Med Intensiva. 2015;39(3):172–178

medicina intensiva

www.elsevier.es/medintensiva

REVIEW

Importance of ventricular function in the election of electro heart mode☆

S. Nicolás-Franco[a,*], F.J. Rodríguez-González[a], A. Nicolás-Boluda[b], A. Sánchez-Martos[a]

[a] *Cardiac Pacing Unit, Hospital General Universitario Rafael Méndez, Lorca, Murcia, Spain*
[b] *Biotechnology, Universidad Politécnica de Valencia, Valencia, Spain*

Received 10 April 2014; accepted 18 September 2014
Available online 29 March 2015

KEYWORDS
Cardiac electrostimulation;
Pacemakers;
Cardioverter-defibrillation;
Biventricular pacing;
Ventricular function

Abstract The integration of the ventricular function is essential when making decisions over a patient subjected to cardiac electrostimulation in order to understand the structure followed in the new cardiac stimulation and resynchronizing therapy guides. To support the importance of ventricular function in cardiac electrostimulation it is important to know: (a) the deleterious effect of stimulation on the right ventricle apex; (b) the effect over the left ventricular function produced by complete blockage of the left branch, and (c) left ventricular disfunction as arrythmogenic substrate. When it comes to decide what type of cardiac electrostimualtion to apply we will know: the percentage of ventricular stimulation needed and its ventricular function. A normal ventricular function will enable electrostimulation from the right ventricle apex or alternative site. On the contrary, if this value is lower than 50% the most recommended electrostimulation is cardiac resynchronization (CRT-P), which will be accompanied by defibrillation (CRT-D) if FEVI is lower than 35%.

PALABRAS CLAVE
Electroestimulación cardiaca;
Marcapasos;
Desfibriladores;
Resincronización cardiaca;
Función ventricular

Importancia de la función ventricular en la elección del modo de electroestimulación cardiaca

Resumen La integración de la función ventricular en la toma de decisiones del paciente sometido a electroestimulación cardiaca resulta fundamental para comprender la estructuración de las nuevas guías sobre estimulación cardiaca y terapia de resincronización. Para argumentar la importancia de la función ventricular en la electroestimulación cardiaca es necesario conocer: a) el efecto deletéreo de la estimulación desde el ápex del ventrículo derecho; b) el efecto del bloqueo completo de rama izquierda sobre la función ventricular izquierda,

☆ Please cite this article as: Nicolás-Franco S, Rodríguez-González FJ, Nicolás-Boluda A, Sánchez-Martos A. Importancia de la función ventricular en la elección del modo de electroestimulación cardiaca. Med Intensiva. 2015;39:172–178.

* Corresponding author.
E-mail address: silvestre.nicolas@carm.es (S. Nicolás-Franco).

2173-5727/

y c) la disfunción ventricular izquierda como sustrato arritmogénico. Así, cuando decidimos el modo de electroestimulación cardiaca a aplicar debemos conocer el porcentaje de estimulación ventricular que precisará y su función ventricular. Si esta es normal, permitirá estimular desde el ápex del ventrículo derecho o desde sitios alternativos al ápex. Por el contrario, si es menor del 50% es recomendable la resincronización cardiaca (CRT-P) acompañada de desfibrilación (CRT-D) si la FEVI es menor del 35%.

Introduction

The integration of ventricular function is essential when making decisions regarding patients subjected to cardiac electrostimulation in order to understand how the new cardiac stimulation and resynchronizing therapy guides are structured.[1] In relation to the present review, it must be taken into account that when we speak of *left ventricular dysfunction*, we are actually referring to left ventricular systolic dysfunction, not to left ventricular diastolic dysfunction, which is a also a cause of cardiovascular symptoms. Furthermore, *cardiac electrostimulation* not only comprises conventional pacemakers but also implantable cardioverter-defibrillators (ICDs) and cardiac resynchronization therapy without defibrillation (CRT-P) or with defibrillation (CRT-D). On the other hand, cardiac electrostimulation has presently extended beyond the ''stimulation of survival'' principle, which aims to achieve a certain heart rate regarded as adequate, and has become a form of ''physiological stimulation'' designed to secure adequate cardiac function, and which can be analyzed through the concepts of ''atrioventricular synchrony'' and ''intraventricular synchrony''.

On the other hand, consideration is required of three premises, described below, which underscore the ''importance of ventricular function in cardiac electrostimulation''.

Deleterious effect of pacing from the right ventricular apex

Since the 1980s, studies conducted in humans[2] have shown pacing in sinus rhythm to be characterized by a left ventricle stimulation sequence with early depolarization zones that start at lower septal level and on the anterior aspect, together with other late depolarization zones at apical level and in the basal segments of the inferolateral region. However, when pacing is made from the right ventricular apex there is a significant delay in left ventricular activation, with the observation of early stimulation zones located in the middle septal region and other late activation zones at the inferolateral base. The total left ventricular activation time is prolonged, thereby resulting in a ''loss of the normal left ventricular activation sequence'' that simulates complete left branch block, with clinical repercussions.

A number of clinical studies have demonstrated the inconveniences of pacing from the right ventricular apex. Andersen et al.,[3] in patients with sick sinus syndrome, paced one group of subjects exclusively from the atrium (AAI)–a pacing mode that preserves the ''left ventricular activation sequence''–and another group exclusively from the right ventricular apex (VVI)–a pacing mode that loses the ''left ventricular activation sequence''. This second group of patients showed an increase in mortality of cardiovascular origin and a greater incidence of atrial fibrillation episodes.

The MOST study,[4] also carried out in patients with sick sinus syndrome, used two pacing modes: (a) dual chamber (DDD), with one electrode in the right atrium and another in the right ventricular apex, in which the left ventricular activation sequence was lost with a high percentage of ventricular pacing (% pacing); and (b) single chamber, with an electrode in the right ventricular apex (VVI) programmed with a low lower frequency limit, implying a low percentage of ventricular pacing. A greater number of hospital admissions due to heart failure and/or atrial fibrillation episodes was recorded in those patients with a higher percentage of ventricular pacing when the latter exceeded 80%.

Lastly, the DAVID study[5] involved patients with left ventricular dysfunction subjected to ICD implantation as primary prevention measure. The subjects were divided into two groups: a DDD pacing group (receiving a high percentage of ventricular pacing) and a VVI pacing group (receiving a low percentage of ventricular pacing). The trial had to be suspended prematurely because of high mortality among the patients in the group with a greater percentage of stimulation.

In addition to these clinical findings, the following functional alterations related to pacing from the right ventricular apex have been described:

- Paradoxical septal motion.[6]
- Shortened relaxation and filling times.[7]
- Mitral valve regurgitation.[8]
- Increased left atrial size.[9]
- Reduced global and regional left ventricular ejection fraction.[10]

A number of structural[11] and molecular alterations have also been described[12] that reaffirm the deleterious effects of pacing from the right ventricular apex as a condition or entity in its own right–hence the descriptive term ''pacing-induced myocardiopathy''.[13]