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Taste and Olfaction in Middle Ear Surgery

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Abstract

Objective: The aim of this study was to assess pre- and postoperative taste ability in patients undergoing middle ear surgery for otosclerosis or chronic otitis media. Olfactory function was also evaluated to rule out taste deficits due to concomitant nasal pathology.

Methods: All patients underwent ear, nose, and throat examination, otomicroscopy, nasal endoscopy, anterior rhinomanometry, taste testing, and olfactory testing. Patients were evaluated at 1 to 5 days preoperatively (T0), and at 1 (T1), 6 (T6), and 12 (T12) months postoperatively.

Results: Both groups of patients experienced worsening of the mean taste threshold postoperatively. This phenomenon was more serious in poststapedotomy patients. Follow-up showed progressive improvement in both groups. All values of olfactory testing were within the normal range for otosclerosis patients. Patients with chronic otitis media showed variable postoperative findings.

Conclusion: Chorda tympani function can be negatively affected by middle ear surgery. Deficits may be more marked in stapedotomy patients than in those undergoing tympanoplasty. Postoperative recovery of taste is satisfactory, although with different timelines for the 2 types of pathology.

Keywords

taste, chronic otitis media, otosclerosis, olfaction

Introduction

The chorda tympani has 2 components: a sensory portion for the anterior two-thirds of the tongue, and a secretory portion innervating the sublingual and submandibular salivary glands. Surgery of the middle ear with manipulation of the chorda tympani may induce transitory or definitive deficits of taste. Taste deficits are caused by traction and partial or complete rupture of the nerve. Many authors have investigated this dysfunction following otosclerosis surgery or tympanoplasty with or without mastoidectomy for purulent chronic otitis media (COM) or cholesteatoma.[1-4]

Chronic inflammation of the middle ear may result in functional damage of the chorda,[5] which is correlated with anatomical nasal alterations and rhinosinusitis. In an analysis of multiple epidemiologic studies, Hoffman et al[6] detected a strict relationship between smell and taste. Olfactory stimulation following the retronasal passage of aromatic substances arising from foods during mastication increases perception of the aromatic component of flavors.

The aim of this study was to assess pre- and postoperative taste ability in patients undergoing middle ear surgery for otosclerosis or COM, with a 1-year follow-up. Each patient underwent contemporary evaluation of olfactory function to rule out taste deficits attributable to concomitant nasal pathology. The influence of surgical injury and the evolution of taste and smell recovery were also evaluated.

Materials and Methods

The study consisted of 60 patients affected by 2 specific diseases of the middle ear. Group A contained 30 patients (11 males, 19 females) with COM, and group B contained 30 patients (8 males, 22 females; mean age = 41.7 years; age range, 33-68 years) affected by otosclerosis. All patients underwent ear, nose, and throat examination, otomicroscopy, nasal endoscopy, anterior rhinomanometry, taste testing, and olfactory testing. Patients were evaluated 1 to 5

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Table 1. Median Taste Test Values in the 2 Study Groups Over Time.

	Chronic Otitis Media (Group A)			Otosclerosis (Group B)		
Time	Operated Side	Unoperated Side	Whole Mouth	Operated Side	Unoperated Side	Whole Mouth
T0	7	9	13	10.5	10	12
T1	6	8	12	7	9	11
T6	7	8	13	8	9	11
T12	7	8	11	10	11	13

Abbreviations: T0, initial testing; T1, postoperative testing at 1 month; T6, postoperative testing at 6 months; T12, postoperative testing at 12 months.

days preoperatively (T0) and at 1 (T1), 6 (T6), and 12 (T12) months postoperatively. In all patients, preoperative computed tomography scans were negative for obstructive or inflammatory nasal and paranasal diseases.

Each patient was asked to provide a self-assessment of his or her smell and taste ability using a 0- to 10-point visual analog scale (VAS), with 0 expressing no taste sensation and 10 expressing maximum taste sensation, at different times (T) of examination.

Taste testing was performed according to a technique previously described and validated by Mueller et al.[7] This technique uses filter paper strips impregnated with 4 concentrations of sweet (0.4, 0.2, 0.1, and 0.05 g/mL sucrose), sour (0.3, 0.165, 0.09, and 0.05 g/mL citric acid), salty (0.25, 0.1, 0.04, and 0.016 g/mL sodium chloride), and bitter (0.006, 0.0024, 0.0009, and 0.0004 g/mL quinine hydrochloride) tastes. Participants were asked not to eat or drink anything other than water for 1 hour prior to testing. All patients were familiarized with the 4 tastes before testing began. The taste strips were presented in increasing concentrations in a randomized order on each side of the anterior tongue. Using a forced choice paradigm, the participant's task was to identify the taste from a list of 4 descriptors (sour, sweet, salty, or bitter). Participants were required to keep the tongue out of the mouth with the taste strip on it until they had made their decision by pointing to the respective descriptor. Then, they rinsed the mouth with tap water. The number of presented taste strips per side was 16; consequently, the "taste scores" for each side of the tongue ranged from 0 to 16. Taste scores of 8 or more per side were considered normal. Finally, to evaluate the overall taste sensation of the oral cavity, the procedure was repeated, placing each taste strip on the tongue and closing the mouth so that the tongue could be moved. Taste scores for the oral cavity were calculated by the same method and ranged from 0 to 16.

The olfactory test was performed using the "Sniffin' Sticks" method (Burghart, Germany). This method evaluates olfactory threshold (T), discrimination (D), and identification (I). The sum of these 3 parameters provides the TDI score, which allows classification of patients as normal (TDI > 30), hyposmic (TDI 15-30), or anosmic (TDI ≤ 15).[8]

Each patient affected by COM underwent tympanoplasty and mastoidectomy using a retroauricular approach and an intact canal wall technique (ICWT). Each otosclerosis patient underwent a stapedotomy technique with positioning of a superelastic nitinol/fluoroplastic prosthesis[9,10] via an endoauricular approach. In all patients, the anatomical integrity of the chorda tympani was preserved. Patients with nerve section were excluded from the study.

Statistical analyses were performed using STATA v.12. The data were analyzed using medians and interquartile intervals due to the abnormality of the distribution. Comparisons between the 2 groups were performed using the Mann-Whitney *U* test. The Pearson chi-square test or the Fisher exact test was used, when possible, to evaluate differences between groups. A value of $P < .05$ was considered to indicate significance.

Results

At T0, group A showed median taste scores of 7.0 and 9.0 for diseased and healthy sides, respectively, whereas group B demonstrated higher values, with median scores of 10.5 and 10.0 (Table 1). The test for the whole mouth yielded a median taste score of 13.0 for group A and 12.0 for group B. At T1, although both groups worsened, the otosclerosis group was affected more dramatically. At T6, a minimal improvement was observed in both groups on the operated side, whereas scores for the unoperated side remained unchanged. At T12, median taste scores were 7.0 and 10.0 for the operated sides in groups A and B, respectively. Median taste scores were stable for both sides of the tongue from the T6 to T12 period in group A, whereas group B showed an improvement in both individual side testing and whole mouth testing from T6 to T12.

Relationships between operated and unoperated sides, and the type of surgical procedure, were also examined by the 4 flavors (Table 2). The scores demonstrated minimal differences due to the small sample size, especially in the comparison of the operated versus contralateral unoperated sides.

For the whole mouth taste test at times T0 and T12 (Table 3), group A showed stable data for all 4 parameters (sweet,

Table 2. Median, Minimum, and Maximum Taste Test Values in the 2 Study Groups at T0 and T12.

		Glucose Solution			Saline Solution			Quinine			Citric Acid		
Type of Surgery	Area and Time	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max
COM (group A)	Op side T0	3	0	4	2	0	4	2	0	4	1	0	4
	Unop side T0	3	0	4	3	0	4	2	0	4	2	0	4
	Op side T12	3	0	4	3	0	4	2	0	4	2	0	4
	Unop side T12	2	0	4	3	0	4	2	0	4	1	0	4
Otosclerosis (group B)	Op side T0	2.5	0	4	3	0	4	3	0	4	2.5	0	4
	Unop side T0	3	0	3	2	0	4	3	0	4	2.5	0	4
	Op side T12	2.5	0	3	2	0	3	2	0	4	2.5	0	4
	Unop side T12	2.5	1	3	3	0	4	3	1	4	2.5	0	4

Abbreviations: COM, chronic otitis media; Max, maximum; Med, median; Min, minimum; Op, operated; Unop, unoperated.

Table 3. Median, Minimum, and Maximum Taste Test Values for the Whole Mouth in the 2 Study Groups at T0 and T12.

		Glucose Solution			Saline Solution			Quinine			Citric Acid		
Type of Surgery	Area and Time	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max
COM (group A)	Whole mouth T0	3	0	4	4	2	4	3	0	4	3	0	4
	Whole mouth T12	3	2	4	3	1	4	3	2	4	2	0	4
Otosclerosis (group B)	Whole mouth T0	3	1	4	3	2	4	3	0	4	3.5	2	4
	Whole mouth T12	3	1	4	3	2	4	3	0	4	3.5	3	4

Abbreviations: COM, chronic otitis media; Max, maximum; Med, median; Min, minimum.

salty, bitter, and sour). Group B showed stable data for 3 tastes, with a mild improvement over time for bitter.

The median TDI score (Figure 1) remained stable at all 4 time periods for group B. The behavior of the median TDI score over time differed for COM patients. At T0 and T1, the values were only minimally below normal. Values normalized at T6 and then worsened slightly at T12, while still remaining improved overall. The *P* value was found to be statistically significant only at time T12 ($P = .047$).

The results of patient self-assessment of taste and smell are depicted in Table 4. All patients reported sufficient taste scores (median = 8; range, 6-10) at all 4 time periods examined. This subjective finding was confirmed by a lack of statistically significant differences in the reported data.

Finally, no significant difference between males and females in gustatory or olfactory function emerged from our data. Further investigation with a larger group of patients to evaluate such a possible correlation is under way.

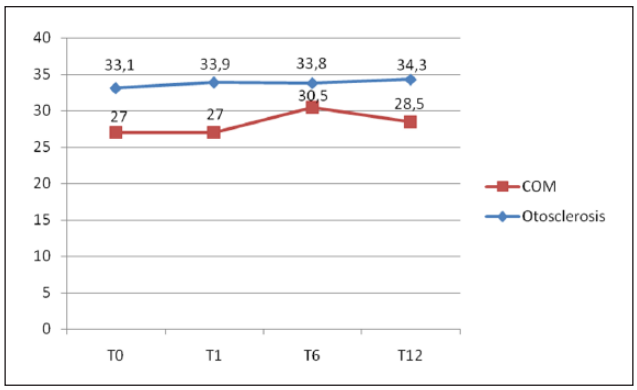

Figure 1. Median values of threshold, discrimination, and identification (TDI) in the 4 time periods of the 2 groups studied.

Discussion

In this study, we evaluated the variability of taste function in 2 groups of patients operated on for lesions of the middle ear: 1 for COM, and the other for otosclerosis. The patients were assessed pre- and postoperatively, and the findings on the ipsilateral and the contralateral sides were compared. Olfactory perception was also investigated in both groups to analyze any possible influence on taste function.

Previous studies have demonstrated that COM may induce histopathologic alterations as well as taste dysfunction. Gedikli et al[11] described fibrous thickening of epineural and perineural connective tissues, proliferation of fibroblasts and connective tissue in the endoneurium, hypertrophy and proliferation of Schwann cells, and moderate degrees of disorganization in the axons in examination of 20 chorda tympani of middle ears with COM.

Table 4. Median Values and Percentiles for the VAS and Taste Testing at T0, T1, T6, and T12.

	Otosclerosis			Chronic Otitis Media		
		Percentile			Percentile	
Time	Median	25th	75th	Median	25th	75th
VAS: Olf T0	9	7.25	10.00	9.00	8.00	10.00
VAS: Olf T1	8.50	7.00	10.00	9.00	8.00	10.00
VAS: Olf T6	9.00	8.00	9.75	9.00	8.00	10.00
VAS: Olf T12	9.00	8.00	10.00	9.00	8.00	10.00
VAS: Taste T0	8.00	7.25	9.00	8.00	8.00	10.00
VAS: Taste T1	8.00	7.00	8.00	8.00	7.00	10.00
VAS: Taste T6	8.00	7.00	8.00	8.00	7.00	10.00
VAS: Taste T12	8.00	7.125	8.00	8.00	8.00	10.00

Abbreviations: Olf, olfaction; VAS, visual analog scale.

An analysis performed using electromicroscopy[12] in 10 patients affected by COM showed evidence of several ultrastructural alterations (altered Schwann cells with condensed nuclei and scarce, vacuolated cytoplasm, axonal edema and vacuolization, interstitial edema, and destruction of the myelin layers).

In reviewing COM patients with or without cholesteatoma, various authors[5,11,13] have reported a significant incidence of taste deficits on the side of the diseased ear. In contrast, no preoperative taste dysfunction has been reported in otosclerosis patients.[14-17] Our study corroborated these findings, confirming hypogeusia in COM patients and normogeusia in otosclerosis patients by comparison of the normal and affected sides of the tongue and by evaluation of taste perception in the whole mouth.

All surgical approaches to the middle ear may require manipulation of the chorda tympani with various degrees of nervous injury. In our study, both groups of operated patients had worsening of the mean taste threshold postoperatively. This phenomenon was more clearly serious in poststapedotomy patients. Follow-up showed a progressive improvement of the median values in both groups. In group B (otosclerosis), a complete recovery to preoperative values was observed. In group A (COM patients), the initial preoperative gustatory deficit, probably caused by the disease itself, exhibited only minimal surgically induced alteration. This finding is confirmed by other studies. Clark and O'Malley[19] reported better taste findings in patients operated on for cholesteatoma than in those undergoing procedures for simple COM or those with otosclerosis. Analogously, many other authors[4,12,15,18] confirmed more severe gustatory disturbances and longer periods of recovery in stapedectomy patients.

It should be noted that taste scores differed by only 1 point in follow-up for many of the groups, with 8 or 9 being the value reported most often. This difference, although not statistically significant, indicated variations in the gustatory clinical perceptions of our patients. Mueller et al[7] endorsed the usefulness of the taste test, despite its requirements for correct identification of the taste strip and a high level of patient concentration, claiming that any score difference should be considered in clinical practice.

Based on questionnaires administered to patients, some studies indicate more rapid recovery of taste function when the chorda tympani is sectioned rather than being subjected to traction trauma.[19,20] A possible explanation for this is that a section of the chorda tympani induces a functional block of the glossopharyngeal nerve, improving the gustatory sensation of the region immediately anterior to the papillae circumvallatae.[15] An alternate explanation may lie in the cross-compensatory innervation of the contralateral side.[21] In our study, we selected patients without intraoperative section of the chorda tympani to rule out these possible mechanisms, thus rendering the groups analyzed more homogeneous.

Although the gustatory test of the whole mouth revealed that in group A, the sweet and sour tastes improved, and that in group B, bitter tastes were better perceived, a self-administered questionnaire revealed that even in patients with an anatomically intact chorda, none complained of significant taste deficits.

Olfactory test evaluation was specifically designed to investigate the potential influence of olfaction on taste in our study groups. All values for otosclerosis patients were within the normal range. Chronic otitis media patients showed variable postoperative findings. This may be explained by the slightly higher average age for patients in this group, suggesting a physiological deterioration of olfaction. However, it should be noted that the COM can be a chronically recurrent condition even in well-treated patients. A hypothetical recurrence of the middle ear inflammation via the Eustachian tube may explain the mild

worsening of olfaction in group A at T12. Although our data seem to rule out a significant influence of olfaction on taste in both of the studied groups, larger studies may facilitate identification of a subgroup of patients for whom repeated episodes of inflammation could postoperatively influence olfaction and its effect on taste. A further study is under way to investigate this specific topic.

Conclusion

1. Inflammatory conditions of the middle ear may induce a taste deficit of variable degrees.
2. The function of the chorda tympani can be altered by surgery of the middle ear.
3. This deficit, due to traumatic processes without nerve section, may be less important in patients undergoing tympanoplasty with or without mastoidectomy, compared to those undergoing stapedotomy.
4. Postoperative recovery of taste is satisfactory, albeit with different timing for the 2 types of pathology.
5. It is mandatory to advise patients undergoing middle ear surgery about the risk of transitory taste dysfunction and, at the same time, to reassure them of the likelihood of recovery.

Declaration of Conflicting Interests

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