The SYNTAX Score and Distal Embolization during Primary Percutaneous Coronary Intervention

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Introduction: Multivessel disease, as well as complex coronary anatomy - characterized by high values of the SYNTAX score - has a major impact on reperfusion and patients' prognostic after an acute myocardial infarction with ST segment elevation (STEMI). Distal embolization, one of the main procedural complications of primary percutaneous coronary intervention (pPCI) could explain this association. However, the relationship between the SYNTAX score and distal embolization has not been studied till now.
Material and methods: A prospective clinical study was performed including all of the cases admitted with STEMI between january 1, 2011 and December 31, 2011. The SYNTAX scores were calculated and distal embolization was appreciated using the recordings of emergency coronary angiographies and pPCI procedures. Statistical analysis was performed, if the SYNTAX score values were higher or not in the cases with distal embolization.
Results: One hundred and thirty-seven patients were enrolled in the study. Distal embolization was present in 45 cases (32.8%); the calculated SYNTAX score values (range: 3 to 42) were significantly higher in these patients (p=0.0035).
Conclusion: Complex coronary anatomy, defined by higher SYNTAX score values, seems to be a contributing factor to distal embolization, determining a negative influence on myocardial reperfusion and subsequently on the prognosis of STEMI.

Keywords: SYNTAX score, distal embolization, STEMI, primary PCI

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Introduction

The widespread use of primary percutaneous coronary intervention (pPCI) dramatically improved the clinical outcomes after an acute myocardial infarction with ST segment elevation (STEMI), becoming the preferred treatment of this condition [1]. However, the invasive mechanical reperfusion strategies have their own complications; one of the most important of them is periprocedural embolization of thrombotic-atherosclerotic debris in the coronary territories situated distally to the culprit lesion. Distal embolization is associated with poor myocardial reperfusion and its consequences such as larger enzymatic infarct size, lower left ventricular ejection fraction and increased long term mortality [2,3].

The negative impact of multivessel disease on myocardial reperfusion and on clinical outcomes of pPCI is well documented [4,5,6]. One of the possible explications would be the greater incidence of distal embolization in patients with more complex disease. At the time of emergency coronary angiography, a precise description of the coronary anatomy is obtained. The SYNTAX score, originally developed to appreciate the complexity of coronary artery disease in patients with chronic three-vessel and/or left main stem disease [7,8], was recently shown to correlate well with myocardial reperfusion [9], as well as prognosis and major adverse cardiovascular events after STEMI [10,11]. A possible association of distal embolization and the SYNTAX score has not been evaluated till now.

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Material and method

As a part of a prospective clinical study, we analyzed the emergency coronary angiography and pPCI recordings of all cases admitted with STEMI in the Center of Cardiovascular Diseases, Târgu Mureş between 2011 January 01 and 2011 December 31. Subjects who met the following inclusion criteria were eligible: acute ischemic chest pain lasting at least 30 minutes, associated with ≥1 mm ST segment elevation in ≥2 contiguous electrocardiographic leads, primary PCI as reperfusion therapy performed in the first 24 hours after symptom onset. During primary PCI standard interventional techniques (including manual thrombus aspiration, direct stent deployment, balloon pre- and/or postdilatation – as considered by the operator) and contemporary medication (aspirin, clopidogrel, unfractionated heparin and occasionally glycoprotein IIb/IIIa blocking agents) were used. Distal embolization was defined as an angiographically visible filling defect with a blunt "cut-off" at the level of a coronary branch situated distally to the lesion responsible for the acute event (Figure 1).

Multivessel disease was defined as ≥50% stenosis of at least one branch with diameter ≥1.5mm of minimum two different coronary arteries (left anterior descending, left circumflex or right coronary artery). Isolated left main stem disease was also considered multivessel involvement.

The SYNTAX score was calculated for each patient on the basis of the diagnostic coronary angiography, (i.e. before performing the intervention) using the Version 2.11 of the SYNTAX Score calculator (available online at www.syntaxscore.com). In summary, all coronary lesions with a diameter stenosis of ≥50% in any vessel with a diameter ≥1.5mm receive a separate score. A multiplication factor of

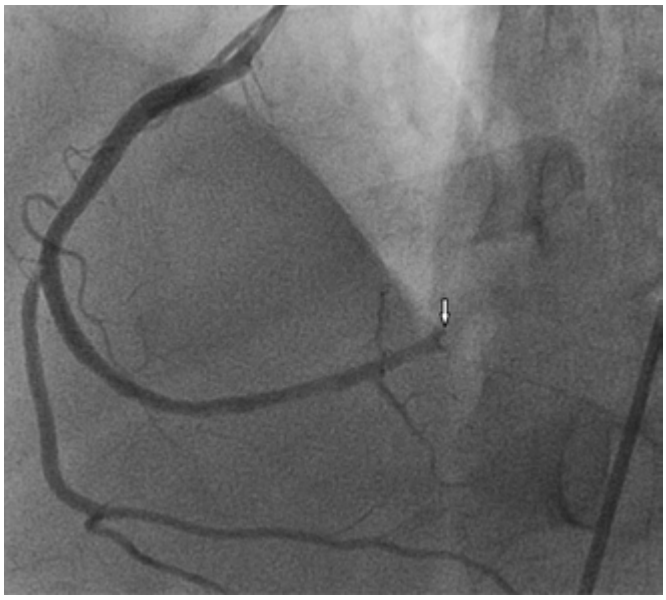

Fig. 1. Distal embolization visible in the main postero-lateral branch after implantation of a stent in the second segment of the right coronary artery (arrow).

2 is used for stenoses 50–99% and 5 for total occlusions. All other adverse lesion characteristics considered in the SXS have an additive value (localization within the coronary artery tree, presence of a trifurcation or bifurcation, vessel angulation, aorto-ostial lesions, severe tortuosity, long, calcified and thrombotic lesions and "diffuse" disease) [8].

Statistical analysis

After data collection, statistical analysis was performed using the Version 3.1 of the GraphPad InStat software. Gaussian distribution of the obtained data was evaluated using the Kolmogorov-Smirnov test. We compared the medians of the SYNTAX scores calculated for the patients with and without distal embolization using the Mann-Whitney U-test. The association between multivessel disease and distal embolization was evaluated with Fisher's exact test. A probability value of <0.05 was considered significant; all tests were two-tailed.

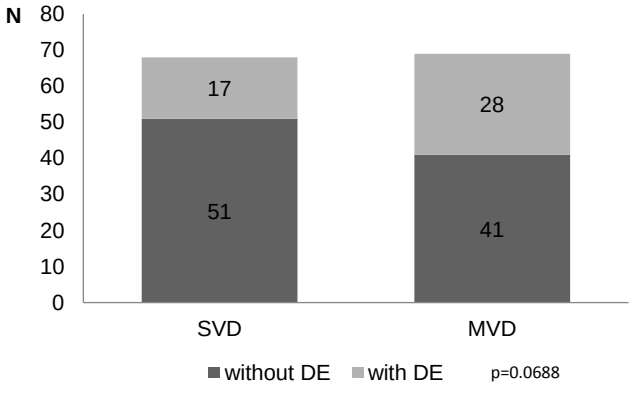

Fig. 2. Distal embolization and multivessel disease. The difference between the patient groups does not reach statistical significance. DE – distal embolization; MVD – multivessel disease; SVD – single vessel disease.

Table I. Clinical, electrocardiographic and angiographic characteristics of the enrolled patients. Values are N (%), unless otherwise stated.

Age (years±SD)	61.6±11.5
Male (%)	88 (64.2)
Hypertension (%)	92 (67.1)
Diabetes mellitus (%)	29 (21.1)
Current smoking (%)	63 (45.9)
Obesity defined as BMI≥30 (%)	34 (24.8)
Dyslipidemia	67 (48.9)
Ischemic time (hours, median)	5.0
Killip class >1 at admission	25 (18.2)
Cardiac arrest at admission	17 (12.4)
Anterior localization of STEMI	55 (40.1)
Multivessel disease	69 (50.3)
Distal embolization	45 (32.8)
Pre-PCI SYNTAX score (median)	16.0

BMI – body mass index; PCI – percutaneouscoronary intervention SD – standard deviation; STEMI – ST segment elevation myocardial infarction

Ethical considerations

The study was approved by the Ethics Committee of the Targu Mures Emergency County Hospital, Romania and was performed in the accordance with standards of the Declaration of Helsinki. All study participants consented to use their clinical data for hospital research, and patients with a certain diagnosis of STEMI upon hospital admission were provided additional details about this particular study. Written informed consent was obtained from each patient or legal representatives. No procedures beyond the standard of care were performed specifically for the purposes of this study.

Results

One hundred and thirty-seven patients fulfilled the inclusion criteria during the enrolling period. Baseline demographic, clinical and paraclinical characteristics of the subjects are shown in table 1.

Angiographically visible distal embolization was present in 32.8% of patients. Multivessel disease, found to be present in 50.3% of cases, was not significantly associated with distal embolization, however, there was a trend observed to this direction (p=0.0688; Figure 2).

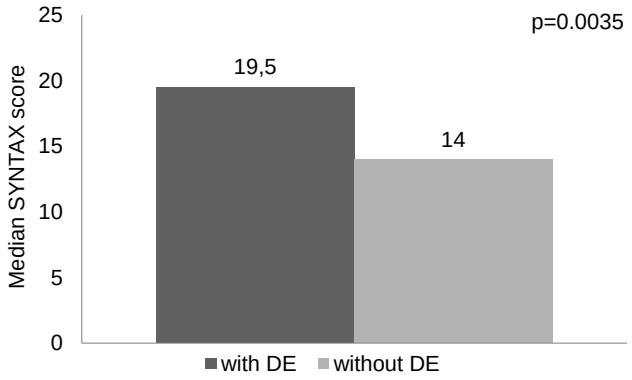

Fig. 3. Distal embolization is associated with higher SYNTAX score values in patients with ST-segment elevation acute myocardial infarction. DE – distal embolization.

The calculated SYNTAX scores ranged between 3 to 42, with a non-Gaussian distribution (median=16). In the group with distal embolization the median SYNTAX score was significantly higher than in patients without this complication (19.5 vs 14, p=0.0035; Figure 3).

Discussions

The exact mechanisms responsible for the negative influence of multivessel disease on myocardial reperfusion are less known. Some of the possible explications are more extensive atherosclerosis, represented for example by the presence of chronic total occlusion(s) [5], more accentuated systemic inflammation [12], as well as distal embolization with subsequent capillary sludge formation [4]. This last condition can be identified with an incidence of 6.3% to 30.5% during pPCI and is clearly associated with major adverse cardiovascular events and higher long term mortality [2,3,13]. The relationship between multivessel coronary disease and the phenomenon of distal embolization is not clear; Hirsch et al. described only a trend toward this direction [2], a finding also confirmed in the present study. To the best of our knowledge, no significant association was demonstrated between the two entities till now. However, the term "multivessel" could be misleading: in different studies there are multiple definitions, and does not mean necessarily a complex anatomy. Two focal stenoses on different coronary branches, as well as multiple chronic occlusions and left main stem disease are also considered multivascular involvement, but the clinical significance of these angiographically described conditions is much different [14].

Originally, the SYNTAX score was designed to grade the complexity of stable coronary artery disease. Higher values of this score, reflecting a more challenging coronary anatomy for the interventional cardiologist, also predict a worse prognosis after STEMI [10,11]. This may be partially caused by a reduced myocardial reperfusion, as expressed by poor resolution of the ST segment elevation after pPCI in patients with higher SYNTAX scores [9].

Our study suggests an association between the complexity of coronary anatomy and the occurrence of postprocedural distal embolization, and this could at least partially explain the observed prognostic significance of the SYNTAX score in the setting of acute myocardial infarction.

Conclusions

Complex coronary anatomy, defined by higher SYNTAX score values, seems to be a contributing factor to distal embolization, determining a negative influence on myocardial reperfusion and subsequently on the prognosis of STEMI.

Abbreviations

BMI Body Mass Index
DE Distal Embolization
MVD Multivessel Disease
PCI Percutaneous Coronary Intervention
pPCI primary Percutaneous Coronary Intervention
SD Standard Deviation
STEMI Acute Myocardial Infarction with ST Segment Elevation
SVD Single Vessel Disease
SXS Syntax Score

Competing interests

The authors have no competing interests to declare.

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