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COMPARATIVE TREATMENT OF PSORIASIS WITH UV-LIGHT, TRIOXSALEN PLUS UV-LIGHT, AND COAL TAR PLUS UV-LIGHT

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Abstract. Areas within psoriasis plaques have been treated with UV-light alone, trioxsalen plus UV-light, and coal tar (liquid carbonis detergens) plus UV-light, using the 313, 365 and 405 nm wavelength bands in various doses. With the 313 nm band, the same degree of healing was obtained with all three types of treatment. With the 365 nm band, no healing was achieved with UV-light alone, but healing did occur with UV-light when the skin was sensitized with trioxsalen. Coal tar itself has a certain healing effect on psoriasis but the effect is so markedly enhanced by light of the 365 nm band that the healing is comparable to that obtained with the 313 nm band. No healing was seen with light of the 405 nm band. The patients who were healed with the 313 nm band alone, also healed with trioxsalen or coal tar plus UV-light of the 365 nm band. With each method there is an individual optimal light dose of 1–2 MED that gives healing.

Key words: UV-light; UV-treatment; Trioxsalen; Coal tar; Psoriasis

Sunlight has long been known to have a favourable effect on psoriasis. Better results with UV-light treatment were obtained after 1925 when Goeckerman (17) described his method of enhancing the effect of UV-light by photosensitizing the skin with a coal tar ointment. The photosensitizing principle has also been tried, successfully, by using oral tryptaflavin (29) and sulfa (8, 40). Psoralens plus UV-light have been shown to heal psoriasis when used either orally (3, 27, 30, 37, 45) or locally (24, 39, 42, 43, 44).

In spite of positive reports on the use of sunlight or artificial UV-light (2, 6, 23, 33, 36, 41), as well as in combination with coal tar (17, 18, 19, 25, 32, 34), the value of the UV-light part of these treatments has long been under dispute (7, 8, 14, 20, 22, 47). In this investigation, a comparison has been made of the effects of UV-light alone, trioxsalen plus UV-light, and of coal tar plus UV-light.

MATERIAL AND METHODS

Thirteen patients having widespread psoriasis for at least 3 years participated in the studies. Nine of them gave a history of improvement from exposure to sunlight and 2 of them had an intolerance to it. The remaining 2 were uncertain about their response. Complete irradiation series were not possible with all patients and 3 of them had only one or two treatment forms with some of the wavelength bands.

This investigation was made parallel with one on treatment with only UV-light (11) where details about the tests and evaluations are described. The lamp equipment was that developed by Alsins et al. (1) and, in this experiment, lamps with the 313, 365 and 405 nm wavelength bands were used.

One hour before each irradiation, the test areas were sensitized to light by applying with a cotton swab either a solution of 0.05% trioxsalen (4,5,8-trimethyl-psoralen; Trisoralen®—Paul B. Elder Co., USA) dissolved in 70% alcohol, or coal tar extract (liquid carbonis detergens).

The daily light doses on the psoriasis test areas are given in Table I. Untreated, as well as daily trioxsalen- or coal-tar-treated, but non-irradiated, psoriasis areas were used as controls. All the test areas were protected by double layers of clothing between treatments.

Light tests

The MED (minimal erythemal dose) was evaluated according to a method described by Alsins et al. (1) and was determined on apparently normal dorsal skin. The erythema threshold at 24 hours with the 313 nm band was the same with and without trioxsalen pretreatment and no accentuation of the trioxsalen-pretreated areas could be noted at 48–72 hours.

Skin pretreated with coal tar extract and then irradiated one hour later with the 313 nm band had a 30–50% higher erythema threshold than that without pretreatment. Here, the tar preparation obviously served as a light

Table 1. *Daily UV-light doses used on psoriatic areas*

Band	Pretreatment		
	None	Trioxsalen	Coal tar extract
313 nm	½, 1, 2 MED	1, 2 MED	1, 2 MED
365 nm	30 J/cm²	1, 2 MED	10, 20 J/cm²
405 nm	30 J/cm²	10-20 J/cm²	10, 20 J/cm²

filter. The MED without pretreatment was used as the basis for all light doses with the 313 nm band. The 48–72 hour MED with trioxsalen and the 365 nm band served as the basis for that light dosage.

RESULTS

The mean degrees of healing with the various treatments are illustrated in Fig. 1. The results can be summarized as follows.

313 nm band

UV-light of the 313 nm band healed 10 of the 13 patients with psoriasis. Trioxsalen pretreatment did not enhance the healing and pigmentation pattern of the psoriatic skin. Pretreatment with the coal tar extract gave a healing effect with the 313 nm band that was about the same as that with light only. Pigmentation was equal in the three treatment types.

365 nm band

UV-light from the 365 nm band without a photosensitizer does not heal psoriasis. Irradiation with the 365 nm band after trioxsalen pretreatment healed psoriatic lesions in 10 of the 12 treated cases. Both 1 and 2 MED had the same good effect. An erythema, together with a slight edema, appeared after 5–7 days' treatment and persisted about 1–2 weeks in 7 of the patients. It was often more noticeable than when using the 313 nm band. The healing occurred 1–3 days sooner than with the 313 nm band, but the final results of 3 weeks' treatment were quite comparable.

Of the 13 patients pretreated with coal tar extract and irradiated with the 365 nm band, 7 were healed and 3 nearly healed after 3 weeks. In 8 of these patients, the healing was distinctly better than in the control areas treated with coal tar extract and no light. The irritation following coal tar pretreatment and light of the 365 nm band was less pronounced than that seen with either light of the 313 nm band alone or with trioxsalen plus the 365 nm band. A smarting pain, regularly appearing with the 405 nm band, could also be noted when using high intensities of the 365 nm band.

The patients who healed with coal tar extract or trioxsalen pretreatment plus UV-light of the 365 nm band were identical with those healing with light of the 313 nm band alone.

A marked pigmentation was often seen, especially on trioxsalen-treated skin. After coal tar extract pretreatment, the pigmentation was somewhat more marked than that occurring after irradiation with only the 365 nm band.

405 nm band

The healing with this band on pretreated skin was no better than that of the non-irradiated control areas. A slight, late pigmentation appeared at the end of the third week in some cases with the psora-

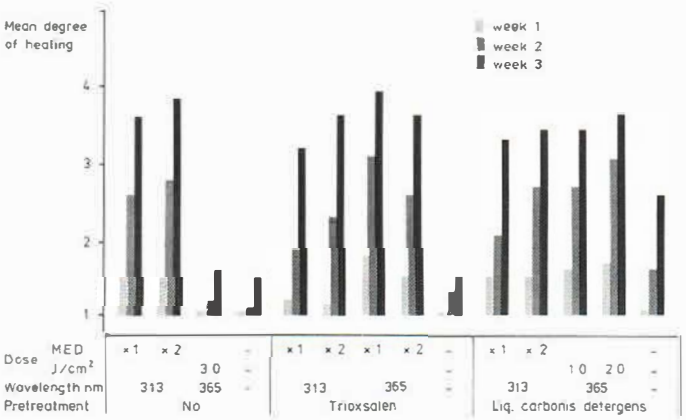

Fig. 1. Mean degree of healing in relation to wavelength, light dosage, and type of pretreatment during 3 consecutive treatment weeks. Judgment of healing: 0= worse, 1=unchanged, 2=slight healing, 3= marked healing, 4=nearly healed, and 5= healed.

len or coal tar pretreatment. With the coal tar extract pretreatment, the patients often experienced a prickling pain in the skin after 1–2 minutes of irradiation with 80–100 mW/cm² and the effect tolerated was often not more than 60–80 mW/cm². The immediate erythema in these cases was very pronounced but the late erythema was slight or non-existent.

Control areas

A slight healing was noted in both the untreated and the trioxsalen pretreated but non-irradiated control areas. There was no difference between these control areas.

Coal tar extract itself, without irradiation, obviously has a slight healing effect on psoriasis. In those control areas so treated, but without light, 10 of the 13 patients obtained a healing that was slightly better than in the untreated control areas.

DISCUSSION

The coal tar extract used has a certain light-filter effect (9, 16). It, by itself, also has a certain healing effect on psoriasis. The healing effect of the combined pretreatment with coal tar and the irradiation with the 313 nm band was about the same as with light alone and no pretreatment. All these factors together make probable the assumption that coal tar sensitization does not potentiate the healing properties of the 313 nm UV-light.

The action spectrum for erythema with coal tar and UV-light is questioned, but there is agreement about erythema effects occurring, at least between 330 and 450 nm (5, 15). Goeckermann (18) was not convinced that the photosensitizing action accounted for the psoriasis-healing properties of coal tar and UV-light.

A good healing of psoriasis occurred with the combined treatment of coal tar extract and the 365 nm band. Light of the 405 nm band on skin pretreated with coal tar extract provoked a moderate immediate erythema but gave no better healing than the extract itself without irradiation. As photosensitization from coal tar results from several of its compounds, the photosensitizing action in the 365 nm region may have the same origin as the psoriasis-healing one. In the 405 nm region, however, the erythema may be provoked by a photosensitizer that has no psoriasis-healing properties.

Hot quartz mercury lamps do not emit much longwave UV-light (9, 10, 13, 25, 38). The energy needed to obtain a therapeutic effect from coal tar baths and longwave UV-light is at least 3–5 J/cm² and the irradiation times needed with a very good, glass-filtered mercury lamp in order to reach this level is between ½ and 1 hour.

Ellis et al. (7) did not find any increase in the psoriasis-healing potential from UV-light after painting with coal tar extract. This was probably due in part to the short period (5 min) between the painting and irradiation and partly to the too-small doses of longwave UV-light. Light doses given were the MED of a non-glass-filtered mercury lamp. The erythema results from shortwave UV-light and the longwave UV-light given this way is insufficient, with coal tar, to heal psoriasis.

Bowers et al. (4) did not find any significant effect from coal tar baths and glass-filtered UV-light. This was also probably due to suboptimal light treatment. In their experiments, they used UV-light from medium-pressure mercury lamps and they concluded that glass-filtering this light gave neither erythema nor a psoriasis-healing effect. Young (47) also used too small light doses. The present investigation does verify his findings that psoriasis is healed by coal tar extract without longwave UV-light; however, contrary to his investigations, it also shows that the healing is far better in most patients when the coal tar treatment is combined with UV-light of the 365 nm band. Probably the healing effect of coal tar without irradiation operates according to a different principle than does coal tar extract plus longwave UV-light. An interesting exception to the usual healing from UV-light was the reaction of a light-sensitive patient who failed to heal with either light of the 313 nm band or coal tar plus 365 nm band light, but who obtained good healing from coal tar alone and coal tar plus the 405 nm band light.

The mode of application of coal tar, as well as the time interval between the application and the irradiation dose needed to heal psoriasis, are important. Crude coal tar has to be removed thoroughly before irradiation.

Frank (16) showed a definite UV-light filter effect with various preparations of coal tar. He also found that the different solvents gave different photosensitizing effects. Kaidbey & Kligman (21) incorporated coal tar in various ointment bases and found that the photosensitizing effect differed widely. In some of our experiments, coal tar extract diluted 1 000 times in a bath has been shown to

give a sensitization about five times stronger than with any other means of application. This finding was the basis for the very effective bath application of trioxsalen already reported (12).

A smarting pain from coal tar and UV-light (5, 46) appears after painting with the coal tar extract and irradiation with the 365 or the 405 nm band. It is most pronounced with the 405 nm band and has a different quality from the pain occurring from high intensities of light alone (1). The pain is probably the result of a photoreaction with a uridine (15).

The first reaction seen in the psoriasis plaque after irradiation is an accentuation of the erythema and a slight edema. This reaction is maximal after 2–4 days when using the 313 nm band or coal tar plus the 365 nm band; however, when using trioxsalen and the 365 nm band, the erythema and edema reaction intensify during the first 5–8 days. If the patient belongs to the group that heals from light, there is a drying and thinning of the plaques with successive clearing and pigmentation of the lesions during the following days of treatment. With psoralen pretreatment and irradiation with the 365 nm band, the inflammatory reaction is more exudative and, in the later stages, more crustaceous than that from light alone. The injury seems to have a deeper quality and this may be related to the deeper penetration of longwave UV-light rather than with the 313 nm band.

Longwave UV-light does not by itself heal psoriasis. The action spectrum for cutaneous photosensitization with trioxsalen has its maximal effectiveness between 330 and 370 nm (26, 31). This report, as well as some earlier reports, confirms the effectiveness of local psoralens and longwave UV-light in healing psoriasis. Light from the 334 plus 365 nm bands was tried on trioxsalen-sensitized skin in 5 patients and was found to be as effective in healing psoriasis as the 365 nm band, but light from the 405 nm band was ineffective. It seems obvious that the psoriasis-healing wavelengths of UV-light on trioxsalen-sensitized skin end between 370 and 405 nm.

The erythema threshold has been shown to be a good guide to the light dosage with the 313 nm band (11). This also holds true for longwave UV-light given after psoralen pretreatment. There is a rather large variation in the erythema threshold for the patients when using trioxsalen and the 365 nm band (0.4–4 J/cm²). The range between the erythema effect and blistering is narrower with psoralen plus the 365 nm band than it is with the 313 nm band alone. There is also a stronger cumulative effect with each additional day of treatment with psoralen plus the 365 nm band than with just the 313 nm band (13). Thus, it is important to evaluate the MED of the individual patient before trioxsalen–black light treatment is started. If the light doses are too low, several treatment days will be lost before the erythema level is reached. If too high doses are permitted, severe erythema, edema and even blisters may be produced.

Using the sun as an UV-light source, the irradiation times needed to give healing are not very long when the skin has been sensitized with local painting of trioxsalen solution. The Swedish sun on a clear summer day (at sea level) has a longwave UV-light output of about 3 mW/cm² (35). With this effect erythema will arise in normal but pallid, trioxsalen-sensitized skin with an exposure of only 5 minutes. A 10-minute exposure is often enough to provoke severe blistering.

The late pigmentation with trioxsalen and UV-light of the 365 nm band is very marked and contrary to irradiation with light only, a slight late pigmentation also occurred in some patients with trioxsalen and the 405 nm band. Coal tar extract stimulated pigmentation with the 365 nm band and, in some cases, also with the 405 nm band.

No certain parallelism between pigmentation and psoriasis healing could be noted. Thus, the melanization itself probably has no healing effect on psoriasis, as has been proposed (28).

Those patients who healed with light of the 313 nm band only, were also those who healed with light sensitization and UV-light of the 365 nm band and it follows from this that, if a patient is sensitive to one form of light treatment, he will also be sensitive to the others. It is, however, very important to give a correct dosage of light according to the patient's degree of sensitivity. If the "strength" of the treatment is too low, no healing will occur, whereas if too "strong" a treatment is given, the skin will be very irritated, resulting in an isomorphic reaction.

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