Heart Failure: All of Your Frequently Asked Questions Answered
South Carolina American College of Physicians
Charleston, SC

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Disclosures
• Abbott – Steering Committee
• Actelion/J&J – Hemodynamic Core Lab
• Abiomed – Research advisory group
• Merck – Hemodynamic Core Lab

• My presentation does include discussion of off-label or investigational use.

Definitions
• Heart Failure: Clinical syndrome characterized by inability of the heart to eject blood sufficient to meet metabolic demands as a result of either a structural or functional disorder of the myocardium, endocardium, or pericardium.

Types of Heart Failure
• Heart Failure with Reduced Ejection Fraction or Systolic Heart Failure
  • Clinical signs and symptoms of heart failure
  • Impaired systolic function (LVEF <50%)

• Heart Failure with Preserved Ejection Fraction or Diastolic Heart Failure
  • Clinical signs and symptoms of heart failure
  • Evidence of preserved systolic function (traditionally LVEF>0.50)
  • Demonstrated diastolic dysfunction/impaired relaxation with non-invasive or invasive measurements.

HFpEF vs. HFrEF
• Various studies estimate HFpEF accounts for 40 to 60 percent of all patients with HF in the US6
• HFpEF is more common in women, with increasing age, and hypertensive patients
• Slightly lower in-hospital mortality (3 versus 4 percent) but similar ICU and hospital length of stay

Which historical and physical exam findings are the most suggestive of heart failure (elevated left heart filling pressures)?
A. PND and Hepato-jugular reflex
B. Orthopnea and jugular venous distension
C. Lower extremity edema and rales/crackles
D. Bendorpnea and S3
E. Weight gain and pleural effusion
A Caveat about Crackles

- Crackles / Rales
  - Poor Sensitivity
    - Increased Pulmonary Lymphatics (especially chronic heart failure patients)
  - May have poor specificity
    - Pneumonia
    - Atelectasis
    - COPD
    - Pulmonary Fibrosis

Best History and Physical Predictors

- ESCAPE Trial Substudy: 192 patients hospitalized with advanced systolic heart failure → RHC
- History and Physical Exam findings correlating to PCWP > 22

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Positive Predictive Value</th>
<th>Negative Predictive Value</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crackles / Rales</td>
<td>15</td>
<td>89</td>
<td>69</td>
<td>38</td>
<td>1.4</td>
</tr>
<tr>
<td>JVP &gt; 12</td>
<td>65</td>
<td>64</td>
<td>75</td>
<td>52</td>
<td>3.3</td>
</tr>
<tr>
<td>HR &gt; 88</td>
<td>83</td>
<td>27</td>
<td>65</td>
<td>49</td>
<td>1.7</td>
</tr>
<tr>
<td>S3</td>
<td>62</td>
<td>32</td>
<td>61</td>
<td>33</td>
<td>0.8</td>
</tr>
<tr>
<td>Orthopnea</td>
<td>86</td>
<td>25</td>
<td>66</td>
<td>51</td>
<td>2.1</td>
</tr>
<tr>
<td>Edema</td>
<td>41</td>
<td>66</td>
<td>67</td>
<td>40</td>
<td>1.3</td>
</tr>
</tbody>
</table>


Jugular Venous Distension

- Distinguishing Venous from Arterial
  - Venous is more commonly seen than arterial
  - Increases by pressing on abdomen (increase venous return)
  - Usually* not palpable
  - Extinguish with light pressure at base of neck
  - Changes with position
  - Takes practice!

Take home point

Most common reasons for refractory HF symptoms:

Inadequate doses of diuretics to achieve and maintain euvolemia

A 40 year old patient with an idiopathic cardiomyopathy, dilated LV and EF 20% is placed on Lisinopril, carvedilol, and spironolactone. Repeat echo 6 months later shows EF 55%, grade I diastolic dysfunction, and just mild LV dilation. When is it safe to stop heart failure medications?

A. EF has normalized, ok to stop now
B. Once diastolic function has completely normalized
C. Once ventricular size has normalized
D. It’s ok to stop spironolactone and coreg, but should remain on Lisinopril
E. Wean one at a time, over period of months
F. Never, unless contraindication develops
## New Approach to the Classification of Heart Failure

<table>
<thead>
<tr>
<th>Stage</th>
<th>Patient Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>High risk for developing heart failure (HF)</td>
</tr>
<tr>
<td></td>
<td>Hypertension</td>
</tr>
<tr>
<td></td>
<td>CAD</td>
</tr>
<tr>
<td></td>
<td>Diabetes mellitus</td>
</tr>
<tr>
<td></td>
<td>Family history of cardiomyopathy</td>
</tr>
<tr>
<td>B</td>
<td>Asymptomatic HF</td>
</tr>
<tr>
<td></td>
<td>Previous MI</td>
</tr>
<tr>
<td></td>
<td>LV systolic dysfunction</td>
</tr>
<tr>
<td>C</td>
<td>Symptomatic HF</td>
</tr>
<tr>
<td></td>
<td>Known structural heart disease</td>
</tr>
<tr>
<td></td>
<td>Shortness of breath and fatigue</td>
</tr>
<tr>
<td></td>
<td>Reduced exercise tolerance</td>
</tr>
<tr>
<td>D</td>
<td>Refractory end-stage HF</td>
</tr>
<tr>
<td></td>
<td>Marked symptoms at rest despite maximal medical therapy (eg, those who are recurrently hospitalized or cannot be safely discharged from the hospital without specialized interventions)</td>
</tr>
</tbody>
</table>

You have a patient with Stage C systolic heart failure, LVEF 30%, moderate dyspnea on exertion, and normal renal function.

- Would you start an ACE or ARB?
- What dose would you use?
- Do you ever use both?

### Treatment

**South Carolina has dispatched its snow plow**

### ARB Evidence

**Valsartan in Acute Myocardial Infarction Trial (VALIANT)**
14,703 patients with post-MI HF or LVSD (EF <0.40) randomized to captopril (50 mg tid), valsartan (160 mg bid), or captopril (50 mg tid) plus valsartan (80 mg bid) for 2 years

- **Valsartan vs. Captopril:** HR = 1.00; P = 0.982
- **Valsartan + Captopril vs. Captopril:** HR = 0.98; P = 0.726

**Ongoing Telmisartan Alone and in Combination with Ramipril Global Endpoint Trial (ONTARGET)**
25,620 patients with CVD or DM randomized to ramipril (10 mg), telmisartan (80 mg), or a combination of both for 56 months

- **Telmisartan vs. Ramipril**: HR = 1.33 (p<0.001)

**ARBS provide similar efficacy to ACE-I in Post-MI LVSD**

**ACE**-I=Angiotensin converting enzyme inhibitors, ARB=Angiotensin receptor blockers, EF=Ejection fraction, LVSD=Left ventricular systolic dysfunction

**ACE + ARB Evidence**

**ARB: Evidence**

- Equally convincing evidence for ARB for LV systolic dysfunction
- Have moved away from ACE/ARB combinations
Principles of Heart Failure and Valvular Disease

ACE-I: Side effects

- Hypotension
- Angioedema
- Cough
- Hyperkalemia
- Renal failure

Consider ARB
Consider Hydralazine + Nitrates

ACE/ARB Dosing

- Data is limited (ATLAS Trial)
- Start low and titrate
- Generally goal is target dose in trials or until symptoms/side effects occur
  - Enalapril 10mg bid
  - Lisinopril 40mg daily
  - Quinapril 40mg daily
  - Captopril 50mg TID (TID is difficult)
  - Candesartan 32mg daily
  - Valsartan 160 twice a day
  - Losartan 150mg daily

Angioedema

Consider ARB
Consider Hydralazine

In the same patient, EF 30%, moderate dyspnea on exertion, and normal renal function. All of the following would be acceptable beta blockers to start EXCEPT:

A) Carvedilol
B) Metoprolol Succinate
C) Metoprolol Tartrate
D) Bisoprolol

β-blocker Evidence: Benefit in HF and/or LVSD

<table>
<thead>
<tr>
<th>Study</th>
<th>Drug</th>
<th>HF Severity</th>
<th>Patients</th>
<th>Follow-up (years)</th>
<th>Mean Dose</th>
<th>Effects on Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIBIS</td>
<td>Bisoprolol</td>
<td>Moderate-Severe</td>
<td>641</td>
<td>1.9</td>
<td>3.8 mg/day</td>
<td>All-cause mortality (p=NS)</td>
</tr>
<tr>
<td>CIBIS-2</td>
<td>Bisoprolol</td>
<td>Moderate-Severe</td>
<td>2,647</td>
<td>1.3</td>
<td>7.5 mg/day</td>
<td>All-cause mortality (p&lt;0.0001)</td>
</tr>
<tr>
<td>BEST</td>
<td>Bucindolol</td>
<td>Moderate-Severe</td>
<td>4,185</td>
<td>2.0</td>
<td>1.4 mg/day</td>
<td>All-cause mortality (p=NS)</td>
</tr>
<tr>
<td>MERIT-HF</td>
<td>Metoprolol succinate</td>
<td>Moderate-Severe</td>
<td>3,901</td>
<td>1.0</td>
<td>15.9 mg/day</td>
<td>All-cause mortality (p&lt;0.0002)</td>
</tr>
<tr>
<td>MDC</td>
<td>Metoprolol</td>
<td>Moderate-Severe</td>
<td>383</td>
<td>1.0</td>
<td>15.9 mg/day</td>
<td>Death or need for TX (p=NS)</td>
</tr>
<tr>
<td>CAPRICORN</td>
<td>Carvedilol</td>
<td>Mild</td>
<td>1,965</td>
<td>1.3</td>
<td>40 mg/day</td>
<td>All-cause mortality &lt;34% (p=0.03)</td>
</tr>
<tr>
<td>US Carvedilol</td>
<td>Carvedilol</td>
<td>Mild-Moderate</td>
<td>1,054</td>
<td>0.5</td>
<td>40 mg/day</td>
<td>All-cause mortality &lt;45% (p=0.001)</td>
</tr>
<tr>
<td>COPERNICUS</td>
<td>Carvedilol</td>
<td>Moderate</td>
<td>2,382</td>
<td>0.3</td>
<td>37 mg/day</td>
<td>All-cause mortality &lt;35% (p=0.0014)</td>
</tr>
<tr>
<td>SENIORS</td>
<td>Nebivolol</td>
<td>Moderate</td>
<td>2,128</td>
<td>3.0</td>
<td>7.7 mg/day</td>
<td>All-cause mortality or CV death &lt;44% (p=0.02)</td>
</tr>
</tbody>
</table>

β-Blockers: Dose Response

**β-Blockers: Dose**

- Beta blockade should not be initiated if patient is in acute decompensated heart failure!
- Start low and titrate up to target dose by doubling dose **every 2 weeks** as tolerated
- Goal doses:
  - Carvedilol 25mg BID (50mg BID if >85kg)
  - Metoprolol succinate (XL) 200mg QD
  - Bisoprolol 10mg QD
- COPD is only a relative contraindication and usually is well tolerated

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**Which do I start first?**

- **CIBIS III**

  ![CIBIS III Graph](image)

  Primary Endpoint (Death or Hospitalization)

  - Bisoprolol-first
  - Enalapril-first

  \[p = 0.046\] for non-inferiority = not significant by per-protocol analysis

  In the intent-to-treat group, non-inferiority criteria was met (HR 0.94, \(p=0.019\))

**ACE vs. β-Blockers**

- ACE usually started first, since BB were added onto ace therapy in most trials
- CIBIS III suggested the opposite order is safe\(^1\)
- Do not have to wait until ace is fully titrated
- **The combination has a synergistic reduction in the risk of death**\(^2\)
- In patients taking low dose ACE, addition of a BB appears to improve symptoms and reduce death more than an increase in ACE to target dose.\(^2\)

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**Aldosterone Antagonist: Mechanism of Action**

- Aldosterone

  ![Mechanism Diagram](image)

  - Sodium and Water Retention
  - Potassium and Magnesium Excretion
  - Collagen deposition
  - Myocardial and Vascular Fibrosis
  - Edema
  - Arrhythmias
**Principles of Heart Failure and Valvular Disease**

**Chronic Heart Failure Syndromes**

**Aldosterone Antagonists**

**Randomized Aldosterone Evaluation Study (RALES)**

- 1,663 patients with NYHA Class III or IV HF and LVSD (EF <0.35) randomized to spironolactone (25-50mg) or placebo for 24 months

**Aldosterone inhibition reduces death in patients with advanced heart failure**

<table>
<thead>
<tr>
<th>Months</th>
<th>Survival (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>94.6</td>
</tr>
<tr>
<td>6</td>
<td>92.2</td>
</tr>
<tr>
<td>9</td>
<td>89.3</td>
</tr>
<tr>
<td>12</td>
<td>86.9</td>
</tr>
<tr>
<td>18</td>
<td>84.2</td>
</tr>
<tr>
<td>24</td>
<td>81.8</td>
</tr>
<tr>
<td>36</td>
<td>79.4</td>
</tr>
</tbody>
</table>

EF=Ejection fraction, HF=Heart failure, LVSD=Left ventricular systolic dysfunction, NYHA=New York Heart Association


**Aldosterone Antagonists: Expanded Role**

**EMPHASIS-HF**: 2,737 patients with NYHA class II HF and EF ≤ 35% randomized to eplerenone (up to 50mg daily or placebo) for avg. of 21 months

**Exclusion criteria**: GFR < 30 ml/min/m² or serum K+ > 5.0 mmol/L


**Hyperkalemia and aldosterone antagonists**

- Hospital claims data from Ontario, CA 1994-2001

**You perform medicine reconciliation on this patient (EF 30%) in clinic after recent hospital discharge. All of the following would be considered contraindicated except:**

A) Meloxicam for arthritis
B) Diltiazem for control of afib (already on BB)
C) Lisinopril/losartan/spironolactone combination
D) Lisinopril/entresto
E) Daily metolazone
F) St. John’s Wort
G) Amiodarone

**Aldosterone Antagonists**

- Mortality benefit post-MI or if class II-IV heart failure symptoms
- Creatinine < 2.5 mg/dL in men or 2.0 mg/dL in women and potassium < 5.0 mEq per liter
- Major limitation is hyperkalemia (especially with concomitant ACE-I/ARB use)
- Requires close monitoring of K+!
  (contraindicated if you can’t)
**Drugs to Avoid in HF**

- Most anti-arrhythmics (except amiodarone and dofetilide)
  - Amiodarone does not improve mortality
- Non-dihydropyridine calcium channel blockers (verapamil, diltiazem) – negative inotropes
- NSAIDs
- Long term inotropes unless for palliasion
- Nutritional supplements and hormonal therapies are not indicated unless repleting deficiencies
- **ACE+ARB+Aldosterone Antagonist combination is contraindicated**
- Daily use of thiazide diuretics (metolazone) in presence of a loop diuretic

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**What is the role of newer heart failure therapies?**

- **Valsartan/Sacubitril**

  **PARADIGM: HF**

  8442 patients
  NYHA class II-IV; EF <=40%
  LCZ696 200mg bid vs enalapril 10mg bid
  Primary endpoint: CV
  Death or first hospitalization for worsening heart failure

  **Table 5. Adverse Events during Randomized Treatment.**

<table>
<thead>
<tr>
<th>Event</th>
<th>LCZ696 (N=4187)</th>
<th>Enalapril (N=4212)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypotension</td>
<td>388 (7.9)</td>
<td>388 (9.2)</td>
<td>0.3049</td>
</tr>
<tr>
<td>Hypotension of systolic blood pressure &lt;=90 mmHg</td>
<td>132 (2.7)</td>
<td>59 (1.4)</td>
<td>0.0239</td>
</tr>
<tr>
<td>Elevated serum creatinine</td>
<td>139 (3.3)</td>
<td>188 (4.5)</td>
<td>0.007</td>
</tr>
<tr>
<td>Elevated serum potassium</td>
<td>63 (1.5)</td>
<td>83 (2.0)</td>
<td>0.10</td>
</tr>
</tbody>
</table>

---

60 year old woman with HFrEF, EF 30% on coreg 25 bid, losartan 150mg (angioedema with Lisinopril), and spironolactone 25mg. Wt 60kg. NYHA class II. Creatinine 1.0. BP 115/65, HR 68 in sinus rhythm. Which of the following would reasonable?

A. Start ivabradine 5mg bid
B. Add sacubitril/valsartan at 24/26mg bid
C. Continue current therapy
D. Stop losartan and add ivabradine 5mg bid
E. Stop losartan and begin sacubitril/valsartan 49/51mg bid after 36 hour wash out
F. Increase coreg to 50mg bid
ARNI Guidelines

- Class I, LOE B: In patients with chronic symptomatic HFrEF NYHA class II or III who tolerate an ACE inhibitor or ARB, replacement by an ARNI is recommended to further reduce morbidity and mortality
- Class III: ARNI should not be administered concomitantly with ACE inhibitors or within 36 hours of the last dose of an ACE inhibitor. ARNI should not be administered to patients with a history of angioedema.


Ivabradine

- First in class specific inhibitor of the If (“funny”) current in the sinoatrial node.
- Unlike β blockers, ivabradine does not modify myocardial contractility and intracardiac conduction, even in patients with impaired systolic function

Savelieva I. Drug Saf 2009; 31:95–107

SHIFT Study: Ivabradine in HFrEF

6558 pts with EF <35% NSR with HR ≥70 bpm, admitted within 1 year for ADHF
Randomized to Placebo v. Ivabradine up to 7.5 mg po BID
Primary Endpt: CV death or HF Hospitalization
Median f/u 22 months

Swedberg et al. Lancet 2010;376:875-85

Ivabradine Guidelines

- Class 2a: Ivabradine can be beneficial to reduce HF hospitalization for patients with symptomatic (NYHA class II-III) stable chronic HFrEF (LVEF ≤35%) who are receiving GDEM, including a beta blocker at maximum tolerated dose, and who are in sinus rhythm with a heart rate of 70 bpm or greater at rest (37-40).


You have a patient with symptoms of heart failure, LVEF 60%, moderate LVH, diastolic dysfunction, RVSP of 60 mmHg, and lower extremity edema. HR 65, BP 115/65. You should consider adding:
A) Add carvediolol
B) Add lisinopril
C) Add sacubitril/valsartan (entresto)
D) Add sildenafil
E) Add spironolactone
**HFpEF Treatment**

- As opposed to systolic heart failure, randomized studies with the specific pharmaceutical agents have **not shown** conclusive benefit:
  - Beta Blockers (OPTIMIZE-HF)
  - ACE inhibitors (PEP-CHF)
  - ARB (CHARM-Preserved, I-PRESERVE)
  - Digoxin (DIG Ancillary Trial)
  - PDE5A Inhibitors (RELAX)

**Recent completed RCTs targeting the PDE5i/NO and endothelin pathway in PH-LHD**

<table>
<thead>
<tr>
<th>Study</th>
<th>Study Drug</th>
<th>N</th>
<th>Duration</th>
<th>Primary/Secondary Outcome</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sibedini2</td>
<td>Sildenafil</td>
<td>44</td>
<td>12 mo</td>
<td>HFpEF</td>
<td>HD, RV performance, improvement</td>
</tr>
<tr>
<td>LEPHT</td>
<td>Riociguat</td>
<td>201</td>
<td>16 W</td>
<td>HF rEF</td>
<td>Change in mPAP vs pbo, PK, PVR, NT-proBNP, safety, tolerability</td>
</tr>
<tr>
<td>Hoendermis3</td>
<td>Sildenafil</td>
<td>52</td>
<td>12 W</td>
<td>HF pEF</td>
<td>Change in mPAP vs pbo, PK, PVR, BNP, peak VO2, safety, tolerability</td>
</tr>
<tr>
<td>SIOVAC</td>
<td>Sildenafil</td>
<td>231</td>
<td>24 W</td>
<td>VHD</td>
<td>Change in mPAP vs pbo, PK, PVR, NT-proBNP, peak VO2, safety, tolerability</td>
</tr>
<tr>
<td>MELODY</td>
<td>Macitentan</td>
<td>48</td>
<td>12 W</td>
<td>HF LVEF &gt; 30%</td>
<td>Safety, tolerability, AE, PK, PVR, NT-proBNP, PK, PVR, NT-proBNP, peak VO2, safety, tolerability</td>
</tr>
</tbody>
</table>

**Sildenafil for improving outcomes in patients with corrected valvular heart disease and persistent pulmonary hypertension: a multicenter, double-blind, randomized clinical trial**

- N= 231 patients at least one year post valvular intervention (mitral 91%), with persistent moderate PH, receiving sildenafil 40 mg tid vs placebo
- Combined Outcome End-Point

**2015 ERS/ESC PH guidelines**

- Optimization of the treatment of the underlying condition is recommended before considering assessment of the LHD, treating structural heart disease
- Is recommended to identify further causes of PH-LHD, where appropriate before considering assessment of the LHD
- Is recommended to perform invasive assessment of the system or unexplained vascular status
- Patients with PH-LHD and a mean pulmonary arterial pressure ≥25 mmHg should be referred for a complete diagnostic workup and individualized treatment selection
- The importance and risk of unnecessary testing is not established in PH-LHD, except in patients who are considered for surgical treatment
- The use of RAS-approach therapies is not recommended in PH-LHD

**TOPCAT**

- CV DEATH, ABORTED ARREST, OR HF HOSPITALIZATION

- HF HOSPITALIZATION


**MELODY**

Macitentan in pulmonary hypertension due to left ventricular dysfunction

Macitentan-treated patients were quantitatively more likely to experience significant fluid retention versus placebo. Macitentan resulted in no significant changes in any exploratory end-points (PVR)
### TOPCAT

<table>
<thead>
<tr>
<th>Country</th>
<th>Hazard ratio</th>
<th>Number of subjects with confirmed primary event</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>0.786</td>
<td>230</td>
</tr>
<tr>
<td>Canada</td>
<td>0.642</td>
<td>49</td>
</tr>
<tr>
<td>Russia</td>
<td>0.950</td>
<td>62</td>
</tr>
<tr>
<td>Republic of Georgia</td>
<td>0.993</td>
<td>14</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.473</td>
<td>9</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td><strong>0.792</strong></td>
<td><strong>382</strong></td>
</tr>
</tbody>
</table>

If Russia and Georgia data excluded, HR 0.82 (0.69, 0.98), p = 0.026

### CHAMPION Study

- **CHAMPION**: A single-blind study randomized 550 NYHA III HF patients to usual care or to an implanted wireless continuous PAP waveform monitoring device

### HFpEF in CHAMPION

- Aldosterone antagonists for reduction in hospitalization (Maybe CV death reduction)
- ***Use diuretics for symptomatic improvement***
- Possible role for PA monitoring
- Control HTN and afib – ? Rhythm control
- Consider referral for clinical trial

HFpEF@musc.edu

### HFpEF Therapy

- **HFpEF**

### All of the following are signs of advancing heart failure except:

A. Sodium < 136 meq/L
B. Two HF hospitalizations in 1 year
C. Inability to tolerate guideline directed medical therapy (ACE/ARB, BB)
D. Need for inotropic therapy during a hospitalization
E. Worsening kidney function
F. LV Ejection fraction of 15%

### HF Prognosis Remains Poor

- **McMurray JJ. EHJ 2002.**

Newest Data: 1-year mortality in PARADIGM (Entresto): ~20%
Effect of recurrent HF Hospitalization on Mortality

Data from EFFECT-HF study (9138 patients)

Among those who lived at least 1 year after EFFECT hospitalization, hospitalizations in the previous year predicted mortality

The American Journal of Medicine (2009) 122, 162-169

Advancing HF

- 2 or more HF hospitalizations in the past year
- Intolerant or withdrawing guideline directed heart failure therapies (ACE/ARB/ARNI, BB, etc)
- Struggling with ADL’s (grocery shopping, flight of stairs, etc)
- High diuretic requirement (>1.5mg/kg furosemide daily)
- Sodium <=135
- Systolic BP < 95mmHg
- Need for inotropes during a hospitalization
- Progressive worsening of kidney function
- Symptomatic despite optimal therapy

What can we do about it?

Ventricular Assist Devices

HEARTWARE HVAD

HEARTMATE 3 LVAS

LVAD Therapy Improves Survival Significantly in End-Stage HF

REMATCH

HMD DT Trial

Devices are getting smaller

Bridge to Transplant (UNOS)

Principles of Heart Failure and Valvular Disease

Design upgrades and outcomes are better

HeartMate 2 vs HeartMate 3 DT and BTT population


Cardiac Transplantation

National 1 year survival after cardiac transplantation and LVAD is ~90%
(If two or more hospitalizations for HF, survival <65% at 1 year)

Transplant Listing Data (Sept 2017):
We need to do better!

<table>
<thead>
<tr>
<th>State</th>
<th># of people on heart transplant waitlist</th>
<th>State Population</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>VA</td>
<td>171</td>
<td>8,411,808</td>
<td>0.0020%</td>
</tr>
<tr>
<td>LA</td>
<td>71</td>
<td>4,649,676</td>
<td>0.0015%</td>
</tr>
<tr>
<td>FL</td>
<td>269</td>
<td>20,612,439</td>
<td>0.0013%</td>
</tr>
<tr>
<td>AR</td>
<td>39</td>
<td>2,994,079</td>
<td>0.0013%</td>
</tr>
<tr>
<td>MS</td>
<td>36</td>
<td>2,984,926</td>
<td>0.0012%</td>
</tr>
<tr>
<td>PA</td>
<td>153</td>
<td>12,784,227</td>
<td>0.0012%</td>
</tr>
<tr>
<td>WV</td>
<td>21</td>
<td>1,850,326</td>
<td>0.0011%</td>
</tr>
<tr>
<td>NC</td>
<td>110</td>
<td>10,146,788</td>
<td>0.0011%</td>
</tr>
<tr>
<td>TN</td>
<td>66</td>
<td>6,651,194</td>
<td>0.0010%</td>
</tr>
<tr>
<td>KY</td>
<td>42</td>
<td>4,413,457</td>
<td>0.0010%</td>
</tr>
<tr>
<td>GA</td>
<td>96</td>
<td>10,310,371</td>
<td>0.0009%</td>
</tr>
<tr>
<td>SC</td>
<td>40</td>
<td>4,832,482</td>
<td>0.0008%</td>
</tr>
</tbody>
</table>

Who to Refer?
- Especially want to capture anyone who may be a candidate for advanced therapies (VAD/transplant)
  - Age <=75 (70 is our cutoff for transplant and occasionally >75 may be considered for VAD)
  - HFrEF, refractory VT, or refractory angina
  - "Relatively" compliant
- New HF Clinics (outpatient referrals for advanced therapies are easiest to implement and most likely to become candidates):
  - East Cooper (Tedford)
  - North Charleston (Judge)
  - West Ashley (Craig)
  - Ashley River Tower (all HF providers)

MUSC Advanced Heart Failure:
The Team

- 8 advanced heart failure and transplant cardiologists
  - Michael Craig
  - Tom DiSalvo
  - Brian Houston
  - Dan Judge
  - Dharini Ramu
  - Ryan Tedford
  - Benny Van Bakel
  - Greg Jackson

- HFrEF Specialists
  - Mike Zile
  - Sheldon Litwin

Thank you

Advanced Heart Failure/Transplant Referrals:

843-792-9259 (office) ; 843-792-1729 (fax)

After hours: 843-792-2200 or 800-922-5250

Ryan Tedford 443-465-5601 (cell)
TedfordR@musc.edu