Association of serum potassium level with ventricular tachycardia after acute myocardial infarction

Ali Pourmoghaddas[(1)], Hasan Shemirani[(2)], Mohammad Garakyaraghi[(3)]

Abstract

BACKGROUND: One of the causes of mortality in acute myocardial infarction (AMI) is ventricular tachycardia. Abnormal serum Potassium (K) level is one of the probable causes of ventricular tachycardia in patients with AMI. This study carried out to determine the relationship between serum potassium level and frequency of ventricular tachycardia in early stages of AMI.

METHODS: Ina cross-sectional study on 162 patients with AMI in the coronary care unit (CCU) of Nour Hospital (Isfahan, Iran), the patients' serum potassium level was classified into three groups: 1) K<3.8 mEq/l, 2) 3.8≤K<4.5 mEq/l and 3) K≥4.5 mEq/l. The incidence of ventricular tachycardia in the first 24 hours after AMI was determined in each group by chi-square statistical method.

RESULTS: The frequency of ventricular tachycardia in the first 24 hours after AMI in K< 3.8 mEq/l, 3.8≤K<4.5 mEq/l and K≥4.5 mEq/l groups were 19.0%, 9.6% and 9.9% respectively. The high frequency of this arrhythmia in the first group as compared with the second and the third group was statistically significant.

CONCLUSION: Hypokalemia increased the probability of ventricular tachycardia in patients with AMI. Thus, the follow up and treatment of hypokalemia in these patients is of special importance.

Keywords: Acute Myocardial Infarction, Ventricular Tachycardia, Hypokalemia, SerumPotassium Level.

ARYA Atherosclerosis Journal 2012, 8(2): 79-81

Date of submission: 18 Jun 2012, ***Date of acceptance:*** 15 Aug 2012

Introduction

Heart diseases are the most common cause of mortality among adults in developed western countries which often are associated with coronary artery diseases. Acute myocardial infarction (AMI) in patients causes early and risky complications such as ventricular fibrillation, free wall rupture, intraventricularrupture and papillary muscle rupture.[1]

Subsequent arrhythmias and hemodynamic abnormalities in left ventricular dysfunction are the major causes of mortality along with acute myocardial infarction. The arrhythmias predisposing factors are: autonomic nervous system dysfunction, electrolyte disorders, left ventricular dysfunction, myocardial ischemia and medications.[1] Ventricular tachycardia might occur unstably (less than 30 seconds) or stably (more than 30 seconds or along with hemodynamic disorders) in patients with acute myocardial infarction, due to the underlying problems such as left ventricular dysfunction, hypoxia, electrolyte disorders or toxic effects of digoxin, quinidine or dobutamine.[1,2] Some studies showed that reduction in potassium level increases theprobability of ventricular tachycardia in patients.[3] However, in most of these studies, patients were divided into two groups with normal potassium or below normal level and relative importance of different potassium levels in prevalence of arrhythmias as well as the involvement of other confounding factors such as consumption of drugs were not evaluated.[4-8]

The present study aimed to determine the association of serum potassium level with ventricular tachycardia in the first 24-hour after acute myocardial infarction.

Materials and Methods

This cross-sectional study conducted on patients with AMI admitted in coronary care unit (CCU) of Nour Hospital (Isfahan, Iran) during January to December 1999. At the beginning of admission and in a resting position, the blood sample was taken from patients' left cubital vein. The sucking pressure in venipuncture

1- Assistant Professor, Department of Cardiology, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran.
2- Associate Professor, Hypertension Research Center, Isfahan Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran.
3- Assistant Professor, Cardiac Rehabilitation Research Center, Isfahan Cardiovascular Research Institute, , Isfahan University of Medical Sciences, Isfahan, Iran.
Correspondence To: Mohammad Garakyaraghi, Email: mgy466@gmail.com

was tried to be very slow. The blood samples were slowly transferred to the test tube and then to the laboratory without any shake. The exclusion criteria were patients treated with medications including digitalis, dobutamine, calcium blocker agents, diuretics, beta-blocker and warfarin and patients with diabetes, patients treated with insulin, patients with uremia or renal failure, atrioventricular block greater than first degree, bundle branch block, patients with coagulation disorders, prolonged QT time and patients with heart failure, cardiogenic shock or those treated with cardio electroconvulsive therapy (ECT).

The sample size was estimated 54 subjects in each group based on pre-test (total population, 162 subjects). The serum potassium level was measured usinga photometer unit by a technician. The afternoon and morning samples immediately were centrifuged and their serum kept in freezer to determine their potassium level. The patients were divided into three groups; firstly, those with serum potassium level less than 3.8 mEq/l, secondly those with serum potassium level from 3.8 to 4.5mEq/l and the third group included patients with potassium level more than 4.5 mEq/l. Thereafter, the patients were screened in terms of occurrence of ventricular tachycardia (onset) at the first 24-hour after AMI. The obtained data were analyzed through SPSS software us in gchi-square test. All the statistical tests were two-tailedand were done in $P < 0.05$ level.

Results

Out of 162 patients, 130 (80.2%) were males and 32 (19.8%) were females. The number of male and female patients was similar in different groups (Table 1). Mean age of subjects was 59 ± 6 years. The onset of tachycardia in patients during the first 24-hour after anterior or inferior myocardial infarction was 7.4 ± 5.2 hours after the admission. Ventricular tachycardia was spontaneously eliminated in 68% percent of the subjects but 20%were treated with lidocaine, 8% with electroconvulsive therapy (ECT) and 4% with cardiogenic shock. The overall mortality rate of the patients was 16%.

Table 1. The frequency of the patients in terms of gender in three studied groups

Gender	K < 3.8 mEq/l n (%)	3.8 ≤ K < 4.5 mEq/l n (%)	K ≥ 4.5 mEq/l n (%)	Total
Male	43 (33%)	42 (32%)	45 (35%)	130
Female	11 (34%)	12 (38%)	9 (28%)	32
Total	54	54	54	162

The risk of tachycardia in the group with potassium level <3.8 mEq/lwas significantly greater than the two other groups ($P < 0.05$).Ventricular tachycardia was significant different between the two groups with potassium levels <3.8 mEq/land 3.8 to 4.5 mEq/l [Odds ratio (OR) = 2.22, P = 0.028]. The risk of ventricular tachycardia was significantly more inpotassium levels less than 3.8 mEq/lcomparing to those with more than 4.5 mEq/l (OR = 1.8, P = 0.035).

However, the occurrence of ventricular tachycardia did not show significant difference between the two groups with potassium levels 3.8-4.5 mEq/l and the more than 4.5 mEq/l (OR = 1.22, P = 0.093) (Table 2).

Table 2. Occurrence of ventricular tachycardia in 4 hours, depending on the different levels of potassium

Potassium level	Yes n (%)	No n (%)	Total n (%)
< 3.8 mEq/l	10 (19%)	44 (81%)	54 (100%)
3.8-4.5 mEq/l	5 (10%)	49 (90%)	54 (100%)
> 4.5 mEq/l	6 (10%)	48 (90%)	54 (100%)

Discussion

Hypokalemia increases the risk of ventricular tachycardia incidence at the first 24-hour after the acute myocardial infarction. In this study, there was a significant correlation between potassium level less than 3.8 mEq/l and ventricular tachycardia at the first 24-hour after the acute myocardial infarction. In most of the conducted studies, different levels of potassium have not been evaluated.[3,9]

A study showed that reduction of serum potassium level linearly increases the risk of ventricular tachycardia incidence.[4]In the study of Vera et al. on 21 canines, it was concluded that reduction in serum potassium level can probably increase the inducibility of ventricular arrhythmia with ischemia; however, mere reduction in serum potassium level in a healthy ventricle would not increase the incidence and complexity of ventricular arrhythmias such as ventricular tachycardia.[1]

The study of Wahr et al. on 2402 patients undergoing heart surgery showed that with potassium level less than 3.5 mEq/l, the incidence of arrhythmias and need for cardiopulmonary resuscitation would be increased in operative and post-operative period.[10]

In this study, the risk of ventricular tachycardia in the group with potassium level less than 3.8 mEq/l was almost two folds higher than the group with potassium level between 3.8 to 4.5 mEq/l; however, the risk of ventricular tachycardia between the two groups of potassium level greater than 4.5 mEq/l and the group with potassium level between 3.8 to 4.5 mEq/l had no significant difference. The relative risk

of ventricular tachycardia occurrence in the group with potassium level more than 4.5 mEq/l was 1.03 folds than the group with potassium level between 3.8 to 4.5 mEq/l. Therefore, maintaining the serum potassium at the range of more than 3.8 mEq/l would minimize the risk of ventricular tachycardia.

Acknowledgements

The Persian version of this article has been previously published in The Journal of Qazvin University of Medical Sciences: 2001, No: 20; 3-8.

Conflict of Interests

Authors have no conflict of interests.

References

1. Vera Z, Janzen D, Desai J. Acute hypokalemia and inducibility of ventricular tachyarrhythmia in a nonischemic canine model. Chest 1991; 100(5): 1414-20.
2. Antman EM, Braunwald E. Acute myocardial infarction. In: Harrison TR, Fauci AS, Editors. Harrison's principles of internal medicine. New York: McGraw-Hill, Health Professions Division; 1998. p. 1352-63.
3. Beck OA, Hochrein H. Initial serum potassium level in relation to cardiac arrhythmias in acute myocardial infarction (author's transl). Z Kardiol 1977; 66(4): 187-90.
4. Antman EM, Braunwald E. Acute myocardial infarction. In: Braunwald E, Zipes DP, Libby P, Editors. Heart Disease: A Textbook of Cardiovascular Medicine. Philadelphia: Saunders; 1997. p. 1184, 1247-8.
5. Nordrehaug JE, Johannessen KA, Von Der LG. Serum potassium concentration as a risk factor of ventricular arrhythmias early in acute myocardial infarction. Circulation 1985; 71(4): 645-9.
6. Nordrehaug JE, Von Der LG. Hypokalaemia and ventricular fibrillation in acute myocardial infarction. Br Heart J 1983; 50(6): 525-9.
7. Ramsay LE, Toner JM, Cameron HA. Diuretic use, serum potassium and ventricular fibrillation in patients with myocardial infarction. Proceedings of the British Pharmacological Society, 1984 Jan 4-6; London, UK; 1984.
8. Solomon RJ, Cole AG. Importance of potassium in patients with acute myocardial infarction. Acta Med Scand Suppl 1981; 647: 87-93.
9. Sobel BE. Acute myocardial infarction. In: Cecil RL, Bennett JC, Plum F, Editors. Cecil textbook of medicine. 20th ed. Philadelphia: Saunders; 1996. p. 301-16.
10. Wahr JA, Parks R, Boisvert D, Comunale M, Fabian J, Ramsay J, et al. Preoperative serum potassium levels and perioperative outcomes in cardiac surgery patients. Multicenter Study of Perioperative Ischemia Research Group. JAMA 1999; 281(23): 2203-10.

How to cite this article: Pourmoghaddas A, Shemirani H, Garakyaraghi M. **Association of serum potassium level with ventricular tachycardia after acute myocardial infarction.** ARYA Atherosclerosis Journal 2012; 8(2): 79-81.