

Sensitization to grass, ragweed, mugwort pollen allergens in Japanese monkeys (*Macaca fuscata*): preliminary report

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Summary

Background The natural occurrence of Japanese cedar (CJ, *Cryptomeria japonica*) pollinosis has been reported in Japanese monkeys (*Macaca fuscata*). Furthermore, most of these monkeys with CJ pollinosis have immunoglobulin (Ig) E sensitization to Japanese cypress (*Chamaecyparis obtusa*) pollen. However, specific IgE to other pollens has not yet been reported.

Objectives The present study was designed to investigate IgE sensitization of Japanese monkeys to grass, ragweed, and mugwort pollen.

Methods Serum samples from 47 monkeys as a general population in one troop were collected at random. We measured specific IgE to grass, ragweed and mugwort pollen. Next, 10 monkeys with CJ pollinosis from the same troop were also examined for their IgE sensitization to grass, ragweed, and mugwort pollen.

Results Of 47 monkeys, 13 (28%) had specific IgE to CJ pollen, 15 (32%) to grass pollen, five (11%) to ragweed pollen, and three (6%) to mugwort pollen. Furthermore, CJ pollinosis monkeys seemed to be sensitized to these pollen allergens with higher frequency; of 10 monkeys, 10 (100%) had specific IgE to CJ pollen, six (60%) to grass pollen, four (40%) to ragweed pollen, and two (20%) to mugwort pollen.

Conclusion Japanese monkeys had specific IgE to grass, ragweed, and mugwort pollen in addition to CJ pollen.

Keywords: grass, immunoglobulin E, Japanese monkey, mugwort, pollen, ragweed

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Introduction

Japanese cedar (CJ, *Cryptomeria japonica*) pollinosis is one of the most common allergic diseases in Japan [1,2], with an increasing number of the patients [3]. A recent study reported that the prevalence of CJ pollinosis is 11% [4].

Natural occurrence of CJ pollinosis has also been reported in Japanese monkeys (*Macaca fuscata*) [5,6], in which the symptoms resemble those of human patients. The monkeys with CJ pollinosis had specific immunoglobulin (Ig) E to CJ major allergens (Cry j 1, Cry j 2) [7–9]. Furthermore,

leucocytes from monkeys with pollinosis demonstrated CJ allergen-specific histamine release. In addition, there was a significant proliferation of peripheral blood mononuclear cells (PBMCs) in response to CJ allergens [10]. The Japanese monkey is well established as a suitable animal model for studying CJ pollinosis [11,12]. Recently, we found that these monkeys have sensitivity to Japanese cypress (*Chamaecyparis obtusa*) pollen [13].

In human patients, grass, ragweed, and mugwort pollen also play an important role in pollinosis during the pollen season in Japan [14]. Some human patients with CJ pollinosis demonstrated sensitivity to grass and ragweed pollen-based on skin tests [15]. However, the sensitivity to grass, ragweed, and mugwort pollen in Japanese monkeys has not

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yet been reported. In this study, we investigated IgE sensitization of monkeys to grass, ragweed, and mugwort pollen.

Materials and methods

Monkeys

Sera from 47 Japanese monkeys aged 3–17 years old (mean age $\pm$ SD, 8.7 ± 3.9) as a general population were collected at random from a troop in Awaji Island, Hyogo Prefecture, Japan. Of these 47 monkeys, four showed CJ pollinosis. This monkeys troop is the only one on this island [11]. Furthermore, sera from 10 monkeys (mean age $\pm$ SD, 8.9 ± 4.3) with CJ pollinosis were also collected from the same troop. These monkeys showed patent clinical symptoms such as tear production, eye redness, sneezing and rhinorrhea.

Monkeys were in a free-range troop, and when they came to a feeding place where we could observe them, we examined the presence of pollinosis symptoms during Japanese cedar pollen season (February to April). All monkeys in this troop are named and identified by staff of Awaji Monkey Park. They were captured by a blowgun and serum samples were taken. A mixture of ketamine HCl (Kettalar, Sankyo, Tokyo, Japan) at 5 mg/kg body weight and xylazine HCl (Celactar, Bayer, Tokyo, Japan) at 1 mg/kg body weight was administered intramuscularly by the blowgun. All serum specimens were stored at -70°C until use.

Measurement of specific IgE to crude pollen allergens

The CAP method (Pharmacia, Uppsala, Sweden) was used according to the manufacturer's instructions to measure specific IgE to Japanese cedar (*Cryptomeria japonica*), orchard grass (*Dactylis glomerata*), short ragweed (*Ambrosia artemisiifolia*), and mugwort (*Artemisia princeps*) pollen.

Results

Specific IgE to various pollen in monkeys in the general population

Table 1 shows specific IgE to various pollen in the 47

monkeys. Of 47 monkeys, 13 (28%) had specific IgE to CJ pollen (mean value $\pm$ SD, 4.5 ± 6.0 Ua/mL). Of 47 monkeys, 15 (32%) had specific IgE to grass pollen (1.3 ± 1.5 Ua/mL), five (11%) had specific IgE to ragweed pollen (2.1 ± 1.6 Ua/mL), and three (6%) had specific IgE to mugwort pollen (0.53 ± 0.1 Ua/mL) (Table 1).

Of 13 monkeys with specific IgE to CJ pollen, nine (69%) had specific IgE to either grass or ragweed or mugwort pollen (data not shown). In contrast, of 34 monkeys without specific IgE to CJ pollen, only six (18%) had specific IgE to either grass or ragweed or mugwort pollen.

Specific IgE to various pollen allergens in pollinosis monkeys

All 10 monkeys with CJ pollinosis had specific IgE to CJ pollen (mean value $\pm$ SD, 12.6 ± 7.4 Ua/mL) (Table 2). Of the 10 monkeys, six (60%) had specific IgE to grass pollen, four (40%) had specific IgE to ragweed pollen, and two (20%) had specific IgE to mugwort pollen.

Discussion

In this study, we found that the positive rate of anti-CJ IgE in this troop was 28%. In our previous study, we collected sera from 51 monkeys (mean age $\pm$ SD, 9.1 ± 3.6 years) in the same troop and measured anti-CJ IgE in the serum samples [11]. The positive rate of anti-CJ IgE in this troop was 26%, which is similar to the positive rate of anti-CJ IgE (28%) in this study. Thus, we reconfirmed the prevalence of sensitivity to CJ pollen allergens among monkeys in this troop.

There is no report that monkeys are naturally sensitized with grass, ragweed, and mugwort pollen. These plants are found in this Awaji island [16]. Consequently, as a preliminary study, we undertook to investigate IgE sensitization of monkeys to grass, ragweed, and mugwort pollen allergens. Surprisingly, 32% of the monkeys in the general population had specific IgE to grass pollen. Furthermore, of 10 monkeys with CJ pollinosis, six (60%) had specific IgE to grass pollen. It is possible that monkeys with specific IgE to grass pollen might show pollinosis symptoms to the grass pollen. In addition, some monkeys have been sensitized

Table 1. Prevalence of specific IgE [n (%)] to various pollen allergens among 47 monkeys in general population

Monkey no.	Specific IgE to pollen allergens			
	Cedar	Grass	Ragweed	Mugwort
47	13 (28)	15 (32)	5 (11)	3 (6)
Mean value $\pm$ SD*	4.5 ± 6.0	1.3 ± 1.5	2.1 ± 1.6	0.5 ± 0.1

*Specific IgE level (Ua/mL)

Monkey no.	Specific IgE to pollen allergens			
	Cedar	Grass	Ragweed	Mugwort
1	16.6	2.08	2.03	0.46
2	21.5	0.96	0.58	<0.35
3	12.4	1.08	0.47	<0.35
4	0.68	0.76	0.73	<0.35
5	15.5	2.83	<0.35	0.42
6	5.1	0.46	<0.35	<0.35
7	24.3	<0.35	<0.35	<0.35
8	12.9	<0.35	<0.35	<0.35
9	12.5	<0.35	<0.35	<0.35
10	4.9	<0.35	<0.35	<0.35
Mean value $\pm$ SD*	12.6 $\pm$ 7.4	1.4 $\pm$ 0.9	1.0 $\pm$ 0.7	0.4 $\pm$ 0.03

*Specific IgE level (Ua/mL)

with ragweed and mugwort pollen. Ragweed and mugwort pollen also might cause pollinosis symptoms to the monkeys sensitized with these pollen. Grass, ragweed and mugwort pollen seasons in this area are May to October, August to September, September to October, respectively [17]. In the future, we will observe the presence of pollinosis symptoms in monkeys during these pollen seasons.

In our study, monkeys sensitized with CJ pollen tended to be sensitized to other pollens. To our knowledge there is no report in the literature of cross-reactivity among CJ pollen and grass, ragweed or mugwort pollen. We found that out of the 10 monkeys with CJ pollinosis six (60%) had specific IgE to either grass, ragweed, or mugwort pollen. Conversely, in monkeys without anti-CJ IgE, only 18% had specific IgE to either grass or ragweed or mugwort pollen.

The monkeys in this troop eat apples which the staff of the Monkey Park feeds them. Cross-reactivity between fruits and these pollen allergens have been reported [18–20]. We measured specific IgE to apples in sera of the 10 monkeys with CJ pollinosis and no monkeys showed specific IgE (data not shown). From this result, we think that specific IgE to grass, ragweed and mugwort pollen allergens that we detected in this study are not related to specific IgE to fruit allergens.

In conclusion, Japanese monkeys had IgE sensitization to grass, ragweed, and mugwort pollen allergens which cause pollinosis symptoms in human patients. Japanese monkeys sensitized with these pollen allergens might serve as a suitable animal model in these pollen allergies. We would do well to observe the presence of pollinosis symptoms in monkeys during these pollen seasons.

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Table 2. IgE reactivity to various pollen allergens in monkeys with Japanese cedar pollinosis

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