

Rhinosinusitis in children and asthma severity

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Purpose of review

Rhinosinusitis is a common condition in children. The association between rhinosinusitis and asthma is supported by strong epidemiological and pathogenic evidence. Moreover, a close relationship between sinusitis and asthma severity has also been reported. This study shows the new findings in this strong relationship.

Recent findings

The profile of inflammatory cells and inflammatory mediators seen in both conditions bears considerable similarity, especially in both diseases with a relevant role played by eosinophils.

Summary

Severe asthma is uncommon in childhood, but there is compelling evidence showing that the most severe asthma is closely associated to upper respiratory illness, especially rhinosinusitis. Treatment of chronic rhinosinusitis, medical or surgical or both, benefits concomitant asthma and has been shown to reduce the severity of asthma.

Keywords

asthma severity, rhinosinusitis in children, rhinosinusitis treatment, upper respiratory illness

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Introduction

Recent studies in both children and adults have suggested that rhinosinusitis and asthma are manifestations of a common inflammatory process rather than entirely separate diseases that only act locally. In fact, upper respiratory illness (URI) often influences lower airway disease [1]. Rhinosinusitis is a common condition in children, and it is usually overlooked.

There is strong evidence of a relationship between rhinosinusitis and asthma based on epidemiological and pathogenic aspects. Moreover, there is a close relationship with asthma severity indicating the significantly important role of severe chronic upper airway disease on lower airway disease. From a pathogenic point of view, many inflammatory cells and mediators and the cells are often common to both conditions, with a relevant role played by eosinophils.

It is well known that asthma and rhinosinusitis, with or without polyps, are the most common chronic diseases in the general population. Samter's triad, asthma, nasal polyps, and NSAIDs intolerance, although frequent in adults, is not common in children.

The prevalence of rhinitis in asthmatics is about 70–80%, whereas the prevalence of one of the most frequent comorbidities of allergic rhinitis such as rhinosinusitis

remains unclear. A recent study [2•] on the prevalence of rhinosinusitis in asthmatic population has shown it to be about 35%. In addition, two study groups reported prevalence between 41 and 51% [3].

Epidemiology of rhinosinusitis

Since the wider use of computed tomography (CT) scan, it has become clearer that a runny nose in a child is not only due to rhinitis or adenoidal hypertrophy, but also that in the majority of the cases the sinuses are frequently involved as well [4•]. According to van der Veken *et al.* [5], 64% of children with chronic purulent rhinorrhea and nasal obstruction showed an involvement of the sinuses. Gwaltney *et al.* [6] reported the presence of CT abnormalities in young adults with common cold. Of the 31 patients with CT scans, 24 (77%) had occlusion of the ethmoid infundibulum, 27 (87%) had abnormalities of one or both maxillary-sinus cavities, 20 (65%) had abnormalities of the ethmoid sinuses, 10 (32%) of the frontal sinuses, and 12 (39%) had abnormalities of the sphenoid sinuses [6]. This study showed that common cold is often associated with important involvement of the paranasal sinuses, and that viral infection is a trigger factor for rhinosinusitis [7]. On the basis of MRI findings, Gordts *et al.* [8] reported that the prevalence of sinusitis in children was 45%. When the patients also had a clinical history of nasal obstruction, the prevalence rose to 50%, and finally to 100% in the presence of mucopurulent

secretions. Another special circumstance to take into account is in the case of the children in day care centres. Younger children in day care centres have been shown to have a dramatic increase in the prevalence of chronic rhinosinusitis compared with children staying at home [4•].

Relationship between asthma and rhinosinusitis

Most recent evidence supports rhinosinusitis and asthma as two compartmental expressions of a common mucosal susceptibility to exogenous stimuli. In addition, there is evidence that the compartmental processes can affect and amplify each other via a systemic intermediary [9]. Nasal sinus disease may contribute to less asthma control in children. Children with severe asthma appear to have the most relevant abnormalities on CT scanning of the paranasal sinuses [10•], again highlighting the importance of severe chronic upper airway disease and its impact on lower airway disease.

Although the precise mechanisms are still unclear, asthma and chronic sinusitis are associated frequently. CT is a sensitive tool for documenting sinonasal mucosal abnormalities. Crater *et al.* [11] studied the CT findings in patients with acute asthma. They concluded that the mucosal thickening in the nasal passages ($P < 0.001$) and sphenoidal, ethmoidal, and frontal sinuses are more common in patients with acute asthma than in controls. However, maxillary sinus mucosal thickening is not more common in asthmatic patients than in controls [11]. In another study [12] evaluating the radiographic findings in the asthmatic group compared with the nonasthmatic control group, the mean scores of the total mucosal changes (8.45 versus 4.67 points, $P < 0.001$), and total sinus scores (5.50 versus 2.69, $P < 0.005$) were significantly higher in the asthmatic group. Bresciani *et al.* [13] compared the presence of rhinosinusitis in patients with mild and severe asthma. The frequency of rhinosinusitis in patients with mild-to-moderate or severe steroid-dependent asthma was similar; however, sinonasal involvement, as evaluated by clinical symptoms and CT scan imaging, was significantly greater in the patients with severe steroid-dependent asthma than in those with mild-to-moderate asthma [13]. Talay *et al.* [14•] investigated the relationships between the presence of rhinosinusitis, sinus site involvement, and total CT sinus scores and the presence of allergy, allergen type, and severity of disease in 128 asthma patients and reported that the prevalence of chronic sinusitis was higher in patients with allergic asthma.

In another study [15•] of 121 patients with chronic rhinosinusitis, the authors concluded that patients with chronic rhinosinusitis when associated with nasal polyps

and asthma constitute the most severe form of unified respiratory tract disease.

Treatment outcomes and integrated approach

The effects of rhinosinusitis treatment on asthma are disputed. Rhinosinusitis plays an important role in initiating or exacerbating asthma. Some authors considered rhinosinusitis as a trigger factor, whereas others support the idea of comorbidity. In either case, rhinosinusitis has been shown to worsen the symptoms of asthma. Therefore, controlling upper airway infection, inflammation, and symptoms may also improve asthma outcomes. Medical and surgical treatments of chronic rhinosinusitis have been shown to be associated with subjective and objective improvement of asthma.

Tosca *et al.* [16] explored the effect of medical treatment for rhinosinusitis on asthma outcomes. Eighteen children were treated with a combination of amoxicillin and clavulanate (20 mg/kg twice daily) and fluticasone propionate aqueous nasal spray (100 µg/day) for 14 days. A short course of oral corticosteroids was also prescribed (deflazacort, 1 mg/kg daily for 2 days, 0.5 mg/kg daily for 4 days, and 0.25 mg/kg daily for 4 days). Asthma symptoms and lung function significantly improved after treatment, and 1 month later, a significant reduction in inflammatory cell numbers was detected in all asthmatic children. IL-4 levels significantly decreased ($P < 0.001$), whereas IFN- γ levels increased ($P < 0.001$) [16].

Tsao *et al.* [17] have suggested that the intensive treatment of sinusitis improves asthma symptoms. They studied 61 children with mild asthma and allergic rhinitis. Forty-one of these 61 children had sinusitis. One group was treated with amoxicillin–clavulanate for 6 weeks and then with nasal isotonic saline solution irrigation for 6 weeks. In the other group, the treatment order was reversed. Children without chronic sinusitis received nasal isotonic saline solution irrigation for 12 weeks. The clinical symptoms and signs of sinusitis, but not forced expiratory volume in 1 s (FEV-1) [1], showed a significant improvement after antibiotic treatment. After aggressive treatment of sinusitis, the dose of methacholine used for methacholine challenge that caused a 20% fall in FEV-1 [1] in children with mild asthma and sinusitis was significantly higher after treatment of rhinosinusitis [17].

Apart from medical treatment, sinus surgery has also been shown to have a positive impact on improving asthma. Ragab *et al.* [18] reported a randomized prospective study of surgery compared with medical therapy in chronic rhinosinusitis. Overall, asthma control improved significantly following both treatment modalities, but was better maintained after medical therapy [18]. On the

contrary, Dejima *et al.* [19] studied the impact of asthma on chronic sinusitis. They conducted a prospective analysis of the outcome of 88 patients with or without bronchial asthma who underwent endoscopic sinus surgery (ESS) for chronic sinusitis. The outcomes of ESS on symptoms and objective findings related to sinusitis were significantly worse in the cases with comorbid asthma, but patients suffering from chronic sinusitis and bronchial asthma showed improvement following ESS in terms of their asthma symptoms, peak flow, and medication score [19].

Conclusion

The bibliography shows clearly the strong association between rhinosinusitis and asthma even in childhood asthma, and how upper respiratory disease worsens asthma symptoms. The relationship between rhinosinusitis and asthma is based on epidemiological data, path mechanistic similarities between the two clinical entities, that patients with severe asthma appear to have the most prominent abnormalities on CT scanning of the paranasal sinuses and treatment outcomes, showing that treating chronic rhinosinusitis, medically or surgically, has beneficial effects on concomitant asthma.

References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest

Additional references related to this topic can also be found in the Current World Literature section in this issue (pp. 182–183).

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This study is the position of the European Academy of Allergy and Clinical Immunology in rhinosinusitis and nasal polyps. It is a very important document evidence medicine based about diagnosis and treatment of rhinosinusitis.

Difficult asthma control and rhinosinusitis could be a strong association. This study assesses the findings of this possible association, and finally explains the treatment of rhinosinusitis and its positive effects on asthma.

An original study that correlates the tomographic score with allergens.

This study investigates radiological findings in asthma and rhinosinusitis, additionally assessing the inflammation markers.