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Review Article

Diabetes Mellitus, Periodontal Disease and Co-morbidity

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Abstract

Diabetes mellitus, especially Type 2, is the most common endocrine disease affecting an increasing number of people worldwide. It has also an important two-way relationship with periodontal disease. Many doctors have not been taught about this connection.

Periodontal disease (PD) was thought to be the sixth complication of diabetes mellitus (DM) because this latter group of patients has a 3 – 4 times greater risk of developing PD when compared with non-diabetics. This rises to 10 times for smokers.

Recent research has concluded that DM and PD are inter-related, one disease affecting the other and vice versa. The exact mechanism is most probably related to inflammation as similar blood markers are raised in both diseases, the dental origin of which is from micro-organisms in mature dental plaque.

There are five medical complications of DM namely cardiac, vascular, renal, ophthalmic and neurological that can be visualised as a simple hub called DM with spokes for the above complications.

However, the evidence has shown that the severity of all these five complications is worse when patients have active, uncontrolled PD. When PD is treated, there is an improvement in glycaemic control. Good oral hygiene is a critical component of glycaemic control.

These results have led to the conclusion that PD is not a separate complication of DM but a co-morbidity factor acting by:modifying the severity of another disease.

A new model is proposed together with a method of result sharing for doctors and dentists to work together because when DM and PD are treated together there may be a synergistic effect.

Key words: COVID-19; adults; post-traumatic stress disorder; behavior

Introduction

The concept that periodontal disease (PD) was the sixth complication of diabetes mellitus (DM) dates back to 1999[1]. However, the first description of this was much earlier in 1928 and forgotten [2]. We now know that this risk for people living with diabetes developing (PD) is about 3-4 times greater than for non-diabetics, rising to 10 times for diabetics who smoke [3].

Pathophysiology

There are five medical complications of diabetes mellitus namely, cardiac, vascular, renal, ophthalmic and neurological. We can visualise this simply as a hub called diabetes mellitus with spokes representing the above complications.

Where does periodontitis fit in this model? Is it another spoke? The evidence is overwhelming that diabetes and periodontitis are interrelated, one disease affecting the other and *vice versa* [4,5]. Therefore, the model relationship has to have both diabetes and periodontitis at a much larger hub with an inter-relationship (Fig 1). It follows that PD cannot then be a spoke or complication of DM. There has to be another explanation.

When the severity of diabetic complications is compared to periodontal status:

Cardiac and Vascular: Poor oral health is associated with atherosclerotic cardiovascular disease. This interaction raises cardiac morbidity fourfold and is associated with chronic infection mediators which may lead to the initiation of endothelial dysfunction [6].

Nephropathy: People on dialysis are at greater risk of developing PD7, with severe Periodontitis there is a 2.6 times greater risk of macroglobinaemia and a 4.9 times risk of end stage renal disease [8]. Periodontal management may contribute to the prevention of renal disease [9]. Patients should be screened for periodontitis before acceptance onto dialysis programmes [10].

Neuropathy; Is a microvascular complication associated with xerostomia in 40 per cent of people living with diabetes mellitus [11]. The increased risk of caries goes without saying. There is an inverse relationship between salivary flow and glycated haemoglobin (HbA1c) levels that may be due to disturbances in glycaemic control [12].

Retinopathy: There are few studies of this complication together with PD using different criteria [13,14]. However, an increase in the severity of diabetic retinopathy is associated with the components of periodontal disease [15].

This evidence shows that the severity of all these five diabetic complications are worse when patients have active, uncontrolled periodontitis. Also, when periodontitis is treated, there is an improvement in glycaemic contro [16]. Good oral hygiene is a critical component of glycaemic control in diabetic patients [17].

The relationship between DM and PD is thought to be inflammatory in origin. There is a common pathogenesis involving an enhanced inflammatory response at both local and systemic levels [18]. This is caused by the chronic effects of hyperglycaemia and the formation of advanced glycation end-products that promote the inflammatory response[18]. Levels of C-reactive protein[4], tissue necrosis factor [18], and cytokines [19] are raised in both diseases.

When dental plaque is left *in situ*, after seven to ten days gingival inflammation ensues and this is the precursor of periodontitis [20]. Polysaccharides in Gram negative bacteria in this mature dental plaque are known to stimulate the production of cytokines. Toxic products from these organisms also initiate tissue breakdown and increased osteoclastic bone resorption in the periodontium [21].

From this evidence it is clear that periodontitis is influencing of diabetic's individual responses and medical complications. It is both:

a. modifyng the severity of another disease
b. and modulating the severity of diabetic complications in the manner of a rheostat, the greater the level of periodontal disease, the worse the complications at one end of the spectrum, while when PD is successfully treated glycaemic control improves at the other.

This is a new concept and means that PD should not be regarded as a complication of DM but a co-morbidity factor. Therefore, for optimum treatment of people living with diabetes there has to be both medical and dental contemporaneous input into their care. When both are treated together there may be a synergistic effect [22].

In summary, the new model shows dentists can support doctors and their diabetic patients and improve outcomes. There is a need for a paradigm shift in thinking and better interprofessional co-operation in care [23,24]. One method may be a traffic light risk assessment form for both diseases that people living with diabetes can share with their professional advisors [25,26].

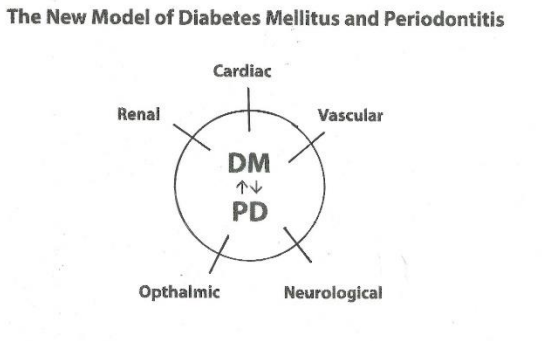

Figure 1:

Defining risk factors for doctors.

The medical gold standard for diabetic monitoring is the serum level of glycated haemoglobin, the HbA1c. This may be recorded as percentage levels that should be maintained below 6.5%, green on the traffic light method above [25,26]. There is an amber band for 6.5 to 8.5% and a red band for greater than 8.5%. Other values are either mmol/mol or mmol/litre (Table 1).

percentage	< 6.5	6.5 – 8.5	8.5>
mmol/mol	< 48	48 – 69	69 >
mmol/L	< 7.8	7.8 – 10.9	10.9 >
Risk factor	Low, green	Moderate, amber	High, red

Table 1: HbA1c levels and medical risks

Defining risk factors for dentists.

Various indices of periodontal health have been described. The measure of choice is the World Health Organisation's Community Periodontal Index of Treatment Need (CPITN) [27]. The mouth is divided into sextants with scores given for pocket depth measurement, bleeding on probing or calculus and the maximum score recorded which gives a periodontal risk factor using the traffic light system,0,1, or 2, green, 2* or 3, amber, and 4 0r 4* as red (Table 2).

Highest sextant score	0 or 1 or 2	2* or 3	4 or 4*
Risk factor	Low, green	Moderate, amber	High, red

Table 2: Periodontal risk factor

A *pro forma* has been developed for people living with diabetes to record their results and share them with their respective professional advisors (Table 3) [25]. This form is freely downloadable at www.chooseabrush.com.

NAME……DOB……

Doctors – HbA1c, this should be below 6.5%

Risk Factor: less than 6.5% low; 6.5-8.5%, medium; 8.5% or more high, or

Less than 48mmol/mol,low;48-70mmol/mol,medium; 70mmol/mol or more,high

Less than 7.8mmol/l, low; 7.8-10.9 mmol/L, medium: more than 10.9 mmol/L high

Date HbA1c…… Risk level……

Previous results

Date HbA1c…… Risk level……

Dentists: The Basic periodontal examination

Date…….. Highest score……..

Risk Factor 0,1,2 low; 2*-3 medium; 4 or 4* high

Previous results

Date…….. Highest score……..

Risk Factor 0,1,2 low; 2*-3 medium; 4 or 4* high

Table 3: my diabetes results for 20

Notes. These numbers range from 0 to 4*. The maximum score in each sextant is recorded.

0	Pockets less than 3.5mm depth, periodontal health.
1	Pockets less than 3.5mm with bleeding on probing (a sign of gingivitis and poor plaque control).
2	Pockets of less than 3.5mm. Presence of supra-gingival calculus indicating a need for professional mechanical plaque removal.
2*	Pockets of less than 3.5mm. Presence of sub-gingival calculus indicating a need for professional mechanical plaque removal.
3	Pockets of 3.5 to 5.5mm (early or moderate periodontal breakdown).
4	Pockets of greater than 5.5mm (severe periodontal breakdown).
4*	Root furcation involvement or severe periodontal breakdown with an increased risk that teeth will require extraction.

 Reference: Brit dent J 233: 1, 2022.
See www.chooseabrush.com to down load this form

Discussion

Doctors need to understand basic facts about periodontitis and record which of their patients is receiving dental care and advise those who are not that they are at greater risk of developing PD and that when PD is treated their blood sugar levels can be better controlled., [30,31]. Dentists need to understand the importance of HbA1c scores and add these to their patient's medical histories, [32].

In a recent study, asking this question in general dental practice, [33] 40 per cent of patients were in the green zone, 20 per cent amber, 12 per cent red and 28 per cent did not know. The importance here is that as the HbA1c increases, bringing PD under control becomes harder. A score of 7 (amber) is associated with the loss of more posterior teeth[7].

Fortunately, periodontitis is both a treatable and preventable disease with good clinical outcomes when detected at an early stage. Prevention depends on daily efficient and effective plaque control by patients, [34].

Where these is bone loss between teeth and gingivae the most efficient way to remove plaque is by using interdental brushes as prescribed by dental professionals.

Conclusions

PD is not the sixth complication of DM. It modifies and modulates the severity of diabetic complications. This means that both diseases should be treated concurrently and that dentists and their teams have a very important role to play together with doctors and their teams.

The glycated haemoglobin results, HbA1c are essential for dentists. The higher the score the more difficult it is to control periodontal disease. Dentists and their teams have a responsibility to help their diabetic patients improve their daily plaque control.

Risk results need to be shared between doctors and dentists. A form has been developed for patients themselves to show their respective professional advisors. This can be downloaded at www.chooseabrush.com.

Doctors need to understand that better dental care can significantly improve outcomes for their patients living with diabetes mellitus.

Dentists need to be more proactive, teach and work with doctors who may not know about the increased risk that their patients living with DM have for PD.

Declaration of interest

The author is the inventor of the Chooseabrush® method of interdental plaque control.

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