Admission Hyperglycemia in Head Injured Patients

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Received: 10 Apr. 2007; Received in revised form: 22 Aug. 2007; Accepted: 12 Nov. 2007

Abstract: Hyperglycemia, in trauma patient, is commonly associated with a hyper metabolic stress response. Our objective is to determine the effects of hyperglycemia on the overall outcome of head trauma patients. In this descriptive study data were collected from head trauma patients' admitted to Intensive Care Unit (ICU) of Poursina University Hospital in a one-year period (Jan 2004-Jan 2005), retrospectively. All patients had stayed in the ICU for more than 48 hours post-injuries. They were divided into two groups according to their serum glucose levels at the time of admission (<200mg/dl or >200mg/dl), age, gender and Injury Severity Score (ISS). Patients with diabetes mellitus were excluded .We determined the outcome according to duration of hospitalization and ICU stay as well as mortality rates. Variables were analyzed with t-test and chi square test. Out of 115 patients, 89.6% were men. About 36 % of patients had serum glucose levels ≥ 200 mg/dl over the study period and this group had significantly greater mortality rate but without necessarily longer ICU or hospital stay. In this study we have shown that admission hyperglycemia has significant effect on patient's mortality but it is still unclear whether it can be a cause for longer ICU/hospital stay.

Acta Medica Iranica 2009; 47(1): 57-60.

Key-words: Craniocerebral trauma, hyperglycemia, inpatients

Introduction

Similar injuries lead to a remarkably different outcome. Individuals seem to respond to the stress of trauma differently. While some are discharged after a relatively uneventful hospital stay, others develop a rather complicated course, while still a few die as a result of injuries. For this reason, several models have been developed to predict outcome (1, 2). Some studies have demonstrated an association between blood glucose concentrations and outcome in hospitalized patients with head trauma as well as in patients with non traumatic injuries (3-5). Few studies have his association in trauma, not restricting the study to patients with traumatic head injuries. Clinically significant hyperglycemia has traditionally been defined as a serum glucose concentration > 200 mg/dl (6-8). However some studies have demonstrated an association between lower hyperglycemic values (<200mg/dl) and adverse outcomes in hospitalized patients prompting investigators to search for lower "cut offs" for blood glucose levels(8-11). Various autonomic and endocrine responses that occur following injuries are classically thought to produce a protective stress response. One such a physiologic response is that of hyperglycemia in association with a stressful event. Stress hyperglycemia is defined as a transient plasma glucose level above 200 mg/dl and it is thought to be caused by increased level of cortisol, glucagons, and epinephrine (13,14). Generally, the magnitude of the stress response is proportional to magnitude of tissue trauma. Likewise, stress hyperglycemia has been linked to increased risk of death, congestive heart failure and cardiogenic shock after a myocardial infarction (15). Control of hyperglycemia during an acute illness in adults is associated with improved outcomes (12,16). A prospective randomized study showed that trauma patients with persistent hyperglycemia have a significantly greater degree of morbidity and mortality (17) In another study, patients with elevated serum glucose had a significantly greater incidence of infection, ICU length of Stay (HLOS, ILOS), hospitalization, and mortality(18) There is a paucity of data evaluating whether hyperglycemia as predictive of outcome, duration of hospitalization and ICU stay (12). Our objective was to determine whether hyperglycemia is an indicator of outcome in head trauma or not.

Patients and Methods

This is a descriptive study and data were collected

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Table 1. Demographics and outcome variables stratified by Glucose level

	Glucose < 200mg/dl N=73	Glucose > 200mg/dl N=42	t	d f	P value
Age	34.68 ± 17.83	38.95 ± 17.99	-1.232	113	0.221
ISS	23.74 ± 4.25	23.60 ± 4.70	0.169	113	0.866
HLS †	22.32 ± 23.30	17.95 ± 20.71	1.006	113	0.317
ILS ‡	10.45 ± 10.87	11.31 ± 14/83	-0.355	113	0.723

P< 0/05 shows significant difference

†HILS= Hospital Length of Stay

‡ILS= Intensive care unit Length of Stay

retrospectively, over a 1-year period (Jan 2004-Jan 2005), from patients with traumatic head injuries were admitted to trauma center of Poursina University Hospital and stayed more than 48 hours in Intensive Care Unit (ICU).Based on a defined protocol in Poursina Admission serum glucose measured for all trauma patients along with some other laboratory tests. We obtained Admission serum glucose of each patient from the file. The patients were subsequently divided according their admission serum glucose levels: < 200 mg/dl or ≥ 200 mg/dl. Age, gender, and Injury Severity Score (ISS) were recorded for each. ISS was calculated according to Abbreviated Injury Scale (AIS 90). Patients with diagnosed diabetes mellitus were excluded from the study to minimize the overlap and confusion between acute stress hyperglycemia and diabetic hyperglycemia. Because we did not measure hemoglobin A1-C levels in our patients, it is possible that we have inadvertently included a few patients previously diagnosed with diabetes. Finally the outcomes were determined according to Hospital and ICU Length of Stays (HLS, ILS) as well as mortality rates. We processed data with SPSS 11.5. Analytic t-test used for quantitative, and Chi square for qualitative variables. Findings are presented in tables 1and 2.

Results

A total of 115 patients were included in study. Men accounted for the majority of study population (N= 109, 89.6%). The mean age of the study population was 36.28 ± 18.09 with no significant difference between the two study groups (Table 1). The mean ISS had no significant difference between the two study groups. About 36% of patients were admitted with hyperglycemia (serum glucose ≥ 200 mg/dl) over the study period. Mortality rate in patients with Glucose ≥ 200mg/dl was 68.28 %(N=27) versus 44.28 %(N=31) in the group with Glucose < 200mg/dl; which was significantly higher (Chi square=5.078, *P* =0.024). Table 1 shows other variables in both groups. We also compared survived and non survived patients in term of ISS, HLOS, ILOS and Serum level of glucose (Table 2).

Discussions

The state of hyperglycemia itself may contribute to morbidity and mortality by creating a toxic cellular milieu, causing electrolyte abnormalities and depressing immune function (19, 20). Catecholamines increase glucagon secretion and inhibit insulin secretion after injury and stress (21).

Table 2. Demographics and outcome variables stratified according to patient's mortality

	Expired N=58	Alive N=57	t	d f	P value
Age	39.81±18.96	32.61±16.19	2.187	113	0.031
ISS	24.19±4.05	23.18±4.70	1.239	113	0.218
HLS†	15.02±18.54	26.53±24.56	-2.839	113	0.005
ILS‡	10. 62±12.93	10.91±11.97	-1.25	113	0.9
Admission serum Glucose	205.41±89.83.31	162.47±58.88	3.026	113	0.003

P< 0/05 shows significant difference

†HILS= Hospital Length of Stay

‡ILS= Intensive care unit Length of Stay

Clinical studies on trauma patients have primarily focused on patients with traumatic brain injuries in which there is a positive correlation between serum glucose levels and mortality rates. Krinsley in a study showed that a modest degree of hyperglycemia occurring after ICU admission was associated with a substantial increase in hospital mortality in patients with a wide range of medical and surgical diagnosis (21). A large prospective randomized clinical trial showed that normalization of blood glucose using an intensive insulin protocol improved clinical outcomes, and decreased mortality by 42%[18]. A study by Sung showed that admission hyperglycemia is an independent predictor of outcome and infection in trauma patients (12). An observational study of 338 traumatically brain-injured patients demonstrated a positive linear relationship between hyperglycemia occurring in the first 24 hours after the initial insult and mortality. They have also found a significant positive correlation between serum glucose levels with the days spent in the hospital and ICU in patients with blood glucose greater than 200mg/dl. These patients were also found to have a greater risk of infections and mortality during their course of hospital stay (22). In this study, we demonstrated that the mortality rate among patients with blood glucose levels≥ 200 mg/dl was significantly higher than those patients with levels below 200mg/dl. This conclusion is consistent with most other studies (12,16), but we were unable to show a statistically significant correlation between higher glucose levels with the length of hospital and ICU stay. Most recently, Yendamari and colleagues retrospectively reviewed the impact of admission hyperglycemia in 738 trauma patients. The authors concluded that hyperglycemia on admission independently predicted increased intensive care unit and hospital length of stay. In addition, there was also an increase in mortality as well as morbidity secondary to infectious processes. Fewer hospital length of stay is a result of higher mortality rate in patients with higher blood glucose levels (i.e. ≥ 200).We conclude that admission hyperglycemia is associated with increased mortality rate in head injured patients, but it is still unclear whether it causes of longer stay in hospital and ICU. We suggest other studies in larger population of trauma patients to clarify admission hyperglycemia on length of hospital stay.

Acknowledgment

Finally we thanks Guilan Trauma Research Center for financial support, and we appreciate Dr Hossein Shodjaie who helped for data analysis, and Dr Mohammad Malekniazi for edit of manuscript.

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