

Postoperative Pulmonary Complications following Adenotonsillectomy in Pediatric Patients with Obstructive Sleep Apnea in a Tertiary Government Hospital

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ABSTRACT

Objective. Our study aimed to identify and describe pulmonary complications and its associated risk factors in children with suspected or confirmed obstructive sleep apnea (OSA) who underwent tonsillectomy or adenotonsillectomy in a tertiary government hospital.

Methods. We conducted a retrospective cohort study. Medical charts of pediatric patients with suspected or confirmed OSA who were admitted for tonsillectomy or adenotonsillectomy from January 1, 2016 to December 31, 2020 were retrieved and reviewed. Information of the individual patients including the demographic data, clinical profile, polysomnography results, and presence of postoperative pulmonary complications were recorded. Descriptive statistics was utilized to present continuous data while frequency and percentage for categorical data. Fisher exact test was used to compare the demographic profile of patients with postoperative pulmonary complications from those without.

Results. A total of 90 patient records were analyzed. The mean age of the patient population was 7.87 years, 55.6% were male, 17.8% of patients were classified as obese. Thirty-four children had preoperative polysomnography and of these, 47.1% were classified as severe. Only two (2.2%) patients had postoperative pulmonary complications, which were bronchospasm and desaturation, respectively. There were no statistically significant differences noted in comparing the clinicodemographic profile of patients with postoperative pulmonary complications from those without complications.

Conclusion. Our results showed that most pediatric patients with suspected or confirmed OSA who underwent adenotonsillectomy did not have pulmonary complications.

Keywords: obstructive sleep apnea, adenotonsillectomy, tonsillectomy, postoperative pulmonary complications, pediatric

INTRODUCTION

The prevalence of obstructive sleep apnea (OSA) in the pediatric population is estimated to be 3% and it peaks around 2 to 8 years old.^{1,2} Adenotonsillar hypertrophy is the most recognized risk factor in children.³ An overnight sleep study or polysomnography (PSG) is often requested for pediatric patients with clinical features suggestive of obstructive sleep apnea for definitive diagnosis. It is also often done as part of preoperative risk evaluation. Untreated OSA is associated with a range of neurobehavioral, cardiovascular and growth consequences.⁴

Adenotonsillectomy remains the first-line treatment in the management of OSA presenting with adenotonsillar hypertrophy.³ Although the procedure is generally considered

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safe and well-tolerated in children⁵, it can occasionally be accompanied by complications especially in patients evaluated preoperatively as high-risk⁶. Postoperative respiratory compromise, which is among the more serious complications is observed more in pediatric patients with OSA than in general population.⁷ As enumerated by the American Academy of Pediatrics (AAP), patients at high-risk for developing postoperative complications after adenotonsillectomy include patients with the following characteristics: age less than 3 years, severe OSA on polysomnography (defined as Apnea Hypopnea Index [AHI] ≥ 24 obstructive events/hour, SpO₂ nadir $< 80\%$ or peak CO₂ ≥ 60 mmHg), presence of cardiac complications of OSA, failure to thrive, obesity, craniofacial anomalies, neuromuscular disorders, and current respiratory infection.⁶ Potential respiratory complications may include minor complications such as desaturation of $> 94\%$ which may either resolve spontaneously or reversed with minor intervention, or major complications such as bronchospasm or pneumonia which may require securing patient's airway and mechanical ventilation.^{8,9}

Review of studies showed that the incidence of post-adenotonsillectomy respiratory complications in children with OSA can range from 1% ¹⁰ to as high as 20% .¹¹ These conflicting reports have socioeconomic implications such as unnecessary pediatric intensive care unit (PICU) admissions especially in a third world country such as the Philippines, where there is high financial cost and limited availability of PICU beds, hence additional studies especially in our local setting may be helpful. We aimed to describe the demographic and clinical profile of pediatric patients with obstructive sleep apnea who underwent adenotonsillectomy in a tertiary government hospital in the Philippines as well as to identify the postoperative pulmonary complications, its rate and its associated risk factors. Data obtained from our study can help in setting a practice standard in terms of preoperative planning and risk evaluation of children with OSA undergoing this procedure.

METHODS

This retrospective cohort study was conducted at the Philippine General Hospital, a tertiary care public hospital in Manila. After obtaining approval from the University of the Philippines Manila Research Ethics Board (UPMREB) with UPMREB Code: 2021-332-01, a self-funded retrospective chart review was performed. Included in the study were medical records of pediatric patients with suspected or confirmed OSA who were admitted for tonsillectomy or adenotonsillectomy from January 1, 2016 to December 31, 2020. Patients who had additional surgical procedure other than adenotonsillectomy, those with craniofacial malformations, genetic abnormalities, neuromuscular conditions, and those who were not able to undergo surgery (i.e., deferred surgery) were excluded from this study.

The following clinicodemographic data were collected: patient age, sex, nutritional status, presence of comorbidities, symptoms of OSA, grade of tonsillar hypertrophy, preoperative ancillary laboratory results (CBC and/or chest x-ray), preoperative 2-D echocardiography findings of absence or presence of pulmonary hypertension, severity of OSA based on polysomnography result, as available, preoperative anesthesia risk assessment based on American Society of Anesthesiologists (ASA) physical status, preoperative pulmonary risk assessment, length of postoperative hospital stay, location of postoperative stay (Ward or Pediatric Intensive Care Unit [PICU]). Postoperative pulmonary complications assessed included minor complication: desaturation $> 80-94\%$, and major complications: desaturation $\leq 80\%$, laryngospasm, bronchospasm, pulmonary edema, atelectasis, pneumonia, and PICU upgrade.

Sample size was determined using a 95% level of confidence with 5% error rate. Obstructive sleep apnea affects an estimated 3% of children. A minimum sample size of 43 was computed using the following formula: $n = Z^2PQ/d^2$.

Descriptive statistics such as mean and standard deviation was utilized to present continuous data while frequency and percentage for categorical data. In comparing the demographic profile of patients with postoperative pulmonary complications from those without, fisher exact test was used. A *p* value of < 0.05 was used to determine statistical significance. Medcalc statistical software was used to carry out statistical calculations (Figure 1).

RESULTS

During the 5-year study period, a total of 104 pediatric patients with suspected or confirmed OSA were admitted to undergo tonsillectomy or adenotonsillectomy. Ninety patients met the inclusion criteria with a mean age of 7.87 years, 50 boys and 40 girls (Table 1).

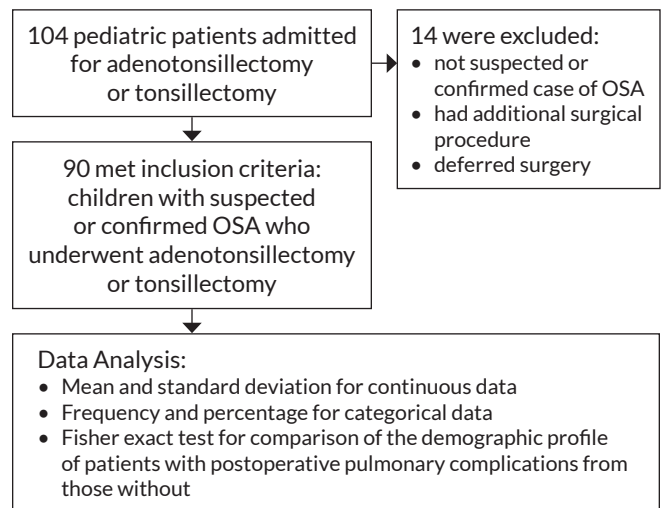


Figure 1. Workflow diagram of the study.

Table 1. Demographic and Clinical Characteristics of Children with Suspected or Confirmed OSA who Underwent Tonsillectomy or Adenotonsillectomy (N=90)

Variable	Frequency (N)	Percentage (%)
Mean age (SD)	7.87 (3.36)	
Age		
<2 years old	0	0.0
2-5 years old	26	28.9
6-11 years old	53	58.9
12-18 years old	11	12.2
Sex		
Male	50	55.6
Female	40	44.4
Nutritional Status		
Underweight	7	7.8
Normal	48	53.3
Overweight	19	21.1
Obese	16	17.8
Presence of Comorbidities		
Present	40	44.4
Absent	50	55.6
Symptoms of OSA		
Habitual (nightly) snoring	90	
Sleep difficulties	71	
Daytime sleepiness	45	
Headache during awakening	7	
Hyperactivity	9	
Grading of Tonsillar Size (Brodsky)		
Grade I	0	0.0
Grade II	4	4.4
Grade III	61	67.8
Grade IV	15	16.7
Mixed	10	11.1
Polysomnography		
Mild	10	29.4
Moderate	8	23.5
Severe	16	47.1
Not done	56	—

Most (58.9%) patients were from the age range of 6 to 11 years old. The prevalence of obesity, allergic rhinitis, and asthma in the patients were 17.8% (n = 16), 11.1% (n = 10) and 6.7% (n = 6), respectively. Fifteen patients had other medical problems: one with juvenile scoliosis, one with bilateral congenital hearing loss, one with benign febrile seizure, two with seizure disorder, three with G6PD deficiency, seven with skin allergy. None of these patients had postoperative pulmonary complications.

The top 3 symptoms of OSA identified include habitual (nightly) snoring, sleep difficulties and daytime sleepiness. On grading of tonsillar size using Brodsky grading scale, majority (67.8%) had grade III tonsils.

Only 34 children had polysomnography results and 47.1% were classified as severe. All patients had normal preoperative CBC. Two (2.2%) of the subjects had preoperative chest x-ray finding of hilar lymphadenopathy. Only two

Variable	Frequency (N)	Percentage (%)
Preoperative CBC		
Normal	90	100.0
Abnormal	0	0.0
Preoperative Chest X-ray		
Normal	88	97.8
Abnormal	2	2.2
Preoperative 2-D Echo Finding of Pulmonary Hypertension		
Absent	88	97.8
Present	2	2.2
Preoperative Anesthesia Risk Assessment		
ASA I	41	45.6
ASA II	46	51.1
ASA III	3	3.3
ASA IV	0	0
ASA V	0	0
ASA VI	0	0
E	0	0
Preoperative Pulmonary Risk Assessment		
Low-risk	67	74.4
High-risk	23	25.6
Postoperative Length of Stay (Days)		
24 hrs	74	82.2
>24 hrs	16	17.8
Postoperative Location of Stay		
Ward	90	100.0
PICU	0	0.0

Abbreviations: ASA - American Society of Anesthesiologists, PICU - Pediatric Intensive Care Unit

(2.2%) of all patients had preoperative 2-D echo finding of mild pulmonary hypertension. Twenty-three (25.6%) patients were classified as high-risk on pulmonary preoperative risk assessment while 46 (51.1%) of the patients were categorized as ASA physical status II and only 3 (3.3%) as ASA III.

Postoperative location of stay was at the regular ward for all patients and majority (82.2%) were discharged 24 hours after surgery.

In this study, only two of 90 (2.2%) patients had postoperative pulmonary complications: one minor complication of desaturation at 92%, and one major complication of bronchospasm (Table 2). The minor complication case was identified in an obese 9-year-old girl with symptoms of OSA, with no polysomnography done and was classified as high-risk for procedure. She was treated with oxygen supplementation for a few hours at the postoperative care unit (PACU) prior to transfer to regular ward on room air. One

Table 2. Rate of Pulmonary Complications in Study Population (N=90)

Type of Complication	Frequency (N)	Percentage (%)
Total rate of respiratory complications	2	2.2
Minor		
Desaturations >80-94%	1	1.1
Major		
Desaturations ≤ 80%	0	0
Laryngospasm	0	0
Bronchospasm	1	1.1
Pulmonary edema	0	0
Atelectasis	0	0
Pneumonia	0	0
PICU upgrade	0	0

bronchospasm case, needing reintubation in the immediate postoperative period happened in a 3-year-old male with normal nutritional status, no comorbidities, and with low preoperative risk assessment. The patient was successfully extubated upon improvement after administration of systemic corticosteroid. He was observed and monitored at the PACU for a few hours prior to transfer to regular ward on room air. There were no other patients who developed complications (Table 2).

There were no statistically significant differences noted in comparing the clinicodemographic profile of patients with postoperative pulmonary complications from those without (Table 3).

Table 3. Demographic and Clinical Data of Children with Suspected or Confirmed OSA based on the Absence or Presence of Pulmonary Complications after Tonsillectomy or Adenotonsillectomy (N=90)

Variable	With Pulmonary Complications (n=2)		No Pulmonary Complications (n=88)		p value
	n	%	n	%	
Age Range					
<2 years old	—	—	—	—	
2-5 years old	1	50.0	25	28.4	0.656 ^{ns}
6-11 years old	1	50.0	52	59.1	
12-18 years old	0	0.0	11	12.5	
Sex					
Male	1	50.0	49	55.7	1.000 ^{ns}
Female	1	50.0	39	44.3	
Nutritional Status					
Underweight	0	0.0	7	8	
Normal	1	50.0	47	53.4	0.490 ^{ns}
Overweight	0	0.0	19	21.6	
Obese	1	50.0	15	17	
Presence of Comorbidities					
Present	1	50.0	39	44.3	1.000 ^{ns}
Absent	1	50.0	49	55.7	
Tonsillar Hypertrophy Grading System (Brodsky)					
Grade I	0	0.0	0	0.0	0.315 ^{ns}
Grade II	0	0.0	4	4.5	
Grade III	1	50.0	60	68.2	
Grade IV	0	0.0	15	17.1	
Mixed	1	50.0	9	10.2	
Polysomnography					
Mild	0	—	10	29.4	—
Moderate	0	—	8	23.5	
Severe	0	—	16	47.1	
Not done	2	—	54	—	
Preoperative CBC					
Normal	2	100.0	88	100.0	1.000 ^{ns}
Abnormal	0	0.0	0	0.0	
Preoperative Chest X-ray					
Normal	2	100.0	86	97.7	1.000 ^{ns}
Abnormal	0	0.0	2	2.3	
Preoperative 2-D Finding of Pulmonary Hypertension					
Absent	2	100.0	86	97.7	1.000 ^{ns}
Present	0	0.0	2	2.3	

Table 3. Demographic and Clinical Data of Children with Suspected or Confirmed OSA based on the Absence or Presence of Pulmonary Complications after Tonsillectomy or Adenotonsillectomy (N=90) (continued)

Variable	With Pulmonary Complications (n=2)		No Pulmonary Complications (n=88)		p value
	n	%	n	%	
Preoperative Anesthesia Risk Assessment					
I	1	50.0	40	45.5	1.000 ^{ns}
II	1	50.0	45	51.1	
III	0	0.0	3	3.4	
IV	—		—		
V	—		—		
VI	—		—		
Preoperative Pulmonary Risk Assessment					
Low-risk	1	50.0	66	75	0.448 ^{ns}
High-risk	1	50.0	22	25	
Postoperative Length of Stay (Days)					
24 hrs	2	100.0	72	81.8	1.000 ^{ns}
>24 hrs	0	0.0	16	18.2	
Postoperative Location of Stay					
Ward	2	100.0	88	100.0	1.000 ^{ns}
PICU	0	0.0	0	0.0	

DISCUSSION

In children with obstructive sleep apnea, adenotonsillar hypertrophy is the most common anatomical abnormality associated.¹² Adenotonsillectomy therefore, is the most common surgical intervention in this group.⁶ Prior to surgery, we request PSG to document OSA and its severity to better stratify patients according to their risk for complications. In our study, only 34 children (37.8%) had polysomnography results. This may be due to several reasons such as cost and limited number of PSG laboratories.¹³

Adenotonsillectomy is generally safe and well-tolerated.⁵ However, this procedure can occasionally be accompanied by complications especially in high-risk patients. In a meta-analysis of 23 articles by De Luca Canto in 2015, children with OSA had a fivefold increase in postoperative respiratory complications namely supraglottic obstruction, breath holding, desaturation on anesthetic induction and emergence from anesthesia after adenotonsillectomy compared to those without OSA.¹⁴ Our study showed that among those 34 children who had preoperative PSG, majority (47.1%) were classified as severe. None of these patients developed postoperative pulmonary complications.

For the other high-risk characteristics, a study by Ma in 2011 showed that patients with higher BMI z-score has a higher risk for developing postoperative respiratory complications.¹⁵ This was the opposite in a study by Kasle and Smith.^{16,17} As for the age, there was noted to be a significantly greater number of postoperative pulmonary complications in children younger than the age of 3 years as reported by Thongyam and Smith.^{8,17} Other risk factors accounted were history of allergic rhinitis^{9,15}, asthma^{15,18}, history of smoke exposure at home¹⁸. Our results showed

no significant statistical associations between the clinico-demographic characteristics of the patients and the presence of respiratory complications.

The wide range of incidence rates of post-adenotonsillectomy respiratory complications in children with OSA ranges from 1%¹⁰ to as high as 20%¹¹ may probably be due to the differences in the definitions of respiratory complications in each study which can be divided into minor and major. Minor respiratory complications may either resolve spontaneously or could be reversed with a minor intervention⁸. An example would be desaturation of less than 95% which may improve spontaneously or after administering non-invasive oxygen support. On the other hand, major complications may require securing patient's airway through endotracheal intubation and/or require admission at the ICU. These may include laryngospasm, bronchospasm, apnea, pneumonia, acute pulmonary edema.^{8,9} Our results demonstrate that most pediatric patients with suspected or confirmed OSA who underwent adenotonsillectomy did not have pulmonary complications. Only two patients had postoperative pulmonary complications, which were bronchospasm and desaturation, respectively. This was also the case in Jiang's retrospective chart review in 2014 which showed that while the overall prevalence of severe OSA out of their 235 subjects was high (38%), there were no patients who had acute postoperative respiratory complications.¹³

As mentioned, earlier studies and the AAP identified high-risk children for developing respiratory complications post-surgery.⁶ Because of this, many hospitals would admit this group of patients electively to the pediatric intensive care unit (PICU) for airway monitoring after adenotonsillectomy. It was also a practice in our institution to refer high-risk patients to PICU for postoperative care

and placement. Some reviews such as by Arambula in 2018 indicate that most children with OSA underwent surgery without complications and routine postoperative ICU admission post-adenotonsillectomy may be unnecessary for many of these patients.¹⁹ In our study, none of the subjects required postoperative PICU care including the two patients who had postoperative pulmonary complications. Aside from a very low rate of respiratory complications in this study, placement at the PACU for a few hours post-surgery with close monitoring and active management may also have contributed to unnecessary PICU admission.

The limitations of our study include a relatively small cohort, as well as the small number of children with pulmonary complications which may have limited the detection of statistically significant differences. Since we did a retrospective study, data collection is limited by information recorded in the charts. Some relevant information may have not been recorded and complications that occurred after discharge may be missed. Additionally, majority of our subjects did not have preoperative PSG done. Analysis of polysomnography results and parameters might also help identify patients who would be at risk of postoperative pulmonary complications. These may serve as areas for further study.

CONCLUSIONS AND RECOMMENDATIONS

Our results showed that most pediatric patients with suspected or confirmed OSA who underwent adenotonsillectomy did not have pulmonary complications. There were no statistically significant differences noted in comparing the clinicodemographic profile of patients with postoperative pulmonary complications from those without. Further studies with larger sample size, involving multiple medical institutions and a prospective study design preferably all subjects with PSG results are recommended for better statistical output and representation of Filipino children.

Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

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