



Characteristics of children under 2 years of age undergoing tonsillectomy for upper airway obstruction



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ABSTRACT

Introduction: To study characteristics of children less than 2 years who underwent a tonsillectomy for sleep disordered breathing (SDB) or obstructive sleep apnea (OSA) to assess for factors associated with requesting a preoperative polysomnogram (PSG) and to identify predictors of upper airway obstruction in this group.

Materials and methods: A retrospective chart review of children under 2 years who underwent a tonsillectomy over a 7-year period at a tertiary care pediatric hospital was undertaken. Patient demographics, characteristics and polysomnography results, when applicable, were collected. In order to determine if the gathered demographics of our cohort differed from the non-surgical population, we compared our data with available Colorado data for each variable. Children were stratified by OSA severity using their obstructive apnea-hypopnea index (OAHI).

Results: 197 (2.2%) of 9038 patients who underwent tonsillectomy for SDB or OSA were ≤ 24 months. The proportions of male, African-American, Hispanic, obese, underweight, premature, syndromic and daycare patients in our cohort were significantly different than in the general population. In a multivariate model, the odds of African-Americans having severe OSA were 12.5 times greater than the odds of Caucasians. The odds of patients with syndromes or craniofacial anomalies were 11 times greater ($p < 0.0001$), and the odds of patients in daycare were 2.2 times lower ($p = 0.04$) of undergoing a PSG before tonsillectomy. Weight did not influence polysomnogram requests.

Conclusions: In children under 2 years, ethnicity seems to be a predictor of OSA severity. African-American, prematurity, daycare and Down syndrome patients were significantly more represented in our study population. PSG is more likely to be requested for syndromic children.

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1. Introduction

Among the estimated 530,000 children who undergo a tonsillectomy every year in the United States [1], the population of children under 2 years of age presents special challenges. Their increased risk for postoperative complications such as oxygen desaturation and transient upper airway obstruction [2] may lead to airway intervention, supplemental oxygen and prolonged hospitalization. One study showed that children younger than 24 months may be up to three times more at risk for complications than children aged 24–36 months [2]. The rate of complications may further climb with prematurity, cerebral palsy, trisomy 21 or craniofacial anomalies [3–5].

The primary indication for tonsillectomy has evolved from chronic infections to upper airway obstruction. Sleep-disordered breathing (SDB) alone can be a sufficient indication for surgery. SDB is a clinical diagnosis and is defined as an abnormal respiratory pattern during sleep including snoring, mouth breathing and pauses in breathing [6,7]. In order to diagnose obstructive sleep apnea (OSA), one must have an abnormal polysomnogram (PSG). Children with complex medical conditions or in whom there is a discordance between tonsillar size and the reported severity of SDB should undergo a PSG to assess for OSA [6].

Previous studies have investigated OSA in younger children [2,8–14]. Our study aims to define the characteristics of children 24 months of age and younger, as well as to determine whether patient characteristics differ between children who have an abnormal PSG (OSA) and those who undergo tonsillectomy on the clinical diagnosis alone (SDB). This age group represents a unique population as tonsil growth typically does not begin until after 2 years of age.

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2. Methods

A retrospective electronic chart review of all tonsillectomies performed over a 7-year period (December 2003–November 2010) at Children's Hospital Colorado was undertaken. All patients who underwent tonsillectomy for OSA or SDB, and who were ≤ 24 months at the time of surgery, were retained for statistical analysis. Respiratory distress patients were retained for comparison. Patients undergoing tonsillectomy for indications other than OSA or SDB were excluded. Patients that met the inclusion criteria were placed in three groups: SDB-diagnosis based on their clinical evaluation, OSA-abnormal PSG with an OAH1 >1.5 events/h and respiratory distress (RD) – urgent tonsillectomy without a PSG after hospital admission for obstructive breathing patterns, oxygen desaturations and enlarged tonsils. All acquisitions and analysis adhered to the AASM guidelines. Severe OSA was defined as an OAH1 of ≥ 10 events/h [6]. All patient charts were reviewed for the following variables: ethnicity, weight preoperative oxygen use, prematurity, reflux diagnosis, the presence of syndromes or craniofacial anomalies, cerebral palsy, neuromuscular disease, daycare exposure and second-hand smoke exposure. Length-for-age was not collected and patients were not categorized into weight percentile groups. In order to determine if the gathered demographics of our cohort differed from the non-surgical population, we compared our data with available Colorado data for each variable. Table 1 presents the variables for which data could be found and their sources [15–20]. A REDCap database was built to securely enter all patient information [21]. All subsequent statistical analysis was carried out using SAS.

All study proportions were compared using a Z-test. SDB patients, PSG patients and total patients (SDB + PSG) were analyzed individually against Colorado and CDC proportions. The RD patient group is presented in demographic analyses, but no further statistical analysis was performed due to small number of patients.

In order to determine which variables differed between the SDB and OSA groups, we performed univariate association tests of all categorical predictors, then included relatively significant predictors in multivariate logistic regression models. Using a backward elimination algorithm, these were then eliminated one at a time using $\alpha = 0.05$ as the threshold. Cumulative logistic regression models were applied on the data in order to determine if variables were predictive of OSA severity. Patients were excluded from analysis based on completeness of data available. The study was approved by the Colorado Multiple Institutional Review Board.

3. Results

Of 9038 tonsillectomies, 215 (2.4%) were done on children ≤ 2 years. Of these, 74/215 underwent tonsillectomy for OSA and

123/215 for SDB. 8/215 patients underwent tonsillectomy for indications other than OSA or SDB. An additional 10/215 patients underwent an urgent tonsillectomy for RD. Each tonsillectomy was counted as a separate event. One child had a partial tonsillectomy at 11 months and required a completion tonsillectomy at 21 months; he was counted twice. Thus, 197 tonsillectomies were analyzed.

Demographic data for the previously described variables is shown in Table 2. The median age was 21 months (10–24 months). There were only 5/197 (2.5%) patients that were ≤ 12 months in the sample, while 155/197 (78.7%) patients were >18 months. Fig. 1 shows the age distribution for the three groups. 6/197 had a previous adenoidectomy and underwent a tonsillectomy alone.

Table 3 and Fig. 2 show the comparison between our study population and the Colorado population of children less than 2 years for the SDB + OSA, SDB and OSA patients. While the male: female ratio within the Colorado population was almost equal to 1, males were significantly more represented only within the SDB group. For the SDB + OSA group, we obtained significant differences for several variables: African-American ($p < 0.0008$), prematurity ($p < 0.0001$), daycare ($p < 0.0001$) and Down syndrome ($p < 0.0001$) patients were significantly more represented in our study population. Hispanic ($p = 0.01$), and second-hand smoke exposed ($p = 0.001$) patients were significantly less represented. For those children without comorbidities, weight did not have any influence on whether a PSG was requested or not. For the SDB and OSA groups, the significant differences obtained are detailed in Table 3. Due to wide variations in disease definition and underreporting, no strong data on reflux was available for Colorado.

Only 188 out of the 197 patients were used in the comparison analysis of those who underwent a PSG prior to surgery vs. no PSG, due to missing data in 9 patients. Univariate association tests of all categorical predictors for the presence in the OSA vs. SDB groups showed a difference in the variables of daycare (OR 0.41, $p = 0.008$), prematurity (OR 3.12, $p = 0.002$), syndromes and craniofacial anomalies (OR 11.5, $p < 0.0001$), and neuromuscular diseases and cerebral palsy (OR 3.47, $p = 0.01$). The final multivariate logistic regression model showed daycare exposure decreases the odds of children under 2 years having a PSG done prior to a tonsillectomy by a factor of 2.24 times (OR = 0.45, $p = 0.03$). On the other hand, the odds of having a PSG done for patients who are premature are 2.58 times greater ($p = 0.03$), and the odds are 11.08 times greater for patients with syndromes or craniofacial anomalies ($p < 0.0001$) (Table 4).

Fig. 3 depicts OSA severity by the OAH1. Thirty nine patients (39/71, 54.9%) had severe OSA with an OAH1 of at least 10 events/h. Table 5 provides the characteristics of the children with severe OSA as well as those who had a saturation nadir $<80\%$ (Table 5). The multivariate cumulative logistic regression model for the OAH1 scale showed significance only for ethnicity in predicting the severity of OSA, with the Caucasian vs. African-American

Table 1
Demographic data for the Colorado population on the variables studied.

Variables	Source of Colorado data
Gender	Health Statistics Section, Colorado Department of Public Health and Environment. (2012) Colorado Birth Data Statistics.
Ethnicity	Categories: White/Caucasian, Hispanic, African-American, Asian and other (including Native Hawaiian/Other Pacific Islander, American Indian/Alaska Native and more than one race) Department of Local Affairs, State of Colorado. (2012). Colorado Population by County, Age, Race, and Gender.
Preoperative Oxygen Use	No clear data available. Study population not compared to the Colorado population.
Prematurity	Gestational age <37 weeks at birth Health Statistics Section, Colorado Department of Public Health and Environment. (2010) Colorado Births and Deaths 2010.
Reflux	Positive if there was a reflux diagnosis entered in the electronic record or if the patient was on antireflux medication No clear data available. Study population not compared to the Colorado population.
Daycare	Administration for Children and Families, United States Department of Health and Human Services. (2012). Child Care and Development Fund.
Smoking	Health Statistics Section, Colorado Department of Public Health and Environment. (2011). Percent of children who live with a smoker in the home who are exposed to secondhand tobacco smoke by age for 2008–2010.
Down syndrome	Health Statistics Section, Colorado Department of Public Health and Environment. (2012) Birth Defect Data Registry.

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