Clinical Assessment of Gustatory Function Before and After Middle Ear Surgery: A Prospective Study With a Two-Year Follow-Up Period

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Objectives: Middle ear surgery can affect gustatory function because of the course of the chorda tympani nerve (CTN) close to the tympanic membrane. The aim of the study was to evaluate the sense of taste before and after middle ear surgery with a test suitable for clinical routine. Moreover, subjective complaints were assessed over a relatively long period of time.

Methods: Forty-seven patients (26 female, 21 male; mean age, 42 years) were investigated before and 4 days after surgery on both sides of the anterior part of the tongue. Self-assessment of taste function was performed by visual analog scales.

Results: The mean (±SD) taste scores significantly decreased on the side ipsilateral to the operated ear in patients with major manipulation of the CTN (12.0 ± 4.5 before surgery and 6.9 ± 4.5 after surgery; p < 0.001), whereas no significant changes were measured in patients with minor manipulation of the CTN (12.5 ± 3.1 before surgery and 11.2 ± 3.9 after surgery; p = 0.14). Self-assessed ratings of taste function significantly decreased after surgery in all patients (p < 0.001). Reassessment of subjective taste function after 2 years indicated no persisting complaints.

Conclusions: Depending on the amount of manipulation of the CTN, taste function is decreased after surgery. However, long-lasting changes of gustatory function seem to be rare.

Key Words: chorda tympani, clinic, gustation, middle ear surgery, taste.

INTRODUCTION

Taste function significantly contributes to the enjoyment of foods during eating and drinking. In turn, an impaired sense of taste may lead to changes of dietary habits and to a decrease in the quality of life. Oral taste perception is mediated predominantly by 2 pairs of cranial nerves: the seventh nerve or chorda tympani nerve (CTN), which joins the lingual nerve and innervates the anterior two thirds of the tongue, and the ninth nerve or lingual branch of the glossopharyngeal nerve, which innervates the rear part of the tongue. The CTN travels through the middle ear, between the long crus of the incus and the manubrium of the malleus, near the upper part of the tympanic membrane. Consequently, during middle ear surgery the CTN is affected to certain degrees depending on the performed procedure.

The aim of the present study was to assess changes of gustatory acuity after middle ear surgery as measured by a validated clinical taste test before and after surgery. Moreover, subjective complaints were assessed over a long period of time in order to provide a database of information to be given to patients before middle ear surgery.

METHODS

The study was carried out at the Department of Otorhinolaryngology at the Medical University Vienna. It was conducted according to the guidelines of the Declaration of Helsinki on Biomedical Research Involving Human Subjects.

The investigation involved 47 patients (26 female, 21 male; mean age, 42.0 years; SD, 13.7 years; range, 20 to 74 years). After the patient’s history had been taken, self-assessment of gustatory function was performed with a visual analog scale (VAS) ranging from 0 (no sense of taste) on the left end of the scale to 100 (excellent sense of taste) on
TABLE 1. GUSTATORY FUNCTION COMPARED TO THAT OF OTHERS

<table>
<thead>
<tr>
<th></th>
<th>Before Surgery</th>
<th>After Surgery</th>
<th>23 Months</th>
<th>Later</th>
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<tbody>
<tr>
<td></td>
<td>Minor</td>
<td>Major</td>
<td>Minor</td>
<td>Major</td>
</tr>
<tr>
<td>1 Very good</td>
<td>4</td>
<td>6</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>2 Significantly better</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<tr>
<td>3 Slightly better</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 Normal</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>5 Slightly worse</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>6 Significantly worse</td>
<td>0</td>
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<td>1</td>
<td>0</td>
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<tr>
<td>7 Very bad</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8 No taste</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
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</table>

Patients had to rate their gustatory acuity compared to that of others. This question was presented before and after surgery, before taste testing with taste strips. Moreover, at mean interval of 2 years after surgery, it was part of questionnaire (question 2). Numbers represent patients choosing certain descriptors.

Minor — middle ear surgery with minor chorda tympani (CTN) manipulation; major — middle ear surgery with major CTN manipulation.

the right. Also, taste function was assigned by the patients to specific descriptions ranging from 1 to 8 (Table 1). This categorization was performed to enable detection of changes of gustatory function in individual patients. Gustatory tests and ratings of taste function were performed the day before and approximately 4 days (mean, 4.4 days; SD, 3.1; range, 2 to 20) after surgery. Moreover, subjective changes of gustatory function or oral sensations were asked about after surgery.

Gustatory Testing. Using a quantitative test, we assessed gustatory function before and after the operation. This test consisted of 32 taste strips made of filter paper that were presented alternately to each side of the tongue (at a distance of approximately 1.5 cm from the tip) in a pseudorandomized sequence. Each side of the tongue was tested with 16 taste strips of 4 basic taste qualities. The taste strips were impregnated with 4 concentrations of sweet (0.4, 0.2, 0.1, 0.05 g/mL sucrose), sour (0.3, 0.165, 0.09, 0.05 g/mL citric acid), salty (0.25, 0.1, 0.04, 0.016 g/mL sodium chloride), and bitter (0.006, 0.0024, 0.0009, 0.0004 g/mL quinine hydrochloride) taste solutions and dried on a slowly rotating wheel. Testing was started with the lowest concentrations, in order to minimize adaptation. The subjects were asked to respond according to a list of 5 possible answers (sweet, sour, salty, bitter, or no taste). After presentation of each taste strip, the mouth was rinsed with tap water. A correct answer yielded 1 point. Consequently, the “taste scores” for each side of the tongue ranged between 0 and 16. The time needed for testing was approximately 15 minutes.

Surgical Procedures. The patients were divided into 2 groups depending on the degree of manipulation of the CTN as stated in the surgical report. One group consisted of 17 patients (9 female, 8 male; mean age, 43.7 years; SD, 15.0 years; range, 20 to 74 years) with minor manipulation of the CTN, ie, touch only, without significant stretching of the nerve. Eight patients had tenotomy (cutting the tendons of the stapedius and tensor tympani muscles in patients with Meniere’s disease). 7 patients had myringoplasty (due to a perforated eardrum), and 2 patients had tympanotomy due to sudden hearing loss.

The other 30 patients (17 female, 13 male; mean age, 41.0 years; SD, 13.2 years; range, 21 to 69 years) experienced moderate to significant manipulation of the CTN (including 3 patients with a severely CTN). This group consisted of 18 patients with tympanoplasty (6 with chronic suppurative otitis media, 5 with cholesteroloma, 3 with disruption of the ossicular chain, 2 with tympanofibrosis, 2 with a perforated eardrum), 10 patients with stapedioplasty due to otosclerosis, and 2 patients with tenotomy due to Meniere’s disease.

Questionnaire After Mean Interval of Two Years. At an interval of 13.0 to 29.3 months (mean, 23.5 months; SD, 4.1 months), 22 patients (47%) replied to a questionnaire concerning taste acuity, consisting of the following questions.

1. How do you rate your taste function concerning sweet, sour, salty, bitter taste? (The answer had to be given on a 10-point scale ranging from 1 [very bad] to 10 [very good], resulting in a minimum score of 1 and a maximum score of 10).

2. How do you rate your taste function compared to others (Table 1)?

3. Do you feel any complaints in the mouth at the moment?

Statistical Analysis. We used t-tests for paired samples for comparisons of the subjects’ ratings before and after surgery and for the results of gustatory testing. The SPSS program package (version 15.0 for Windows; SPSS Inc, Chicago, Illinois) was used for analysis. The alpha level was set at 0.05.

RESULTS

The results of ratings and psychophysical measures of taste function of patients with minor or significant manipulation of the CTN are presented in Table 2. Statistical analysis revealed significant reduction of subjective taste acuity 4 days after sur-
dugery in both groups (mean difference of VAS scores before and after surgery in patients with major manipula-
tion of the CTN, 21.0; SD, 26.8, t = 4.28, p < 0.001; and in patients with minor manipulation, 23.1; SD 26.6, t = 3.58, p < 0.001). However, the taste strip scores significantly changed on the operated side in the patients with major manipulation of the CTN (mean difference of taste strip scores before and after surgery, 5.0; SD, 5.5, t = 5.04, p < 0.001), whereas no significant changes were detected in the patients with minor manipulation (mean difference of taste strip scores before and after surgery, 1.3; SD, 3.4, t = 1.57, p = 0.14). The taste strip scores of the other side of the tongue (contralateral to the operated ear) showed no significant change in either group (mean difference of taste strip scores before and after surgery in patients with major manipulation of the CTN, -0.5; SD, 2.4, t = -1.14, p = 0.26; and in the patients with minor manipulation, -0.5; SD, 2.9, t = -0.68, p = 0.51).

Subjective Changes of Gustatory Function and Oral Sensations After Surgery. Nine of the 17 patients with minor CTN manipulation and 12 of the 30 patients with major CTN manipulation did not report any changes in gustatory function 4 days after surgery. The remaining 8 patients (47%) of the first group reported taste loss only (2 patients), gustatory and trigeminal alterations (5 patients: taste loss and/or distorted taste combined with dry, numb, or tingling tongue), or trigeminal alterations (1 patient: raspy tongue). Eighteen (60%) of the patients with major CTN manipulation reported the following changes of taste and/or oral feeling: taste loss only (5 patients), gustatory and trigeminal alterations (9 patients), or trigeminal alterations only (4 patients).

Questionnaire After Two Years. All 22 patients (8 with minor and 14 with major CTN manipulation) who replied to the questionnaire rated their taste function on the 10-point scale (question 1) in the upper normal range (range, 5 to 10). Self-assessed gustatory function (question 2) was reported as normal or better by all patients with minor manipulation of the CTN, and as slightly worse by only 3 patients with major manipulation. These results compare to the ratings before surgery (Table 1). No patient reported persisting gustatory dysfunction or other sensations such as burning of the tongue (question 3).

Results of Individual Patients. In 3 patients with major CTN manipulation, the CTN had to be severed during surgery (Table 3). Accordingly, the post-operative taste scores were in the range of ageusia, with a maximum of 4 of 16 taste strips correctly identified. Two of these patients replied to the questionnaire 24 and 22.5 months after surgery, respectively. Self-assessed gustatory function on the 10-point scale was reported as 9 and 8, respectively. Both rated their taste function as normal, with no persisting complaints.

DISCUSSION

This study was aimed at the assessment of objective (using a quantitative psychophysical taste test) and subjective (using the subjects' ratings and verbal descriptions of taste) measures before and after middle ear surgery and yielded the following major findings. First, about half of the patients reported gustatory and/or trigeminal oral dysfunction after surgery irrespective of the severity of manipulation of the CTN, confirming previous reports. Self-assessment of gustatory function by means of a VAS indicated a significant reduction of taste function after surgery. Second, concerning the severity of CTN manipulation, patients with major manipulation showed significant reduction in taste scores, whereas no significant differences in taste scores before and after surgery could be observed in patients with minor CTN manipulation. Third, persisting subjective taste complaints, as assessed at a mean interval of 2 years after surgery, seem to be rare. As an additional result, the current study suggests that the taste strips are a valid tool for the assessment of gustatory function in clinical routine.
In 3 patients the CTN had to be severed during surgery, and all of them had postoperative oral complaints. However, as in the other patients who had temporary oral disorders after major manipulation of the CTN, the complaints resolved after 2 years in both patients available for reevaluation. This finding is consistent with the results of Nin et al. who found complete resolution of symptoms in patients with bilateral section of the CTN 2 years after surgery, although electrogustometric thresholds did not recover.

One explanation of the subjective recovery of regional taste loss was provided by Todrank and Bartoshuk, who described that taste localization is mediated by touch in the oral cavity. Thus, spatially restricted areas of diminished or absent gustatory sensitivity might be compensated for by other, intact areas. Moreover, Kveton and Bartoshuk reported that unilateral taste loss might remain undetected because of processes of lateral inhibition. The gustatory afferent inputs of the seventh cranial nerve (front part of the tongue) and the ninth cranial nerve (base of the tongue) have been shown to inhibit each other centrally. Consequently, a loss of inhibition leads to an increase in taste sensitivity on the other side.

The question whether and to what extent a severed CTN can regenerate was also investigated by Saito et al. In 22 of 52 patients, regenerated CTN fibers were found in the submucosal layer of the reconstructed eardrum during a second surgery. Sixteen patients showed electrogustometric threshold recovery before the second surgery. However, in these patients the stumps of the severed CTN were end-to-end anastomosed or fixed with fibrin glue in the original position, as is not routinely performed in middle ear surgery. In a retrospective study, Saito et al. analyzed the recovery rate of taste function of 371 patients after middle ear surgery with respect to the severity of CTN damage. Three quarters of patients with elevated electrogustometric thresholds after middle ear surgery with significant manipulation of the CTN had complete recovery.

It is important to provide patients with information about complications before surgery. Previous reports about subjective and measured taste dysfunction after minor CTN manipulation provide inconsistent data. Clark and O'Malley reported symptoms in 9 of 12 patients (75%) after myringoplasty with minor CTN manipulation. In another study, 24 of 54 patients (45%) with minor CTN manipulation had symptoms; this finding compares to the results of our study. The present data indicate that patients with minor manipulation of the CTN are likely to have temporary oral complaints without compromised taste function. On the other hand, patients who have surgery with major manipulation of the CTN should know that some taste loss might occur in about 50% of cases, with resolution of the symptoms in the vast majority. Consequently, the data encourage otologists to be as careful as possible regarding CTN function, which is often ignored during middle ear surgery.

Why is taste dysfunction associated in many patients with oral sensations such as numbness or a metallic taste? Two recent studies have addressed this topic. Chen et al. described a phenomenon named "tactile dysgeusia" in patients after middle ear and skull base surgery. The patients reported taste sensations at the anterolateral dorsal tongue triggered by touching various areas of the outer ear and adjacent parts of the face. It is explained by the authors as aberrant reinnervation of CTN fibers with trigeminal nerve fibers of the surgical field. However, it is more likely that general sensations from the tongue are mediated by CTN fibers after middle ear surgery. Perez et al. documented a reversible reduction in sensitivities to touch and 2-point discrimination on the operated side of the tongue.

It was concluded by the authors that the CTN also confers somatosensory sensations from the tongue, which might explain symptoms such as numbness or tingling after middle ear surgery.

CONCLUSIONS

Using a chemosensory test of gustatory function intended for clinical routine, the present investigation showed that self-assessment of gustatory function does not correspond with measured taste scores in many patients after middle ear surgery. As already indicated by previous work, patients should be informed before operation about the possibility of postoperative gustatory dysfunction, which resolves in the vast majority of cases. Because complete taste loss of one side of the tongue often goes unnoticed and thus will not be reported by many patients before surgery, taste testing is recommended at least in those patients who already have undergone operation on the contralateral ear.

REFERENCES


