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ORIGINAL ARTICLE

Cardiac Resynchronisation Therapy in Patients with Atrioventricular Nodal Disease and Reduced Ejection Fraction - Can We Afford it?

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Background Recent pacing guidelines from the European Society of Cardiology recommend cardiac resynchronisation therapy (CRT) in patients with an atrioventricular (AV) nodal pacing indication and reduced ejection fraction (EF). However, concerns over added expenditure may limit its widespread implementation. We investigate the potential incremental cost of biventricular over right ventricular pacing if such a practice was adopted.

Methods Retrospective analysis was performed of devices implanted over eight years. The database was analysed for device type, pacing indication and EF. Cost analysis was performed.

Results 1751 devices were implanted over eight years at an averaged cost of AUD$1,369,125 per year. 172 with CRT were excluded. 25.4 (11.6%) patients per year had an EF≤50% and AV nodal disease. 18.4 were in sinus rhythm (SR) and 7.0 in atrial fibrillation (AF). Of these, 13.5 (6.2%) had EF≤45% (9.9 SR, 3.6 AF) and 8.2 (3.8%) had EF≤35% (5.6 SR, 2.6 AF). Based on an incremental cost of $4,000 per device, if all patients with EF≤50% received CRT, the total cost increment per year equates to $73,500 for SR patients or $101,500 if AF patients were included. In patients with EF≤35% and EF≤45%, this amounts to $22,500 and $39,500 per year for SR patients respectively or $33,000 and $54,000 per year if AF patients were included. Depending on the EF and rhythm, this represents a 1.6% to 7.4% increase per year in the pacing budget for an increased patient population of between 2.6% (EF≤35% in SR) to 11.6% (EF≤50%).

Conclusion A small proportion of additional patients will qualify for CRT based on the chosen cut-off and rhythm. Although the individual incremental cost for biventricular over right ventricular pacing is high in patients with AV nodal disease and reduced EF, overall this represents at most, a modest increase in the total pacing budget.

Keywords Cardiac resynchronisation therapy • Biventricular pacing • Right ventricular pacing • Atrioventricular nodal disease • Heart failure

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Introduction

The 2013 European Society of Cardiology guidelines on Cardiac Pacing and Cardiac Resynchronization Therapy (CRT) have recently advised that *de novo* CRT in patients with an atrioventricular (AV) nodal pacing indication and reduced ejection fraction is a Class IIa indication [1]. While it is well documented that CRT with and without an implantable cardioverter defibrillator (ICD) reduces mortality and hospitalisation due to heart failure in patients with reduced ejection fraction, a wide QRS and symptomatic heart failure [2–4], the utility of CRT in patients with advanced AV nodal disease and impaired left ventricular systolic function has only recently gained support.

The PAVE study showed in patients undergoing AV nodal ablation for atrial fibrillation (AF), biventricular pacing was superior to right ventricular pacing, especially in patients with impaired systolic function [5]. More recently, BLOCK-HF found that in patients with AV nodal disease and impaired ejection fraction, biventricular pacing reduced all cause mortality and urgent visits for heart failure compared with right ventricular pacing [6]. Given this emerging evidence to support biventricular pacing in such a cohort of patients, this has led to a change in guidelines with *de novo* CRT a Class IIa indication in patients with AV nodal disease and impaired left ventricular systolic function [1].

However, concerns over the cost of implanting a biventricular device over a standard pacemaker in such patients may limit the widespread adoption of these guidelines. Indeed, these guidelines have recommended that physicians take into account excess costs when considering biventricular pacing in these patients [1]. Although the incremental cost is high in an individual, the overall cost to institutions and the healthcare budget is unclear.

We sought to determine the potential additional number of patients and therefore incremental cost to a tertiary pacing service if the practice of implanting a biventricular device rather than a standard pacemaker or ICD in patients with AV nodal disease and left ventricular systolic dysfunction was adopted.

Methods

Study Population

A retrospective analysis was performed of all devices implanted at Flinders Medical Centre, Australia between 1st October 2004 and 30th September 2012. Only patients undergoing their first implantation of a cardiac device were included. The database was searched for device type. All patients received either a standard pacemaker or an ICD. Those who had a biventricular device inserted were excluded from the study.

Patients were divided into four categories of ejection fraction (> 50%, ≤ 50%, ≤ 45% and ≤ 35%) using transthoracic echocardiography performed within three months of implant. In patients with an ejection fraction ≤ 50%, device indication was categorised by the presence or absence of an AV nodal indication which was defined as advanced AV block (Mobitz type II or complete heart block). Underlying rhythm at the time of implant was documented and dichotomised into AF and sinus rhythm. All patients in sinus rhythm received a dual chamber device and those in permanent AF had a single chamber device inserted.

Cost Analysis

Given costs of devices have varied over the last eight years, several assumptions were made on device costing to allow cost comparative analysis. All estimates are quoted in Australian dollars and are based on cost of devices at our institution. We assumed the cost per device was $2,500 for a standard pacemaker (both single and dual chamber systems) and $6,500 for a biventricular pacemaker or $15,000 for an ICD and $19,000 for a biventricular ICD. Therefore, on the basis of these figures, the additional cost of biventricular pacing over right ventricular pacing was assumed to be $4,000 per device. Using this increased cost of $4,000 per device, the potential incremental cost of biventricular pacing in all patients with left ventricular systolic dysfunction and AV nodal disease was calculated according to the three cut-offs of reduced ejection fraction (≤ 50%, ≤ 45%, ≤ 35%) and underlying rhythm (AF and sinus rhythm). The percentage incremental increase in the pacing budget per year for each group was calculated by dividing the incremental cost by the yearly pacing budget at Flinders Medical Centre.

Ethics

The study complied with the Declaration of Helsinki and the research protocol was approved by the local human research ethics committee.

Results

Study Population

1751 devices (pacemakers and ICDs) were implanted between 1st October 2004 and 30th September 2012 (See Figure 1). 172 patients with CRT were excluded. 273 with an unknown ejection fraction and 790 with an ejection fraction > 50% were excluded. 516 had an ejection fraction ≤ 50%.

25.4 (11.6%) patients per year had an ejection fraction ≤ 50% and evidence of AV nodal disease (see Table 1). 18.4 (8.4%) per year were in sinus rhythm and 7.0 (3.2%) per year were in AF. 13.5 (6.2%) patients per year had an ejection fraction ≤ 45% and AV nodal disease. 9.9 (4.5%) per year were in sinus rhythm and 3.6 (1.7%) per year were in AF. 8.2 (3.8%) patients per year had an ejection fraction ≤ 35% and AV nodal disease. 5.6 (2.6%) per year were in sinus rhythm and 2.6 (1.2%) per year were in AF.

Of the 66 patients over eight years with an ejection fraction ≤ 35%, 10 had an ICD inserted and the remaining 56 received a standard pacemaker.