Salivary Calcium and Phosphorous in Caries Active Type II Diabetic Patients

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ABSTRACT

BACKGROUND

Diabetes mellitus is a metabolic disorder which favours the progression of dental caries and affects the oral health. Studies have revealed that diabetic condition affects salivary electrolytes concentration contributing to demineralization of the teeth. This study was carried out to evaluate the impact of age in diabetes affecting oral health. We wanted to compare calcium and phosphate level in diabetic and non-diabetic patients and its impact on prevalence of dental caries.

METHODS

A total of 96 patients were examined and divided into groups of age 20-39 yrs. with and without caries and 40-64 yrs. with and without caries. After obtaining their consent, diabetic status was assessed. Patients were divided into diabetic and non-diabetic groups based on diabetic status and inclusion criteria. The groups were further subdivided into with caries and without caries. The dental caries was assessed using Decayed, Missing, Filled Tooth (DMFT) Index.

RESULTS

Calcium and phosphate ions are significantly reduced in caries active young diabetic patients (4A). In this study it showed that salivary calcium and phosphate ions in type II diabetic patients directly influence the prevalence of caries in young diabetic patients when compare to old patients.

CONCLUSIONS

Thus, within the limitations of the study, impact of calcium and phosphate ions in type II diabetic patients had much more influence on young diabetic patients when compared to old patients.

KEY WORDS

Diabetes Mellitus, Dental Caries, Calcium, Phosphorous

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BACKGROUND

Diabetes is a clinical condition characterized by defect in insulin secretion, insulin action or both resulting in hyperglycaemia.¹ It has been classified into type I, type II and gestational diabetes. Type I diabetic is due to defect in insulin secretion resulting in severe hyperglycaemia and ketoacidosis includes immune mediated diabetes and idiopathic diabetes. Type II is characterized by altered insulin production without autoimmune destruction of beta cells, common factors are the age, obesity and overweight. Gestational diabetes is usually seen in pregnancy. It increases significantly the risk for later development of type II diabetes.² Xerostomia or hyposalivation is prevalent in diabetic patients. Lamsher et al proved that diabetes affects the quality of life in patients. Individuals with good diabetic control have low caries index when compare to normal healthy individuals because of high intake of cariogenic food. In certain conditions due to periodontal problems and aggravating factors results in exposure of root surface resulting in root caries. Other factors such as poor oral hygiene favours the progression of caries³

Decrease salivary flow rate, salivary pH, increased salivary glucose concentration are the risk factors for dental caries.⁴ Studies revealed that buffering capacity of saliva neutralizes the acids produced by the bacteria, thus preventing the demineralization of tooth structure.⁵ Salivary factors such as salivary calcium, flow rate and pH directly influence on prevalence of dental caries⁶ and calculus formation in diabetic patients is due to high phosphate level in saliva which favours a suitable environment for progression of caries.⁷ Saliva contains locally produced, serum derived markers useful in diagnosis of systemic disorders. It is economical and an alternative to the patients in whom blood drawing is difficult or due to some complications.⁸

A limited study was done on salivary calcium and phosphorous level in diabetic and non-diabetic patients. Considering this the present study aims to evaluate and compare salivary calcium and phosphorous levels in young and old diabetic and non-diabetic patients with and without caries.

METHODS

A Case control study was carried out in the outpatient department of conservative dentistry and endodontics after being approved by the institutional ethical committee. The sample size was calculated based on assumption of standard deviation 0.5 and 0.75 and mean difference of 0.52 between diabetic and control group. The power used 90% and 5% of error the sample size was obtained 24 in each group. (n-mastering software Vellore). A total of 96 patients were examined and divided into 4 groups of age 20-39 yrs. with and without caries and 40 – 64 yrs. with and without caries.

By obtaining their consent, diabetic status was assessed. Patients were divided into diabetic and non-diabetic group based on diabetic status and inclusion criteria. The groups were further subdivided into with caries and without caries.

The dental caries was assessed using Decayed, Missing, Filled Tooth (DMFT) Index.

Inclusion Criteria

Patients with type II diabetic and non-diabetic of either sex age group between 20–39 yrs. and 40 – 64 yrs. with random blood sugar level >160 mg/dL.

Subjects with good oral hygiene of 0.1-1.2.

Exclusion Criteria

- Patients with any other systemic diseases apart from diabetes.
- Patients taking drugs causing xerostomia.
- Patients with h/o smoking and alcohol intake.

Collection of Saliva for Salivary Analysis

Patients were asked to rinse mouth with 15 ml of distilled water to wash out exfoliated cells. 5 ml of unstimulated saliva was collected by asking the subjects to expectorate into sterile tubes. The collected saliva was centrifuged, and the supernatant obtained was evaluated using an Erba autoanalyzer Chem 5Xf or Ca & P. When the evaluation could not be done immediately, it was stored at 4°C for subsequent analysis.

Statistical Analysis

Independent sample 't' test was used to correlate the salivary electrolytes concentration among the groups. A 'p' value of 0.05 or less was considered significant. Results are presented as mean ± standard deviation. SPSS 17 soft ware analysis was used.

RESULTS

Electrolytes	A Groups	Mean	S.D.	T Value	p
Calcium	Non-diabetic with caries	(7.67)	(4.13)	-1.049	0.305
	Non-diabetic without caries	(9.29)	(3.39)		
Phosphorous	Non-diabetic with caries	(5.99)	(3.64)	-1.408	0.173
	Non-diabetic without caries	(8.62)	(5.34)		
Electrolytes	B Group	Mean	S.D.	T Value	p
Calcium	Non-diabetic with caries	(6.97)	(3.72)	-0.535	0.598
	Non-diabetic without caries	(7.72)	(3.10)		
Phosphorous	Non-diabetic with caries	(9.48)	(3.93)	-1.366	0.186
	Non-diabetic without caries	(12.3)	(6.23)		

Table 1. Control Group with and without Caries in 20 to 39 Years Young-Adult Age Group (A) and 40 to 64 Years Old-Adult Age Group (B)

N=12

Electrolytes	A Group	Mean	S.D.	T Value	p
Calcium	Diabetic with caries	(4.166)	(1.21)	-5.919	0.00
	Diabetic without caries	(10.21)	(3.32)		
Phosphorous	Diabetic with caries	(12.63)	(3.52)	-5.587	0.00
	Diabetic without caries	(18.75)	(1.41)		
Table 2. Diabetic Group with and without Caries in 20 to 39 Years Young-Adult Age Group (A) and 40 to 64 Years Old-Adult Age Group (B)					
N = 12					

Electrolytes	B Groups	Mean	S.D.	T Value	p
Calcium	Diabetic with caries	(6.70)	(2.867)	0.035	0.972
	Diabetic without caries	(6.64)	(4.73)		
Phosphorous	Diabetic with caries	(13.45)	(5.56)	0.392	0.699
	Diabetic without caries	(12.52)	(6.05)		
Table 2. Diabetic Group with and without Caries in 20 to 39 Years Young-Adult Age Group (A) and 40 to 64 Years Old-Adult Age Group (B)					
N = 12					

Electrolytes	A Groups	Mean	S.D.	T Value	p
Calcium	Diabetic without caries	(10.21)	(3.32)	-0.673	0.508
	Non-diabetic without caries	(9.29)	(3.39)		
Phosphorous	Diabetic without caries	(18.75)	(1.41)	-6.342	0.00
	Non-diabetic without caries	(8.62)	(5.34)		
Table 3. Comparison of Diabetic and Non-Diabetic Patients without Caries in 20 to 39 Years Young-Adult Age Group (A) and 40 to 64 Years Old-Adult Age Group (B)					
N=12					

Electrolytes	B Groups	Mean	S.D.	T Value	p
Calcium	Diabetic without caries	(6.64)	(4.73)	-0.661	0.516
	Non-diabetic without caries	(7.72)	(3.10)		
Phosphorous	Diabetic without caries	(12.52)	(6.05)	-0.051	0.960
	Non-diabetic without caries	(12.39)	(6.23)		
Table 3. Comparison of Diabetic and Non-Diabetic Patients without Caries in 20 to 39 Years Young-Adult Age Group (A) and 40 to 64 Years Old-Adult Age Group (B)					
N=12					

Electrolytes	A Groups	Mean	S.D.	T Value	p
Calcium	Diabetic with caries	(4.166)	(1.21)	2.820	0.010
	Non-diabetic with caries	(7.67)	(4.13)		
Phosphorous	Diabetic with caries	(12.63)	(3.52)	-4.541	0.000
	Non-diabetic with caries	(5.99)	(3.64)		
Electrolytes	B Groups	Mean	Std deviation	T value	P value
Calcium	Diabetic with caries	(6.70)	(2.866)	0.203	0.841
	Non-diabetic with caries	(6.97)	(3.72)		
Phosphorous	Diabetic with caries	(13.45)	(5.56)	-2.016	0.056
	Non-diabetic with caries	(9.48)	(3.93)		
Table 4. Comparison of Diabetic and Non-Diabetic Patients with Caries in 20 to 39 Years Young-Adult Age Group (A) and 40 to 64 Years Old-Adult Age Group (B)					
N=12					

In control group 1A and 1B young adult age group and older adults' groups there was no any statistically significant among the groups. In diabetic group table 2A there was statistically significant decrease in calcium and phosphorous in young adult group and no changes in older adult age group. (2B). Between control and diabetic patients without caries (table 3A) phosphate level was higher. Between control and diabetic patients with caries (table 4A) the calcium and phosphates levels were significantly reduced when compare to old group.

DISCUSSION

Dental caries is a unique multifactorial disease and diabetic condition resulting in imbalance of the oral environment

favouring the progression of caries.⁷ Literature reveals that poor metabolic control in diabetic patients favours the growth of streptococcus mutans and lactobacillus. Dental caries is one of the most common consequence of hyposalivation.⁴

Saliva is constantly present in the oral cavity whose function is to lubricate and protect tissues from abrasion during mastication, antibacterial activity against microorganisms, facilitating in digestion of carbohydrates, flushing the oral cavity to remove the food particles and debris from the tissues and chemically maintaining an environment rich in calcium, phosphates and acid buffering agents. The plaque pH goes from acidic to normal (or the resting level) depends on the presence of saliva and the components in it, that are the carbonates and phosphates pH buffering agents in the saliva. Dawes stated that increased concentration of protein, chloride and bicarbonates and decreased concentration of magnesium and phosphorous is directly proportional to rate of salivary flow. The increased concentration of bicarbonates diffuse into the plaque, neutralizes plaque acids, increase the pH of the plaque and favours the remineralization of damaged enamel and dentin.⁹

Dental remineralization and in maintenance of salivary pH buffer capacity of saliva plays an important role. The buffering system of saliva is always correlated with the salivary flow rate and any factors inhibits the salivary flow rate, it declines the buffering capacity and increase the risk of caries development.¹⁰ The buffering system of the saliva includes phosphates, bicarbonates and proteins. Hyposalivation contributes to decrease in phosphate, bicarbonates and proteins. Apart from that hormonal, metabolic and altered general health also influence on the secretion of phosphate, bicarbonates and proteins which favours an environment for the initiation of caries.¹¹ Diet also plays a vital role in initiation and progression of caries. The high intake of refined carbohydrates, high glucose content in the saliva and gingival fluid of diabetes favours the progression of caries in the cervical area of the teeth.¹²

It has been reported that pH regulates the calcium deposition which is helpful in reducing caries formation. Alteration in salivary composition and flow directly influence on the oral symptoms and severity in diabetic patients.⁶ The phosphate in the saliva neutralizes the acids produced by the bacteria and prevents demineralization. Apart from that calcium is considered as chief mineral which prevents demineralization. Calcium and phosphate secretion is severely affected in patients with poorly controlled young diabetic patients. In the present study the phosphate level was higher in young diabetic patients. (table 3A). Studies revealed that alkaline phosphatase enzyme is the prime enzyme in balancing remineralization and demineralization in type II diabetic patients.

Calcium and phosphate ions is significantly reduced in caries active young diabetic patients (4A). In this study it showed that salivary calcium and phosphate ions in type II diabetic patients directly influence on the prevalence of caries in young diabetic patients when compare to old patients. Hence the current study evaluated that in young diabetic patients calcium and phosphate ions play a vital role in demineralization and remineralization of the teeth. But in older age group irrespective of diabetes and caries it doesn't show any significant difference. Apart from that altered acinar

structure and physiologic aging process had an effect on salivary dysfunction in old patients.

CONCLUSIONS

Thus, within the limitations of the study impact of calcium and phosphate ions in type II diabetic patients had much more influence on young diabetic patients when compared to old patients. A positive relationship exists between calcium, phosphate ions, diabetes mellitus and dental caries. Young diabetic patients should be motivated regarding the oral health complications and the prevalence of dental caries so that monitoring their diabetic status and diet helps in reduction of dental caries.

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