Dental Treatment Effect on Blood Glucose Level Fluctuation in Type 1 Balanced Diabetic Children

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Abstract

Introduction: Pediatric dentists, while treating diabetic patients, have a major concern about the occurrence of hypo- or hyperglycemia complications. So far, no dental care protocol is elaborated to help practitioners in creating a safe environment for their patients. This study aims to evaluate the blood glucose level (BGL) fluctuation in type 1 diabetic children according to the type of the delivered treatment and its duration, to outline guidance for predicting the occurrence of a hypo- or hyperglycemia complication.

Materials and methods: A cross-sectional approach was conducted on 70 balanced diabetic children aged between 7 years and 12 years old (32 females and 38 males) in the Department of Pediatric Dentistry at the Lebanese University in Beirut. Only the patients having a BGL between 70 mg/dL and 300 mg/dL could undergo dental treatment. The gender, the duration of the dental session (≤30 or >30 minutes), the BGLs at the baseline and the end of the session were noted. The types of the performed dental treatment were classified as simple, and unpleasant acts.

Results: For the female group, only eight sessions lasted ≤30 minutes. The results of simple and unpleasant interventions >30 minutes showed that BGLs before and after treatment were almost identical (p > 0.05). In the male group, for the simple acts >30 minutes, the BGL showed a significant fluctuation (p = 0.02).

Conclusion: Dentists must be aware of signs of discomfort in balanced type 1 diabetic children to avoid severe complications. This study highlights a new range of BGLs (70–300 mg/dL) that allows safe dental treatment.

Keywords: Blood glucose level, Dental treatment, Diabetic child.

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Introduction

The American Diabetes Association (ADA) defines type 1 diabetes mellitus (T1DM) as an absolute insulin deficiency caused by T-cell-mediated autoimmune destruction of pancreatic β-cells.¹ This type is the predominant form of diabetes mellitus in childhood and adolescence with typical symptoms of polyuria, polydipsia, and weight loss.²

The ADA’s standards of medical care in diabetes are updated and published annually. These standards include the most current evidence-based recommendations for diagnosing and treating adults and children with all forms of diabetes.³ These recommendations target clinicians mainly.

As it is proven that a bidirectional relationship exists between diabetes and dental ill-health,⁴ the oral complications and the general guidelines are described extensively to improve patient’s oral health.⁵

Unfortunately, while pediatric dentists are faced with diabetic patients, there is no dental care protocol elaborated to help practitioners in creating a safe environment for their patients. The major concern of the dentist treating a diabetic child is the occurrence of hypo- or hyperglycemia complications in the dental office. It is worth mentioning that, in a 2016 study, Nirmala and Saikrishna provided an overview of the standard procedures required to treat a diabetic child’s teeth correctly. However, his findings do not cover the effects of the types of dental care, and the time spent on a dental chair, on the patient’s blood glucose level (BGL).⁶

General knowledge about diabetes and detailed management with the appropriate measures are mandatory, even necessary, before proceeding with any dental treatment.

Materials and Methods

A cross-sectional approach was conducted on type 1 diabetic children, from the Chronic Care Center (CCC)⁵, treated and followed by specialists for at least 1 year.

For dental treatments, diabetic children attend the Department of Pediatric Dentistry at the Lebanese University in Beirut, Lebanon. The population of interest consisted of 70 balanced diabetic...
children with a hemoglobin A1c (HbA1c) ≤7%, aged between 7 years and 12 years old, divided into 32 females and 38 males.

All patients were familiar with dental care. Moreover, all were instructed to take their breakfast and habitual insulin shot at least 1 hour before their dental appointment, as it was scheduled for the morning session. Only the patients having a BGL between 70 and 300 mg/dL could undergo dental treatment. All patients were required to be equipped with insulin (pen or syringe), a blood glucose meter, and a snack.

One operator filled a chart indicating the gender of each child, the duration of the dental session (≤30 or >30 minutes), the BGL at the baseline (T0), and the end of the session (T1). The types of performed dental treatment were classified into simple acts (dental cleaning, fissure sealant, simple restoration, etc.) and unpleasant acts (e.g., complex restorations, pulp treatments, stainless steel crown, extractions, etc.). The simple acts did not require any local anesthesia. The other ones have carried out under 2% lignocaine.

All the dental procedures were performed by a second operator. An informed consent form was signed by the children’s parents or guardians.

The ethics committee of the Faculty of Medicine at the Lebanese University approved the study protocol (# CUER14-2020).

The analysis of data was carried out using Statistical Package for Social Sciences Computer Software (SPSS 21.0, Inc., Chicago, IL, USA). Kolmogorov–Smirnov test was used to examine if variables are normally distributed. Paired t-test or paired Wilcoxon signed-rank test was used to compare two paired samples. Unpaired t-test or Mann–Whitney test were used to compare two independent groups. A p value ≤0.05 was considered significant.

*CCC is a Lebanese private non-lucrative institution with a multidisciplinary medical team for preventing and monitoring certain chronic childhood diseases including T1DM.

Results

In Table 1, the result of the simple interventions shows a significant decrease in the BGL after the dental treatment (p = 0.0089). No significant variation was found in both genders, for the unpleasant acts, either the session exceeded or not 30 minutes.

Table 2 shows a significant decrease in the BGL after dental treatments, only in males with simple acts (p = 0.0061). The duration of the dental treatments did not have any significance in the variation of the BGL in both female and male groups.

Table 3 displays that in the female group, no significant difference was found in BGL taken before and after treatment for the simple or unpleasant acts exceeding or not 30 minutes. In the male group, a significant decrease was found only in children whose interventions were simple and exceeding 30 minutes (p = 0.02). No significant variation was found in males whose interventions were unpleasant, independently of the duration.

Table 4 indicates that in the male group, a significant difference in the means of BGL variation was found between simple interventions and unpleasant ones (p = 0.049). For the female group, no significant differences were found according to the type or the duration of the dental session.

Discussion

In the present study, the level of HbA1c <7 is the reference to consider diabetic patients as control. In 2016, the ADA recommended that patients with diabetes attempt to achieve HbA1c <7%.9 In line with this, Inoue et al. considered the value <7% as a good predictive of satisfactory blood glucose control in type 1 diabetes.10 For Gillery et al. to minimize the long-term complications of diabetes mellitus and the risk of severe hypoglycemia, the target is to obtain an HbA1c between 7 and 7.5%.11

Dental treatments were classified as simple or unpleasant according to the behavior and attitude of the children. The dental session was considered simple when the child did not express any sign of fidget or discomfort. In all other cases, the treatments were considered unpleasant (Table 1).

The major concern of the dentist treating a diabetic child is the risk of hypo- or hyperglycemia occurrence in the dental office. Therefore, studying the variation of the BGL at the beginning of the dental session and its end could be relevant and helpful to dentists. Fritschi and Quinn stated that fluctuations in glucose levels may occur rapidly, over minutes, or even hours. In the clinical setting, glucose variability may be missed, since glucose fluctuations will not be revealed through a single measure of blood glucose or with HbA1c test.12

Being precautious and aware of such complications increases the safety of dental treatments in diabetic patients. According to the ADA (2016), alert strategies must be in place for hypoglycemia (BGL <70 mg/dL) and hyperglycemia (BGL >250 mg/dL) across all pediatric age groups.19

In the present study, when some patients presented at T0 a BGL over 300 mg/dL, without showing any alarming signs of hyperglycemia such as headache, sweating, dizziness, trembling, and blurred vision,13 they were advised physical activity (e.g., running, climbing stairs, or hopping) to decrease their BGL to ≤300 mg/dL.

In Table 2, for the female group, the obtained results relative to simple and unpleasant interventions for a dental session ≤30 minutes showed that BGL before and after treatment were almost identical (p > 0.05).

Table 1: Blood glucose level (BGL) before and after the dental treatment according to the gender, the type, and the duration of the intervention

| Variable                      | N (% | mean | mean | SD | SD | Mean | SD | Mean | SD | p value |
|-------------------------------|------|------|------|----|----|------|----|------|----|---------|
| Gender                        |      |      |      |    |    |      |    |      |    |         |
| Female                        | 32   | 41.4%| 145.4| 45.58| 144.1| 72.18| 1.25| 0.96 |    |         |
| Male                          | 38   | 58.6%| 179.9| 66.58| 176.4| 50.51| 3.5 | 0.704|    |         |
| Type of the dental treatment  |      |      |      |    |    |      |    |      |    |         |
| Simple                        | 30   | 58.6%| 181.3| 69.87| 159.1| 70.31| 22.43| 0.0089|   |         |
| Unpleasant                    | 40   | 41.4%| 151.3| 48.6 | 163.8| 57.78| 7.96 | 0.2839|   |         |
| Duration of the intervention  |      |      |      |    |    |      |    |      |    |         |
| ≤30 minutes                   | 54   | 70.39%| 167.1| 60.31| 159.1| 57.31| 7.96 | 0.2839|   |         |
| >30 minutes                   |      |      |      |    |    |      |    |      |    |         |

*minor change in BGL can be neglected
For the dental sessions >30 minutes, BGL values at T0 and T1 were almost identical and comparable to the results obtained in treatments ≤30 minutes (Table 2).

In the female group, and for all types of dental interventions independently of the duration, no variations in BGL were noticed. If we consider the patients’ insulin intake and the time elapsed between breakfast and the end of the dental session, the BGL should have dropped, especially for the simple acts. Surprisingly, the BGL did not. It can be explained by the fact that dental fear is more pronounced in females than males as Luoto et al. stated.14

The magnitude of patients’ stress and its physiological consequences are influenced by the individuals’ perception of their ability to cope with the stressor. Stressors are perceived and processed by the brain: glucocorticoids and catecholamines (adrenaline and noradrenaline) are released and raise BGL by triggering the release of glucose from the liver into the bloodstream.15 In the same vein, Anderson et al. revealed that anxiety disorders are associated with hyperglycemia in diabetic patients.16

In both groups, for the unpleasant acts, the similarity of BGLs at T0 and T1 could be explained by the stress generated by the local anesthesia injection. In his study, Berge et al. demonstrated that high fear of intraoral injections was prevalent and might lead to avoidance of necessary dental treatment.17

In the male group, all types of dental treatments do not show a statistical significance in BGL variations for a session lasting ≤30 minutes (Table 2). For the sessions >30 minutes, the BGL before a simple intervention is significantly higher than the BGL after treatment with a p value = 0.02 (Table 3). As simple dental treatments (e.g., sealant, cleaning) are painless and non-stressful, the decrease in BGL could be due to the child’s fatigability on the dental chair and the time elapsed since the last meal. According to Moebus et al., the minimum duration to achieve comparable BGLs between fasting and non-fasting measurements is 3 hours. A random blood glucose sample or a fasting duration of 3 hours seems sufficient for reliable blood glucose measurements.16 In 2001, the ADA stated that in non-diabetic individuals, BGLs return to pre-prandial levels within 2–3 hours.19 Moreover, patients with type 1 diabetes are characterized by both a higher fatigability and a lower muscle strength.20 Sugahara et al. described peripheral fatigue (skeletal muscle fatigue) as a combination of neurological, musculoskeletal, and metabolic aberrations, such as reductions in hepatic or muscular glycogen stores, reduced oxygen consumption during activity, and muscle fiber changes resulting from physical activity or aging.21 In the present study, the patients follow a precise protocol from the CCC dictating that the first insulin injection is taken after breakfast. Considering the time elapsed between the first insulin injection and the end of the dental treatment, the decrease of BGL is justifiable.

For the unpleasant dental acts >30 minutes, the results did not show any statistical significance. The common point in these two types of dental acts is the administration of a local anesthetic (lidocaine with epinephrine 1:100,000). Many authors demonstrated that the use of vasoconstrictor in balanced diabetic patients did not show any significant effects on the BGL. Khawaja et al. concluded that the use of epinephrine in local anesthesia is safe in healthy and diabetic patients under hypoglycemic medications.22 Alves dos Santos-Paul et al. observed that the use of epinephrine (1:100,000) does not interfere with BGLs on pharmacologically controlled type 2 diabetes patients.23

None of the children showed any signs of hypo- or hyperglycemia during and after the dental treatment. Blood glucose level

### Table 2: Blood glucose level (BGL) before and after dental treatments according to the type and the duration of the dental intervention, in both genders

| Gender     | Dental treatment | BGL before Mean | SD | BGL after Mean | SD | p value |
|------------|------------------|----------------|----|----------------|----|---------|
| Female N = 32 | Simple           | 152.9          | 58.28 | 140.8          | 77.75 | 12.07   | 0.36 |
|            | Unpleasant       | 139.6          | 33.29 | 146.7          | 69.73 | 7.16    | 0.659 |
|            | ≤30 minutes      | 142.3          | 61.5  | 149.6          | 97.02 | 7.375   | 0.736 |
|            | >30 minutes      | 146.4          | 40.55 | 142.3          | 64.37 | 4.125   | 0.2034 |
| Male N = 38 | Simple           | 206.2          | 71.26 | 174.7          | 61.25 | 31.5    | 0.0061* |
|            | Unpleasant       | 160.8          | 57.23 | 177.7          | 42.56 | 16.86   | 0.1934 |
|            | ≤30 minutes      | 165.9          | 60.47 | 190.6          | 60.76 | 24.77   | 0.387 |
|            | >30 minutes      | 183.7          | 68.59 | 172.6          | 47.89 | 11.03   | 0.226 |

*p value ≤0.05

### Table 3: Blood glucose level (BGL) before and after dental intervention according to the type of treatment

| Gender     | Duration | Type | N | BGL before Mean | SD | BGL after Mean | SD | p value |
|------------|----------|------|---|----------------|----|----------------|----|---------|
| Female N = 32 | ≤30 minutes | Simple | 4 | 158.5          | 34.16 | 156.8          | 140.8 | 1.75   | nd |
|            |          | Unpleasant | 4 | 126            | 34.71 | 142.5          | 44.81 | 16.5   | nd |
|            | >30 minutes | Simple | 10 | 150.6         | 50.81 | 134.4          | 44.34 | 16.2   | 0.06 |
|            |          | Unpleasant | 14 | 143.4         | 33.14 | 147.9          | 76.73 | 4.5    | 0.83 |
| Male N = 38 | ≤30 minutes | Simple | 2 | 246.5          | 61.52 | 197.5          | 37.48 | nd    | nd |
|            |          | Unpleasant | 6 | 139            | 29.91 | 188.3          | 69.73 | 49.33  | 0.15 |
|            | >30 minutes | Simple | 14 | 200.4         | 72.68 | 171.4          | 64.25 | 29     | 0.02* |
|            |          | Unpleasant | 16 | 169            | 63.45 | 173.7          | 29.21 | 4.68   | 0.71 |

*p value ≤0.05

*nd = not determined (small sample size)

*minor change in BGL can be neglected
fluctuations were evident but mild and not hazardous between 70 mg and 300 mg.

In a study conducted in 2017, diabetic children were shown to be conscious of their chronic disease and aware of the importance of their treatment. The medical staff in the CCC educates children and parents about the management of the disease. The results of the study show that BGL can be controlled by either the children themselves (54.1%) or with parents’ help (45.9%).

**Conclusion**

This study shows that clinicians must have a clear understanding of T1DM, which helps make treatments as problem-free as possible. The knowledgeable diabetic patient can be a great source of information as to how treatment can best be managed.

Dental treatment in balanced diabetic children is a carefully sequenced routine starting preferably in the morning, after the breakfast intake and the insulin injection, and followed by BGL tests before and after the dental session. Throughout the dental sessions, dentists and staff members must be aware of signs of discomfort in the diabetic children indicating either hypo- or hyperglycemia, to perform an early and proper intervention, and avoid severe complications.

The results of this study highlight the wide range of BGLs (70–300 mg/dL) that allow safe dental treatments.

This study leads us to carry out a parallel evaluation of the variables studied in this research in cases of non-balanced diabetic patients, as well as compare results to further understand the nuances and/or similarities between them.

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