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EDITORIAL COMMENT

Coronary Plaque Erosion

Recognition and Management*

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Guidelines for clinical care are derived most commonly from large clinical trials involving thousands of patients. These trials are usually conducted to test hypotheses that have been developed from interesting clinical observations and innovative pilot trials. In this issue of *iJACC*, Prati et al. (1) describe interesting hypothesis-generating observations in patients with ST-segment elevation myocardial infarction (STEMI).

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For almost a half-century, cardiac pathologists have focused on the atherosclerotic lesions underlying the thrombotic coronary occlusions responsible for STEMI. Postmortem examination of patients who died early after acute STEMI have revealed principally 2 kinds of abnormalities. The more common, described by Constantinides (2), Davies et al. (3), and Falk (4) is the rupture of a thin fibrous cap overlying a lipid-rich atherosclerotic plaque, a so-called vulnerable plaque. In many instances, there is evidence of inflammation in the walls of the plaque, with macrophages and T lymphocytes that secrete inhibitors of collagen synthesis, and of proteases that digest the thin fibrous cap. As a consequence of plaque rupture, tissue factor is exposed to the flowing blood, and this in turn causes activation of platelets and the coagulation cascade. The coronary obstruction is caused in part by the plaque that encroaches on the arterial lumen and by the overlying thrombosis that delivers the *coup de grace* and usually results in total luminal occlusion. Prompt percutaneous coronary intervention (PCI), with stent insertion, is the centerpiece of therapy of these patients.

Plaque erosion, a second pathological lesion underlying coronary thrombosis, has been studied by van der Wal et al. (5) as well as Virmani et al. (6) (Dr. Virmani is one of the coauthors of the paper by Prati et al. [1]). Plaque erosion is responsible for the development of STEMI and/or sudden cardiac death in most of the patients who do not exhibit plaque rupture. These erosions are characterized by an absent or disrupted endothelium overlying a plaque that is characterized by greater proliferation of smooth muscle than inflammatory cells and by the presence of abundant proteoglycans. Plaques with superficial erosions do not, by themselves, cause critical obstruction. In such cases, the coronary obstructions are precipitated largely by the thrombi that develop on the dysfunctional intima. Based on autopsy findings in patients who died suddenly, endothelial plaque erosion may occur in as many as 40% of patients with fatal coronary thrombi (5,6). Plaque erosions appear to be more common in younger women (younger than 50 years of age) and in premenopausal smokers. Kubo et al. (7) characterized these lesions by optical coherence tomography (OCT) and reported that they are characterized by loss of endothelial lining with intimal tears.

The 31 patients described in the report by Prati et al. (1) were studied relatively early in the development of STEMI. After arteriography, which revealed total coronary occlusion in 60% of these patients, the investigators removed the offending thrombi by aspiration thrombectomy and/or

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thrombolysis. They then performed OCT, which showed no evidence of residual, critically obstructive plaques. The decision of how these patients would be treated was left to the interventional cardiologists. Nineteen patients received the recommended treatment of STEMI (i.e., stents were deployed after aspiration thrombectomy). In the other 12 patients, the operators apparently reasoned that nothing might be gained by stenting an artery without a severely obstructing plaque. Indeed, such a procedure might even damage the arterial wall unnecessarily and expose it to a stent, which carries its own, albeit small, risk. Instead, they treated these patients with aspirin, heparin, a thienopyridine, and in some instances a glycoprotein IIb/IIIa inhibitor. The residual coronary stenosis was similar in the 2 groups. Remarkably, after a follow-up of >2 years, none of the 12 patients treated by thrombectomy alone and only 1 of the 19 who received a stent required an additional revascularization.

A number of questions should be addressed to evaluate this novel approach to this sizable subgroup of patients with early STEMI. 1) How often are plaque erosions the culprit lesion in a contemporary sample of STEMI patients? 2) What are the risks of PCI with stent implantation in patients with plaque erosion compared with those with the more commonly encountered flow-limiting ruptured plaque? 3) How much time is added to the period of severe myocardial ischemia by interposing OCT in patients in whom this procedure reveals a ruptured plaque and who will require PCI with stenting? 4) What is the balance of risk to benefit by adding diagnostic OCT in patients with a STEMI as opposed to simply proceeding with aspiration thrombectomy and stent placement in all patients with early STEMI, including those in whom the thrombus occurs on an eroded plaque? 5) What is the optimal antithrombotic treatment in patients who are not treated with a stent? 6) Could the addition of a very low dose of the oral factor Xa inhibitor rivaroxaban to an antiplatelet regimen be of benefit? In the 15,526-patient ATLAS–TIMI 51 (Anti-Xa Therapy to Lower Cardiovascular Events in Addition to Standard Therapy in Subjects with Acute Coronary Syndrome–Thrombolysis in Myocardial Infarction 51) trial of patients with acute coronary syndromes, which included 7,817 patients with STEMI, we observed that the addition of 2.5 mg twice daily of this anticoagulant, when added to dual antiplatelet therapy and begun an average of 4 days after presentation, was associated with a robust long-term reduction in mortality in STEMI patients. Although this regimen does cause some extra bleeding, in appropriately selected patients, it was not associated with fatal bleeding (8).

Although plaque erosion is not the most common cause, it certainly is not an infrequent cause of coronary thrombosis and STEMI. OCT is a relatively new imaging modality and is now being introduced into a variety of clinical situations. Its application by Prati et al. (1) in 12 patients with STEMI secondary to plaque erosion who were treated successfully without PCI should lead to further investigation of this ingenious therapeutic approach.

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Key Words: optical coherence tomography ■ plaque rupture ■ STEMI.