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EFFECTS OF OSTEOPOROSIS ALONG WITH DIABETES MELLITUS ON THE PERIODONTAL STATUS OF POST-MENOPAUSAL INDIAN WOMEN – A CROSS-SECTIONAL DOUBLE-BLIND STUDY.

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ABSTRACT

Aim – Periodontitis, an inflammatory condition of the tissues surrounding the tooth, is a complex multifactorial disease. Diabetes mellitus (DM) and osteoporosis are considered well-established risk factors for periodontal disease. Thus, the aim of this study was to compare the periodontal health status in middle-aged and elderly women with osteoporosis versus those with DM along with osteoporosis.

MATERIAL AND METHOD – 30 post-menopausal women were divided into two groups – Group A (osteoporosis) and group B (osteoporosis + DM) based on the glycosylated hemoglobin. T-score, gingival and periodontal index were evaluated and compared using independent student's t-test and Pearson's correlation co-efficient.

RESULTS – The average T-score for group A and B were -1.69 and -2.04 respectively. A higher gingival ($p = 0.01$) and periodontal index ($p = 0.007$) was noted in group B.

CONCLUSION – Periodontal destruction is more severe in subjects with DM with osteoporosis than subjects with only osteoporosis.

INTRODUCTION

Periodontal disease, including gingivitis and periodontitis, are one of the most widespread chronic condition affecting population worldwide.[1] A destruction of connective tissue around the tooth and the supporting alveolar bone is the hallmark of a periodontal disease. This is due to the inflammatory host response secondary to the periodontal bacteria.[2]

Being a multifactorial disease, a number a risk factors are associated with periodontitis. These include environmental factors such as tobacco smoking, diet, oral hygiene and intrinsic factors such as cardiovascular disease, host response, hematological disorders particularly diabetes mellitus (DM), female hormonal alterations, and osteoporosis.[3]

DM is a group of metabolic disorders characterized by chronic hyperglycemia with disturbances of carbohydrates, fat and protein metabolism resulting from the defects in insulin secretion, insulin action or both.[4] As per WHO estimate, the total incidence of adults with DM will rise from 171 million in 2000 to 366 million in the year 2030 over the world.[5] The hyperglycemia associated with DM results in the formation of advanced glycation endproducts (AGEs) which further causes secretion of proinflammatory cytokines (such as TNF-α, IL-1β, IL-6). These secreted cytokines along with AGE induced bone resorption have been postulated to cause periodontal tissue inflammation and destruction, thus explaining an increased incidence of periodontitis in uncontrolled DM.[6,7]

Estrogen and progesterone are responsible for physiological changes in women at specific phases of their life: puberty, menstrual cycle, pregnancy, menopause, and postmenopause.[8] Osteoporosis is frequently seen affecting middle-aged and elderly women due to hormonal fluctuations, causing a decrease in the bone mass and volume.[9,10] Periodontal bone loss is also noted in subjects suffering from osteoporosis; furthermore, osteoporosis has long been considered a prominent risk factor for periodontal disease.[11]

AGEs induce human mesenchymal stem cell apoptosis and subsequently prevent cognate differentiation into adipose tissue, cartilage, and bone. Thus, they act as a molecular link between DM and osteoporosis.[12] An increased risk of osteoporotic bone fractures has been noted in individuals suffering from DM[13] which explains its possible participation in the pathogenesis of osteoporosis. Since osteoporotic bone changes are noted in individuals suffering from DM, an excessive periodontal bone loss may be expected in subjects with DM and osteoporosis. Thus, the aim of the present cross sectional study was to compare the periodontal health status in middle-aged and elderly women with osteoporosis versus those with DM along with osteoporosis.

MATERIALS AND METHODS

The study was conducted at King Edward Memorial hospital, Mumbai, by the department of Dental Surgery in conjunction with the Endocrinology department of the same hospital. Ethical approval was attained from the institutional ethics board of the hospital and written informed consent was taken from each patient. Post-menopausal female subjects, between the age of 45-80 years were recruited for the study. Patients were excluded if they were having parathyroid or metabolic bone disease, cancer, or were on long-term steroid therapy. Also were excluded subjects with a history of hysterectomy, early onset of menopause and alcohol or tobacco consumption in any form. In addition, patients who had undergone periodontal therapy in the past 1 year were also not considered for this study.

Demographic data of age and duration of menopause was recorded for each subject. Periodontal parameters of gingival index and Russel's periodontal index were recorded for the participants with the aid of a mouth mirror, probe and orthopantomograph radiographs by a blinded investigator. Glycosylated hemoglobin levels were measured to determine the status of DM. Each participant had the bone mineral density of the spine (T-score) evaluated using peripheral dual-energy x-ray absorptiometry (AccuDEXA, Schick, Long Island City, NY). These values were co-related with the periodontal parameters, by a blinded statistician, to assess its effects on periodontal health using Pearson's correlation co-efficient. Independent student's t-test was performed to compare the periodontal parameters between the two groups.

RESULTS

A total of 30 post-menopausal women who met the inclusion criteria were recruited for this cross-sectional study. The average age of the participants was 63.1 years ± 4.8 years (range 38 to 79 years). These participants were categorized into two groups – Group A were subjects with osteoporosis without DM (Glycosylated hemoglobin level <6.5%) and Group B were subjects with osteoporosis along with DM (Glycosylated hemoglobin level >6.5%). The average glycosylated hemoglobin levels for groups A and B were 5.84 and 7.68 respectively and the average T-score values were -1.69 and -2.04 respectively (Table 1).

Table 1. T-score, glycosylated hemoglobin levels, gingival index and periodontal index for group A and B.

	Group A				Group B			
Sr. No.	T-score	Glycosylated hemoglobin (%)	Gingival index	Periodontal index	T-score	Glycosylated hemoglobin (%)	Gingival index	Periodontal index
1	-1.4	5.7	0.58	1.78	-2.6	6.51	0.58	1.68
2	-3.1	5.8	0.29	0.87	-1.6	7.1	0.82	3.69
3	-1.7	5.4	0.35	0.83	-2.7	7.2	0.92	2.64
4	-1.3	5.9	0.63	0.91	-1.9	6.8	0.46	1.74
5	-1.9	6.1	0.79	0.94	-1.3	6.9	0.75	1.69
6	-1.7	5.6	0.48	0.62	-2.8	7.5	1.08	2.19
7	-0.8	5.9	0.42	0.73	-2.6	8.8	0.93	3.85
8	-1.8	6.2	0.35	0.68	-2.1	7.9	0.83	1.42
9	-1.3	5.9	0.39	0.77	-2.1	8.55	0.33	0.84
10	-1.5	5.8	0.48	1.07	-1.4	6.6	0.44	1.29
11	-2.1	6.3	0.51	0.89	-0.7	6.9	0.38	1.34
12	-1.3	5.8	0.47	0.92	-1.2	8.3	0.41	0.82
13	-2.3	6.3	0.56	1.42	-2.3	8.2	0.64	1.28
14	-1.7	5.3	0.38	0.68	-3.2	7.8	0.79	2.23
15	-1.4	5.7	0.44	0.85	-2.2	10.2	0.58	1.36

The results of student's t-test showed statistically greater periodontal (p = 0.0007) index level in group B as compared to group A. Although not statistically significant, a trend towards an increased gingival index (p = 0.01) was noted in group B as compared to group A (Figure 1, Table 2). Pearson's correlation co-efficient showed a negative association between the T-score and periodontal index (r = -0.35) and gingival index (r = -0.59) for group B.

Table 2. Results of independent student's t-test for gingival index and periodontal index between group A and B.

Group	Gingival index	Periodontal index
A	0.4746	0.9306
B	0.6626	1.8706
p value	0.01	0.0007

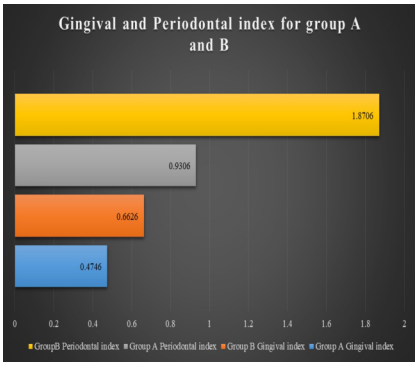

Figure 1. Graph comparing the gingival and periodontal index for group A and B.

DISCUSSION

Gingivitis is the inflammation of soft tissues around the tooth. The microbial plaque attached to the tooth surface is responsible for a direct response in the immune system to cause this condition.[14] Clinically, the gingiva appears red and swollen, and often bleeds upon probing or touching. When untreated, gingivitis progresses into periodontitis which is an inflammation of bacterial origin that destroys the dental supportive structures. It is characterized by progressive destruction of periodontal ligaments and the alveolar bone supporting the tooth.[15] Although the main etiologic factor for periodontal diseases is the microbial film, a number of local and systemic factors that aid in the pathogenesis of periodontal disease should not be disregarded.

Cellular proliferation, differentiation and growth, including the fibroblasts in the gingiva is directly influenced by the sex steroid hormones. Along with being the primary hormone responsible for stimulating endometrial blood flow, estrogen also has an inhibitory effect on the osteoclast activity.[16] However, after menopause, the estrogen level drops considerably resulting in increased susceptibility to osteopenia or osteoporosis. Osteoporosis is a chronic, progressive reduction of the bone mineral density causing micro-architecture changes of the bone. The bones become brittle and more susceptible to fracture.[17] The T-score is the bone mineral density deviation expressed in the number of standard deviations from the maximal mean bone density in a healthy individual of the same sex. This is the mineral substance present in the bone and is the standard for the diagnosis of osteoporosis. The dual-energy x-ray absorptiometry is the most popular method of investigating the bone mineral density in the central and peripheral bones. According to the World Health Organization (1994), the diagnostic criteria were[18] –

T-score between +1 and -1 : Normal bone mass
T-score between -1 and -2.5 : Osteopenia
T-score below -2.5 : Osteoporosis

The effects of osteoporosis in these women include delayed wound healing of the periodontium, less attachment formation, decreased bone mineral density in the jaws, increased susceptibility to periodontitis and tooth loss.[19]

A hypothesis that DM may have effects on osteoporosis has been put forth by numerous studies.[20-22] It has been found that people with type 1 DM have a high rate of bone resorption combined with a low bone mineral density. Increased risk of osteoporotic bone fractures, particularly of the hip, have been noted in type 1 and type 2 DM subjects.[23,24] DM results in the increased formation of advanced glycation end-products in the body. These may be involved in the pathogenesis of osteoporotic bone diseases. It has been noted in in-vitro studies that the advanced glycation end-products increase the osteoclast-induced bone resorption in unfractionated bone cells.[25] Also, an in-vivo study shows an elevated serum advanced glycation end-product level in patients with osteoporosis.[26] Thus, an increased risk for osteoporosis may be evident in subjects with DM.

A high percentage of the population are affected by DM along with osteoporosis all over the world. In the present study, its effects on the periodontal status of post-menopausal women were evaluated. Ample literature evidence is available to show the effects of DM and osteoporosis on periodontitis.[27-30] However, to the authors' knowledge, this was the first study that evaluated its combined effects on the periodontium. It was noted that the gingival index and periodontal index were relatively higher in subjects affected by DM along with osteoporosis than in subjects with osteoporosis alone. This could be attributed to the combined effect of osteoporosis induced bone resorption along with increased risk for periodontitis in DM. Also, a negative Pearson's co-relation value denoted that as the T-score levels drop down, the periodontal destruction levels increase in subjects with DM.

Although this study was the first one to assess the periodontal status in post-menopausal women affected with osteoporosis and

DM, it did have its share of limitations. A longitudinal study with a periodontal intervention would have shown the comparative resolution of periodontal inflammation in both the groups. Future studies on a similar front may consider sub-categorizing the subjects according to the age and T-score levels, along with a higher sample size.

CONCLUSION

Within the limitations of this study, it can be concluded that osteoporotic bone changes are more pronounced in post-menopausal females with DM. Gingival and periodontal index are higher in subjects with osteoporosis with DM than subjects with only osteoporosis, denoting an increased periodontal destruction in this population.

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