Eczematous Dermatitis Occurring on a Café-au-Lait Spot Long after Laser Radiation

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Key Words
Atrophic sebocytes · Café-au-lait spot · Eczematous dermatitis · Histopathology · Laser · Neurogenic inflammation · Recall dermatitis · Sebaceous gland

Abstract
A 40-year-old woman presented with an itchy erythematous change of a café-au-lait spot in her face. The onset of this change occurred just after her relocation. The café-au-lait spot had been irradiated by laser approximately 20 years ago. Clinically, there was a coin-sized erythema with a slight scale on the pigmented lesion in the left lateral orbital region. Histopathologically, the lesion demonstrated both spongiotic dermatitis and interface dermatitis together with lymphohistiocytic cell infiltration, in addition to moderate acanthosis and elongation of rete ridges with slight basal hyperpigmentation. From these clinical and histopathological findings, the lesion was diagnosed as eczematous dermatitis occurring on the café-au-lait spot after laser radiation. Another interesting histopathological finding was that some parts of a lobule of the sebaceous gland were occupied exclusively by degenerative atrophic sebocytes. From the viewpoint of pathogenesis, the eczematous dermatitis of this patient could have been an accompanying feature of a neurogenic inflammation occurring on the café-au-lait spot after laser radiation, and the atrophic change of a part of the sebaceous lobule might have been induced by a morphogenetic alteration of certain germinative cells of the sebaceous lobule due to laser radiation.

Introduction

It is approximately 50 years that lasers have been used in the dermatologic field. Clinically, the side effects of lasers on the skin include blistering, fine epidermal crusting and erosion, resulting from epidermal injury in the early stage after laser radiation. In the late
stage, hyperpigmentation, hypopigmentation, scar or keloid formation may occur. This report describes peculiar clinical and histopathological findings of eczematous dermatitis occurring on a café-au-lait spot long after laser radiation.

Case Presentation

On August 7, 2006, a 40-year-old woman with an itchy erythemosquamous lesion in her left lateral orbital region presented to my clinic. The lesion was a congenital, coin-sized, pigmented macule that had never been treated before. At the age of about 20, her pigmented lesion was treated with laser. Although the pigmentation of the lesion disappeared after laser radiation, it recurred slightly after some time. Thereafter, the pigmentation remained unchanged without any treatment. The patient moved from Tokyo to Niimi City, Okayama Prefecture, in July 2006. Immediately after her relocation, an erythemosquamous change on her pigmented lesion occurred.

Clinical Findings

There was erythema with a slight scale on roundish, sharply defined, light brown macule sized approximately 3 × 3 cm in the left lateral orbital region. The lesion was slightly infiltrated.

Histopathological Findings

A specimen was obtained from the lesion by biopsy. In the epidermis, there were relatively thick, confluent parakeratosis, moderate acanthosis, irregularly elongated rete ridges of uneven width, mild focal spongiosis and focal liquefaction degeneration of basal cells. Exocytosis of lymphocytes and histiocytes was observed. The basal layer was slightly hyperpigmented. There was moderate lymphohistiocytic infiltration from the dermal-epidermal junction to the papillary dermis. In the subpapillary and superficial reticular dermis, slight to moderate perivascular lymphohistiocytic infiltration was seen. Melanophages were scattered from the papillary dermis to the superficial reticular dermis. The histopathological findings of these inflammatory skin reactions were applicable to spongiotic dermatitis and interface dermatitis together with lymphohistiocytic cell infiltration (fig. 1).

As for cutaneous appendages, the pilosebaceous apparatus was normal in number and distribution. In the sebaceous glands, one of the sebaceous lobules had sharply defined, circumscribed parts, which were occupied exclusively by small-sized sebocytes (fig. 2, fig. 3). Their size was reduced to almost half or one-third of the size of normal sebocytes. Some of their nuclei were compressed peripherally in the cell body and pyknosis, and the cytoplasm was scanty. In a word, these small-sized sebocytes were degenerative atrophic ones. None of the sebocytes, including the atrophic ones, did show atypia. There was slight lymphohistiocytic infiltration in the periannexal dermis.

In some of the hair follicles, the lowermost portions had inflammatory cell infiltration of lymphocytes and histiocytes, in which a small number of eosinophilic degenerative follicular keratinocytes were present.
Discussion

Café-au-lait spots are one form of pigmented skin disease, which is treated with laser. From the mid-1980s to the early 1990s, the period during which our case received laser therapy, ruby laser was available in Japan for the treatment of pigmented skin lesions such as café-au-lait spots, nevus cell nevus, nevus of Ota, etc. [1].

The present case showed that eczematous dermatitis occurred restrictedly on a café-au-lait spot of the facial skin that was irradiated with laser. This fact may suggest that laser radiation participates in the occurrence of such an eczematous tissue reaction because, to my knowledge, there are no descriptions of eczematous dermatitis developing spontaneously and exclusively on a café-au-lait spot. The histopathological features of this case showed both spongiotic dermatitis and interface dermatitis. Spongiotic dermatitis and interface dermatitis include a variety of skin diseases, each of which is quite different etiologically and pathogenetically [2, 3]. In the present case, the onset of eczematous dermatitis was just after the patient had travelled the long distance from Tokyo to her new residence in Niimi; it may thus be presumed that she must have endured a strong physiological and psychological stress. In fact, cutaneous neurogenic inflammation can be induced by endogenous trigger factors such as stress, neurotransmitters, etc. [4]. However, there are no descriptions showing that neurogenic inflammation is liable to occur in certain portions irradiated by laser. Nonetheless, taking the clinical observations of this case into account it is possible that there was an unknown pathogenesis between the occurrence of neurogenic inflammation and laser radiation. While there is a paper that describes the development of a chemotherap- py-induced recall reaction (recall dermatitis) in a laser-induced wound [5], the recall phenomenon in the laser-irradiated café-au-lait spot in the face of the present patient may have been induced by psychosomatic factors.

In the case presented here, another interesting histopathological feature was the appearance of atrophic parts in a lobule. These parts were composed exclusively of massive degenerative atrophic sebocytes. In contrast to normally differentiated sebocytes, which have a centrally situated, crenated nucleus and a delicate network of fine cytoplasmic vacuoles, these atrophic sebocytes showed a peripherally located pyknotic nucleus and scanty cytoplasm. To my knowledge, there are no descriptions of such peculiar histopathological findings in sebocytes. Possibly, these histopathological features did not merely indicate massive degenerative atrophy of the sebocytes but rather showed laser-induced alteration in the process of morphogenesis of the sebocytes, because the atrophic sebocytes were present only in the circumscribed areas of the same lobule and not in the normal parts of the lobule. All sebocytes derive from basement membrane-bound germinative cells in the sebaceous lobules, from which arises the inner zone of the lipid-laden vacuolated cells [6, 7]. These germinative cells are analogous to basal cells of the epidermis, matrix cells of a follicular bulb and cells of a nail matrix [8]. They consist of stem cells and transient amplifying cells. In general, the biological action of lasers is attributable to photothermal, photochemical and photoacoustic effects, of which the photothermal effect plays a crucial role [9]. It has also been considered that visible light of a long wavelength has no influence on DNA, because visible light is hardly absorbed by nucleic acid [10]. However, according to recent descriptions, it has been shown that visible light can induce indirect DNA damage through the generation of reactive oxygen species [11]. The optical penetration depth of the ruby laser (approx. 50%) is considerably deeper than the existing portion of the pilosebaceous apparatus. This suggests that only the DNA of certain germinative cells in the lobule is damaged by laser radiation, resulting in the aggregation of atrophic sebocytes in the same lobule. In any event, there may be the possibility that the appearance of the circumscribed
areas of massive degenerative atrophic sebocytes in the same lobule express alteration in the morphogenetic process of the sebocytes, which is caused by laser radiation.

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**Fig. 1.** Histopathology of eczematous dermatitis. The image shows spongiotic dermatitis and interface dermatitis together with lymphohistiocytic cell infiltration. HE stain. Original magnification ×50.
Fig. 2. Histopathology of sebaceous glands. There are two atrophic parts (A1 and A2) in a lobule. N indicates the normal part of the lobule. HE stain. Original magnification ×100.

Fig. 3. Magnification of figure 2. There are the two parts of the lobule (A1 and A2), which are composed exclusively of degenerative atrophic sebocytes. Some of their nuclei are compressed peripherally in the cell body and pyknosis, and their cytoplasm is scanty. In contrast to these atrophic sebocytes, the normal sebocytes (N) (upper right corner of the image) have a centrally situated, crenated nucleus and a delicate network of fine cytoplasmic vacuoles. HE stain. Original magnification ×200.