Short Report

Effects of periodontal therapy on glucose management in people with diabetes mellitus

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Abstract

Aim. – The primary aim of this study was to examine the effects of intensive periodontal therapy on HbA\textsubscript{1c} in a mixed diabetes mellitus (DM) (types 1 and 2) population with moderate periodontitis (PD).

Methods. – A total of 93 subjects with PD and DM, recruited from referrals to the Department of Endocrinology at the Perugia Hospital, were included in a follow-up cohort clinical study comprising two parallel periodontal therapy groups—one receiving intensive periodontal therapy (IPT, \(n=44\)) and the other serving as controls (CPT, \(n=49\))—with an 8-month follow-up. Clinical periodontal examinations and blood samples were collected 4 and 8 months after the completion of therapy.

Results. – The IPT group presented with greater reductions of all periodontal indices compared with the CPT group at both follow-ups (\(P<0.001\)). Whereas, after 4 months, there were no major differences in HbA\textsubscript{1c} levels between groups, after 8 months, the IPT group presented with a 0.57% (95% CI: 0.12 to 1.09) greater reduction in HbA\textsubscript{1c} than the CPT group (\(P=0.03\)). This reduction was independent of age, gender, smoking and body mass index. However, the difference in HbA\textsubscript{1c} was greater in individuals with type 2 DM (0.95% reduction, 95% CI: 0.32 to 1.58; \(P=0.004\)) compared with those with type 1 DM.

Conclusion. – IPT resulted in greater improvement of gingival health in patients with DM. Improved oral health in those with type 2 DM may have an effect on medium-term glucose management and could possibly lead to long-term health benefits. (ISRCTN00559156).

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Keywords: Periodontitis; Diabetes mellitus; HbA\textsubscript{1c}; Periodontal therapy; Glucose

Résumé

Effets sur l’équilibre glycémique de la thérapie parodontale chez des patients atteints de diabète sucré.

But. – Le but de cette étude était d’examiner les effets sur l’HbA\textsubscript{1c} du traitement parodontal intensif chez des diabétiques de type 1 (DT1) et de type 2 (DT2) atteints de parodontite modérée (PD).

Méthodes. – Quatre-vingt-treize diabétiques présentant une parodontite modérée, recrutés parmi les patients suivis dans le département d’endocrinologie de l’hôpital de Pérouse, ont été inclus dans une étude clinique comportant deux groupes de traitement parallèles avec un suivi de huit mois : traitement parodontal intensif (\(n=44\)) et groupe témoin (\(n=49\)). Des examens parodontaux cliniques et des prélèvements sanguins ont été réalisés quatre et huit mois après la fin du traitement.

Résultats. – Dans le groupe traitement parodontal intensif comparé au groupe témoin, ont été observées des réductions plus importantes de tous les paramètres parodontaux à la fin de l’étude (\(P<0.001\)). Bien que quatre mois après la fin du traitement les HbA\textsubscript{1c} moyennes des deux groupes soient comparables, une différence de l’HbA\textsubscript{1c} moyenne de 0,57% (IC à 95% 0,12–1,09, \(P=0,03\)) en faveur du groupe traitement parodontal intensif a été observée au huitième mois après fin du traitement. Cette différence était indépendante de l’âge, du sexe, du tabagisme et des différences de poids. Elle était, en revanche, plus importante chez les patients atteints de DT2 (0,95%; IC à 95% 0,32–1,58, \(P=0,004\)) que chez les patients atteints de DT1.
Conclusions. – Ces résultats indiquent qu’un traitement parodontal intensif est susceptible d’améliorer de manière plus importante la santé gingivale des patients diabétiques. Ce traitement semble améliorer l’équilibre glycémique à moyen terme et pourrait améliorer l’état clinique à long terme. (ISRCTN00559156).
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Mots clés : Parodontite ; Diabète sucré ; HbA1c ; Thérapie parodontale ; Glycémie

1. Introduction

Diabetes mellitus (DM) and periodontitis (PD) are two common chronic diseases diagnosed in millions of people worldwide [1,2]. DM is universally considered a risk factor for PD [3]. On the other hand, PD and its host-related inflammatory response [4] can affect glucose management in patients with DM [5].

To date, a number of small interventional trials investigating the effects of PD treatment on glucose control in patients with DM have been reported [6,7]. However, due to the wide variety of study designs, populations recruited and interventions performed, the reported evidence remains inconclusive. In the latest systematic review and meta-analysis of the published evidence so far, it was clear that a potential benefit from periodontal therapy on metabolic control could be hypothesized [7]. Nevertheless, a number of unanswered questions remain, including: (i) would both types 1 and 2 DM patients benefit from PD therapy on glucose management; (ii) are systemic antimicrobials a prerequisite for PD therapy in those with DM; and (iii) is the benefit of PD therapy on glucose control sustained for more than 6 months?

The aim of the present study was to assess the effects of intensive PD therapy on a standard measure of glycaemic control (HbA1c) in a mixed DM (types 1 and 2) group of patients who also had moderate PD.

2. Methods

A total of 225 patients with DM, according to World Health Organization (WHO) criteria [2], were screened for PD between June 2004 and September 2006 at the Perugia Hospital. All individuals were screened for signs of PD on a consecutive basis. Given the plethora of case definitions of PD [8], a widely accepted definition of PD was used: moderate PD, defined as two sites not on the same tooth with loss of periodontal attachment \( \geq 4 \) mm, or one site with a gingival probing depth \( \geq 4 \) mm; and severe PD, defined as two sites not on the same tooth with loss of periodontal attachment \( \geq 6 \) mm and at least one site with a gingival probing depth \( \geq 4 \) mm [8]. Those individuals not falling into either of these categories were defined as having no or mild PD.

Radiographic confirmation of alveolar bone loss was also obtained. A single trained examiner (N.C.) collected all of the patients’ demographics, complete medical history and periodontal parameters (probing pocket depths, gingival recession and bleeding upon probing at six sites per tooth, excluding third molars) [9]. A total of 10 non-study subjects were also recruited, and used by the examiner for calibration of the clinical periodontal parameters, as previously described [10].

All subjects aged 18–65 years and diagnosed with moderate-to-severe PD were invited to take part in a non-randomized, controlled clinical trial comprising two parallel PD therapy groups with 8 months of follow-up (93 of whom consented to participate). Exclusion criteria included: the use of anti-inflammatory medications, excluding aspirin (75 mg), or immunosuppressant medications; chronic treatment with antibiotics; increased risk of bleeding complications from dental treatment based on medical history; and any periodontal treatment received in the preceding 6 months. Ethics approval of the trial was given by the local academic board, and written consent was signed by each study participant.

Patients in the intensive PD therapy (IPT, \( n = 44 \)) group received oral hygiene instructions (a modified toothbrushing technique and interdental brushing), underwent extraction of compromised teeth (based on \( > 80\% \) bone loss, grade 3 mobility and apical infection) and non-surgical therapy (supra- and subgingival debridement of entire diseased sites, using hand and ultrasonic instruments to remove debris and dental biofilm) within 24 h, while under local anaesthesia [10]. IPT group individuals were chosen based on the median distribution of the number of full-mouth periodontal sites, serum HbA1c levels and age within 5 years, based on their medical records. The control PD therapy group (CPT, \( n = 49 \)) received oral hygiene instructions, and supragingival scaling and polishing of their whole dentition.

A non-randomized design was chosen in view of the risk of delaying PD therapy during the follow-up (8 months) in the CPT group. All CPT individuals, on completing the study or on presenting with any signs of deterioration during the trial, also received IPT therapy.

Fasting blood samples from all participants were collected and processed for HbA1c levels (using a standardized liquid chromatography method) by staff who were blind to the patients’ group allocation. Laboratory and clinical analyses were performed at baseline, and after 4 and 8 months of PD therapy. Thirty-seven individuals per group were sufficient to detect a difference in HbA1c at least of 0.5 units between the two groups (5% significance, 90% power and 0.65 standard deviation based on the available evidence) [7]. ANCOVA models were created to determine differences in HbA1c between cases and controls using SPSS v.17 software (alpha value = 0.05, two-tailed statistics). Age, gender, smoking, body mass index (BMI) and type of diabetes were included as covariates in all models. Changes calculated as the percent difference in HbA1c relative to baseline were compared between cases and controls.
Table 1
Clinical characteristics of the trial participants.

<table>
<thead>
<tr>
<th>Variable</th>
<th>IPT group (n = 44)</th>
<th>CPT group (n = 49)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>58.5 ± 1.6</td>
<td>60.0 ± 1.7</td>
<td>0.515</td>
</tr>
<tr>
<td>Gender, males, n (%)</td>
<td>34 (77.3)</td>
<td>28 (57.1)</td>
<td>0.049</td>
</tr>
<tr>
<td>Smokers, n (%)</td>
<td>13 (29.5)</td>
<td>13 (26.5)</td>
<td>0.369</td>
</tr>
<tr>
<td>Body mass index, kg/m²</td>
<td>27.3 ± 0.6</td>
<td>27.5 ± 0.8</td>
<td>0.853</td>
</tr>
<tr>
<td>Diabetes type, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 1</td>
<td>19 (43.2)</td>
<td>18 (36.7)</td>
<td>0.672</td>
</tr>
<tr>
<td>Type 2</td>
<td>25 (56.8)</td>
<td>31 (63.3)</td>
<td></td>
</tr>
<tr>
<td>Diabetes duration, years</td>
<td>16.5 ± 0.9</td>
<td>18.0 ± 1.7</td>
<td>0.558</td>
</tr>
<tr>
<td>HBP, n (%)</td>
<td>17 (38.6)</td>
<td>26 (53.1)</td>
<td>0.212</td>
</tr>
<tr>
<td>MI, n (%)</td>
<td>6 (13.6)</td>
<td>5 (10.2)</td>
<td>0.751</td>
</tr>
<tr>
<td>CVD, n (%)</td>
<td>9 (20.5)</td>
<td>13 (26.5)</td>
<td>0.330</td>
</tr>
<tr>
<td>HChol, n (%)</td>
<td>5 (11.4)</td>
<td>6 (12.2)</td>
<td>1.0</td>
</tr>
<tr>
<td>HbA1c, % Baseline</td>
<td>7.8 ± 0.2</td>
<td>7.9 ± 0.2</td>
<td>0.798</td>
</tr>
<tr>
<td>HbA1c, % 4 months</td>
<td>7.9 ± 0.2</td>
<td>7.8 ± 0.2</td>
<td>0.664</td>
</tr>
<tr>
<td>HbA1c, % 8 months</td>
<td>7.4 ± 0.2</td>
<td>8.0 ± 0.2</td>
<td>0.030</td>
</tr>
<tr>
<td>PPK Baseline</td>
<td>19.3 ± 2.6</td>
<td>8.9 ± 1.5</td>
<td></td>
</tr>
<tr>
<td>PPK 4 months</td>
<td>9.3 ± 1.0</td>
<td>8.1 ± 1.8</td>
<td></td>
</tr>
<tr>
<td>PPK 8 months</td>
<td>9.9 ± 2.0</td>
<td>7.6 ± 1.4</td>
<td></td>
</tr>
<tr>
<td>FMBS (%) Baseline</td>
<td>66.2 ± 3.6</td>
<td>50.5 ± 5.5</td>
<td></td>
</tr>
<tr>
<td>FMBS 4 months</td>
<td>21.6 ± 2.4</td>
<td>48.0 ± 2.8</td>
<td></td>
</tr>
<tr>
<td>FMBS 8 months</td>
<td>26.1 ± 2.8</td>
<td>46.3 ± 2.9</td>
<td></td>
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<tr>
<td>FMPS (%) Baseline</td>
<td>85.9 ± 10.9</td>
<td>75.6 ± 11.8</td>
<td></td>
</tr>
<tr>
<td>FMPS 4 months</td>
<td>31.5 ± 3.0</td>
<td>75.2 ± 2.3</td>
<td></td>
</tr>
<tr>
<td>FMPS 8 months</td>
<td>35.2 ± 3.4</td>
<td>71.5 ± 2.8</td>
<td></td>
</tr>
</tbody>
</table>

HBP: hypertension; MI: myocardial infarction; CVD: cardiovascular diseases; HChol: hypercholesterolaemia; PPK: average number of periodontal pockets > 4 mm; FMBS: average full-mouth gingival bleeding scores on probing; FMPS: average full-mouth dental plaque scores; a Chi² test. b Intragroup comparison P < 0.05 vs baseline values; all other comparisons were by independent tests.

3. Results

Demographic characteristics of the IPT (n = 44) and CPT (n = 49) subjects are presented in Table 1. In brief, there were no substantial differences between the groups except for a minor imbalance of gender distribution and PD. Also, there were no changes in medical history, body weight, lifestyle or medications reported by any individuals during the 8-month study period. In addition, there were no patients lost to follow-up, with all participants attending both the 4- and 8-month follow-up visits (Fig. 1).

After periodontal therapy, a reduction in all periodontal clinical parameters was observed in both study groups at the 4- and 8-month follow-up visits (Table 1).

After 4 months, no major differences in HbA1c levels between groups were noted whereas, at the 8-month visit, the IPT group presented with lower HbA1c levels (Table 1). The average difference in HbA1c between groups at 8 months was 0.57% (95% CI: 0.12 to 1.09; P = 0.03), and was independent of age, gender and BMI differences. The relative change in HbA1c compared with baseline in the IPT group was greater than that observed in the CPT group (average change: 7.3%, 95% CI: 1.1 to 13.4; P = 0.02). This change correlated with the reduction in probing pocket depth (R = −0.32; P = 0.03) and dental plaque scores (R = 0.29; P = 0.04). The improvement in HbA1c over time was predominantly observed in the type 2 DM patients, with a 0.95% reduction (95% CI: 0.32 to 1.58; P = 0.004) seen after 8 months, whereas no statistically significant differences in the type 1 DM subgroup were observed.

4. Discussion

IPT in a sample of patients with DM resulted in a 0.5% net reduction of HbA1c after 8 months of follow-up compared with a control therapy group. This difference was attributable to almost a twofold reduction of HbA1c (0.9%) in the patients diagnosed with type 2 DM. The magnitude of difference in HbA1c levels after periodontal therapy is in line with those reported in previous systematic reviews of the effects of periodontal therapy on metabolic control [5,11].

PD is associated with a substantial local bacterial load [12] and systemic inflammation [4]. There is sufficient evidence to suggest that low-grade inflammation induced by increases in interleukin (IL)-6 and tumour necrosis factor (TNF)-α, as observed in PD, can also induce a state of insulin...
resistance [13,14]. Our present data suggest that the potential benefits of improving oral health in patients with diabetes may extend beyond the mouth. Indeed, recent evidence from uncontrolled studies confirms that periodontal therapy can reduce systemic inflammation and HbA1c in patients with DM [15].

The present preliminary data also suggest that the use of antimicrobials in the treatment of PD in those with DM is not a prerequisite for demonstrating improvements in glucose management. Indeed, most of the studies included in a published meta-analysis used antimicrobial therapy as an adjunct to standard mechanical dental instrumentation [11]. The IPT used in our present protocol produced a similar effect. Thus, future clinical trials involving this target population should use an appropriate randomized design that also takes these factors into account.

However, some limitations of the present study need to be highlighted. A non-randomized study design was chosen on the basis of the ethical dilemma of providing or delaying periodontal therapy to DM patients. Several research groups have preferred the latter option, deciding to postpone the delivery of periodontal therapy until the end of the study (follow-up maximum of 6 months). In our opinion, the length of follow-up needed to be greater, as both PD and DM are chronic conditions and, therefore, longer follow-ups would appear to be more appropriate. Thus, we agreed with the ethics board reviewing the protocol to use a non-randomized treatment allocation. Selection bias (those with a different risk of PD), information bias (lack of blinding of patients and healthcare staff to group allocation) and potential confounding (imbalance of potential confounders between study groups) remain, however, the major limitations of the present trial, as it is with most non-randomized controlled trials [16]. Furthermore, our results cannot be generalized to all patients with either PD (severe generalized cases) or DM. Nevertheless, the fact that most of the potential factors affecting outcome, with the exclusion of PD extent, were balanced in our trial may have reduced the impact of potential confounding on the present results. This point is further strengthened by the fact that the primary outcome was analyzed by blinded staff (to minimize any information bias).

5. Conclusion

The present results indicate that PD therapy is associated with a decrease in HbA1c levels after 8 months, especially in patients with type 2 DM. These data further support the notion that all healthcare professionals should aim to promote oral health in patients with DM not only to reduce the burden of oral diseases and prevent tooth loss, but potentially contributing to better glucose management.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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