

# Heart failure

2022

- Complex clinical syndrome resulting in insufficient blood supply/oxygen to tissues and organs
  - Involves diastolic or systolic dysfunction
  - May include reduced \_\_\_\_\_
- Associated with cardiovascular diseases
- Increase in incidence and prevalence
  - Better survival after cardiac events
  - Aging population
- Costly
  - Most common cause for hospitalization in adults over age 65

# Pathophysiology

## Heart Failure

- Ventricular failure leads to:
  - Low BP
  - Low CO
  - Poor renal perfusion
- Abrupt or sudden onset
- Compensatory mechanisms mobilized to maintain adequate CO

# Risk factors

- Primary Risk Factors
  - Hypertension
    - Modifiable risk factor
    - Properly treated and managed, incidence of HF can be reduced by about 50%
  - CAD
- Co-morbidities contribute to development of HF
  - DM
  - Metabolic syndrome
  - Advanced age
  - Tobacco use
  - Vascular disease

# Etiology

## Primary Causes

- HTN, hypertensive crisis
- CAD
- MI
- Rheumatic heart disease
- Congenital heart defects
- Pulmonary HTN
- Cardiomyopathy
- Hyperthyroidism
- Valvular disorders, stenosis
- Myocarditis

## Precipitating Causes

- Anemia
- Infections
- Thyrotoxicosis and Hypothyroidism
- Dysrhythmias
- OSA
- Pulmonary Embolism
- Nutritional Deficiencies
- Hypervolemia

# LEFT SIDED FAILURE



- Most common form of heart failure
- Results from inability of LV to
  - \_\_\_\_\_ adequately during systole
  - \_\_\_\_\_ adequately during diastole
- Can be further classified as systolic, diastolic, or mixed systolic and diastolic failure

# Pathophysiology

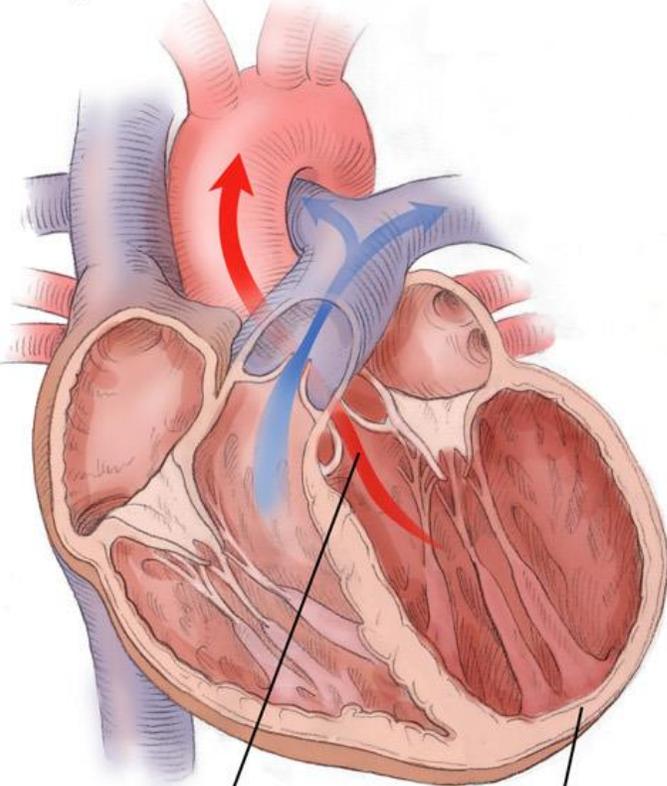
## **Systolic heart failure**

- HF with reduced EF (HFrEF)
- Inability to pump blood forward
- Caused by:
  - Impaired contractile function
  - Increased afterload
  - Cardiomyopathy
  - Mechanical abnormalities
- Decreased LVEF

## **Diastolic heart failure**

- HF with preserved EF (HFpEF)
- Impaired ability of the ventricles to relax and fill during diastole, resulting in decreased stroke volume and CO
- Result of LV hypertrophy from HTN, older age, female, DM, obesity
- Same result as systolic function

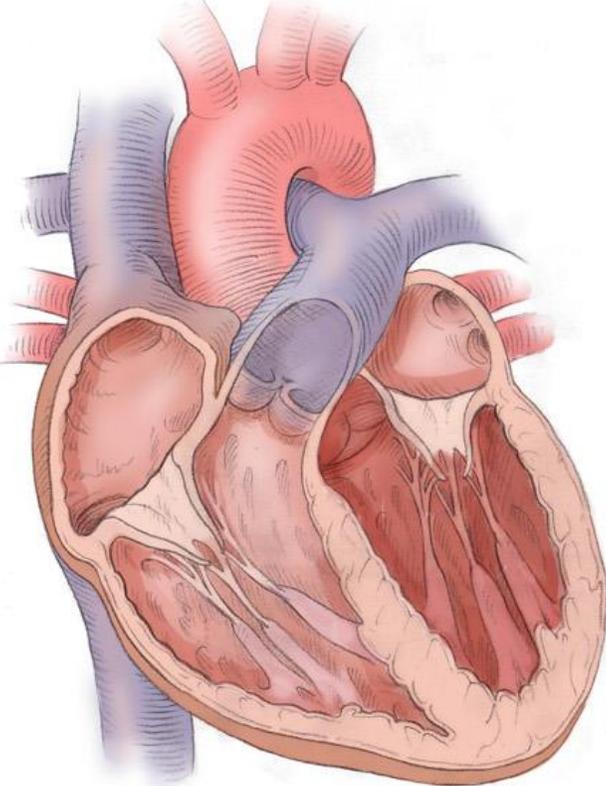
**Systolic Heart Failure**



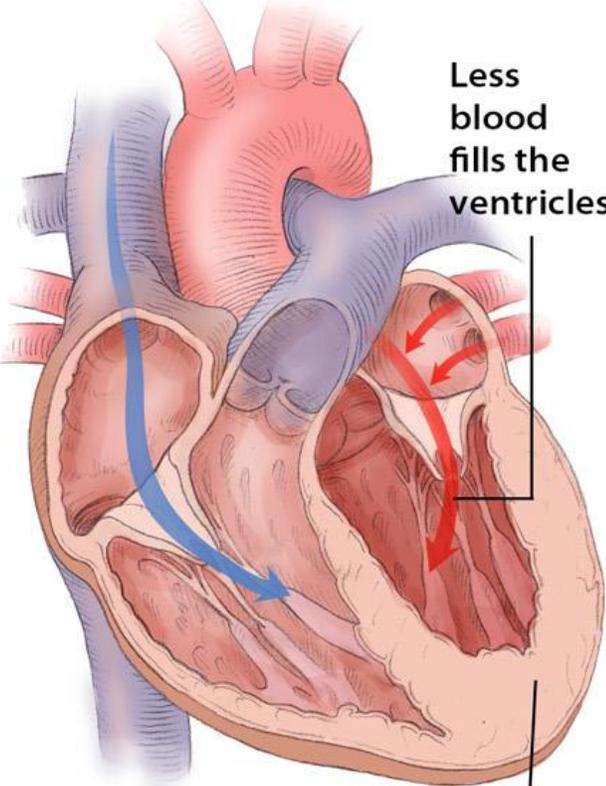
Less blood pumped out of ventricles

Weakened heart muscle can't squeeze as well

**Normal Heart**



**Diastolic Heart Failure**



Less blood fills the ventricles

Stiff heart muscle can't relax normally

# Right-sided heart failure

## Pathophysiology

- Right ventricle fails to pump effectively
  - Fluid backs up into the
- 
- Fluid moves into tissues and organs
  - Left-sided HF is most common cause
  - Other causes include
    - RV infarct
    - PE
    - Cor pulmonale (RV dilation and hypertrophy)

## Expected Findings

### RIGHT SIDED ♥ FAILURE (Cor Pulmonale)



# Mixed Heart Failure

## Pathophysiology

- Seen in disease states such as dilated cardiomyopathy
- Poor EF: <35%
- High pulmonary pressures
- Biventricular failure
  - Both ventricles may be dilated and have poor filling and emptying capacity

# Compensatory Mechanisms: Neurohormonal Response

## SNS Response

- **FIRST**
- Inadequate stroke volume and CO
  - Release of catecholamines (epi and norepi)
    - Increase HR
    - Increase myocardial contractility
    - Peripheral vasoconstriction
  - Initially helpful but then harmful

## Renal Response

- **SECOND**
  - Kidneys release Renin
    - Renin converts angiotensinogen to angiotensin I
    - Angiotensin I is converted to angiotensin II by a converting enzyme made in the lungs.
- What medications do we use to prevent this conversion?
- Angiotensin II causes:
    - Adrenal cortex to release aldosterone
      - (sodium and water retention)
    - Increased peripheral vasoconstriction
      - (increases BP)

# Compensatory Mechanisms: Neurohormonal response

- Low CO causes decrease in cerebral perfusion pressure
- Antidiuretic hormone (ADH) is secreted and causes:
  - Increase H<sub>2</sub>O reabsorption in the renal tubules leading to water retention and increased blood volume
- Endothelin is stimulated by ADH, catecholamines, and angiotensin II
- Results in:
  - Arterial vasoconstriction
  - Increase in cardiac contractility
  - Hypertrophy

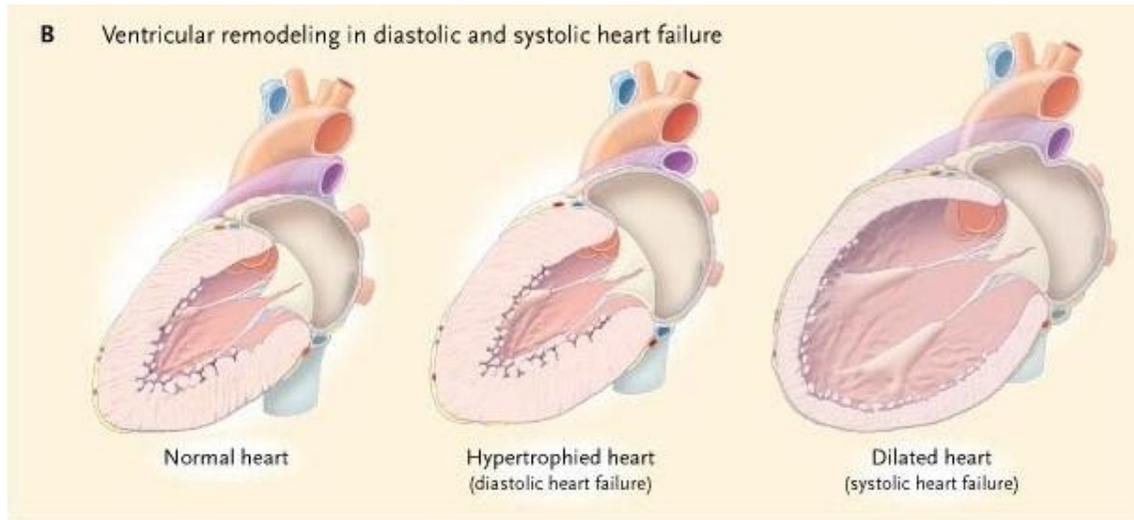
# Compensatory Mechanisms:

- Proinflammatory cytokines (tumor necrosis factor and interleukins) are then released
  - Released by cardiac myocytes in response to cardiac injury
  - Depress cardiac function by causing cardiac hypertrophy, contractile dysfunction, and myocyte cell death
- What this means:
  - Over time a systemic inflammatory response is mounted, resulting in:
    - Cardiac wasting
    - Muscle myopathy
    - Fatigue

# Compensatory Mechanisms: Renin-angiotensin-aldosterone system (RAAS)

- Homeostatic regulatory system
  - Results in BP control and fluid and electrolyte balance
- Fluid and sodium retained in response to stress
  - Causes vasoconstriction to \_\_\_\_\_ BP
- As CO falls, blood flow to kidneys falls and is sensed as a decrease in volume
  - SNS is activated to increase HR and BP
  - Release of aldosterone from adrenal cortex results in Na and H<sub>2</sub>O retention
  - Peripheral vasoconstriction and increased BP
  - Pituitary gland releases ADH which results in H<sub>2</sub>O reabsorption

## Consequences of compensatory mechanisms: Ventricular remodeling



- Continuous activation of hormonal responses (RAAS and SNS)
- Hypertrophy of ventricular myocytes
- Ventricles are larger, but less effective in pumping due to muscle fiber overstretching
- Can cause life-threatening dysrhythmias and sudden cardiac death

# Counter Regulatory Mechanisms: Natriuretic Peptides

- Atrial natriuretic peptide (ANP) – released from atria
- B-type natriuretic peptide (BNP) – released from ventricles
- Released in response to increased blood volume in heart
- Causes diuresis, vasodilation, and lowered BP
- Counteracts effects of SNS and RAAS

# Counter Regulatory Mechanisms: Nitric Oxide and Prostaglandin

- Released from vascular endothelium in response to compensatory mechanisms
- Nitric oxide and prostaglandin relax arterial smooth muscle, resulting in vasodilation and decreased afterload

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**TABLE 34-3 Comparison of ACCF/AHA Stages of Heart Failure and NYHA Functional Classifications**

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

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ACCF, American College of Cardiology Foundation; AHA, American Heart Association; HF, heart failure; NYHA, New York Heart Association.

# Acute Decompensated Heart Failure (ADHF): Clinical Manifestations

- Sudden onset of signs and symptoms
- Requires urgent medical care
- Pulmonary and systemic congestion due to increased left-sided and right-sided filling pressures
- Early → increased pulmonary venous pressure
  - Increase in RR
  - Decrease in PaO<sub>2</sub>
- Later → interstitial edema
  - Tachypnea
- Further progression → alveolar edema
  - Respiratory acidemia

# Pulmonary Edema: Clinical Manifestations

- Anxious, pale, cyanotic
- Cool and clammy skin
- Dyspnea
- Orthopnea (unable to lie flat)
- Tachypnea
- Use of accessory muscles
- JVD
- Cough with frothy, blood-tinged sputum
- Crackles and wheezes
- Tachycardia
- Hypo- or hypertension
- Abnormal S3 or S4

# Acute Decompensated Heart Failure: Clinical Manifestations

- Based on hemodynamic and clinical status, patients can be categorized into one of four groups:
  1. Dry-warm
  2. Dry-cold
  3. Wet-warm
  4. Wet-cold

# Chronic Heart Failure Clinical Manifestations

- Fatigue
- Dyspnea
- Orthopnea
- Paroxysmal Nocturnal Dyspnea
- Tachycardia
- Edema
- Nocturia

## FACES

Fatigue

Activity limitations

Chest congestion/cough

Edema

Shortness of breath

# Chronic Heart Failure

## Clinical Manifestations

- Skin changes
- Behavioral changes
- Chest pain
- Weight changes



# Heart Failure Complications

- Pleural effusion
- Dysrhythmias – atrial and ventricular
- Left ventricular thrombus
- Hepatomegaly
- Renal failure

# Diagnostic Studies

- Determine and treat underlying cause
- Echocardiogram
  - Provides information on EF, heart valves and chambers
- EKG
- X-ray
- Stress test
- MUGA scan
- Heart catheterization
- Endomyocardial biopsy
- BNP levels

# Acute Decompensated HF: Inter-professional Care

- Continuous monitoring and assessment
  - VS, O2 sat, UO
    - Provide supplemental O2 PRN
    - May need BiPAP or even intubation and mechanical ventilation
    - BiPAP is effective in \_\_\_\_\_
- Hemodynamic monitoring if unstable
  - May have invasive lines to monitor arterial BP and pulmonary wedge pressures
- High Fowler's position
  - Decreases preload
- Ultrafiltration (aquapheresis) for patients with volume overload and resistance to diuretics
- Circulatory devices
  - Intraaortic Balloon Pump (IABP)
  - Ventricular Assist Devices (VADs)

# Acute Decompensated HF: Drug Therapy

- Vasodilators

- Reduce circulating blood volume and improve coronary artery circulation
- Reduce systemic vascular resistance
  - IV NTG
  - Sodium Nitroprusside
  - Nesiritide (Natrecor)

- Diuretics:

- Decrease volume overload (preload)
  - Loop diuretics- furosemide (Lasix)

- ACE inhibitors

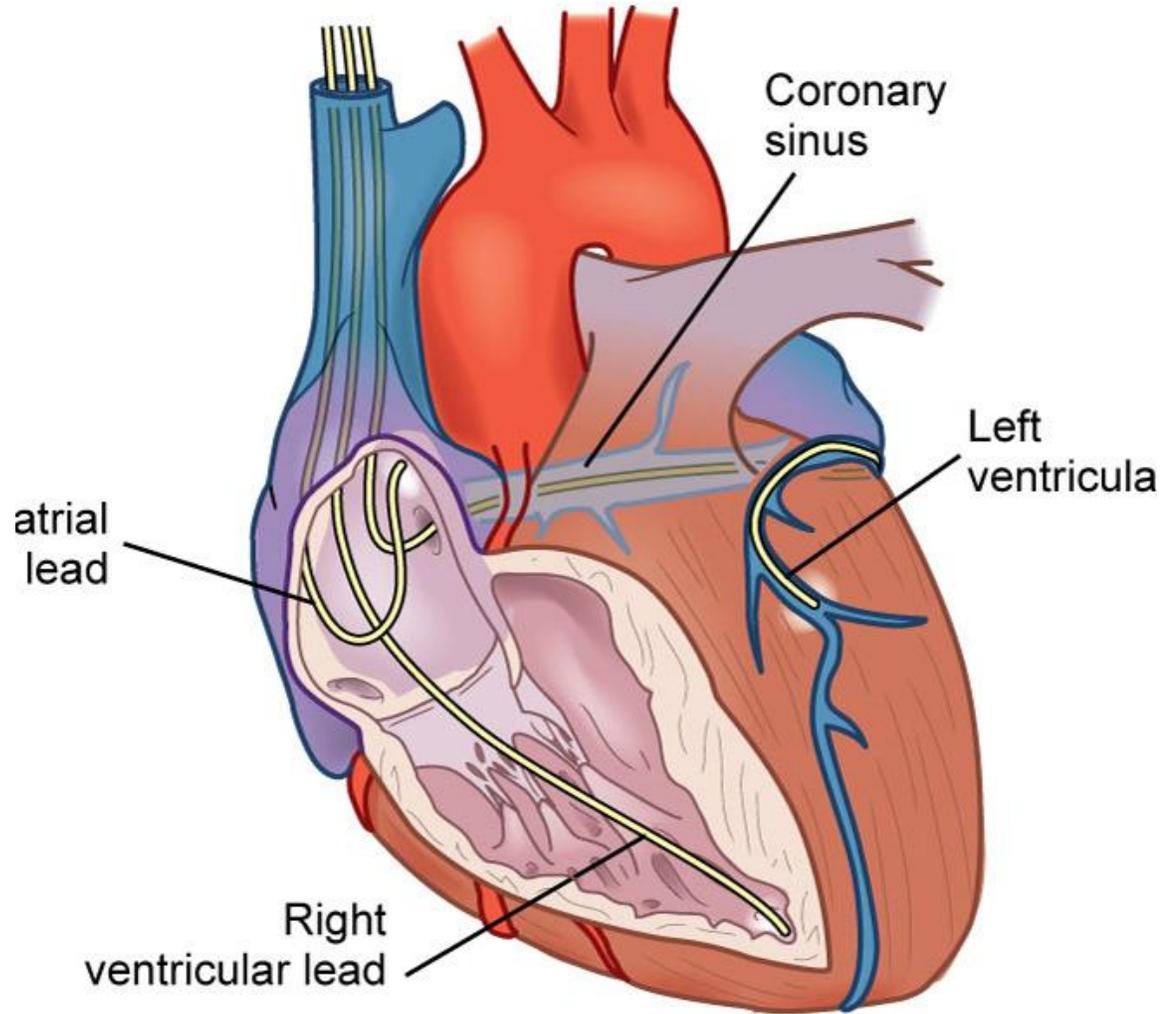
- Decrease afterload
  - Enalapril, captopril (-PRILs)

# Acute Decompensated HF: Drug Therapy

- Morphine
  - Reduces preload and afterload
  - Relieves dyspnea and anxiety
- Positive inotropes
  - Increase myocardial contractility
    - Beta-agonists (dopamine, dobutamine, norepinephrine)
      - Short term for ADHF
    - Phosphodiesterase inhibitor (milrinone)
      - Increases myocardial contractility
      - Promotes peripheral vasodilation
    - Digitalis (digoxin)
      - Increases contractility
      - Increases myocardial oxygen consumption
      - Requires loading dose and time to work- not first line tx
      - Hold for HR <60

# Chronic HF - Main Goals of Treatment

- Treat the underlying cause and contributing factors
- Maximize CO
- Reduce symptoms
- Improve ventricular function
- Improve quality of life
- Preserve target organ function
- Improve Mortality and Morbidity
- O2 therapy
  - Relieves dyspnea and fatigue
- Physical and emotional rest
  - Conserve energy and decrease O2 needs
  - Dependent on severity of HF
- Structured exercise program
  - Cardiac rehab associated with better outcomes
- CardioMems system
  - New implanted device to monitor pulmonary pressures
- Implanted cardioverter-defibrillator (ICD)
- Biventricular pacing/cardiac resynchronization therapy (CRT)
- IABP and VADs bridge to transplant or as destination therapy



# Placement of Pacing leads in Cardiac Resynchronization Therapy

# Chronic HF: Drug therapy

- Diuretics:
  - Reduce edema, pulmonary venous pressure, and preload
  - Promote sodium and water excretion
  - Loop diuretics
  - Thiazide diuretics
- RAAS inhibitors
  - ACE inhibitors
  - Angiotensin II receptor blockers
  - Aldosterone antagonists
  - Monitor potassium levels (hyperkalemia)

# Chronic HF: Drug therapy

- Beta Blockers
- Vasodilators
  - Nitrates
- Combination therapy
  - BiDil
- Positive inotropic agents
  - Digitalis (Digoxin)
    - Decreases preload
    - First SEs of digoxin toxicity are GI disturbances (nausea, vomiting)
- Inhibitor of cardiac sinus node
  - Ivabradine (Corlanor)
  - Must be in sinus rhythm with resting HR of  $\geq 70$  bpm and taking highest dose beta-blockers
    - Inhibits sinus node
    - Reduces HR
    - Decreases risk of hospitalization for worsening HF

# Chronic HF: Nutritional therapy

- Low sodium diet
  - Individualize recommendations and consider cultural background
  - Recommend *Dietary Approaches to Stop Hypertension* (DASH) diet
  - Sodium is usually restricted to 1500mg/day
- Fluid restriction not generally required
- If required, <2L/day
  - Ice chips, gum, hard candy, mouth care, ice pops to help thirst
- Daily weights important
  - Same time, same clothing each day
- Weight gain of \_\_\_\_\_ lbs over 2 days or a \_\_\_\_\_ lb. gain over a week should be reported to HCP

# Chronic HF:

## Nursing Assessment: Subjective Data

- Past health history
  - Cardiac history or diseases that increase risk for cardiac dysfunction
- Drugs
  - Cardiac drugs, estrogens, corticosteroids, NSAIDs, OTC drugs, herbs
- Fatigue, depression, anxiety
- Usual sodium intake
- Nausea, vomiting, anorexia
- Stomach bloating
- Weight gain
- Ankle swelling (edema)
- Nocturia
- Decreased daytime UO
- Constipation
- Dyspnea, orthopnea, cough
- Palpitations
- Dizziness, fainting
- Number of pillows used for sleeping
- PND
- Insomnia
- Chest pain or heaviness
- RUQ pain, abdominal discomfort
- Behavioral changes
- Visual changes

# Chronic HF:

## Nursing Assessment: Objective data

- Skin color and temperature
- Edema
- RR and sounds
- Frothy, blood-tinged sputum
- HR and sounds
- Abdominal distention
- Changes in LOC
- Serum electrolytes
- BUN, creatinine
- LFTs
- NT-proBNP or BNP
- CXR
- Echocardiogram
- EKG
- O2 saturation

# Chronic HF

## **Nursing Diagnoses**

- Impaired gas exchange
- Decreased cardiac output
- Excess fluid volume
- Activity intolerance

## **Planning/ Overall Goals**

- Decrease in symptoms
- Decrease in peripheral edema
- Increase in exercise tolerance
- Compliance with treatment regimen
- No complications related to HF

# Nursing Implementation

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## Health Promotion

Interprofessional communication and decision making WITH patient and family

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Identify and treat risk factors for HF to prevent or slow progression

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# Nursing Interventions

## Basic Principles of Care

- HF is a progressive disease: establish treatment plans and quality of life goals
- Use of self-management tools for symptom management
- Restrict salt (and water at times)
- Conserve energy
- Maintain support systems

- Monitor resp status PRN Administer O2
- Semi-Fowler's position hemodynamic status Monitor
- Daily weights I&O
- Administer Rx drugs Monitor edema
- Alternate rest with activity
- Provide diversional activities
- Monitor response to activity
- Collaborate with OT/PT Reduce anxiety
- Evaluate support system Patient teaching

# Ambulatory care

- Explain to patient and caregiver physiologic changes that have occurred
- Assist patient to adapt to both physiologic and psychologic changes
- Include patient and caregiver(s) in overall care plan

# Patient teaching

- Assess the knowledge of illness and the treatment plan
- S/Sx of exacerbations- what to do/report
- Importance of early detection
- Can have positive outlook with chronic health problem if tx plan is followed

# Patient Teaching - Drug Therapy

Expected actions

Signs of drug toxicity

How to take HR and what to report

S/sx of hypo and hyperkalemia

BP monitoring PRN

# Patient Teaching Dietary Therapy

- Written plan
- Reading labels for sodium
- No added salt
- Daily weights
- Smaller, more frequent meals

# Patient teaching: activity/rest

- Energy-conserving and energy-efficient behaviors
- Exercise training (cardiac rehab)
- Increase gradually
- Avoid heat and cold extremes
- Rest after exertion
- Avoid emotional upsets

# Patient Teaching

## Ongoing monitoring

- Know *FACES*
- Reappearance of symptoms
- What to report
- Regular follow-up
- Support group

## Health promotion

- Vaccinations
- Reduce risk factors

### FACES

F  
A  
C  
E  
S



Home-Based Telehealth Monitoring

# Evaluation

- Monitoring to assess outcomes and prevent/limit future hospitalizations
  - VS
  - Weight
  - SpO2
  - Dyspnea
- Home health nurses can be essential
- Can use electronic monitoring

# Heart Transplant

- Treatment of choice for patients with refractory end-stage HF, inoperable CAD, and cardiomyopathy
  - 3,000 on list; average 2,000 available
  - Survival rate of 85-90% at 1 year, 75% ta 3 years
- Selection process identifies patients who would most benefit from a new heart
- Candidates must undergo physical, diagnostic, and psychologic evaluation
- Transplant candidates are placed on a list
  - Stable patients wait at home and receive ongoing medical care
  - Unstable patients may require hospitalization for more intensive therapy
  - Overall waiting period for a heart is long; patients may die while waiting.

# Heart transplant

- Heart retrieval from donor is first step
- Second step is removal of recipient's heart except for portions of the atria (2 different approaches) and venous connections
- Final step is implantation of donor heart
- Cardiopulmonary bypass is needed to maintain oxygenation and perfusion to vital organs

# Heart transplant

- Post transplantation monitoring
  - Acute rejection
  - Infection
  - Malignancy
  - Cardiac Vasculopathy
- Immunosuppressive therapy
- Endomyocardial biopsy
  - To detect rejection- weekly for first month, monthly for 6 months, then yearly
- Nursing care focuses on:
  - Promoting patient adaptation to the transplant process
  - Monitoring cardiac function
  - Managing lifestyle changes
  - Providing ongoing teaching

A patient with a history of chronic heart failure is hospitalized with severe dyspnea and a dry, hacking cough. Assessment findings include pitting edema in both ankles, BP 170/100 mm Hg, pulse 92 beats/minute, and respirations 28 breaths/minute. Which explanation, if made by the nurse, is *most* accurate?

- a. “The assessment indicates that venous return to the heart is impaired, causing a decrease in cardiac output.”
- b. “The myocardium is not receiving enough blood supply through the coronary arteries to meet its oxygen demand.”
- c. “The manifestations indicate impaired emptying of both the right and left ventricles, with decreased forward blood flow.”
- d. “The patient’s right side of the heart is failing to pump enough blood to the lungs to provide systemic oxygenation.”

A patient with left-sided heart failure is prescribed oxygen at 4 L/min per nasal cannula, furosemide (Lasix), spironolactone (Aldactone), and enalapril (Vasotec). Which assessment should the nurse complete to *best* evaluate the patient's response to these drugs?

- a. Observe skin turgor
- b. Auscultate lung sounds
- c. Measure blood pressure
- d. Review intake and output

The home care nurse visits a patient with chronic heart failure who is taking digoxin (Lanoxin) and furosemide (Lasix). The patient complains of nausea and vomiting. Which action is *most* appropriate for the nurse to take?

- a. Notify the health care provider immediately.
- b. Perform a dipstick urine test for protein.
- c. Have the patient eat foods high in potassium.
- d. Ask the patient to record a weight every morning.