

## Relationship Between Glycemic Control and Coated Tongue in Type 2 Diabetes Mellitus Patients with Xerostomia

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Academic Editors: Alessandro Leite Cavalcanti and Wilton Wilney Nascimento Padilha

Received: 29 March 2019 / Accepted: 26 July 2019 / Published: 15 August 2019

### Abstract

**Objective:** To examine the relationship between the level of glycemic control and coated tongue in type 2 diabetes mellitus patients with xerostomia. **Material and Methods:** This study was an analytical survey and involved 64 type 2 diabetes mellitus patients, aged between 17 to 65 years old with 34 males and 30 females. Diagnosis of diabetes mellitus was determined from the patient's medical records. The level of glycemic control was obtained from the patient's last blood sugar examination. Xerostomia was diagnosed with a questionnaire, while coated tongue diagnosis based on clinical features and the severity of coated tongue was assessed using the Kojima index. **Results:** There was a significant relationship between the level of glycemic control and coated tongue ( $p=0.0026$ ) in type 2 diabetes mellitus patients with xerostomia. Moreover, there was a significant relationship between the level of glycemic control and the severity of the coated tongue ( $p=0.001$ ). Specifically, poor glycemic control was associated with a higher occurrence of the coated tongue as well as more severe tongue coating. **Conclusion:** There was a significant relationship between the level of glycemic control in and coated tongue in type 2 diabetes mellitus patients with xerostomia. Therefore, diabetes mellitus patients should control their level of glycemic control to prevent the oral complication of the disease.

**Keywords:** Diabetes Mellitus; Glycemic Index; Xerostomia; Tongue Diseases.

## Introduction

Diabetes mellitus is a chronic metabolic disorder where the pancreas does not produce sufficient insulin, or the body cannot use the insulin that is produced effectively which causes elevation of glucose concentration (hyperglycemia) [1]. Diabetes mellitus patients have symptoms such as polyuria. Polyuria is a condition where diabetes mellitus patients urinate so much that the fluid in the body decrease, which can cause the amount of saliva to decrease, and the patients will experience xerostomia [2].

Xerostomia is a subjective symptom of dry mouth [3]. According to the symptom, not all xerostomia patients experience hyposalivation or changes in the quality and quantity of saliva [4]. Xerostomia causes the oral mucosa to become dry and susceptible to irritation due to lack of lubrication and protection from saliva. Lack of lubrication and protection from saliva also cause bacterial accumulation in the oral cavity, which will then cause caries, periodontitis, and tongue disorder such as coated tongue [5].

Recent research about the prevalence of diabetes mellitus manifestations found a coated tongue as much as 26.8% of 106 patients [6]. Moreover, another study developed in 2011 revealed a high prevalence of coated tongue, which is 28.7% in people with type 2 diabetes mellitus. This is thought to be caused by decreased salivary flow and increased salivary viscosity resulting in decreased self-cleansing ability and decreased antimicrobials in saliva [7].

This study aims to examine the relationship between the level of glycaemic control and the presence and severity of coated tongue in type 2 diabetes mellitus patients with xerostomia.

## Material and Methods

### Study Design and Sample

This study was observational research to examine the correlation type 2 diabetes mellitus patients with xerostomia and coated tongue. The study was done at the Endocrine Polyclinic Department of Internal Medicine, Universitas Sumatera Utara.

This study involved 64 type 2 diabetes mellitus patients. The sample size calculation was done with one sample group hypothesis test. The sampling technique was purposive non-probability sampling. The inclusion criteria were type 2 diabetes mellitus patients with xerostomia and less than 60-years old. The patients should have no salivary gland disorder, and condition that contributes to xerostomia such as antidepressant and antihypertension use, HIV, head, and neck radiation therapy, not in menopause phase and do not smoke and consume alcohol.

Diagnosis of diabetes mellitus was determined from the patient's medical records. Blood sugar control level was obtained from the patient's last blood sugar examination. The glycaemic control was classified to good glycaemic control with fasting blood sugar level was 80-100 mg/dl and blood sugar level 2-hour post-prandial was 80-144 mg /dl, moderate glycaemic control with fasting blood sugar level was 100-125 mg/dl and blood sugar level 2-hour post-prandial was 145-179

mg/dl, and poor glyceemic control with fasting blood sugar level more than 126 mg/dl and blood sugar level 2-hour post-prandial was more than 180 mg/dl [8].

Xerostomia was diagnosed with a previous questionnaire [3], which consists of four questions. The questions were, did you feel your saliva is too little, too much or you do not know your saliva is little or much? Do you have problems with chewing? Does your mouth feel dry when eating? And do you prefer watery foods than dry foods? Patients who answered "yes" to all questionnaire questions can be diagnosed as xerostomia [3].

The coated tongue was diagnosed based on clinical features that can be seen directly or can be assisted by using the dental mirror. Kojima parameters were used to assess the location of the coating rather than its thickness and color [9]. The scores according to the Index of Kojima are 0 – no coating (visual), 1 – a thin coating of less than one third of the back of the tongue, 2 – a thin coating of less than two thirds of the tongue or less than 1/3 covered with a thick coating, 3 – more than two thirds covered with a thin tongue coating or less than 2/3 covered with a thick tongue coating, and 4 – more than two thirds of the tongue is covered with a thick coating [9].

#### Data Analysis

The data obtained were analyzed with Fisher's Exact test to determine the relationship between two variables with a significance level at  $p < 0.05$ . Data were analyzed using IBM SPSS Statistics Software, version 22 (IBMCorp., Armonk, NY, USA).

#### Ethical Aspects

This research was approved by the Health Research Ethical Committee of Medical Faculty, and all patients were given informed consent.

#### Results

Among the total of 64 type 2 diabetes mellitus patients with xerostomia included in this research, 53.1% were male and 46.9% female. Patients at the age of the group of 46-55 years were most commonly affected with 32 (50%) patients and patient at the age group of 17-25 years was the least affected with 1 (1.6%) patient (Table 1).

**Table 1. Distribution of the patients according to age.**

Age (Years)	N	%
17-25	1	1.6
26-35	3	4.7
36-45	10	15.6
46-55	32	50.0
56-60	18	28.1
Total	64	100.0

Table 2 showed the distribution of coated tongue based on glyceemic control level in type 2 diabetes mellitus patients with xerostomia. The highest percentage of the coated tongue was

recorded in the group with a poor glycemic control level. There was a significant relationship between glycemic control level and the presence of coated tongue in type 2 diabetes mellitus patients with xerostomia ( $p = 0.0026$ ).

**Table 2. Association between glycemic control level and coated tongue.**

Glycemic Control Level	Coated Tongue				Total		p-value
	Yes		No		N	%	
	N	%	N	%			
Good	8	12.5	6	9.4	14	21.9	0.0026
Moderate	18	28.1	5	7.8	23	35.9	
Poor	25	39.1	2	3.1	27	42.2	
Total	51	79.7	13	20.3	64	100.0	

Table 3 shows the distribution of coated tongue severity in type 2 diabetes mellitus patients with xerostomia based on glycemic control level. In the group with good glycemic control, the highest percent of individuals were with score 0. The moderate glycemic control group had the highest percentage of individuals with score 2, whereas the patients with poor glycemic control mostly showed score 3 of coated tongue per the classification of Kojima. There was a significant correlation between coated tongue severity and level of glycemic control in type 2 diabetes mellitus patients with xerostomia ( $p=0.001$ ).

**Table 3. Association between glycemic control level and coated tongue severity.**

Glycemic Control Level	Coated Tongue Severity					Total N (%)	p-value
	Score 0	Score 1	Score 2	Score 3	Score 5		
	N (%)	N (%)	N (%)	N (%)	N (%)		
Good	6 (9.4)	3 (4.7)	4 (6.2)	1 (1.6)	0 (0.0)	14 (21.9)	0.001
Moderate	5 (7.8)	2 (3.1)	13 (20.3)	1 (1.6)	2 (3.1)	23 (35.9)	
Poor	2 (3.1)	1 (1.6)	7 (11.0)	13 (20.3)	4 (6.2)	27 (42.2)	
Total	13 (20.3)	6 (9.4)	24 (37.5)	15 (23.5)	6 (9.3)	64 (100.0)	

## Discussion

This study was conducted in type 2 diabetes mellitus patients. Type 2 diabetes mellitus is more prevalent than type 1 diabetes mellitus. Patients with type 1 diabetes mellitus less than 5-10%, meanwhile type 2 diabetes mellitus patients are about 90-95% of diabetes mellitus patients [10].

The distribution of type 2 diabetes mellitus patients with xerostomia according to gender was higher in males than females. This result was in accordance with the previous study, which reported that the percentage of patients with diabetes mellitus who experienced xerostomia was higher in males (72%) than women (28%) [11]. Patients at the age of 46-55 years were most commonly affected (Table 1). In the previous study, the distribution of xerostomia based on age showed that those with the highest number of the subject experiencing xerostomia were at the age of 61-70 years (45.45%). Aging can lead to changes and deterioration of salivary gland function, where the parenchymal gland is broken and replaced by fat and connective tissue, which results in a decrease in the salivary flow [12]. The result of this study was not in accordance with the result of

the previous research [12]. This is possibly due to the unequal distribution of the subject for each group.

The frequency of type 2 diabetes mellitus patients with xerostomia who experienced coated tongue is higher in those with poor glycemic control (Table 2). Patients with diabetes mellitus experience symptoms such as polyuria or an increased amount of urine, which can result in decreased fluid in the body so that salivary secretions are also reduced and cause xerostomia [13]. Xerostomia can cause the mucosa to become dry and prone to irritation that can affect the cleanliness of hard and soft tissues, especially the tongue [10]. The high prevalence of coated tongue in type 2 diabetes mellitus can be associated with the decreased salivary flow and high salivary viscosity, which can reduce the cleaning capacity and reduced salivary antimicrobial function [6,7].

The majority of subjects who experienced coated tongue were poor glycemic control level group (Table 2). Glycemic control plays a key role in the initiation and development of many signs and symptoms [14]. Previous studies have shown a decrease in salivary secretion in diabetes mellitus patients with poor glycemic control levels compared with the good and moderate glycemic control levels. Hyperglycemia in people with diabetes mellitus leads to an increase in chronic complications [10]. Chronic complications are divided into two types that are microvascular and macrovascular - chronic microvascular complications, such as retinopathy, angiopathy, neuropathy, and diabetic nephropathy [8]. Moreover, oral manifestations such as disorder of saliva secretion, periodontitis, delayed wound healing, and burning mouth increase in diabetes mellitus patients. Among the several reasons which contribute to the decreased salivary flow rate in diabetes mellitus patients are pathologic changes in the structure of salivary glands neuropathy of the sympathetic and parasympathetic system, and microvascular disorders that disrupt saliva production. Additionally, following the hyperglycemia and glucosuria, body fluids are more excreted, and subsequently, secretion of saliva is reduced [14].

Another manifestation of diabetes mellitus is the presence of opportunistic infections, such as oral candidiasis. A high number of reports suggest that *Candida albicans* is the most prevalent species that harbor in the oral mucosa of diabetes mellitus patients, and the high stratum of colonization occurs in with poor glycemic control patients [15]. Oral thrush is an oral infection caused by *Candida*. The main symptom of oral thrush is white lesions that resemble cottage cheese, usually found on the tongue or inner cheeks. Therefore, tongue coating can be a symptom of more severe health conditions, such as oral thrush [16].

There was a relationship between type 2 diabetes mellitus patients with xerostomia and coated tongue based on glycemic control level (Table 3). Prolonged hyperglycemia will lead to polyuria, which ultimately can lead to dehydration, which is considered as the main cause of xerostomia [17]. Xerostomia is reported to occur in 40-80% of diabetic patients and related to decreased salivary flow rates. The oral mucosa is usually protected by saliva when it is adequate in quantity and quality. Diabetic patients are at increased risk for mucosal and other disorders because salivary gland function and immune function are negatively affected by diabetes [18]. The salivary

function can be impaired, such as protection and lubrication functions, decreased levels of secretory immunoglobulin A (IgA), antibacterial effect, and self-cleaning effect. The self-cleaning effect plays an essential role in cleaning the oral mucosa and prevent the attachment and growth of bacteria on oral hard and soft tissues [19].

Patients with diabetes mellitus usually experience a decrease in salivary flow and an increase in salivary viscosity, which causes a decreased self-cleaning ability and reduces the antimicrobial capacity of saliva. Diabetes mellitus also affects a person's immune response, such as a decrease in chemotaxis and vascularization, which causes susceptibility to irritation in the oral cavity [7]. These conditions can cause disruption of cell desquamation and microorganisms' proliferation, especially on the surface of the tongue [8]. Protection and lubrication function of saliva protect the oral cavity from bacterial and fungal colonization as well as a defense against the proteolytic attack by microorganisms. Also, saliva contains proteins such as secretory IgA that can neutralize viruses and bacteria. Moreover, it can function as antibodies to bacteria antigens and inhibit attachment of bacteria to oral tissue [20].

This study showed the highest percentage of the coated tongue was 20.3% (13 patients) with score 2 in moderate glycemic control level and score 3 in poor glycemic control level (Table 3). Previous research stated there was a relationship between oral manifestations of diabetes mellitus with poor glycemic control level, which will further lower the blood flow, which can disturb the function of the salivary glands [18]. Severe decreased of salivary glands function will impact the salivary secretion and will affect the increase in the thickness of the coated tongue [21].

There was an association between type 2 diabetes mellitus patients with xerostomia and coated tongue severity based on glycemic control level (Table 3). The thickness of the coated tongue in diabetes mellitus patients is influenced by blood glucose control level, salivary IgA level, periodontal disease, and age [22]. Poor glycemic control level in diabetes mellitus patients affects an increase in oral manifestations [18]. The secretion of IgA in the saliva is one of the main functions of saliva that has the ability to inhibit bacterial adhesion thus preventing bacterial colonization on the mucosal surface, kills bacteria as a soft and hard tissue protection mechanism, as well as inhibits and reduces the accumulation of coated tongue [22]. Aging process can cause changes and deterioration of salivary gland function. The parenchyma gland will be replaced by connective tissue and fat that can aggravate the coated tongue [10].

This study was not examining the relationship between oral hygiene and coated tongue; therefore, in the next research, it is expected that oral hygiene should be observed. Moreover, this study uses the blood sugar control levels of the patient's last routine blood sugar test; further research is expected to obtain the patient's blood sugar control levels by conducting a blood sugar test at the time of the research.

According to the results of this study, patients with diabetes mellitus should be controlling their blood sugar control levels, so the complications that have arisen are not getting worse and

prevent other complications. Dentists and physicians should be able to educate diabetes mellitus patients about oral hygiene and the importance of maintaining oral hygiene.

## Conclusion

There was a relationship between the presence and severity of coated tongue and level of glycemic control in type 2 diabetes mellitus patients with xerostomia, in a way that poor glycemic control is associated with more frequent and more severe tongue coating.

**Authors' Contributions:** N contributed to the conception and data design, wrote the manuscript, and critically revised the manuscript, and ISM contributed to the conception and data design, performed the research, analysis, and interpretation. All authors declare that they contributed to the critical review of intellectual content and approval of the final version to be published.

**Financial Support:** None.

**Conflict of Interest:** The authors declare no conflicts of interest.

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