GE Healthcare

Automated Function Imaging (AFI)

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Overview

Automated Function Imaging (AFI) provides a clinical decision support tool for assessing left ventricular function at rest. When left ventricular function can be visualized, yet assessment is questionable, AFI uses computerized quantitative assessment to highlight potential wall motion abnormalities. AFI can also potentially be used to differentiate disease from non-disease segments, and to learn more about the various strain patterns indicative of specific disease types.

The computerized assessment presents the data in four different modes: a parametric image, an anatomical M-Mode, a strain graph and bull's-eye display. The AFI algorithm non-invasively tracks and analyzes peak systolic strain based on 2D strain.

In addition to providing clinical decision support, AFI also decreases LV function assessment variability and streamlines workflow while improving laboratory quality assurance. The clinician selects the views to activate the algorithm, marks aortic valve closure timing critical to accuracy, and then anchors three points inside the myocardial tissue. The algorithm differentiates tissue from blood space to improve accuracy when defining the region of interest.

The three-click method minimizes variability potentially created in a manual tracing process. Two points placed at the base along the mitral valve annulus, and one at the apex, triggers the automated process. The clinicians can override the processed image results at any time.

AFI is available on Vivid™ 7 Dimension system and EchoPAC™ workstation with Breakthrough 2006. It can process and analyze data acquired on any GE Vivid product that meets the algorithm's minimum requirements.

How AFI works

The algorithm tracks the percent of wall lengthening and shortening in a set of three longitudinal 2D-image planes (apical long, two chamber and four chamber) and displays the results for each plane. It then combines the results of all three planes in a single bull's-eye summary, which presents the analysis for each segment along with a global peak systolic value for the left ventricle.

Similar in concept to MRI tagging, AFI objectively analyzes myocardial motion by tracking features ("natural acoustic tags") in the ultrasonic image in two dimensions (see Figure 1). AFI could potentially be used to differentiate disease from non-disease segments, and to learn more about the various strain patterns indicative of specific disease types. AFI is not a border detection program.

Integrating into clinical practice

AFI is easily integrated in routine clinical practice. The following steps require little time to become proficient.

Vivid 7 Dimension AFI Acquisition

- Acquire APLAX, A4-C and A2-C and store. Acquiring all views at the same time will assure similar heart rate.

V7 Dimension and EchoPAC Analysis

Measurement:

- Load APLAX view, press Measure and select AFI folder. Then define APLAX view.
- Define ROI by following instructions on screen.
- Assess tracking, then press Approve.
- Adjust AVC closure by preferred method.
- Repeat the define and assess process for A4C and A2C.

Analysis:

- Press Bull's-eye Display key and Lower Panel Assign key. Then press Store.

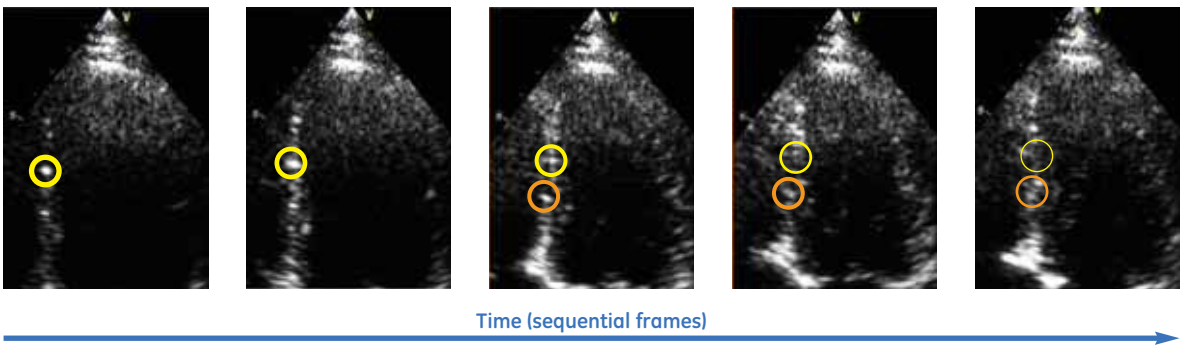


Figure 1.
Motion and velocities are analyzed by calculating frame-to-frame changes using "natural acoustic tagging." New features (orange circles) keep coming into the image as old ones (yellow circles) fade away.

Case study one

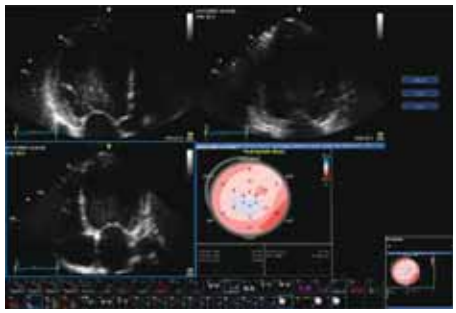
Evaluating cardiomyopathy correlating AFI with MRI

Optimization tip:

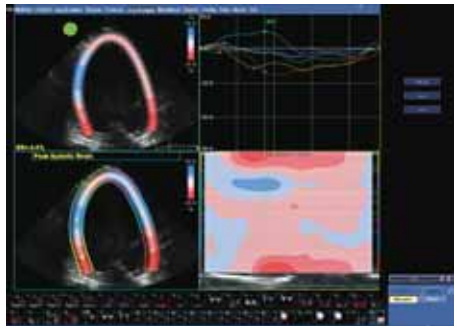
Acquire all three apical views sequentially to get similar heart rate. The algorithm accepts 40-70 frames per second with or without dual focus.

Workflow tip:

The bull's-eye button is active when all three apical views are analyzed.



This patient had an MRI study showing diffuse scar with a regionally viable area that localized very well on the AFI strain bull's-eye.



Display of the 2D parametric image, anatomical M-Mode, strain graph and bull's-eye for each plane helps the clinician build knowledge of the patient's heart before the three planes are combined for final result.

Optimization tip:

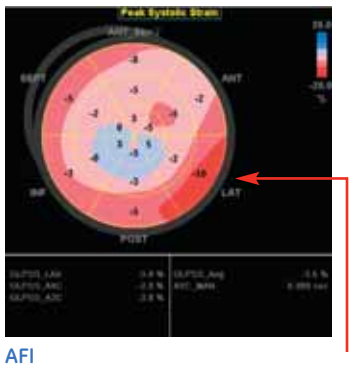
Aortic Valve Closure (AVC), which is critical to the accuracy of results, can be set by the user before AFI processing and adjusted after processing.

Workflow tip:

To adjust AVC once it is defined and confirmed:
1. Use the AVC rotary on the scanner
2. Move cursor AVC marker on the EPPC

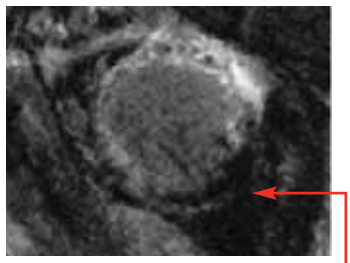
Workflow tip:

Store the quad screen to the clipboard for documentation and use later in the report.



AFI

The patient has non-ischemic cardiomyopathy with global hypokinesis and akinesis on MRI. AFI displays viable tissue in the lateral wall.



MRI

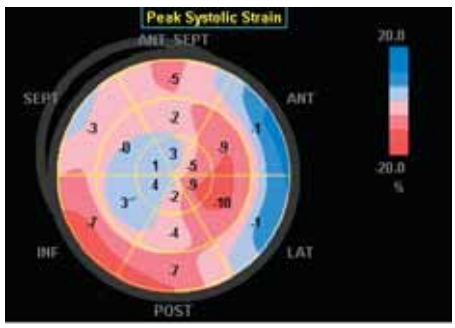
The contrast-enhanced MRI in the short axis shows extensive transmural scar with relative preservation of the lateral wall.

Case study two

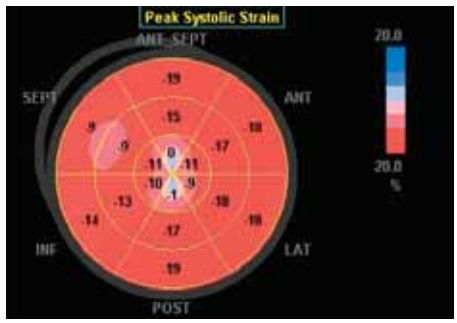
Evaluating myocarditis

Quick tip:

A full set of data is stored to the worksheet when storing bull's-eye.



Myocarditis



Recovery

The bull's-eye parametric image of the peak systolic deformation (strain) is from a patient with myocarditis. The left image was taken at the onset of the disease. The right image is after recovery.

References:

1. Becker M, Bilke E, Kuhl H, Katoh M, Kramann R, Franke A, Bucker A, Hanrath P, Hoffmann R. Analysis of myocardial deformation based on pixel tracking in 2D echocardiographic images allows quantitative assessment of regional left ventricular function. Heart. 2005 Dec 30;published online.
2. Korinek J, Wang J, Sengupta P, Miyazaki C, Kjaergaard J, McMahon E, Abraham T, Belohlavek M. Two-dimensional strain–doppler-independent ultrasound method for quantitation of regional deformation: validation in vitro and in vivo. J Am Soc Echocardiogr. 2005;18(12):1247-1253.
3. Reisner SA, Lysyansky P, Agmon Y, Mutlak D, Lessick J, Friedman Z. Global longitudinal strain: a novel index of left ventricular systolic function. J Am Soc Echocardiogr. 2004;17(6):630-633.

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ULTC-0137-05.06-EN-US