Cardiac Risk Factors and Non-invasive Cardiac Diagnosis-ECG, ECHO, et al.

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ACOI IM Board Review Course 2017

No Disclosures

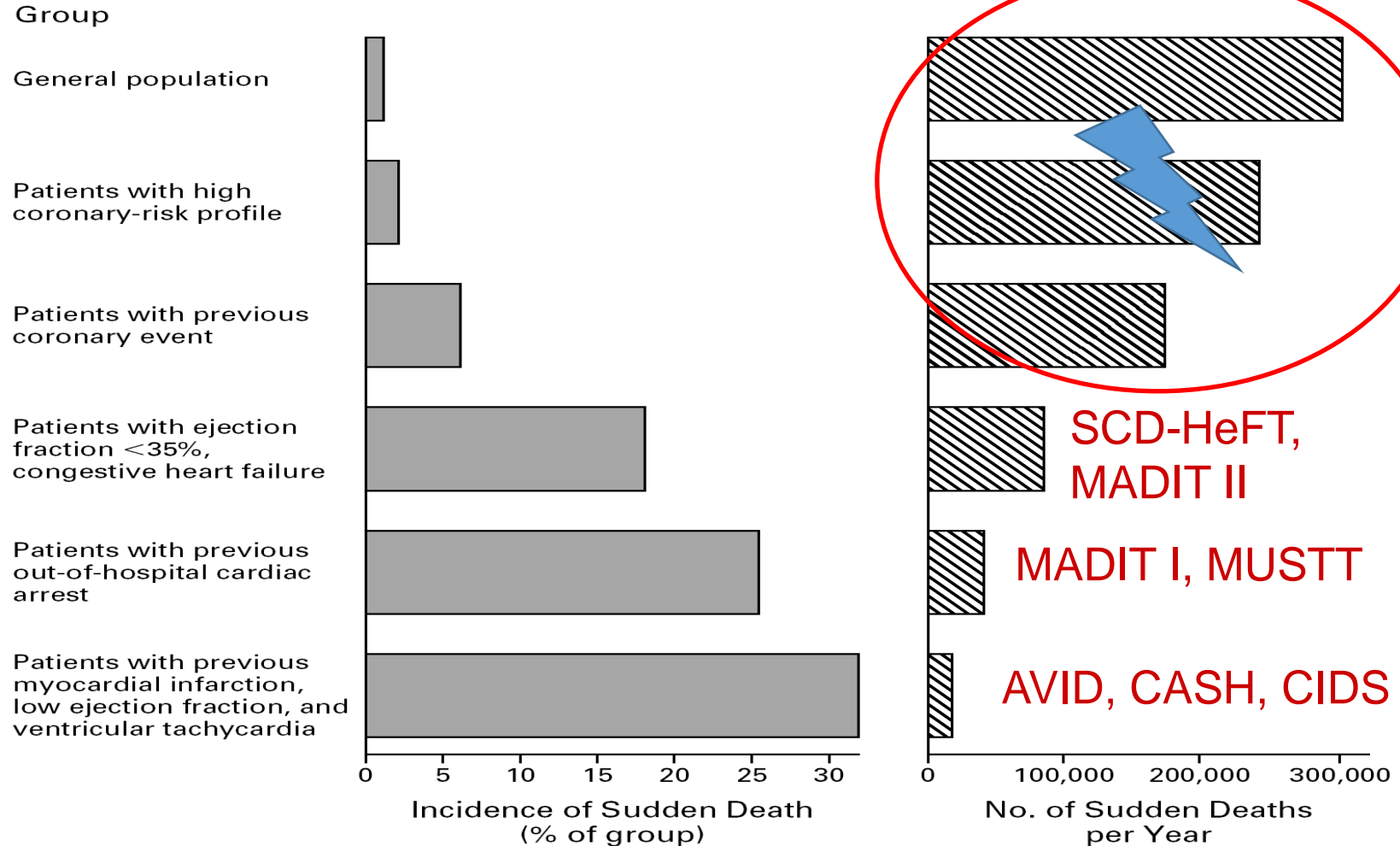# The American Heart Association Evidence-Based Scoring System

Classification of Recommendations

- **Class I:** Conditions for which there is evidence, general agreement, or both that a given procedure or treatment is useful and effective.

- **Class II:** Conditions for which there is conflicting evidence, a divergence of opinion, or both about the usefulness/efficacy of a procedure or treatment
  - **Class IIa:** Weight of evidence/opinion is in favor of usefulness/efficacy.
  - **Class IIb:** Usefulness/efficacy is less well established by evidence/opinion.

- **Class III:** Conditions for which there is evidence, general agreement, or both that the procedure/treatment is not useful/effective and in some cases may be harmful.
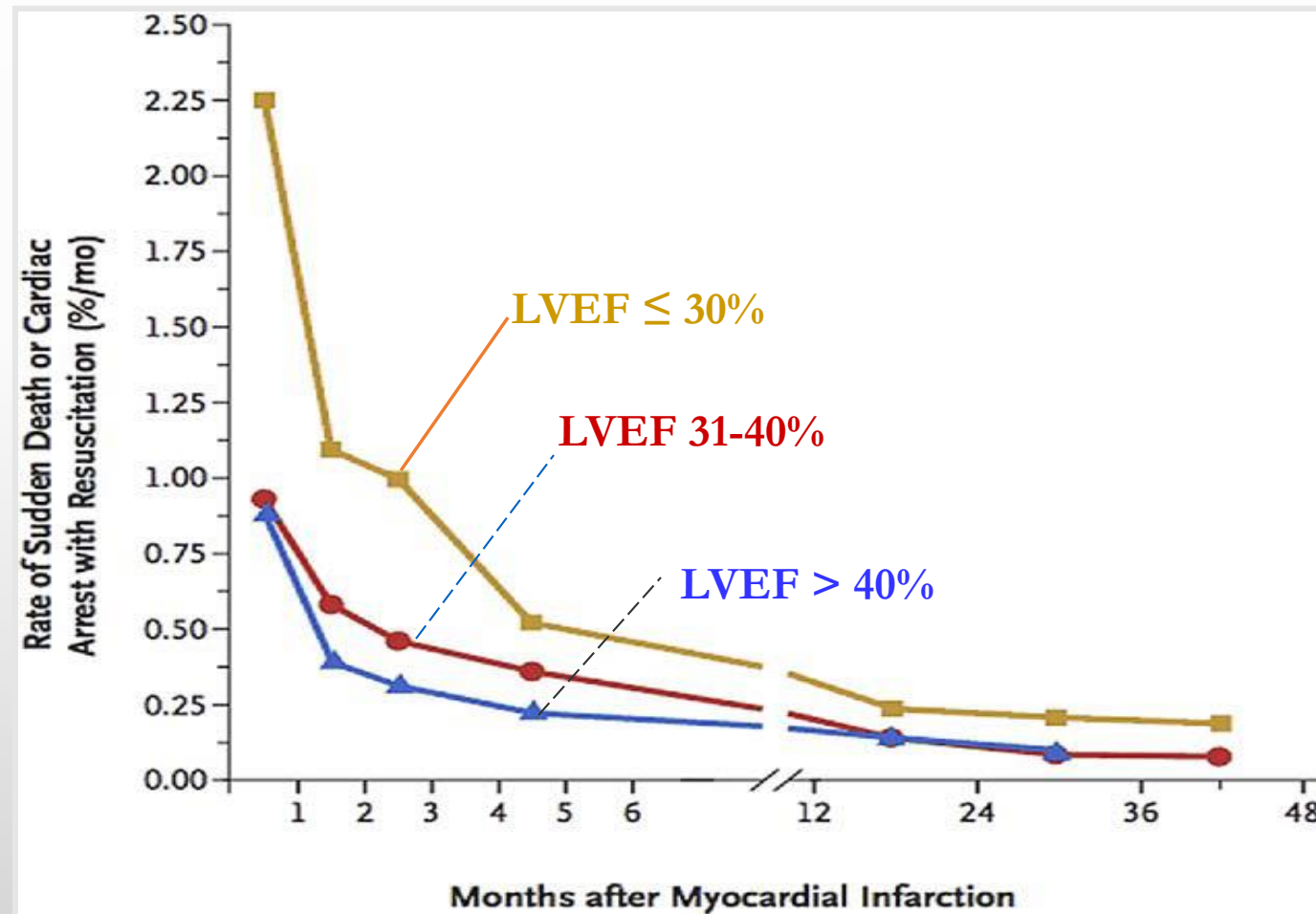
Level of Evidence

- **Level of Evidence A:** Data derived from multiple randomized clinical trials

- **Level of Evidence B:** Data derived from a single randomized trial or nonrandomized studies

- **Level of Evidence C:** Consensus opinion of experts

Circulation 2006 114: 1761 – 1791.

Populations at Risk

Myerburg RJ, et al. *Circulation*. 1998. 97:1514-1521.

Event rates of SCD after acute MI
(Stratified by LVEF)

Solomon SD et al VALIANT Study, NEJM 2005

Introduction to Noninvasive Cardiac Imaging

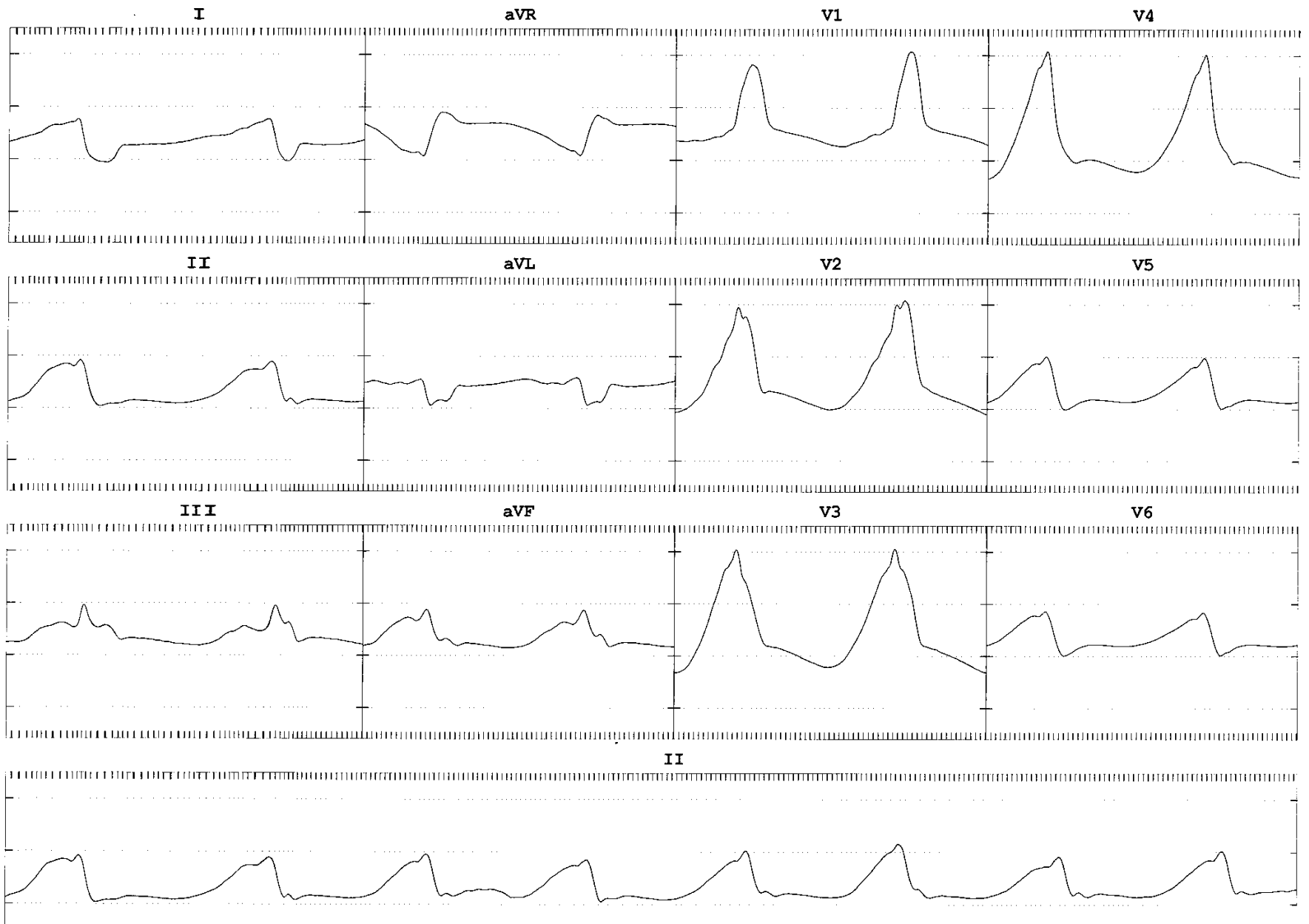*by Ron Blankstein*

Example of images/data typically provided by various noninvasive cardiac tests.

TEST / IMAGING MODALITY	EXAMPLE OF IMAGES / DATA PROVIDED
EXERCISE TREADMILL TESTING	Electrocardiogram showing electrical activity of the heart during rest / exercise
ECHOCARDIOGRAM	Images of heart muscle function and valves
NUCLEAR CAMERA	Images showing bloodflow to the heart muscle
CARDIAC CT	Images showing arteries that supply blood to the heart muscle
CARDIAC MRI	Images showing the heart muscle function / scar related to disease

Case Presentation

- 50 y/o caucasian male with no prior history other than hypercholesterolemia presents with palpitations and near syncope and was found in the ER to have wide complex tachycardia that was self limiting.

- Pertinent history included his father's sudden death at age 55. No autopsy was performed.
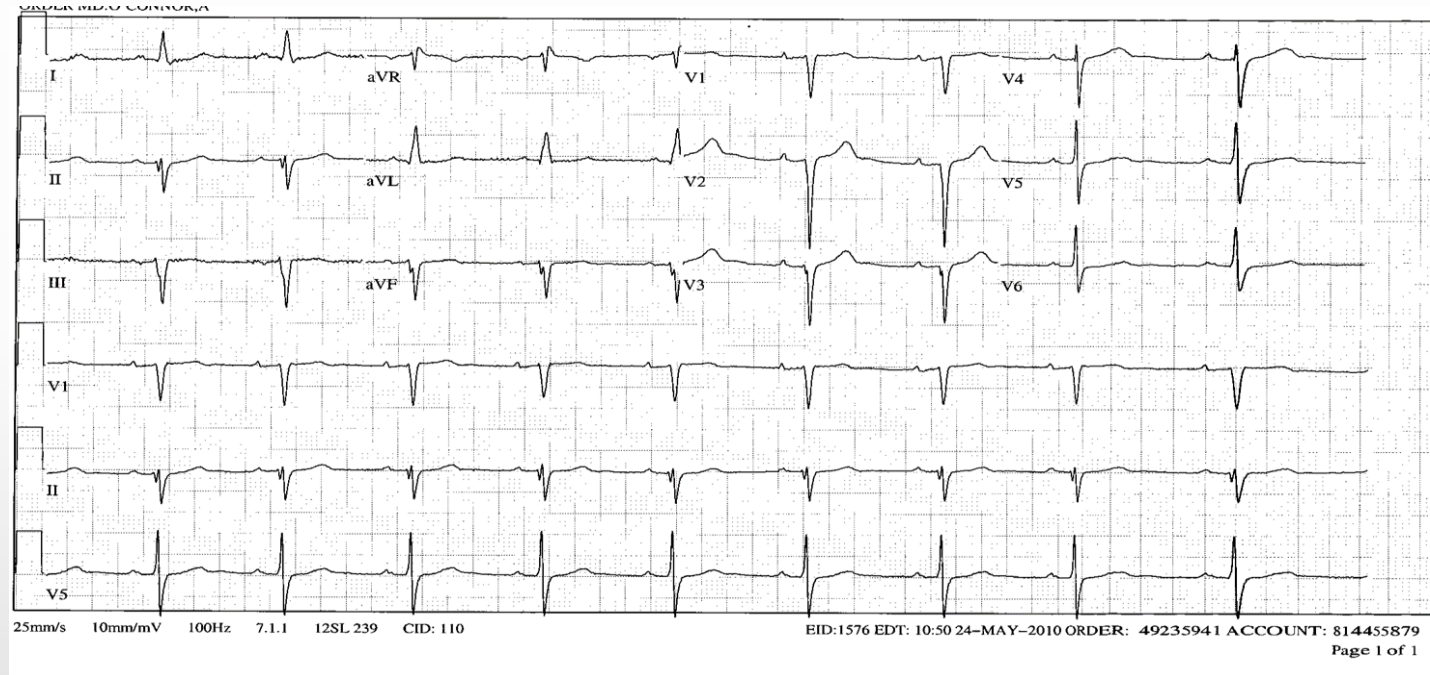
- His exam was unremarkable.

I aVR V1 V4

II aVL V2 V5

III aVF V3 V6

V1

II

V5

25mm/s   10mm/mV   100Hz   7.1.1   12SL 239   CID: 110   EID:1576 EDT: 10:50 24−MAY−2010 ORDER: 49235941 ACCOUNT: 814455879

Page 1 of 1
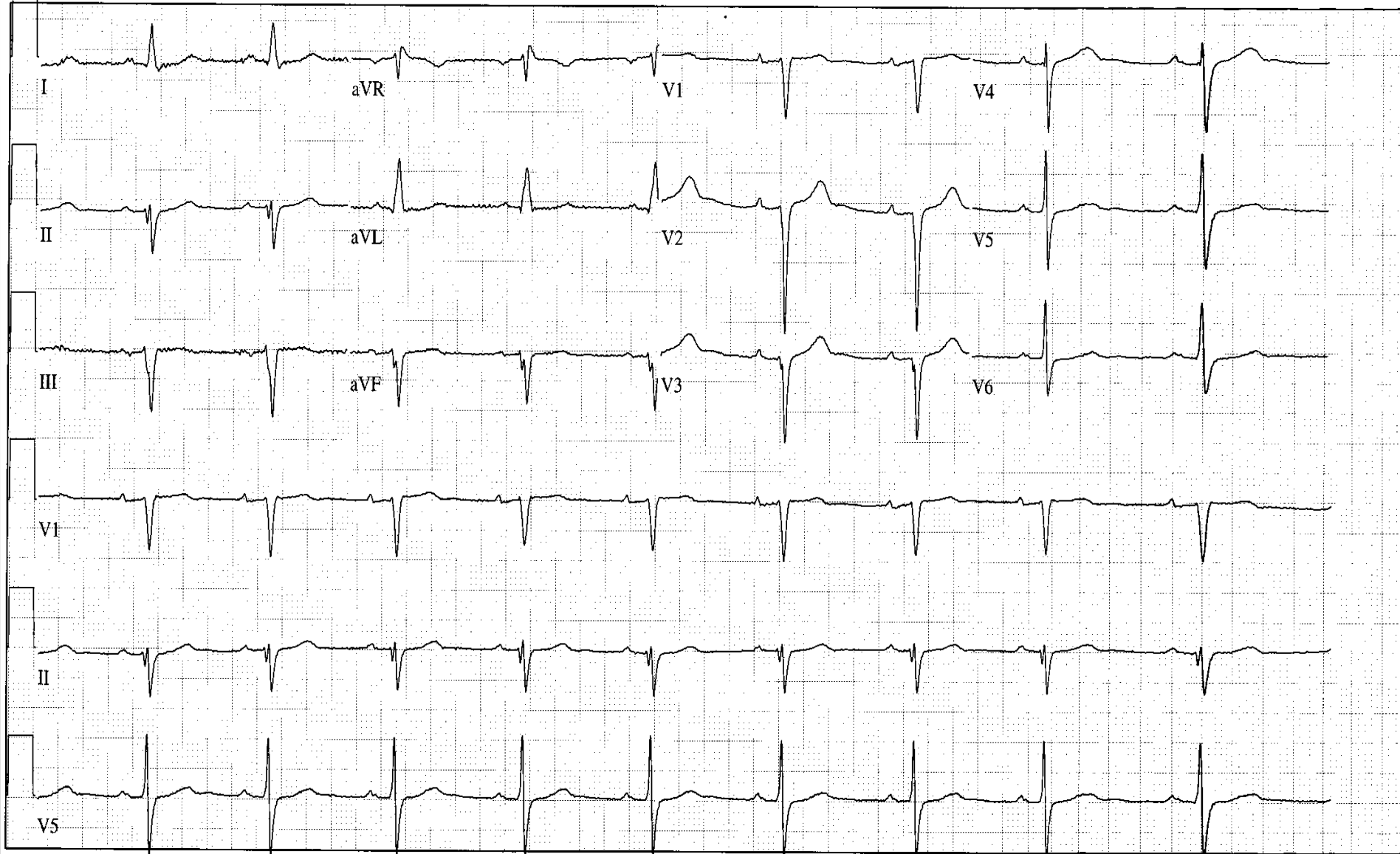
Cardiac Testing

- Electrocardiogram-abnormal
- Chest x-ray normal.
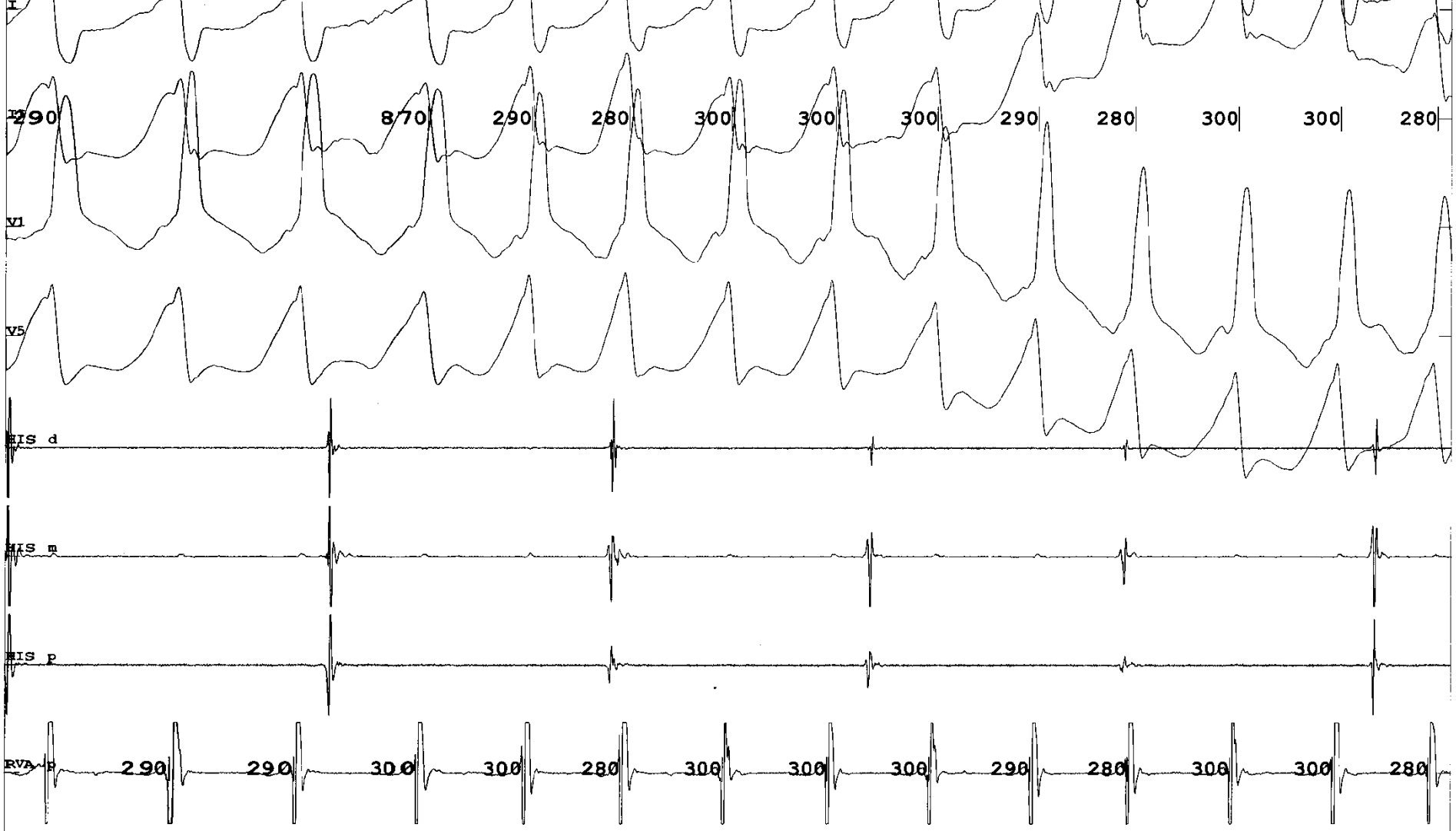- Echocardiography normal
- Angiography?

Further Diagnostic Testing

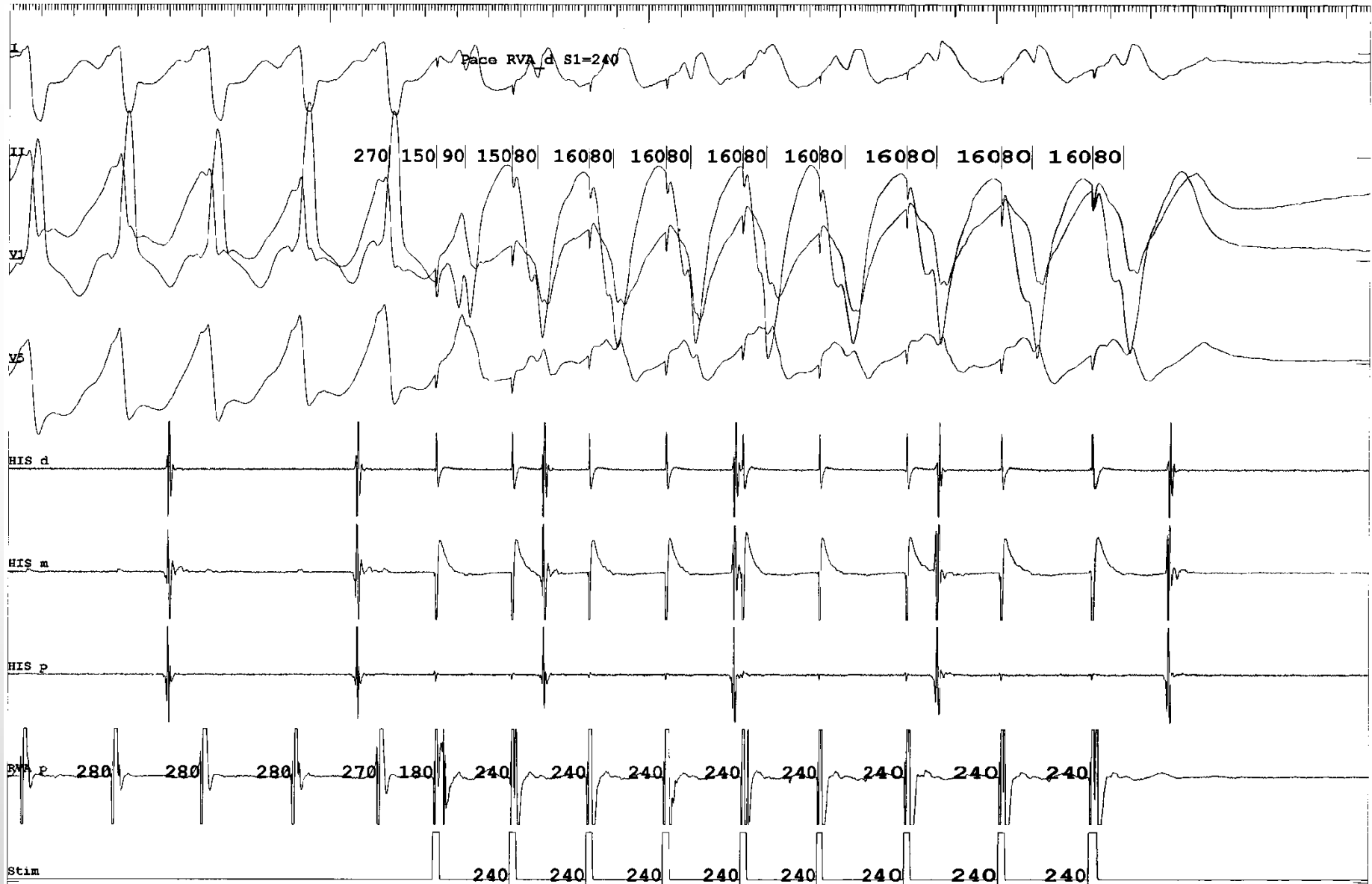- Cardiac MRI – Positive for Late Gadolinium Enhancement in the Septum (Remember the ECG)

- Electrophysiology Testing

Clinical VT#1, RBBB, inferior axis, CL 280 bpm

University of Chicago

I

Pace RVA d S1=240

II

270| 150|90| 15080| 16080| 16080| 16080| 16080| 16080| 1608O| 1608O| 16080|

V1

V5

HIS d

HIS m

HIS p

RVA p   280| 280| 280| 270| 180| 240| 240| 240| 240| 240| 240| 240| 240|

Stim   240| 240| 240| 240| 240| 240| 240| 240|

Differential Diagnosis

- Arrhythmic Cardiomyopathy (Normal LV)
  - Focal
  - Diastolic dysfunction
  - ARVC
  - Sarcoidosis
  - Inherited
  - Vasculitis

Genetic Testing

- The Subject should be informed and counseled in advanced of any sampling

- The decision to make the test is the choice of the individual concerned

- Written informed consent has to be signed and retained

- There must be respect of the right to know and not to know for the subject

- Molecular analysis should be performed in high quality Medical laboratory

- Results should be given in person to the individual

- Confidentiality should be respected

AHA 2014 Guidelines for Cardiac Genetic Testing Circ

Goals of Imaging Cardiomyopathy

- Exclude ischemic etiology

- Determine underlying etiology

- Risk stratification

- Prediction of need/ response to device therapy

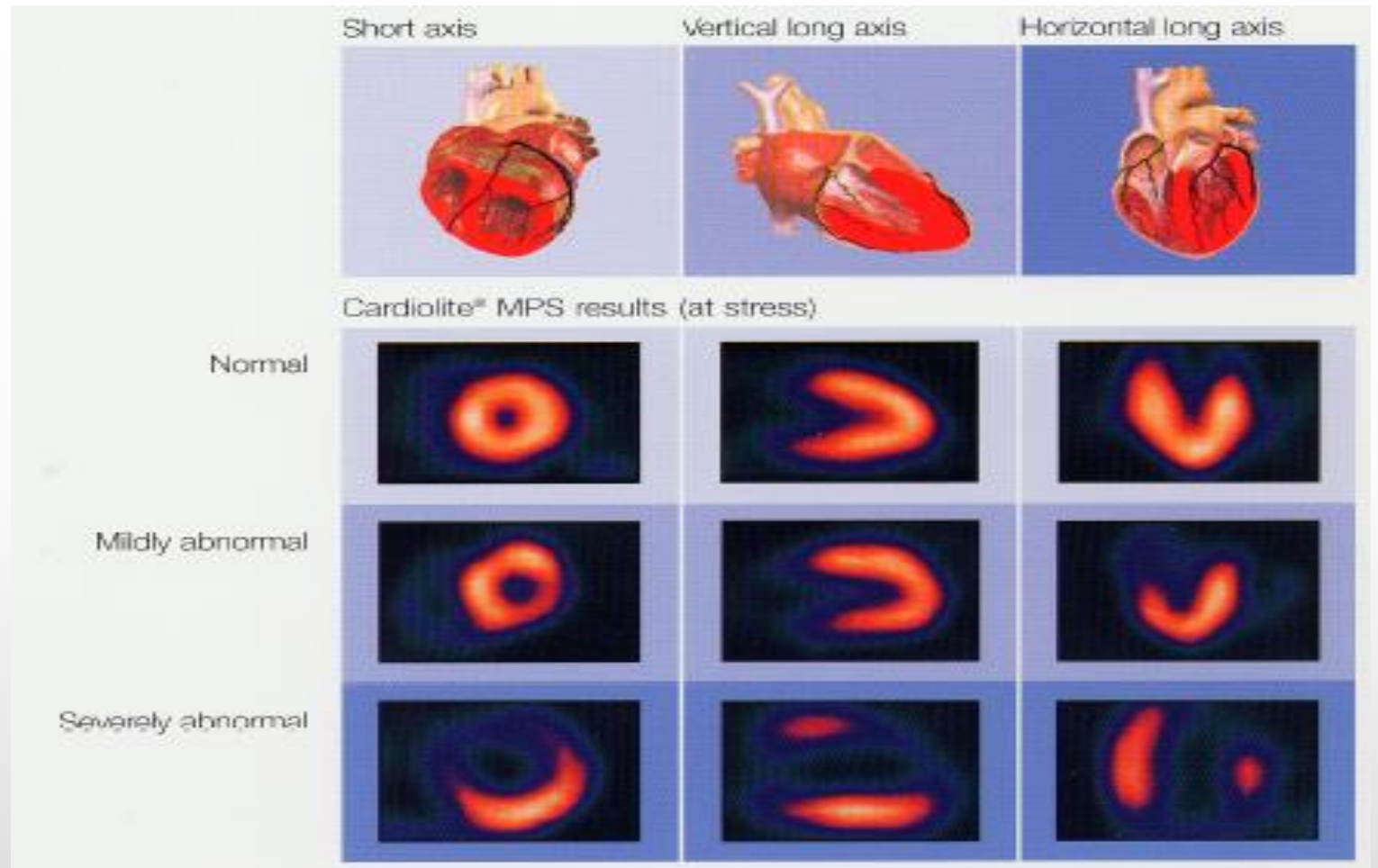| Appropriate Use Criteria (Appropriate Indications for CMR) |
| --- |
| Evaluation of specific cardiomyopathies (infiltrative,HCM, due to cardiotoxic therapy) |
| Evaluation of LV function in heart failure patients (technically limited images from echo) |
| Quantification of LV function (discordant results from prior tests) |

What is Myocardial Perfusion Imaging?

■ In the U.S., nuclear cardiology (MPI) procedures have overtaken non-cardiology procedures in procedural volume.
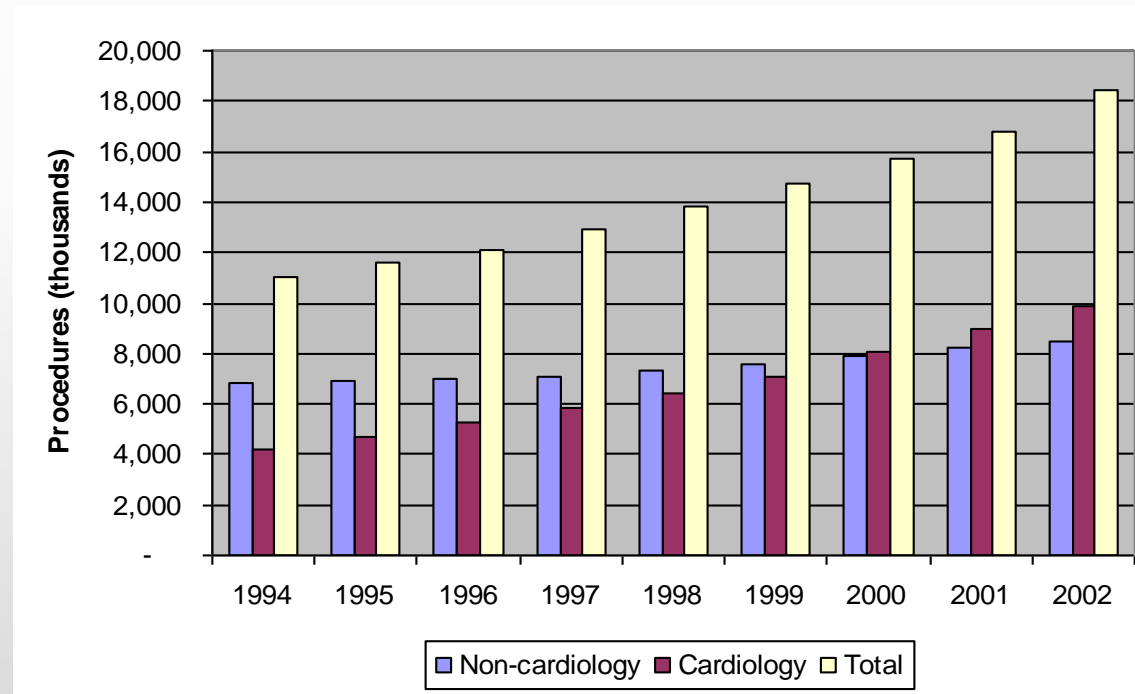
What do MPI images look like?

- In a typical nuclear cardiac imaging exam, the physician reviews:
  - Static "Summed Perfusion Images"
  - Dynamic "Gated Images"

Short axis · Vertical long axis · Horizontal long axis

Cardiolite® MPS results (at stress)

Normal

Mildly abnormal

Severely abnormal

Perfusion Images are viewed in three orientations:
SA – Short Axis
VLA – Vertical Long Axis
HLA - Horizontal Long Axis

Special Situations in Modality Selection

- If your patient has a resting ECG that impairs diagnostic interpretation
  - LBBB
  - LV hypertrophy with "strain pattern"
  - Digitalis effect
- Concomitant stress imaging with TTE or MPI may be appropriate
- *Pharm stress MPI is suggested for LBBB*

The Diabetic

- 48 year old man presents with a 1 month history of angina

- PMH: Diabetes mellitus, hypertension, hyperlipidemia, and morbid obesity. Previously abused tobacco and cocaine

- FamHx: Both parents with CAD

- Meds: lisinopril, atorvastatin, ASA, HCTZ, metformin, and glipizide

- Exam: BP 120/81 HR 67. Obese patient otherwise unremarkable

- EKG: NSR with non-specific t-wave abnormality

- Treadmill EKG: 6 minutes on Bruce Protocol, 2mm horizontal ST depression in leads I and II.
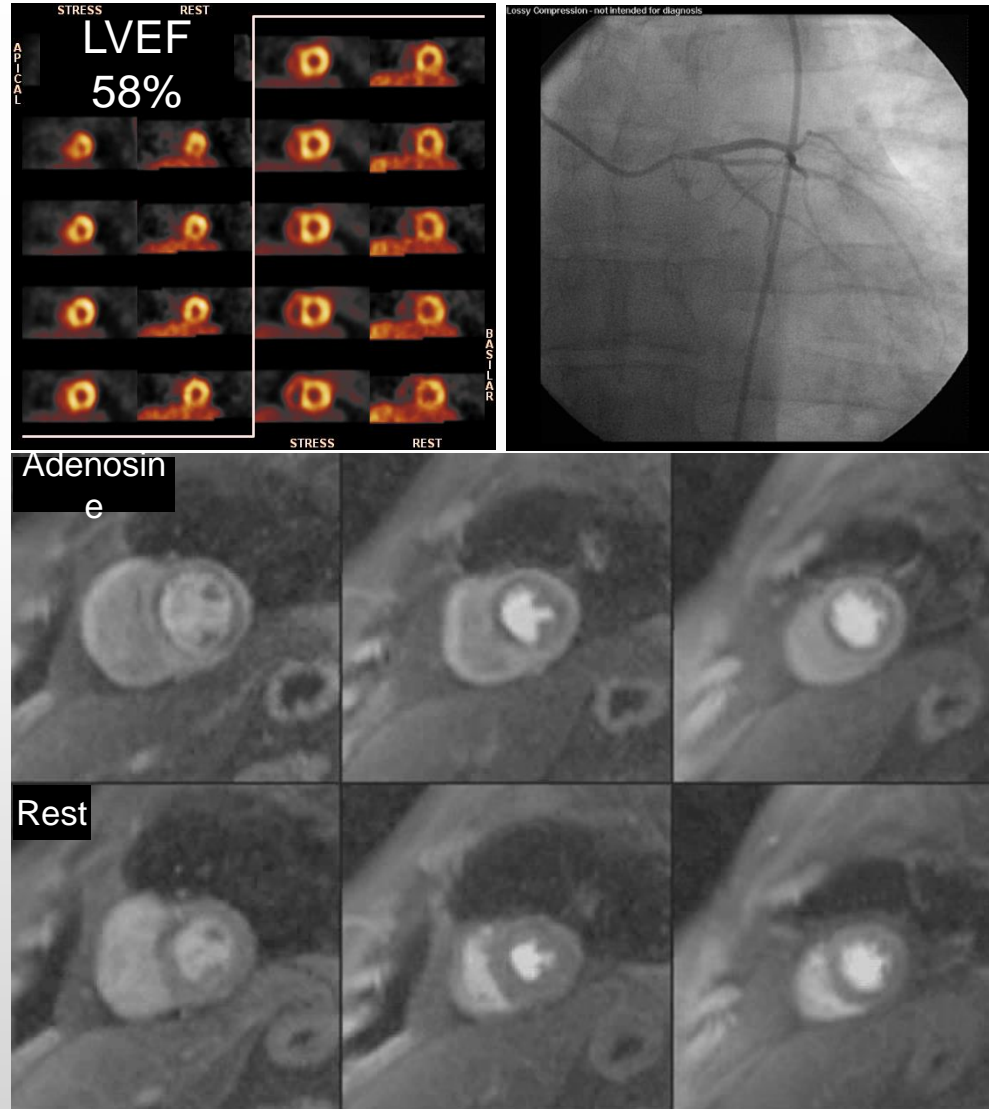
Components of a Stress CMR Study

- Assessment of left ventricular and right ventricular function

- Detection of myocardial infarction/ assessment of viability

- Detection of ischemia

Daou. JNC 2006
Bellenger. JCMR 2000
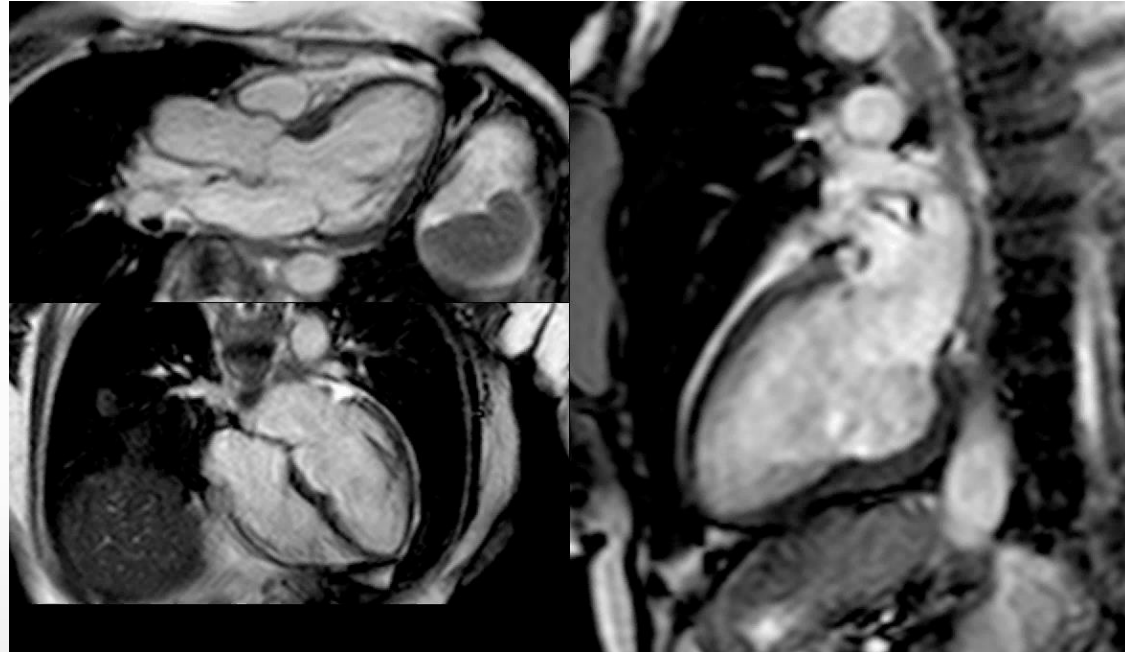
	CMR	MUGA	2D ECHO
LVEF (3% change)	n=15	n=40	n=102
LVEDV (10ml change)	n=12	n=54	n=121
LVESV (10ml change)	n=10	n/a	n=53

Components of a Stress CMR Study

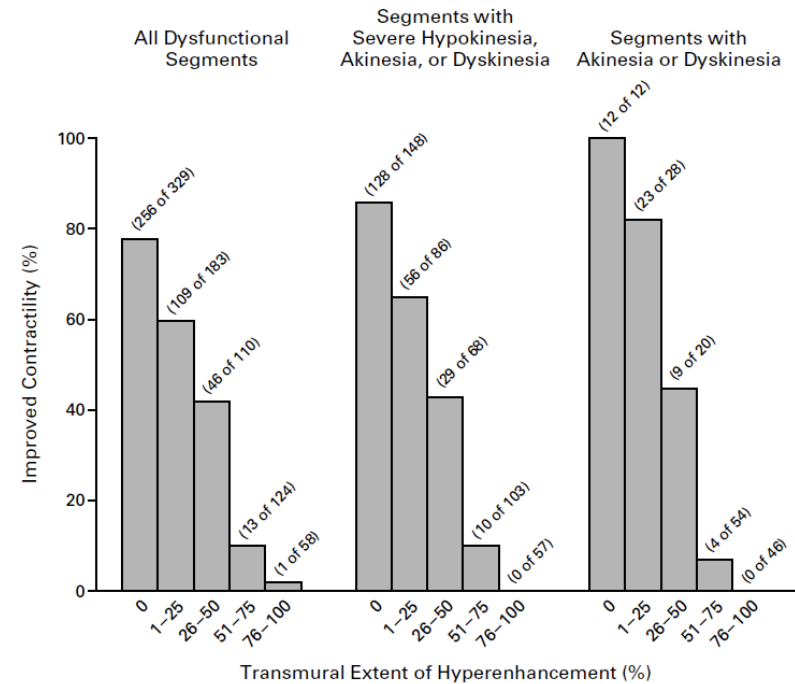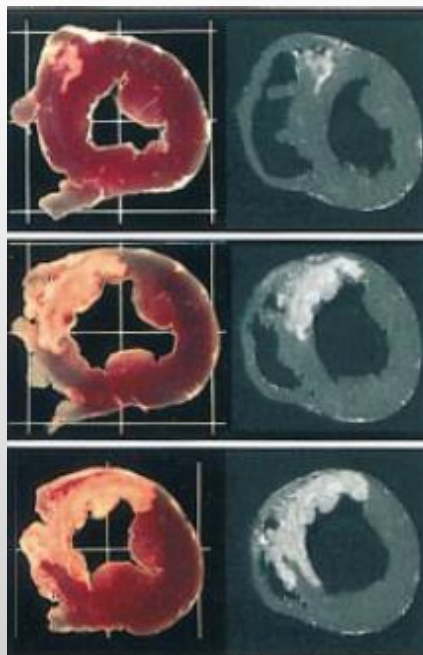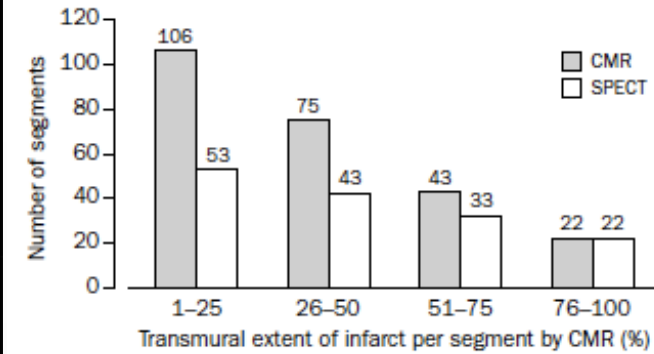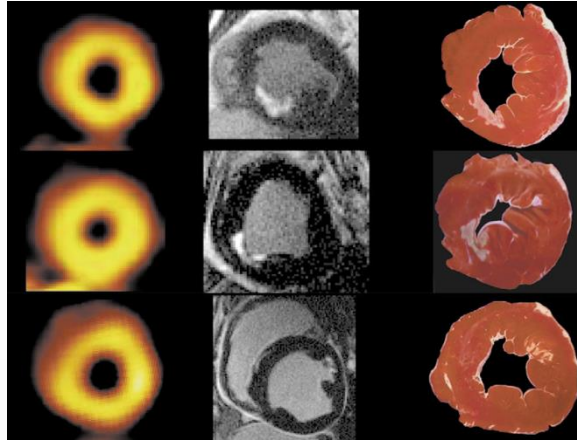- Assessment of left ventricular and right ventricular function

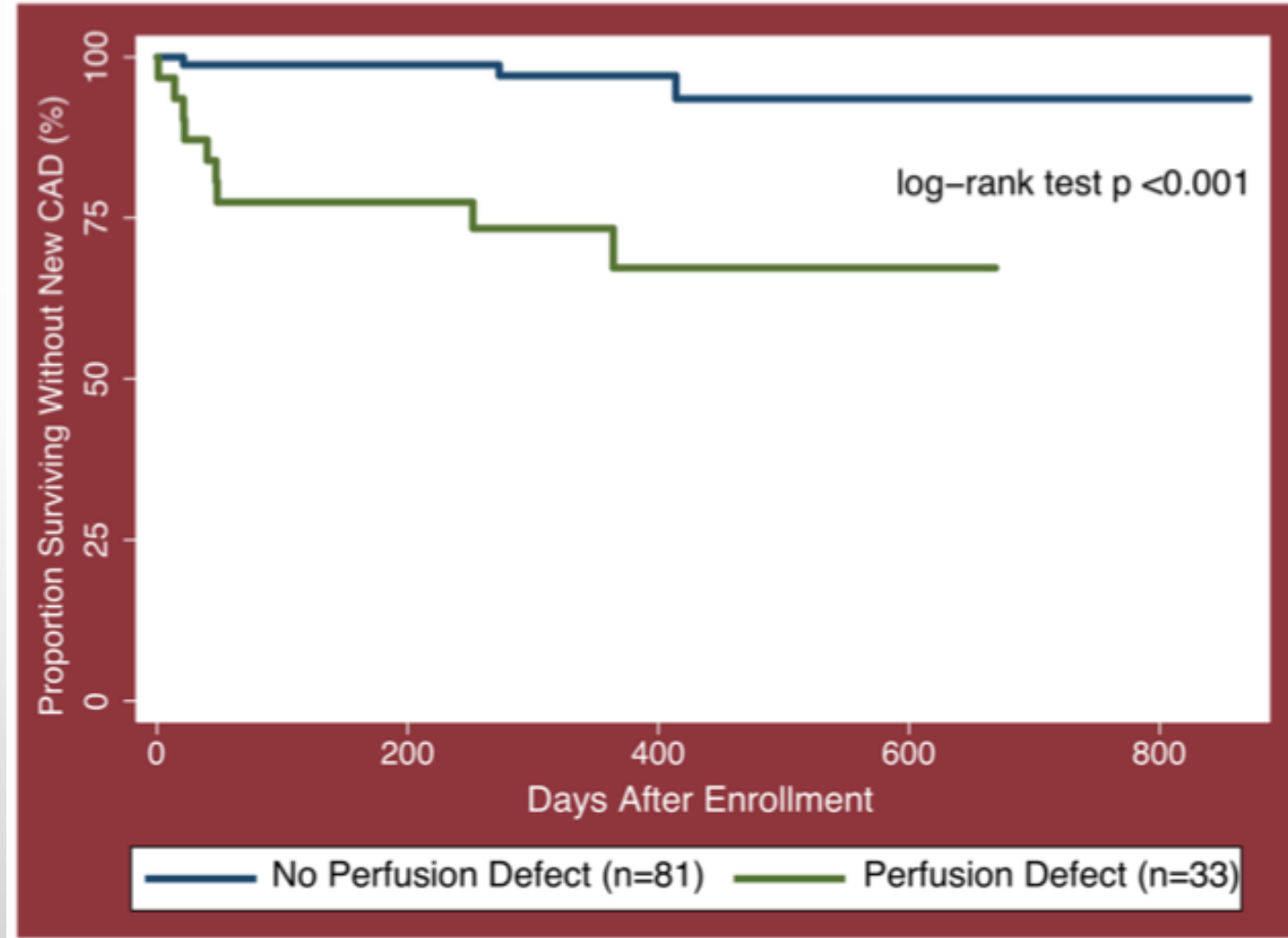- Detection of myocardial infarction/ assessment of viability
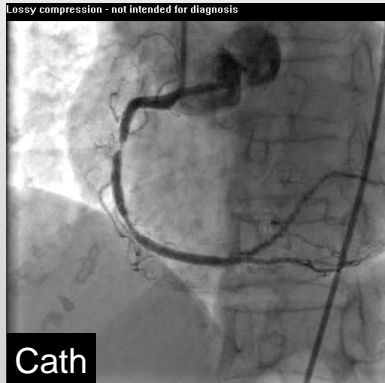
- Detection of ischemia

Kim. Circulation 1999

Kim. NEJM 2000

Wagner. Lancet 2003

Prognostic Value of Regadenoson Stress CMR

Freed. SCMR 2012
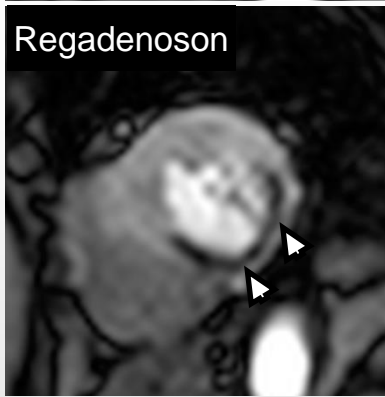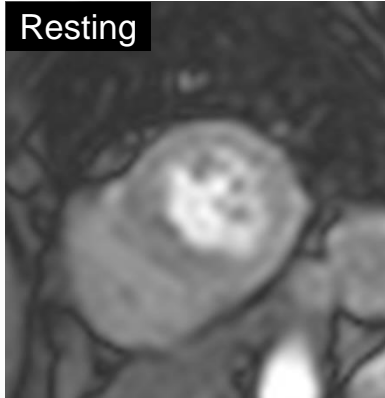
ACSM's Guidelines
for Exercise Testing and Prescription

ACSM. Lippincott, Williams & Wilkins

6th Edition 2000

Age	Gender	Typical/Definite Angina Pectoris	Atypical/Probable Angina Pectoris	Non-Anginal Chest Pain	Asymptomatic
30-39	Males	Intermediate	Intermediate	low (<10%)	Very low (<5%)
30-39	Females	Intermediate	Very Low (<5%)	Very low	Very low
40-49	Males	High (>90%)	Intermediate	Intermediate	low
40-49	Females	Intermediate	Low	Very low	Very low
50-59	Males	High (>90%)	Intermediate	Intermediate	Low
50-59	Females	Intermediate	Intermediate	Low	Very low
60-69	Males	High	Intermediate	Intermediate	Low
60-69	Females	High	Intermediate	Intermediate	Low
High = >90%		Intermediate = 10-90%		Low = <10%	
Very Low = <5%					

Comparison of Tests for Diagnosis of CAD

Grouping	# of Studies	Total # Patients	Sens	Spec	Predictive Accuracy
Standard ET	147	24,047	68%	77%	73%
• ET Scores	24	11,788			80%
• Score Strategy	2	>1000	85%	92%	88%
Thallium Scint	59	6,038	85%	85%	85%
SPECT	16+14	5,272	88%	72%	80%
Adenosine SPECT	10+4	2,137	89%	80%	85%
Exercise ECHO	58	5,000	84%	75%	80%
Dobutamine ECHO	5	<1000	88%	84%	86%
Dobutamine Scint	20	1014	88%	74%	81%
Electron Beam Tomography (EBCT)	16	3,683	60%	70%	65%
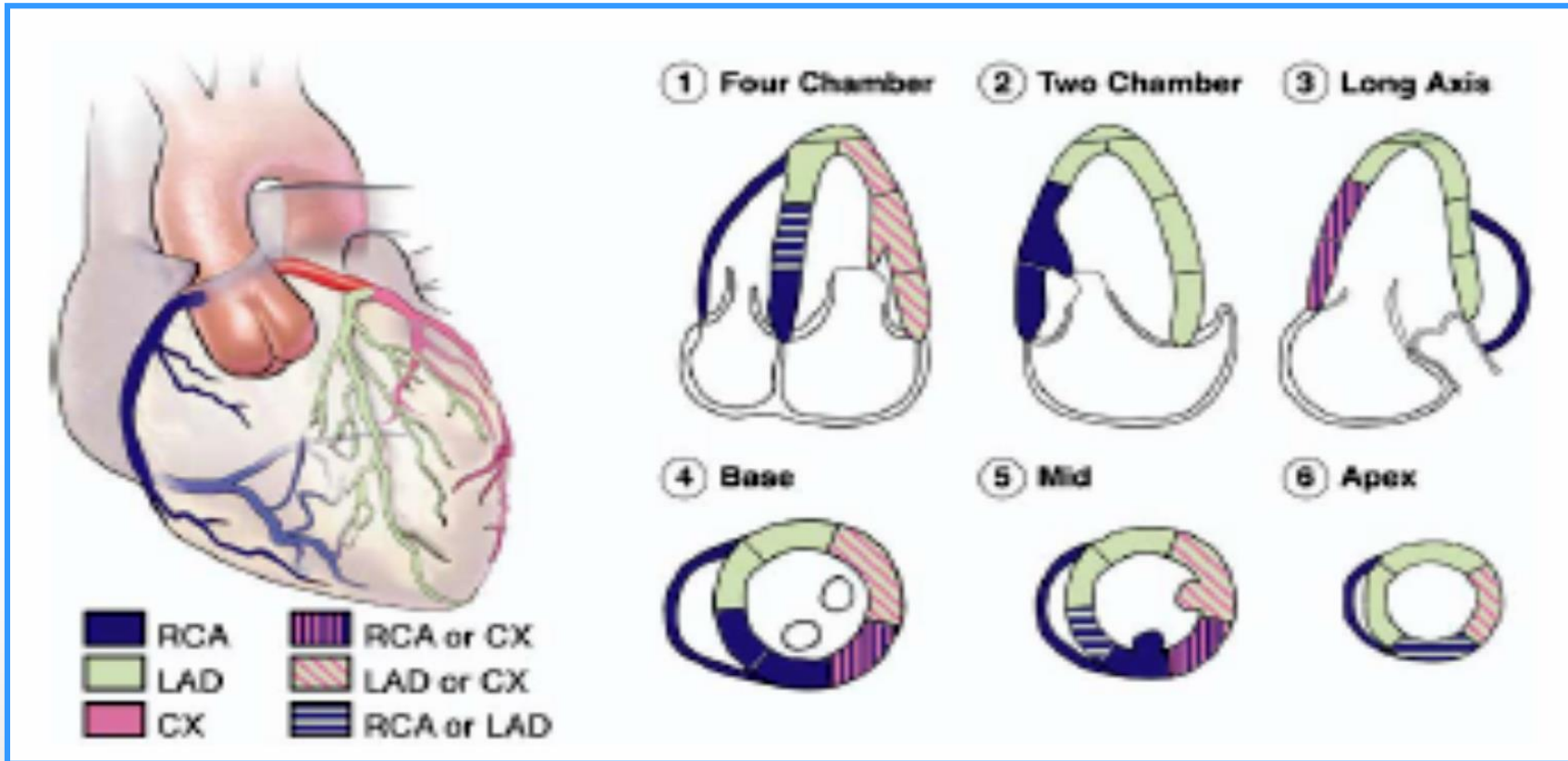
Typical distributions of the right coronary artery (RCA), the left anterior descending (LAD), and the circumflex (CX) coronary arteries. The arterial distribution varies between patients. Some segments have variable coronary perfusion.

Lang et al. J Am Soc Echocardiogr 2005;18:1440-1463

Caveats in Stress echo

- False positives are seen in patients with hypertensive responses to exercise

  and in patients with cardiomyopathies.

  The LBBB does not disqualify a patient from a stress echo as you CAN read the anterior wall looking for an LAD lesion. However, the septal and anteroseptal walls are influenced by the LBBB so can not be used.

Review of 2014 ACC/AHA Guidelines and Implications for Clinical Care

Fliesher et al. "2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery." http://content/onlinejacc.org/

Perioperative Stress Test
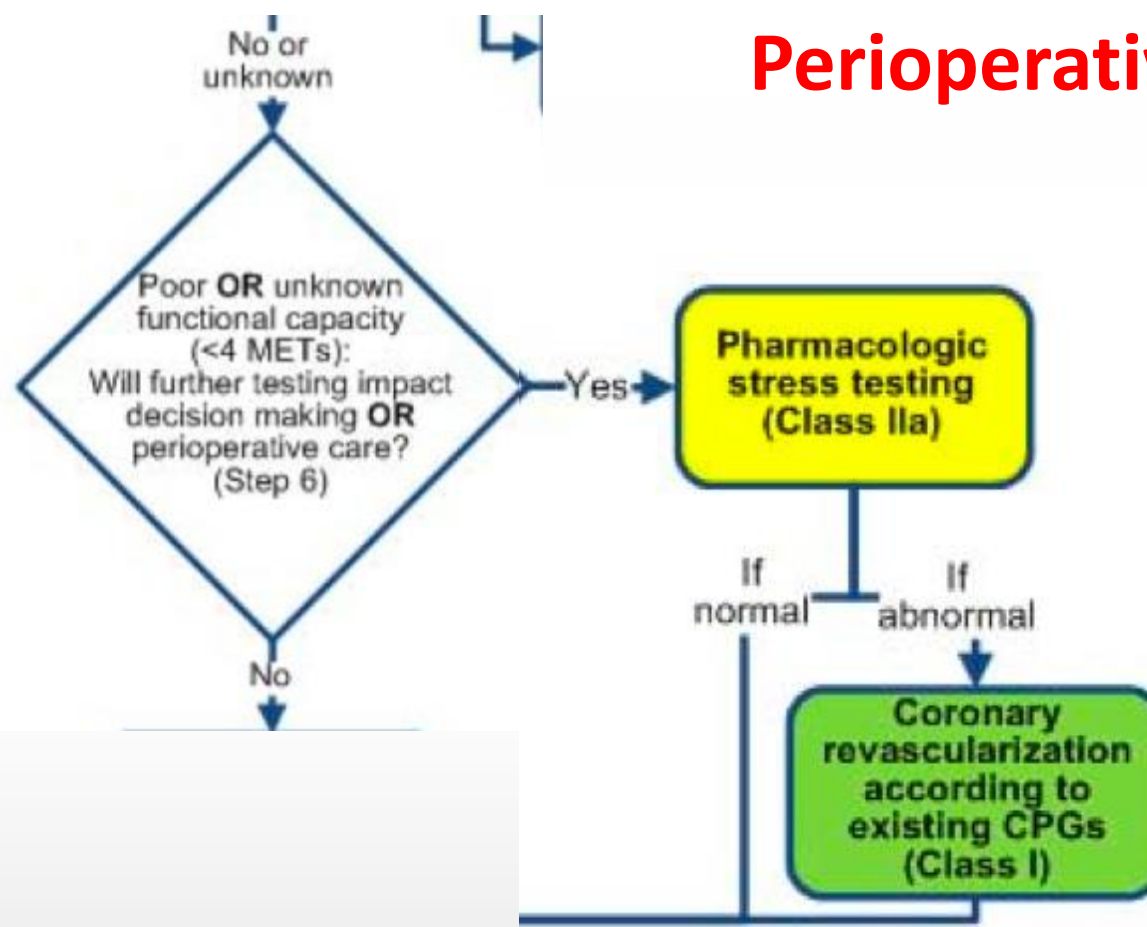
Step 6: If the patient has poor (<4 METs) or unknown functional capacity, then the clinician should consult with the patient and perioperative team to determine whether further testing will impact patient decision making (e.g., decision to perform original surgery or willingness to undergo CABG or PCI, depending on the results of the test) or perioperative care. If yes, then pharmacological stress testing is appropriate. In those patients with unknown functional capacity, exercise stress testing may be reasonable to perform. If the stress test is abnormal, consider coronary angiography and revascularization depending on the extent of the abnormal test. The patient can then proceed to surgery with GDMT or consider alternative strategies, such as noninvasive treatment of the indication for surgery (e.g., radiation therapy for cancer) or palliation. If the test is normal, proceed to surgery according to GDMT (Section 5.3).

Fliesher et al. "2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery."
http://content/onlinejacc.org/

Next Step

**Step 7:** If testing will not impact decision making or care, then proceed to surgery according to GDMT or consider alternative strategies, such as noninvasive treatment of the indication for surgery (e.g., radiation therapy for cancer) or palliation.

Fliesher et al. "2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery." http://content/onlinejacc.org/

Table 5. Summary of Recommendations for Supplemental Preoperative Evaluation

Recommendations	COR	LOE	References
The 12-lead ECG			
Preoperative resting 12-lead ECG is reasonable for patients with known coronary heart disease or other significant structural heart disease, except for low-risk surgery	IIa	B	(137-139)
Preoperative resting 12-lead ECG may be considered for asymptomatic patients, except for low-risk surgery	IIb	B	(37, 138-140)
Routine preoperative resting 12-lead ECG is not useful for asymptomatic patients undergoing low-risk surgical procedures	III: No Benefit	B	(35, 141)
Assessment of LV function			
It is reasonable for patients with dyspnea of unknown origin to undergo preoperative evaluation of LV function	IIa	C	N/A
It is reasonable for patients with HF with worsening dyspnea or other change in clinical status to undergo preoperative evaluation of LV function	IIa	C	N/A
Reassessment of LV function in clinically stable patients may be considered	IIb	C	N/A
Routine preoperative evaluation of LV function is not recommended	III: No Benefit	B	(146-148)
Exercise stress testing for myocardial ischemia and functional capacity			
For patients with elevated risk and excellent functional capacity, it is reasonable to forgo further exercise testing and proceed to surgery	IIa	B	(132, 135, 136, 162, 163)
For patients with elevated risk and unknown functional capacity it may be reasonable to perform exercise testing to assess for functional capacity if it will change management	IIb	B	(162-164)
For patients with elevated risk and moderate to good functional capacity, it may be reasonable to forgo further exercise testing and proceed to surgery	IIb	B	(132, 135, 136)
For patients with elevated risk and poor or unknown functional capacity it may be reasonable to perform exercise testing with cardiac imaging to assess for myocardial ischemia	IIb	C	N/A
Routine screening with noninvasive stress testing is not useful for low-risk noncardiac surgery	III: No Benefit	B	(165, 166)
Cardiopulmonary exercise testing			
Cardiopulmonary exercise testing may be considered for patients undergoing elevated risk procedures	IIb	B	(171-179)
Noninvasive pharmacological stress testing before noncardiac surgery			
It is reasonable for patients at elevated risk for noncardiac surgery with poor functional capacity to undergo either DSE or MPI if it will change management	IIa	B	(183-187)
Routine screening with noninvasive stress testing is not useful for low-risk noncardiac surgery	III: No Benefit	B	(165, 166)

Perioperative Cardiac Testing of Risk
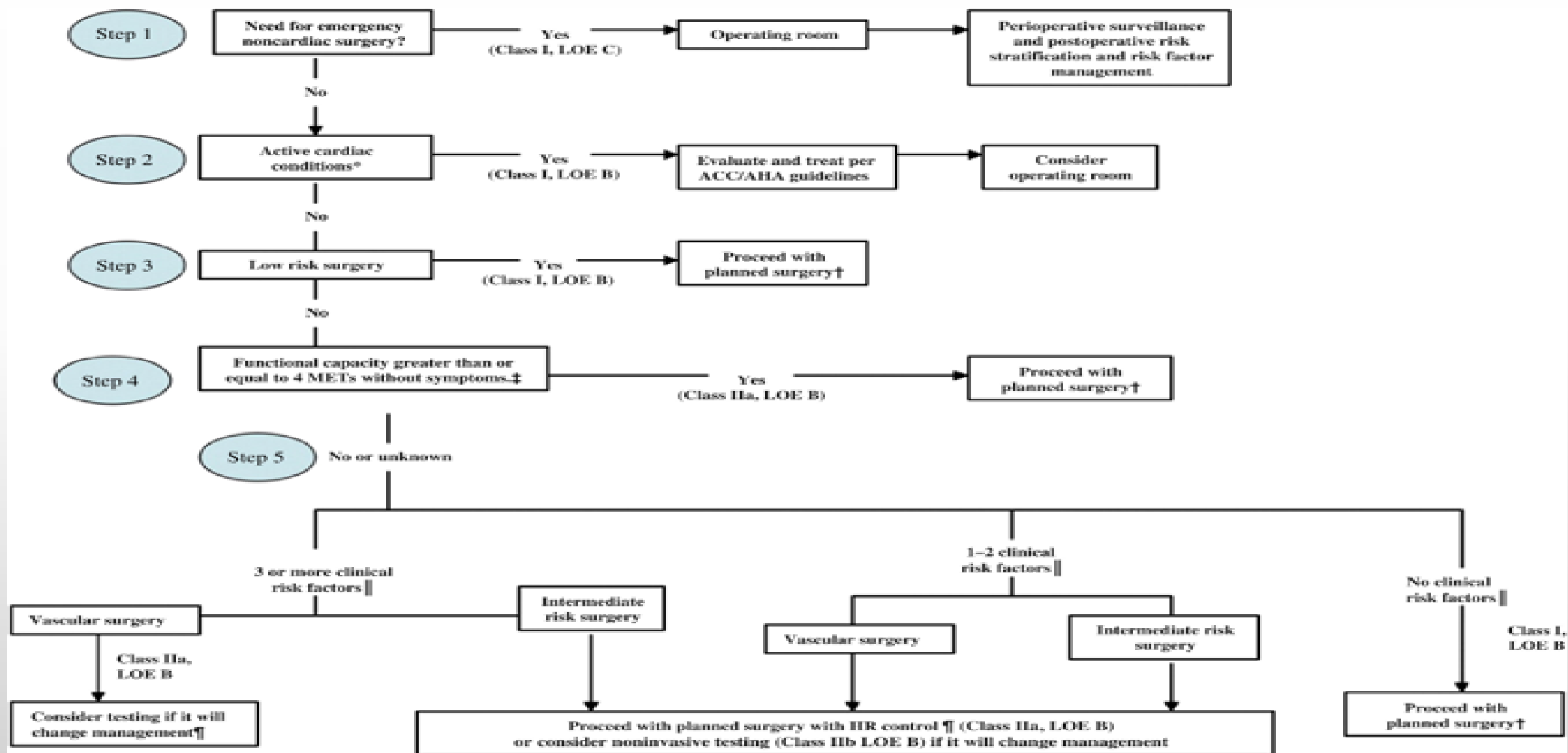
Perioperative Percutaneous Coronary Intervention (PCI)

- Performing PCI before noncardiac surgery should be limited to:
  - Patients with Left Main disease who can't get bypass surgery without undue risk
  - Patients with unstable CAD who are candidates for emergent or urgent revascularizations (NSTEMI, STEMI)

- CARP Trial (Coronary Artery Revascularization Prophylaxis)
  - Showed no difference in perioperative and long term cardiac outcomes with or without preoperative CABG or PCI in patients with CAD
  - Exception: Left Main Disease, LVEF < 20%, Severe AS

McFalls EO, Ward HB, Moritz TE, et al. Predictors and outcomes of a perioperative myocardial infarction following elective vascular surgery in patients with documented coronary artery disease: results of the CARP trial. Eur Heart J. 2008;29:394-401.

References

- Fliesher et al. 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery. http://content/onlinejacc.org/

- McFalls EO, Ward HB, Moritz TE, et al. Predictors and outcomes of a perioperative myocardial infarction following elective vascular surgery in patients with documented coronary artery disease: results of the CARP trial. Eur Heart J. 2008;29:394-401

- Fliesher et al. ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery. Circulation. 2007. 116:e418-500

- http://riskcalculator.facs.org/PatientInfo/PatientInfo

- http://www.mdcalc.com/revised-cardiac-risk-index-for-pre-operative-risk/