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THE DIAGNOSTIC VALUE OF TROPONIN I TESTING TO CORONARY ANGIOGRAPHY WITH A POINT OF CARE TESTING INSTRUMENTIN PATIENTS WITH ACUTE MYOCARDIAL INFARCTION

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ABSTRACT

Myocardial infarction consists of STEMI and NSTEMI. Acute myocardial infarction is diagnosed by WHO criteria when at least two of the following three criteria are met: chest pain, electrocardiography (ECG) result changes, and biomarker. Troponin I is specific for cardiac muscle and has an increased level even in small cardiac muscle necrosis and not affected by the renal failure and muscle trauma but have not been standardized by WHO. This research aimed to find the effectivity of Troponin I examination with POCT to help the diagnosis and early detection of AMI. Thus each product has varied sensitivity and specificity. A cross-sectional study was conducted in the Clinical Pathology Laboratory and Cardiac Center of the Dr. Wahidin Sudirohusodo Hospital Makassar using suspected AMI patients as the subject. Troponin I level tested by POCT from August 2015 to July 2016. Data were analyzed statistically using the ROC curve with SPSS software. A total of 88 patients suspected with AMI, aged 36 to 75 years old. From the tested cut-off values (0.02, 0.03, 0.04, 0.5, 0.06, 0.07, 0.08 μg/L) the best cut-off value was 0.03 μg/L (93.9% sensitivity, 95.5% specificity, PPV 98.4%, NPV 84.0%, and 94.3% accuracy) where the cut-off value of 0.03 μg/L was the value recommended by the toolkit manual. Even if the cut-off value of 0.02 or 0.04 was used, the sensitivity and specificity value was still fairly good. Troponin I testing using POCT with a cut-off value of 0.03 μg/L can be used routinely in supporting the AMI diagnosis because it is a rapid test with a portable instrument and excellent diagnostic value.

Key words: Troponin I, acute myocardial infarction, sensitivity, specificity

INTRODUCTION

Cardiovascular disease was the leading cause of death in the world in 2011. According to data from the World Health Organization (WHO), this disease caused 1,7 million deaths during 2011; this shows that 3 of 10 deaths in this world is caused by cardiovascular disease. According to the American Heart Association (AHA) in 2015, the death rate of cardiovascular disease in the United States of America was 31.1%. According to the report of the Directorate General of Medical Services (Ditjen Yanmed) Indonesia during 2005, circulation system disease, including cardiovascular disease and stroke were the leading causes of death.[1,2]

Myocard infarct consists of myocardial infarcts with ST-segment elevation (STEMI) and myocardial infarct without ST-segment elevation (NSTEMI). The diagnosis of Acute Myocardial Infarction (AMI) needs confirmation and identification because they are the basic necessity and are related to correct patient caregiving. The main reason for accurate and fast diagnosing is immediately giving the patient with AMI the correct therapy and intervention.[3,4]

Acute myocardial infarction diagnosis using the WHO criteria, where there are two or more from the three criteria's which are chest pain, change of the Electrocardiogram (ECG) and biochemical markers. The diagnostic criteria have limitations because only a few patients with AMI have typical symptoms.[2,4]

Biochemical markers examined are myoglobin, Total Creatinine Kinase Enzyme (CK-total), Lactate Dehydrogenase (LDH), Creatinine Kinase Isoenzyme (CK-MB), Cardiac Troponin I and T (cTnI & cTnT). Myoglobin, total CK and LDH are not specific for heart muscle, while CK-MB cannot detect small lesion and only rises a little in muscle trauma.[3,5]

Cardiac Troponin I and T (cTnI & cTnT) are specific for heart muscle with high sensitivity and rise in small myocardial necrosis (microscopic zone). Quantitative cTnI and cTnT can be used for mortality risk stratification of cardiac attack and follow the disease course. Cardiac troponin T is already standardized by WHO so the variation of sensitivity and specificity between products are relatively small and affected by kidney failure and muscle failure.[2,5]

There are a lot of qualitative cTnI kit in Indonesia but are not used to follow the disease course and mortality risk stratification. There is now a rapid test kit for quantitative cTnI using a whole blood sample with a smaller instrument. [6]

Fluorometry method for cTnI is fast but needs a fluorometer, while quantitative cTnI with the enzyme immunoassay needs more extended time.[7] Due to the variation of sensitivity and specificity for the cTnI test, an experiment is needed.

Sheila report about troponin I examination with Point of Care Testing (POCT) compared to the Enzyme-Linked Fluorescent Assay (ELFA) method resulted in POCT results can help the diagnosis of ACS quickly and accurately, due to the high correlation and suitability of results compared to laboratory-based analysis. The use of POCT can shorten the waiting time and give results that are almost the same with laboratory-based study so this equipment can be used to replace laboratory-based study in hospitals to make health services better. Due to that the researcher is interested to see the diagnostic value of troponin I with POCT to improve the health services of heart disease patients in the hospital.

This research aimed to find the effectivity of Troponin I examination with POCT to help the diagnosis and early detection of AMI.

METHODS

The experiment was conducted with cross-sectional study in the Clinical Pathology Laboratory Installation and Cathlab of the Cardiac Center Installation of the Dr. Wahidin Sudirohusodo Hospital Makassar starting August 2015. Inclusion criteria were subjects that had Troponin I levels examined by clinicians. Eighty-eight subjects were examined and data from the previous and present examination and had their troponin I examined using POCT (Alere Triage Meter, Alere San Diego, Inc. California USA). This deviceused fluorescent immunoassay with a whole blood sample. This experiment uses coronary angiography as the gold standard. Ethical clearance was given by the Health Ethics Committee of the Faculty of Health Hasanuddin University Hasanuddin College University Hospital, Makassar (KEPK FUH-RSWS-RSPTN UH).

Troponin I diagnostic value was obtained by calculating sensitivity, specificity, positive predictive value, negative predictive value and accuracy towards Coronary Angiography. Cut-off of Troponin I was based on the Reciever Operating Characteristics (ROC) curve. Statistical analysis was done with SPSS.

RESULTS AND DISCUSSION

This experiment was done to 88 subjects suspected with AMI that fulfilled the criteria.

Table 1. Characteristics of experimental subjects

Variable		n	%
Sex	Male	74	84.1
	Female	14	15.9
Age (years)	<40	3	3.4
	40-49	18	20.5
	50-59	40	45.5
	60-69	23	26.1
	≥70	4	4.5

Table 1 showed the age groups of patients suspected of AMI with the range of 36 – 75 years, with the most in the 50 – 59 years (45.5%), most subjects were male (84.1%). These results were in line with the previous experiment by Malinrungi *et al*., that most AMI patients were in the 40 – 60-year range (63%).[9]

An analysis of Reciever Operating Characteristic (ROC) showed cut-off of Troponin I was 0.03 µg/L and AUC was 95.9% that means it had statistically strong diagnostic value (Figure 1).

The results of coronary angiography were divided into significant coronary angiography and nonsignificant coronary angiography. The results were stated significant if there is stenosis > 70% in or

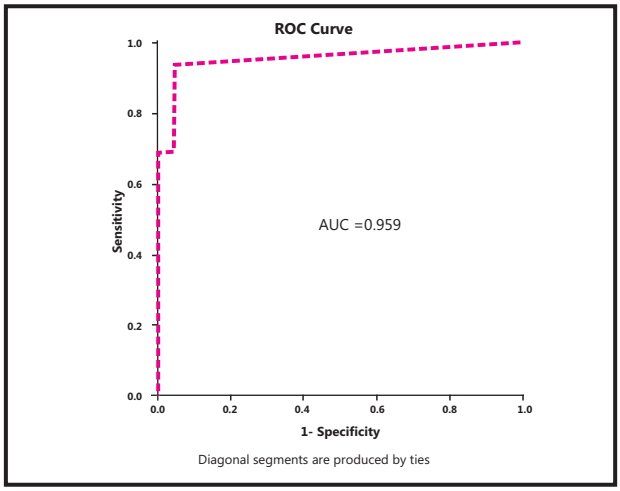

Figure 1. ROC curve of Troponin I compared to coronary angiography

Table 2. Diagnostic tests of Troponin I towards angiography

Cut - off point Troponin I (µg/L)	Coronary Angiography		Total n (%)
	Significant n (%)	Non significant n (%)	
≥0,03	62 (93.9)	1 (4.5)	63 (71.6)
< 0,03	4 (6.1)	21 (96.0)	25 (28.4)
Total	66 (75)	22 (25)	88 (100)

more than four arteries, left main, left anterior descending, left circumflex and right coronary artery, and nonsignificant if in the left main, left anterior descending, left circumflex and right coronary artery there were normal results or stenosis < 70%.

In the experiments samples, there were 66 patients with significant coronary angiography, 62 people (93.9%) showed an increased troponin I (Table 2).

Examination of coronary angiography was significant for four patients (6.1%) with low troponin I results. It was due to the difference in time of troponin I levels for each patient, and the time of the attack weren't known because the patients inability to remember the time of the heart attack, whereas troponin I levels increased in 3 to 5 hours after the attack, reaches it's peak at 12 to 24 hours and keep on increasing from 7 to 10 days after the attack.[10]

Troponin I increased in one patient with nonsignificant coronary angiography (4.5%), that could be caused by an increase in oxygen need and insufficient oxygen supply to the heart muscles, causing an increase in troponin I in patients with normal coronary arteries.[10]

Statistical analysis was performed using data from Table 2 and had a sensitivity of 93.9%, specificity of 96.0%, the positive predictive value of 98.4%, the negativepredictive value of 84.0% and accuracy of 94.3%.

The limitations of this experiment were that the levels of troponin I examinedfor each patient had a different time of the attack and some patients attack time were unknown due to the inability of the patients to remember.

CONCLUSION AND SUGGESTIONS

Examination of Troponin I with Point of Care Testing (POCT) with a cut-off 0.03 µg/L has a sensitivity, specificity, positive predictive value, negative predictive value and accuracy of 93.9%, 96.0%, 98.4%, 84.0%,and 94.3% respectively. The examination of troponin I using quantitative POCT is practical to be used routinely to support the diagnosis of AMI because it is fast, samples can be used with routine hematologic examinations, uses small equipment and has excellent diagnostic value. Tests can be used routinely to support hospital services and helping clinicians to make the diagnosis faster.

Further research is needed to know the diagnostic value of Troponin I according to the time troponin I raise until the patient has an attack.

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