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The Syntax score predicts peri-procedural myocardial necrosis during percutaneous coronary intervention

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Abstract

Background: Peri-procedural myocardial injury (PPI) during percutaneous coronary intervention (PCI) is common and associated with a poor outcome. No reliable angiographic or clinical predictors of PPI exist. We evaluated the ability of the SYNTAX score (SXscore), Gensini score, American Heart Association/American College of Cardiology (AHA/ACC) and Society for Cardiovascular Angiography and Intervention (SCAI) classifications to predict PPI.
Methods: Consecutive patients were included from two existing databases of PCI. Patients with coronary bypass grafts or instent restenosis were excluded. PPI was defined as troponin I elevation (>1.0 μg/L) at 6–24 h post-PCI. Delayed enhancement magnetic resonance imaging distinguished PPI territory in patients undergoing multi-vessel PCI. Quantitative coronary angiography was performed blinded to PPI. In total, 100 patients underwent PCI to 122 vessels. PPI occurred in 20/100 (20.0%) patients.
Results: Mean patient SXscore was higher in patients with PPI (20.6 vs. 12.4, $p=0.0001$), however Gensini score was not significantly different (34.2 vs. 27.3, $p=0.15$). Mean vessel SXscore was higher in vessels associated with PPI (12.1 vs. 7.6, $p=0.002$), but not different for vessel Gensini score (16.2 vs. 13.6, $p=0.42$). No vessels with AHA type A or B1 lesions were associated with PPI. Higher AHA scores (B2 and C) were associated with PPI (χ^2 for trend 11.6, $p=0.0007$). SCAI scores were not predictive of PPI (χ^2 for trend 3.6, $p=0.06$). By ROC analysis, a patient SXscore of ≥17 predicted PPI with a sensitivity of 75.0% and specificity of 70.0%.
Conclusion: Higher SXscores are predictive of myocardial injury, whilst AHA type A and B1 lesions have a high negative predictive value for PPI.

Keywords: Coronary artery disease; PTCA; Coronary stenting; Myocardial infarction

1. Introduction

Peri-procedural myocardial injury (PPI) during percutaneous coronary intervention (PCI) is common, and may occur in up to 50% of otherwise successful procedures [1–3]. Even minor elevations in biochemical markers are associated with worse clinical outcomes, including death [4,5]. The occurrence, extent and spatial distribution of PPI may be evaluated using delayed enhancement magnetic resonance imaging (DE-MRI) [1,6]. Using this technique combined with intravascular ultrasound, we have demonstrated that PPI during PCI can be due to plaque shift causing side branch impairment, or plaque embolization causing distal microvascular obstruction [6]. Although the incidence of PPI is associated with worse clinical outcomes, and some

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insights into the pathophysiology of PPI now exist, there is currently no reliable method of stratifying the risk of PPI in patients undergoing PCI.

The aim of this study was to investigate the ability of four angiographic classification schemes to predict PPI in patients undergoing PCI for stable angina. The Syntax score (SXscore) has recently been proposed as a comprehensive angiographic scoring algorithm incorporating several validated angiographic classifications based on the morphology and location of coronary artery disease within the coronary tree [7,8]. The SXscore reflects the pattern of atheroma and the technical difficulty of PCI. Each coronary lesion producing a ≥50% luminal obstruction in vessels ≥1.5 mm is scored, however no assessment of plaque burden is incorporated. The Gensini score is an angiographic scoring system that reflects plaque burden based on quantitative coronary angiography (QCA) of lesion severity in each coronary segment [9]. However, the pattern of disease such as bifurcation lesions, tortuosity and calcification is not represented. The American College of Cardiology/American Heart Association (ACC/AHA) [10,11] and Society for Cardiovascular Angiography and Intervention (SCAI) [12] lesion classifications are related and represent target lesion complexity and procedural difficulty.

2. Methods

2.1. Study design and patient population

The first 50 patients were chosen consecutively from a prior study of peri-procedural myocardial injury (PPI) occurring during complex PCI. Inclusion and exclusion criteria for this study have been previously published [6]. Briefly, patients were enrolled if undergoing insertion of >30 mm of stent to a single vessel and/or bifurcation PCI involving a side branch >2.0 mm in diameter, and/or patients undergoing double-vessel PCI. Patients with previous stent insertion, coronary bypass grafts and recent unstable angina were excluded.

In order to obtain a mix of procedural complexity and breadth of angiographic scores, a further 50 consecutive patients were included from a registry of day case PCI. Inclusion criteria for day case PCI were stable angina, age <80 years, normal renal function, and no requirement for intra-aortic balloon counterpulsation or planned use of glycoprotein IIb/IIIa inhibition. Patients with heart failure and lesions >30 mm in length were excluded from day case PCI. Patients who underwent day case PCI with a history of coronary artery bypass were excluded from the present analysis. Thus in total, 100 patients with stable angina undergoing native vessel PCI were included in the present analysis. All patients received aspirin 75 mg and a loading dose of clopidogrel ≥24 h prior to PCI. The Oxfordshire Local Research Ethics Committee approved both studies.

2.2. Angiographic analysis

Each angiogram was analysed independently by two experienced interventional cardiologists (WJVG, FP) who were blinded to the procedural, MRI and troponin I results. In cases of disagreement, the decision of a third observer (LT) was obtained and the final decision was made by consensus. Each coronary lesion producing a ≥50% luminal obstruction in vessels ≥1.5 mm by quantitative coronary analysis (MEDCON TCS QCA, Medcon Telemedicine Technology Inc., Middlesex, United Kingdom) was separately scored and added for each coronary vessel to provide the vessel SXscore, and then summed to provide the overall patient SXscore as previously described [7,8] using a dedicated software (Syntax score V1.0.003, Cardialysis B.V., Rotterdam, The Netherlands). Percent luminal stenosis was also quantified for each coronary segment, and the Gensini score was calculated for each coronary vessel and summed to provide the overall patient Gensini score as previously described [9]. The modified ACC/AHA lesion classification was also measured for each treated lesion (A, B1, B2 or C), as well as the SCAI score (I, II, III or IV).

2.3. Study objective and endpoint

The objective of this study was to analyze the value of four currently available scores (SXscore, Gensini, ACC/AHA and SCAI classifications) in predicting PPI in patients undergoing PCI for stable angina. Troponin I was measured using the Immulite troponin I solid phase chemiluminescent enzyme immunometric assay (Diagnostic Product Corporation, Los Angeles, California, USA). The upper cutoff concentration for normality suggested by the manufacturer is ≥1.0 μg/L, and PPI was defined as troponin I elevation (≥1.0 μg/L) 6–24 h post-PCI. For patients who underwent multi-vessel PCI, the vascular territory sustaining new myocardial injury was defined by DE-MRI performed 24 h post-PCI.

2.4. Statistical analysis

Continuous data are expressed as mean ± standard deviation. Categorical data are expressed as frequency (percent). Differences between groups (PPI vs. no-PPI) for vessel based and overall SXscore and Gensini score were analysed using the unpaired *T* test. Differences between groups for ACC/AHA and SCAI classifications were analyzed using χ^2 with trend. A *p*-value ≤0.05 was considered significant. Optimal cutoff for SXscore in predicting PPI was quantified by receiver operator characteristic (ROC) curve analysis. All analyses were performed using StatsDirect 2.5.6 (StatsDirect Ltd., Cheshire, United Kingdom).

3. Results

3.1. Peri-procedural myocardial injury

In total, 100 patients undergoing PCI to 122 vessels were included in the analysis. Patient characteristics and procedural details are detailed in Table 1. There were 20/100