Can Serum Glucose Level in Early Admission Predict Outcome in Patients with Severe Head Trauma?

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BACKGROUND: **Traumatic brain injury is a major general health concern. This study aims to evaluate a possible relationship between the serum level of glucose during admission and the outcome of patients with severe traumatic brain injury.**

METHODS: **In this prospective study, 80 patients with severe traumatic brain injury were recruited from the emergency department of Urmia Imam Khomeini Hospital. Serum level of glucose was measured at the time of admission and its correlation was investigated with the Glasgow Coma Scale score (on admission, 24 hours, 48 hours, and 1 week later, and at discharge) and Glasgow Outcome Score. In addition, the value of admission serum glucose was compared between deceased and discharged patients.**

RESULTS: **Eighty patients with severe head trauma, 71 men (88%) and 9 women (11.2%) with a mean age of 31.71 $\pm$ 15.66 years, were enrolled into the study. The in-hospital mortality rate was 25% ($n = 20$). There was no significant correlation between serum glucose level and Glasgow Coma Scale score (at different intervals) or Glasgow Outcome Score. The mean serum level of glucose was comparable between deceased and discharged patients (186.10 $\pm$ 51.36 vs. 187.98 $\pm$ 76.03 mg/dL, respectively; $P = 0.91$).**

CONCLUSIONS: **Admission serum glucose is not a significant indicator of outcome in patients with severe head trauma.**

INTRODUCTION

Despite tremendous progress in modern medicine, traumatic brain injury still constitutes a huge burden worldwide. Although most cases (75%–80%) involve mild lesions, almost all patients with severe head trauma and roughly two thirds of patients with moderate head trauma have lifelong disability.[1] Primary injury is caused by direct mechanical damage and secondary (delayed nonmechanical) damage is induced by changes in cerebral blood flow (such as hypoperfusion and hyperperfusion), inadequate cerebral oxygenation, and impairment of cerebrovascular autoregulation, cerebral metabolic dysfunction, excitotoxic cell damage, and inflammation. Primary damage cannot be therapeutically influenced, and treatment should focus on secondary damage.[2,3] According to some reports, patients with head trauma and hyperglycemia may have a lower Glasgow Coma Scale (GCS) score[4-6] and have an unfavorable neurologic outcome. Acute hyperglycemia is probably a result of stress-induced catecholamine release.[7,8] Some investigators[9] do not believe that there is a relationship between hyperglycemia and poor prognosis in head trauma. They believe that this hyperglycemia is transient and is merely a physiologic body response to injury. The present prospective study investigates a possible association between serum glucose levels of patients with severe head trauma at the time of admission with in-hospital prognosis.

METHODS

After approval by the ethics committee of Urmia University of Medical Sciences, this prospective cross-sectional study was performed in an emergency department and intensive care unit over a 24-month period (January 2011–December 2012). Written informed consent was obtained from the patients' accompanying

Key words
- Trauma
- Serum glucose level
- Severe head trauma
- Traumatic brain injury

Abbreviations and Acronyms
GCS: Glasgow Coma Scale
GOS: Glasgow Outcome Score

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family members/guardians before enrollment. Patients with accompanying trauma to the thoracic/abdominal regions, hospital stay less than 24 hours, patients younger than 7 years of age, patients without a documented blood glucose value on admission, and diabetic patients were excluded. The patients had no general injury. The type of fluid resuscitation used was Prostigmin and anticholinergics. The patients had been referred to hospital less than 1 hour previously and they had not received any D5 (dextrose 5%) intravenous solutions. Glybencliamide was used to control glucose levels. Eighty patients with severe head trauma (GCS score $\leq$8) were included in the current study. All patients were thoroughly examined by a neurosurgeon at the time of admission and regularly during their hospital stay. All patients were managed in a similar way during hospitalization. Severity of head trauma was accessed by GCS score on admission, and 24 hours, 48 hours, and 1 week later, and at discharge. Glasgow Outcome Score (GOS) was also calculated for discharged patients. Blood samples were taken from the peripheral vein in the emergency department at admission, and levels of blood glucose in the blood samples were recorded.

Statistical Analysis

Data are given as means $\pm$ standard deviation. A χ^2 test (categorical data) and independent samples t test (numerical data) were used for comparisons. The Pearson correlation coefficient (r) was calculated to investigate the relationship between serum glucose value and GCS/GOS score. Statistical analysis was performed using SPSS software (SPSS, Chicago, Illinois, USA). P value $\leq$ 0.05 was regarded as statistically significant.

RESULTS

Eighty patients with severe head trauma, including 71 men (88.8%) and 9 women (11.2%), were enrolled in the study. The mean age of the patients was 31.71 $\pm$ 15.66 (range, 18–76) years. The mechanism of head trauma was traffic accidents (n = 70), fall (n = 7), and quarrel (n = 3). The final diagnoses are summarized in Table 1. Craniotomy was performed in 12 patients (15%). Variables at the time of admission and during hospitalization are summarized in Table 2. The mean hospital stay was 14.93 $\pm$ 11.55 (range, 2–57) days. Twenty patients (25%) died during hospitalization and the remaining 60 patients (75%) were discharged. There was no significant correlation between the serum level of glucose at admission and GCS score at baseline (r = −0.06; P = 0.63), 24 hours (r = −0.67; P = 0.55), 48 hours (r = −0.13; P = 0.90), 1 week (r = −0.19; P = 0.13), and at discharge (r = −0.13; P = 0.26), or GOS (r = −0.63; P = 0.58). Variables of the study are compared between the deceased and discharged patients in Table 3. According to this table, there was no significant difference between the deceased and discharged patients in terms of sex, serum level of glucose at admission, and GCS score 24 hours after admission. Although the mean age of the deceased patients was higher, the difference was only marginally insignificant (P = 0.06). The mean GCS score was significantly higher in the discharged patients at the time of admission (P = 0.04) and 48 hours and 1 week later (P = 0.001 for both comparisons).

Table 1. Final Diagnoses in the Study Population with Severe Head Trauma

Diagnosis	Number (%)
DAI	31 (38.8)
SDH	10 (12.5)
Contusion	5 (6.2)
SAH + contusion	5 (6.2)
SDH + contusion	5 (6.2)
EDH	3 (3.8)
SAH + SDH	3 (3.8)
SAH	2 (2.5)
DAI + open fracture	2 (2.5)
DAI + SAH	2 (2.5)
ICH + contusion	2 (2.5)
SAH + EDH + contusion	2 (2.5)
SAH + SDH +EDH	2 (2.5)
SDH + ICH + contusion	1 (1.2)
SAH + ICH + contusion	1 (1.2)
EDH + IVH	1 (1.2)
Contusion + SAH + open fracture	1 (1.2)
EDH + contusion	1 (1.2)
IVH + SAH	1 (1.2)

DAI, diffuse axonal injury; SDH, subdural hemorrhage; SAH, subarachnoid hemorrhage; EDH, epidural hemorrhage; ICH, intracerebral hemorrhage; IVH, intraventricular hemorrhage.

DISCUSSION

It is generally believed that hyperglycemia after traumatic brain injury is a physiologic response to stress. Stress-induced release of catecholamines enhances gluconeogenesis and glycogenolysis, leading to the increased level of serum glucose in these patients.[10-13] Insulin resistance is another proposed underlying cause of hyperglycemia after severe head trauma.[14] In this study, we demonstrate that there was no significant relationship between the serum level of glucose at early admission with GCS score at different periods (admission, 24 hours, 48 hours, and 1 week) or GOS (Table 3). Likewise, the mean level of serum glucose was not significantly different between the deceased and discharged patients (P = 0.91). This finding is in contrast with the results of many previous reports. For example, Laird et al.[15] demonstrated that hyperglycemia (glucose level >200 mg/dL) at admission was significantly associated with higher rates of infection and mortality in patients with trauma. Even milder hyperglycemia (glucose level >150 mg/dL) has been proposed as an indicator of poor prognosis in these patients.[16,17] This association has been claimed to be independent of age and Injury Severity Score.[18] It is suggested that hyperglycemia is an indirect marker of