Expectation of Predicting No-Reflow Phenomenon

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ABSTRACT

Percutaneous Coronary Intervention (PCI) has been increasingly utilized for the treatment of coronary artery disease; however, no-reflow phenomenon is one of the crucial complications during PCI. Patients with no-reflow phenomenon are associated with poor clinical outcomes when compared with patients with adequate reflow after reperfusion therapy, and no-reflow phenomenon is an independent prognostic factor. Thus, it is clinically important to predict and if possible, prevent no-reflow phenomenon during PCI. Here, we demonstrate the possibilities and evidences of the tools which are used in the clinical practice for predicting no-reflow phenomenon.

Keywords: Coronary imaging; No-reflow phenomenon; PCI

DESCRIPTION

Coronary computed tomography

Multi Detector Computed Tomography (MDCT) has been demonstrated to permit not only the visualization of coronary artery stenosis but also the assessment of quality and morphology including plaque density and/or positive remodeling [1-4]. Low-attenuation plaque and positive remodeling assessed by MDCT has been identified as independent predictors of no-reflow phenomenon [5]. Representative vulnerable plaque showing low attenuation surrounded by a rim-like area of higher attenuation detected by MDCT, namely napkin-ring sign is also independently associated with no-reflow phenomenon [6]. Thus, MDCT can noninvasively provide for the prediction of no-reflow phenomenon.

Intravascular ultrasound

Previous studies using Intravascular Ultrasound (IVUS) have identified plaque rupture [7], large attenuated plaque [8], Thin-Cap Fibro Atheroma (TCAF) [9], plaque burden [10] and thrombus [11] as predictors of no-reflow phenomenon. The positive and negative predictive values and accuracy for prediction of no-reflow phenomenon were almost equivalent between very low attenuation plaque assessed by Computed Tomography Angiography (CTA) and attenuated plaque evaluated by IVUS. Interestingly, however, the combination of very low attenuation plaque assessed by CTA and attenuated plaque evaluated by IVUS improves the predictive power for no-reflow phenomenon [12].

Optical coherence tomography

Optical Coherence Tomography (OCT) can detect the more details of atherosclerotic plaques, including TCFA, which is recognized as a precursor lesion for plaque rupture with a high spatial resolution of 10 μm. TCFA is a plaque with lipid content covered with thin fibrous cap. PCI for TCFA is associated with no-reflow phenomenon which is caused by microvascular obstruction [13]. Cholesterol Crystals (CCs) by OCT appear as thin, linear regions of high intensity usually associated with a fibrous cap or necrotic core. Previous OCT study reported that CCs are also one of the independent predictive factors for no-reflow phenomenon detected by OCT [14].

Near-infrared spectroscopy

MDCT, IVUS, and OCT have evolved to detect high-risk plaque, however, these modalities are not sufficient to discern the amount of lipid core burden. Near-Infrared Spectroscopy (NIRS) can accurately identify lipid core plaques, is specialized in lipid detection, and has the potential to provide quantitative information on plaque vulnerability by assessing lipid burden in terms of the Lipid Core Burden Index (LCBI) [15]. High LCBI

measured using NIRS is independently associated with microvascular dysfunction by distal embolization [16], periprocedural myocardial infarction which results from distal embolization of lipid-core plaque constituents [17], decreased post-PCI thrombolysis in myocardial infarction flow by plaque embolization [18].

CONCLUSION

Although MDCT, IVUS, OCT, and NIRS each have inherent strengths and weaknesses, these techniques can complement each other, and selective utilization in appropriate patient subgroups or combined usage is expected to be beneficial for predicting no-reflow phenomenon during PCI procedures. Not only predicting but preventing no-reflow phenomenon merit future research as well. Distal protection device is one of the options preventing no-reflow phenomenon. Nowadays, however, no consensus of using the distal protection device is established for preventing no-reflow phenomenon. Further studies are needed in the future to predict the "no-reflow phenomenon" using these imaging modalities, in a randomized trial, and to test the strategy of coronary imaging-guided use of a distal protection device.

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