ejpmr, 2024, 11(4), 287-294

SJIF Impact Factor 7.065

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

SELVESTER SCORE AS A PREDICTOR OF LEFT VENTRICULAR SYSTOLIC FUNCTION RECOVERY IN ST-SEGMENT ELEVATION MYOCARDIAL INFARCTION (STEMI)

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Article Received on 19/02/2024 **Article Revised on 10/03/2024** **Article Accepted on 31/03/2024**

ABSTRACT

Background: Ischemic heart disease is the most common contributor to left ventricular dysfunction. The extent of left ventricular (LV) function varies considerably among patients with extensive coronary disease of patients at the highest risk for developing left ventricular (LV) dysfunction could serve to inform the use of certain therapies. **Objective:** The aim of this study is to assess the correlation between the Selvester score and the left ventricular dysfunction improvement in patients with anterior STEMI and reduced EF. **Patients and Methods:** This prospective observational study was done on patients with acute anterior STEMI with LVSD. All patients were subjected to full history taking, twelve lead surface ECG, and echocardiography data were performed for all patients. **Results:** The difference in the Selvester Score on discharge and after three months showed no statistically significant correlation with LV dysfunction improvement. The studied patients demonstrated a cut-off point of ≥7 for the Selvester Score at discharge, the ROC analysis revealed a sensitivity of 85.71% and a specificity of 100.00%. The positive predictive value (+PV) is 100.0%, while the negative predictive value (-PV) is 79.2%. **Conclusion:** Our study and suggest that high selvester score at hospital discharge in patients with STEMI whom underwent primary PCI is associated with poor LV systolic function recovery after 3months.

KEYWORDS: ST-Segment Elevation Myocardial Infarction, left ventricular.

INTRODUCTION

Ischemic heart disease is the most common contributor to left ventricular dysfunction. The extent of left ventricular (LV) function varies considerably among patients with extensive coronary disease ***(Gao et al., 2012).*** Early identification of patients at the highest risk for developing left ventricular (LV) dysfunction could serve to inform the use of certain therapies ***(Bhave et al., 2012).***

Recent studies have highlighted a fall in acute and long-term mortality following ST-segment elevation myocardial infarction (STEMI) in parallel with greater use of reperfusion therapy, including Percutaneous coronary intervention (PCI) ***(Townsend et al., 2016; Puymirat et al., 2012).*** However, a problem with this approach is that not all patients with STEMI improve or maintain heart function following PCI. 4.7–8.6% of patients may experience decreased heart function even after undergoing successful primary PCI ***(Kelly et al., 2011; Spencer et al., 2002).***

Methods of detection and monitoring of left ventricular systolic dysfunction in STEMI patients should be simple, objective, non-invasive, and feasible for common implementation. Two- -dimensional transthoracic echocardiography (TTE) enables the assessment of global and regional left ventricular systolic function(LVSF). Left ventricular ejection fraction (LVEF) is a well-recognized marker of LVSF and an independent prognostic factor ***(Oh, 2007).***

Selvester QRS score in Non ischemic dilated cardiomyopathy (NIDCM) might reflect the electrophysiological and pathological changes of myocardial and interstitial tissues. It may be attributed to the structural or functional changes accompanied by the progression of cardiac remodeling or successful reverse remodeling. Thus, we believe that the Selvester QRS scoring system, which is noninvasive and can be evaluated repeatedly using a resting ECG, may be useful for the quantification of myocardial fibrosis in NIDCM ***(Chaudhry et al., 2017).***

Recently, the Selvester QRS score was demonstrated to be a strong predictor of infarct size and poor outcomes in patients with STEMI ***(Watanab et al., 2016).***

AIM OF THE WORK

The aim of this study is to assess the correlation between the Selvester score and the left ventricular dysfunction improvement in patients with anterior STEMI and reduced EF.

PATIENTS AND METHODS

This study was done in the coronary care unit and the coronary catheterization lab unit at the cardiology department at Misr University for Science and Technology (MUST) hospital from August 2022 till February 2023.

- **Patients:** This study was conducted on patients who presented with ST-segment elevation anterior myocardial infarction (anterior STEMI) with left ventricular systolic dysfunction (EF<50%) and who underwent primary percutaneous intervention, The Selvester QRS score and Echocardiography were done for all patients at hospital discharge and three months after to obtain a correlation between the Selvester score and the EF improvement.

Criteria of patient selection

Inclusion criteria: Age > 18 years. Patients presented with chest pain associated with ECG changes fulfilling criteria for diagnosis of anterior ST elevation myocardial infarction within 48 hours of symptom onset (chest pain) or after 48 hours if they had persistent symptoms (chest pain) suggestive of ongoing myocardial ischemia or hemodynamic instability and who also present with new onset left ventricular systolic dysfunction (LVSD) (EF<50%) that underwent primary PCI.

Exclusion Criteria: Patients who presented with STEMI after 48 hours and no evidence suggestive of ongoing ischemia. Patient who underwent thrombolytic reperfusion therapy. Patients are known to have heart failure with reduced ejection fraction before presenting with STEMI. Patients with congenital heart diseases. Patients with previous Coronary Artery Bypass Graft (CABG). Patients who refused to participate in this study.

METHODS

Diagnosis

All patients were subjected to the following

Full history taking; focusing on Risk factors for Coronary Artery Disease (CAD): Age. Sex. Smoking status. Diabetes mellitus. Hypertension. Dyslipidemia. Family history of premature CAD. Prior MI. Chronic kidney disease.

Full general examination

Clinical examination; focusing on Killip class on admission: Killip class I includes individuals with no clinical signs of heart failure. Killip class II includes individuals with rales or crackles in the lungs, an S 3 gallop, and elevated jugular venous pressure. Killip class III describes individuals with frank acute pulmonary edema. Killip class IV describes individuals in cardiogenic shock or hypotension (measured as systolic blood pressure < 90 mmHg), and evidence of low cardiac output (oliguria, cyanosis, or impaired mental status). The history and clinical exam were done in a private space to ensure the privacy of the patient and the confidentiality of the data obtained.

Procedural Parameters

All patients received adjuvant medical therapy (loading dose of Aspirin (300 mg), P2Y12 inhibitors (Clopidogrel 600 mg or Ticagrelor 180 mg), and High-Intensity dose of Statins (Atorvastatin or Rosuvastatin) according to the ESC guidelines of STEMI ***(Ibanez et al., 2018).*** Primary PCI was performed by an expert interventional cardiologist who performs more than 75 primary PCIs per year according to the 2017 ESC guidelines of STEMI. All patients received Heparin (100 IU/Kg) when the coronary anatomy was first defined.

Post-procedural parameters

Twelve lead surface ECGs

Twelve lead surface ECGs (serial): Twelve lead surface ECG at discharge, and 3 months after discharge. Selvester-QRS score was calculated by the researcher and revised blindly by consultant cardiology who did not have any information about the patient.

(Yontar et al., 2021). Selvester-QRS score was measured using the ECG recording. The amplitude, duration, amplitude ratio, and notch of Q, R, and S waves were measured in each ECG lead except lead III, the score was individually calculated with each criterion. Using 37 ECG criteria capable of generating a total of 29 points, each point was assigned 3% of the LV mass.

Lead	Duration (msec.)	Points	Amplitude Ratios	Points	Max Leads Points
I	Q≥30	**(1)**	R/Q≤1	**(1)**	**2**
II	Q≥40 Q≥30	**(2)** **(1)**			**2**
AVL	Q≥30	**(1)**	R/Q≤1	**(1)**	**2**
AVF	Q≥50	**(3)**	R/Q≤1	**(2)**	**5**

	Q≥40 Q≥30	**(2)** **(1)**	R/Q≤2	**(1)**	
V1	Any Q Q≥50 Q≥40	**(1)** **(2)** **(1)**	R/S≥1	**(1)**	**4**
V2	Any Q or R≤20 R≥60 R≥50	**(1) (2)** **(1)**	R/S≥1.5	**(1)**	**4**
V3	Any Q or R≤30	**(1)**			**1**
V4	Q≥20	**(1)**	R/Q or R/S≤0.5 R/Q or R/S≤1	**(2)** **(1)**	**3**
V5	Q≥30	**(1)**	R/Q or R/S≤1 R/Q or R/S≤2	**(2)** **(1)**	**3**
V6	Q≥30	**(1)**	R/Q or R/S≤1 R/Q or R/S≤3	**(2)** **(1)**	**3**

Echocardiography data: Transthoracic echocardiography was performed by using a GE Vivid E9 echo machine, Recordings were taken on patients positioned in the left lateral decubitus position. Echocardiography was performed by experienced cardiologists who were blinded to other data. All measurements were performed according to the latest guidelines. Left ventricular ejection fraction (LVEF) was calculated according to the Modified Simpson's method, eye balling method ***(Yontar et al., 2021)***. Echocardiography was done at hospital admission and three months after.

Ethical Consideration: Agreement for this study was obtained from the ethical committee, approval number (2022/0012) in addition, informed consent was obtained from patients after adequate provision of information regarding the study requirements, purpose, and risks. The study was approved by the Ethics Committee of the Faculty of Medicine Misr University Science and Technology. There were adequate provisions to maintain the privacy of participants and the confidentiality of the data were as follows. We put code numbers to each participant with the name and address kept in a special file. We hide the patients' names when we use the research. We used the results of the study only in a scientific manner and did not use it in any other aims.

Sample Size calculation: Sample size calculation was based on the difference in the no-reflow phenomenon observed in patients with high QRS scores (≥4) than in those with low QRS scores retrieved from previous ***(Uyarel et al., 2006)***.

Using G*power version 3.0.10 to calculate sample size based on the difference of 31%, 2-tailed test, α error =0.05, and power 80.0% the total sample size was 50 cases at least.

RESULTS

This study was conducted on 54 patients who presented with ST-segment elevation anterior myocardial infarction (anterior STEMI) with left ventricular systolic dysfunction (EF<50%) and who underwent primary percutaneous intervention**.**

Table 1: Demographic data and characteristics of the studied patients.

		Total no. = 54
Age (years)	Mean ± SD	55.83 ± 11.80
	Range	21 – 86
Sex	Female	16 (29.6%)
	Male	38 (70.4%)
Smoking Status	No	22 (40.7%)
	Yes	32 (59.3%)
DM	No	26 (48.1%)
	Yes	28 (51.9%)
HTN	No	25 (46.3%)
	Yes	29 (53.7%)
Dyslipidemia	No	21 (38.9%)
	Yes	33 (61.1%)
Family Hx of IHD	No	37 (68.5%)
	Yes	17 (31.5%)
Prior MI	No	44 (81.5%)
	Yes	10 (18.5%)
CKD	No	45 (83.3%)

	Yes	9 (16.7%)
Duration of symptoms/ Ischemic Time (hrs)	Median (IQR)	5.5 (2 – 18)
	Range	0.25 – 72
Killip Class	I	25 (46.3%)
	II	13 (24.1%)
	III	7 (13.0%)
	IV	9 (16.7%)

Table (2): Relation of improvement with demographic data and characteristics of the studied patients.

		Total no. = 54
Age (years)	Mean ± SD	55.83 ± 11.80
	Range	21 – 86
Sex	Female	16 (29.6%)
	Male	38 (70.4%)
Smoking Status	No	22 (40.7%)
	Yes	32 (59.3%)
DM	No	26 (48.1%)
	Yes	28 (51.9%)
HTN	No	25 (46.3%)
	Yes	29 (53.7%)
Dyslipidemia	No	21 (38.9%)
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Family Hx of IHD	No	37 (68.5%)
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	Range	0.25 – 72
Killip Class	I	25 (46.3%)
	II	13 (24.1%)
	III	7 (13.0%)
	IV	9 (16.7%)

P-value > 0.05: Non-significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant, *: Chi-square test; •: Independent t-test.

Table 3: Relation of improvement with primary PCI details among the studied patients.

Primary PCI		**Improved No. = 19**	**Not improved No. = 35**	**Test value**	**P-value**	**Sig.**
Door to balloon time/ Reperfusion Time (min.)	**Mean ± SD**	47.89 ± 15.12	66.57 ± 19.99	-3.552•	0.001	HS
	Range	20 – 75	20 – 120			
TIMI flow post-stenting	**I**	2 (10.5%)	10 (28.6%)	8.202*	0.017	S
	II	6 (31.6%)	18 (51.4%)			
	III	11 (57.9%)	7 (20.0%)			
MBG post stenting	**0**	2 (10.5%)	7 (20.0%)	11.726*	0.008	HS
	I	1 (5.3%)	14 (40.0%)			
	II	7 (36.8%)	9 (25.7%)			
	III	9 (47.4%)	5 (14.3%)			
Duration of symptoms/ Ischemic Time (hrs)	**Median (IQR)**	2 (1.5 – 6)	10 (2 – 48)	-2.620≠	0.009	HS
	Range	0.5 – 24	1 – 72			

P-value > 0.05: Non-significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant, *: Chi-square test; •: Independent t-test.

Table (4): Relation between improvement and QRS selvester score ECG bat discharge and after 3 months follow-up among the studied patients.

		Improved No. = 19	Not improved No. = 35	Test value	P-value	Sig.
Before						
Echo (EF)	Mean ± SD	33.05 ± 9.83	29.54 ± 9.51	1.280•	0.206	NS
	Range	17 – 45	10 – 45			
ECG (Selvester Score)	Median (IQR)	4 (4 – 6)	11 (9 – 12)	-5.035≠	<0.001	HS
	Range	0 – 7	1 – 13			
After 3 months						
Echo (EF)	Mean ± SD	48.89 ± 10.03	33.57 ± 9.50	5.552•	<0.001	HS
	Range	27 – 70	15 – 50			
ECG (Selvester Score)	Median (IQR)	4 (2 – 4)	10 (8 – 11)	-5.378≠	<0.001	HS
	Range	0 – 6	2 – 12			
Difference						
Echo (EF)	Median (IQR)	15 (13 – 18)	5 (0 – 6)	-5.624≠	<0.001	HS
	Range	7 – 27	0 – 21			
ECG (Selvester Score)	Median (IQR)	-1 (-2 – 0)	-1 (-1 – 0)	-0.724≠	0.469	NS

P-value > 0.05: Non-significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant, •: Independent t-test; ≠: Mann-Whitney test.

ROC curve for ECG (Selvester Score) at discharge detecting non-improvement among the studied patients.

Cut off point	AUC	Sensitivity	Specificity	+PV	-PV
>7	0.916	85.71	100.00	100.0	79.2

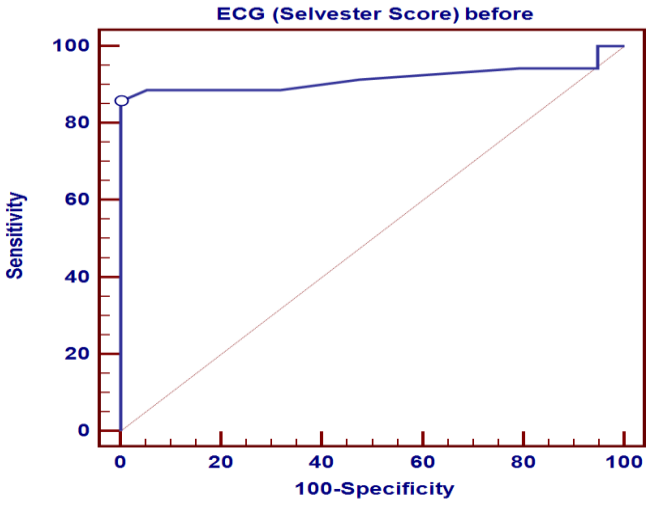

Figure (1): ROC curve for ECG (Selvester Score) at discharge detecting non-improvement among the studied patients.

Table (5): Univariate and multivariate logistic regression analysis for factors associated with non-improvement among the studied patients.

	Univariate				Multivariate (Backward: Wald)			
	P-value	Odds ratio (OR)	95% C.I.for OR		P-value	Odds ratio (OR)	95% C.I.for OR	
			Lower	Upper			Lower	Upper
Sex (male)	**0.009**	5.370	1.526	18.903	–	–	–	–
Smoking Status	**0.016**	4.286	1.309	14.032	–	–	–	–
DM	**0.032**	3.667	1.120	12.001	–	–	–	–
HTN	**0.019**	4.153	1.260	13.689	**0.042**	15.536	1.104	218.545
Dyslipedemia	**0.038**	3.437	1.068	11.068	–	–	–	–
Family Hx of IHD	**0.024**	6.375	1.273	31.920	0.071	20.749	0.775	555.602
Duration of symptoms/ Ischemic Time >5 (hrs)	**0.013**	4.738	1.385	16.211	–	–	–	–
Killip Class	**0.011**	2.506	1.237	5.076	**0.011**	10.286	1.690	62.617

Door to balloon time/ Reperfusion Time >45 (min.)	**0.009**	5.370	1.526	18.903	**0.012**	130.268	2.907	5836.734
TIMI flow post stenting	**0.011**	0.311	0.126	0.769	**0.039**	0.110	0.013	0.896
MBG post stenting	**0.006**	0.394	0.203	0.766	–	–	–	–

Table (6): Relation of Selvester Score at discharge with other studied parameters among the studied patients.

		ECG (Selvester Score) before		Test value	P-value	Sig.
		Median (IQR)	Range			
Sex	Female	6 (4 – 10)	2 – 13	-1.523•	0.128	NS
	Male	10 (5 – 11)	0 – 13			
Smoking Status	No	5.5 (4 – 10)	2 – 13	-2.000•	0.046	S
	Yes	10 (6 – 11.5)	0 – 13			
DM	No	6 (4 – 10)	0 – 13	-2.689•	0.007	HS
	Yes	10 (6.5 – 12)	3 – 13			
HTN	No	6 (4 – 10)	0 – 13	-1.683•	0.092	NS
	Yes	10 (6 – 11)	1 – 13			
Dyslipidemia	No	6 (4 – 10)	2 – 13	-2.346•	0.019	S
	Yes	10 (6 – 12)	0 – 13			
Family Hx of IHD	No	6 (4 – 11)	0 – 13	-1.292•	0.196	NS
	Yes	10 (9 – 11)	1 – 13			
Prior MI	No	7.5 (4 – 11)	0 – 13	-2.731•	0.006	HS
	Yes	11 (10 – 13)	6 – 13			
CKD	No	8 (5 – 11)	0 – 13	-0.700•	0.484	NS
	Yes	10 (10 – 11)	3 – 13			
Killip Class	I	5 (4 – 8)	1 – 12	16.631≠	0.001	HS
	II	11 (10 – 11)	3 – 13			
	III	11 (7 – 12)	0 – 12			
	IV	11 (10 – 13)	3 – 13			
TIMI flow post-stenting	I	9.5 (4.5 – 11)	1 – 12	3.380≠	0.185	NS
	II	10 (6.5 – 11)	3 – 13			
	III	6 (4 – 10)	0 – 13			
MBG post stenting	0	9 (4 – 11)	4 – 12	6.092≠	0.107	NS
	I	10 (9 – 11)	1 – 13			
	II	9.5 (4.5 – 12.5)	3 – 13			
	III	5.5 (3 – 7)	0 – 13			

P-value > 0.05: Non-significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant, •: Mann-Whitney test; ≠: Kruskal-Wallis test

LIMITATIONS

Our study is observational in nature with the known limitations of this kind of studies including selection bias, slow investigation and expensive. The results were obtained from a single medical center with a relatively small sample size.

RECOMMENDATIONS

More clinical trials with larger sample sizes and more data are needed for further evaluation .More studies are needed to proof the effectiveness of using selvester score as a simple predictor for LV systolic dysfunction recovery after primary PCI .It is vital to define higher-risk patients for early intervention and close follow-up after discharge in acute coronary syndromes**.**

CONCLUSION

Selvester score wasn't used before as a predictor of LV systolic function recovery with STEMI patients, so it is the first time to use in Our study and suggest that high selvester score at hospital discharge in patients with STEMI whom underwent primary PCI is associated with poor LV systolic function recovery after 3months.Our findings may aid in the clinical management of patients with STEMI in the early stages of their hospitalization, patients with high selvester score are high risk for developing congestive heart failure and arrhythmias so they need close monitoring and early aggressive medical treatment.

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