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Taste disorders

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Abstract. *Taste disorders*. The guidelines presented in this review relate exclusively to disorders of the physiological sensation of taste i.e. the disorders of the perception of the four basic tastes: sweet, salt, sour and bitter.
Despite the low prevalence of dysgeusia and the difficulty of making a precise diagnosis of the aetiologies, a precise and complete evaluation of the problem is important because of the significant impact on patients' nutrition and quality of life.
These guidelines also propose include recommendations for good practice based on a review of the relevant literature using Medline.
It should be kept in mind that:

1. From a diagnostic point of view, an elaborate anamnesis, including drug intake and nutritional elements and a detailed clinical examination, are very often adequate to elucidate the problem. Gustometry objectivates the complaint and localises the site of the defect. Complementary investigations should be determined on the basis of the diagnostic hypothesis: cultures, sialometry and salivary biopsy, or imaging to investigate lesions in the taste pathways or in the central nervous system and blood.
2. From a therapeutic point of view, the treatment should be confined to the aetiology as much as possible. If this is not possible, the administration of zinc gluconate is recommended because it can significantly improve the gustatory function. In all cases, the help of a dietician is recommended.

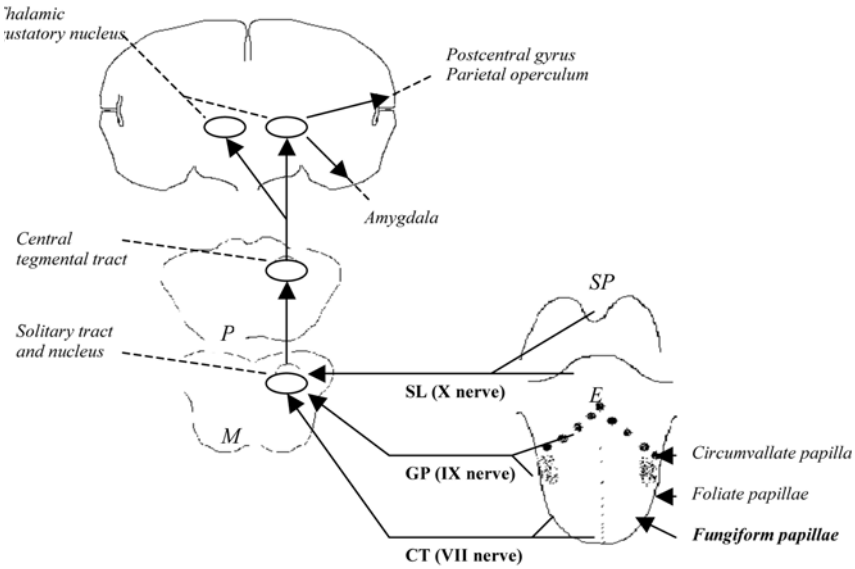
Introduction

Taste results from the sensation born in the taste buds, i.e. in the calceiform, foliate and fungiform gustative papillae found on the tongue, the palate, the posterior wall of the pharynx and the epiglottis, when taste molecules transported by saliva come into contact with the microvilli of the taste cells. The sensation is then transmitted, depending on the stimulation site, either via the chorda tympani to the facial nerve or to the glossopharyngial nerve, and finally to the upper branch of the vagus nerve (Figure 1). Classically, there are four basic tastes: sweet, salty, sour (acidic) and bitter. They condition alimentary behaviour and the rejection of toxic substances. They also initiate certain biological reactions indispensable to the equilibrium of the internal environment, such as the secretion of insulin.

A taste problem may be qualitative and/or quantitative. A qualitative problem consisting of an erroneous perception of the stimulus is called a parageusia. A quantitative problem relating to the perception threshold may be defined as an ageusia, a hypogeusia or a hypergeusia. Gustative hallucinations are also possible.

It is important to highlight the difference between the physiological phenomenon of "taste", and the common sense of the word "taste", meaning "flavour", which results not only from the stimulation of the taste buds, but also from the stimulation of heat-sensitive and tactile trigeminal receptors on the tongue and on the olfactory mucous membrane during retrochoanal movement accompanying deglutition. Taken together, these stimuli form a sensory image, the perception of which also depends on the type of stimulus and the affective context. The sensory image plays an important role that varies from person to person.

This discussion deals exclusively with disorders of the physiological sensation of taste. It provides a guide for good diagnostic and therapeutic practice on the basis of a review of the literature up to January 2005 using Medline. By contrast with research dealing with other ENT pathologies, this review mainly found expert opinions and studies conducted in a non-randomised and uncontrolled



CT: chorda tympani; GP: glossopharyngeal nerve; SL: superior laryngeal nerve; E: epiglottis; SP: soft palate; M: medulla; P: pons.

Figure 1
Taste Pathways

way, corresponding to level III of evidence-based medicine. There are probably two reasons for this. The first is the low prevalence of this complaint. In a study conducted in a chemosensory clinical ENT population, Pribitkin *et al.*[1] found only 10 patients out of 1176 who presented with a hypogeusia (0.85%), whereas 371 experienced a profound olfactory deficit (32%). Secondly, there is the multiplicity and multi-disciplinary nature of possible aetiologies (see Tables 1 and 2). According to the review of Kitagoh *et al.*[2] (n = 119), the most frequent aetiologies are idiopathic in 37.8% of cases (n = 45/119); related to the side-effects of medication in 32% (n = 38/119) of cases or linked to a zinc insufficiency in 30.2% (n = 36/119) of cases. According to the review of Osaki *et al.*[3] (n = 39 patients), aetiologies of hypogeusia listed by decreasing order of frequency are: iron deficiency (28%, n = 7/25), oral candidosis (24%, n = 6/25), xerostomia (24%, n = 6/25), psychiatric pathology (12%, n = 3/25) and, finally, idiopathic in 12% (n = 3/25). Parageusiae are of psychiatric origin in 57% of cases (n = 8/14), linked to oral candidosis in 21% of cases (n = 3/14), the side-effect of medication in 14% of cases (n = 2/14) and linked to a hyposalia in 7% of cases (n = 1/14).

Guidelines for the diagnosis of taste disease

Proving the aetiology of a dysgeusia is not an easy matter because of the number of anatomical and functional structures involved, the multi-disciplinary nature of the aetiologies, and the extreme difficulty of dealing with a rare condition. A sound knowledge of the anatomy and physiology of the gustative system associated with an elaborate anamnesis and a thorough examination of the oral cavity are the keys. Chemical and electrical gustometry, as well as semi-objective tests, provide information about the nature of the complaint and often about the location of the defect. Complementary investigations should then be ordered depending on the diagnostic hypothesis.

A complete anamnesis has considerable diagnostic value: a checklist adapted from Cullen *et al.*[4] is given in Table 3. A precise description of the type of dysgeusiae is an important step in arriving at a diagnosis: in the case of a dysfunctional taste receptor, it involves one or perhaps two taste archetypes; in the case of a neurological disorder, the disorder involves all four taste archetypes, and is localised in the innervation area of the implicated nerve; gustative hallucinations are found in the context of psychiatric pathologies or damage to the central nervous system.

Medication must be checked very thoroughly because it may be the cause of gustatory disorders.[2,3]

The evaluation of nutritional consequences, of the dysgeusia, and of its impact on quality of life should also be considered during the anamnesis.[5]

The clinical examination is based on the checklist suggested in Table 4 adapted from Cullen *et al.*[4]

Semi-objective report

A review of the literature worldwide demonstrates that gustometry can be a precious source of diagnostic information. However, there are few references which deal with this type of investigation and both the technique used and the protocol are frequently specific to the individual authors. This lack of standardisation, associated with a wide variability in the individual thresholds and the lim-

Table 1
Causes of taste dysfunction

Category of disorders	**Localisation and types**	**Description**
Epithelial pathways	Oral mucosa and tongue	Autoimmune disease, discoloured lesions, amyloidosis, infection, local injury, chemotherapy and radiotherapy, neoplasia
	Gingival, dental and periodontal structures	
	Salivary gland disorders	
	Gastro-oesophageal reflux disease	
	Sinus abnormalities	
Peripheral neural pathways	Facial nerve	Infection, neoplasia, trauma, inflammatory disease, degenerative disease
	Vagus nerve	
	Glossopharyngeal nerve	
Central pathways	Central lesion	Neurovascular stroke or arteriovenous malformation, neoplasia, CNS infection, multiple sclerosis
	Psychiatric	Bulimia, conversion disorder, depression, malingering, schizophrenia
	Genetic	Riley-Day syndrome, hereditary spinocerebellar degeneration, Turner's syndrome
Systemic dysfunction	Medications	c.f. table 2
	Nutritional	Blood transfusion, cancer-related wasting syndrome, chronic renal failure, HIV wasting syndrome, liver disease, malnutrition, zinc and copper deficiency, vitamin deficiency (B3, B12, C)
	Endocrine	Adrenocortical insufficiency, Cushing's syndrome, cretinism, diabetes, hypopituitarism
Special circumstances		Ageing
		Pregnancy
		Burning mouth syndrome

ited number of studied patients, explains the differences in the standards published until now.

Chemical gustometry is a rapid and non-expensive test. Solutions in increasing concentrations of citric acid, glucose, sodium chloride and quinine are applied to the tongue with the aid of a dropper or taste strips.[6] Chemical gustometry tests the functioning of the receptor cells for each of the archetypical tastes. It is particularly useful in diagnosing dissociated dysgeusiae. Although rather imprecise in terms of determining the exact extent of the stimulated zone, it can nonetheless provide topographical information about the taste receptors: quinine is preferentially recognised in the circumvallate papillae and the foliate papillae, the innervation of which depends on the glossopharyngeal nerve; citric acid, glucose and sodium chloride are recognised in the anterior portion of the tongue, the innervation of which depends on the chorda tympani.[7] In the case of a nerve lesion, the identification of the thresholds will be overestimated within the limits of the topography of the innervation.[8]

In addition to the difficulty of localising the stimulation, Bergdahl *et al*.[9] identified other factors that may influence the results, and therefore the interpretation and the reproducibility, of the test: the learning process, the temperature of the stimulus, olfactory contamination, the individual profile and degree of sensitivity, physiological factors such as the menstrual cycle, anxiety or depression, and the use of certain medications (anti-asthmatic, anxiolytic).

Electrogustometry is a fast and easy test. Electro-anodic stimulation with a continuous current causes hydrolysis of the saliva. The resultant liberation of ions stimulates the gustative chemoreceptors.

Table 2

Drugs that may affect taste according to Hawkes[16]

Antihelminthic	Levamisole
Antithyroid	Carbimazole, methylthiouracil, propylthiouracil
Antiseptic	Chlorhexidine
Anti-inflammatory	Penicillamine, colchicines, gold salts, nonsteroidal anti-inflammatory drugs
Antimitotic	Bleomycin, α-interferon, interleukine-2, methotrexate, vincristine, doxorubicin, chlorambucil, procarbazine, cisplatin, 5-fluorouracil
Antifungals	Amphotericin B, griseofulvin
Antibiotics	Tetracycline, sulfonamides, penicillins, cephalosporins, ethambutol
Anti-protozoal	Metronidazole, pentamidine
Antiviral	Idoxuridine, zidovudine, didanosine, protease inhibitors
Calcium channel blocker	Nifedipine, amlodipine, diltiazem
Anti-cholinergic	Benxheol, tricyclic antidepressants, oxybutynin
Diuretic	Acetazolamide, amiloride, frusemide, hydrochlorthiazide
Anti-arrhythmic	Amiodarone, procainamide, propranolol
Oral hypoglycaemic agents	Phenformin, glipizide
Anti-epileptic	Phenytoin, carbamazepine
Antipsychotic/antidepressant	Trifluoperazine, lithium carbonate, amitryptiline, clomipramine, paroxetine, sertraline
Drugs for Parkinson disease	Levodopa, pergolide, bexhexol, selegiline
Miscellaneous	Theobromine, theophylline, quinine, strychnine, sumatriptannasal spray, metoclopramide, cimetidine, disulfiram, pesticides, lead, industrial solvents and paints

Table 3

Dysgeusia: checklist for history

1	Is smell also affected?
2	Description: ageusia, hypogeusia, hypergeusia, parageusia, phantogeusia?
3	One or more tastes?
4	Localisation: bilateral or unilateral? Anterior or posterior?
5	Timing: continuous or intermittent?
6	Onset: sudden or gradual?
7	Precipitating event: surgery, trauma, chemotherapy, radiotherapy ...
8	Others symptoms: facial numbness, dysphagia, hoarseness, pain on swallowing, dry mouth, dry eyes, pain, burning, numbness in tongue, vesicules on tongue, dental procedures ...
9	Medication
10	Past medical health: diabetes, endocrine disease, Bell's palsy, gastro-oesophageal reflux...
11	Social and occupational history for smoking, work exposure to toxins

The intensity of the stimulation is increased until a metallic sensation is detected. This defines a threshold of detection which is representative of the overall function of the taste buds and gustative nerve paths and therefore helps to discriminate between ageusia and hypogeusia. When this test is used in the different zones of the oral cavity, the advantage is that the precise point of stimulation is known and the affected nerve is located quickly.

Four points from Gomez's study, which included a large number of normal patients (n = 147), are worth keeping in mind when interpreting the results:

– the thresholds on the right side may be lower than those on the left. According to the author, this is due to the specialisation of the right-hand hemisphere of the brain in matters of taste perception;
– the thresholds are higher in the region of the lingual V than in the region of the tongue or the soft palate;
– a difference between the thresholds on the two sides of 19.5 µA ± 4.5 µA for an average threshold of 38.5 µA ± 5.5 µA is admissible;

Table 4

Dysgeusia: checklist for physical examination

1	Oral cavity	Tongue: number, size, distribution of papillae health of mucosae: mycosis saliva: quantity and quality condition of teeth nasopharyngeal mass gustatory function: methylene blue staining of the tongue (taste pores innervated remain blue), topical anaesthesia applied to the tongue (persistent dysgeusia after anaesthesia in case of phantom taste), thermal stimulation (persistent cold sensation in the area of the foliate papillae in case of glossopharyngeal nerve integrity)
2	Ears	SOM, previous surgery, hearing tests
3	Eyes	Dry eyes, Schrimer strip test
4	Neck	Masses, thyroid enlargement, previous neck surgery
5	Nervous system	Cranial nerves examination, cerebellar and sensory motor function, psychiatric impression

– a threshold difference of at least 50% from one side to the other is considered pathological.[10]

The reproducibility of this technique is considered controversial in the literature on the basis of a small number of studies involving a limited number of patients. It is weak according to Lobb *et al*.[11] (n = 2, 80 examinations over 3 months) who observes variable results from one session to the next or from one side to the other for one and the same subject. It is improved, according to Gomez, if the subject is familiarised through pre-examination stimulation (n = 4, 100 measures, variations of 0.4 to 0.5 µA, confidence interval of 5%).[10] This drawback was not experienced by Kuga *et al*.[12] who found no statistically significant reduction of the thresholds after a third examination of 30 patients. Doubts about the reproducibility of this examination mean that some circumspection is required when it is used in the evaluation of dysgeusia.

Objective examinations

As a result of their burdensome nature, objective examinations will be reserved for patients for whom the clinical and gustometric tests do not permit the establishment of aetiology:

– *culture* is proposed when a fungal or a bacterial buccal infection is suspected;
– *sialometry and salivary biopsy* to exclude salivary dysfunction;
– the use of *imaging* depends on the diagnostic hypothesis. CT is appropriate when there is a suspected post-traumatic fracture or erosion of bone in the area of the middle ear. MRI is the examination of choice when evaluating the cortical structures and the pons in search of an ischaemic, haemorrhagic, demyelinating, tumorous or epileptic pathology;
– *a blood test* should also be ordered. It will focus on the blood count (anaemia, effects of medication), sedimentation rate (vasculitic disease, malignancy), B12 and folate level (nutritional state), glucose (diabetes and pituitary disease), thyroid function (myxoedema), electrolytes (renal disease, Addison's or Cushing's disease), liver function tests (cirrhosis), and autoimmune tests (Sjörgen's disease);
– *evoked taste potentials* were recorded for the first time by Kobal[13] in 1985 with acetic acid and afterwards with chloroform (sweet), ammonium chloride (salty) and thujone (bitter). They are likely to provide objective grounds for the results, but they are still in the experimental stage owing to the difficulty of obtaining pure taste stimulation and to the presence of the gag reflex for the territory innervated by the glossopharyngeal nerve.

Guidelines for treatment of taste disease

Treatment can be limited to the aetiology: administration of zinc in the case of zinc deficiency, equilibration of diabetes, buccal and dental care, psychiatric treatment in case of depression...

Zinc administration would appear to be helpful in the treatment of idiopathic dysgeusia. Heckmann *et al*.[14] demonstrated that zinc gluconate (140 mg/day for 3 months) improves general gustatory function and general scores (n = 50) independently of the level of zinc in serum.[14] No "fundamental" treatment such as vitamin B or corticoids has been demonstrated to be efficacious as yet.[15,16]

The help of a dietician may be valuable in guiding patients in the control of what they eat and in the development of compensatory

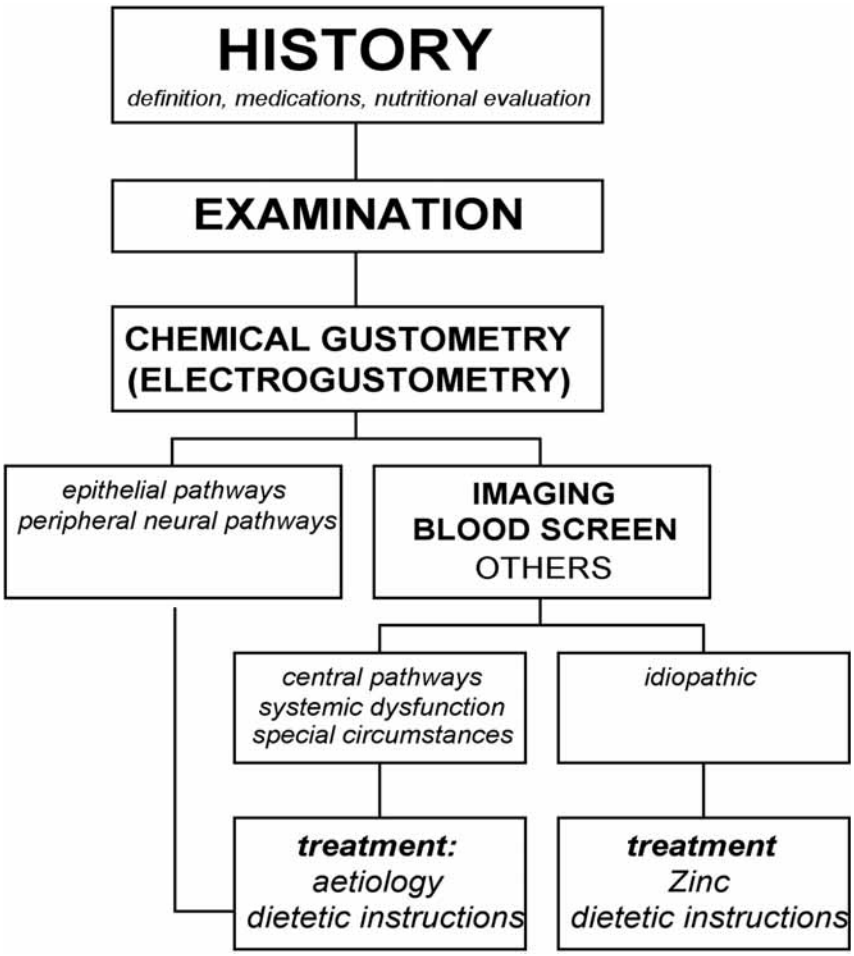


Figure 2
Algorithm for taste disorders

mechanisms such as the visual and olfactory aspects of their food in order to maintain nutritional and quality of life status.

The support of a psychologist may occasionally be necessary, for example for professionals whose sense of taste is essential for their job.

Conclusion

Figure 2 contains a diagnostic and therapeutic algorithm, based on the literature review, for the isolated taste disorders. From a diagnostic point of view, an elaborate anamnesis and a detailed clinical examination are required. Gustometric tests should be used to support the diagnosis. Imaging and blood screening should be reserved for the most difficult cases only.

From a therapeutic point of view, the treatment should focus on the aetiology when it can be proven. The help of a dietician is often necessary.

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Patient information

It is important to start by explaining what taste is.

In the medical sense of the word, taste is the sensation born in the taste receptors in the oral cavity when eating or drinking. There are four recognisable tastes: sweet, salt, sour and bitter. So the taste of a strawberry ice cream, for example, is in medical terms no more than the perception of its sweet properties.

In the common sense of the word, taste consists not only of the stimulation of the taste receptors by food and drink, but also of the perception of texture and temperature by the tongue and, especially, the smell of the foodstuff as perceived during chewing and swallowing. These stimuli form a complex sensation, the perception of which also depends on the characteristics of the foodstuff and emotional associations; the sensation is particular to each individual. So the taste of a strawberry ice cream, in the common sense of the word, corresponds not only to the perception of sweetness but also to the perception of texture, temperature and smell. It is appreciated all the more because the ice cream may be consumed in good company and recall, for example, pleasant childhood memories.

This information deals exclusively with the medical definition of taste and targets people with taste disorders in particular.

Your problem may be:

- either a modification of the perception of one or more of the four tastes of foodstuffs

(for example, you are not able to tell whether crisps are salty, even if you add more salt);

- the perception of an erroneous taste sensation, whether or not in the presence of a foodstuff (for example, a strawberry ice cream causes a salty sensation or you have a permanent salty sensation in your mouth).

This situation is sometimes difficult to live with.

The reasons for your disorder can be numerous but not always recognisable.

In order to help us understand the situation, you will be submitted to specific taste tests after a thorough clinical examination and, depending on the diagnostic hypothesis, to blood tests or scans.

This point cannot be emphasised enough: the treatment of your problem will be limited to the causes if they can be diagnosed objectively. The help of a dietician is important to guide you in watching what you eat and to teach you ways to improve your pleasure in eating. This may include:

- the appearance of your meals;
- starting by smelling your food before putting it in your mouth;
- choosing foodstuffs with different textures,
- the use of aromatic herbs, ...

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CME Questions

1. Taste in the common sense of the word corresponds to the perception of a sensation resulting from:

   A – The stimulation of gustatory receptors
   B – The stimulation of gustatory and olfactory receptors
   C – The stimulation of gustatory, trigeminal and olfactory receptors
   D – The stimulation of gustatory and trigeminal receptors
   E – The stimulation of olfactory receptors and gustatory receptors bathed in a saliva of certain quality

2. The taste buds are innervated by:

   A – The chorda tympani (VII) and the lingual nerve (V3)
   B – The chorda tympani (VII) and the glossopharyngeal nerve (IX)
   C – The chorda tympani (VII), the glossopharyngeal nerve (IX) and the upper branch of the vagus nerve (X)
   D – The chorda tympani (VII), the lingual nerve (V3) and the upper branch of the vagus nerve (X)
   E – The chorda tympani (VII), the lingual nerve (V3) and the glossopharyngeal nerve (IX)

3. The prevalence of dysgeusia in an ENT population is:

   A – <1%
   B – 1–5%
   C – 6–12%
   D – 15–20%
   E – 20–30%

4. One of the following aetiologies is not responsible for parageusiae:

   A – Psychiatric pathology
   B – Paraneoplasic syndrome
   C – Buccal candidosis
   D – Hyposialia
   E – Side-effect of medication

5. One of the following aetiologies is not responsible for hypogeusia:

   A – Iron deficiency
   B – Buccal candidosis
   C – Xerostomia
   D – Psychiatric pathology
   E – Pregnancy

6. One sentence is wrong.

   A – Chemical gustometry tests the functioning of the gustative and olfactive receptors
   B – Chemical gustometry confirms a dissociated dysgeusia
   C – Chemical gustometry can localise the damaged nerve
   D – The results of chemical gustometry can be disrupted by the temperature of the stimulus, olfactory contamination and the use of anxiolytics
   E – The results of chemical gustometry depend on good cooperation from the patient

7. One sentence is wrong.

   A – In electrical gustometry, the detection of a metallic sensation defines a gustative threshold of detection
   B – Electrical gustometry can localise the affected nerve
   C – The reproducibility of electrical gustometry is controversial in the literature
   D – Olfactory contamination can disrupt the results of electrical gustometry
   E – Electrical gustometry can be impossible to interpret in patients with Sjörgen's syndrome

8. Guidelines for the treatment of taste disease. One sentence is wrong.

   A – The aetiology should be treated if possible
   B – Zinc administration should be used in the treatment of idiopathic dysgeusia
   C – Prolonged chlorhexidin mouthwash should be used in the treatment of idiopathic dysgeusia
   D – Dietetic evaluation is indicated
   E – An evaluation of quality of life is indicated

9. Taste disorders after tonsillectomy. One hypothesis is wrong.

   A – Glossopharyngeal nerve damage
   B – Anorexic status known before the surgery
   C – Postoperative buccal candidosis
   D – Chlorhexidin mouthwash
   E – Povidone iodine mouthwash

10. Metallic taste for previous 24 hours in a woman aged fifty-four. One hypothesis is wrong.

    A – Onset of viral facial palsy
    B – Burning mouth syndrome
    C – Lyme's disease treated by tetracycline for the last 15 days
    D – Allopurinol for the last month
    E – Considerable passive smoking over a period of several years

Answers: 1C; 2C; 3A; 4B; 5E; 6A; 7D; 8C; 9E; 10E