ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 4, Issue – 4, July - 2021, Page No. : 482 - 487

Wafer test: To assess the salivary flow rate in patients with type 2 diabetes mellitus

[1]Dr. Sangeetha R, Senior Lecturer, Department of Oral Medicine and Radiology, Bangalore Institute of Dental Sciences and Hospital, Bangalore, India

[2]Dr. Raghavendra Kini, Professor and HOD, Department of Oral Medicine and Radiology, A. J. Institute of Dental Sciences and Hospital, Mangalore, India

[3]Dr. Vathsala, Professor and HOD, Department of Oral Medicine and Radiology, Bangalore Institute of Dental Sciences and Hospital, Bangalore, India

[4]Dr. Amandeep Sodhi, Reader, Department of Oral Medicine and Radiology, Bangalore Institute of Dental Sciences and Hospital, Bangalore, India

Corresponding Author: Dr. Sangeetha. R, Senior lecturer, Oral Medicine & Radiology, Bangalore Institute of Dental Sciences, Rajiv Gandhi University of Health Sciences, Bangalore, India.

Citation of this Article: Dr. Sangeetha. R, Dr. Raghavendra Kini, Dr. Vathsala, Dr. Amandeep Sodhi, "Wafer test: To assess the salivary flow rate in patients with type 2 diabetes mellitus", IJDSIR- July - 2021, Vol. – 4, Issue - 4, P. No. 482 – 487.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Introduction: Hyposalivation is the most common complaint observed in patients with type 2 diabetes mellitus. Several methods have been traditionally utilized to measure the salivary flow rate, such as gravimetric and volumetric measurements. These methods, such as drooling or spitting, however are cumbersome, mainly used in research, and impractical in clinical practice. Therefore, several simple techniques for measuring salivary flow rate have been developed. Among these tests, a semi-quantitative test, the wafer test has emerged as a time and cost effective chair side screening tool for hyposalivation.

Purpose: To develop an inexpensive and simple method to assess salivary flow rate, using wafer test

Material and method: This prospective study included 150 subjects. One hundred diagnosed type 2 diabetes mellitus (DM) patients were in the study group and 50 healthy subjects were included in control group. A validated screening questionnaire was recorded; followed by spitting method of saliva collection and wafer test.

Results: Most of the subjects with type 2 DM had decreased salivary flow rate (less than 0.5 ml/5 mins) and time taken for dissolution of wafer was more than 4 minutes (min). A statistical analysis was done to know the relationship between the time taken for the dissolution of wafer and salivary flow rate.

Conclusion: Subjects with decreased salivary flow rate required more time for dissolution of wafer. Hence a significant negative correlation was observed between time taken for the dissolution of wafer and salivary flow rate.

Keywords: Saliva, flow rate, Diabetes mellitus, wafer test.

Introduction

Saliva plays a significant role in the protection and integrity of the oral tissues [1]. The protective mechanisms of saliva involve lubrication and debridement of the oral cavity. Saliva facilitates initial digestion, swallowing, and speech. In addition, saliva buffers acids generated by oral bacteria [2]. Saliva is also entrusted with antimicrobial action, which is mediated through antibodies and nonspecific defensive factors such as lysozyme, lactoferrin, peroxidase and histatins [3].

Saliva production and salivary flow are mediated by autonomous nervous system, through its action in the cholinergic neurotransmitter acetyl choline [4]. A reduction in saliva production may cause burning sensation of the mouth, changes in taste perception, difficulties in swallowing and speech, increase the risk of caries and oral infection [5].

Diseases of salivary gland, systemic diseases, medications, and therapeutic radiation are common causes of salivary gland dysfunction [6,7]. Of the systemic diseases, xerostomia and hyposalivation have been commonly associated with diabetes mellitus (DM). In type 2 diabetic patients, both unstimulated and stimulated salivary flow rates are reported to be significantly reduced [8].

Although salivary flow have been studied earlier in patients with type 2 DM, methods such as gravimetric and volumetric measurements were employed. Wafer test is a simple, inexpensive and semi-quantitative test, which may be useful for screening patients with hyposalivation [9,10].

Objective

1. To investigate the prevalence of xerostomia and hyposalivation in patients with type 2 DM.
2. To develop an inexpensive and simple method to assess salivary flow rate, using wafer test
3. To compare wafer test with spitting method of saliva collection, in patients with type 2 DM and healthy control subjects.

Methodology

Salivary flow rate was assessed by investigating the relationship between time taken for the dissolution of wafer and resting whole salivary flow rates. After obtaining consent, 100 diagnosed type 2 DM patients were included in the study group and 50 healthy subjects without history of any systemic diseases or on any medications causing hyposalivation were selected as control group.

Inclusion criteria

a) Study group consisted patients above 25 years of age, who had been diagnosed and confirmed as type 2 diabetics
(Fasting blood glucose > 126mg/dl)
(Post prandial plasma glucose > 200mg/dl).

b) Control group included, age and gender matched healthy individuals, who were willing to participate in the present study.

Exclusion criteria

a) Patients with salivary gland disorders or who have undergone salivary gland surgery.

b) Patients with systemic diseases affecting saliva production.

c) Patients on medication known to cause hyposalivation (like antidepressants, diuretics, antihistamines, antihypertensive drugs).

d) Patients on radiotherapy of head and neck region.

e) Any other condition, which would affect production of saliva or its flow, was excluded from the present study.

All participants were asked to refrain from eating, drinking, smoking, chewing or any oral hygiene procedures for at least 1 hour (hr) before the study. For all subjects, a validated screening questionnaire were recorded, saliva collection using spitting method and wafer test were carried out between 9.00 to 11.00 am.

Questionnaire for assessment of xerostomia:

Three questions, modified from Fox et al was used to assess the patient's feeling of mouth dryness

a) Do you feel that your mouth is dry?

b) Do you have difficulty in eating dry food?

c) Do you feel your tongue sticks to palate when you wake up in the morning? [6]

Spitting method

The patients were instructed to make as few movements as possible, including swallowing during the saliva collection procedure. The collection of saliva was initiated immediately after an initial swallow. Then resting whole saliva was collected by asking the patient to spit the accumulated saliva in a plastic container at the end of 5 mins. Volume of the saliva was estimated by weighing the container before and after collection, assuming the specific gravity of the saliva to be 1gram/cubic centimeter (g/cm^3). The flow rate was calculated in gram/5 mins, which is almost equivalent to milliliter (ml)/5 mins [11].

Wafer test

A round dry wafer made of wheat flour (tasteless) was used in the study. The wafer had the following dimensions:

Diameter : 33.7±0.3mm (millimeter)

Weight : 0.114±0.01g (gram)

Thickness: 1±0.1mm

The main outcome was taken for dissolution of wafer

Test procedure

The subjects were asked to sit in a relaxed and upright position and not to speak during the test. After the subjects swallowed any residual saliva, the wafer was placed on the center of the subject's tongue. The subjects were asked to close the mouth and keep the wafer in the mouth without chewing or swallowing it, but swallowing saliva was allowed. Time of dissolution was measured, from the moment when the wafer was placed on the tongue (time 0) up to the time when the wafer dissolved (time 1). Every minute, the subjects were asked to open the mouth to verify the presence of the wafer. The subjects reported, the moment when the wafer dissolved completely. This was verified by direct inspection.

The procedure was repeated three times in each subject with a resting period of 5 min between each test. The mean of the three results was the score recorded. If the wafer did not dissolve in 15 mins period, the test was stopped and 15 mins was recorded as the time of dissolution. When the time of dissolution of wafer was 15 mins in the first and second tests, the third test was omitted and the mean of the first two tests was the score recorded. If the time taken for dissolution of wafer was more than 4 min, then the subject was considered to have hyposalivation [9].

Result

In the control group, minimum time required for dissolution of wafer was 1.310 min and maximum time for dissolution of wafer was 6.340 min respectively, with a mean of 2.592 min and standard deviation of 1.061 min. The study group required minimum and maximum time of 3.050 min and 15 min respectively for the dissolution of wafer. Saliva flow rate in control group and study group assessed by wafer test was compared using Student 't' test. The difference between the control and the study

group was 17.291, which was statistically very highly significant (p<0.001) (Table 1).

The salivary flow rate obtained by spitting method of saliva collection was compared between the control group and the study group using Mann Whitney test (z). The study showed that the control group had minimum flow rate of saliva of 0.406 ml and maximum saliva flow rate of 3.436, with the mean of 1.535 ml and standard deviation of 0.740 ml for 5 min. The study group had minimum flow rate of saliva of 0.116 ml and maximum saliva flow rate of 1.506 ml, with the mean of 0.373 ml and standard deviation of 0.271 ml for 5 min. The results revealed a difference of 9.405 between the control and study group, which was significant statistically (p<0.001) (Table 2).

One of the objective of this study was to compare salivary flow rate obtained by spitting method with wafer test. Hence to obtain the correlation between spitting method and wafer test, Pearson Chi-square test was utilized. The correlation between the spitting method and wafer test revealed a negative difference of -0.786 in the control group and -0.776 in the study group which was statistically significant (p<0.001).

Table1

Group	Minimum time taken for dissolution of wafer (min)	Maximum time taken for dissolution of wafer (min)	Mean	Standard deviation	t
Control group (50)	1.310	6.340	2.592	1.061	17.291
Study group (100)	3.050	15.000	11.356	3.332	p<0.001

Table 2

Group	Minimum flow rate of saliva at 5 minute by spitting method (ml)	Maximum flow rate of saliva at 5 minute by spitting method (ml)	Mean	Standard deviation	z
Control group (50)	0.406	3.436	1.535	0.740	9.405
Study group(100)	0.116	1.506	0.373	0.271	p <0.001

Discussion

DM is an endocrine disease characterized by a deficit in the production of insulin with consequent alteration of the process of assimilation, metabolism and balance of blood glucose concentration [12]. Type 2 DM is characterized by abnormalities in carbohydrate, lipid and protein metabolism that result from target-tissue resistance, related commonly to obesity.

The oral complications of uncontrolled diabetes mellitus are devastating. These may include, but are not necessarily limited to, xerostomia and salivary gland dysfunction; gingivitis and periodontal disease; increased susceptibility to bacterial, viral and fungal infections; dental caries; periapical abscesses; loss of teeth; impaired ability to wear dental prostheses; taste impairment; and burning mouth syndrome. Difficulty in lubricating, masticating, tasting

and swallowing are among the most devastating complications from salivary dysfunction and may contribute to impaired nutritional intake [13].

The present study was designed to investigate the prevalence of hyposalivation in patients with type 2 DM and also to develop a simple and inexpensive method to assess salivary flow rate in patients with type 2 DM.

Salivary flow rate was assessed by spitting method and wafer test, following which xerostomia was assessed by using questions modified from Fox et al questionnaire. The results were analyzed using SPSS.

The salivary flow rate was assessed in both control group and study group participants by spitting method and wafer test. The mean salivary flow rate using spitting method was 1.535±0.740 ml in control group and 0.373±0.271 ml in study group at 5 mins. Mann Whitney test showed a very highly significant difference between the control group and study group by spitting method. One similar study carried out by Chavez EM et al. [14], found that poorly controlled diabetes showed trends toward lower unstimulated whole salivary flow rate (UWSFR) (p=0.08) and significantly lower stimulated parotid flow rates (p=0.015) in comparison with non-diabetic subjects.

The participants of our study were divided based on the time taken for dissolution of wafer and it was recorded that 92% of control group dissolved wafer within 5 mins, whereas 4% required between 6 -10 mins and the remaining 4% required between 11-15 mins to dissolve the wafer. In the study group, wafer dissolved within 5 mins only in 8%, between 6 -10 mins in 20% and between 11 -15 mins in 72% of patients.

The mean time required to dissolve the wafer completely was 2.592 ± 1.061 min in controls and 11.356 ± 3.332 min in study group. By using Student 't' test, a significant difference was found between the control group and study group ($p<0.001$). There were not too many studies in the literature, where salivary flow rate was assessed by wafer test. In one of the study performed by Guerrero JS et al. [9], time taken for dissolution of wafer was 2.8 ± 2.1 min in the healthy group, 3.3 ± 1.5 min in the connective tissue diseases group, and 9.2 ± 3.9 min in the primary SS group. By these two methods of salivary flow assessment, we can arrive at the conclusion that most of the study group participants required longer duration for dissolution of wafer, as well as saliva collected in such individuals were significantly of lower volume. Hence time required for dissolution of wafer is inversely proportional to the quantity of saliva obtained by spitting method.

Xerostomia is a common complaint among diabetic patients. In our study prevalence of xerostomia was recorded in 55 subjects belonging to study group, whereas the remaining 45 subjects did not have any symptoms of xerostomia. Chi-square test was used to compare prevalence of xerostomia among study group and was found to be insignificant. These results were similar to the study performed by Sandberg GE et al. [15], where more than half of the type 2 DM individuals (53.5%) reported xerostomia.

Conclusion

From the results of our study it can be concluded that salivary flow rate was evidently decreased in most of the patients with type 2 DM and this can be assessed by wafer test, which is a semi quantitative test. The prevalence of xerostomia was also recorded among the study group, but the results were not statistically significant.

References

1. Wolff A, Paz LZ, Kaplan I. Major salivary gland output differs between users and non-users of specific medication categories. Gerodontology. 2008; 25: 210-216.
2. Khovidhunkit SP, Suwantuntula T, Thaweboon S, Mitrirattanakul S, Chomkhakhai U, Khovidhunkit W.

Xerostomia, hyposalivation and oral microbiota in type 2 diabetic patients: a preliminary study. J Med Assoc Thai. 2009; 92: 1220-1228.

3. Janet SJ, Jones J, Rich S, Miller D, Wehler CJ, Vandyke TE, Garcia R, Meurman JH. The effects of xerogenic medications on oral mucosa among Veterans Dental study participants. Oral Surg Oral Med Oral Pathol Oral Radiol and Endod. 2007; 103: 223-230.
4. Negreto CA, Tarzia O. Buccal alterations in diabetes mellitus. Diabetol Metab Syndr. 2010; 2: 3-8.
5. Flink H, Bergdhal M, Tegelberg A, Rosenblad A, Lagerlof F. Prevalence of hyposalivation in relation to general health, body mass index and remaining teeth in different age group of adults. Community Dent Oral Epidemiol. 2008; 3: 523-531.
6. Chavez EM, Taylor GW, Borrell LN, Ship JA, Arbor A. Salivary function and glycemic control in older patients with diabetes. Oral Surg Oral Med Oral Pathol Oral Radiol and Endod. 2000; 89: 305-311.
7. Navazesh M, Brightman VJ, Pogoda JM. Relationship of medical status, medications and salivary flow rates in adults of different ages. Oral Surg Oral Med Oral Pathol Oral Radiol and Endod. 1996; 81: 172-176.
8. Dodds MWJ, Yeh CK, Johnson DA. Salivary alterations in type 2 (non-insulin dependent) diabetes mellitus and hypertension. Community Dent Oral Epidemiol. 2000; 28: 373-381.
9. Guerrero JS, Garcia EA, Dosal MRP, Kraus A, Cardiel MH, Rojas AES. The wafer test: a semi quantitative test to screen for xerostomia. Rheumatology. 2001; 41: 381-389.
10. Guerrero JS, Dosal MRP, Velazquez FC, Reguera AP, Aguilar EC, Rojas AES. Prevalence of Sjogren's syndrome in ambulatory patients according to the American- European Consensus Group criteria. Rheumatology. 2005; 44: 235-240.
11. Sreebny LM, Vissink A. Dry mouth –the malevolent symptom: A clinical guide. Dry mouth a multifaceted diagnostic dilemma. 1st edition; 2010: 33-77.
12. Vasconcelos ACU, Soares MSM, Almeida PC, Soares TC. Comparative study of the concentration of salivary and blood glucose in type 2 diabetic patients. J Oral Sci. 2010; 52: 293-298.
13. Vernillo AT. Dental considerations for the treatment of patients with diabetes mellitus. JADA. 2003; 134: 24-33.
14. Chavez EM, Borrell 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 Oral Radiol and Endod. 2001; 91: 166-173.
15. Sandberg GE, Wikblad KF. Oral dryness and peripheral neuropathy in subjects with type 2 diabetes. J Diabetes Complications. 2003; 17:192-198.