

Pyrethroids- could they be dangerous?

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Abstract

Pyrethroids are powerful insecticides, which are worldwide use in pest control, in agriculture, forestry, even in households. The amount of used pyrethroids is growing every year. They were created as the result of a modification of natural pyrethrin, which is botanical insecticide extracted from chrysanthemum flowers. The pyrethroids are the substances with powerful effects on insects nervous system due to binding to voltage-gated sodium channels of nerve cells. Despite of relatively low risk of toxicological effect on humans and other mammals, there are many reports of acute or chronic exposure on pyrethroids. Based on available literature implicates that pyrethroids induce adverse health effects on non-target organisms. The associations between exposure to pyrethroids and the effect on nervous, endocrinological and

immunological systems were reported. The purpose of this study was to analyze an association between exposure to pyrethroids and its potential poisoning effect on humans.

Keywords: Pyrethroids, Insecticides, Poisoning, Toxicology

Introduction

Insecticide are the group of the pesticides, which are natural or chemical substances. They are used for insect pest control. One of the most popular group of insecticides are pyrethroids with one-fourth of world market of all insecticides[1]. They are extensively used in forestry, textile industry, residential and agriculture areas in order to counteract broad spectrum of pests.

Pyrethroids are synthetic pesticides, which were developed in 1970s as the result of modification of pyrethrin (botanical insecticide found in chrysanthemum flowers). Both of them have similar neurotoxic properties, but the pyrethroids was found to be more stable for physical factors and increased toxicity for insects than pyrethrin. It was discovered that they are causing impairment of motor coordination and paralysis of insects due to prolonged flow of sodium in the voltage-gated sodium channels, which keeps the axonal membrane depolarized permanently[2].

Pyrethroids have been divided into two groups based on the affection on nervous system of non-target animals (rats). Type I (permethrin, d-phenothrin, bifenthrin) poisons mostly peripheral nerves and causes ataxia, progressive paralysis and convulsions. Type II (deltamethrin, cyfluthrin, fenvalerate, lambda-cyhalothrin cypermethrin) affects central nervous system and provokes salvation and choreoathetosis[3,4].

Pyrethroids are thought to be relatively safe for non-target organisms. They have low toxicity for mammals due to the rapid metabolism, stable internal body temperature and lower sensitivity of voltage-gated sodium channels [5]. However, according to number of studies, it is confirmed that the exposure to pyrethroids may develop acute or chronic symptoms of intoxication.

Toxicological effects on vertebrates animals

Several studies which have been published, describe the impact of pyrethroids upon non target vertebrates animals and their influence over different organs and systems. In mice, the exposure to deltamethrin significantly affects male reproductive system by the reduction of inhibin B and

testosterone concentrations. It causes impaired libido as well.[6]. In another study, subacute intoxication of deltamethrin led to memory impairment, decrease locomotor activity, liver failure and blood morphology changes as the result of oxidative stress[7]. Another mice study showed that cypermethrin causes a dysregulation of metabolic energy and is hepatotoxic [8]. In subsequent study [9] the hepatotoxic effect of cypermethrin was confirmed as the results of impair homeostasis of fatty acid and glucose metabolism. Hepatic damage may be induced through the proinflammatory gene expression as well. The results of *B. Aouey's* [10] studies, clearly indicate the correlation between significantly increased levels of interleukins (IL-6 and IL-1 β) and tumor necrosis factor- α (TNF- α) gene expressions following acute and subacute exposure to lambda-cyhalothrin.

Pyrethroids are extremely toxic to fish. It can be explained by slow metabolism of fish. The study in crucian carp indicates cardiotoxic effects of deltamethrin due to disruption of ion channels[11]. Moreover, the combination of two types of pyrethroids (permethrin and cypermethrin) was studied on zebrafish embryos. The study demonstrated that mixture of two pyrethroids led to deleterious effect of embryonic development of zebrafish due to the repression of proneural gene expression [12]. Another study on *Anguilla anguilla L.* showed that, even short-term exposure to pyrethroids is hazardous. It can induce chromosomal and cytogenic damage [13].

Toxicological effects on humans

A number of researchers have investigated the possible influence of pyrethroids on human bodies. They are considered safe even though many studies described negative health effects. Pyrethroids can easily be absorbed through the skin, pulmonary and digestive system. Moreover, they may cause eye irritation. In acute poisoning the symptoms may include the following: weakness, tremors, nausea, headache, chest tightness, cardiac rhythm abnormalities, fever, runny nose, coughing, blurred vision and extensive tearing. There is no official data about chronic exposure to the pyrethroids. They are not considered carcinogens, except permethrin which is considered as weak carcinogens by Federal Environmental Protection Agency (EPA) [14].

Very few studies have reported an association between the occupational and residential chronic exposure to pyrethroids and impact upon human health. The chronic exposure to this group of insecticides may be responsible for number of serious health effects. For example *Jurewicz et al* [15] reported an association between exposure to pyrethroids and human reproductive health effects. They proved that the damage of sperm DNA were linked to high

levels of pyrethroid metabolites (3PBA, CDCCA, TDCCA, DBCA) found in urine samples. Furthermore, studies of prenatal pyrethroids exposure confirmed the connection between maternal pyrethroid exposure and decreased birth sizes of neonates (birth weight and head circumference) [1,16]. Another study also showed that the gestational pyrethroid exposure is responsible for neurodevelopmental disorders such as autism spectrum disorders or developmental delay [17].

There are very few research studies that have evaluated the connection between chronic exposure to pyrethroids and hematological disorders. *Huang X.*[18] found that pyrethroid exposure is the least toxic to humans from all of the most popular pesticides. His results showed that pyrethroids cause increased level of C-reactive protein (CRP). Different studies have been proved that this pesticides are associated with abnormal glucose regulation in terms of higher risk of diabetes [19].

There are some data describing acute poisoning effect of pyrethroids on humans. Occupational exposure to these insecticides is the most frequent type of intoxication. In review of 4,974 cases of acute pyrethroid, the most frequently reported symptoms were respiratory (cough, upper respiratory irritation, dyspnea), neurological (confusion, headache, muscle weakness) and gastrointestinal symptoms (abdominal pain, diarrhea, nausea). Furthermore, dermal, eye, cardiovascular and others symptoms were described. Five people died due to poisoning effects [20]. Sometimes, the acutely poisoned patients present atypical signs, which is a huge problem for doctors. Respiratory failure requiring life-support machine, pneumonia, acute kidney injury and seizures were presented by 39% of pyrethroid poisoned patient, which required hospitalization [21]. In very few cases, acute pyrethroid intoxication was the result of suicide attempts [20]. There is no specific antidote for pyrethroids. That's why supportive management should be started immediately.

SUMMARY

The environmental pollution with pesticides can cause a lot of symptoms of poisoning both human beings and animals. Both acute and chronic exposure to pyrethroids can cause complications of excretory, digestive, reproductive, neurological systems or immunological disorders. Many of studies indicate that small amounts of pyrethroids in food and in indoor residential environments are major source of exposure which may cause vary health problems. Unfortunately, the knowledge about its harmful effects on humans is still insufficient. A number of studies on animal models play a substantial role in understanding the pyrethroids influence on humans. Further research is warranted.

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