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Original Research Article

Corelation between Troponin I and the severity of coronary artery disease in patients with acute myocardial infarction

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Abstract

This study analyzes the relationship between the value of troponin I and the severity of coronary lesions detected by coronary angiography in patients with acute myocardial infarction. We conducted a retrospective study on a number of 197 patients, hospitalized in the Emergency Clinical County Hospital, Oradea, Romania. These patients were diagnosed with acute myocardial infarction (STEMI and NSTEMI) at the time of presentation to the emergency department. Also, coronary angiography was performed and the level of troponin I was determined for these patients. After using Statistix 8.0 for data analysis, the results of this study show that troponin I is an independent predictor of the severity of coronary lesions in this category of patients. Furthermore, the sensitivity of troponin I in the prediction of severe coronary lesions increases to 100% after 96 hours, if it is maintained above 1.53 ng / ml.

Keywords: myocardial infarction, coronary artery disease, troponin I

Abbreviations: CT- computed tomography, cTnI- troponin I, ECG-electrocardiogram, GRACE score -Global Registry of Acute Coronary Events Score, LAD-left anterior descending coronary artery , NSL- non severe lesions, NSTEMI-myocardial infarction without ST-segment elevation , RCA-right coronary artery , SL-severe lesions, STEMI-myocardial infarction with ST-segment elevation

INTRODUCTION

Troponins I and T are contractile proteins, which are found in cardiac myocytes, with increased sensitivity and specificity. For this reason, they are the main recommended biomarkers for the detection of myocardial necrosis. In patients with myocardial infarction, troponin begins to increase approximately 3 hours after the onset of pain reaching its peak at 24-48 hours. Troponin I can remain elevated for up to 7-10 days after a heart attack, while troponin T persists for up to 10-14 days (Braunwald et al., 2014; Van Beek et al., 2016). However, there are a number of cardiac and extracardiac conditions associated with an increase in troponin level in the absence of acute coronary syndrome, such as: severe aortic disease, aortic dissection, pulmonary hypertension, heart failure, severe anemia, renal failure, respiratory failure and so on (Braunwald et al., 2014). Myocardial injury is defined as an increase in troponin by at least one value above the 99th percentile of the reference limit.The term acute myocardial infarction can be used if there is myocardial injury and at least one of the following: symptoms of myocardial ischemia, new ECG changes of ischemia, development of pathological Q waves, imaging evidence of a new regional wall motion abnormality or new loss of viable myocardium, identification by coronary

angiography or autopsy of the intra coronary thrombus (Thygesen, 2019). The main cause of myocardial infarction is coronary atherosclerosis (Braunwald et al., 2014). There are several studies that have linked the value of troponin to the extension of coronary lesions detected angiographically or by angio CT in patients with stable coronary artery disease (Januzzi et al., 2010; Laufer et al., 2010; Korosoglou et al., 2011; Ndrepepa et al., 2011; Seifarth et al., 2014; Ali, Faiz and Azam, 2015; Samman Tahhan et al., 2018). However, its role in predicting the severity of coronary lesions in patients with myocardial infarction has been little studied. Knowing the severity of coronary artery disease before angiography could help us establish the prognosis of the patient and the right course of treatment (conservative versus invasive) especially in the countries where coronarography is not a routine procedure.

The aim of the study was to find a relationship between the value of troponin I at hospitalization and the severity of coronary lesions detected angiographically, in patients with acute myocardial infarction with or without ST-segment elevation.

METHOD

We performed a retrospective study on a number of 197 patients, hospitalized in the Emergency Clinical County Hospital, Oradea, between 1.01.2017-31.12.2017. The study group included inpatients diagnosed with myocardial infarction with and without ST-segment elevation, who performed coronary angiography and who had a sample of troponin taken, at the time of presentation to the emergency department. We excluded from the analysis patients treated conservatively, those who didnt had troponin I sample taken at presentation, as well as patients with: severe anemia, sepsis, acute renal failure, acute respiratory failure, conditions that could have influenced the value of troponin.Since the relationship between the ECG changes, cardiovascular risk factors and the severity of coronary lesions in patients with myocardial infarction is well outlined in the literature, for each patient we have extracted from the observation sheet only: age, sex, type of infarction, Killip class, ejection fraction of the left ventricle, GRACE score and coronary lesions detected by angiography. The study was approved by the hospital's ethics committee.

Statix 8.0 was used for statistical analysis. The tests used were: the Student's test for comparing numerical variables, chi-square test for comparing ordinal variables and univariate analysis and multiple regression to establish the role of independent predictor of tropony I of the severity of coronary artery disease. The ROC curve was used to identify the sensitivity and specificity of troponin I in predicting the severity of coronary artery disease.

RESULTS

After applying the inclusion and exclusion criteria, the final study group included 195 patients hospitalized in the Emergency Clinical County Hospital Oradea with the diagnosis of acute myocardial infarction, with ST segment elevation (n = 105, 54.1%) or without ST segment elevation (n = 89, 45.9%). The mean age of the patients was 63.32 ± 11.58 years, ant they were predominantly male (n = 118, 60.5%, p = 0.004).

The time elapsed from the onset of specific symptoms to the presentation to the emergency department, respectively to the collection of troponin I, was 17.67 ± 33.29 hours, values that could indicate a late presentation of patients with specific symptoms in the emergency department. In fact, there were a small number of patients (n = 8) who presented very late from the onset of symptoms (120-168 hours). A number of 178 of the patients included in the study (91.28%) presented in the first 30 hours after onset.

After coronarography , the following were detected: monovascular coronary artery disease in 76 cases (39.0%), bivascular disease in 39 cases (20.0%), trivascular disease in 39 cases (20.0%) and multivascular disease in 41 of the cases (21.0%). Patients with left main lesion were classified as patients with trivascular disease and if they associated lesions in other territories, they were consider multivascular (n = 27, 13.8%, p <0.001).

In order of impairment, lesions of the anterior descending coronary artery (LAD) were detected in 135 patients (69.2%), the right coronary artery (RCA) was affected in 109 patients (55.9%), and the circumflex artery in 85 patients (43.6%) and other coronary vessels in 60 patients (30.8%).

The characteristics of the patients included in the study are shown in Table 1

Troponin I values did not vary significantly depending on the number of affected coronary vessels (Figure 1), and no correlations could be established between trononin I values and the number of affected vessels (r = 0.05; p = 0.470)

The result can be justified by the fact that, although the number of affected coronary vessels may be high, the severity of the lesions varies among patients. Therefore, we considered it appropriate to classify patients according to severity criteria, based not only on the number of vessels affected but also on the degree of damage and the location of the culprit lesion. At the same time, the timing of troponin measurement is not similar, there being considerable variations of this parameter in the studied group.

To remove these confounding factors, we classified patients according to the extentsion of the lesions and the location of the culprit lesion. Thus, patients were divided into 2 categories. First, patients in whom the culprit lesion affected the trunk of the left coronary artery (left

Table 1. Caracteristics of patients included in study

		Mean±Std.Dev.	Number of patients(n) Frequency (%)	p
Age		63,33±11,58		-
Sex (male)			n=118 (60,5%)	0,004
KILLIPclass	I		n=97 (49,7%)	<0,001
	II		n=72 (36,9%)	
	III		n=9 (4,6%)	
	IV		n=17 (8,7%)	
FEVS (%)		44,65 ±8,34		-
GRACEscore		128,53±31,54		-
cTNI (ng/ml)		3,03±6,19		-
Time from symptoms onset and hospital presentasion(h)		17,67 ±33,29		-
Coronarography findings				
	Monovascular		n=76 (39,,0%)	0,0001
	Bivascular		n=39 (20,0%)	
	Trivascular		n=39 (20,0%)	
	Multivascular		n=41 (21,0%)	
Left main artery			n=27 (13,8%)	<0,001
LAD			n=135 (69,2%)	<0,001
RCA			n=109 (55,9%)	0,11
Circumflex artery			n=85 (43,6%)	0,08
Other vessels			n=60 (30,8%)	<0,001

Table 2. Troponin I values related to number of vessels afected

		cTNI (ng/ml) Mean ±Std.Dev.	p
Number of vessels with atherosclerotic lesions	monovascular	2,81 ±7,82	0,4560
	bivascular	2,59 ±3,85	
	trivascular	2,47 ±3,38	
	multivascular	4,40±6,62	

main), as well as patients with trivascular or multivascular disease in which the culprit lesion was located in the anterior descending artery, were considered as having severe lesions, with an increased risk of unfavorable evolution (group SL, n = 71, 36.4%). Second, the other patients who were considered having medium or mild severity lesions, with a medium or low risk of unfavorable evolution (NSL group, n = 124, 63.3%).

The distribution of patients with severe lesions did not show significant differences between patients with STEMI (n = 34; 38.20%) and those with NSTEMI (n = 37; 34.91%), p = 0.853.

Troponin I values in patients with severe lesions were 1.67 ± 2.87 ng / ml, compared to 5.39 ± 9.10 ng / ml in patients with moderate or mild lesions (p <0.001).

A directly proportional, highly statistically significant correlation could be established between troponin I values and the severity of coronary lesions (r = 0.28; p <0.001).

Applying the multiple regression model, it was observed that troponin I is an independent predictor for the severity of coronary lesions (p <0.001), but not for the number of affected vessels, Grace score, Killip class at admission or the presence of thrombotic occlusion in the coronary arteries. (Table 3)

Also, depending on the moment of troponin determination and taking into account its dynamics, already known, we extended the analysis by time categories as follows: <24 hours, time in which troponin increases but does not reach the maximum level (category I), between 24- 30 hours, when troponin I has maximum values (category II), between 31-96 hours category III, when the level of troponin I remains high but not at the maximum level, and after 96 hours, when the levels of troponin are on a downward curve, (category IV).

The dynamics of troponin I in our group, depending on the selected time intervals, was in accordance with the dynamics described in the literature, which proves the

Table 3. Multiple regression using troponin I as independent predictor

R= ,42578470 R2= ,18129261 Adjusted R2= ,13679764 F(10,184)=4,0745 p	
	p-level
KILLIP	0,309675
GRACE	0,502311
number of vessels	0,736077
Left main	0,714205
RCA	0,610934
LAD	0,826206
Circumflex artery	0,853984
Other vessels	0,674693
Thrombus	0,997334
Lesionsseverity	0,000003

Table 4. The troponin I values in the whole group, depending on the selected time intervals

		cTNI Mean±Std.Dev.	**p**
Rank time	<24 h	2,04±4,99	0,007
	24-30 h	7,88±7,00	
	31-96 h	5,96±11,70	
	>96 h	4,50±9,65	

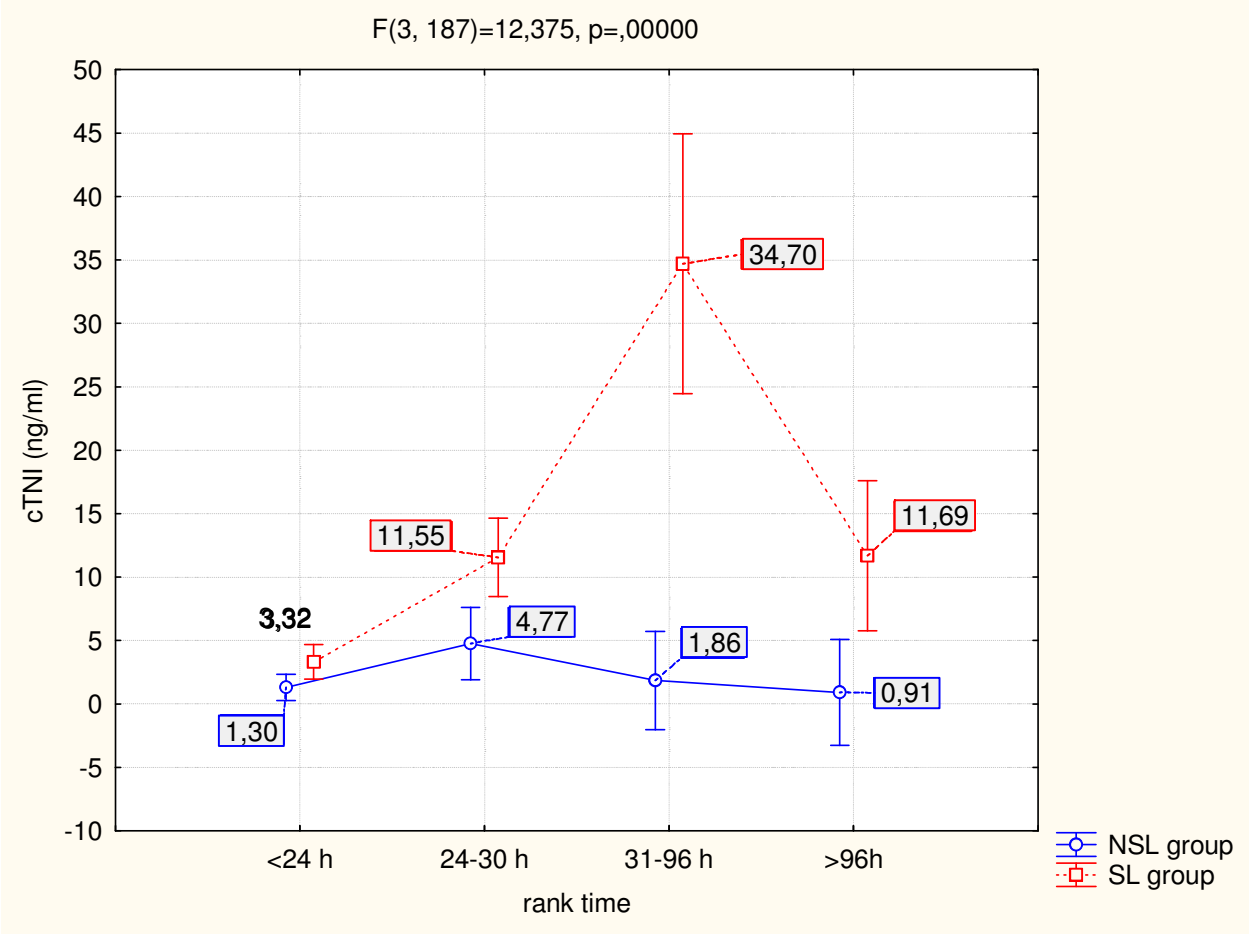

Figure 1. The troponin values, depending on the time of sampling and the severity of the lesions

Table 5. The sensitivity and specificity of troponin I values in our group, to predict the severity of coronary lesions

Rank time	Sensitivity	Specificity	Predictive values of cTn I
<24 h	60,7%	71,4%	> 0,693 ng/ml
24-30 h	90,9%	61,5%	> 5,48 ng/ml
31-96 h	-	-	-
>96 h	100%	83,3%	> 1,53 ng/ml

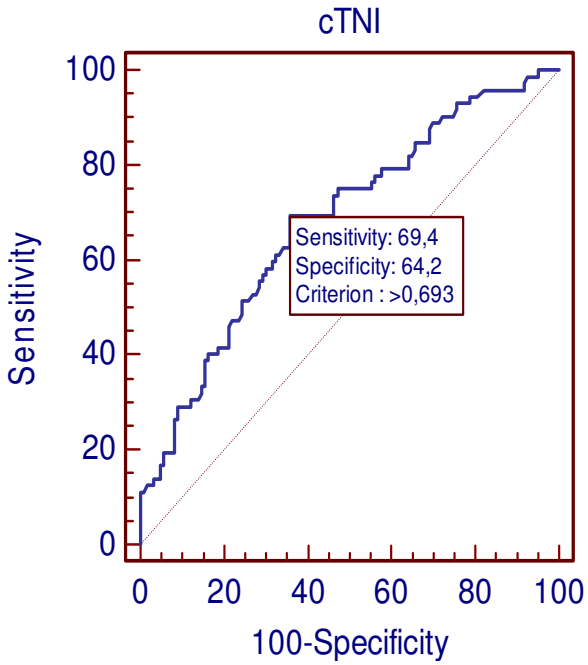

Figure 2. The overall sensitivity and specificity of troponin I for predicting the severity of coronary lesions

correctness of the classification. (Table 4)

The troponin values, depending on the time of sampling and the severity of the lesions, follow the same dynamics in the group of patients without severe lesions, but with a deviation in the group of patients with severe lesions, where the highest troponin values are recorded in patients in whom troponin I, was taken in the time interval 31-96 hours. The observation is justified by the fact that the late presentation of patients allows the increase of troponin to substantial values in the presence of severe coronary lesions (according to our classification), an increase that can deviate from the range considered standard for reaching the peak of troponin I. (Figure 1)

Next, we analyzed the sensitivity and specificity of troponin I values in our group, to predict the severity of coronary lesions, by plotting ROC curves.

For the time interval <24 hours, troponin I had a sensitivity of 60.7% and a specificity of 71.4% for the prediction of coronary lesions, with a predictive power at troponin I values> 0.693 ng / ml. Prediction sensitivity increases progressively, up to 100% after 96 hours, at troponin values greater than 1.53. For the time interval 31-96 hours, the analysis could not be performed due to the insufficient number of cases with severe lesions. (Table 5)

Overall, the sensitivity and specificity of troponin I were 69.4% and 64.2%, respectively, for predicting the severity of coronary lesions, the accuracy of the results being clearly influenced by considerable variations in the timing of troponin I harvesting in the study group. (Figure 2)

DISCUSSIONS

The relationship between troponin and the severity of coronary lesions has been studied mainly in patients with stable coronary artery disease. Thus, Ndrepepa G et al demonstrated in a case-control study that included 904 patients with stable coronary artery disease and 412 patients with chest pain but no coronary lesions (control group) that high sensitive T troponin is a predictor of

coronary lesions (Ndrepepa et al., 2011). Similar results were obtained by Ali et al. (2015) in an observational study of 100 patients with chest pain who were hospitalized. Half had positive troponin T (rapid test), the other half negative. Patients with positive troponin had about 94% multivascular damage of which about 88% involved the anterior descending artery, while patients with negative troponin had mainly a mild impaired (70%), the most frequently involved being the circumflex artery. The role of troponin as a predictor of multivascular lesions has not been evaluated in any of the mentioned studies. Korosoglou et al. (2011) also dosed high-sensitive troponin T in a number of 124 patients with suspected coronary heart disease (based on clinical symptoms) who subsequently underwent a angio CT scan. Patients with non-calcific atherosclerotic plaques had a higher level of troponin compared to patients with normal vessels according to Samman Tahhan et al. (2018).

In contrast to these studies, our research included patients with acute myocardial infarction and not stable coronary artery disease, in whom troponin I was taken, not troponin T. Although troponin was not statistically significantly correlated with the number of affected vessels, considering the extent of coronary lesions and culprit lesion, we demonstrated that the value of troponin I at presentation is an independent predictor for the severity of coronary lesions, more precisely for left main lesion and/or trivascular or multivascular disease involving the anterior descending artery.

A larger study, but with similar results to our research, was conducted by Samman Tahhan et al. (2018). The group included a number of 3087 patients without evidence of acute myocardial infarction, who underwent coronary angiography. For all patients was measured high sensitive troponin I, unlike our study. Following coronary angiography, 11% of patients had permeable coronary arteries, 23% non-obstructive lesions, 20% monovascular involvement, 20% bivascular involvement and 26% were trivascular. The severity of angiographically detected lesions was assessed by Gensini score. Multivariate analysis has shown that high-sensitivity troponia I is an independent predictor of the severity of coronary lesions assessed by the Gensini score. (ρ = 0.26, $P < 0.00001$) (Januzzi et al., 2010).

In our study, we also analyzed the sensitivity and specificity of troponin I values to predict the severity of coronary lesions. Thus we found that the sensitivity of troponin prediction increases progressively, up to 100% after 96 hours, at values greater than 1.53ng/ml. In patients with myocardial infarction with ST segment elevation, the current guideline of the European Society of Cardiology does not recommend performing routine angiography in asymptomatic patients presenting >48 hours after onset , recommendation class III, level of evidence A (Ibanez et al., 2018). However, considering the results of the present study, asymptomatic patients, but with troponin levels above 1.53 ng / ml at 96 hours, most likely have severe angiographic lesions (left main lesion and / or trivascular or multivascular involvement with involvement LAD).

Limitations of the study

Among the limitations of current research is that the study was conducted retrospectively. We have included patients with myocardial infarction, who were hospitalized consecutively in our hospital a so the troponia was determined at various times since the onset of pain, which could have interfered with the results obtained. Also, high sensitive troponin I, whose sensitivity and specificity is higher, was not measured.

CONCLUSION

Although we have extensive information on the importance of troponins in the diagnosis of acute myocardial infarction, their role in predicting the severity of angiographically detected coronary lesions in patients with myocardial infarction is almost non-existent. The present research demonstrates that troponin I is an independent predictor of the severity of coronary lesions in this category of patients. Furthermore, we showed that the sensitivity of troponin I in the prediction of severe coronary lesions increases to 100% after 96 hours, if it is maintained above 1.53 ng / ml. In the same manner , in the group of patients with severe lesions, the highest troponin I values were recorded in the time interval of 31-96 hours, so the patients with acute myocardial infarction that follow this trend for troponin I could have, most probably severe coronary lesions, with an increased risk of unfavorabil evolution. Based on these results, we suggest that performing coronary angiography in this type of patient followed by resolving lesions detected by stenting or surgery, could have major benefits for the evolution of patients even if the therapeutic response to conservative treatment is satisfactory. We believe that this should be confirmed in a larger, prospective study that includes only patients with myocardial infarction with ST-segment elevation, to whom high sensitive troponin I should be determineted, at the same time interval from the onset of the pain. This is what we intend to do in further research.

REFERENCES

Ali L, Faiz A, Azam M (2015). Correlation of Troponin Rapid Test and Severity of Coronary Artery Disease in patients with chest pain. Pakistan J. Med. Health Sci. *9*(1), 131-135.

Braunwald E, Mann L, Zipes P, Libby P, Bonow R (2014). Braunwald Heart Disease 10th Edition. Elsevie Sanders,

pages 1087-1091

Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, Caforio ALP, Crea F, Goudevenos JA, Halvorsen S, Hindricks G, Kastrati A, Lenzen MJ, Prescott E, Roffi M, Valgimigli M, Varenhorst C, Vranckx P, Widimský P (2018). 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). European Heart Journal, 39(2), 119–177.

Januzzi JL Jr, Bamberg F, Lee H, Truong QA, Nichols JH, Karakas M, Mohammed AA, Schlett CL, Nagurney JT, Hoffmann U, Koenig W, Januzzi JL, Jr, Bamberg F, Lee H, Truong QA, Nichols JH, Karakas M, Mohammed AA, Schlett CL, Nagurney JT (2010). High-sensitivity troponin T concentrations in acute chest pain patients evaluated with cardiac computed tomography. Circulation, 121(10), 1227–1234.

Korosoglou G, Lehrke S, Mueller D, Hosch W, Kauczor HU, Humpert PM, Giannitsis E, Katus HA (2011). Determinants of troponin release in patients with stable coronary artery disease: insights from CT angiography characteristics of atherosclerotic plaque. Heart, 10, 823.

Laufer EM, Mingels AMA, Winkens MHM, Joosen IAPG, Schellings MWM, Leiner T, Wildberger JE, Narula J, Van Dieijen-Visser MP, Hofstra L (2010). The extent of coronary atherosclerosis is associated with increasing circulating levels of high sensitive cardiac troponin T. Arteriosclerosis, Thrombosis, and Vascular Biology, 30(6), 1269–1275.

Ndrepepa G, Braun S, Schulz S, Mehilli J, Schömig A, Kastrati A (2011). High-Sensitivity Troponin T Level and Angiographic Severity of Coronary Artery Disease. The Ame. J. Cardiol. 108(5), 639–643.

Samman Tahhan A, Sandesara P, Hayek SS, Hammadah M, Alkhoder A, Kelli HM, Topel M, O'Neal WT, Ghasemzadeh N, Ko Y, Gafeer MM, Abdelhadi N, Choudhary F, Patel K, Beshiri A, Murtagh G, Kim J, Wilson P, Shaw L, Vaccarino V (2018). High-Sensitivity Troponin I Levels and Coronary Artery Disease Severity, Progression, and Long-Term Outcomes. Journal of the American Heart Association, 7(5), 1.

Seifarth H, Schlett CL, Lehman SJ, Bamberg F, Donnelly P, Januzzi JL, Koenig W, Truong QA, Hoffmann U (2014). Correlation of concentrations of high-sensitivity troponin T and high-sensitivity C-reactive protein with plaque progression as measured by CT coronary angiography. Journal of Cardiovascular Computed Tomography, 8(6), 452–458.

Thygesen K, Alpert JS, Jaffe AS, Chaitman BR, Bax JJ, Morrow DA, White HD, Group ESD (2019). Fourth universal definition of myocardial infarction (2018). Eur. Heart J. 40(3), 237.

van Beek D, van Zaane B, Looije M, Peelen L, van Klei W (2016). Typical rise and fall of troponin in (peri-procedural) myocardial infarction: A systematic review. World J. Cardiol. 8(3), 293–301.