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WILEY
Polysomnography Outcomes in Children With Small Tonsils Undergoing Drug-Induced Sleep Endoscopy–Directed Surgery

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Objectives/Hypothesis: The optimal surgical treatment to improve sleep apnea in children with small tonsils is not known. Drug-induced sleep endoscopy (DISE) may be useful in selecting effective surgical procedures for this patient population. This study compared polysomnography (PSG) measures before and after DISE-directed surgery in children with small tonsils. We hypothesize that DISE-directed surgery improves PSG measures in children with small tonsils. We also aimed to identify the most common surgery performed in this population.

Study Design: Retrospective chart review.

Methods: A retrospective review was performed of subjects who underwent DISE at a single pediatric tertiary care center over a 6-year period. Inclusion criteria were 1+ tonsils and PSG performed before and after DISE-directed surgery. Exclusion criteria were previous tonsillectomy and tonsils score 2+ or greater. Pre- and postoperative PSG parameters were compared using paired t tests.

Results: Average age was 7 ± 4 years old at the time of surgery. The most common DISE-directed intervention was supraglottoplasty (n = 23). DISE-directed surgery significantly improved mean apnea-hypopnea index (AHI) from 14.4 to 8.0 (P = .02). Although improvements were seen in mean obstructive AHI (12.5 to 5.5), O₂ nadir (87.0 to 88.3), and ODI (10.6 to 5.8), these measures did not reach statistical significance.

Conclusions: DISE-directed surgery significantly improves AHI in children with small tonsils. The most common intervention performed on these children was supraglottoplasty. Interestingly, adenotonsillectomy was rarely performed in this cohort. Additionally, supraglottic collapse, prompting supraglottoplasty, is difficult to accurately assess in an awake child, supporting use of a DISE-directed approach in this population.

Key Words: Obstructive sleep apnea, drug induced sleep endoscopy, polysomnography, sleep disordered breathing, pediatrics.

Level of Evidence: 4

INTRODUCTION

Obstructive sleep apnea (OSA) affects 1% to 4% of children, and has been linked to a number of health-related issues, such as behavioral problems, growth failure, cor pulmonale, and other morbidities. Children with OSA have decreased health-related quality of life. Adenotonsillectomy is the recommended surgical treatment for children with OSA, and randomized controlled trials have found that adenotonsillectomy generally improves symptoms and quality of life of children with OSA.

However, children with small tonsils may not experience the same benefit from adenotonsillectomy. Tonsil size is commonly rated using the Brodsky standardized system for evaluation of tonsil size. It is possible that children with small tonsils may have other sources of obstruction contributing to their OSA, which may deem adenotonsillectomy less effective, leading to residual disease. Imanguli and Ulualp found that children with grade I tonsils had a median postoperative apnea-hypopnea index (AHI) of 2.2 after adenotonsillectomy, indicating that the majority of them had residual OSA despite surgery.

Studies have shown up to 30% of pediatric patients will have residual OSA after adenotonsillectomy. This observation has led to increased interest in the role of drug-induced sleep endoscopy (DISE) in the evaluation of airway obstruction in children with OSA. DISE typically involves a flexible fiberoptic examination of the upper airway performed while the child is under sedation while maintaining spontaneous ventilation.

We have previously described and validated a systematic approach to scoring severity of airway obstruction at five different levels during DISE, which include adenoid, velum, lateral pharyngeal wall, tongue base, and...
supraglottis.12 Our group has previously demonstrated a positive correlation between Brodsky tonsil size and lateral pharyngeal wall score.13 With this correlation in mind, we hypothesized that children with OSA and small tonsils would demonstrate obstruction at a level (or levels) other than the lateral pharyngeal wall. Furthermore, we hypothesized that using a DISE-directed approach to identify specific sites of collapse and tailoring surgery to those specific sources of obstruction would lead to improvement in PSG over preoperative PSG. The objective of this study was to compare PSG parameters before and after DISE-directed surgery in children with small tonsils. We also aimed to identify the most common surgery performed in this population.

MATERIALS AND METHODS

This was a single-center, retrospective chart review of subjects who had undergone DISE from an institutional database. Institutional review board approval was obtained prior to data extraction and review. Per standard clinical practice at this institution, surgeons performed DISE-recorded findings in a standardized fashion using the Chan-Parikh scoring system, a validated instrument for DISE severity stratification.12 This score is based on the assessment of five anatomic locations: the adenoids, velum, lateral pharyngeal wall, base of tongue, and supraglottis. Each site is graded on a four-point scale according to severity of obstruction: 0 = no obstruction, 1 = <50% obstruction, 2 = >50% obstruction, and 3 = complete obstruction. The anesthetic technique for all DISE utilized sevoflurane and propofol per institutional protocols.

Records of all subjects who underwent DISE and DISE-directed surgery between January 1, 2011 and October 31, 2017 were reviewed. Inclusion criteria for this study were those with documented preoperative Brodsky tonsil score of 1+, and presence of both pre- and post-DISE polysomnography (PSG). Exclusion criteria were those with 2+ or greater tonsil size, lack of pre- and post-PSG, or history of adenotonsillectomy/tonsillectomy. Medical records were further reviewed with extraction of subject demographics, growth parameters, and significant comorbid conditions including genetic syndromes, neuromuscular disorders, or craniofacial abnormalities.

PSG was obtained as part of routine clinical care. All PSGs were performed at a pediatric-specific accredited sleep laboratory, with results interpreted by board-certified pediatric sleep medicine physicians. AHI, obstructive AHI (oAHI), nadir oxygen saturations, Oxygen Desaturation Index (ODI), and mean CO₂ were extracted.

Analysis

Descriptive statistics were performed to characterize subject cohort. Means were calculated for continuous variables, such as AHI, age at time of DISE, and body mass index (BMI).

### TABLE I. Demographics and Clinical Characteristics (n = 51).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>35 (66.6%)</td>
</tr>
<tr>
<td>Average age at DISE, yr</td>
<td>7.2 (SD = 6.0)</td>
</tr>
<tr>
<td>Not obese, BMI &lt;95th percentile</td>
<td>45 (88.2%)</td>
</tr>
<tr>
<td>Mean BMI percentile, %</td>
<td>57.7% (SD = 34)</td>
</tr>
</tbody>
</table>

SD = standard deviation.

### TABLE II. Single-Level DISE-Directed Surgery (n = 41) and Multilevel DISE-Directed Surgery (n = 10) Performed.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>No. of Patients</th>
<th>Frequency, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-level DISE-directed surgery performed (n = 41)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supraglottoplasty</td>
<td>14</td>
<td>27.5</td>
</tr>
<tr>
<td>Multilevel surgery (including SGP)</td>
<td>9</td>
<td>17.7</td>
</tr>
<tr>
<td>Adenotonsillectomy</td>
<td>5</td>
<td>9.8</td>
</tr>
<tr>
<td>Adenoidectomy</td>
<td>3</td>
<td>5.9</td>
</tr>
<tr>
<td>Lingual tonsillectomy</td>
<td>2</td>
<td>3.9</td>
</tr>
<tr>
<td>Tonsillectomy</td>
<td>1</td>
<td>2.0</td>
</tr>
<tr>
<td>Multilevel DISE-directed surgery performed (n = 10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tonsillectomy + lingual tonsillectomy</td>
<td>1</td>
<td>2.0</td>
</tr>
<tr>
<td>Adenoidectomy + SGP</td>
<td>4</td>
<td>7.8</td>
</tr>
<tr>
<td>Adenotonsillectomy + SGP</td>
<td>3</td>
<td>5.9</td>
</tr>
<tr>
<td>Lingual tonsillectomy + SGP</td>
<td>2</td>
<td>3.9</td>
</tr>
</tbody>
</table>

DISE = drug-induced sleep endoscopy; SGP = supraglottoplasty.

Proportions were calculated for binary variables such as presence of syndrome or craniofacial abnormality. Pre- and postoperative PSG parameters were compared using a paired t tests, with P < .05 considered statistically significant. We used AHI as our primary outcome measure, and the power analysis was performed using this to detect a clinically significant change in pre- and postoperative AHI. Power analysis suggested that to see 10% improvement in AHI using prior means, our study would need 300 subjects. Stata 13.1 (StataCorp, College Station, TX) statistical software was used for all analyses.

RESULTS

There were 144 subjects who underwent DISE with pre- and postoperative PSG during this time period, and of those, 51 had 1+ tonsils preoperatively who were included in the final analyses. Table I contains subject characteristics at time of sleep endoscopy. Mean age (± standard deviation) at DISE was 7.2 years (± 6.0 years), and average BMI percentile was 57% (± 34%), with six subjects (11.8%) greater than the 95th percentile qualifying as morbidly obese. Twelve (24%) children had a comorbid genetic, craniofacial, or neuromuscular diagnosis. The most common DISE-directed surgery performed was a supraglottoplasty (n = 23, 27% of cases).
surgery has frequently led to clinical and objective improvement. Fortunately, DISE protocol is widely standardized at our institution to help decrease effects of different anesthesia techniques. Generalizability of these results to typically developing and otherwise healthy children may be less given the tertiary nature of this institution’s patients.

CONCLUSION

DISE-directed surgery significantly improves AHI in children with small tonsils, providing identification of obstruction not visible on physical exam. The most common intervention performed in these subjects was supraglottoplasty, either alone or in conjunction with other site of obstruction, and not adenotonsillectomy, which historically is an empirically performed surgery for pediatric OSA. Interestingly, in this cohort, adenotonsillectomy was rarely performed. Typically, preoperative assessment of tonsil size, which is easily performed in all children, allows for surgical decision making. This study suggests that supraglottic collapse, a finding not easily assessed on an awake child, is an often-performed site of surgical intervention. These findings support the use of DISE to help guide surgical management of children with OSA, especially when noted to have small tonsils on physical exam. This study is limited by its retrospective nature and lack of control group; however, in children with small tonsils, primary adenotonsillectomy should be weighed against other DISE-directed surgery, such as supraglottoplasty.

BIBLIOGRAPHY


