

Original article

The impact of co-existing seasonal allergic rhinitis caused by Japanese Cedar Pollinosis (SAR-JCP) upon asthma control status



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ACT, asthma control test; AR, allergic rhinitis; ARIA, allergic rhinitis and its impact on asthma; FeNO, fractional exhaled nitric oxide; GINA, global initiative for asthma; ICS, inhaled corticosteroids; LABA, long-acting β_2 -agonists; LTRA, leukotriene receptor antagonists; SACRA, self assessment of allergic rhinitis and asthma questionnaire; SAR-JCP, seasonal AR caused by Japanese cedar pollinosis; VAS, visual analog scale

ABSTRACT

Background: Seasonal Allergic Rhinitis Caused by Japanese Cedar Pollinosis (SAR-JCP) is a most common allergic rhinitis, affecting about 40% in Japan, but the influence from SAR-JCP upon asthma is controversial. The purpose of this study is to investigate the effect of coexistence of SAR-JCP upon control status of asthma using SACRA (Self-Assessment of Allergic Rhinitis and Asthma Questionnaire).

Methods: The design was prospective, single-center, observational study. Asthmatic patients were classified into 3 groups, patients without rhinitis, those with perennial rhinitis or those with SAR-JCP from the results of SACRA. The control status of asthma were evaluated by Visual Analog Scale (VAS) in SACRA and Asthma Control Test (ACT) score. They were evaluated twice, from September to January (nonpollen-season) and February to April (pollen-season) and compared.

Results: 451 patients were enrolled and 325 cases (72%) were diagnosed as having comorbidity of rhinitis, among which 173 with only perennial rhinitis, while 152 with SAR-JCP. There was no significant difference in asthma control level measured by VAS and ACT score among 3 groups during nonpollen-season. The asthma control level measured by VAS (1.91–2.95) and ACT score (22.7–21.6) got worse during pollen-season among patients with SAR-JCP, even though 84% received treatment for rhinitis. Although it differed according to criteria, asthma control during pollen-season was impaired in 18–38% asthmatic patients with SAR-JCP.

Conclusion: It is possible to minimize the influence of AR on asthma control by obtaining an accurate diagnosis and providing sufficient treatment for rhinitis.

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Introduction

Asthma and allergic rhinitis (AR) are common health problems that cause major illness worldwide. Several studies have shown that rates for asthma vary from one country to another and there are more than 300 million asthmatics worldwide.¹ The prevalence of AR is estimated to range from 10 to 30% in the United States and

European countries.^{2–4} Using conservative estimate, it is proposed that AR occurs in approximately 500 million people and about 200 million people also have asthma as a comorbidity.^{5,6}

According to the epidemiological survey in Japan, the prevalence of AR in general population was 39.4%, extremely high level compared with those in other developed countries. Seasonal allergic rhinitis caused by Japanese cedar pollinosis (SAR-JCP), a disease unique to Japan, showed a prevalence of 26.5%, accounting for majority of AR cases.^{7,8} Furthermore, according to cross-sectional nation-wide surveillance in Japan, SACRA (State of the Impact of Allergic Rhinitis on Asthma Control) study,⁹ rhinitis was present in 67.3% of asthmatics and asthma control was significantly impaired in patients with rhinitis.

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Japanese cedar pollens have a diameter of approximately 30 μm and, because of their large size, do not reach the lower respiratory tract and were therefore considered unlikely to cause asthma. As a result, only perennial AR was suspected to be strongly related to asthma aggravation, whereas reports on seasonal rhinitis-induced aggravation of asthma were limited.¹⁰ However, with the growing awareness in recent years that airborne orbicules (particle size approx. 1 μm) on the surfaces of cedar pollen grains are widely disseminated, their relationship to asthma has been attracting attention, and there are now sporadic reports suggesting SAR-JCP-induced aggravation of asthma.^{11,12} However, influence of SAR-JCP on asthma control is still controversial.

The purpose of this study is to investigate the effect of coexistence of SAR-JCP upon asthma control status receiving long-term controller medications. We have reported clinical usefulness of SACRA (Self-Assessment of Allergic Rhinitis and Asthma Questionnaire), which GINA and ARIA Japan Committees developed in 2011, a simple guideline-based tool to evaluate the severity of both diseases.¹³ In this study, control status of asthma were evaluated by Visual Analog Scale (VAS), GINA asthma control criteria in SACRA, and Asthma Control Test (ACT) score.

Methods

Subjects and study design

The subjects of the study were outpatients of the National Center for Global Health and Medicine, aged 20 years or older, with asthma who had been treated with controller medication for more than 6 months. The diagnosis of asthma was defined as the presence of compatible clinical history and pulmonary function tests demonstrating variable airflow limitation by means of

bronchodilator responsiveness or by demonstrating bronchial-hyperresponsiveness using methacholine challenge, which satisfied those of GINA.¹⁴ In order to exclude the influence of upper airway inflammation on the symptoms of rhinitis and asthma, patients complaining of fever and/or pharyngeal pain were excluded from the survey. These patients were to be surveyed only after these symptoms had shown amelioration.

The study design was prospective, single-center, observational study. Asthmatics from whom written consent was obtained were included in the study. During a routine examination, the patients were asked to take ACT survey (asthma control status for only the previous one week; ACT originally inquired for the past 4 weeks). Fractional exhaled nitric oxide (FeNO) value was measured using NIOX-MINO (Aerocrine Ltd., Solna, Sweden).¹⁵ Thereafter patients were asked to fill out SACRA in the presence of physician. We have already reported the content of SACRA in detail.¹³ In short, asthma control questionnaire consisted of questions about symptoms (qualitative) in the past one week to assess the asthma control level as specified by GINA and visual analog scale (VAS) (quantitative), which ranged from not at all bothersome (0) to extremely bothersome (10). AR symptoms were also evaluated quantitatively by VAS. After the entries were checked, blood tests (eosinophil count and IgE RAST) were performed. Antigen-specific IgE measured were as follows; house dust, *Dermatophagoides*, Japanese cedar, cypress, ragweed, Japanese mugwort, orchard grass, fungi (*Aspergillus*, *Candida*) and pets (dog, cat).

The first survey was carried out nonpollen scattering season from September 2011 to January 2012. Strictly to say, September to January is non-Japanese cedar pollen scattering season, because Grass pollen is dispersed from June to October, while weeds pollen dispersed from August to October in Japan. In this study, however, we dare describe this period as nonpollen season, because the

Table 1
Demographic characteristics of all patients at first surveillance.

	All subjects	Allergic rhinitis (–)	Allergic rhinitis (+)	p Value
Patients, number	451	126	325	
Age				
Mean $\pm$ SD (y.o.)	56.9 $\pm$ 16.7	61.6 $\pm$ 117.1	55.2 $\pm$ 16.2	<0.01 [†]
≥ 60 years old	226	76	150	0.02 ^{*,†}
<60 years old	225	50	175	
Sex				
Male	196	62	134	0.01 ^{*,†}
Female	255	64	191	
Asthma duration (y)	14.3 $\pm$ 13.4	12.6 $\pm$ 12.9	15.1 $\pm$ 13.6	0.07 [†]
FEV _{1.0} (L)	2.19 $\pm$ 0.78	2.10 $\pm$ 0.82	2.25 $\pm$ 0.78	0.02 [†]
FEV _{1.0} % (%)	71.9 $\pm$ 12.3	70.0 $\pm$ 10.9	72.9 $\pm$ 12.3	0.01 [†]
Total IgE (IU/mL)	602.3 $\pm$ 2034	531.8 $\pm$ 2386	661.2 $\pm$ 1809	0.53
Serum eosinophil	311.8 $\pm$ 369.6	193.4 $\pm$ 337.5	399.8 $\pm$ 404	<0.01 [†]
GINA treatment step				
Step 2	63	19	44	0.05 ^{*,†}
Step 3	102	35	67	
Step 4	251	67	184	
Step 5	35	5	30	
Asthma treatment				
ICS/LABA	314 (69.6%)	85 (67.5%)	229 (70.5%)	0.88
LTRA for asthma (A)	195 (43.2%)	37 (29.45)	158 (48.6%)	0.03 [†]
Treatment for rhinitis (B)	194 (43%)	13 (10.3%)	182 (56%)	<0.01 [†]
A or B	298 (66.1%)	47 (37%)	251 (77%)	<0.01 [†]
ACT score	22.08 $\pm$ 3.67	22.51 $\pm$ 3.16	22.51 $\pm$ 3.16	0.57
Asthma VAS	1.78 $\pm$ 2.34	1.78 $\pm$ 2.34	1.96 $\pm$ 2.36	0.21
Rhinitis VAS	0.79 $\pm$ 1.59	0.79 $\pm$ 1.59	4.03 $\pm$ 3.26	<0.01 [†]
FeNO (ppb)	35.7 $\pm$ 25.8	35.7 $\pm$ 25.8	42.6 $\pm$ 36.7	0.03 [†]
GINA control status				
Well controlled		103 (81.8%)	263 (80.9%)	
Partly controlled		19 (15.1%)	46 (14.2%)	0.08*
Uncontrolled		4 (3.1%)	16 (4.9%)	

Data are presented as mean $\pm$ SD. p values of chi-square test (*) and Mann–Whitney U-test are shown.

[†] Revealed statistically significant.

purpose of this study is to know the influence from Japanese cedar pollen. The diagnosis of AR was made mainly based on rhinitis symptoms reported on SACRA and serum allergen-specific IgE RAST as a reference to Japanese diagnostic criteria for AR.^{7,16} The patients diagnosed as SAR-JCP with IgE positive for Japanese cedar received another survey during pollen-season February to April 2013, and the results of SACRA, ACT scores were compared with those obtained during nonpollen-season.

Statistical analysis

All measurement values were presented as mean $\pm$ standard deviation (SD). The chi-square tests and Mann–Whitney *U*-tests were analyzed to compare each group. Comparisons between each measured values during nonpollen and pollen season were analyzed using paired Student *t*-test, and McNemar test. The correlation between 2 parameters such as VAS and ACT score was analyzed by the Pearson correlation coefficient method. Logistic regression analysis was performed to explore the multivariate odds ratios between risk factors and outcomes of interest.

Performance of this study was approved by the Ethics Committee of the National Center for Global Health and Medicine (NCGM-G-001108-00). Clinical trial registration number was UMIN000012457. Use of SACRA questionnaire, and translation in English of Japanese original version were approved by GINA and ARIA Japan committee.

Results

Subjects and background

From 462 patients surveyed, valid responses were obtained from 451 patients. This included 196 males and 255 females, with a mean age of 56.9 years old, and FEV_{1.0}% 71.9%. Asthma treatment included leukotriene receptor antagonists (LTRA) in 195 patients. There were 194 patients already receiving some treatment, either oral or nasal drugs, for AR (Table 1).

Prevalence of AR and its impact upon asthma control during nonpollen-season

The AR comorbidity rate based upon the previously mentioned criteria, was 72% (325 patients). As shown in Table 1, the mean age of asthmatic patients with comorbid AR was significantly lower and there were more females as compared with those free of comorbid AR. Judging from the GINA treatment step, severely asthmatics receiving intensive treatments were significantly more numerous among those with comorbid AR. In the group with comorbid AR, LTRA was prescribed as asthma medication to 158 patients (48.6%) and, if these patients were included, 251 (77%) had already been given some form of treatment for AR. The first survey conducted during nonpollen-season had shown a relatively favorable level of asthma control, with the overall mean ACT score being 22.3 and GINA asthma control level of “well controlled” in 366 patients. Furthermore, no significant difference was observed between the groups with and without comorbid AR in any of the following evaluation criteria: ACT score, asthma VAS, and GINA asthma control level. Only FeNO was significantly higher in the group with comorbid AR than in the group without comorbid AR. When patients were classified by GINA treatment step into 2 subgroups, i.e., the mild asthma subgroup in steps 2 to 3 and the moderate to severe subgroup in steps 4 to 5, no significant difference was observed in asthma VAS between patients with versus without comorbid AR in mild subgroup. In moderate to severe subgroup, in contrast, the asthma VAS was significantly higher in the group with

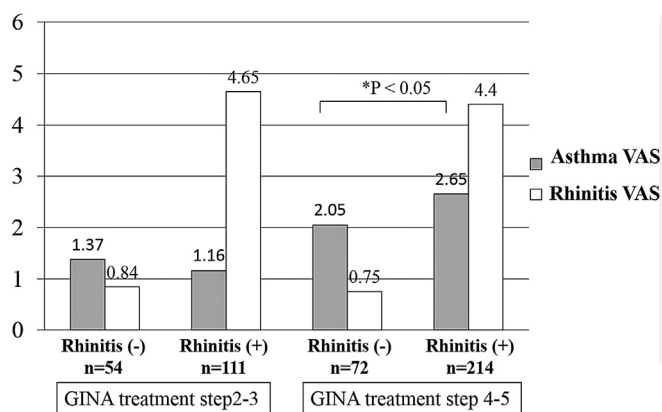


Fig. 1. Asthma control level measured by VAS during nonpollen scattering season based upon GINA treatment step (asthma severity) at first surveillance. * Revealed statistically significant with Cochran and Cox analysis.

comorbid AR than in the group without comorbid AR, showing a tendency for poorer asthma control in the former group (Fig. 1).

Prevalence of SAR-JCP and its impact upon asthma control

When patients with comorbid AR were assessed for SAR-JCP based on results of IgE RAST and on symptom aggravation during pollen-dissemination season, 173 patients (38.4% of all patients) were found to have perennial AR only, whereas 152 (33.7%) had SAR-JCP either with ($n = 53$) or without perennial AR ($n = 99$). In addition to SAR-JCP, there were small number of other pollinosis. Forty-five patients were IgE positive for ragweed, 55 cases positive for Japanese mugwort and 59 cases positive for orchard grass. For example, among 59 patients IgE positive for orchard grass, 57 cases were simultaneously IgE positive for Japanese cedar, while other 2 cases were IgE positive for house dust, and there were no cases IgE

Table 2
Demographic characteristics of patients with allergic rhinitis at first surveillance.

	Perennial rhinitis only	SAR-JCP (+/- perennial rhinitis)	p Value
Patients, number	173	152	
Age			
Mean $\pm$ SD (y.o.)	56.3 $\pm$ 16.9	53.9 $\pm$ 15.3	0.09
≥ 60 years old	84	66	0.35*
<60 years old	89	86	
Sex			
Male	66	68	0.23*
Female	107	84	
Asthma duration (y)	13.8 $\pm$ 13.6	16.7 $\pm$ 13.6	0.03 [†]
FEV _{1.0} (L)	2.22 $\pm$ 0.74	2.28 $\pm$ 0.81	0.26
FEV _{1.0} % (%)	73.9 $\pm$ 11.3	71.8 $\pm$ 13.3	0.07
Total IgE (IU/mL)	712.9 $\pm$ 2222	602.3 $\pm$ 1180	0.29
Serum eosinophil	338.9 $\pm$ 397.4	340.8 $\pm$ 413.2	0.48
GINA treatment step			
Step 2	30	14	0.04* [†]
Step 3	41	26	
Step 4	93	91	
Step 5	9	21	
Asthma treatment			
ICS/LABA	109 (63%)	120 (78.9%)	<0.01 [†]
LTRA for asthma (A)	75 (43.3%)	83 (54.6%)	0.04 [†]
Treatment for rhinitis (B)	87 (50.3%)	95 (62.5%)	0.03 [†]
A or B	123 (71%)	128 (84%)	0.01 [†]

Data are presented as mean $\pm$ SD. p values of chi-square test (*) and Mann–Whitney *U*-test are shown.

[†] Revealed statistically significant.

Table 3

Change of control status of asthma and allergic rhinitis between 2 surveillances among the patients with comorbid AR.

	Non pollen scattering season	Pollen scattering season	p Value
ACT score	22.7 ± 3.05	21.6 ± 3.89	<0.01
Asthma VAS	1.91 ± 2.32	2.95 ± 2.48	<0.01
Rhinitis VAS	2.72 ± 3.33	3.73 ± 2.68	0.04
FeNO (ppb)	45.3 ± 36.7	43.1 ± 35.9	0.14
GINA control status			
Well controlled	123 (80.9%)	109 (71.7%)	0.16*
Partly controlled	18 (11.8%)	28 (18.4%)	
Uncontrolled	11 (7.3%)	15 (9.9%)	

Data are presented as mean ± SD. p values of McNemar test (*) and Mann–Whitney U-test are shown.

positive only for orchard grass. Then 59 cases were classified as follows; 2 cases perennial rhinitis only, 15 cases only SAR-JCP, and 42 cases both SAR-JCP and perennial rhinitis.

The second survey was conducted in these 152 patients during pollen-season. As shown in Table 2, no difference was observed in either age or sex between patients with and without comorbid SAR-JCP, in those with comorbid AR. The only difference was a higher percentage of patients with severe asthma in the group with comorbid SAR-JCP, as judged by the GINA treatment step. AR therapy of any type, including LTRA prescribed for asthma, had already been administered to as many as 123 patients (71%) with comorbid perennial AR only, but the number of treated patients was significantly greater, 128 (84%), in the group with comorbid SAR-JCP.

During nonpollen-season, no significant difference was observed in asthma control levels, as measured by VAS and ACT scores, among the groups without comorbid AR, with perennial AR, and with SAR-JCP. During pollen-season, in contrast, the group with comorbid SAR-JCP showed an overall tendency for poor asthma control, with a significant decrease in the ACT score from 22.7 to 21.6 and a significant increase in the asthma VAS from 1.91 to 2.95 (Table 3).

Regarding the correlation between asthma VAS and rhinitis VAS, the Pearson correlation coefficient (*r*) was 0.2759 in the group without comorbid AR and 0.2212 in the group with perennial AR, showing no correlation in either group. In the group with comorbid SAR-JCP, in contrast, *r* was 0.2611 during nonpollen-season but increased to 0.4252 during pollen-season, showing a correlation (*p* = 0.03), and thereby suggesting the aggravation of rhinitis symptoms to exert an influence on the worsening of asthma control (Table 4).

Worsening of asthma control in patients with comorbid SAR-JCP during pollen-season

The influence of SAR-JCP on asthma control in individual patients was investigated. GINA asthma control level decreased from

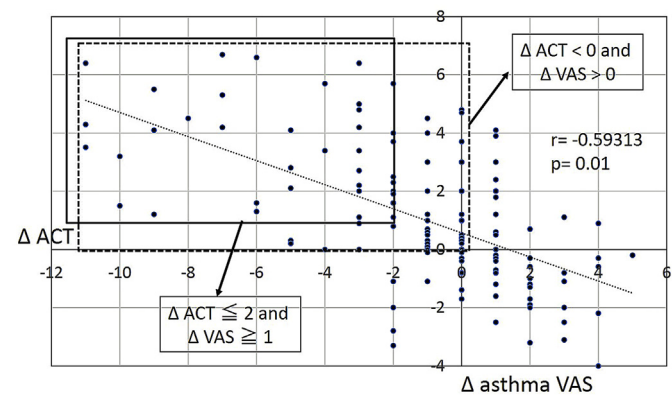


Fig. 2. The change of asthma VAS value and ACT score from nonpollen season to pollen season. The differences in ACT score or asthma VAS between the pollen season and the non-pollen season are defined as Δ ACT and Δ VAS, respectively. For both parameters, any degree of aggravation, i.e., Δ ACT < 0 and/or Δ VAS > 0, is defined as “lax criteria for aggravation”, 58 patients (38.2%) met these criteria, while Δ ACT ≤ 2 and Δ VAS ≥ 1” is defined as “more strict criteria for aggravation”, 39 patients (25.7%) met these criteria.

“well controlled” during nonpollen-season to “partly controlled/uncontrolled” during pollen-season in 28 patients (18%).

The differences in ACT score or asthma VAS between pollen-season and nonpollen-season are defined as Δ ACT and Δ VAS, respectively. For both parameters, any degree of aggravation during nonpollen-season, i.e., Δ ACT < 0 and/or Δ VAS > 0, is defined as “lax criteria for aggravation”. We found that 58 patients (38%) met these criteria. On the other hand, in the assessment of ACT scores over time, clinically significant differences in the score were reportedly 2 to 3.¹⁷ If “ Δ ACT ≤ 2 and Δ VAS ≥ 1” is defined as “more strict criteria for aggravation”, 39 patients (26%) in our survey met these criteria (Fig. 2). Thus, 18%–38% of asthmatics with comorbid SAR-JCP showed a worsening of asthma control during pollen-season, depending on the method of the assessment.

Factors related to a worsening of asthma control during pollen-season among the group with “more strict criteria for aggravation” were investigated employing multivariate analysis. As shown in Table 5, lack of comorbid perennial AR and the occurrence of nasal congestion symptoms were identified as significant factors.

Discussion

We investigated the influence of rhinitis symptoms on asthma control in asthmatics with comorbid AR using the SACRA and obtained the following findings: (i) Seventy-two percent of asthmatics have comorbid AR of some type, and 34% have comorbid SAR-JCP, (ii) during nonpollen-season, comorbid AR has no effect on asthma control, not only in patients with comorbid SAR-JCP but also in those with perennial AR, provided that asthma and rhinitis are appropriately treated, whereas during pollen-season, asthma control worsens in patients with comorbid SAR-JCP, and (iii)

Table 4

Correlation of between VAS, ACT score and FeNO value in each sub-groups.

	Allergic rhinitis (–)	Perennial rhinitis	SAR-JCP	
			Non pollen scattering season	Pollen scattering season
Asthma VAS vs ACT score	–0.72436 [†]	–0.69621 [†]	–0.72618 [†]	–0.64754 [†]
Asthma VAS vs Rhinitis VAS	0.27588	0.22118	0.26111	0.42515 [†]
Asthma VAS vs FeNO	–0.16251	–0.03591	0.09271	0.07509
Rhinitis VAS vs FeNO	–0.04129	–0.10671	0.03584	0.03627

The Pearson correlation coefficient value (*r*) are shown.

[†] Revealed statistically significant.

Table 5

Contributory factors for the asthma exacerbations during pollen season among the patients with comorbid SAR-JCP; results of multivariate logistic regression analysis.

Factors	p Value	Hazard ratio	95% CI
Sex; female	0.98	0.926	0.446–1.923
Age; < 60 years old	0.93	1.036	0.501–2.144
FEV1.0; < 70%	0.48	1.394	0.669–2.911
GINA step 2 or 3	0.92	0.954	0.415–2.191
GINA step 5	0.95	0.892	0.304–2.619
Without perennial rhinitis	0.03 [†]	2.564	1.081–6.082
LTRA for asthma	0.65	1.269	0.608–2.654
Yearly anti-allergic drug	0.11	0.326	0.092–1.154
Nasal corticosteroid use	0.66	0.788	0.374–1.658
Nasal obstruction	0.03 [†]	2.362	1.126–4.956
Watery discharge	0.21	1.714	0.823–3.569

[†] Revealed statistically significant.

asthma symptoms worsen with the exacerbation of rhinitis symptoms in 18–38% of patients with comorbid SAR-JCP, and in particular, exacerbation of nasal congestion correlates significantly with a worsening of asthma control.

According to the above-mentioned SACRA study⁹ and to others, AR comorbidity rate in asthmatics in Japan is approximately 65%, whereas the prevalence of AR was observed to be slightly higher in our study. However, given that patients examined by primary care physicians are the main targets of most epidemiological surveys, whereas patients with relatively severe disease treated in tertiary care medical institutions were the targets of our study, the prevalence of 72% can be regarded as clinically reasonable. The SAR-JCP comorbidity rate of 33.7% is not significantly different from the rates in other reports on asthmatic patients in Japan.^{18–20} Previously, we reported a strong correlation between VAS and the ACT score during nonpollen season.¹³ In the preset study, we analyzed subgroups classified by the presence or absence of comorbid AR and based on the presence or absence of pollen dissemination, and observed strong correlations between these two parameters in all subgroups studied. These results confirm the usefulness of the asthma VAS as an index for assessing asthma control.

In our study, comorbid AR did not influence asthma control during nonpollen-season. This observation differs from those described in previous reports which showed a worsening of asthma control in patients with comorbid AR. There are several possible reasons for this discrepancy. First, SACRA and other studies included the pollinosis season in the study period, whereas in our study, seasonal factors were strictly separated when making comparisons. Second, patients with comorbid AR had already received more intensive treatment for asthma than those without comorbid AR, as judged by the GINA treatment step. Third, most of our target patients had already achieved favorable asthma control, solely as a result of receiving adequate treatments for asthma and rhinitis.

Regarding asthma control in our study, the rate of partly controlled/uncontrolled was 18.6%. A recent survey in Japan that reported that 61% of asthma patients had symptoms in the prior one month,²¹ which suggests good asthma control in our patients. In addition, mean asthma VAS value in the group without comorbid AR was 1.78, and in the group with comorbid AR, it was 1.96. In the SACRA study, the mean was 2.90 in the group without and 4.75 in the group with comorbid rhinitis. From this perspective as well, asthma control in the present patients can be judged as relatively good. Several reasons for this may be considered. All the attending physicians in this clinical study were certified specialists of allergology. Compared to the situation in the SACRA study where 86% of patients were examined by a general physician, our study had more specialists involved in diagnosis and treatment, in which LTRA had already been prescribed to 48% of the patients and 56% received

some type of rhinitis treatment may have been a substantial factor in having achieved good asthma control. This fact suggests the importance of comorbid AR and its treatment for asthma control. However, the sub-analysis of patients with moderate to severe asthma showed a worsening of asthma control in those with comorbid AR, suggesting that there was a limit to the efficacy of aggressive rhinitis treatment in patients with severe asthma.

Among causes of pollen-induced seasonal asthma, ragweed-induced asthma is frequently observed in the United States and some other countries and, in this type of asthma, the local treatment of rhinitis alone is reported to be effective for improving asthma control.²² Thus, the close relationship between rhinitis and asthma is well known. In contrast, SAR-JCP has been considered unlikely to be related to the occurrence and aggravation of asthma, despite the far greater quantities of pollen grains being disseminated as compared with ragweed. Attention has only recently been paid to the relationship between cedar pollinosis and asthma, and there are sporadic reports indicating that asthma symptoms worsen with the aggravation of rhinitis symptoms in approximately one third of asthmatic patients with comorbid SAR-JCP, but these reports were based on the results of general questionnaire surveys only.^{11,18} In our study, we evaluated asthma symptom aggravation using a combination of the SACRA prepared based on GINA and ARIA, and ACT which is widely used clinically. For ACT (25 full score), the cut-off level of 2–3 has been established for diagnosing clinical worsening, whereas no such cut-off level has been established for VAS. Therefore, we directly applied the percent change at the cut-off ACT score to VAS (full score 10) for the sake of convenience, and obtained a score of 1 as the cut-off level for VAS. Although the appropriateness of this method for determining the cut-off level of VAS requires further validation, the assessment of asthma control using these two quantitative parameters is considered to be highly reliable. In our study, asthma symptoms worsened with the aggravation of rhinitis symptoms in 18%–38% of patients, depending on the method of evaluation. This aggravation rate, which was observed under the situations in which 128 patients (84%) among those with comorbid SAR-JCP were considered to be receiving some form of treatment for rhinitis, suggests the presence of a substantial impact of SAR-JCP on asthma control.

Furthermore, the finding that aggravation of nasal congestion among rhinitis symptoms correlated significantly with asthma aggravation suggests the importance of more aggressive treatment for rhinitis, particularly for nasal congestion symptom. The fact that lack of comorbid perennial AR significantly related to a worsening of asthma control during pollen-season among SAR-JCP patients also suggest the importance of more aggressive treatment for rhinitis even during non-pollen-season, because 46 cases out of 53 patients with SAR-JCP with perennial rhinitis already received LTRA, while 37 out of 99 patients with only SAR-JCP received LTRA.

A limitation of the present study is that it was conducted only in the limited number of patients in a single medical institution. On the other hand, this resulted in studying a relatively homogeneous patient population receiving essentially identical levels of treatment from specialists, allowing investigation based on detailed information not available in most epidemiological surveys. The results demonstrated that, in asthmatic patients with comorbid AR, it is possible to minimize the influence of AR on asthma control by obtaining an accurate diagnosis and providing sufficient treatment for rhinitis. We believe that diagnosis and treatment of AR, especially SAR-JCP can greatly contribute to improved quality of asthma management and improved QOL in asthmatics.

Authors' contributions

MH performed the primary data analysis and wrote the manuscript. KO was responsible for developing SACRA questionnaire as a chairman of GINA Japan

Committee and ARIA Japan Committee. MI and JH helped data collection of asthmatics. HS and KT contributed to study design and interpreted data. All authors approved the final version of the manuscript.

Conflict of interest

MH has received honoraria for lectures from AstraZeneca, GlaxoSmithKline, and Astellas. The rest of the authors have no conflict of interest.

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