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Original Research Article

Taste Dysfunction and Its Relationship to Hba1c Level and Disease Duration in Type 2 Diabetes Mellitus Patients with Autonomic Neuropathy

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Abstract

Background and Aim: Type 2 diabetes mellitus (T2DM) affect quality of life very much and causes various complications. Diabetic autonomic neuropathy (DAN) is one of the common complications in diabetes. Thus present study was aimed at determining taste dysfunction in a population of T2DM subjects and its correlation with HbA1c level.

Material and Methods: This was an observational cross sectional study which was carried over a period of one year in the department of medicine, Tertiary care institute of India. The 100 patients of T2DM with autonomic neuropathy and 100 healthy controls were taken for the study. Autonomic neuropathy was assessed clinically. Chemical taste test using four solutions of basic tastes (sweet, sour, salty, bitter) were done.

Results: There was a significant difference between the 2 groups in terms of HbA1c (%) ($p \leq 0.05$), with the median HbA1c (%) being highest in the chemical taste dysfunction: sweet: yes group. Strength of association (Point-Biserial correlation) =0.49. There was a significant difference between the various groups in terms of distribution of chemical taste dysfunction: Sweet ($p \leq 0.05$). There was no significant difference between the groups in terms of duration of T2DM (years) ($p > 0.05$).

Conclusion: The study found a significant correlation between taste dysfunction and HbA1C level and blood sugar fasting level in type 2 diabetes mellitus patients. Alteration in taste was mainly for sweet. Sour, and bitter did not show any difference in case groups compared to controls.

Keywords: HbA1C, Neuropathy, Taste Dysfunction, Type 2 diabetes mellitus.

Introduction

Type 2 diabetes mellitus (T2DM) is a multifactorial, complex disease associated with chronic hyperglycemia, resulting from the interplay of genetic, environmental, and epigenetic factors. [1] Diabetes is caused by a defect in insulin secretion, insulin action or both. Pathogenic processes involved in the development of diabetes range from autoimmune destruction of beta cells of the pancreas to abnormalities in carbohydrate, fat, and protein metabolism. [2]

This chronic hyperglycemia is associated with long term damage, dysfunction, and failure of different organs and result into macrovascular and microvascular complication. T2DM often presents with mild manifestations, to the point that at the time of diagnosis many patients already present with one or more complications which negatively affect the patient's quality of life and account for the mortality and morbidity associated with the disease. Taste perception and food preferences are shown to be important determinants of dietary practices, thus guiding and helping us in the identification and consumption of nutrients. [3,4,5]

Diabetic autonomic neuropathy (DAN) is one of the common complications in diabetes. DAN may manifest with gastrointestinal (GI) symptoms like gastroparesis, esophageal dysmotility, constipation, diarrhea, fecal incontinence, or gallbladder atony.

Taste is the sensory modality that guides organisms to identify and consume nutrients while avoiding toxins and indigestible materials. For humans, sweet, umami, sour, salty, and bitter called "basic" tastes. An important, unrecognized aspect of taste is that it serves 'functions' in addition to guiding dietary selection.

Stimulating the taste buds initiates physiological reflexes that prepare the gut for absorption and other organs for metabolic adjustments. Abnormalities in any or several taste receptors are known to influence intake of specific food components or ingredients related to the taste receptor. [6] To date, there very few reports describing changes in overall taste sensitivity in T2DM. Whether/ not environmental influences, such as habitual diet, can alter taste sensitivity, or vice versa, is still unclear. Thus present study was aimed at determining taste dysfunction in a population of T2DM subjects and its correlation with HbA1c level.

Material and methods

This was an observational cross sectional study which was carried over a period of one year in the department of medicine, Tertiary care institute of India. Patients of age above than 30 years and known case of T2DM for more than 5 years of any sex included in study. Type 1 diabetes mellitus patients, smokers and alcoholics, patients on prescribed medicines known to cause taste alteration like sulphonylureas, ace inhibitors, pregnant and lactating women, patients with upper respiratory dysfunction and herpes infection excluded from studies. Total 100 patients were included in the study.

The study procedure was fully explained after the procedures and prior to the anthropometric parameter measurements and taste test execution. The controls were healthy, non-T2DM volunteers, selected in the same period among hospital healthcare professionals and their relatives, and they were matched for sex, age, and body mass index with patients. All required details about cases such as demographic data, clinical presentation general examination findings, systemic examination taste test were carried out.

Blood sample were taken from all patients to check HbA1C, fasting blood sugar, post prandial blood sugar. Diabetes mellitus was defined as an HbA1C>6.5 g% or history of receiving treatment for diabetes mellitus or previously diagnosed diabetes mellitus. Solution was prepared as directed below. [7] Each solution was made using a volumetric flask to ensure precision of concentrations to ±0.0002 M. The compounds included were: 1. Quinine (bitter): Place 0.011 g of quinine HCl dihydrate in a 500 ml volumetric flask. Add water to bring the volume to 500 ml, producing a solution with a final concentration of 56 μM. 2. Sodium chloride (salty): Place 7.5 g of sodium chloride in a 500 ml volumetric flask. Add water to bring the volume to 500 ml, producing a solution with a final concentration of 0.25 M. 3. Sucrose (sweet): place 60 g of sucrose in a 500 ml volumetric flask. Add water to bring the volume to 500 ml, producing a solution with a final concentration of 0.35 M and 4. Citric acid (sour): place 25 g of citric acid in 500 ml volumetric flask. Add water to bring volume to 500 ml, producing a solution with a final concentration of 0.26 M.

Subjects were provided with 4 solutions, a bottle of water, empty cup, pen, and pen-and-paper taste questionnaire samples, 2 subjects were instructed to rate both the intensity and quality of each tastant and 3 subjects were asked to rinse mouth twice with water and spit it out in the cup provided. After that 5 ml of sample was provided whose nature was kept unknown to the subject and asked to hold it there for 5 seconds before spitting the solution into the cup. After which they were asked to mark the quality and intensity of solutions in the questionnaire scale as mild, moderate and very. Afterward, was asked to rinse mouth with water twice before proceeding to the next sample.

Statistical analysis

The recorded data was compiled and entered in a spread sheet computer program (Microsoft Excel 2007) and then exported to data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). For all tests, confidence level and level of significance were set at 95% and 5% respectively.

Results

There was a significant difference between the 2 groups in terms of HbA1c (%) ($p \leq 0.05$), with the median HbA1c (%) being highest in the chemical taste dysfunction: sweet: yes group. Strength of association (Point-Biserial correlation) =0.49. There was a significant difference between the various groups in terms of distribution of chemical taste dysfunction: Sweet ($p \leq 0.05$).

Participants in the group case had the larger proportion of chemical taste dysfunction: sweet: yes. Participants in the group control had the larger proportion of chemical taste dysfunction: sweet: no.

The variable duration of T2DM (years) was not normally distributed in the 2 subgroups of the variable chemical taste dysfunction: sweet. Thus, non-parametric tests were used to make group comparisons. There was no significant difference between the groups in terms of duration of T2DM (years) ($p>0.05$). Strength of association (Point-biserial correlation) =0.01.

Table 1: Comparison of the 2 subgroups of the variable chemical taste dysfunction: sweet in terms of HbA1c (%) (n=100).

HbA1c (%)	Chemical taste dysfunction: sweet		P value
	Yes	No	0.01*
Mean (SD)	10.44 (2.20)	8.16 (2.01)	

* indicates statistically significance at p≤0.05.

Table 2: Comparison of the 2 subgroups of the variable chemical taste dysfunction: sweet in terms of duration of T2DM (Years), (n=100).

Duration of T2DM (Years)	Chemical taste dysfunction: sweet		P value
	Yes	No	0.52
Mean (SD)	9.42 (2.50)	9.53 (4.19)	

Statistically significance at p≤0.05

Discussion

It has been noticed that the taste sensation is an important factor in the regulating type of food ingestion, in digestive process control, and in the release of neuroendocrine hormones for hunger and satiety. It has been largely demonstrated that the sense of taste is an important tool in the regulation of nutrient ingestion, in digestive process control, and in the release of neuroendocrine hormones for hunger and satiety. Many studies have focused on changes in taste sensitivity in both physiological and pathological situations.[8,9]

A decrease in taste functions in patients with diabetes, particularly concerning the sweet taste. [10] There were no differences in sour and bitter sensation sensitivity between diabetic and non-diabetic healthy individuals. A rise in taste threshold has been shown to be related with hyperglycemia. [11] A significant correlation between taste thresholds and plasma glucose concentration has been described in many previous studies, indicating that patients with T2DM are almost insensitive to the sweet taste response. [12]

Our results show significant relationship between taste dysfunction and HbA1c levels. An increase in taste threshold has been shown to be associated with hyperglycemia. [13]

A significant correlation between taste thresholds and plasma glucose concentration has been described in a previous study, suggesting that patients with T2DM are almost insensitive to the sweet taste response Individuals less sensitive to sweetness could be at risk of long-term health outcomes, such as diabetes, as they need to introduce more sugar compared to more sensitive people, to obtain the same taste sensation. [14]

Although there is no conclusive evidence suggesting that the decrease in sweet taste function in T2DM patients results from an alteration in glucose homeostasis, or vice versa, the reduced sensitivity to sweet taste might explain the development of a vicious circle leading to a deterioration of glycemic control. Different nutritional surveys have described the presence of a significant prevalence of sweet foods in the diet of elderly people [15].

Our study didn't show any correlation between taste dysfunction and type of treatment being taken by the patients. Though some previous studies showed some gender related differences in taste function among healthy and diseased individuals.9While in some previous studies gender-related differences in taste function among healthy and diseased individuals were recognized. Moreover, in agreement with Gondivkar et al., no correlation regarding side of stimulation was found; thus, taste function was equivalent on left and right sides of the tongue.

Limitation of the study was sample size of our study was relatively small, so the subject pool may not be entirely representative of general population.

Conclusion

The study found a significant correlation between taste dysfunction and HbA1C level and blood sugar fasting level in type 2 diabetes mellitus patients. Alteration in taste was mainly for sweet. Sour, and bitter did not show any difference in case groups compared to controls. The taste dysfunction was not related to gender, duration of T2DM or type of treatment being taken.

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