

# Cardiac Resynchronization Therapy Is Appropriate for All Patients Requiring Chronic Right Ventricular Pacing

## The Pro Perspective

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### KEYWORDS

• Cardiac pacing • Biventricular pacing • Cardiac resynchronization • Cardiomyopathy • Heart failure

### KEY POINTS

- Pacemaker-induced cardiomyopathy (PICM) owing to right ventricular pacing is a well-known phenomenon that depends the cumulative pacing burden and is partially reversible with biventricular pacing.
- A 40% pacing burden is the current threshold considered high enough to induce PICM; however, more recent data suggest that lower pacing burden can be deleterious.
- Indications for preventive biventricular pacing in patients with preserved left ventricular (LV) function who require long-term pacing is still not well-defined in current guidelines.
- The identification of LV dyssynchrony may help to isolate a subgroup that may benefit in particular from biventricular pacing.

Long-term right ventricular (RV) pacing has well known deleterious effects on the left ventricle (LV). The risk of developing a pacemaker-induced cardiomyopathy (PICM) seems to be lower in patients with a normal baseline LV ejection fraction (LVEF).<sup>1-3</sup> The activation pattern during RV pacing mimics that of a left bundle branch block, with delayed activation of the LV free wall, resulting in electrical and mechanical dyssynchrony.<sup>4-8</sup> Important early trials (Mode Selection [MOST], Dual Chamber and VVI Implantable Defibrillator

[DAVID], Multicenter automated defibrillator implantation trial II [MADIT II], and the Danish AAIR/DDDR trials) have documented the occurrence and importance of PICM (Table 1).<sup>9-14</sup> As a result, biventricular (Bi-V) pacing has emerged as an important therapeutic option for the prevention and treatment of PICM.

The true incidence of PICM in patients with a normal LVEF at baseline is difficult to determine because in many studies, the outcome was not analyzed separately in those with a normal and

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**Table 1**  
Observational studies of pacing-induced cardiomyopathy

Authors, Year	No. of Patients	Follow-up (mo)	Basal LVEF	% Pacing	F/U LVEF	Incidence of PICM	Heart Failure Hospitalization	Comments
Shimano et al, <sup>25</sup> 2007	18	81 ± 10	18 patients: 54 ± 3.1% 13 patients: >50%	Complete AV block (pacemaker dependent)	18 patients: 28.21	Selected patients with PICM only	All: 2.1 ± 0.2/y	Mean LVEF all
Zhang et al, <sup>23</sup> 2008	304	92	64 ± 0.1	99%	47 ± 0.11	26%	HF 79 (26%); 87% were hospitalized	CV mortality was higher in patients with HF (36.7% vs 2.7%; <i>P</i> <.001); median
Dreger et al, <sup>24</sup> 2012	26	>15 y	No structural heart disease	>99%	4 patients; LVEF 41.0 ± 4.5% vs 22 patients: LVEF 61.2 ± 5.8%	15.4%	—	PICM defined as LVEF of ≤45%
Khurshid et al, <sup>22</sup> 2014	277	Mean 3.3 y	>50%	Variable	207 patients: unchanged 50 patients: PICM (LVEF 62.1%–36.2%)	19.5%	—	PICM defined as LVEF drop of >10% with LVEF of <50% 20 patients were excluded for an alternative explanation
Hori et al, <sup>27</sup> 2011	367	113 ± 69	64.0 ± 11.3	>90% in all patients	HF group: 56.6 ± 13.3 vs 65.5 ± 10.2 in the non-HF group	16%	60 (16%)	No symptoms
Ahmed et al, <sup>26</sup> 2014	91	AVJ ablation for AF; start at a median of 4 mo after implantation. Late F/U: >28 mo median after implantation Group I: no decline LVEF of ≥5% (63 patients) in F/U Group II: decline LVEF ≥5% (28 patients) in F/U	Group I: 59 ± 5% (63 patients) Group II: 60 ± 5% (28 patients) (31%) QRS >120 ms excluded	100%	Group I: unchanged Group II: decline to 49 ± 8%	31%	—	Group II: LVESI 36 ± 12–46 ± 21.

*Abbreviations:* AF, atrial fibrillation; AVJ, AV junction; CV, cardiovascular; F/U, follow-up; HF, heart failure; LVEF, left ventricular ejection fraction; LVESI, left ventricular end systolic index; PICM, pacing-induced cardiomyopathy.

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