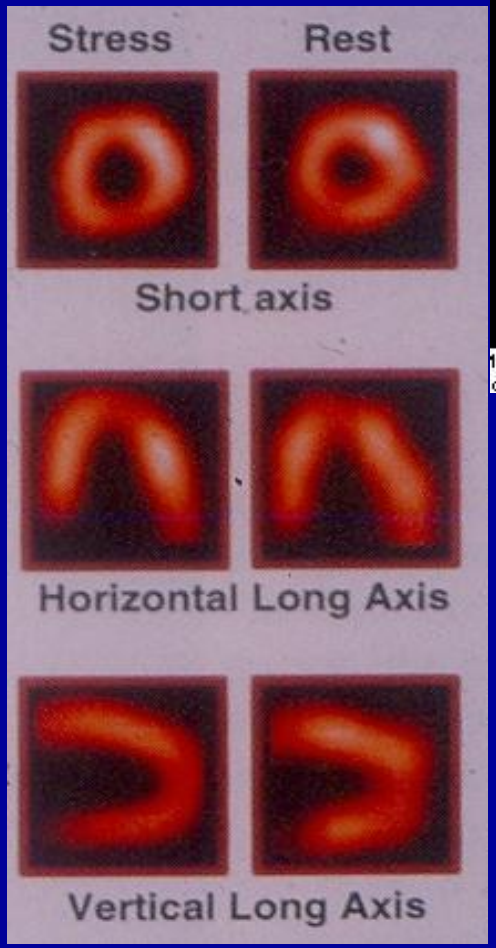
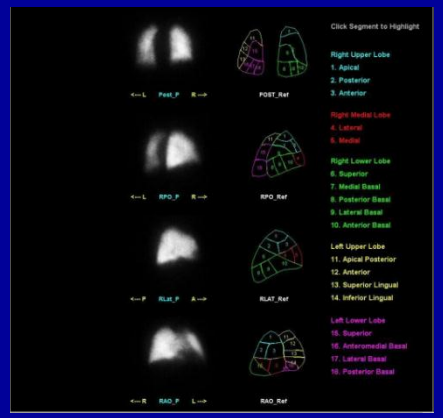
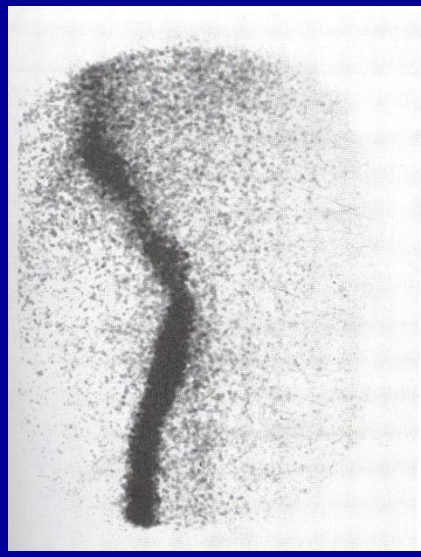
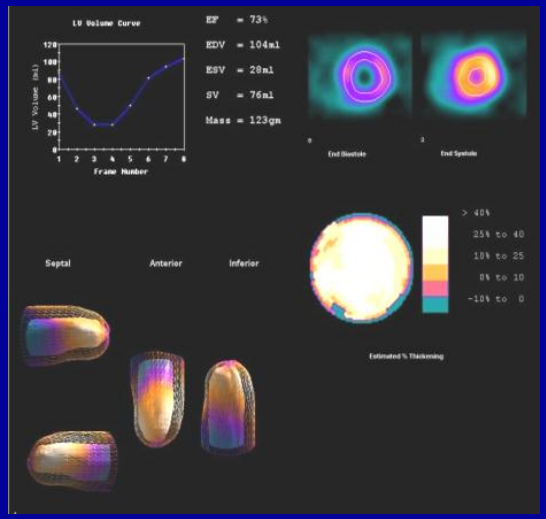
NUCLEAR IMAGING OF THE HEART, LUNG AND BLOOD VESSELS









Assoc. prof. A. Punda, MD, PhD

Assoc. prof. V. Marković, MD, PhD

S. Gračan, MD, nucl. med. spec.

Nuclear medicine in cardiology

- **Perfusion :** myocardial perfusion scintigraphy
- **Function:** readionuclide ventriculography
- **Shunts:** first-pass angiocardiography
- **Myocardial infarction scintigraphy**
- **Metabolisam:** fatty acid, glucose, oxidative metabolisam, hypoxia
- **Inervation:** chatecolamin analogs, antagonists of ß-receptors
- **Atherosclerosis:** proliferration smooth muscle cells labeled antibodies
- **Angioscintigraphy**
- **Thromb formation**

Myocardial perfusion scintigraphy

- Based on the fact that the distribution of some radiopharmaceuticals is proportional to the blood flow through specific myocardial segment
- Significance of coronary stenosis
- Quantification posibility

Radiofarmaceuticals and their biodistribution

- Thallium -201 cloride
- monocation compounds labeled with Tc-99m (Isonitril, Tetrofosmin, Teboroxim, Furofosfin)

- N-13-ammonia and Rubidium-82-cloride (PET) (N-13: $T_{1/2}$=10 min; Rb-82: $T_{1/2}$=1,3 min)

Tl-201

- cyclotrone-produced, potassium analog
- $T_{½}$ = 73 h
- X - rays: 69-83 keV (98%)
- y - emission: 135 keV (2%) and 167 keV (8%)
- distribution – 40 min after injection
- redistribution

Tl- 201

- **advantages:** significant extraction fraction and redistribution allows for simultaneously assesment of coronary blood flow and myocardial viability

- **disadvantages**: unfavorable physical characteristics (energy and T ½); cyclotrone produced (cost and availability)

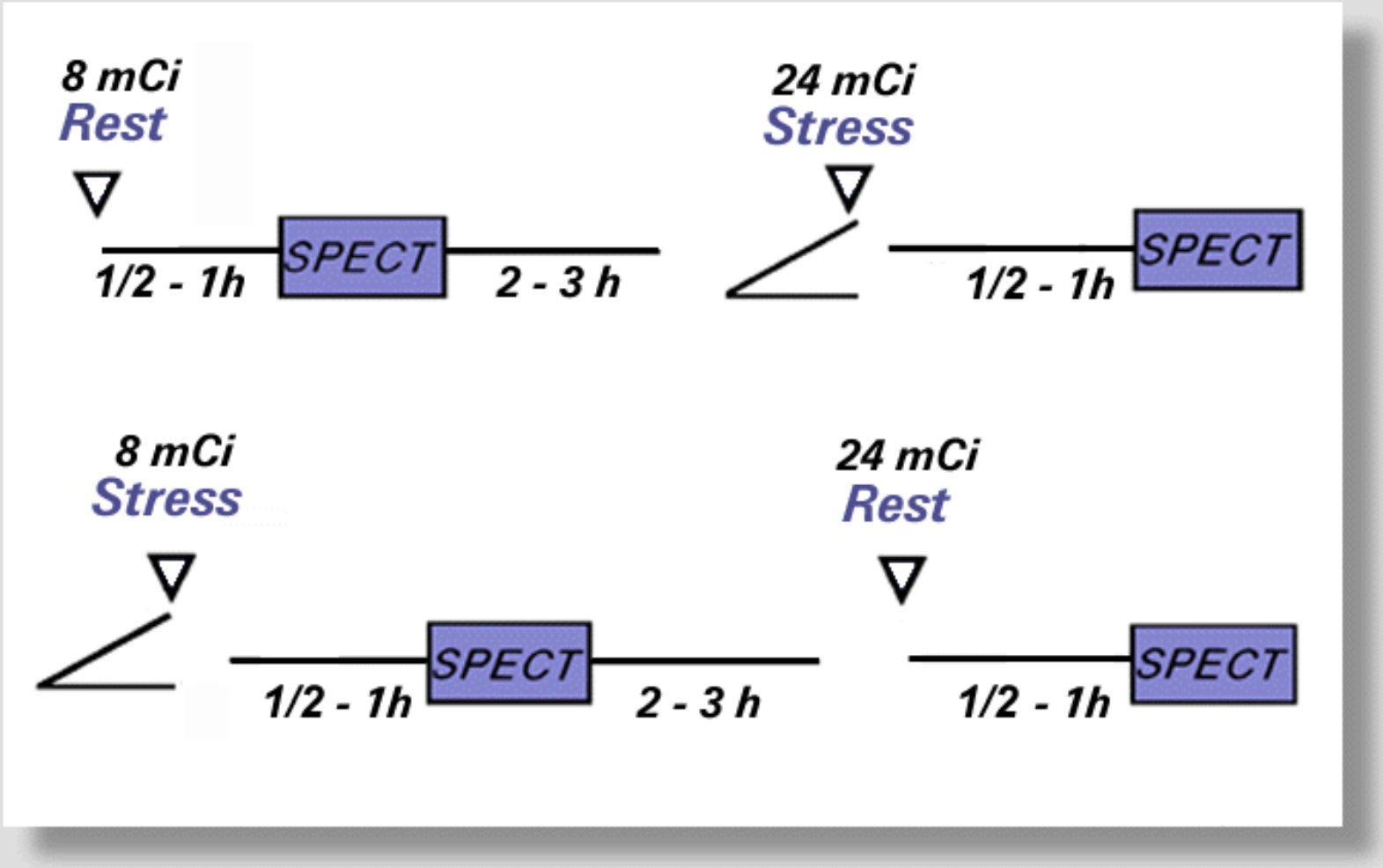
Imaging protocols for Tl-201

- Intravenous injection during peak exercise
- "stress" image (10 min after injection)
- "rest" image (180-240 min after injection)

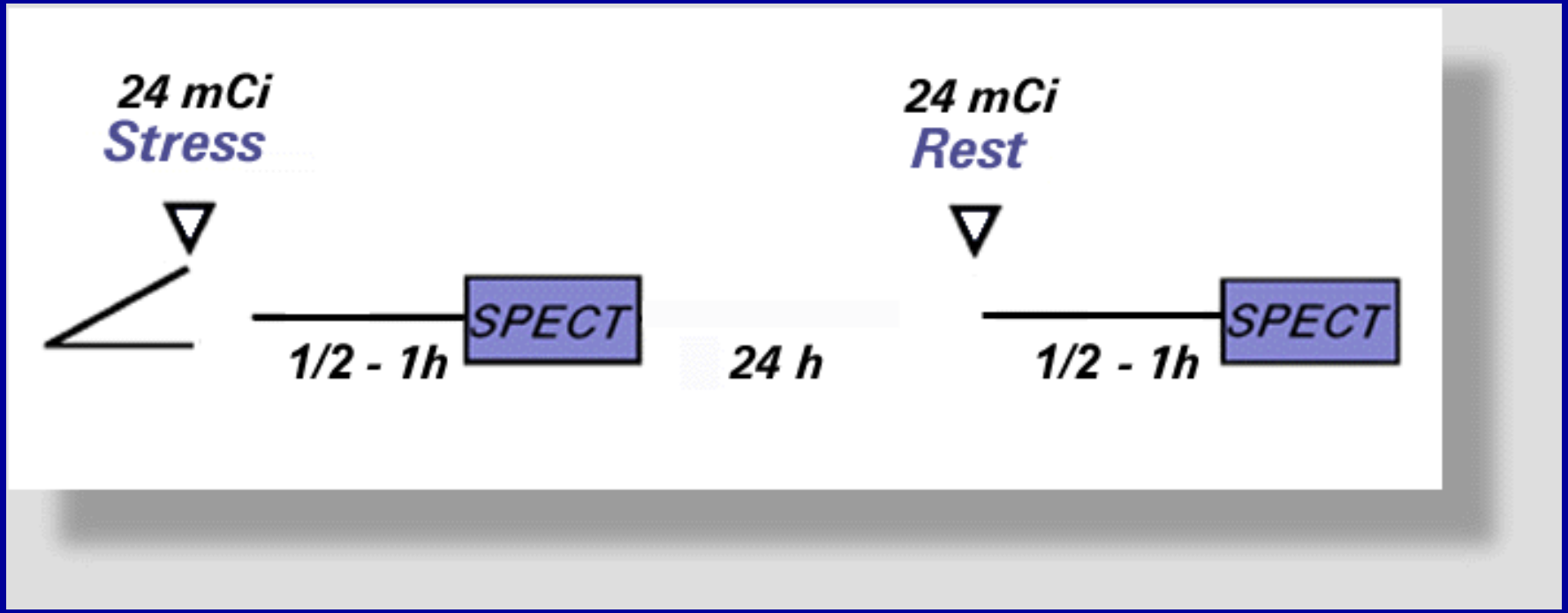
Tc-99m-labeled radiopharmaceuticals

- Tc-99m labeled MIBI (isonitril), tetrofosmin, teboroxsim, furofosfin
- advantages: more favorable physical characteristics, availability, "freezing" perfusion myocardial image in the moment of injection, posibility of simultaneous assesment of perfusion and function ("gated" study)
- Disadvantages: no redistribution – need for 2 injections, lesser extraction fraction; viability?

Imaging protocols for Technetium-99m radiopharmaceuticals: One day protocol



Imaging protocols for Technetium-99m radiopharmaceuticals : two day protocol



Exercise

- Dynamic exercise, treadmill or bicycle exercise; sensitivity of the test depends on achieved expected load (submax. 85%)

- Farmacological stress: when dynamic exercise isn't possible or in pts. with left brand branch block (LBBB); dipyridamole, adenosine – vasodilatators; dobutamine - simpatomymetic

Imaging methods

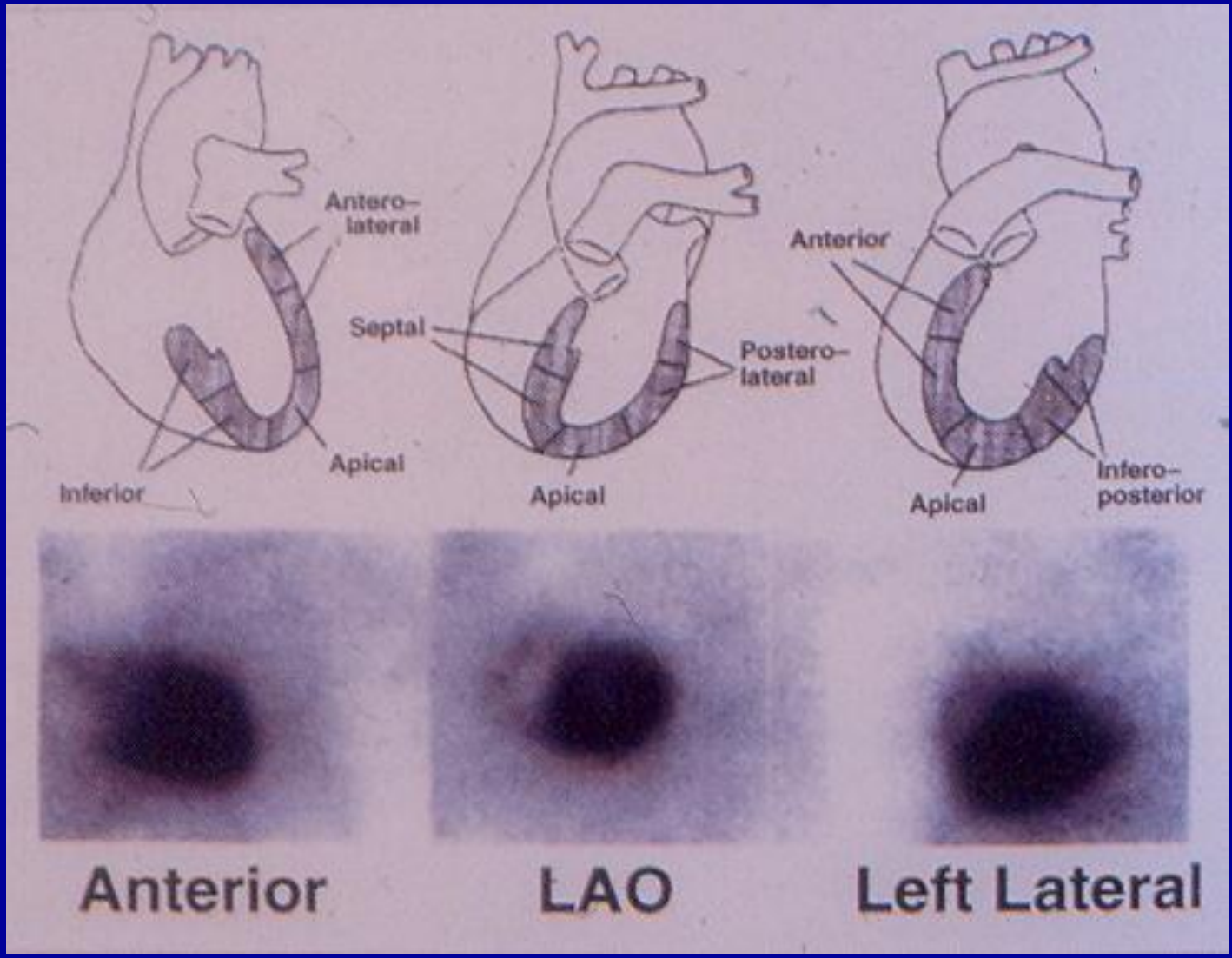
planar scintigraphy

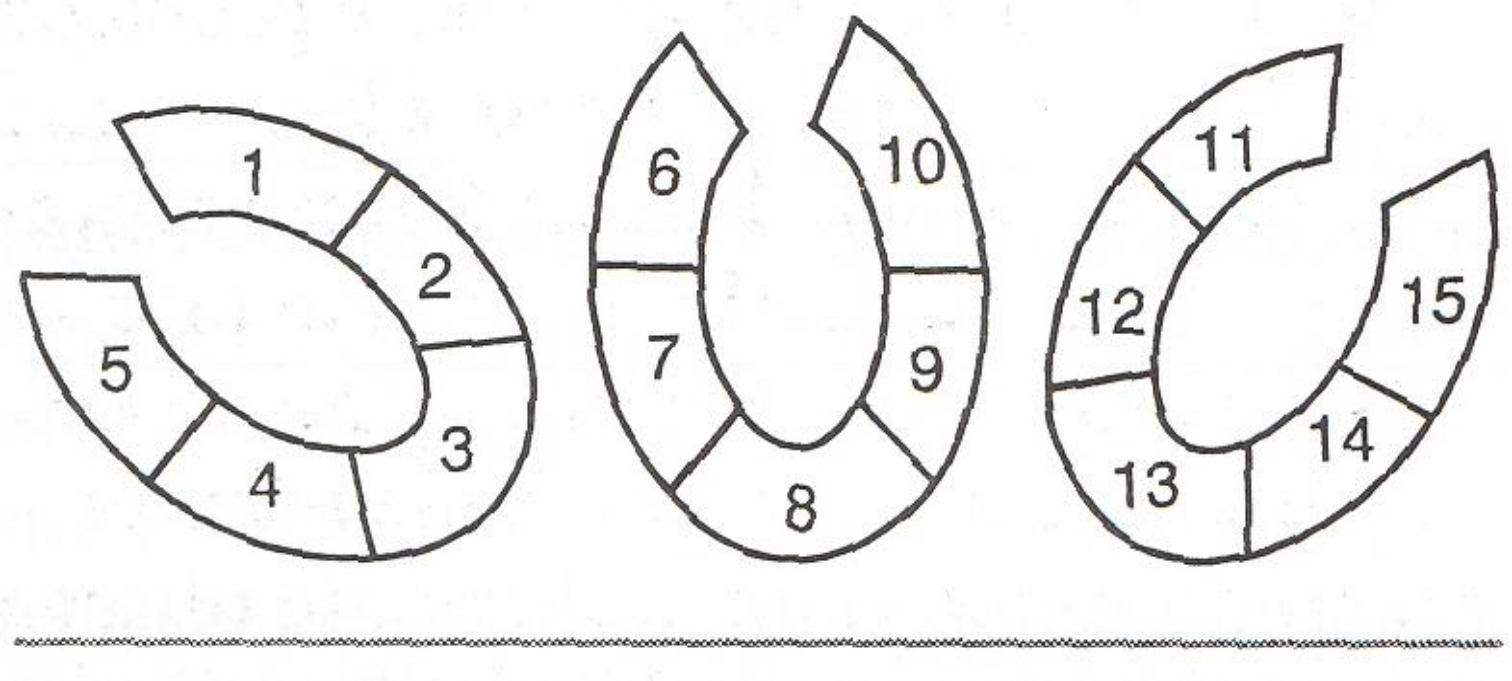
SPECT

PET

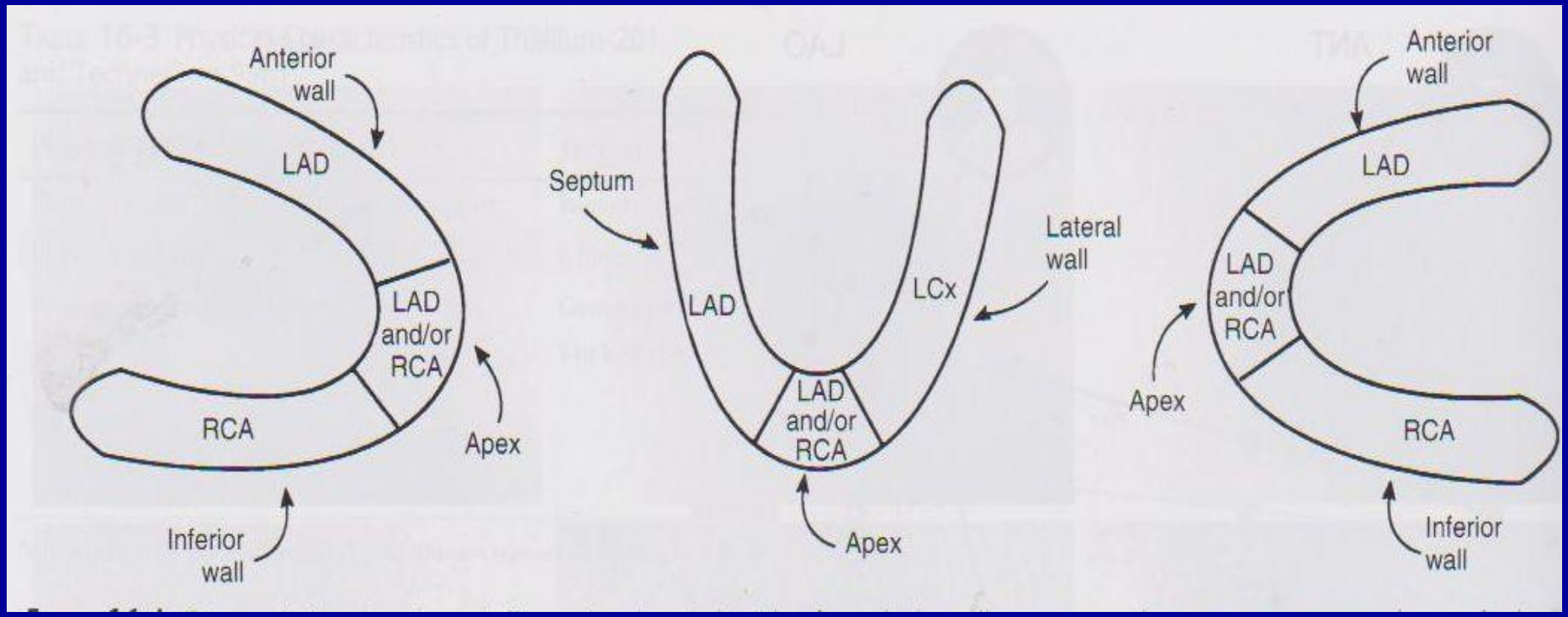
Planar scintigraphy

- Anterior (ANT)
- left anterolateral 45º (LAO)
- left lateral 70º (LL)
- duration of projection: 6-10 min.


Antero-
lateral
Septal
Apical
Inferior
Apical
Anterior
Postero-
lateral
Apical
Infero-
posterior
Anterior
LAO
Left Lateral



Schematic representation of segmental division of myocard on planar images. Segments 1 and 2 are anterolateral, 6 and 7 septal, 11 and 12 anterior, 4 and 5 inferior, 14 and 15 inferoposterior, 9 and 10 posterolateral, 3, 8 and 13 apical wall of the left ventricul.



Segments 1,2,6,7,11 and 12 are perfused from left descending artery (LAD), segments 4,5,14 and 15 are perfused from right coronary artery (RCA),
and segments 9 and 10 are perfused from left circumflex artery (LCx).
Apex can be perfused from all three vessels, and posterior wall is perfused dominantly from RCA
or LCx.

Diagnostic patterns:stress myocardial perfusion

TABLE 16-10 Diagnostic Patterns: Stress Myocardial Perfusion

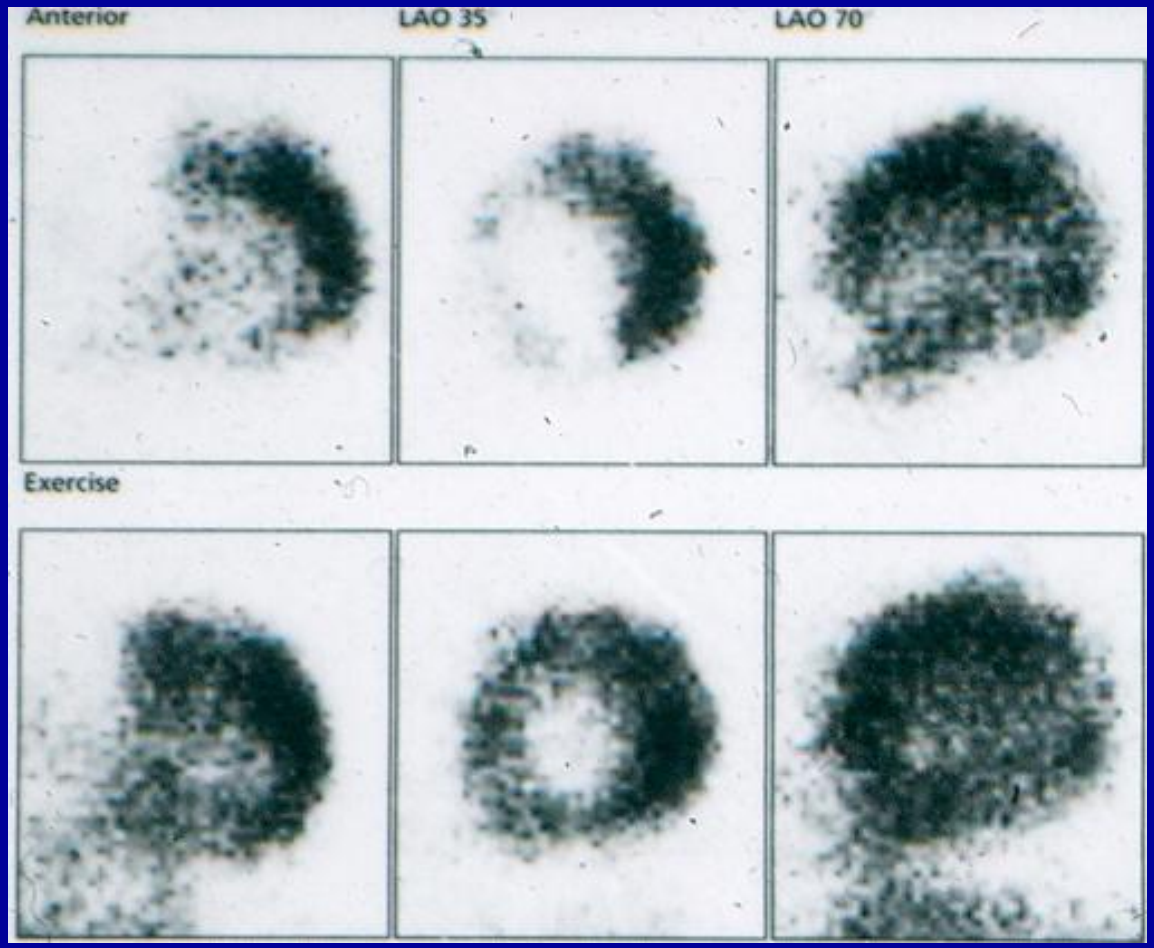
Stress	Rest	Diagnosis
Normal	Normal	Normal
Defect	Normal	Ischemia
Defect	Defect (unchanged)	Infarction
Defect	Some normalization with areas of persistent defect	Ischemia and scar
Normal	Defect	Reverse redistribution*

Definitions describing the status of the myocardium

ABLE 16-9 Definitions Describing the Status of the Myocardium

erm	Definition and scan appearance
Myocardial ischemia	Oxygen supply below metabolic requirements because of inadequate blood circulation caused by coronary stenosis
	Hypoperfusion (cold defect) on stress perfusion scintigrams
Myocardial infarction	Necrosis of myocardial tissue, as a result of coronary occlusion
	Hypoperfusion on rest–stress perfusion and decreased uptake with metabolic imaging
Transmural infarction	Necrosis involves all layers from endocardium to epicardium
	High sensitivity for detection by perfusion imaging
Subendocardial infarction	Necrosis involves only muscle adjacent to endocardium
	Lower sensitivity for detection on perfusion imaging
Myocardial scar	Late result of infarction; hypoperfusion on scintigraphy
Hibernating myocardium	Chronic ischemia with decreased blood flow and down regulation of contractility; reversible with restoration of blood flow
	No perfusion on rest imaging, poor ventricular contraction
	Improved perfusion given a long recovery between rest–rest imaging or delayed reinjection Tl-201
	Increased uptake by FDG metabolic imaging mismatched to reduced uptake on perfusion scan
Stunned myocardium	Myocardium with persistent contractile dysfunction despite restoration of perfusion after a period of ischemia; usually improves with time
	Normal by perfusion imaging, poor ventricular contraction
	Uptake by FDG metabolic imaging

Reversible perfusion defects (Ischemia): anteroseptal, inferoseptal and apical regions
Irreversible perfusion defect (Scar): inferoposterior wall



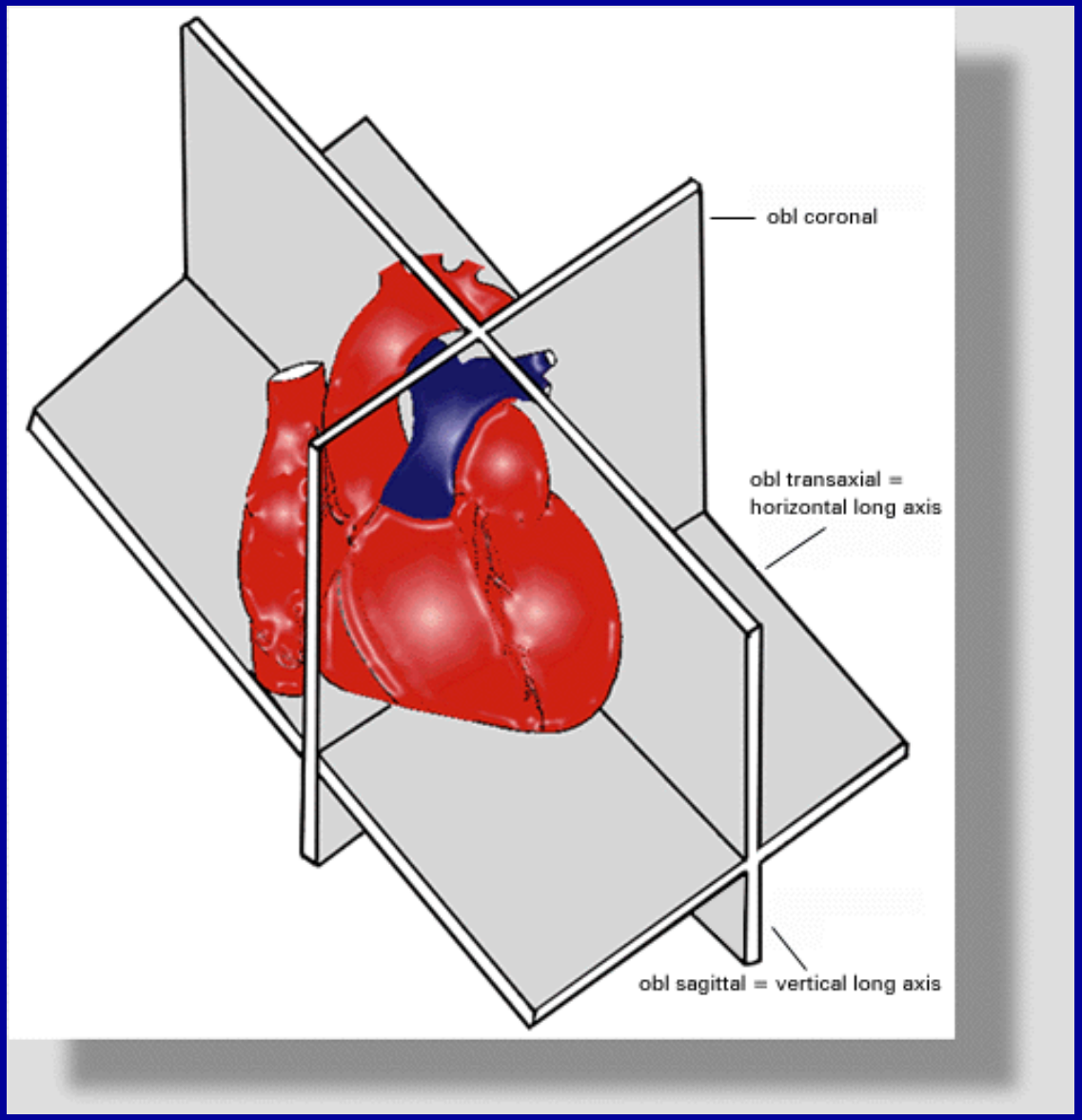
Coronary arteriography revealed an occluded right coronary artery and subtotal stenosis located in the proximal segment of the left anterior descending coronary artery.

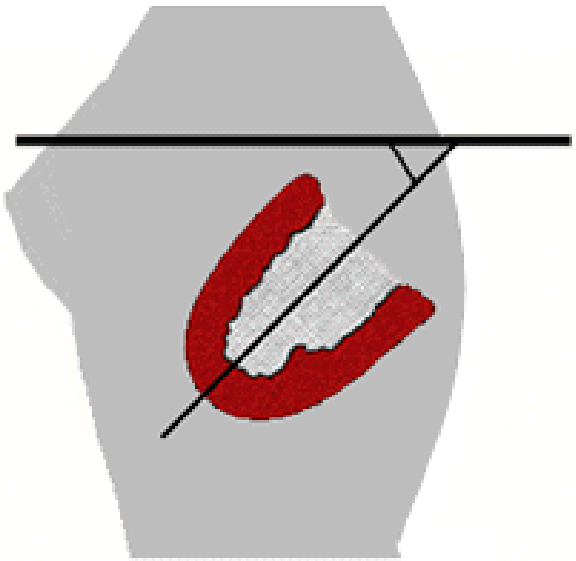
Imaging methodes

Planar scintigraphy

SPECT

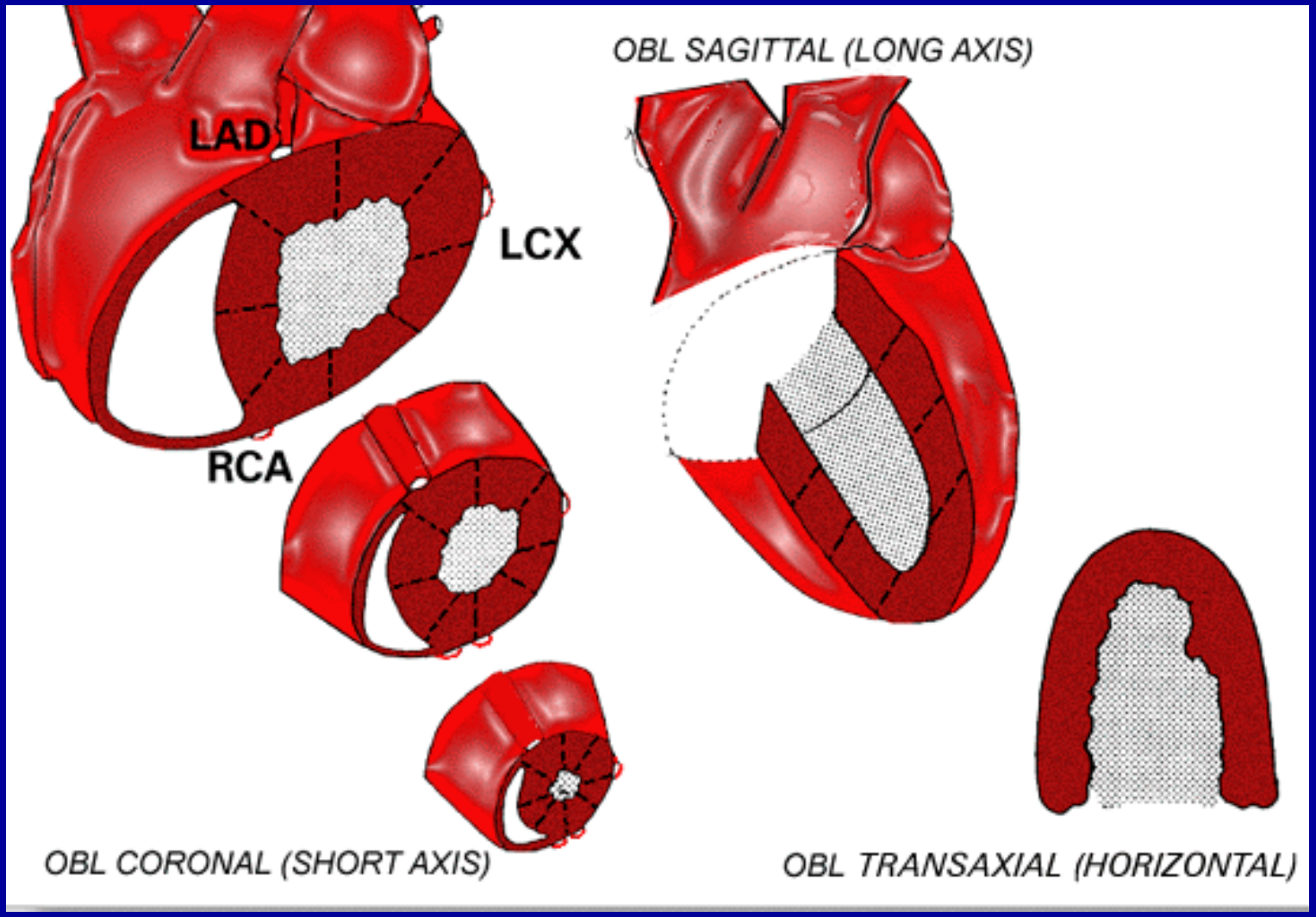
PET

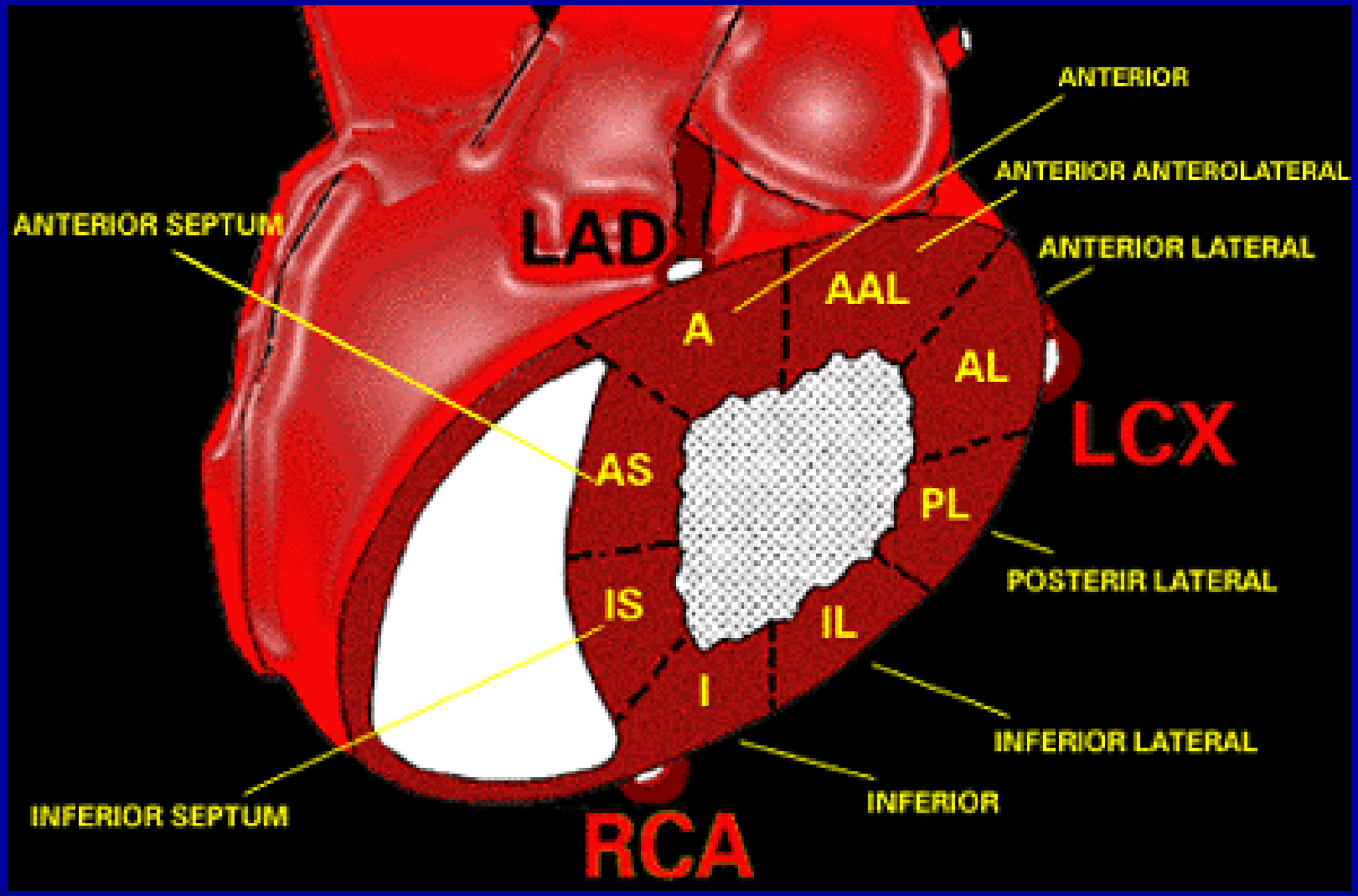

obl coronal
obl transaxial =
horizontal long axis
obl sagittal = vertical long axis

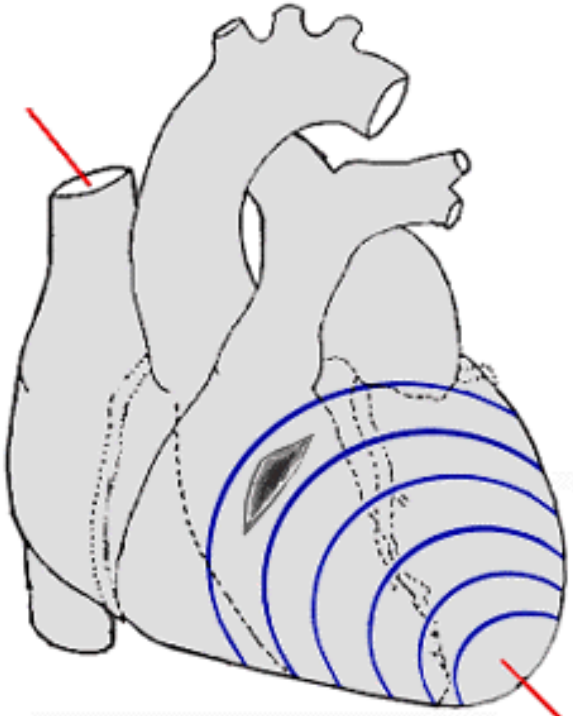


Basic saqgittal reorientation

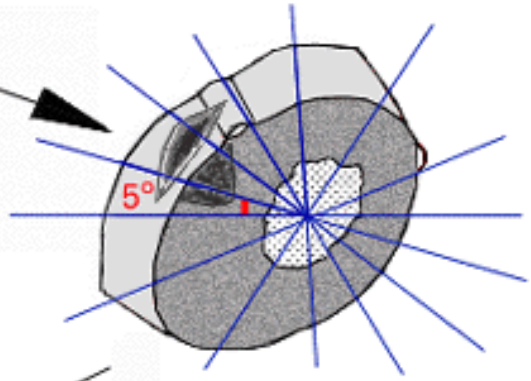
Basic transaxial reorientation


OBL SAGITTAL (LONG AXIS)
LAD
LCX
RCA
OBL CORONAL (SHORT AXIS)
OBL TRANSAXIAL (HORIZONTAL)

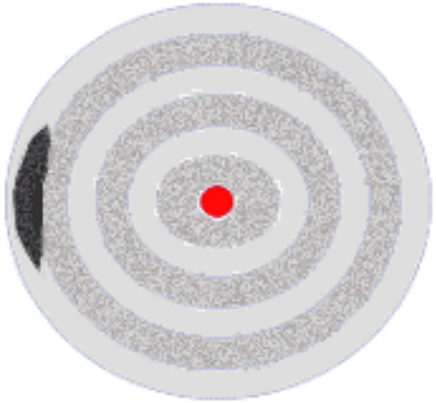

ANTERIOR
ANTERIOR ANTEROLATERAL
ANTERIOR SEPTUM
LAD
ANTERIOR LATERAL
AAL
A
AL
LCX
AS
PL
POSTERIR LATERAL
IS
IL
I
INFERIOR LATERAL
INFERIOR
INFERIOR SEPTUM
RCA



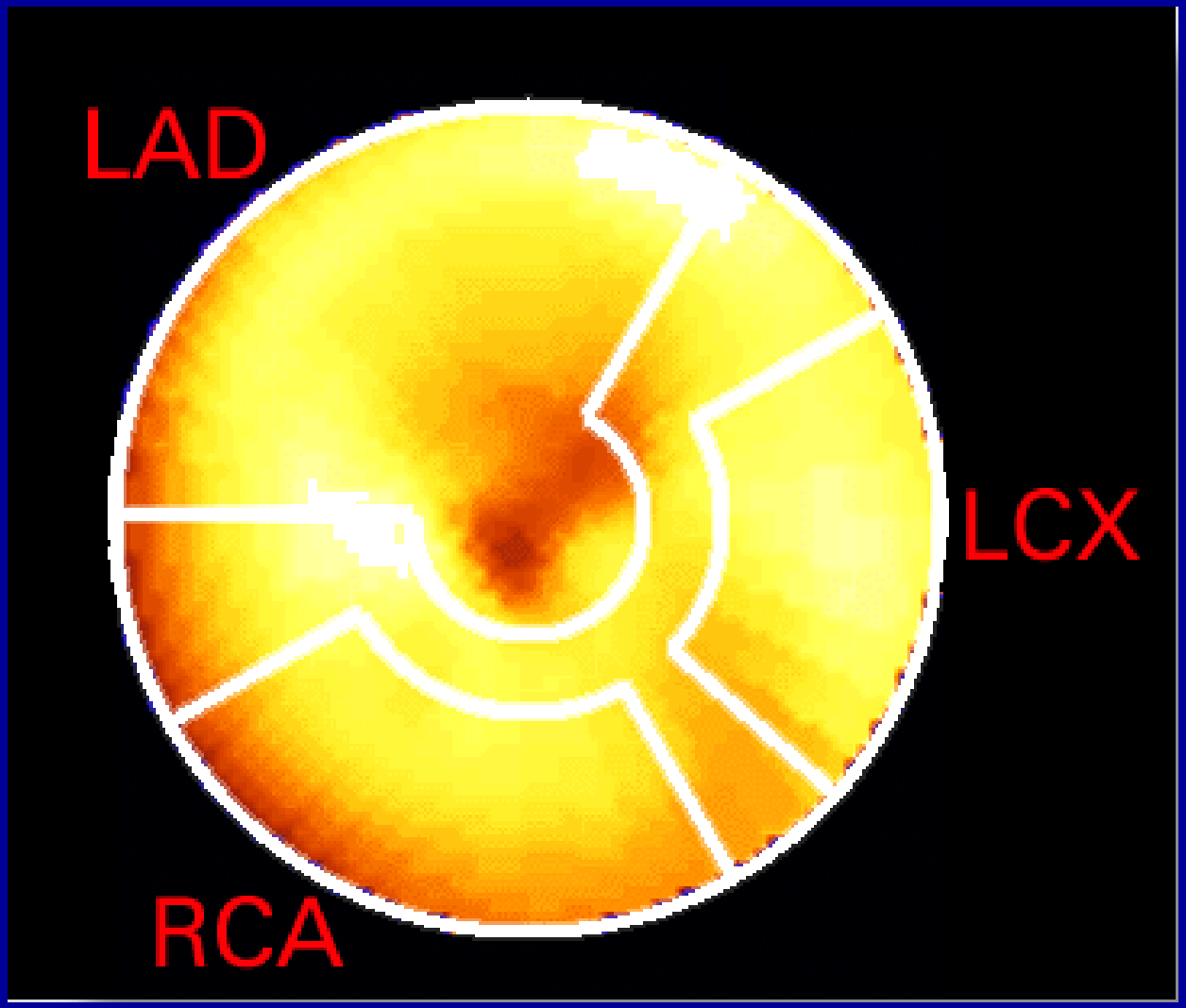
A. *Heart with long axis and short axis slices indicated*



B. *Each short axis slice is divided in 5 pieces and maximum counts computed*



C. *The result of the slice by slice quantification is displayed in Bulls-eye display.*
One is looking at the heart from apex, septum is to the left, lateral wall to the right, anterior wall is up, and the inferior wall is down.
The indicated septal abnormality in A) is quantified in B) and displayed in C).


LAD
LCX
RCA

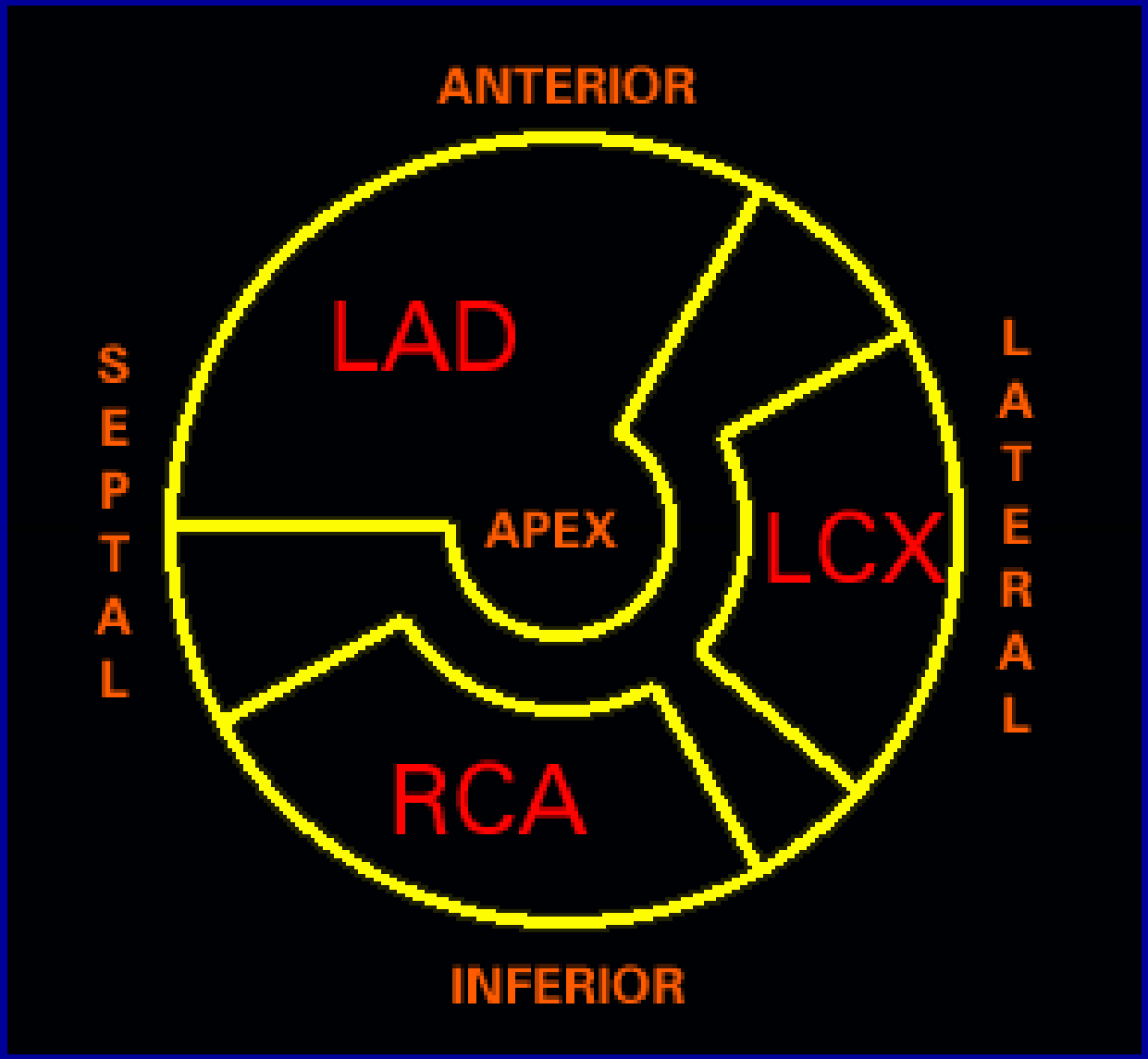
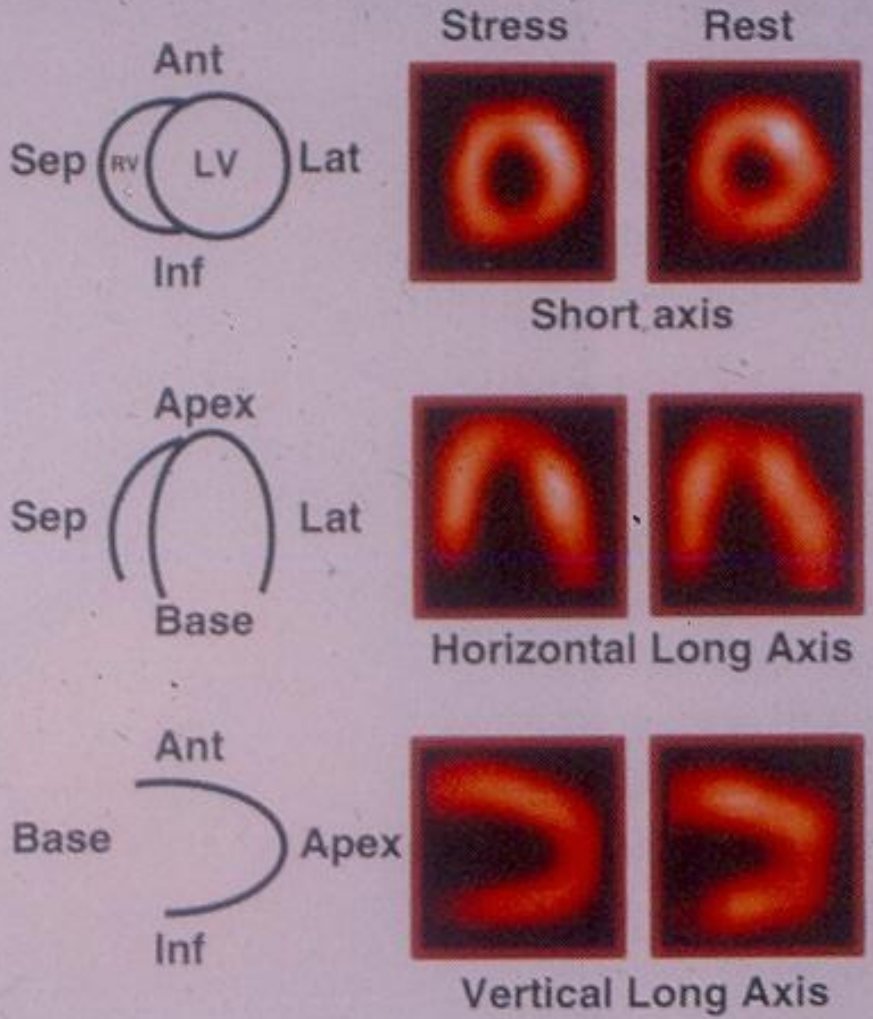
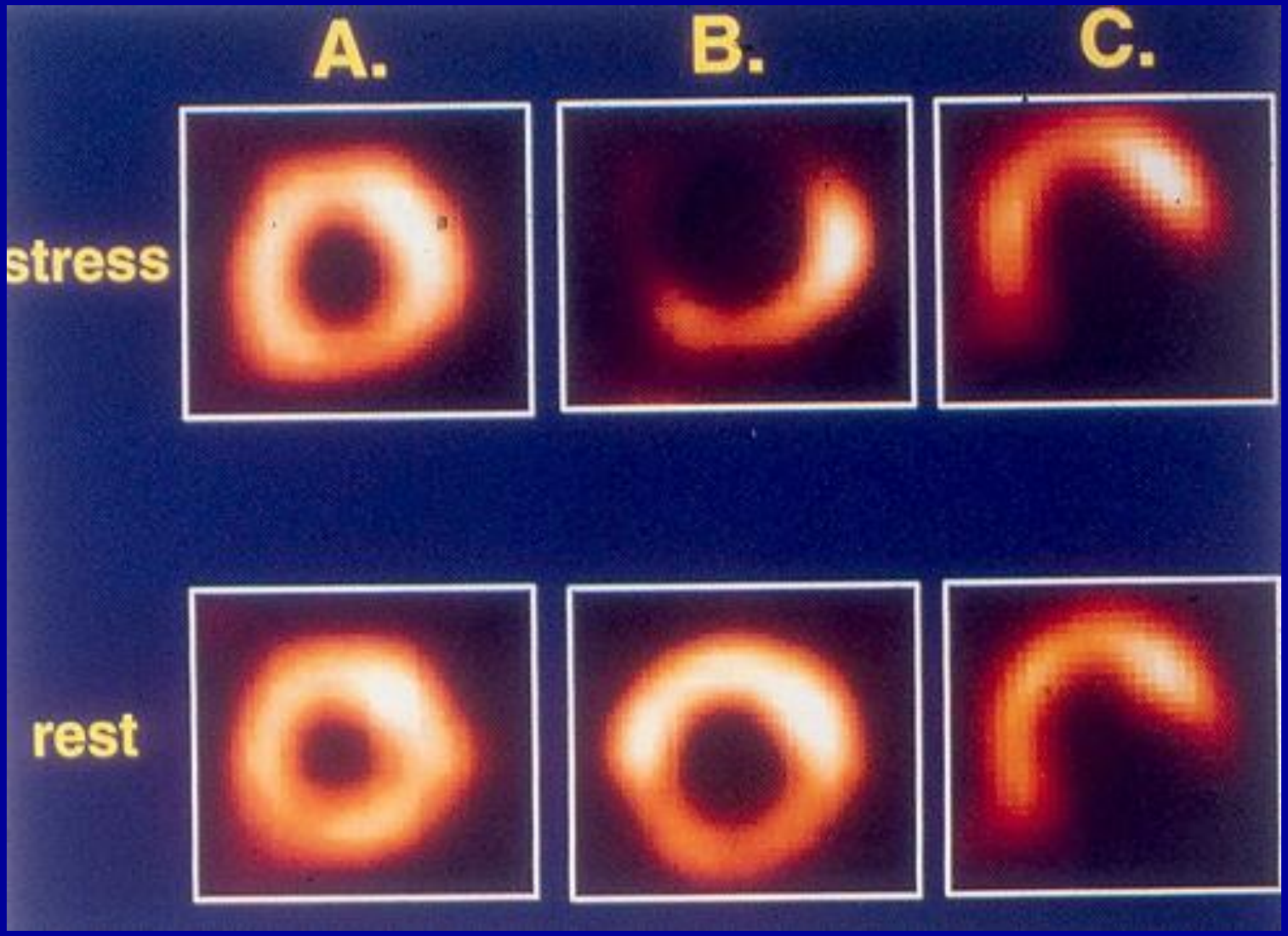

ANTERIOR
LAD
SEPTAL
APEX
LCX
LATERAL
RCA
INFERIOR

Figure 3: Tomographic images reoriented in short axis, vertical and horizontal long axis views. Correlation with coronary anatomy is provided by the drawing

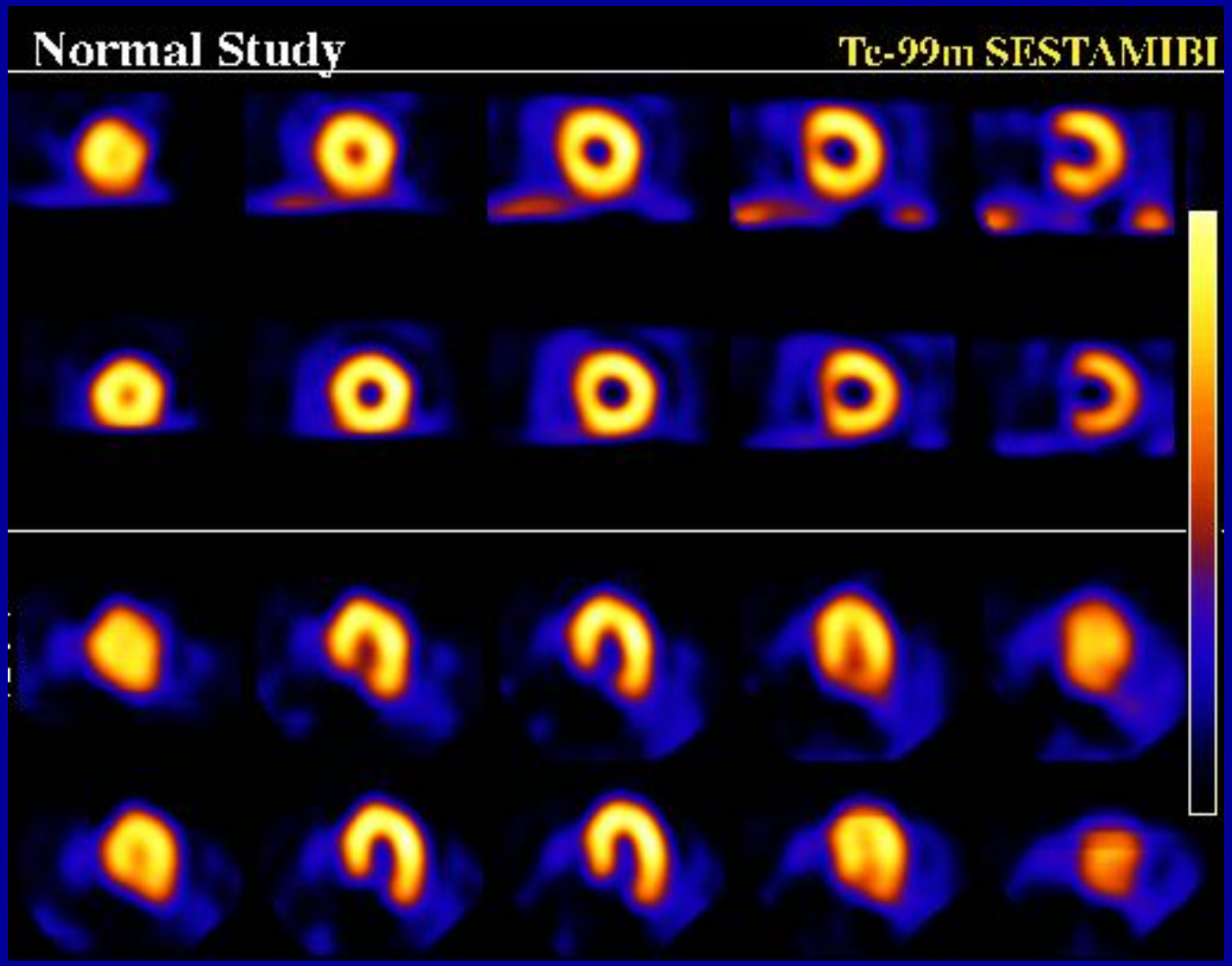


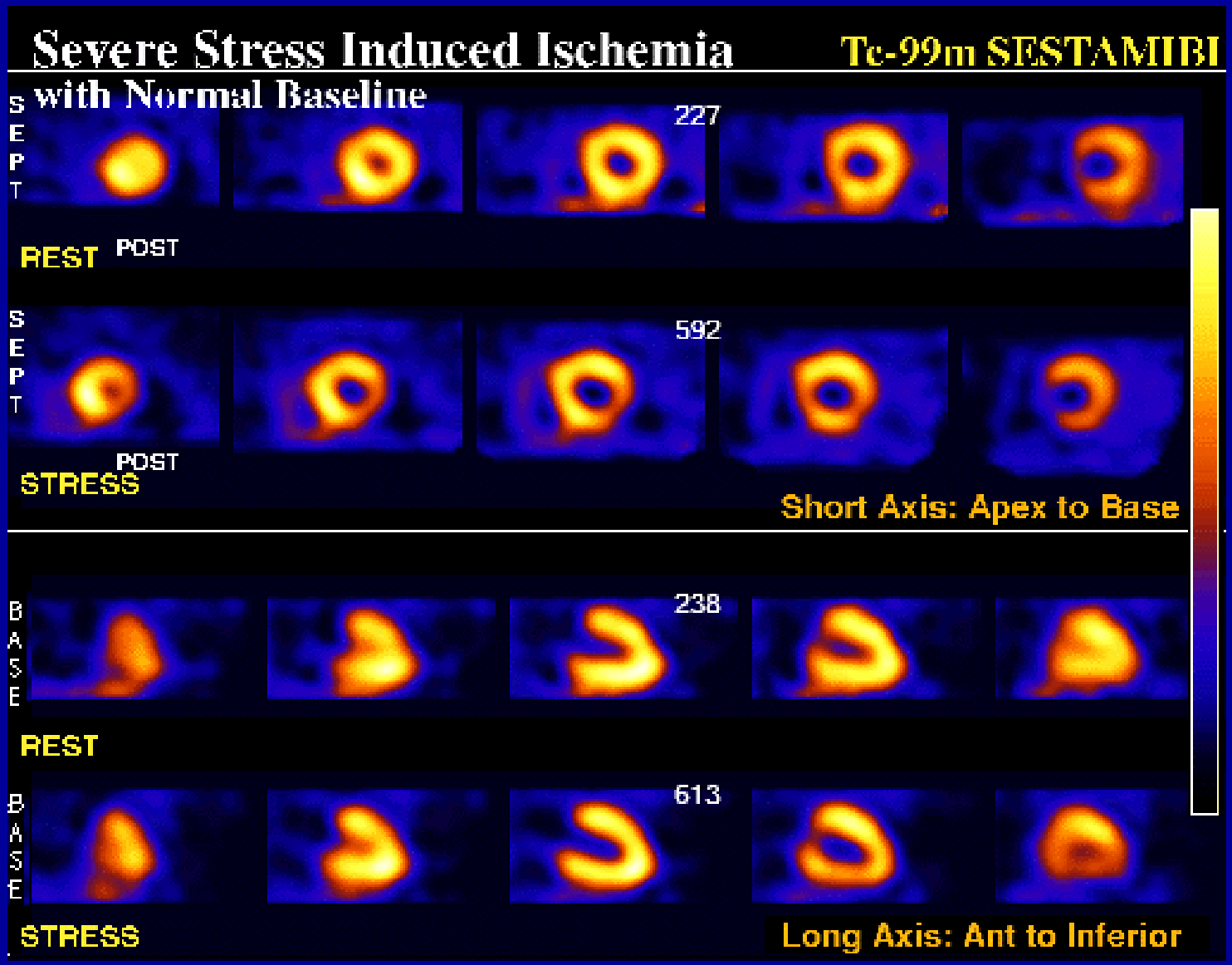


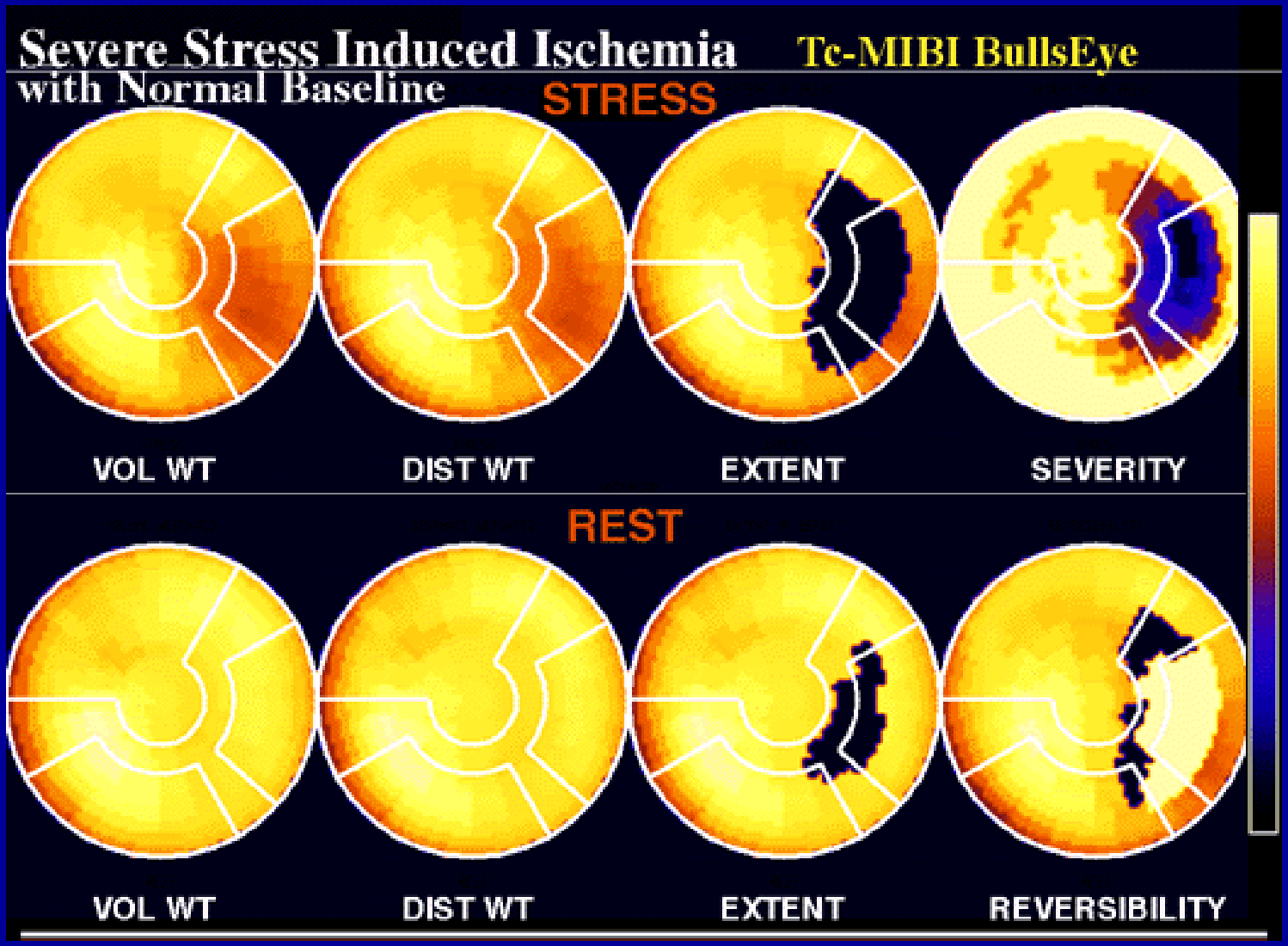
A: normal perfusion

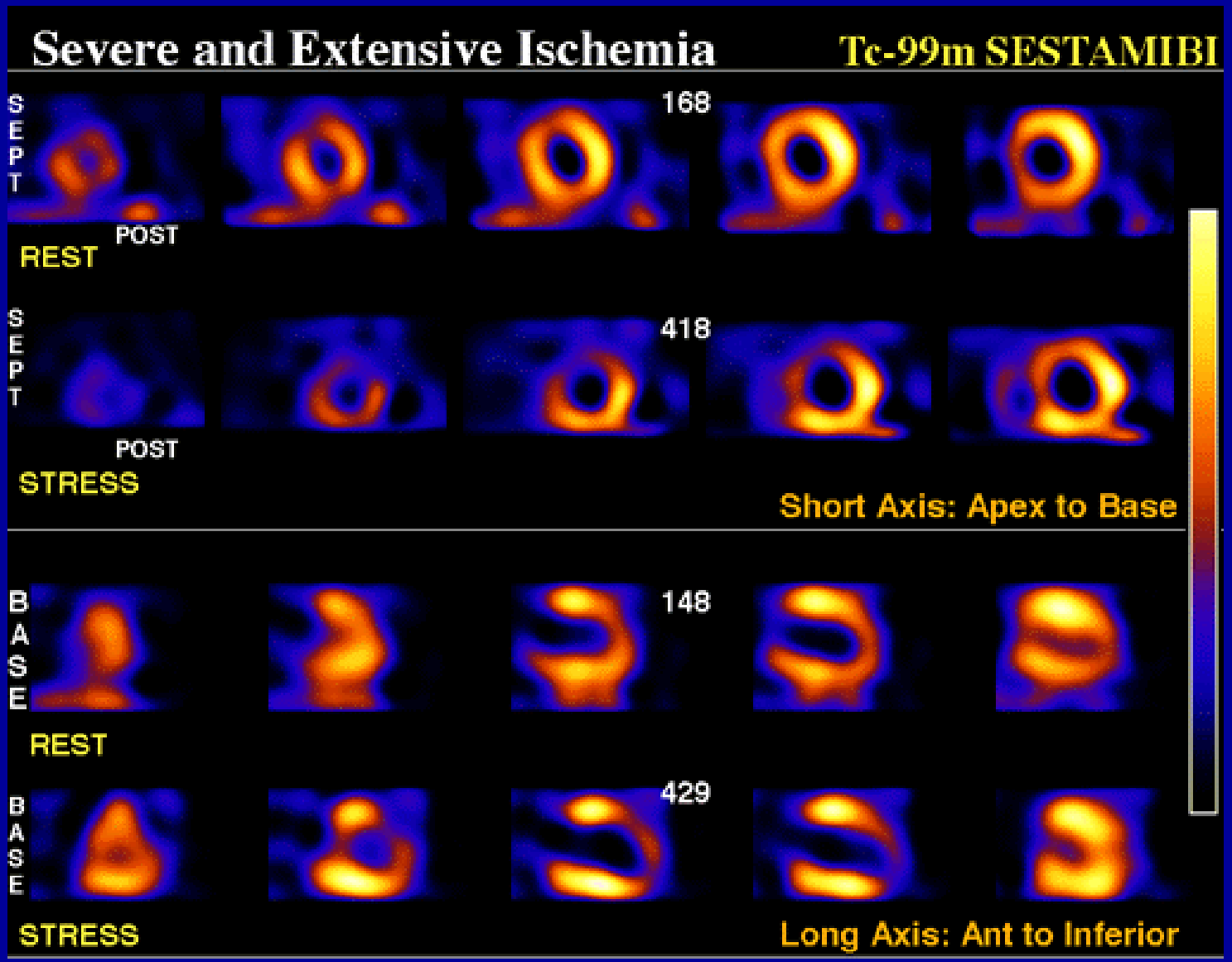
B: **exercise induced ischemia** in the anterior and septal segment

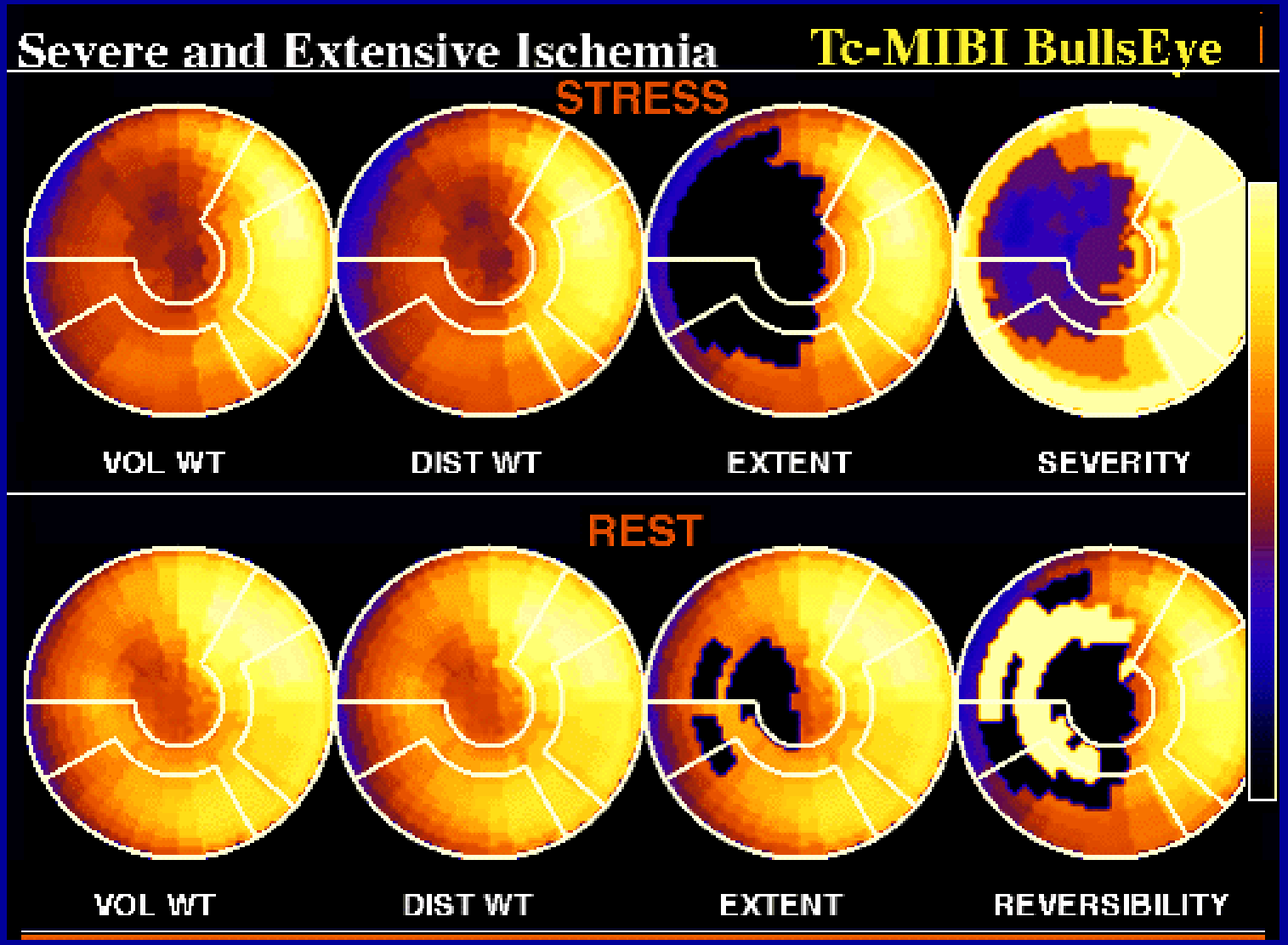
C: **fixed defect (scar)** in the inferior segment

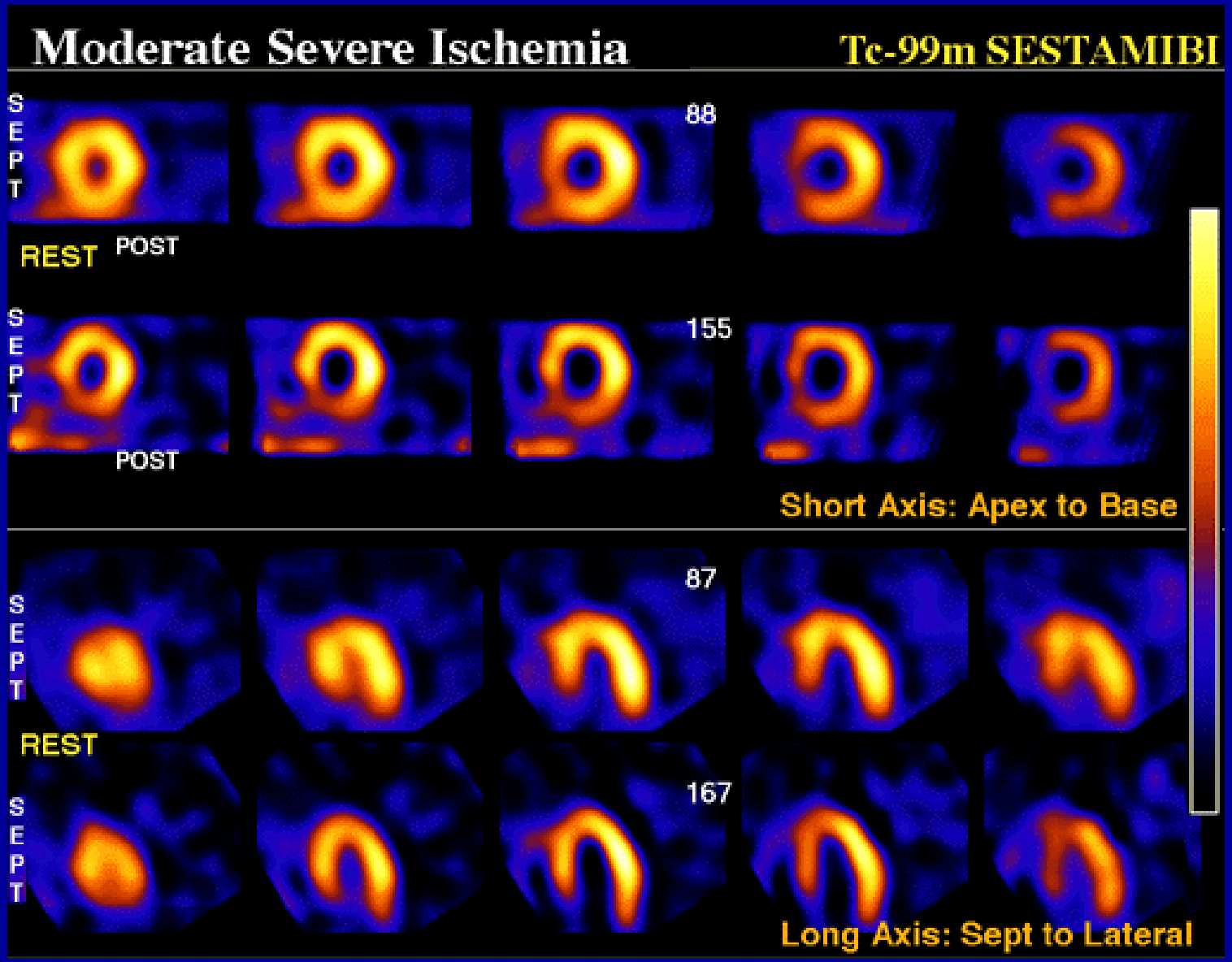

Normal Study
Tc-99m SESTAMIBI

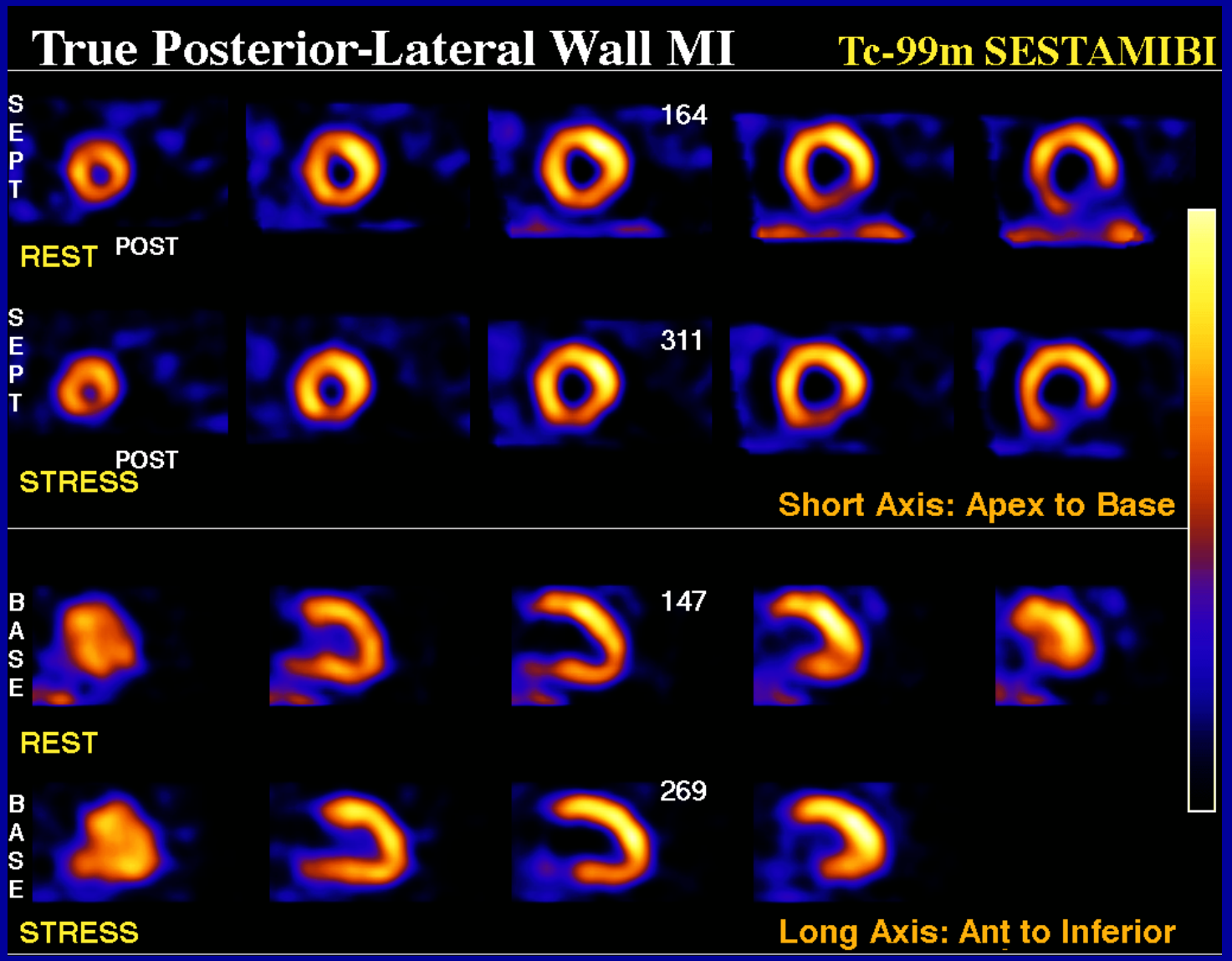

Severe Stress Induced Ischemia
Tc-99m SESTAMIBI
with Normal Baseline
SEPT
227
REST
POST
SEPT
592
POST
STRESS
Short Axis: Apex to Base
BASE
238
REST
BASE
613
STRESS
Long Axis: Ant to Inferior

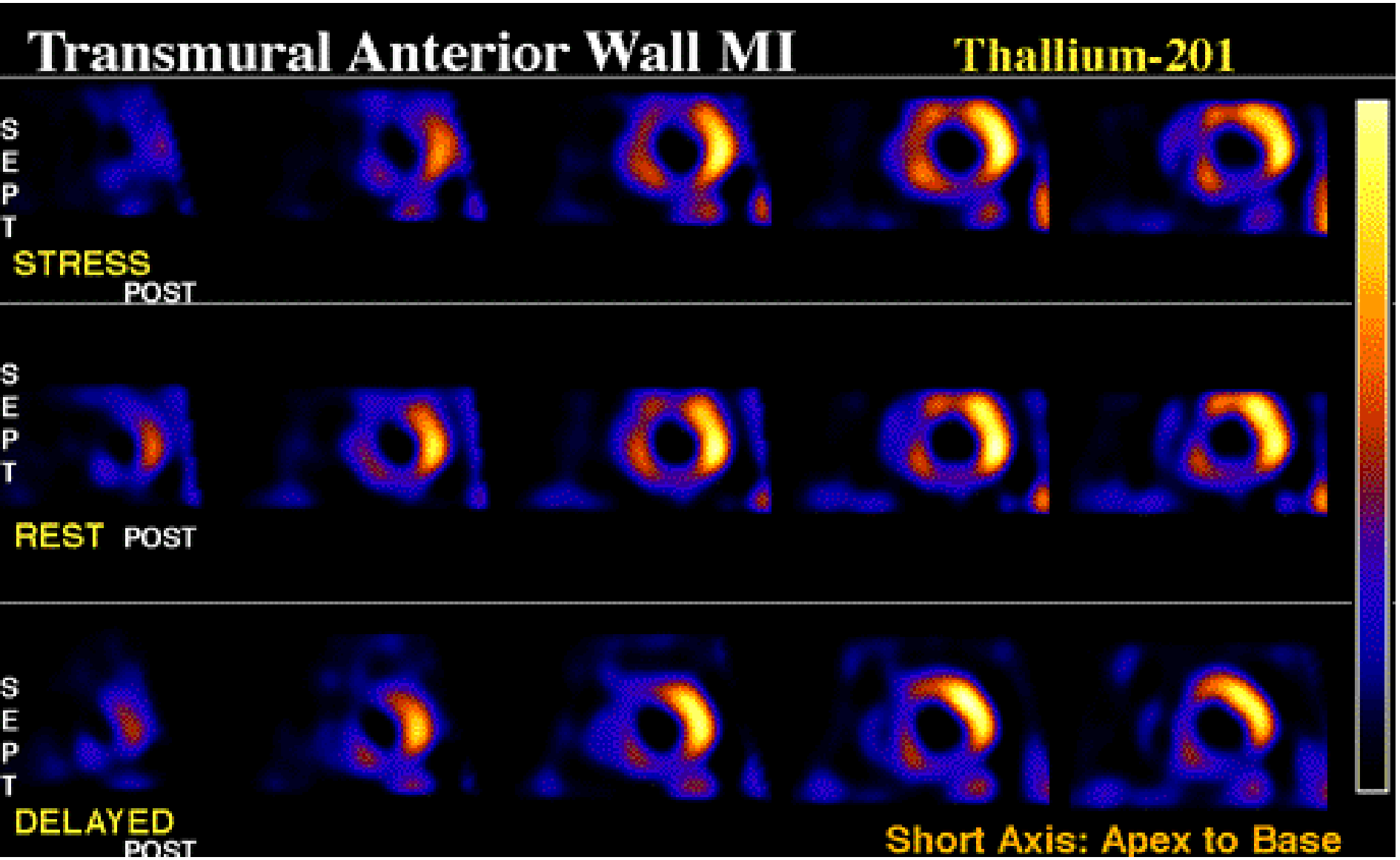

Severe Stress Induced Ischemia
with Normal Baseline
Tc-MIBI BullsEye
STRESS
VOL WT
DIST WT
EXTENT
SEVERITY
REST
VOL WT
DIST WT
EXTENT
REVERSIBILITY

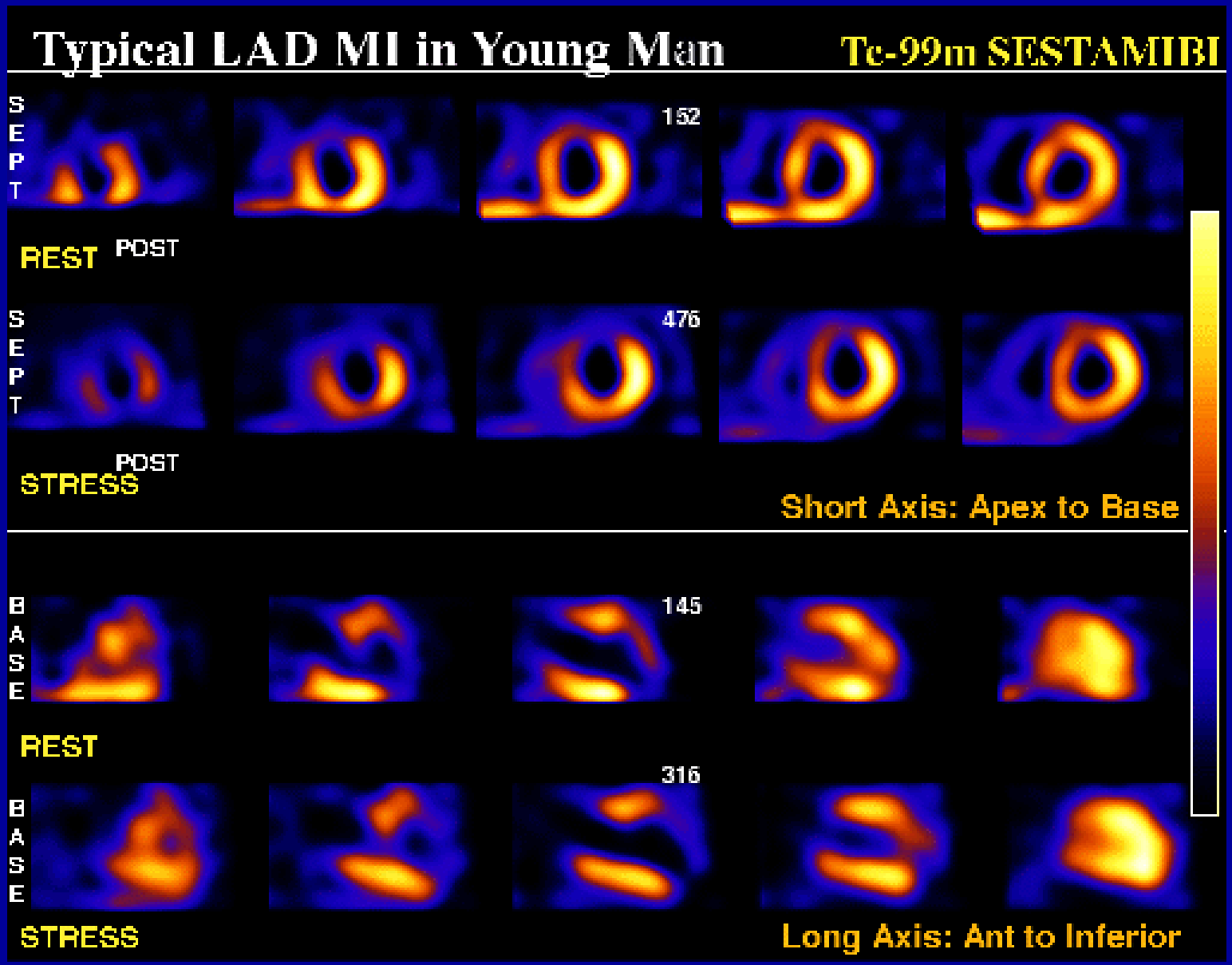

Severe and Extensive Ischemia
Tc-99m SESTAMIBI
SEPT
168
POST
REST
SEPT
418
POST
STRESS
Short Axis: Apex to Base
BASE
148
REST
BASE
429
STRESS
Long Axis: Ant to Inferior

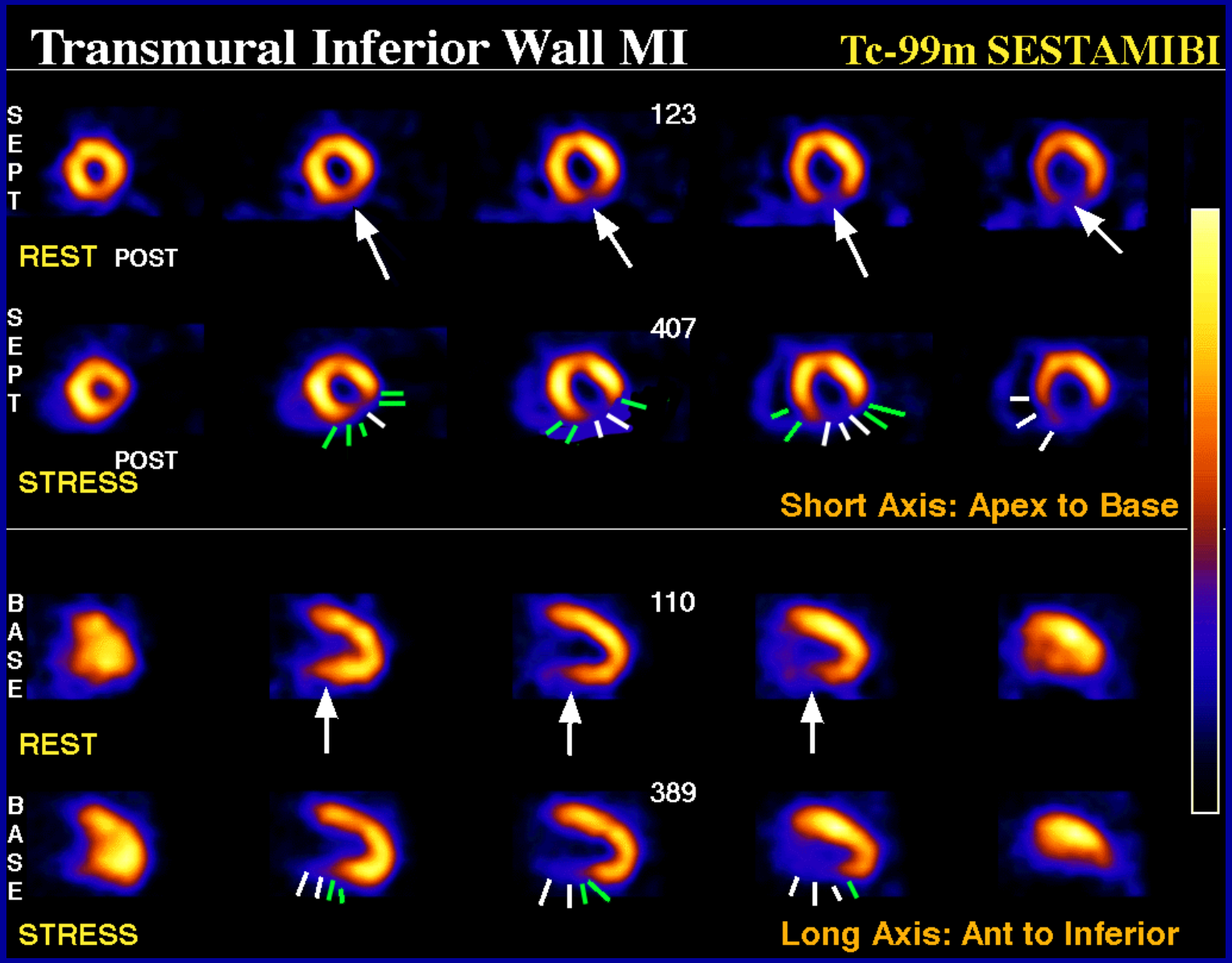

Severe and Extensive Ischemia
Tc-MIBI BullsEye
STRESS
VOL WT
DIST WT
EXTENT
SEVERITY
REST
VOL WT
DIST WT
EXTENT
REVERSIBILITY

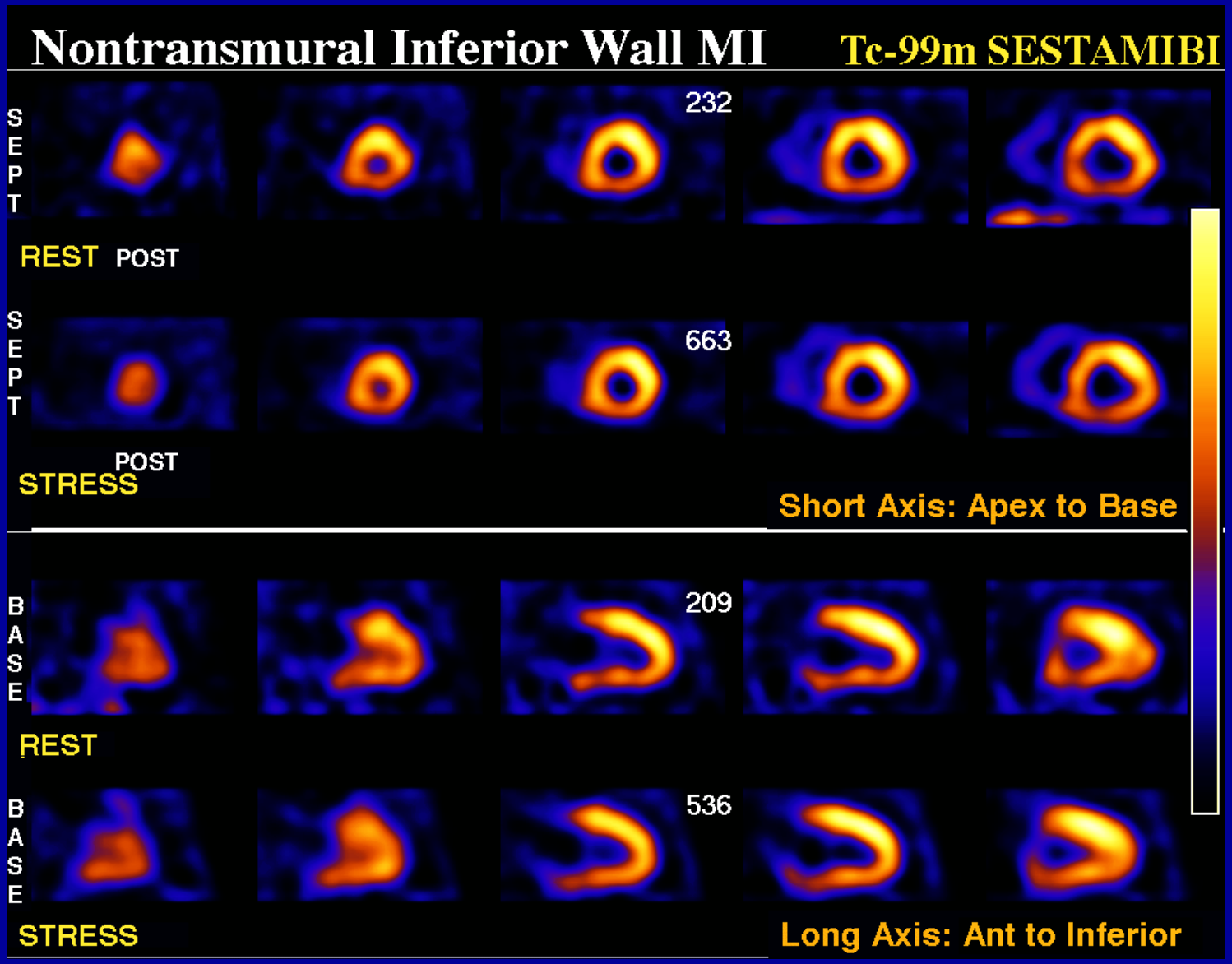

Moderate Severe Ischemia
Tc-99m SESTAMIBI
SEPT
REST
POST
88
SEPT
POST
155
Short Axis: Apex to Base
SEPT
REST
87
SEPT
167
Long Axis: Sept to Lateral

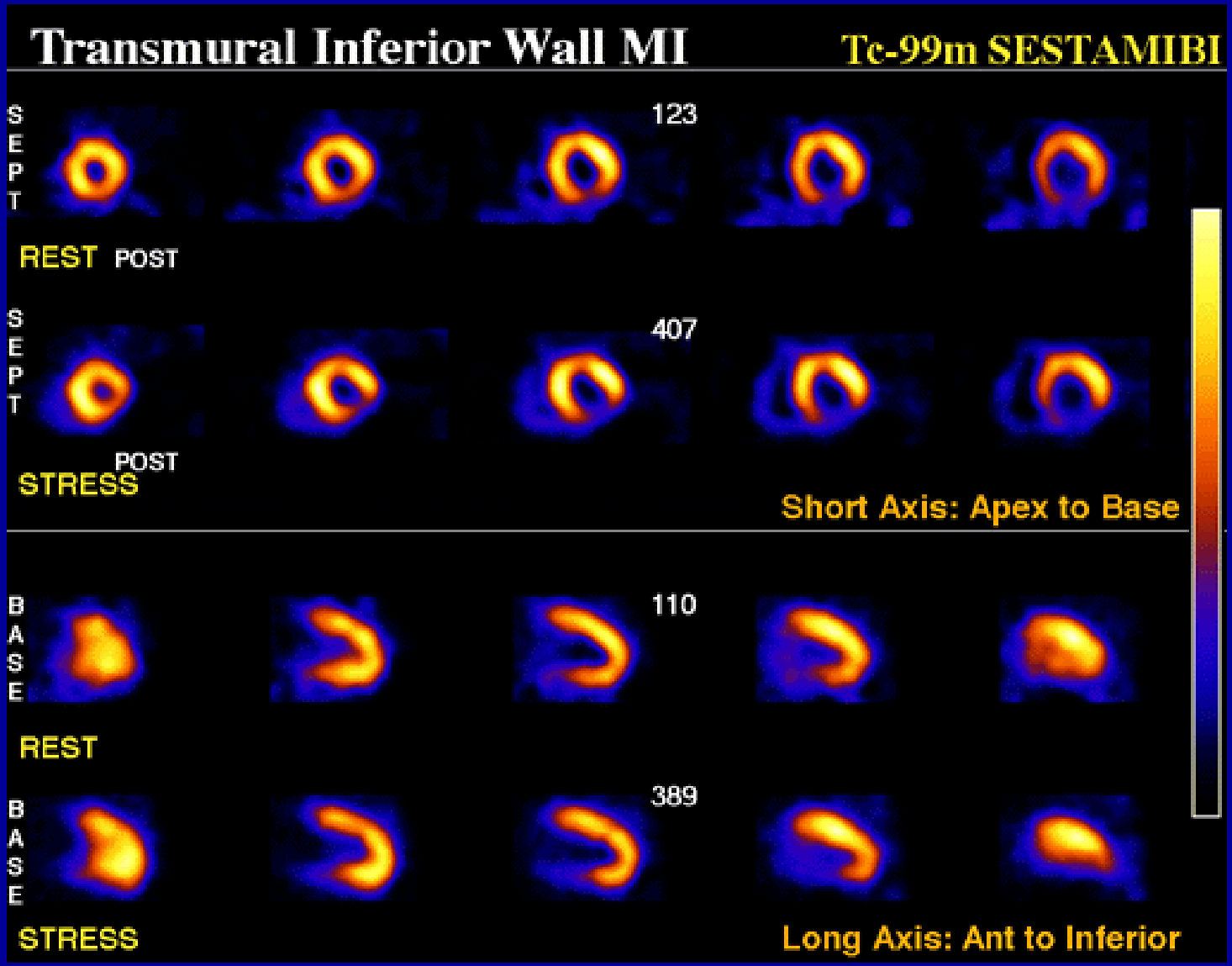

True Posterior-Lateral Wall MI
Tc-99m SESTAMIBI
SEPT
164
REST
POST
SEPT
311
STRESS
POST
Short Axis: Apex to Base
BASE
147
REST
BASE
269
STRESS
Long Axis: Ant to Inferior

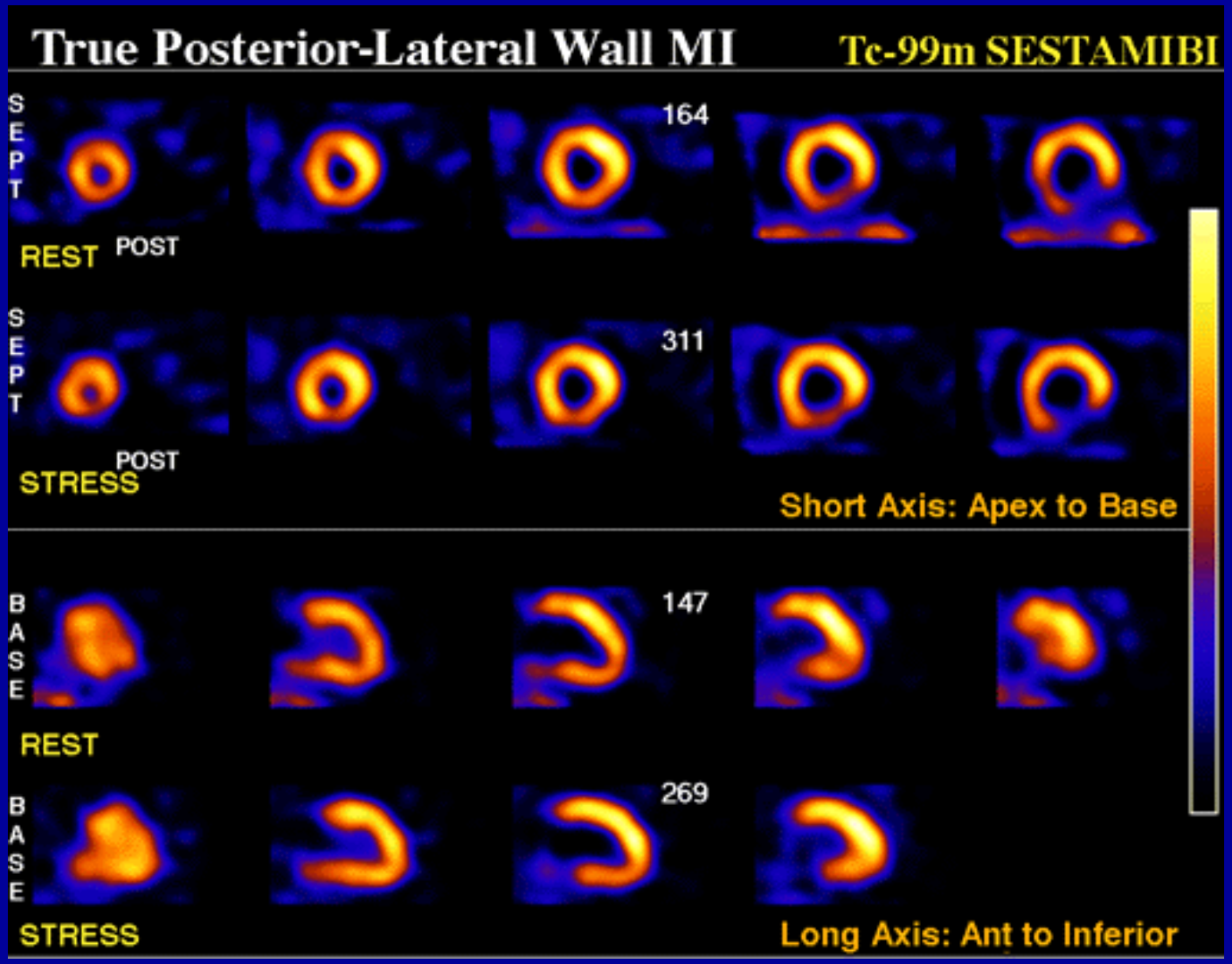

Transmural Anterior Wall MI
Thallium-201
SEPT
STRESS
POST
SEPT
REST POST
SEPT
DELAYED
POST
Short Axis: Apex to Base

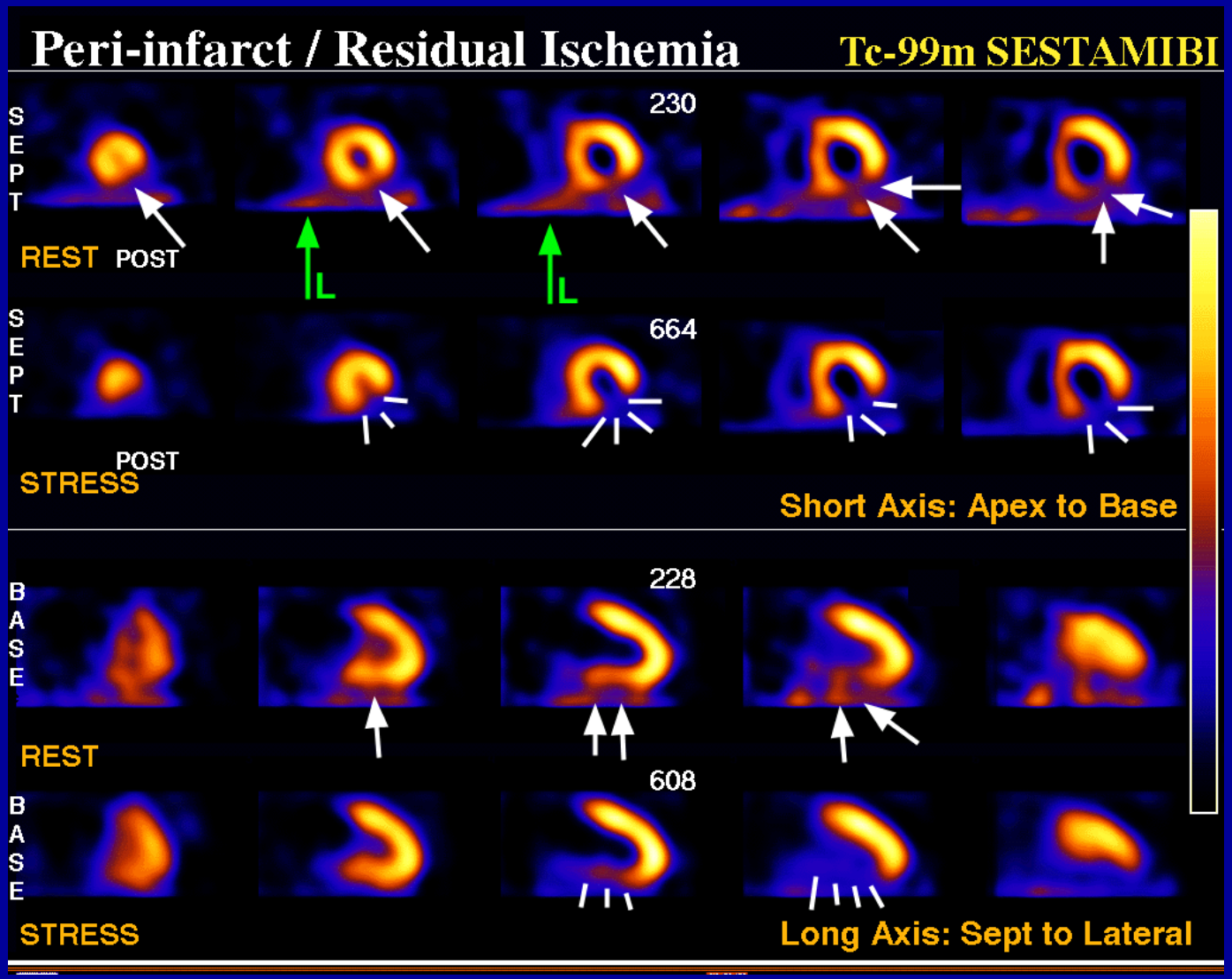

Typical LAD MI in Young Man
Tc-99m SESTAMIBI
SEPT
152
REST
POST
SEPT
476
POST
STRESS
Short Axis: Apex to Base
BASE
145
REST
316
BASE
STRESS
Long Axis: Ant to Inferior

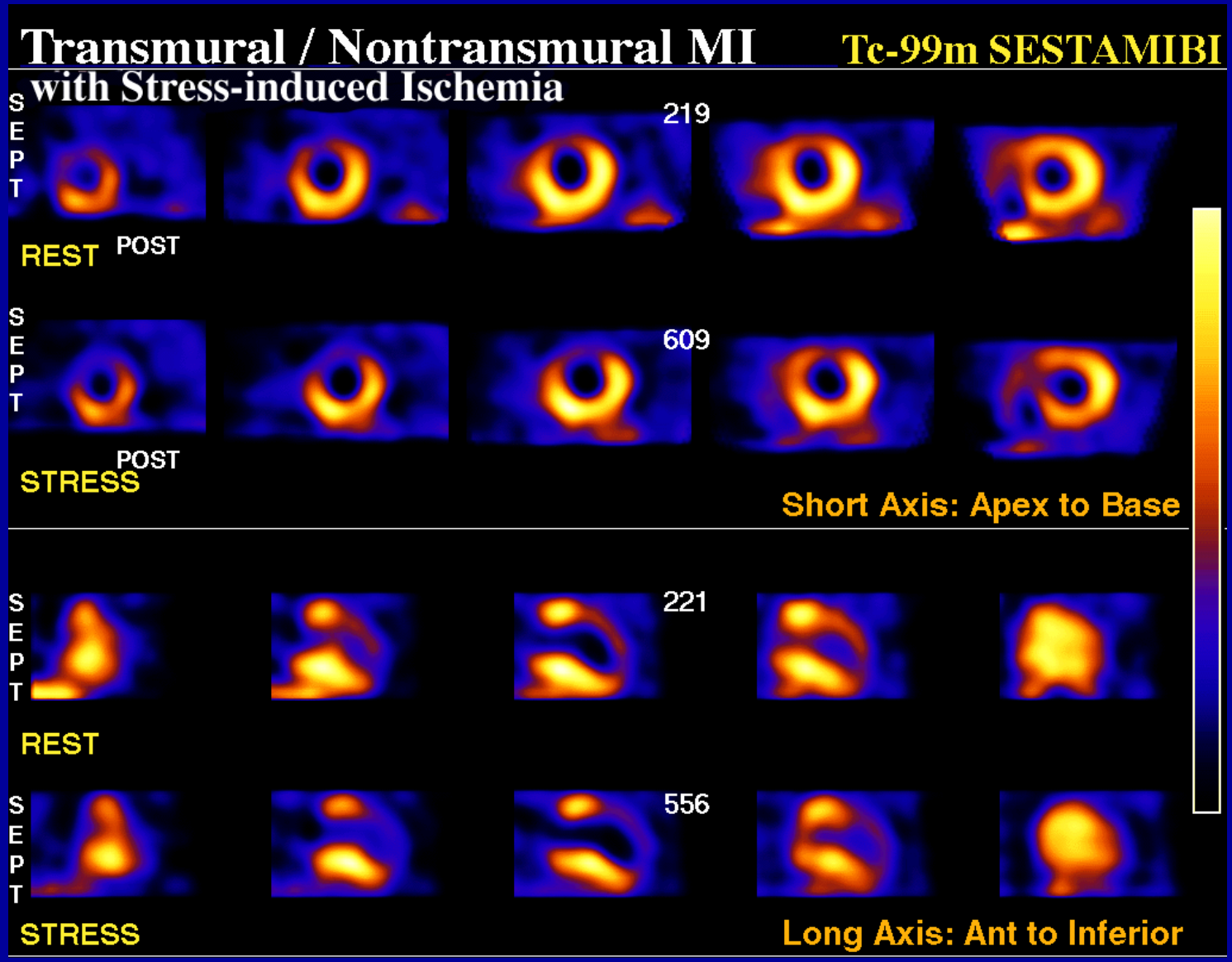

Transmural Inferior Wall MI
Tc-99m SESTAMIBI
SEPT
123
REST POST
SEPT
407
POST
STRESS
Short Axis: Apex to Base
BASE
110
REST
BASE
389
STRESS
Long Axis: Ant to Inferior

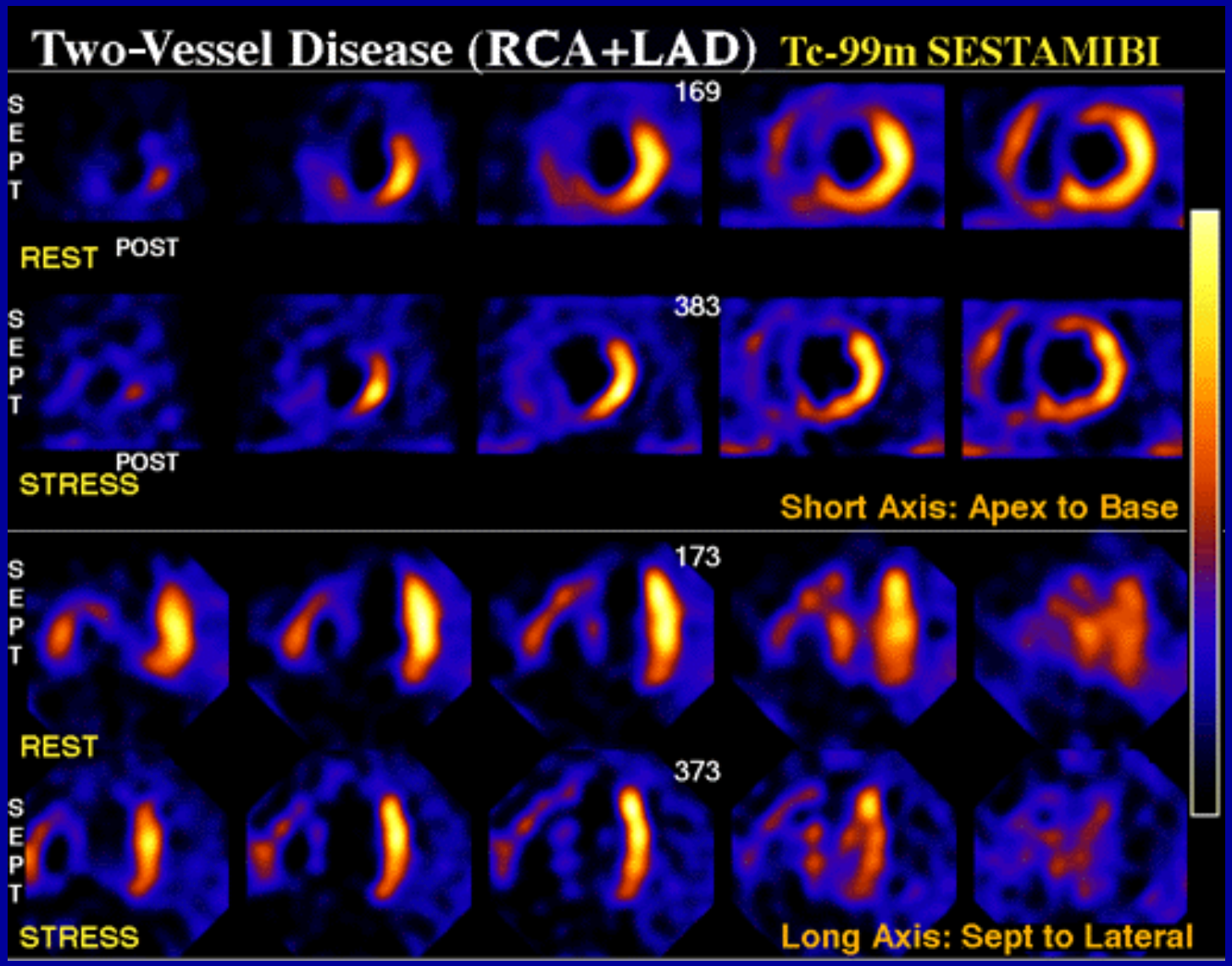

Nontransmural Inferior Wall MI
Tc-99m SESTAMIBI
SEPT
232
REST POST
SEPT
663
STRESS POST
Short Axis: Apex to Base
BASE
209
REST
BASE
536
STRESS
Long Axis: Ant to Inferior

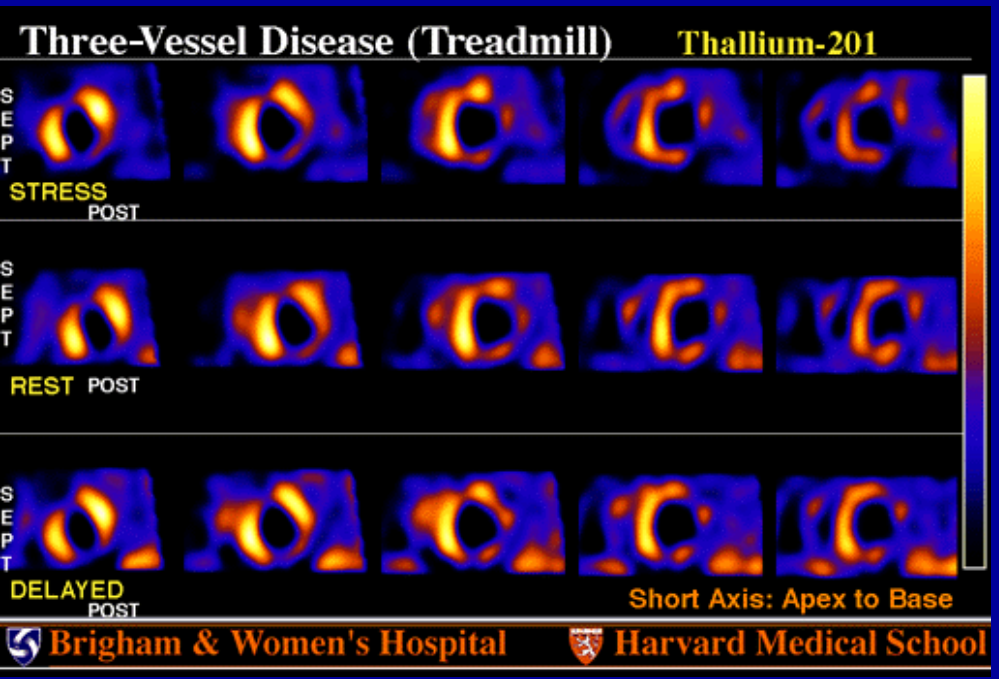

Transmural Inferior Wall MI
Tc-99m SESTAMIBI
SEPT
123
REST POST
SEPT
407
POST
STRESS
Short Axis: Apex to Base
BASE
110
REST
BASE
389
STRESS
Long Axis: Ant to Inferior

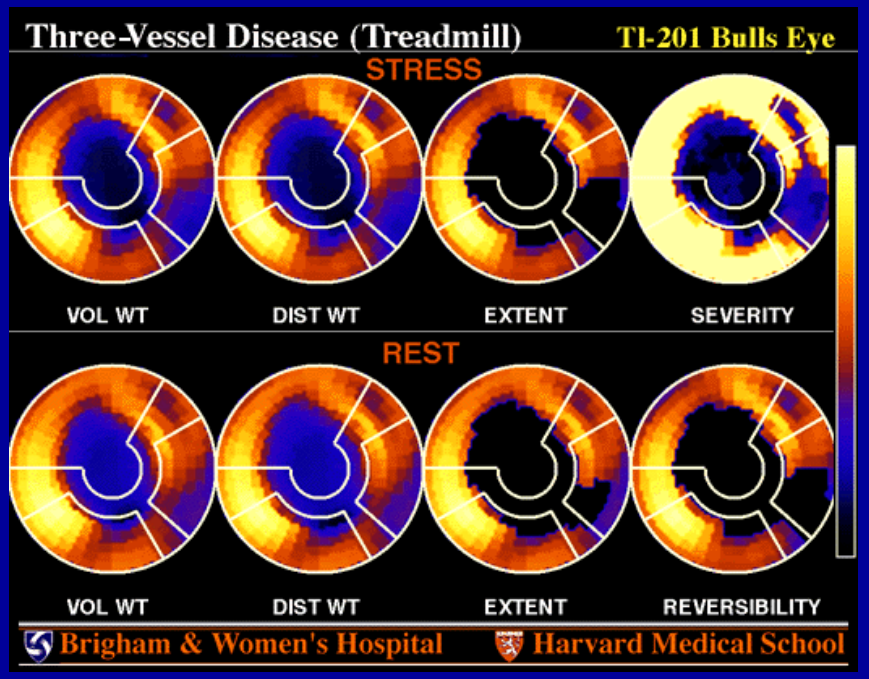

True Posterior-Lateral Wall MI
Tc-99m SESTAMIBI
SEPT
164
REST
POST
SEPT
311
POST
STRESS
Short Axis: Apex to Base
BASE
147
REST
BASE
269
STRESS
Long Axis: Ant to Inferior

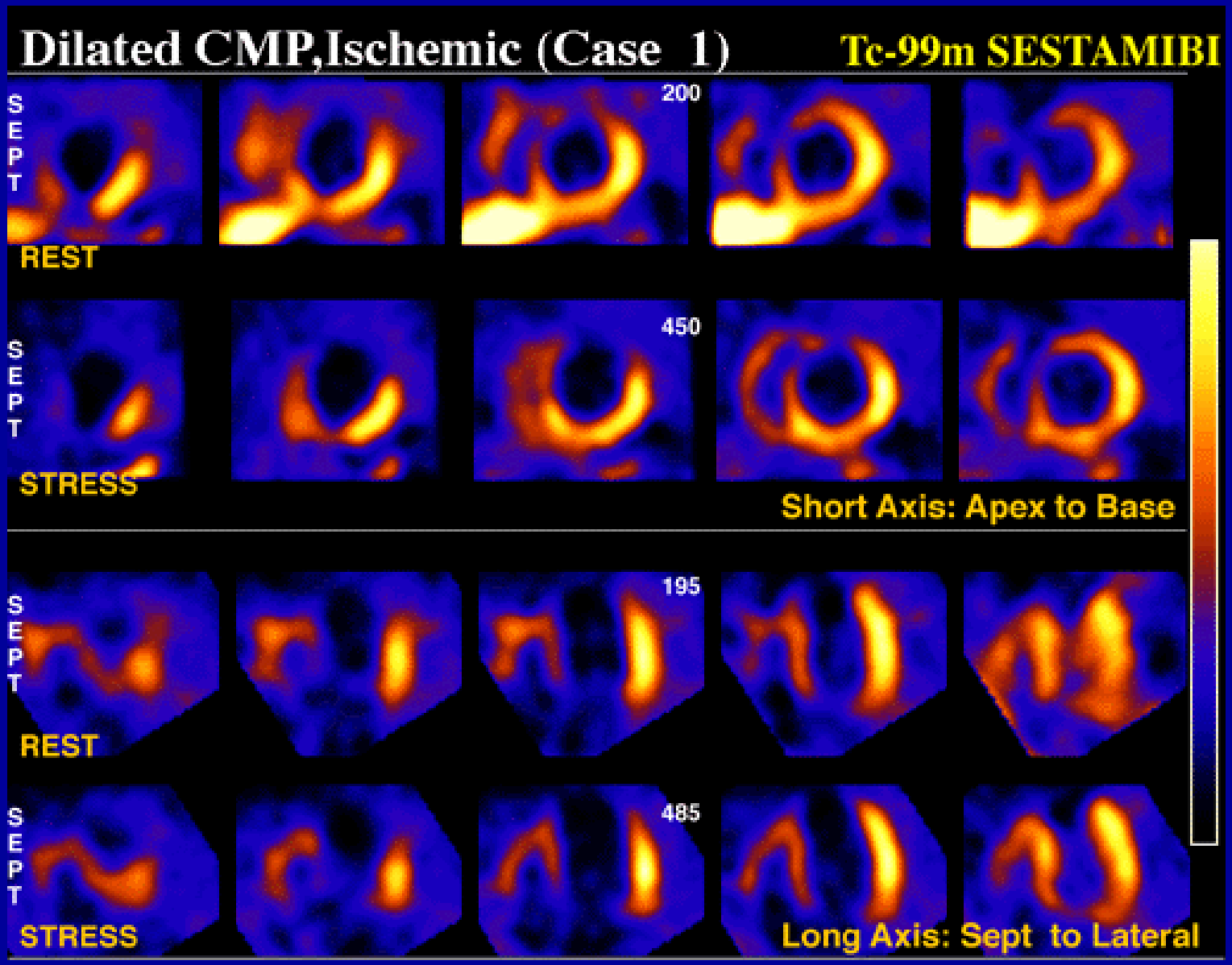

Peri-infarct / Residual Ischemia
Tc-99m SESTAMIBI
SEPT
REST
POST
230
L
L
SEPT
664
POST
STRESS
Short Axis: Apex to Base
BASE
228
REST
608
BASE
STRESS
Long Axis: Sept to Lateral

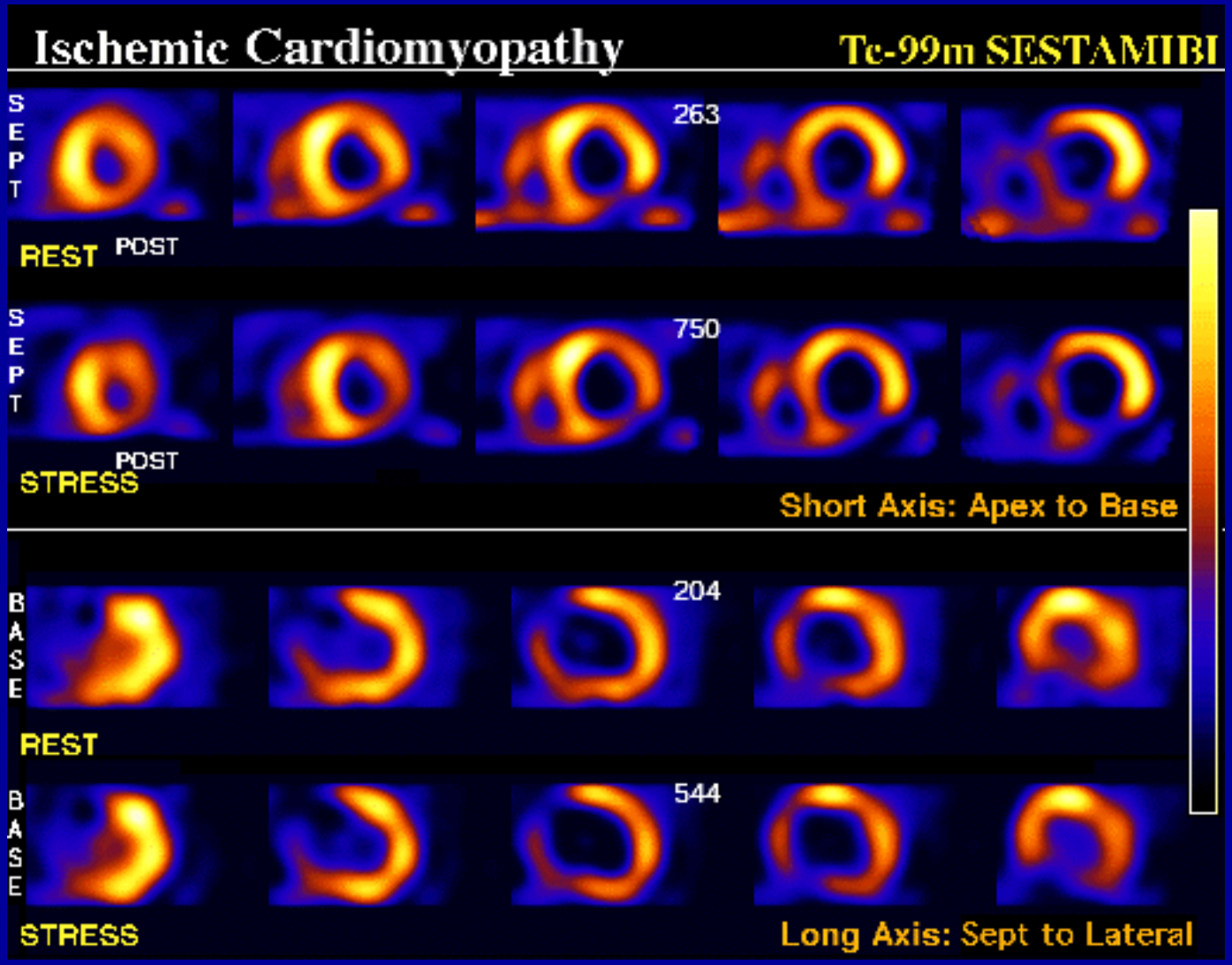

Transmural / Nontransmural MI
with Stress-induced Ischemia
Tc-99m SESTAMIBI
SEPT
219
REST
POST
SEPT
609
STRESS
POST
Short Axis: Apex to Base
SEPT
221
REST
SEPT
556
STRESS
Long Axis: Ant to Inferior

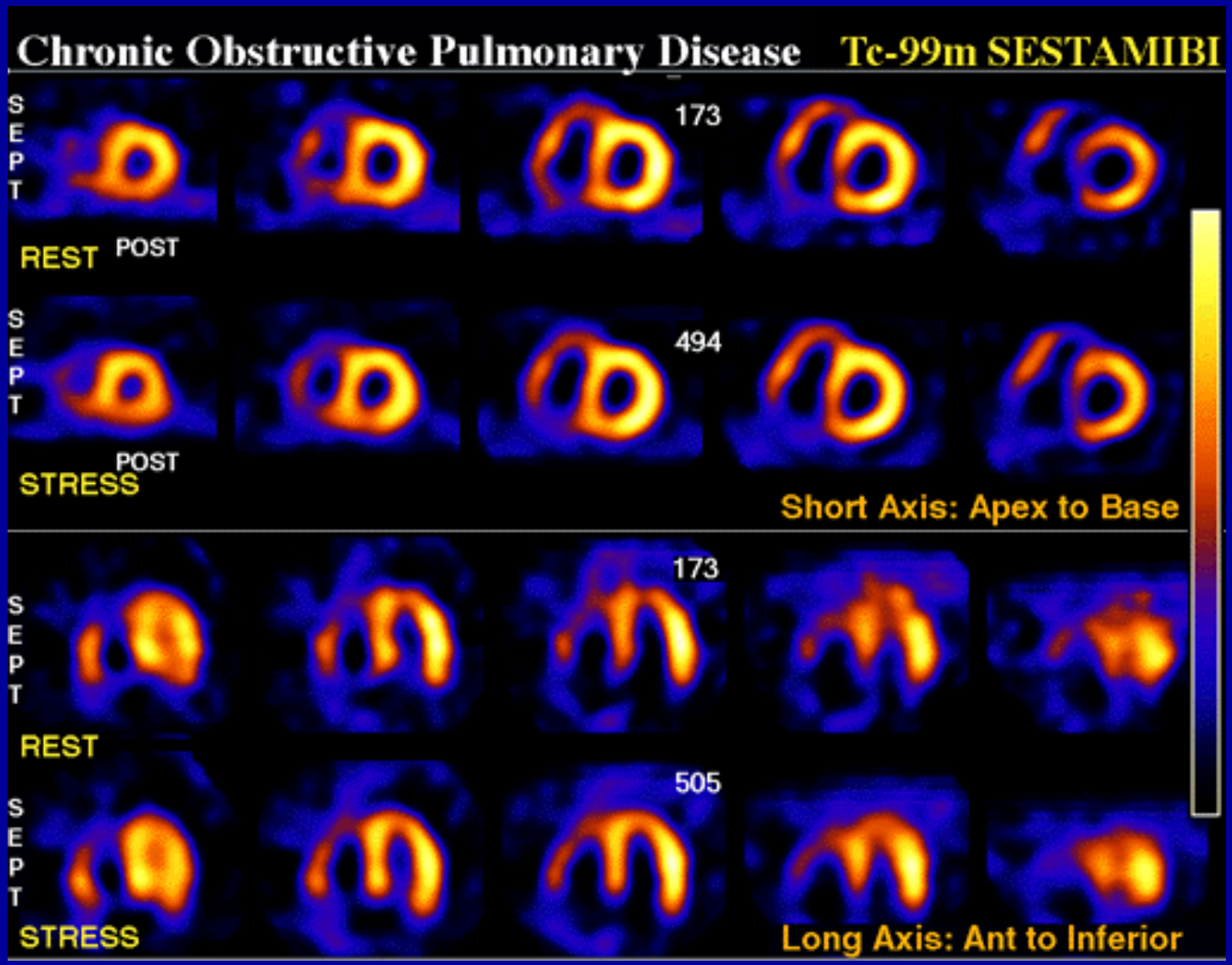

Two-Vessel Disease (RCA+LAD)
Tc-99m SESTAMIBI
169
SEPT
REST
POST
383
SEPT
STRESS
POST
Short Axis: Apex to Base
173
SEPT
REST
373
SEPT
STRESS
Long Axis: Sept to Lateral

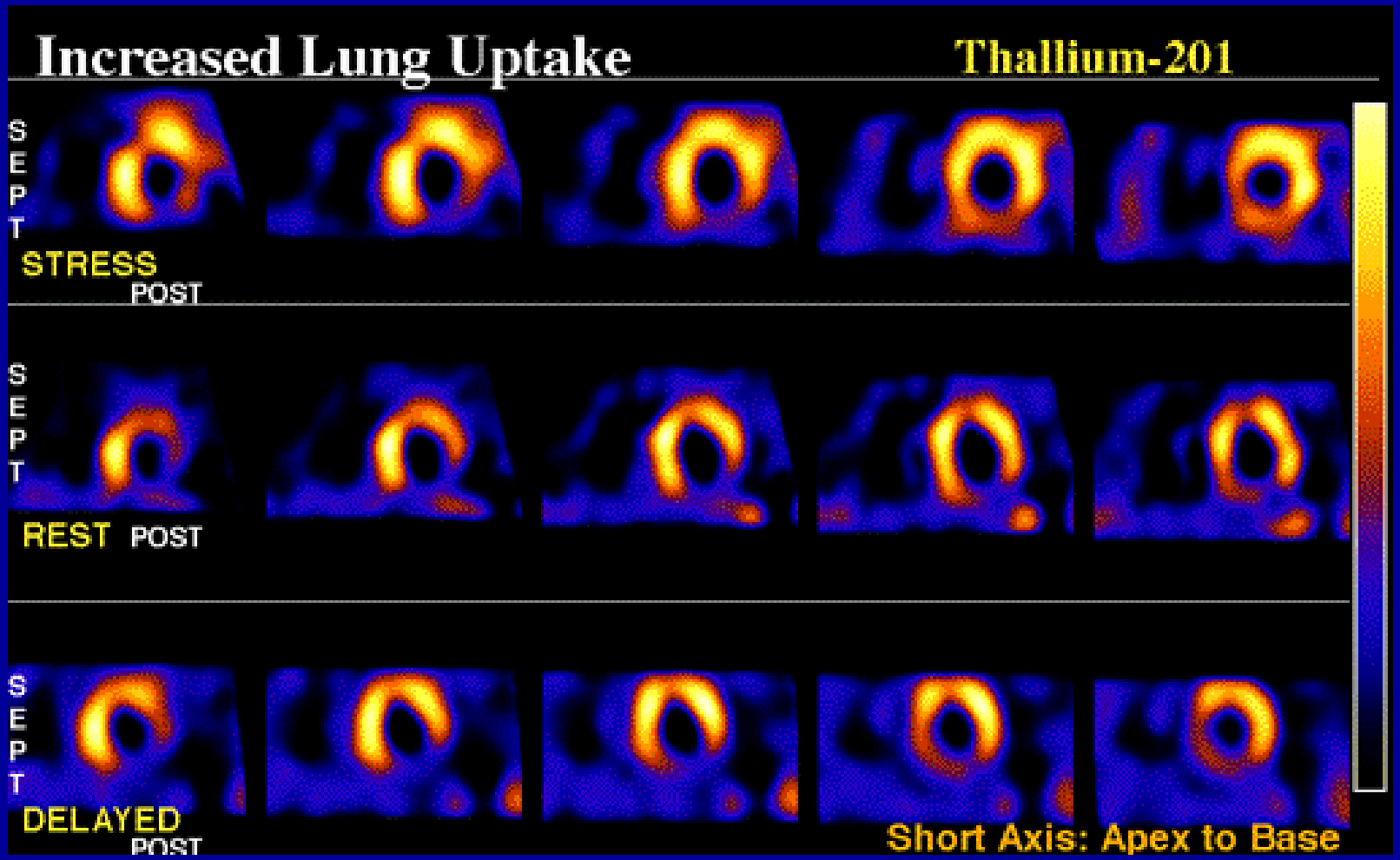

Three-Vessel Disease (Treadmill)
Thallium-201
SEPT
STRESS
POST
SEPT
REST POST
SEPT
DELAYED
POST
Short Axis: Apex to Base
Brigham & Women's Hospital
Harvard Medical School

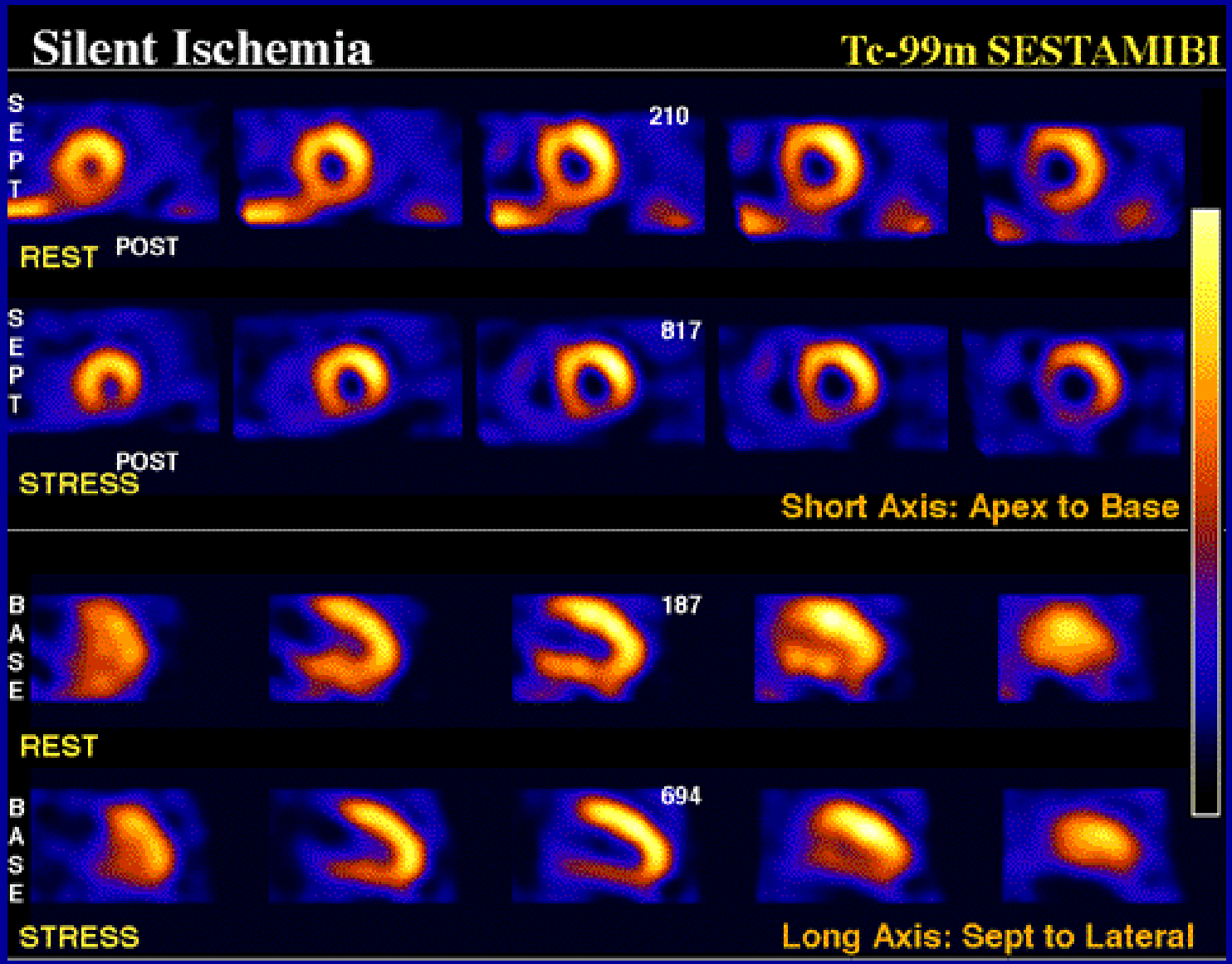

Three-Vessel Disease (Treadmill)
Tl-201 Bulls Eye
STRESS
VOL WT
DIST WT
EXTENT
SEVERITY
REST
VOL WT
DIST WT
EXTENT
REVERSIBILITY
Brigham & Women's Hospital
Harvard Medical School

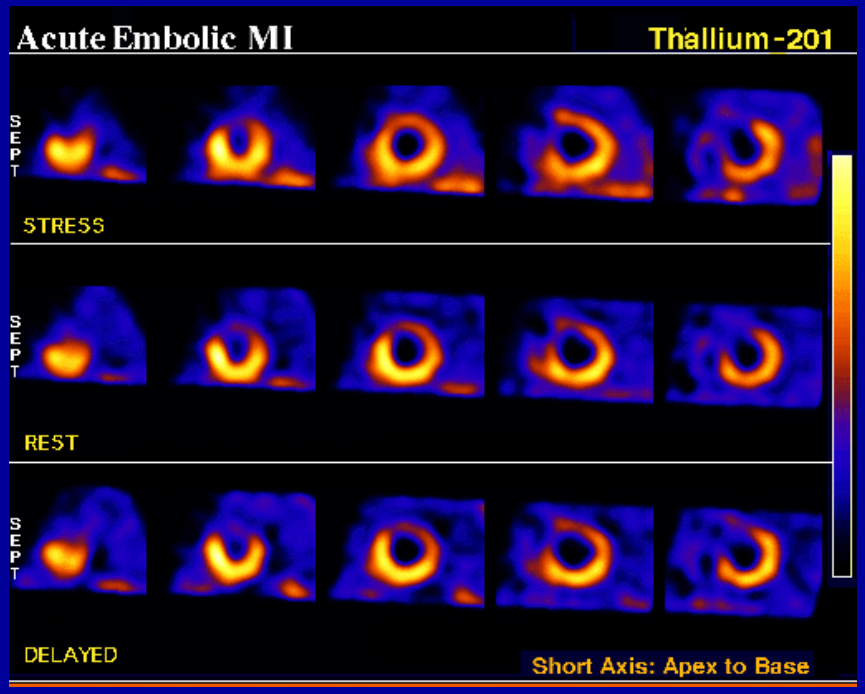

Dilated CMP,Ischemic (Case 1)
Tc-99m SESTAMIBI
SEPT
REST
200
SEPT
STRESS
450
Short Axis: Apex to Base
SEPT
REST
195
SEPT
STRESS
485
Long Axis: Sept to Lateral

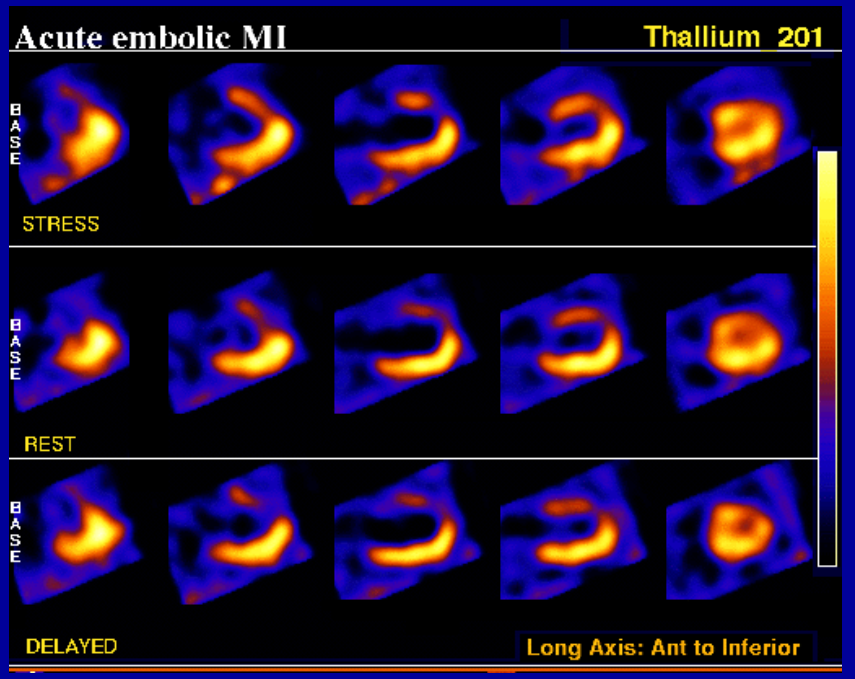

Ischemic Cardiomyopathy
Tc-99m SESTAMIBI
SEPT
263
REST
POST
SEPT
750
STRESS
POST
Short Axis: Apex to Base
BASE
204
REST
BASE
544
STRESS
Long Axis: Sept to Lateral

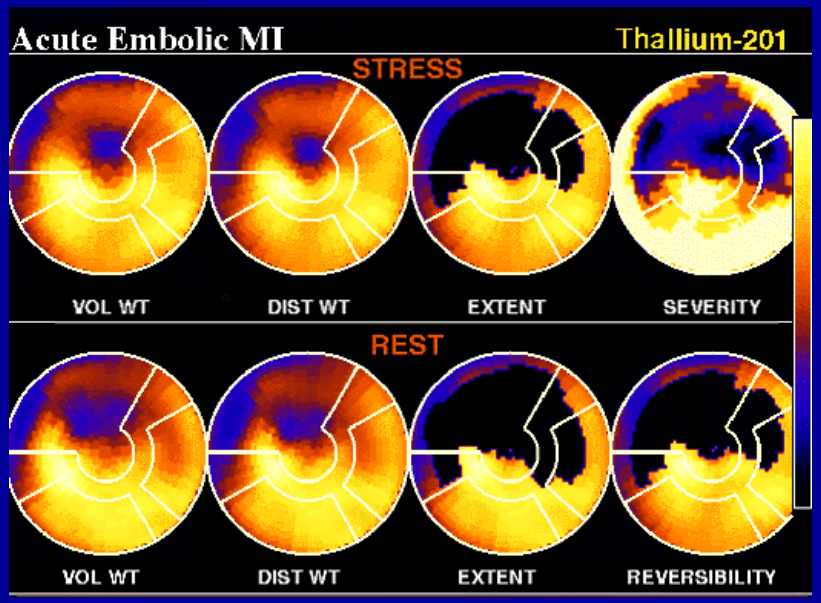

Chronic Obstructive Pulmonary Disease
Tc-99m SESTAMIBI
SEPT
173
REST
POST
SEPT
494
STRESS
POST
Short Axis: Apex to Base
SEPT
173
REST
SEPT
505
STRESS
Long Axis: Ant to Inferior

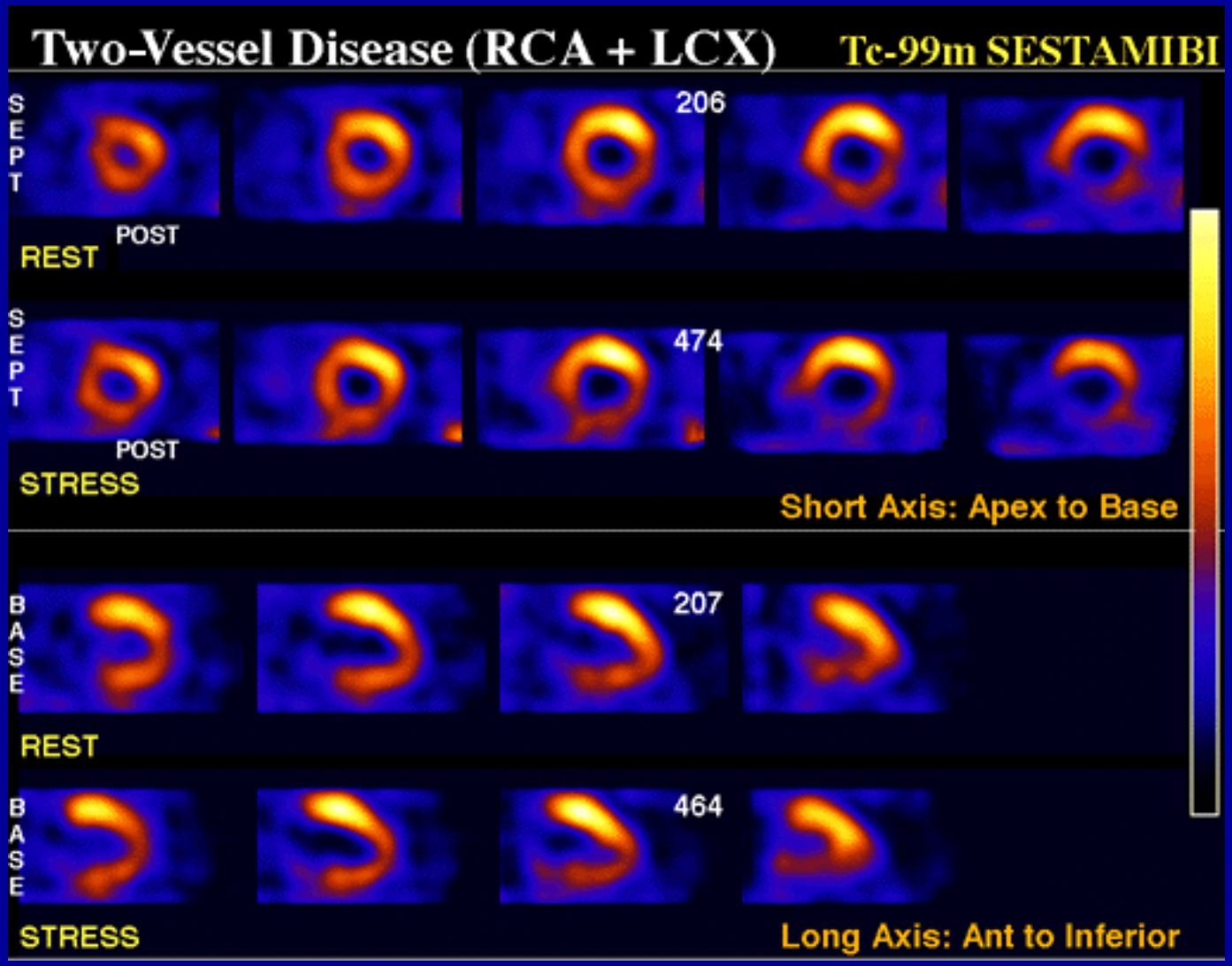

Increased Lung Uptake
Thallium-201
SEPT
STRESS
POST
SEPT
REST
POST
SEPT
DELAYED
POST
Short Axis: Apex to Base

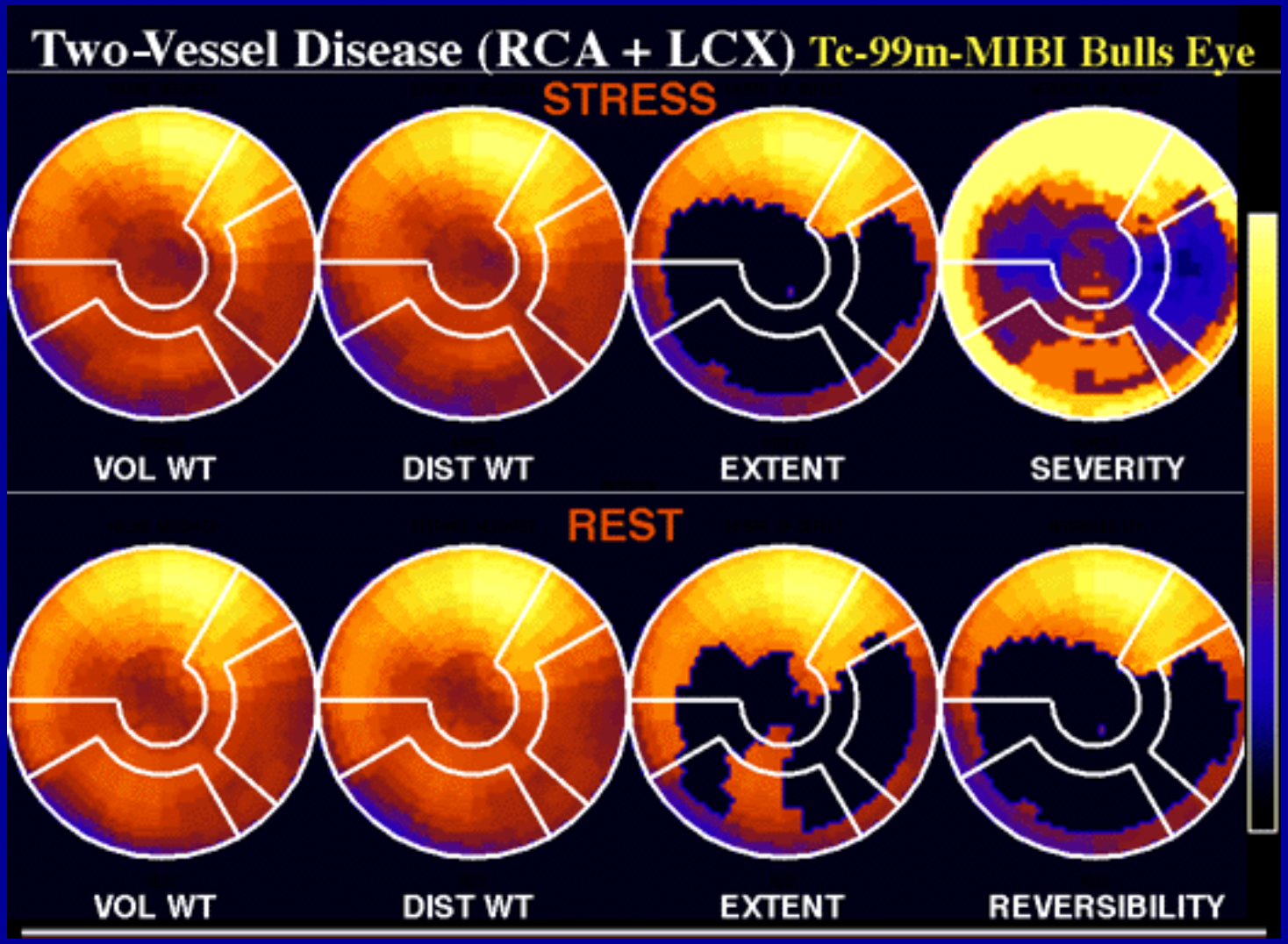

Silent Ischemia
Tc-99m SESTAMIBI
SEPT
210
REST
POST
SEPT
817
STRESS
POST
Short Axis: Apex to Base
BASE
187
REST
BASE
694
STRESS
Long Axis: Sept to Lateral

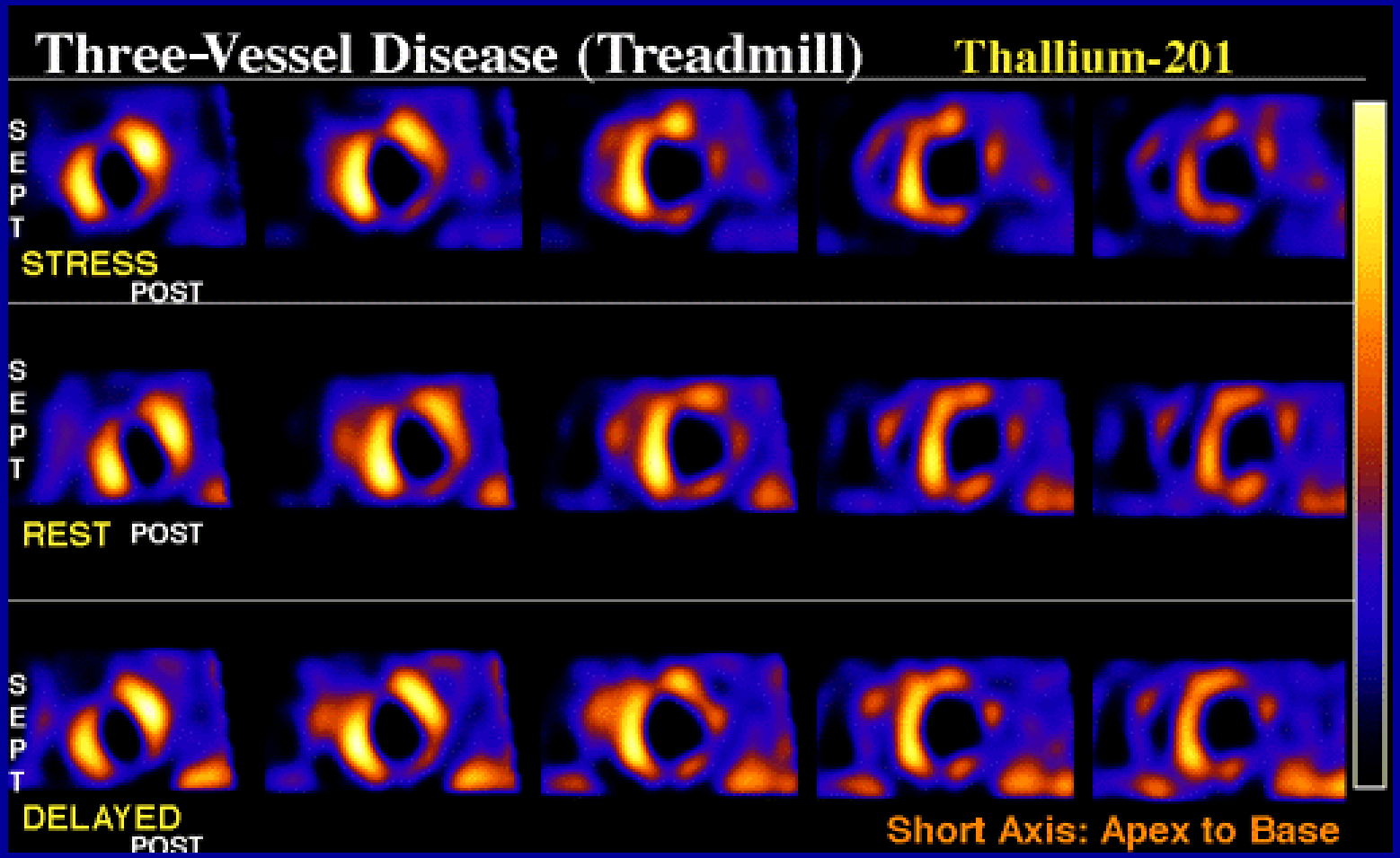

Acute Embolic MI
Thallium-201
SEPT
STRESS
SEPT
REST
SEPT
DELAYED
Short Axis: Apex to Base

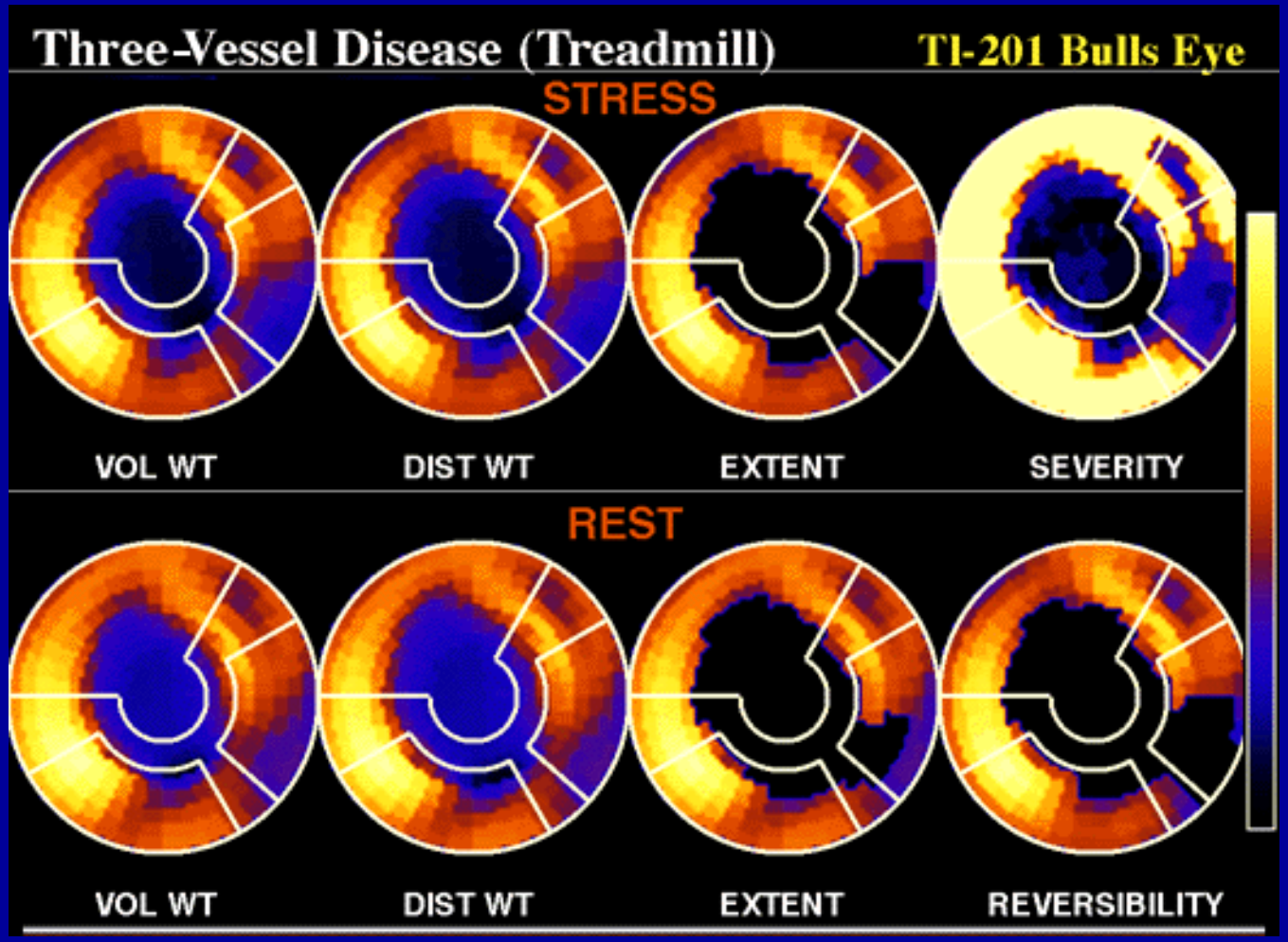

Acute embolic MI
Thallium 201
BASE
STRESS
BASE
REST
BASE
DELAYED
Long Axis: Ant to Inferior

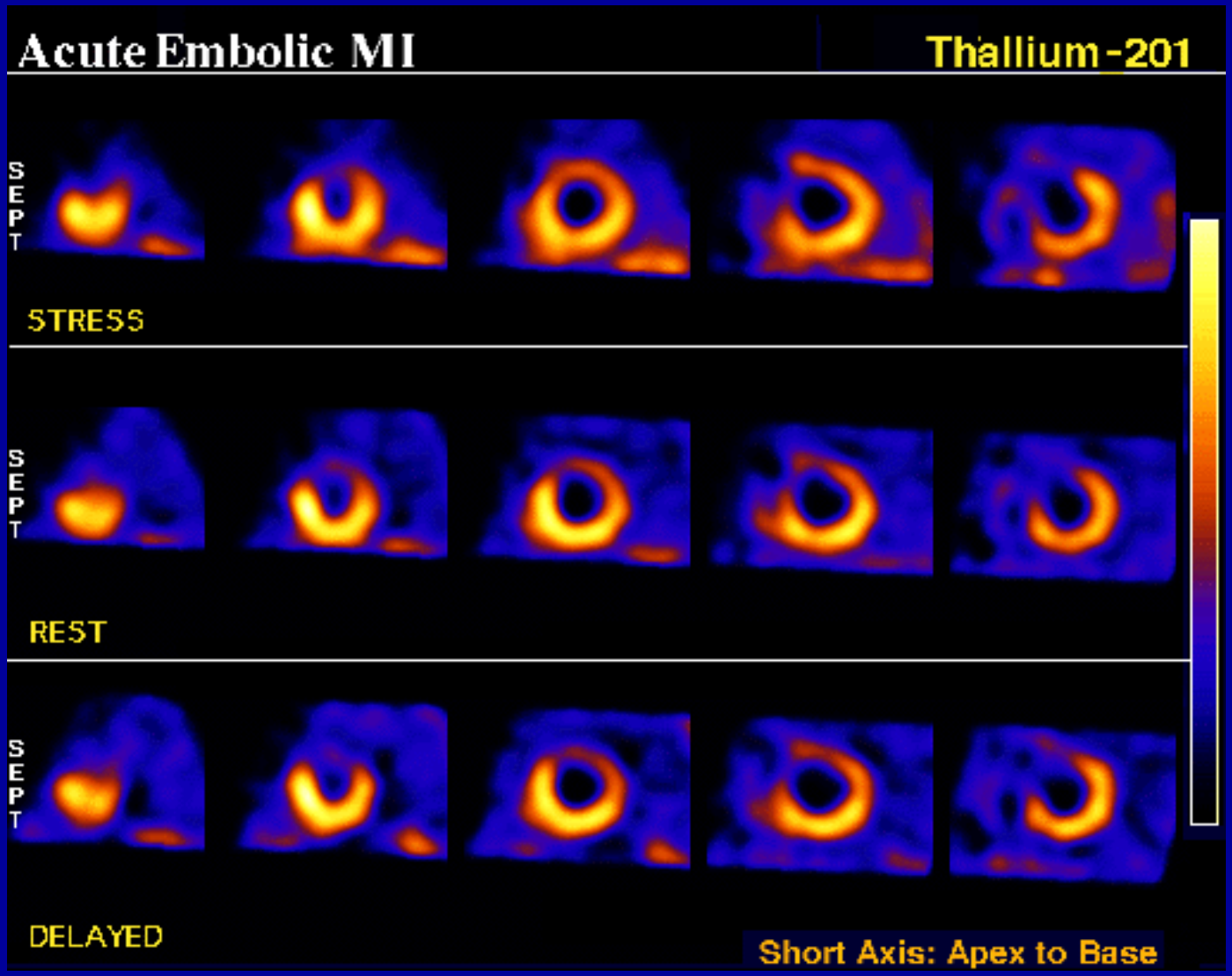

Acute Embolic MI
Thallium-201
STRESS
VOL WT
DIST WT
EXTENT
SEVERITY
REST
VOL WT
DIST WT
EXTENT
REVERSIBILITY

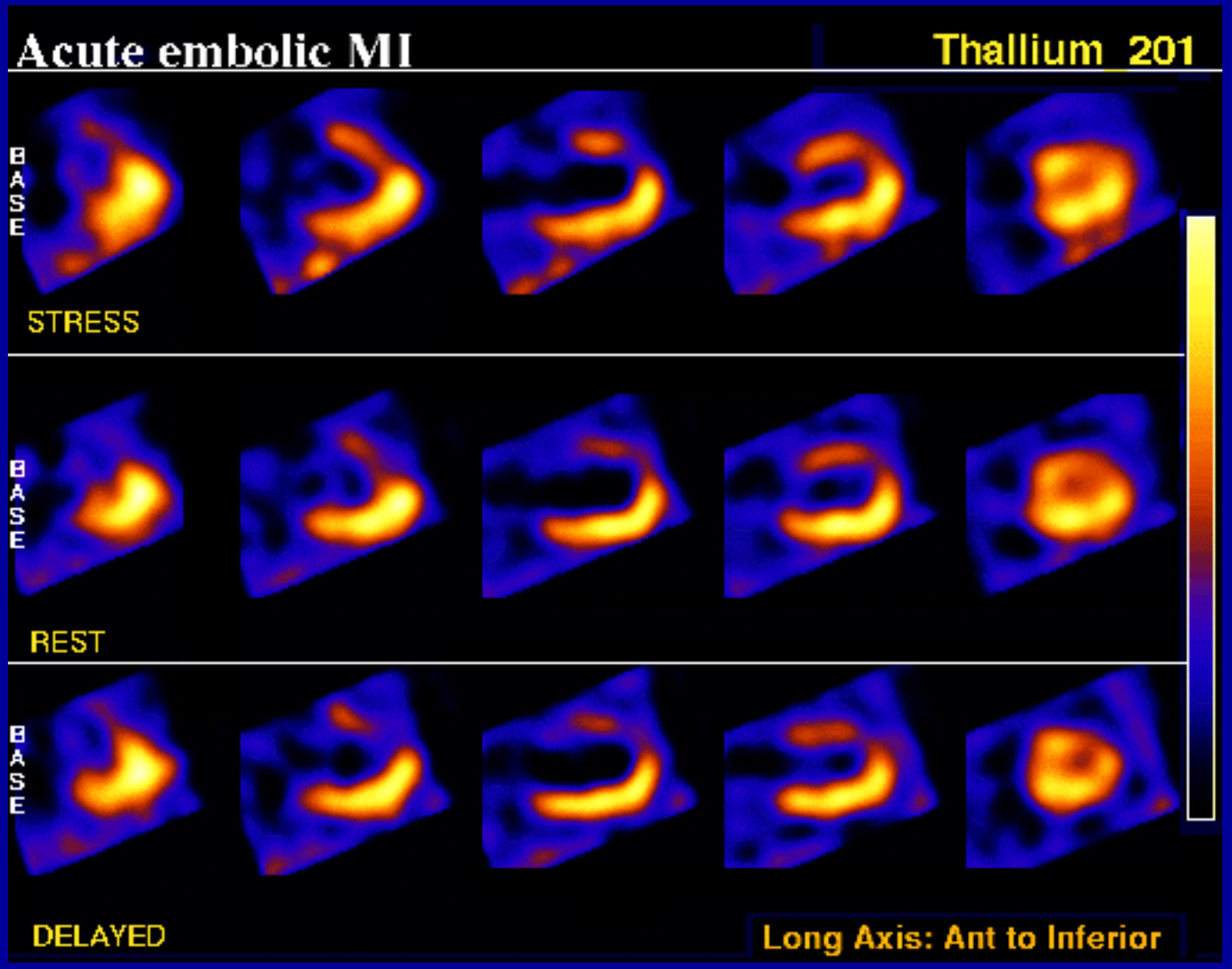

Two-Vessel Disease (RCA + LCX)
Tc-99m SESTAMIBI
SEPT
206
POST
REST
SEPT
474
POST
STRESS
Short Axis: Apex to Base
BASE
207
REST
BASE
464
STRESS
Long Axis: Ant to Inferior

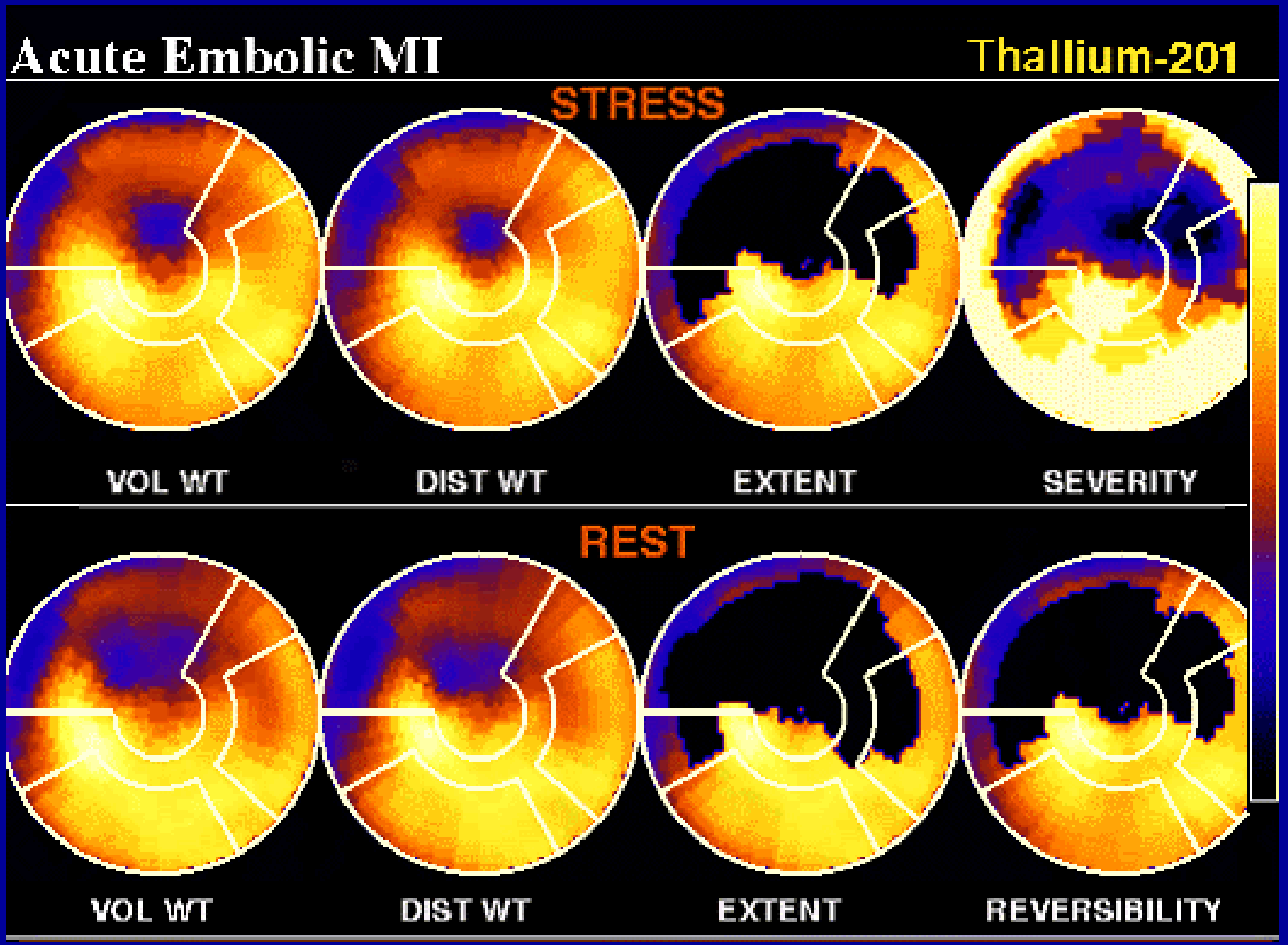

Two-Vessel Disease (RCA + LCX) Tc-99m-MIBI Bulls Eye
STRESS
VOL WT
DIST WT
EXTENT
SEVERITY
REST
VOL WT
DIST WT
EXTENT
REVERSIBILITY


Three-Vessel Disease (Treadmill)
Thallium-201
SEPT
STRESS
POST
SEPT
REST
POST
SEPT
DELAYED
POST
Short Axis: Apex to Base

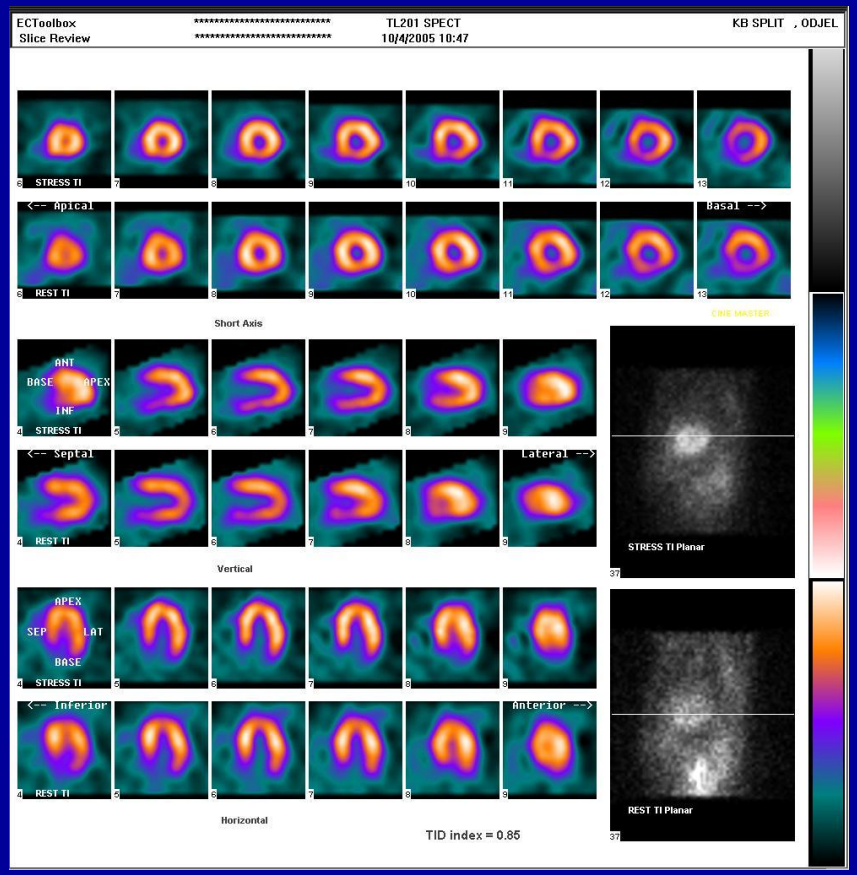

Three-Vessel Disease (Treadmill)
Tl-201 Bulls Eye
STRESS
VOL WT
DIST WT
EXTENT
SEVERITY
REST
VOL WT
DIST WT
EXTENT
REVERSIBILITY

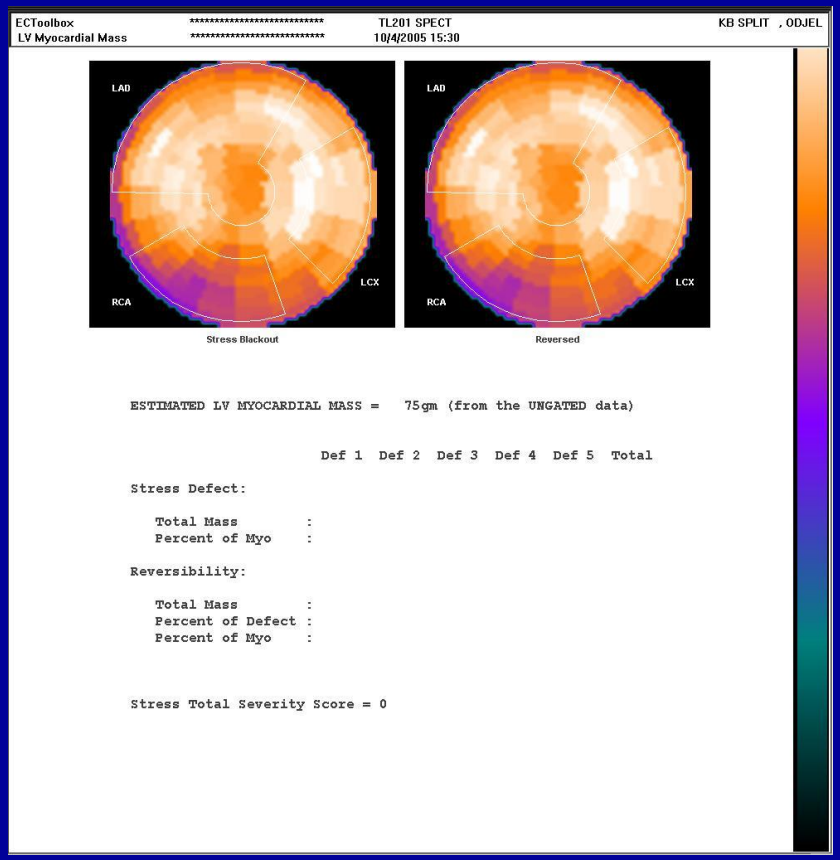

Acute Embolic MI
Thallium-201
SEPT
STRESS
SEPT
REST
SEPT
DELAYED
Short Axis: Apex to Base


Acute embolic MI
Thallium 201
BASE
STRESS
BASE
REST
BASE
DELAYED
Long Axis: Ant to Inferior

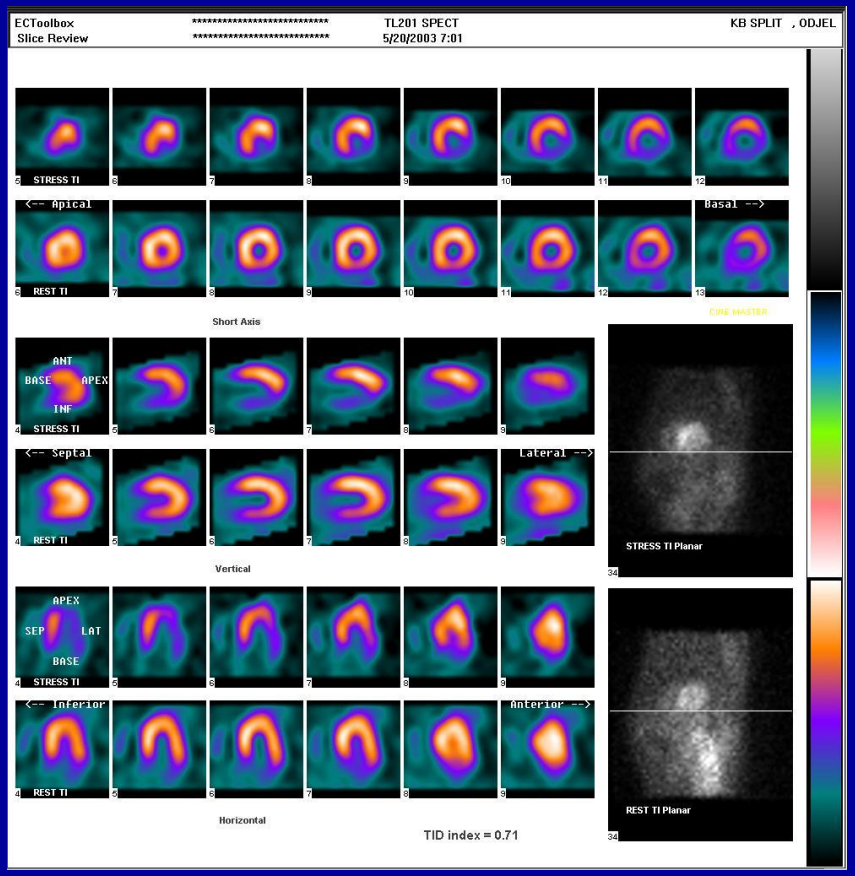

Acute Embolic MI
Thallium-201
STRESS
VOL WT
DIST WT
EXTENT
SEVERITY
REST
VOL WT
DIST WT
EXTENT
REVERSIBILITY

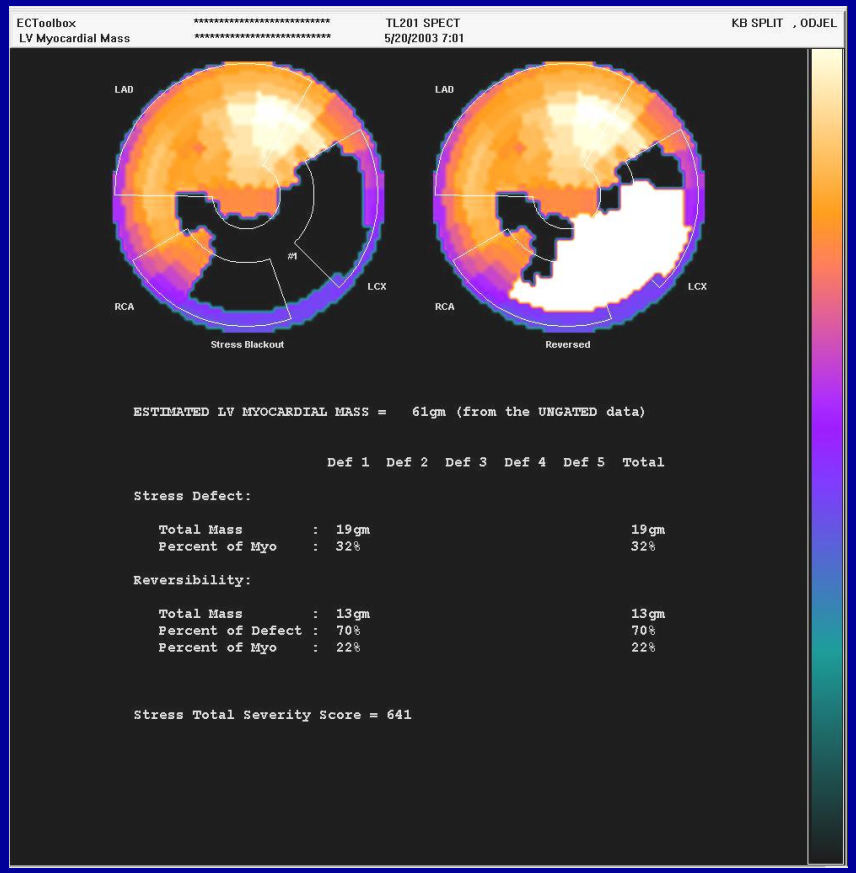
Normal finding



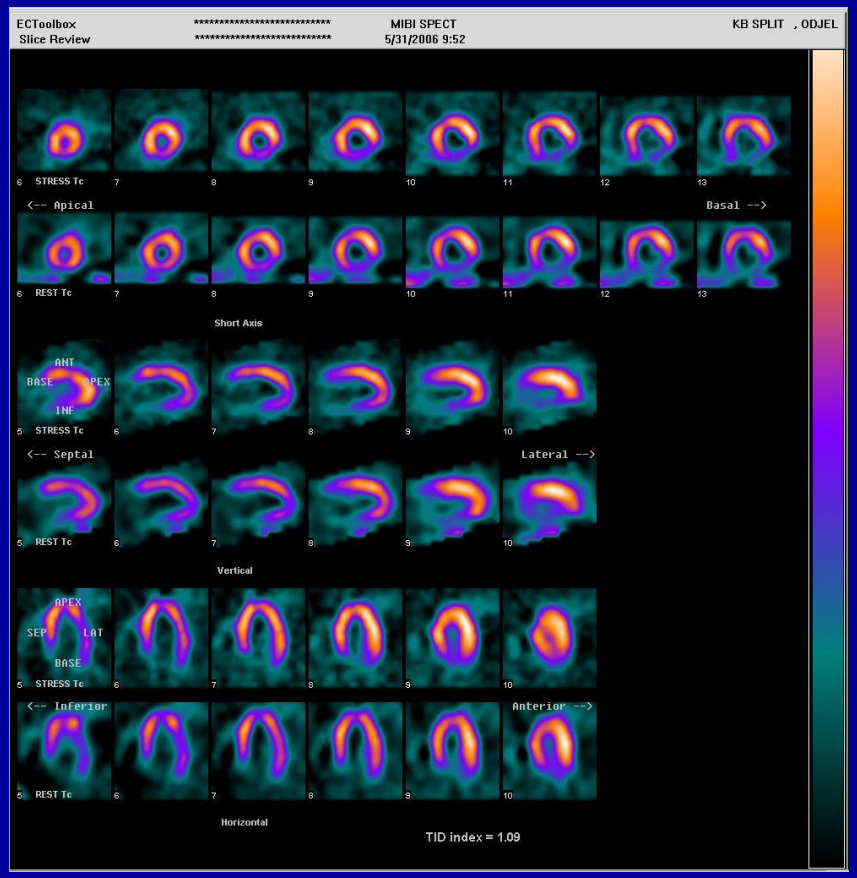


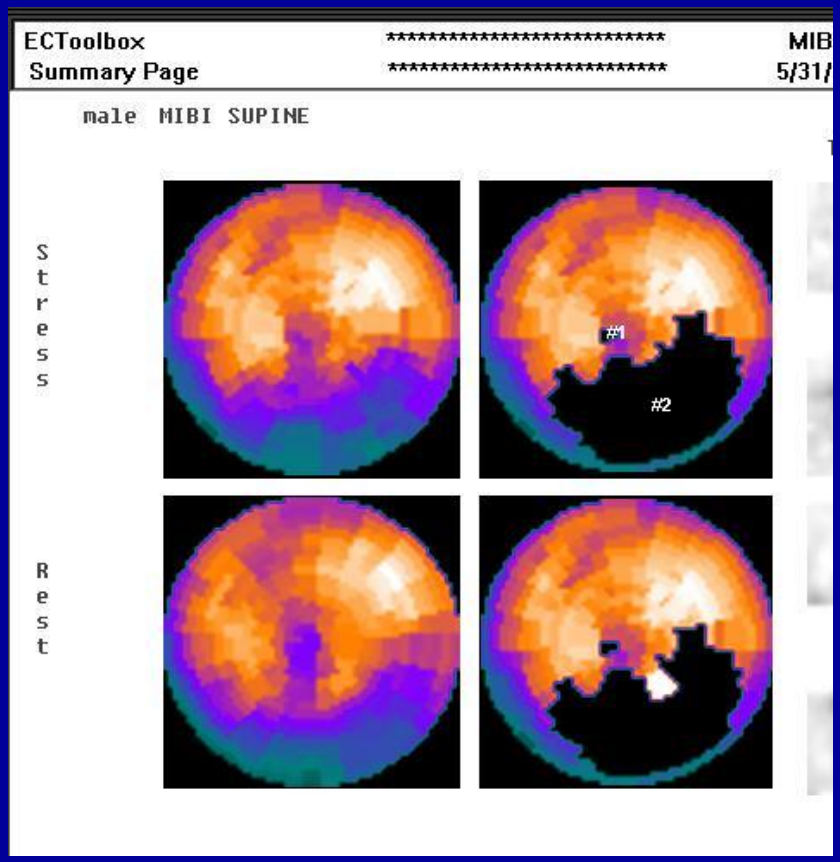
Reversible perfusion defect



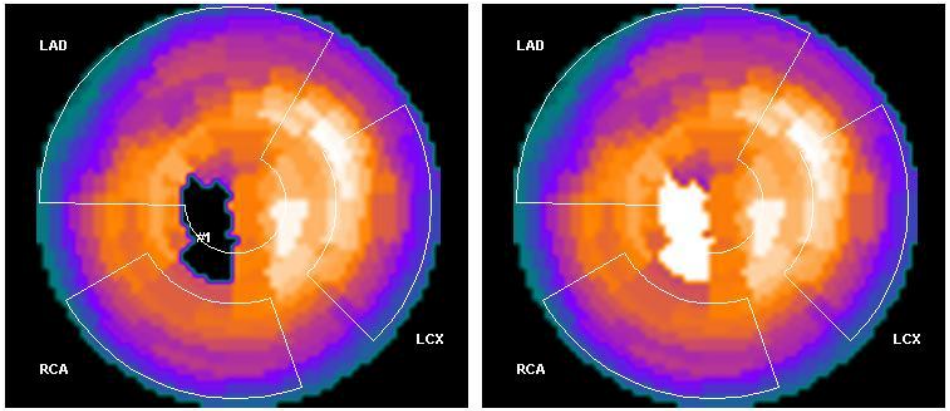


Irreversible perfusion defect





ECToolbox ********** TL201 SPECT KB SPLIT , ODJEL
LV Myocardial Mass ********** 9/26/2006 13:41



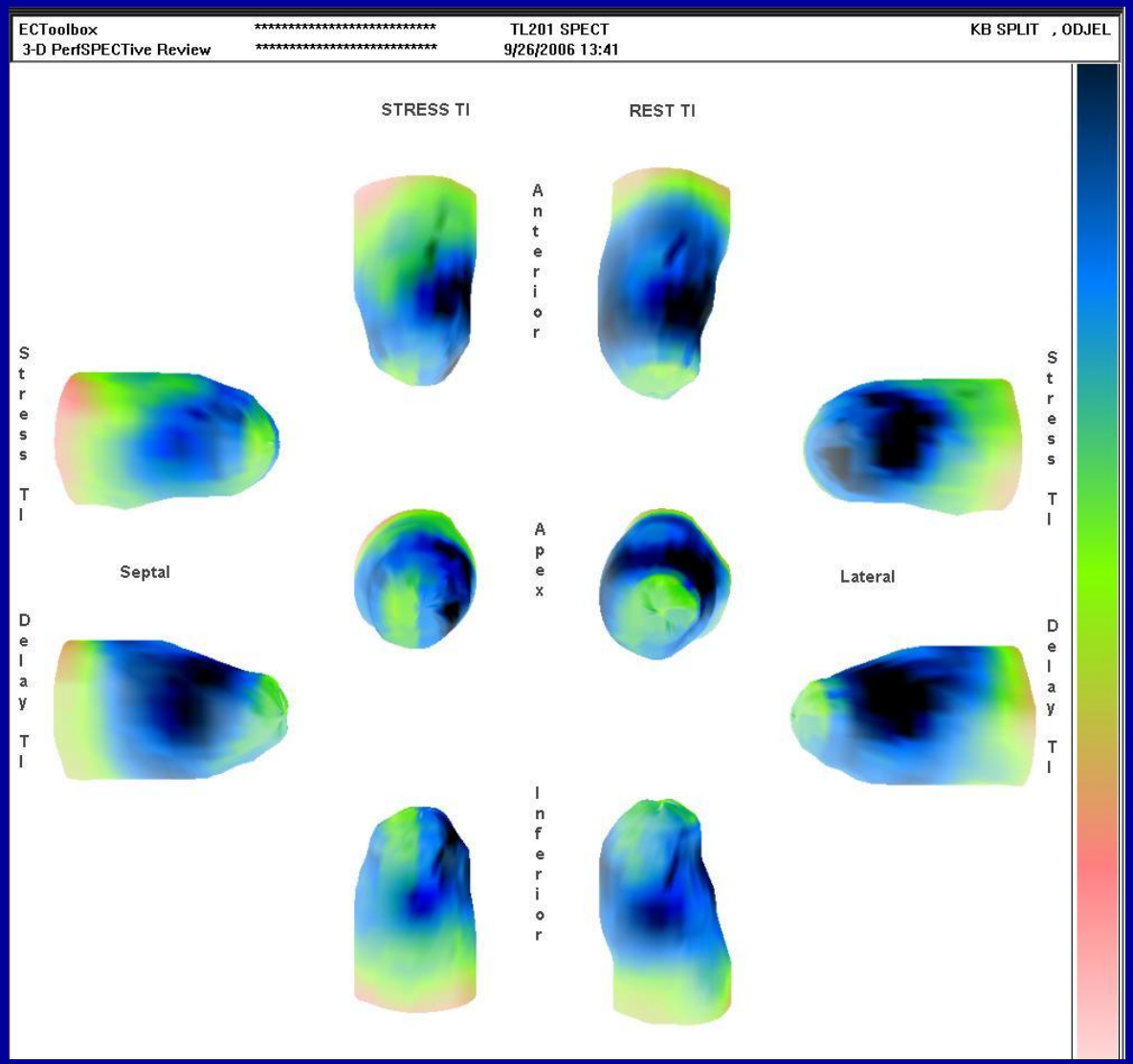
Stress Blackout Reversed

ESTIMATED LV MYOCARDIAL MASS = 104gm (from the UNGATED data)

	Def 1	Def 2	Def 3	Def 4	Def 5	Total
Stress Defect:						
Total Mass :	3gm					3gm
Percent of Myo :	3%					3%
Reversibility:						
Total Mass :	3gm					3gm
Percent of Defect :	84%					84%
Percent of Myo :	2%					2%

Stress Total Severity Score = 127

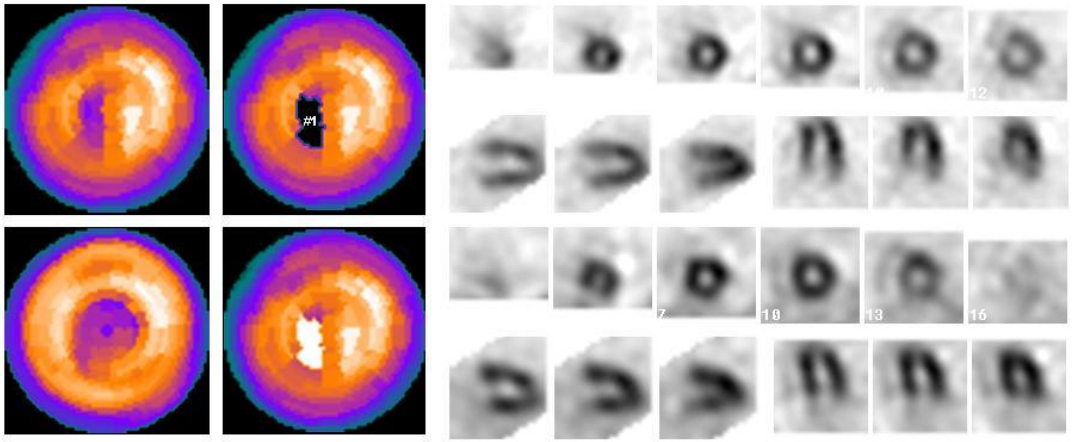
3-D perfusion review



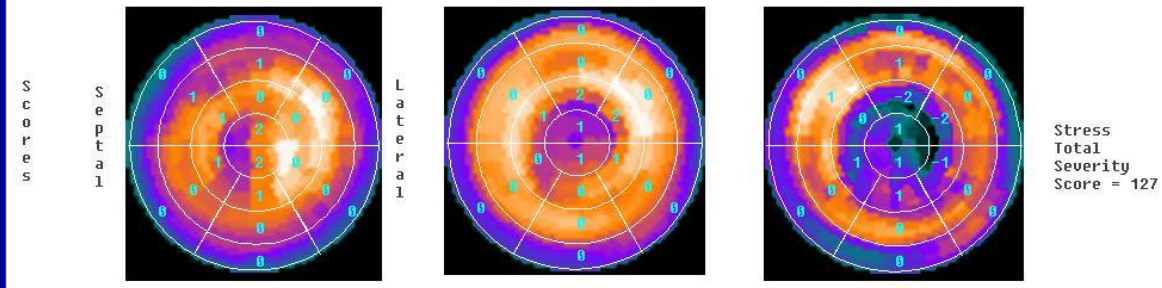
ECToolbox ********** TL201 SPECT KB SPLIT , ODJEL
Summary Page ********** 9/26/2006 13:41

female THALLIUM TOMO

TID index = 0.86



Scores: 0=Normal 1=Equivocal 2=Moderately Reduced 3=Severely Reduced 4=Absent



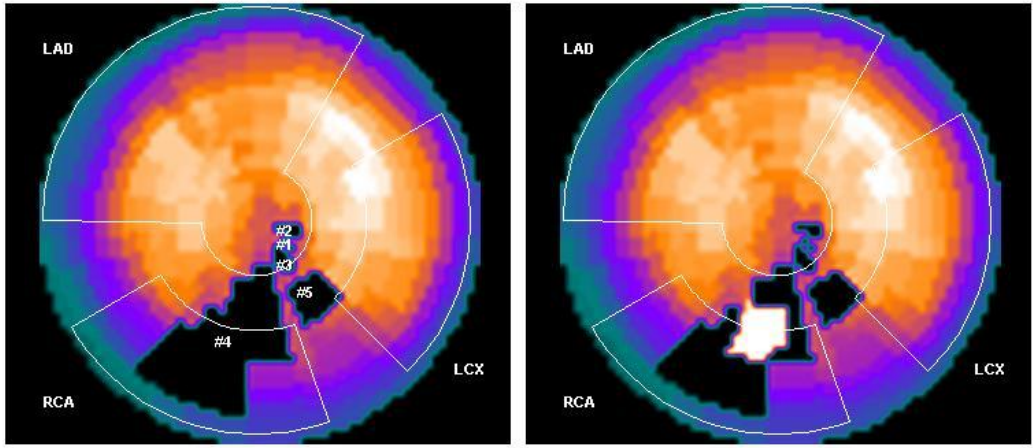
Summed Stress Score = 9

Summed Rest Score = 8

Summed Difference Score = 1

Stress Total Severity Score = 127

ECToolbox ********** TL201 SPECT KB SPLIT , ODJEL
LV Myocardial Mass ********** 9/26/2006 14:06



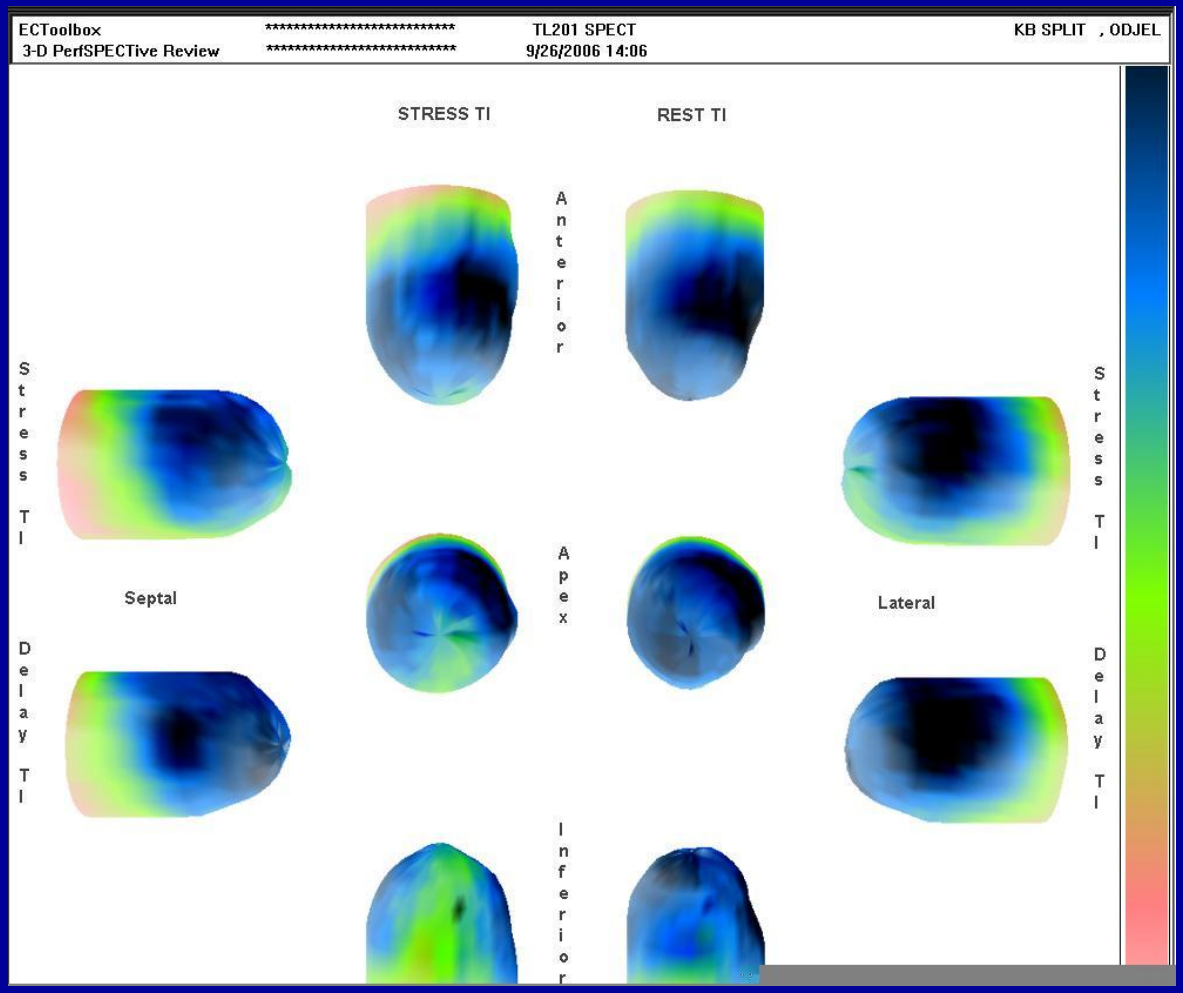
Stress Blackout Reversed

ESTIMATED LV MYOCARDIAL MASS = 126gm (from the UNGATED data)

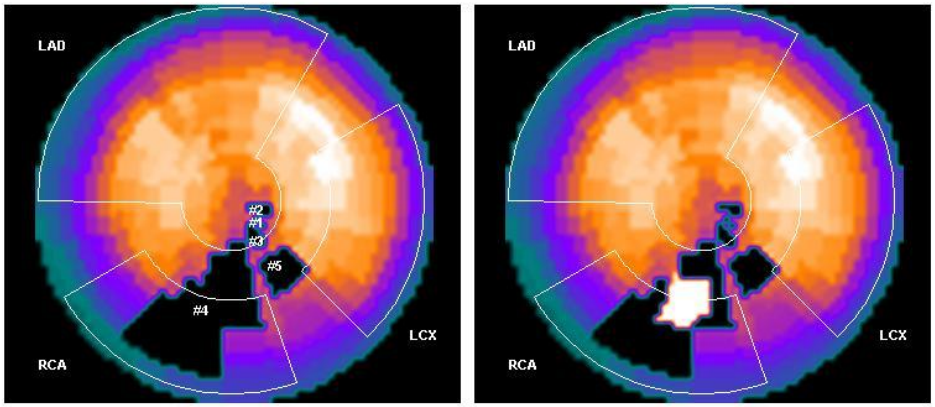
	Def 1	Def 2	Def 3	Def 4	Def 5	Total
Stress Defect:						
Total Mass :	1gm	1gm	1gm	11gm	2gm	16gm
Percent of Myo :	1%	1%	1%	10%	2%	15%
Reversibility:						
Total Mass :	0gm	0gm	0gm	3gm	0gm	3gm
Percent of Defect :	0%	0%	0%	23%	0%	16%
Percent of Myo :	0%	0%	0%	2%	0%	2%

Stress Total Severity Score = 178

3-D perfusion review



ECToolbox ********** TL201 SPECT KB SPLIT , ODJEL
LV Myocardial Mass ********** 9/26/2006 14:06



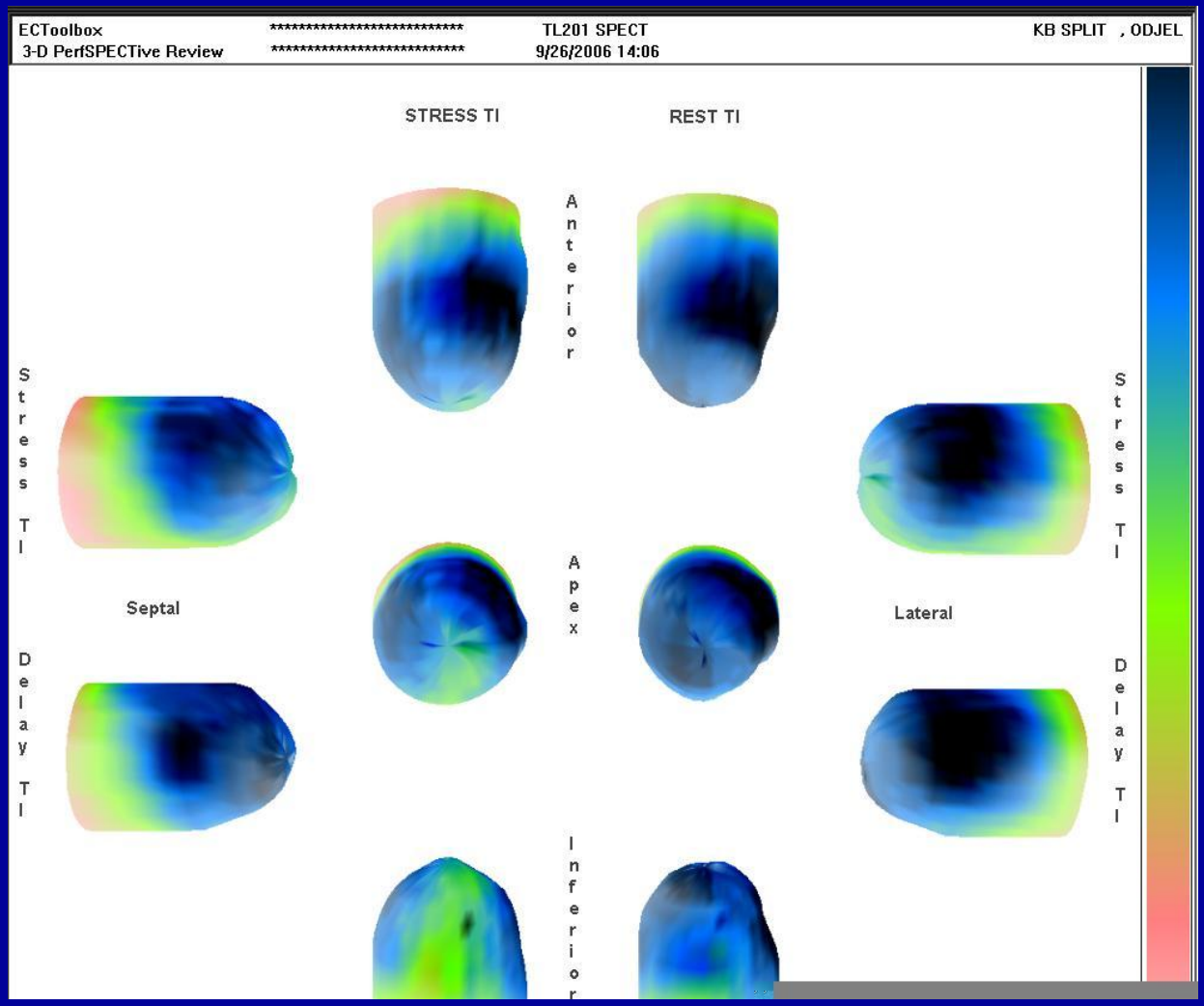
Stress Blackout Reversed

ESTIMATED LV MYOCARDIAL MASS = 126gm (from the UNGATED data)

	Def 1	Def 2	Def 3	Def 4	Def 5	Total
Stress Defect:						
Total Mass :	1gm	1gm	1gm	11gm	2gm	16gm
Percent of Myo :	1%	1%	1%	10%	2%	15%
Reversibility:						
Total Mass :	0gm	0gm	0gm	3gm	0gm	3gm
Percent of Defect :	0%	0%	0%	23%	0%	16%
Percent of Myo :	0%	0%	0%	2%	0%	2%

Stress Total Severity Score = 178

3-D perfusion review



ECToolbox
Summary Page

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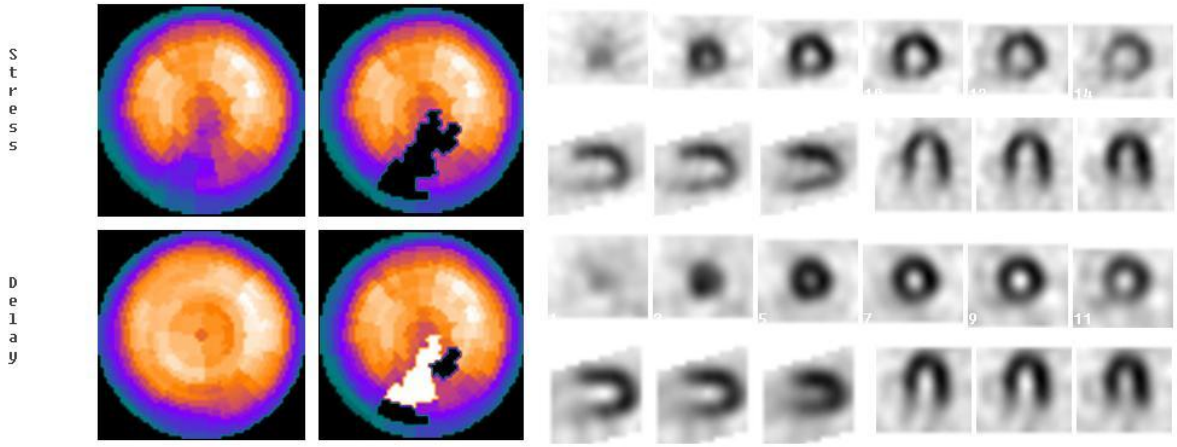
****

TL201 SPECT
9/26/2006 14:06

KB SPLIT , ODJEL

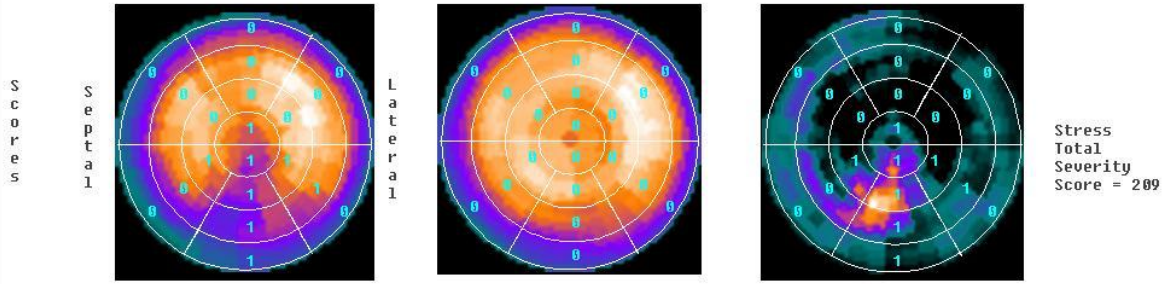
male THALLIUM TOMO

TID index = 1.16



Anterior

Scores: 0=Normal 1=Equivocal 2=Moderately Reduced 3=Severely Reduced 4=Absent



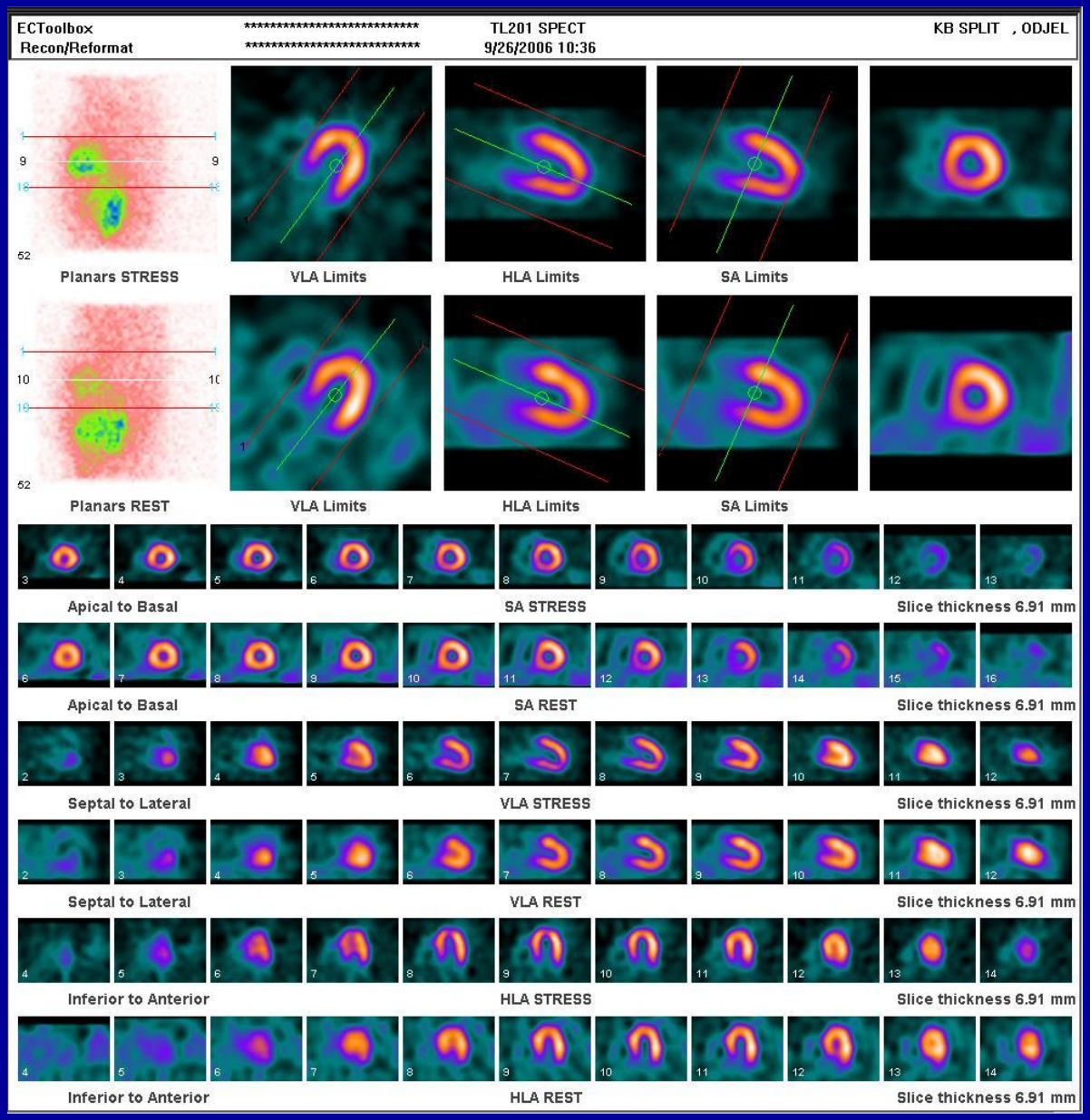
Inferior

Summed Stress Score = 8

Summed Rest Score =

Summed Difference Score = 8

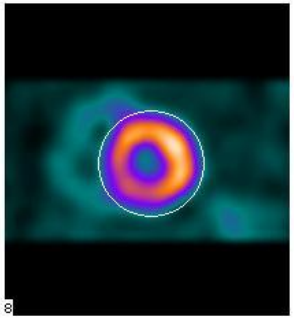
Stress Total Severity Score = 209


ECToolbox
Recon/Reformat
****
****
TL201 SPECT
9/26/2006 10:36
KB SPLIT , ODJEL
Planars STRESS
VLA Limits
HLA Limits
SA Limits
Planars REST
VLA Limits
HLA Limits
SA Limits
Apical to Basal
SA STRESS
Slice thickness 6.91 mm
Apical to Basal
SA REST
Slice thickness 6.91 mm
Septal to Lateral
VLA STRESS
Slice thickness 6.91 mm
Septal to Lateral
VLA REST
Slice thickness 6.91 mm
Inferior to Anterior
HLA STRESS
Slice thickness 6.91 mm
Inferior to Anterior
HLA REST
Slice thickness 6.91 mm

ECToolbox ********** TL201 SPECT KB SPLIT , ODJEL

Set Quantitative Parameters ********** 9/26/2006 10:36

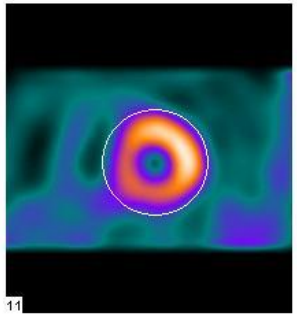
STRESS TI



center: 31.82 31.89

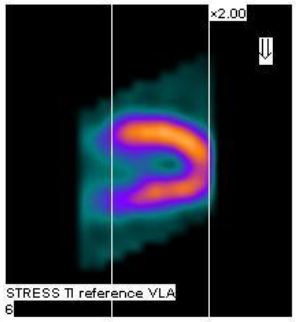
radius: 6

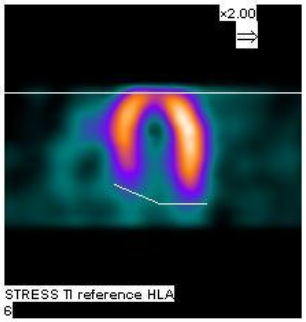
REST TI

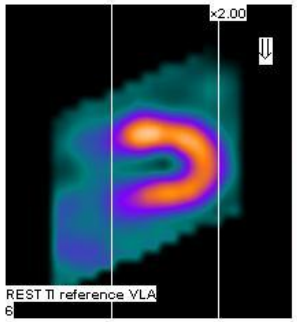


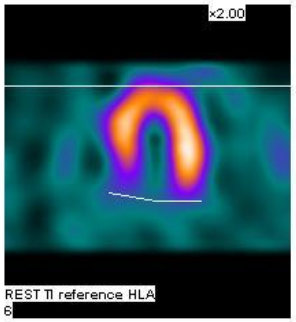
center: 32.23 31.90

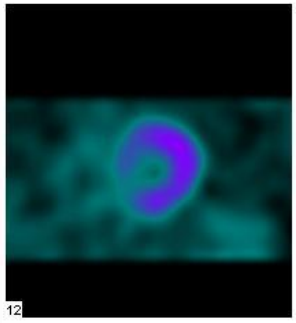
radius: 6



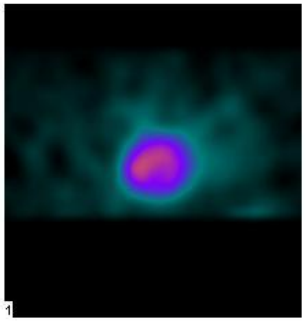




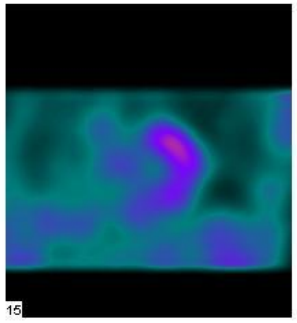




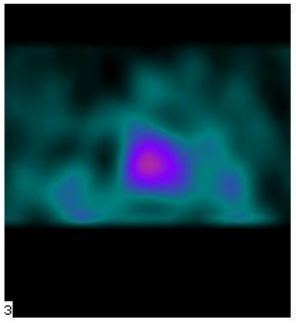
BASE



APEX



BASE



APEX

ECToolbox
Slice Review

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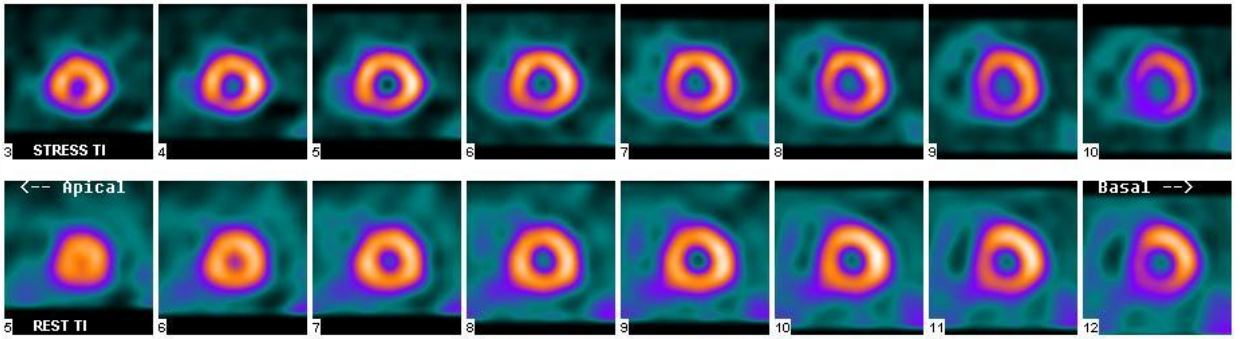
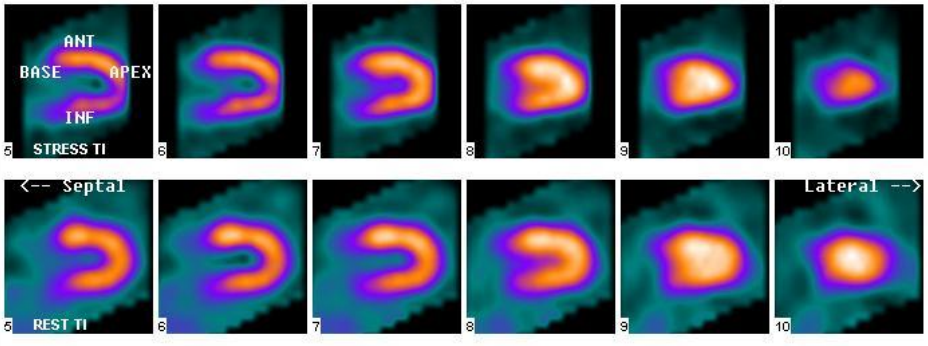
TL201 SPECT
9/26/2006 10:36

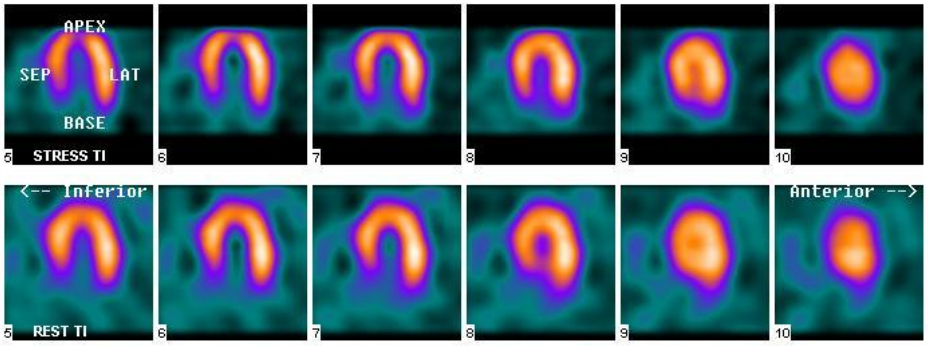
KB SPLIT , ODJEL



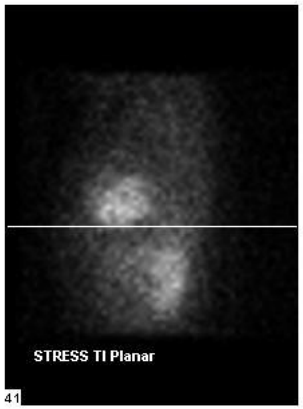
Short Axis

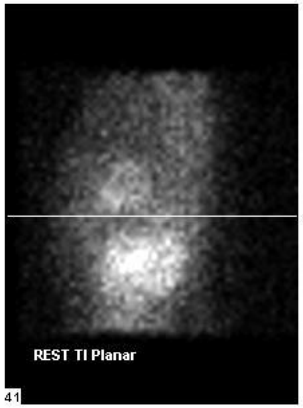


Vertical



Horizontal



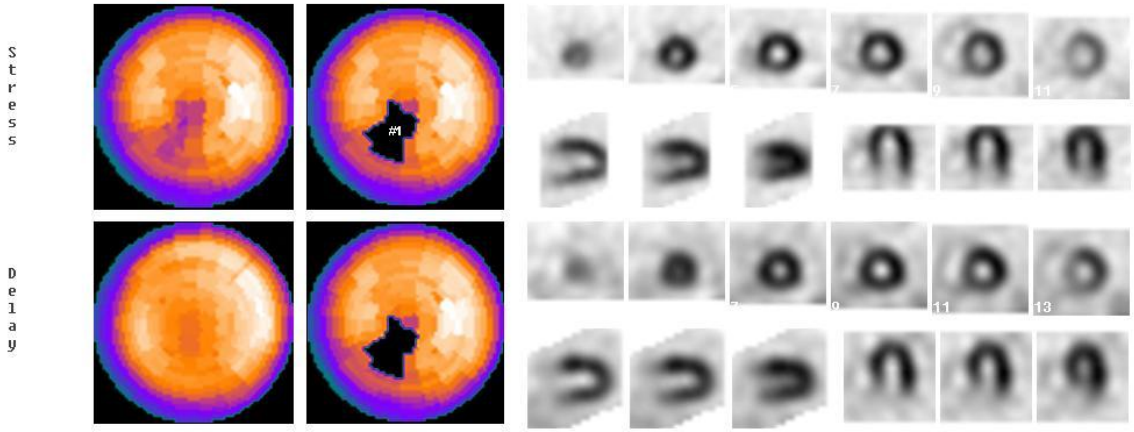


TID index = 1.03

ECToolbox ********** TL201 SPECT KB SPLIT , ODJEL
Summary Page ********** 9/26/2006 14:30

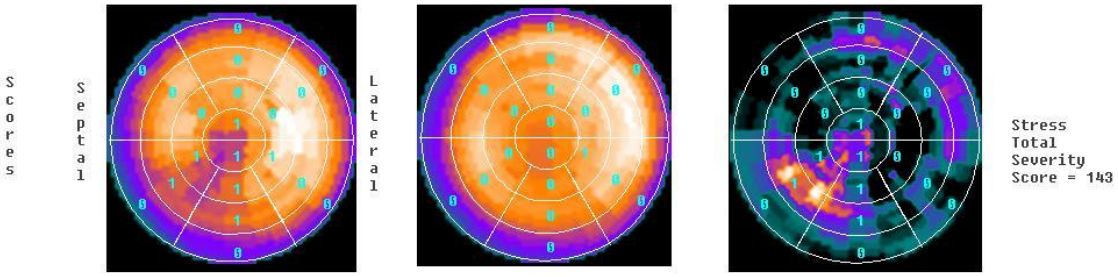
female THALLIUM TOMO

TID index = 1.03



Anterior

Scores: 0=Normal 1=Equivocal 2=Moderately Reduced 3=Severely Reduced 4=Absent



Inferior

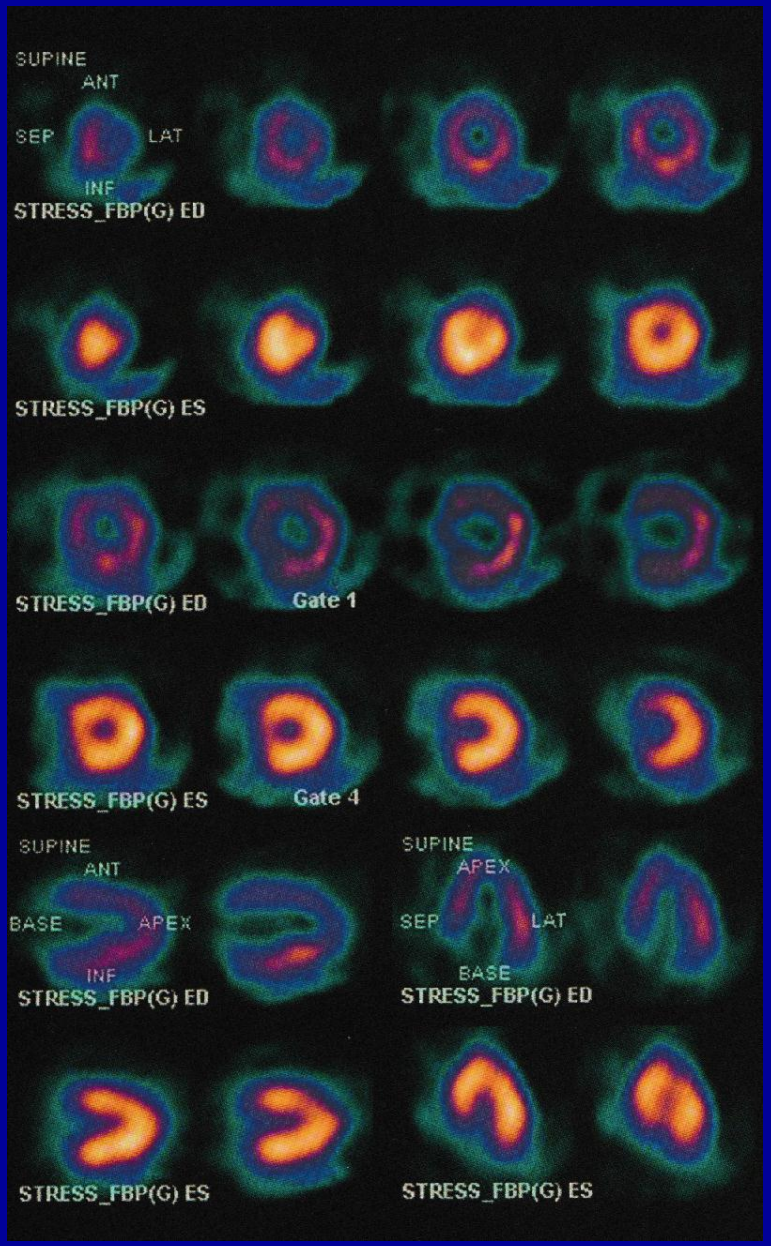
Summed Stress Score = 7

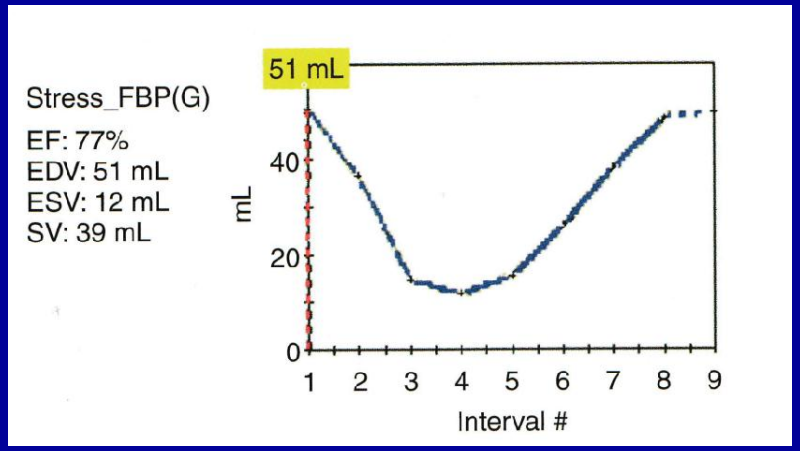
Summed Rest Score = 1

Summed Difference Score = 6

Stress Total Severity Score = 143

Gated SPECT perfusion study





16-10. Gated SPECT perfusion study. End-diastolic and end- images of the short-axis views (*top four rows* of images) and vertical izontal long-axis views *(bottom two rows)* are shown. The TAC for all lices is shown at the *top*. *ANT*, Anterior; *EDV*, end-diastolic volume; ction fraction; *ESV*, end-systolic volume; *FBP(G)*, filtered back pro- (gated); *INF*, inferior; *Lat*, lateral; *SEP*, septal; *SV*, stroke volume.

Clinical indications for myocardial perfusion scintigraphy

- Detection of coronary disease
- Risk assesment in patients with known coronary disease
- Determening the signifcance of angiographicly found stenosis
- Follow-up after revascularisation
- Viability assesment

Detection of coronary disease

- High sensitivity (75-90% -SPECT, >90% PET) in confirming or dissmissing coronary disease
- Specificity (69-83%), depending on patient included in the study
- Significantly higher sensitivity with regard to ergometry
- The highest significance in patients with intermidium probability of coronary disease

Prognostic value of myocardial perfusion scintigraphy

- The biggest value is of the negative founding
- Patients with negative myocardial perfusion findings and small pretest risk have one-year risk for infarction and sudden heart death less then 1%
- Variables that influence the posttest risk after scintigraphy: age, value of systolic blood pressure, DM, angina pectoris, family history of coronary disease, value of blood cholesterol

Prognostic factors in myocardial perfusion findings

- Size and intensitiy (character) of defect
- Size of defect: percentage or number of involved segments (left ventricule divided in 20 segments)
- Character of ischaemic defect (5 degrees of deviation from the normal for age, sex, type of radiopharmaceutical and type of methode)
- Combination of the size and character defect:
  - SSS – stres summed score
  - RSS – rest summed score
  - DSS – difference summed score

Prognostic factors in myocardial perfusion findings – non perfusion

- TID – transient ishemic dilatation (significantly higher left ventricule volume during "stress" imaging in regard to "rest" imaging) – high specificity for critical stenosis

- Higher lung uptake of radiopharmaceutical (Tl-201) in "stress" imaging

- Value of poststress EF

Proved usefull indications for myocardial perfusion scintigraphy

- Detection, localisation, assesment of size and extent of ischaemia in patients with intermedium probability for coronary disease
- Assesment of functional importance of angiography determined coronary lesion (stenosis 25-75%)
- Patients with known coronary diesase, after revascularisation with persistent or worsening of the symptoms
- Diagnosis of coronary a. disease in patients with non-diagnostic findings during exercise, or patients that can't be adequately stressed (pharmacolocigal stress)
- Assesment of myocardial viability

Myocardial viability

- Assesment of “stunned” and/or “hibernated” myocard
- Assesment of possibility for improving LV function by revascularisation
- Tl-201 “rest” or reinjection
- Tc-99m radiopharmaceutical – “rest”
- PET – combination with perfusion SPECT scintigraphy

Definitions describing the status of the myocardium
Myocardial viability

ABLE 16-9 Definitions Describing the Status of the Myocardium

erm	Definition and scan appearance
Myocardial ischemia	Oxygen supply below metabolic requirements because of inadequate blood circulation caused by coronary stenosis
	Hypoperfusion (cold defect) on stress perfusion scintigrams
Myocardial infarction	Necrosis of myocardial tissue, as a result of coronary occlusion
	Hypoperfusion on rest–stress perfusion and decreased uptake with metabolic imaging
Transmural infarction	Necrosis involves all layers from endocardium to epicardium
	High sensitivity for detection by perfusion imaging
Subendocardial infarction	Necrosis involves only muscle adjacent to endocardium
	Lower sensitivity for detection on perfusion imaging
Myocardial scar	Late result of infarction; hypoperfusion on scintigraphy
Hibernating myocardium	Chronic ischemia with decreased blood flow and down regulation of contractility; reversible with restoration of blood flow
	No perfusion on rest imaging, poor ventricular contraction
	Improved perfusion given a long recovery between rest–rest imaging or delayed reinjection Tl-201
	Increased uptake by FDG metabolic imaging mismatched to reduced uptake on perfusion scan
Stunned myocardium	Myocardium with persistent contractile dysfunction despite restoration of perfusion after a period of ischemia; usually improves with time
	Normal by perfusion imaging, poor ventricular contraction
	Uptake by FDG metabolic imaging

Potentially useful indications for myocardial perfusion scintigraphy

- Asymptomatic, hig risk patients 3-5 years after revascularisation
- Asymptomatic, high risk patients with diabetes or other risk factors for coronary disease
- Asymptomatic patients in high risk professions (pilots, flight controlers)

Conclusion

- Mypcardial perfusion scintigraphy is important part of diagnostic algorytham for coronary disease
- Because of mutual influence, it can’t be assesed separatly from other anamnestic, clinical, functional or other informations
- The existance of “scoring” system of individual risk assesment, which together with myocardial perfusion scintigraphy findings involves all risk factors, will contribute to better risk assesment for each patient

Imaging methods

Planar scintigraphy

SPECT

PET

Positron emission scintigraphy - PET

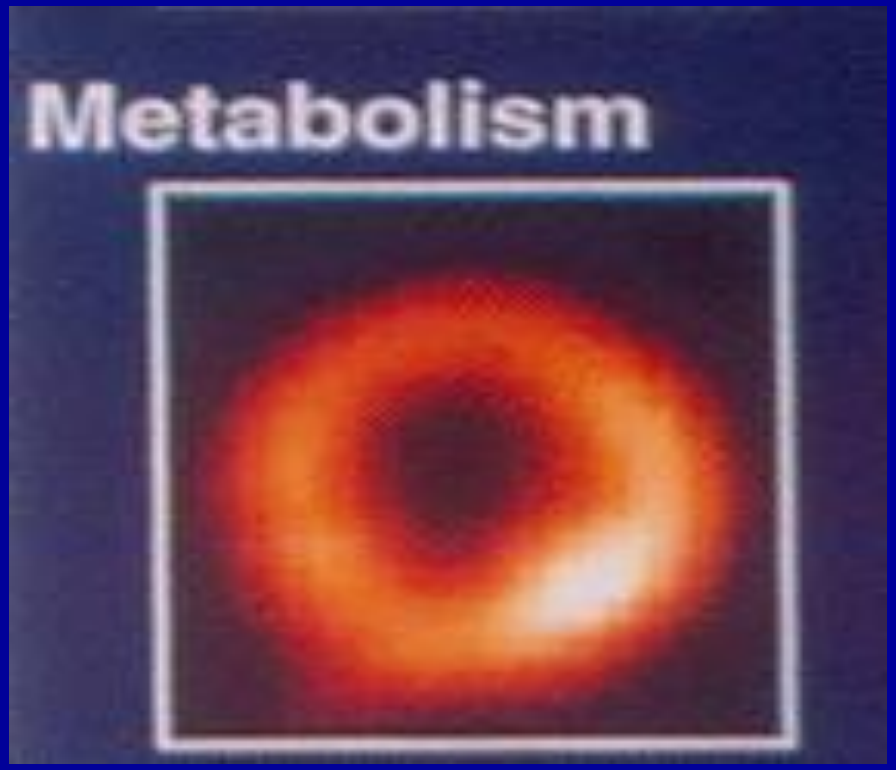
- Radiopharmaceuticals:
  - F^{18} –FDG (fluorodeoxyglocose);
  - C^{11} acetat;
  - N^{13}-ammonia;
  - O^{15};
  - Rb ^{82}
- **perfusion and metabolic examination, assesment of myocardial viability**
- Cost and limited avialibilty

Myocardial metabolisam examination – PET

- C-11 – free fatty acid
- C-11 – acetate
- F-18 – FDG
- O-15 – water
- Rubidium – 82-chloride
- N-13 - ammona

PET study

N-13-amonia



F-18-deoxyglucose

Normal finding

PET study

Perfusion (N-13-ammonia)

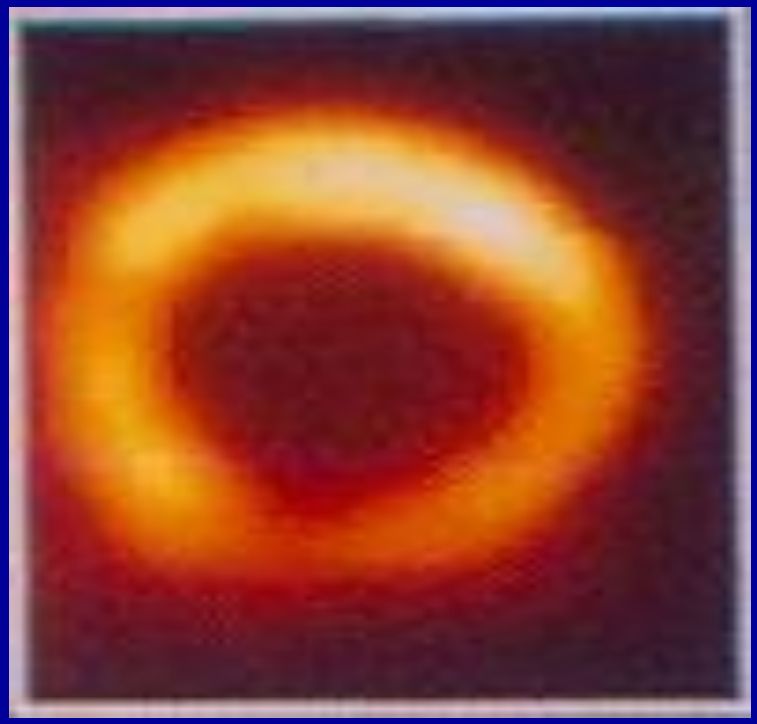
Metabolisam (F-18-deoksiglucose)

Scar: no perfusion and no metabolisam

PET study

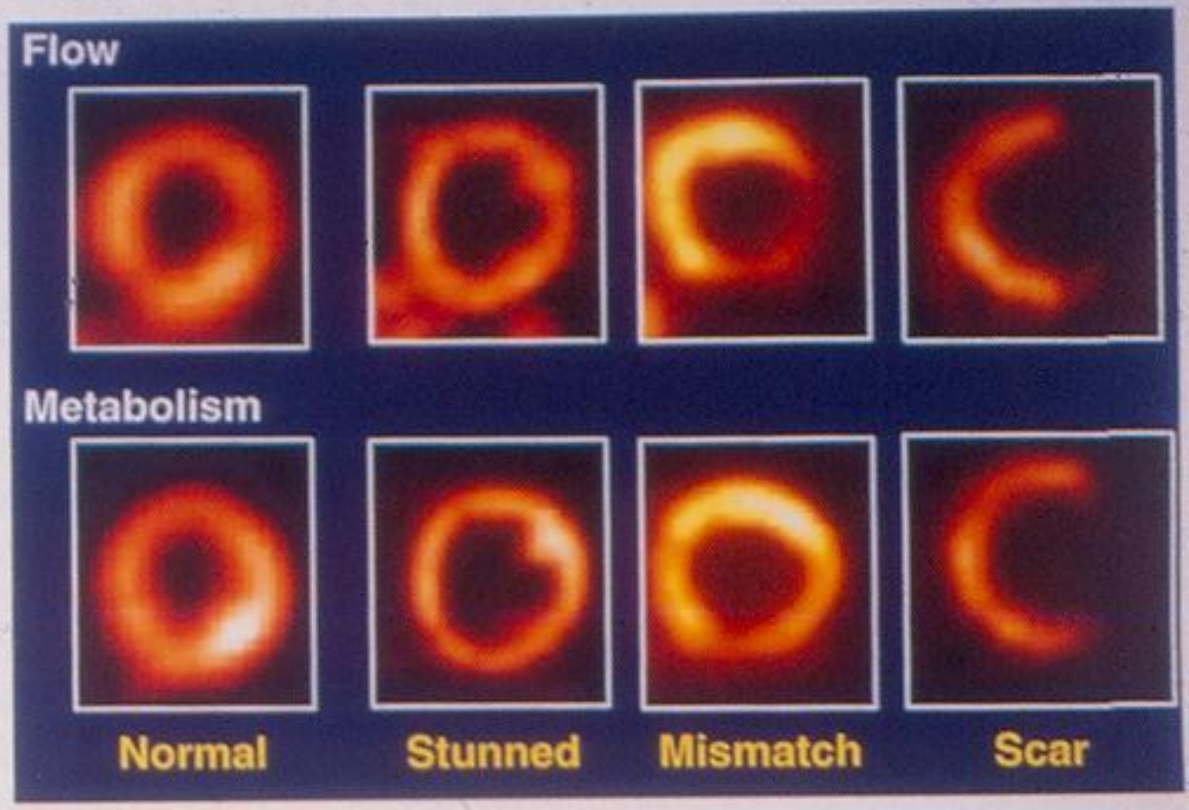
Perfusion (N-13-ammonia)

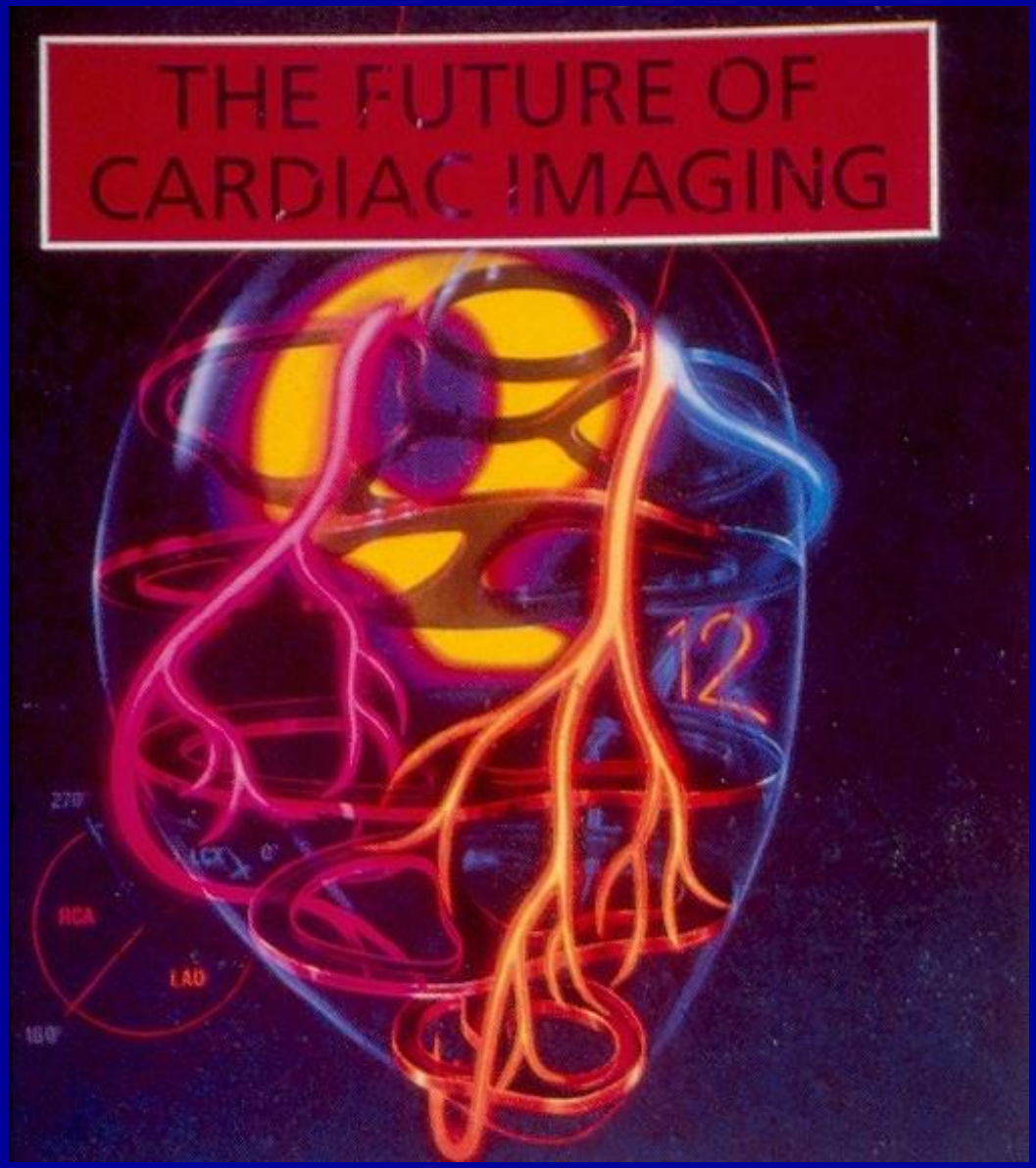
Metabolisam (**F-18-deoksiglucose**)



Mismatch: diminished flow, but maintained metabolisam

Figure 7: Examples of PET viability studies (short axis views). Myocardial flow is determined using N-13 ammonia, metabolism using the glucose analogue F-18-deoxyglucose. Mismatch denotes reduced blood flow and maintained metabolism; while scar is characterised by reduced flow and metabolism.





The end!