Long-Term His-Bundle Pacing and Cardiac Function

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The article by Deshmukh et al1 published elsewhere in the journal represents a tour de force for a number of reasons. The ability to chronically and selectively pace the His bundle not only represents an important methodological advance but also allows us to test the hypothesis that septal pacing in a fashion nearly identical to normal activation of the His-Purkinje system is superior to ventricular pacing.

This technical breakthrough deserves strong accolades. Those of us who have used His-bundle pacing either to validate His-bundle records2 or for detection of concealed parahisian pathways3 will attest to the difficulty in achieving even temporary consistent His-bundle pacing. The authors have shown that placing a standard multipolar mapping catheter as a guide at the His bundle facilitates placement of a commercially available steroid-eluting long-term pacing lead, incorporating an exposed helix, to be embedded in the membranous septum on or near the His bundle. This technique is feasible and allows for long-term pacing with acceptable stimulation thresholds.

The study group included 14 patients with atrial fibrillation and severe dilated cardiomyopathy but with narrow QRS complexes in whom reliable His-bundle stimulation was possible. Twelve of the 14 underwent insertion of the long-term lead, but 10 required AV junctional ablation allowing for rate control and persistent His-bundle pacing. Over a mean follow-up of nearly 2 years, they found rather dramatic improvements in both hemodynamic function and New York Heart Association class. The limitations of right ventricular pacing in improving ventricular function have been well appreciated. Right ventricular apical stimulation has been shown to produce asynchronous cardiac contractions,4 negative inotropic effects,5 and structural changes in the left ventricle.6 In the presence of dilated heart failure, in which structural changes in ventricular muscle, such as diffuse or dense myocardial fibrosis, already compromise ventricular mechanical contraction, right ventricular apical pacing can have particularly deleterious effects on ventricular synchrony.7 In 1 study of 557 patients with advanced dilated heart failure, the presence of a permanent pacemaker incorporating a right ventricular lead for long-term ventricular pacing identified a high-risk group of patients who had a 49% higher risk of death from progressive pump dysfunction than a control group matched for severity of heart failure.8

These observations, as well as the limitations of drug therapies to treat heart failure symptoms and the limited number of donor hearts available for cardiac transplantation, have led to a host of short-term and long-term studies exploring alternative-site ventricular pacing for improvement of symptom status in patients with dilated heart failure.9-13 Unlike the patients enrolled in the study by Deshmukh et al,1 the majority of patients enrolled in studies of pacing for improvement of heart failure have overt bundle-branch block. This group was targeted because they have the greatest degree of ventricular contractile dyssynchrony and would be expected to show the greatest benefit.9,10

Short- and long-term studies of patients who were paced from the right ventricular outflow tract have shown controversial effects, with no clear-cut benefit established with long-term pacing.9,10,12-14 Preliminary short- and long-term data from controlled clinical trials indicate that improvements in systolic contractile function and symptom class can be achieved with either left ventricular or biventricular pacing in patients with left bundle-branch block and sinus rhythm.9-14 The greatest improvements are seen in those with the widest QRS complex at baseline.10 No randomized, controlled trial data exist of biventricular pacing in patients with dilated heart failure and chronic atrial fibrillation. There are still many unresolved issues in determining how to optimally pace the heart in patients with dilated heart failure, including issues of determining optimal left atrial/left ventricular delay, ideal placement of the left ventricular epicardial lead, and identification of the heart failure patients most likely to benefit, which do not allow for definitive conclusions relative to the efficacy of these pacing modalities. However, there are promising preliminary data from long-term controlled pacing studies indicating long-term symptom benefit, but no current study is using a mortality as an end point.9

In the largest controlled long-term pacing trial reported to date, Auricchio and colleagues11,15 reported results in 42 patients with dilated heart failure and bundle-branch block. Based on a short-term study, which identified optimal AV delay and best ventricular site, patients received either long-term biventricular or univentricular pacing for 4 weeks, followed by a nonpaced washout period (4 weeks), followed by 4 weeks of pacing at the crossover mode. After the 12-week study, patients then underwent long-term pacing for 1 year based on the best-choice pacing mode. They found improvement in functional capacity (oxygen uptake at peak exercise) as well as in the 6-minute walk test. There was no difference in benefit between left ventricular and biventricular pacing modalities for patients with left bundle-branch block.
How does His-bundle pacing affect cardiac function? Although the observations presented by Deshmukh et al clearly represent an important step forward, many questions persist. The fact that a majority of their patients required AV junctional ablation with establishment of resultant rate control and regularity serves to cloud the mechanism of reported hemodynamic benefit. It is not clear from their observations whether most benefit was derived from rate control and regularity or from pacemaker site. It would appear that a more directed study should involve use of a dual-chamber pacemaker system allowing synchronization between atrial and His-bundle stimulation. Such an arrangement would more closely mimic true physiological pacing. In the present study, only patients with narrow QRS complexes were included. Approximately 15% to 30% of advanced heart failure patients have associated intraventricular conduction delay (IVCD), but the remainder may be candidates for His-bundle pacing.\(^{16}\) It is not clear whether the patients with IVCD will benefit most from His-bundle pacing rather than pacing from the left ventricle or biventricular pacing. If these patients also require AV junctional ablation, there may be some risk associated with long-term His-bundle pacing alone, if conduction system disease intervenes. In addition, in view of the complexity of achieving selective His-bundle pacing and failure to achieve consistent pacing in a subset of patients, one might legitimately inquire whether pacing over the summit of the right ventricle in close proximity to the His bundle might produce equally laudatory hemodynamic effects.

The excellent study by Deshmukh et al is a solid new approach in the use of pacing for patients with severe heart failure. Although much work remains to determine the exact role of this new modality and how it compares with left ventricular or biventricular modes, the authors are to be congratulated on providing the medical community with a potentially exciting and important new tool for treating an often very difficult problem.

References
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