بسم الله الرحمن الرحيم

السلام عليكم ورحمة الله وبركاته

Cardiovascular System Block
Jugular Venous Pulse
Heart Failure
(Physiology)

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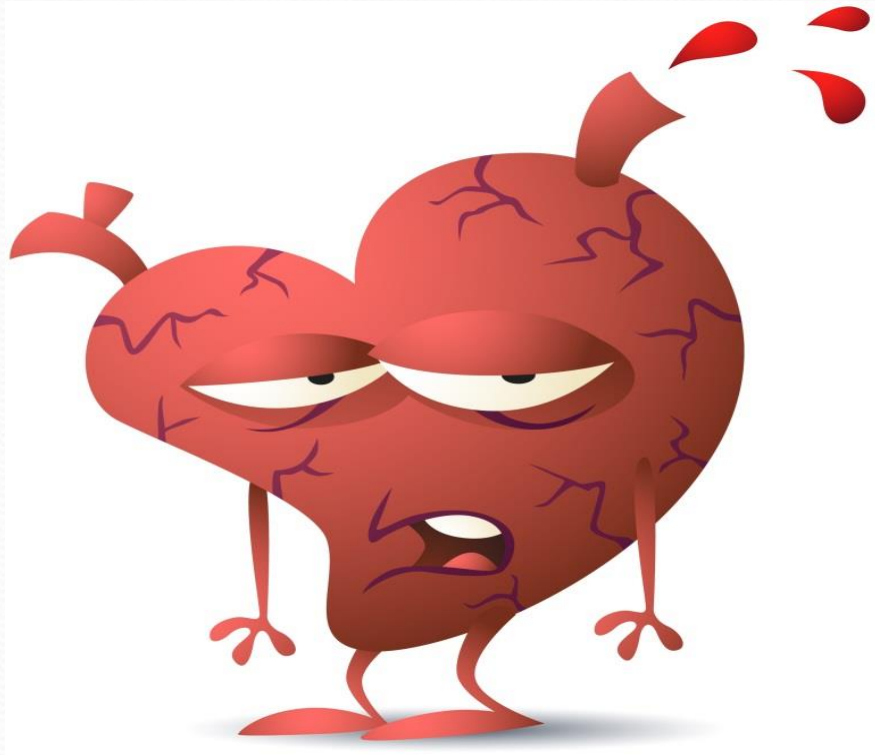


Learning Objectives

- Identify the jugular venous pressure
- Know the method of examination of the internal venous pressure
- Normal pattern of the jugular venous pulse
- What are the abnormalities of jugular venous pulse
- Define heart failure
- Know how fast does heart failure develop
- Identify types of heart failure
- Discuss the causes of heart failure
- Know the symptoms & signs of heart failure
- Indicators for diagnosis of heart failure

Definition of:-

- **Jugular Venous Pulse:**

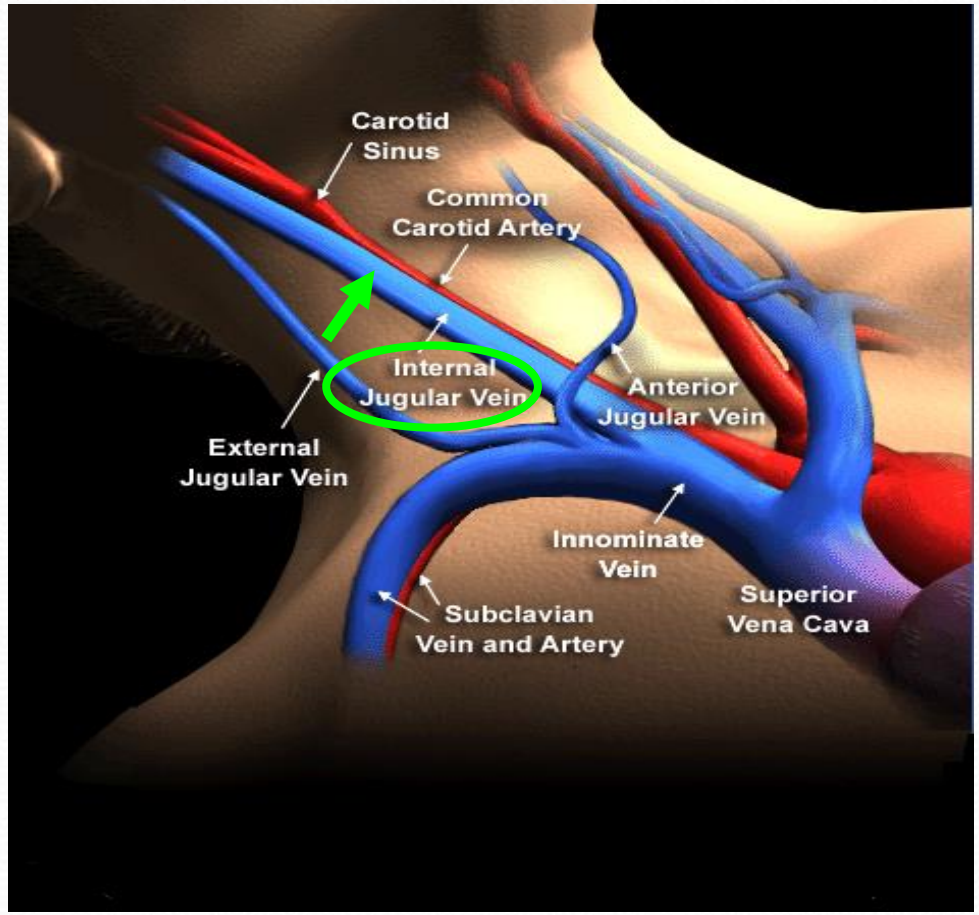
  Defined as the oscillating top of vertical column of blood in right internal jugular vein. It reflects pressure changes in right atrium in cardiac cycle.

- **Jugular Venous Pressure:**

  Vertical height of oscillating column of blood.

Why Right Internal Jugular Vein (IJV)?

- Right internal jugular veins (IJV) extend in an almost straight line to superior vena cava and has a direct course to RA, thus favoring transmission of the haemodynamic changes from the right atrium.
- IJV is anatomically closer to RA.
- IJV has no valves (valves in EJV prevent transmission of RA pressure)
- The left innominate vein is not in a straight line and may be kinked or compressed between aortic arch and sternum, by a dilated aorta, or by an aneurysm.



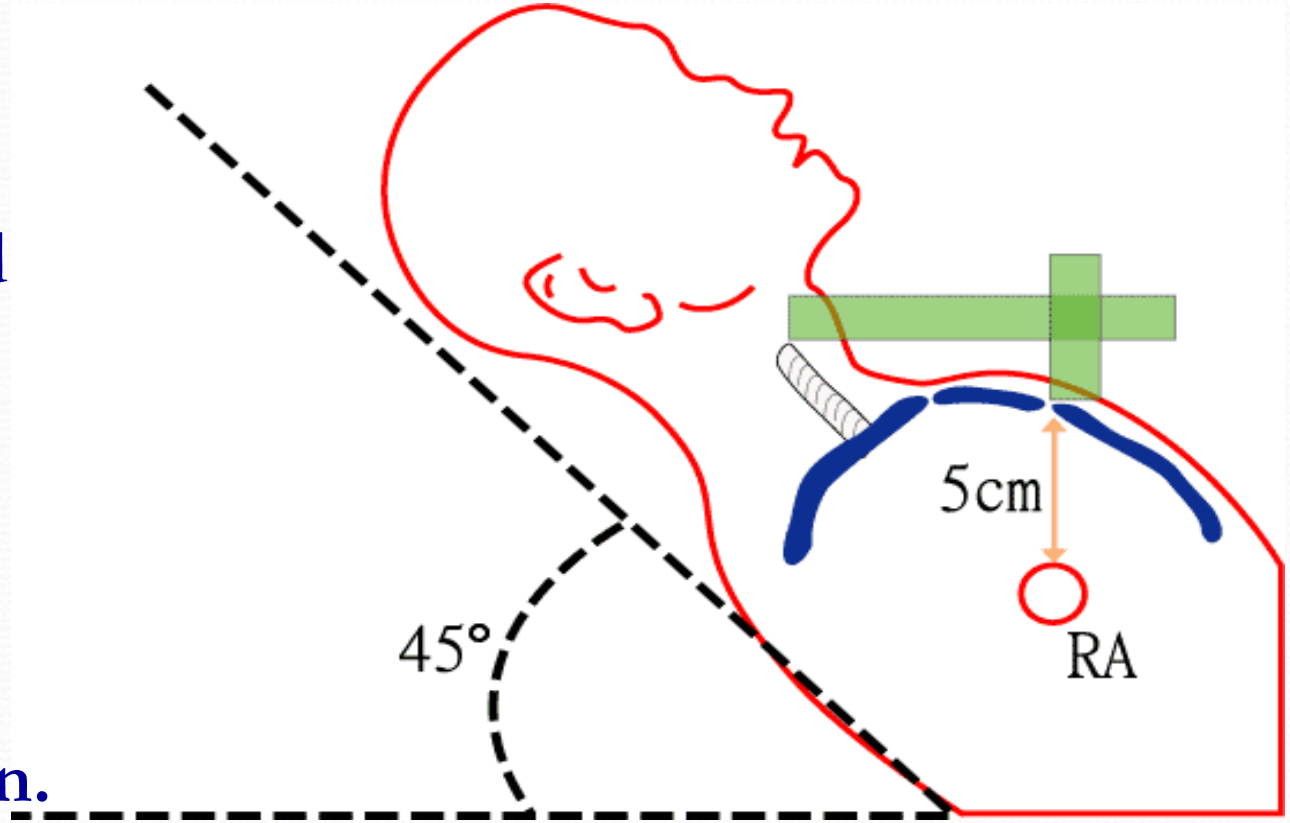
Method Of Examination

- The patient should lie comfortable during the examination.
- Clothing should be removed from the neck and upper thorax.
- Patient reclining with head elevated 45 °.
- Neck should not be sharply flexed.
- Examined effectively by shining a light across the neck.
- There should not be any tight bands around abdomen.

Observations Made

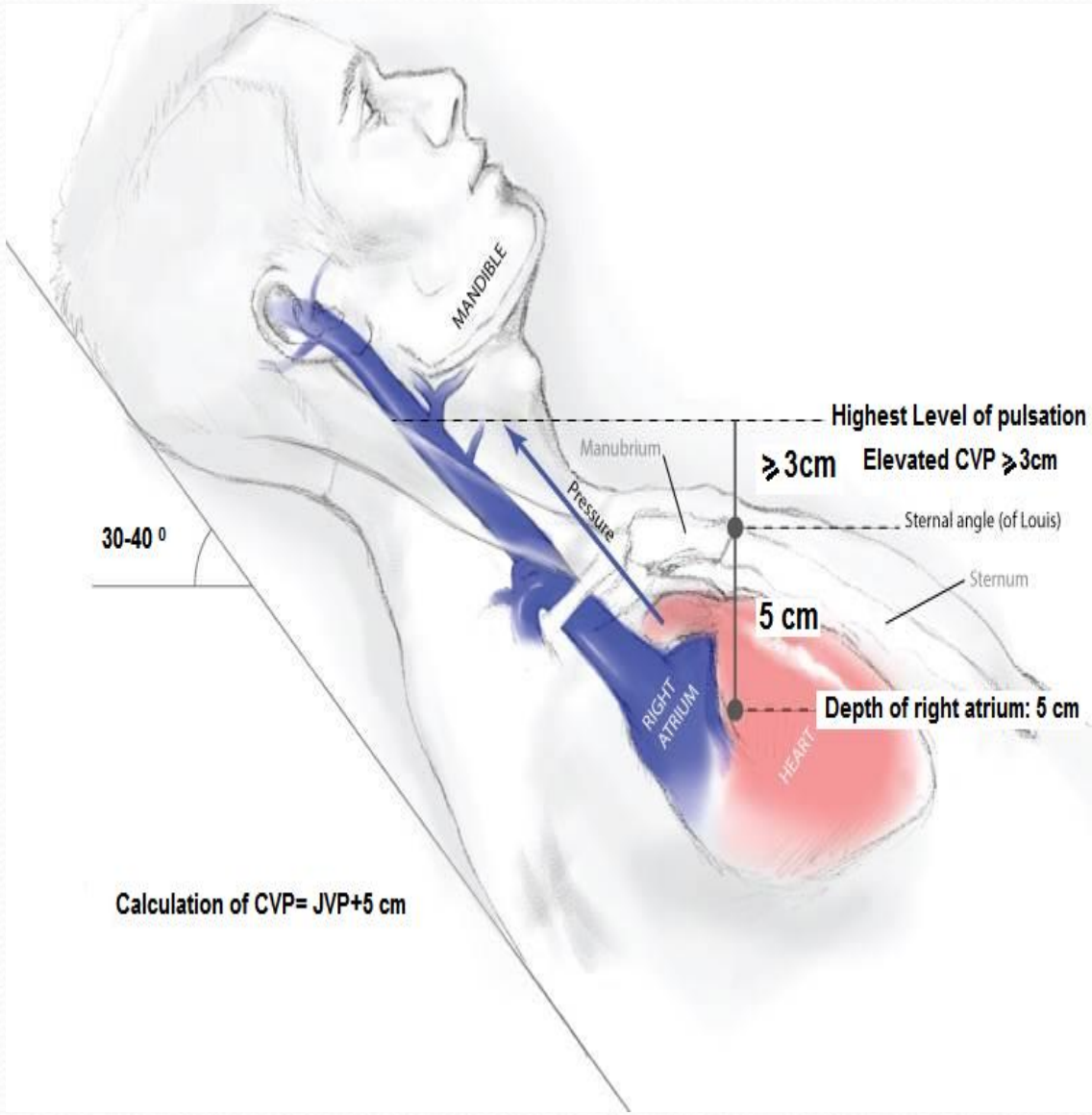
When the patient reclining with head elevated 45 °, observe:-

- **The level of venous pressure.**
- **The type of venous wave pattern.**

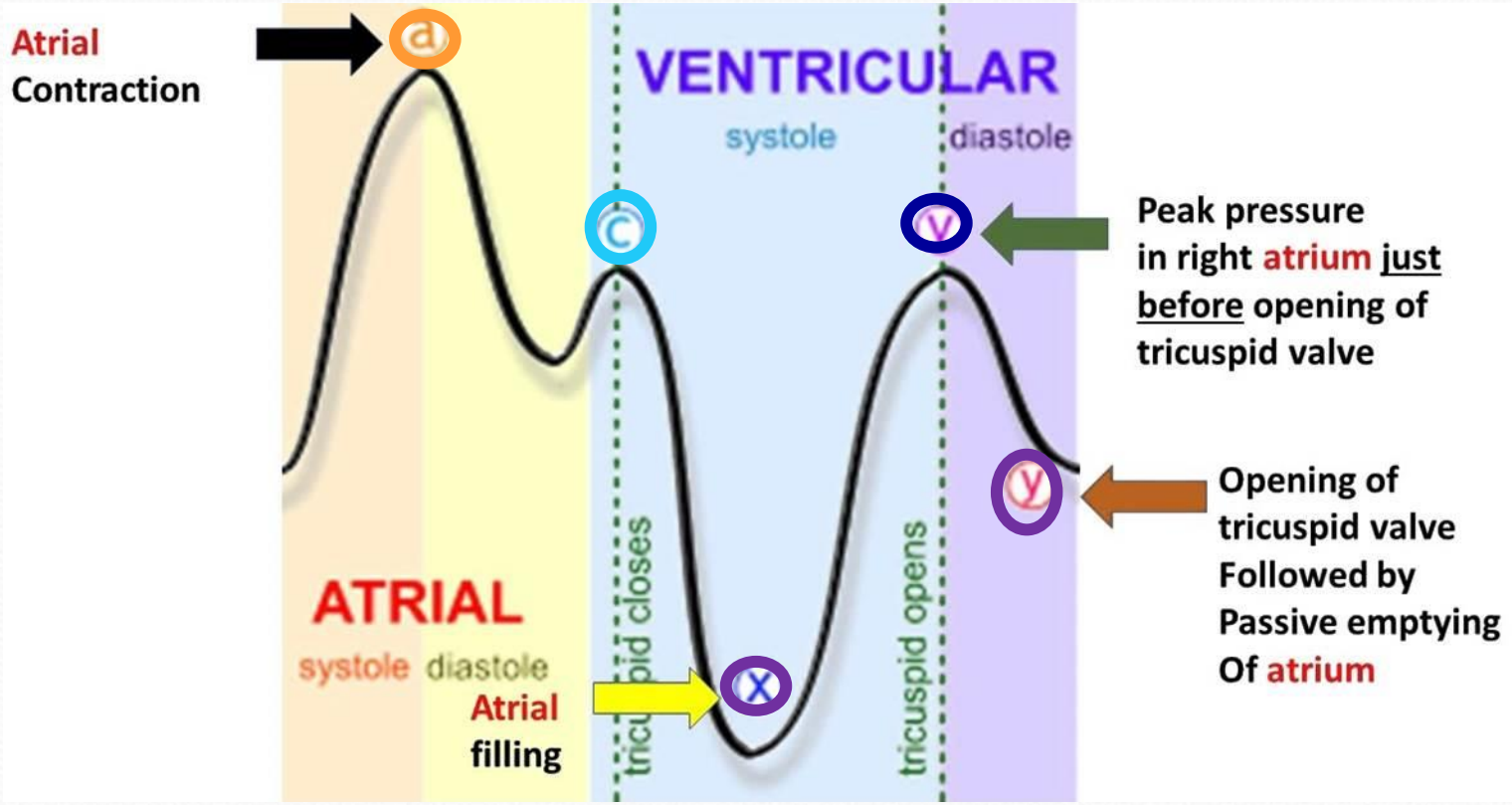


The level of venous pressure

- Using a centimeter ruler, measure the vertical distance between the angle of Louis and the highest level of jugular vein pulsation.
- The upper limit of normal is 3 cm above the sternal angle.
- Add 5 cm to measure central venous pressure since right atrium is 5 cm below the sternal angle.
- Normal CVP is < 8 cm H2O



Normal pattern of the jugular venous pulse



- The normal JVP reflects phasic pressure changes in the right atrium and consists of:
- Three positive waves
- Two negative descents.

The "a" Wave: Atrial systole

- +ve, venous distension due to RA contraction and retrograde blood flow into SVC and IJV
- -ve due to blood passage into ventricles.

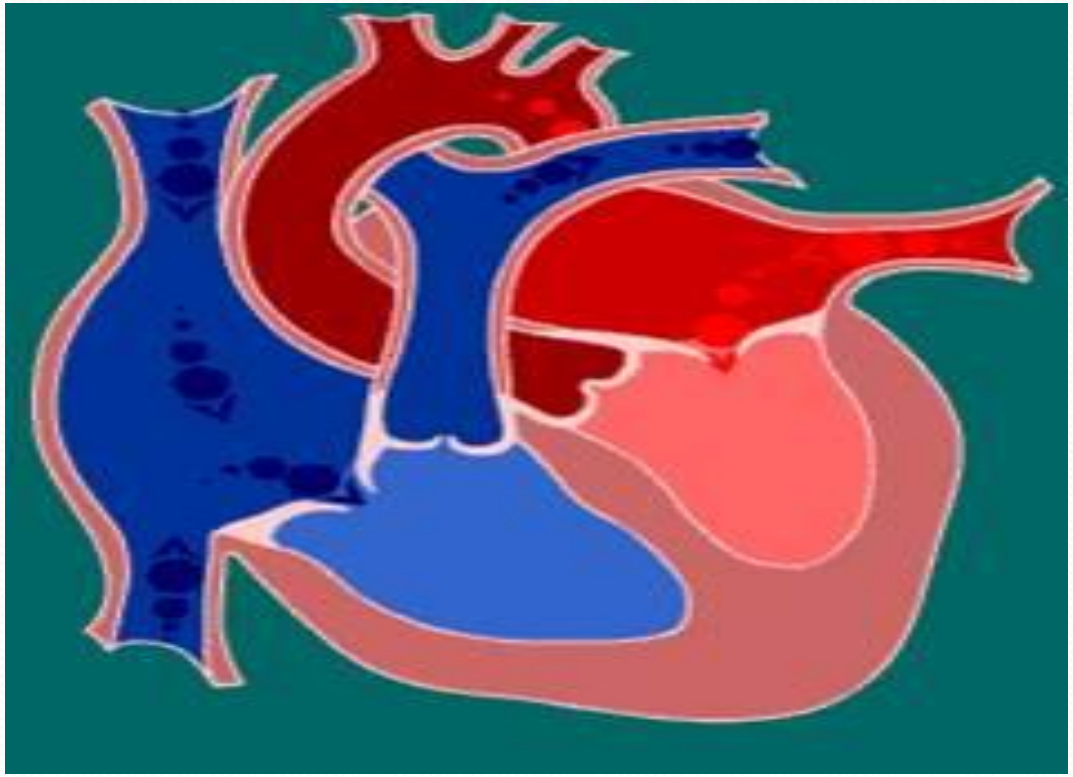
The "x" descent:

- It is due to atrial relaxation and downward displacement of the tricuspid valve during 'reduced ejection phase.'

The "c" wave: Ventricular systole

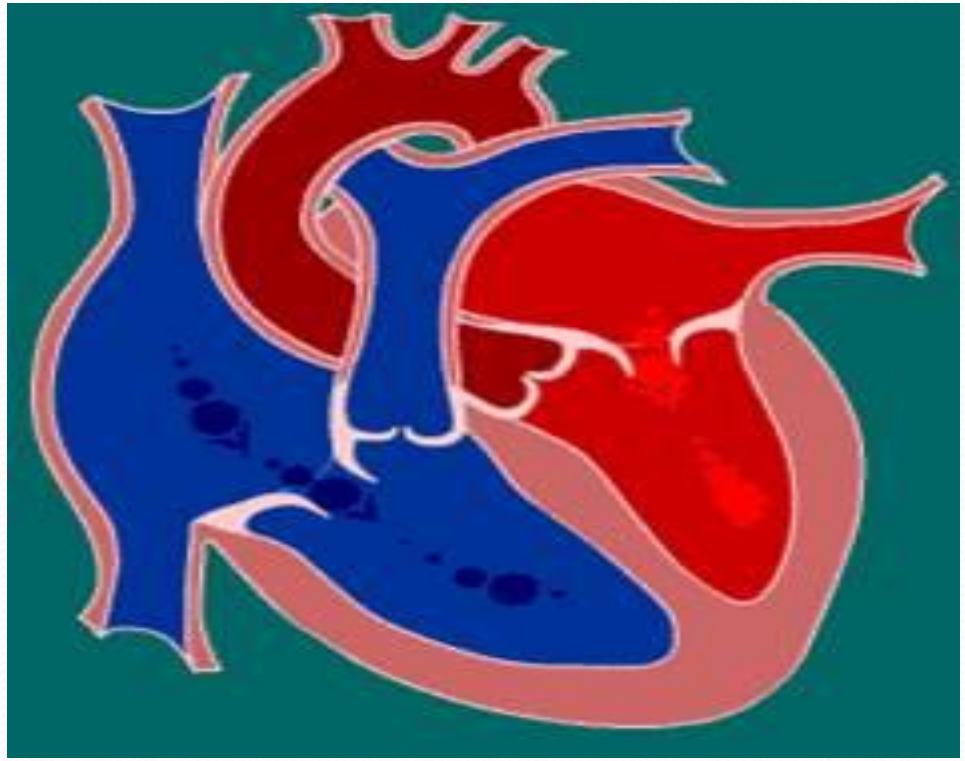
- +ve due to ventricular contraction and resulting bulging of tricuspid valve into the right atrium during isovolumetric contraction.
- -ve due to the pulling down of the atrial muscle & A-V cusps during 'rapid ejection phase', resulting in ↓ atrial pressure.

"v" Wave :



- +ve due to ↑ venous return rising right atrial pressure when blood flows into the right atrium during atrial diastole while the tricuspid valve is shut.
- -ve due to entry of blood into ventricles during 'rapid filling phase.'

"y" Descent



It is due to decline in right atrial pressure due to entry of blood into ventricles when the tricuspid valve reopens during 'reduced filling phase.'

Abnormalities of jugular venous pulse

A- Low jugular venous pressure

1. Hypovolemia.

B- Raised Jugular Venous Pressure

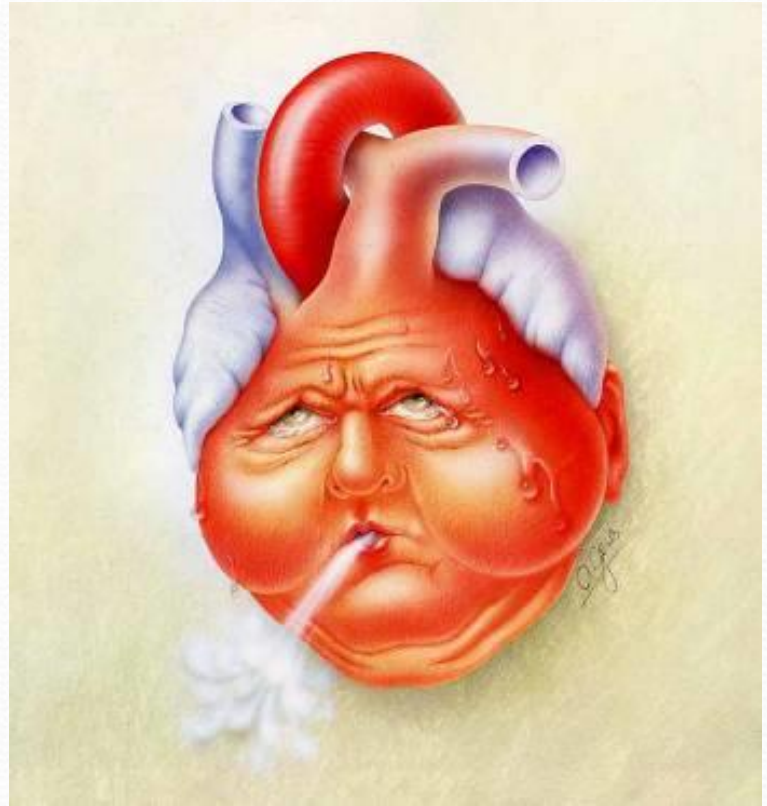
1. Increased right ventricular filling pressure e.g in heart failure , fluid overload.
2. Obstruction of blood flow from the right atrium to the right ventricle e.g tricuspid stenosis.
3. Superior vena caval obstruction e.g retrosternal thyroid goiter.
4. Positive intrathoracic pressure e.g pleural effusion, pneumothorax.

N.B: The JVP usually drops on inspiration along with intrathoracic pressure.

Heart failure

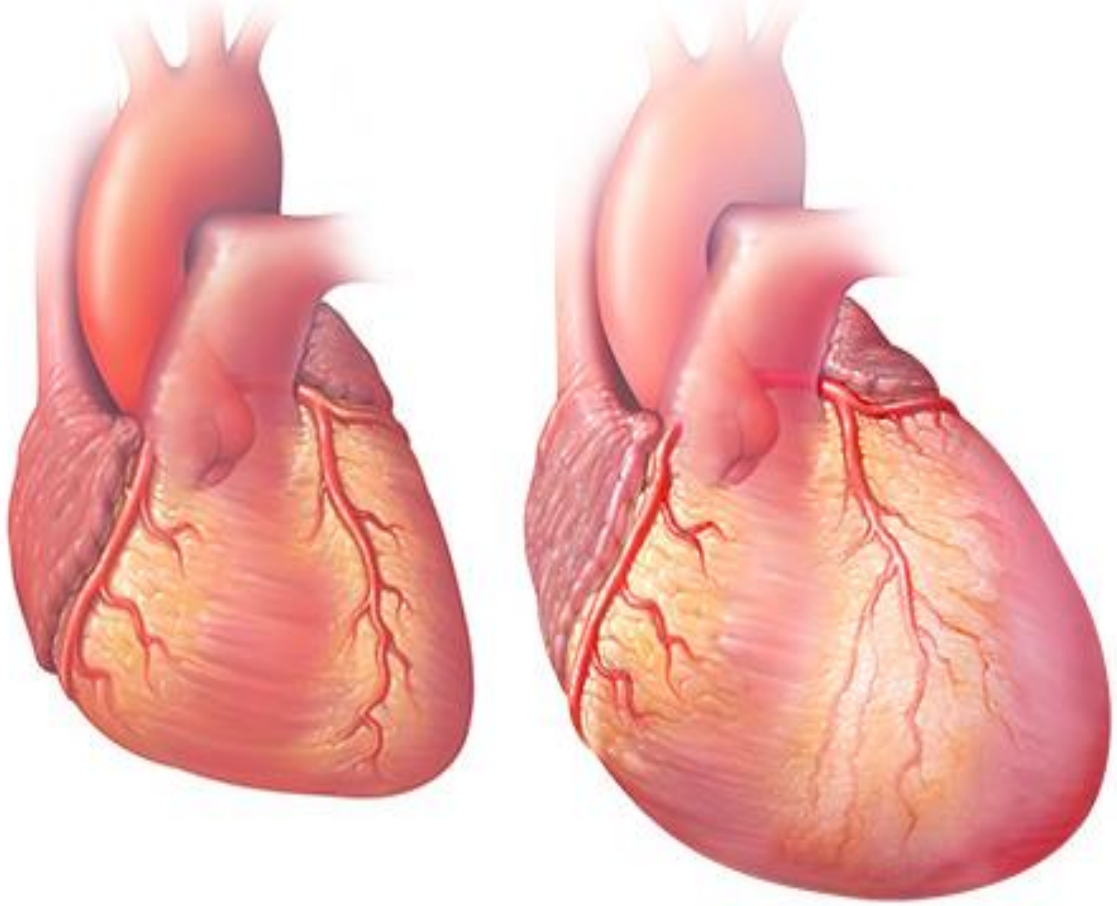
Definition

It is the pathophysiological process in which the heart as a pump is unable to meet the metabolic requirements of the tissue for oxygen and substrates despite the venous return to heart is either normal or increased.



How fast does heart failure develop?

- ✓ Usually a chronic disease
- ✓ The heart tries to compensate for the loss in pumping function by:
  - Developing more muscle mass
  - Enlarging
  - Pumping faster



Normal Heart

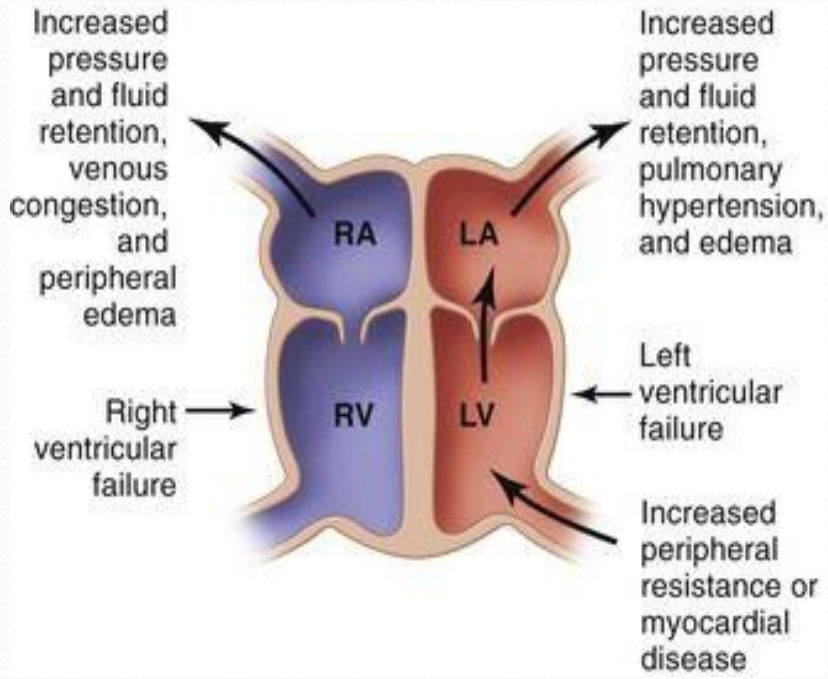
Heart Failure

Heart assumes a more spherical shape, enlargement of all 4 chambers

Types of Heart Failure

- ***Left sided heart failure***

  Inadequate output of LV causing decreased CO to body and back pressure to the lungs. The left side of the heart is usually where heart failure begins.

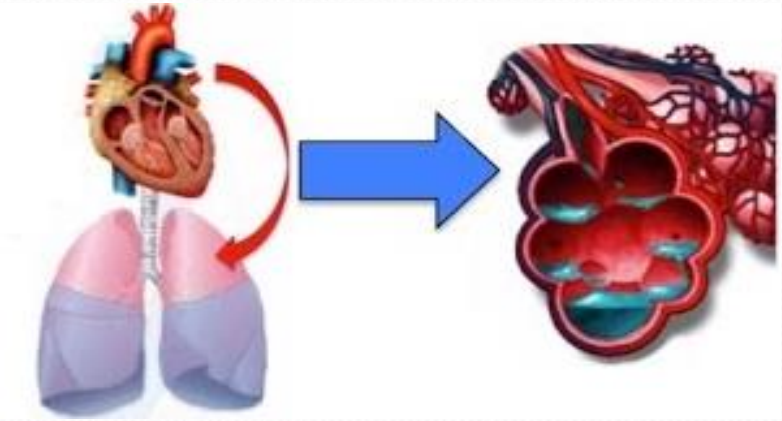


- ***Right sided heart failure***

  Inadequate output of RV causing decreased CO to lungs and back pressure to venous system. It may occur alone but is usually a result of left-sided failure.

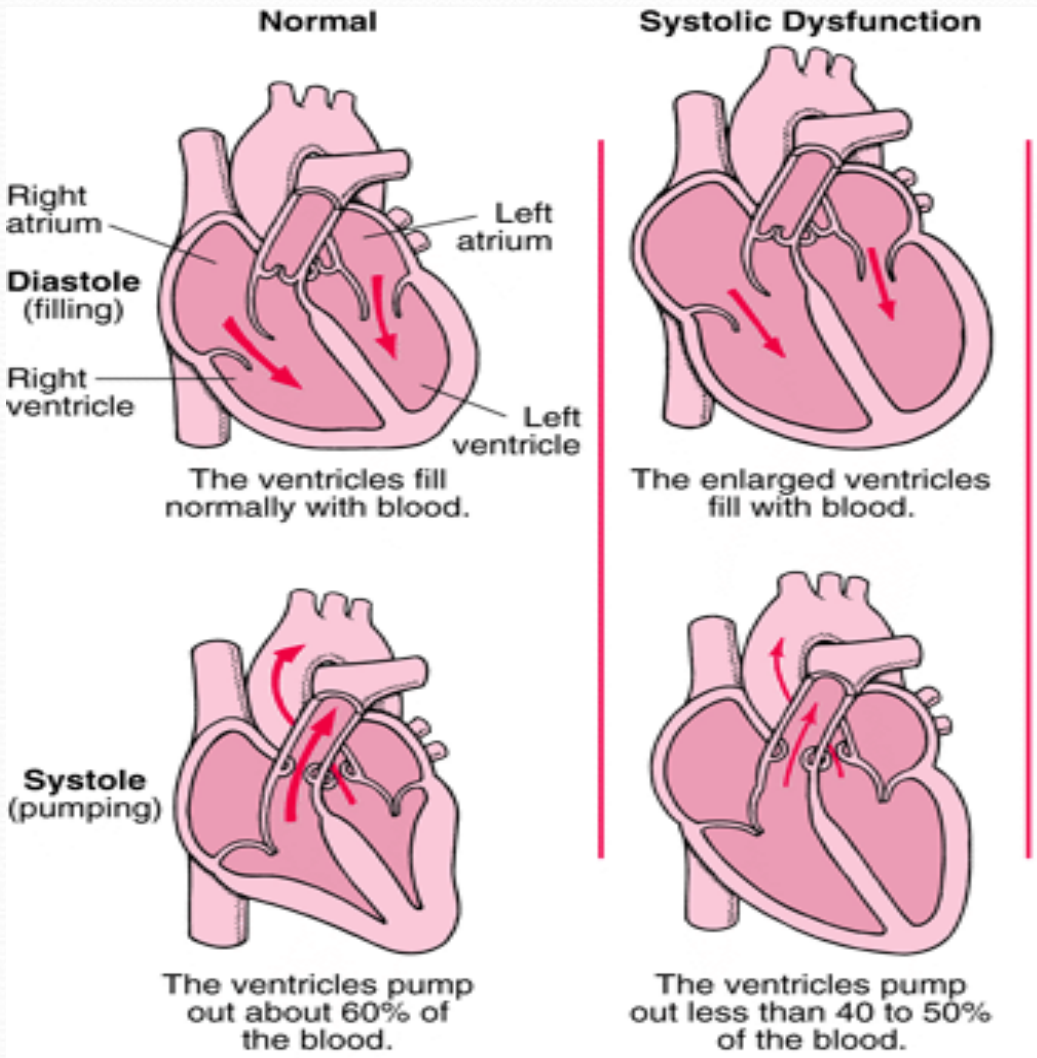
- ***Congestive heart failure***

  Chronically, left HF results in secondary pulmonary hypertension and right HF



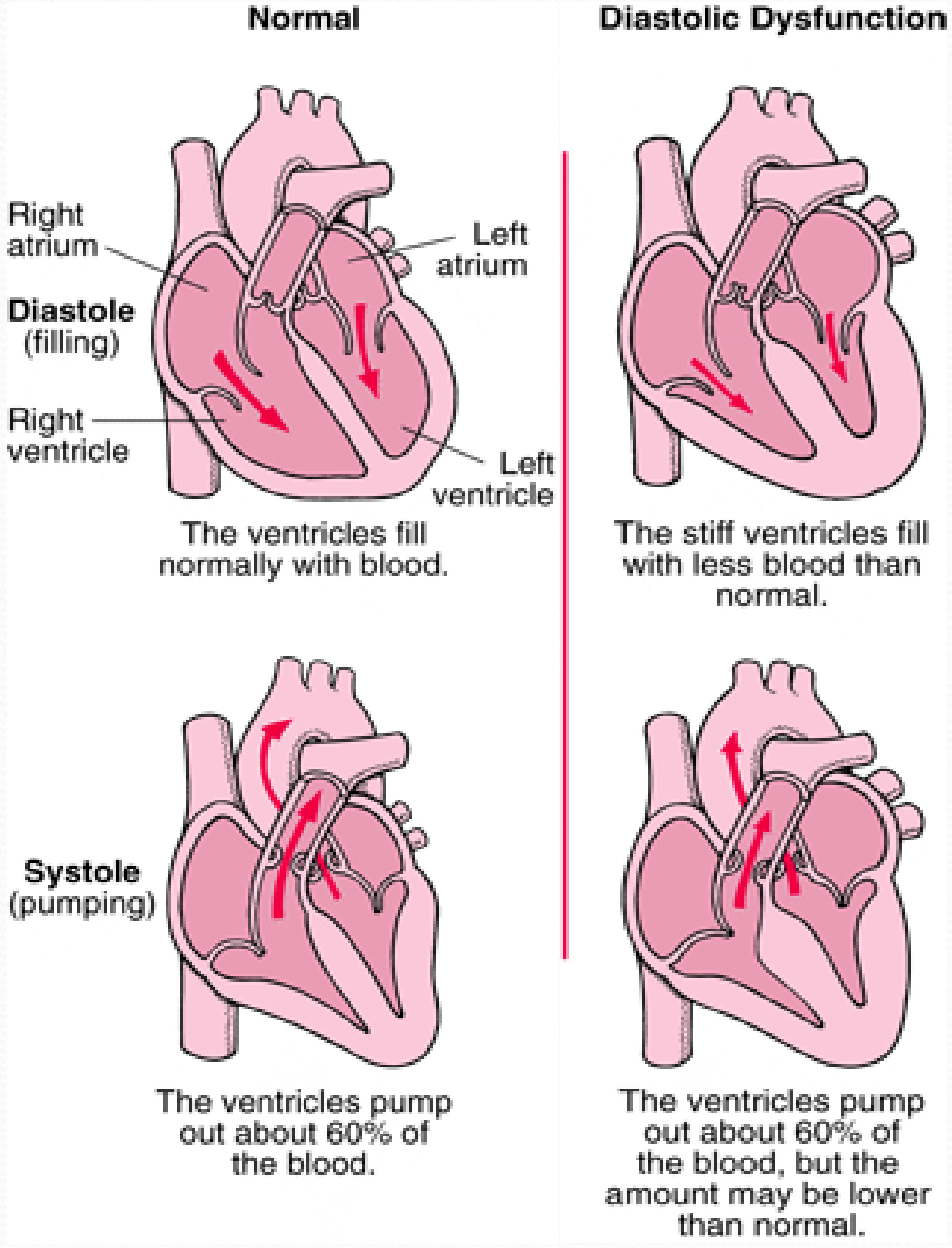
Types of heart dysfunction that lead to HF

- ***Systolic (or squeezing) heart failure***
  - This is the most common cause of HF
  - The muscle of ventricle is weak and enlarged and loses some of its ability to contract or shorten.
  - In turn, it may not have the muscle power to pump the amount of oxygenated and nutrient-filled blood the body needs into the circulation



Types of heart dysfunction that lead to HF….Cont.

- ***Diastolic (or relaxation) heart failure***
  - The muscle becomes stiff and loses some of its ability to relax.
  - As a result, the affected chamber has trouble filling with blood during the rest period that occurs between each heartbeat.
  - Often the walls of the heart thicken, and the size of the chamber may be normal or reduced.



Causes of Heart Failure

1- Impaired cardiac function

- Coronary heart disease
- Cardiomyopathies (muscle disease)
- Rheumatic fever
- Endocarditis

2- Increased cardiac workload

- Hypertension
- Valvular disorders
- Anemias
- Congenital heart defects

3- Acute non-cardiac conditions

- Volume overload
- Hyperthyroidism
- Fever
- Infection

Causes of left Sided HF

Impaired Contractility
- Myocardial infarction
- Transient ischemia
- Chronic volume overload
  - MR/AR

Increased Afterload
- AS
- Uncontrolled HTN

Systolic Dysfunction

Left Sided HF

Diastolic Dysfunction

- In both types, blood may "back up" in the lungs causing fluid to leak into the lungs (pulmonary edema)
- Fluid may also build up in tissues throughout the body (edema)

Obstruction of LV filling
- MS
- Pericardial constriction or tamponade

Impaired ventricular relaxation
- Hypertrophic or restrictive cardiomyopathy
- Transient ischemia

Causes right Sided HF

Cardiac Causes

- Usually occurs as a result of left HF
- Pulmonary stenosis
- Right ventricular infarction

Right Sided HF

Pulmonary Vascular Disease

- Pulmonary emobolism
- Pulmonary HTN
- Right ventricular infarction

Pulmonary Parenchymal disease

- COPD
- Interstitial lung disease
- Chronic infections
- Adult respiratory distress syndrome

Symptoms and Signs of HF

Poor Cardiac Output

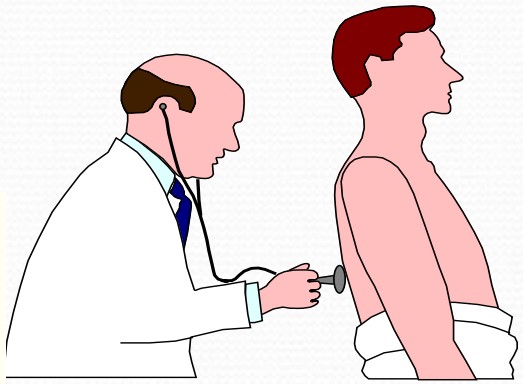
Poor Perfusion

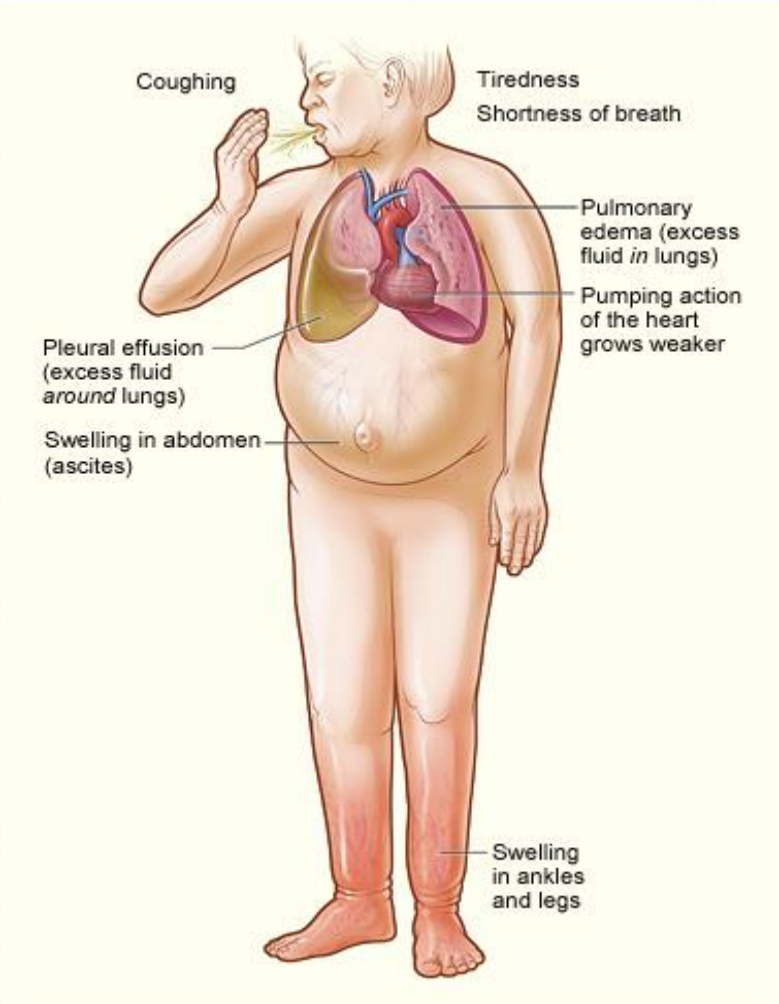
Increased filling pressures

Congestion

Signs and Symptoms of Left Ventricular Failure

- Rales (crackles) duo to pulmonary edema
- Shortness of breath (dyspnea)
- Breathing worsens with lying flat (orthopnea)
- Paroxysmal nocturnal dyspnoea
- Fatigue
- Anxiety
- Pallor, cyanosis
- Increased HR and BP





Signs and Symptoms of Right Ventricular Failure

- Fatigue
- Weakness
- Lethargy
- Weight gain, including abdominal girth
- Anorexia
- Elevated neck veins
- Edema
- Hepatomegaly

Edema of the extremity, common to right sided HF

Signs and Symptoms of Congestive Heart Failure

Symptoms:

- Shortness of breath
- Leg swelling (edema)
- Orthopnea
- Fatigue

Explanation of some Signs and Symptoms of HF

"Persistent Cough or Wheezing"

WHY?

Fluid "backs up" in the lungs

SYMPTOMS

Coughing that produces white or pink blood-tinged sputum

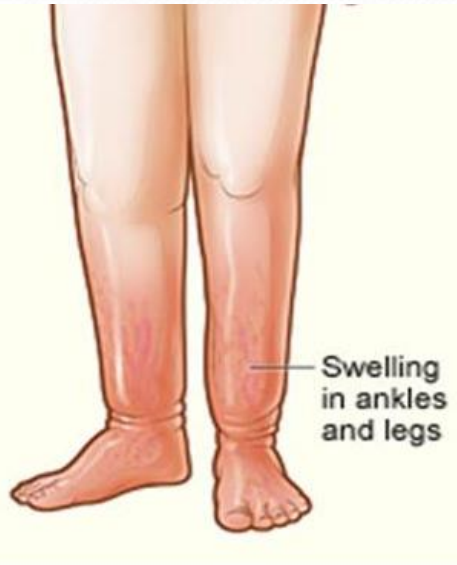
Explanation of some Signs and Symptoms of HF

Edema

WHY?

Decreased blood flow out of the weak heart

Blood returning to the heart from the veins "backs up" causing fluid to build up in tissues



SYMPTOMS

Swelling in feet, ankles, legs or abdomen

Weight gain

Explanation of some Signs and Symptoms of HF

Tiredness, fatigue

WHY?

Heart can't pump enough blood to meet needs of bodies tissues

Body diverts blood away from less vital organs (muscles in limbs) and sends it to the heart and brain

SYMPTOMS

Constant tired feeling

Difficulty with everyday activities

Explanation of some Signs and Symptoms of HF

Lack of appetite/ Nausea

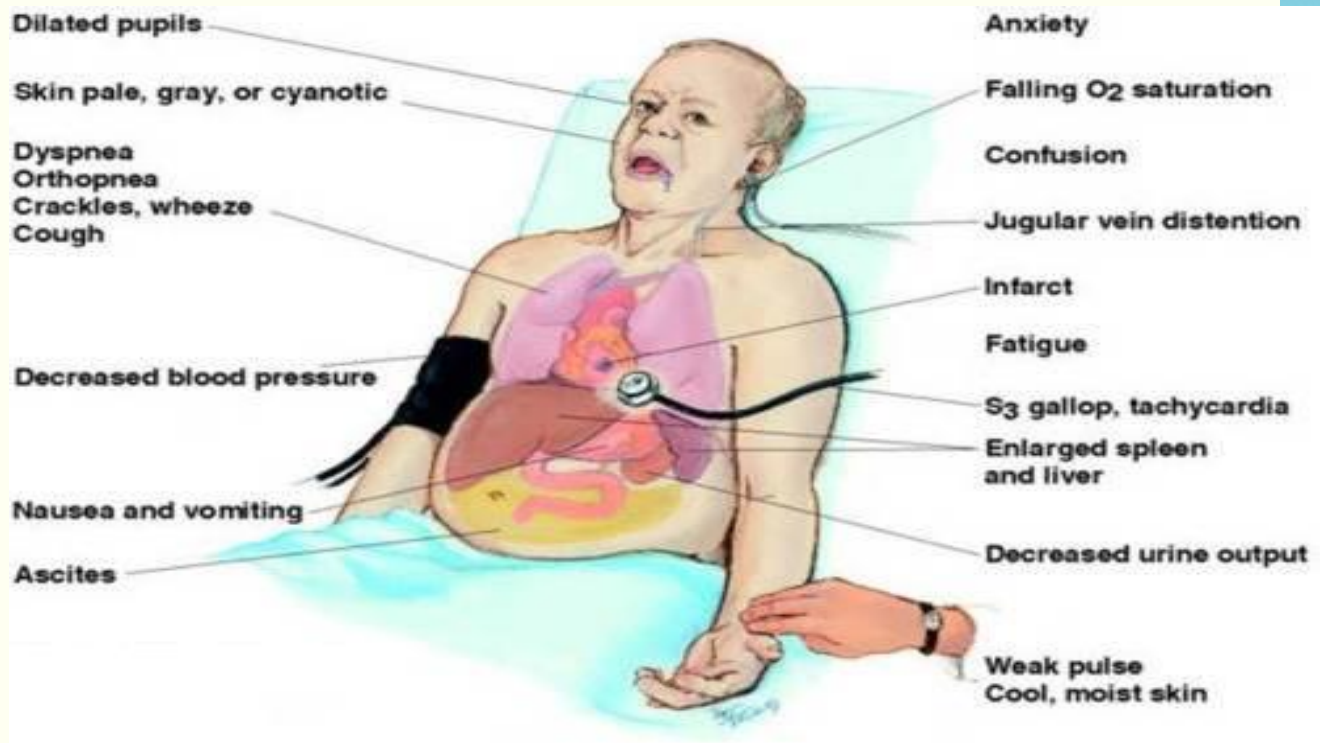
WHY?

The digestive system receives less blood causing problems with digestion

SYMPTOMS

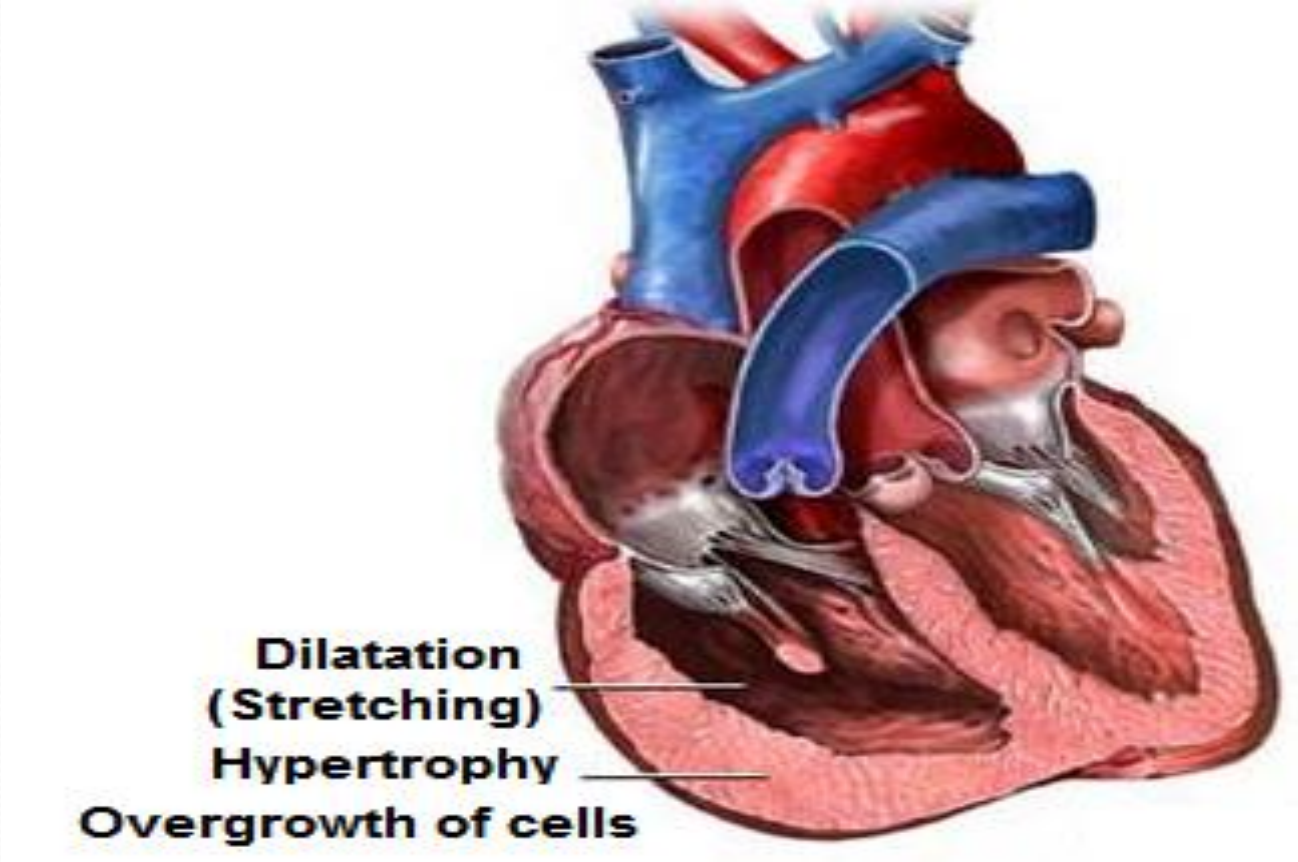
Feeling of being sick or full stomach

The major symptoms & signs of HF



Can a Person Have RVF Without LVF? (COR PULMONALE)

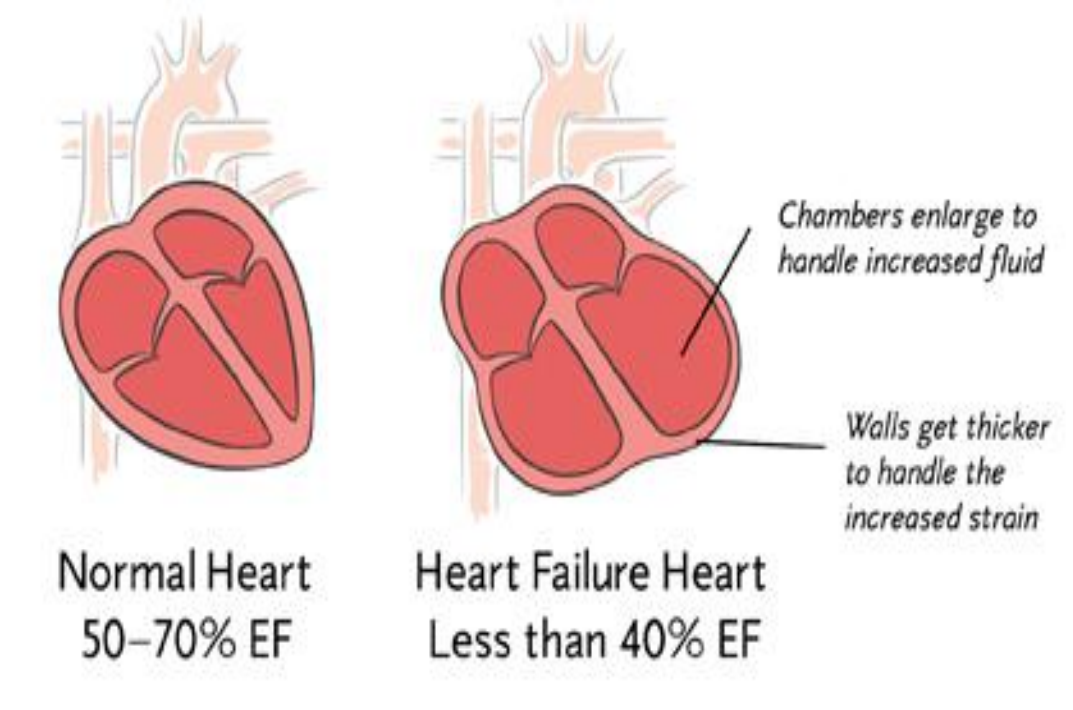
- Cor pulmonale, or right-sided HF, is an enlargement of the right ventricle
- It is due to high blood pressure in the lungs
- It is usually caused by chronic lung disease

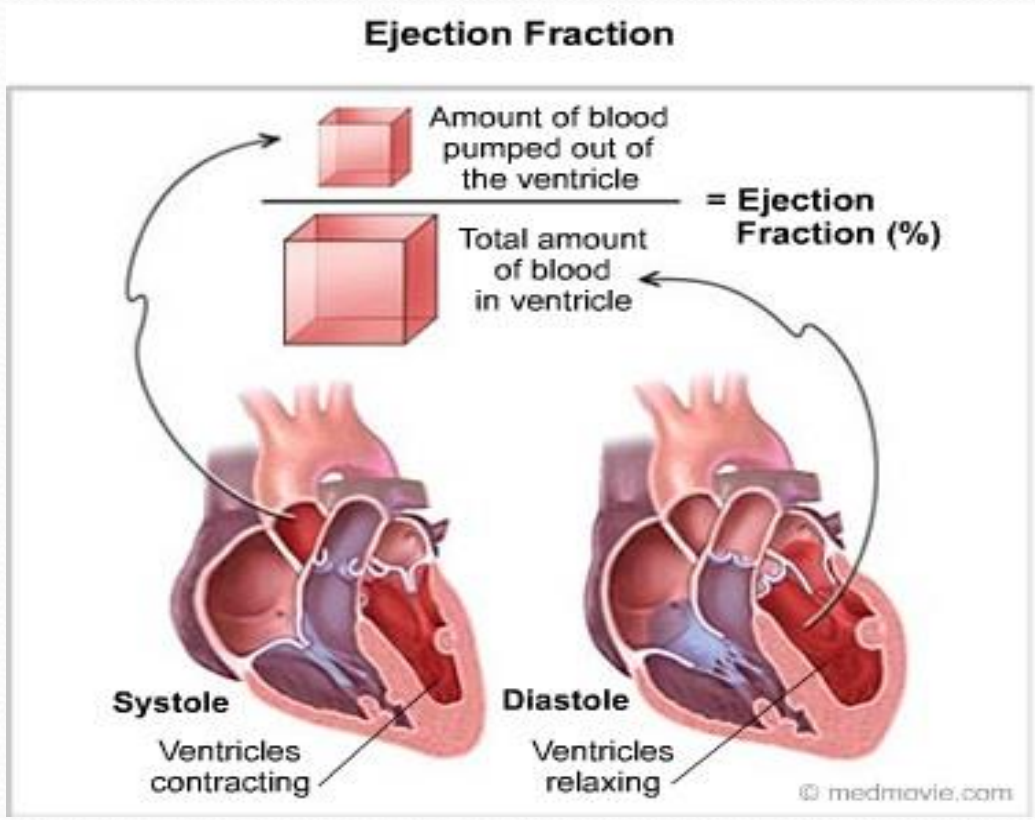


A Key Indicator for Diagnosing Heart Failure

Ejection Fraction (EF)

- Ejection Fraction (EF) is the percentage of blood that is pumped out of the ventricle during each beat





How Heart Failure Is Diagnosed

- Medical history is taken to reveal symptoms
- Physical exam is done
- Tests
  - Chest X-ray and Angiogram
  - Electrical tracing of heart (Electrocardiogram or "ECG")
  - Ultrasound of heart (Echocardiogram or "Echo")
  - Biomarkers

For further readings and diagrams:

Textbook of Medical Physiology by Guyton & Hall

Chapter 19 (Cardiac Failure)


Thank You