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Taste Sensation And Its Alteration In Cancer

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ABSTRACT

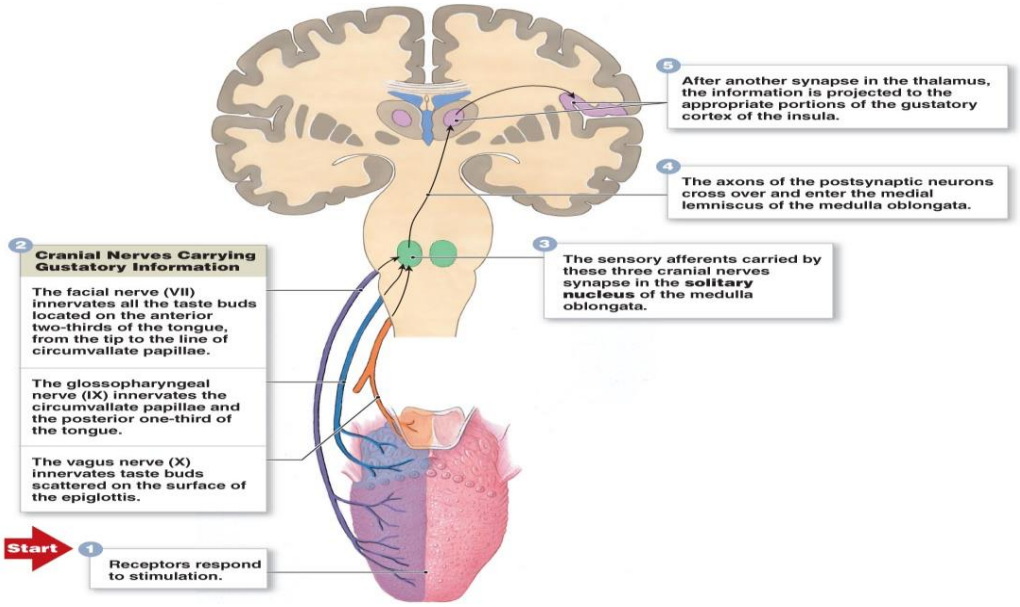
Taste sensation plays a major role in detection and ingestion of food to face the nutritional requirements in health and disease. Alteration in taste perception causes malnutrition which is one of the usual causes of morbidity and mortality in cancer patients. This review reveals the mechanism of taste perception and their alteration in cancer, it also reveals the role of radio- and chemotherapy in the modulation of taste sensation. Preventive measures, dietary supplements and pharmacotherapy to improve the patient's status in advanced cancer stage are also explained in this review.

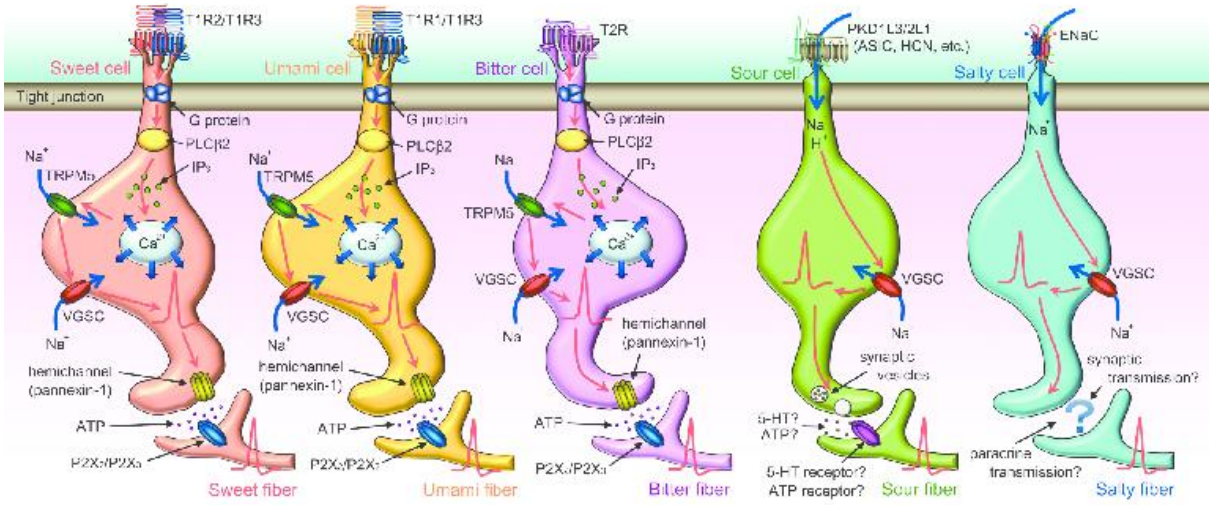
Keywords:Taste Alterations, Cancer, Chemotherapy, Radiotherapy.

INTRODUCTION

Basically, there are five taste sensation. They are sweet, sour, bitter, salty, umami and sixth fat taste[1]. Taste is necessary for life since it promotes food intake and it also produces a nice pleasure from eating. Neuronal pathways are activated by taste perception which helps in digestion, absorption, and nutrient storage[2]. Dysgeusia (disorder in taste perception) affects the life quality by causing loss of appetite, body weight, and psychological status[3]. There are various factors affecting taste perception; they are medication, nutrition, oral mucosal lesions, chronic exposure to radiotherapy and chemotherapy, smoking, chronic hepatitis, renal dysfunction, aging, and perturbation in hormonal secretions[4]. Alteration in taste perception is important in diseases like cancer since it is one of the main causes of morbidity and mortality in the world. Usually clinicians ignore changes in taste sensation in cancer patients because this symptom does not affect the survival of the patient. Certain indications altering the taste sensation can be an alarming sign of tumour cell invasion in cancer patients. Most annoying symptom in cancer patients is GIT disorders and altered taste is the fourth most common symptom after dry mouth, weight loss, and early satiety[5]. Several studies have reportedthat 15 to 100 % of cancer patients might suffer with altered taste sensation [6].

MECHANISM OF TASTE SENSATION





INFLAMMATION AND TASTE SENSATION

- One of the characteristic features of advanced cancer is the inflammatory condition associated with an infection. Proliferating cancer cells releases cytokines/chemokines which helps in the recruitment of macrophages and neutrophils, and hence a series of cytokines and cytotoxic mediators including prostaglandins are produced.[7]
- In neck cancer, pro-inflammatory cytokines level, i.e., IL-1α, RANTES, MIG, G-CSF, GM-CSF, INF-γ, TNF-a, IL-17, IL-4, IL-6, and IL-10, in the body is raised by various fold [8].
- The cytokines such as IL-12 and IFNγ has anti-tumor role, while IL-6, IL-17, and IL-23 are protumor[9].
- Inflammation plays a major role in cachexia.
- Cancer cachexia is related to an increase in blood levels of C-reactive protein, cytokines (interleukin 1b, interleukin-6, TNF-α, and leukemia inhibitor factor, LIF) and other tumour derived factors like lipid mobilizing factor (LMF) and protein mobilizing factor (PMF).
- Inflammatory markers through blood circulation exerts their action in the brain and control the areas of feeding behaviour (smell and taste sensation)[10].
- The above observation recommends that taste alteration in cancer patients might be controlled at taste bud and brain levels.
- Wang et al in 2009 have reported that expression of Toll-like receptors (TLRs), type I and II interferon (IFN) receptors, and their downstream signalling compounds in taste tissue.
- Systemic administration of IFNs triggers apoptosis of taste bud cells and in turn contributes the development of taste disorders.
- High concentration of IFNγ and TNF-a, and INFγcauses apoptosis of TRCs.
- Taste sensation such as bitter, sweet and umami taste is also decreased. these mice.
- Another relationship between inflammation and hyperglycemia in cancer patient was observed since carbohydrate metabolism is altered in type 2 diabetic cancer patients [11]
- Gondivkar et al. in 2009 have stated that type 2 diabetic patientsmight suffer from taste alterations.
- Therefore, there is a possibility of alteration carbohydrate metabolism and taste perception among type 2 diabetes and cancer patients.

MICROBIOME AND TASTE SENSATION

- Schmidt et al. in 2014have proposed that oral microbiomediffers in oral cancer patients.
- Oral mucositis is associated with taste alteration can be observed in cancer patients undergoing chemotherapy frequently.[12]
- Wang et al. (2015) suggested that disruption of oral microbiomecauses chemotherapy-induced inflammation through tolllike receptors (TLRs) and nucleotide oligomerization domain (NOD)-like receptors (NLRs).

- Ligands for these receptors like peptidoglycan, lipopolysaccharide, bacterial DNA, and protein flagellin are usually provided by disrupted microbiome, thus resulting in induction of inflammatory process.
- Microbial alterations may cause inflammation and taste sensation disorder which was later assumed that disruption of gut microbiota can cause altered taste in cancer patients.

CANCER THERAPY AND TASTE ALTERATION

CHEMOTHERAPY

- Chemotherapy alters taste perception[13].
- In a study, the incidence of taste alterations was reported as 69.9%, and a relationship was detected between taste alterations and life change pattern like appetite and fatigue[14].
- Taste-test reveals that these patients had raised thresholds for bitter taste. Such changes can be resolved within months after chemotherapy [15].
- Zinc is an important micronutrient which plays a vital role in taste perception. Studies proposes that Zinc deficiency is associated with taste alteration in cancer patients[16].
- Deficiency of Zinc can be caused by the drugs treating cancer, where it causes binding and chelation of Zinc and other heavy metals by sulfhydryl group in their structures, promoting Zinc depletion and loss of taste[17].

RADIOTHERAPY

- Taste disorders can be commonly observed in patients undergoing radiation therapy for head and neck cancers.
- In a study, it was observed that bitter taste was mostly affected than sweet taste[18].
- Another study expressed that bitter and salty taste were the first affected taste modalities, while sweet taste was the least affected due to radiotherapy.
- Taste alteration can be seen in a few weeks after the beginning of radiotherapy but it may recover to its normal level within 6 months to 1 year once the treatment has been stopped but some patients suffer from permanent taste loss .[19]
- Taste alterations are caused due to the damage of taste cells by radiotherapy and the change in taste pattern is highly encouraged by the distribution of taste buds damaged during the radiation treatment.
- Radiotherapy also promotes xerostomiasince radiation frequently affects saliva quantity and composition [20]and hence resulting in damaging salivary glands.

RADIOTHERAPY AND CHEMOTHERAPY

Combined force of radiotherapyand chemotherapy targets taste progenitor and existing taste cells. Sonic hedgehog (SHH) and notch pathways are altered during cancer[21]. Use of SHH pathway inhibitor, Vismodegib, in cancer patients causes profound taste alterations.[22]Hence it is clear that modified SHH leads to taste alterations in cancer patients.After radiation, the progenitor cells repair damaged DNA but if they fail, they start apoptosis. Chemotherapy also targets rapidly dividing cells and hence taste alterations can be seen in patients undergoing chemotherapy for non-head/neck cancer.

MEASUREMENT OF TASTE ALTERATION

Several methods are used for the measurement of taste impairment and detection thresholds in cancer patients. It is the clinician's choice to use any of the following methods:

Electrogustometer

- One electrode is the tongue electrode, while the other reference electrode is located on dorsal side or the wrist.
- Electrical current is applied in various steps and the lowest current intensity, recognized by the patient, is taken as the detection threshold[23].

Chemical Detection

- ❖ Tastant solution is used with suprathreshold concentrations for detecting taste modalities[24].
- ❖ Patient's mouth is rinsed with a sip of distilled water before testing each sample.
- ❖ The lowest solute concentration at which the subject consistently perceives the taste is considered as taste threshold[25].

3-Armed Forced Choice (3-AFC) Method

Patient is asked to locate a cross-hatch on a 10-cm line labelled at each end (0 = dislike extremely, no sweetness, sourness, saltiness, or bitterness, and 10 = like extremely, extremely sweet, sour, salty, or bitter) to degree of liking and intensity of each sample[24]. A scale ranging from 0 (total taste loss) to 3 (no taste loss) can be engaged to classify the subjects, based on the recognition of particular concentration of taste.[26]

PREVENTION AND TREATMENT OF TASTE ALTERATIONS

- Counselling in advance is necessary to prepare patient mentally before time. Rhodes et al. (1994) have suggested that if the patients are psychologically prepared for taste alterations, they can resist taste changes easily.
- Prior to chemotherapy, patients can be motivated to try new food items. Lemon juice and chewing gum can be used before meals to make the meals more pleasant.[27]
- Patient must maintain good oral hygiene as it promoteschanges in taste.
- To evaluate alteration in taste perception in cancer patients, the clinicians can use various methods such asMalnutrition Screening Tool, Interdisciplinary Nutrition Care Plan or the Patient-Generated Subjective Global Assessment[28].
- Nutritional status should be assessed to improve the life quality of the patients. Zinc supplementation is essential for patients undergoing cancer chemotherapy.
- Halyard et al. (2007) in his clinical study proposed that intake of Zinc protects against taste alterations. Therefore, regular use of Zinc sulfatecan be encouraged for patients undergoing cancer therapy.
- Amifostine, an organic thiophosphate, protects normal tissues from radiation and chemotherapy [29].
- Amifostine also protects salivary glands and, thus eradicating xerostomia.
- Pilocarpine and bethanechol increases the salivary production. It was tested upon salivary secretion in cancer patients with hypo-salivation after radiotherapy[30]. Though both the drugs improve salivary secretion, only bethanechol improved taste perception.

CONCLUSION

Taste alterations varies with disease and specific treatment. Studies should be conducted by collecting the data so that specific patient care protocols can be created to lessen the effect of a change in taste on patient's quality of life. Alteration of taste should be taken into consideration and food supplements are provided accordingly to makethe patients more acceptable. In order to balance this condition, an interesting idea can be to test the particular taste impairment and add taste enhancersto make food more palatable for patients.

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