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ORIGINAL ARTICLE

Long-term prognostic implication of coronary plaque characterization as detected by 64-multidetector computed tomography in Egyptian population

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KEYWORDS

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Abstract *Objectives:* We aimed to determine the role of multi-detector computed tomography (MDCT) in prognosis of patients with known or suspected coronary artery disease (CAD) by applying plaque characterization and whether obstructive versus non-obstructive plaque volume is a predictor of future cardiac events.
Background: Vulnerable plaques may occur across the full spectrum of severity of stenosis, underlining that also non-obstructive lesions may contribute to coronary events.
Methods: We included 1000 consecutive patients with intermediate pretest likelihood of CAD who were evaluated by 64-MDCT. Coronary artery calcium scoring, assessment of degree of coronary stenosis and quantitative assessment of plaque composition and volume were performed. The end point was cardiac death, acute coronary syndrome, or symptom-driven revascularization.
Results: After a median follow-up of 16 months, 190 patients had suffered cardiac events. In a multivariate regression analysis for events, the total amount of non-calcified plaque (NCP) in non-obstructive lesions was independently associated with an increased hazard ratio for non-fatal MI (1.01–1.9/100-mm^3 plaque volume increase, $p = 0.039$), total amount of obstructive plaque was independently associated with symptoms driven revascularization ($p = 0.04$) and coronary artery calcium scoring (CACS) was independently associated with cardiac deaths ($p = 0.001$).
Conclusion: MDCT is a non-invasive imaging modality with a prognostic utility in patients with known or suspected coronary artery disease by applying plaque characterization and it could identify vulnerable plaques by measuring the total amount of NCP in non-obstructive lesions which

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could be useful for detecting patients at risk of acute coronary syndrome (ACS) and guide further preventive therapeutic strategies. CACS was shown to be an independent predictor of mortality, while total amount of obstructive volume was shown to be an independent predictor of symptoms driven revascularization.

1. Background

Coronary artery disease (CAD) is the most common cause of hospitalization and premature mortality in both developed and developing countries; even with advances in the preventive cardiology its prevalence is still increasing.[1,2] Acute coronary syndrome (ACS) and sudden cardiac death (SCD) are frequently the first clinical manifestations of CAD. The term "atherosclerosis" is typically describing the association of fatty degeneration with vessel stiffening.[3] The atherosclerotic plaque which is the mainstay of established atherosclerosis, sometimes progresses to contain large amounts of lipid core and excess smooth muscle cell migration; when it becomes unstable, injury of the overlying endothelium, or plaque rupture, could result in thrombotic occlusion of the overlying vessel.[4] Vulnerable plaque rupture is the principal cause of luminal thrombosis in ACS occurring in 75% of patients dying of an acute myocardial infarction (AMI).[5] The introduction of the concept of plaque vulnerability in conjunction with an increased understanding of the limitations of plaque imaging was reflected on quantifying the risk based only on the severity of arterial stenosis. In several retrospective and prospective serial angiographic studies, the culprit lesion in nearly two-thirds of patients with ACS was documented to be less than 70% (often $<50\%$) diameter narrowing on a coronary angiography several weeks or even months before the occurrence of the serious events.[6,7] Early detection of vulnerable plaques and aggressive medical intervention of these high-risk plaques can lead to its stabilization and effectively reduce the incidence of future ACS and SCD. Hence, the refining of the available non-invasive imaging modalities to assess the natural progression of vulnerable plaque is of utmost importance.[8] Noninvasive imaging of the coronary arteries with multi-detector computed tomography (MDCT) has emerged as an important diagnostic tool in patients suspected of CAD. Detection of coronary plaque composition has become a rapid noninvasive modality for evaluation of the overall plaque burden in the coronary tree with characterization of calcified and non-calcified plaque (NCP) composition.[9] Plaque composition as evaluated by MDCT has a strong correlation to clinical outcomes in patients with CAD. Motoyama and colleagues[9,10] compared plaque morphology on MDCT in 38 patients with ACS versus 33 patients with stable angina pectoris and demonstrated that plaques associated with ACS showed lower density values, positive remodeling and spotty calcification. In this study we tested the hypothesis that MDCT carries prognostic role in-patient with CAD, via application of coronary plaque characterization and detection of vulnerable plaques.

2. Method

2.1. Patient selection and study design

It is an observational retrospective study conducted in single center in period from June 2010 to December 2012, One thousand patients with intermediate pretest likelihood of (CAD)[11] were evaluated by 64-slice MDCT included in this retrospective study. All patients were informed about the technique, an informed consent was obtained and the local ethics committee approved the protocol. Patients with renal impairment (GFR < 30 mL/min/1.73 m^2), pregnancy, atrial fibrillation, inability to stop breathing for 12 s, recent acute coronary syndrome and previous revascularization were excluded.

Patient's histories as regards their symptoms and CAD risk factors including DM, hypertension, smoking, dyslipidemia and family history of premature CAD were obtained. Patients were followed up for at least one year, and information was obtained by either clinical visits or telephone interviews. Hospital records of all patients were screened for the occurrence of clinical events to confirm the obtained information.

Clinical primary end points were Cardiac death (Defined as death caused by acute myocardial infarction, ventricular arrhythmias, or refractory heart failure), Non-fatal infarction (Defined based on criteria of typical chest pain, elevated cardiac enzyme levels, and typical changes on the electrocardiogram) and symptoms driven revascularization.[12]

2.2. MDCT scan protocol

Patients were fasting for 4–6 h, flexible venous cannula catheters were placed in the antecubital vein and oral B-blocker was administered before the scan for those with a heart rate above 65 beats per minute.

Images were acquired using 64-MDCT (Aquilion 64 Toshiba Medical system). Scan parameters were as follows: slice collimation of 64×0.5 mm, a tube voltage of 120 kV, and a tube current of 70 mA s, gantry rotation time of 400 ms and slice thickness of 0.5 mm. First a non-contrast enhanced, prospectively electrocardiogram-triggered calcium score was performed at 75% of R-R interval and then a contrast enhanced scan obtained with helical retrospective gating using a bolus of 80 mL of intravenous non-ionic contrast (Iopamidol 370) (0.5–2.0 mL/kg, 80 mL maximum volume) was injected by mechanical power injector followed by a 10–30 mL saline flush at rates ranging from 1.5 to 2.5 mL/s during the scan, which was performed during an inspiratory breath hold of 12 s, and the MDCT data and ECG trace were acquired.

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