Adenotonsillectomy for Obstructive Sleep Apnea Syndrome in Young Children

Prevalence of Pulmonary Complications

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Objective: To determine, in a series of children younger than 6 years undergoing adenotonsillectomy for treatment of clinical obstructive sleep apnea syndrome (OSAS), the effect of age on prevalence of postoperative respiratory complications. The primary objective was to define a practice standard for postoperative hospital admission.

Design: Retrospective analysis.

Setting: Cincinnati Children’s Hospital Medical Center, Cincinnati, Ohio.

Patients: All children younger than 6 years who underwent adenotonsillectomy to treat OSAS from June 1, 1999, to May 31, 2001.

Main Outcome Measures: The percentage of children younger than 3 years undergoing adenotonsillectomy to treat OSAS who experience a postoperative respiratory complication.

Results: Of 2315 patients younger than 6 years undergoing an adenotonsillectomy for treatment of OSAS, 149 (6.4%) developed a postoperative respiratory complication. Even though there was a lower incidence of comorbid medical conditions in this cohort, children younger than 3 years were at a greater risk for developing a postoperative respiratory complication compared with those aged 3 to 5 years (9.8% vs 4.9%, \( P < .001 \)). Logistic regression analysis revealed that children younger than 3 years had a nearly 2-fold increased risk for respiratory complications postoperatively (odds ratio, 1.98; 95% confidence interval, 1.41-2.77) when controlling for race and sex.

Conclusions: Adenotonsillectomy to treat OSAS is associated with a significantly higher rate of postoperative respiratory complication in children younger than 3 years compared with children aged 3 to 5 years. Our results support hospital admission for all patients younger than 3 years undergoing adenotonsillectomy for treatment of OSAS.


Obstructive sleep apnea syndrome (OSAS) in children is characterized by recurrent events of partial or complete upper airway obstruction during sleep, resulting in disruption of normal ventilation and sleep patterns.\(^1\) If untreated, childhood OSAS may lead to significant morbidity\(^3\) and, in rare cases, mortality. These sequelae are the result of chronic nocturnal hypoxemia, acidosis, and sleep fragmentation. Obstructive sleep apnea syndrome has become an important indication for adenotonsillectomy, which has become the first-line treatment for OSAS in children.\(^2\) Several studies\(^4\) have shown that adenotonsillectomy reverses the symptoms associated with childhood OSAS. Because physicians have increasing awareness of neurocognitive deficits associated with OSAS treated later in childhood, more children are now undergoing adenotonsillectomy at a younger age.

Because of advances in anesthetic and surgical techniques, third-party payers often encourage physicians to perform pediatric adenotonsillectomies on an outpatient basis. Altering practice patterns to include children at high risk for postoperative morbidity as candidates for outpatient adenotonsillectomy requires careful examination. With the use of dexamethasone phosphate and ondansetron hydrochloride, perioperative care of patients undergoing adenotonsillectomy has improved by reducing postoperative discomfort, improving dietary tolerance, and reducing postoperative emesis.\(^5\) By reducing these postoperative complications, respiratory morbidity now accounts for most hospitalizations after adenotonsillectomy for OSAS and is a major factor in determining whether to perform inpatient vs outpatient surgery. The goal of this study is to determine, in a population of children undergoing adenotonsillectomy to treat clinical OSAS, the effect of age on prevalence of postoperative respira-
tory complications so as to set a more clearly defined prac-
tice standard for postadenotonsillectomy hospital admission. Cincinnati Children’s Hospital Medical Center (CCHMC) serves as the community hospital for children in Cincinnati, Ohio, and as the tertiary care center for the greater Cincinnati area. Because more than 2500 adenotonsillectomies are performed annually at CCHMC, it is well suited to provide evidence that may guide practice patterns for care of children after adenotonsillectomy.

METHODS

STUDY DESIGN

All children who underwent an adenoidectomy, tonsillec-
tomy, or both at CCHMC or its satellite facilities from June 1, 1999, to May 31, 2001, were identified from a medical records database. A search was performed using Current Procedural Terminology codes to determine the type of surgery and International Classification of Diseases, Ninth Revision (ICD-9)12 diagnosis codes to determine the indication for surgery. In this manner, we identified children who had undergone an adenotonsillectomy for obstructive breathing during sleep. A retrospective medical record review was undertaken to describe the children who met the inclusion criteria. The study was approved by the institutional review board at CCHMC.

Exclusion criteria for study enrollment are as follows:

- Recurrent adenotonsillitis as an indication for adenotonsillectomy.
- No report of snoring on preoperative history and physical examination.
- Concurrent surgical procedures that could lead to increase in the duration of general anesthesia.
- Children with baseline low oxygen saturation or those requiring respiratory support preoperatively.

The presence of obstructive breathing during sleep was determined by a history of snoring and the presence of adenotonsillar hypertrophy on physical examination by an otolaryngologist. The preoperative physician evaluation history, and physical examination were reviewed to determine the presence of comorbid conditions. Effects of comorbid conditions have been previously reported in children older than 3 years.13 The patients were then stratified by age to establish the prevalence of postoperative respiratory complications in each age group. In this study, the exclusion criteria consisted of recurrent adenotonsillitis as an indication for adenotonsillectomy, no report of snoring on the preoperative physical examination and medical history obtained by the nursing staff, a lack of adenotonsillar hypertrophy on physical examination, any concurrent surgical procedures that could lead to an increase in the duration of general anesthesia, and a baseline preoperative awake hypoxia or the need for respiratory support before surgery.

OPERATIVE PROCEDURE

General anesthesia was induced, and most patients were given balanced gas anesthesia as well as intravenous nondepolarizing paralytics, short-acting narcotics, dexamethasone, and ondansetron at doses appropriate for patient weight. Unless patients were allergic to penicillin, patients received ampicillin intravenously, with the dose adjusted according to patient weight. Tonsillar tissue was removed using monopolar electrocautery, and hemorrhage was obtained with suction electrocautery. Adenoid tissue was removed by suction electrocautery. The large number of adenotonsillectomies performed at our institution has resulted in a fairly standardized surgical technique that is followed closely by all attending physicians, fellow physicians, and resident house staff.

STATISTICAL ANALYSIS

We used SAS software (version 8.2; SAS Inc, Cary, NC) for the statistical analyses. We performed descriptive analysis to calculate mean age and frequency counts of demographic variables and to identify children with postadenotonsillectomy respiratory complications stratified by age and those with comorbid medical conditions. We performed χ² analysis to compare patient age groups (<3 years and 3-5 years) for differences in percentages according to (1) sex and race and (2) postadenotonsillectomy respiratory complications. We calculated univariate logistic regression analysis to identify risk factors that independently predicted the presence of postoperative respiratory complications in children with OSAS. We then used multiple logistic regression analysis to calculate the odds ratios, which were adjusted for the effects of other risk factors in the model. In all regression analyses, the dependent variable was the occurrence of postoperative respiratory complications. The effect of age on the dependent variable was evaluated in separate models using age as a continuous variable or as a dichotomous variable (<3 years vs 3-5 years). A P value of less than .05 was used to determine statistical significance.

RESULTS

A total of 3404 patients younger than 6 years underwent tonsillectomy and/or adenoidectomy at CCHMC from May 1999 to June 2001. Obstructive breathing during sleep was the indication for surgery in 2315 children (68%). The 149 children who developed postoperative respiratory complications requiring intervention constituted the study group, and no mortalities were noted among those children.

Of all children with clinical OSAS, 55.3% were boys, and 44.7% were girls; 83.4% were white, and 14.1% were African American. We noted no significant differences in the percentage of patients in the group younger than 3 years and the group who were 3 to 5 years based on race or sex (Table). In analysis of all patients younger than 6 years who experienced respiratory complications, the most common complication was oxygen desaturation, which was seen in
57.7% of patients. Of note, an artificial airway was required for treatment, with 34.0% of patients receiving a nasopharyngeal airway and 8.8% requiring endotracheal intubation. Among the 27 children with complications who had a chest radiograph, the findings for 17 (63%) revealed abnormalities that included atelectasis, infiltrate, and pulmonary edema. Other respiratory complications included the following:

1. Oxygen desaturations below 90%, requiring oxygen supplementation or diuretic therapy.
2. Apnea or increased work of breathing requiring the following interventions:
   - Insertion of nasopharyngeal airway
   - Continuous positive airway pressure
   - Endotracheal intubation and mechanical ventilation
   - Chest radiograph changes of atelectasis, infiltrate, edema, pneumomediastinum, pneumothorax, or pleural effusion.

Among children younger than 6 years, 58.3% had a history of comorbid medical conditions, and these conditions included asthma (29.5%), history of prematurity (15.4%), obesity (13.4%), central nervous system conditions (7.3%), craniofacial malformations (4.0%), and a history of previous airway surgery (4.0%). Obesity was defined as weight equal to or greater than the 97th percentile for age and sex. It should be noted that fewer children in the group that was younger than 3 years had a comorbid medical condition than those in the 3- to 5-year-old group (51.4% vs 64.9%).

Children younger than 3 years with clinical OSAS were at a greater risk for experiencing postoperative respiratory complications compared with children who were aged 3 to 5 years (9.8% vs 4.9%; P<.001) (Figure). Likewise, comparing 2-year-olds with 3-year-olds yielded a significant increase in prevalence in respiratory complications (P<.02).

Logistic regression analysis demonstrated that children younger than 3 years have a nearly 2-fold increased risk for respiratory complications after adenotonsillectomy for clinical OSAS (odds ratio, 1.98; 95% confidence interval, 1.41-2.77) when controlling for race and sex. Using age as a continuous variable, for every year the child ages after 1 year the risk of a postoperative respiratory complication is 78% of the risk for each year younger (odds ratio, 0.78; 95% confidence interval, 0.69-0.90).

The number of adenotonsillectomies performed annually in the United States decreased from 1.4 million in 1959 to 340,000 in 1985. Chronic infection was the primary surgical indication for adenotonsillectomy in previous decades, whereas now airway obstruction and OSAS have become important preoperative indications for surgery. In a recent review of the National Hospital Data Survey from 1995 to 1999, adenotonsillectomy remains the most common inpatient otolaryngologic surgical procedure for American children younger than 15 years. Several reports confirm the beneficial effects of adenotonsillectomy for OSAS on children’s growth, school performance, and cardiac function.

Postoperative respiratory complications have been reported to occur in 5% to 25% of children with OSAS undergoing an adenotonsillectomy. These complications include oxygen desaturation, atelectasis, pneumonia, pulmonary edema, pleural effusion, pneumothorax or pneumomediastinum, and upper airway obstruction manifested as inspiratory stridor with increased work of breathing. The interventions employed to treat these conditions include oxygen supplementation, nasopharyngeal airway, administration of antibiotics to treat pneumonia, or diuretic therapy to treat pulmonary edema. The increased work of breathing may necessitate respiratory support ranging from continuous positive airway pressure to endotracheal intubation and mechanical ventilatory support.

We present the largest young study population with clinical OSAS as the indication for adenotonsillectomy. In this series, the prevalence of postadenotonsillectomy respiratory complications in children with clinical OSAS, over a 2-year period, was 9.8% for children younger than 3 years and 4.9% for children aged 3 to 5 years. Several factors could have contributed to the lower prevalence of postadenotonsillectomy respiratory complications in our study compared with prevalence rates reported in previous studies. These factors include differences in referral patterns, study population, and diagnostic criteria for OSAS. Our results are in agreement with previous studies that report an increased risk for postoperative respiratory complications in children younger than 3 years. It is important to mention that some of these previous studies were limited by small numbers of patients younger than 3 years or included patients with OSAS and chronic adenotonsillitis as an indication for adenotonsillectomy in their case series.

Advances in anesthetic and surgical techniques have been reported to reduce postoperative morbidity...
in children undergoing an adenotonsillectomy, and third-party payers often encourage adenotonsillectomy in these patients to be performed on an outpatient basis. Studies\textsuperscript{15,29-33} have shown outpatient adenotonsillectomy to be a safe and cost-effective procedure for many pediatric patients, but some of these studies are limited owing to exclusion of patients with OSAS\textsuperscript{29} or by small numbers of young pediatric patients.\textsuperscript{72,33} The use of dexamethasone and ondansetron has improved the perioperative care of patients undergoing adenotonsillectomy. Dexamethasone has been shown to reduce postoperative discomfort, improve dietary tolerance, and almost eliminate postoperative emesis, presumably by reducing the inflammation in the oropharynx.\textsuperscript{31} With reduction of these postoperative complications, respiratory morbidity now accounts for a major number of hospitalizations after adenotonsillectomy for OSAS. Thus, the risk for postoperative respiratory complications is a major factor in determining whether to perform inpatient vs outpatient surgery. Despite using dexamethasone and ondansetron as a common procedure in all pediatric adenotonsillectomies at CCHMC, postoperative respiratory complications are persistently higher in very young children with OSAS.

To best use health care dollars, it is thus essential to identify which children with OSAS are better suited to undergo inpatient adenotonsillectomy. The presence of comorbid conditions such as asthma, prematurity, and craniofacial malformations have been correlated with occurrence of postoperative respiratory complications,\textsuperscript{2,11,17,18,22,27} and as such, inpatient adenotonsillectomy is well accepted in these patients. Even for children without comorbid medical conditions, young age remains a widely accepted risk factor for postoperative respiratory complications.\textsuperscript{27} In our study population of children with postoperative respiratory complications, 51.4% of children younger than 3 years had a history of comorbid medical conditions, leaving nearly half of these children who experienced a postoperative respiratory complication with no medical history. Despite having no comorbid medical conditions, a large number of young children experienced postoperative respiratory complications, further highlighting young age as a criterion to consider when planning hospital admission. These findings are supported by Shapiro and Bhattacharya,\textsuperscript{34} who found outpatient adenotonsillectomy to be less cost-effective than hospital admission in children younger than 3 years (P < .001).

There are some limitations to this study. Parental history of snoring and a diagnosis of adenotonsillar hypertrophy were used as markers for obstructive breathing during sleep. This may have lead to the inclusion of some children with adenotonsillar hyper trophy who do not have objective OSAS, as could be proved with polysomnography. Also, the retrospective design prevents us from determining the association of severity of comorbid conditions with type and severity of postoperative respiratory complications.

In conclusion, treating OSAS with adenotonsillectomy is associated with postoperative respiratory complications in about 10% of children younger than 3 years in our study group. The prevalence of postoperative respiratory complications is significantly higher in children younger than 3 years compared with children aged 3 to 5 years. This study provides additional evidence for guidelines from the Academy of Otolaryngology Head and Neck Surgery promoting inpatient adenotonsillectomy in patients younger than 3 years.

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REFERENCES


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