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The Benefits of using an Intravenous Infusion of Mixture of Soluble Insulin in 50% Dextrose in Controlling Diabetic Patient's Blood Sugar During Open Heart Surgery

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Abstract

The main aim of this study is to compare the effect of the mixture of soluble insulin in 50% dextrose and the effect of mixture of the soluble insulin in 0.9% saline in controlling blood sugar of diabetic patients during open heart surgery. Fifty adult patients aged 45-75 years, Anesthesiologists physical status class 3 and 4 scheduled for open heart surgery operations were clinically randomized to receive either 50 IU soluble insulin in 0.9% saline (group A, n=25) according to their blood glucose level or 50 IU soluble insulin in 50% dextrose (group B, n=25) 0.1ml/kg/hr. The comparison between the two groups was based on four blood samples had been taken before induction of anesthesia, after induction, 30 minutes from establishing the full rate of bypass machine, and 30 minutes from off bypass. These results indicated that using a mixture of soluble insulin in 50% glucose water shows a positive effect in controlling blood sugar than in 0.9% saline in four blood sampling. The most significant result was the third sample which was 30 minutes from establishing the full rate of bypass machine.

Keywords: Anesthesiologists, Blood sugar, Bypass machine, Diabetic, Open heart surgery, Soluble insulin.

Introduction

Diabetes mellitus is a chronic systemic disease that is characterized by an array of abnormalities, the most notable of which is disturbed glucose metabolism resulting in inappropriate hyperglycemia. Diabetes is divided into two types:

Type-I: Causes: Hereditary inclination, Environmental introduction: infection, poison, stress. Immune system response: beta-cells that produce insulin in the pancreas are demolished. At the point when 80-90% of the beta-cells are decimated, unmistakable side effects happen.

Characteristics: 1-Usually happens before 30 years old, at the same time, can happen at any age. Crest rate happens amid pubescence, around 10-12 years old in young ladies and 12-14 years in boys.2-Abrupt onset of signs and side effects of hyperglycemia: expanded thirst and craving, successive pee, weight reduction, and fatigue.3-Prone to ketosis.

Treatment: Insulin by infusion with syringes or pumps, diet, activity, training and observing.

Type-II: Causes: Insulin resistance: unable to utilize insulin that the body makes because of cell-receptor defect; glucose is unable to be absorbed into cells for fuel. Decreased insulin secretion: pancreas does not secrete enough insulin in response to glucose levels. Excess production of glucose from the liver: Result of defective insulin secretary response.

Characteristics: Usually happens following 30 years old, however, is currently happening in kids and teenagers. Expanded pervasiveness in some ethnic gatherings, e.g., African Americans, Hispanic/Latino, Native Americans, Asian Americans, and Pacific Islanders. Solid hereditary inclination as often as possible fat, not inclined to ketoacidosis until late in the course or with delayed hyperglycemia. Might have side effects of hyperglycemia may additionally have amazing tiredness, obscured vision, postponed mending, deadness and shivering of hands and feet, repeating yeast contamination. Youngsters between the ages of 10-19 that have one or a greater amount of the accompanying are at an expanded danger: family history, individual from certain ethnic populaces, overweight, stationary way of life[1].

Grownups such as adults basically discharge roughly 50 units of insulin every day from the beta cells of the islets of Langerhans in the pancreas. The rate of insulin emission is essentially dictated by the plasma glucose level. Insulin, the most imperative anabolic hormone, has numerous metabolic impacts, including expanded glucose and potassium section into fat and muscle cells; expanded glycogen, protein, and unsaturated fat amalgamation; and diminished glycogenolysis, gluconeogenesis, ketogenesis, lipolysis, and protein catabolism. All in all, insulin animates anabolism while its need is connected with catabolism and a negative nitrogen equalization. There is no single plan to control of blood glucose level after some time of surgery to cover all cases. It is normally savvier to have a somewhat expanded glucose than to hazard

hypoglycemia. The aim is to keep blood glucose around 120-180 mg/dl and to maintain the use of glucose by the cells. Problem arises from the following: i. Hypoglycemia: probably the greatest danger, especially to the brain[2]. ii. The normal endocrine stress response to surgery and trauma: which involves the secretion of catabolic hormones such as corticosteroid and catecholamine, and which is normally antagonized by insulin. iii. Starvation: inevitable, especially in abdominal surgery, but the resulting catabolic response with ketoacidosis is more severe in a diabetic.

The use of insulin and dextrose IV throughout the perioperative period to avoid hyper and hypoglycemia and maintain plasma glucose between 120 and 180 mg/dl. Dextrose and insulin infusion should be through the same iv cannula. To reduce risk of accidental overdose of one infusion should the other infusion cease running. Several regimens have been successfully used. Insulin formulation may be classified as rapid acting (regular, crystalline zinc insulin) onset (0.5-1 hr), duration (6-8 hr), and peak (2-3 hr). Very rapid acting (lispro) onset (0.25-0.50 hr) duration (4-6 hr) peak (1-2 hr).Intermediate acting (lente) onset (2-4 hr) duration (10-14 hr) peak (4-8 hr). Long acting (ultralente) onset (8-14 hr) duration (18-24 hr) peak (10-14 hr).Coronary artery bypass graft (CABG) surgery has been the very much a backbone in the treatment of coronary conduit malady. Diabetes is pervasive in these patients and has huge impacts in the operative time frame and additionally in long survival time. Diabetes is a danger component in expanded occurrence of mortality and also profound sternal injury contamination after CABG surgery[3]. Long survival is additionally essentially influenced by diabetes. The objective is to show how the mixture of soluble insulin in 50% dextrose keeps blood glucose in more steady level than the use of the mixture of soluble insulin in 0.9% saline. Glycemic control in heart surgical patients has become an essential piece of standard consideration as a means for lessening diseases and, conceivably, to improve understanding results. In a point of interest trial, Van den Berghe et al. shown that tight glycemic control (glucose 80–110 mg/dl) diminished in-doctor's facility mortality by 34% in a blended therapeutic surgical emergency unit populace that included cardiovascular surgery patients.

Cardiovascular surgeries instigate counter administrative hormone discharge and modifications in starch digestion system, for example, improved hepatic gluconeogenesis, insulin resistance, and relative insulin inadequacy. These reactions to surgical stretch frequently make keeping up euglycemia troublesome amid surgery. Moreover, forceful insulin organization amid surgery dangers hypoglycemia after surgery when surgical anxiety decreases. To grow new methodologies to enhance results in diabetic CABG patients, it is imperative to comprehend the components in charge of impeded capacity in the diabetic ischemic myocardium. Amid times of ischemia, glucose is the favored metabolic substrate for the myocardium. Be that as it may, glucose oxidation in the diabetic heart is uniquely impeded, not just as an aftereffect of weakened glucose transport into the myocyte additionally by the decreased rate of phosphorylation of glucose inside the cell. Convergences of free unsaturated fats are expanded, which are inconvenient to the ischemic myocardium since they build oxygen utilization, hinder glucose use, diminish contractility, incline to arrhythmias, and expand free radical amassing.Insulin resistance, which is known not amid cardiopulmonary detour, additionally adds to expanded groupings of free unsaturated fats and diminished myocardial uptake of glucose[4].

Exogenous insulin likewise diminishes oxidative anxiety and the provocative reaction. Low-measurements imbuements of insulin (2 IU/h) in hefty patients fundamentally diminished levels of receptive oxygen species, bond particles, and C-responsive protein inside 2 hours. Insulin may likewise avoid coronary thrombosis by 2 instruments. It upwardly manages the L-arginine–NO pathway, which enhances endothelial capacity, and it diminishes serum levels of plasminogen activator inhibitor-1, numerous conventions for insulin organization have been proposed, however these conventions don't adjust the varying insulin requests of the intraoperative and postoperative periods. Besides, a large portion of the proposed insulin regimens were only assessed in diabetic or in nondiabetic patients. In expansion, most conventions either acknowledge a danger of hypoglycemia in endeavoring to accomplish strict glycemic control or acknowledge higher glucose levels than those connected with enhanced results.

Methodology

Patients and study design: 50 adult diabetic patients, ASA Class 3 and 4 of both sexes, Aged between 45-75(61 ±8) years, 17 female, 33 male attended to Cardiac Center in Erbil. They underwent variable open heart surgery, and required insulin infusion, and were included in this prospective, randomized, comparative study. At the ward the full history was taken from the patient and examination done to detect any abnormality of the patient and the first sample of blood sugar was taken[5].

Medications used: i. Soluble insuline (Actrapid) 10 ml. 100 IU/ml, Solution for injection, Insulin human, SC , IV use. ii. 50% glucose water. 50% Dextrose Injection 20 ml. Each 1000 ml contains: Dextrose monohydrate 500 gm. Water for injection. Osmolarity 2523 mOsm/l. iii. 0.9% saline. Sodium Chloride Injection. Intravenous Injection, Single dose container, 500 ml. Each 100 ml contains: Sodium Chloride 0.9 gm Water for injections, Na^+ 154 mmol/l, Cl^- 154 mmol/l, Osmolarity = 308 mOsmol/L. Recommended dosage: Up to 7.7ml/kg/h. iv. Fentanyl, (100µg/2 ml). Talgesil Injection 0.1 mg/2ml each ml contains: Fentanyl 0.05 mg as fentanyl citrate. For i.m. and i.v. injections. v. Thiopental sodium, (1gm). For i.v. injection or rectal instillation. vi. Isoflurane 1 MAC. Aerrane isoflurane inhalation anesthetic 100 ml. vii. Pancurunium Bromide 4 mg/2ml for i.v. injection.

Material and Instruments: material and equipments used intravenous and intra arterial canula, CV line, infusion set, i.v. fluid, syringes, direct laryngoscope, endotracheal tube, and mechanical ventilator, infusion syringe pump and Cardiopulmonary bypass machine[6].

1st samples: before induction of anesthesia.
2nd samples: after induction of anesthesia.
3rd samples: 30 minutes from full rate of bypass machine.
4th samples: 30 minutes from off bypass.
group A,(n=25) : 50 IU soluble insulin in 0.9% saline.
group B, (n=25) 50 IU soluble insulin in 50% glucose water.

Anaesthetic technique: after insertion of intravenous and intra arterial canulae, central venous catheter. The patient was monitored for ECG, pulse oximetry, etCO2, heart rate, invasive arterial BP and CVP monitoring. After pre-oxygenation for 3 min, fentanyl 5-10 µg/kg was given intravenously to attenuate cardiovascular response to direct laryngoscope and endotrachial intubation. Anaesthesia was induced with IV injection of thiopentone sodium 4-6 mg/kg sleeping dose and muscle relaxant pancurunium was given 0.1 mg/kg, the anaesthesia were maintained with isoflurane, and infusion of soluble insulin in 0.9% saline (50 IU of soluble insulin in 50 ml 0.9% saline) and given according to blood glucose level and 50% dextrose, was given according to BG level and insulin in 50% dextrose (50 IU of soluble insulin in 50 ml 50% dextrose) and 0.1 ml/kg/hr was given to control of blood sugarand the infusion started with induction of anesthesia[7]. Following intubation the lung were mechanically ventilated. At the end of the surgery the patient discharged to the cardiac ICU where weaning done gradually and the extubation done without using reversal of neuromuscular block (neostigmin and atropine). Blood sugar were recorded at the day of operation and after induction then 30 minuts after bypass and then 30 minuts after off bypass. Statistical analysis: data were entered into a computer using the statistical package for social science (SPSS version 18) paired student (t) test was used to compare between mean of baseline parameter and mean of studied parameter after administering the mixture of soluble insulin in 0.9% saline and in 50% dextrose, and independent samples (t) test was used to compare between samples mean of group A and group B. A p value ≤ 0.05 was considered as statistically significant[8].

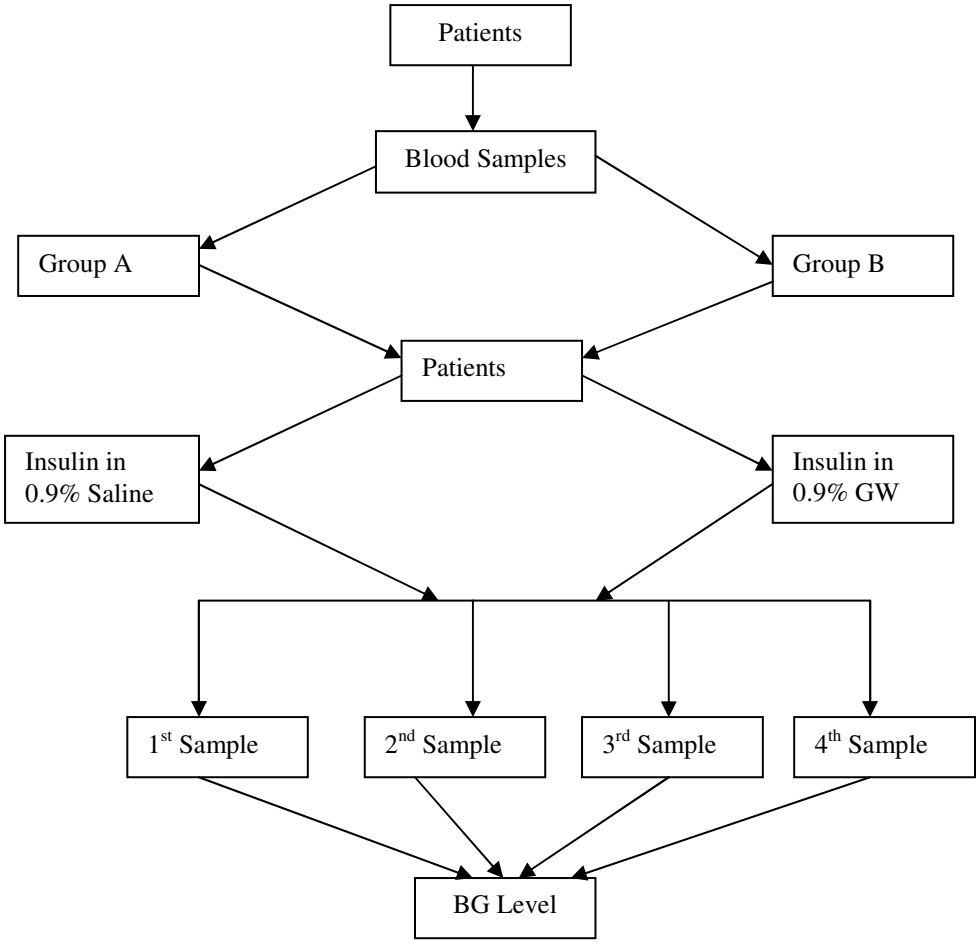

Figure-1
The experimental design of our protocol[1]

Results and Discussion

Changes in mean blood glucose level: Mean glucose level at baseline value 1st sample, in group A (soluble insulin in 0.9% Saline) was 153.24±26.70 and in group B (soluble insulin in 50% dextrose was 155.48±27.29. After induction the mean glucose level significantly decreased in group A to 140.36±22.49 (p value < 0.05) and in group B was non-significantly increased to 157.40±18.69 (p value > 0.05). After 30 minutes from establishing the full rate of bypass machine mean glucose level was significantly increased (p value < 0.05) in group A to 182.00±45.89 and was not significantly in group B reduced to 155.32±23.96 (p value > 0.05), And 30 minutes from off bypass mean glucose level was significantly increased to 168.88±27.31 (p value < 0.05) in group A and was non-significantly reduced to 154.44±31.94 (p value > 0.05) in group B. In four blood samples significant difference (P value < 0.05) steady blood glucose level have been obtained in the second and third samples by the use of 50 IU insulin in 50% dextrose compared to 50 IU insulin in 0.9 % Saline, and no significant difference (P value > 0.05) occurred in the fourth samples[9].

Values are Mean ± Standard Deviation
No. of patients = 50
* P value < 0.05 significantly difference from group A.
Values are Mean ± Standard Deviation
No. of patients = 50
1st samples: before induction of anesthesia.
2nd samples: after induction of anesthesia.
3rd samples: 30 minutes from full rate of bypass machine.
4th samples: 30 minutes from off bypass.

Table-1
Mean blood glucose level (mg/dl) at baseline value (at surgical word), after induction, 30 minutes from establishing the full rate of bypass machine, and 30 minutes from off bypass

Patients	Mean blood glucose level mg/dl			
	Baseline	After induction	30 minutes from bypass	30 minutes from off bypass
Group A (Soluble insulin in 0.9% Saline)	153.24 ±26.70	140.36 ±22.49	182.00 ±45.89	168.88 ±27.31
Group B (Soluble insulin in 50% dextrose)	155.48 ±27.29	*157.40 ±18.69	*155.32 ±23.96	154.44 ±31.94

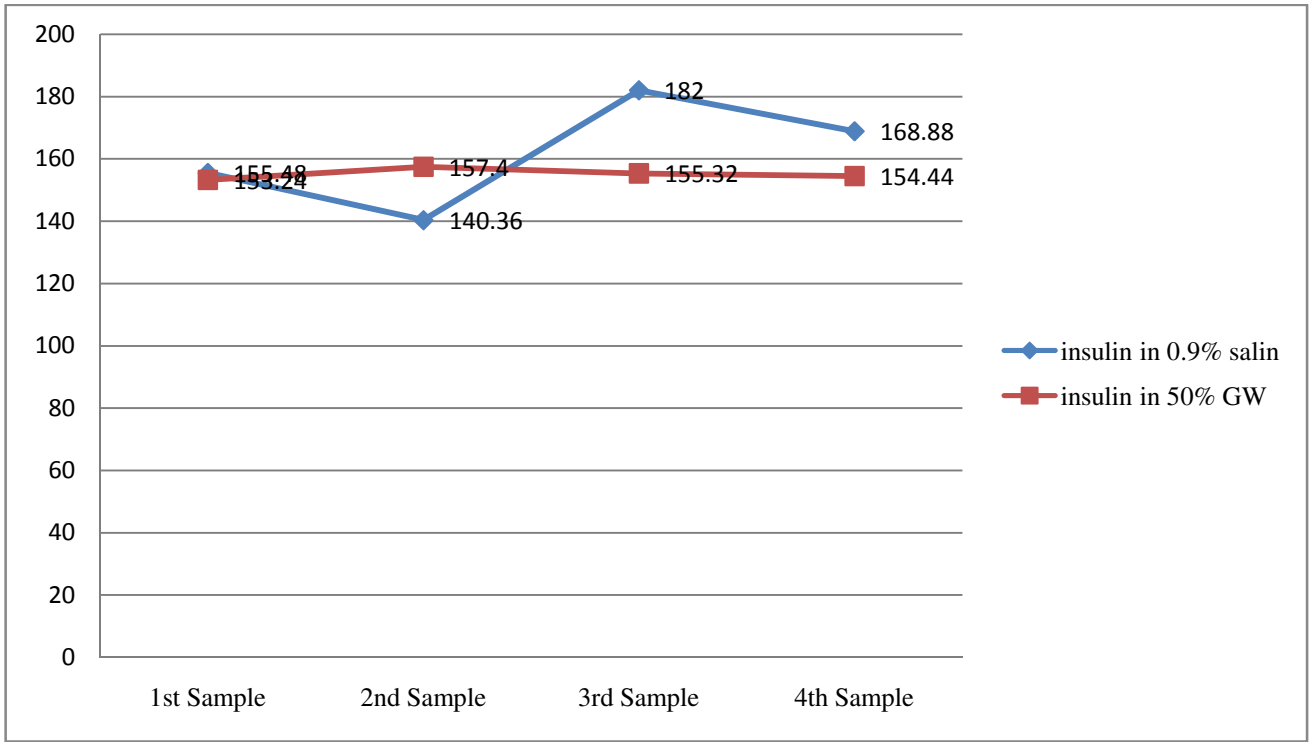

Figure-2
Mean blood glucose level changes with time

Discussion: In group A (use of mixture of 50 IU soluble insulin in 0.9% saline) in 2nd sample mean blood glucose level was significantly decreased after induction of anesthesia, in 3rd sample mean blood glucose level was significantly increased after 30 minutes from establishing the full rate of bypass machine and in 4th sample mean blood glucose level was significantly decreased 30 minutes from off bypass machine. In the 2nd sample there was a significant decrease in mean blood glucose level due to the infusion of mixture of 50 IU soluble insulin in 0.9% saline did not contain the enough glucose to maintain the blood glucose level therefore the blood glucose level decreased, in the 3rd sample there was a significant increase in mean blood glucose level due to catecholamine release and given of direct 50% dextrose infusion according to blood glucose level therefore the blood glucose level increased and in the 4th sample there was a significant decrease in mean blood glucose level due to the continuous infusion of mixture of 50 IU soluble insulin in 0.9% saline which did not contain the enough glucose that maintain blood glucose level in a steady level therefore the blood glucose level decreased. In group B (use of mixture of 50 IU soluble insulin in 50% dextrose) in 2nd sample there was a non-significant increase in mean blood glucose level after induction of anesthesia, in 3rd sample there was a non-significant decrease in mean blood glucose level after 30 minutes from establishing the full rate of bypass machine and in 4th sample there was a non-significantly decrease in mean blood glucose level 30 minutes from off bypass machine[10]. These minimal changes and maintenance of mean blood glucose level during all samples before induction of anesthesia, after induction of anesthesia, after 30 minutes from establishing the full rate of bypass machine and 30 minutes from off bypass machine due to the continuous infusion of 50% dextrose with insulin and in a regular rate which maintain the blood glucose level at a steady range that not affected even by catecholamine release.

In the 2nd sample there was a significant difference between group A and group B in mean blood glucose level after induction of anesthesia due to the infusion of mixture of 50 IU soluble insulin in 0.9% saline was not contain the enough glucose to maintain the blood glucose level therefore the blood glucose level decreased in group A and the continuous infusion of 50% dextrose with insulin and in a regular rate maintain the blood glucose level at a steady range in group B. In the 3rd sample there was a significant difference between group A and group B in mean blood glucose level after 30 minutes from establishing the full rate of bypass machine due to catecholamine release and given of direct 50% dextrose infusion according to blood glucose level therefore the blood glucose level increased in group A and the continuous infusion of 50% dextrose with insulin and in a regular rate maintain the blood glucose level at a steady range in group B[11]. In the 4th sample there was a non-significant difference between group A and group B in mean blood glucose level 30 minutes from off bypass machine due to the continuous infusion of mixture of 50 IU soluble insulin in 0.9% saline which does not contain the enough glucose that maintain blood glucose level in a steady level therefore the blood glucose level decreased in group A and the continuous infusion of 50% dextrose with insulin and in a regular rate maintain the blood glucose level at a steady range in group B.

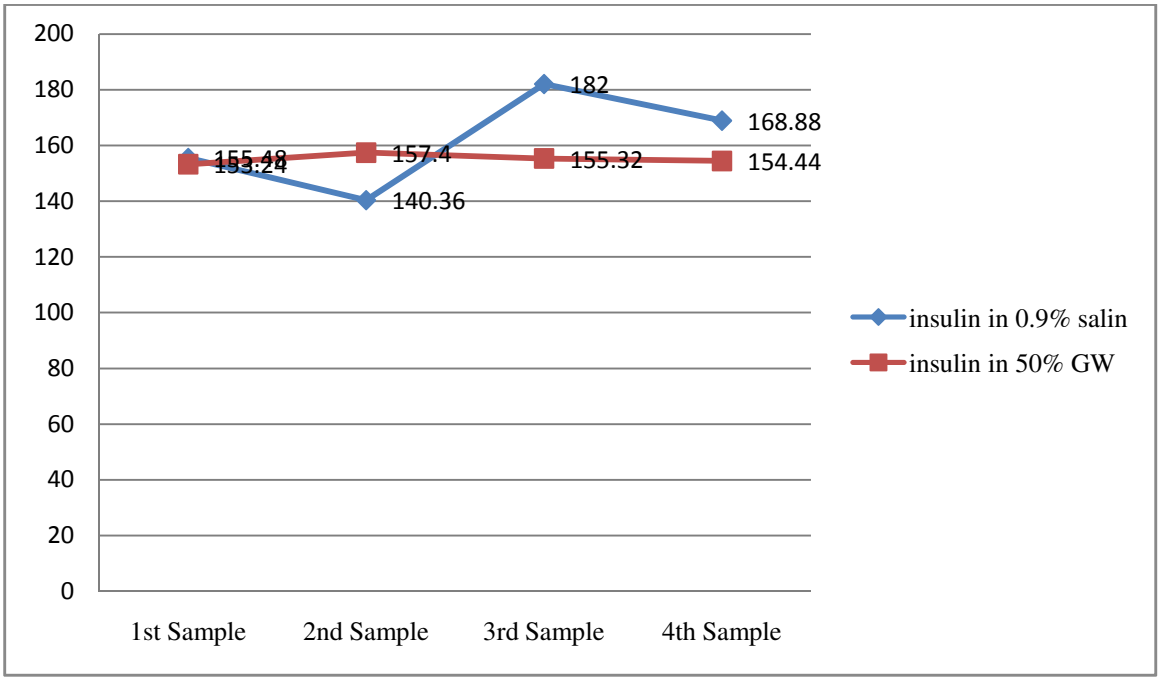

Figure-3
Mean blood glucose level changes with time

Our outcomes regarding the results demonstrates that the utilization of 50 IU dissolvable insulin in half dextrose amid heart surgery with CPB was powerful in keeping up blood glucose levels inside the focused on scopes of 120 to 160 mg/dl. None of our patients experienced hypoglycemia < 50 mg/dl by the utilization of 50 IU dissolvable insulin in half dextrose. In a few patients, the time expected to lessen changes in blood glucose is long, almost the term of surgery[12].

Conclusion

Utilization of 50 IU dissolvable insulin in half dextrose is viable in controlling blood glucose level amid open heart surgery. Utilization of 50 IU solvent insulin in half dextrose is connected with insignificant danger of hypoglycemia. By Using of 50 IU dissolvable insulin in half dextroseal however we didn't achieve 80-120 mg/dl level, yet this mellow hyperglycemia is superior to anything hypoglycemia. Utilization of 50 IU dissolvable insulin in half dextrose in every diabetic patient with fasting glucose ≥ 125 mg/dl was considered diabetics as indicated by the global rules. Further inquires about expected to examine the impact of utilization of 50 IU solvent insulin in half dextrose on the electrolytes. Study the impact of utilization of 50 IU dissolvable insulin in half dextrose on doctor's facility remain.

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