



Respiratory events after adenotonsillectomy requiring escalated admission status in children with obstructive sleep apnea



Alexandra M. Arambula^{a,b}, Deborah X. Xie^{a,b}, Amy S. Whigham^{a,b,c,*}

^a Vanderbilt University School of Medicine, Nashville, TN USA

^b Surgical Outcomes Center for Kids, Vanderbilt University Medical Center, Nashville, TN, USA

^c Department of Otolaryngology - Head and Neck Surgery, Pediatric Otolaryngology, Vanderbilt University Medical Center, Nashville, TN USA

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ABSTRACT

Objectives: To characterize postoperative respiratory complications following adenotonsillectomy (AT) in children with obstructive sleep apnea (OSA) and to identify variables associated with pediatric intensive care unit (PICU) admission.

Methods: Retrospective analysis of 133 pediatric OSA patients with prior AT. Assessment of the postoperative hospital course informed patient stratification based on respiratory event severity, PICU admission status, and unscheduled escalation of care.

Results: Thirty-six (26.8%) patients were admitted to the PICU. Compared to non-PICU admissions, these patients were significantly younger and with greater preoperative apnea-hypopnea indices, comorbidities, and percentage of post-anesthesia care unit (PACU) time requiring supplemental oxygen. Seventy-one respiratory events occurred in 59 patients, with 60.6% affecting PICU patients. Fifteen severe events occurred, affecting 31% of PICU patients. Of 14 unscheduled escalations of care, 7 were PICU admissions who, compared to planned PICU admissions, spent significantly more time in the PACU and exhibited a trend towards greater PACU time on supplemental oxygen.

Conclusions: Pediatric patients requiring post-AT PICU care have more risk factors for respiratory compromise. Total PACU time and total PACU time requiring supplemental oxygen may indicate patient risk for postoperative respiratory complications and need for intensive care. Future work includes prospective determination of appropriate post-AT PICU admission.

1. Introduction

Obstructive sleep apnea (OSA) is an increasingly common sleep-related breathing disorder that affects 1–5% of children [1]. OSA is characterized by disruptions in sleep patterns secondary to partial or complete collapse of the upper airway. Well-known risk factors for OSA include male gender, black race, obesity, craniofacial disorders, neuromuscular disease, and Down syndrome [1–4]. As adenotonsillar hypertrophy (ATH) contributes to a large percentage of pediatric OSA cases, the American Academy of Pediatrics and American Academy of Otolaryngology – Head and Neck Surgery recommend adenotonsillectomy (AT) as the primary treatment modality for children with OSA and ATH, as this procedure leads to significantly improved polysomnographic findings in uncomplicated patients [1,5–7].

One serious complication associated with AT is postoperative respiratory compromise secondary to upper airway obstruction. This risk increases from 0–1.3% to 16–27% with a diagnosis of OSA [8]. The

likelihood of respiratory compromise further increases in high-risk patients, including children with age < 3 years, weight < 5th percentile for age, craniofacial abnormalities, severe OSA as measured on polysomnography (PSG), cardiac disease, prematurity, obesity, and hypotonia [8–10]. Identification of these characteristics in the early 1990s led many hospitals to electively admit high-risk patients to the pediatric intensive care unit (PICU) for airway monitoring after AT. Retrospective reviews indicate that routine postoperative ICU admission may be unnecessary for many of these patients, although no consensus exists [8,11–15]. Our own institution lacks clear guidelines regarding postoperative elective ICU admission. Given the increased financial cost of ICU admission and limited availability of PICU beds, identification of patient variables associated with a need for intensive care is essential in developing a best-practice algorithm. This study investigates post-AT respiratory complications in pediatric OSA patients in order to identify possible factors that may correlate with necessity for an ICU level of care.

* Corresponding author. Doctors' Office Tower, 7th Floor, 2200 Children's Way, Nashville, TN 37232-8605, USA.
E-mail address: amy.s.whigham@vanderbilt.edu (A.S. Whigham).

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2. Methods

This retrospective review was approved by the Vanderbilt University Institutional Review Board (IRB #170372). Patients with diagnosed sleep disordered breathing (SDB) or OSA (clinically or by PSG) managed by the pediatric otolaryngology service at our institution were identified from a clinic database. Inclusion criteria were patients less than 18 years of age, a diagnosis of sleep disordered breathing (SDB) or OSA (clinically or by PSG), evaluation by otolaryngologists at our institution between 2014 and 2015, and prior AT at our institution. Patient demographic information was recorded. Comorbid risk factors were defined as Down syndrome, cerebral palsy, hypotonia, craniofacial abnormalities, neuromuscular disease, or laryngotracheomalacia. Data about each patient's postoperative hospital course were also collected.

Though surgeon and anesthesiologist dependent, this institution's postoperative ICU admission criteria include factors identified by Hill et al.: obstructive apnea-hypopnea index (AHI) > 24; age < 24 months; oxygen saturation < 90% on room air in the post-anesthesia care unit (PACU); and intraoperative complications including bronchospasm or laryngospasm requiring treatment [16]. Additional admission criteria include airway obstruction requiring nasal trumpet placement; oxygen requirement exceeding 40% fraction of inspired oxygen (FiO₂) in the PACU; craniofacial abnormalities including Down syndrome and Pierre Robin sequence; and neuromuscular/neurodevelopmental disorders such as cerebral palsy and other conditions where patients require frequent suctioning to assist in management of secretions.

Respiratory events occurring during the postoperative hospital course, defined as the time period from surgical extubation to discharge, were recorded and stratified into mild and severe events (Table 1). A desaturation requiring multiple interventions was counted as a single respiratory event. Desaturations requiring interventions under both the mild and severe event categories were classified as severe respiratory events. Respiratory events were further categorized based on whether the complications required an escalation of care. This was defined as any unplanned admission to either the hospital floor or PICU. Patients experiencing multiple respiratory events were categorized based on the most severe event.

Descriptive statistics were performed and computed as means with standard deviation (SD) for quantitative variables and counts and percentages for categorical variables. Differences between patients who did or did not require PICU admission and between patients who did or did not have an unexpected escalation of care were determined. Unpaired, two-sample *t*-tests and univariate analysis were used to compare continuous variables, and chi-squared tests were used to compare categorical variables. Statistical significance was set *a priori* at *p* < 0.05.

3. Results

Of 312 pediatric patients with SDB/OSA, 133 met inclusion criteria. Demographic information is shown in Table 2. A small majority of patients were male (56.4%), with this predominance increasing further among PICU patients (69.4%). Over 90% of all patients identified as either white or African American. Preoperative PSG was performed in 105 (78.9%) patients, with obstructive AHIs ranging from 0.6 to 63.5 events/hr. Fifty-seven percent of all patients had a comorbid diagnosis (47% of standard admission [non-PICU] patients, 83% of PICU patients).

Following their operation, two patients were directly admitted to the PICU. The remaining 131 patients went to the PACU and were either discharged home (20 patients, 15.3%) or admitted to the hospital floor (77 patients, 58.8%) or the PICU (34 patients, 26.0%). Thus, a total of 36 patients (27.1%) were admitted to the PICU. As seen in Table 2, these patients were significantly younger than non-PICU patients, with higher preoperative AHIs, and with more comorbid risk factors for respiratory compromise.

Table 3 contains information on the patients' immediate postoperative and hospital course. Within this group, 7 patients (1 PICU, 6 non-PICU) had missing PACU records. The two groups spent a similar amount of time in the PACU; however, patients admitted to the PICU ultimately spent a significantly longer percentage of this time on supplemental oxygen. They also had significantly longer hospital admissions (*p* < 0.001), more hospital days on supplemental oxygen (*p* < 0.001), and more hospital days requiring additional respiratory support (*p* = 0.041).

Seventy-one respiratory events occurred in 59 patients (44.4%), requiring 125 interventions (Table 3). The most common respiratory event was a desaturation (*n* = 55, 77.5% of all events). The average oxygen saturation for children placed on supplemental oxygen was 82.9 ± 9.8%, with a trend towards lower saturations in the PICU group (Table 3). The lowest recorded saturations were 53% and 50% in the PACU and PICU, respectively. Nearly all desaturations were treated with administration of supplemental oxygen (*n* = 54, 43.2% of all interventions, Fig. 1). Of all events requiring supplemental oxygen, 61.1% occurred in the PACU (Fig. 2). Additional respiratory interventions were more commonly needed by patients ultimately admitted to the PICU (63 vs. 8 in non-PICU patients). These interventions more often occurred in the PICU compared to the PACU, including placement of a nasal trumpet (*n* = 13, 46.2% vs. 30.8%), airway suctioning (*n* = 19, 47.4% vs. 31.6%), and steroid administration (*n* = 11, 45.5% vs. 27.3%).

Fifteen respiratory events (21.1%) were classified as severe, occurring in 15 patients (11 PICU, 4 non-PICU). The remaining 56 mild respiratory events (78.9%) occurred in 50 patients, including 6 of the

Table 1
Stratification of respiratory events.

Mild respiratory events	Apnea Stridor Laryngospasm Bronchospasm Oxygen desaturation requiring at least one of the following: Re-initiation of supplemental oxygen Jaw thrust Nasal trumpet placement Airway suctioning
Severe respiratory events	Respiratory distress requiring initiation of rapid response team Oxygen desaturation requiring at least one of the following: Bronchodilator Muscle relaxant Initiation of continuous positive airway pressure (CPAP) Initiation of bilevel positive airway pressure (BiPAP) Intubation

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