

# The Enhancing Agent: Clinical Utility in 2019

## ▣ Stress Lab: Value of Left Ventricular Cavity Opacification (LVO)

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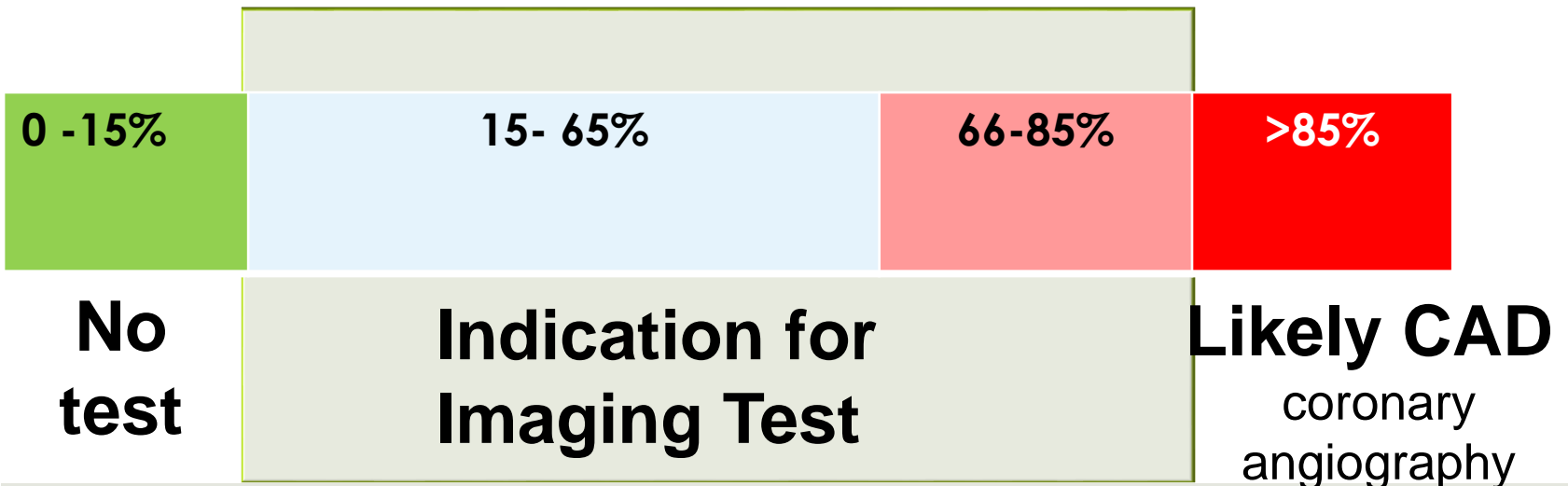
Alberta Heart Institute, Canada

# Selection of test in patients with symptoms suggestive of CAD

2013 ESC guidelines on stable angina

Pretest  
Probability

Age	Typical angina		Atypical angina		Non-anginal pain	
	Men	Women	Men	Women	Men	Women
30-39	59	28	29	10	18	5
40-49	69	37	38	14	25	8
50-59	77	47	49	20	34	12
60-69	84	58	59	28	44	17
70-79	89	68	69	37	54	24
>80	93	76	78	47	65	32



## Key Points Regarding Current FDA Labeling of Ultrasound Contrast Agents

- The only FDA/EMA-approved use for UEAs in cardiovascular disease is for LVO at rest.
- However, **given significant scientific literature support**, other off-label uses of UEAs (such as MP, pediatric and vascular applications, and **use during stress echocardiography**) are recommended in the present ASE document according to the 2015 clinical practice guidelines.

Clinical Applications of Ultrasonic Enhancing Agents in Echocardiography: 2018 American Society of Echocardiography Guidelines Update

**Table 5** Studies reporting benefit of using ultrasound contrast agents for stress echocardiography

Patients (n)	Stress method	Contrast agent	Author	Year
50	Dobutamine	son.Albumin	Porter et al. <sup>94</sup>	1994
30	Dobutamine	Albunex	Falcone et al. <sup>95</sup>	1995
100	Dobutamine	Definity	Porter et al. <sup>96</sup>	2007
611	Dobutamine	Definity/Optison	Lerakis et al. <sup>109</sup>	2007
101	Dobutamine	Definity	Plana et al. <sup>110</sup>	2008
70	Dobutamine	SonoVue	Jung et al. <sup>111</sup>	2008
42	Dobutamine	SonoVue	Cosyns et al. <sup>112</sup>	2008

Only those studies are listed in which contrast agents were used to enhance endocardial visualization.

**improved visualization of RWMA**  
**improved study quality,**  
**increased reader confidence in study interpretation**

**six studies demonstrated**  
**better agreement of coronary angiographic findings**  
**with UEA compared with non-contrast studies**

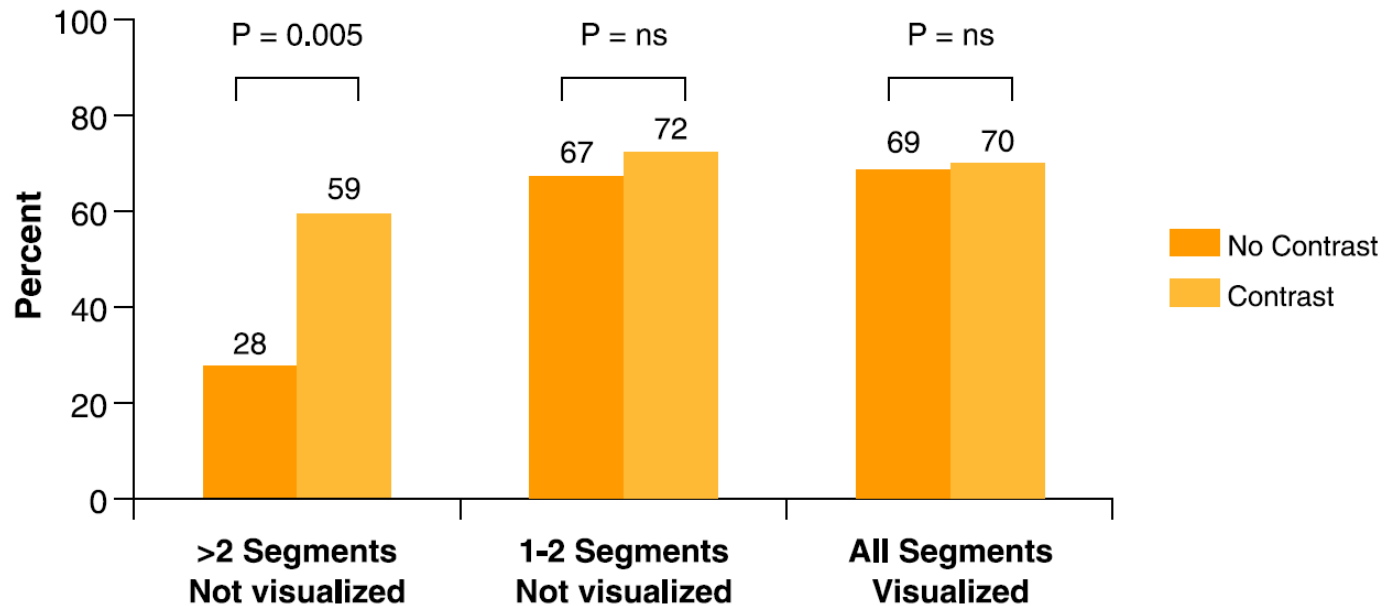
# Contrast agents in stress echocardiography

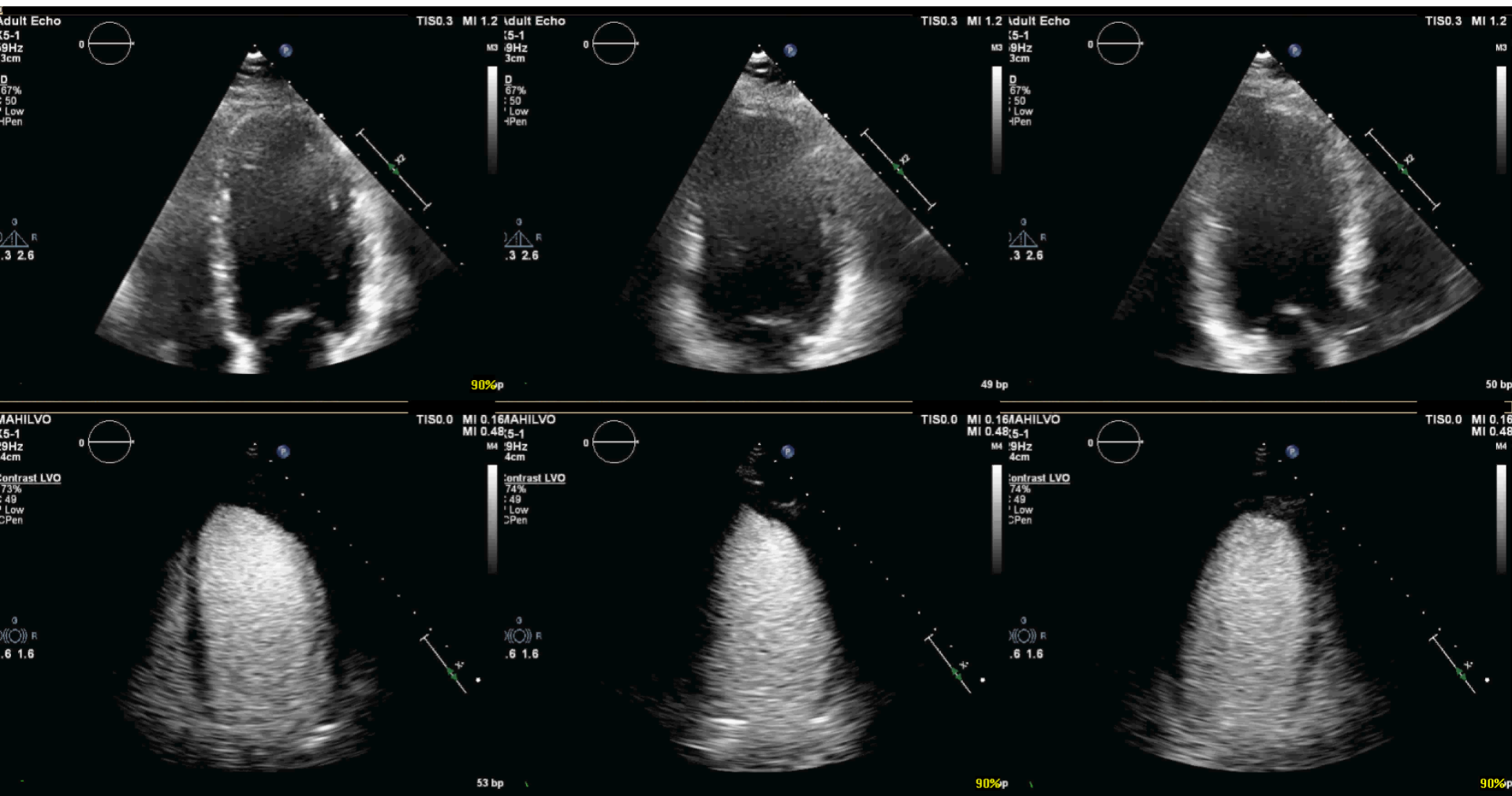
- The use of contrast agents during both exercise and dobutamine stress echocardiography (DSE) improves sensitivity, specificity, and diagnostic accuracy
- to a greater extent in patients with suboptimal versus optimal imaging windows.
- All approved UEAs are suitable for stress echocardiography

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# The OPTIMIZE trial

- 101 patients underwent DSE studies with and without UEA
- Accuracy was assessed by comparing the results of DSE with coronary angiography





# Value of Left ventricular opacification in patients with 'adequate' image quality

Larsson *et al. Cardiovascular Ultrasound* (2016) 14:2  
DOI 10.1186/s12947-015-0045-0

Cardiovascular Ultrasound

RESEARCH

Open Access

## The potential clinical value of contrast-enhanced echocardiography beyond current recommendations



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# Echocardiography with UEAs in Patients with “adequate” Image Quality

- 192 patients without indications for contrast echocardiography, referred for stress echocardiography
- Objective: **to compare the variability of LV assessment between studies with and without UEA**

- Intra-class correlation coefficient

■ EF	0.95 (UEA)	0.8 (non enhanced)
■ WMSI	0.87 (UEA)	0.61 (non enhanced)

- **Intra- and interobserver variability for experienced readers as well as the variability between inexperienced and experienced readers decreased for WMSI and EF when UEAs were given.**

# Regional LV Wall Motion Greyscale vs Contrast Echo

RWM no UEA	RWM in recordings with UEAs			
	normal	hypok.	akinetic	dyskinetic
normal	<b>2311</b>	345	27	0
hypokinetic		<b>185</b>	<b>207</b>	44
akinetic	27	38	<b>73</b>	10
dyskinetic	1	2	2	<b>1</b>

# 2017 Clinical practice of contrast echocardiography: recommendation by the European Association of Cardiovascular Imaging (EACVI) 2017

Roxy Senior<sup>1\*</sup>, Harald Becher<sup>2</sup>, Mark Monaghan<sup>3</sup>, Luciano Agati<sup>4</sup>, Jose Zamorano<sup>5</sup>, Jean Louis Vanoverschelde<sup>6</sup>, Petros Nihoyannopoulos<sup>7</sup>, Thor Edvardsen<sup>8</sup>, and Patrizio Lancellotti<sup>9</sup>

## GUIDELINES AND STANDARDS

# 2018 Clinical Applications of Ultrasonic Enhancing Agents in Echocardiography: 2018 American Society of Echocardiography Guidelines Update



Thomas R. Porter, MD, FASE (Chair), Sharon L. Mulvagh, MD, FASE (Co-Chair), Sahar S. Abdelmoneim, MBBCH, MSc, MS, FASE, Harald Becher, MD, PhD, J. Todd Belcik, BS, ACS, RDCS, FASE, Michelle Bierig, MPH, ACS, RDCS, FASE, Jonathan Choy, MD, MBA, FASE, Nicola Gaibazzi, MD, PhD, Linda D. Gillam, MD, MPH, FASE, Rajesh Janardhanan, MD, MRCP, FASE, Shelby Kutty, MD, PhD, MHCM, FASE, Howard Leong-Poi, MD, FASE, Jonathan R. Lindner, MD, FASE, Michael L. Main, MD, FASE, Wilson Mathias, Jr., MD, Margaret M. Park, BS, ACS, RDCS, RVT, FASE, Roxy Senior, MD, DM,

# Evidence based recommendations for stress echocardiography (SE)

For assessment of RWMA for the detection of myocardial ischemia

I

A

When two or more contiguous segments are not adequately visualized at rest

or during deep inspiration mimicking cardiac motion during stress

IIA

C

Low MI contrast-specific imaging modalities should be used for SE,

I

C

irrespective of whether only wall motion or both wall motion and perfusion are assessed

Clinical practice of contrast echocardiography: recommendation by the European Association of Cardiovascular Imaging (EACVI) 2017



# Low and Very Low Mechanical Index (MI) Imaging Techniques for Contrast Echo

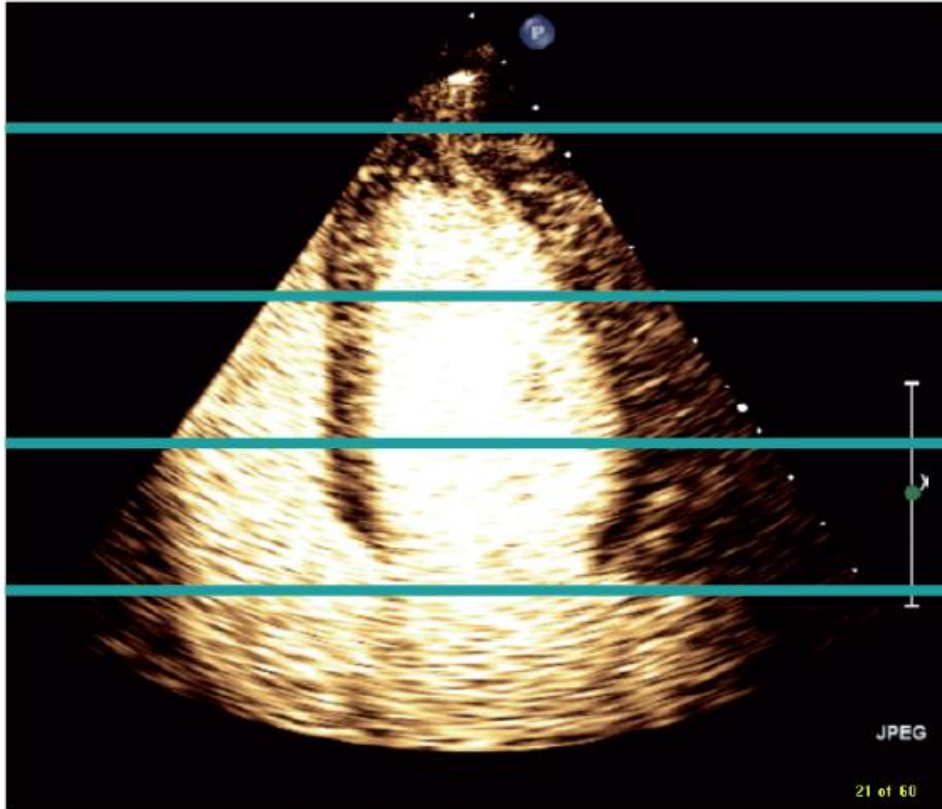
Descriptor	Company Manufacturer(s)	Advantage(s)	Disadvantage(s)
Pulse-inversion Doppler and very low MI*	Philips Epiq/ iE33 Toshiba Aplio/Xario GE 1.5-, 1.6- and 1.7-MHz transducers	High resolution	Attenuation and dynamic range
Power modulation and very low MI*	Philips Sonos /iE33 GE 2.1- and 2.4 MHz transducers	High sensitivity	Resolution, image quality and dynamic range
Contrast pulse sequencing and very low MI*	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

\*Very low MI, <0.2.

†Low MI, <0.3.

**Recommended**

*ASE sonographer guidelines 2014*



**APICAL:** No swirling, no blooming

**BASAL:** No attenuation

Contrast should be visible in LA  
1-2 cm behind the mitral valve

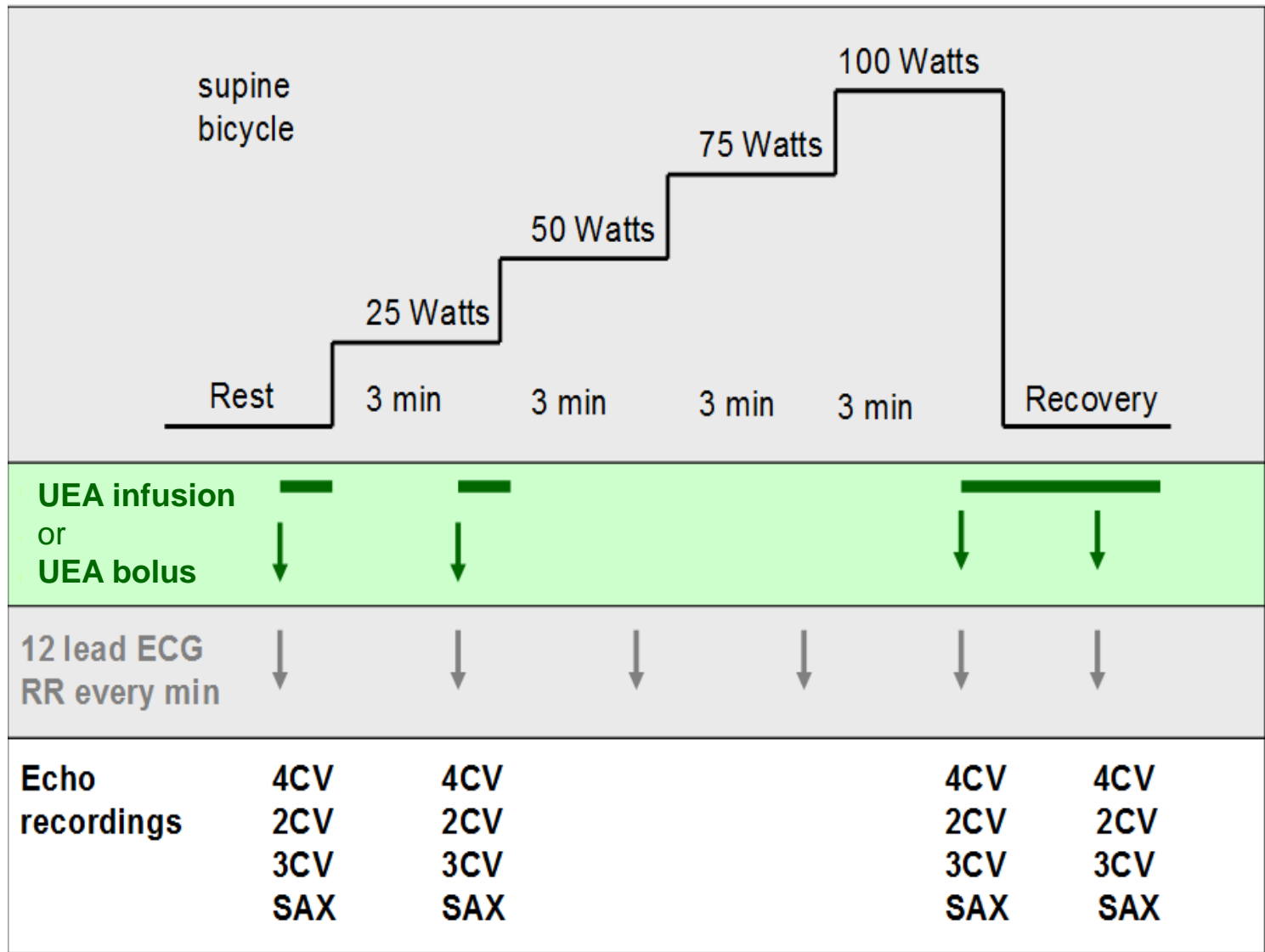
# Criteria for adequate images in Dobutamine Stress Echocardiography

- **Optimize for good endocardial border definition (EBD) in 4-chamber view – accept low contrast in the myocardium at rest**
- **Apical swirling as low as possible**
- **Avoid attenuation in the basal LV cavity, ideally contrast should be visible up to 1-2 cm in the left atrium**
- *After optimization of the 4-chamber view usually no further adjustments are needed in the 2- and 3-chamber views*

# Troubleshooting for apical recordings

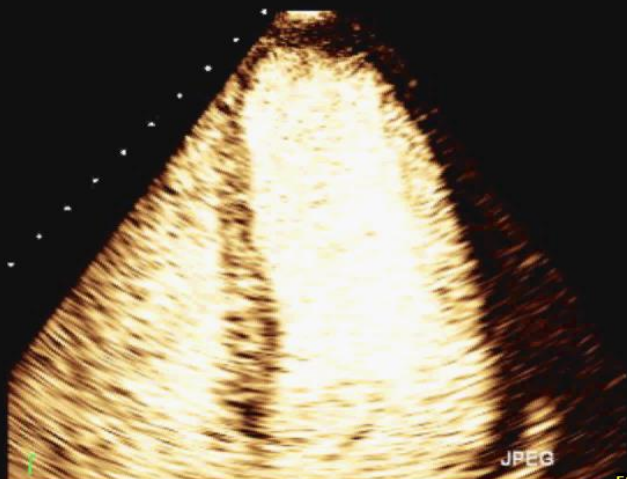
- Apical swirling  
good basal contrast  
MI too high
- Basal attenuation  
no apical swirling  
MI too low
- Apical blooming and  
basal attenuation  
Contrast too high
- Apical swirling and  
inhomogeneous contrast  
in the entire cavity  
Contrast too low





2017 Clinical practice of contrast echocardiography: Recommendations by the EACVI

Rest Angle  
HR 60 BPM



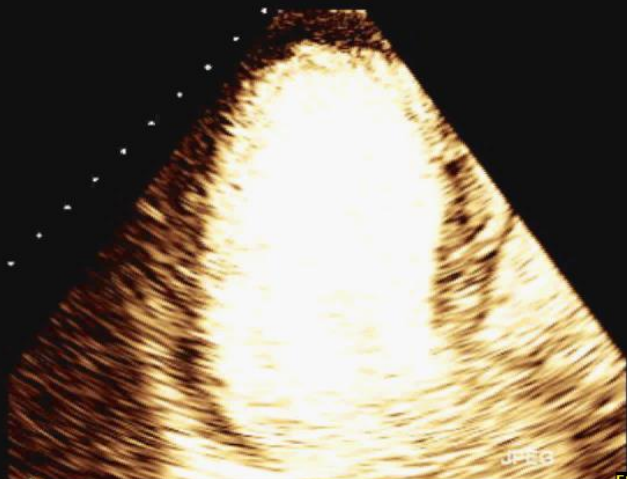
JPEG CR 13:1

Rest AP2  
HR 61 BPM



JPEG CR 12:1

Rest AP3  
HR 75 BPM



JPEG CR 14:1

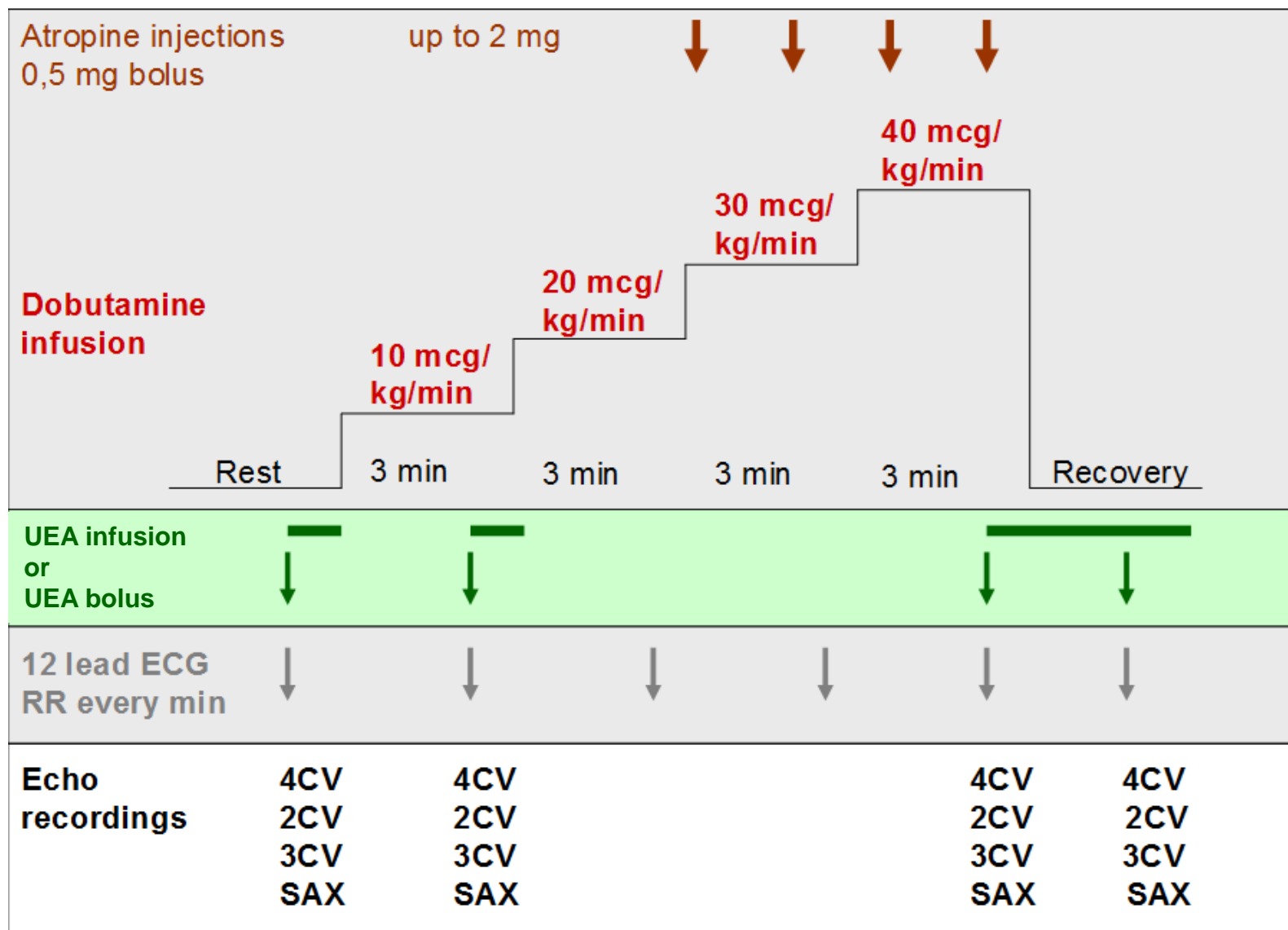
Rest SAX  
HR 58 BPM



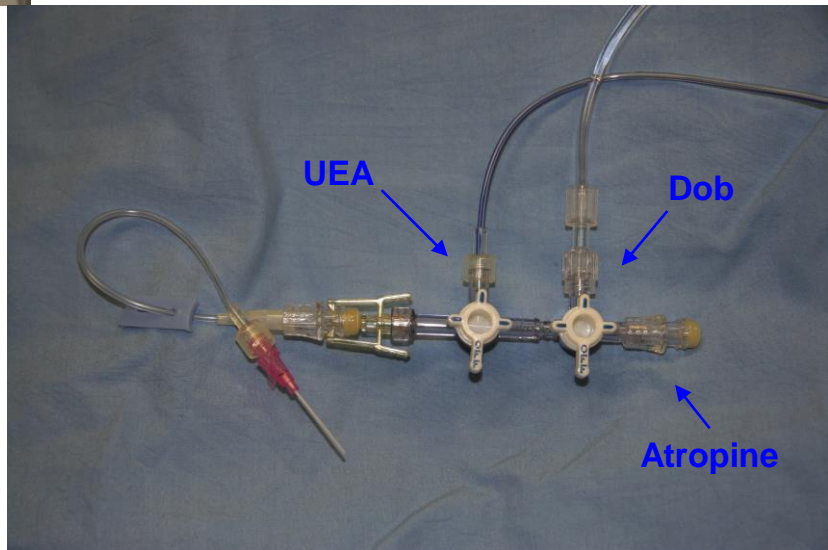
JPEG CR 10:1

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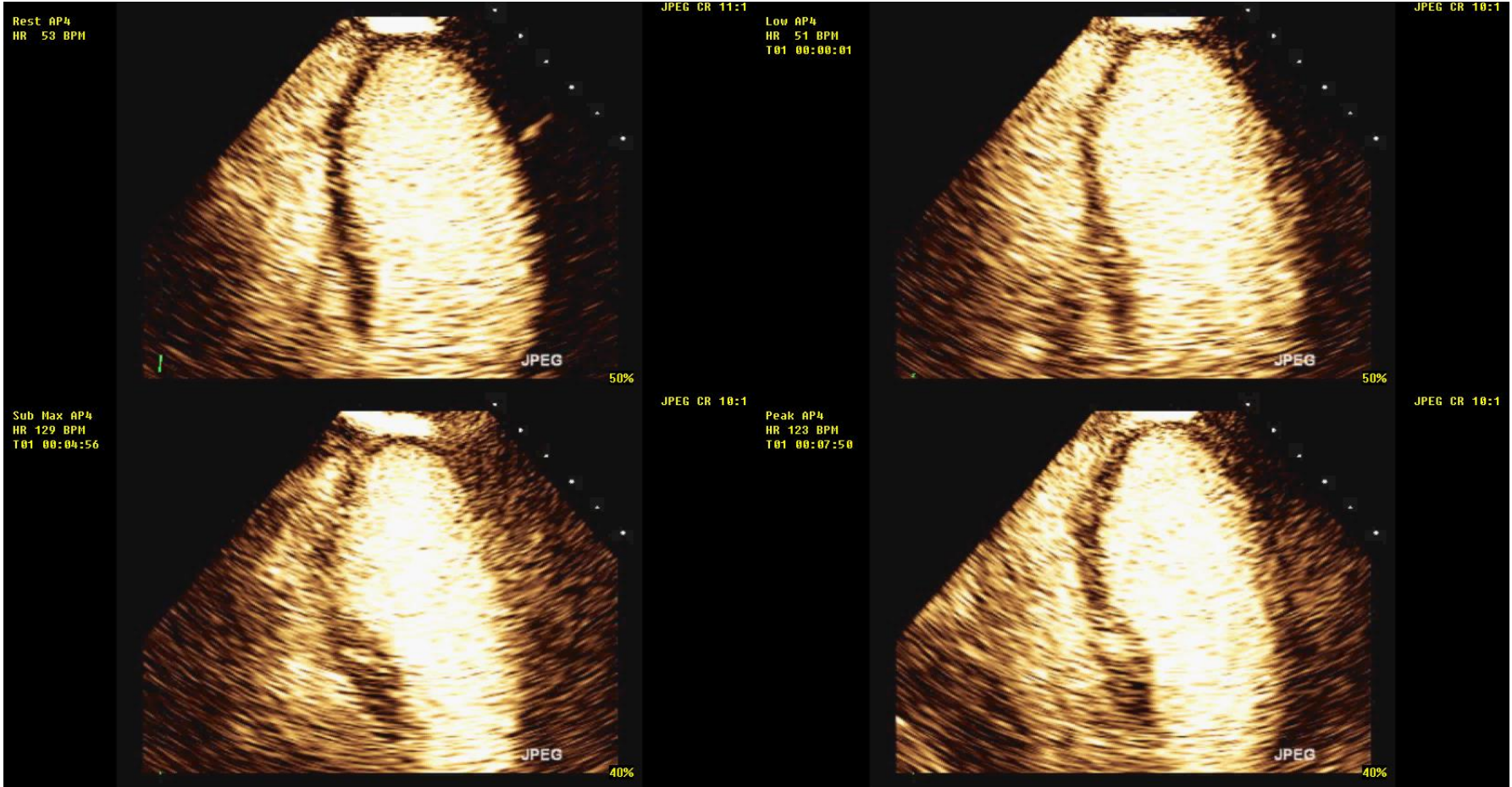
2017 Clinical practice of contrast echocardiography: Recommendations by the EACVI





rest

10  $\mu\text{g}/\text{kg}/\text{min}$  Dobutamine



30  $\mu\text{g}/\text{kg}/\text{min}$  Dobutamine

early recovery

## ...but even the best display of LV wall motion has limitations

- Ischemic cascade
- Reduced sensitivity when target heart rate not been achieved
- Small areas of ischemia may be missed
- Ischemia in LBBB/paced rhythm can be difficult to assess by wall motion
- Foreshortening cannot be excluded