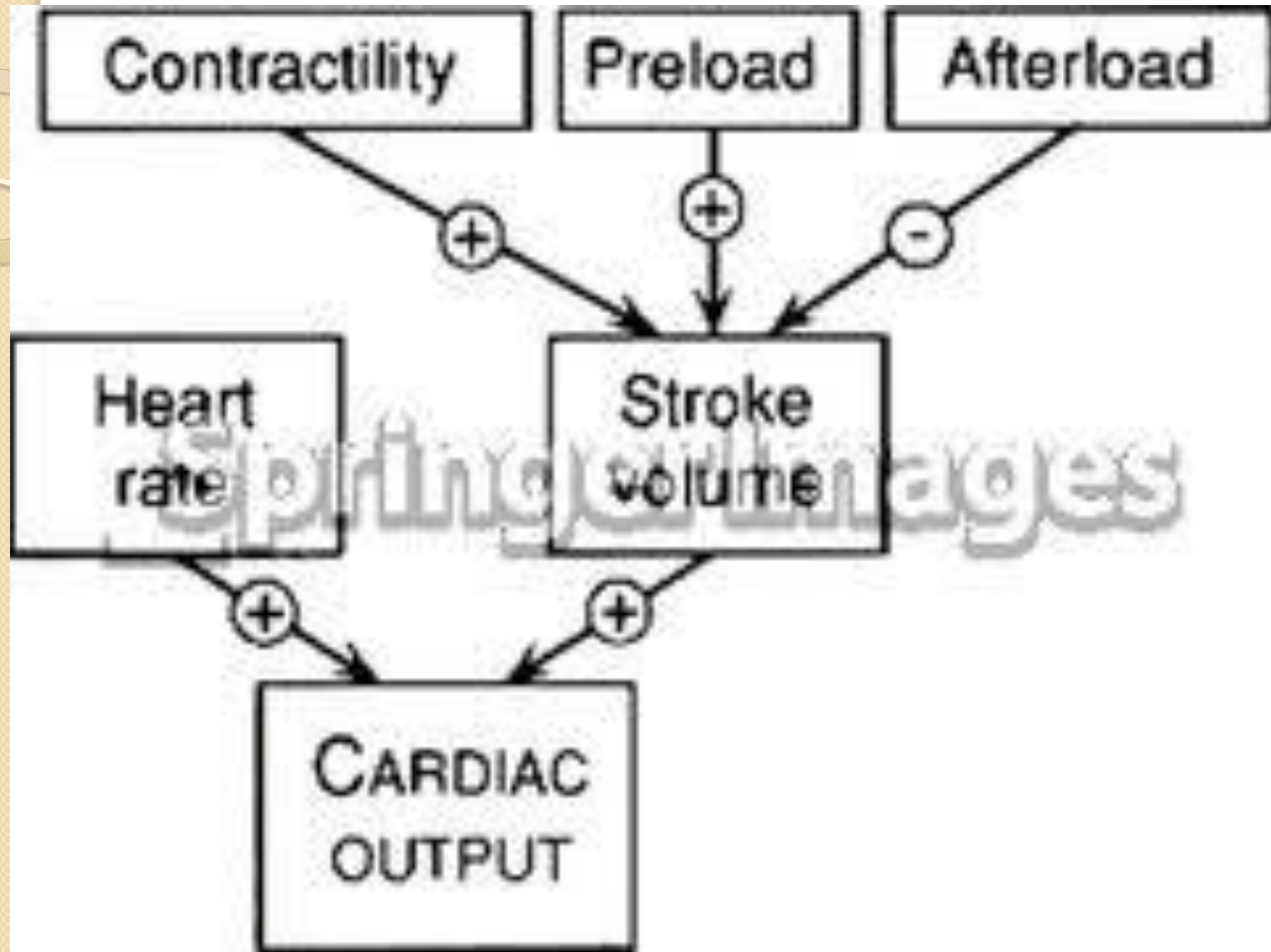




**Lecture:**

# **Stroke volume and Heart Failure**

Dr. Eman El Eter



# Cardiac contractility and stroke volume

**Systolic function of the heart is controlled by:**

- **1. Contractile state of the myocardium.**
- **2. Preload of the ventricle.**
- **3. Afterload applied to the ventricle.**
- **4. Heart Rate.**

# Heart Failure

- **What is Heart Failure?**
- **It is a pathological process in which systolic and /or diastolic function of the heart is impaired as a result, CO is low and unable to meet the metabolic demands of the body.**

# Pathophysiology of heart failure

- ▶ Heart failure can be caused by factors originating from within the heart (i.e., intrinsic disease or pathology) or from external factors that place excessive demands upon the heart.
- ▶ **Intrinsic factors:**  
dilated cardiomyopathy and hypertrophic cardiomyopathy, myocardial infarction..
- ▶ **External factors:**
  - long-term, uncontrolled hypertension,
  - increased **stroke volume :**  
(volume load; arterial-venous shunts), hormonal disorders such as hyperthyroidism.

# Causes of Heart Failure

- **Myocardial infarction**
- **Coronary artery disease**
- **Valve disease**
- **Idiopathic cardiomyopathy**
- **Viral or bacterial cardiomyopathy**
- **Myocarditis**
- **Pericarditis**
- **Arrhythmias**
- **Chronic hypertension**
- **Thyroid disease**
- **Septic shock**
- **Anemia**

# Acute HF

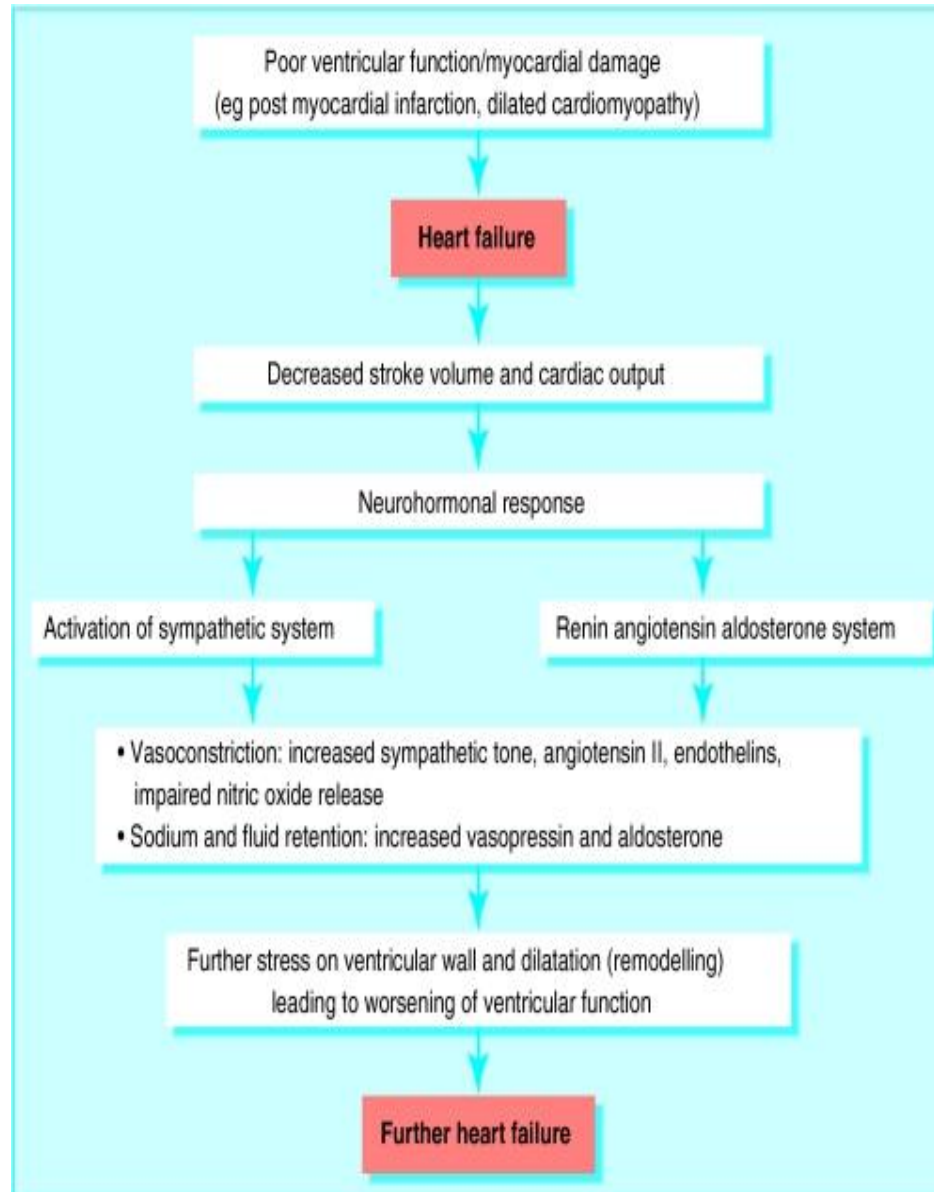
- Acute heart failure develops **rapidly** and can be immediately life threatening because the heart does not have time to undergo compensatory adaptations. Acute failure (hours/days) may result from cardiopulmonary by-pass surgery, acute infection (sepsis), acute myocardial infarction, severe arrhythmias, etc. Acute heart failure can often be managed successfully by pharmacological or surgical interventions.

# Chronic HF

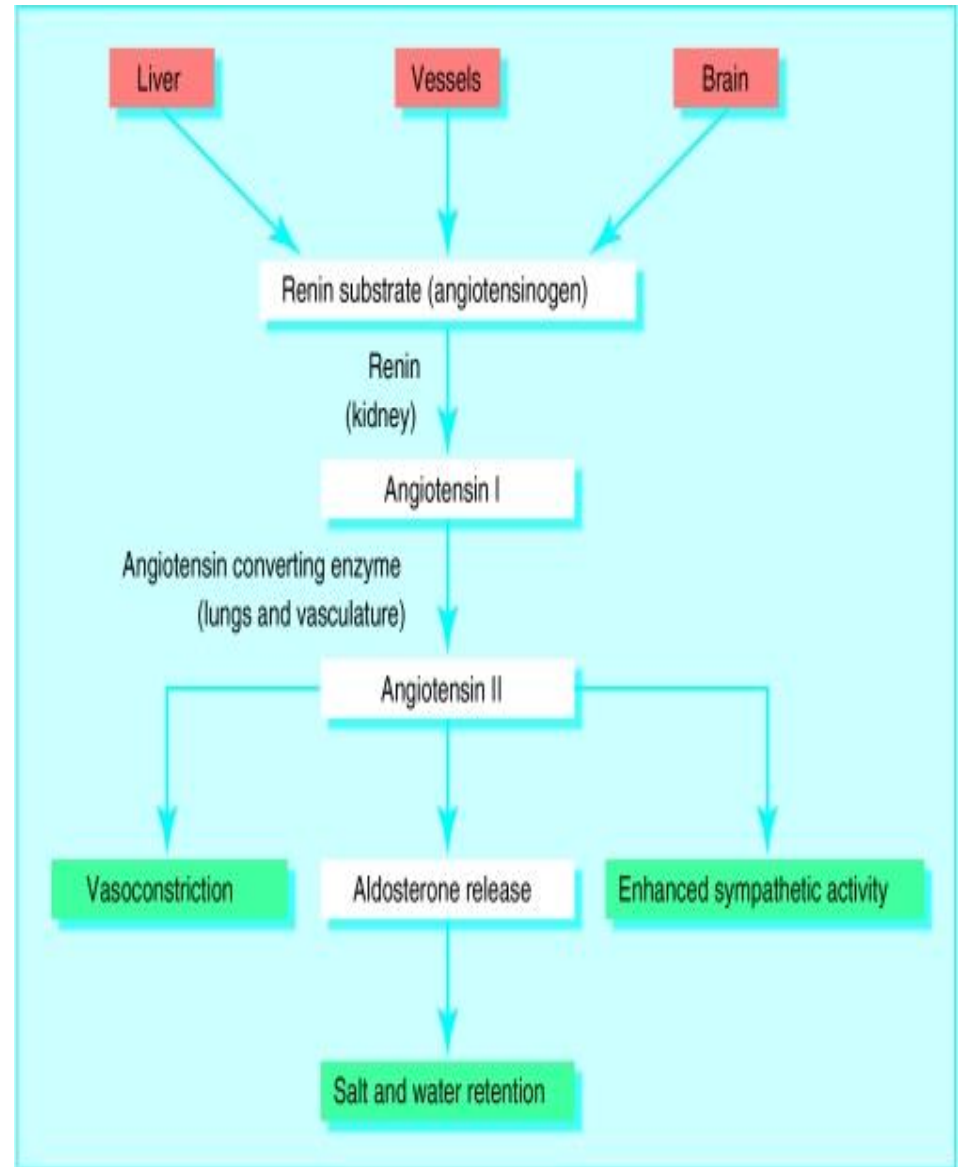
- Chronic heart failure is a long-term condition (months/years) that is associated with the heart undergoing **adaptive responses** (e.g., dilation, hypertrophy) . These adaptive responses, however, can be **deleterious ?**



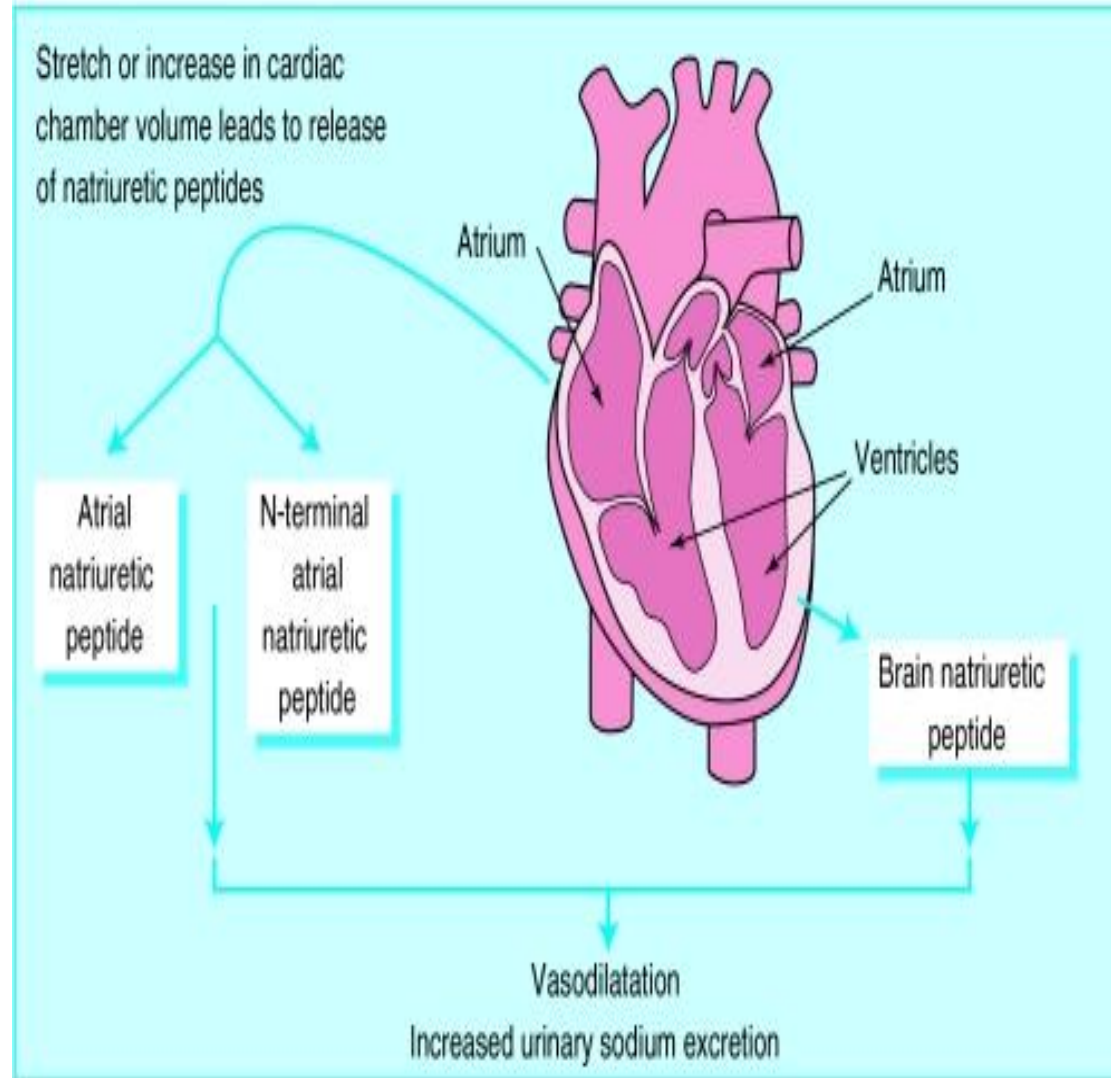
# Neurohormonal mechanisms and compensatory mechanisms in heart failure , BMJ 2000; 320:167-170



# Renin-angiotensin-aldosterone system in HF



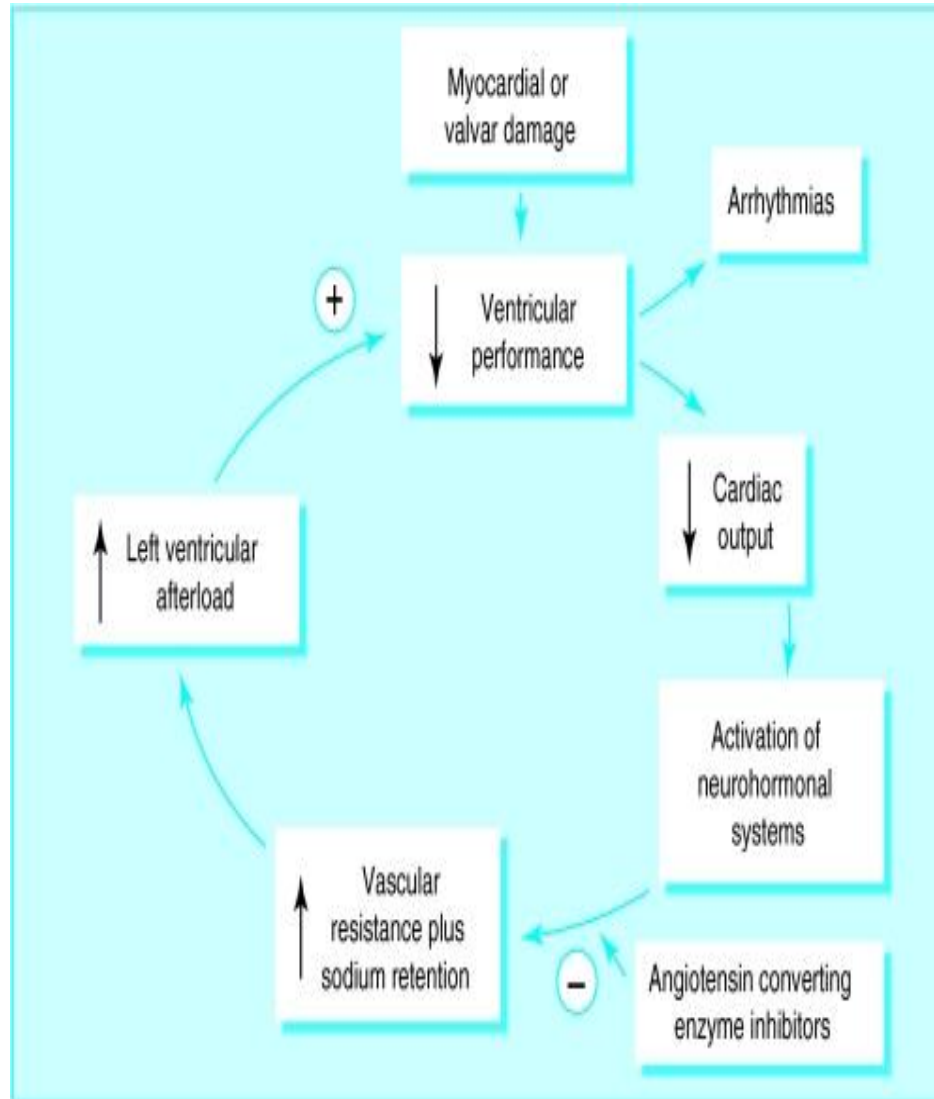
# Effect of natriuretic peptide



## Summary of the consequences to the neurohormonal responses to impaired cardiac performance

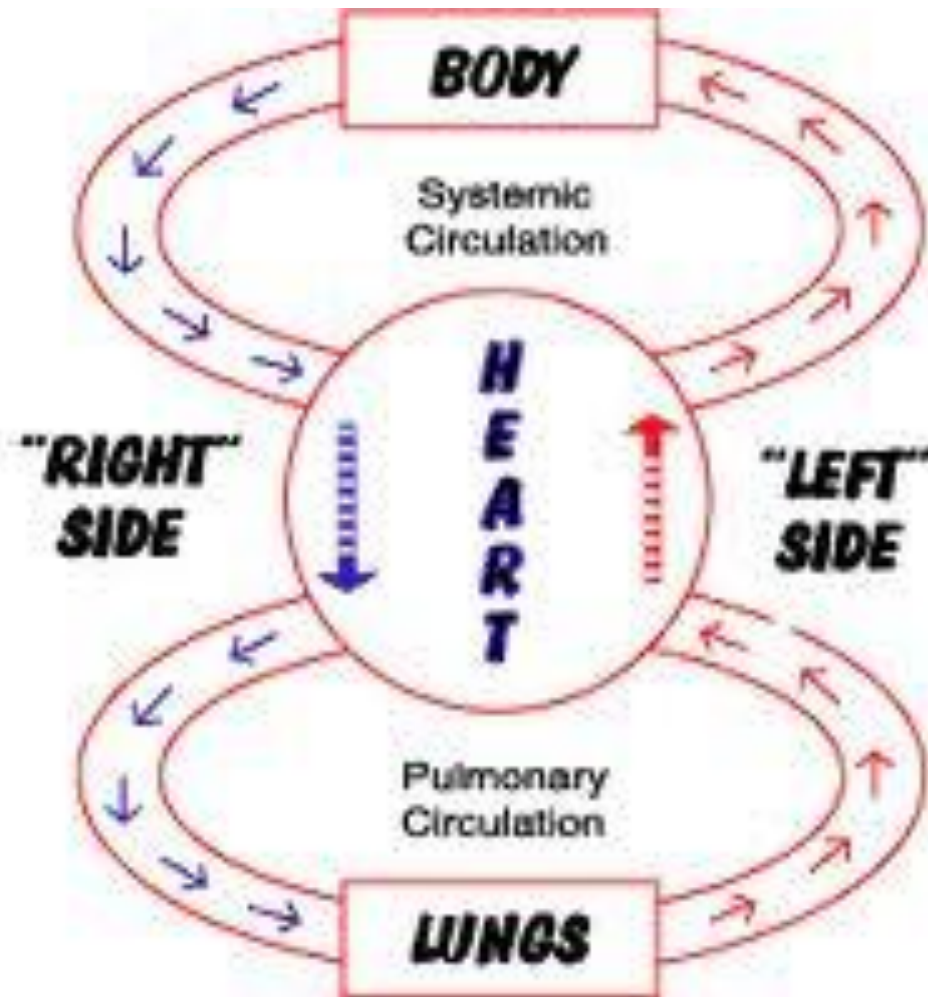
Responses	Short-term effects	Long-term effects
Salt & water retention	Increase preload	Pulmonary congestion Systemic congestion
Vasoconstriction	Maintain BP for perfusion of vital organs	Exacerbate pump dysfunction by increasing afterload Increase cardiac energy expenditure
Sympathetic stimulation	Increase heart rate and ejection	Increase energy expenditure, Risk of dysrhythmia, Sudden death

# Summary & effect of ACE inhibitors



# Left-sided failure

- ▣ **Common respiratory signs :**
- ▣ **Signs & symptoms are due to pulmonary congestion and low CO**
- ▣ **Tachypnea** (increased *rate* of breathing) and increased *work* of breathing (non-specific signs of respiratory distress).
- ▣ **Rales or crackles**, heard initially in the lung bases, and when severe, throughout the lung fields suggest the development of **pulmonary edema** (fluid in the alveoli).
- ▣ **Cyanosis** which suggests severe hypoxemia, is a late sign of extremely severe pulmonary edema.





# Left-sided HF





# Right-sided failure

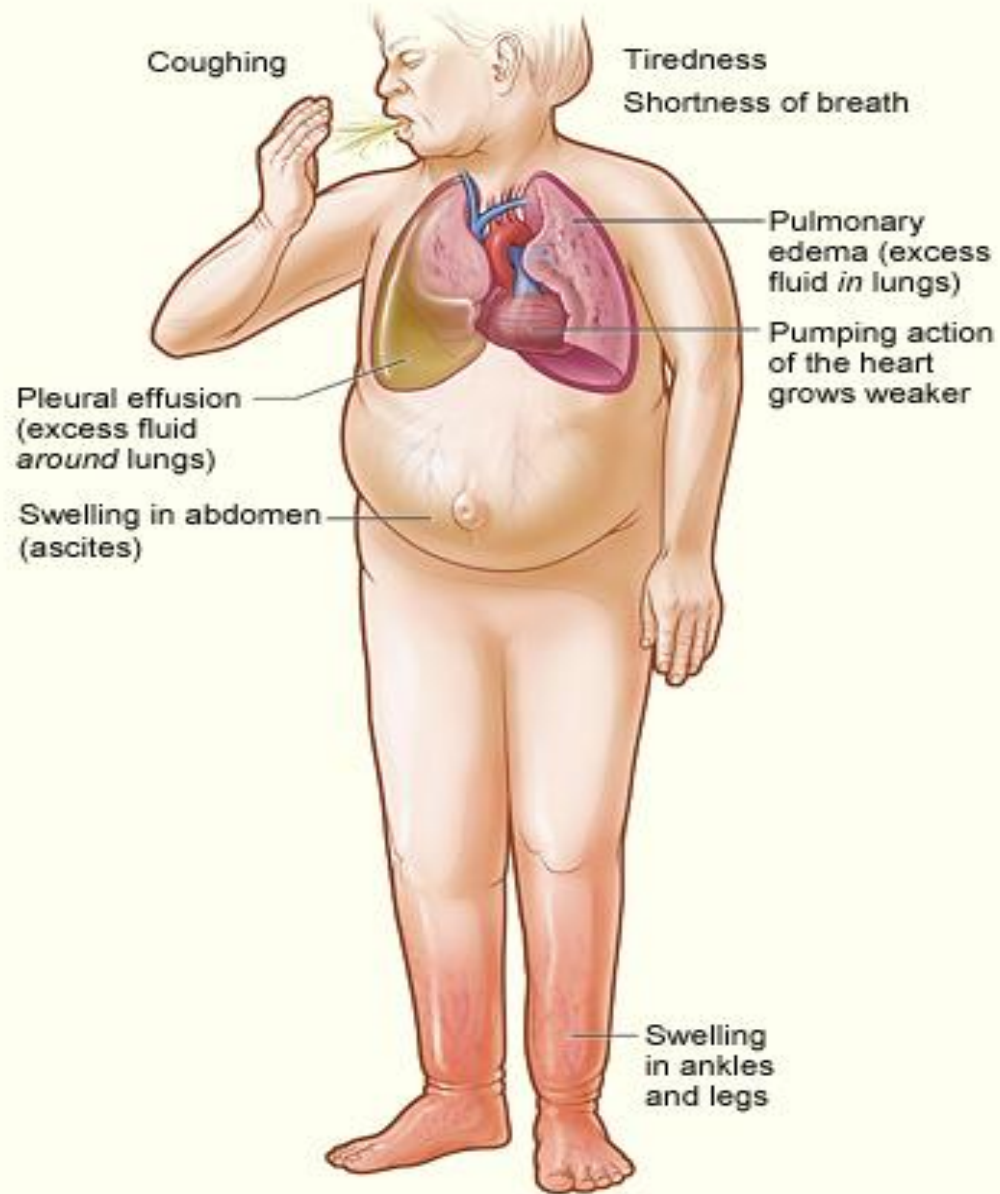
- Pitting peripheral edema,
- ascites,
- Hepatomegaly
- Jugular venous pressure is frequently assessed as a marker of fluid status, which can be accentuated by the hepatojugular reflux. If the right ventricular pressure is increased, a parasternal heave may be present, signifying the compensatory increase in contraction strength.



# Elevated JVP, in a patient with congestive HF



# HF



# Left vs Right HF

<b>Signs/Symptoms</b>	<b>Left-Sided Heart Failure</b>	<b>Right-Sided Heart Failure</b>
Pitting Edema (Legs, Hands)	Mild to moderate.	Moderate to severe
Fluid Retention	Pulmonary edema (fluid in lungs) and pleural effusion (fluid around lungs).	Abdomen (ascites).
Organ Enlargement	Heart.	Liver. Mild jaundice may be present.
Neck Veins	Mild to moderate raised jugular venous pressure (JVP).	Severe jugular venous pressure (JVP). Neck veins visibly distended.
Shortness of Breath	Prominent dyspnea. Paroxysmal nocturnal dyspnea (PND).	Dyspnea present but not as prominent.
Gastrointestinal	Present but not as prominent.	Loss of appetite. Bloating. Constipation. Symptoms are significantly more prominent than LHF

# Treatment

- The control of congestive heart failure symptoms, can be divided into three categories:
- (1) reduction of cardiac workload, including both preload and afterload;
- (2) control of excessive retention of salt and water; and
- (3) enhancement of myocardial contractility.