Research

Open Access

Correlation between Troponin I and Serum Sodium and Potassium Levels in Acute Coronary Syndrome

Hadiyatur Rahma[1), Ricke Loesnihari[2], Dewi Indah Sari Siregar[2],

[1)Faculty of Medicine, Universitas Islam Sumatera Utara
[2)Department of Clinical Pathology, Faculty of Medicine,
Universitas Sumatera Utara/ Central Hospital Adam Malik Medan

ABSTRACT

Background: Acute Coronary Syndrome covers a spectrum of conditions that include patients who have recently changed symptoms or clinical signs, with or without changes in the 12-lead electrocardiogram, and with or without acute elevations in cardiac troponin (Tn) concentrations. Advances in technology have refined troponin testing and increased its accuracy in detecting and measuring cardiomyocyte injury, high sensitivity, and can detect small myocardial necrosis that is not detected on an electrocardiogram or CKMB examination. This study aims to analyze the correlation between troponin I and sodium and potassium levels in acute coronary syndrome.

Subjects and Method: This study was an analytical observational research with a cross-sectional design, involving 40 patients with acute coronary syndrome who visited the Integrated Heart Center Emergency Department. The independent variable is acute coronary syndrome, while the dependent variables are troponin I, sodium, and potassium. The study was conducted at H.Adam Malik Hospital in Medan from February to March 2024. Patients were interviewed for medical history, and then blood samples were taken for troponin I examination and serum electrolyte (sodium and potassium) examination. Data were analyzed using the Spearman correlation test.

Results: 40 study subjects, most of the study subjects over 55 years, mostly male (72.5%), with a smoking history of 67.5%, and a family history of hypertension of 52.5%. The median troponin I level was 6.09 ng/ml (range 0.12-15), the median sodium level was 143.5 mmol/L (range 130-155), and the mean potassium level was 4.19 mmol/L (SD= 0.52). There was a weak and non-significant positive correlation between troponin I and sodium (r= 0.129, p= 0.429), as well as a weak and non-significant positive correlation between troponin I and potassium (r= 0.059, p= 0.717).

Conclusion: There was no correlation between troponin I and sodium, as well as troponin I and potassium.

Keywords: acute coronary syndrome, calcium, potassium, sodium

Correspondence:
Hadiyatur Rahma. Faculty of Medicine, Universitas Islam Sumatera Utara, Medan, Indonesia. Email: hadiyatur.rahma-@fk.uisu.ac.id. Mobile: +628535907125.

BACKGROUND

Acute Coronary Syndrome (ACS) is a major cardiovascular problem because it causes high hospitalization rates and mortality rates and also uses a fairly high budget. Based on data from the World Health Organization (WHO), coronary heart disease is the leading cause of death in the world, with more than 9 million people dying in 2016, and is still the leading cause of death globally in the last 15 years (WHO, 2020). The results of the 2018 Basic Health Research (Riskesdas) stated that the prevalence of heart disease in Indonesia based on a diagnosis by a doctor was 1.5% or 1,017,290 people (Health Research and Development Agency, Ministry of Health of the Republic of Indonesia. 2018. Basic Health Research, 2018).

Acute myocardial infarction occurs when blood flow to the heart is interrupted. This lasts longer and causes damage to the heart muscle, increasing the metabolic demands of the myocardium and reducing the supply of oxygen and nutrients reaching the heart muscle through the coronary circulation. Severe and prolonged chest pain that can radiate further is common neck, shoulders, and even arms (Lily, 2019). One of the biochemical markers of Troponin T specifically for the heart is used to diagnose heart attacks Troponin T (TnT) and troponin I specific for the heart / TnI (Indonesian Cardiovascular Specialist Doctors Association, 2018). In a study conducted in Surabaya in 2020 on 33 patients suspected of having ACS, the average TnI level was higher within 6 hours with p=0.000 indicating a significant relationship between TnI and the incidence of acute myocardial infarction in RSUD Dr. Soetomo Surabaya. A study of 35 AMI patients in Bojonegoro in 2021 showed an increase in troponin I with an average of 5.79 ng/ml. (Sutikno, 2022).

Serum electrolytes such as sodium, potassium, and calcium are the three main electrolytes of heart muscle cell electrophysiology associated with acute myocardial infarction (AMI). (Lily, 2019). Electrolytes also play a role in prognostication in patients with acute myocardial infarction. According to several previous studies, electrolyte changes are used to monitor the course of AMI patients.

A study conducted on 50 patients with AMI, 50 healthy people, in India in 2018 stated that sodium and potassium levels were lower than healthy people, $p<0.001$. (Rathore et al., 2018). A study of 57 AMI patients in Surakarta in 2018 stated that hyponatremia occurred in 71.9% and potassium within normal limits in 83.5% (Putri et al, 2018).

A study conducted in Pakistan in 2019 on 20 normal people, and 20 patients with AMI stated an increase in sodium and a decrease in potassium in AMI patients compared to healthy people. (Hasan et al., 2019). Research conducted in Karad in 2016 stated that 27% of all AMI patients experienced hyponatremia, 24% hypokalemia, and 49% hypocalcemia. (Patil et al., 2019).

A study conducted on 35 ACS patients in Semarang in 2020 stated that there was a strong negative correlation between troponin and sodium (r=-0.746, p=0.000), troponin and potassium (r=-0.574 and p=0.000), troponin and chloride and troponin and magnesium (r=-0.564 and p=0.000) (Wijayanti and Adipireno, 2020). A study conducted on 65 ACS patients in Jakarta in 2020 stated that there was a correlation between troponin I and sodium (r=-0.39, p<0.05), and potassium (r=-0.487, p<0.05) (Prasetyorini et al., 2022).

The correlation value of several studies that have been studied previously with different correlation values, namely

positive correlation and negative correlation. Based on the differences in correlation results from previous studies and the absence of similar research data, especially in the city of Medan, researchers are interested in examining the correlation of troponin I with serum sodium and potassium levels in acute coronary syndrome.

This study was to analyze the correlation of troponin I with serum sodium and potassium levels in acute coronary syndrome.

SUBJECTS AND METHOD

1. Study Design
This study is an analytical observational study with a cross-sectional design at H. Adam Malik General Hospital, Medan from February 2024 to March 2024.

2. Population and Sample
The subjects in this study were 40 patients diagnosed with acute coronary syndrome, who met the inclusion criteria, namely new patients who came for treatment to the Emergency Room of the Integrated Heart Center and were diagnosed with acute coronary syndrome, with an onset of attack <24 hours and had not received fluid therapy and exclusion criteria, namely patients who received drug therapy that affected sodium, potassium, calcium levels (insulin, glucose fluid, spironolactone, furosemide, captopril). Creatinine> 2mg / dL, known to have a history of heart valve disease, a history of hypothyroidism, and hyperthyroidism.

3. Study Variables
The dependent variables are troponin, potassium, and sodium, the independent variable is acute coronary syndrome.

4. Operational Definition
Acute coronary syndrome is a spectrum of conditions that includes patients who have a recent change in symptoms or clinical signs, with or without changes in the 12-lead electrocardiogram (ECG), and with or without an acute increase in cardiac troponin (Tn) concentrations.

Troponin I is a regulatory protein in muscle cells that controls the interaction between myosin and actin. Troponin examination using the ichroma II tool.

Natrium is a compound in solution that dissociates into positively and negatively charged particles (ions) which are the most abundant extracellular electrolytes. Sodium examination using the Biocare Biolyte 2000 tool.

Kalium is a compound in solution that dissociates into positively and negatively charged particles (ions) which are the most abundant intracellular electrolytes. Potassium examination using the Biocare Biolyte 2000 tool.

5. Study Instrument
Patients were anamnesis by interview to obtain subject characteristic data including age, gender and family history of hypertension.

6. Data Analysis
Data were analyzed using Statistical Program and Service Solution (SPSS) software. Bivariate test to analyze the Spearman Correlation test.

7. Research Ethics
This research has received approval from the Ethics Commission of the Faculty of Medicine, University of North Sumatra with No. 56/KEPK/USU/2024, and a research permit from the Research and Development Installation of H. Adam Malik General Hospital, Medan with No. DP.04.03/D.XX-VIII.2.2.3/290/2024.

RESULTS
The subjects who participated in this study were 40 people who were overall aged 55-60 years (35%) with an average age of 59 years. The gender of the study subjects was more male, namely 29 people (72.5%)

compared to female, namely 11 people (27.5%). Of the study subjects who had a family history of hypertension 21 people (52.5%) while 19 people (47.5%) did not have a family history of hypertension (Table 1). Median Troponin I levels were 6.09 ng/mL with a minimum-maximum range of 0.12-15 ng/mL. Median Sodium levels were 143.5 mmol/L with a minimum-maximum range of 130-155 mmol/L. Average Potassium levels were 4.19 with a standard deviation range of ±0.52 (Table 2). The correlation value with the Spearman test between Troponin I and Sodium levels was not significant, namely r=0.129, p = 0.429. The correlation between Troponin I and Potassium was not significant, namely r= 0.059, p= 0.717 (Table 3).

Table 1 Characteristics of research subjects

Characteristics	Subjects(n=40)
Age (Year)	
37-42 (%)	3(7.5)
43-48 (%)	2(5)
49-54 (%)	5(12.5)
55-60 (%)	14(35)
61-66 (%)	8(20)
67-72 (%)	3(7.5)
73-78 (%)	3(7.5)
79-84 (%)	2(5)
Mean (SD)	59.2 (10.10)
Gender	
Male (%)	29(72.5)
Female (%)	11(27.5)
Family History of Hypertension	
Hypertension (%)	21(52.5)
No hypertension (%)	19(47.5)

Table 2 Laboratory results of research subjects (n=40)

Parameter	Value
Troponin I (ng/ml)	
Median (Min-Max)	6.09 (0.12-15)
Natrium (mmol/L)	
Median (Min-Max)	143.5 (130-155)
Kalium (mmol/L)	
Mean (SD)	4.19 (0.52)

Table 3 Spearman Correlation Test

Troponin I (ng/ml)	r	p
Natrium (mmol/L)	0.129	0.429
Kalium (mmol/L)	0.059	0.717

DISCUSSION

In table 1, the age of the research subjects was in the age range of 37-79 years with an average age of 59 years. and the most in the range of 55-60 years as many as 14 people (35%). In line with the research of Muhibbah et al. in 2019 which stated that the majority of SKA sufferers were over 45 years old (Muhibbah *et al.,* 2019). The findings of this study are the same as those of Rodgers et al. in 2019, namely that increasing age can cause blood vessels to

experience changes that can gradually affect heart function (Rodgers *et al*, 2019). Increasing age is related to the increase in time used for the process of fat deposition on the walls of the arteries. In addition, the process of fragility of the walls of the arteries is getting longer so the older a person is, the greater the possibility of being attacked by coronary heart disease (Visseren *et al*, 2021).

The gender of the research subjects was found to be more male than female, namely 29 males (72.5%) and 11 females (27.5%). Most SKA sufferers in this study were male, namely 72.5%. The results of this study follow research conducted by (Rodgers *et al*, 2019) the majority of SKA sufferers are male. Other research conducted by (Firdaus *et al.,* 2018) that SKA occurs more often in men than women. The results of this study follow the theory that men are 4 times more likely to die from heart disease than women (Winzer *et al.,* 2018). Men are more susceptible to SKA, this is because women have estrogen hormones and increased lipids that protect against atherosclerosis (Meyer & Barton, 2016). Women are at risk of developing ACS after menopause due to decreased estrogen levels and increased lipids in the blood (Rodgers et al., 2019). In the United States, the SKA symptoms comparison of SKA case findings is 1 in 5 men and 1 in 17 women. This means that men have a risk 2-3 times greater than women (Lopez *et al.,* 2022).

In this study, subjects who had a family history of hypertension were found in 21 subjects (52%). The risk of developing acute coronary syndrome due to hypertension is in line with research by Weber et al in 2016, which states that there is a relationship between a history of hypertension and the occurrence of acute coronary syndrome (Weber *et al,* 2016). Hypertension is related to coronary heart disease by accelerating the process of atherosclerosis, increasing peripheral vascular resistance increases afterload (after filling) and ventricular needs, resulting in increased myocardial oxygen needs to cope with reduced supply (Lopez et al, 2022; Visseren et al, 2021).

In table 2, the median Troponin I level is 6.09 ng/mL with a minimum-maximum value range of 0.12-15 ng/mL. The results of this study state that acute coronary syndrome patients experience an increase in troponin I which is in line with research in Bojonegoro (2021), with an average increase in troponin I of 5.79 ng/mL (Sutikno, 2019).

The median sodium level was 143.5 mmol/L with a minimum-maximum range of 130-155 mmol/L. The results of this study stated that serum sodium levels in ACS patients were still within normal limits with a median value of 143.5 mmol/L. Patients in this study had not shown hyponatremia which theoretically states that sodium plays an important role in the electrophysiology of heart muscle cells associated with acute myocardial infarction (AMI) (Lily, 2019). The results of this study are not in line with the IMA study in Surakarta (2018) which stated that hyponatremia occurred by 71.9% and potassium was within normal limits of 83.5% (Putri *et al.,* 2018) and also not in line with research in Semarang (2017) which stated that in STEMI patients sodium was lower than in NSTEMI patients, but there was no difference in potassium between STEMI and NSTEMI patients (Ciptono and Rahayu, 2017).

The average potassium level was 4.19 mmol/L with a standard deviation range of ±0.52. The results of this study are not in line with research in Gaza (2016) which stated that there was a decrease in

potassium in AMI patients (Marzoq et al., 2016). The results of this study are not in line with research in Semarang (2019) which stated a strong negative relationship between sodium and potassium with TnI which showed that serum sodium and potassium levels were significantly reduced in AMI cases when compared to normal healthy controls (Wijayanti and Adipireno, 2020).

Serum sodium, potassium and calcium in the results of this study were still within normal limits, this is because the occurrence of AMI has not caused changes in serum sodium and potassium in the body, although there is research that states that the occurrence of hyponatremia and hypokalemia is comparable to the risk of death from AMI (Jain and Sharma, 2018).

In table 3, the correlation value with the Spearman test between Troponin I and Sodium levels is not significant, namely r= 0.129, p= 0.429. The results of this study are not in line with the results of a study in Semarang (2020) which stated that there was a strong negative correlation between troponin I and sodium (r= -0.746, p< 0.001), that the higher the troponin I levels, the lower the serum sodium levels (hypo-natremia). The difference in the results of this study could be caused by differences in the onset of attacks, genetic variations, and fast and appropriate treatment so that after the attack, there has been no change in electrolyte levels, especially sodium. Theo-retically, the occurrence of AMI attacks is not directly related to body electrolyte levels (different pathways), but theoreti-cally, they can influence each other.

The correlation between Troponin I and Potassium was not significant, namely r= 0.059, p= 0.717. The results of this study are not in line with the results of a study by Semarang (2020) which stated that there was a strong negative correlation between troponin I and sodium (r= -0.574, p <0.001), that the higher the troponin I levels, the lower the serum potassium levels (hypokalemia). The difference in the results of this study could be caused by differences in the onset of attacks, genetic variations, and fast and appropriate treatment so that after the attack, there has been no change in electrolyte levels, especially potassium. Potassium is most quickly excreted through gastrointestinal secretions. Potassium moves continuously into and out of cells, this rapid movement in the event of AMI is still in balance, so that hypokalemia has not occurred.

This study concluded that there was no significant correlation between troponin I and serum sodium and potassium levels in acute coronary syndrome.

AUTHOR CONTRIBUTIONS
Rickel Loesnihari and Dewi Indah Sari Siregar as supervisors and input providers related to literature review, and research methods. Hadiyatur Rahma as the writer and thinker of data analysis and discussion of the results.

ACKNOWLEDGEMENT

FINANCIAL AND SPONSORSHIP

CONFLICT OF INTEREST
There is no conflict of interest in this study.

REFERENCE
Adidharma IF, Nugraha J, Aminuddin M (2020). The association between myoglobin, troponin i, hfabp and nt-probnp levels with acute myocardial infarction in patients with acute

coronary syndrome. Indian J Med Forensic Med Toxicol. 14(2):8. https://doi.org/10.37506/ijfmt.v14i2.3157.

Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan RI. 2018. Riset Kesehatan Dasar 2018. Jakarta

Ciptono F, Rahayu M (2017). The differences of sodium, potassium and chloride levels in STEMI and NSTEMI patients. Indonesian Journal of Clinical Pathology and Medical Laboratory. 24(1): 91-94. https://doi.org/10.24293/ijc-pml.v24i1.1163.

Firdaus AAA, Savitri AD, Bistara DN (2018). Hubungan Peningkatan Nilai Kadar Creatine Kinase-MB Mortalitas Pasien Sindroma Koroner Akut (SKA). The Indonesian Journal of Health Science, 10(2): 26-35. https://-doi.org/10.32528/ijhs.v10i2.1854

Hasan R, Serafi A, Javed A, Mushtaq S, Sahar N (2019). A study to compare serum electrolytes concentrations of normal individuals with valvular heart disease and myocardial infarction patients. Int J Cardiovasc Dis Diagn. 4(1): 022-027.

Jain S, Sharma R (2018). Evaluation of Electrolyte Imbalance in Myocardial Infarction Patients at Tertiary Care Center. International Journal of Medical Science and Education. 5(1): 117-121.

Lily SL (2019). Patofisiologi Penyakit Jantung, Edisi 6. Diterjemahkan oleh Ahmad Handayani dkk. Jakarta: EGC.

Lopez EO, Ballard BD, Jan A (2023). Cardiovascular disease. In StatPearls [Internet]. StatPearls Publishing.

Marzoq LA, Jaber WH, Azzam DKH (2016). Electrolyte level changes in acute myocardial infarction patients as compared to healthy individuals in Khan Younis Governorate, Gaza Strip.

Advances in Biochemistry, 4(2): 9-15. https://doi.org/10.11648/j.ab.20160402.11.

Meyer MR, Barton M (2016). Estrogens and coronary artery disease: new clinical perspectives. Advances in Pharmacology. 77: 307-360. https://doi.org/10.1016/bs.apha.2016.05.003.

Muhibbah M, Wahid A, Agustina R, Illiandri O (2019). Karakteristik pasien sindrom koroner akut pada pasien rawat inap ruang tulip di RSUD Ulin Banjarmasin. Indonesian Journal for Health Sciences, 3(1): 6-12. https://-doi.org/10.24269/ijhs.v3i1.1567.

Patil S, Gandhi S, Prajapati P, Afzalpurkar S, Patil O, Khatri M (2016). A study of electrolyte imbalance in acute myocardial infarction patients at a tertiary care hospital in western Maharashtra. Int J Contemporary Med Res. 3(12): 3568-71.

Perhimpunan Dokter Spesialis Kardiovaskuler Indonesia (2018). Pedoman Tatalaksana Sindrom Koroner Akut. http://www.ina-heart.org/upload/-image/Buku-ACS-2018.pdf

Prasetyorini T, Lestari D, Farhah DG, Fratidhina Y (2022). Correlation Between Troponin I Levels and Electrolytes of Sodium and Potassium in Acute Coronary Syndrome Patients at Budhi Asih Hospital. International Journal of Science and Society. 4(1): 187-95. https://doi.org/10.54783/ijsoc.v4i1.428.

Putri RN, Suryanti S, Lestari S (2018). Gambaran Serum Elektrolit Pada Pasien Acute Miocard Infark (AMI) Di Ruang Intensive Cardiovaskuler Care Unit (ICVCU) RSUD Dr. Moewardi Di Surakarta. (JKG) Jurnal Keperawatan Global, 3(2): 119-131. https://doi.org/10.37341/-jkg.v3i2.59.

Rathore V, Singh N, Mahat RK (2018). Electrolyte imbalance in patients of acute myocardial infarction: a study from Central India. Age (years), 58 (10-36): 61-96. https://dx.doi.org/10-.18535/jmscr/v6i5.117.

Rodgers JL, Jones J, Bolleddu SI, Vanthenapalli S, Rodgers LE, Shah K, Karia K, Panguluri SK (2019). Cardiovascular risks associated with gender and aging. Journal of cardiovascular development and disease, 6(2): 19. https://doi.org/10.3390/jcdd-6020019.

Sutikno E (2022). Hubungan Kadar Troponin I dengan SGOT pada Pasien Infark Miokard di RSUD Dr. R. Sosodoro Djatikoesoemo Bojonegoro. Jenggala: Jurnal Riset Pengembangan dan Pelayanan Kesehatan, 1(02).

Visseren FL, Mach F, Smulders YM, Carballo D, Koskinas KC, Bäck M, Benetos A, Biffi A, Boavida JM, Capodanno D, Cosyns B (2022). 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice: Developed by the Task Force for cardiovascular disease prevention in clinical practice with representatives of the European Society of Cardiology and 12 medical societies With the special contribution of the European Association of Preventive Cardiology (EAPC). European journal of preventive cardiology, 29(1): 5-115. https://doi.org/-10.10-93/eurjpc/zwab154

Weber T, Lang I, Zweiker R, Horn S, Wenzel RR, Watschinger B, Slany J, Eber B, Roithinger FX, Metzler B (2016). Hypertension and coronary artery disease: epidemiology, physiology, effects of treatment, and recommendations: A joint scientific statement from the Austrian Society of Cardiology and the Austrian Society of Hypertension. Wiener Klinische Wochenschrift. 128: 467-479. https://doi.org/10.1007/s00508-016-0998-5

Wijayanti E, Adipireno P (2020). Hubungan Kadar Elektrolit dengan Petanda Jantung pada Sindrom Koroner Akut. Medica Hospitalia: Journal of Clinical Medicine. 7(1): 27-33. https://doi.org-/10.36408/mhjcm.v7i1.424.

Winzer EB, Woitek F, Linke A (2018). Physical activity in the prevention and treatment of coronary artery disease. J Am Heart Assoc. 7(4): p.e007725. https://doi.org/10.1161/JAHA.117.007725.

World Health Organisation, 2020. The top 10 causes of death. World Health Organisation.