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The effect of adenoidectomy on cough reflex sensitivity in atopic children

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ABSTRACT

The aim of this study was to determine whether cough sensitivity is changed after adenoidectomy in atopic children with chronic cough.

21 Children having symptoms of chronic cough and adenoid hypertrophy verified by nasal fiberoptic endoscopy were submitted to cough sensitivity measurement before and after adenoidectomy. Their pulmonary function was within normal range. Concentrations of capsaicin causing two (C2) and five coughs (C5) were reported. Children' (14 boys and 7 girls, mean age 6,52 yrs) cough sensitivity (geometric mean, with 95% CI) for C2 was preoperatively (before adenoidectomy) 19.95 (9.95–39.98) micromol/l vs. children' C2 postoperatively 14.04 (7.16–27.55) (P = .083 for Wilcoxon paired two sample test). Children' C5 was preoperatively 86.26 (39.25–189.57) micromol/l vs. C5 postoperatively 95.23 (46.33–195.75) micromol/l (P = .794 for Wilcoxon paired two sample test).

We conclude that cough sensitivity for C2 and C5 was not significantly changed after adenoidectomy in atopic children with chronic cough.

1. Introduction

Chronic cough is a common reason for parents to seek specialist evaluation for their children. In children, chronic cough is associated with impaired quality of life (Chang et al., 2012), multiple doctor visits (Marchant et al., 2008), and adverse effects from inappropriate use of medications (Thomson et al., 2002).

Chronic cough in children should be defined as > 4 weeks' duration and children should be systematically evaluated with treatment targeted to the underlying cause irrespective of the cough severity (Chang et al., 2016). Common etiologies of chronic cough children are different to than that of adults and are dependent on age and setting. Common etiologies of chronic cough in adults are not presumed to be common causes in children aged ≤14-years and their age and the clinical settings (e.g. country and region) could be taken into consideration when evaluating and managing their chronic cough (Chang et al., 2017). The inhalation cough challenge permits measurement of the sensitivity of the cough reflex (CRS) (Morice et al., 2007).

Edema of nasal mucosa, chronic runny nose, postnasal drip, throat clearing, upper airway cough syndrome, chronic cough, chronic and recurrent infections of upper and lower airways, feeding aversion, nausea, obturation of the Eustachian tube, hearing loss, recurrent and chronic persistent otitis media are frequent concomitant complications related to adenoid hypertrophy (AH). These disorders may be caused by both nasal obstruction, and/or phlogistic problems – adenoiditis (Cassano et al., 2003).

When nasopharyngeal tonsil is excessively hypertrophied, we talk about AH. The nasopharyngeal tonsil is physiologically present in

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children from their birth and it gradually grows until reaching the age of 5–7 years. The natural enlargement is most significant in 3–5 years. From the age of 8 it gradually regresses and it can be present approximately until the individual is 15 years old. In a long-term the nasopharyngeal tonsil can be colonized by pathogenic bacteria, chronic inflammation develops (Rajeshwary et al., 2013), lymphatic tissue losses its immunologic and protective function (Santos et al., 2013), it becomes hypertrophic, the self-purification function is violated and adenoid tissue ceases to fulfil its function. (Papaioannou et al., 2013). In a randomized representative sample the prevalence of AH in children and adolescents was 34.46%; however, in convenience samples the prevalence ranged from 42 to 70% (Pereira et al., 2017). While the pathogenesis of AH is not fully understood, inflammatory and allergic factors are thought to be involved.

The most accurate, effective and reliable diagnostic method enabling direct view of the AH tissue is nasal fiberoptic endoscopy (NFE) (Feres et al., 2013). Presence of AH in rhinopharyngeal cavity creates a physical obstacle in location of posterior choanae and in posterior part of the nasal cavity, which results in decreased nasal cavity patency (Dinis et al., 1999). It leads to nasal obstruction with manifest clinical symptoms such as nasal breathing obstruction, oral breathing, rhinolalia clausa, snoring, obstructive sleep apnea, nocturesis, inattention, daytime sleepiness (Sardón Prado et al., 2006).

We hypothesized that cough reflex sensitivity will eventually return to normal values after the surgical removal of adenoids (endoscopic adenoidectomy) in atopic children with chronic cough. The main study objective was to determine whether cough reflex sensitivity is changed after endoscopic adenoidectomy in atopic children with chronic cough.

2. Materials and methods

2.1. Study subjects

Atopic children were enrolled in the study based on following inclusion criteria: (a) age from 3 to 15 years; (b) objectified presence of adenoid hypertrophy; (c) no contraindication to endoscopic adenoidectomy in general anaesthesia; (d) no adenoidectomy in the past; (e) cough lasting longer than 4 weeks; (f) medical history negative for asthma; (g) medical history negative for any chronic respiratory or systemic diseases; (h) absence of obstructive pattern on spirometry; (i) no upper or lower respiratory tract infections for at least 15 days ahead of the test; (j) atopy positive status; (k) no topical and systemic corticosteroids, antihistamines, antileukotrienes and decongestants during the examination and minimally 2 weeks before being examined; (k) good cooperation during the examinations. The characteristics of the subjects are shown in Table 1.

21 Atopic children (14 boys and 7 girls, age range 4–13 years, mean age 6,52 years) were included into the study.

Atopy positive status was based on immunoallergic examination – total immunoglobulins E (IgE, normal range: 2–5 years < 60 IU/ml, 6–9 years < 90 IU/ml, 10–15 years < 200 IU/ml), specific IgE, pediatric panel for selected inhalation and food allergens, skin prick tests for year-round and seasonal inhalation allergens.

This prospective clinical study was approved by the institutional Research Ethics Committee and was performed according to the Declaration of Helsinki. Each parent of the observed child was properly informed about the study, about the cough reflex sensitivity and was asked to sign an informed consent.

2.2. Adenoid hypertrophy objectification

Objectified presence of AH was stated by NFE examination in sitting position by using the flexible NFE (Karl Storz 11101RP2, Ø2.5 mm, Germany); complete entrance examination with elimination of other possible causes of nasal obstruction (anatomical and congenital abnormalities of nasal cavity and septum, polyps, foreign bodies, infectious and non- infectious inflammatory problems); performed inspection of oral cavity, oropharynx, otomicroscopy, tympanometry, anterior rhinomanometry and microbial cultivation from nasopharynx.

The parents filled out a questionnaire (score 0–70) of the most frequent AH symptoms based on anamnestic data (nasal breathing obstruction, oral breathing, rhinolalia clausa, snoring, obstructive sleep apnea, nocturesis, inattention, daytime sleepiness, chronic runny nose, postnasal drip, throat clearing, chronic and recurrent infections of upper and lower airways, feeding aversion, nausea, obturation of the Eustachian tube, hearing loss, recurrent and chronic persistent otitis media). The control postoperative measurements were performed using the same method (Tables 1 and 2).

2.3. Endoscopic adenoidectomy

The endoscopic adenoidectomy was carried out in general anaesthesia with endotracheal intubation under the endoscope control (Karl Storz rigid endoscope, 4 mm, 70°). We used McIvor mouth gag to keep mouth open and subsequently AH were completely removed using Beckmann adenoid curette, St. Clair-Thompson and Jurasz adenoid forceps. Bipolar forceps were used for haemostasis. Besides the surgery, patients did not undergo any other form of treatment that might have led to influencing of observed parameters. Adenoidectomy was performed by the same surgeon in all patients.

2.4. Spirometry and cough sensitivity testing

CRS was assessed using capsaicin cough challenge, performed in agreement with the ERS guidelines (Morice et al., 2007) with modification for pediatric use (Varechova et al., 2008) (we used a compressed air-driven nebuliser (model 646; DeVilbiss Health Care, Inc., Somerset, PA, USA) controlled by a dosimeter (KoKo DigiDoser-Spirometer; nSpire health Inc., Louisville, CO, USA) with an inspiratory flow regulator valve added (RIFR; nSpire health Inc., Louisville, CO,USA) to assign identical inspiratory flow rate during capsaicin inhalations in all subjects. Each subject inhaled saline randomly interposed among 12 inhalations of incremental capsaicin aerosol concentrations (0.61-1250 micromol/l). Each administration of saline and capsaicin aerosol was performed at 1 min intervals with the inhalation time set at 400 msec. The number of coughs within 30 s after aerosol administration was counted by two independent observers. The endpoint of cough challenge was the inhalation of capsaicin concentration that provoked at least 5 coughs (C5) or when the maximum concentration of capsaicin (1250 μmol/l) was achieved. The concentration of capsaicin causing at least two coughs was assigned as C2 and concentration of capsaicin causing at least 5 coughs was assigned as C5. For children that did not cough at any concentration of capsaicin, CRS value was assigned 1250 μmol/l. Spirometry and baseline CRS measurement was realized 1 day before adenoidectomy and 3 months after it (Table 1). Each parent of the observed child was asked to fill out Hull Cough Hypersensitivity Questionnaire before and after adenoidectomy (Morice, 2011) (Tables 1 and 2).

2.5. Statistical analysis

Obtained preoperative and postoperative parameters of CRS were mutually statistically compared and relation between CRS and adenoidectomy was statistically evaluated. The results were evaluated separately for each individual and subsequently for the group as a whole. The results were expressed as geometric mean and 95% confidence interval or as median and lower and upper interquartile range; the level of statistical significance was determined as $P < 0.05$ and $P < 0.01$. Wilcoxon paired two sample test was used. Software used: R Core Team (2015), R: A language and environment for statistical computing (R Foundation for Statistical Computing, Vienna, Austria, URL – https://www.R-project.org/, R version 3.2.3, 2015-12-10).