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**Solar urticaria with a wide action spectrum from UVB to visible light complicated with
UVA-induced polymorphous light eruption**

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Running Head: Solar Urticaria with PLE

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Dear Editor,

Solar urticaria and polymorphous light eruption (PLE) are acquired idiopathic photosensitivity disorders, but each phenomenon is extremely different; one is an immediate reaction, and one is a delayed-type reaction. Phototesting is necessary not only for the diagnosis of these photosensitivity disorders but also for the determination of the action spectrum so that the patient can try to avoid the triggering wavelengths in ordinary life. Solar urticaria is unique in that the particular spectra that inhibit or enhance the reactions by action spectra are present in some cases. In contrast, with PLE,

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phototesting is difficult, because a single or even repeated exposure of ultraviolet light or visible light sometimes fails to provoke the reaction. Here, we report a case of solar urticaria complicated with PLE. Solar urticaria with an action spectrum ranging from UVB to visible light was diagnosed by clinical presentation, phototesting and intradermal injections of photo-irradiated autologous serum. PLE induced by UVA was diagnosed by clinical presentation and phototesting.

A 60-year-old man experienced erythematous skin eruptions on sun-exposed areas immediately after exposure to sunlight while riding a bicycle. The eruptions disappeared within 1 hour. The next day, he went fishing in the sun and experienced pruritic erythema and swelling on the face and dorsal surface of the hands, ~~which~~. The swelling improved within a few hours but erythema persisted until the following day. He is otherwise healthy and takes no medications. There were no abnormal laboratory findings, including antinuclear antibody and porphyria profiles. Photoprovocation tests were performed with a sunlamp (Philips Ultra Violet-B TL 20W-12) for UVB, a black light (Torex FL 20S, BL-BMR) for UVA and a slide projector (160W, Cabin Kogyo Co) for visible light. A single exposure to 3.0 J/cm² of UVA (Fig. 1a), 8.7 mJ/cm² of UVB (Fig. 1b), or ~~10 minutes of~~ visible light (Fig. 1c) at the target distance of 15 cm for 15 min induced erythema or wheal immediately after exposure. Erythema was observed in a visible light-irradiated area with a Y-50 cutoff filter (Fig. 1d), but not with a Y51 filter (Fig. 1e), indicating that the action spectrum in the visible light wavelengths

was shorter than 500 nm. Skin reactions provoked by UVB and visible light faded within 45 minutes, but those provoked by UVA persisted for 30 hours (Fig. 2a-c). Histological examination of the skin reaction 30 hours after UVA irradiation revealed spongiosis and dense perivascular mononuclear cell infiltrations (Fig. 2d), compatible to polymorphous light eruption. Inhibitory and augmentation spectra were not observed. Next, the serum of the patient was examined for the presence of chromophore to induce urticaria. An aliquot of serum was exposed *in vitro* to 1.5 J/cm² of UVA, 104 mJ/cm² of UVB, or 5 minutes of visible light alone or with an R60 cutoff filter. 0.1 ml of the exposed and nonexposed sera were injected intradermally into the patient's flexor forearm. UVA, UVB or visible light alone but not visible light with the R60 filter or unexposed sera produced urticaria (Fig. 1f). All of the positive reactions disappeared within 40 minutes. Thus, we diagnosed the patient with solar urticaria with a wide-ranging action spectrum, UVB to 500 nm visible light, complicated with PLE induced by UVA radiation. Strict avoidance of sunlight, and daily use of photoprotective clothing and a broad spectrum sunscreen, and treatment with 5mg/day of olopatadine and 2mg/day of d-chlorpheniramine maleate, prevented photosensitivity reactions.

The action spectra of solar urticaria vary by study. Wide-ranging action spectra from UVB to visible light, as in our case, are not common, 0% (0/19 cases in Singapore¹) to 20.2% (17/87 in Scotland²). In our previous report of 40 Japanese patients with solar urticaria, only 4 patients had

wide-ranging action spectra from UVB to visible light³. Solar urticaria occurs immediately after exposure to sunlight and artificial radiation, with erythema and wheal for a short duration, similar to other forms of urticaria. On the other hand, a delayed-onset or a long-lasting reaction of solar urticaria has been reported as a rare case. Ihm⁴ reported a case of solar urticaria showing wheals that appeared 2-3 hours after irradiation and faded after 24-48 hours. Ghigliotti et al⁵ reported a case of persistent solar urticaria, which was elicited 4 hours after UVA irradiation and persisted for 28 hours. Wheal formation by action spectra in some cases of solar urticaria is inhibited by irradiation with other wavelengths of irradiation, usually longer wavelengths than those of the action spectra. This is a so-called inhibitory spectrum, which may be associated with a long latent time after irradiation of action spectra. Our case had no inhibitory spectra and showed immediate reactions after UVB, UVA, or visible light. On the other hand, our case is similar to these two cases, in that the induced eruption persisted for more than 24 hours. Furthermore, the patient had pruritic eruptions lasting until the next day after sunlight exposure. There are several possible interpretations for such a long-lasting reaction in phototesting, including a subtype of solar urticaria, persistent solar urticaria, and the complication of solar urticaria with a delayed-type photosensitivity disorder. In our case, a long-lasting reaction was observed in the skin site exposed to UVA radiation but not in an intradermal site of injection of pre-exposed serum to UVA. This indicates the presence of two types of photo-induced reactions.

Since other delayed type photosensitivity disorders, such as photocontact dermatitis, drug-induced disorders, collagen disease and porphyria, were excluded, the patient was diagnosed with PLE.

Solar urticaria has been reported to be associated with other photodermatoses, including polymorphous light eruption², chronic actinic dermatitis⁶, and porphyria cutanea tarda⁷. While the occurrence of solar urticaria and polymorphous light eruption was not reported as rare by Beattie *et al*², as an incidence of 23% in 87 patients, there have been few reports of both photosensitivity disorders confirmed by phototesting and supported by histological findings of PLE. Recently, a case of delayed-onset solar urticaria was reported in which UVB induced a delayed onset of wheals not only at the irradiated site but also at covered body sites⁸. This case was complicated UVA-induced PLE confirmed by phototesting and skin biopsy. Patel *et al*⁹ reported a case of UVB-induced solar urticaria complicated with PLE that appeared on the provocation site of solar urticaria, as in our case. In our case, dissociation of UVA radiation results in phototesting and intradermal injection tests suggests that two different chromophores produced by UVA irradiation are involved an immediate reaction and a delayed-type reaction.

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LEGENDS

Figure 1. Immediate reaction to (a) 3.0 J/cm² of UVA, (b) 8.7 mJ/cm² of UVB, and visible light for 15 minutes exposure at a targeted distance of 15 cm (c) alone, (d) with a Y50 cutoff filter or (e) with a Y51 cutoff filter. (f) Skin reaction to intradermal injection of in vitro irradiation of patient's sera by UVA, UVB, visible light alone, visible light with the R60 cutoff filter, or no treatment

Figure 2. 3.0 J/cm² of UVA-induced skin reaction (a) 10 minutes, (b) 6 hours, and (c) 30 hours after irradiation. (d) Histological findings of UVA-induced erythema 30 hours after irradiation.



