DOI 10.47176/sjmshm.4.3.1

Original Article

SRPH

SJMSHM, 2022; 4(3): 1-10

Determining the Predicting Value of the Shock Index in Early Prediction of Mortality in Patients with Acute Myocardial Infarction under Primary PCI

Reza Faramrzzadeh[1*] and Venus Shahabi Raberi[2]

[1,2]Assistant Professor, Department of Cardiology, Urmia University of Medical Sciences, Urmia, Iran.

***Corresponding Author:**

Faramarzzadeha@uums.ac.ir

Received: 15 May, 2022
Accepted: 21 July, 2022
Published: 25 August, 2022

ABSTRACT

Introduction: shock index (heart rate (HR) divided by systolic blood pressure (SBP) may play a substantial role in evaluation and prediction of cardiovascular events, especially in the patients with ischemic heart disease under cardiac procedures. The present study attempted to evaluate the predictive value of the shock index in early prediction of mortality in patients with acute myocardial infarction under primary PCI. Method: 200 patients with acute myocardial infarction who were candidates for primary PCI and were gone under which at Seyedoshohada Hospital in Urmia, participated in this study. At the time of admission, the indexes of heart rate and blood pressure were determined, the shock index (heart rate (HR) divided by systolic blood pressure (SBP)) was calculated, and hence, the patients were divided into two groups: one group with an index lower than or equal to 0.7 and the other one with an index of more than 0.7. SPSS 21 software was used to analyze the above study. Results: in this study, the frequency of hospital mortality in the group with a lower shock index was lower than the group with a higher shock index (p-value = 0.001). According to the evaluation of the area under ROC curve, the shock index was of a high capability to predict hospital mortality (the area under ROC curve = 0.895; p-value<0.001). At the cutpoint of 0.7, the shock index with the sensitivity of 70% and the specificity of 88.4% was the predictor of hospital mortality. Similarly, according to the evaluation of the area under ROC curve, the shock index was of a high capability to predict mid-term mortality after hospital discharge (the area under ROC curve = 0.888; p-value<0.001). At the cutpoint of 0.7, the shock index with the sensitivity of 100% and the specificity of 86.9% was the predictor of mid-term mortality. Conclusion: the shock index was of a high value in predicting both hospital mortality and mid-term mortality in patients with acute myocardial infarction under primary PCI.

Keywords: Primary PCI, Acute myocardial infarction, Shock index, Mortality

Introduction

Coronary heart disease (CHD) is regarded as one the most important causes of death in the world which results in acute myocardial infarction as its important representation. Nearly, 1.2 million American people suffered from coronary heart disease in 2006 [1]. About a quarter to one-third of these people caught myocardial infarction with increased ST [2-6]. 25 to 35 percent of the patients with myocardial infarction die before receiving necessary cares; this mostly happens due to ventricular fibrillation [7]. Disease prognosis is better for patients who access medical and clinical cares; overall, hospital prognosis has been considerably improved in the recent years [2,8,9,10,11]. Reduction in the rate of mortality in the said patients was mostly due to developing fibrinolytic and angioplasty treatment methods through skin interventions or PCI. Analyzing the data of the American national association of myocardial infarction, the mortality in patients

[DOI: 10.47176/sjmshm.4.3.1]

Publisher: Scientific Research Publishing House (SRPH), Shirvan, Iran
http://srpub.org
Email: sjmshm@srpub.org

receiving reperfusion treatment was 5.7%, compared to the 14.8%-mortality in other treatment methods [12].

Pathogenesis of coronary atherosclerosis is completely multifactorial [13,14]. Basically, endothelial cell injury and endothelial dysfunction are resulted from the migration of leucocytes from the blood flow into intima-media layer and the migration of smooth muscle cells from media layer to into intima; they pave the grounds for the formation of atheroma or atherosclerotic plaques [14]. The atherosclerotic plaques narrow the coronary progressive lumen causing coronary artery occlusion. However, the myocardial infarction may cause a sudden coronary artery obstruction when ST increases; it sometimes results in a sudden death, too. When such an obstruction happens, the possibility for plaque surface injury and platelet adhesion and invasion is provided, as a result [15]. This provides the conditions for thrombus which causes vessel obstruction. If a coronary vessel is obstructed, all the myocardia fed by the said vessel take ischemic changes. As such, it results in the chest pain and transmural changes on ECG. As a result, a few hours after the obstruction of the vessel and the emergence of initial fibrosis, the myocardial tissue necrosis takes place and can spread from the endocardial surface to the epicardium. If the ischemia remains for several hours, the transmural infarction happens, as well [16]. On the contrary, in the same time interval, the size of the ischemic region decreases if the district blood flow to the ischemic region is maintained. Regarding the fact that the rate of mortality and morbidity has a close relationship with ischemic region level, the maintenance of the blood flow in the affected area can lead to decreased mortality and morbidity [17].

Primary coronary intervention through the skin or Primary PCI, with and without stenting, is usually regarded as an emergency method to maintain the affected coronary blood flow followed by myocardial infarction along with the increased ST, even before fibrinolytic treatment or prescription of glycoprotein inhibitors IIb/IIIa. After the diagnosis of the area affected by coronary obstruction by using angiography, a metal wire is navigated to thrombosis area and the balloon catheter is passed through which; it is placed in the narrowed area, inflated, and hence maintains the retrograde flow. This method maintains the natural blood flow in the affected vessel up to 90% [18,19] while the fibrinolytic treatment has been effective only in 50 to 60 percent of the cases. Compared to the typical treatment methods like medical treatment without reperfusion, the fibrinolytic treatment improves the function of the left ventricle and survives the patients with myocardial infarction and increases ST. A comprehensive evaluation was made in clinical trials and it was indicated that the rate of the 35-day deaths among the patients receiving fibrinolytic treatment was 9.6% whereas it was 11.5% for other patients [20]. However, fibrinolytic treatment has several main limitations. First, when the ST of some of the patients with myocardial infarction increased, they were prohibited from using fibrinolytic medicine [21]. Second, thrombolysis did not happen in about 15% of the patients receiving fibrinolytic treatment [22,23]. Third, three months after treatment, about a quarter of these patients again face with the obstruction of the vessel under treatment with medicine [24]. These limitations were minimized using the primary PCI method. In a meta-analysis study conducted on 23 clinical studies comparing fibrinolytic treatment with primary PCI, the rate of death after 4 to 6 weeks after treatment was respectively 7% and 9% [25]. The recurrences of myocardial infarction and stroke were also decreased desirably [26].

Reperfusion treatment (using mechanical or pharmaceutical method) for patients with chest pain occurs less than 12 hours of indication corresponding to the diagnosis of myocardial infarction. As such, treating with primary PCI is prioritized if the related doctor is highly skillful; it is better to be done during the first 90 minutes after calling the medical center [27]. These patients include the ones who are prohibited from fibrinolytic treatment, those who are at high risk of bleeding, the ones with clinical symptoms such as tachycardia, hypotension, or pulmonary congestion, and the patients with cardiogenic shock [28-30]. Compared to the patients under angioplasty balloon, the patients under stenting are of less recurrence of stenosis and do not need much to go under revascularization [31]. In general, stenting is always preferred. However, when the size of the artery related to infarction is not sufficient for stent planting, the angioplasty balloon is prioritized. Compared to the metal stents, the drug-eluting stents decrease the recurrence of stenosis 12 months after the procedure [32-34].

Therefore, in spite of the major benefits of primary PCI, it has some limitations and even complications. The main local vascular complications of which are bleeding, hematoma, pseudoaneurysm, and arterial venous fistulas which happen in about 2 to 3 percent of the patients and even two-thirds of whom need a transfusion [35-37]. Major bleeding occurs in about 7% of the patients [25]. The incidence of intracerebral hemorrhage is remarkably low (about 0.05%) [25]. Severe nephropathy has been observed in about 2% of the patients after primary PCI [38]; it is mostly observed in the cases with cardiogenic shock, renal failure, and in the elderly patients [38-40]. The occurrence of anaphylaxis to contrast agent is very rare [41]. Ventricular tachycardia or ventricular fibrillation is observed in 4.3% of the patients [42]. The need to perform bypass surgery is reported for less than 1% of the patients [43-45]. The occurrence of thrombosis is recognizable in less than 1.5% of the patients [46-48].

[DOI: 10.47176/sjmshm.4.3.1]

Besides, the occurrence of hospital mortality caused by primary PCI is reported in about 2.5% of the patients [49].

Overall, although the efficiency of the primary PCI in the patients with myocardial infarction and increase ST is high, the prediction of the occurrence of the aforementioned complications is necessary so as to reduce their occurrence. Therefore, the most accurate indices need to be used for this prediction. The objective of the above study was to determine the predictive value of the shock index in early prediction of mortality in patients with acute myocardial infarction under primary PCI.

Materials and Methods

The above study was a case-control research in which 200 patients participated. First, the patients' records were reviewed with the diagnosis of the acute coronary syndrome and under coronary artery angiography and the primary information of the patients were extracted. They included demographic information, height, weight, body mass index of patients, and history of heart disease risk factors including family history of heart disease, hypertension, hyperlipidemia, diabetes mellitus and smoking, patients' history of drug use especially the use of cardiac medications, previous experience of cardiovascular interventions, previous experience of myocardial infarction, history of heart failure, previous history of cerebrovascular accidents, history of renal failure, history of peripheral vascular failure, and history of chronic obstructive pulmonary disease; they were recorded in the special questionnaire of the project. Furthermore, the information related to coronary angiography (including the number and extent of the affected coronary arteries) was recorded. At the time of admission, the indexes of heart rate and blood pressure were determined, the shock index (heart rate (HR) divided by systolic blood pressure (SBP) was calculated, and hence, the patients were divided into two groups: one group with an index lower than or equal to 0.7 and the other one with an index of more than 0.7. Moreover, the hospital mortality, the 7-day mortality and the 30-day mortality of the patients were determined and recorded. The inclusion and exclusion criteria of the study were as follows:

The inclusion criteria: 1) The existence of diagnostic criteria of acute myocardial infarction including clinical manifestations, ECG changes, and the increased cardiac enzymes

The exclusion criteria: previous history of myocardial infarction or invasive cardiac treatment interventions, different contra-indications for performing PCI such as different kinds of underlying comorbidities

The data of the abovementioned study were collected, entered the software, and finally analyzed by SPSS 21.

Results

The results of this study indicated that the average age of the 200 participants in the study was 58.10 ± 13.21 years old; 156 people (78%) of the participants were male and 44 people (22%) of whom were female.

The mean of the patients' body mass index was 26.46 ± 3.41Kg/M². Regarding the previous factors, the frequency of hypertension was 77 (38.5%), that of hyperlipidemia was 16 (8%), that of diabetes was 40 (20%), that of smoking was 113 (56.5%), that of opioid use was 17 (8.5%), the frequency of previous MI was 21 (10.5%), that of heart failure was 3 (1.5%), that of family history of heart disease was 23 (11.5%), and the frequency of brain stroke was 2 (1%).

With regard to the use of medications, the use of digitalis was observed in 14 cases (7%), that of beta blockers was observed in 25 cases (12.5%), that of calcium blocker was observed in 9 cases (4.5%), that of anti-hyperglycemic drugs was observed in 41 cases (20.5%), that of ACE inhibitors was observed in 46 cases (23%), the use of diuretic was observed in 17 cases (8.5%), that of statins was observed in 21 cases (10.5%), that of antithrombotics was observed in 3 cases (1.5%), and the use of aspirin was observed in 25 cases (12.5%).

Regarding the severity of coronary artery involvement, the involvement of one vessel was reported in 43 cases (21.5%), that of two vessels was reported in 79 cases (39.5%), and that of three vessels was reported in 78 cases (39%).

With regard to heart function, the mean of the left ventricular ejection fraction was 35.91±9.29 percent. Regarding the valvular involvement, mitral failure was reported in 161 cases (80.5%), tricuspid insufficiency was reported in 140 cases (70%), aortic failure was reported in 24 cases (12%), and pulmonary failure was reported in 5 cases (2.5%). Wall motion involvement was also observed in 142 cases (71%).

Overall, 172 patients of the 200 patients with acute coronary syndrome were of a shock index less than or equal to 0.7 and 28 patients were of a shock index more than 0.7. The average shock index was 0.58±0.13 in the range of 0.30 to 0.93.

In comparing the primary indices of the patients in the two groups with a shock index less than or equal to 0.7 and the shock index more than 0.7, the frequency of the male gender was respectively 134 (78.4%) and 22 (78.6%) which had no difference between the two groups (p-value=0.98).

The average age of the patients was respectively 59.04±12.68 and 52.39±14.48 years old; it was lower in the first group (p-value=0.028). Moreover, the mean of BMI was respectively 26.39±3.46 and 27.14±2.96 which had no difference between the two groups (p-value=0.581).

[DOI: 10.47176/sjmshm.4.3.1]

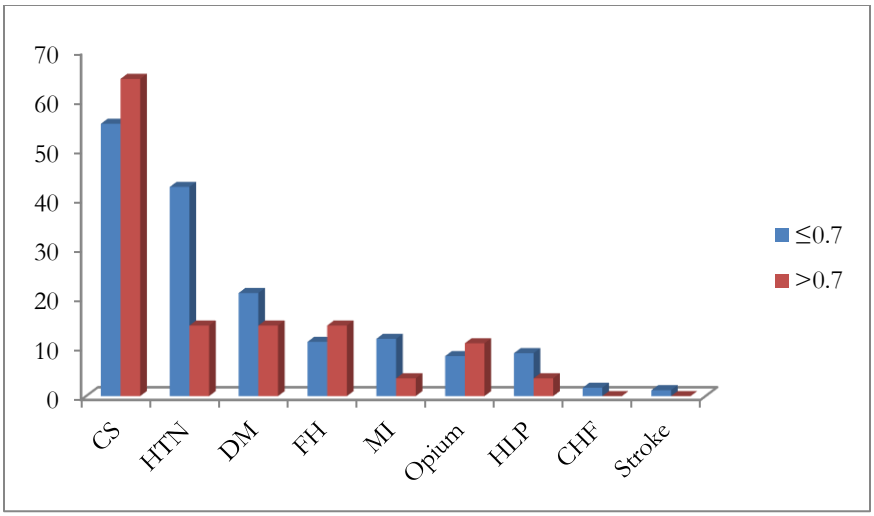

Figure 1. The frequency of risk factors in the patients with SI ≤ 0.7 and SI > 0.7

In comparing the frequency of heart disease risk factors in the two groups with a shock index less than or equal to 0.7 and the shock index more than 0.7, the hypertension frequency was respectively 73 (42.4%) and 4 (14.3%); the difference was significant (p-value=0.005). The frequency of hyperlipidemia was respectively 15 (8.7%) and 1 (3.6%) (p-value=0.705). The frequency of diabetes was respectively 36 (20.9%) and 4 (14.3%) (p-value=0.415). The frequency of smoking was respectively 95 (55.2%) and 18 (64.3%) (p-value=0.37). The frequency of previous use of opium was respectively 14 (8.1%) and 3 (10.7%) (p-value=0.713). The frequency of previous MI was respectively 20 (11.6%) and 1 (3.6%) (p-value=0.32). The frequency of previous CHF was respectively 3 (1.7%) and 0 (0%) (p-value=0.999). The frequency of family history of heart disease was respectively 19 (11%) and 4 (14.3%) (p-value=0.538). Finally, the frequency of the previous stroke was respectively 2 (1.2%) and 0 (0%) (p-value=0.999); there was no difference between the two groups (Figure 1).

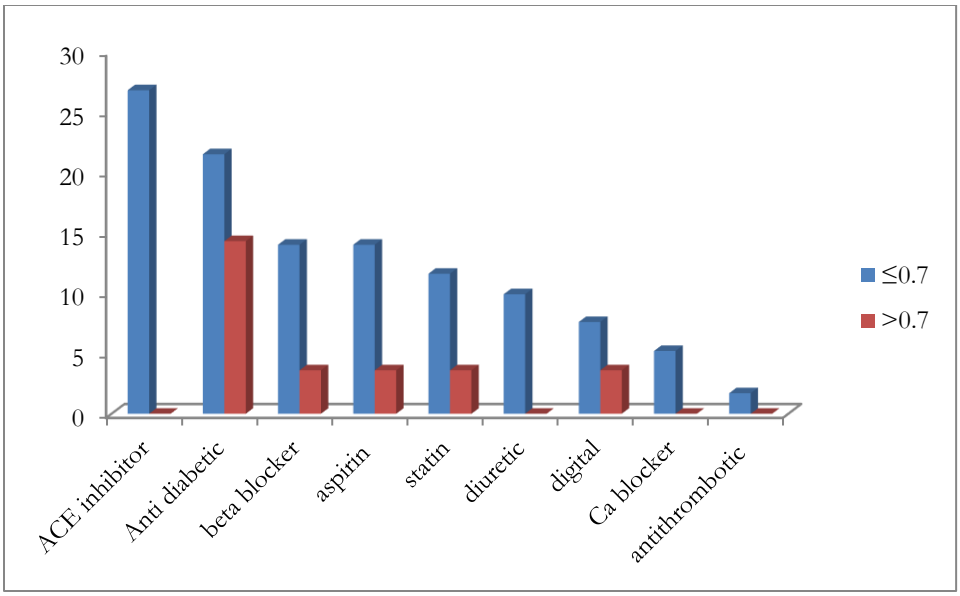

Figure 2. The frequency of the use of medications in patients with SI ≤ 0.7 and SI > 0.7

The frequency of the use of antithrombotic medications in patients with SI ≤ 0.7 and SI > 0.7 was respectively 3 (1.7%) and 0 (0%) (p-value=0.99), that of statins was respectively 20 (11.6%) and 1 (3.6%) (p-value=0.32), that of diuretics was respectively 17 (9.9%) and 0 (0%) (p-value=0.137), that of ACE inhibitors was respectively 46 (26.7%) and 0 (0%) (p-value=0.002), the frequency of the use of antidiabetic medicine was respectively 37 (21.5%) and 4 (14.3%) (p-value=0.38), that of calcium blocker was respectively 9

[DOI: 10.47176/sjmshm.4.3.1]

(5.2%) and 0 (0%) (p-value=0.365), that of beta blocker was respectively 24 (14%) and 1 (3.6%) (p-value=0.213), and the frequency of the use of digitalis was respectively 13 (7.6%) and 1 (3.6%) (p-value=0.697) which indicated the only difference in the use of ACE inhibitors between the two groups (Figure 2).

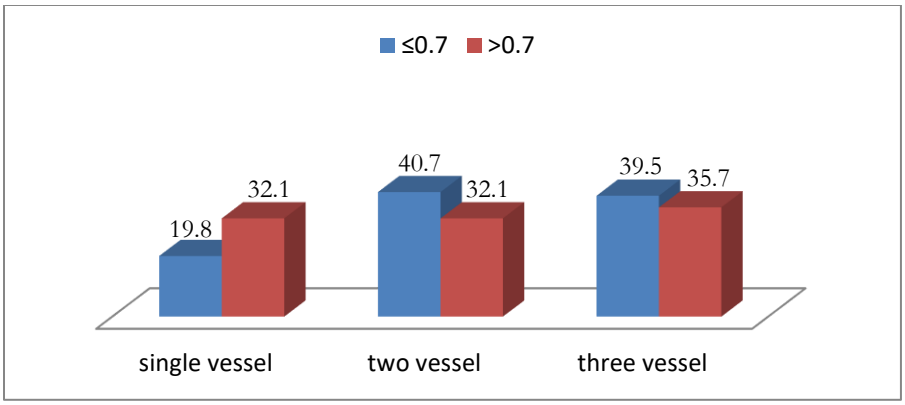

Figure 3. The frequency of the coronary involvement severity in patients with SI ≤ 0.7 and SI > 0.7

Regarding the coronary artery involvement in the two groups with a shock index less than or equal to 0.7 and the shock index more than 0.7, the frequency of one vessel was respectively 34 (19.8%) and 9 (32.1%), that of two vessels was respectively 70 (40.7%) and 9 (32.1%), and that of three vessels was respectively 68 (39.5%) and 10 (35.7%) which was not different between the two groups (p-value=0.324) (Figure 3).

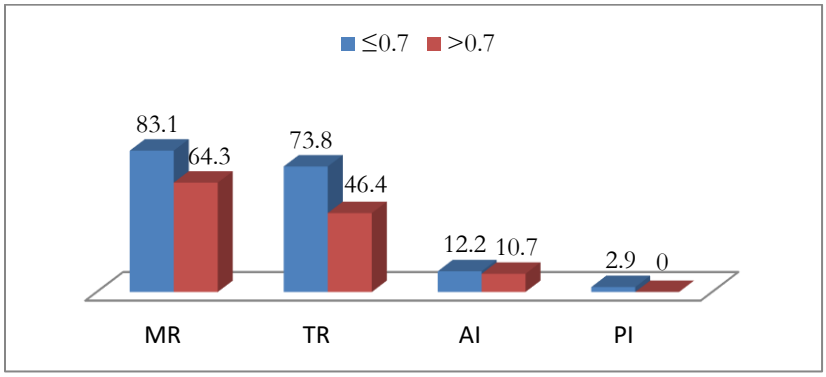

Figure 4. The frequency of valvular involvement in patients with SI ≤ 0.7 and SI > 0.7

In terms of the valvular involvement in the two groups with a shock index less than or equal to 0.7 and the shock index more than 0.7, mitral failure was respectively observed in 143 (83.1%) and 18 (64.3%) cases (p-value=0.02), tricuspid insufficiency was respectively observed in 127 (73.8%) and 13 (46.4%) cases (p-value=0.003), aortic failure was respectively observed in 21 (12.2%) and 3 (10.7%) cases (p-value=0.999), and pulmonary failure was respectively observed in 5 (2.9%) and 0 (0%) cases (p-value=0.999). It indicated the higher frequency of mitral failure and tricuspid insufficiency in the first group (Figure 4). In the two groups with a shock index less than or equal to 0.7 and the shock index more than 0.7, the mean of LVEF was respectively 35.99 ±9.13 and 35.24±10.66 which had no difference between the two groups (p-value=0.727).

The mean of LVEDD was respectively 4.59±0.59 and 4.55±0.47 (p-value=0.826) and the mean of LVESD was respectively 3.35±0.69 and 3.41±0.58 (p-value=0.782) which there was no difference between the two groups.

Furthermore, the frequency of wall motion disorder was respectively 129 (75%) and 13 (46.4%) which was higher in the first group (p-value=0.002).

Overall, the frequency of hospital mortality in the two groups with a shock index less than or equal to 0.7 and the shock index more than 0.7 was respectively 2 (1.2%) and 8 (28.6%) which was higher in the first group (p-value=0.001). Moreover, the frequency of the 30-day mortality was observed in one case and the frequency of the 60-day mortality was observed in one case, both of which happened in the patients with a shock index more than 0.7. Overall, the frequency of mortality after hospital discharge was respectively 0%

[DOI: 10.47176/sjmshm.4.3.1]

and 7.1% which there was no difference between the two groups (p-value=0.019).

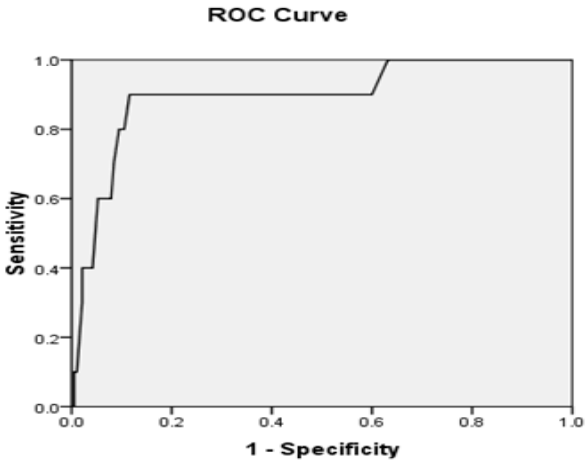

Figure 5. The area under ROC curve in the evaluation of SI capability in predicting hospital mortality

According to the evaluation of the area under ROC curve, the shock index was of a high capability to predict hospital mortality (the area under ROC curve=0.895; p-value=0.001). At the cutpoint of 0.7, the shock index with the sensitivity of 90% and specificity of 88.4% was the predictor of hospital mortality (Figure 5).

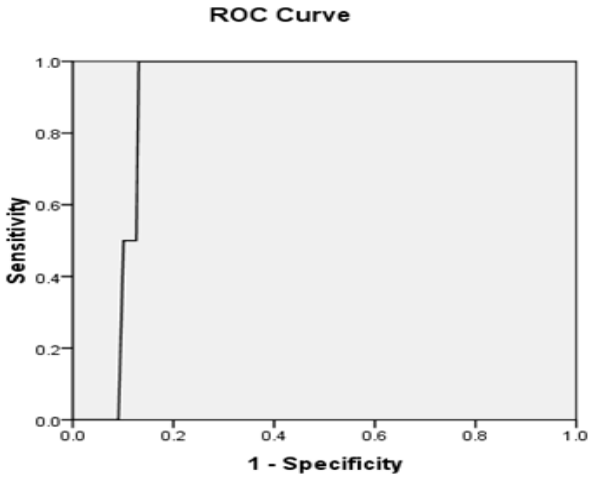

Figure 6. The area under ROC curve in the evaluation of SI capability in predicting mid-term mortality

Besides, according to a similar analysis and based on the evaluation of the area under ROC curve, the shock index was of a high capability to predict mid-term mortality after hospital discharge (the area under ROC curve= 888/0; p-value=0.001). At the cutpoint of 0.7, the shock index with the sensitivity of 100% and the specificity of 86.9% was the predictor of mid-term mortality.

Discussion and Conclusion

The diagnostic value of shock index or the heart rate (HR) divided by systolic blood pressure (SBP) in predicting the severity of cardiac disorder and failure has been mentioned in various studies. As already pointed out, the shock index has an inverse relationship with left ventricular activity and since the left ventricular activity depends on the cardiac outflow and intravascular volume status, the shock index is directly influenced by the reduction of the left ventricular activity and hypovolemia. Therefore, it is logically expected that an increase in the above index may be effective in predicting the undesirable consequences in patients with coronary artery disease, especially in predicting mortality and morbidity. Regarding the above assumption, the present study sought to evaluate the shock index value in predicting mortality and morbidity. Moreover, in the second phase, the study looked for a suitable cutpoint for the above index with the highest sensitivity and specificity in predicting

[DOI: 10.47176/sjmshm.4.3.1]

hospital mortality and mid-term mortality in the patients with acute coronary syndrome. In the first phase, the study indicated that both hospital mortality and mid-term mortality was higher for the patients with SI > 0.7 compared to the patients with lower SI; the hospital mortality and mid-term mortality in the patients with SI > 0.7 were respectively 24 times and 7 times higher. Furthermore, the evaluation of the area under ROC curve strongly confirmed the above finding. This issue was interesting where many of the comorbidities such as hypertension, aging, the use of ACE inhibitor, and the involvement of valvular failure in the population of the study were mainly prevalent among the patients whose SI was lower than 0.7.

In fact, the capability of the high SI prediction was completely independent of the patients' basic indices and cardiovascular disease risk factors. Moreover, the evaluation with ROC curve showed that the best cutpoint for SI in predicting hospital mortality and mid-term mortality was 0.7; it was of high sensitivity and specificity.

A few studies were evaluated in accordance with this study. Abe et al. [50] conducted a study and indicated that, in general, the MACE cases were higher in patients with increased shock index. In the evaluation with Cox model, the shock index more than 0.66 was a risk factor for the 5-year MACE [50]. Although the presented cutpoint was slightly different from that of the present study, the capability of high SI in predicting mortality was the scaling capability of the present study. In the study done by Spyridopoulos et al., the positive shock index was regarded as the predictive factor of long-term mortality in the elderly people having more than 70 years old [51]. Bilkova et al. [52] conducted a study and showed that the shock index along with age and diabetes are the predictive factors of mortality in the patients. The mortality cases were 20% in the patients with the shock index more than 0.8 whereas mortality was observed in 4% of the patients in the cases with a shock index less than 0.8 [52]; again, the cutpoint above 0.8 was the best one for predicting mortality. Wilson et al. conducted a study and indicated that the shock index is the predictor of mortality [53]. In the study done by Shangguan et al., the shock index was able to predict the seven-day MACE [54]. The study of Spyridopoulos et al. showed that the high shock index increases the rate of mortality by 3.5 times. In the case of long-term consequences, the high shock index was the predictive factor of long-term mortality only in the elderly people [55]. In the study done by Huang et al., the patients with a shock index above 0.7 had a higher 7- and 30-day mortality and MACE, compared to the patients with a shock index lower than 0.7. Overall, the patients with a shock index above 0.7 had 2.2 times of 7-day mortality and 1.9 times of 30-day mortality [56] which was totally in line with the present study.

The present study desirably proved that the shock index is of a high value in predicting both hospital mortality and mid-term mortality in patients with acute myocardial infarction under primary PCI. This capability was also resulted from ROC curve such that owing to its high sensitivity and specificity, the cutpoint of 0.7 was able to predict hospital mortality and mid-term mortality in the aforementioned patients.

References

1. American Heart Association. Cardiovascular disease statistics. 2006; http://www. americanheart.org

2. Rogers WJ, Canto JG, Lambrew CT, et al. Temporal trends in the treatment of over 1.5 million patients with myocardial infarction in the U.S. from 1990 through 1999: The National Registry of Myocardial Infarction 1, 2 and 3. *J Am Coll Cardiol.* 2000; 36: 2056-2063.

3. Furman MI, Dauerman HL, Goldberg RJ, Yarzebski J, Lessard D, Gore JM. Twenty two year (1975 to 1997) trends in the incidence, in-hospital and long-term case fatality rates from initial Q-wave and non-Q-wave myocardial infarction: a multi-hospital, community-wide perspective. *J Am Coll Cardiol.* 2001; 37: 1571-1580.

4. Khademvatani K, Basiri M, Alinejad V, Seyed Mohammad Zad MH. Prevalence and correlates of aortic root dilatation in patients with essential hypertension admitted to Seyedoshohada Hospital, Urmia 2012-2013. *J Glob Pharm Tech.* 2016; 02(8): 01-06.

5. Seyed Mohammad Zad MH, Khalili N, Alinejad V, Khadem Vatani K. Is there a correlation between coronary artery ectasia and neutrophil-lymphocyte ratio?. *J Glob Pharm Tech.* 2016; 02(8): 01-06.

6. Khademvatan K, Alinejad V, Eghtedar S, Rahbar N, Agakhani N. Survey of the relationship between metabolic syndrome and myocardial infarction in hospitals of Urmia University of medical sciences. *Glob J Health Sci.* 2014 Sep 18; 6(7 Spec No): 58-65. doi: 10.5539/gjhs.v6n7p58

7. Zheng ZJ, Croft JB, Giles WH, Mensah GA. Sudden cardiac death in the United States, 1989 to 1998. *Circ.* 2001; 104: 2158-2163.

8. Haghjoo M, Hajahmadi M, Fazelifar AF, Sadr-Amel MA. Efficacy and safety of different antitachycardia pacing sites in the termination of ventricular tachycardia in patients with biventricular implantable cardioverter-defibrillator. *Europace,* 2011; 13(4): 509-513

9. Heris SO, Rahimi B, Faridaalaee G, Hajahmadi M, Sayyadi H, Naghipour B. QT dispersion after thrombolytic therapy. *Int Cardiovasc Res J.* 2014; 8(4): 161-165

10. Rahimi Darabad B, Vatandust J, Pourmousavi Khoshknab MM, Hajahmadi Poorrafsanjani M. Survey of the effect of opioid abuse on the extent of coronary artery diseases. *Glob J Health Sci.* 2014; 6(7): 83-91.

[DOI: 10.47176/sjmshm.4.3.1]

11. Hajahmadi Poorrafsanjani M, Rahimi Darabad B. Evaluate the sensitivity and specificity echocardiography in trans-Doppler and tissue Doppler method in the estimation of left ventricular end-diastolic pressure. *Glob J Health Sci.* 2014; 6(7): 92-97.
12. Gibson CM. NRMI and current treatment patterns for ST-elevation myocardial infarction. *Am Heart J.* 2004; 148:Suppl: S29-S33.
13. Libby P. Current concepts of the pathogenesis of the acute coronary syndromes. *Circ.* 2001; 104: 365-372.
14. Libby P, Theroux P. Pathophysiology of coronary artery disease. *Circ.* 2005; 111: 3481-3488.
15. Freedman JE. Molecular regulation of platelet-dependent thrombosis. *Circ.* 2005; 112: 2725-2734.
16. Reimer KA, Lowe JE, Rasmussen MM, Jennings RB. The wavefront phenomenon of ischemic cell death. 1. Myocardial infarct size vs duration of coronary occlusion in dogs. *Circ.* 1977; 56: 786-794.
17. Weir RA, McMurray JJ, Velazquez EJ. Epidemiology of heart failure and left ventricular systolic dysfunction after acute myocardial infarction: prevalence, clinical characteristics, and prognostic importance. *Am J Cardiol.* 2006; 97:Suppl 10A: 13F-25F.
18. Grines CL, Cox DA, Stone GW, et al. Coronary angioplasty with or without stent implantation for acute myocardial infarction. *N Engl J Med.* 1999; 341: 1949-1956.
19. Stone GW, Brodie BR, Griffin JJ, et al. Prospective, multicenter study of the safety and feasibility of primary stenting in acute myocardial infarction: in-hospital and 30-day results of the PAMI stent pilot trial. *J Am Coll Cardiol.* 1998; 31: 23-30.
20. Fibrinolytic Therapy Trialists' (FTT) Collaborative Group. Indications for fibrinolytic therapy in suspected acute myocardial infarction: collaborative overview of early mortality and major morbidity results from all randomised trials of more than 1000 patients. *Lancet,* 1994; 343: 311-322. [Erratum, *Lancet,* 1994; 343: 742].
21. Juliard J-M, Himbert D, Golmard J-L, et al. Can we provide reperfusion therapy to all unselected patients admitted with acute myocardial infarction? *J Am Coll Cardiol.* 1997; 30: 157-164.
22. The GUSTO Angiographic Investigators. The effects of tissue plasminogen activator, streptokinase, or both on coronary- artery patency, ventricular function, and survival after acute myocardial infarction. *N Engl J Med.* 1993; 329: 1615-1622. [Erratum, *N Engl J Med.* 1994; 330: 516].
23. Anderson JL, Karagounis LA, Becker LC, Sorensen SG, Menlove RL. TIMI perfusion grade 3 but not grade 2 results in improved outcome after thrombolysis for myocardial infarction: ventriculographic, enzymatic, and electrocardiographic evidence from the TEAM-3 Study. *Circ.* 1993; 87: 1829-1839.
24. Gibson CM, Karha J, Murphy SA, et al. Early and long-term clinical outcomes associated with reinfarction following fibrinolytic administration in the Thrombolysis in Myocardial Infarction trials. *J Am Coll Cardiol.* 2003; 42: 7-16.
25. 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: 13-20.
26. Nallamothu BK, Wang Y, Magid DJ, et al. Relation between hospital specialization with primary percutaneous coronary intervention and clinical outcomes in ST-segment elevation myocardial infarction: National Registry of Myocardial Infarction 4 analysis. *Circ.* 2006; 113: 222-229.
27. Antman EM, Anbe DT, Armstrong PW, et al. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction - executive summary: a report of the American College of Cardiology/ American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 1999 Guidelines for the Management of Patients with Acute Myocardial Infarction). *Circ.* 2004; 110: 588-636. [Erratum, *Circ.* 2005; 111: 2013].
28. Ahmed S, Antman EM, Murphy SA, et al. Poor outcomes after fibrinolytic therapy for ST-segment elevation myocardial infarction: impact of age (a meta-analysis of a decade of trials). *J Thromb Thrombolysis.* 2006; 21: 119-129.
29. Thune JJ, Hoefsten DE, Lindholm MG, et al. Simple risk stratification at admission to identify patients with reduced mortality from primary angioplasty. *Circ.* 2005; 112: 2017-2021.
30. Taher T, Fu Y, Wagner GS, et al. Aborted myocardial infarction in patients with ST-segment elevation: insights from the Assessment of the Safety and Efficacy of a New Thrombolytic Regimen-3 Trial Electrocardiographic Substudy. *J Am Coll Cardiol.* 2004; 44: 38-43.
31. Stone GW, Grines CL, Cox DA, et al. Comparison of angioplasty with stenting, with or without abciximab, in acute myocardial infarction. *N Engl J Med.* 2002; 346: 957-966.
32. Valgimigli M, Percoco G, Malagutti P, et al. Tirofiban and sirolimus-eluting stent vs abciximab and bare-metal stent for acute myocardial infarction: a randomized trial. *JAMA.* 2005; 293: 2109-2117.
33. Spaulding C, Henry P, Teiger E, et al. Sirolimus-eluting versus uncoated stents in acute myocardial infarction. *N Engl J Med.* 2006; 355: 1093-1104.
34. Laarman GJ, Suttorp MJ, Dirksen MT, et al. Paclitaxel-eluting versus uncoated stents in primary percutaneous coronary intervention. *N Engl J Med.* 2006; 355: 1105-1113.
35. Piper WD, Malenka DJ, Ryan TJ Jr, et al. Predicting vascular complications in percutaneous coronary interventions. *Am Heart J.* 2003; 145: 1022-1029.
36. Grines CL, Browne KF, Marco J, et al. A comparison of immediate angioplasty with

[DOI: 10.47176/sjmshm.4.3.1]

thrombolytic therapy for acute myocardial infarction. *N Engl J Med.* 1993; 328: 673-679.
37. Aversano T, Aversano LT, Passamani E, et al. Thrombolytic therapy vs primary percutaneous coronary intervention for myocardial infarction in patients presenting to hospitals without on-site cardiac surgery: a randomized controlled trial. *JAMA.* 2002; 287: 1943-1951. [Erratum, *JAMA.* 2002; 287: 3212.]
38. Bartholomew BA, Harjai KJ, Dukkipati S, et al. Impact of nephropathy after percutaneous coronary intervention and a method for risk stratification. *Am J Cardiol.* 2004; 93: 1515-1519.
39. Sadeghi HM, Stone GW, Grines CL, et al. Impact of renal insufficiency in patients undergoing primary angioplasty for acute myocardial infarction. *Circ.* 2003; 108: 2769-2775.
40. DeGeare VS, Stone GW, Grines L, et al. Angiographic and clinical characteristics associated with increased in-hospital mortality in elderly patients with acute myocardial infarction undergoing percutaneous intervention (a pooled analysis of the primary angioplasty in myocardial infarction trials). *Am J Cardiol.* 2000; 86: 30-34.
41. Goss JE, Chambers CE, Heupler FA Jr. Systemic anaphylactoid reactions to iodinated contrast media during cardiac catheterization procedures: guidelines for prevention, diagnosis, and treatment. *Cathet Cardiovasc Diagn.* 1995; 34: 99-104.
42. Mehta RH, Harjai KJ, Grines L, et al. Sustained ventricular tachycardia or fibrillation in the cardiac catheterization laboratory among patients receiving primary percutaneous coronary intervention: incidence, predictors, and outcomes. *J Am Coll Cardiol.* 2004; 43: 1765-1772.
43. Yang EH, Gumina RJ, Lennon RJ, Holmes DR Jr, Rihal CS, Singh M. Emergency coronary artery bypass surgery for percutaneous coronary interventions: changes in the incidence, clinical characteristics, and indications from 1979 to 2003. *J Am Coll Cardiol.* 2005; 46: 2004-2009.
44. Wharton TP Jr, Grines LL, Turco MA, et al. Primary angioplasty in acute myocardial infarction at hospitals with no surgery on-site (the PAMI-No SOS study) versus transfer to surgical centers for primary angioplasty. *J Am Coll Cardiol.* 2004; 43: 1943-1950.
45. Wharton TP Jr. Should patients with acute myocardial infarction be transferred to a tertiary center for primary angioplasty or receive it at qualified hospitals in community? The case for community hospital angioplasty. *Circ.* 2005; 112: 3509-3520.
46. Bavry AA, Kumbhani DJ, Helton TJ, Bhatt DL. What is the risk of stent thrombosis associated with the use of paclitaxeleluting stents for percutaneous coronary intervention? A meta-analysis. *J Am Coll Cardiol.* 2005; 45: 941-946.
47. Moreno R, Fernandez C, Hernandez R, et al. Drug-eluting stent thrombosis: results from a pooled analysis including 10 randomized studies. *J Am Coll Cardiol.* 2005; 45: 954-959.
48. Iakovou I, Schmidt T, Bonizzoni E, et al. Incidence, predictors, and outcome of thrombosis after successful implantation of drug-eluting stents. *JAMA.* 2005; 293: 2126-2130.
49. Keeley EC, Grines CL. Should patients with acute myocardial infarction be transferred to a tertiary center for primary angioplasty or receive it at qualified hospitals in the community? The case for emergency transfer for primary percutaneous coronary intervention. *Circ.* 2005; 112: 3520-3532.
50. Abe N, Miura T, Miyashita Y, Hashizume N, Ebisawa S, Motoki H, Tsujimura T, Ishihara T, Uematsu M, Katagiri T, Ishihara R, Tosaka A, Ikeda U. Long-term prognostic implications of the admission shock index in patients with acute myocardial infarction who received percutaneous coronary intervention. *Angiol.* 2016 Jun 14; pii: 0003319716653885.
51. Spyridopoulos I, Noman A, Ahmed JM, Das R, Edwards R, Purcell I, Bagnall A, Zaman A, Egred M. Shock-index as a novel predictor of long-term outcome following primary percutaneous coronary intervention. *Eur Heart J Acute Cardiovasc Care.* 2015 Jun; 4(3): 270-7. doi: 10.1177/2048872614561480
52. Bilkova D, Motovska Z, Widimsky P, Dvorak J, Lisa L, Budesinsky T. Shock index: a simple clinical parameter for quick mortality risk assessment in acute myocardial infarction. *Can J Cardiol.* 2011 Nov-Dec; 27(6): 739-742. doi: 10.1016/j.cjca.2011.07.008
53. Wilson WM, Andrianopoulos N, Clark D, Duffy SJ, Brennan A, Harries I. Long-term predictors of mortality after percutaneous coronary intervention in the era of drug-eluting stents. *Am J Cardiol.* 2011 Oct 1; 108(7): 936-42. doi: 10.1016/j.amjcard.2011.05.024
54. Shangguan Q, Xu JS, Su H, Li JX, Wang WY, Hong K, et al. Modified shock index is a predictor for 7-day outcomes in patients with STEMI. *Am J Emerg Med.* 2015 Aug; 33(8): 1072-1075. doi: 10.1016/j.ajem.2015.04.066
55. Spyridopoulos I, Noman A, Ahmed JM, Das R, Edwards R, Purcell I, et al. Shock-index as a novel predictor of long-term outcome following primary percutaneous coronary intervention. *Eur Heart J Acute Cardiovasc Care.* 2015 Jun; 4(3): 270-277. doi: 10.1177/2048872614561480
56. Huang B, Yang Y, Zhu J, Liang Y, Tan H, Yu L, et al. Usefulness of the admission shock index for predicting short-term outcomes in patients with ST-segment elevation myocardial infarction. *Am J Cardiol.* 2014 Nov 1; 114(9): 1315-1321. doi: 10.1016/j.amjcard.2014.07.062

[DOI: 10.47176/sjmshm.4.3.1]

SJMSHM

Citation: Faramrzzadeh R, Shahabi Raberi V. Determining the Predicting Value of the Shock Index in Early Prediction of Mortality in Patients with Acute Myocardial Infarction under Primary PCI. SJMSHM, 2022; 4(3): 1-10.

https://doi.org/10.47176/sjmshm.4.3.1

[DOI: 10.47176/sjmshm.4.3.1]