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Original Research Article

Correlation of concentrations of high-sensitivity troponin T and high-sensitivity C-reactive protein with plaque progression as measured by CT coronary angiography

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ABSTRACT

Background: Elevated levels of inflammatory biomarkers are associated with increased cardiovascular morbidity and mortality.

Objective: We sought to determine whether elevated concentrations of high-sensitivity troponin T (hs-TnT) and high-sensitivity C-reactive protein (hs-CRP) predict progression of coronary artery disease (CAD) as determined by coronary CT angiography (coronary CTA).

Methods: Patients presenting to the emergency department with acute chest pain who initially showed no evidence of an acute coronary syndrome underwent baseline and follow-up coronary CTA (median follow-up, 23.9 months) using identical acquisition and reconstruction parameters. Coronary CTA data of each major coronary artery were co-registered. Cross-sections were assessed for the presence of calcified and noncalcified plaques. Progression of atherosclerotic plaque and change of plaque composition from

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noncalcified to calcified plaque was evaluated and correlated to levels of hs-TnT and hs-CRP at the time of the baseline CT.

Results: Fifty-four patients (mean age, 54.1 years; 59% male) were included, and 6775 cross-sections were compared. CAD was detected in 12.2 ± 21.2 cross-sections per patient at baseline. Prevalence of calcified plaque increased by 1.5 ± 2.4 slices per patient ($P < .0001$) over the follow-up period. On average, 1.6 ± 3.6 slices with new noncalcified plaque were found per patient ($P < .0001$) and 0.7 ± 1.7 slices with pre-existing noncalcified plaque had progressed to calcified plaque ($P < .0001$). After multivariate adjustment, change of overall CAD burden was predicted by baseline hs-TnT and hs-CRP ($r = 0.29$; $P = .039$ and $r = 0.40$; $P = .004$). Change of plaque composition was associated with baseline hs-TnT ($r = 0.29$; $P = .03$).

Conclusion: Concentrations of hs-TnT and hs-CRP are weakly associated with a significant increase in CAD burden and change in plaque composition over 24 months independent of baseline risk factors.

1. Introduction

Major adverse cardiovascular events are often the initial manifestation of coronary artery disease (CAD).[1] In recent years, several studies have demonstrated a link between circulating biomarkers of myocardial injury and inflammation and major adverse cardiovascular events.[2,3] With the advent of coronary CT angiography (CCTA), it has been established that circulating biomarkers such as high-sensitivity troponin T (hs-TnT) and high-sensitivity C-reactive protein (hs-CRP) are associated with both the extent and composition of coronary atherosclerotic plaques as determined by CT.[4] Moreover, it has been suggested that the release of such biomarkers is associated with a clinically silent rupture of atherosclerotic plaques.[4,5] On the other hand, plaque rupture is believed to be the one factor determining the progression of coronary atherosclerosis.[6] Thus, the purpose of this study was to assess whether circulating biomarkers, hs-TnT and hs-CRP, predict the progression of CAD as determined by CCTA in patients presenting with acute chest pain and whether this association is independent of baseline CAD and traditional risk factors.

2. Material and methods

The patient population of this study is a subset of patients prospectively enrolled into the Rule Out Myocardial Infarction using Computer Assisted Tomography (ROMICAT) I trial. The ROMICAT I trial is a prospective observational cohort study of patients presenting to the emergency department with chest pain but with normal conventional troponin and without ischemic changes on the initial electrocardiography who underwent CCTA before hospital admission. Detailed design and inclusion and exclusion criteria have been published elsewhere.[7] The present study included consecutive patients who agreed to participate in a 2-year follow-up CCTA study during their index visit. Patients were contacted by phone, and the return visit included a clinical interview. Subjects with a creatinine clearance <50 mL/min or atrial fibrillation were excluded. Additionally, we excluded patients who had undergone bypass surgery from follow-up imaging. The study complied with local and federal regulations and was approved by the local institutional review board. All subjects provided written informed consent. All patients were examined using 64-slice scanner technology. Details of the CCTA acquisition and image analysis have been published elsewhere.[8]

Coronary CT data sets were anonymized. Curved multiplanar reformations of the left main coronary artery and the proximal 40 mm of the 3 major coronary arteries were generated as 1-mm thick cross-sections in 1-mm increments without gaps or overlaps. For the left circumflex artery, the larger of the actual circumflex and the obtuse marginal artery were used.

The data sets were co-registered using the first cross-section distal to the origin of the vessel as reference and advancing in 1-mm steps along the centerline of the vessel. Only cross-sections deemed evaluable at both baseline and follow-up were included in the analysis.

Atherosclerotic plaque burden and composition were assessed in identical sections and with identical window settings at baseline and follow-up (Fig. 1) using a semiquantitative cross-section–based score. Calcified plaque was defined as any structure within the coronary vessel wall demonstrating a CT attenuation of >130 Hounsfield units (HU) that could be visually distinguished from the vessel lumen. The presence of any calcification within the corresponding cross-section rendered the entire cross-section calcified. Noncalcified plaque was defined as a structure in continuity with the coronary artery wall and a CT density greater than that of the surrounding tissue but lesser than that of the contrast-enhanced lumen and without any detectable calcification.[11] This semiquantitative score has been shown to correlate well with the absolute plaque volumes determined on CCTA.[8]

Based on the semiquantitative score, we assessed the change of plaque burden and plaque morphology in the co-registered data sets and defined 4 categories of plaque progression. Change of CAD burden was defined as any plaque (noncalcified or calcified) observed in slices without plaque at baseline. Incident noncalcified plaque was defined as new