IMAGES IN NUCLEAR CARDIOLOGY

A Pitfall of Simultaneous Acquisition Stress ^{201}Tl/rest ^{99m}Tc Dual-isotope Myocardial Perfusion Single-photon Emission Computed Tomography with a Semiconductor Gamma Camera

Shonosuke Sugai, MD[1)], Naoya Matsumoto, MD[1)], Ayano Makita, MD[1)], Keiichiro Kuronuma, MD[1)], Yasuyuki Suzuki, MD[1)], Shunichi Yoda, MD[2)], Yasuo Okumura, MD[2)] and Yasuo Amano, MD[3)]

Received: June 9, 2022/Revised manuscript received: July 4, 2022/Accepted: July 4, 2022

Ann Nucl Cardiol 2022; 8 (1): 120–122

The usefulness of stress myocardial perfusion single-photon emission computed tomography (SPECT) in the diagnosis of coronary artery disease (CAD) is well established (1, 2). Recently developed cadmium-zinc-telluride (CZT)-SPECT has high sensitivity, high spatial resolution, and high energy-spectrum resolution. CZT-SPECT has high diagnostic accuracy, and also improves acquisition time and reduces radiation exposure, compared to conventional SPECT (3). The first report of CZT -SPECT was documented about diagnostic accuracy and low radiation exposure in obese patients in 2012 (4, 5). Increasing of the CZT-SPECT use for low radiation exposure is reasonable. A simultaneous acquisition stress ^{201}Tl/rest ^{99m}Tc dual-isotope myocardial perfusion SPECT (MPS) protocol (SDI protocol) reported by Makita et al. has high diagnostic performance to detect significant CAD (6). However, this protocol may have a pitfall of potentially missing the presence of ischemic myocardium because of the different radioisotope use to diagnose CAD.

^{201}Tl is known to have a high sensitivity in detecting ischemic myocardium because of good myocardial blood flow tracking (high myocardial extraction fraction), compared to ^{99m}Tc tracers (sestamibi or tetrofosmin) (7). After the first simultaneous acquisition of stress ^{201}Tl/rest ^{99m}Tc in the SDI protocol, we routinely recommend to have a second acquisition of stress ^{201}Tl/rest ^{99m}Tc after a meal break for 1–2h (Figure 1). Even when the diagnosis of ischemic or non-ischemic myocardium based on the first acquisition alone shows a fixed defect, it may be possible to diagnose ischemic myocardium by comparing the ^{201}Tl redistribution images.

An 80-year-old male, who has a history of chronic kidney disease and diabetes mellitus, during hospitalization for urinary tract infection, developed heart failure and underwent stress MPS for eliminating CAD. When comparing stress ^{201}Tl and rest ^{99m}Tc imaging, fixed defects were observed in the apical anterior wall and apex (summed stress score [SSS] 6, summed rest score [SRS] 6, and summed difference score [SDS] 0) (Figure 2A, white arrows). However, when comparing stress ^{201}Tl images between the first and second acquisitions, ischemic myocardium was observed (SSS 6, SRS 4, SDS 2) (Figure 2B, yellow arrows). Coronary artery angiography (CAG) showed 90% stenosis in proximal left anterior descending artery (LAD) (Figure 3). Although MPS showed a small amount of ischemia, but a proximal lesion in the LAD, then percutaneous coronary intervention was performed.

In discussion, there are two possibilities that in this situation. Different extraction fraction between two tracers (stress ^{201}Tl and rest ^{99m}Tc) may miss a slight difference of myocardial perfusion even after the normalization. Another possibility is that ^{99m}Tc tracer may not be enough to track a

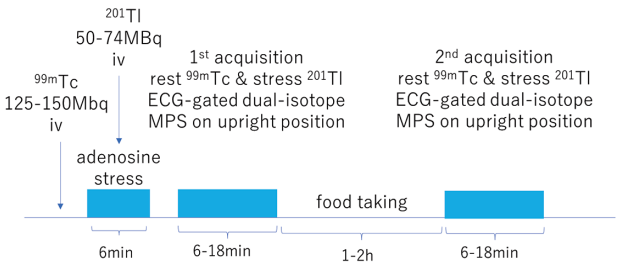

Figure 1 Schematic display of SDI protocol.

doi: 10.17996/anc.22-00165

1) Department of Cardiology, Nihon University Hospital, Tokyo, Japan
2) Division of Cardiology, Department of Medicine, Nihon University School of Medicine, Tokyo, Japan
3) Department of Radiology, Nihon University Hospital, Tokyo, Japan

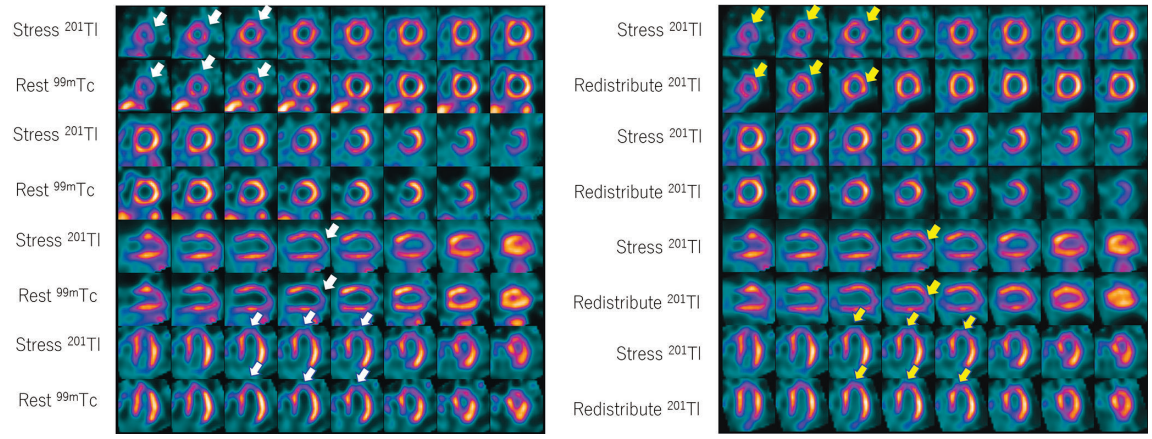

Figure 2 SDI and ^{201}Tl-redistribution images.
A: SDI images.
B: ^{201}Tl-redistribution images.

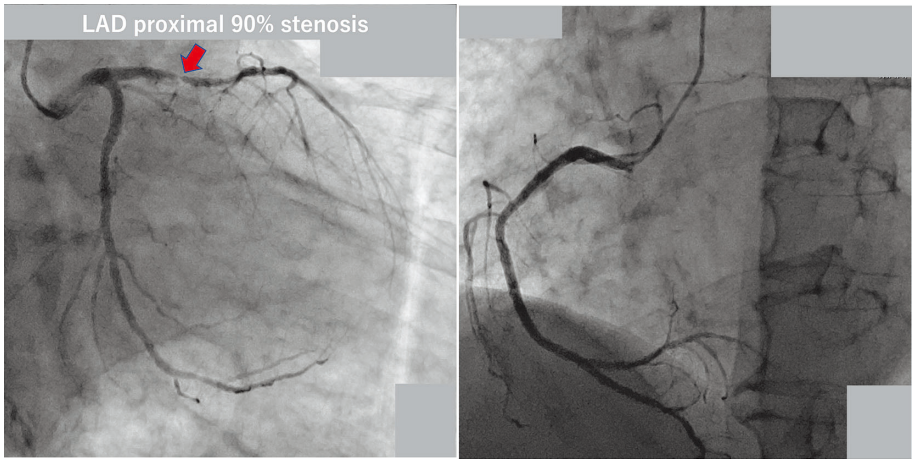

Figure 3 Coronary angiogram.
left: left coronary artery (LAD stenosis).
right: right coronary artery.

resting ischemia in critical stenosis. This case reveals 90% of stenosis in the LAD, which causes a minimum blood flow and myocardial counts with ^{99m}Tc at rest. However, delayed ^{201}Tl image may help to reveal a resting ischemia with its redistributional characteristic. In conclusion, even a small amount of ischemic myocardium can be diagnosed with redistribution image in SDI protocol, which is expected to improve diagnostic accuracy. In addition, one of the reasons to develop SDI protocol was time saving of total examination which is less than 30 min. Adding redistribution image of ^{201}Tl within 60 min after stress test may show recognizable ischemia. This waiting time between 1st and 2nd ^{201}Tl images is shorter than that with regular stress / redistribution protocol with ^{201}Tl. Finally, American Society of Nuclear Cardiology has proposed that the exposure dose for more than 50% of all examinations be 9 mSv per test or less. CZT-SPECT achieved to reduce radiation exposure of ^{201}Tl by its high sensitivity. Minimum usage is 50 MBq of ^{201}Tl and 125 MBq of ^{99m}Tc in SDI protocol achieved totally 8.0 mSv/ test, which was less than 9 mSv.

Acknowledgments

We deeply appreciate clinical radiological technologists (Mr. Yoshitaka Hori and Takahito Terada) for their assistance to prepare this manuscript.

Sources of funding

None.

Conflicts of interest

N. Matsumoto received lecture fees from Nihon Medi-Physics, Tokyo, Japan and PDRadiopharma, Tokyo, Japan, and had a scholarship fund from PDRadiophama.

Reprint requests and correspondence:
Shonosuke Sugai, MD
Nihon University Hospital, Department of Cardiology
1-6 Kanda Surugadai, Chiyoda-ku, Tokyo, 101-8309 Japan
E-mail: suganosuke@gmail.com

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