Qualitative and Quantitative Representation of Taste Disturbances: How We Do It by Pentagon Chart

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Abstract Taste is a chemical sense responding to chemical stimuli. In our daily practice as ENT practitioners or Neurologists we do come across patients complaining of taste disturbances. Tests for taste have to be performed regularly in the clinical centres as well as in neurological labs as a part of complete work up for neurotology cases. Assessment of taste sensation can be easily done in a neurological clinic by chemogustometry as described by Claussen. The stimuli used are chemicals, representative substances for the four qualities of sweet, salty, sour and bitter, in graded solutions. These semi-quantitative results are plotted on a pentagon scheme devised by Claussen. The points of the best results for glucose, sodium chloride, citric acid, phenylthio-urea and quinine then are connected with a coloured line. That gives a linked graphic structure, which can be read by the physician at one glance. Different patterns are obtained for normal taste, taste-blindness for phenylthio-urea, ageusia, partial ageusias for glucose, or sodium chloride or citric acid or quinine or their combinations and parageusias. In this article we present different patterns of taste disturbances depicted on the pentagon chart highlighting the easy interpretation of chemogustometry.

Keywords Chemogustometry · Taste · Pentagon chart · Ageusia · Parageusia

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Introduction

Taste is a chemical sense responding to chemical stimuli which are more difficult to define. The sense of taste and smell are intimately related to each other. The qualitative and quantitative analysis is difficult as the response has a major subjective component. Over the years various techniques for assessment of taste have been devised, most important being chemogustometry and electrogustometry.

Taste stimulus has different qualities. Aristotle described seven different basic qualities. To make things easier Kiesow proposed that combinations of just four primary tastes can produce all the tastes. He used sodium chloride, weak hydrochloric acid, sucrose and quinine as these stimuli could produce pure sensations of salty, sour, sweet and bitter, respectively.

The taste quality is thus determined by the combined activity of four different channels that are each tuned to one of the four primary tastes. This is supported by the observation that different areas of the tongue are selectively sensitive to different taste qualities. The tip of the tongue is more sensitive to sweet. The sides of tongue are sensitive to salty in anterior part, whereas to sour in posterior part. Bitter is best tasted on the posterior third of tongue. The dorsal aspect of the tongue doesn't have many taste buds and is relatively insensitive.

Disturbances in perception of taste can occur due to various causes common being viral infections, glossitis, trauma to nerves, tumors, vascular causes affecting the neural pathway, neuropathies and iatrogenic. Presbygeusia is also noted in elderly. Ageusia is loss of taste, hypogeusia is decreased sensation of taste and parageusia is altered quality of taste also seen in subjects with anosmia. Apart from the routine examination and investigations assessment of taste sensation can be easily done in an out patient

clinic by Gustometry. Gustometry could be chemogustometry or electrogustometry.

Electrogustometry, used by clinicians to examine taste sensitivity, through the response of taste buds to electrical current of different intensities. However, if we want to examine taste sensitivity to individual taste categories we should use more laborious gustometry with the application of taste substances, in which main advantage is the use of physiological stimuli [1]. Various methods of using the chemical stimuli, their concentrations and application methods are described. We followed the technique described by Claussen. We have devised a chemogustometry chart in form of pentagon scheme to represent the results of gustometry which makes interpretation very easy just as the audiogram for representing results of pure tone audiometry.

Material and Method

The representative chemical stimuli used are for sweet—glucose in solutions of 0.1, 1, 10%, for salty—sodium chloride solutions of 0.1, 1, 10, for the sensation of sour—citric acid in the dilutions of 0.1, 1 and 10%, for the sensation of bitter—solutions of quinine in 0.001, 0.01 and 0.1%. A second substance for the quality of bitter is used the phenylthio-urea. The phenylthio-urea also is applied in dilutions of 0.001, 0.01 and 0.1%. However, like colour blindness, there exists also a taste blindness, which can be tested by phenylthio-urea. Approximately 7 to 8% of the population is unable to recognize the bitter sensation of phenylthio-urea. By means of a cotton bud they are rubbed into the most sensitive area of the tongue for sweet, around the tip of the tongue for salty, in lateral aspects of anterior parts of the tongue, for sour, posterior lateral aspect and for bitter, centre of the tongue.

A pentagon (C5KCG) scheme has been established, which carries the semi-quantitative results of the Claussen's 5-Komponent-Chemo-Gustometry (C5KCG) (Fig. 1). The pentagon is divided into five sectors each representing each of the five representative chemical stimuli. Each sector is further divided into six segments, each one further representing the coded response of the subject to each graded dilution of the chemical. Figure 1 shows the pentagon chart devised by Claussen indicating the various segments and codes.

The test is started with maximal dilution. The glucose is expected to be identified by the patient as sweet. Sweet is marked with the test code "1". Starting with the maximal dilution (0.1%) the test is continued through the three dilution stages to 10%. Where the patient recognizes the result is marked with a "1". However, in cases of a paraesthesia the patients also may respond with a metallic sensation "5", a sensation of hot "6", and a sensation of soapy

Fig. 1 Claussen's 5-Komponent-Chemo-Gustometry (C5KCG) Chart

"7". This then is marked in the fourth section of the sector. If there is only an unspecific sensation we mark an "8" in the fifth sector and if there is no sensation we mark a "9" in the centre. Tongue is cleaned to proceed with next solution.

This procedure is succeeded by the test for sodium chloride. There we expect the sensation of salty, which is encoded by a number "2". Again the test is carried out through various dilutions and findings marked accordingly in the scheme.

Next step, citric acid for sour is applied which is marked with a code "3". Other sensations are marked in the fourth, fifth or sixth field.

In place number "4" phenylthio-urea is tested. In cases with sensorial taste blindness there is no sensation, which is marked in the centre with a "9". In the fifth test, quinine with the dilutions of 0.001, 0.01 and 0.1% is used.

The Claussen's 5-Komponent-Chemo-Gustometry (C5KCG) scheme contains graphical fields for marking the results for the test of the right side of the tongue and that of the left side of the tongue separately. The points of the best results for glucose, sodium chloride, citric acid, phenylthio-urea and quinine then are connected with a coloured line. That gives a linked graphic structure, which can be read by the experienced physician at one glance.

Observations and Interpretations

By using the Claussen's pentagon chart, we easily can discriminate patterns for:

1. Normal taste responses (Fig. 2)
2. Taste-blindness for phenylthio-urea (Fig. 3)
3. Ageusias with no responses (Fig. 4)
4. Partial ageusias like ageusias for glucose (Fig. 5)
5. Ageusias for the bitter sensation (Fig. 6)

Various patterns of parageusias, where the patients do not recognize the true qualities of the stimuli, but they have a distortion in their sensorial percept, can also be differentiated. They can be expressed as metallic, hot or soapy feelings, or that they may perceive the sweet sensation as salty, sour and/or bitter.

Here we present the pentagon charts of various taste disturbances extracted from our databank to illustrate the

easy interpretation of the findings by just looking at the chart as in an audiogram (Figs. 2, 3, 4, 5 and 6).

Discussion

Aristotle (384–322 BC) proposed that there are seven basic qualities of taste: sweet, bitter, sour, salty, astringent, pungent and harsh.

Taste disturbances may have various etiological causes. There could be congenital disturbances of taste, lingual causes like glossitis, neural cause e.g. damage to chorda tympani, brainstem lesions or even gustatory hallucinations.

Fig. 2 Claussen's 5-Komponent-Chemo-Gustometry (C5KCG) scheme with normal taste responses

Fig. 3 Claussen's 5-Komponent-Chemo-Gustometry (C5KCG) scheme showing taste-blindness for phenylthio-urea

Fig. 4 Claussen's 5-Komponent-Chemo-Gustometry (C5KCG) scheme showing ageusia with no responses

Fig. 5 Claussen's 5-Komponent-Chemo-Gustometry (C5KCG) scheme showing partial ageusia at anterior of the tongue, for glucose

Disorders of olfaction may also present as taste disturbances. Smell and taste disturbances are very often symptoms of nasal polyposis [2]. It has been found that, olfactory and gustatory functions significantly decrease during chemotherapy and recover almost completely 3 months after chemotherapy [3].

The human taste is qualitatively as well as quantitatively diminishes with age. Based on a major clinical data bank NODEC IV with 10,335 patients (Claussen), it is shown that incidence of taste disturbances is 3.19% during nine decades of life. However, during the first 25 years of life only 1.92% of the patients complain of taste disorders, whereas during the next 25 years 4.48% suffer from taste disorders. Also statistically it was found that posttraumatic,

metabolic and cardiovascular taste disorders are more frequent than idiopathic or infectious disturbances of the gustatory function.

The taste disturbances are investigated through chemical as well as through electrical tests. Taste tests are more frequently based upon chemical substances (chemogustometry), various methods being described by different authors. The stimuli used in gustometry are: citric acid (sour), caffeine or quinine hydrochloride (bitter), sodium chloride (salty), saccharose (sweet), monosodium glutamate (umami) [1]. The Polish Committee of Standards (Polski Komitet Normalizacyjny-PKN) recommends the use of method based on rinsing the mouth with water solutions of taste substances (sip-and-spit method) at their

Fig. 6 Claussen's 5-Komponent-Chemo-Gustometry (C5KCG) scheme showing partial ageusia for the bitter sensation in the posterior part of tongue for phenylthio-urea and quinine

growing concentrations. The range of concentrations used in sucrose solutions is 0.34–12.00 g/l, in sodium chloride solutions, 0.16–2.00 g/l, in citric acid solutions in the range of 0.13–0.60 g/l. However, another study showed that the range of citric acid concentration (0.0036–0.2000 g/l) appeared to be more proper for examination of the sour taste sensitivity [4]. The Börstein method is based on four substances (each of them in three increasing concentrations) related to four basic tastes: sweet (glucose), bitter (chininum hydrochloride), sour (citric acid) and salty (sodium chloride). The taste threshold, that means the lowest concentration of each solution being correctly recognized by a person, is noticed for each taste [2]. We have used glucose, common salt, citric acid, phenylthio-urea and quinine in our method of chemogustometry.

Documentation of the results in a systematic manner is also important for future references and prognosis. To assist easy interpretation by the clinician at a glance we have devised the pentagon chart already described above. A prognostic analysis of taste disorders is easier due to the graphical documentation just like the audiograms in hearing assessment.

Moreover, clinical assessment of the patient who has olfactory and taste disorders requires understanding of the etiology of the olfactory and gustatory disorders. Available clinical tests of olfactory and gustatory systems allow detecting and measuring the degree of the sensory loss, but are unable to determine the cause and give neither prognostic information nor therapeutic guidance. With physical examination, however, clinical history can help to establish the diagnosis and guide the treatment if available. A clinician evaluating a patient who has olfactory and taste loss must understand that “taste” complaints usually are

symptoms of an olfactory dysfunction. The distinction between true gustatory loss and olfactory loss, the inability to perceive complex flavors of food, will help clarify the patient's diagnosis [5].

Conclusion

Chemogustometry and its interpretation by Claussen's pentagon chart is a fairly easy, inexpensive method of analyzing taste disorders, it being semiquantitative and qualitative. The taste estimation ought to be an integral part of routine patient examination in otolaryngology department.

References

1. Klimacka-Nawrot E, Suchecka W (2008) Methods of taste sensitivity examination. *Wiad Lek* 61(7–9):207–210
2. Dzaman K, Pleskacz WA, Wąkanis A, Rapijko P, Jurkiewicz D (2007) Taste and smell senses estimation in patients with nasal polyps. *Otolaryngol Pol* 61(5):831–837 (in Polish)
3. Steinbach S, Hummel T, Böhner C, Bertold S, Hundt W, Kriner M et al. (2009) Qualitative and quantitative assessment of taste and smell changes in patients undergoing chemotherapy for breast cancer or gynecologic malignancies. *J Clin Oncol* 27(11):1899–1905. Epub 2009 Mar 16
4. Klimacka-Nawrot E, Suchecka W, Błońska-Fajfrowska B (2007) Gustometry usefulness for the evaluation of taste sense efficiency. Part I. The range of taste substances concentrations and the result of gustometry examination. *Wiad Lek* 60(9–10):409–414 (in Polish)
5. Wrobel BB, Leopold DA (2004) Clinical assessment of patients with smell and taste disorders. *Otolaryngol Clin North Am* 37(6):1127–1142