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MAIN ARTICLE

Could seasonal allergy be a risk factor for acute rhinosinusitis in children?

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Abstract

Objective: To evaluate the incidence of acute rhinosinusitis in children with grass pollen induced rhinitis during the period of grass pollinosis.

Methods: Children with nasal symptoms from grass pollen induced rhinitis but without rhinosinusitis symptoms were selected. Their parents were asked to complete a diary during pollen exposure to report nasal symptoms and drugs used daily. When rhinosinusitis was suspected, the confirmatory diagnosis of acute rhinosinusitis was made by fibro-endoscopy. Children without inhalant allergy served as controls.

Results: Seventeen out of 242 children (7.0 per cent) had a diagnosis of acute rhinosinusitis, confirmed by fibro-endoscopy, during grass pollination, compared to 3 out of 65 (4.6 per cent) in the control group ($p = 0.49$). Among allergic children, those with acute rhinosinusitis had symptoms for a greater number of days and/or a higher symptoms score than children without acute rhinosinusitis.

Conclusion: Children with grass pollen induced rhinitis during exposure to pollen have an incidence of endoscopically confirmed acute rhinosinusitis comparable to non-allergic children. This suggests that grass pollen induced rhinitis is a negligible risk factor for acute rhinosinusitis.

Key words: Sinusitis; Seasonal Allergic Rhinitis; Children; Endoscopy

Introduction

According to the European Position Paper on Rhinosinusitis and Nasal Polyps ('EPOS'), acute rhinosinusitis in children is defined as 'inflammation of the nose and paranasal sinuses characterised by two or more symptoms, one of which should be either nasal blockage/obstruction or nasal discharge (anterior or posterior)'.[1] Acute rhinosinusitis has a duration of less than 12 weeks; a duration of 12 weeks or longer reflects chronic rhinosinusitis.[1]

The European Position Paper reported an estimated prevalence of acute rhinosinusitis of 6–12 per cent, with no distinction between adults and children.[1] In contrast, other studies have found differences between adults and children. For example, in the Netherlands, in 2015, an incidence of 18.8 cases per 1000 per year in the general population was reported.[2] In a previous survey addressing children, acute rhinosinusitis was reported in 18 cases per 1000 per year in participants aged 12–17 years, similar to the incidence in the general population, but in 2 cases per 1000 per year in participants aged 0–4 years.[3]

Phase two of the International Study of Asthma and Allergies in Childhood ('ISAAC') reported that the prevalence of rhinoconjunctivitis and rhinitis without conjunctivitis varied widely among allergic rhinitis patients within the different countries studied (1.5–24.5 per cent and 1.4–45.2 per cent, respectively).[4] The relationship between rhinosinusitis and respiratory allergy is controversial, with some studies, but not others, suggesting an important role for allergy as a risk factor for chronic rhinosinusitis.[5]

This study aimed to prospectively evaluate the incidence of acute rhinosinusitis during the grass pollen season in children with seasonal allergic rhinitis.

Materials and methods

Between 2010 and 2011, children with allergic sensitisation to grass pollen and rhinitis symptoms, but without rhinosinusitis symptoms, were selected.

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Exclusion criteria were: odontogenic causes of sinusitis, gross anatomical or congenital abnormalities of the upper airway, immunodeficiency, Down syndrome, cystic fibrosis, metabolic diseases, and ciliary dyskinesia. A group of children without inhalant allergies served as controls.

The children's parents were asked to complete a diary over a three-month period (April, May and June 2011) to report the symptoms experienced and the drugs used daily. We used the daily data to calculate the mean percentage of days with symptoms (or drug use) and the mean severity (or drug consumption) score (calculated only for those days with symptoms or requiring drug use) in children with and without endoscopically confirmed acute rhinosinusitis.

The symptoms indicative of acute rhinosinusitis, according to consensus documents, were: nasal blockage or stuffiness, nasal discharge, or post-nasal drip (mucopurulent or not); facial pain or pressure; headache; reduction or loss of smell; and cough.

Among the children with clinical symptoms, confirmatory diagnosis was made by nasal fibro-endoscopy, based on the observation of nasal polyps, mucopurulent discharge primarily from the middle meatus, and/or oedema or mucosal obstruction primarily in the middle meatus.[1] The endoscopic findings for each patient were graded according to a 0–3 scoring system, depending on the level of nasal polyps involvement, the severity of nasal mucopurulent discharge primarily from the middle meatus, and the degree of oedema or mucosal obstruction primarily in the middle meatus.

Skin tests

Skin prick tests were performed according to the European Academy of Allergology and Clinical Immunology guidelines[6] using standardised extracts (Stallergenes, Antony, France) of the common aeroallergens (grasses, parietaria, ragweed, artemisia, olive, birch, alder, *Dermatophagoides pteronyssinus* and *D farinae*, alternaria, aspergillus, and cat and dog epithelia).

The positive control was a 10 mg/ml solution of histamine dihydrochloride and the negative control was a saline solution. A positive skin prick test result was defined by the appearance of a wheal with an area larger than 7 mm,[2] with no reaction to the negative control.

Endoscopy

Nasopharyngeal endoscopy was performed using a 2.5 mm diameter fibre-optic, flexible nasopharyngoscope (Storz 11101 SK; Karl Storz, Tuttlingen, Germany). In all cases, the endoscopic evaluation included examination of the nasal turbinates and middle meatus, and the rhinopharynx to assess the adenoids and Eustachian tube orifice.

Statistical analysis

We compared acute rhinosinusitis prevalence among allergic children and controls by calculating the chi-square test values. Among allergic children, the average percentage of days with symptoms (or drug use) and the mean severity (or drug consumption) score (calculated only for those days with symptoms or requiring drug use), in children with and without endoscopically confirmed rhinosinusitis, were compared using the Wilcoxon-Mann-Whitney test. Data management and statistical analyses were performed with Stata statistical software, version 13 (StataCorp, College Station, Texas, USA).

Results

A total of 242 children with grass pollen induced allergic rhinitis were enrolled (173 males and 69 females), with a mean age of 13.2 ± 3.5 years (range, 6.1–18 years). The control group comprised 65 children (34 males and 31 females), with a mean age of 12.3 ± 3.2 years (range, 6.5–18 years).

In the allergy group, 17 children (7.0 per cent) were diagnosed with acute rhinosinusitis, as confirmed by nasal endoscopy, during the period from April to June. In the control group, 3 out of 65 children (4.6 per cent) developed acute rhinosinusitis. There was no difference between the two groups ($p = 0.49$).

Table I shows the demographic data for allergic children with and without acute rhinosinusitis. All allergic children with endoscopically confirmed acute rhinosinusitis had oedema and 71 per cent had discharge, but none had polyps.

In five children who were diagnosed with acute rhinosinusitis, endoscopy did not confirm the clinical diagnosis (false positive rate: 5 out of 225, 2.2 per cent).

For most symptoms, children with acute rhinosinusitis had symptoms for a higher mean percentage of days and/or a higher symptoms score than children without acute rhinosinusitis (Table II). Oral antihistamine use was similar in the two groups of children, while for children with acute rhinosinusitis a slightly higher consumption of beta-agonists was reported.

TABLE I
CHARACTERISTICS OF ALLERGIC CHILDREN WITH AND WITHOUT ACUTE RHINOSINUSITIS*

Characteristic	Children with rhinosinusitis	Children without rhinosinusitis
Total (*n* (%))	17 (100)	225 (100)
Sex (*n* (%))		
– Males	11 (65)	162 (72)
– Females	6 (35)	63 (28)
Age (mean (SD); years)	12.5 (3.5)	13.3 (3.5)
Polyps (*n* (%))	0 (0.0)	–
Severe oedema (*n* (%))	17 (100)	–
Discharge (*n* (%))	12 (71)	–

*Confirmed endoscopically. SD = standard deviation

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TABLE II
MEAN PERCENTAGE OF DAYS WITH SYMPTOMS (OR DRUG USE) AND MEAN SEVERITY SCORE IN ALLERGIC CHILDREN*

Symptom or drug	Children with rhinosinusitis	Children without rhinosinusitis	$p^{\dagger}$
Ocular itching			
– % of days	49	35	0.10
– Mean score	1.4	1.2	0.07
Lacrimation			
– % of days	33	23	0.34
– Mean score	1.2	0.9	0.09
Eye redness			
– % of days	42	27	0.12
– Mean score	1.3	1.1	0.26
Sneezing			
– % of days	67	51	0.03
– Mean score	1.6	1.3	0.01
Rhinorrhoea			
– % of days	65	41	0.002
– Mean score	1.5	1.1	0.001
Nasal stuffiness			
– % of days	68	38	0.0005
– Mean score	1.7	1.1	0.0000
Cough			
– % of days	31	18	0.04
– Mean score	1.1	1.0	0.32
Dyspnoea			
– % of days	7	4	0.14
– Mean score	0.8	0.5	0.07
Asthma			
– % of days	4	4	0.67
– Mean score	0.6	0.5	0.59
Oral antihistamines			
– % of days	40	32	0.48
– Mean score	0.6	0.7	0.81
Intranasal steroids			
– % of days	4	4	0.43
– Mean score	0.3	0.2	0.33
Inhaled steroids			
– % of days	4	6	0.87
– Mean score	0.2	0.2	0.88
Oral steroids			
– % of days	0	0	0.64
– Mean score	0.1	0.0	0.63
Beta-agonists			
– % of days	3	1	0.04
– Mean score	0.4	0.2	0.04
Allergen immunotherapy			
– % of days	12	23	0.29
– Mean score	0.1	0.2	0.28

Mean severity score calculated only for those days with symptoms. *With and without endoscopically confirmed rhinosinusitis. †Calculated using the Wilcoxon-Mann-Whitney test.

Discussion

The potential role of respiratory allergy in the development of sinusitis was first suggested in 1978, when acute rhinosinusitis was diagnosed in 53 per cent of allergic children.[7] However, the diagnosis was made using sinus X-ray, which is no longer admitted as a diagnostic tool for rhinosinusitis.[1] Ten years later, the issue was reappraised, assessing the occurrence of allergy in patients with verified acute maxillary sinusitis, which was found in 25 per cent of patients.[8] Furukawa, based on the analysis of such studies and a number of abstracts, concluded that 'the literature supports that allergy is an important associated factor in sinusitis'.[9]

Different results were reported when chronic rhinosinusitis was considered. Nguyen *et al.* examined the prevalence of chronic rhinosinusitis in children presenting to allergy clinics with respiratory symptoms lasting three months or more, and concluded that allergic rhinitis was not a risk factor associated with sinus abnormalities.[10] This was confirmed by another study in which the diagnosis of chronic rhinosinusitis was achieved by computed tomography scanning.[11] In fact, the 1998 Practice Parameters on Diagnosis and Management of Rhinitis described the relationship between allergy and sinusitis as 'in need of elucidation'.[12]

In a study published in 2006, on 351 children with chronic rhinosinusitis as defined by European Position Paper on Rhinosinusitis and Nasal Polyps criteria, the prevalence of both sensitisation to at least one inhalant allergen (determined by skin tests) and high total immunoglobulin E was 29.9 per cent.[13] This figure is comparable to that of the general paediatric population (not including the results of routine investigations for allergy in children with chronic rhinosinusitis).[13] Still, the role of allergy was raised again in later studies.

A retrospective study reported a prevalence of allergic rhinitis of 27 per cent in chronic rhinosinusitis children.[14] The authors concluded that allergy testing 'should be strongly considered in all children with chronic rhinosinusitis'. Again, other surveys did not confirm such a suggestion. For example, in a 5-year analysis of cross-sectional data from 35 511 participants, the mean prevalence of allergic rhinitis was 18.5 per cent for participants of all ages, but the correlation between sensitisation to aeroallergens and chronic rhinosinusitis was weak.[15]

In a very recent review, Tint *et al.* highlighted the role of a number of co-morbidities in chronic rhinosinusitis, deeming that 'allergy has been hypothesised to increase the risk of developing CRS [chronic rhinosinusitis] by inducing chronic inflammation and obstructing the sinus ostia', but stated that the data on this topic had produced inconclusive results.[16]

One study considered aspirin-exacerbated respiratory disease in a large group of patients.[17] When 171 patients with aspirin-exacerbated respiratory disease were compared to 459 patients with chronic rhinosinusitis alone, 300 patients with asthma alone, or 412 patients with both chronic rhinosinusitis and asthma, the prevalence of atopy was significantly higher in patients with aspirin-exacerbated respiratory disease (84 per cent) or asthma (85 per cent), than in patients with chronic rhinosinusitis (66 per cent). Furthermore, the prevalence of atopy in chronic rhinosinusitis patients was higher than that reported in the general population.[17]

Regarding acute rhinosinusitis, only one recent study on the role of allergy is available.[18] All patients, consisting of 69 children aged 3–12 years, were followed up for a period of one and a half years. Of these, the 27 children (39.1 per cent) who had allergic rhinitis

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were more likely to develop acute rhinosinusitis than non-atopic children.[18]

- **Acute rhinosinusitis is a very common disorder in children**
- **The most common risk factor for acute rhinosinusitis development is viral upper respiratory infection**
- **The role of allergic rhinitis in acute rhinosinusitis development is not clear**
- **Allergy to grass pollen during exposure to the causative pollen is not an important risk factor for acute rhinosinusitis**

We prospectively evaluated the incidence of acute rhinosinusitis during the grass pollen season in a population of 242 children with grass pollen induced allergic rhinitis. During the pollen season, 7.0 per cent of children had acute rhinosinusitis as assessed by nasal endoscopy, a rate very similar to the 4.6 per cent observed in the control group of children without an inhalant allergy. This shows that the risk of developing acute rhinosinusitis in children with allergic rhinitis caused by sensitisation to pollens is very low, and does not warrant performing examinations for acute rhinosinusitis. It is likely that the duration of allergic inflammation in a pollen season is not sufficiently prolonged to involve the paranasal sinuses. In children who developed acute rhinosinusitis, the scores for nasal symptoms, particularly sneezing, rhinorrhoea, nasal stuffiness and cough, were significantly higher in children with acute rhinosinusitis than in those without acute rhinosinusitis. Thus, the severity of symptoms should drive the choice to perform nasal endoscopy to disclose the disease.

Conclusion

The development of acute rhinosinusitis during the grass pollen season in children sensitised to grass pollen is very rare. Performing nasal endoscopy to detect possible acute rhinosinusitis in children with seasonal, pollen-induced rhinitis is warranted only in the presence of nasal symptom scores that indicate severe allergic rhinitis. However, such an observation cannot be translated to participants with longer exposure to allergens, particularly when the causative allergen sources are house dust mites. The possible higher risk of acute rhinosinusitis in this kind of allergy deserves to be investigated by specific studies.

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