Dental Caries and Salivary Alterations in Type I Diabetes

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Insulin dependent diabetes mellitus is a severe disease that raises blood glucose levels because of hyperglycemia and insulinopenia. Fluctuations in water and electrolyte levels may result in xerostomia and other changes in the salivary composition. Since diabetes has an influence on oral health, it is important for the dentist to be aware of newer advances in the field of diabetes and to recognize specific oral problems related to diabetes. Thus, the dentist becomes an important part of the health care team for the patients with diabetes. ***Aim:*** *The present study correlated salivary flow rate, salivary pH and total salivary antioxidant levels and dental caries in type I diabetic patients.* ***Method:*** *A total of 200 children that included 100 known diabetic children (study group) and 100 healthy children (controls) of both the sexes and from similar socioeconomic backgrounds formed the part of this study. Dental caries was assessed using DMFT index. The salivary total anti-oxidant level was estimated using phospho molybdic acid using spectrophotometric method. The salivary flow rate was recorded using the Zunt method and the salivary pH using the pH indicating paper. The results were statistically analyzed using t-test.* ***Conclusions:*** *The analyzed parameters showed increase in salivary anti-oxidant levels, reduced salivary flow rate, increase incidence of dental caries, salivary pH was decreased when compared to the control group.*

Keywords: *Salivary Total Anti-oxidant, Salivary Flow Rate, Dental Caries, Salivary pH and Type I Diabetes.*

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INTRODUCTION

Type 1 diabetes mellitus is an endocrine – metabolic syndrome of childhood and adolescence, characterized by hyperglycemia as a cardinal biochemical feature, with important consequence for physical and emotional development.[1]

Diabetes mellitus is a systemic disorder affecting 2-10% of the human population. Many systemic complications such as micro and macroangiopathies, neuropathy, and nephropathy have been recognized as common complications of diabetes.[2] As to the oral cavity, amongst early clinical symptoms are xerostomia, pathological changes in periodontal tissue and candidiasis, with enlargement of the parotid glands occurs later.[3]

Healthy flow of saliva is deemed essential for critical maintenance of both oral and general health. Saliva is a valuable oral fluid taken for granted, receiving little attention until the quality and quantity are diminished.[4]

Salivary flow is diminished in diabetic individuals. Saliva may constitute a first line of defense against free radical mediated oxidative stress, since the process of mastication promotes a variety of such reactions, including lipid peroxidation. More over during gingival inflammation, gingival crevicular fluid flow increases, adding to saliva with products from the inflammatory response. This is why the anti oxidant capacity of saliva is of increasing interest.[5]

The association of diabetes and dental caries has received much less attention and the results have been controversial. Most studies are cross sectional and show either higher, similar or lower caries prevalence among diabetic than among the controls.[6]

Since the salivary flow rate, and salivary total anti-oxidants levels may be alerted in juvenile diabetic patients, this study was designed to assess the oral health, salivary flow, salivary pH and the effect of possible stress on the antioxidant levels in these children.

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MATERIALS AND METHOD

A total of 200 children (100 Type I Diabetic children, study group and 100 normal healthy children, control group) between the age 6-12 years reported to the Institute of Child Health (ICH), Chennai, Tamil Nadu, India, were included in the study after getting an approval from the ethical committee.

Oral health status was recorded using a modified WHO[7] format by the same examiner in all the groups. Caries assessment was done using 'DMFT' and 'dft' index. Oral hygiene assessment was done using 'OHI-S' index.[8]

All the subjects were instructed to refrain from eating or drinking for a minimum of 2 hours before the saliva sample were collected. Before treatment un-stimulated saliva (1.0 - 1.5ml) was collected by allowing the patient sit in the coachman position, the patient was asked to passively drool into a funnel inserted into a graduated cylinder for 5 min. The volume of saliva collected in the cylinder after 5 minutes was divided by 5 to determine the un-stimulated salivary flow rate.[9] Salivary pH was estimated using pH indicating paper (Indikrom Papers, Glaxosmithkline Pharma, Mumbai, India with a pH range between 4.5-6).[9] The collected saliva was stored in glass or plastic vials, then in the chiller at *4°C*. The total antioxidant capacity of saliva was evaluated using the spectrophotometric assay.[10]

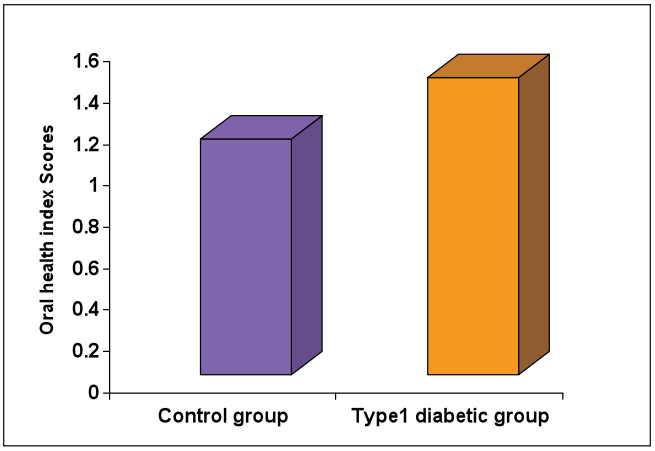
The results were statistically evaluated using Student's-t-test with SPSS data processing software version 15.0.

RESULTS

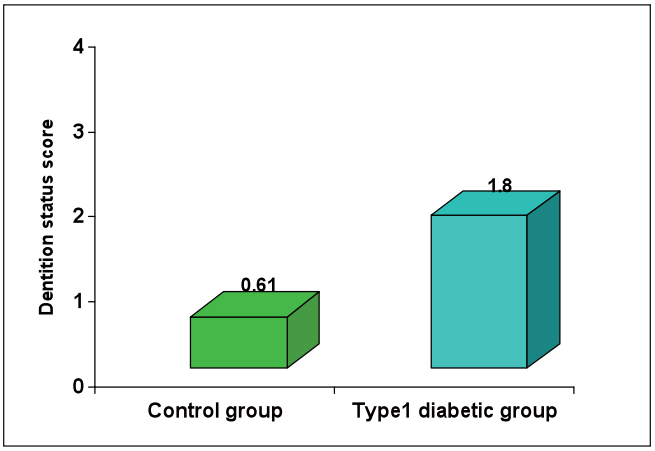
The oral hygiene of study group showed a mean value of 1.142 when compared with the control group and were statistically significant. (p<.0005). {Graph 1}. The salivary flow was reduced in the study group with mean value of 0.17ml/min and control group had a mean value of 0.7ml/min which was statistically highly significant (p<0.005). {Table 1}The salivary pH in the control group showed a mean of 7.071 and, that of the type 1 diabetic group was 6.406 which is statistically significant (p<.0005). {Table 1} The total salivary antioxidant level was increased in the study group with mean of 1.4877 which was statistically significant (p<.0005). {Table 1} The score for DMFT score in the control group showed a mean DMFT of 0.61 whereas, that of the type 1 diabetics was 1.80, which is statistically significant (p<.0005). {Graph 2}

Table 1. Mean scores of salivary flow rate, salivary pH and total salivary antioxidant levels in study group and control group.

	Groups	Mean	Std.deviation	p-value
Salivary flow rate (ml/min)	Control	.722	.2227	<0.0005
	Type I Diabetic	.178	.1165	
Salivary pH	Control	7.071	.2686	<0.0005
	Type I Diabetic	6.406	.6296	
Salivary antioxidants ((µmol/dl)	Control	.5485	.42499	<0.0005
	Type I Diabetic	1.4877	1.36723	



Graph 1. Bar graph showing the mean values of oral hygiene index among two groups.



Graph 2. Bar graph showing the mean values of dental caries experience among two groups.

DISCUSSION

Diabetes mellitus is the term used for a group of metabolic disorders that are clinically and genetically heterogeneous, but share the common characteristic of glucose intolerance.[11,12,13] Higher prevalence of dental diseases like dental caries, xerostomia, gingival inflammation are reported for children with Type I diabetes when compared to systemically healthy children.[3] Similar findings were observed in the present study.

The oral health status in diabetic patients deteriorated compared to the control group. Poor oral hygiene contributes to accumulation of plaque, but increased plaque in the poorly controlled diabetic subjects was probably a result of other factors besides inadequate oral hygiene. Decreased salivary flow in poorly controlled diabetics may have resulted in less effective cleansing and a decreased supply of antibacterial substance. In addition, elevated salivary glucose concentration ensured that an increased supply of fermentable carbohydrate was continually available to plaque bacteria. The combination of decreased salivary flow, increased salivary glucose, and poor oral hygiene contribute to an increased accumulation of plaque in poorly controlled diabetics.[14]

The results of the present study demonstrated that the prevalence and severity of dental caries in type I diabetics was high. Documentation reporting the lower caries prevalence in the diabetic population has been attributed to the restricted intake of carbohydrate and modern management of diabetes care, characterized by the flexibility in the use of insulin and less rigid meal planning, in turn reducing the significance of the dietary factor as a sole indicator in caries development.[15]

In this study group, caries development was a result of the combination of the disease related factors and oral hygiene management, which at the end of the day comes back to personal behavior. This assumption is further supported by the fact that a tendency towards impaired oral health was evident already at baseline in those with less good metabolic control.

Our study established that the patients with Type I diabetes suffered from decreased salivary flow. The possible reason could be as cited in various literature that insulin deficiency causes degenerative changes in the salivary glands, mainly include, the intracellular accumulation of the lipids. Apart from the effect of insulin deficiency on salivary glands, it might be that the overall dehydration associated with hyperglycemia, decrease the volume of saliva excreted.[16]

Contradictory results have been reported with respect to the relationship between salivary dysfunction and diabetic neuropathy. Patients with diabetes have been reported to have both increased and decreased flow rates. Other investigations have been unable to discern any difference in salivary function. These conflicting results (Conner *et al*, 1970) (Kjellman, 1970) may be due to the large variability of normal salivary functions, the duration of diabetes for the population studied, and the limited samples sizes used in some studies.[17]

Evidence is accumulating that most of the degenerative diseases that afflict humanity have their origin in deleterious free radical reactions. Human diabetes is accompanied by a strong oxidative predominance in blood. In diabetes, the persistence of hyperglycemia has been reported to cause increased production of oxygen free radicals through glucose auto-oxidation and non enzymatic glycation. Generation of oxygen free radicals by glycation protein is widely believed to be one of the main causes of oxidative stress in diabetes.[18]

It is established from our study that total salivary antioxidant levels in juvenile diabetics were increased. On the contrary, studies have shown that juvenile diabetics have shown a decrease in anti-oxidant levels. This could be attributed to the role of oxidative stress in pathogenesis of type I diabetes mellitus and involvement of salivary glands in the diseases.[18] The increase in salivary total anti-oxidant in diabetic children could be because of the altered dietary regimen as well as increase in salivary protein concentration.

Salivary pH plays a vital role in the maintaining the oral health. The normal salivary pH is 6.2 to 7.6.[19] The mean pH of saliva in the control group was found to be 7.07 and that of study group was 6.4, which was statistically significant. According to Faulconbridge *et al*, analysis of the saliva revealed that the patients with diabetes had the same pH as the control subjects.[16]

Salivary glucose concentration will be significantly higher in the diabetic patient compared to the control group. This can be attributed for the fall in the pH, because the glucose which is in the free form in the oral cavity (saliva and gingival crevicular fluid) can be metabolized into lactic acid and other acids by the plaque bacteria.[20]

Normal salivary function is essential to the preservation of the integrity of teeth and oral soft tissue. When treating patients with diabetes, practitioners should be alert to complaints of dry mouth and signs of decreased salivary function. Dental management strategies for patients with diabetes should be individualized with respect to patient needs and should possibly include more frequent visit to dentist.[17] Because of the importance of saliva in maintaining and preserving oral health, the management of oral disease in patients with diabetes should always include a comprehensive evaluation of salivary function.

CONCLUSION

From the above study we concluded that salivary flow rate and salivary pH were decreased, oral hygiene was compromised, and incidence of dental caries and total salivary antioxidants levels were increased when compared to the healthy control group.

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