



มหาวิทยาลัยราชภัฏนครปฐม



Mechanism and Illness of Human Body 2

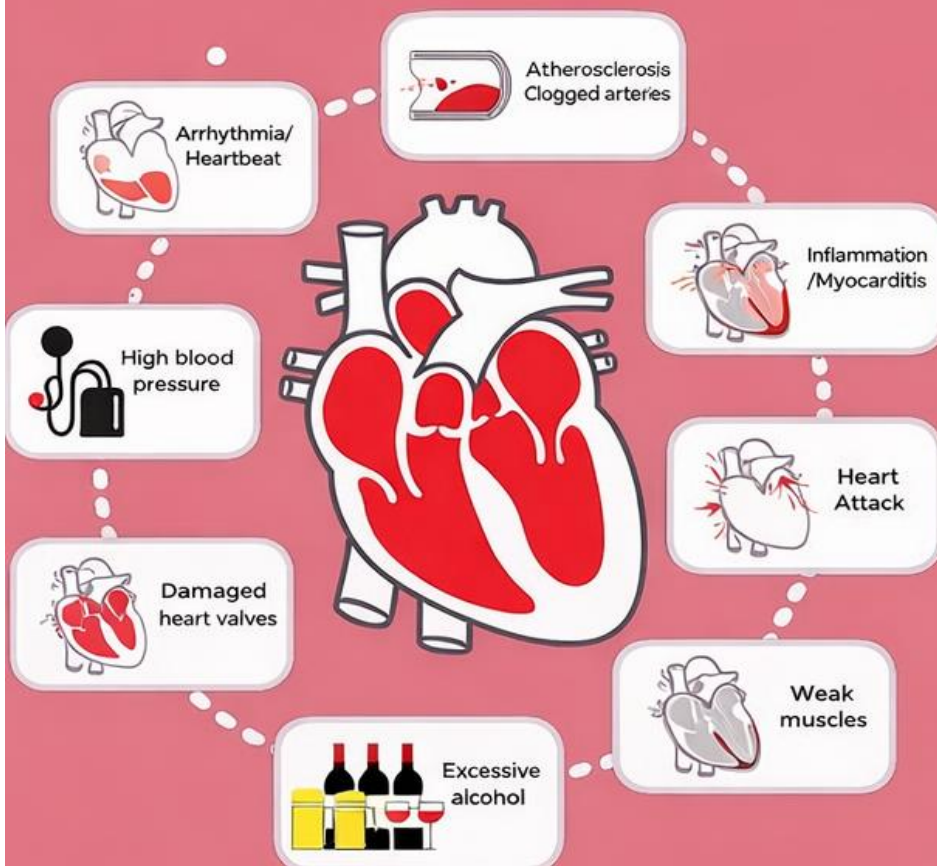
Napat rattanahongsa

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Disorders of the Cardiovascular System (part 2)



Heart Failure (Congestive Heart Failure)



1. **Pump dysfunction:** Heart muscle is damaged or weakened
2. **Volume overload:** Heart has to pump an excessive amount of blood
3. **Pressure overload:** Heart has to pump against a higher pressure
4. **Obstruction:** Left ventricular outflow tract is obstructed
5. **Severe pulmonary hypertension**
6. Cardiac arrhythmia:
 - Fast heart rate (Tachyarrhythmia)
 - **Slow heart rate** (Bradycardia)

A **clinical syndrome** resulting from the heart's inability to adequately meet the body's **cardiac output demands**, leading to the activation of **compensatory mechanisms and physiological adaptations**.

Body demands:

- The heart fails to function effectively and is unable to pump sufficient blood to supply oxygen and nutrients to various organs and tissues throughout the body.
- The condition is caused by **cardiovascular diseases** or **other systemic disorders that affect cardiac function**.



Disorders of the Cardiovascular System (part 2)

Type of HF		HFrEF	HFmrEF	HFpEF
CRITERIA	1	Symptoms ± Signs ^a	Symptoms ± Signs ^a	Symptoms ± Signs ^a
	2	LVEF <40%	LVEF 40–49%	LVEF ≥50%
	3	–	1. Elevated levels of natriuretic peptides ^b ; 2. At least one additional criterion: a. relevant structural heart disease (LVH and/or LAE), b. diastolic dysfunction	1. Elevated levels of natriuretic peptides ^b ; 2. At least one additional criterion: a. relevant structural heart disease (LVH and/or LAE), b. diastolic dysfunction

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Disorders of the Cardiovascular System (part 2)

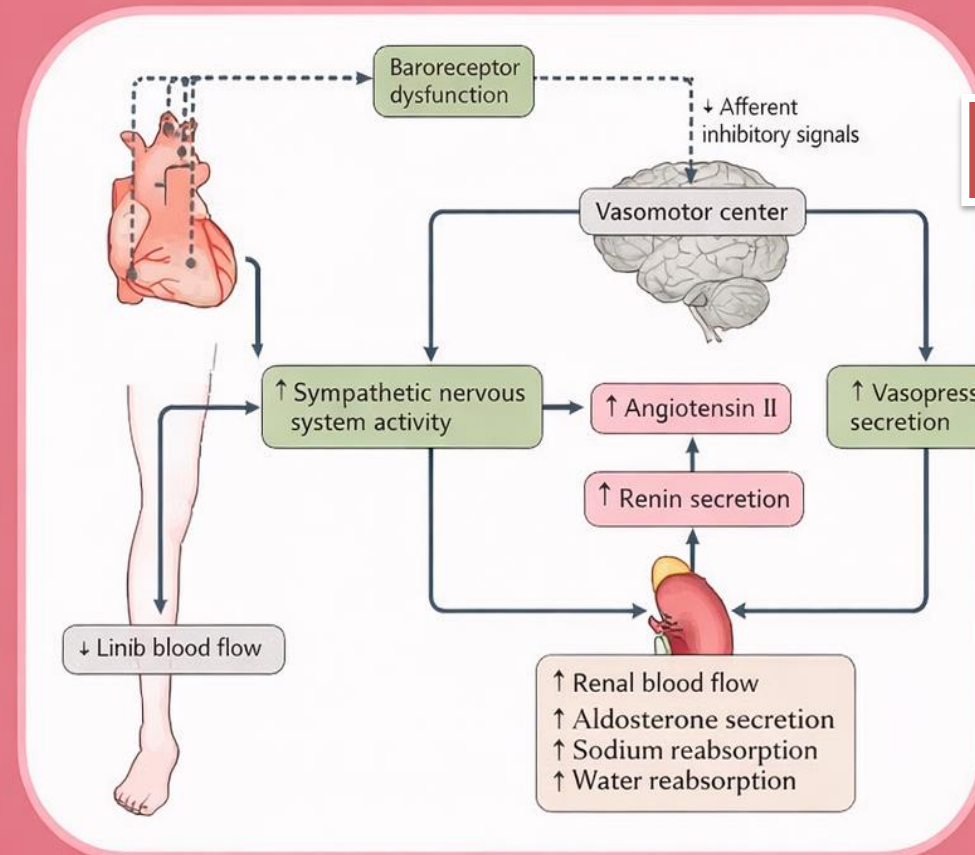


Pathophysiology of Heart Failure

1. Neurohormonal activation: 5 systems

Pathophysiology of heart failure involves compensatory responses to reduced cardiac output as follows:

- Renin-Angiotensin-Aldosterone System (RAAS)
- Sympathetic Nervous System (SNS)
- Natriuretic Peptide System
- Endothelin System
- Arginine Vasopressin (AVP) System



Pathophysiology of Heart Failure

Hemodynamic derangements: Conditions that contribute to heart failure

1. Failure of the pump:

- The heart cannot effectively eject blood (Systolic dysfunction)
- The heart cannot relax properly and fill with blood (Diastolic dysfunction)

2. Obstruction to outflow:

- Blockage or narrowing in the aortic valve (Aortic valve stenosis)

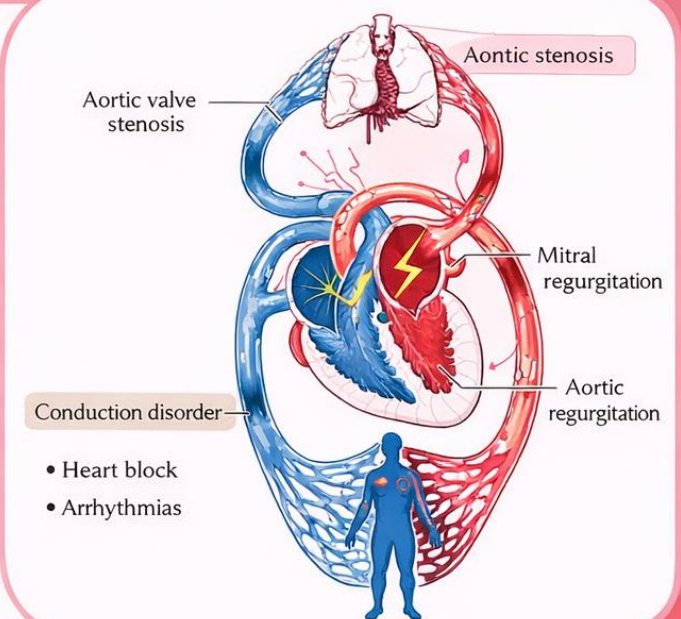
3. Regurgitation flow:

- Valve leakage, which leads to backward flow of blood
- Conditions like mitral regurgitation or aortic regurgitation

4. Disorders of cardiac conduction:

- Heart block
- Arrhythmias

5. Disruption of the continuity of the circulatory system: Vessel rupture or bleeding



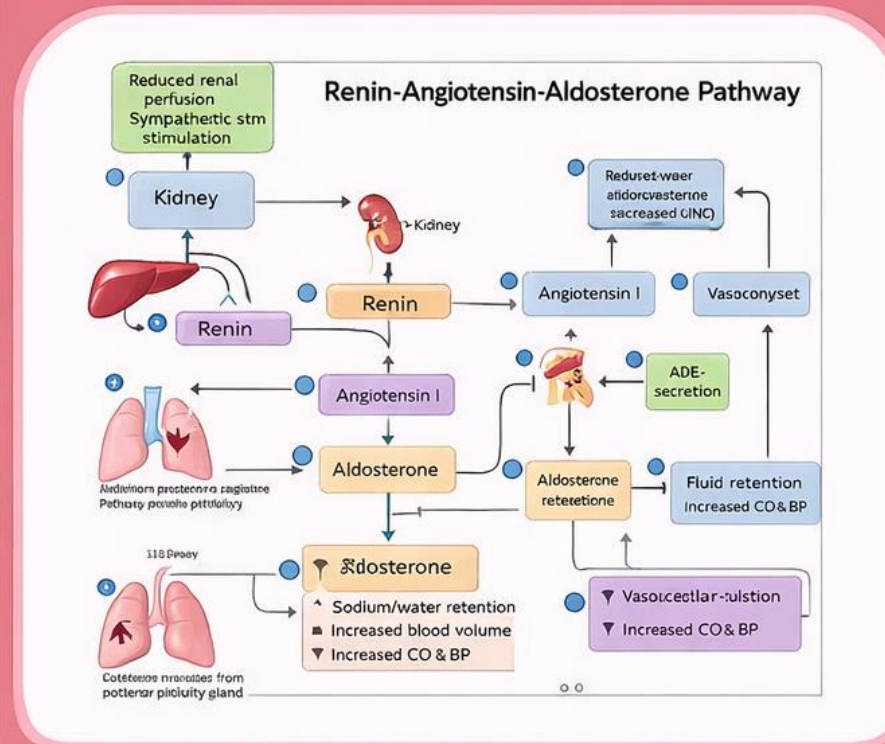
Disorders of the Cardiovascular System (part 2)



Heart Failure

Heart Failure: Compensatory mechanisms

- 1 Frank-Starling mechanism**
 - When the heart is weakened, filling pressure increases end-diastolic volume, enhancing the force of contraction
- 2 Baroreceptor reflex:**
 - When CO drops, BP falls and signaling from baroreceptors in the cardiovascular center declines
 - Sympathetic activity increases HR, cardiac contractility, TPR, and helps raise CO and BP
- 3 RAAS (Renin-angiotensin-aldosterone system)**
 - CO drops and renal blood flow decreases, triggering renin release
 - Angiotensin II and aldosterone levels increase
 - ADH levels rise
- 4 Net capillary filtration**
 - Venous pressure increases and venoconstriction occurs
 - Edema and ascites occur



Heart Failure

Types of Heart Failure

According to time

1. Acute Heart Failure

- Sudden onset or worsening of symptoms due to acute damage to the heart

Acute de novo heart failure: No prior history of heart failure

- Dyspnea
- Cause: Ischemic heart disease

Acute decompensated heart failure (ADHF): Worsening of existing heart failure

- Dyspnea
- Cause: Hypertensive heart disease

2. Chronic Heart Failure

- Long-term, persistent, or recurring symptoms of heart failure

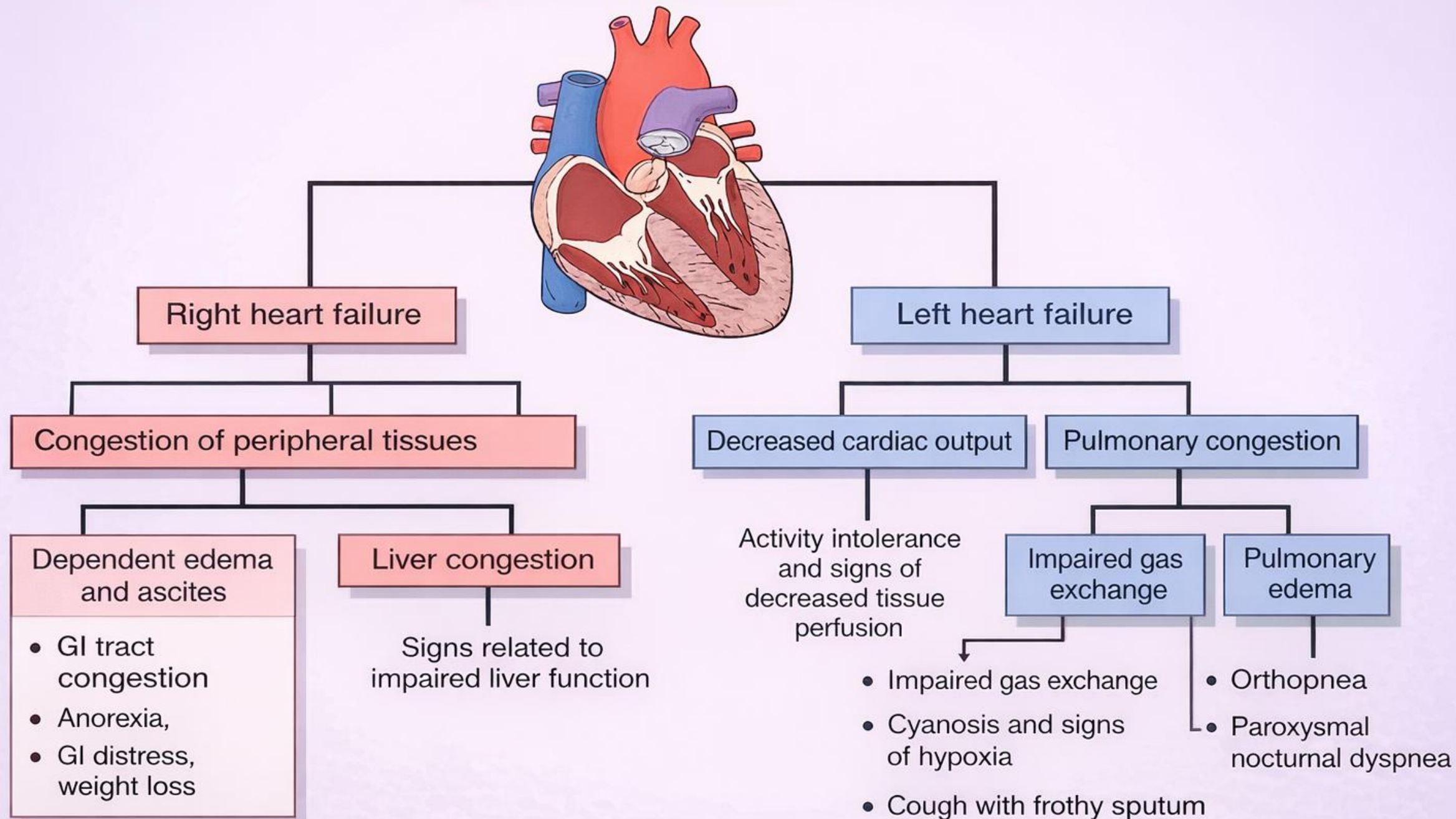
- Recurrent or persistent symptoms of heart failure
- Stable chronic heart failure

- Recurrent or persistent symptoms of heart failure
- Stable chronic heart failure

Disorders of the Cardiovascular System (part 2)



Types of Heart Failure



Disorders of the Cardiovascular System (part 2)



Left-sided Heart Failure

(Left-sided heart failure)

Mechanisms:

- Congestion of pulmonary circulation
- Diminished peripheral blood pressure and flow

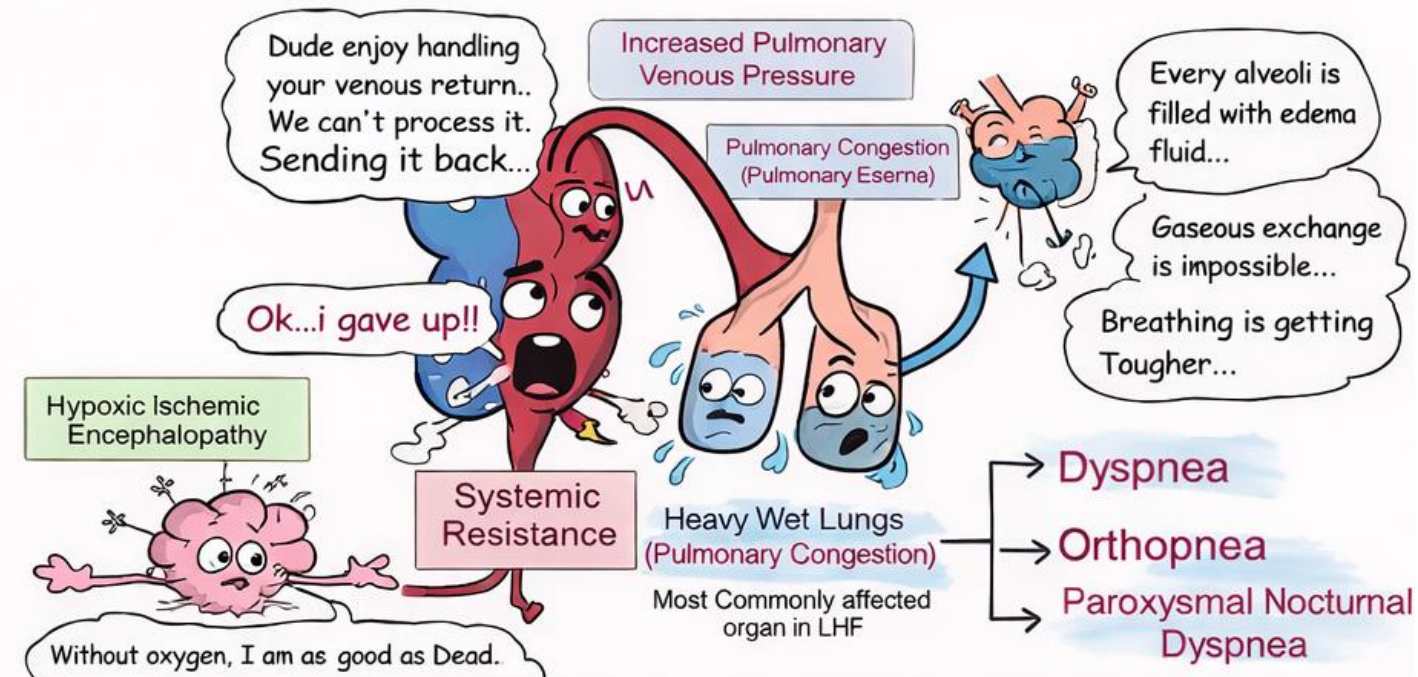
Complications:

- Pulmonary edema
 - Fluid leaks into the lungs
 - Shortness of breath when lying down (Orthopnea)
 - Attacks of severe shortness of breath during sleep (Paroxysmal nocturnal dyspnea)

Blood: Decreased renal perfusion

- Sympathetic Nervous System activation and RAAS activation 🤝
- Increased neurohormones

Left side → Venous Return from Lungs → Failure leads to Pulmonary Congestion & Pressure



Left side → Supply Body Organs → Failure leads to low organ perfusion and hypoxia

Causes: Ischemic heart disease

- Hypertension
- Aortic and/or mitral valvular disease

Disorders of the Cardiovascular System (part 2)



Heart Failure

Heart Failure

Right-sided heart failure

Symptoms

Portal system:

- Hepatomegaly: Liver congestion causing liver to swell
- RUQ pain: Abdominal pain in right upper quadrant
- Liver dysfunction leading to outcomes like Fibrosis, Cirrhosis
- Ascites
 - Transudate **fluid** buildup in the abdomen

Jugular vein engorged

- Visible distention of the jugular veins due to increased venous pressure

Causes

• Left-sided heart failure:

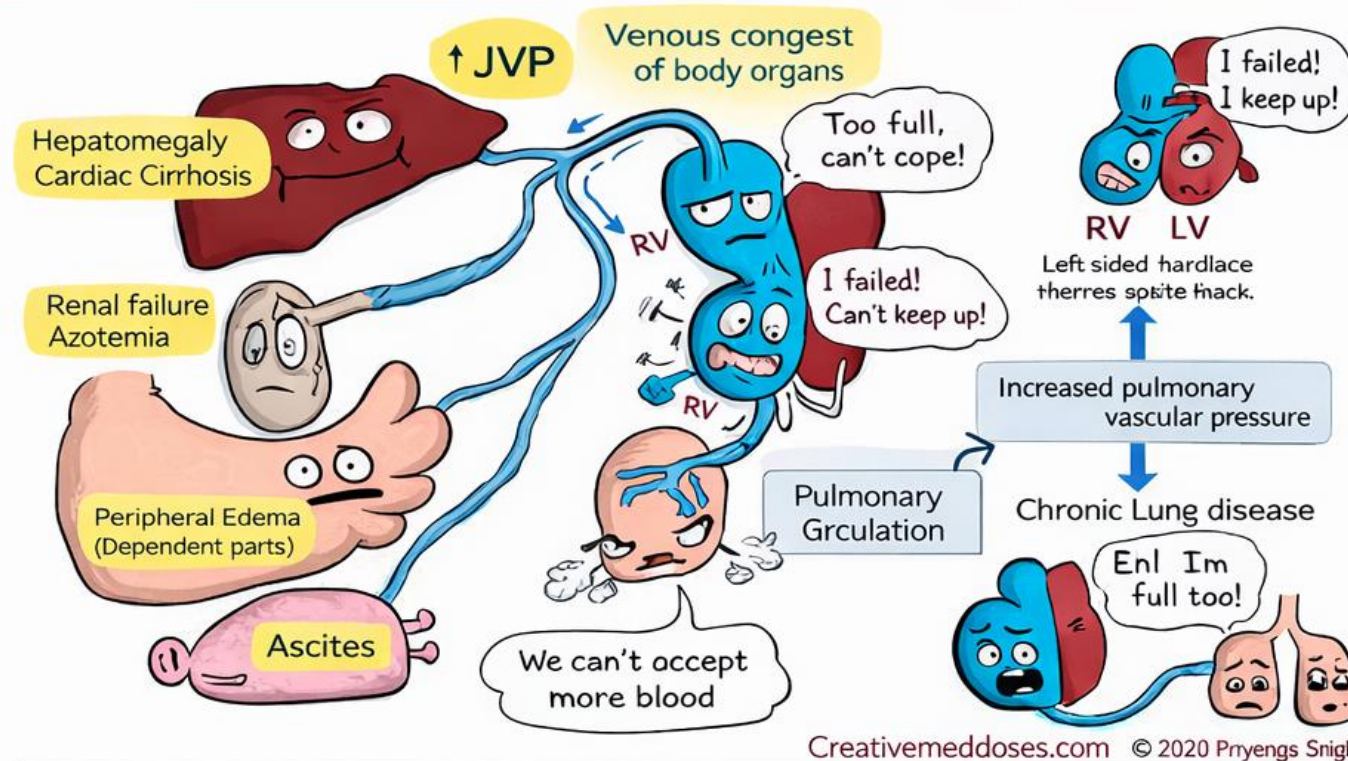
- Blood backs up into lungs
- Increasing pulmonary vascular pressure

Causes

• Left-sided heart failure:

- Blood backs up into the lungs

Right side → Venous return from body organs (except Lungs) → Failure leads to venous congestion body organs



Right side → Pumps blood into Lungs → Increased pulmonary vascular pressure

Causes:

• Left-sided heart failure:

- Blood backs up into lungs
- Increasing pulmonary vascular pressure

• Cor pulmonale : Occurs together with lung disease

- Right-sided HF usually follows,
→ Right-sided HF usually foll follows

Disorders of the Cardiovascular System (part 2)



Jugular vein engorged



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