RESEARCH ARTICLE

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

Nahla Nassif[1], Balsam Noueiri[2]

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.

International Journal of Clinical Pediatric Dentistry (2021): 10.5005/jp-journals-10005-1907

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.

[1,2]Department of Pediatric Dentistry, School of Dentistry, Lebanese University, Beirut, Lebanon

Corresponding Author: Balsam Noueiri, Department of Pediatric Dentistry, School of Dentistry, Lebanese University, Beirut, Lebanon, Phone: +9613396996, e-mail: dr.balsam@live.com

How to cite this article: Nassif N, Noueiri B. Dental Treatment Effect on Blood Glucose Level Fluctuation in Type 1 Balanced Diabetic Children. Int J Clin Pediatr Dent 2021;14(2):212–216.

Source of support: Nil

Conflict of interest: None

Many authors described the screening of patients with diabetes risk in dental settings, but none of them devised an elaborated management protocol in the case of identified diabetic patients.[7,8]

The present study aims to evaluate the BGL fluctuation in T1DM children according to the type of the delivered treatment and its duration to outline a prospective protocol predicting the occurrence of hypo- or hyperglycemia complications.

Materials and Methods

A cross-sectional approach was conducted on type 1 diabetic children, from the Chronic Care Center (CCC)*, 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 with 1:200,000 epinephrine.

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.[9]

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

			BGL before		*BGL after*			
Variable		*N (%) mean*	*Mean*	*SD*	*Mean*	*SD*	*Mean of differences*	*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	158.9	70.33	22.43	0.0089*
	Unpleasant	40 (41.4%)	151.3	48.6	163.8	57.78	−12.5	0.2126
Duration of the intervention	≤30 minutes	16 (29.41%)	154.1	60.16	170.1	81.02	−16.06	0.3496
	>30 minutes	54 (70.39%)	167.1	60.31	159.1	57.31	7.96	0.2839

*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 acts, 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.[18] 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

			BGL before		*BGL after*			
Gender	*Dental treatment*		*Mean*	*SD*	*Mean*	*SD*	*Mean of differences*	*p value*
Female *N* = 32	Simple	22	152.9	58.28	140.8	77.75	12.07	0.36
	Unpleasant	18	139.6	33.29	146.7	69.73	−7.16	0.659
	≤30 minutes	8	142.3	61.5	149.6	97.02	−7.375	0.736
	>30 minutes	24	146.4	40.55	142.3	64.37	4.125	0.2034
Male *N* = 38	Simple	16	206.2	71.26	174.7	61.25	31.5	0.0061*
	Unpleasant	22	160.8	57.23	177.7	42.56	−16.86	0.1934
	≤30 minutes	8	165.9	60.47	190.6	60.76	−24.75	0.387
	>30 minutes	30	183.7	68.59	172.6	47.89	11.03	0.226

*minor change in BGL can be neglected

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

	Dental treatment			*BGL before*		*BGL after*			
Gender	*Duration*	*Type*	*N*	*Mean*	*SD*	*Mean*	*SD*	*Mean of differences*	*p value*
Female *N* = 32	≤30 minutes	Simple	4	158.5	83.16	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

nd = not determined (small sample size)
*minor change in BGL can be neglected

Table 4: Blood glucose level (BGL) variation according to the type and the duration of the dental treatment in both genders

		BGL variation									
		Type of the dental treatment					*Duration of intervention*				
		Simple		*Unpleasant*			*≤30 minutes*		*>30 minutes*		
		Mean	*SD*	*Mean*	*SD*	*p value*	*Mean*	*SD*	*Mean*	*SD*	*p value*
Gender	Male	31.5	39.5	−16.86	58.87	0.049*	−24.75	75.93	11.03	48.92	0.329
	Female	12.07	47.61	−7.167	67.76	0.5	−7.375	59.58	4.125	60.72	0.461
	p value	0.232		0.631			0.618		0.645		

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%).[24]

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.

References

1. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care 2010;33(l1):62–69. DOI: 10.2337/dc10-S062.
2. de Ferranti SD, de Boer IH, Fonseca V, et al. Type 1 diabetes mellitus and cardiovascular disease: a scientific statement from the American Heart Association and American Diabetes Association. Circulation 2014;130(13):1110–1130. DOI: 10.1161/CIR.0000000000000034.
3. American Diabetes Association. Improving care and promoting health in populations: standards of medical care in diabetes. Diabetes Care 2018;41(1):S7–S12. DOI: 10.2337/dc18-S001.
4. Sahril N, Aris T, Asari ASM, et al. Oral health seeking behaviour among Malaysians with type II diabetes. J Public Health Aspe 2014(1):1–8. DOI: 10.7243/2055-7205-1-1.
5. Moursi Amer M, Fernandez Jill B, Marcia D, et al. Nutrition and oral health considerations in children with special health care needs: implications for oral health care providers. Am Acad Pediat Dentis 2010;32(4):333–342.
6. Nirmala SVSG, Saikrishna D. Dental care and treatment of children with diabetes mellitus- an overview. J Pediatr Neonat Care 2016;4(2):00134. DOI: 10.15406/jpnc.2016.04.00134.
7. Myers-Wright N, Lamster IB, Jasek JP, et al. Evaluation of medical dental visits in New York City: opportunities to identify persons with and at risk for diabetes mellitus in dental settings. Commun Dentis Oral Epidemiol 2018;46(1):102–108. DOI: 10.1111/cdoe.12334.
8. Acharya A, Cheng B, Koralkar R, et al. Screening for diabetes risk using integrated dental and medical electronic health record data. JDR Clin Translat Res 2018;3(2):188–194. DOI: 10.1177/2380084418759496.
9. American Diabetes Association. Standards of medical care in diabetes-2016 abridged for primary care providers. Clin Diabetes 2016;34(1):3–21. DOI: 10.2337/diaclin.34.1.3.
10. Inoue K, Matsumoto M, Kobayashi Y. The combination of fasting plasma glucose and glycosylated hemoglobin predicts type 2

diabetes in Japanese workers. Diabetes Res Clin Pract 2007;77(3):451–458. DOI: 10.1016/j.diabres.2007.01.024.
11. Gillery P, Bordas-Fonfrède M, Chapelle JP, et al. HBA1c: concertation clinico-biologique pour la standardisation des méthodes de dosage. Diabetes Metabol 1999(25):283–287.
12. Fritschi C, Quinn L. Fatigue in patients with diabetes: a review. J Psychosom Res 2010;69(1):33–41. DOI: 10.1016/j.jpsychores.2010.01.021.
13. Wray L. The diabetic patient and dental treatment: an update. BDJ 2011;211(5):209–215. DOI: 10.1038/sj.bdj.2011.724.
14. Luoto A, Tolvanen M, Pohjola V, et al. A longitudinal study of changes and associations in dental fear in parent/adolescent dyads. Int J Paediat Dentis 2017;27(6):506–513. DOI: 10.1111/ipd.12289.
15. Fink G. Stress, definitions, mechanisms, and effects outlined: lessons from anxiety. Hand Book Stress Series 2016;1:3–11.
16. Anderson R, Grigsby AB, Freedland KE, et al. Anxiety and poor glycemic control: a meta-analytic review of the literature. The Int J Psychia Med 2002;32(3):235–247. DOI: 10.2190/KLGD-4H8D-4RYL-TWQ8.
17. Berge KG, Agdal ML, Vika M, et al. High fear of intra-oral injections: prevalence and relationship to dental fear and dental avoidance among 10- to 16-yr-old children. Eur J Sci 2016;124(6):572–579. DOI: 10.1111/eos.12305.
18. Moebus S, Göres L, Lösch C, et al. Impact of time since last caloric intake on blood glucose level. Eur J Epidemiol 2011;26(9):719–728. DOI: 10.1007/s10654-011-9608-z.
19. American Diabetes Association. Postprandial blood glucose. Diabetes Care 2001;24(4):775–778. DOI: 10.2337/diacare.24.4.775.
20. Orlando G, Balducci S, Bazzucchi I, et al. The impact of type 1 diabetes and diabetic polyneuropathy on muscle strength and fatigability. Acta Diabetol 2017;54(6):543–550. DOI: 10.1007/s00592-017-0979-9.
21. Sugahara H, Akamine M, Kondo T, et al. Somatic symptoms most often associated with depression in an urban hospital medical setting in Japan. Psychiatry Res 2004;128(3):305–311. DOI: 10.1016/j.psychres.2004.06.015.
22. Khawaja N, Khalil H, Parveen K, et al. An influence of adrenaline (1: 800.000) containing local anesthesia (2% Xylocaine) on glycemic level of patients undergoing tooth extraction in Riyadh. Saudi Pharmacolog J 2014;22(6):545–549. DOI: 10.1016/j.jsps.2014.02.006.
23. Alves dos Santos-Paul M, Itagiba Neves IL, Neves RS, et al. Local anesthesia with epinephrine is safe and effective for oral surgery in patients with type 2 diabetes mellitus and coronary disease: a prospective randomized study. Clinics 2015;70(3):185–189. DOI: 10.6061/clinics/2015(03)06.
24. Nassif N, Noueiri B, Olleik A. Impact of general and oral complications of diabetes mellitus type 1 on Lebanese children's quality of life. IJCPD 2017;10(4):1–6. DOI: 10.5005/jp-journals-10005-1481.