Patterns of Dental Diseases in Diabetic Females in Primary Health Centers in Qatar:
Cross-sectional, observational study

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Background:

Periodontal diseases comprise a large group of predominantly infectious and/or inflammatory disorders affecting periodontal tissues. They are diagnosed by assessment of the dento-gingival area, including the gingival sulcus depth, and the presence of bleeding with radiographic assessment of the alveolar bone. The prevalence of periodontitis (PD) is reported to be 20-50% worldwide, while the aggressive form of PD is found in less than 10% of the population.

Periodontitis is a chronic infectious/inflammatory disease of multi-factorial etiology with a number of risk factors that are shared with other chronic inflammatory conditions; increasing age, low socio-economic conditions, stress, increased body weight, dyslipidemia, hypertension, metabolic syndrome, cigarette smoking and Diabetes mellitus. Systemic reviews have shown a clear association between PD and coronary heart diseases (CHD) emphasizing the need to consider PD as a risk factor for CHD.

Diabetes mellitus (DM) is a common chronic condition with increasing prevalence all over the world, especially in the Middle East, with a well known effect on oral cavity conditions, the degree of glycemic control having an impact on gingivitis, teeth loss, dental caries, periodontitis and bone loss. The mechanism is attributed to diabetic microvascular complications with sub-gingival microbiota and alteration in the immuno-inflammatory response to pathogens, which may lead to hyper-response of monocyte macrophage phenotypes resulting in significant increase in production of pro-inflammatory cytokines and mediators.

Key words: Periodontitis, Diabetes mellitus, carries, missing teeth, oral hygiene

Tooth loss is common in older persons and is associated with many risk factors including socio-economic factors, smoking and diabetes. The number of missing teeth was found to be significantly higher in patients with longer DM duration although this relation between teeth loss and DM is not well established.

Many studies report increase, decrease, or similar rates of dental caries in diabetes mellitus so it is difficult to confirm such a relationship. Lin BP et al found that the number of root/surface caries was higher in diabetics than non-diabetics but no corresponding difference was observed between well controlled and poorly controlled diabetics. The results of this study suggest that diabetes and poor glycemic control may not be associated with an increased prevalence of past coronal and root/surface experience in older adults.

Reports from England, Hungary, Japan, Sweden, United States, Yugoslavia, Japan, Sweden document and analyze the relationship between DM and dental condition but there are no reports from the Arabian Gulf area and only two from the Middle East. Consequently our study aimed to find the prevalence and patterns of dental conditions like teeth loss, dental carries, periodontitis, and oral hygiene; disease process and complications in diabetic females in Qatar, knowing that we have different genotype, socio-economic standards with a high prevalence of DM in the region.

Method:

The study group consisted of a random sample of 106 adult patients with diabetes mellitus Type II attending three Primary Health Centers in Doha, Qatar over a period of 16 months. All patients accepted to be enrolled in the study and signed the consent; the research protocol was approved by the Research Committee of Hamad Medical Corporation, Doha, Qatar. The clinical examination for oral cavity was done with specific instruments, standard mirror and periodontal and dental probes. To minimize the radiation hazards the clinical examination was done without additional orthopantomogram or X-ray.

Diabetes mellitus was defined according to the report of a WHO/IDF consultation as:

- fasting plasma glucose ≥ 7.0 mmol/l (126 mg/dl)
- or 2-h plasma glucose ≥ 11.1 mmol/l (200mg/dl)
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The dental status was recorded for missing teeth which were distinguished from teeth extracted due to orthodontic, trauma, prosthetic, and elective removal of third molar; missing teeth were reported only for conditions like dental caries and periodontitis.

The presence of periodontitis is defined as “inflammation of the periodontium caused by a complex reaction initiated when subgingival plaque bacteria are in close contact with the epithelium of the gingival sulcus. Injury arises from toxins and enzymes produced by the bacteria and from host-mediated defense responses. Apical movement of the junctional epithelium indicates attachment loss and alveolar bone loss.” (37) Those who fulfilled the criteria for periodontitis according to the guidelines (38) were recorded as positive cases for periodontitis.

Dental caries, also known as tooth decay or cavity, is a disease where bacterial processes damage hard tooth structure (enamel, dentin and cementum). These tissues progressively break down, producing dental cavities measured and reported by the DMF (decay, missed, filled) index.

Finally, oral hygiene was reported as good/bad status; as well as whether the patient was attending a dentist. Data were correlated with age, duration of diabetes, hypertension and its duration, level of HbA1C, and smoking. The current WHO diagnostic criteria for diabetes as follows: fasting plasma glucose ≥ 7.0 mmol/l (126 mg/dl) or 2-h plasma glucose: ≥ 11.1 mmol/l (200 mg/dl).

Excel software was used for data collection and statistics. Patients’ dental clinical examination was recorded and they were notified and given appointments for further management. Those with high HbA1C were sent back to the general physician in the Primary Health Center for diabetes mellitus control.

Results:

During the 16 months period 106 adult females with diabetes mellitus Type 2, aged 37 to 76 years (mean 53 years), suffering diabetes mellitus for durations from one year to 25 years (mean 9.3 years were examined and assessed. All were non-smokers. The HbA1C levels ranged from 5.3 to 12.1 (average 8.06). Eighty-eight (83%) had caries; the oral hygiene of 78 was classified as poor, 28 cases had good oral hygiene; 91 (86%) cases had periodontitis (this was statistically significant; p=0.004) and there was a relationship between diabetes mellitus duration and presence of periodontitis (Figure 1).

Teeth were missing in 94 (89%) cases (statistically significant; p=0.042. Only 83 of the 106 cases were attending a dental clinic. The cases with poor oral hygiene had higher HbA1C levels than the other groups but this was not statistically significant (borderline, p=0.051). There was an increase in the prevalence of all oral conditions with HbA1C level increment (Figure 2).

Discussion:

Poorly controlled diabetes is a risk factor for the development of periodontitis but the literature for Type 1 diabetes is not as clear as that for Type 2. In our study 86% of diabetics had periodontitis with a significant relation
Table 1: Patients’ Demography

<table>
<thead>
<tr>
<th>Parameter</th>
<th>n = 106</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE (Years)</td>
<td>53 (37-76) years</td>
</tr>
<tr>
<td>Duration of DM</td>
<td>9.3 (1-25) years</td>
</tr>
<tr>
<td>HTN Present</td>
<td>68 (65%)</td>
</tr>
<tr>
<td>Duration of HTN</td>
<td>7.6 (1-23) years</td>
</tr>
<tr>
<td>Caries Present</td>
<td>88 (83%)</td>
</tr>
<tr>
<td>Periodontitis present</td>
<td>91 (86%)</td>
</tr>
<tr>
<td>Good Oral Hygiene</td>
<td>28 (26%)</td>
</tr>
<tr>
<td>Poor Oral Hygiene</td>
<td>78 (74%)</td>
</tr>
<tr>
<td>Attending Dentist</td>
<td>83 (78%)</td>
</tr>
<tr>
<td>Missing Teeth</td>
<td>94 (89%)</td>
</tr>
</tbody>
</table>

to DM duration, as has been found in other studies of the adult populations which have shown a definite relationship between Type 1 diabetes and periodontitis.\(^{(39)}\) Firali et al\(^{(40)}\) found significantly greater levels of clinical periodontal attachment loss in insulin dependent diabetics. Susceptibility to and severity of periodontitis in the diabetic group increased with the duration of diabetes. Subjects with poorly controlled diabetes showed more attachment and bone loss compared to well-controlled diabetics.

Many reports on Type 2 diabetes and periodontitis are based on studies of Pima Indians in Arizona. Emrich et al\(^{(17)}\) concluded that diabetics were approximately three times more likely to develop periodontitis than non-diabetics although Taylor et al\(^{(41)}\) made a longitudinal study of 100 Pima Indians and found that poorly controlled diabetics had more severe periodontitis than controlled diabetics and that subjects with Type 2 diabetes and periodontitis had an increased risk of poor glycaemic control. Individuals with longer duration diabetes have a greater degree of periodontal disease.\(^{(14)}\)

The main mechanisms by which diabetes and periodontitis are related are via alterations in host responses and collagen metabolism. The primary factor responsible for the development of diabetic complications is prolonged tissue exposure to hyperglycemia that results in the production of advanced glycation end products (AGEs). This leads to an increase in collagen cross-linking and the generation of reactive oxygen intermediates, such as free radicals. The modified collagen fibers accumulate in the tissues, resulting in thickening of the basement membrane. This impairs oxygen diffusion, waste elimination, leukocyte migration and the diffusion of immune factors and may thereby contribute to the pathogenesis of periodontitis. There may be an increase in the local production of cytokines that enhances the inflammatory response, leading to connective tissue damage, bone resorption and delayed wound repair.

Higher cytokine levels have been found in the gingival crevicular fluid of diabetics when compared with non-diabetics, with both groups demonstrating periodontitis.\(^{(24)}\) Hyperglycemic conditions result in decreased cellular proliferation and growth of periodontal ligament (PDL) fibroblasts and collagen synthesis.

Patients with diabetes have an increase in gingival crevicular fluid collagenase activity when compared with non-diabetics.\(^{(42)}\) This greater collagenase activity would suggest an increased degree of collagen breakdown in the tissues of diabetics. Polymorphonuclear leukocytes (PMNs) are the primary defense cells of the periodontium. Poorly controlled diabetes is associated with abnormalities in PMN functions such as impaired adherence, chemotaxis and phagocytosis, all of which render the host more susceptible to infections. Abnormalities in PMN function can be improved markedly with insulin therapy and meticulous control of the disease.\(^{(42,43)}\) Studies have demonstrated association between HbA1c in DM II and periodontal disease.\(^{(44)}\) Many reports\(^{(25,45,46)}\) suggest a direct causal association between hyperglycemia and periodontitis, as demonstrated on this current study although not statistically significant. However, there also is evidence that the relation between DM and periodontitis is bi-directional since periodontitis is an inflammatory condition that increases insulin resistance.

Tooth loss is common in older persons and is associated with many risk factors including socio-economic factors, smoking and diabetes.\(^{(26)}\) Eighty-nine per cent of our cases had teeth missing, as in many other studies that have demonstrated that the number of missing teeth were found significantly higher in patients with longer DM duration.\(^{(27)}\) Kaur G et al found that type II DM had a substantially higher mean attachment loss and a higher number of missing teeth than in non-diabetics (p < 0.01); 48% of DM II in his study had HbA1c above 7%.\(^{(44)}\)

Other studies have reported significant increment in tooth loss in subjects with DM II than in non-diabetics,\(^{(47)}\) especially in younger age group;\(^{(48)}\) in contrast, Oliver et al\(^{(42)}\) reported that tooth loss was similar in diabetic and non-diabetic employed adults. Not only DM with its sequel led to teeth loss and extraction but also social, cultural, psychological and economical issues contributed to the decision of teeth extraction. So it is difficult to attribute all tooth loss to a single factor such as DM\(^{(49)}\) and studies that show increase, decrease or similar rates of dental caries in diabetics and non diabetics reveal flaws in such a hypothesis.

Dental caries may decrease in DM because of several factors such as the low carbohydrate diet that diabetic patients follow, increased protein intake which will increase the buffering capacity of saliva,\(^{(50)}\) and lastly due to delayed eruption of permanent teeth in childhood i.e. less time exposure to caries process.\(^{(51)}\) On the other hand, dental caries may be increased due to increased glucose in saliva and/or in gingival fluid with de-
crease in salivary flow and frequent food intake that lowers oral pH. Lin BP et al found that the number of root/surface caries was higher in diabetics than non-diabetics but no corresponding difference was observed between well-controlled and poorly controlled diabetics. The results of Lin study suggest that diabetes and poor glycemic control may not be associated with an increased prevalence of past coronal and root/surface experience in older adults but there is a tendency for more active caries lesions in missing teeth. The same result was found in the current study. Such association between DM and caries are still not well established; as many studies have found no relation while others found greater caries in poorly controlled DM than in well-controlled ones. Other studies did not find a relationship between the duration of DM and caries while some studies reported more caries with longer duration and others reported more caries with shorter duration of DM.

Conclusion:

Our study was conducted in the primary health center as a screening study to evaluate the magnitude of the dental conditions as teeth loss, dental carries and periodontal diseases in our diabetic patients. Evaluation also covered the burden and the magnitude of the problem by having a data, which will ultimately improve our program and assist us for better understand, plan, and take future actions towards improving the dental health in diabetics.

References:

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