CLINICS

RAPID COMMUNICATION

Can fasting plasma glucose and glycated hemoglobin levels predict oral complications following invasive dental procedures in patients with type 2 diabetes mellitus? A preliminary case-control study

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OBJECTIVE: To evaluate the effects of the levels of glycemic control on the frequency of clinical complications following invasive dental treatments in type 2 diabetic patients and suggest appropriate levels of fasting blood glucose and glycated hemoglobin considered to be safe to avoid these complications.

METHOD: Type 2 diabetic patients and non-diabetic patients were selected and divided into three groups. Group I consisted of 13 type 2 diabetic patients with adequate glycemic control (fasting blood glucose levels $<$140 mg/dl and glycated hemoglobin (HbA1c) levels $<$7%). Group II consisted of 15 type 2 diabetic patients with inadequate glycemic control (fasting blood glucose levels $>$140 mg/dl and HbA1c levels $>$7%). Group III consisted of 18 non-diabetic patients (no symptoms and fasting blood glucose levels $<$100 mg/dl). The levels of fasting blood glucose, glycated HbA1c, and fingerstick capillary glycemia were evaluated in diabetic patients prior to performing dental procedures. Seven days after the dental procedure, the frequency of clinical complications (surgery site infections and systemic infections) was examined and compared between the three study groups. In addition, correlations between the occurrence of these outcomes and the glycemic control of diabetes mellitus were evaluated.

RESULTS: The frequency of clinical outcomes was low (4/43; 8.6%), and no significant differences between the outcome frequencies of the various study groups were observed ($p>0.05$). However, a significant association was observed between clinical complications and dental extractions ($p=0.02$).

CONCLUSIONS: Because of the low frequency of clinical outcomes, it was not possible to determine whether fasting blood glucose or glycated HbA1c levels are important for these clinical outcomes.

KEYWORDS: Type 2 Diabetes Mellitus; Oral Infections; Glycemic Control.

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INTRODUCTION

Diabetes mellitus (DM) is a progressive chronic disease that has a high level of morbidity because of the comorbidities that occur during disease evolution, which can compromise patient quality of life (1). One of the most important complications of DM is the observed increase in susceptibility to infections (2), likely due to impaired immunological defenses (3), which have been associated with increased concentrations of plasma glucose (4). It has been reported that chronic hyperglycemia accelerates the accumulation of advanced glycated end-products (AGEs) (5), which results in local tissue alterations that can increase susceptibility to infections (6).

It is important to be able to identify patients who have an elevated risk of developing oral complications related to invasive dental procedures. Thus, this study aimed to evaluate the frequency of clinical complications following invasive dental procedures in type 2 diabetic patients based on their levels of glycemic control. Furthermore, this study sought to determine the levels of fasting blood glucose (FBG) and HbA1c that could be considered safe to avoid these complications.

SUBJECTS AND METHODS

Ethics statement

This study was approved by the Ethics Committee of the Dentistry School of Ribeirão Preto, São Paulo University,

No potential conflict of interest was reported.

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Brazil (CAAE #0012.0.138.000-10). All subjects provided written informed consent prior to their participation in this study.

Subjects

Type 2 diabetic patients and non-diabetic patients over 35 years of age were selected and divided into three groups. The study cohort consisted of individuals of both genders and a range of ethnicities. Group I consisted of type 2 diabetic patients with adequate glycemic control (FBG levels below 140 mg/dl and HbA1c levels less than 7%). Group II consisted of type 2 diabetic patients with inadequate glycemic control (FBG levels >140 mg/dl and HbA1c levels >7%). Group III was the control group and consisted of non-diabetic patients (no symptoms of diabetes and FBG levels <100 mg/dl). Diabetes diagnoses were made based on the World Health Organization (WHO) recommendations (7). All diabetic patients included in this study had met the diagnostic criteria for diabetes for at least five years. The following inclusion criteria were used: at least six teeth, a requirement for dental surgery (simple extraction) or complex periodontal treatment (non-surgical scaling and root planning). The need for extraction was evaluated using clinical and radiographic examinations. The requirement for periodontal treatment was evaluated via periodontal screening and recording (PSR), and patients classified as PSR 3 or 4 codes were selected. Subjects were excluded if they presented with co-existing local or systemic infections, severe complications related to diabetes, or if they had received antimicrobial treatment for oral infections in the previous three months.

Study design

A case-control study was developed and performed between May 2010 and November 2011. The charts from diabetic patients treated at the Diabetes Outpatient Clinics of the University Hospital of the Medical School of Ribeirão Preto, São Paulo University, were reviewed, and patients that met the eligibility criteria were referred to the Dental School of Ribeirão Preto for dental treatments. Patients for the control group were selected from the clinics of the Dental School of Ribeirão Preto. Prior to performing any dental work, the levels of FBG, HbA1c, and fingerstick capillary glycemia (FCG) were determined in all type 2 diabetic patients. Seven days after the dental procedure, the frequency of clinical complications (surgery site infections and systemic infections) in the three study groups was analyzed. In addition, the presence of tissue necrosis, purulent secretion, pain, edema, and dehiscence/wound breakdown was examined. Symptoms were registered using a 10-cm visual analog scale (VAS; 0 = no pain to 10 = extreme pain). The correlations between clinical outcomes and dental procedures, clinical outcomes and symptoms, and symptoms and type of dental procedure were also evaluated.

Statistical analysis

Fisher's exact tests were used to evaluate the differences in clinical outcomes after invasive dental procedures in the three groups, the association between clinical outcome and procedure type, and the effects of gender in each of the three groups. These analyses were performed using SAS software (Statistical Analysis System - SAS® 9.0 software; Cary, NC, USA). Differences in age, glycemic control, and symptoms reported by the patients between the three groups were analyzed using Kruskal-Wallis tests with Dunn post hoc tests, and these analyses were performed using R software (R Foundation for Statistical Computing, Vienna, Austria; http://www.r-project.org). The data were reported as the means and standard deviation (SD), and the level of significance was set at 5% for all analyses.

RESULTS

The demographic characteristics and glycemic control of the subjects are shown in Table 1. After reviewing 1,175 charts for inclusion and exclusion criteria, 147 type 2 diabetics were initially selected. However, only 28 subjects were found to be eligible for the current study. Of these, 13 subjects had type 2 diabetes with adequate glycemic control (Group I), and 15 exhibited inadequate glycemic control (Group II). The other 119 patients were excluded for at least

Table 1 - Clinical characteristics of type 2 diabetic patients with adequate (Group I) and inadequate glycemic control (Group II) and non-diabetic subjects (Group III) and the frequency of symptom levels (0-5 and 6-10) reported after dental invasive procedures.

Variables	Group I (n = 13)	Group II (n = 15)	Group III (n = 18)	*p*-value
Gender*				
Male	7 (53.8%)	4 (26.7%)	3 (16.6%)	0.10†
Female	6 (46.2%)	11 (73.3%)	15 (83.4%)	
Age (years)				
Mean ± SD	58.53±6.11	52.86±7.24	46.53±7.61	<0.01‡
Capillary glycemia (mg/dl)**				
Mean ± SD	151.33±39.80	240.93±72.89	105.26±22.91	<0.01‡
Fasting blood glucose (mg/dL)**				
Mean ± SD	134.76±25.18	197.33±71.79	88.73±9.78	<0.01‡
HbA1c (%)**				
Mean ± SD	6.5±0.50	10.22±1.33	-	<0.01‡
Clinical outcomes*				
No	12 (92.3%)	13 (86.6%)	17 (94.4%)	0.81†
Yes	1 (7.7%)	2 (13.3%)	1 (5.6%)	
Symptoms (VAS)				
0-5	12 (92.3%)	14 (93.4%)	17 (94.4%)	0.80‡
6-10	1 (7.7%)	1 (6.6%)	1 (5.6%)	

*Values shown as n (%); ** values shown as the means and standard deviation (SD); † Fisher's exact test; ‡ Kruskal-Wallis test; VAS: visual analog scale.

one of the following reasons: FBG levels >300 mg/dl and/or HbA1c levels >10%, which are associated with complications of diabetes; not having at least six teeth; or refusing to participate in the study. Eighteen non-diabetic patients were also studied as a control group (Group III). FBG, HbA1c, and FCG levels were higher in type 2 diabetic patients with inadequate glycemic control compared with those with adequate glycemic control.

The frequency of clinical complications was low and similar ($p = 0.80$) in the three groups, and this frequency was independent of glycemic control (Table 1). Of the 46 patients examined here, only four (8.6%) showed oral complications: one in Group I, two in Group II, and one in Group III. These four patients were treated by dental extraction, and their outcomes were all characterized by intra-oral swelling, redness, pus, and wound dehiscence. All 27 patients underwent scaling and root planning, which did not induce any complications. Thus, dental extractions were associated with increased numbers of complications compared with scaling and root planning ($p = 0.02$) (Table 2).

Most patients (43/46; 93.4%) reported pain symptoms ranging from 0 and 5 (VAS), but three patients reported symptoms ranging from 6 to 10 (Table 1). All of the patients who received scaling and root planning had VAS scores of 5 or lower, and all three of the patients who reported symptoms greater than 6 had undergone extractions (of 19 total, 15.7%) (Table 2). However, no significant associations were observed between the clinical outcomes and symptoms ($p = 0.81$) or between the type of dental procedure and symptoms ($p = 0.20$).

DISCUSSION

This study evaluated the frequency of postoperative dental complications in patients with type 2 diabetes based on their levels of glycemic control. The results demonstrated a low frequency of complications, and no evidence of an effect of glycemic control on clinical outcomes was observed (Table 1). Of the 46 patients who underwent invasive procedures, only four (8.6%) had surgical site infections, and this outcome occurred in patients from each of the three groups: one patient from Group I, two patients from Group II and one patient from Group III.

The following FBG and FCG values were observed in the patients who had postoperative complications: FBG = 137 mg/dl and FCG = 225 mg/dl (Group I patient); FBG = 219 mg/dl; FCG = 300 mg/dl and FBG = 301 mg/dl; FCG = 195 mg/dl (Group II patients); and FBG = 88 mg/dl; FCG = 98 mg/dl (Group III patient). Regarding the HbA1c values, the three diabetic patients who had postoperative complications had HbA1c values as follows: 7% (Group I patient) and 9% and 11% (Group II patients).

Table 2 - Frequency of type 2 diabetic patients presenting outcomes and symptoms based on the type of dental procedure.

	Procedure		*p*-value**
	SRP	Extraction	
Outcomes*			
No	27 (100%)	15 (78.9%)	0.02
Yes	0 (0%)	4 (21.1%)	
Symptoms (VAS)*			
0-5	27 (100%)	16 (84.2%)	0.20
6-10	0 (0%)	3 (15.8%)	

*Values shown as n (%); VAS: visual analog scale; SRP: scaling and root planning; ** Fisher's exact test.

The use of antibiotics has been recommended for type 2 diabetics prior to dentoalveolar surgery (8,9) to prevent surgical site infections and facilitate the healing process. In this study, antibiotics were not used prior to dental procedures in any of the groups, but the frequency of clinical complications was low nonetheless. The similar prevalence of surgical site infections in type 2 diabetic patients with adequate and inadequate glycemic control and in non-diabetics suggests that the rate of infections may not depend on glycemic control, despite the reports of an increased risk of infections in diabetic patients (10). In addition, these results suggest that antibiotic prophylaxis may only be appropriate in specific cases, not during routine practice. All of the patients in the current study were treated with local antibiotic irrigation, and the surgical wounds of all patients were clinically repaired within 10 days.

The present study failed to identify a direct relationship between FBG levels or HbA1c values and postoperative complications; thus, it was impossible to suggest FBG or HbA1c values that would be predictive of complications. This study did reveal that dental extractions are more frequently characterized by complications than scaling and root planning procedures, but this effect was not linked to glycemic control. The limitations of this study included the small number of patients and the fact that postoperative FBG values were not evaluated. It is possible that studies with larger sample sizes might be sufficiently powered to assess the impact of glycemic control on the occurrence of postoperative complications.

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AUTHOR CONTRIBUTIONS

Motta AC conceived and designed the study and drafted the manuscript. Bataglion CA performed the study. Foss-Freitas MC, Foss MC, and Komesu MC participated in the design and coordination of this study.

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