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Tonsillectomies and respiratory complications in children: A look at pre-op polysomnography risk factors and post-op admissions

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ABSTRACT

Objective: To identify predictors of post-operative respiratory complications in children undergoing tonsillectomy.

Methods: Consecutive case series with chart review of children who underwent polysomnography (PSG) and subsequent tonsillectomy with or without adenoidectomy for obstructive sleep apnea (OSA). Patients with craniofacial anomalies or significant cardiopulmonary comorbidities were excluded. Rates of post-surgical respiratory complication were reviewed and compared to patient specific factors and PSG findings to identify possible risk factors.

Results: Eighty-six patients (mean age 5.3 ± 2.2 years) were included. There was a statistically significant ($p = 0.03$) relationship between an AHI ≥40 (AHI40) and post-operative respiratory complications. AHI40 also had the greatest magnitude of association with postoperative respiratory complications (OR = 5.313). An AHI ≥25 (AHI25) was marginally significant ($p = 0.067$). No significant difference in outcome occurrence was found when analyzing rates of complication in patients with BMI above and below 18 ($p = 0.20$) or oxygen (O2) nadir above and below 80% ($p = 0.09$). The AHI ranged from 0 to 112.2, and no postoperative respiratory complications were identified in children with an AHI less than 10.

Conclusions: Our results indicate an association between an AHI ≥40 and respiratory complications following an adenotonsillectomy, but we were not able to observe any significant difference at a cutoff of 25. An association between BMI or O2 nadir and postoperative respiratory complication was not able to be identified. Our results support the importance of AHI as a predictor of postoperative respiratory complications in children undergoing tonsillectomy for OSA.

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1. Introduction

Up to 4% of children suffer from obstructive sleep apnea (OSA), a disorder characterized by recurring collapse and obstruction of the upper airway during sleep [1,2]. This consistent rise in resistance to airflow increases intra-thoracic pressure and respiratory effort producing a myriad of deleterious effects on the neurobehavioral, cardiovascular, endocrine, and metabolic health of children [3]. The diagnosis of OSA is often made by overnight polysomnography (PSG), an electrographic recording performed while the patient is asleep [4].

Much of childhood OSA can be attributed to adenotonsillar hypertrophy, and removal of tonsils and adenoids is accepted as first line therapy for most children with obstructive sleep symptoms and hypertrophic tonsils and/or adenoids [1,5]. Postoperative respiratory complications are documented as having a prevalence of close to 6.5% in children [6]. Children under the age of 3 years have a rate of post-operative pulmonary complication that approaches 10% [6]. Current recommendations from the American Academy of Otolaryngology state that all patient who have severe OSA, including an AHI≥10 should be observed overnight in a monitored setting following an adenotonsillectomy, while the American

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Academy of Pediatrics recommends monitoring children with an AHI≥24 [4,13].

However, in otherwise healthy children with severe OSA, there is little data to demonstrate which levels of AHI severity actually confer an additional risk of postoperative respiratory complications. While an increased risk of postoperative respiratory complications corresponding to OSA severity has been shown, no stratification of severity above the AHI cutoff of 10 has been supported. In our institution, this decision is made by individual clinicians taking into consideration previous PSG studies, current patient status, and AAO and AAP recommendations into account. In order to provide care that is safe, convenient, and economically responsible, it is important to identify risk factors for respiratory compromise as a means to determine which patients would benefit from inpatient observation. Furthermore, other patient characteristics and sleep study parameters may more reliably portray an increase in the risk of respiratory complication following an adenotonsillectomy.

We aimed to examine overnight polysomnographies of otherwise healthy, non-syndromic children to identify clinical predictors of patients who may be at increased risk of perioperative respiratory complications following an adenotonsillectomy. Our primary goal is to potentially help stratify postoperative respiratory risk in children with severe OSA, specifically focusing on AHI cutoffs, following adenotonsillectomy. We secondarily sought to detect other meaningful PSG data that could be used to predict respiratory complications.

2. Methods

After institutional review board (IRB) approval was obtained, a consecutive case series with chart review over a 3-year period, from 2011 to 2014, was performed. Children, ages 2–12, with sleep disordered breathing symptoms and evidence of tonsil hypertrophy on physical examination were identified. Only those who were assessed with overnight polysomnography, diagnosed with OSA, and subsequently underwent extra-capsular tonsillectomy with or without adenoidectomy at a tertiary-care, academic children's hospital were included.

Oxygen (O2) nadir, apnea-hypopnea index (AHI), and body mass index (BMI) were obtained from each patient's PSG. O2 nadir was defined as the single lowest oxygen saturation recorded overnight. Post-anesthesia care unit (PACU) records in patient progress reports, notes for readmissions, and office notes describing reported home complications were reviewed. Respiratory complications including persistent oxygen desaturation requiring supplementary oxygen, laryngospasms, bronchospasms, need for medical therapy, and other respiratory complications requiring support while in the hospital were noted. Children with confounding medical comorbidities including craniofacial, cardiopulmonary, neurologic, or hematologic comorbidities were excluded, as were patients who had an additional procedure requiring admission.

In addition to weight and BMI, demographic data such as age was recorded. Fisher's exact test and a univariate logistic regression analysis was performed to compare the presence of respiratory complications in relation to the O2 nadir, AHI (subdivided into AHI >10, >25, and >40; labeled AHI10, AHI25, and AHI40 respectively), and BMI. Additionally, a two-sample proportion test was performed comparing the incidence rates of complications between two patient groups for AHI above and below each of the following cutoffs: 10, 25, and 40, respectively.

3. Results

Eighty-six patients met the inclusion criteria. The mean age was 5.3 ± 2.2 years (Table 1). A BMI was recorded for eighty-four patients (97.7%). The average body mass index (BMI) was 20.66 ± 6.52 (range: 11.6–55.5). The median AHI was 25.5 ± 23.26 and ranged from 0 to 112.2 with 20 reported below 10, 45 patients below 25, and 36 with an AHI under 40. There was an overall observed postoperative respiratory complication rate of 11.63%, with complication occurrence rates in subdivided populations reported in Table 1. Seventy-two had a recorded AHI and BMI (83.7%) and were included in the univariate analysis examining the presence of post-adenotonsillectomy respiratory complications.

A total of 10 (11.6%) children experienced postoperative respiratory complications. Six (7.0%) of these were in the PACU, 5 (5.8%) on the floor after admission, with one child experiencing both a complication in the PACU and on the floor. No complications were reported to have occurred at the patients' home after discharge. In the PACU, where patients who are discharged stay for an average of three to six hours depending on physician comfort and logistical considerations, all six patients with complications had O2 desaturations requiring supplemental oxygen. This was true of the five complications occurring on the floor though 2 of the floor patients required BiPAP to be given as well.

No postoperative respiratory complications were identified in children with an AHI less than 10. There was a statistically significant relationship between an AHI of greater than 40 and respiratory complications (OR = 5.313, 95%CI = 1.24–22.82, p = 0.03). There was a trend toward significance for an AHI of greater than 25 (OR = 4, 95%CI = 0.91–17.60, p = 0.067). With no complications occurring below an AHI of 10, an association with complications and AHI10 could not be determined. However, using AHI as a continuous variable we did observe an increase odds in complications of 1.45 (CI = 1.092–1.922, p = 0.01) for every rise in AHI of 10 which barely changed when adjusting for BMI and O2 nadir (OR = 1.40, CI = 1.003–1.953, p = 0.048).

No significant association was found between the occurrence of complications and BMI (p = 0.20) or O2 nadir (p = 0.09). Additionally, a two-sample proportion test was performed analyzing the relationship between complications above and below a given AHI cutoff with only an AHI of 40 showing a significant increase in complication incidence above 40 (29.41%) as compared to below 40 (7.27%) (Table 2).

Table 1
Patient demographics and overnight polysomnography data.

	With complications	Without complications	p-Value[b]
Age			1.0000
≤3 (%)	4 (12.90)	27 (87.10)	
4–6 (%)	4 (10.26)	35 (89.74)	
>6 (%)	2 (11.77)	15 (88.24)	
BMI			0.3024
<18 (%)	2 (5.13)	31 (93.94)	
≥18 (%)	8 (15.69)	43 (84.31)	
O2 Nadir			0.1310
<90 (%)	6 (16.67)	30 (83.33)	
≥90 (%)	2 (4.76)	42 (95.45)	
AHI Median (IQR[a])	41 (20.8–64.1)	21.2 (3.5–30.8)	0.0289
AHI10			0.0509
<10 (%)	0 (0)	21 (100.00)	
≥10 (%)	9 (17.65)	42 (82.35)	
AHI25			0.0713
<25 (%)	3 (6.67)	42 (93.33)	
≥25 (%)	6 (22.22)	21 (77.78)	
AHI40			0.0290
<40 (%)	4 (7.27)	51 (92.73)	
≥40 (%)	5 (29.41)	12 (70.59)	

[a] IQR = Inter-Quartile Range.
[b] p-value from the fisher's exact test or the wilcoxon rank sum test.

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