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INTRAOPERATIVE GLUCOSE LEVEL IN NON-DIABETIC PATIENT UNDERGOING ELECTIVE MAJOR SURGERY UNDER GENERAL ANAESTHESIA RECEIVING DIFFERENT CRYSTALLOID SOLUTIONS AS MAINTENANCE FLUID (A COMPARISON BETWEEN NS AND RL)

Anaesthesiology

Dr. Saunak Nath Senior Resident, Department Of Anaesthesiology, ESIC Medical College And Hospital, JOKA.

Dr. Niladri Sekhar Mukhopadhyay* Senior Resident, Department Of Anaesthesiology, ESIC Medical College And Hospital, JOKA. *Corresponding Author

Dr. Avinab Das Senior Resident, Critical Care Medicine, Bombay Hospital.

ABSTRACT

INTRODUCTION: The present study was undertaken to observe the effect of different maintenance fluid regimen on intraoperative blood glucose levels in non-diabetic patients undergoing elective major surgery under general anesthesia.

AIMS AND OBJECTIVES: This study was conducted to observe the effect of different maintenance fluids in intraoperative blood glucose levels of non-diabetic patients undergoing elective major non-cardiac surgery under general anesthesia.

MATERIALS AND METHODS: The present study was conducted in the Department of Anesthesiology of Assam Medical College, Dibrugarh for a period of one year. Hospital based observational study. Patients undergoing elective major surgeries at operation theatres of Department of General Surgery of Assam Medical College & Hospital, Dibrugarh. One (1) year from July 2015 to June 2016.

RESULT: The mean difference of capillary blood glucose level between baseline and 1.5 hours after intubation for those procedures lasted that long in Group N was 22.87 mg/dl with a 95% confidence interval of 103.83-108.61 while in Group R it was 26.82 mg/dl with a 95% confidence interval of 108.41-111.59. The mean difference of capillary blood glucose level between baseline and 2 hours after intubation for those procedures lasted that long in Group N was 34.14 mg/dl with a 95% confidence interval of 117.29–117.71 while in Group R it was 34.07 with a 95% confidence interval of 116.38–118.12.

CONCLUSION: This study we can come to a conclusion that though there is a rising trend in change in intraoperative capillary blood glucose level in both the solutions used perioperatively, yet the mean change in intraoperative capillary blood glucose level in non-diabetic patients undergoing major surgeries under general anaesthesia receiving either 0.9% sodium chloride or Ringer's lactate solutions as maintenance fluid perioperatively, is comparable, yet needs larger groups of study.

KEYWORDS

Intraoperative blood glucose, Non-diabetic patients, General anesthesia.

INTRODUCTION

Long before the introduction of anaesthesia, surgery was distressful for both the patient and the surgeon. No surgical procedure is devoid of stress to the human body. With progression in medical care, which depends upon a better understanding of patho-physiologic disturbances, it is found that this stress is multi-factorial including-tissue damage, fasting before and during the procedure, blood and fluid loss, effect of anaestheisa and medication used, temperature changes etc. from the metabolic point of view.[1]

And due to stress response of the surgical procedures there is increased secretion of pituitary hormones and activation of sympathetic nervous system[2] resulting in elevation of circulating catecholamines, glucagon, cortisol, growth hormone which trigger a state of tissue resistance to the effect of insulin and there is neoglucogenesis and catabolism of lean body mass which is ultimately reflected by a state of hyperglycaemia. This metabolic changes appear to be proportionate to the severity of the surgical trauma and the stress response is more prominent in major surgeries than in minor surgeries.[3]

During any major surgery we have to maintain the fluid balance of the body to maintain- adequate oxygen delivery, normal electrolyte concentration by administration of extraneous fluids and this fluid requirement is composed of-compensatory intravascular volume expansion (CVE), deficit replacement, maintenance fluid supplementation, restoration of intraoperative losses, substitution of fluid redistribution.[4]

Lactate, a product of glycolysis, is converted into glucose via the Cori's cycle and lactate from Ringer's lactate solution is hypothesized to convert into glucose in the same manner and may precipitate hyperglycaemia in diabetic surgical patients.[5] Persistent hyperglycemia in the perioperative period has been consistently shown to be associated with increased postoperative complications particularly after cardiac and vascular surgery in diabetic patients.

The effect of different fluid regimen has been studied in neonates and pediatric populations.[6] Though the prevalence of perioperative hyperglycemia in non-diabetic patients undergoing cardiac surgery is very high[7] but its incidence in non-diabetic patients undergoing elective major abdominal surgery is yet to be established. The present study was undertaken to observe the effect of different maintenance fluid regimen on intraoperative blood glucose levels in non-diabetic patients undergoing elective major surgery under general anesthesia.

AIMS AND OBJECTIVES

This study was conducted to observe the effect of different maintenance fluids in intraoperative blood glucose levels of non-diabetic patients undergoing elective major non-cardiac surgery under general anesthesia.

Specific objectives:

(1) To know the intraoperative blood glucose level in two groups of patients receiving different maintenance fluids.

(2) To know the incidence of intraoperatve hyperglycaemia [capillary blood glucose level ≥150mg/dl] in patients receiving Ringer's Lactate solution.

(3) To know the incidence of intraoperatve hyperglycaemia [capillary blood glucose level ≥150mg/dl] in patients receiving 0.9% Sodium chloride solution.

MATERIALS AND METHODS

Place of study: The present study was conducted in the Department of Anesthesiology of Assam Medical College, Dibrugarh for a period of one year.

Study design: Hospital based observational study

Source of data: Patients undergoing elective major surgeries at operation theatres of Department of General Surgery of Assam Medical College & Hospital, Dibrugarh.

Study period: One (1) year from July 2015 to June 2016.

Approval and consent:

This study was conducted after the approval from the Institutional Ethics Committee (Human) and with written informed consent from each patient after explaining the study procedure to them in their own understandable language.

Sample size:

A total of 90 adult patients of either sex between the age group of 20 to 50 years of ASA PS-I and ASA PS-II undergoing elective major general surgeries were randomly allocated into 2 groups of 45 patients each based on sequentially numbered opaque sealed envelope technique (SNOSE).

Group N : 0.9% Sodium Chloride solution as maintenance fluid

Group R : Ringer's Lactate solution as maintenance fluid

INCLUSION CRITERIA:
- Patients aged between 20 – 50 yrs. of either sexes.
- Patients with ASA physical status grade I or II.
- Mallampati airway assessment of grade I. or II
- Non-diabetic patients
- Patients undergoing elective major surgeries

EXCLUSION CRITERIA:
- Any kind of Emergency surgeries
- Patients with ASA physical status grade III or higher
- Diabetic patients
- Cardiologically compromised patients
- Patients with deranged Liver and Renal Function test
- Unwilling patients

RESULT AND DISCUSSION

Any surgical procedure is a stressful condition which is multi-factorial including-tissue damage, fasting before and during the procedure, blood and fluid loss, effect of anaestheisa and medication used temperature changes etc. from the metabolic point of view.

The metabolic changes due to surgical stress response which is proportionate to the severity of the surgical trauma, more prominent in major surgeries than in minor surgeries is because of increased secretion of pituitary hormones and activation of sympathetic nervous system resulting in elevation of circulating catecholamines, glucagon, cortisol, growth hormone that leads to insulin resistance, neoglucogenesis and catabolism of lean body mass which is reflected by a state of hyperglycaemia. Persistent hyperglycemia in the perioperative period has been consistently shown to be associated with increased postoperative complications particularly after cardiac and vascular surgery in diabetic patients.

In this study, in Group N 20% were males and 80% were females and in Group R 17.78% were males and 82.22% were females. Hence, both the groups had compatible sex distribution. Most of the patients (group N 51.11% and group R 46.67 %) in both the groups were aged between 40-50 years. But the mean age of patients in Group N was 37.73 ± 7.72 years and in Group R was 37.64 ± 8.19 years with a p value more than 0.05 and hence both the groups were comparable. The mean weight of patients in Group N was 54.29 ± 6.55 kg and in Group R was 54.60 ± 5.90 kg with p value of more than 0.05 which is not significant and hence both the groups were comparable. In the whole study, 85.56% belonged to ASA I and 14.44% were having ASA II physical status. In Group N 86.67% were of ASA I as compared 84.44% in Group R. Patients having ASA II comprised 13.33% in Group N and 15.56% in Group R. The p value is more than 0.05 and hence, both the groups were comparable with respect to ASA physical status. In Group N 86.67% of patients had Mallampati grade I while in Group R there was 84.44% patient of Mallampati grade I. In Group N there was 13.33% of patients had Mallampati grade II and 15.56% of patient in Group R with the p value of >0.05 hence comparable. Among the operative procedure in my study there were open cholecystectomy (66.67% in Group N and 71.11% in Group R), choledocholithotomy (20.00% in both the groups) and open cholecystectomy with appendicectomy (13.33% in Group N and 8.89% in Group R), which were also comparable because of p value of more than 0.05. The mean duration of operative procedure in Group N was 61.00 ± 18.14 min while in Group R it was 60.78 ± 22.76 min with a p value of 0.96. So the duration of operative procedure is also comparable in two study groups. And 9 cases in Group N and 10 cases in Group R were lasted longer than one hour in my study.

Hence all the demographic parameters were comparable in both the groups.

Perioperative Capillary Blood Glucose Level Variation:

In the study the base line capillary blood glucose level were comparable in both the groups (in Group N 83.36 ± 5.76 mg/dl; in Group R 83.18 ± 6.58 mg/dl) and during intraoperatively after one hour from intubation the capillary blood glucose values in Group N was 100.11 ± 5.08 mg/dl and in Group R it was 101.40 ± 6.10 mg/dl which was again comparable between both the groups as the p value was 0.279 (> 0.05). In Group N the mean percentage change in capillary blood glucose level after one hour from intubation in respect to baseline was 20.28 ± 3.67 while in Group R the value for the same was 22.25 ± 6.76 which was insignificant with a p value of 0.09.

Intraoperatively the capillary blood glucose level in this study was found to be at a rising trend thorough out the operative procedures and at any measured interval the values in both the groups were comparable. In this study though the mean duration of operative procedures was 1hour (for Group N 61.00 ± 18.14 min and for Group R 60.78 ± 22.76 min), 9 cases (20%) in Group N and 10 cases (22.22%) in Group R were lasted longer than one hour and during this period the mean difference of capillary blood glucose level in respect to baseline values in Group N and Group R after 90mins from intubation were 22.87 mg/dl (95% Confidence Interval of 103.83–108.61) and 26.82 mg/dl (95% Confidence Interval of 108.41–111.59) respectively, while the values after 2 hours from intubation were 34.14 mg/dl (95% Confidence Interval of 117.29–117.71) and 34.07 mg/dl (95% Confidence Interval of 116.38–118.12) respectively.

There was no hyperglycaemic event (CBG value ≥150 mg/dl) in any case perioperatively measured at different intervals in either group (Group N & Group R).

In 1978 Thomas D, Alberti K[8] in their study for observing the metabolic effect of 1.0-1.5 litre of Hartmann's solution infused intraoperatively to normal subjects and those with maturity onset diabetes they found that five hours after induction of anaesthesia, there was an increase in the mean plasma concentration of glucose from 4.5 ± 0.2 to 7.0 ± 0.4 mmol/litre (81.0 ± 3.6 to 126.0 ± 7.2 mg/dl) in normal subjects which was statistically significant and in contrast, the diabetic subjects who received Hartmann's solution showed a mean increase from 8.5 ±1.7 to 16.0 ±2.6 mmol/litre (153.0 ±30.6 to 288.0 ±46.8 mg/dl) which was significantly greater than previous group. But the sample size was too small (6 normal subjects and 5 diabetic subjects) and the operative procedures were not comparable between the groups. In 1983 Walsh et al.[9] studied effects of infusion of 0.9% sodium chloride solution, Hartmann's and 5% dextrose solution on the concentrations of circulating metabolites and insulin in patients undergoing cholecystectomy. They found that those patients who received the 0.9% sodium chloride solution and Hartmann's solution showed the typical glycaemic response to surgery and after 100 mins passed the blood glucose concentration attained a mean of 6.70 mmol/litre (120.6 mg/dl) in the sodium chloride group and 6.11 mmol/litre (110 mg/dl) in the Hartmann's group. So they concluded that Hartmann's solution had a similar effect on the metabolic response to 0.9% sodium chloride solution. The present study showed the comparable metabolic response between the Group N and Group R.

In 2001 Swamy MN, Murthy HS, Rao GS[10] conducted a study in 52 neurosurgical patients among which 32 patients received alternately 500 ml of 5% dextrose in normal saline and Ringer's lactate (DNS/RL Group) and 18 patients received alternately 500 ml of Ringer's lactate and normal saline (RL/NS Group). Blood glucose concentrations were determined at the end of each unit of fluid, until the patient received 4 units of fluid. They found that the DNS/RL regimen maintains blood glucose levels within acceptable limits while avoiding the risk of hyperglycaemia.

In 2009 Saringcarinkul A, Kotrawera K[11] conducted a study on 60 patients aged 18-60, with ASA physical status I to II, who were scheduled for elective surgery. The patients received either lactated Ringer's solution (Group L), or 5% dextrose in 0.45% NaCl (Group D) in the morning of the operation day. Blood glucose levels were determined before intravenous fluid administration (T0), at the beginning (T1), after the 1st hr (T2), and at the end of surgery (T3). They found that though the patients fasted many hours before surgery, no patients became hypoglycemic and the large volume of lactate Ringer's solution had minimal effect on the blood sugar levels compared to the levels in 5% dextrose in 0.45% NaCl group which is again comparable to my study.

In 2015 R. Raghu, W. R. Pathanjali, R. Pandu Naik[12] conducted a study in 60 non-diabetic patients of ASA Grade-I and II in the age group of 20 to 60 yrs, weighing 40 to 70 kgs undergoing elective lower abdominal surgeries under subarachnoid block which were anticipated to complete within 2hrs and they randomly divided them into two groups 30 patients in each [Group I (R): Patients preloaded with Ringer's Lactate 20ml/kg and Group II (H): Patients preloaded with Hydroxy Ethyl Starch 10 ml/kg]. Pre loading was done over a period of 30 mins prior to spinal anaesthesia. They found that mean blood glucose levels of 94.72±1.27 mg/dl at 60 mins from the onset of preloading in the Group I (R) which is again comparable with my study group R (101.40 ±6.1mg/dl after 1 hour).

The possible explanation for this minimal change in blood glucose level after Ringer's lactate infusion is, as suggested by by Simpson et al.93 in 2008, 28 mmol/L of lactate from Ringer's lactate solution could yield 14.5 mmol of glucose at most, which could lead to an approximate increase of 261 mg/dL in blood glucose. Though this number is clinically significant, after accounting for extracellular redistribution, this number is considerably reduced to approximately 1 mmol/L or 18 mg/dL, which is clinically insignificant.

Another potential explanation for the minimal change in blood glucose level is that the lactate is converted to glycogen rather than to glucose by the liver in a process known as the glucose paradox. Radioisotope tracer studies have revealed that lactate is also directly oxidized as a fuel source in the heart and active skeletal muscles.

Again, another explanation is the lactate is metabolized into bicarbonate by the liver, which can help to correct metabolic acidosis.

In this present study as there was no hyperglycaemic events observed in either group at any measured intervals perioperatively, use of insulin infusion was not indicated in any case.

With the better understanding of the surgical anatomy and improvement of surgical skill with time and experience and the use of diathermy in surgery has limited the intraoperative blood loss to a minimum. For this reason, in this study use of Gelofusine® (a colloid solution) that was planned to use to replace the intraoperative blood loss up to the transfusion threshold at 1:1 ratio was also minimum, with 3 cases (6.66%) in Group N and 5 cases (11.11%) in Group R which was not significant.

Table: Change In Blood Glucose Level 1 Hour 30 Mins After Intubation

GROUP	Baseline (T1)		1 hour 30 minutes after Intubation (T5)		*Mean Difference*	*95% Confidence Interval*
	Mean	± *S.D.*	*Mean*	± *S.D.*		
GROUP–N	83.36	5.76	106.22	8.18	22.87	103.83–108.61
GROUP–R	83.18	6.58	110.00	5.46	26.82	108.41–111.59

Table: Change In Blood Glucose Level 2 Hours After Intubation

GROUP	Baseline (T1)		2 hours after Intubation (T6)		*Mean Difference*	*95% Confidence Interval*
	Mean	± *S.D.*	*Mean*	± *S.D.*		
GROUP–N	83.36	5.76	117.50	0.71	34.14	117.29–117.71
GROUP–R	83.18	6.58	117.25	2.99	34.07	116.38–118.12

CONCLUSION

With the expanded knowledge of biochemistry and on the basis of our present hospital based observational study we can now appreciate that lactate does not contribute significantly to glucose load and based on the result of our study, Ringer's lactate solution used perioperatively does not appear to cause a significant change in mean capillary blood glucose level in respect to 0.9% sodium chloride solution.

From the findings of this study, we can come to a conclusion that though there is a rising trend in change in intraoperative capillary blood glucose level in both the solutions used perioperatively, yet the mean change in intraoperative capillary blood glucose level in non-diabetic patients undergoing major surgeries under general anaesthesia receiving either 0.9% sodium chloride or Ringer's lactate solutions as maintenance fluid perioperatively, is comparable, yet needs larger groups of study.

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