

Original Research

Effect of local anesthesia without and with adrenaline on blood glucose level in type-2 diabetic patients

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ABSTRACT

Background and Objective:- The present study was conducted with the aim to evaluate the effect of local anesthesia with adrenaline as compared to local anesthesia without adrenaline on blood glucose level in diabetic patients. **Materials and Methods:-** This randomized prospective study consisted of 100 patients. The age of the patients were between 20 to 70 years, irrespective of sex. All patients were having controlled type-2 diabetes mellitus, requiring multiple extractions to be performed. The study was carried out in two appointments, where in the first appointment tooth extraction was carried out under plain local anesthesia (Group A) and after 5 to 7 days, remaining extractions were carried out under local anesthesia with adrenaline (Group B). Serial blood glucose estimations were carried out at identical intervals on both occasions. **Results:-** The mean increase of blood glucose level in patients with plain local anesthesia was 0.15, 0.09 and 0.08 mg/dl while those in patients with local anesthesia plus adrenaline was 7.07, 23.22 and 36.83 mg/dl respectively immediately after injecting, after 10 mins and after 20 mins respectively. **Conclusion:-** The use of local anesthetic with adrenaline produces a significant increase in blood glucose level among controlled diabetic subjects.

Keywords: Local anesthesia, adrenaline, type-2 diabetes mellitus, blood glucose level

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INTRODUCTION

Diabetes is rapidly gaining the status of a potential epidemic in India with more than 62 million diabetic individuals currently diagnosed with the disease.⁽¹⁾ Type 2 diabetes mellitus is one of the most common systemic condition encountered in routine dental practice.⁽²⁾ In dentistry, local anesthetics are frequently used to control intra-operative pain.⁽³⁾ The most commonly used local anesthetic agent is Lignocaine hydrochloride as it provides significant efficacy with minimal adverse effects. To increase the efficacy of local anesthetic solutions, vasoconstrictors are added

to the solution, among which adrenaline is most commonly employed.⁽⁴⁾ Studies have shown that local anesthetics containing adrenaline, when injected, reduces plasma potassium and raises blood glucose concentration in healthy volunteers.⁽⁵⁾ It causes hyperglycemia by both, increasing glucose production and decreasing glucose clearance.⁽⁶⁾ An increase in blood glucose level due to vasoconstrictors in local anesthetics, may be insignificant in normal patients, but can be significantly relevant in diabetic patients.⁽²⁾ The present study was conducted in the Department of oral and maxillofacial surgery of College of dental

science and research centre, Ahmedabad from 2014-17 with the aim to evaluate and compare the effect of “adrenaline-free” and “adrenaline” containing local anesthetic solutions among diabetic patients who underwent dental extractions.

MATERIALS AND METHODS

A total of 100 patients between 20 and 70 years of age, requiring multiple dental extractions were included in this study, who were known type-2 diabetic patients. Approvals of the Institute Research Council and Ethical Committee were obtained prior to commencement of the study.

Inclusion criteria:

- Patients with controlled type-2 diabetes mellitus.
- Patients requiring multiple extractions.
- Patients with age between 20 and 70 years.

Exclusion criteria:

- Patients who are not willing to be a part of the study.
- Patients who need surgical extractions.
- Patients taking insulin injections.
- Medically compromised patients.
- Patients with known lignocaine or sulphur allergy.

Armamentarium:

- Glucometer.
- Sterile lancet.
- 2% lignocaine hydrochloride.(plain)
- 2% lignocaine hydrochloride.(adrenaline 1:80,000)
- Disposable syringe.(2 ml)

For each patient, the treatment was carried out in two appointments, with a gap of minimum 5 days between appointments. All the patients were requested to obtain written consent from physician following general physical examination and routine blood check up on the day of procedure. Written Consent for willingness was obtained both for study sampling and for procedure recorded.

The procedures were divided into two groups, namely :

Group A: Plain lignocaine

Group B: Lignocaine with adrenaline (1:80,000)

At the first appointment, tooth extraction was carried out under plain lignocaine (Group A). At the second appointment, scheduled 5-7 days later, the remaining extractions were carried out under lignocaine with adrenaline (Group B). Serial blood glucose estimations were carried out at identical intervals on both occasions.

All the appointments were scheduled in the morning time. At first appointment, local anesthetic solution without adrenaline was used in each patient. Blood was drawn by pricking the fingertip with a sterile lancet and peripheral blood glucose was estimated by using a glucometer. First reading was taken before administering local anesthesia. Immediately after administration, second reading was taken. Third and fourth readings were obtained 10 mins and 20 mins after local anesthetic administration respectively. After 5-7 days, at the second appointment, same quantity of local anesthetic solution with adrenaline (1:80,000) was administered in the patients for remaining extractions. Blood glucose estimation was done at identical intervals to that of the first appointment.

OBSERVATION AND RESULTS

Of total 100 patients 62% were male with a mean age of 60.38 years and 38% were female with a mean age of 58.71 years. The mean blood glucose level of diabetic patients before injecting local anesthesia without adrenaline (i.e. Group A) was 149.23mg/dl, immediately after administering local anesthesia was 149.38 mg/dl, after 10 mins was 149.32 mg/dl and after 20 mins of administration of local anesthesia was 149.31 mg/dl. The mean blood glucose level of diabetic patients before injecting local anesthesia with adrenaline (i.e. Group B) was 154.56 mg/dl, immediately after administering local anesthesia was 161.63 mg/dl, after 10 mins after 10 mins was 177.78 mg/dl and after 20 mins of administration was 191.39 mg/dl. (Table-1) (Graph-1)

As observed in our study, the blood glucose concentration was higher in lignocaine with adrenaline when compared to plain lignocaine at 10 mins. This was statistically significant. (p=0.000) When comparing baseline value with the value at 20 mins interval, statistically significant difference in the blood glucose concentration was observed. (p=0.000) (Table-1)

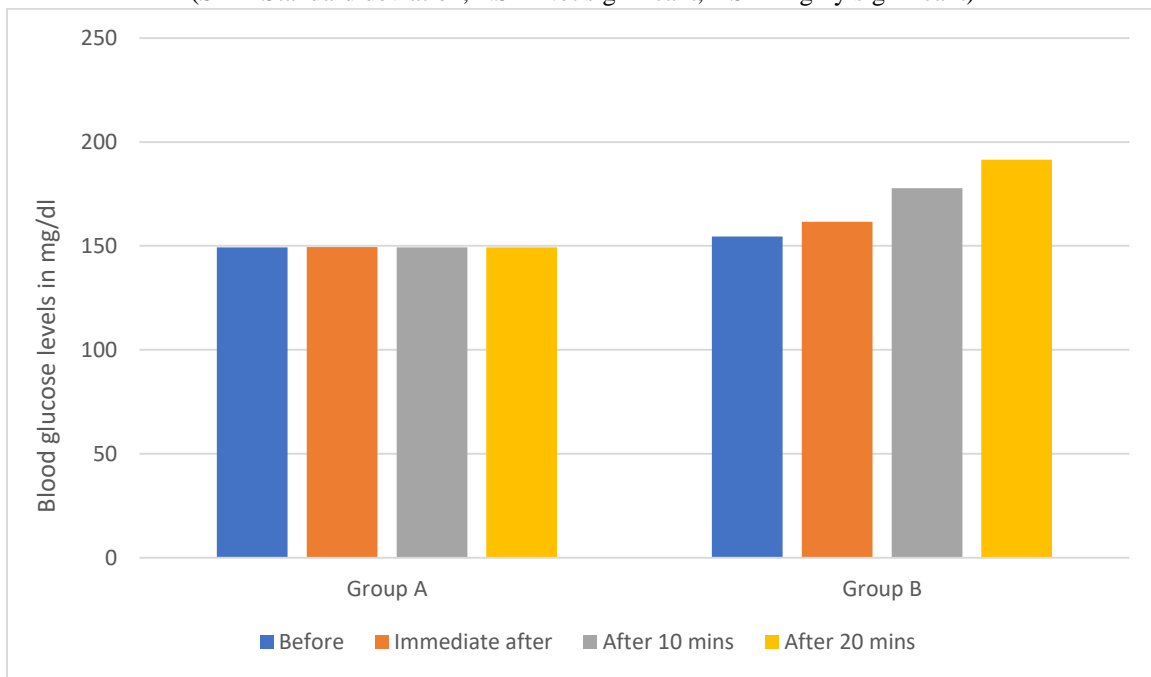
While comparing baseline value with value of just immediately after giving L.A no significant difference in blood glucose level was found. (p=0.633) (Table-1)

The end results concluded that in diabetic patients, no significant difference ($p > 0.05$) was seen in cases after administering local anesthesia without adrenaline. But

highly significant ($p < 0.05$) result was observed in cases after administering local anesthesia with adrenaline undergoing tooth extractions.

	Group A			Group B		P value	Result
	Mean	SD	Result	Mean	SD		
Before local anesthesia	149.23	36.508	NS	154.56	38.432	0.995	NS
Immediate after	149.38	36.067	NS	161.63	38.957	0.633	NS
After 10 mins	149.32	35.782	NS	177.78	40.962	0.000	HS
After 20 mins	149.31	35.881	NS	191.39	40.360	0.000	HS

Table-1 :- Blood glucose level of patients included in both the groups.
(SD = Standard deviation, NS = Not significant, HS = Highly significant)



Graph-1 :- Comparison of mean blood glucose levels in group A and group B

DISCUSSION

Diabetes mellitus is a chronic endocrine disorder, characterized by hyperglycemia resulting from absolute or relative insulin deficiency. It is predicted that by 2030, diabetes mellitus may afflict up to 79.4 million individuals in India.⁽¹⁾ Many patients visiting a dental clinic suffer from diabetes mellitus, hence it is important to take appropriate precautionary measures before performing any dental procedure. Local anesthetics are frequently used by the dental surgeons to control intra-operative pain.⁽³⁾ The most commonly used local anesthetic agent is Lignocaine hydrochloride. To increase its efficacy, vasoconstricting agents are added to the solution.

Among which, adrenaline is the most commonly used.⁽⁴⁾

It has been shown that adrenaline containing local anesthetic agent, when injected in clinical doses, reduces plasma potassium and raises blood glucose level, in healthy individuals.⁽⁵⁾ Adrenaline is known to cause elevation of blood glucose level by increase in glycogenolysis in liver and muscle. An increase in blood glucose level due to vasoconstrictors used with local anesthetics may be insignificant in normal patients, but can be relevant in diabetic patients.⁽²⁾

Change in glucose concentration of the body following administration of local anesthesia containing adrenaline is a topic of research in ongoing studies. Alteration in plasma glucose levels after the

administration of anesthetic solution containing adrenaline has been reported in literature. Hence, we undertook this study to evaluate and compare the effect of adrenaline-free and adrenaline containing local anesthetic solutions among diabetic patients who needed dental extractions.

Tolas, Pflug and Halter (1982) measured plasma catecholamine concentration following injection of adrenaline (18 microgram) during posterior superior alveolar nerve block. In awake patients about to undergo dental extractions, they found that plasma adrenaline concentration had increased from 0.54 mmol/ml to 1.26 mmol/ml after 3 mins of injection.⁽⁶⁾

A study done by Meechan et al. (1991) on the effects of adrenaline containing and adrenaline free local anesthetic solutions on blood glucose concentration in a group which was undergoing third molar surgery showed that results observed in both groups were identical : with a significant increase in blood glucose levels. Thus, although endogenous adrenaline would inevitably be released due to stress, the effect of exogenous epinephrine also undoubtedly is very significant.⁽⁷⁾

In our study, with 2% lignocaine without adrenaline, although there was hyperglycemia, but it was clinically insignificant and it may be attributed to endogenous catecholamine release. The blood glucose level increased from mean baseline value of 149.23 mg/dl to 149.31 mg/dl after 20 mins of administering local anesthesia without adrenaline. In lignocaine with adrenaline, however, there was a highly significant increase in blood glucose concentration observed from mean glucose level of 154.56 mg /dl rising up to 177.78 mg/dl after 10 mins and upto 191.39 mg/dl after 20 mins. Thus the increase in blood glucose level in the patient receiving local anesthesia with adrenaline can be contributed to the adrenaline present in local anesthetic. This finding coincides with the results published by Meechan et al.⁽⁷⁾

Since the same patients were treated for both procedures at two different appointments under local anesthesia without any sedation, the effect of stress was not significant in our study. This finding supports the findings of Dionne et al.⁽⁸⁾

Adrenaline increases blood glucose levels probably due to the following reasons:⁽³⁾

1. Reduction in insulin secretion by the action of α_2 adrenergic receptors causing inhibition of b cells of the islets of langerhans in the pancreas.

2. Stimulation of glycogenolysis via adrenergic stimulation of b receptors resulting in cyclic AMP-dependent activation of phosphorylation.
3. Decrease in glucose utilisation both directly by affecting peripheral tissue glucose uptake and indirectly by decreasing insulin release.
4. b-Adrenergic mediated increase in glucagon concentration. Glucagon increases glucose production by stimulating glycogenolysis and gluconeogenesis and inhibiting hepatic glycolysis.
5. b-Adrenergic stimulation causes skeletal muscles glycogenolysis thereby increasing the lactate concentration, which thus become available for hepatic gluconeogenesis.

CONCLUSION

Initial increase in blood glucose concentration during the operative procedures under plain local anaesthesia (immediately and after 10 mins) can be attributed to the stress related hormonal response and endogenous catecholamine release which invariably results in hyperglycaemic episode. In the adrenaline containing local anaesthesia group, the levels of blood glucose were found to be comparatively higher. This added response can only be due to the adrenaline content of local anaesthesia. Hence, from the results of the present study we can conclude that local anesthetic solutions injected in clinical doses can exert systemic metabolic responses and that these effects are still apparent in patients under some degree of stress. Also, lignocaine containing adrenaline should be used with caution in type-2 diabetic patients as it significantly increases blood sugar level.

REFERENCES:

1. Kaveeshwa SA, Cornwall J. Current status of diabetes mellitus in India. *Australas Med J* 2014;7(1):145-8.
2. Pradeep PS, Prasad G. Comparison of glycemic effect of adrenaline containing local anesthetic in diabetic and non diabetic patients undergoing minor oral surgical procedure. *J Evid Based Med* 2015;2(53):8737-40.
3. Kalra P, Rana AS, Peravali RK, Gupta D, Jain G. Comparative evaluation of local anaesthesia with adrenaline and without adrenaline on blood glucose concentration in patients undergoing tooth extraction. *J Maxillofac Oral Surg* 2011;10(3):230-5.
4. Goel M, Nagpal R, Sidhu J, Jain S, Haranal SD. Clinical assessment of impact of adrenaline on blood glucose

- levels in patients undergoing dental extraction. *J Int Oral Health* 2016;8(4):1-4.
5. Meechan JG, Welbury R. Metabolic responses to oral surgery under local anesthesia and sedation with intravenous midazolam: The effects of two different local anesthetics. *Anesth Prog* 1992;39:9-12.
 6. Tolas AG, Pflug AE, Halter JB. Arterial plasma epinephrine concentrations and hemodynamic responses after dental injection of local anesthetic with epinephrine. *J Am Dent Assoc* 1982;104(1):41-3.
 7. Meechan JG. The effects of dental local anesthetics on blood glucose concentration in healthy volunteers and in patients having third molar surgery. *Br Dent J* 1991;170(10):373-6.
 8. Goldstein DS, Dionne R, Sweet J, Gracely R, Brewer BH, Gregg R et al. Circulatory, plasma catecholamines, cortisol, lipid, and psychological responses to a real-life stress (third molar extractions): Effects of diazepam sedation and of inclusion of epinephrine with the local anesthetic. *Psychosom Med* 1982;44(3):259-72.