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Anaphylaxis in an Airplane After Insecticide Spraying

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Flights departing from malarious areas are sprayed with pyrethroids. They are presumed to be safe since reports of adverse responses among passengers or crew were only anecdotal. However, asthmatic reactions after domestic and occupational exposure have been published. We present the first case description of pyrethroid allergy in an airplane.

Case Report

A 29-year-old woman with unremarkable medical history took her first trip to Africa, flying from Brussels to Kinshasa via Douala. Before departing Douala, after closing the doors, cabin crew sprayed insecticides as part of routine vector control procedures for flights originating in territories with endemic malaria, yellow fever, or other insect vector-borne diseases as defined in the International Health Regulations.[1] This procedure is also referred to as disinsection and the described method is called the "blocks-away method." Shortly after the cabin spraying, the woman's lips and eyelids became swollen, she developed diarrhea, shortness of breath and felt as if she would lose consciousness. Is there a doctor on board? This time there was. He found a dyspneic woman with a red face, slightly edematous eyes, and pronounced edema of the lips. She appeared to be suffocating and he noticed a prolonged expiration. Her pulse rate and blood pressure were normal. He administered albutarol inhalation and oral corticosteroids which he carried in his luggage since the flight crew brought a first-aid kit containing bandages, not the emergency medical kit containing epinephrine. Her condition started improving, and after a 30-minute flight delay the pilot decided that the plane could continue and the woman stayed on board to Kinshasa. Initially food allergy seemed most likely and a detailed food inventory was requested from the airline so that exposure could be compared in case of future reactions. Also, the insecticide spray ingredients were obtained. Once in Kinshasa, the woman suffered from persistent mild wheezing, which she had never experienced before. This wheezing resolved after nighttime use of an electric anti-mosquito vaporizer was cessated. Three months after the airplane incident, the woman developed an itchy, swollen eyelid (Figure 1) after contact with a neighborhood dog whose fur had just been treated with flea powder. Comparing the composition of the flight cabin insecticide spray, the electric anti-mosquito vaporizer, and the flea powder revealed one common ingredient: pyrethroids. The pyrethroid in the insecticide spray was D-phenothrin. Other ingredients were tetrafluoroetane, C11-15-iso-alkanes, methoxypropoxypropanol, and peach perfume. The vaporizer contained transfluthrin, kerosene, and butylated hydroxytoluene. The flea powder contained another pyrethroid. This was confirmed by her physician who read the label, but the exact type of pyrethroid was not recorded in the patient's medical file.

Bronchial provocation with histamine showed an immediate drop of the forced expiratory volume at 1 second (FEV1) from 92% to 67% predictive value after the first dose (0.125 mg/mL), so histamine provocation was stopped and albutarol inhalation was administered which allowed the FEV1 to rise to 96%. The patient was advised to take prophylactic corticosteroids and an anti-histamine on future flights where pyrethroid spraying was expected. Also an epinephrine auto-injector was prescribed for life-threatening reactions. Two years later, her pulmonary function was reassessed and FEV1 was 88% before and 101% after albutarol inhalation, suggestive for asthma. When using prophylactic medication and

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Figure 1 Itchy swollen eyelid after rubbing a dog that had just been treated with flea powder containing pyrethroids.

covering her face during the spraying with a scarf, the woman did not have any adverse reactions following pyrethroid spraying on three subsequent international flights. Of interest, when the woman explained her condition to cabin crew on these flights and asked if they could indicate when the spraying was about to take place, they replied that insecticide spraying is perfectly harmless.

Pyrethroids are synthetic chemical compounds similar to natural pyrethrins. Purified natural pyrethrins are manufactured by removing impurities such as the sensitizing sesquiterpene lactones (chemicals found in many plants that are known to cause allergic reactions) from the extract (pyrethrum) derived from chrysanthemum flowers. Pyrethrins and pyrethroids are widely used for insect control and studies carried out in the European Union and the United States have shown detectable amounts of pyrethroid metabolites in urine samples from the general population.[2] The World Health Organization recognizes acute direct toxicity which can occur in two forms, systemic and dermal.[2,3] Systemic poisoning is characterized by an acute excitatory action upon the nervous system, with either tremor, chorea, or seizures. Dermal toxicity is characterized by paraesthesia, typically without inflammation. The American Association of Poison Control Centers database includes reports of over 200,000 pyrethrins and pyrethroid total incidents recorded from 1993 to 2005 and each year increasing.[4] Despite these reports, there is controversy regarding the sensitizing potential of pyrethrins and synthetic pyrethroids as these agents are generally not considered allergenic and thus not able to induce inflammation.[2,4]

Asthma is a chronic inflammatory disease of the airways. Once sensitized to an allergen, an asthmatic patient may develop asthma attacks not only when exposed to the specific sensitizing agent but also when exposed to "nonspecific" stimuli, eg, exercise, cold air, and smoke. A sensitizing agent may cause immediate as well as prolonged attacks of asthma, which are associated with a further exacerbation of airway inflammation. Nonspecific stimuli cause immediate transient asthma attacks, not associated with airway inflammation. Two deaths from acute asthma have been attributed to pyrethrins.[5,6] One case report clearly describes an asthmatic reaction provoked by synthetic pyrethroids in an insect control worker.[7] Newton and Breslin studied seven patients with asthma and a history of chest tightness on exposure to domestic insecticide aerosols, and demonstrated that one patient had a decrease in FEV1 greater than 20% after exposure to a mixture of pyrethrins and pyrethroids.[8] A double-blind crossover study of 25 asthmatic subjects with reported sensitivity to insecticide aerosols confirmed that the insecticide formulation used in the Newton and Breslin study[8] caused adverse effects on lung function and chest, nose, and eye symptoms.[9] Two other formulations containing either pyrethrins (administered to a subgroup of 12 subjects) or pyrethroids (administered to a subgroup of 13 subjects) also demonstrated severe adverse effects on airway responsiveness and symptoms when the subgroups were combined. A third formulation, manufactured for sensitive subjects using only "biopyrethroids" did not differ significantly from the negative control. The authors remarked that they were unable to determine whether the mechanism of action was due to an irritant effect of the spray on sensory nerves in the airways or due to an allergic response.

Although the passenger's allergic reactions are common, they have not been historically correlated with insecticides by cabin crew or airline companies' medical departments (personal communication with three major airlines). However there are some anecdotal reports of symptoms following aerosol spraying, eg, by flight attendants.[10] In their 2005 report about safety of pyrethroids for public health use, the World Health Organization states that in these reports the symptoms are often not typical for pyrethroids and might be attributable to other etiological factors, such as unreported solvents present in the formulation, other pesticides, the microclimatic conditions in the aircraft, or psychological reactions.[2] The reported symptoms varied from metallic taste, slight and unspecific irritation of eyes, throat and upper respiratory tract, and skin, to severe respiratory symptoms such as dyspnea, cough, and asthma. Data suggested that the most severe symptoms were observed in sensitized subjects (ie, asthma patients). In the 2005 report it is further emphasized that it was the affected subjects that attributed their symptoms to aircraft disinsection. We believe that in our case the timely association between exposure to different pyrethroids and onset of symptoms of inflammation on multiple occasions strongly suggests that what happened on that plane was a severe multisystem allergic reaction, or anaphylactic reaction to pyrethroids. Whereas measures to prevent the dissemination of vector-borne illnesses around the globe are necessary, this case introduces a possible downside to this public health approach: flight cabin pyrethroid

spraying can provoke life-threatening allergic reactions, at least in one individual, maybe unrecognized in others.

Mechanical alternatives to insecticide spraying like "air curtains" should be implemented if proven effective. In the meantime passengers and crew should be notified in advance if, how, and when they might get exposed to insecticides during their flight. Telling people that these insecticides can provoke allergic reactions will allow them to choose to protect themselves. It should be possible to avoid most of the pyrethroid exposure through inhalation after in-flight spraying (like the blocks-away method) since a 2004 study by Berger-Preiss and colleagues determined that more than 90% of the total amount inhaled insecticides was within the first 5 to 10 minutes following spraying.[10] One of the airlines we contacted already tells their passengers prior to spraying that they can cover their eyes and nose if they wish to. Based on the findings from Berger-Preiss and colleagues, we will also advise our patient to use a face mask during the first 15 minutes following the spraying. Finally, we believe it might be useful if cabin crew received a formal training in how to recognize and manage allergic reactions to insecticides. Asthma can be countered with bronchodilatating agents like albutarol and for life-threatening allergic reactions epinephrine auto-injectors should be made available.

Declaration of Interests

The authors state they have no conflicts of interest to declare.

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