Risk and Outcomes in Ambulatory Heart Failure

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Professor of Medicine
Advanced Heart Failure, Transplantation and Mechanical Circulatory Support

Saturday, October 19, 2019
9:55 – 10:25 a.m.
Bonsai Room
Disclosure:
I am a consultant, research investigator for Abbott (CardioMEMS, HeartMate3)
Learning Objectives

1. Assess risk of morbidity and mortality in heart failure.

2. Appreciate when to consider ambulatory monitoring.
How can we “see sick people”?

What opportunities are we leaving on table?

How can new technology impact outcomes?
76 yo Caucasian male
ICM diagnosed 2006
CABG 2002, 2012
Former smoker, moderate COPD, mild PVD

Six months ago was able to play 18 holes of golf
Four months ago developed AF with RVR
Failed catheter ablation

Four hospital admissions in the last 3 months

ICD shock requiring admission
Inappropriate for afib with RVR
Now on Bumex 2 mg BID
Lisinopril held due to rising creatinine

Unable to climb a flight of stairs
Trouble with ADLs on “bad” days
Na 129, BUN 20, Creat 1.6 (GFR 50)

AST 35/ALT 42, Bili 1.6
Over next 12 months, what is this patient’s risk of mortality?

a. 20%
b. 30%
c. 50%
d. 80%
AHA Scientific Statement

Recommendations for the Use of Mechanical Circulatory Support: Device Strategies and Patient Selection

A Scientific Statement From the American Heart Association

Jennifer L. Pena, MD, Chair; Monica Calvin-Adams, MD, MS, FAHA, Co-Chair;
Gary S. Francis, MD, FAHA; Kathleen L. Grady, PhD, APN, FAHA;
Timothy M. Hoffman, MD, FAHA; Mariell Jessup, MD, FAHA; Ranjit John, MD;
Michael S. Kierman, MD; Judith E. Mitchell, MD, FAHA; John B. O’Connell, MD;
Francis D. Pagani, MD, PhD, FAHA; Michael Petty, PhD, RN; Pasala Ravichandran, MD;
Joseph G. Rogers, MD; Marc J. Semigran, MD, FAHA; I. Matthew Toole, MD, FAHA; on behalf of
the American Heart Association Heart Failure and Transplantation Committee of the Council on
Clinical Cardiology, Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation,
Council on Cardiovascular Disease in the Young, Council on Cardiovascular Nursing, Council
on Cardiovascular Radiology and Intervention, and Council on Cardiovascular Surgery and Anesthesia
# Risk Stratification

## Table 6. Prognostic Determinants in Advanced HF

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Clinical</th>
<th>Laboratory</th>
</tr>
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<tbody>
<tr>
<td>Advanced age</td>
<td>Frequent hospitalizations (&gt;1 in past 6 months)</td>
<td>Hyponatremia</td>
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<tr>
<td>Male gender</td>
<td>Advanced NYHA class (III or IV)</td>
<td>Renal insufficiency (BUN/serum creatinine)</td>
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<tr>
<td></td>
<td>Intolerance to neurohormonal antagonists</td>
<td>Hepatic insufficiency</td>
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<tr>
<td></td>
<td>Increased diuretic requirement</td>
<td>Elevated neurohormones, natriuretic peptides, troponins, CRP</td>
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<tr>
<td></td>
<td>Hypotension</td>
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<td></td>
<td>Failed CRT</td>
<td>Doppler-echo and right heart catheterization</td>
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<tr>
<td></td>
<td>Inotrope dependence</td>
<td>Low LV EF (&lt;30%)</td>
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<tr>
<td></td>
<td>Co-morbidities (diabetes, anemia, COPD, etc.)</td>
<td>Mitral regurgitation/increased LA volume</td>
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<td></td>
<td>Increased filling pressure (PCWP &gt;16 mmHg or RAP&gt;12 mmHg)</td>
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<td>Low RV EF</td>
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<tr>
<td></td>
<td></td>
<td>Increased pulmonary vascular resistance</td>
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<td></td>
<td>Functional capacity</td>
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<td></td>
<td>Inability to perform an exercise test</td>
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<tr>
<td></td>
<td></td>
<td>Low peak VO2 (&lt;12-14 ml/kg/min)</td>
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<tr>
<td></td>
<td></td>
<td>Increased ventilatory response to exercise (VE/VCO2 slope)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low 6-minute walk test distance (&lt;300 m)</td>
</tr>
<tr>
<td>Class</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Class I</td>
<td>No limitation of physical activity. Ordinary physical activity does not cause undue breathlessness, fatigue, or palpitations.</td>
<td></td>
</tr>
<tr>
<td>Class II</td>
<td>Slight limitation of physical activity. Comfortable at rest, but ordinary physical activity results in undue breathlessness, fatigue, or palpitations.</td>
<td></td>
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<tr>
<td>Class III</td>
<td>Marked limitation of physical activity. Comfortable at rest, but less than ordinary physical activity results in undue breathlessness, fatigue, or palpitations.</td>
<td></td>
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<tr>
<td>Class IV</td>
<td>Unable to carry on any physical activity without discomfort. Symptoms at rest can be present. If any physical activity is undertaken, discomfort is increased.</td>
<td></td>
</tr>
</tbody>
</table>
NYHA Class: Predicts Mortality

Case Presentation
NYHA III-IV
Renal Function: Predicts Mortality

1906 patients

EF 26.2%

NYHA class

III  59.7%

III/IV  31.8%

IV  8.4%

Case Presentation

GFR 50
Renal Function: Predicts Mortality

Case Presentation
GFR 50, NYHA III-IV

1-yr mortality increases by 15% for every 10 mL/min reduction in GFR
Drugs That Reduce Mortality in Heart Failure With Reduced Ejection Fraction

Based on results of SOLVD-Treatment, CHARM-Alternative, COPERNICUS, MERIT-HF, CIBIS II, RALES and EMPHASIS-HF
Drugs that Reduce Mortality

- **Angiotensin receptor blocker**
- **ACE inhibitor**
- **Beta blocker**
- **Mineralocorticoid receptor antagonist**

Drugs that inhibit the renin-angiotensin system have modest effects on survival.
Med Intolerance: Predicts Mortality

Case Presentation
Stopped ACEI

Outcome of Hospitalized Patients Discontinuing Chronic ACEI Due to Cardio-Renal Limitations

<50% 12 mo survival

Med Intolerance: Predicts Mortality

Post-discharge Survival by Beta-Blocker Treatment Group

Fonarow GC et al. J Am Coll Cardiol 2008;52:190-199.
Diuretic Dose: Predicts Mortality

**Diuretic (high)**
Lasix > 80 mg/d
Bumex > 2 mg/d

**ACEI (high)**
Lisinopril > 10 mg/d (or equivalent)

<table>
<thead>
<tr>
<th>High diuretic</th>
<th>Low ACEI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low diuretic</td>
<td>High ACEI</td>
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</tbody>
</table>

40% 12 mo Mortality

**Case Presentation**
Bumex 2 mg BID, no ACEI

Chi-square = 33.83
P = 0.0001
Serum Na: Predicts Mortality

Case Presentation
Na 129

80% 12 mo Mortality

Serum Na: Predicts Mortality

Hyponatremia and HF Clinical Outcomes

# ICD Shock: Predicts Mortality

<table>
<thead>
<tr>
<th>Association of ICD Shocks and Long-Term Mortality</th>
<th>HR</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock vs. no shock</td>
<td>1.97</td>
<td>1.51-5.57</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Appropriate shock vs. no shock</td>
<td>2.95</td>
<td>2.12-4.11</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Inappropriate shock vs. no shock</td>
<td>1.71</td>
<td>1.45-2.02</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

## Case Presentation

ICD shock for Afib
Hospital Admissions: Predicts Mortality

- Median Transplant survival: 12
- Median VAD survival: 5

Adapted from Thorvaldsen T et. Al. JACC 2014; 63:661-671
Case Presentation

This patient has high risk of mortality due to multiple risk factors.

Easily identifiable risk factor= multiple hospital admissions.
Can anything be done to reduce hospital admissions?
CardioMEMS: CHAMPION

Wireless pulmonary artery haemodynamic monitoring in chronic heart failure: a randomised controlled trial

William T Abraham, Philip B Adamson, Robert C Bourge, Mark F Aaron, Maria Rosa Costanza, Lynne W Stevenson, Warren Strickland, Suresh Neelagaru, Nirav Ravat, Steven Krueger, Stanislav Weiner, David Shavelle, Bradley Jeffries, Jay S Yadav, for the CHAMPION Trial Study Group

Summary

Background Results of previous studies support the hypothesis that implantable haemodynamic monitoring systems might reduce rates of hospitalisation in patients with heart failure. We undertook a single-blind trial to assess this approach.

Methods Patients with New York Heart Association (NYHA) class III heart failure, irrespective of the left ventricular ejection fraction, and a previous hospital admission for heart failure were enrolled in 64 centres in the USA. They were randomly assigned by use of a centralised electronic system to management with a wireless implantable haemodynamic monitoring (W-HM) system (treatment group) or to a control group for at least 6 months. Only patients were masked to their assignment group. In the treatment group, clinicians used daily measurement of pulmonary artery pressures in addition to standard of care versus standard of care alone in the control group. The primary efficacy endpoint was the rate of heart-failure-related hospitalisations at 6 months. The safety endpoints assessed at 6 months were freedom from device-related or system-related complications (DSRC) and freedom from pressure-sensor failures. All analyses were by intention to treat. This trial is registered with ClinicalTrials.gov, number NCT00531661.

Findings In 6 months, 84 heart-failure-related hospitalisations were reported in the treatment group (n=270; rate 0.32 vs 0.44, hazard ratio [HR] 0.72, 95% CI 0.60–0.85, p=0.0002). During the entire follow-up (mean 15 months [SD 7]), the treatment group had a 37% reduction in heart-failure-related hospitalisation compared with the control group (158 vs 254, HR 0.63, 95% CI 0.52–0.77; p=0.0001). Eight patients had DSRC and overall freedom from DSRC was 98.6% (97.3–99.4) compared with a prespecified performance criterion of 80% (p=0.0001); and overall freedom from pressure-sensor failures was 100% (99.3–100.0).

Interpretation Our results are consistent with, and extend, previous findings by definitively showing a significant and large reduction in hospitalisation for patients with NYHA class III heart failure who were managed with a wireless implantable haemodynamic monitoring system. The addition of information about pulmonary artery pressure to clinical signs and symptoms allows for improved heart failure management.

Funding CardioMEMS.
CardioMEMS: Implantable hemodynamic monitoring system

CardioMEMS: Outpatient Implantation

CardioMEMS: Ambulatory Monitoring

Abraham WT et al, Lancet 2011;377:658-66
CardioMEMS: CHAMPION

NYHA III
Hospital admission ≤12 months
HFrEF and HFrEF

HF Hospitalization Rate (events/year)

67% Reduction
PAP Managed Patients vs Control Group (HR 0.33, 95% CI 0.16-0.59, p=0.0007)

Control Group
(Clinical Triggered Rx Only)
Baseline PA Mean = 30.0 mmHg

PAP Managed Patients
(Clinical and PAP Triggered Rx)
Baseline PA Mean = 29.0 mmHg

PAP Managed Patients
(PAP Triggered Rx Only)
Baseline PA Mean = 32.0 mmHg

CHAMPION: Open Access

18-month endpoint

- Admissions to hospital for heart failure
- All-cause admissions to hospital

- Effect size during randomised access
  - Treatment group—randomised access: 0.46 (33% reduction)
  - Control group—randomised access: 0.68
  - Control group—open access: 1.65 (16% reduction)

Abraham WT et al Lancet 2016;387:453-61
Cumulative HF Medication Changes

Days After Implant
CHAMPION Cohort HFpEF hospitalization Decreased by 50%

Cumulative HF Hospitalizations

Days After Implant

p<0.0001
HF Related Cost Reduction

6 months  - $7,433
12 months - $11,260
Triage of Patients With Moderate to Severe Heart Failure

Who Should Be Referred to a Heart Failure Center?

Tone Thorvaldsen, MD,† Lina Benson, MSc,‡ Marcus Ståhlberg, MD, PhD,†
Ulf Dahlström, MD, PhD,‡ Magnus Edner, MD, PhD,° Lars H. Lund, MD, PhD°
Stockholm and Linköping, Sweden

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>1-yr Survival</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>90%</td>
</tr>
<tr>
<td>1</td>
<td>79%</td>
</tr>
<tr>
<td>2</td>
<td>60%</td>
</tr>
<tr>
<td>3-5</td>
<td>39%</td>
</tr>
<tr>
<td>Transplant</td>
<td>90%</td>
</tr>
<tr>
<td>VAD</td>
<td>81%</td>
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</tbody>
</table>

Risk factors
Thank You