Dobutamine stress MRI versus three-dimensional contrast echocardiography: It's all Black and White

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Dobutamine stress magnetic resonance imaging is considered the superior stress modality to detect wall motion abnormalities. In this report we demonstrate the strengths of a newly developed stress modality: dobutamine stress contrast-enhanced real-time three-dimensional echocardiography. This stress modality may become a competitor of stress magnetic resonance imaging allowing fast acquisition and an unlimited number of left ventricular cross sections. Unfortunately, at the moment adequate imaging with stress real-time three-dimensional echocardiography is only possible in a minority of cardiac patients. (*Neth Heart J* 2008;16:217-8.)

Keywords: stress echocardiography, contrast echocardiography, magnetic resonance imaging, three-dimensional

Two-dimensional stress echocardiography (DSE) has become a well-established stress modality for the detection of coronary artery disease (CAD).¹ However,

the number of left ventricular cross sections and in particular variable image quality may limit this imaging modality. Magnetic resonance imaging (MRI) overcomes these limitations and in stress MRI studies superior results with respect to the diagnosis of CAD were reported.² More recently, the diagnostic accuracy of DSE has been improved by new developments such as second harmonic imaging,³ contrast imaging⁴ and three-dimensional imaging.⁵ The optimal DSE test may include the use of all these new techniques in combination. In this article we show the imaging potentials of dobutamine stress real-time three-dimensional contrast-enhanced echocardiography (RT3DE), simulating a stress MRI study with respect to unlimited left ventricular cross sections and image quality.

Case study

A 65-year-old woman was admitted to our outpatient clinic for preoperative risk stratification (infected knee prosthesis). For several years she had been experiencing stable angina. Risk factors for coronary artery disease were negative. Because of her symptoms and orthopaedic problems (that precluded an exercise test) dobutamine stress MRI was performed. During dobutamine stress (40 µg/kg/min) the heart rate increased from 75 to 125 beats/min (target heart rate was 115 beats/min) and blood pressure increased from 120/75 to 125/65 mmHg. The patient did not experience angina, nor were electrocardiographic signs of myocardial ischaemia seen. Routine four-chamber, two-chamber and three-chamber views and basal, mid and apical short axes were recorded at rest, low-dose and peak stress. To show the capabilities of stress RT3DE, this study was performed several weeks apart from the stress MRI study using a Sonos 7500 ultrasound system (Philips, Best, the Netherlands) attached to an X4 matrix-array transducer and repeated SonoVue boluses of 0.5 ml. During stress RT3DE similar haemodynamic data were achieved (stress heart rate 123 beats/min).

As seen in figures 1 and 2, identical left ventricular cross sections (short-axis views at basal, mid and apical level and long-axis views) could be cropped out of the three-dimensional dataset.

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Figure 1A, B and C. Identical left ventricular cross sections (short-axis views at apical, mid and basal level) by stress MRI and RT3DE with and without LVO. LVO=left ventricular opacification, MRI=magnetic resonance imaging, RT3DE=real-time three-dimensional echocardiography.

Figure 2. Apical four-chamber views by stress MRI and RT3DE with and without LVO. LVO=left ventricular opacification, MR=magnetic resonance imaging, RT3DE=real-time three-dimensional echocardiography.

Discussion

During stress RT3DE it takes only seven cardiac cycles (3 to 5 seconds at peak stress) to record a full three-dimensional dataset. Subsequently, an unlimited number of left ventricular cross sections can be cropped out of this dataset. Contrast-enhanced images have been shown to improve left ventricular endocardial border detection and to increase the diagnostic accuracy of conventional DSE.⁴ In our experience echo contrast is mandatory in most stress RT3DE studies because image quality is somewhat lower compared with conventional two-dimensional imaging (because of lower resolution and frame rate).⁶ Eventually, contrast-enhanced stress RT3DE may become a competitor of stress MRI allowing fast acquisition and an unlimited number of left ventricular cross sections. However, at

the moment adequate imaging with stress RT3DE is only possible in a minority of cardiac patients. Although stress MRI may be limited by local availability and not all patients can undergo this test due to claustrophobia (in approximately 5% of patients) or contraindications such as noncompatible biometallic implants and pace-makers or implanted cardiac defibrillators, stress MRI should be considered the gold standard test to induce and visualise myocardial ischaemia.^{7,8} Stress MRI is well suited for overcoming the limitations of DSE. It has no acoustic window limitations and thus can comprehensively visualise the left ventricular myocardium regardless of body habitus. ■

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