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Relationship of VSC with Analysis of Acetone Levels In Halitosis Examination In Type 2 Diabetes Mellitus Patients

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Abstract
Halitosis is an oral health condition characterized by persistent bad breath. As many as 85% of the incidence of halitosis is caused by microbial decay in the oral cavity. This decay produces volatile sulfur compounds (VSC), the main cause of halitosis. One of the factors that cause halitosis is reduced salivary flow rate. Reduction of salivary flow rate is one of the complications of the oral cavity in patients with type 2 diabetes mellitus which can cause dry mouth and a decrease in the pH of the oral cavity. The purpose of this study was to analyze the value of VSC, flow rate, pH, and saliva buffer, and to analyze the relationship between blood sugar levels and acetone levels, flow rate, pH, and saliva buffer. This research is an observational analytic study using a cross-sectional research design with a total sample of 31 people. A sampling of saliva and acetone levels in patients with type 2 diabetes mellitus at Aviati Clinic Medan. The salivary flow rate was obtained by measuring the saliva that was collected for 5 minutes in a saliva pot, while measuring the pH and buffering of saliva using the GC Saliva Check Buffer, and measuring the level of acetone using the Diasen device. Measurement of VSC value using the Breathtron sulfide monitor. Collection of unstimulated saliva by spitting method. Measurement of salivary flow rate using a digital scale, and measurement of salivary pH using a pH meter. The results of this study indicate that the average salivary flow rate is normal with a value of 1.5 ml/minute, and normal pH with a value of 7.2 while the average salivary buffer is low with a value of 8.2 and the average acetone level in this study. normal with a value of 377.38mV. The Pearson correlation test showed an insignificant correlation between fasting blood sugar levels and salivary flow rate, salivary pH, saliva buffer, and acetone levels with a positive overall correlation type, which means that the tendency of fasting blood sugar levels to increase will cause flow rate, pH, buffering. saliva and acetone levels increase. This study concludes that normal salivary status will give normal acetone levels and no correlation between VSC and acetone level

Keywords:*volatile sulfur compound, salivary flow rate, salivary pH, salivary buffer capacity, acetone level.*

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I. Introduction

Halitosis is a very common problem in society. Nearly 50% of the population suffers from halitosis.1,2 In the U.S. population, 50% complain of bad breath and sufferers experience the negative effects of halitosis at times. Halitosis is a very disturbing factor in social communication, thus making it the origin of the problem not only for possible health conditions but also for psychological changes that cause sufferers to isolate themselves from society.2 As many as 85% of halitosis occurrences are caused by microbial decay in the oral cavity. This decay produces volatile sulfur compounds (VSCs) which are the main cause of halitosis.3 VSCs are mostly produced in places where bacteria congregate such as the base of the tongue, periodontal pockets, dental caries, dentures, etc.2 The components most commonly found in VSCs are hydrogen. sulfide, methyl mercaptan,1,2,3,4 dimethyl sulfide,2,3,4, and methyl sulfide.2 Volatile Sulfur Compound is the result of the breakdown of substances such as food debris, cells, saliva, and blood by enzymes produced by bacteria. Amino acids are metabolized through this process and produce a foul-smelling gas.4 In general, the bacteria that produce these components are anaerobic gram-negative bacteria such as Porphyromonasgingivalis, Prevotella intermedia, Fusobacterium nucleatum, Bacteroides forsythus, Treponema denticola.1,2,4 With the increase in the accumulation of gram-negative bacteria, there was an increase in pH to 7.2 and the formation of indole and amine in the oral cavity.

Diabetes mellitus (DM) is a metabolic disease characterized by hyperglycemia due to absolute or relatively reduced insulin secretion or caused by insulin resistance. Fasting blood glucose levels in people with diabetes mellitus are >126 mg/dl, and temporary blood glucose >200 mg/dl.1,2 The World Health Organization (WHO) estimates that in 2025 the number of people with diabetes mellitus will swell to 300 million people and will increase to 438 million people by 2030 worldwide. According to WHO estimates, 70% of the prevalence of

DM is found in developing countries. ReRiket Kesehatan Dasar (RISKESDAS) in 2013, the prevalence of diabetes mellitus in North Sumatra province was 1.8%.1,3,4 Several physiological factors in salivary function can be dangerous in type 2 diabetes that is not well controlled which manifests in the oral mucosa DM patients in the form of candidiasis, burning mouth syndrome, oral lichen planus, recurrent aphthous stomatitis, xerostomia, and salivary gland dysfunction. In DM patients there is a decrease in saliva, both in controlled and uncontrolled DM patients, oral health complications reported associated with type 2 DM, which are commonly encountered by practitioners include xerostomia, tooth loss, gingivitis, periodontitis, odontogenic abscess, and tissue lesions. Saliva is an oral fluid consisting of salivary gland secretions and gingival crevicular fluid, about 90% of saliva is produced by the major salivary glands, and about 10% of saliva is produced by the minor salivary glands. Diabetes is associated with microvascular complications, and autonomic neuropathy, both of which can affect salivary secretion. In patients with type 2 diabetes mellitus, there is a change in the flow rate of saliva and saliva components, this occurs because of damage to the parenchyma gland, changes in salivary gland microcirculation, dehydration, and impaired glycemic contraction. Several factors that can cause salivary dysfunction in DM patients are aging, head and neck radiotherapy, systemic disorders, and some drugs. Research by Prathibha K.M et al in 2013 stated that there was a significant decrease in salivary pH in type 2 diabetes mellitus patients compared to non-diabetic subjects. Acidic pH also occurs in diabetics, this is related to microbial activity or decreased bicarbonate, which occurs simultaneously with salivary flow rate. 3,6,7,8 Acetone (C_3H_6O) is one of the most abundant compounds in human respiration. The concentration of acetone in the breath is increased in patients with uncontrolled diabetes mellitus. The concentration of acetone in the breath in people who do not suffer from diabetes is 800-900ppb, while in people with diabetes the concentration of acetone in the breath ranges from 1800ppb. Patients with diabetes mellitus cause bad breath with a pear odor, this is caused by ketoacidosis.9,10 Patients with type 2 diabetes mellitus increase every year and many manifestations occur in the oral cavity, one of the manifestations in the oral cavity is a decrease in salivary flow, It is known that diabetics have high concentrations of acetone in their breath. Based on this description, the authors intend to conduct research on VSC levels, acetone, and salivary status in type 2 diabetes mellitus at Aviati Clinic on Jl. JaminGinting Padang Bulan, Medan

II. Research Methods

This study is an analytic observational, with a cross-sectional design. The research subjects were patients with type 2 diabetes mellitus at Aviati Clinic Padang Bulan, Medan aged 40-55 years who were undergoing treatment. Determination of the sample is done by using the purposive sampling method. After the patient has met the inclusion and exclusion criteria of the study, the research subject is prepared to follow the research procedure. Saliva was collected using the spitting method and carried out at 08.00-10.00 WIB, which is two hours before lunch, during the measurement it is not allowed to eat, drink, brush teeth, or smoke.32 Salivary pH will be measured using a digital pH meter and then the saliva buffer is measured by way of saliva that has been accommodated in a cup with a buffer capacity indicator based on the GC Saliva Check Buffer indicator. Acetone measurements were taken in the morning after the study subjects were instructed to fast for at least 8 hours. After that the subject was taken to breathe air samples by exhaling normally 3 times each which was accommodated in a special tube which was then analyzed for the gas content with the tool, which was done first, namely, setting up the device by turning on the diasen and connected to the cellphone via Bluetooth. , then a sterile pipette is attached to the diasen, then the patient is instructed to exhale for 7 seconds. The reader data is then transferred and displayed on the cellphone screen, after 5 minutes the test can be stopped and the data can be displayed in the form of screenshots or the form of data stored in dropbox. If the tester wants to retest, the sensor can be restored first using silica gel which is pumped using an air pump. VSC measurements were carried out using a sulfide monitor called a Breathtron. A disposable mouthpiece is inserted into the end of the Teflon tube connected to the monitor. This mouthpiece has a filter to eliminate other volatile compounds such as acetone and alcohol in toothpaste or mouthwash. Measurements were made by holding the mouthpiece and inserting the mouthpiece into the subject's oral cavity. Cover the gap between the lips and the mouthpiece with the surface of your finger. Subjects were asked to cover their mouth and breathe through their nose during the measurement. Measurements were carried out for 45 seconds. Breathtron measurement results are presented in ppb units.

III. Research Result

Table 1. Demographic data of respondents

Statistics description		
Variable	n	*x*+SD
Age	31	49,8±4,4
Heavy	31	66,5± 12,2
Height	31	163 ± 7,68
Saliva Flowrate	31	1,5 ± 0,7
pH	31	7,2 ± 0,5
Buffer	31	8,2 ± 3,0
Acetone level	31	377,38 ± 171,2
Vsc	31	127.26±75.99

Table 1 shows demographic data on respondents with a sample age range according to the inclusion criteria, namely 40-55 years. The patient's average weight was 66.5 kg with the minimum body weight of the respondents in this study was 49 kg and the maximum was 98 kg, while the average height was 163 cm with a minimum height of 150 cm and a maximum height of 178 cm. The average salivary flow rate in patients is 1.5 ml/minute. The salivary pH of the patients is also the majority in normal conditions, namely 7.2, while the average salivary buffer in patients is low, namely 8.2. The average level of acetone in high patients was 377.38 mV. the average value of VSC is 127.26 with a standard deviation of 75.99. The normal VSC value is 0-250 ppb, there are only 6 people who have a VSC value above normal.

Table 2. Results of Analysis of the Relationship of Fasting Blood Sugar Levels with Flow Rate Saliva, Saliva pH, and Saliva Buffer Capacity

Variable	Fasting blood sugar level	
	r	p
Saliva Flow Rate	0,181	0,527
Saliva pH	0,043	0,82
Saliva Buffer	0,192	0,3

Description: Pearson correlation test significance $p<0.05$

Table 2 shows the relationship between fasting blood sugar levels with salivary flow rate, salivary Ph, and salivary buffering capacity, this has been tested using the Pearson correlation test with a significance of $p<0.05$. The Pearson correlation between fasting blood sugar levels and salivary flow rate showed a nominal value ($p>0.05$) with a very weak positive correlation type ($r = +0.181$) a positive correlation value can be interpreted when fasting blood sugar levels increase then salivary flow rate tends to increase. The Pearson correlation between fasting blood sugar levels and salivary pH showed a nominal value ($p>0.05$) with a very weak positive correlation type ($r = +0.043$) which means that the tendency of fasting blood sugar levels to increase will cause saliva pH to increase, and The same results were obtained in the correlation of fasting blood sugar levels with salivary buffer capacity which showed an insignificant value with a very weak positive correlation type ($r = +0.192$), which means that when fasting blood sugar levels increase it will cause saliva buffer capacity to increase.

Table 3 Results of Analysis of the Relationship of Fasting Blood Sugar Levels with Acetone Levels in Patients with Type 2 Diabetes Mellitus

Variable	Fasting blood sugar level	
	r	p
Acetone level	0,078	0,678

Description: Pearson correlation test significance p<0.05

Table 3 shows acetone levels with categories of normal, moderate, and high fasting blood sugar levels. In research with high fasting blood sugar levels, subjects had normal acetone levels, but there was only a slight difference in high fasting blood sugar levels, subjects had high acetone levels. This table describes the relationship between fasting blood sugar levels and acetone levels in type 2 diabetes mellitus. The Pearson correlation between fasting blood sugar levels and acetone levels shows an insignificant value (p>0.05) with a very weak positive correlation type (r = +0.078), which means that the tendency of fasting blood sugar levels to increase will cause an increase in acetone levels.

The correlation value of salivary pH to the value of VSC in patients with type 2 diabetes is 0.259, which means that the two variables have a unidirectional relationship. This shows that if the salivary pH increases, the VSC value will also increase. The correlation coefficient indicates the strength of the relationship between the two variables which tends to be strong.

IV. Discussion

The results of the study of the relationship between fasting blood sugar levels and salivary flow rate, salivary pH value, salivary buffer capacity, VCS levels, and oral acetone levels in patients with type 2 diabetes mellitus were analyzed using the Pearson correlation test. Statistical tests were carried out with a significance level of p<0.05. The results obtained in this study include demographic data of respondents, frequency of salivary flow rate, pH value, salivary buffer capacity, and frequency of oral acetone levels in patients with type 2 diabetes mellitus, and the relationship between fasting blood sugar levels and salivary flow rate. Salivary pH, salivary buffer capacity, and oral acetone levels in type 2 diabetes mellitus patients. According to the American Diabetes Association (ADA), that DM is associated with risk factors that cannot be changed and that can be changed. Risk factors that cannot be changed include a family history of DM (first-degree relative), age >45 years, associated with the subject of this study, the average age according to the inclusion criteria was 45-55 years. Modifiable risk factors include obesity based on BMI >25kg/m2 or abdominal circumference >80 cm in women and >90 cm in men.

This study had an average weight of 66.5 kg with a height of 163 cm, but the shortcomings of this study were that the researchers did not control.The research hypothesis regarding the relationship between fasting blood sugar levels and acetone levels (table 3) was rejected because the results of the analysis as proven by using the Pearson correlation test with a significance of p <0.05 did not have a significant relationship with a very weak positive correlation.11,12,13 According to Mitrayana et al (2014), acetone is an abundant compound in human respiration, and the concentration of acetone in respiration increases in patients with uncontrolled diabetes mellitus. According to research by Muttaqin (2012), blood sugar levels and acetone levels in saliva do have a relationship, whereas someone with higher blood sugar levels has higher acetone levels in saliva. 9,14 The results of research that have been studied by Muttaqin (2012) are different because of differences in the use of tools for the examination, whereasMuttaqin's research was carried out using a spectroscopic tool with a concentration unit of acetone mol/l while the research that has been done using a Diasen tool with units of mV. Cases of abnormalities in human metabolism occur, among others, in patients with type 2 diabetes mellitus who are not controlled causing breath or bad breath with a pear aroma, this is due to ketoacidosis, where acid molecules known as ketones form waste products, waste ketones can be excreted in the breath. which causes bad breath.9,15

V. Conclusion

There is no relationship between fasting blood sugar levels with VSC and oral acetone levels in controlled type 2 diabetes mellitus patients with a very weak positive correlation, this has been proven by the Pearson correlation test of significance

VI. Suggestion

Based on the research that has been done, it can be suggested that a study be conducted to determine the relationship between salivary flow rate, salivary pH, salivary buffer capacity, and acetone levels in type 2 diabetes mellitus patients who use insulin injections.

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