Obesity and Tonsillectomy: Correlation Between Body Mass Index and Indication for Surgery

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Introduction

Tonsillectomy is one of the most commonly performed surgeries worldwide, and it represents more than 15 percent of all surgical procedures performed in United States in children under the age of 15 years[1,2]. The indications for tonsillectomy have slowly evolved over the last few decades from recurrent strep tonsillitis being most common to obstructive sleep apnea or sleep-disorder breathing (SDB). The most recent guideline published by American Academy of Otolaryngology – Head and Neck Surgery (AAO-HNS) uses the well known Paradise criteria for recurrent tonsillitis: at least seven episodes of tonsillitis in one year, at least five episodes in each of the previous two years or at least three episodes in each of the previous three years[3,4]. Increasingly more common, tonsillectomy is performed in children for SDB or obstructive sleep apnea syndrome (OSAS) which is defined as a "disorder of breathing during sleep characterized by prolonged partial upper airway obstruction and/or intermittent complete obstruction that disrupts normal ventilation during sleep and normal sleep patterns[5]." The increase in the incidence of SDB and OSAS also parallels the increasing prevalence of obesity in United States (**Figure 1**).

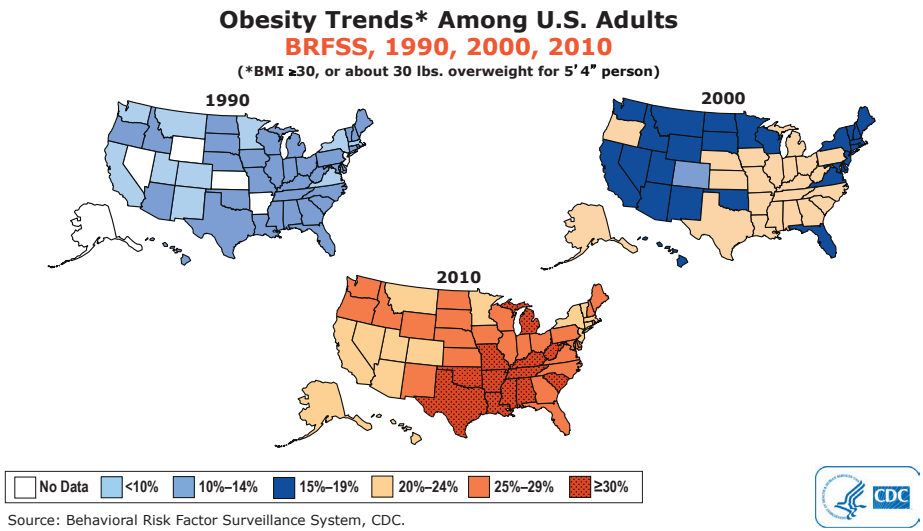

Figure 1. Obesity trends among U.S. adults according to the Center for Disease Control and Prevention (CDC)

Body mass index (BMI) is generally used to determine childhood overweight and obesity status. Overweight is defined as a BMI at or above the 85th percentile and below the 95th percentile for children of the same age and sex. Obesity is defined as a BMI at or above the 95th percentile and below the 99th percentile, and morbid obesity being above the 99th percentile[6].

From 1980 to 2012, according to the Center for Disease Control (CDC) executive summary, the percentage of youth who were obese increased from 7% to nearly 18% in children (6-11 years) and 5% to nearly 21% in adolescents (12-19 years)[7-10]. It is difficult to assess how much obesity as a co-morbidity is contributing to SDB in children. The objective of this current study is to compare the prevalence of obesity in children undergoing tonsillectomy for SDB, recurrent tonsillitis or both.

Material and Methods

We reviewed the electronic medical records of all patients undergoing tonsillectomy (with or without adenoidectomy) at Rady Children's hospital in San Diego in a 12 months period, from 2/1/2015 to 1/31/2016. Patients' demographics were recorded including age, gender, procedure, indications for surgery and BMI percentiles.

Statistical analysis was performed using logistic regression with nominal logistic fit with weight class as dependent variable; gender and indication as independent variables.

Results

A total of 1150 children underwent tonsillectomy at our tertiary pediatric hospital during the 12 months of the study period. The genders were evenly distributed with 563 females and 587 males. The average age of the patients was 7.2 years (1 to 19 years). A total of 817 children had tonsillectomy for SDB, 190 for tonsillitis and 141 for both indications. The average age for patients with SDB was 6.2 years, for tonsillitis was 10.8 years and an average of 8.1 years when both indications existed. Gender or age was not significantly associated with weight class, i.e. likelihood of obesity. Furthermore, gender and age were not significantly different among the different surgical groups (**Figure 2**).

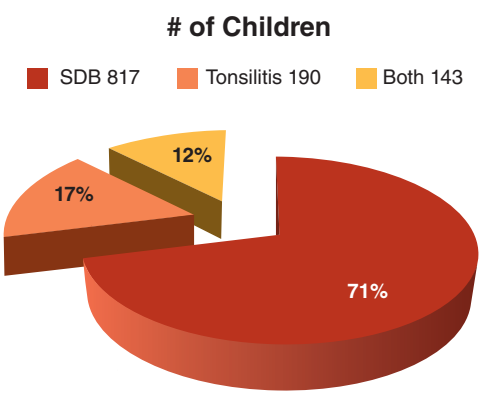

Figure 2. Surgical indications for tonsillectomy

The average BMI percentile was 62.05 for all patients, 62.99 for patients with SDB, 57.25 for patients with tonsillitis, 63.11 for patients with recurrent tonsillitis and SDB. In the group of children who underwent tonsillectomy for **tonsillitis**, 14.2% were overweight, 7.9% were obese and 1.1% was morbidly obese, which is similar to the distribution in the general population. **In the group of children who underwent tonsillectomy for**

both tonsillitis and SDB, 12.1% were overweight, 20.6% were obese and 7.8% were morbidly obese. In the group of children who underwent tonsillectomy for SDB, 11.8% were overweight, 16.5% were obese and 9.8% were morbidly obese. Children who had tonsillectomy due to SDB (with or without recurrent tonsillitis) had a statistically significant higher chance of being obese or morbidly obese (p <0.0001) (Figure 3).

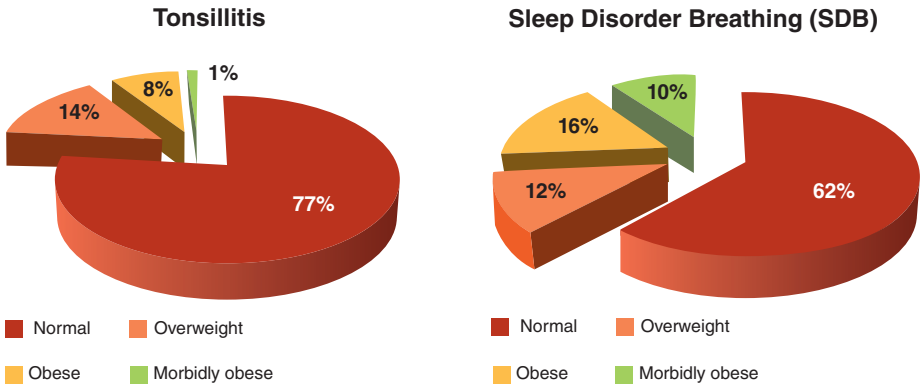

Figure 3. Tonsillectomy in children for SDB has a statistically significant higher chance of being obese or morbidly obese when compared to tonsillitis group.

Discussion

Children undergoing tonsillectomy with the diagnosis SDB are more likely to be overweight, obese or morbidly obese when compared to children that undergo this procedure for recurrent tonsillitis only. Even though effective treatments for childhood obesity have not yet been established[11], the co-morbidity of obesity may contribute significantly to residual sleep apnea after surgery and needs to be addressed for both pre-operative counseling and post-operative management of these children.

In the most recent publication on the comparative effectiveness review of tonsillectomy for obstructive sleep disorder breathing (OSDB) or recurrent throat infection in children[12], one retrospective cohort study[13] with a mostly overweight/obese population with OSDB reported a significant improvement in apnea hypopnea index (AHI) in children who received tonsillectomy compared with those who did not. However, data were insufficient to suggest effect modification by obesity/overweight status in this single, small study. In another retrospective cohort including children with mild OSA, surgery compared to watchful waiting did not show a significant benefit in the subgroup analysis of obese children[14]. The discrepancy in the findings between these two studies may be due to the mild OSA severity in the later study.

Overweight or obesity status does not preclude the surgical intervention of tonsillectomy. Surgery may be very effective in this group; however, if possible, a preoperative sleep study should be obtained in order to guide immediate

postoperative management in terms of outpatient surgery, overnight observation or intensive care unit (ICU) status. The severity of OSA may also help predict the success of the surgery postop. In the study by Chang *et al.*, pre-operative cephalometry parameters, BMI and age did not show significant correlation with surgical success; however, pre-op AHI and tonsil size correlated with surgical success. Higher pre-op AHI value and higher tonsil grade showed higher rate of surgical success[15].

In a large hospital database study, obese children have been shown to have statistically significant increased risk of immediate post-operative hemorrhage[16] (0.1%) and respiratory complication rate[17] (16.2% vs. 9.6% in non-obese patients) when compared to their normal weight peers, although the actual rates are still well within the acceptable range for postoperative complications for tonsillectomy in general. So the decision of postoperative observation should be predominantly based on preoperative sleep study AHI with obesity considered as an additional risk factor for complications.

In this group of children, it is imperative for the surgeon to discuss the expected benefit of surgery preoperatively and discuss that **in fact the obesity is a significant contributing factor to the child's SDB, and tonsillectomy and adenoidectomy alone may not resolve the sleep problem completely. Postoperative sleep study for this population is essential to document either resolution or persistence of the problem**. The Spanish Sleep Network demonstrated in their treatment outcome study that both respiratory disturbance index (RDI) and obesity are risk factors for relatively unfavorable surgical treatment outcomes at follow-up[18]. Also, **the family needs to be counseled on the possible risk of short-term additional weight gain after surgery**[19]. If there is persistent OSA after surgery, increasingly, we are considering other multi-level sleep related surgeries such as nasal and hypopharyngeal procedures, particularly lingual tonsillectomy, midline posterior glossectomy and supraglottoplasty to address residual pediatric sleep apnea in children with obesity and/or other syndromic co-morbidities[20, 21].

Finally, **adenotonsillectomy may also have positive impacts on the underlying metabolic abnormalities in obese children with an overall improved quality of life[22]. A study has shown that, after surgery, there is an overall significant decrease in a subset of systemic inflammatory and metabolic biomarkers among community-based obese children**. This further reinforces the concept of the interactive pro-inflammatory effects of sleep disorders such as OSA and obesity contributing to downstream end-organ morbidities[23]. Obese children, not surprisingly also demonstrate significant insulin resistance (IR) and abnormal lipoprotein profile. Koren *et al.* showed that adenotonsillectomy improved IR and lipoprotein profiles; however following surgery, residual metabolic dysfunction is related to underlying adiposity rather than remaining sleep-disordered breathing[24].

A systematic approach with nutrition and weight loss program should be offered to the family for the child's long-term health. As otolaryngologists, we should seize this opportunity to make a difference in the overall health of these obese children rather than simply perform the surgical procedure of tonsillectomy.

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