HEART FAILURE:

A Clinical Review

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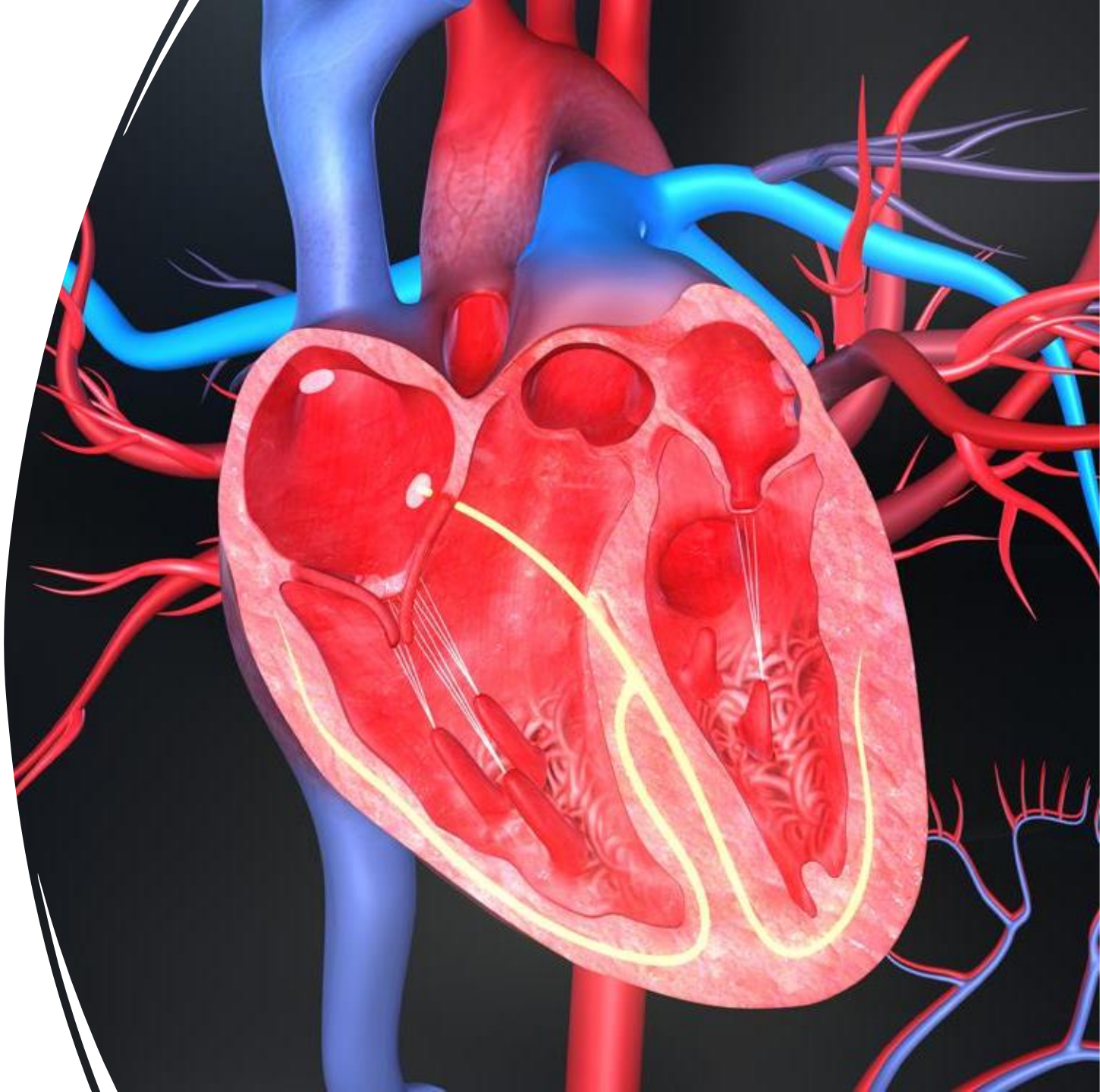
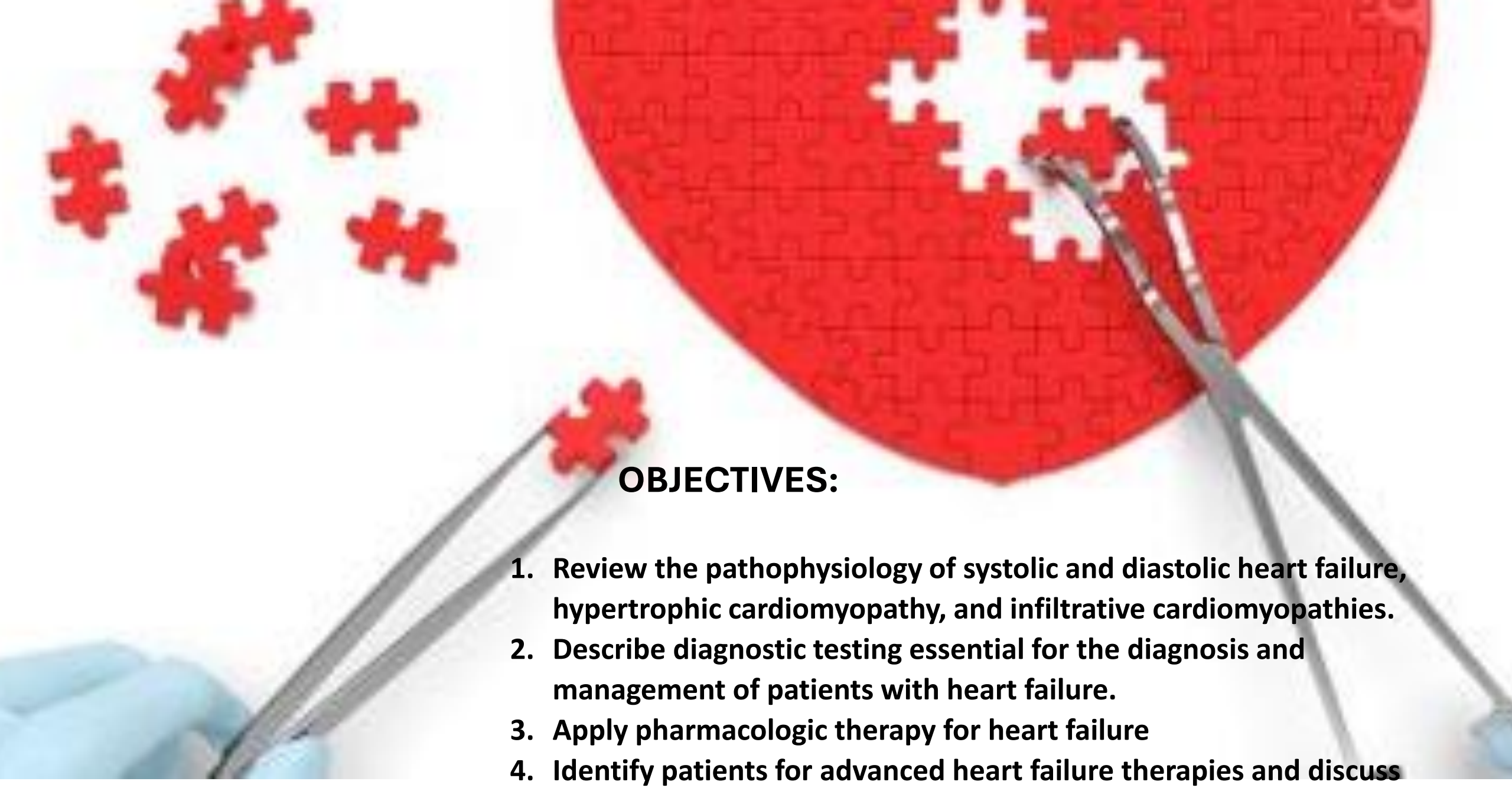




OBJECTIVES:

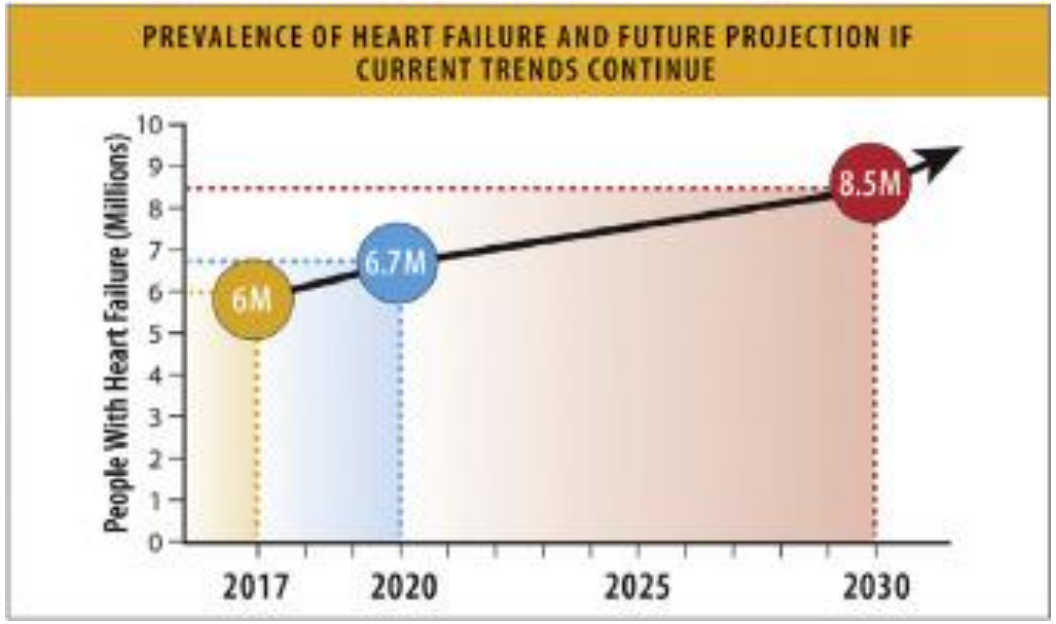
1. Review the pathophysiology of systolic and diastolic heart failure, hypertrophic cardiomyopathy, and infiltrative cardiomyopathies.
2. Describe diagnostic testing essential for the diagnosis and management of patients with heart failure.
3. Apply pharmacologic therapy for heart failure
4. Identify patients for advanced heart failure therapies and discuss treatment options.

Epidemiology of Heart Failure in America

1. Approximately 6.7 million Americans over 20 years of age have heart failure (HF), and the prevalence is expected to rise to 8.5 million Americans by 2030.

2. The risk of HF has increased to 24%; approximately 1 in 4 persons will develop HF in their lifetime.

3. Approximately 33% of the United States adult population is at-risk for HF (Stage A HF) and 24-34% of the US population have pre-HF (Stage B HF). The risk of developing HF is increased with obesity and hypertension.



4. The incidence and prevalence of HF is higher among Black individuals compared with other racial and ethnic groups.

5. Black, American Indian, and Alaska Native individuals have the highest all-cause age-adjusted HF mortality rates compared with other racial and ethnic groups.

6. Greater increase in HF-related mortality rates for younger (35–64 years) compared with older (65–84 years) adults.

7. Highest HF death rates have been reported in the Midwest, Southeast, and Southern states.

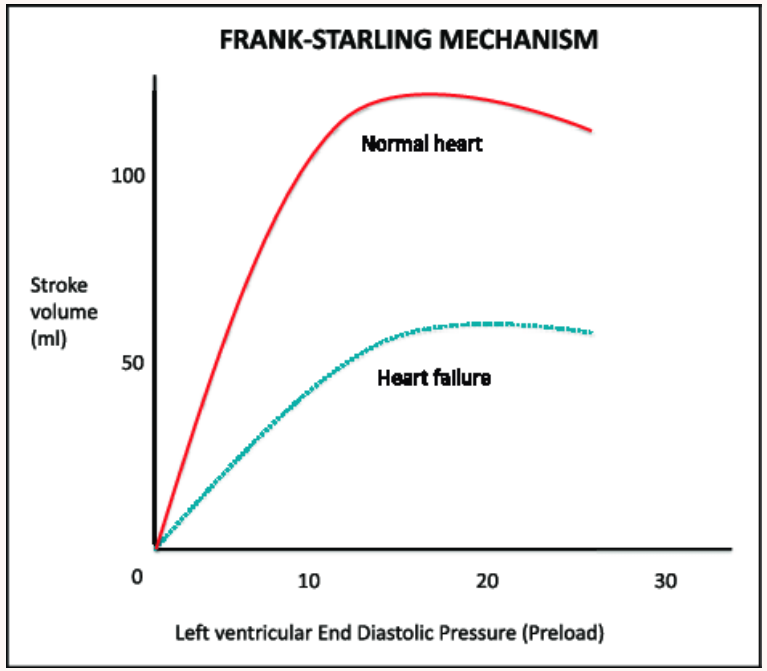
8. Rates of HF hospitalizations have increased from 2014 to 2017.

9. Disparities in social determinants of health and health inequities result in increased mortality and adverse outcomes in individuals with HF or at risk of HF.

10. HF mortality rates have been increasing since 2012.

Bozkurt B, et al. Journal of Cardiac Failure, 2023.

Pathophysiology of Heart Failure



A Review of Key Terminology

- **Stroke volume**: the amount of blood pumped out of the heart from each contraction
- **Cardiac output**: the amount of blood pumped out of the heart in one minute, equivalent to HR x SV
- **Preload**: stretching of cardiomyocytes at the end of diastole.
- **Afterload**: pressure or load against which the ventricles must contract.
- **Inotropy**: refers to myocardial contractility

Frank-Starling law

Stroke Volume: Preload, Myocardial contractility, and Afterload

Mean arterial pressure (MAP): is the average arterial pressure throughout one cardiac cycle. (Cardiac Output, Systemic Vascular Resistance)

Pathophysiology of Heart Failure: Compensatory Mechanisms

- **Increase preload** (increasing venous pressures):

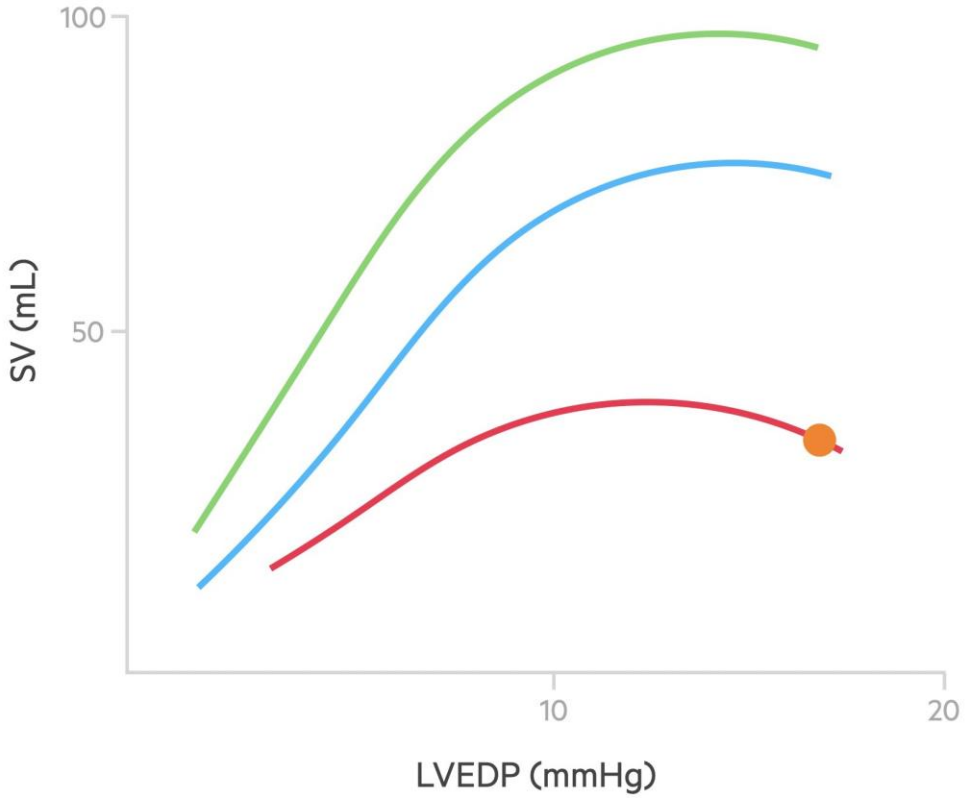
Increases end-diastolic volume (EDV) compensating for the reduced ejection fraction, thus maintaining cardiac output. (Pulmonary Edema, Ascites, peripheral edema)

- **Increasing heart rate**

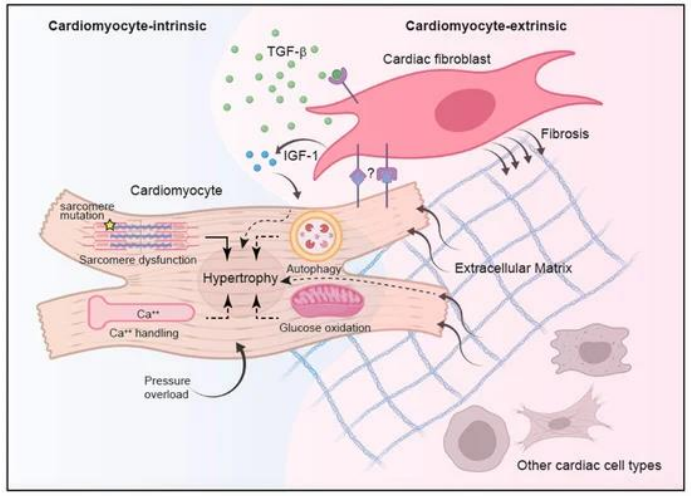
Remember cardiac output = stroke volume x heart rate

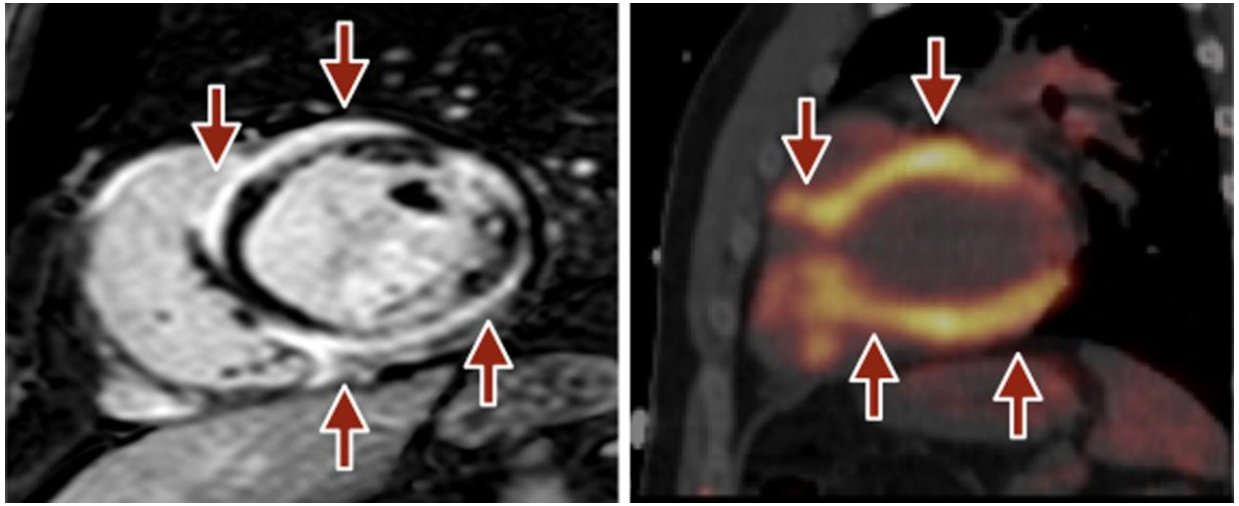
- **Activation of the renin-angiotensin-aldosterone system (RAAS)**

- **Sympathetic nervous system activation**



Pathophysiology of Hypertrophic and Infiltrative Cardiomyopathy





Hypertrophic Cardiomyopathy

Increase in left ventricular wall thickness
causes left ventricular outflow obstruction
Diastolic dysfunction
Myocardial ischemia
Mitral regurgitation.

Infiltrative Cardiomyopathy

Myocardial infiltration (inherited or acquired)
generates an inflammatory response
that can progress to fibrosis.

1.Chou C, Chin MT. International Journal of Molecular Sciences. 2021; 22(16):8933.
2.Patel A, Rashedi N. ournal of the American Heart Association. 9 May 2019. https://doi.org/10.1161/JAHA.119.012715

Heart Failure with Reduced Ejection Fraction (HFrEF) vs. Heart Failure with Preserved Ejection Fraction (HFpEF)

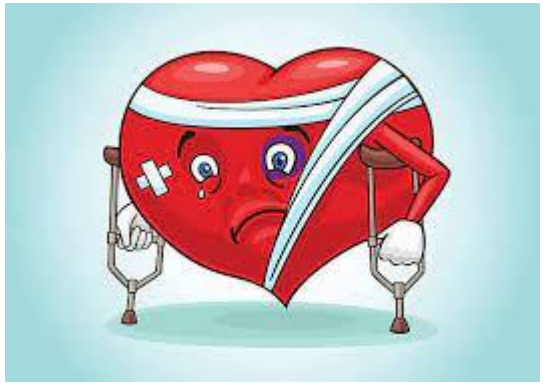
HFeEF: EF <40%[3]

- Ventricle does not fill or contract adequately
- Normal LVEF 60-65%
- Mid Range Ejection Fraction EF 40-50%

HFpEF: EF>50%

- Diastole: Low Pressure and Low tension filling the ventricles
- Stiffness of Heart Muscles Reduces Relaxation and Filling of the Ventricles;
- Heart Strain

3. AHA. Types of Heart Failure. 2023



Etiology of Heart Failure

1. Vascular

These are the most common causes of heart failure.

- Ischemic heart disease (35-40%)
- Hypertension (15-20%)

2. Cardiomyopathy is a common cause of heart failure.

- Dilated cardiomyopathy (30%)
  Autoimmune, infiltrative (sarcoid, amyloid, cancer)
  Alcohol (holiday heart)
- Hypertrophic cardiomyopathy
- Restrictive Cardiomyopathy (sarcoid, amyloid, cancer radiation, hemochromatosis)
- Congenital heart disease

3. Valvular

Valvular disease may lead to either acute or chronic heart failure.

4. Electrical

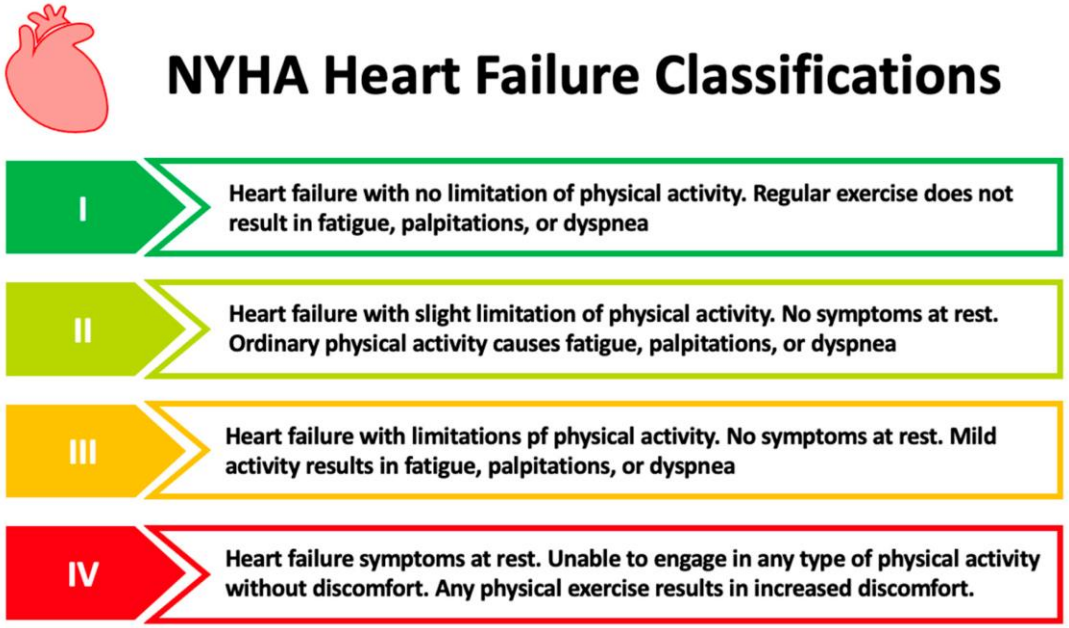
- Arrhythmias (abnormalities of normal conduction) may cause acute heart failure through decompensation.

5. High-output

Typically heart failure is caused by a reduced cardiac output. In some cases, the cardiac output may be raised but the systemic vascular resistance very low. Causes include:

- Anemia
- Septicemia
- Thyrotoxicosis
- Liver failure
- Thiamine deficiency (alcoholics)
- Pregnancy “peripartum cardiomyopathy”

Stage A: At risk for heart failure	People who are at risk for heart failure but do not yet have symptoms or structural or functional heart disease Risk factors for people in this stage include hypertension, coronary vascular disease, diabetes, obesity, exposure to cardiotoxic agents, genetic variants for cardiomyopathy and family history of cardiomyopathy
Stage B: Pre-heart failure	People without current or previous symptoms of heart failure but with either structural heart disease, increased filling pressures in the heart or other risk factors
Stage C: Symptomatic heart failure	People with current or previous symptoms of heart failure
Stage D: Advanced heart failure	People with heart failure symptoms that interfere with daily life functions or lead to repeated hospitalizations



Diagnosis of Heart Failure:

History

American College of Cardiology (ACC) and AHA Guidelines:[4]

Heart Failure Stages based on Heart Structure and Function (A, B, C, D)

New York Heart Association:[5]

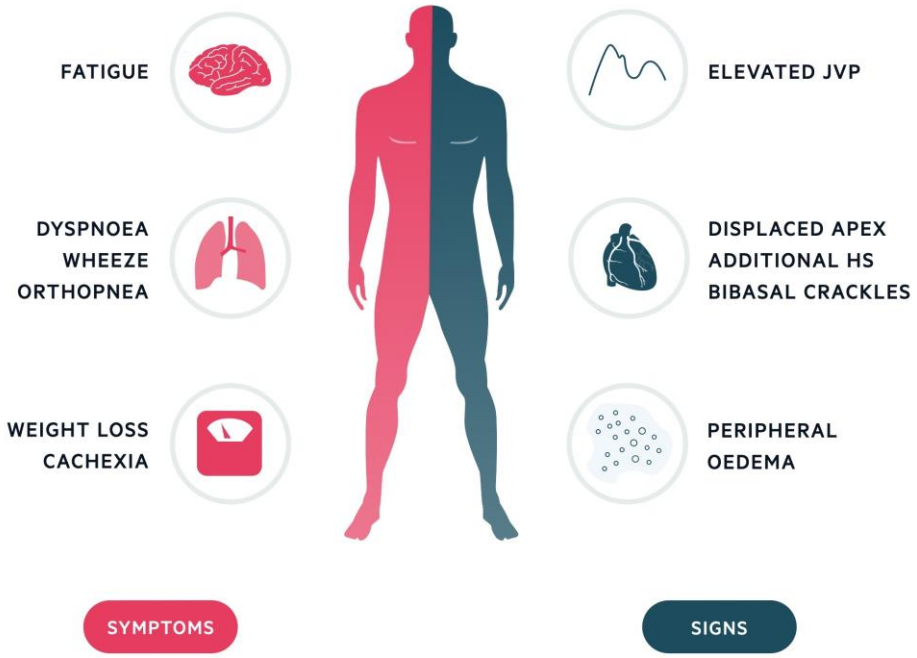
Stages based on patient's physical abilities and symptoms

Boston Criteria:[6]

Higher score more likely heart failure

4. Yancy CW, et al. Circulation. 2013
5. Aaronson KD, et al. Circulation. 1997
6. University of Washington. Seattle Heart Failure Model.

Diagnosis of Heart Failure: Risk Factors and Symptoms



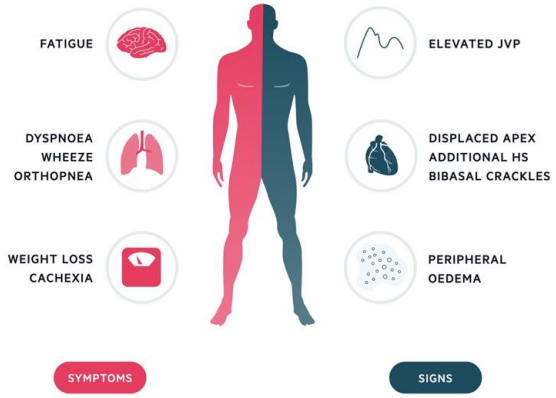
Most Common (earliest) Symptom is Exertional Dyspnea[8]

Risk Factors[7]

- Advanced Age
- Hypertension
- Obesity
- Metabolic Syndrome
- COPD
- Pulmonary Hypertension

7. Guazzi M. Circ Heart Fail. 2014;7(2):367-377

8. Lam C, Lim SL. The Cardiology Advisor. January 20, 2019



Diagnosis of Heart Failure: Physical Exam

- **Vital Signs**: Uncontrolled Hypertension Increases Risk
- **Heart Sounds**: S3 is an indication of Advanced Heart Failure
- **Edema:** pitting in lower extremities, ascites, scrotal edema
- **Boston Criteria**: Elevated Heart Rate and Narrow Pulse Pressure

Lack of Abnormalities on Physical Exam Does NOT exclude Heart Failure as the Diagnosis

Diagnosis of Heart Failure: Lab Testing

NT-proBNP

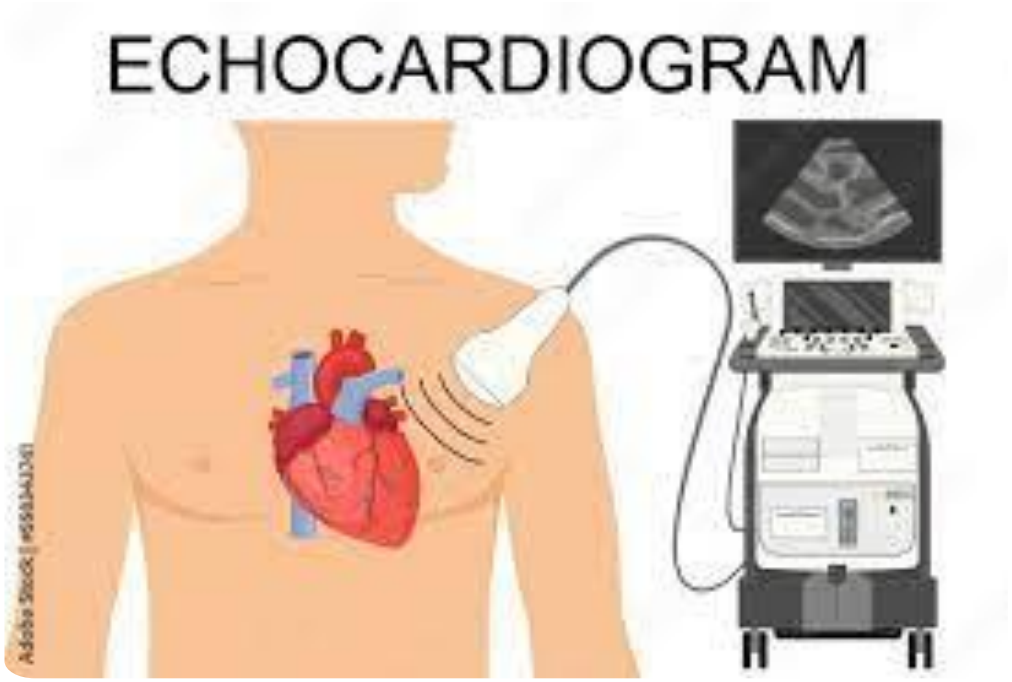
- Elevated NT-proBNP can be used to support heart failure diagnosis
- BNP remains low when patients are asymptomatic
- BNP can also be elevated in chronic kidney disease, renal failure, obesity, medications
- Other cardiac disorders can cause elevated BNP: coronary disease, valvular disease, pulmonary hypertension, sepsis

Troponin[9]

- Elevated level of troponin is associate with poor clinical outcomes and increase in mortality
- Consider ischemia

CBC - exclude anemia and infection
LFT - exclude liver failure
Cholesterol and HbA1c - cardiovascular risk stratification.
TFT - exclude thyroid disease.

9. Peacock WF, et al. N Engl J Med. 2008;358(20):2117-2126.



Diagnosis of Heart Failure: Echocardiogram

- **Recommended for Patients with Signs, Symptoms, and Risk of Heart Failure**
- **Echocardiogram is also recommended for patients with Heart Failure symptoms**
- **Echocardiogram will evaluate LVEF, valvular structures, and wall motion**
- **Echocardiogram should be done annually at a minimum to evaluate effectiveness of treatment and disease progression**

Diagnosis of Heart Failure:

CXR:
- Cardiomegaly (Cardiothoracic ratio > 50% on PA film)
- Alveolar shadowing edema
- Kerley B Pleural effusion

Cardiac MRI:
- May be used when transthoracic echo is non-diagnostic
- May be used to determine the etiology of heart failure

Coronary angiogram: used for diagnostic and therapeutic purposes to diagnose and treat coronary artery disease

Right heart catheterization: reserved for the investigation of right-sided heart failure

Mobile Cardiac Telemetry: if an arrhythmia is suspected

Lung function tests: to exclude alternative pathology impacting on symptoms

Cardiac PYP Scan: to evaluate for cardiac amyloidosis

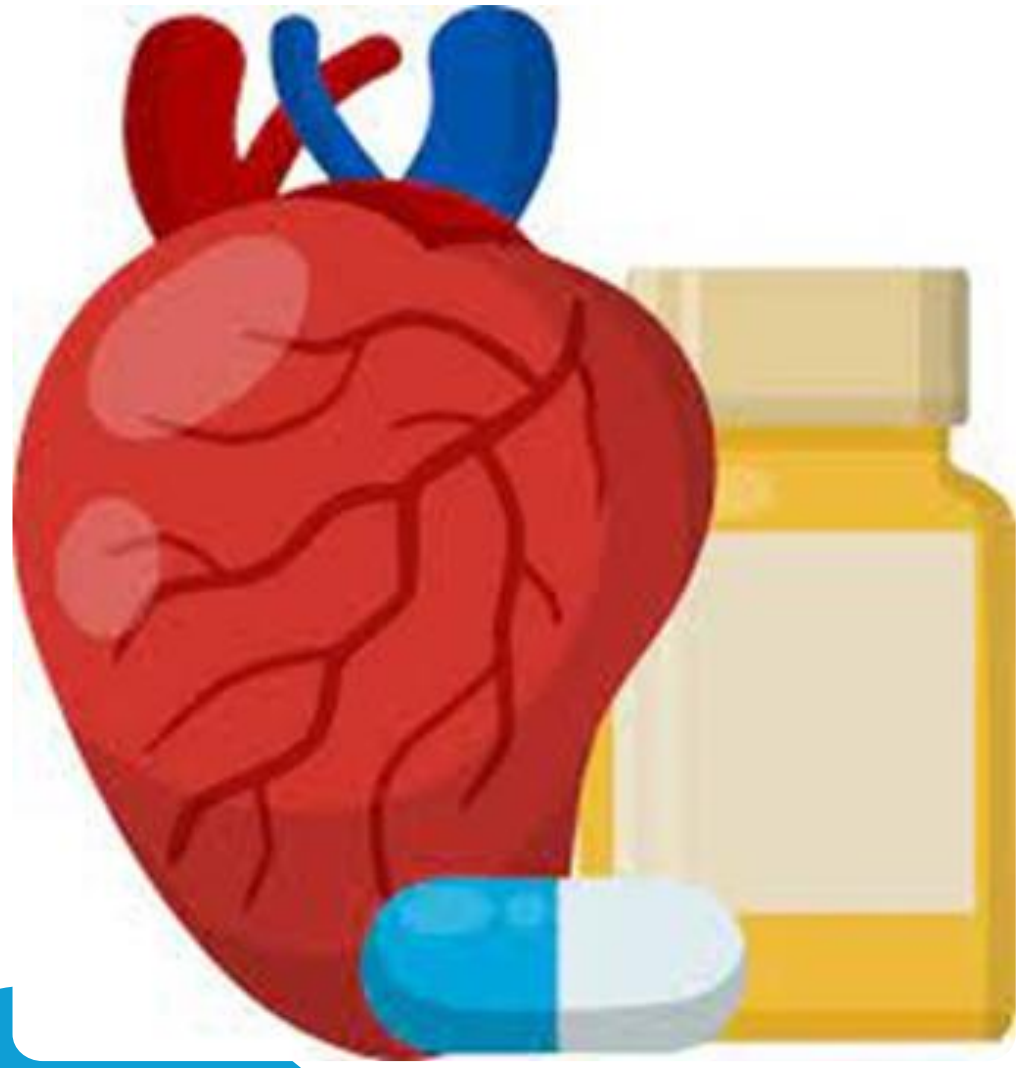
Management of Heart Failure

Nonpharmacological Therapy

- Lifestyle modification and patient education are paramount in treating heart failure
- Consider Palliative Care to Manage treatment expectations
- Social Work to coordinate care

ACC and AHA Treatment Pathway (Medications):

- ARNI, ARB, ACE and
- SGLT-2 inhibitors
- Aldosterone Receptor Antagonist
- Beta Blockers
- Diuretics
- Hydralazine and Isosorbide



Management of Heart Failure: SGLT-2 Adverse Effects

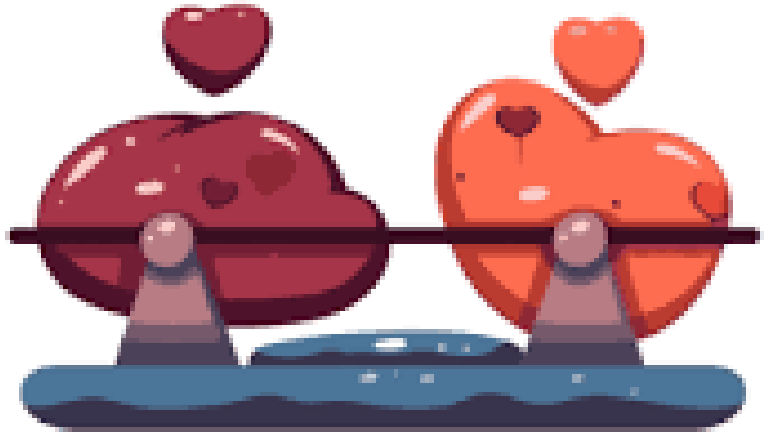
- **Hypoglycemia**

- **Hypotension:** especially when used with diuretics
  - STOP the diuretic

- **Mycotic Infections** (groin area for men)

Management of Heart Failure:

Balancing Creatinine, Blood Pressure, and Fluid Status



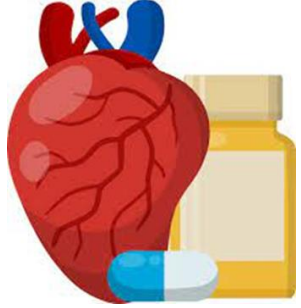
ACC Recommendations

1. Reduce or temporarily stop the medication that is contributing to worsening symptoms.

Reintroduce later at a lower dose

2. SGLT-2 or sacubitril-valsartan (ARNI):

Reduce or remove diuretic



Management of Heart Failure: Pharmacotherapy

If a patient remains symptomatic despite optimal treatment consider :

Digoxin

Ivabradine: Reduce hospitalizations and death in patients with chronic HFrEF[13]

- Stable, symptomatic heart failure
- EF<35%, sinus rhythm, heart rate > 70bpm
- On maximally tolerated beta blockers

Vericiguat: Guanylate Cyclase Stimulator[14]

- VICTORIA Study: vericiguat reduces hospitalizations and CV death compared to Placebo
- Adverse Effects: hypotension, syncope

Furoscix: treatment of fluid overload in adult patients with New York Heart Association (NYHA) Class II and Class III chronic heart failure.

Tafamidis: (cardiac amyloidosis): stabilizes the transthyretin protein and keeps it from misfolding, reducing the levels of the amyloid fibrils that build up in the heart.

13. Shen L, et al. N Engl J Med. 2017;377(1):41-51.

14. Gheorghiade M, et al. Eur Heart J. 2007;28(8):980-988.

Management of Advanced Heart Failure

If a patient remains symptomatic despite optimal treatment consider:

Implantable cardiac defibrillator (ICD): important for primary and secondary prevention of sudden cardiac death (specific indications).

Cardiac resynchronisation therapy (CRT): biventricular pacing, which is indicated in certain patients with HFrEF (≤ 35%) and prolonged QRS. Usually receive combined device with defibrillator.

LVAD: destination versus bridge to transplant

Cardiac transplant: certain patient groups with heart failure.

Heart Failure Clinical Pearls

- A Good History, Physical Exam, and Clinical Suspicion are Important for Diagnosis
- Get an Echocardiogram Early in the evaluation
- Monitor Patients Regularly
- Use a Team Approach (PCP, nephrology, pulmonology, palliative care, social work)
- Use recommended treatment pathways to guide therapy and dosing
- Consider and treat undiagnosed contributing conditions (sleep apnea, valve disorder, pulmonary)

Heart Failure Tools

American College of Cardiology
Treat HF: https://www.acc.org/tools-and-practice-support/mobile-resources
LDL Manager and Calculator
ASCVD Risk

Get with the Guidelines
https://www.ahajournals.org/journal/circoutcomes

MDCalc
https://www.mdcalc.com/calc/3829/gwtg-heart-failure-risk-score

QUESTIONS?

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