



<b>National Imaging Associates, Inc.</b>	
<b>Clinical guidelines</b> <b>CARDIAC RESYNCHRONIZATION THERAPY (CRT)</b>	<b>Original Date: February 2013</b>
<b>CPT Codes: 33221, 33224, 33225, 33231</b>	<b>Last Revised Date: August 2019</b>
<b>Guideline Number: NIA_CG_320</b>	<b>Implementation Date: January 2020</b>

#### **INDICATIONS FOR CARDIAC RESYNCHRONIZATION THERAPY (CRT):**

(Brignole 2013, Cleland 2005, Epstein 2012, Ponikowski 2016, Russo 2013, Yancy 2013)

- Left ventricular ejection fraction (LVEF)  $\leq$  35%, sinus rhythm, left bundle branch block (LBBB) with a QRS  $\geq$  150 ms, and New York Heart Association (NYHA) class II, III, or ambulatory class IV symptoms on guideline-directed medical therapy (GDMT) (Adelstein 2018, Ponikowski 2016).
- LVEF  $\leq$  35%, sinus rhythm, LBBB with a QRS duration 120 to 149 ms, and NYHA class II, III, or ambulatory class IV symptoms on GDMT.
- LVEF  $\leq$  35%, sinus rhythm, a non-LBBB pattern with a QRS duration  $\geq$  150 ms, and NYHA III or ambulatory class IV symptoms on GDMT (Epstein 2012, Ponikowski 2016, Yancy 2013).
- Atrial fibrillation and LVEF  $\leq$  35% on GDMT if:
  - Patient requires ventricular pacing or otherwise meets CRT criteria; **AND**
  - AV nodal ablation or pharmacologic rate control will allow nearly 100% ventricular pacing with CRT (Yancy 2013).
- LVEF  $\leq$  35% and undergoing new or replacement device with anticipated requirement for significant (> 40%) ventricular pacing (Adelstein 2018, Brignole 2013, Curtis 2013, Ponikowski 2016, Yancy 2013).

#### **NOT Indicated for Cardiac Resynchronization Therapy (CRT)**

- NYHA class I or II symptoms and non-LBBB pattern with QRS duration < 150 ms (Epstein 2012).
- Comorbidities and/or frailty expected to limit survival with good functional capacity to < 1 year.

#### **INDICATIONS FOR CRT IN ADULT CONGENITAL HEART DISEASE:**

(Hernandez-Madrid 2018, Khairy 2014, Stout 2018)

- Systemic LVEF  $\leq$  35%, sinus rhythm, complete LBBB with a QRS complex  $\geq$  150 ms (spontaneous or paced) and NYHA class II to ambulatory IV.
- Systemic LVEF  $\leq$  35%, sinus rhythm, complete LBBB with a QRS complex 120-149 ms (spontaneous or paced), and NYHA class II to ambulatory IV.

- Systemic ventricular EF  $\leq$  35%, intrinsic narrow QRS complex, NYHA functional class I to ambulatory class IV and undergoing new or replacement device implantation with anticipated requirement for significant ( $>$  40%) ventricular pacing (single site pacing from the systemic ventricular apex or mid-lateral wall may be considered as an alternative).
- Systemic right ventricle (RV) with an EF  $\leq$  35%, NYHA function Class II – ambulatory class IV, complete right bundle branch block (RBBB) with a QRS complex  $\geq$  150 ms (spontaneous or paced).
- Single ventricle with an ejection fraction (EF)  $\leq$  35%, NYHA function Class II—ambulatory class IV and a QRS complex  $\geq$  150 ms due to intraventricular conduction delay causing either a complete right or left bundle branch block morphology (spontaneous or paced).

#### **NOT Indicated for CRT in Adult Congenital Heart Disease**

- Patients with a narrow QRS complex ( $<$  120 ms).
- Patients whose co-morbidities and/or frailty limit survival with good functional capacity to less than 1 year.

#### **INDICATIONS FOR CRT AS THE APPROPRIATE PACING MODALITY IN SPECIAL SITUATIONS WITH $<$ 3 MONTHS OF GDMT**

(Katsumoto 2014, Marine 2018, Russo 2013)

- Criteria are met for a non-elective implantable cardioverter defibrillator (ICD) or a non-elective pacemaker, either initial or replacement, and based upon the low likelihood of improvement in symptoms and adequate recovery of LVEF, despite less than 3 months GDMT for heart failure or  $<$  40 days post myocardial infarction or 3 months post revascularization, criteria for CRT are otherwise met. This avoids a second implantation procedure within less than 3 months.

#### **BACKGROUND:**

(Brignole 2013, Epstein 2012, Ponikowski 2016, Russo 2013, Yancy 2013)

CRT, which paces the left and right ventricle in rapid sequence, also known as biventricular pacing, improves coordination of ventricular contraction in the presence of a wide QRS complex in systolic heart failure.

CRT improves cardiac function and quality of life, and it decreases cardiac events and mortality among appropriately chosen patients. The improved survival in patients with CRT is greater than that provided by ICD insertion alone.

Guiding principles in the consideration of CRT:

- NYHA class is an important qualifying factor, with candidacy ranging from New York Heart Association (NYHA) class II to *ambulatory* NYHA class IV.
- Bundle branch block/intraventricular conduction delay should be persistent, not rate-related (Russo 2013).
- GDMT should have been in place continuously for at least 3 months (Epstein 2012; Ponikowski 2016; Yancy 2013), unless a non-elective permanent pacemaker and/or ICD is indicated prior to completion of the 3 months, and CRT would have been likely required even after 3 months of GDMT. Otherwise, recovery of LVEF from myocardial infarction (40 days) if no intervening revascularization or > 3 months if revascularization was performed, and reversible causes (e.g. ischemia) should be allowed (Katsumoto 2014, Marine 2018).
- The patient should have expected survival with reasonably good functional status for more than 1 year (Epstein 2012, Khairy 2014, Ponikowski 2016).

## OVERVIEW:

### NYHA Class Definitions

(Goldman 1981, Russo 2013)

- Class I: No limitation of functional activity or only at levels of exertion that would limit normal individuals (patient can carry 24 pounds up 8 stairs, play basketball, and shovel soil).
- Class II: Slight limitation of activity. Fatigue, palpitation, or dyspnea with moderate exercise (patient able to dance, garden, and walk 4 mph on level ground).
- Class III: Marked limitation of activity. Fatigue, palpitation, or dyspnea with minimal activity (patient able to shower, make bed, bowl or golf, dress, and walk 2.5 mph on level).
- Class IV: Severe limitation of activity. Symptoms even at rest, worse with activity (patient unable to comfortably perform any significant activity).
- Ambulatory Class IV: Class IV heart failure that is not refractory due to fluid retention, frequent hospitalization for heart failure, or dependent on continuous intravenous inotropic therapy.

### Heart Block Definitions

(Epstein 2012)

- First Degree: All atrial beats are conducted to the ventricles, but with a delay of > 200 ms.
- Second Degree: Intermittent failure of conduction of single beats from atrium to ventricles.
  - Type I: Conducted beats have variable conduction times from atrium to ventricles.
  - Type II: Conducted beats have uniform conduction times from atrium to ventricles.
  - Advanced: Two or more consecutive non-conducted beats (premature atrial beats might not normally be conducted).
- Third Degree: No atrial beats are conducted from atrium to ventricle

## Guideline Directed (or Optimal) Medical Therapy in Heart Failure

(Yancy 2013, Yancy 2017)

- Angiotensin converting enzyme inhibitor (ACE-I), angiotensin receptor blocker (ARB), or combined angiotensin receptor inhibitor and neprilysin inhibitor (ARNI)
- Beta blocker
- Addition of loop diuretic for all NYHA class II – IV patients
- Addition of hydralazine and nitrate for persistently symptomatic African Americans, NYHA class III-IV
- Addition of an aldosterone antagonist, provided eGFR is  $\geq 30$  ml/min/1.73m<sup>2</sup> and K<sup>+</sup> < 5.0, NYHA class II-IV
- Not required for consideration of CRT: Ivabradine for NYHA class II – III, when a beta blocker has failed to reduce a sinus rate to < 70 bpm. Ivabradine listed as a class IIa recommendation, while others are class I recommendations. CRT trials antedated routine use of ivabradine.

### Abbreviations

ACE-I	Angiotensin converting enzyme inhibitor
ARNI	Combined angiotensin receptor inhibitor and neprilysin inhibitor
AV	Atrioventricular
CAD	Coronary artery disease, same as ischemic heart disease
CHF	Congestive heart failure
CRT	Cardiac resynchronization therapy (also known as biventricular pacing)
CHD	Congenital heart disease
ECG	Electrocardiogram
eGFR	Estimated glomerular filtration rate
EPS	Electrophysiologic Study
GDMT	Guideline-Directed Medical Therapy
HF	Heart Failure
HRS	Heart Rhythm Society
HV	His-ventricular
ICD	Implantable cardioverter-defibrillator
LBBB	Left bundle-branch block
LV	Left ventricular/left ventricle
LVEF	Left ventricular ejection fraction
MI	Myocardial infarction
ms	Milliseconds
NYHA	New York Heart Association
STEMI	ST-Elevation Myocardial Infarction
SND	Sinus node dysfunction
VT	Ventricular tachycardia

### POLICY HISTORY:

**Review Date:** August 13, 2019

## Review Summary:

- Changed ms from 130 to 150 in indication: 'left ventricular ejection fraction (LVEF)  $\leq$  35%, sinus rhythm, left bundle branch block (LBBB) with a QRS  $\geq$  150 ms, and NYHA class II, III or ambulatory class IV symptoms on GDMT'
- Added indication for LVEF  $\leq$  35%, sinus rhythm, LBBB with a QRS duration 120 to 149 ms, and NYHA class II, III, or ambulatory class IV symptoms on GDMT
- Changed ms from 130 to 150 in indication: 'LVEF  $\leq$  35%, sinus rhythm, a non-LBBB pattern with a QRS duration  $\geq$  150 ms, and NYHA III or ambulatory class IV symptoms on GDMT'
- Revised indication to state that LVEF  $\leq$  35% and are undergoing new or replacement device placement with anticipated requirement for significant ( $>$  40%) ventricular pacing
- Removed indication for LVEF  $\leq$  30%, ischemic etiology of HF, sinus rhythm, LBBB with a QRS duration  $\geq$  150 ms, and NYHA class I on GDMT
- Removed indication for LVEF  $\leq$  35%, sinus rhythm, a non LBBB pattern with a QRS duration  $\geq$  150 ms, and NYHA class II on GDMT
- Adult congenital heart disease, added indication for systemic LVEF  $\leq$  35%, sinus rhythm, complete LBBB with a QRS complex 120 - 149 ms (spontaneous or paced), and NYHA class II to ambulatory IV
- Adult congenital heart disease, removed the following indications:
  - Cardiac surgery with a QRS duration  $>$  150 ms
  - Systemic RV with significant tricuspid valve regurgitation
  - Severe subpulmonic RV dysfunction
  - Severe ventricular dysfunction and NYHA class IV in attempt to delay transplant or mechanical support
- The following statement has been revised to add 'or 3 months post-revascularization.' Criteria are met for a non-elective implantable cardioverter defibrillator (ICD) or a non-elective pacemaker, either initial or replacement, and based upon the low likelihood of improvement in symptoms and adequate recovery of LVEF, despite less than 3 months GDMT for heart failure or  $<$  40 days post myocardial infarction or 3 months post revascularization, criteria for CRT are otherwise met. The following statement has been added: 'This avoids a second implantation procedure within less than 3 months.'

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