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Original Article

Upgrading patients with pacemakers to resynchronization pacing: Predictors of success

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ABSTRACT

Background: The investigations of predictors of success or failure of cardiac resynchronization therapy were studied previously. Assessment of success in patients already on dual or single pacemakers and upgraded to cardiac resynchronization therapy (CRT) were not extensively studied before. How to select patients in whom this may be the most optimal strategy is unclear. We sought to determine factors associated with success or failure in this group of patients who were already paced for heart block.
Methods: 81 pts were subjected to upgrade to CRT implantation after being on pacemaker. The study was conducted in Germany. Data was presented as Median (Min.–Max.) for abnormally distributed data or Mean ± SD. for normally distributed data. Parameters that revealed no statistical significance in response: Age, sex, EF, diabetes, renal disease, GFR, MR, QRS duration (all above 150 ms), history of ablation, AF recurrence, previous pacemaker, optimization. The following parameters revealed significant influence on response to CRT: Less responders with: Higher C reactive protein (CRP), presence of tricuspid incompetence (TR), presence of pulmonary hypertension (PHN), presence of previous MI, being ischemic vs nonischemic cardiomyopathy (CM) (less responders with ischemic CM).
Conclusions: The findings through light on specific parameters that predict response to upgrade to CRT after usual pacemaker.
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1. Introduction

Cardiac resynchronization therapy (CRT) has a broader range of therapeutic benefits in appropriately selected patients. The improvement includes cardiac function symptoms and quality of life and reductions in HF-related hospitalizations and death.[1–6] The investigations of predictors of success or failure of cardiac resynchronization therapy were studied previously. But assessment of success in patients already on dual or single pacemakers and upgraded to CRT were not extensively studied before. How to select patients in whom this may be the most optimal strategy is unclear. We sought to determine factors associated with success or failure in this group of patients who were already paced for heart block.

Aim of the work was to study the value of upgrading patients with pacemakers to CRT and assess the significant parameters between responders and non-responders in this special population.

2. Methods

The study included 81 who were implanted with pacemakers for heart block. Later they were found to be legible or in need for CRT upgrading pts. The study was conducted in Germany. The study was conducted from January 2010 to June 2012. All new comers with ventricular pacing were studied (40%) plus previous patients done before and their data were preserved.

How success was assessed: By improvement in NYHA class > o ne level at least, improvement in EF > 5% at least, improvement of LV end systolic volume by 15% at least. 6 min walk distance, if the distance increased than before CRT by > 25% (not done in all so not included in the statistics).

Follow up: Patients were followed one year after CRT implantation.

3. Parameters assessed were

Sex, Age, C reactive protein (CRP), Ejection Fraction (LVEF), Tricuspid incompetence, pulmonary hypertension, previous infarction, QRS duration and etiology of HF (ischemic or cardiomyopathy).

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4. Statistical analysis of the data

Data were fed to the computer and analyzed using IBM *SPSS software package version 20.0*. Qualitative data were described using number and percentage. Quantitative data were described using mean and standard deviation. Comparison between different groups regarding categorical variables was tested using Chi-square test. When more than 20% of the cells have expected count less than 5, correction for chi-square was conducted using Fisher's Exact test. Correlations between two quantitative variables were assessed using Pearson coefficient. Significance of the obtained results was judged at the 5% level. Data was presented as Median (Min.–Max.) for abnormally distributed data or Mean ± SD. for normally distributed data.

5. Results

In Tables 1–3. Of 81 cases, 24 (29.6%) were nonresponders and 57 (70.3%) were responders.

Data was presented as Median (Min.–Max.) for abnormally distributed data or Mean ± SD. for normally distributed data. Data presented in coming lines of nonresponders then responders respectively then P value:

EF: 30.17 ± 9.19 vs 30.30 ± 8.60, P = NS
Age years: 75 vs 72, P = NS
Sex: Males 16.7% vs 17.5%, P = NS
Mitral incompetence: 97.6% vs 99.4%, P = NS
Tricuspid incompetence (TR): 100% vs 79%, P = 0.001
Pulmonary Hypertension: 77% vs 59%, P = 0.037
Previous infarction: 87.5% vs 56%, P = 0.032
Ischemic vs nonischemic cardiomyopathy: 87.5% vs 59.6%, P = 0.014
Optimization after procedure was not compared as they were not studied in all cases.
Atrial fibrillation: 12.5% vs 22.8%, P = NS
Rate of hospitalization during one year after procedure:
Renal function glomerular filtration rate (GFR): 49% vs 50%, P = NS
QRS duration msec: 180 vs 190, P = NS
Diabetes: 41.7% vs 43.9%, P = NS
CRP: 11 vs 3.35, P = 0.001

Revascularization: 87.5% vs 50.9%, P = 0.002 (ischemic cases and those with previous infarction were less responders than nonischemic cardiomyopathy; revascularization was done in most ischemic patients).

Parameters that revealed no statistical significance in response: Age, sex, EF, diabetes, renal disease, GFR, MR, QRS duration (all above 150 ms), history of ablation, AF recurrence, previous pacemaker, optimization. The following parameters revealed significant influence on response to CRT: Less Responder with: Higher CRP, presence of TR, presence of PHN, presence of previous MI, being ischemic vs nonischemic cardiomyopathy (less responder with ischemic CM).

6. Discussion

In the present study, we found that biventricular pacing through the insertion of a transvenous LV lead in previously RV-paced patients offers a remarkable benefit in symptoms, functional status and rate of hospitalizations. Also this is accompanied by an improvement in echocardiographic measurements and a decrease in QRS duration.

Table 1
Relation between response and demographic data, CRP and EF.

	Non Responder (n=24)	Responder (n=57)	p
Sex			
Male	4 (16.7%)	10 (17.5%)	1.000
Female	20 (83.3%)	47 (82.7%)	
Age	75.77 ± 6.73	72.15 ± 9.01	0.081
CRP	11.0 (0.80–74.0)	3.35 (0.30–20.60)	<0.001
SMEAN(CRP)	10.51 (0.80–74.0)	3.60 (0.30–20.60)	<0.001
LVEF	30.17 ± 9.19	30.30 ± 8.60	0.951
EF-I	30.17 ± 9.19	30.30 ± 8.60	0.951

Data was presented as Median (Min.–Max.) for abnormally distributed data or Mean ± SD. for normally distributed data.
Abbreviations: CRP: C reactive protein, DCM: dilated cardiomyopathy, ICM: ischemic cardiomyopathy, MR: mitral regurgitation, TRI: tricuspid incompetence, DM: diabetes mellitus, SMEAN: mean & range.
Data in next two pages.

Table 2
Relation between response and different studied parameters.

	Non Responder (n=24)	Responder (n=57)	p
Revascularization	1.0 (0.0–3.0)	1.0 (0.0–3.0)	0.002
0	3 (12.5%)	28 (49.1%)	
1	10 (41.7%)	15 (26.3%)	
2	3 (12.5%)	7 (12.3%)	
3	8 (33.3%)	7 (12.3%)	
DCM	3 (12.5%)	23 (40.4%)	0.014
DM	10 (41.7%)	25 (43.9%)	0.856
Renal disease	11 (45.8%)	24 (42.1%)	0.757
GFR	49.28 ± 13.01	50.43 ± 12.36	0.724
EF	30.17 ± 9.19	30.30 ± 8.60	0.951
MR	1.0 (0.0–2.0)	1.0 (0.0–3.0)	0.796
0	2 (8.3%)	5 (9.6%)	
1	13 (54.2%)	28 (53.8%)	
2	9 (37.5%)	12 (23.1%)	
3	0 (0.0%)	7 (13.5%)	
TRI	2.0 (1.0–2.0)	1.0 (0.0–2.0)	0.001
0	0 (0.0%)	11 (21.2%)	
1	9 (39.1%)	27 (51.9%)	
2	14 (60.9%)	14 (26.9%)	
PHN	1.0 (0.0–2.0)	1.0 (0.0–2.0)	0.037
0	5 (22.7%)	20 (40.8%)	
1	7 (31.8%)	19 (38.8%)	
2	10 (45.5%)	10 (20.4%)	
QPS duration	180 (120–220)	190 (100.0–250)	
Ablation			
–	21 (87.5%)	44 (77.2%)	0.102
0	2 (8.3%)	13 (22.8%)	
His	1 (4.2%)	0 (0.0%)	
AF recurrence			
Previous pace maker			
0	0 (0.0%)	1 (1.8%)	0.178
1	9 (37.5%)	11 (19.3%)	
2	9 (37.5%)	34 (59.6%)	
3	4 (16.7%)	4 (7.0%)	
4	2 (8.3%)	7 (12.3%)	

Data was presented as Median (Min.–Max.) for abnormally distributed data or Mean ± SD. for normally distributed data.
Abbreviations: CRP: C reactive protein, DCM: dilated cardiomyopathy, ICM: ischemic cardiomyopathy, MR: mitral regurgitation, TRI: tricuspid incompetence, DM: diabetes mellitus, SMEAN: mean & range.

The results presented in this work are, in general, consistent with the published reports,[7–10] and suggest that it is possible to partially reverse the harmful effect of chronic RV pacing.

In most studies, the benefits of CRT have been elucidated in patients with dyssynchrony due to an "intrinsic" LBBB, but patients with HF and previous RV-pacing systems were excluded from most clinical trials of CRT.

In the current study, beneficial treatment effects of BiV pacing were shown in patients with RV-pacing–induced dyssynchrony (paced LBBB). Patients with HF and an RV pacemaker often fulfill the current indications for CRT.

Table 3
Significance of other parameters before CRT implantation.

	Non Responder (n=24)	Responder (n=57)	p
Pace	97 (62.0–100.0)	98 (40.0–100.0)	0.854
Operative success			
–	0 (0.0%)	1 (1.8%)	0.833
0	1 (4.2%)	4 (8.8%)	
0&1	0 (0.0%)	1 (1.8%)	
1	23 (95.8%)	50 (87.7%)	
BV Pacing	99 (90.0–100.0)	99 (86.0–100.0)	0.888
Optimization			
0	12 (50.0%)	25 (45.5%)	0.710
1	12 (50.0%)	30 (54.5%)	
Paced QRS duration	160 (110.0–170.0)	140 (120.0–200.0)	0.692
Previous infarction			
No previous infarction	3 (12.5%)	25 (43.9%)	0.032
Previous infarction	6 (25.0%)	14 (24.6%)	
2	8 (33.3%)	10 (17.5%)	
3	7 (29.2%)	8 (14.0%)	
Etiology			
ICM	21 (87.5%)	34 (59.6%)	0.014
DCM	3 (12.5%)	23 (40.4%)	
EF-I	30.17 ± 9.19	30.30 ± 8.60	0.951
SMEAN(CRP)	10.51 (0.80–74.0)	3.60 (0.30–20.60)	<0.001
LVEF	30.17 ± 9.19	30.30 ± 8.60	0.951

Data was presented as Median (Min.–Max.) for abnormally distributed data or Mean ± SD. for normally distributed data.

These patients may have significant interventricular dyssynchrony, although the severity and frequency of these abnormalities in this group remain poorly explored.

A number of studies have reported on the effects of upgrading from RV pacing to biventricular pacing in either the acute setting or in the short term.[11–14] Early reports examining the feasibility of adapting chronic RV pacemaker systems to provide biventricular stimulation showed improvements in quality of life in patients with HF, but without thoroughly assessing the echocardiographic response to resynchronization therapy.

Similar improvement in symptoms, functional capacity and quality of life emerged from additional crossover observational and retrospective studies.[12–14]

Other reports examining the impact of CRT upgrade on the acute echocardiographic and hemodynamic effects of biventricular pacing indicated an acute increase in EF and a reduction in intraventricular mechanical delay.

Several of these studies found overall similar improvements induced by CRT in patients having a primary implantation as compared to patients receiving an upgrade procedure after chronic RV pacing.[15–24]

7. Conclusions

This study elucidates the benefit of upgrading RV pacing to CRT and reveals the factors affecting response. The following parameters revealed significant influence on response to CRT: Less responders with: Higher CRP, presence of TR, presence of PHN, presence of previous MI, being ischemic vs nonischemic cardiomyopathy (less responders with ischemic CM).

Conflicts of Interest

No conflict of interest.

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