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Original Research Article

Study of Salivary Electrolytes in Diabetic and Non-Diabetic Patients with Active Caries

Mariam Faisal Aburuzaiza[1], Amal M. Aldeeb[2], Fathy M. Elfasakhany[3]

[1]Dental intern, [2]Professor of Oral Pathology, Department of Basic and Clinical Oral Sciences, Faculty of Dentistry, Umm Al-Qura University, Makkah, Saudi Arabia,
[3]Associate professor of Medical Biochemistry and Molecular Biology, Department of Basic and Clinical Oral Sciences, Faculty of Dentistry, Umm Al-Qura University, Makkah, Saudi Arabia, Department of Medical Biochemistry, Faculty of Dentistry, Tanta, Egypt.

Corresponding Author: Mariam Faisal Aburuzaiza

ABSTRACT

Background: Dental caries is a major oral health problem in most countries. It is defined as the breakdown of the hard tooth structure due to activities of bacteria. Diabetes mellitus is a chronic, life-long condition which occurs because either the pancreas can't produce enough insulin or the target cells in the body have become resistant to insulin. People with diabetes mellitus have predisposing factors to increased risk of dental caries. Saliva is an indicator of health of the oral cavity and containing many elements like sodium, magnesium, potassium and chloride that can be used as biomarkers. Salivary biomarkers are utilized to measure and evaluate the normal biologic and pathogenic processes, or pharmacologic responses.
Objectives: This study aimed to evaluate and compare the salivary electrolyte levels (K, Cl and Na) between caries active type 2 diabetes mellitus (T2DM) and caries active non-diabetic patients.
Materials and methods: This study included 40 randomly selected adult individuals classified into three groups, 10 caries free individuals (control group), 15 subjects with T2DM and active dental caries, 15 non diabetic patients with active dental caries. Analysis was performed using SPSS software version 17. DMFT score (Decayed, Missing, Filled Tooth) was calculated for each patient. Unstimulated saliva from each patient was collected into sterile tubes after the use of the mouth rinse with 15 ml of distilled water and salivary sodium, potassium and chloride were determined using Elyte 3 Kit and using spectrophotometric technique.
Results: Salivary potassium is significantly higher in T2DM with active caries than control group. There was no statistically significant difference of salivary Cl and Na between all groups (P >0.05).
Conclusions: It could be concluded that there is a positive relationship between salivary electrolyte levels (salivary potassium) and diabetes mellitus with dental caries than non-diabetic patients with active caries or the control subjects.

Key words: salivary sodium, potassium, chloride, dental caries, T2DM

INTRODUCTION

Oral health is Important and essential for the general health. The most common oral diseases that may affect our oral health are dental caries, periodontal disease, oral cancer, trauma from injuries and hereditary lesions. [1] Dental caries is a major oral health problem. It is the most prevalent disease worldwide. [2] Approximately 2.43 billion people (36% of the population) have dental caries in their permanent teeth. In baby teeth it affects about 620 million people or 9% of the population. [3] It is a breakdown of teeth due

to activities of bacteria. [4] This occurs due to production of acid from the fermentation of the dietary carbohydrates with bacteria present in the dental biofilm on the tooth surface leading to a loss of calcium and phosphate (demineralization) from the enamel. [5] Dental caries is usually associated with increased numbers of mutans streptococci and lactobacilli at the sites of disease; estimation of salivary levels of these organisms may be useful for assessing caries risk in patients and for monitoring their response to preventive measures. [6] Bacteria in a person's mouth convert glucose, fructose, and most commonly sucrose into acids such as lactic acid through a glycolytic process called fermentation. [7]

Many systemic diseases such as diabetes, arthritis, osteoporosis, and AIDS can directly or indirectly compromise oral tissues. People with theses systemic diseases especially diabetes mellitus always have predisposing factors to increase the risk of dental caries. Dental caries has been more prevalent and even severe in diabetic patients than non diabetics. [8]

The diabetic patients may also be at risk to infections, including dental abscesses that result from progressive dental caries. [9] Approximately 5% of all patients seen in dental clinics are reported to have diabetes. [10]

Diabetes mellitus is a group of metabolic diseases that affects the body's ability to use the energy. It is characterized by high blood sugar levels over a prolonged period. There are three types of diabetes: type 1 diabetes, type 2 diabetes, and gestational diabetes. [11] About 415 million adults have diabetes worldwide. From 2012 to 2015, approximately 1.5 to 5.0 million deaths each year resulted from diabetes. [12] Saliva is an indicator of the health of oral cavity. It is a watery substance (water forms 99.5%) secreted by the salivary glands. [13] It has electrolytes, mucus, white blood cells, epithelial cells, glycoproteins, enzymes and antimicrobial agents. [14]

Many elements like sodium, magnesium, potassium, chloride, zinc are present in the saliva. It is important to maintain the balance of electrolytes in the body. They are important for the cells to maintain voltage across their cell membranes and carry electrical impulses across themselves and to other cells. These electrolytes can be used as an indicator of normal biologic and pathogenic processes, or pharmacologic responses. [15] This study aimed to evaluate and compare the salivary electrolyte levels between caries active type 2 diabetes mellitus (T2DM) and caries active non-diabetic patients.

(Mithra et al, 2014) demonstrated that the salivary levels of electrolytes show a positive relationship between diabetics and non-diabetics with active dental caries. [16]

MATERIALS AND METHODS

Subjects: this study included 40 randomly selected adult individuals, 10 adult individuals who are caries free, 15 diabetic patients with active dental caries, 15 non diabetic patients with active dental caries.

Inclusion criteria: Type 2 Diabetic mellitus with age range from 20-65 years, Patients with active dental caries according to the DMFT index.

Exclusion Criteria: Patient with other systemic condition or under any medications, Patient under radiotherapy, Patients who have consumed alcohol or smoked during last 24 hours, Pregnant women, Patients taking any caries preventive regimen.

Calculation of DMFT: All surfaces of all teeth were cleaned, dried and clinical examination performed to determine the DMFT score. The teeth not counted to determine the DMFT score are unerupted teeth, congenitally missing teeth or supernumerary teeth, teeth removed for reasons other than dental caries, and primary teeth retained in the permanent dentition. When a carious lesion(s) or both carious lesion(s) and a restoration are present, the tooth is recorded as a D. When

a tooth has been extracted due to caries, it is recorded as an M. When a permanent or temporary filling is present, or when a filling is defective but not decayed, this is counted as an F.

Collection of saliva for salivary analysis: Unstimulated saliva from each patient was collected into sterile tubes after the use of the mouth rinse (15 ml of distilled water). 5ml of saliva was collected from each patient, centrifuged and the supernatant was stored at -20° C for subsequent analysis.

Determination of salivary electrolytes: salivary Na, K and Cl were performed using Elyte 3 Kit (Human Diagnostics, Wiesbaden, Germany).

Statistical analysis:

We used SPSS for Windows version 20.0 (SPSS Inc, Chicago, IL, USA) for data analysis. The comparison between means was tested using t-test and one-way ANOVA test. All the statistical analyses were performed considering $P < 0.05$ to be significant.

Table 1: Comparison of salivary K, Cl, Na ions between the control group, diabetics with active dental caries and Non-diabetics with active dental caries.

	Controls	Diabetics with active dental caries	Non-diabetics with active dental caries	*P*- value
Salivary K	10.96±3.29	16.89±6.97	10.33±4.49	0.004*
Salivary Cl	20.5530±8.7492	30.5773±22.42905	19.8133±8.12623	0.125
Salivary Na	8.53±5.79	17.89±20.19	14.41±7.69	0.252

Data are shown as mean ±SD.

Table 2: Two group comparison of salivary K, Cl and Na among studied groups

Variable	Group	*P*- value
K	Controls vs diabetics with active dental caries	0.02*
	Controls vs non-diabetics with active dental caries	0.710
	Non-diabetics with active dental caries vs Diabetics with active dental caries	0.005*
CL	Controls vs diabetics with active dental caries	0.194
	Controls vs non-diabetics with active dental caries	0.831
	Non-diabetics with active dental caries vs diabetics with active dental caries	0.092
Na	Controls vs diabetics with active dental caries	0.134
	Controls vs non-diabetics with active dental caries	0.106
	Non-diabetics with active dental caries vs diabetics with active dental caries	0.457

There was no significant differences between control group and diabetics with active dental caries in Na, Cl (*P*> 0.05). On the other hand there was a statistically significant difference of salivary K between control group and diabetics with active dental caries (**P*=0.02).There is no statistically significant differences of salivary K, Cl , Na between control group and non-diabetics with active dental caries regarding K, Cl , Na. (**P* value > 0.05).

There was no statistically significant differences between non-diabetics with active dental caries group and diabetics with active dental caries in Na, Cl (*P*> 0.05). On the other hand there was a statistically significant difference of salivary K between non-diabetics with active dental caries group and diabetics with active dental caries (**P*= 0.005).

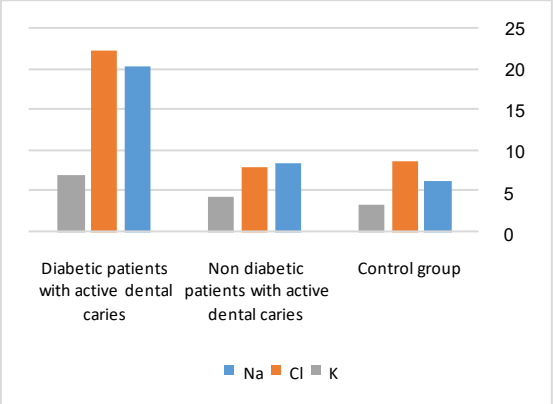

Fig. 1: Comparison between salivary Na, K, Cl levels in control group, non-diabetics and diabetics with dental caries.

RESULTS

Salivary electrolytes (Na, Cl and K) levels in studied groups:

The levels of the salivary electrolytes in diabetics patients with active caries was more than that in non diabetics with active caries. The mean value of salivary K ions in the control group was 10.96±3.29, in non-diabetics was found to be 10.33±4.49 and in

diabetic patients was 16.89±6.97. There was statistically significant difference between salivary K ion level in all the studied groups (P<0.05). Salivary Cl ions in the control group was 20.55±8.74, in non-diabetics was found to be 19.81±8.12and in diabetics was 30.57±22.42 as shown in table 2. There was no statistically significant difference of salivary Cl between all groups (P>0.05).
Regarding salivary sodium (Na) ions, its level in control group was 8.53±5.79, in non-diabetics was 14.41±7.69 and in diabetics was 17.89±20.19 as shown in table 3. There was no statistically significant difference of salivary Na between all groups (P>0.05)

DISCUSSION

Human saliva contains markers that have been found to be useful in the diagnosis of a variety of systemic disorders. The analysis of biochemical constituents in saliva is of great help in diagnosis of diseases in oral cavity. Several elements like sodium, magnesium, potassium, chloride, zinc are present in the saliva. It is important to maintain the balance of electrolytes in the body. These electrolytes can be used as an indicator of normal biologic and pathogenic processes, or pharmacologic responses. [15] Dodds et al (1997) concluded that caries activity is related to salivary electrolyte alterations, but not to protein composition. Salivary electrolyte alterations were demonstrated in the present study in the caries active patients more than the control. [17] Many studies have found that patients with diabetes are more susceptible to periodontal and salivary disorders, which could increase their risk for developing new and recurrent dental caries. [18]

In the present study the mean value of salivary electrolytes, sodium, potassium and chloride ion concentrations were higher in diabetic patients with dental caries than in non-diabetic individuals with dental caries. This results were in accordance with (Mithra et al, 2014) in which they concluded that salivary levels of electrolytes show a positive relationship between diabetics and non-diabetics with active dental caries. [10]

Chloride is the major ion found in the fluid outside of cells and in the blood. [19] In our study an increased level of chloride ion levels have been found in diabetic individuals than in non-diabetic individuals with non statistically significant differences (p value >0.05). Delaney et al (2000) concluded that this may be due to hyperchloremia, one of the complications involved in diabetes.

The mechanism behind the increased level of salivary electrolytes in our study is not fully understood and still necessitates extensive research. Some studies reported a significant high level of potassium and chloride ions in caries active groups. [17] Moreover, it is well established that diabetic patients have salivary gland hypofunction which makes them prone to decreased mucosal integrity and increase xerostomia, eventually categorized to high caries risk. [17]

Afrid et al (2008) demonstrated that sodium controls our body's fluid volume and maintains our acid-base balance or pH, nerve conduction, the passage of nutrients into our cells and our blood pressure. The increased level of sodium as a salivary modulator in diabetics has not yet been extensively studied and still requires more research. [20]

In the present study there was a significant difference of salivary K between non diabetic patients with active dental caries group and diabetic patients with active dental caries in favor of diabetic patients with active dental caries.

Chatterjee et al (2011) explained that Potassium is a vital electrolyte, both high and low levels are already associated with various medical conditions, including hypertension, cardiac arrhythmias, osteoporosis and nephrolithiasis and diabetic individuals. An extensive study on this salivary factor in diabetics has not been conducted yet. However, there are fairly strong associations between low serum potassium and increased diabetes risk. [21]

CONCLUSION

Our study showed that there is a positive relationship between salivary electrolyte levels, diabetes mellitus and dental caries and there is increase in salivary levels of electrolytes in diabetics patients with active caries more than that in nondiabetics patients with active caries.

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