

Improved Symptoms, Physical Limitation, and Self-Efficacy After Resynchronization in a Patient With Heart Failure and a Prolonged QRS Duration

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This report examines the impact of resynchronization therapy in a patient with class IV heart failure and a prolonged QRS duration on electrocardiogram. The Kansas City Cardiomyopathy Questionnaire (KCCQ) was used to assess the patient's health status prior to, immediately after, and 2 months after placement of a biventricular pacemaker. B-type natriuretic peptide (BNP) values and electrocardiogram QRS duration were recorded to further document clinical status. Our patient experienced statistically significant improvements in 7 of 10 KCCQ domains after resynchronization. QRS duration narrowed following the procedure and BNP values decreased. Resynchronization therapy improved this patient's symptoms, physical limitations, and self-efficacy when maximal medical therapy failed.

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A 55-year-old white man with a known severe nonischemic cardiomyopathy diagnosed in April 2001, an ejection fraction of 15%, and functional class III-IV heart failure, presented in July 2002 with progressive fatigue and class III symptoms after frequent hospitalizations and clinic visits over the last year. He is on permanent medical disability. Biventricular pacing was discussed as a therapeutic option to improve his symptoms and physical limitations

and decrease his hospitalizations. Medication adjustments were made and a 1-month follow-up appointment was scheduled. Despite compliance with his medications he continued to decline and presented to the clinic soon thereafter with decompensated congestive heart failure (New York Heart Association [NYHA] functional class IV).

This case report uses the Kansas City Cardiomyopathy Questionnaire (KCCQ), B-type natriuretic peptide (BNP) values, and QRS duration to demonstrate the impact of implanting a biventricular device in a patient with severe, decompensated heart failure, in terms of improving his symptoms, physical limitations, and self-efficacy.

The Kansas City Cardiomyopathy Questionnaire

The KCCQ is a 23-item, disease-specific, health status measure that quantifies physical functioning, symptoms, social limitations, self-efficacy, and quality of life in heart failure patients. These domains can be summarized by two scales: the clinical summary score, which is the average of the physical limitation score and the symptom scales, and the overall summary score, which is the average of the physical function, symptom, social limitation, and quality of life scales. Each domain and the summary scales of the KCCQ have been previously demonstrated to be valid, reliable, and responsive measures of health status in heart failure patients.¹ In addition, the clinical summary score has been shown to be predictive of outcomes, including NYHA class, hospitalizations, and death.² Scores range from 0–100, with 100 indicating the best functioning in that domain.

B-Type Natriuretic Peptide

BNP was measured using the Triage®

B-Type Natriuretic Peptide test (Biosite, Inc., San Diego, CA), a fluorescence immunoassay for the quantitative determination of BNP in whole blood and plasma specimens.³

History

The patient was diagnosed with dilated cardiomyopathy, most likely secondary to alcohol abuse, in April 2001 when he presented to the hospital and was admitted for heart failure symptoms. Our team evaluated him after his primary team requested a consultation for further evaluation of his heart failure symptoms and known atrial fibrillation/flutter that had been documented on several occasions throughout 2001. A transthoracic echocardiogram revealed left ventricular enlargement with global hypokinesis of the left ventricular walls and an estimated ejection fraction of approximately 20%. He had moderate mitral regurgitation with a normal left atrial dimension, moderate tricuspid regurgitation, and pulmonary artery systolic pressure of 57 mm Hg, suggestive of at least moderate pulmonary hypertension. Right heart chambers were within normal dimensions. A transesophageal echocardiogram revealed mild left ventricular hypertrophy, a mildly dilated left ventricle, severely diminished left ventricular systolic function with an estimated ejection fraction of 15%–20%, and global hypokinesis. The left atrium and left atrial appendage were normal in size and without thrombus. Right-sided chambers were normal, the interatrial septum was normal, and the mitral, aortic, tricuspid, and pulmonic valves were normal. The descending aorta and the arch of the aorta were noted to have mild atherosclerotic plaque, with the largest in the descending aorta measuring 2 mm. No dissection was present. Trace mitral regurgitation and tricuspid



Figure 1. Implanted biventricular device.

regurgitation were noted. Heart catheterization in June 2001 was negative for occlusive coronary artery disease.

His past medical history was remarkable for atrial fibrillation/flutter, poorly controlled hypertension, and alcoholism. He denied illicit drug use or recent alcohol consumption. He was a tobacco user. His family history was not significant for cardiomyopathy or premature atherosclerosis.

Physical Examination

The patient underwent a follow-up physical examination in August 2002, which revealed hypertension with a blood pressure of 159/72 mm Hg. There was no jugular venous distention in the neck. Cardiac examination revealed a normal heart rate and rhythm, with a notable third heart sound. No murmurs, rubs, or gallops were noted. The lungs had crackles bilaterally at the bases. The extremities were without edema. Neurologically he was alert and oriented to person, place, and time.

Treatment

The patient was admitted and underwent placement of a biventricular pacemaker in August 2002 (Figure 1). Subsequently, his electrocardiographic (ECG) QRS duration narrowed, and BNP values decreased

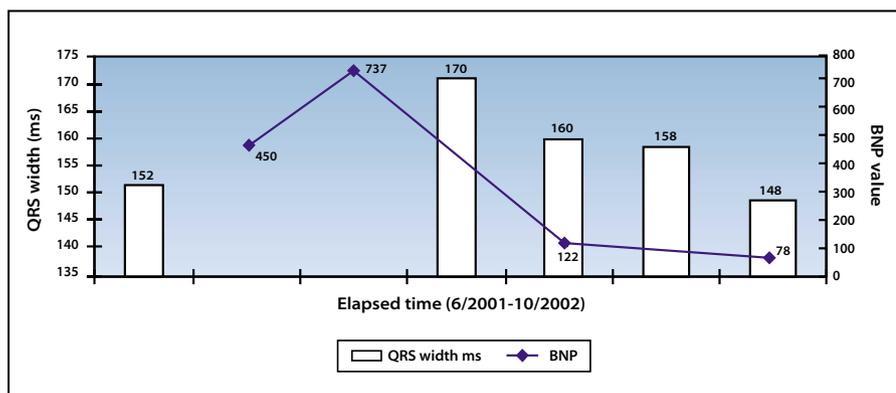


Figure 2. B-type natriuretic peptide values and QRS width before and after biventricular pacemaker placement.

(Figure 2). In addition, 7 of 10 domains on the Kansas City Cardiomyopathy Questionnaire significantly improved, and there was mild improvement in one domain (Figure 3).

As Figure 2 shows, the patient's electrocardiogram revealed a QRS duration of 152 milliseconds in June 2001, which increased to 170 milliseconds by February 2002. An ECG in June 2002 was again prolonged (160 milliseconds). Immediately following device implantation, the patient's QRS duration decreased to 158 milliseconds and, by October 2002, it had decreased to 148 milliseconds.

BNP values showed a similar trend: they were higher prior to device

implantation, with the highest value noted when the patient was acutely decompensated. Following pacemaker implantation, BNP values began to improve, as Figure 2

Approximately 20% of the heart failure population has widened QRS complexes on electrocardiography, which are associated with higher long-term mortality rates.

shows. In July and August of 2001, one year prior to implantation, BNP values were 450 and 737, respectively. Postimplantation, BNP was measured at 78 (November 2002).

Discussion

Congestive heart failure is the most

common hospital discharge diagnosis, and affects 1%–2% of the United States population.⁴⁻⁶ Results from a large dataset have demonstrated a tripling of heart failure prevalence, confirming that we are in the midst of a heart failure epidemic.⁷ Approximately 20% of the heart failure population has widened QRS complexes on electrocardiography, which are associated with higher long-term mortality rates.⁸ There is increasing evidence that biventricular pacing improves outcome and symptoms in severe heart failure⁹ by restoring ventricular relaxation and contraction sequences as homogeneously as possible.¹⁰ Farwell and colleagues suggest that approximately 10% of an unselected group of congestive heart

failure patients would be appropriate candidates to receive a biventricular pacemaker.⁹ This obviously represents a large patient population and could have a tremendous impact on the management of congestive heart failure. The questions that remain unanswered at this point are

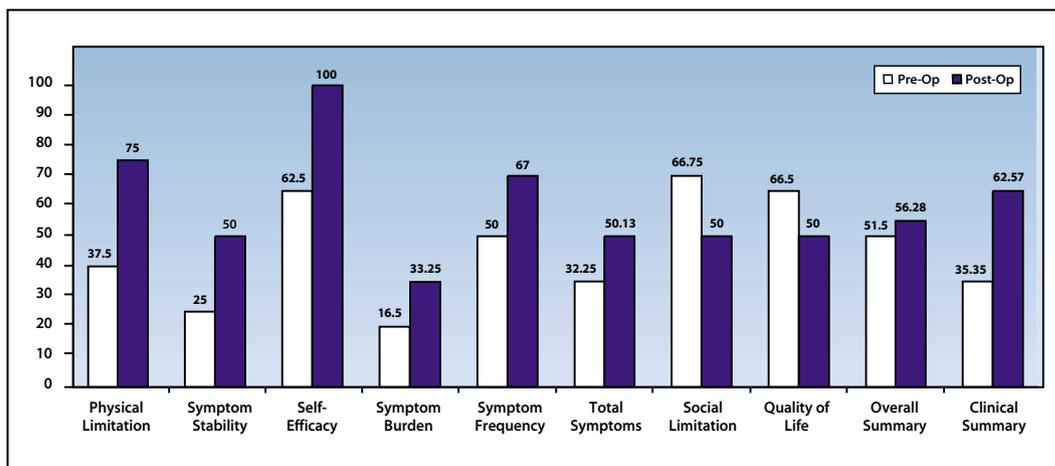


Figure 3. Kansas City Cardiomyopathy Questionnaire domain scores before and after biventricular device placement.

which heart failure patients stand to benefit from a biventricular pacing device, and if this treatment strategy is cost effective.

This case study demonstrates one patient who had clear benefits in terms of physical functioning (prepacer score of 37.5 points vs 75 points postpacer), symptom severity (total symptom score of 33.3 points vs 50.1 points), and self-efficacy (62.5 points vs 100 points). His dramatic improvement in overall clinical summary score (35.4 points vs 62.6 points) is evidence that he felt a marked improvement following implantation of the biventricular pacemaker. It follows that this patient will have fewer future hospitalizations, suggesting that the biventricular pacemaker is cost effective, and improves long-term quality of life.

It is interesting to note that this patient had a decrease in two of the KCCQ scales: quality of life and social limitation. We are left to speculate that perhaps if this patient were followed for a longer period of time his quality of life would improve. It may also reflect unrealistic postoperative patient expectations. The MIRACLE trial, which evaluated 453 patients with moderate to severe congestive heart failure (ejection fractions of 35% or less

and QRS durations of 130 milliseconds or more), followed patients for 6 months and found that cardiac resynchronization improved not only exercise time and ejection fraction, but also improved quality of life.¹¹ More recently, the *Journal of the American Medical Association* published a meta-analysis of randomized controlled trials of cardiac resynchronization and death from progressive heart failure.

One of the best options we have to decrease the healthcare costs imposed by this disease is to prevent hospitalizations by improving patients' symptoms, physical limitations, and quality of life.

The meta-analysis pooled data from four randomized trials (N = 1634), and showed that cardiac resynchronization reduced progressive heart failure-related mortality by 51%, from 3.5% among controls to 1.7% among cardiac resynchronization patients.¹²

Conclusion

There are several key points to be emphasized with this case presentation. First, heart failure is an epidemic that places a huge economic burden on society—there will be nearly half a million new cases of heart failure reported this year alone,¹³ at a cost

of \$20 billion.¹⁴ One of the best options we have to decrease the healthcare costs imposed by this disease is to prevent hospitalizations by improving patients' symptoms, physical limitations, and quality of life. Resynchronization therapy has been shown in several studies to do exactly this. Importantly, the 2001 American College of Cardiology/American Heart Association guidelines have classified resynchroniza-

tion therapy as a class IIa indication for patients with ejection fractions less than or equal to 35% and left bundle branch block (QRS duration > 130 milliseconds).

Second, the evolving focus of medicine from morbidity and mortality as standard endpoints in treatment of disease to that of improving patients' symptom burden and physical limitations, thereby improving their quality of life, is a shift that enables physicians to truly care for the patient. We are developing the ability to not only prolong patients' lives, but to improve and have a positive impact on their lives.

Main Points

- One of the best strategies to decrease the costs of the heart failure epidemic is to prevent repeat hospitalizations with treatment strategies, such as resynchronization therapy, that reduce disease severity and physical limitations and improve quality of life.
- There is increasing evidence that biventricular pacing reduces disease burden and improves overall outcome by homogeneously restoring ventricular relaxation and contraction sequences in patients with severe heart failure.
- As many as 10% of heart failure patients may be appropriate candidates for implantation of a biventricular device, which, in this case study, was associated with decreased QRS duration and B-type natriuretic peptide levels, and increased overall clinical summary scores, indicating that the patient felt a marked improvement following device implantation.
- The issues of determining which heart failure patients would benefit most from device implantation, and whether biventricular pacing is a cost-effective treatment strategy, require further study.

Resynchronization therapy is a reflection of this evolving focus. ■

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