Original Article

Bilateral Comparison of Liquid Paraffin and Cream Base on Transepidermal Water Loss among Psoriasis Patients: A Randomized Trial

Chutima Churee MSc[1], Sukhum Jiamton MD, PhD[2], Kamol Udol MD, MSc[3], Walaiorn Pratchyapruit MD[4]

[1] Department of Photobiology, Institute of Dermatology, Bangkok, Thailand
[2] Department of Dermatology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand.
[3] Department of Preventive and Social Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand.
[4] Department of Bioengineering, Institute of Dermatology, Bangkok, Thailand

Background: Psoriasis is a common chronic inflammatory disease. Psoriasis lesions have water-holding and show increased transepidermal water loss (TEWL). Patients experience pain, discomfort, and skin dryness or dehydration. Skin moisturizing is a major component of treatment for these patients to maintain the smoothness of the skin and to break the dry-skin cycle.

Objective: To compare the skin moisturizing efficacy of liquid paraffin (LP) with cream base (CB) on TEWL and skin hydration on normal and psoriasis lesions of psoriasis patients.

Materials and Methods: The present study was conducted among 100 participants with Psoriasis Area and Severity Index (PASI) score less than 10. Participants aged 18 years or older who visited the Outpatient Department of Institute of Dermatology were randomly selected to have the substances applied on normal skin and psoriasis lesions twice daily with LP on one side and CB on the other side. TEWL and skin hydration were measured at baseline and after application at the end of the fourth week.

Results: There were 48 females and 52 males, with the mean (SD) age of 45 (13) years and average duration of psoriasis of 12 years. For normal skin, TEWL at the end of 4-week treatment period significantly decreased in areas applied with LP compared to CB (median change from baseline -0.30 g/m^2/hour versus 0.30 g/m^2/hour, respectively, p=0.01). For psoriasis lesions, change of TEWL was not different between the two agents (p=0.22). Regarding skin hydration after four weeks of treatment, there was no statistically significant difference between LP and CB in normal skin (change from baseline of 5.04 AU for LP and 4.20 AU for CB). For psoriasis lesions, skin hydration increased more significant with CB than with LP (change from baseline 4.00 AU for CB versus 2.65 AU for LP, p<0.01).

Conclusion: For the patients with plaque type psoriasis, LP reduced TEWL more than CB in normal skin, but CB increased skin hydration more than LP in psoriasis lesions.

Keywords: Psoriasis, Transepidermal water loss, Skin hydration

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Psoriasis is a common chronic inflammatory disease of the immune system[1] that appears on the skin on arms, legs, trunk, or scalp as thick red scaly patches, papules, or plaques[2]. This condition has a significant negative impact on quality of life such as pain, discomfort, physical disability, or psychological distress as well as social stigma[3]. To date, psoriasis only has therapies that minimize lesions with no permanent cure and interferes with the patient's life. Treatments consist of four main types, phototherapy, topical, systemic, and biologic therapy[4]. Topical treatments such as creams and ointments are the first line treatment in mild psoriasis.

Dry-looking skin in psoriasis is less hydrated and less capable of binding water than in normal skin[5,6]. Moisturizer is usually well tolerated with low side effects, help rehydrate the skin, reduce itching and scaling make patient feels more comfortable. The main function of moisturizers are reducing transepidermal water loss (TEWL), by attracting water to the stratum corneum (SC) and repairing the overall barrier function[7].

There is no report on comparison the efficacy of liquid paraffin (LP) and cream base (CB) on skin of psoriasis patients. In the present study, the authors conducted a randomized trial among patients with

Correspondence to:
Churee C. Department of Photobiology, Institute of Dermatology, Rajavithi Road, Ratchathewi, Bangkok 10400, Thailand.
Phone: +66-86-1069446
Email: chutimatape@gmail.com

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mild plaque psoriasis to compare the clinical outcomes on skin moisturizing efficacy, Psoriasis Area and Severity Index (PASI) score, and EQ-5D-5L of the two moisturizers (LP versus CB) when applied on normal skin and psoriasis lesions.

Materials and Methods

Study population

The 4-week prospective clinical trial was conducted in the Outpatient Department of the Institute of Dermatology, Bangkok, Thailand. The present study was approved by the Institutional Review Board of the Faculty of Medicine Siriraj Hospital, Mahidol University, and of the Institute of Dermatology (IOD), Bangkok, Thailand. The sample size of the present study was calculated based on an α=0.05 and a standard deviation (SD) in the primary end point score of 2.82 assuming from the study of Kattipathanapong et al (citation)[8], in each arm a sample size of 83 participants was required to detect a minimum difference in scores of 0.87 with more than 80% power. Allowing an expected loss-to-follow-up subjects of 10%, a sample size of at least 100 cases was recruited. Eligible subjects recruited in the present study were individuals aged from 18 years up, diagnosed with mild plaque type psoriasis by dermatologist. Those who had chronic diseases such as, liver or kidney diseases or had a history of allergy to LP or CB were excluded. All participants gave written-informed consents before enrolled into the study.

Intervention

In each participant, the author (Churee C) marked one square area of 4×4 cm on normal skin with permanent ink on one side of the body, and made another identical symmetrical mark on another side of the body. In addition, two identical symmetrical marks were done on psoriasis skin in the same manner. Each subject was randomly assigned to apply LP to the marked areas of normal skin and psoriasis lesions on one side of the body, and CB to symmetrical normal skin and psoriasis lesions on other side. The present study interventions consisted of 1) CB (the moisturizer formulating by IOD), which is composed of stearyl alcohol, cetyl alcohol, LP, propylene glycol, sodium lauryl sulfate, methyl paraben, propyl paraben, and DI water qs or, 2) LP, which is composed of saturated hydrocarbons and obtained from petroleum. The medication was applied 0.5 g twice daily in each marked by the participants as assigned for four weeks. All participants were advised to stop any topical treatment and other moisturizers on four areas during the trial. Other medications were still administered at the discretion of the attending dermatologists.

Outcome evaluation

Study outcomes in the present study were TEWL, skin hydration, severity of psoriasis, and quality of life measured by EQ-5D-5L questionnaire. The measurements of both outcomes were performed in normal skin and psoriasis lesions by a trained technician using noninvasive bioengineering methods at baseline and after applying the medication at the end of the fourth week. TEWL, a parameter of the water barrier function of the SC, was measured using close-chamber evaporimeter (Delfin Technologies Ltd., Kuopio, Finland) in the unit of g/m²/hour[7]. Skin hydration was measured using the corneometer® CM 825 (Courage and Khazaka, Cologne, Germany), which measures electrical capacitance of the skin surface expressed in arbitrary units (AU)[9]. Prior to every measurement, subjects rested in the testing room for at least 30 minutes to stabilize temperature (20±2°C) and humidity (50% to 70%). Severity of psoriasis was evaluated using PASI score by a dermatologist at baseline and at the end of the fourth week. PASI score varies from 0 to 72 with higher scores indicating more severe conditions[10]. At baseline and at the end of the fourth week, quality of life was measured using EQ-5D-5L questionnaire (Thai versions), which was evaluated by Pattanaphesaj[11] in 2014 to assess general health status. The respondent was asked to indicate the health state by checking in the box corresponding to the most appropriate statement in each of the five dimensions[11] (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression). Each dimension has five levels, no problems, slight problems, moderate problems, severe problems, and extreme problems.

Statistical analysis

Statistical analyses were performed using SPSS 18 for Windows software (SPSS Inc., Chicago, IL, USA). Means ± SD and median with inter-quartile range (IQR) were used to summarize the data in the present study. Effects of LP and CB on TEWL and skin hydration in normal skin and psoriasis lesions were compared within the same subject using Wilcoxon sign rank test. Comparisons of PASI score and EQ-5D-5L between baseline and at the end of the fourth week were also carried out using Wilcoxon sign rank test. All *p*-values were two-sided, with a *p*-value smaller than 0.05 considered statistically significant.

Table 1. Characteristics of the participants (n = 100)

Characteristics of patients	n (%)
Gender	
Male	52 (52)
Female	48 (48)
Age (years)	
Mean ± SD	45±13
Range (min-max)	18 to 74
Duration of psoriasis (years)	
Mean ± SD	12±9
Range (min, max)	0.5 to 45.0
Fitzpatrick skin type	
III	2 (2)
IV	95 (95)
V	3 (3)
Psoriasis area and severity index (PASI)	
Median (IQR*)	4.5 (3.0, 8.0)
Range (min-max)	0.8 to 10.0
EQ-5D-5L	
Median (IQR*)	0.96 (0.92, 1.00)
Range (min-max)	0.56 to 1.00

* Inter-quartile range (Q1, Q3)

Results

One hundred participants (52% male) with mean age of 45±13 years were included in the final analysis. Demographic characteristics of the participants are shown in Table 1. Average duration of psoriasis prior to enrolling into the present study was 12 years and most of patients (95%) had Fitzpatrick skin type IV. Median (IQR) of PASI score was 4.50 (3.00, 8.03) ranged 0.80 to 10.00 and EQ-5D-5L was 0.96 (0.92, 1.00). PASI score showed statistically significant improvement after four weeks of treatment with median (IQR) PASI score of 4.50 (3.00, 8.03) at baseline versus of 3.70 (2.30, 5.68) at the end of the study, $p<0.0001$. Quality of life as measured using EQ-5D-5L did not show significant change at the end of the study with median (IQR) EQ-5D-5L score at baseline of 0.96 (0.92, 1.00) versus 0.97 (0.93, 1.00) at week 4.

Figure 1 showed changes of TEWL at the end of the study comparing from baseline in normal skin and psoriasis lesions applied by LP and CB. For normal skin, TEWL at the end of 4-week treatment period significantly decreased in areas applied with LP compared to CB (median change from baseline -0.30 g/m²/hour versus 0.30 g/m²/hour respectively, $p=0.011$).

The effect of LP and CB on skin hydration in normal skin and psoriasis lesions are shown in Figure 2. For normal skin, both treatments increased skin hydration after four weeks of treatment (5.04 AU for LP and 4.20 AU for CB), but not statistically significant different between LP and CB. For psoriasis lesions, application with CB increased skin hydration to a statistically significant level at a greater extent than with LP (4.00 AU for CB versus 2.65 AU for LP, $p=0.006$).

Discussion

Comparisons of TEWL (g/m²/hour) change from baseline between areas applied with LP and CB in normal skin and psoriasis lesions

Normal skin: At the end of a 4-week treatment, LP-treated area showed non-significant decrease of TEWL ($p=0.371$) while CB-treated area showed non-significant increase of TEWL ($p=0.155$) when compared to their baseline values. Comparing the mean difference values of pre/post treatment from both areas, the mean difference of CB-treated area was significantly higher than the mean difference of LP-treated area ($p=0.011$), therefore, LP showed better trend of decreasing TEWL than CB. This reflected that the normal skin was highly capable in adapting to any moisturizers (in this case occlusive versus emollient),

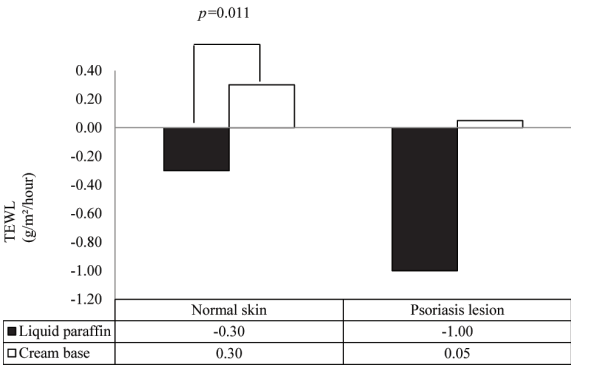

Figure 1. Comparison of TEWL (g/m²/hour) change from baseline between areas applied with LP and CB.

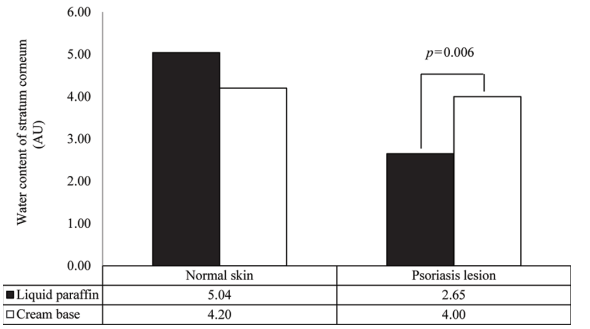

Figure 2. Comparison of skin hydration (arbitrary unit, AU) change from baseline between areas applied with LP and CB.

no matter how a moisturizer exerts its action on the skin. Draelos found that the net decrease in TEWL after product application signified a moisturizer's advantage on the skin[12]. Based on the present study, LP was better than CB in terms of decrease TEWL. According to literature review, moisturizers can be subdivided by their ingredients and mechanisms of action. In general, the main components included in a moisturizer are emollients, humectants, and occlusive. CB contains many effective emollients and humectants including propylene glycol, which is the most effective humectants. Even though, some humectants may promote water loss from the skin by pulling water from the dermis to the epidermis[13], they are efficient in hydrating the skin resulting in the better physiologic state of the epidermis. Meanwhile, LP is an occlusive[14,15] that can reduce TEWL by about 20% to 30%[16]; therefore, the present study found decreased TEWL.

Psoriasis lesions: At the end of a 4-week treatment, LP-treated area showed non-significant increase of TEWL (p=0.179), while CB-treated area showed non-significant decrease of TEWL (p=0.996) when compared to their baseline values. Comparing the mean difference values of pre/post treatment from both areas, there was no statistical difference (p=0.221). The present study found similar result to the study done by Tagami and Yoshikuni. They found that there was reduced skin hydration and increased TEWL in plaque type psoriasis[17]. Based on the present study, it seemed that in case of skin barrier defected, for example, in psoriatic lesion, LP could reduce TEWL better than CB. In such case, LP is an occlusive that protects the evaporation of water from the psoriasis lesions. Therefore, it indirectly enhances reduced TEWL more than CB. Meanwhile, CB, as mentioned earlier, is an humectant. It absorbs water from underlying dermis into epidermis. Thus it increases risk of water loss from the epidermis to the environment.

Comparisons of skin hydration (AU) change from baseline between areas applied with LP and CB in normal skin and psoriasis lesions.

Normal skin: At the end of a 4-week treatment, both studied areas showed significant increase skin hydration (p<0.0001) when compared to their baseline values. Comparing the mean difference values of pre/post treatment from both areas, the mean difference of both studied areas (median LP-5.04 and CB-4.20 AU) was not different (p=0.810). Based on the present study, LP was equal to CB in terms of increase skin hydration. Repeated applications of moisturizers on normal skin have been reported to increase skin hydration without changing TEWL[18] as the author has discussed earlier under heading comparison change of TEWL on normal skin.

Psoriasis lesions: At the end of a 4-week treatment, psoriasis lesions treated with either LP or CB showed significant increase of skin hydration (p<0.0001, p<0.0001, respectively) when compared to their baseline values. Comparing the mean difference values of pre/post treatment from both areas, the mean difference of both studied areas (median LP 2.65 and CB 4.00 AU) there was statistically significant difference (p=0.006), CB was better than LP in increasing skin hydration on the psoriasis lesions. CB contains many effective emollients, humectants, and occlusive (LP 53.2%). CB was classified as emollient. The use of emollient to maintain skin hydration and barrier function remains the principal treatment for dry skin conditions[19]. Emollients should have effect on reducing the clinical signs of dryness, such as roughness or scaling, and improving sensations, such as itching and tightness[20] as it was confirmed that a moisturizer alone (without concomitant medication use) could decrease skin dryness in patients with psoriasis[6]. Additionally, an emollient was able to normalize cell proliferation and cell differentiation in psoriatic plaques[6]. Fluhr et al reported that moisturizers showed wide range of benefit on skin diseases such as to restore barrier function of the epidermis, to provide a soothing protective layer, and to hydrate epidermis[5].

Conclusion

In conclusion, CB showed a better hydrating effect on the psoriasis lesions than LP. Thus, CB should be recommended to apply on the psoriasis lesions for patients with plaque type psoriasis.

What is already known on this topic?

Moisturizers are categorized into several groups based on their ingredients and mechanisms of action are widely used in many dermatologic conditions. The main function of moisturizers is reducing TEWL, attracting water to the SC, and repairing the overall barrier function. In healthy skin on TEWL and skin hydration after an application of moisturizers available at the IOD, reported of all tests were found that the moisturizers can decrease TEWL and increase skin hydration. However, there is no report of comparison about the efficacy of LP and CB on psoriasis lesion and

normal skin in psoriasis patients.

What this study adds?

On the psoriasis lesions plaque type with PASI score less than 10, CB showed a better hydrating effect on the psoriasis lesions than LP.

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Potential conflicts of interest

The authors declare no conflict of interest.

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