Cases from a busy nuclear cardiology laboratory

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CASE 1

A 46-year-old man with a history of coronary artery disease (CAD) status post drug-eluting stent placement 8 years prior, and heart failure with reduced left ventricular (LV) ejection fraction (EF) presented to the emergency room with shortness of breath, chest pain, and malaise of 1 month duration. Physical examination was normal with a heart rate of 87 beats per minute (bpm) and blood pressure of 129/83 mmHg. The chest x-ray showed no acute abnormality. The electrocardiogram (ECG) is shown below (Figure 1A). Laboratory studies were remarkable for an elevated hemoglobin (17.3gm/dl), normal BNP (41.0 pg/ml), and undetectable Troponin-I (<0.030 ng/ml).

He was admitted to the chest pain observation unit where repeat troponin and ECG were unchanged 6 hours later. A regadenoson stress Single Photon Emission Computed Tomography (SPECT) myocardial perfusion imaging (MPI) study with technetium-99m sestamibi was performed. The perfusion images (Figure 1B) showed no perfusion defects, and the LV EF was 39%. There was, however, increased radio-tracer uptake in the right ventricle (RV) with associated RV dilatation. The coronary angiogram showed mild diffuse disease with a patent stent in the mid right coronary artery. The right heart catheterization revealed pulmonary arterial hypertension (Table 1).

Teaching Point

Assessment of the RV is an essential component of interpreting MPI and can lead to the proper diagnosis and appropriate clinical management.[1] At present, RV perfusion and function are often done by visual analysis when using SPECT although quantitative analysis software are available.[2] Quantitative techniques for measuring myocardial blood flow and metabolism are more widely available with positron emission tomography PET.[3] The findings from such studies should be integrated in the final report. The report on this patient read:

1. Normal Regadenoson SPECT myocardial perfusion images.
2. Abnormal left ventricular systolic function (left ventricular ejection fraction = 39%). Diffuse hypokinesis.
3. Markedly abnormal RV function and RV dilation.

CASE 2

A 66-year-old man with a history of hypertension, dyslipidemia, and heart failure with preserved LV EF presented to the emergency room with a chief complaint of atypical chest pain in relation to character, location, duration, and provocation. The physical exam was remarkable for trace pretibial, pitting edema with a heart rate of 80 bpm and blood pressure of 113/89 mmHg.

The ECG (Figure 2A) showed no evidence of acute ischemia or MI. The Troponin-I was within normal limits (<0.030 ng/ml). He was admitted to a chest pain observation unit. A treadmill exercise stress test with technetium 99m sestamibi SPECT MPI was performed. He exercised for 9 minutes on a standard Bruce protocol representing 115% of expected exercise capacity and reached 89% of age-predicted maximal heart rate. The

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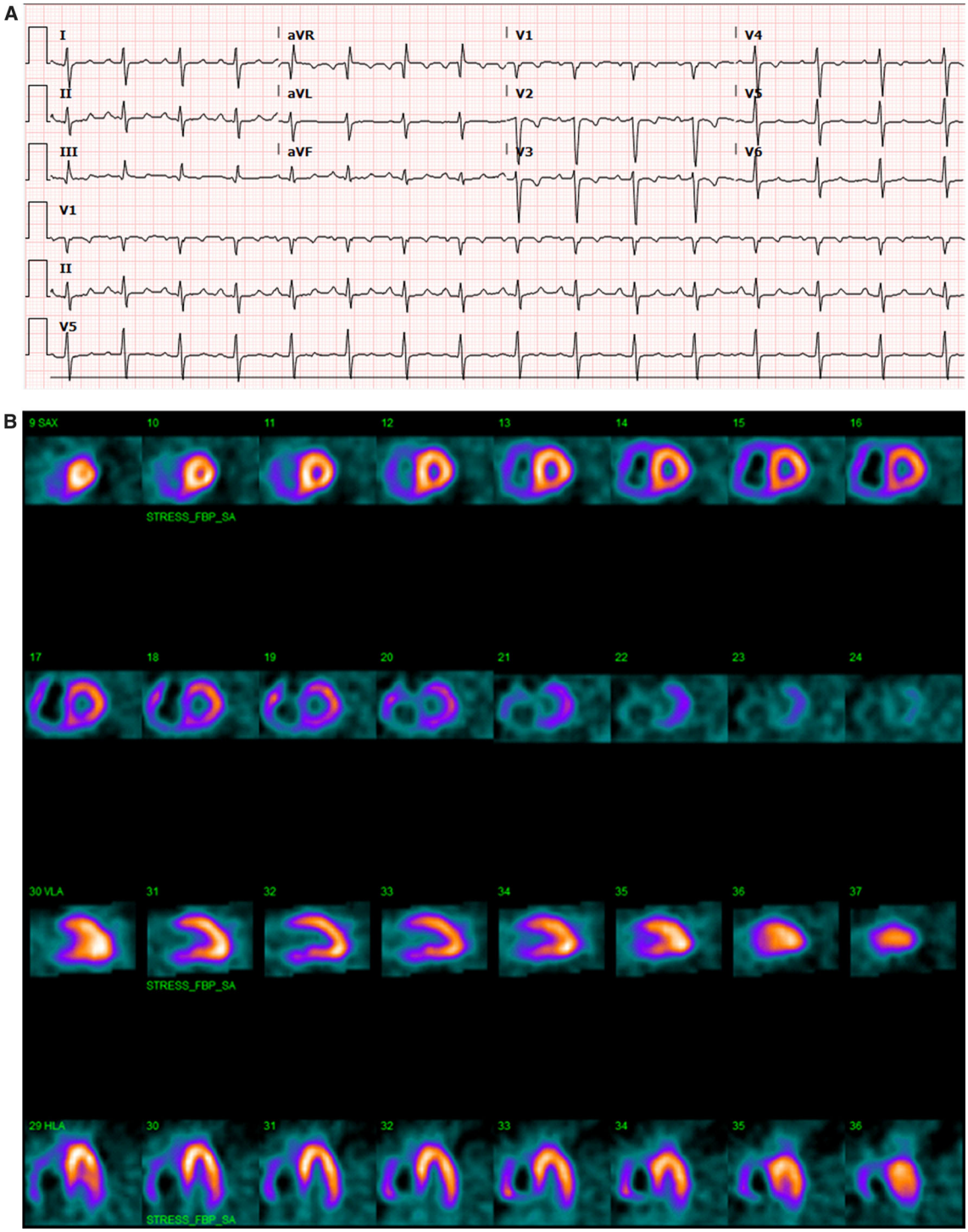

Figure 1. A ECG on presentation to the emergency room showing no significant ischemic changes, right precordial T wave inversions, and right axis deviation. **B** SPECT MPI study showing no perfusion defects with increased radio-tracer uptake in the RV and RV dilatation.

Table 1. Right heart catheterization pressures showing moderate primary pulmonary hypertension

Hemodynamics:
State: AIR REST

Pressures

Site	Systolic	Diastolic	Mean or EDP
RA	9	7	7
RV	46	5	8
PA	53	27	35
PW	12	13	12
RA	12	6	10
AO	117	84	98

Thermodilutions
Cardiac Output: 4.5
Cardiac Index: 1.98

Fick
Cardiac Output : 3.56
Cardiac Index: 1.57

Resistances (dec-5)
Pulmonary- 409
Systemic- 1618

test was terminated due to fatigue with no other symptoms during exercise.

Stress ECG (Figure 2B) showed 4-5 mm ST depression in the inferior and anterolateral leads during peak exercise. The SPECT images were normal (Figure 2C). He was discharged home to follow up with his primary care physician.

Due to the severity of his ECG changes, his primary care physician ordered a coronary computed tomography angiography (CTA) scan (Figure 2D). There was < 50% stenosis of the left main and ostial left anterior descending artery (LAD) but severe distal circumflex disease. The coronary calcium score was 308. Fractional flow reserve (FFR) of the left main and LAD stenosis on invasive angiography were normal (0.87). PCI of the distal circumflex lesion was deferred due to lack of symptoms. His medical regimen was changed to include aspirin, rosuvastatin, and amlodipine.

Teaching Point

The discrepancy between ECG and MPI findings should alert the interpreting physician to 'double check' the images and pay special attention to non-perfusion findings on stress testing. [4,5] Balanced ischemia was not the reason for the normal images in this patient despite the dramatic ECG changes. Small area of ischemia due to distal left circumflex disease could be seen with normal images but as in this case, not likely to require coronary intervention. The good exercise performance was another marker of good outcome. Obviously aggressive medical therapy is warranted. Note that treadmill exercise test alone without imaging will not be useful for future follow up in this patient.

CASE 3

A 61-year-old man with a history of cryptogenic organizing pneumonia, obesity, and sleep apnea was referred to a pulmonologist for evaluation of possible recurrence of his disease after a recent increase in shortness of breath and a decrease in functional capacity. Physical examination was normal with a heart rate of 81 bpm and blood pressure of 104/64 mmHg.

A non-contrasted computed tomography (CT) scan of the chest showed multifocal, ill-defined, ground-glass parenchymal changes largely unchanged from prior studies. The CT scan also showed severe three vessel coronary artery calcification.

A treadmill exercise stress test with 99mTc sestamibi imaging was performed for further risk stratification. He exercised for 6 minutes and 39 seconds

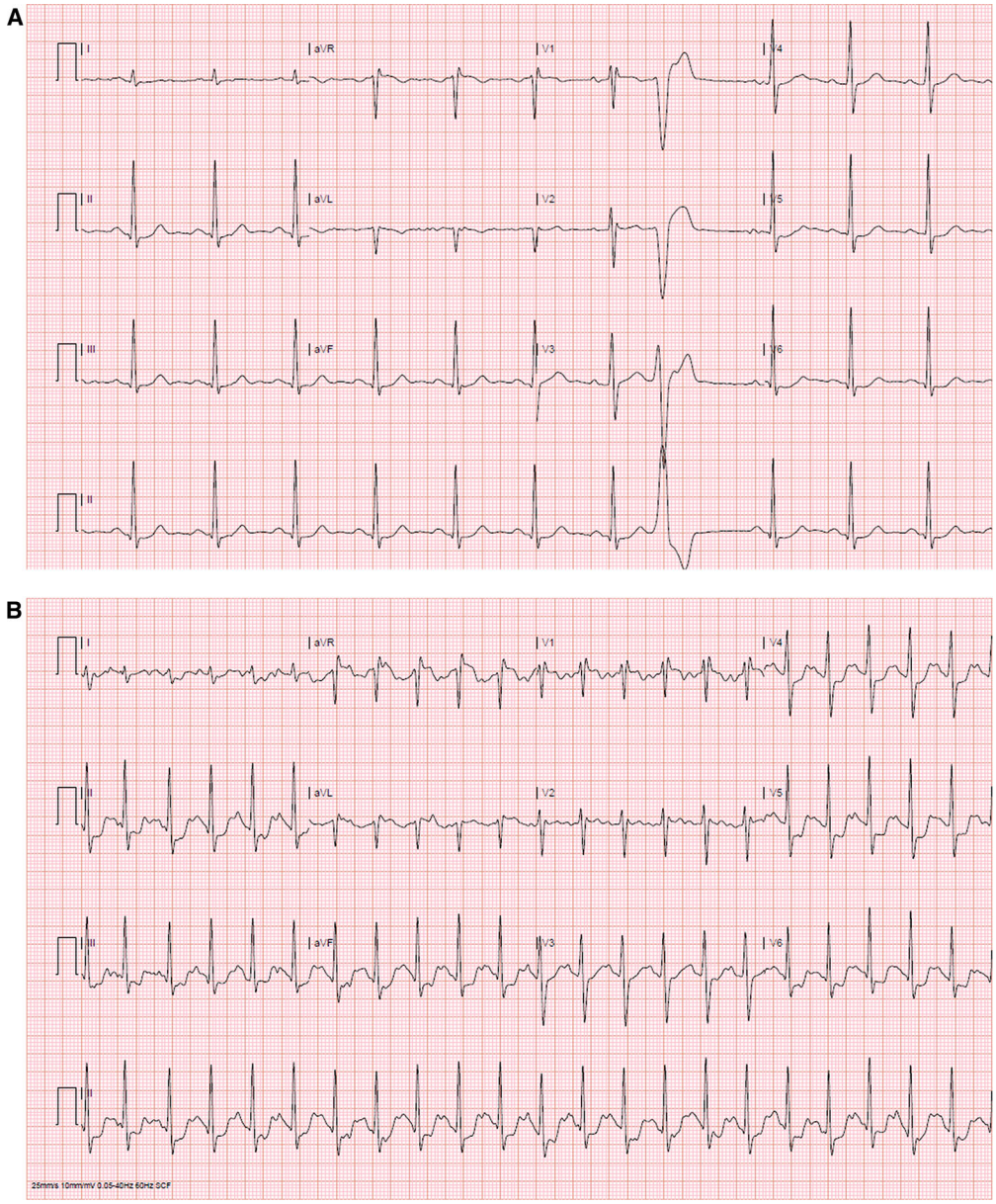

Figure 2. **A** Baseline ECG showing no ischemic changes, incomplete right bundle branch block, and PVC. **B** Stress ECG showing 4-5 mm ST depression in the inferior and anterolateral leads immediately following peak exercise. **C** SPECT MPI study showing normal perfusion. **D** Coronary CTA scan showing calcified stenosis of the left main artery and ostial LAD.

on a standard Bruce protocol representing approximately 75% of his expected exercise capacity and reached 93% of his age-predicted maximal heart rate. The test was terminated due to shortness of breath. The stress ECG showed no evidence of ischemia. The perfusion images showed a large area of ischemia in the distal septum, mid to distal anterior wall, and apex of the LV involving 50% of the LV myocardium. (Figure 3A, B) There was associated LV stunning; LV EF was 35% post stress and 51% at rest.

Coronary angiography showed a 95% severely calcified lesion in the LAD with moderate stenosis in his other coronary arteries (Figure 3C). Percutaneous coronary intervention (PCI) was performed of the LAD lesion without complication.

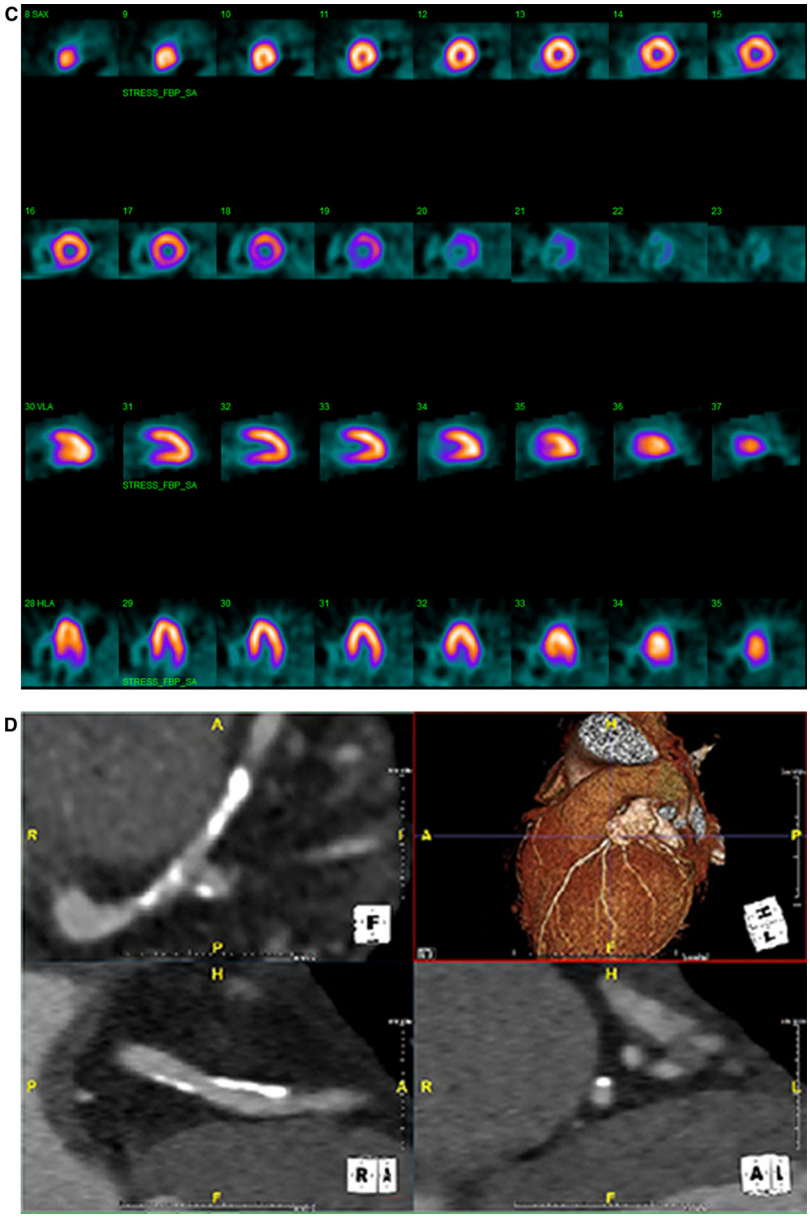

Figure 2. continued.

Teaching Point

Several studies show that coronary angiography in patients with high calcium score however it is obtained (incidental finding in our patient) correlates with the presence of CAD and is predictive of future events. [6,7] MPI can be considered in these patients to add a physiologic assessment and further risk stratify. [8] The precise threshold and the need for downstream resource utilization continue to be moving targets in this patient population. One thing that remains constant is the need for aggressive medical therapy, which was pursued in this patient.

CASE 4

A 43-year-old man with a history of hypertension, hepatitis C, and polysubstance abuse presented to the emergency department with a chief complaint of three hours of sub-sternal chest pain. Physical examination

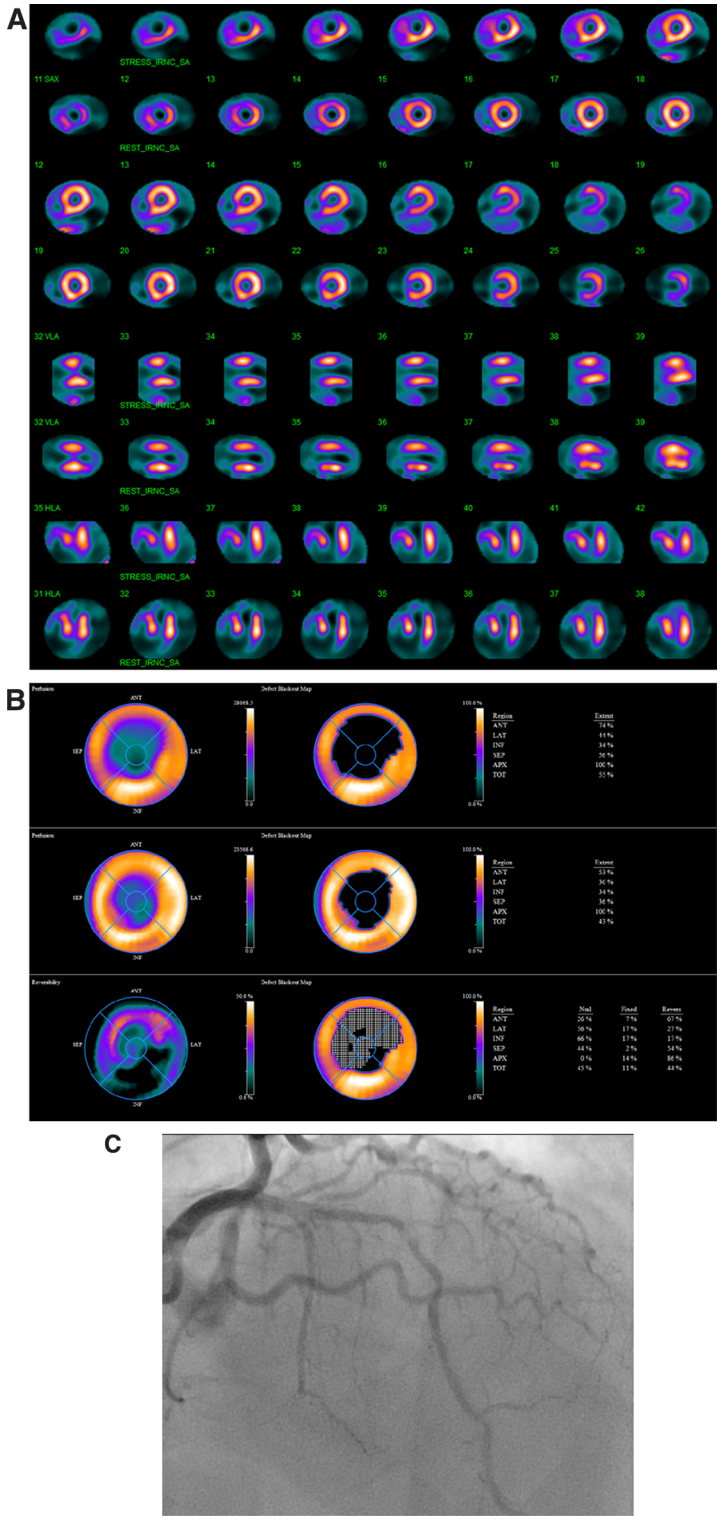

Figure 3. **A** SPECT MPI study showing a large area of ischemia in the distal septum, mid to distal anterior wall, and apex of the LV involving 50% of the LV myocardium. **B** SPECT MPI study polar map showing a large area of ischemia in the distal septum, mid to distal anterior wall, and apex of the LV involving 50% of the LV myocardium. **C** Coronary angiography showing a 95% severely calcified lesion in the LAD.

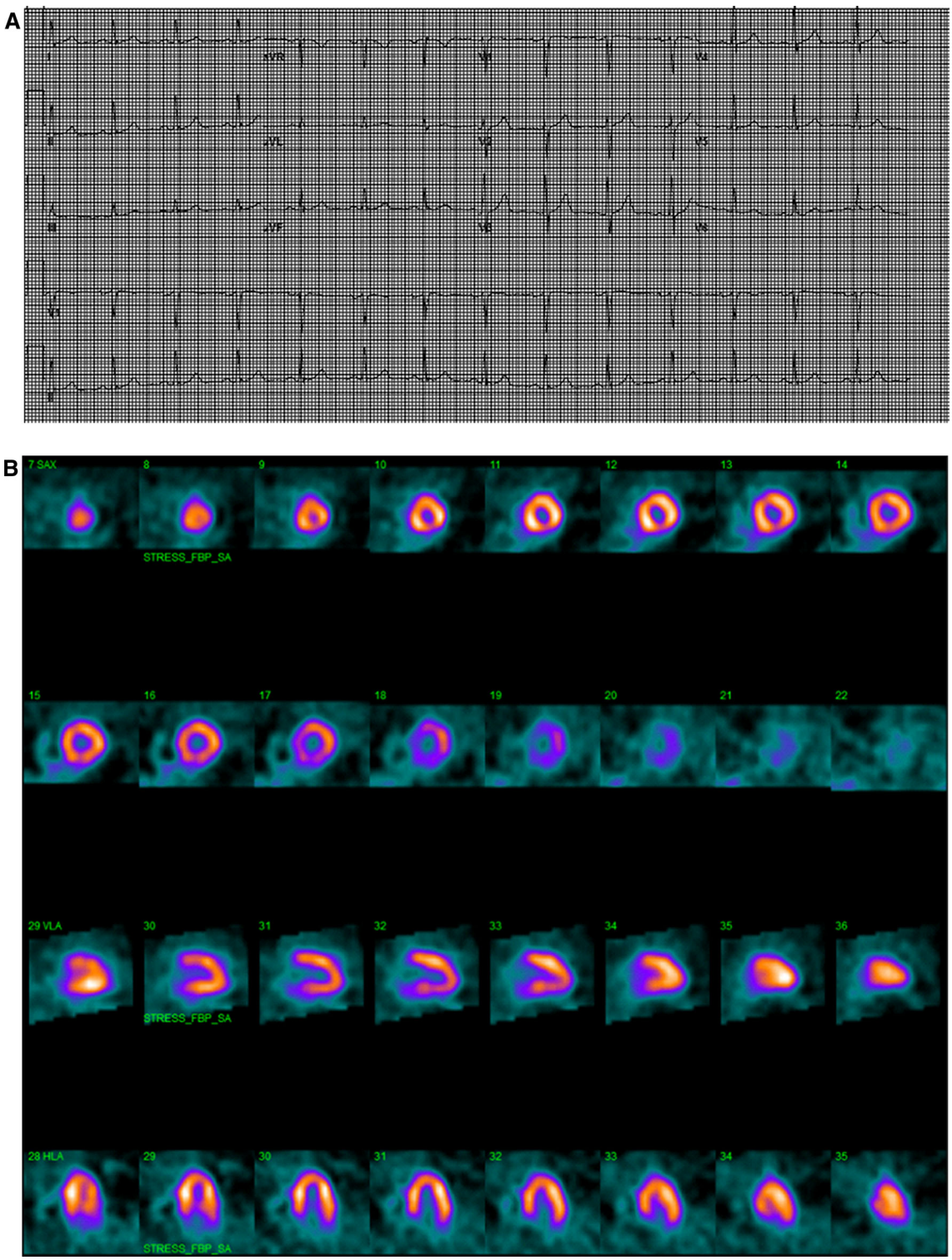

Figure 4. **A** ECG on initial presentation to the emergency room showing no significant ischemic changes. **B** SPECT MPI study showing normal perfusion. **C** ECG on representation to the emergency room showing ST elevation in the inferior leads. **D** Coronary angiogram showing an acute thrombus in the distal right coronary artery.

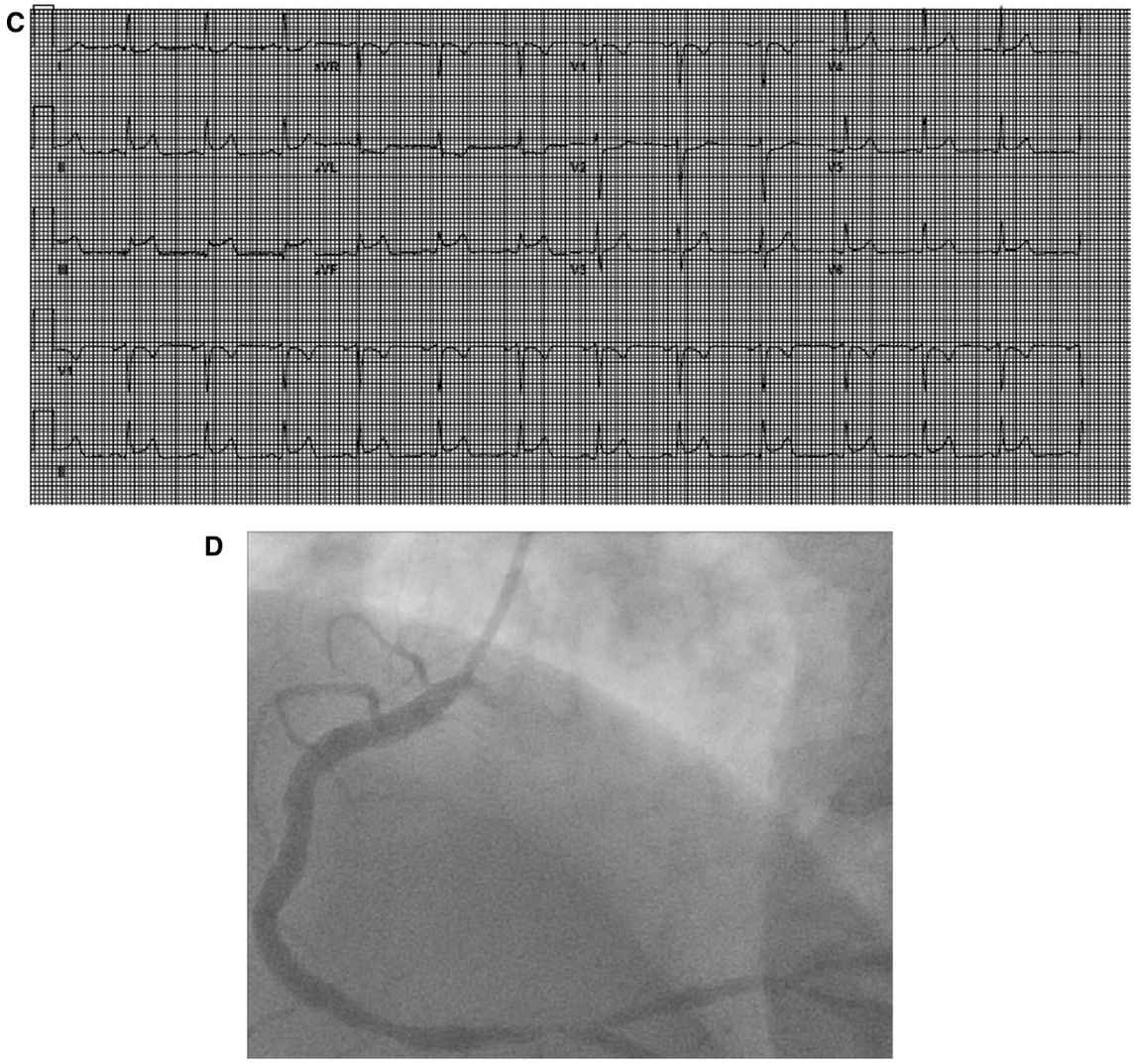

Figure 4. continued.

revealed him to be hypertensive with a blood pressure of 153/73 mmHg but was otherwise normal with a heart rate of 96 bpm. The coronary risk factors included hypertension, history of illicit drug use, and tobacco use.

The ECG (Figure 4A) showed no evidence of acute ischemia or MI. The initial Troponin-I was mildly elevated at 0.033 ng/ml (upper limit of normal 0.030 ng/ml) which trended up to a peak level of 0.183 ng/ml 5 hours later. Urine drug screen (UDS) was positive for amphetamines, opiates, and cannabinoids.

He was admitted to a chest pain observation unit. A regadenoson SPECT MPI was performed. Stress ECG was negative for ischemia and the perfusion images were normal. (Figure 4B) LVEF was 52%.

The troponin elevation was labeled a type 2 non-ST-elevation myocardial infarction (NSTEMI) and was attributed to his recent amphetamine use. Following counseling on cessation of illicit drug use, he was scheduled follow up and discharged home. He returned to the emergency department six days later again with complaints of chest pain. The ECG showed ST-elevation MI (STEMI) in the inferior leads. (Figure 4C). He was urgently taken to the cardiac catheterization laboratory where he suffered a ventricular fibrillation arrest on arrival. He was successfully resuscitated and a coronary angiogram was performed showing an acute thrombus in the distal right coronary artery. (Figure 4D) PCI was performed without incidence. UDS was again positive for amphetamines.

Teaching Point

Normal MPI is associated with low risk in the intermediate term in the majority of patients presenting with suspected CAD. However, use of illicit drugs is associated with vasospasm, plaque rupture, and thrombus formation even in the absence of underlying CAD.[9] Patients should be advised of the increased risk with continued drug use and encouraged to seek help.

Disclosures

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