Effect of Burn on Blood Glucose Level in Patients Attending Al_Hussein Teaching Hospital in Samawa City

By

Hussein Karim Shakir

Evan Ahmed Aziz

Sixth grade medical students in Al Muthanna University College of medicine

Supervised by

Dr.Zaid Ali Majeed

M.B.CH.B., C.A.B.M.S., F.A.B.M.S.

Dr.Anas Mohammad Al_Mansour

M.B.CH.B., S.M.I.M.

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Abstract

1. Abstract

1.1 Background

Burn considered as stressful condition, severely burned patients typically experience a systemic response expressed as increased metabolism, inflammation, alteration of cardiac and immune function, and associated hyperglycemia. Hyperglycemia has been associated with an increased risk of morbidity and mortality in critically ill patients.

1.2 Methods and Patients

Fifty patient with different types of burn were taken in this study which is done in burn unit in AL Hussein teaching hospital during the period from August 2018 to January 2019 to assess the risk of hyperglycemia.

1.3 Result

Hyperglycemia was found in 52.27 % of patients with burn, proportion of male with hyperglycemia (63.63%) was more than of female (36.36%).

1.4 Conclusion

It was concluded that there is association between burn and hyperglycemia and considered as a predisposition to development of diabetes.

1.5 Abbreviations

APACHE (Acute physiology , Age , Chronic Health Evaluation) ,SIH (stress induce hyperglycemia), HPA (Hypothalamus ,Pituitary , Adrenal axis).

Introduction

2.1 Introduction

A burn is a type of injury to skin, or other tissues, caused by heat, cold, electricity, chemicals, friction, or radiation. Most burns are due to heat from hot liquids, solids, or fire. Burns can also occur as a result of self-harm or violence between people.

Many factors guide the evaluation and management of burns. These include the type of burn (thermal, chemical, electrical or radiation), the extent of the burn that expressed as the percentage of total body surface area (%TBSA) involved & the depth of the burn which described as superficial (first degree), partial (second degree) or full thickness (third degree). Other factors also influence the treatment of burn, that are specific for each patient as the age of the patient (< 10 or > 50 years old); presence of medical or health problems; specialized locations of the burn (face, eyes, ears, nose, hands, feet and perineum); and if there are any associated injuries, particularly smoke inhalation and other traumatic injuries.

Severely burned patients typically experience a systemic response expressed as increased metabolism, inflammation, alteration of cardiac and immune function, and associated hyperglycemia. Hyperglycemia has been associated with an increased risk of morbidity and mortality in critically ill patients. (1)

Stress hyperglycemia is common in critically ill patients and appears to be a marker of disease severity. Furthermore, both the admission as well as the mean glucose level during the hospital stay is strongly associated with patient outcomes. Acute illness or injury may result in hyperglycemia, insulin resistance and glucose intolerance, collectively termed stress hyperglycemia. Numerous studies in both ICU and hospitalized non-ICU patients have demonstrated a strong association between stress hyperglycemia and poor clinical outcomes, including mortality, morbidity, and length of stay, infections and overall complications [2-3] this association is well documented for both the admission as well as the mean glucose level during the hospital stay

The stress response is mediated largely by the hypothalamic-pituitary-adrenal (HPA) axis and the sympathoadrenal system. In general, there is a graded response to the degree of stress. Cortisol and catecholamine levels correlate with the type of surgery, the severity of injury, the Glasgow Coma Scale and the APACHE score .The increased release of stress hormones results in multiple effects (metabolic, cardiovascular and immune) aimed at restoring homeostasis during stress. The HPA axis, sympathoadrenal system and proinflammatory cytokines (TNF-α, IL-1 and IL-6) act collectively and .synergistically to induce stress hyperglycemia (4)

2.2 PATHOPHYSIOLOGY OF STRESS INDUCED HYPERGLYCEMIA

The excess presence of any substance can generally be explained by three conditions: excess of production; reduced clearance (intake or excretion); or the presence of both these conditions. Hyperglycemia in severely burned patients results from a similar set of factors. Burned patients exhibit increased gluconeogenesis and glycogenolysis (increase of glucose production), as well as insulin resistance, leading to decreased glucose uptake and reduced clearance. The underlying mechanisms are not entirely defined, but multiple studies have indicated that SIH is associated with excessive release of catecholamine's, cytokines, hormones, and acute phase proteins (5,6).

2.3 INCREASE GLUCOSE PRODUCTION

The metabolic changes in burns occur in two different phases: the initial shock or "ebb" phase, present in the first five days, and the subsequent "flow" phase or hypermetabolic phase of injury (7) During the ebb phase, activation of the sympathoadrenal and the hypothalamopituitary-adrenal axis occurs, leading to increased plasma levels of catecholamines, glucocorticoids and cytokines(8). This results in a significant increase of total glucose (9) but mass flow of glucose to peripheral tissue is only slightly altered. In the subsequent hypermetabolic flow phase of injury, mass flow of glucose to peripheral tissues increases, directed by sympathetic stimulation (10) significant impairment of hepatic function is

observed in these patients (11) but hepatic gluconeogenesis via Cori and alanine cycles is increased (12). A study in rodents has suggested that burn

related hyperglycemia arises from glycogen breakdown and gluconeogenesis (13), and similar findings were later described by Wolfe et al. in humans (14). Genes encoding for gluconeogenesis are known to be up-regulated as early as six hours after burn injury (15), whilst clinically, peak glucose levels are observed between the 2^{nd} and 4^{th} day post burn (16).

As can be seen, SIH is multifactorial and involves a complex cascade leading to increased hepatic output of glucose, which can be increased by about 50% in comparison to healthy controls whilst clearance is similar (5). Evidence also indicates that all insulin-counteracting hormones (epinephrine, glucagon, hydrocortisone, and growth hormone) are involved in stimulating SIH and insulin resistance.

2.4 REDUCED GLUCOSE TOLERANCE

Under physiological conditions, once glucose is released, it can either be utilized by insulin independent tissues, for example in the brain, or by erythrocytes, or by insulin-dependent glucose uptake in other tissues such as muscle, or liver (17,18,,21).

The actions of insulin normally cause a switch from catabolic breakdown and a state of gluconeogenesis and glucose release, to anabolism and a state of glucose uptake with inhibition of gluconeogenesis. Such anabolic effects are typically not seen following severe burns, were catabolic breakdown predominates. Burn patients typically present with insulin resistance and increased proteolysis, associated with increased hepatic gluconeogenesis and muscle protein catabolism (20,23,24)These features lead to loss of lean body mass and profound muscle wasting, with consequent muscle weakness, delayed mobilization, impairment of cough reflexes, and prolonged mechanical ventilation; all of which may contribute to increased mortality in these patients(25,26,27) .

2.5 EFFECTS OF HYPERGLYCEMIA IN BURNED PATIENTS

1. Hyperglycemia was considered a desired condition in critically-ill patients, but recent evidence suggests significant deleterious effects of hyperglycemia. Critically-ill patients with hyperglycemia have a higher incidence of infections and sepsis in both adult and pediatric populations In burns, patients with poor glucose control have shown poorer outcomes and glucose levels higher than 200 mg/dl have been associated with a significant risk of infectious complications, especially wound infections, pneumonia and bacteremia. A glucose level greater than 140mg/dl seems to heighten the clinical suspicion for the presence of an infection in patients with burn injury (31)**.**
2. and hospital length of stay in burned children with poor glucose control and those with good glucose control; however they also found a statistically greater frequency of fungemia in those patients deemed hyperglycemic Hyperglycemia has also been shown to impair wound healing by decreasing tensile wound strength, with reduced graft take in burned patients with hyperglycemia compared with those with adequate glucose control (32, 33, 34).
3. The extent of the burn surface area has not been shown to correlate to mean glucose levels, but our group has found that insulin levels were significantly increased in following >80% total body surface area burns (5) Lower levels of insulin were also observed following smaller burns, indicating that with increasing severity of burn injury, insulin resistance may increase, and more insulin needs to be synthesized to maintain normoglycemia(5,7).
4. By studying the relationship between glucose levels and mortality, it has been suggested that admission glucose levels may be a better marker for the overall initial severity of illness of the patient whereas mean glucose may predict overall mortality more closely.

Objective of study

3. Objective of Study:

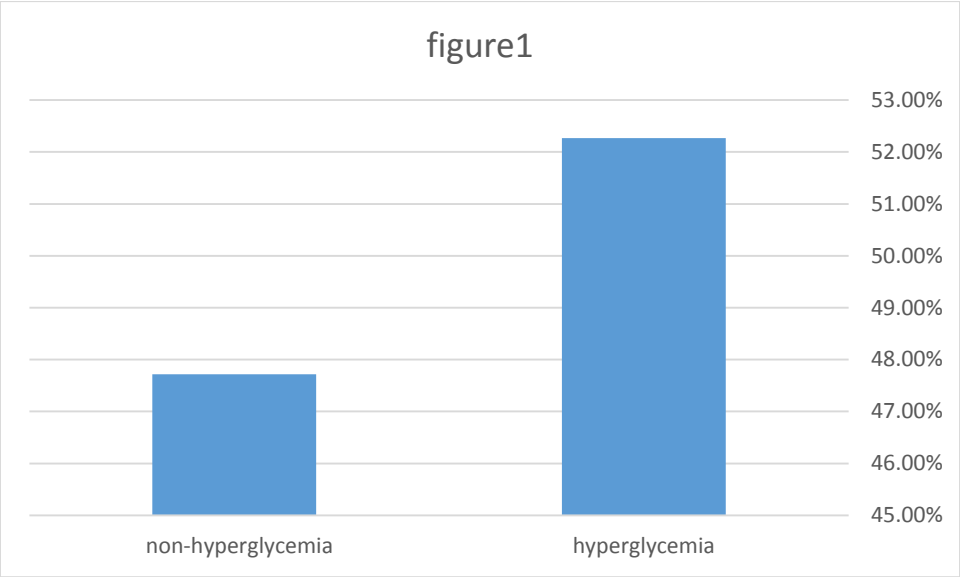
To Evaluate the Risk of Hyperglycemia in Burned Patients

Patients and methods

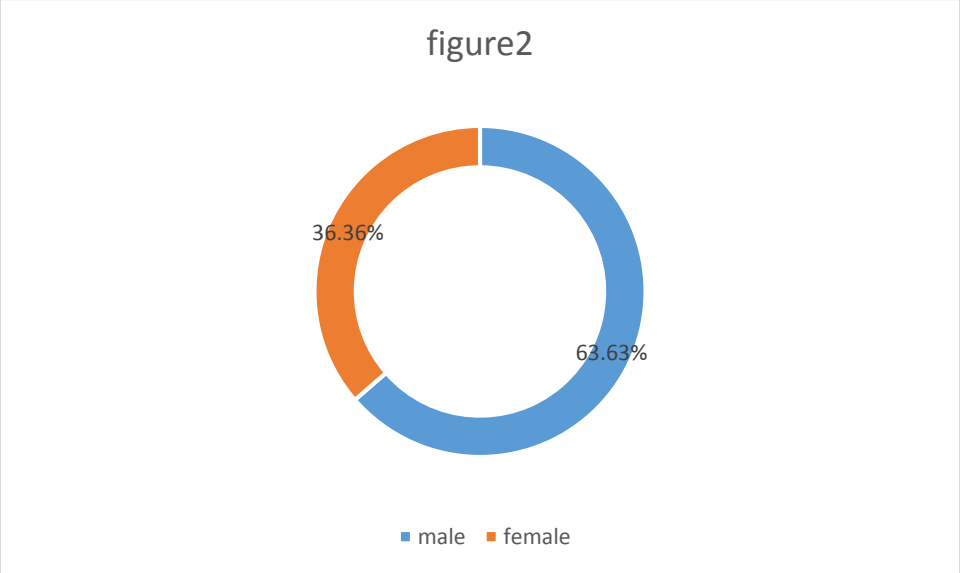
4. Patients And Methods

A hospital based gross sectional study of 50 patients with different types of burn that admitted to the burn unit in Al Hussein teaching hospital from August 2018 to January 2019, for the detection of increased of blood sugar based on random blood sugar taken at day one and day 3 post admission

Results



Our study show that 52.27% of patents have hyperglycemia and 47.72% non-hyperglycemic patient (fig.1), 36.36% of them were females and 63.63% were males (fig.2).



Discussion

6. Discussion

Stress-induced hyperglycemia is a multi-factorial condition, and is a complex process in severely burned patients. The incidence and prevalence of hyperglycemia in burned patients is difficult to determine, and this review has found that at present, there is as yet no consensus on a glucose level that defines hyperglycemia or a safe target glucose range for treatment in burned patients. It should be taken into consideration that by defining hyperglycemia at a level higher than 110mg/dl, which is the consensus in other patients, would imply that higher glucose levels are normal or acceptable in burned patients. The glucose level used to define hyperglycemia does not necessarily have to be the same as the target glucose range used for therapy.

There is risk of increased incidence of fungemia, bacterial infections, and sepsis in hyperglycemic patients. These conditions themselves can produce or perpetuate hyperglycemia, indicating that hyperglycemia may also be a marker of sepsis rather than a direct cause. The fact that diabetic patients have an increased incidence of infection, and that impairment occurs of immune cells, immunoglobulins, and inflammatory mediators *in vitro* when exposed to high glucose levels supports the role of hyperglycemia in increasing the incidence of infection. Furthermore, by treating hyperglycemia, infection rates are decreased, resulting in a beneficial impact on mortality, as infection and sepsis are major causes of death in severely burned patients (36)Length of stay (LOS) has also been found to be increased in critically-ill patients with hyperglycemia although this has not been found specifically among burned patients .

Insulin has both anabolic and anti-inflammatory effects as previously described, making it unlikely that the beneficial effects observed with intensive insulin treatment result only from normalization of glucose levels, being rather the combination of both glucose modulation and insulin action to some degree.

Interesting findings from a recent study in healthy individuals reported the effect of insulin following glucose ingestion, and indicated that some humans are selectively resistant to insulin's suppression of proteolysis, whereas others to insulin's suppression of lipolysis, which potentially leads to an "insulin response profile"

This finding may provide an explanation of the different responses to insulin observed even within the same study (37).

In the NICE – SUGAR study, survival was found to be better in the conventional group, but further analysis of the odds ratio for death (95% CI), resulted in better outcome within the trauma subpopulation with intensive insulin treatment Unfortunately, it was not described if burn patients were included in the study.

The utility of alternative anti-hyperglycemic drugs in order to decrease the incidence of hypoglycemic events observed with insulin is still under study. The decreased mortality rates described by Gore et al. using metformin in burned patients which included only 5 patients per group, included a death in the placebo group secondary to dislodgement of an endotracheal tube, making it difficult to achieve a conclusion in this study. The literature on the use of metformin in burned patients remains scarce.

It is likely that decreasing glucose levels with intensive insulin therapy may be beneficial in critically-ill patients, but the current evidence is not decisive, especially for burned patients. Although the available studies have shown improved survival with lower glucose levels, the studied population is small, with the studies being either retrospective or not controlled. It is yet to be determined whether insulin or euglycemia would be responsible for the mentioned effects.

A table of up-to date clinical trials studying hyperglycemia in burned patients has been compiled, but based on this review, we can conclude that an ideal target range for glucose levels in burned patients is still to be determined.

Conclusion and Recommendations

7. Conclusion and Recommendations

1. Burn patients have high risk to develop hyperglycemia.

2. Hyperglycemia increase morbidity and mortality by increase the risk of infection and sepsis.

3. Male at higher risk than female.

We recommended that although most burn centers may be implementing intensive insulin practices, the available literature fails to unequivocally confirm superior risk-benefit ratio of intensive insulin treatment in these patients. Severely burned patients represent the most critical trauma model, necessitating prospective, randomized and controlled studies to assess the impact of hyperglycemia and its treatment specifically in burned patients. It is likely that multi-center studies will be needed to collect enough information to be able to produce a consensus that will determine the paradigm of treatment of hyperglycemia in burned patients.

And finally recommended also that any admitted patient in burn unit need close observation & monitoring of RBS & treatment accordingly to decrease effects of hyperglycemia on healing process of burn patients and decrease rate of infections.

Limitations: the most important limitation in our study was the small size samples and a narrow time period.

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