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# Overview Profile of High Sensitive Troponin I (hsTnI) Levels Based on Infarction Location in Acute Myocardial Infarction Patients: A Single Center Observational Study at Dr. M. Djamil General Hospital, Padang, Indonesia

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**A B S T R A C T**

**Background:** Acute myocardial infarction (AMI) remains an important health problem globally. A diagnosis of AMI can be made by finding at least two of the three criteria, namely typical angina pain, electrocardiography (ECG) abnormalities, and increased cardiac biomarkers. Variations in troponin levels based on examination time and infarct location were obtained from previous studies. High-sensitive troponin I (hsTnI) is a very specific biomarker in detecting myocardial damage. This study aims to determine the description of hsTnI levels based on the location of the infarction in AMI patients of Dr. M. Djamil General Hospital Padang. The location of the infarction in AMI determines the management and prognosis for the clinician. **Methods:** This research is a retrospective study with a cross-sectional design at the Laboratory Installation of Dr. M. Djamil General Hospital Padang. The sample was adult patients diagnosed with AMI with complete data that met the inclusion and exclusion criteria, taken from medical records. **Results:** This study showed that from a total of 140 AMI patients, 67 samples met the inclusion criteria. A total of 67 AMI patients consisted of 59 men (88.06%) and 8 women (11.94%) with an average age of 60.1 + 10.5 years. The highest hsTnI levels were found at the posterior infarction location, 40,000 ng/L (16,639-48,997). The location of the infarction was dominated by the inferior infarction location in 20 people (29.9%). **Conclusion:** The highest hsTnI levels were found at the posterior infarction location. The location of the infarction is dominated by the inferior infarction location in AMI patients with ST elevation at Dr. M. Djamil General Hospital Padang.

## 1. Introduction

Cardiovascular disease is the main cause of death globally. Acute coronary syndrome (ACS) is a clinical manifestation of the critical phase of coronary artery disease, namely a collection of complaints and clinical signs consistent with acute myocardial infarction. Acute coronary syndrome occurs when there is an imbalance between the supply and demand of oxygen in the myocardium due to inadequate blood and oxygen supply to the myocardium. Acute myocardial infarction (AMI) is classified into three based on history, physical examination, electrocardiogram (ECG) examination, and cardiac biomarker examination, namely ST-elevation myocardial infarction (STEMI), non-ST elevation myocardial infarction (NSTEMI) and unstable angina pectoris (STEAM).[1,2] World Health Organization (WHO) data states that coronary artery disease has been the number one cause of death in the world for the last 15 years and in 2019 caused the death of 17.9 million people or the equivalent of 32% of deaths worldwide. The World Health Organization estimates that this figure will continue to increase and by 2030 there will be 23.6 million people in the world who will die from cardiovascular disease. Southeast Asia found 3.5 million cardiovascular disease deaths, 52% of which were caused by myocardial infarction.[2-4] The prevalence of heart disease in Indonesia based on Basic Health Research published by the Ministry of Health of the Republic of Indonesia in 2018 is 1.5%, while in West Sumatera Province it is 1.6%. Acute myocardial infarction is a frequent emergency. Increased mortality due to AMI occurs in Indonesia every year, 70% of fatal events are caused by atherosclerotic plaque occlusion.[2-4]

Myocardial infarction must be treated quickly and efficiently because prolonged ischemia can cause irreversible damage and determine the prognosis. The ECG examination at the beginning of the examination may not be clear, but the ECG is important to use in diagnosing myocardial infarction, especially for the purpose of subsequent therapy. An electrocardiogram is an important examination for the initial evaluation of patients with chest pain because ECG can predict the location of the infarct, the extent of the infarct, and the prognosis. The location of the infarct plays an important role in the management of AMI patients and in determining the prognosis of AMI. Biomarker examination is needed in "low risk" cases, in cases that are undiagnosed or have a normal ECG.[7] Definitive AMI is with symptoms and signs of typical angina pain, an ECG with elevation that is diagnostic of acute ST-segment elevation myocardial infarction (AMI-EST), ST depression or T inversion that is diagnostic of myocardial ischemia or left bundle branch block (LBBB) new/presumed new and improved cardiac biomarkers.[2,8]

Troponin I/T as a biomarker of cardiac necrosis has higher sensitivity and specificity than creatine kinase myocardial band (CK-MB). Troponin levels in patients with acute myocardial infarction increase in peripheral blood 3-4 hours after the onset of the infarction and persist for up to 2 weeks. A mild increase in troponin levels usually disappears within 2-3 days, but if extensive necrosis occurs, the increase can persist for up to 2 weeks.[2,5] The European Society of Cardiology (ESC) recommends checking troponin one to three hours after an attack using a probe highly sensitive troponin compared with conventional troponin. Inspection high sensitive troponin I (hsTnI) can meaningfully diagnose early ACS.[7,9]

Based on previous research, troponin variations were found based on the location of the infarction. Research by Baheti et al. (2002) found variations in troponin levels based on the time of troponin examination and the location of the infarction. Troponin levels increased at 4-6 hours of examination and ≥10 hours and troponin levels were higher in the anterior location compared to other locations when viewed based on the location of the infarction.[10] Sagala et al. (2016) examined the description of troponin levels based on examination time and infarction location in AMI patients at Prof. Dr. R. D Kandou General Hospital Manado, obtained from a total of 61 AMI patients, 26 samples met the criteria. NSTEMI infarction types are dominated by anteroseptal and anterolateral infarct locations. The most common infarct locations were anteroseptal and anterolateral, 6 people each (23.1%). Troponin T levels based on infarct location were highest in the right ventricular infero with a mean value of 1363 ng/L (38%) followed by anteroseptal 619.67 ng/L (17%), lateral 473 ng/L (13%), anterolateral 395 ng/L (11%), extensive anterior 272.5 ng/L (8%), anterolateral infero 191 ng/L (5%), inferior 115.67 ng/L (3%), anteroseptal infero 111.5 ng/L ( 3%) and infero posterior 74.5 ng/L (2%).[11,12] The results of several studies regarding increased troponin levels are considered to have a role in assessing the location of infarction in AMI, but there is no specific description of hsTnI levels as the most sensitive and specific cardiac biomarker based on infarct location in AMI patients.[8] Research regarding the description of hsTnI levels based on infarction location in Indonesia is still limited. Based on the background above and research on the description of hsTnI levels based on the location of the infarction in AMI patients at Dr. M. Djamil General Hospital Padang has never been carried out, this study aims to determine the description of hsTnI levels based on the location of the infarction in AMI patients at Dr. M. Djamil General Hospital Padang.

## 2. Methods

The research was conducted at the Central Laboratory Installation and Medical Records Installation at Dr. M. Djamil General Hospital Padang from April 2023 to September 2023. This research is a retrospective study with a cross-sectional design. The population is all patients who were diagnosed with AMI by a heart and blood vessel specialist who performed an hsTnI examination when they first came to the emergency room at Dr. M. Djamil General Hospital Padang for the period April 2023 to September 2023. The research sample is part of the population that meets the inclusion and exclusion criteria.

The inclusion criteria for this study were patients aged ≥18 years who underwent hsTnI laboratory tests and an ECG while in the emergency room and had complete medical record data, namely age, gender, infarction location, and hsTnI levels. The exclusion criteria for this study were patients with chronic kidney disease, patients with ECG results of infarction locations other than anterior STEMI, extensive anterior STEMI, anteroseptal STEMI, inferior STEMI, inferolateral STEMI, inferoposterior STEMI, and posterior STEMI.

Patient characteristic data is processed and presented in tabular form and numerical data are carried out Kolmogorov-Smirnov test for data normality. Abnormal data is displayed as the median and normal data is displayed as the mean. The analysis data was processed descriptively to describe hsTnI levels based on infarction location in AMI patients with ST elevation. Data is processed and presented in the form of tables and graphs.

## 3. Results

The characteristics of AMI patients with ST elevation who meet the inclusion criteria in this study can be seen in Table 1. Table 1 shows the characteristics of the 67 patients involved in the study. The average patient age was 60.1 years with a standard deviation of 10.5 years. The majority of patients were male (88.06%), with only 8 females (11.94%) included in the study. The mean age of patients suggests that myocardial infarction is more common in older adults. The predominance of men in this study is in line with epidemiological findings which show that men are more susceptible to myocardial infarction than women.

Table 1. Patient characteristics.

| **Characteristics** | **n=67** |
|---|---|
| **Age (years) (Mean (SD))** | 60,1 (10,5) |
| **Gender (n(%))** | |
| Male | 59 (88,06%) |
| Female | 8 (11,94%) |

The location of the infarction was found in the emergency room at Dr. M. Djamil General Hospital Padang is shown in Table 2. Based on data from 67 patients, the most common locations for myocardial infarction were inferior (29.9%) and anterior (26.9%). This shows that these two areas are the areas most vulnerable to ischemia and damage due to blocked coronary arteries. Followed by inferioroposterior (25.4%), extensive anterior (6%), anteroseptal (3%), and posterior (4.5%) locations. This distribution of infarct locations can help doctors understand the pattern of myocardial damage and estimate the areas of the heart that are most affected. Median hsTnI levels (6519 ng/L) indicated significant myocardial damage.

hsTnI (high-sensitivity troponin I) is a sensitive and specific troponin biomarker for myocardial damage. Elevated hsTnI levels reflect the release of troponin I from necrotic myocardial cells. Information about infarct location and hsTnI levels is important for the diagnosis and management of myocardial infarction. Doctors can use this information to determine the type of infarction, identify the areas of the heart most affected, and predict potential complications.

Table 2. Location of infarction in the emergency room of Dr. M. Djamil General Hospital Padang.

| **Infarct location** | **n=67** | **Percentage (%)** |
|---|---|---|
| Anterior | 18 | 26,9 |
| Extensive anterior | 4 | 6 |
| Anteroseptal | 2 | 3 |
| Inferior | 20 | 29,9 |
| Inferolateral | 3 | 4,5 |
| Inferoposterior | 17 | 25,4 |
| Posterior | 3 | 4,5 |
| **hsTnI level (ng/L) (median (IQR))** | 6519 1-40000) | |

The differences in hsTnI levels depending on the location of the infarction in this study are presented in Table 3. Table 3 shows the median levels of hsTnI (high-sensitivity troponin I) in patients with myocardial infarction at various infarction locations. hsTnI is a sensitive and specific troponin biomarker for myocardial damage. Elevated hsTnI levels reflect the release of troponin I from necrotic myocardial cells. The highest median hsTnI levels were found in patients with posterior infarction (40,000 ng/L), followed by anterior (24,458 ng/L). The lowest median hsTnI levels were found in patients with extensive anterior (1,037 ng/L) and anteroseptal (10,621 ng/L) infarctions. This distribution of hsTnI levels indicates that posterior and anterior infarctions generally cause more extensive myocardial damage than other infarction locations. The higher levels of hsTnI in posterior and anterior infarctions may be due to the larger infarcted area and greater blood supply to that area. The lower levels of hsTnI in extensive anterior and anteroseptal infarcts may be due to the smaller infarcted area and less blood supply to the area.

Table 3. Differences in hsTnI levels depending on infarction location.

| **Infarct location** | **Median (ng/L) (IQR)** |
|---|---|
| Anterior | 24.458 (1.288-40.000) |
| Extensive anterior | 1.037 (170-4.040) |
| Anteroseptal | 10.621 (8.872-10.621) |
| Inferior | 3.428 (608-35.715) |
| Inferolateral | 12.783 (10.645-12.783) |
| Inferoposterior | 2.311 (292-18.008) |
| Posterior | 40.000 (16.639-48.997) |

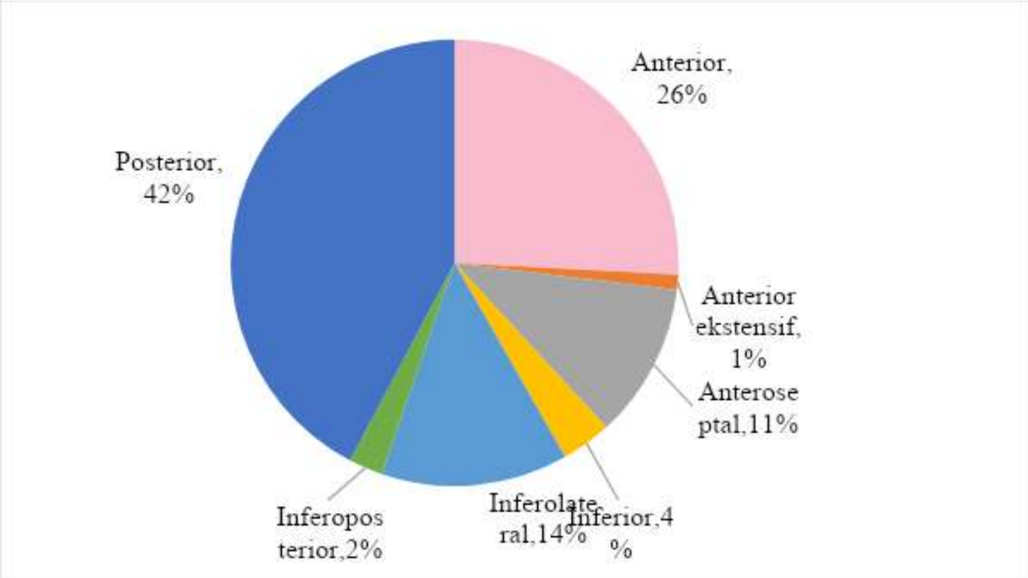


Figure 1. The median value of HsTnI levels based on infarction location.

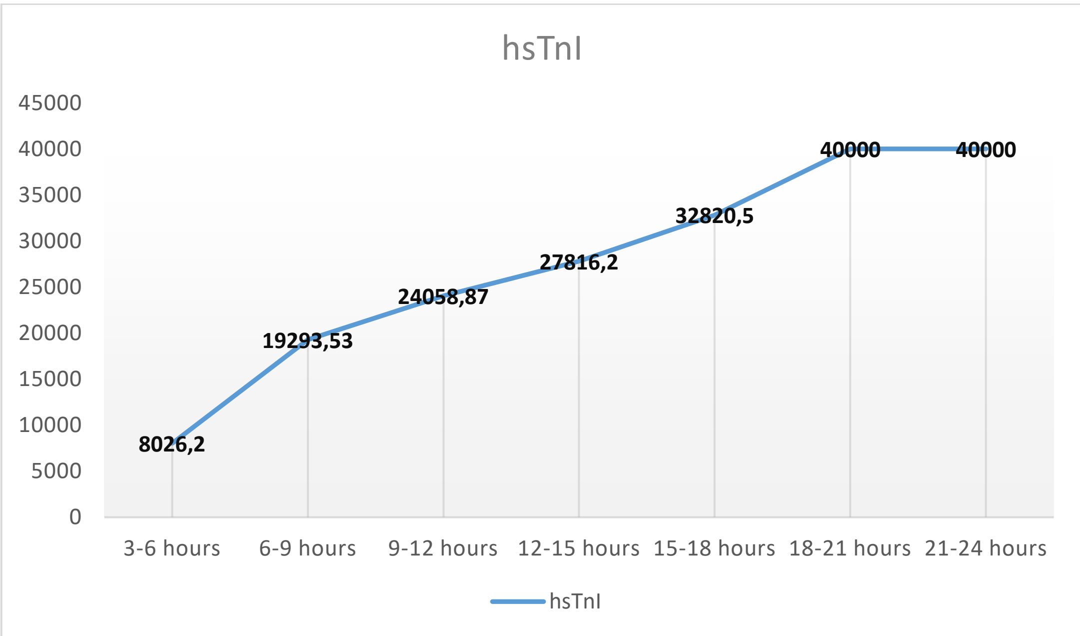


Figure 2. The average value of HsTnI levels based on examination time.

The percentage of median hsTnI levels based on infarct location is shown in Figure 1. Figure 1 shows the highest percentage of hsTnI levels in the posterior with a percentage of 42% and the lowest in the extensive anterior with a percentage of 1%. The results of differences in hsTnI levels relative to examination time can be seen in Figure 2. Figure 2 shows the differences in mean values of hsTnI levels based on examination time. The hsTnI examination time used is the time period calculated from the onset until the hsTnI examination is carried out when the patient first comes to the emergency room at Dr. M. Djamil General Hospital Padang. The division of the 3-hour examination time span on the average value of hsTnI levels starting from the highest hsTnI levels at 21-24 hours and 18-21 hours is 40,000 ng/L, 15-18 hours is 32,820.5 ng/L, 12- 15 hours was 27,816.2 ng/L, 9-12 hours was 24,058.87 ng/L, 6-9 hours was 19,293.53 ng/L and 3-6 hours was 8,026.2 ng/L.

**4. Discussion**

Basic characteristics in this study were assessed using descriptive analysis. The characteristics assessed were age, gender, infarct location, and hsTnI levels. Statistical analysis shows that the majority of AMI patients with ST elevation are aged 60.1 $\pm$ 10.5 years. This is in line with the research of Nugraha et al. (2022) who also found that most patients were aged between 40-69 years, namely, 55.56%, Sagala et al. (2016) who found that the majority of AMI patients were aged 55-74 years and Mishra et al. (2022) in their research which shows that the distribution of the highest average incidence of AMI is at the age of 51-60 years.[11,13-15] The gender of AMI patients with ST elevation in this study was predominantly male (88.06%). This is in line with the research of Nugraha et al (2022) regarding the role of troponin examination in the diagnosis and treatment of AMI, it was found that the percentage of males was greater than that of females, namely 39 males (72.2%) and 15 females (27.8%). Research by Khalista et al. (2020) regarding troponin levels with length of stay and mortality, also found that the majority of patients were men, namely 65 patients (75.6%). Research by Hastuti et al. (2017) regarding the relationship between troponin levels and length of stay in AMI patients at Dr. M. Djamil General Hospital Padang for the period 01 January – 31 December 2013, it was found that the majority of patients were men with a total of 43 people (86%).[13,16] The most common location of infarction in the study was inferior with 20 people (29.9%) followed by anterior with 18 people (26.9%). In line with Ahmed et al. (2022) who wrote that the majority of myocardial infarctions occur in the right coronary artery (RCA) which had an impact on the inferior myocardial area (92.44%) and Research by Rosa et al. (2017) which showed inferior STEMI was more common (79.1%) in the group with complete atrioventricular block compared to the group without complete atrioventricular block.[17]

Slightly different from the research of Gupta et al. (2020) which shows that the arteries most often involved in myocardial infarction are left anterior descending (LAD) in 83.5% of cases affecting the anterior area of the myocardium. This may occur due to the difference in age of the study of Gupta et al. (2020) who were very young aged ≥18 years and ≤35 years who were diagnosed with AMI compared to the age of the subjects in this study who were average 60.1 $\pm$ 10.5 years. Although more infarctions occur in one location, research by Gupta et al. (2020) also showed that 14.4% of cases experienced disorders in more than one vessel which ultimately had an impact on several areas of the myocardium. In line with this study, there were research subjects with inferoposterior infarction locations (25.4%).[17–19]

The hsTnI levels in this study had a median of 6,519 ng/L. In line with the research by Marston et al. (2020) which showed a five-fold increased risk of cardiovascular events in patients with hsTnI exceeding 6 ng/L. Research by Tahhan et al. (2018) showed differences in hsTnI levels on the location and severity of vascular heart disease. Study subjects without significant coronary artery disease had a median hsTnI of 3.3 pg/mL, compared to study subjects with coronary artery disease in 1 vessel with a median hsTnI of 4.3 pg/mL, coronary artery disease in 2 vessels with a median hsTnI of 5.1 pg/mL, and coronary artery disease in 3 vessels with a median hsTnI of 5.7 pg/mL.[20,21] Increased hsTnI levels are related to the location and severity of coronary artery disease, although they cannot explain the differences in hsTnI levels from each location of the infarction, research by Tahhan et al. (2018) is in line with this research, namely that in this study there was a difference in median hsTnI levels depending on the location of the infarction in AMI patients with ST elevation. The highest hsTnI levels were seen in posterior infarction locations with a median of 40,000 ng/L, while the lowest hsTnI levels were seen in extensive anterior locations with a median of 1,037 ng/L. Compared to the group with low hsTnI, patients with high hsTnI, especially those who experienced disorders in 3 blood vessels, had a hazard ratio of 11.1 for cardiovascular death/myocardial infarction.[20,21]

The difference in mean values of hsTnI levels based on the time of examination in this study was carried out within 3 hours from onset, hsTnI levels starting from the highest hsTnI levels were at 21-24 hours and 18-21 hours at 40,000 ng/L, at 15-18 hours at 32,820 .5 ng/L, 12-15 hours 27816.2 ng/L, 9-12 hours 24,058.87 ng/L, 6-9 hours 19,293.53 ng/L and 3-6 hours 8,026.2 ng/L. Research by Peacock et al. (2020) concluded that hsTnI can be used to rule out a diagnosis of AMI in patients who arrive >3 hours after the onset of symptoms of acute coronary syndrome if they have an hsTnI value of less than the upper reference level (17.9 ng/L) because it has negative predictive value (NPV) 100%. However, this is not adequate if the hsTnI level examination is carried out between 1-3 hours from the onset of symptoms. In line with this study, the examination was carried out 3 hours after onset and showed an increase in hsTnI levels.[22] Research by Lin et al. (2022) also showed that hsTnI levels examined at 0, 3, and 6 hours had a median of 6, 5.30, and 53.15 (pg/mL) which shows an increase in hsTnI levels with time after onset. Research by Lin et al. (2022) wrote that the median time to diagnosis was 200 minutes and the mean time to diagnosis using hsTnI was 215 minutes compared to TnI, namely 415 minutes, which concluded that the examination using hsTnI was faster in diagnosing AMI than TnI.[23] This research has a number of limitations, especially since the research was conducted at only one research center, the small sample size, and the retrospective nature of the research which could result in missing data on the research sample used.

## 5. Conclusion

The importance of early diagnosis in establishing myocardial infarction quickly and efficiently aims to prevent prolonged ischemia which can cause irreversible damage to the myocardium. Definitive AMI is with symptoms, ECG, and increased cardiac biomarkers. An electrocardiogram is an important examination for the initial evaluation of patients with chest pain because ECG can predict the location of the infarct, the extent of the infarct, and the prognosis. The location of the infarction plays an important role in the management and determination of the prognosis of AMI patients. High-sensitive troponin I as a cardiac biomarker is the most sensitive and specific test to detect minimal myocardial injury. Based on the results of this study, it can be concluded that there are differences in the description of hsTnI levels based on the location of the infarction.

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