

Recommendations for pacemaker implantation for the treatment of atrial tachyarrhythmias and resynchronisation therapy for heart failure

*A report from the task force on pacemaker indications of the Dutch Working Group on Cardiac Pacing**

N.M. van Hemel, B. Dijkman, W.G. de Voogt, W.P. Beukema, H.A. Bosker, C.C. de Cock, L.J.L.M. Jordaens, I.C. van Gelder, L.M. van Gelder, R. van Mechelen, J.H. Ruiter, M.I. Sedney, L.C. Slegers

Today, new pacing algorithms and stimulation methods for the prevention and interruption of atrial tachyarrhythmias can be applied on patients who need bradycardia pacing for conventional reasons. In addition, biventricular pacing as additive treatment for patients with severe congestive heart failure due to ventricular systolic dysfunction and prolonged intraventricular conduction has shown to improve symptoms and reduce hospital admissions. These new pacing technologies and the optimising of the pacing programmes are complex, expensive and time-consuming. Based on many clinical studies the indications for these devices are beginning to emerge. To support the cardiologist's decision-making and to prevent waste of effort and resources, the 'ad hoc committee' has provided preliminary recommendations for implantable devices to treat atrial tachyarrhythmias and to extend the treatment of congestive heart failure respectively. (*Neth Heart J* 2004;12:18-22.)

Key words: atrial tachyarrhythmias, heart failure, pacemaker, recommendations, resynchronisation

In 1999, the Dutch guidelines for implantation of temporary and permanent cardiac pacemakers were published after approval by the Dutch Society of

Cardiology.¹ Recently, specific atrial and ventricular stimulation methods for the prevention and termination of atrial tachyarrhythmias with implanted pacemakers have been developed. Electrical ventricular resynchronisation with biventricular stimulation has also been introduced recently as a supportive treatment for congestive heart failure due to systolic left ventricular dysfunction. The clinical value in terms of patient profit, cost-effectiveness and safety of both new stimulation methods has been evaluated in selected patient groups and several large-scale studies are underway.

Based on initially encouraging results and preliminary data, pacemaker companies are marketing pacemakers for prevention and termination of atrial tachyarrhythmias and for ventricular resynchronisation. Faced with this development, there is a strong need for recommendations for implantation of these devices to optimise patient selection and prevent inappropriate use of resources and personnel. The objective of this ad hoc task force is to deliver recommendations for the implantation of these pacemakers despite restricted clinical evidence and unclear mechanisms of and reasons for therapeutic success. These recommendations are, therefore, of a preliminary character and need to be refined in the near future.

Pacing for atrial tachyarrhythmias

The initial attempts to reduce atrial tachyarrhythmias were undertaken by permanently increasing the lower

N.M. van Hemel.
Heart Lung Centre Utrecht/St. Antonius Hospital,
PO Box 2500, 3430 EM Nieuwegein.

Address for correspondence: N.M. van Hemel.
E-mail: n.m.vanhemel@hetnet.nl

* The background and contents of these recommendations were presented and discussed at the 2002 Fall Meeting and presented again and approved at the 2003 Spring Meeting of the Dutch Working Group on Cardiac Pacing, and of the Dutch Society of Cardiology.

or sensor basic atrial stimulation rate. This atrial overdrive pacing resulted in less sinus rhythm and suppression of atrial premature beats. Faster atrial pacing was suggested to decrease the number and duration of the mode-switching episodes, reflecting bouts of atrial tachyarrhythmias.²⁻⁶ However, this assumption could not be confirmed in later studies⁷⁻¹⁰ using improved arrhythmia diagnostics. Pacing algorithms developed later allowed a more sophisticated on-demand increase in atrial rate. For example, if the sinus rate becomes too low or prolonged intervals occur after atrial premature beats or following the termination of atrial arrhythmia, pacing algorithms can be applied for stabilisation, smoothing or increase in the atrial rate. Studies on pacing prevention algorithms have not consistently resulted in a reduction in recurrences of atrial arrhythmias.¹¹⁻¹⁵

The improved pacemaker diagnostics provide better insight into atrial tachyarrhythmias, including their type, cycle length, initiation, duration and response to pacing interventions.¹⁶⁻¹⁸ In many patients with paroxysmal atrial fibrillation the diagnostics revealed co-existence of different types of atrial tachyarrhythmias in the same patient.

The contemporary devices for atrial arrhythmia management provide algorithms not only for arrhythmia prevention but also for termination. These electrical therapies include adaptive antitachycardia pacing of the 'ramp' and 'burst' type and non-adaptive 50 Hz bursting. Other devices are capable of performing electrical cardioversion. Pacing therapies could terminate 50% of spontaneous atrial arrhythmia recurrences and were especially successful in tachyarrhythmias that were more organised and had a cycle length of >220 msec.¹⁹⁻²⁹ To summarise, these pacing therapies are painless in contrast to the atrial defibrillator and may reduce arrhythmia burden.¹⁹

An alternative treatment modality for atrial tachyarrhythmias consists of selecting alternative atrial pacing sites. Bi-atrial,^{30,31} dual-site right atrial,³²⁻⁴¹ atrial septal⁴²⁻⁴⁸ and Bachmann's bundle^{49,50} pacing have been explored. The efficacy of these alternative pacing sites in reducing atrial tachyarrhythmias was confirmed in some studies but rebutted in others.³⁰⁻⁵⁰

In patients in whom device implantation is considered to prevent or to reduce atrial tachyarrhythmias, full information on the arrhythmia profile is needed including arrhythmia type, burden, mode of initiation, antiarrhythmic drug effects, symptoms and underlying heart disease. These characteristics influence the decision about the indication for implantation and the selection of the device, leads and site of permanent stimulation.

Studies on the role of pacing algorithms in atrial tachyarrhythmia prevention result in different out-

Recommendations for pacemaker implantation for prevention and/or treatment of atrial tachyarrhythmias

- Class I: None.
- Class IIa: Documented paroxysmal atrial tachyarrhythmias with or without symptoms in patients with Class I and II indications for permanent pacing therapy or indication for ICD therapy.
- Class IIb: Documented recurrent atrial tachyarrhythmias with or without symptoms when antiarrhythmic drugs therapies fail and/or ablative methods are neither successful nor feasible. Prevention of symptomatic, drug refractory atrial tachyarrhythmias in patients with sinus node dysfunction.
- Class III: Chronic atrial tachyarrhythmias. Atrial tachyarrhythmias that can be cured by other therapies.

comes even when comparable endpoints are investigated. At present, it is too early to recognise atrial tachyarrhythmia as the sole indication for permanent heart stimulation in the general population.

Pacing for heart failure

Intraventricular conduction delay, resulting in asynchronous contraction of the left ventricle, is observed in about 30% of patients with severe chronic heart failure due to depressed systolic left ventricular function. Sometimes interventricular conduction is also delayed, leading to important differences between the time of contraction of the right and left ventricle.^{51,52} Intraventricular conduction delay is often accompanied by prolonged atrioventricular conduction. This delay in intraventricular conduction in the left ventricle is deleterious to pump function because septal and lateral regions contract out of phase: when septal regions contract the lateral region is stretched in the outward direction. The intraventricular conduction delay also prolongs the time of relaxation at the expense of the ejection period. This reduces the diastolic filling because the passive and active filling periods tend to merge.⁵¹⁻⁵³ Systolic mitral regurgitation is frequently present in systolic left ventricular failure and will worsen with increasing intraventricular conduction delay. This may even result in diastolic mitral regurgitation. Finally, a severe intraventricular conduction delay is associated with an increased cardiac mortality.⁵⁴⁻⁵⁷

In the past decade, acute haemodynamic⁵⁸⁻⁶³ as well as short-term observational studies have demonstrated the clinical value of left ventricular or bi-ventricular pacing for resynchronisation of electrical and mechanical activation as a supportive treatment for severe heart failure.⁵⁸⁻⁷² Improvement of quality of life, walking distance, oxygen consumption and a reduction in

hospital admissions for heart failure were observed and associated with reduction in the paced QRS interval. Biventricular pacing appears to be capable of reversing the pathophysiological process involved in left ventricular systolic dysfunction: both a reduction in the left ventricle diameter as well as increase in left ventricular systolic ejection fraction and diminishing myocardial oxygen consumption have been reported.⁷¹ These summarised findings indicate that severely symptomatic patients (NYHA class III to IV), showing a widened pre-implant QRS complex (>120 msec) and a prolonged PR interval (>200 msec) and asynchrony of vital left ventricular regions benefit most from chronic electrical resynchronisation treatment.⁵⁸⁻⁷¹ At present, several prospective large-scale studies are being conducted to elucidate the efficacy of this pacing therapy and to refine patient selection.

Recommendations for pacemaker implantation for resynchronisation therapy in congestive heart failure

- Class I: None.
- Class IIa: Therapy additive to optimised medical treatment for severe symptomatic heart failure caused by reduced systolic left ventricular function due to documented contractile asynchrony of all causes. The patient profile includes severely depressed functional status (NYHA class III to IV), a prolonged QRS interval of >150 msec with left bundle branch morphology >150 ms or QRS >120 ms with documented ventricular asynchrony, left ventricular end-diastolic diameter of >60 mm and left ventricular ejection fraction of <35%.
- Class IIb: Patients with heart failure with the above-mentioned profile (class IIa) in whom ICD therapy for ventricular tachyarrhythmias is indicated. Patients with heart failure with the above-mentioned profile (class IIa) in whom permanent pacing for sick sinus syndrome or atrioventricular block is needed.
- Class III: Heart failure curable with other therapeutic modalities (surgery, revascularisation). Systolic heart failure without ventricular asynchrony.

Despite these preliminary favourable results, it is currently still unclear whether biventricular pacing promotes survival of patients with severe heart failure. A high incidence of sudden arrhythmic death reported in two cardiac resynchronisation studies^{66,68} was the reason for prospective studies to be launched to assess the value of chronic electrical resynchronisation treatment combined with ICD therapy. ■

Committee members

N.M. van Hemel, chairman, B. Dijkman, W.G. de Voogt, W.P. Beukema, H.A. Bosker, C.C. de Cock, L.J.L.M. Jordaens, I.C. van Gelder, L.M. van Gelder, R. van Mechelen, J.H. Ruiters, M.I. Sedney, L.C. Slegers.

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