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EDITORIAL COMMENT

Benefit of Distal Protection During Percutaneous Coronary Intervention in Properly Selected Patients*

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The no-reflow phenomenon during percutaneous coronary intervention (PCI) in ST-segment elevation acute myocardial infarction is associated with impaired ST-segment resolution, increased infarct size, reduced recovery of ventricular function, and poor clinical outcomes (1). One possible cause of no-reflow is microemboli of atherosclerotic debris and thrombi generated by PCI. Although previous studies suggested that the routine use of distal protection during primary PCI was not effective in reducing no-reflow (2,3), the selective use of distal protection for patients at high risk for atherothrombotic embolization may have some clinical benefit. According to intravascular ultrasound (IVUS), attenuated plaques (characterized by hypoechoic or mixed atheroma with ultrasound attenuation but without calcification) have a high likelihood of developing atherothrombotic embolization and no-reflow during PCI (4-6).

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In this issue of *JACC: Cardiovascular Interventions*, Hibi et al. (7) report the results of the VAMPIRE 3 (Vacuum Aspiration Thrombus Removal 3) study. The VAMPIRE 3 study is a randomized control trial comparing the incidence of no-reflow during PCI between use of distal protection with filter device and no distal protection in patients with IVUS-derived attenuated plaques in the culprit lesions of acute coronary syndrome (defined as ST-segment elevation myocardial infarction, non-ST-segment elevation myocardial infarction, or unstable angina). IVUS-derived attenuate plaque was defined as signal attenuation of ≥180° in cross-sectional angle and ≥5 mm in longitudinal length. Hibi et al. demonstrate that: 1) the incidence of no-reflow during PCI was significantly lower in the distal protection group than in the no distal protection group; 2) in-hospital adverse cardiac events were less common in the distal protection group; and 3) there were no complications related to the distal protection device.

The main difference between the VAMPIRE 3 study and the previous studies of distal protection is that the VAMPIRE 3 study used IVUS. The VAMPIRE 3 study is a single-country trial conducted in Japan, where IVUS use is considerably higher than in other countries. IVUS use in Japan is roughly 80% for all PCI, whereas that number in the United States, for example, is close to 10%. The VAMPIRE 3 study is an important study showing the clinical significance of IVUS guidance in PCI. IVUS assessment before PCI is a prerequisite for getting benefit from distal protection.

Several IVUS studies have demonstrated that the attenuated plaque is associated with an increased risk for no-reflow. In the VAMPIRE 3 study, no-reflow occurred in 42% of patients with attenuated plaques during PCI without distal protection. Like conventional grayscale IVUS, recently developed imaging techniques are potentially capable of identifying the plaques at high risk for no-reflow. Necrotic core-rich plaque on IVUS-virtual histology (8), lipid-laden plaque on integrated backscatter IVUS (9), intensive yellow plaque on coronary angioscopy (10), thin-capped fibroatheroma on

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optical coherence tomography (11), lipid core plaque on near-infrared spectroscopy (12), low-density plaque on computed tomographic angiography (13), and high-intensity plaque in magnetic resonance angiography (14) are associated with no-reflow. Precise identification of the high-risk plaque might contribute to increase the benefit from distal protection.

The pathogenesis of no-reflow is complex. There are at least 4 interacting mechanisms responsible for no-reflow, such as distal atherothrombotic embolization, ischemia-related injury, reperfusion-related injury, and individual susceptibility to microvascular injury (15). Therefore, distal protection may be inadequate to prevent no-reflow. In fact, in the VAMPIRE 3 study, no-reflow occurred in 24% even in the distal protection group. Furthermore, the current filter-based distal protection device has several issues: 1) the device is not useful in cases with bifurcation lesions; 2) deployment of the device is a problem in cases with tortuous or calcified vessels or with very tight lesions; 3) passage of the device across the lesion may induce atherothrombotic embolization; 4) complex manipulation of the device may prolong procedure time and then extend ischemia time and increase infarction size; 5) the device may cause mechanical vessel injury at the site of filter deployment such as dissection and hematoma; 6) the device may cause vessel spasm, leading to an underestimation of the vessel diameter and to undersizing of the implanted stent; and 7) retrieval of the device may affect the stent apposition.

The unique point of the VAMPIRE 3 study in comparison with the previous studies is the combined use of distal protection device and aspiration catheter. When the VAMPIRE 3 study was conducted, use of aspiration catheter in primary PCI was a Class IIa recommendation. In the VAMPIRE 3 study, aspiration during distal protection was performed in 67% of the patients. Therefore, the decrease of no-reflow may be associated with the combination of distal protection and aspiration rather than distal protection alone.

The VAMPIRE 3 study demonstrated that distal protection during PCI improved angiographic and clinical outcomes immediately after the procedure in patients at high risk for atherothrombotic embolization. Further investigation is needed to evaluate the long-term effects of distal protection in those selected patients.

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