

Paranasal sinus disease could be a reason for unsuccessful immunotherapy of inhalant allergy in children

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ABSTRACT

Purpose: The aim of this study was to evaluate the role of paranasal sinuses condition assessed in computed tomography on inhalant allergen desensitization effects.

Materials & methods: Retrospective analysis of medical records of children undergoing allergen immunotherapy in outpatient otolaryngology clinic of University Children Hospital in Lublin was performed. Control group consisted of children who underwent allergen immunotherapy and obtained satisfying effects; study group consisted of children who did not experience significant improvement after desensitization therapy.

Results: Computed tomography of nose cavity and paranasal sinuses exposed numerous pathologic changes affecting both, control and study group. Blockage of ostiomeatal complex was twice more common in children who did not respond adequately to desensitization therapy. In our study group, radiological findings suggesting rhinosinusitis were found in 73% of patients, while retention cysts in maxillary sinuses were discovered in 27% of patients.

Conclusions: Pathological findings in paranasal sinuses in computed tomography may arise from uncontrolled allergic rhinitis. If surgical management is indicated, allergen immunotherapy should be postponed until total recovery from operational procedure and repeated.

1. Introduction

Inhalant allergens presence in nasal cavity causes inflammatory IgE-mediated reaction, which manifests as middle turbinate oedema; this is a characteristic feature of physical examination in patients hypersensitive towards inhalant allergens [1]. In certain cases, inflammation could involve superior turbinate and upper segment of nasal septum, which may result in mechanical blockage of apical part of nasal cavity where sinuses apertures drain [2]. Persistent oedema of mentioned above structures may lead to sinusitis development [3].

Allergic rhinitis and sinusitis symptoms often overlap each other. Nasal blockage and congestion are basic symptoms for diagnosis of both diseases, while allergic rhinitis characteristic features include sneezing and pruritus of eyes or nose. Adolescents and adults in cases of rhinosinusitis often manifest headache, pressure localized in central compartments of face, mucus dripping on the posterior throat wall or smell disturbance; in children mentioned distinctive symptoms are less intensified and the main complaints concentrate on persistent and lingering cough [4].

Numerous studies investigated the role of allergy in pathogenesis of rhinosinusitis [5–7]. It is suggested that allergic inflammation of

mucosa predisposes development of chronic rhinosinusitis [8]. Allergy-based chronic or recurrent oedema of nasal mucosa, especially localized within ostiomeatal complex, contributes to sinus ventilation and drainage constraint and eventually complete blockage of natural sinus orifice leading to mucus retention and infection development [9].

Studies show that 36–60% patients suffering from allergic rhinitis also present with chronic rhinosinusitis; adequate control of allergen hypersensitivity may significantly reduce risk of concomitant nasal disease exacerbations by reducing nasal mucosa swelling and inflammation [10].

Role of concomitant inhalant allergy in surgical treatment of sinusitis has been extensively described in literature. However, not much current studies focus on impact of accompanying sinus disease on effects of allergy therapy [11]. Patients suffering from chronic rhinosinusitis show higher prevalence of allergen hypersensitivity compared to general population [12]. This incidence seems to be even higher, reaching 84%, among patients undergoing sinus surgery [13]. Moreover, concomitant allergy significantly worsens post-surgical effects [14].

The aim of this study was to assess the condition of paranasal sinuses in computed tomography in children treated for inhalant allergy

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undergoing allergen immunotherapy and evaluate its impact on desensitization effects in children admitted to outpatient otolaryngology clinic of University Children Hospital in Lublin.

2. Material and methods

Retrospective analysis of medical records of children undergoing allergen immunotherapy due to serious complaints arising from inhalant allergy in outpatient otolaryngology clinic of University Children Hospital in Lublin was performed. Analysed group emerged after exclusion of children with other concomitant diseases and those who underwent sinus surgical procedures in the past.

Analysed group comprised of 30 children aged from 6 to 17 years old, including 13 girls and 17 boys. Control group consisted of 15 children who underwent allergen immunotherapy and obtained satisfying effects after therapeutic procedure; study group consisted of 15 children who did not experience significant improvement after desensitization therapy.

Every patient underwent diagnosis oriented on allergy including skin prick test and evaluation of specific IgE antibodies against specific allergens before they were qualified for immunotherapy. Prior to beginning of treatment procedure patients were examined by paediatrician and otolaryngologist; physical examination was performed each time before the vaccination. Each patient underwent desensitization therapy which consisted of initial and maintenance immunotherapy. Initial therapy was conducted by administration of 10 vaccines in one week intervals and maintenance therapy required vaccines administration every 4–6 weeks for 2 years. Therapeutic outcomes were assessed based on subjective complaint trends, physical and otolaryngologic examination. Computed tomography of paranasal sinuses was performed in the interval of about one month after completion of immunotherapy scheme.

3. Results

Analysed group basic characteristics are presented in a table (Table 1).

In control group, immunotherapy was prosecuted mostly against house dust mite (7 cases; 47%), followed by grass pollen (3 cases; 20%), rye pollen (2 cases; 13%), birch pollen (2 cases; 13%) and moulds (1 case; 7%). In study group, the most common allergen causing hypersensitivity was also house dust mite (10 cases; 67%), followed by moulds (3 cases; 20%), cat dander (1 case; 7%) and grass pollen (1 case; 6%) (Fig. 1).

Computed tomography of nose cavity and paranasal sinuses exposed numerous pathologic changes affecting both, control and study group (Table 2).

In control group, mucosal thickening of ethmoidal sinuses was the most common change described in computed tomography found in 7 patients (47%) and mucosal thickening of maxillary sinuses found in 5 patients (33%). Middle nasal turbinate pneumatization (*concha bullosa*) was present in 4 cases (27%), ostiomeatal complex blockage in 2 cases (13%). Mucosal thickening of nasal turbinates was observed in 4 patients (27%), in 2 cases involving inferior nasal turbinate (13%). One patient (7%) presented modest intensity exudative and proliferative

lesions of left maxillary sinus. No retention cysts of maxillary sinuses were exposed in control group.

In study group, mucosal thickening of ethmoidal and maxillary sinuses were the most common changes described in computed tomography; each found in 9 patients (60%). 5 patients (33%) presented exudative and proliferative lesions of maxillary sinuses comprising at least one half of sinus capacity. Both retention cysts of maxillary sinuses and ostiomeatal complex blockage were present in 4 patients (27%). Mucosal thickening of nasal turbinates was observed in 4 patients (27%), in 2 cases involving inferior nasal turbinate (13%). One patient (7%) presented middle nasal turbinate pneumatization (*concha bullosa*).

4. Discussion

In Australian study the main allergens responsible for development of changes seen in radiological pictures of nasal cavity and paranasal sinuses in patients sensitive to inhalant allergens were house dust mites [3]. Analysis performed in University Children Hospital in Lublin seems to confirm these findings – 17 of our patients (57%) were allergic to house dust mites. Frequency of that kind of allergy was 20% higher in children with unsatisfying effects of immunotherapy, which may suggest higher predisposition of house dust mites to cause actual pathology in paranasal sinuses.

Isolated disturbance of drainage of sinonasal cavity central compartment is a distinctive feature for patients suffering from inhalant allergies [2]. Oedematous changes of mucosa located in upper part of nasal cavity and ethmoid cells observed in computer tomography pictures correspond with inflammatory reaction towards irritant particles and do not reflect actual sinus acquisition. That explains frequent radiological findings of ethmoid cells mucosal thickening in both, control and study groups. It is important to remember, that radiological pathologic changes subside slower than symptoms and complaints raised by the patient; that explains presence of opacification concerning central compartment of nasal cavity and medial segments of paranasal sinuses in computed tomography of patients who underwent successful allergen immunotherapy. In our study, abnormalities involving ostiomeatal complex could be observed in both, control and study groups; however, blockage of that structure was twice more common in children who did not respond adequately to desensitization therapy.

Middle nasal turbinate oedema is distinctive for patients with inhalant allergies, so presence of that pathological change in study, as well as control group was not a surprise. Nonetheless, in half of analysed cases swelling concerned also inferior nasal turbinate, which may suggest concomitant food allergy or cross-reactions between food and inhalant allergens [15]. The close proximity of inferior nasal turbinate to gastrointestinal tract provides its exposure towards allergens that penetrate the organism through oral cavity. Inflammatory reaction leads to swelling and redness of turbinate, while presented by the patient symptoms may be described as gustatory rhinitis [15,16]. It is also suggested that certain types of food may exacerbate inhalant allergic rhinitis symptoms also by non-IgE-mediated process [16]. In these cases, additional allergic tests and proper dietary restrictions implementation are recommended.

Pneumatization of nasal turbinates (*concha bullosa*) is suggested to provide defensive reaction of organism against irritant factors invasion [17]. Turbinates surface enhancement poses mechanical barrier for airflow and decreases prevalence of inhalant allergens attendance within nasal cavity. This protective role of pathological abnormality involving nasal turbinates fosters decline of inhalant allergy symptoms, which may explain its frequent presence in children who benefited from immunotherapy.

Epidemiological studies show high prevalence of inhalant allergy in patients suffering from acute and chronic sinusitis, which in some cases reach even 84% of studied groups [18]. Subjects with inhalant allergy more commonly arise complaints concerning paranasal sinuses compared to general population; most of them are allergic to perennial

Table 1
Socio-demographic characteristics of analysed children.

Characteristics		Control group	Study group
Gender	Female	6	7
	Male	9	8
Age	School children (6–11)	6	5
	Adolescents (12–17)	9	10
Residence	Rural	6	7
	Urban	9	8

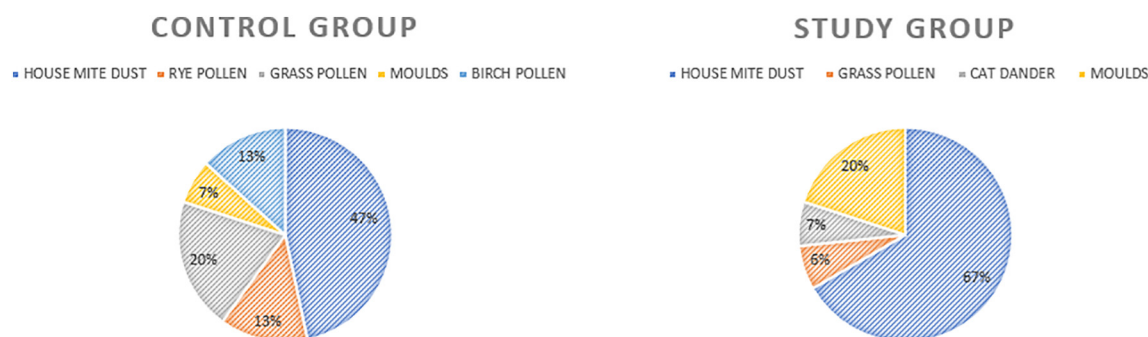


Fig. 1. Specific allergen hypersensitivity in control and study groups.

Table 2

Pathologic changes of nasal cavity and paranasal sinuses.

Pathologic changes	Control group	Study group
Ostiomeatal complex blockage	2	4
Mucosal thickening of ethmoidal sinuses	7	9
Mucosal thickening of nasal turbinates	4	4
Nasal turbinate pneumatization (<i>concha bollosa</i>)	4	1
Mucosal thickening of maxillary sinuses	5	9
Exudative and proliferative lesions of maxillary sinuses	1	5
Retention cysts of maxillary sinuses	0	4

rather than seasonal allergens [19]. In study group, radiological findings unequivocally suggesting rhinosinusitis was found in 11 patients (73%), at the same time retention cysts in maxillary sinuses were discovered in 4 patients (27%). None of mentioned above patients benefited from allergen desensitization.

Studies on allergy role in paranasal sinus diseases progression suggest that mucosal IgE-mediated inflammation favours development of acute and chronic sinusitis; nonetheless, direct mechanisms of that relation are still not fully evaluated and recent studies focus on searching for actual pathophysiological evidences [20].

Allergic rhinitis leads to nasal mucus congestion, which blocks the ostiomeatal complex initiating pathophysiological process in paranasal sinuses [21]. Gwaltney et al. did not observed higher prevalence of allergic patients in group of subjects with severe rhinosinusitis, which allows to suspect that additional risk factors may contribute to more severe forms of sinusitis [22]. Other authors suggest that exposure to inhalant allergens in sensitive individuals causes increased interleukin-5-mediated eosinopoiesis in bone marrow, which results in systemic eosinophilia and eosinophils cumulation in tissues including paranasal sinus mucosa being a trigger to inflammation development [23,24].

Some studies imply that pathological findings in paranasal sinuses in computed tomography may arise from uncontrolled allergic rhinitis [3]. Taking into account mentioned above pathophysiological mechanisms, this may explain unsatisfying results of immunotherapy in fraction of patients.

We recommend additional anti-inflammatory therapy in cases of concomitant sinusitis in patients with allergic rhinitis undergoing allergen desensitization [18]. If surgical management is indicated, allergen immunotherapy should be postponed until total recovery from operation and repeated. Recent studies show that immunotherapy may not be necessary after the procedure in some cases due to satisfactory effects of sinus surgery [25].

We thoroughly searched through existing literature and with regard to lack of reports on the specific subject of imaging findings in patients with allergic rhinitis undergoing immune therapy were not able to further discuss our results.

Some limitations in the research should be noted. The size of our patient population is small, which resulted from the fact that the study was conducted in one medical centre only. Due to that thorough

analysis would not, for the most part, yield any statistically significant results. In time of preparing this paper some of patients enrolled in our study was still waiting for surgical procedures; due to incomplete data we decided not to publish the results of our management.

This article is an initial report and our study team will continue research in that field of interest. With greater study population and complete results of recommended therapeutic pathway we would be able to draw more validated conclusions.

5. Conclusions

Treating patients with inhalant allergy and paranasal sinus disease is complex. Rhinosinusitis always has multifactorial aetiology. In choosing adequate management potential factors should be taken under consideration including genetics, anatomy, immunology, microbiology and environment [23]. In patients not responding to allergen immunotherapy it is recommended to perform otolaryngologic examination and commission additional studies in search for paranasal sinus disease; when sinus disease is confirmed, adequate management should be implemented.

Authors' contribution statement

According to The International Committee of Medical Journal Editors Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals authorship of Our study is based on the following criteria:

1. Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of the work are appropriately investigated and resolved – Marciniak Aleksandra
2. Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work – Anna Horaczyńska-Wojtaś, Marciniak Aleksandra
3. Drafting the work or revising it critically for important intellectual content – Marciniak Aleksandra
4. Final approval of the version to be published – Mielnik-Niedzielska Grażyna

Declaration of competing interest

The authors certify that they have NO affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in the manuscript.

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