SQUEEZing a Guide to Resynch Targets Out of CT and ECG Data

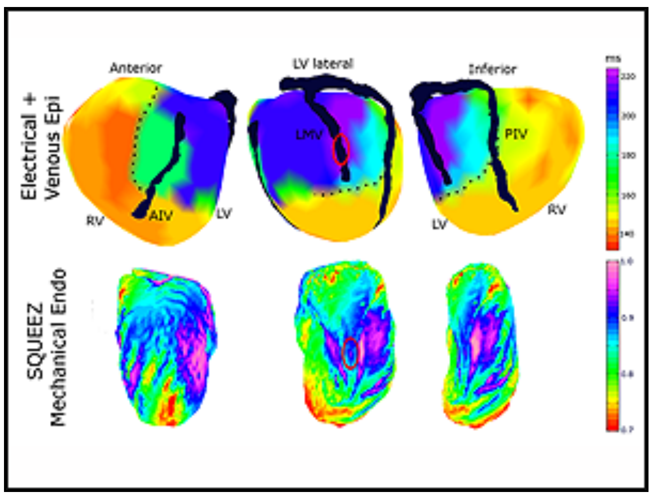
Reed Miller | July 30, 2012

July 30, 2012 (Baltimore, Maryland) — Computed tomography (CT), used in conjunction with ECG imaging (ECGI), may soon be used to guide the placement of leads for cardiac resynchronization therapy (CRT) [1].

At the Society of Cardiovascular Computed Tomography (SCCT) 2012 Annual Scientific Meeting, **Dr Fady Dawoud** (Johns Hopkins University, Baltimore) presented promising results of an animal study showing that CT and ECGI information can be translated into a map that not only helps to identify the best candidates for CRT therapy but can also guide CRT lead placement.

Senior author **Dr Albert Lardo** (Johns Hopkins University, Baltimore) told **heart*wire*** , "What happens now a lot in the echo world is people base where they put the lead purely on the mechanical maps. This is a major oversight from a basic physiology standpoint, because we know that the relationship between mechanical and electrical activation is not very straightforward in patients who have complex substrates. You need both the electrical and mechanical data before you can make a very good informed decision about where to put the lead."

The combination CT/ECGI map is the "holy grail" for CRT preprocedure planning, because it shows myocardial scaring and identifies the area of latest mechanical activation in the left ventricle, the best target for lead placement, Lardo said. It also shows venous anatomy to allow the implanting physicians to plan how they will guide the lead into position.



An electrical map created by ECG imaging and a mechanical map created by computed tomography [Source: Johns Hopkins University]

The innovation that allows this mapping is a computer program called **Stretch Quantifier for Endocardial Engraved Zones** (SQUEEZ), developed by **Dr Amir Pourmorteza** (Johns Hopkins University). Lardo explained that SQUEEZ creates a "blood cast"--an extremely high-resolution image of blood flow--revealing the fine trabecular features of the heart that can serve as "nodes" to be tracked in space and time. "You can see the influence that the endocardial surface has on the blood," Lardo said. "With that, we can track the trabecular features, and those features become spatial markers." No other imaging modality has sufficient resolution to do that.

"For years now, we've just been putting the lead in blindly on the lateral wall or we're using echo to [find] the area of latest mechanical activation," Lardo said. "That works sometimes, but the nonresponse rate is still pretty high from that approach, which means we're missing information that is necessary to understand the physiology and understand where to put the lead. The problem [has been] that clinically, this type of electrical mapping is incredibly tedious and very invasive."

However, Dawoud and his colleagues have developed an ECGI technique for creating a detailed electrical map of the heart based entirely on data collected noninvasively from electrodes outside the patient. This voltage activity data can be used to create an accurate voltage map of the heart that is superimposed on the mechanical model created by the CT. "You want to activate the areas that are activating the latest to bring the whole heart toward having a shorter activation duration," Dawoud told **heart*wire*** .

These combination mechanical/electrical maps could also be used to guide other types of intramyocardial intervention, such as stem-cell therapies, Lardo said.

Animal Trials Show Promise, Human Trials Coming Soon

At the SCCT meeting, Dawoud presented data from a study in mongrel dogs in which ischemic dyssynchronous heart failure was induced with occlusion/reperfusion, left-bundle ablation, and three weeks of rapid right ventricular pacing. The images created with the CT/ECGI method showed that epicardial electrical activation is consistent with a left bundle branch block conduction pattern that begins in the right ventricle before spreading in a U-shaped pattern to the left ventricle. The CT/ECGI map shows areas of delayed left ventricular wall shortening and delayed depolarization in the mid left marginal vein, marking a good candidate site for preactivation of the left ventricle.

The next step in the development of this technology will be to compare the outcomes of CRT patients implanted with a device the traditional way with those of CRT patients whose leads were implanted with the guidance of CT/ECGI. Dawoud, Lardo, and colleagues have already begun using their technique in patients and hope to have some pilot clinical data within a year.

The authors have nothing to disclose.

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