3rd Stress Echo Interpretation Course

Stress echocardiography modalities, laboratory requirements, safety

Harald Becher MD PhD
Professor of Medicine
Heart&Stroke Foundation Chair
Alberta Heart Institute, Canada

MAZANKOWSKI
ALBERTA HEART INSTITUTE

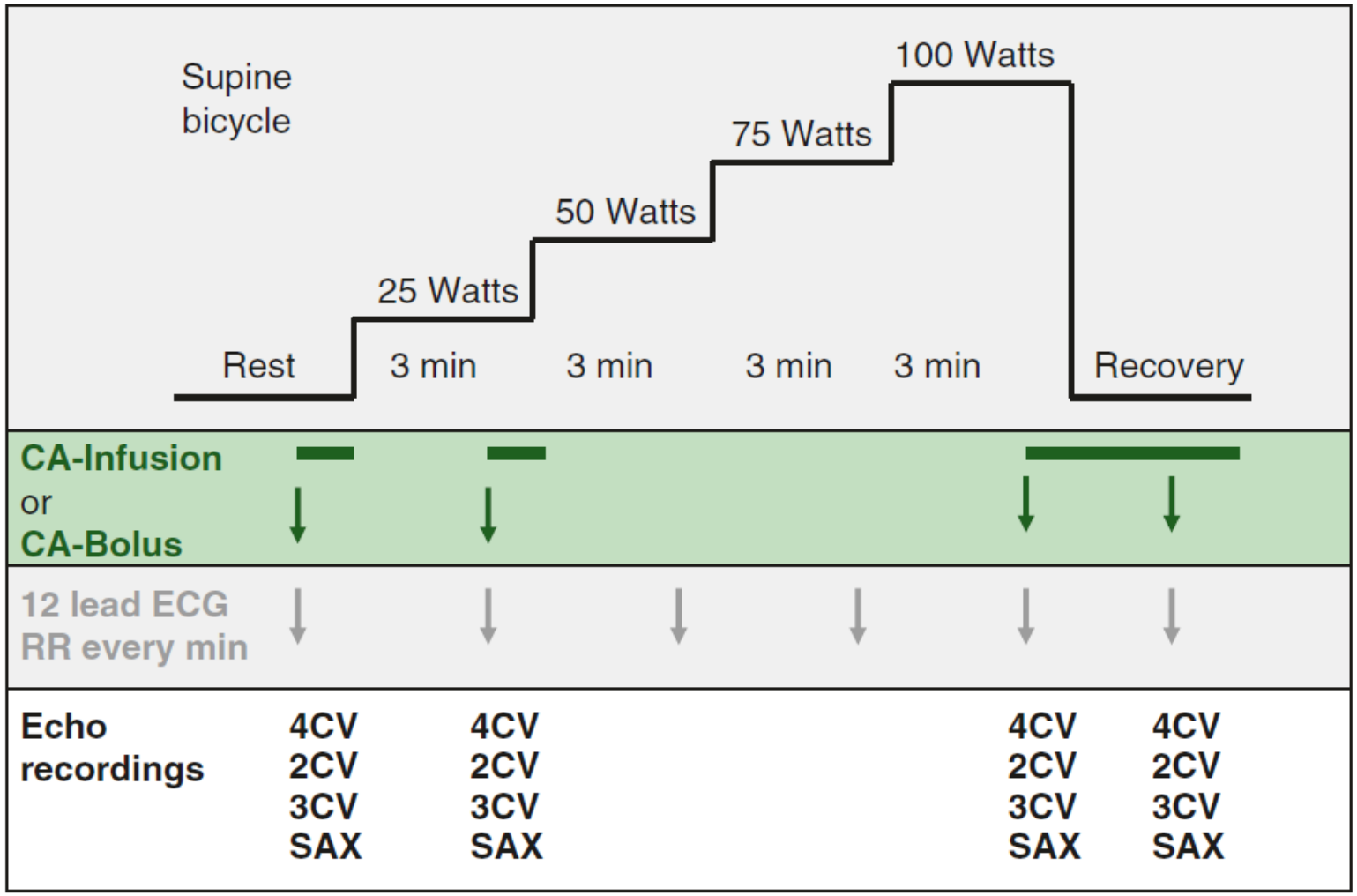
Disclosures

- Bracco Imaging: research grants, participation/analysis in multicenter studies, honoraria for presentations on Bracco sponsored workshops
- Philips Ultrasound: honorarium for presentation at Philips sponsored workshop
- Ultromics consulting
- Springer publisher, Oxford University press: book royalties

Learning goals

- Methods – selecting the appropriate stress
  - Exercise – supine bicycle
  - Dobutamine
  - Vasodilator-multiparametric stress
- Laboratory requirements
  - Staff
  - (equipment)
  - training
- Safety

Exercise stress echocardiography



MAZANKOWSKI ALBERTA HEART INSTITUTE

How to optimize recordings in supine bicycle echocardiography I

1. When attempting to see the display of the ergometer, many patients strain the abdominal muscles and narrow the spaces between the ribs by raising the head
   A comfortable support pillow for the head results in a significant improvement in image quality. This way the head is not actively raised when looking at the display
2. With this trick many patients can be scanned laying on their back or tilted 5° to the left if necessary
   The left arm should grip the handle and be lifted above the head

How to optimize recordings in supine bicycle echocardiography II

3. The transducer is placed almost horizontally to the floor and quite laterally
4. The rest images are recorded while the patient pedal without resistance. The movement of the legs changes the position of the chest and results in a surprising improvement of the image quality

[a]We owe this practical advice to Dr. S. Beckmann, Berlin

Reaching the target heart rate is no reason for termination of exercise!

When exercise is stopped at the 85% of the maximum heart rate (target heart rate), the exercise capacity and extent of myocardial ischemia may be underestimated (Jain et al. 2011). Therefore the patients should continue pedalling after reaching 85% of maximum heart rate as long as they are not exhausted or other termination criteria apply

When is exercise stress first choice?

Special echo couch for supine bicycle testing available	
High probability that the patient can reach target heart rate —85% of maximum heart rate (220 - age)	– Good mobility and motivation – Beta-blocker paused
No left bundle branch block or paced rhythm	
Patient not suitable for adenosine stress	– Suboptimal native image quality[a] (which precludes reliable assessment of myocardial perfusion) – Contraindications to adenosine (asthma, conduction abnormalities) – No expertise of the echocardiographer In CFR and myocardial perfusion

With ultrasound contrast agents the LV wall motion can be reliably assessed in patients with poor acoustic windc
However, myocardial perfusion may be limited.

When exercise stress is not possible

Consider vasodilator stress Adenosine preferable Possible with betablocker, LBBB and paced rhythm	– Good native image quality – No contraindication to adenosine (asthma, conduction abnormalities) – Expertise of the echocardiographer in CFR and myocardial perfusion
Consider dobutamine stress Ideally betablocker pause , but in patients on beta-blockers the target heart rate often can be achieved after atropine injections With a atropine injections	– Suboptimal native image quality – Contraindication to adenosine – No expertise in CFR, perfusion imaging – No left bundle branch block or paced rhythm

MAZANKOWSKI
ALBERTA HEART INSTITUTE

echo research and practice | R P Steeds *et al.* | Stress echo in coronary disease | 6:2 | G17–G33

GUIDELINES AND RECOMMENDATIONS

Stress echocardiography in coronary artery disease: a practical guideline from the British Society of Echocardiography

Richard P Steeds[1,*], Richard Wheeler[2,*], Sanjeev Bhattacharyya[3], Joseph Reiken[4], Petros Nihoyannopoulos[5,*], Roxy Senior[6,*], Mark J Monaghan[4,*] and **Vishal Sharma[7,*,†]**

[1]Department of Cardiology, Institute of Cardiovascular Science, University Hospital Birmingham, Birmingham, UK
[2]Department of Cardiology, University Hospital of Wales, Cardiff, UK
[3]Department of Cardiology, St Bartholomew's Hospital, London, UK
[4]Department of Cardiology, Kings College Hospital, London, UK
[5]Department of Cardiology, National Heart Lung Institute, Hammersmith Hospital, London, UK
[6]Department of Cardiology, Royal Brompton Hospital, London, UK
[7]Department of Cardiology, Royal Liverpool and Broadgreen University Hospital, Liverpool, UK

2019 BSE guidelines: equipment requirements for stress echocardiography

All cases

1. Digital echocardiography machine with appropriate SE analysis package.
2. Automated blood pressure machine with manual back up if needed.
3. Continuous ECG monitoring.
4. Fully equipped resuscitation trolley with defibrillator.
5. Oxygen supply and suction.
6. Availability of transpulmonary contrast when echo window is suboptimal.
7. Drugs to manage severe allergic reactions and anaphylactic shock. To include – IV/IM adrenaline 1:1000, IV chlorpheniramine, IV hydrocortisone, salbutamol nebuliser – in dose and preparation to meet current Resuscitation UK guidelines
8. Cannulation equipment

2019 BSE guidelines: equipment requirements for stress echocardiography

Specific to exercise stress echo

1. Exercise treadmill and/or semi-supine bike with protocol options.

Specific to dobutamine stress echo

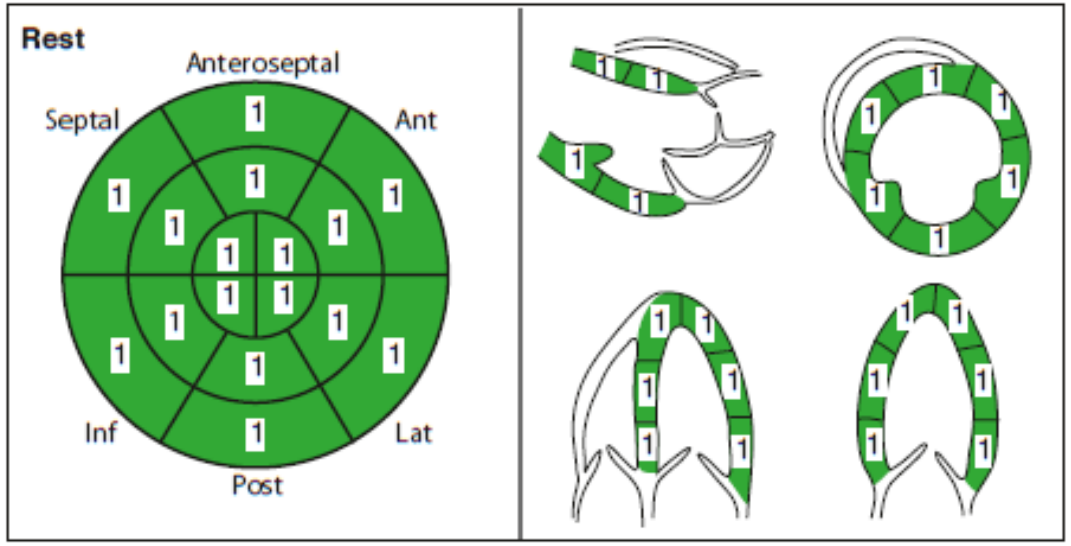
1. Dobutamine infusion and administration pump.
2. IV Atropine – up to 1.2 mg.
3. IV beta-blockers e.g. metoprolol.

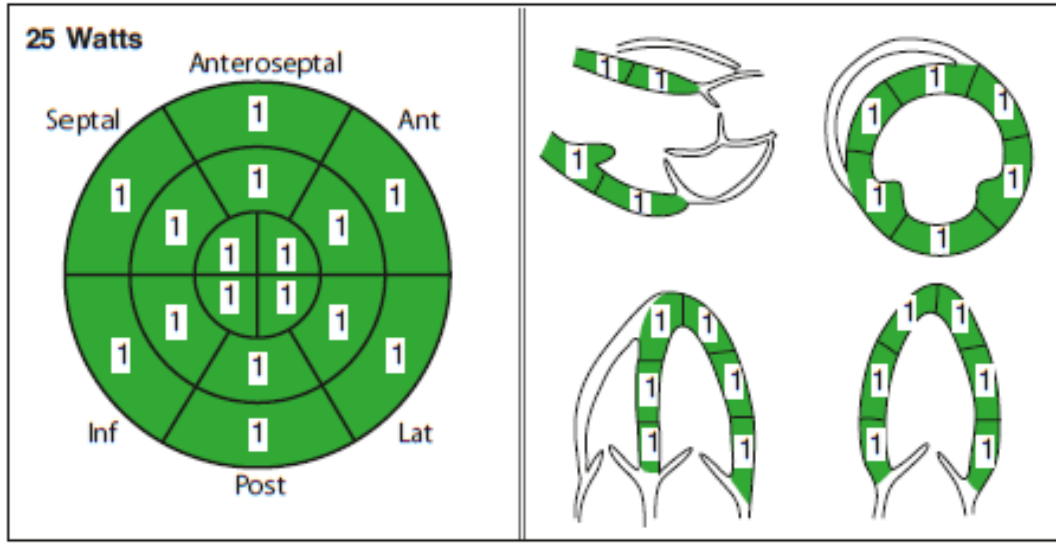
2019 BSE guidelines: staff

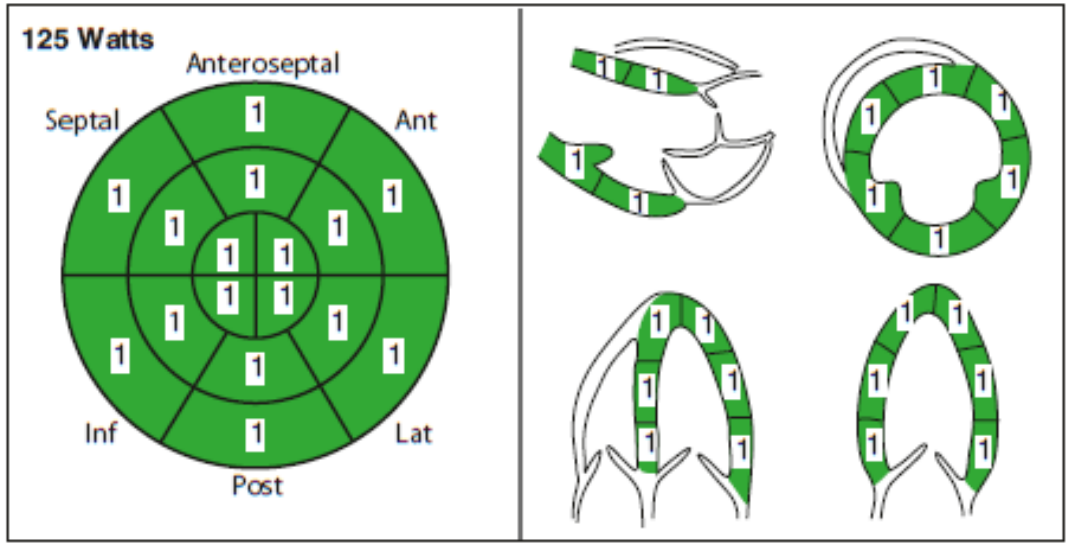
A minimum of two individuals are required

1. **Sonographer/Physician:** for scanning
   BSE TTE Proficiency Accreditation or equivalent
   BSE stress echo accreditation desirable

2. **clinician, nurse, cardiac physiologist, clinician:**
   for haemodynamic monitoring,
   ECG acquisition and drug administration





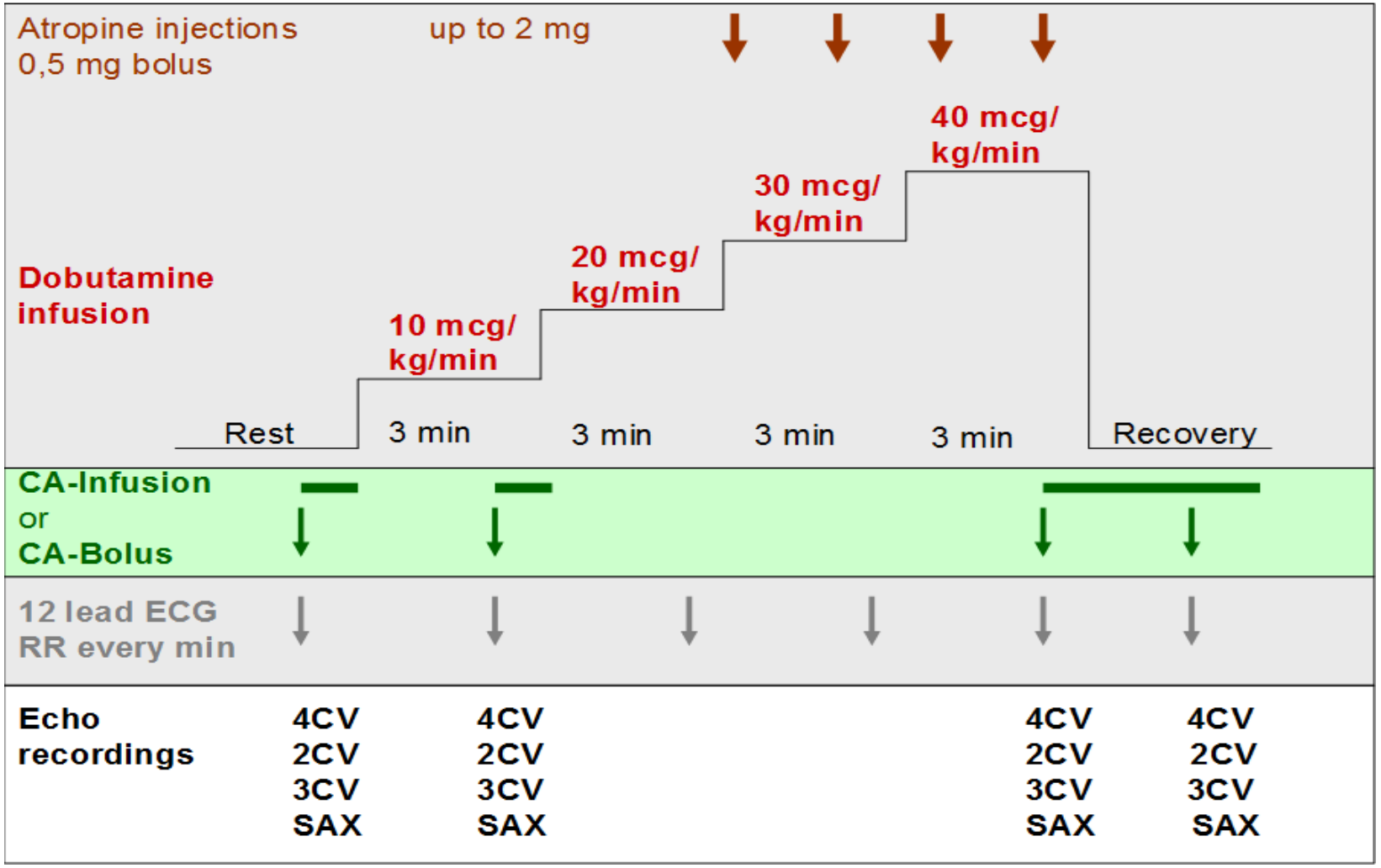


Stage	Heart rate (bpm)	Blood pressure
Rest	69	114/71
25 Watts	111	140/80
125 Watts	160	187/100

91% maximum predicted heart rate
RR × HR 30668
No significant ECG changes


ECHO 1

Dobutamine Stress Echocardiography
- assessment of LV wall motion -

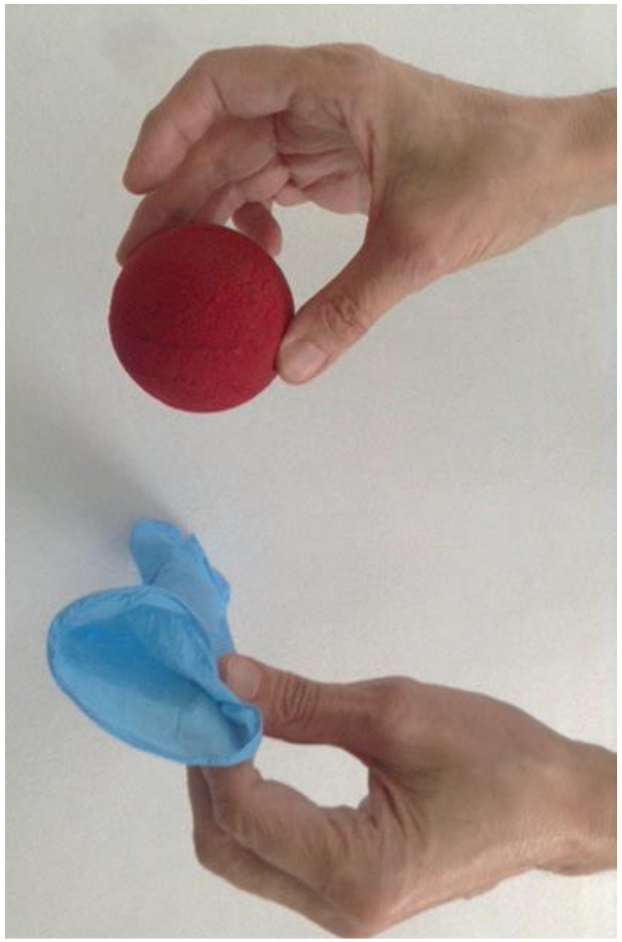


Endpoints

- Reach target heart rate

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

Handgrip exercise
to mitigate discomfort during dobutamine stress

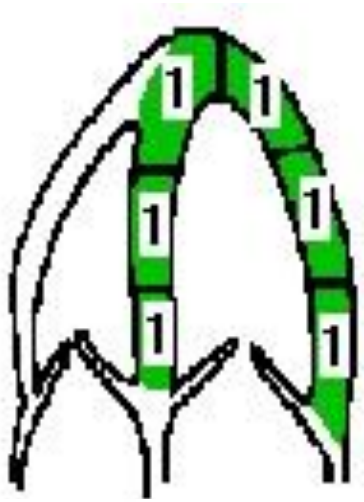


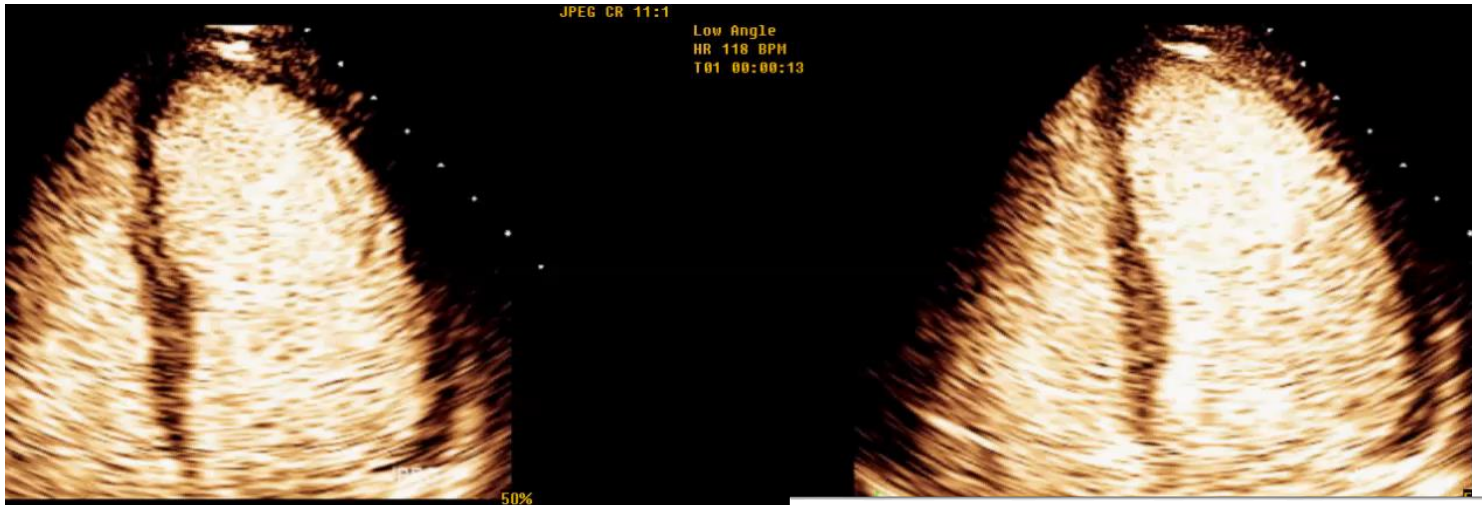
When to stop dobutamine infusion?

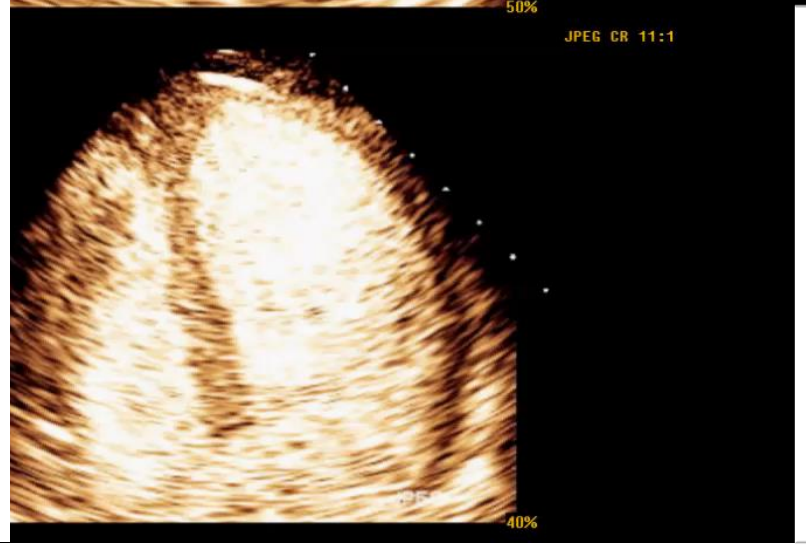
1. Target heart rate
2. Severe chest pain, shortness of breath
3. Arrhythmias: atrial fibrillation, ventricular arrhythmias
4. Systolic blood pressure >240 mmHg, diastolic blood pressure >120 mmHg
5. Drop in systolic pressure, drop >20 mmHg
6. New LV wall motion abnormalities in >2 segments

Rest

10µg/kg/min Dobutamine

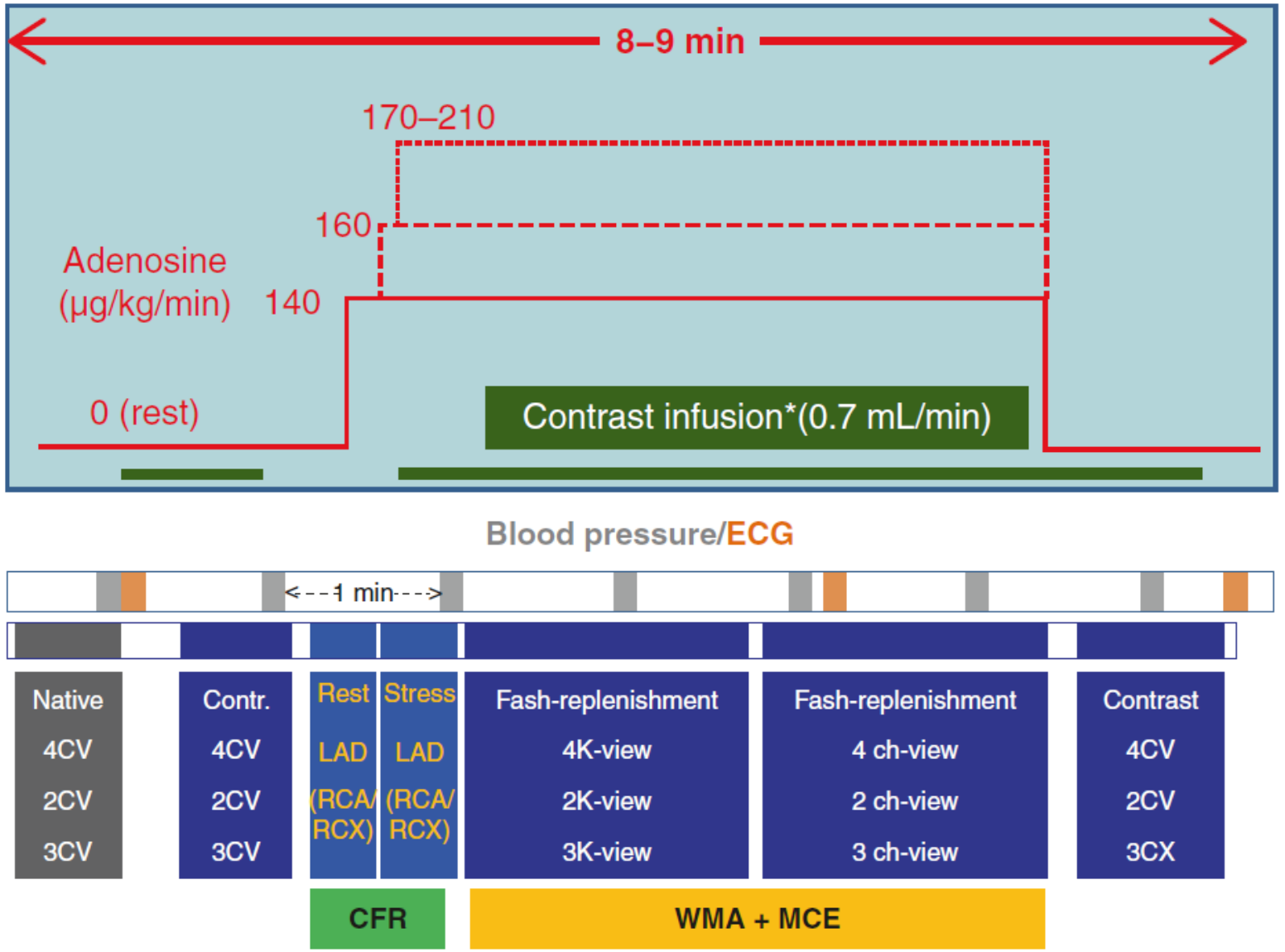






20µg/kg/min Dobutamine target heart rate achieved

The future


8–9 min
170–210
160
Adenosine
(µg/kg/min)
140
0 (rest)
Contrast infusion*(0.7 mL/min)
Blood pressure/ECG
<---1 min--->
Native
4CV
2CV
3CV
Contr.
4CV
2CV
3CV
Rest
LAD
(RCA/
RCX)
Stress
LAD
(RCA/
RCX)
Fash-replenishment
4K-view
2K-view
3K-view
Fash-replenishment
4 ch-view
2 ch-view
3 ch-view
Contrast
4CV
2CV
3CX
CFR
WMA + MCE

Stress Echocardiography - safety

	Major life-threatening effects (myocardial infarction, ventricular fibrillation, sustained ventricular tachycardia, stroke)
exercise stress	1 in 6000 tests
dobutamine	1 in 600 tests
dipyridamole	1 in 1200 tests

Sicari and Cortigiani Cardiovascular Ultrasound (2017) 15:7