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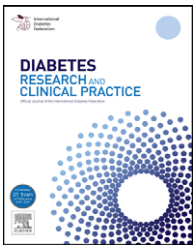

Newly diagnosed hyperglycemia and stress hyperglycemia in a coronary intensive care unit☆,☆☆

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ABSTRACT

Aims: To determine prevalence of newly diagnosed hyperglycemia (NDH) among patients with acute coronary disease, inquire relationship of stress hyperglycemia (SH) with functional outcomes.

Methods: Admission (APG) and first morning fasting plasma glucose (FPG) measurements were obtained, capillary glucose measurements (CGM) every 6-h within first day were performed—Group 1: Normoglycemics. Group 2: NDH cases: No known diabetes, APG > 200 mg/dl and/or FPG > 126 and/or any of CGM > 200. Group 2a: unrecognized glycemic disorder, HbA1c > 6.0%. Group 2b: stress hyperglycemia, HbA1c < 6.0%. Group 3: Recognized diabetes. Duration of ICU stays, APACHE-II scores were recorded. Logistic regression analysis was performed using ICU stay as dependent variable and age, groups, co-morbidities, problems in hospital, APACHE-II scores, CGMs were used as independent risk factors.

Results: There were 255 (51.6%) in Group 1, 82 (16.6%) in Group 2; 37 (7.5%) cases in Group 2a, 45 (9.1%) in Group 2b and 157 (31.8%) in Group 3. Group 2b spent longer time in ICU, had higher APACHE-II scores ($p = 0.0001$, $p = 0.0001$). Regression analysis demonstrated SH as an independent risk factor for duration of ICU stay (OR: 2.8, 95% CI: 1.3–6.2).

Conclusions: Hyperglycemia was present in 48.4%; 16.6% had NDH, 9.1% had SH. Poor functional conditions of SH cases pointed that they need to be considered carefully.

1. Introduction

In-hospital hyperglycemia is a common co-morbidity and is closely associated with poor outcomes regardless of diabetes [1,2]. The probability of stress hyperglycemia makes the diagnosis of diabetes a challenge in hospitals, and the prevalence of diabetes among hospitalized adult patients is supposed to be about 12–25% [3,4]. In a recent retrospective study, hyperglycemia was detected in 38% of the cases admitting to the hospital, even though one-third had no history of diabetes prior to admission. The latter cases were grouped as those with newly diagnosed hyperglycemia (NDH) [1]. Owing to the retrospective design of that study, it was not possible to discuss whether those NDH cases were the patients

☆ This study is registered at www.clinicaltrials.gov with the registration # NCT00984737.

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with unrecognized diabetes or those with stress hyperglycemia (SH). However, they were observed to be more severely ill than the ones with known diabetes and than the normoglycemics.

Stress hyperglycemia represents a transient increase in blood glucose in reaction to acute illness and is reported to be a non-physiological condition. It is the result of a cascade of hormonal events; increased substrate supply in the form of lactate, increased gluconeogenesis and decreased glycogenolysis [5]. Insulin resistance is also seen in an acutely ill patient and is attributed to cytokine excess in addition to the release and actions of counter-regulatory hormones [6]. Cases with stress hyperglycemia have higher mortality rates and worse functional outcomes than the ones with known diabetes or normoglycemia. It is not clear whether a high blood glucose concentration is independently associated with poor prognosis or it indicates more severe underlying illness with an augmented response to stress [5,7,8].

Considering the limitations of currently available large-scale studies, it seems not possible to detect the prevalence of glycemic disorders among hospitalized cases. They are usually meta-analysis or retrospectively designed studies, they include both intensive care unit (ICU) and ward patients, follow-up records are usually not available, inadequate information is presented about the drugs and fluids given during hospitalization, objective scoring systems are not used for determining disease severity, no information is given regarding the therapeutic strategies to treat hyperglycemia and finally HbA1c is usually not measured routinely [1,2,9,10]. Controlled studies with sufficient number of in-hospital cases in convenient clinics should be performed to high-lighten this dilemma. Coronary ICU seems to be the best place to perform such a study. Accordingly, there are trials in the literature demonstrating the negative impact of hyperglycemia on mortality, heart failure and cardiogenic shock among patients with acute myocardial infarction (AMI) regardless of diabetes [2,10,11]. Coronary ICU is almost always free of infection, the admitted patients are acutely ill and usually with any disease requiring medications such as glucocorticoids and mannitol solution that may interfere with blood glucose negatively.

The aim of the present study is twofold: (1) to determine the prevalence of newly diagnosed hyperglycemia among cases admitted to coronary ICU with acute coronary artery disease, (2) to search for the cases with stress hyperglycemia and inquire the relationship of SH with disease severity and functional outcomes, such as length of stay in ICU.

2. Subjects, materials and methods

Patients with acute coronary artery disease; acute coronary syndrome with non-ST segment elevation (ACS) and acute myocardial infarction (AMI), admitted to the coronary ICU of Adana Research Center, Baskent University Faculty of Medicine, through emergency room were recruited consecutively between May 2007 and November 2008. Patients who had non-coronary artery heart diseases and who were admitted through wards, other ICU's or out-patient clinics were excluded. Those who required medications that might interfere with blood glucose, such as glucocorticoids, mannitol solution or vasopressor agents and who had accompanying infectious diseases were also not included in the study. The first admission was used for patients with multiple ICU admissions. The Local Ethics Committee approved the study protocol (# KA07/101), the participants and when required their first degree relatives gave written informed consent.

The ACC/AHA 2007 guidelines were used to determine the cardiologic diagnosis of the participants. Acute myocardial infarction represented the classical disease with ST segment elevation, whereas ACS with non-ST segment elevation included the diagnoses of unstable angina pectoris and non-Q MI [12].

The participants were categorized by using the following algorithm: Admission plasma glucose (APG) and fasting plasma glucose (FPG; the first morning after admission) measurements were obtained from forearm and each participant was subjected to capillary glucose measurement (CGM) every 6 h within the first day. Accordingly they were separated into 4 groups:

Group 1: Normoglycemic cases: No known diabetes, APG < 200 mg/dl and FPG < 126 mg/dl and all of the CGM < 200 mg/dl.
Group 2: Newly diagnosed hyperglycemic cases: No known diabetes, APG > 200 mg/dl and/or FPG > 126 mg/dl and/or any of the CGM > 200 mg/dl.
Group 2a: Unrecognized glycemic disorder, HbA1c $> 6.0\%$.
Group 2b: Stress hyperglycemia, HbA1c $< 6.0\%$.
Group 3: Known, previously diagnosed diabetes.

Following the first 24 h, capillary glucose measurements were regularly kept being performed every 6 h throughout the hospital stay of Group 2 and Group 3. The highest and mean CGMs of each day were documented and demonstrated as graphics in Fig. 1. Cases were given anti-diabetic medications

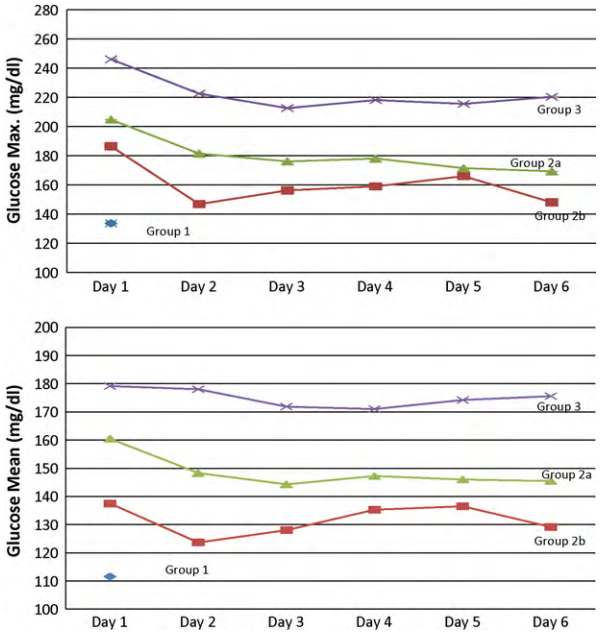

Fig. 1 – Maximum and mean glucose levels of the subgroups on each hospitalisation day (ANOVA, $p < 0.05$).