Does Cardiac Resynchronization Therapy Benefit Patients With Right Bundle Branch Block?

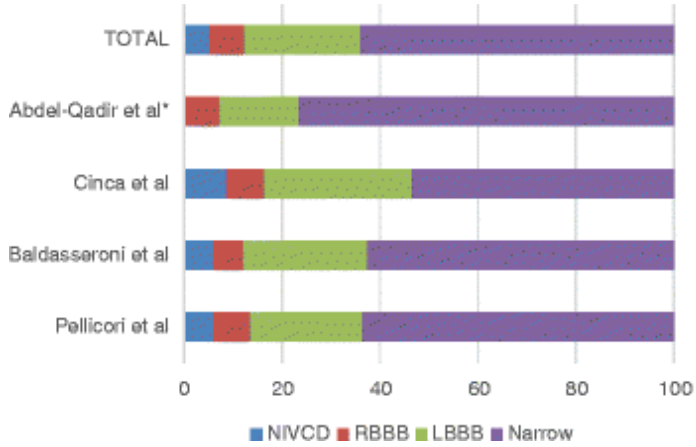
CRT Has a Role in Patients With RBBB

Emmanuel Fares, MD
EP service, Department Of Cardiovascular Medicine
Cairo University

Agenda

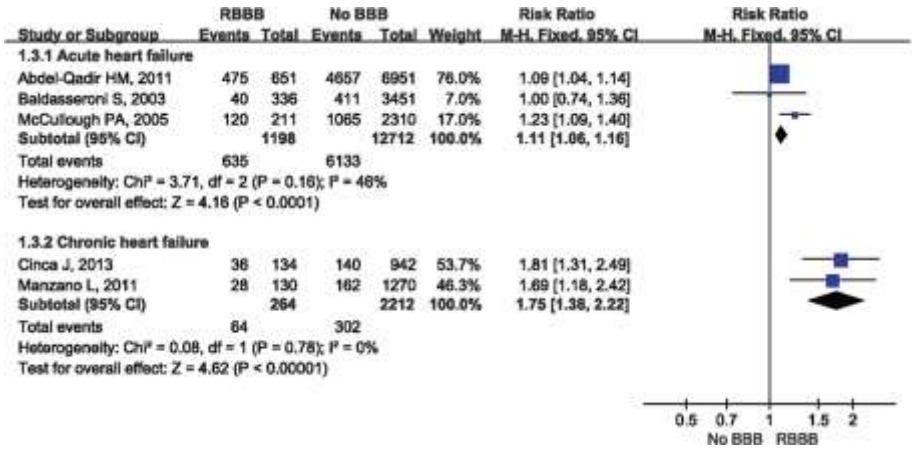
- Introduction & Magnitude of the Problem
- What Do the Guidelines Say?
- Evidence behind the Guidelines
- Special RBBB Subpopulations:
  - Electromechanical dyssynchrony
  - RBBB with long PR interval
  - Use of LV Lead Electrical Delay (LVLED)
- Conclusion

Magnitude of the Problem



RBBB, although less common than narrow QRS or typical LBBB, is frequently encountered in the HF population, affecting between 10 and 15% of patients

The Prognostic Significance of Right Bundle Branch Block: A Meta - analysis of Prospective Cohort Studies



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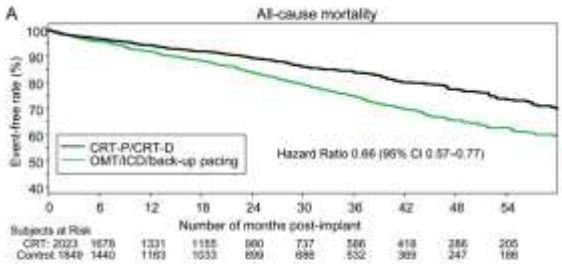
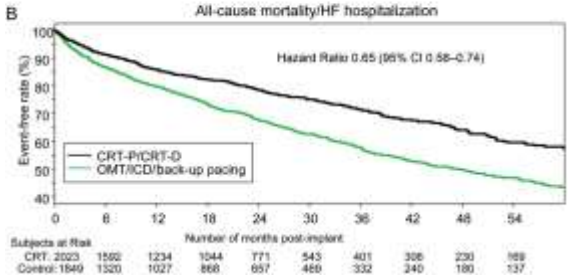


CRT has been established as a useful therapy for patients with heart failure with prolonged QRS duration and low ejection fraction



CRT has been shown to reduce mortality and morbidity in these patients

From: An individual patient meta-analysis of five randomized trials assessing the effects of cardiac resynchronization therapy on morbidity and mortality in patients with symptomatic heart failure
Eur Heart J. 2013;34(46):3547-3556. doi:10.1093/eurheartj/eht290

Recommendations for cardiac resynchronization therapy implantation in patients with heart failure

Recommendations	Class[a]	Level[b]	Ref[c]
CRT is recommended for symptomatic patients with HF in sinus rhythm with a QRS duration ≥150 msec and LBBB QRS morphology and with LVEF ≤35% despite OMT in order to improve symptoms and reduce morbidity and mortality.	I	A	261–272
CRT should be considered for symptomatic patients with HF in sinus rhythm with a QRS duration ≥150 msec and non-LBBB QRS morphology and with LVEF ≤35% despite OMT in order to improve symptoms and reduce morbidity and mortality.	IIa	B	261–272
CRT is recommended for symptomatic patients with HF in sinus rhythm with a QRS duration of 130–149 msec and LBBB QRS morphology and with LVEF ≤35% despite OMT in order to improve symptoms and reduce morbidity and mortality.	I	B	266, 273
CRT may be considered for symptomatic patients with HF in sinus rhythm with a QRS duration of 130–149 msec and non-LBBB QRS morphology and with LVEF ≤35% despite OMT in order to improve symptoms and reduce morbidity and mortality.	IIb	B	266, 273
CRT rather than RV pacing is recommended for patients with HFrEF regardless of NYHA class who have an indication for ventricular pacing and high degree AV block in order to reduce morbidity. This includes patients with AF (see Section 10.1).	I	A	274–277
CRT should be considered for patients with LVEF ≤35% in NYHA Class III–IV[a] despite OMT in order to improve symptoms and reduce morbidity and mortality, if they are in AF and have a QRS duration ≥130 msec provided a strategy to ensure bi-ventricular capture is in place or the patient is expected to return to sinus rhythm.	IIa	B	275, 278–281
Patients with HFrEF who have received a conventional pacemaker or an ICD and subsequently develop worsening HF despite OMT and who have a high proportion of RV pacing may be considered for upgrade to CRT. This does not apply to patients with stable HF.	IIb	B	282
CRT is contra-indicated in patients with a QRS duration < 130 msec.	III	A	266, 283–285

AF = atrial fibrillation; AV = atrio-ventricular; CRT = cardiac resynchronization therapy; HF = heart failure; HFrEF = heart failure with reduced ejection fraction; ICD = implantable cardioverter-defibrillator; LBBB = left bundle branch block; LVEF = left ventricular ejection fraction; NYHA = New York Heart Association; OMT = optimal medical therapy; QRS = Q, R and S waves (combination of three of the graphical deflections); RV = right ventricular.

Study	Year of publication	NYHA Class	Mean LVEF	Mean QRS Duration	Total number of patients	conduction abnormality		
						LBBB	RBBB	IVCD
Prospective randomized studies*								
PATH-CHF I[1]	2002	3–4	21±6	174±30	42	93%	7%	0%
PATH-CHF II[2]	2003	2–4	23±7	155±20	86	88%	5%	6%
CONTAK CD[3]	2003	2–4	21±7	155±27	490	54%	14%	33%
MIRACLE[4]	2004	3–4	22±6	166±21	453	80%	11%	9%
MIRACLE ICD II[5]	2004	2	25±7	166±24	186	NA	17%	NA
COMPANION[6]	2004	3–4	22	158	1520	71%	11%	18%
CARE-HF[7]	2005	3–4	25†	160†	813	94%	5%	1%
REVERSE[8]	2008	1–2	26±7	151±23	680	54%	8%	19%
MADIT-CRT[9]	2009	1–2	24±5	152±18	1817	70%	13%	17%
RAFT[10]	2010	2–3	23±5	158±24	1866	69%	9%	11%

QRS width was the inclusion criterion in all randomized trials

None of the landmark trials selected patients for inclusion according to QRS morphology

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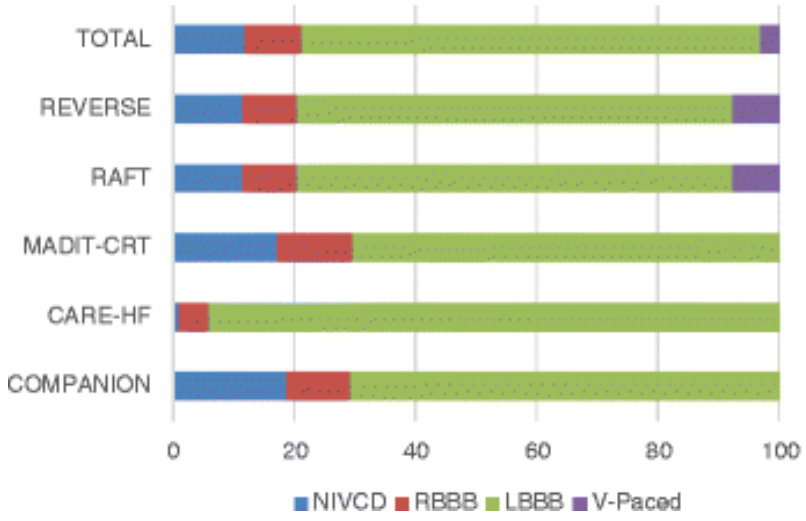
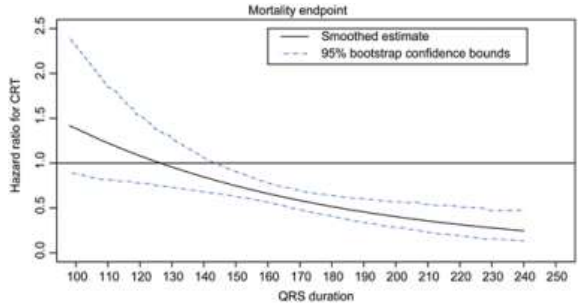
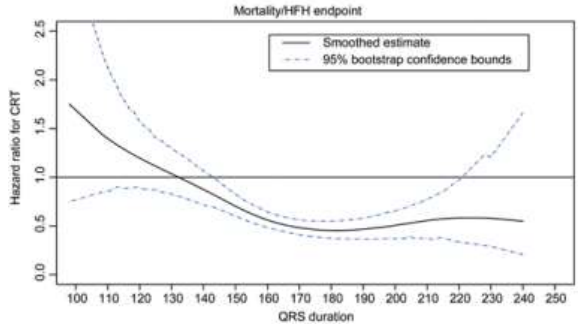
Intraventricular conduction delay in HF patients with QRS intervals > 120 ms







Meta-analysis of 5 CRT trials showed that QRS duration was the only predictor of magnitude of response to CRT

The intersection of the 95% confidence interval and the line indicating a hazard ratio of 1.0 (no effect) indicates the QRS duration above which there is a high certainty of response.

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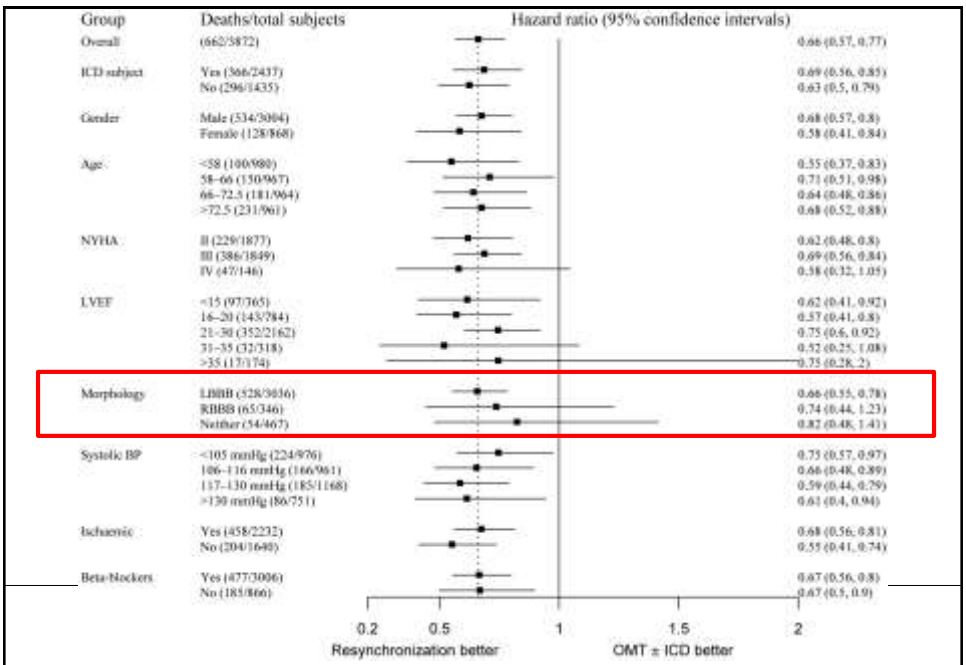

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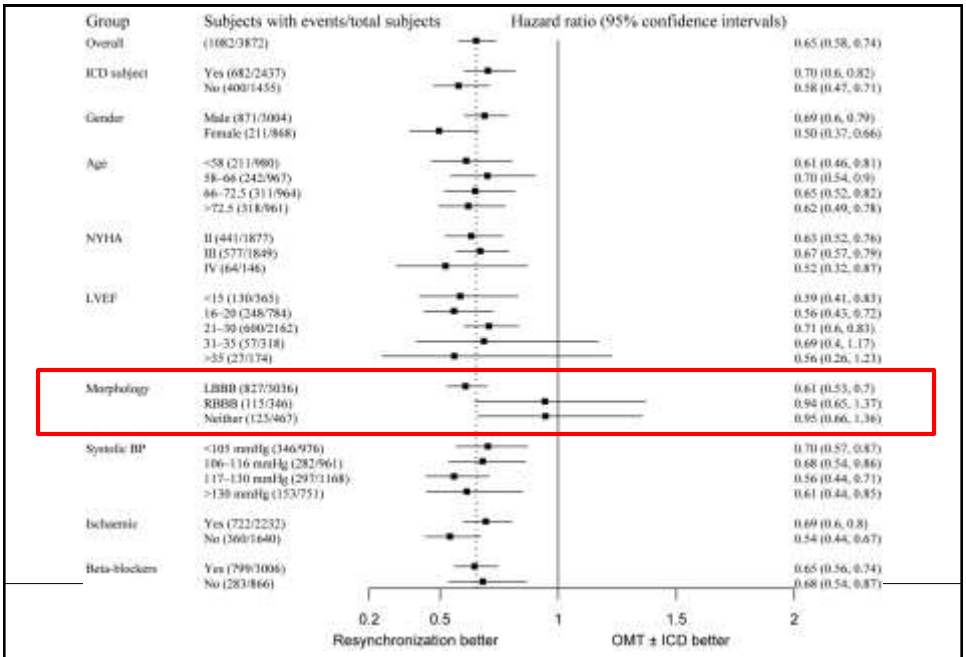

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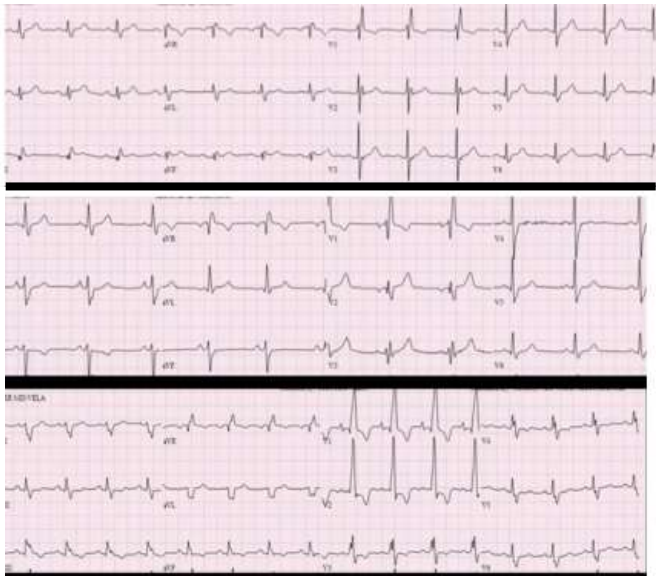
Do RBBB patients represent a homogenous group?

- RBBB masking LBBB (associated LV electromechanical dyssynchrony)
- RBBB with long PR interval
- Use of intraprocedural LVLED

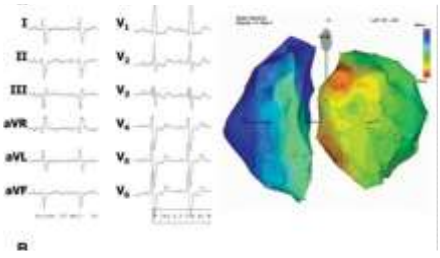
RBBB

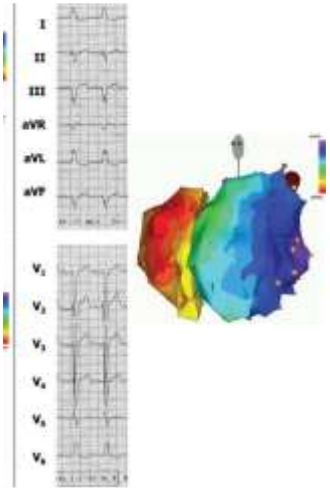
RBBB
+
LAFB

RBBB
+
LPFB



Electroanatomic mapping and surface 12-lead ECG in a patient with RBBB in a patient with LBBB

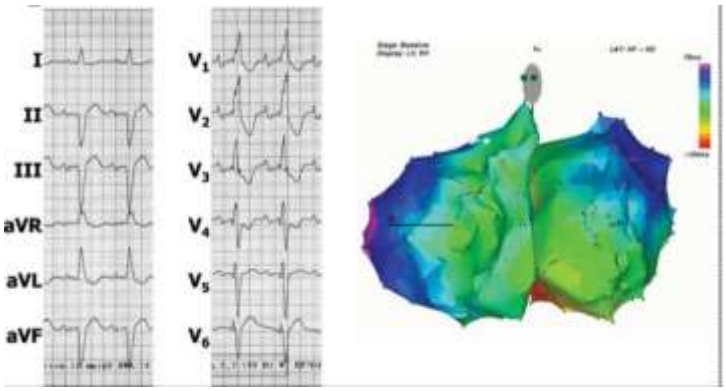




Angelo Auricchio et al. Circ Arrhythm Electrophysiol. 2014;7:532-542

American Heart Association.

Electroanatomic mapping and surface 12-lead ECG in a patient with RBBB masking left LBBB



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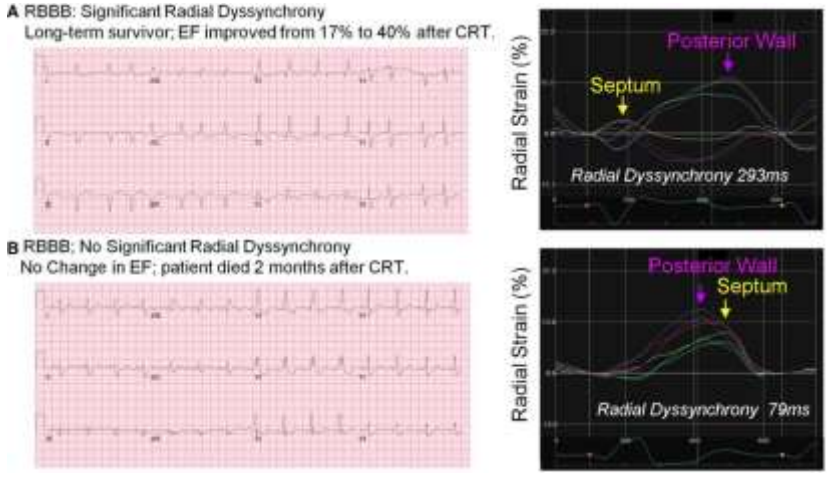
Two patient examples of different right RBBB morphology and long-term outcome after CRT



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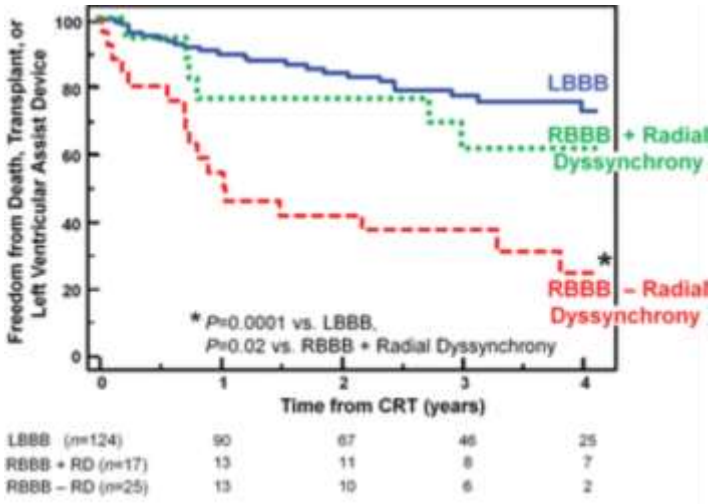
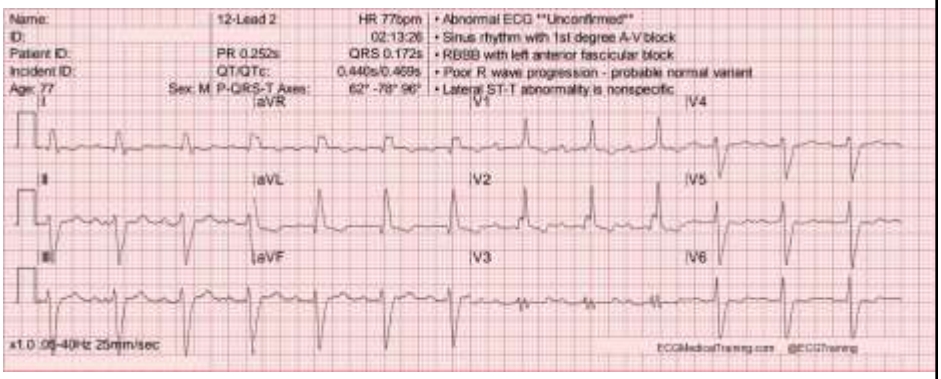
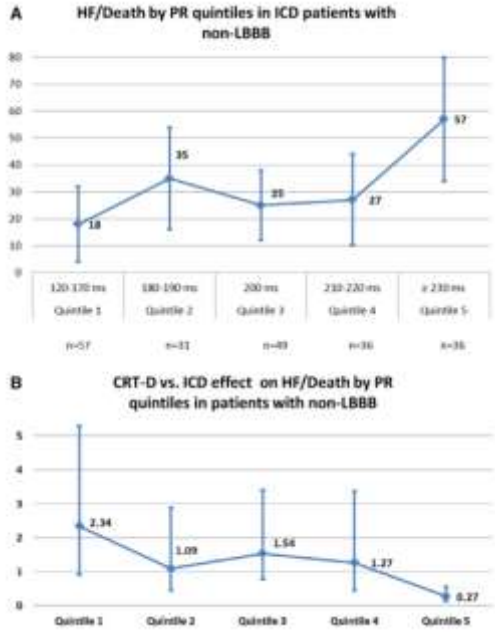


The Kaplan–Meier curves demonstrating the probability of freedom from death, transplant, or ventricular assist device after CRT comparing patients with LBBB, to those with RBBB with or without significant radial dyssynchrony.

From: The relationship of QRS morphology and mechanical dyssynchrony to long-term outcome following cardiac resynchronization therapy
Eur Heart J. 2012;33(21):2680-2691. doi:10.1093/eurheartj/ehs013

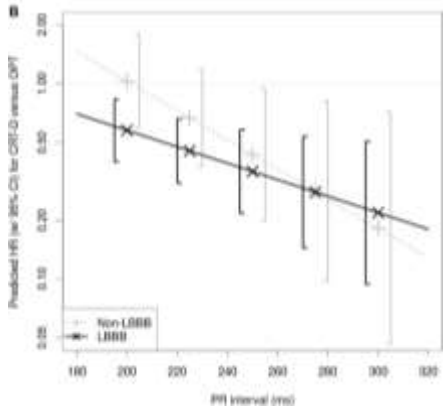
RBBB associated with first degree HB





In a substudy of the MADIT CRT Non-LBBB patients with a long PR interval derive a significant clinical benefit from the implantation of CRT-D versus ICD-only

Effect of PR Interval on Outcomes Following Cardiac Resynchronization Therapy: A Secondary Analysis of the COMPANION Trial



Predicted hazard ratios (estimates and 95% CIs) according to baseline PR intervals and QRS morphology. In patients with non - LBBB and LBBB, there was a statistically significant decrease in hazard ratio (favoring CRT - D treatment) for all - cause mortality with increasing PR intervals.

There was no significant difference in either endpoint between patients with non - LBBB and LBBB

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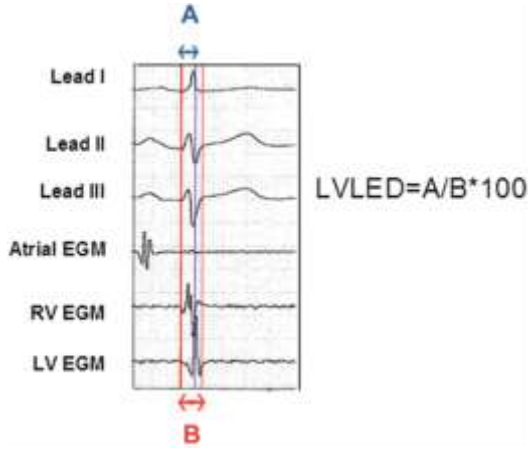
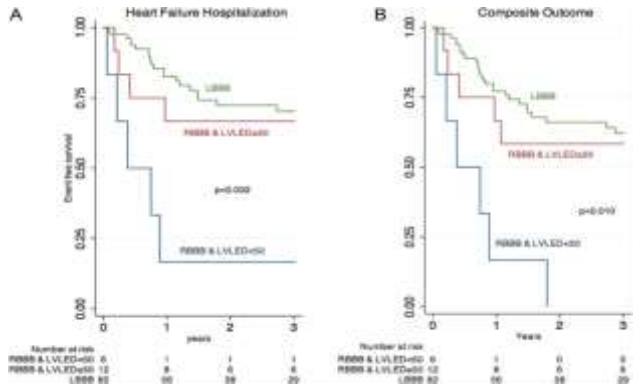
http://onlinelibrary.wiley.com/doi/10.1111/jce.13131/full#jce13131-fig-0002

Use of left ventricular lead electrical delay



From: QRS morphology, left ventricular lead location, and clinical outcome in patients receiving cardiac resynchronization therapy
Eur Heart J. 2013;34(29):2252-2262. doi:10.1093/eurheartj/eht123

Event-free survival for (A) heart failure hospitalization and (B) composite outcome at 3 years comparing LVLED ≥50% and LVLED <50% in RBBB patients. LBBB patients are plotted to provide comparison



From: QRS morphology, left ventricular lead location, and clinical outcome in patients receiving cardiac resynchronization therapy
Eur Heart J. 2013;34(29):2252-2262. doi:10.1093/eurheartj/eht123

Conclusion

- Heart failure patients with RBBB represent a sizeable subgroup in need of adjunct therapies on top of the best pharmacological therapy
- CRT provide some benefits to unselected patients with RBBB, albeit modest
- Some RBBB patient subpopulations seem to benefit more from CRT and they include:
  - Associated LAFB or LPFB (masked LBBB)
  - Associated LV electromechanical dyssynchrony
  - Long PR > 230 ms
  - Intraprocedural LVLED >50%

Thank You