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ORIGINAL RESEARCH

Salivary Output in Type 2 Diabetic Patients

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ABSTRACT

Background: Diabetes mellitus (DM) is a common but complex metabolic disorder affecting various systems in the body. Oral cavity is no exception as this chronic condition exerts a huge impact on oral health. Salivary dysfunction has been reported to be a frequent oral complication in type 2 diabetics which in turn leads to an array of oral complications because oral health is to a greater extent dependent on the quality and quantity of saliva.

Aim: The aim of the present study was to evaluate and compare the salivary flow rate and prevalence of subjective symptoms of xerostomia in diabetics and nondiabetics.

Materials and methods: The study was conducted on 100 type 2 diabetic patients and 50 nondiabetic subjects. Random nonfasting plasma glucose and glycosylated hemoglobin levels were used to determine the diabetic status of the individuals. Unstimulated saliva was collected using 'Spit technique'. Stimulated saliva was collected using 2% citric acid. Unstimulated and stimulated salivary flow rate (USFR and SSFR) was calculated for every patient and expressed as ml/min. Xerostomia was evaluated using a multi-item inventory comprising 19 questions.

Results: In our study, both whole unstimulated and stimulated salivary flow rates were decreased in diabetics compared to nondiabetics and this difference was statistically significant ($p = 0.000$). A greater percentage of diabetic patients perceived xerostomia symptoms compared to nondiabetics.

Conclusion: Type 2 diabetics have higher prevalence of xerostomia and significantly reduced salivary flow rate compared to nondiabetics. Alterations in salivary flow create an imbalance in the homeostasis of oral environment leading to spectrum of oral ailments in these individuals.

Keywords: Type 2 diabetes, Saliva, Flow rate, Xerostomia, Oral.

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INTRODUCTION

DM is a clinically complex metabolic disorder characterized by chronic hyperglycemia and long-term systemic dysfunction. Widespread multisystem damage is the ultimate consequence of this disease leading to an array of manifestations collectively termed as 'Diabetic complications' namely macroangiopathy, microangiopathy and nephropathy.[1]

Type 2 diabetes is an established risk factor for periodontitis which has been designated as the sixth complication of diabetes.[2] Diabetes causes a wide spectrum of oral manifestations which include xerostomia, sialosis, dental caries, fungal infections, taste impairment, decreased resistance to infections and delayed wound healing.[1]

Saliva is an essential biological oral fluid which plays a crucial role in maintaining homeostasis of the oral cavity. Saliva is important for lubrication, digestion, mastication, taste, speech, deglutition and antibacterial action.[3] Oral health is to a greater extent dependent on quality and quantity of saliva, both of which may be altered in diabetics. Decreased salivary flow causes significant oral discomfort and leads to increased susceptibility to dental caries, oral candidiasis, altered taste sensation and host of other abnormalities.[4]

Though numerous studies have evaluated the association between type 2 diabetes and salivary flow, the knowledge of the effect of diabetes on salivary function remains equivocal. In the present study, the authors investigated both unstimulated and stimulated salivary flow rate and prevalence of subjective symptoms of xerostomia in 100 type 2 diabetic patients.

MATERIALS AND METHODS

Subjects and Study Design

Diabetic patients (n = 100) attending the Department of Diabetology, Voluntary Health Services, Chennai, India were included in the study. Control group comprised of fifty age-matched nondiabetics who attended the Department of Oral and Maxillofacial Pathology, Ragas Dental College for routine dental treatment such as oral prophylaxis and restorations. Verbal consent was obtained from every participant of the study. The study was approved by the Institutional Review Board of Ragas Dental College and Hospital.

The study subjects were divided into three groups: Controlled diabetics (n = 50) of 40 to 60 years of age

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who were being treated for diabetes and had random nonfasting plasma glucose (RNFPG) values >120 mg/dl and ≤200 mg/dl constituted group I, Uncontrolled diabetics (n = 50) of 40-60 years of age who were being treated for diabetes and had RNFPG values >200 mg/dl were included in group II and nondiabetics (n = 50) who were age- matched with groups I and II, with RNFPG ≥80 mg/dl and ≤120 mg/dl constituted group III.

Diagnostic Criteria for Diabetes

All diabetic subjects in this study had been diagnosed and were being managed for diabetes at the voluntary health service using established criteria. (The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus, 2003).[5] For this study; 2 ml of peripheral venous blood was obtained from every patient. Glucose-oxidase method was used for estimation of RNFPG levels. Subjects with RNFPG ≥200 mg/dl were diagnosed as diabetics. Glycosylated hemoglobin (HbA1c) was also measured using the ion-exchange resin method, which further confirmed the level of glycemic control in the diabetic patients.

Estimation of Salivary Flow Rate

Salivary samples were collected 2 hours after the subject's breakfast. All the participants were instructed to refrain for a duration of 2 hours before sample collection. 'Spit technique' was used for collection of unstimulated saliva.[6] The patient was made to sit in the dentalchair with head tilted forward. They were instructed not to speak, swallow or do any head movements during the procedure. The patient was instructed to spit in a sterile graduated container every minute for 10 minutes.

Two percent food grade citric acid was used to collect stimulated saliva. Citric acid was applied to the dorsolateral surface and the tip of the tongue every 30 seconds, and patient was instructed to spit the pooled saliva into a sterile container without swallowing, for 3 minutes. Salivary flow rate was calculated for every patient and expressed as ml/min.

Assessment of Xerostomia

Detailed case history was obtained following which the subjective symptoms of xerostomia was evaluated using a multi-item inventory comprising 19 questions pertaining to dryness of mouth (#).

THE XEROSTOMIA INVENTORY (#)

1.	Often my mouth feel dry	Yes/No
2.	I sip liquids to aid swallowing	Yes/No
3.	I get up in night to drink water	Yes/No
4.	My mouth feels dry while eating	Yes/No
5.	My mouth feels dry always	Yes/No
6.	Difficulty while eating	Yes/No
7.	I suck lollies	Yes/No
8.	Difficulty in swallowing certain foods	Yes/No
9.	Skin of my face feel dry	Yes/No
10.	My eyes feel dry	Yes/No
11.	My lips feel dry	Yes/No
12.	The inside of my nose feel dry	Yes/No
13.	Burning sensation in gums	Yes/No
14.	Burning sensation in tongue	Yes/No
15.	I feel itching sensation in tongue	Yes/No
16.	I feel itching sensation in gums	Yes/No
17.	I feel burning sensation in mouth	Yes/No
18.	I feel taste alterations	Yes/No
19.	I feel pain in jaws while eating	Yes/No

Statistical Analysis

Statistical package for the social sciences (SPSS, version 11) software was used for Data entry, database management and all statistical calculations. Descriptive statistics were calculated for all variables. Differences in proportions were assessed using the Chi-square test or fisher exact test. Differences in means between more than two groups were assessed using the analysis of variance (ANOVA) and the Kruskal-Wallis H test when the data was not normal. A p-value of <0.05 was considered to be statistically significant.

RESULTS

The study population included 150 subjects divided into 3 groups of 50 each (group I, II and III). The mean unstimulated and stimulated salivary flow rate (USFR and SSFR) were significantly higher in group III (USFR = 0.41 ± 0.06 ml/min, SSFR = 0.89 ± 0.16 ml/min) than in group I (USFR = 0.34 ± 0.09 ml/min, SSFR = 0.65 ± 0.12 ml/min) and group II (USFR = 0.26 ± 0.008 ml/min, SSFR = 0.54 ± 0.13 ml/min) ($p < 0.05$) (Table 1, Figs 1 and 2).

Table 1: Mean USFR and SSFR in the study population (N = 150)

Variable	*Study groups (Mean ± SD)*			*p-value*		
	I (n = 50)	*II (n = 50)*	*III (n = 50)*	*I and II*	*I and III*	*II and III*
USFR	0.34 ± 0.09	0.26 ± 0.008	0.41 ± 0.06	0.000*	0.000*	0.000*
SSFR	0.65 ± 0.12	0.54 ± 0.13	0.89 ± 0.16	0.000*	0.000*	0.000*

* p < 0.05

The xerostomia questionnaire comprised of 19 questions. When asked the question 'Does your mouth feel dry often?', 72% of group I patients, 94% of group II and 52% of group III gave a positive response (p = 0.000). Sixty-eight percent of group I, 92% of group II and 52% of group III gave a positive response when asked 'whether they sip liquids to aid swallowing' (p = 0.000). Fifty-eight percent of group I, 94% of group II and 14% of group III gave a positive response when asked 'if they get up in night to drink water' (p = 0.000).

When asked the question 'Does your mouth feel dry while eating', 20% of group I, 80% of group II and 12% of group III gave a positive response (p = 0.000). To the question 'Does your mouth feel dry always', 4% of group I and 16% of group II gave a positive response while none of the patients in group III gave a positive response (p = 0.004). When asked whether they have difficulty in eating, 4% of group I and 2% of group II gave a positive response whereas none in group III had such a problem. When asked the question 'Do you suck cough lollies', 1% of group I gave a positive response whereas none in groups II and III gave a positive response. Twenty percent in group II had 'difficulty in swallowing certain foods' (p = 0.000). Four percent in group I and 2% in group II said 'yes' when asked if 'their eyes felt dry'. Twenty-two percent of group II and 4% of group III gave a

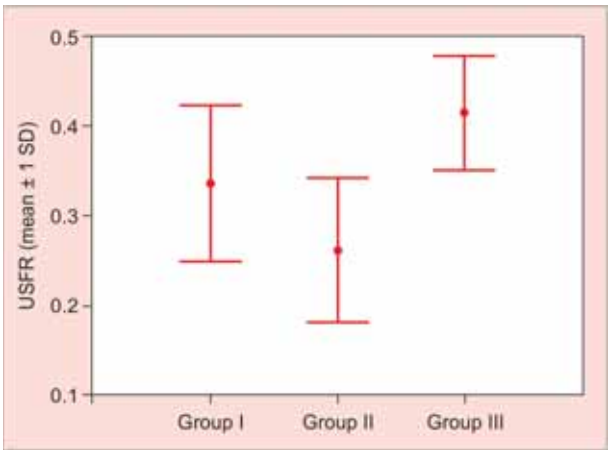

Fig. 1: Mean unstimulated salivary flow rate (USFR) in the study groups (N = 150)

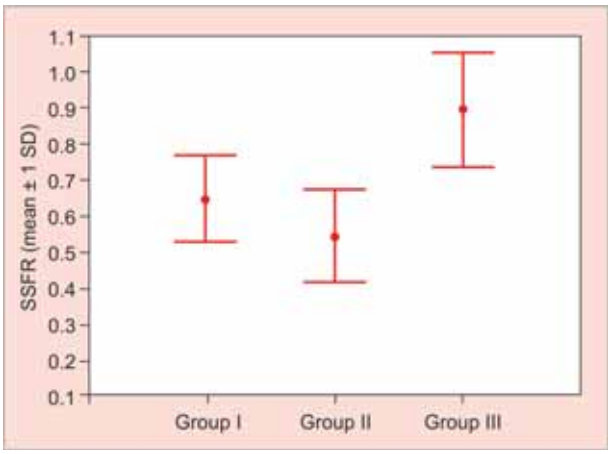

Fig. 2: Mean stimulated salivary flow rate (SSFR) in the study groups (N = 150)

Table 2: Results of xerostomia questionnaire

Xerostomia inventory questionnaire#	*Group I N = 50*		*Group II N = 50*		*Group III N = 50*		*p-value*
	n	*(%)*	*n*	*(%)*	*n*	*(%)*	
1	36	72	47	94	26	52	0.000*
2	34	68	46	92	26	52	0.000*
3	29	58	47	94	7	14	0.000*
4	10	20	40	80	6	12	0.000*
5	2	4	8	16	–	–	0.004*
6	2	4	1	2	–	–	0.360
7	1	2	–	–	–	–	0.365
8	–	–	10	20	–	–	0.000*
9	–	–	–	–	–	–	–
10	2	4	1	2	–	–	0.360
11	–	–	11	22	2	4	0.000*
12	–	–	5	10	–	–	0.006*
13	7	14	1	2	1	2	0.014*
14	–	–	11	22	2	4	0.000*
15	–	–	2	4	–	–	0.132
16	7	14	–	–	–	–	0.001*
17	–	–	14	28	2	4	0.000*
18	–	–	6	12	–	–	0.002*
19	–	–	–	–	1	2	0.365

*p < 0.05; #The xerostomia inventory

positive response when asked, 'Do your lips feel dry'. 10% of groups II complained of dryness inside the nose (p = 0.000). 14% of group I, 2% of groups II and III gave a positive response when asked if they felt burning sensation in gums (p = 0.006). Twenty-two percent of group II and 4% of group III gave a positive response when asked if they have burning sensation in tongue (p = 0.014). Four percent of group II patients gave a positive response when asked if they feel itching sensation in tongue (p = 0.000). Fourteen percent of group I patients gave a positive response when asked if they feel itching sensation in gums (p = 0.000). When asked the question 'Do you feel burning sensation in mouth' (p = 0.000), 28% of group II and 4% of group III gave a positive response (p = 0.002). Twelve percent of group II patients felt taste alterations whereas 2% of group III patients felt pain in jaws while eating (Table 2).

DISCUSSION

Diabetes mellitus affects various organs including salivary glands. It can have profound impact on salivary flow and composition thereby influencing the oral health of these patients. The study population comprised of 150 patients, 50 each in groups I, II and III. The mean age of patients with uncontrolled diabetes (group II) was lesser than that in controlled diabetes (group I). Given the fact that both the controlled and uncontrolled diabetics had a similar diet pattern and counseling, the decreased mean age in uncontrolled diabetes may indicate that the early onset type II diabetes, in these patients is more uncontrolled and resistant to therapy.

In our study both whole unstimulated and stimulated salivary flow rates were decreased in diabetics compared to nondiabetics and this difference was statistically significant (p = 0.000). This finding was consistent with that of Chavez et al, Kadir et al, Bernardi et al, Vaziri et al, Jawed M et al.[7-11] However, Marder et al, Dodds et al, Collin et al and Lasisi et al did not observe significant reduction in salivary flow rate in diabetics compared to nondiabetics, unlike our study.[12-15] This difference could be attributed to the difference in the timing of salivary sample collection or the technique used for collection of salivary samples. USFR and SSFR were the least in uncontrolled diabetics (uncontrolled diabetics < controlled diabetics < nondiabetics). In controlled diabetics (group I) though blood glucose levels were within normal limits, salivary flow rate was less than in nondiabetics. This could be due to the fact that even though the blood glucose levels are normal end organs including salivary gland can show pathoses as suggested by Chavez et al.[7] Murrah et al (1985) has proved that changes in basement membrane of the parotid gland could alter the ability of the glands to transfer molecules, electrolytes and water resulting in altered salivary output.[16]

In this study, xerostomia was evaluated using a 'multi-item' inventory comprising nineteen questions which included those eliciting the subjective symptoms of the patients such as dryness of mouth, skin of the face, eyes, lips and nose; itching sensation in tongue, gums and burning sensation in gums and tongue. Few questions elicited the patient's response to xerostomia like getting up in night to drink water, sucking lollies or difficulty in swallowing. A greater percentage of diabetic patients (groups I and II) perceived xerostomia symptoms compared to non-diabetics (group III). Out of the 19 questions, significant difference in response was observed for 13 questions. Out of these 13 questions, a highly significant difference was found between diabetics and nondiabetics for questions related to symptoms of dryness of mouth, frequent consumption of water in night, difficulty in swallowing certain foods and burning sensation in tongue and mouth. Increased burning sensation in the diabetics could be due to increased candidal colonization in these subjects, which could be a sequelae to decreased salivary flow rates or increased salivary glucose levels.[17] Hence, we postulate that the increased prevalence of subjective symptoms of xerostomia observed in diabetics, in our study based on the xerostomia inventory, could probably be due to the decreased salivary flow rate observed in these subjects.

CONCLUSION

Type 2 diabetics have higher prevalence of xerostomia and significantly reduced salivary flow rate compared to non-diabetics. Alterations in salivary flow create an imbalance in the homeostasis of oral environment leading to spectrum of oral ailments in these individuals.

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REFERENCES

1. Manfredi M, McCullough MJ, Vescovi P, Al-Kaarawi ZM, Porter SR. Update on diabetes mellitus and related oral diseases. Oral Dis 2004;10:187-200.
2. Lowe GD. The relationship between infection, inflammation, and cardiovascular disease: an overview. Ann Periodontol 2001;6: 1-8.
3. Chavez EM, Borell LN, Taylor GW, Ship JA. A longitudinal analysis of salivary flow in control subjects and older adults with type 2 diabetes. Oral Surg Oral Med Oral Pathol 2001;91: 166-173.
4. Mese H, Matsuo R. Salivary secretion, taste and hyposalivation. J Oral Rehabil 2007;34:711-723.

5. Gavin JR, Alberti KGMM, Davidson MB, DeFronzo RA, Drash A, Gabbe SG, et al. The expert committee on the diagnosis and classification of diabetes mellitus. Report of the expert committee on the diagnosis and classification of diabetes mellitus. Diabetes Care 2003;26:S5-S20.
6. Navazesh M. Methods for collecting saliva. Ann NY Acad Sci 1993;694:72-77.
7. Chavez EM, Taylor GW, Borell LN, Ship JA. Salivary function and glycemic control in older persons with diabetes. Oral Surg Oral Med Oral Pathol 2000;89:305-311.
8. Kadir T, Pisiriciler R, Akyuz S, Yarat A, Emekli N, Ipbuker A. Mycological and cytological examination of oral candidal carriage in diabetic patients and non-diabetic control subjects: analysis of local aetiologic and systemic factors. Journal of Oral Rehabilitation 2002;29:452-457.
9. Bernardi MJ, Reis A, Loguercio AD, Kehrig R, Leite MF, Nicolau J. Study of the buffering capacity, pH and salivary flow rate in type 2 well-controlled and poorly controlled diabetic patients. Oral Health Prev Dent 2007;5:73-78.
10. Vaziri BP, Vahedi M, Mortazavi Abdollahzadeh SH, Hajilooi M. Evaluation of salivary glucose, IgA and flow rate in diabetic patients: a case-control study. Journal of Dentistry 2010;7:13-18.
11. Jawed M, Shahid SM, Qader SA, Azhar A. Dental caries in diabetes mellitus: role of salivary flow rate and minerals. J Diabetes Complications 2011 May-Jun;25:183-186.
12. Marder MZ, Abelson DC, Mandel ID. Salivary alterations in diabetes mellitus. J Periodontol 1975;46:567-569.
13. Dodds MWJ, Dodds AP. Effects of glycemic control on saliva flow rates and protein composition in non-insulin-dependent diabetes mellitus. Oral Surg Oral Med Oral Pathol 1997;83: 465-470.
14. Collin HL, Niskanen L, Uusitupa M, Toyry J, Koivisto AM, Viinamaki H, et al. Oral symptoms and signs in elderly patients with type 2 diabetes mellitus. Oral Surg Oral Med Oral Pathol 2000;90:299-305.
15. Lasisi TJ, Fasanmade AA. Comparative analysis of salivary glucose and electrolytes in diabetic individuals with periodontitis. Ann Ibd Pg. Med 2012;10:25-30.
16. Murrah VA, Crosson JT, Sauk JJ. Parotid gland basement membrane variation in diabetes mellitus. J Oral Pathol 1985; 14:236-246.
17. Sashikumar R, Kannan R. Salivary glucose levels and oral candidal carriage in type II diabetics. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010;109:706-711.