

ORIGINAL ARTICLE

doi: 10.5455/medarh.2015.69.46-48

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Med Arh. 2015 Feb; 69(1): 46-48
 Received: December 15th 2014 | Accepted: February 07th 2014

Insulin Resistance in Early Vs Late Nutrition and Complications of SIRS in Neurosurgical Intensive Care Unit (ICU)

Kliti Pilika¹, Enver Roshi²

¹Anesthesiology and Intensive Care Service – Neurosurgical ICU “Mother Theresa” University Hospital Center Tirana, Albania

²Public Health Institute, Tirana, Albania

Corresponding author: Kliti Pilika, MD, MSc, PhD candidate Anesthesiology and Intensive Care Service – Neurosurgical Intensive Care Unit (ICU) of Mother Theresa” University Hospital Center Tirana, Albania. Email: kpilika@yahoo.com

ABSTRACT

Background: Systemic Inflammatory Response Syndrome (SIRS) is a common complication in neurosurgical diseases in Intensive Care Unit (ICU). Because of associated insulin resistance (IR) the ICU is in dilemma in which stage to start the nutrition to patients and what is the amount of Insulin Unit to control the hyperglycemia. **Aim:** to define the IR and to compare IR and amount of insulin among ICU patients in “Mother Theresa” University Hospital Center (MTUHC) in Tirana Albania. **Methods:** 154 patients with neurosurgical disease and SIRS complications were randomized in two groups: early nutrition 73 patients (47%) and late nutrition 81 (53%) and compared for a number of variables. **Results:** There was no statistical age and gender difference between the two groups ($P > 0.05$). The amount of insulin units to control the level of glycemia (80-110 mg/dc) was 12.8 ± 7 unit per day in early nutrition and 23.8 ± 12.9 units in late nutrition group ($p < 0.01$). No patient in early nutrition group but six (7.4%) patients in late nutrition group developed insulin resistance ($p = 0.03$). **Conclusions:** the IR due to the infection complications is higher among late than early nutrition group. Therefore, we suggest that in neurosurgical ICU it would be better to start the nutrition within 72 hours.

Keywords: Insulin resistance, early nutrition, late nutrition, neurosurgical complication, Intensive care unit, Albania.

1. INTRODUCTION

Sepsis, the host response to infection, involves a series of clinical, haematological, inflammatory and metabolic responses that can ultimately lead to organ failure (1). Insulin resistance generally refers to resistance to the metabolic effects of insulin, including the suppressive effects of insulin on endogenous glucose production, the stimulatory effects of insulin on peripheral (predominantly skeletal muscle) glucose uptake and glycogen synthesis and the inhibitory effects of insulin on adipose tissue lipolysis (2). Sepsis is an insulin resistance state and the degree of insulin resistance is directly proportional to the severity of stress response (3). Multi organ dysfunction syndrome (MODS) as per the definition proposed by a consensus conference committee in 1992, fever or hypothermia, leucocytosis or leukopenia, tachypnea and tachycardia are the cardinal signs of systemic response often called as Systemic Inflammatory Response Syndrome (SIRS) (4). SIRS may be due to infections or a non-infectious aetiology. Sepsis is defined as SIRS due to known infectious aetiology. When sepsis is associated with dysfunction of organs e.g. distant from the site of infection, the patient has severe sepsis. Severe sepsis may be accompanied with hypotension or evidence of hypo-perfusion. When hypo-

perfusion cannot be corrected by infusing fluids, the diagnosis is septic shock. Refractory septic shock is defined as septic shock that lasts for > 1 h and does not respond to fluid or pressure administration, and Multiple organ dysfunction syndrome is the dysfunction of more than one organ, requiring intervention to maintain homeostasis. As sepsis progresses to septic shock and MODS, the probability of mortality increases substantially. Sepsis is usually reversible whereas patients with septic shock and MODS, often succumb despite aggressive therapy (5).

The metabolic response to critical illness includes stimulation of the hypothalamic-pituitary-adrenal axis, resulting in increased levels of growth hormone, prolactin and ACTH level which stimulates excess of cortisol production from the adrenal cortex. These endocrine changes are counter regulatory to insulin and result in hyperglycemia. Catecholamine, both endogenous and exogenous (given to maintain circulation), also contribute to the hyperglycemia during critical illness. Mediators of systemic inflammatory response such as interleukin-1 (IL-1) and tumor necrosis factor alpha (TNF- α), cause hyperglycemia and peripheral insulin resistance by inducing the release of stress hormones. They also alter insulin receptor signaling pathway in the target cells and create insulin re-

sistance (6-8). Mild hyperglycemia in critically ill patients can also be harmful since it acts as procoagulant, induces apoptosis, impairs neutrophils function, increases risk of infection, impairs wound healing and is associated with increased mortality even after adjusting for severity of illness (1, 9).

The aim of the study is to define the Insulin Resistance (IR) and to compare IR and amount of insulin with infectious complication among neurosurgical intensive care (NSIC) patients in “Mother Theresa” University Hospital Center (MTUHC) in Tirana Albania.

2. PATIENTS AND METHODS

154 patients with infectious complication among neurosurgical intensive care patients in MTUHC, were selected and randomized in two groups according to early versus late nutrition. Finally 73 (47%) patients were randomly assigned to early nutrition group and 81 (53%) to late nutrition group.

The data included age, gender, length of stay, white blood account, glycemia was measured every hour, amount of insulin used per patients measured as units per day, SIRS complications, Body Mass Index (BMI), body temperature, cardiac and respiratory frequencies, blood pressure. Blood, urine, cerebrospinal Liquor (CSL) and bronchial secretions bacteriological examinations were also performed.

The amount of insulin was according to this protocol. We define the insulin resistance as need of 200 or more units of insulin per day to control blood sugar levels (10). The level of glycemia was maintained between 80-110 mg/dL based (Tight Glycaemic Control Protocol) (11).

In the early nutrition group the nutrition begun within the first 72 hours after admission in ICU and in the late nutrition group the nutrition begun more than 72 hours after admission. All groups were given the same nutrition: Fresubine (enteral) and Cabiven (parentral). The difference between two groups it the time when nutrition begun (11, 12).

European Society of Parenteral and Enteral Nutrition (ESPEN) guidelines were used for nutrition in ICU. During the acute and initial phase of critical illness an exogenous energy supply in excess of 20-25kcal/kg BW/day may be associated with a less favorable outcome. During recovery (anabolic flow phase), the aim should be to provide 25–30 total cal/kg BW/day (12,13). All patients receiving less than their targeted enteral feeding after 2 days should be considered for supplementary Parenteral Nutrition (13, 14).

2.1. Statistical analysis

For our purposes, average and standard deviation for age, BMI, length of stay, amount of insulin per day (unit/day), amount of calories per kg/weight per day used were calculated and reported. Chi square test was used to compare categorical variables between two groups. The analysis of covariance (ANOVA) was used to compare the average amount of insulin between two groups. SPSS version 20, Chicago Illionis was used to perform statistical analysis.

3. RESULTS

Out of 154 patients selected in our study, 73 (47%) were assigned to the early nutrition group and 81 patients (53%) to the late nutrition group. Table one shows the BMI after 7 days in late nutrition group is lower than the early nutrition group (p=0.04) due to probably serious complications. Comparing other variables did not find reveal any statistical difference between the two groups (P>0.05).

| Continues Variables | Nutrition | | P value ³ |
|--|--------------|-------------|----------------------|
| | Early (n=73) | Late (n=81) | |
| 1. Age (mean ±SD) | 53.7 (15.3) | 53.9 (14.5) | 0.9 |
| 2. Weight(kg) (mean ±SD) | | | |
| Weight(kg) 0-7 day ¹ | 74.3 (10.4) | 75.3 (10.9) | 0.6 |
| Weight(kg) > 7 day | 73.8 (9.7) | 70.6 (9.3) | 0.04 |
| 3. BMI ² (mean±SD) | | | |
| 22 - 24.9 | 18 (24.7) | 26 (32.1) | 0.5 |
| 25 - 29.9 | 43 (58.9) | 41 (50.6) | |
| ≥30 | 12 (16.4) | 14 (17.3) | |
| 4. Average± SD amount of Insulin used per day UI | 12.8 (7) | 23.8 (12.9) | <0.01 |

Table 1. Some characteristics of subjects under study (continuous variables). ¹ day after ICU admission, ² BMI Body Mass Index. ³Statistical significance P≤0.05

Table 2 shows that there are no statistical differences between two groups regarding all categorical variables.

| Categorical variables | Nutrition | | P value ¹ |
|--|--------------|-------------|----------------------|
| | Early (n=73) | Late (n=81) | |
| Cerebral Space occupying lesions | 37 (50.7) | 41 (50.6) | NS |
| Cerebral Vascular lesions | 34 (46.6) | 36 (44.4) | NS |
| Others(neurosurgical diagnosis not included above) | 2 (2.7) | 4 (4.9) | NS |
| Female | 39 (53) | 42 (52) | NS |
| Male | 34 (47) | 39 (48) | |

Table 2. Some characteristics of subjects under study (categorical variables). ¹Statistical significance P≤0.05

Average insulin value was 12 (±8.7) UI among early nutrition group and 23.8 (±12.9) among late nutrition group , with statistical significance difference (p<0.01) (Figure 1).

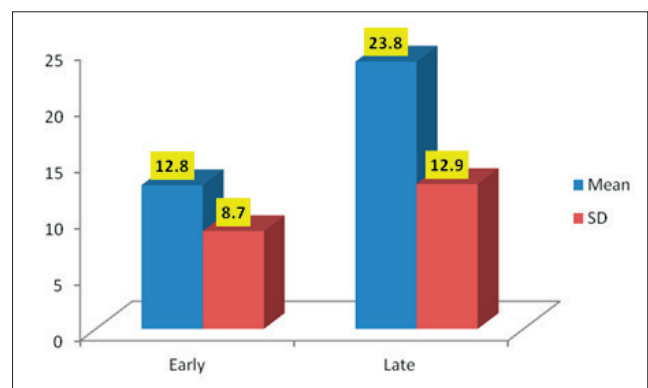


Figure 1. Insulin amount (U/day) according to nutritional way (early vs late nutrition).

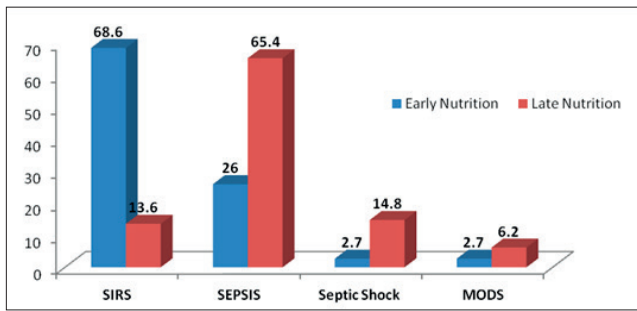


Figure 2. Comparison of complications according to nutrition way (early vs late nutrition).

We had no patient in early nutrition group who developed insulin resistance but among the patients of late nutrition group, six of them (7.4%) developed insulin resistance. This difference was statistically significant ($p=0.03$).

We noted that with SIRS was present in 45 (68.6%) patients of early nutrition group and 11 (13.6) patients of late nutrition group ($p<0.01$) (Figure 2). Sepsis had developed in 19 (26.0%) patients in early nutrition group and 58 (65.4%) patients in late nutrition group ($p<0.01$). Moreover, septic shock had developed in 2 (2.7%) patients of early nutrition group and 12 (14.8%) patients of late nutrition group ($P=0.01$). Finally, MODS was present in 2 (2.7%) patients of early nutrition group and 5 (6.2%) patients of late nutrition group ($p<0.01$) (Figure 2).

4. DISCUSSION

This study was carried out in the Neurosurgical Intensive Care Unit. It is the first study evaluating insulin resistance in our intensive care unit and in the field of intensive care in Albania. There was homogeneity among the patients (neurosurgical diagnoses). In admission, all the patient were not diabetics nor did they present with infectious problems and we think that in this contingent of patients it is feasible to exactly define the role of insulin and the effects of early and late nutrition on infectious problems (SIRS and its complications), through an experimental study design.

In our study we included patients that stayed 7 days or more in our ICU in order to better distinguish the influence of nutrition way (early vs. late) and to study appropriately evaluate the insulin resistance among them. The overweight patients prevailed in our study. Sepsis was the most frequent complication among our patients (50%) compare with other complications ($p<0.01$). Among the ICU patients and especially among septic patients hyperglycemia is a very frequent phenomenon. This hyperglycemia is due to increasing level of counter regulatory hormones of glucose metabolism (cortisol, glucagon) as well as increasing level of catecholamine. Important role is also played by insulin resistance and for this reason we have implemented the tight glycaemic control protocol, maintaining the blood sugar at levels 80 – 110 mg/dL (12).

We found in our study that the average amount of insulin per day in order to maintain the glycemia levels above mentioned levels was higher in the late nutrition group than in the early nutrition group ($p<0.01$). We think that this is due to less severe infective complications that were found in this group. About the insulin resistance we didn't

found any patient with insulin resistance in early nutrition group compared with 6 (7.4%) patients in the late nutrition group. This is according to the definition of insulin resistance that we use in our study (10).

5. CONCLUSION

From this study we concluded that the insulin resistance developed more commonly in neurosurgical ICU patients that received late nutrition compared to receiving early nutrition. This is associated with the high rate of infectious complications and severity of the infections in these patients.

CONFLICT OF INTEREST: NONE DECLARED.

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