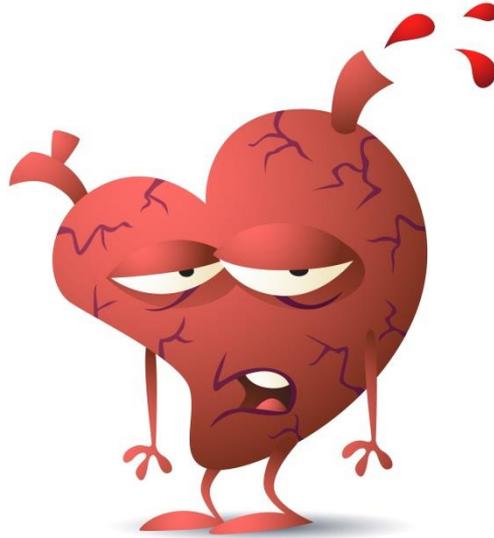


Congestive Heart Failure



Overview

- Epidemiology
- Definition of Heart Failure (HF)
- Types of HF
- Classes of HF
- Common diagnostic tests/procedures
- Treatment options
 - Chronic
 - Acute

Impact of Heart Failure

- Nearly 5 million adults in the U.S. are currently living with HF
- Approximately 550,000 new cases are **diagnosed** in the U.S. each year
- HF is responsible for 11 million physician visits each year, and more hospitalizations than all forms of cancer combined
- HF costs the nation an estimated \$30.7 billion each year

- Diseases that damage the heart, which increase the risk of HF
Some of these diseases include:
 - Coronary heart disease and heart attacks
 - Hypertension
 - Diabetes
- In the U.S., most cases are due to damage from an MI (myocardia infarction) or from long-standing hypertension

Demographics

- HF affects people of all ages, from children and young adults to the middle-aged and the elderly
- Almost 1.4 million person with HF are under 60 years of age
- More than 5% of person age 60 to 69 have HF
- The incidence of HF is equally frequent in men and women
- African Americans are 1.5 times more likely to develop HF than Caucasians

Life expectancy

- Depends on many factors and there is no one answer for an individual patient
- For patients with severe or advanced HF
 - Only around 10 to 20% of patients will be alive after one year.



- The heart muscle is unable to pump enough blood to meet the body's needs for blood and oxygen
 - Not supplying the cells with enough blood
 - Cannot keep up with its workload
 - The body may not get the oxygen it needs

At first the heart tries to make up for this by:

1. Enlarging

- The heart stretches to contract more strongly and keep up with the demand

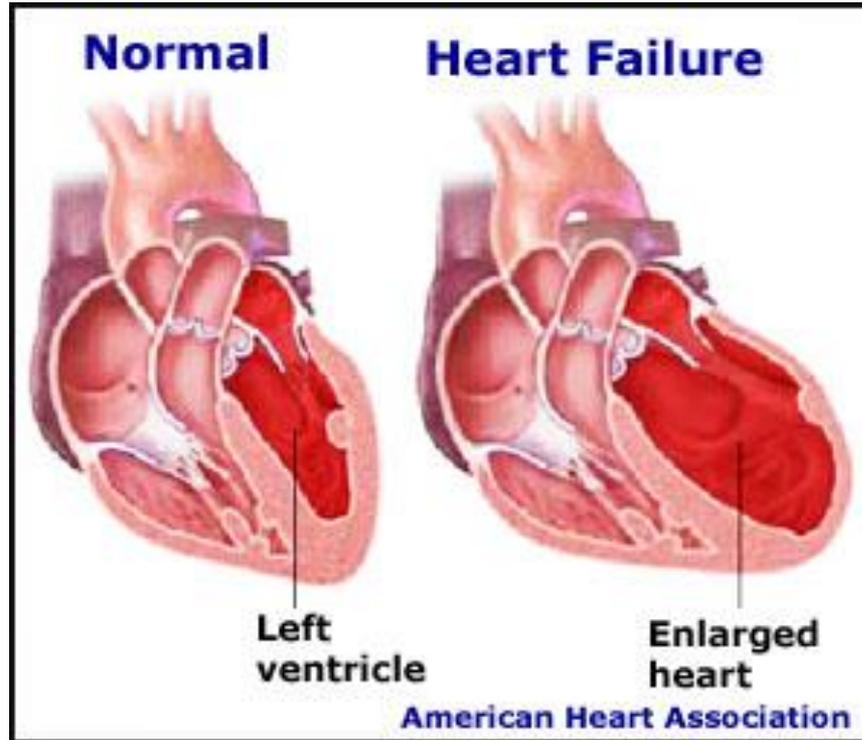
2. Developing more muscle mass

- Due to contracting cells of the heart get bigger, this allows for the heart pump more strongly

3. Pumping faster

- This helps increase the output

Normal vs Heart Failure



- Compensatory mechanisms
 - Renin angiotensin aldosterone system (RAAS)
 - Sympathetic nervous system (SNS)
 - Vasopressin

Diagnostic test for HF

- Echocardiography (ECHO)
 - An ultrasound of the heart
 - Provides an estimate of left ventricular ejection fraction (LVEF)
- LVEF
 - measurement of how much blood is pumped out of the left ventricle with each contraction

Ejection Fraction

| EF | Term | Primary Problem |
|--------|------------------------------------------------------------------|-------------------------------------------------------------|
| 55-70% | Normal | Normal |
| ≥50% | Heart Failure with Preserved EF (HFpEF) Diastolic Dysfunction | Impaired ventricular relaxation and filling during diastole |
| 40-49% | Heart Failure with mid-range HF (HFmrEF) | Likely mixed systolic and diastolic dysfunction |
| <40% | Heart Failure with Reduced EF (HFrEF) Systolic Dysfunction | Impaired ability to eject blood during systole |

Preserved vs Reduced Ejection Fraction

Preserved EF

- EF \geq 50%
- Diastolic dysfunction (systolic function in tact)
- Usually older women with a hx of hypertension, obesity, CAD, diabetes, atrial fibrillation and hyperlipidemia

Reduced EF

- EF \leq 40 %
- Clinical diagnosis of HF
- Systolic dysfunction

- General Signs and symptoms
 - Dyspnea (shortness of breath at rest or upon exertion)
 - Cough
 - Swollen ankles
 - Fatigue, weakness
 - Reduction in exercise capacity

- B-type natriuretic peptide: normal is <100 pg/mL
- N-terminal pro B-type natriuretic peptide: normal is <300 pg/mL
- Both are increased in HF

Classification of Heart Failure

| ACCF/AHA Stages of HF | | NYHA Functional Classification | |
|-----------------------|-----------------------------------------------------------------------------|--------------------------------|------------------------------------------------------------------------------------------------------------------------|
| A | At high risk for HF but without structural heart disease or symptoms of HF. | None | |
| B | Structural heart disease but without signs or symptoms of HF. | I | No limitation of physical activity. Ordinary physical activity does not cause symptoms of HF. |
| C | Structural heart disease with prior or current symptoms of HF. | I | No limitation of physical activity. Ordinary physical activity does not cause symptoms of HF. |
| | | II | Slight limitation of physical activity. Comfortable at rest, but ordinary physical activity results in symptoms of HF. |
| | | III | Marked limitation of physical activity. Comfortable at rest, but less than ordinary activity causes symptoms of HF. |
| | | IV | Unable to carry on any physical activity without symptoms of HF, or symptoms of HF at rest. |
| D | Refractory HF requiring specialized interventions. | | |



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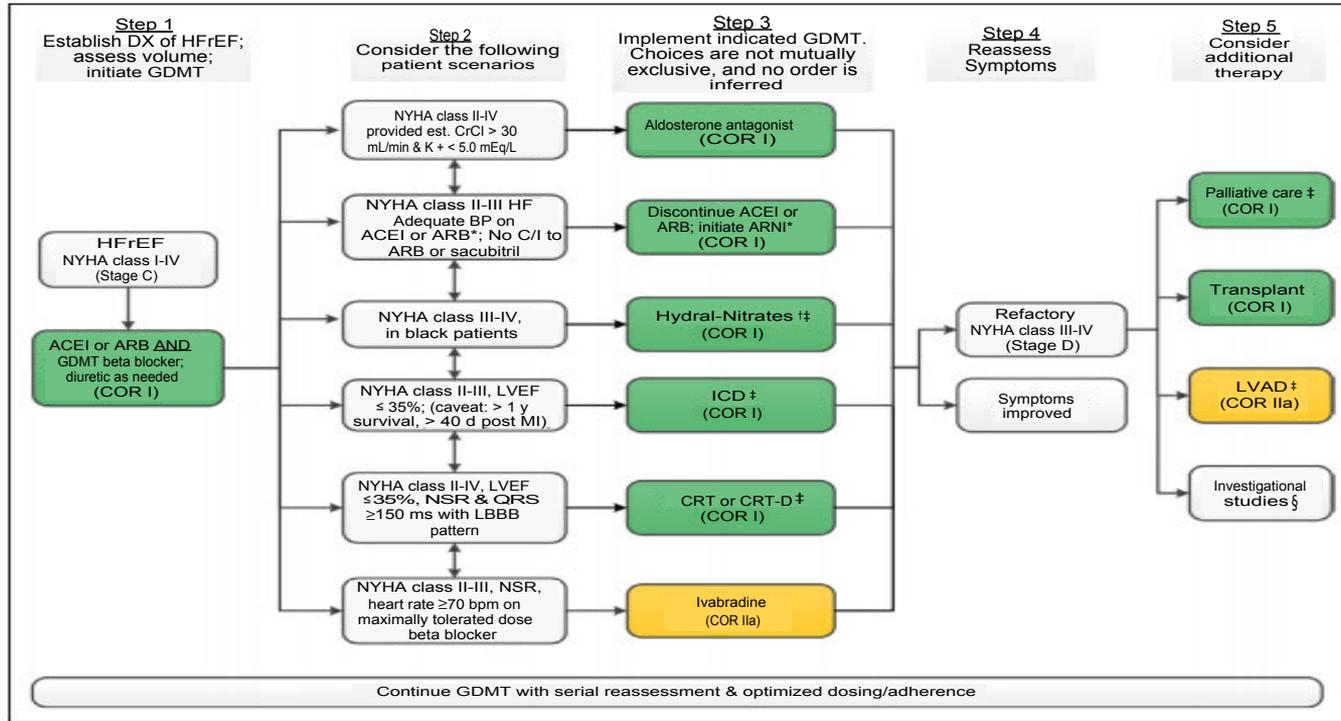
Treatment Options

Treatment of Chronic Systolic Heart Failure

Overview

- First-line therapy
 - Angiotensin converting enzyme (ACE) inhibitors or Angiotensin receptor blocker (ARBs) or Angiotensin receptor and Neprilysin inhibitor (ARNI)
 - Beta blockers
 - Aldosterone receptor antagonists (ARAs)
- Alternative/Additive therapies
 - Hydralazine and nitrates
 - Loop diuretics
 - Digoxi
 - Ivabradine

Treatment of HFrEF Stage C and D



Yancy, Clyde, et al. ACC/AHA/HFSA Focused Update of the 2013 ACCF/AHA Guideline for the Management of Heart Failure. *American College of Cardiology/American Heart Association*. 2017; 136-161

Drug Treatment

| Drug Therapy Targets | Mechanism of Action | Benefit with Drug Class |
|----------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| ACE inhibitors/ARB | Block neurohormonal activation of the RAAS, resulting in vasodilation and improved EF | Reduces morbidity & mortality , decreases cardiac remodeling, improves LVEF |
| ARNI | Counteract effects of RAAS activation and produce vasodilation | Reduces morbidity & mortality |
| Beta blockers | Block the activation of the SNS by blocking Epinephrine and Norepinephrine | Reduces morbidity & mortality , provides benefit in controlling heart rate and reducing arrhythmia risk |
| ARA | Reduces sodium and water retention | Reduces morbidity & mortality , improve symptoms and ejection fraction |
| Hydralazine/Nitrate | A direct arterial vasodilator and venous vasodilation | Improves survival |
| Digoxin | Increases cardiac output and decrease heart rate through inhibition of the Na/K ATPase pump | Improves symptoms, exercise tolerance and quality of life, improves symptoms and reduces hospitalizations |
| Ivabradine | Reduces heart rate through inhibition of the “funny” current | Reduces hospitalizations |
| Loop Diuretics | Increase excretion of Na, K, Cl, Mg, Ca and H2O | Improves symptoms |

Potassium Oral Supplementation

- Loop diuretics cause a decrease in potassium while other HF drugs (RAAS inhibitors, ARAs) increase potassium
- Maintenance of potassium levels is essential to reduce the pro-arrhythmic risk
- Range of potassium is 3.5-5 mEq/L

- Provides a small increase in cardiac output
 - Decreases HR
- Improves symptoms and decreases hospitalizations
- Added in patients who remain symptomatic despite receiving standard treatment of an ACE inhibitor or ARB with a beta blocker

Heart Failure with preserved ejection fraction of $\geq 50\%$ (HFpEf)

- Systolic and diastolic blood pressure should be controlled
 - Less than 130/80 mm Hg
- *Diuretics* should be used for relief of symptoms due to volume overload
- *Aldosterone receptor antagonist* might be considered to decrease hospitalization
 - With HF admission within 1 yr, eGFR >30 ml/min, creatinine <2.5 mg/dL, potassium <5 mEq/L.

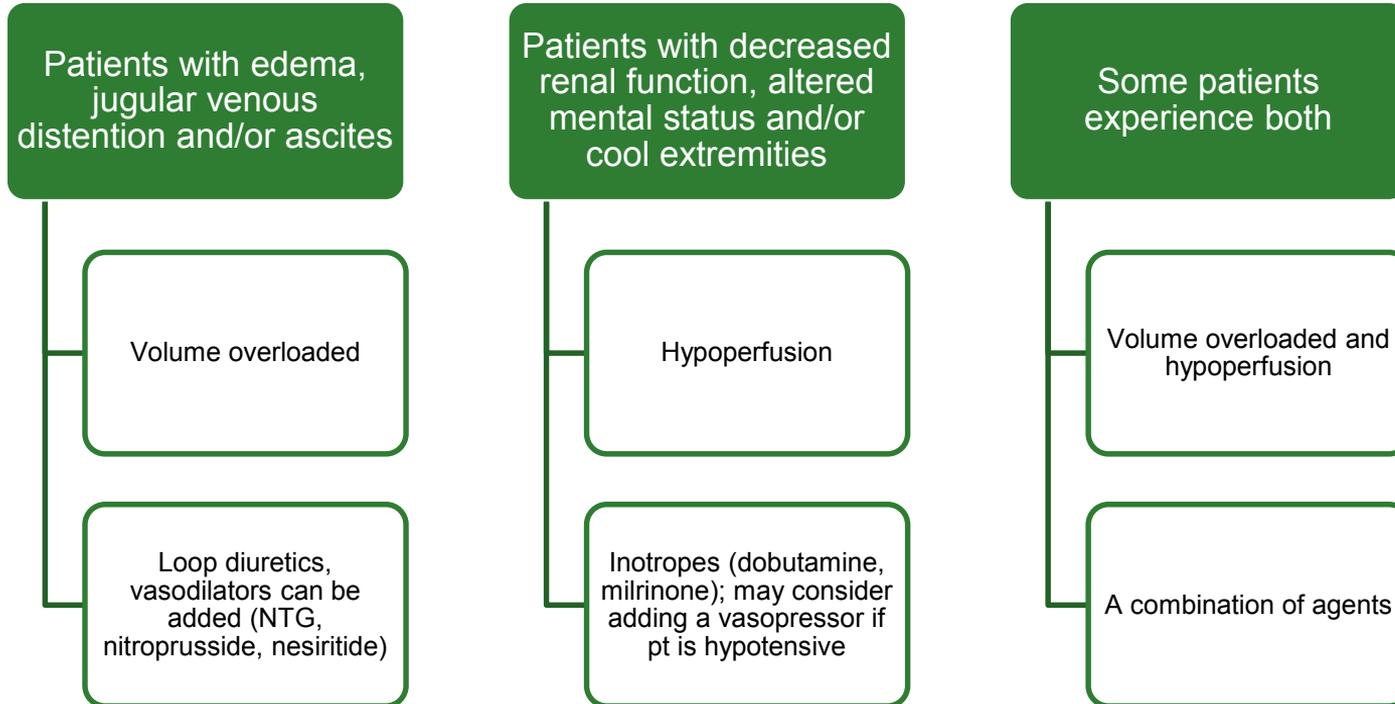
- Body weight
- Sodium Restricted diet, <1500 mg/day
- Fluid restriction (1.5-2 L/day)
- Limit alcohol intake
- Avoid illicit drug use, stop smoking
- Exercise training or regular physical activity

Acute Decompensated Heart Failure

- Worsening symptoms
 - Sudden weight gain
 - Weight gain of more than 5 lbs in 1 week
 - Increasing shortness of breath and fatigue
 - Inability to lie flat without becoming short of breath
- Due to Nonadherence with medications and/or lifestyle recommendations



Treating Acute Decompensated Heart Failure



Clinical Pearls

| Drug class | Target Dosing | Black Box Warnings | Contraindications | Monitoring Parameters |
|-----------------------|---------------------------------------------------------------------------|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| <i>ACE inhibitors</i> | Lisinopril 20-40mg daily Enalapril 10-20mg bid | can cause injury and death to the developing fetus | History of angioedema, use with aliskiren in pts with diabetes, use within 36 hrs of Entresto | Potassium, renal function |
| <i>ARBs</i> | Candesartan 32mg daily Losartan 50-150 mg daily Valsartan 160mg bid | Same BBW as above | use with aliskiren in pts with diabetes | Potassium, renal function |
| <i>ARNI</i> | Entresto 200mg bid | Same BBW as above | Use with ACE inhibitors or ARBs, hx of angioedema, use with aliskiren with diabetes | Potassium, renal function, requires renal adjustment |
| <i>Beta Blockers</i> | Zebeta 10 mg daily Toprol XL 200 mg daily Coreg IR 3.125 mg BID | Do not discontinue abruptly | Severe bradycardia, 2 nd or 3 rd degree heart block or sick sinus syndrome or cardiogenic shock | Heart rate (decrease dose if HR < 55 bpm), BP |

Clinical Pearls

| Drug class | Target Dosing | Contraindications | Warnings | Monitoring Parameters |
|----------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| ARA | Spirolactone 25 mg daily Eplerenone 25 mg daily | Hyperkalemia, anuria, CrCl ≤ 30 mL/min, Addison's disease | Do not initiate tx in HF pts with K > 5 mEq/L or SCr > 2 mg/dL (females) or SCr > 2.5 mg/dL (males) | Potassium, renal function, fluid status |
| <i>Hydralazine/Nitrate</i> | Bidil 300 mg/day in divided doses Isosorbide mononitrate 120 mg in divided doses | Mitral valve rheumatic heart disease, CAD; for nitrates use with PDE-5 inhibitors and riociguat | Drug-Induced lupus erythematosus (hydralazine) | Heart rate, Blood pressure |
| <i>Digoxin</i> | 0.125-0.25 mg daily | Ventricular fibrillation | 2 nd /3 rd degree heart block without a pacemaker, Wolff-Parkinson-White syndrome with Afib, electrolyte imbalances | Heart rate, ECG, electrolytes, renal function, dig level |
| <i>Ivabradine</i> | 2.5-7.5 mg bid Target resting heart rate between 50-60 bpm | Acute decompensated HF, BP < 90/50 mmHg, sick sinus syndrome or 3 rd degree AV block without pacemaker, resting heart rate <60 bpm, severe hepatic impairment | bradycardia, risk of QTc prolongation, fetal toxicity (females should use effective contraception) | Heart rate, ECG |
| <i>Loop Diuretics</i> | Furosemide Bumetanide Ethacrynic Acid Torsemide | Anuria | Sulfa allergy (does not apply to ethacrynic acid), electrolyte abnormalities | Renal function, fluid status, electrolytes |

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