Treatment of Refractory Heart Failure

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Disclosures: Dr. Poon

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  - Heart Failure Update 2022 has sponsored the travel to Montreal, QC (Thank you!)

Objectives

- 1. Provide a practical approach to the management of refractory heart failure (HF)
- 2. Identify when patients need to be considered for advanced therapies

OBJECTIVE I:

Management of Refractory Heart Failure (HF)

Approaches to Specific Refractory HF Presentations

- Individualized according to a patient's clinical condition
- Based on whether they have:
  - 1) Refractory volume overload
  - 2) Low cardiac output
- AND response to therapy

Case: Ms. Anne Uric

- 33 year old woman
- Past medical history:
  - Bioprosthetic tricuspid and mitral valve replacements for infective endocarditis, complicated by embolic events including anterior MI requiring PCI to LAD
  - Now has severe biventricular dysfunction (LVEF 27%) with failing bioprosthetic valves as a result of recurrent endocarditis due to ongoing iv drug use
- To ER with increasing dyspnea, worsening lower limb edema and 1 episode of vomiting
- Had been taking ibuprofen for generalized “muscle aches” and furosemide 80 mg BID at home
- On examination: 109/80 mmHg, 86 beats/min, 98% on 3L nasal prongs, JVP 5 cm above the sternal angle, moderate pitting edema to mid-shins

- Labs: hemoglobin 101 (stable), sodium 137, potassium 4.5, creatinine 166 (baseline), lactate 1.5
- Admitted to GIM ward with worsening HF
- Given furosemide 80 mg iv in ER and ibuprofen stopped
- Next day, creatinine increased to 214
- Furosemide held
- Two days later: creatinine up to 355, potassium 6.8, lactate 4.1
- Urine output now down to 20 cc/h, still appears volume-overloaded

What should we do next?

- A. Shift potassium
- B. Start her on furosemide bolus and infusion
- C. Start dialysis
- D. A and B

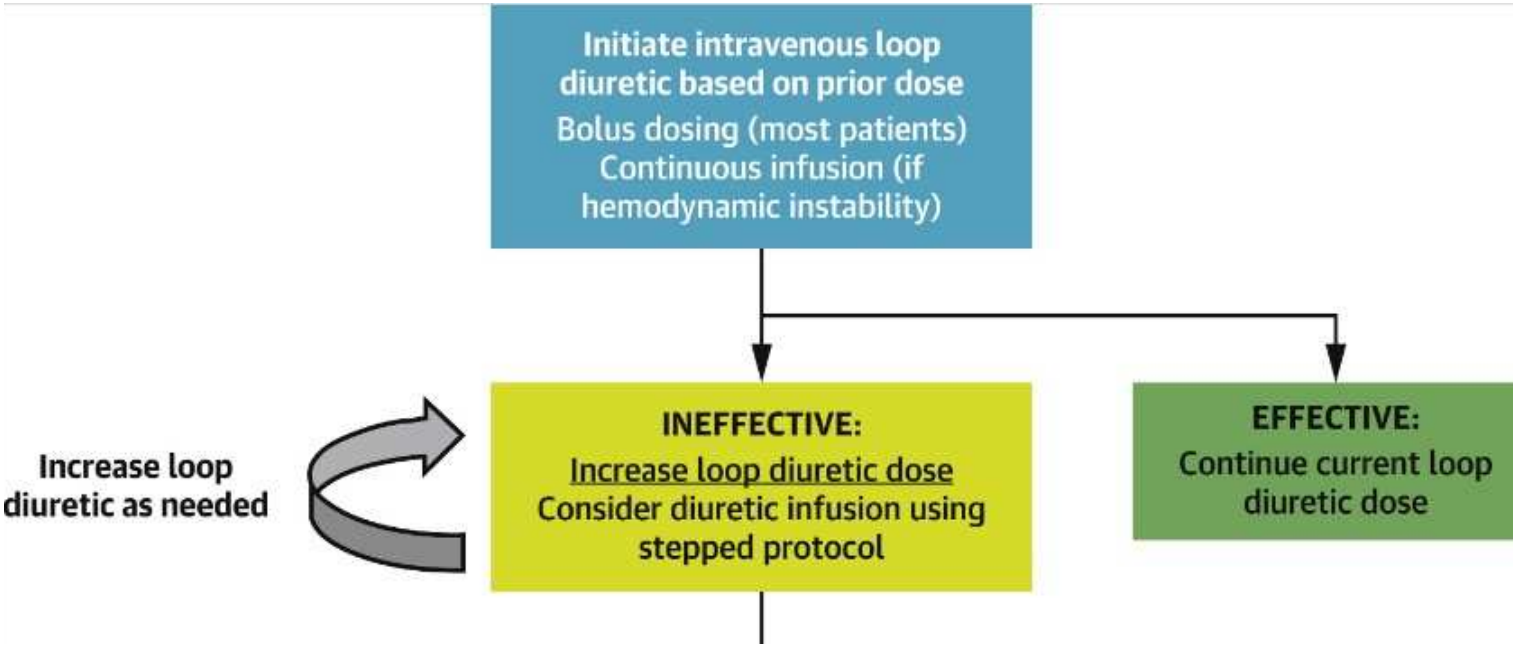
Ms. Anne Uric: ICU

- Patient transferred to ICU
- Potassium shifted
- Patient given 1 dose of furosemide 80 mg iv and started on furosemide infusion at 20 mg/h
- On examination: 92/61 mmHg, 85 beats/min, 95% 2L NP
- Urine output only 20-30 cc/h and fluid balance positive 750 cc for past 24 hours
- Labs: sodium 135, potassium 5.7, creatinine 344, lactate 2.1

What should we do next?

- A. Start dialysis
- B. Increase furosemide bolus and infusion
- C. Add metolazone and/or spironolactone
- D. Add low dose dopamine
- E. B and C

Volume Management in Patients with Acute HF and Cardiorenal Syndrome (CRS)



Jentzer JC et al. *J Am Coll Cardiol* 2020;76(9):1084-101.

Stepped Diuretic Algorithm Used in CARRESS-HF[1]

Step	Current Diuretic Regimen		Suggested Diuretic Regimen	
	Furosemide Dose (PO)	Thiazide	Furosemide Dose (IV)	Metolazone
1	≤ 80 mg/day	+/-	40 mg + 5 mg/h	0
2	81-160 mg/day	+/-	80 mg + 10 mg/h	5 mg OD
3	161-240 mg /day	+/-	80 mg + 20 mg/h	5 mg BID
4	>240 mg/day	+/-	80 mg + 30 mg/h	5 mg BID

- The starting diuretic dose is determined by the outpatient or current inpatient diuretic dose
- Patient is moved to a higher diuretic dose if urine output is < 3L/day on current dose
- All loop diuretic doses are given in furosemide equivalents, although alternative could be used
- Vasodilator or inotrope can be added for patients who have urine output < 3L/day on Step 4

[1]Bart BA et al. *N Engl J Med* 2012;367:2296-304

CARRESS-HF: Ultrafiltration in Decompensated Heart Failure with Cardiorenal Syndrome

- 188 patients with acute decompensated heart failure, worsened renal function, and persistent congestion.
- Stepped pharmacologic therapy (94 patients) or ultrafiltration (94 patients).
- Primary endpoint: bivariate change from baseline in the serum creatinine level and body weight, as assessed 96 hours after random assignment.
- Patients were followed for 60 days.

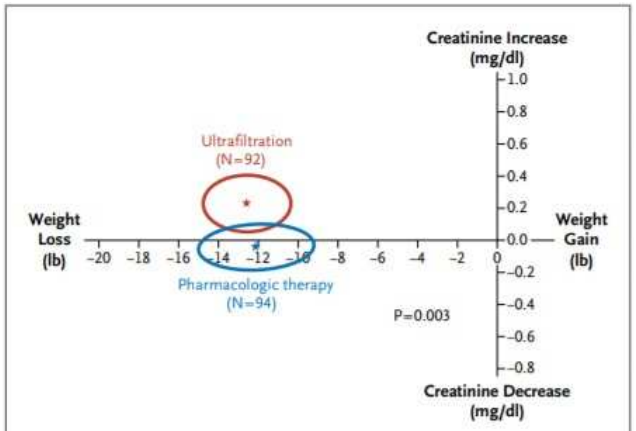


Figure 1. Changes in Serum Creatinine and Weight at 96 Hours (Bivariate Response).

The ellipses represent the 95% confidence regions and the stars the exact values for the mean changes in the serum creatinine level and weight at 96 hours in the ultrafiltration group and the pharmacologic-therapy group. Data from two patients who had been randomly assigned to the ultrafiltration group were excluded from the analysis: baseline creatinine measurements were missing for one patient, and all post-baseline creatinine measurements were missing for the other patient. To convert the values for creatinine to micromoles per liter, multiply by 88.4. To convert the values for weight to kilograms, multiply by 0.45.

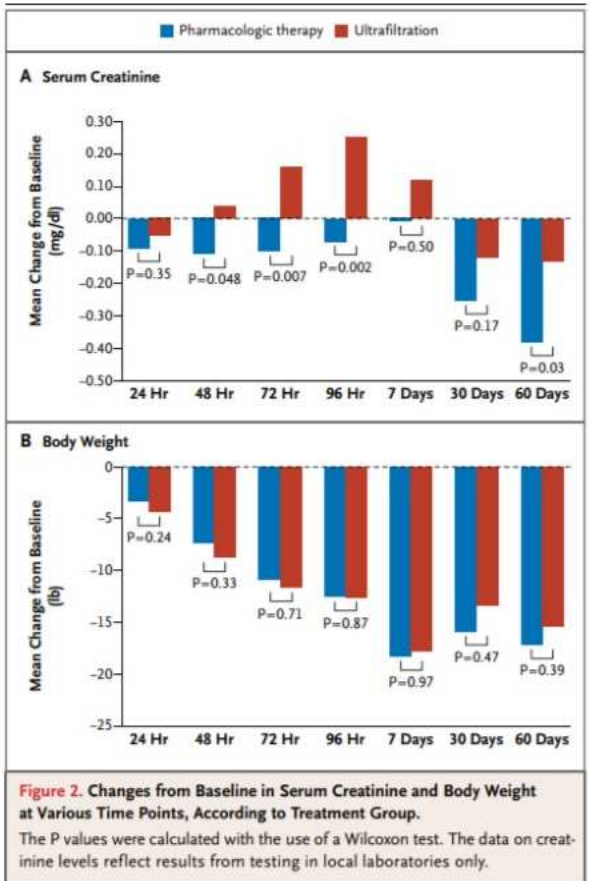
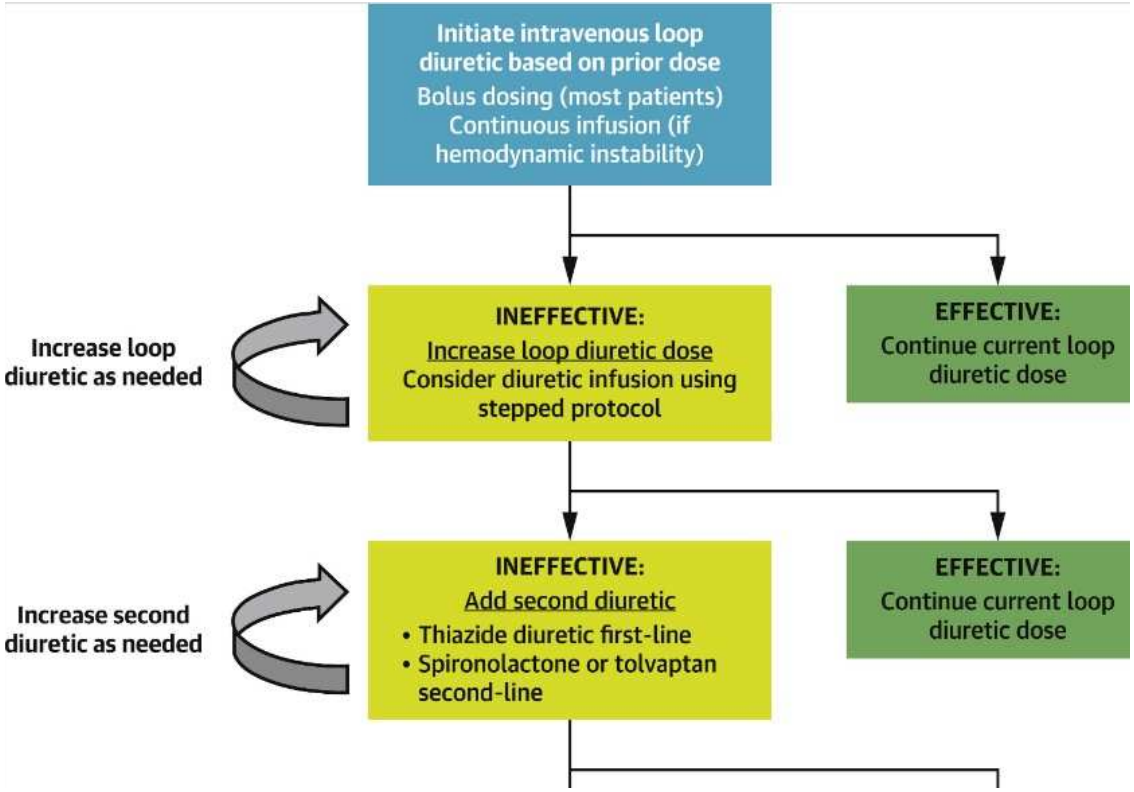


Figure 2. Changes from Baseline in Serum Creatinine and Body Weight at Various Time Points, According to Treatment Group.

The P values were calculated with the use of a Wilcoxon test. The data on creatinine levels reflect results from testing in local laboratories only.

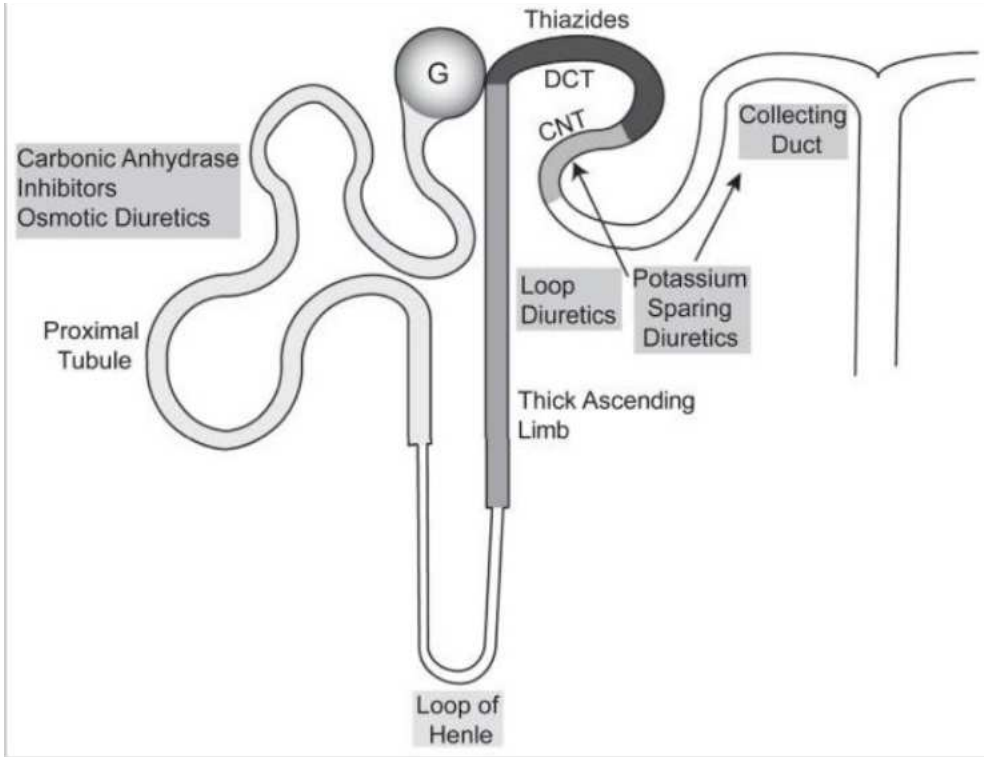
[1]Bart BA et al. *N Engl J Med* 2012;367:2296-304

Volume Management in Patients with Acute HF and CRS



Jentzer JC et al. *J Am Coll Cardiol* 2020;76(9):1084-101.

General Principles of Managing Diuretic Resistance

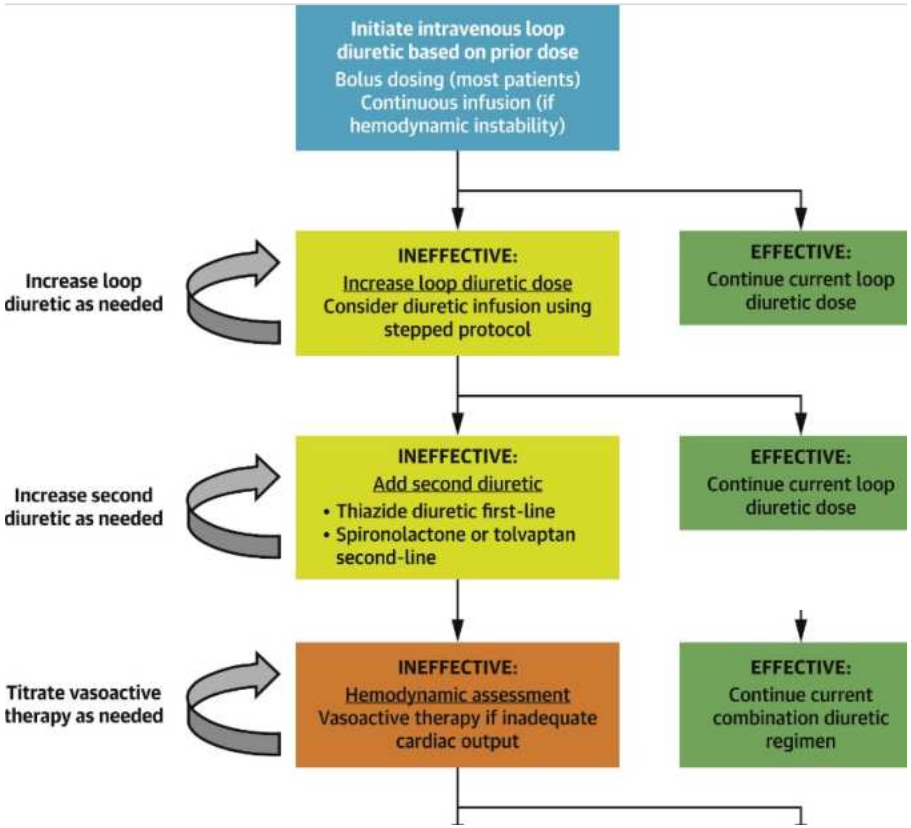


Schematic of a nephron shows sites of action of diuretics along the various segments. Abbreviations: CNT, connecting tubule; DCT, distal convoluted tubule; G, glomerulus.

- A key strategy to overcome diuretic resistance frequently relies on combining 2 types of diuretic (diuretic synergism)
- There are several classes of diuretics, dictated by their site of action in the nephron
- Because loop diuretics are the first drug of choice in edematous disorders, this implies adding a diuretic that targets another tubular segment.
- Especially for patients with liver cirrhosis and ascites, the specific combination of furosemide and spironolactone is supported by data[2].
- For the other edematous disorders, the evidence for specific combinations of diuretics is less obvious, and usually a thiazide diuretic is recommended as a second diuretic[1].

[1]Hoorn EJ and Ellison DH. *Am J Kidney Dis*. 2017;69:136-42.
[2]Moore KP et al. *Hepatology.* 2003;38:258–266.

Volume Management in Patients with Acute HF and CRS



Jentzer JC et al. *J Am Coll Cardiol* 2020;76(9):1084-101.

Use of Inotropes and Vasodilators in Treatment of AKI or CRS

- Inotropic therapy is most likely to be effective in patients with CRS who are also hypotensive and/or have objective evidence of reduced cardiac output
- Empirical use of inotropes should be avoided due to their potential toxicity
- No specific vasoactive drug has been shown to prevent or treat AKI or CRS, including inotropes or vasodilators[1, 2]

Canadian Journal of Cardiology 29 (2013) 168–181

Society Guidelines

The 2012 Canadian Cardiovascular Society Heart Failure Management Guidelines Update: Focus on Acute and Chronic Heart Failure

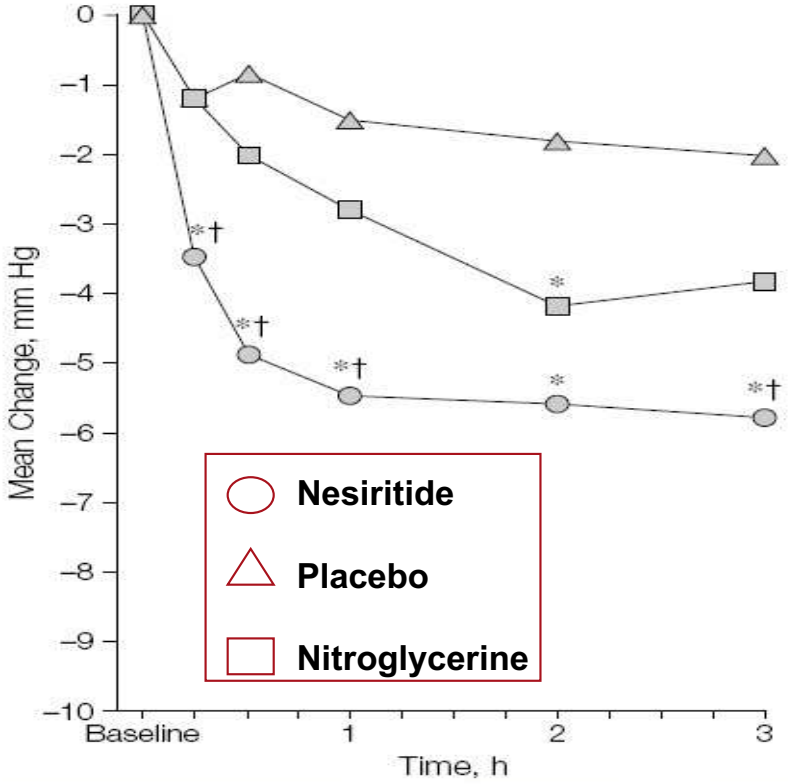
- Recommend the following intravenous vasodilators, titrated to a systolic blood pressure (sBP) over 100 mm Hg, for relief of dyspnea in hemodynamically stable patients (sBP over 100 mm Hg):
  - Nitroglycerine (Strong Recommendation, Moderate-Quality Evidence);
  - Nesiritide (Weak Recommendation, High-Quality Evidence);
  - Nitroprusside (Weak Recommendation, Low-Quality Evidence).

[1]Jentzer JC, Chawla LS. *Crit Care Clin* 2015;31:685-703
[2]Rangaswami J et al. *Circulation* 2019;139:e840-78.

Intravenous Nesiritide vs Nitroglycerin for Treatment of Decompensated Congestive Heart Failure

A Randomized Controlled Trial

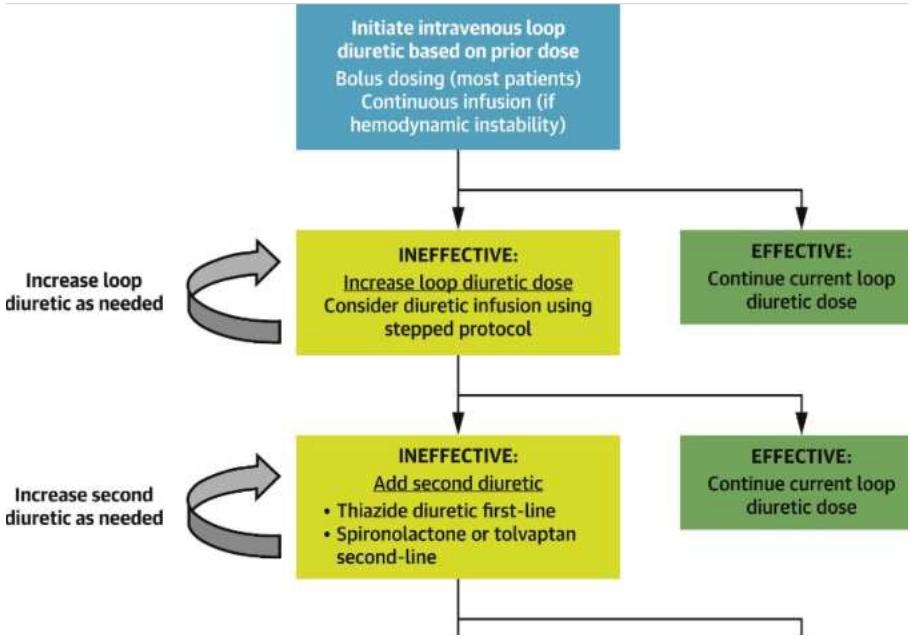
- VMAC trial compared nesiritide (n=204), nitroglycerine (n=143), or placebo (n=142) to standard therapy for 3 h, followed by nesiritide (n=278) or NTG (n=216) added to standard treatment for 24 h in acute HF patients with dyspnea at rest

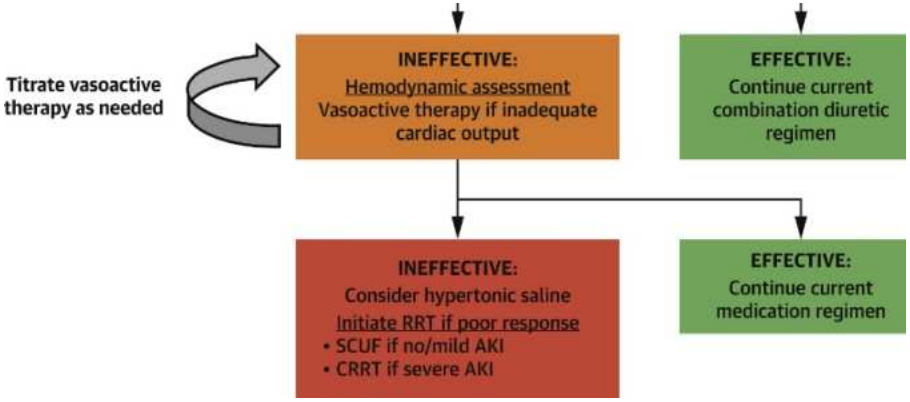


- At 3 hours, the mean (SD) decrease in PCWP from baseline was -5.8 mmHg for nesiritide, -3.8 mmHg for NTG, and -2 mmHg for placebo

VMAC Investigators *JAMA* 2002;287:1531-40

Volume Management in Patients with Acute HF and CRS





Jentzer JC et al. *J Am Coll Cardiol* 2020;76(9):1084-101.

Heart Failure

Ultrafiltration Versus Intravenous Diuretics for Patients Hospitalized for Acute Decompensated Heart Failure

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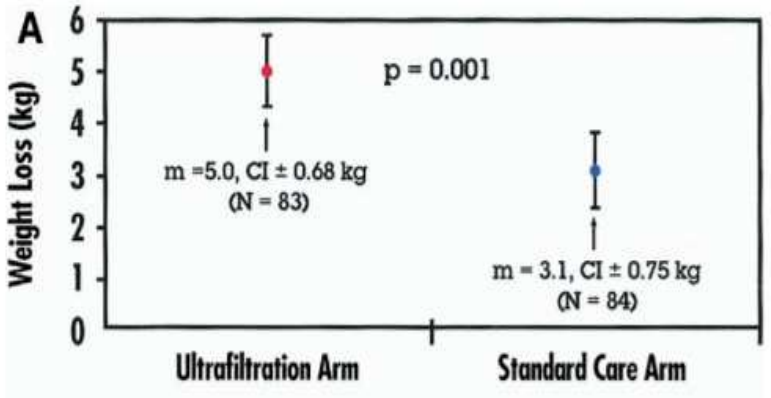
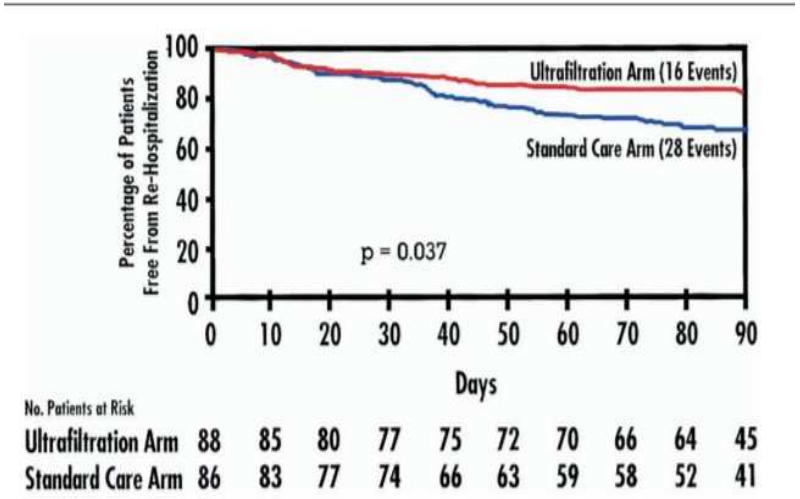
Mitchell T. Saltzberg, MD, FACC,* Mariell L. Jessup, MD, FACC,‡ Bradley A. Bart, MD, FACC,§
John R. Teerlink, MD, FACC,‖ Brian E. Jaski, MD, FACC,¶ James C. Fang, MD, FACC,#
Erika D. Feller, MD, FACC,** Garrie J. Haas, MD, FACC,†† Allen S. Anderson, MD, FACC,‡‡
Michael P. Schollmeyer, DVM,§§ Paul A. Sobotka, MD, FACC,§§ for the UNLOAD Trial Investigators

Lombard and Chicago, Illinois; Detroit, Michigan; Philadelphia, Pennsylvania; Minneapolis and Brooklyn Park, Minnesota; San Francisco and San Diego, California; Boston, Massachusetts; Baltimore, Maryland; and Columbus, Ohio



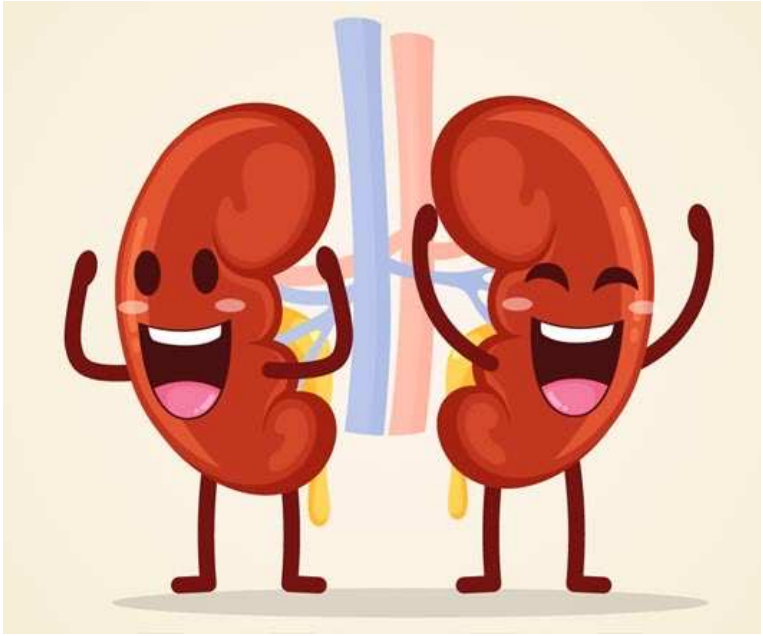
- This study was designed to compare the safety and efficacy of veno-venous ultrafiltration and standard intravenous diuretic therapy for hypervolemic HF patients.
- Two hundred patients (63±15 years, 69% men, 71% LVEF ≤ 40%) were randomized to ultrafiltration or intravenous diuretics.
- Conclusion: in decompensated HF, ultrafiltration safely produces greater weight and fluid loss than intravenous diuretics, reduces 90-day resource utilization for HF, and is an effective alternative therapy.



Costanzo MR et al. *J Am Coll Cardiol.* 2007;49:675-83.

Back to Case: Ms. Anne Uric

- Nephrology on standby for possible initiation of CRRT since urine output 30 cc/h
- Patient transferred to CICU
- Diuretics escalated stepwise to furosemide 80 mg iv BID and 30 mg/h with metolazone 5 mg BID
- Following this, urine output increased to 200 cc/h
- Potassium 3.0, so furosemide decreased and patient started on spironolactone
- Creatinine decreased from 355 back down to 188, lactate normalized
- Patient now transitioned to and stable on bumetanide 4 mg BID with spironolactone 50 mg OD and intermittent use of metolazone



Mr. C.O. Lo

- 70-year-old man
- Cardiac risk factors: hypertension, diabetes, dyslipidemia, former smoker (quit at 45 years old), father had MI at 60 years old
- Past medical history:
  - 1) Anterior STEMI: PCI to LAD at 61 years old, residual 100% chronic total occlusion of the RCA to be managed medically
  - 2) Ischemic cardiomyopathy with LVEF 23% and mildly reduced RV function
  - 3) Primary prevention ICD implanted after being on optimal medical therapy for 3 months
  - 4) Atrial fibrillation (AF)
  - 5) Chronic kidney disease:
    - baseline creatinine 150-160
- Was on quadruple therapy, but family doctor reduced carvedilol by half and stopped sacubitril valsartan due to patient starting to feel “weak and dizzy” all the time
- Systolic blood pressure decreasing from usual baseline of 100-110 mmHg to 85-90 mmHg
- Presents to ER in decompensated heart failure
- Short of breath walking from bed to bathroom, 3 day history of PND, sitting upright in chair last night to sleep as a result of dyspnea, increasing peripheral edema now up to knees
- Vitals: 75/52 mmHg, 110 beats/min in AF, 95% on 4L NP, afebrile
- Labs:
  - Hemoglobin 110 (stable)
  - Wbc 4.7
  - Platelets 260
  - Sodium 129
  - Potassium 3.7
  - Creatinine 330
  - ALT 844, total bilirubin 15
  - Lactate 5.7
  - High sensitivity troponin 35 (baseline)
- Echocardiogram: LVEF 19%, moderately reduced RV function, RVSP 68 mmHg with RAP 15 mmHg

In addition to starting him on furosemide, what should we do next?

- A. Put in an intraaortic balloon pump
- B. Start him on dobutamine and vasopressin
- C. Start him on milrinone and norepinephrine
- D. Call transplant center for consideration of advanced therapies

What options do we have to treat patients in cardiogenic shock?

- Medical therapy: still first line
  - Inotropes
  - Vasopressors

Inotropes

DOBUTAMINE

- Beta-receptor agonist
- Inotropic response may be reduced in patients treated with a beta-blocker
- Most patients will experience an increase in heart rate and blood pressure with use of dobutamine
- Can start at 2 mcg/kg/min, titrating by 1-2 mcg/kg/min every 2 hours until optimal hemodynamic response or max dose of 20 mcg/kg/min is achieved
- Usual maintenance dose: 2-7.5 mcg/kg/min
- Half-life: 2 minutes, can be uptitrated quickly

MILRINONE

- Phosphodiesterase inhibitor
- In addition to inotropic properties, also a vasodilator for both systemic and pulmonary circulation
- Limiting factor: hypotension
- Start at 0.125 mcg/kg/min, titrating by 0.125 mcg/kg/min every 6 hours until optimal hemodynamic response or max dose 0.75 mcg/kg/min achieved
- Usual maintenance dose: 0.125-0.5 mcg/kg/min
- Doses > 0.25 mcg/kg/min are not recommended in patients with significant renal impairment

Comparison of dobutamine versus milrinone therapy in hospitalized patients awaiting cardiac transplantation: A prospective, randomized trial

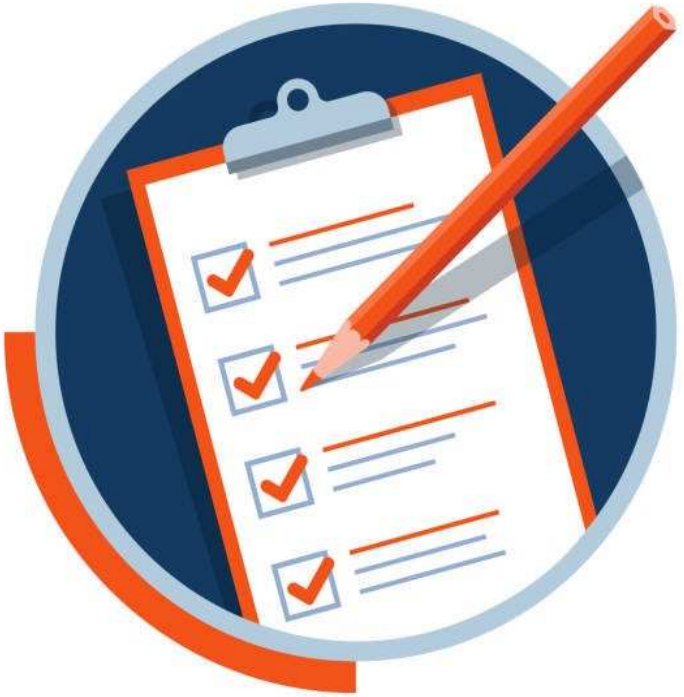
Juan M. Aranda, Jr, MD, Richard S. Schofield, MD, Daniel F. Pauly, MD, PhD, Timothy S. Cleeton, ARNP, Tracy C. Walker, ARNP, V. Steven Monroe, Jr, MD, Dana Leach, RN, Larry M. Lopez, Pharm D, and James A. Hill, MD, MS *Gainesville, Fla*

- Dobutamine (n=17) vs milrinone (n=19)
- No differences between the 2 groups:
  - Right heart hemodynamics
  - Death
  - Need for additional vasodilator/inotropic therapy or mechanical cardiac support before transplantation
- Ventricular arrhythmias occurred frequently in both groups
- Total cost of milrinone was significantly higher than that of dobutamine ($16,270 ± 1334 vs $380 ± 533 P <.00001)

Clinical Pearls

- Prefer use of **DOBUTAMINE** in patients with:
  - ✓ Baseline hypotension and/or
  - ✓ Chronic renal insufficiency

- Prefer use of **MILRINONE** in patients with:
  - ✓ Elevated pulmonary vascular resistance and/or
  - ✓ RV failure
  - ✓ Settings where continuation of beta-blocker is preferred



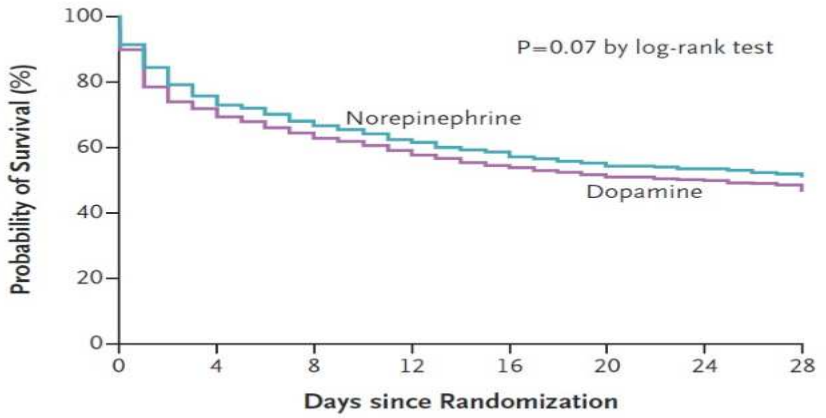
Vasopressors Used in Treatment of Shock

Agent	Dose ranges in shock	Role in therapy and selected characteristics
Norepinephrine (noradrenaline)	-5-15 mcg/min (0.05-0.15 mcg/kg/min) to 80-250 mcg/min (1-3.3 mcg/kg/min)	-initial vasopressor of choice in cardiogenic, septic, and hypovolemic shock -wide range of doses utilized clinically
Epinephrine (adrenaline)	-1-15 mcg/min (0.01-0.2 mcg/kg/min) to 40-160 mcg/min (0.5-2 mcg/kg/min)	-initial vasopressor of choice in anaphylactic shock -increases heart rate; may induce tachyarrhythmias and ischemia -elevates lactate concentrations during initial administration; may decrease mesenteric perfusion
Phenylephrine	-40-160 mcg/min (0.5-2 mcg/kg/min) to 80-730 mcg/min (1.1-9.1 mcg/kg/min)	-pure alpha-adrenergic vasoconstrictor -may be considered when tachyarrhythmias preclude use of norepinephrine -may decrease stroke volume and cardiac output in patients with cardiac dysfunction
Dopamine	2-5 mcg/kg/min to 20 mcg/kg/min	-an alternative to norepinephrine in septic shock in highly selected patients (e.g. bradycardic)
Vasopressin (antidiuretic hormone)	0.03 units/min to 0.04 units/min	-add on to norepinephrine to raise blood pressure -not recommended as replacement for first-line vasopressor -pure vasoconstrictor; may decrease stroke volume and cardiac output in myocardial dysfunction or precipitate ischemia

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 MARCH 4, 2010 VOL. 362 NO. 9

Comparison of Dopamine and Norepinephrine in the Treatment of Shock



No. at Risk

Norepinephrine	821	617	553	504	467	432	412	394
Dopamine	858	611	546	494	452	426	407	386

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

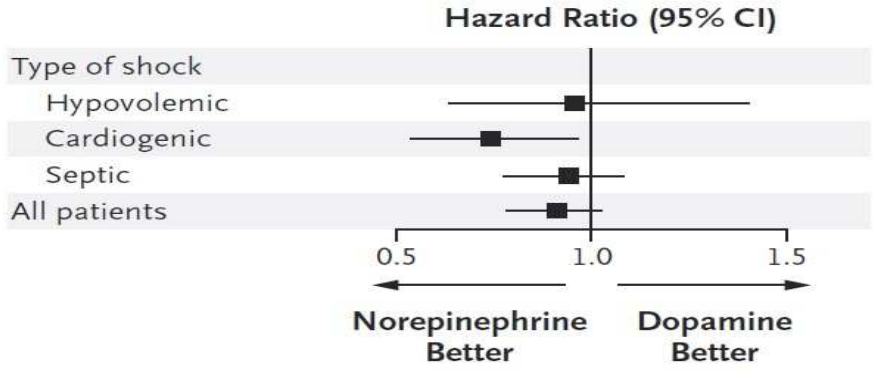


Figure 3. Forest Plot for Predefined Subgroup Analysis According to Type of Shock.

De Backer et al, *N Engl J Med* 2010;362:779-89.

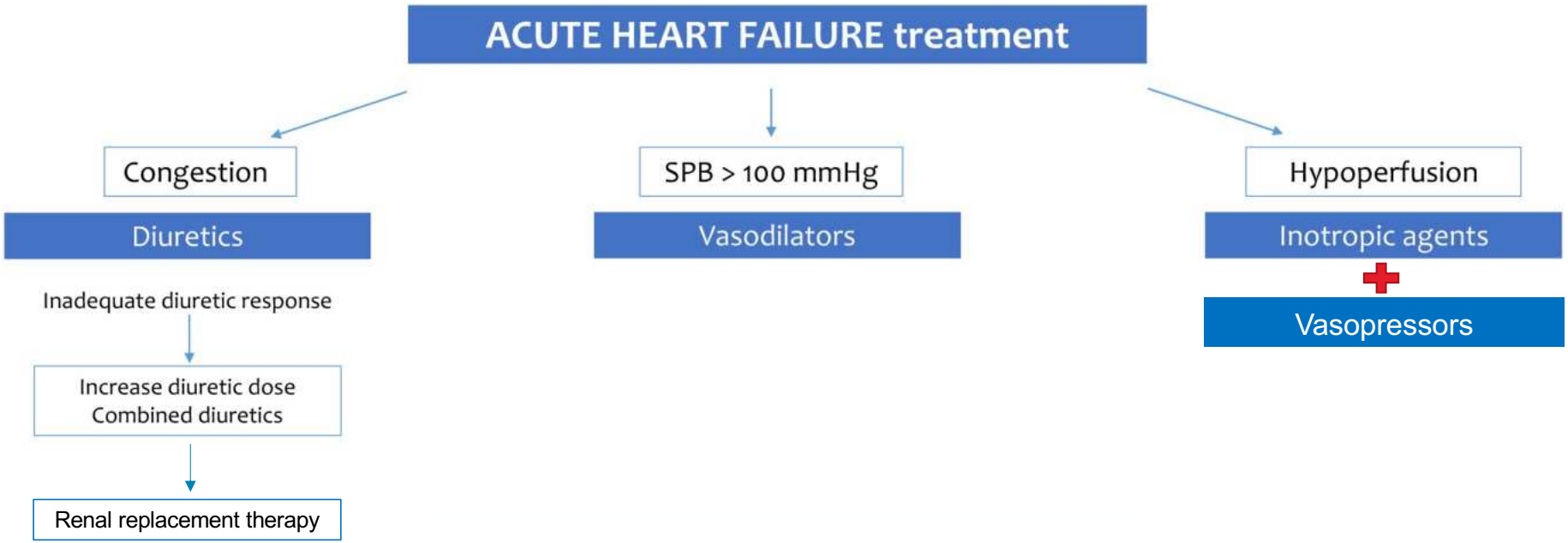
Case Update: Mr. C.O. Lo

- Patient on furosemide 80 mg iv BID and 30 mg/h infusion with metolazone 5 mg BID
- Started on norepinephrine, vasopressin, epinephrine, and milrinone 0.25 mcg/kg/min
- Blood pressure has not improved, now anuric, lactate hovering around 7
- Nephrology consulted and CRRT started, but patient still remains in cardiogenic shock
- ….what next?

What is mechanical circulatory support (MCS)?

- Group of technologies that increase forward output in patients
- Consist of ventricular assist devices (VADs) that augment or replace the ventricle
- Can assist LV (LVAD), RV (RVAD), or both ventricles (BiVAD)
- 2 categories: temporary or long term

- Different types of temporary MCS:
  - Intraaortic balloon pump (IABP)
  - Percutaneous non-IABP mechanical circulatory assist devices (ex. Impella, TandemHeart)
  - Extracorporeal membrane oxygenator pumps (ECMO)
  - Non-percutaneous centrifugal pumps (ex. Centrimag)



Modified from Gupta AK et al. Can J Cardiol. 2021 Apr;37(4):621-631.

Objective 2:

- ***Identify when patients need to be considered for advanced therapies***

Clinical Case

48M w ischemic cardiomyopathy

Left ventricular ejection fraction 33%

Hospitalized for 5 days with orthopnea and peripheral edema 2 months ago

-second admission this year

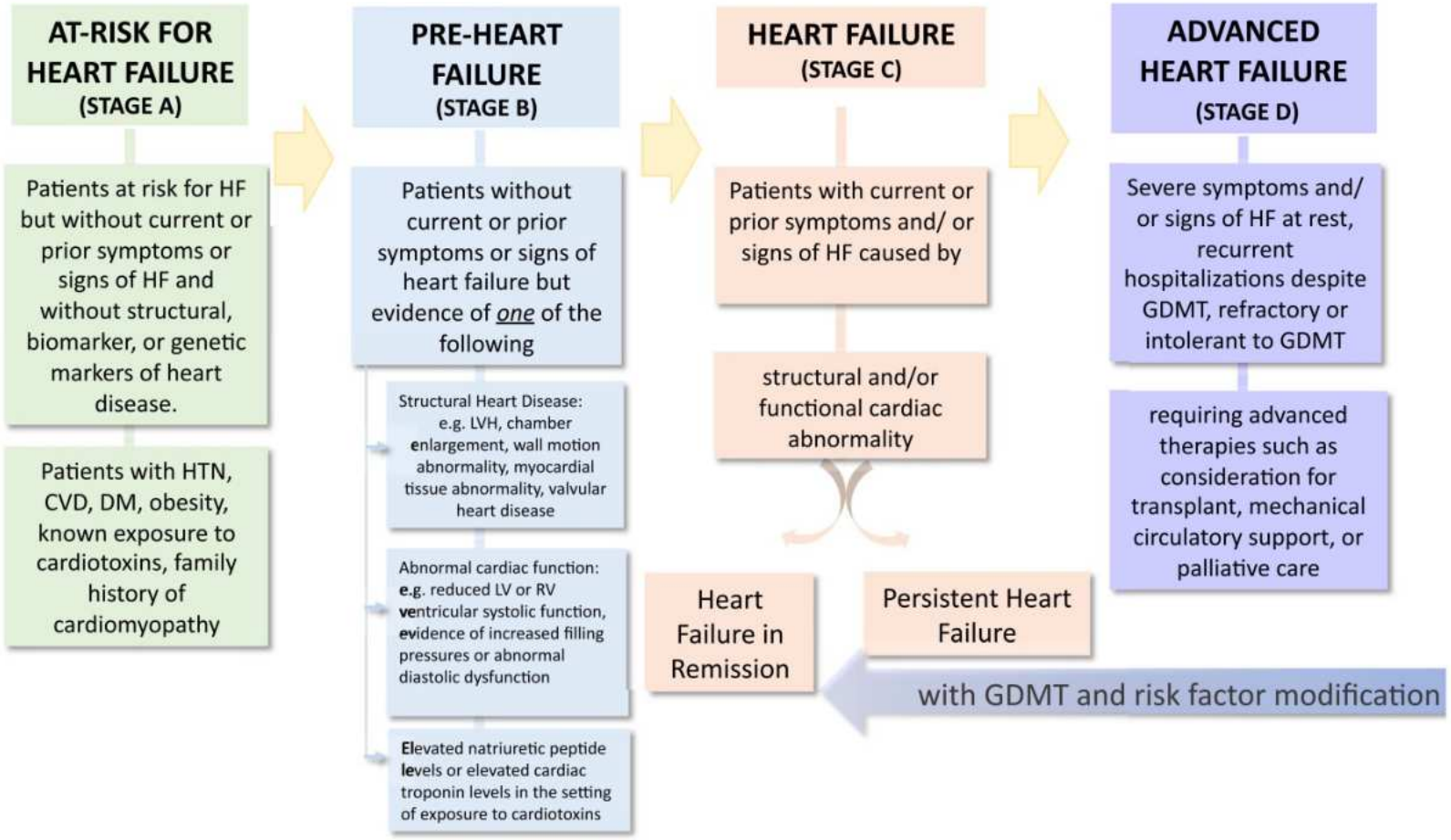
Optimized on standard GDMT

Audience Response Question

- Are you worried about this patient?

A. Yes
B. No
C. Maybe/Not sure

Heart Failure Stage



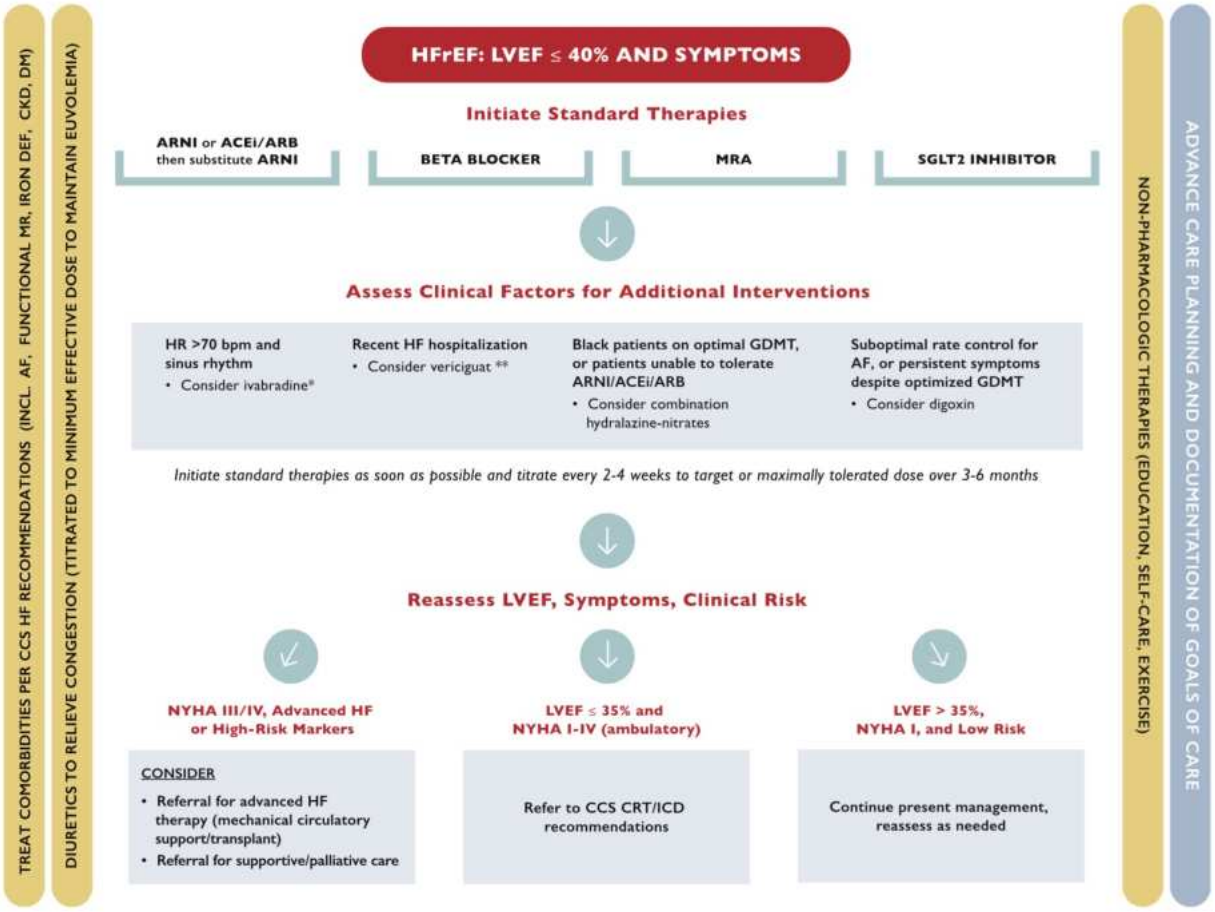
Bozkurt et al., Universal Definition of Heart Failure, JCF 2021, 27;4.

What to do?

- Escalation of disease-modifying therapies
  - Don’t focus on decongestion with diuretics alone
- Lack of improvement is a marker of worse prognosis
  - ***Persistent*** HF
  - Should prompt clinicians to further optimize therapy
- Consider right heart catheterization
- Referral to advanced heart failure

Bozkurt et al., Universal Definition of Heart Failure, JCF 2021, 27;4.

CCS/CHFS Guidelines



McDonald et al., CCS/CHFS HF Guidelines Update, CJC 2021.

What to do? Consider…

- Medications
  - Vericiguat
  - ~~Ivabradine~~
  - ~~Vasodilators~~
  - Digoxin - added
- Device Therapies
  - ~~Cardiac resynchronization therapy~~
  - ~~Consider pulmonary artery pressure monitoring~~

Heart rate 66bpm
Sinus rhythm

Has an ICD
Does not meet criteria for CRT

Next steps?

- Patient optimized on medical therapy but …

Still symptomatic with:

- dyspnea walking short distances
- dizziness and low blood pressure 86/64

Audience Response Question

- What would you do next?

A. Continue current management
B. Optimize medications further
C. Refer to advanced heart failure team
D. Refer to respirology

I-NEED-HELP Mnemonic

- **I** = inotropes
- **N** = NYHA class/natriuretic peptides
- **E** = end-organ dysfunction (renal, liver)
- **E** = LVEF ≤25%
- **D** = defibrillator shock
- **H** = at least 1 HF hospitalization in the prior 12 months
- **E** = edema, escalating diuretics
- **L** = low blood pressure
- **P** = prognostic medications (inability to increase or need to decrease).

Baumwol J. "I NEED HELP": a mnemonic to aid timely referral in advanced heart failure. *J Heart Lung Transplant.* 2017;36:593–594.

Clinical indicators of advanced HF

- **I** = inotropes
- **N** = NYHA class/natriuretic peptides
- **E** = end-organ dysfunction (renal, liver)
- **E** = LVEF ≤25% to 35%
- **D** = defibrillator shock
- **H** = repeated HF hospitalization in the prior 12 months
- **E** = edema, escalating diuretics
- **L** = low blood pressure (< 90mmHg)
- **P** = prognostic medications (inability to increase or need to decrease).

- Cardiac cachexia
- Severely reduced exercise capacity
  - VO2 < 14ml/kg/min or < 50%
  - 6-min walk < 300m
  - Inability to walk 1 block
- Diuretics with furosemide > 160 or adding metolazone
- Refractory congestion
- Worsening right heart failure or secondary pulmonary hypertension
- Persistent hyponatremia <134 mEq/L
- Not responding to CRT
- Increased predicted 1 year mortality (>20%) according to HF survival models or calculator (MAGGIC, SHFM)

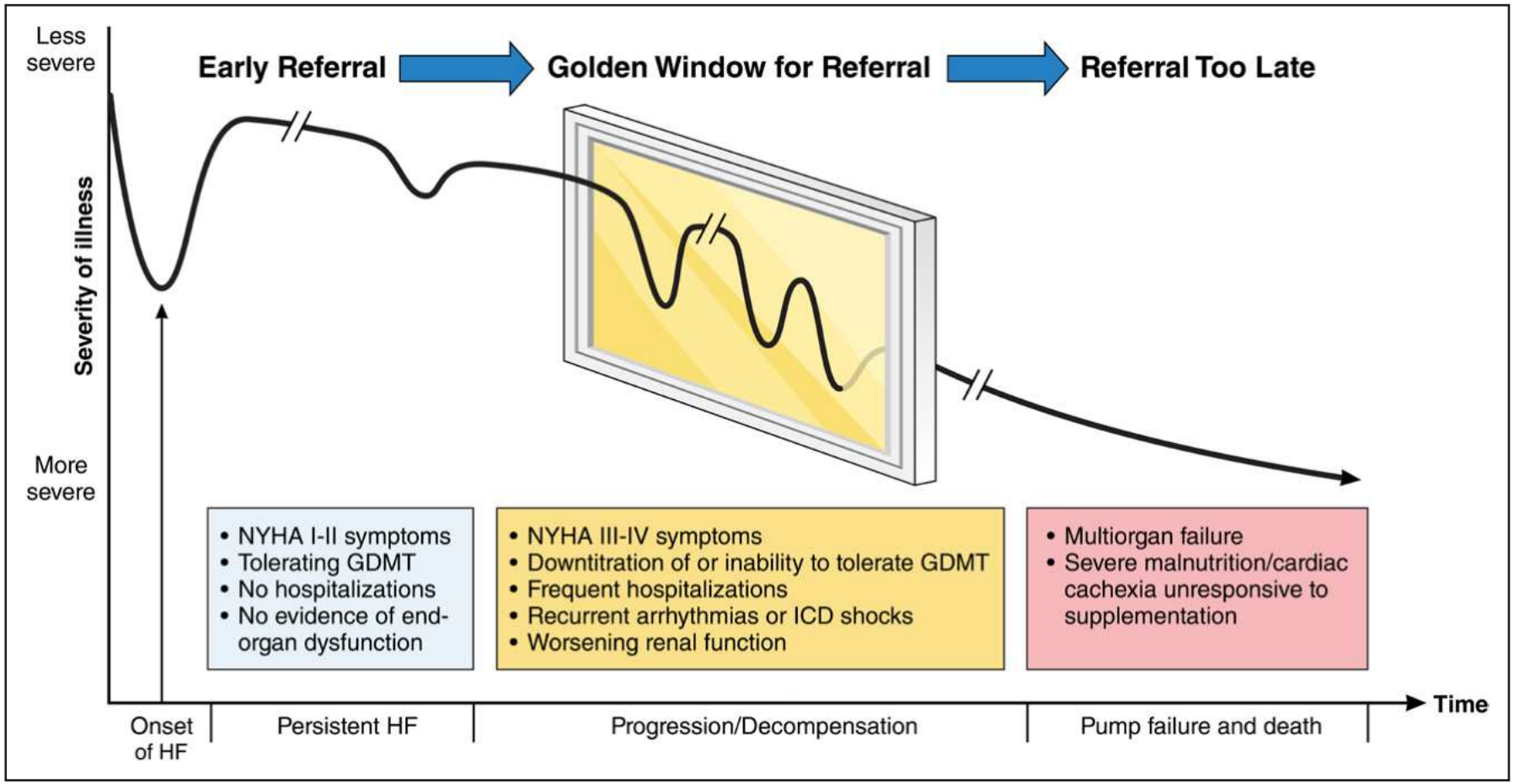
Baumwol J. "I NEED HELP": a mnemonic to aid timely referral in advanced heart failure. *J Heart Lung Transplant.* 2017;36:593–594.
Morris et al., Guidance for Timely and Appropriate Referral of Patients with Advanced HF, *Circulation* 2021.
Heidenreich et al., AHA/ACC/HFSA Guideline for the Management of Heart Failure. JACC 2022

When to refer?

- Early referral to Heart Failure Specialist or centre with Advanced HF therapies is key.

- **Don’t wait!**

When to refer?



Morris et al., Guidance for Timely and Appropriate Referral of Patients with Advanced HF, *Circulation* 2021.

When to refer?

- Late referral increases risk of:
  - Right heart failure
  - Renal and liver dysfunction
  - Pulmonary hypertension
  - Cardiac cachexia
- Associated with poorer outcomes after advanced heart failure therapies
- May result in patients being considered too sick for advanced therapies

Morris et al., Guidance for Timely and Appropriate Referral of Patients with Advanced HF, *Circulation* 2021.

What to do?

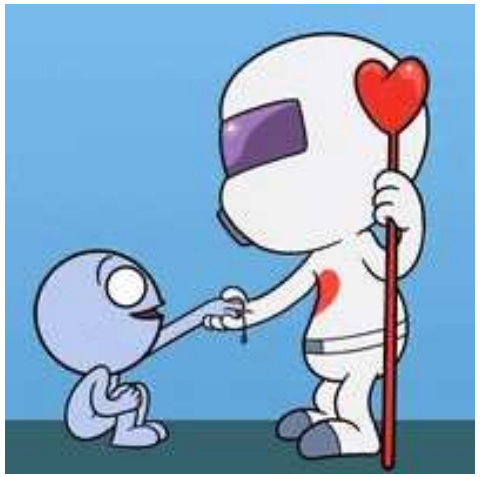
- Step 1 – Recognize advanced HF
- Step 2 – Will the patient benefit from and advanced HF care centre?
- Step 3 - Use “I-NEED-HELP”

“ Guard against implicit bias to avoid disadvantaging populations who are more likely to be affected by social determinants of health, including race, ethnic minority patients and women. ”

Morris et al., Guidance for Timely and Appropriate Referral of Patients with Advanced HF, *Circulation* 2021.

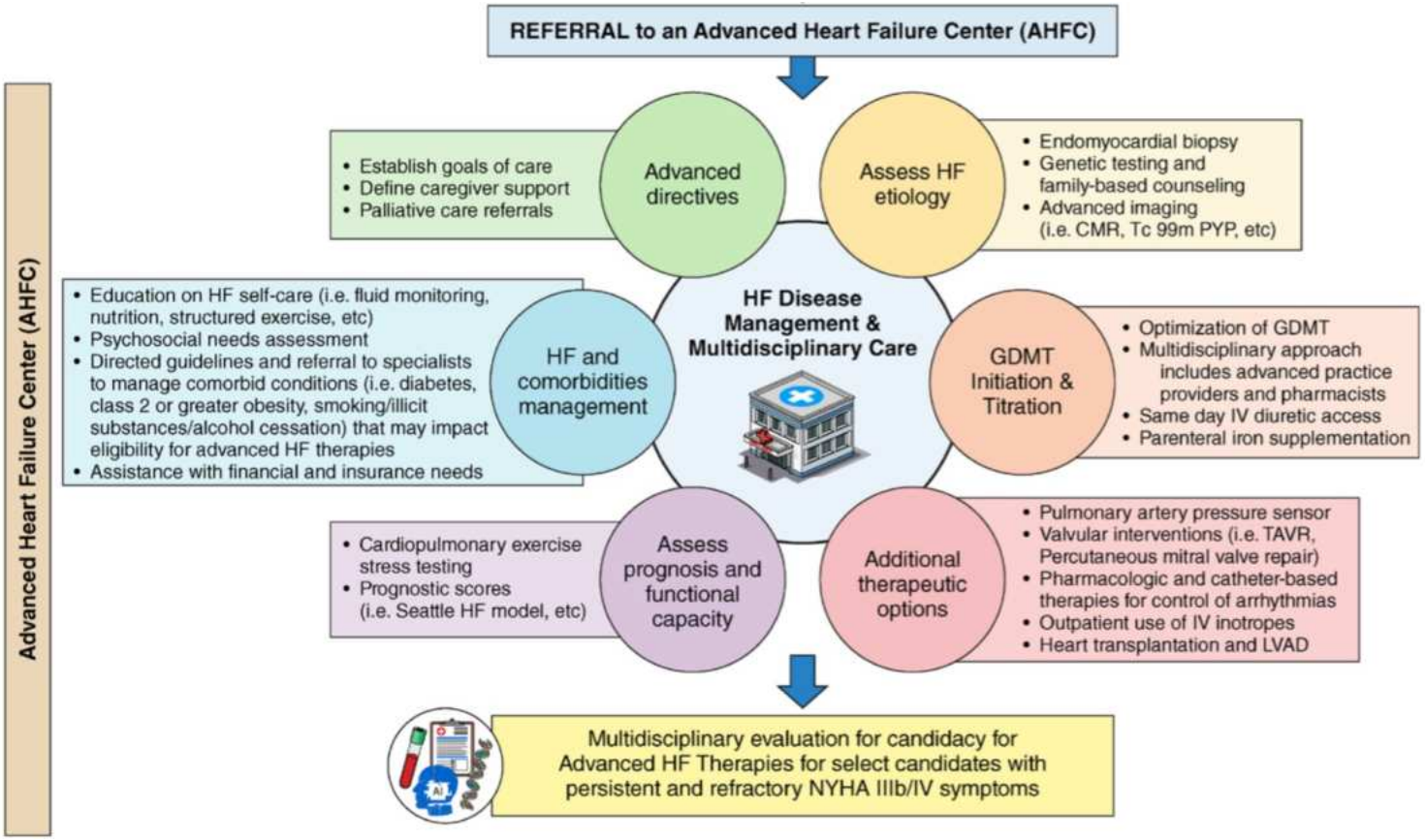
What WE do as advanced HF specialists

- 1. Search for reversible cause
- 2. Implement intensive disease management
- 3. Assess eligibility for “advanced” therapies
  - Continuous Infusion Therapy
  - Mechanical Circulatory Support
  - Heart Transplant
- 4. Clarify goals of care



Morris et al., Guidance for Timely and Appropriate Referral of Patients with Advanced HF, *Circulation* 2021.
Heidenreich et al., AHA/ACC/HFSA Guideline for the Management of Heart Failure. JACC 2022

What WE do as advanced HF specialists



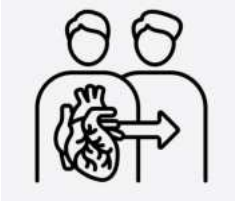
Morris et al., Guidance for Timely and Appropriate Referral of Patients with Advanced HF, *Circulation* 2021.

The “Advanced Therapies” for “Advanced HF”

1. Continuous Intravenous Infusions

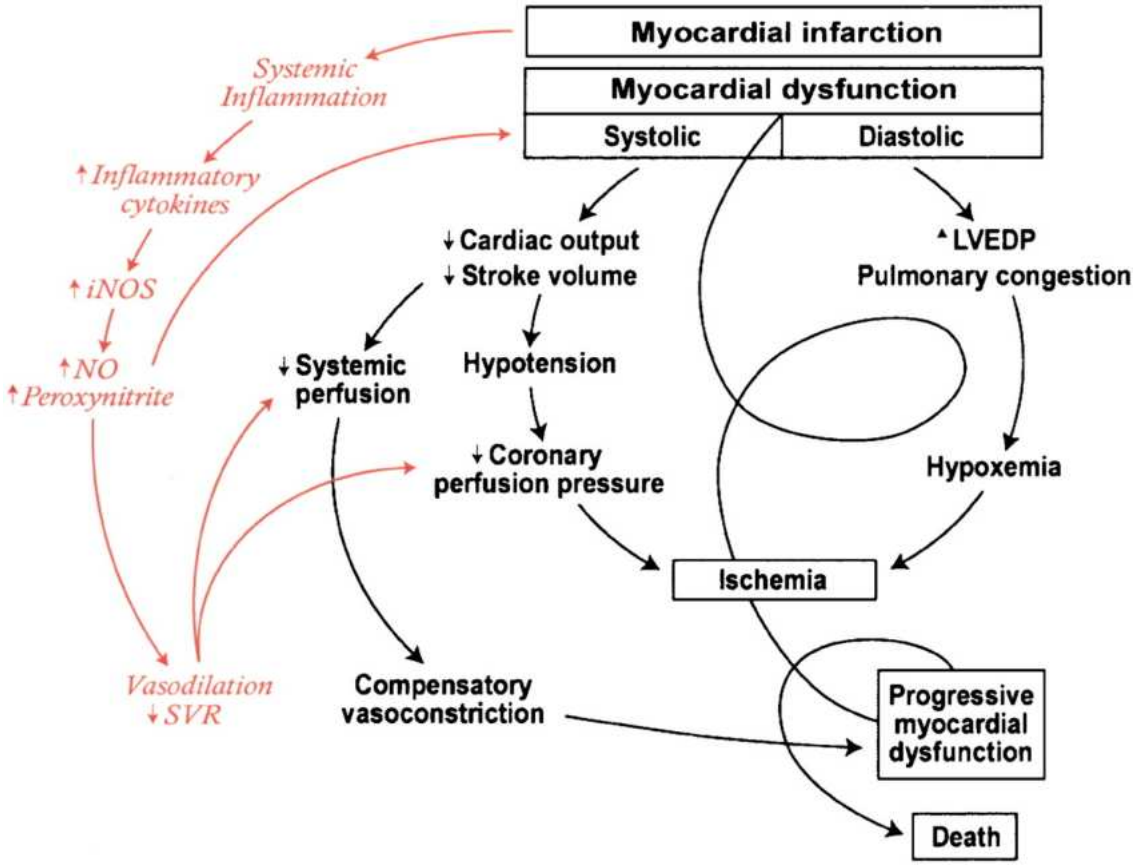
2. Mechanical Circulatory Support

3. Heart Transplant



4. Palliative Care

Cardiogenic Shock



Antman EM, Braunwald E. Acute myocardial infarction. In: Braunwald E, Fauci A, Kasper D, et al, eds. Harrison's Principles of Internal Medicine. 15th ed. New York, NY: McGraw-Hill; 2001:1395.

Cardiogenic Shock

Henry et al., Circulation, 2021, 143;15.

INTERMACS Profiles

TABLE 17 INTERMACS Profiles

Profile*	Profile Description	Features
1	Critical cardiogenic shock	Life-threatening hypotension and rapidly escalating inotropic/pressor support, with critical organ hypoperfusion often confirmed by worsening acidosis and lactate levels.
2	Progressive decline	"Dependent" on inotropic support but nonetheless shows signs of continuing deterioration in nutrition, renal function, fluid retention, or other major status indicator. Can also apply to a patient with refractory volume overload, perhaps with evidence of impaired perfusion, in whom inotropic infusions cannot be maintained because of tachyarrhythmias, clinical ischemia, or other intolerance.
3	Stable but inotrope dependent	Clinically stable on mild-moderate doses of intravenous inotropes (or has a temporary circulatory support device) after repeated documentation of failure to wean without symptomatic hypotension, worsening symptoms, or progressive organ dysfunction (usually renal).
4	Resting symptoms on oral therapy at home	Patient who is at home on oral therapy but frequently has symptoms of congestion at rest or with activities of daily living (dressing or bathing). He or she may have orthopnea, shortness of breath during dressing or bathing, gastrointestinal symptoms (abdominal discomfort, nausea, poor appetite), disabling ascites, or severe lower extremity edema.
5	Exertion intolerant	Patient who is comfortable at rest but unable to engage in any activity, living predominantly within the house or housebound.
6	Exertion limited	Patient who is comfortable at rest without evidence of fluid overload but who is able to do some mild activity. Activities of daily living are comfortable, and minor activities outside the home such as visiting friends or going to a restaurant can be performed, but fatigue results within a few minutes or with any meaningful physical exertion.
7	Advanced NYHA class III	Patient who is clinically stable with a reasonable level of comfortable activity, despite a history of previous decompensation that is not recent. This patient is usually able to walk more than a block. Any decompensation requiring intravenous diuretics or hospitalization within the previous month should make this person a Patient Profile 6 or lower.

Heidenreich et al., AHA/ACC/HFSA Guideline for the Management of Heart Failure. JACC 2022

The “Advanced Therapies” for “Advanced HF”

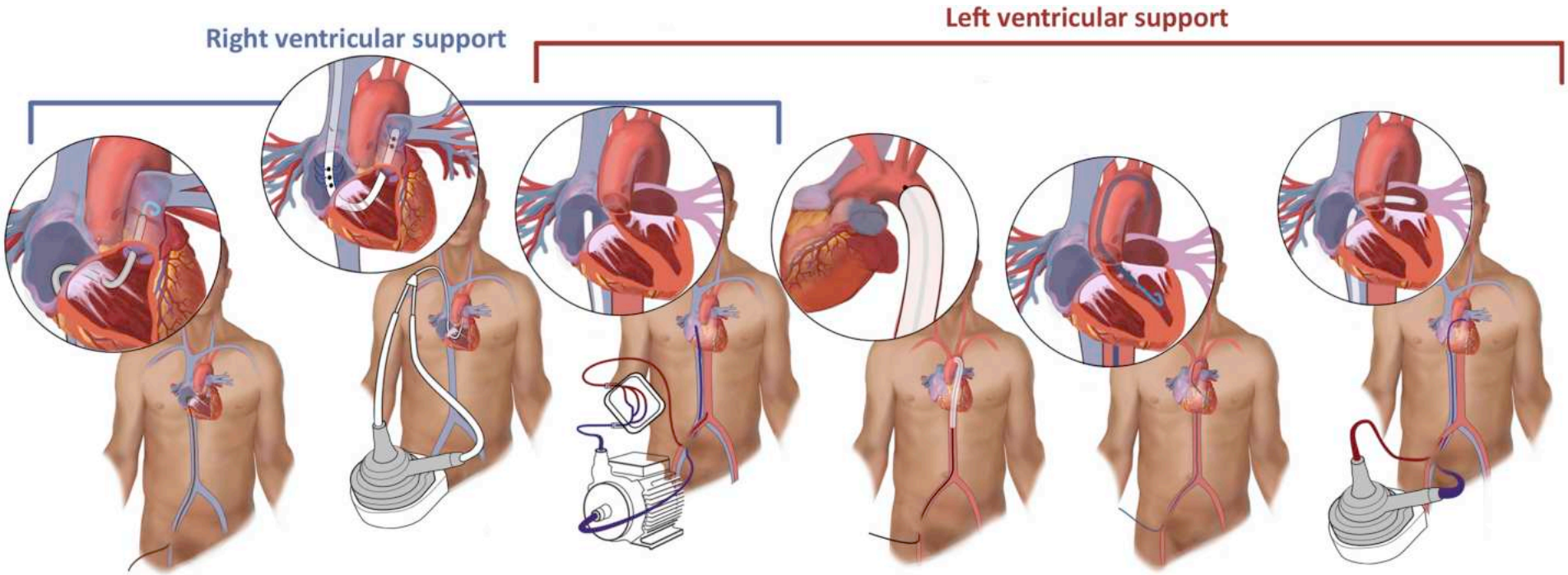
1. Continuous Intravenous Infusions

2. **Mechanical Circulatory Support**

3. Heart Transplant

- 4. Palliative Care

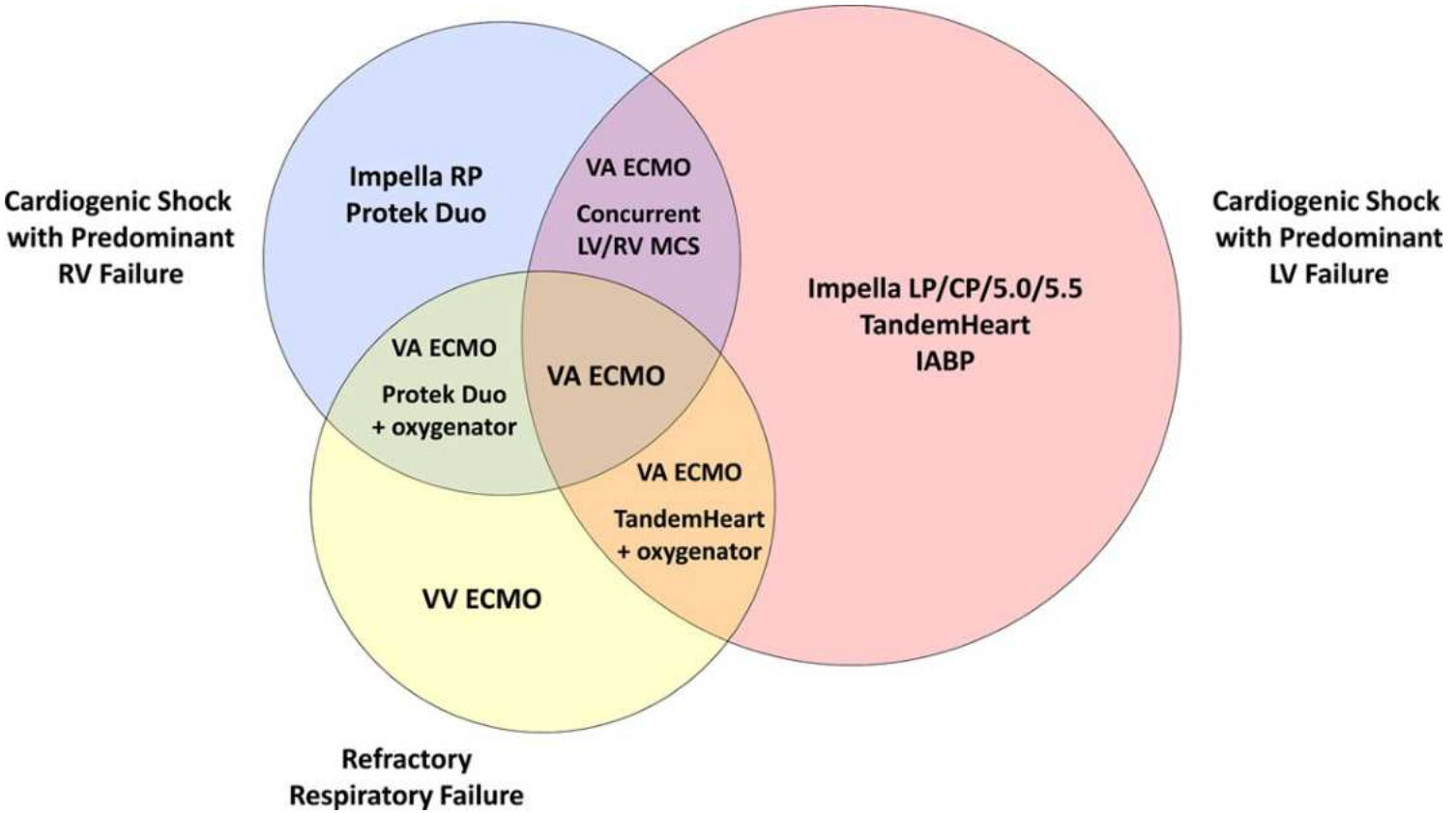
Types of Mechanical Circulatory Support



	Impella RP	TandemHeart RA-PA	VA-ECMO	IABP	Impella (2.5, CP, 5.0, 5.5)	TandemHeart LA-FA

Tehrani et al. J Am Coll Cardiol HF. 2020 Nov, 8 (11) 879–891

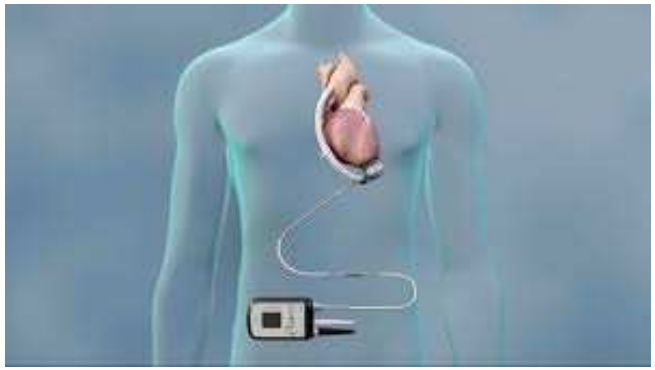
Types of Mechanical Circulatory Support



Henry et al., Circulation, 2021, 143;15.

Indications for Durable Mechanical Support

- Frequent hospitalizations for HF
- NYHA class IIIb to IV functional limitations despite maximal therapy
- Intolerance of neurohormonal antagonists
- Increasing diuretic requirement
- Symptomatic despite CRT
- Inotrope dependence
- Low peak VO2 (<14–16)
- End-organ dysfunction attributable to low cardiac output



Heidenreich et al., AHA/ACC/HFSA Guideline for the Management of Heart Failure. JACC 2022

Contraindications

Absolute
■ Irreversible hepatic disease
■ Irreversible renal disease
■ Irreversible neurological disease
■ Medical nonadherence
■ Severe psychosocial limitations
Relative
■ Age >80 y for destination therapy
■ Obesity or malnutrition
■ Musculoskeletal disease that impairs rehabilitation
■ Active systemic infection or prolonged intubation
■ Untreated malignancy
■ Severe PVD
■ Active substance abuse
■ Impaired cognitive function
■ Unmanaged psychiatric disorder
■ Lack of social support

CRT indicates cardiac resynchronization therapy; HF, heart failure; NYHA, New York Heart Association; VO_2, oxygen consumption; and PVD, peripheral vascular disease.

Heidenreich et al., AHA/ACC/HFSA Guideline for the Management of Heart Failure. JACC 2022

The “Advanced Therapies” for “Advanced HF”

1. Continuous Intravenous Infusions

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3. **Heart Transplant**

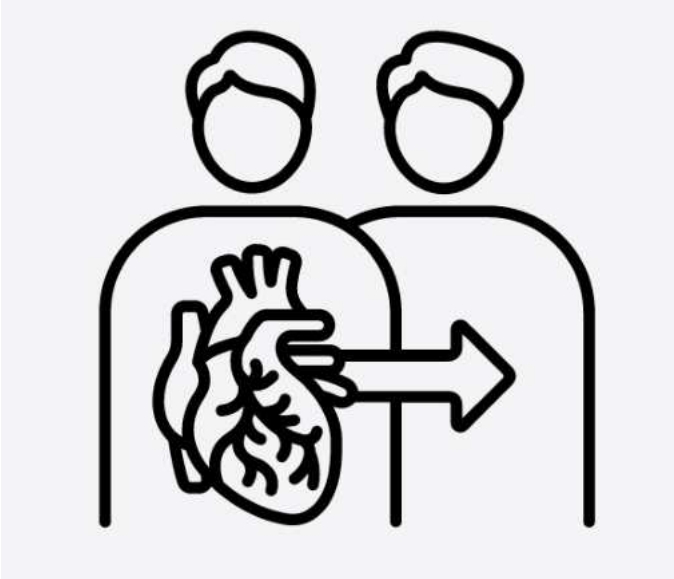
- 4. Palliative Care

Transplant Eligibility Considerations

- Age
- Frailty
- Obesity
- Pulmonary Hypertension
- Psychosocial considerations and substance use

Select patient populations

- Amyloid
- Congenital heart disease
- Retransplantation
- Combined solid organ transplant
- Highly sensitized patients



Chih et al., CCS/CCTN Position statement on heart transplantation *CJC* 2020,36;3.

Take Home Points

1. Optimize medical therapy
2. Add on additional therapies as indicated
3. Monitor for warning signs
4. Refer early and often

Thank you