



Evaluation of correlation between Salivary pH and prevalence of Dental Caries in subjects with and without Diabetes Mellitus

Arul A Sri Kennath J¹, R Sanjay² and Palanivelu Peramachi¹

¹Department of Molecular Microbiology, School of Biotechnology, Madurai Kamaraj University, Madurai, Tamil Nadu, INDIA

²Department of Botany, the American College, Madurai, Tamil Nadu, INDIA

Available online at: www.isca.in, www.isca.me

Received 29th November 2013, revised 25th January 2014, accepted 31st March 2014

Abstract

The relationship between diabetes mellitus and dental caries, particularly among adults has received far less attention. However, a consistent relationship between diabetes mellitus, dental caries and salivary pH is lacking. Therefore, the correlation between salivary pH and caries prevalence in non-diabetics and diabetics was evaluated. Fasting blood glucose level and salivary pH for each subject were measured and caries index was recorded as DMFT index. The results show that a decreased salivary pH and an increased incidence of dental caries in subjects with uncontrolled diabetes as compared to control group and those with controlled diabetes. Decreased salivary pH and increased dental caries rate was observed in subjects with controlled diabetes as compared to control group. Thus, diabetes mellitus may have a direct effect on salivary pH, reducing it from normal levels irrespective of diet.

Keywords: Dental caries, diabetes mellitus, diet, DMFT, salivary pH.

Introduction

Diabetes mellitus (DM) characterized by sustained hyperglycemia affects multiple organ system together with the oral cavity^{1,2}. The oral manifestations include xerostomia, gingivitis, periodontitis, odontogenic abscess, dental caries and opportunistic infections of tongue and oral mucosa³. DM has also been related to increased carriage of pathogens in saliva^{4,5}.

The link between diabetes and dental caries, particularly among adults has received far less attention. Some studies have demonstrated increased caries incidence in diabetics⁶; while other have shown similar or decreased caries rate^{7,8}. However, the literature lacks unswerving relationship between the two. Similarly its relation to salivary pH is not clearly understood. With this aforementioned problem in mind, the correlation between salivary pH and caries prevalence in non-diabetics and diabetics was evaluated.

Material and Methods

The study was approved by the Institutional Review Board of Madurai Kamaraj University at Madurai, Tamil Nadu (India) on activities involving human subjects.

Sample Collection: A total of 150 subjects (45-70 years) were enrolled in the study with their informed consent and were categorized as per WHO Criteria⁹ into:

Group I: 50 subjects with no known history of diabetes mellitus and a fasting plasma glucose level less than 100 mg/dl (Control group).

Group II: 50 subjects who had a known history of type 2 diabetes mellitus with fasting plasma glucose levels less than 126 mg/dl and were under medication (Controlled Diabetic Group).

Group III: 50 subjects with a known history of type 2 diabetes mellitus with fasting plasma glucose levels greater than 126 mg/dl and were under medication (Uncontrolled Diabetic Group).

Morning blood and salivary samples were collected from each subject. Glucose levels were estimated by blood glucose monitoring system (Johnson and Johnson; One Touch). The subjects were asked to abstain from any oral hygiene method prior to saliva collection. Unstimulated saliva was collected in a dappen glass and immediately following that, HiIndicator pH paper (HiMedia LA318-1PX) was used to measure salivary pH, in to avoid any time-related changes in the pH value.

World Health Organization (WHO) probe and a mouth mirror were utilized for the dental examination. To calculate DMFT caries index, the examiner recorded the teeth as decayed (D), missing (M), and filled (F) as per the WHO criteria. The sum of decayed, missing, and filled teeth for each patient gave the overall DMFT value. Mean of salivary pH scores and DMFT scores were taken individually for each group and the data for all the values were skewed and non parametric tests were applied.

Results and Discussion

Results: The fasting blood glucose of subjects in the group I ranged from 76-98 mg/dl with a mean of 88.88 ± 5.63 mg/dl, in group II ranged from 114-125 mg/dl with a mean of 120.98 ± 2.20 mg/dl; while in group III ranged, it from 186-225 mg/dl with a mean of 215.24 ± 9.67 mg/dl.

The salivary pH values of subjects in group I ranged from 7.0 to 7.5 with a mean of 7.4 ± 0.20 . Similarly, salivary pH values of subjects in group II ranged from 6.5 to 7.0 with a mean of 6.7 ± 0.24 and salivary pH values of subjects in group III ranged from 5.5 to 6.0 with a mean of 5.7 ± 0.24 . The DMFT score of subjects in group I ranged from 1 to 4 with a mean of 2.74 ± 0.96 . Similarly, DMFT score of subjects in group II ranged from 4 to 6 with a mean of 4.86 ± 0.75 and that in group III ranged from 6 to 10 with a mean of 7.76 ± 1.02 (table 1).

Mean salivary pH value was 6.7 for group II and 7.4 for cases in group I. The difference in mean pH value between Group II and Group I was significant ($t = 15.50, p < 0.01$). The mean pH value, 5.7 for Group III was significantly less than that of Group I ($t = 37.6, p < 0.01$) and Group II ($t = 20.2, p < 0.01$). Thus salivary pH value was significantly at much lower level for the uncontrolled diabetic patients.

Mean DMFT score was 4.86 for Group II and 2.74 for cases in Group I. The difference in mean DMFT score between Group II and Group I was significant ($t = 12.23, p < 0.01$). The mean DMFT score, 7.76 for Group III was significantly more when compared to that of control, Group I ($t = 16.1, p < 0.01$) and Group II ($t = 16.14, p < 0.01$). Thus, the DMFT score was significantly higher for uncontrolled diabetic patients.

Therefore, as per the results, dental caries prevalence is more in patients with uncontrolled diabetes; and salivary pH value became acidic as disease state progressed from non-diabetics to uncontrolled diabetics.

Discussion: Diabetes has emerged as a major health care problem in the world, with high degree of morbidity and mortality related to multiple organ systems involvement. Like

other organs; the oral cavity show changes related to the disease; and oral infections may adversely affect metabolic control of the diabetic state. The intimate relationship between the oral health and diabetes suggests a need for assessment of oral clinical parameters in such patients. Therefore, in the present study salivary pH was determined in non diabetics and diabetics; and the possible difference in the occurrence of dental caries was evaluated. To avoid the effect of diet, blood samples were obtained during fasting state and unstimulated saliva of subjects was collected for monitoring salivary pH. DMFT index was selected so to measure the dental caries rate in these subjects.

The present study demonstrated that when the uncontrolled diabetics were compared with the control group and those with controlled diabetes in terms of the clinical parameters assessed; the uncontrolled diabetics had decreased salivary pH values and increased DMFT score. This may be attributed to the changes in the metabolic processes of the uncontrolled diabetics due to higher glucose levels, resulting in a more acidic environment and thus increased incidence of dental caries.

In agreement to the present study results, a study reported significantly lower salivary pH and significantly higher DMFT index in patients with type 1 and type 2 DM as compared to the normal subjects. The effect could be secondary to decreased salivary flow rates and pH value that leads a series of caries risk factors especially if the disease is inadequately controlled and uncontrolled¹⁰. Association of dental caries and poor control of DM has been reported and in such individuals, the presence of yeasts may be a caries risk indicator¹¹.

As per the study comparing the salivary flow rate, pH and its buffering capacity between subjects with type 2 DM and control concluded that, the metabolic control of hyperglycemia was not sufficient to improve the salivary flow rate or the salivary glucose concentration¹². Another study on type 1 DM supported the view that, evaluation of salivary flow rate and buffer capacity is recommended when assisting diabetic children¹³.

Table-1
Mean and standard deviation values of the clinical parameters obtained in all the three groups

Group	Mean fasting blood glucose levels (mg/dl) \pm S.D	Mean salivary pH values \pm S.D	Mean DMFT score \pm S.D
Group I (Control)	88.88 ± 5.63	7.4 ± 0.20	2.74 ± 0.96
Group II (Controlled Diabetics)	120.98 ± 2.20	6.7 ± 0.24	4.86 ± 0.75
Group III (Uncontrolled Diabetics)	215.24 ± 9.67	5.7 ± 0.24	7.76 ± 1.02

In contrast, a study reported that, patients with DM had fewer caries and plaque, lower salivary flow rates and buffering effect and more frequent growth of yeasts than the control group. Patients with well-to-moderately controlled diabetes had fewer decayed surfaces and lower mutans streptococci counts than those with poorly controlled disease¹⁴. Further, no difference in salivary flow rates, organic composition of saliva, acidogenic bacteria counts in saliva, or coronal and root caries rates was seen when comparing control group with type 2 DM individuals. Such findings suggest that individuals with diabetes as a group are similar to healthy subjects in regard to these oral conditions^{15,16}.

Since both controlled and uncontrolled diabetics showed a significant decrease in salivary pH, the present study suggests that diabetes may have a direct effect on salivary pH reducing it from normal levels irrespective of diet thus influencing the oral environment.

Conclusion

Since the insidious nature of the type 2 diabetes mellitus allow prolonged periods of hyperglycemia to begin exerting negative effects on various organ system including oral cavity; adequate measures to prevent the dental caries in these patients at early stage are necessary. Understanding the implications of diabetes mellitus on the oral health is therefore, must for the dental professionals.

References

1. Kumar V., Abbas A.K., Fausto N. Robbins and Cotran Pathologic Basis of Disease. 7th edition. Thoma Press Ltd: Noida, 1189 (2004)
2. Greenberg M.S. and Glick M. Oral Medicine: Diagnosis and Treatment, 10th ed. Harcourt Private Limited: New Delhi, 563 (2003)
3. Reddy C.V.K. and Maurya M., A comparative study to assess the oral health status and treatment needs of diabetics and non-diabetic population attending some of the hospitals in Mysore City, *JIAPHD*, **12**, 1-14 (2008)
4. Khovidhunkit S.P., Suwantuntula T., Thaweboon S., Mitirattanakul S., Chomkhakhai U., Khovidhunkit W., Xerostomia, hyposalivation, and oral microbiota in type 2 diabetic patients: a preliminary study, *J Med Assoc Thai.*, **92**, 1220-1228 (2009)
5. Newman M.G., Takei H., Carranza F.A. and Klokkevold P.R., Clinical Periodontology, 10th ed. Philadelphia: Saunders Elsevier, 113-131 (2003)
6. Jones R.B., McCallum R.M., Kay E.J., Kirkin V. and McDonald F., Oral health and oral health behavior in a population of diabetic clinic attenders, *Community Dent Oral Epidemiol.*, **20**, 204-207 (1992)
7. Tenovuo J., Alanen P., Larjava H., Viikari J. and Lehtonen O.P., Oral health of patients with insulin dependent diabetes mellitus. *Scand J Dent Res.*, **94**, 338-346 (1986)
8. Tavares M., DePaola P., Soparkar P. and Joshipura K., Prevalence of root caries in a diabetic population, *J Dent Res.*, **70**, 979-983 (1991)
9. Definition and diagnosis of diabetes mellitus and intermediate hyperglycemia: Report of a WHO/IDF consultation. World Health Organization Press: Geneva, (2006)
10. Ciglar I., Sutalo J., Sjaljac-Staudt G. and Bozиков J., Saliva as a risk factor for caries in diabetic patients, *Acta Stomata Croat.*, **25**:143-149 (1991)
11. Karjalainen K.M., Knuutila M.L. and Kaar M.L., Relationship between caries and level of metabolic balance in children and adolescents with insulin-dependent diabetes mellitus, *Caries Res.*, **31**,13-18 (1997)
12. Bernardi M.J., Reis A., Loguercio A.D., Kehrig R., Leite M.F. and Nicolau J., Study of the buffering capacity, pH and salivary flow rate in type 2 well-controlled and poorly cotrolled diabetic patients, *Oral Health Prev Dent.*, **5**, 73-78 (2007)
13. Moreira A.R., Passos I.A., Sampaio F.C., Soares M.S.M. and Oliveira R.J., Flow rate, pH and calcium concentration of saliva of children and adolescents with type I diabetes mellitus, *Braz J Med Biol Res.*, **42**, 707-711 (2009)
14. Siudikiene J., Machiulskiene V., Nyvad B., Tenovuo J. and Nedzelskiene I., Dental caries and salivary status in children with type 1 diabetes mellitus, related to the metabolic control of the disease, *Eur J Oral Sci.*, **114**, 8-14 (2006)
15. Meurman J.H., Collin H.L., Niskanen L., Töyry J., Alakuijala P. and Keinänen S., et al., Saliva in noninsulin-dependent diabetic patients and control subjects, The role of the autonomic nervous system, *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.*, **86**, 69-76 (1998)
16. Collin H.L., Uusitupa M., Niskanen L., Koivisto A.M., Markkanen H. and Meurman J.H., Caries in patients with non-insulin-dependent diabetes mellitus, *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.*, **85**, 680-685 (1998)