

Clinical Value of Contrast in Stress Echo Examinations

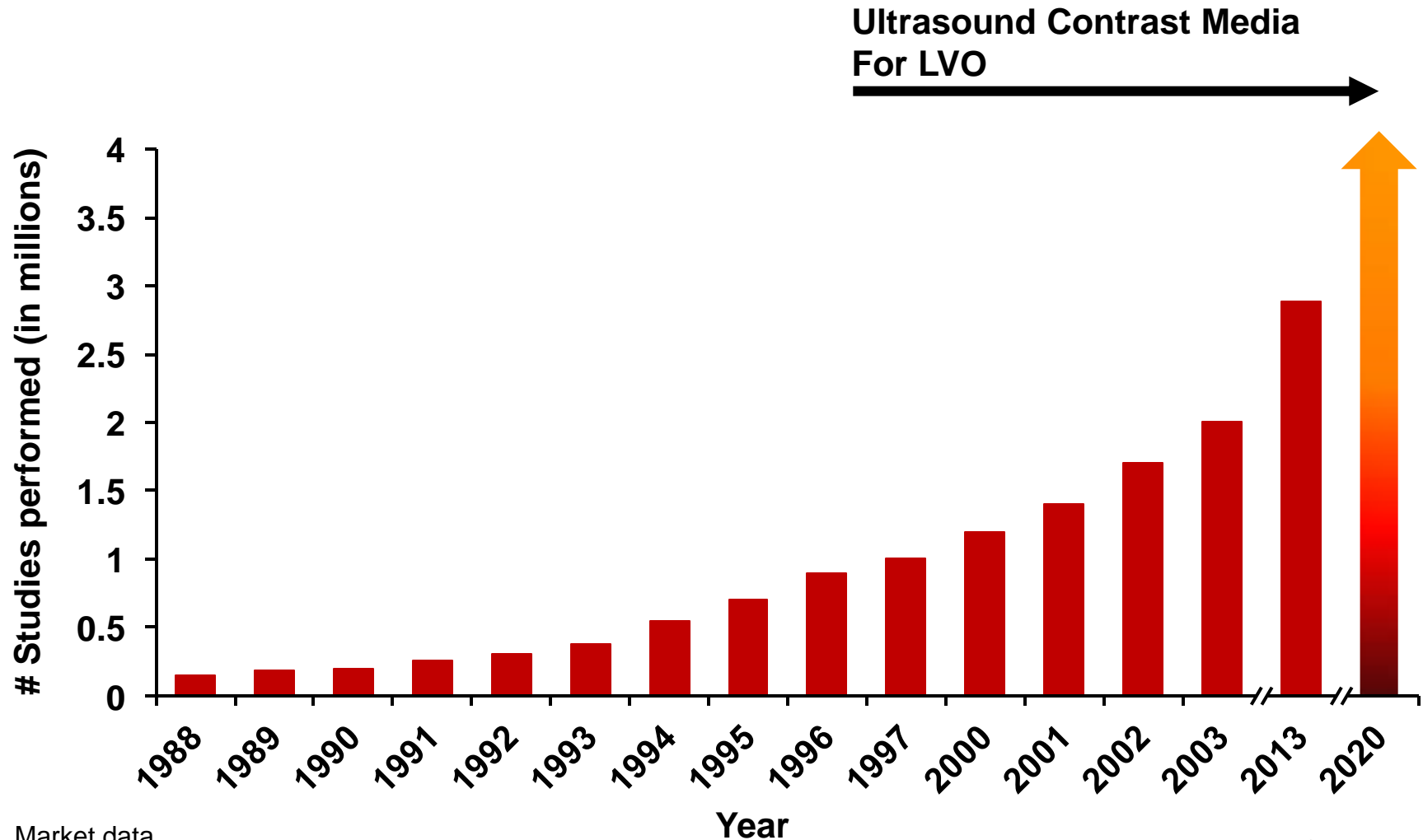
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Total Stress Echocardiography Studies United States



Market data.

Clinical Value of Contrast in Stress Echo Examinations

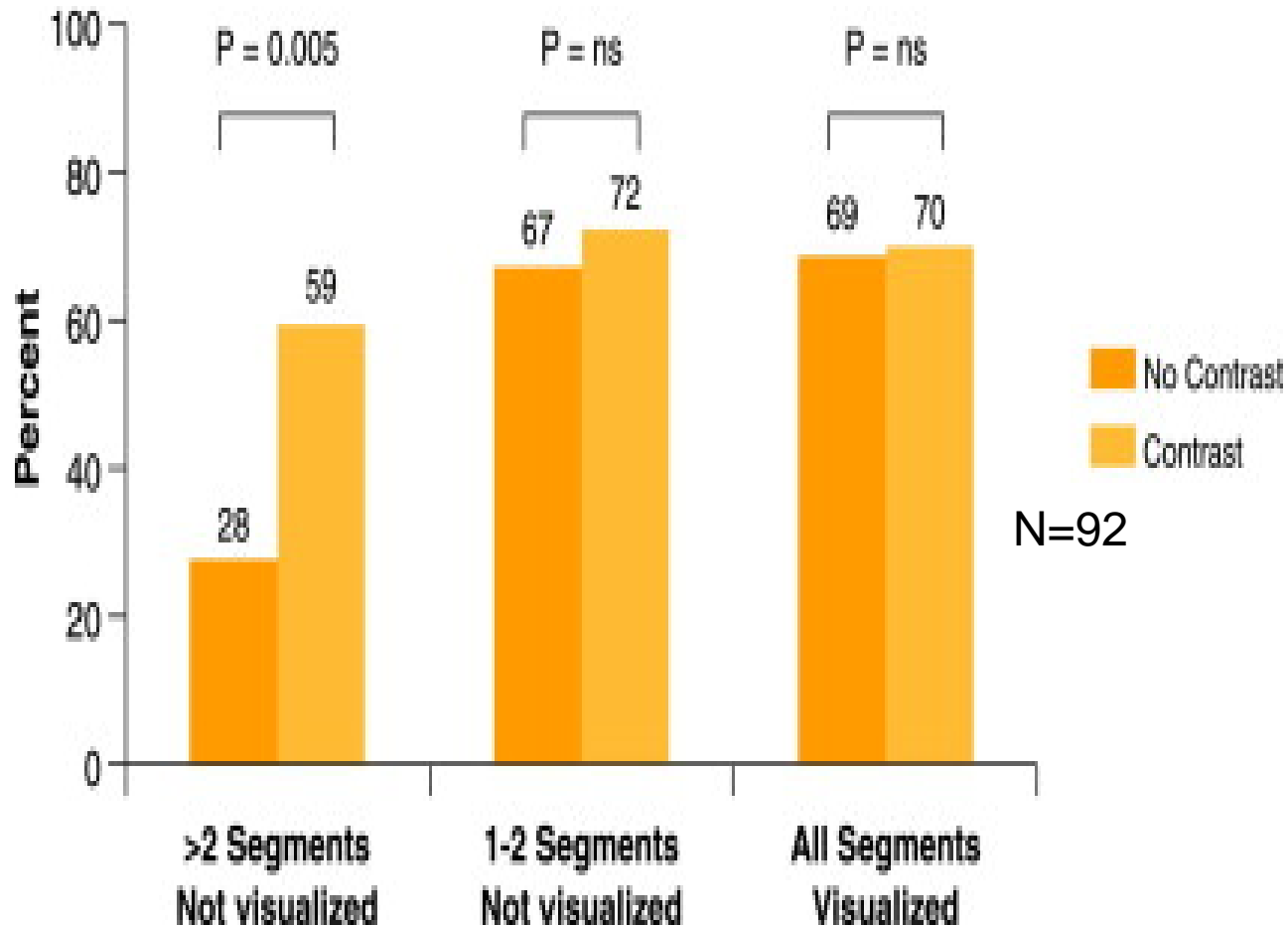
- Indications for contrast agents
- Which echo techniques
- Which stress modalities
- Which protocols for contrast use in stress echo (assessment of ischemia)
- Evidence and guidelines
- Case examples

Clinical Value of Contrast in Stress Echo Examinations

➤ **Indications for contrast agents**

- Which echo techniques
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Accuracy of Stress Echocardiography comparison with coronary angiography





2014 SonoVue revised contraindications

SonoVue can be used with extreme caution in

- Evolving or ongoing myocardial infarction
- **Typical angina at rest within the last 7 days**
- Significant worsening of cardiac symptoms
- **Recent coronary intervention**
- Other factors suggesting clinical instability
- Acute heart failure
- **Class III/IV heart failure**
- Severe rhythm disorders

Contrast use in stress echocardiography

ASE 2011 Appropriateness Criteria

Appropriate Use Score (1-19)

➤ **Routine use of contrast**
all segments visualized on
non-contrast images

I (1)

➤ **Selective use of contrast**
≥2 contiguous LV segments
not seen on non-contrast images

A (8)

I=inappropriate, A=appropriate

J Am Soc Echocardiogr. 2011 Mar;24(3):229-67

Stress Echocardiography

Mazankowski Alberta Heart Institute

➤ Standing order:

Stress Echo for assessment of myocardial ischemia

1. **Always** with infusion of ultrasound contrast agent

1 vial Definity diluted in 30 ml saline,

1 ml/min after 1 ml bolus injection at each stage

1 vial SonoVue, diluted in 10 ml saline

0.8 ml/min

unless there is a contraindication against Definity, SonoVue or

2.very low mechanical index (MI) setting

Contrast use in stress echocardiography

ASE 2011 Appropriateness Criteria

Appropriate Use
Score (1-19)

- **Routine use of contrast**
all segments visualized on
non-contrast images

I (1)

ASE did not include evidence of contrast for accurate assessment of LV volumes and perfusion

- **Selective use of contrast**
≥2 contiguous LV segments
not seen on non-contrast images

A (8)

I=inappropriate, A=appropriate

J Am Soc Echocardiogr. 2011 Mar;24(3):229-67

2013 ESC Guidelines on the Management of Stable Coronary Artery Disease

Myocardial Contrast Echocardiography Included in the Diagnosis Chapter

- Myocardial contrast echocardiography, which utilizes microbubbles, allows assessment of myocardial perfusion, which provides information beyond wall thickening assessment during both vasodilator and inotropic stress echocardiography.

Clinical Value of Contrast in Stress Echo Examinations

- When are contrast agents indicated
- **Which echo techniques**
- Which stress modalities
- Provide protocols for contrast use in stress echo (assessment of ischemia)
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- Case examples

GUIDELINES AND STANDARDS

Guidelines for the Cardiac Sonographer in the Performance of Contrast Echocardiography: A Focused Update from the American Society of Echocardiography

Thomas R. Porter, MD, FASE (Chair), Sahar Abdelmoneim, MD, J. Todd Belcik, BS, RCS, RDCS, FASE, Marti L. McCulloch, MBA, RDCS, FASE, Sharon L. Mulvagh, MD, FASE, Joan J. Olson, BS, RDCS, RVT, FASE, Charlene Porcelli, BS, RDCS, RDMS, FASE, Jeane M. Tsutsui, MD, and Kevin Wei, MD, FASE, *Omaha, Nebraska; Rochester, Minnesota; Portland, Oregon; Houston, Texas; Charleston, South Carolina; São Paulo, Brazil*

(J Am Soc Echocardiogr 2014;27:797-810.)

Keywords: Echocardiography, Sonographer, Contrast, Imaging

Low and Very Low MI Imaging Techniques for Contrast Echo

Descriptor	Company Manufacturer(s)	Advantage(s)	Disadvantage(s)
Pulse-inversion Doppler and <u>very low MI*</u>	Philips Sonos/iE33 Toshiba Aplio/Xario GE 1.5-, 1.6-, and 1.7-MHz; transducers	High resolution	Attenuation and dynamic range
Power modulation and <u>very low MI*</u>	Philips Sonos/iE33 GE 2.1- and 2.4-MHz transducers	High sensitivity	Resolution, image quality, and dynamic range
Contrast pulse sequencing and <u>very low MI*</u>	Siemens Acuson	Image quality and high sensitivity	Attenuation and dynamic range
Low-MI [†] harmonic (LVO)	All vendors	Image quality	Decreased contrast sensitivity, apical swirling, and no perfusion

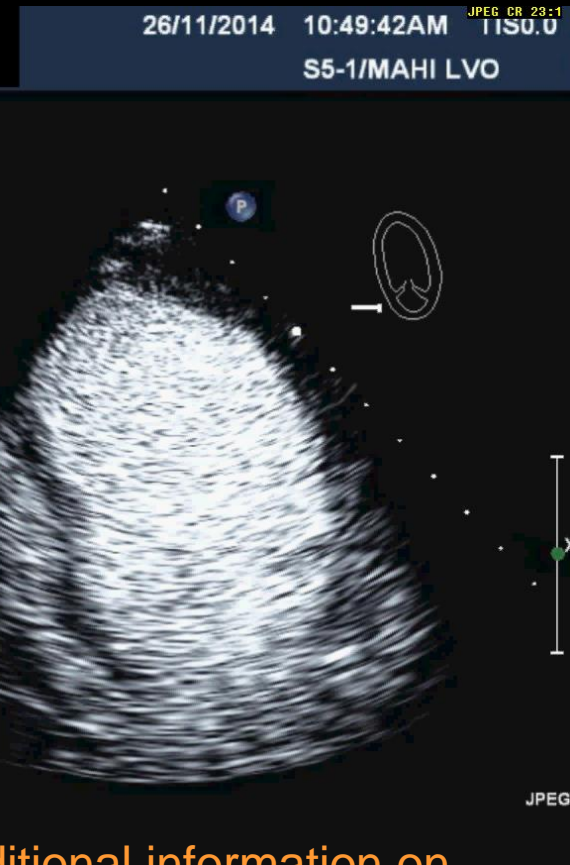
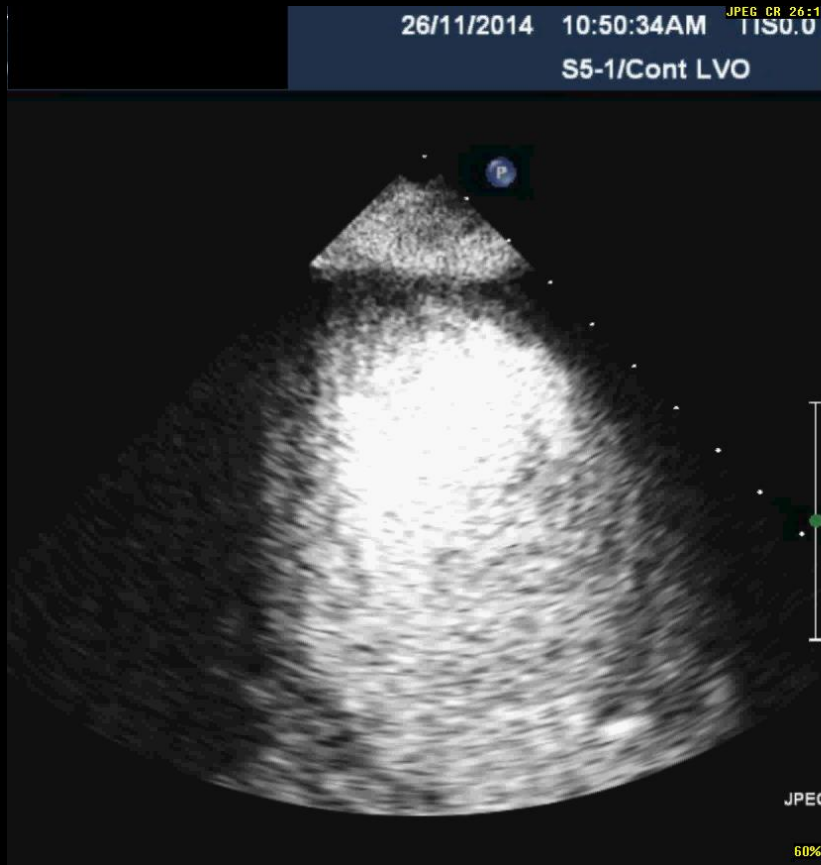
ASE guidelines 2014

recommended

Low MI
> 0.3

Very Low MI
<0.15

Less artifacts
Less SonoVue needed



additional information on
myocardial perfusion
provided

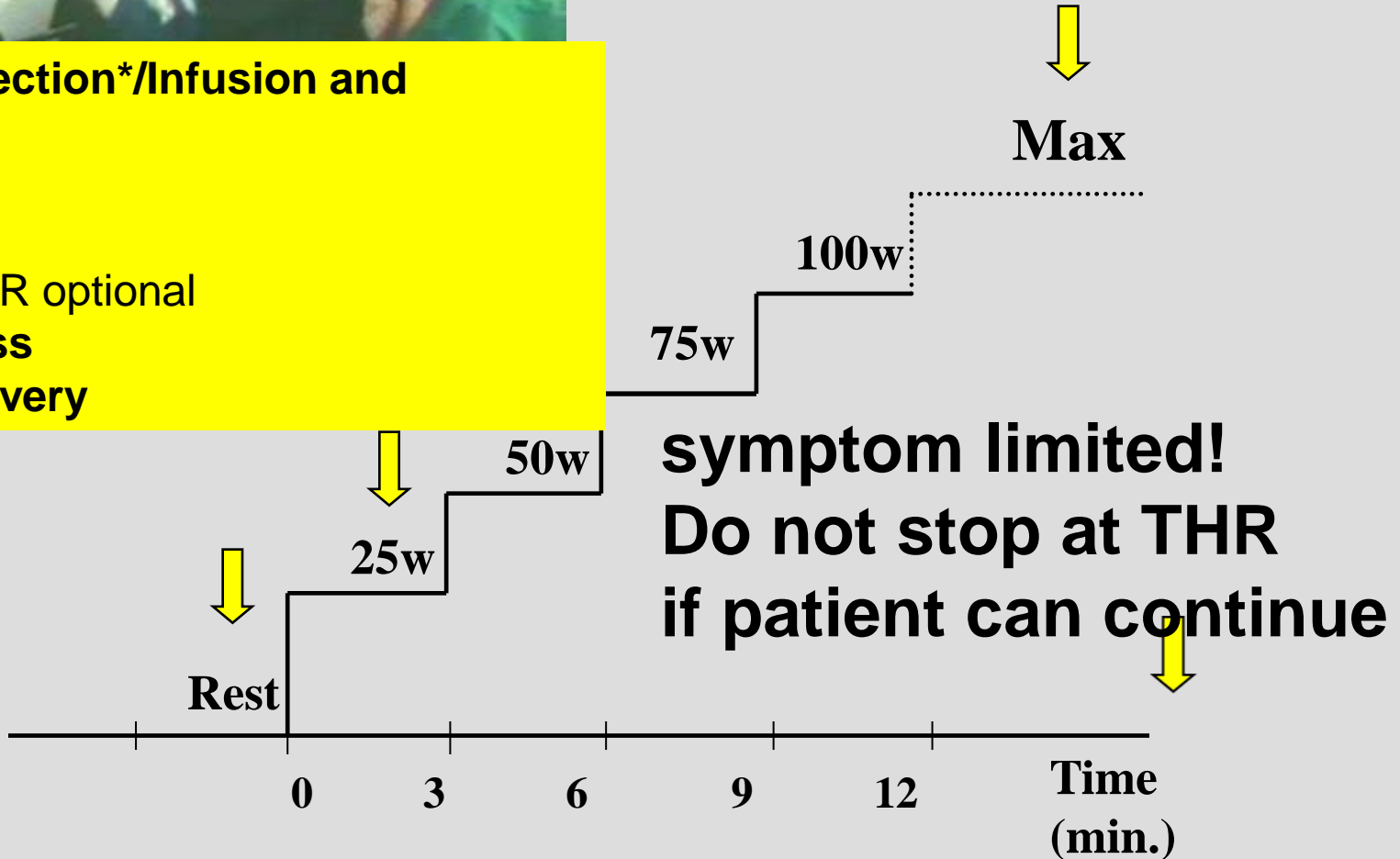
Clinical Value of Contrast in Stress Echo Examinations

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Bicycle Stress Echo

- Contrast Injection*/Infusion and Recordings**
1. rest
 2. 25 Watts
 3. 70% of THR optional
 4. peak stress
 5. early recovery



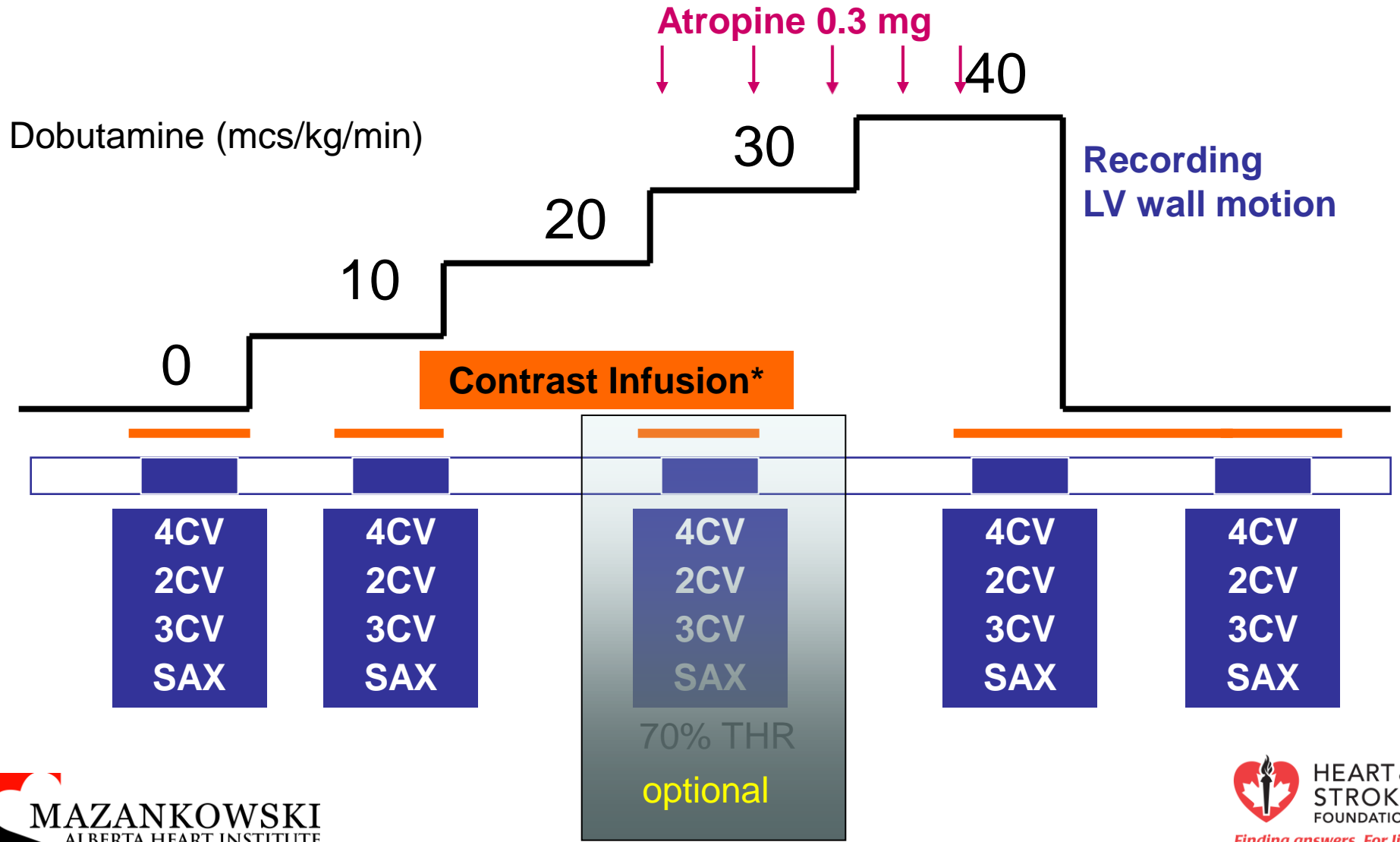
Recordings at each stage

- 4 chamber view
- 2 chamber view
- 3 chamber view
- SAX
- (LAX optional)

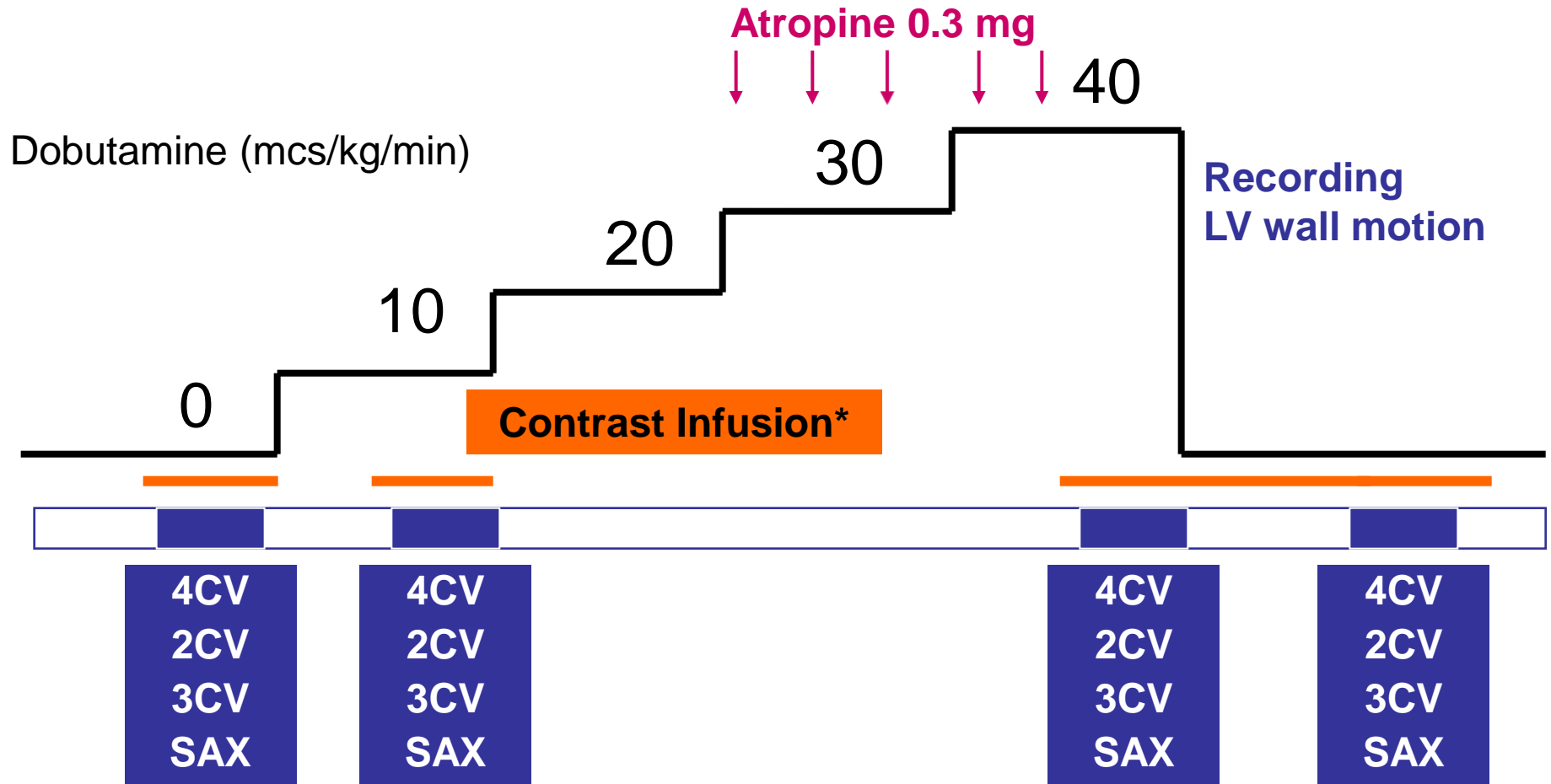
Using Contrast Agents for LVO in Stress Echocardiography: The Evidence

- More LV segments are confidently assessed compared to non-contrast stress echo.
- Reliable studies in obese patients and patients with non diagnostic native recordings
- Improved reader confidence and inter-observer variability for assessment of regional systolic LV function
- Improved diagnostic accuracy assessed by coronary angiography compared to unenhanced studies
- Better agreement with the findings of FFR measurements

Dobutamine 2D Contrast Stress Echo

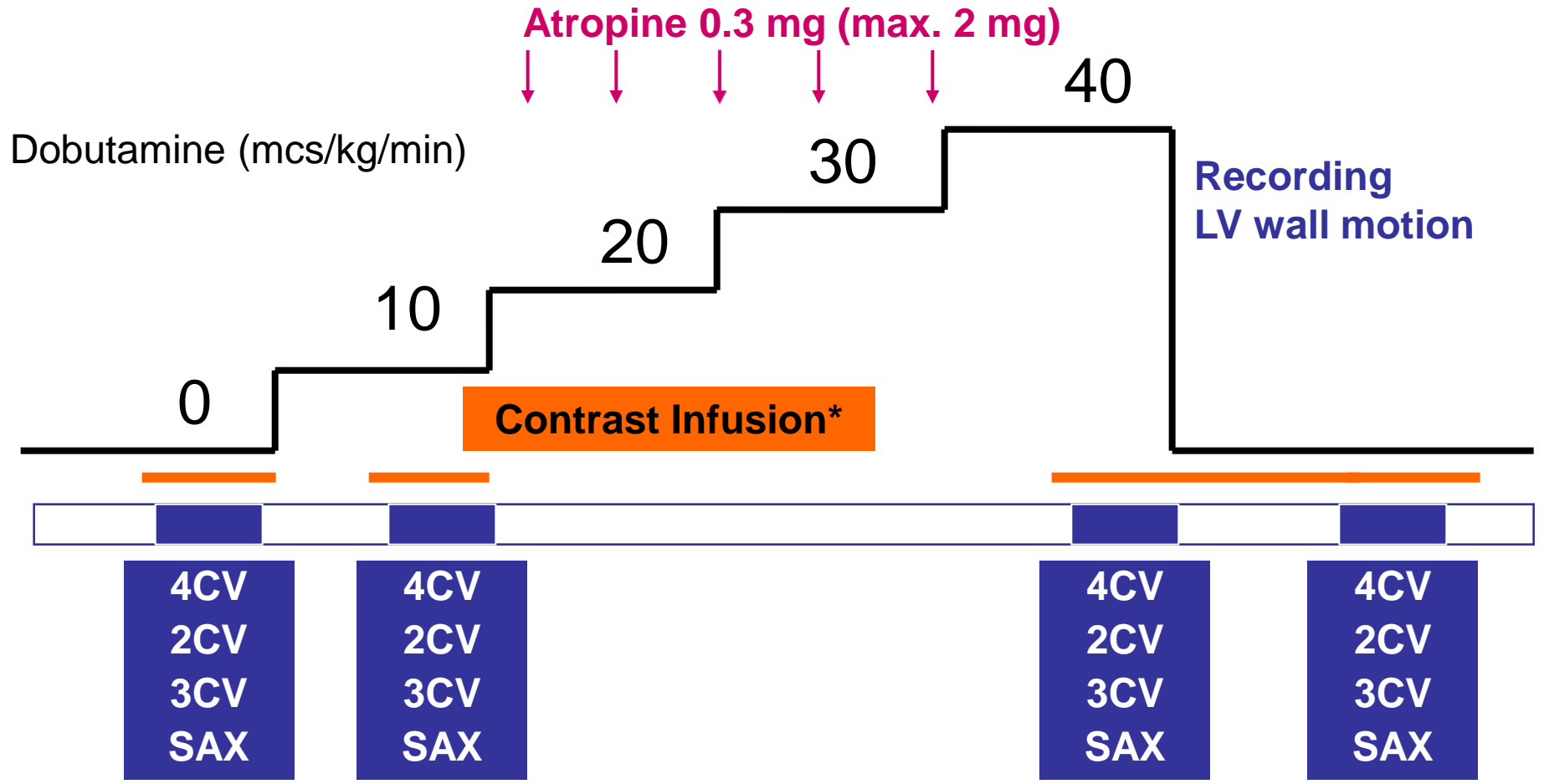


Dobutamine 2D Contrast Stress Echo



Dobutamine 2D Contrast Stress Echo

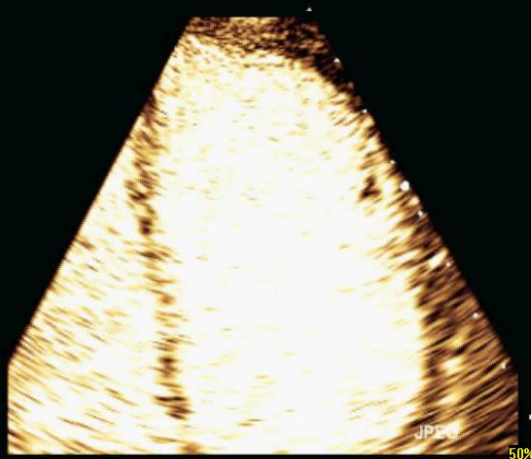
patient taking betablocker



Dobutamine Stress Echocardiography

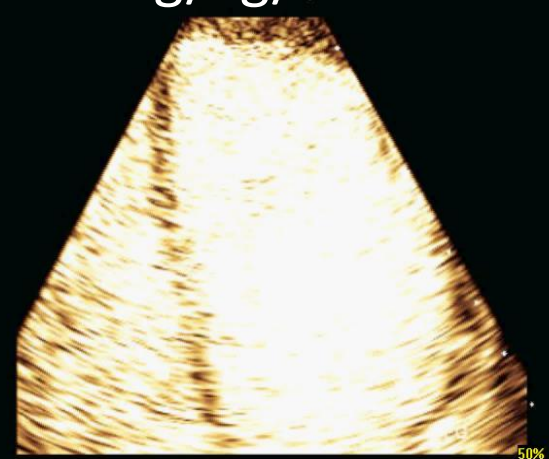
rest

Rest AP4
HR 68 BPM

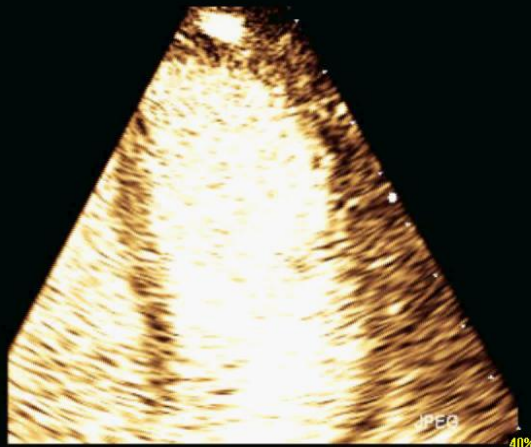


10 mcg/kg/min

Low AP4
HR 71 BPM
T01 00:00:01

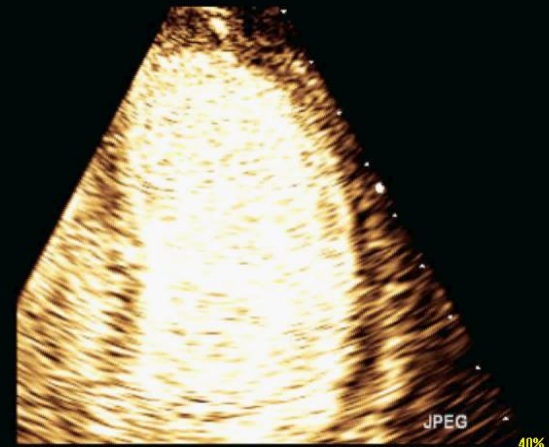


Sub Max AP4
HR 119 BPM
T01 00:05:55



30 mcg/kg/min

Peak AP4
HR 128 BPM
T01 00:08:20



40 mcg/kg/min

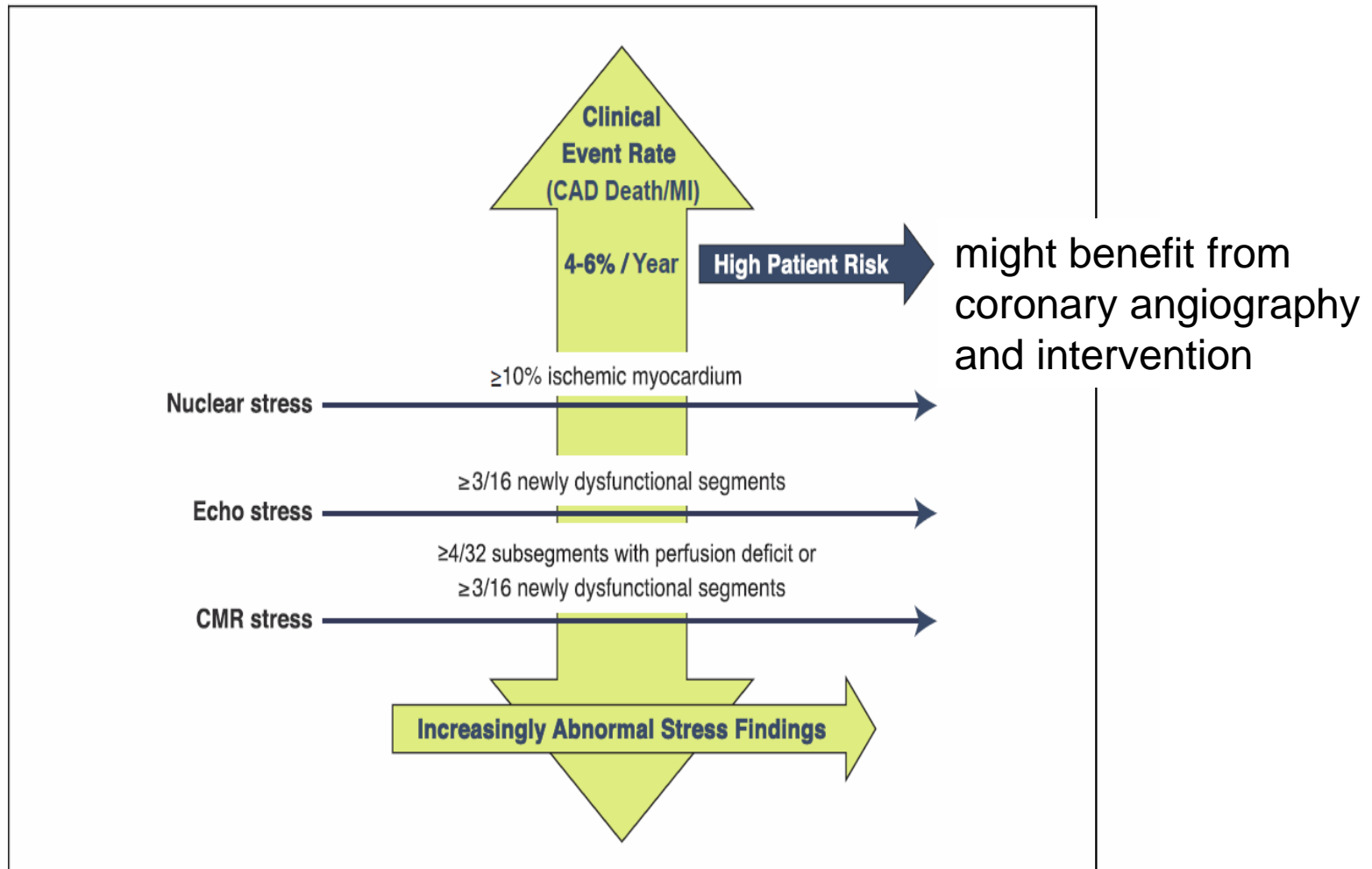
referral to coronary angiography*

normal systolic function at rest

- ≥ 3 segments abnormal during stress
 - LAD territory
 - low level of stress
 - 2 or 3 coronary territories
 - severe typical angina
- ≤ 2 segments abnormal during stress
 - Severe typical angina

*criteria for referral to coronary angiography
not different for contrast and non contrast stress echo

Comparative Definitions for Moderate-Severe Ischemia in Stress Nuclear, Echocardiography, and Magnetic Resonance Imaging. [J Am Coll Cardiol Img 2014;7:593–604.](#)



Clinical Value of Contrast in Stress Echo Exams

Conclusions

- Contrast agents are beneficial in all currently available stress modalities
- For exercise and dobutamine stress contrast agents provide optimal wall motion analysis which is the basis for clinically solid judgment
- The contrast imaging modalities suggested by ASE facilitate display of myocardial contrast. This is helpful to enhance the assessment of wall motion abnormalities.

Appendix 1

Perfusion Imaging in Stress Echo A

- Not recommended for exercise stress echo,
- may be considered as an add-on to wall motion imaging in Dobutamine stress echo.
- In Dobutamine stress echo assessing perfusion
 - increases the confidence in reading wall motion
 - can help when patients do not reach target heart rate
 - has been used to increase the sensitivity for detecting CAD as perfusion abnormalities precede wall motion abnormalities (ischemic cascade). However perfusion abnormalities without wall motion abnormalities have been very rare in our practice
- The final call in Dobutamine stress echo should be **mainly** based on assessment of LV wall motion!

When is Perfusion Imaging showing something relevant on top of assessment of LV Function

- **Exercise Stress-Echo**
- **Dobutamine Stress Echo**
- **Adenosine Stress Echo**



Perfusion-Echocardiography

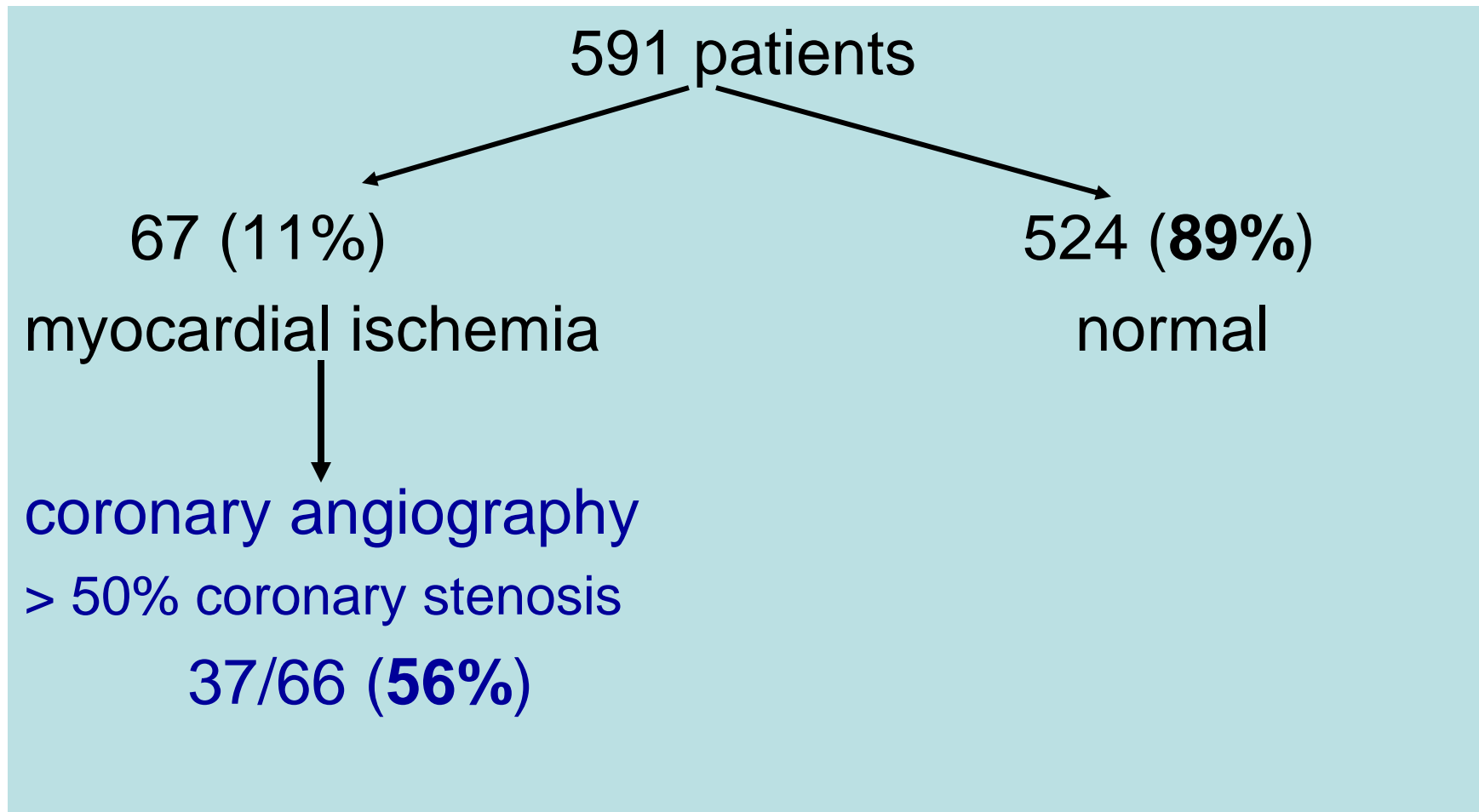
- Only reliable with **continuous infusion** of the ultrasound contrast agent
- **Very low MI (mechanical index) contrast imaging setting*** needed: the brightness of the myocardium reflects the level of myocardial perfusion
- The brightness of the myocardium depends on the gain, which should be adjusted before the rest recordings are taken
- The brightness of the myocardium should be well below the level of the contrast in the LV cavity in order to provide an optimal display of the endocardial border and LV wall thickening.
- During stress the brightness increases in normally perfused myocardium due to hyperemia and may obscure the definition of the endocardium. A flash/replenishment sequence helps to provide loops with optimal endocardial definition and gives additional information on perfusion.

**imaging presets are provided by most manufacturers*

Appendix 2

“False” positive findings

Stress Echo in Patients with Chest Pain and no previous history of CAD



Characteristics and Outcomes of Patients With Abnormal Stress Echocardiograms and Angiographically Mild Coronary Artery Disease (<50% Stenoses) or Normal Coronary Arteries

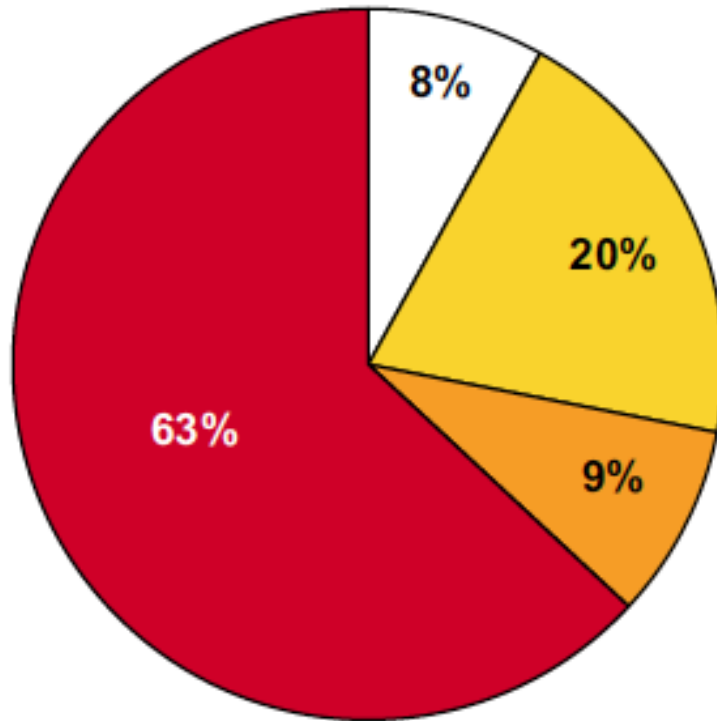
Aaron M. From, MD, Garvan Kane, MD, PhD, Charles Bruce, MD, Patricia A. Pellikka, MD, Christopher Scott, MS, and Robert B. McCully, MD, *Rochester, Minnesota*

JASE 2010; (23) 207-214

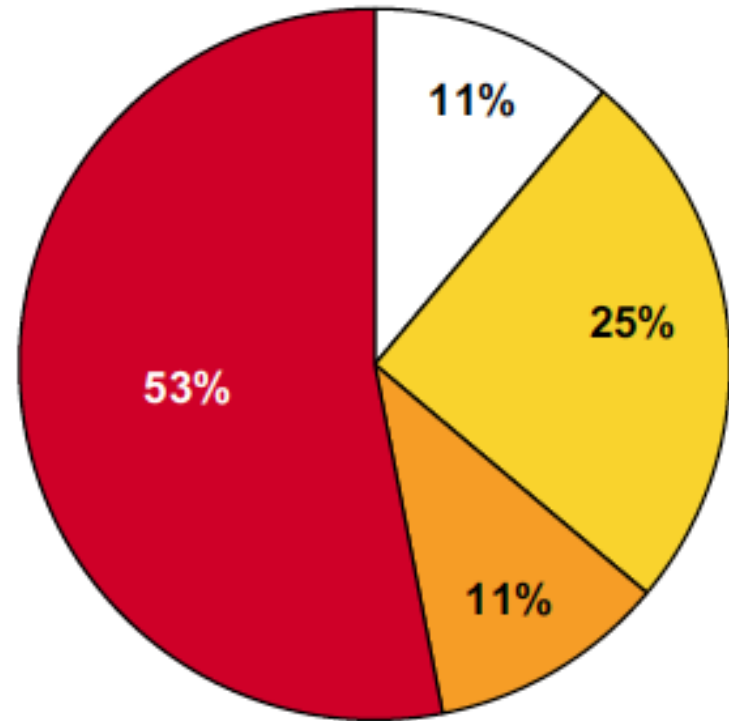
- 1,477 patients with positive stress echo
- All underwent coronary angiography
- 480 (32.5%) had “false-positive” results

The Mayo Clinic Experience: 1,477 patients with positive stress echo

■ $\geq 70\%$ stenosis ■ 50-69% stenosis ■ $< 50\%$ stenosis □ Normal

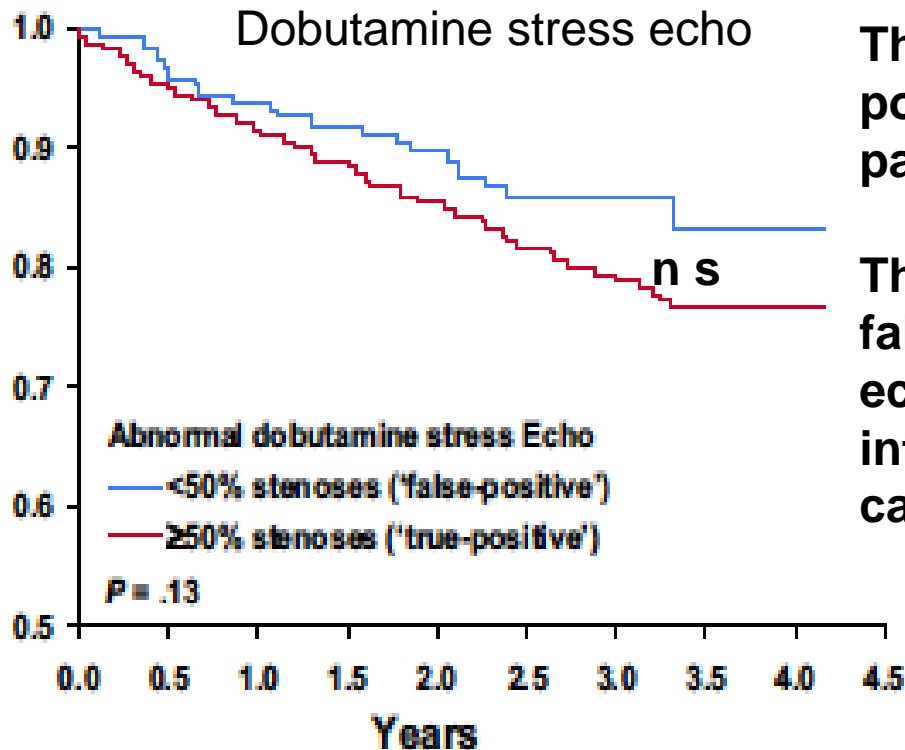


Markedly abnormal
n=605



Mildly or moderately abnormal
n=872

Mortality According To Stress Echo Results



The outcomes of patients with false-positive results were similar to those of patients with true-positive results.

This finding suggests that patients with false-positive results on stress echocardiography should still receive intensive risk factor management and careful clinical follow-up.