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Hypokalemia, Arrhythmias and Early Outcomes in Acute Myocardial Infarction

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Abstract: Serum potassium concentration was determined in 500 patients with Acute anterior Myocardial Infarction (AMI) on admission to Coronary Care Unit (CCU), within 12 h of onset of symptoms, at Madani heart center (Tabriz-Iran). About 12.2% of the overall patients studied, had significant hypokalemia (Serum Potassium level less than or equal to 3.5 mmol Lit^{-1}) while, hypokalemia was recorded in 15.4% of the patients associated with previous diuretic treatment. Hypokalemia was very rare in our patients, it was determined that diabetics have a higher level of potassium than nondiabetics (4.31 mmol Lit^{-1} versus 4.02 mmol Lit^{-1}). Considering the baseline characteristics and riskfactors between two study groups (Hypokalemia and Normokalemia) similar, the incidence of dysrrhythmias occurring during the first 12 h was referred to the initial serum potassium level. Ventricular Tachycardia (VT) was found in 29.1% of patients with hypokalemia as compared to 17.8% in normokalemic patients. Atrial Fibrillation (AF) and Ventricular Fibrillation (VF) were significantly more frequent in the hypokalemic (17.1 and 21.3%) than in the normokalemic patients (8.6 and 13.2%), although intraventricular and atrioventricular blocks were similar in the 2 groups. Also, total mortality was more frequent in hypokalemic group than normokalemic group (20.6% versus 16.9%). Thus, hypokalemia was an important predictor of malignant arrhythmias, mortality and poor outcome in AMI patients. A point of value that we found is lower incidence of hypokalemia in diabetic patients post AMI.

Key words: Hypokalemia, arrhythmias, acute myocardial Infarction, outcome, diabetic patients

INTRODUCTION

Electrolyte abnormalities, including abnormal serum potassium concentrations, are considered a correctable cause of life threatening ventricular arrhythmias according to American Heart Association/American College of Cardiology Practice Guidelines (Gregory *et al*., 2001).

The role of hypokalemia (LK) in cardiovascular disease in general, or in myocardial ischemia and Myocardial Infarction (MI) in particular, has been under investigation for a long time. LK is found as a determinant of excessive morbidity, mortality and arrhythmias (John *et al*., 2000). Also, results on the effect of treatment with diuretics in predisposing to LK on admission of patients with MI have been variable (John *et al*., 2000). Herein, we evaluated the arrhythmias and outcomes of LK in patients with Acute Anterior MI.

MATERIALS AND METHODS

Five hundred consecutive patients with Acute Anterior MI who admitted to the Coronary Care Unit (CCU) of Madani heart center of Tabriz, Iran from Jan 2005 to April 2007 were included in this study. The diagnosis of AMI was substantiated by suggestive symptoms, sequential changes in serial ECGs, peak CK (Creatine kinase) greater than two times the upper reference value of our laboratory and peak myocardial isomer of CK (CK-MB) >60%. CK enzymes were measured thrice daily for 2 days, every day for 5 days and as clinically indicated there after. Identified variables included: serum potassium level, CK-MB, prior use of diuretics, DM history and ECG. Patient outcome variables included mortality, Atrial Fibrillation (AF), Ventricular Tachycardia (VT), Ventricular Fibrillation (VF).

All data were considered in the analysis by SPSS (Chicago, IL, Version 13). Variables were analyzed using a t-test or analysis of variance with repeated measure. Nominal variables were compared using Pearson Chi-square analysis. Statistical significance was accepted when $p \leq 0.05$. Data are reported as percentage occurrences of a variable.

RESULTS

The database contained 500 patients with Acute Anterior MI. Serum potassium level measured on admission to CCU within 12 h of onset of symptoms,

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Table 1: Arrhythmias of patients with Acute Ant MI in LK and NK groups

Variables	LK (%)	NK (%)	p-value
VT	29.1	17.8	0.01
VF	17.1	8.6	0.001
AF	21.3	13.2	0.01

revealed hypokalemia in 12.2% of the overall patients (Serum potassium level less than or equal to 3.5 mmol Lit^{-1}).

Of the patients with hypokalemia, 15.4% were associated with previous diuretic treatment, while 10.4% of normokalemic patients had received prior diuretics. History of diabetes was asked in all patients. Mean serum potassium concentration in diabetics was 4.31 while it was 4.02 mmol Lit^{-1} in nondiabetics. It confirmed the lower incidence of hypokalemia in diabetic patients. The frequency of dysrrhythmias such as VT, VF, AF were higher in hypokalemic than in normokalemic patients. The incidence of these dysrrhythmias occurring during the first 12 h was due to the differences in initial serum potassium level. Table 1 details the frequency of arrhythmias of the two cohorts.

Other inraventricular and atrioventricular blocks were similar in the 2 groups, but total mortality was significantly frequent in hypokalemic patients than normokalemic group (20.6% versus 16.9%, p = 0.02).

DISCUSSION

In agreement with others we found more MIs in the LK patients (John *et al*., 2000). Hypokalaemia is a relatively common biochemical abnormality found on routine screening. There are many causes including diarrhea and vomiting, inappropriate fluid replacement and drugs, such as loop and thiazide diuretics. In addition to the biochemical diagnosis, ECG can be a useful diagnostic tool which may help the physician start lifesaving treatment while awaiting confirming biochemical tests (Webster *et al*., 2002). The effect of hypokalaemia on the cell membrane is to increase the resting membrane potential and increase the duration of the action potential and refractory period, which are potentially arrhythmogenic. So, hypokalemia has been showen to increase the risk of various malignant ventricular arrhythmias (Helfant, 1986). A Swedish study demonstrated the increased risk of ventricular tachycardia postmyocardial infarction in patients with hypokalaemia (Nordrehaug *et al*., 1985). Other arrhythmias described include ventricular ectopic beats and ventricular fibrillation (Helfant, 1986).

In our study, we found that VT, VF, AF occurred more frequently in LK patients than NK patients with Ant AMI. Nordrehaug *et al*. (1985) showed that patients with MI and LK are not at risk for increased mortality and LK does not significantly predict increased occurrence of any of arrhythmias. John *et al*. (2000) like others (Nodrehaug, 1981; Brezins *et al*., 1996; Nordrehaug and Von der Lippe, 1983; Kafka *et al*., 1987; Salerno *et al*., 1987; Thomas, 1983) did not find a relation between prior diuretic use and LK, although, Herlitz *et al*. (1988) and some other studies (Nordrehaug and Von der Lippe, 1983; Johansson and Dziamski, 1984) have detected such an effect like our investigation. We found that hypokalemia is more relevant to prior use of diuretics in comparison to NK patients. Only 15.4% of hypokalemic patients used diuretics prior to admission, a much lower rate than noted in older studies (Solomon and Cole, 1981). Based on our recent data, we believe that hypokalemia may be assopciated with glucose and insulin metabolism and it is the reason of low incidence of hypokalemia in diabetic patients.

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