Case Study
IQ•SPECT: LAD Territory Ischemia

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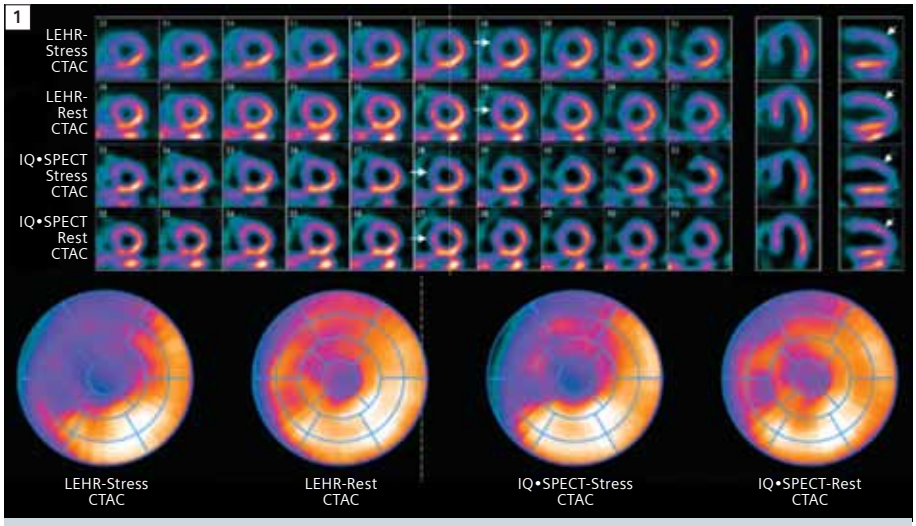
Case study data provided by University of Michigan, Ann Arbor, MI, USA

HISTORY

A 78-year-old male (86 kg;190 lbs) with long-standing history of diabetes, hypertension and dyslipidemia presented with complaints of exertional chest pain with associated shortness of breath progressively increasing for the last 6 months. The patient had no previous history of acute myocardial infarction or cardiac investigation. The patient underwent a ^{99m}Tc MIBI stress-rest myocardial perfusion SPECT•CT procedure. Routine LEHR imaging was followed by an IQ•SPECT study using a SMARTZOOM collimator and cardiocentric orbit for acquisition of myocardial perfusion SPECT in only four minutes.



1 As seen in the image, the attenuation corrected LEHR stress study shows dilated LV with severe but reversible ischemia involving the whole of the anterior wall, septum and apex (LAD territory). Severe perfusion defect in the LAD territory at peak stress shows significant improvement in uptake at rest, suggesting complete reversibility of LAD ischemia. The lateral wall and inferior wall shows normal perfusion both during stress and rest. There is significant amount of post stress LV dilatation with reduction in LV cavity size at rest. However, resting LV appears slightly dilated as well probably reflecting some amount of resting ischemia related to the severity of LAD stenosis. Ejection fraction at 50% was borderline normal.

EXAMINATION PROTOCOL

The patient exercised on a treadmill for two minutes at stage III of the Bruce protocol with total exercise duration of eight minutes. He achieved a maximum workload of 10.2 METS and achieved a peak heart rate of 81% of target. Exercise was discontinued due to fatigue. There was 1.9 mm downsloping ST depression in anterior, inferior and inferolateral leads during peak stress and during recovery. 21.5 mCi ^{99m}Tc MIBI was injected at peak stress and SPECT•CT study was performed 24 minutes after injection.

Initial study was performed on a Symbia™ T16 SPECT•CT system using standard LEHR collimator. Low-dose diagnostic CT at end tidal expiratory breath-hold was performed for attenuation correction followed by SPECT acquisition. Following completion of the standard SPECT•CT study, the collimator was changed to a SMARTZOOM collimator and an IQ•SPECT study was performed without any change in the patient's position. The LEHR and IQ•SPECT studies were both attenuation corrected using the low-dose CT data.

Rest study was performed four hours following the stress study after a resting injection of 42 mCi of ^{99m}Tc MIBI. Similar acquisition protocol with LEHR and IQ•SPECT was followed.

The acquisition parameters of the LEHR and IQ•SPECT studies were as follows:

- **LEHR Stress:** 32 frames 22 sec per frame (total acquisition time 13 min)
- **LEHR Rest:** 32 frames 11 sec per frame (total acquisition time 7 min)
- **IQ•SPECT Stress:** 17 frames 9 sec per frame (total acquisition time 4 min)
- **IQ•SPECT Rest:** 17 frames 9 sec per frame (total acquisition time 4 min)

DIAGNOSIS

The attenuation-corrected IQ•SPECT study depicted in the image above at the same slice levels also shows similar level of reversible LAD territory ischemia, as well as stress-induced LV dilatation. Visually, as well in the bull's eye view, there is apparently no difference in the LEHR and IQ•SPECT studies, although the IQ•SPECT study was acquired in just four minutes.

From the SPECT study, the clinical impression was of severe, but completely reversible, LAD territory ischemia—probably reflecting tight proximal LAD stenosis without significant involvement of RCA or left circumflex artery.

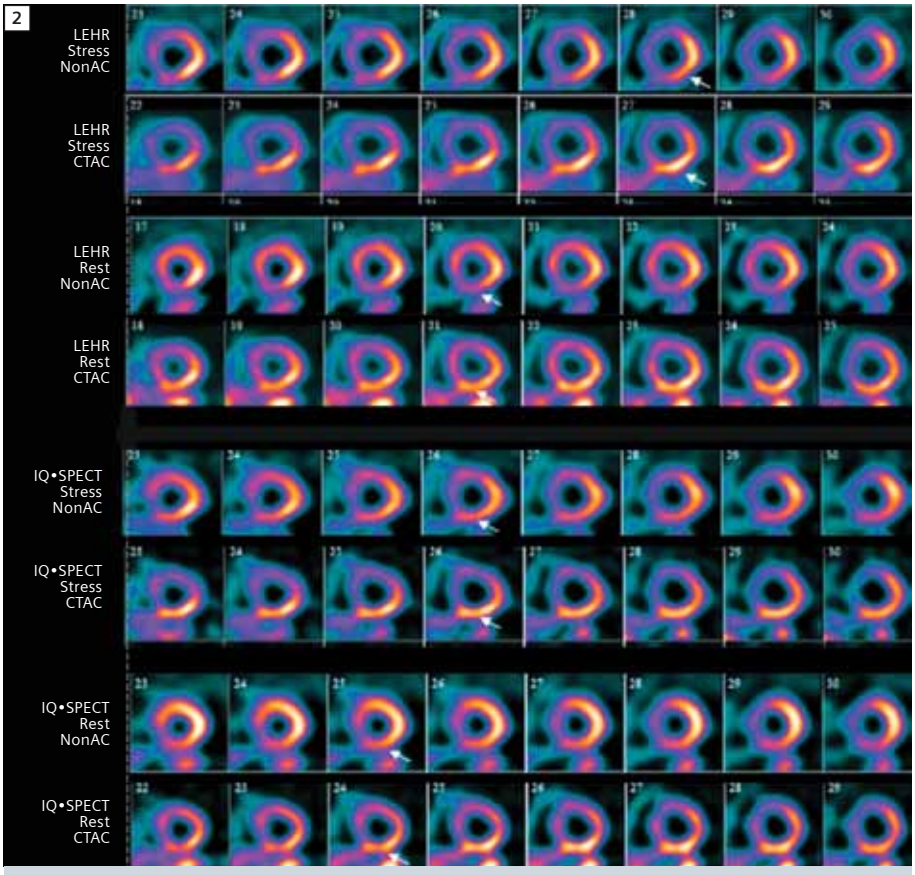
CT calcium score was performed as part of the SPECT•CT procedure and revealed extensive calcification of the LAD with significant calcification in the RCA and left circumflex as well. The calcium score values indicated:

- Lt. Main: 177
- LAD: 1421
- Lt Cx: 517
- RCA: 385
- Total: 2500

The patient was subjected to coronary angiography which revealed 90% ostial stenosis in the LAD with another 70% stenosis at mid LAD at the bifurcation of D2 (second diagonal). The left circumflex was the dominant vessel with 30% ostial stenosis and mid 20% stenosis. The right coronary artery was non-dominant with a mid 90% stenosis.

The coronary angiography results positively correlate with the SPECT results and demonstrate tight ostial LAD stenosis which explains the severe, but reversible, ischemia in the entire LAD territory (anterior wall, apex and septum) with absence of significant stenosis in the left circumflex. This explains normal perfusion in lateral wall and inferior wall. Since the left circumflex is dominant, the contribution of RCA to the inferior and inferolateral wall perfusion is lower, and thus, a mid 90% stenosis in RCA does not compromise inferior wall perfusion.

In view of the cardiac catheterization and SPECT results, the patient was referred for revascularization—preferably CABG with LIMA to LAD and SVG to diagonal grafts. However, PCI to LAD stenosis was a choice as well.



2 Comparison of uncorrected and CT-attenuation-corrected LEHR Stress and Rest as well as uncorrected and CT-attenuation-corrected IQ•SPECT short-axis views clearly show inferior and inferolateral wall attenuation being corrected by CTAC in both LEHR and IQ•SPECT studies. The attenuation correction improves the uptake in the inferior wall, while more clearly defining the perfusion defect in the ischemic anterior wall and septum. The degree of attenuation correction is well defined in both LEHR and IQ•SPECT studies, showing that in both approaches CTAC works correctly.

COMMENTS

This study illustrates the correlation of stress-rest myocardial perfusion SPECT in delineation of significant ischemia, estimation of reversibility and severity of ischemia as well as prediction of the degree of stenosis in individual coronary arteries. Although SPECT is an established procedure, the ability of IQ•SPECT to produce similar results as LEHR SPECT in terms of defect size and reversibility, LV dilatation, myocardial thickness and LV function is remarkable since it is just a 4-minute acquisition. The ability of IQ•SPECT to reflect functional information obtained from a much longer LEHR study is key to its adoption as an ultrafast cardiac imaging technology with integrated CT attenuation correction which can be adapted to any Symbia SPECT or SPECT•CT system without the need for a dedicated cardiac SPECT imaging system.