

Indoor spraying with the pyrethroid insecticide lambda-cyhalothrin: effects on spraymen and inhabitants of sprayed houses

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In March 1990 a study was carried out in the village of Kicheba, United Republic of Tanzania, in which the pyrethroid insecticide lambda-cyhalothrin was sprayed on all the internal surfaces of houses and other shelters at a coverage of about 25 mg of active ingredient per m². Every day for 6 days, 12 spraymen and 3 squad-leaders were interviewed about symptoms of overexposure to the insecticide. Each sprayman used up to 62 g of lambda-cyhalothrin over 2.7–5.1 hours every day. All the spraymen complained at least once of symptoms that were related to exposure to lambda-cyhalothrin, the commonest being itching and burning of the face, and nose or throat irritation frequently accompanied by sneezing or coughing. Facial symptoms occurred on non-protected areas only. The symptoms were experienced at various times after the beginning of exposure and disappeared before the following morning. The number of subjects affected and the duration of their facial symptoms were proportional to the amount of compound sprayed. A sample of individuals was interviewed 1 day and 5–6 days after their houses had been sprayed. One woman, who entered her house 30 minutes after the end of spraying, complained of periorbicular itching, but this lasted only a few minutes. No other significant, insecticide-related adverse effect was reported by the inhabitants of the sprayed houses.

Introduction

Pyrethroids are highly active insecticides whose use for pest control has increased in recent years. Compared with other commonly used insecticides, such as organophosphates and carbamates, pyrethroids have a higher insect:mammalian toxicity, mainly because of their rapid metabolic inactivation by mammals (1). Pyrethroids are therefore frequently used for the public health control of vectors.

Exposed humans report that pyrethroids cause abnormal facial sensations and irritative symptoms of the skin and of the upper respiratory tract (2–9). Acute pyrethroid poisoning is usually characterized by nervous excitability, but the prognosis is generally good (10). Cases of acute pyrethroid poisoning in China have recently been reviewed; however, the two distinct syndromes elicited in rats by α -cyano (CS-type syndrome) and non- α -cyano pyrethroids (T-type syndrome) (11) have not been described in humans (10).

In vertebrates, pyrethroids are thought to interfere with the sodium channel gating mechanism thereby prolonging the sodium permeability of the neuronal membrane during depolarization. This induces repetitive firing of the sensory nerve terminals, producing trains of impulses (12).

Lambda-cyhalothrin (Icon[®], ICI) is a pyrethroid that consists of a racemic mixture of the two more active of the four isomers of cyhalothrin. It is stable on a variety of inert surfaces and can be used for vector control since it is active against insects that are resistant to organophosphates and carbamates (13).

This article reports the results of a field health survey in which lambda-cyhalothrin was sprayed on all the internal surfaces of human dwellings and other shelters for malaria control purposes. The spraymen, squad-leaders and supervisors, as well as a sample of the population living in the sprayed houses, were interviewed to identify the symptoms associated with exposure to the insecticide.

Subjects and methods

Spraying conditions

During March 1990 in Kicheba, a village located about 6 km from Muheza town in the northern coastal belt of the United Republic of Tanzania, lambda-cyhalothrin ((\pm)- α -cyano-3-(phenoxyphenyl)methylcis-3-(Z-2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate) was sprayed on all the internal surfaces of human dwellings and other shelters at a target coverage of 25 mg/m². The insecticide was applied using standard Gloria-Hudson hand pumps. Each pump charge (8 litres of water) was prepared using 62.5 g of 10% (w/v)

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lambda-cyhalothrin water-dispersible powder that was contained in a soluble sachet. All spraymen wore cotton overalls and rubber boots, and some also wore a gauze nose-mouth mask, rubber gloves, and a cap. One sprayman used a face-shield for 3 days. The inhabitants were asked to remove all food-stuffs, cooking utensils, and furniture from the houses to be sprayed and to re-enter their homes no earlier than one hour after spraying had been completed.

Study subjects

Occupationally exposed. A total of 12 spraymen and three squad-leaders were interviewed immediately after the end of each of six daily spraying sessions; also, two supervisors were interviewed twice in 6 days and were instructed to report immediately any adverse symptom that they noticed.

Inhabitants of the sprayed houses. A total of 73 interviews were conducted 24 hours after spraying in 56 houses occupied by 370 inhabitants (19% of the village population). In 11 of these houses, interviews were also conducted 5–6 days after the spraying operation.

Results

Over the 6-day study period the spraymen were exposed daily for an average of 3.8 hours (range, 2.7–5.1 hours) to lambda-cyhalothrin, and each day used 41 g (range, 31–62 g) of the insecticide. Table 1 shows the symptoms reported by the spraymen. All but one complained, at least once, of facial cutaneous sensations that were usually described as itching and burning. Other symptoms reported were nose irritation associated with sneezing and throat irritation associated with coughing. The cutaneous sensations were felt on the exposed areas of the face; irrespective of whether or not gloves had been used, no such sensations were reported for the hands. Periorbicular sensations were reduced by using masks. When a face-shield was used by one sprayman for three consecutive days no cutaneous sensation was reported. In three cases (2 spraymen, 1 squad-leader) the facial symptoms were ipsilateral and began a few minutes after the insecticide had been accidentally splashed on the affected side of the face. The cutaneous sensations appeared between a few minutes and greater than 3 hours after spraying began (data not shown), while in one case they occurred 1 hour after exposure had ceased. Early onset of cutaneous sensations was usually associated with a draught or with spraying of high ceilings,

Table 1: Cumulative number of daily reports of symptoms made by the 12 spraymen for the 6-day study period

Symptoms	No. of reports
Cutaneous sensations	31
Forehead	27
Cheeks	21
Periorbicular	7
Neck	1
Hand	0
Nose irritation and/or sneezing	11
Throat irritation and/or coughing	6
Eye irritation (without redness)	1

both of which resulted in a greater skin deposition of the insecticide. The number of subjects affected and the duration of symptoms after the end of spraying appeared to be related to the amount of lambda-cyhalothrin used (Table 2). With some subjects, washing with cold water reduced (in 6 cases) or stopped (in 10 cases) the symptoms. Few individuals exhibited a protracted recovery period, regardless of the amount of compound used, while two reported that symptoms always disappeared at the end of exposure. All noncutaneous symptoms generally cleared up when spraying stopped.

Inhabitants entered their sprayed houses at times that ranged from 10 minutes to a maximum of 9 hours after spraying had stopped (median, 2 hours; mean, 2.4 ± 0.4 hours). Thirteen inhabitants complained of sneezing and coughing that were related to sweeping their houses. One woman, who entered her house about 30 minutes after it had been sprayed, experienced periorbicular itching, which lasted for a few minutes. No symptoms were, however, reported by a squad-leader who entered almost every house a few minutes after it had been sprayed.

Table 2: Incidence and duration of cutaneous sensations among the 12 spraymen over the first 5 days of the study

No. of spraymen with symptoms	Amount of lambda-cyhalothrin used (g)	Duration of symptoms (hours) ^a	
		Mean \pm SE	Median
2 (17) ^b	13–25	0	0
6 (38)	26–38	2.3 ± 1.8	1.5
10 (63)	39–51	3.2 ± 0.9	3.0
9 (64) ^c	52–62	3.8 ± 1.3	4.0

^a No. of hours after the end of the spraying session.

^b Figures in parentheses are percentages.

^c Two spraymen were excluded because their symptoms arose after the compound was accidentally splashed on their faces.

Discussion

Paraesthesias and skin sensations, usually described as itching and burning, have been reported after cutaneous exposure to various pyrethroids such as cypermethrin, deltamethrin, fenpropathrin, fenvalerate, flucythrinate, and permethrin (2-9). Other symptoms, such as rhinorrhea, and nose and throat irritation with sneezing and coughing, have also been reported by occupationally exposed subjects (3, 9). Although no structure-activity relationships can be deduced from existing data, it appears that pyrethroids differ in their potential to produce cutaneous sensations; for example, permethrin is less active in this respect than fenvalerate (6). In most cases, cutaneous sensations start about 30 minutes after exposure and disappear within 24 hours. No signs of inflammation (4) or of permanent abnormalities in electrophysiological tests have been reported (2). It is thought that the sensory symptoms described are caused by spontaneous repetitive firing of sensory nerve fibres or endings in the skin (2, 12) — a local effect that occurs when the pyrethroid reaches a threshold concentration in or on the skin.

Acute pyrethroid poisoning in humans is characterized by headache, nausea and, when severe, by muscle fasciculation and convulsive attacks. In the few cases that have been followed up, recovery occurred without permanent sequelae (10). Slight peripheral nerve damage has been reported in rats treated with near-lethal doses of several pyrethroids (2, 14). A reversible increase in β -glucuronidase and β -galactosidase levels, indicating axonal damage, has also been observed in rats treated with high multiple doses of various pyrethroids (14).

In the present study exposure to lambda-cyhalothrin was associated with abnormal skin sensations on the face and, less frequently, with nose and throat irritation, sneezing, and coughing. Among the spraymen, skin sensations appeared at various times (minutes to hours) after a spraying session had begun, possibly because of the different intervals required for the compound to reach the necessary concentration on the skin. The incidence and mean duration of skin sensations were proportional to the amount of active ingredient used. For some spraymen, however, the duration of the sensations was always longer than for other similarly exposed individuals. It was not possible to ascertain whether slower disappearance of skin sensations was due to differences in the amount of lambda-cyhalothrin deposited on the skin, its absorption, or metabolism, or in the sensitivity to the effects of nerve membranes. Only non-protected areas of the skin were affected and when an accidental splash was the cause, the sensation was ipsilateral.

Some of the spraymen had had up to four previous exposures to lambda-cyhalothrin over a 6-month interval. Cutaneous responses appeared not to be influenced by repeated exposures.

When they were interviewed 1 day and 5-6 days after their houses had been sprayed, the inhabitants did not complain of any significant adverse reactions upon re-entering their homes.

When used as described, lambda-cyhalothrin caused abnormal facial cutaneous sensations to the spraymen; this can be prevented by protecting the skin from direct contact with the compound. Manifestations of acute poisoning were not found. Entering sprayed houses was not associated with adverse effects, provided that at least 1 hour had elapsed after spraying had been completed.

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Résumé

Pulvérisations en intérieur de lambda-cyhalothrine, un pyréthri-noïde : effets sur les agents pulvérisateurs et les habitants des maisons traitées

On a étudié dans le village de Kicheba, situé en République-Unie de Tanzanie, les effets indésirables de l'exposition à l'intérieur des habitations à la lambda-cyhalothrine, un insecticide appartenant à la classe des pyréthri-noïdes. L'insecticide a été appliqué avec des pulvérisateurs à main courants de type Gloria-Hudson (environ 0,8 g/l d'eau). On a rempli les réservoirs (8 litres) avec de l'eau à laquelle on a ajouté un sachet de 62,5 g de poudre de lambda-cyhalothrine à 10% (p/v) dispersable dans l'eau. Toutes les surfaces intérieures des habitations humaines et autres abris du village ont été pulvérisées, à raison d'environ 25 mg de matière active par m², pour lutter contre les vecteurs du paludisme. Chaque agent pulvérisateur a utilisé 13 à 62 g de lambda-cyhalothrine pendant 2,7 à 5,1 heures par jour pendant 6 jours. Tous les agents portaient des combinaisons en

coton et des bottes en caoutchouc; certains d'entre eux portaient également un masque de gaze couvrant la bouche et le nez, des gants en caoutchouc et une casquette. Douze agents et trois chefs d'équipe ont été interrogés quotidiennement pendant 6 jours, juste après la pulvérisation, de manière à pouvoir observer tout symptôme de surexposition au pesticide.

Tous les agents pulvérisateurs se sont plaints au moins une fois de symptômes associés à l'exposition à la lambda-cyhalothrine: les plus fréquemment cités étaient des démangeaisons, des sensations de brûlure du visage et une irritation du nez ou de la gorge souvent accompagnée d'éternuements ou de toux. Les symptômes enregistrés au niveau du visage ne se sont produits que sur les endroits non protégés et sont apparus à divers moments après le début de la pulvérisation; le lendemain matin, ils avaient disparu. Un agent ayant été éclaboussé accidentellement sur un côté du visage a éprouvé des sensations anormales homolatérales dans les quelques minutes qui ont suivi. Que des gants aient été utilisés ou non, aucune sensation cutanée anormale n'a été rapportée par les agents au niveau des mains. L'incidence des symptômes cutanés a été proportionnelle à la quantité d'insecticide pulvérisée. Un des chefs d'équipe, qui a pénétré dans toutes les habitations juste après la pulvérisation, n'a jamais rapporté de sensations anormales au niveau du visage, ni aucun autre symptôme lié à l'exposition. Un échantillon des habitants de certaines des habitations traitées (19% du total) a également été interrogé au bout de 24 heures, puis 5 à 6 jours après la fin du traitement. Après être retournés chez eux, quelques-uns se sont plaints d'éternuements liés à la poussière soulevée en balayant. Une femme qui était rentrée chez elle 30 minutes après la pulvérisation s'est plainte de démangeaisons périoculaires ayant duré quelques minutes.

La pulvérisation de lambda-cyhalothrine à l'intérieur des habitations dans les conditions décrites ici provoque donc des symptômes locaux, mais aucun symptôme général, chez les agents pulvérisateurs. Les sensations cutanées anormales peuvent être évitées en se protégeant le visage pendant la pulvérisation. A la dose employée, aucun effet indésirable important n'a été mis en évidence chez les habitants des maisons traitées.

Il semble qu'il suffise d'attendre environ une heure après la pulvérisation avant de pénétrer dans les maisons pour éviter tout effet indésirable.

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