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ORIGINAL RESEARCH

The Value of Angio CT Multislice for Pre-operative Assessment and Prediction of Post PCI Successful Intervention in Acute Coronary Syndromes Associated by Left Main Disease

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ABSTRACT

Introduction: The location of culprit lesions on the left main is associated with an increased procedural risk in acute coronary syndromes. Our study aims to evaluate the utility of CT angiography determined Syntax score (CCTA) in comparison with the classical angiographic Syntax score for predicting the procedural success in percutaneous coronary interventions (PCI) of left main lesions.

Methods: We included 23 patients presenting to the Cardiology Clinic with an acute coronary syndrome. All patients underwent coronary angiography ± angio CT multisclice for assessment of the target lesion, defined as a significant (>50%) left main disease. Patient population consisted in: group 1 – 13 patients (56.52%), in whom revascularization indication was based on lesion severity assessment by CCTA score correlated with the angio Syntax score (SS), and group 2 – 10 patients (43.48%), in whom revascularization indication was based only on angio SS. According to the SS, the study population was divided into subgroup A – low SS (<22), subgroup B – intermediate SS (23–32) and subgroup C –high SS (>32). All patients were followed for 1 year.

Results: Despite similar SS in both groups (35.38 in group 1 vs. 32.4 in group 2), the use of Angio CT multislice increased the rate of PCI indication – 76.92% PCI in group 1 versus 50% PCI in group 2. In patients with high SS, PCI rate was 66.66% in group 1 compared with 50% in group 2 ($p<0.05$). High calcium score >100 was recorded in 50% of patients in the low SS subgroup (<22), 50% in the medium SS subgroup (23–32) and 22.22% in the high SS (>33) subgroup. One-year follow-up showed an overall mortality of 8.69%, slightly higher in group 2 (10%), as compared to group 1 (mortality of 7.69%).

Conclusions: Additional evaluation by angio CT of culprit left main stenoses in acute coronary syndromes provides more information about the complexity of atherosclerotic plaques in this location, and could be extremely useful in establishing the indication for PCI in high risk stenoses, showing a predictive significance for post-procedural 1 year follow up mortality.

Keywords: left main, stenting, angioplasty, acute coronary syndromes

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INTRODUCTION

Survival in acute coronary syndromes (ACS) caused by atheromatous plaques located in the left main could be significantly influenced by the culprit lesion complexity. The location of the culprit lesions at this level is frequently associated with the development of malignant tachyarrhythmias and hemodynamic instability. Even more, in an ACS related to unprotected left main culprit lesion, survival is inferior to the mortality encountered in cases complicated with cardiogenic shock [1].

The use of angiographic Syntax score was introduced by the Syntax trial (The Synergy between Percutaneous Coronary Intervention with TAXUS and Cardiac Surgery) in order to angiographically assess the coronary lesions based on angiographic characteristics (the degree of tortuosity, the presence of thrombus, bifurcation lesions, the presence of calcifications, coronary system dominance, the length of the stenosis). The Syntax trial demonstrated that in patients with STEMI, this score is significantly correlated with no reflow post-procedural phenomenon and is predictive of in-hospital mortality, being significantly associated with long-term outcomes. According to the Syntax classification, the Syntax score is considered to be low when it is below 22, medium between 22 and 32, and high when it is superior to 33 [2,3].

The development of imagistic methods for assessment of the coronary vessels by Angio CT multislice is highly promising for the accurate characterization of the complex coronary lesions, Cardiac Computed Tomographic Angiography (CCTA) representing a facile method to investigate a left main lesion, especially when PCI revascularization is proposed. The introduction of Ca scoring for calcium quantification in coronary disease allowed the identification of patients at high risk for subsequent ischemic acute complications and led to the introduction of this new parameter in clinical guidelines for the diagnosis and treatment of ischemic coronary disease [4,5].

This study aims to follow the evolution of patients with ACS and left main culprit lesions assessed using two types of Syntax score: conventional coronary angiography Syntax Score and CCTA Syntax score.

MATERIAL AND METHODS

STUDY PROTOCOL

The study was a single center, prospective, non-randomized study, performed in order to evaluate the incremental value of the information provided by CCTA on top of those obtained by classical coronary angiography, in complex characterization of coronary lesions in patients with significant left main disease and acute coronary syndromes.

Twenty-three patients with LM disease and acute coronary syndromes were enrolled in the study. Group 1 (13 patients) underwent CCTA followed by coronary angiography and percutaneous revascularization, while group 2 (10 patients) underwent coronarography and PCI.

The inclusion criteria were: documented significant (>50%) stenosis of the LM coronary artery and willingness to participate in the study, age >21 years, and presence of an ACS syndrome at admision in the hospital. Patients with contraindications for the repeated administration of contrast agents were excluded from the study.

CCTA ANALYSIS

All CT acquisitions were made using multi-slice 64 Somatom Sensation CT (Siemens, Germany) with a 64 × 0.5 mm detector collimation. After the administration of a short-acting betablocker to achieve the desired heart rate, and after a stable heart rate below 60 beats/min was achieved, a iodinated contrast agent (Iopamidol, 370 mg I/ml, Bayer Healthcare, Germany) was infused, first using a speed of administration of 4.0 ml/sec followed by 20 ml at 2.0 ml/sec. All acquired images were transferred to a workstation (Siemens, Germany) for data processing, measurements and interpretation.

According to the standard method for calculation of the Syntax score, the following information provided by CCTA associated with multiplanar reconstruction were used for the calculation of the CCTA-Syntax score, based on lesion severity: degree of calcification in the left main lesion, global calcium burden expressed by calcium score, coronary stenosis severity (in the left main and in the rest of the coronary tree), length and diameter of the left main, involvement of the origin of left anterior descending artery and circumflex artery, anatomic distribution (type of dominance), extension of calcification at the origin of the main arteries.

CORONARY ANGIOGRAPHY ANALYSIS

A significant left main stenosis was defined as a >50% narrowing of the LM lumen at coronary angiography, in at least one incidence.

According to the same standard method for the calculation of the Syntax score, the following information were used for the calculation of the CCTA-Syntax score:

TABLE 1. Syntax score, 1 year mortality and PCI rate in the study population

	Group 1	Group 2	Significance
Patients	13 (56.52%)	10 (43.48%)	
Syntax score	35.38	32.4	
1 year mortality	7.69%	10%	
PCI rate in high syntax score group	66.66%	50%	p<0.05

coronary dominance, number and location of lesions, presence of a total occlusion in one coronary artery, bifurcation or aorto-ostial lesion, severe tortuosity, lesion length, presence of calcification or thrombus. All these parameters were assesed for each individual lesion, and included in a software for automatic calculation of the Syntax score.

STUDY OBJECTIVES

1. To demonstrate the correlation between CCTA-derived Syntax score and coronary angiography-Syntax score in significant culprit LM lesions responsable for acute coronary syndrome in the subsets of patients with low, medium and high risk lesions.
2. To demonstrate the relationship between Syntax score determined by CCTA and Coronary Angiography and prediction for short and long term mortality.

We enrolled 23 patients (69.56% males and 30.43% females, average age 64 years) with significant (>50%) LM disease, admitted in the emergency department of the Cardiology Clinic from the County Emergency Clinical Hospital of Tîrgu Mureș with acute coronary syndroms (STEMI/NSTEMI myocardial infarction, unstable angina).

Patients were divided into 2 groups: group 1 — 13 patients (56.52%), in whom indication for treatment was based on CCTA syntax score correlated with Syntax score (angio CT + coronarography data), and group 2 — 10 patients (43.48%), in whom indication relied only on angio Syntax score.

In all patients we performed a careful clinical and paraclinical examination, including history, clinical status, lab tests, ECG, coronarography, and all patients were followed for 1 year.

RESULTS

According to the Syntax score, the study population was divided into subgroup A — low Syntax score (<22), subgroup B — intermediate Syntax score (23–32) and subgroup C — high Syntax score (>32).

Despite similar Syntax scores in both groups (35.38 in group 1 versus 32.4 in group 2), the use of Angio CT multislice increased the rate of PCI indication — 76.92% PCI in group 1 vs. 50% PCI in group 2 (Table 1).

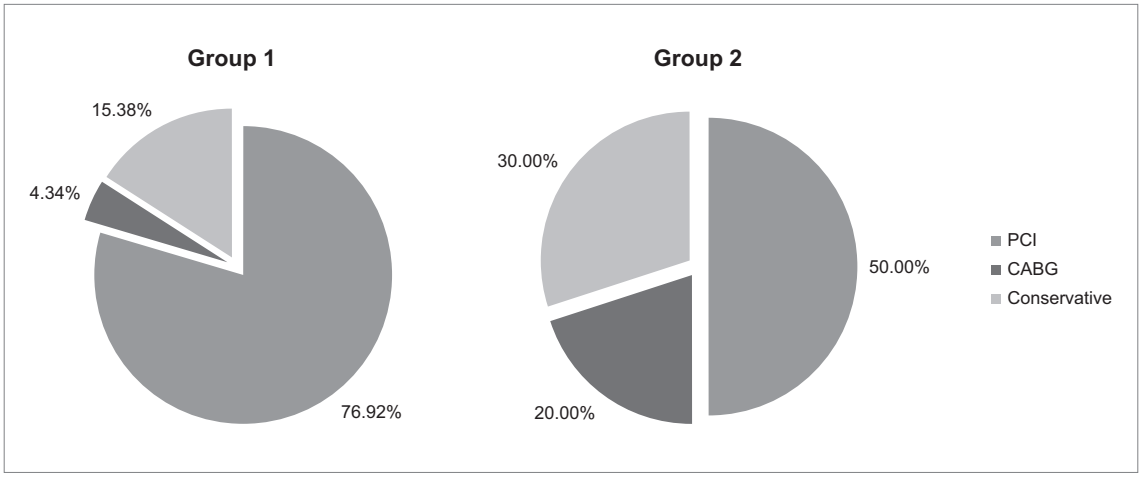

FIGURE 1. Treatment type in the study population

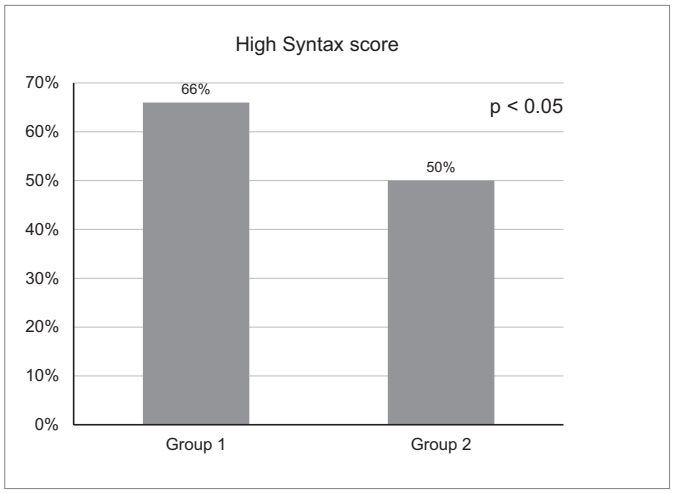

FIGURE 2. Distribution of high Syntax score

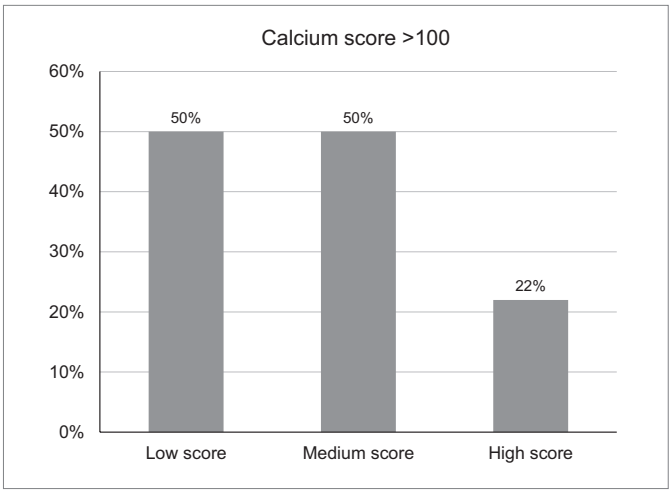

FIGURE 3. Association between calcium scoring and Syntax score

Coronary bypass was performed in 1 case (4.34%) in group 1 and in 20% of cases in group 2, while conservative treatment was indicated in 15.38% of cases in group 1 compared with 30% in group 2 (Figure 1).

PCI was performed in 10 cases from group 1 and 5 from group 2 with good results, without procedural complications or periprocedural deaths.

Indication for PCI or bypass in group 1 was not correlated with calcium score.

A high calcium score >100 was recorded in a percentage of 50% patients in the low Syntax score subgroup (<22), 50% in the medium Syntax score subgroup (23–32) and 22.22% in the high Syntax score (>33) subgroup (Figure 2).

Analysis of data regarding the type of therapy in high Syntax score subgroups showed a C-subgroup PCI rate of 66.66% in group 1 compared with 50% in group 2 ($p<0.05$), as presented in Figure 3.

One-year follow-up showed a total 8.69% mortality in the study group. Mortality was higher in group 2 (10%), where the indication was based only on syntax score, compared with a mortality of 7.69% in group 1, where the indication was based on Angio CT multislice + coronarography, as presented in Table 1.

DISCUSSIONS

Addressability to PCI or CABG of the left main lesions and acute coronary syndromes depends significantly on anatomic features, hemodynamic status and association with other diseases (cardiac patology or other non-cardiac comorbidities).

In patients with LMCA culprit lesion, the optimal revascularization strategy is not clear in many cases [6,7,8,9].

Comparative studies including the Syntax trial showed that interventional approach of the left main lesions has a high rate of revascularization, while the surgical approach carries a high risk of stroke [10]. PCI as the choice of revascularization is followed by a rapid restoration of flow in the related infarct artery in STEMI patients, and obtaining a TIMI III flow is correlated with a favorable prognosis, and a reduction of up to 5 times in mortality in a 1 year follow-up [11,12]. Moreover, studies demonstrated that the Syntax score was correlated with no-reflow in the infarct-related artery in STEMI [10,13]. However, mortality in acute coronary syndromes caused by stenoses involving the left main as the culprit lesion is four times higher than the selective, interventional left main PCI [14,15].

Studies regading the left main culprit lesions showed some prognostic factors for left main PCI in acute coronary syndromes:

- Association of the cardiogenic shock (except isolated cases of left main disease, which has relatively more favorable prognosis compared to the association with multivascular coronary disease [16];
- ST elevation myocardial infarction [17]
  - initial TIMI 1/0 flow;
  - reduced left ventricular ejection fraction;
  - older age;
  - multivessel disease and high Syntax score;
  - diabetes mellitus.

Recent studies showed that some lesions on the left main are favorable for interventional approach: isolated left main and/or shaft lesion accompanying culprit lesion, higher operative risk assessed by euro SCORE, favorable anatomy providing complete revascularization [11].

The use of new techniques of left main angioplasty (T stenting, high inflation pressure, IVUS, kissing technique, various DES types) demonstrate that the success of the results depends on the identification of imagistic markers for complex plaques (hystological composition, calcium content, bifurcation angle, thrombus, dissection etc) [18].

In this study we demonstrated that the use of CCTA Syntax score may stratify better the patients with significant LM stenosis according to their risk, than does the stratification based only on angiography-derived Syntax score. We found a good correlation between the angiography derived and CCTA-derived Syntax scores, especially in cases with high Syntax scores. As in the rest of the cases angiography seems to underestimate the severity of the lesions, we can conclude that the incremental role of CCTA to coronary angiography is more obvious especially in high risk lesions. These are usually heavily calcified lesions, with high atheromatous burden, coronary calcification and plaque burden being exactly the parameters easily assessed by the CCTA [19].

This superior value of CCTA relies mainly in providing incremental information to coronary angiography with regard to lesion characterization and complex 3D visualization of coronary plaques in the same time with plaque quantification and determination of calcium content within the coronary arteries [19,20].

Dual evaluation by CCTA derived score and Angio Syntax score showed that although the values of these parameters were not statistically different, the use of CT angiography examination allows the increase of PCI rate compared with classical indication, proving that CT angiography is very important, especially in patients with a high Syntax score.

Correlating a high calcium score (recognized as a marker of atherosclerosis in international guidelines) with the Syntax score, we observed that the proportion of patients with extensive calcification in the left main is significantly lower in the group of patients with very high Syntax score, which can be explained by the instability of atherosclerotic plaques in the left main due to necrotic core. The CCTA-derived Syntax score in these patients has a high value, and demonstrates a high prediction for PCI postprocedural complication.

CONCLUSIONS

Additional evaluation by CCTA of culprit left main stenoses in acute coronary syndromes provides more information about the complexity of atherosclerotic plaques in this location, and could be extremely useful in establishing the indication for PCI in high risk stenoses, showing a predictive significance for post-procedural 1 year follow-up mortality.

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