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The Role of Syntax Scores in Predicting Intracardiac Defibrillator Implantation in Acute Anterior Myocardial Infarction

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Abstract

Cardiovascular heart diseases are the most common mortality and morbidity cause in developed countries. In our retrospective study we searched for patients who admitted to hospital with acute anterior myocardial infarction that underwent reperfusion therapy with primary percutan coronary intervention. We assessed these patients with SYNTAX, clinical SYNTAX and residual SYNTAX score and investigate the role of those to predict intracardiac defibrillator device (ICD) implantation. 345 patients with acute myocardial infarction who received primary percutan coronary invention, through 2011-2013 years, were included. Angiographic pictures are investigated and SYNTAX, clinical SYNTAX ve residual SYNTAX scores were calculated. 52 of the patients had ICD implantation. In these patients, with one variable analysis, mean age, diabetes mellitus, hypertension, hyperlipidemia prevalence, smoking rate, glomerular filtration rate, thrombolysis in myocardial infarction flow score, SYNTAX score, clinical SYNTAX score and residual SYNTAX score were significantly higher. With the multiple variable logistic regression analysis ejection fraction (EF) and three SYNTAX score was considered significant. We found that after 3-month follow up, prediction of ICD implementation could be reckoned with EF, SYNTAX, clinical SYNTAX and residual SYNTAX scores calculated at first admission with acute anterior MI patients. We recommend that close follow is needed for patients with low EF and high SYNTAX score.

Key Words: *Acute anterior myocardial infarction, SYNTAX, Clinical SYNTAX, Residual SYNTAX scores, ICD.*

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Introduction

Cardiovascular diseases are among the leading causes of morbidity and mortality all over the world, especially in developed countries and the western world. The majority of deaths due to cardiovascular diseases are deaths due to coronary artery disease. In the USA, approximately 2.5 million cases of acute myocardial infarction (AMI) occur each year, of which 25% die before reaching hospital (1). In-hospital mortality decreased from over 20% in 1965 to approximately 5-6% in 1990 (1). The development of specialized coronary care units, percutaneous coronary intervention and the introduction of direct electrical defibrillators have contributed to this dramatic decrease, along with the advances in medicine making it possible to use more and more treatment methods in the treatment of coronary artery disease (2, 3). The acute manifestations of coronary artery disease are referred to as unstable angina pectoris (USAP), non-ST elevation acute myocardial infarction (NSTEAMI), and ST elevation acute myocardial infarction (STEAMI) "acute coronary syndromes" (4). Although there are some clinical differences in acute coronary syndromes (ACS), there is a common underlying pathophysiological mechanism in all of them. Diagnosis and treatment methods in AMIs with ST elevation on electrocardiogram (ECG) are well defined. In these patients, there is usually acute complete occlusion of the coronary artery, and the treatment principle is rapid recanalization of the occluded vessel with thrombolytic therapy or primary angioplasty, or there may be a surgical option. Restoration of blood flow after ischemia is called reperfusion (5, 6). Despite the development of reperfusion treatment regimens, heart failure is an inevitable outcome.

In patients with heart failure (HF), about half of deaths occur suddenly and unexpectedly, and a significant proportion is associated with malignant ventricular arrhythmias. Intracardiac defibrillators (ICD) have an important role in reducing the risk of death from ventricular arrhythmias (7). In heart failure developing after acute myocardial infarction, ICD implanted with guidelines makes a significant contribution to mortality reduction (6). SYNTAX score and its derivatives; It is the world-accepted scoring system for evaluating the severity of Coronary Artery Disease (CAD) and predicting in-hospital and out-of-hospital events. The SYNTAX score is one of the most important scoring methods comparing percutaneous coronary intervention (PKI) (drug-eluting stent) and coronary artery bypass surgery (CABS) in patients with complex multivessel coronary artery disease (8). After many large-scale studies with the SYNTAX score calculated in patients with stable angina pectoris, this scoring method has found its place in the guidelines. Today, the SYNTAX score has been widely used in patients presenting with acute myocardial infarction and undergoing PCI (8).

In our retrospective study, we investigated the role of SYNTAX, clinical SYNTAX and residual SYNTAX scores, which we calculated from patients who underwent primary percutaneous coronary intervention as reperfusion therapy, in predicting future ICD implantation in patients admitted to our emergency department with acute anterior myocardial infarction.

Materials and Methods

Between 2011 and 2013, 345 patients who applied to the emergency department with acute myocardial infarction and were taken to the primary catheter laboratory were included in our study. All coronary angiographic procedures and percutaneous coronary interventions were performed on a Siemens Angio Core device and by interventional cardiologists with >75 interventional procedures per year. Percutaneous coronary intervention was performed using 7F sheathile femoral artery, coronary artery cannulation with 7F guiding catheter in accordance with traditional standard techniques. All patients were given a loading dose of 300 mg aspirin and 600 mg clopidogrel before the procedure. 10,000 units of IV heparin was administered during the procedure. Primary stenting was applied to the patients who were suitable for stenting, and the operation decision was made for a small number of patients who were not suitable for stenting. No patient received thrombolytic therapy before or after the procedure. After the procedure, all patients were followed in the coronary intensive care unit until they stabilized.

Coronary angiography images of 345 patients presenting with AMI were viewed. The scores of all patients were calculated with the SYNTAX scoring system. First, the patient's right-left dominant coronary nutritional status was determined according to the SYNTAX scoring system. Then, the scoring was started in the following order:

1) A baseline score was given according to the level of the lesion above the coronary artery and the right-left dominant feeding of the heart (for example, LMCA stenosis was given 5 points in right-dominant feeding, while 6 points were given in left-dominant feeding). In this way, a total of 15 segments were examined.

2) The basal score was multiplied by 2 if the percentage of stenosis was 50-99% and by 5 if the total occlusion was.

3) In lesions with total occlusion;

a) +1 if the duration is longer than 3 months or unknown

b) If it is blunt-ended + 1

c) +1 if there are bridging collaterals

d) + 1 for each segment not seen after total occlusion

e) If the lateral branch diameter is less than 1.5 mm, +1 point is added.

4) In trifurcation lesions; If 1 segment is sick + 3, if 2 segments are sick + 4, if 3 segments are sick + 5, if 4 segments are sick + 6 points are added.

5) In bifurcation lesions, 1 or 2 points were added according to the involvement of the main vessel and side branch ostium.

6) +1 point was added for aorto-osteal lesions.

7) In severe convoluted vessels, diffuse lesion, and severe calcifications, +2 points were added for each separately.

8) Added +1 point if there is thrombus.

9) If the vessel diameter is less than 2 mm and the distal of the lesion is more than 75% of the total vessel length, +1 point is added for each distal segment.

The residual SYNTAX score of the patients was then calculated. The residual SYNTAX score was considered the same as the SYNTAX score if the patient did not

undergo primary stenting or balloon angioplasty. In patients who underwent primary stenting or balloon angioplasty, the score was recalculated without assigning a score to the infarct-related lesion score and was accepted as the residual SYNTAX score. Flow in the epicardial coronary arteries after the procedure; Thrombolysis In Myocardial Infarction (TIMI) was evaluated by coronary flow classification (Table 1).

Table 1: Thrombolysis in Myocardial Infarction (TIMI) flow classification.

TIMI 0	No perfusion after occlusion
TIMI 1	Contrast stenosis resolves but does not completely fill the distal coronary bed
TIMI 2	Contrast material passes the stenosis and fills the coronary distal after stenosis. However, the rate of filling or flushing of the contrast agent is noticeably slow compared to normal arteries.
TIMI 3	The rate of filling and washing of the contrast agent in the distal coronary bed is the same as in normal arteries.

Statistical Analysis

The clinical SYNTAX score of the patients was calculated. Clinical SYNTAX score: It is obtained by multiplying the SYNTAX score by the modified ACEF score. In the modified ACEF score, 1 point is given for every 10 mL/min that falls below 60 mL/min in age / ejection fraction + creatinine clearance (maximum 6 points). Creatinine clearance was calculated with the Cockcroft-Gault formula (9). Statistical analysis was performed using SPSS 16.0.

Results

A total of 345 patients admitted to the Mustafa Kemal University Research Hospital with acute anterior myocardial infarction between January 2011 and December 2013 and taken to the primary catheterization laboratory were included in the study. The mean age of the patients was 60.9 ± 13.1%, with 74.2% male and 24.8% female. 41.2% of the patients were diagnosed with DM and 36.2% with hypertension. The diagnosis of hyperlipidemia was made in 13.3% of the patients and 45.8% of the patients were smokers.

The mean hemoglobin value was 13.8 g/dl ± 1.8, white blood cell count 12 ± 4.2, neutrophil count 8.7 ± 4.1, lymphocyte count 2.4 ± 1.1 in the routine hemogram results taken at the emergency department at the time of admission. , platelet count was 275000 ± 95000.

Ejection fraction was calculated as 34.5 ± 8.2% in the echocardiography of the patients. The arrival glomerular filtration rate was calculated as 72 ml/min ± 13.5. The mean SYNTAX score was calculated as 20.2 ± 5.8 as a result of the coronary angiography performed for diagnostic purposes in the catheter laboratory of the patients (Figure 1).

The residual Syntax value calculated after coronary angiography and primary percutaneous coronary intervention was 4.7 ± 6.2 (Figure 2).

The mean TIMI flow score of the patients after the procedure was 2.8 ± 0.6. The procedure of patients with TIMI 3 flow was considered successful. Transaction success was recorded as 93%. The mean

clinical SYNTAX score of the patients was calculated as 45.4 ± 36 (Figure 3).

Our patients were followed up in the coronary intensive care unit until they stabilized after coronary angiography. Our patients were discharged in an average of 4 days. Our patients were followed up with optimal medical treatment for 3 months after AMI. At the end of 3 months, ICD implantation was performed in our clinic to patients who were in compliance with

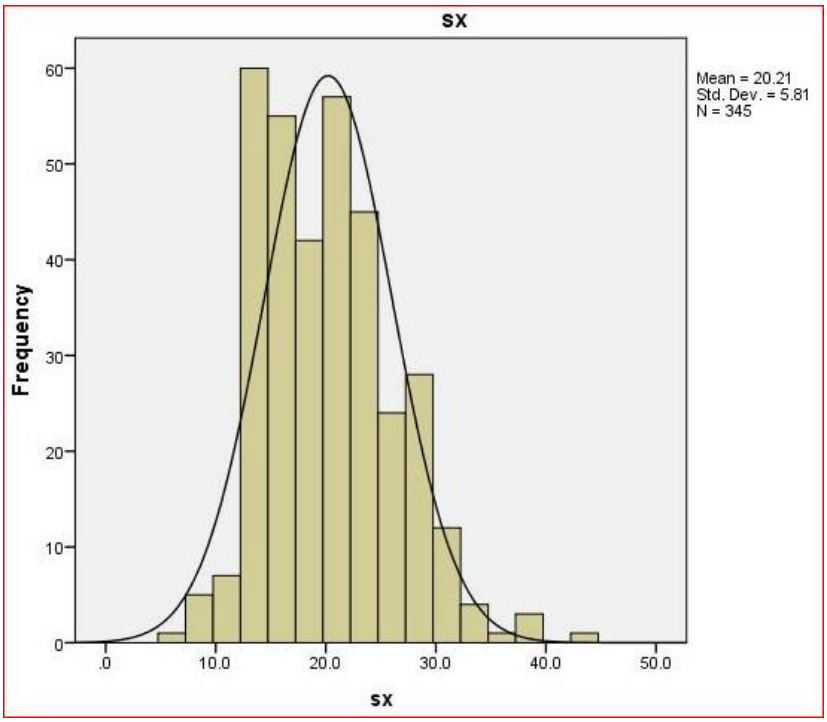

Figure 1: Mean SYNTAX score (SX) as a result of diagnostic coronary angiography.

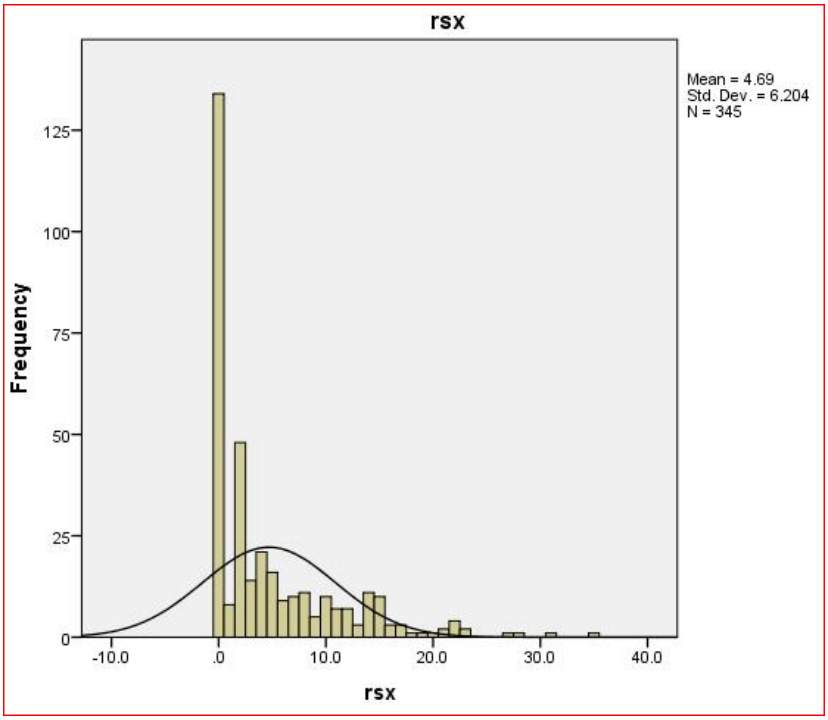

Figure 2: The residual SYNTAX value (rsx) calculated after coronary angiography and primary percutaneous coronary intervention.

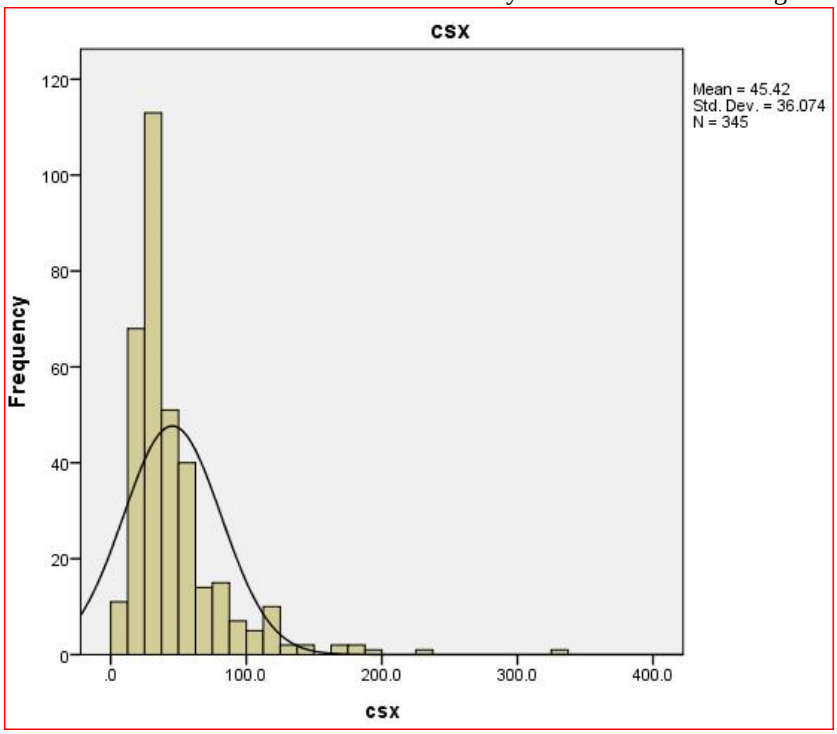

Figure 3: Clinical SYNTAX score (csx) of the patients.

current guidelines. ICD was implanted in 52 (15.1%) of 345 AMI patients.

When we divided our patient group into 2 groups as ICD+ and ICD-, we examined the baseline characteristics. According to the observation, in ICD implanted ones mean age (p =0.032), glomerular filtration rate (p = 0.001), diabetes mellitus (DM) (p = 0.044), hypertension (HT) (p = 0.001), and hyperlipidemia (HPL) (p = 0.001) prevalence and smoking rate (p: 0.001) were found to be significantly higher (Table 2).

The syntax score of the patients who underwent ICD implantation was 27.6 ± 3.8, and those of the patients who did not have ICD implantation was determined as 18.8 ± 5.0, indicating a significant difference between them (p = 0.001).

The clinical syntax score was measured as 86.7 ± 41.4 in patients with ICD implanted, and 38.079 ± 29.5626 in patients without ICD implantation (p = 0.001). The mean residual syntax score was 11.135 ± 4.4238 in patients with ICD implanted, and 3.549 ± 5.7636 in patients without ICD

implantation (p = 0.001).

Three different logistic regression models were created for the parameters that were significant in the univariate analysis (age, DM, HT, HPL, smoking, GFR, TIMI flow score, procedural success, no reflow history, SYNTAX score, clinical SYNTAX score and residual SYNTAX score).

In model 1, SYNTAX score (HR: 1.3; 95%: 1.2-1.4, p < 0.001) and ejection fraction (HR: 0.881; 95%: 0.83-0.93; p < 0.001) was calculated to be significant in predicting ICD implantation. In model 2, residual SYNTAX score (HR: 1.15; 95%: 1.08-1.22 p: <0.001) and ejection fraction (HR: 0.868; 95%: 0.82-0.91; p<0.001) was calculated to be significant in predicting ICD implantation. In Model 3, clinical SYNTAX score (HR: 1.02; 95%: 1.01-1.04, p <0.001) and ejection fraction (HR: 0.91; 95%: 0.86-0.97, p < 0.006) was calculated to be significant in predicting

ICD implantation. All Syntax scores had a significant correlation with patients' ejection fraction (p<0.001).

Table 2: ICD + and ICD – baseline characteristics of patients.

	ICD + (n:52)	ICD – (n:293)	p value
Age (years)	64.06±1	60.3±13.4	**0.032**
Gender male %)	%76.9	%73.7	0.627
Diabetes Mellitus (n; %)	%61.1	%53.8	**0.044**
Hypertension (n; %)	%67.2	%55.8	**0.001**
Hyperlipidemia (n; %)	%89.8	%30.8	**0.001**
Cigarettes (n; %)	%67.3	%58.0	**0.001**
Hemoglobin (g/dl)	13.7 g/dl	13.8 g/dl	0.436
Glomerular filtration rate (ml/min)	73.6 ± 12.6	61.8 ± 13.4	**0.001**

In the ROC analysis, the syntax score for ICD implantation was determined as 23 predictive values. The sensitivity value of this value in predicting ICD implantation was 90.4% and the specificity value was 84.6% (Figure 4).

The clinical syntax score for ICD implantation was determined as 45.5 in the ROC analysis. The sensitivity of this value in predicting ICD implantation was 88.0%, and the specificity value was 75.0% (Figure 5).

In the ROC analysis, the residual syntax score for ICD implantation was determined as 7.5. The sensitivity value of this value in predicting ICD implantation was 82.0% and the specificity value was 85.0% (Figure 6).

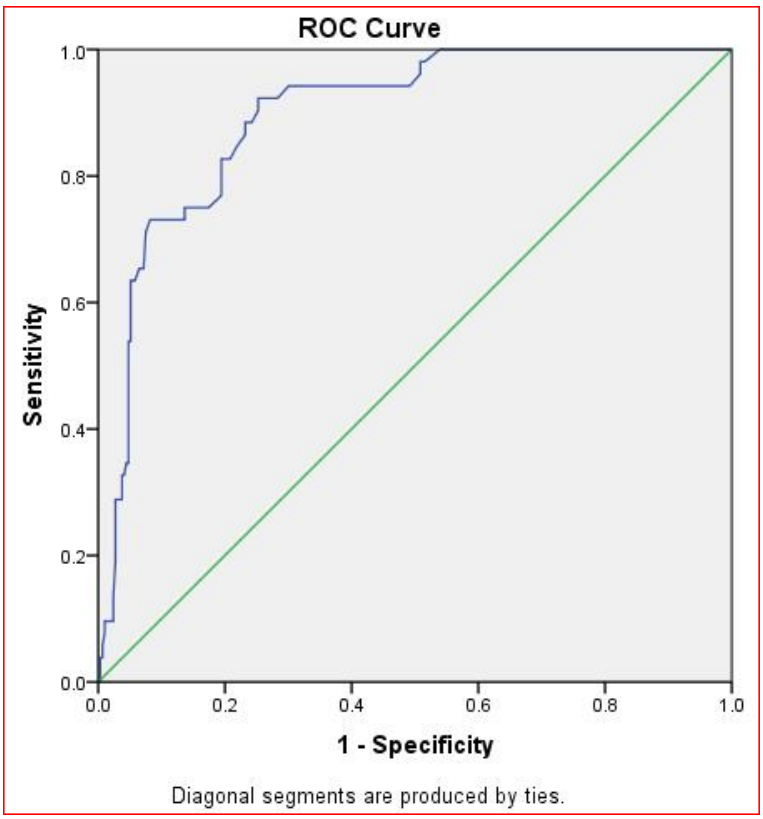

Figure 4: SYNTAX score cut-off value for ICD implantation in ROC Curve analysis and the sensitivity (90.4%). specificity value (84.6%) for this value.

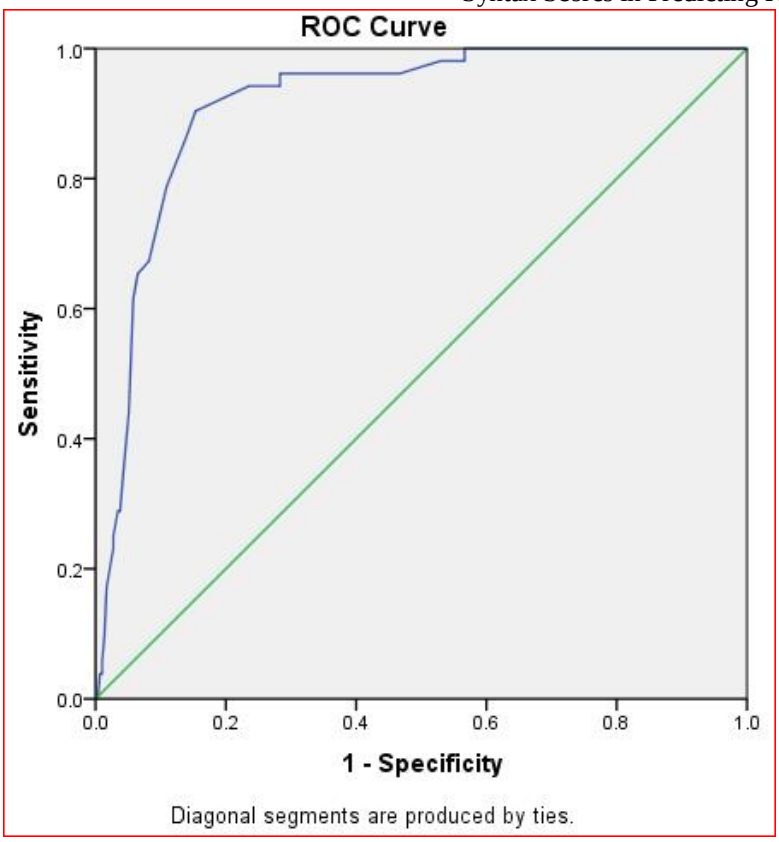

Figure 5: Clinical SYNTAX score cut-off value for ICD implantation in ROC Curve analysis and the sensitivity (88.0%). specificity value (75.0%) for this value.

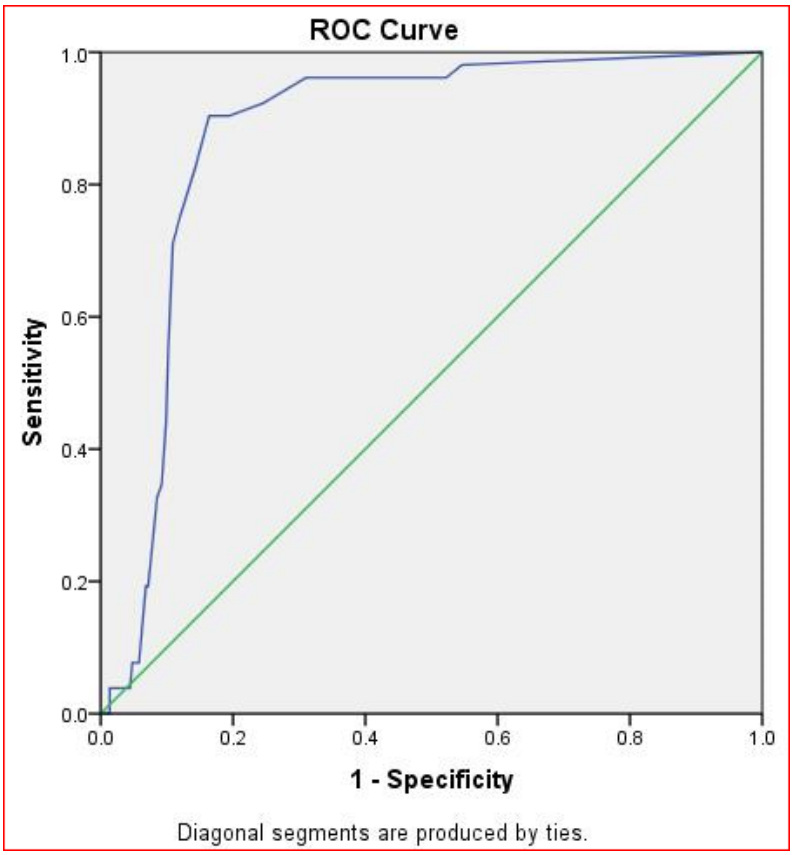

Figure 6: Cutoff value of residual SYNTAX score for ICD implantation in ROC Curve analysis and sensitivity (82.0%). specificity value (85.0%) for this value.

Discussion

Our study shows that the basal EF value and all three SYNTAX (SYNAX, clinical SYNTAX, and residual SYNTAX) scores of patients admitted with acute anterior myocardial infarction and admitted to the primary catheterization laboratory have an important role in predicting ICD implantation in the follow-up of these patients. Patients with an advent SYNTAX score of 23 and above predicted ICD implantation with 90.4% sensitivity and 84.6% specificity. Patients with an onset clinical SYNTAX score of 45.5 and above predicted ICD implantation with 88.0% sensitivity and 75.0% specificity. Patients with a residual SYNTAX score of 7.5 and above predicted ICD implantation with 82.0% sensitivity and 85.0% specificity.

Today, death is most frequently due to heart diseases. Acute coronary syndromes constitute an important part of coronary artery disease. The ideal treatment of STEAMI is possible with early provision of effective hospital care. In many studies, it has been shown that the patency to be provided in the artery related to the infarction (pharmacological or mechanical way) in acute myocardial infarction has a positive effect on life expectancy (10). In recent years, significant reductions in hospital mortality in AMI have been achieved with reperfusion treatments. One of the most important elements of reperfusion therapy is primary PTCA. Randomized studies comparing timely primary PCI with in-hospital fibrinolysis in high-volume, experienced centers have repeatedly shown that primary PCI is superior to in-hospital fibrinolysis (11). In our clinic, we have been applying primary PTCA as the first choice to patients who have been admitted to the emergency department with AMI for about 4 years.

Left ventricular dysfunction is the single strongest predictor of mortality after STEMI. Ischemic heart failure is the cause of 60-75% of heart failure in developed countries (12). It is the most common cause of heart failure in our clinic. About one-third of those with heart disease die in the form of Sudden Cardiac Death (SCD).

Mortality due to heart failure and malignant ventricular arrhythmias due to heart failure has begun to decrease with the inclusion of ICD implantation in current guidelines and its application to patients for primary and secondary prevention (13). Indications for ICD implantation in current guidelines after AMI; Patients with NYHA class 2-3 heart failure with an EF of less than 35% with a history of MI, at least 40 days past, and NYHA class 2-3 heart failure patients with a history of MI at least 40 days past, with an EF of less than 30% 1 patients with heart failure are patients with a history of MI, EF less than 40%, with discontinuous VTs, and VT or VF induced in an electrophysiological study (14). In our study, we followed the patients who were taken to the primary and given optimal medical treatment in the light of current guidelines for 3 months, and then evaluated by 2 independent cardiologists and put an ICD indication. As a result, ICD was implanted in 52 of 345 patients admitted to our clinic with acute STEAMI after 3 months of follow-up. And no complications developed during implantation.

The SYNTAX score was developed to help us choose a revascularization strategy in patients with coronary artery disease with multivessel stenosis. It is a scoring method that helps us to have information about coronary anatomy and complexity. Syntax score has been shown to be an independent predictor of major adverse cardiac events

(MACE) in patients treated with PCI but not CABG (15, 16). Current guidelines also recommend the use of this scoring method. The 2014 ESC myocardial revascularization guideline also referred to the long-term results of the Syntax score and changed its recommendations (17). The SYNTAX score and the clinical SYNTAX score make it easier to predict the undesirable clinical outcomes of PCI. A clinical SYNTAX score can be obtained by adding age, EF, and creatinine clearance to reinforce the SYNTAX score and major adverse cardiovascular and cerebrovascular events (MACCE) and mortality risk estimation.

In our literature review, there is no information that there will be a significant relationship between SYNTAX score and ICD implantation. We also think that our study is a first in this respect. In our retrospective study, we found a correlation between all three SYNTAX scores and ejection fractions. We predicted that SYNTAX, residual SYNTAX and clinical SYNTAX scores would be high in patients with low ejection fraction. We demonstrated that a SYNTAX score of 23, a clinical SYNTAX score of 45.5, and a residual SYNTAX score of over 7.5 have high sensitivity and specificity in predicting ICD implantation at the end of 3 months of optimal medical treatment and follow-up.

Limitations of the Study

Despite the relatively high number of patients (n=345), studies with larger patients are needed on this subject. It is obvious that the EF calculated visually is subjective. However, in our clinic, the echocardiography of the patients with an indication for ICD implantation was performed by two very experienced specialist cardiologists. However, different methods (MRI, radionuclide ventriculography) could be used to measure EF more quantitatively in these patients.

Conclusion

In conclusion, we showed that baseline EF and all three Syntax scores play an important role in predicting ICD implantation in patients presenting with acute anterior myocardial infarction. We demonstrated that patients admitted to the emergency department with acute anterior myocardial infarction require close follow-up in terms of ICD implantation, especially if the scores of all three syntax (syntax, clinical syntax, and residual syntax) calculated on admission are higher than the cut-off values.

Conflict of interest

The authors declare that they have no competing interests with regards to authorship and/or publication of this paper.

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Syntax Scores in Predicting ICD in Anterior AMI
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