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Glycemic Control in Intensive Care Unit: A Proposal for the Safe Application in the Post-Surgical Patient

Claudio Tacconi,[1,*] and Andrea Schiavon[2]
[1]Rianimazione Ospedale Maggiore Bologna Italy
[2]Rainimazione Azienda Ospedaliera Padova Italy

[*]*Corresponding author*: Claudio Tacconi, Rianimazione Ospedale Maggiore Bologna Italy. E-mail: claudiotacconi80@gmail.com

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Abstract

Objectives: This study is to propose recommendations regarding glycemic control in intensive care in the post surgical patient.
Methods: It was carried out as a literature review using the following search terms: post anesthesia nursing, hypoglycemia, hyperglycemia, intensive care units, glycemic control.
Results: Within each article, outcomes of patients undergoing continuous treatment with insulin infusion were examined in addition to the percentage of patients who fell in hypoglycemia or hyperglycemia.
Conclusions: Given the risks of hypoglycaemia, the authors recommend: Start early infusion at a constant supply of glucose; the start of continuous infusion of insulin to the overrun of 180 mg/dL; the use of solutions for infusion at a concentration of 1 unit mL, and glucose monitoring every 2 hours

Keywords: Post Anesthesia Nursing, Hypoglycemia, Hyperglycemia, Intensive Care Units, Glycemic Control

1. Background

An analysis of existing literature and practical experience has emerged as the critical patient may develop hyperglycemia in the absence of previous diabetes due to stress and systemic impairment, at which the disease submit it. It was also demonstrated that hyperglycemia may increase morbidity and mortality in critically ill patients.

The clinical interest in this situation began in 2001 after the publication of a trial of a group of Belgian researchers (1). The 1 547 patients involved in the experimentation were hospitalized in post-operative intensive therapy of hyperglycemia diagnosis and were subjected to continuous infusion of insulin through a nursing management protocol for maintaining normoglycaemia (80 - 110 mg/dL). The control group was made up in the conventional treatment of patients with maintaining a glycemic target between 180 - 200 mg/dL. The study reported excellent results in terms of the incidence of infection and survival.

After the publication of this landmark study, many other clinics actually focused on experiencing this type of approach to getting results but rather heterogeneous.

On this basis, the audit aims to assess the current situation and find the most current scientific evidence on the treatment, specifically for post-operated patients in intensive care.

Contribution to emergency nursing practice:

- Decrease the risk of neurological damage in patients admitted to ICU;
- Increase the safety of the treatment with insulin continuous infusion in ICU;
- Improve the treatment of patients with impaired glucose in the ICU

1.1. Hyperglycemia and Stress Related Disorders

The term hyperglycemia means a condition in which there is an excessive amount of glucose circulating in the blood stream. People tend to consider hyperglycemia as a content exceeding 10 mmol/L (180 mg/dL). Traditionally, acute hyperglycemia was defined as a concentration of circulating glucose greater than 200 mg/dL, however, in 2010, the American Diabetes Association has proposed a threshold of 140 mg/dL. A value greater than 250 mg/dL is still considered severe hyperglycemia.

Hyperglycemia is a common condition in patients during acute illness, therefore it includes those treated in intensive care and is especially a problem seen in patients with sepsis (1, 2).

The incurring in hyperglycaemia, in particular severe, is associated with increased morbidity and mortality in a variety of patients groups (3).

The hyperglycemia in intensive care, does not seem to be responsible for worse prognosis in patients with preexisting diabetes or rather, they are connected to worse outcomes for patients without known diabetes who are admitted to the department (4).

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The negative effects of this condition have been studied in many clinical situations leading to significant conclusions:

- The level of glucose in the patient cardiac post-work is a significant predictor of infection (5).

- The stress hyperglycemia in the absence of diabetes was associated with worse out as after myocardial infarction and stroke.

- The high plasma glucose at admission was shown to be an independent prognostic factor after acute myocardial infarction.

- The presence of hyperglycemia after stroke of ischemic or haemorrhagic is associated with a death risk 3 times higher and significant problems in the subsequent functional recovery (6).

In general, in critical patients, the alteration that leads to hyperglycemia is stress-related type and may also be independent of the presence of diabetes mellitus (6-8).

This type of hyperglycemia is given by different factors that act synergistically with one another as in a cascade leading to the elevation of blood glucose.

The presence of glucocorticoids (cortisol) and circulating catecholamines, both exogenous that endogenous, lead to insulin resistance and demonstrated failure of pancreatic B-cells. This situation already in itself is able to lead to hyperglycemia. The use of solutions for nutrition (dextrose administered iv or enteral), lipolysis, and hepatic gluconeogenesis influence this process, exacerbating the situation (4).

Once hyperglycemia has been established it is capable of producing effects both at the level of the circulatory stream and electrolytes as well as at the cellular and molecular level. In the blood stream you will notice a decrease in circulating liquids, hypoperfusion of organs, and loss of electrolytes. At the cellular level, the mitochondrial damage, neutrophils, and endothelial dysfunction; at the molecular level, we will damage by oxidation, glycation of proteins, and inhibit complement. This scenario leads to an increased risk of infections (sepsis in particular), impaired wound healing, and neuro-myopathy (4).

1.2. The Glycemic Protocol

The release of this evolution, the recognition of a greater centrality of the person in the course of treatment, and the recognition of nursing as a discipline with autonomy make that more and more nurses are involved in critical thinking that leads him to identify and take autonomous decisions in solving health problems.

The care protocols, guide and facilitate professional behaviour in a clinical situation are unequivocally outlined and shared. The adoption of protocols allows to acquire competence and responsibility in the function of assistance always more effective and efficient.

A tool that allows the pharmacological management of some diseases nurse, is an added value in the expression of their professionalism and, above all, a greater guarantee for users.

The application of the protocols has the purpose of:

- Standardize the working methods
- Change in behavior
- Assess the quality of care
- Promoting the upgrade

The nurse, in this field, plays a key role in both the data collection for the initial assessment and the monitoring and evolution of therapy.

He becomes a “special observer” and assumes responsibility for the management of the case.

Using these operational tools, it allows the nurse to make clinical decisions, supported by scientific evidence and to overcome the assistance tasks, based on the routines and habits, which often results in waste of resources and low efficiency of care (9).

The first evidence regarding the fact that hyperglycemia may adversely affect the outcome of a critically ill comes from animal experiments published between the 80s and early 90s (10, 11). These studies also showed that the outcome could be further improved by avoiding or treating hyperglycemia. Subsequent clinical studies confirmed that hyperglycemia was related to worse outcomes for patients in post AMI and stroke both diabetics without diabetes (12, 13).

Early indications that treatment of blood sugar could improve outcomes arrived around 1990 with the publication of 2 randomized clinical trials in patients with diabetes both conducted in surgical patients (14, 15).

Egi Bellomo, the group, in 2006, showed that the variability of blood glucose is an independent and significant predictor of mortality in intensive care and hospital treatment and that the decrease variability itself may be an important aspect of glucose management (16).

Initial studies on the use of modular insulin infusions to decrease blood sugar levels took root for the management of glycemic control of patients and various organizations expected the implementation of the IIT "intensive insulin therapy" titrated to a strict glycemic control in intensive care (17). The study that opened the doors in this world is dated in 2001, a group of university students of Leuven in Belgium (Van de Berge Group) concluded a randomized trial involving patients admitted to a surgical ICU and showed that IIT with normoglycemia target of significantly reduced hospital mortality of patients (18). In spite the first evidence of benefit arising dall’IIT many subse-

quent trials including the most impressive studies published at the time, found no consistent benefits (17).

A noteworthy clinical trial, was the NICE-SUGAR randomized trial published in 2009, which examined 6 104 patients admitted to the ICU of 42 hospitals in Canada, Australia, and New Zealand. The results were clear: IIT increased mortality among adults hospitalized in intensive care and that a blood glucose level < 180 mg/dL resulted was able to lower the mortality rate more than they had been able to make the range 80 - 110 mg/dL. Another great result obtained from this trial was the significant increase in the risk of hypoglycemia in the IIT group.

Additionally, the demonstrated lack of security in the application of narrow ranges for glycemic control, 4 large associations have updated their guidelines in 2009 in terms of intensive blood glucose control in order to guide future studies for a more critical approach and without the treatment. Table 1 summarized recent positions taken by major medical associations in terms of glycemic control.

2. Objective

The scientific evidence to date regarding the safe application of a nursing protocol for the management of hyperglycemia in hospitalized in intensive care, with a focus on post-surgical patient (5).

3. Methods

This study was conducted by evaluating bibliographic material obtained from:

- Studies provided the abstract in English
- Articles after examination of the abstract.
- Relevant articles objective charge.
- Only systematic reviews, LG, relevant meta-analysis the topic.

The validity and importance of the various sources used and the studies analysed were evaluated considering:

- Importance of publishing magazine
- Numerosity of the study population
- The study performed Validity

3.1. Search

The research was carried out mainly through the Internet on the MEDLINE database searching studies published after 2009, only reviews, guidelines, and meta-analysis using the keywords:

- Critical care
- Intensive Care Unit
- Hyperglycemia
- Hypoglycemia
- Insulin
- Protocol

3.2. Literature Review

The articles examined are: a systematic review (2011), a guideline (2012) and a meta-analysis (2009). Altogether, within these studies, we examined 74 trials. Given the specificity, clearly, some trials were included in more articles. In order to obtain a safe application of a nursing management protocol for the management of hyperglycemia in the post-surgical patient is critical, the following parameters are assessed:

Change in outcome to changes in blood sugar (blood glucose concentrations, vs Hyperglycemia permissive): after processing the claims of the studies, it can be concluded that in terms of mortality XVIII, all studies agree on a substantial lack of statistically significant differences between the 2 approaches. Griesdale and Jacobi group, veering more on a statistically significant improvement only for the post-surgical patient due to the fact that both articles are influenced by the excellent results obtained in the Van De Berge study, however, never played.

Incidence of surgical/wound sepsis: Kansagara and Jacobi group infections are focused both on the same result positively influenced by the Van De Berge study, which aimed normoglycaemia in the experimental group, however, to a wider analysis of the same, reinforced the concept based other studies claiming that, it might be possible to get an improvement already with a glycemic target stabilized at around 150 mg/dL.

Length of stay (LOS), length of stay in ICU: Kansagara, the only study that has taken more precisely the subject examination, found no statistically significant differences between the studies.

The risk of hypoglycemia is definitely worth further studies on this analysis, to understand what the risks involved in maintaining target blood glucose tending to normoglycaemia are. As expected, all the studies surveyed agree that the increased risk is statistically significant in patients required target with tending to normoglycemia.

It is also arguable that hypoglycemia is as valuable as a serious result, it was seen that there is a risk 6 times greater in keeping a target of less than 120 mg/dL. The Jacobi group goes further, confirming that this risk can also be an independent factor of increased mortality, neurological disorders (epileptic seizures). They are also contributing factors that can increase the risk of hypoglycaemia, which were always focused on the same study: kidney failure, a decrease in caloric intake without concomitant adjustment of continuous infusion of insulin, use of vasoactive drugs in the case of sepsis, renal replacement therapy (CRRT), diabetes, mechanical ventilation, disease severity, and female.

Table 1. Locations of Large Organizations in Terms of Glycemic Control

Organization	Patient Population	Target Treatment, mg/dL	Target Glycemic, mg/dL	Definition Hypoglycemia, mg/dL
American Association of Clinical Endocrinologist	T.I.	180	140 - 180	< 70
America Diabetes Association	T.I.	180	140 - 180	< 70
Surviving Sepsis Campaign	T.I.	180	150	X
Institute for Healthcare Improvement	T.I.	180	< 180	< 40

Usually we tend to consider hypoglycemia levels lower than 80 mg/dL. It is defined as severe if we came under 40 mg/dL. In critically ill patients, it is seen as innate metabolic control mechanisms in healthy patients (gluconeogenesis and glycogenolysis) as well as the sensitivity of tissues to insulin, are in an important way altered.

Even the very manifestation of the typical signs and symptoms of hypoglycemia appear to be obscured even by the state of disease (sedation, ventilation, mechanical ...) (3).

If the hypoglycaemia is prolonged and is not promptly recognized it can lead to neurological damage (19).

The hypoglycemia neurological consequences are difficult to determine in critically ill patients but they are a real problem. Hypoglycemia can cause acute EEG abnormalities and, in a follow-up to 4-years away, a subgroup of patients treated with IIT has had problems in the quality of life and social functions, when compared with those who, during the trial, received conventional treatment.

However, there remain doubts regarding the difficulties in measuring the long-term sequelae of hypoglycemia and to establish which of damage thresholds (4).

Even nursing research was keen to emphasize that the safe implementation of a protocol for blood glucose management in the intensive care, the first concern of nurses has increased the risk of the occurrence of hypoglycemic events (20).

It has been shown that hypoglycemia event can take place even when the controls are frequent (hourly) in the presence of service experienced team. It was considered interesting to explore new technologies (subcutaneous glucose sensors) that carry blood glucose measurements every 5 minutes. This practice is still not free from complications. The sensor monitors the interstitial glucose which, affected by late changes in the blood and as a result, in case of evolution towards hypoglycemia, the degree of hypoglycemia same could be substantially more important than measured (8). Sensors for continuous intravascular glucose monitoring are currently under development (4).

4. Discussion

The purpose of the research was to find scientific evidence on the applicability of a security protocol for hyperglycemic patients hospitalized in intensive care after surgery. All items considered have referred to patients admitted to intensive care and underwent blood glucose control according to established protocols.

An analysis of studies shows how state management of hyperglycemia for the critically ill patient is not an easy question.

There have not been found consistent evidence that demonstrate an improvement in health outcomes by using tight glycemic control tends normoglycemic (19) (80 - 110 mg/dL). Indeed, this type of intervention, with respect to target blood glucose less rigid, may be associated with an increased risk of severe hypoglycemia.

The literature review allowed us to be able to detect the following advantages in favour of the protocol for:

- Decreased incidence of hyperglycemia seen as a negative prognostic factor for critically ill patients.
- Systematic and organized approach in the management of blood glucose
- Better control of blood glucose levels in the patient
- Autonomous nursing care during the treatment period

However, there have also highlighted the negative aspects:

- Increased risk of hypoglycemia development
- High glycemic variability multifactorial typical of the critical patient
- Increased nursing workload (Table 2)

5. Conclusions

By focusing on the post-surgical patient, from the analysis of the most current literature and the highest degree of reliability available, you can then derive the security bundles for the drafting of a glycemic protocol:

- All items surveyed reported a marked avoidance target glycemic tending to normoglycaemia and Jacobi group

Table 2. Research

Reference	Year	Title/Autors	Study Type	Objective	Patient/Method
CMAJ, 2009; 180 (8): 821 - 7; PMID: 19318387	2009	Intensive insulin therapy and mortality among critical ill patients: a meta-analysis including NICE-SUGAR study data; Donald E.G Griesdale, Russel J De Souza, Rob M. van Dam, Daren K. Heyland, Deborah J. Cook, Atul Malhotra, Rupinder Dhaliwal, William R. Henderson, Dean R. Chittock, Simon Finfer, Daniel Talmor	Meta-analysis	To update the totality of evi-dence regarding the influence of intensive insulin therapy compared with conventional insulin therapy on mortality and severe hypoglycemia in the ICU	Published RCT conducted in the ICU that directly compared intensive insulin therapy with conventional glucose man-agement and that documented mortality. We included in our meta-analysis the data from the recent NICE-SUGAR
Ann. Internal Med., 2011; 154: 268 - 282; PMID: 21320942	2011	Intensive insulin therapy in hospitalized patients: a systematic review; Devan Kansagara, Rongwei Fu, Michele Freeman, Fawn Wolf, Mark Hefland	Systematic-Review	To evaluate the benefits and harms of IIT in hospitalized patients.	English-language randomized, controlled trials comparing protocols titrated to strict or less strict glycemic targets.
Crit. Care Med. 2012;40 (12): 3251-3276; PMID: 23164767	2012	Guidelines for the use of an insulin infusion for the management of hyperglycemia in critical ill patients ; Judith Jacobi, Nicholas Bircher, James Krinsley, Micheal Agus, Susan S. Braithwaite, Clifford Deutschmann et. Al.	Guidelines	To evaluate the literature and identify important aspects of insulin therapy that facilitate safe and effective infusion therapy for a defined glycemic end point.	G.R.A.D.E. to assess the impact of insulin infusions on outcome for general ICU patients and those in specific subsets of neurologic injury, traumatic injury, and cardiovascular surgery. Elements that contribute to safe and effec-tive insulin infusion therapy were determined through literature review and expert opinion.

(as well as the latest LG of surving Sepsis Campaign) said that they might be sure of maintaining a target of around 150 mg/dL and a cut-off of entry into the protocol at the time when the blood sugar level attests to higher values to 150 mg/dL (though never more than 180 mg/dL) justify that selection on the need to avoid exceeding the renal threshold of urine glucose (160 mg/dL).

- The continuous infusion with insulin therapy is considered as a treatment "high risk-high alert," according to the Jacobi group, it is considered necessary a standardized protocol for the operational reality, constant monitoring take in glucose, and particular attention to modifications of enteral nutrition/parenteral;

- The process of decision making "bedside" by the operator should be minimize as much as possible;

- Monitor blood sugar every 2 hours;

- Setting up a shared schema for the treatment of any hypoglycemia;

- Preparation of infusion syringes with insulin dilution up to concentrations of 1 UI/1 mL in normal saline (0.9% NaCl) or Ringer's Lactate.

- Start as early as possible infusion at a constant concentration of glucose

Contribution to Emergency Nursing Practice:

- Decrease the risk of neurological damage in patients admitted to ICU

- Increase the safety of the treatment with insulin continuous infusion in ICU

- Improve the treatment of patients with impaired glucose in the ICU

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