Original Article

Clinical and Demographic Characteristics of Patients with ST-Elevation Myocardial Infarction in Siloam Heart Center: A Single Center Study

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Abstract

Introduction: *Cardiovascular disease remains the leading cause of death globally, with ST-elevation myocardial infarction (STEMI) posing the highest mortality among acute coronary syndromes (ACS). Early intervention, such as percutaneous coronary intervention (PCI), improves outcomes. Objective: To describe the clinical and demographic profile of STEMI patients in Indonesia and identify risk factors associated with disease severity.*
Methods: *A retrospective descriptive study was conducted on STEMI patients who underwent PCI at a Heart Center Hospital from January to December 2024. Data from electronic medical records were analyzed, including only confirmed STEMI cases with complete documentation.*
Result: *87 patients were included, most male (92%) and aged over 50 (66.7%). Hypertension (49.4%), smoking (46%), and diabetes mellitus (27.6%) were common comorbidities. Leukocytosis occurred in 86.2%, with universally elevated troponin levels. Despite frequent cardiomegaly on chest X-rays, 46% had preserved ejection fraction on echocardiography. Inferior (34.5%) and anterior (19.5%, 17.2%) infarctions were the most common ECG findings. The left anterior descending (LAD) artery was affected in 85.1%, with three-vessel disease present in 49.4%. Mean door-to-balloon (DTB) time was 86.25 minutes. In Intra-PCI Complications, dissection in 2.3%.*
Conclusion: *STEMI in Indonesia predominantly affects older males with modifiable cardiovascular risk factors. These factors are closely linked to severe coronary involvement, particularly multi-vessel disease.*

Keywords: *STEMI, Indonesia, Characteristics, Risk Factor*

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Karakteristik Klinis dan Demografi Pasien Infark Miokard Elevasi ST di Siloam Heart Center: A Single Center Study

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Abstrak

Pendahuluan: *Penyakit kardiovaskular tetap menjadi penyebab utama kematian secara global, dengan ST-elevation myocardial infarction (STEMI) sebagai penyebab kematian tertinggi di antara acute coronary syndromes (ACS). Intervensi dini, seperti percutaneous coronary intervention (PCI), terbukti meningkatkan luaran klinis. Tujuan: Mendeskripsikan profil klinis dan demografis pasien STEMI di Indonesia serta mengidentifikasi faktor risiko yang berhubungan dengan tingkat keparahan penyakit.*
Metode: *Studi deskriptif retrospektif dilakukan pada pasien STEMI yang menjalani PCI di Rumah Sakit Pusat Jantung dari Januari hingga Desember 2024. Data diperoleh dari rekam medis elektronik, hanya mencakup kasus STEMI yang telah terkonfirmasi dan memiliki dokumentasi lengkap.*
Hasil: *Sebanyak 87 pasien dimasukkan dalam studi, Sebagian besar berjenis kelamin laki-laki (92%) dan berusia di atas 50 tahun (66.7%). Hipertensi (49.4%), merokok (46%), dan diabetes melitus (27.6%) merupakan komorbiditas yang paling sering ditemukan. Leukositosis terjadi pada 86.2% pasien, dan seluruh pasien menunjukkan kenaikan kadar troponin. Meskipun pembesaran jantung sering terlihat pada foto toraks, 46% memiliki fraksi ejeksi yang masih baik berdasarkan pemeriksaan ekokardiografi. Infark inferior (34.5%) serta anterior (19.5%, 17.2%) merupakan temuan EKG yang paling umum. Arteri left anterior descending (LAD) terdampak pada 85.1% pasien, dan three-vessel disease ditemukan pada 49.4% pasien. Rata-rata waktu door-to-balloon (DTB) adalah 86.25 menit. Pada komplikasi intra-PCI, dissection terjadi pada 2,3% pasien.*
Kesimpulan: *STEMI di Indonesia lebih banyak menyerang laki-laki lanjut usia dengan faktor risiko kardiovaskular yang dapat dimodifikasi. Faktor-faktor ini berkaitan erat dengan keterlibatan koroner yang berat, terutama penyakit multi-vessel.*

Kata Kunci: *STEMI, Indonesia, Karakteristik, Faktor Risiko*

Introduction

Cardiovascular disease (CVD) remains the leading cause of morbidity and mortality worldwide, with a significant proportion of this burden affecting low- and middle-income countries.[1] According to the World Health Organization, CVD was responsible for 17.9 million deaths in 2016, accounting for approximately 31% of all global deaths. This number is projected to rise to 23.6 million by 2030.[2] Acute Coronary Syndrome (ACS) is often the first clinical presentation of CVD. It is characterized by chest pain accompanied by recent changes in clinical symptoms or signs, with or without alterations on a 12-lead electrocardiogram (ECG), and with or without elevated cardiac troponin (cTn) levels, typically indicating myocardial infarction.[1,3] ACS is classified into ST-elevation myocardial infarction (STEMI), non-ST-elevation myocardial infarction (NSTEMI), and unstable angina. Data from the multicenter One ACS Registry reported that STEMI accounts for 48.8% of ACS cases, while NSTEMI comprises 51.2%. The mortality rate in STEMI patients is significantly higher compared to those with NSTEMI (11.7% vs. 6.2%).[4,5]

According to the INTERHEART study, a global case-control investigation of

risk factors for acute myocardial infarction (AMI), nine easily measurable and modifiable risk factors account for over 90% of the initial risk of AMI. These include smoking, elevated serum lipid levels, hypertension, diabetes mellitus, obesity, physical inactivity, low daily consumption of fruits and vegetables, excessive alcohol intake, and psychosocial stress.[3]

Management of STEMI includes both pharmacological and non-pharmacological therapies. Percutaneous coronary intervention (PCI) is the preferred reperfusion strategy, as it is superior to fibrinolysis in reducing mortality, non-fatal reinfarction, and stroke. Pharmacological therapy should be initiated early and continued as long-term treatment in STEMI patients, including the use of antiplatelets, anticoagulants, beta-blockers, statins, calcium channel blockers (CCBs), nitrates, renin-angiotensin-aldosterone system (RAAS) inhibitors, and other medications tailored to the patient's comorbidities. Delayed or inadequate treatment may lead to complications such as cardiac arrest, heart failure, arrhythmia, and other worsening or life-threatening conditions.[1]

Methods

This retrospective descriptive study aimed to evaluate the clinical and demographic characteristics of patients diagnosed with STEMI who underwent percutaneous coronary intervention at the Siloam Heart Center Hospital between January and December 2024. No comparison group was included, as the study design focused on descriptive analysis. This study employed a retrospective descriptive design to analyze patients' electronic medical records (e-MR). The study population consisted of patients admitted to the Siloam Heart Center from January to December 2024, who were diagnosed with ST-Elevation Myocardial Infarction (STEMI). Inclusion criteria were: (1) patients hospitalized at Siloam Heart Center within the specified period, (2) confirmed diagnosis of STEMI, (3) complete medical records—including anamnesis, physical examination, 12-lead electrocardiography (ECG), laboratory and radiological investigations, echocardiography, and documented medical therapy—and (4) having undergone percutaneous coronary intervention (PCI). Exclusion criteria included: (1) patients diagnosed with other forms of acute coronary syndrome (ACS), such as high-risk non-ST-elevation myocardial infarction (NSTEMI), and (2) patients with incomplete, illegible, or damaged medical records.

Data were analyzed using descriptive statistical methods to determine the frequency distributions and percentages of the study variables, which are presented in narrative form. Data processing was performed using Microsoft Excel 2016 and SPSS version 22.0. Patient anonymity and confidentiality of medical records were maintained throughout the study under ethical research standards. Ethical approval for this research was obtained from the of Medical and Health Research Ethics Committee Siloam Heart Center under the approval number 2025/KEP/2a/003/120525.

Results

This retrospective study analyzed electronic medical records to identify the clinical profile of STEMI patients treated at Siloam Heart Center Hospital between January and December 2024. A total of 87 patients met the inclusion criteria. The majority were male (92%) and aged 50 years or older (66.7%). Most patients presented with normal hemodynamic parameters, although a proportion exhibited hypertension (stage 1 and 2) and tachycardia upon admission. Body mass index (BMI) distribution indicated that 35.6% of patients had a normal BMI, while the remainder were categorized as overweight, obese, or underweight, highlighting variability in body composition among STEMI patients. Hypertension (49.4%), smoking (46.0%), and type 2 diabetes mellitus (27.6%) were the most common comorbid conditions than others. %). It is important to note that patients may present with one or more comorbid conditions.

All patients underwent laboratory and radiographic examinations. Chest radiographs were normal in 43.7% of cases, while 34.5% demonstrated signs of both pulmonary congestion and cardiomegaly. Heart failure may either precede acute coronary syndrome (ACS) or arise as a complication of ACS. It can be assessed through echocardiography by evaluating left ventricular ejection fraction (LVEF) and tricuspid annular plane systolic excursion (TAPSE) for right ventricular function. Echocardiographic assessment revealed that 19.5% of patients had reduced EF and 4.6% had impaired right ventricular function based on TAPSE values. Laboratory analyses showed that all patients had elevated troponin levels. Leukocytosis was present in 86.2% of patients, while 16.1% had hyperglycemia. Additionally, 56.3% had elevated LDL cholesterol levels. Anemia, increased urea, and creatinine were less frequently observed.

Upon arrival, all patients underwent

Table 1. Characteristic Sample of Study

Variable	Frequency	Percentage (%)
Age		
< 50 years old	29	33.3
≥ 50 years old	58	66.7
Gender		
Male	80	92
Female	7	8
Blood Pressure		
Hypotension	4	4.6
Normotension	51	58.6
Hypertension stage 1	15	17.2
Hypertension stage 2	17	19.5
Body Mass Index (BMI)		
Underweight	6	6.9
Normal weight	31	35.6
Overweight	21	24.1
Obesity stage 1	22	25.3
Obesity stage 2	7	8.0
Comorbid		
Hypertension	43	49.4
Smoking	40	46
Type 2 Diabetic mellitus	24	27.6
Pulmonary edema	18	20.7
Heart failure	15	17.2
Dyslipidemia	13	14.9
Arrythmia	6	6.9
Previous myocardial infarction	3	2.4
Renal disease	2	2.3
Previous PCI	1	1.1
Stroke	1	1.1
Chest X-ray		
Normal	38	43.7
Cardiomegaly/ Pulmonary edema	19	21.8
Cardiomegaly	87	34.5
Echocardiography		
EF preserved	40	46
EF mild	30	34.5
EF reduced	17	19.5
Normal TAPSE	83	95.4
Decrease TAPSE	4	4.6

Table 1. Characteristic Sample of Study (Continued)

Variable	Frequency	Percentage (%)
Laboratory tests		
Anemia	3	3.4
Leukocytosis	75	86.2
Hyperglycemia	14	16.1
Increase urea level	1	1.1
Increase creatinine level	4	4.6
Increase LDL cholesterol concentra-tion	49	56.3
Increase Troponin level	87	100
ECG findings (lead location)		
Anterior	15	17.2
Lateral	1	1.1
Inferior	30	34.5
Extensive anterior	17	19.5
Inferoposterior	12	13.8
Inferolateral	2	2.3
Anteroseptal	8	9.2
Anteroinferior	1	1.1
Anteroposterior	1	1.1
Killip		
Killip 1	34	39.1
Killip 2	33	37.9
Killip 3	20	23
PCI		
1VD	20	23
2VD	24	27.6
3VD	43	49.4
Coronary artery		
LM	21	24.1
LCX	54	62.1
LAD	74	85.1
RCA	56	64.4
Door-to-Balloon Time	**(mean = 86.25 mins)**	
Intra-PCI Complications		
Arrest in cathlab	1	1.1
Dissection	2	2.3
Stent Dislodgement	1	1.1

EF: ejection fraction, TAPSE: Tricuspid Annular Plane Systolic Excursion, ECG: Electrocardiography, PCI: Percutaneous Coronary Intervention, VD: Vascular Disease, LM: Left Main, LCX: Left Circumflex, LAD: Left Anterior Descending, RCA: Right Coronary Artery

electrocardiography. The most common ECG findings were inferior infarction (34.5%), extensive anterior infarction (19.5%), and anterior infarction (17.2%). According to the Killip classification, 49.4% of patients were classified as Killip class I. All patients underwent primary percutaneous coronary intervention (PPCI). Coronary angiography revealed that the left anterior descending artery (LAD) was the most frequently involved vessel (85.1%), followed by the right coronary artery (RCA), left circumflex artery (LCX), and left main (LM) artery. Three-vessel disease was found in 49.4% of patients, two-vessel disease in 27.6%, and single-vessel disease in 23.0%. These angiographic findings corresponded with the ECG results, which often indicated infarctions affecting multiple anatomical regions. Our mean door-to-balloon (DTB) time was calculated to be 86.25 minutes. In Intra-PCI Complications, arrest in cathlab was found in 1.1% of patients, dissection in 2.3%, and stent dislodgement in 1.1%.

Discussion

STEMI is associated with high morbidity and mortality rates globally. Understanding the demographic and clinical profile of STEMI patients, particularly in specific populations such as Indonesia, is crucial. Such data can inform targeted early screening and preventive strategies, especially for individuals with established risk factors, ultimately aiming to reduce the incidence and severity of complications. In this study, the majority of STEMI patients were in the age group of 50 years and above. This finding is consistent with a study by Anthony,[6] et al. (2024), which reported that 58.3% of Acute Coronary Syndrome (ACS) cases occurred in individuals aged 50 years and older. Similarly, a study conducted in Indonesia found the highest incidence of ACS in the 55–64 age group (46%), followed by the 45–54 age group (34%).[2] Age is not only a significant risk factor for the development of cardiovascular disease but also serves as an independent predictor of adverse outcomes following cardiovascular events, procedural complications, and pharmacotherapy-related side effects, particularly from antithrombotic agents. Additionally, increased vascular stiffness in older adults contributes to impaired coronary perfusion, which can lead to more extensive ischemia and larger infarct sizes.[7]

Studies have shown that men tend to experience heart attacks at a younger age than women, even after menopause.[8] Research indicates that males generally exhibit higher mean levels of blood pressure, lower HDL cholesterol, and elevated levels of BMI, LDL cholesterol, triglycerides, and HOMA-IR. In contrast, females benefit from the protective effects of premenopausal hormones and sex-based differences in endothelial function.[9] This finding is supported by the present study, which revealed that among 29 patients classified as obese, only one was female, while the remaining were male. Obesity itself is a well-established risk factor for cardiovascular disease. It significantly affects hemodynamic, metabolic, and inflammatory pathways, ultimately contributing to a markedly increased risk of acute coronary syndrome (ACS). Women, particularly those who are premenopausal, benefit from estrogen and progesterone, which provide a degree of protection against the adverse effects of obesity.[10]

This study found that most patients experiencing acute coronary syndrome (ACS) presented with normal blood pressure and heart rate. However, several patients exhibited elevated blood pressure and heart rate despite having no prior history of hypertension. This may represent a compensatory physiological response. The acute response to myocardial infarction (MI) involves reflex mechanisms aimed at maintaining mean arterial pressure (MAP), including increased heart rate, systemic arterial resistance, venoconstriction, and enhanced contractility of the surviving myocardium.[11]

Many studies have reported various risk factors for cardiovascular disease. In this study, the most commonly observed risk factors among patients were hypertension, type 2 diabetes mellitus (T2DM), and smoking. Hypertension has long been recognized as a major risk factor for coronary artery disease. Similarly, diabetes mellitus is a well-established contributor to cardiovascular complications.[2] A recent study showed that up to 32.3% of diabetic patients develop cardiovascular disease and stroke, making these the leading causes of death in this population. Smoking is another critical factor; studies have shown that quitting smoking can reduce the risk of myocardial infarction by up to 50%. This is understandable, as smoking increases levels of matrix metalloproteinases (MMPs), which contribute to the destabilization of atherosclerotic plaques. Other conditions identified in this study population as potential risk factors for acute coronary syndrome include pulmonary edema, heart failure, dyslipidemia,

arrhythmia, previous myocardial infarction, renal disease, history of PCI, and stroke. Dyslipidemia contributes to atherosclerosis through inflammatory processes that promote plaque formation and endothelial dysfunction.[12,13]

Approximately 86.2% of patients in this study presented with leukocytosis. This finding is consistent with the understanding that leukocytosis, defined as an elevated white blood cell (WBC) count, is a simple marker of systemic inflammation and physiological stress, and has been associated with adverse outcomes in critically ill patients. Moreover, previous studies have reported that an early complete blood count is associated with an increased risk of mortality in a diverse cohort of cardiac intensive care unit (CICU) patients.[14] Blood urea nitrogen (BUN) is recognized as a powerful predictor and a sensitive marker for hemodynamic changes and kidney perfusion. However, data regarding the prognostic value of BUN in acute coronary syndrome (ACS) patients—independent of changes in glomerular filtration rate (GFR)—remain limited. Although serum creatinine (Cr) is considered the gold standard for estimating GFR and holds prognostic significance in ACS patients, it is less sensitive in detecting normal or mildly reduced renal function compared to BUN. Therefore, evaluation of renal function is essential in ACS patients. In this study, four patients demonstrated elevated serum creatinine levels, while only two were diagnosed with renal dysfunction. This discrepancy can be explained by the fact that serum BUN may increase independently of GFR changes, influenced by activation of the sympathetic nervous system, arginine-vasopressin, and the renin-angiotensin-aldosterone system—all of which are activated during ACS. These mechanisms enhance renal tubular reabsorption of urea, making BUN a potentially superior prognostic marker compared to serum creatinine in ACS patients[15] Hyperglycemia is a common condition in patients with ACS. In this study, approximately 14 patients (16.4%) exhibited elevated blood glucose levels, including 4 patients without a prior diagnosis of type 2 diabetes mellitus (T2DM). Hyperglycemia in non-diabetic patients with ACS may result from an inflammatory and adrenergic response to ischemic stress, which triggers catecholamine release and glycogenolysis. A similar pattern was observed in a study by Umpierrez et al. (2002), which reported hyperglycemia in 38% of patients, with 12% having no history of T2DM.[16] Low-density lipoprotein (LDL) cholesterol testing is recommended by the American College of Cardiology as part of the management of ACS to reduce morbidity and mortality through LDL-lowering interventions.[17] While elevated troponin I levels can occur in various conditions; the highest initial levels are typically observed in ST-elevation myocardial infarction (STEMI). Accordingly, all patients in this study showed elevated troponin I levels, a biomarker of myocardial injury.[18] Although STEMI is not diagnosed solely based on troponin levels, several studies have reported that higher peak troponin I levels are associated with worse clinical outcomes in STEMI patients.[19]

A study conducted at Siloam Heart Center in 2024 demonstrated that the majority of STEMI cases were classified as inferior STEMI, followed by extensive anterior and anterior STEMI. Similarly, a study by Janjani P, et al. (2024) reported a higher incidence of inferior STEMI (69.36%) compared to anterior STEMI (30.64%). The infarct location itself may independently influence prognosis. Recent studies have suggested that inferior wall STEMI may be associated with a significantly higher long-term mortality risk than anterior wall STEMI. Inferior myocardial infarctions involving extensive myocardial damage are typically large and often include right ventricular involvement, a key factor impacting long-term outcomes. Moreover, patients with inferior wall acute MI are more susceptible to atrioventricular nodal conduction disturbances. Several complicating factors can increase the mortality of inferior MI, including right ventricular infarction, high-degree atrioventricular block, cardiogenic shock, and an increased likelihood of requiring coronary artery bypass grafting (CABG).[20]

This study showed that the majority of patients (87) presented with cardiomegaly, although only 17 patients had a reduced ejection fraction, and most of them exhibited normal TAPSE values. This finding may be explained by the fact that heart failure can occur with preserved or even normal ejection fraction, which is often associated with structural remodeling of the heart.[21] The Killip classification system was developed for the clinical assessment of patients with acute myocardial infarction (AMI), stratifying them based on the severity of heart failure following the infarction. This system effectively predicts both short- and long-term outcomes and guides treatment strategies. In this study, the majority of patients were classified as Killip class I, with no patients in Killip class IV. These

findings are consistent with previous studies reporting the highest incidence in Killip class I (81.4%) and the lowest in Killip class IV (3.5%).[22]

Several studies have demonstrated an association between cardiovascular risk factors and the extent of vessel involvement in patients with acute coronary syndrome (ACS). One study reported that patients with diabetes mellitus and hypertension had a significantly higher incidence of three-vessel disease (3VD).[23] In the present study, among the three categories of vessel disease, the majority of patients with a history of hypertension (20 patients) and type 2 diabetes mellitus (12 patients) were classified as having 3VD. Moreover, the occurrence of 3VD was found to be associated with left main (LM) artery occlusion. In this study, among 21 patients with LM occlusion, 18 were found to have 3VD. Since the LM artery supplies both the left circumflex (LCX) and left anterior descending (LAD) arteries, its occlusion may result in a significant reduction in blood flow to these territories.[24]

Conclusion

This retrospective study showed that most STEMI patients were male, aged over 50 years, with a history of hypertension, smoking, and type 2 diabetes mellitus. Common findings included leukocytosis, elevated troponin levels, cardiomegaly, preserved ejection fraction with normal TAPSE, inferior and anterior ECG changes, involvement of the LAD artery, and three-vessel disease identified through PCI. This study reveals that the majority of clinical and demographic profiles of STEMI patients in Indonesia are older males with prevalent cardiovascular risk factors that were significantly associated with the incidence of three-vessel disease.

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References

1. Byrne RA, Rossello X, Coughlan J, Barbato E, Berry C, Chieffo A, et al. 2023 ESC Guidelines for the management of acute coronary syndromes. European heart journal. 2023 Oct 7;44(38):3720-826.
2. Qothi I, Fuadi MR, Subagjo A. Profile of Major Risk Factors in Acute Coronary Syndrome (ACS) at Pusat Pelayanan Jantung Terpadu (PPJT) Dr. Soetomo Public Hospital Surabaya Between the Period of January-December 2019. Cardiovasc Cardiometabolic J (CCJ). 2021;2(2):59-72.
3. Shang C, Veliz DH, Arrocha MF, Martinez MIA, et al. Cardiovascular risk factors in patients with ST-segment elevation myocardial infarction. CorSalud. 2020;12(1):31-7.
4. Salari N, Morddarvanjoghi F, Abdolmaleki A, Rasoulpoor S, Khaleghi AA, Hezarkhani LA, et al. The global prevalence of myocardial infarction: a systematic review and meta-analysis. BMC Cardiovascular Disorders. 2023;23(206):1-12.
5. Juzar DA, Sungkar S, Firman D, Taufiq N, Widyantoro B, Bagaswoto HP, et al. Pedoman tata Laksana Sindroma Koroner Akut. PERKI. 2024.
6. Anthony N, Hassan A, Ghani U, Rahim O, Ghulam M, James N, et al. Age-Related Patterns of Symptoms and Risk Factors in Acute Coronary Syndrome (ACS): A Study Based on Cardiology Patients' Records at Rehman Medical Institute, Peshawar. Cureus. 2024 Apr 16;16(4):1-6.
7. Engberding N, Wenger NK. Acute Coronary Syndromes in the Elderly. F1000Res. 2017;6(1791):1-7.
8. Rathore V, Singh N, Mahat RK, Kocak MZ, Fidan K, Ayazoglu TA, Aydin Karahan YG, Onk D, Akar E, Yolcu A. Risk factors for acute myocardial infarction: a review. Ejmi. 2018 Jan;2(1):1-7.
9. Najman JM, Kisely S, Scott JG, Ushula TW, Williams GM, Clavarino AM, et al. Gender differences in cardiovascular disease risk: Adolescence to young adulthood. Nutrition, Metabolism & Cardiovascular Diseases. 2024;34:98-106.
10. Guglielmi W, Grave RD, Leonetti F, and Solini A. Female obesity: Clinical and Physiological Assessment Toward the best Treatment. Frontiers in Endocrinology. 2024;15:1-21.
11. Witzenburg CM, Holmes JW. The Impact of Hemodynamic Reflex Compensation Following Myocardial Infarction on Subsequent Ventricular Remodeling. J Biomech Eng. 2019;141(9):0910101–09101010.
12. Nazir A, Ujjar SS, Seddiki MO, Jheinga M, Fan L, et al. Smoking Cessation Strategies after Acute Coronary Syndrome. J Clin Med. 2025;14(4):1-15.
13. Aminuddin A, Cheong SS, Roos NAC,

Ugusman A. Smoking and Unstable Plaque in Acute Coronary Syndrome: A Systematic Review of The Role of Matrix Metalloproteinases. Int J Med Sci. 2023;20(4):482-492.
14. Smith RJ, Sarma D, Padkins MR, Gajic O, Lawler PR, Diepen SV, et al. Admission Total Leukocyte Count as a Predictor of Mortality in Cardiac Intensive Care Unit Patients. JACC. 2024;3(1):1-12.
15. Adam AM, Nasir SAR, Merchant AZ, Rizvi AH, Rehan A, Shaikh AT, et al. Efficacy of serum blood urea nitrogen, creatinine and electrolytes in the diagnosis and mortality risk assessment of patients with acute coronary syndrome. Indian Heart J. 2018 May-Jun;70(3):353-359.
16. Angeli F, Reboldi G, Poltronieri C, Lazzari L, Sordi M, Garofoli M, et al. Hyperglycemia in Acute Coronary Syndromes: From Mechanisms to Prognostic Implications. Therapeutic Advances in cardiovascular Disease. 2015;9(6):412-24.
17. Gencer B, Giugliano RP. Management of LDL-cholesterol after an acute coronary syndrome: Key comparisons of the American and European clinical guidelines to the attention of the healthcare providers. Clin Cardiol. 2020 Jul;43(7):684-690.
18. Harvell B, Henrie N, Ernst AA, Weiss SJ, Oglesbee S, Sarangarm D, et al. The meaning of elevated troponin I levels: not always acute coronary syndromes. The American Journal of Emergency Medicine. 2016;34(2):145-8.
19. Khullar N, Buckley AJ, O'Connor C, Ibrahim A, Ibrahim A, Ahern C, et al. Peak troponin T in STEMI: a predictor of all-cause mortality and left ventricular function. Open Heart. 2022 May 23;9(1).
20. Janjani P, Godarzi F, Salehi N, Asadmobini A. Comparing One-Year Survival in Anterior Versus Inferior ST-Elevation Myocardial Infarction Patients: Results of a Cohort Study in Western Iran. International Cardiovascular Research Journal. 2024;18(1):1-6.
21. Ma C, Luo H, Fan L, Liu X, Gao C. Heart failure with preserved ejection fraction: an update on pathophysiology, diagnosis, treatment, and prognosis. Brazillian Journal of Medical and Biological Research. 2020;53(7):1-16.
22. Hashmi KA, Adnan F, Ahmed O, Yaqeen SR, Ali J, Irfan M, et al. Risk Assessment of Patients After ST-Segment Elevation Myocardial Infarction by Killip Classification: An Institutional Experience. Cureus. 2020;12(12):1-6.
23. Naghshtabrizi B, Moradi A, Amiri J, Aarabi S, Sanaei Z. An Evaluation of the Numbers and Locations of Coronary Artery Disease with Some of the Major Atherosclerotic Risk Factors in Patients with Coronary Artery Disease. J Clin Diagn Res. 2017 Aug;11(8):21-4.
24. Jang JJ, Bhapkar M, Coles A, Vemulapalli S, Fordyce CB, Lee KL, et al. Predictive model for high-risk coronary artery disease: insights from the PROMISE Trial. Circulation: Cardiovascular Imaging. 2019 Feb;12(2):e007940.