The Effect of Viscosity and Saliva Buffer in Diabetes Melitus Patients on the Dental Caries

Pengaruh Visikositas dan Buffer Saliva Terhadap Terjadinya Karies Gigi Pada Pasien Diabetes Melitus

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Abstract

Oral complications will occur in the form of dental caries when Diabetes Mellitus (DM)is not controlled. The purpose of this study was to determine the effect of viscosity and salivary buffer on the severity of dental caries in DM patients. This research was an analytic survey with cross sectional approach involving 61 subjects (42 women and 19 men) who were patients with type II DM in Dr. Pirngadi Hospital Endocrine Clinic Medan. This research was conducted by carrying out an oral examination to calculate the DMF-T index and checking the viscosity of the saliva visually and salivary buffer is measured by using buffer test strip.The results obtained from this study showed that there are 77.0% DM patients who experienced dental caries and 23.0% DM patients who did not experience dental caries. Based on saliva viscosity, subjects had poor saliva viscosity (80.3%). This study also showed that salivary buffer in DM patients was low (67.2%). Data were analysed by chi-square test showed significant results ($p < 0.05$) with a significant value of $p = 0{,}000$. The significance value of the effect of salivary buffer on DM patients with the occurrence of dental caries is $p = 0.02$. Based on these results, it can be concluded that there is a significant effect between viscosity and salivary buffer with the occurrence of dental caries.

Keywords: Diabetes Mellitus, saliva viscosity, salivary buffer, caries

Abstrak

Diabetes Melitus (DM) yang tidak terkontrol akan terjadi komplikasi oral berupa karies gigi. Tujuan Penelitian ini adalah untuk mengetahui bagaimana pengaruh viskositas dan buffer saliva terhadap derajat karies gigi pada pasien DM. Jenis penelitian ini adalah survey analitik dengan pendekatan *cross sectional* dengan melibatkan 61 subjek (42 orang perempuan dan 19 orang laki-laki) yang merupakan pasien DM tipe II di Poli Endokrin RSU Dr. Pirngadi Medan. Penelitian ini dilakukan dengan melakukan pemeriksaan klinis intra oral untuk menghitung indeks DMF-T kemudian diukur viskositas saliva secara visual dan buffer saliva diukur dengan menggunkan *buffer test strip*. Hasil yang diperoleh dari penelitian ini menunjukkan pasien DM yang mengalami karies gigi 77,0% dan pasien DM yang tidak mengalami karies gigi 23,0%. Berdasarkan viskositas saliva, subjek mempunyai viskositas saliva buruk (80,3%). Penelitian ini juga menunjukkan bahwa buffer saliva pada pasien DM rendah (67,2%). Data dianalisa dengan uji *chi-square.* menunjukkan hasil yang signifikan ($p < 0{,}05$) yaitu dengan nilai signifikan $p = 0{,}000$. Nilai signifikansi dari pengaruh buffer saliva pada pasien DM dengan terjadinya karies gigiadalah $p = 0{,}02$. Berdasarkan hasil tersebut, dapat disimpulkan bahwa adanya pengaruh yang signifikan antara viskositas dan buffer saliva dengan terjadinya karies gigi.

Kata kunci: Diabetes Melitus, viskositas saliva, buffer saliva, karies

INTRODUCTION

One of the causes of increasing DM patients in Indonesia is genetic factors and modern lifestyles such as consuming foods that contain high amount of carbohydrates and sugar. DM patients especially those who are uncontrolled will be susceptible to diseases in the oral cavity and teeth.[1] High blood glucose levels in DM patient'scauses high glucose levels in saliva. Saliva with high glucose levels can increase acid production through the fermentation process by bacteria in the oral cavity, which leads to a demineralization process that causes dental caries. Based on Anggita and Gunawan's research in 2012, the prevalence of caries in uncontrolled DM individuals was 53%.[2] Oral manifestations in DM patients can result in reduced quality of life, impaired nutrition, and, potentially, a reduction in glycaemic control.[3,4]

Saliva is one of the components that affect the process of caries because saliva always keeps the teeth moist, therefore it affects the environment in the oral cavity. Saliva has a different composition and concentration that can affect the salivary secretion conditions. Factors affecting salivary composition and concentration include salivary flow rate, volume, pH, and salivary buffer capacity.[5] Salivary components (salivary protein, salivary calcium, inorganic phosphate and organic content), flow rate, viscosity, buffer capacity and pH played a major role in the occurrence and development of dental caries.[6]When the viscosity of the saliva increases, the composition of water in saliva decreases and this causes the saliva to become thick. Therefore, there will be a reduction of self-cleansing in the oral cavity.[7,8] The concentration of bicarbonate is influenced by the level of secretion because bicarbonate is the main determinant of buffer capacity. Therefore there is a relationship between pH, secretion of carbonate and salivary buffer capacity.[7] Based on the research of Seethalakshmi et al. (2016), the study consisted of 40 people with the results that there was a decrease in average salivary pH of 6.51 in the study group, compared with the average salivary pH of 7.88 in the control group. The average DMFT index was higher in the results of the study group (8.10) when compared to the results of the control group (1.15). The results of this study concluded that there was a significant relationship between DM and an increase in the incidence of dental caries and there was also a significant decrease in salivary pH in DM patients, compared with non-diabetics.[9] In addition, Jawed et al. study(2012)which compared salivary pH, salivary flow rate, and calcium saliva in type II DM patients with dental caries and in non-diabetic subjects with dental caries, showed that salivary pH, calcium, and flow rate were found to be significantly lower (P <0.001) compared to the control group.[10]

Theoretically, changes in pH, salivary flow rate, volume, viscosity and salivary buffer cause dental caries including in DM patients. Previous studies have not explained the relationship between the effect of viscosity and salivary buffer in DM patients with the occurrence of dental caries in the oral cavity. Therefore, research needs to be done regarding the effect of viscosity and salivary buffer in DM patients with dental caries.

MATERIALS AND METHOD

The research was analytic descriptive with cross sectional approach. The study population was type II DM patients in Dr. Pirngadi Medan. This study sample consisted of 61 patients with type II DM patients in Dr. Pirngadi Hospital. The sampling method in this study is a non-probability sampling method of purposive sampling[11], which is based on the inclusion criteria as follows: 1) DM type II patients, 2) Patients above 40 years old, 3) Subjects did not eat 1 hour before research to avoid the effect of food and drink on salivary buffer capacity, 4) Subjects agree to the informed consent given by researchers. Exclusion criteria are as follows: 1) Smokers, 2) Patients with other systemic diseases such as hypertension, chronic kidney failure, asthma, chronic obstructive pulmonary disease, etc. 3) Non-cooperative subjects.

Eligible patients were given an explanation of the study and if the patient agreed to take part in the study, then the patient were asked to sign the Informed Consent. The DMF-T index measurement started with instructing the subject to rinse with water, and then the observation of the teeth is carried out using a dental mouth mirror. Saliva was collected without stimulation into the container specimen as much as 0.5 ml, by spitting technique and then the viscosity of saliva was directly measured visually by looking through the specimen container. Hence, saliva buffer is measured using a buffer strip.

RESULT

This study consisted of 61 subjects as DM patients who were under care in Dr. Pirngadi Hospital Medan. The result shows that there was 42 women (68.9%) and 19 men (31.1%) with DM. Based on the age group, the highest amount of patients who suffer from DM is the age group of 46-55 years old consisted of

28 people (45.9%), followed by the age group of 56-65 years old consisted of 23 patients (37.7%), and the age group 36-55 years old consisted of 6 patients (9,8%). The results showed that there were 47 subjects had dental caries (77.0%) and 14 subjects (23.0%) had no caries. The results showed that subjects with poor saliva viscosity consisted of 49 people (80.3%), followed by good saliva viscosity in 7 people (11.5%). The results showed high amount of subject who have low salivary buffers, at 41 people (67.2%) and followed by very low salivary buffers consisted of 20 people (32.8%).

The study examined the effect of salivary buffer on the occurrence of dental caries. There were 41 peo-ple with low salivary buffer, 28 of whom had caries and 13 people without caries. There are 20 people with very low salivary buffer, 19 of whom have caries and 1 person without caries. Statistical test re-sults using chi-square obtained significance values $p = 0.020$ or $p = <\alpha\ 0.05$.

Table 1. Effect of salivary buffer on DM patients with the occurrence of dental caries.

Salivabuffer	Dental caries		Total	p-value
	Caries	Without caries		
Normal	0	0	0	0,020
Low	28	13	41	
Very low	19	1	20	

This study also examined the effect of salivary viscosity with the occurrence of dental caries. The result showed 49 people with poor saliva viscosity, 43 of whom had caries and 6 others without caries. There are 7 people with good saliva viscosity, 2 of whom have caries and 5 people without caries. There are 5 people with moderate viscosity, 2 of them have caries and 3 others do not have caries. Statistical test results using chi-square obtained significance value $p = 0{,}000$ or $p = <\alpha\ 0.05$.

Table 2. Effect of salivary viscosity on DM patients with the occurrence of dental caries

Saliva viscosity	Dental Caries		Total	p-value
	Caries	Without caries		
Good	2	5	7	0,000
Normal	2	3	5	
Bad	43	6	49	

DISCUSSION

This research was conducted at Dr. Pirngadi Hospital Endocrine Clinic Medan showed there was more women (68.9%) than men (31.1%) with DM. This is because women aged over 40 years are experiencing pre-menopause. During pre-menopause, oestrogen decreases which resulted in increasing insulin resistance and might cause type II DM.[12] This condition is in accordance with the results of Liuw et al. study thatstated higher DM occurrence in women patients at 68.8%. The results of this study also stated that the highest number of DM patients was the age group of 46-55 years. As the age increases, organ function will deteriorate and disrupt insulin production and glucose metabolism.[13]Panelewen et al. study of type II DM patients also produced similar results, which stated that most of DM patients were in the age group of 51-55 years (36.8%) followed by the age group of 46 - 50 years (28.9%).[14]

The prevalence of dental caries in DM patients is at 77.0%. The result from research conducted by Anggita et al. (2012) showed that the prevalence of caries in DM patients was 53%. Saliva plays a main role in the process of caries which affects the envi-ronment in the oral cavity. DM patients are sus-ceptible to infections that lead to caries and tooth loss, which causes patients to wear full dentures. Most DM patients in this study used full dentures because of tooth loss due to caries. This is associated with the oc-currence of salivary secretions dysfunction and xeros-tomia. This situation will reduce the ability of self-cleansing and the capacity of salivary buffer that trig-gers dental caries.[13] Xerostomiacan cause dentures to be less retentive. This will cause loose dentures when the subject is chewing and cause trauma to the oral mucosal tissue resulting in denture stomatitis.[15]

The results of this study also showed that poor saliva viscosity occurred in 80.3% of DM patients and low salivary buffer occurred in 67.2% of DM patients. Different concentration and composition of sa-liva will affect the environment of oral cavity and plays a major role in the initiation and development of dental caries.[5,6]

Analysis of the salivary buffer's impact on occurrence of dental caries in DM patients with the chi-square statistical test showed the value of $p = 0.020$ ($p <\alpha\ 0.05$) which means that the acidity of the oral ca-vity plays an important role in the process of tooth hard tissue generalization. Neuropathy will occur in patients with DM. As a result, the nervous system that innervates the flow of saliva is disrupted, thusreduce the saliva. If salivary secretion in the mouth decree-ses, the buffer in saliva also decreases. Hence, the mouth experiences an acidic condition and anaerobic bacteria develop easily in the mouth, which caused dental caries.

The results showed that there was a significant relationship between the effects of salivary viscosity on

the occurrence of dental caries on DM patients with a value of p = 0,000 from the results of statistical tests. In uncontrolled DM patients xerostomia occurs, due to decreased salivary secretion and diuresis. In DM patients, there is also an increase in glucose levels both in salivary fluid and blood.[15] Glucose in saliva will metabolized by oral bacteria such as *Streptococcus mutans*in order to produce acid and decrease pH level in saliva.[16] This will also lead to reduced salivary viscosity. If salivary pH becomes acidic, it will speed up the demineralization process and will cause caries.[19,20]

Salivary viscosity and buffer can affect the oral cavity ecosystem, which causes dental caries. The results of the study show that poor viscosity of saliva and low salivary buffer can reduce the ability of self-cleansing which triggers dental caries. The research conducted only uses the observation method to measure the viscosity of saliva. A laboratory examination using a Brookfield viscometer is recommended to get more precise results. Research needs to be done to find out the factors that influence changes in salivary viscosity and buffer with the occurrence of dental ca-ries in DM patients. It is recommended to health wor-kers and doctors to educate DM patients to maintain oral health to minimize the side effects that caused by DM such as dental caries, in order to maintain the health of the oral cavity. It is important for dentists to gain an understanding about DM that increases the risk of dental caries and health workers, especially dentists can arrange the right treatment plan for each patient.

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