NCA III Critical Care

Unit IV Heart Failure

Heart Failure

- The #1 DRG in the United States

Heart Failure

- Definition of heart failure:

  "A condition in which the heart fails to meet the demands of the body"

  "Decreased cardiac output"

Heart Failure

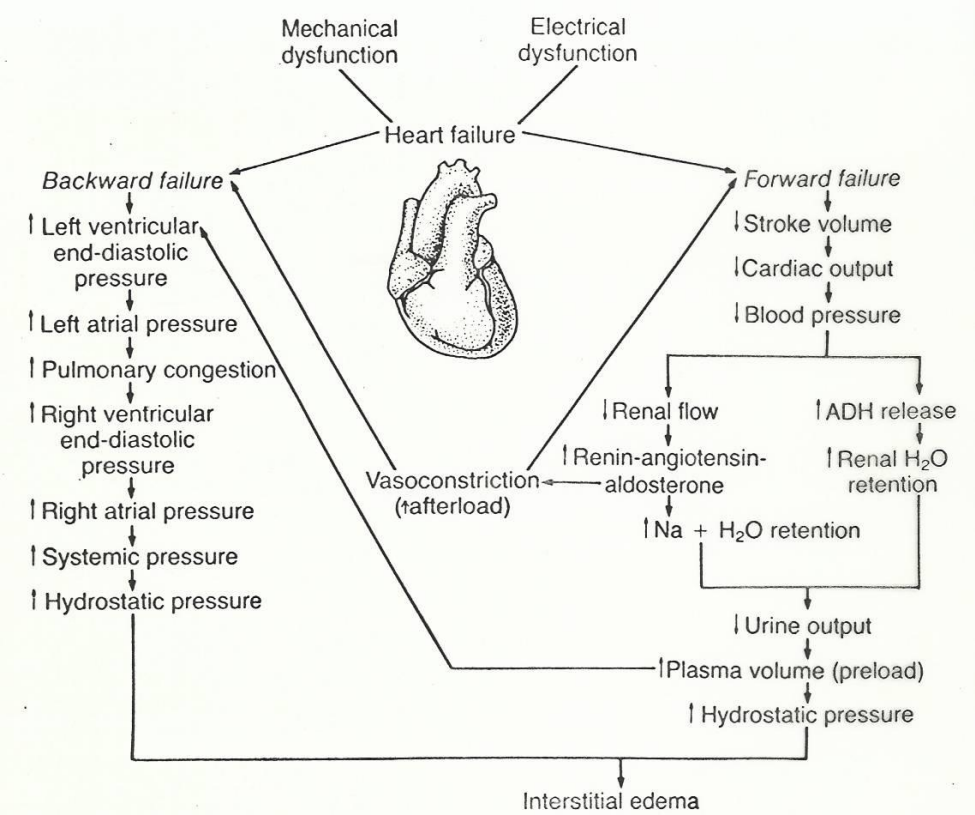


Figure 16–1. Pathophysiology of congestive heart failure.

Heart Failure

- Congestive heart failure:
  - A misnomer
  - Not all patients with heart failure have "congestion"
  - "Congestive" refers to the build up of fluid either in the pulmonary system or the periphery of the body

Heart Failure

- Etiology/epidemiology:
  - Affects 5 million Americans
  - Only heart disease that is increasing in frequency
  - Hypertension is the major risk factor
  - One of the leading causes of hospital admissions in the US

Heart Failure

HEART FAILURE

LEFT,

RIGHT,

OR BOTH:

CAUSES:

MECHANICAL

- **TOO POOPED TO PUMP**
- **OVERUSED RUBBERBAND SYNDROME**

ELECTRICAL

- **HEART RATE TOO FAST**
- **HEART RATE TOO SLOW**
- **QB'S (QUEER BEATS)**

Heart Failure

- Causes:
  - Hypertension
  - Coronary artery disease
  - Cardiomyopathies
  - Valve problems
  - Inflammatory diseases

Heart Failure

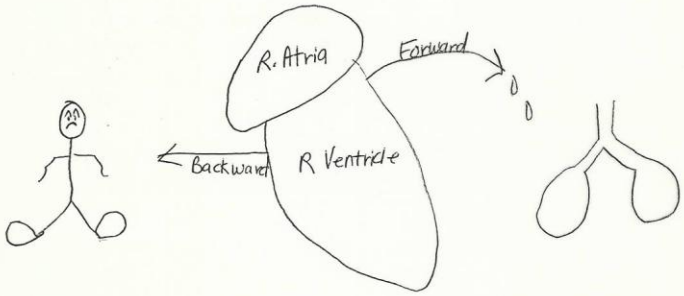
- Types of heart failure:
  - Right sided:
    - Caused by left sided failure most commonly
    - Caused by lung diseases
    - If the right side fails first, the left will soon follow
    - Has systemic symptoms

Heart Failure

RIGHT HEART FAILURE

Back up of fluid to the body.

Decreased blood flow to the lungs.

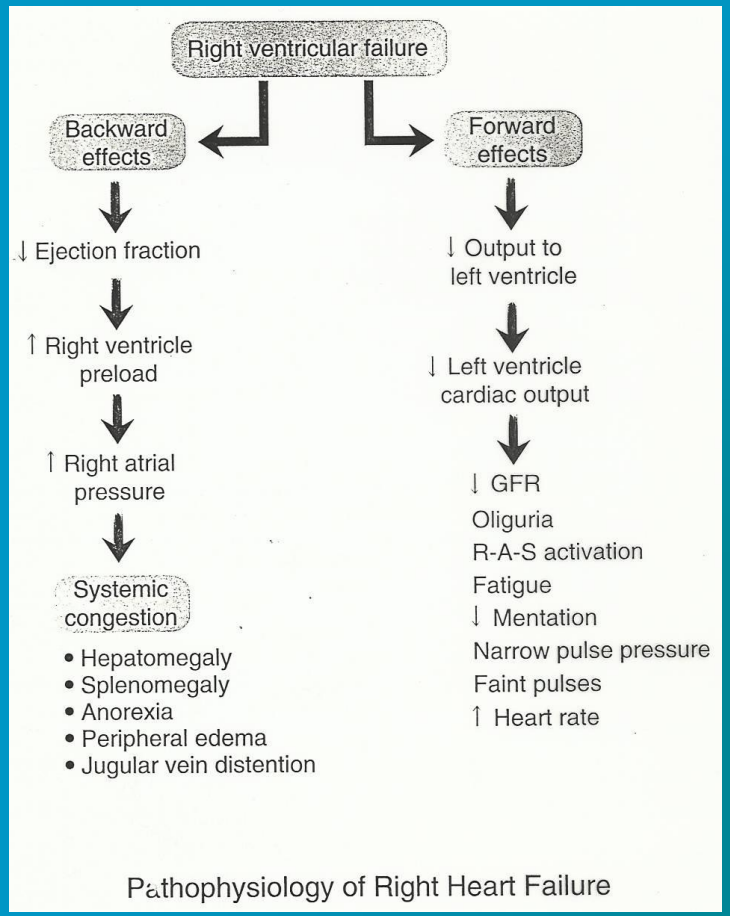


Pedal edema
Sacral edema
JVD
RUQ "ouch" due to enlarged liver
+ hepatojugular reflex

CAUSES
Pulmonary hypertension
COPD
Pre-existence of L. CHF

Hemodynamic Parameter:
CVP

Heart Failure



Pathophysiology of Right Heart Failure

Heart Failure

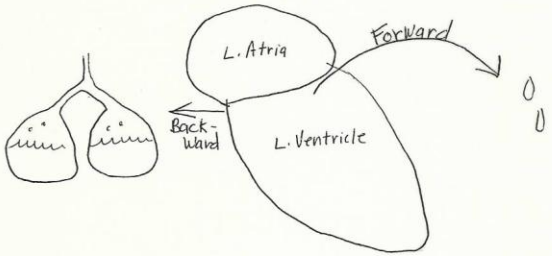
- Types of heart failure:
  - Left sided
    - Usually fails first
    - Cause frequently is ACS or ischemic heart disease
    - Hypertension is also a major risk factor
    - Aortic valve disease also a major cause
    - Has pulmonary symptoms

Heart Failure

LEFT HEART FAILURE

DIASTOLIC DYSFUNCTION (BACKWARD FAILURE)
Back up of blood into the lungs.

SYSTOLIC DYSFUNCTION (FORWARD FAILURE)
Decrease in amount of blood pumped to the body.

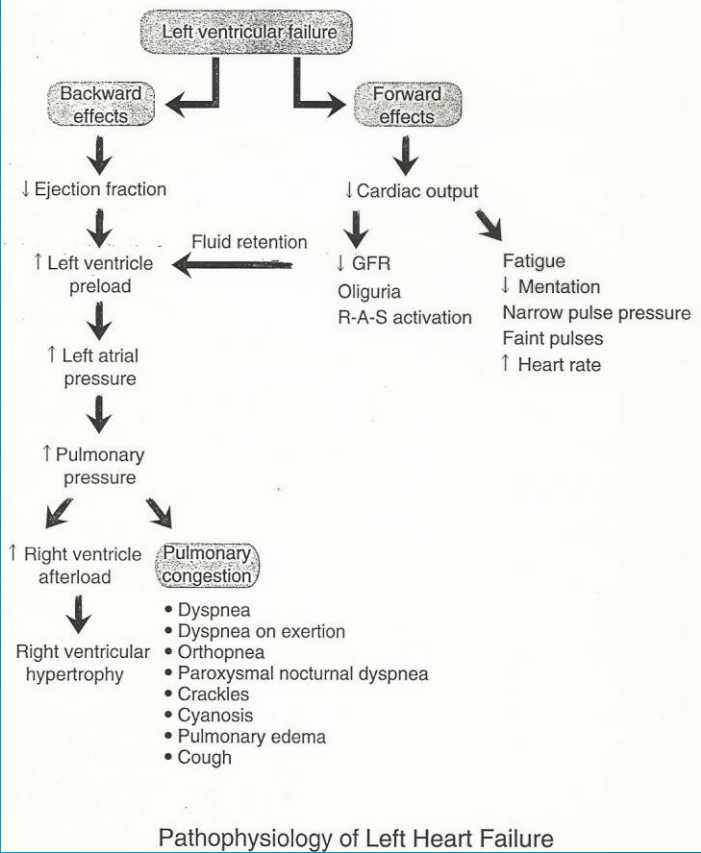


Crackles in the lungs
Increased resistance in the lungs causes the right heart to fail

Decreased BP
Decreased GFR
Decreased stroke volume
Decreased CO/CI
Sympathetic stimulation
Activation of R-A-A
Arterial Vasoconstriction (increased afterload)
Decreased urinary output

HEMODYNAMIC PARAMETERS:
PAP--high
PAWP--high
CO/CI--low

Heart Failure



Pathophysiology of Left Heart Failure

Heart Failure

- Types of heart failure:
  - Diastolic dysfunction:
    - Ventricles cannot relax in diastole
    - Decreased left ventricular end diastolic volumes
    - Contraction is usually normal
    - Can be caused by previous systolic dysfunction, fibrotic changes, constrictive pericarditis and myocarditis

Heart Failure

- Types of heart failure:
  - Systolic dysfunction:
    - Ineffectual contraction of the ventricles
    - Causes can be previous MI, remodeling after MI, diffuse coronary artery disease, hypertension, cardiomyopathies
    - Left ventricular end diastolic volume is normal, but contraction is weak so cardiac output falls

Heart Failure

- Types of heart failure:
  - Forward:
    - This simply means there is decreased cardiac output. Instead of the usual stroke volume, there is much less blood pumped with each beat.

Heart Failure

- Types of heart failure:
  - Backward:
    - Backward flow from the left ventricle goes to the lungs
    - Backward flow from the right ventricle goes to the body
    - This type of heart failure is "congestive"

Heart Failure

- Types of heart failure:
  - High output heart failure:
    - Heart is FAFH (fine as frog hair)
    - Increased metabolic demand is the problem
    - Can occur with hyperthyroidism
    - Heart pumps like crazy, but still fails to meet the demands of the body

Heart Failure

- Types of heart failure:
  - Low output heart failure:
    - Most commonly seen type
    - Cardiac output, cardiac index, ejection fraction, stroke volume are all below normal
    - Directly affects the activity level that the patient can tolerate

Heart Failure

- Pathophysiology:
  - Decreased cardiac output
    - Insufficient glucose and oxygen for the body and for heart function
    - Cell metabolism becomes abnormal
    - Cardiac output below 4.0 L/min is considered to be decreased

Heart Failure

- Pathophysiology:
  - Cardiac index:
    - An index below 2.5 is considered to be diagnostic of heart failure
    - Physicians may accept a lower index after cardiac surgery due to stunning

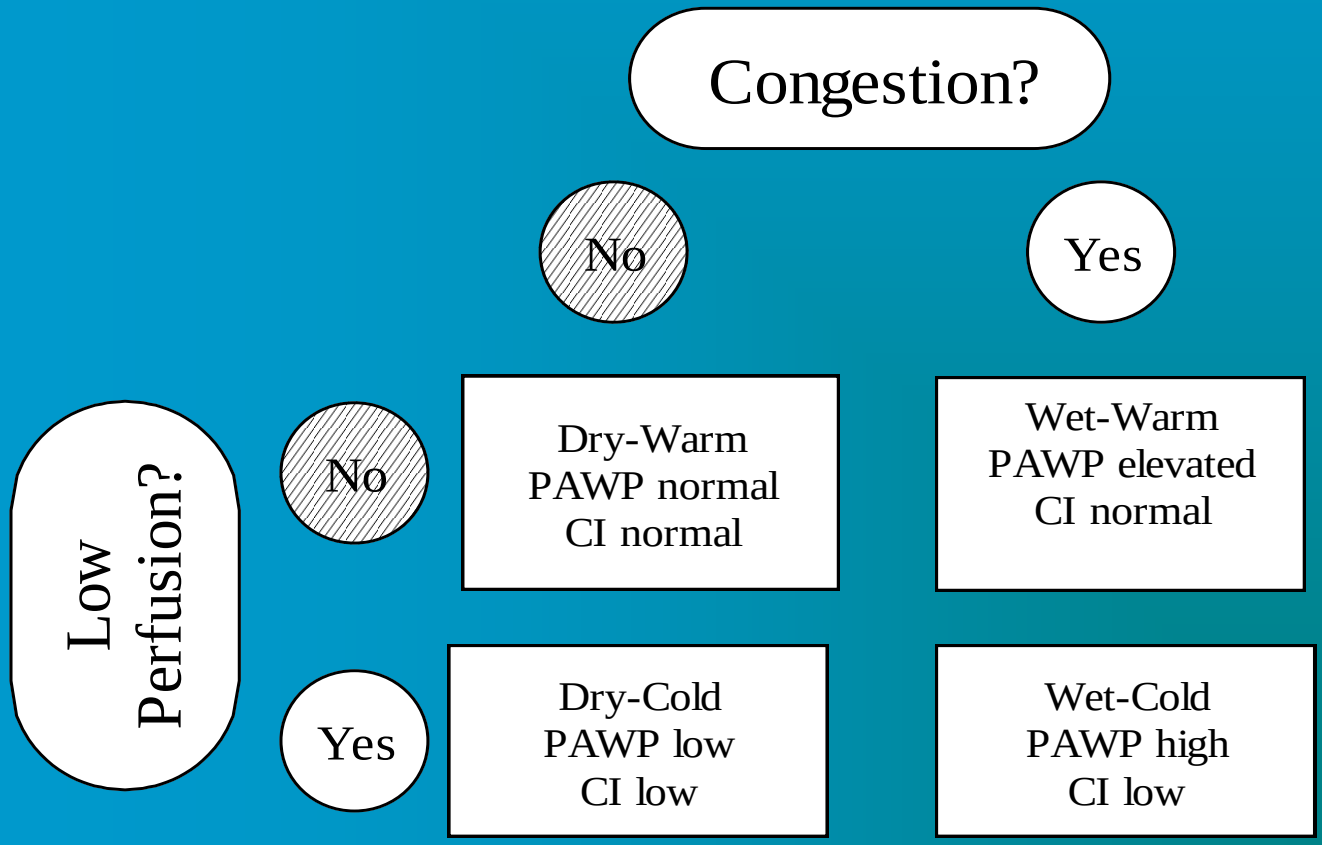
Heart Failure

- Pathophysiology:
  - Ejection fraction:
    - Can be determined by scans, echo, and cardiac catherization
    - Some patients may have symptoms with ejection fractions of 40%
    - Some patients who are stable in the disease process may only have ejection fractions of 15 – 20%

Heart Failure

- Pathophysiology:
  - Remodeling:
    - Tissue around an infarcted zone hypertrophies to "make up" for the damage
    - Makes for a more inefficient contraction
    - Fibrosis
    - Hypertrophy

Heart Failure



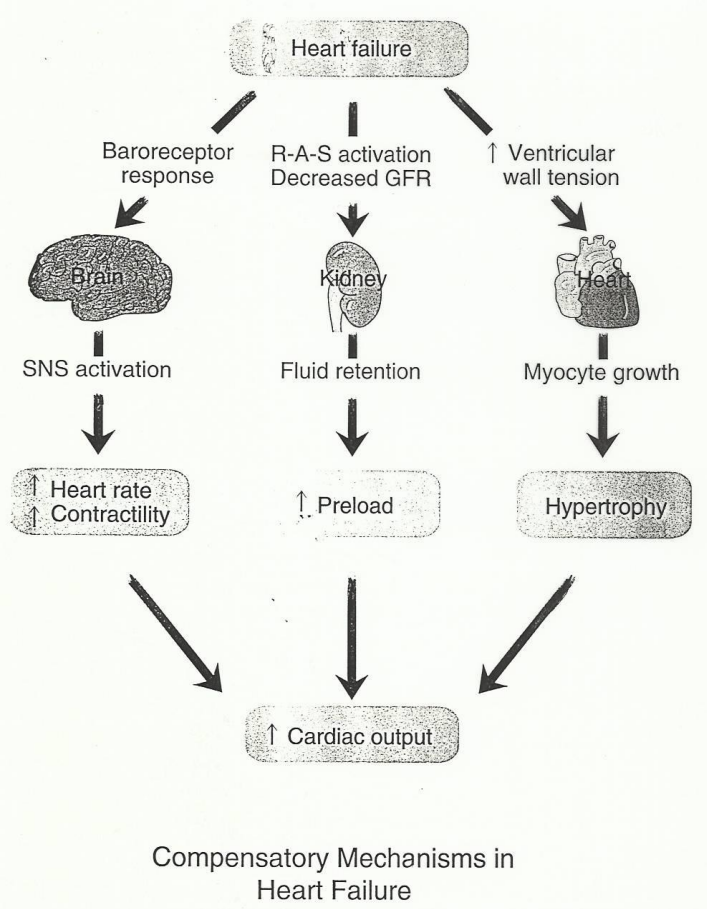
Heart Failure

- Type of presentation will vary how treatment is ordered:
  - Dry-Warm = oral medications
  - Wet-Warm = IV diuretics
  - Wet-Cold = IV diuretics, nesirititde, inotropes
  - Dry-Cold = inotropes, volume, IABP, VAD

Heart Failure

- Pathophysiology:
  - Compensatory mechanisms:
    - Sympathetic nervous system
      - Increased HR
      - Increased BP
      - Increased contractility

Heart Failure



Compensatory Mechanisms in Heart Failure

Heart Failure

- Pathophysiology:
  - Compensatory mechanisms:
    - Renin-angiotensin-aldosterone
      - Decreased renal perfusion initiates release of Renin
      - Renin triggers the release of Angiotensin I
      - ACE in the lung converts Angiotensin I into Angiotensin II
      - Angiotensin II triggers the release of Aldosterone

Heart Failure

- Pathophysiology:
  - Compensatory mechanisms:
    - Starling's Law:
      - Good muscle stretch = good contraction
      - Over-stretched muscles = poor contraction

Heart Failure

- Pathophysiology:
  - Compensatory mechanisms:
    - A type and B type natruretic peptides
      - Hormone released from atrial and ventricular muscle cells
      - Helpful because:
        - Excrete sodium and water
        - Interferes with RAA
        - Directly vasodilate
        - Interferes with release of ADH
        - Interferes with SNS

Heart Failure

- Pathophysiology:
  - Compensatory mechanisms:
    - Endothelin:
      - Three types of this substance-released with low cardiac output
      - All types are potent vasoconstrictors
      - Released from endothelial cells
      - Cousin to asp venom

Heart Failure

- Pathophysiology:
  - Compensatory mechanisms:
    - Vasopressin
      - Also known as antidiuretic hormone (ADH)
      - Released from pituitary gland when low cardiac output is present
      - Causes water retention

Heart Failure

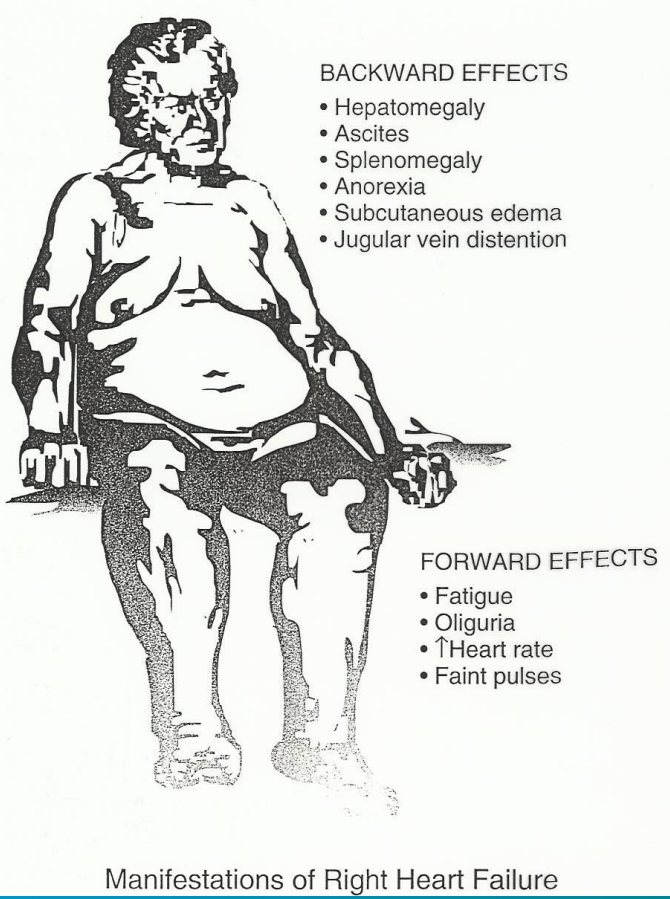
- Signs and symptoms:

Most persons with heart failure have a combination of right and left sided symptoms. Very rare to see “pure” symptoms of one type.

Heart Failure

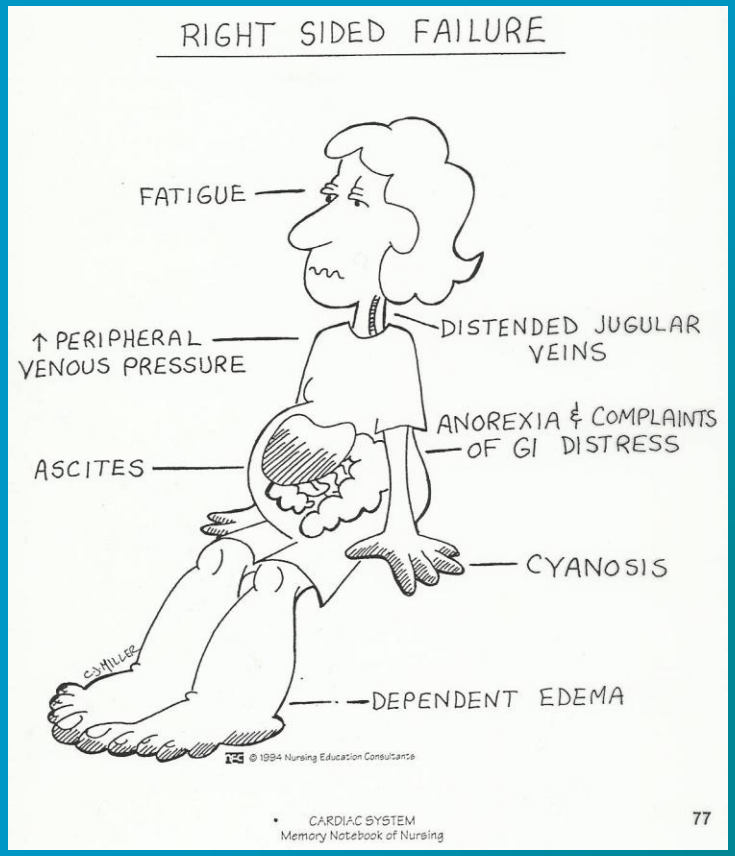
- Signs and symptoms:
  - Right sided, forward, backward, diastolic

Heart Failure

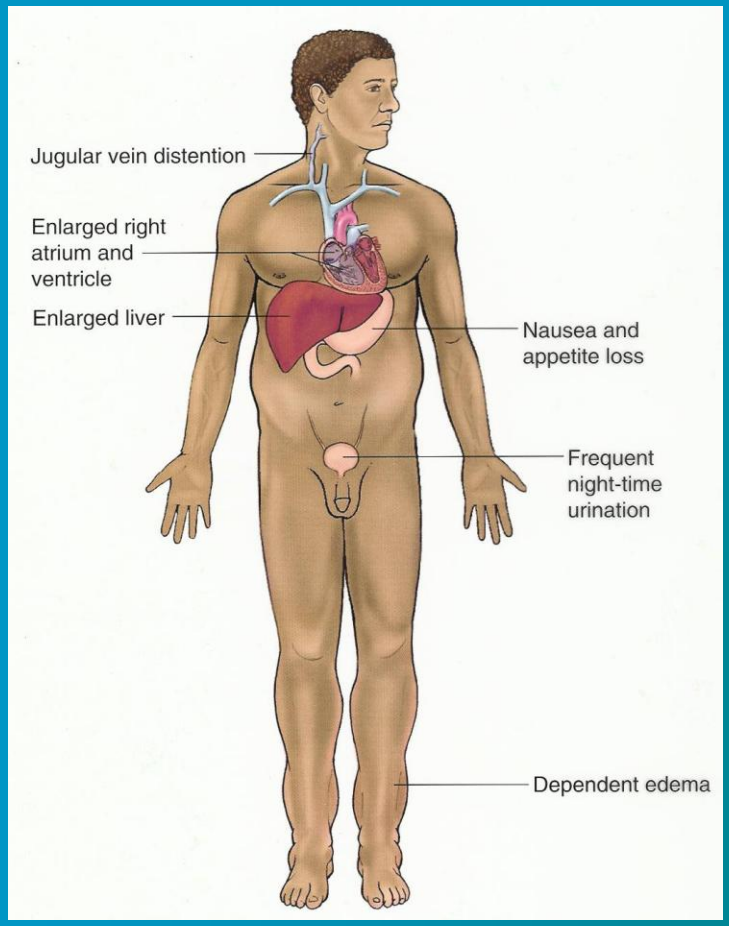


Manifestations of Right Heart Failure

Heart Failure



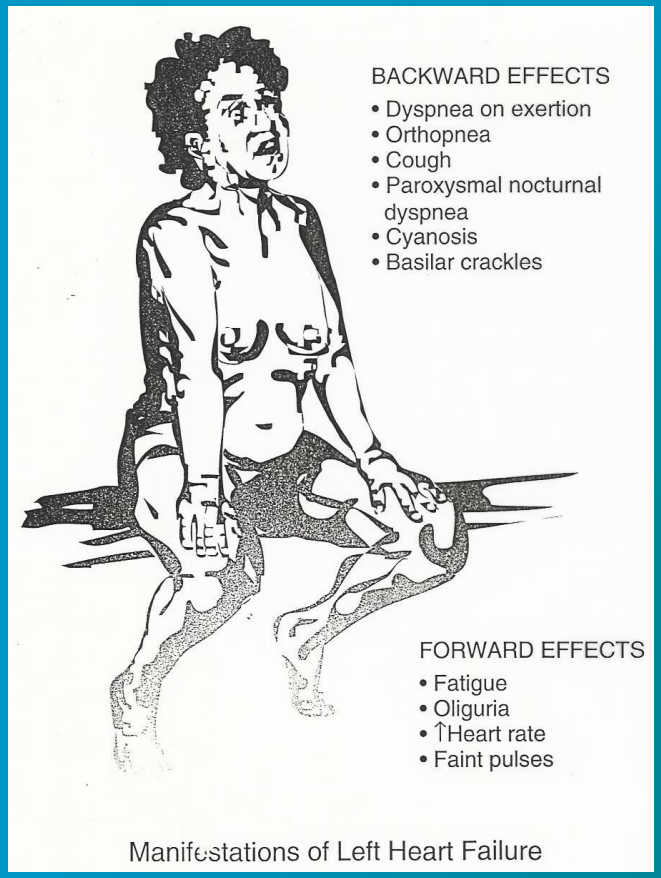
Heart Failure



Heart Failure

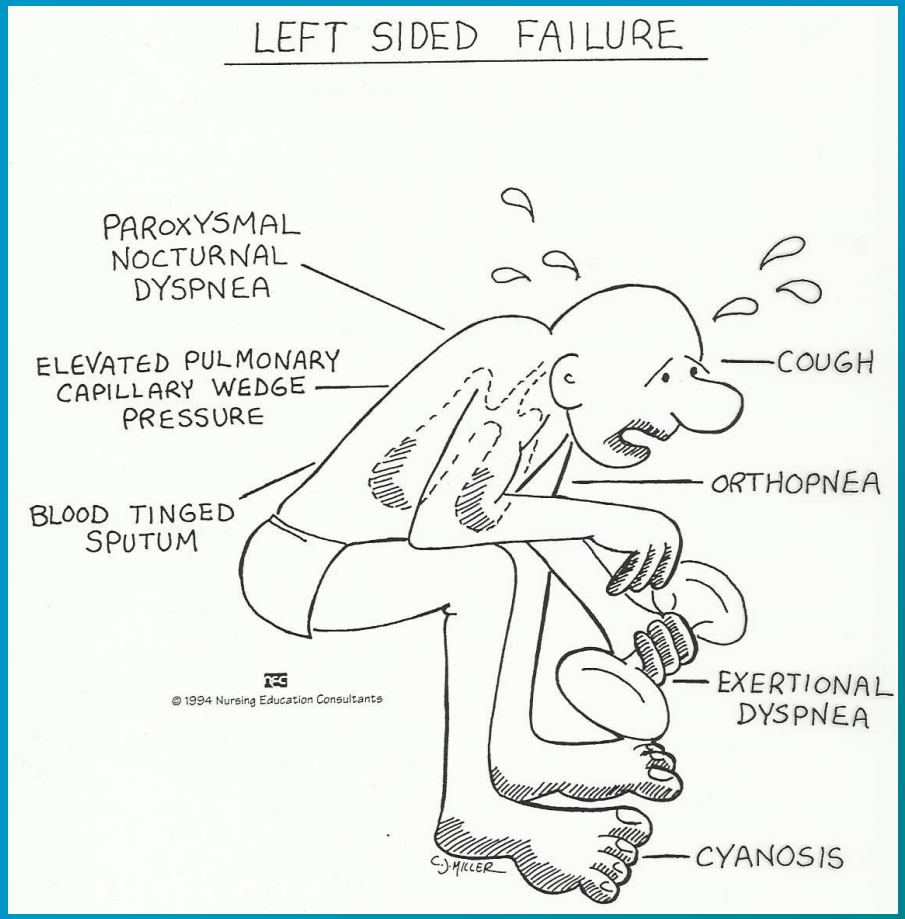
- Signs and symptoms:
  - Left sided, forward, backward, diastolic

Heart Failure



Manifestations of Left Heart Failure

Heart Failure



Heart Failure

- Signs and symptoms:
  - New York Heart Association classifications:
    - Class I
    - Class II
    - Class III
    - Class IV

(know these)

Heart Failure

- Classification:
  - Stage A
  - Stage B
  - Stage C
  - Stage D

Heart Failure

- Diagnostic tests:
  - Electrolytes
  - BUN/creatinine

Heart Failure

- Diagnostic tests:
  - CBC
  - AST/ALT

Heart Failure

- Diagnostic tests:
  - Blood gases
    - Initially-respiratory alkalosis
    - End stage HF-respiratory acidosis

Heart Failure

- Diagnostic tests:
  - BNP-definitive laboratory test for heart failure

Heart Failure

- Diagnostic tests:
  - Chest X-ray:
    - Heart size
    - Pulmonary vascular congestion
    - Pleural effusions
    - Pericardial effusions

Heart Failure

- Diagnostic tests:
  - ECG:
    - Dysrhythmias
    - Ventricular hypertrophy

Heart Failure

- Diagnostic tests:
  - Echocardiogram:
    - Structural changes
    - Ejection fraction measurement
    - Ventricular hypertrophy

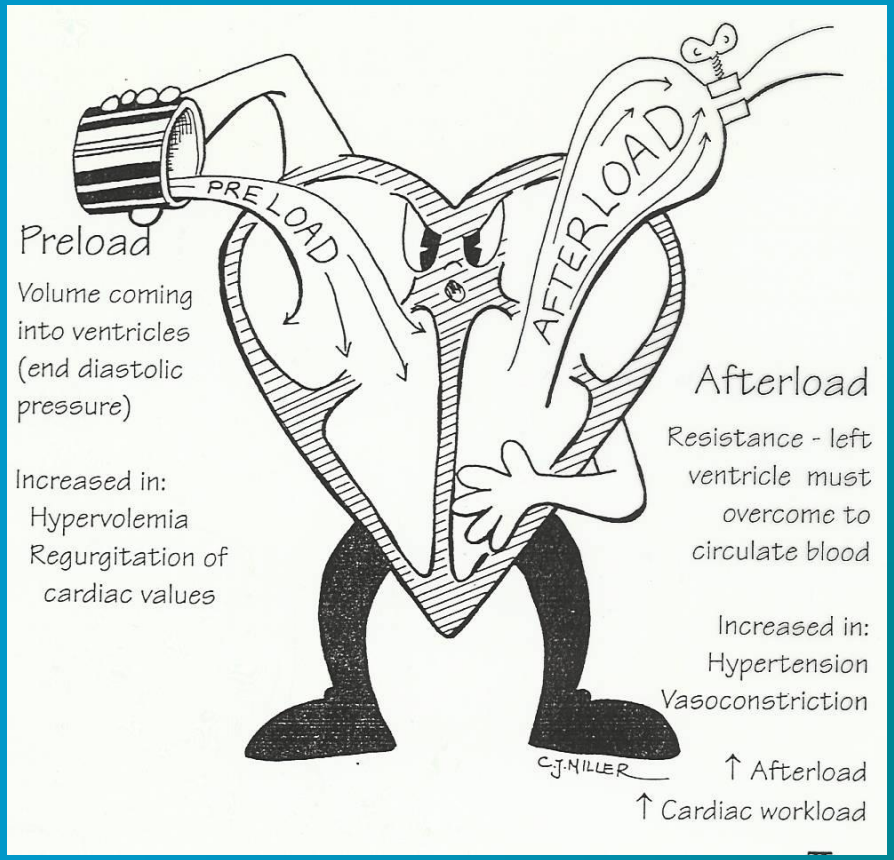
Heart Failure

- Diagnostic tests:
  - Cardiac catherization:
    - Cardiac output
    - Cardiac index
    - Ejection fraction
    - Central venous pressure
    - Systemic vascular resistance

Heart Failure

- Treatment:
  - Four overall goals:
    - Reduce afterload
    - Reduce preload
    - Control heart rate
    - Optimize pump function (improve contractility)

Heart Failure



Heart Failure

- Treatment:
  - Reduce afterload:
    - ACE inhibitors
    - ARB's
    - Arterial vasodilators
    - IABP

Heart Failure

- Treatment:
  - Reduce preload:
    - Diuretics:
      - Loops
      - Thiazide
      - Potassium sparing
    - Beta blockers
    - Nitrates

Heart Failure

- Treatment:
  - Reduce preload:
    - Nesiritide (Natrecor) (B type natruretic peptide)
      - Vasodilates
      - Excretes sodium
      - Excretes water
      - Interferes with SNS

Heart Failure

- Treatment:
  - Control heart rate:
    - Digoxin
    - Beta blockers
    - Calcium channel blockers

Heart Failure

- Treatment:
  - Control heart rate:
    - Pacemakers
      - Traditional
      - Three or four chamber
    - ICD's
    - Antiarrhythmic drugs (Amiodarone)

Heart Failure

- Treatment:
  - Improve contractility:
    - Digoxin
    - Dobutamine
    - Dopamine
    - Amrinone/milrinone
    - Four chamber pacing

Heart Failure

- Treatment:
  - Improve contractility:
    - Digoxin:
      - Onset of action is slow
      - Affects of renal disease

Heart Failure

- Treatment:
  - Improve contractility:
    - Dobutamine
    - Dopamine

Heart Failure

- Treatment:
  - Improve contractility:
    - Amrinone/milrinone
    - Four chamber pacing

Heart Failure

- Treatment:
  - Surgical:
    - Cardiomyoplasty: plastic surgery on the heart
      - Resect a ventricular aneurysm
      - Nip and tuck an enlarged ventricle
      - Some patients have latissimus dorsi wraps (no longer approved)

Heart Failure

- Treatment:
  - Surgical:
    - Ventricular assist devices
      - LVAD
      - RVAD
      - BiVAD

Heart Failure

- Treatment:
  - Surgical:
    - Total artificial heart
    - Heart transplant

Heart Failure

- Nursing diagnoses and interventions:
  - Activity intolerance

Heart Failure

- Nursing diagnoses and interventions:
  - Fluid volume excess:

List all the defining characteristics you can think of that patients might exhibit with this nursing problem.

Heart Failure

- Nursing diagnoses and interventions:
  - Impaired gas exchange

Heart Failure

- Nursing diagnoses and interventions:
  - Decreased cardiac output:

    This diagnosis is almost a collaborative one; physicians and nurses co manage this problem

Decreased cardiac output IS heart failure

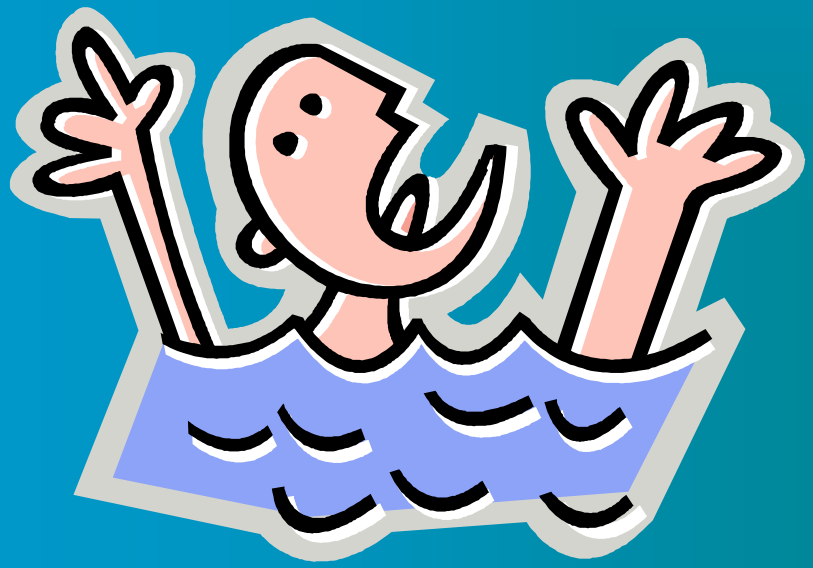
Heart Failure

- Nursing diagnoses and interventions:
  - Hopelessness/powerlessness:

    What are some interventions that nurses can do to help give these patients hope or control over their situation?

Heart Failure

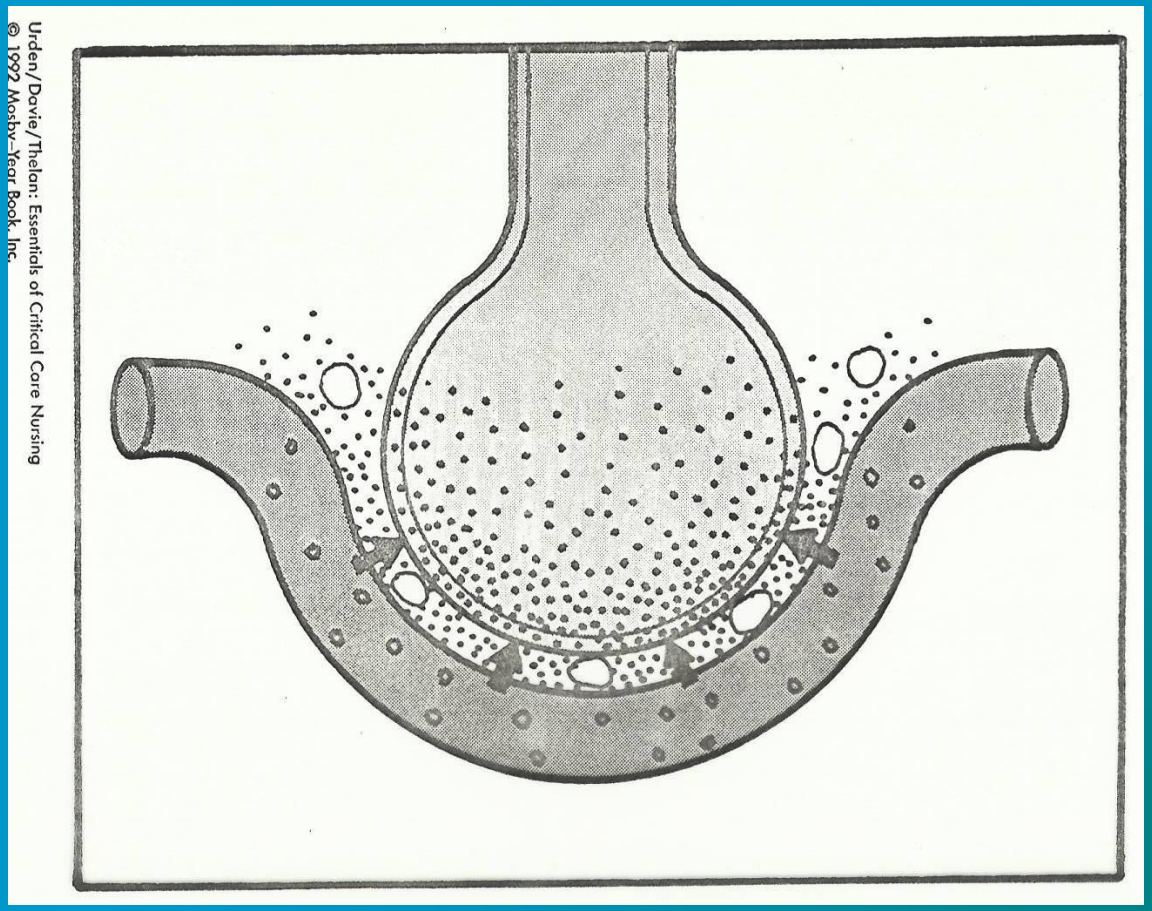
- Acute pulmonary edema:
  "Drowning from within"



Heart Failure

- Acute Pulmonary Edema:
  - ARDS vs. cardiogenic pulmonary edema
    - They look the same!
    - Their mechanism is different
    - Their treatment is different

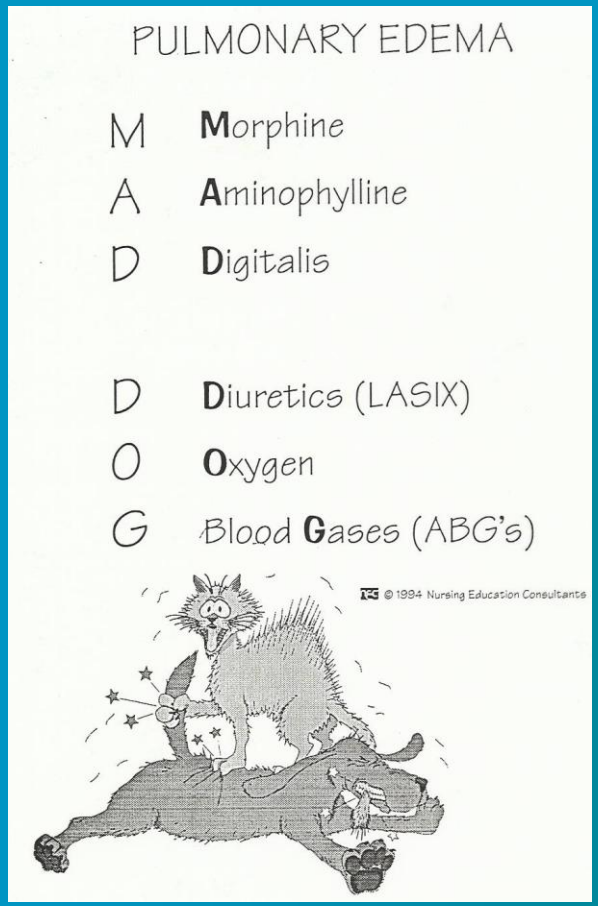
Heart Failure



Heart Failure

- Acute Pulmonary Edema:
  - Treatment:
    - Diuretics
    - Morphine sulfate
    - Aminophylline
    - Vasopressors
    - Oxygen

Heart Failure



Heart Failure

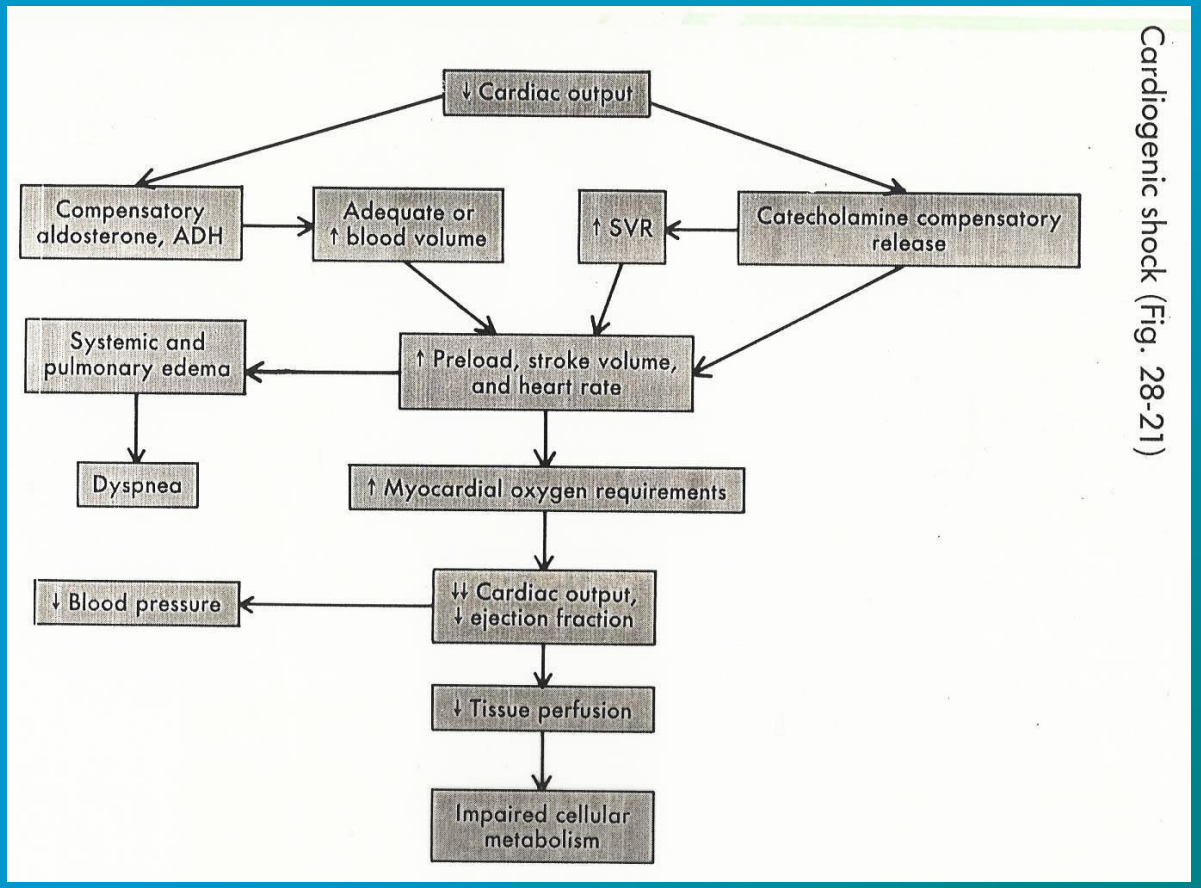
- Acute Pulmonary Edema:
  - Nursing problems/interventions:
    - Impaired gas exchange
    - Fluid volume excess
    - Decreased cardiac output
    - Anxiety

Heart Failure

- Cardiogenic shock:

Where does shock happen?

Heart Failure



Heart Failure

- Cardiogenic shock:

  What are the symptoms?

Heart Failure

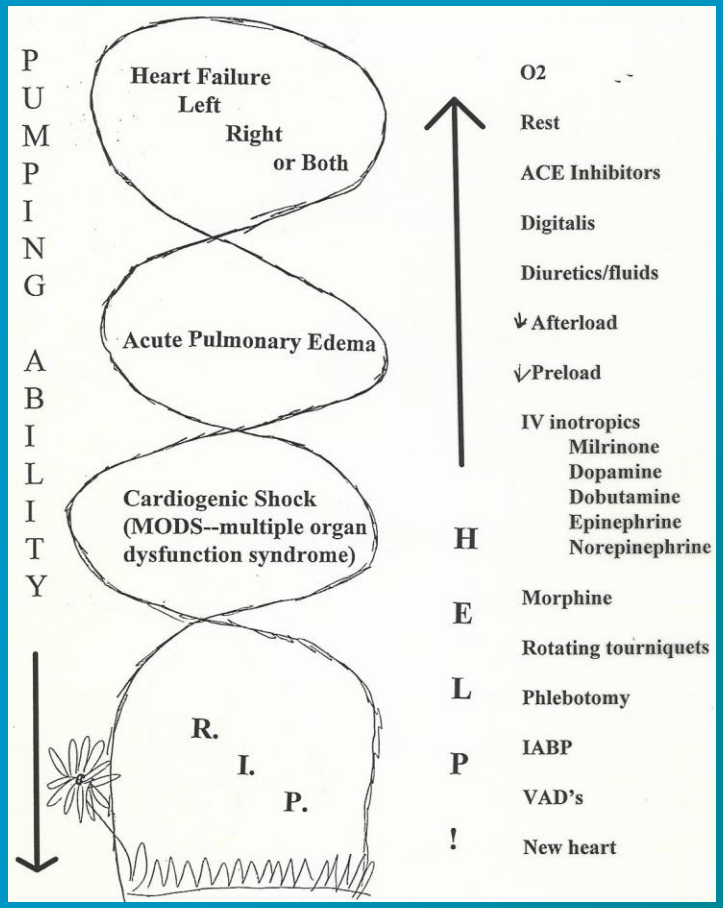
- Cardiogenic shock:

  Mortality rates more than 50% despite optimal treatment

Heart Failure

- Cardiogenic shock:
  - Prevention and early detection are the keys to survival
  - Patients may require emergency CABG or surgical repairs
  - IABP, VAD's may serve as a bridge to transplant

Heart Failure



Heart Failure

- MODS:

  Multiple Organ Dysfunction Syndrome

  (previously known as a “train wreck”)

Heart Failure

- MODS:
  - Heart failure may precipitate:
    - Renal shutdown
    - GI shutdown
    - Liver dysfunction
    - Respiratory failure or arrest

Hemodynamic Monitoring

- Hemodynamic:

  “Blood moving”

Hemodynamic Monitoring

- Technology is used to obtain readings that reflect heart functioning:
  - Central venous pressure
  - Arterial blood pressure
  - Pulmonary artery pressure
  - Left ventricular end-diastolic pressure/volume
  - Vascular resistance
  - Cardiac output/index

Hemodynamic Monitoring

- Central venous pressure:
  - Need a central line with the tip in the right atrium
  - May measure using IV tubing and a manometer
  - May measure using an electronic transducer connected to the IV line and do an ECG monitor

Hemodynamic Monitoring

A patient may be in left heart failure with a normal CVP since left heart failure often precedes right heart failure.

Error in CVP measurement is most commonly failure to place the manometer or transducer at the zero reference mark.

Complications: Pneumothorax, fluid overload, arrhythmias, infection

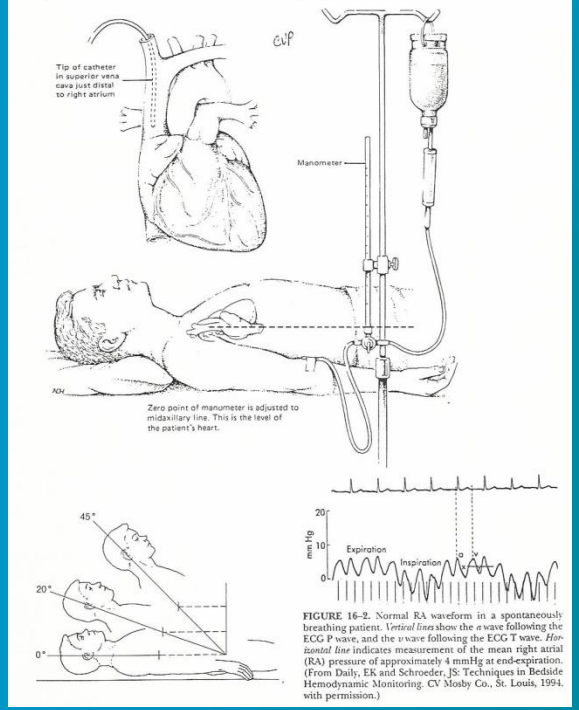
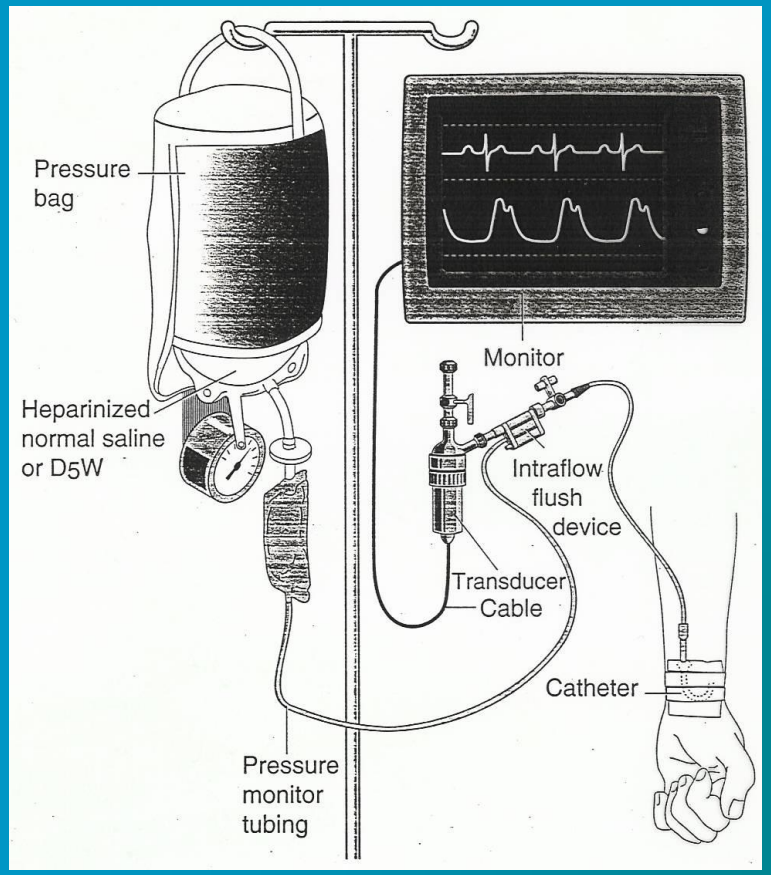


FIGURE 16–2. Normal RA waveform in a spontaneously breathing patient. *Vertical lines* show the *a* wave following the ECG P wave, and the *v* wave following the ECG T wave. *Horizontal line* indicates measurement of the mean right atrial (RA) pressure of approximately 4 mmHg at end-expiration. (From Daily, EK and Schroeder, JS: Techniques in Bedside Hemodynamic Monitoring. CV Mosby Co., St. Louis, 1994. with permission.)

Hemodynamic Monitoring



Hemodynamic Monitoring

- Central venous pressure:
  - The level of the manometer or the transducer must be at the “0” point. The zero point is at the midaxillary line.
  - If the patient changes position, the manometer or transducer must be moved to match the phlebostatic angle.

Hemodynamic Monitoring

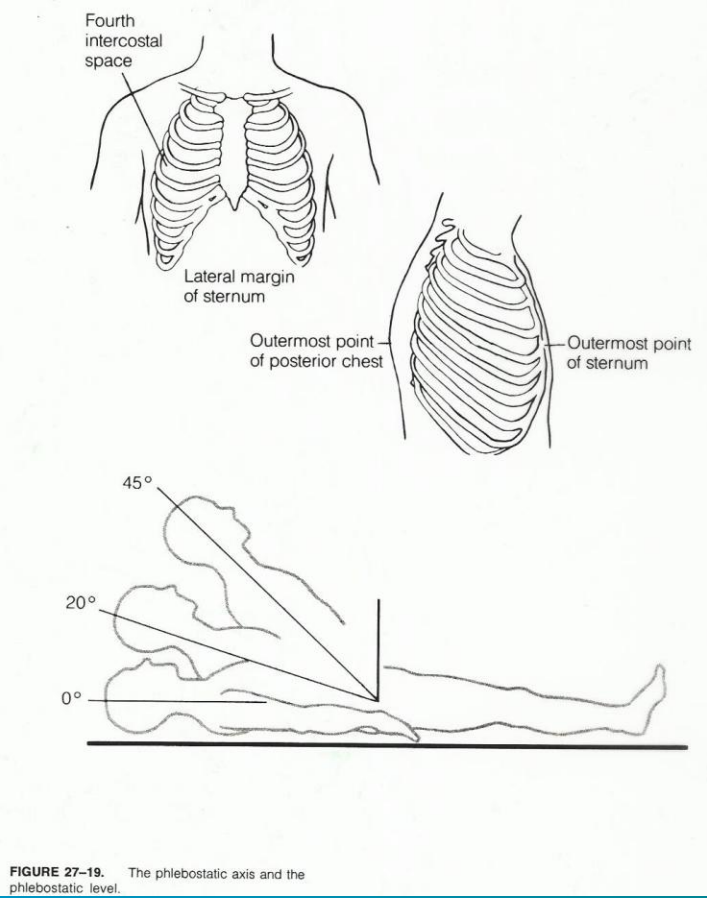


FIGURE 27–19. The phlebostatic axis and the phlebostatic level.

Hemodynamic Monitoring

- Central venous pressure:
  - If using an electronic transducer, gravity (760 torr) must be erased from the system periodically.
  - Erasing gravity is termed “zeroing” the transducer

Hemodynamic Monitoring

- Central venous pressure:
  - Normal readings:
    - 2-8 cm of H2O (manometer)
    - 2-6 mm Hg (transducer)

Hemodynamic Monitoring

- Central venous pressure:
  - Low readings:
    - Inadequate preload
      - Hypovolemia
      - Relative hypovolemia due to vasodilatation

Hemodynamic Monitoring

- Central venous pressure:
  - High readings:
    - Increased preload:
      - Fluid overload
      - Fluid retention
      - Valvular insufficiency

Hemodynamic Monitoring

- Central venous pressure:
  - High readings:
    - Decreased contractility
      - Right ventricle MI
      - Myocarditis
      - Cardiac tamponade

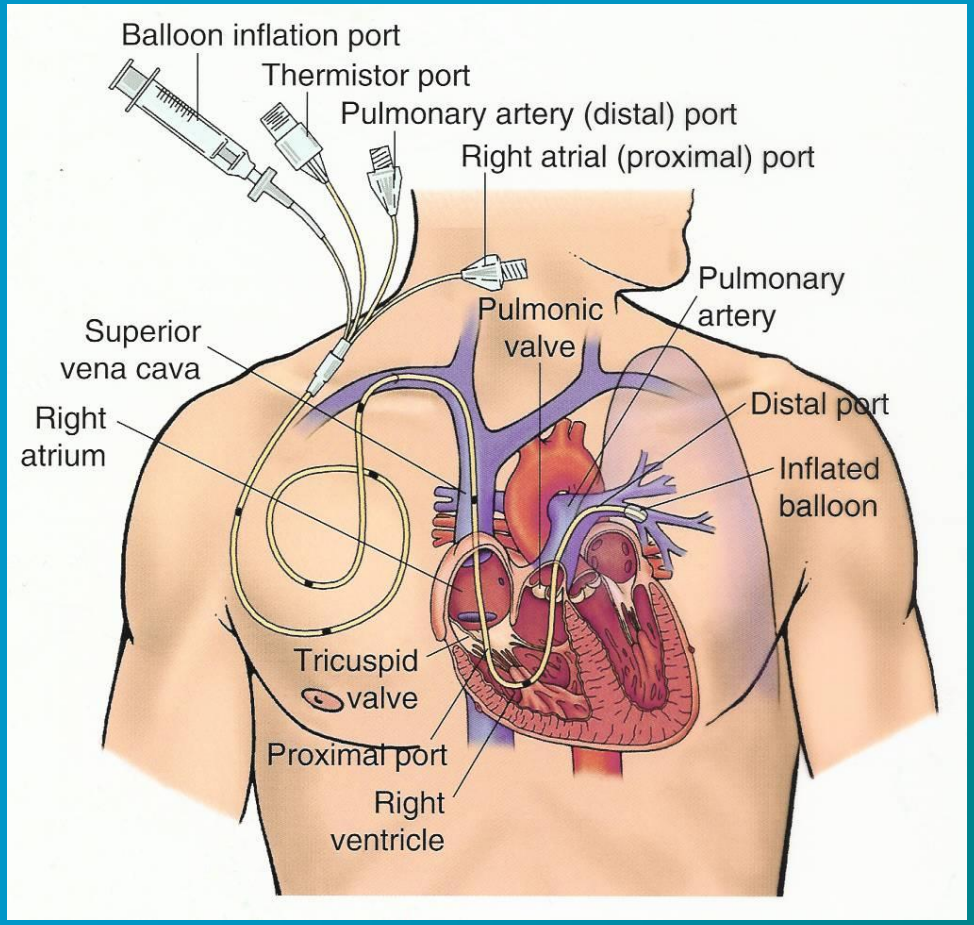
Hemodynamic Monitoring

- Central venous pressure:
  - High readings:
    - Increased afterload:
      - Increased pulmonary vascular resistance
        - COPD
        - Pulmonary embolism
        - Pulmonic valve stenosis

Hemodynamic Monitoring

- Pulmonary artery and pulmonary wedge pressures
  - Special catheter used (Swan-Ganz)
  - Numerous lumens and a small balloon at the end
  - Inserted into a large vein, threaded through the heart and into the pulmonary artery

Hemodynamic Monitoring



Hemodynamic Monitoring

- Pulmonary artery and pulmonary wedge pressures
  - Swan-Ganz catheter:
    - Balloon inflation causes a “wedge” in the pulmonary artery
    - Balloon deflation allows for pressure monitoring in the pulmonary artery

Hemodynamic Monitoring

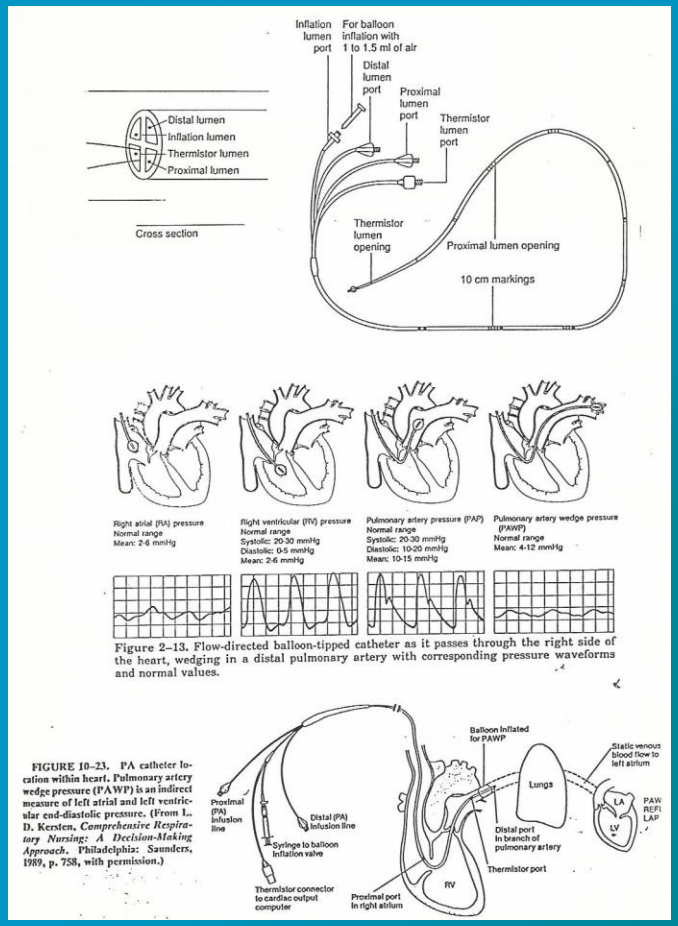


Figure 2–13. Flow-directed balloon-tipped catheter as it passes through the right side of the heart, wedging in a distal pulmonary artery with corresponding pressure waveforms and normal values.

FIGURE 10–23. PA catheter location within heart. Pulmonary artery wedge pressure (PAWP) is an indirect measure of left atrial and left ventricular end-diastolic pressure. (From L. D. Kersten, *Comprehensive Respiratory Nursing: A Decision-Making Approach*. Philadelphia: Saunders, 1989, p. 758, with permission.)

Hemodynamic Monitoring

- Pulmonary artery and pulmonary wedge pressures
  - Swan-Ganz catheter:

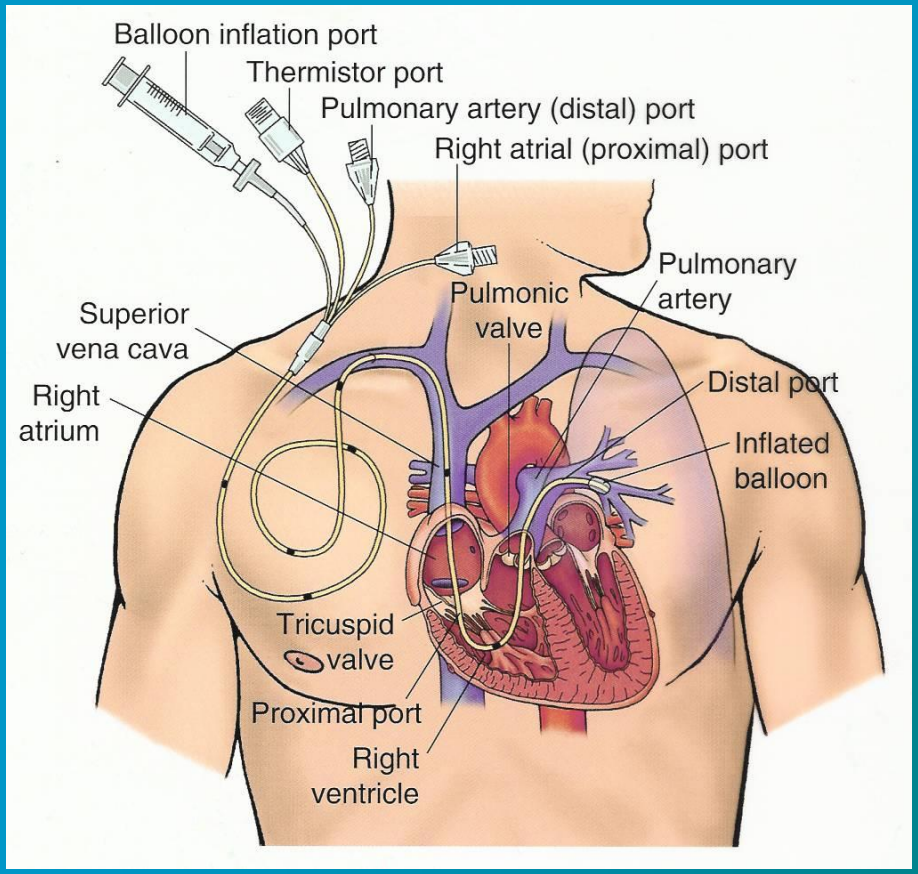
A “wedge” (PCWP) is the same as LVEDV/P

A “wedge” is a direct measurement of preload

Hemodynamic Monitoring

- Pulmonary artery and pulmonary wedge pressures
  - Swan-Ganz catheter
    - Lumens:
      - Distal-at the tip, measures wedge
      - Proximal-in the right atrium-measures CVP
      - Balloon-allows for inflation and deflation
      - Cardiac output-allows for a bolus of fluid
      - Thermistor-measures temperature in the pulmonary artery

Hemodynamic Monitoring



Hemodynamic Monitoring

- Pulmonary artery and pulmonary wedge pressures
  - Normal pulmonary artery pressures:
    - 20-30 mm Hg Systolic
    - 10-15 mm Hg Diastolic
    - 10-20 mm Hg Mean

Hemodynamic Monitoring

- Pulmonary artery and pulmonary wedge pressures
  - Low PAP:
    - Hypovolemia due to fluid loss or vasodilatation
  - High PAP:
    - Fluid overload, mitral valve disease, L CHF, cardiac tamponade
    - Pulmonary embolism, pulmonary hypertension, vasoconstriction of pulmonary vessels due to hypercapnea

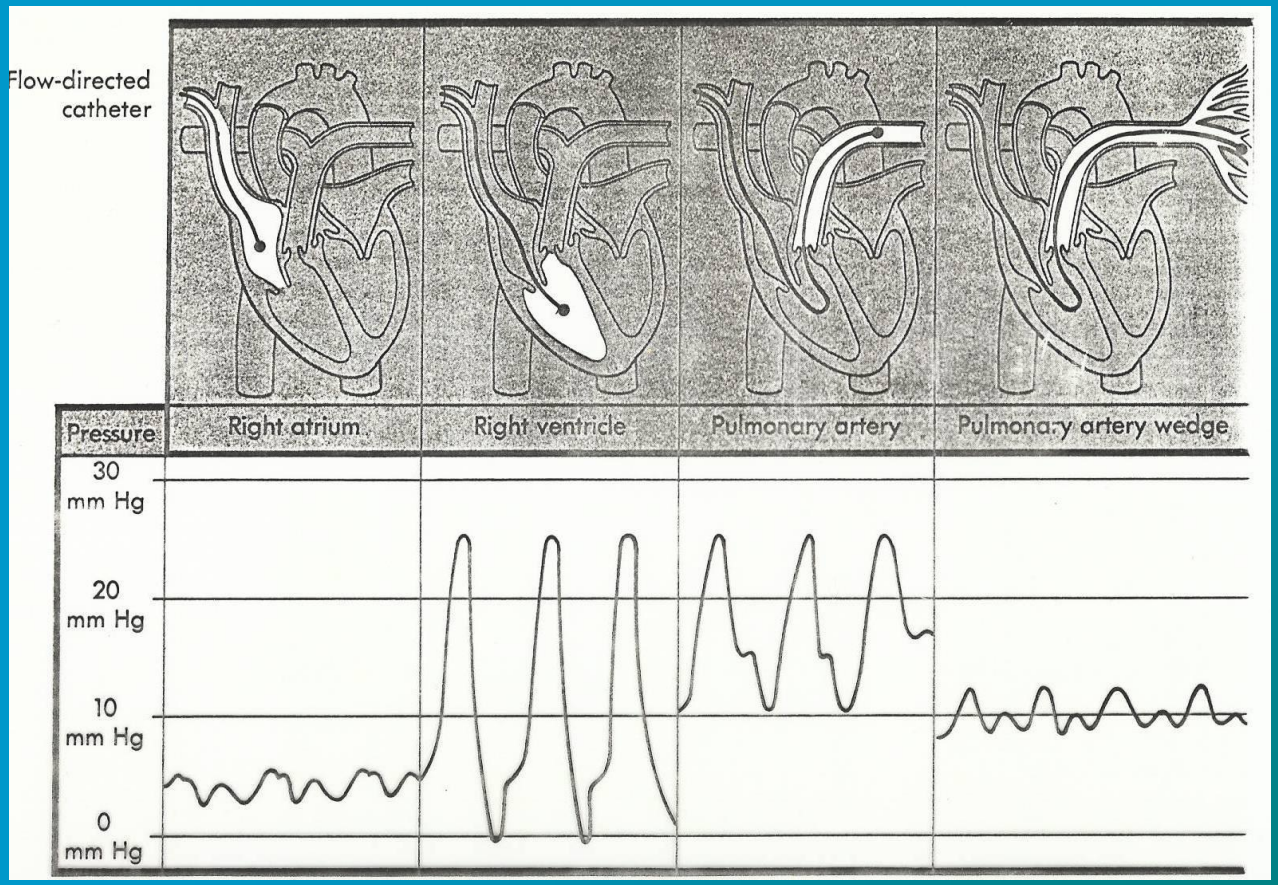
Hemodynamic Monitoring

- Pulmonary artery and pulmonary wedge pressures
  - Normal PCWP
    - Mean reading: 4-12 mm Hg
  - Low PCWP
    - Hypovolemia

Hemodynamic Monitoring

- Pulmonary artery and pulmonary wedge pressures
  - High PCWP
    - Increased preload:
      - Volume overload
      - Fluid retention
      - Aortic or mitral valve disease
    - Decreased contractility:
      - Myocardial ischemia or infarction
      - Ventricular aneurysms
      - Myocarditis
      - Acid/base imbalances
    - Increased afterload:
      - Systemic HTN
      - Vasoconstricting drugs

Hemodynamic Monitoring



Hemodynamic Monitoring

- Pulmonary artery and pulmonary wedge pressures
  - Complications:
    - Infection
    - Ventricular ectopics
    - Thromboemboli
    - Pulmonary infarction
    - Balloon rupture
    - Air emboli
    - Catheter kinking
    - Pulmonary artery rupture

Hemodynamic Monitoring

- Cardiac output
  - A Swan-Ganz catheter can measure this parameter using a technique called, “thermo dilution”
  - 10 cc of D5W at a known temperature is injected rapidly into the right atrium
  - The thermistor on the catheter near the balloon measures the temperature changes

Hemodynamic Monitoring

- Cardiac output:
  - The bedside monitor graphs these temperature changes and displays a “curve”
  - Three to five measurements are taken
  - The measurements are averaged and a cardiac output obtained
  - Usually done every 8 hours
  - Newest technology provides continuous CO

Hemodynamic Monitoring

- Cardiac output:
  - Besides the minute volume other parameters can be measured:
    - Cardiac index
    - Systemic vascular resistance
    - Right and left ventricular workloads
    - And more…

Hemodynamic Monitoring

- Arterial pressures
  - Arteries do not have valves
  - The pressure waveform in any artery in the body will resemble the one in the aorta
  - Provides a continuous reading of BP
  - Most accurate measurements compared to external cuff BP

Hemodynamic Monitoring

- Arterial pressures
  - Use a transducer set up connected to an arterial line (radial artery is common)
  - Do Allen's test prior to insertion of radial artery line
  - Arterial line can be used to obtain blood specimens (do not let the lab draw these)

Hemodynamic Monitoring

- Arterial pressures
  - Nursing interventions:
    - Watch for leaks and clogs
    - Watch the insertion site
    - Change system every 96 hours; change bag every 24 hours
    - Zero the transducer prn
    - Check circulation to the fingertips

Hemodynamic Monitoring

- Arterial pressures
  - Complications:
    - Blood loss
    - Obstruction
    - Air embolism
    - Infection-septicemia
    - Ischemia to hand or distal to line insertion

Heart Failure