THE EVALUATION OF TASTE THRESHOLD FOR FOUR MAIN TASTES BETWEEN DIABETIC AND HEALTHY INDIVIDUALS

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Abstract

Background: Diabetes mellitus is a metabolic condition which affects multiple organs. Serious systemic complications of diabetes mellitus has led to multiple signs and symptoms which has affected dental care. Aim of the study: To assess therealationship between taste thresholds in type 2 diabetics and non-diabetics patients for four basic taste modalities. Patients and Methods: This single-blind case-control study was implemented on hundred diabetic patients who visited diabetes and endocrine center in Sulaimani; and hundred healthy individuals who visited Peramerd dental clinic, for detection of taste sensitivity for four primary tastes. Taste thresholds were detected by the whole mouth taste method and the use of five concentrations for each taste. Thus, the data were analyzed by Mann-Whitney U Test and Spearman’scorelation coefficient.

Results: Statistical analysis indicate taste threshold measured for each yielded normal range for all tastes in diabetic group(0.032molar for sucrose, 0.032for NaCl, 0.001molar for citric acid and 0.00001molar for quinine hydrochloride) but there was a significant difference in the perception of sweet and salt taste between the two groups(P<0.05).

Conclusions: Decreased sweet taste sensitivity may result in an increased preference for glucose in diabetic patients.

Keywords: Taste sensation, taste threshold, type 2 diabetes, non-diabetes

Introduction

Diabetes mellitus is a syndrome of abnormal carbohydrate, protein and fat metabolism which results in acute or chronic complications due to the absolute or relative lack of insulin and/or concomitant resistance to the metabolic action of insulin on target tissues (Shailesh et al 2004). Individuals
with diabetes have to take control over the disease and prevent complications. That is why there are organizations that are established to make diabetic persons more informed and motivated to stay as healthy as possible (Cepada and Viajanate2011). Diabetes mellitus is a set of related disease in which the body cannot regulate the amount of sugar, especially glucose in the blood. Therefore, it affects all age groups, but is more common in adults. It prevalence has increased dramatically over the past few decades and it is expected to triple in the next decade. Various inflammatory diseases and soft tissue pathologies in oral cavities are associated with diabetes mellitus. However, awareness of these complications is lacking worldwide (Al- Maskari et al 2011). The sense of taste is one important oral chemical sense that plays a critical role in human life. Taste threshold increases by the number of factors; however, one of them is diabetes mellitus (Khobragade et al 2011). Some researchers evaluated the change in sweet taste perception in these patients but because of diabetic neuropathy, there is possibility to change the perception of all four primary senses of taste in diabetic patients in comparison with non-diabetes (Navabi et al 2008). Type 2 diabetic patients and their first degree relatives showed significantly higher glucose threshold than the type one diabetic patients. Hence, these findings indicate that there may be a widespread impairment of cellular glucose recognition in type 2 diabetic and their relative (Lawson et al 1979). Taste impairment was found in diabetic group relative with control group; in diabetic group, taste impairment was significantly associated with the complications and duration of the disease (Abbasi, 1981). Therefore, this study was designed to assess the relationship between taste thresholds in type 2 diabetics and non-diabetics individuals for four basic taste modalities.

Patients and Methods

This study was carried out from November 2012 till March 2013. Hundred healthy individuals (26 males and 74 females) and 100 diabetic patients (28 males and 72 females) were chosen. This research was approved by the ethical committee of Research at the University of Sulaimani. The subjects were selected after a detailed history, taking and ruling out factors that could alter the taste sensation like: 1. Influenza, smoking and alcohol drinkers. 2. Hypertension or other systemic diseases except diabetes mellitus 3. Bad oral hygiene and denture wearing. 4. Medications except for diabetes mellitus. 5. Pregnancy, halitosis and burning mouth syndrome. The substances used for different taste modalities were: sweet taste (sucrose), salty taste (sodium chloride), sour taste (citric acid) and bitter taste (quinine hydrochloride) as shown in Table 1. Each solution was prepared in five different concentrations (20 bottles) by using distilled water, each bottle contains 1000cc of the specific tastant, and the solution was kept at room
temperature during the study. The preparation was done by pharmacologist. Before the tests began, the following precautions were taken: a. the subjects asked not to eat or drink any things except water at least one hour before the threshold measurement. b. the tests were carried out in the morning time between 9 a.m. to 11 a.m. c. at the time of testing, the entire procedure was explained to each subject. The taste sensitivity for each solution was carried out as a whole mouth taste method. Subjects were given 3cc of solutions of the lowest concentration to taste it for 30 seconds first and then tasted successive higher solutions until a definite taste was identified. Furthermore, the taste tube corresponding to the concentration was noted and tap water was used in between to rinse the tongue to remove the effect of the previous solution. Rinsing of the mouth was repeated till the subject declares that no taste of the previously tasted concentration lingers on the tongue. The actual threshold concentration was determined and then test tube number noted. Standard sequence was followed for taste recognition threshold i.e. sweet first, followed by salt and bitter taste solution.

The statistical analysis was done with the help of computer SPSS software package by using Man Whitney “U” test.

Table 1- concentration of the four solutions Sucrose, Sodium chloride, Citric acid and Quinine hydrochloride according to molarities:

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Sucrose</td>
<td>0.01</td>
<td>0.032</td>
<td>0.1</td>
<td>0.32</td>
<td>1</td>
</tr>
<tr>
<td>Sodium chloride</td>
<td>0.01</td>
<td>0.032</td>
<td>0.1</td>
<td>0.32</td>
<td>1</td>
</tr>
<tr>
<td>Citric acid</td>
<td>0.00032</td>
<td>0.001</td>
<td>0.0032</td>
<td>0.01</td>
<td>0.032</td>
</tr>
<tr>
<td>Quinine hydrochloride</td>
<td>0.0000032</td>
<td>0.00001</td>
<td>0.000032</td>
<td>0.0001</td>
<td>0.00032</td>
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</tbody>
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Results

In this present study, it was observed that in diabetic patients taste response to sweet taste at 0.032 and lower concentration (1,2) only 75 patients were able to recognize it, while 81 healthy individuals recognize it correctly. For higher concentrations that is 0.1 and above (3, 4, and 5), 25 diabetic and 19 healthy individuals recognize sweet taste properly. Generally, there is a statistically significant difference to sweet taste response between diabetic and control groups (P<0.05). As shown in Table 2, it was observed that at 0.01 molar (concentration 1), only 9 diabetic subjects were able to recognize salty taste, while 26 healthy subjects were able to recognize it correctly. In general, diabetic subjects were less sensitive than non-diabetic subjects for salty taste (P <0.05).

Table 2 shows that for taste sensation for sour taste at 0.001 and lower concentrations (1,2), 84 diabetics and 74 non diabetics were able to recognize it correctly, and for bitter taste at 0.00001 and lower
concentrations (1,2), 80 diabetic and 83 non-diabetic subjects were able to recognize it correctly. Generally, there is no statistically significant difference in sensitivity for sour and bitter taste between two groups (P>0.05). Also, there were no statistically significant difference between chronicity and sex and alter taste sensation between two groups.

Table 2: taste response to different concentrations of four solutions in both groups.

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</thead>
<tbody>
<tr>
<td>Sucrose</td>
<td>Non-diabetic</td>
<td>23</td>
<td>58</td>
<td>16</td>
<td>2</td>
<td>1</td>
<td>significant</td>
</tr>
<tr>
<td></td>
<td>Diabetic</td>
<td>10</td>
<td>65</td>
<td>15</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Sodium chloride</td>
<td>Non-diabetic</td>
<td>26</td>
<td>61</td>
<td>12</td>
<td>1</td>
<td></td>
<td>significant</td>
</tr>
<tr>
<td></td>
<td>Diabetic</td>
<td>9</td>
<td>71</td>
<td>9</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citric acid</td>
<td>Non-diabetic</td>
<td>17</td>
<td>57</td>
<td>22</td>
<td>4</td>
<td></td>
<td>Not significant</td>
</tr>
<tr>
<td></td>
<td>Diabetic</td>
<td>38</td>
<td>56</td>
<td>5</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quinine hydrochloride</td>
<td>Non-diabetic</td>
<td>26</td>
<td>57</td>
<td>13</td>
<td>4</td>
<td></td>
<td>Not significant</td>
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<tr>
<td></td>
<td>Diabetic</td>
<td>18</td>
<td>62</td>
<td>16</td>
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Discussions

The study conducted was mainly aimed at comparing the taste thresholds of diabetics and non-diabetics individuals. Based on the data available in this study, we conclude that taste acuity is partially disturbed in diabetic patients, and has contributed to increase in appetite for sweet and salty foods which is leading to malnutrition and poor prognosis. True ageusia is not frequent; as it never involved all tastes in any of our patients. Diabetic patients were unaware of their reduced taste acuity. However, none of the 100 diabetic patients in this study spontaneously noticed any taste alterations. The result shows that there is a significant difference between diabetic and non-diabetic individuals in sweet and salt taste sensations. This result was similar to studies done by Lawson et al(1979), Abbassi(1981) and Navabi et al(2008), but differs from the study done by Hardy (1981), who added that sweet and salt diabetic patients have less sensitivity to bitter taste. This study also differs from the study done by Khobragade et al (2011), he mentioned that diabetic patients have a reduction in taste acuity in all four tastes. Furthermore, Le Floch et al(1989) had mentioned about the deterioration of all four primary taste modalities. Diabetics have significantly accelerated levels of oxidative stress and this almost accounts for most complications, which include neuropathic, cardiovascular, retinal, and renal etc. (Ford and Herman, 1994). Some authors have shown that diabetes mellitus is a free radical mediated disease. Partial loss of taste function can take a variety of forms. Therefore, losses can be specific to one taste quality or to one tongue locus (Ameen, 2003). The other school of thought specifically points towards a significant and specific impairment in glucose taste detection. It is said that in diabetes, a taste abnormality for sugar might
conceivably be due to frequent elevations of blood glucose levels, i.e. a “Station effect” (Khobragade et al 2011). Thereby, the decreased taste sensitivity to glucose may result in an increased preference for glucose because more of the sugar would have to be ingested in order to produce the same taste sensation (Lawson et al 1979). Inherent or acquired defect of the taste receptor or abnormality of the mechanism underlying the central appreciation of taste within the brain or microangiopathy involving the taste buds may also be responsible for the taste impairment. The decrease in taste sensitivity may also reflect a generalized defect in cellular glucose sensitivity involving both the glucose sensing percentage beta cells as well as the specialized taste cells in the tongue (Bartoshuk, 1989). According to our study, the duration of the disease has no any effects in taste disturbance; this may be as a result of good control of the disease in these patients because of their periodic checkup by the physicians in the diabetic center from which the samples were taken. Sex also appears not to have a major influence on our results because sex was not strongly associated with the subject’s status or complications.

**Conclusion**

Evaluating of taste sensation shows that: 1. Diabetic patients have less sensitivity to sweet and salty taste than healthy individuals. 2. There were no differences in sour and bitter sensation between diabetic and healthy individuals and 3. Age, sex and duration of the disease have no effect on taste disturbance.

**References:**


Navabi N., Maryam Farzad and ArezoAlaeei. Taste threshold of four main tastes between healthy and diabetic individuals; Journal of Dental School, ShahidBahashti University of Medical Sciences 2008; 4, 420-425.