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The immediate effect of adenotonsillectomy on Eustachian tube function in children

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ABSTRACT

Objectives: The aim of this study was to evaluate the effect of adenotonsillectomy on immediate Eustachian tube (E-tube) function in children with adenotonsillar hypertrophy.
Methods: All children who were scheduled to undergo adenotonsillectomy were assessed. Physical examinations were performed on the preoperative day, and on postoperative days 1 and 2. Exams included visual inspection of the tympanic membrane and tympanometry including measurement of middle ear pressure (MEP) (daPa). The children were divided into four types (AA, CA, CC, and BB types) based on the tympanometric results of postoperative days 1 and 2.
Results: A total of 50 ears from 25 children (mean age ± standard deviation [SD] = 8.6 ± 3.2; male/female = 10/15; mean body mass index ± SD [kg/m^2] = 18.5 ± 3.7) were included. The rates of AA, CA, CC, and BB types were 10% (5/50), 14% (7/50), 74% (37/50), and 2% (1/50), respectively. On postoperative day 2, 76% of cases were abnormal or unresolved (38/50), while 24% were normal or resolved (12/50). There were significant decreases in MEP both before and after adenotonsillectomy (p's < 0.001). However, there were no significant differences in the MEPs measured on postoperative days 1 and 2. There were no significant differences between the right and left ears with regard to the MEPs on the preoperative day, or postoperative days 1 and 2.
Conclusions: Immediate E-tube dysfunction is a relatively common complication in children after adenotonsillectomy. Therefore, in the setting of immediate E-tube dysfunction, it is important to properly plan postoperative care and management.

1. Introduction

Adenotonsillectomy is commonly performed in children who have various problems related to their adenoids and tonsils [1–3]. Generally, it is indicated when children have obstructive symptoms (such as habitual snoring, witnessed apnea, mouth breathing, restless sleep) and/or infective symptoms (including frequent or severe adenotonsillitis, or adenotonsillitis associated with complications) [1–3]. Adenotonsillectomy is well known to be a very effective and critical procedure in children with obstructive sleep apnea [4,5].

Despite the careful techniques of ear–nose–throat (ENT) surgeons, adenotonsillectomy is associated with both intraoperative and postoperative complications [6–8]. Intraoperative complications include side effects related to anesthesia, bleeding, and potential risks associated with the endotracheal tube including accidental extubation [6–8]. Postoperative complications can occur immediately (within 24 h of surgery, including operative site or referred pain, nausea, vomiting, Eustachian tube [E-tube] dysfunction, and bleeding), be delayed (within two weeks, including operative site pain or discomfort, velopharygeal insufficiency [VPI], bleeding), or occur in the long-term (>2 weeks after surgery, including foreign body sensation, throat dryness, operative site stenosis, VPI) [6–8]. E-tube dysfunction is an immediate complication of adenotonsillectomy; however, there is insufficient information regarding its prevalence, mechanism, and diagnosis in children with enlarged adenoids and tonsils who undergo adenotonsillectomy. To our knowledge, there were no prior clinical trials related with changes in the middle ear pressure

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of children after adenotonsillectomy. Therefore, we planned this clinical research as a pilot study with relatively small number of subjects. The purpose of the study was to investigate the effect of adenotonsillectomy on immediate E-tube function using tympanometric results including tympanograms and middle ear pressure (MEP) in pediatric patients with adenotonsillar hypertrophy.

2. Materials and methods

2.1. Subjects

The present study was reviewed and approved by the Institutional Review Board of Korea University Ansan Hospital. Inclusion criteria included children who: (1) presented with various symptoms and/or signs of adenotonsillar hypertrophy (e.g., snoring, witnessed apnea, restless sleep, nasal obstruction, mouth breathing, hyponasal speech); (2) were diagnosed with adenotonsillary hypertrophy by means of direct visual examination and/or imaging study; (3) had normal ear findings (intact tympanic membrane [TM], A type on tympanometry) in preoperative assessment; (4) underwent adenotonsillectomy between July 2008 and September 2008; and (5) completed physical and tympanometric examinations on postoperative days 1 and 2. Children were excluded if they: (1) had preexisting craniofacial anomalies or neuromuscular disorders; (2) were previously treated with adenoidectomy, tonsillectomy and/or ear surgery (including ventilation tube insertion for otitis media with effusion); (3) had abnormal ear findings based on visual TM inspection and tympanometry (e.g., acute or chronic otitis media, otitis media with effusion, E-tube dysfunction, etc.) and (4) refused postoperative examination or study enrollment.

2.2. Physical examinations

Before adenotonsillectomy in pediatric patients, a detailed history was taken and a physical examination was performed. Physical examination included visual inspection of the adenoids, tonsils, and TM. On postoperative days 1 and 2, patients' symptomatic complaints were elicited, and physical examinations included visual inspection of the surgical sites and TM. Heights and weights were measured and used to calculate body mass index (BMI = weight [kg]/height [m^2]). Adenoid size was measured using imaging study such as lateral X-ray. Based on the ratio of adenoid depth to nasopharyngeal diameter (adenoid–nasopharynx [AN] ratio), adenoid size was classified from grades 1 to 4. The grades were defined using the AN ratio as follows: grade 1, 0–25%; grade 2, 25–50%; grade 3, 50–75%; grade 4, 75–100% [9]. The degree of space that both palatine tonsils occupy in the oropharyngeal space was also used to categorize tonsil size from grades 1 to 4 as follows: grade 1, 0–25%; grade 2, 25–50%; grade 3, 50–75%; grade 4, 75–100% [10,11]. We defined adenotonsillary hypertrophy in patients with grade 3 or 4 tonsils and grade 3 or 4 adenoids.

2.3. Tympanometry

A Madsen Electronics Zodiac 901 Middle Ear Analyzer Tympanometer (GN Otometrics, Assens, Denmark) was used to perform tympanometry and measure MEP on the preoperative day, and on postoperative days 1 and 2. Tympanograms are generally categorized from types A to C. Type A refers to a tympanogram with normal MEP (pressure peak between +100 daPa to −100 daPa). Type B tympanograms are characterized by clearly abnormal MEP with no pressure peak [12]. Finally, Type C tympanograms have abnormally low MEP with pressure peaks <-100 daPa [12]. The children were divided into types AA, CA, CC, and BB according to their tympanometric results on postoperative days 1 and 2.

2.4. Surgery

Adenotonsillectomy was carried out by an experienced surgeon. Under general anesthesia, children underwent adenoidectomy using a microdebrider (Medtronic Xomed, Inc., Jacksonville, FL, USA) under endovisual systems (Olympus, Japan) and tonsillectomy using an angled Celon bipolar forceps (Celon/Olympus, Germany). Hemostasis was achieved with transient packing gauze (within 5–10 min) for adenoidectomy site and with the above mentioned bipolar forceps for tonsillectomy site.

2.5. Statistical analysis

Repeated measures ANOVA was used to compare MEP on preoperative and postoperative days. Paired *t*-tests were used for parametric comparisons, and the Wilcoxon signed-rank test was used for nonparametric comparisons of the MEP between the right and left ears on the preoperative, and postoperative days. *p*-Values < 0.05 were considered statistically significant.

3. Results

3.1. Subjects

A total of 50 ears from 25 children were included in the current study. The average patient age was 8.6 ± 3.2 years. There was a male-to-female ratio of 10:15, and the mean BMI was 18.5 ± 3.7 kg/m^2. Baseline data are presented in Table 1.

3.2. Tympanometry

The tympanograms from every patient treated with adenotonsillectomy during the perioperative period are shown in Table 2. The rates of AA, CA, CC, and BB types were 10% (5/50), 14% (7/50), 74% (37/50), and 2% (1/50), respectively. On postoperative day 2, 76% (38/50) of cases were unresolved (CC and BB types), while 24% (12/50) were normal (AA type) or resolved (CA type). Table 3 provides MEP comparisons in children who underwent adenotonsillectomy during the perioperative period. There were statistically significant differences in bilateral MEPs between preoperative and postoperative days. However, there were no significant MEP differences between postoperative days 1 and 2. Comparisons between the MEPs of the right and left ears pre- and postoperatively are shown in Table 4. There were no significant differences in the right- and left- MEPs between the preoperative and postoperative days.

4. Discussion

The current study used objective measures such as tympanometry to determine if adenotonsillectomy immediately influences E-tube function in pediatric patients with adenotonsillar hypertrophy. On postoperative day 2, we found that there was a relatively high rate of unresolved cases (76%, CC and BB types). Only 24% of cases were normal (AA type) or resolved (CA type),

Table 1
Baseline data ($N = 25$).

	Subjects ($N = 25$)
Age (yrs)	8.6 ± 3.2
Sex (M/F)	10/15
BMI (kg/m^2)	18.5 ± 3.7
Adenotonsillar hypertrophy (+)	All ($N = 25$)
Preoperative tympanic membrane status	Intact ($N = 50$)
Preoperative tympanogram	A type ($N = 50$)

Data are presented as mean ± SD (standard deviation).