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Original research

THE RATE OF MAJOR ADVERSE CARDIOVASCULAR EVENTS (MACE) IN PATIENTS WITH ACUTE CORONARY SYNDROME UNDERGOING PERCUTANEOUS CORONARY INTERVENTION

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ABSTRACT

Background: *Acute coronary syndrome (ACS) is still the leading cause of mortality, percutaneous coronary intervention (PCI) has become an important treatment method. Post-ACS patients still have a high risk of cardiovascular events such as all - cause mortality, myocardial infarction and nonfatal stroke in 12 months, so we conduct this study with 2 objectives: To investigate clinical and subclinical characteristics and cardiovascular risk factors in patients with acute coronary syndrome and to evaluate the rate of major cardiovascular event, associations with cardiovascular risk factors in patients with acute coronary syndrome undergoing percutaneous coronary intervention.*

Methods: *A cross - sectional descriptive method was conducted on 337 patients with acute coronary syndrome undergoing percutaneous coronary intervention at the Emergency - Interventional Cardiology Department - Hue Central Hospital from January 2021 to December 2021 and followed up 12 months.*

Results: *The mean age was 68.19 ± 10.73, the male/female ratio was approximately 2/1. ST-segment elevation myocardial infarction (STEMI), non-ST segment elevation myocardial infarction (non-STEMI) and unstable angina accounted for 56.4%, 27.3% and 16.3%, respectively. The rate of major cardiovascular events (MACE) within 12 months after the intervention was 3.6%, of which 75% occurred during hospital stay and 1 month after discharge. Age > 75, BMI, tachycardia, cardiogenic shock, decreased glomerular filtration rate on admission, fibrinolytic therapy, and bleeding were associated with major cardiovascular events within 12 months after discharge.*

Conclusion: *The rate of major cardiovascular events after 12-month follow - up was 3.6%, of which the mortality rate was 2.4%, in - hospital and 30-day post-discharge MACE accounted for more than 75%. Therefore, it is necessary to have an attitude of following up and optimal medical treatment within 30 days in patients with acute coronary syndrome undergoing percutaneous coronary intervention, especially in high - risk patients.*

Keywords: *Acute coronary syndrome, major cardiovascular events, percutaneous coronary intervention.*

I. INTRODUCTION

According to the World Health Organization, coronary artery disease (CAD), especially acute coronary syndrome (ACS), remains the leading cause of death globally. In 2016, it was estimated that 31% of deaths in Vietnam were due to cardiovascular disease, of which more than half were due to coronary artery disease [1]. In recent years, with the development of technology as well as new generation drug-eluting stents, the effectiveness and safety have been proven to significantly improve mortality events for acute coronary syndromes [2]. However, this is still a serious and complicated disease, with many dangerous complications that are always life-threatening, with a high mortality rate. Patients who survive ACS remain at high risk for major adverse cardiovascular events (MACE) such as death, myocardial infarction, and nonfatal stroke at 1 year. The morbidity and socioeconomic burden of this disease will therefore continue to be a

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major problem for the next several decades. MACE mostly appeared during the hospital stay and the first 30 days of follow-up.

Early risk stratification is needed for early coronary intervention strategies, optimal combination therapy, and disease prognosis [3]. High-risk patients often have cardiovascular events and require aggressive drug therapy, early intervention, and appropriate follow-up, thereby making an important contribution to improving the prognosis of patients with ACS. Risk stratification should be based on anthropometric, clinical, electrocardiographic, biomarkers, and scores. In Vietnam, studies often focus on treatment strategies in the acute and early stages of ACS [4]. However, there are few studies on major adverse cardiovascular events and cardiovascular risk factors especially in patients undergoing percutaneous coronary intervention in Vietnam as well as at Hue Central Hospital. Therefore, we conducted this study to investigation of clinical, paraclinical characteristics, and cardiovascular risk factors in patients with acute coronary syndrome; and evaluate the rate of major cardiovascular event, associations with cardiovascular risk factors in patients with acute coronary syndrome undergoing percutaneous coronary intervention.

II. MATERIALS AND METHODS

A cross-sectional descriptive was conducted on patients diagnosed with acute coronary syndrome. These patients were treated with percutaneous coronary intervention were hospitalized and treated at the Emergency - Interventional Cardiology Department - Hue Central Hospital from January 2021 to December 2021 and continued to have 12-month post-PCI follow-up. The study was conducted with the correct indications and approved by the study subjects and the Medical Ethics Committee of Hue Central Hospital.

We excluded patients with no indications for coronary intervention; patients with coronary intervention failed such as not being able to pass the guidewire, balloon, and stent through the lesion; patients with severe medical diseases accompanied by cirrhosis, cancer, chronic obstructive pulmonary disease group C-D, or chronic heart failure stage D; or other conditions affecting optimal medical treatment, such as internal bleeding active organ or recent intolerance or allergy to aspirin or clopidogrel, history of hypersensitivity to iodinated contrast; or complications related to PCI procedure.

Patients were conducted to collect anthropometric characteristics, risk factors, history, clinical and laboratory examinations, and follow-up major adverse cardiovascular events (MACE) (all-cause mortality, myocardial reinfarction, or stroke) up to 12 months after hospital discharge. All-cause mortality included in-hospital mortality (death occurring during hospitalization, or critically ill patients returning home) and death within 12 months (death from discharge to 12 months later). Nonfatal myocardial reinfarction was defined by the presence of (a) recurrent angina lasting more than 20 minutes; (b) recurrent ST segment elevation, T wave inversion, or new pathological Q wave in at least two consecutive leads; and (c) increased cardiac troponin compared to the above reference value. Non-fatal cerebral stroke was defined with focal neurological symptoms (weakness or paralysis, loss of sensation in a quarter of a person, central vertigo, etc., after ACS) lasting more than 24 hours. Based on the results of computed tomography or cranial magnetic resonance imaging to classify as cerebral infarction or cerebral hemorrhage [5, 6].

Quantitative variables were calculated as mean, standard deviation, median, interquartile range and compared by Student t test for continuous variables for 2 variables, or Mann-Whitney U test for non-standard variables. Checking the relationship between qualitative variables by Chi-Square test when the number of cells with expected valued less than 5 does not exceed 20% of the total number of cells, in which MACE were also qualitative variables. Overall survival was analyzed by the method of survival analysis and represented by the Kaplan Meier survival curve. Using univariate and multivariate logistic regression analysis to find the association between MACE events and cardiovascular risk factors.

III. RESULTS

Through the study of 337 ACS patients undergoing percutaneous coronary angiography and intervention, we obtained some results as follows

3.1. Clinical and paraclinical characteristics of the study population

Table 1: Baseline characteristics of the study population

	Gender		General (n=337)
	Male (n=226)	Female (n=111)	
Age	63.7 ± 12.24	71.69 ± 10.27	68.19 ± 10.73
BMI (kg/m^2)	22.22 ± 3.22	21.32 ± 3.04	21.86 ± 2.96
Smoking	115 (18.6)	6 (1.6)	121 (12.2)
Hypertension	110 (46.8)	58 (52.4)	168 (48.9)
Diabetes	65 (10.5)	48 (12.9)	113 (11.4)
Hyperlipidemia	13 (2.1)	8 (3.9)	21 (2.1)
Chronic kidney disease	5 (0.8)	3 (0.8)	8 (0.8)
Peripheral artery	11 (1.8)	3 (0.8)	14 (1.4)
Stroke	18 (2.9)	11 (3.0)	29 (2.9)

The percentage of ACS patients undergoing percutaneous coronary intervention was in the majority of men. The mean age of the study subjects was 68 years old, while the mean BMI was 21.86 kg/m^2. Most of the study subjects had hypertension with 48.9%. Patients with a history of smoking and diabetes accounted for 12.2% and 11.4%, respectively. The rates of chronic kidney disease and peripheral artery disease were very low.

Table 2: Distribution of clinical and paraclinical characteristics at hospital admission

Vital signs		Median	Percentile
Heart rate		79	70 - 88
Systolic Blood Pressure		130	110 - 150
Diastolic Blood Pressure		80	70 - 80
Clinic		Quantity	Percentage (%)
Diagnosis of acute coronary syndrome	STEMI	190	56.4
	NSTEMI	92	27.3
	Unstable angina	55	16.3
Cardiogenic shock		14	4.2
Cardiac arrest		1	0.3
Paraclinic		Mean/Median	SD/Percentile

Vital signs	Median	Percentile
EF	50	40 - 60
Hb	12.1	±1.7
Hct	36.9	34.4 - 39.6
Platelet	258	215 - 315
eGFR	73.7	±18.5

The median subjects' heart rate was about 79 bpm, while the median blood pressure was 130/80 mmHg. About 4.2 % of patients presented with cardiogenic shock and 1 patient presented with cardiac arrest on admission. The EF of the study subjects had a median of 50%, the platelet count was 258 and the mean glomerular filtration rate was 73.7ml/min. The proportion of patients with ST-segment elevation MI diagnosed before PCI was the majority, followed by the group of patients with non-ST-elevation MI.

3.2. Rate of major adverse cardiovascular events and association with major cardiovascular factors

Table 3: Major adverse cardiovascular event rate

	Number	Rate (%)
All - cause mortality	8	(2.4%)
Nonfatal myocardial infarction	3	(0.9%)
Nonfatal stroke	1	(0.3%)
Total	12	(3.6%)

12 out of 337 patients had MACE, accounting for 3.6%. In which, there were 8 patients (4 died in hospital and 4 during the 12 - month follow - up period) accounting for 2.4%. Nonfatal myocardial infarction and nonfatal stroke constituted 0.9% and 0.3%, respectively.

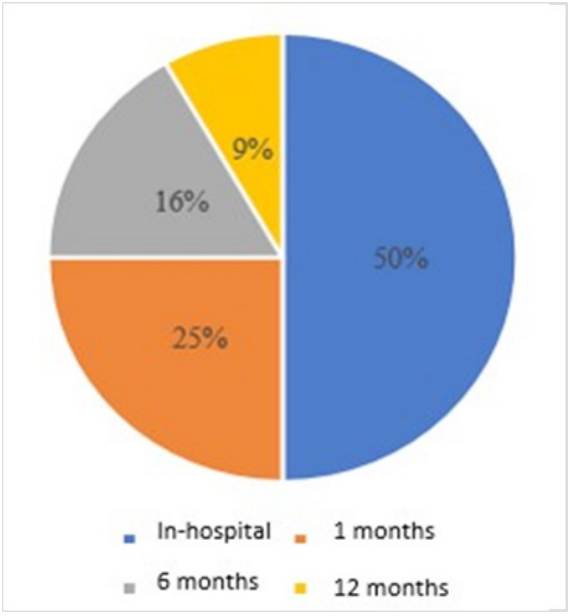

Figure 1: Time to occur MACE

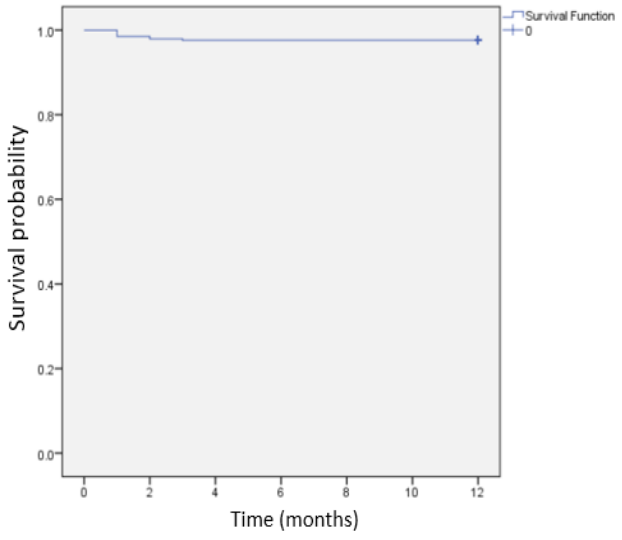

Figure 2: Kaplan Meier survival curve

50% of MACEs occured during hospital stay. MACE occurrences during the 30 - day follow - up period accounted for 25%. From 1 month to 12 months, MACE occurred in the remaining 25% cases.

Table 4: Association of MACE within 12 months and cardiovascular risk factors

		Univariate logistic regression analysis			Multivariate Logistic Regression Analysis		
		OR	**Cl (95%)**	**p**	**OR**	**Cl (95%)**	**p**
Gender		3.506	0.823 - 14.95	0.090			
Age >75		1.079	1.006 - 1.156	0.033	0.856	0.546 - 1.34	0.495
BMI		0.740	0.569 - 0.962	0.024	1.103	0.984 - 1.236	0.091
Hypertension		0.418	0.083 - 2.101	0.29			
Diabetes		1.094	0.131 - 9.136	0.934			
Previous PCI		1.064	0.127 - 8.866	0.955			
Tachycardia		1.036	1.011 - 1.063	0.005	1.035	1.000 - 1.070	0.047
SBP		0.974	0.943 - 1.006	0.116			
DBP		0.946	0.890 - 1.006	0.078			
Cardiogenic shock		31.9	6.962 - 146.2	< 0.001	0.006	0.000 - 0.138	0.001
EF		0.975	0.920 - 1.033	0.396			
Hct		0.898	0.792 - 1.018	0.094			
Hb		0.751	0.523 - 1.079	0.122			
Platelet		0.988	0.976 - 1.000	0.058			
eGFR		0.960	0.929 - 0.992	0.015	1.016	0.947 - 1.089	0.666
Diagnosis	STEMI	0.423	0.084 - 2.127	0.296			
	NSTE-ACS	2.364	0.470 - 11.887	0.296			
Fibrinolytic		27.08	4.134 - 177.4	0.001	0.010	0.000 - 0.555	0.025
Bleeding		0.094	0.017 - 0.525	0.007	2.178	0.057 - 82.55	0.675

Univariate analysis of factors related to MACE with statistical significance included age, body mass index, tachycardia, cardiogenic shock, glomerular filtration rate, use of fibrinolysis, and bleeding. Using regression analysis of multivariable analysis, we recorded 3 variables with predictive value of all-cause mortality over 12 months of follow-up of ACS including (1) cardiogenic shock (2) use of fibrinolysis (3) tachycardia.

IV. DISCUSSION

In our study on 337 patients, the results showed that men prevailed over women, with a ratio of about 2:1. The average age of the study subjects was 68 years old, and the average BMI was 21.86kg/m2. Comparing age between men and women, it was

found that the age of men was lower than that of women. The results are similar to other domestic and foreign studies such as Giao Thi Thoa (2018), Nguyen Hoang Hai (2019), Bui Long (2018), or the Euro Heart 2 study (2006) [7-10]. This can be explained because women before menopause are a protective factor for patients from atherosclerotic diseases, especially coronary artery disease, so the age of coronary artery disease in men is about 7-10 years earlier than in pre-menopausal women.

Researching cardiovascular risk factors in ACS is important because effective treatment of cardiovascular risk factors will improve survival by 4 times compared to other cardiovascular treatments. Hypertension is a common cardiovascular risk factor in the general population and also accounted for the highest proportion of cardiovascular risk factors in our study with nearly 50%. Domestic and foreign studies and trials recorded that the rate of hypertension in ACS ranged from 50-70%. Smoking was present in 12.2% and diabetes was reported in about 12% of ACS patients, lower than in the study of Nguyen Lan Viet (2009) with 22% and 19.17% respectively, or that of Nguyen Van Linh with about 31% and 21.04% [11, 12]. Other risk factors such as dyslipidemia, chronic kidney disease, and peripheral artery disease accounted for 1-3%. The results of our study and those of other authors had relative differences in the proportion of risk factors. But in general, these risk factors accounted for a high proportion.

Results of the patient's hemodynamic characteristics at admission showed that the median pulse value was 79 beats/minute, SBP and DBP were 130mmHg and 80mmHg, respectively. Compared with the study on 227 patients by Bui Long (2018), the average values of pulse, SBP and DBP were 77 beats/minute, 131mmHg and 77mmHg, respectively [8]. In the study of Truong Phi Hung in 2019, the average results of 3 indicators on 245 ACS patients were 83.97 times/minute, 134.03 mmHg, 84.34 mmHg, respectively [13]. Other foreign studies such as Mrdovic et al. 2013 recorded an average pulse of 76 beats/minute, SBP of 140mmHg. Tamara's (2017) study showed results of 80 beats/minute and 140mmHg, respectively, in the average heart rate and SBP of the study subjects [5, 14].

We recorded that 46.6% of patients had symptoms of heart failure. This is quite similar to the results from the study of Bui Long (2018) and Giao Thi Thoa (2018) with the rates of 37.89% and 33.99% respectively [52], [54]. About 4.2% of patients showed cardiogenic shock, quite similar to Nguyen Van Linh's study (2015) with 6.85%. However, it is lower than Giao Thi Thoa's study recorded 18.3% and Pham Quang Tuan's was 12.3% [11, 15].

The result of the platelet count was 237 Giga (205 - 284) and the female platelet count was higher than that of the male, compared with that of Bui Long, it was also equivalent to 231.35±56.82 [8]. Some studies have demonstrated that women often have higher platelet counts than men, so there are some opinions that the use of antiplatelet drugs should have a higher dose in women [16]. The average Hb level in the study was 12.9 ± 1.82 g/l and there was a difference between men and women. Hb concentration is a prognostic factor in patients with ACS due to its association with many comorbidities and an increased risk of bleeding complications, especially in men [17]. In the general population, the Hb level of women is usually about 12% lower than that of men. Therefore, the fact that Hb of women was lower than that of men in the ACS study group can be explained. Our study had a MLCT of 75.9 ± 20.3 ml/min compared to that of Nguyen Hoang Hai (2019) which resulted in a MLCT of 69.3 ± 18.8 ml/min [7].

Based on diagnosis, they were divided into 3 groups as follows: STEMI (56.4%), NSTEMI (27.3%) and Unstable angina (16.3%), which was quite similar to Nguyen Hoang Hai's study with rates of 53.4%, 37.1% and 9.5%, respectively [7]. As compared to Tamara Jakimov's study in 2017, the results of 3 diseases were similar to ours with 58%, 34.5% and 7.5% [14].

There were 12 patients recorded MACE accounting for 3.6%, of which 8 patients died from all causes. MI and nonfatal stroke accounted for 0.9% and 0.3%, respectively. Analyzed over time, 75% of MACE occurred in the hospital and 30 days later. Compared with the study by author Trinh Tien Hung (including 25.5% of patients treated conservatively and 74.5% undergoing coronary artery intervention), 10.02% had in-hospital MACE, following patients discharged from hospital, there was 3.2% at 30 days, and finally from 1-12 months,

an additional 9.1% had MACE [18]. Nguyen Quang Tuan concluded that MACE in the first 30 days was 9.6% and 24.2% respectively in the intervention group and conservative treatment group, after 30 days - 1 year it was 5.1% and 8.8%, respectively [4]. L.Savic's study on 2096 patients found that the MACE rate within 30 days and 1 year was 9.1% and 12.2%, respectively [6]. Thus, MACE from other studies was higher (possibly because we performed the study later, when there were advances in treatment in the hospital as well as after ACS, and all of our patients received PCI); however, all studies agreed that MACE mostly appeared during the hospital stay and the first 30 days of follow-up.

Logistic regression analysis of factors related to MACE included age, body mass index, heart rate, presence of cardiogenic shock, glomerular filtration rate, use of thrombolysis, and bleeding. Other studies also reached similar conclusions: Truong Phi Hung identified factors related to MACE including: age, NTproBNP, EF and blood NGAL concentration [13]. Risk factors in Nguyen Hoang Hai's study include: age, gender, heart rate at admission, Killip class, diabetes, history of heart failure, hemoglobin concentration, estimated glomerular filtration rate, serum uric acid level, left ventricular ejection fraction, atrial fibrillation [7]. Timoteo (2013) concluded that many prognostic factors were similar to our study (age, gender, heart rate at admission, Killip class, diabetes, estimated glomerular filtration rate, uric acid concentration) [19]. Thus, we can identify high-risk patients for optimal treatment and monitoring as discussed above.

V. CONCLUSION

The rate of major adverse cardiovascular events (MACE) within 12 months of follow-up was 3.6%, of which the mortality rate was 2.4%, the time in which MACE occurred in hospital and 30 days after discharge accounted for 75%. Old age >75, tachycardia, reduced glomerular filtration rate at admission, cardiogenic shock, use of fibrinolysis, and bleeding were risk factors predicting the occurrence of major adverse cardiovascular events. Therefore, it is necessary to have optimal monitoring and medical treatment within 30 days in patients with acute coronary syndrome undergoing percutaneous coronary intervention, especially in high-risk patient groups.

REFERENCES

1. LI H. Global Health Estimates 2016: Deaths by cause, age, sex, by country and by region, 2000–2016. Geneva, World Health Organization; 2018.
2. Keeley EC, Boura JA, Grines CL. Primary angioplasty versus intravenous thrombolytic therapy for acute myocardial infarction: a quantitative review of 23 randomised trials. Lancet. 2003;361(9351):13-20.
3. Bueno H, Fernández-Avilés FJH. Use of risk scores in acute coronary syndromes. 2012;98(2):162-168.
4. Tuấn NQ. Nghiên cứu hiệu quả của phương pháp can thiệp động mạch qua da trong điều trị nhồi máu cơ tim cấp. 2005, Đại học Y Hà Nội.
5. Mrdovic I, Savic L, Lasica R, Krljanac G, Milika A, Brdar N, et al. Usefulness of the RISK-PCI score to predict stent thrombosis in patients treated with primary percutaneous coronary intervention for ST-segment elevation myocardial infarction: A substudy of the RISK-PCI trial. Heart and vessels. 2012;28.
6. Savic L, Mrdovic I, Asanin M, Stankovic S, Krljanac G, Lasica R. Using the RISK-PCI Score in the Long-Term Prediction of Major Adverse Cardiovascular Events and Mortality after Primary Percutaneous Coronary Intervention. J Interv Cardiol. 2019;2019:2679791.
7. Hải NH. Nghiên cứu vai trò của acid uric trong tiên lượng hội chứng mạch vành cấp. 2019, Đại Học Y Dược Thành Phố Hồ Chí Minh.
8. Long B. Nghiên cứu kết quả điều trị can thiệp bệnh nhân hội chứng động mạch vành cấp bằng Stent phủ thuốc có Polymer tự tiêu. 2018, Học Viện Quân Y.
9. Mandelzweig L, Battler A, Boyko V, Bueno H, Danchin N, Filippatos G, et al. The second Euro Heart Survey on acute coronary syndromes: Characteristics, treatment, and outcome of patients with ACS in Europe and the Mediterranean Basin in 2004. Eur Heart J. 2006;27(19):2285-93.
10. Thoa GT. Nghiên cứu nồng độ H-FABP trong chẩn đoán và tiên lượng nhồi máu cơ tim cấp. 2018, Trường Đại học Y Dược Huế.
11. Linh NV, Đặc điểm lâm sàng và cận lâm sàng ở bệnh nhân hội chứng mạch vành cấp được can thiệp động mạch vành qua da tại Bệnh Viện Đa Khoa Trung Ương Thái Nguyên. 2015, Trường Đại học Y Dược Thái Nguyên.
12. Phạm Nguyễn Vinh, Việt NL. Nghiên Cứu Quan Sát Điều Trị Bệnh Nhân Nhập Viện Do Hội Chứng Động Mạch Vành Cấp (MEDI- ACS Study). Tim mạch học Việt Nam. 2011;58,tr.12-23.

13. Hùng TP. Giá trị của NGAL trong tiên đoán các biến cố tim mạch ở bệnh nhân hội chứng mạch vành cấp. 2019, Trường Đại Học Dược Tp Hồ Chí Minh.
14. Jakimov T, Mrdović I, Filipović B, Zdravković M, Djoković A, Hinić S, et al. Comparison of RISK-PCI, GRACE, TIMI risk scores for prediction of major adverse cardiac events in patients with acute coronary syndrome. Croat Med J. 2017;58(6):406-415.
15. Tuấn PQ. Nghiên cứu vai trò chẩn đoán của IMA (Ischemia Modified Albumin) huyết thanh phối hợp với hs-troponin t ở bệnh nhân hội chứng vành cấp. 2019, Trường Đại học Y Dược Huế.
16. Ranucci M, Aloisio T, Di Dedda U, Menicanti L, de Vincentiis C, Baryshnikova E. Gender-based differences in platelet function and platelet reactivity to P2Y12 inhibitors. PLoS One. 2019;14(11):e0225771.
17. Pei J, Wang X, Chen P, Zheng K, Hu X. Hb Levels and Sex Differences in Relation to Short-Term Outcomes in Patients With Acute Myocardial Infarction. Front Cardiovasc Med. 2021;8:653351.
18. Hùng TT. Nghiên cứu tỷ lệ biến cố tim mạch chính trong một năm ở các bệnh nhân nhồi máu cơ tim cấp tại Viện Tim Mạch Việt Nam. 2015, Đại Học Y Hà Nội.
19. Timóteo AT, Lousinha A, Labandeiro J, Miranda F, Papoila AL, Oliveira JA, et al. Serum uric acid: a forgotten prognostic marker in acute coronary syndromes? Eur Heart J Acute Cardiovasc Care. 2013;2(1):44-52.