Factors Associated with Hypertrophy of the Lingual Tonsils

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Abstract
Objective. To identify factors that may be associated with lingual tonsil hypertrophy (LTH).

Study Design. Case series with chart review.

Setting. Tertiary academic center.

Subjects and Methods. Retrospective chart review identified 380 patients from August 2013 to April 2014 with graded lingual tonsils, documented during routine flexible laryngoscopy. Lingual tonsils were graded using a 0 to 4 scale: 0 = complete absence of lymphoid tissue, 1 = lymphoid tissue scattered over tongue base, 2 = lymphoid tissue covers entirety of tongue base with limited thickness, 3 = lymphoid tissue 5 to 10 mm in thickness, 4 = lymphoid tissue >1 cm in thickness (rising above the tip of epiglottis). Reflux symptom index (RSI collected during patient intake), presence of obstructive sleep apnea hypopnea syndrome (OSAHS; confirmed by polysomnogram), smoking habits, and basic demographics were gathered. Chi-square and linear multivariate regression analyses were used to identify significant relationships with LTH levels.

Results. Overall, 59.8% were male with a mean age of 50.2 ± 16.5 years and BMI of 30.1 ± 18.0. Chi-square analysis revealed no significant relationship between OSAHS and LTH (P = .059). When RSI was stratified to ≥10 or <10, a Cochran-Armitage test supported the trend hypothesis that as RSI increases, lingual tonsil grading increases. Significant univariate correlates included younger age (r = −0.307, P < .001) and smoking (r = 0.186, P = .002). Multivariate regression revealed the combination of younger age, increasing RSI, and smoking (r = −0.297, P < .001) to be a significant correlate.

Conclusion. LTH does not seem to be associated with OSAHS or BMI in this group of patients. High RSI, younger age, and gender may be factors associated with increased lingual tonsil thickness.

Keywords
lingual tonsil hypertrophy, sleep apnea, reflux

Introduction
Enlargement of the lingual tonsils is implicated in a variety of airway pathologies, ranging from difficult intubation to sleep-related breathing disorders and apnea. Due to its ability to obstruct the airway, lingual tonsil tissue (LTT) is often removed during surgical treatment of obstructive sleep apnea hypopnea syndrome (OSAHS). Despite the frequency with which lingual tonsils are addressed clinically, there has never been a direct correlation between OSAHS and lingual tonsil size.

The lingual tonsils are a section of lymphoid tissue in the Waldeyer Ring. The cause of lingual tonsil hypertrophy (LTH) has not been clearly elucidated. Multiple studies have found laryngopharyngeal reflux (LPR) to be correlated to LTH.¹-⁴ BMI has also been found to be associated with LTH.² However, no studies have looked at the incidence of LTH in OSAHS patients in comparison to the general population. Furthermore, few studies have correlated the levels of hypertrophy with precipitating factors. Given that there is currently no universal grading scale for LTH, all previous studies have used heterogeneous methods of grading LTH. Other studies of the lingual tonsils have viewed the degree of hypertrophy using a static view of the vallecula, often with tongue protrusion.²,⁴,⁵ However, it is important to judge the lingual tonsils in multiple views in order to accurately determine the level of hypertrophy.

Therefore, the objective of this study was to identify the factors that are associated with the development of LTH in the general population as well as in a subset of OSAHS patients, using a graded scale to judge the level of hypertrophy.

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Methods

Patient Selection
This retrospective chart review was approved by the Advocate Health Care Institutional Review Board (Chicago, Illinois, USA). The charts of 380 patients who underwent flexible laryngoscopy between August 2013 and April 2014 were reviewed. Patients underwent laryngoscopy for a variety of indications, including sleep complaints, evaluation of OSAHS, vocal fold pathologies, and chronic rhinosinusitis. All patients in the study were screened for OSAHS with a 10-point questionnaire similar to STOP-Bang as part of a routine screening administered to all new patients at their first visit. Those who screened positive for symptoms received 1-night formal laboratory polysomnogram (PSG) evaluation. Patients with apnea-hypopnea index (AHI) > 5 were diagnosed with OSAHS. Those who screened negative for symptoms did not receive any further testing for OSAHS. Patients with OSAHS all had confirmed diagnoses by PSG. Patient demographics (age, sex) and physical exam findings (weight, height, BMI) were collected.

Evaluation of the Lingual Tonsils
Lingual tonsil hypertrophy was graded on a scale ranging from 0 to 4. Grade 0 represents a complete absence of lymphoid tissue. Lymphoid tissue scattered over the tongue base was given a score of grade 1. Lymphoid tissue covering the entirety of the tongue base with limited vertical thickness was given a score of grade 2. Significantly raised lymphoid tissue covering the entirety of the tongue base, with noticeable vertical thickness approximately 5 to 10 mm in height, was scored as grade 3. Grade 4 represented lymphoid tissue covering the entire tongue base, rising above the tip of the epiglottis, with approximate vertical height 1 cm or more in thickness. The lingual tonsils were graded and recorded in live assessment during flexible laryngoscopy by trained otolaryngologists as part of routine airway examination. The tonsils were evaluated in multiple positions, both with the tongue protruded and nonprotruded, before a grade was assigned. The interrater reproducibility of this scale was recently tested and produced a kappa score of 0.8665, denoting nearly perfect agreement in live assessment.

Outcome Measures
Severity of laryngopharyngeal reflux was judged by reflux severity index (RSI). RSI is a 9-item questionnaire on subjective symptoms of LPR (hoarseness, vocal fatigue, chronic cough, dysphagia, etc) that has been shown to be highly valid and reproducible.6 Each patient included in the study completed the RSI questionnaire. For this study, an RSI score of >10 was designated as a high score, and RSI < 10 was designated as a low score.

All patients were screened for OSAHS with a 10-point questionnaire similar to STOP-Bang. The STOP-Bang questionnaire incorporates subjective symptoms such as fatigue and snoring with objective demographics such as BMI neck circumference. This questionnaire has been proven to be a simple and valid initial screening tool for OSAHS.7,8

Statistical Analysis
All statistical analyses were carried out using SAS Version 9.3 software. Chi-square tests and Cochran-Armitage were performed on the categorized data to evaluate relationships and trends between the different factors and the LTH grades. Pearson r correlations and multiple regression analyses were calculated to determine relationships using continuous data. Results are expressed as mean ± standard deviation for continuous data and n-percent for categorical data. A P < .05 was accepted as statistically significant.

Results
A total of 380 patients were included in this retrospective chart review. The mean age was 50.2 ± 16.5 years; mean body mass index was 30.1 ± 18.0 kg/m². Of the patients, 227 (59.7%) were male, and 153 were female. Of these patients, 234 (61.6%) had diagnosed OSAHS, and 146 (38.4%) patients did not have OSAHS. Of the patients with OSAHS, 75 (32.0%) had mild OSAHS (AHI, 5-15), 67 (28.6%) had moderate OSAHS (AHI, 15-30), and 92 (39.3%) had severe disease (AHI >30). Finally, 228 (60%) patients had a high RSI score (RSI >10), and 152 (40%) patients had low scores (RSI <10) (Table 1).

Overall, 18 (4.7%) patients were graded as LTH 0, 136 (35.8%) were LTH 1, 149 (39.2%) were LTH 2, 63 (16.6%) were LTH 3, and 14 (3.7%) were LTH 4 (Figure 1). Within the OSA subgroup, 9 (2%) patients had LTH 0, 82 (35%) had LTH 1, 101 (43%) had LTH 2, 35 (15%) had LTH 3, and 7 (3%) had LTH 4. Within the non-OSA subgroup, 9 (6.1%) patients had LTH 0, 54 (37%) had LTH 1, 48 (33%) had LTH 2, 28 (19%) were LTH 3, and 7 (5%) were LTH 4 (Figure 2).

Chi-square tests were run to evaluate the relationship between increasing LTH grade and various factors. Among the demographic characteristics, male gender was found to be significantly related to LTH grade. Decreasing age was also found to be significantly related to increasing LTH grade. RSI scores were found to be significantly related to LTH grade (P = .002), but proton pump inhibitor (PPI) or allergy medication use was not related. Neither BMI nor presence of OSA was found to be significantly related to lingual tonsil thickness (Table 2). Gender (chi-square = 15.3, P = .004) and age (chi-square = 29.34, P = .0003) were found to be significant univariate correlates. Pearson r correlation suggests that significant correlations exist between age (r = −0.307, P < .001) and smoking (r = 0.186, P = .002) for the different LTH grades.

A multiple regression analysis was used to determine which factors are mostly associated with LTH in this study. A stepwise selection method was implemented to determine which predictor variables are significant to the regression model. The model indicates that LTH is a function of the predictor variables age, RSI, and smoking status (F = 10.95, P < .0001). This model suggests that increasing LTH is...
associated with younger patients, increased RSI, and smokers. Although there was a smaller decrease of age between LTH 2 and LTH 3 patients, age decreased by approximately 18% for each increasing LTH level.

A multivariate regression was done to determine which factors were associated with increased BMI for the OSAHS patients observed in this study. LTH level was not found to be a significant predictor. However, increased AHI, gender, smoking, and PPI are significant predictors for increased BMI in OSAHS patients ($F = 14.41, P < .0001$).

**Discussion**

Enlargement of the lingual tonsils is a problematic and often misunderstood pathology. LTH has been found to contribute to airway obstruction, resulting in a range of issues from difficult intubation to sleep apnea. However, the etiology of enlarged lingual tonsils is not clear. Previous studies have found LTH to be related to LPR and BMI. However, few studies have related contributory factors to increasing levels of hypertrophy. Even fewer have addressed the level of hypertrophy on an accurate scale, which requires viewing the lingual tonsils in live assessment and in multiple positions rather than in a static view of the vallecula.

LTH is frequently addressed as part of a surgical treatment plan for OSAHS patients. However, no study to date has examined whether LTH is related to the presence of OSAHS in comparison to the general population. Friedman et al. found that patients without LPR and/or OSAHS had smaller lingual tonsils by computed tomography (CT) measurement. However, this study did not find significant differences between lingual tonsil tissue sizes in patients with LPR or OSAHS alone. Our study found that increasing LTH was significantly correlated to increasing LPR, as judged by RSI scores. The mechanism by which LPR causes LTH is still unclear and may be due to the repetitive stress on lymphoid tissue from acid. Theoretically, it is also possible that increases in LTH cause LPR instead of the reverse.

Similarly, our multivariate regression showed younger ages...
and smoking to be significant correlates to increasing LTH. It is likely that the damage caused by smoking results in increased lymphoid hyperplasia of the tonsils in young smokers.

However, our analysis showed that increasing LTH was not significantly predicted by presence of OSAHS. Our study also showed no significant correlation between BMI or respiratory parameters such as AHI with increasing LTH. Sung et al., who studied only a population of patients with sleep disordered breathing, found a correlation between BMI and LTH. This correlation was not found in our study, even when analyzing data from only OSAHS patients. We believe this difference in results may be attributed to the method used by each study to view the lingual tonsils. Sung et al. viewed the lingual tonsils in a static view of the vallecula, with the tongue protruded. However, patients with increased BMI have been shown to have increased tongue fat. A fatty tongue by itself could cause obstruction of the view of the vallecula. Particularly for OSAHS patients, for whom there is an established association with increased BMI, an obstructed view of the vallecula does not necessarily suggest that the lingual tonsils are large but that the tongue alone may be obese. It is our belief that viewing the lingual tonsils in live assessment, with the tongue in multiple positions, allows for a more accurate evaluation of the lingual tonsils.

The clinical implications of this study are to suggest reevaluation of the lingual tonsils prior to surgical removal for the adult OSAHS patient. Lingual tonsillectomy has proven to be effective in the treatment of pediatric sleep apnea, secondary to the increased size of lymphoid tissue in pediatric populations. However, the pathogenesis of adult OSA is often much more complicated, with the involvement of multilevel obstruction. While it is certainly true that LTH contributes to tongue base obstruction, the frequency with which enlarged lingual tonsils are found in adult OSA patients has not been clarified. Therefore, surgical removal of the lingual tonsils may not always be indicated in adult sleep apnea patients. Yet the frequency with which lingual tonsillectomy is performed has markedly increased with the advent of transoral robot surgery (TORS) and various surgical approaches to the base of tongue. In our study, the presence of OSAHS was not significantly related to LTH. However, it is worth noting that 18% of OSAHS patients did have increased lingual tonsil tissues, graded as LTH grade 3 or 4. The lingual tonsils, therefore, do need to be considered as a significant point of obstruction in at least a proportion of OSAHS patients. However, surgical removal of the lingual tonsils must be evaluated on an individual basis, as presence of OSAHS does not necessarily predict LTH. Furthermore, studies assessing the impact of lingual tonsillectomy on OSAHS should identify LTH grade.

This study has several limitations. LTH grading was done by otolaryngologists trained in the grading scale, but subjective decisions on LTH grade were made. Future studies could include more objective parameters, such as volumetric measurements of the tonsils through magnetic resonance imaging (MRI). Furthermore, LPR severity was judged based on RSI score findings. Although this scoring system has shown to have external validity in diagnosing LPR, 24-hour esophageal pH monitoring may be a more objective means of testing.

**Conclusion**

In this study of 380 patients with and without OSAHS, increasing sizes of lingual tonsils was found not to be significantly related to OSAHS. Factors significantly associated with increasing LTH grade were found to be RSI scores ≥10, younger age, and smoking.

**Author Contributions**

Michelle S. Hwang, acquisition of data, analysis and interpretation of data, drafting and editing manuscript, final approval; Anna M. Salapatas, acquisition of data, analysis and interpretation of data, drafting and editing manuscript, final approval; Sreeya Yalamanchali, acquisition of data, analysis and interpretation of data, critical revision of manuscript, final approval; Ninos J. Joseph, acquisition of data, analysis and interpretation of data, drafting and editing manuscript, final approval; Michael Friedman, conception and design, analysis and interpretation of data, critical revision of manuscript, final approval.

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**Table 2. Chi-square Results of Factors Associated with LTH Grades.**

<table>
<thead>
<tr>
<th>Factors (N = 380)</th>
<th>LTH 0</th>
<th>LTH 1</th>
<th>LTH 2</th>
<th>LTH 3</th>
<th>LTH 4</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male gender, n (%)</td>
<td>8 (44.44)</td>
<td>74 (54.41)</td>
<td>104 (69.8)</td>
<td>37 (58.73)</td>
<td>4 (28.57)</td>
<td>.0041</td>
</tr>
<tr>
<td>Age, y</td>
<td>66.9 ± 11.5</td>
<td>53.9 ± 15.8</td>
<td>47.4 ± 15.7</td>
<td>45 ± 17</td>
<td>46.8 ± 15.9</td>
<td>.0003</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>27.7 ± 5.1</td>
<td>28.8 ± 6.2</td>
<td>29.3 ± 5.8</td>
<td>28.8 ± 5.4</td>
<td>29.0 ± 6.9</td>
<td>.5232</td>
</tr>
<tr>
<td>AHI, mean ± SD</td>
<td>39.1 ± 27.7</td>
<td>29.8 ± 23.0</td>
<td>32.5 ± 25.8</td>
<td>30.9 ± 26.3</td>
<td>19 ± 13.5</td>
<td>.193</td>
</tr>
<tr>
<td>RSI, mean ± SD</td>
<td>11.0 ± 11.5</td>
<td>8.6 ± 8</td>
<td>10.8 ± 7.8</td>
<td>11.4 ± 10.4</td>
<td>11.3 ± 9.5</td>
<td>.0018</td>
</tr>
<tr>
<td>PPI, n (%)</td>
<td>8 (44.44)</td>
<td>41 (30.15)</td>
<td>51 (34.23)</td>
<td>17 (26.98)</td>
<td>7 (50)</td>
<td>.2579</td>
</tr>
<tr>
<td>Allergy medication, n (%)</td>
<td>6 (33.33)</td>
<td>46 (33.82)</td>
<td>47 (31.54)</td>
<td>21 (33.33)</td>
<td>5 (35.71)</td>
<td>.9937</td>
</tr>
<tr>
<td>Smoking history, n (%)</td>
<td>1 (5.88)</td>
<td>8 (5.97)</td>
<td>12 (8.28)</td>
<td>6 (9.68)</td>
<td>2 (14.29)</td>
<td>.8737</td>
</tr>
</tbody>
</table>

Abbreviations: AHI, apnea-hypopnea index; LTH, lingual tonsil hypertrophy; OSA, obstructive sleep apnea; PPI, proton pump inhibitor; RSI, reflux symptom index.
Disclosures

Competing interests: Michael Friedman, ImThera Medical advisory board.

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References


