Stress Echocardiography

Steven J. Lester MD, FRCP(C), FACC, FASE

DISCLOSURE

Relevant Financial Relationship(s)

None

Off Label Usage

None

The apical inferior wall receives its blood supply from which coronary artery?

a. The right coronary artery.
b. The left anterior descending coronary artery.
c. Either the right or left anterior descending coronary artery.
d. The right coronary artery or the circumflex coronary artery.

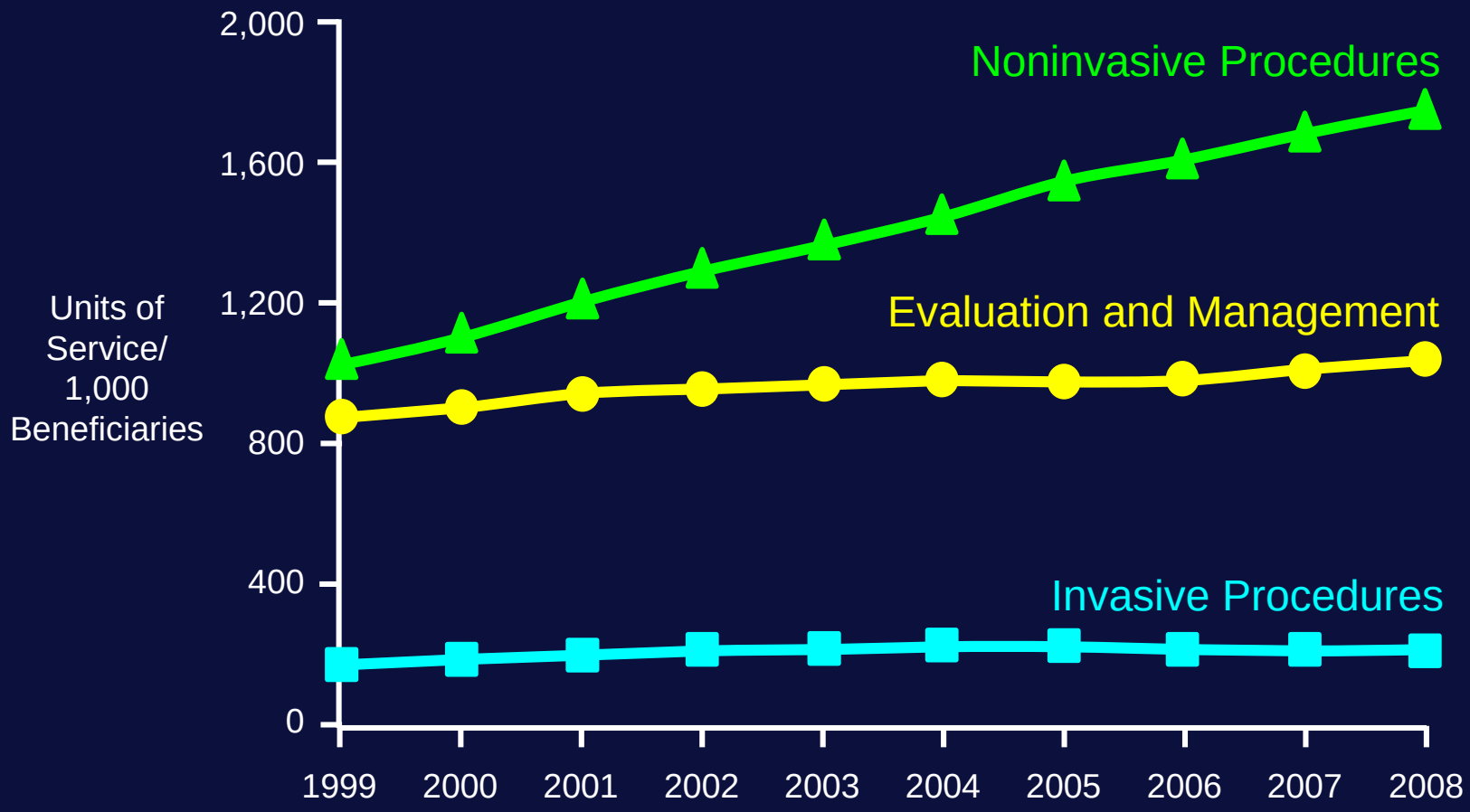
For the detection of coronary artery disease, compared to myocardial perfusion imaging, stress echocardiography is?

a. Less sensitive but more specific.
b. More sensitive but less specific.
c. Less sensitive and less specific.
d. More sensitive and specific.

Which of the following statements about the interpretation of wall motion are true?

a. If at rest there is myocardial dysfunction and with stress there is slow sustained improvement this suggests hibernating myocardium.
b. If at rest there is myocardial dysfunction and with stress there is a biphasic response this suggests stunned myocardium.
c. A resting akinetic segment that becomes dyskinetic with stress suggests an ischemic response.
d. None of the above
e. All of the above

Growth in Services Provided by Cardiologists



Andrus and Welch, Circ Cardiovasc Qual Outcomes. 2012;5:31-36.

ACCF/AHA/ASE/ASNC/HFSA/HRS/SCAI/SCCT/SCMR/STS 2013 Multimodality Appropriate Use Criteria for the Detection and Risk Assessment of Stable Ischemic Heart Disease

A Report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and Society of Thoracic Surgeons

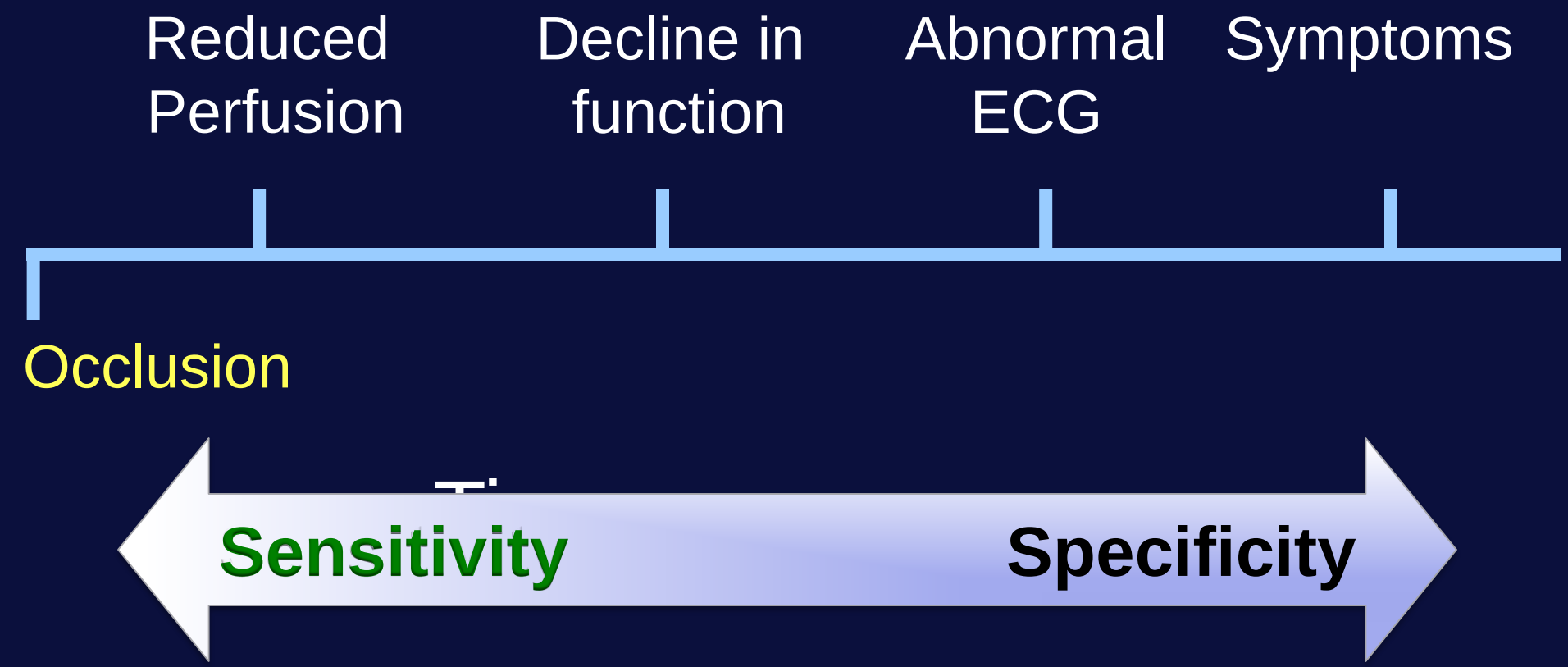
Multimodality Writing Group for Stable Ischemic Heart Disease

MICHAEL J. WOLK, MD, MACC, *CHAIR*, STEVEN R. BAILEY, MD, FACC, FSCAI, FAHA, JOHN U. DOHERTY, MD, FACC, FAHA, PAMELA S. DOUGLAS, MD, MACC, FAHA, FASE, ROBERT C. HENDEL, MD, FACC, FAHA, FASNC, CHRISTOPHER M. KRAMER, MD, FACC, FAHA, JAMES K. MIN, MD, FACC, MANESH R. PATEL, MD, FACC, LISA ROSENBAUM, MD, LESLEE J. SHAW, PhD, FACC, FASNC, FAHA, RAYMOND F. STAINBACK, MD, FACC, FASE, AND JOSEPH M. ALLEN, MA

Technical Panel

RALPH G. BRINDIS, MD, MPH, MACC, *MODERATOR*, * CHRISTOPHER M. KRAMER, MD, FACC, *WRITING COMMITTEE LIAISON*, * LESLEE J. SHAW, PhD, FACC, FASNC, FAHA, *WRITING COMMITTEE LIAISON*, * MANUEL D. CERQUEIRA, MD, FACC, FASNC,† JERSEY CHEN, MD, FAHA,‡ LARRY S. DEAN, MD, FACC, FAHA, FSCAI,§ REZA FAZEL, MD, FACC,* W. GREGORY HUNDLEY, MD, FACC,‖ DIPTI ITCHHAPORIA, MD, FACC,* PAUL KLIGFIELD, MD, FACC, FAHA,* RICHARD LOCKWOOD, MD,* JOSEPH EDWARD MARINE, MD, FACC,¶ ROBERT BENJAMIN McCULLY, MD, FACC, FASE,#

Ischemic Cascade



Prediction of Mortality and Major Cardiac Events by Exercise Echocardiography in Patients With Normal Exercise Electrocardiographic Testing

Alberto Bouzas-Mosquera, MD,* Jesús Peteiro, MD, PHD,* Nemesio Álvarez-García, MD,* Francisco J. Broullón, MS,† Victor X. Mosquera, MD,‡ Lourdes García-Bueno, MD,* Luis Ferro, MD,* Alfonso Castro-Beiras, MD, PHD*§

- **16.7% of patients who did not develop chest pain or ischemic ECG changes developed new or worsening regional wall motion abnormalities (+ Exercise Echo)**
- **Significant prognostic implications for predicting Mortality and MACE.**

Methods We studied 4,004 consecutive patients (2,358 men, mean age [± SD] 59.6 ± 12.5 years) with interpretable

313 patients died, and 183 patients had a MACE before any revascularization procedure. The 5-year mortality and MACE rates were 6.4% and 4.2% in patients without ischemia versus 12.1% and 10.1% in those with ischemia, respectively ($p < 0.001$). In the multivariate analysis, ΔWMSI remained an independent predictor of mortality (hazard ratio [HR]: 2.73, 95% confidence interval [CI]: 1.40 to 5.32, $p = 0.003$) and MACE (HR: 3.59, 95% CI: 1.42 to 9.07, $p = 0.007$). The addition of the EE

cise hemodynamic data significantly increased the

($p = 0.005$) and MACE ($p = 0.009$).

Conclusions The use of EE provides significant prognostic information for predicting mortality and MACE in patients with interpretable ECG and normal exercise ECG testing. (J Am Coll Cardiol 2009;53:1981–90)

J Am Coll Cardiol 2009;53:1981-90

Case

- 73 year old male
- No antecedent CV disease history. Asymptomatic
- Reduced functional capacity due to orthopedic limitations
- Hypertension, diabetes
- Pre-operative cardiac risk stratification prior to an orthopedic procedure

ACCF/ASE/AHA/ASNC/HFSA/HRS/SCAI/SCCM/SCCT/SCMR

2011 Appropriate Use Criteria for Echocardiography

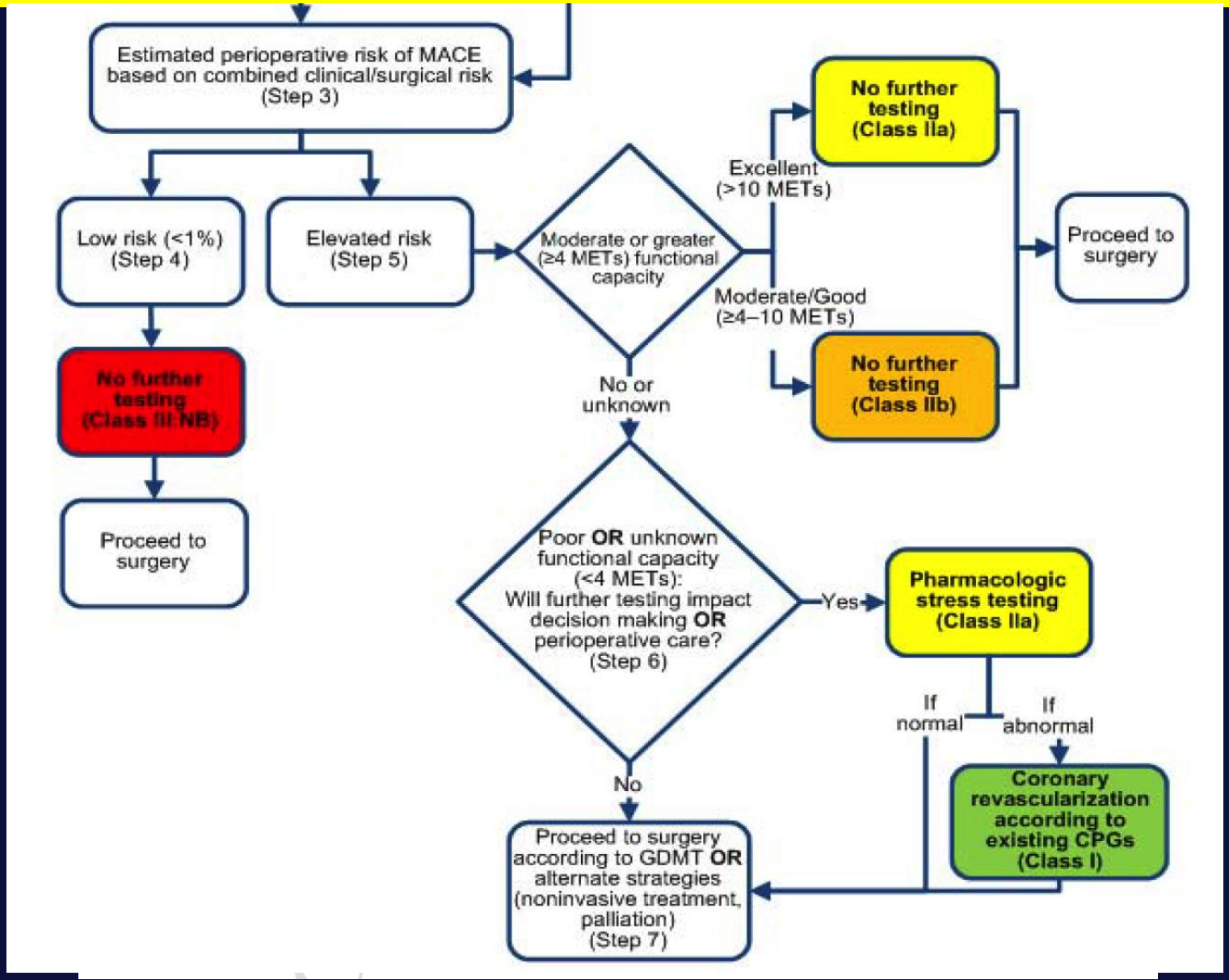
Clinical Risk Factors

Ischemic Heart Disease, Cerebral Vascular Disease, Compensated or prior heart failure, Diabetes (requiring insulin), Renal Insufficiency (Scr > 2.0)

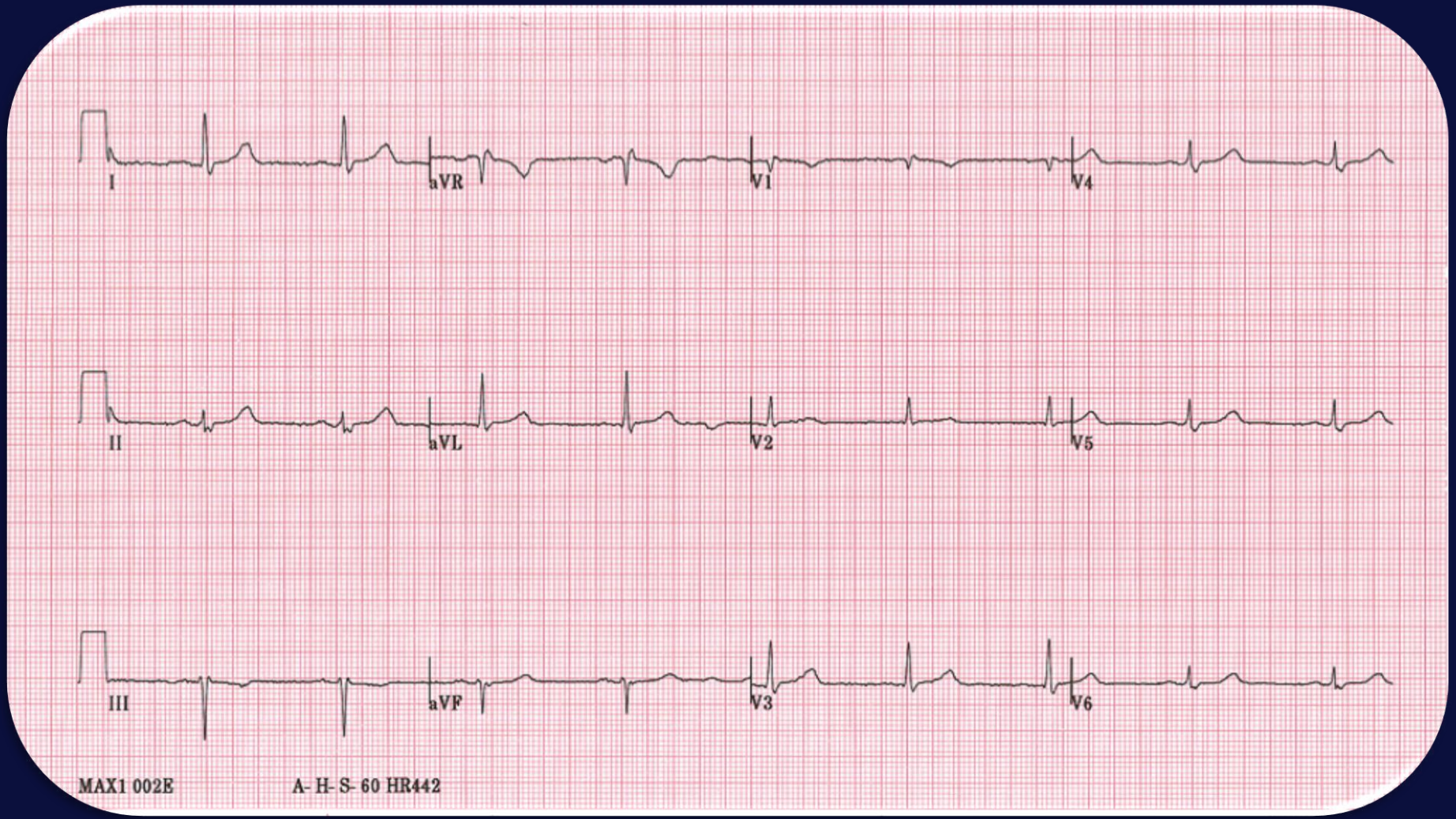
Indication		Appropriate Use Score (1–9)
	Low-Risk Surgery With Stress Echocardiography	
154.	• Perioperative evaluation for risk assessment	I (1)
	Intermediate-Risk Surgery With Stress Echocardiography	
155.	• Moderate to good functional capacity (≥4 METs)	I (3)
156.	• No clinical risk factors	I (2)
157.	• ≥1 clinical risk factor • Poor or unknown functional capacity (<4 METs)	U (6)
158.	• Asymptomatic <1 y post normal catheterization, noninvasive test, or previous revascularization	I (1)
	Vascular Surgery With Stress Echocardiography	
159.	• Moderate to good functional capacity (≥4 METs)	I (3)
160.	• No clinical risk factors	I (2)
161.	• ≥1 clinical risk factor • Poor or unknown functional capacity (<4 METs)	A (7)
162.	• Asymptomatic <1 y post normal catheterization, noninvasive test, or previous revascularization	I (2)

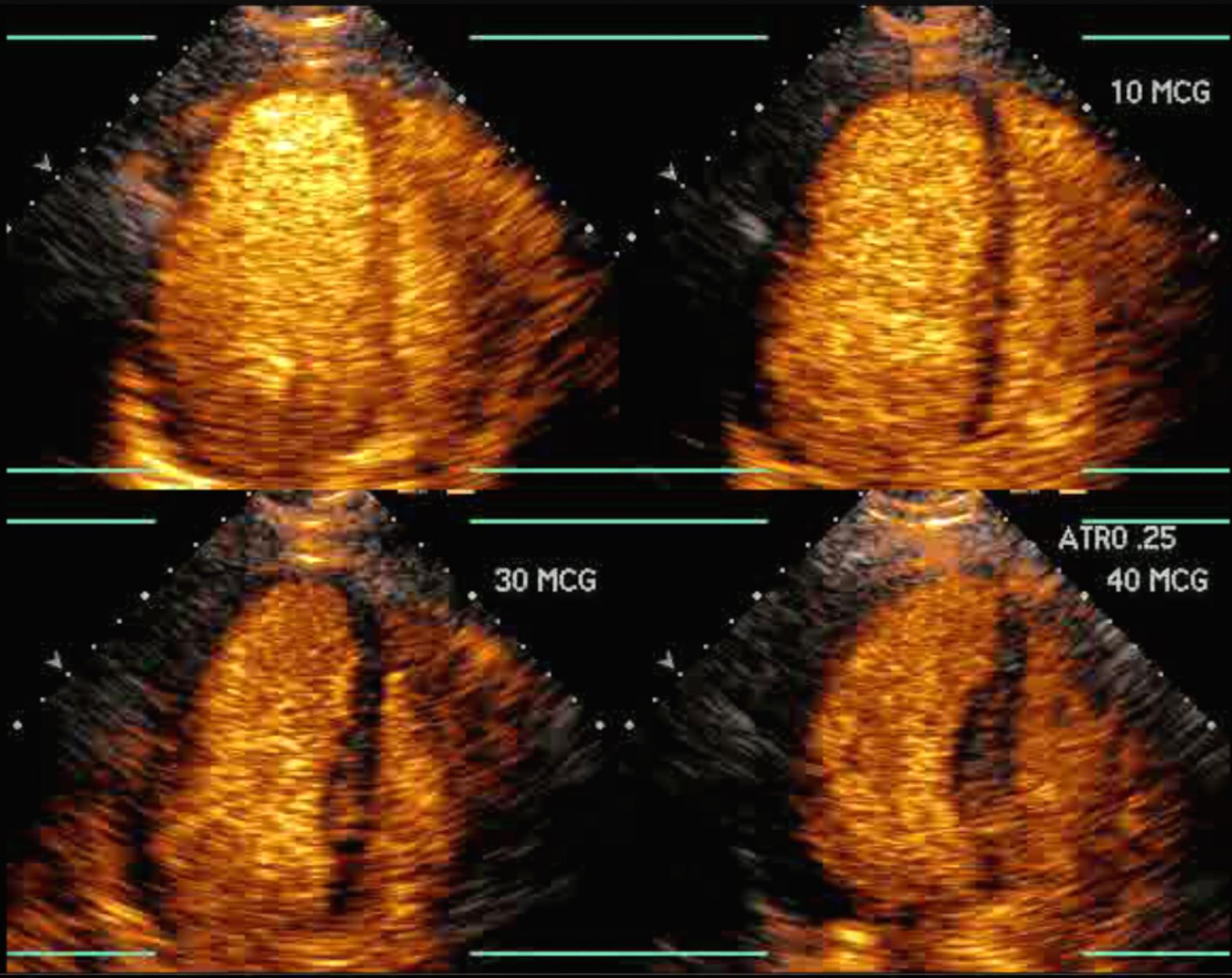
Paul A. Heidenreich, MD, FACC#
Luci K. Leykum, MD, MBA, MSc
Chest Physicians Representative

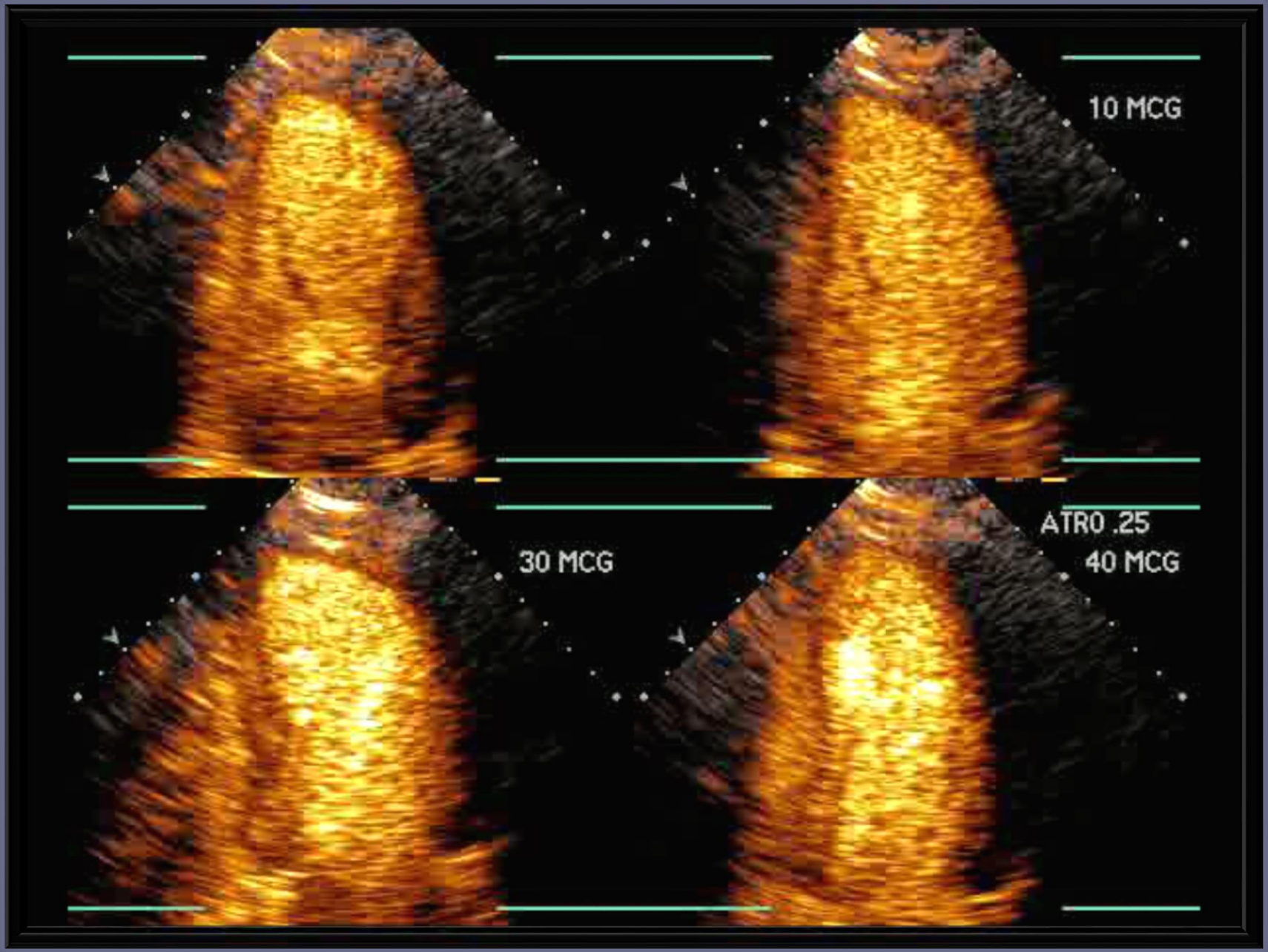
2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery



Resting ECG




10 MCG
30 MCG
ATRO .25
40 MCG


10 MCG
30 MCG
ATRO .25
40 MCG

RHYTHM REPORT

RHYTHM REPORT

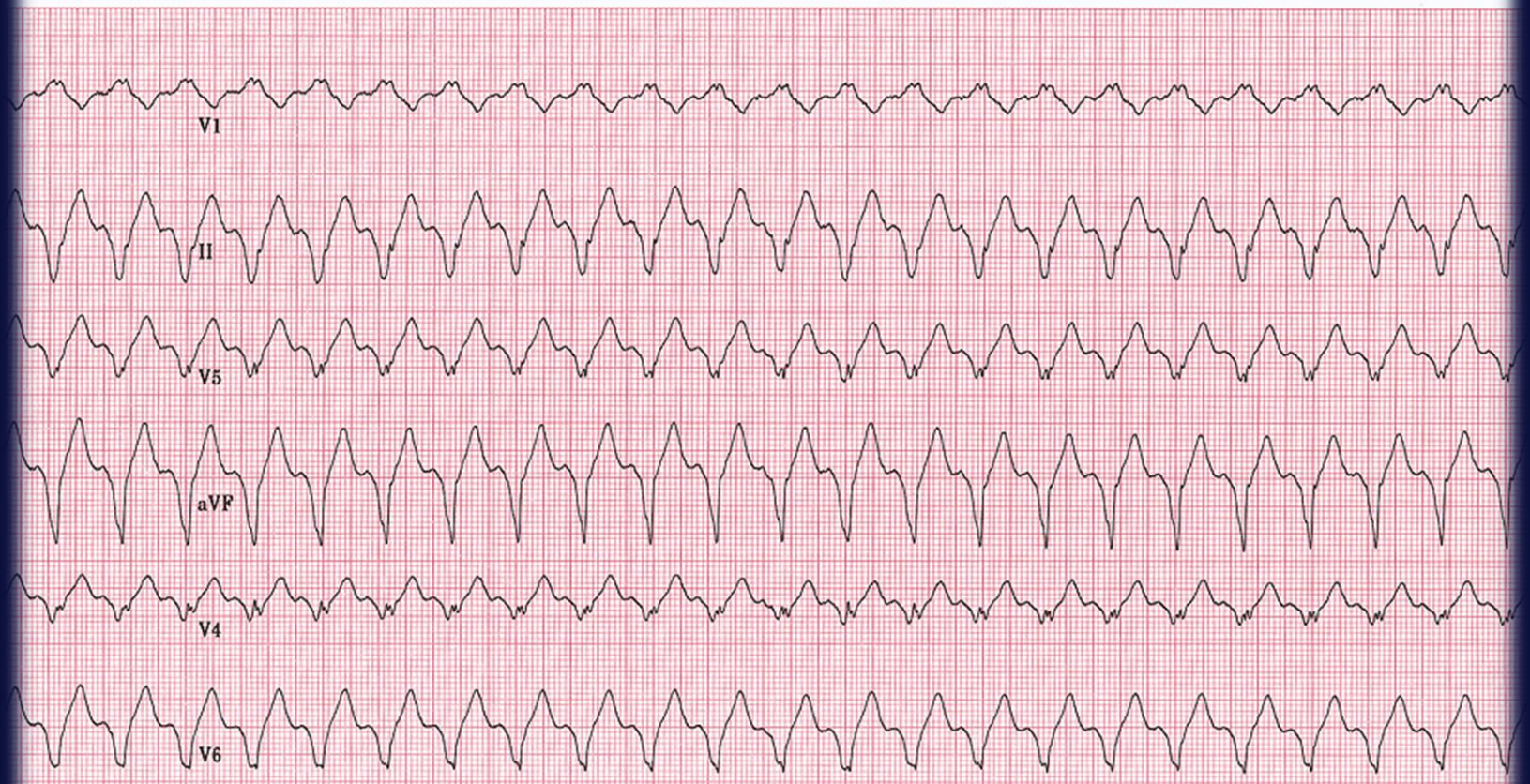
ID:

124bpm

Infusion
INFUSION
14:17

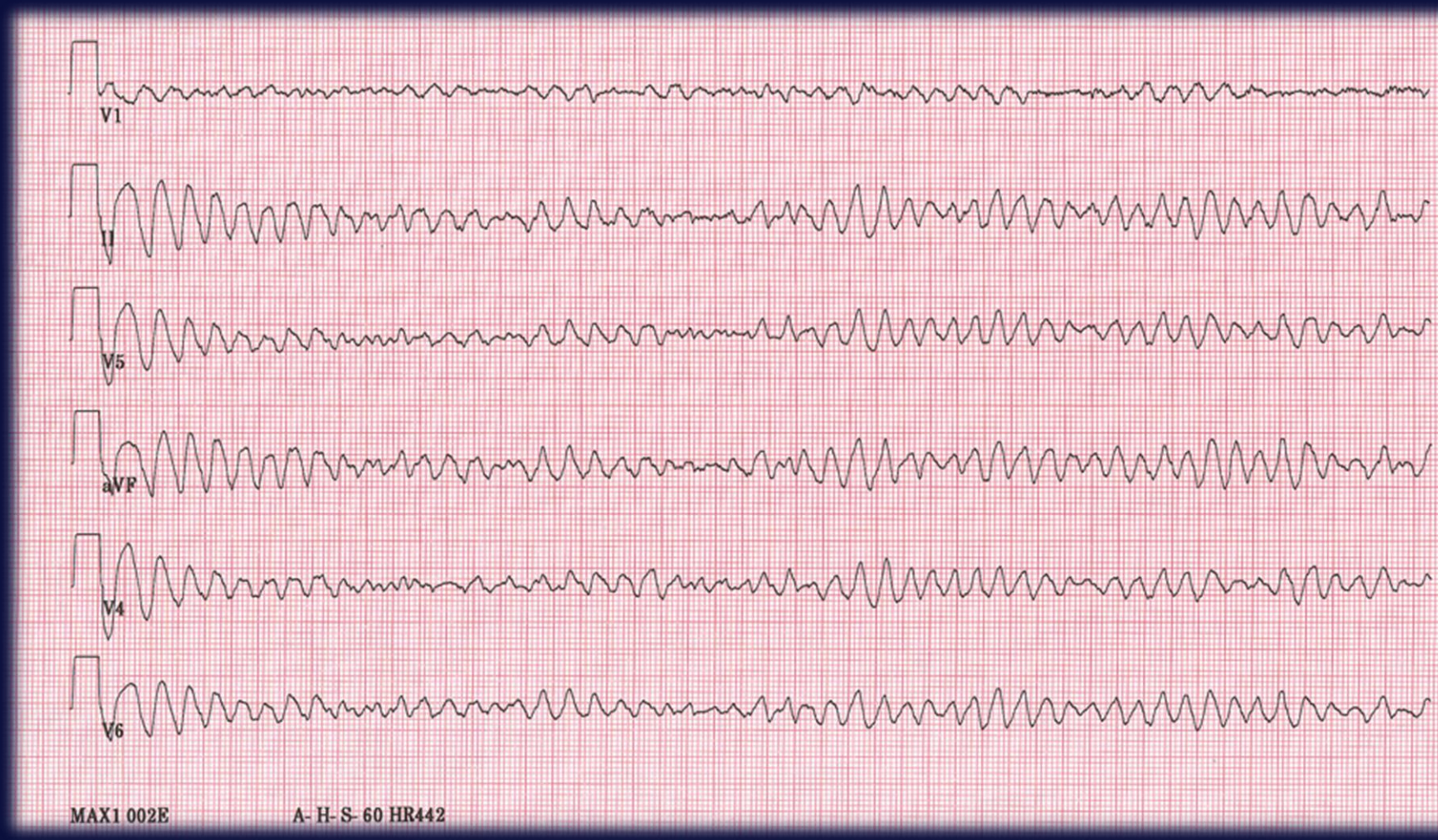
Dobutamine
0.0 mph
0.0 %

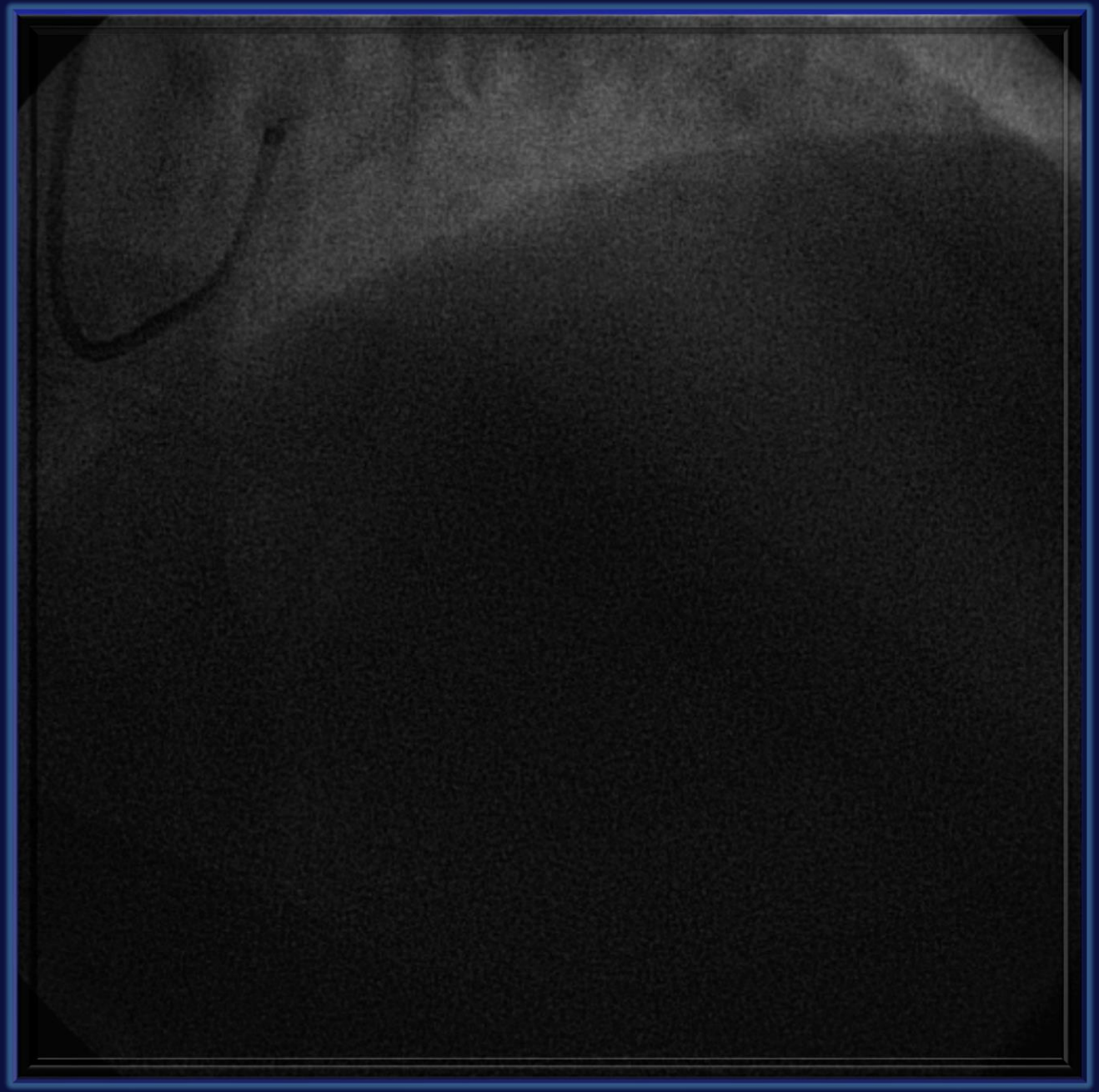
25mm/s
10mm/mV
40hz



MAX1 002E

A- H- S- 60 HR442


V1
II
V5
aVF
V4
V6
MAX1 002E
A- H- S- 60 HR442



Objectives

1. Stress Modalities
2. Interpretation
3. Test Characteristics: Diagnosis
4. Prognostic Value
5. Safety
6. Other Uses
7. Appropriate Use

Stress Echocardiography Modalities

Exercise

- Treadmill
- Bicycle
  - -Supine
  - -Upright

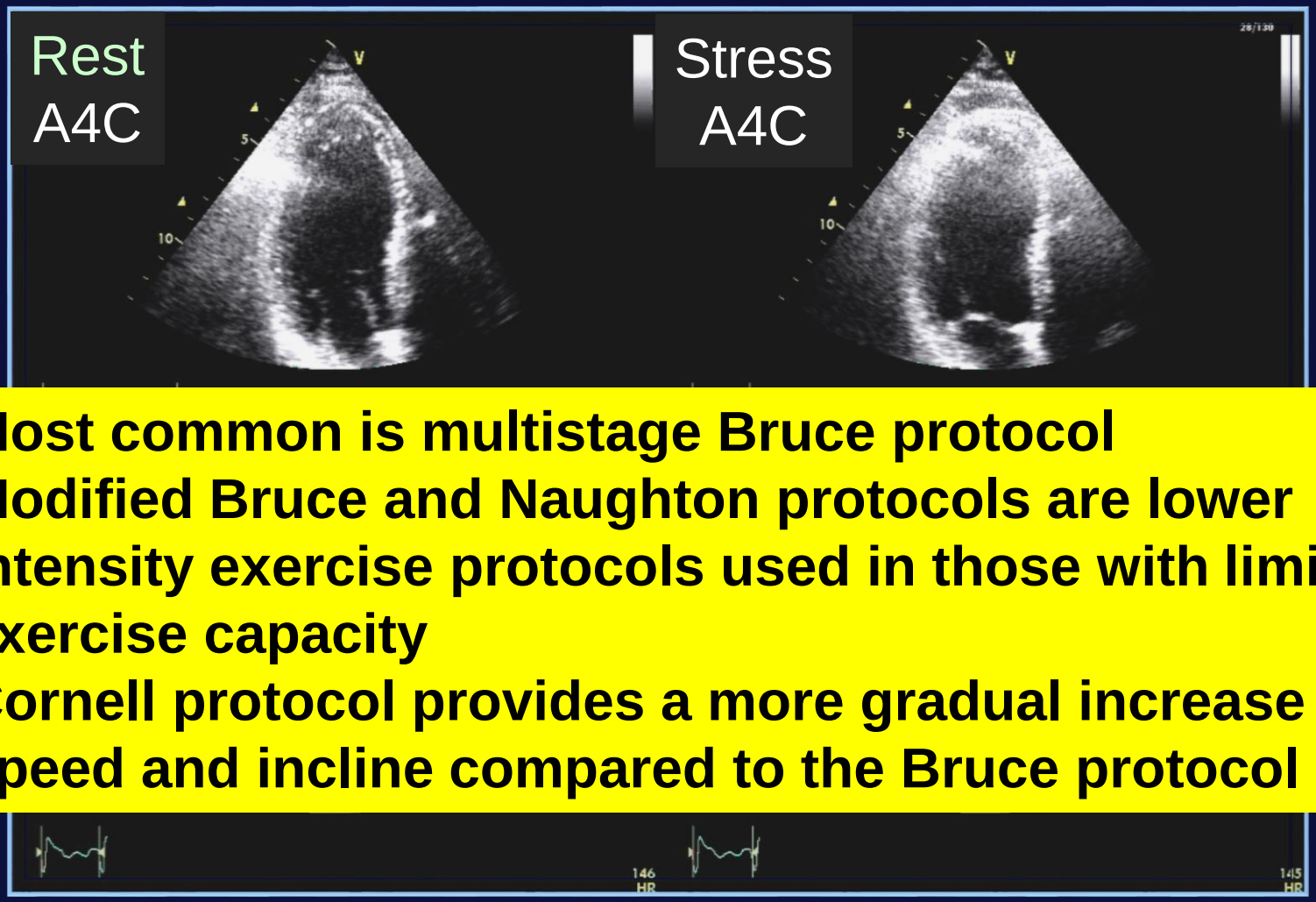
Pharmacologic

- Dobutamine / Atropine
- Vasodilator
  - -Dipyradamole
  - -Adenosine

Other

- Handgrip
- Pacing

Stress Echocardiography Treadmill



- **Most common is multistage Bruce protocol**
- **Modified Bruce and Naughton protocols are lower intensity exercise protocols used in those with limited exercise capacity**
- **Cornell protocol provides a more gradual increase in speed and incline compared to the Bruce protocol**

Stress Echocardiography Bicycle

- The cycles are calibrated in kiloponds or Watts which can then be converted to metabolic equivalents (METs).
- It may allow image acquisition during exercise… Doppler information.

Treadmill Versus Bicycle

1. Heart rate increase is greater with treadmill then supine bicycle
2. BP rise greater with supine bicycle then treadmill.

Exercise Stress Echocardiography
Indications To Stop

Absolute

- ST elevation ≥ 1 mm in leads without Q waves
- Ventricular tachycardia
- Decrease in systolic blood pressure > 10 mm Hg from baseline with other signs of ischemia
- Moderate to severe angina
- Nervous system symptoms
- Signs of poor perfusion (cyanosis, pallor)
- Technical difficulties with ECG or blood pressure monitoring
- Patient's desire to stop

Relative

- Arrhythmias other than ventricular tachycardia
- ST or QRS changes including horizontal or downsloping ST depression > 2 mm
- Development of bundle branch block or intraventricular conduction delay that cannot be distinguished from ventricular tachycardia
- Increasing chest pain
- Decrease in systolic blood pressure > 10 mm Hg from baseline without other signs of ischemia
- Fatigue, shortness of breath, wheezing, leg cramps, claudication
- Hypertensive response (> 250 mm Hg systolic and/or > 115 mm Hg diastolic)

Stress Echocardiography Pharmacologic

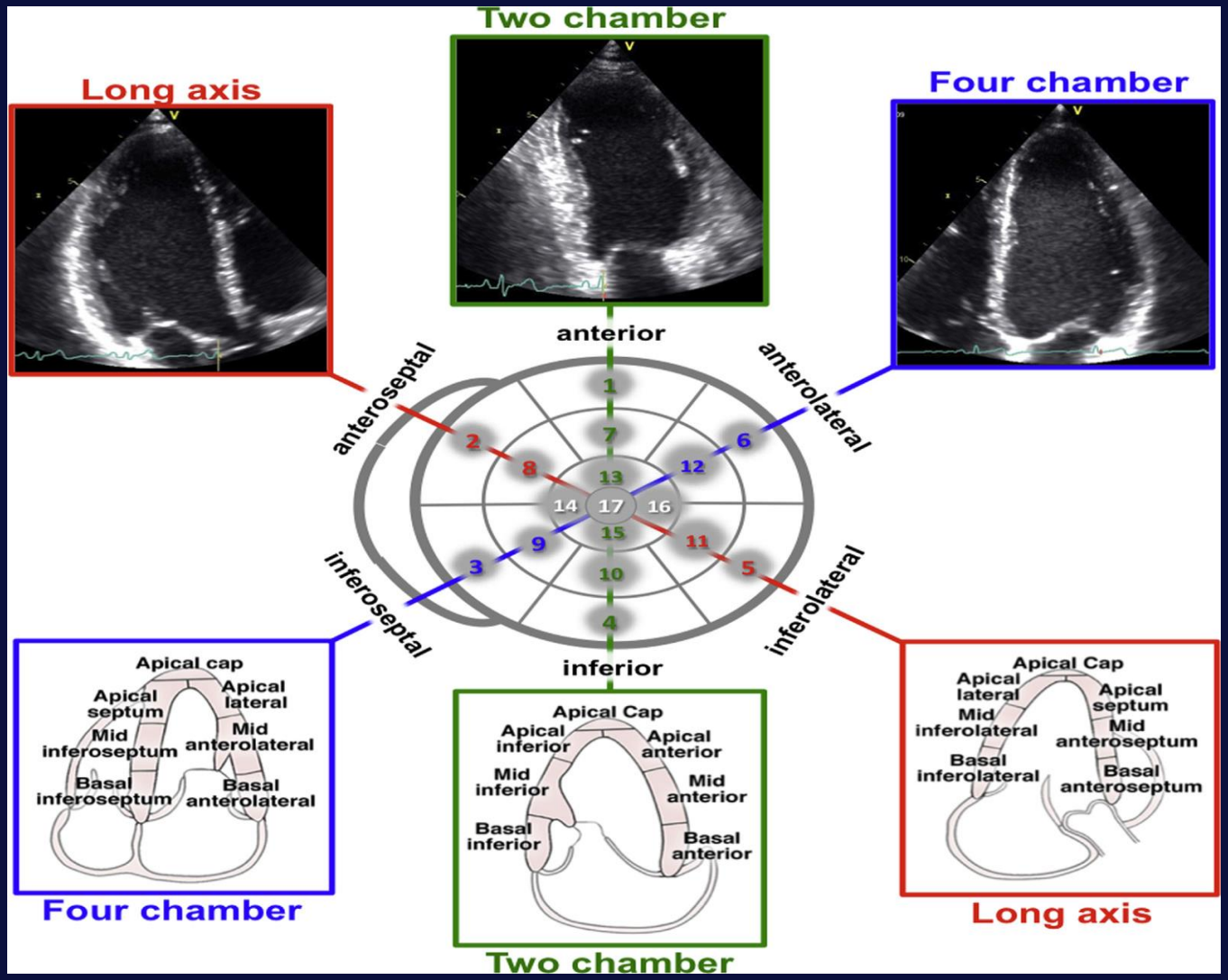
Inotropic

- Dobutamine / Atropine
- Dobutamine has effects on β-1, β-2 and α-1 receptors, leading to balanced effect on the peripheral vasculature at lower doses
- As dobutamine dose increases there is a greater β-2 response resulting in peripheral vasodilation which may lead to a drop in BP

Vasodilator

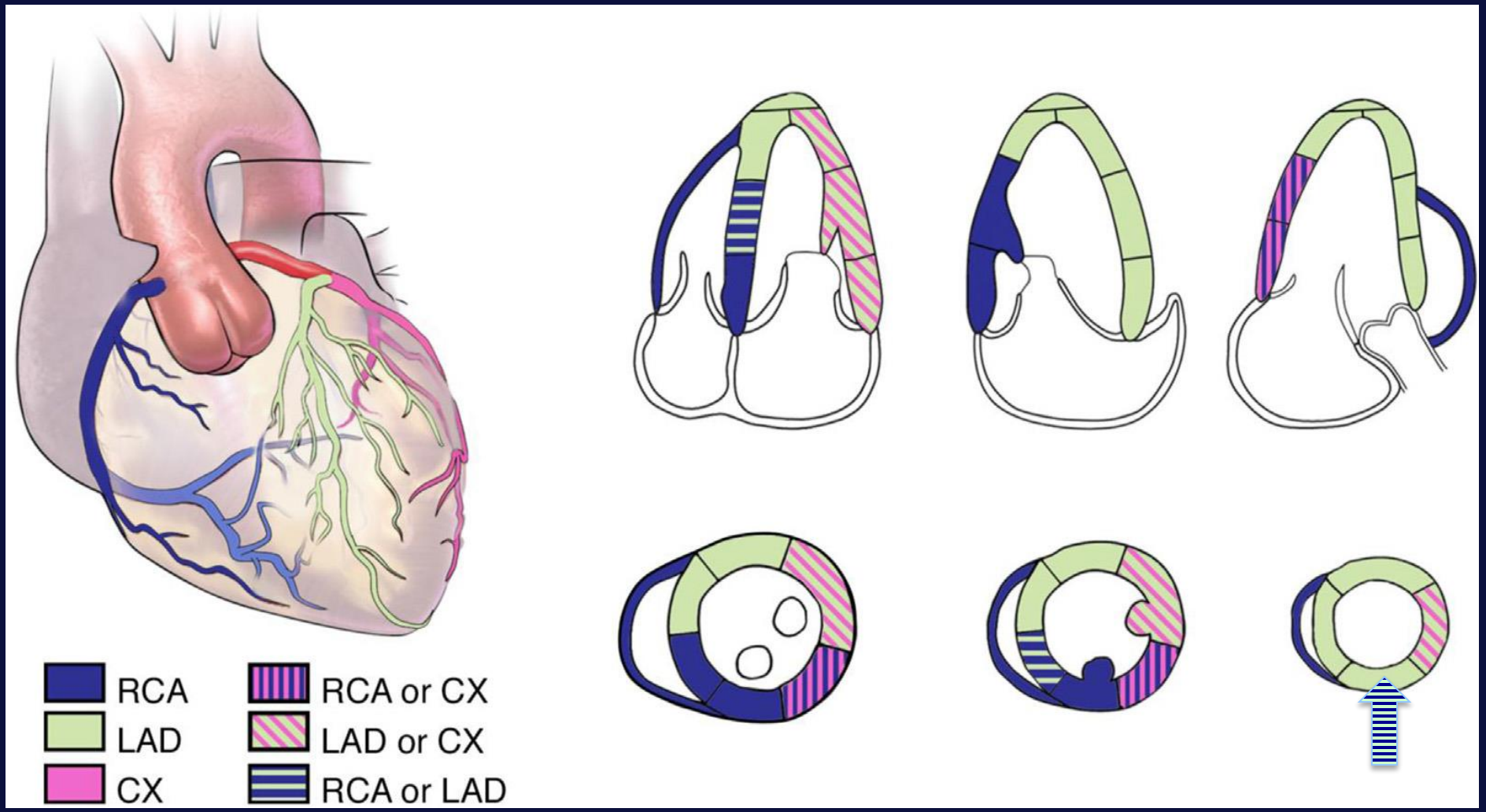
- Dipyridamole / adenosine
- Work by creating maldistribution of blood flow.
- Less sensitive as redistribution of blood flow may occur without RWMA
- Perhaps better with imaging that looks more at relative changes in perfusion.

Segmental Analysis of Left Ventricular Walls



Lang RM et al. J Am Soc Echocardiogr 2015;28:1-39

Arterial Distribution



Lang RM et al. J Am Soc Echocardiogr 2015;28:1-39

Segmental Wall Motion Scoring

1 = Normal or hyperdynamic: (systolic increase in thickness >50%)

2 = Hypokinetic: delay in the velocity or onset of contraction (<30-40% systolic increase in thickness)

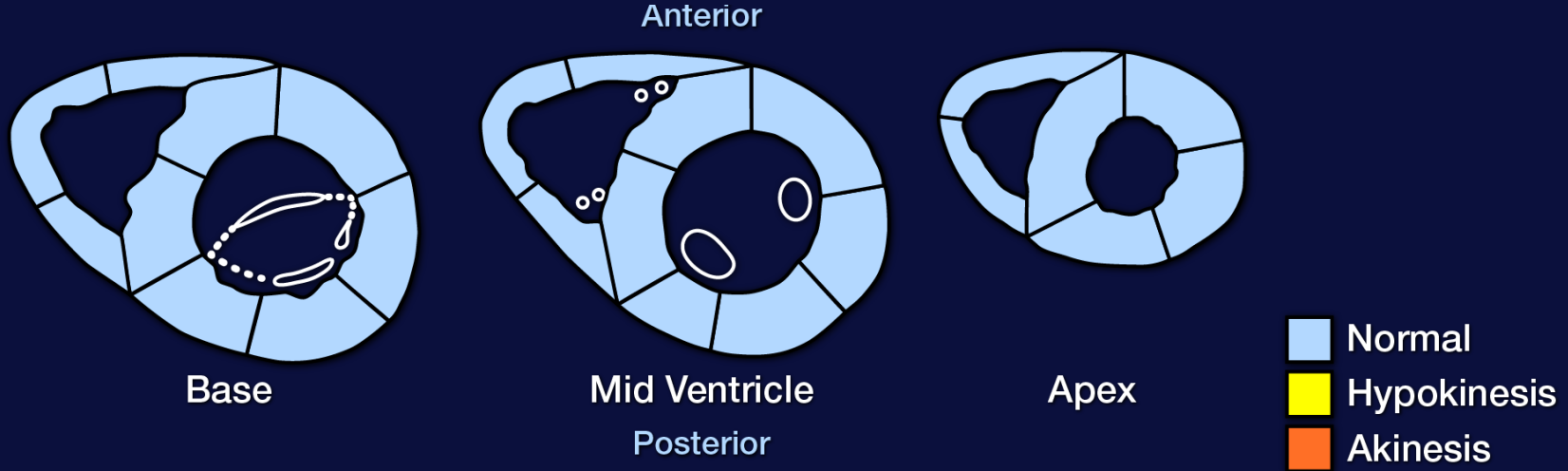
3 = Akinesis: <10%

4 = Dyskinetic: Systolic outward motion of the segment

Wall Motion Score Index

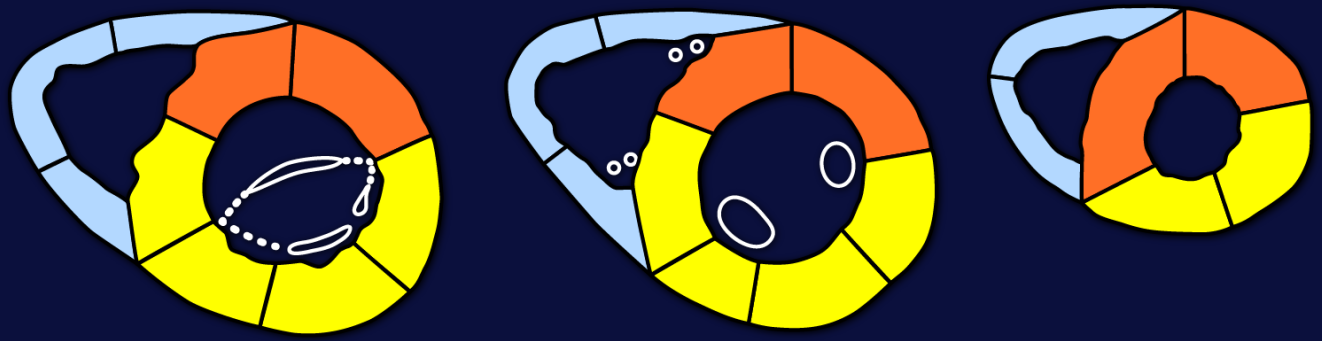
Wall Motion

Wall Motion Score Index = 1.0



Stress

Wall Motion Score Index = 38/16 = 2.38



Interpretation Of Wall Motion

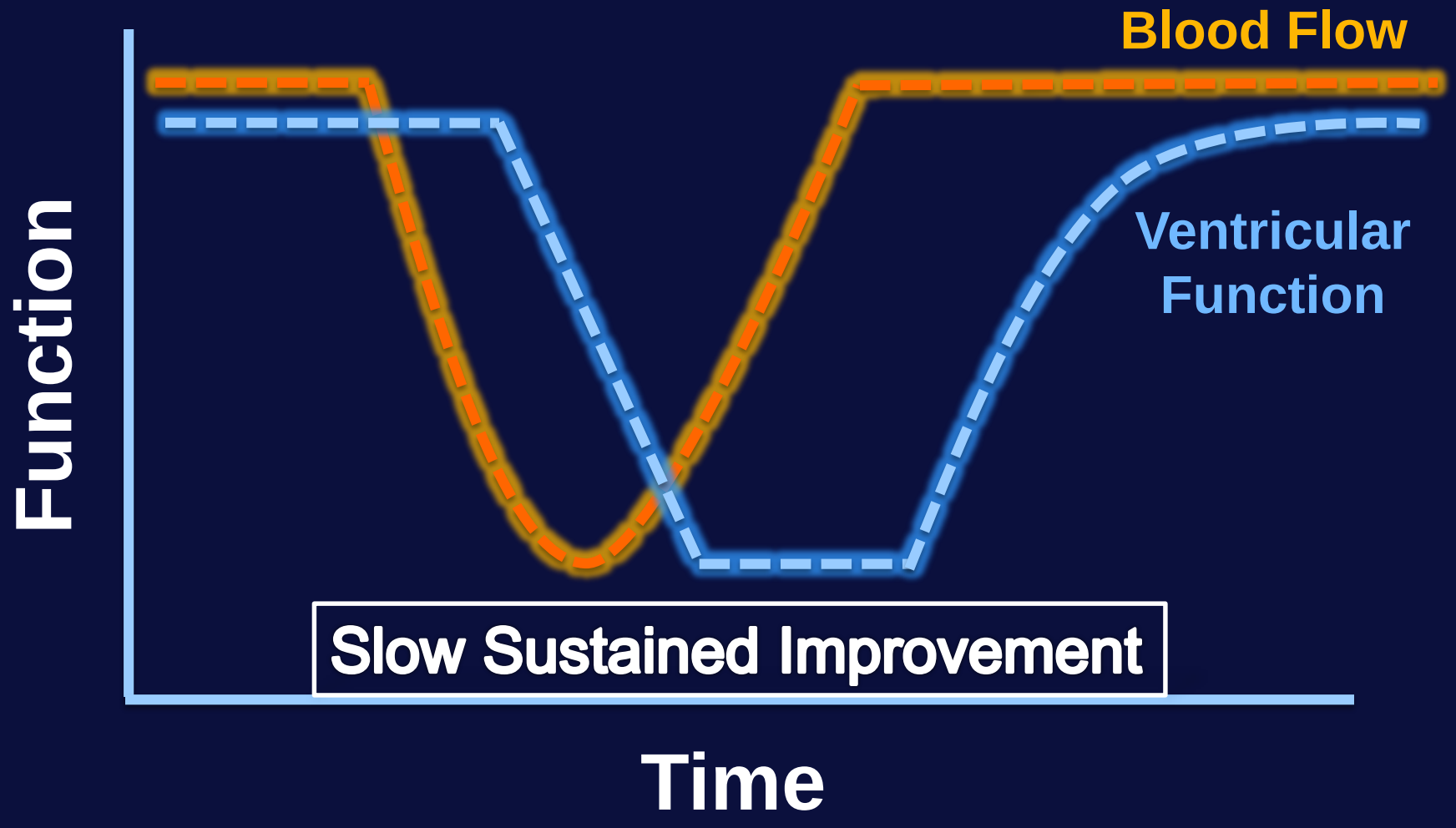
Rest	Stress	Interpretation
Normokinetic	Normal-hyperkinetic	Normal
Normokinetic	Wall Motion abnormality (segment worsens function)	Ischemic Response
Hypokinetic	Akinetic / Dyskinetic (segment worsens function)	Ischemic Response
Resting Dysfunction	Fixed / No Change in Function	Infarct / Necrotic
Resting Dysfunction	Slow Sustained Improvement	Stunning or Cardiomyopathy
Resting Dysfunction	Biphasic Response	Hibernating
Akinetic	Dyskinetic	Passive / Mechanical

Cause of Wall Motion Abnormalities

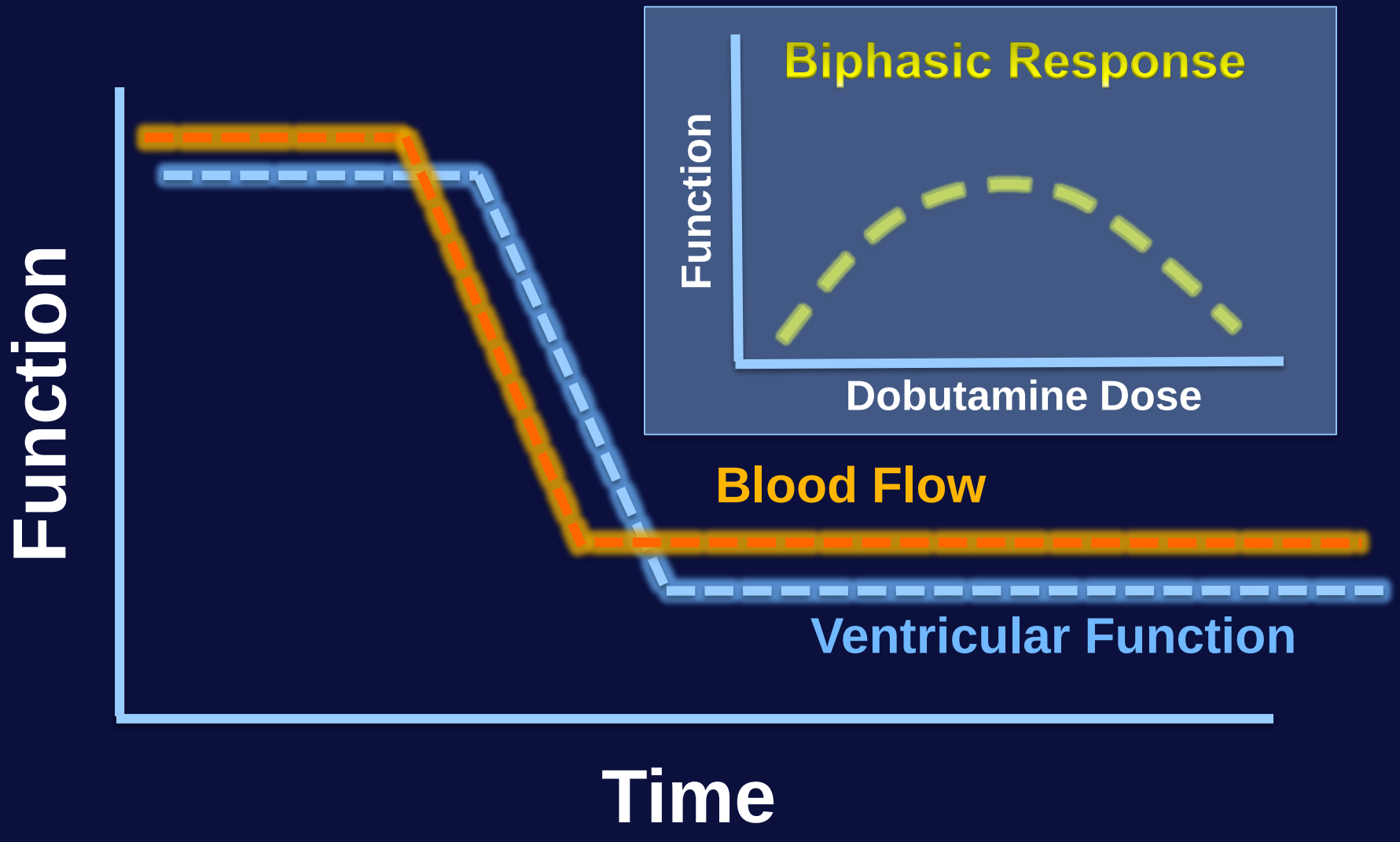
Wall Motion Abnormalities at Rest

- Ischemic heart disease
  - -Infarction
  - -Stunned / Hibernating
- Conduction
  - -Pacing
  - -LBBB
- Cardiomyopathy
- Myocarditis
- Right ventricular volume / pressure overload

Stunned Myocardium



Hibernating Myocardium



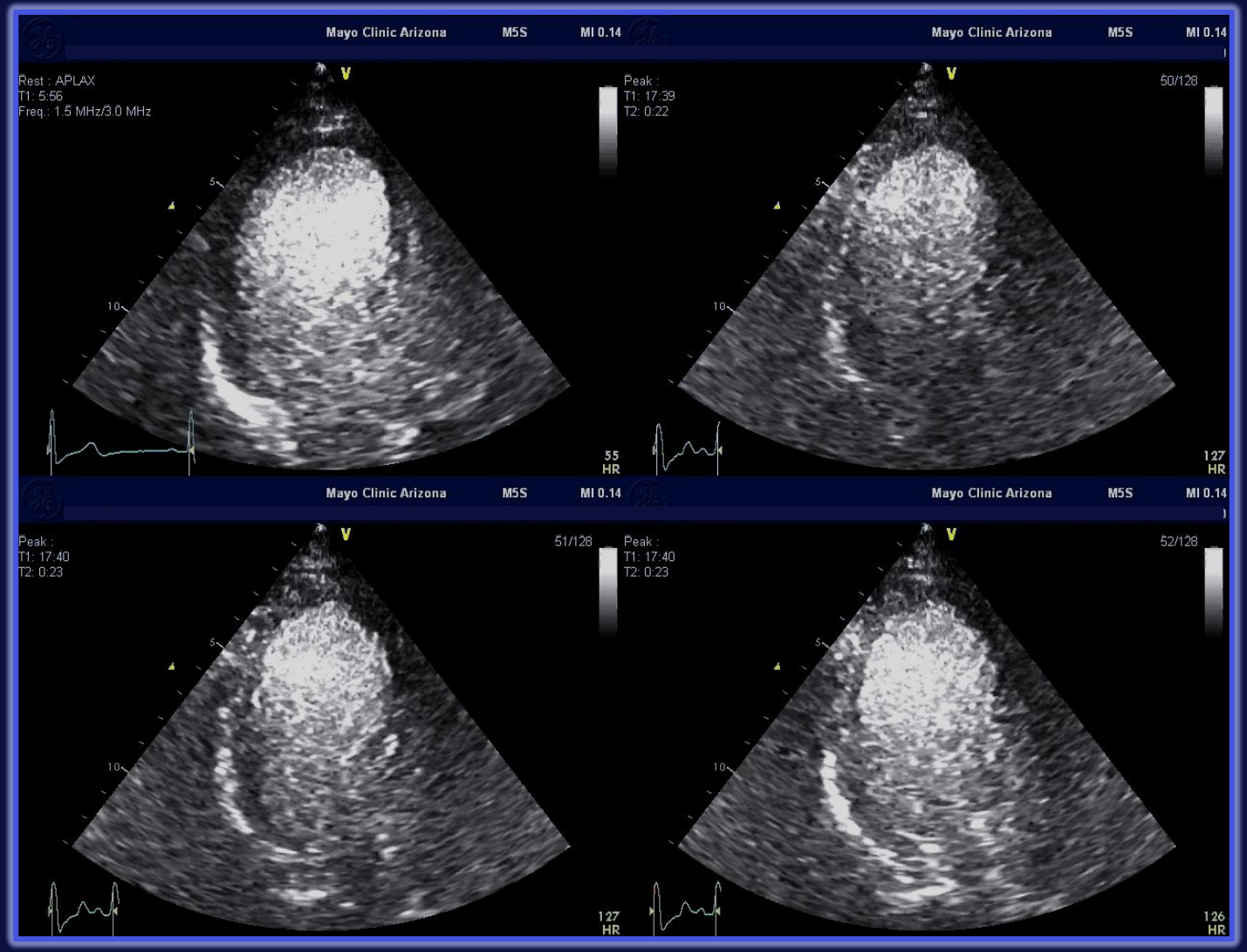
Cause of Wall Motion Abnormalities

Wall Motion Abnormalities at Rest

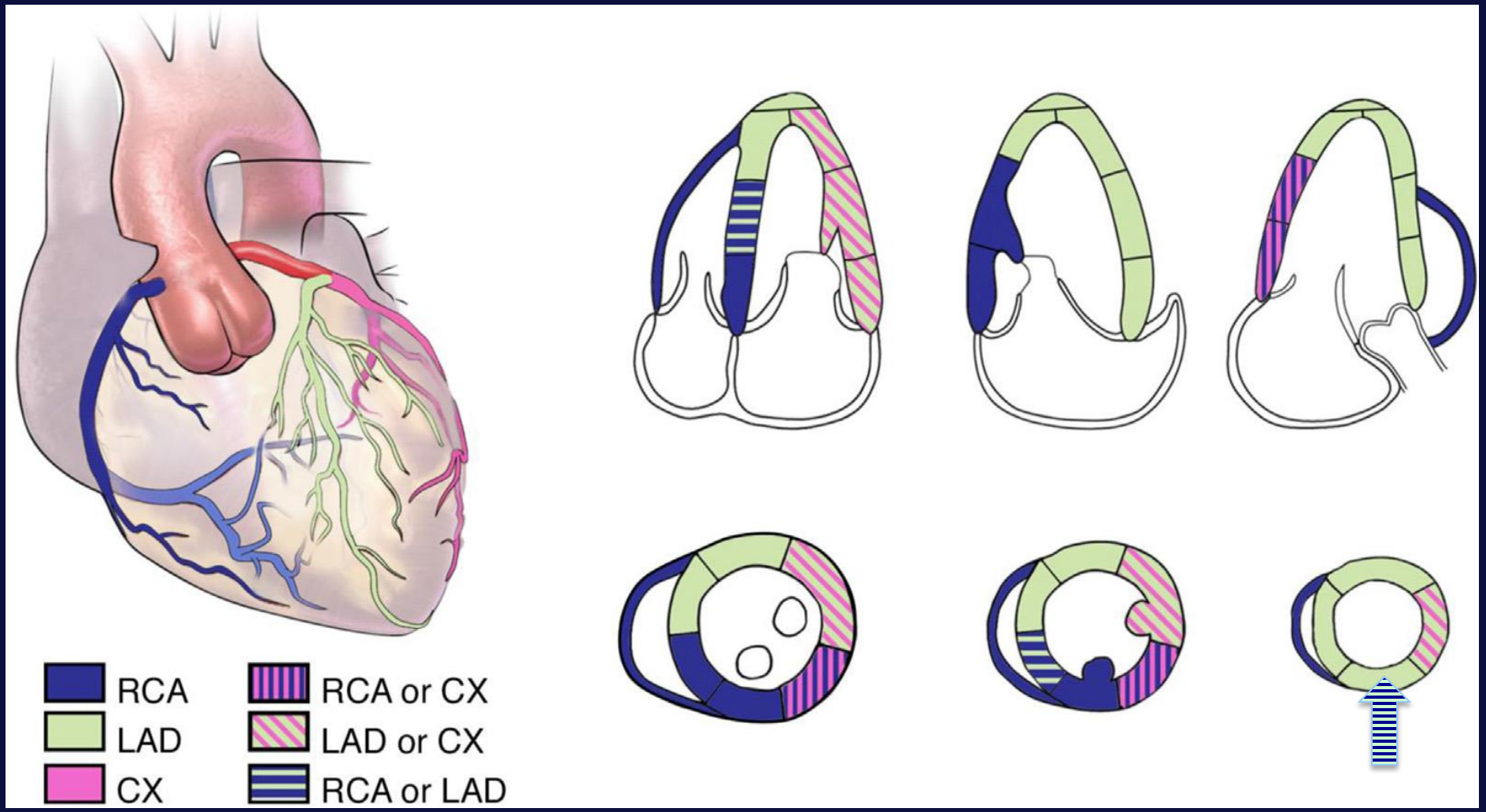
- Ischemic heart disease
  - -Infarction
  - -Stunned / Hibernating
- Conduction
  - -Pacing
  - -LBBB
- Cardiomyopathy
- Myocarditis
- Right ventricular volume / pressure overload

Wall Motion Abnormality

Conduction



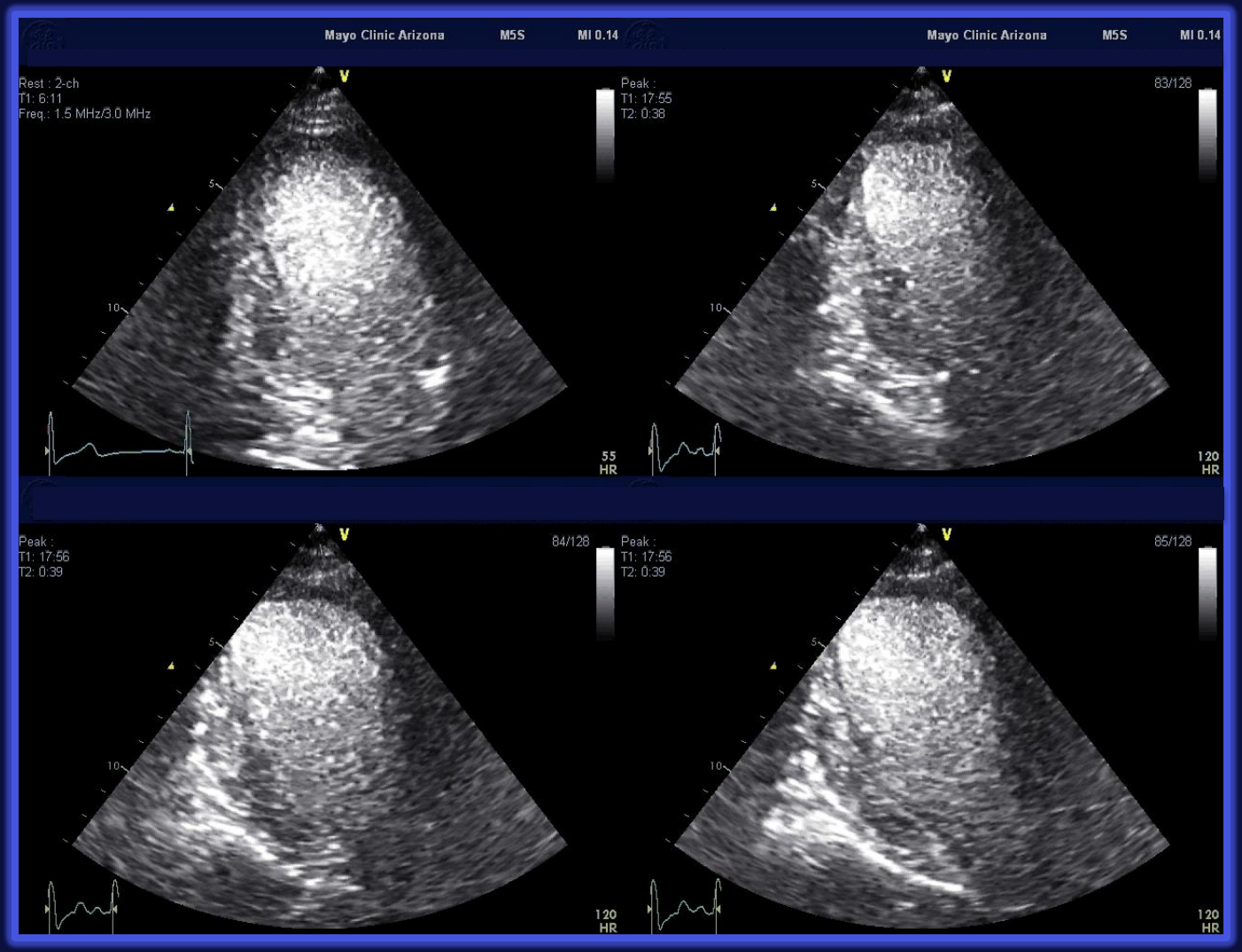
Arterial Distribution



Lang RM et al. J Am Soc Echocardiogr 2015;28:1-39

Wall Motion Abnormality

Conduction

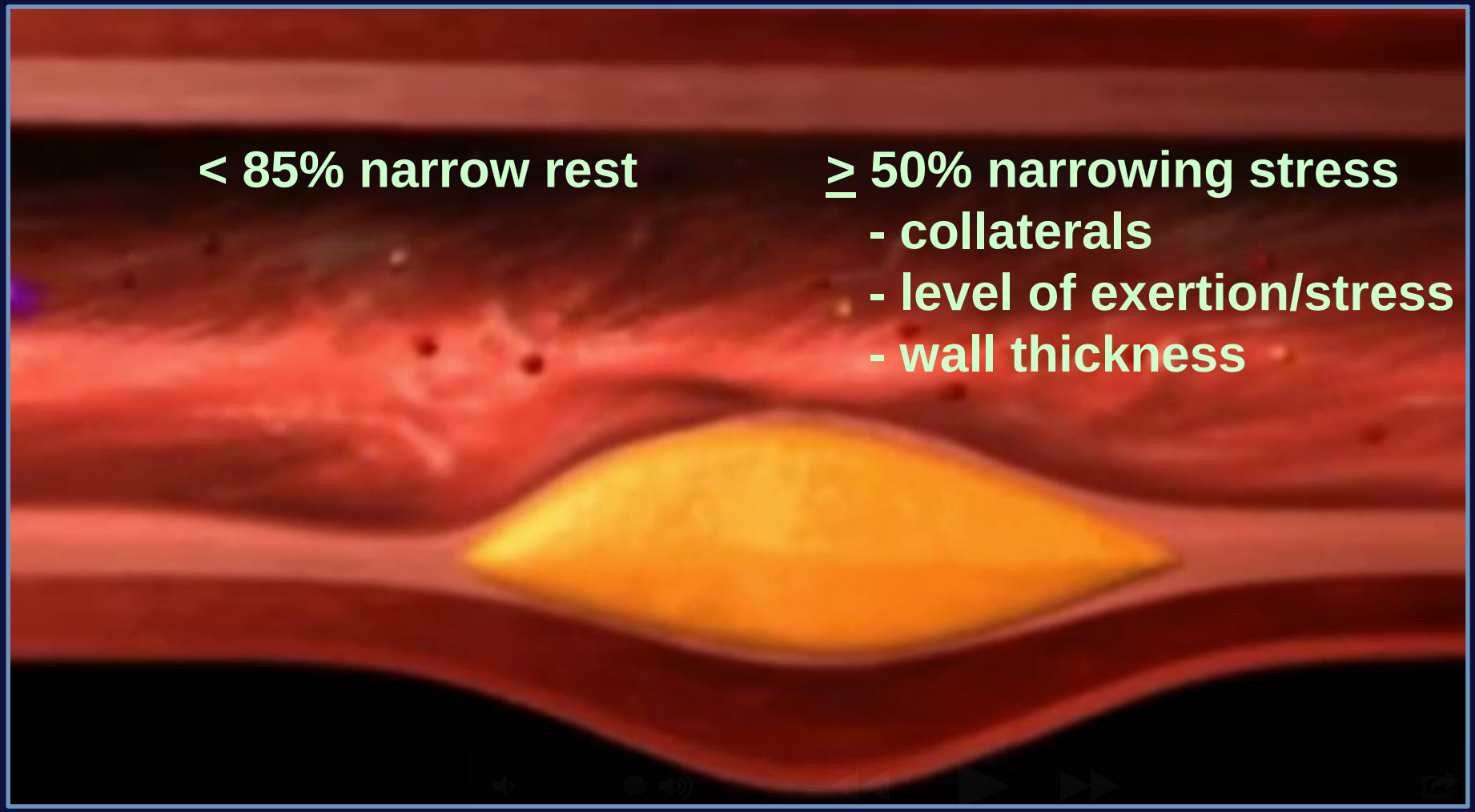


Cause of Wall Motion Abnormalities

Wall Motion Abnormalities at Rest	Wall Motion Abnormalities during Stress
• Ischemic heart -Infarction -Stunned / Hibernating • Conduction -Pacing -LBBB • Cardiomyopathy • Myocarditis • Right ventricular volume / pressure overload	• Ischemia with obstructive epicardial CAD • Ischemia in the absence of epicardial obstruction -hypertensive response -microvascular disease • Cardiomyopathy • Rate-related LBBB • Pulmonary

Wall Motion Abnormality

Diameter Stenosis



Left Ventricular Size and Global Function

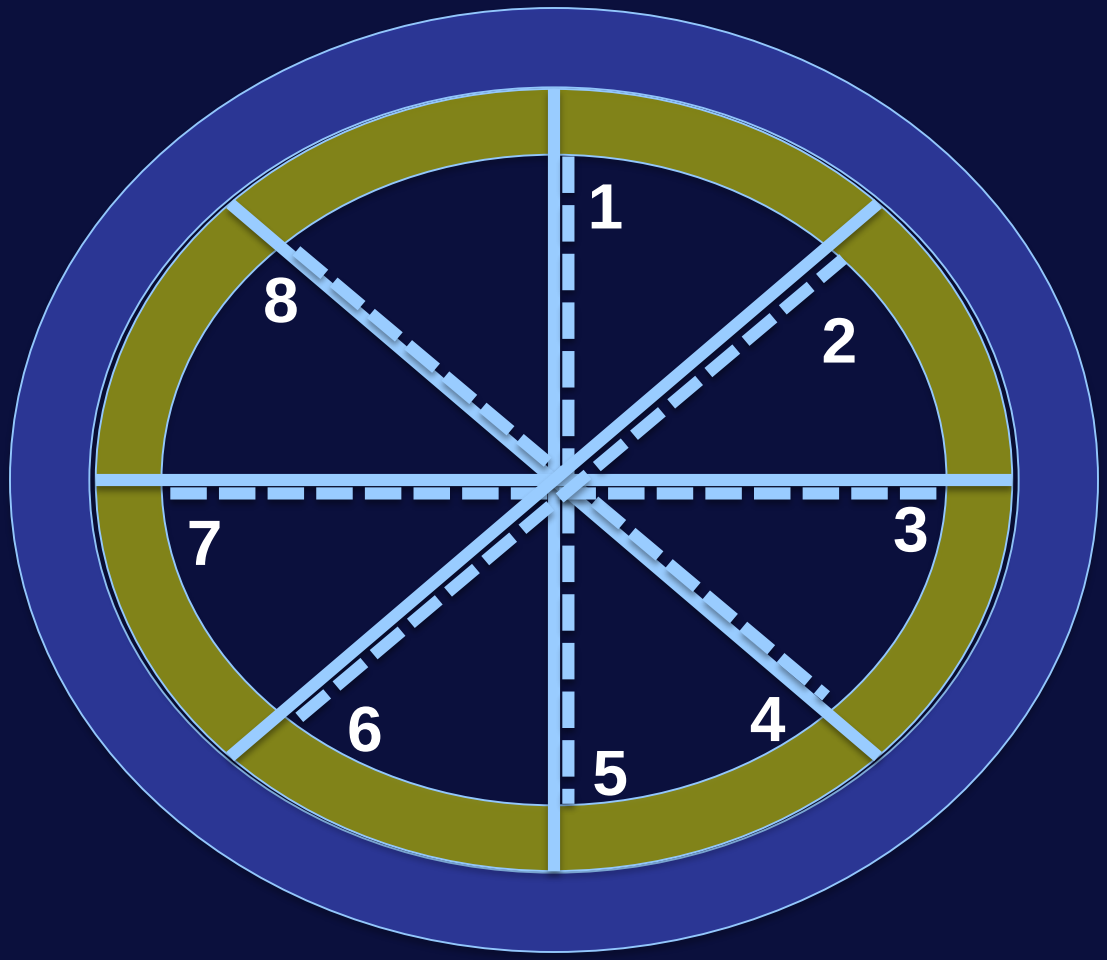
- Normal response is a reduction in both end-systolic and end-diastolic volumes (25-30%).

  *supine bicycle

- An increase in volume (more 17%) has a good threshold for increased cardiac events.

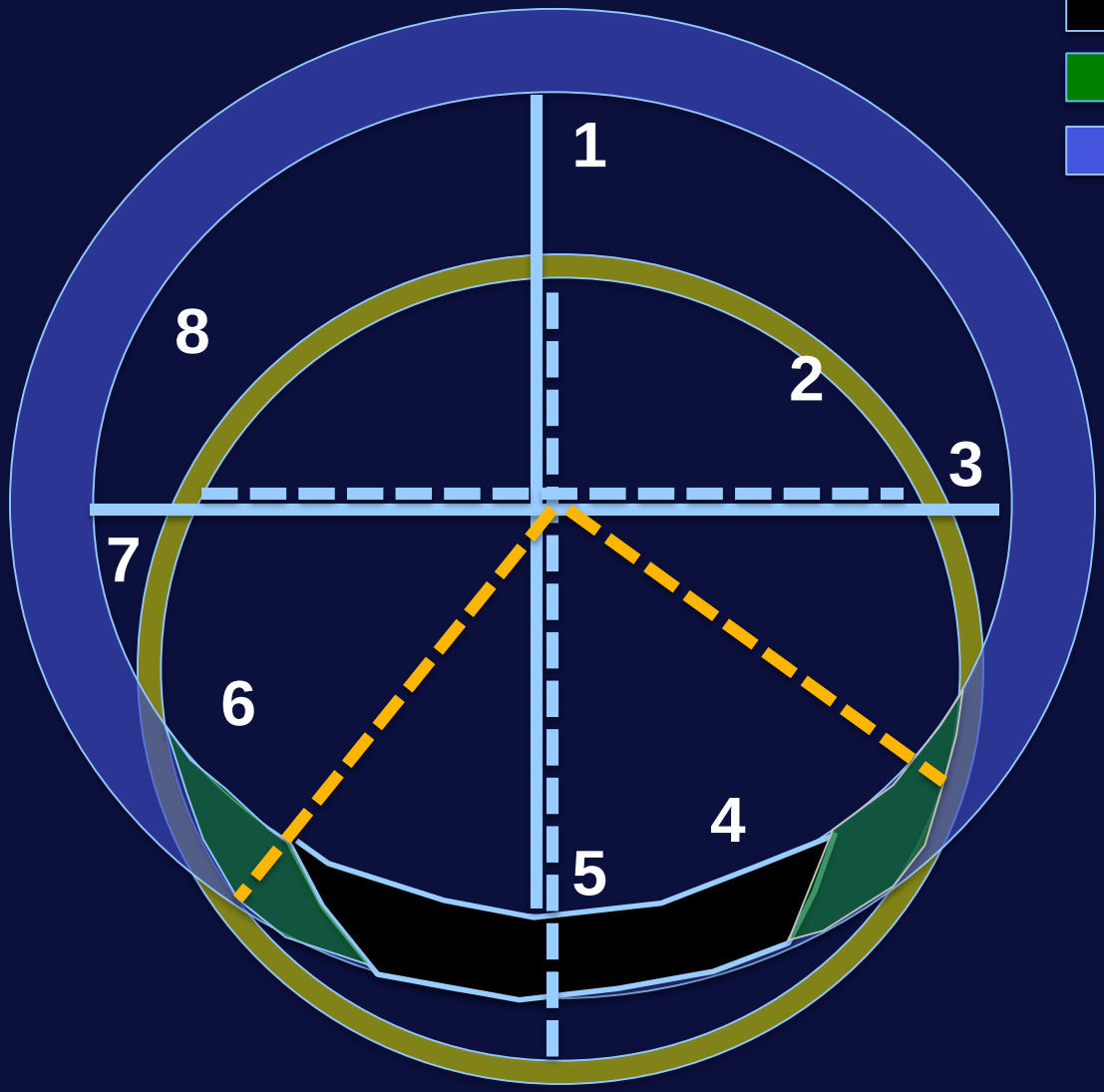
Quantitative Evaluation of Left Ventricular Function

Chordal Center Line Analysis (Centroids)



Dyskinesis

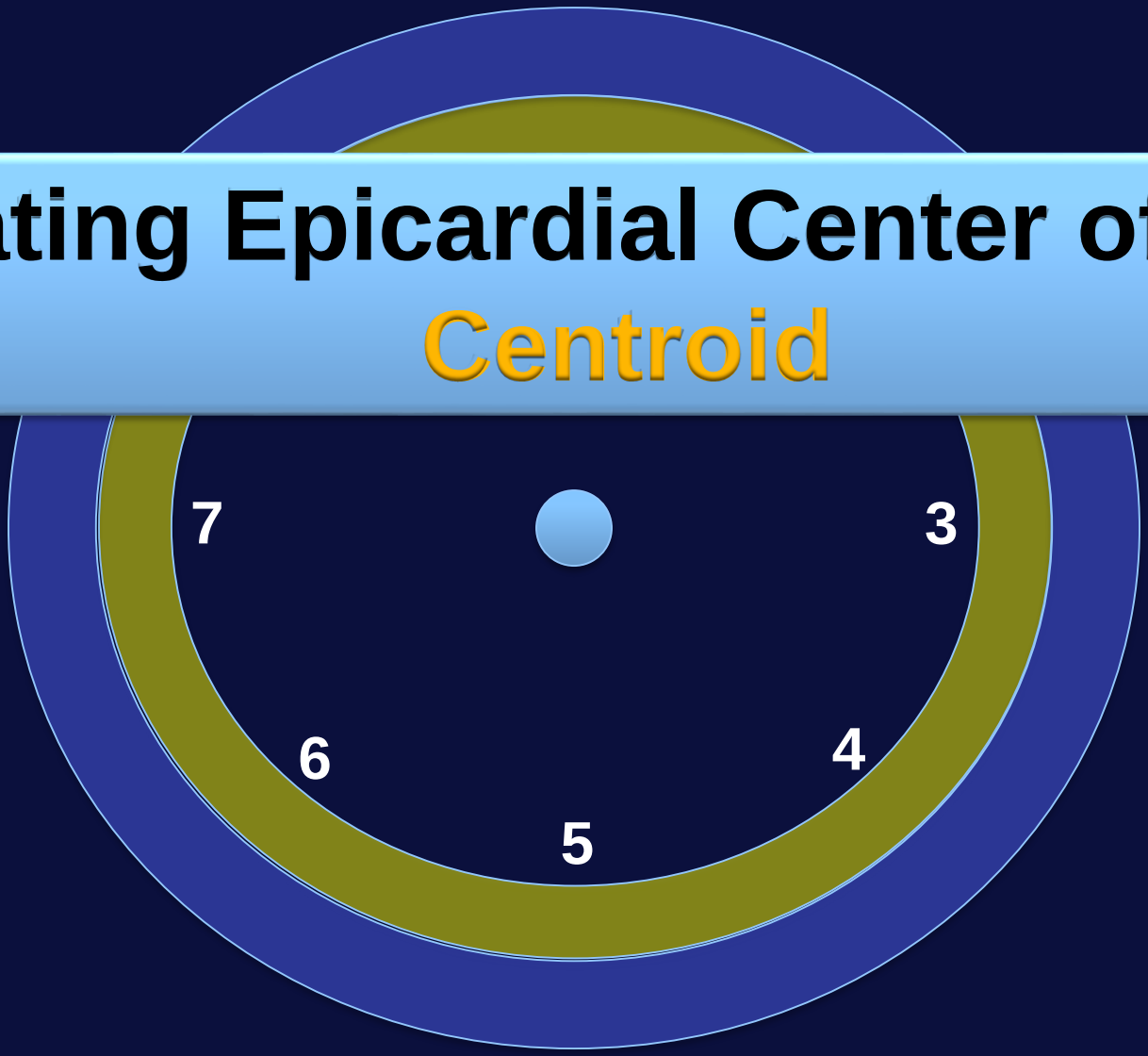
Tethering



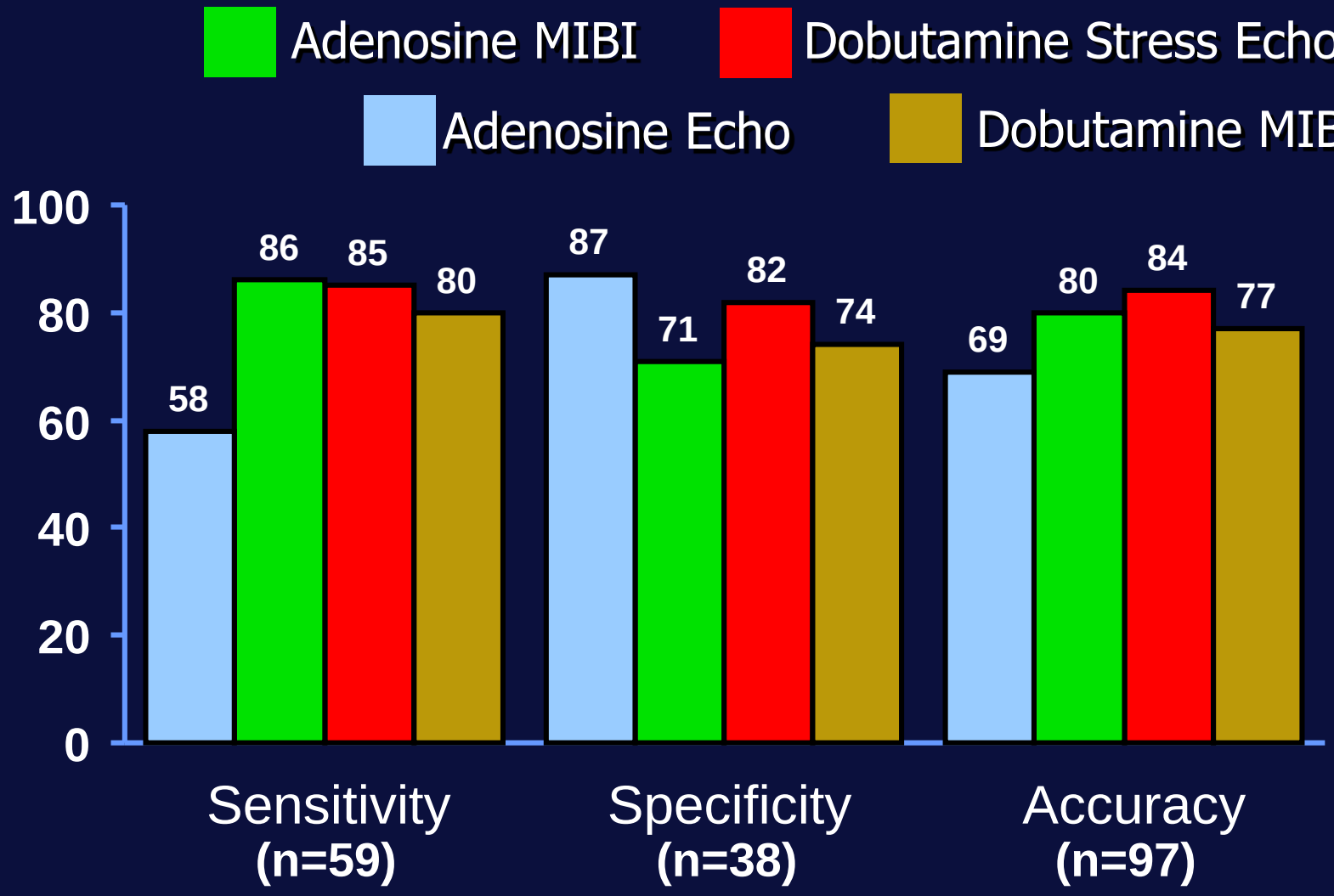
Translation and Rotation

Floating Epicardial Center of Mass

Centroid



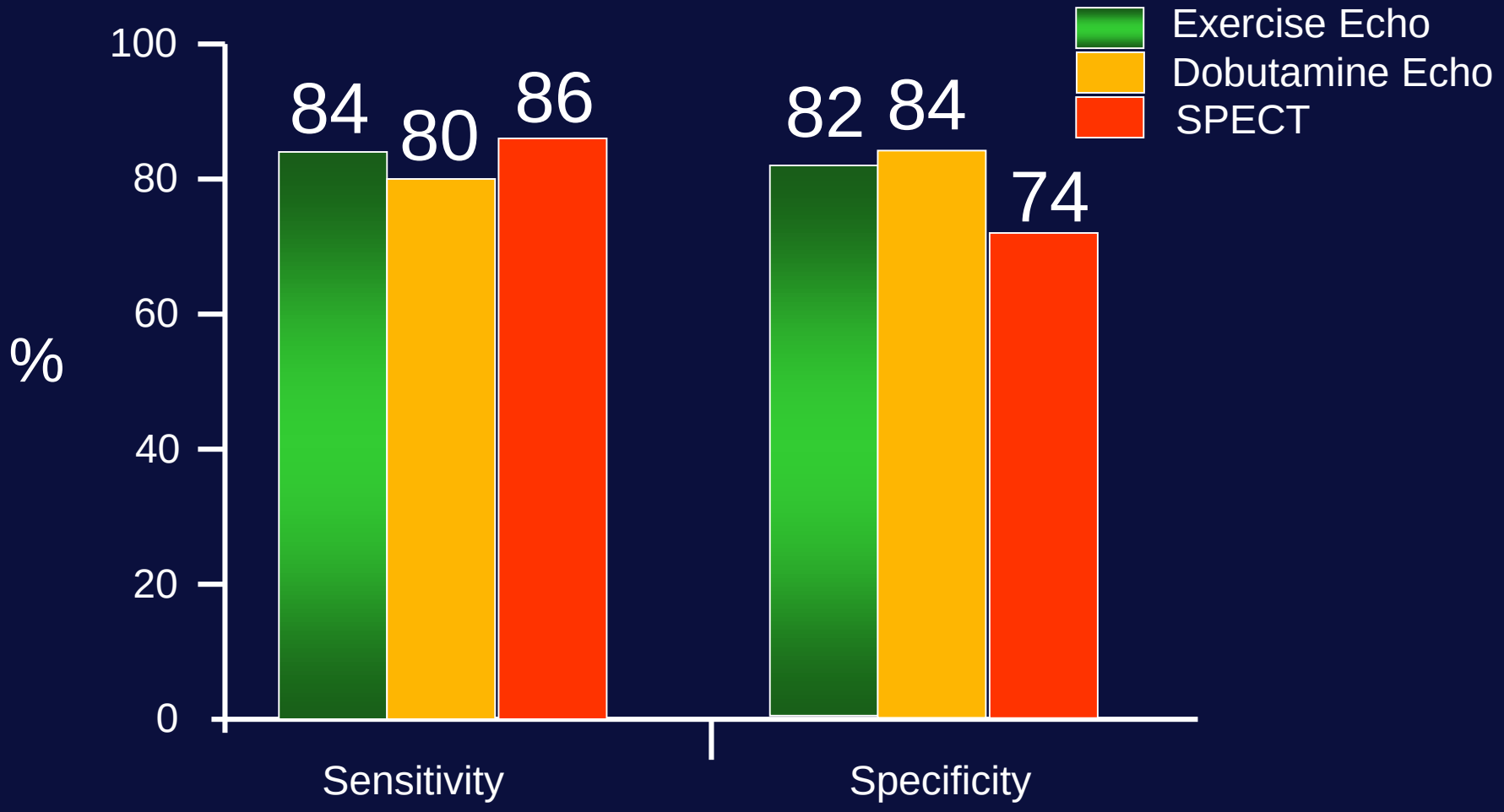
Pharmacologic Stress Testing with Imaging



Marwick et al. *Circulation*, 1993

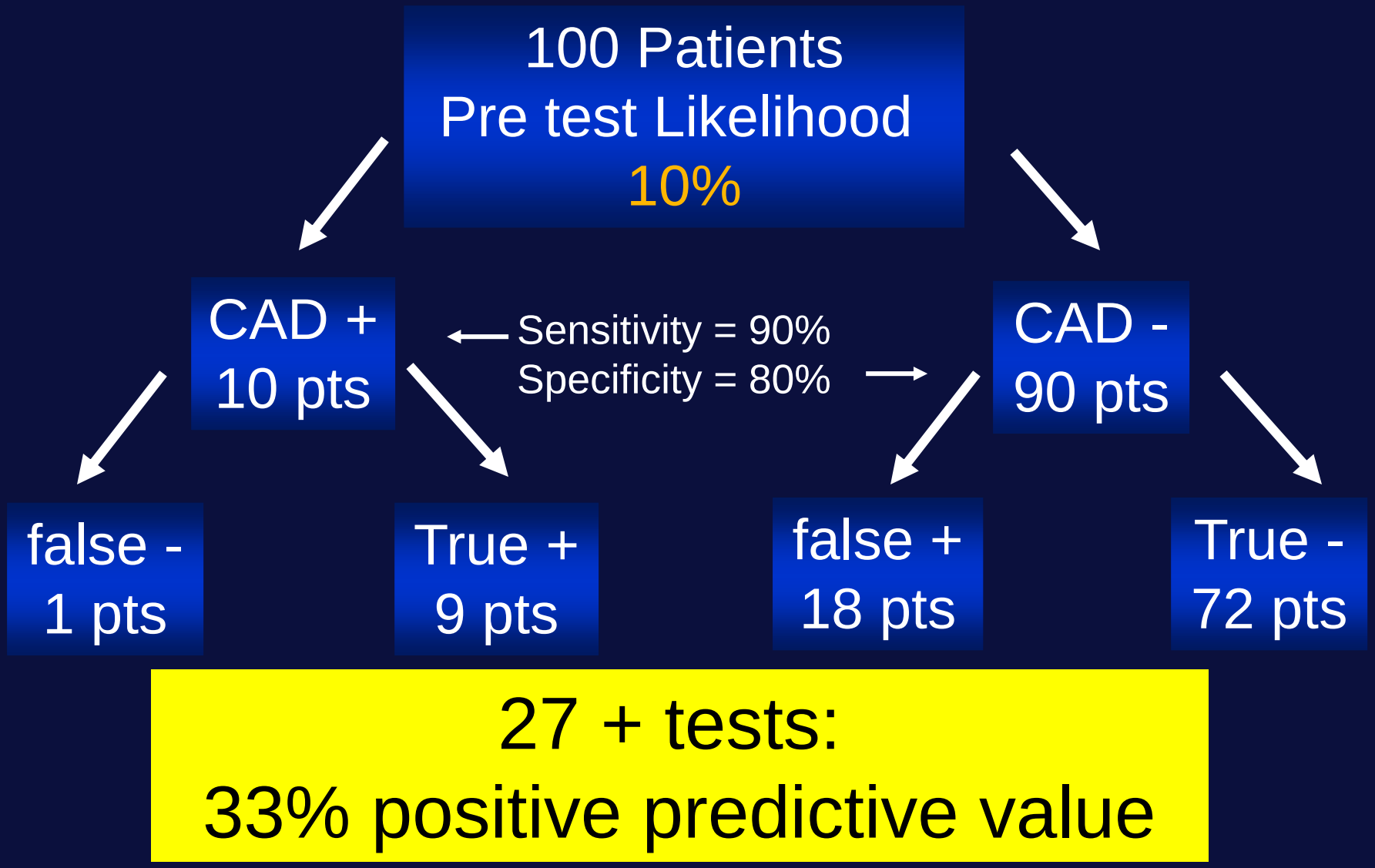
Test Characteristics:

Diagnosis - CAD



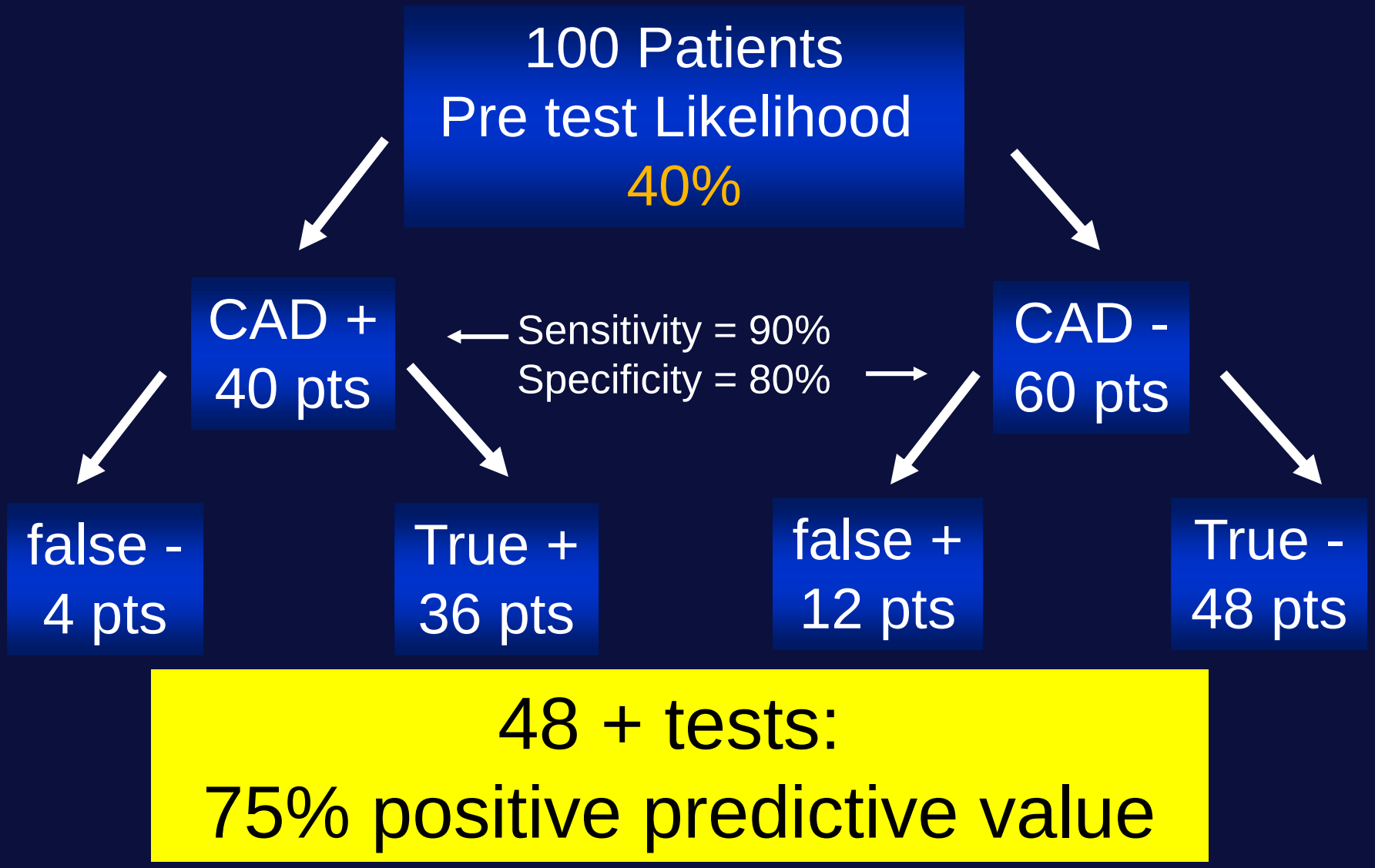
Schuijf Eur J Nucl Med Mol Imaging 2006;33:93

Impact of Pretest Probability



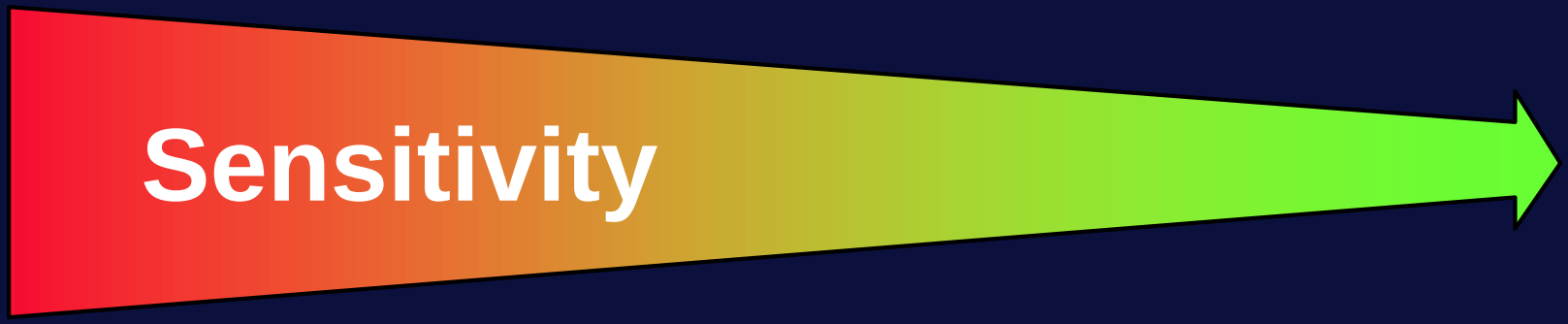
27 + tests:
33% positive predictive value

Impact of Pretest Probability

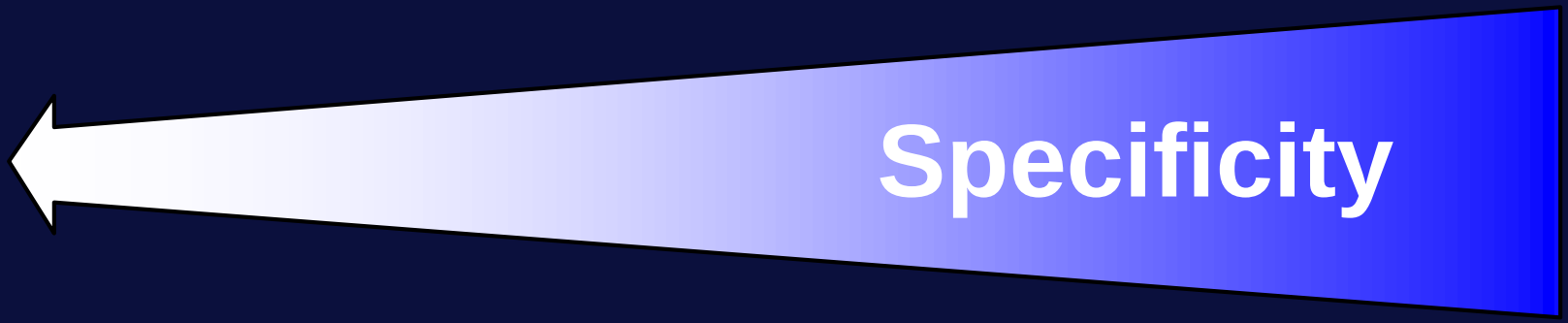


48 + tests:
75% positive predictive value

Test Characteristic:
Diagnostic Criteria



1 Segment, > 1 Segment, LV dilation



Stress Echocardiography

Risk of adverse event

Prognosis

Detection/Exclusion CAD

Diagnosis

Normal SECHO
Physical or Pharmacologic

Very Low Risk

- < 1% per year risk of MI or cardiac death

Low Risk

- 1-3% per year risk of MI or cardiac death
  - -submaximal stress
  - -LVEF <40%

Mertz et al. J Am Coll Cardiol 2007;49:227–37
Sicari et al. European Heart Journal (2009) 30, 278–289

Safety of Stress Echocardiography Supervised by Registered Nurses: Results of a 2-Year Audit of 15,404 Patients

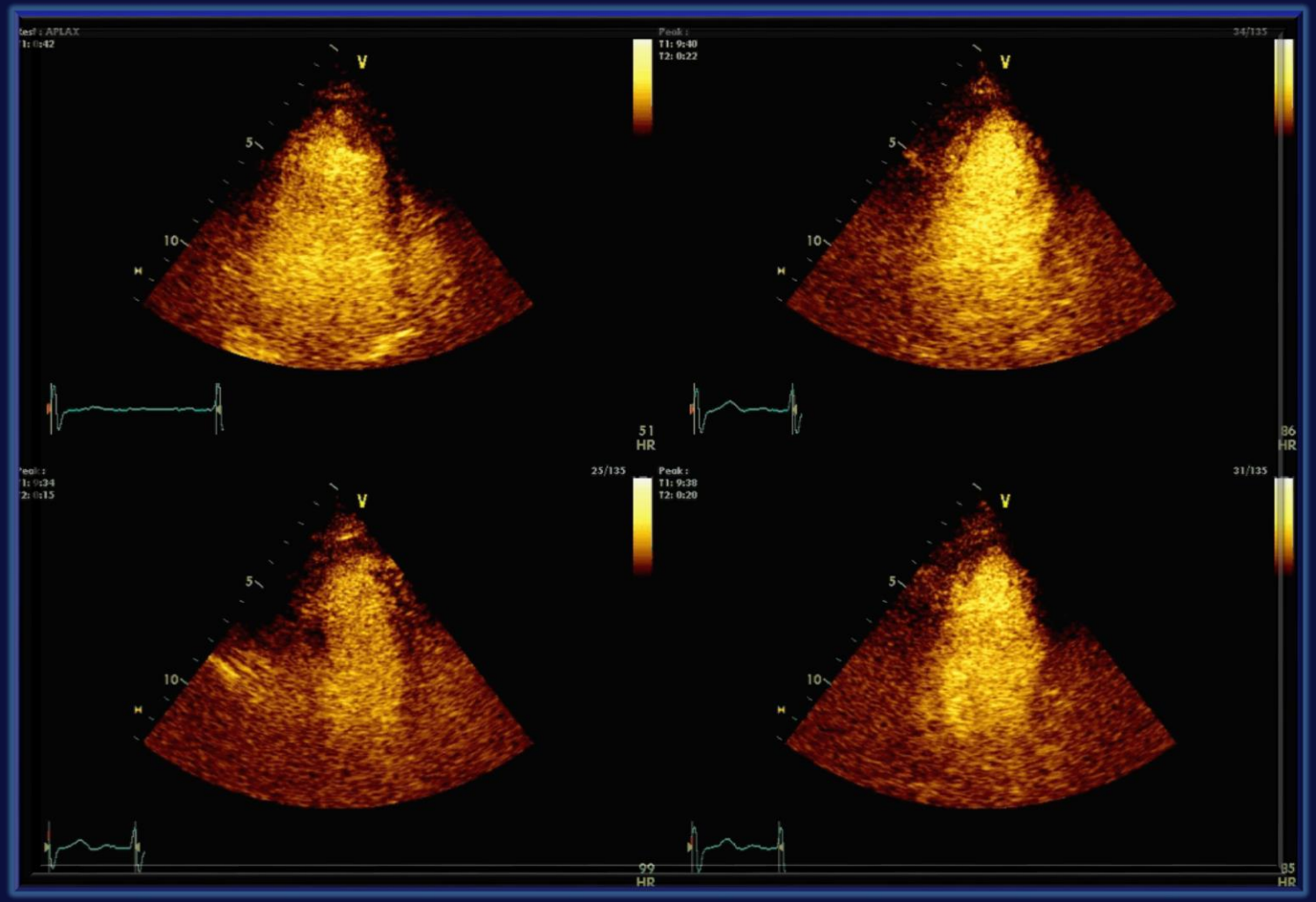
Garvan C. Kane, MD, PhD, Mary J. Hepinstall, RN, Glenda M. Kidd, RN,

	ExEcho n=8592	DSE n= 6755	P value	Total n = 5349
Overall Complication Rate	8 (0.09%)	47 (0.7%)	<0.001	55 (0.36%)
Arrhythmia Requiring Rx	4 (0.05%)	39 (0.58%)	<0.001	43 (0.28%)
SVT / AF	4 (0.05%)	33 (0.49%)	<0.001	37 (0.24%)
VT / VF	0	6 (0.09%)	<0.005	6 (0.04%)
Markedly + / Prolonged CP requiring hospitalization	3 (0.03%)	5 (0.07)	0.56	8 (0.05%)
Symptomatic hypotension requiring hospitalization	1 (0.01%)	3 (0.04%)	0.44	4 (0.03%)
Transfer to Hospital	5 (0.06%)	21 (0.31%)	0.0005	26 (0.17)
Cardiac Rupture or Death	0	0	----	0

comparable with previously reported studies evaluating the safety of stress echocardiography supervised by physicians.

Stress Echocardiography

Diastolic Stress Test



Diastolic Stress Echocardiography: A Novel Noninvasive Diagnostic Test for Diastolic Dysfunction Using Supine Bicycle Exercise Doppler Echocardiography

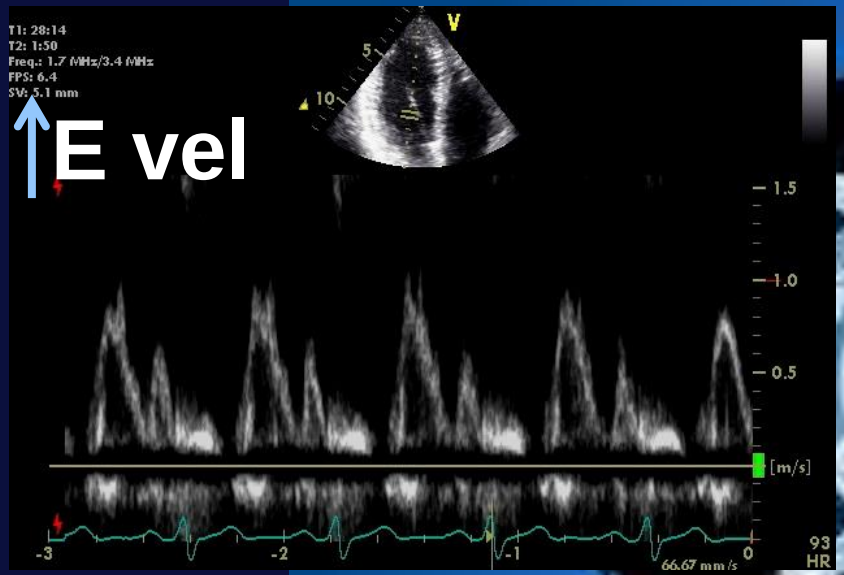
Jong-Won Ha, MD, PhD, Jae K. Oh, MD, Patricia A. Pellikka, MD, Steve R. Ommen, MD, Vicky L. Stussy, RN, RDCS, Kent R. Bailey, PhD, James B. Seward, MD, and A. Jamil Tajik, MD, *Rochester, Minnesota*

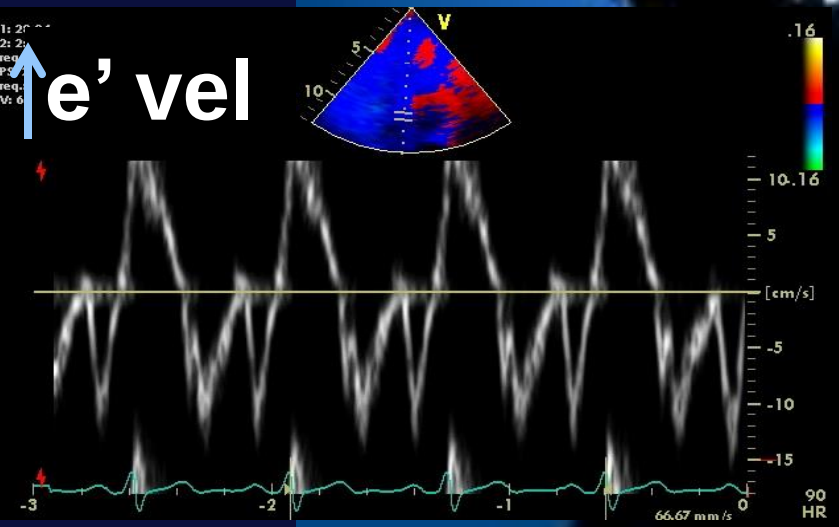
Left ventricular filling pressures can be estimated reliably by combining mitral inflow early diastolic velocity (E) and annulus velocity (E′). An increased E/E′ ratio reflects elevated filling pressures and may be useful in assessing an abnormal increase in filling pressures for patients with diastolic dysfunction. The purpose of this study was to evaluate the feasibility of supine bicycle exercise Doppler echocardiography for assessing left ventricular diastolic pressure during exercise. Mitral inflow and septal mitral annulus velocities were measured at rest and during supine [illegible] for demonstrations) in [illegible] sure) with exertion in [illegible] years) referred [illegible] st the hemodynamic consequences of exercise-induced increase in diastolic filling pressure can be demonstrated noninvasively with exercise Doppler echocardiography. None had echocardiographic or electrocardiographic evidence of myocardial ischemia with exercise. Patients were classified according to E/E′ ratio at rest: 26 had E/E′ ≤ 10 at rest (group 1) and 19 had E/E′ > 10 (group 2). For group 1, 17 had no increase in E/E′ during exercise (group 1A) and 9 did (group 1B). For group 2, E/E′ did not increase during exercise. Despite different responses of E/E′, there was no significant difference in changes of mitral inflow indices (E, A, E/A, deceleration time) between groups. Although the percentage of dyspnea as a primary reason for stopping exercise was similar for the groups, exercise duration was significantly shorter for groups 1B (7.2 ± 2.5 minutes) and 2 (7.1 ± 3.3 minutes) than in group 1A (10.4 ± 3.7 minutes, $P = .0129$). Diastolic stress echocardiography using

J Am Soc Echocardiogr 2005;18:63-8

(J Am Soc Echocardiogr 2005;18:63–8.)

What do we expect?

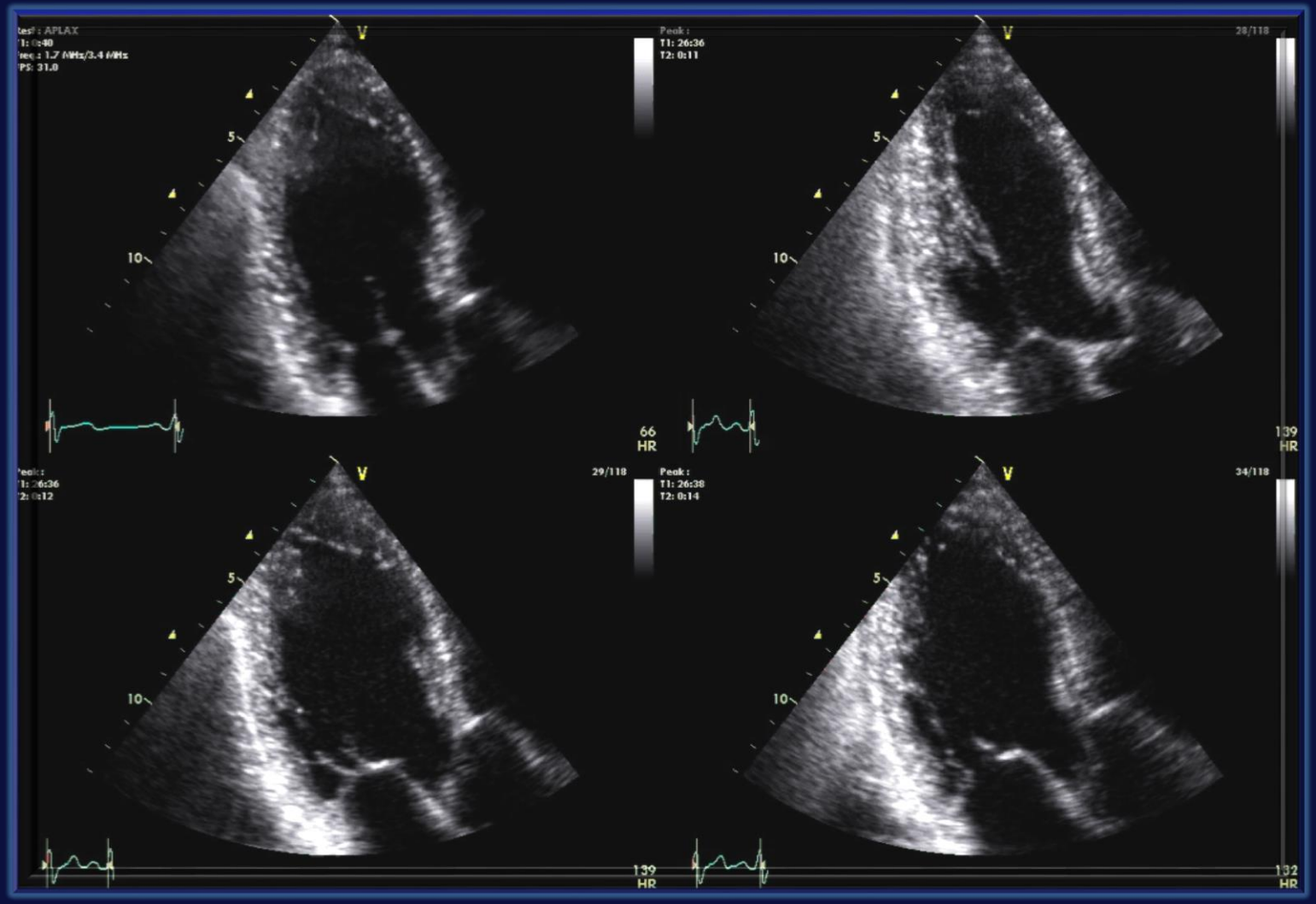




Case

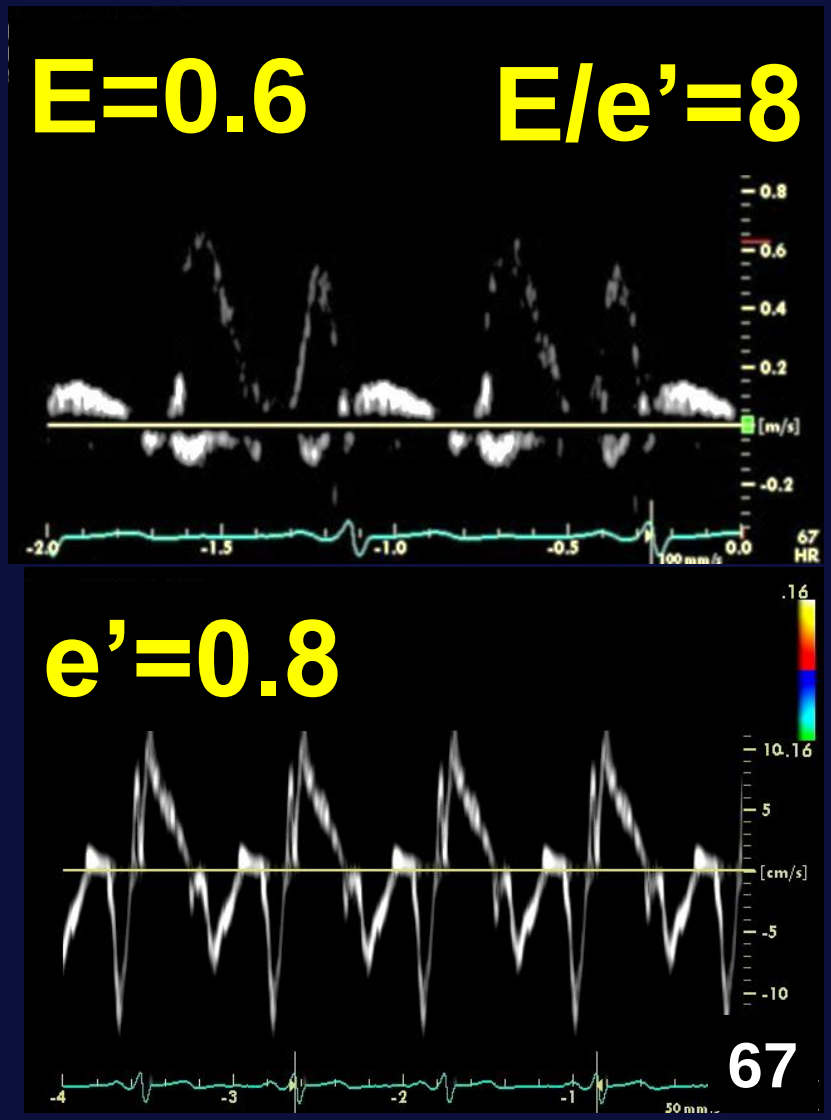
- 55 year old male
- No known CAD
- Hypertension & exertional dyspnea

Stress Echo

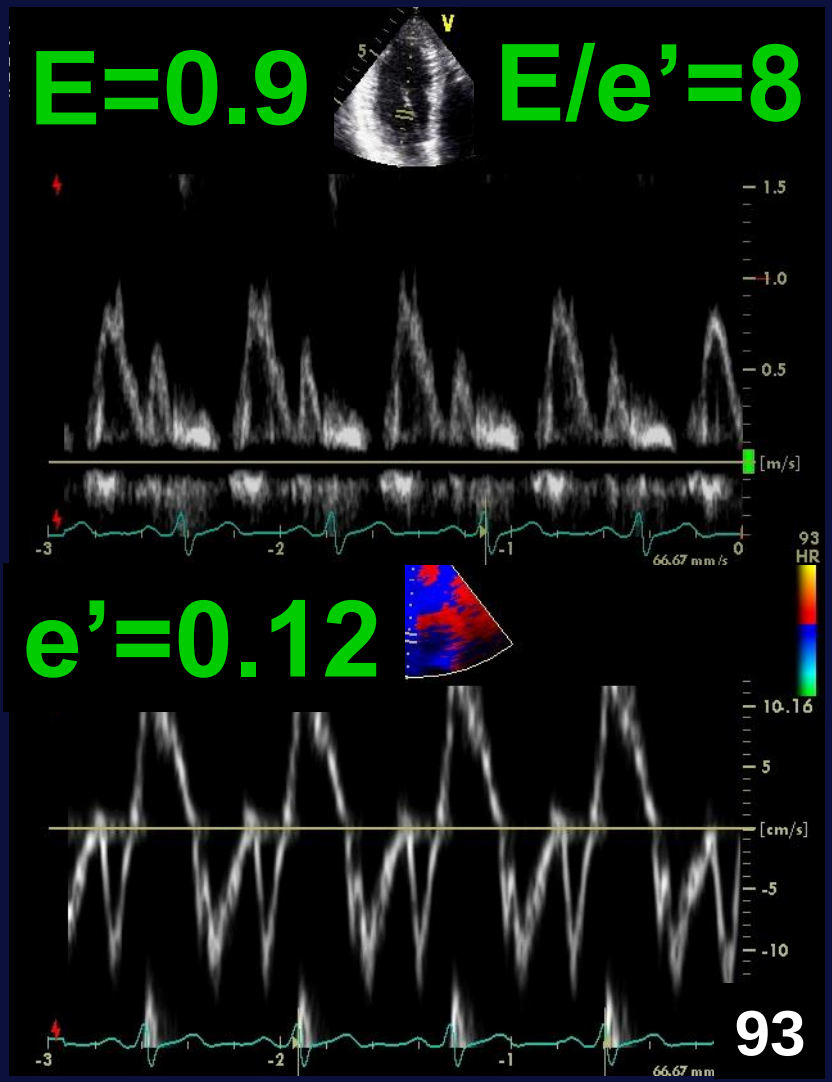


Diastolic Stress Test

Pre



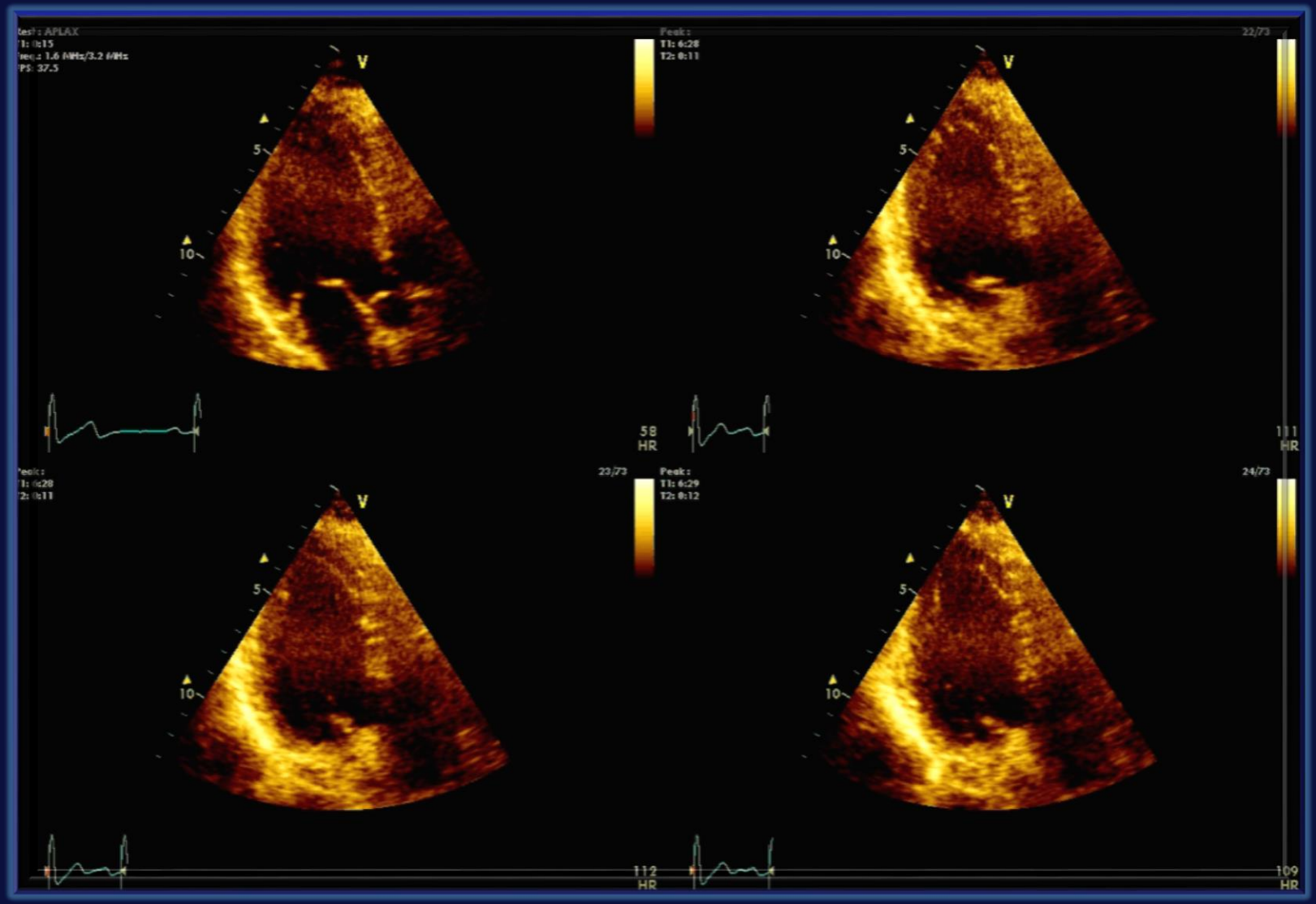
Post



Case

- 67 year old male
- No known CAD
- Diabetes and hypertension
- Complains of dyspnea on exertion (NYHA II)

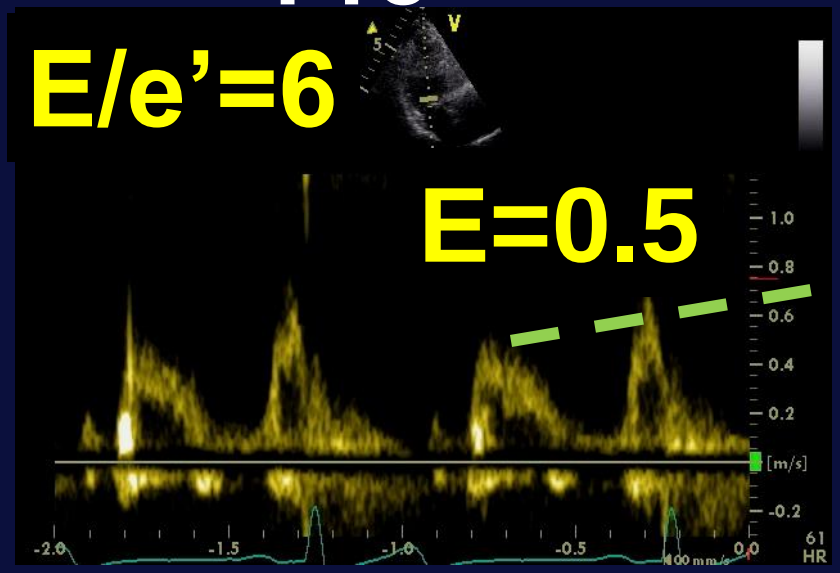
Stress Echo

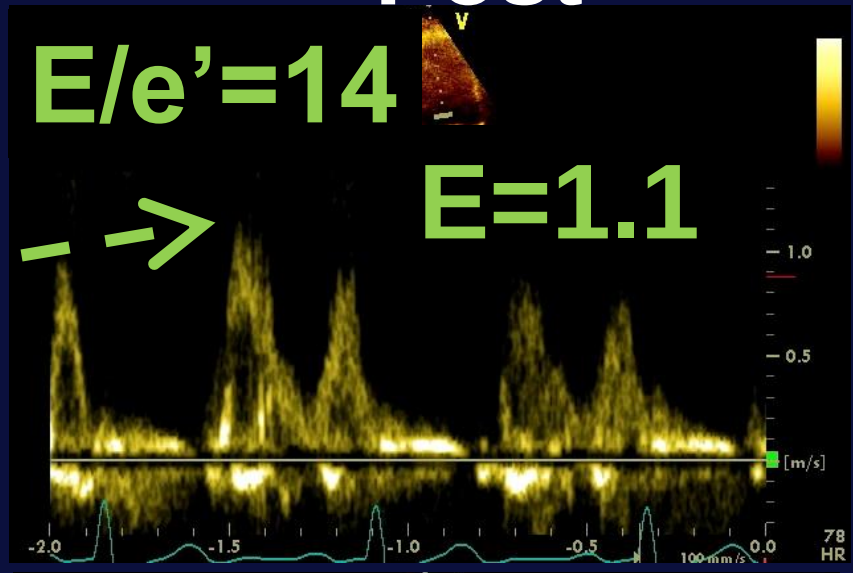


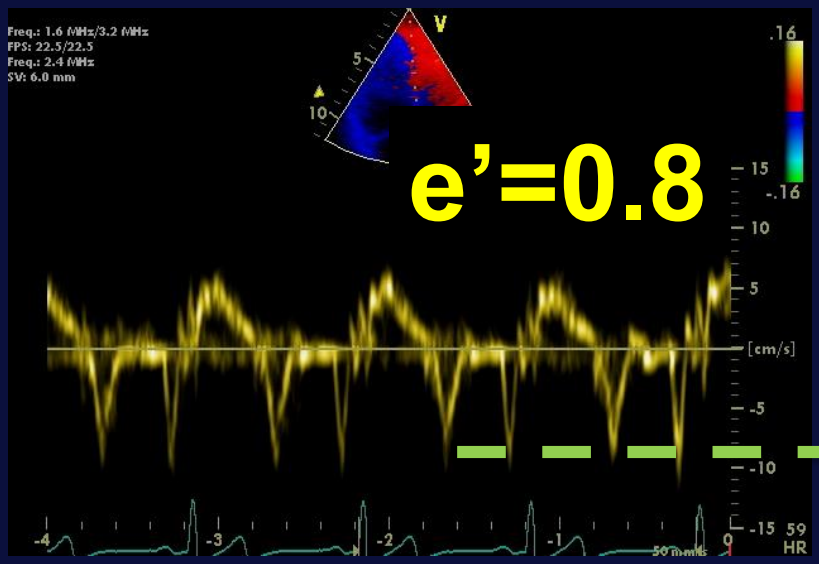
Diastolic Stress Test

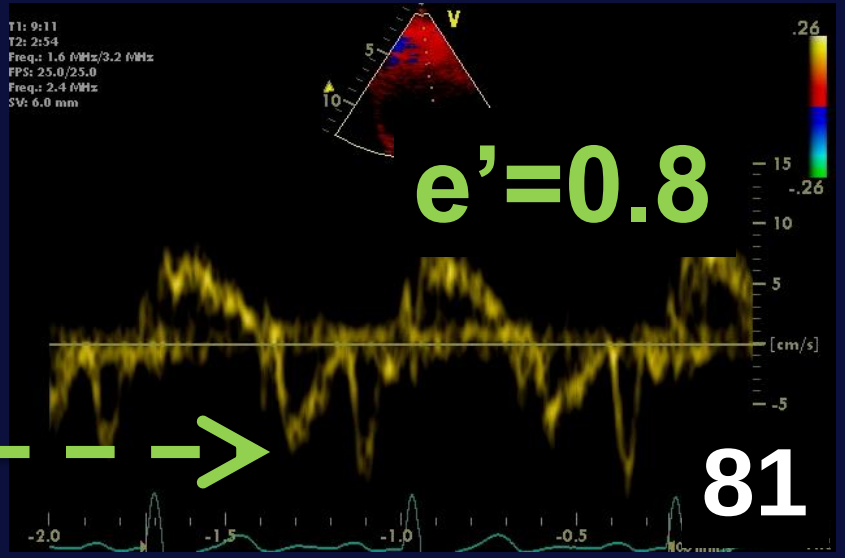
Pre

Post

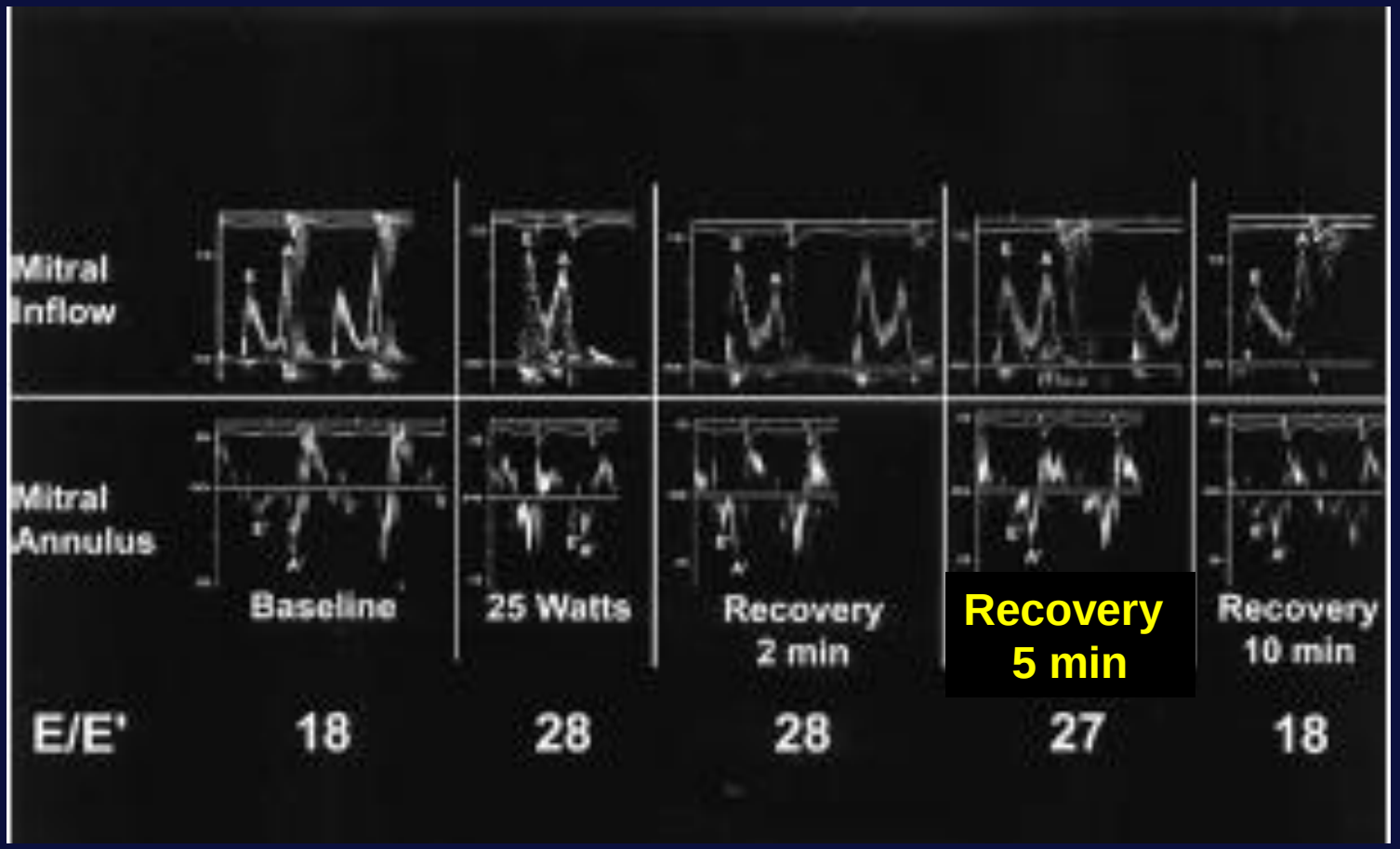








Important Observations From the Initial Studies



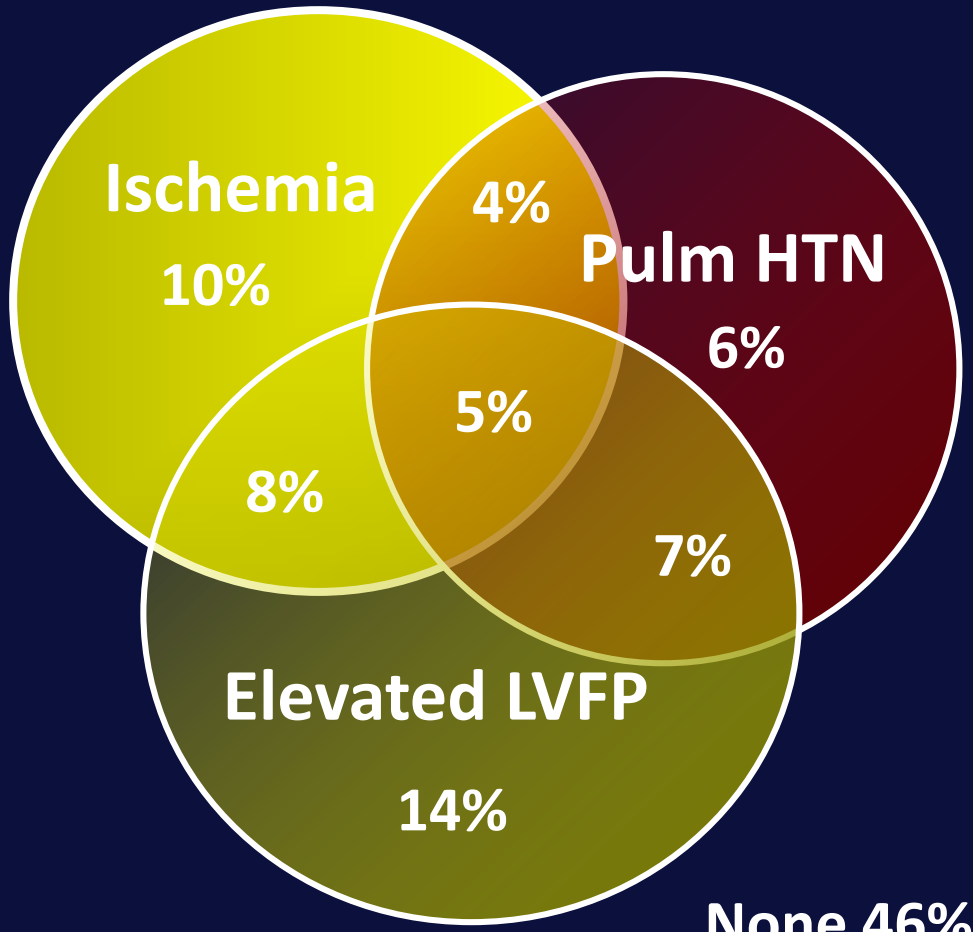
Ha et al J Am Soc Echocardiol 2005;18:63-8

Important Observations From the Initial Studies

- Those with increased filling pressure at baseline will further increase filling pressure with exercise
- Therefore, those who benefit most from diastolic stress testing are those with normal resting LVFP but abnormal relaxation (grade I)

Exercise-limiting Dyspnea

Courtesy Rob McCully



Ischemia 27%

Pulmonary HTN 22%

Elevated LVFP 34%

Any abnormality 54%

None 46%

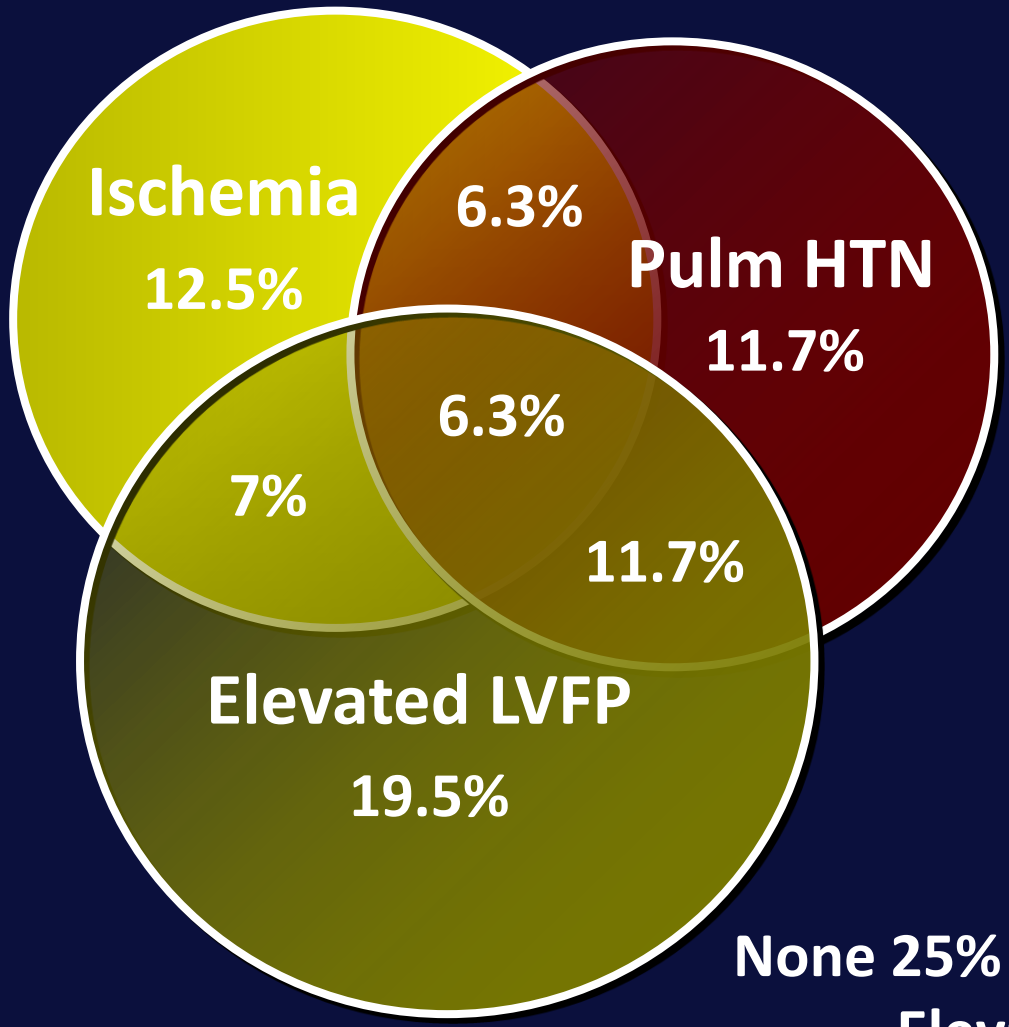
Elevated LVFP: ex. E/e' >13

Pulm HTN: ex. RVSP >50 mm Hg

n=630

Reduced Exercise Capacity

Women <5 METs, Men <7 METS



Courtesy Rob McCully

Ischemia 32%

Pulmonary HTN 36%

Elevated LVFP 45%

Any abnormality 75%

None 25%

Elevated LVFP: ex. E/e' >13

Pulm HTN: ex. RVSP >50 mm Hg

n=128

Treadmill Exercise Echo (2010 →)

Mayo Clinic, Rochester, MN

Baseline

EF, RWMAs, valves

Color flow

+

LA Volume

E, A, E/A, DT

e', E/e'

TR Vmax

RV systolic pressure

Post-exercise

Quads for

EF, LVESV resp, RWMAs

+

Then

TR Vmax

RV systolic pressure

Then

LV filling pressure

E, e', E/e'

Recommendations for the Evaluation of Left Ventricular Diastolic Function by Echocardiography: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging

Diastolic Stress Test Interpretation

Definitely Abnormal

1. Average E/e' > 14 or Septal >15
2. Septal e' < 7 cm/sec

   or

   Lateral e' < 10 cm/sec
3. Peak TR velocity > 2.8 m/sec

Normal

1. Average (or septal) E/e' < 10
2. Peak TR velocity < 2.8 m/sec

ogr 2016;29:277-314

opescu, MD, PhD, has received research support from GE Healthcare and Hitachi Aloka.

University, the Institute of Medical Sciences, Uppsala, Sweden (F.A.F.); Ghent University and University Hospital, Ghent, Belgium (T.C.G.); Cleveland Clinic, Cleveland, Ohio (A.L.K.); the University of Liège Hospital, Liège, Belgium (P.L.); Universita Piemonte Orientale, Novara, Italy (P.M.); Mayo Clinic, Rochester, Minnesota (J.K.O.); the University of Medicine and Pharmacy "Carol Davila," Institute of Cardiovascular Diseases, Bucharest, Romania (B.A.P.); and Washington University School of Medicine, St Louis, Missouri (A.D.W.).

The following authors reported no actual or potential conflicts of interest in relation to the document: Sherif F. Nagueh, MD, Otto Smiseth, MD, PhD, Christopher P. Appleton, MD, Benjamin F. Byrd III, MD, Hisham Dokainish, MD, Thor Edvardsen, MD, PhD, Frank A. Flachskampf, MD, PhD, Thierry C. Gillebert, MD, PhD, Allan Klein, MD, Patrizio Lancellotti, MD, PhD, Paolo Marino, MD, and Alan D. Waggoner, MHS, RDCS. The following authors reported relationships with one or more commercial interests: Jae K. Oh, MD, has served as a consultant for Medtronic and received a research grant from Toshiba. Bogdan Alexandru

Reprint requests: American Society of Echocardiography, 2100 Gateway Centre Boulevard, Suite 310, Morrisville, NC 27560 (E-mail: ase@asecho.org).
[1] Writing Committee of the American Society of Echocardiography.
[2] Writing Committee of the European Association of Cardiovascular Imaging.

0894-7317/$36.00

http://dx.doi.org/10.1016/j.echo.2016.01.011

Summary

1. Exertional dyspnea portends a poor prognosis (> angina).
2. An exercise induced increase in E/e' relates to changes in filling pressure and its finding has adverse prognostic significance.

Summary

3. The post exercise E/e' can be measured minutes into recovery, ideally as soon as the discrete waves are appreciated.

4. The ideal patient is one with exertional dyspnea and baseline grade I diastolic dysfunction.

2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American Association for Thoracic Surgery, American Society of Echocardiography, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons

Class IIa
Exercise testing is reasonable in selected patients with asymptomatic severe VHD to
1) confirm the absence of symptoms, or
2) assess the hemodynamic response to exercise, or
3) determine prognosis.

(Level of Evidence: B)

Lesley H. Curtis, PhD, FAHA
David DeMets, PhD
Robert A. Guyton, MD, FACC§§
Frank W. Sellke, MD, FACC, FAHA
Win-Kuang Shen, MD, FACC, FAHA
William G. Stevenson, MD, FACC, FAHA§§
Clyde W. Yancy, MD, FACC, FAHA§§

Stress Echocardiography
Aortic Stenosis

Class IIa
Exercise testing is reasonable to assess physiological changes with exercise and to confirm the absence of symptoms in asymptomatic patients with a calcified aortic valve and an aortic velocity 4.0 m per second or greater or mean pressure gradient 40 mm Hg or higher (stage C)

Asymptomatic Severe AS
Stress Testing Guidelines

	Event-Free Survival		
ETT	1 year	3 years	5 years
*Positive	30	15	15
Negative	95	85	85

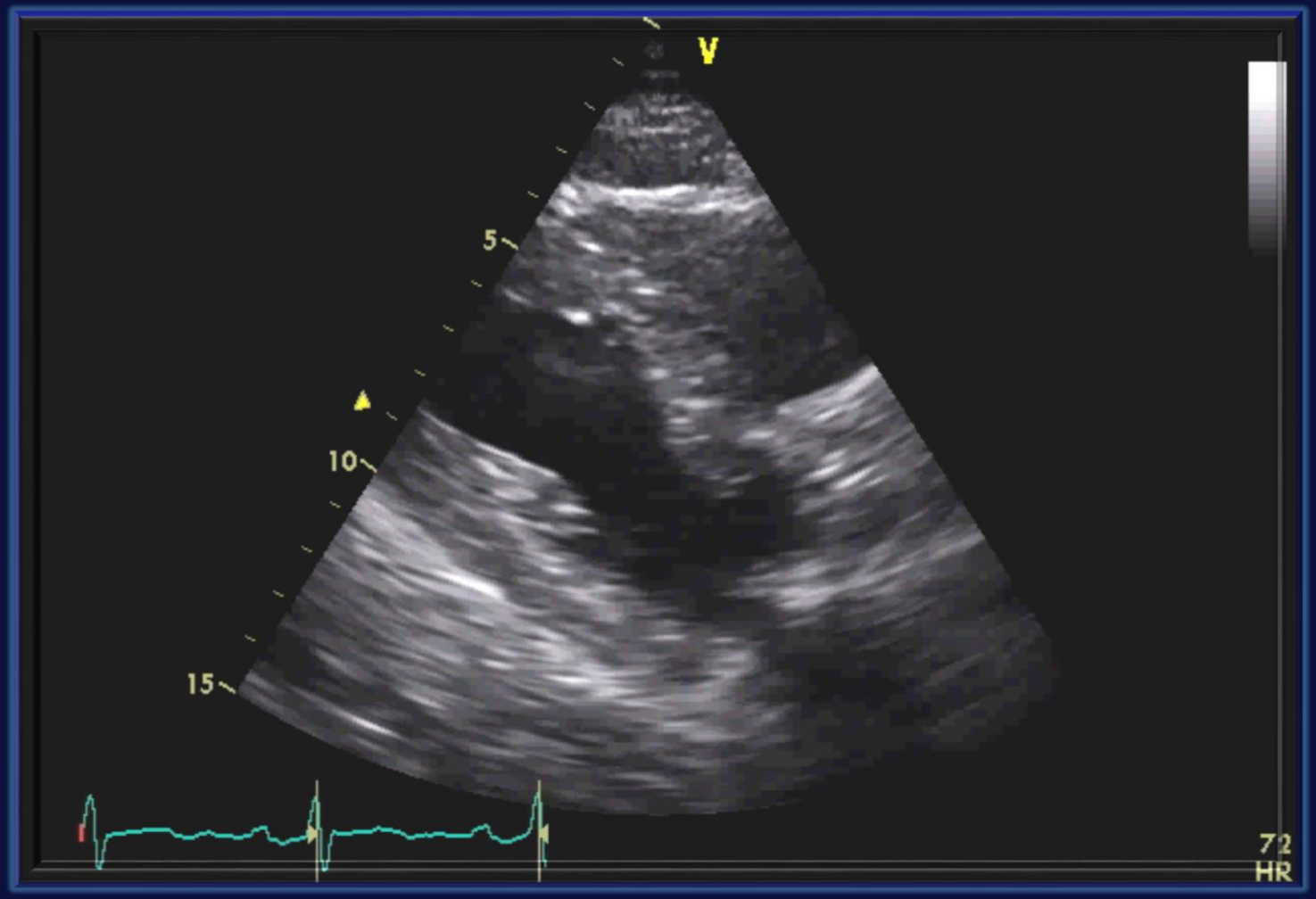
*symptoms; abnormal BP response; arrhythmias

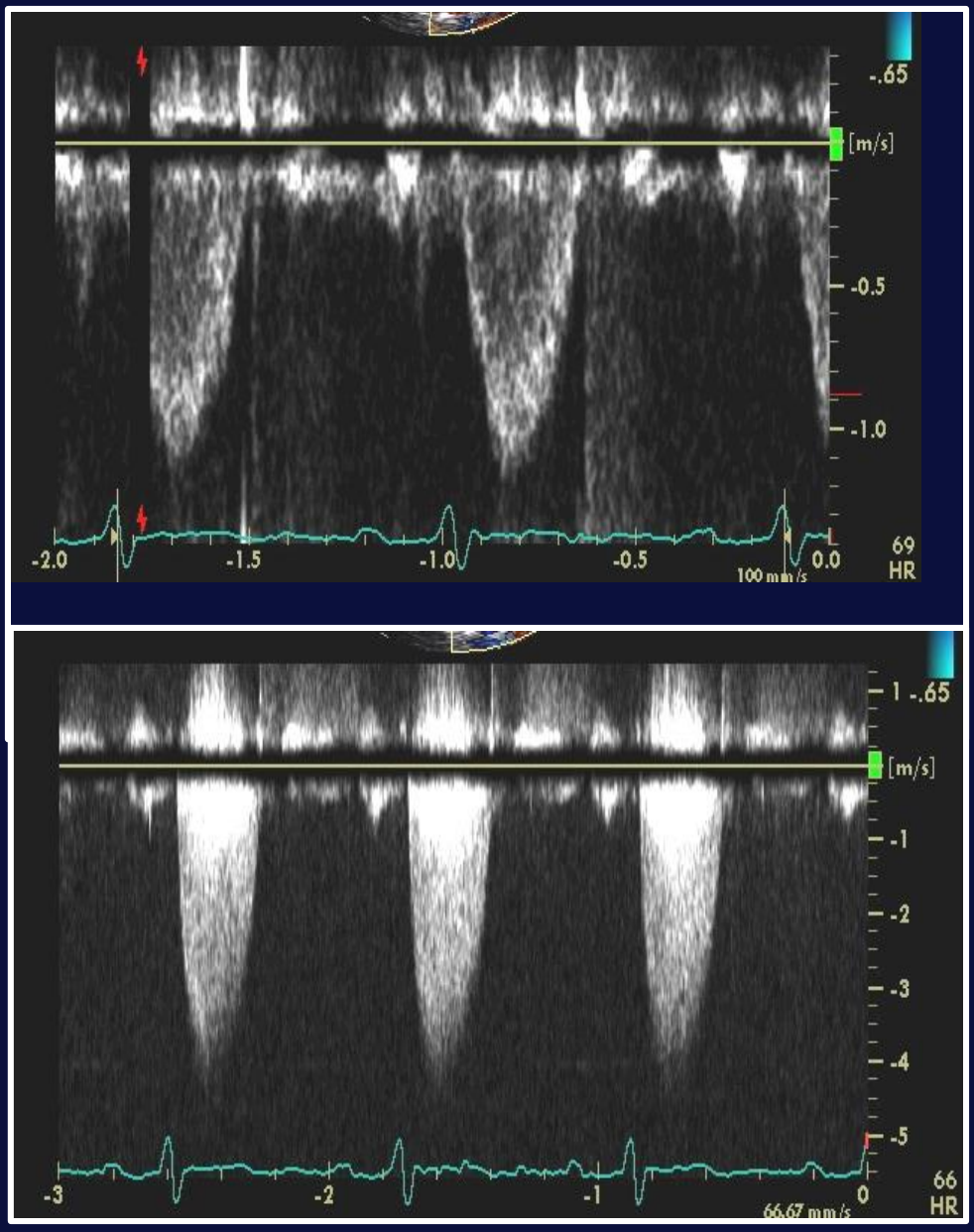
Heart 2001;**86**:381–386

Case

- 64 year old male: known heart murmur for 20 years
- Hypertension and hyperlipidemia
- NYHA Class I: walks 30-40 minutes daily with no symptoms
- Needs a TURP

Septum 15 mm; Posterior wall 13 mm
LVEF 72%





Peak velocity: 4.2 m/s

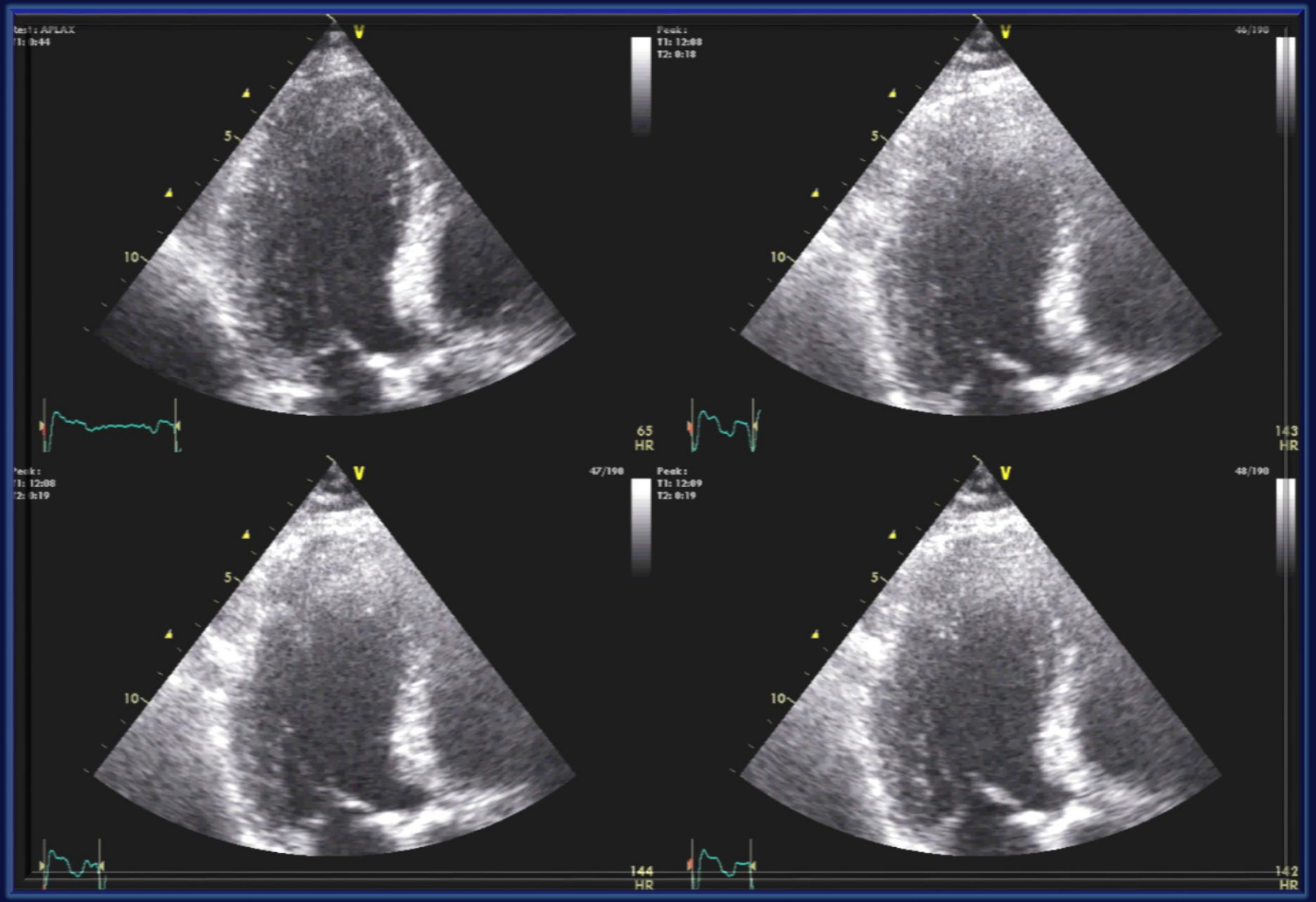
Mean gradient: 43 mmHg

AVA: 1.04 cm^2

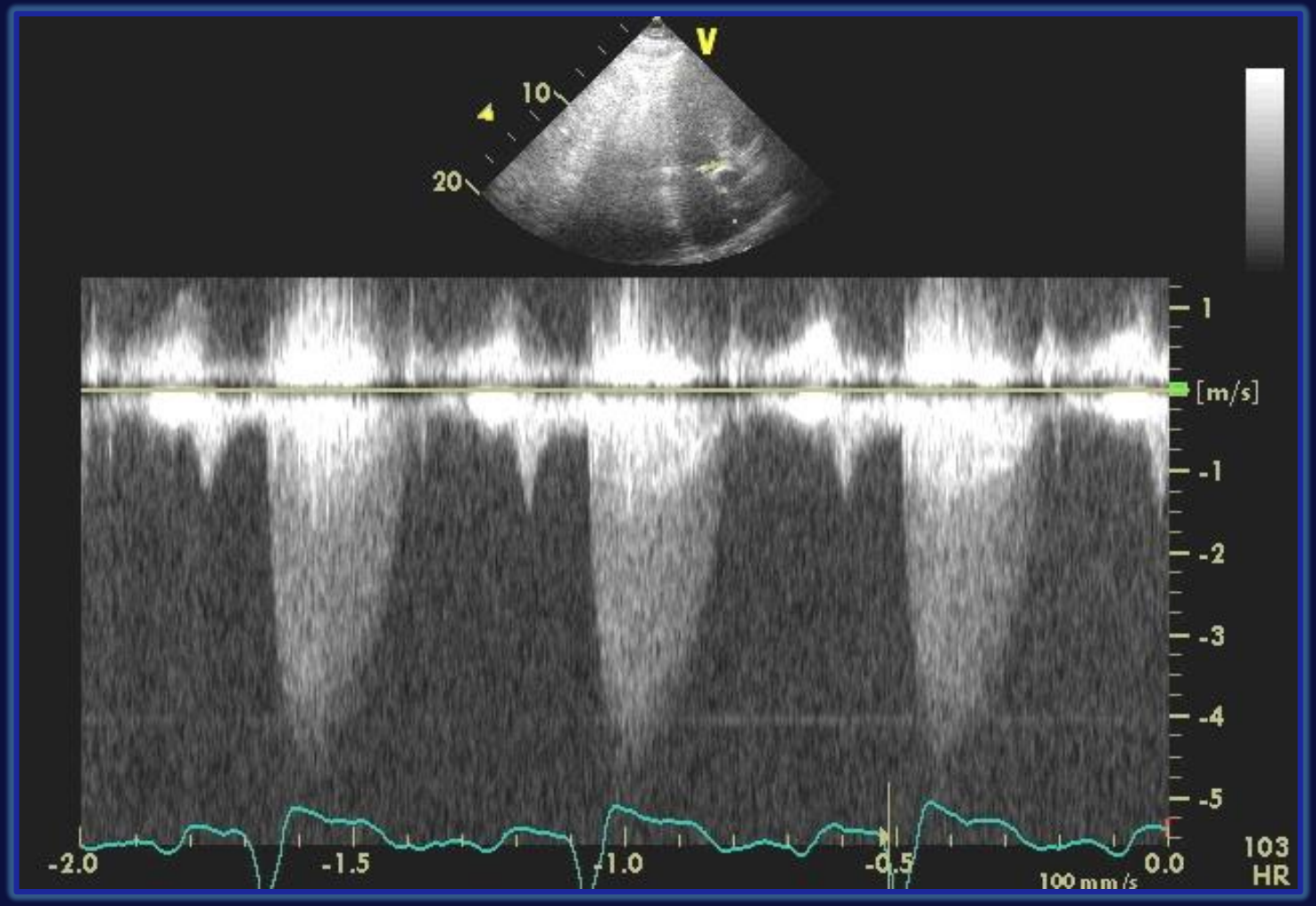
Indexed AVA: 0.51 cm^2

Stress Echo

- Bruce protocol: 6.29 min:sec
- 83% FAC
- BP 128/84 mmHg (rest); 160/ 70 mmHg (peak)
- 85% maximal predicted HR
- 7.5 METS; double product: 26240
- Stress ECG: 1 mm downsloping inferior ST segment depression


Peak:
T1: 12:08
T2: 0:18
65
HR
143
HR
47/190
Peak:
T1: 12:09
T2: 0:19
48/190
144
HR
142
HR

Mean gradient: 54 mmHg



What to advise?

1. AVR before TURP
2. TURP then AVR
3. Proceed cautiously with TURP
4. Proceed cautiously with TURP; then watchful waiting

ACC Guidelines: IIa

Moderate-risk elective noncardiac surgery with appropriate intraoperative and postoperative hemodynamic monitoring is reasonable to perform in patients with asymptomatic severe AS

Low EF Area Gradient Mismatch

Baseline Doppler hemodynamics

Class IIa

AVR is reasonable in symptomatic patients with low-flow/low-gradient severe AS with reduced LVEF (stage D2) with a low-dose dobutamine stress study that shows an aortic velocity ≥ 4.0 m/s (or mean pressure gradient ≥ 40 mm Hg) with a valve area ≤ 1.0 cm2 at any dobutamine dose

True Severe AS

Pseudo Severe AS

APPROPRIATE USE OF ECHOCARDIOGRAPHY

ACCF/ASE/AHA/ASNC/HFSA/HRS/SCAI/SCCM/
SCCT/SCMR 2011 Appropriate Use Criteria for
Echocardiography

A REPORT OF THE AMI ... SK FORCE, AMERICAN
SOCIETY OF ECHOC ... LEAR CARDIOLOGY,
HEART FAILURE SOC ... ANGIOGRAPHY AND
INTERVENTIONS, S ... TED TOMOGRAPHY,
SOCIETY FO ... PHYSICIANS

Appropriate

- **Detection of CAD with symptoms or ischemia equivalent**
- **Asymptomatic**
  - **Sustained VT**
  - **Exercise induced VT or NSVT**
  - **Newly diagnosed heart failure of LV dysfunction**
  - **Troponin elevation without evidence of ACS**
  - **CTCS > 400AU**
- **Coronary stenosis of unclear significance**
- **Within 3 months of ACS, no cath, to evaluate for inducible ischemia**
- **Vascular surgery, ≥ 1 clinical risk factor, < 4 METS**

Angiography and interventions Representative.

Conclusion

1. Understand the differences and indications for the various stress modalities.
2. Know the walls and their coronary supply.
3. Understand the methods and interpretation of wall motion.
4. Viability: stunning versus hibernation.
5. Understand the test characteristics.
6. Emerging uses: Valve Disease and SOB.
7. Appropriate use.

The apical inferior wall receives its blood supply from which coronary artery?

a. The right coronary artery.
b. The left anterior descending coronary artery.
c. Either the right or left anterior descending coronary artery.
d. The right coronary artery or the circumflex coronary artery.

For the detection of coronary artery disease, compared to myocardial perfusion imaging, stress echocardiography is?

a. Less sensitive but more specific.
b. More sensitive but less specific.
c. Less sensitive and less specific.
d. More sensitive and specific.

Which of the following statements about the interpretation of wall motion are true?

a. If at rest there is myocardial dysfunction and with stress there is slow sustained improvement this suggests hibernating myocardium.
b. If at rest there is myocardial dysfunction and with stress there is a biphasic response this suggests stunned myocardium.
c. A resting akinetic segment that becomes dyskinetic with stress suggests an ischemic response.
d. None of the above
e. All of the above


mayo