

Efficacy of Permethrin-Impregnated Uniforms in the Prevention of Cutaneous Leishmaniasis in Iranian Soldiers

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Abstract

Background: One approach for prevention of cutaneous leishmaniasis is creation of a barrier between the insect vector (phlebotomus) and the host. Many, but not all, researchers claim that permethrin-impregnated uniforms are effective for prevention of cutaneous leishmaniasis. We determined the efficacy of permethrin-impregnated uniforms for prevention of cutaneous leishmaniasis among Iranian soldiers.

Methods: 324 soldiers were randomized into two equal groups. 272 soldiers completed the study. In Group A, 134 soldiers were issued permethrin impregnated uniforms. In Group B, 138 soldiers were issued uniforms washed in water. The soldiers wore uniforms day and night for 3 months, and were observed for an additional 6 months. All of the soldiers remained during this 3 months in the leishmaniasis-endemic area of Isfahan.

Results: 9 (6.5%) of 138 soldiers wearing control uniforms and 6 (4.4%) of 134 soldiers wearing permethrin-impregnated uniforms acquired cutaneous leishmaniasis. The difference between the two groups was not statistically significant.

Conclusion: Permethrin-impregnated uniforms may not be effective in prevention of cutaneous leishmaniasis.

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Keywords • Permethrin • prevention • leishmaniasis

Introduction

Protection against cutaneous leishmaniasis (CL) could be accomplished by elimination of the arthropod vector, but this approach is difficult to implement. An alternative means is the creation of a barrier between the insect vector (phlebotomus) and the host. Treatment of house curtains or bed nets with the insecticide permethrin has been effective against malaria in Kenya^{1,2}, Guatemala³ and Solomon islands⁴.

For military population or for those who are out during evening hours, when insects are most likely to bite, additional personal protective measures are needed. In the state of Florida, application of DEET to the skin reduced the average number of mosquito bites per subject per day from 2287 to 98; permethrin-impregnated clothing reduced the number of bites to one⁵.

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Permethrin-impregnated uniforms for prevention of cutaneous leishmaniasis

Although insect repellents applied to the skin are effective, their disadvantages include the need for extensive and frequent administration, skin irritation, absorption into the systemic circulation, and, consequently, potentially poor compliance^{5,8}.

In Zambia repellents on the skin were more effective against tsetse flies than insecticides in the clothing; DEET reduced the average number of bites per subject per 75 minutes from 19 to 5; permethrin-impregnated clothing reduced the number of bites to 13.⁶

In an Alaskan field trial against mosquitoes, subjects wearing permethrin-treated uniforms and a polymer-based 35% DEET product showed greater than 99.9% protection (16 bites/hour), over 8 hours; unprotected subjects were bitten with an average of 1188 bites/hour⁷.

We investigated the efficacy of permethrin-impregnated uniforms for prevention of CL in Iranian soldiers.

Materials and Methods

This study was a double blind, placebo-controlled study of the efficacy of permethrin-impregnated uniforms for prevention of CL in Iranian soldiers.

Members of the Iranian Army, with no history of leishmaniasis or any evidence of active CL residing in the leishmaniasis endemic area of Isfahan were selected for the study. All of the soldiers signed the informed consent.

Three hundred and twenty four soldiers were randomly divided into two groups. All of the soldiers were male with an age range between 19 and 21 years. In Group A, 162 soldiers were issued permethrin-impregnated uniforms.

Uniforms consisting of a shirt, an undershirt, pants, socks, and hat were soaked in a solution containing 15 mL of permethrin (Agr Evo, United Kingdom; cis: trans isomer ratio, 25:75) per 2L of water for 2 minutes, then air dried for 4 hours.

This resulted in a permethrin concentration of 850 mg/m² of clothing. Control uniforms were soaked in water that did not contain permethrin. The uniforms were distributed in such a way that neither the soldier nor the researcher knew which uniforms were permethrin-impregnated. The uniforms covered all body surfaces except head and neck, hands and feet.

The soldiers wore uniforms day and night for three months, and were permitted to wash their uniforms every other week with water and soap. They were instructed not to use insect repellents or other protective measures, and adherence to these instructions was monitored. The uniforms were impregnated with permethrin (in permethrin group) and water (in nonpermethrin group) for three months (From June to September 2001) and the

Table 1: Efficacy of permethrin-impregnated uniforms in the prevention of CL in Iranian soldiers

Parameter	Group	
	Permethrin	Control
n	134	138
Infection	6	9
Hand	0	4
Face	5	2
Arm	0	2
Wrist	1	0
Trunk	0	1

soldiers were followed for further six months (From September 2001 to March 2002).

All the soldiers were visited monthly. Diagnosis of CL was confirmed in every suspected lesion parasitologically using Giemsa-stained direct smears, and if amastigotes were not seen, the lesion was biopsied.

Results

Two hundred and seventy two soldiers completed the study. Six (4.4%) of 134 soldiers wearing permethrin-impregnated uniforms and nine (6.5%) of 138 soldiers wearing control uniforms acquired CL. (Table I). Statistical analysis showed that there was no significant difference between the incidence of CL in the permethrin-treated group and that in the control group ($p>0.05$).

Side effects, such as contact dermatitis was not observed in any of the soldiers. Diagnosis and treatment of cases of CL has been done in Skin Disease and Leishmania Research Center.

Discussion

Permethrin is a powerful, rapidly acting insecticide, originally derived from the crushed dried flowers of the daisy *chrysanthemum cinerariifolium*.

Permethrin is a man-made synthetic pyrethroid. It does not repel insects, but instead works as a contact insecticide, causing nervous system toxicity leading to death or "knockdown" of the insect. The chemical is effective against mosquitoes, flies, ticks, fleas, human lice, and chiggers.⁸⁻¹⁰

Permethrin-impregnated uniforms did not provide significant protection against CL in our study. Similarly, skin repellents were 95%-100% protective against sand flies in Panama, whereas the use of permethrin-impregnated uniforms resulted in a much less effective protection (6%-9%)¹¹.

In another study, it was shown that permethrin-treated uniforms did not reduce the incidence of malaria in Thai troops on patrol¹².

In contrast to our study, another study showed that permethrin-impregnated uniforms reduced the incidence of CL to 75% in Colombia military personnel on patrol.¹³

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In the Colombia study, however, troops were in area of endemicity for only 6.6 weeks and were observed out of the endemic area for 12 weeks thereafter. However, in our study, the soldiers wore permethrin-impregnated uniforms for three months, and were observed for six months thereafter during their residence outside the endemic area.

It should be emphasized that washing of uniforms cannot decrease the efficacy of permethrin-impregnated clothes against CL.

In a study, the uniforms were washed for a maximum of three times, and there was a 20%-40% loss of permethrin from two military fabrics after the first two washings with hot soapy water with only a further 20% or 10% loss of drug during the next eight washings.¹⁴ Accelerated weathering of impregnated fabrics in an Atlas Ci35 Weather Ometer (Atlas Electric Devices, Chicago) rapidly reduced permethrin concentration and the ability of the fabric to kill mosquitoes from 100% to 0-2%, but the washed fabric still provided 94% protection from bites.¹⁵ Thus, concentration of permethrin too low to kill arthropods, may nevertheless, be high enough to function as an effective repellent, however, it may be advisable to re-impregnate clothing if washed frequently.

Snodgrass¹⁴ studied rabbits during one week when they had continuous contact with tightly adherent permethrin impregnated "military cloth." Each day, 0.5% of impregnated drug was recovered from the animals; this finding led to a calculated absorption for human of 0.0006 mg of permethrin/kg/d. Because the no-observed-effect level in a 2-year chronic-feeding study of rats was 5 mg/kg/d, the US Environmental Protection Agency has set 1/100 of this value (0.05 mg/kg/d) as the maximum amount permitted for ingestion by humans. Thus, the amount of permethrin that might leach from uniforms to skin (prior to metabolism in the skin) is only about 1% of the amount permitted for direct ingestion by the Environmental Protection Agency. Therefore, permethrin-impregnated uniforms are safe.

Five percent permethrin cream used to treat scabies does not result in systemic toxicity since the 2% of applied permethrin that is absorbed is hydrolyzed to inactive metabolites in the skin faster that it can be absorbed.¹⁶

It should be mentioned that there is no evidence of phlebotomus resistance to permethrin in our leishmaniasis endemic area of Isfahan.

In conclusion, our study indicated that permethrin-impregnated uniforms may not be effective in the prevention of CL in our endemic area.

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