OPEN ACCESS
Saudi Journal of Pathology and Microbiology
Abbreviated Key Title: Saudi J Pathol Microbiol
ISSN 2518-3362 (Print) |ISSN 2518-3370 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: http://scholarsmepub.com/sjpm/

Original Research Article

Association between Blood Glucose Level and Outcome of Traumatic Brain Injury among Sudanese Patients

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| **Received:** 05.02.2019 | **Accepted:** 16.02.2019 | **Published:** 28.02.2019
DOI:10.21276/sjpm.2019.4.2.10

Abstract

Background: Traumatic brain injury is defined as an alteration in brain function caused by an external force; it is responsible for high mortality around the world. Hyperglycemia aggravates underlying brain damage and influences both morbidity and mortality in critically ill patients. ***Aim*:** The aim of our study is to examine the relationship between blood glucose and outcome after traumatic brain injury in Sudanese Patients. ***Methods:*** This is a cross-sectional study conducted at the National Center for Neurological Sciences from October 2015 to October 2018; blood specimens were obtained from 210 TBI patients and processed for plasma glucose measurement. ***Results:*** Two hundred and ten patients with TBI were enrolled in the study, 91.0% were males and 9.0% were females. The most affected age group ranged between 19-34 years in 75 patients. The present study revealed that normoglycemia (Glucose level 70-180 mg/dl) was detected in 79.0%of patients, while dysglycemia was detected in 21% of patients. Moreover, in this study, regarding the outcome and blood glucose, among dysglycemic patients (44), 61.1% of the hypoglycemic patients were found with mild disability according to GOS classification, while 66.6% of the hyperglycemic patients died. ***Conclusion:*** This study demonstrated a significant difference in blood glucose levels among patients with TBI.
Keywords: Traumatic brain injury, Hyperglycemia, Dysglycemia, Outcome, Sudanese patients.

INTRODUCTION

Traumatic brain injury (TBI) is the major cause of disability, morbidity, and mortality among individuals younger than 45 years and is responsible for a significant proportion of all traumatic deaths in the United States (US) and other developed nations [1-3]. TBI is a critical public health and socio-economic problem throughout the world [4]. Although high-quality prevalence data are scarce, it is estimated that in the US, around 5.3 million people are living with a TBI-related disability [5], and in the European Union, approximately 7.7 million people who have experienced a TBI have disabilities [4, 6].

TBI induces a complex pathophysiological cascade of cellular events. Central components of this response includes an increase in cerebral glucose uptake, reductions in cerebral blood flow, ionic disequilibrium and intracellular calcium accumulation [7]. Restoration of homeostasis requires a significant increase in glucose metabolism. experimental models have shown that TBI results in a significant increase in glucose utilization within the first 30 minutes post-injury, after which glucose uptake diminishes and then remains low for about 5-10 days [7, 8]. The initial hyperglycolysis described above results from disruption of ionic gradients across the neuronal cell membrane, activating energy-dependent ionic pumps [7]. Hyperglycemia aggravates underlying brain damage and influences both morbidity and mortality in critically ill patients [9] by inducing tissue acidosis, oxidative stress, and cellular immunosuppression [10] which in turn promote the development of multiorgan failure [11]. Hypoglycemia impairs energy supply causing metabolic perturbation [12]. Several studies have mentioned that intensive glycemic control is essential following traumatic brain injury for a better clinical outcome; controversially the majority of currently available clinical and preclinical evidence does not support tight glucose control during the acute care of patients with severe TBI [13]. The aim of our study is to estimate the random blood sugar levels in TBI patients within 24 hours of injury and to examine the relationship between blood glucose and outcome after traumatic brain injury in Sudanese Patients.

MATERIALS AND METHODS

This is a cross-sectional hospital-based study conducted in the National Center for Neurological Sciences (NCNC) in Khartoum state, during the period from October 2015 to October 2018**.** Two hundred and ten Sudanese patients with traumatic brain injury attending NCNC were enrolled in this study. The data were collected using a pre-designed interview questionnaire. A venous blood sample was collected from all participants, in fluoride oxalate container for glucose measurement. Verbal and written consent from each participant was obtained. Glucose concentrations were obtained by using the semi-auto chemistry analyzer (Mindray BA-88A). Data were analyzed using Microsoft office Excel 2007 and Statistical Package for Social Sciences (SPSS) version 21 software program with the p-value of <0.05 considered as statistically significant by using the Chi-square test.

RESULTS

This study was conducted among two hundred and ten traumatic brain injury patients attending the National Center for Neurological Science. Males were 191(91.0%) and females were 19 (9.0%). The most affected age group was ranging between 19-34years in 35.7 %, followed by the age group (51-66 years) in19.0%. The majority of the patients had no past medical illness (92.9%), but hypertension was encountered in 9.4% of the patients, and diabetes in 1.9% (Table-1). Finally; most of the patients constituting 185 (87.7%) were discharged from the hospital with different outcome according to Glasgow Outcome Score (GOS) as shown in (Table-2).

Table-1: Distribution of demographic characteristics

Characteristics	Frequency (N =210)	Percentage (%)
Sex		
Male	191	91.0%
Female	19	9.0%
Age group/year		
3 to 18	30	14.3%
19 to 34	75	35.7%
35 to 50	37	17.6%
51 to 66	40	19.1%
67 to 82	24	11.4%
83 to 98	4	1.9%
History of past medical illness		
No history of past medical illness	195	92.8%
Hypertension	9	4.3%
Diabetes	4	1.9%
Heart disease	2	1.0%

Table-2: Shows the frequency distribution of outcome in TBI patients

	GOS	Clinical status	Frequency	Percentage %
Outcome	1	Death	25	12.3%
	2	Vegetative	9	4.4%
	3	Severe disability	30	14.7%
	4	Moderate disability	16	7.8%
	5	Mild disability	130	60.8%
Total			210	100%

The frequency of glucose levels revealed that the blood glucose level of 70-180 mg/dL was detected in 79% of the patients and dysglycemia was found in 21% of the patient (Table-3). The correlation between blood glucose level and GOS were displayed in (Table-4).

Table-3: Shows the frequency of Glucose results in traumatic brain injury patients

		Frequency	Percentage %
Glucose (mg/dL)	Less than 70	38	18.1%
	70 to 180	166	79.0%
	More than 180	6	2.9%
Total		210	100%

Table-4: Shows cross-tabulation of blood glucose and GOS in TBI patients

Clinical status (GOS)	Blood glucose (mg/dL)			Total
	<70	70-180	>180	
Dead (1)	6(15.8%)	15(9%)	4(66.6%)	25(12.3%)
Vegetative state (2)	2(5.3%)	7(5.4%)	0	9(4.4%)
Severe disability (3)	4(10.5%)	25(15%)	1(16.7%)	30(14.7%)
Moderate disability(4)	2(5.3%)	14(8.4%)	0	16(7.8%)
Mild disability (5)	24(63.1%)	105(63.2%)	1(16.7%)	130(60.8%)
Total	38(100%)	166(100%)	6(100%)	210(100%)

DISCUSSION

Traumatic brain injury occurs when a traumatic event causes the brain to move rapidly within the skull, leading to damage [14]. A TBI occurs every 15 seconds in the US, generating 1.7 million new head injury victims per year [14, 15]. Primary brain damage and secondary brain damage are the main two types of traumatic brain injury [16-18]. Moreover, TBI is a major cause of mortality and disability in Europe and the US, as well as in under developing countries, 2.5 million people in the U.S is suffering from a bad outcome. Many head-injured patients die or survive with severe brain damage, even after mild or moderate head injury [19, 20].

The findings of this study showed that among 210 patients, males were 191 with the male to female ratio 10:1, several studies showed similar results to our study [21-24]. However, a study was done by Kumar, et al. Showed that among 216 patients, 154 patients were males and females were 62, with a male to female ratio 2.5:1 [21].

The distribution of the ages of the studied material revealed that the most affected age group was ranging between 19-34 years. A study was done by Mustafa, et al, revealed that males between the ages of 14-24 years seem to be the group most commonly affected by TBI [25]. The findings of this study did not differ from the international studies of TBI among age groups [21, 26-29]. In this study, the majority of the patients had no previous medical illness, which is similar to several studies from the literature [21, 30]. The findings of the present study revealed that most of the patients in the study were discharged from hospital constituting 88%. Studies done by Kumar and Johannesson showed similar findings to our results [21, 30].

In this study, 18.1% of the patients were hypoglycemic and only 2.9% were hyperglycemic. A study done by Sekeon showed that dysglycemia was detected in 4.8% of all TBI cases [31]. In Malaysia, there was a different blood glucose level in TBI [32]. Patients with severe TBI were at higher risk to develop hyperglycemia. However, hypoglycemia also is important in determining patients' outcome [31, 33-35]. According to Chara study, the central nervous system has limited tolerance to low glucose level because it will activate contra regulatory mechanisms [31, 33-35]. During this mechanism, there will be elevated of cerebral blood flow, depletion of glucose, activation of hormonal responses and releasing of glucagon hormones [31, 33-35]. The mechanism contributes to the activation of glutamate responses and apoptotic pathways [31, 33-35].

Regarding the outcome and blood glucose, among dysglycemic patients (44), this study showed that 61.1% of the hypoglycemic patients were found with mild disability according to GOS classification, while 66.6% of the hyperglycemic patients died. Rovlias reported that patients who subsequently had an unfavorable outcome had higher glucose levels (>200 mg/dL) than did those with a better prognosis [36]. Several studies have investigated blood glucose levels as a prognostic factor. These study results are similar to some of them, which reported that a high level of Blood glucose is associated with poor prognosis [37-42].

CONCLUSION

This study demonstrated a significant difference in blood glucose levels among patients with TBI. Mild disability was the outcome in 61.1% of hypoglycemic patients, while death was the outcome in 66.6% of hyperglycemic patients.

Acknowledgment

We gratefully acknowledge all committees in the National Center of Neurological Sciences for training, support and help all the time in the preparation of this paper.

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