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Original Article

Comparison of Short-Term Outcomes of Occlusive and Non-Occlusive Non-ST Elevation Myocardial Infarction

Asfandyar Ashraf, Muhammad Nadir Khan, Muhammad Husnain Yousaf, Hira Zakria, Nouman Hameed, Javeria Kamran*

Department of Cardiology, Armed Forces Institute of Cardiology/National Institute of Heart Diseases/National University of Medical Sciences (NUMS) Rawalpindi, Pakistan, *Department of Research & Development, Armed Forces Institute of Cardiology/National Institute of Heart Diseases/ National University of Medical Sciences (NUMS) Rawalpindi, Pakistan

ABSTRACT

Objective: To compare the short-term outcomes of patients with Occlusive Myocardial Infarction and Non-occlusive Myocardial Infarction in the context of non-ST Elevation Myocardial Infarction.

Study Design: Analytical cross-sectional study.

Place and Duration of Study: Armed Forces Institute of Cardiology/National Institute of Heart Diseases, Rawalpindi Pakistan; from Jul to Nov 2023.

Methodology: One hundred and ninety four patients aged 20 to 75 years with NSTEMI were consecutively enrolled. Patients were classified into OMI and NOMI groups using angiographic, laboratory tests and electrocardiographic findings. Short-term outcomes such as stroke, heart failure, recurrent myocardial infarction, and mortality were recorded. The comparative analysis assessed differences in baseline characteristics and clinical endpoints between Occlusive Myocardial Infarction and Non-occlusive Myocardial Infarction patients. Chi square test was applied to compare the categorical variables among study groups and *p*-value <0.05 was considered as statistically significant.

Results: Among 194 patients, there were 71(36.6%) patients with Occlusive Myocardial Infarction & 123(63.4%) with Non-occlusive Myocardial Infarction and mean age was 60.68 ±12.97 years. Majority of the patients presented with Triple Vessel Coronary Artery Disease 89(45.9%), followed by Single and Double Vessel Coronary Artery Disease [60(30.9%); 45(23.2%)] respectively. Short-term outcomes included heart failure 50(25.8%), stroke 4(2.1%), recurrent MI 8(4.1%), and death 7(3.6%). However, the difference was not significant among study groups (p>0.05). In OMI group, diabetes mellitus, hypertension, hyperlipidemia and Coronary Artery Disease were found significantly associated with morbidity and mortality (p<0.05), while none of the variables were significantly associated with morbidity and mortality in NOMI group (p>0.05).

Conclusion: The study emphasizes tailored management strategies for NSTEMI patients, specifically, the disconnect between baseline risk of the two groups and the timely utility of invasive strategy can help improve prognosis.

Keywords: Non-Occlusive Myocardial Infarction, Non-ST Elevation Myocardial Infarction, Occlusive Myocardial Infarction, Outcome.

How to Cite This Article: *Ashraf A, Khan MN, Yousaf MH, Zakria H, Hameed N, Kamran J. Comparison of Short-Term Outcomes of Occlusive and Non-Occlusive Non-ST Elevation Myocardial Infarction. Pak Armed Forces Med J 2024; 74(Suppl-1): S48-S53. DOI: https://doi.org/10.51253/pafmj.v74i-SUPPL-1-11850*

INTRODUCTION

Coronary Artery Disease (CAD) is the leading disease of the cardiovascular system, causing high morbidity and mortality. CAD has a high prevalence all over the world and is significantly increasing day by day.[1,2] A study in Pakistan revealed high prevalence of myocardial infarction (MI) risk factors, affecting over 30% of the population aged 45 and above.[3] Patients with CAD usually seek attention when they present to emergency department as Acute Coronary Syndrome (ACS).[4] ACS can be either ST Elevation Myocardial Infarction (STEMI) for which patients undergo Primary Percutaneous Coronary Intervention (PPCI) or thrombolysis depending upon facilities available or Non-ST Elevation ACS (NSTE-ACS) for which patient is admitted and subsequently undergoes coronary angiogram to ascertain disease burden and then treated accordingly.[5,6]

Acute STEMI is the most severe manifestation of CAD with high morbidity and mortality. In the current era of routine PPCI for STEMI, in-hospital mortality rate is 5.4% in PPCI centers and 15.7% in untreated STEMI.[7] Although, morbidity and mortality due to Unstable Angina (UA)/Non-STEMI (NSTEMI) is lower as compared to STEMI, however there are ample chances of reinfarction and mortality to occur later on in such cases.[8]

There is little contemporary data and gaps in knowledge regarding differences in mortality and morbidities in terms of angiographic characterization

Correspondence: Dr Asfandyar Ashraf, Department of Cardiology, AFIC/NIHD, Rawalpindi, Pakistan

of NSTEMI. Understanding this will help us to identify and treat those subsets of patients who can derive greater benefit from earlier invasive strategies. This may give valuable insights into the existing practices, identify the weak points of our current treatment and will help in the implementation of new strategies to improve the quality of care for NSTEMI patients. Moreover, conducting this study at the AFIC adds a unique dimension as AFIC is a highly specialized and esteemed cardiac institute in Pakistan. It offers a specialized environment for the diagnosis and management of cardiovascular diseases. Thus, understanding the outcomes of occlusive and non-occlusive NSTEMI in this setting can have broader implications for healthcare system. This study was conducted with the aim to compare the short-term clinical outcomes of patients with occlusive and non-occlusive NSTEMI.

METHODOLOGY

This analytical cross-sectional study was conducted at Armed Forces Institute of Cardiology/ National Ins-titute of Heart Diseases, Rawalpindi, Pakistan; from 15 July to 15 November 2023 after approval from Institutional Ethical Review Board (Ltr# 9/2/R&D/2023/275)

Sample size of 48 per group was obtained by using WHO sample size calculator for two population proportions. Power of study was taken as 90%, margin of error 5% and reported prevalence of OMI and NOMI as *p*1=33.8% and *p*2=66.2% respectively in NSTEMI patients was used.[9] However, the data was collected from 194 patients (n1=71, n2=123).

Inclusion criteria: All patients aged 20 to 75 years of both gender who presented with NSTEMI were consecutively enrolled.

Exclusion criteria: Individuals with prior thrombolysis, facilitated PCI, iatrogenic STEMI, prior Coronary Artery Bypass Grafting (CABG), and ACS being medically treated were excluded.

Patients were enrolled via non-probability consecutive sampling technique and underwent a comprehensive diagnostic & therapeutic process in accordance with international guidelines and protocols. The patient management strategy was tailored based on the nature of their presentation with invasive approach either immediate or delayed for NSTEMI patients, stratified according to risk assessment. Patients were categorized into two groups (Group-I=OMI and Group-II= NOMI). Detailed demographic information of each patient was collected. This included age, gender, past medical history, and risk factors, such as hypertension, diabetes, smoking, and family history of Coronary Artery Diseases (CAD). ECG characteristics, such as ST-segment changes and the presence of Q-waves were noted. Laboratory investigations were performed to determine cardiac troponins and other baseline characteristics.

Coronary angiography enabled detailed assessment of the coronary arteries. In particular, the presence or absence of Infarct-Related Artery (IRA) occlusion was determined. Patients with a confirmed IRA occlusion, characterized by 100% stenosis and a Thrombolysis In Myocardial Infarction (TIMI) flow score of 0 distal to the occlusion, were classified as OMI. Those with a patent IRA, featuring stenosis between 50-90% and a TIMI flow score of I-III, were categorized as NOMI.[10]

Patients were closely monitored for short-term outcomes such as; stroke, heart failure, recurrent myocardial infarction (MI), and mortality. Data regarding these critical endpoints was recorded and analyzed to compare among OMI and NOMI groups.

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 23:00. Means and standard deviations were calculated for quantitative variables i.e. age, Body Mass Index (BMI), Heart Rate, Hemoglobin (Hb), Total Leucocyte Count (TLC), Platelet Count, Troponin-I Level, Serum Creatinine, and Ejection Fraction. While frequencies and percentages were calculated for qualitative variables i.e., gender, diabetes, hypertension, smoking, hyperlipidemia, Chronic Kidney Disease (CKD), family history of CAD, stroke, heart failure, recurrent MI and death. Chi-Square test was applied to find association of categorical variables with OMI and NOMI. *p*-value of <0.05 was considered as statistically significant.

RESULTS

A total number of 194 patients were enrolled in the study. The mean age of the patients was 60.68 ±12.97 years. There were 121(62.4%) males and 73(37.6%) females. There were 92(47.4%) diabetics, 99(51.0%) hypertensive, 54(27.8%) smokers, 48(24.7%) hyperlipidemic, and 35(18.0%) patients with CKD were reported. Detailed baseline and clinical characteristics are shown in Table-I.

Most of the patients presented with Triple Vessel CAD (TVCAD) 89(45.9%). Heart failure was observed in 50(25.8%), stroke in 4(2.1%), recurrent MI in 8(4.1%),

and death in 7(3.6%) patients. No significant association was observed between heart failure, stroke, recurrent MI and death in OMI and NOMI groups (p>0.05) (Table-II).

Table-I: Baseline and Clinical Characteristics of Study Participant (n=194)

Variables			Frequency (%)
Gender		Male	121(62.4)
		Female	73(37.6)
Comorbids	Diabetes	Yes	92(47.4)
		No	102(52.6)
	Hypertension	Yes	99(51.0)
		No	95(49.0)
	Smoking	Yes	54(27.8)
		No	140(72.2)
	Hyperlipidemia	Yes	48(24.7)
		No	146(75.3)
	CKD	Yes	35(18.0)
		No	159(82.0)
	Family History of CAD	Yes	35(18.0)
		No	159(82.0)
			Mean±SD
Age (years)			60.68±12.97
Heart Rate (bpm)			81.29±8.69
Body Mass Index (kg/m2)			28.73±3.31
Hemoglobin (g/dL)			12.86±1.39
Total Leucocyte Count (/µL)			11.34±4.05
Platelet count (10^9 L)			256.79±59.66
Troponin-I (ng/mL)			4281(2195-9500)
Creatinine (mg/dL)			1.36±0.85
Ejection Fraction (%)			47.62±11.85

CAD=Coronary Artery Disease; CKD=Chronic Kidney Disease

Table-II: Comparison of Short-Term Outcomes Between OMI and NOMI Cohorts (n=194)

Variables	Total (n=194) Frequency (%)	OMI (n=71) Frequency (%)	NOMI (n=123) Frequency (%)	*p*-value
Heart Failure				
Yes	50 (25.8)	20 (28.2)	30 (24.4)	0.68
No	144 (74.2)	51 (71.8)	93 (75.6)	
Stroke				
Yes	4 (2.1)	2 (2.8)	2 (1.6)	0.62
No	190 (97.9)	69 (97.2)	121 (98.4)	
Recurrent MI				
Yes	8 (4.1)	2 (2.8)	6 (4.9)	0.38
No	186 (95.9)	69 (97.2)	117 (95.1)	
Death				
Yes	7 (3.6)	2 (2.8)	5 (4.1)	1.00
No	187 (96.4)	69 (97.2)	118 (95.9)	

MI=Myocardial infarction; NOMI=Non-Occlusive Myocardial Infarction; OMI= Occlusive Myocardial Infarction

The comparison was done to determine the association of short-term morbidity and mortality with baseline and clinical characteristics of the patients in both OMI and NOMI groups. Findings revealed that in patients with OMI, a significant association of morbidity and mortality with diabetes mellitus (p=0.04), hypertension (p=0.04), hyperlipidemia (p=0.03), and coronary artery disease (p=0.04) was found, whereas in NOMI patients, none of the variables was significantly associated with morbidity and mortality. (Table III)

There was a slightly higher but statistically insignificant occurrence of composite short-term outcomes, including stroke, heart failure, recurrent Myocardial Infarction (MI), and mortality, in the OMI group as compared to the NOMI group (28.2% vs. 24.4%; p=0.56). (Figure-1).

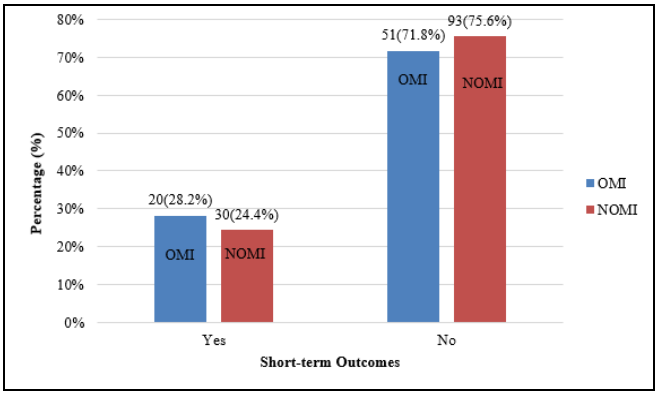

Figure-1: Comparison of Composite Short-term outcomes (stroke, Heart failure, recurrent MI, and mortality) in study groups (n=194)

DISCUSSION

In our study, we investigated the spectrum of acute coronary syndromes within the context of NSTEMI. Notably, we found that while OMI and NOMI both contribute significantly to the NSTEMI population, NOMI was more prevalent, accounting for 123(63.4%) of cases, whereas OMI constituted 71(36.6%). This distribution showed the heterogeneous nature of NSTEMI and diversity in clinical presentation. Kos *et al*., reported NOMI in 33.8% NSTEMI cases and OMI in 66.8% NSTEMI cases.[9,10] The divergence in these findings underscores the varied landscape of acute coronary syndrome, with implications for resource allocation and treatment.

NSTEMI patients with OMI experienced greater delays in receiving angiography, indicating a potential issue in the timelines of treatment for this group.

In terms of angiographic findings, our study revealed a substantial proportion of patients presenting with TVCAD 89(45.9%), while a significant number exhibited SVCAD and DVCAD [60(30.9%) and 45(23.2%)] respectively. This distribution

Table-III: Comparison of Outcomes with Baseline and Clinical Characteristics of the Patients with OMI and NOMI (n=194)

Variables	OMI Frequency(%) (n=71)					NOMI Frequency(%) (n=123)				
	Heart Failure (n=20)	Stroke (n=2)	Recurrent MI (n=2)	Death (n=2)	*p*-value	Heart Failure (n=30)	Stroke (n=2)	Recurrent MI (n=6)	Death (n=5)	*p*-value
Gender										
Male	16(72.7)	2(9.1)	2(9.1)	2(9.1)	0.70	20(60.6)	2(6.1)	6(18.2)	5(15.2)	0.13
Female	4(100)	-	-	-		10(100)	-	-	-	
Diabetes Mellitus										
Yes	16(80.0)	2(10.0)	2(10.0)	-	0.04	20(76.9)	-	2(7.7)	4(15.4)	0.10
No	4(66.7)	-	-	2(33.3)		10(58.8)	2(11.8)	4 (23.5)	1(5.9)	
Hypertension										
Yes	16(80.0)	2(10.0)	2(10.0)	0(0)	0.04	22(71.0)	2(6.5)	4(12.9)	3(9.7)	0.74
No	4(66.7)	-	-	2(33.3)		8(66.7)	-	2(16.7)	2(16.7)	
Smoking										
Yes	10(62.5)	2(12.5)	2(12.5)	2(12.5)	0.18	12(70.6)	-	2(11.8)	3(17.6)	0.51
No	10(100)	-	-	-		18(69.2)	2(7.7)	4(15.4)	2(7.7)	
Hyperlipidemia										
Yes	6(50.0)	2(16.7)	2(16.7)	2(16.7)	0.03	10(76.9)	-	2(15.4)	1(7.7)	0.73
No	14(100)	-	-	-		20(66.7)	2(6.7)	4(13.3)	4(13.3)	
Chronic Kidney Disease										
Yes	10(71.4)	2(14.3)	2(14.3)	-	0.11	20(64.5)	2(6.5)	6(19.4)	3(9.7)	0.27
No	10(83.3)	-	-	2(16.7)		10(83.3)	-	-	2(16.7)	
Family history of CAD										
Yes	-	-	-	-	-	4 (66.7)	-	-	2(33.3)	0.24
No	20(76.9)	2(7.7)	2(7.7)	2(7.7)		26(70.3)	2(5.4)	6(16.2)	3(8.1)	
Coronary Artery Disease										
SVCAD	2(100)	-	-	-	0.04	-	-	-	-	0.59
DVCAD	2(50.0)	-	-	2(50.0)		4(50.0)	1(12.5)	2(25.0)	1(12.5)	
TVCAD	16(80.0)	2(10.0)	2(10.0)	-		26(72.2)	2(5.6)	4(11.1)	4(11.1)	

SVCAD=Single Vessel Coronary Artery Disease; DVCAD=Double Vessel Coronary Artery Disease; TVCAD=Triple Vessel Coronary Artery Disease

underscores the complex coronary anatomy often observed in NSTEMI patients and reflects the need for a comprehensive evaluation of the coronary vasculature. In the field of cardiology, the accuracy of the 12-channel electrocardiogram for identifying coronary artery occlusion is constrained, particularly in cases of NSTEMI.[11-13] It has been observed that around one in five NSTEMI patients presents with complete occlusion of the infarct-related artery. However, a comprehensive review of published original studies showed conflicting results regarding the influence of occluded infarct-related arteries on outcomes in NSTEMI patients, with most studies indicating a lack of a significant link between occlusion and adverse results.[9,14,15]

Regarding short-term outcomes, our study observed heart failure in 50(25.8%) patients, stroke in 4(2.1%), recurrent MI in 8(4.1%), and death in 7(3.6%) cases. The absence of a statistically significant difference between OMI and NOMI in terms of heart failure, stroke, recurrent MI, and death (p>0.05) suggested that both OMI and NOMI patients face comparable short-term clinical risks. This contrast with some previous researches indicate that OMI patients may experience worse short-term outcomes as compared to NOMI patients.[16,17] A meta-analysis by Hung *et al*., reported higher death rate and recurrent MI between OMI and NOMI patients.[18] According to the findings of Kos N *et al*., there was no significant difference in previous stroke, previous coronary bypass surgery, cardiovascular mortality between OMI and NOMI group.[9] These discrepancies might be attributed to several factors, including variations in sample size, patient characteristics, study design, and definitions of outcomes across different studies.

Importantly, our analysis reported the association of baseline and clinical characteristics with short-term morbidity and mortality in both OMI and NOMI groups. We found that in OMI patients, there was a significant association between morbidity and mortality and key comorbidities, including diabetes mellitus, hypertension, hyperlipidemia, and the presence of coronary artery disease. These findings underscore the critical role of these risk factors in shaping the clinical trajectory of OMI patients and emphasize the need for vigilant management of these high-risk individuals. Conversely, in the NOMI group, no specific variables were found to be significantly associated with short-term morbidity and mortality. This contrast between OMI and NOMI further signifies the complexity of NSTEMI patient profiles, with OMI patients exhibiting distinct risk factors that contribute to their differential short-term outcomes. A prior investigation also revealed that patients experiencing NOMI carry a notable comorbidity burden, influencing their subsequent mortality rates, ultimately resulting in long-term mortality rates equivalent to those of OMI patients.[9]Another study carried out by Hung *et al*., compared the OMI/NOMI approach to the STEMI/NSTEMI paradigm revealed that 28.2% of patients initially diagnosed with NSTEMI were subsequently reclassified by ECG reviewers as having OMI, highlighting potential discrepancies in the initial diagnosis of these patients.[18]

The categorization of patients into OMI and NOMI based on coronary angiography findings adds depth to our understanding of NSTEMI subtypes and their implications for short-term clinical outcomes. Furthermore, the systematic collection of comprehensive patient data, including demographic, ECG, laboratory, echocardiographic, and angiographic parameters, provides a robust foundation for our analysis.

LIMITATIONS OF STUDY

This was a single-center study hence findings may not be fully generalizable to all healthcare settings. Categorization of OMI and NOMI was based on angiographic criteria, which may not fully capture the heterogeneity within NSTEMI patients, and this approach could benefit from further refinement. Additionally, the short-term follow-up duration is a limitation, as the long-term prognosis of NSTEMI patients may differ. A prospective multicenter study is warranted to provide more comprehensive understanding of NSTEMI outcomes in diverse patient populations. The refinement of criteria for categorizing OMI and NOMI, also includes other diagnostic modalities, such as intravascular imaging. Long-term follow-up studies are crucial for assessing the enduring impact of occlusion on NSTEMI patient outcomes.

CONCLUSION

The study emphasizes tailored management strategies for NSTEMI patients. Specifically, the disconnect between baseline risk of the two groups and the timely utility of invasive strategy can help improve prognosis. Increasing prevalence of delayed PCI for patients admitted with myocardial infarction presents the opportunity for a large-scale retrospective analysis of ECG patterns other than ST elevation that are suggestive of occlusion (OMI).

ACKNOWLEDGEMENT

The authors acknowledge the support of the research department of AFIC in analyzing the statistics and editing of the document.

Conflict of Interest: None

Authors' Contribution

Following authors have made substantial contributions to the manuscript:

AA & MNK: Concept, study design, drafting the manuscript, approval of the final version to be published

MHY& HZ: Data acquisition, data analysis, data interpretation, approval of the final version to be published

NH & JK: Data acquisition, critical review, approval of the final version to be published

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Shao C, Wang J, Tian J, Tang YD. Coronary Artery Disease: From Mechanism to Clinical Practice. Adv Exp Med Biol. 2020; 1177:1-36. https://doi.org/10.1007/978-981-15-2517-9_1.
2. Malakar AK, Choudhury D, Halder B, Paul P, Uddin A, Chakraborty S. A review on coronary artery disease, its risk factors, and therapeutics. J Cell Physiol. 2019 Aug; 234(10): 16812-16823. https://doi.org/10.1002/jcp.28350.
3. Gaziano TA, Bitton A, Anand S, Abrahams-Gessel S, Murphy A. Growing epidemic of coronary heart disease in low- and middle-income countries. Curr Probl Cardiol. 2010; 35(2): 72–115. https://doi.org/10.1016/j.cpcardiol.2009.10.002.
4. Hertz JT, Kweka GL, Bloomfield GS, Limkakeng AT Jr, Loring Z, Temu G, et al. Patterns of Emergency Care for Possible Acute Coronary Syndrome Among Patients with Chest Pain or Shortness of Breath at a Tanzanian Referral Hospital. Glob Heart. 2020; 15(1): 9. https://doi.org/10.5334/gh.402.
5. Awan A, Ogunti R, Fatima U, Gonzalez H, Ganta N, Rizwan M, et al. Timing of Percutaneous Coronary Intervention in Non-ST Elevation Acute Coronary Syndrome - Meta-Analysis and Systematic Review of Literature. Cardiovasc Revasc Med. 2020; 21(11): 1398-1404. https://doi.org/10.1016/j.carrev.2019.10.004.
6. Mitsis A, Gragnano F. Myocardial Infarction with and without ST-segment Elevation: a Contemporary Reappraisal of Similarities and Differences. Curr Cardiol Rev. 2021; 17(4):

e230421189013. https://doi.org/10.2174/1573403X16999201210195702.
7. Lambert LJ, Brophy JM, Racine N, Rinfret S, L'Allier PL, Brown KA, et al. Outcomes of Patients With ST-Elevation Myocardial Infarction Receiving and Not Receiving Reperfusion Therapy: The Importance of Examining All Patients. Can J Cardiol. 2016; 32(11): 1325.e11-1325.e18. https://doi.org/10.1016/j.cjca.2016.02.073.
8. Rodríguez-Padial L, Fernández-Pérez C, Bernal JL, Anguita M, Sambola A, Fernández-Ortiz A, et al. Differences in in-hospital mortality after STEMI versus NSTEMI by sex. Eleven-year trend in the Spanish National Health Service. Rev Esp Cardiol (Engl Ed). 2021; 74(6): 510-517. English, Spanish. https://doi.org/10.1016/j.rec.2020.04.017.
9. Kos N, Zeljković I, Krčmar T, Golubić K, Šaler F, Erceg M, et al. Acute Occlusion of the Infarct-Related Artery as a Predictor of Very Long-Term Mortality in Patients with Acute Myocardial Infarction. Cardiol Res Pract. 2021; 2021: 6647626. https://doi.org/10.1155/2021/6647626.
10. Jayachandra A, Datta R, Swamy A, Issar NK, Sarkar S, Aggarwal V. Profile of acute coronary syndromes in serving personnel presenting to a field cardiology center without cath lab facilities. J Mar Med Soc. 2022 Jul 1; 24(2): 176-9. https://doi.org/10.4103/jmms.jmms_40_22
11. Faramand Z, Helman S, Ahmad A, Martin-Gill C, Callaway C, Saba S, et al. Performance and limitations of automated ECG interpretation statements in patients with suspected acute coronary syndrome. J Electrocardiol. 2021; 69S: 45-50. https://doi.org/10.1016/j.jelectrocard.2021.08.014.
12. Zègre-Hemsey JK, Hogg M, Crandell J, Pelter MM, Gettes L, Chung EH, et al. Prehospital ECG with ST-depression and T-wave inversion are associated with new onset heart failure in individuals transported by ambulance for suspected acute coronary syndrome. J Electrocardiol. 2021; 69S: 23-28. https://doi.org/10.1016/j.jelectrocard.2021.08.005.
13. Fakhri Y, Andersson H, Gregg RE, Babaeizadeh S, Kastrup J, Holmvang L, et al. Diagnostic performance of a new ECG algorithm for reducing false positive cases in patients suspected acute coronary syndrome. J Electrocardiol. 2021 Nov-Dec; 69: 60-64. https://doi.org/10.1016/j.jelectrocard.2021.07.005.
14. Hwang HJ, Park CB, Cho JM, Jin ES, Sohn IS, Kim DH, et al. Clinical characteristics of occluded culprit arteries and collaterals in patients with non-ST-segment elevation myocardial infarction and impact on clinical outcomes. Exp Ther Med. 2018 Oct; 16(4): 3710-3720. https://doi.org/10.3892/etm.2018.6605.
15. Karwowski J, Gierlotka M, Gąsior M, Poloński L, Ciszewski J, Bęćkowski M, et al. Relationship between infarct artery location, acute total coronary occlusion, and mortality in STEMI and NSTEMI patients. Pol Arch Intern Med. 2017; 127(6): 401-411. https://doi.org/10.20452/pamw.4018.
16. Avdikos G, Michas G, Smith SW. From Q/Non-Q Myocardial Infarction to STEMI/NSTEMI: Why It's Time to Consider Another Simplified Dichotomy; a Narrative Literature Review. Arch Acad Emerg Med. 2022; 10(1): e78. https://doi.org/10.22037/aaem.v10i1.1783.
17. Hung CS, Chen YH, Huang CC, Lin MS, Yeh CF, Li HY, et al. Prevalence and outcome of patients with non-ST segment elevation myocardial infarction with occluded "culprit" artery - a systemic review and meta-analysis. Crit Care. 2018; 22(1): 34. https://doi.org/10.1186/s13054-018-1944-x.
18. Aslanger EK, Yıldırımtürk Ö, Şimşek B, Bozbeyoğlu E, Şimşek MA, Yücel Karabay C, et al. Diagnostic accuracy of electrocardiogram for acute coronary occlusion resulting in myocardial infarction (DIFOCCULT Study). Int J Cardiol Heart Vasc. 2020 Jul 30; 30: 100603. https://doi.org/10.1016/j.ijcha.2020.100603.