

Epidemiologic Investigation of Hornet and Paper Wasp Stings in Forest Workers and Electrical Facility Field Workers in Japan

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ABSTRACT

Background: Forestry and field workers who work outdoors are at high risk for Hymenoptera stings and may develop occupation-related allergies from being stung. However, clinical and immunological surveys of Hymenoptera stings in the occupational setting have rarely been reported. We surveyed the natural history of Hymenoptera stings in Japanese forestry workers (FWs) and electrical facility field workers (EFFWs), and we assessed the utility of measuring specific (s)IgE Ab to Hymenoptera venom.

Methods: Questionnaires on hornet and paper wasp stings were completed by 999 FWs, 354 EFFWs, and 365 office workers as controls between July and November 2009. Sera from these participants were tested for sIgE Ab levels to Hymenoptera venom with a CAP system using a fluoroenzyme immunoassay.

Results: Of the participants who had experienced Hymenoptera stings, 914 (91.5%) were FWs, 293 (82.8%) were EFFWs, and 295 (80.8%) were controls. Of the participants who had experienced systemic reactions, 210 (21.0%) were FWs, 51 (14.4%) were EFFWs, and 39 (10.7%) were controls. sIgE Ab in response to hornet and wasp venom was positive (\geq class 2) in 42.4% and 41.4% of FWs, 30.1% and 31.4% of EFFWs, and 15.1% and 18.1% of controls, respectively. The likelihood of being sIgE-positive to wasp and hornet venom was significantly higher in FWs and EFFWs than in controls ($P < 0.05$).

Conclusions: 21% of FWs and 14% of EFFWs had experienced systemic reactions to Hymenoptera stings with a higher frequency compared with office workers in the same area. 40% of FWs and 30% of EFFWs had sera that were sIgE positive to Hymenoptera venom.

KEY WORDS

forestry and field workers, hornet stings, Hymenoptera allergy, paper wasp stings, venom-specific IgE

ABBREVIATIONS

SR, systemic reaction; OR, odds ratio; RAST, radioallergosorbent test; CAP, immunoCAP; FEIA, fluoroenzyme immunoassay; FWs, forestry workers; EFFWs, electrical facility field workers; OW, office workers; sIgE, specific IgE; Ab, antibody.

INTRODUCTION

The number of deaths attributed to Hymenoptera

stings is about 40 per year in the United States^{1,2} and about 16 to 38 per year in France.³ In addition, fatalities following insect stings are rare and occur in 0.03-

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0.48 per 100000 inhabitants per year.^{4,6} These data are largely from studies carried out in the United States and Europe. Furthermore, Pumphery^{7,8} reported that between 1992 and 2001 in the United Kingdom, 47 out of 214 deaths, due to anaphylaxis, were caused by bee or wasp stings and the average age of death was 50 years.⁸ On the other hand, in Japan approximately 20 people die annually of anaphylaxis caused by Hymenoptera stings.⁹ Not only bee-keeper but also forestry and field workers who work outdoors are at especially high risk for these stings, and may develop occupational-related allergies from being stung. In the bee keepers and their family members, the sensitization rate to bee venom is 30-60%.⁶ The prevalence of local reactions is 9-31%, and the prevalence of systemic reactions is 14-32%. Venom allergy is an important cause of anaphylaxis accounting for about one quarter of cases where the cause was determined in adults.⁷

The clinical and immunological surveys of Hymenoptera stings in the occupational setting, especially forestry and field workers, have rarely been reported. Here we recently conducted a large epidemiological study to survey the natural history of Hymenoptera stings in Japanese forestry and field workers, and in office workers as controls.

METHODS

PARTICIPANTS

A total of 1,718 participants agreed to take part in this study (Table 1). Forestry workers (FWs) were staff members of a private forest owner's cooperative in Tochigi and Fukushima prefectures, Japan and electrical facility field workers (EFFWs) were employed by Tokyo Electric Power, Kandenko, Tokyo and Tochidenko, Tochigi, Japan. The main work of FWs is forestation, which includes weeding, planting, and felling of trees, and these workers are frequently exposed to Hymenoptera stings. EFFWs also usually work outdoors and are at a high risk of Hymenoptera stings. In comparison, office workers in the same area have a low risk for exposure to Hymenoptera stings and were recruited as controls in this study. All participants completed questionnaires and underwent peripheral blood tests between July and November 2009.

This study was approved by the Dokkyo Medical University Research Ethics Committee, and written informed consent was obtained from each participant prior to study enrollment.

QUESTIONNAIRE

A questionnaire on the following items was administered by an allergist: age; sex; history of Hymenoptera stings; and history of systemic reaction (SR), including severity. The severity of anaphylactic reactions was classified according to the method of Mueller¹⁰: grade 0, no systemic reaction; 1, skin symptoms

(generalized urticaria, itching, or erythema) or anxiety; 2, gastrointestinal symptoms (stomach pain, nausea, or vomiting) or angioedema; 3, respiratory symptoms (dyspnea, difficulty swallowing, hoarseness, or stridor); and 4, cardiovascular symptoms (hypotension defined as a decrease of 15 mm Hg or more in mean arterial pressure, requiring immediate intervention, with or without cyanosis, collapse, arrhythmias, or angina pectoris). The symptoms of each participant were classified according to the most severe symptoms that he or she had experienced.

To analyze the relationship between frequency of Hymenoptera stings and severity of systemic reaction, the participants were classified according to the number of Hymenoptera stings they had experienced: few (1-5), intermediate (6-10), and many (≥ 11). Systemic reaction was classified as mild (grades 1-3) or severe (grade 4).

BLOOD TESTING

A 15-mL peripheral blood sample was drawn from each participant. Serum was extracted and stored at -80°C until used for analysis. We measured total serum IgE antibody (Ab) and sIgE Ab to Hymenoptera venom in FWs, EFFWs, and controls. The measurement of total IgE Ab (>250.0 IU/ml) and sIgE Ab to wasp and hornet venom was determined by Mitsubishi Chemical, SRL, Tokyo, Japan. Detection of sIgE Ab by the CAP-fluoroenzyme immunoassay (FEIA) system is expressible in quantitative units (kIU/L) and also in the traditional spectrum of seven semi-quantitative classes ranging from class 0 (<0.35 kIU/L) to class 6 (>10 kIU/L). sIgE Ab-positive results were defined as those \geq class 2, considering the effects of cross-reactive carbohydrate determinants.¹¹

STATISTICAL ANALYSIS

Data are presented as mean \pm standard deviation of the mean. Student *t* tests were used to assess the significance of difference between the groups. The χ^2 test was used to assess differences in bivariate analysis and revised with analysis of variance with Bonferroni's test. The χ^2 test was also used to test for independence and odds ratio (OR). *P* values of less than 0.05 were considered to indicate statistical significance. Statistical analyses were performed with JMP software (Version 7.0 for MAC, SAS Institute, Cary, NC, USA).

RESULTS

ANALYSIS OF QUESTIONNAIRE DATA

Table 1 summarizes the characteristics of FWs and EFFWs in this study, based on the questionnaire data provided. The number of participants (mean age) in the FWs, EFFWs, and controls were 999 (51 ± 14.0 years), 354 (42 ± 15.1 years), and 365 (50 ± 11.7 years), respectively. In the FWs and EFFWs, all participants were male; in the controls, 231 were male

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