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Pre- and post-operative application of acoustic rhinometry in children with otitis media with effusion and with or without adenoid hypertrophy-a retrospective analysis

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ABSTRACT

Background: There is no standardized scheme for preoperative evaluation of adenoid hypertrophy or a consensus on surgical indications for adenoidectomy in children with otitis media with effusion (OME), especially for young children intolerant to nasal endoscopic assessment. The aim of this study was to evaluate the efficacy and reliability of acoustic rhinometry (AR) in evaluating benefits from adenoidectomy in children with OME.

Method: Children with OME who were scheduled for surgical intervention were reviewed and AR tests performed preoperatively and postoperatively. The patients were divided into two groups based on the surgical strategy (Group I: tympanostomy tube placement alone; Group II: tympanostomy tube placement plus adenoidectomy). Correlation and regression analyses were performed to assess the relationship between findings of AR and nasal endoscopy. AR parameters including minimal nasal cross-sectional area (MCA), and nasopharyngeal volume (NPV), as well as scores of subjective symptoms were obtained to evaluate the utility of AR pre- and post-surgery.

Results: Sixty-five children aged 4–10 years who met the inclusion criteria were included. No significant differences in gender or age distribution were observed between Group I and Group II. MCA, as well as NPV significantly decreased in Group II when compared with Group I ($p = 0.000$). A significant inverse correlation was observed between NPV and choanal obstruction ratio in both groups I (r = -0.625, $p < 0.001$) and II ($r = -0.570$, $p < 0.001$). A significant difference between preoperative and postoperative NPV and subjective symptom scores was observed in group II after adenoidectomy ($p = 0.000$).

Conclusion: AR parameters showed a good clinical correlation with findings of nasal endoscopy and thus may be useful for evaluating candidacy for surgical adenoidectomy among children with OME, especially in whom preoperative nasal endoscopic examination is not feasible. Additionally, AR can reveal the changes occurring within the nasopharyngeal passage before and after adenoidectomy.

1. Introduction

Otitis media with effusion (OME) is a common recurrent condition in children. Surgical management of OME including tympanostomy tube placement is recommended for patients who do not respond to conservative treatment. Adenoid hypertrophy, a common risk factor for OME in children, is commonly treated with tympanostomy tube placement in addition to adenoidectomy. Systematic reviews of relevant RCTs have shown that adenoidectomy is an effective adjuvant surgical intervention for treatment of OME in children aged ≥4 years. In addition, the benefit of adenoidectomy far outweighs its risks in children aged < 4 years with distinct nasal blockage or chronic adenoditis [1,2]. However, adenoidectomy is not always recommended, owing to the role of adenoids in development of immunity in early childhood. There are increasing concerns about the excessive resort to adenoidectomy in patients with OME [3]. An appropriate evaluation of the need to perform adenoidectomy in OME based on the severity of nasopharyngeal obstruction or chronic adenoiditis is not clear. Nasal endoscopy is considered as the current gold standard for assessment of the adenoids in clinical settings. Good cooperation by the patient and nasal decongestion are two key factors for successful and accurate nasal endoscopy, which therefore alleviates the difficulty in objective evaluation of nasal and nasopharyngeal condition before surgery. The absence of a precise surgical plan prior to the procedure is largely attributed to lack of an

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objective evaluation of the upper airway. This also hampers communication with the patients' guardians regarding the management plan.

Compared with nasal endoscopy, acoustic rhinometry (AR) appears to be an objective, noninvasive method for preoperative assessment of the anatomy of the nasal and nasopharyngeal cavity. Moreover, it requires minimal patient cooperation, which is a major advantage [4,5]. The extent and location of the stenosis are calculated by the intensity, phase, and the time delay between the transmitted and the reflected acoustic signals [6,7]. Indeed, AR is a convenient method for an objective preoperative assessment of nasal conditions as well as nasopharyngeal cavity volume. Some studies have evaluated the use of AR for objective assessment of the severity of subjective nasal and nasopharyngeal symptoms in children with obstructive sleep apnea [8–10]. However, few studies have assessed the use of AR in children with OME to evaluate the candidacy for surgical adenoidectomy.

In this study, we investigated whether AR could offer precise and consistent information, comparable to that obtained with endoscopic examination, for preoperative evaluation of nasopharyngeal airway obstruction in children with OME, and to determine their candidacy for adenoidectomy.

2. Materials and methods

2.1. Subjects

This study was approved by the Ethics in Research Committee at the Affiliated Hospital of Southwest Medical University. Informed consent was obtained from guardians of all participants prior to their enrolment.

Patients with OME who were hospitalized in our otolaryngology clinic for tympanostomy tube placement with or without adenoidectomy were included in the study. None of the patients had undergone nasal endoscopic examination until after administration of general anesthesia for surgery owing to various reasons such as intolerance and nasal congestion in the conscious state. Patients with history of adenoidectomy, anatomical anomalies, congenital craniofacial syndromes or developmental delay were excluded. The case history, e.g., symptoms of nasal obstruction, sleeping with an open mouth, snoring or restless sleep, history of allergy, and frequent upper respiratory tract infection was obtained from the patients' guardians. A special symbol "+" was recorded for each of the aforementioned symptoms and the number of "+" represented the score of subjective symptoms. The more number of the "+" indicated increased severity of subjective symptoms. The diagnosis of OME was based on current guidelines. Follow-up examination was performed 1 month and 3 months post surgery. Patients with incomplete aforementioned information and incomplete follow-up details were excluded.

2.2. Acoustic rhinometry

Acoustic rhinometry was performed using the Eecovision Acoustic Rhinometer, Model AR1003, a product of American Hood instruments. The processed bandwidth ranged from 100 Hz to 10 kHz. A 10-kHz low-pass filter was used to reduce the errors associated with cross modes in the human nasal cavity. Each subject was brought to the examination room five minutes in advance of the procedure in order to eliminate the potential interference of humidity, temperature, activity, and noise on measurement. The children were seated and accompanied by their parents during the measurement.

A properly fitted nosepiece was selected to prevent any acoustic leakage from the junction between the nostril and the nosepiece. The nosepiece was positioned appropriately to maintain light contact with the nostril, and to avoid distortion of the nasal valve during the assessment. The subjects were told to hold their breath during the short testing period. Before the start of each test, the device was calibrated using the calibration tube. Three repeat measurements were performed on each side and the minimum cross-sectional area value was averaged from the readings. Curves with irregular shapes or with a significant deviation from the others were considered abnormal and immediately retaken. The minimal nasal cross-sectional area (MCA) (cm^2) and its distance (cm) from the nostrils was recorded without decongestion [11]. Nasal cavity volume (NCV) was defined as the area under the rhinogram curve from 0 cm to 6 cm, according to the reference value from AR device, which was calibrated for use in the Asian population.

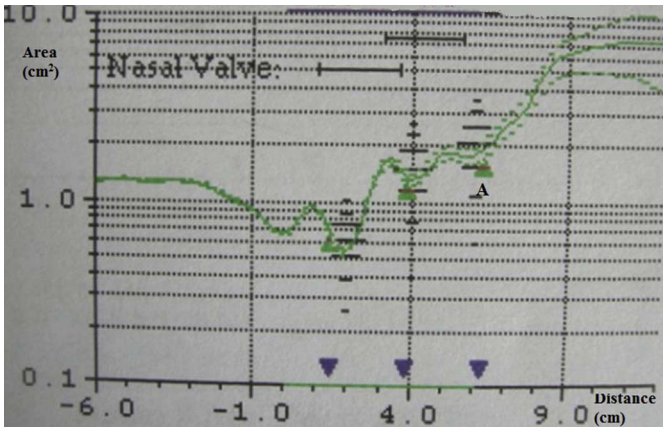

Fig. 1. Preoperative acoustic rhinometric curve (non-decongested). A, the notch by the adenoid.

The area under the rhinogram curve was calculated by AR measurements pre-operatively and at 3 months post-operation. Rhinogram curve from the 6–9 cm were related to nasopharyngeal volume (NPV) [8,12] (Fig. 1). However, in very young children, the cut-off point for nasal and nasopharyngeal cavity was moved forward to the value between 4 cm and 5 cm [13]. Preoperative and postoperative AR values of each patient were compared.

2.3. Audiological measurement

Pure-tone audiometry and play audiometry tests were performed using AC 40 (Interacoustic), which was calibrated based on the standards of the 1996 American National Standards Institute (ANSI; 3.6). All the audiometry tests were performed by experienced audiology technicians. To measure aural acoustic impedance and admittance, conventional tympanometry and acoustic reflexes were performed using the Middle Ear Analyzer, GSI-TYMPSTAR, which was calibrated according to the 1987 ANSI specifications for instruments.

2.4. Surgery and nasal endoscopic examination

A 0° telescope was used to obtain pre-operative pictures of the nasopharynx in patients under general anesthesia without nasal decongestion. An obstruction ratio of adenoid tissue to choanal opening was calculated for each patient by the same examiner. All patients underwent myringotomy and 'T' grommet insertion. Adenoidectomy was also performed on patients with validated subjective symptoms coupled with adenoid hypertrophy (choanal obstruction ratio ≥75%), as assessed by nasal endoscopy [14]. Of note, adenoidectomy was also performed in patients who had a choanal obstruction ratio < 75% concurrent with a high score of subjective symptoms. Patients who underwent tympanostomy tube placement alone were included in group I, while those who underwent tympanostomy tube placement plus adenoidectomy were included in group II. The surgeries were performed by otolaryngologists in the same department.

2.5. Statistical analysis

Data pertaining to normally distributed variables are presented as