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The Significance of Hyperglycemia in the First 24 Hours of Stroke

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Abstract

Background The study focused on acute stage of stroke patients and investigated which parameters of glucose in acute phase of stroke are significant in nondiabetic stroke patients.

Objective To evaluate hyperglycaemia in acute phase of stroke.

Methods Cross sectional study was conducted in Al-Imamain Al-Kadhimiyan Medical City in Baghdad city from October 2013 to September 2014. We studied glucose levels and glycosylated haemoglobin in 100 consecutive patients with acute stroke admitted within 24 hours after onset of symptoms.

Results One hundred consecutive patients (65 men and 35 women) were included in this study, 76 patients with diagnosis of ischemic stroke and 18 of them with diagnosis of intracerebral haemorrhage and 6 patients with transient ischemic attack Hyperglycemia was found in 44 patient. High glycosylated haemoglobin levels were found in 29 patients, 16 patients of them have history of diabetes. The other 13 with elevated glycosylated haemoglobin levels were considered as prediabetes. The remaining 15 patients had normal glycosylated haemoglobin.

Conclusion There is significant relationship between idiopathic hyperglycemia and prediabetes with acute stroke.

Keywords Stroke, diabetes mellitus, hyperglycaemia

List of abbreviation: ICH = intracerebral hemorrhage, HbA1c = glycosylated haemoglobin, DM= diabetes mellitus, RBS = random blood sugar, FBS = fasting blood sugar.

Introduction

Stroke is classically characterized as a neurological deficit attributed to an acute focal injury of the central nervous system by a vascular cause, including cerebral infarction, and intracerebral hemorrhage (ICH) and is a major cause of disability and death worldwide [(1)]. Ischemic strokes are caused by interruption of the blood supply, while hemorrhagic strokes result from the rupture of a blood vessel or an abnormal vascular structure. About 87% of strokes are ischemic, the rest are hemorrhagic. Some hemorrhages develop inside areas of ischemia (hemorrhagic transformation). It is unknown how many hemorrhagic strokes actually start as ischemic stroke [(2)].

The origin of the term hyperglycaemia is Greek, hyper-, meaning excessive, glyc-, meaning sweet and -emia, meaning of the blood, is a condition in which an excessive amount of glucose circulates in the blood plasma [(3)]. Hyperglycaemia was defined as a random glucose of 200 mg/dl or greater or a fasting glucose of 126 mg/dl or greater. Glycosylated haemoglobin (HbA1c) was determined by high-performance liquid chromatography (BioRad) on a cation-exchange column. The upper level of the nondiabetic reference range was less than 6.30% [(4)].

Chronic hyperglycemia that persists even in fasting states is most commonly caused by diabetes mellitus (DM). In fact, chronic

hyperglycemia is the defining characteristic of the disease. Intermittent hyperglycemia may be present in prediabetic states. Acute episodes of hyperglycemia without an obvious cause may indicate developing diabetes or a predisposition to the disorder [5].

A high proportion of patients suffering an acute stress such as stroke or myocardial infarction may develop hyperglycemia, even in the absence of a diagnosis of diabetes. Or perhaps stroke or myocardial infarction was caused by hyperglycemia and latent diabetes [6]. Certain medications increase the risk of hyperglycemia [7].

Stress-induced hyperglycemia typically described as blood glucose concentrations above 200 mg/dl, has been described in the literature for almost 150 years. The causes of stress-induced hyperglycemia can be attributed to the impact of integrated endogenous hormonal, cytokine, and counterregulatory nervous system signals on glucose metabolic pathways [8].

The detection of abnormal metabolic milieu is a window of opportunity for aggressive management in persons with stroke as this will improve outcome. Routine screening for hyperglycaemia in persons with stroke using HbA1c tests and blood glucose may uncover previously undiagnosed DM [9].

Methods

Design and Setting: cross sectional study was conducted in the wards of internal medicine and neurology of Al-Imamian Al-Kadhimiyain Medical City in Baghdad city. The period of data collection was one year started from October 2013 to September 2014.

Study population: We studied 100 consecutive patients who were admitted to the hospital. This centre has no specific selection criteria for the admission of stroke patients. All patients were screened according to a strict protocol consisting of a full neurological examination, standardized blood tests, at least one and usually one computed tomographic scans, magnetic Resonance imaging of the brain, duplex scanning of the carotid arteries, and cardiac analysis including standard 12-lead electrocardiography in all patients and 24-hour electrocardiographic monitoring and echocardiography on indication. Patients were excluded if the neurological signs onset more than 24 hours.

Data collection and analysis: The population was divided into the following subgroups:

(1) Diabetics with hyperglycaemia

(2) Nondiabetics with hyperglycaemia and increased HbA1c levels

(3) Idiopathic hyperglycaemia; hyperglycaemia and normal HbA1c levels

(4) Normoglycemia.

In all patients, at least one glucose level was obtained within 24 hours after onset: a random glucose level on admission, a fasting glucose on the morning after the stroke. Glucose was measured in hemolyzed whole blood using the hexokinase method.

Statistical analysis: The data were analyzed by means of statistical package for social sciences (SPSS) software programs. Values were expressed as mean +\- SD. A comparison of continuous variables was performed by unpaired two-tailed student's t test. A level of $p < 0.05$ (two-sided testing) was considered statistically significant.

Results

One hundred consecutive patients (65 men and 35 women) were included in this study, 76 patients with diagnosis of ischemic stroke and 18 of them with diagnosis of primary intracerebral haemorrhage and 6 patients with transient ischemic attack. The mean±SD age of the 100 patients was 65.14± 3.848 min 55 and max 78.

Random blood sugar (RBS) and fasting blood sugar (FBS) were measured in all patients. Hyperglycemia was found in 44%. None of the patients with hyperglycemia had received glucose infusions during the first day after admission. 29 patients had elevated HbA1c levels, 16 patients with a history of diabetes and 13 were prediabetes.

The remaining 15 patients had normal HbA1c but with elevated blood sugar. Table 1 shows the mean+/- SD values of glucose on admission, fasting glucose, and HbA1c, in patients with known diabetes, prediabetes, idiopathic hyperglycemia, and normoglycemia. In patients with a history of diabetes and prediabetes, all glucose levels were significantly higher ($p < 0.01$) than in all other patients.

Table 1. Illustrates the random blood sugar on admission, fasting blood sugar and glycosylated haemoglobin in the diabetic, prediabetes, idiopathic hyperglycemia with normoglycemic group using t test.

Parameters	Diabetes (type 1 & 2) (n=16) mean±SD	Prediabetes (n=13) mean±SD	idiopathic hyperglycaemia (n=15) mean±SD	Normoglycemia (n=56) mean±SD
RBS	264.44+66.52	207.0+7.09	205.27+15.48	111.23+12.24
FBS	146.88+23.43	130.62+3.45	131.67+7.4	93.39+6.57
HbA1c	7.41+0.49	7.01+0.03	4.53+0.52	4.93+0.66

RBS = random blood sugar, FBS = fasting blood sugar, HbA1c = glycosylated haemoglobin.

The mean RBS of patient with idiopathic hyperglycemia was significantly higher than normal range (205.27±15.48; p = 0.001) as shown in fig. 1.

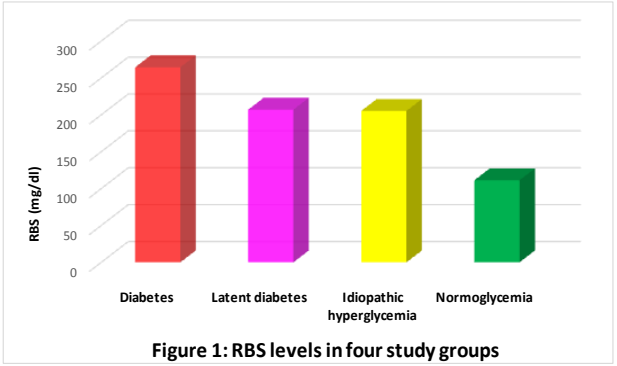

Figure 1: RBS levels in four study groups

The mean FBS of patient with idiopathic hyperglycemia was significantly higher than normal range (131.67±7.4; p = 0.001) as demonstrated in fig. 2.

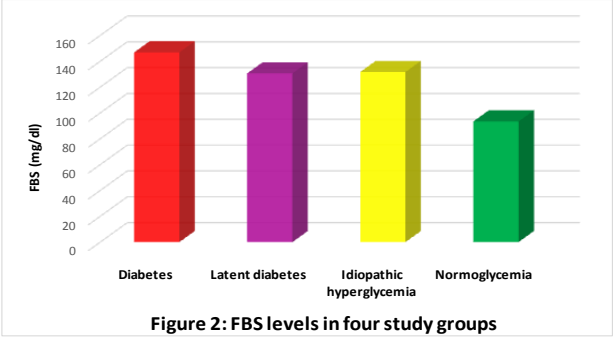

Figure 2: FBS levels in four study groups

The mean HbAc1 of patient with idiopathic hyperglycemia was significantly lower than diabetes and prediabetes (4.53±0.52 versus 7.41±0.49 and 7.01±0.03, respectively) **as** illustrated in fig. 3.

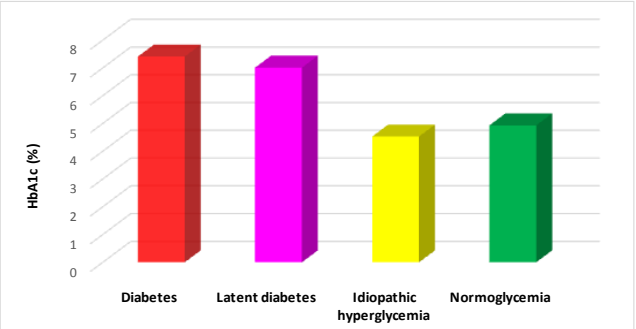

Figure 3: HbA1c levels in four study groups

Discussion

In this study, the relation of hyperglycaemia in acute phase of stroke was evaluated. We have found that 44% of patients with hyperglycemia, 29% with history of DM or previously undiagnosed DM. Hyperglycaemia is a strong risk factor for poor outcome after stroke [(10)]. Diabetic patient is liable for ischemic stroke and for intercerebral haemorrhage due to macrovascular disease which is the process of atherosclerosis, which leads to narrowing of arterial walls throughout the body.

Atherosclerosis is thought to result from chronic inflammation and injury to the arterial wall [11]. Ogbera et al [9] reported that 47% of patient with hyperglycaemia (24% known DM and 8% previously undiagnosed DM) this nearly the same of our study as this study sample slightly larger than our sample.

However a higher incidence of previously undiagnosed DM in stroke (18%) was noted in a Japanese report but this may be ascribed to the fact that oral glucose tolerance test was employed in making the diagnosis [12]. In our study we found 15% of patient with idiopathic hyperglycaemia (table 1). This may ascribe acute stress results in a raised concentration of counter-regulatory hormones (catecholamines, cortisol, glucagons, and growth hormone) that promote pathways opposite to the action of insulin in the liver and peripheral tissues. Catecholamine, cortisol, and growth hormone antagonize insulin action, which decreases peripheral glucose uptake. In addition, increased catecholamine and cytokines promote triglyceride breakdown (lipolysis) to free fatty acids increased release of cytokines (i.e., tumor necrosis factor, interleukin-1, and interleukin-6) also contributes to insulin resistance through direct effects on insulin receptors [13]. Słowik et al [14] found transient hyperglycaemia in 31.9% of patient and this differ from our study, this may ascribe to large sample involved in this study. Kooten et al [15] suggest the transient hyperglycaemia is not related to the stress and this differ from our study as it takes the measurement plasma catecholamine with RBS, fasting blood sugar and HbA1c. In our study we found HbcA1 elevated in patient with DM and previously undiagnosed DM but in patient with idiopathic hyperglycaemia we found HbA1c was normal. HbA1c can reflect pre-stroke glycaemia status and is one of the criteria for diagnosing diabetes, Roquerj et al [16] suggested HbA1c determination detected both previously undiagnosed DM and prediabetes in acute stroke patients and HbA1c determination should be included in the systematic screening of all acute stroke patients. He found new DM in cases (11.5%) and detected patients with prediabetes (36.2%) this differ from our study since he not study idiopathic hyperglycaemia we not involve oral glucose tolerance test in our study but we find HbA1c of patient with idiopathic hyperglycaemia was significantly lower than diabetes and prediabetes.

We conclude that there is significant relationship between idiopathic hyper-glycaemia and prediabetes with acute stroke.

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Author contribution

Dr. Kadhim did the acquisition of the data, analyse, and interpret the data and statistical analysis; Dr. Al-Hamadani revises the manuscript and study concept and design; and Dr. Hamzah collect the data.

Conflict of interest

No potential conflicts of interest.

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