

Original Article

Unilateral Increase of Gustatory Thresholds in Acute Otitis Media: A Pilot Study

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Cite this article as: Klein L, Barkai T, Carmel-Neiderman N, et al. Unilateral increase of gustatory thresholds in acute otitis media: A pilot study. *J Int Adv Otol.* 2023;19(2):112-115.

BACKGROUND: To evaluate chorda tympani nerve function as measured by unilateral increases of gustatory thresholds in the presence of ipsilateral acute otitis media.

METHODS: Prospective clinical study comparing electrogustometric measurements was conducted to evaluate the taste thresholds of each side of the tongue in a patient during an acute episode of unilateral acute otitis media. Included were patients aged 12-40 who presented to the emergency department and outpatient ear, nose, and throat clinic of a university-affiliate tertiary medical center with unilateral acute otitis media between January 2019 and January 2020 and consented to the study.

RESULTS: Eleven patients were initially recruited into the study, and 10 patients aged (mean \pm standard deviation) 26.1 ± 11.2 years comprised the final study group. Taste thresholds were significantly elevated on the side ipsilateral to the ear affected by acute otitis media ($P < .05$).

CONCLUSION: Chorda tympani nerve conductance is impaired during the acute stage of acute otitis media. This may have implications in the understanding of peripheral neural properties during acute middle ear inflammatory conditions and on the diagnosis of acute otitis media.

KEYWORDS: Chorda tympani, acute otitis media, electrogustometry, taste

INTRODUCTION

Acute otitis media (AOM) is an inflammation of the middle ear and is among the most common diseases in young children.¹ The pathophysiology is multifactorial and can result in complications, such as conductive hearing loss, tympanic membrane perforation, mastoiditis, meningitis, sinus vein thrombosis, and facial nerve paralysis.^{2,3} Acute facial nerve paralysis is a rare complication, and there are several hypotheses regarding its specific pathophysiology, such as direct involvement of the facial nerve by infection, facial nerve infarcts due to inflammatory edema, and demyelination of nerve fibers by bacterial toxins.^{4,5,6} The chorda tympani nerve (CTN) is a branch of the facial nerve which passes through the middle ear. It carries afferent special sensory fibers from the anterior two-thirds of the tongue and efferent parasympathetic innervation to the submandibular ganglion which innervates the submandibular and the sublingual glands.⁷ Middle ear inflammation during AOM is likely to affect the conductance and function of the CTN by means of the same mechanisms of acute facial nerve paralysis. Moreover, there is evidence for dysfunction of nerves which pass through an inflammatory environment.⁸

Chorda tympani nerve dysfunction has been reported in chronic otitis media and other pathologies of the ear, nose, and throat, but there have not been any publications on CTN involvement in AOM.^{9,10} Therefore, the present pilot study was conducted to investigate CTN function in AOM patients under the hypothesis that CTN dysfunction, as measured by changes in gustatory thresholds, will be greater in the presence of middle ear inflammation in AOM.

METHODS

This clinical trial was performed from January 2019 to January 2020 in the emergency room (ER) of the Otolaryngology Head and Neck Surgery Department in a tertiary care center. Research ethics board approval was obtained (Ministry of Health Ethics committee number 20185094, institutional request number TLV-0311-17). It was conducted according to the Declaration of Helsinki on biomedical research involving human subjects. Written consent was obtained after the provision of detailed information about the potential benefits and risks of the study by an otolaryngologist to the patient or guardian.

Study Subjects

Patients were recruited during their acute care visit in the ER and were asked to arrive at the outpatient clinic on the following day. Consenting patients that were diagnosed in the ER with unilateral AOM were recruited for participation in this study. Chart reviews were conducted to extract the following information: age, sex, smoking history, history of ear surgery, past medical history, and history of any issues or concerns with taste function. Eligible patients were those aged 6-40 years who were able to cooperate with and consent to the experimental procedure. Patients with a history of chronic otitis media, gustatory dysfunction, head and neck trauma or pathologies, as well as pregnant women were excluded.

The patients who had been diagnosed as having unilateral AOM within the past 48 hours were contacted and invited to arrive at the outpatient clinic to participate in the study. First, the inflammatory AOM diagnosis was validated as still being in an active state by an otolaryngologist's examination that included otomicroscopy, and then bilateral electrogustometric (EGM) threshold measurements were performed by the investigators. The otolaryngologist was blinded to the EGM measurements.

Electrogustometry

Chorda tympani nerve function was assessed by determining the taste threshold, and EGM analysis was performed with a RION TR-06 electrogustometer (Sensonics Inc., Haddon Heights, NJ, USA).¹¹ The stimulus was applied by placing a 5-mm monopolar probe 1.5 cm lateral to the midline and 1.5 cm proximal from the tongue tip in the territory innervated by the CTN. The strength of the stimulus ranged from -6 dB to 34 dB, and the stimuli duration was 500 ms. Both sides of the tongue were tested separately, with the healthy side tested first. Two alternative forced choice paradigms were performed, with alternating increasing and decreasing stimulus strength within a staircase paradigm. The turning point was defined as 2 correct answers or one incorrect answer, leading to an increase or decrease, respectively, of stimulus strength. The taste threshold was the average of the last 4 turning points.

Statistical Analysis

The statistical analyses were performed with MATLAB (2018A, MathWorks). The 1-tailed paired *t*-test was used to compare taste thresholds between the healthy and the affected sides. The significance level was set at $P < .05$.

RESULTS

A total of 11 participants were recruited for the study, and 1 patient was dropped due to active smoking. The 10 suitable patients with inflammatory unilateral AOM included 9 females and 1 male whose mean age \pm standard deviation was 26.1 ± 11.2 years. One patient also had mild external otitis ipsilateral to the study ear, 1 also had acute mastoiditis ipsilateral to the study ear, and 1 also had serous otitis media contralateral to the study ear. Comparison of the taste threshold in the AOM-affected side (mean 1.9 ± 4.75) to the healthy side (mean -1.45 ± 4.44) revealed a significant increase in taste threshold on the affected side ($P < .05$). Figure 1A presents the taste thresholds per patient per side, and Figure 1B presents a boxplot of taste thresholds in both the affected and healthy sides.

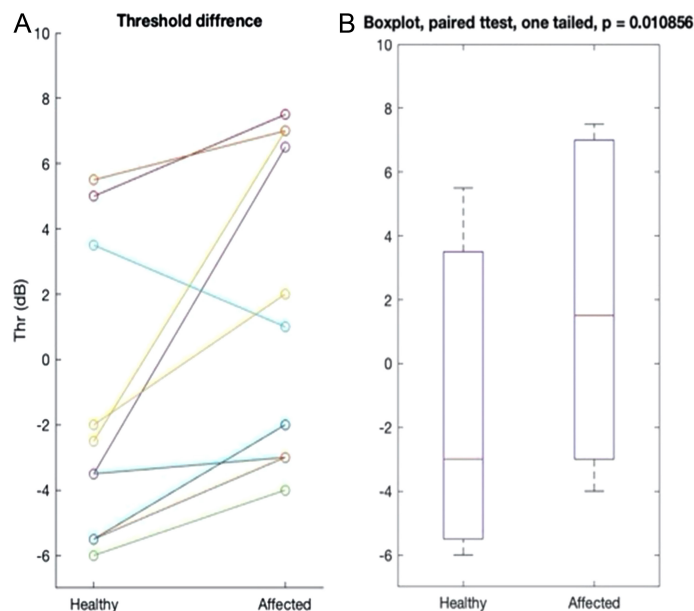


Figure 1. Taste thresholds in acute otitis media (AOM). (A) Patient-specific taste thresholds. Each patient is represented by a single line, where the left column represents the healthy side and the right column represents the side of the ear with AOM. (B) Boxplot of taste thresholds on the affected and healthy sides.

DISCUSSION

The effect of AOM on CTN function has not been studied in depth. This study employed an EGM methodology in order to evaluate the taste thresholds of each side of the tongue of patients with verified unilateral inflammatory AOM. The principal finding was a unilateral increase in EGM tracings of gustatory thresholds on the affected side during the inflammatory phase of AOM. This heretofore unreported association has possible implications on the understanding of the pathophysiology of acute infection on CTN conductance as well as on the diagnosis of AOM.

Previous studies have shown the effect of chronic ear infection and otologic surgery on CTN function.^{12,13,14,15,16,17} Seaberg et al¹⁸ performed EGM studies in 142 obese children and stratified the study groups based on a history of Otitis Media (OM). Those authors did not find any correlation between a history of OM and gustatory dysfunction, but they did not look at an ongoing middle ear infection in the acute phase. The current study appears to be the first to address the effect of middle ear inflammation in the setting of AOM on gustatory thresholds during the acute phase of the disease.

The strengths of this study are that the measurements were performed during the acute phase of infection and that they revealed an increase in the EGM thresholds on the side ipsilateral to the affected ear. The weaknesses of the study are related to the study population having an average age of 26 years, which does not reflect the pediatric age group that is most affected by AOM. This was the result of the reduced ability of younger children to complete EGM examinations, as shown by Leung et al.¹⁰ Moreover, both the adult and pediatric patients were recruited during their acute care visit in the ER and they were asked to arrive at the outpatient clinic on the following day. The lack of compliance for the return visit was mostly on the part of the parents of the suitable children. Nevertheless, the pathophysiology of acute inflammation in the middle ear with the resulting reduction of CTN conductance among adults should not be fundamentally different from those in younger age groups, and these results can be extrapolated to apply to children. Another limitation is the relatively small cohort of 10 patients and the use of EGM technology which is operator-dependent and has low sensitivity. The sensitivity of electrogustometry for assessing taste abnormalities, as demonstrated in the literature, is 0.21, with a specificity of 0.79.¹⁹ These characteristics may be attributed to the method's weaknesses, as described by Stillman et al²⁰; for example, variations in the instructions given by different testers, and variations in what patients' perception of the stimulus required for reporting of taste sensation.

In summary, the results of this pilot study demonstrated that there is a measurable increase in gustatory thresholds that is most likely a result of CTN dysfunction during acute inflammation of the middle ear in AOM. Further research is required to define the relevance of this finding in children with AOM.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of Tel-Aviv Sourasky Medical Center (Approval No: 0311-17-TLV).

Informed Consent: Written informed consent was obtained from each patient included in the study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – L.K, T.B., A.D.; Design – L.S., T.B.; Supervision – A.D., M.S.; Materials – A.D., M.S.; Data Collection and/or Processing – N.C.-N., S.S.; Analysis and/or Interpretation – L.K., T.B.; Literature Review – L.K., T.B.; Writing – L.K., T.B.; Critical Review – A.D., M.S.

Declaration of Interests: The authors declare that they have no conflict of interest.

Funding: BioMedTech Program at Tel-Aviv University. The study was part of the MD dissertation of Linor Klein, Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel.

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