COMPARATIVE STUDY OF INTRA OPERATIVE BLOOD SUGAR LEVEL IN SPINAL ANESTHESIA AND GENERAL ANESTHESIA IN PATIENTS UNDERGOING ELECTIVE SURGERY

Bajracharya A[1], Sharma SM[2], Bawa SN[3], Rajbanshi LK[1], Arjyal B[1]*

Affiliation

1. *Lecturer, Department of Anesthesia and Intensive Care, Birat Medical College and Teaching Hospital Biratnagar, Nepal.*
2. *Professor, Department of Anesthesia and Intensive Care, Manipal College of Medical Sciences*
3. *Professor and HOD, Department of Anesthesia and Intensive Care, Manipal College of Medical Sciences*

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**** Corresponding Author***

Dr. Akriti Bajracharya
Lecturer
Department of Anesthesia and Intensive Care
Birat Medical College and Teaching Hospital
Email: akriti854@gmail.com
ORCID: https://orcid.org/0000-0001-5948-161X

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ABSTRACT

Introduction

The aim of the study was to carry out the comparative study of variations in blood glucose levels intra operatively in patients undergoing surgical procedures in Spinal Anesthesia and General Anesthesia by capillary blood glucose level.

Objective

To compare intra operative blood glucose level in Spinal and General Anesthesia.

Methodology

Sixty non diabetic patients (30 in each group) aged between 20 – 60 years belonging to ASA I and ASA II status were enrolled for this prospective comparative study. Capillary blood glucose was measured preoperatively and there after at 15 minutes interval after incision in Spinal Anesthesia and after induction of General Anesthesia till one hour of surgery. For statistical analysis paired sample t – test was used for comparing mean of quantitative data. Difference was considered statistically significant if $p < 0.05$.

Results

Blood sugar level was well controlled in patients receiving spinal anesthesia. General anesthesia produced more increase in blood sugar level compared to base line value which was statistically significant ($P<0.05$). Similarly, Glycaemia was significantly higher in the General anesthesia group ($p < 0.05$) when compared with Spinal Anesthesia group suggesting poor control of stress response during general anesthesia.

Conclusion

Based on capillary blood glucose level, spinal anesthesia proved more effective in suppressing stress response as compared to general anesthesia in elective surgical patients.

KEYWORDS

Capillary blood glucose; general anesthesia; spinal anesthesia; stress response

INTRODUCTION

Perioperative morbidity and mortality can be affected by the inadequate glycemic control in the surgical patients.[1–3] High blood glucose level has been associated with poor clinical outcomes in both diabetic and non diabetic surgical patients. Adequate perioperative glycemic control is in fact a challenge especially in diabetic patients.[4] The evidences have shown that the mortality in patients with non cardiac surgery was 24% at one year.[5] Ischemic heart disease, urgent surgery, higher American Society of Anesthesiologists (ASA) physical status score and hyperglycemia were the major predictors of increased perioperative mortality.[5,6] Perioperative blood sugar control was the major component of anesthetic care that may need more stringent control but tight control of blood sugar level may also have negative outcomes as shown in the data from the Normoglycemia in Intensive Care Evaluation– Survival Using Glucose Algorithm Regulation (NICE-SUGAR) study.[7]

Surgery is usually associated with increased stress response which is characterized by increased secretion of pituitary hormones and activation of the sympathetic nervous system.[8] Activation of sympathetic nervous system increases the secretion of adrenal medulla. Central nervous system response to stress is hypophyseal pituitary axis activation and increase in adrenocorticotrophic hormone (ACTH) secretion leading to increase in cortisol level. The effect of these endocrine and metabolic changes ultimately leads to increased neoglucogenesis and hyperglycemia. So this stress response can be quantified by the incidence of hyperglycemia. Surgery itself causes a reduction in insulin sensitivity leading to hyperglycemia, which is proportional to the length and technique of the procedure.[9]

The negative impact increase stress response and therefore the hyperglycemic response during surgery can be minimized by various surgical and anesthetic techniques such as minimally invasive surgeries and neuraxial anesthesia.[5,10,11] Surgery itself causes a reduction in insulin sensitivity, which is proportional to the length and technique of the procedure.

Although there has been large number of studies done comparing the increase in blood sugar levels between general anesthesia and epidural anesthesia there are few studies comparing the general anesthesia (GA) and spinal anesthesia (SA). This study was conducted with the objective of comparing blood sugar level between spinal and general anesthesia in surgical patients. The comparison between two groups are considered in the present study because large number of cases are undertaken everyday and an anesthesiologist should be familiar with each group regarding the increase in blood sugar level.

METHODOLOGY

This was a prospective comparative study conducted at the department of anesthesiology and critical care of Manipal College of Medical Sciences, Pokhara. The study had a duration of one and half year starting from 2014 October to 2016 April. Ethical approval for the study was taken from the institutional review committee. The study included 60 non diabetic patients of age between 20 to 60 years with ASA grading of I or II without difficult airway undergoing various surgical procedures. For sample size calculation, we considered 5% as acceptable level of significance (Type I error) and 80% as power of study. On the basis of the study conducted by Moller I W, Hjortso E, Krantz T, et al[12] the effect size was considered 0.6 and considering 10% as drop out sample size was calculated to be 30 in each group.

Group 1: Spinal anesthesia including 30 patients.

Group 2: General anesthesia including 30 patients.

Patients with the ASA grade more than III, abnormal anatomy of spine, diabetic patient, patients with cardiovascular, respiratory, renal disease or neuromuscular disease, patients taking beta blockers and statins and patients undergoing cesarean section were excluded from the study. All the patients in the study were subjected to a detailed pre- anesthetic evaluation. Premedication of the patients was done with Tab. Ranitidine 150 mg, Tab. Metoclopramide 10 mg and Tab. Alprazolam 0.5 mg. Inj. 0.5% Hyperbaric Bupivacaine was used for SA. In GA, patients were further premedicated with Inj. Fentanyl 1 mcg/kg IV. Induction was done with Inj. Propofol 1.5 mg/kg IV and Inj. Vecuronium 0.1 mg/kg IV was used for muscle paralysis. General anesthesia was maintained with Oxygen (40%), Nitrous Oxide (60%), Isoflurane and Inj. Vecuronium 0.02 mg/kg/half an hourly intravenously. Minimum alveolar concentration (MAC) of isoflurane was maintained at 2% at the time of induction and 1-1.5% was used during maintenance of general anesthesia. MAC value displayed on the monitor was used to monitor the depth of anesthesia. Capillary blood glucose (CBG) level was measured half an hour before induction of general anesthesia (GA) or before spinal anesthesia(SA). After the induction of GA or skin incision in SA, CBG level was measured at 15 minutes interval till 1 hour of surgery.

Non-invasive blood pressure, electrocardiogram, heart rate and oxygen saturation was continuously monitored as soon as the patient was shifted on the operation table till the end of the surgery in SA or till the recovery of the patient from GA.

Statistical Analysis

Data was collected and entered in Microsoft Office Excel 7. Then data was analyzed using Statistical Software IBM SPSS statistics Version 16. Continuous data were presented as mean and standard deviation whereas categorical data were presented as frequency and percentage. Paired t test was used to compare mean for continuous data and Chi square test was used for categorical data. P value < 0.05 was considered statistically significant.

RESULTS

The table 1 shows demographic distribution and ASA grading of population undergoing this comparative study that was statistically non significant between the two groups.

The table 2 shows the statistical analysis of the data collected at various time intervals before and after spinal each time interval is compared with the baseline values. Paired sample t-test was applied and the p value was calculated for each time interval. The values obtained after SA at all the time intervals were not statistically significant (p value < 0.05).

The table 3 shows the statistical analysis of the data collected at time intervals before general anesthesia and at 15, 30, 45 and 60 minutes after general anesthesia. Data at each time interval is compared with the baseline values. The values obtained after General Anesthesia at all the time intervals were statistically significant (p value < 0.05) when compared with the baseline value.

The table 4 shows comparison of blood glucose levels between Spinal (group 1) and General (group 2) anesthesia. Blood glucose level at baseline and 15 minutes after anesthesia was comparable between the groups. While after 15 minutes, there was significant difference (P<0.05) in the blood glucose level with the increasing sugar level in general anesthesia group.

Table 1: Comparison of demographic and ASA grading between the groups.

Variables		Group 1	Group 2	P-value
Age (years)		42.97 ± 13.182	39.73 ± 13.658	0.184
Weight (kg)		58.48 ± 14.20	61.73 ± 18.42	0.204
Sex	Male	21 (70%)	19 (63.3%)	0.743
	Female	9 (30%)	11 (36.7%)	
ASA	I	29 (96.6%)	28 (93.3%)	0.816
	II	1 (3.4%)	2 (6.7%)	

Note: Group 1 - spinal anesthesia, Group 2 - general anesthesia

Table 2: Comparison of Blood Glucose levels in Spinal Anesthesia

Variables	Baseline BGL	BGL at different time	P-value
15 minutes	88.03 ± 14.33	87.86 ± 13.42	0.892
30 minutes	88.03 ± 14.33	86.50 ± 12.19	0.385
45 minutes	88.03 ± 14.33	86.13 ± 12.95	0.398
60 minutes	88.03 ± 14.33	86.33 ± 11.77	0.439

Note: BGL - blood glucose level

Table 3: Comparison of Blood Glucose levels in General Anesthesia

Time	Baseline BGL	BGL at different time	P value
15 minutes	84.66 ± 7.68	88.66±10.87	0.001
30 minutes	84.66 ± 7.68	91.13±12.52	0.000
45 minutes	84.66 ± 7.68	95.23±13.21	0.000
60 minutes	84.66 ± 7.68	99.73±16.70	0.000

Note: BGL - blood glucose level

Table 4: Comparison of Blood Glucose levels in Spinal and General Anesthesia

Time	Group 1 BGL (mean ± SD)	Group 2 BGL (mean ± SD)	P-balue
Baseline	88.03 ± 14.33	84.66 ± 7.68	0.065
15 minutes	87.86 ± 13.42	88.66 ± 10.87	0.082
30 minutes	86.50 ± 12.19	91.13 ± 12.52	0.025
45 minutes	86.13 ± 12.95	95.23 ± 13.21	0.005
60 minutes	86.33 ± 11.77	99.73 ± 16.70	0.001

Note: Group 1 - Spinal anesthesia, Group 2 - General anesthesia, BGL - blood glucose level

DISCUSSION

Surgery elicits broad alterations in hemodynamic, endocrine - metabolic and immune responses. Consequently, blood glucose levels increase in response to surgical stress. This stress-induced hyperglycemia represents a complex metabolic syndrome that compromises insulin resistance, reduced glucose clearance and relative insulinopenia. The degree of insulin resistance after general surgery increases with the degree of surgical trauma. Stress-induced release of hormones such as cortisol, glucagon, epinephrine and growth hormone, among others, appear to be the main mediators. The results of various studies have shown that the choice of anesthesia technique affects intraoperative stress response and thus significantly affects the outcome and morbidity of surgical patients and the reduction of postoperative pain.[13,14]

The present study observed that the blood glucose level was more stable during SA throughout the surgery. The SA produces significant sympathetic blockage which attenuates the stress induced physiological changes in cardiovascular and endocrine system.[15] The inhibition of sympathetic system during SA results in significant decrease in cortisol level, decrease in adrenergic activity and inhibition of renin angiotensin aldosterone system which ultimately helps to maintain a stable blood glucose level during surgery. This result is supported by the study conducted by Pflug AE et al[16]. They demonstrated that the surgical stress and the resultant hyperglycemia was produced by the stimulus from the afferent nerves from the site of tissue injury. SA inhibited these afferent nerves and thus the intra operative and post operative increase in epinephrine and norepinephrine were not observed. The similar result was also observed in the previous study where the SA inhibited the stress response to surgery by blunting adrenocorticophic hormone, norepinephrine, growth hormone and cortisol response intra operatively and in the immediate postoperative period.[12]

We observed that there was a significant increase in the blood glucose level from the baseline after the induction of GA. The blood glucose level was poorly controlled throughout the surgery. The endotracheal intubation and the surgical stimulus produce significant stress response with the increase in sympathetic activity which resulted in increased blood glucose level. The study observed that stress response induced by induction of anesthesia and surgical stimulus was poorly inhibited by GA. This ongoing stress response increased the secretion of adrenaline, noradrenaline, cortisol level and resistance to insulin which resulted in poor control on blood glucose level during GA.[17,18]

When SA was compared with the GA for blood glucose level intra operatively, it was observed that there was significant difference in the blood glucose level after 15 minutes of surgery. Patient with GA had significantly increased blood glucose level as compared to SA. Milosavljevic SB et al.[9] had clearly demonstrated that the perioperative cortisol level was significantly decreased in SA as compared to GA. The same result was observed in 1 hr and 24 hour postoperative period. Serum cortisol level is the determining factor for the blood glucose control and has positive correlation with the glycaemia during GA.[9] In our study, the following procedures: cholecystectomy, hernioplasty, appendectomy, tonsillectomy, vaginal hysterectomy and ORIF were undertaken and were of major severity and can potentially cause an increase in cortisol secretion in response to surgical stimulation. Davis FM et al.[19] Observed that there was transient increase in the stress response and blood glucose level in SA. This sympathetic activation might be due to the anxiety of undergoing needle prick for regional injection and surgical procedure. In the GA group blood glucose concentration continued to increase during surgery which is almost identical to the present study.

Similarly, Gottschalk A et al.[20] found that the blood sugar level was significantly high both in diabetic and non diabetic patients during GA while intra operative blood glucose level was stable in patient receiving SA.

Contradicting our result and the previous studies, Amiri F et al.[21] observed that there was no significant change in the blood glucose level in GA and SA. Their study had SA in the lower segment. He justified that lower level block in surgical procedures such as curettage can't completely suppress the hormonal and metabolic changes. Our study did not include the patient with lower segment block.

CONCLUSION

The stress response to surgery results in the activation of the sympathetic system with the increase in adrenaline, noradrenaline, cortisol and blood glucose levels. The SA can significantly inhibit the surgical stress response producing a more stable blood glucose level as compared to GA. The blood glucose level was poorly controlled in GA due to the minimal blunting of stress response.

RECOMMENDATION

As the stress response to surgery is comparatively less in spinal anesthesia, glycemic control is better in spinal anesthesia as compared to general anesthesia. We recommend spinal anesthesia over general anesthesia when ever possible in reducing surgical stress response.

LIMITATIONS OF THE STUDY

The study didn't address other various factor that can affect the stress response and the blood glucose level. Blunting of stress response during endotracheal intubation, pain during intra operative period could be the possible reason for increase in blood glucose level in general anesthesia which were not explained in the study. The surgical stress depends on the type of surgery. Our study did not maintain a uniformity in the type of surgery which might have produced different level of surgical stress thus variation in blood sugar level.

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CONFLICT OF INTEREST

None

FINANCIAL DISCLOSURE

None

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