



Congestive Heart Failure

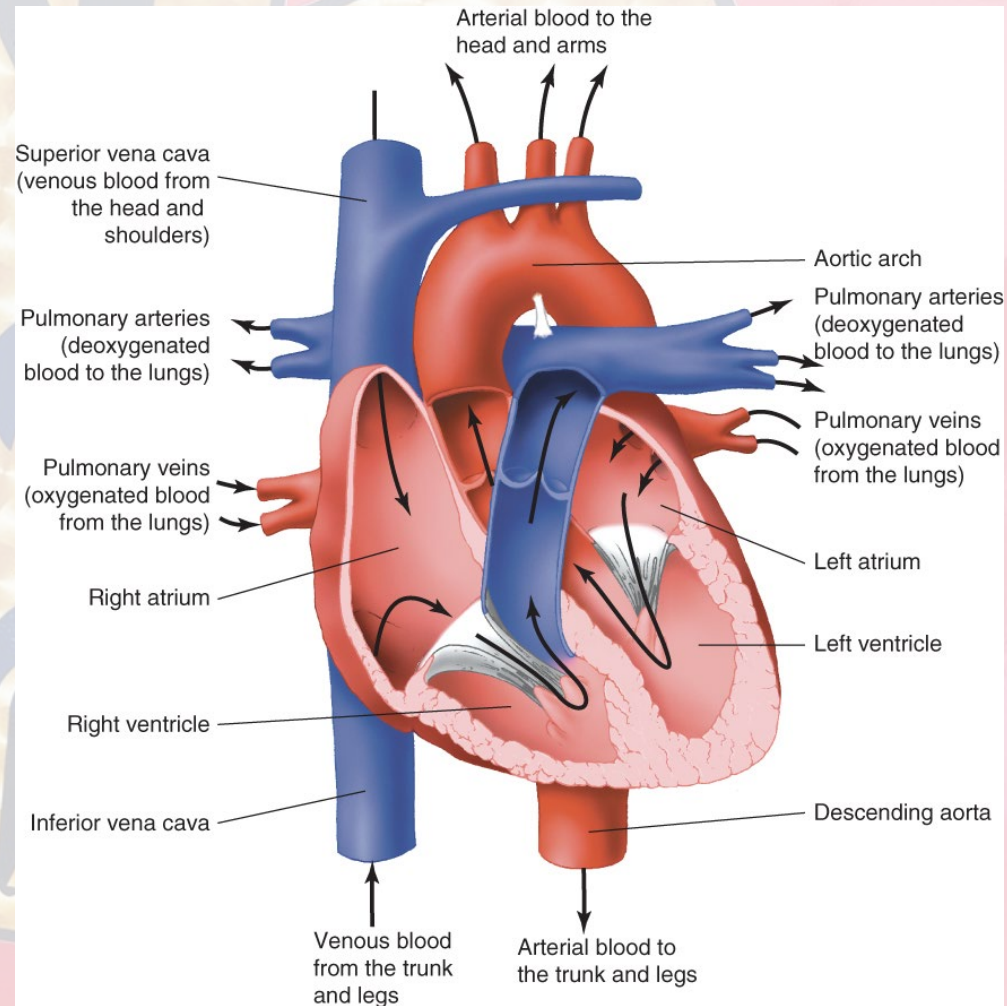
Pea Ridge Fire Department
EMS Refresher

Anatomy and Physiology Review

- Structure and function
 - Cardiovascular system
 - Composed of heart and blood vessels
 - Delivers oxygenated blood and nutrients to cells
 - Delivers chemical messengers (hormones)
 - Transports waste products to disposal sites

The Heart

- The heart has four chambers
 - Right atrium
 - Left atrium
 - Right ventricle
 - Left ventricle



The Heart

- Right atrium
 - Receives blood low in oxygen from the superior vena cava, inferior vena cava, and the coronary sinus
- Left atrium
 - Receives oxygenated blood from the lungs via the right and left pulmonary veins

The Heart

- Right ventricle
 - Pumps deoxygenated blood to the lungs
- Left ventricle
 - Pumps oxygenated blood throughout the body

The Heart

- The septa separate the heart into two functional pumps
 - Right heart: the right atrium and right ventricle
 - A low-pressure system (pulmonary circulation)
 - Left heart: the left atrium and left ventricle
 - A high-pressure system (systemic circulation)

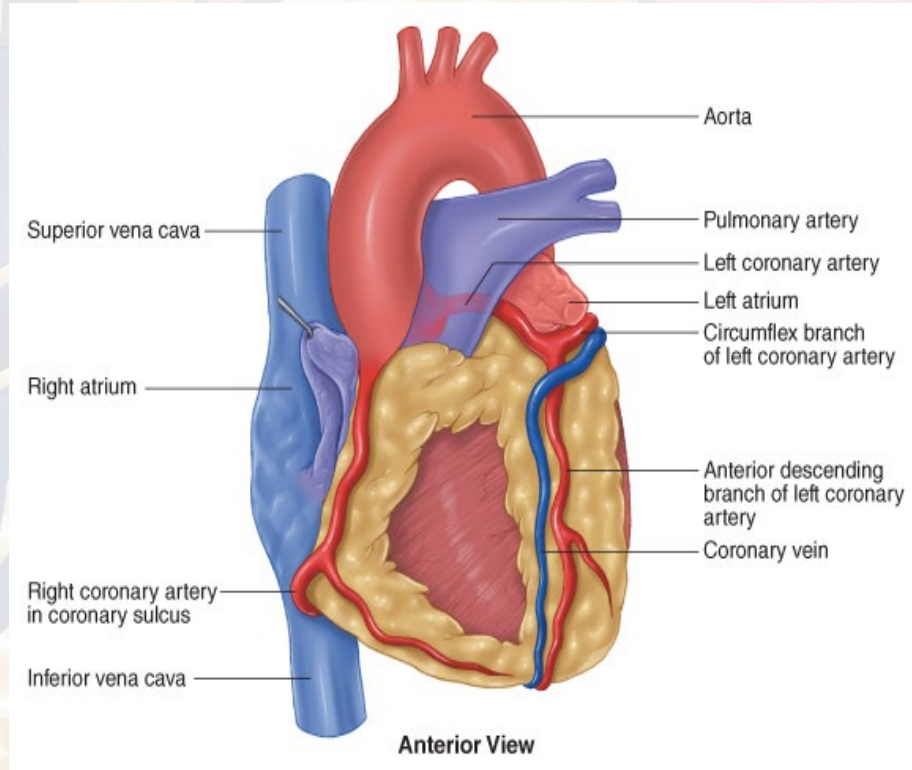
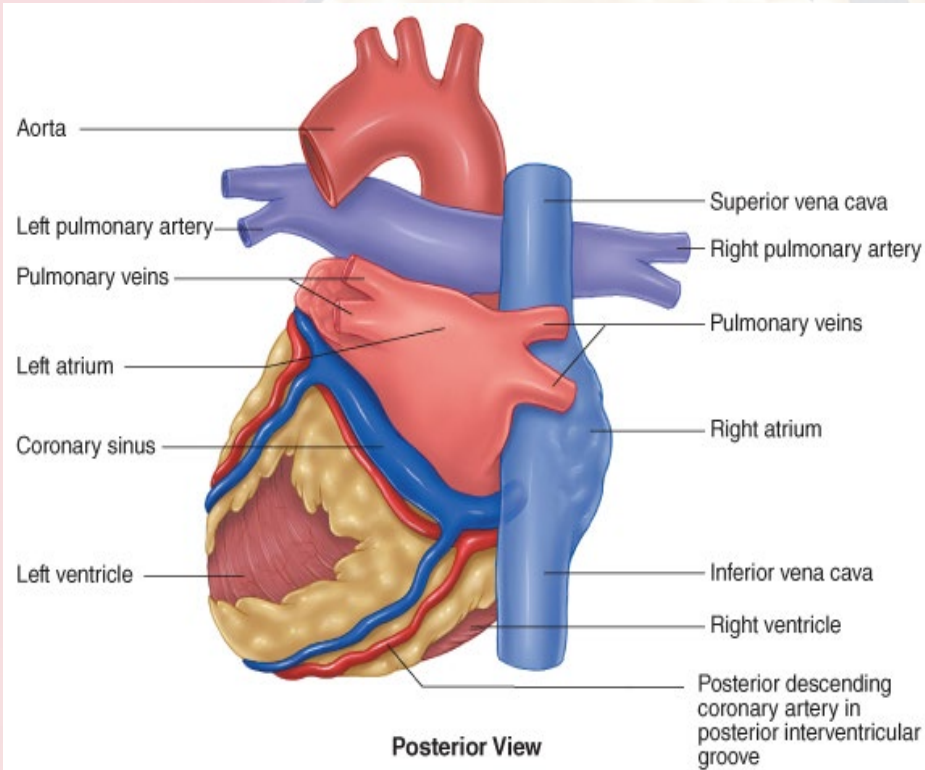
The Heart

- The myocardium is the middle layer of the heart wall.
 - Composed of thick muscle tissue
 - Responsible for:
 - Cardiac contraction
 - Efficient ejection of blood from the heart

The Heart

- Coronary arteries
 - The left main coronary artery supplies:
 - Left ventricle
 - Interventricular septum
 - The right coronary artery (RCA) supplies:
 - Right atrium
 - Right ventricle
 - Part of the left ventricle
 - Portions of the conduction system

The Heart



The Heart

- Cardiac cells have four properties that help the heart function:
 - Automaticity
 - Excitability
 - Conductivity
 - Contractility

The Heart

- The cardiac conduction system comprises six parts:
 - Sinoatrial (SA) node
 - Atrioventricular (AV) node
 - The bundle of His
 - Right and left bundle branches
 - The Purkinje fibers

The Heart

- Nerve stimulation
 - Stimulation of sympathetic nerves
 - Strengthens the force of contraction
 - Increases the heart rate

The Heart

- Nerve stimulation (cont'd)
 - Stimulation of parasympathetic nerves
 - Slows the rate of discharge of the SA node
 - Slows conduction through the AV node
 - Weakens the strength of atrial contraction
 - Can cause a small reduction in the force of ventricular contraction

Primary Survey

- The order of primary survey steps varies.
 - Normally ABCDE (assess airway, breathing, and then circulation, disability, and exposure)
- If the patient is unresponsive and is suspected of being in cardiac arrest:
 - Order is CABDE (assess circulation, then airway, breathing, disability, and exposure)

History Taking

- Acute coronary syndromes (ACSs): a series of cardiac conditions caused by an abrupt reduction in blood flow through a coronary artery
 - Unstable angina
 - Non–ST segment elevation myocardial infarction (NSTEMI)
 - ST segment elevation myocardial infarction (STEMI)

History Taking

- Chest pain is often the presenting symptom of ACSs.
- Dyspnea is another chief complaint.
- If your patient has fainted, try to determine whether he or she fainted from cardiac or noncardiac causes.
 - Cardiac: dysrhythmias, increased vagal tone, and heart lesions

History Taking

- Palpitations: sensation of abnormally fast or irregular heartbeat
 - Often caused by dysrhythmia.
 - Inquire about:
 - Onset, frequency, and duration
 - Previous episodes

History Taking

- Patients may also report:
 - Feelings of impending doom
 - Nausea or vomiting
 - Trauma involvement
 - Hypoxia
- Inquire about medical history.

History Taking

- Ask about medications
 - Prescription (particularly cardiac)
 - Over-the-counter drugs
 - Herbal supplements
 - Recreational drugs

History Taking

- Determine if the patient has been diagnosed with diseases such as:
 - Coronary artery disease (CAD)
 - Atherosclerotic heart disease
 - Valvular disease
 - Aneurysm
 - Pulmonary disease
 - Diabetes

Secondary Assessment

- The physical exam should emphasize cardiac issues.
- Skin color and temperature may indicate circulation problems.
 - Pale, mottled, or cyanotic skin
 - Flushed, warm skin

Physical Exam

- Begin with inspection, auscultation, and palpation.
 - Inspect neck and tracheal position.
 - Inspect adjacent structures (neck veins, etc.).
 - Estimate jugular venous pressure.

Physical Exam

- Inspect/palpate chest.
 - Surgical scars
 - Nitroglycerin (NTG) patch
 - Pacemaker or defibrillator
 - Chest enlargement
 - Crepitus
- Listen with a stethoscope.

Physical Exam

- Palpate the patient's abdomen for distention and pulsations.
 - Pulsations in the epigastric area may be a sign of an abdominal aortic aneurysm.
- Check for swelling.
 - Bilateral pitting edema may be a sign of right ventricular failure (RVF).
 - One-sided pitting edema suggests blockage.

Physical Exam

- Monitoring devices
 - Cardiac monitor
 - Waveform capnography
 - Pulse oximeter
- Pulse findings
 - Pulse deficit
 - Pulsus paradoxus
 - Pulsus alternans

Physical Exam

- Blood pressure
 - Elevated blood pressure: anxiety or pain
 - Systolic blood pressure lower than 90 mm Hg: hypotension or shock
 - Increased pulse pressure: arteriosclerosis
 - Reduced SV: cardiogenic shock or cardiac tamponade

Physical Exam

- S_1 : occurs when tricuspid and mitral valves close
 - Decreased sounds can indicate:
 - Fibrotic or calcified mitral valve
 - Obesity
 - Emphysema
 - Cardiac tamponade

Physical Exam

- S₂: occurs when pulmonary and aortic valves close
 - Louder: chronic high blood pressure or pulmonary hypertension
 - Decreased: hypotension
 - Split: right bundle branch

Physical Exam

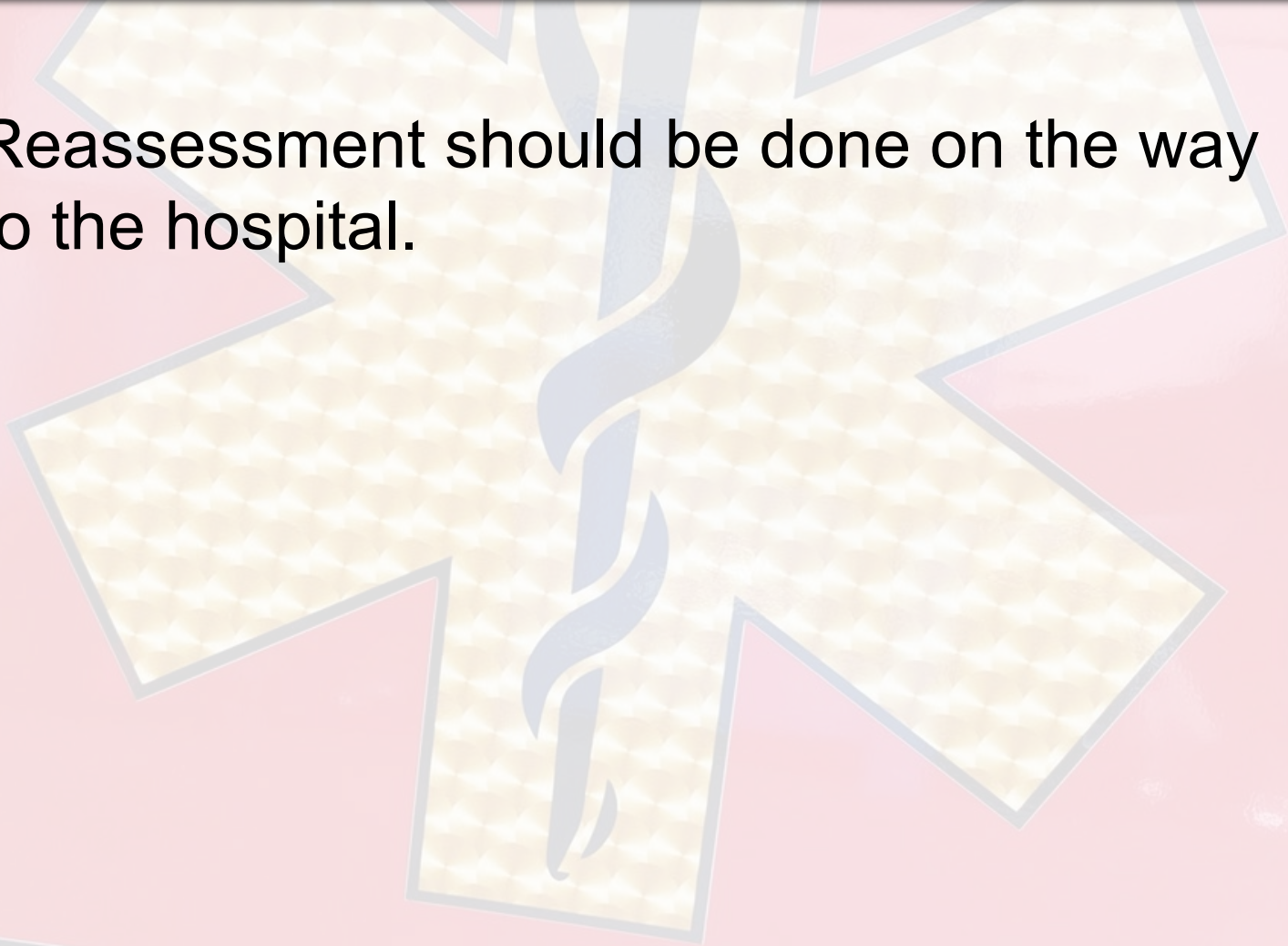
- S_3 : caused by ventricular wall vibrations
 - Abnormal sound associated with heart failure
- S_4 : heard just before S_1
 - Turbulent filling of stiff ventricle in hypertrophy
 - Possible myocardial infarction

Physical Exam

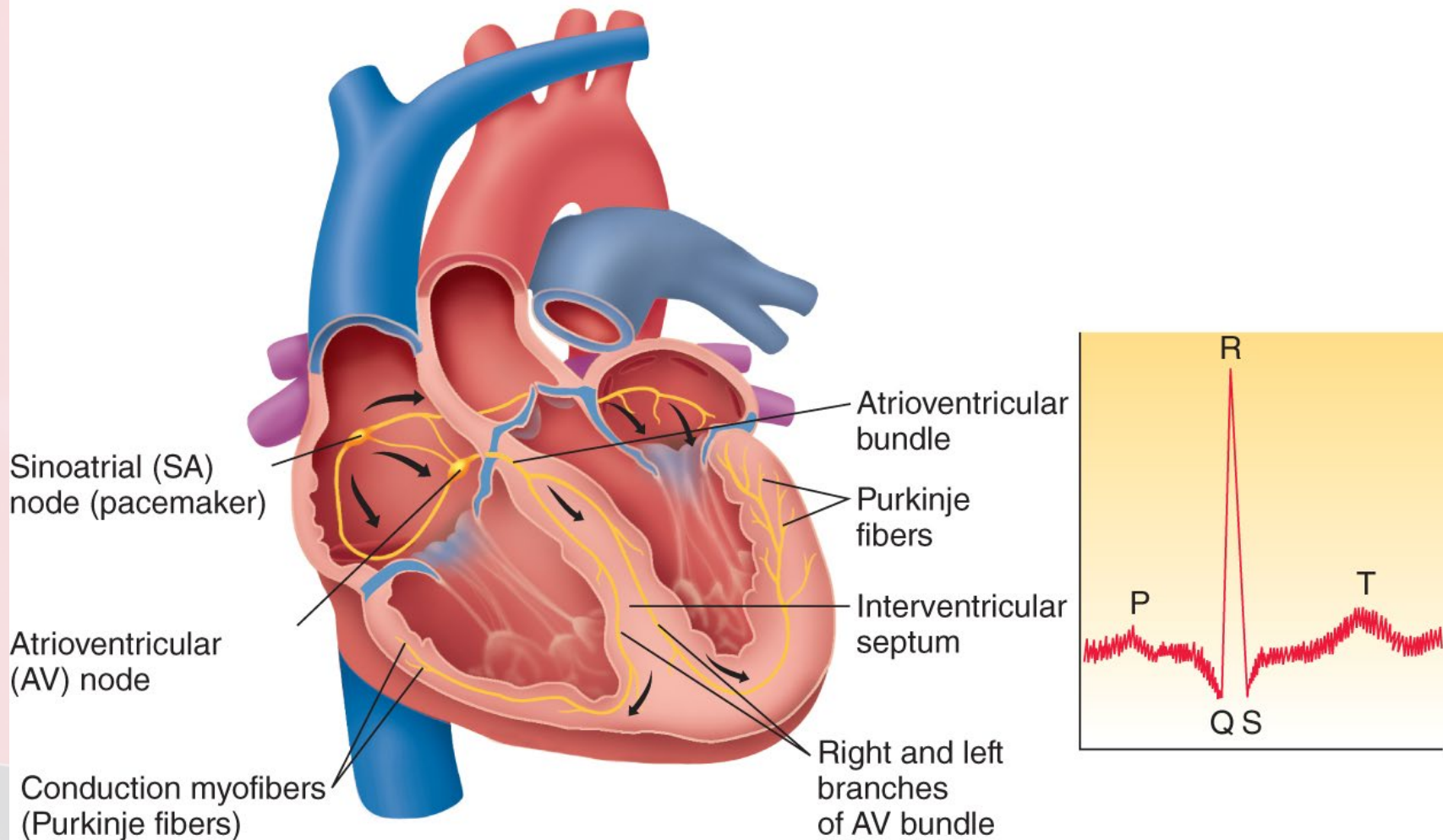
- Heart murmur:
 - Ambiguous sound from turbulent blood flow through the valves
 - May indicate
 - Increased blood flow across a normal valve
 - Flow across an irregular or constricted valve
 - Blood flow into an enlarged heart chamber
 - Backwards blood flow through a compromised valve

Reassessment

- Reassessment should be done on the way to the hospital.

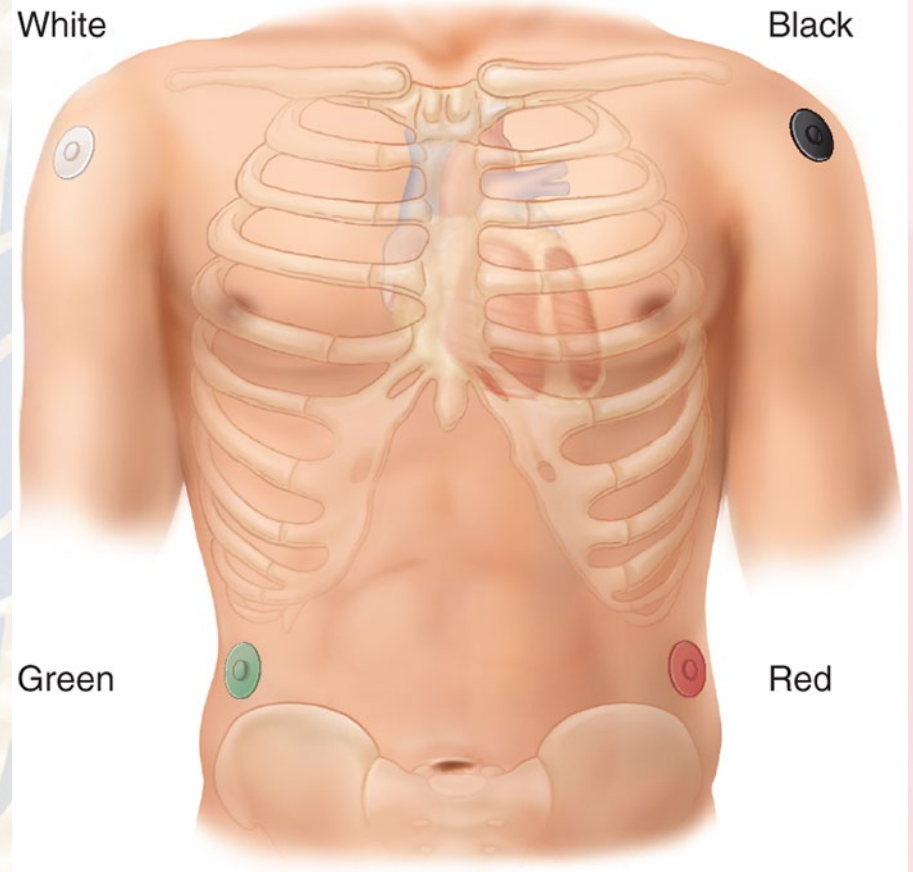


The Electrical Conduction System



Electrode Placement

- Predetermined spots
- Usually adhesive with gel center



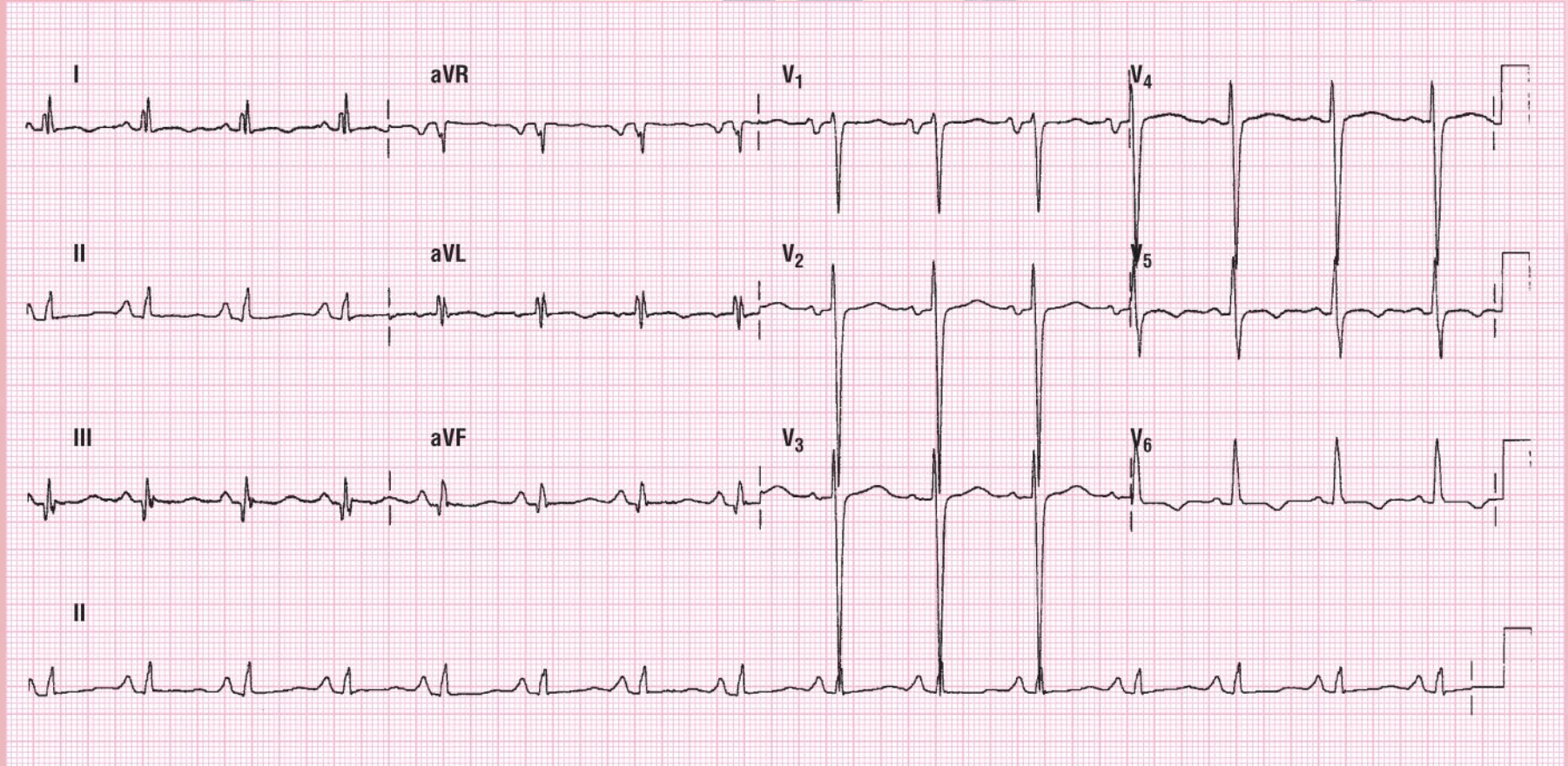
12-Lead ECGs

- Indications
 - Chest pain
 - Right or left ventricular heart failure
 - Electrolyte imbalance
 - Medication overdose
 - Syncope or near-syncope
 - Stroke
 - Hemodynamic instability

Chamber Size

- Right atrial abnormality
 - Results from chronic pulmonary disorders
 - Characterized by P wave with an amplitude:
 - Higher than 2.5 mm in lead II
 - And/or higher than 1.5 mm in lead V₁

Chamber Size

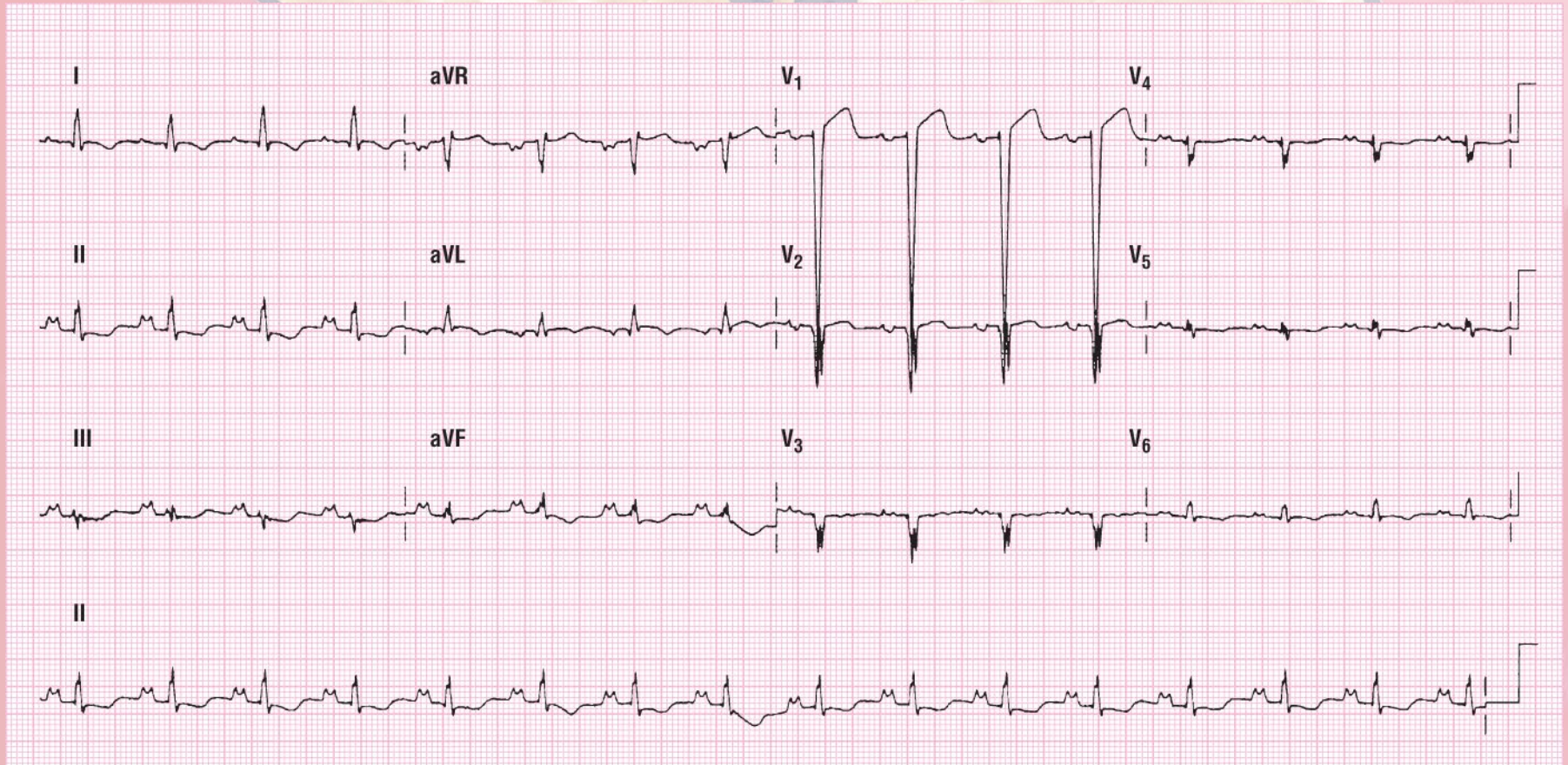


Reproduced from *12-Lead ECG: The Art of Interpretation*, courtesy of Tomas B. Garcia, MD.

Chamber Size

- Left atrial abnormality
 - Characterized by:
 - A P wave longer than 0.12 seconds in lead II
 - A P wave with a notched appearance
 - A biphasic P wave in lead V_1 predominantly negative
 - Caused by:
 - Mitral or aortic valve stenosis
 - Hypertensive heart disease
 - Cardiomyopathy
 - CAD

Chamber Size

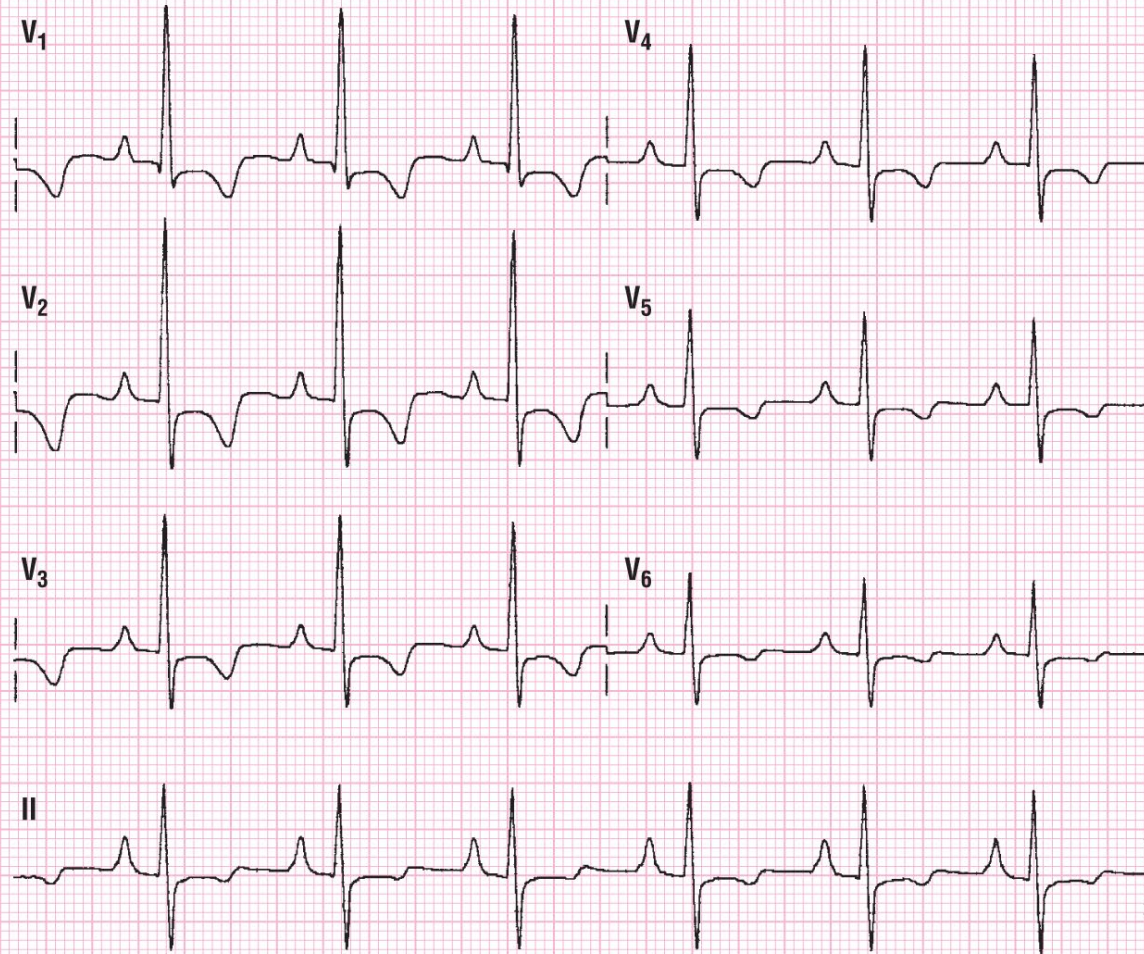


Reproduced from *12-Lead ECG: The Art of Interpretation*, courtesy of Tomas B. Garcia, MD.

Chamber Size

- Right ventricular hypertrophy
 - Usually caused by pulmonary hypertension
 - Diagnosed by R wave that exceeds the height of the S wave in V_1

Chamber Size

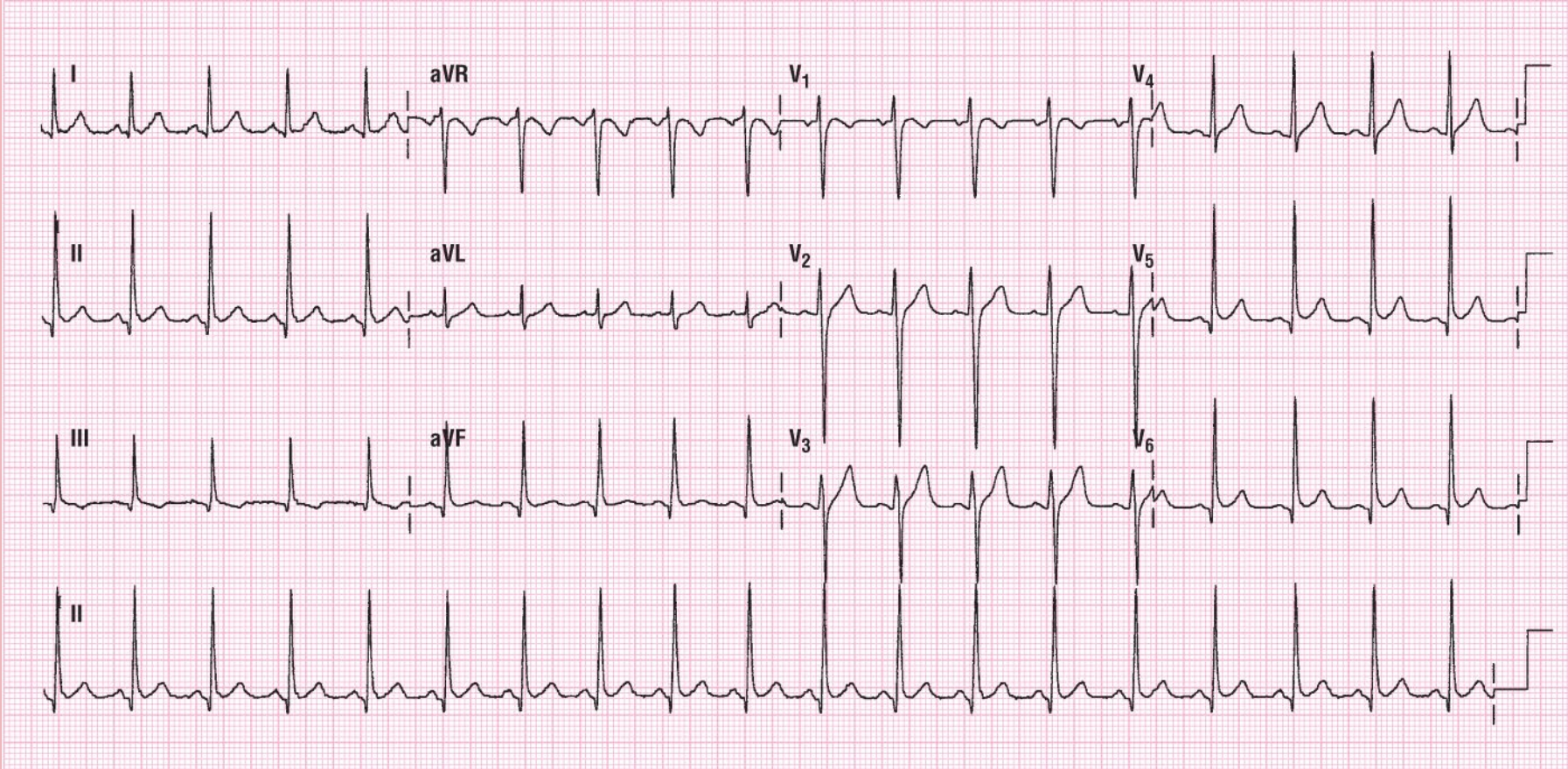


Reproduced from *12-Lead ECG: The Art of Interpretation*, courtesy of Tomas Brugada, MD

Chamber Size

- Left ventricular hypertrophy
 - From hypertension or cardiac abnormalities
 - Diagnosed by:
 - Deepest S wave in V_1 plus
 - Tallest R wave in V_5/V_6 , taller than 35 mm, and/or
 - R wave in lead aVL taller than 11 mm
 - QRS voltages

Chamber Size



Epidemiology of Cardiovascular Disease

- According to the AHA, cardiovascular disease (CVD) is the leading global cause of death.
- It is estimated that more than one in three Americans has one or more types of CVD.

Epidemiology of Cardiovascular Disease

- Disease of coronary arteries and associated signs, symptoms, and complications
 - Such as angina pectoris and AMI
 - Characterized by atherosclerotic narrowing and blockage of arteries

Acute Coronary Syndromes

- Characterized by:
 - Diminished flow through the coronary arteries
 - Coronary artery occlusion by a blood clot (thrombus)
 - Coronary artery spasm
 - Reduction of overall blood flow from any cause

Risk Factors for CHD

- Hypertension
- Cigarette smoking
- Diabetes
- High serum cholesterol
- Lack of exercise
- Obesity
- Family history
- Male gender

Risk Factors for CHD

- Modifiable risk factors include:
 - Diabetes
 - Excessive alcohol use
 - Obesity
 - Smoking
- Modification can make a difference.

Physiology of Heart Failure

- $CO = SV \times HR$
- Three main factors affect stroke volume
 - Preload
 - Afterload
 - Cardiac contractility

Physiology of Heart Failure

- Heart failure can be caused by any condition that affects:
 - Preload
 - Afterload
 - Contractility
 - Heart rate

Physiology of Heart Failure

- Starling law of the heart: Increased venous return augments preload.
 - Heart muscle fibers stretch in response to the expanded volume (preload).
 - Stretching allows the heart to eject more forcefully the additional volume, boosting stroke volume.
 - In a normal heart, this results in increased CO.

Left Ventricular Failure

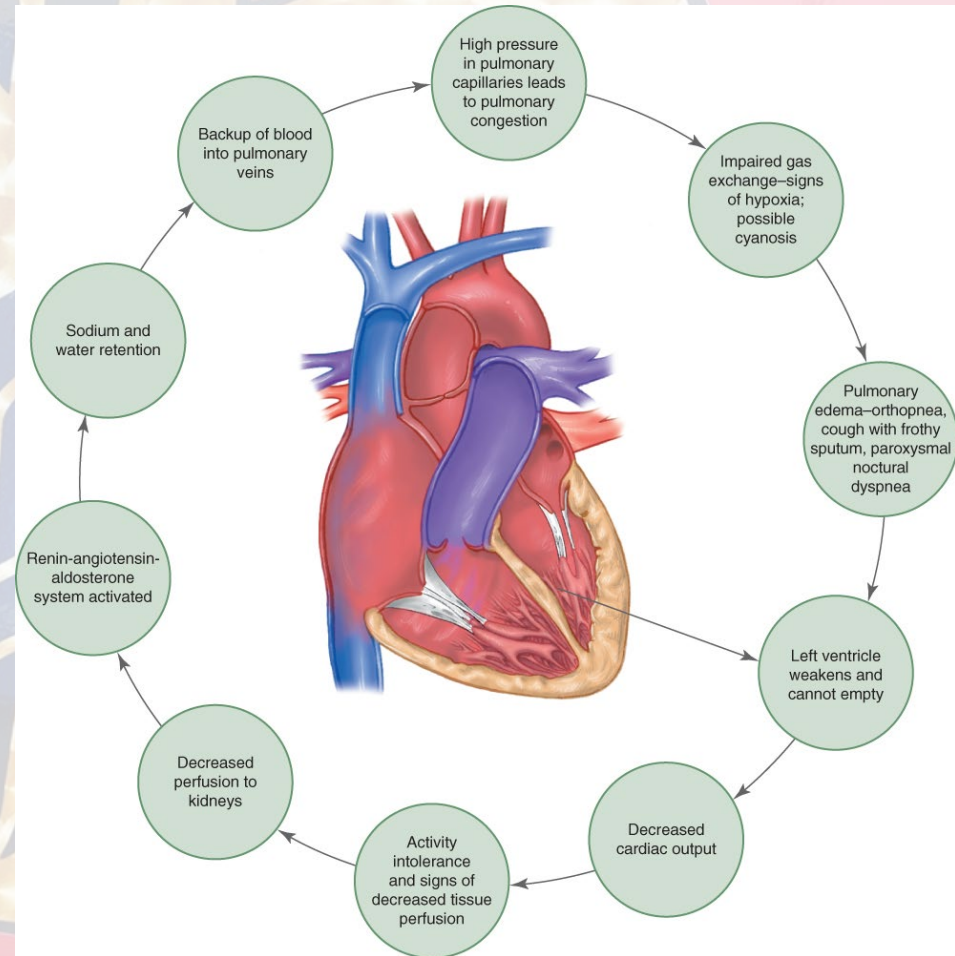
- Two types of LVF
 - Systolic failure
 - Diastolic failure
- Common causes
 - Faulty heart valve
 - AMI
 - Cardiomyopathy
 - Excessive volume or pressure

Left Ventricular Failure

- Pathophysiology
 - Left ventricle most commonly damaged
 - The right side continues to pump normally.
 - The left side cannot keep up, and pressure increases.
 - Fluid is forced into alveoli and forms a pulmonary edema.

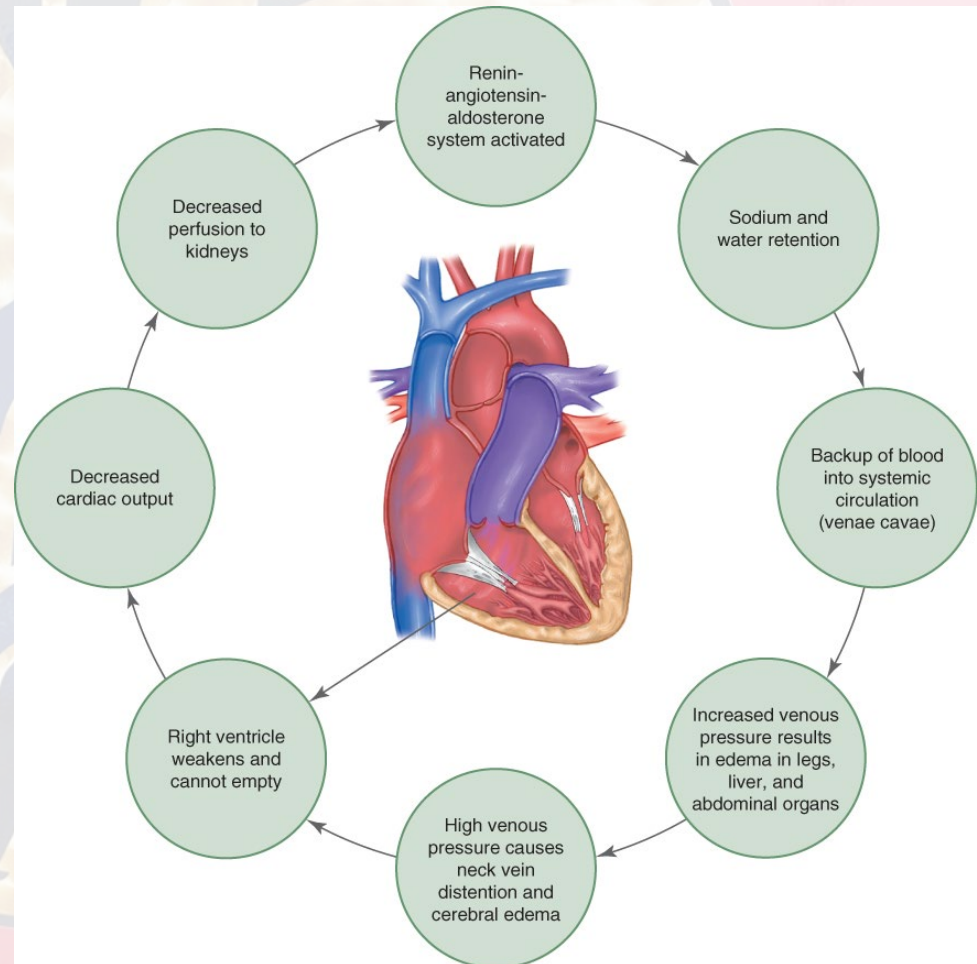
Left Ventricular Failure

- Pathophysiology (cont'd)
 - Buildup of fluid widens the gap between the alveoli/capillary membrane.
 - Oxygenation becomes impaired.



Right Ventricular Failure

- Pathophysiology
 - To eject the blood, the right ventricle must overcome high pressure and congestion within the pulmonary vessels.



Right Ventricular Failure

- Pathophysiology (cont'd)
 - When the right ventricle cannot keep up, it fails.
 - Blood backs up behind the right ventricle.
 - Pressure rises in the right atrium.
 - Veins and organs become congested with blood.
 - Edema occurs.
 - This causes fluid to build up in the abdomen, pleural cavity, and/or pericardial cavity.
 - Generalized edema may occur.

Cor Pulmonale

- RVF may occur by itself (without LVF) in conditions such as:
 - Right ventricular infarction (RVI)
 - Pulmonary embolism
 - Pulmonary hypertension
- Cor pulmonale is RVF caused by pulmonary disease.
 - Usually the result of COPD

Compensatory Mechanisms

- Mechanisms manipulate preload, afterload, cardiac contractility, and heart rate to improve CO.
 - Sympathetic nervous system
 - Boosts heart rate
 - Increases force of contraction
 - Constricts blood vessels

Compensatory Mechanisms

- Accelerated heart rate and stronger force of contraction.
 - Increase the heart's oxygen demand
 - Reduce ventricle filling time
 - Decrease time for coronary artery perfusion

Compensatory Mechanisms

- Decreased blood flow to the kidneys stimulates the renin-angiotensin-aldosterone system.
 - The heart works even harder to pump against high pressure.
 - Aldosterone encourages sodium and water retention and increased blood volume (increased preload).

Compensatory Mechanisms

- Mechanisms increase CO for a time, but eventually heart failure advances.
 - Sodium and water enlarge the heart chambers.
 - Ventricle walls thicken, weakening the force of contraction.
 - Force of contraction decreases.
 - The heart is unable to handle the increased volume of fluid, and CO decreases.

Heart Failure

- Assessment
 - Symptoms
 - Sudden shortness of breath (even during rest)
 - Trouble sleeping, concentrating
 - Feeling tired or weak
 - Nausea
 - Loss of appetite
 - Restlessness
 - Jugular venous distension (JVD) if RVF accompanies LVF

Heart Failure

- Assessment (cont'd)
 - Signs and symptoms present with heart failure may be present with other conditions.

Table 17-14

Differential Diagnosis of Heart Failure

Classification	Possible Diagnoses
Cardiovascular causes	▪ Cardiac tamponade ▪ Cardiogenic pulmonary edema ▪ Cardiogenic shock ▪ High-altitude pulmonary edema ▪ Myocardial ischemia ▪ Myocardial infarction ▪ Noncardiogenic pulmonary edema ▪ Pulmonary embolism
Respiratory causes	▪ Acute respiratory distress syndrome ▪ Asthma ▪ Chronic bronchitis ▪ Chronic obstructive pulmonary disease ▪ Pneumonia ▪ Pneumothorax ▪ Respiratory failure
Other causes	▪ Anaphylaxis ▪ Aspiration ▪ Toxin exposure

Heart Failure

- Management
 - Goals:
 - Decrease work of breathing
 - Maintain adequate oxygenation and perfusion
 - Support efforts to decrease workload of the heart

Heart Failure

- Management (cont'd)
 - Place the patient in a position of comfort.
 - Apply a pulse oximeter.
 - Provide supplemental oxygen as needed.
 - Maintain SpO₂ at 94% or higher.
 - Monitor the patient's respiratory status.

Heart Failure

- Management (cont'd)
 - Place the patient on a cardiac monitor and obtain a 12-lead ECG.
 - Establish IV access.
 - Administer pharmacologic therapy according to local protocol.
 - Transport the patient without lights and siren.

Heart Failure

- Management (cont'd)
 - Surgically implanted ventricular assist devices (VADs) may be used in patients who have heart failure.
 - Act as an artificial ventricle
 - Left ventricular assist device (LVAD)
 - Right ventricular assist device (RVAD)
 - Biventricular assist device (BIVAD)

Heart Failure

- Management (cont'd)
 - LVF is more common than RVF, so LVAD is the most common type of VAD.
 - A VAD coordinator can assist in making treatment and transport destination decisions.

Please move to the next section
Thank you !

