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STUDY ON THE IDENTIFICATION OF CLINICAL FEATURES AND RISK FACTORS OF MYOCARDIAL INFARCTION

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Abstract

Introduction: Myocardial infarction (MI) is a leading cause of mortality worldwide, affecting millions of people annually. MI can be categorized as ST-segment elevation MI (STEMI) or non-ST-segment elevation MI (NSTEMI). Reduced coronary blood flow due to factors such as atherosclerotic plaque rupture and thrombosis leads to MI.

Aims and Objectives: To determine the risk factors and evaluate the clinical features in patients with Myocardial Infarction.

Method: This prospective study included 178 patients from March 2021 to February 2022, who visited the Department of Medicine OPD & IPD & also collaborated with Biochemistry. Biomarkers of Myocardial Infarction (MI) were examined alongside clinical features, following the diagnostic criteria set by the World Health Organization. The patients were divided into two groups: the MI group and the control group. Laboratory parameters such as blood sugar, lipid profile , hsCRP, IL-6, and plasma fibrinogen, were statistically analyzed to assess the association between these variables and the risk of MI. Inclusion criteria involved patients with chest pain and MI features, diagnosed by experienced cardiologists, while exclusion criteria included non-cooperation, chronic conditions, and failure to follow the study protocol.

Results: Total number of (n=178) participants (males=65; mean age of 65years, females=24, mean age of 58 years) at 95% CI were considered in this study, out of these, 89 individuals were expected to have risk of myocardial infarction (especially observed in case groups), and remaining 89 individuals were considered as control groups, all were included as, study subjects. The case group exhibited elevated risk factors associated with cardiovascular health issues and higher levels of inflammation, indicating their potential contribution to the specific condition studied.

Conclusion: The study has concluded that there are several parameters which significantly correlated with occurrence of MI.

Keywords: Myocardial Infarction, Risk Factors, Clinical Features, Smoking, Cardiovascular disease.

Introduction

Myocardial necrosis brought on by cardiac ischemia is known as myocardial infarction (MI). The most prevalent cause of mortality worldwide is MI, a cardiovascular illness. About every 40 seconds, someone is creating MI in the USA. Each year, it is predicted that 200 000 Americans will experience a recurring MI event and 605 000 Americans will experience a new acute MI. For managing the condition of patients with MI, numerous cutting-edge strategies, including thrombolytic therapy & interventional therapy, have been developed [1,2]. However, MI is still a significant issue in the world. Gene susceptibility & non-genetic. The main risk factors for MI include elements like high blood pressure. Contrary to certain other studies,

cigarettes have not been substantially connected to MI development or outcome. In MI patients, high levels of aerobic activity (PA) have been observed to reduce the risk of a 1-year readmission for illnesses other than cardiovascular disease. Although a different study did not find a connection involving PA and the likelihood of acute coronary artery disease, PA continues to be a factor in preventing MI from happening. The prevalence of earlier coronary artery disease in the family has a major impact on the likelihood of MI [3,4].

An illness, which impacts nearly to three million people globally, kills over a million Americans per year. ST-segment enlargement MI (STEMI) and non-ST-segment augmentation MI (NSTEMI) are the two different kinds of abrupt coronary artery disease. NSTEMI and unstable angina are comparable. Cardiovascular symptoms, however, remain same [5]. Due to a shortage of oxygen, the heart muscle suffers chronic damage in coronary artery disease. A MI can affect the evaluation of s and systolic function, increasing someone's likelihood of developing arrhythmias [6]. A myocardial infarction can result in a number of significant adverse effects. Both blood flow restoration and heart resuscitation are critical. The prognosis is improved by early intervention [7].

A MI is identified once two of the ensuing conditions are satisfied [8]

1. Ischemic stroke symptoms
2. A modern ST or left package blocked branch (LBBB)
3. There are unusual type of peaks shown in the ECG.
4. A pictured analysis identifies a brand-new regional wall motion anomaly.
5. intracoronary thrombus discovered during an autopsy or an angiography

Reduced coronary blood flow causes acute myocardial infarction. Because there's not enough oxygen to fulfil the demand, heart ischemia occurs. Numerous factors may contribute to decreased coronary blood flow [9,10]. Traditional atherosclerotic plaque rupture and thrombosis result in acutely reduced coronary blood flow. Ventricular artery embolism, myocardial imaging, arterial a condition known as and cocaine-induced ischemia are additional causes of reduced oxygenation. A sign of myocardial ischemia is the occurrence of a coronary bursting, that is particular to 2.9% of patients [11,12]. Inescapable risk elements: Sex, Age, Family Background, baldness on the male pattern. [13].

Risk factors that are adaptable: Nicotine, lipid issues, sweet diabetes, sugary hypertension, issues, existence of peripheral vascular disease, high homocysteine levels [13]. Trauma Vasculitis, use of cocaine, Anomalous coronary arteries, cardiovascular artery emboli, the aorta is torn, the heart is under too much stress (hyperthyroidism, anaemia) [13]. The occlusion of atherosclerotic plaque is the primary factor in 70% of fatal outcomes among individuals with acute myocardial infarction. Acute myocardial infarction is mostly brought on by atherosclerosis, therefore disease prevention usually entails reducing risk factors for the disease[14,15]. Modifiable risk factors account for ninety per cent of heart attacks in men and 94% of cardiac infarctions in women. Risk factors that can be changed include tobacco use, physical activity, obesity, and elevated fat on the other hand, are risk factors for arteries that cannot be altered [16].

Platelet aggregation, thrombus formation, and a cycle of inflammation involving monocytes and macrophages. As a result, the coronary artery receives less oxygen, which reduces the myocardium's oxygenation. Endocardial loss (cell mortality) or myocardial infarction occur when the mitochondria fail to make ATP [17,18]. With a few minor exceptions brought on by genetic variability, the geographical arrangements of blood vessels are distinct and diagnostic. For instance, the septum of the interventricular cavity, hind wall, and ventricular apex all receive blood flow from the left early descending coronary artery [19,20]. The inferolateral wall receives blood from the left circumflex vein. The right ventricle receives blood from

the coronary artery. Either the dominant side coronary artery or the left circumflex flow supplies blood to the inferior wall [21].

Research design

This prospective study included 178 patients from March 2021 to February 2022, patients visited the Department of Medicine in the OPD, IPD & Emergency also collaborated with Department of Biochemistry. The patients were examined for biomarkers of Myocardial Infarction along with their clinical features. The diagnosis of MI was made by applying criteria set by World Health Organization [10,12]. The diagnosis of MI was confirmed by two experienced cardiologists independently. The patients were divided into2 groups, namely, the MI group and Control group. The patients with diagnosed MI were considered in the MI group while those who did not have MI, were taken as control. The laboratory parameters like blood sugar, lipid profile , hsCRP, IL-6, and plasma fibrinogen were statistically analyzed between the two groups to associate the risk of MI with each variable. Weare divided two group pf this study, (i) Myocardial Infarction (Case), Non-MI group (Control).

Inclusion criteria:

- Patients more than 55 years of age, electrocardiogram (ECG) findings and biochemical markers: Suggestive of acute myocardial infarction
- Elevated level of creatine kinase-MB and Trop T
- Chest pain lasting 24 hours, suggestive of myocardial ischemia of accelerated pattern, or a prolonged one (>20 minutes), or with recurrent episodes at rest, or at minimal excretion, in addition to at least one of the following:
    - (a) New or presumed ECG changes (any of the following three characteristics): ST-segment depression ≥ 0.5 mm, transient ST-segment elevation (< 20 minutes) ≥ 1 mm, T-wave inversion ≥ 3 mm in two or more contiguous leads;
    - Development of pathological Q waves in the ECG
    - (b) Raised levels of cardiac markers (CK ≥ 2X the upper limit of normal).

Exclusion criteria:

- Known causes of elevated uric acid level (chronic kidney disease, gout, hematological malignancy, and hypothyroidism).
- Patients on drugs which increase serum uric acid e.g. salicylates (2gm/dl, hydrochlorothiazide, pyrazinamide).
- Chronic alcoholics.
- Acute phase of impaired subject of obesity (body mass index > 30) was excluded. In addition, patients receiving medications affecting lipid metabolism, such as lipid lowering drugs, beta-blockers, oral contraceptives, estrogen, thyroxin and vitamin E was also excluded.
- Present or past aspirin, statins or hormone replacement therapy, autoimmune diseases and malignancies smokers, Subjects with any chronic diseases or acute infections, antioxidant vitamin supplements, hepatic disease etc.
- Renal dysfunction, Myocarditis, Rhabdomyolysis, Cardiomyopathy, Cardiac Surgery, Stroke, etc.

Statistical Analysis

The study used SPSS 22 for effective statistical analysis. The continuous data were expressed as Mean±SD while discrete data were expressed as frequency and its respective percentage. The study employed ANOVA to associate the occurrence of MI with each variable. The level of significance was considered to be $p<0.05$. The tested parameters were considered significant when critical, P >0.01level was set up, for a 95% CI.

Ethical Approval

The study process has been explained clearly to each patient and the authors obtained written consent from each patient. The study was approved by the Ethical Committee of the concerned hospital before the collection of data.

Results

The current study discusses lipid and biochemical marker features using a case-control design. In total, 178 individuals (n=178) participated in the study (males=65; mean age of 65 years; females=24; mean age of 58 years at 95% CI); 89 of these were expected to have a myocardial infarction (cases), and the remaining 89 were healthy individuals (controls), study subjects. In Table 1, a case-control population study is summarized. Men and women were both included in the research population, and while addressing the incidence of coronary heart disease (CHD), it was discovered that the age groups of all the patients were very comparable during the 5-year study period.

Table 1:Baseline variables in this case control study.

Characteristics	Case (n=89)	Control (n=89)	Odds ratio (95%) CI	*P* value
Age				
<35	5	3	Reference	
35-40	14	16	0.71(0.1-3.3)	0.73
41-45	26	21	0.66 (0.1-3)	0.71
>45	44	49	0.52 (0.11-2.3)	0.47
Mean±SD	44.2±4.96	45.32±4.16	-	0.07
Gender				
Male	65	57	Reference	
Female	24	36	0.5 (0.3-0.99)	0.06

Diabetes				
No	58 (52.7%)	110 (100%)	NA	<0.001*
Yes	52 (47.3%)	0 (0%)		
Alcohol consumption				
No	32 (29.1%)	107 (97.3%)	86.9 (25.7-294.2)	<0.001*
Yes	78 (71.1%)	03 (2.7%)		
Tobacco consumption				
No	35 (31.8%)	107 (97.3%)	76.4 (22.6-257)	<0.001*
Yes	75 (68.2%)	03 (2.7%)		
Smoking				
No	18 (16.4%)	107 (97.3%)	182.3 (52-638)	<0.001*
Yes	92 (83.6%)	03 (2.7%)		
Physical activity				
No	99 (90%)	84	0.34 (0.16-0.76)	0.012*
Yes	11 (10%)	26		
STEMI				
No	80 (72.7%)	110 (100%)	NA	<0.001*
Yes	30 (27.3%)	0 (0%)		
NSTEMI				
No	98 (89.1%)	0 (0%)	NA	<0.001*
Yes	12 (10.9%)	0 (0%)		

Table 1: Baseline and principal characteristics of cases and controls:

The baseline characteristics of selected case and control groups are summarized in Table 1. The mean age (± SD) of cases and controls are 44 ± 4.9 years and 45.32 ± 4.16 years. Comparing the mean age of the two groups, Univariate binary logistic regression analysis showed similar ($p>0.05$) age between the two groups i.e. did not differ significantly. In other words, subjects of two groups were age matched. Further, gender was also found similar ($p>0.05$) between the two groups i.e. also not differed significantly.

Table 2: Clinical Characteristics of the study subjects					
Considered Risk factors	**Group**	**N**	**Mean ±Std. Deviation**	**Std. Error Mean**	**p-Value**
BSF (mg/dl)	Case	89	170.31±40.22	3.92539	<0.001*
	Control	89	84.35± 12.83	1.25298	
TC (mg/dl)	Case	89	208.34±62.20	6.07057	<0.001*
	Control	89	155.79±42.92	4.18934	
TG (mg/dl)	Case	89	166.09±46.94	4.58143	<0.001*
	Control	89	108.38± 34.61	3.37779	
HDL (mg/dl)	Case	89	40.40±4.47	.43687	<0.001*
	Control	89	82.61±21.38	2.08717	
LDL (mg/dl)	Case	89	134.72±58.28	5.68851	<0.001*
	Control	89	51.50±29.96	2.92434	
VLDL (mg/dl)	Case	89	33.21±9.38	.91629	<0.001*
	Control	89	21.67±6.92	.67556	
TG/HDL-c	Case	89	4.17±1.33	.13071	<0.001*
	Control	89	1.33±.35	.03462	
TC/HDL-c	Case	89	5.32±1.60	.15680	<0.001*
	Control	89	1.92±.44	.04388	
hsCRP (mg/l)	Case	89	4.57±1.48	.14488	<0.001*
	Control	89	.48±.21	.02140	
IL-6 (pg/ml)	Case	89	36.37±23.63	2.30690	<0.001*
	Control	89	8.08±3.26	.31884	
Plasma Fibrinogen (ng/ml)	Case	89	25.85±25.90	2.52773	<0.001*
	Control	89	4.80±1.71	.16780	
BMI (kg/m^2)	Case	89	26.99±3.13	.30601	<0.001*
	Control	89	24.44±3.96	.38711	

Table 2 presents the clinical characteristics of the study subjects, comparing various risk factors between the case group and the control group. The case group represents individuals with a specific condition or disease, while the control group consists of individuals without that condition. The table provides information on different risk factors such as blood sugar fasting (BSF), total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL), very low-density lipoprotein (VLDL), TG/HDL-c ratio, TC/HDL-c ratio, high-sensitivity C-reactive protein (hsCRP), interleukin-6 (IL-6), plasma fibrinogen, and body mass index (BMI).

Analyzing the data, it is evident that significant differences exist between the case and control groups for all risk factors listed ($p < 0.05$). In the case group, compared to the control group, several patterns emerge. First, individuals in the case group exhibit higher levels of risk factors associated with cardiovascular health issues. The mean values for BSF (170.31±40.22

mg/dl), TC (208.34±62.20 mg/dl), TG (166.09±46.94 mg/dl), LDL (134.72±58.28 mg/dl), and VLDL (33.21±9.38 mg/dl) are all significantly elevated compared to the control group. Conversely, the case group demonstrates lower levels of HDL (40.40±4.47 mg/dl), indicating reduced protective effects against cardiovascular diseases.

Furthermore, the ratios of TG/HDL-c (4.17±1.33) and TC/HDL-c (5.32±1.60) in the case group are considerably higher than in the control group. These ratios serve as indicators of cardiovascular risk, with elevated values suggesting an unfavorable lipid profile. Additionally, the case group exhibits higher levels of inflammatory markers, including hsCRP (4.57±1.48 mg/l), IL-6 (36.37±23.63 pg/ml), and plasma fibrinogen (25.85±25.90 ng/ml), compared to the control group. Such elevated levels of inflammation may contribute to the development and progression of the underlying condition.

Lastly, the case group has a higher mean BMI (26.99±3.13 kg/m²) compared to the control group (24.44±3.96 kg/m²). This finding suggests that individuals with the specific condition studied tend to have a higher body mass index, which is associated with increased health risks such as metabolic disorders and cardiovascular complications. The results demonstratesignificant differences in various clinical characteristics between the case and control groups. These differences highlight thepotential role of the listed risk factors in the development or progression of the specific condition under investigation.

Discussion

A cross-sectional, retrospective investigation was carried out over a 7-year period to describe the risk variables & clinical presentation for individuals under the age of 40 who report to the emergency department (ED) at a local hospital with an acute coronary artery disease (MI). The World Health Organization criteria (chest discomfort, ECG alterations, and serum enzyme increases) were met by 219 consecutive patients of first MI who were admitted in one of five collaborating hospitals. Tobacco use was the biggest risk factor, and it was followed by familial history of hypertension, and hyperlipidemia. In the ED, 183 patients reported ECG results showing myocardial ischemia, damage, or infarction. The inferior wall was the most typical anatomical location associated with MI. The distribution and prevalence of acute MI in young people were described in this study as follows: Smoking became the primary risk factor for coronary disease, atherosclerosis remained the main cause, the single-vessel disease frequently caused inferior wall infarction on angiography, the complication rate had been comparable for older populations, but in-hospital mortality amounted to just 1.9% [22].

India is currently in the fourth decade of epidemiological changes, and cardiovascular disease is the primary cause of deaths. This research work's goal was to evaluate the dangers, medical manifestation, and disease profile, including type and spread, as well as inside prognosis of youth who are having an age less than 30 years having their initial AMI disorder. From March 2013 and February 2015, 1,116 individuals suffering from elevated ST-segment elevation due to transient coronary artery disease (STEMI) received cardiac surgery by the LPS Institute of Cardiac in Kanpur, the state of Uttar Pradesh, India. Males were the most typical AMI gender among very young adults. The most prevalent risk factor was smoking. The most frequent presentation was AWMI due to LAD artery involvement. The median time to onset of symptoms is 17 hours. Comparing with the West side people, that has sooner onset, later presentation, more severe, diffuse disease, and worse morbidity, but it also has better in-hospital mortality [23].

The goal of the study was to compare elderly patients (those who were 75 years or older) with patients who are younger (those who were less than 75 years old) in terms of medical profiles and treatment changes. At the specialised Clinic in Radom, Poland, the Cardiology Ward treated 80 patients in succession with a heart attack (MI) in 2005. Analysis has previously been done. Forty individuals below the age of 75 made up the patient group II surveillance group (aged 42–67; mean 60 years), whereas Forty individuals 75 years of age or older made up the group I study population (aged 75–95; mean

81 years). Our findings confirm the disparities in the clinical profile of MI among seniors that have been previously described. All senior patients should be regarded of to have a greater chance of dying away and acquiring complications [24].

To research the clinical characteristics and hospital outcomes of young Singaporean people with acute myocardial infarction (AMI). At our facility, 333 consecutive patients under the age of 45 who had been diagnosed with AMI between January 2005 and September 2010 received the diagnosis. Given that Singapore is a multiethnic culture, we also examined whether there are any clinical feature differences between three of its dominant ethnic groups, Malay, Chinese, and Indian. Clinical information on demographics, presenting symptoms, blood work, angiographic results, and in-hospital medical results was gathered retrospectively. Male preponderance, high smoking prevalence, and obesity are characteristics of Singapore's young AMI patients. Clinical outcomes while in the hospital are generally positive. Indians had the highest risk of having early AMI of the three ethnic groups [25].

Acute myocardial infarction (AMI) in young people differs from that in older patients in several ways. With regard to risk factors, presenting symptoms, characteristics of myocardial angiographic (CAG) or echocardiographic outcomes, complications, and in-hospital mortality, the current study aimed at contrasting young patients with AMI in a referral teaching cardiac centre to older patients. A descriptive-analytic analysis included 100 individuals with anatomical evidence of AMI that were under 35 and Hundred individuals who were over 35. Between January 2000 & September 2009, the differences between the two groups' risk variables, clinical traits, and CAG and echocardiographic data were analyzed. The greatest risk factor for AMI in adults under the age of 35—who usually have less stenosis of the coronary arteries than elderly patients—is a positive family history, not smoking or dyslipidemia. The young adult population in MI has a higher prevalence of alcoholism is a social habit. With identical mortality, young individuals appear to have reduced morbidity [26].

Conclusion

This study concludes that high levels of Interleukin-6 and plasma fibrinogen are more significant risk factors for coronary artery blockage or cardiac heart disease than high sensitivity C-reactive protein. The case and control groups are distinguished using the lipid profiles and markers for lipids. These indicators are crucial for identifying relationships between the lipid and non-lipid profile markers, such as age, smoking, alcohol use, tobacco use, body mass index and cholesterol, triglyceride levels that cause dyslipidemia, diabetes, and arterial hypertension conditions, especially in case groups, and no discernible relationship between physical activity and these associations was found. Body mass index (BMI), which was not statistically linked with hsCRP in the case group, was substantially covariate with it at the P =0.01 level, it was strongly associated at a level with hsCRP in the case group but not in the control group. However, the study's findings revealed that the case group's cholesterol, LDL cholesterol, and triglycerides were considerably greater than those in the control group, while the case group's HDL cholesterol was lower. According to the current study, male case group members were shown to be at greater risk than female case group members.

References

1. Zhan C, Shi M, Wu R, He H, Liu X, Shen B. MIRKB: a myocardial infarction risk knowledge base. Database (Oxford). 2019; 2019:baz125.
2. Benjamin E.J., Muntner P., Alonso A. et al. (2019) heart disease and stroke statistics-2019 update: a report from the American Heart Association. *Circulation*, 139, e58–e528.
3. Bawaskar H.S., Bawaskar P.H. and Bawaskar P.H. Preintensive care: thrombolytic (streptokinase or tenecteplase) in ST elevated acute myocardial infarction at peripheral hospital. *J Family Med Prim Care*, 2019; 8, 62–71.
4. Chien C.W., Wang C.H., Chao Z.H. et al. (2019) Different treatments for acute myocardial infarction patients via outpatient clinics and emergency department. *Medicine*, e13883, 98.
5. Wang K., Chen L., Liu L. et al. (2019) The effects of atorvastatin on interventional therapy in patients with acute myocardial infarction. *Minerva Med.*, 110, 101–106.
6. Forcadell M.J., Vila-Corcoles A., de Diego C. et al. (2018) Incidence and mortality of myocardial infarction among Catalonian older adults with and without underlying risk conditions: the CAPAMIS study. *Eur. J. Prev. Cardiol.*, 25, 1822–1830.
7. Martin Castellanos A., Cabanas Armesilla M.D., Barca Duran F.J. et al. (2017) Obesity and risk of myocardial infarction in a sample of European males. Waist to-hip-ratio presents information bias of the real risk of abdominal obesity. *Nutr. Hosp.*, 34, 88–95.
8. Alzahrani T., Pena I., Temesgen N. et al. (2018) Association between electronic cigarette use and myocardial infarction. *Am. J. Prev. Med.*, 55, 455–461.
9. La Torre G., Saulle R., Di Murro F. et al. (2018) Mediterranean diet adherence and synergy with acute myocardial infarction and its determinants: a multicenter case-control study in Italy. *PLoS One*, 13, e0193360.
10. Nascimento BR, Brant LCC, Marino BCA, Passaglia LG, Ribeiro ALP. Implementing myocardial infarction systems of care in low/middle-income countries. Heart. 2019 Jan;105(1):20-26.
11. Barberi C, van den Hondel KE. The use of cardiac troponin T (cTnT) in the postmortem diagnosis of acute myocardial infarction and sudden cardiac death: A systematic review. Forensic Sci Int. 2018 Nov;292:27-38.
12. Alaour B, Liew F, Kaier TE. Cardiac Troponin - diagnostic problems and impact on cardiovascular disease. Ann Med. 2018 Dec;50(8):655-665.
13. Massberg S, Polzin A. [Update ESC-Guideline 2017: Dual Antiplatelet Therapy]. Dtsch Med Wochenschr. 2018 Aug;143(15):1090-1093.
14. Scheen AJ. [From atherosclerosis to atherothrombosis : from a silent chronic pathology to an acute critical event]. Rev Med Liege. 2018 May;73(5-6):224-228.
15. Berg DD, Wiviott SD, Braunwald E, Guo J, Im K, Kashani A, Gibson CM, Cannon CP, Morrow DA, Bhatt DL, Mega JL, O'Donoghue ML, Antman EM, Newby LK, Sabatine MS, Giugliano RP. Modes and timing of death in 66 252 patients with non-ST-segment elevation acute coronary syndromes enrolled in 14 TIMI trials. Eur Heart J. 2018 Nov 07;39(42):3810-3820.
16. Deng D, Liu L, Xu G, Gan J, Shen Y, Shi Y, Zhu R, Lin Y. Epidemiology and Serum Metabolic Characteristics of Acute Myocardial Infarction Patients in Chest Pain Centers. Iran J Public Health. 2018 Jul;47(7):1017-1029.
17. Haig C, Carrick D, Carberry J, Mangion K, Maznyczka A, Wetherall K, McEntegart M, Petrie MC, Eteiba H, Lindsay M, Hood S, Watkins S, Davie A, Mahrous A, Mordi I, Ahmed N, Teng Yue May V, Ford I, Radjenovic A, Welsh P, Sattar N, Oldroyd KG, Berry C. Current Smoking and Prognosis After Acute ST-Segment Elevation Myocardial Infarction: New Pathophysiological Insights. JACC Cardiovasc Imaging. 2019 Jun;12(6):993-1003.

18. Alquézar-Arbé A, Sanchís J, Guillén E, Bardají A, Miró Ò, Ordóñez-Llanos J. Cardiac troponin measurement and interpretation in the diagnosis of acute myocardial infarction in the emergency department: a consensus statement. Emergencias. 2018 Oct;30(5):336-34

19. Zimmerman FH, Cameron A, Fisher LD, Ng G. Myocardial infarction in young patients: angiographic characterization, risk factors and prognosis (Coronary Artery Surgery Study Registry) J Am Coll Cardiol. 1995;**26**:654–661.

20. Kanitz MG, Giovannucci SJ, Jones JS, Mott M. Myocardial infarction in young adults: risk factors and clinical features. J Emerg Med. 1996;**14**:139–145.

21. Moccetti T, Malacrida R, Pasotti E, Sessa F, Genoni M, Barlera S, Turazza F, Maggioni AP. Epidemiologic variables and outcome of 1972 young patients with acute myocardial infarction. Data from the GISSI-2 database. Investigators of the Gruppo Italiano per lo Studio della Sopravvivenza nell'Infarto Miocardico (GISSI-2) Arch Intern Med. 1997;**157**:865–869.

22. Kanitz, M. G., Giovannucci, S. J., Jones, J. S., & Mott, M. (1996). Myocardial infarction in young adults: Risk factors and clinical features. *The Journal of Emergency Medicine*, *14*(2), 139-145

23. Sinha SK, Krishna V, Thakur R, Kumar A, Mishra V, Jha MJ, Singh K, Sachan M, Sinha R, Asif M, Afdaali N, Mohan Varma C. Acute myocardial infarction in very young adults: A clinical presentation, risk factors, hospital outcome index, and their angiographic characteristics in North India-AMIYA Study. ARYA Atheroscler. 2017 Mar;13(2):79-87. PMID: 29026414; PMCID: PMC5628855.

24. Goch, A., Misiewicz, P., Rysz, J., & Banach, M. (2009). The Clinical Manifestation of Myocardial Infarction in Elderly Patients. *Clinical Cardiology*, *32*(6), E45-E50.

25. Wong CP, Loh SY, Loh KK, Ong PJ, Foo D, Ho HH. Acute myocardial infarction: Clinical features and outcomes in young adults in Singapore. World J Cardiol. 2012 Jun 26;4(6):206-10. doi: 10.4330/wjc.v4.i6.206. PMID: 22761974; PMCID: PMC3386311

26. Doughty M, Mehta R, Bruckman D, Das S, Karavite D, Tsai T, Eagle K. Acute myocardial infarction in the young--The University of Michigan experience. Am Heart J. 2002;**143**:56–62.