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Review Article

Asthma outcomes after adenotonsillectomy: A systematic review

Nikita Kohli, MD [a, *], Dana DeCarlo, BA [b], Nira A. Goldstein, MD [a], Joshua Silverman, MD, PhD [a]

[a] Department of Otolaryngology, State University of New York Downstate Medical Center, 450 Clarkson Ave Box 126, Brooklyn, NY 11203, USA
[b] School of Medicine, State University of New York Downstate Medical Center, USA

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ABSTRACT

Outcome objective: For over fifty years, otolaryngologists, allergists, and immunologists have debated the effect of adenoidectomy or adenotonsillectomy on asthma outcomes in children. Although some have suggested that adenotonsillectomy may contribute to the subsequent development of asthma in children, others have argued that a common mechanism may cause both upper and lower airway disease, and that children who have symptoms severe enough to warrant adenotonsillectomy are also at increased risk of asthma and atopic disease. The link between asthma and upper airway disease may involve upper airway inflammation.

Our goal is to perform a systematic review of asthma outcomes following adenoidectomy or adenotonsillectomy in the pediatric population. Our goal is to assess the effect of adenoidectomy or adenotonsillectomy on markers of asthma severity in children with obstructive sleep apnea.

Methods: We performed a systematic review using the PubMed, EMBASE, and CINAHL databases using search terms related to asthma, adenoidectomy, and adenotonsillectomy. Inclusion criteria were defined as pediatric subjects aged 18 years or younger with a history of asthma, undergoing adenoidectomy, or adenotonsillectomy for obstructive sleep apnea. Database studies and case studies with or without control groups were included in the study. Exclusion criteria were patients with follow-up greater than 1 year after surgery, craniofacial syndromes, or additional significant comorbidities.

Results: A total of 567 abstracts were identified; 549 were excluded immediately. Eighteen full-text articles were assessed for eligibility and four articles were included in the qualitative synthesis. These data are consistent in correlating adenotonsillectomy in asthmatic children with decreased asthma severity. Markers of asthma severity including respiratory medication use, emergency room visits for asthma-related symptoms, overall asthma symptoms, and asthma-related exacerbations were all significantly reduced following adenotonsillectomy.

Conclusion: We present a systematic review of asthma outcomes following surgical intervention for sleep apnea in the pediatric population. All included studies found clinically significant reductions in markers of asthma severity after adenotonsillectomy. Though further prospective trials are needed to determine a causal relationship between adenotonsillectomy and modulation of asthma, the compilation of data suggest a definitive association.

1. Introduction

For over fifty years, otolaryngologists, allergists, and immunologists have debated the effect of adenoidectomy or adenotonsillectomy on asthma outcomes in children [1]. Although some have suggested that adenotonsillectomy may contribute to the subsequent development of asthma in children [1,2], others have argued that a common mechanism may cause both upper and lower airway disease, and that children who have symptoms severe enough to warrant adenotonsillectomy are also at increased risk of asthma and atopic disease [3,4]. The link between asthma and upper airway disease may involve upper airway inflammation [5].

* Corresponding author.
E-mail address: nikitavkohli@gmail.com (N. Kohli).

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The unified airway hypothesis suggests a common mechanism behind the pathophysiology of asthma and rhinitis. Inflammation associated with rhinitis may cause the upregulation of inflammatory mediators leading to changes in lower airways. Studies have suggested that multiple viral infections introduce inflammatory mediators leaving an immune "memory effect". This memory effect may cause an exacerbated response to future viral infections [13]. In addition, both respiratory syncytial virus (RSV) and the increased synthesis of inflammatory markers may increase proliferation of adenotonsillar tissues leading to OSA [14–17] Through this mechanism, multiple upper respiratory infections may cause chronic upper airway irritation and trigger asthma exacerbations.

Various other studies have commented on the link between snoring, obstructive sleep apnea (OSA), and lower airway disease. For example, Kaditis et al. found that children with a history of wheezing were more likely to have a history of tonsillar hypertrophy [14]. The authors proposed that increased leukotriene activity leads to decreased caliber of the lower airways and increased nasal resistance. These anatomic changes may cause increased snoring and wheezing.

Both physiological tests and clinical measures have been used to explore the effects on adenotonsillectomy on asthma outcomes [1]. One early study measured change in respiratory resistance after exercise and showed that adenoidectomy or adenotonsillectomy had no effect on this parameter [1]. In contrast, Saito et al. demonstrated that 60% of asthmatic patients who underwent adenotonsillectomy completely eliminated the need for asthma-control medications, up to one year after surgery [6].

Our goal in this systematic review is to assess current data regarding the effect of adenoidectomy or adenotonsillectomy on markers of asthma severity. The conclusions of this review may aid in counseling patients and their families regarding the impact of surgical intervention on the modulation of asthma symptoms.

2. Methods

We performed a comprehensive literature search using the search terms adenoid, adenoidectomy, tonsillectomy, adenotonsillectomy, and asthma of the PubMed, EMBASE, and CINHAL databases from 1965 through 2016 with results restricted to English-language articles. Results were reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) chart. The references for each of the included articles were also reviewed for additional relevant articles that were not found in the database search.

Our inclusion criteria were defined as pediatric subjects aged 18 years or younger with a history of asthma undergoing adenoidectomy, adenotonsillectomy, or tonsillectomy for obstructive sleep apnea or recurrent infections. Database studies and case studies with or without control groups were included in the study. Exclusion criteria were patients with follow-up greater than 1 year after surgery, craniofacial syndromes, mucopolysaccharidoses, sickle cell disease, and immune compromise.

The databases were reviewed using the selected search terms. Two authors then reviewed the selected articles that met the inclusion criteria, and eliminated articles as appropriate. The results are summarized in the PRISMA diagram (Fig. 1) The articles selected for inclusion were reviewed using the following parameters: study characteristics; study design; inclusion/exclusion criteria; characteristics of participants; setting; interventions; comparison; and a list of study outcomes.

Observational studies were assessed for bias using the Methodological Index for Non-Randomized Studies (MINORS) criteria. The MINORS instrument is used to assess the validity of non-randomized trials [7]. Each study was graded based on 8 or 12 criteria on a scale from 0 to 2 for a highest score of 16 for non-comparative studies and 24 for comparative studies. A score of 0 indicates that the parameter was not reported; 1 indicates that the parameter was reported but inadequate; and score of 2 indicates that the parameter was reported and adequate.

3. Results

Based on our search criteria, a total of 567 records were obtained. Of these 567 records, 549 were excluded. Eighteen articles were assessed for full-text eligibility and after applying our inclusion and exclusion criteria, four articles were included in the qualitative synthesis. The results are summarized in the PRISMA diagram in Fig. 1.

The demographic data for the four articles included in this review are summarized in Table 1. One database review, two case series, and one cohort study were included in the analysis. Bhattacharjee et al. [18] conducted a cross-sectional study to compare asthmatic children that underwent adenotonsillectomy with age-matched controls who did not have surgery. Kheirandish-Gozal et al. compared asthmatic children who underwent adenotonsillectomy after positive nocturnal polysomnography (PSG) with asthmatic children who had a negative PSG and so did not require surgery. Levin et al. compared asthmatic children with non-asthmatic children who underwent adenotonsillectomy in a retrospective manner. Finally, Saito et al. conducted a case series with chart review that studied children with asthma who underwent adenotonsillectomy. They compared pre- and post-surgical asthma symptoms.

Papers using a non-randomized methodology were assessed for bias using the MINORS criteria (Table 2). The ideal global score for comparative studies is 16, while non-comparative studies have a maximum score of 24 [7]. A score of 21 was allocated to Kheirandish-Gozal et al., a score of 18 to Levin et al., and a score of 9 to Saito et al.

The outcomes for each of the papers studied are summarized in Table 3. The authors assessed multiple endpoints for asthma severity. Three papers (Levin et al., Kheirandish-Gozal et al., and Saito et al.) showed a reduction in asthma symptoms following adenotonsillectomy, with outcomes assessed six months to one year following surgical intervention. Bhattacharjee et al. and Kheirandish-Gozal et al. both cited statistically significant reductions in the frequency of asthma exacerbations per year.

There was also a statistically significant reduction in the use of respiratory medications following adenotonsillectomy in patients with asthma noted in all four articles. In their analysis of the MarketScan database, Bhattacharjee et al. found statistically significant reductions in refills for bronchodilators, steroids, and leukotriene receptor agonists in the year following surgery. Similarly, Kheirandish-Gozal et al. found reductions in beta-agonist use while Levin et al. found decreases in oral steroids. Saito et al. found overall reductions in respiratory medications, although this study did not identify the class of medication.

Additionally, Bhattacharjee et al. found reductions in the frequency of acute status asthmaticus from 37% in patients who underwent surgical intervention versus 7% in controls. Kheirandish-Gozal et al. cited statistically significant reductions in forced expiratory volume (FEV1), which indicated reduced levels of airway obstruction. Levin et al. discovered reductions in emergency department visits, hospitalizations for asthma, and missed school days.

4. Discussion

The results of this systematic review suggest an overall