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RESEARCH

THE DIFFERENCES OF SODIUM, POTASSIUM AND CHLORIDE LEVELS IN STEMI AND NSTEMI PATIENTS

(Perbedaan Kadar Natrium, Kalium dan Klorida di Pasien STEMI dan NSTEMI)

Freddy Ciptono, Muji Rahayu

ABSTRAK

Infark miokard telah menjadi salah satu penyebab terbesar kematian di seluruh dunia yaitu sebesar 30% dari angka kematian secara global. STEMI dan NSTEMI dibedakan berdasarkan derajat iskemia yang dialami berupa elevasi segmen ST di pemeriksaan EKG di pasien STEMI. Peningkatan kadar enzim jantung juga ditemukan baik pada STEMI maupun NSTEMI. Beberapa penelitian terdahulu mengungkapkan adanya perubahan kadar elektrolit di pasien infark miokard. Penelitian ini bertujuan untuk menganalisis perbedaan kadar natrium, kalium dan klorida di pasien STEMI dan NSTEMI. Penelitian potong lintang, subjek pasien STEMI dan NSTEMI yang dirawat di RSUP Dr. Kariadi, Semarang keluhan angina yang khas, pemeriksaan EKG dengan atau tanpa elevasi segmen ST, disertai dengan peningkatan kadar enzim jantung melebihi batas diagnostik. Data natrium dan klorida dianalisa menggunakan student's t-test dan data kalium dianalisa menggunakan Mann Whitney U Test. Perbedaan bermakna apabila $p < 0,05$. Penelitian ini dilakukan di 60 subjek dengan rerata umur 53,9 tahun pada kelompok STEMI dan 58,47 pada kelompok NSTEMI. Terdapat perbedaan bermakna pada kadar natrium antara pasien STEMI dan NSTEMI ($p=0,00$). Kadar kalium ($p=0,625$) dan klorida ($p=0,423$) tidak memiliki perbedaan bermakna antara dua kelompok tersebut. Terdapat perbedaan yang bermakna antara kadar natrium di pasien STEMI dengan NSTEMI ($p < 0,05$). Kadar natrium yang didapatkan lebih rendah di pasien STEMI dapat menjadi salah satu petanda laboratorium dalam melakukan diagnosis banding antara STEMI dengan NSTEMI.

Kata kunci: Infark miokard, STEMI, NSTEMI, natrium, kalium, klorida

ABSTRACT

Myocardial infarction has become one of the biggest causes of death in the world which is 30% of global death rate. STEMI and NSTEMI are distinguished by the degree of ischemia in the form of ST-segment elevation in the ECG of STEMI patients. Increased levels of cardiac enzymes are also found in both STEMI and NSTEMI. Several previous studies revealed changes in electrolyte levels in patients with myocardial infarction. This study aimed to analyze the differences in sodium, potassium and chloride levels of STEMI and NSTEMI patients. Cross-sectional design study, subjects were STEMI and NSTEMI patients which were treated at the Dr.Kariadi Hospital, Semarang with typical angina complaints, ECG with or without ST-segment elevation, accompanied by an increase of cardiac enzyme levels exceeding the diagnostic limit levels. The data of sodium and chloride were analyzed by student's t-test and the data of potassium was analyzed by Mann Whitney U Test. Significant when $p < 0.05$. This study was conducted on 60 subjects with an average age of 53.9 years in the group of STEMI and 58.47 in the NSTEMI group. There were significant differences in sodium levels between STEMI and NSTEMI patients ($p=0.00$). Potassium levels ($p=0.625$) and chloride ($p=0.423$) had no significant differences between the two groups. There were significant differences between the levels of sodium in patients with NSTEMI and STEMI ($p < 0.05$). Sodium levels were lower in patients with STEMI and it had a potential to be a laboratory biomarker in making the differential diagnosis between STEMI and NSTEMI.

Key words: Myocardial infarction, STEMI, NSTEMI, sodium, potassium, chloride

INTRODUCTION

Myocardial infarction has been considered as the biggest factor causing death in the world, reaching 30% of global mortality.^{1,2} A previous research even stated that 4% of the population in Indonesia has experienced angina.³

Myocardial infarction, moreover, is part of an acute coronary syndrome, involving some clinical situations, such as ST-Segment Elevation Myocardial Infarction (STEMI) and Non-ST-Segment Elevation Myocardial Infarction (NSTEMI). Myocardial infarction, thus, is a condition that can occur due to the state of ischemia prolonged in the heart muscle, where the availability of blood flow to the heart through the coronary arteries decreases beyond the critical threshold and then defeats the repair mechanism of cardiac muscle in maintaining normal homeostasis and function. As a result, this condition leads to irreversible damage and death of heart muscle cells.^{1,4,5}

Consequently, a quick and easy diagnosis is essentially needed since early treatment is expected to improve patient safety. Myocardial infarction is usually characterized by typical chest pain, changes in ECG and increased heart enzymes. Thus, cardiac enzymes, such as troponin and CKMB, must be examined to support and confirm the diagnosis of myocardial infarction.^{6,7}

In addition, electrolyte level is also impaired in the state of myocardial infarction. Electrolyte ions, especially sodium and potassium, are needed in generating the activation of the heart muscles, having a continual displacement between the intracellular and extracellular spaces, either by passive or active diffusion. The membranes of the heart muscle cells that are damaged in the state of myocardial infarction then will interfere with the sodium, potassium, and chloride channels, as well as sodium-potassium pumps, resulting in disruption of sodium and potassium levels in blood serum.⁸⁻¹¹

Therefore, this research aimed to determine whether there were differences in levels of sodium, potassium and chloride between STEMI and NSTEMI patients. This research was expected to improve knowledge about the significances of sodium, potassium and chloride levels used as parameters in the diagnosis of STEMI and NSTEMI patients.

METHODS

This research was a cross-sectional study conducted from January to September at the Dr. Kariadi

Semarang. Data used were taken from the medical records of patients diagnosed with myocardial infarction based on the diagnostic criteria of the European Society of Cardiology (ESC), The American College of Cardiology Foundation (ACCF), American Heart Association (AHA) and the World Heart Federation (WHF).¹² Those patients were then categorized into two groups based on the results of the ECG and cardiac enzymes, namely STEMI patients and NSTEMI patients. Those patients were also hospitalized in the Dr. Kariadi Hospital, Semarang during the research period.

This research involved sixty patients, aged over 18, consisting of 44 males and 16 females. Thirty patients were diagnosed with ST-Segment Elevation Myocardial Infarction (STEMI) together with angina symptoms based on ECG results as well as increased cardiac enzymes. Meanwhile, the other thirty subjects were diagnosed with NSTEMI together with angina symptoms based on ECG results as well as increased cardiac enzymes. However, those patients with comorbidities, such as kidney failure, diarrhea, stroke, COPD, gastrointestinal bleeding and cardiac surgery that can interfere with cardiac enzymes and electrolyte levels were excluded from this research. In addition, material used was blood serum. Ethical clearance then was obtained from the Committee of Medical and Health Research Ethics in Faculty of Medicine, University of Diponegoro, Semarang.

Next, electrolyte level examination was performed by using ion selective electrode method by ADVIA 1800 and TMS 50i. Normality test then was carried out by using Saphiro-Wilk test. Results of Saphiro-Wilk test indicated whether the data were normally distributed with a mean \pm SD of 95% CI. Afterwards, different tests were conducted by using T-test. The abnormally distributed data were presented in median form (the lowest value–the highest value) and then analyzed by using Mann Whitney U Test. Results of the statistical test were considered to be significant if $p < 0.05$.

RESULTS AND DISCUSSION

This research involved myocardial infarction patients with STEMI and NSTEMI treated in the Dr. Kariadi Hospital, Semarang. The total number of subjects who met the inclusion and exclusion criteria were 30 patients with STEMI and 30 patients with NSTEMI. The STEMI group consisted of 23 males (76.67%) and 7 females (23.33%) with an average age of 53.9 years. Meanwhile, the NSTEMI group consisted of 21 males (70%) and 9 females (30%) with

Table 1. Characteristics of the research subjects

Parameters	STEMI	NSTEMI	p
Sex			
Males	23 (76.67%)	21 (70%)	
Females	7 (23.33%)	9 (30%)	
Age (years)	53.9 ± 9.182	58.47 ± 9.576	0.064
Sodium (mmol/L)	134.27 ± 3.81	138.23 ± 3.31	0.00
Potassium (mmol/L)	3.95 (3.1 – 4.5)	3.95 (3.3 – 4.8)	0.625
Chloride (mmol/L)	100.03 ± 4.01	100.77 ± 2.94	0.423

an average age of 58.47 years. Characteristics of the research subjects can be seen in Table 1.

Normally distributed data were indicated with mean ± standard deviation and non-paired T-test

Non normally distributed data were indicated with median (min-max) and Mann-Whitney test

The results showed that the mean percentage of sodium level in the STEMI group was 134.27 ± 3.81 mmol/L. Meanwhile, the mean percentage of sodium level in the NSTEMI group was 138.23 ± 3.31 mmol/L. It means that the lower sodium level was found in the STEMI group. Thus, it can be said that there was a significant difference in sodium level between the two groups (p=0.00). Moreover, the median potassium levels in the STEMI group was 3.95 (3.1-4.5) mmol/L and 3.95 (3.3-4.8) mmol/L in the NSTEMI group. It means that there was no significant difference in potassium level between both groups (p=0.625). Similarly, there was no significant difference in chloride levels between the two groups (p=0.423), which is also in line with previous researches. The mean chloride level in the STEMI group was 100.03 ± 4.01 mmol/L and 100.77 ± 2.94 in the NSTEMI group.

Furthermore, the significant difference in sodium level between the STEMI group and NSTEMI group may suggest that disturbances in the sodium and potassium channels as well as in sodium-potassium pumps tend to occur more in STEMI patients than in NSTEMI patients, corresponding to the degree of ischemia experienced. Similarly, previous researches conducted by Mati et al⁹ and Wali and Yatiraj¹⁰ showed that hyponatremia and hypokalemia are often found in patients with myocardial infarction. Like those two previous researches, in this research hyponatremia was mostly found in the STEMI group (14 patients), while only five patients in the NSTEMI group

In addition, myocardial infarction will also lead to hypoxia and ischemia, affecting the permeability of the heart muscle membrane so that sodium diffuses more easily into the cells, as well as decreasing the function of the sodium-potassium pumps so that

sodium cannot be pumped out of the cell, resulting in hyponatremia.^{8,13-15} Hyponatremia in patients with myocardial infarction may also occur due to non-osmotic secretion of vasopressin, which then triggers a water excretion disorder, resulting in hyponatremia due to plasma dilution.⁹ In another previous research conducted by Goldberg et al and reinforced by other previous researches, the presence of hyponatremia in STEMI patients from the beginning of treatment or during the first 72 hours is independently associated with an increased risk of death in the first 30 days and in long-term.¹⁶⁻¹⁸

On the other hand, the incidence of hypokalemia was found in 8 patients of the STEMI group (26.67%) and 5 patients of the NSTEMI group (16.67%). The results of this research, however, were not in line with results of the previous researches conducted by Mati et al, Wali and Yatiraj.^{9,10} The low percentage of hypokalemia in those two research groups as well as the presence of insignificant differences may be due to the small number of the subjects or the disrupting factors of electrolyte levels, especially potassium, which have not been considered before, such as the use of drugs and the presence of coexisting diseases affecting potassium level.

CONCLUSION AND SUGGESTION

In conclusion, there was a difference in sodium levels between STEMI and NSTEMI patients (p <0.05). But, there was no difference in potassium and chloride levels between STEMI and NSTEMI patients (p > 0.05). The low level of sodium in STEMI patients can be considered as one of the laboratory markers in making differential diagnoses between STEMI and NSTEMI. This condition can also determine the effects of electrolyte level in the pathogenesis and treatment of patients with myocardial infarction.

As a result, further researches must involve more subjects with more detailed data, such as drug use and history of other diseases. Further researches also had

better focus more on hyponatremia and hypokalemia as predictors of mortality and morbidity rates between STEMI and NSTEMI patients.

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