What is this image? 2018: Image 1 result
The value of diastole perfusion

Francesco Nudi, MD,[a,b,c] Orazio Schillaci, MD,[d,e] Alessandro Nudi, MD,[c] and Giuseppe Biondi-Zoccai, MD, MStat[e,f]

a Service of Hybrid Cardio Imaging, Madonna della Fiducia Clinic, Rome, Italy
b Ostia Radiologica, Rome, Italy
c ETISAN, Rome, Italy
d Division of Nuclear Medicine, Tor Vergata University, Rome, Italy
e Department of AngioCardioNeurology, IRCCS Neuromed, Pozzilli, Italy
f Department of Medico-Surgical Sciences and Biotechnologies, Sapienza University of Rome, Latina, Italy

CLINICAL HISTORY

A 68-year-old gentleman underwent stress/rest myocardial perfusion imaging (MPI) at our institution for recurrence of chest pain during exercise ECG testing. He reported prior smoking, hypercholesterolemia, arterial hypertension, and obesity. His clinical history was significant for ST-elevation myocardial infarction (STEMI) due to mid left anterior descending (LAD) disease 6 months earlier, which had been treated with primary percutaneous coronary intervention (PCI) with drug-eluting stent (DES) implantation (Figure 1).

Discharge echocardiography had shown a mild reduction in global left ventricular systolic function (ejection fraction 48%), with apical hypokinesis. Subsequently, he had felt well and maintained an active lifestyle, without recurrence of cardiovascular symptoms. Medical therapy included aspirin, metoprolol, lisinopril, amlodipine, simvastatin, ezetimibe, and lansoprazole. Follow-up exercise ECG testing 6 months after PCI showed equivocal non-diagnostic changes of ST segment and T wave, due to baseline abnormalities, but was positive for mild anginal chest pain during stress (Figure 2). Thus, he was referred for stress/rest MPI.

IMAGING

After adequate drug washout (temporary discontinuation of metoprolol), he underwent bicycle exercise stress with administration of ^{201}Tl and image acquisition with a cadmium-zinc-telluride (CZT) camera (Discovery NM 530c with Alcyone technology, GE Healthcare, Haifa, Israel). He developed mild angina at maximum workload of 100 Watts, but without ST-T changes. Ungated images showed the presence of moderate apical necrosis (scar, fixed defect) with mild residual ischemia (reversible defect, Maximal Ischemia Score [MIS] = 2; Maximal Necrosis Score [MNS] = 3) (Figures 3, 4).[1,2]

Gated end-systole single photon emission computed tomography (SPECT) images suggested the presence of a severe apical necrosis with minimal residual ischemia (MIS = 1; MNS = 4) (Figure 5).

Conversely, gated end-diastole SPECT images showed a largely reversible perfusion defect compatible with severe apical ischemia with minimal residual necrosis (MIS = 4, MNS = 1) (Figure 6; Table 1). Additional ungated analysis with bullseye and 3D reconstruction, as well as 3D-gated imaging and phase analysis all suggested that the apical region was characterized by myocardial necrosis with mild residual ischemia associated with abnormal wall motion/thickening, i.e., severe hypokinesis (Figures 7, 8, 9). The images also show inferior and distal anterior ischemia.
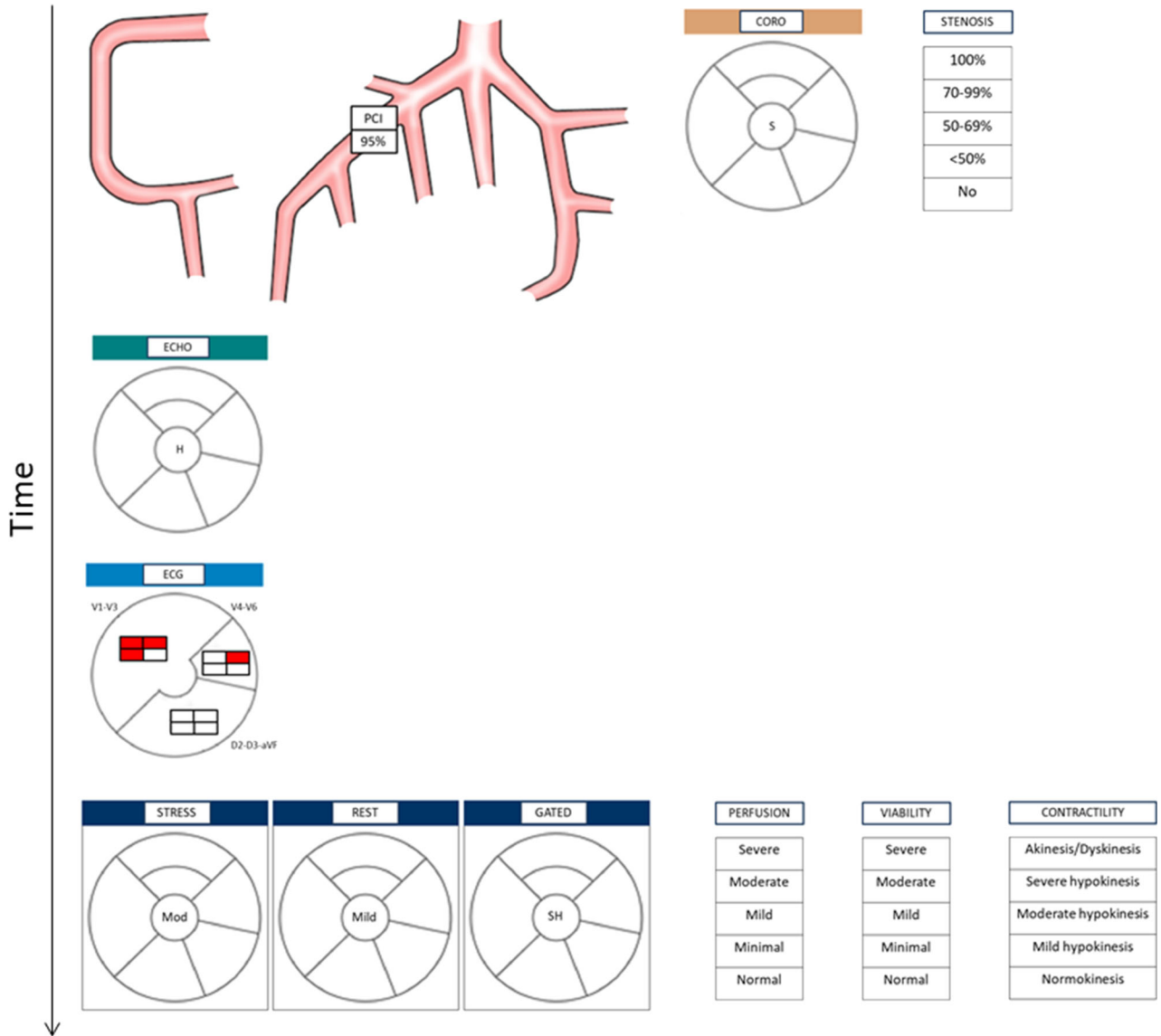
Figure 1. Parametric summary of prior coronary angiography (in brown), echocardiography (in green), ECG stress testing (in light blue), and ungated myocardial perfusion imaging details (in dark blue). The seven myocardial regions are summarized graphically for echocardiography (*H*, hypokinesis) and myocardial perfusion imaging (*Mod*, moderate defect; *SH*, severe hypokinesis), and the three main ECG axis as well (left top square: baseline QS; right top square: baseline ST-T changes; left bottom square: stress T changes; right bottom square: stress ST changes).
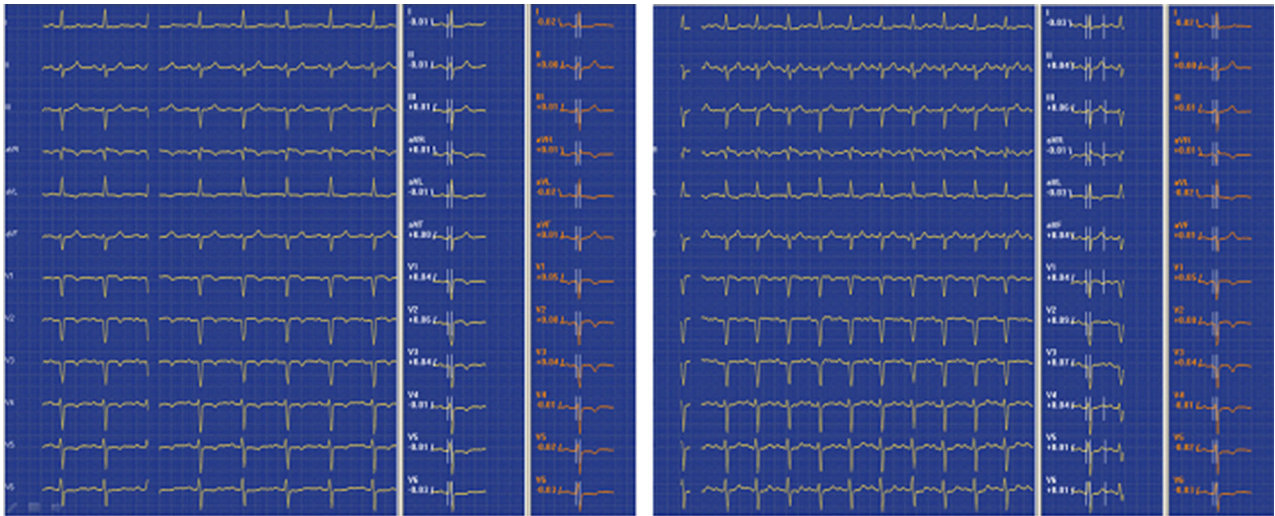
Figure 2. ECG at baseline and during peak exercise stress test (respectively, left and right panel), showing baseline QS, with ST-T changes during stress which were not significant in comparison to baseline.
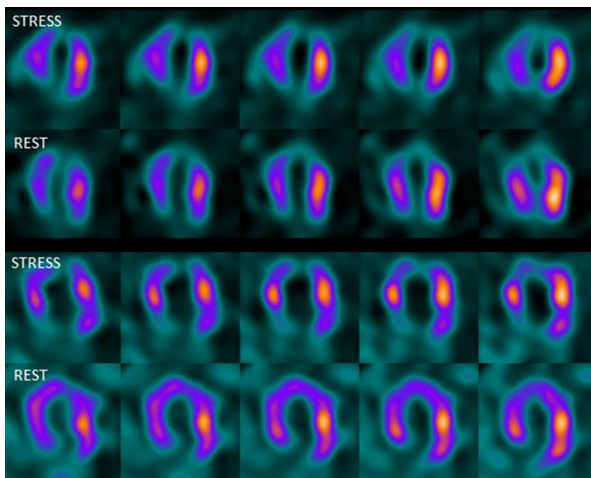

Figure 3. The image as presented in the original survey question (with two vertical panels obtained from selected slices of, from top to bottom, Figures 5 and 6, showing, respectively, end-systolic and end-diastolic stress/rest myocardial perfusion images).

MANAGEMENT

The patient was thus referred for coronary angiography, which showed sub-occlusive in-stent restenosis of the LAD. He underwent repeat PCI with a drug-eluting balloon.[3] The right coronary artery was chronically occluded and was not revascularized. Therapy at discharge included aspirin, clopidogrel, metoprolol, lisinopril, amlodipine, simvastatin, ezetimibe, and lansoprazole. No adverse event was reported up to 10 months after the procedure.

TEACHING POINTS

- Accurate interpretation of MPI for diagnostic or prognostic purposes is a multidimensional task, and cannot rest on a reductionist approach.
- No single image or result should be interpreted in isolation, but instead put into the broader context of the test results, exploiting rather than ignoring apparent discrepancies.
- CZT cameras provide in general satisfactory quality imaging for MPI, which compares favorably to Anger cameras.
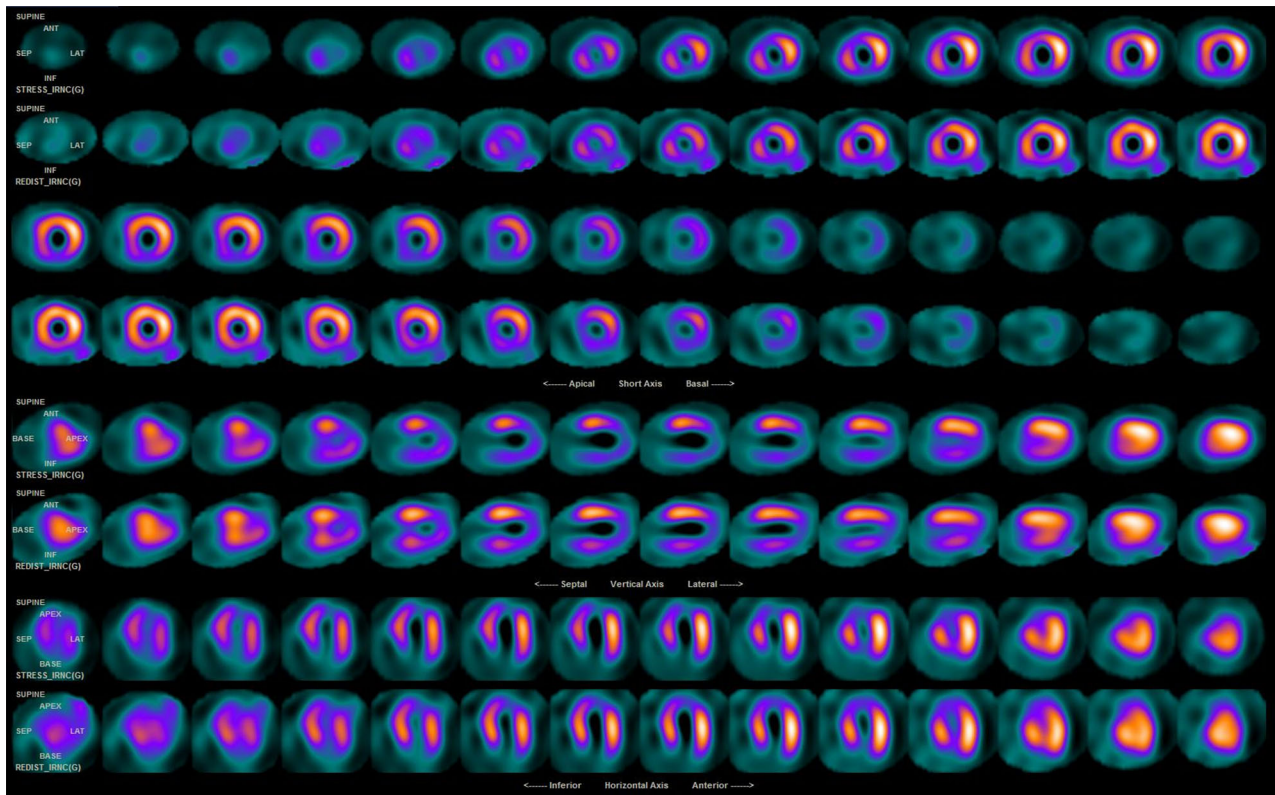
Figure 4. Ungated stress/rest myocardial perfusion images suggesting the presence of moderate apical necrosis with mild residual ischemia. There is also ischemia in distal anterior and antero-septal segments and in the inferior wall.

- CZT cameras provide good-quality imaging even at end-diastole, at odds with a lower-quality imaging provided by Anger camera.
- Partial volume effect is reduced by CZT cameras given their better spatial resolution.
- It is important to evaluate the end-diastolic and end-systolic images in some patients when using the newer generation CZT cameras although more studies are needed in this area.
- CZT cameras, for instance, enable in patients with septal defects the differential diagnosis between left bundle branch block and LAD disease.[4]

FEATURE RESULTS

There were 56 responses from around the world, of which 2 were nearly correct. Other responses included ischemia, scar (or both) in the distribution of the LAD, multi-vessel or left main disease, some sort of artifact, attenuation corrected images, aneurysm, thallium redistribution, Takotsubo cardiomyopathy, and before and after revascularization.

The winner was:

**Saara Sillanmäki, Kuopio University Hospital, Finland**

Her response was: ''There are two set of images; I name them as A and B. In the first one (A) these seems to be an apical scar. In the second set (B) these is ischemia in apical area and in the septo-basal area.''

Submitted by

Francesco Nudi, MD
Orazio Schillaci, MD
Alessandro Nudi, MD
Giuseppe Biondi-Zoccai, MD, MStat

Disclosures

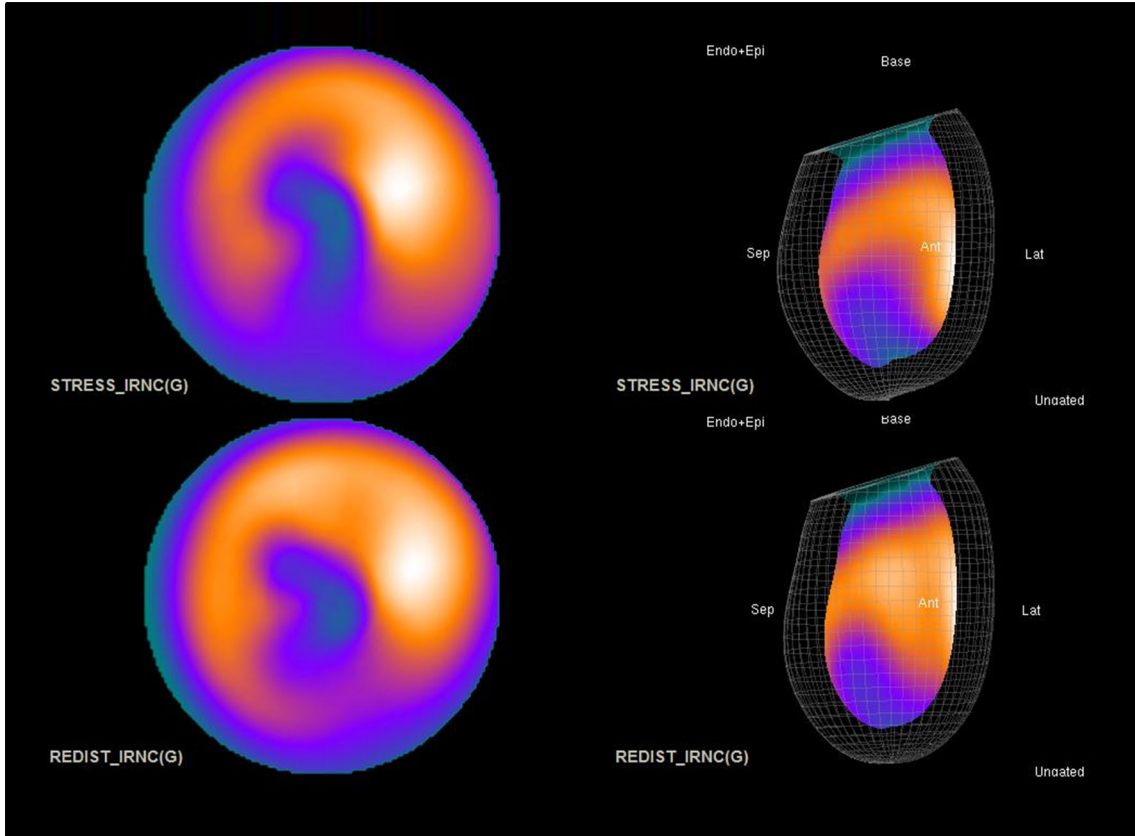*The authors declare that they have no conflicts of interest.*
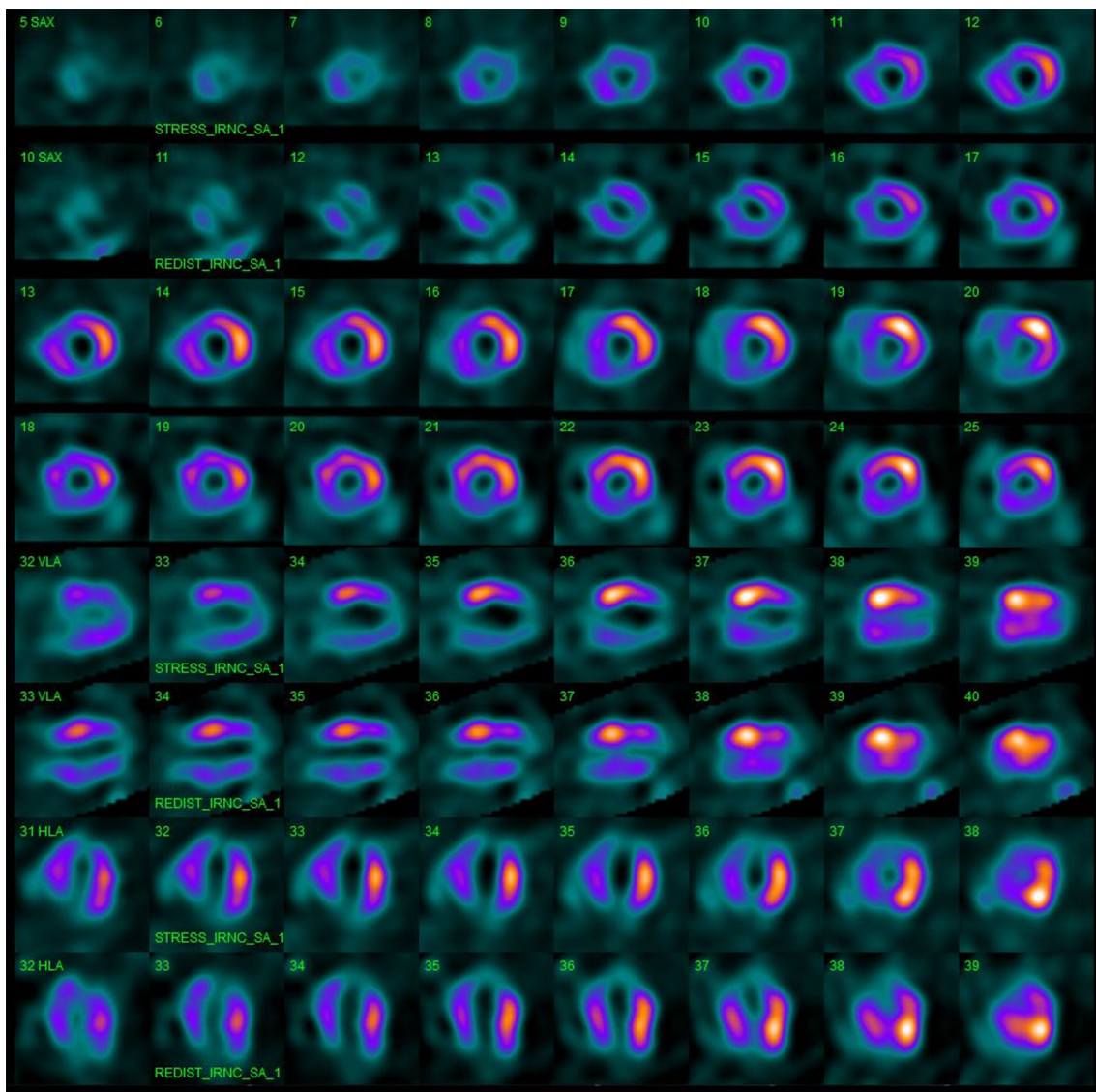
Figure 5. Stress/rest myocardial perfusion imaging with end-systolic gated acquisition, suggesting the presence of severe apical necrosis with minimal residual ischemia. The other abnormalities are also seen.
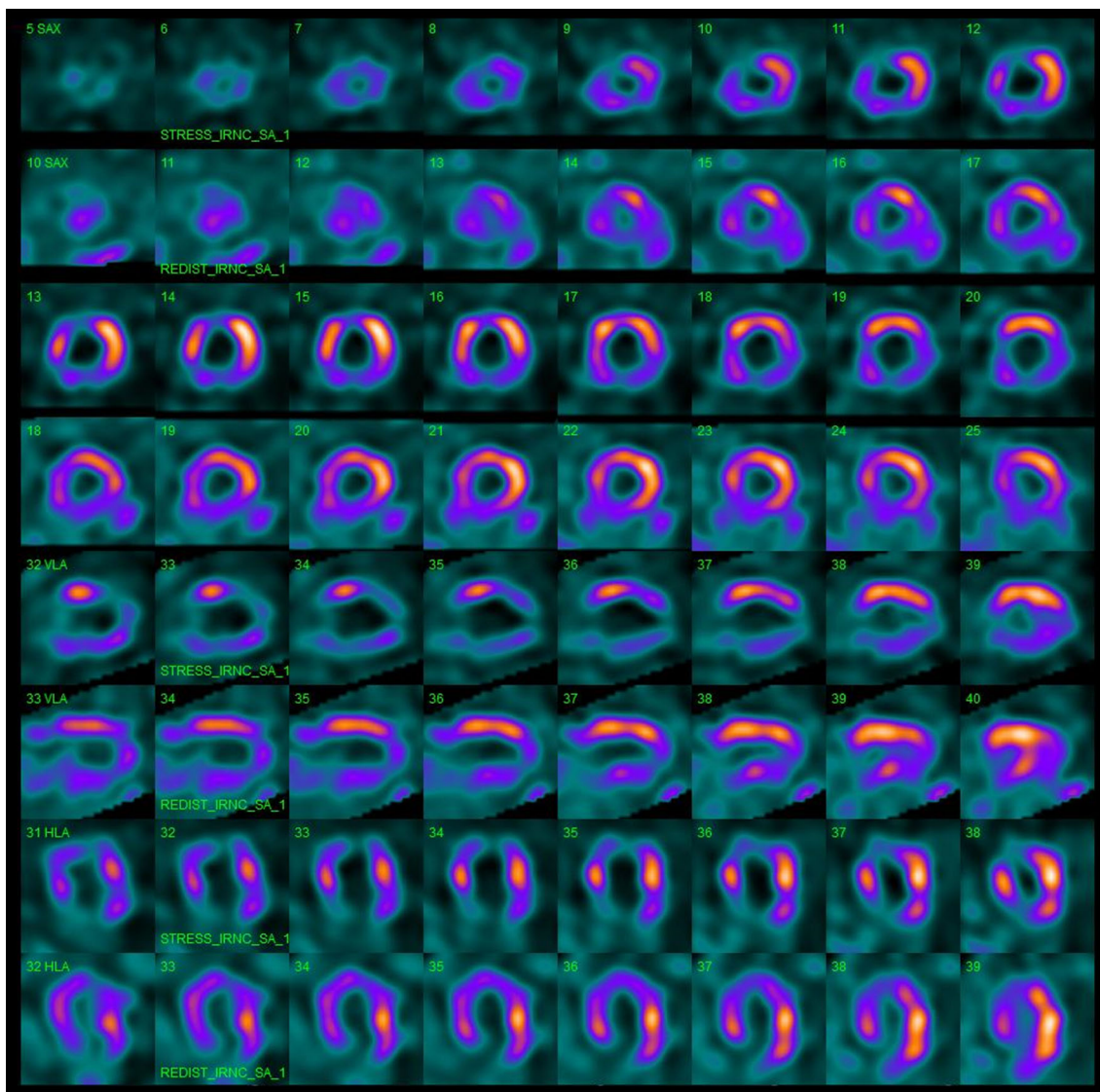
Figure 6. Stress/rest myocardial perfusion imaging with end-diastolic gated acquisition, suggesting the presence of severe apical ischemia with minimal residual necrosis. The other abnormalities are also seen.

Table 1. Discrepancies in maximal ischemia score (MIS) and maximal necrosis score (MNS) during end-systolic and end-diastolic myocardial perfusion imaging

Imaging	MIS	MNS
Stress$_{systole}$ − Stress$_{diastole}$	1	4
Rest$_{systole}$ − Rest$_{diastole}$	4	1

Figure 7. Stress/rest myocardial perfusion imaging with ungated acquisition, in bullseye and 3D reconstruction, suggesting the presence of moderate apical necrosis with minimal residual ischemia.
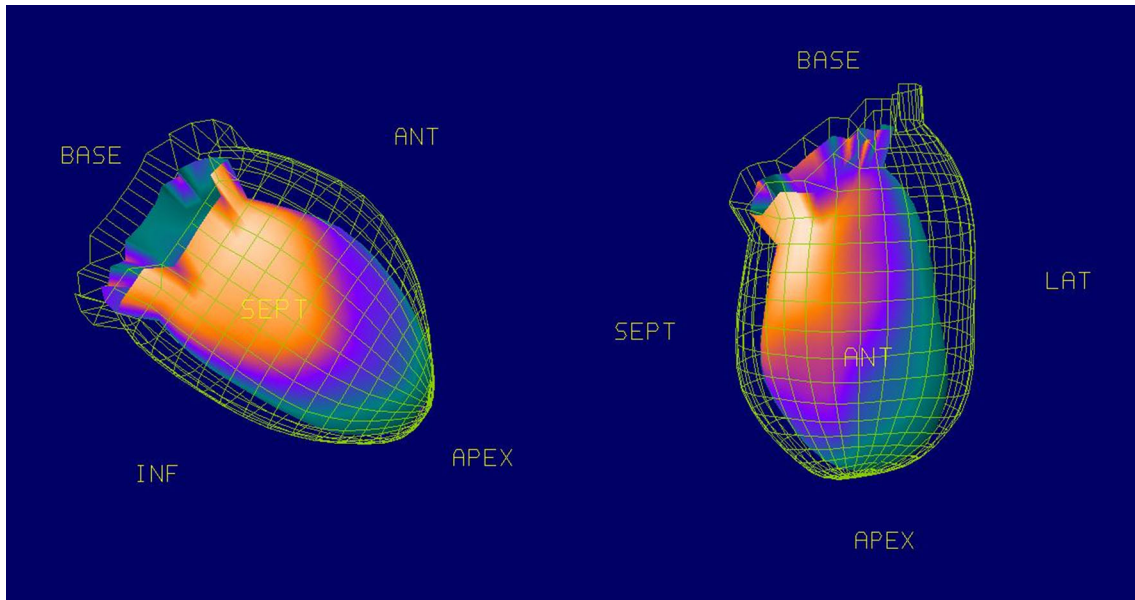
Figure 8. 3D-gated imaging in the right anterior oblique and left anterior oblique projections, suggesting the presence of severe apical hypokinesis.
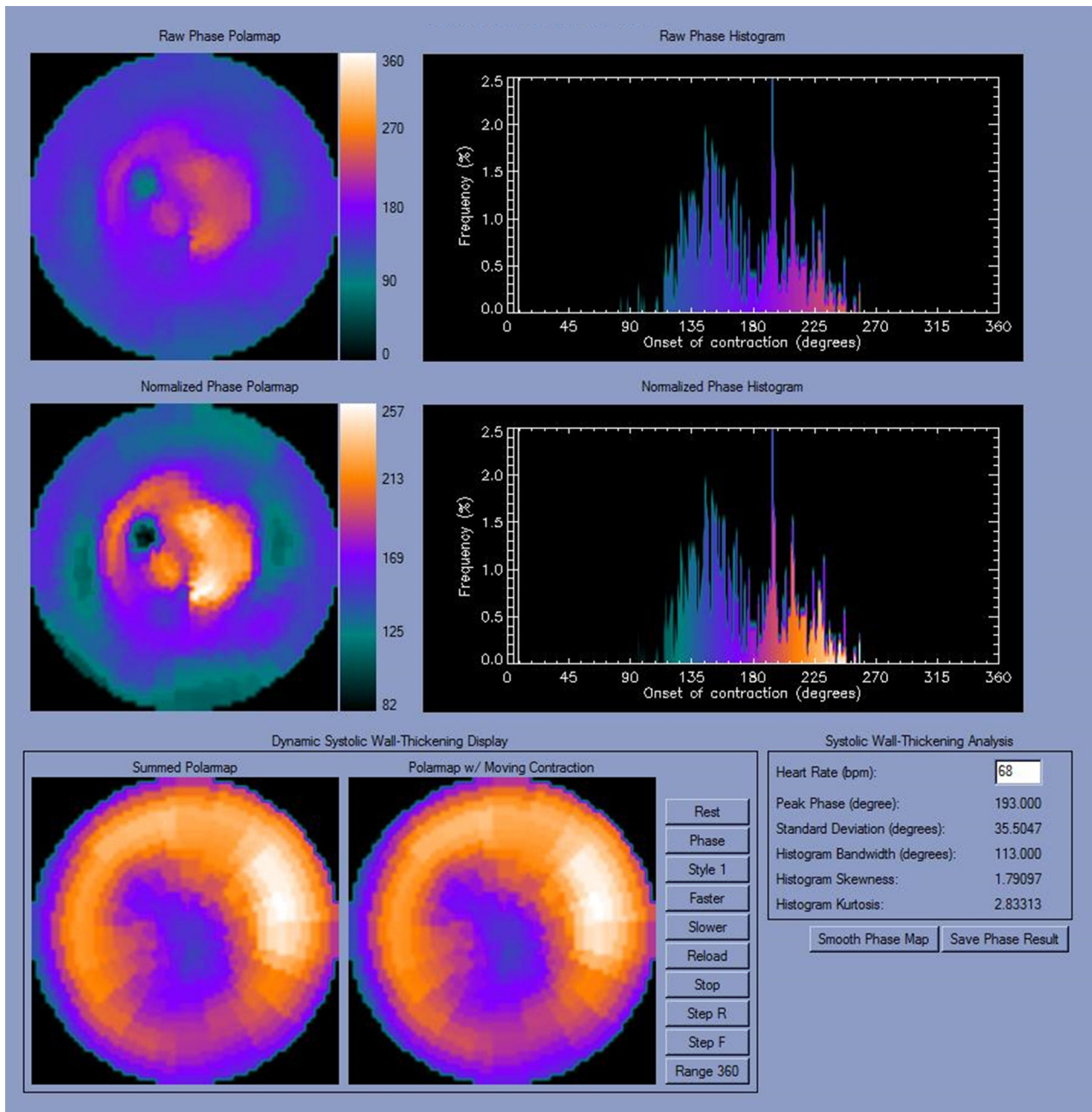
Figure 9. Rest myocardial dyssynchrony by phase analysis, suggesting the presence of apical dyssynchrony.

References

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