Insulin therapy in severe burns – methods of glycemic control and intensive insulin protocol

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INTRODUCTION

Characterization of the response to trauma in critically ill patients has shown the association of severe hypermetabolism, inflammatory and stress responses with development of a hyperdynamic circulation, changed body temperature regulation, glycolysis, proteolysis, lipolysis and inefficient substrate cycling. The severe burn injury (>40% of the total body surface area - TBSA) is not an exception. A profound hypermetabolic response persists up to 24 months after the injury.

Cuthbertson originally described a stress response to fractures characterized by an „ebb” phase and „flow” phase. An „ebb” phase is described as a decrease in tissue perfusion and in metabolic rate. In severe burns this response lasts for the first 2 to 3 days post burn. The „flow” phase is characterized by an increase in metabolic rate and hyperdynamic circulation. It starts 3 to 5 days post injury. Severe burns show the most dramatic hypermetabolic stress response of any injury.

Hypermetabolic response in severe burns:

Catecholamines, corticosteroids and inflammatory cytokines are primary mediators of the hypermetabolic catabolic response in severe burns. They cause glucose production by the liver, amino acids from muscle and free fatty acids and glycerol from fat. The increase 2.5-fold in glycolytic - gluconeogenic cycling and the increase 4.5-fold in triglyceride fatty acid cycling, has been noticed during the post burn period. Changes mentioned above lead to hyperglycemia and worsen insulin sensitivity - post receptor insulin resistance. There are many factors having their impact on a blood glucose concentration but the insulin is the only hormone lowering glycemia in a human body.

Modulation of hyper metabolic response in severe burns:

- Early excision and grafting
- Nutrition
- Environmental thermoregulation
- Anabolic agents (rhGH, IFG-1, IGFBP-3, **Insulin**, Fenofibrates, Oxandrolone)
- Beta receptor antagonists
- Exercise

The administration of the insulin to severely burned patients that decreases glycemia (80-110 mg/dL), reduces the time of donor site healing, increases muscle protein synthesis and reduces muscle wasting, reduces infection rates and acute renal failure, it also has an anti-inflammatory effect. The continuous intensive insulin treatment may increase the risk of hypoglycemia in critically ill patients, so intensive insulin therapy needed to be interrupted.

METHODS

We analyzed the glucose levels measured from capillary blood (n=936, measured 6 times per day) and venous blood (n=156, measured 1 time per day) for 10 ICU patients with burns of >40% of the TBSA and inhalatory injury, with no history of diabetes. Measurements were made according to the tabular method protocol (SPRINT - Specialized Relative Insulin and Nutrition Table) and computerized intensive insulin dosing (Glucose Stabilizer Program). Any other factors affecting the instability of glucose level were not analyzed.

SPRINT (tabular method):

Glucose level measurements made in 80-90 min.

Advantage: low costs, safe, effective.

Disadvantage: complicated, additional job has to be done, doubts.

SOURCE:
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Fig 1. Tabular Method		
GLYCEMIA	INSULIN BOLUS (UI)	INSULIN INFUSION (UI/h)
121-140	0	1
141-169	6	1
170-249	8	2
250-299	10	3
300-399	10	4
400-500	10	5
>500	10	6

Glucose Stabilizer Program:

A solution to achieve safe and repeatable glucose level control.

Advantage: Automatic feeding integration. Choice of three target blood glucose levels (95, 115, 130 mg / dl), providing maximum flexibility in glycemic control. New range of target glucose concentration: 130 mg / dl (100 - 160 mg / dl).

Disadvantage: Expensive, requires training

RESULTS

Levels of glucose in the venous blood and capillary blood for ICU patients, were analyzed and compared.

In 13 cases the false positive results (unnecessary interventions) were noticed and false negative results (not taken interventions) - in 19 cases. The difference in results was on average 12,05 [mg%] (min. = 0, max. = 70). Cases of hyperglycemia and hypoglycemia where analyzed as well.

Fig.3. Results of glucose blood level after insulin infusion		
GLYCEMIA (mg%)	n	%
<40	0	0
40-79	21	2,2
80-109	136	14,5
110-149	562	60,1
150-179	118	12,6
>180	99	10,6

CONCLUSION

There is no optimal method for assessing blood glucose levels for patients with severe burns. The same glucose level values in both methods indicated different insulin dose.

In the tabular method the insulin therapy is interrupted as a result of achieving the expected level of glucose. In the computer method the insulin therapy is maintained for several hours despite achieving the desired level of glucose. The computer method results may be disturbed by the computer malfunction/computer computation failure.