



Clinical Significance of Lipid-Rich Plaque Detected by Optical Coherence Tomography

A 4-Year Follow-Up Study

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ABSTRACT

BACKGROUND Lipid-rich plaque (LRP) is thought to be a precursor to cardiac events. However, its clinical significance in coronary arteries has never been systematically investigated.

OBJECTIVES This study investigated the prevalence and clinical significance of LRP in the nonculprit region of the target vessel in patients undergoing percutaneous coronary intervention (PCI).

METHODS The study included 1,474 patients from 20 sites across 6 countries undergoing PCI, who had optical coherence tomography (OCT) imaging of the target vessel. Major adverse cardiac events (MACE) were defined as a composite of cardiac death, acute myocardial infarction, and ischemia-driven revascularization. Patients were followed for up to 4 years (median of 2 years).

RESULTS Lipid-rich plaque was detected in nonculprit regions of the target vessel in 33.6% of patients. The cumulative rate of nonculprit lesion-related MACE (NC-MACE) over 48 months in patients with LRP was higher than in those without LRP (7.2% vs. 2.6%, respectively; $p = 0.033$). Acute coronary syndrome at index presentation (risk ratio: 2.538; 95% confidence interval [CI]: 1.246 to 5.173; $p = 0.010$), interruption of statin use ≥ 1 year (risk ratio: 4.517; 95% CI: 1.923 to 10.610; $p = 0.001$), and LRP in nonculprit regions (risk ratio: 2.061; 95% CI: 1.050 to 4.044; $p = 0.036$) were independently associated with increased NC-MACE. Optical coherence tomography findings revealed that LRP in patients with NC-MACE had longer lipid lengths ($p < 0.001$), wider maximal lipid arcs ($p = 0.023$), and smaller minimal lumen areas ($p = 0.003$) than LRPs in patients without MACE.

CONCLUSIONS Presence of LRP in the nonculprit regions of the target vessel by OCT predicts increased risk for future NC-MACE, which is primarily driven by revascularization for recurrent ischemia. Lipid-rich plaque with longer lipid length, wider lipid arc, and higher degree of stenosis identified patients at higher risk of future cardiac events.

(The Massachusetts General Hospital Optical Coherence Tomography Registry; [NCT01110538](https://clinicaltrials.gov/ct2/show/study/NCT01110538))

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Despite advances in pharmacological therapy and percutaneous coronary intervention (PCI), recurrent major adverse cardiac events (MACE) still occur in patients with coronary artery disease (1,2). Lipid-rich plaque (LRP) is thought to be responsible for most cases of MACE (3). In recent years, research has been focused on the detection of LRP, under the premise that local treatment of LRP may prevent future MACE. However, the clinical significance and natural history of LRP have not been systematically investigated. Optical coherence tomography (OCT) is a promising intravascular imaging modality used to detect LRP. The aim of this study was to investigate the prevalence and clinical significance of LRP in the nonculprit regions of the target vessel in patients undergoing PCI and to determine morphological characteristics of LRP-related MACE during 4 years of follow-up.

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METHODS

STUDY POPULATION. Study patients were retrospectively selected from the Massachusetts General Hospital (MGH) OCT Registry (NCT01110538), which is an international multicenter registry of patients who have undergone OCT of the coronary arteries, and involves 20 sites across 6 countries. The registry was approved by the institutional review board at each participating site. Written informed consent was obtained from all patients before enrollment. Patients were followed longitudinally for up to 4 years.

From August 2010 to May 2015, the MGH OCT registry enrolled 2,714 patients. Among them, we

identified 2,084 patients who had at least 1 year of follow-up. Of those patients, 588 patients were excluded because of incomplete imaging of the nonculprit regions. An additional 22 patients were excluded because of poor image quality. Finally, 1,474 patients were included in the analysis (Figure 1). For this study, all patients had OCT imaging performed in the nonculprit regions of the target vessel (Online Figure 1). The patients were followed annually, with a median follow-up period of 24 months. The primary outcome measurement was MACE, which was defined as a composite of cardiac death; acute myocardial infarction (AMI), defined as ST-segment elevation myocardial infarction and non-ST-segment elevation myocardial infarction by American College of Cardiology/American Heart Association guidelines (4); and ischemia-driven revascularization. Ischemia-driven revascularization was defined as a repeat PCI or bypass surgery of the lesions with either: AMI, unstable angina, stable angina, or documented silent ischemia. On the basis of follow-up angiography, MACE was further adjudicated as culprit (previous PCI site) lesion-related MACE and lesion-related nonculprit-MACE (NC-MACE) (previously untreated segment in any 1 of 3 coronary arteries). If follow-up angiography was not performed, the site associated with the event was classified as indeterminate. Culprit lesion-related, NC-, or indeterminate MACE, whichever occurred first in the patient, was set as the endpoint. More than 1 event recorded for the same patient at the same time point was attributed as 1 composite cardiac event for further statistical analysis.

ABBREVIATIONS AND ACRONYMS

ACS = acute coronary syndrome
AMI = acute myocardial infarction
LRP = lipid-rich plaque
MACE = major adverse cardiac event(s)
NC-MACE = nonculprit lesion-related major adverse cardiac events
OCT = optical coherence tomography
PCI = percutaneous coronary intervention

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