European Journal of Echocardiography (2008) 9, 415–437
doi:10.1093/ejechocard/jen175

Stress echocardiography expert consensus statement

European Association of Echocardiography (EAE) (a registered branch of the ESC)

Rosa Sicari[1]*, Petros Nihoyannopoulos[2], Arturo Evangelista[3], Jaroslav Kasprzak[4], Patrizio Lancellotti[5], Don Poldermans[6], Jen-Uwe Voigt[7], and Jose Luis Zamorano[8] on behalf of the European Association of Echocardiography

European Heart Journal (2009) **30**, 278–289
doi:10.1093/eurheartj/ehn492

SPECIAL ARTICLE

Stress Echocardiography Expert Consensus Statement—Executive Summary

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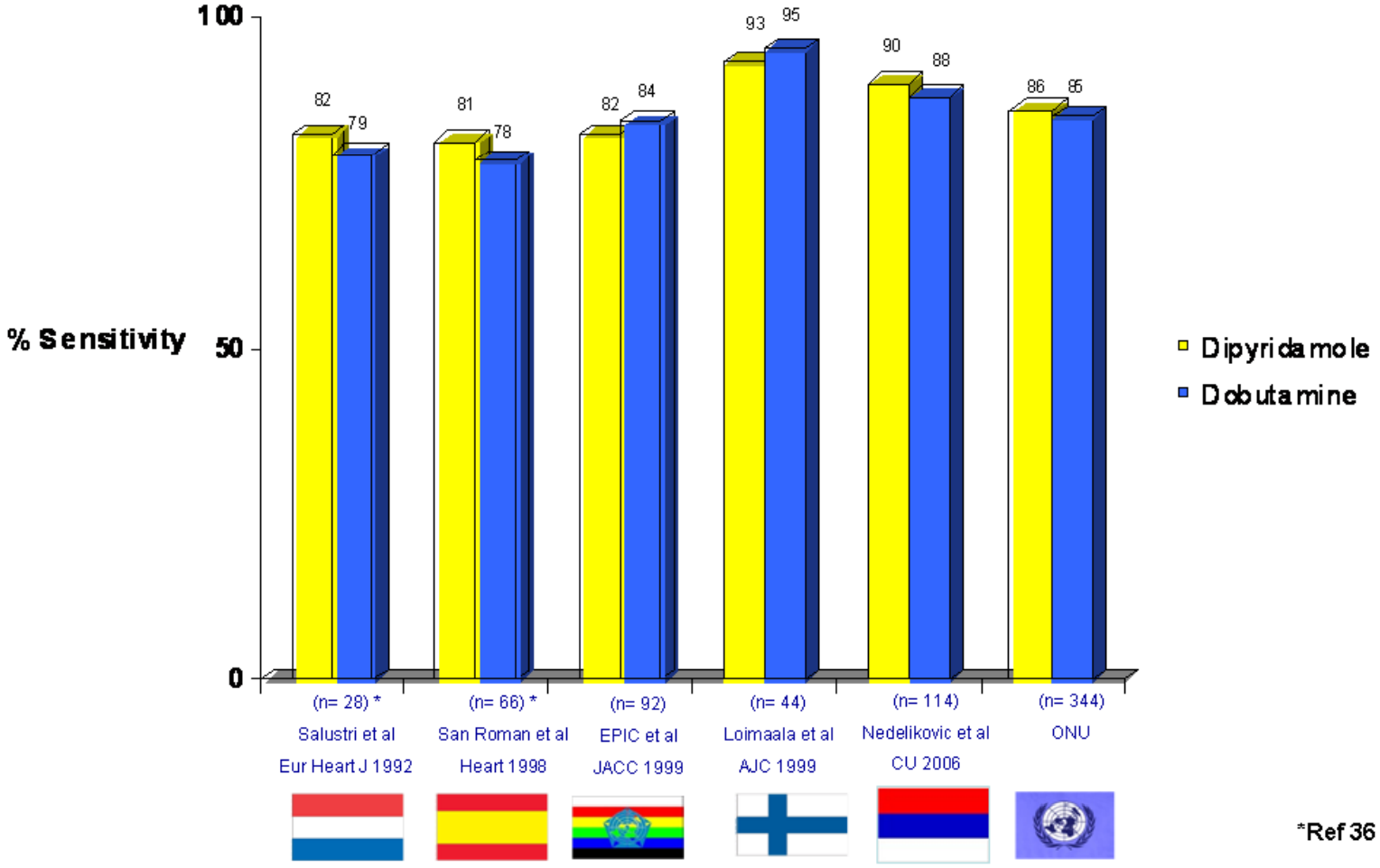
The Stressors: Dip and Dob*
0.84 in 6'* or 0.84 in 10' + atropine



*Ref 36

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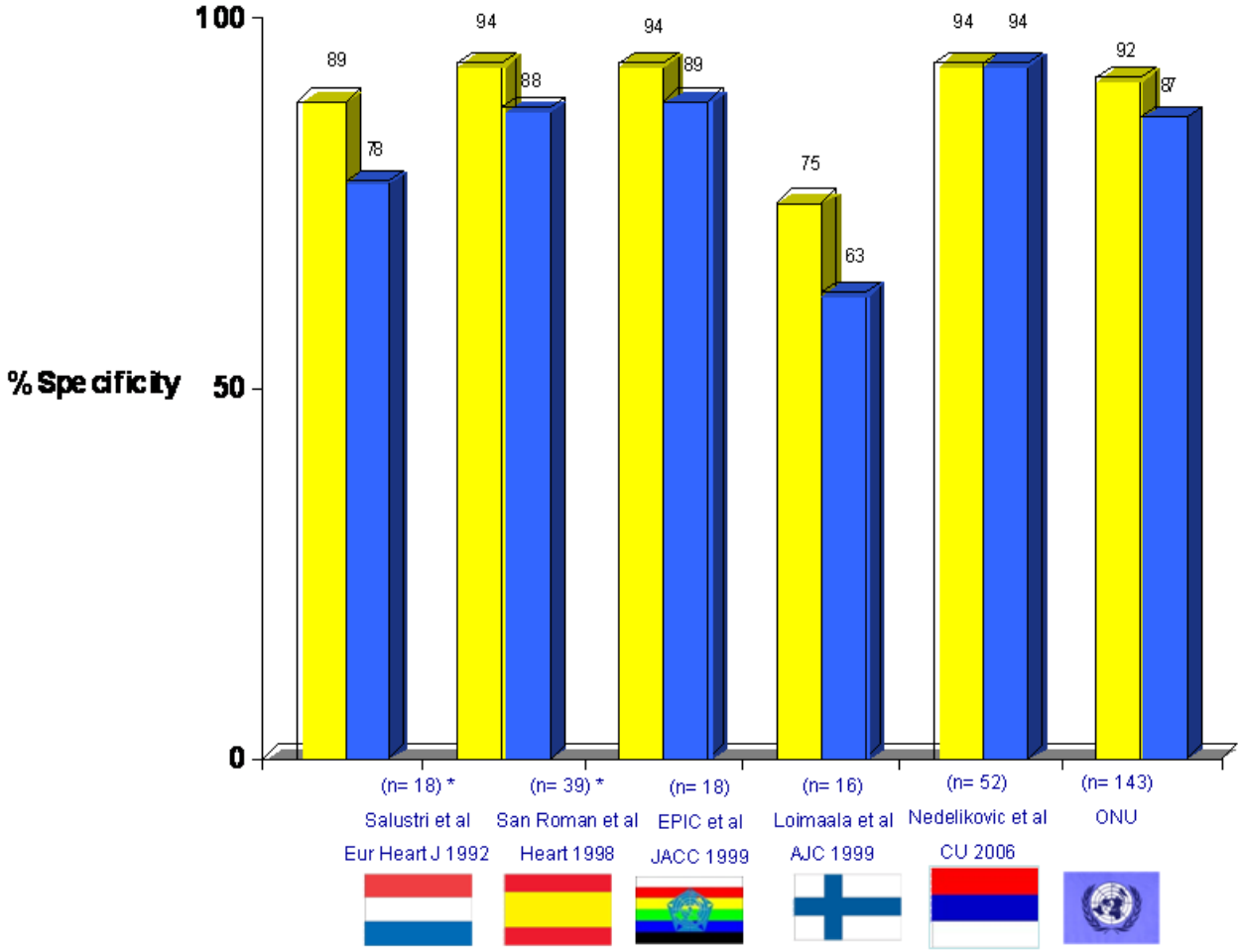

Key point: Both dobutamine and dipyridamole should be performed with high-dose protocols to obtain high sensitivities, comparable with maximal exercise.

*Ref 36

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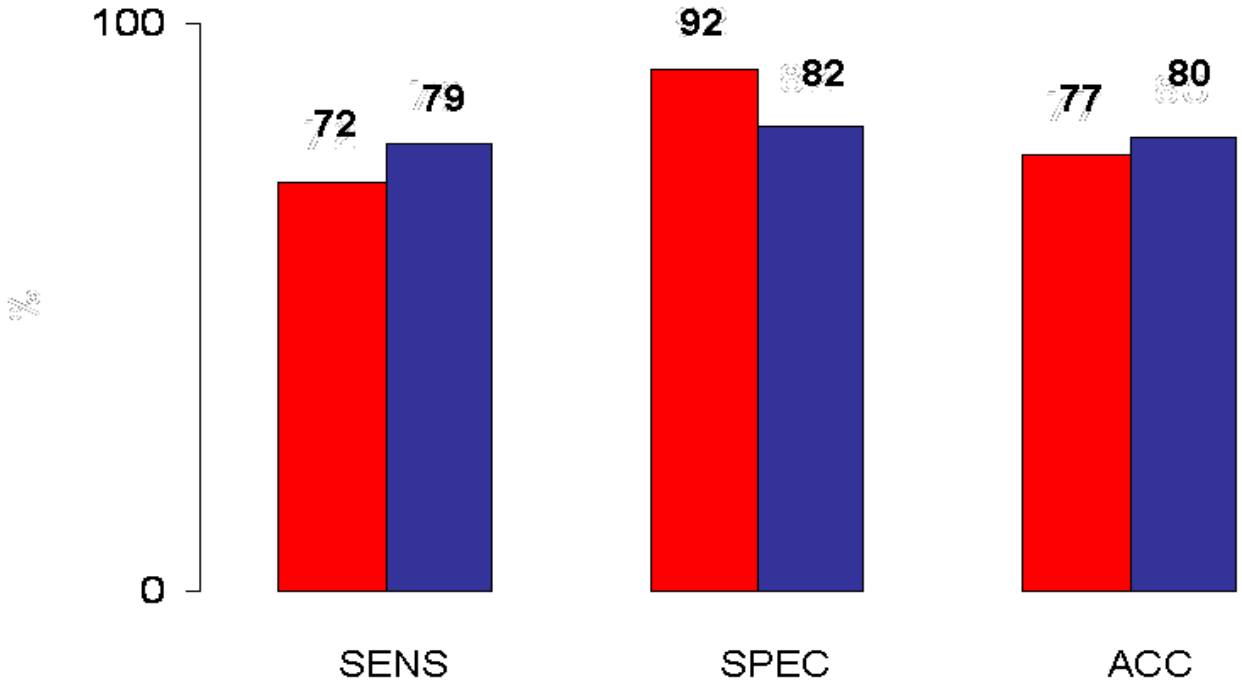
DIP vs. EXE*



Key point: Physical or pharmacological (inotropic or vasodilator) stress echocardiography have comparable diagnostic accuracies. The choice of one test over the other will depend on relative contraindications. Large volume laboratories should be fully acquainted with all the three main forms of stress in order to apply the test in all patients. In the presence of a submaximal first-line stress for limiting side effects, the second choice should be applied, since submaximal (physical or pharmacological) stresses have suboptimal diagnostic value.

*Ref 120

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Stress Echocardiography in 4 equations

Rest +  Stress = NORMAL

Rest +  Stress = ISCHEMIA

Rest +  Stress = VIABILITY

Rest +  Stress = NECROSIS

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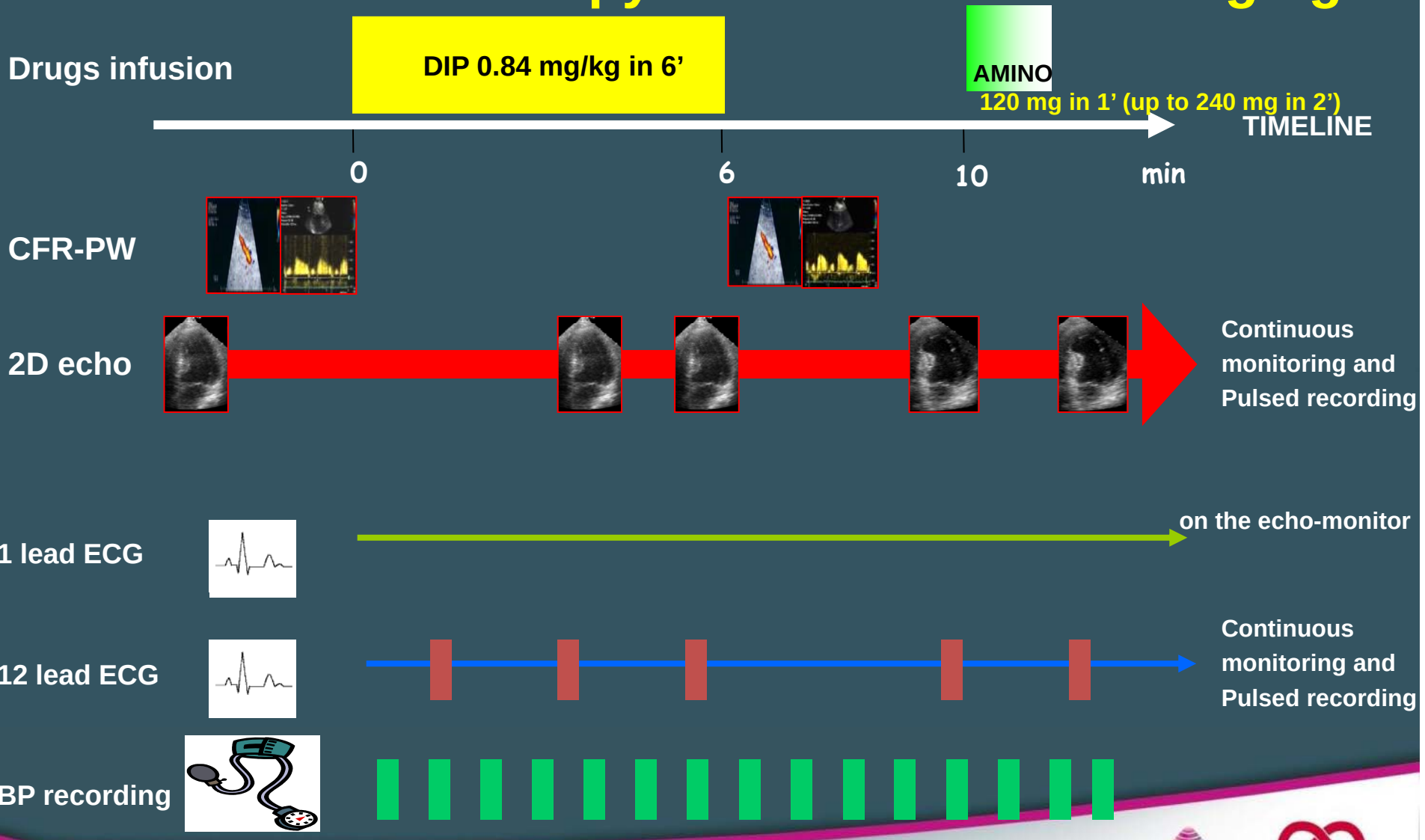
Stress Protocols: Dipyridamole for Dual Imaging



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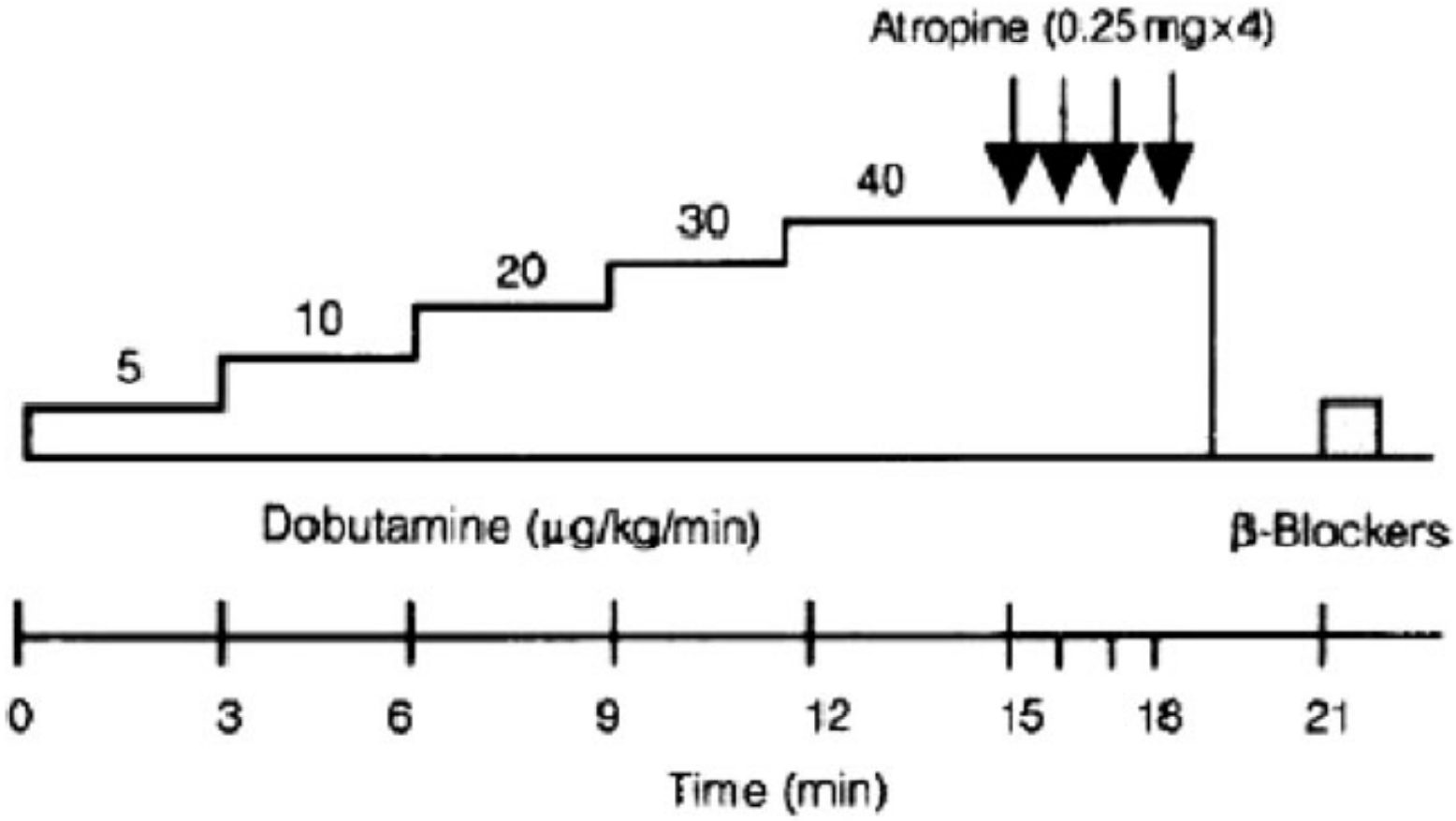

Figure 1 State-of-the art protocol of dobutamine stress echocardiography.

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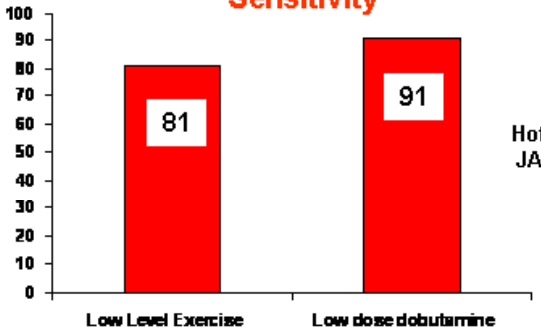
Viability and Stress echo: Not only Dobutamine

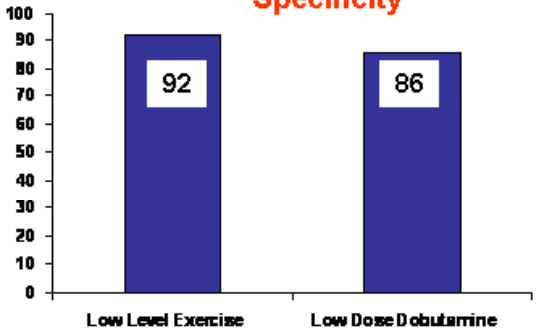
Low Level Exercise
(25 W x 3')

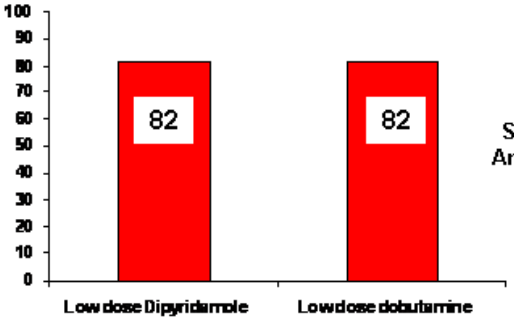
Low Dose Dipyridamole
(0.28 mg/Kg over 4')

Enoximone
(1.5 mcg/Kg over 10')

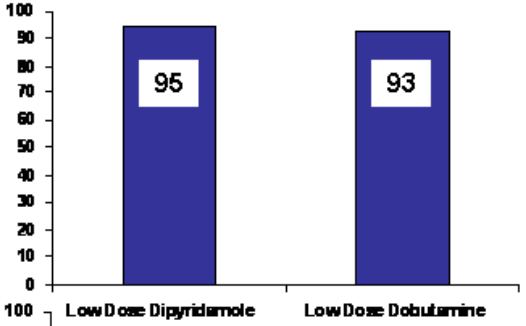


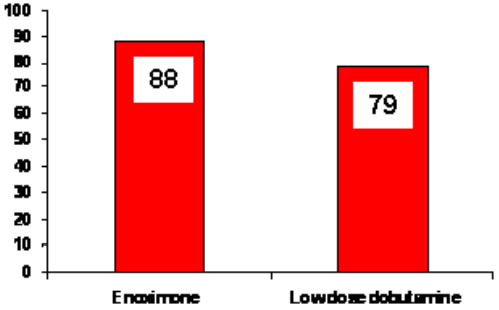
Hoffer et al.
JACC 1999



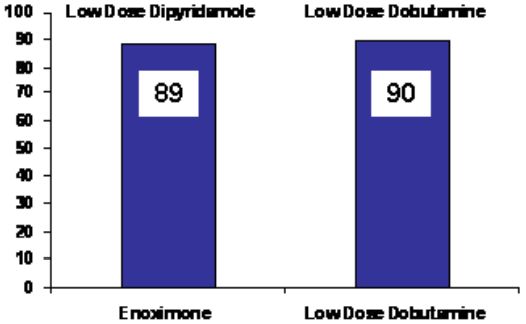


Sicari et al.
Am J Cardiol
2001





Lu et al.
Circulation
2000



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“Each to his/her own”

	Inability exercise	Asthma	Tachyarrhythmia	Severe hypertension	Low echogenicity
EX					
DIP					
DOB					

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Indications for Stress Echo

1 – Coronary artery disease

2 – Prognosis and risk stratification in patients with established diagnosis

3 – Preoperative risk assessment

4 – Evaluation of cardiac etiology of exertional dypnea

5 – Evaluation after revascularization

6 - Ischemia location

7 – Evaluation of heart valve stenosis severity

Indications for Stress Echo

Key point: Stress echocardiography **should not be** used as a first-line imaging

technique for diagnostic and prognostic purposes in patients with known or

suspected coronary artery disease but only when exercise ECG stress test is either

non-diagnostic or non-interpretable (e.g. for left bundle branch block or pacemaker).

The less informative and/or interpretable exercise electrocardiography the higher is the

level of appropriateness to stress echocardiography.

Stress Echo Risk Titration of a Positive Test

1-year risk (hard events)	Intermediate (1–3% year)	High (>10% year)
Dose/workload	High	Low
Resting EF	>50%	<40%
Anti-ischaemic therapy	Off	On
Coronary territory	LCx/RCA	LAD
Peak WMSI	Low	High
Recovery	Fast	Slow
Positivity or baseline dyssynergy	Homozonal	Heterozonal
CFR	>2.0	<2.0

LAD, left anterior descending artery; LCx, left circumflex; RCA, right coronary artery.

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Stress Echo Risk Titration of a Negative Test

1-year risk (hard events)	Very low (<0.5% year)	Low (1–3% year)
Stress	Maximal	Submaximal
Resting EF	>50%	<40%
Anti-ischaemic therapy	Off	On
CFR	>2.0	<2.0

CFR, coronary flow reserve.

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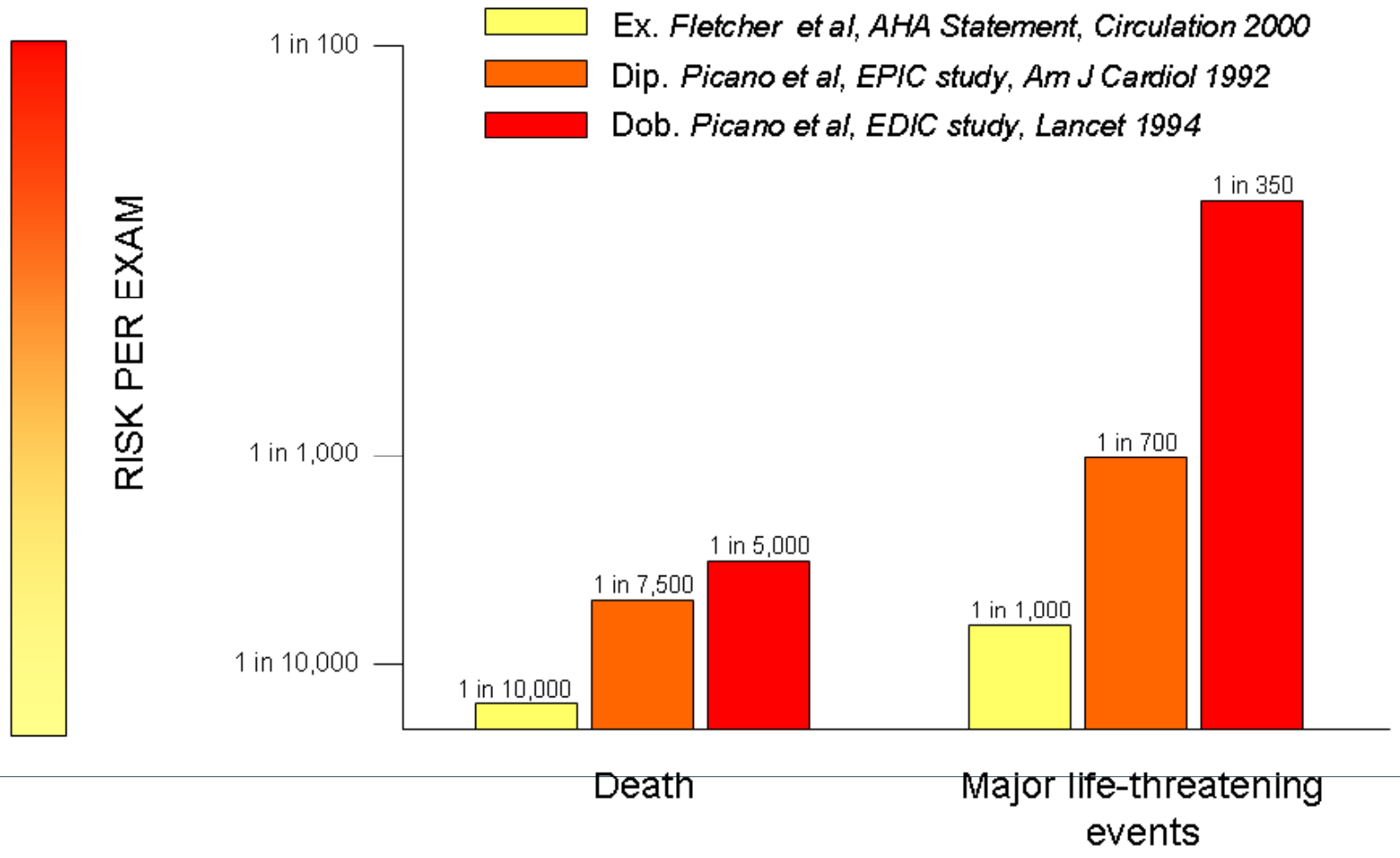
Acute risks of stress



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Stress Echo:The Safety Rules

- Avoid contraindications
- Never exceed standard dosages
- After signed informed consent
- Always physician attending
- Outpatients kept for 60’ after testing
- Indications must be class I
- Ex whenever possible, Dip first choice for pharmacological testing

Stress Echo in Special Subsets

Aortic Stenosis

	Severe AS	Pseudostenosis	Indeterminate
Aortic valve area	No change	Increase $\geq 0.3\ cm^2$	No change
Mean pressure gradient	Markedly increased	No change	No change
Stroke volume >20%	Yes	Yes	No

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Key point: In the presence of LV dysfunction and low-gradient aortic stenosis, low-dose dobutamine stress
echocardiography is recommended to assess stenosis
severity. In asymptomatic patients with severe aortic stenosis, exercise echo may play a role in decision-making.

Non-Cardiac Surgery

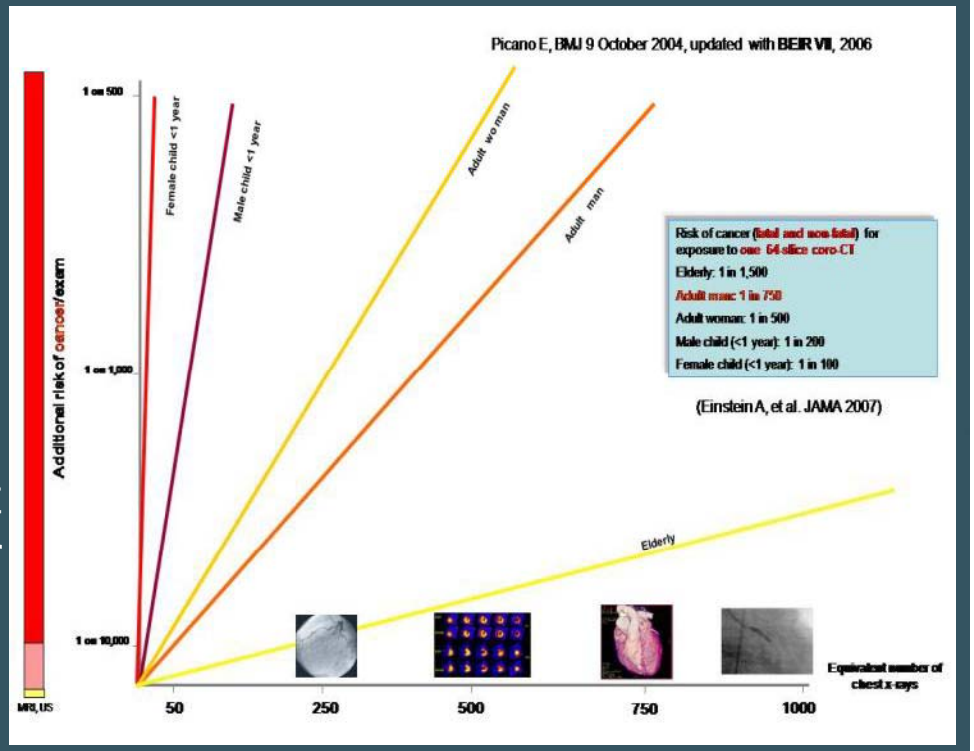
Key point: Stress echocardiography is recommended in high-risk patients with a previous history of CAD scheduled for elective high-risk surgical procedures. The test is not recommended in low-to-medium-risk patients.

Emergency Department

Key point: Stress echocardiography is recommended in patients with chest pain admitted to the ER for risk stratification purposes—especially when ECG stress test is submaximal, not feasible, or non-diagnostic.

Stress Echo vs. Competing Techniques

Key point: Stress echocardiography should be preferred due to it lower cost, wider availability and—most importantly— for the radiation-free nature. Stress scintigraphy offers similar information to stress echocardiography,
but with a radiation burden between 600 and 1300 chest X-rays for every single stress scintigraphy. This poses a significant biological risk both for the individual and for the society, since small individual risks multiplied
by millions stress tests per year become a significant population burden.



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“When similar information is obtained with ionizing and non- ionizing techniques, the latter should be employed”

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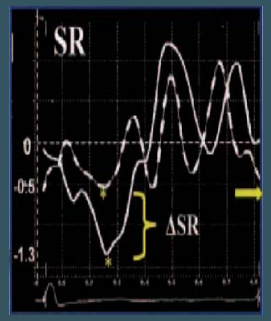
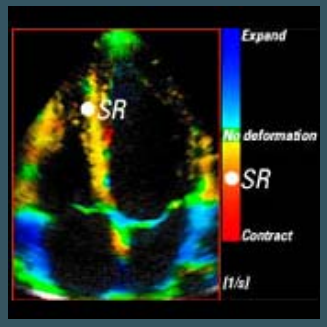
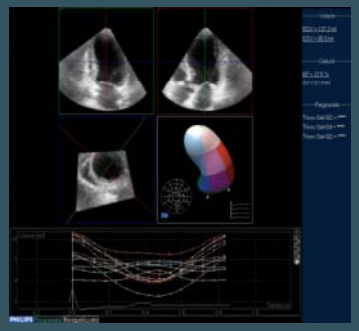
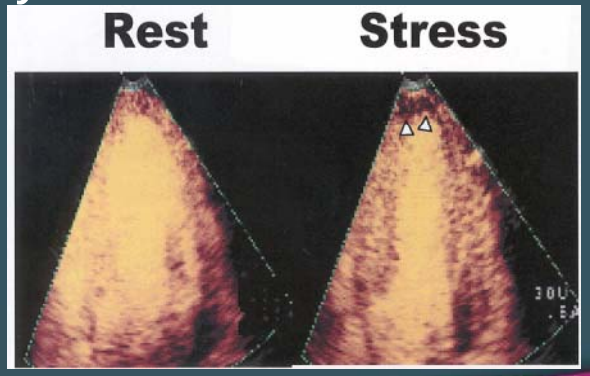
New technologies for stress

Key point: "No new technology application to stress echocardiography is routinely recommended except for contrast for endocardial border enhancement, which should be used whenever there are suboptimal resting or peak stress images. Intravenous contrast for LV opacification improves endocardial border definition and may salvage an otherwise suboptimal study."









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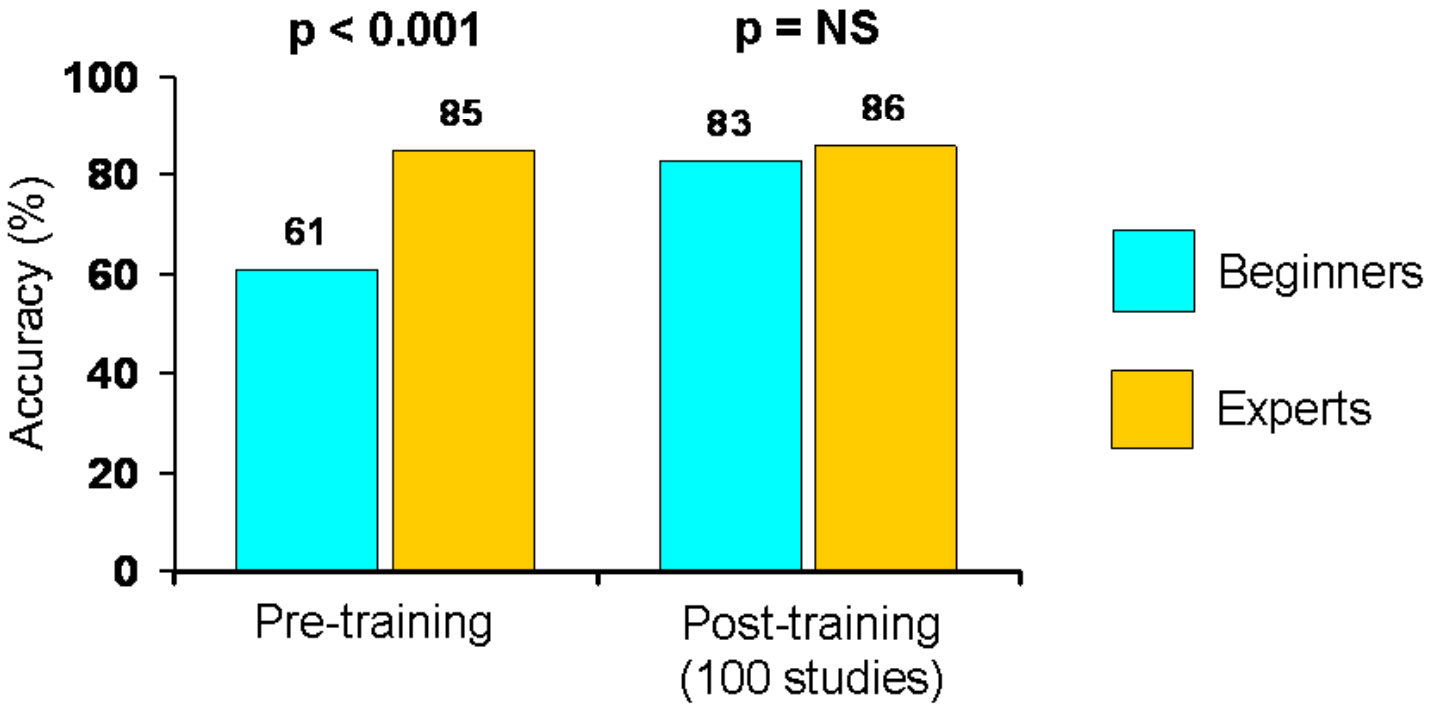
Learning curve in stress echo



Picano E et al JACC 1991;17:666

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The Training Issue

	To start	To learn	To keep competence	Top level
Competence in resting TTE	√			
BLS and ALS certification	√			
Experience with exercise-ECG	√			
100 stresses under qualified supervision		√		
100 stress echo studies per year			√	
Familiarity with all stresses (exercise, vasodil, dob)				√
Mixed caseload (ischemia, valvular, cardiomyopathy, CHD)				√
Appropriateness verification				√

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