Managing Acute Heart Failure: In the Hospital and Post-discharge

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- 40 years old
- STEMI 12/2021
- Late LAD stent
- Ischemic cardiomyopathy LVEF 30%, RV normal
- Discharged

- Started on torsemide
- Sacubitril/valsartan
- Carvedilol
- Aldactone
- Dapagliflozin

- Admitted for HF March 2022
- SOB at rest, no edema
- ECG: Afib
- CXR: increased interstitial markings
- cardioverted
- Diuresis, improved, discharged

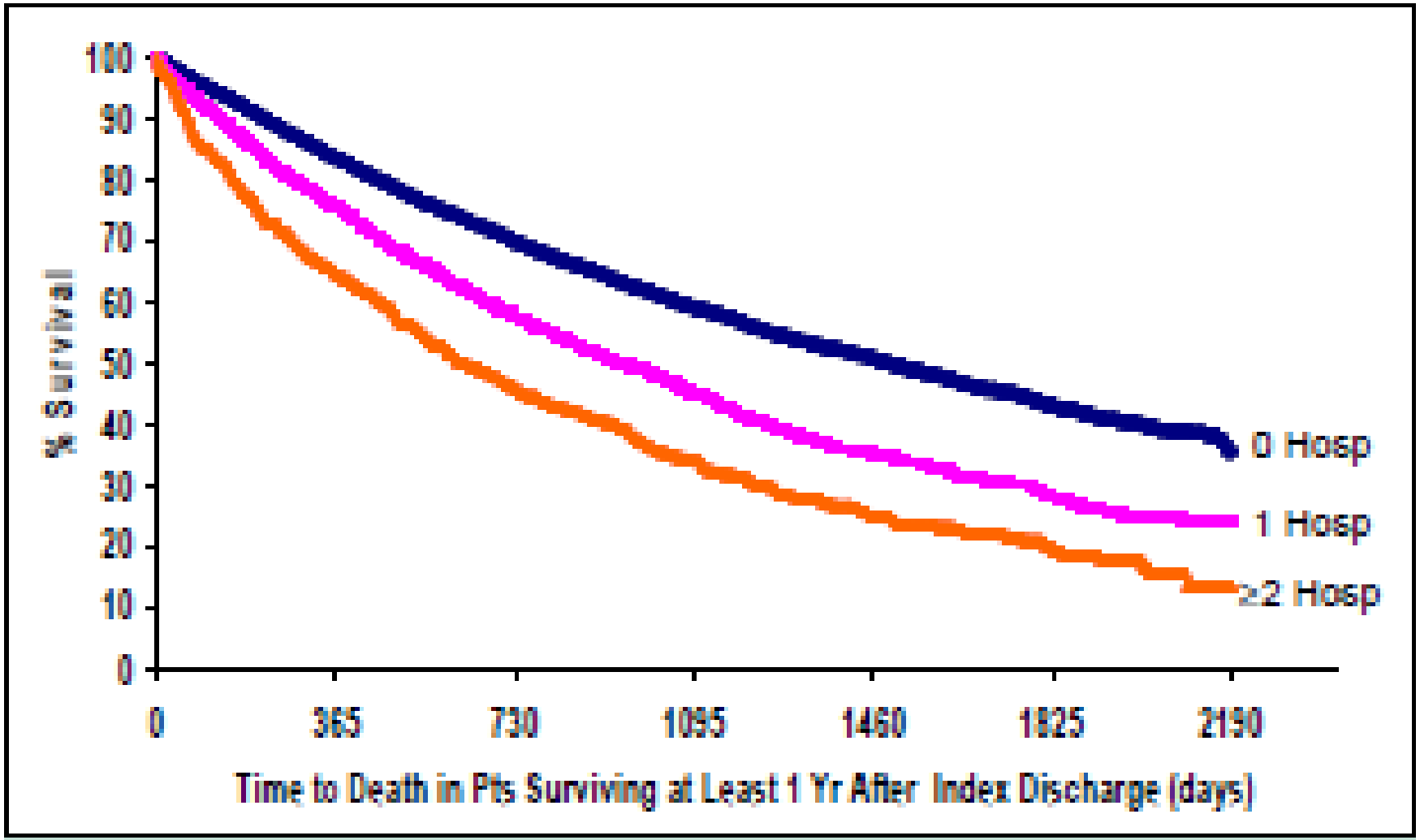
Table 21. Common Factors Precipitating HF Hospitalization With Acute Decompensated HF

ACS
Uncontrolled hypertension
AF and other arrhythmias
Additional cardiac disease (eg, endocarditis)
Acute infections (eg, pneumonia, urinary tract)
Nonadherence with medication regimen or dietary intake
Anemia
Hyper- or hypothyroidism
Medications that increase sodium retention (eg, NSAID)
Medications with negative inotropic effect (eg, verapamil)

ACS indicates acute coronary syndrome; AF, atrial fibrillation; HF, heart failure; and NSAID, nonsteroidal anti-inflammatory drug.

9.2. Maintenance or Optimization of GDMT During Hospitalization

Recommendations for Maintenance or Optimization of GDMT During Hospitalization Referenced studies that support the recommendations are summarized in the Online Data Supplements.		
COR	**LOE**	**Recommendations**
1	B-NR	1. In patients with HFrEF requiring hospitalization, preexisting GDMT should be continued and optimized to improve outcomes, unless contraindicated.[1–5]
1	B-NR	2. In patients experiencing mild decrease of renal function or asymptomatic reduction of blood pressure during HF hospitalization, diuresis and other GDMT should not routinely be discontinued.[6–11]
1	B-NR	3. In patients with HFrEF, GDMT should be initiated during hospitalization after clinical stability is achieved.[2,3,5,13–18]
1	B-NR	4. In patients with HFrEF, if discontinuation of GDMT is necessary during hospitalization, it should be reinitiated and further optimized as soon as possible.[19–23]



Lee D et al. 2009;122:162.e1-162.e9.

ACE. ARBs ARNI
Beta-blockers
Aldosterone antagonists
CRT
ICD
LVAD
Heart transplantation

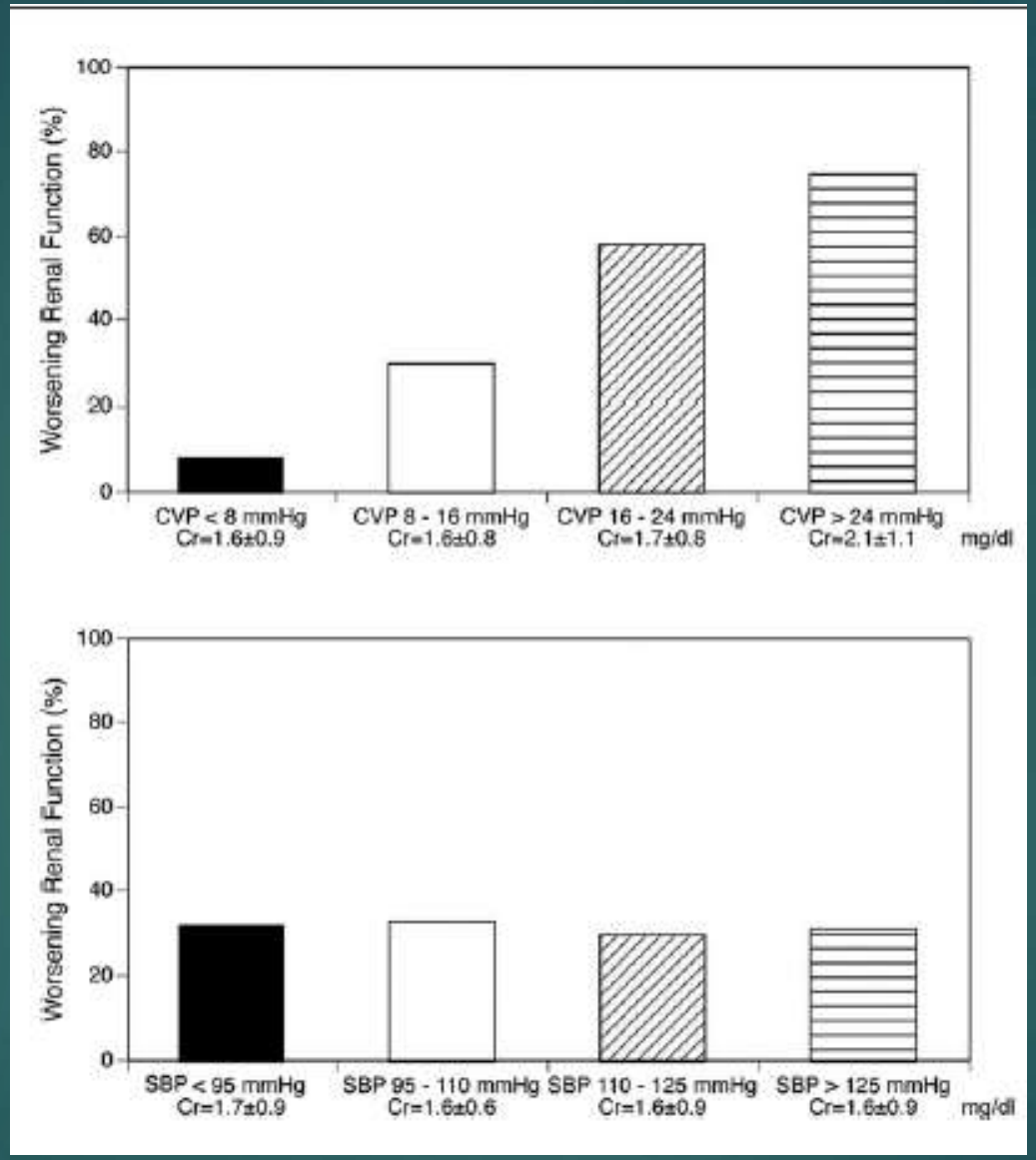
Shah 2017

JACC VOL. 70, NO. 20, 2017
NOVEMBER 14/21, 2017:2476-86

Admitted Patients with HF are "Wet"

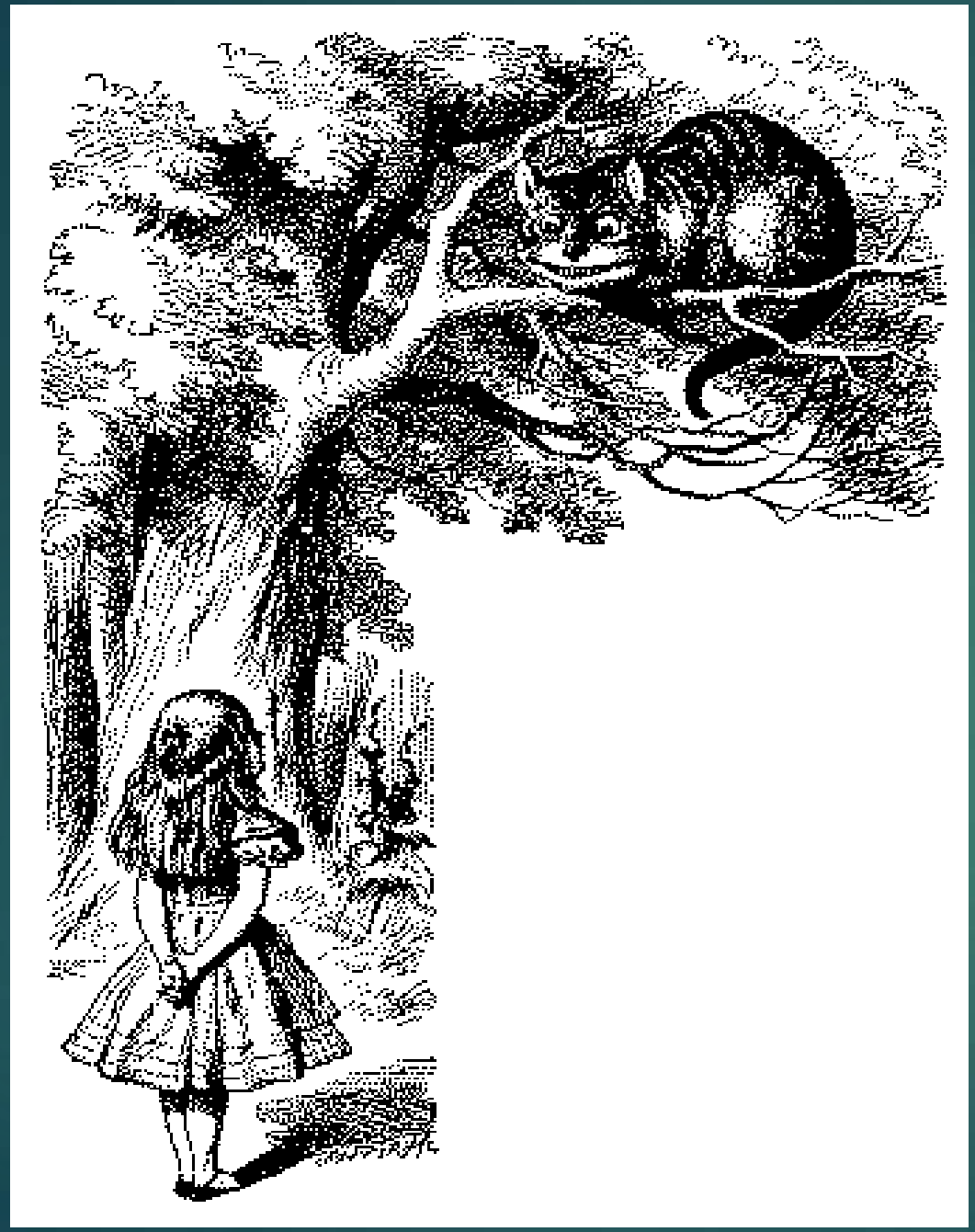
- Dyspnea – 89%
- Pulmonary congestion (CXR) – 74%
- Rales – 67%
- Peripheral edema – 65%

Yancy C, Fonarow G. Curr Heart Fail Rep. 2004;1:121-128. ADHERE registry
Stevenson LW et al. JAMA. 1989; 261: 884



Mullens W, Abrahams Z, Francis GS, et al. J Am Coll Cardiol 2009;53:589-96.

Congestion = Elevated LVEDP



‘Well! I’ve often
seen a cat without
a grin,’
thought Alice;
‘but a grin without
a cat!

Lewis Carroll

De-congest!

Diuretics

Furosemide 40-100 mg IV 1-3 times a day

Drip 20-40 mg/hr

Bumetanide 1-2 mg 1-3 times a day

Drip 1-2 mg/hr

Metolazone 2.5-5 mg PO BID

HCTZ IV 500 mg IV

SGLT2-inhibitors

Sacubitril/Valsartan

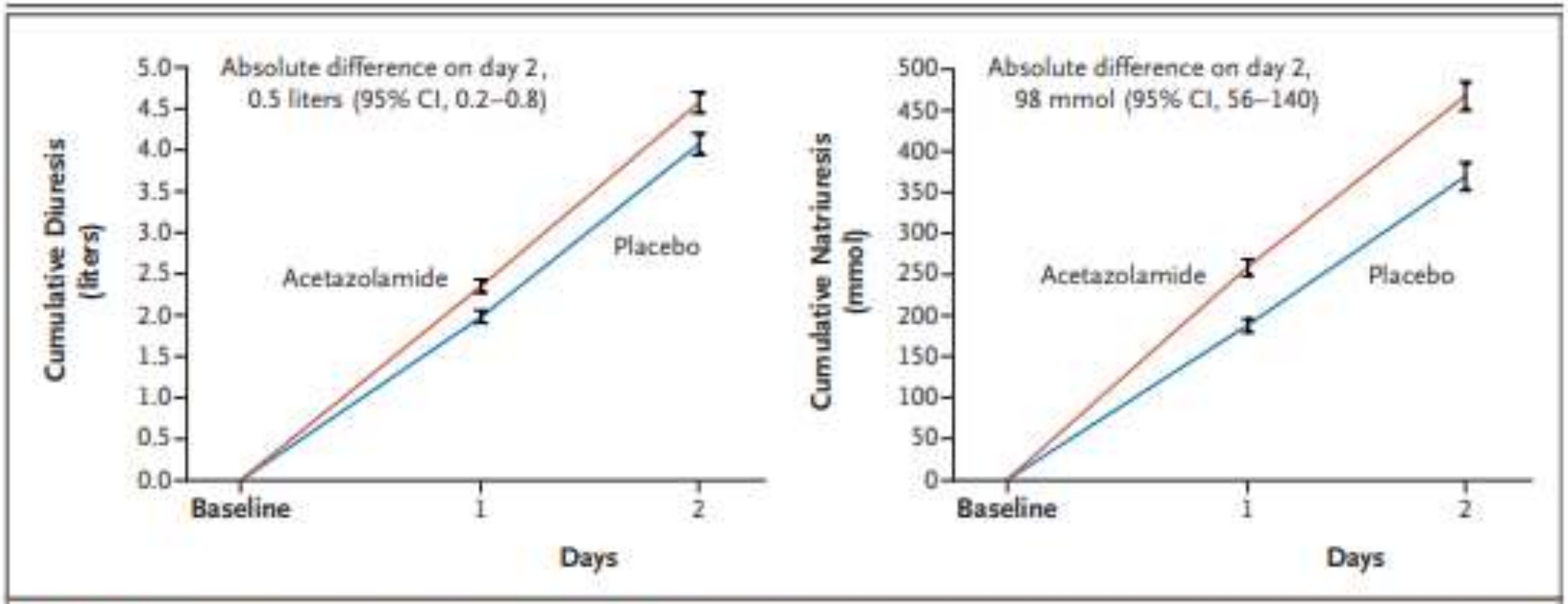


Figure 3. Diuresis and Natriuresis According to Trial Group.

I bars indicate standard errors.

Published in final edited form as:
Eur Heart J. 2006 June ; 27(12): 1431–1439.

ESC European Society of Cardiology
European Heart Journal - Cardiovascular Pharmacotherapy (2018) **4**, 54–63
doi:10.1093/ehjcvp/pvx020

Review

Published in final edited form as:
Circ Heart Fail. 2009 January 1; 2(1): 56–62. doi:10.1161/CIRCHEARTFAILURE.108.821785.

Loop Diuretics in Acute Decompensated Heart Failure: Necessary? Evil? A Necessary Evil?

G. Michael Felker, MD, MHS[1], **Christopher M. O'Connor, MD**[1], and **Eugene Braunwald,**

***"In times of great danger, you are permitted to walk with the devil until you have crossed the bridge."* — Bulgarian proverb**

Felker GM, O'Connor CM, Braunwald E;
Circ Heart Fail. 2009 Jan;2(1):56-62

Double-blind comparison of captopril alone against frusemide in mild heart failure

14 patients with HF with dyspnea on Furosemide 40 mg /day

Randomized (8 weeks)

Furosemide + placebo

Captopril + placebo

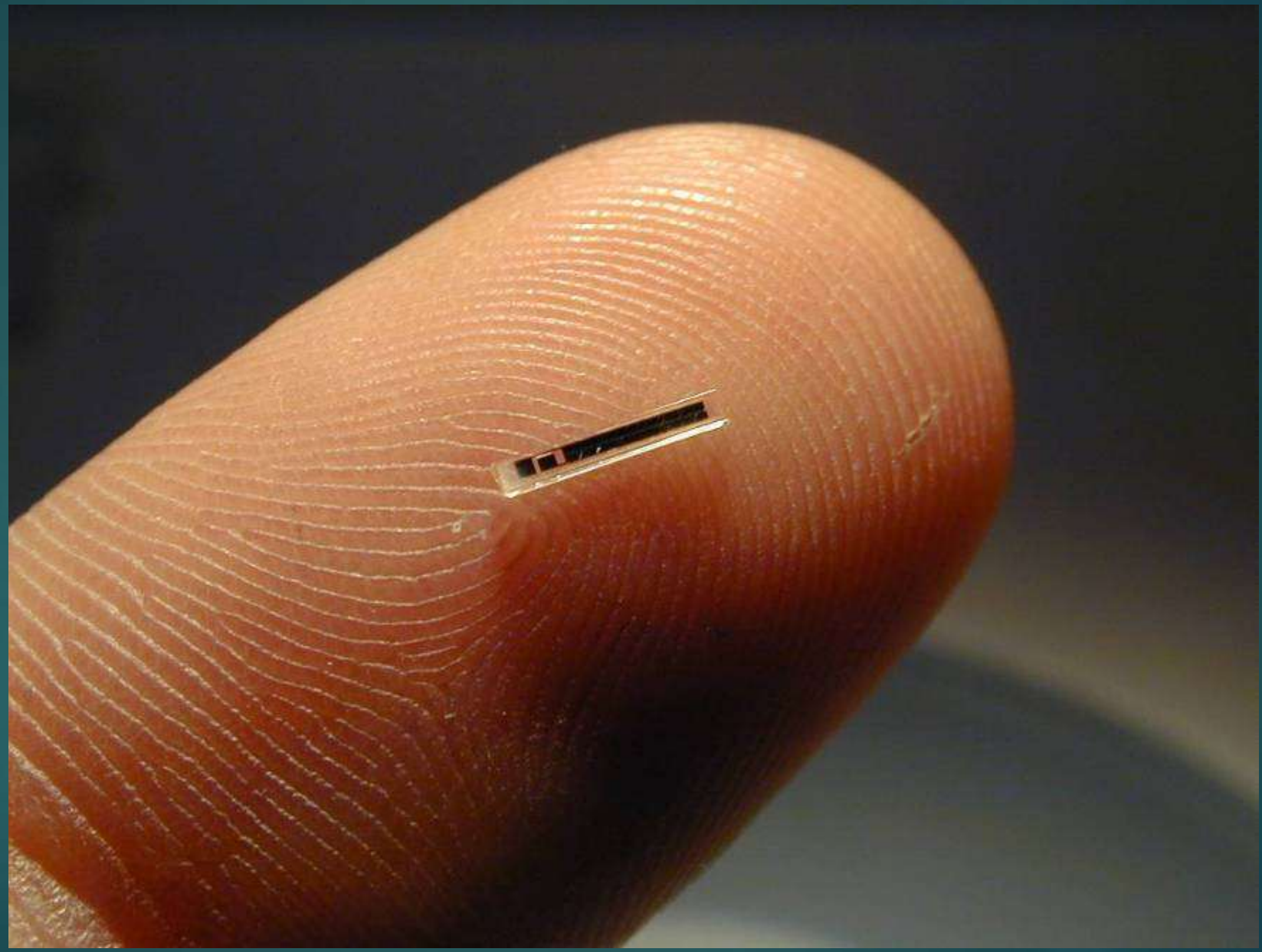
40% patients deteriorated on Captopril alone

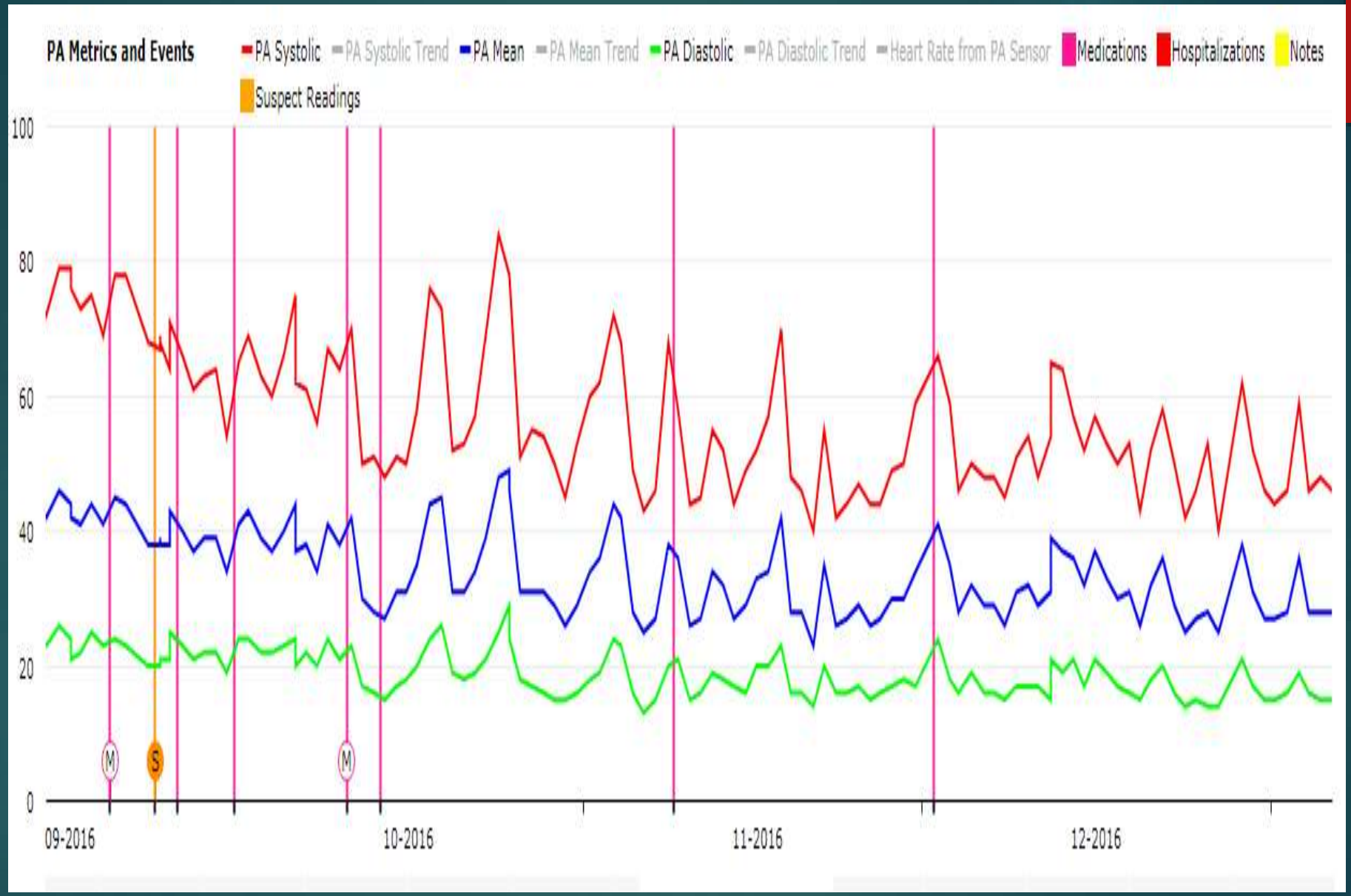
2 - pulmonary edema

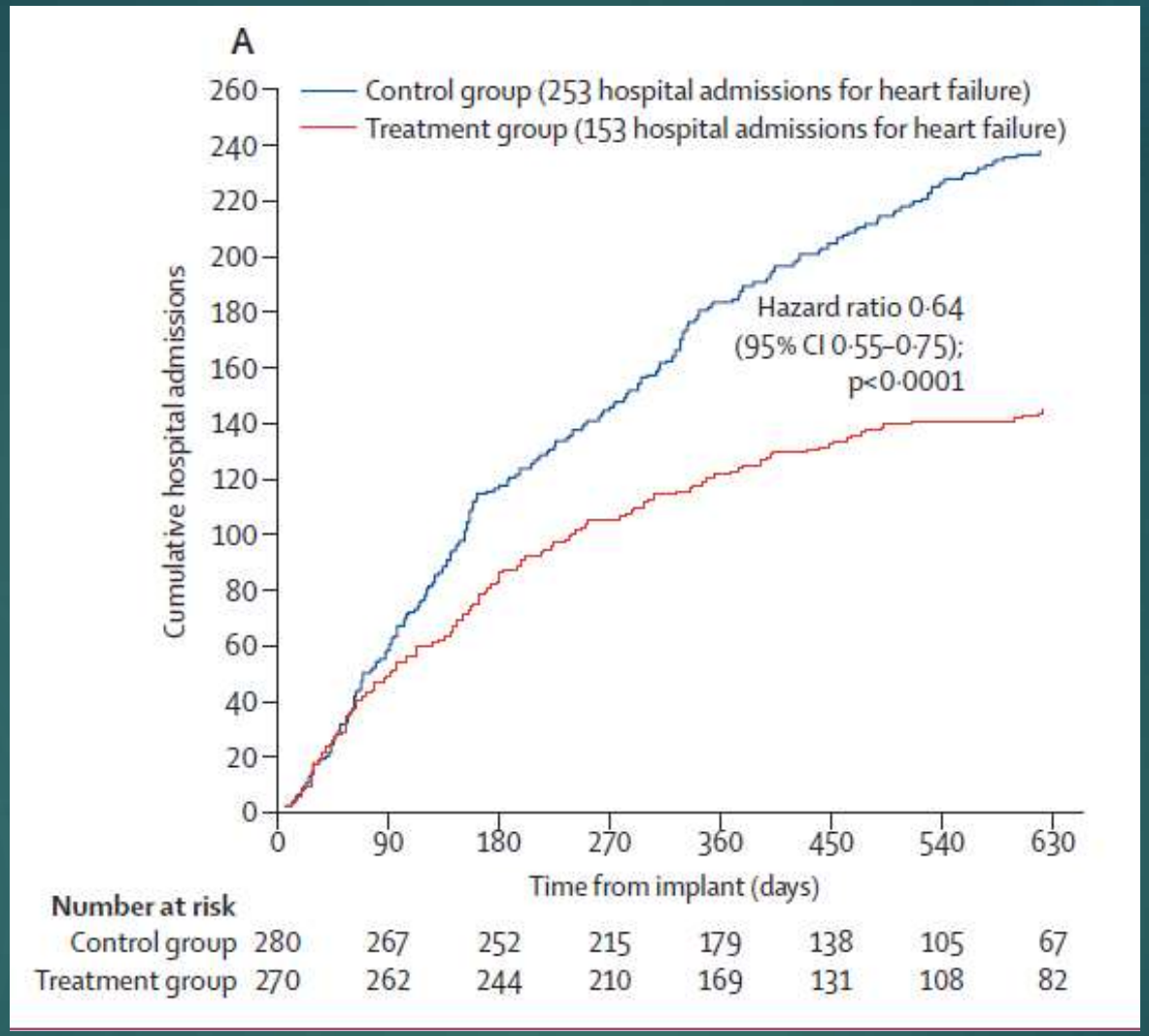
2 – more dyspnea

Richardson A et al Lancet. 1987;2(8561):709-11

CardioMMEMSs

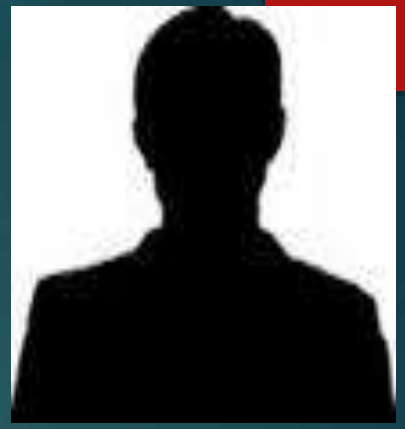



PA Metrics and Events
PA Systolic
PA Systolic Trend
PA Mean
PA Mean Trend
PA Diastolic
PA Diastolic Trend
Heart Rate from PA Sensor
Medications
Hospitalizations
Notes
Suspect Readings
100
80
60
40
20
0
M
S
M
09-2016
10-2016
11-2016
12-2016



Abraham et al. CHAMPION Trial

Lancet 2011; 377: 658–66



One year later
Chest pain – admitted
Second MI
BP 70/40
HR 120 bpm regular
EF 20%

LVEF 20%, RV dilated, moderately depressed
Peripheral edema

- RHC (6/15/22)
- RA 23
- PA 73/32 (46),
- PCW 23
- CO/CI 2.7/1.5

Cardigenic Shock: Criteria

Clinical: evidence of low output

- SBP < 90 mmHg for > 30 min (or pressor to maintain SBP)
- End organ hypoperfusion
- Lactate level > 2
- Decreased urine output (< 0.5 ml/kg/hr)

RHC

- CI < 1.8L/kg/m^2 w/o vasopressors (< 2.2 with vasopressors)
- PCWP > 15 mmHg

Clinical and Invasive Assessment of Hemodynamics in Patients with Decompensated Heart Failure

CV ICU

201 surveys (80 fellows, 46 attendings, 43 residents, 32 interns)

Correct perfusion status and filling pressure was predicted in 41%

Perfusion status (warm or cold) 53%

Filling pressure (wet or dry) 67%

No difference in accuracy between training levels was detected

Therapeutic changes following PAC in 70% of the cohort.

	Dry Filling Pressure	Wet Filling Pressure
Warm Perfusion Status	PPV: 17.2% NPV: 85.7%	PPV: 35.4% NPV: 84.1%
Cold Perfusion Status	PPV: 15.4% NPV: 93.6%	PPV: 67.5% NPV: 45.3%

Narang et al ISHLT 2018

Circulation
Volume 136, Issue 16, 17 October 2017, Pages e232-e268
https://doi.org/10.1161/CIR.0000000000000525

CLINICAL STATEMENTS AND GUIDELINES - AHA SCIENTIFIC STATEMENTAHA SCIENTIFIC STATEMENT

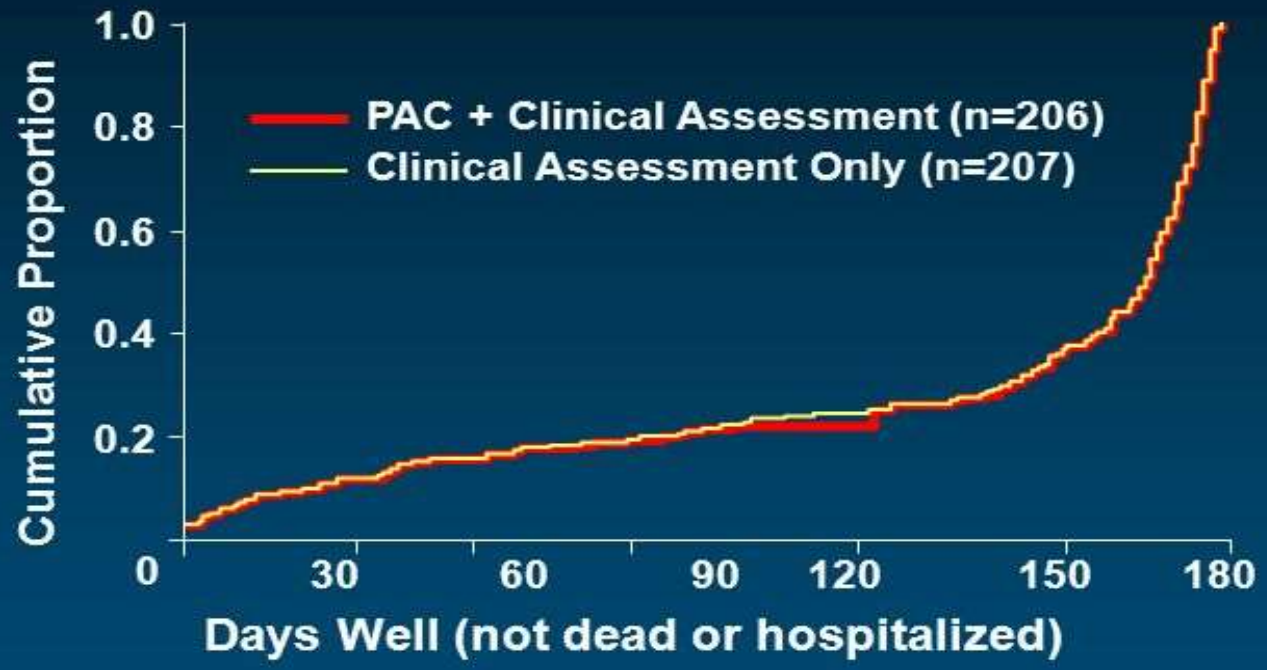
Contemporary Management of Cardiogenic Shock: A Scientific Statement From the American Heart Association

Sean van Diepen, MD, MSc, FAHA, Chair, Jason N. Katz, MD, MHS, Vice Chair, Nancy M. Albert, RN, PhD, FAHA, Timothy D. Henry, MD, FAHA, Alice K. Jacobs, MD, FAHA, Navin K. Kapur, MD, Ahmet Kilic, MD, Venu Menon, MD, FAHA, E. Magnus Ohman, MD, Nancy K. Sweitzer, MD, PhD, FAHA, Holger Thiele, MD, Jeffrey B. Washam, PharmD, FAHA, and Mauricio G. Cohen, MD

We suggest the use of PACs in cases of diagnostic or CS management uncertainty or in patients with moderate to severe CS who are unresponsive to initial therapy.

Hemodynamic monitoring should complement (and not replace) other markers of end-organ perfusion in CS.

Use of Pulmonary Artery Catheterization: No Effect on Mortality and Hospitalization (ESCAPE)



Reproduced with permission from The ESCAPE Investigators and ESCAPE Study Coordinators. *JAMA*. 2005;294:1625-1633.

Marik *Annals of Intensive Care* 2013, **3**:38
http://www.annalsofintensivecare.com/content/3/1/38

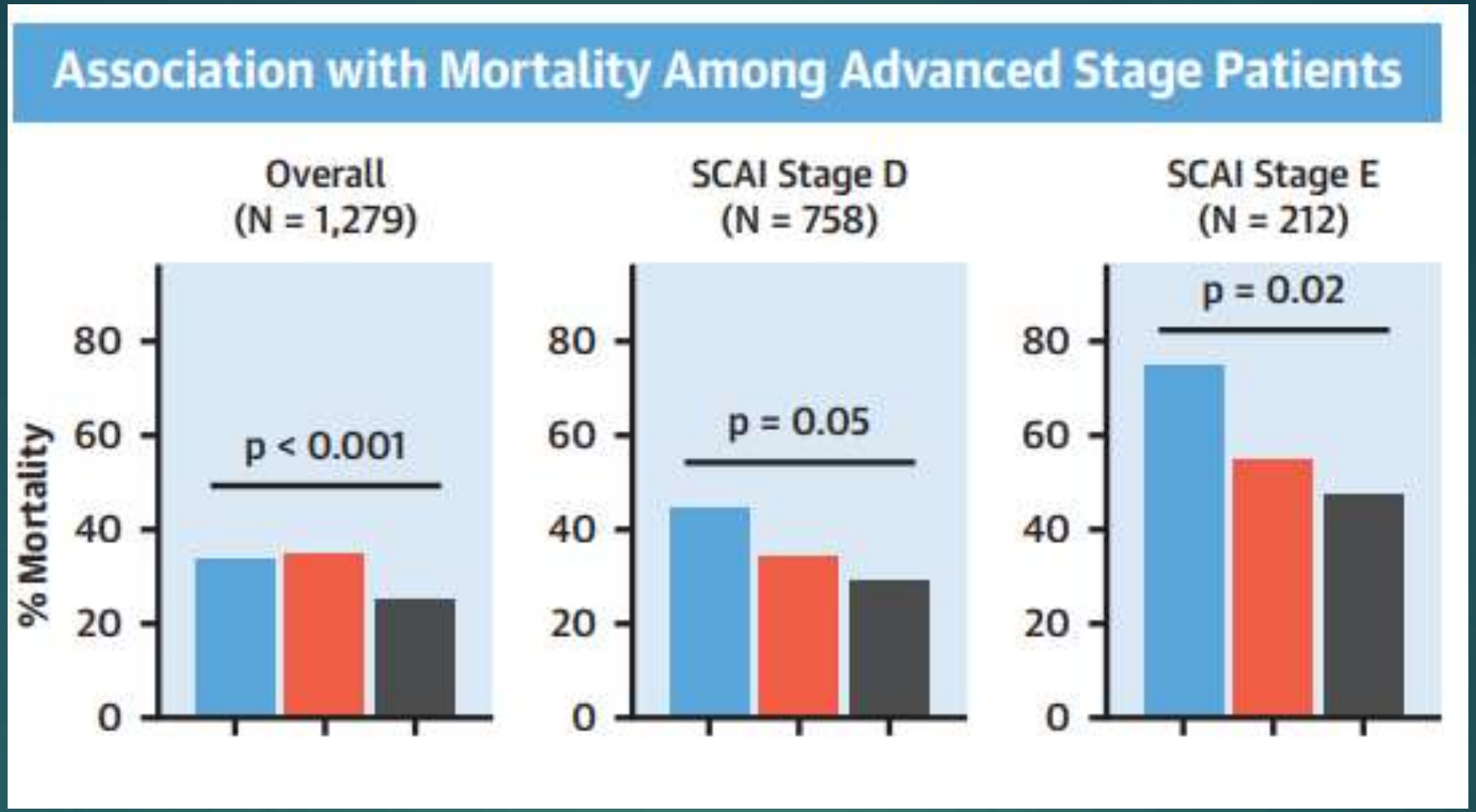
Annals of Intensive Care
a SpringerOpen Journal

REVIEW Open Access

Obituary: pulmonary artery catheter 1970 to 2013

Paul E Marik

The birth of the intermittent injectate-based conventional pulmonary artery catheter (fondly nicknamed PAC) was proudly announced in the *New England Journal of Medicine* in 1970 by his parents HJ Swan and William Ganz. PAC grew rapidly, reaching manhood in 1986 where, in the US, he was shown to influence the management of over 40% of all ICU patients.
His reputation, however, was tarnished in 1996 when Connors and colleagues suggested that he harmed patients.



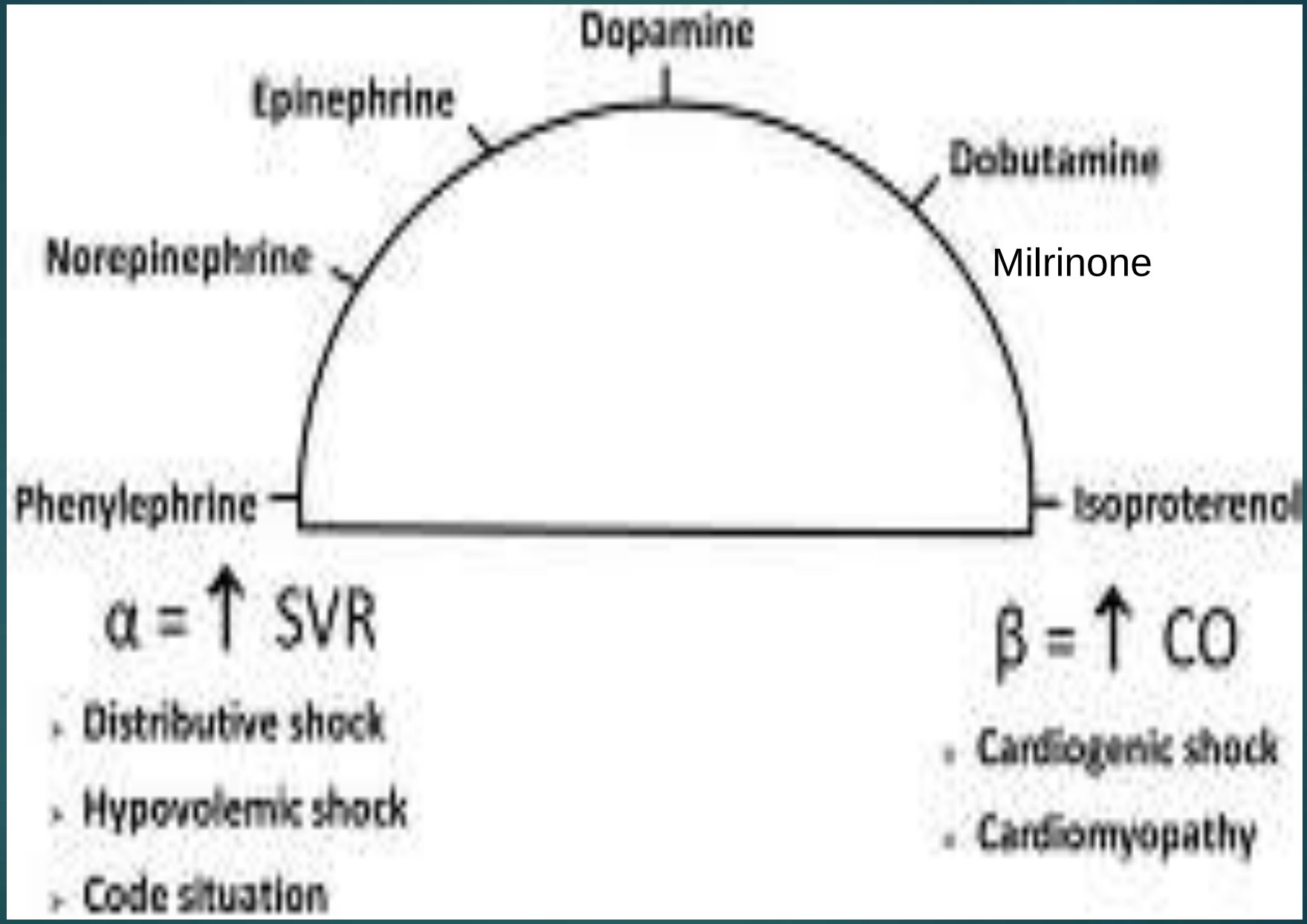
Blue – no PAC
Red – incomplete data
Black – complete data

Garan et al J Am Coll Cardiol HF 2020;8:903–13

- Medical management
- Revascularizaton
- Mechanical circulatory support

Dobutamine and Milrinone

- Increase cardiac output
- Cause peripheral vasodilation
- Decrease pulmonary capillary wedge pressure


Dopamine
Epinephrine
Dobutamine
Norepinephrine
Milrinone
Phenylephrine
Isoproterenol
α = ↑ SVR
β = ↑ CO
Distributive shock
Hypovolemic shock
Code situation
Cardiogenic shock
Cardiomyopathy

Dopamine vs Norepinephrine in Cardiogenic Shock

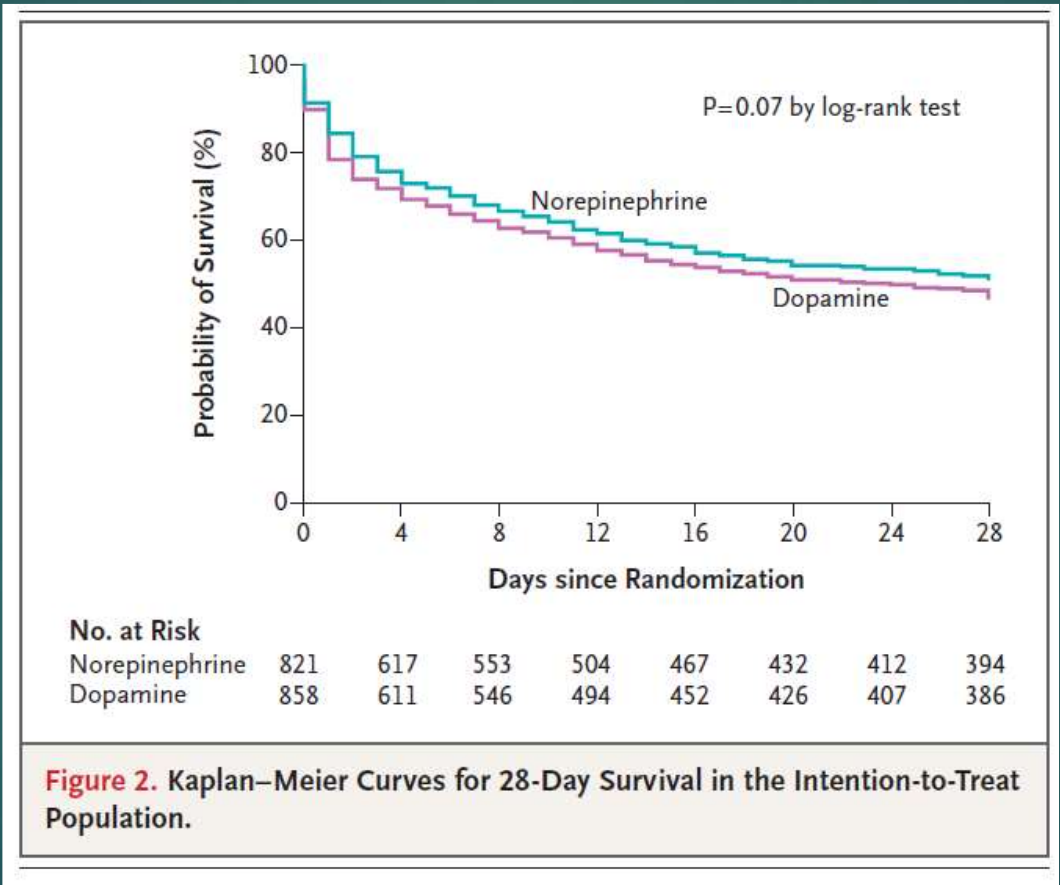


Figure 2. Kaplan–Meier Curves for 28-Day Survival in the Intention-to-Treat Population.

N ENGL J MED 362;9 NEJM.ORG MARCH 4, 2010

Milrinone as Compared with Dobutamine in the Treatment of Cardiogenic Shock

Randomized controlled trial

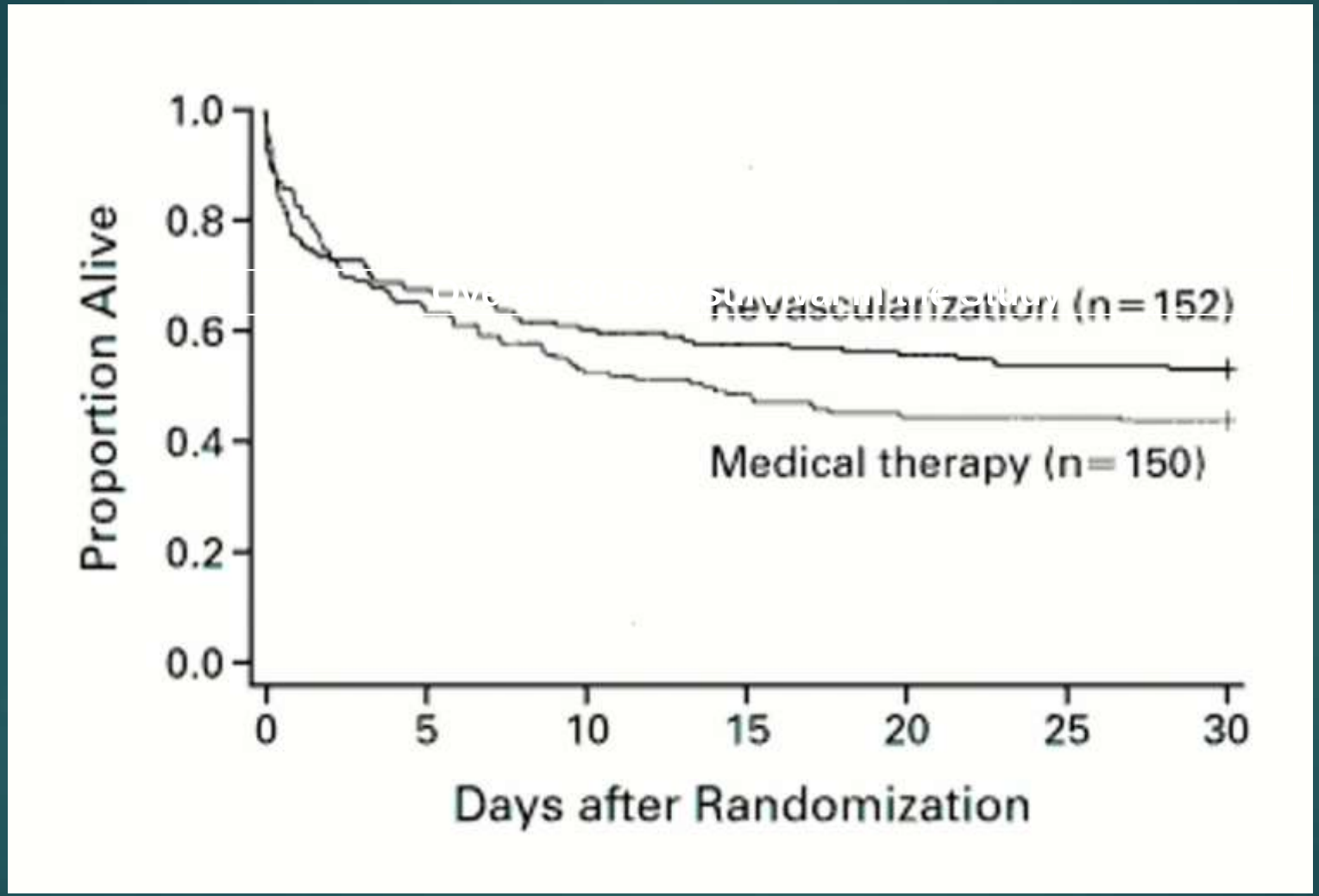
Table 2. Primary and Secondary Outcomes.*

Outcome	Milrinone (N=96)	Dobutamine (N=96)	Relative Risk or Hazard Ratio (95% CI)†	P Value‡
Primary outcome: composite of in-hospital death from any cause, resuscitated cardiac arrest, receipt of cardiac transplant or mechanical circulatory support, nonfatal myocardial infarction, transient ischemic attack or stroke diagnosed by a neurologist, or initiation of renal replacement therapy — no. (%)	47 (49)	52 (54)	0.90 (0.69–1.19)	0.47

Mathew et al

N ENGL J MED 385;6 NEJM.ORG AUGUST 5, 2021

Revascularization – SHOCK trial



Hochman J et al. N Engl J Med 1999;341:625-634

Comparison of devices

	Impella 2.5	Impella CP	Impella 5.0	ECMO	TandemHeart®	IABP
Pump mechanism	Axial flow/Transvalvular	Axial flow/Transvalvular	Axial flow/ Transvalvular	Centrifugal/Bypass	Centrifugal/Bypass	Pneumatic Counterpulsation
Cannula size	12 Fr	14 Fr	21 Fr	18-21 Fr inflow 15-22 Fr outflow	21 Fr inflow 15-17 Fr outflow	7-9 Fr
Cardiac output	2.5 L/min	3.7 L/min	5.0 L/min	>4.5 L/min	4-5 L/min	0.5 L/min
Vascular Surgery	No	No	Yes	Yes	No	No
Complexity of Insertion	Medium	Medium	High	Medium	High	Low
Wall Puncture	No	No	No	No	Yes	No
Hemorrhagic Complications	Medium	Medium	Medium	High	High	Low

Conclusions

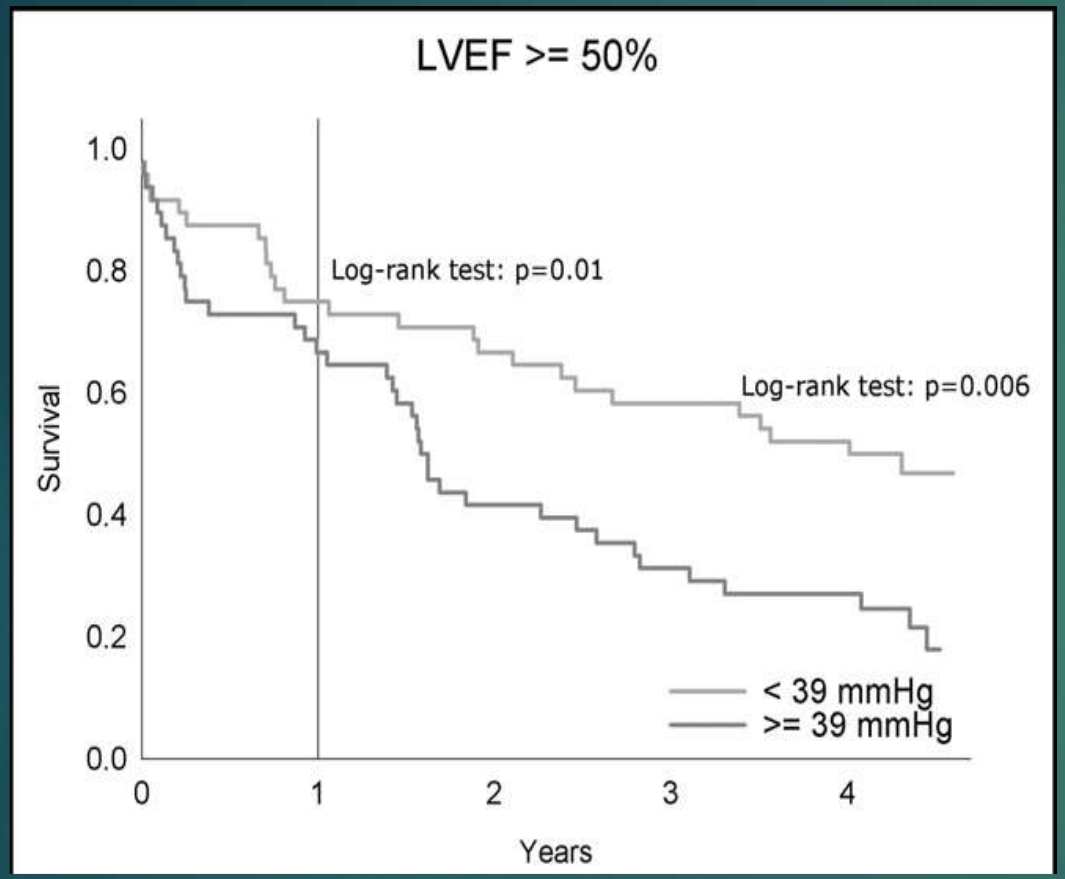
- Acute HF in an outpatient: increase oral or give IV diuretics
- Hospitalize if no rapid effect
- Treat reversible precipitating factors
- Do not d/c GDMT
- Admit immediately if BP is decreased
- Inotropes and vasopressors for cardiogenic shock
- Aggressive mechanical circulatory support for cardiogenic shock

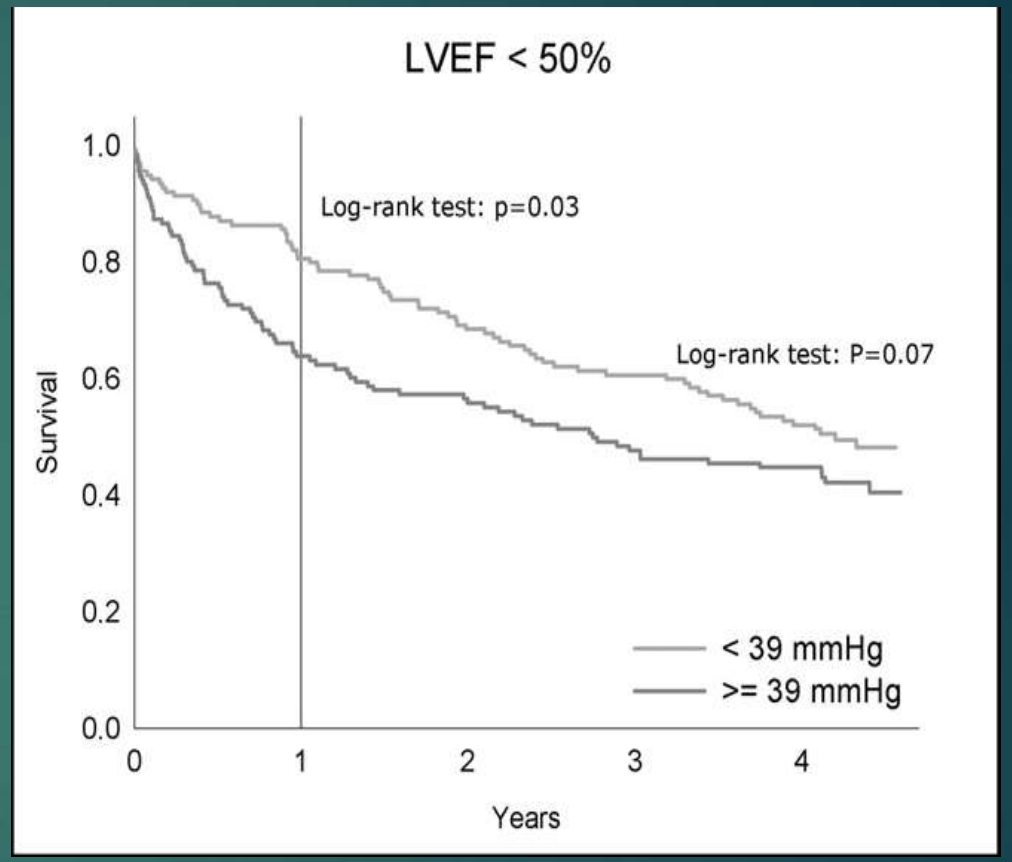
T

INDIANA
CHAPTER
AMERICAN COLLEGE of CARDIOLOGY

Loop diuretic	PO	IV
Fursemide (lasix)	40 mg	20 mg
Torsemide	20 mg	20 mg
Bumetanide	1 mg	1 mg

Mortality increases by 9% per 5 mm Hg increase in right ventricular systolic pressure in both normal and reduced EF





Kjaergaard J, Akkan D, Iversen KK, et al. Prognostic importance of pulmonary hypertension in patients with heart failure. Am J Cardiol 2007;99:1146-50.

9.4a. Parenteral Vasodilation Therapy in Patients Hospitalized With HF

Recommendation for Parenteral Vasodilation Therapy in Patients Hospitalized With HF

Referenced studies that support the recommendation are summarized in the Online Data Supplements.

COR	LOE	Recommendation
2b	B-NR	1. In patients who are admitted with decompensated HF, in the absence of systemic hypotension, intravenous nitroglycerin or nitroprusside may be considered as an adjuvant to diuretic therapy for relief of dyspnea.[1,2]

Contemporary Outcomes Of Pulmonary Artery Catheter Use In The Management Of Cardiogenic Shock Due To Acute Myocardial Infarction

89,718 patients were included in our analysis.

6.1% were managed with PAC

Le Dung Ha…Maya Guglin ACC 2018

Phenotypes

1. **Hypertrophy, small left ventricular cavity**
2. **Right ventricular failure**
3. **Arrhythmias (Afib)**
4. **Overall fluid overload**

- "High output HF"

  anemia

  hyperthyroidism

  pregnancy

  AV fistula

  cirrhotic cardiomyopathy