Research Article

Insulin enriched blood cardioplegia effect on serum blood glucose and arterial blood gas in coronary artery bypass graft.

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Abstract

Background/aim: The main energy source of ischaemic myocardium is glucose and converts to pyruvate and increases citric acid substrates which improves contractile function. Insulin stimulates pyruvate dehydrogenase activity and thus, enhances aerobic metabolism. Exogenous insulin also stimulates myocardial glucose uptake. Insulin–blood cardioplegia stimulates myocardial aerobic metabolism and improves left ventricular stroke work index.

Patients and methods: This study was a prospective, randomized, double blinded study on forty patients of both sexes allocated into two groups of ٢٠ patients each aged between ١٨ and ٥٠ years, ASA physical status II or III who underwent elective coronary artery revascularization surgery with cardiopulmonary bypass between May ٢٠١٥ and January ٢٠١٦.

Results: No significant difference inbetween the studied groups. **Conclusions:** Insulin did not cause any change in serum blood glucose level.

Keywords: Glucose, insulin and coronary revascularization.

Introduction

Insulin reverses the harmful effects of hyperglycemia on vascular oxidative stress by increasing myocardial glucose uptake, diminishing the inflammatory response and decreasing apoptosis. Insulin enhances myocardial glucose metabolism by facilitating glucose transport into the myocyte, inhibiting the release of free fatty acids and augmenting aerobic metabolism by stimulating pyruvate dehydrogenase[١]. Insulin is a known vasodilator and when administered to maintain euglycemia, it may have anti-inflammatory and antithrombotic effects[٢]. Insulin may also be used in combination with glucose as a metabolic therapy. In this setting, achieving euglycemia is not the therapeutic goal; rather the intent is to provide the myocardium with the substrates for glucose metabolism. While free fatty acids are the preferred energy source for myocytes under nonischemic conditions, free fatty acid oxidation is inefficient and produces harmful metabolites under low oxygen conditions. It has been postulated that

supplying glucose and insulin (with or without potassium) to the ischemic myocardium enhances oxygen efficient glucose metabolism, which ultimately reduces ischemic injury[٣]. The use of GIK patients undergoing coronary artery bypass graft (CABG) surgery is associated with improved left ventricular recovery and favourable hemodynamics and may even be associated with a reduction in atrial fibrillation (AF)[٤]

Because insulin is a potent stimulator of endothelial nitric oxide formation and an inhibitor of tumor necrosis factor synthesis, it may ultimately promote neuron survival and reduce apoptosis.[٥].

Patients and methods

Study design: This prospective randomized, double blinded study was approved by local Ethical Committee of anesthesia

and intensive care department, faculty of medicine, Minia university. Prior written consent was obtained from each patient.

Study participants: Forty patients underwnt elective coronary revasculerization surgery under CPB were enrolled between May ٢٠١٥ and January ٢٠١٦.

Exclusion criteria: The exclusion criteria for participants in this study were diabetic patients, emergency operation and preoperative congestive heart failure.

Randomization and statistical analysis: The collected data were coded, tabulated, and statistically analyzed using SPSS program (Statistical Package for Social Sciences) software version ٢٠.

- Descriptive statistics were done for Parametric quantitative data by mean, standard deviation and minimum & maximum of the range, while they were done for categorical data by number and percentage.
- Analyses were done for parametric quantitative data between the three groups using One Way ANOVA test followed by Post Hoc Tukey correction between each two groups, and for non-parametric quantitative data between the three groups using Kruskal Wallis test followed by Mann Whitney test between each two groups.
- The level of significance was taken at (P value < ٠.٠٥).

Results.

A- Serum blood glucose.

Table (١): Serum blood glucose (data expressed as mean ± SD)

Blood glucose level (mg/dl)	Group C (n=٢٠)	Group I (n=٢٠)	
Preoperative Range Mean ± SD	(٨٩-١٢٥) ١١٤.١٥±١١.٧	(٦٩-١٦٠) ١١٣.٤±١٩.٨٥	**C vs I** ٠.٩٨٧
fter induction Range Mean ± SD	(٩٦-١٣٤) ١١٦.١±٩.٥٣	(٨٩-١٤١) ١٠٦.٠٥±١٤.٤٨	**C vs I** ٠.٠٥٣
٢٠ min on CPB Range Mean ± SD	(٨٨-١٨٠) ١٢٢.٠٥±٢٤.٠	(٨٩-١٩٩) ١١٤.٣±٢٣.٨٦	**C vs I** ٠.٤٨٧
٢٠ min after CPB Range Mean ± SD	#(٩٩-٢٠١) ١٣٠.٤±٢٧.٢٢	(٩٥-١٨٤) ١٢٠.٥±٢٠.٦٤	**C vs I** ٠.٣٥١
١ h Range Mean ± SD	(٨٩-١٢٩) ١١٠.٩٥±١١.٧	(٧٦-١٨٠) ١١١.٣٥±٢٢.٩	**C vs I** ٠.٩٩٨
٦ h Range Mean ± SD	(٨٩-٢٣٢) ١٢٢.٧٥±٣٨.٢٩	(٦٩-١٣٧) ١٠٤.٠٥±١٨.٤٣	**C vs I** ٠.٠٩٦
١٢ h Range Mean ± SD	(٨٩-٢٥٩) ١١٩.٦٥±٣٤.٤٣	(٨٥-٢٣٨) ١١٣.٢±٣٣.٦٢	**C vs I** ٠.٧٩٦
٢٤ h Range Mean ± SD	(٨٦-١٣٨) ١١١.٥٥±١٣.٥٥	(٨٢-١٤٤) ١٠٩.٣٥±١٢.٩١	**C vs I** ٠.٨٦٨
٤٨ h Range Mean ± SD	# (٨٥-١٣٢) ١٠١.٧±١٣.٢٩	(٦٧-١٤٤) ١٠٤.٥٥±١٦.٦٤	**C vs I** ٠.٨٢٩

#significant difference within the group (p<٠.٠٥)

Changes in serum blood glucose showing insignificant difference between the studied groups.

B- Arterial blood gas.

- No significant difference was recorded between the studied groups regarding PH changes and sodium bicarbonate, oxygen saturation and tension at all time intervals of recordings.

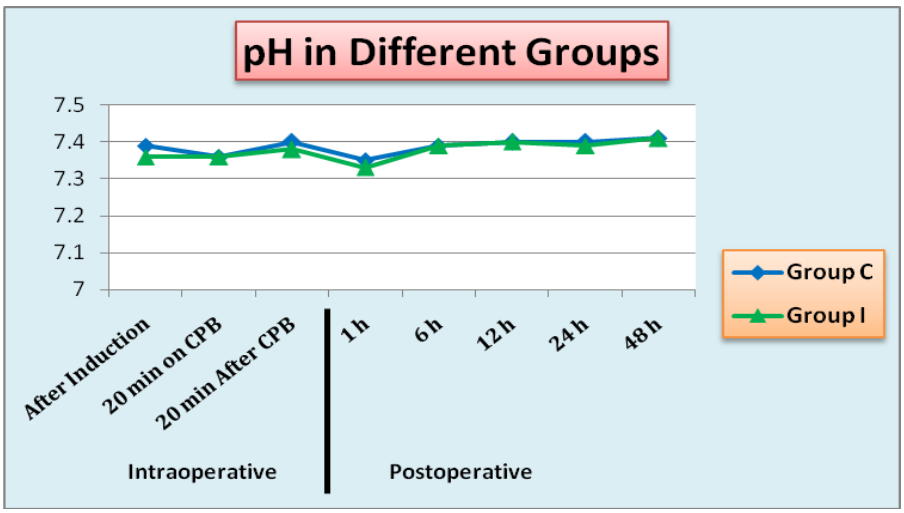

Fig. ١ PH in the studied groups.

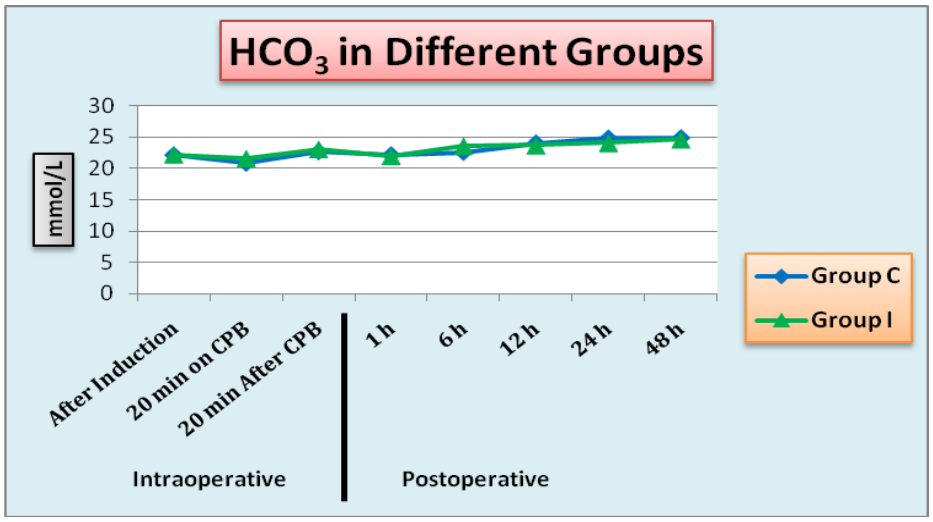

Fig. ٢ Bicarbonate in the studied groups.

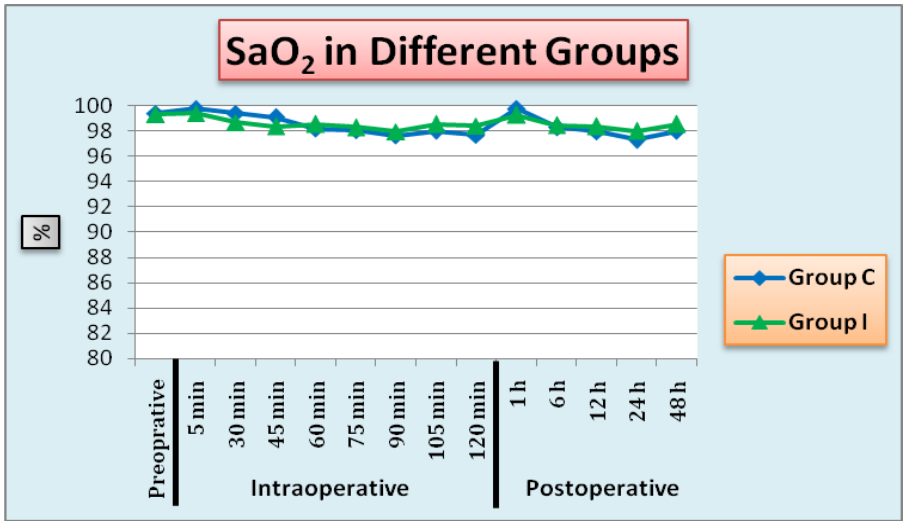

Fig.٣ oxygen saturation in the studied groups

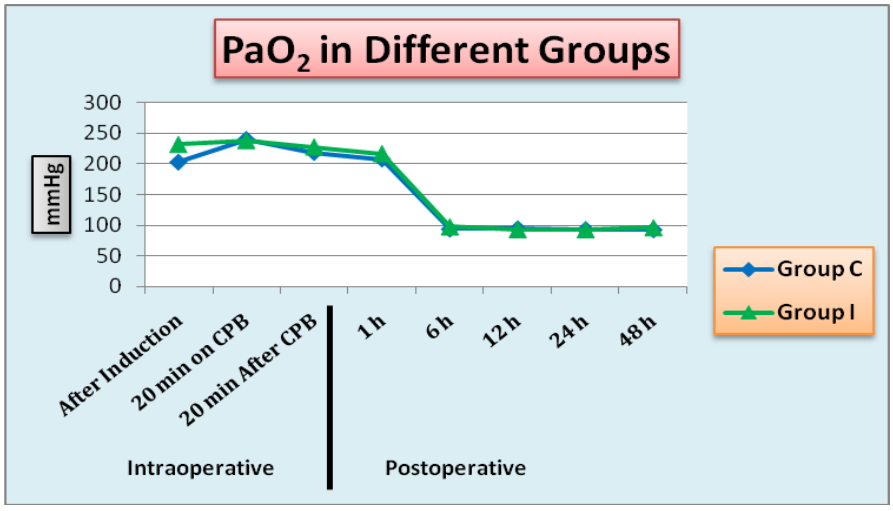

Fig.٤ oxygen tension in the studied groups.

Discussion

CPB induced hyperglycemia has injurious effects on myocardium which should be treated. Local protocol was followed considering normal serum glucose between ٩٠-١٨٠ mg/dl. Inspite of insignificance difference in-between groups, serum glucose level was more stable in insulin group than control group. In a research carried by Müzeyyen et al., ٢٠١٠ where ١٢٠ patients were randomly divided into three groups. During the operation, ١٠ IU/L of regular insulin-added blood cardioplegia was administered to the patients in group ١ (n=٤٠), cardiac arrest was induced with antegrade and retrograde cold intermittent blood cardioplegia with insulin ١٠ IU/L. In group ٢ (n=٤٠), cardiac arrest was induced by antegrade and retrograde cold intermittent blood cardioplegia with insulin ١٠ IU/L. In this group GIK solution was started at time of ACC at a dose of ٠.٧٥ ml/k/h for ٢٤ hour after surgery. In group ٣ (n=٤٠), cold intermittent blood cardioplegia was used, insulin was given to maintain blood glucose levels ١٥٠-٢٠٠ mg preoperative.

In agreement with our results Müzeyyen et al., ٢٠١٠ demonstrated that the levels of blood glucose were found to be significantly higher in group ٣ compared to others groups in all points of measurement except ٣٠ min. after induction.

References

١- Lazar HL, McDonnell MM, Chipkin S. Effects of aggressive vs moderate glycemic control on clinical outcomes in diabetic coronary artery bypass graft patients. *Annals of Surgery*. ٢٠١١; ٢٥٤: ٤٥٨–٦٤.

٢- Ouattara A, Lecomte P, Le Manach Y, Landi M, Jacqueminet S, Platonov I, et al. Poor intraoperative blood glucose control is associated with a worsened hospital outcome after cardiac surgery in diabetic patients. Anesthesiology. ٢٠٠٥; ١٠٣:٦٨٧–٩٤.

٣- Onorati F, Renzulli A, De Feo M,: Myocardial protection with insulin cardioplegia: Who can really benefit? J Cardiovasc Surg (Torino). ٢٠٠٥; ٤٦: ٥٦٩–٧٦.

٤- Bothe W, Olschewski M, Beyersdorf F, Doenst T. Glucose-insulin-potassium in cardiac surgery: A meta-analysis. Ann Thorac Surg. ٢٠٠٤; ٧٨: ١٦٥٠–٥٧.

٥- Shemesh E, Rudich A, Harman-Boehm I, Cukierman-Yaffe T Effect of intranasal insulin on cognitive function: a systematic review. J Clin Endocrinol Metab.٢٠١٢; ٩٧: ٣٦٦–٧٦.