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Case Report

Reverse redistribution on Rb-82: Does the mechanism of stress play a role?

ABSTRACT

We present a case of reverse redistribution in a patient imaged with Rb-82 positron-emitting tomography. The patient was imaged twice in rapid succession using pharmacological stress – once with dipyridamole and once with dobutamine. The patient demonstrated reverse redistribution after dipyridamole but not after dobutamine administration. We speculate on the relationship between the pharmacological stressing agent and the presence of reverse redistribution.

Keywords: Myocardial perfusion imaging, positron-emitting tomography, Rb-82, reverse redistribution

INTRODUCTION

Reverse redistribution on myocardial perfusion imaging (MPI), in which resting perfusion images demonstrate a defect absent on poststress images, has been described with various single-photon emission computerized tomography tracers, with exercise stress as well as after pharmacological stress. The significance of this finding remains unclear, but an association with significant coronary artery disease, subendocardial scarring, recent myocardial infarction, recent revascularization, and regional wall motion abnormalities has been noted.[1] The pathophysiology underlying this phenomena remains controversial, but it has been suggested to represent either areas of nontransmural scar with increased blood flow to viable tissue in the reperfused zone, normal blood flow to viable tissue in the reperfused zone, and diminished blood flow in the infarcted portion, or tracer uptake by the necrotic tissue or interstitium in the reperfused zone.[2]

CASE REPORT

We present the case of a 70-year-old man who underwent dipyridamole Rb-82 positron emitting tomography (PET) 3 days following percutaneous coronary intervention with right coronary artery (RCA) stenting [Figure 1]. There was complete occlusion of the proximal RCA, as well as multiple

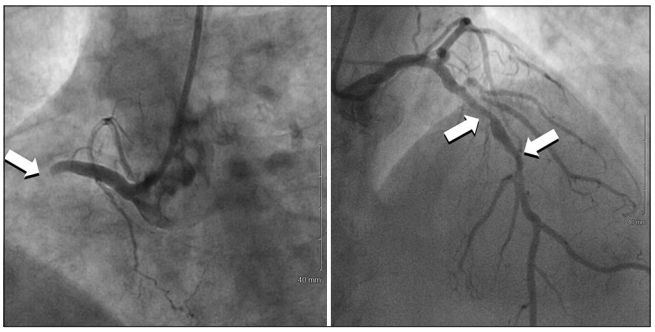

Figure 1: The patient's initial coronary angiography findings. Note the complete occlusion of the proximal right coronary artery (left panel, arrow), and multiple borderline lesions in the left anterior descending (right panel, arrows)

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borderline lesions in the left anterior descending (LAD) and circumflex territories (LCx). Postthrombectomy and stenting [Figure 2], angiography showed complete resolution of the proximal RCA lesion and no residual disease in the remainder of the RCA territory. No intervention was attempted for the lesions in the LAD and LCx territories.

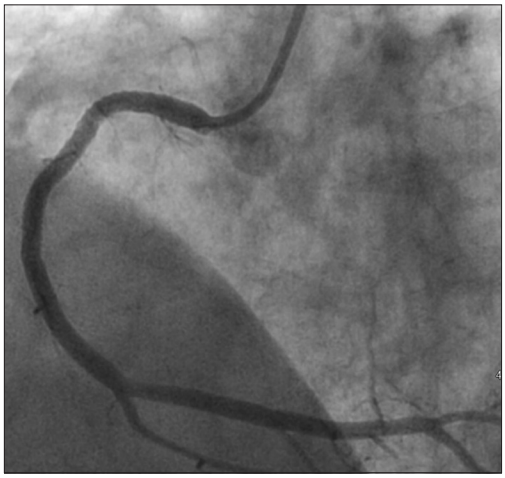

Figure 2: Postthrombectomy and stenting angiography showing complete resolution of the proximal right coronary artery lesion with no residual disease in the remainder of the right coronary artery territory

A follow-up dipyridamole Rb-82 PET MPI study was requested to assess the significance of the lesions in the LAD and LCx territories [Figure 3]. Perfusion images showed significantly decreased tracer uptake in the inferior wall, which normalized on the poststress images. No other significant perfusion defects were appreciated. Flow quantification revealed an impaired global myocardial flow reserve (MFR) of 1.37 with relatively homogeneous myocardial blood flow (MBF) in all territories at stress at a stress rate-pressure product (RPP) of 7850 mmHg × bpm. Hypokinesis of the inferior wall was present on both rest and poststress studies, in keeping with stunned myocardium. No misregistration errors, or other obvious source of artifact, were noted on either rest or poststress images. On the rest study, there was a clear defect in the inferior wall, which normalized on the stress acquisition following a dipyridamole infusion. On the same day, the patient underwent a repeat MPI study, using dobutamine as the stressing agent. This study again demonstrated a defect

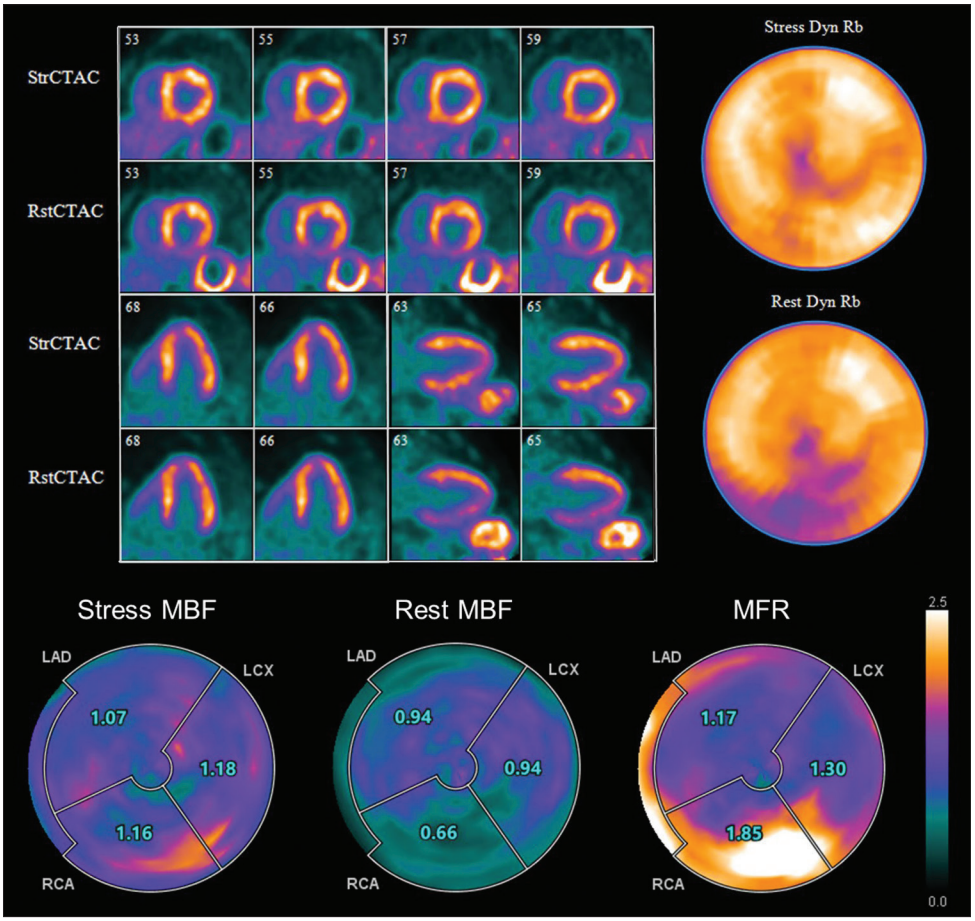

Figure 3: A dipyridamole Rb-82 positron-emitting tomography myocardial perfusion imaging study was requested to assess the significance of the lesions in the left anterior descending and LCx territories. Perfusion images showed significantly decreased tracer uptake in the inferior wall, which normalized on the poststress images

in the inferior wall which was present on both the rest and stress studies. Aminophylline was administered after the study dipyridamole study with no additional interventions performed in the time between the two studies.

Eight hours later, a repeat Rb-82 PET MPI study was performed using dobutamine as a stressing agent [Figure 4]. Stress RPP reached 14350 mmHg × bpm. The inferior wall defect was again seen on the rest study; however, the defect persisted on stress images. MFR to the inferior wall was again diminished on both sets of images (rest = 0.59, stress = 1.21), with a corresponding regional wall motion abnormality. The reason for the difference in findings between the two studies is unclear but is likely related to the differences in mechanism of action between the two stressing agents.

DISCUSSION

This case demonstrates reverse redistribution with Rb-82, which has not widely been reported.[3] The existence of this phenomena, well-described using Thallium-201 imaging, could have been anticipated due to the similarities between the uptake mechanisms of rubidium and thallium, both of which act as potassium analogs. MBF quantification provides additional information on the underlying pathophysiology of reverse redistribution. In addition, this case demonstrates the potential role of the stressing agent on the reverse redistribution pattern, another finding which has yet to be explored in the literature and may shed some light on the physiological processes underpinning reverse redistribution.

Despite the fact that this phenomenon was first identified nearly four decades ago,[4] the precise physiological mechanisms underpinning reverse redistribution have yet to be elucidated. Numerous explanations have been proposed, including the hypothesis that reverse redistribution was artifactual;[5,6] however, subsequent work confirmed the physiological nature of this finding[7] without clarifying the biological mechanisms at play. It is also been noted that reverse distribution can be seen in two disparate populations: individuals undergoing routine myocardial perfusion imaging for coronary artery disease and more frequently,[2] in the setting of acute myocardial infarction. In the latter context, the results of numerous authors are compatible with the observation that the presence of reverse

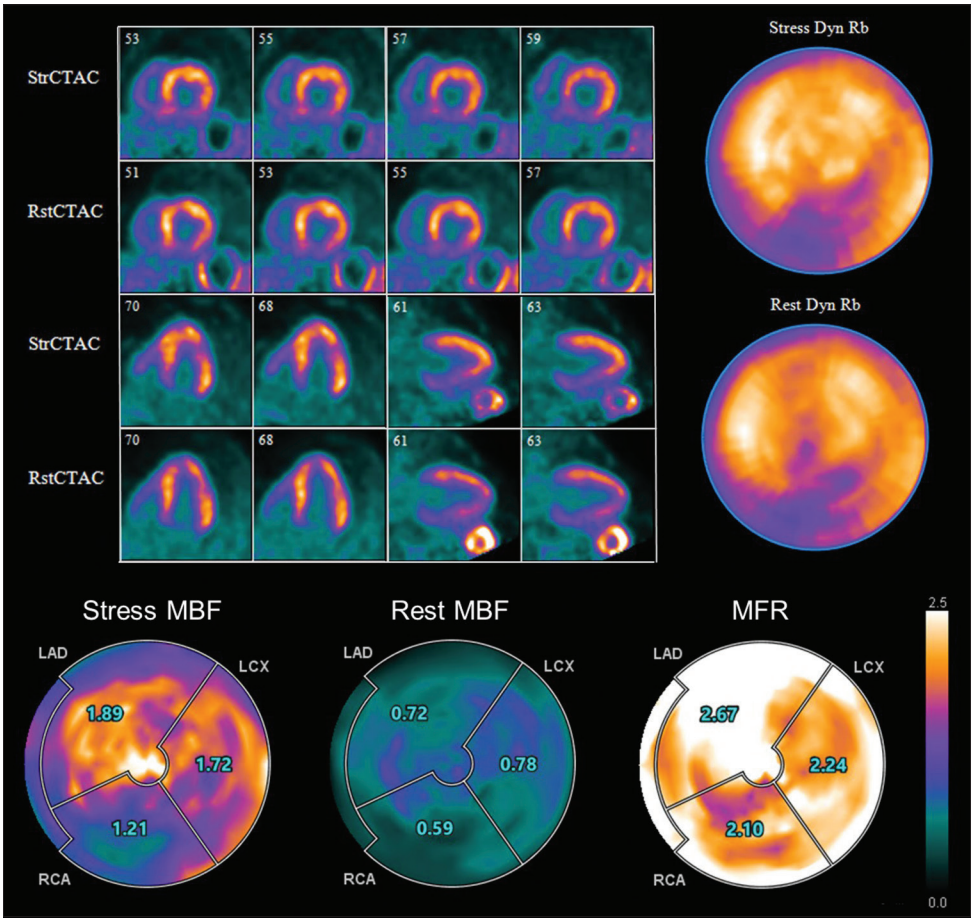

Figure 4: Repeat Rb-82 positron-emitting tomography myocardial perfusion imaging study using dobutamine as a stressing agent. The inferior wall defect was again seen on the rest study; however, the defect persisted on stress images

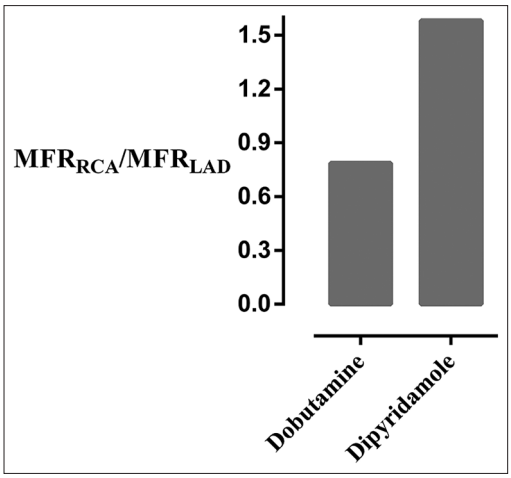

Figure 5: Ratio of myocardial flow reserve in the right coronary artery territory to the myocardial flow reserve in the left anterior descending territory, postdobutamine (left) and dipyridamole (right)

redistribution postmyocardial infarction is associated with the presence of viable myocardium.[2,7-9]

The ratios of MFR in the RCA territory to the MFR in the LAD territory for dipyridamole and dobutamine are shown in Figure 5. After dobutamine infusion, the MFR in the RCA territory was nearly the same as that in the LAD territory; however, postdipyridamole, the MFR in the RCA territory was more than 50% greater than the MFR in the LAD territory. This difference accounts for the inferior wall defect seen after dobutamine but not dipyridamole. Although the physiological mechanism for this difference is not clearly understood, a comparable phenomenon was reported by Ito *et al*.[10] In particular, they reported that in dogs, the use of adenosine produced a greater increase in regional blood flow in stunned myocardium compared to normal myocardium. To the best of our knowledge, this phenomenon has not been reported with dobutamine and has not previously been reported in humans.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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