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Polysomnography results in pediatric patients with mild obstructive sleep apnea: Adenotonsillectomy vs. watchful waiting

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ABSTRACT

Objective: There is a lack of consensus and a paucity of data regarding how to best treat pediatric patients with mild obstructive sleep apnea. The objective of our study was to compare outcomes following adenotonsillectomy vs. observation in children with mild obstructive sleep apnea based on polysomnography results.

Methods: A retrospective chart review was performed on children ages 9 months to 9 years with 2 or more polysomnograms completed at a tertiary care academic center. Children diagnosed with mild obstructive sleep apnea (obstructive apnea–hypopnea index 1–5) on polysomnography performed from 1999 to 2013 were included. Patients underwent adenotonsillectomy or watchful waiting for obstructive sleep apnea. The primary outcome was the change in apnea–hypopnea index.

Results: There were 62 patients who met inclusion criteria for the study; 19 of the 62 patients were obese, while 15 had a craniofacial syndrome or hypotonia. Eighteen patients underwent adenotonsillectomy for mild obstructive sleep apnea while 44 were observed. The mean apnea–hypopnea index of patients after adenotonsillectomy improved from 3.50 (95% Confidence Interval [CI] 2.97–4.03) to 2.69 (95% CI 1.48–3.90), while the mean apnea–hypopnea index of the observation group worsened from 3.09 (95% CI 2.76–3.42) to 5.18 (95% CI 2.46–7.90). Between-group analysis showed significant improvement in the surgery group ($p = 0.03$), with a persistent improvement on multivariate analysis adjusting for baseline apnea–hypopnea index ($p = 0.05$). This difference was seen mostly in non-obese, non-syndromic children ($p = 0.04$). There was no significant difference between groups amongst obese ($p = 0.25$) and syndromic ($p = 0.36$) patients.

Conclusions: Adenotonsillectomy leads to a significant improvement in apnea–hypopnea index on follow-up polysomnography over an observational approach, especially in non-obese, non-syndromic children. A prospective, randomized trial is necessary to help determine appropriate treatment strategies for pediatric mild obstructive sleep apnea.

1. Introduction

Obstructive sleep apnea (OSA) is a common condition known to affect 1–4% of all children [1]. Adenotonsillectomy is considered to be the first line treatment for pediatric obstructive sleep apnea [2,3], with large prospective studies showing improvements in polysomnography findings, quality of life (QOL) metrics, and symptom severity scales compared to age-matched controls [4–6].

The efficacy of adenotonsillectomy in cases of mild OSA (AHI less than 5) is less clear. While surgery can have a positive impact on QOL even in cases of mild OSA [7], the degree of improvement in symptoms is not consistent in all children. Additionally, studies often exclude children with comorbid conditions such as obesity, asthma, and craniofacial abnormalities for which success rates may be lower [3].

Polysomnography (PSG) is the gold standard for diagnosing OSA yet, to our knowledge, there is a paucity of data regarding the effects of adenotonsillectomy on polysomnographic data in patients with mild OSA. The Childhood Adenotonsillectomy Trial (CHAT) compared PSG findings in children who were randomized to adenotonsillectomy vs. observation for OSA, however many of the children had moderate or severe OSA on their initial PSG [4]. In

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addition, only patients ages 5–9 were included, thus the findings may not be generalizable to younger children who commonly present with concerns of sleep-disordered breathing. This helps explain the lack of consensus regarding how to best treat such patients.

The objective of our study was to compare cure rates and the degrees of improvement following adenotonsillectomy vs. observation in children with mild OSA based on polysomnography results.

2. Materials and methods

The study was approved by the Cleveland Clinic institutional review board. A retrospective chart review was performed on all pediatric patients under 10 years of age with mild OSA, defined as obstructive apnea–hypopnea index (OAHI, subsequently referred to as AHI) between 1 and 5, on PSG performed at a tertiary care academic center from 1999 to 2013 who also had a second PSG as ordered by their primary care physician, otolaryngologist and/or sleep medicine doctor. Inclusion criteria were that the patient (1) was seen clinically at our institution during the specified time period; (2) was under the age of 10 years at the time of the initial PSG; and (3) had 2 or more PSG's performed within our health system available for review. Obstructive apnea/hypopnea index was chosen as the sole indicator of sleep apnea as per American Academy of Sleep Medicine (AASM) guidelines [8]. Patients who were 10 years or older at the time of initial PSG or who had undergone previous upper aerodigestive tract surgery, including adenoidectomy alone or combined adenotonsillectomy, were excluded. All patients who underwent use of positive pressure ventilation, including continuous positive airway pressure (CPAP), and dental appliances were also excluded. Information regarding baseline clinical characteristics and the timing and results of PSG findings were recorded from the electronic medical records.

2.1. Polysomnography and definitions

All patients underwent standard overnight PSG at our institution in an AASM accredited laboratory that was interpreted by a pediatric physician board-certified/eligible in sleep medicine. Measured parameters included: bilateral electro-oculography using left and right leads; electroencephalography using bilateral frontal, central, and occipital leads; electromyography using mental, submental, and bilateral anterior tibialis leads; electrocardiography; continuous airflow monitoring with a thermistor and nasal pressure transducer; chest and abdominal effort; oxygen saturation using a pulse oximeter; end tidal carbon dioxide using a CO_2 sensor; and body positioning via video monitoring. Obstructive apnea and hypopnea were defined based on AASM guidelines [8]. OSA was identified by the AHI and was used to screen patients with mild OSA. Resolution of mild OSA was defined as a subsequent PSG with an obstructive AHI value less than 1.0.

Clinical characteristics such as medical comorbidities and the use of medications were retrieved from the medical records. Tonsil size was based on clinician's transoral examination using the Brodsky grading scale [9] and was taken from the appointment at which the initial PSG was ordered, if available. Obesity was determined based on the body mass index (BMI) Z-score calculated using the Centers for Disease Control and Prevention 2000 growth charts [10]. A BMI Z-score in the 95th percentile (greater than 1.645) was considered obese. Patients were classified as syndromic if they had a previously diagnosed craniofacial syndrome or abnormality, Trisomy 21, cerebral palsy, or other neuromuscular disorder resulting in hypotonia.

2.2. Intervention

After the initial PSG, patients underwent observation or underwent tonsillectomy and adenoidectomy based on individualized clinician's practice and parental input on impact on the child. Tonsillectomy was performed primarily in an extracapsular fashion using monopolar cautery. Adenoidectomy was performed using curettage, suction ablation and cautery, or microdebridement. Patients had repeat PSGs at various intervals based on clinical discretion.

2.3. Statistical analysis

Descriptive statistics, including means and standard deviations for continuous variables and percentages for categorical variables, were used to compare the treatment groups. Chi-square analysis was used to compare categorical data between groups, including whether or not patients showed resolution of OSA as defined above. Between-group comparisons of PSG changes were performed on log-transformed variables using the independent samples t test. In order to account for the baseline difference in AHI between treatment groups, a multivariate linear regression model was created using the log-transformed change in AHI as the dependent variable and the baseline AHI value as a covariate. Statistical analysis was performed using JMP (JMP®, Version ⟨10⟩. SAS Institute Inc., Cary, NC, 1989–2007) software. Statistical significance was set at $p \leq 0.05$.

3. Results

3.1. Patient characteristics

There were 62 patients, ages 9 months to 9 years, identified with a diagnosis of mild OSA on polysomnography who had more than 1 PSG to review. Of the 62 patients, 18 patients underwent adenotonsillectomy for mild OSA while 44 patients were observed; 1 of the 18 surgical patients underwent partial intracapsular tonsillectomy. The clinical characteristics of the surgery and observation groups are shown in Table 1. There were no significant differences in age, gender, or baseline tonsil size between groups.

Table 1
Clinical characteristics of 62 patients with mild obstructive sleep apnea.

Characteristics	Surgery ($n=18$)	Observation ($n=44$)	p-Value
Gender			0.88
Male	11 (61%)	26 (59%)	
Female	7 (39%)	18 (41%)	
Mean age, years (SD)	3.1 (2.3)	4.5 (2.7)	0.12
Mean initial AHI, events/h (SD)	3.5 (1.1)	3.1 (1.1)	0.16
Mean time between PSGs, months (SD)	16.0 (13.9)	16.7 (13.4)	0.54
Obesity			0.13
Yes	8 (44%)	11 (25%)	
No	10 (56%)	33 (75%)	
Syndromic			0.28
Yes	6 (33%)	9 (20%)	
No	12 (67%)	35 (80%)	
Tonsil size			0.69
1–2	10 (56%)	27 (61%)	
3–4	7 (39%)	15 (34%)	
Unknown	1 (6%)	2 (5%)	

SD, Standard deviation.