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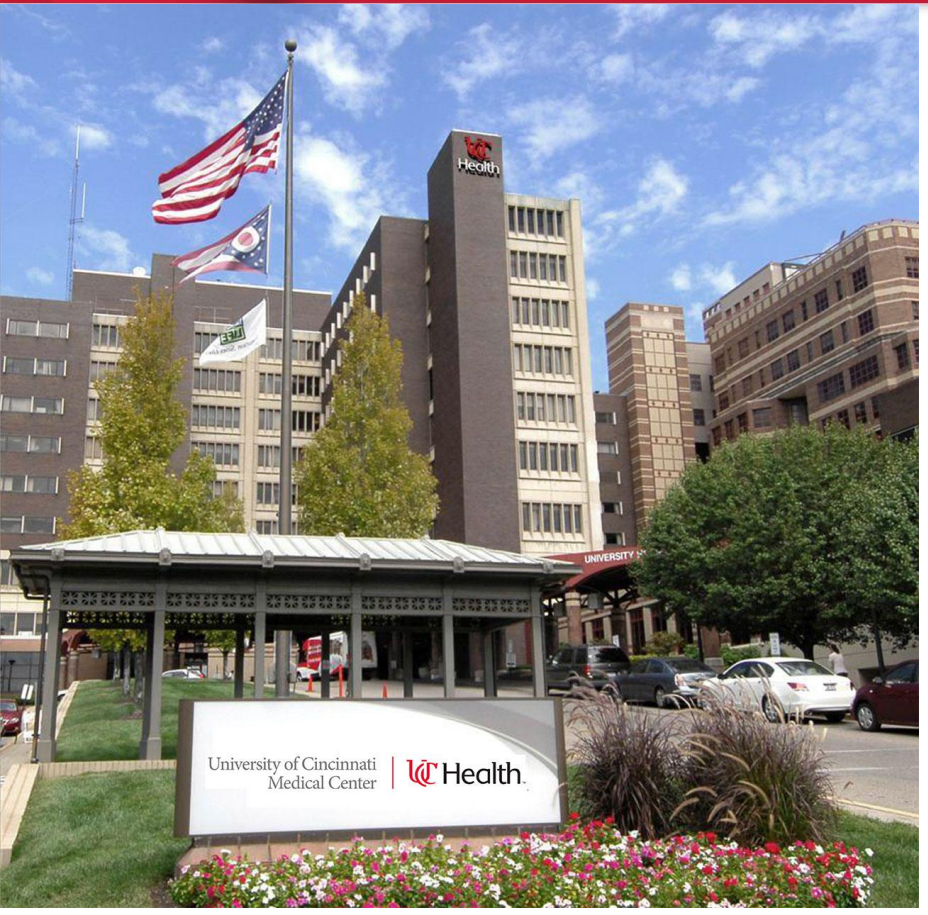


Risk and Outcomes in Ambulatory Heart Failure

Jennifer Cook, MD FAHA FACC

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

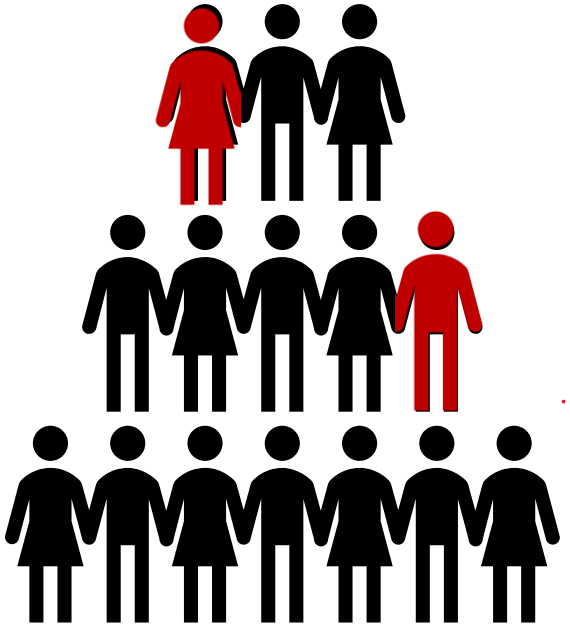
1. Assess risk of morbidity and mortality in heart failure.

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. Peura, MD, Chair; Monica Colvin-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. Kiernan, 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; J. 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

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Peura Cook JL, et. al. Circulation 2012; 126(22):2648-26

Risk Stratification

Table 6. Prognostic Determinants in Advanced HF

Demographic

- Advanced age
- Male gender

Clinical

- Frequent hospitalizations (>1 in past 6 months)
- Advanced NYHA class (III or IV)
- Intolerance to neurohormonal antagonists
- Increased diuretic requirement
- Hypotension
- Failed CRT
- Inotrope dependence
- Co-morbidities (diabetes, anemia, COPD, etc.)

Laboratory

- Hyponatremia
- Renal insufficiency (BUN/serum creatinine)
- Hepatic insufficiency
- Elevated neurohormones, natriuretic peptides, troponins, CRP

Doppler-echo and right heart catheterization

- Low LV EF (<30%)
- Mitral regurgitation/increased LA volume
- Increased filling pressure (PCWP >16 mmHg or RAP>12 mmHg)
- Low RV EF
- Increased pulmonary vascular resistance

Functional capacity

- Inability to perform an exercise test
- Low peak VO2 (<12-14 ml/kg/min)
- Increased ventilatory response to exercise (VE/VCO2 slope)
- Low 6-minute walk test distance (<300 m)

Peura Cook JL, et. al. Circulation 2012; 126(22):2648-2667

Table 2 New York Heart Association functional classification based on severity of symptoms and physical activity

Class I	No limitation of physical activity. Ordinary physical activity does not cause undue breathlessness, fatigue, or palpitations.
Class II	Slight limitation of physical activity. Comfortable at rest, but ordinary physical activity results in undue breathlessness, fatigue, or palpitations.
Class III	Marked limitation of physical activity. Comfortable at rest, but less than ordinary physical activity results in undue breathlessness, fatigue, or palpitations.
Class IV	Unable to carry on any physical activity without discomfort. Symptoms at rest can be present. If any physical activity is undertaken, discomfort is increased.

Class IIIa

Class IIIb

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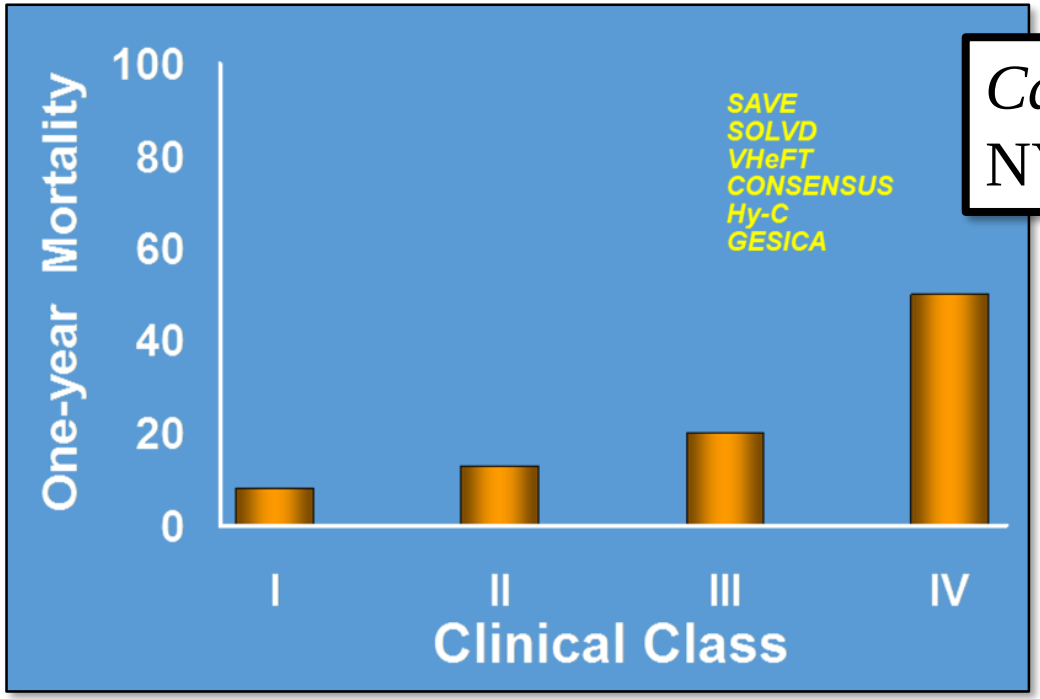
ESC HF Guidelines. Eur J Heart Fail 2012;14:803-69

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%

Renal Function, Neurohormonal Activation, and Survival in Patients With Chronic Heart Failure

Hans L. Hillege, MD; Armand R.J. Girbes, MD; Pieter J. de Kam, MSc; Frans Boomsma, PhD; Dick de Zeeuw, MD; Andrew Charlesworth, MSc; John R. Hampton, MD; Dirk J. van Veldhuisen, MD

Background—Because renal function is affected by chronic heart failure (CHF) and it relates to both cardiovascular and hemodynamic properties, it should have additional prognostic value. We studied whether renal function is a predictor for mortality in advanced CHF, and we assessed its relative contribution compared with other established risk factors. In addition, we studied the relation between renal function and neurohormonal activation.

Methods and Results—The study population consisted of 1906 patients with CHF who were enrolled in a recent survival trial (Second Prospective Randomized study of Ibopamine on Mortality and Efficacy). In a subgroup of 372 patients, plasma neurohormones were determined. The baseline glomerular filtration rate (GFR_c) was calculated using the Cockroft Gault equation. GFR_c was the most powerful predictor of mortality; it was followed by New York Heart Association functional class and the use of angiotensin-converting enzyme inhibitors. Patients in the lowest quartile of GFR_c values (<44 mL/min) had almost 3 times the risk of mortality (relative risk, 2.85; $P<0.001$) of patients in the highest quartile (>76 mL/min). Impaired left ventricular ejection fraction (LVEF) was only modestly predictive ($P=0.053$). GFR_c was inversely related with N-terminal atrial natriuretic peptide (ANP; $r=-0.53$) and, to a lesser extent, with ANP itself ($r=-0.35$; both $P<0.001$).

Conclusions—Impaired renal function (GFR_c) is a stronger predictor of mortality than impaired cardiac function (LVEF and New York Heart Association class) in advanced CHF, and it is associated with increased levels of N-terminal ANP. Moreover, impaired renal function was not related to LVEF, which suggests that factors other than reduced cardiac output are causally involved. **(*Circulation*. 2000;102:203-210.)**

Key Words: heart failure ■ prognosis ■ kidney ■ hormones

Case Presentation

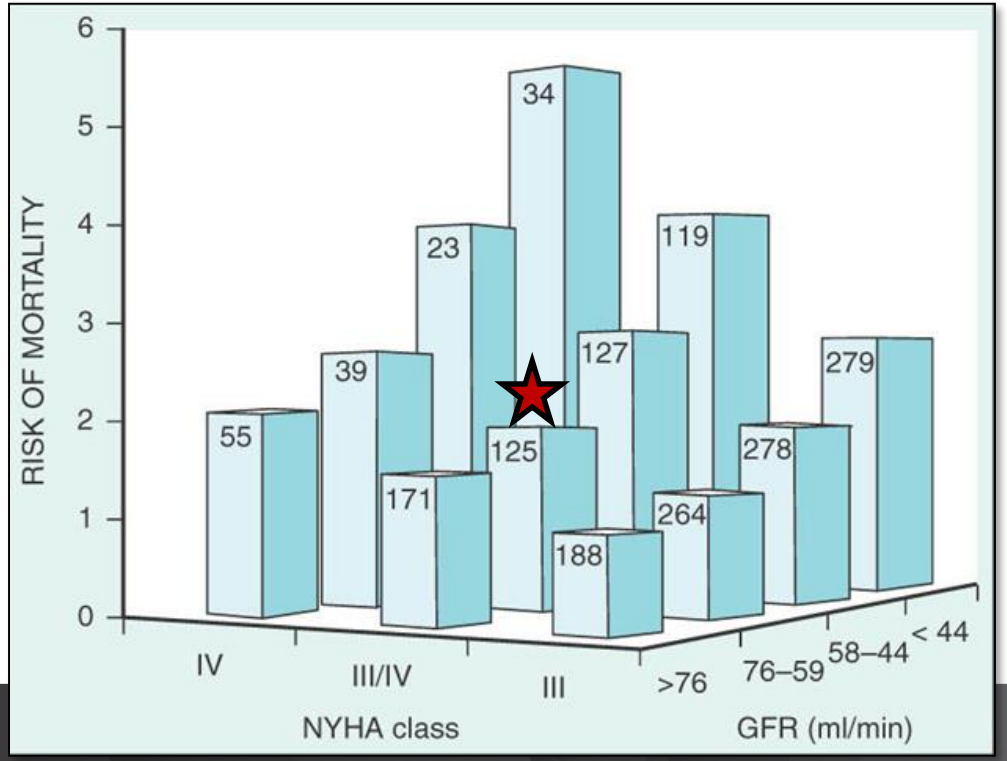
GFR 50

Hillege H L et al. Circulation 2000;102:203-210

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



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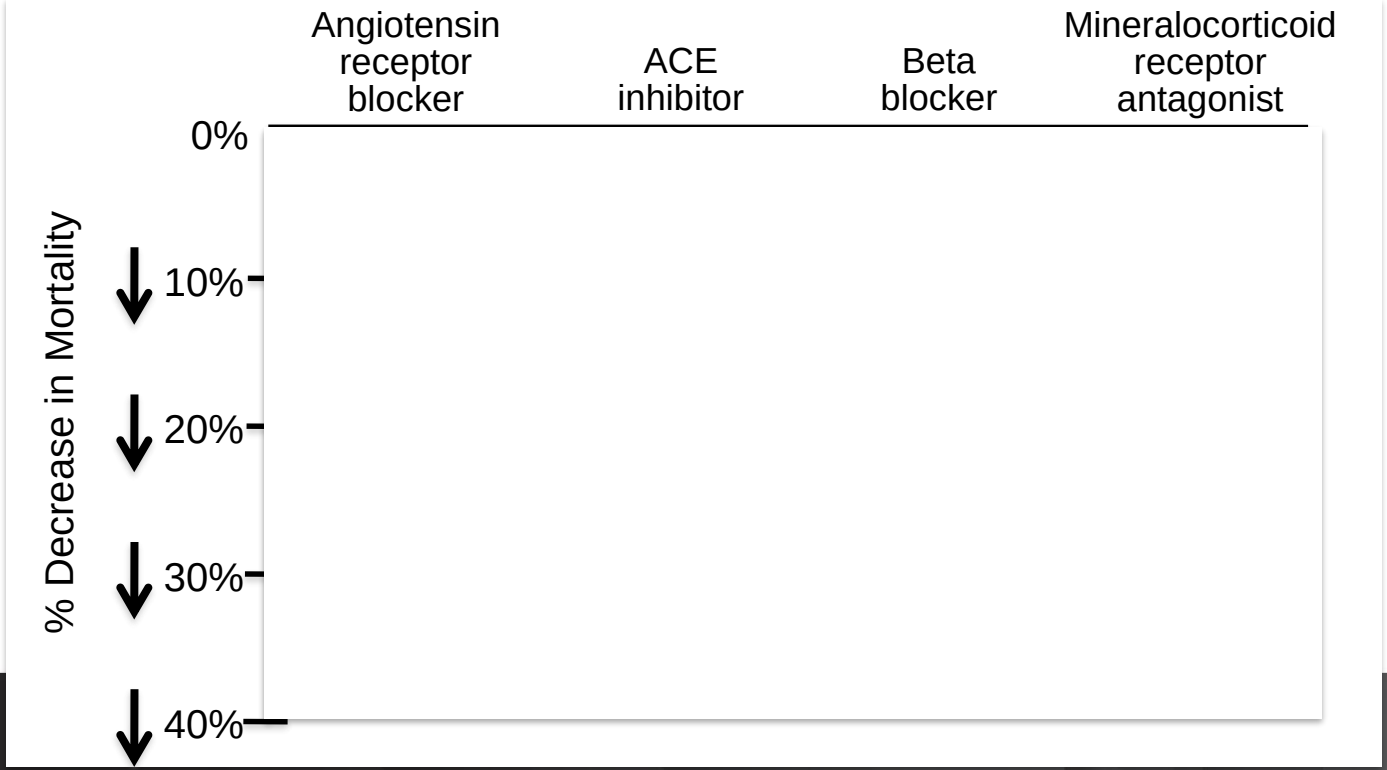
Hillege H L et al. *Circulation* 2000;102:203-210

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

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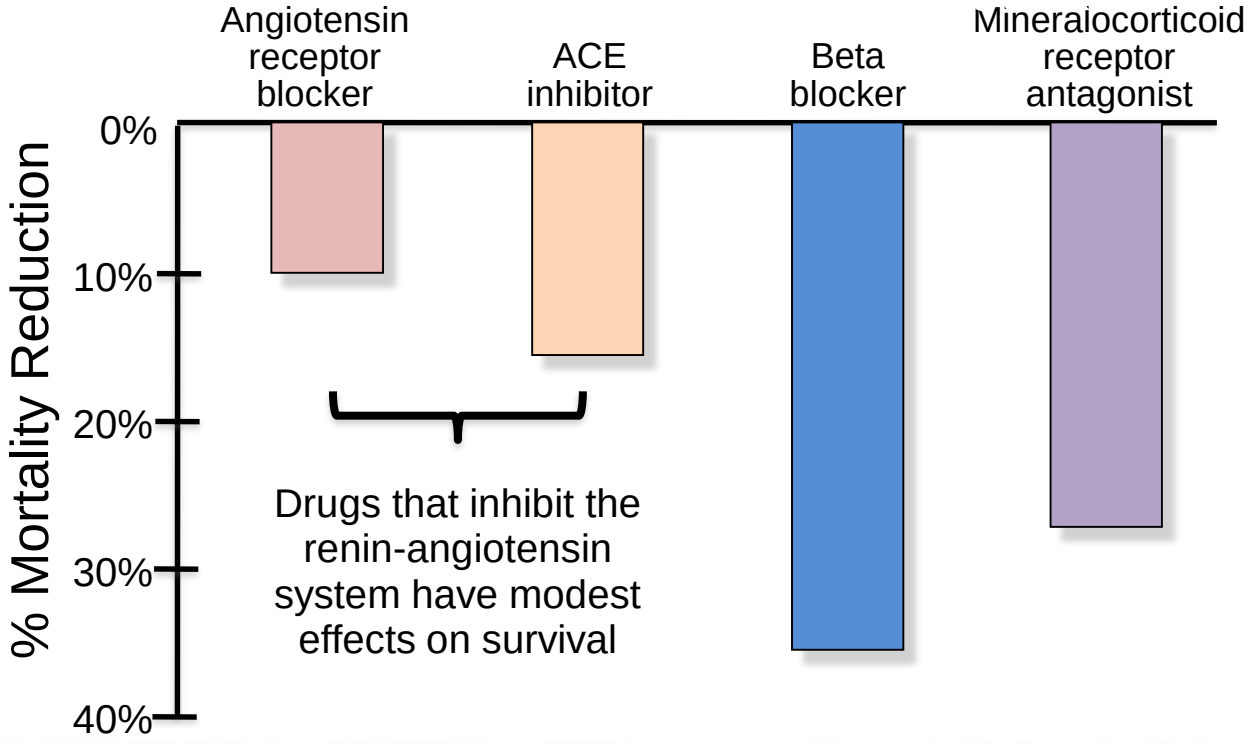
PARADIGMHF

Drugs that Reduce Mortality

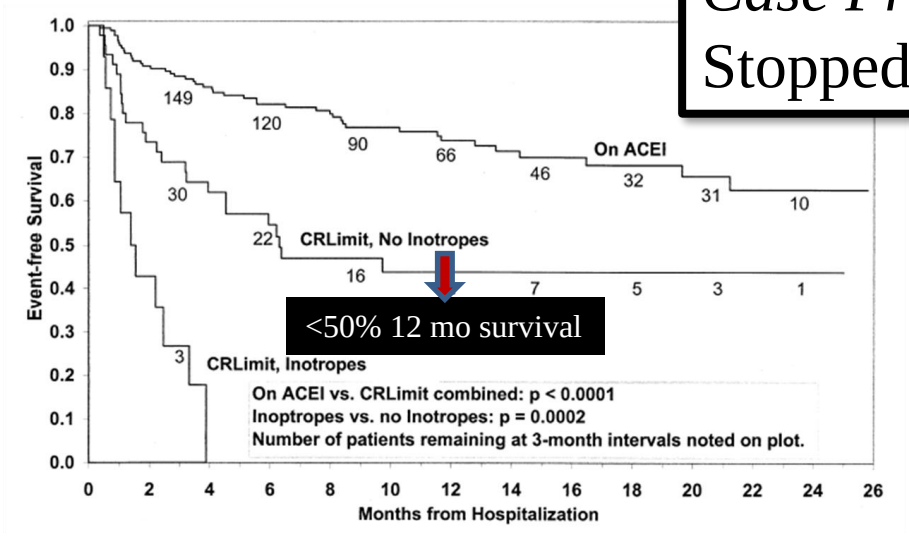


McMurray et al NEJM 2014;371

Med Intolerance: Predicts Mortality

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

Case Presentation
Stopped ACEI



Kittleson M et al. J Am Coll Cardiol 2003;41:2029.

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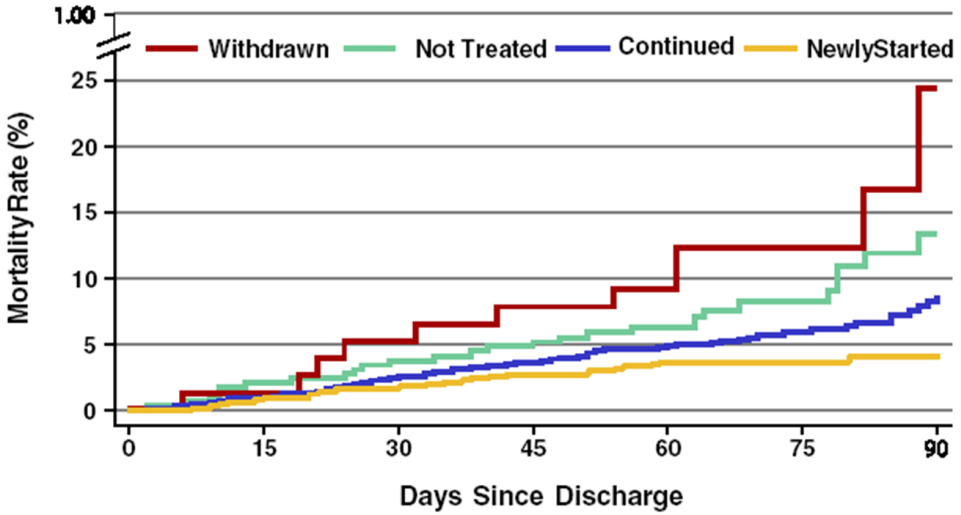
Med Intolerance: Predicts Mortality

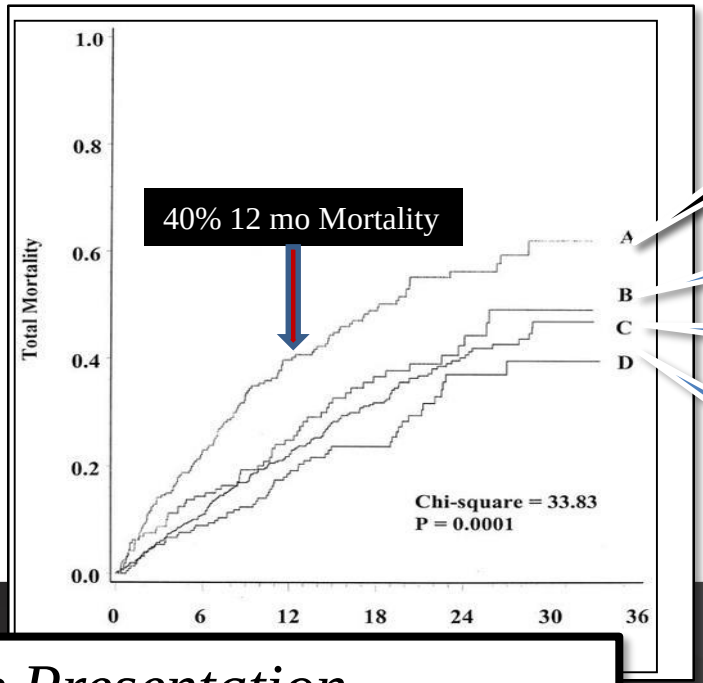
Post-discharge Survival by Beta-Blocker Treatment Group



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



High diuretic
Low ACEI

High/ High

Low/ Low

Low diuretic
High ACEI

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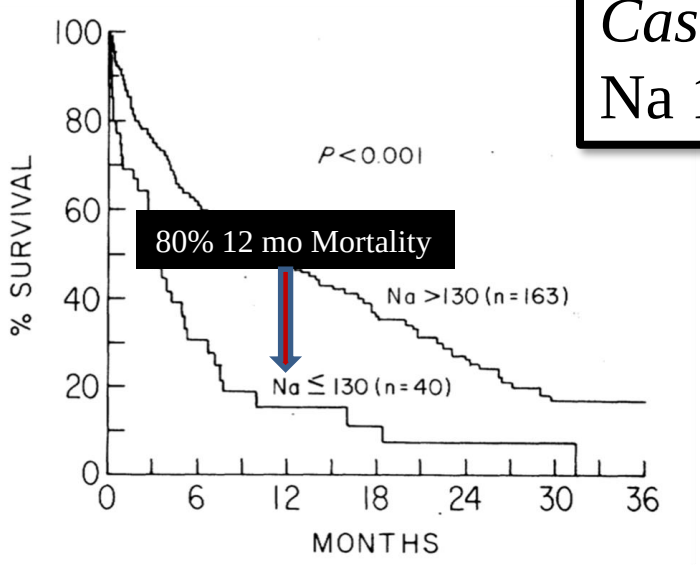
Case Presentation

Bumex 2 mg BID, no ACEI

Serum Na: Predicts Mortality

Pre-treatment Hyponatremia and Survival



Case Presentation
Na 129

Lee WH, Packer M. *Circulation 1986*;73:257-267.

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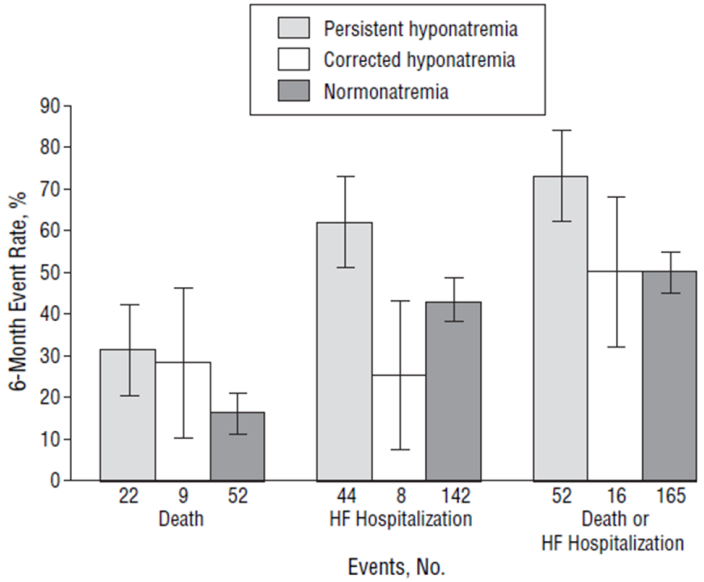
Serum Na: Predicts Mortality

Hyponatremia and HF Clinical Outcomes



Gheorghiade M, et al. *Arch Intern Med* 2007;167:1998-2005.

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ICD Shock: Predicts Mortality

Association of ICD Shocks and Long-Term Mortality			
	HR	95% CI	*p-value*
Shock vs. no shock	1.97	1.51-5.57	*p<0.001*
Appropriate shock vs. no shock	2.95	2.12-4.11	*p<0.001*
Inapproprite shock vs. no shock	1.71	1.45-2.02	*p<0.001*

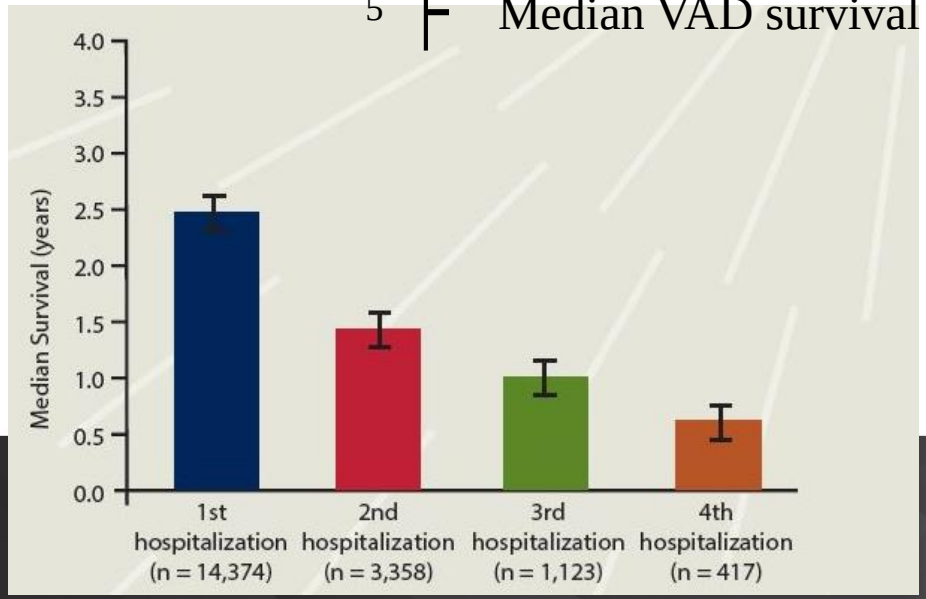
Case Presentation
ICD shock for Afib

Borne R, JAMA IM 2013;173:859-865 Proietti R 2015; Canadian J Card 31: 270-277

Hospital Admissions: Predicts Mortality

12 Median Transplant survival

5 Median VAD survival



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Adapted from Thorvaldsen T et. Al. JACC 2014; 63:661-671
Abraham W et al Lancet 2011:377:658-66

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 Costanzo, Lynne W Stevenson, Warren Strickland, Suresh Neelagaru, Nirav Raval, Steven Krueger, Stanislav Weiner, David Shavelle, Bradley Jeffries, Jay S Yadav, for the CHAMPION Trial Study Group*

Lancet 2011; 377: 658–66
Published Online
February 10, 2011
DOI:10.1016/S0140-6736(11)60101-3

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-IHM) 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) compared with 120 in the control group (n=280; 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.

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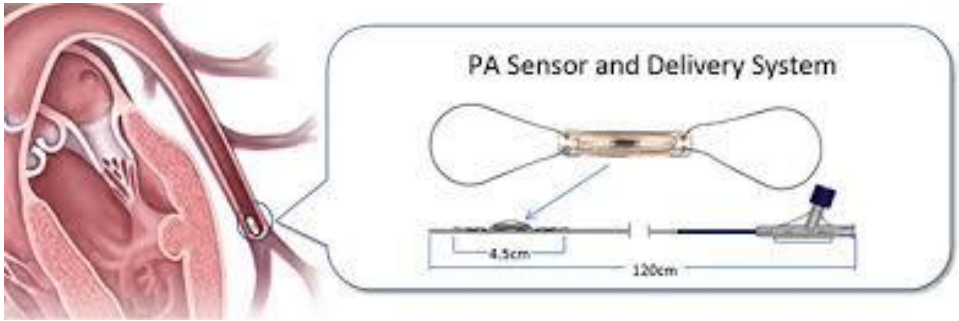
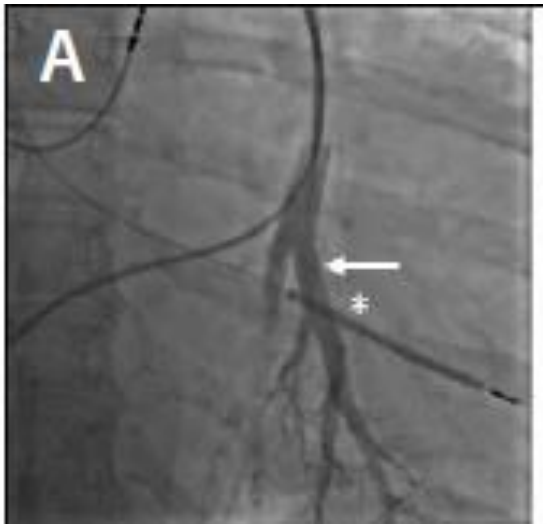
CardioMEMS: Implantable hemodynamic monitoring system



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

https://citoday.com/2018/02/how-to-implant-the-cardiomems-heart-failure-sensor/

CardioMEMS: Outpatient Implantation



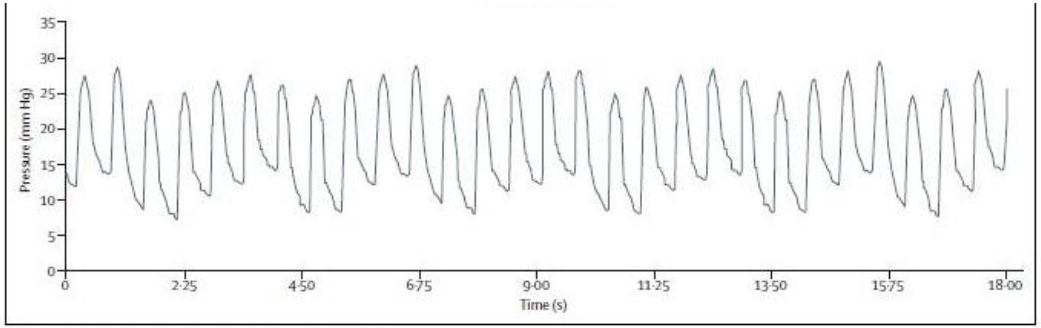
Abraham WT et al Lancet 2011;377:658-66

https://citoday.com/2018/02/how-to-implant-the-cardiomems-heart-failure-sensor/

CardioMEMS: Ambulatory Monitoring

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

https://citoday.com/2018/02/how-to-implant-the-cardiomems-heart-failure-sensor/



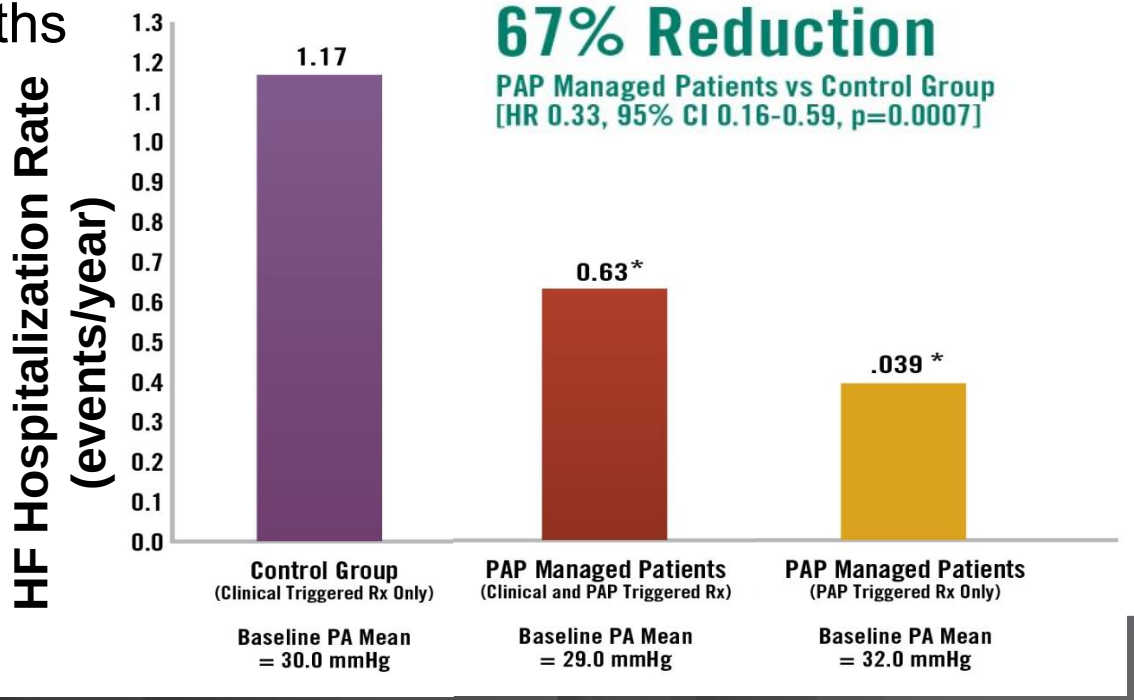
Abraham WT et al Lancet 2011;377:658-66

CardioMEMS: CHAMPION

NYHA III

Hospital admission ≤12 months

HFpEF and HFrEF



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Abraham W et al Lancet 2011:377:658-66

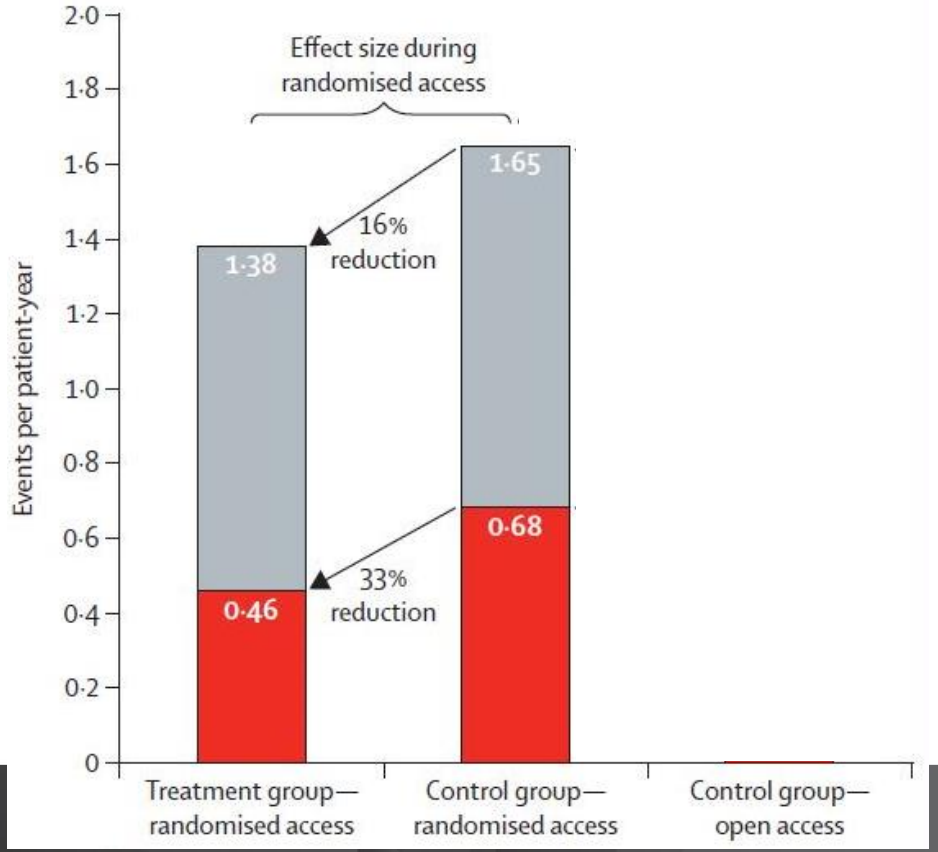
Goldberg et al, HRS 2015, Boston Abstract AB36-02.

CHAMPION: Open Access

18-month endpoint

Admissions to hospital for heart failure

All-cause admissions to hospital



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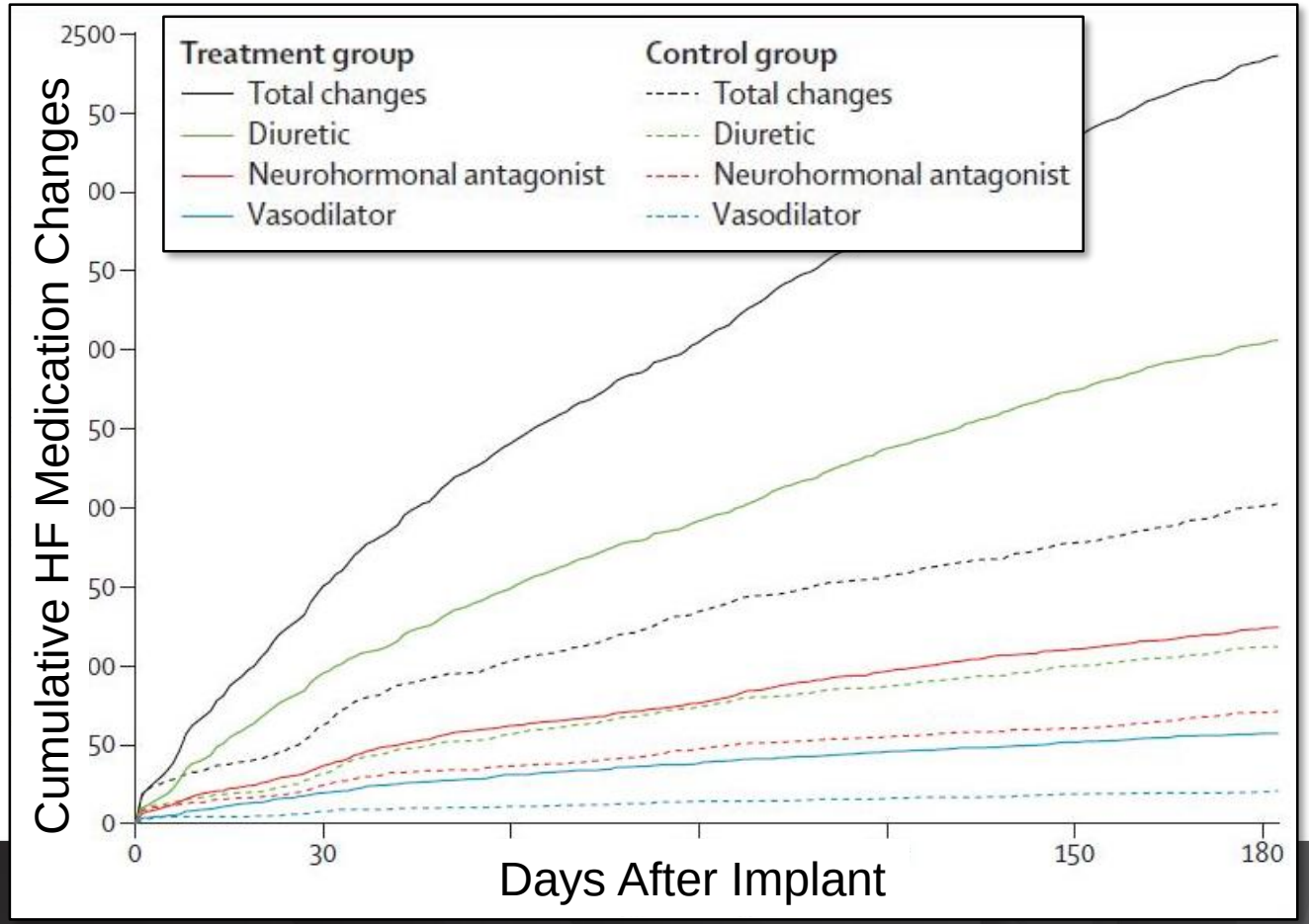
Abraham WT et al Lancet 2016;387:453-61



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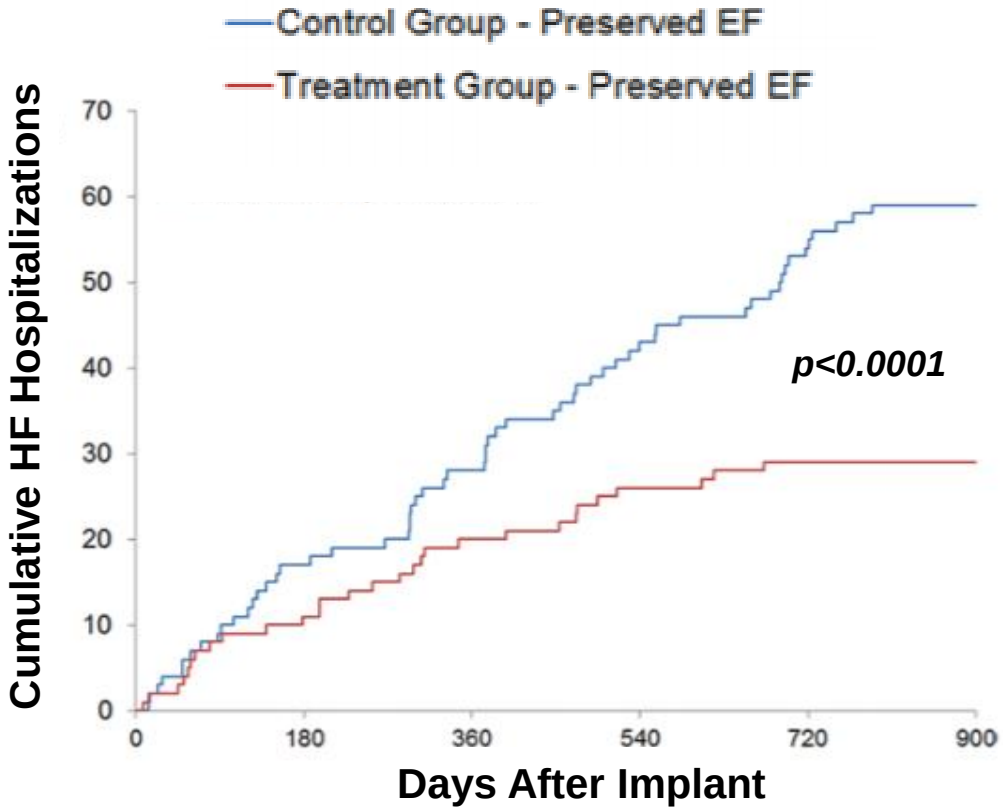
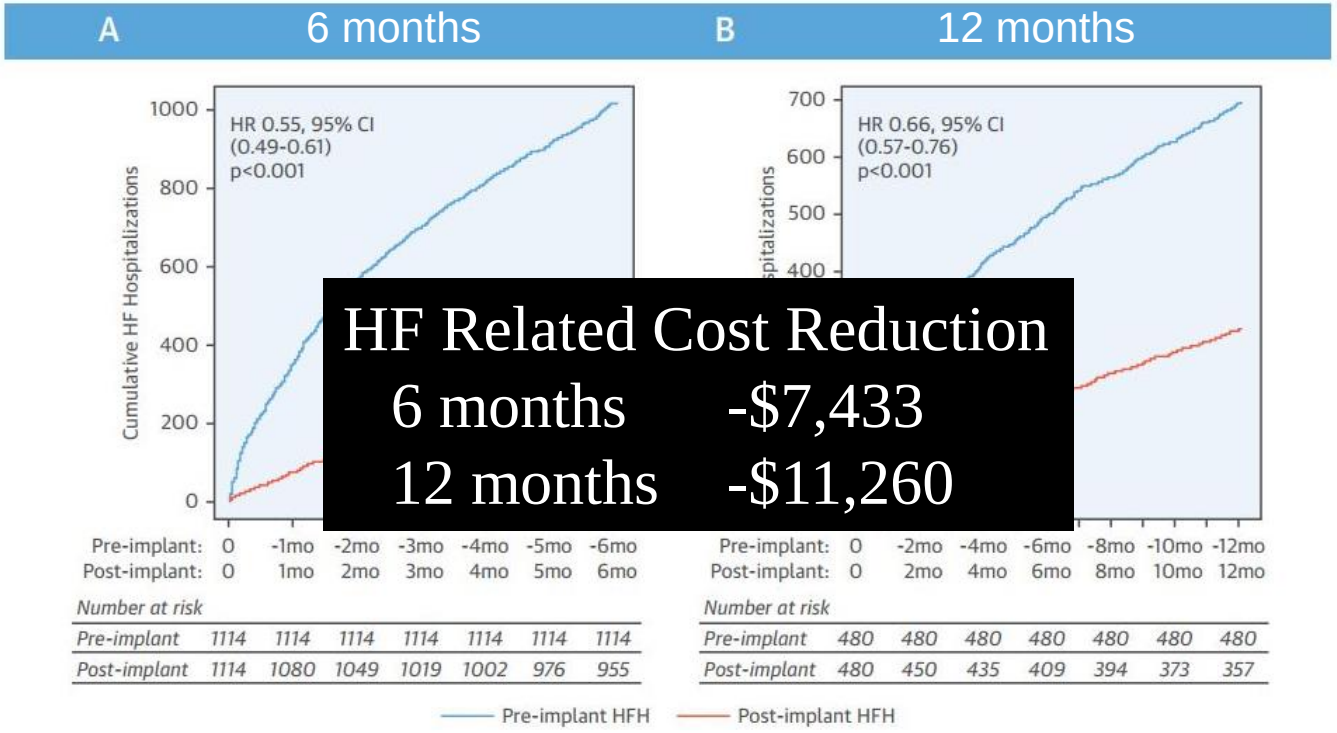
Abraham WT et al Lancet 2016;387:453-61



CHAMPION Cohort
HFpEF hospitalization
Decreased by 50%

Adamson et al Circ Heart Fail. 2014 Nov;7(6):935-44

CENTRAL ILLUSTRATION **Cumulative HFHs During the Period Before and After Pulmonary Artery Pressure Sensor Implantation**



HF Related Cost Reduction

6 months -$7,433

12 months -$11,260

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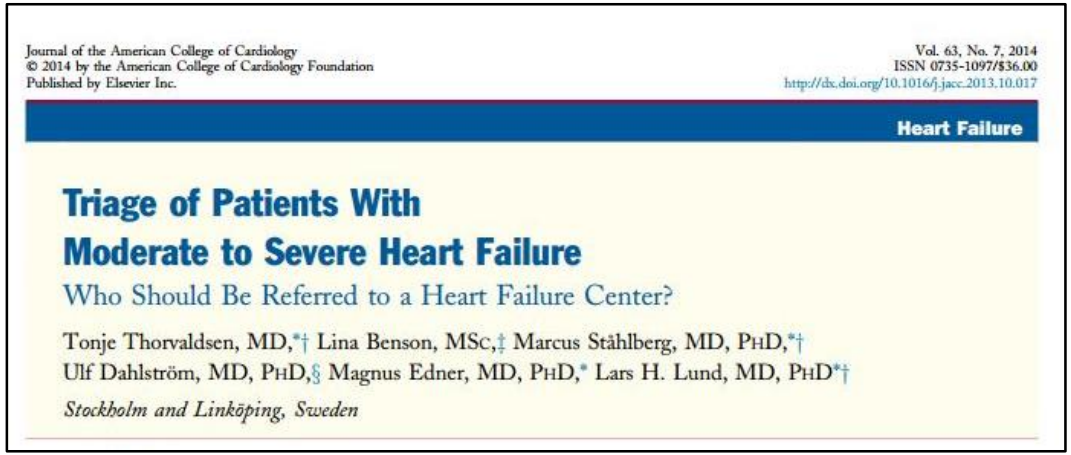
Desai et. al. JACC 2017;69:2357-65



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Heart Failure

Triage of Patients With Moderate to Severe Heart Failure

Who Should Be Referred to a Heart Failure Center?

Tonje 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

Risk Factors	1-yr Survival
0	90%
1	79%
2	60%
3-5	39%
Transplant	90%
VAD	81%

Risk factors

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Thank You