Tissue Synchronization Imaging (TSI)

According to recent estimates, 4.7 million patients in the United States and 10 million patients worldwide have chronic heart failure. This number is increasing rapidly, with over 500,000 new cases diagnosed each year in the U.S. alone.

Recent studies have demonstrated the clinical benefits of cardiac resynchronization therapy (CRT), including improved heart failure symptoms, quality-of-life, exercise capacity and left ventricular (LV) systolic performance.

Up to 30% of heart failure patients are candidates for CRT, but not all of these patients respond. CRT is effective in approximately 60% of patients undergoing therapy.

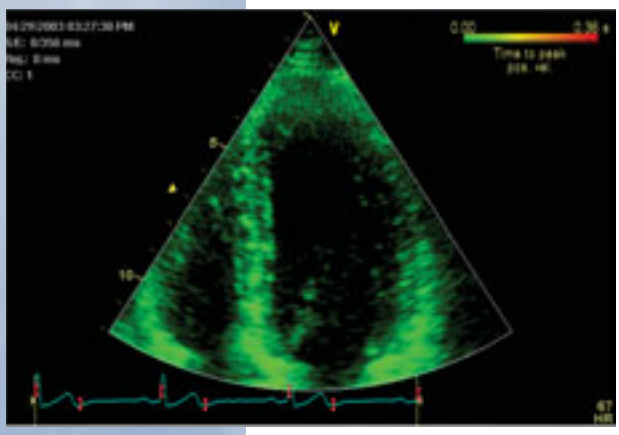
Critical to improving the cost effectiveness of this technique is the development of better quantitative and qualitative tools capable of predicting response to the therapy before implantation.

A leading innovator in quantitative assessment of left ventricular wall motion and function

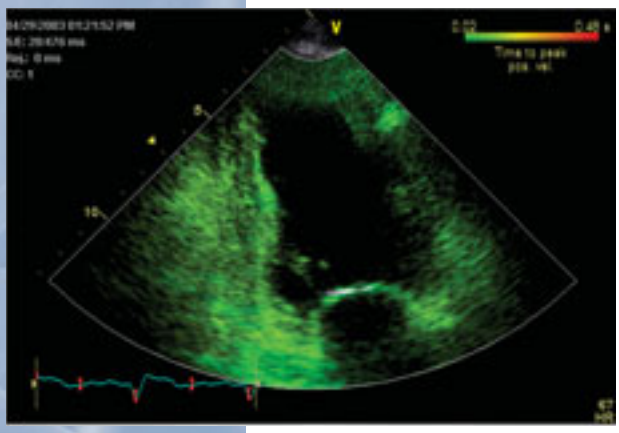
In recent years, GE Medical Systems has introduced breakthrough ultrasound tools based on leading-edge technologies, such as Tissue Velocity Imaging (TVI), Tissue Tracking, Strain and Strain Rate Imaging. These tools provide precise, quantitative measurement of regional wall motion and function, while adding new parametric imaging options.

These new technologies have proven beneficial for evaluating regional myocardial motion before, during and after cardiac resynchronization. Researchers have used them to begin developing echocardiography indices for identifying appropriate patients for CRT, determining proper lead placement, quantification of normal/abnormal and optimizing timing delays after implantation.

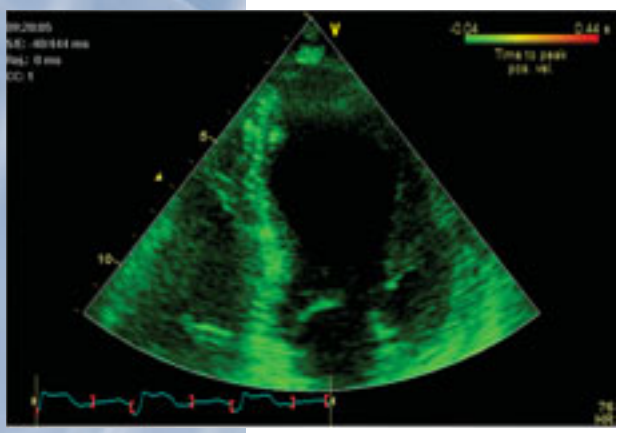
Normal



Before CRT



After CRT



TSI parametric image of the left ventricle before and after implantation of a biventricular pacemaker. In the first image, much of the lateral wall is red, which indicates that the peak contraction toward the apex occurs after end of systole. Delayed peak velocity is present in this area. The second, post-CRT image shows improvement in the proportion of normally contracting myocardium in the lateral wall. Abnormal distribution of myocardial motion has been normalized, so the image appears green.

Introducing a breakthrough quantitative parametric imaging tool

In October 2002, GE Medical Systems held a summit with the top 40 luminaries in Tissue Tracking, Strain and Strain Rate Imaging to gather input for the development of innovative new parametric imaging tools. Overwhelmingly, researchers demanded an easy-to-understand tool that would simplify analysis of patients who are candidates for, or who are undergoing, CRT.

Committed to annual clinical breakthroughs, GE Medical Systems immediately set about developing such technology for release with the Vivid 7 Vantage system. The result is a new parametric imaging technique – Tissue Synchronization Imaging (TSI) – for understanding synchronicity of biventricular pacing.

The next level of echocardiography gets the green light

TSI leverages GE's leadership in LV quantification and TVI technology, and employs the latest breakthroughs in Tissue Tracking, Strain and Strain Rate Imaging.

TSI employs a simple-to-use "red light/green light" approach, which provides visualization of the extent of myocardium with delayed peak velocity. This at-a-glance assessment helps determine whether additional quantitative research is required. Like Tissue Tracking, users can easily access quantification methods within the Vivid 7 Vantage system or the Vivid 7 Vantage EchoPAC offline PC.

Here's how it works: TSI uses the time-to-peak velocity parameter, a commonly accepted indicator of ventricular asynchrony. For each part of the myocardial tissue, the peak positive velocity during the ejection and the early part of diastole is automatically detected, and the time from the last QRS to the peak is stored. TSI creates a color map of the left ventricle, in which colors represent the time-to-peak contraction velocity: green represents early contracting tissue and red represents late contracting tissue.

Screening tool for identifying CRT patients

TSI provides an excellent assessment before, during and after CRT. As a screening tool, TSI can be used by the echocardiographer and the electrophysiologist in determining which patients should be considered for CRT therapy.

By imaging the timing of peak systolic velocity, TSI indicates asynchrony within the LV. Based on the assessment of this variable, TSI can be used to help accurately evaluate electromechanical coupling, which may improve identification of patients who may benefit from CRT prior to implantation of a biventricular pacemaker.

Research is ongoing to determine how TSI can be used for lead placement in the EP lab during pacemaker implantation. By providing an at-a-glance view of asynchrony within the left ventricle, TSI may prove useful for optimizing pacemaker programming.

Post-implantation analysis

Research also continues to determine TSI's use in evaluating patients' response to CRT post-implantation. A recent study concluded that measuring the time-to-peak systole adds important information regarding the location and reduction of mechanical LV asynchrony during CRT. Research suggests that TSI may be useful for optimizing AV and VV timing delays. Several recent studies have concluded that tissue Doppler echocardiography may be the ideal method for optimizing AV delay and assessing LV filling and cardiac output.

TSI may eventually prove useful for treating NYHA Class II/III/IV heart failure patients. Currently, echocardiography is used only for routine assessment of ejection fraction or time-consuming conventional Doppler measurements. TSI could be added to the clinical pathway for these patients to provide a more accurate assessment of their treatment and progress.

TSI software is available as an option for GE's new Vivid 7 Vantage release. The Vivid 7 Vantage includes numerous image quality improvements, as well as workflow and productivity enhancements, advanced functionality and even broader applications.

For more than 100 years, healthcare providers worldwide have relied on GE Medical Systems for medical technology, services and productivity solutions.

So no matter what challenges your healthcare system faces – you can always count on GE to help you deliver the highest quality healthcare.

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Internet – gemedical.com
GE Medical Systems – Americas: Fax 262-544-3384
P.O. Box 414, Milwaukee, Wisconsin 53201 U.S.A.
GE Medical Systems – Europe: Fax 49-212-28-02-28
Solingen, Germany
GE Medical Systems – Asia:
Tokyo, Japan – Fax: +81-425-85-5490
Hong Kong – Fax: +852-2559-3588