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Letter to the Editor

Non-invasive vs. Invasive Functional Tests after Coronary Stent Implantation

Doyeon Hwang, MD, and Bon-Kwon Koo, MD, PhD

Department of Internal Medicine and Cardiovascular Center, Seoul National University Hospital, Seoul, Korea

▸ See the letter "Non-Invasive Physiological Assessment after Coronary Stent Implantation" in volume 51 on page 547.

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Correspondence to
Bon-Kwon Koo, MD, PhD
Department of Internal Medicine and Cardiovascular Center, Seoul National University Hospital, 101, Daehak-ro, Jongno-gu, Seoul 03080, Korea.
E-mail: bkkoo@snu.ac.kr

ORCID iDs
Doyeon Hwang
https://orcid.org/0000-0002-0215-5319
Bon-Kwon Koo
https://orcid.org/0000-0002-8188-3348

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We thank Lee and Burns for their interest in our review article focused on the invasive physiologic methods for evaluating the appropriateness of percutaneous coronary intervention (PCI).[1] Lee and Burns introduced non-invasive cardiac imaging methods that can be used for detecting residual myocardial ischemia after PCI.[2] While agreeing that these non-invasive cardiac imaging tests can provide important information in patients who underwent PCI, we would like to discuss the strengths and weaknesses of invasive and non-invasive tests for post-PCI patients.

Single-photon emission computed tomography, positron emission tomography, echocardiography, and cardiac magnetic resonance are well-established modalities for coronary artery disease (**Table 1**)[3-7] and have been used to evaluate patients with suspected coronary artery disease and guide treatment strategies.[8] The common purpose of these cardiac imaging tests is to identify the presence of myocardial ischemia and can also be used to define residual ischemia after PCI. Previous studies reported that residual ischemia was present after PCI in about one-third of patients from non-invasive imaging tests, and these patients were associated with worse clinical outcomes.[9][10] Therefore, it is important to acknowledge these imaging tests and recognize their collective ability to non-invasively evaluate PCI results by confirming the degree of resolution of ischemia both after PCI and during patient follow-up. However, these non-invasive cardiac imaging tests have limited value in evaluating coronary anatomy and residual anatomical disease severity, including stented segments, and cannot be used in a cardiac catheterization laboratory immediately after PCI. As suboptimal results of PCI, which can originate from stent deployment itself and remaining residual disease, do not always translate to the presence of residual myocardial ischemia, non-invasive cardiac imaging tests have inborn limitations to evaluate the subtle problems after PCI. In contrast to non-invasive cardiac imagings, invasive physiologic assessment can be performed immediately after the procedure, assess the appropriateness of PCI, and reveal the cause of sub-optimal PCI results.[1] Therefore, post-PCI physiologic assessment can detect hidden problems after PCI, even though there is no residual ischemia, thereby allowing physicians to maximize the benefits of PCI in a cardiac catheterization laboratory.

Table 1. Strength and weakness of non-invasive cardiac imaging

	Strength	Weakness
SPECT	· Most widely used · Quantifies extent of myocardial ischemia · Evaluates ventricular function and volume	· Radiation issues · Limited quantification of myocardial flow · Limited value in cases with balanced ischemia Cannot discriminate macro- and microvascular dysfunction · Cannot evaluate coronary anatomy
PET	· The standard for perfusion quantification · Quantifies extent of myocardial ischemia · Evaluates ventricular function and volume · Can assess multivessel disease with balanced ischemia · Lower radiation than SPECT	· Limited availability, expensive · Cannot evaluate coronary anatomy · Lower spatial resolution compared with CCTA or CMR
CMR	· No use of ionizing radiation · Quantifies extent of myocardial ischemia · Evaluates ventricular function and volume · Evaluates myocardial fibrosis and other conditions such as cardiac amyloidosis	· Limited availability · Limited evaluation of coronary anatomy · Cannot be used in pacemaker patients
Echocardiography	· Available at the bedside · No use of ionizing radiation · Assesses global and regional left ventricular dysfunction	· Cannot evaluate coronary anatomy · Cannot discriminate macro- and microvascular dysfunction · Inter-observer variability

CCTA = coronary computed tomography angiography; CMR = cardiac magnetic resonance; PET = positron emission tomography; SPECT = single-photon emission computed tomography.

Data Sharing Statement

The data generated in this study is available from the corresponding author(s) upon reasonable request.

Author Contributions

Conceptualization: Hwang D, Koo BK; Data curation: Hwang D, Koo BK; Formal analysis: Hwang D, Koo BK; Investigation: Hwang D, Koo BK; Methodology: Hwang D, Koo BK; Project administration: Koo BK; Resources: Hwang D, Koo BK; Supervision: Koo BK; Validation: Koo BK; Writing - original draft: Hwang D, Koo BK; Writing - review & editing: Hwang D, Koo BK.

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