Relationship between serum Ascorbic Acid and Periodontal Status among the Patients with Diabetes Mellitus

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Abstract

Oral micro organisms are the major etiological factors of periodontal disease. A secondary role in this infectious process has been postulated for ascorbic acid deficiency. In diabetes mellitus ascorbic acid metabolism is disturbed. Microangiopathy is the main cause of retinopathy and nephropatathy in diabetes mellitus. The same microvascular lesion is found in the gingiva and alveolar mucosa of the diabetics which make the diabetics more susceptible to periodontitis. In this respect attempts were made in this study to findout the inter relationship between the degree of peridontitis with the glycaemic status and their plasma ascorbic acid level. In this study no such positive finding was observed which might correlate the diabetic vascular complications and the presence of periodontitis. While comparing the plasma ascorbic acid level with their dietary intake the majority of the subjects both cases and controls failed to achieve the expected value. But with an increment of ascorbic acid in the diet by 10% of the RDA the resultant ascorbic acid value reached the expected level.

Introduction

Periodontal disease, synonymous with periodontitis, is an inflammatory condition characterized by microbial colonization of dental plaque causing destruction of the periodontal tissues, resulting in formation of pathological pocket around the diseased tooth and loss of alveolar bone. [1,2] It is one of the most prevalent disease of the community, mostly found in Asia and Africa. In the underveloped countries females are more affected than males with increasing age.

Low socio-economic condition, poor oral hygiene and various systemic disease show a high association with periodontal disease.[3] Dental plaque is the primary extrinsic etiologic factor in periodontitis.There are certain systemic diseases which are considered to have secondary influence on

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periodontitis, e.g. hormonal change's, particularly during puberty and pregnancy, certain nutrient deficiency (particularly ascorbic acid,) hematological factors and diabetes mellitus[3]. Bacteria commonly found in the oral cavity are the primary extrinsic etiologic factor in periodontitis. Any factor that decreases the body's ability to fight these oral bacteria will increase the chance of periodontal breakdown. Several studies have shown that, in diabetes mellitus there is altered polymorphonuclear chemotaxis and microangiopathy in the gingival tissues. These factors probably play a possible role in the higher incidence of periodontitis in diabetics.[4] On the other hand ascorbic acid which has a definite function on maintaining the periodontal health, its transportation inside the cell is impaired in diabetes mellitus.[5] Ascorbic acid deficiency has been quantitatively related to an altered mucosal barrier function, decreased resistance to infections, altered synthesis of basement membrane collagen and increased incidence of periodontal disease.[6] Species like man who require dietary ascorbate, must have an appropriate transport mechanism for ascorbic acid. Hyperglycaemia interferes with the intracellular transport of ascorbic acid. It may be suggested that diabetic microangiopathy which is the main complication of human diabetes may be the consequence of local ascorbate deficiency.[7]

The aim of this study was to find out the relationship between the periodontal health and plasma ascorbic acid level in patients with diabetes mellitus.

Methods and materials

Subject

One hundred and ninety established diabetics were selected from the patients admitted to BIRDEM Hospital, Dhaka. For the detection of diabetes the WHO diagnostic criteria were followed.[8] Patients were grouped into non-insulin dependent diabetes (NIDDM) and impaired glucose tolerance (IGT). As the insulin dependent diabetics (IDDM) are not well defined in our country, a third group, under the age of forty years only on insulin, was described as insulin treated young diabetics (ITYD). The selection of the one hundred subjects was based on the presence of periodontitis. For the clinical assessment of periodontitis the WHO methods (CPITN) were followed.[9] The remaining ninety patients who did not have periodontitis were classified as control group. Patients consents were taken and they were informed about study.

All the patients, both cases and controls, were in the age group of 30-65 yrs. Only high and middle socio-economic class of people were included in this study. No strict criteria for education and occupation were followed.

Data collection

Date were collected by interviewing using a precoded questionnaire. The personal habits like smoking, chewing of betel leaves, maintenance of personal hygiene were looked for. Dietary informations were taken from the daily diet charts made for the individual patient in BIRDEM hospital. Special emphasis was given of ascorbic acid containing foods, mainly vegetables and fruits. The cooking loss of ascorbic acid in the vegetables was calculated from the standard charts. Thus the actual intake of ascorbic acid of the patients, specially in the meals prior to blood drawing was assessed. Their past dietary history was also taken. Duration and treatment for diabetes, and specific complications of the diabetes were also recorded.

Blood collection

Blood was collected aseptically and stored in glass test tubes. These were covered with black papers to protect from light to prevent destruction of ascorbic acid. Blood was collected in the morning between 10-11 a.m. About 3 ml of blood was collected from each patient. Blood samples were centrifuged within 30 minutes of collection for biochemical analysis. Plasma ascorbic acid was measured by dinitrophenyl hydrazine method with modification according to Lowry et al (1945).[10] The plasma sugar level was obtained from the hospital (BIRDEM) record book.

Results

A total of one hundred and ninety subjects were included in the study. Out of them one hundred were in the case group and the rest were in the control group. The majority of the cases in the study belonged to 51-60 years age group irrespective of their sexes, followed by 41-50 years age group. But for the controls the picture was reversed. Most of the controls were in the 41-50 years age group, followed by 51-60 years age group (table-1). Table-2 shows the distribution of the subjects (both cases and controls) by their diabetic status. Eighty three percent of the cases were of non-insulin dependent type (NIDDM), followed by insulin treated young diabetics (15%). The remaining 2% belonged to the impaired glucose tolerance (IGT). On the other hand 72% of the control group were of NIDDM type. The ITYD group represented 27% and the IGT group only 1%. In both the groups the majority of the patients were NIDDM type.

Table 1. Distribution of the subjects (cases and controls) by their age and sex.

Age / Sex	30-40 yrs.		41-50 yrs.		51-60 yrs.		61+yrs.	
	Case	Cont.	Case	Cont.	Case	Cont.	Case	Cont.
Male	3	6	7	18	22	11	15	5
Female	5	10	12	25	24	9	12	6

Table 2. Distribution of the subjects (cases and controls) according to their diabetic status.

Type of diabetes	Cases n=100	Controls n=90
NIDDM	83	65
ITYD	15	24
IGT	2	1

NIDDM- Non-insulin dependent diabetes mellitus, ITYD- Insulin treated young diabetes, IGT- Impaired glucose tolerance

The personal habits like smoking, taking tea or coffee or chewing betel leaves by the cases are shown in table-3. The table shows that about 50% of the patients with severe (pocket measurement 6mm is considered as severe periodontitis and moderate is 4-5 mm) periodontitis were heavy betel leaves chewier, followed by mild (20%) and moderate cases 26% Regarding smoking there was no significant difference between the moderate and severe group of periodontitis. In case of the controls only 19% took heavy betel and 9% were heavy smokers (table-4). Most of the subjects took tea/coffee. The persons taking heavy betel leaves, smoking heavily are more prone to develop moderate to severe type of periodontitis. Seventy percent cases of all the groups (periodontitis type) were taking tea/coffee, suggesting that the degree of disease severity is little related with drinking tea/coffee compared to smoking or chewing betel. The fasting blood sugar level of the cases and controls are shown in table-5. Significant difference ($p<0.05$) is observed between the groups.

Table 3. Types of periodontitis and personal habits of the cases.

Periodontal Status	Betel leaves								Smoking				Tea/Coffee					
	Female				Male				Male				Female			Male		
	No	M	H	P	No	M	H	P	No	M	H	P	No	Yes	P	No	Yes	P
Mild (n=15)	3	2	2	1	6	-	1	-	6	-	-	--	1	7	1	1	5	-
Moderate (N=30)	4	3	3	-	8	6	5	1	6	1	12	2	5	7	-	5	12	1
Severe (n=55)	7	12	15	1	5	4	11	-	-	2	17	1	11	19	3	3	17	2

M– Mild. H-Heavy; P-Past, Male = 47. Female = 53

Table 4. Personal habits of the control group.

Female				Male				Smoking				Tea			Coffee		
No	M	H	p	No	M	H	P	No	M	H	P	No	Yes	P	No	Yes	P
29	8	13	-	34	2	4	-	18	10	8	-	22	28	-	16	24	-

M– Mild; H-Heavy; P-Past, Male = 40, Female = 50

Table 5. Percent distribution of the subjects (cases and controls) according to their fasting blood sugar (FBS) level

Periodontal status	FBS (mmol/L)		t-value (at 5% level of significance
	≤ 6.7	> 6.7	
Case	22%	78%	7.11
Controls	62%	38%	

Table-6 shows the distribution of the cases according to the vascular complications of diabetes (retinopathy, nephropathy and diabetic foot problem). Fiftyeight percent of the cases were without such problems. Among the control group majority (59%) did not show any type of diabetic vascular complications (table-7). No significant relationship were found between periodontitis and vascular complications of diabetes. Table-8 shows the plasma ascorbic acid level in relation to the dietary ascorbic acid intake. In both the groups, while they were on RDA (recommended dietary

allowance), their ascorbic acid levels in the blood were 40-50% lower than the expected value. But when the dietary intake was 10% more than the RDA the plasma ascorbic acid reached their expected level. Majoriy of the subjects (cases and controls) were consuming 50-60 mg ascorbic acid dialy in their diet. The fact suggests that the dietary ascorbic acid requirement in the diabetics is more than the recommended allowance.

Table 6. Distribution of the different types of periodontitis by the states of vascular complications

States of vascular lesion	Periodontal status		
	Mild	Moderate	Severe
Present	5	11	26
Absent	10	19	29

Table 7. Percent distribution of the subjects (cases and controls) by their vascular complications

States of vascular lesion	Cases	Controls
Present	42%	41%
Absent	58%	59%

Table 8. Plasma ascorbic acid level in the subject (cases and controls) in relation to their dietary intake

Intake of ascorbic acid (mg/day)	Plasma ascorbic acid mg/dl)		Expected range (mg/dl)
	Cases n=100	Controls n=90	
Group A (n=123) 50-60 mg	0.3689±0.0914	0.37±0.1491	0.5-0.6
Group B (n=22) 61-70 mg	0.6307±0.3853	0.677±0.33	0.6-0.7
Group C (n=45) 71-80 mg	0.7721±0.2456	0.8672±0.35	0.7-08.

Insignificant difference between plasma ascorbic acid level among the cases and controls are shown in table-9. No significant relationship was found between the plasma ascorbic acid and the development of periodontal disease.

Table 9. Comparison of plasma ascorbic acid levels in diabetics with periodontitis (cases) and without periodontitis (controls)

Subjects	Plasma ascorbic acid (mg/dl)	t-value (at 5% level of significance)
Cases	0.4815±0.2526	-1.454
Controls	0.5433±0.3299	

Discussion

Though no national prevalence survey of diabetes mellitus in Bangladesh has yet been done, but several small scale studies suggest that 2.1% of the population have been suffering from this disease.[11] Among this vast diabetic population only about two hundred thousand patients are getting proper treatment. In case of untreated or uncontrolled diabetes mellitus, complications like retinopathy, nephropathy, neuropathy, diabetic foot problems etc. are recognized as common problems of diabetes mellitus. One of the most prevalent complications of diabetes, periodontal disease, may be less widely recognized and addressed.

Oral microorganisms are the major etiological factors of periodontal disease. A secondary role in this infectious process has been postulated for ascorbic acid deficiency. [2,3] In diabetes mellitus ascorbic acid metabolism is disturbed.[12] In this respect, attempts were made in this study to find out the inter-relationship between the degree of periodontitis with the glycaemic status and their plasma ascorbic acid level. Betel chewing and smoking influences oral hygiene. Patients suffering from periodontitis were heavy betel chewers and heavy smokers (table 3,4). WHO technical reports (1978) noted that smokers had poor oral hygiene, and these two groups had a much higher prevalence and severity of periodontal disease than the non-smokers and non-chewers. Several studies revealed that periodontal disease strongly related to oral hygiene.[13] Plaque is the main etiological factor strongly related to oral hygiene. Efficient tooth cleansing, irrespective of the method used, has been demonstrated to be important in maintaining periodontal health and reducing the disease prevalence. But in case of smokers and betel chewers manual brushing of the teeth is not sufficient enough for removing the debris.[3] Patients with uncontrolled diabetes suffer from periodontal disease more than the others (table-5). Poor metabolic control of diabetes mellitus had the tendency to have a higher frequency of gingivitis and periodontitis than those with well-controlled diabetes, even in

the presence of similar plaque and calculus condition[14]. In diabetes mellitus reduced phagocytosis, leukotaxis and leukocyte index in neutrophil have been reported.[15] On the other hand the vascular changes that occur in diabetes mellitus, that is thickening of the basement membrane of the small vessels which may impede oxygen diffusion and metabolic waste elimination. All these factors increase the incidence and prevalence of periodontal disease in diabetes.[16] In case of uncontrolled diabetes mellitus all these factors are more prominent than in well-controlled diabetes. By controlling the glycaemic status the incidence of periodontitis can be lowered down.

Incidence of periodontal disease is found more among the patients with diabetic vascular complications like retinopathy etc. Microangiopathy is the main cause of retinopathy and nephropathy in diabetes mellitus. The same microvascular lesion is found in the gingiva and alveolar mucosa of the diabetics which make the diabetics more sultant ascorbic acid value reached the expected level as observed by several authors. Several workers like Jennings PE et al (1987), Banarjee A (1982), Som, S et al (1981), Ali SM K, Chakraborty SK (1989) suggested that diabetic patients had low plasma ascorbic acid level.[17] Dietary ascorbic acid requires an appropriate mechanism for transporting this into the cells. Mann and Newton (1975) showed that glucose impairs the transport of ascorbic acid into human red cells. Glucose and ascorbic acid (both are hexose derivatives) share a common transport mechanism and they inhibit each other competitively for cellular entrance.[18] Moreover the transporters and the rate of transport of ascorbic acid are found to be diminished in diabetics. All these mechanisms together may reflect low plasma ascorbic acid level among the diabetics.

Insignificant difference of plasma ascorbic acid level was found between the cases and controls in this study (table-9). Ascorbic acid has a definite role on collagen synthesis of the periodontal tissue and intercellular ground substance.[19] Deficiency of ascorbic acid in diabetes mellitus indirectly influences the periodontal health[7]. But several studies failed to establish ascorbic as an etiological factor of periodontitis. Ismail AL, Burt BA, Ekluend SA (1983) found that larger dietary intake of ascorbic acid did not seem to be associated with better periodontal health.[20] Touyz LZ (1984) suggested that avitaminosis C did not cause periodontal disease but would aggravate established periodontitis.[21] Legott PJ et al (1986) and Robertson PB et al (1991) observed in their study that depletion or supplementation of ascorbic acid did not change the pocket depth or plaque accumulation.[22]

Summary and Conclusion

The present study suggests that periodontal disease is not a manifestation of a specific nutritional deficiency like beriberi or pellagra. Low ascorbic acid level in all the subjects with normal dietary ascorbic acid consumption might be due to abnormal ascorbic acid metabolism in diabetes mellitus. Deficiency of ascorbic acid possibly modify the severity and extent of periodontal disease by altering the host resistance and the potential for repair of the affected tissues. Defective cellular uptake and high turnover of ascorbic acid suggest that larger amount of ascorbic acid than recommended dietary allowance should be supplemented to the diabetics. Plaque has a major role on periodontal tissue. Plaque formation is influenced by oral hygiene. Individuals with poor oral hygiene suffer more from severe periodontitis. Poor metabolic control of diabetes mellitus is also associated with severe periodontitis. It further influences the host resistance by impairing leukocyte function and also by increasing the vascular changes. It is therefore suggested that diabetes with better metabolic control and good oral hygiene will have better periodontal health.

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