



# The Impact of Obesity and ASA Classification in Pediatric Tonsillectomy

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## ABSTRACT

### Objective

To identify the impact of body mass index and ASA classification on complications, PICU admission and length of stay following tonsillectomy.

### Methods

A retrospective chart review of all tonsillectomies performed from 7/2008 through 12/2009 at tertiary pediatric institution was conducted. Data collected included age, BMI, ASA class. Primary outcomes were length of hospitalization, length of intubation, occurrence of hemorrhage and PICU admission.

### Results

671 patients were identified, with 601 included in the final study population. 26 patients (5%) were underweight, 300 (50%) normal weight, 92 (15%) overweight, and 183 (30%) obese. 144 patients (24%) were classified as ASA I, 430 (71%) as ASA II (n=430, 71%), and 27 (5%) as ASA III. For rate of hemorrhage or length of intubation, no significant difference was found either among BMI categories or across ASA classifications. For length of stay and PICU admission, a significant difference (p<0.001) was found among BMI categories as well as across ASA classifications. Obesity was an independent predictor of hospitalization, with an odds ratio of 1.58 (95% CI 1.06-2.34) relative to normal weight. ASA class was an independent predictor of hospitalization, with ASA II having an odds ratio of 5.38 (95% CI 3.23-8.96) and ASA III having an odds ratio of 12.76 (95% CI 4.67-34.84), relative to ASA I.

### Conclusion

Obese patients are a significant percentage of children undergoing tonsillectomy. Obesity and ASA class II and III are independent predictors of likelihood of hospitalization following tonsillectomy, and many of these patients utilize PICU resources. BMI category and ASA class might be used to help guide preoperative discussions with families and perioperative decision making for patients undergoing tonsillectomy.

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## INTRODUCTION

Over 400,000 tonsillectomies are performed on pediatric patients annually in the United States<sup>1</sup>. Despite the relatively low incidence of complications, tonsillectomies are not without risk, such as post-tonsillectomy hemorrhage, pain, otalgia, dehydration, post obstructive pulmonary edema, hypoventilation and other complications related to anesthesia<sup>2</sup>. The average weight of the pediatric population has been increasing in recent years<sup>3</sup> and more tonsillectomies are being performed for overweight patients to address upper airway obstruction and obstructive sleep apnea (OSA)<sup>4</sup>. Patients with OSA have shown to have a higher incidence of difficult intubation, post-obstructive pulmonary edema, oxygen desaturations and prolonged intubation or re-intubations<sup>5,6</sup>.

The American Society of Anesthesiologists (ASA) physical status classification provides a gauge for assessing patient health preoperatively. Patients with higher ASA classifications are generally thought to be at increased risk of perioperative anesthetic complications. No study has directly addressed the potential correlation of ASA scores to the rate of post-tonsillectomy complications.

As we are performing more tonsillectomies in obese pediatric patients for treatment of OSA, it is important to have a thorough understanding of the increased risk that may be incurred in this patient population.

In this study we sought to investigate the impact of ASA classification and BMI category on complications, PICU admission, and length of stay following tonsillectomy.

## METHODS

A retrospective chart review of 671 patients aged 4 to 18 undergoing tonsillectomy or adenotonsillectomy was conducted. Exclusion criteria were incomplete data sets, secondary causes of obesity, chronic pulmonary disease, associated airway anomalies, neuromuscular disease, or concurrent hospitalization or surgery for other medical problem that could artificially prolong intubation or length of hospitalization.

Data collected consisted of age at surgery, gender, significant co-morbidities, height, weight, and American Society of Anesthesiologists (ASA) physical status classification. Body mass index (BMI) was calculated as weight (kg)/squared height (m<sup>2</sup>). Children were classified as underweight (BMI <5<sup>th</sup> percentile), normal weight (BMI ≥5<sup>th</sup> and <85<sup>th</sup> percentile), overweight (BMI ≥85<sup>th</sup> and <95<sup>th</sup> percentile), or obese (BMI ≥95<sup>th</sup> percentile) using age- and gender-specific reference growth charts from the National Center for Health Statistics/Centers for Disease Control and Prevention.

Primary outcomes were length of hospitalization, admission to the pediatric intensive care unit (PICU), length of intubation, and occurrence of postoperative hemorrhage.

Means, standard deviations, and percentages were calculated for demographic and anthropometric data. Pearson Chi-square and Fisher’s exact test were used to examine the relationship of BMI status and ASA class on the primary outcomes. Logistic regression models were constructed for variables which demonstrated statistically significant correlation with the primary outcomes. A p-value of <0.05 was chosen to indicate statistical significance.

## RESULTS

The final study population consisted of 601 patients. Demographic and anthropometric characteristics of our population are displayed in Table 1. Mean age was 7.7 ± 3. Mean age for our population was 7.7 ± 3.1 years, and the mean BMI was 19.7 ± 6.3 kg/m<sup>2</sup>. 300 patients (50%) were classified as normal weight, 92 patients (15%) as overweight, and 183 (30%) as obese. The majority of patients were classified as ASA I (n=144, 24%) or ASA II (n=430, 71%), with the remainder being classified ASA III (n=27, 5%). No patients were assigned an ASA classification greater than III.

The relationship between BMI category and ASA classification is displayed in Figures 1a and 1b (p<0.001). Of the 183 obese patients, 14 (8%) were designated ASA I, versus 130 of the 418 non-obese patients (31%). 150 obese patients (82%) were designated ASA II, versus 280 non-obese patients (67%). Finally, 19 obese patients (10%) were designated ASA III, versus 8 non-obese patients (2%).

Outcomes are displayed in Table 2. Of all 601 patients, 342 (57%) were discharged on the day of surgery (length of stay <1 day). Of the 259 patients admitted postoperatively (length of stay ≥1 day), 250 (96%) were discharged on postoperative day 1, while only 9 (3%) remained hospitalized beyond the first postoperative day. 15 patients (3%) experienced post-tonsillectomy hemorrhage. No patients remained intubated postoperatively. Although our sample size may not have enough power to detect a difference, no significant difference in rate of hemorrhage was found either among BMI categories or across ASA classifications (data not displayed).

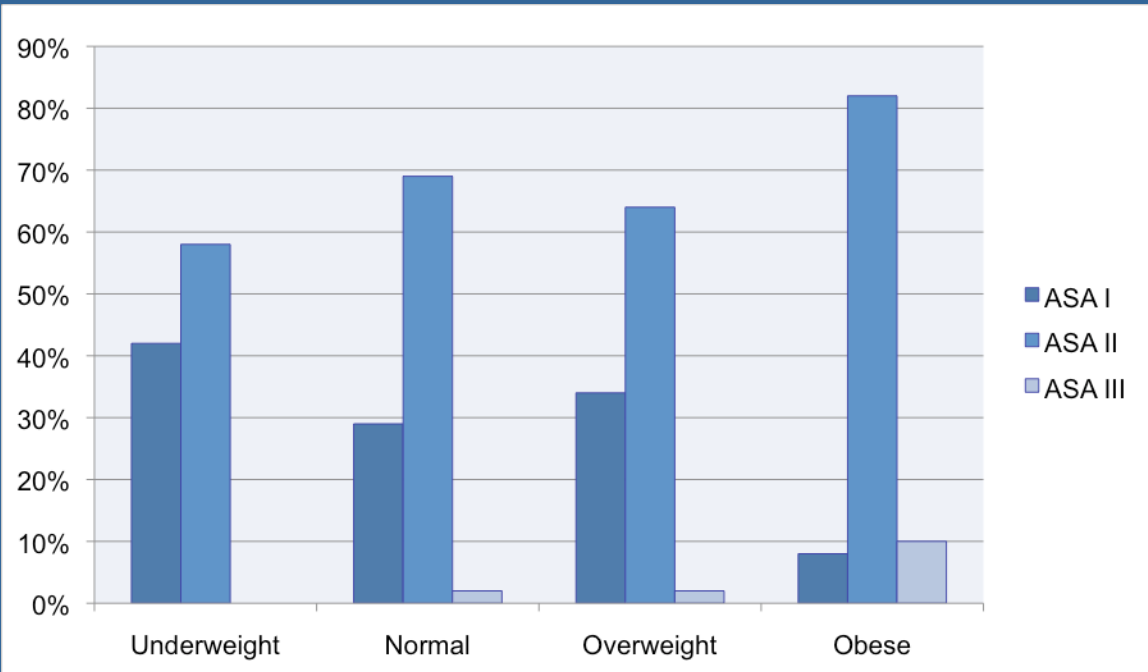
Variable	Frequency (%) or mean (± standard deviation)
Gender	
Male	278 (46%)
Female	323 (54%)
Age at surgery	7.7 ± 3.1
BMI	19.7 ± 6.3
BMI percentile	70 ± 31
BMI category	
Underweight	26 (5%)
Normal	300 (50%)
Overweight	92 (15%)
Obese	183 (30%)
ASA classification	
I	144 (24%)
II	430 (71%)
III	27 (5%)

BMI, body mass index for age and gender; ASA, American Society of Anesthesiologists

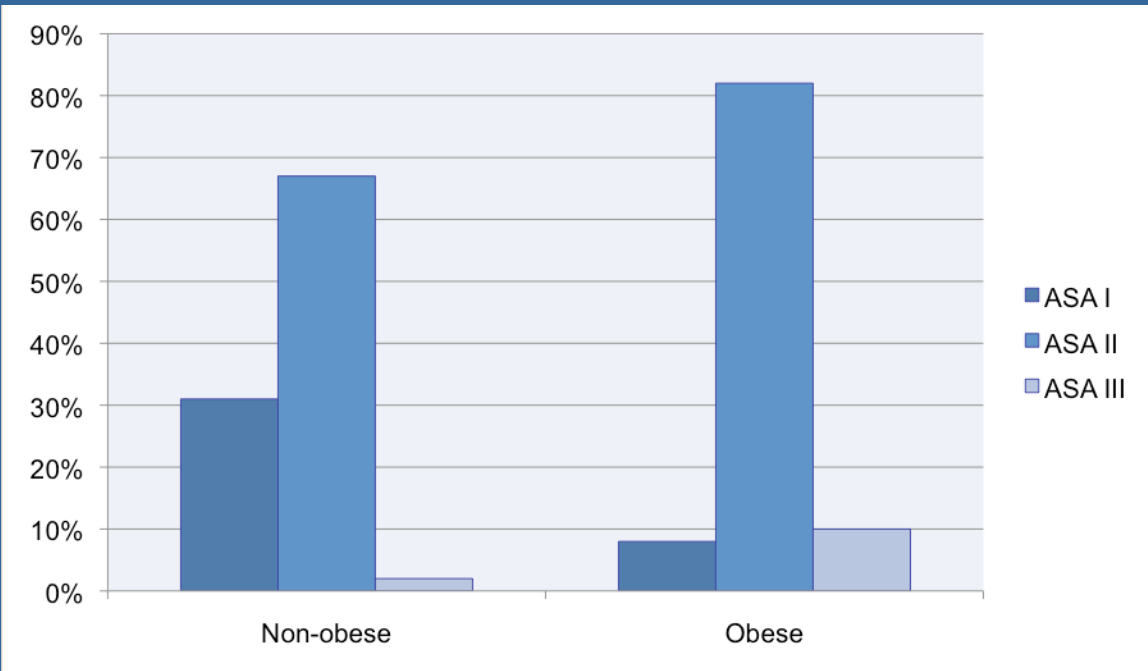
**Table 1.** Characteristics of our study population

Outcome	Number (%) of patients
Length of stay	
< 1 day	342 (57%)
≥1 day	259 (43%)
PICU admission	
No	576 (96%)
Yes	24 (4%)
Hemorrhage	
No	585 (97%)
Yes	15 (3%)

**Table 2.** Outcomes



**Figure 1a.** Relationship between BMI status & ASA Classification (p<0.001)



**Figure 1b.** Relationship between BMI status & ASA Classification (p<0.001)

For length of stay and PICU admission, however, a significant difference (p<0.001) was found among BMI categories (Table 3) as well as across ASA classifications (Table 4). Whereas 265 of the 418 non-obese patients (63%) were discharged home on the day of surgery, 106 of the 183 obese patients (58%) were hospitalized for at least one day. 7 non-obese patients (2%) required PICU admission, in contrast to 17 obese patients (9%). Of all patients admitted to the PICU, 17 of 24 (71%) were obese.

ASA classification also correlated significantly with length of stay and PICU admission (Table 4). 123 of the 144 ASA I patients (85%) were discharged home on day of surgery. With ASA class advancing to ASA II and ASA III, the percentage of patients discharged home on day of surgery decreased to 49% and 26%, respectively. Similarly, whereas no ASA I patients required PICU admission, PICU admission was required in 17 of 430 ASA II patients (4%) and in 7 of the 27 ASA III patients (26%).

We created a logistic regression model to predict the likelihood of hospitalization based on BMI category and ASA classification. The dependent variable was length of stay. Independent variables were BMI category and ASA classification. The reference BMI category was normal, and the reference ASA classification was ASA I. Results showed that the obesity was an independent predictor of hospitalization, with an odds ratio of 1.58 (95% CI 1.06-2.34) relative to normal weight. In addition, ASA class was an independent predictor of hospitalization, with ASA II having an odds ratio of 5.38 (95% CI 3.23-8.96) and ASA III having an odds ratio of 12.76 (95% CI 4.67-34.84), relative to ASA I.

	Length of stay		PICU admission	
	< 1 day	≥1 day	No	Yes
Non-obese (n=418)	265 (63%)	153 (37%)	411 (98%)	7 (2%)
Obese (n=183)	77 (42%)	106 (58%)	166 (91%)	17 (9%)

Data expressed as frequency (percentage)

BMI, body mass index for age and gender; PICU, pediatric intensive care unit

**Table 3.** Obesity as a predictor of length of stay and PICU admission (p<0.001)

	Length of stay		PICU admission	
	< 1 day	≥1 day	No	Yes
ASA I (n=144)	123 (85%)	21 (15%)	144 (100%)	0
ASA II (n=430)	212 (49%)	218 (51%)	413 (96%)	17 (4%)
ASA III (n=27)	7 (26%)	20 (74%)	20 (74%)	7 (26%)

Data expressed as frequency (percentage)

ASA, American Society of Anesthesiologists; PICU, pediatric intensive care unit

**Table 4.** ASA class as a predictor of length of stay and PICU admission (p<0.001)

The rate of obesity within our pediatric tonsillectomy population, 30%, is significantly higher than the most recent U.S. estimate of childhood obesity at 16.9%<sup>7</sup>, a Connecticut-specific estimate of 12.5%<sup>8</sup>, as well as estimates of 13.3%-17.2% within the pediatric surgical population<sup>9,10,11</sup>. One prior study specifically looked at the rate of obesity of 7.5% in the tonsillectomy population; this estimate is noticeably lower than that in our study<sup>12</sup>. The increasing rate of obesity in pediatric patients with obstructive sleep apnea<sup>13</sup> may explain these differences, as well as the socioeconomic status of our population, which is known to have an impact on the rate of childhood obesity<sup>7</sup>. Our finding that increased BMI category correlates significantly with advancing ASA class is consistent with Cook-Sather et al.’s finding that pediatric ASA III patients across all surgical specialties are more likely to be overweight or obese<sup>14</sup>.

Ultimately, we found that obesity and ASA class had an impact on rate of admission and the requirement for PICU monitoring. In addition to ASA class II or III, obesity alone was an independent predictor of hospitalization. This correlates with the findings of Naifu et al., who found that “overweight or obese” children undergoing tonsillectomy were more likely to be admitted than “normal” children and that BMI and the presence of medical comorbidities were independent predictors of length of stay<sup>14</sup>.

At our institution, the estimated total billing charge for a day surgery tonsillectomy is \$8261; combined with 23 hours of observation, the estimated total is \$13,505 and increases to \$14,146 if PICU monitoring is required. There is little doubt that the degree of resource utilization for tonsillectomy is increasing as a result of a disproportionate number of obese patients who are more likely to have advanced ASA class and and require hospitalization as well as PICU monitoring. Obese pediatric patients undergoing tonsillectomy have been shown to accrue higher hospital charges than patients of normal weight<sup>12</sup>. With approximately 400,000 tonsillectomies performed annually<sup>1</sup>, the increased economic burden of performing tonsillectomy on an increasingly obese pediatric population would be dramatic.

## CONCLUSIONS

The rate of obesity within our pediatric tonsillectomy population was significantly higher than that of the general pediatric population, the overall pediatric surgical population, as well as one prior estimate in the pediatric tonsillectomy population. A higher percentage of obese patients and ASA II/III patients were admitted postoperatively and required PICU care. Obesity and ASA class II and III were independent predictors of likelihood of hospitalization following tonsillectomy. We suggest that BMI category and ASA class might be used to help guide preoperative discussions with families and perioperative decision making for patients undergoing tonsillectomy.

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