Rev Esp Cardiol. 2016;69(4):377–383

Original article

Sequential Atrioventricular Pacing in Patients With Hypertrophic Cardiomyopathy: An 18-year Experience

Alfonso Jurado Román,[◇] José M. Montero Cabezas,[*,◇] Belén Rubio Alonso, Julio García Tejada, Felipe Hernández Hernández, Agustín Albarrán González-Trevilla, María T. Velázquez Martín, Raúl Coma Samartín, Jesús Rodríguez García, and Juan C. Tascón Pérez

Departamento de Cardiología, Hospital Universitario 12 de Octubre, Madrid, Spain

Article history:
Received 17 March 2015
Accepted 10 August 2015
Available online 21 December 2015

Keywords:
Hypertrophic cardiomyopathy
Pacemakers
Obstruction
Systole
Diastole

ABSTRACT

Introduction and objectives: Controversy persists regarding the role of sequential atrioventricular pacing in patients with obstructive hypertrophic cardiomyopathy and disabling symptoms. The aim of this study was to evaluate the effect of pacing on symptoms, dynamic gradient, and left ventricular function in patients with hypertrophic cardiomyopathy.

Methods: From 1991 to 2009, dual-chamber pacemakers were implanted in 82 patients with obstructive hypertrophic cardiomyopathy and disabling symptoms despite optimal medical therapy. Sequential pacing was performed with a short atrioventricular delay. Clinical and echocardiographic parameters were measured before and immediately after implantation and after a long follow-up (median, 8.5 years [range, 1-18 years]).

Results: The New York Heart Association functional class was immediately reduced after pacemaker implantation in 95% of patients ($P < .0001$), and this improvement was maintained until the final follow-up in 89% ($P = .016$). The gradient was significantly reduced after implantation (94.5 ± 36.5 vs 46.4 ± 26.7 mmHg; $P < .0001$) and at final follow-up (94.5 ± 36.5 vs 35.9 ± 24.0 mmHg; $P < .0001$). Mitral regurgitation permanently improved in 52% of the patients ($P < .0001$). There were no differences in ventricular thickness or diameters, ejection fraction, or diastolic function.

Conclusions: Sequential pacing in selected patients with obstructive hypertrophic cardiomyopathy improves functional class and reduces dynamic gradient and mitral regurgitation immediately after pacemaker implantation and at final follow-up. Prolonged ventricular pacing has no negative effects on systolic or diastolic function in these patients.

Estimulación auriculoventricular secuencial en pacientes con miocardiopatía hipertrófica: 18 años de experiencia

Palabras clave:
Miocardiopatía hipertrófica
Marcapasos
Obstrucción
Sístole
Diástole

RESUMEN

Introducción y objetivos: El papel de la estimulación auriculoventricular secuencial en pacientes con miocardiopatía hipertrófica obstructiva y síntomas incapacitantes sigue siendo controvertido. El objetivo de este trabajo es valorar su efecto en los síntomas, el gradiente dinámico y la función del ventrículo izquierdo.

Métodos: Desde 1991 a 2009, se implantó un marcapasos bicameral a 82 pacientes con miocardiopatía hipertrófica obstructiva y síntomas incapacitantes a pesar de tratamiento médico óptimo. Se programó una estimulación secuencial con un intervalo auriculoventricular corto. Se analizaron parámetros clínicos y ecocardiográficos antes, inmediatamente tras el implante y al final de un largo seguimiento (mediana, 8,5 [1-18] años).

Resultados: La clase funcional de la *New York Heart Association* se redujo inmediatamente tras el implante en el 95% de los pacientes ($p < 0,0001$), y esta mejoría se mantenía al final del seguimiento en el 89% ($p = 0,016$). Se observó una reducción significativa del gradiente tras el implante (94,5 ± 36,5 frente a 46,4 ± 26,7 mmHg; $p < 0,0001$) y al final del seguimiento (94,5 ± 36,5 frente a 35,9 ± 24,0 mmHg; $p < 0,0001$). La insuficiencia mitral mejoró de manera constante en el 52% de los casos ($p < 0,0001$). No hubo diferencias en el grosor o los diámetros ventriculares, la fracción de eyección o la función diastólica.

◇ A. Jurado Román and J.M. Montero Cabezas contributed equally to this manuscript and therefore both are considered as first authors.
* Corresponding author: Departamento de Cardiología, Hospital Universitario 12 de Octubre, Avda. de Córdoba s/n, 28041 Madrid, Spain.
E-mail address: jmmonterocabezas@gmail.com (J.M. Montero Cabezas).

http://dx.doi.org/10.1016/j.rec.2015.08.023

Conclusiones: La estimulación secuencial en pacientes seleccionados con miocardiopatía hipertrófica obstructiva mejora la clase funcional y reduce el gradiente dinámico y la insuficiencia mitral inmediatamente tras el implante y al final de un largo seguimiento. La estimulación ventricular prolongada no produce efectos deletéreos en la función ventricular sistólica o diastólica en estos pacientes.

Abbreviations

HCM: hypertrophic cardiomyopathy
LV: left ventricular
LVOT: left ventricular outflow tract
NYHA: New York Heart Association
SAVP: sequential atrioventricular pacing

INTRODUCTION

Left ventricular outflow tract (LVOT) obstruction is a key pathophysiological element in obstructive hypertrophic cardiomyopathy (HCM). Between 70% and 75% of patients with symptomatic obstructive HCM have some degree of obstruction, whether at rest or after provocative maneuvers.[1] The obstruction can cause symptoms, sometimes disabling, such as exertional dyspnea, angina, and syncope, due to an acute reduction in cardiac output, increased left ventricular (LV) filling pressure, or myocardial ischemia. Patients with LVOT obstruction also have a higher rate of overall mortality and greater risk of sudden cardiac death.[2,3] Accordingly, a reduced obstructive gradient is one of the therapeutic targets in obstructive HCM.

Medical therapy of obstructive HCM is based on beta-blockers and verapamil.[4,5] These treatments improve symptoms in most patients. In nonresponders to monotherapy with first-line drugs, disopyramide can be useful. Nonetheless, a considerable number of patients remain symptomatic despite optimal medical therapy. Surgical myectomy and alcohol septal ablation effectively reduce the LVOT obstructive gradient and improve symptoms.[4] However, these procedures are associated with complications and mortality, especially in older patients or patients with comorbidity. Both techniques also require highly specialized surgeons who are unavailable in most centers.[3,6] The symptoms of these patients have also been improved by sequential atrioventricular pacing (SAVP).[3,6–11] Preexcitation of the right ventricular apex alters the septal activation sequence, reducing the LVOT gradient and mitral regurgitation severity and possibly attenuating long-term LV remodeling.[3,7,11] This therapy has shown a small benefit in randomized clinical trials, particularly in patients older than 65 years.[8,9] However, its true long-term efficacy remains a matter for debate due to the possible placebo effect induced by pacemaker implantation.[8]

The diastolic function of patients with obstructive HCM may show long-term effects from continued DDD pacing with a short atrioventricular delay.[12,13] Additionally, prolonged ventricular pacing can negatively impact LV systolic function, leading to long-term clinical decline.[13]

Currently, and based on controversial data, SAVP has been relegated to a second-line treatment of obstructive HCM.[4,5] Its indication is restricted to patients with considerable comorbidity and an unacceptable risk for septal reduction procedures or another indication for dual-chamber pacing.[14]

Here, we report our 18-year experience in the treatment of patients with obstructive HCM with SAVP, analyzing the effects of this therapy on the LVOT obstructive gradient, mitral regurgitation, functional class, LV remodeling, and systolic and diastolic function.

METHODS

Patients

The present study included 82 patients with obstructive HCM, sinus rhythm, and disabling symptoms despite optimal medical therapy who were treated with SAVP in *Hospital Universitario 12 de Octubre* between 1991 and 2009. Each patient's treatment was discussed in a multidisciplinary clinical conference before the intervention, and the final decision considered comorbidities, alternative treatment availability, and patients' wishes. Obstructive HCM was diagnosed using 2-dimensional echocardiographic visualization of unexplained ventricular hypertrophy $>$ 15 mm in any myocardial segment. All patients had severe LVOT obstruction ($>$ 50 mmHg) on continuous wave Doppler imaging. At the time of patient inclusion, disopyramide was not available in our center.

Study Protocol

Informed consent was obtained from all patients before pacemaker implantation. Clinical and echocardiographic parameters were measured before and immediately after implantation and after a long follow-up (median, 8.5 years [range, 1-18] years). Final data collection was retrospective.

Functional class and angina were evaluated according to the classifications of the New York Heart Association (NYHA) and the Canadian Society of Cardiology, respectively. Information was also collected on history of syncope, presyncope, and heart failure. The echocardiographic variables measured were peak subaortic velocity, peak and mean LVOT gradients at rest and after Valsalva maneuvers, systolic anterior movement of the mitral valve (scored from 0 to 4),[11] maximum wall thickness, maximum left atrial diameter in the apical 4-chamber plane, LV ejection fraction (LVEF; measured using the biplane Simpson method), and end-diastolic and end-systolic LV volumes and diameters. Mitral regurgitation was semiquantitatively evaluated based on visual estimation and information from pulsed, continuous, and color Doppler imaging. Regurgitation was classified into 5 grades (0, absent; I, trivial; II, mild; III, moderate, and IV, severe). Diastolic function was assessed using Doppler echocardiography. Also analyzed were the peak velocity of the E and A waves, E/A and E/E' ratios, pressure half-time, mitral deceleration time of early filling, isovolumic relaxation time, and pulmonary systolic pressure. Calculation of the E/A ratio was omitted in patients with atrial fibrillation during follow-up.

A permanent dual-chamber pacemaker in DDD mode was implanted according to the standard method in all patients, with the ventricular lead placed in the right ventricular apex.[3] The atrioventricular delay was determined using echocardiographic