose	1 week after last embolization	Rectangular bald patch	Lack of terminal hairs, presence of vellus hairs and yellow dots
Ounsakul et al. [10]	1	M	46	Cerebral angiography with fistula embolization	Occipital scalp	2.9 Gy peak dose	2 weeks	Rectangular nonscarring alopecic patch	Yellow dots, black dots, short vellus hairs and blue-gray dots (target-like pattern)
Seol et al. [2]	1	M	33	Arteriovenous malformation embolization	Left parietal scalp	–	2 weeks	Rectangular-shaped alopecic patches	Yellow dots, black dots and short vellus hairs

Table 1 (continued)

Authors	Patient no.	Sex	Age	Neurointerventional procedure	Location	Radiation dose	Onset of alopecia after procedure	Shape of alopecia	Dermoscopic/trichoscopic findings
Guerrero-Putz et al. [present study]	1	F	4	Posttraumatic carotid cavernous fistula embolization (5 sessions)	Right temporo-occipital area	1° 1.716 Gy 2° 5.64 Gy 3° 3.312 Gy 4° 5.591 Gy peak 5° 1.92 Gy Cumulative: 18.46 Gy	3 weeks	Rectangular-shaped pseudo-alopecic patch	Black dots and short vellus hairs
	2	M	19	Cerebral aneurysm embolization (3 sessions)	Occipital scalp	1° 3.09 Gy 2° 8.13 Gy peak 3° 1.033 Gy Cumulative: 12.25	2 weeks	Rectangular-shaped pseudo-alopecic patch	Yellow dots, black dots and short vellus hairs
	3	M	49	Cerebral aneurysm embolization (1 session)	Occipital scalp	2.1 Gy	2 weeks	Rectangular-shaped pseudo-alopecic patch	Black dots, yellow dots and vellus hairs

Table 2. Demographic and clinical characteristics

Characteristics	n (%)
Patients	22 (100)
Gender	
Male	8 (36.4)
Female	14 (63.6)
Age range	4–70
<20 years	2 (9)
20–50 years	14 (63.6)
>50 years	6 (36.4)
Shape of alopecia	
Rectangular	13 (59)
Square	3 (13.6)
Oval	1 (4.5)
Onset of alopecia	
1 week	5 (22.7)
2 weeks	9 (40.9)
3 weeks	3 (13.6)
4 weeks	2 (9)
6 weeks	2 (9)
8 weeks	1 (4.5)

Table 3. Trichoscopic findings

Trichoscopic findings	n (%)
Black dots	11 (50)
Yellow dots	11 (50)
Short vellus hairs	9 (41)
Absence of exclamation mark hairs	5 (23)
Vellus hairs	2 (9)
Peripilar sign	1 (4.5)
Dystrophic hair roots	1 (4.5)
White dots	1 (4.5)
Broken hairs	1 (4.5)
Coiled hairs	1 (4.5)

get-like pattern [2, 3, 9, 10]. The location of the alopecic patch corresponded to the area that received radiation during the endovascular procedure (Fig. 3). The time from the procedure to the onset of alopecia (Fig. 4) ranged between 1 and 8 weeks, with an average of 2 weeks. The radiation dose reached was not reported consistently, recorded doses ranged from a peak single dose of 2.9 Gy [10] to a cumulative dose of 18.46 Gy in one of our cases (Table 1, Guerrero-Putz et al. [present study] case 1).

Alopecia areata (AA) is one of the most important differential diagnoses in this clinical setting. Trichoscopic characteristics are similar between both entities. Wąskił et al. [11] performed a systematic review in 2018 to up-

Fig. 3. Shape of alopecic patch.

Fig. 4. Onset of alopecia after neurointerventional radiation.

date trichoscopic findings in AA, the most frequent trichoscopic features were the following, in order of frequency: yellow dots, black dots, exclamation mark hairs, tapered hairs, broken hairs, short vellus hairs, upright regrowing hairs, and Pohl-Pinkus constrictions. In patients presenting anagen effluvium after neurointerventional radiation, we found that the most frequent features are similar to those found in AA, being yellow dots and black dots the most frequent, followed by short vellus hairs. An important feature of AA that has not been reported in radiation-induced temporary alopecia is exclamation mark hairs, which could be a specific marker for the differential diagnosis.

Histopathology findings have been reported in few cases. Histopathology features include increased numbers of catagen and telogen hairs without perifollicular infiltration, with no peribulbar inflammatory cell infiltrate [3, 10]. Medical history in patients with radiation-induced temporary alopecia often shows that they are undergoing stressful situations and induce doctors to think to “stress induced” AA.

Patients usually do not require treatment, it is important to reassure them that hair regrowth will occur, topical 5% minoxidil BID and intralesional triamcinolone have been utilized [2, 10]. Hair regrowth onset ranges from 2 to 24 weeks after the procedure [5–8, 12–14] up until 12 months after [9].

Conclusion

Hair loss is a known side effect of radiation treatments such as radiotherapy and endovascular procedures. High doses of ionizing radiation, as used for radiotherapy, cause scarring alopecia due to stem cell damage [15]. Low

doses as utilized in neurointerventional procedures cause temporary alopecia due to anagen effluvium.

As dermatologists, it is important to think of radiation-induced temporary alopecia in patients who develop patchy hair loss after neurointerventional procedures. Physicians that perform such procedures should be able to anticipate these outcomes among other complications associated with radiation injury and monitor patients throughout the treatment course [16]. Further research including trichoscopic features may help in making the correct diagnosis in a timely manner, avoiding unnecessary treatment as well as to provide a prognosis.

Statement of Ethics

Written informed consent was obtained from the patient for publication of any accompanying images.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Dr. Guerrero-Putz and Dr. Garza-Rodriguez contributed to the design, drafting of the work, and interpretation of data. Dr. Flores-Dominguez contributed to data analysis and interpretation of data. Dr. Tosti contributed to drafting the work and design. Dr. Castillo-de la Garza contributed to literature and data analysis. Dr. Figueroa-Sanchez contributed to drafting of the work and interpretation of data.

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