A Case-Control Study of Repeated Adenoidectomy in Children

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Objectives: To determine the rate of repeated adenoidectomy in children and examine the risk factors associated with this condition.

Design: A retrospective nested case-control study was performed. All cases of adenoidectomy performed at a single pediatric institution between 1990 and 2010 were examined. A total of 168 children who had undergone a repeated adenoidectomy were identified. A 1:1 matched case-control study was performed. The data were analyzed using a conditional logistic analysis.

Setting: Single tertiary pediatric institution.

Patients: Children aged 0 to 18 years having undergone at least 1 adenoidectomy.

Main Outcome Measures: Risk factors associated with repeated adenoidectomy.

Results: A total of 10 948 adenoidectomies were performed in the study period. The rate of repeated adenoidectomy was 1.5% (168 cases). The mean age at first adenoidectomy was significantly lower in the repeated adenoidectomy group (P < .001), and children younger than 5 years at the time of adenoidectomy were 2.5 times more likely to require a repeated procedure. The case-control study identified a strong association between adenoidectomy without tonsillectomy and repeated adenoidectomy, with children who had undergone a repeated adenoidectomy having a 3.68-times higher odds (95% CI, 2.10-6.45) of having an adenoidectomy alone.

Conclusions: Age younger than 5 years and adenoidectomy without tonsillectomy were identified as important risk factors for repeated adenoidectomy in children. Parents should be made aware of the increased risk of adenoid regrowth if surgery is performed at a young age. Children undergoing adenoidectomy alone should be followed up carefully to monitor for symptom recurrence.


Adenoidectomy is one of the most common surgical procedures performed in children. In 2000, the annual rate of adenoidectomy in the province of Ontario, Canada, was estimated to be 5 per 1000 children younger than 15 years, and it is estimated that 10 000 adenoidectomies are performed on a yearly basis in Ontario. Over the past few years, adenoid regrowth after adenoidectomy has received much attention. Previously published studies suggested that the rate of this phenomenon varied between 0% and 1.6%. In a recent survey of otolaryngologists in the United Kingdom, 38.8% recognized that the need for revision adenoidectomy is a problem. While it is a well-recognized entity, uncertainty remains regarding its risk factors. Adenoid regrowth may be attributable to the indistinct border of this lymphatic tissue and the likelihood of incomplete resection with older techniques such as curettage without indirect visualization. Other hypotheses on what causes the recurrence of adenoid obstructive symptoms include the contribution of other pathologic conditions such as allergies, gastroesophageal reflux disease, an unrecognized intranasal pathologic condition, or tubal tonsil hyperplasia. In addition, young age may lead to an increased rate of repeated adenoidectomy through a mechanism that remains uncertain.

The objectives of this study were to determine the rate of repeated adenoidectomy at our institution and identify risk factors associated with increased rate of repeated adenoidectomy.

Methods

The records of the Children’s Hospital of Eastern Ontario were searched to identify all cases of adenoidectomy or adenotonsillectomy per-
formed between 1990 and 2010. During this period, 10,948 adenoidectomies were performed and 180 cases of repeated adenoidectomy were identified. Information on age at time of surgery, date of surgery, procedure, and diagnosis was extracted from the surgical database for all adenoidectomy or adenotonsillectomy cases.

The medical charts of the 180 potential cases of repeated adenoidectomy were reviewed for confirmation of the diagnosis. Demographic information was then collected into a database including adenoid tissue size, type of surgery, surgical technique, surgical indication, surgeon, complication, and patient comorbidities. Adenoid size was defined as grade 1 if the adenoid tissue filled 25% or less of the nasopharynx, grade 2 if it filled 26% to 50%, grade 3 if it filled 51% to 75%, and grade 4 if it filled 76% or more. After medical chart review, there were 168 confirmed cases of repeated adenoidectomy. A nested-case-control study was then performed by matching each child who had undergone a repeated adenoidectomy to an age-matched child from the adenoidectomy cohort who had undergone a single adenoidectomy within 5 years of each case. The control medical charts were then reviewed, and their demographic information was collected into a database.

To identify risk factors associated with repeated adenoidectomy, data from the cohort study were analyzed using non-parametric methods. Data from the matched case-control study were analyzed using the McNemar test, and conditional fixed-effect logistic analysis was performed with Stata v.10 software (StataCorp). \( P < .05 \) was considered statistically significant.

### RESULTS

#### COHORT STUDY

A total of 10,948 adenoidectomies were performed over a 20-year span, including 168 cases of repeated adenoidectomy, for an incidence of 1.5%. The incidence of repeated adenoidectomy was 7.1% in children 2 years or younger and 2.5% for children 5 years or younger. The rate of repeated adenoidectomy in children 6 years or older at the time of surgery was 0.7%. The age difference between children having undergone a single procedure and children having undergone 2 or more adenoidectomies was statistically significant, as given in Table 1. Children 2 years or younger at the time of the first procedure were 5.6 times more likely to undergo a repeated procedure \( (P < .001) \), and children 5 years or younger were 3.2 times more likely to undergo a repeated procedure \( (P < .001) \). Children having undergone an adenoidectomy alone were 4.0 times more likely to require a repeated procedure \( (P < .001) \) compared with children having undergone a concurrent tonsillectomy.

### CASE-CONTROL STUDY

The distribution of characteristics within cases and controls is given in Table 2. Children who had undergone a repeated adenoidectomy were less likely to have undergone the procedure for recurrent tonsillitis and were more likely to have had an adenoidectomy alone (without tonsillectomy). They were also more likely to have undergone an adenoidectomy with the curettage technique.

The mean duration between primary and secondary adenoidectomy was 40 months (range, 3-132 months). The median age at primary adenoidectomy was 3.9 years, and at second adenoidectomy, 7.4 years. There were 27 surgeons who contributed at least 1 case or 1 control. Surgeons used a range of surgical technique including curettage alone, curettage with electrosurgery, and electrocautery alone. It was not possible to determine whether the surgeons had used mirror visualization at the time of surgery. However, owing to the long period over which our study was conducted, it is likely that a large number of surgical procedures were performed with palpation of the adenoid bed without indirect visualization with a mirror.

Adenoid size as noted by the surgeon at the time of surgery was generally larger at the initial procedure. In patients undergoing a second adenoidectomy, 55% had an adenoid grade of 1 or 2 compared with 20% at the initial procedure. Adenoid size at primary surgery was comparable to adenoid size in controls.

Adjusted odds ratio by conditional logistic regression for variables evaluated for their association with repeated adenoidectomy are presented in Table 3. The only factor significantly associated with repeated adenoidectomy was adenoidectomy alone compared with adenotonsillectomy, with a 3.68-times higher odds (95% CI, 2.10-6.45). There was also a trend toward increased odds of obstructive sleep apnea (OSA) and cold technique in children with repeated adenoidectomy.

Two children underwent 5 adenoidectomies for OSA. The first child was noted to have bilaterally narrow choanae, and the second child went on to require bilevel positive airway pressure to treat his OSA. Five children required 3 procedures. However, there was no predominant surgical indication, and only 1 child had a comorbidity (asthma).

### COMMENTS

This study demonstrated a 1.5% rate of repeated adenoidectomy. This rate is in line with previously published re-
The risk factors for repeated adenoidectomy identified in our initial cohort study include young age at the time of surgery and an adenoidectomy being performed without tonsillectomy. These findings are consistent with that of a few small studies that have suggested that a young age at the time of surgery increases the risk of having a repeated procedure. Possible explanations include a greater difficulty to perform a complete removal because of a small nasopharynx and persistence of the etiologic factors that led to adenoid hypertrophy initially. However, one large, previously published study on repeated adenoidectomy failed to detect such an association. Factors explaining the different results include a greater heterogeneity in surgical technique and surgical indications in our study due to a larger number of surgeons (n = 27), a longer study duration, and an older mean and median age at the time of adenoidectomy. While the mean and median age at time of adenoidectomy was older in our study compared with that in the study by Monroy et al, the age distribution in our study is similar to that in the study by Dearking et al, in which a strong association with decreasing age and revision adenoidectomy was found. Difference in mean age between the different studies could be attributed to differences in the health care systems or regional variation in surgical indications. Nevertheless, results from our study confirm that the possibility of adenoid regrowth should be discussed with parents as part of informed consent when performing an adenoidectomy on a child younger than 5 years.

As illustrated in our study, the preferred surgical technique for adenoidectomy has evolved with time. It has previously been suggested that performing an adenoidectomy without visualization with a mirror or endoscope could lead to adenoid regrowth because of incomplete tissue removal at the torus tubarius or at the choanae. In a study in which mirror visualization was performed after the surgeon was satisfied with the completeness of the adenoidectomy, as assessed with palpation, an 80% rate of residual adenoid requiring further tissue removal was recognized. While we were unable to evaluate whether surgeons used indirect visualization or palpation to assess the completeness of adenoid removal, the finding that a greater proportion of cases of repeated adenoidectomy occurred in the 1990s compared with the proportion of all adenoidectomies performed in that period suggests that the lack of direct visualization may lead to an increased rate of repeated adenoidectomy. However, an alternative explanation would be that surgeons may have had a lower threshold to recommend repeated surgery.

While the crude odds ratio suggested that the use of electrocautery could decrease the rate of repeated adenoidectomy, the strength of this association decreased after multivariate analysis. Because few patients in our study underwent adenoidectomy with the use of electrocautery, these results suggest that further studies are needed to determine the potentially beneficial impact of

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Cases (n = 168)</th>
<th>Controls (n = 168)</th>
<th>Crude Odds Ratio</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>3.8</td>
<td>3.9</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Median (range)</td>
<td>4.6 (0.8-12.5)</td>
<td>4.6 (0.9-13.1)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Male sex, No. (%)</td>
<td>97 (57.7)</td>
<td>94 (56.0)</td>
<td>NA</td>
<td>.73</td>
</tr>
<tr>
<td>Indication for surgery, No. (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OSA</td>
<td>46 (27.4)</td>
<td>37 (22.0)</td>
<td>1.33</td>
<td>.26</td>
</tr>
<tr>
<td>Recurrent tonsilitsis and/or adenoiditis</td>
<td>28 (16.7)</td>
<td>54 (32.1)</td>
<td>0.47</td>
<td>.002</td>
</tr>
<tr>
<td>Ear disease</td>
<td>50 (29.8)</td>
<td>40 (23.8)</td>
<td>1.33</td>
<td>.23</td>
</tr>
<tr>
<td>Hypertrophy NOS/other</td>
<td>44 (26.2)</td>
<td>37 (22.1)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Surgical procedure, No. (%)</td>
<td></td>
<td></td>
<td>0.30</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Adenoidectomy ± BMT</td>
<td>99 (58.9)</td>
<td>54 (32.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adenotonsillectomy ± BMT</td>
<td>69 (41.1)</td>
<td>114 (67.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgical technique, No. (%)</td>
<td></td>
<td></td>
<td>1.95</td>
<td>.009</td>
</tr>
<tr>
<td>Curette alone</td>
<td>115 (68.4)</td>
<td>96 (57.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curette and electrocautery or electrocautery alone</td>
<td>48 (28.6)</td>
<td>69 (41.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other/unknown</td>
<td>5 (3.0)</td>
<td>3 (1.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adenoid size, No. (%)</td>
<td></td>
<td></td>
<td>2.5</td>
<td>.26</td>
</tr>
<tr>
<td>Grade 1-2</td>
<td>10 (20.0)</td>
<td>16 (26.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 3-4</td>
<td>40 (80.0)</td>
<td>44 (73.3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: BMT, bilateral myringotomy and tube; NA, not applicable (odds ratio was not performed owing to the heterogeneity of this subgroup); NOS, not otherwise specified; OSA, obstructive sleep apnea.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adjusted OR (95% CI)</th>
</tr>
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<tbody>
<tr>
<td>Adenoidectomy alone (no concurrent tonsillectomy)</td>
<td>3.676 (2.097-6.452)</td>
</tr>
<tr>
<td>Cold technique</td>
<td>1.665 (0.959-2.920)</td>
</tr>
<tr>
<td>Indication of OSA</td>
<td>1.702 (0.996-3.148)</td>
</tr>
<tr>
<td>Indication of repeated infections</td>
<td>1.049 (0.531-2.073)</td>
</tr>
</tbody>
</table>

Abbreviations: OR, odds ratio; OSA, obstructive sleep apnea.
electrocautery on preventing adenoid regrowth. A previous randomized trial evaluating the differences between suction cautery and curette adenoidectomy in a group of 100 children found that electrocautery seemed to be superior in reducing adenoid size.3 Six months after surgery, the mean adenoid size was 1.9 in patients treated with curettages and 1.5 in patients treated with electrocautery (P = .02). However, the 2 groups had the same level of satisfaction, and the follow-up period and the size of the study were too small to determine if suction diathermy may decrease the rate of repeated adenoidectomy. A possible explanation for the decreased rate of regrowth includes deeper tissue injury from electrocautery or use of mirror for indirect visualization of the nasopharynx.

On the basis of our case-control study multivariate analysis, children were 3.7 times more likely to require a repeated adenoidectomy if they had not undergone a concurrent tonsillectomy at the time of primary surgery. The fact that controls were age-matched to each case indicates that this association is independent of the age of the child at the time of surgery. A previous study has shown that in children who underwent an adenoidectomy before the age of 2 years, the rate of subsequent tonsillectomy within 5 years was 29%, compared with a rate of 2% if the adenoidectomy was performed after age 7 years.10 These results seem to indicate the important role of follow-up in patients receiving an adenoidectomy alone for nasal obstructive or sleep-disordered breathing-type symptoms.

Univariate analysis suggested that in children who underwent a repeated adenoidectomy, compared with children in the control group, the surgical indication at initial procedure was less likely to be recurrent infection. However, that factor was not statistically significantly associated with a decreased rate of repeated adenoidectomy after multivariate analysis.

Although not statistically significant, our results suggest that children undergoing adenoidectomy for OSA may be at increased risk of undergoing a second adenoidectomy, even after controlling for the effect of adenotomy. A similar phenomenon has previously been reported in 2 studies in which children undergoing adenoidectomy alone for upper airway obstruction were 1.9 times more likely to require a subsequent tonsillectomy10 or 3 times more likely to require tonsillectomy and/or revision adenoidectomy.11

Strengths of our study include the long duration of follow-up and the large number of patients studied. In addition, the fact that the procedures were performed by a number of surgeons using different surgical techniques enabled us to evaluate a large number of possible risk factors. Our study was performed in an institution that has a relatively captive population because it was the only institution performing pediatric surgery in the region during the study period. While it is possible that children could have undergone repeated adenoidectomy outside our region, the rate of this event is unlikely to be significant.

Limitations to our study included that we were unable to evaluate the recurrence of adenoid hypertrophy following adenoidectomy that did not necessitate surgical intervention. We were limited to assessing the rate of repeated surgery. In addition, we could not evaluate the benefit of undergoing a second adenoidectomy. The decision to go ahead with a second adenoidectomy is subjective in some cases, and different otolaryngologists may have had different surgical indications and thresholds for repeated surgery. It is also possible that some patients underwent a second adenoidectomy because of recurrence of obstructive symptoms suspected to be due to adenoid hypertrophy, while the true origin of symptoms was the nasal cavity. This has been investigated in a study in which 175 children were evaluated 2 to 5 years following adenoidectomy. Only 26% of children reported at least 1 symptom of nasal obstruction and none of the 35 of 46 children who underwent endoscopic evaluation had an adenoid bed with greater than 40% obstruction.9 The authors concluded that adenoid regrowth is very rare 2 to 3 years postoperatively and that other causes of nasal obstruction should be sought in children presenting with symptoms recurrence. Another study confirmed these findings by reporting a 63% prevalence of nasal anatomic abnormality in children complaining of nasal obstruction after adenoidectomy.11 In addition, a study evaluating a group of children reporting symptoms of nasal obstruction following adenoidectomy revealed that none of them had adenoid hypertrophy.9 The retrospective nature of our study did not allow us to accurately collect information for all possible risk factors. Previous studies have suggested that allergies and gastroesophageal acid reflux may lead to an increased rate of adenoid regrowth.2,3,6 While we tried to gather that information from the patient’s medical charts, the information was not present in most medical charts because most children were followed up by a primary care physician and an otolaryngologist in the community.

In conclusion, this is one of the largest studies investigating the factors associated with repeated adenoidectomy. We have confirmed a rate of repeated adenoidectomy of 1.5%. Young age and adenoidectomy alone without tonsillectomy were found to be important risk factors for repeated adenoidectomy. Children younger than 2 years were 5.6 times more likely and children younger than 5 years were 3.2 times more likely to require a repeated adenoidectomy. Patients with OSA and undergoing an adenoidectomy by curettage may also be at an increased risk for repeated adenoidectomy. However, these factors did not reach statistical significance in our study, and more research is needed to confirm their effect of the rate of repeated adenoidectomy. These findings confirm that adenoid regrowth is a relatively common phenomenon, especially in patients younger than 5 years at the time of surgery. Informed consent for adenoidectomy should make parents aware that there is a higher possibility of adenoid regrowth in these patients following surgery. These patients should be followed up regularly to monitor for symptoms of adenoid regrowth that may require further surgical treatment.

Submitted for Publication: May 31, 2012; final revision received September 5, 2012; accepted September 26, 2012.

Published Online: December 17, 2012. doi:10.1001/jamaoto.2013.1060
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Author Contributions: Dr Vaccani had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Duval and Vaccani. Acquisition of data: Duval, Chung, and Vaccani. Analysis and interpretation of data: Duval, Chung, and Vaccani. Drafting of the manuscript: Duval and Vaccani. Critical revision of the manuscript for important intellectual content: Duval, Chung, and Vaccani. Statistical analysis: Duval and Vaccani. Conflict of Interest Disclosures: None reported.

REFERENCES


