HOSPITAL CHRONICLES 2008, 3(2): 52–54

EDITORIAL

Echocardiography to Identify Responders to Cardiac Resynchronization Therapy

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ABSTRACT

Cardiac resynchronization therapy (CRT), effected via biventricular pacing, is now considered an established therapy for patients with severe heart failure, with good clinical results. However, 20-30% of patients do not respond to CRT. At present, patient selection is mainly based on QRS duration. Evidence is accumulating that echocardiography may be an ideal technique to identify responders to CRT. Based on assessment of intra-ventricular dyssynchrony, accurate prediction of response to CRT will be feasible. In particular, tissue Doppler imaging, assessing *septal-to-lateral wall delay (>60 ms),* may allow precise assessment of intraventricular dyssynchrony.

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KEY WORDS: *heart failure; cardiac dyssynchrony; biventricular pacing; cardiac resynchronization therapy; echocardiography; tissue Doppler imaging*

INTRODUCTION

Heart failure is one of the leading causes of morbidity and mortality in the Western world nowadays.[1] A novel therapeutic option for patients with end-stage heart failure is cardiac resynchronization therapy (CRT) effected via biventricular pacing. Recent large clinical trials have shown sustained clinical benefit from CRT.[2] Observed beneficial effects of CRT consisted of an improvement in heart failure symptoms, exercise capacity, left ventricular (LV) systolic performance and a reduction in hospitalization for decompensated heart failure.[2]

ABBREVIATIONS
CRT = cardiac resynchronization therapy
LV = left ventric-le(-ular)
SPWMD = septal-to-posterior wall motion delay
TDI = tissue Doppler imaging

RESPONSE TO CRT

The presence of (intra-ventricular) LV dyssynchrony seems mandatory for a positive response to CRT.[3] At present, a wide QRS complex is considered to reflect LV dyssynchrony, but recent studies have shown that 20-30% of patients with a wide QRS complex do not respond to CRT. In addition, only 60-70% of patients with a wide QRS complex have substantial LV dyssynchrony.[4]

ROLE OF ECHOCARDIOGRAPHY

Accordingly, the QRS duration alone is not enough to identify the patients with

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Presented in part at "**Cardiology Update 2004**", International Cardiology Symposium of Evagelismos General Hospital of Athens, Athens, Greece, October 14-16, 2004

substantial dyssynchrony who have a high likelihood to respond to CRT. Imaging techniques are needed to adequately assess LV dyssynchrony and echocardiography in particular is well-suited for this purpose. M-mode echocardiography may be useful for assessing intraventricular dyssynchrony.[3] Using an M-mode recording from the parasternal short-axis view (at the papillary muscle level), the septal-to-posterior wall motion delay (SPWMD) can be obtained, and a cut-off value ≥130 ms was proposed as a marker of intraventricular dyssynchrony. However, frequently the SPWMD cannot be obtained, either because the septum is akinetic following extensive anterior infarction or because the maximal posterior motion is ill-defined. In addition, it is often not possible to obtain perpendicular M-mode sections of the proximal LV.

Newer echocardiographic methods include phase analysis of wall motion[5] and assessment of displacement maps using contrast-enhanced echocardiography.[6] Tissue Doppler imaging (TDI) allows measurement of peak systolic velocity of different regions of the myocardium, and timing of peak systolic velocity in relation to electrical activity (QRS complex).[7] Based on these variables, TDI can provide accurate information on electromechanical coupling, and assess inter- and intra-ventricular dyssynchrony. Various analyses of the TDI data have been proposed and the most simple and reliable form is assessment of the *septal-to-lateral delay*, assessing the mechanical delay between the septum and the lateral wall; a delay ≥60 ms between peak systolic velocities of the septum versus lateral wall was used as an indicator of the substantial intraventricular dyssynchrony.[7] Different studies have indicated that accurate prediction of benefit from CRT is possible using TDI to assess LV dyssynchrony.[7,8]

Using the digitally stored color-coded tissue Doppler images further extended off-line analysis can be performed, i.e. strain and strain-rate analysis.[9,10] *Strain analysis* allows direct assessment of the degree of myocardial deformation during systole and is expressed as the percentage of segmental shortening or lengthening in relation to its original length; it provides important information on the timing of onset and peak of myocardial contraction, permitting also measurement of (dys-)synchrony. These methods are more time-consuming and the relative merits of simple TDI versus these complex analyses remain to be assessed.

CONCLUSION

CRT is now considered an established therapy for patients with severe heart failure, with good clinical results although 20-30% of patients do not respond to CRT. At present, patient selection is mainly based on QRS duration. Evidence is accumulating that echocardiography may be the ideal technique to identify responders to CRT.[3,5-16] Based on assessment of intraventricular dyssynchrony, accurate prediction of response to CRT will be feasible. In particular TDI may allow precise assessment of intraventricular dyssynchrony. Future studies will provide more data on which echocardiographic parameters might be more useful than others.[17]

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