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COMMON RISK FACTORS ASSOCIATED WITH OSTEOPOROSIS AND TOOTH LOSS

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Abstract:*Osteoporosis is a systemic skeletal disease characterized by low bone mass and bone tissue deterioration with a consequent increase in bone fragility and susceptibility to fracture. Low bone mineral density [BMD], age and low body mass index have been found to be major risk factors for osteoporosis. Periodontitis presents as a pathological loss of periodontal ligaments and alveolar bone resorption. The disease develops due to complex interactions between microbes and exaggerated immune response. Since both the diseases have a convergent mechanism leading to tissue destruction, investigation of the common markers would enable early diagnosis of the diseases. The aim of the present study was to identify these common inflammatory markers associated with osteoporosis and tooth loss by text-mining process. Furthermore, the brief review throws light on the underlying mechanisms behind the development of the disease, its management, treatment and prevention options. An extensive review of literature was carried to locate studies relating world-wide prevalence of osteoporosis and its association with tooth loss and other oral problems.*

Keywords *- Bone mineral density; estrogen; inflammation; osteoporosis; periodontitis; osteopenia; prostaglandin*

1. INTRODUCTION

Osteopenia is a condition caused by a progressive reduction in bone mineral density [BMD]. There is an alteration of the bone micro-architecture. When a patient's BMD decreases to or below 2.5 standard deviations under the mean peak bone mass that person is classified as osteoporotic. The condition affects one in three post-menopausal women and one in five men over the age of 50. Across both sexes there is a decline in BMD over the age of about 50 years. In females this is more pronounced with a reduction of circulating estrogen following the menopause whereas in men it is due alcohol consumption and smoking. The result of this reduction in BMD is a greater likelihood of bone fracture. Though common sites include ribs, spine and wrist, the most notable consequence is fracture of the hip. This is associated with an increased mortality of 30% over the year following injury commonly due to increased risk of DVT and pulmonary embolism [1].

Changes in BMD also have an impact upon oral health. There is considerable variation in the BMD of trabecular and cortical bone of the mandible among individuals. Osteoporosis may have an impact upon this variation also there is a significant relationship between jaw measurements [bone mass, bone mineral content, BMD] and those at other skeletal

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sites. Thus, there is a strong argument that osteoporosis and osteopenia states may have a negative influence upon the bone quantity and quality of the mandible and maxilla. Indeed, it is possible to use mandibular cortical width measurements on dental panoramic radiographs as a screening tool for skeletal osteoporosis [2].

If osteopenic and osteoporotic conditions influence the bone mineral content of the mandible and maxilla then this may be most obvious in those who are edentulous. It failed to demonstrate a correlation with skeletal osteopenia and residual ridge reduction but there was a relationship demonstrated between osteopenia and residual ridge density, particularly in the edentulous mandible. It is also found that a reduction in the alveolar ridge height in patients with reduced BMD but periosteal resorption and a change in the external dimensions of bone are not characteristic features of osteoporosis. In dentate patients there indicate that osteoporosis may be linked to tooth loss. It demonstrated a correlation between tooth loss and hip fracture incidence which is based on the known correlation between hip fracture and osteoporosis. The primary aim of this study was to assess whether there is a relationship between the osteoporotic status of patients and the number of their teeth. Age, smoking status, alcohol consumption and the use of hormone replacement therapy are known in the literature to affect tooth number and were also included as explanatory variables in the regression model. The secondary aim was to assess whether molar teeth are disproportionately affected in the osteoporotic patients [3].

Risk factors of osteoporosis

Several risk factors been related to osteoporotic fractures in postmenopausal women such as personal history of fractures, low body weight, current smoking status, impaired vision, estrogen deficiency at an early age [younger than 45 years] poor health, recent falls, low dietary calcium intake where as in men it is due to low physical activity and alcohol intake more than 2 drinks per day are the systemic conditions associated with osteoporosis which also includes chronic obstructive pulmonary disease, gastrectomy, diabetes mellitus, hyperparathyroidism, hypogonadism, multiple myeloma, and coeliac disease. deficiency in oestrogen leads to an upregulation of macrophages and osteoblasts, which in turn produces inflammatory mediators such as interleukins, TNF alpha and granulocyte-macrophage colony stimulating factor. This results in a generalised increased bone collagen destruction and bone resorption. Interleukin 1B has been demonstrated to be integral to the resorption of periapical and periodontal dental hard tissues [4]

Biochemical markers of bone turnover

Biochemical markers of bone turnover are useful indicators to assess bone microarchitectural deterioration. These markers include serum-based assays for bone alkaline phosphatase [ALP], osteocalcin [bone formation markers] and urine-based assays for free and peptide-bound pyridinium crosslinks of type I collagen [bone resorption markers]. It is found that ALP and bone resorption markers and urinary hydroxyproline excretion were significantly increased in postmenopausal women. There are major inflammatory markers like C-reactive protein [CRP], interleukin-6 [IL-6] and monocyte chemotactic protein-1 [MCP-1] for osteoporosis or osteopenia whereas CRP increased stepwise with increasing tooth loss. Those with 1–16 teeth lost had a mean CRP 1.15 mg/L higher than those without tooth loss [$p < 0.0001$], and those with 17–32 teeth lost had a mean 1.48 mg/L higher than those without tooth loss. Monocytes, macrophages and other cells respond to the dental plaque microorganisms, membrane-associated vesicles, lipopolysaccharides [LPS], and other soluble and particulate fractions by secreting a number of chemokines and inflammatory cytokines, especially tumor necrosis factor [TNF]-a such as prostaglandin [PGE2], interleukins [IL-1b and IL-6]. These inflammatory cytokines and prostaglandin are associated with the presence of various bacterial infections including periodontitis. [9][10]

Nutritional deficiency

With regards to nutritional approaches to bone metabolism, calcium and vitamin D have beneficial effects. Calcium is required for the deposition of bone mineral throughout life and is the major non-hormone replacement therapy [HRT] intervention used in osteoporosis. The National Osteoporosis Society [NOS] accepts reference nutrient intake [RNI] of calcium of 700 mg/day for the general population, however, higher intakes are required for osteoporotic females. Therefore, dietary calcium supplementation is essential to improve bone density.

It has been postulated that, although the role of dietary calcium in the attainment of peak bone mass has been controversial, calcium supplements [0.5–2 g daily] can reduce the rate of bone loss at or after the menopause. The effects are less complete than those of estrogens, particularly at the time of menopause when losses are rapid, but bone loss can be halved, at least in cortical bone [5].

Vitamin D is important because it facilitates intestinal calcium absorption and new bone formation. Inability to synthesize adequate amounts of 1,25-dihydroxyvitamin D [1,25[OH]2 D] may play a role in decreased calcium absorption from the intestines causing increased osteoclast production, and hence mobilizing calcium from the bone.Vitamin D is made in the skin, however, aging is accompanied by a decrease in skin composition and thickness that affects vitamin D production. Low serum 25–hydroxyvitamin D [25[OH] D] concentration is often noted in the elderly, particularly those with hip fracture are frequently associated with high serum parathormone [PTH] concentrations, thus activating osteoclast production and accelerating bone loss leading to fracture risk. Low dose vitamin D supplements in elderly people improves vitamin D status, suppresses parathyroid hormone function, and reduces bone loss. Vitamin D taken with calcium reduces PTH and markers of bone resorption, hence reducing the fracture rates in postmenopausal women. These nutrients must be recommended in the dosages applicable for the age of the patient. The recommended dosage of calcium is 1500 mg/day [>65 years] and 600 to 800 IU of vitamin D per day.[6][7]

Diagnosis of osteoporosis

Hip fracture is the most serious complication of osteoporosis and the most disabling type of fracture. Therefore, BMD testing for all postmenopausal women may be preferable to reduce the rate of osteoporotic fractures and its future complications. At present, various techniques of bone densitometry have been applied to detect low BMD to predict fracture risk and to monitor the response to therapy. These techniques should be selected based on the clinical purpose and skeletal sites for evaluation [2, 8].

2. SELF- ASSESSMENT TOOLS

Quantitative ultrasound:

Quantitative ultrasound [QUS] methods have been used for the assessment of the skeletal status in osteoporosis and provide information about not only bone density but also the microarchitecture and elastic properties of bone. The QUS statuses of bone status has been shown to be related to fracture risk, independent of BMD. However, calcaneal QUS thresholds for the diagnosis or treatment have not as yet been defined; moreover, precision of QUS devices has been reported to be poor. Hence, they are not recommended in patient follow-up for osteoporosis. In addition, there are several unresolved techniques and cross calibration between the various QUS devices.[9,11]

Dual energy X-ray absorptiometry:

Dual energy X-ray absorptiometry [DXA] is effective in tracking the effects of treatment for osteoporosis and to assess an individual's risk for developing fractures. The risk of fracture is affected by age, body weight, history of prior fracture, family history of osteoporotic fractures, and lifestyle issues such as cigarette smoking and excessive alcohol consumption.DXA results are reported as T-scores and Z-scores. The T-scores are comparisons of the patients BMD with a young populations peak reference value, whereas Z-scores are comparison of the patients BMD with a population's age-matched reference value, allowing a comparison with the patients peer group.[12][13][14]

Oral implications of osteoporosis:

The jawbone supports and anchors our teeth. Osteoporosis can cause jawbones to lose density, increasing the risk of fracture and permanent tooth loss. Low bone density can also cause issues such as fitting of dentures and may find certain treatments more difficult. It is found that the density of maxillary alveolar process bone is significantly related to the density of the mandibular alveolar process, lumbar spine, coxa, and radius in healthy women which declines with age. In temporomandibular dysfunction [TMD], bony changes and bone resorption occur in both the condyle and temporal components of the temporomandibular joint and may range from mild decreases in cortical bone to severe destruction of the condyle and temporal components which may disturb the functional harmony of the masticatory system and increase the possibility for TMD.

Treatment for osteoporosis:

Treatment includes medication, a healthy diet and weight-bearing exercise to help prevent bone loss or strengthen already weak bones. The medications that are associated with reduced bone mass in adults are oral glucocorticoids [>3 months], anticonvulsants, gonadotropin-releasing hormone agonists, excessive thyroxine doses, and lithium. Osteoporosis is also influenced by the body mass index [BMI] of the women. For both men and women at increased risk of fracture, the most widely prescribed for osteoporosis medications is bisphosphonates. It also includes Alendronate [Binosto, Fosamax] and Risedronate. In younger women or in women who have menopausal symptoms also require estrogen therapy [15,16].

Limitations and future scope:

The limitation of present study is that it deals only with the risk factors associated with the host, whereas there are numerous microbial factors associated with chronic inflammatory conditions which might as well precipitate into the disease status. [17, 18, 19]. The future scope of identifying common risk factors associated with osteoporosis and tooth loss might aid in identifying patients who may be prone to disease at a later age. Inflammation identified earlier and prompt treatment of the same could help in preventing the advancement of disease condition. Fracture management would also be much easier when the disease is identified at an early stage. Therefore it would reduce the potential impact of fracture burden, reduces frequency and improves adherence [20][21][22].

3. CONCLUSION

There is a significant correlation between tooth loss and osteoporosis. It is more probable that local and other systemic factors exert greater influences upon tooth loss. Clinicians should inform patients diagnosed as osteoporotic that they may be at greater risk of losing molar teeth in the future. These patients should be reviewed more frequently and their oral hygiene measures reinforced so as to prevent tooth loss. Understanding the association between these common diseases and the mechanisms underlying the associations which will aid health professionals to provide improved ways to prevent, diagnose, and treat these very common diseases.

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