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Chorda tympani nerve function in children: Relationship to otitis media and body mass index☆

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ABSTRACT

Objective/hypothesis: A relationship between acute otitis media and elevated body mass index has recently been reported. Intriguingly, it was postulated that this relationship may result from altered chorda tympani nerve function impacting taste sensation and eating habits. We sought to test this directly by measuring chorda tympani nerve function in children with and without a previous history of acute otitis media and to determine the relationship to body mass index.
Study design: Retrospective cohort study.
Methods: Institutional research ethics board approval was obtained. Study participants included 142 children (5–18 years of age) who were recruited from an otolaryngology outpatient clinic at a tertiary academic pediatric hospital between May and August 2009. Children were excluded if they were not able to communicate effectively, younger than age 5, or had developmental disabilities. Body mass index was calculated and the history of previous otologic disease carefully elicited from the caregivers. Electrogustometric threshold, a validated measure of chorda tympani function, was obtained bilaterally in each child. Children were divided into cohorts based on the number of acute otitis media episodes, and electrogustometry thresholds were compared between cohorts.
Results: Electrogustometric thresholds were successfully obtained in all children. There was no significant relationship between chorda tympani nerve function and history of acute otitis media. Similarly, there was no significant association between the history of otitis media and body mass index.
Conclusion: This study did not demonstrate any effect of previous acute otitis media history on chorda tympani nerve function. Furthermore, it did not demonstrate a relationship between acute otitis media and elevated body mass index. This is counter-evidence to the previous hypothesis that increasing acute otitis media is responsible for increasing childhood obesity through alteration in chorda tympani nerve function.

1. Introduction

The reported prevalence of recurrent acute otitis media (AOM) in children has been increasing, despite the development of antibiotics [1]. In developed countries, it is the most common indication for antibiotics and surgery in young children [2]. Concurrently, in North America, the incidence of childhood obesity has also been increasing. Current data using World Health Organization body mass index (BMI) criteria shows that 22% of Canadian children are overweight and another 13% are obese [3]. Interestingly, a relationship between AOM and BMI was recently reported [4]: adults who had experienced moderate to severe AOM as children were more likely to be obese. The authors of this study postulated that the chorda tympani nerve (CTN) may play a role in the apparent relationship between childhood OM and obesity [4].

There is some anatomical support for this idea. The CTN is a branch of the seventh cranial nerve that traverses the middle ear space and conveys taste sensation from the anterior two-thirds of the tongue to the brain. It has been hypothesized that chronic or repeated episodes of inflammation, as may occur in the case of chronic or acute OM, may injure the CTN. Indeed, histopathological studies have confirmed that characteristic abnormalities are found

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in the CTNs of patients with chronic OM [5]. It has been suggested that this inflammation may result in altered taste sensation which in turn may impact food choices and eating habits, ultimately leading to obesity [4].

The hypothesis that OM can impact CTN function and alter taste sensation in children is intriguing. However, it has never been directly tested. Using electrogustometry (EGM), a surrogate measure of CTN function, we sought to definitively determine whether a detectable relationship exists between AOM and CTN function in children.

2. Materials and methods

One hundred and forty-two consecutive pediatric patients aged 5–18 years who were seen in the outpatient otolaryngology clinic between May and August 2009 were recruited for participation in this study. Research Ethics Board approval was obtained. Patient and parents were consented for participation and chart reviews were conducted to extract the following information: age, gender, history of ear surgery, past medical history, and history of any issues or concerns with taste function. Participants were asked to recall the number of previous episodes of AOM: 0 episodes, 1–5 episodes, or more than 5 episodes. This grouping was established a priori before data collection commenced. The primary comparison of interest was children with extremes of experience with AOM: children with a history of 0 episodes and children with more than 5 episodes. Indeed, the aim of the study was to dichotomize these two patient groups; however, for transparency and completeness, data from all groups was collected with the caveat that the retrospective data collection would be subject to some degree of recall bias. Participants were also asked to report any subjective alteration in taste perception; this was elicited by direct questioning of both parents and children. In addition, height and weight were measured and BMI calculated (weight in kilograms divided by height in meters squared). Included patients were developmentally within normal limits, able to understand instructions, and able to communicate responses effectively. Specifically, they were able to provide a behavioral response during electrogustometric threshold measurement.

CTN function was directly tested by determining the threshold of electrogustometric stimulation. This measure has been previously shown to be a quick, reproducible and quantifiable method of assessing taste dysfunction [6,7]. A Rion TR-06 electrogustometer [8] (Sensonics Inc., Haddon Heights, NJ) was utilized in this study. The side tested first was randomized for each patient using a coin flip. A 5 mm probe was touched to the anterior edge of the tongue 2 cm lateral to the midline on the tested side. A small, painless current was passed from the probe on the patients' tongue to a ground current placed on the wrist. This resulted in a local change in pH on the tongue, which was perceived by the patient as a sour or metallic taste [9]. Electrical current was scaled using the logarithmic decibel unit (dB). Stimulation was increased from −6 dB. Patients were instructed to push a button as soon as they perceived a sour/metallic taste, thus providing a threshold of CTN function. Abnormal function is defined by thresholds of 16 dB or more, or a difference of greater than 6 dB between the two sides of the tongue [10].

2.1. Statistical analysis

Left and right EGM thresholds were compared to determine whether there was a significant correlation using simple linear regression. If this relationship was found, lowest thresholds were to be used for all subsequent analyses.

Statistical analyses included analysis of variance to compare EGM threshold by history of prior AOM, and BMI by prior history of AOM. Multiple regression analysis was used to investigate the relationship between EGM threshold and age, gender, BMI, history of otologic surgery, history of myringotomy and tubes, and history of AOM. All analyses were two-tailed with $p < 0.05$ representing statistical significance.

Table 1
Distribution of patient groups.

Patient information	Statistics
Mean age (years)	11.6 (range, 5–18)
Gender (M:F)	1.6:1
Mean BMI (kg/m^2)	19.7 (range 12.7–51.6)
History of otologic surgery (n)	62/142
History of myringotomy and tubes (n)	52/142
History of OM	
0 prior episodes (n)	41/142
1–5 episodes (n)	41/142
5 episodes (n)	60/142

3. Results

Patient demographics are presented in Table 1.

EGM thresholds were obtained for all patients in each of the three AOM groups (zero, 1–5, and greater than 5 prior episodes of AOM). For each patient, left and right thresholds showed a statistically significant correlation ($R = 0.71$, $p < 0.0001$). Lowest (i.e., most sensitive perception of taste) thresholds for each patient were therefore used in subsequent analyses as planned in the study protocol. There was no difference in thresholds between patients who had experienced 0 episodes of AOM and those who experienced more than 5 episodes (0.73 dB vs. −2.13 dB). EGM thresholds were significantly lower in patients who had experienced 1–5 prior episodes of AOM than those who had 0 episodes (−3.4 dB vs. −0.7 dB, $p = 0.0006$) or greater than 5 episodes (−3.4 dB vs. −2.1 dB, $p = 0.005$) (Fig. 1). Stepwise linear multiple regression analysis was employed to determine whether any other patient factors predicted EGM threshold; the details are provided in Table 2. This analysis confirmed that the only significant predictor of EGM threshold was the prior experience of between 1 and 5 episodes of AOM (coefficient – 2.23, $p = 0.015$). None of the AOM groups exhibited EGM thresholds outside of the normal range. Moreover, none of the 142 patients reported subjective alterations in taste sensation.

The mean BMI for each AOM group is shown in Fig. 2. No significant association between the number of episodes of AOM and the calculated BMI was found ($p = 0.89$).

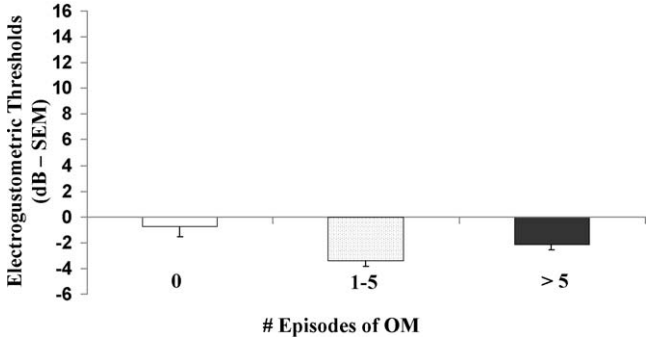

Fig. 1. History of AOM does not predict abnormal EGM thresholds. Although the group of children with a history of between 1 and 5 episodes of OM demonstrated lower EGM thresholds, all groups demonstrated thresholds well within the normal range (up to 16 dB). Error bars represent standard error of the mean.