RESEARCH ARTICLE

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

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Abstract

Diabetic patients struggle to maintain their blood glucose near normal levels to avoid the occurrence of hypo- or hyperglycemia discomfort. Dental practitioners must foresee such complications as they can also take place during dental treatment.

Aim and objective: This study aims to evaluate the impact of the type and duration of dental treatment on the blood glucose level (BGL) fluctuation in type 1 unbalanced diabetic children [hemoglobin A_{1c} (HbA_{1c}) >7].

Material and methods: A cross-sectional approach was conducted on 83 type 1 unbalanced diabetic children (HbA_{1c}) > 7%, aged between 7 years and 12 years, divided into 40 females and 43 males in the Department of Pediatric Dentistry at the Lebanese University in Beirut. For dental treatments, diabetic children were scheduled for morning sessions 60–90 minutes after breakfast intake and a habitual insulin shot. Only patients with a BGL between 70 mg/dL and 300 mg/dL underwent dental treatments. The type, the duration of the dental session, and the BGL at the baseline (T0), and at the end of the session (T1) were recorded. The dental acts were classified into simple (without local anesthesia) and unpleasant with a solution of 2% lignocaine with 1:200,000 epinephrine. Statistical analyses were performed.

Results: Fifty of 83 showed a decrease in their BGLs after dental treatments, 20 an increase, and 13 no change. For both genders, in simple acts, a statistical significance was noted ($p = 0.0002$) for the female and ($p = 0.0014$) for the males.

Conclusion: Treatment unbalanced diabetic children can be safely done by taking some precautions and measures to avoid a hypo- or hyperglycemia episode.

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

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Introduction

Type 1 diabetes is a life-threatening, autoimmune disease that strikes children and adults and can be fatal when uncontrolled. Excess of insulin can lead to hypoglycemia, seizures, coma, or even death. While hyperglycemia, over time, leads to kidney, heart, nerve, and eye damage.[1]

Many authors advised that people with type 1 diabetes should be treated intensively to achieve hemoglobin A_{1c} (HbA_{1c}) levels as close to normal as possible and as early in the course of the disease as possible to prevent and delay the late micro- and macrovascular complications of the disease.[2,3]

The monitoring of glycemic status is considered to be a cornerstone of diabetes care. The continuous adjustment of medications and the regular evaluation of the HbA_{1c} are essential to achieve the best possible blood glucose control safely. The HbA_{1c} test reflects time-averaged blood glucose during the previous 2–3 months and is used as the gold standard for long-term follow-up of glycemic control.[4]

According to the American Diabetes Association (ADA) treatment guidelines, adults with type 1 diabetes should aim at target HbA_{1c} levels <7.0%, whereas the target in children and adolescents is set at <7.5% (58 mmol/mol).[5]

According to Miller et al., even with diligent monitoring, the majority of people with type 1 diabetes do not achieve recommended target glucose levels.[1]

The long-term effects of type 1 diabetes engender general complications characterized by damage to the vasculature and lead to macro- and microvascular diseases. Macrovascular complications concern cardiovascular disease (e.g., coronary artery disease, cerebrovascular disease, and peripheral artery disease). Microvascular diseases include retinopathy, nephropathy, neuropathy, and oral pathologies (e.g., periodontitis, gingivitis, decay, and xerostomia). The oral complications affect diabetic children's quality of life and their families.[6,7] Therefore, prevention and early management of oral pathologies in diabetes care practice are crucial but remain a major challenge for diabetes care professionals.[8–10]

In a dental setting, practitioners can face complications with diabetic children. They must be aware and ready to deal with potential problems. A previous study on balanced diabetic children (considered normal patients as their HbA_{1c} is <7) demonstrated that dental treatments are possible and safe while following strict measures.[11]

This study aims to evaluate the impact of the type and duration of dental treatment on BGLs fluctuation in type 1 unbalanced diabetic children (HbA_{1c} >7) and the risk of occurrence of hypo- or hyperglycemia.

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Materials and Methods

A cross-sectional approach was conducted on 83 type 1 unbalanced diabetic children (HbA_{1c}) > 7%, aged between 7 years and 12 years, divided into 40 females and 43 males. The sample is recruited from the Chronic Care Center (CCC)*, where the children are treated and followed by diabetologists for at least 1 year.

For dental treatments, diabetic children attended the Department of Pediatric Dentistry at the Lebanese University in Beirut. They were scheduled for morning sessions at least one hour after breakfast intake and their habitual insulin shot.

Only patients with a BGL between 70 mg/dL and 300 mg/dL could undergo dental treatments. All patients were required to be equipped with insulin (pen or syringe), a blood glucose meter, and a snack (juice, apple, cake, etc.).

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 unpleasant ones were carried out under 2% lignocaine with 1:200,000 epinephrine. All dental procedures were performed by a second operator.

The study was approved by the ethics committee for medical research at the Lebanese University, and written informed consent was obtained from each child's parent/tutor during recruitment.

*CCC: the Chronic Care Center is a Lebanese private non-lucrative institution with a multidisciplinary medical team for preventing and monitoring Thalassemia and Diabetes in Children.

Results

In Figure 1, among 83 unbalanced diabetic children, 50 of them showed a decrease in their BGLs after dental treatments (T1), 20 an increase, and 13 no change.

Figure 2 shows that 29 unbalanced diabetic children underwent dental treatments with a duration ≤30 minutes. From 21 children exposed to a simple act, 12 (57.15%) showed a decrease in their BGLs, 3 (14.28%) presented an increase in their BGLs, and 6 (28.57%) did not show any change in their BGLs.

For dental treatments lasting over 30 minutes, among 30 children who underwent simple acts, 20 (66.67%) revealed a decrease in their BGLs at T1, 7 (23.33%) showed an increase in their BGLs, and 3 (10%) did not present any change.

Among eight children who underwent unpleasant dental treatment for a duration <30 minutes, 50% showed a decrease in their BGLs at T1. For unpleasant acts lasting over 30 minutes, 58.33% of the patients presented a decrease in their BGLs at T1.

The comparison of the BGLs, before and after treatment, was performed according to the gender (40 females and 43 males), the type of intervention (simple or unpleasant), and the duration of the treatment (≤30 or >30 minutes) (Table 1). The results show a significant decrease in the BGL after treatment in the female group ($p = 0.0002$) and the male group ($p = 0.0014$). A significant decrease was found in children whose intervention was simple ($p = 0.00008$), unpleasant ($p = 0.0004$), and in children whose intervention exceeded 30 minutes ($p = 0.0055$) or more ($p < 0.0001$) (Table 1).

The comparison of the BGLs at T0 and T1 in both genders according to the type of treatment showed a significant decrease of the BGLs at T1 for the females whose intervention was unpleasant ($p = 0.0006$) and for the males whose intervention was simple ($p = 0.0064$). Furthermore, the results according to the duration of treatment showed a significant decrease of the BGLs at T1 in both genders for the interventions exceeding 30 minutes ($p = 0.0005$ and $p = 0.006$, respectively) (Table 2).

Discussion

Diabetic children do not control their diet well. A previous study demonstrated that 67.6% of diabetic children are annoyed by their restricted diet.[6] Moreover, according to Debono and Cachia, few parents understand that diabetes is a condition that cannot be controlled simply by medication and the strict diet is a crucial part of their child's treatment.[12]

At least 1 hour before any dental work, the diabetic child must have taken his breakfast and insulin injection.[13] Sunita also

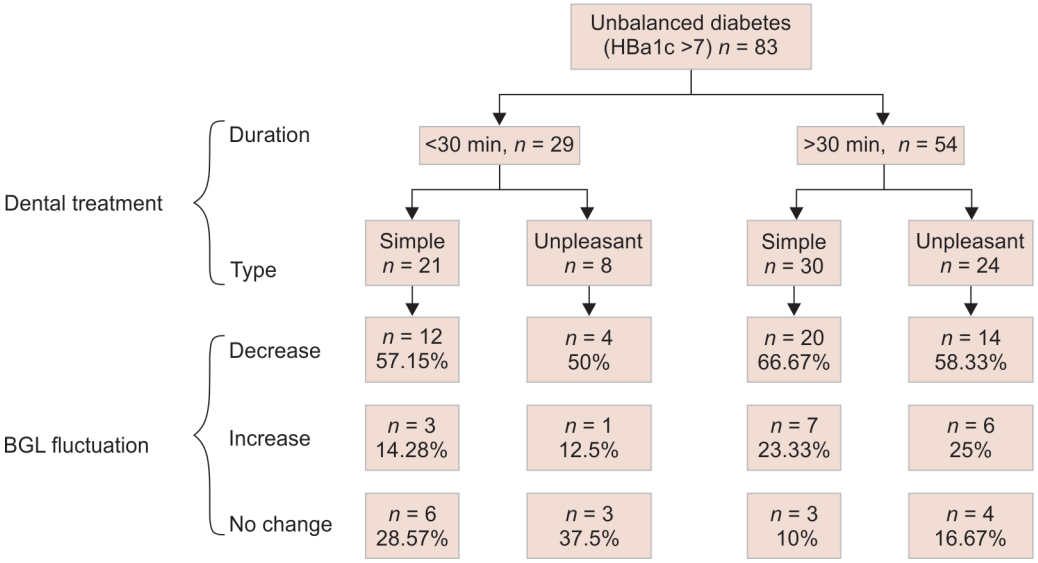

Fig. 1: BGLs (mg/dL) fluctuation between T0 and T1 in different levels groups

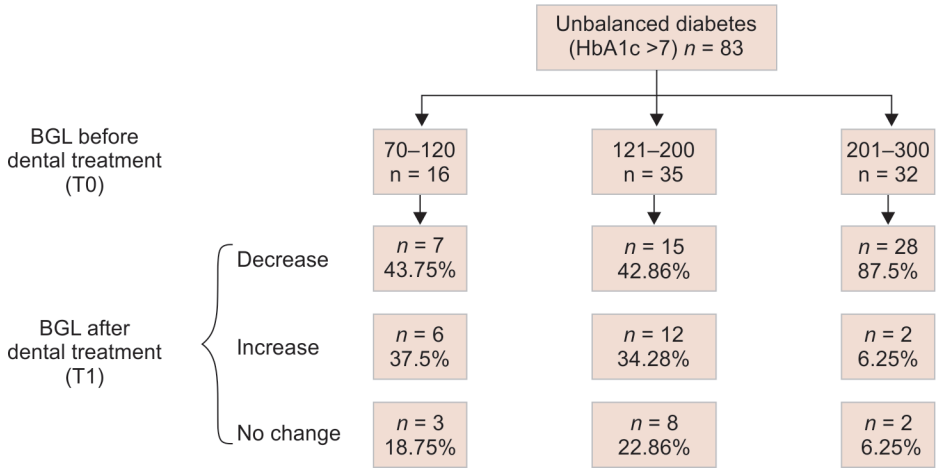

Fig. 2: BGLs fluctuation according to the time and the type of the dental treatment

Table 1: BGLs before and after dental treatments according to the gender, the type, and the duration of the intervention. *p* value < 0.05 is considered as significant

			BGL before		*BGL after*			
Variable		*N (%)*	*Mean*	*SD*	*Mean*	*SD*	*Mean of differences*	*p value*
Gender	Female	40 (48.2%)	183.4	63.92	143.9	62.45	39.5	0.0002*
	Male	43 (51.8%)	183.4	68.31	145.7	65.26	37.72	0.0014*
Type of the dental treatment	Simple	51 (61.4%)	193.2	63.63	160.7	64.65	32.49	0.0008*
	Unpleasant	32 (38.6%)	167.8	67.24	119.5	48.28	48.28	0.0004*
Duration of the intervention	≤30 minutes	29 (34.9%)	186.1	68.23	163.7	62.15	22.38	0.0055*
	>30 minutes	54 (65.1%)	181.9	65.11	134.7	62.48	47.28	<0.0001*

*Significance decrease in BGL in females, males and children

recommends morning appointments to avoid the peak active time of insulin and since the endogenous cortisol levels are generally higher at this time.[14]

The BGL is measured and registered at the beginning of the dental session (T0). For patients with BGL >300 mg/dL, exercise is recommended (e.g., running for a few minutes) to quickly decrease the BGL. The ADA (2016) recommends a BGL between 70 mg/dL, under which the risk of hypoglycemia increases, and 250 mg/dL, over which the risk of hyperglycemia rises.[15]

In the present study, the lowest BGL encountered at T0 was 90 mg/dL as the patients have taken their breakfast. The upper value was set at 300 mg/dL after ensuring that the patient was not showing any sign of hyperglycemia (e.g., nausea, stomach ache, trouble seeing, and drowsiness) and that he underwent physical activity to reach a BGL ≤300 mg/dL. For that reason, it is important to schedule a morning session to achieve dental treatment. In the same vein, the lowest BGL value at T1 was 70 mg/dL, and none of the patients showed at any time of the dental session any sign of hypoglycemia (e.g., hunger, sweating, or tremor).

In Table 1, the results show a significant decrease in the BGL after treatment, independently of the gender as well as the type and the duration of the dental treatment. The time elapsed since the morning insulin intake could explain this decrease. According to Yardley et al., little is known about the possible variables that might affect blood glucose responses in individuals with T1DM.[16]

In the female group, for the unpleasant acts and independently of their duration, the BGLs' decrease was statistically significant ($p = 0.0006$, $p = 0.0005$) (Table 2). The unpleasant dental acts are those requiring the administration of a local anesthetic (2% lignocaine with 1:200,000 epinephrine). This type of act can be stressful for young patients. According to Jarczok et al., stress may be an additional factor to promote the development of hyperglycemic-metabolic states.[17] Hilliard et al. and Walker et al. stated that stressful situations contribute to higher or lower A1c, respectively, making it difficult to extricate the unique role of stress in the glycemic outcome.[18,19]

Besides, the administration of an anesthetic solution with a vasoconstrictor during dental treatment for some authors causes a significant increase of the blood glucose level (BGL)[20,21] and for others, considering the vasoconstrictor and the volume of anesthetic solution used, the vasoconstrictor does not significantly alter the BGL and is safe to use in dentistry.[22,23]

The BGLs decrease may be attributed to the time elapsed from the morning routine (breakfast + insulin injection) to the achievement of the dental work.

In the male group, similar results were noted: the mean of BGLs at T0 (186.9) was higher than the mean at T1 (149.5). The BGL decrease may be explained by the same reasoning adopted in the female group. It is interesting to highlight that in the simple acts a statistical significance is current while it is not the case for the female group. On the one hand, it may be explained that the musculature composition is different in males than in females.[24] Wu

Table 2: BGLs at T0 and T1 according to the type and the duration of the dental treatment in both genders. *p* value < 0.05 is considered as significant

			BGL before		BGL after			
Gender	*Dental treatment intervention*		*Mean*	*SD*	*Mean*	*SD*	*Mean of differences*	*p value*
Female (*N* = 40)	Simple	22	201.6	64.86	175.5	52.81	26.09	0.0591
	Unpleasant	18	161.2	58.62	105.3	51.33	55.89	0.0006*
	≤30 minutes	7	167.7	79.13	146.3	55.4	21.71	0.078
	>30 minutes	33	186.8	61.16	143.5	64.62	43.27	0.0005*
Male (*N* = 43)	Simple	29	186.9	63.07	149.5	70.88	37.34	0.0064*
	Unpleasant	14	176.1	80.16	137.6	80.16	38.05	0.18
	≤30 minutes	22	192	65.34	169.4	64.3	22.29	0.09
	>30 minutes	21	174.4	71.77	120.8	57.75	53.59	0.006*

and O'Sullivan stated that the female metabolism is lower compared with males' during exercise.[25]

On the other hand, caloric intake can increase the BGL. External factors, such as caloric intake or metabolic demands (muscle activity), have an impact on BGLs.[26,27]

Conclusion

A few factors must be considered in the dental management of unbalanced diabetic children to avoid the occurrence of hypo- or hyperglycemia. This study shows the importance of the role of BGL in decision-making. The first steps in its organization are as follows:

- Schedule morning sessions for dental treatment after breakfast and insulin intake.
- Ensure the patient is not showing any sign of hypo- or hyperglycemia.
- Measure BGLs before and after dental treatment.
- Ensure BGLs are between 70 mg/dL and 300 mg/dL.
- Ensure sugar intake in case of BGL <70 mg/dL.
- Recommend exercise to decrease the BGL at T0 ≤ 300 mg/dL.

During the dental session, the practitioner must always be aware of any signs of mood changes, weakness, sweating, or tachycardia that predict hypoglycemia; the most common complication of DM1.

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