ORIGINAL ARTICLE

# EVALUATION OF BLOOD GLUCOSE CONCENTRATION IN PATIENTS WITH DIABETES UNDERGOING TOOTH EXTRACTION AFTER ADMINISTRATION OF LOCAL ANESTHESIA WITH OR WITHOUT ADRENALINE

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**ABSTRACT**

*The aim of this study was to determine the mean blood glucose concentration in patients with diabetes undergoing tooth extraction after administration of local anesthesia with or without adrenaline. A Randomized control trial (RCT) study was carried out from October 2015 to June 2016 in the Department of Oral & Maxillofacial Surgery of Islamic International Dental Hospital (IIDH) Islamabad on 60 diabetic patients undergoing tooth extraction requiring administration of local anesthesia. All patients were randomly divided into two equal groups that is group A (lignocaine without adrenaline) and group B (lignocaine with adrenaline). Blood glucose concentration measurements were taken 10 minutes before, 10 minutes and 20 minutes after administration of local anesthesia. Data were analyzed through SPSS version 17.*

*Patient's age ranged from 25-75 years. Average age of patient was 64.5±9.86. There were 37% males and 23% females in both groups. The mean blood glucose concentration was increased in group B when compared to group A from 154 to 163.2mg/dl at 10 minutes. This increase in blood glucose concentration was statistically not significant ($P \geq 0.05$). There was statistically significant ($P<0.05$) increase in blood glucose concentration in group B when compared to group A from 155.0 to 176.16 mg/dl at 20 minutes.*

*It was concluded that though 2% lignocaine with adrenaline is widely used local anesthetic, it should be cautiously used in type 2 diabetics.*

**Key Words:** *Diabetes mellitus, Local anesthesia, Adrenaline*

## INTRODUCTION

Local anesthetics are frequently used by the dental surgeons to control intra-operative pain. An oral surgeon uses it during different minor oral surgical procedures.[1]

Adrenaline, a vasoconstrictor, is used in local anesthetic solutions to retard their systemic absorption, localizing it to the site of injection, control bleeding, to decrease toxicity, prolonging the duration of anesthesia, and to decrease the total dose of the local anesthetic drug required.[1]

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Adrenaline has systemic and hemodynamic effects like increase in blood pressure, heart rate and blood glucose levels due to release of endogenous adrenaline as well as injected exogenous adrenaline.[2] Hyperglycemia may result from both the direct and indirect action of adrenaline. Indirect hyperglycemic actions include the suppression of insulin secretion. Direct hyperglycemic actions result from stimulation of hepatic glucose release and limitation of glucose utilization. A physiological rise in adrenaline can stimulate both glycogenolysis and glyconeogenesis. Although its effects on glycogenolysis vary rapidly, hyperglycemia continues because of gluconeogenesis.[3]

One study concluded that in healthy patients and in diabetics who had taken their hypoglycemic medications, no significant ($p > 0.05$) result was found in both cases after administration of local anesthesia containing adrenaline and extraction. The only significant ($p < 0.05$) result was found in diabetic patients who had not taken their hypoglycemic medication undergoing tooth extractions.[4]

Nakamura et al.[5] investigated that administration of local anesthetics and tooth extraction activates sympathoadrenal outflow resulting in increase in blood pressure, heart rate and glucose concentration. The increase in glucose level was small and transient for healthy patients due to compensatory & regulatory mechanism of the body, this however not be the case for diabetic with an inherent defect in response & metabolism. Tiley and Thomas [4] found no significant difference ($p > 0.05$) in healthy and diabetic patients who had taken their hypoglycemic medications undergone tooth extraction with adrenaline containing local anesthetics, however significant changes ($p < 0.05$) were seen in diabetics patients who had not taken their medications. They concluded that hypoglycemic medications mask the effect of adrenaline on blood glucose levels. Haji IH et al[3] compared the effect of adrenaline on blood glucose concentration in patients with diabetes undergoing dental extraction under local anesthesia with and without adrenaline and found results from 10 minutes before local anesthesia to 10 minutes after local anesthesia were higher in Group A (LA without adrenaline) than in Group B (LA with adrenaline) but were not statistically different ($p=0.615$ & $p=0.945$ respectively). Similarly 20 minutes after Group B had a non-significantly higher mean blood glucose concentration (111.16±16.901) than in Group A (107.36±23.29). Kalra P et al [1] when compared blood glucose concentration between plain lignocaine Group A and lignocaine with adrenaline Group B in controlled diabetic patients, they found statistically significant difference at 20 min interval between Group A (205.61±29.35) and Group B (242.46±32.86) in blood glucose concentration. Though all studies have been conducted previously with regard to this issue, no conclusive results found on the hemodynamic and metabolic effects of adrenaline on blood glucose level. The purpose of this study was to evaluate the effect of local anesthetics containing vasoconstrictor (adrenaline) on blood glucose in diabetic patients.

## MATERIALS AND METHODS

This study was conducted at the Department of Oral & Maxillofacial Surgery, Islamic International Dental Hospital (IIDH), Islamabad from October 2015 to June 2016 over the period of 8 months. Approval of the study from the ethical committee of Islamic International Dental hospital was obtained. Sixty adult subjects, 30 in each group within the age range of 25-75 years were assessed for eligibility to participate in this clinical trial. The patients selected for this study gave informed consent, having type II diabetes mellitus (Fasting Blood Sugar upto 125 mg/dl and Random Blood Sugar upto 200 mg/dl) and not receiving any other medication other than oral hypoglycemic and insulin. Pregnant women, patients requiring surgical extraction, preoperative blood glucose concentration > 250 mg/dl and patients with any other systemic disease like cardiovascular disease, hepatic disease, renal disease & neurological diseases were excluded from the study. All patients were divided randomly into two equal groups. Group A was treated with local anesthesia without adrenaline. Group B was treated with adrenaline containing local anesthetics. Informed written consent was obtained from each subject after explaining risk and benefit of procedure.

After obtaining consent finger was cleaned with alcohol swab. The area was dried with sterile gauze. A drop of blood was obtained with sterile lancet & placed on sterile strip of glucometer. Preoperative measurement of blood glucose concentration 10 minutes prior to administration of local anesthesia was recorded. After local anesthetic administration peripheral blood glucose estimation was repeated after 10 minutes & 20 minutes. Average values were compared with baseline.

Means ± Standard Deviations were calculated for quantitative variables like blood glucose concentration. Frequencies and percentages were calculated for qualitative variables like gender. Independent t-test was used to compare mean of blood glucose concentration in both groups at significant level of P-value $\leq 0.05$. All analyses were done by means of SPSS Version 17 software.

## RESULTS

This study compared the blood glucose concentration in total of 60 patients with 30 patients in Group A lignocaine without adrenaline and 30 patients in group B lignocaine with adrenaline.

The age of the patients ranged from 25-75 years. The average age of the patients was 64.5 ± 9.86. Thirty seven (61.7%) of the patients were male and 23(28.3%) were female (Fig 1).

Table 1 shows a comparison of blood glucose concentration between plain lignocaine and lignocaine with adrenaline in type 2 diabetic patients.

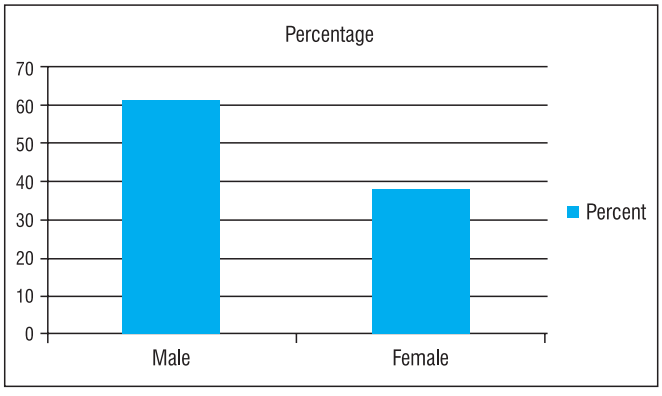


Fig 1: Gender Distribution

TABLE 1: CONCENTRATION OF BLOOD GLUCOSE IN GROUP A AND GROUP B

| | Group A | Group B | p-value | Sig |
|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | | |
| Blood sugar before LA | 148.6 ±30.6 | 143.5 ±30.2 | .519 | NS |
| 10 min after LA | 154.0 ±32.3 | 163.2 ±30.5 | .264 | NS |
| 20 min after LA | 155.0 ±32.7 | 176.1 ±30.7 | .012 | S |

The blood glucose concentration was higher in lignocaine with adrenaline when compared to lignocaine without adrenaline with a mean difference of 9.2 mg % (154.0-163.2mg/dl) at 10 min which was statistically not significant P 0.264 (P >0.05). (Table 1)

## DISCUSSION

Local anesthetics containing adrenaline are widely used because adrenaline delays the absorption of lignocaine in to the circulation, there by prolonging the duration of anesthesia and reducing the toxic effects.[6] Adrenaline is known to cause increase in blood glucose level by increasing glycogenolysis in liver and muscle. It also increases the amount of glucose released into the blood by liver and decreases the use of glucose by muscles. Another advantage of using vasoconstrictors is control of bleeding or maintenance of hemostasis.

In the present study, an effort was made to assess the blood glucose concentration in diabetic patients undergoing tooth extractions under local anesthesia among 60 patients.

Although there was slight hyperglycemia in patients receiving 2% lignocaine without adrenaline, clinically this was insignificant and may occur as result of endogenous catecholamine release, whereas the values observed 20 minutes after administration of plain lignocaine were slightly increased from baseline values. The blood glucose level increased from mean baseline value of 148.6 to 155.0mg/dl at 20 minutes interval and 148.6 to 155.0mg/dl in patient obtained 10 minutes after local anesthesia administration. Though not significant this slight increase may be attributed to the stress induced catecholamine release.

In case of lignocaine with adrenaline, however, there was a highly significant increase in blood glucose concentration observed 10 and 20 minutes after administration of local anesthesia. The blood glucose concentration increased from 143.5 to 163.2 mg/dl after 10 minutes. Blood glucose concentration increased from 143.5 to 176.1 mg/dl at 20 minutes. These observations indicate a highly significant increase in blood glucose concentration in Type 2 diabetic patients when adrenaline containing local anesthetics were administered.

Physical and emotional stress increases blood glucose levels and also pain from injection can cause release of epinephrine in the body, and this in turn increases the blood glucose concentration. Dionne et al.[7] studied the circulating adrenaline levels in sedated and non sedated patients undergoing third molar surgery under local anesthesia without adrenaline and found that diazepam decreases the sympathetic and adrenal response to surgical stress, while adrenaline containing local anesthetics results in elevated adrenaline levels.[7]

Since procedures were carried out under local anesthesia without any sedation, the effect of stress on the projected result has been controlled in our study. This finding supports the findings of Dionne et al.[7]

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

Due to action of $\alpha_2$ adrenergic receptors there is decrease in insulin release and cause inhibition of $\beta$ cells of the islets of Langerhans in the pancreas.[8] Adrenergic stimulation of $\beta$ receptors causes stimulation of glycogenolysis resulting in cyclic AMP-dependent activation of phosphorylation. Decrease in glucose utilization both directly by affecting peripheral tissue glucose uptake and indirectly by decreasing insulin release.[8] $\beta$-adrenergic mediated increase in glucagon concentration. Glucagon increases glucose production by stimulating glycogenolysis and gluconeogenesis and inhibiting hepatic glycolysis.[9] $\beta$-Adrenergic stimulation causes skeletal muscles glycogenolysis thus increasing the lactate concentration, which then becomes available for hepatic gluconeogenesis.

Since we have exposed the same patients under the same sets of circumstances, time, nutrition and environment to injections of plain lignocaine and lignocaine with adrenaline, the settings can be considered to be standardized. The hyperglycemic reactions to lignocaine with adrenaline can be safely ascribed to the action of adrenaline, through the mechanisms outlined above. Therefore, it can be believed that the injection of lignocaine with adrenaline causes an increase in blood glucose concentration.

The effect defined should not be a danger to well controlled diabetics, especially those on insulin, but would definitely be a cause of concern to patient with Type 2 diabetics. The results suggest that when consid-

ering the systemic effects of local anesthetic injections metabolic as well as hemodynamic changes should be considered.[10] As a result to this finding, it is reasonable to assume that vasovagal syncope could also be prevented by injecting local anesthetic with adrenaline as significant increase in blood glucose after injecting local anesthetic with adrenaline was detected in the present study.

## CONCLUSION

It was concluded that local anesthetic containing adrenaline should be used with caution in patients with Type 2 diabetes.

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| CONTRIBUTIONS BY AUTHORS | |
|---|---|
| **1 Sidra Tul Muntaha:** | Article writer, Conception, design and analysis and interpretation of data. |
| **2 Mohsin Fazal:** | Final drafting of the manuscript. |
| **3 Bibi Khalida:** | Data collection and interpretation of data. |
| **4 Kamran Khan:** | Provided substantial help in various aspects. |