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Review

Taste disorders in diabetes – An insight

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Abstract

Taste sensation or gustation is an important feature that determines the food selection and nutrition of human beings. Gustation is a complex process that takes place in the taste buds resulting in the chemosensory perception of the food substances. Humans have the ability to perceive a variety of tastes such as sweet, sour, bitter, salty, and umami. Taste disorder is a broad term used to denote any alteration in the perception of tastes. Taste disorder is one of the commonly encountered oral manifestations of both type 1 and type 2 diabetes mellitus (T1DM, T2DM), which is often ignored. These disorders can have a direct impact on the glycemic control of diabetic patients. There are various chairside investigations that can help in the detection of taste disorders. Early detection and appropriate management of taste disorders in patients with diabetes are essential for better control of glycemic levels.

Keywords: diabetes mellitus, low-level laser therapy, taste buds, taste disorders.

Introduction

Sense of taste is one of the essential sensations that play a vital role in the food selection and nutrition of humans. The process of taste sensation involves the perception of chemicals from the food substances by the receptor cells located in the taste buds [1]. Humans have the ability to perceive a variety of tastes such as sweet, sour, bitter, salty, and umami [2]. Alterations in the perception of any of these tastes can be referred to as taste disorders. There are various factors such as age, drugs, alcohol consumption, tobacco chewing or smoking, other local and systemic diseases that can alter the taste threshold [3]. Chronic consumption of beverages containing alcohol can also result in an altered perception of sweet taste, leading to a higher intake of sugars contributing to diabetes [4]. Type 1 diabetes is one of the most common systemic diseases affecting children and young individuals resulting in complications that can affect all systems of the body [5]. Taste disorder is one of the commonly observed oral manifestation of diabetes mellitus, seen in both type 1 (T1DM) and type 2 (T2DM) [6, 7]. Taste disorders in diabetes may be encountered along the clinical course of the disease having a direct impact on the glycemic control of the patients [8]. Hence, it is necessary for early diagnosis and management of taste disorders. With this aim, we present a brief review on taste disorders in diabetes and their management.

Taste perception in humans

The tongue is considered the primary organ of taste sensation, even though parts of the soft palate also contribute to the taste sensation or gustation. The tongue contains four types of

papillae such as filiform, fungiform, foliate, and circumvallate papilla. The sensory nerve endings present on the papillae help in the accurate sensation of various tastes [2]. The gustatory papillae contain structures called taste buds which accommodate about 50–100 taste receptor cells (TRCs). Filiform papilla does not have any taste buds and they are responsible for perceptions of touch and temperature [9]. Taste receptor cells comprise four different types of cells, type I–IV cells. The cells differ based on their granularity and each cell has a unique morphology and function. Type I cells are glial-like cells that contain numerous electron-dense granules in their cytoplasm. Type II cells are spindle-shaped, with a large nuclei and short microvilli that protrude out from the apical region of the cell. The sensation of sweet, bitter, and umami tastes involves type II cells. Type III cells contain synapses with primary sensory terminals and they express synapse-related proteins. These cells are also called as presynaptic cells, they are slender-shaped and contain large vesicles. They also contain a single microvillus that protrudes inside the taste pore. Immature and undifferentiated cells in the taste buds are referred to as type IV cells [10]. Once the taste buds are sensitized by food substances, the primary afferent fibers in the TRC get excited and the gustatory signals are transmitted from the taste buds to the central nervous system (CNS) through the cranial nerves and their branches such as the chorda tympani, glossopharyngeal, and trigeminal nerve. This process results in the perception of the taste and aids the person in accepting or rejecting the food based on its taste [11].

Pathophysiology of taste disorders in diabetes

The association between taste disorders and diabetes mellitus is being studied extensively in recent decades. The chemosensory effect of diabetes on taste sensation is still unclear. According to Schelling et al., alterations of taste perceptions in diabetics can be attributed to microvascular deficits, sensory neuropathy, or a non-specific satiation effect due to persistently elevated blood glucose concentrations [12]. Type 1 taste receptors (T1Rs) are the principal receptors for the sensation of the consumption of sweet and savory foods. T1Rs are also present in extra-oral sites such as the intestine, stomach, and liver. They play an important role in monitoring the energy stores and influencing the appetite for various foods and satiety [13]. Literature evidence state that T1Rs are affected in diabetes mellitus causing alterations in the glucose metabolism [14]. Consumption of certain oral hypoglycemic drugs is also known to produce taste disturbances. A direct association of oral hypoglycemic drugs such as Metformin and Glibenclamide, with taste disorders has been reported in the literature. These drugs are known to produce a metallic taste [15]. Zinc is an essential micronutrient that is necessary for maintaining insulin metabolism, appetite, and gustation. The deficiency of zinc can cause loss of appetite, delayed healing of wounds, disturbances in smell and taste [16]. Zinc deficiency has been proved in both type I and II diabetes, which can be a contributing factor to the development of taste disorders [17, 18]. Apart from this, the density and number of taste buds and papilla reduce with aging leading to taste disorders and resulting in alterations in the dietary preferences, which could possibly have an effect on diabetes [19].

Various taste disorders and their implications

Taste disorders can be broadly classified into four types (Table 1) [20]. Apart from Hypogeusia, Dysgeusia is the most common taste disturbance occurring in diabetes. Hypogeusia is also considered an early indicator of diabetic neuropathy [21]. According to the literature evidence, the taste dysfunction in diabetes is especially more with the sensation of sweet taste [6, 8]. An increased taste threshold is seen in cases with hyperglycemia. Pugnaloni et al., found patients with T2DM to be almost insensitive to the sweet taste [8]. The decreased taste sensitivity to glucose and sugar substances in patients with diabetes leads to increased consumption of sugars so as to perceive the sweet taste sensation. This in turn could have an implication on the glycemic levels because of the increased consumption of

Table 1: Classification of taste disorders.

Taste disorders	Features
Ageusia	Complete loss of taste sensation
Dysgeusia	Alteration or distortion in taste perception
Hypogeusia	Reduced ability to taste
Phantoguesia	Gustatory hallucination

sugars [12]. Sour and salt taste sensations are also affected in patients with T2DM [6].

The ability to sense various tastes is affected in T1DM also, decreased perception of sweet taste is the most commonly reported taste disorder. But sensations of other tastes such as sour, salt, and bitter can also be affected [22]. Taste disorders in diabetics could have direct systemic complications as well, sweet taste disorder in diabetics is known to be associated with increased sugar intake and diabetes-related vascular complications [23].

Investigations

Most cases of taste disorders among diabetics may be missed out, which could lead to further implications. Clinical evaluation of diabetics with a detailed history and oral examination of the patient is necessary to identify taste disorders. Patients with diabetes usually present with candidiasis of the tongue and atrophic glossitis that could also serve as a contributing factor to the development of taste disorders [7, 24]. There are several chairside clinical tests that could be carried out for the detection of various taste disorders [25, 26].

a. Whole mouth test: Solutions of sweet, salty, bitter, or sour ingredients in varied concentrations are given to the patient to gargle the solution and spit out. After spitting out, the subject is asked to identify the taste and its concentration. However, this test cannot be used for detecting loss of taste sensation in a localized area of the tongue as the taste perception can take place by remaining taste cells in other parts of the tongue and oral cavity.

b. Spatial taste test: Specific areas of the tongue can be tested by placing a cotton swab dipped in a solution of various taste ingredients. The patient is asked to identify the intensity and quality of tastes and the ability to sense the taste is evaluated.

c. Filter-paper and taste strip test: Filter papers coated with different tastes will be placed on localized areas of the tongue and palate and the patient is asked to detect the taste. Similarly, edible strips made of methylcellulose solutions with different taste substances incorporated into them can also be used for evaluation of the taste sensation.

d. Flavor discrimination test: The patient is asked to taste different solutions with varying degrees of sweetness in a random manner and the ability to detect the taste is evaluated. This test can be used to detect the perception of different degrees of sweetness.

e. Electrogustometry: Quantitation of taste thresholds is possible by the use of electrogustometry. The testing procedure involves the passage of an anodal current to various parts of the tongue mucosa to test the nerves associated with gustation and the gustatory pathway. Evaluation of taste thresholds can aid even in the detection of even slight differences in taste perception which may not be reported as a subjective symptom.

Management

Impaired taste sensations among diabetics that is independent of somatic or autonomic nerve function can be improved partially by achieving better glycemic control [15, 27]. Diabetic patients may present with oral infections such as candidiasis that may contribute to taste disorders. In such cases treatment of the candidal infection is necessary by appropriate use of anti-fungal drugs and instigation of oral hygiene measures [28].

Oral zinc supplementation has proved to improve the sensation of taste. Zinc is a trace element that is essential for the maintenance of gustin levels and the integrity of the taste buds. Various forms of zinc such as zinc gluconate, zinc acetate, and zinc aspartate have been studied

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extensively with regard to their use in the management of taste disorders [29]. Heckmann et al., found the oral administration of zinc gluconate in a dosage of 140 mg per day to be effective in the management of idiopathic dysgeusia [30]. Zinc Sulfate in a dose of 45 mg/day is also effective in the management of dysgeusia [31]. Sakagami et al., in their randomized control trail observed improvement in taste sensation with the administration of Polaprezinc therapy for a period of 12 weeks [32]. According to the observations of Femiano et al., alpha-lipoic acid can be used for the reversal of neuropathic changes in the tongue and aid in improving dysgeusia [33].

Photobiomodulation therapy with low-level lasers can induce micro circulatory changes, promote the regeneration of taste buds and local neuronal complex. Application of low-level lasers in contact mode for irradiation of different parts of the tongue has shown significant improvement in taste perception [34, 35]. Photobiomodulation therapy is a promising therapeutic modality for the management of oral mucositis and taste disorders in post-radio and chemotherapy cancer patients. El Mobadder et al., suggested a photobiomodulation therapy protocol for the management of taste disorders using low-level lasers of 630–680 nm wavelength operating at a power of 20–150 mW at 3 J/cm² for irradiation of multiple sites in the dorsum of the tongue [35]. Low-level lasers are also efficient in the management of taste disorders associated with burning mouth syndrome [36].

Conclusion

There is a high chance that taste disorders in diabetics are overlooked by the patients and remain unreported until proper clinical evaluation and investigation by the physician. Early identification and management of these disorders may be beneficial in improving patient care and help in achieving better glycemic control.

Conflict of Interest

The authors declare no conflict of interest.

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