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Original research article

Right bundle branch block and heart failure: Can a bifocal right ventricular pacing be an alternative to biventricular pacing?



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ABSTRACT

Patients with right bundle branch block (RBBB) and heart failure (HF) are not well represented in large randomized clinical trials evaluating the efficacy of cardiac resynchronization therapy (CRT), which included mainly left bundle branch block morphology. According to a recent meta-analysis, in our series we have 14 patients with RBBB and HF treated with conventional CRT (biventricular pacing), all of them turned out to be “non-responders”.

Bifocal pacing, a particular modality of simultaneous pacing with two leads implanted in the right ventricle, is a current option in case of unsuccessful biventricular pacing. In accordance with the results of the BRIGHT study, 25 patients with heart failure and unsuccessful biventricular pacing underwent right ventricular bifocal pacing implantation in our Cardiology Department, with significant improvements of NYHA functional class and left ventricular ejection fraction at 12-month follow-up (survival rate 77% after 2 years).

Right ventricular bifocal pacing could be an alternative to conventional biventricular pacing in patients with RBBB and advanced HF, ensuring a more rational electric “resynchronization”, even if hemodynamic and functional benefit remains to be demonstrated.

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Introduction

Cardiac resynchronization therapy (CRT) with biventricular pacing demonstrated efficacy in improving survival and quality of life in patients with advanced heart failure and wide QRS duration (>120 ms) [1–3]. These benefits are largely documented in literature in patients with left bundle branch

block (LBBB), while those with right bundle branch block (RBBB) experienced poorer outcome [4].

Moreover, CRT is sometime not applicable for several reasons (unsuccessful intubation of coronary sinus, catheter instability in left cardiac veins, high left ventricular pacing threshold, phrenic nerve stimulation) [5]. In this case, a proposed alternative technique is bifocal right ventricular pacing. Bifocal pacing is obtained with a simultaneous

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stimulation of the apex and of the right ventricular outflow tract, locating one catheter in apical position and one in the high inter-ventricular septum: it is easier to be performed and implies lower complication rates, not requiring coronary sinus catheterization [6].

The lack of an established strategy in case of CRT implant failure and in case of RBBB was a stimulus to analyze outcomes of patients implanted at our Center.

Methods

We prospectively collected data about all patients receiving an ICD or CRT pacemaker at our Center, compiling a database at the moment of implant and at every subsequent outpatient visit for device check. Collected data regarded demographic features, death/cause of death, complications at implant, etiology of cardiac disease, comorbidities, risk factors, pharmacological therapy, arrhythmias at follow-up, echocardiographic measures (at enrollment and at follow-up) and NYHA class. All patients gave informed consent to the collection of data. We then performed a retrospective analysis focusing on two populations:

1. Patients with RBBB receiving a conventional CRT.
2. Patients with LBBB and indication to CRT who received bifocal pacing for CRT implant failure.

Bifocal pacing was obtained with a simultaneous stimulation of the right ventricular apex (with a passive or active fixation lead) and of the high interventricular right septum in the parahisian site (with an active screw-in fixation lead).

Descriptive statistical analysis was performed with Microsoft Excel XP; Kaplan-Meier analysis of mortality, t-test (for normally distributed data) and Fisher exact (for distribution) were performed as appropriate with R software for Macintosh (R Foundation for Statistical Computing, 2012).

Results

Patients with RBBB treated with CRT

From 2003 to 2012 we performed 14 biventricular pacing implants in RBBB patients (versus approximately 400 LBBB patients); all devices were CRT-D and all patients had a basal QRS > 150 ms.

At 2-year follow-up, 10 patients were alive, 2 dead (1 for refractory heart failure and 1 for extracardiac causes) and 2 lost at follow-up, with a 2-year survival of 83% (Fig. 1). Ejection fraction did not significantly improve and no improvement

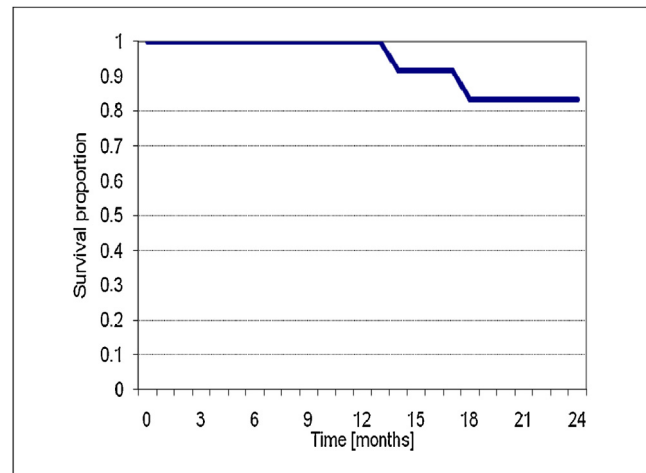


Fig. 1 – Survival curve of 14 RBBB patients implanted with biventricular pacing in our Center.

was obtained in New York Heart Association (NYHA) functional class (Table 1 and Fig. 2).

Patients with failed CRT receiving bifocal pacing

In our Center we treated with bifocal pacing 25 patients eligible to CRT (all with LBBB and QRS > 130 ms) with previous unsuccessful biventricular pacing implantation. Patients were 19 males and 6 females; mean age was 73 ± 7 years; 12 patients had ischemic, 12 idiopathic and 1 valvular dilated cardiomyopathy; 13 patients were in NYHA functional class II (52%), 11 in NYHA class III (44%) and 1 in NYHA class IV (4%); 6 patients received a biventricular pacemaker (24%), 19 patients a biventricular ICD (76%). At the pre-implant echocardiography, left ventricular telediastolic volume (mean \pm st dev) was 212 ± 75 cc, telesystolic volume (mean \pm st dev) was 166 ± 70 cc, and ejection fraction was $23.3 \pm 8.4\%$.

Survival at 24-month follow-up was 77% (Fig. 3).

We observed a significant improvement of NYHA functional class both at 6-month and 12-month follow-up (respectively $p = 0.001$ and $p = 0.03$ compared with pre-implantation values), while at 24-month follow-up the improvement was not statistically significant ($p = 0.18$) (Table 2). Echocardiographic parameters showed an improvement in ejection fraction at 6-, 12- and 24-month follow-up, achieving statistical significance only at 24-month follow-up ($p = 0.08$ at 6 months; $p = 0.013$ at 12 months; $p = 0.07$ at 24 months) (Table 2 and Fig. 4).

Complication rate was extremely low in these two groups of patients (probably because of the low numbers considered):

Table 1 – Clinical outcomes in 14 RBBB patients implanted with biventricular pacing in our Center.

	Basal	6 months	12 months	24 months
Left ventricular ejection fraction (%)	26.8 ± 6.58	29.6 ± 7.78	33.9 ± 11.9	30.7 ± 10.4
NYHA functional class	2.5 ± 0.52	2 ± 0.6	1.91 ± 0.54	2 ± 0.53

p – not significant for any parameter comparison.

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