Contemporary Heart Failure Management: Implantable Devices for the Full Spectrum of Disease

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Contemporary Heart Failure Management: Implantable Devices for the Full Spectrum of Disease

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Disclosures:

Conflict of Interest: None
Objectives

- Discuss signs/symptoms of advancing heart failure
- Discuss current invasive methods of monitoring heart failure
- Discuss current mechanical circulatory support therapies available for advanced heart failure
Overview

• Case
• Overview on Heart Failure
• Identifying Advanced Heart Failure
• Treatment options along the spectrum of disease
• Questions
Overview

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Case

• 67 y/o M with NICM (LVEF 30%) s/p ICD who was referred to the UH Advanced Heart Failure clinic for ongoing HF symptoms
• Recently hospitalized and diuretics were increased
• Medications
  – Metoprolol succinate 100 mg daily
  – Lisinopril 10 mg daily
  – Furosemide 80 mg twice a day
  – ASA 81 mg daily
Case

• He is seen in the Advanced Heart Failure clinic and felt to have NYHA class IIIb symptoms

• His medications are adjusted:
  – ACEi → ARNi
  – started on Spironolactone

• To further evaluate he undergoes an echo, right heart catheterization, and cardiopulmonary exercise test (CPET)
Case

• **Echo**
  – LVIDD: 6.4 cm
  – LVEF: 20-25%
  – Moderate MR
  – Normal RV size/function

• **RHC**
  – RA: 13
  – PA: 62/34/(43)
  – PCW: 30
  – CO/CI: 4.5/2.2
  – SVR: 1250 dynes
  – PVR: 2.8 WU

• **CPET**
  – VO2: 14.7
  – VE/VCO2: 44
  – RER: 1.01
Case

- 1 month later he undergoes implantation of CardioMEMS™ HF System
Case

- Despite diuresis (guided by CardioMEMS™ HF System) he is admitted two months later with ADHF
- Due to concern for low output he undergoes repeat RHC
  - PA sat: 51%
  - CO/CI: 3.1/1.5
  - Placed on inotropic support
- Case presented at Advanced HF Therapy Committee
- Given ABO (O) and pulmonary venous HTN decision is made to pursue durable MCS as a BTT
  - HeartMate II™ LVAD
Case

HeartMate II™ LVAD Implanted
Case

- Remained on LVAD support for ~1 year
- Underwent cardiac transplant
- Post-transplant course without complications
- Currently >2 years out living life to its fullest
Device therapy across the spectrum of disease

- CardioMEMS™ HF System implanted
- HeartMate II™ LVAD implanted
- Heart transplant

From: 11-16-2017 To: 06-23-2017

PA Metrics and Events

Date Range: 30 days 90 days 180 days All

- PA Systolic
- PA Systolic Trend
- PA Mean
- PA Mean Trend
- PA Diastolic
- PA Diastolic Trend
- Heart Rate from PA Sensor
- Medications
- Hospitalizations
- Notes
- Suspect Readings

mmHg
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How common is it?

- **5.7 million** Americans
- Estimated to grow to >30 million by 2030
- **Only** form of heart disease increasing in prevalence
- **1 in 5** Americans will develop heart failure
- Most common cause of hospitalizations
  - Primary diagnosis in >1 million discharges per year
  - Affects 10% of men, 8% women over age 60
  - 30-Day readmission rate 20-25%
HF-associated mortality

• Post-hospitalization mortality
  – 30-day: 10%
  – 1-year: 20-30%
  – 5-year: 48%

• Higher mortality than many cancers at 5 years
  – Breast, lymphoma/leukemia, colon
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Advanced Heart Failure

• 4 R’s
  – Recognition
  – Referral
  – Re-evaluation
  – Realistic

There is no “too early” communication!
What is “Advanced” Heart Failure?

- When conventional heart failure therapies and symptom management no longer work
- It does **NOT** mean, you have run out of options
  - Although, in some cases it may mean we shift the focus away from *quantity* of life to *quality* of life
- Referred to as ACC/AHA “Stage D” disease
- Primary options for stage D disease
  - Cardiac transplantation
  - Left ventricular assist device (LVAD)
  - Inotropic support
  - Hospice
Paths of HF

Stage C
- Stable
- Progressive

“Advanced” Stage D
- Transplant
- LVAD
- Inotropes
- Hospice

Your patient
Overview

300 million US population

HF=2.6% population; 7 million

“Diastolic” HF
HFpEF: 45-50% 3-3.5 million
Class I: 35%
Class II: 35%

“Systolic” HF
HFrEF: 50-55% 3-3.5 million
Class III: 25-28%
Class IV: 2-5%

Class IV: 150-350,000

Class IV (<70 y/o): 150-250,000
Potential Advanced Therapy Candidates

JACC. 2013.
A Tale of Two Presentations...

“Stable” advancing disease

“Crash and burn” shock
Clues to Advancing Heart Failure
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AHF management secrets

• Maximize afterload reduction (ie. ↓ BP)
• Reduce myocardial oxygen consumption (ie. ↓ HR)
• Relieve congestion
• Reassess
  – If improved → maintain
  – If declining → optimize GDMT
  – If still declining → consider advanced therapies
*If wt >85 kg; consider up to 50 mg bid
Device therapies for HF

- ICD/CRT
- PA pressure monitoring
- LVAD
ICD/CRT

• ICD
  – Management of ventricular arrhythmias
    • Primary vs secondary prevention
    • LVEF <35%
    • Single chamber vs dual chamber
• CRT
  – Improve mechanical dyssynchrony
  – “Biventricular” pacing
  – +/- ICD
  – LV wire via coronary sinus
    • LBBB (QRS >120 ms)
Volume monitoring

- Most pts admitted for ADHF have symptoms of congestion, resulting from increases in intra-cardiac and pulmonary artery pressures
- Increases in pressure can be seen days to weeks before the onset of symptoms
- COMPASS-HF trial showed that intra-cardiac pressures arose independently of weight changes
- Prior attempts of implanted hemodynamic monitoring has not proven to be beneficial
Symptoms are late in the game
CardioMEMs®

- Continuous monitoring
- RHC
- Implanted into left PA
- No battery/replacement
- Remote monitoring
CardioMEMs
• NYHA class III for at least 3 months, no LVEF cutoff, and hospitalized within the last year for HF

• 550 pts implanted
  – 270 randomized to treatment
  – 280 pts randomized to control group
  – Post-procedure medication
    • prior anticoagulants resumed
    • otherwise ASA 81 + Clopidogrel 75 x30 days, then ASA 81 alone

• Mean duration of follow up: 15 months
• 28% reduction in HF hospitalizations within the first 6 months and 37% by 15 months
• Improved QOL
• Treatment group required <1 medication adjustment per patient per month vs. control
• No PE or pulm infarct during study time
UH/VA experience

- 50-60% reduction in 1 year readmission rates for HF
Advanced Heart Failure treatment options

- Cardiac transplantation
- Left ventricular assist device (LVAD)
- Palliative inotropes
- Hospice
Left Ventricular Assist Device (LVAD)

• Intra-corporeal pump
• 1st generation: pulsatile
• 2nd/3rd generation: continuous
• Axial or Centrifugal flow pump
• Constant power source
• Antiplatelet/anticoagulant
LONG-TERM USE OF A LEFT VENTRICULAR ASSIST DEVICE FOR END-STAGE HEART FAILURE

ERIC A. ROSE, M.D., ANNETINE C. GELIJNS, PH.D., ALAN J. MOSKOWITZ, M.D., DANIEL F. HEITJAN, PH.D., LYNNE W. STEVENSON, M.D., WALTER DEMBITSKY, M.D., JAMES W. LONG, M.D., PH.D., DEBORAH D. ASCHEIM, M.D., ANITA R. TIERNEY, M.P.H., RONALD G. LEVITAN, M.Sc., JOHN T. WATSON, PH.D., AND PAUL MEIER, PH.D., FOR THE RANDOMIZED EVALUATION OF MECHANICAL ASSISTANCE FOR THE TREATMENT OF CONGESTIVE HEART FAILURE (REMATCH) STUDY GROUP*

• 129 patients with NYHA IV, stage D HF who were ineligible for cardiac transplantation
• Primary endpoint: death from any cause
Rise of the Machines — Left Ventricular Assist Devices as Permanent Therapy for Advanced Heart Failure

James C. Fang, M.D.
LVAD Complications

- RV failure
- Arrhythmias
- Pump thrombosis
- GI bleeding
- Infection

- Stroke
LVAD Thrombosis
A Fully Magnetically Levitated Circulatory Pump for Advanced Heart Failure

Mandeep R. Mehra, M.D., Yoshifumi Naka, M.D., Nir Uriel, M.D.,
Daniel J. Goldstein, M.D., Joseph C. Cleveland, Jr., M.D., Paolo C. Colombo, M.D.,
Mary N. Walsh, M.D., Carmelo A. Milano, M.D., Chetan B. Patel, M.D.,
Ulrich P. Jorde, M.D., Francis D. Pagani, M.D., Keith D. Aaronson, M.D.,
David A. Dean, M.D., Kelly McCants, M.D., Akinobu Itoh, M.D.,
Gregory A. Ewald, M.D., Douglas Horstmanshof, M.D., James W. Long, M.D.,
and Christopher Salerno, M.D., for the MOMENTUM 3 Investigators*

- Investigate the effectiveness of a new magnetically levitated centrifugal continuous-flow pump that was engineered to avert thrombosis.
- 294 patients, 152 were assigned to the centrifugal-flow pump group and 142 to the axial-flow pump group

NEJM. 2017.
HeartMate 3™ LVAD

- Fully magnetically levitated
- Larger gaps in pump housing
- Built-in pulsatility
Significantly lower rate of pump replacement at 2 years
Current FDA Approved Durable MCS

- HeartMate II™ LVAD
- HeartMate 3™ LVAD
- Heartware HVAD™
- Total Artificial Heart (TAH)

- BTT
- DT
- BTT
- DT
- BTT
- DT
- BTT
Future of LVAD

• Improved patient selection
• Smaller devices (w/o compromising support)
• Elimination of the driveline
Smaller devices
LVAD Driveline

• Sepsis was the most common cause of death (41%) in pts receiving LVADs in the REMATCH trial

• Goal: eliminate the driveline
Wireless Technology

- Transcutaneous energy transfer (TET)
- Magnetically coupled resonators that transfer power wirelessly
- Ex: wireless cellphone charging pads
Transcutaneous Energy Transfer (TET)

• Matching resonance and frequency to allow acoustic energy to be converted into kinetic energy
Free Range Electrical Energy Delivery
What you really need to know
Patients with any of the following should be referred for evaluation for advanced heart failure therapies

**I NEED HELP**

<table>
<thead>
<tr>
<th>I</th>
<th>IV inotropes</th>
</tr>
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<tbody>
<tr>
<td>N</td>
<td>NYHA IIIB/IV or persistently elevated natriuretic peptides</td>
</tr>
<tr>
<td>E</td>
<td>End-organ dysfunction (Cr &gt; 1.8 mg/dL or BUN &gt; 43 mg/dL)</td>
</tr>
<tr>
<td>E</td>
<td>Ejection fraction ≤ 35%</td>
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<tr>
<td>D</td>
<td>Defibrillator shocks</td>
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<tr>
<td>H</td>
<td>Hospitalizations &gt; 1</td>
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<tr>
<td>E</td>
<td>Edema (or elevated PA pressure) despite escalating diuretics</td>
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<tr>
<td>L</td>
<td>Low blood pressure, high heart rate</td>
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<tr>
<td>P</td>
<td>Prognostic medication — progressive intolerance or down-titration GDMT</td>
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Additional patient considerations for referral:
- CRT non-responder
- Physical activity limited or impaired quality of life

When to refer

- **S**odium (hyponatremia Na<136)
- **H**ospitalizations
  - readmit in 30 days or ≥ 2 hospital stays in 6 months
- **A**rrhythmias (atrial/ventricular)
- **R**efractory to meds (ACE/ARB/BB)
- **K**idney failure (Cr ≥1.2, or >0.3 from b/l)
In summary

- Heart failure is a growing epidemic despite contemporary medical therapy
- New invasive technology allows earlier identification and management of volume status to prevent acute decompensation
- LVAD technology has continued to evolve/improve and now provides viable options (bridge or permanent therapy)
- Future advances of LVAD therapy look to identify patients earlier and limit complications
Thank You

Questions

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