

## Resynchronization Therapy with a Conventional Dual-Chamber Pacemaker: A Doppler Tissue Imaging Study

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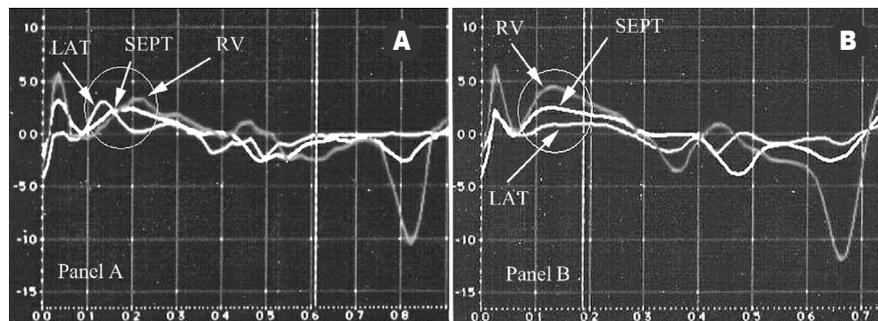
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Resynchronization therapy with the use of biventricular pacing has become the mainstay of therapy in patients with systolic heart failure. Unfortunately, only about two-thirds of patients undergoing biventricular pacemaker implants benefit from this type of therapy. Recent studies have shown that mechanical resynchronization may actually be more important than electrical resynchronization. We report a case of non-ischemic dilated cardiomyopathy and congestive heart failure in which resynchronization and significant clinical improvement were achieved with a conventional dual-chamber pacemaker. The clinical improvement correlated with improvement in Doppler tissue parameters.

### Patient Description

We present a 51 year old man with a 20 year history of dilated cardiomyopathy and a left ventricular ejection fraction of 15%. Cardiac catheterization showed normal epicardial coronary arteries. The patient had a history of paroxysmal atrial fibrillation and had multiple admissions to the hospital because of weakness, shortness of breath, nausea and fullness in the stomach. He was treated with amiodarone, lasix, carvedilol, enalapril and coumadin. The echocardiogram showed severe left ventricular dilatation, severe global left ventricular dysfunction, mild left atrial dilatation, mild mitral regurgitation, and mild tricuspid regurgitation. Electrocardiography showed normal sinus rhythm with atypical left bundle branch block, PR interval of 240 msec, and QRS duration of 140 msec. An attempt was made to implant an atrioventricular pacemaker. A coronary venous system angiogram was obtained during the procedure. The lateral vein



**[A]** Baseline Doppler tissue imaging study shows that the lateral wall of the left ventricle contracts first, then the septum contracts, and then the right ventricle. The sample was obtained from the base of the heart. **[B]** Doppler tissue imaging study with dual-chamber pacing shows simultaneous contraction of the right ventricle, septum and lateral wall of the left ventricle. The sample was obtained from the base of the heart. LAT = lateral wall of the left ventricle, SEPT = septum, RV = right ventricle.

was missing and the coronary sinus had very small branches that were difficult to cannulate.

A dual-chamber pacemaker was implanted with an electrode in the right atrium and the second electrode in the right ventricular apex. Following the pacemaker implant, the patient showed a dramatic improvement over a follow-up period of 3 years. He had fewer episodes of atrial fibrillation and was not admitted to hospital because of heart failure. He regained his appetite and had less bloating of the stomach. Echocardiographic measurements with and without pacing were obtained. Doppler tissue imaging showed that right ventricular pacing achieved mechanical synchrony. According to the baseline Doppler tissue imaging study, the sequence of contraction was: lateral wall of the left ventricle first, then the septum, followed by the right ventricle.

With dual-chamber pacing, simultaneous contraction of the right ventricle, the septum and the lateral wall was achieved

and accounted for the patient's dramatic clinical improvement [Figure A,B]. The sample was obtained from the basal segments of the left and right ventricles during the Doppler tissue imaging study. Furthermore, there was improvement in interventricular delay, intraventricular delay, dp/dt and myocardial performance index.

### Comment

Studies have shown that biventricular pacing improves the hemodynamics and well-being of patients with heart failure by reducing ventricular asynchrony [1,2]. Unfortunately, only about two-thirds of patients benefit from biventricular pacing [3]. Recent studies have raised the question whether the baseline QRS duration is a good marker of asynchrony or whether we should explore other methods to identify patients with mechanical asynchrony [4].

The patient presented in this report is an example of an individual who probably would not have benefited from biventricular

pacing, even though he fulfilled the ECG criteria for eligibility for such an implant. The echocardiographic measurements with Doppler tissue provided information regarding the activation sequence of different segments of the heart. Without pacing, the lateral wall of the left ventricle contracted before the septum and before the right ventricle. Biventricular pacing would have paced the lateral wall of the left ventricle first and would have worsened the degree of asynchrony. Programming the pacemaker with the guidance of echocardiographic measurements enabled us to tailor the pacemaker programming to this specific patient in whom resynchronization was achieved with conventional dual-chamber pacing.

A recent case report demonstrated resynchronization therapy achieved by dual-site right ventricular stimulation (right ventricular apex and right ventricular outflow tract). In that specific case, similar to what we observed in our patient,

Doppler tissue imaging correlated with clinical improvement even though the left ventricle was not paced [5].

In conclusion, echocardiographic studies with Doppler tissue should be part of the planning strategy of the implant procedure and programming of pacemakers in patients with congestive heart failure and dyssynchrony of contraction of the cardiac chambers. Tailoring the pacemaker implantation in each patient with the use of Doppler tissue imaging will increase the number of patients who can benefit from pacing for the treatment of heart failure.

## References

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## Capsule

### RNA silencing in AIDS

Among its many functions, RNA silencing provides broad cellular defense against viruses in many plant and animal species. To perform defense functions, microRNAs (miRNAs) arm an RNA-induced silencing complex (RISC), which either degrades messenger RNA or inhibits its translation. Triboulet et al. show that proteins responsible for generating miRNA potentially inhibit human immunodeficiency virus-type 1 (HIV-

1) in naturally infected cells and that HIV-1 counters this by down-modulating the expression of selected cellular miRNAs to favor replication. Targeting the miRNA processing pathway may offer a strategy for activating latent viral reservoirs, which remain barriers to eliminating chronic HIV-1 infection.

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## Capsule

### Necrotizing pneumonia threat

Methicillin-resistant *Staphylococcus aureus* is escaping hospital wards and causing severe disease among otherwise healthy people in the community. Increasingly, this bacterium is now traveling with a distinct virulence phenotype called Panton-Valentine leukocidin toxin, which alone can cause fatal pneumonia, but Labandeira-Rey and co-authors have found that the disease picture is even more complicated. By characterizing the pathology in a mouse model, they

discovered that the insertion of the two genes that express the toxin components also causes down-regulation of a repressor, which regulates the expression of an inflammatory mediator, and other cell wall-anchored proteins. The combination of these effects exacerbates the risk of dangerous pneumonia.

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