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The presence of atopy and its effect on bacterial colonization of the upper airways in children with adenoid vegetation

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ABSTRACT

Background: The aim of this study was to determine the frequency of atopy and the influence of atopy on bacterial colonization of upper airway in children with adenoid hypertrophy. **Material and methods**: Forty children were enrolled in the prospective study. Presence of atopy was diagnosed by skin-prick test. Differences in bacterial colonization of middle nasal meatus and nasopharynx according to the presence of atopy were analyzed. **Results**: Atopy was diagnosed in 75% children with adenoid hypertrophy. Presence of atopy was associated with significantly more often colonization of pathogenic bacteria (*Streptococcus pneumoniae, Hemophillus influaenzae, Moraxella catarrhalis, Staphylococcus aureus*) in the middle nasal meatus but not in nasopharynx ($P = 0.045$, $P = 0.483$, respectively). Identification of pathogenic bacteria in middle nasal meatus did not correlate with isolation of pathogenic bacteria in nasopharynx in both groups of children. **Conclusion**: There is a high incidence of atopy in children with adenoid hypertrophy. Atopy is related to increased colonization by pathogenic bacteria in middle nasal meatus but not in nasopharynx.

Introduction

The pharyngeal tonsil is part of the lymphoid tissue that surrounds the pharynx: collectively defined as the Waldeyer's ring. Tonsils physiologically serve as a defence against inhaled antigens (microbes, allergens, *etc.*). Therefore, tonsils are deeply involved in the innate and adaptive immune response because of their peculiar position at the entry of the upper aerodigestive tract. As consequence of chronic stimulation (result of prolonged antigenic exposure associated with chronic inflammation), pharyngeal tonsil may enlarge so it may almost fill the space in nasopharynx,

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limiting the airflow passage. Pharyngeal tonsil hypertrophy, also called adenoid hypertrophy or adenoid vegetation (AV) is detected in approximately one-third of the general paediatric population with maximum of appearance in pre-school children (60%) and constitutes the most frequent otorhinolaryngological indication for surgical intervention. AV has been associated with recurrent respiratory infections, respiratory dysfunction, recurrent otitis media and sleep disorders [1–3].

Allergic rhinitis (AR) is the most common immune-mediated disorder because it may affect up to 40% of the general population. AR is characterized by an inflammatory reaction after allergen exposure. AR is also frequently associated with relevant comorbidities, including other allergies, rhinosinusitis, recurrent respiratory infections, otitis media and adenoid hypertrophy. In this regard, there is firm belief that children with AR may have lymphoid hypertrophy of the upper airways, mainly concerning the adenoids [1, 4]. Moreover, it was clearly shown, that children with atopy suffer from higher frequency of respiratory infections compared to healthy children without atopic environment in the airways [5, 6].

Material and methods

Design of the study

The prospective study was conducted with 40 children divided into 2 groups according to the presence of atopy. All children enrolled in the study were scheduled to endoscopic adenotomy for adenoid vegetation at the Department of Otorhinolaryngology, Head and Neck Surgery, Comenius University, Jessenius Faculty of Medicine, University Hospital in Martin, Slovakia.

Children with systemic or local antibiotics treatment within the 2 weeks before enrolment, recent respiratory infection, increased level of C-reactive protein and those with recurrent tonsillitis were excluded from the study. We excluded all children who used drugs that could compromise the reliability of the skin test for inhalant allergens, such as antihistamines and corticosteroids. Children with skin lesions that did not allow performing the skin test were also excluded from the study.

The presence of atopy was evaluated according to the results of skin prick tests. Differences in bacterial colonization of middle nasal meatus and nasopharynx according to the allergic status were analyzed.

The study was approved by the Ethics Committee of Jessenius Medical Faculty, Comenius University in Martin, Slovakia. An informed consent was signed by all parents of participating children.

Adenoid volume assessment

The children were evaluated by nasal endoscopy for adenoid hypertrophy. Children were divided into 3 groups according to the volume of adenoids: group I: less than 30% obstruction of the cavum in both nostrils, group II: 30% to 70% obstruction and group III: greater than 70% of cavum obstruction in at least one of the nostrils.

Skin-prick test

Skin-prick tests (SPT) were carried out in the pre-defined on the volar side of the left forearm, with a space of at least 2.5 cm between each prick with the following panel of allergens: *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, mixed spring trees (*Betula verrucosa, Corylus avellana, Alnus glutinosa*), mixed grasses (*Avena sattiva, Hordeum vulgare, Secale cereale, Triticum sativa*), wormwood, *Alternaria alternata*, *Aspergillus fumigatus*, birch, cat and dog dander (Stallergenes, France). A histamine dihydrochloride solution in distilled water (10 mg/mL) was used as positive control and the glycerol in saline solutions was used as negative control. We used 1-mm tip plastic lancets (Stallerpoint®, Stallergenes, France). The lancet was pricked vertically into the skin through each drop for 2 s with firm pressure. A new lancet was used for each prick tests. The tests were performed as stated by the European Academy of Allergy and Clinical Immunology [7]. The skin reaction was recorded after 15 min by evaluating the skin response in comparison with the wheal given by the positive and the negative control. A prick test was defined positive if the wheal was $\geq$ 3 mm in its longest dimension. The children with at least one positive SPT to common inhalant allergens were considered as atopic.

Bacteriology

Middle nasal meatus and nasopharyngeal swab specimens were obtained under endoscopic control by using sterile cotton-wool swabs and transported in Stuart's transport medium to the microbiological laboratory within 2–4 h. The swab was inoculated onto Sheep blood agar (Columbia Bio-Rad, Bratislava, Slovakia), Chocolate agar with bacitracin disc, Mac Conckey agar (Bio-Rad, Bratislava, Slovakia) and placed into a 7% CO_2 incubator at 37 °C. The plates were examined after 18–24 h of incubation. The incubation was further extended to 48 h to detect the slow-growing microbes. Identification of colonies to genus or species level was based upon typical colony morphology by subculture, Gram stain, standard rapid tests (catalase, pyrrolidonyl aminopeptidase – PYR and oxidase tests), identification by latex agglutination tests and biochemical tests. All pathogenic strains were tested for their susceptibility to antimicrobial agents by using the agar diffusion method (by EUCAST) with commercial discs (Oxoid).

Statistical analysis

Frequencies of categorical data were tabulated and evaluated with chi-square test using the Yates's correction. For other data, median and interquartile range was calculated and tested with Mann–Whitney test. The statistical analysis was performed with STATISTICA Cz 10. All conclusions were based on a significance level of $P < 0.05$.

Results

Forty children (26 male, 14 female, mean age 4 ± 2.6 years) were prospectively enrolled in the study. Demographic and