Heart Failure Device Therapy – ICD and CRT

Systolic Dysfunction, Diastolic Dysfunction

Mitral Regurgitation

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CRT = Cardiac Resynchronization Therapy
Disclosure of Relationships (All Modest)

- Biotronik: Lecture Honorarium
- Boston Scientific: Lecture Honorarium
- Medtronic: Lecture Honorarium, Advisory panel
- St. Jude Medical: Lecture Honorarium, Advisory Panel
ICD therapy is recommended for primary prevention of SCD in patients with nonischemic or ischemic heart disease (at least 40 days post-MI) with EF \( \leq 35\% \), and NYHA class II or III on GDMT, who have anticipated survival for more than 1 year (Level of Evidence A)

Bardy et al NEJM 2005
NYHA ≥ Class 1 - Post MI, EF ≤ 30%

ICD therapy is recommended for primary prevention of SCD to reduce total mortality in selected patients at least 40 days post-MI with LVEF ≤ 30%, and NYHA class I symptoms while receiving GDMT.
Failure to conform to baseline quality HF measures

*Underutilization more common in women 79% vs 52% (Hoang et al Heart Rhythm 2014;11:849-55)*

**Underutilization more common in hospitals with underutilization of other guidelines (Shah et al JACC 2009;53:416-22)*

Reasons for Not Recommending ICD/CRT

- **Questionable?**
  - Not aware of the guidelines or data that support it.
  - Patient is too sick when seen in hospital and too well in the office (*Class 2 patients with most benefit!!!*)

- **Legitimate concerns?**
  - Don’t like implanting ICD in patients who never need it (need better selection criteria)
  - **Too many device related complications!**
    - Lead fracture
    - Infection
    - Inappropriate shocks
Standard (Intravascular Leads) vs SQ ICD

+++ Brady/ Anti Tachy/ Bi V Pacing

- - - Lead related complications (Failures/Infection/thrombus)

+ + + No intravascular leads
- - - No Brady/Anti-Tachy/ Bi V Pacing
- - Longevity/Bigger device

? Role in primary prevention in HF pt
CRT Therapy for Heart Failure – 15 yr Journey

- Initial “feasibility” studies, looking at LV mechanics/mitral regurgitation
- Demonstration of anatomic, CHF hospitalization, and mortality benefit (Guidelines) (COMPANION, CARE-HF, MADIT CRT)

- **Current studies** – New Indications (RethinQ, BLOCK HF/Biopace)

- **Late Outcome studies/Identifying who will respond and how to optimize response**
Biventricular pacing – Cardiac Resynchronization (CRT)

Severe LV dysfunction with LBBB

DCM - CRT

- Increases diastolic filling time
- Improves LV dP/dt

Courtesy of C. Stellbrink, MD.
Metabolic “cost” of biventricular pacing

\[ \frac{\text{MVO}_2}{\text{HR}} \] (Relative Units)

- **LV Pacing**
- **Dobutamine**

\[ \frac{\text{dP/dt}}{\text{max}} \] (mmHg/s)

\[ P < 0.05 \]

CRT Effect on Echo - LV size and EF

MIRACLE Trial

Sutton M: Circulation 2002
Effect of CRT (biventricular pacing) on MR

LA-LV resynchronization
- Reduces mitral regurgitation\(^1,2,3\)
  - Restores synchronous activation of pap muscles
  - Decrease in LV size

- MR - common in CRT HF patient (35% with grade 3-4 MR)
- Reduction of MR was observed in 46% of subjects (> 1 grade)
- Improvement in MR was associated with better CRT functional response

Companion trial: Mortality/HF Hospitalization

1520 pts randomized 1:2:2 to optimal CHF therapy: OPT + biV PM: OPT + biV ICD

Inclusion:
NYHA class III or IV
LVEF ≤ 35%
QRS ≥120
LVEDD ≥ 60 mm

CARE-HF: All cause mortality

813 patients, follow up 29.4 months

Inclusion:
NYHA class III or IV
LVEF ≤ 35%
QRS ≥120

CRT therapy resulted in 36% reduction in total mortality (80 vs. 120)

MADIT – CRT (HF Events-ICD vs CRT ICD)

1820 patients with EF ≤ 30, NYHA I, II, QRS ≥ 130

41% reduction of heart failure events

No. at Risk (Probability of Survival)

<table>
<thead>
<tr>
<th></th>
<th>ICD only</th>
<th>CRT–ICD</th>
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</thead>
<tbody>
<tr>
<td>Survival</td>
<td>731</td>
<td>1089</td>
</tr>
<tr>
<td>Probability</td>
<td>621 (0.89)</td>
<td>985 (0.92)</td>
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<tr>
<td>Survival</td>
<td>379</td>
<td>651</td>
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<tr>
<td>Probability</td>
<td>0.78</td>
<td>0.86</td>
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<tr>
<td>Survival</td>
<td>173</td>
<td>279</td>
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<tr>
<td>Probability</td>
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<td>0.80</td>
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<tr>
<td>Survival</td>
<td>43</td>
<td>58</td>
</tr>
<tr>
<td>Probability</td>
<td>0.63</td>
<td>0.73</td>
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Long Term Mortality in MADIT-CRT (5year) – Influence of LBBB

Goldenberg et al. NEJM 2014;370:1694-1701
Long Term (5yr) Outcome (Survival) in MADIT-CRT – All patient groups benefit

All with LBBB

Goldenberg et al. NEJM 2014;370:1694-1701
Mortality after CRT-D implantation by sex, QRS morphology, and duration. NCDR ICD Registry 31892 patients (median 2.9 yrs fu)

If LBBB, women had 21% lower mortality risk than men
(HR: 0.79; 95% CI: 0.74 to 0.84; p < 0.001)

Zusterzeel R et al J Am Coll Cardiol 2014;64:887–94)
If LBBB is Bad – How about if we need to RV pace- CRT? In less sick patients?

**BLOCK HF trial (691 patients with AV block)**

AV block / EF 50% or less (average 40%)

Endpoints: Death, an urgent care visit for heart failure that required IV therapy, or a 15% or more increase in the left ventricular end-systolic volume index.

Primary outcome occurred in 64.3 (RV pacing) and 55.3% (BiV pacing) pts; hazard ratio for BiV 0.74; 0.60 to 0.90.

Freedom from Mortality /CHF Hospitalization

1810 Patients/LVEF 55.4 ± 12.2%

P = 0.08  95%-CI: [0.75; 1.01]

Right ventricular (RV)
Biventricular (BiV)

<table>
<thead>
<tr>
<th>Block HF</th>
<th>BIOPACE</th>
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<tbody>
<tr>
<td>% BiV Pacing</td>
<td>97%</td>
</tr>
<tr>
<td>LVEF</td>
<td>40%</td>
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<tr>
<td>3rd ° AVB</td>
<td>46%</td>
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BIOPACE TRIAL PRELIMINARY RESULTS – ESC Presentation 2014
**CRT: Guidelines**

ACCF/AHA/HRS Focused Update of 2008 DBT Guidelines
Tracy C et al JACC 2012;60:1297-1313

**EF ≤ 35, NSR, LBBB,**
QRS ≥ 150, class II, III, ambulatory IV HF on GDMT

**EF ≤ 35, class II, III, IV HF and one of the following:**
1) LBBB and QRS 120-149;
2) AF or Heart Block with RV pacing > 40%;
3) non LBBB QRS ≥ 150, class III, IV

**EF ≤ 30, class I; LBBB > 150 (MADIT CRT);**
EF ≤ 35, non LBBB (QRS 120-150, Class III/IV; and EF ≤ 35, non LBBB QRS ≥ 150, class II HF
CRT is not recommended for patients with NYHA class I or II symptoms and non-LBBB pattern with QRS duration less than 150 ms.

CRT is not indicated for patients whose comorbidities and/or frailty limit survival with good functional capacity to less than 1 year.
Important Questions?

• Why doesn’t a patient respond to CRT therapy?
• What can you do about it?
Lead placement: part of failure to respond – anatomy and operator dependent

Butter C et al Circulation 2001;104:3026-29
Atrial Fibrillation and CRT

- Pts with AT/AF had worse outcomes
- 1193 pts with CRT-D in SR at implant followed mean 13 months
- BiV pace% 98% during SR and 71% during AT/AF
- BiV pace% of >95% associated with better outcome

Santini et al JACC 2011;57:167
Effect of Ectopy on BiV Pacing/Efficacy (Goal >97% pacing)

MADIT- CRT with Holter (801 patients)

- Odds Ratio for Achieving Low BIV Pacing<97%

- Percentage Ectopy of all Beats During Pre-implantation 24h-Holter

Using [<0.01 percent ectopy as the reference group]
95% CI: [0.22-5.21] [0.40-10.06] [0.85-17.18] [1.40-34.51] [1.86-37.54] [3.85-83.22] [8.08-186.66]

Echo Parameters after 1 year

- Percent Change in Echocardiographic Parameters

Heart Failure and Mortality

- Cumulative Probability of HF or Death

Ruwald M et al JACC 2014:64:971-981
Heart Failure Device Therapy – ICD and CRT

- **ICD** if EF < 35% and class II/III HF on GDMT; Class I HF and EF<30%, prior MI

- **CRT**
  - In appropriate patients, CRT improves objective variables (LV size/function, reduces HF admissions and mortality)
  - Most marked EF + mortality benefit in patients with wide LBBB and EF ≤ 35% regardless of gender (F> M), chamber size, age, both ICM and NICM,
  - Critical to get LV lead in the right position and make sure pacing at least 95 -97% of the time with AF and eliminate frequent VPDs