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Characteristics of taste disorders

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Abstract Aim of this retrospective study was to obtain information about the frequency of taste disorders, their most frequent causes, and typical symptoms. A total of 491 out of 4,680 patients (presenting for the first time between 1998 and 2011) exhibited taste disorders (10.5 %). All patients underwent a thorough physical otorhinolaryngological examination including detailed assessment of smell and taste functions. The three most frequent causes of disorders were idiopathic (34 %), posttraumatic (24 %), and postoperative (15 %). Patients with idiopathic and postoperative taste disorders complained mainly about hypogeusia and parageusia; in comparison, patients with posttraumatic taste disorders exhibited a relatively higher degree of partial, local, or complete ageusia. Among patients with phantogeusia and parageusia, 38 % reported salty, and 22 % mixed sensations like bitter–salty or sour–sweet. In approximately 1/3 of this group of patients the cause of dysgeusia is unknown. Twenty-one percent of the patients complained of qualitative rather than quantitative taste problems.

Keywords Dysgeusia · Gustatory function · Burning mouth syndrome · Parageusia · Phantogeusia · Frequency

Introduction

In everyday life we use the word "taste" for a sensation which is typically elicited during eating and drinking. From a physiological point of view, this impression is a result of the simultaneous input from three different sensory systems: retronasal olfaction, mechano- and chemo-sensitivity via the trigeminal nerve, and the gustatory system. Patients who see a doctor because of "taste loss" can often not tell which sense is actually affected. For diagnostic purposes it is therefore important to test the systems separately. Isolated gustatory impairment is less frequently found than isolated olfactory dysfunction [1, 2]. Less than 10 % of the patients consulting a specialized smell and taste clinic report problems with the sense of taste [2]. Typically, these taste disorders are divided into qualitative and quantitative disorders (Table 1).

Using quantitative measures, typically three conditions are discriminated: normogeusia, hypogeusia, and ageusia. As there are three different nerves conducting taste sensations (facial, glossopharyngeal, and vagus nerves), taste losses are often relatively localized and may go unnoticed [3], for example, after damage of the chorda tympani during surgery of the middle ear [4, 5], surgery of an acoustic neuroma [6], or after irritation of the glossopharyngeal nerve during tonsillectomy [7–9]. In general, hypogeusia is present in roughly 5 % of the population—depending on the definition—while ageusia seems to be very rare [10].

Qualitative taste disorders cannot be measured and are assessed by means of the patients' own reports. They may

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Table 1 Classification of taste disorders

Taste disorders (dysgeusias)		
Quantitative taste disorders	Hypergeusia	Gustatory hypersensitivity in comparison to young healthy subjects
	Normogeusia	Normal gustatory sensitivity
	Hypogeusia	Gustatory hyposensitivity in comparison to young healthy subjects
	Ageusia	Complete: complete loss of the sense of taste
		Functional: pronounced reduction of the sense of taste, without any relevance in everyday life
		Partial: loss of sensitivity in a single taste quality
Qualitative taste disorders	Parageusia	Changed perception of taste qualities
	Phantogeusia	Perception of taste without a stimulus

have an impact on the quality of life and are mostly distinguished as being disturbing and unpleasant [11]. There are two different kinds of qualitative taste disorders: "phantogeusia" means that patients report taste sensations in the absence of a stimulus. "Parageusia" is an inadequate or "wrong" taste sensation elicited by a taste stimulus [11]. Phantogeusia and parageusia can, for example, be found in patients with multiple sclerosis [12], depression [13], and epilepsy [14]; phantogeusia of a sweet taste may be associated with thoracic tumors [15]. Very often, parageusia and phantogeusia occur together, or are very difficult to separate based on the patients' history. Therefore, in this study, parageusia, and phantogeusia were analyzed as one entity.

The main reasons for taste disorders are craniocerebral injury, infection of the upper respiratory tract, exposition to toxic substances, iatrogenic causes (e.g., radiation, middle ear surgery, tonsillectomy, dental operation), and side effects of medication and burning mouth syndrome [16]. The aim of the present retrospective study was to evaluate the frequency of hypogeusia, ageusia, phantogeusia, and parageusia in 4,680 patients presenting at a specialized smell and taste clinic, with respect to etiologic categories as well as gender and age effects.

Subjects and methods

From 1998 to 2011, 4,680 patients visited for the first time the Smell and Taste Clinic at the Dresden University Hospital's ENT Department; among these, 10.5 % (491) had taste disorders: 4 % (185) had isolated taste dysfunctions and 6.5 % (306) presented with combined smell and taste disorders. The remaining 89.5 % were diagnosed with isolated olfactory dysfunctions.

The dysgeusic sample contained 256 male (52 %) and 235 female (48 %) patients. Ages ranged from 9 through 92 years (mean 56, SD 15 years). All patients filled in a standardized questionnaire [17], where age, gender, smoking habits, medical history, medication, etc. were documented; all patients underwent a professional otorhinolaryngological examination including nasal endoscopy. To investigate the sense of smell, a TDI test (threshold, discrimination, identification) was performed using "Sniffin' Sticks" [18]. 'Sniffin' Sticks' is a test of nasal chemosensory performance based on pen-like odor dispensing devices. It comprises three tests of olfactory function, namely tests for odor threshold, odor discrimination (16 pairs of odorants, triple-forced choice), and odor identification (16 common odorants, four-alternative forced choice). From the results of the three tests, the so called TDI-Score can be generated. It can lie between a minimum of 1 point to maximum of 48 points. People who achieve 1–15 points are labeled as functional anosmics. A score between 16 and 30.5 points is equivalent to hyposmia, a score above 30.5 points shows normosmia. The "Sniffin' Sticks" are produced by Burghart Messtechnik GmbH in Wedel, Germany.

A basic whole-mouth test (WMT) using taste sprays [19] was applied in all 491 patients, and 228 patients who mainly complained about taste problems were additionally tested in greater detail using the taste strips (regional test, RT) [20]. Taste strips permit to detect local taste loss. In both tests, WMT and RT, sucrose was used as sweet stimulus, sodium chloride as salty, quinine hydrochloride as bitter, and citric acid as sour stimulus. Sprays were used in one single supra threshold concentration each (4 stimuli per patient) whereas taste strips were applied with four different concentrations for each taste (Table 2) and were tested on the left and the right sides of the tongue separately (32 stimuli per patient). Both tests were based on a forced choice identification test where patients had to identify the stimuli as sweet, sour, salty, or bitter. In the whole-mouth test, patients were asked to respond by naming the taste. As during taste strip testing patients had to keep their tongues extended, answers were indicated by pointing to one out of the four names printed on a sheet of paper. Answers were noted irrespective of their correctness; no feedback was given to the patients during testing. The total count of correctly identified items represented the

Table 2 Concentrations of taste solutions used in the two taste tests (g/ml)

	Sucrose	Sodium chloride	Citric acid	Quinine hydrochloride
Spray	0.1	0.07	0.05	0.0005
Strips				
1	0.6	0.3	0.4	0.006
2	0.25	0.1	0.2	0.002
3	0.1	0.04	0.09	0.0009
4	0.05	0.01	0.05	0.0003

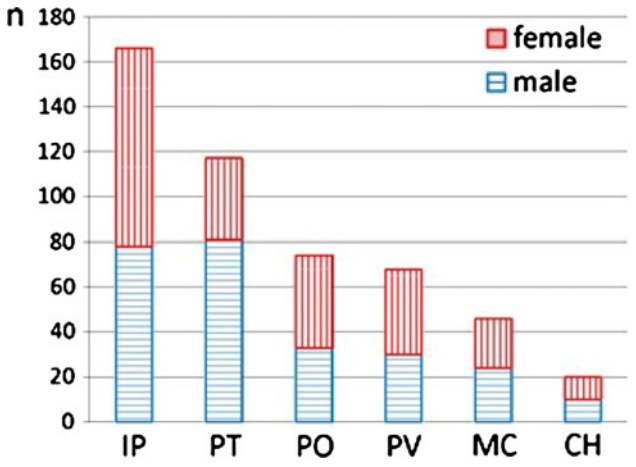

Fig. 1 Pathogenetic categories and gender distribution (*IP* idiopathic, *PT* posttraumatic, *PO* postoperative, *PV* postinfectious, *MC* associated with medical causes, *CH* chemicals: either pharmaceutical drugs or contact with toxic substances)

test scores. Critical values were set up to identify hypogeusic conditions (WMT: scores below 4; RT: scores below 17), unilateral hypogeusia (RT: unilateral score below 9) and ageusia (both WMT score zero and RT score below 9).

Descriptive and χ^2 statistics were performed to evaluate group counts, portions, and scores.

Results

The majority of the 491 patients (54 %) had taste problems for 3–24 months before they first presented at the clinic; 32 % reported to have the symptoms for more than 2 years; 6.5 % consulted the clinic within the first 3 months after symptom onset; 7.5 % were unable to report the duration of their complaints.

Causes of taste dysfunction According to etiologic aspects, dysgeusic patients were assigned to six groups due to the reports in the patients' history (Figs. 1, 2).

- IP = idiopathic (no explanation for the gustatory disorder).

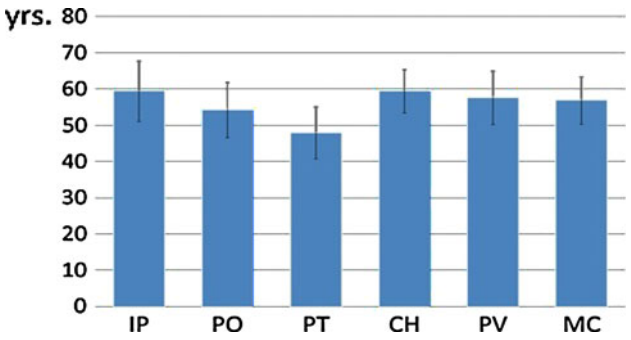

Fig. 2 Age distribution among etiologic categories (means, SD)

- PT = posttraumatic (e.g., after craniocerebral injury, basal skull fracture, or midfacial fracture).
- PO = postoperative (e.g., after middle ear surgery or tonsillectomy; including dental treatment as extraction of wisdom teeth, dental prostheses, or treatment of abscess of the tooth root).
- PV = postinfectious (occurence shortly after viral infections of the upper respiratory tract; gravity of infections were variable and types of viruses remained unknown).
- MC = associated with medical causes such as apoplectic insult, Parkinson's disease, radio-chemotherapy, or diabetes mellitus.
- CH = chemicals: either pharmaceutical drugs (e.g., doxycycline, ACE-inhibitors, metoprolol, terbenafin, finasteride) or contact with toxic substances such as Clorix® cleaning products or formaldehyde.

The largest group (34 %) comprised IP cases, followed by PT (24 %), PO (15 %), and PV (14 %). MC cases were identified in 9 %, while only 4 % were induced by chemicals (CH).

Gender was not equally distributed within groups (χ^2 [5] = 18.9; $p = 0.002$). This deviance was due to the PT group containing a significantly larger number of men than women (χ^2 [1] = 13.7; $p < 0.001$).

Age PT patients were markedly younger than the remaining sample (PT vs. IP: $p < 0.01$; PT vs. PV: $p = 0.04$; PT vs. MC: $p = 0.031$).

Burning mouth sensations (BMS) were experienced by 240 patients out of 4,680 patients (5.1 %). Out of the 491 dysgeusic patients, 54 patients indicated BMS (11 %), associated with the following causes: IP: 16 %, PO: 12 %, MC: 11 %, CH: 10 %, PV: 10 %, PT: group comparisons revealed that BMS occurred significantly more often in IP patients than among other groups (χ^2 [1] = 4.7; $p = 0.04$), and that BMS was significantly less associated with PT than any other etiologic cause (χ^2 [1] = 6.8; $p = 0.04$).

A total of 103 patients (21 %) complained about phanto- or para-geusia (PPG), with uneven distribution among etiologic categories (IP: 33 %, PO: 31 %, MC: 24 %, CH:

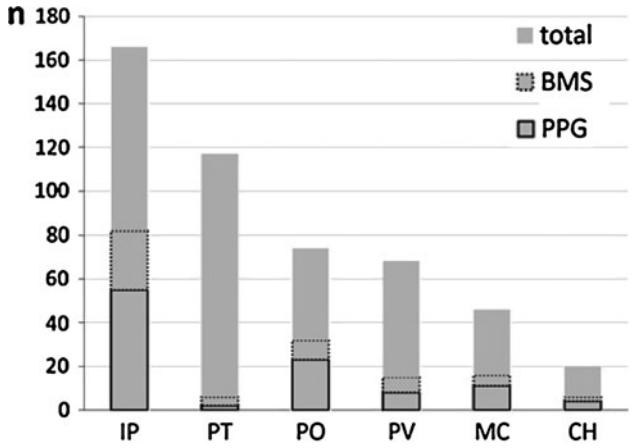

Fig. 3 BMS and PPG portions among etiologic categories (*IP* idiopathic, *PT* posttraumatic, *PO* postoperative, *PV* postinfectious, *MC* associated with medical causes; *CH* chemicals: either pharmaceutical drugs or contact with toxic substances, *BMS* burning mouth sensations, *PPG* parageusia, and phantogeusia)

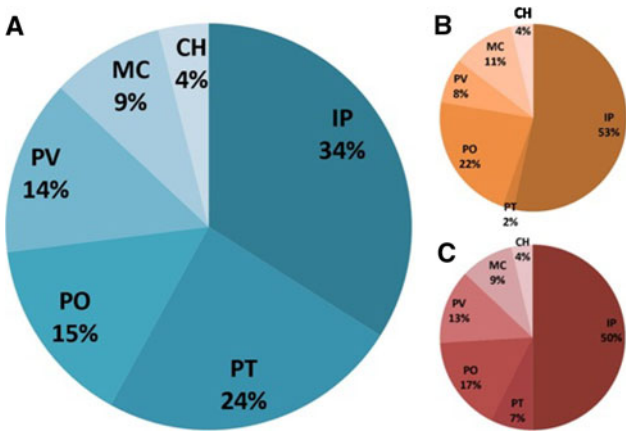

Fig. 4 Distribution of etiologic conditions. **a** In the entire dysgeusic sample ($n = 491$); **b** among PPG cases ($n = 103$); **c** among BMS cases ($n = 54$)

20 %, PV: 11.7 %, and PT: 1.7 %). Similar to BMS, PPG was significantly more frequently associated with IP (χ^2 [1] = 14.8; $p < 0.001$) and PS (χ^2 [1] = 4.5; $p < 0.001$) and significantly less so with PT (χ^2 [1] = 26.2; $p < 0.001$) (Fig. 3). The majority (38 %) of PPG patients reported salty sensations; 22 % described mixed sensations like bitter–salty or sour–sweet. Some sensations (13 %) were not denoted as taste qualities at all but labeled "disgusting", "unpleasant" or "fecal"; although these descriptions are reminiscent of parosmias [21], these patients showed no signs of olfactory dysfunction as indicated by a detailed history and extensive olfactory testing. Bitter (11 %), metallic (6 %), sweet (6 %), and sour (4 %) sensations were less frequent.

WMT and RT According to the applied taste tests, patients were divided into two groups: 263 patients only

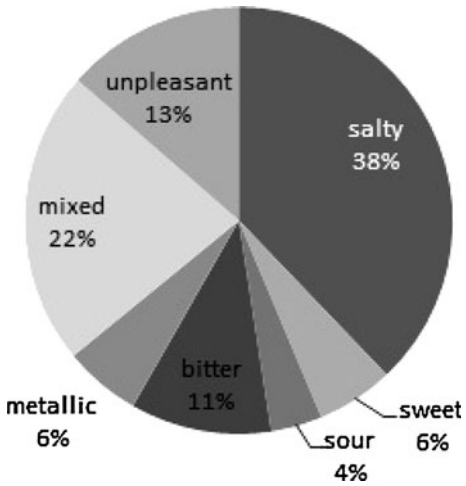

Fig. 5 Distribution of PPG taste qualities

Table 3 Correct identifications in both taste tests: basic test (WMT) and detailed procedure (RT)

BT correct	IP	PO	PT	CH	PV	MC	Total	% Out of 263
2–3	59	11	67	6	46	11	200	76
1	7	1	12	0	0	3	23	9
0	5	4	24	1	2	4	40	15
Total	71	16	103	7	48	18	263	100
	27 %	6 %	39 %	3 %	18 %	7 %	100 %	
DP correct	IP	PO	PT	CH	PV	MC	Total	% Out of 228
Global 9–16	48	34	11	8	10	20	131	57
Unilat. <9	27	15	1	3	5	6	57	25
Global <9	20	9	2	2	5	2	40	18
Total	95	58	14	13	20	28	228	100
	42 %	25 %	6 %	6 %	9 %	12 %	100 %	

received the WMT, and 228 patients additionally received the detailed procedure (RT). None of the patients in the WMT group was able to identify all four taste sprays (Table 3); thus, all 263 patients were hypogeusic. RT scores provided more detailed results. Global hypogeusia was observed in 164 out of 228 patients (72 %) with scores between 9 and 16. The special finding of unilateral hypogeusia—indicated by unilateral scores below 9—was found in 57 patients (25 %). Only seven patients out of the entire WMT plus RT sample (1.4 % out of 491, or 3 % among the RT group, respectively) were found to be ageusic, failing to identify <9 strips and any of the sprays (Figs. 4, 5).

Discussion

The majority of patients presenting at the Smell and Taste clinic (89.5 %) were diagnosed with olfactory dysfunction, and 10.5 % suffered from taste disorders; among the latter, taste and smell disorders were combined in 6.5 % of the cases; solitary taste disorders were found in 4 %. These findings are in agreement with other studies [2]. While olfactory disorders in general are more common [22], taste disorders are rarely found [23]. However, recent studies indicate taste disorders might be somewhat more frequent than previously estimated [19]. On the other hand, the reported portions of dysgeusic patients relate to the test instruments applied. As previously shown in olfaction [24], it has been observed that patients are unable to estimate their taste function correctly [25] and that taste qualities are often misnamed [10, 26–28]. Thus, depending on the method of assessment, patients who are able to detect taste stimuli but fail to properly identify them may or may not be found to be dysgeusic.

The *etiologic background* of taste disorders remains unclear in many cases [29]. In fact, in the present study, roughly one-third (34 %) of the taste disorders could not be categorized, which agrees with other reports [30]. Among the cases with identifiable origins, the two main categories were PT (24 %) and PO (15 %). It has to be critically remarked that the categorization of etiologic backgrounds followed the self-reports by the patient, and the answers while evaluating the patients' history. As we speak of 13-year period several doctors were included, but the supervisor was always the same.

While *age and gender* were similarly distributed in most groups, PT held significantly more males and younger patients than the remaining groups. The relatively high rate of head injuries in young males (e.g., from motorcycle, car, or sports accidents) may explain this finding [31–34]. Interestingly, PT patients mainly reported hypogeusia and ageusia while PPG and BMS were rarely found in this group.

The majority of *PPG and BMS* complaints were observed among IP and PO cases which might be a result of nerve or tongue irritation rather than complete damage. Typical PPG sensations have been described as bitter or metallic [8], whereas in the present study the prevailing PPG complaints concerned saltiness. This discrepancy may be due to different approaches of assessment, stressing once more the general difficulty of patients with chemosensory descriptors. In the present study, approximately twice as many patients (21 %) reported PPG as compared to BMS complaints, which were reported by only 11 %. Altogether, the prevalence of BMS seems difficult to establish; reports vary between 0.7 and 4.5 % [35]. The causes for BMS often remain unknown and are probably of multifactorial origin where local, systemic, and psychological factors are implicated [35]. Thorstensson and Hugoson [36] showed that BMS is significantly correlated with mandibular dysfunction and negatively correlated with number of teeth. In our study, most BMS patients had to be categorized as idiopathic.

While in PPG and BMS, only diagnostic tools rely on subjective reports and thus yield imprecise results, "objective" taste tests permit to assess decreased gustatory function either by means of sprays administered to the whole mouth or with regionally applied taste strips; the latter yielding differentiated findings according to sensory innervation by the glossopharyngeal nerve and chorda tympani [37, 38]. In the present study, taste strips were used for lateralizing purposes only.

However, comparisons of scores from both taste tests revealed considerable differences—underlining the difficulty of taste assessment even with "objective" instruments which in turn reflects the problem of clearly distinguishing between hypogeusic and ageusic conditions.

Conclusions

Roughly every tenth patient consulting a specialized smell and taste clinic reports taste dysfunction, with the portion of cases reporting gustatory as well as olfactory complaints seeming to be somewhat bigger than the remaining group of exclusive taste disorders. Among patients with clear causes of dysgeusia, PT ranges first and PO second. Approximately one-fifth of dysgeusic patients have qualitative taste disorders (PPG), and half as many BMS. Complete loss of taste (ageusia) occurs rarely, in ca. 3 % of all patients with taste disorders.

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Conflict of interest The authors declare no conflict of interest.

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