Crude Coal Tar and Ultraviolet (UV) A radiation (Modified Goeckerman Technique) in Treatment of Psoriasis

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ABSTRACT Psoriasis is a chronic inflammatory dermatosis that has a substantial impact on the quality of life. Goeckerman's technique (GT) has been implemented for the treatment of psoriasis with high clearance rates and long periods of remission. The objective of this article was to evaluate the efficacy and safety of modified GT (crude coal tar 2.5% plus UVA) as an alternative therapeutic modality for psoriatic patients with skin types III-V. Twenty two patients with moderate, severe, and erythrodermic psoriasis were included in this study. All patients received modified GT (crude coal tar 2.5% plus UVA) six days per week for a period of 3 months. Assessment of the rate of reduction of psoriasis area severity index (PASI) was performed, as well as photographic documentation of each patient at baseline and after completion of therapy. There was a significant reduction in PASI scores after therapy in all patients (P=0.001). The rate of PASI reduction after therapy was >50% in 63.6% of patients; 27.3% of patients achieved >75% reduction and 9.1% of patients achieved 26-50% reduction. No serious side effects were reported in any of the patients. Modified GT is a safe and effective therapeutic option for patients with moderate and severe psoriasis.

KEY WORDS: psoriasis; modified Goeckerman's technique; efficacy; safety

INTRODUCTION

Psoriasis is a chronic inflammatory dermatosis that affects about 0.6-4.8% of the general population (1). It has a substantial impact on the quality of life which is comparable to that of major medical illnesses such as cancer, diabetes, and heart disease (2).

Currently, there is no treatment available for psoriasis. The current therapeutic approaches are focused only on alleviation of inflammation (3). In 1925, Goeckerman first described the clinical efficacy of UVB radiation combined with coal tar for the treatment of psoriasis, resulting in high clearance rates and long periods of remission (4). Although the use of coal tar has waned in western countries, it is still considered the first-line treatment in many parts of the world (5,6). Coal tar is a proven remedy as evidenced by clinical experience and trials conducted on patients with various skin disorders (7). Currently, it is used mainly for chronic stable plaque psoriasis, scalp psoriasis, seborrheic dermatitis, and atopic dermatitis (8).

The original Goeckerman's technique (GT) for treatment of psoriasis was based on daily application of pharmacy grade coal tar (pix lithanthracis) to the affected skin with subsequent exposure of the body surface to UVB radiation (9).

The mechanism of action of topical coal tar and UVB has not been clearly elucidated. However, there are several possible effects that have been suggested,

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including suppression of DNA synthesis, reduction of epidermal hyperproliferation, modulation of pro-inflammatory cytokines, depletion of T-lymphocytes, and inhibition of angiogenesis (10-12).

Coal tar has a photosensitizing effect within the range of 330 to 550 nm in the UVA and visible light spectrum (8). The current application of GT uses UVB (290-311 nm). The use of UVB is justified, despite being outside the spectrum of coal tar photosensitization, to avoid the possible phototoxic effects of UVA especially in skin types I-II (10).

Several modifications of the use of coal tar followed by UVB radiation have been tried in the treatment of psoriasis with variable degrees of success, before the implementation of narrow-band (NB) UVB which has a wavelength close to the photosensitizing spectrum of crude coal tar (8,25,26,30).

The combination of coal tar and UVA radiation is known for its suppressive effect on DNA synthesis in normal-appearing and proliferating skin in mouse models, that was more extensive compared to the use of coal tar alone (13). This suppression of DNA synthesis has not been observed with either UVB or UVC (14). Although UVA radiation is on that part of the spectrum that activates coal tar, it has not been used because of its potential phototoxic reactions especially in patients with white skin (15).

Accordingly, the current study was conducted to evaluate the efficacy and safety of modified GT (crude coal tar 2.5% plus UVA instead of UVB which was used in the original GT) as an alternative therapeutic modality for psoriatic patients with skin types III-V.

PATIENTS AND METHODS

Patients

This prospective clinical study included 22 patients with moderate, severe, and erythrodermic psoriasis (12 women and 10 men). The study was approved by the Dermatology Research Ethics Committee (REC). Written informed consent was obtained from all patients before conducting the study.

Any previous systemic medication for psoriasis was discontinued for three months before conducting the study, and only topical emollients were allowed.

Patients aged <13 years and >60 years as well as pregnant and lactating women were excluded. All patients were skin types III-V according to Fitzpatrick skin type criteria.

Each patient was subjected to the following: Full history taking (age, sex, medical condition, previous anti-psoriasis therapy) and thorough clinical examination, and psoriasis area severity index (PASI) score evaluation was performed for each patient before and after completion of therapy. Routine investigations (complete blood picture, liver function tests, kidney function tests, blood sugar, and ophthalmologic consultation) were done for each patient.

Methods

Modified Goeckerman technique

All patients recruited in this study were instructed to do the following steps: Take a shower and then apply crude coal tar 2.5% in petrolatum to the whole body except face and genitals for at least 6 hours. Afterwards, the tar was removed using cotton soaked with vegetable oil. Patients were instructed not to remove the whole application and leave traces of tar over their body. This procedure was carefully monitored by a fixed investigator for all patients. After at least 8 hours, each patient was exposed to UVA radiation. These steps were repeated 6 days per week for a period of 3 months. This technique added two modifications to the original GT which are: The application of coal tar for 6 hours only instead of overnight and the usage of UVA radiation instead of UVB.

- UVA irradiation (broad-band UVA: 320-400 nm); Radiation source UVA 1000; Waldman lighting cabin (Germany) equipped with 26 UVA lamps, having a radiation spectrum of 315 nm to 400 nm with a peak at 365 nm; Patients started at a dose of 0.5 J/cm^2; Doses were increased by increments of 20% according to patient response and tolerance.

Patient Assessment

The following grading system was utilized to assess the efficacy of modified GT through the measurement of the PASI reduction rate after completion of therapy: Grade 1: 0-25% reduction (poor); Grade 2: 26-50% reduction (fair); Grade 3: 51-75% reduction (good); Grade 4: >75% reduction (excellent). Photographic documentation was kept for each patient at baseline and at the end of the study.

Side effects

Adverse effects from tar application and/or UVA radiation were recorded during the study period, such as phototoxic reactions (itching, burning, erythema) and side effects of coal tar (local irritation, tar folliculitis, acneiform eruption, phototoxic reaction, and contact allergy).

Follow-up period

All recruited patients were followed up for a period of one year after cessation of therapy to determine the duration of remission and the rate of relapse.

Statistical analysis

Data were statistically described in terms of range, mean ± standard deviation (±SD). Comparison of PASI pre and post treatment was done using Wilcoxon signed-rank test for paired (matched) samples. *P* values less than 0.05 were considered statistically significant. All statistical calculations were done using computer programs Microsoft Excel 2007 (Microsoft Corporation, NY, USA) and SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

RESULTS

Twenty two patients (12 women (54.5%) and 10 men (45.5%)) were included in this study. Their ages ranged between 13-60 years (36.6±14.5). Thirteen patients (59.1%) had erythrodermic psoriasis, 6 (27.3%) had severe psoriasis, and 3 (13.6%) suffered from moderate psoriasis according to the PASI score.

When comparing PASI scores before and after 3 months of modified GT, a significant statistical difference was found in all patients (n=22), where the mean PASI score before treatment was 39.631±19.475 and 14.143±9.673 after treatment (*P*=0.001) (Figure 1). The rate of PASI reduction after therapy was >50% (good response) (Grade 3) in 63.6% (n=14) of the patients, while 27.3% (n=6) of the patients had an excellent response (Grade 4) (>75% reduction) and two patients (9.1%) had fair response (Grade 2) (26-50% reduction) (Figures 1, 2, 3).

The mean value of the cumulative UVA dose received by each patient was 184.71±SD 2.72, throughout the duration of the study.

There were no serious side effects reported in any of the patients, apart from mild irritant dermatitis in two patients and mild folliculitis in another due to tar application.

Follow-up period

Thirteen patients stayed in remission for a period of 8 months and 5 patients stayed in remission for 6 months after cessation of therapy. These patients applied only topical emollients during the remission period. Four patients had a relapse of psoriasis (return of psoriatic lesions to PASI score prior to therapy) within one month of cessation of GT; three of them agreed to repeat GT, while the fourth patient was shifted to another modality.

DISCUSSION

All patients enrolled in this study achieved a statistically significant reduction in PASI score after receiving treatment with a modified Goeckerman technique (UVA instead of BB-UVB combined with topical coal tar 2.5%), and most of our patients had a long remission period ranging from six to eight months.

During the past century, many modifications have been made to the original Goeckerman regimen to make it more practical as outpatient treatment. Data have accumulated both supporting and questioning the efficacy of this approach (16-20). The crude coal tar preparations available today range from 1%-5% in petrolatum, starch, and zinc oxide (21).

In this study, we adopted another modification to the classic GT by using UVA instead of broad band UVB. To our knowledge, this modification has not been reported in the literature. The use of coal tar with near UVA light leads to the suppression of DNA synthesis in normal-appearing and proliferating skin in mouse models, greater than when coal tar is used alone (13). This suppression of DNA synthesis has not been noted with either UVB or UVC treatment (14). Although UVA light contains that part of the spectrum

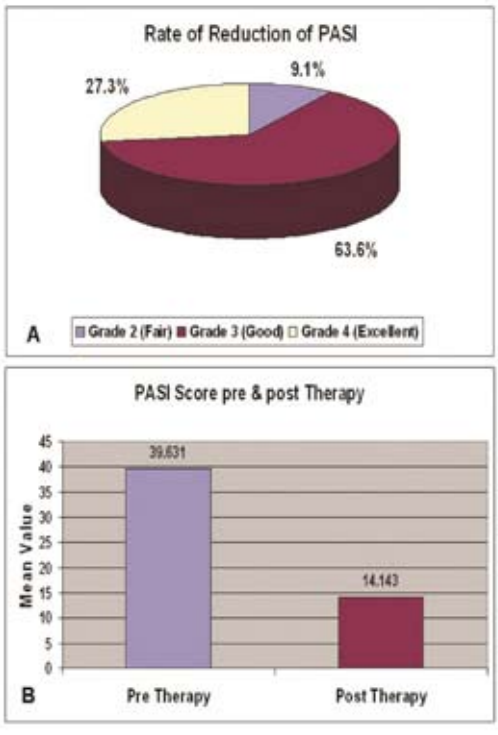

Figure 1. A: Rate of reduction of psoriasis area severity index (PASI) after modified Goeckerman's technique (GT), where 9.1% of patients showed fair response, 63.6% showed good response, and 27.3% showed excellent response. B: Psoriasis area severity index (PASI) score at baseline and 3 months after modified GT, showing significant reduction in all patients (n=22).

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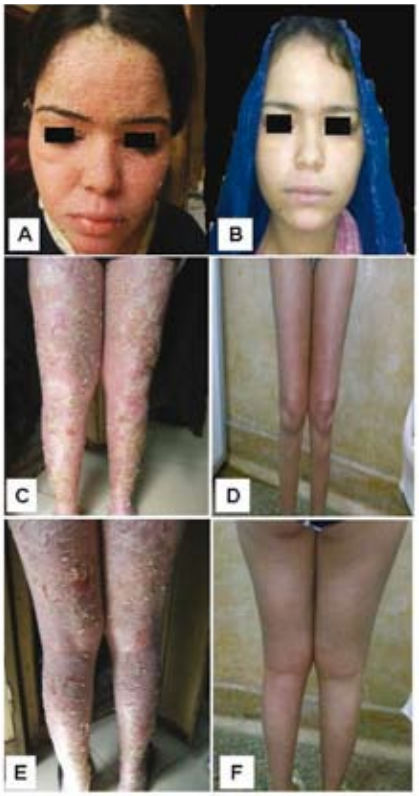

Figure 2. A female patient aged 25 years with erythrodermic psoriasis. A: The face of the patient at baseline with scaly erythematous lesions. B: The face 3 months after modified Goeckerman's technique (GT). C: The anterior view of both lower limbs at baseline. D: The anterior view of both lower limbs 3 months after modified GT. E: The posterior view of both lower limbs at baseline. F: The posterior view of both lower limbs 3 months after modified GT. Photos B, D, and F show an excellent response (Grade 4).

that activates coal tar, it has not been used because of its known phototoxic reactions, especially in patients with white skin (15).

The mechanism of action of topical coal tar is not well understood. However, there are several possible effects including suppression of DNA synthesis leading to a reduction of epidermal hyperproliferation in psoriatic skin (10-12). Conversely, it increases the mitotic rate labeling index and initially thickens the epidermis in healthy skin (21). This variance in activity may be because coal tar is correcting a defect in differentiation in psoriatic skin. In addition, antibacterial, antifungal, and anti-parasitic effects have been described, as well as anti-pruritic and anti-inflammatory effects (8,22). Recently, it has been shown that the number of immunoregulatory T cells (Tregs) increased in psoriatic patients after GT, which is likely associated with amelioration of inflammation by GT (23).

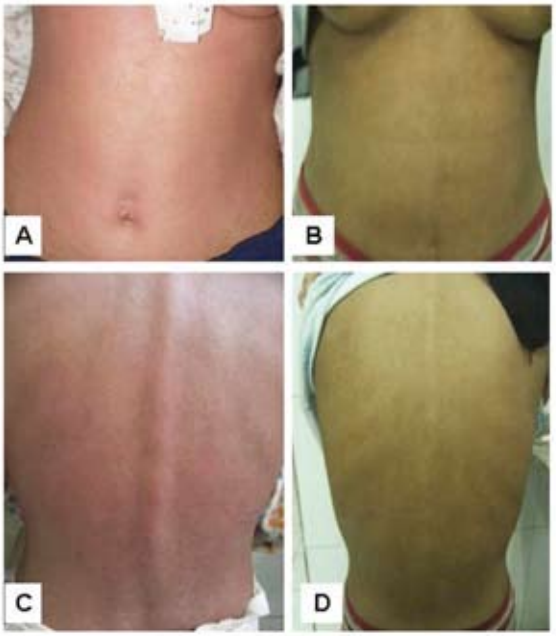

Figure 3. A female patient aged 20 years with erythrodermic psoriasis. A: The anterior view of the trunk at baseline with diffuse erythema and scaling. B: The anterior view of the trunk 3 months after modified Goeckerman's technique (GT). C: The posterior view of the trunk at baseline with diffuse erythema and scaling. D: The posterior view of the trunk 3 months after modified GT. Photos B and D show an excellent response (Grade 4).

The results of the current study show that at the end of 12 weeks, 27.3% of patients achieved PASI 75 (>75% reduction) and 63.6% achieved >50% reduction in their PASI scores after modified GT, which is especially significant considering most of the patients enrolled in this study suffered from severe and erythrodermic psoriasis.

Leon *et al*. reviewed the efficacy and safety of the most scientifically acceptable clinical trials published for psoriasis therapy from 1986 to 2006. The percentage of PASI 75 reduction at week 12 obtained by Goeckerman (classic technique with BB-UVB) therapy and retinoid plus psoralen plus UVA (Re-PUVA) was 100%, compared with 49% and 34% for etanercept 50 mg twice weekly and 25 mg twice weekly respectively, 31.4% for efalizumab, and 21% for alefacept. The authors concluded that the risk-benefit was more favorable for Goeckerman therapy and Re-PUVA. It is noteworthy to mention that GT does not include the use of systemic retinoids used in the Re-PUVA regimen, thus avoiding the possible side effects occurring with systemic retinoid therapy (24).

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In addition, Chern *et al.*, using modified Goeckerman therapy (narrow-band UVB), demonstrated that 56.2% of their patients achieved PASI 75 (>75% reduction) (25). Lee and Koo also used the modified "ultra" Goeckerman therapy with narrow-band UVB, showing that this treatment was effective for psoriasis resistant to both prebiologic therapies, such as cyclosporin, methotrexate, or phototherapy, and biologic treatments. They reported that all their patients (n=25) achieved PASI 75 by week 12 (26).

Two recent clinical trials have demonstrated the efficacy and safety of GT for the treatment of severe generalized psoriasis as well as psoriasis refractory to biologic therapy (27,28).

Remission rates for Goeckerman treatment have been reported to be 1.7-1.8 years (29). One study showed average remission rates of up to 1 year (1). Other studies in the literature reported that Goeckerman therapy induces remission for a minimum of 6-8 months (30,31). This duration is similar to the one achieved in our study (13 patients stayed in remission for 8 months and 5 patients had a remission period of 6 months).

In our study, most of the patients reported resistance to conventional therapeutic modalities (methotrexate, retinoids, and phototherapy) but showed a dramatic response to modified GT (63.6% of the patients achieved >50% reduction of PASI after therapy).

Possible side effects of coal tar include local irritation, tar folliculitis, acneiform eruption, phototoxic reaction, and contact allergy.

In this study, 3 out of 22 patients (13.6%) experienced side effects from tar application in the form of folliculitis and irritant contact dermatitis. Furthermore, none of the patients suffered from phototoxicity from UVA exposure. These results are in contrast to what has been reported in literature about the high risk of phototoxic reactions that occur with UVA exposure (30). The fact that patients who were recruited in this study did not suffer from phototoxic reactions after UVA exposure is probably due to their pigmented skin (skin types III-V). This observation is supported by Hinds and Heald who reported that patients with pigmented skin may achieve maximal levels of light exposure (20-30 minutes of UVA light) and not show phototoxicity (32).

Regarding the cost of different therapeutic modalities for psoriasis, GT is becoming an attractive modality for many patients with moderate to severe psoriasis, being a relatively cost-effective treatment option. In contrast, other options including biologics are quite expensive, lack long-term remission effects, and carry a high risk of serious side effects as a result of immunosuppression (1). These findings are supported by the consensus of the Canadian Psoriasis Expert Panel (33) and the Czech Republic (34) which consider Goeckerman treatment as a first-line therapy for psoriasis because of its low cost and long-term efficacy.

CONCLUSION

Goeckerman therapy is reemerging as a standard therapeutic option for patients with moderate and severe psoriasis. It stands out as a low-cost, safe, and effective modality for a chronic and potentially incapacitating disease. Furthermore, our modification (UVA phototherapy) could offer another safe and effective way of implementing this old technique for treating psoriatic patients with skin types III-V.

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