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Adenoidectomy Without Tonsillectomy for Pediatric Obstructive Sleep Apnea

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Abstract

Objective. The primary objective was to determine if obstructive sleep apnea (OSA) can improve after adenoidectomy.

Study Design. Case series with chart review.

Setting. Tertiary children's hospital between 2016 and 2018.

Methods. The study included children under 3.5 years with small (1+ or 2+) palatine tonsils, large (3+ or 4+) adenoids, and documented OSA on polysomnogram (PSG).

Results. Seventy-one children were included. Age at adenoidectomy was 2.0 years (95% CI, 1.8-2.2) and 71.8% were male. Mean follow-up was 2.5 years (95% CI, 2.3-2.7). Twenty-six children (36.6%) obtained a repeat PSG at a mean of 9.7 months (95% CI, 6.3-13.2) after adenoidectomy. Among those with a postoperative PSG, apnea-hypopnea index decreased in 77.0% (mean, –3.2 events/h; 95% CI, –14.1 to 7.6), and the proportion with moderate to severe OSA decreased from 65.4% to 30.8% (P = .03). Six children (23.1%) had a normal PSG after adenoidectomy. Tonsillectomy was performed in 14.1% of children at 12.1 months (95% CI, 7.5-16.7) after adenoidectomy. Despite similar preoperative PSG variables, younger children (1.5 vs 2.1 years, P = .02) were more likely to require tonsillectomy. Substantial adenoid regrowth was identified in 1 child at the time of tonsillectomy.

Conclusion. Adenoidectomy may improve OSA in young children with large adenoids and small tonsils. However, younger age predicted the need for subsequent tonsillectomy. Prospective studies with additional PSG data are necessary to corroborate these findings.

Keywords

adenoidectomy, pediatrics, polysomnogram, obstructive sleep apnea, tonsillectomy

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Adenoidectomy without tonsillectomy is performed for more than 129,000 children annually in the United States,[1] with an estimated 69,000 ambulatory adenoid procedures under 15 years of age.[2] Adenoidectomy is a safe, well-tolerated surgery commonly indicated for sleep-disordered breathing and nasal obstruction.[3] In the pediatric population, sleep-disordered breathing is often secondary to tonsil and adenoid hypertrophy.[4] However, adenoidectomy does not address oropharyngeal obstruction from the tonsils.[5] The American Academy of Otolaryngology–Head and Neck Surgery Foundation (AAO-HNSF) defines tonsillectomy as a surgical procedure that often, but not always, includes the removal of the adenoid with the tonsils. The AAO-HNSF guideline on pediatric tonsillectomy does not apply to children younger than 2 years or to those having adenoidectomy alone.[6]

Clinicians often consider adenoidectomy for obstructive symptoms in children with small tonsils and large adenoids. Low rates of respiratory complications[7] and rare secondary hemorrhage events[8] advocate for adenoidectomy over adenotonsillectomy in select children. Although a number of studies have shown that adenoidectomy is effective for obstructive symptoms,[9-12] others report less success and appreciable rates of subsequent tonsillectomy.[13,14] To date, there has not been any level 1 study looking at the efficacy of adenoidectomy alone for the treatment of obstructive sleep apnea (OSA) or sleep-disordered breathing (SDB).[15] The current evidence is limited by a paucity of polysomnogram (PSG) data that objectively measure OSA before and after adenoid surgery.

This series looked at outcomes for young children with OSA after adenoidectomy. All children had OSA on preoperative PSG and were followed for persistent symptoms or postoperative PSG. The primary objective was to determine if children who underwent an adenoidectomy for OSA had clinical improvement or resolution of obstructive symptoms. Secondary objectives included comparing postoperative PSG parameters, identifying variables for persistent OSA, and determining risk factors for subsequent tonsillectomy.

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Methods

A case series with chart review was performed on consecutive children under the age of 3.5 years who obtained an adenoidectomy without tonsillectomy. The Children's Hospital of Philadelphia Institutional Review Board approved this project with exemption for surgeries between 2016 and 2018. Surgeries performed in the main operating room on children with an apnea-hypopnea index (AHI) greater than or equal to 1 event/h on PSG met inclusion. Charts were reviewed for age, sex, race, gestational age, and comorbidities. Physical exam determined size of the palatine tonsils, and adenoid obstruction was assessed by lateral neck X-ray or nasopharyngoscopy based on clinician practices, caregiver preference, and patient cooperation. Exclusion criteria included prior adenoidectomy, a concomitant tonsillectomy, or major surgery at the time of adenoidectomy. Comorbidities excluded were chronic respiratory failure, tracheostomy dependence, unrepaired choanal atresia, severe laryngomalacia, severe tracheomalacia, and/or subglottic stenosis. Acceptable minor procedures included myringotomy tube placement, cerumen removal, nasal cautery, or short-duration surgeries by other services.

Measured Outcomes

Variables extracted from PSG included total AHI, nadir oxygen saturation, and peak end-tidal CO_2. Records were assessed until December 2019 for office visits, hospital readmissions, nursing telephone calls, PSG results, or surgical notes. Operative reports for adenoidectomy characterized adenoid size, surgical technique, and concomitant procedure. Children's Hospital of Philadelphia comprises 16 surgeons using various surgical techniques for adenoidectomy and tonsillectomy. Admission after adenoidectomy, if applicable, was reviewed for duration, unit location, need for oxygen support, significant events, or complications. In addition, nurse triage calls, emergency department visits, and readmissions 30 days after discharge determined postoperative complications. Follow-up visits captured persistent obstructive symptoms, repeat PSG results, and recommendation for subsequent tonsillectomy. Tonsillectomy operative reports characterized the size of tonsils and amount of adenoid tissue that may have regrown. Posttonsillectomy complications, including operative control of oropharyngeal hemorrhage, were recorded for the 30 days after surgery. Children requiring positive pressure treatment at the conclusion of their surgical interventions were also noted.

Statistical Analysis

Data analysis was performed using SPSS Statistics for Windows (version 25.0; SPSS, Inc). Continuous variables were expressed in means with 95% confidence intervals. Categorical values were represented by the absolute number along with percentage. Tests for statistical significance were performed by using Student t test and Fisher exact test, where appropriate. Significance levels were set at $P < .05$.

Results

Patient Characteristics

Seventy-one children met inclusion criteria and **Table 1** shows the characteristics of the study population. Mean age was 2.0 years (95% CI, 1.8-2.2), 71.8% were male, and mean gestational age was 37.0 weeks (95% CI, 36.1-38.0). Most were black or African American (46.5%), and 32.4% had reactive airway disease. Craniofacial syndromes included 1 child with Pierre Robin sequence, 1 with Crouzon syndrome, and 1 with Beckwith-Wiedemann syndrome (BWS). Length of follow-up was a mean of 2.5 years (95% CI, 2.3-2.7).

Adenoidectomy Surgical Course

Based on preoperative physical examination, radiographic studies, and intraoperative findings, all palatine tonsils were 1+ or 2+ in size, and all adenoids were 3+ or 4+ obstructing. A 3+ or 4+ adenoid was based on an estimated 75% (moderate) or 100% (complete) obstruction of the nasopharyngeal airway. Procedures included 60.6% having an adenoidectomy with minor ear surgery and 2.8% having adenoidectomy with nasal cautery. The most common surgical technique used a microdebrider in 43.7%, followed by 32.4% using suction cautery and 23.9% using coblation. Neither the need for a second PSG ($P = .78$) nor the need for subsequent tonsillectomy ($P = .91$) correlated with technique.

After adenoidectomy, 43 children (60.6%) had a planned admission to the hospital for airway monitoring due to young age. Children admitted were 1.7 years old (95% CI, 1.5-1.9) compared to 2.5 years old (95% CI, 2.2-2.7) ($P < .001$) for those discharged on the day surgery. Of the 36 (83.7%) admitted to the floor, 32 (88.9%) were discharged within 24 hours. All prolonged admissions, highlighted in **Table 2**, were not related to respiratory events. The other 16.3% of admitted children had planned intensive care monitoring with all but 1 being discharged within 24 hours. During admission, 3 children (7.0%) had brief, self-resolved oxygen desaturations to mid-80%. These were managed with low-flow nasal cannula or blow-by oxygen and quickly weaned to room air. One child had bronchospasm prior to anesthesia induction requiring albuterol, and 1 child in the intensive care unit (ICU) briefly needed high-flow oxygen. From the entire cohort of 71 patients, 88.4% of the admitted children and 96.4% of the outpatient children did not require oxygen supplementation following adenoidectomy. Within 30 days of surgery, 7 children were readmitted: 4 due to fevers or upper respiratory tract infections (URIs), 2 for gastrointestinal symptoms, and 1 for pain control. All returning children were either discharged from the emergency department or observed for less than 24 hours.

Postadenoidectomy Outcomes

A second PSG was obtained in 36.6% of patients at a mean of 9.7 months (95% CI, 6.3-13.2) after adenoidectomy. As shown in **Table 3**, characteristics of children with and

Table 1. Characteristics of Children Who Did and Did Not Require a Subsequent Tonsillectomy After Adenoidectomy.

Characteristic	All patients	No subsequent tonsillectomy	Required tonsillectomy	*P* value
Total No. (%)	71 (100)	61 (85.9)	10 (14.1)	
Age, mean (95% CI), y	2.0 (1.8-2.2)	2.1 (1.9-2.3)	1.5 (1.0-1.9)	.02
Males, No. (%)	51 (71.8)	43 (70.5)	8 (80)	.71
Gestational age, mean (95% CI), wk	37.0 (36.1-38.0)	37.2 (36.2-38.1)	36.3 (32.9-39.8)	.51
Race, No. (%)				
Black or African American	33 (46.5)	27 (44.3)	6 (60)	.70
White	31 (43.7)	28 (45.9)	3 (30)	
Other[a]	7 (9.9)	6 (9.8)	1 (10)	
Comorbidities, No. (%)				
Reactive airway disease	23 (32.4)	17 (27.9)	6 (60)	.07
Neuromuscular disorder	13 (18.3)	13 (21.3)	0 (0)	.19
Trisomy 21	5 (7.0)	4 (6.6)	1 (10)	.54
Other[b]	15 (21.1)	13 (21.3)	2 (20)	1.0
None	25 (35.2)	22 (36.1)	3 (30)	1.0
Adenoid size, No. (%)				
Completely obstructing (4+)	37 (52.1)	31 (50.8)	6 (60)	.74
Moderately obstructing (3+)	34 (47.9)	30 (49.2)	4 (30)	
Tonsil size, No. (%)				
Mildly obstructing (2+)	28 (39.4)	23 (37.7)	5 (50)	.50
Nonobstructing (1+)	43 (60.6)	38 (62.3)	5 (50)	

[a]Other races include Asian (1), Indian (1), and other (5).
[b]Other comorbidities include cardiovascular disease, bleeding disorders, and/or craniofacial syndromes.

Table 2. Postadenoidectomy Admissions Longer Than 24 Hours.

Patient	Age, y	Sex	Duration	Unit	Reason for prolonged admission
1	2.0	Female	4 days	Floor	Glucose monitoring for adrenal insufficiency
2	1.6	Male	3 days	Floor	Initiation of gastrostomy tube feeds and instruction
3	2.6	Male	2 days	Floor	Monitoring for G6PD and platelet defect
4	1.8	Female	2 days	Floor	Parent preference, low-grade fever, slow oral intake
5	1.2	Male	2 days	ICU	Pan-hypopituitarism monitoring and low-flow O_2 for first 12 hours

Abbreviations: G6PD, glucose-6-phosphate dehydrogenase deficiency; ICU, intensive care unit.

without a postoperative PSG were similar. Initial PSG data could not predict which children needed subsequent tonsillectomy (**Table 4**). All postoperative sleep studies were ordered for persistent symptoms or for abnormal preoperative testing, namely, O_2 nadir and sleep study severity. Depicted in **Table 5**, children obtaining a second PSG initially had a lower mean nadir O_2 on the original sleep study (85.0% vs 87.9%, $P = .02$) and were more likely to have moderate or severe OSA (65.4% vs 31.1%, $P < .01$) compared to children without a subsequent PSG.

Children with a postadenoidectomy PSG had a significant reduction in the rates of moderate or severe AHI from 65.4% to 30.8% ($P = .03$). No difference in mean AHI (12.9 vs 9.7, $P = .53$), nadir O_2 saturation (85.0 vs 86.9, $P = .16$), or peak end-tidal CO_2 (54.0 vs 50.7, $P = .10$) occurred when PSG was obtained after adenoidectomy. An AHI reduction of any amount was most common in children with moderate AHI or trisomy 21 but less common in children with mild AHI or reactive airway disease (**Figure 1**). Although there was no change in the proportion of severe OSA (42.3% vs 19.2%, $P = .13$), 6 children (23.1%) had a normal PSG (AHI $\leq$1 event/h) after adenoidectomy alone ($P = .02$). Notably, the child with BWS and no history of tongue reduction went from a mild AHI of 2.4 events/h to a normal AHI of 0.1 events/h after adenoidectomy.

Subsequent Tonsillectomy

Tonsillectomy with revision adenoidectomy was required for 14.1% of children. These children were significantly younger at the time of adenoidectomy (1.5 years; 95% CI, 1.0-1.9) compared to children not requiring tonsillectomy (2.1 years; 95% CI, 1.9-2.3) ($P = .02$). Tonsillectomy occurred 12.1 months (95% CI, 7.5-16.7) after adenoidectomy, and 20% were intracapsular. Intraoperative adenoid

Table 3. Polysomnography (PSG) Data Separated by Children Who Did and Did Not Obtain a Postadenoidectomy PSG.

Characteristic	No second PSG obtained	Second PSG obtained	*P* value
Total No. (%)	45 (63.4)	26 (36.6)	
Age, mean (95% CI), y	2.1 (1.9-2.3)	1.8 (1.4-2.2)	.08
Males, No. (%)	32 (71.1)	19 (73.1)	1.0
Gestational age, mean (95% CI), wk	36.8 (35.5-38.1)	37.4 (36.1-38.7)	.52
Race, No. (%)			
Black or African American	20 (44.4)	12 (46.2)	.46
White	22 (48.9)	10 (38.5)	
Other[a]	3 (6.7)	4 (15.4)	
Comorbidities, No. (%)			
Reactive airway disease	13 (28.9)	10 (38.5)	.44
Neuromuscular disorder	10 (22.2)	3 (11.5)	.35
Trisomy 21	1 (2.2)	4 (15.4)	.06
Other[b]	7 (15.6)	8 (30.8)	.14
None	19 (42.2)	6 (23.1)	.13

[a]Other races include Asian, Indian, and other.
[b]Other comorbidities include cardiovascular disease, bleeding disorders, and/or craniofacial syndromes.

Table 4. Preadenoidectomy Polysomnography Data Separated by Children Who Did and Did Not Obtain a Subsequent Tonsillectomy After Adenoidectomy

Characteristic	All patients	No subsequent tonsillectomy	Required tonsillectomy	*P* value
Polysomnography, No. (%)	71 (100)	61 (85.9)	10 (14.1)	
AHI, mean (95% CI)	9.3 (6.1-12.4)	9.1 (5.5-12.6)	10.4 (4.0-16.8)	.78
Nadir oxygen saturation, mean (95% CI), %	86.9 (85.7-88.0)	86.9 (85.6-88.2)	86.6 (83.3-89.9)	.85
Peak end-tidal CO_2, mean (95% CI), mm Hg	52.3 (50.9-53.6)	51.9 (50.4-53.4)	54.5 (50.5-58.5)	.18
Moderate or severe AHI, No. (%)[a]	31 (43.7)	26 (42.6)	5 (50)	.74

Abbreviation: AHI, apnea-hypopnea index.
[a]A moderate or severe AHI is defined as an AHI over 5 events/h.

Table 5. Mean PSG Data Comparing the Children Who Did or Did Not Obtain a Second PSG After Adenoidectomy.[a]

Characteristic	No second PSG obtained	Second PSG obtained	*P* value	Postadenoid PSG	*P* value
Polysomnography, No. (%)	45 (63.4)	26 (36.6)		26 (100)	
AHI, mean (95% CI)	7.1 (3.1-11.1)	12.9 (7.8-18.1)	.08	9.7 (0.6-18.7)	.53
Nadir oxygen saturation, mean (95% CI), %	87.9 (86.5-89.3)	85.0 (83.1-87.0)	.02	86.9 (85.0-88.8)	.16
Peak end-tidal CO_2, mean (95% CI), mm Hg	51.2 (49.7-52.8)	54.0 (51.4-56.5)	.05	50.7 (47.5-53.8)	.10
Moderate or severe AHI, No. (%)	14 (31.1)	17 (65.4)	<.01	8 (30.8)	.03

Abbreviations: AHI, apnea-hypopnea index; PSG, polysomnogram.
[a]The first *P* value compares the PSG variables between the 2 groups, while the postadenoid PSG and subsequent *P* value compare the 26 children before and after adenoid surgery.

assessment revealed only 1 fully obstructive adenoid and absent or mild regrowth for the remaining 9 patients. Two patients, both without a bleeding disorder diagnosis, had a posttonsillectomy hemorrhage requiring return to the operating room: 1 on postoperative day 5 and the other on postoperative day 7.

Third PSG Data

Six children obtained a third PSG. Clinicians typically ordered these studies due to ongoing obstruction concerns. In this small cohort, initial adenoidectomies occurred at 1.8 years of age (95% CI, 0.5-3.1), and 3 children had a subsequent tonsillectomy. The group included 5 males with a

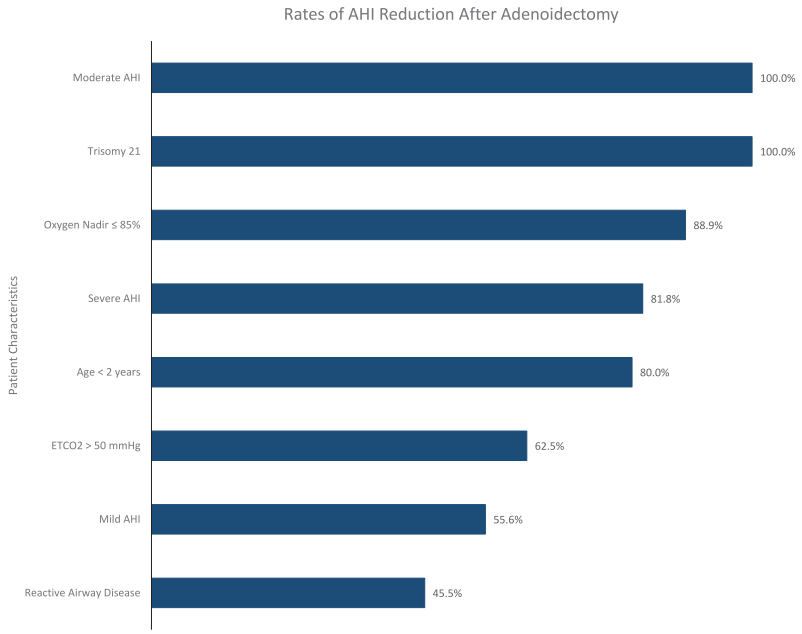

Figure 1. Percentage of children by preoperative polysomnogram category that obtained a postadenoidectomy polysomnogram and had a reduction in apnea-hypopnea index (AHI).

Table 6. Children Who Obtained a Third PSG Separated by Those Who Did (3 Patients) and Did Not (3 Patients) Have a Tonsillectomy After Adenoidectomy.

Characteristic	Initial PSG	Postadenoid	*P* value	Third PSG	*P* value
Tonsillectomy					
AHI	10.9 (2.8-16.2)	16.3 (3.3-23.5)	.52	14.7 (0.2-35.6)	.90
Nadir oxygen saturation, %	86.0 (83-88)	84.3 (81-91)	.67	86.7 (80-92)	.66
Peak end-tidal CO_2, mm Hg	53.7 (50-57)	59.3 (57-63)	.11	53.7 (50-56)	.10
No tonsillectomy					
AHI	17.3 (9-30.6)	3.6 (0.5-6.3)	.12	3.8 (0.1-7.9)	.96
Nadir oxygen saturation, %	84.7 (80-87)	91.3 (87-95)	.11	91.3 (87-94)	1.0
Peak end-tidal CO_2, mm Hg	56.0 (50-66)	47.7 (44-53)	.22	47.0 (45-49)	.83

Abbreviations: AHI, apnea-hypopnea index; PSG, polysomnogram. Values represent mean (range).

mean gestational age of 39.2 weeks (95% CI, 37.4-41.1), 3 of whom were black or African American, 3 having comorbidities of reactive airway disease, and 1 diagnosed with Pierre Robin sequence. The third PSG was obtained at a mean of 19.3 months (95% CI, 6.8-31.9) after adenoidectomy and between 1 and 15 months after tonsillectomy (mean, 6.9 months), if performed. **Table 6** highlights the impact of adenoid and tonsil surgery on PSG data for these children.

Positive Pressure Interventions

At latest follow-up, 3 patients required ongoing positive pressure support. This included (1) continuous positive airway pressure (CPAP) for a female born at 34 weeks with adenoidectomy at 1 year who had mild OSA on repeat PSG but did not have a tonsillectomy, (2) bilevel positive airway pressure (BiPAP) (10/8 cm H_2O) for a full-term male with reactive airway disease and adenoidectomy at 1 year who was found to have moderate OSA after tonsillectomy, and (3) CPAP for a full-term male with Crouzon syndrome and adenoidectomy at 3 years who had moderate OSA without subsequent tonsillectomy.

Discussion

This is the largest reported series of PSG outcomes after adenoidectomy for pediatric patients with OSA. The surgical management of a child with large adenoids, nonobstructing tonsils, and obstructive symptoms raises varied considerations. For example, while most American Society of Pediatric Otolaryngology (ASPO) members and active AAO-HNS practitioners would perform an adenoidectomy, over half of these surgeons would sometimes offer an adenotonsillectomy.[16] Tonsillectomy could add considerable morbidity. Postoperative hemorrhage rates increase from 0.25% after

adenoid surgery to 2.9% after tonsillectomy,[17] and recovery periods can last for 2 weeks.[18] Since SDB is likely related to a combination of tonsil and adenoid hypertrophy,[6] it is reasonable to address each site in isolation, particularly in younger children. Glossoptosis, which was not looked at in this series, is another important etiology of obstruction in this patient population. Adenoid hypertrophy occurs between the age of 2 and 5 years[19] as the area of the nasopharyngeal airway diminishes slightly from 3 to 5 years.[20] Although few adenoidectomies are performed in children under 12 months, the peak age for this procedure is around 3 years. Adenoidectomy is commonly performed in children less than 2 years of age while adenotonsillectomy is most common for children older than 2 years.[21] Careful consideration of the child's age, likelihood for adenoid growth, and morbidity of tonsil surgery provides the framework for clinicians contemplating adenoidectomy without tonsillectomy.

The majority of children in this series had clinical resolution of obstructive symptoms following adenoidectomy. Fifty-eight children (81.7%) did not require tonsillectomy or positive pressure support. A notable finding was age under 18 months at adenoidectomy correlating significantly with the need for tonsillectomy. Only 1 of the 10 postadenoidectomy tonsillectomy cases in this series found obstructing adenoid tissue. Nonetheless, if a child younger than 18 months with OSA has large adenoids and small tonsils, the need for subsequent tonsillectomy should be closely monitored. It also raises the question of multiple surgical interventions in the young child, which, given concerns about general anesthesia exposure, would be a drawback to consider.

Adenoid regrowth is estimated at 3%, with most regrowth clinically insignificant.[11] Based on the symptomatology and intraoperative findings in this study, the rate of clinically substantial adenoid regrowth was 1 out of 71 cases (1.4%). Revision adenoidectomy procedures occur after 0.6% to 1.5% of reported surgeries,[22-24] with younger age[25,26] identified as a risk factor. Rates of tonsillectomy are estimated for 7.8% to 34.5% of children after adenoidectomy.[14,27] Obstructive symptoms double the risk of subsequent tonsillectomy, and for each unit increase in tonsil size, the risk grows by 1.6 times.[13] In 1 series, children under 2 years were 5.6 times more likely to need a revision adenoidectomy compared to children under 5 years who were 3.2 times more likely.[24] Another series found 22% of children under 2 years of age requiring tonsillectomy after adenoidectomy.[28] However, those studies included nonobstructive indications, the amount of adenoid regrowth was not described, and PSG data were not captured. Nonetheless, this series is consistent with prior reports that younger age is a risk factor for subsequent tonsillectomy.

A significant reduction in the proportion of moderate or severe OSA occurred after adenoidectomy. A second PSG was ordered for a lower baseline O_2 nadir, moderate or severe OSA on initial study, or persistent symptoms. Any reduction in AHI most commonly occurred in children with moderate AHI or trisomy 21 but was less likely in children with a mild AHI or reactive airway disease. Furthermore, 6 children (23.1%) with a postoperative PSG had a normal AHI. It is important to note that 63.3% of the entire cohort did not have a second PSG. Therefore, rates of objective OSA improvement or resolution are likely underestimated. Symptomatic improvement among those not obtaining a postadenoidectomy PSG has clinical relevance. Clinicians often repeat a sleep study if there is a high suspicion of ongoing OSA. A low rate of second PSG suggests a resolution in symptoms consistent with obstruction for many in this cohort. Among the 71 children, the majority had no symptoms after adenoid surgery, and among those who did, nearly all had objective PSG improvement.

Improvement in postoperative PSG suggests that adenoidectomy is a reasonable surgical option. OSA severity has been previously correlated to relative adenoid size and not with size of the tonsils.[29] Others found significant improvements in AHI and O_2 nadir for 84.5% of adenoidectomy patients.[9] Infants less than 1 year with OSA have had resolution of obstructive symptoms and decreases in AHI after adenoidectomy.[10] Children with an AHI $\geq$10 events/h and/or tonsil size $\geq$3+ have a higher failure rate after adenoidectomy compared to adenotonsillectomy with respect to patient-identified symptoms.[30] A systematic review and meta-analysis concluded that AHI and O_2 nadir improve after adenoidectomy, with the largest AHI reductions observed in children under 12 months.[31] Testing asymptomatic children in our cohort without a second PSG may have identified persistent OSA, but the clinical utility remains unclear.

The limited number of children with a third PSG revealed an uncertain role for tonsillectomy after failed adenoidectomy. Regardless of whether a tonsillectomy was performed, the third PSG parameters did not significantly change compared to the postadenoidectomy PSG. This questions whether children with small tonsils and large adenoids who fail adenoidectomy (ie, with persistent sleep apnea) have any benefit from subsequent tonsillectomy. The small number of patients in this subgroup limits a strong conclusion until corroborated by larger, prospective trials. Nonetheless, it might suggest judicious use of tonsillectomy in similar scenarios.

A small percentage of patients required ongoing positive pressure support. Even after adenotonsillectomy, OSA can persist, especially in children with craniofacial anomalies, trisomy 21, neuromuscular disease, and obesity.[4] Despite efficacy, CPAP is not recommended as first-line therapy for OSA when adenotonsillectomy is an option, in part due to poor compliance. CPAP may, however, be useful for children who do not respond to surgery or in whom surgery is contraindicated.[5] Prior work found that adenoidectomy in children less than 6 months of age showed an 86% decrease in AHI, which was equivalent to the efficacy of CPAP/BiPAP.[12] Further work is needed to determine the timing and utility of CPAP for young children after adenoidectomy.

Limitations

This study is limited by selection bias and the lack of comparison to an older age group. Not all patients obtained a

postoperative PSG, and the decision was based on preoperative PSG severity, persistence of symptoms, or clinician suspicion. The decision to recommend a subsequent tonsillectomy, while often guided by symptoms or PSG data, could be affected by patient-physician decision making that can be varied in a group of 16 physicians. While many comorbidities were assessed, the presence of gastroesophageal reflux disease, which is known to cause high rates of failure after adenoidectomy,[14,26] was not reported. Finally, length of follow-up may have been too limited in some children to determine if symptoms returned or tonsillectomy was required.

Conclusions

Adenoidectomy for young children with large adenoids and nonobstructing tonsils is a reasonable surgical option for OSA. This series identified decreases in OSA severity based on PSG data after adenoidectomy. While the majority of children had symptom resolution and did not require tonsillectomy, younger children were more likely to require tonsillectomy after adenoidectomy. Future prospective studies will be necessary to corroborate these findings.

Author Contributions

Stephen R. Chorney, study design, data acquisition and interpretation, manuscript drafting and revision, and final manuscript approval; **Karen B. Zur**, study design, data acquisition and interpretation, manuscript drafting and revision, and final manuscript approval.

Disclosures

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