Stress echo is a study for the evaluation and management of Coronary Artery Disease (CAD). During a stress echo, images of the heart are acquired before and after exercise or pharmacological stress. Those images are subsequently compared by the cardiologist. In the presence of CAD, the affected regions of the heart will have abnormal wall motion and potentially reduced ejection fraction.

In a 2007 article from heart.org regarding the current American Society of Echocardiography (ASE) Guidelines on Stress Echo, Dr. Patricia A. Pellikka (Mayo Clinic, Rochester, MN) indicated that since 1998 there has been a wealth of outcomes data published on the role of stress echo in predicting myocardial viability. “But that's not all. One of the special things about stress echo is that it is so versatile, you get so much information from this stress test, and this document recommends that you include all that information in your interpretation. You are not just looking at whether or not there is ischemic heart disease (IHD). You can also take a look at the valves, the aorta, the chamber sizes, and wall thickness, and these things might just help you to recognize other causes of chest pain besides IHD.” Stress echo provides “so much information that isn’t available with other tests, such as nuclear cardiology, and has the advantage of not requiring radiation,” Pellikka continues. Also, it can be performed at lower costs (Nainggalon, 2007).

The ASE Guidelines for Stress Echo include recommendations on optimizing a stress echo program with methods of testing and interpretation, including recommendations on strain imaging.

**Issues at Hand**

Most stress echo studies rely on subjective, visual wall motion assessment and ejection fraction estimation. When the wall motion is adequately imaged, stress echocardiography is an excellent test for the diagnosis and management of cardiac disease. However, the diagnostic quality of studies vary, with many being un-interpretable due to a variety of technical issues. Reduced image quality leads to difficulties visualizing wall motion. Furthermore, subtle changes in contractility, image translation due to respiratory or probe motion, and poor distinction between myocardium and nearby tissues (e.g., trabecula and chord) present challenges for interpretation. Because of these complexities, this test requires significant training and experience to interpret. Being a subjective test, diagnostic accuracy and inter-reader variability can be an issue as study quality degrades and tissue dynamics become more complex. The more challenging studies require longer interpretation time and result in lower accuracy.

**Power of Strain Imaging for Stress Echo Studies**

Strain imaging provides additional information on tissue motion and contraction to assist interpretation of stress echo studies. The greatest benefit may be for poor quality
Strain Imaging can provide repeatable assessment of regional heart mechanics and consistent global functional parameters (e.g., EF and volumes). This added information can reduce interpretation time on demanding cases and increase confidence. Quantification of left ventricle (LV) function can also reduce variability between readers. Research on the diagnostic utility of using strain for stress echo has been presented over the past five years yielding capabilities upwards of 86% sensitivity and 89% specificity in detecting coronary artery disease (Voigt, et al., 2003). In addition, strain imaging has been shown to have clinical value for other applications such as heart failure, cardio oncology, cardiomyopathies, and cardiac resynchronization therapy (CRT).

Despite the benefits, strain imaging has not received broad acceptance as the software solutions have been research-oriented, vendor-specific and cumbersome to use in clinical practice.

The Solution to Today’s Stress Echo Challenges

As a vendor-neutral, intuitive software platform, EchoInsight for Stress Echo is the solution for today’s challenges in stress echo. At EchoInsight for Stress Echo’s core are proprietary speckle tracking algorithms for assessment of LV wall motion and automatic chamber function analysis based on a user defined region of interest. Wall and chamber function measurements are produced by tracking the distinct signature of speckle in every region of the LV. By measuring speckle movement from frame to frame, tissue displacement and velocity of each region is determined, as illustrated in Figure 1. The arrows in the image on the far right indicate the location of each region of tracking and the length of the arrow shows the regional velocity. From this tracking, strain (i.e., deformation) can be measured, which reflects myocardium contraction. Epsilon’s speckle tracking is designed for routine clinical use, and has been shown to provide repeatable assessment of heart mechanical function (Negishi 2013, Kraigher-Krainer 2012, Hamilton 2010) and ex-vivo models (Lucas 2011).

Furthermore, validation of tracking accuracy has been done using sonomicrometry (Lucas 2011, Ashraf 2010).

EchoInsight for Stress Echo describes LV motion using wall and chamber function measurements. Wall function is described by deformation, which is combination of longitudinal and transverse (radial) strain. Wall Deformation represents the shortening (longitudinal) and thickening (transverse) of the myocardium through systole, as illustrated in Figure 2. Chamber function, illustrated in Figure 3, is described by the regional area change of the cavity through systole. That is, it describes the rate of cavity size reduction, which is related to pumping function. These metrics correspond to visual cues used by clinicians for qualitative assessment of stress echo image loops like systolic wall thickening and chamber reduction.
Workflow-Enhancing Strain Imaging With Parametric Displays for Improved Stress Echo

EchoInsight for Stress Echo combines robust, proprietary speckle tracking algorithms with an easy to use, workflow-enhancing software platform offering parametric displays to aid clinicians in achieving improved confidence in regional and global assessment of LV function.

In Epsilon’s solution, speckle tracking provides consistent myocardial strain and chamber size measurements based on a user defined region of interest. This strain imaging technology is combined with a simplified workflow solution, including intuitive visualization and efficient analysis tools, providing streamlined assessment of LV function.

Unique features include a parametric display of overall ventricle function, providing a novel, quick glance assessment of the patient’s response to exercise. The graphic, shown in Figure 4, displays average wall and chamber function, for both rest and stress conditions, through a 2D plot. Response to exercise is visualized by an arrow drawn between the rest and stress measurements. In addition to the stream-lined interpretation offered by quick look response summary, detailed regional function information is provided through 2D graphical snap-shots of the ventricle which are color-encoded based on speckle tracking measurements. An example is presented in Figure 5. In addition, composite information is provided using Bull’s Eye graphics, showing full ventricle behavior by combining measurements from apical 2,3 and 4 chamber views as illustrated in Figure 6.

EchoInsight products connect to information technology (IT) networks, providing quick access and analysis of data from scanners and PACS (picture archiving and communication systems). Study results, including strain imaging measurements, heart rate information, clinician wall motion assessment, and ejection fraction are summarized in a report that can be exported in a number of different forms, including achieving in PACS.

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Figure 3
Chamber function measured by area rate

End Diastole  End Systole

Area rate describes change in chamber size through systole

Figure 5
Display of regional wall and chamber function

Figure 4
Graphical overview of rest and stress function

Figure 6
Full ventricle regional function, rest and stress
EchoInsight for Stress Echo

Until now, strain imaging has traditionally been research oriented, cumbersome to use and usually vendor specific. EchoInsight is a vendor-neutral software platform that provides visualization and analysis with practical strain imaging for streamlined workflow in the clinical environment. Developed in collaboration with cardiologists, EchoInsight aids clinicians in transforming the way they analyze and interpret echo studies.

EchoInsight for Stress Echo assists clinicians to quickly and easily integrate strain imaging into their program, and improve patient management. Features include automated processing, rapid rest-stress comparison, global and regional wall and chamber function analysis based on strain and area rate, clear, concise, highly reliable and detailed visual based reporting to aid patient management and customized integration to customer healthcare IT workflow.


Learn more about integrating EchoInsight for Stress Echo into your practice: www.epsilon-imaging.com.