



The influence of birch pollination on the adenoid size in children with intermittent allergic rhinitis

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KEYWORDS

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Summary

Introduction: Allergic sensitization of the airways occurs not only in the mucosa of the shock organ, but also in the lymphatic stations draining these structures. The lymphatic structure closest to the nasal mucosa in humans is the adenoid. Many researches show that in part of children allergic rhinitis can be a risk factor for adenoid hypertrophy.

Materials and methods: We used acoustic rhinometry and endoscopy to evaluate the influence of the birch pollination on the adenoid size in 67 children between 5 and 12 years old.

Four separate groups of children were examined. The study group consisted of 28 children hypersensitive to tree pollen with seasonal allergic rhinitis (interview, positive skin prick test results, presence of sIgE in the serum and positive nasal provocation test with birch pollen allergens).

The first control group consisted of 14 atopic children hypersensitive to motherwort pollen. The second control group consisted of 15 non-atopic children. The third control group consisted of 10 children hypersensitive to tree pollen, they have got anti-allergic treatment (topical nasal steroid and antihistaminic) a week before birch pollination. In all of the groups the adenoid size was examined before, during and after birch pollination. In the study group, we examined the influence of specific nasal provocation test on the adenoid size too.

Results: In most children from the study group (71.4%) we observed the significant increase of adenoid size in endoscopic examination and decrease of nasopharyngeal cavity volume in acoustics rhinometry (92.9%) during the birch pollination. The changes returned after pollination period in most children (90%). In the first and the second control group there were almost no changes observed ($p > 0.05$). The medical treatment used in the third control group avoided the increase of adenoid

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size during birch pollination season. In the study group there was no statistically significant correlation between the changes in nasopharyngeal volume during the pollination period and the results of nasal provocation test ($r = 0.18$).

Conclusion: The result of our study suggests that in children with seasonal allergic rhinitis the exposure on the allergenic factor can influence the adenoid size. Properly administered nasal glucocorticoid together with antihistaminic in standard doses can probably avoid this effect.

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1. Introduction

The hypertrophy of tonsils affects 1/3 of the population of children and is the most frequent otolaryngorhinological indication of the need for surgical intervention [1,2]. At present, it is assumed that pathological enlargement of the adenoid is largely a result of antigenic stimulation connected with severe or chronic inflammation processes in the immediate environment. Inflammatory changes occurring within nasal and sinus mucosa are of special significance here as the adenoid constitutes a local, most closely situated cluster of organised lymphatic tissue. Professional literature from the past few years suggests that in a certain group of children the factor responsible for the occurrence of hypertrophy of the third tonsil is co-existing allergic rhinitis [3]. If that is really the case, children with specific allergies should experience adenoidal enlargement during times of exposure to those antigens defined by objective measures of adenoid size and airway resistance. In the case of perennial allergens that circulate in the air all year long at a similar level of concentration (e.g. dust mites) or occur irregularly (e.g. mold allergens or animal allergens) inducing chronic allergic rhinitis, demonstrating such changes would be difficult. Things are different with seasonal allergens (plant pollens) whose exposure period is to a large extent predictable.

2. The aim of the study

The aim of the study is the evaluation of whether the exposure of children with seasonal allergic rhinitis to a sensitising factor influences the size of the adenoid.

3. Materials and methods

In a survey conducted in the years 2003–2005, 67 children took part. The actual study group (SG) included 28 children (16 girls and 12 boys) aged between 5 and 12 (mean age of 7.25 ± 2.12 years)

all suffering from periodic (seasonal) allergic rhinitis caused by an allergy to birch pollen allergens. The allergic background of their illnesses was revealed during interview and confirmed by simultaneous incidence of positive results of a skin prick test with birch pollen allergens as well as the appearance of appropriate sIgE antibodies detected in the sera of patients (the ELISA method, RV mini-system Allergopharma co.; discs tx 902) and a positive result of a nasal provocation test (NPT) with birch pollen (Allergopharma co; 108 – birch – 100%).

The study group patients did not have other sensitivities (except for other trees) and the onset of clinical symptoms correlated with the onset of tree pollination season. The control groups (CG) described below consisted of 39 children. In all the children from both SG and CG the estimation of the size of the adenoid was performed three times—about a week before the expected beginning of the birch pollination period (designated “I”), about 5–7 days after the occurrence of the first clinical symptoms (designated “II”) and 2 months after the end of the pollination period (designated “III”). Immediately after the second examination, treatment with orally administered cetirizine (Zyrtec, 10–15 drops a day) and fluticasone propionate (Flixonase spray, once a day to each nostril) was applied. This treatment was continued till the end of April. The assessed children had not undergone adenoidectomy and were not allowed to take any nasally administered steroids or antihistaminics. The study also excluded children in whom presence of infection was detected or children who demonstrated aberrated results of rhinoscopy (deviated nasal septum, etc.).

The study was conducted in two phases:

During the first phase, the changes observed in SG during the pollination period were compared to the potential changes found in the three CGs.

- the first control group (“atopic” control group ACG) included 14 children (5 girls and 9 boys; mean age of 6.79 ± 1.93 years) with allergic rhinitis caused by sensitivity to mugwort pollen (*Artemisia vulgaris*; diagnosis criteria were analogous with the criteria in SG);

- the second control group ("non-atopic" control group NACG) included 15 children (9 girls and 6 boys; mean age of 6.60 ± 1.72 years) who did not manifest symptoms of allergic illness or other atopic symptoms (negative interview result, negative results in skin prick tests with inhalatory allergens);
- the third control group ("treated" control group TCG) included 10 children (6 girls and 4 boys; mean age of 6.40 ± 1.35 years) with allergic seasonal rhinitis caused by sensitivity to birch pollen (diagnosis criteria were analogous with the criteria in SG). In this control group, preventive treatment was administered immediately after the first assessment (that is a week before the expected beginning of pollination period). Drugs and doses were analogous with those in SG. Treatment was continued till the end of April (assignment to SG and CG was random, in accordance with randomisation principles).

In all the children, the estimation of adenoid size and the size of nasopharyngeal cavity was based on acoustic rhinometry results (AR; RhinoScan 2000, a Danish acoustic rhinometer) and endoscopic examination (Olympus ENF-P3, a Japanese nasopharyngolaryngoscope).

Acoustic rhinometry was conducted after applying a vasoconstrictor to the nose (nasal mucosa anemisation), always prior to the endoscopic examination. In this examination, the mean change of value of nasopharyngeal volume (NPV) was estimated. In accordance with the literature, it was assumed that the most representative section of the rhinometric curve is a 4 cm section situated at a distance of 6–12 cm from the front nostril [4–8].

The endoscopic assessment employed a 4° classification of adenoid hypertrophy (AH) following Cho et al. [9]:

- 1° mild, adenoid obstructing less than 25% of nasopharyngeal airway;
- 2° moderate, adenoid obstructing between 25 and 50% of nasopharyngeal airway;
- 3° moderately severe, adenoid obstructing between 50 and 75% of nasopharyngeal airway;
- 4° severe, adenoid obstructing more than 75% of nasopharyngeal airway.

The aim of the second phase of the study that was performed on only 26 children from the SG about 6 months later (adenoidectomy was performed earlier in 2 children from the original SG) was to determine whether NPT with birch pollen allergen influences the size of the adenoid (nasopharyngeal volume). In this phase, only AR was conducted as the objective

measure 20 min before, 1 day and then 1 week after the NPT. Each time before the examination, nasal mucosa was vasoconstricted in order to eliminate a resultant swelling. In order to conduct the test, a new nasal provocation test manufactured by Allergopharma co. was used (test 108, birch 100%)—single dose method [10]. The result of the test was qualified as positive according to the criteria proposed by Bellia et al. [11].

All the children underwent examination at more or less the same time, in the autumn season, at least 3 months before the expected beginning of the pollination period [12].

Depending on the type of data to be analysed and their distribution in the statistical analysis, different parametric and non-parametric tests were used (described in the text). Differences where the value of p was lower or equal to 0.05 were considered as relevant. The calculations were made with the aid of STATISTICA 5 (StatSoft, USA) suite.

The study presented here was done as part of a larger study concerning the relations between atopic allergy with pathologies of the pharyngeal lymphatic system. Consent for the study was granted by the local bioethics committee.

4. Results

The results obtained for each group under comparison can be presented as follows.

4.1. SG

In this group, adenoid enlargement during pollination period was observed in endoscopic examination in 20 cases (71.4%). In 18 children, the adenoid enlarged by 1° and in 2 children by 2°. In two cases, the size of the adenoid remained increased 2 months after the end of pollination.

Friedman ANOVA test, at any significance level ($p < 0.00000$), showed a statistical difference between the results of successive endoscopic examinations in this group.

By analogy, rhinometric examination demonstrated similar, though even more pronounced changes. During pollination the nasopharyngeal volume of the examined area decreased by a varying degree in 26 cases (92.9%), and in set III increased in all cases (when compared with set II). Appropriate mean values in SG before the beginning of pollination were $6.72 \pm 1.89 \text{ cm}^3$ and decreased to $5.23 \pm 1.72 \text{ cm}^3$ during pollination (statistical significance for sets I and II; Student's t -test for related variables; $p < 0.00000$) just to increase again to $6.93 \pm 1.94 \text{ cm}^3$ 2 months after the

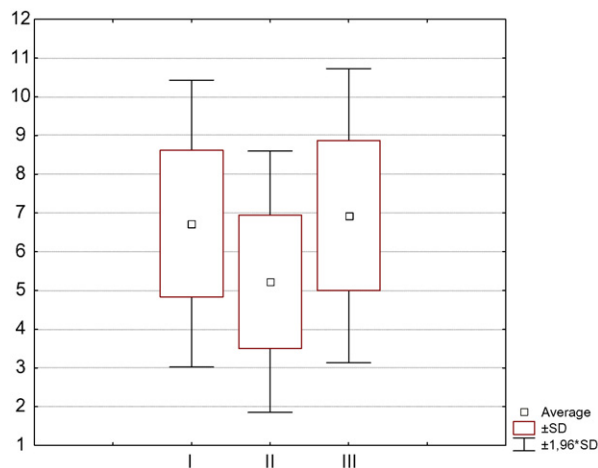


Fig. 1 The average volume of nasopharyngeal space (cm^3) in the study group. I: 1 week before birch pollination, II: during birch pollination period and III: 2 months after birch pollination.

completion of pollination (statistical significance for sets II and III; Student's *t*-test for related variables; $p < 0.00000$).

Mean values for sets I and III did not differ in a statistically significant way (Student's *t*-test for related variables; $p = 0.07$). This is depicted by Fig. 1.

4.2. ACG

In this group the endoscopic examination showed an enlargement only in the case of two children. In one child, the change took place during birch pollination and in the other between sets II and III. The differences that were observed between II and III were not statistically significant. This was also true of the AR results. The mean values obtained were $6.60 \pm 1.97 \text{ cm}^3$ in set I, $6.23 \pm 2.03 \text{ cm}^3$ in set II and $6.14 \pm 2.07 \text{ cm}^3$ in set III. The differences between the sets were not statistically significant (analysis of variance; $p = 0.82$).

4.3. NACG

In this group adenoid enlargement observable in endoscopy was found in just one child (difference between examination I and II). Between sets I and II the adenoid enlarged in two cases, and became smaller in one case.

AR results were $5.70 \pm 2.51 \text{ cm}^3$ for set I, $5.45 \pm 2.59 \text{ cm}^3$ during birch pollination and $5.44 \pm 2.62 \text{ cm}^3$ in III, after the pollination. Minor downward changes were observed. These were, however, not significant statistically (Friedman ANOVA test; $p = 0.1$).

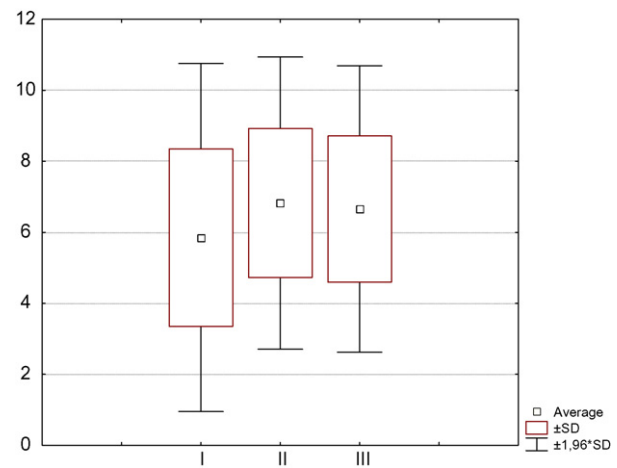


Fig. 2 The average volume of nasopharyngeal space (cm^3) in the "treated" control group. I: 1 week before birch pollination, II: during birch pollination period and III: 2 months after birch pollination (statistical significance; ANOVA Friedman test; $p = 0.002$).

4.4. TCG

This group is characterised by a noticeable decrease (endoscopy) in the size of adenoid in as many as five cases. In the five remaining cases, no changes were observed. Between sets II and III, adenoid enlarged noticeably in one child. Similar displacements were to be observed in AR, where the increase in nasopharyngeal volume between sets I and II occurred in all cases to a different extent. Appropriate mean values changed from $5.85 \pm 2.50 \text{ cm}^3$ before pollination to $6.82 \pm 2.10 \text{ cm}^3$ during pollination (statistical significance of the differences; Wilcoxon test; $p = 0.005$). After the pollination season, AR result was $6.66 \pm 2.06 \text{ cm}^3$ and the difference between III and II was not statistically significant (Student's *t*-test for related variables; $p = 0.2$). This is depicted by Fig. 2.

The table below is a collective representation of mean changes in nasopharyngeal volume as found during AR. It presents changes between the three sets in all groups that were compared (Table 1).

4.5. NPT results

AR results after NPT was conducted are presented in Fig. 3.

As can be seen, the differences between the initial mean measurement and the measurement recorded 20 min later were minute (the values were $7.28 \pm 1.74 \text{ cm}^3$ and $7.25 \pm 1.73 \text{ cm}^3$, respectively) and statistically insignificant (Wilcoxon test; $p = 0.1$). The sharpest drop in NPV occurred in the examination that was carried out a week after NPT (mean value $7.10 \pm 1.70 \text{ cm}^3$). The drop, although it

Table 1 The mean changes in nasopharyngeal volume (cm³) demonstrate in acoustic rhinometry

	SG	ACG	NACG	TCG
A	-1.50 ± 1.27	-0.34 ± 1.09	-0.25 ± 0.53	0.97 ± 0.93
B	1.70 ± 1.17	-0.12 ± 0.40	0.01 ± 0.63	-0.17 ± 0.41

SG, study group; GKA, "atopic" control group; NACG, "non-atopic" control group; TCG, "treated" control group; A, changes between first and second investigations; B, changes between second and third investigations.

was generally fairly insubstantial (-0.19 ± 0.12 cm³), was very significant statistically (Wilcoxon test; $p = 0.00002$). In some children there was merely a weak and statistically insignificant correlation between these changes and the corresponding changes that were observed between sets I and II during pollination ($r = 0.18$; $p = 0.4$).

The results of the examination conducted after a week after NPT (mean value 7.33 ± 1.74 cm³) did not differ significantly from the initial examination (Wilcoxon test; $p = 0.1$).

5. Discussion

The number of allergic diseases has been increasing for a fairly long time and allergic rhinitis is more and more often a problem affecting children from younger age groups [13]. It seems that allergic rhinitis may be one of the factors responsible for AH [14]. The fact that in the age group in which the incidence of AH is highest allergic rhinitis occurs relatively rarely makes this factor relevant for some children, but it cannot be the key cause of AH in the general population. Probably, this is why in children affected by AH the incidence of allergy is only slightly higher than in children without AH.

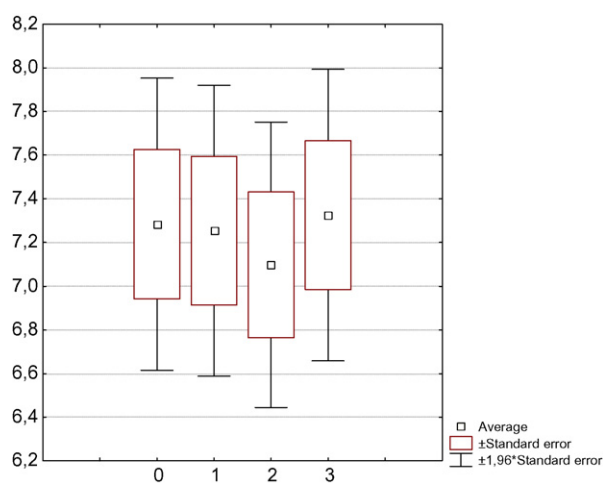


Fig. 3 The results of acoustic rhinometry (nasopharyngeal volume; cm³) during specific nasal provocation test in the study group. 0: before application of the allergen, 1: after 20 min, 2: after 1 day and 3: after 7 days.

Since the clinical symptoms of allergic rhinitis and AH are similar, it is likely that very often only one disease entity is recognised.

In the study presented here, the evaluation of the size of adenoid was performed with a group of children sensitive to birch pollen. This choice was based upon a number of reasons. Firstly, the sensitivity to tree pollens and especially birch pollen is common in a moderate climate. This is because the pollination period of birch is distinct and short and the concentration of pollen becomes high relatively quickly which makes it a convenient object of research. From the allergological point of view, the pollination period of birch in Poland begins around April 15 and the period of high pollen concentration (over 80 pollen/m³) lasts up to 2 weeks. Significant deviations from this pattern have not been observed throughout the past few years and it is worth stressing that in the period during which this study was conducted, concentration of pollens exceeded several times the threshold value on some days and reached several thousand grains per cubic meter [15]. It is worth underlining that tree pollens are the first allergens to appear after the winter season, which reduces the long-known priming effect [16] that could be brought by pollens of other plants and thus affecting the results.

Mugwort pollen is the predominant weed allergen in Central Europe with its season of pollination running from July to September. In Poland the pollination periods of trees and mugwort never coincide.

In this study, the size of the adenoid was evaluated by means of endoscopic examination (which served as direct assessment) and AR (indirect assessment). Both methods are widely recognised and practised [17,18]. Acoustic rhinometry is a valid and objective test for the evaluation of total volumes, valvular area and the area corresponding to the head of inferior turbinate, instead the posterior areas of rhinopharynx is not always and easily detectable [19–21]. Therefore, the vasoconstriction of nasal mucosa before AR was, in our opinion, indicated because the accuracy of measurement in this method decreases substantially when the nasal passages are narrowed, especially towards the back from the largest narrowing (MCA, minimal cross sectional area) [22]. We agree with other

researchers, that acoustic rhinometry is a fast and non-invasive method. In addition, it is very well tolerated and accepted by small children [23,24].

In the group of children that we examined (SG), in most cases adenoid enlargement occurred during birch pollination.

In ACG and NACG similar changes were not noted. In the study group, adenoid returned to its initial size in most children 2 months after the completion of pollination. Presumably this was a result of discontinued antigenic stimulation (lack of a sensitising factor in the environment) as well as the treatment provided. In several past papers it was pointed out that antiallergic drugs may not only have an influence on nasal mucosa, but also the adenoid [25–29]. In our case, this factor seems to be all the more relevant when considering the change of adenoid size in the TCG in which the drugs used not only prevented adenoid enlargement during birch pollination but also caused it to decrease in size in half of the cases. It may be assumed that in children from this group pollination of early pollinating trees (alder, hazel) could cause inflammatory reactions and adenoid enlargement which subsided after administration of drugs similarly to SG, even though symptoms of allergic rhinitis were not evident. The fact that this condition persisted even 2 months after the administration of drugs additionally confirms this assumption.

The outcome of the second phase of the examination where NPT was used shows that a single allergenic stimulation did have some influence on adenoid size, but was insignificant and short-lived (a return to the initial state within a week). Additionally, the fact that the more significant changes did not appear immediately after NPT (as usually takes place in the case of nasal mucosa) but on the second day may indicate that in adenoid pathologies the late phase of allergic reaction is vital. Also microscopic images showing adenoids of children affected by allergic rhinitis confirm this indirectly through the presence of eosinophil infiltration (histopathological examination) and increased activity of phagocytes and antigen-presenting cells (immunohistochemical study) [30–35]. The lack of correlation between the changes in NPT and analogical changes observed during pollination seems to disqualify this study as a tool for predicting the degree of adenoid reaction to a natural sensitising factor. By analogy to what we have observed, it can be assumed that in the case of perennial allergens, continuous antigenic stimulation may be responsible for preserving reactive enlargement and bringing about a typical hypertrophy.

6. Conclusions

- (1) The whole study seems to confirm the assumption that exposure to a sensitising factor may be one of the causes responsible for hypertrophy in children with allergic rhinitis.
- (2) Appropriately administered treatment of allergic rhinitis may reduce the incidence of adenoid hypertrophy in hypersensitive children.

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