Early Diagnosis of Acute Myocardial Infarction by ST-Segment Deviation Score

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Abstract

Acute myocardial infarction is a major cause of death and disability. Its rapid and reliable diagnosis is a major clinical need. The electrocardiogram and the measurement of myocardial enzymes are among others two important and fast methodologies to decide further management of chest pain patients after their presentation at the emergency department. The ST-segment deviation score has been invented for the early detection of ischemia signs in a standard 12-lead electrocardiogram in patients with symptoms suggestive of acute myocardial infarction. However, little is known about the optimal cutoff-values or the time of measurement in the repolarization phase.

1. Introduction

When a patient shows up at the emergency department (ED) with chest pain symptoms, one important diagnosis which requires quick decisions for further patient work-up is acute coronary syndrome (ACS). If the patient's diagnosis is an acute myocardial infarction (AMI), further treatment should be provided as quickly as possible in order to safe as much viable myocardial muscle mass as possible preventing additional disabilities. This is known as the "time is muscle" paradigm. The patient's status whether an AMI can be ruled-in or not includes patient anamneses, 10s resting electrocardiogram (ECG), blood samples and may be echocardiography. With more and more specific biomarkers to identify acute myocardial infarction, the accuracy of detecting an AMI has changed. Today, the diagnosis is more and more based on myocardial enzymes as the decision time to rule-out or rule-in an AMI has dramatically decreased from 6 to 1h [1,2]. Nevertheless, the ECG still completes a diagnosis within the first minutes, which again would shorten time-to-needle time.

We conducted a prospective study to examine the diagnosis accuracy of the ST-segment deviation Score (STDS) in consecutive patients who presented with symptoms suggestive of AMI to the emergency department.

2. Methods

908 electronically available ECGs from consecutive patients presenting to the emergency department suggestive of AMI were collected and STDS was calculated. STDS was defined as the sum of absolute value of the ST-segment deviation in all 12 leads of the initially recorded ECG. ST-segment deviation was measured at four different time points within the ST-segment being at the J-point, 20 ms after J-point, 60 ms after J-point and 80 ms after J-point. Further the ST-Integral was defined as the mean value during repolarisation measured from the J-point to the middle point between J-point and T-maximum.

All patients underwent an initial clinical assessment that included a clinical anamnesis, a physical examination, 12-lead ECG, continuous ECG monitoring, pulse oximetry, standard blood measurements, and chest radiography. Cardiac troponin I or T, CK-MB, and myoglobin were measured at the presentation and 6 to 9 hours after presentation for as long as clinically needed (Tab. 1).

The final clinical diagnosis of either AMI, unstable Angina (UA), cardiac symptoms of origin other than CAD, non-cardiac symptoms or symptoms of unknown origin was adjudicated by two independent cardiologists by looking at all available clinical records taken from the patient before presentation to the ED, after presentation to the ED and during a 360 day follow-up period. Full details of the framework of the study can be found in [2].

The area under the curve (AUC) and its corresponding 95% confidence interval (95% CI) of the receiver operator curve (ROC) was used to quantify the STDS detection performance for detection of AMI and for detection of ST-elevation myocardial infarction (STEMI).

3. Results

Out of 908 patients only 9.4% (n=85) showed other

All relevant patient data
Anamnesis performed at emergency department
Pain description such as location, amplitude, peak etc.
Diagnostic measurements at ED such as blood pressure, cardiopulmonary examination etc.
Cardiac proteins @ 1,2,3 and 6h
10s resting and exercise ECG including morphological description and measurement parameters
Findings of coronary angiography and possible interventions
Description of performed bypass surgery
Follow-up including death, AMI, PCI, PTA
GS / Reference defined by two independent cardiologists

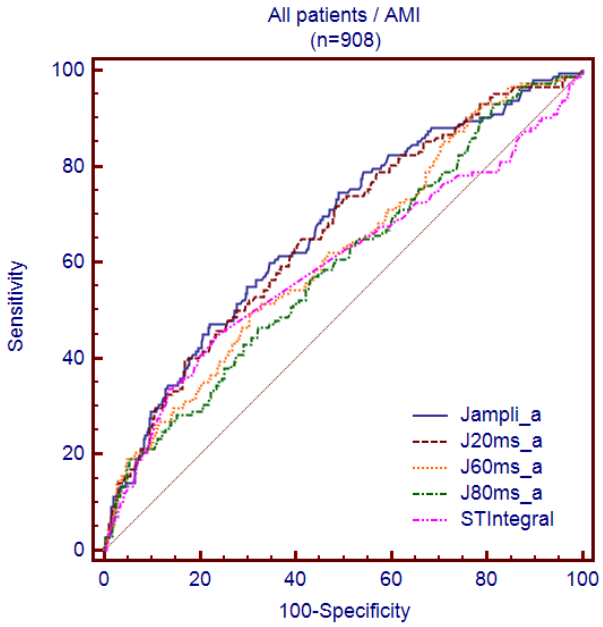
Table 1. Clinical measurement parameters/subtypes.

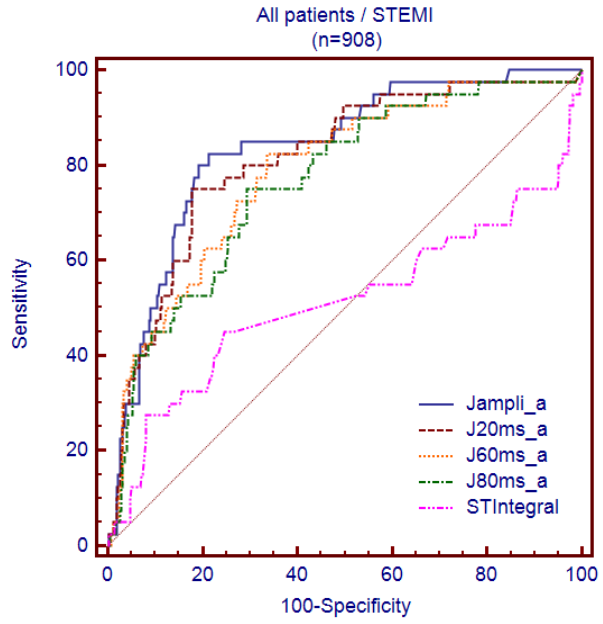
than sinusoidal rhythm, such as atrial fibrillation, atrial flutter or other types of atrial rhythm (n=75) and ventricular rhythm (n=10). 748 (82.4%) patients did not have any type of bundle branch block and four (0.4%) patients had a pacemaker ECG. 690 (67.0%) patients did not present any ST-elevation, whereof 121 presented a non-significant and 48 presented a significant ST-elevation. 751 (82.7%) patients did not present any ST-depression, whereas 15 presented ascending, 56 horizontal and 39 descending ST-depression.

Final clinical diagnosis	Number of patients (%)
AMI	142 (15.6%)
UA	151 (16.7%)
Cardiac other than CAD	123 (13.5%)
Non-cardiac	416 (45.8 %)
unknown	76 (8.4%)

Table 2. Diagnostic Performance of the STDS in AMI and STEMI patients.

AMI was adjudicated in the final diagnosis in 142 (15.6%) patients with 806 (88.8%) NSTEMI and 102 (11.2%) STEMI cases. The diagnostic accuracy of the STDS-measurements obtained at the presentation was best at the J-point for the detection of AMI as well as STEMI (0.667, 95% CI: 0.636-0.698 resp. 0.833, 95% CI: 0.807-0.857) and significantly higher when compared to measurements during later ST-segment phases ($p<0.05$, Fig. 1, Tab. 3). E.g. a cutoff value of 1250µV in the STDS at the J-point resulted in a positive likelihood of 3.08 (95% CI 1.8-5.2) for the diagnosis of AMI. A cutoff value of 620µV resulted in a positive likelihood ratio of 3.87 (95% CI 3.2-4.7). At this detection point, the sensitivity was 83% with a specificity of 79%.





4. Conclusions

The STDS in acute chest pain patients for the early

diagnosis of AMI is determined best at the J-point and, in conjunction with clinical examination and biomarker findings, might be of particular help to select those patients without a diagnostic ECG but at higher risk of having an AMI.

Determination of the STDS at:	AMI patients AUC (95% CI)	STEMI patients AUC (95 % CI)
J-Point	0.667 (0.636-0.698)	0.833 (0.807-0.857)
J-Point + 20ms	0.659 (0.627-0.690)	0.812 (0.785-0.837)
J-Point + 60ms	0.617 (0.584-0.648)	0.785 (0.757-0.811)
J-Point + 80ms	0.593 (0.561-0.626)	0.765 (0.736-0.792)
ST segment Integral	0.593 (0.561-0.626)	0.512 (0.479-0.545)

Table 3. Diagnostic Performance of the STDS in AMI and STEMI patients.

References

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