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Research Article

Application of conventional blood glucose control strategy in surgical ICU in developing countries: Is it beneficial?

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KEYWORDS

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Abstract *Background:* Hyperglycemia is common among critically ill patients and is associated with increased morbidity and mortality and there is no clear answer to the question: which to apply tight or conventional glycemic control?
Objective: Evaluation and comparison of the effects of tight versus conventional glycemic control on critically ill patients in our surgical intensive care unit (ICU).
Design: Prospective randomized controlled trial.
Methods: 120 Patients were divided into two groups: group (I) received intensive insulin therapy targeting blood glucose level between 80 and 110 mg/dl, who referred to as intensive treatment group, and group (II) received conventional insulin therapy targeting blood glucose level between 150 and 200 mg/dl, and referred to as conventional treatment group.
Results: 120 Patients were enrolled in the study, the incidence of hypoglycemia (blood glucose <70 mg/dl) was 29.09% in group I who received intensive insulin therapy versus 6.15% in group II who received conventional insulin therapy (p value 0.000) with no demonstrable complications, regarding mortality rate, impairment of Liver function tests, change in total leukocytic count, the need for red blood cell transfusion, ICU stay and Total hospital stay and we reported no statistical significant difference between the two groups.
Conclusion: Tight glycemic control for critically ill patients in ICU in poor resources countries showed increased incidence of hypoglycemia with no significant benefits when compared with conventional glycemic control.

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1. Introduction

Hyperglycemia is common among critically ill patients and is associated with increased morbidity and mortality, and in the past decades there was strong recommendation for tight glycemic control [1–3] as Van den Berghe et al. [4] reported a dramatic 42% relative reduction in mortality in the surgical Intensive Care Unit (ICU) when blood glucose was normalized to 80–110 milligram per deciliter (mg/dl) by means of insulin infusion in a prospective, randomized fashion. However this strategy was associated with increased risk of hypoglycemia [5–6]. Few years later, the same authors demonstrated no mortality benefit from intensive glucose control in their medical ICU, except in a subgroup requiring critical care for 3 or more days [7].

The Normoglycemia in Intensive Care Evaluation-Survival Using Glucose Algorithm Regulation (NICE-SUGAR) trial compared Intensive and conventional glycemic control in a randomized, unblinded fashion in 6104 patients in the ICU and demonstrated that intensive insulin therapy (target 81–108 mg/dL) in critically ill patients was associated with increased 90-day mortality when compared with conventional treatment (target $\leqslant$180 mg/dL) [8].

So into this controversy the question was If intensive insulin therapy targets blood glucose level (80–110 mg/dL) can be proven effective in optimal conditions, how to make that benefit available to millions of critically ill patients in both developed and poor resources countries around the world.

There is no clear answer to the complex problem of glycemic control in critically ill adults; at present, targeting tight glycemic control cannot be said to be either right or wrong.

2. Aim of the work

Our objective was to evaluate and compare the effects of tight glycemic versus conventional glycemic control on critically ill patients in our surgical intensive care unit (ICU) regarding mortality, incidence of hypoglycemia, ICU length of stay, total hospital stay and occurrence of complications as sepsis and organ dysfunction e.g.; acute respiratory distress syndrome (ARDS), hemodynamic instability, renal and hepatic dysfunction and need for red cell transfusion.

3. Methods

3.1. Study population

After getting the approval from Ethics and Research Committee of Anesthesia Department, Faculty of Medicine, Cairo University and obtaining written informed consents, all postoperative critically ill hyperglycemic patients between 20 and 70 years admitted to surgical intensive care unit during the period 2010–2012 were included in the study excluding patients with sepsis, hemodynamic instability, ARDS, renal dysfunction (creatinine above 2 mmol/l) and chronic hepatic dysfunction.

3.2. Sample size calculation

We used standard methods to calculate sample sizes for a trial with 80% power to detect a treatment effect and 95% confidence level. The sample size calculated to detect a confidence interval of 0.5–5 in the percentage incidence of hypoglycemia as a complication of the glycemic control protocols was 102. So we included 120 patients in the different study groups.

3.3. Study design

On admission to the intensive care unit, patients were randomly allocated into two groups using a closed envelope group (I) who received intensive insulin therapy to achieve blood glucose level between 80 and 110 mg/dl, and referred to as intensive treatment group, and the other group (II) received conventional insulin therapy targeting blood glucose level between 150 and 200 mg/dl and this group referred to as conventional treatment group.

If patients were on insulin therapy before ICU admission so hyperglycemic critically ill patients were classified according to total insulin dose in the preceding 24 h before admission into insulin-sensitive (who received <50 units insulin/day and those patients who were not on insulin therapy), usual (received 50–100 units insulin/day), or insulin-resistant (who received >100 units insulin/day) categories. After enrollment, venous blood samples were sent to the laboratory to determine basal blood glucose level and correlate the result with that determined with the glucometer, and this is to know the error factor between the two results as glucometer was used during rest of the day. Capillary blood obtained via finger stick was checked every hour until 4 successive values within the target range: (80–110 mg/dl) in intensive treatment group and (150–200 mg/dl) in conventional treatment group.

Once the target range was achieved, blood glucose values were checked every 2 h.

Management of hypoglycemia: if the blood glucose level was less than 70 mg/dl, the insulin infusion was stopped, and the patient was given 50 ml of 25% dextrose in water as a slow intravenous infusion over 5 min and the blood glucose level was checked every 15 min for 3 times.

For patients received total parenteral nutrition, insulin was not added to their total parenteral feeding except when daily insulin requirements exceeded 50 units, in which case two-thirds of the previous day's total insulin dose was added to the next feeding.

Intensive glucose control: target blood glucose level 80–110 mg/dl. No insulin infusion was started if the initial blood glucose level was 110 mg/dl or less. If the initial blood glucose level was greater than 110 mg/dl but less than 500 mg/dl, then an insulin infusion was started at a rate (blood glucose level in mg/dl) $\times$ 0.01 units/h. If the initial blood glucose level was 500 mg/dl or greater, then an insulin infusion was started at 6 units/h.

For blood glucose levels between 201 and 250 mg/dl, the insulin infusion was increased by 3–4 units/h and an intravenous bolus of regular insulin was given 2–3 units for an insulin sensitive subject, 4–5 units for a usual subject, and 6–8 units for an insulin-resistant subject. For blood glucose levels between 141 and 200 mg/dl, the insulin infusion was increased by 1–2 units/h and intravenous bolus of regular insulin was given 2 units for an insulin sensitive subject, 3 units for a usual subject, and 6 units for an insulin resistant subject. For blood glucose levels between 111 and 140 mg/dl the insulin