The Effects of Sera and Salivary Glucose Levels on Oral Status in Diabetic Patients

Raghad H Al-Ani*[1], Hala A. Alwan[2], Ahmed Ayad Shehab[3], Sahar Hamdan Abdulghafoor[4]

Collage OF Dentistry, Al- Farahidi University, Baghdad, Iraq.
*Corresponding author email is: raghadhamdan@uoalfarahidi.edu.iq

Abstract

Introduction: DM is the most popular metabolic disease with implications of saliva. That increase oral infections susceptibility as periodontitis or dental caries, salivary hypofunction have been recognized particularly when there has been poorly controlled blood glucose ($C_6H_{12}O_6$) levels and dehydration in diabetes mellitus patients. **Aim** This study aimed to detect and correlate the salivary and plasma glucose levels as well as comparison the salivary pH that associated with increased risk of dental caries and periodontal diseases. **Material and Methods:** Group 1 (study group): include twenty (20) of diabetic patients, Group 2 (control group): include twenty (20) non diabetic participants, Fasting blood and saliva glucose levels and pH of saliva were measured by biochemical analyser and digital pH meter for each subject respectively. decay, missing, filled, treatment (DMFT)index and (PDI)index using to record Caries index andperiodontal diseasesrespectivly. **Results**: glucose levels in saliva were higher significantly among(group 1) diabetics incomparison with (group 2). it is a significant associationbetween glucose levels in saliva and plasma among study populations, that mean salivary levels of glucose can be used for predicting glucose level as a monitoring tool in DM patients. Decrease salivary pH mean of(6.51) in group 1(study group),in comparisonwith the normal mean of salivary pH of (7.21) in the group2(control group). The DMFT index and PDI index means (8.10 and 4.0) respectively was higher in the group1 when compared to that of group2 (1.15and 0.45) respectively. **Conclusion:** saliva glucose can be used as an indicator for diabetes. There was a significant association between the DM and development of periodontitis and dental caries. As well as a significant decrease in pH of saliva in DM patients in comparisonwithnon-diabetic subjects.

*Keywords***:** Diabetes mellitus, dental caries, periodontal disease, saliva pH and salivary glucose estimation.

Introduction

Heart, eyes, kidneys,blood vessels, various oral diseases and other organ systems with serious complications are associatedwith Diabetes mellitus (DM), patient's lifespan and life quality are markedly impaired. [1]Diabetes affects many people all over the world and the number is markedly increased.[2]DM is the most commonly metabolic disorder related with salivary complication.Thatincreased responsiveness to oral disease as periodontitis or dental caries, salivary hypo functionhave been recognized in this DM patients, especiallyat dehydration and poorly controlled blood glucose ($C_6H_{12}O_6$) levels. [3] However; there is non-adequateunderstandingabout the effects of DM on salivary and oralcomponents of patients with controlled DM and how the disease affects the patients.[4] The current conception in diabetic care is through the monitoring frequent of blood glucose use of short-acting insulin or oral hypoglycemic and a restricted diet.[5]

However, there are several external and internal factors affected the general health and especially oral health that contribute to DM. [6] salivary functions and composition is altered by DM, pathogenic bacteria initiates changes in oral environment, periodontal lesions and cariogenic activity increased by hard andsoft tissues damaging of the oral cavity,a protective effects is provided by Saliva,therefor, dental caries and periodontitis are developingwhen salivary functions decrease significantly.[7]Salivary pH is oftenaltered in patients with diabetes mellitus. [8] An acidogenic environment is associated with decrease salivary pH, this provides a good environment for growth of cariogenic acidemic bacteria which further to loweringpH of saliva causing a vicious cycle and leading to dental caries,as well as periodontitis produced due to an excessive inflammatory response to the periodontal microflora through DM. [9]periodentitis, is the most popularoral disease and a chief cause of losing a tooth, is due to a difference of oral plaque microorganisms. [10]Thisstudy aimed to detect and correlate the saliva and plasma glucose levels as well as comparison the salivary pHthat associated with increased riskof dental caries and periodontal diseases

Material and methods

This study was manage in the dentistrydepartment, Ibn Hayyan UniversityCollege from January to March 2017 a total of forty (40) subject (age ranges 20-40) male and female, the informed consent and institutional ethical clearance were takenfrom the samples. Two groups of participantswas included in this study:

Group 1 (study group):include twenty(20)of diabetic patients, a fasting blood glucose greater than (120mg/dl), with adisease duration of more than 2 years.

Group 2 (control group):include twenty (20) non diabetic participants, with age matched to diabetic group. The patients and participant detailed history was taken, including drug andpersonal history with allergies. Subjects were examined clinically and assessed for periodontal status and dental caries using the Decay, Missing, Filled, Treatment (DMFT) index and the Periodontal Disease Index (PDI). Levels of fasting blood glucose were estimated in serum and saliva. The samples collection of unstimulated whole salivary doneby spitting method from subjects in eachgroup, waiting for ten minutes, to prevent sample dilution before collection,for15 minutes every five minutes, a sterile container used to collect saliva by askedsubjects to bend their head forward to accumulated saliva in the mouth floor and expectorate it on. Samplessalivary pH was immediately analyzed using the pH meter.

Determination of salivary and plasma glucose

Glucose levels estimation in salivary andplasmawere done by ancolorimetric enzymatic test kit, by glucose oxidase-peroxidase method (GOD-POD method).

Statistical analysis

The Statistical package for social sciences (SPSS) program was used, data were entered and analyzed with appropriate statistical tests. Descriptive statistics were presented as frequencies, proportions, mean and

standard deviation (SD). Levels of (P value) ≤0.001, and ≤0.05 considered ashighly significant andsignificant respectively. Finally all findings and results are presented in tables with explanatory paragraphs accordingly.

Results andDiscussion

Twenty diabetic and twenty ofparticipant subjects were participated. Table1 showed that the mean fasting blood sugar (FBS) level in the group1 was (167.06 ± 12.24 mg/dl) and group2was (78.94 ± 8.50 mg/dl), the mean of glucose levels in saliva wasgreater in the group1(DM pateints) (13.96 ± 7.09 mg/dl) compared togroup 2(control) (4.61 ± 2.58 mg/dl) as shown in table 1 . low mean of salivary pH (6.5 ± 0.71692) was shown in group2 compared to the group1 (7.21 ± 0.279117) and the mean PDI (4±1.589) and DMFT (8.1 ± 2.875) score were greater in group 1than group 2 whose PDI and DMFT score were (0.45±0.105) and(1.25 ±0.461) respectively as shown in table 2. t-test of independent sample showed that a significantly mean difference between group1 and group2, (p-valve of <0.05).

Table1:salivary and FBS glucose in the studies groups.

variables	Group	No.	Mean	SD	P value
FBS (mg/dl)	1	20	167.06	12.24	<0.03
	2	20	78.94	8.50	<0.03
Salivary glucose (mg/dl)	1	20	13.96	7.09	<0.04
	2	20	4.61	2.58	<0.03

Table 2:Comparisonbetween mean salivary pH, PDI and DMFT between group1 and group2.

Parameter	Group	N	Mean	SD	P value
Saliva PH	1	20	6.5	0.716	<0.03
	2	20	7.21	0.279	<0.02
DMFT	1	20	8.1	2.875	<0.04
	2	20	1.25	0.461	<0.01
PDI	1	20	4	1.589	<0.03
	2	20	0.45	0.105	<0.03

(p<0.05 – Statistically Significant)

DM is a chronic metabolic disorder, which have numerous systemic and oral manifestations. They include oral mucosal, salivary dysfunction, dental caries and other oral infections, gingivitis, periodontitis, taste and many disorders. [11]In (DM), Advanced Glycation End Products (AGEs) is anonreversible glycated

proteins accumulated in the tissues including periodontium due to chronic and prolonged hyperglycaemia, thus wound healing and increased periodontal tissue destruction caused by accumulation of this protein. This study evaluated effects of salivary pH on periodontal status and dental caries of DM patients, then comparing them with control subjects. [8] The pH in oral cavity remains by saliva near neutrality (6.8-7.2). There are two mechanisms that maintain salivary pH: In first mechanism carbohydrates are eliminated by salivary flow, as bacterial acid –that is produced when bacteria metabolizing carbohydrates - is removed. In second mechanism, salivary buffers neutralize the microbial activity and the acidity formed by drinks and food [8].The salivary pH mean was compared between control group and diabetics. DM samples have decreased salivary pH when comparing it with control group.This decrease is due to metabolic changes in DM patients leading to acidic PH. In diabetes bicarbonates level decreased in all body fluids resulting in metabolic acidosis. This explains the reason why DM patients have acidic saliva. [12]Abikshyee*et al*. (2012) showed in his similar study an elevation levels of glucose in saliva when increased plasma level.[13]López*et al* (2003) proposed that blood glucose can be filtered by salivary glands which may be changed by neural or hormonal regulation.[14] Qureshi *et al*. (2007) proposed that increasinglevel of salivary glucose of DM patients is due to increased glucose leakage from salivary gland ductal cells.[15] This is due to basement membrane change in DM patients, in addition to blood vessels microvascular changes. Hyperglycemia caused an (AGEs) products formation, which will crosslink proteins, like extracellular matrix proteins and collagen, resulting in endothelial dysfunction and alteration of basement membrane, that make them more permeable.[16] This result is similar toBelazi*et al*. who suggested that basement membrane permeability increases in DM patients may enhance smaller molecules (like glucose) leakage via gingival crevices into whole saliva. [17]DM Patients had a high DMFT score when comparing them with the control group. due to loss of salivary protective mechanism. In addition to impairment of the buffering and cleansing action of saliva. Low pH of saliva promotes aciduric bacteria growth which allows the proliferation of acidogenic bacteria that create an unwelcoming environment for the protection effects of oral bacteria. This make balancein oral environmental shift to decrease the PH of saliva and continues the cycle by cariogenic bacteria,.[18] Cariogenic bacteria thrive more in acidic environment. In addition risk factors like reduced salivary flow rate, increase the level of blood glucose, buffering capacity, dental caries risks increased by poorly diet control in DM patients.A study done by Elkafri et al., Deepak Goyal et al., Rai K et al., Ciglar et al., who proposedthat a decrease in PH of saliva and an increase in dental caries in DM patients [18, 19]periodontal disease increased in Group 1 with DM than the group 2 control group when the periodontal status was compared. change in the microvascular integrity isone of the major complications of DM thatat higher risk of periodontal disease (gingivitis and periodontitis).There aresimilarity between our study andPoplawaska-Kita *et al*., study who proposed that there is association between   periodontitis andDM[20]as well as, in this study increase periodontal-pathogens growing due todecrease in Ph of saliva which is in similarto the study done byGalgut, Fujikawa*et al*.,andTakahashi *et al*.[21, 22]that was founda significantly association between DMFT and salivary pH and between PDI and salivary pH, which proposed that when the salivary pH is decreased (acidic), the occurrence of dental caries increased. These resultsis in line with Michelle Hurlbutt*et al*., study who proposed that decrease pH of

salivaencouragethe oral cavity cariogenic lesions. [23,24] Similarly, salivary pH in patients with periodontal disease is less than group 2(control), which is the same toSharmilaBaliga*et al*. study, who proposed that salivary pHmore acidic with chronic generalized periodontal disease patients than those control group [8] This is similar Takahashi et al. study, who proposed that an acidic pH isa favourable environment for microorganism growing which are responsible for periodontal disease such as*p.intermedia* ,*P. gingivalis* and *F. nucleatum*are growing at a pH of (5.0-7.0,6.5-7.0 and 5.5-7.0) respectively.[23]

Conclusion: saliva glucose level can be used as an indicator for diabetesmeletus. There is a significant association between the DM and developmentof periodontitis and dental caries. As well as a significant decrase in the pH of saliva in DM patients in comparison with non-diabetic subjects.

References

1. Little RR, Goldstein DE. Endocrine (standardization of glycohemoglobin measurement) Anal chem. 1995; 67(12):393R–397R.

2. World Health Organization, International Diabetes Federation. Diabetes Action Now. Geneva: World Health Organization; 2004. [Accessed August 12, 2008].

3. Leite RS, Marlow NM, FernandesJK, Hermayer K "Oral health and type 2 diabetes" The American Journal of the Medical Sciences, vol. 345, no. 4, pp. 271–273, 2013.

4. Buyuk B, Parlak SN, Keles ON*et al*. "Effects of diabetes on post-menopausal rat submandibular glands: a histopathological and stereological examination," Eurasian Journal of Medicine, vol. 47, no. 3, pp. 199–207, 2015.

5. Alavi AA, Amirhakimi E, Karami B. "The prevalence of dental caries in 5-18 year-old insulin-dependent diabetics of Fars Province, southern Iran," Archives of Iranian Medicine, vol. 9, no. 3, pp. 254–260, 2006.

6. Canepari P, Zerman N, Cavalleri G. "Lack of correlation between salivary Streptococcus mutans and lactobacilli counts and caries in IDDM children," Minerva Stomatologica, vol. 43, no. 11, pp. 501–505, 1994.

7. Devi TJ. Saliva-A Potential Diagnostic Tool. IOSR Journal of Dental and Medical Sciences. 2014; 13(2):52–57.

8. Baliga S, Mugilkar S, Kale R. Salivary pH: A diagnostic biomarker. J Indian SocPeriodontol. 2013; 17(4):461–65.

9. Lamster IB, Lalla E, Borgnakke WS, Taylor GW. The relationship between oral health and diabetes mellitus. J Am Dent Assoc. 2008; 139(10 supply):19S–24S.

10. Masayuki Ueno, Susumu Takeuchi, Akiko Oshiro, Kayoko Shinada, SatokoOhar, Yoko Kawaguchi. Association between Diabetes Mellitus and Oral Health Status in Japanese Adults ,Int J Oral Sci, 2(2): 82–89, 2010

11. Bangash RY, Khan AU, Tariq KM, Yousaf A. Oral aspects and complications in type 2 diabetes mellitus – a study. Pakistan Oral & Dental Journal. 2012; 32(2):296-99

12. Prathibha KM, *et al*. Evaluation of salivary profile among adult type 2 diabetes mellitus patients in South India, Journal of Clinical and Diagnostic Research 2013;7(8):1592-95.

13. Abikshyeet P, Ramesh V, Oza N. Glucose estimation in the salivary secretion of diabetes mellitus patients. Diabetes MetabSyndrObes. 2012; 5:149–54.

14. Nagalaxmi V, Priyanka V. Can saliva be a marker for predicting type 1 diabetes mellitus?-A pilot study. J Indian Acad Oral Med Radiol. 2011; 23(4):579–82.

15. Qureshi A, Qureshi A, Qureshi H, Khan AA. Blood glucose level, salivary pH and oral bacterial count in type 1 diabetic childrens. Dis J. 2007; 16(2):45–8.

16. SreedeviShashikanth MC, Shambulingappa P. Comparison of plasma glucose and salivary glucose in diabetic patients. J Indian Acad Oral Med Radiol. 2008; 20(1):9–13.

17. Dodds MW, Yeh CK, Johnson DA. Salivary alterations in type 2 (non-insulin-dependent) diabetes mellitus and hypertension. Community Dent Oral Epidemiol. 2000; 28(5):373–81.

18. Goyal D, Kaur H, Jawanda MK, et al. Salivary pH and dental caries in diabetes mellitus. International Journal of Oral & Maxillofacial Pathology. 2012; 3(4):13-16.

19. Elkafri IH, Mashlah A, Shaqifa A. Relationship between blood glucose levels and salivary pH and buffering capacity in type II diabetes patients. East Mediterr Health J. 2014; 20(2):139-45.

20. Popławska-Kita A, Siewko K, Szpak P, Król B, Telejko B, Klimiuk PA, et al. Association between type 1 diabetes and periodontal health. Adv Med Sci. 2014; 59(1):126-31.

21. Takahashi N, Schachtele CF. Effect of pH on the growth and proteolytic activity of Porphyromonasgingivalisand Bacteroidesintermedius J Dent Res 1990; 69:1266–69.

22. Galgut PN. The relevance of pH to gingivitis and periodontitis. J IntAcad Periodontal. 2001; 3:61–67

23. Hurlbutt M, Novy B, Young D. Dental Caries: A pH-mediated disease. Canadian Dental Hygienists' Association. Winter 2010.

24. Arati S. Panchbhai1, Correlation of Salivary Glucose Level with Blood Glucose Level in Diabetes Mellitus. J Oral Maxillofac Res 2012 (Jul-Sep) | vol. 3 | No 3 | e3 | p.1