Student Lecture #1

Heart Failure: 4 hours

Audience: Nursing students

Heart Failure

Chapter 34

4 Hour Student Lecture

Objectives

- To convey the prevalence, risk factors for, diagnosis, and prognosis with heart failure
- Explain the physiological basis for the clinical manifestations of heart failure
- Describe expected clinical assessment findings for patients with heart failure
- Monitor the laboratory values/diagnostics for patients with heart failure
- Describe current evidence-based pharmacological guideline recommendations for heart failure therapy
- Identify the four Heart Failure Core Measures required by the Joint Commission
- Identify priority problems for patients with heart failure, including impaired gas exchange
- To highlight the benefits of device therapy and disease management for heart failure
- Formulate a teaching plan for patients and families regarding heart failure
- Evaluate the status of patients with end-stage heart failure regarding advance directives
- Provide the patient with heart failure and the family information on discharge to home, hospice, or other community-based setting
- Describe the indications for heart transplantation and the nursing care of heart transplant recipients

Heart Failure (HF)

- Clinical syndrome resulting in insufficient blood flow to meet the O2 needs of tissues and organs
- Associated with numerous cardiovascular diseases (CVD)
  - Hypertension, coronary artery disease (CAD), myocardial infarction (MI)
- Most common reason for hospital admission in adults > 65 years
  - ~25% discharged with heart failure are readmitted within 30 days

How can we prevent hospital readmissions?

HF Risk Factors

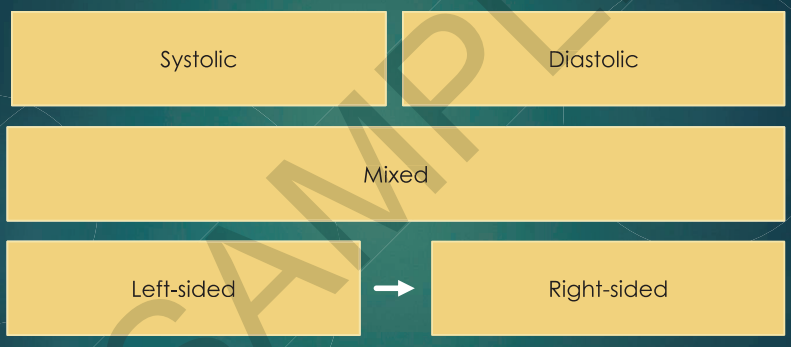
- Primary risk factors
  - Hypertension
  - Coronary Artery Disease (CAD)
- Contributing factors
  - Diabetes
  - Metabolic syndrome
  - Advanced age
  - Tobacco use
  - Vascular disease

HF Etiology

- Caused by any interference with the normal mechanisms regulating cardiac output (CO)

1. **Primary causes** (directly damage the heart)
   - Hypertension, valvular disorders
2. **Precipitating causes** (increase workload of the heart)
   - Pulmonary embolism, obstructive sleep apnea, infection

HF Pathophysiology

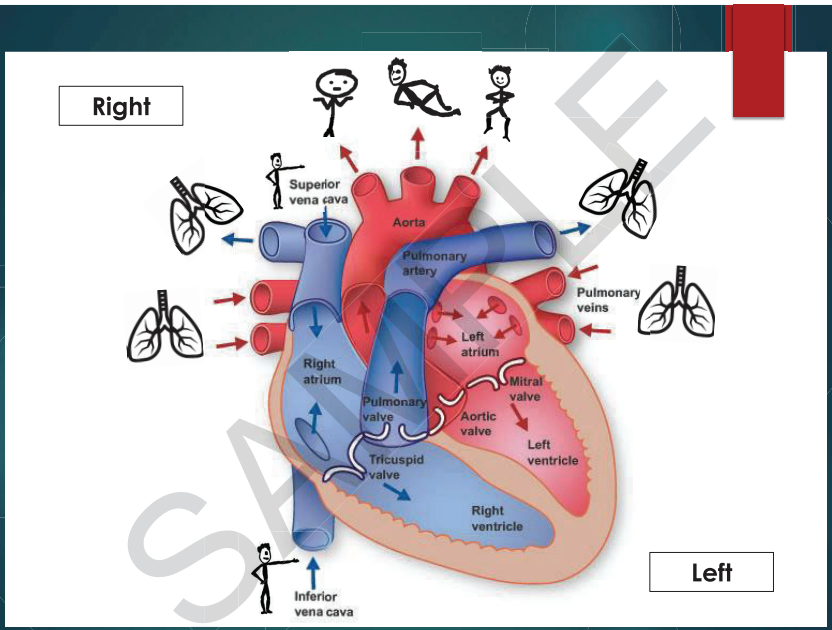


HF Pathophysiology

Acute Decompensated (ADHF)

HF Pathophysiology

- Cardiac output (CO) = heart rate (HR) X stroke volume (SV)
  - CO depends on preload, afterload and contractility
- Stroke volume
  - Volume of blood pumped from the left ventricle per beat
- Preload
  - Amount ventricle is stretched before contraction
- Afterload
  - Pressure ventricle must overcome to eject blood
- Contractility
  - Ability to contract



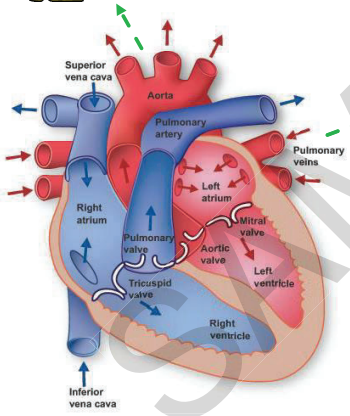
Left-Sided HF

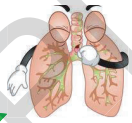
- Left-sided
  - Systolic
  - Diastolic
  - Mixed

- Results from inability of left ventricle (LV)
  1. Empty adequately during **systole**
  2. Fill adequately during **diastole**

Forward failure – fails to pump enough blood to body

- Fatigue
- ↓ urine output
- ↑ or irregular HR





Backward failure – not able to receive enough blood into heart = congestion

- Pulmonary edema
- Difficulty breathing
- Dry, hacking cough
- Frothy, pink tinged phlegm

Left- Sided

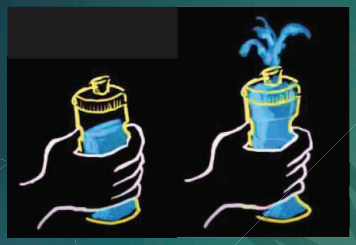
Systolic HF (HFrEF)

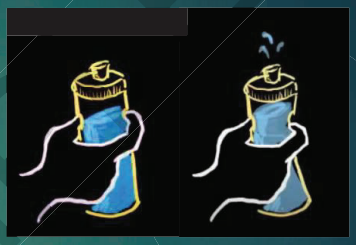
- Left-sided
  - Systolic
  - Diastolic
  - Mixed

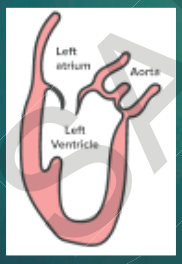
- Heart failure with reduced ejection fraction (EF) – HFrEF
  - **EF <45% (book)**
  - **EF ≤40% (ACCF/AHA)**
- Results from inability of left ventricle (LV) to empty adequately during systole
  - ↓ stroke volume
  - ↓ force of contraction (inotrope)

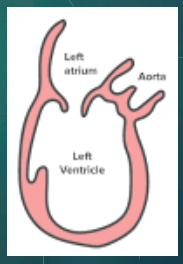
Normal

Systolic HF









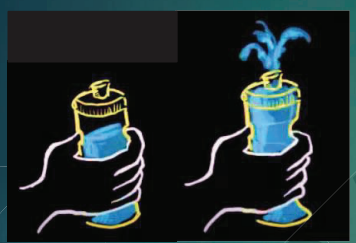
Diastolic HF (HFpEF)

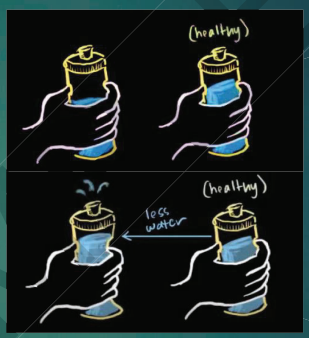
- Left-sided
  - Systolic
  - Diastolic
  - Mixed

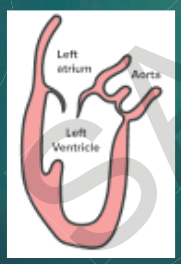
- Heart failure with preserved ejection fraction (EF) – HFpEF
  - Normal EF 55-60%
- Results from inability of left ventricle (LV) to fill adequately during diastole
  - Hypertension

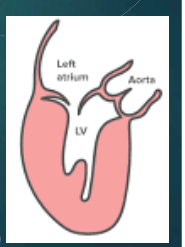
Normal

Diastolic HF









Mixed Systolic and Diastolic HF

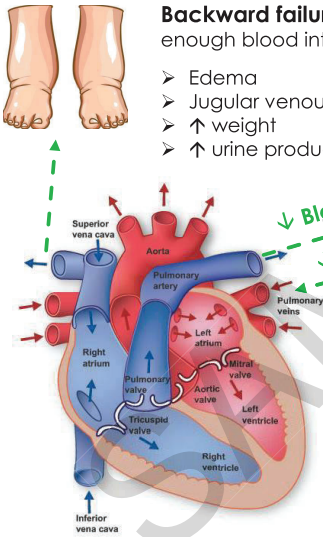
- Left-sided
  - Systolic
  - Diastolic
  - **Mixed**

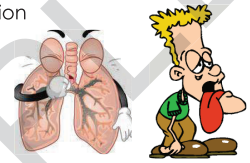
- Seen in
  - Dilated cardiomyopathy (DCM)
- Generally have
  - Poor EF (<35%)
  - High pulmonary pressure
  - Biventricular failure
    - Both ventricles are dilated and have poor filling and emptying capacity

Right-Sided HF

- Systolic
- Diastolic
- Mixed
- Left-sided → **Right-sided**

Right-sided HF usually caused by left-sided HF





Backward failure – not able to receive enough blood into heart from body

- Edema
- Jugular venous distention
- ↑ weight
- ↑ urine production

↓ Blood
↓ O_2

Forward failure – fails to pump enough blood to lungs, resulting in ↓ O_2

- Fatigue
- ↑ HR

Right-Sided

Overall Clinical Manifestations

- Fatigue
- Dyspnea
- Paroxysmal nocturnal dyspnea (PND)
- Tachycardia
- Edema
- Nocturia
- Skin changes
- Behavioral changes
- Chest pain
- Weight changes

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	
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	IV	Unable to carry on any physical activity without symptoms of HF, or symptoms of HF at rest

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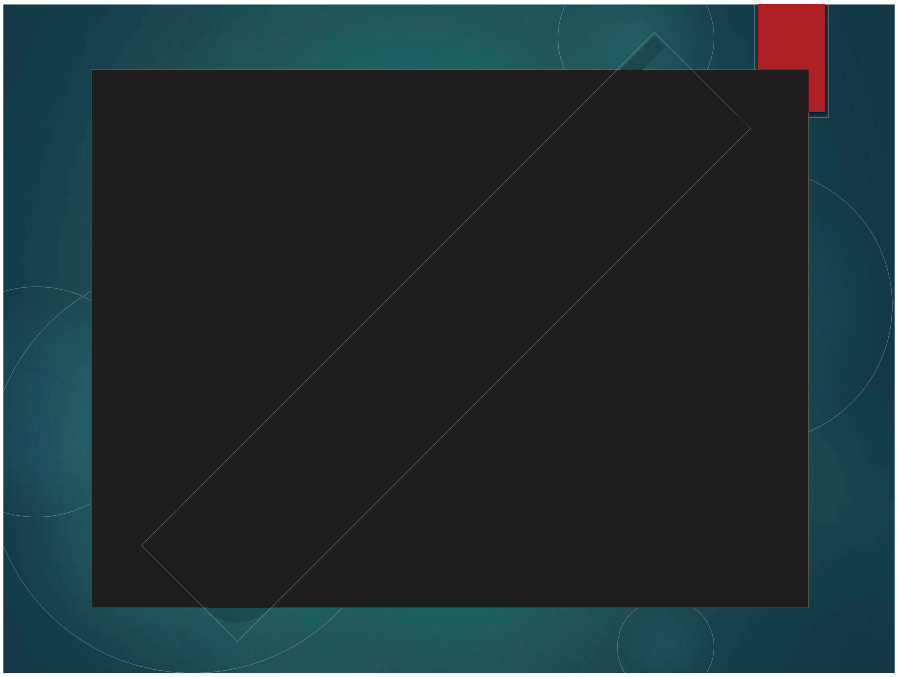
ACCF, American College of Cardiology Foundation; *AHA*, American Heart Association; *HF*, heart failure; *NYHA*, New York Heart Association.

Compensatory Mechanisms

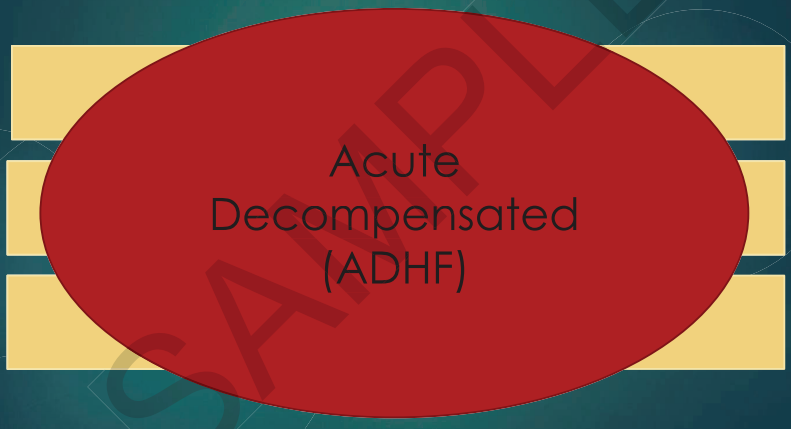
- Heart uses compensatory mechanisms to maintain CO
  1. Neurohormonal responses
     - Renin-angiotensin-aldosterone system (RAAS)
     - Sympathetic nervous system (SNS)
  2. Ventricular dilation
  3. Ventricular hypertrophy



Complications

- Pleural effusions
- Dysrhythmias
- Left ventricular thrombus
- Hepatomegaly
- Renal failure

ADHF



ADHF

- Sudden onset of signs and symptoms of HF requiring urgent medical care
- Result of disease progression
- Universal finding
  - Pulmonary and systemic congestion

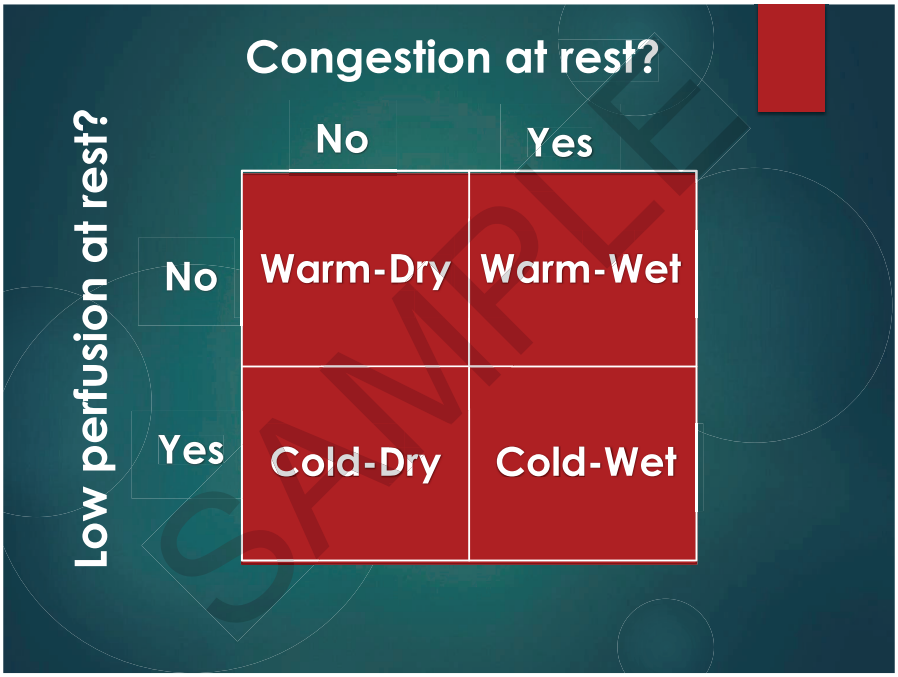
ADHF Clinical Manifestations

- Early – Increased pulmonary venous pressure
  - Increase in respiratory rate
  - Decrease in PaO_2
- Later – interstitial edema
  - Tachypnea
- Further progression – alveolar edema
  - Respiratory acidemia

ADHF Clinical Manifestations

- Pulmonary edema!
  - Life threatening situation – alveoli fill with fluid
  - Left-sided HF secondary to CAD

- Dyspnea
- Orthopnea
- Jugular venous distention
- Anxious
- Pale, cyanotic
- Clammy and cold skin
- RR >30 breaths/minute
- Wheezing
- Coughing
- Blood-tinged sputum
- Crackles/wheezes in lungs
- Rapid HR



Diagnosis

- Primary goal
  - Identify the underlying cause
- Difficult!
  - Signs and symptoms not highly specific and mimics other medical conditions

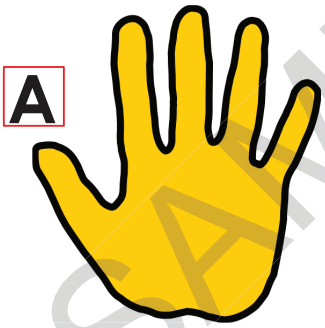
Diagnostic Studies

- Echocardiogram
  - Provides information on EF (HFpEF vs. HFrEF)
  - Heart valves (structure and function)
  - Heart chambers (enlargement or stiffness)
- Laboratory studies
  - BNP
- Other
  - Electrocardiogram (ECG), chest x-ray, 6 minute walk test, multi-gated acquisition (MUGA) scan, cardiopulmonary exercise stress test, heart catheterization → endomyocardial biopsy (EMB)

Pharmacologic Treatment

- Renin-angiotensin-aldosterone system inhibitors
- Beta-adrenergic blockers
- Diuretics
- Positive inotropes
- Vasodilators
- Cardiac sinus node inhibitor
- Anticoagulants

Pharmacologic Treatment



Ace Inhibitor (ACE-I)

- Benazepril (Lotensin)
- Enalapril (Vasotec)

Angiotensin II Receptor Blocker (ARB)

- Losartan (Cozaar)
- Valsartan (Diovan)

ARNI

- Valsartan/sacubitril (Entresto)

ACE Inhibitors

Reduce preload and afterload	Improve survival	Decrease symptoms

Mechanism of Action

- Inhibits angiotensin converting enzyme (ACE), which
  - Prevents conversion of angiotensin I to angiotensin II, resulting reduced levels of angiotensin II
    - Decreased plasma aldosterone levels
    - Decreased SNS activity
    - Vasodilation
    - Sodium and water excretion

Angiotensin II Receptor Blocker

Similar benefits as ACE inhibitors

Mechanism of Action

- Block the action of angiotensin II by preventing angiotensin II from binding to angiotensin II receptors on the muscles surrounding blood vessels
  - Results in vasodilation

ARNI

Approved in 2015 by FDA and indicated to reduce the risk of cardiovascular death and hospitalization in patients with chronic HF (NYHA Class II-IV) and reduced EF

Mechanism of Action

- Sacubitril + Valsartan
  - Sacubitril = blocks neprilysin, therefore raises BNP and ANP levels which helps maintain cardiac function
  - Valsartan = Angiotensin II receptor blocker

Side Effects

- Hyperkalemia
- Angioedema
- Renal insufficiency
- Hypotension

- ACE Inhibitors – Cough!
- ARB's – No cough!

Monitoring/Clinical Pearls

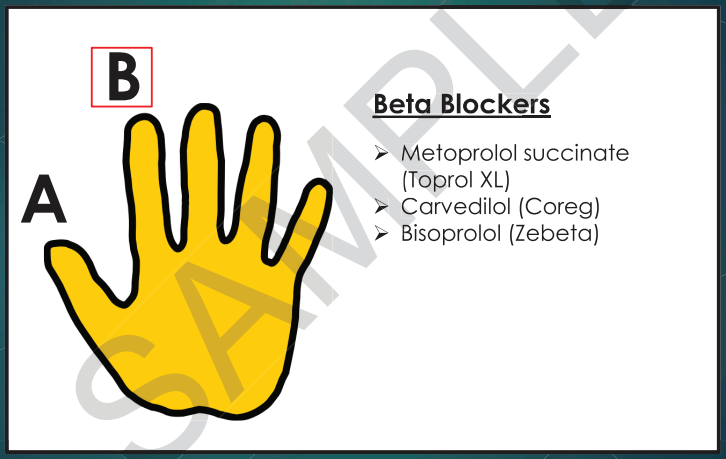
- Titrate to reduce symptoms, not blood pressure
- ACE + ARB = No!
- BBW:
  - Can cause injury and death to developing fetus
  - Pregnancy category D

Na	Cl	BUN	Glucose
K	CO2	SCr	

Brand-Generic!!!

Benazepril	Diovan
Valsartan	Lotensin
Enalapril	Vasotec

Pharmacologic Treatment



Metoprolol succinate vs. tartrate?

Beta Blockers

Decrease afterload	Decrease mortality
Improve ejection fraction (EF)	Reduce symptoms

Mechanism of Action

- Antagonize effects of catecholamines at beta-1 and beta-2 adrenergic receptors, resulting in
  - Reduced vasoconstriction
  - Improve ventricular systolic function

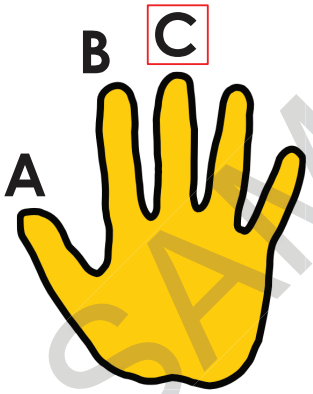
Side Effects

- Edema
- Hypotension
- Fatigue
- Dizziness
- Decreased heart rate

Monitoring/Clinical Pearls

- Heart rate
- Should not be withdrawn abruptly – taper
- Only 3 proven to reduce mortality!
  - Which ones?!

Pharmacologic Treatment



Aldosterone Antagonist (Stage C HFrEF)

- Spironolactone (Aldactone)
- Eplerenone (Inspra)

Aldosterone Antagonist

Reduce morbidity and mortality
Add to therapy when progressed to NYHA Class III or IV

Mechanism of Action

- Block effects of aldosterone on the heart blood vessels
  - Increased excretion of Na, chloride, and water
  - "Potassium-sparing diuretics" – retain potassium

  - Spironolactone – non-selective
  - Eplerenone – selective

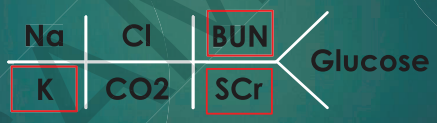
Side Effects

- Hyperkalemia
- Increase in SCr

- Spironolactone
  - Gynecomastia, breast tenderness
  - BBW: Tumor risk

Monitoring/Clinical Pearls

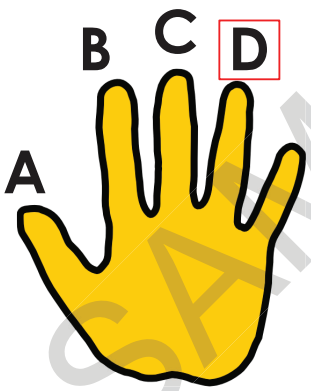
- CAUTION in patients taking digoxin (hyperkalemia can reduce levels of digoxin)
- CAUTION with foods high in potassium (bananas, oranges)



Brand-Generic!!!

Metoprolol Succinate	Lopressor
Spironolactone	Aldactone
Metoprolol Tartrate	Toprol XL

Pharmacologic Treatment



Digitalis Glycoside

- Digoxin (Lanoxin)

Digitalis Glycoside

Does not decrease mortality
Reduces symptoms, improve QOL, and increase exercise tolerance

Mechanism of Action

- Positive inotrope
  - Increases force of contraction
- Increase cardiac output
- Decrease heart rate

Side Effects

- Dizziness
- Diarrhea
- Mental disturbance
- Toxicity!

Digoxin Toxicity

- Signs of toxicity
  - Nausea/vomiting
  - Anorexia
  - Fatigue/headache
  - Visual changes – green-yellow halo
  - Dysrhythmia/bradycardia
- Increase risk of toxicity
  - Hypokalemia, hypomagnesemia, hypercalcemia
- Treatment
  - Withhold drug until symptoms subside
  - DigiFab

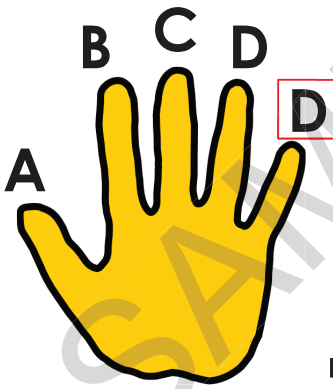
Monitoring/Clinical Pearls

Na	Cl	BUN	Glucose
K	CO2	SCr	

Ca, Mg, ECG

Drug level
0.5-0.9 ng/mL

Pharmacologic Treatment



Diuretics

Loop
- Furosemide (Lasix)
- Bumetanide (Bumex)

Thiazide
- Hydrochlorothiazide (HCTZ)
- Metolazone (Zaroxolyn)

***Aldosterone Antagonist = Potassium Sparing Diuretics**

Diuretics

Mainstay of treatment in patients with volume overload (edema)

Mechanism of Action

- Promote sodium and water excretion
- Decrease preload
- Decrease pulmonary venous pressure

Side Effects

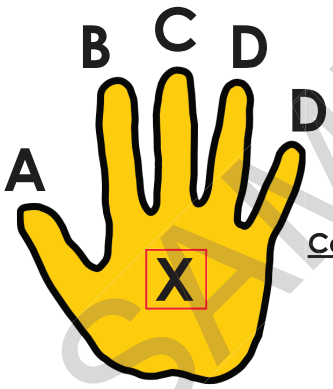
- Orthostatic hypotension
- Decreased electrolytes
  - Decreased potassium
- Ototoxicity
- Sulfa allergy

Monitoring/Clinical Pearls

- Effective in relieving symptoms, however can exacerbate HF
  - Use lowest effective dose

Na	Cl	BUN	Glucose
K	CO2	SCr	

Pharmacologic Treatment



Vasodilators

- Hydralazine (Apresoline)
- Isosorbide dinitrate/hydralazine (BiDil)
- Isosorbide dinitrate (Isordil)
- Nitrates

Cardiac Sinus Node Inhibitor

- Ivabradine (Corlanor)

Cardiac Sinus Node Inhibitor

Reduces risk for hospitalization

Mechanism of Action

- Inhibits sinus node and reduces HR

Side Effects

- Symptomatic bradycardia
- Increase blood pressure
- Atrial fibrillation
- Vision disturbance (flashes of light)

Monitoring/Clinical Pearls

- Patient must be in sinus rhythm with a resting HR of at least 70 beats per minute
- Must be taking a beta-blocker at the highest dose tolerated

- HR
- BP

Vasodilators

Improves survival, increases exercise tolerance

Mechanism of Action

- Hydralazine
  - Arterial vasodilator
  - Decreases afterload
- Nitrates
  - Vasodilation
  - Reduces preload

Side Effects

- Hydralazine
  - Headache, nausea, anorexia
  - Tachycardia, angina
  - Flushing, peripheral edema
  - Lupus like syndrome
- Nitrates
  - Reflex tachycardia
  - Nausea, headache, dizziness, syncope, orthostatic hypotension

Monitoring/Clinical Pearls

- Hydralazine, isosorbide dinitrate, nitrates
  - HR, BP, signs and symptoms of HF
- Long-term use may result in tolerance to the drug
- Contraindicated with phosphodiesterase inhibitors (PDE-5 inhibitors)
- Combination therapy with isosorbide dinitrate/hydralazine (Bidil) improves survival in African-Americans

ADHF Pharmacologic Treatment

Positive Inotropes

Beta-Adrenergic Agonists

- Dopamine
- Dobutamine

Phosphodiesterase Inhibitor

- Milrinone

Morphine

Vasodilators

- Nesiritide
- Nitroprusside
- Nitroglycerin

Brand-Generic!!!

Isosorbide dinitrate/ hydralazine — Bidil

Furosemide — Lasix

Eplerenone — Inspra

Non-Pharmacologic Treatment

- Chronic HF
  - CardioMems system
  - Implantable cardioverter defibrillator (ICD)
  - Biventricular pacing/cardiac resynchronization therapy (CRT)
  - Intra aortic balloon pump (IABP)
  - Ventricular assist devices (VAD) → bridge to transplant (BTT) or as destination therapy (DT)
- ADHF
  - Ultrafiltration (aquapheresis) → patient with volume overload and resistant to diuretics
  - Circulatory assist device → patients with deteriorating HF
    - IABP
    - VAD

Non-Pharmacologic Treatment

- Chronic HF
  - Oxygen therapy
  - Physical and emotional rest
  - Structured exercise program
- ADHF
  - Oxygen therapy
  - Continuous monitoring and assessment
  - Hemodynamic monitoring if unstable
  - Noninvasive ventilatory support (BiPAP)
  - Mechanical ventilation if unstable
  - High Fowler's position feet horizontal or dangling

Nursing Management

Assessment

- Subjective (important health information)
  - Past health history
    - CAD, hypertension, cardiomyopathy etc…
  - Medications
    - Prescription and OTC!
  - Functional health patterns
    - Health perception – health management
    - Nutritional – metabolic
    - Elimination
    - Activity – exercise
    - Sleep – rest
    - Cognitive – perceptual

Assessment

- Objective
  - Integumentary
  - Respiratory
  - Cardiovascular
  - Gastrointestinal
  - Neurologic
  - Possible diagnostic findings

Can you perform a medication reconciliation correctly?

Medication Reconciliation

- Medication information
  - Prescription medications
  - Over-the-counter (OTC) drugs
  - Vitamins
  - Herbals
- Get all of the information!
  - Name of the medication
  - Strength
  - Formulation
  - Route
  - Frequency
- Medication history prompts
  - Routes of administrations (do you put it on your skin? Is it an inhaler?)
  - Medications they take for certain disease states (what do you take for your diabetes?)
  - Type of prescriber (who prescribes the medication?)
  - When they take medications (at night?)
  - Size or color of medication
  - Started or stopped any medications?
- When in doubt, call the pharmacy for a fill history!

Medication Reconciliation

- ADHERENCE, ADHERENCE, ADHERENCE!!!

- Are they taking their medication?
- How do they take it?

Diagnoses

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

Planning

- Goal
  1. Decrease in symptoms
  2. Decrease in peripheral edema
  3. Increase in exercise tolerance
  4. Adherence with treatment regimen
  5. No complications related to HF

Implementation

- Principles of care – slow progression of the disease

Educate!!!

Implementation

- Health promotion
  - Communication and joint decision-making – patient + caregiver + interprofessional team
  - Identify and treat modifiable risk factors
  - Immunizations
  - Be proactive!

What are modifiable risk factors?

Implementation

- Diet
  - Consult diet plan – list of permitted and restricted foods
  - Examine labels (food and OTC medications) for sodium content
  - Avoid using salt when preparing foods
  - Eat small, frequent meals

Implementation

- Activity
  - Stay active – as much as can tolerate (increase gradually)
  - Cardiac rehabilitation program
  - Avoid extremes of heat or cold

Implementation

- Rest
  - Plan regular daily rest and activity
  - Rest after exertion
  - Avoid emotional upsets

Implementation

- Medication therapy
  - Take as prescribed
  - Lots of pills = pill box
  - Importance of adherence

Implementation

- Monitoring
  - Reappearance of initial symptoms
  - Worsening HF – *FACES*
    - F – fatigue
    - A – limitation of activities
    - C – chest congestion/cough
    - E – Edema
    - S – Shortness of breath
  - Weight
    - 3 lb in 2 days, 3-5 lb in 1 week
  - Medications
- Contact provider if – difficulty breathing, dry/hacking cough, swelling of ankles, feet or abdomen, nausea with abdominal swelling

Implementation

- ADHF – oh no!
  - Reinforce previous information
  - Monitor patients oxygen response
  - Provide calming activities to promote relaxation
  - Reduce anxiety
  - Collaborate with occupational and/or physical therapy

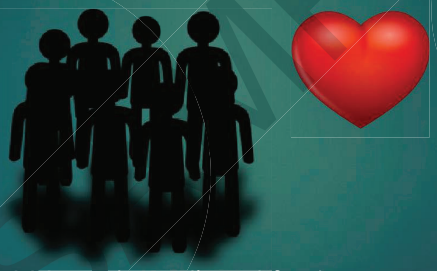
Evaluation

- Prevent/limit future hospitalizations
  - Vital signs
  - Weight
  - Pulse oximetry
  - Dyspnea

  - Home health nurses can be essential
  - Electronic monitoring (telehealth)
  - Cape Fear Valley – Community Paramedic Program

Heart Transplantation

- Transfer of a healthy donor heart to a patient with a disease heart



3,000 patients listed for heart transplant
2,000 hearts become available

Criteria For Selection

- Selection process identifies patients who would benefit most from a new heart
  - Physical exam, diagnostic workup, psychologic evaluation, donor and recipient matching
- Candidate placed on transplant list
  - Stable may wait at home
  - Unstable may require hospitalization

Indications	Contraindications
- Refractory end-stage HF - Severe, decompensated, inoperable, valvular heart disease - Refractory life-threatening dysrhythmias - Others heart conditions that limit normal function and/or have mortality of >50% at 2 years	- Chronologic age > 70 years or physiologic age > 65 years - Survival limited to < 5 years - Active infection (Ex. HIV) - Severe pulmonary disease likely resulting in patient being ventilator dependent after transplant

Surgical Procedure x 2

1. Donor heart retrieved (<4 hours)
2. Donor heart implanted
   - Biatrial approach
     - Recipients damaged heart is removed at midatrial level and donor heart connected at the left atrium, pulmonary artery, aorta, and right atrium
   - Bicaval approach
     - Right atrium of recipients heart is preserved, then donor heart connected
     - Cardiopulmonary bypass needed to maintain oxygenation and perfusion of vital organs

Post Transplantation ♥

- Treatment
  - Immunosuppressive therapy
- Monitoring
  - Acute rejection
    - Endomyocardial biopsy (EMB)
      - Weekly x 1 month → monthly x 6 months → yearly
  - Infection
  - Malignancy
  - Cardiac vasculopathy

Nurses! ♥

- Promote patient adaptation to transplant process
- Monitoring heart function
- Managing lifestyle changes
- Educate, educate, educate!

Patient Case

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Questions?!

Thank you!