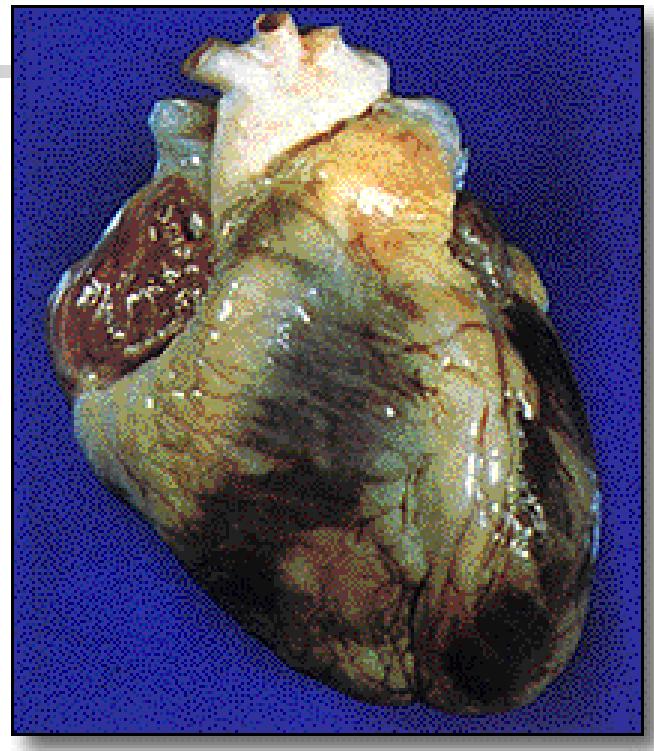
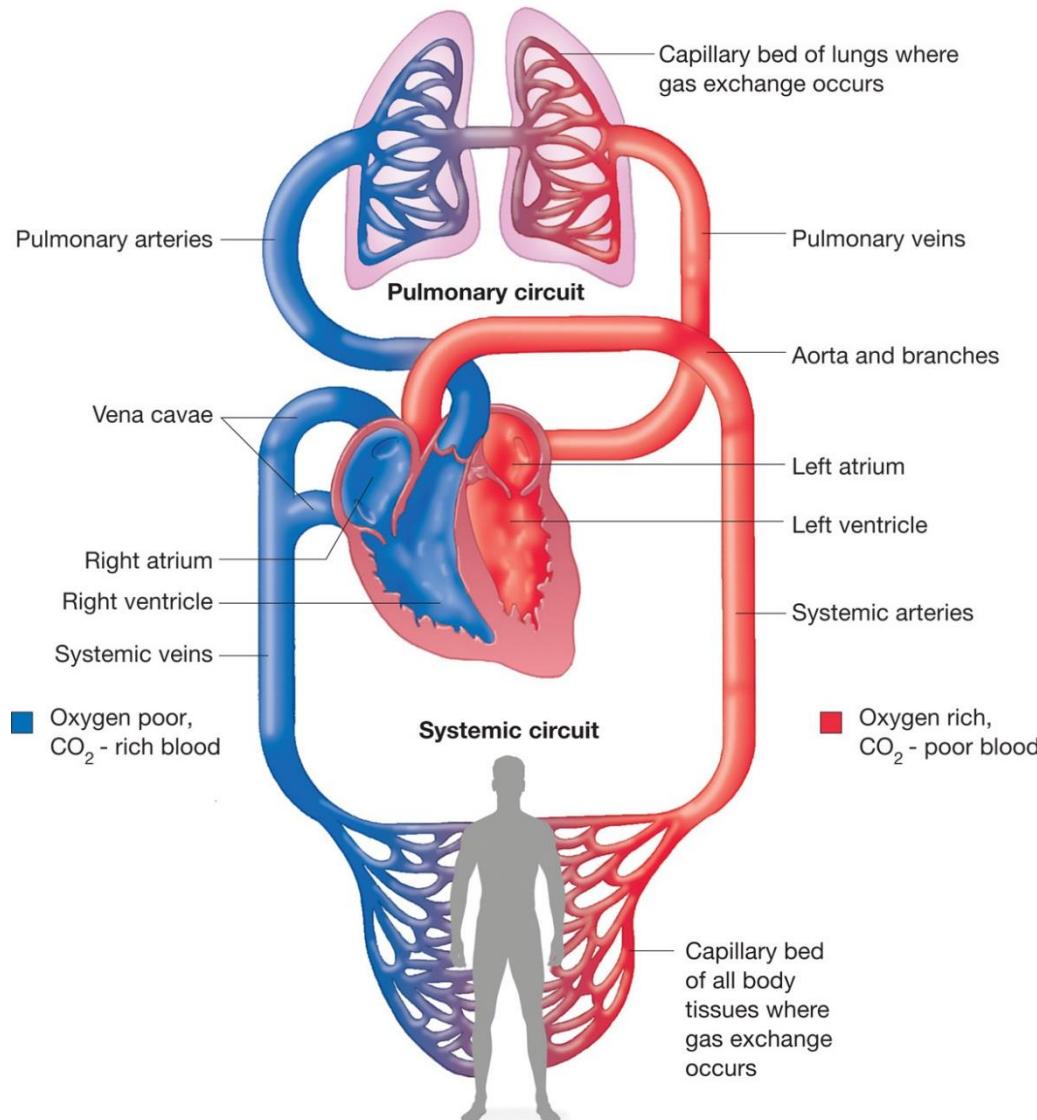


# Cardiovascular system I

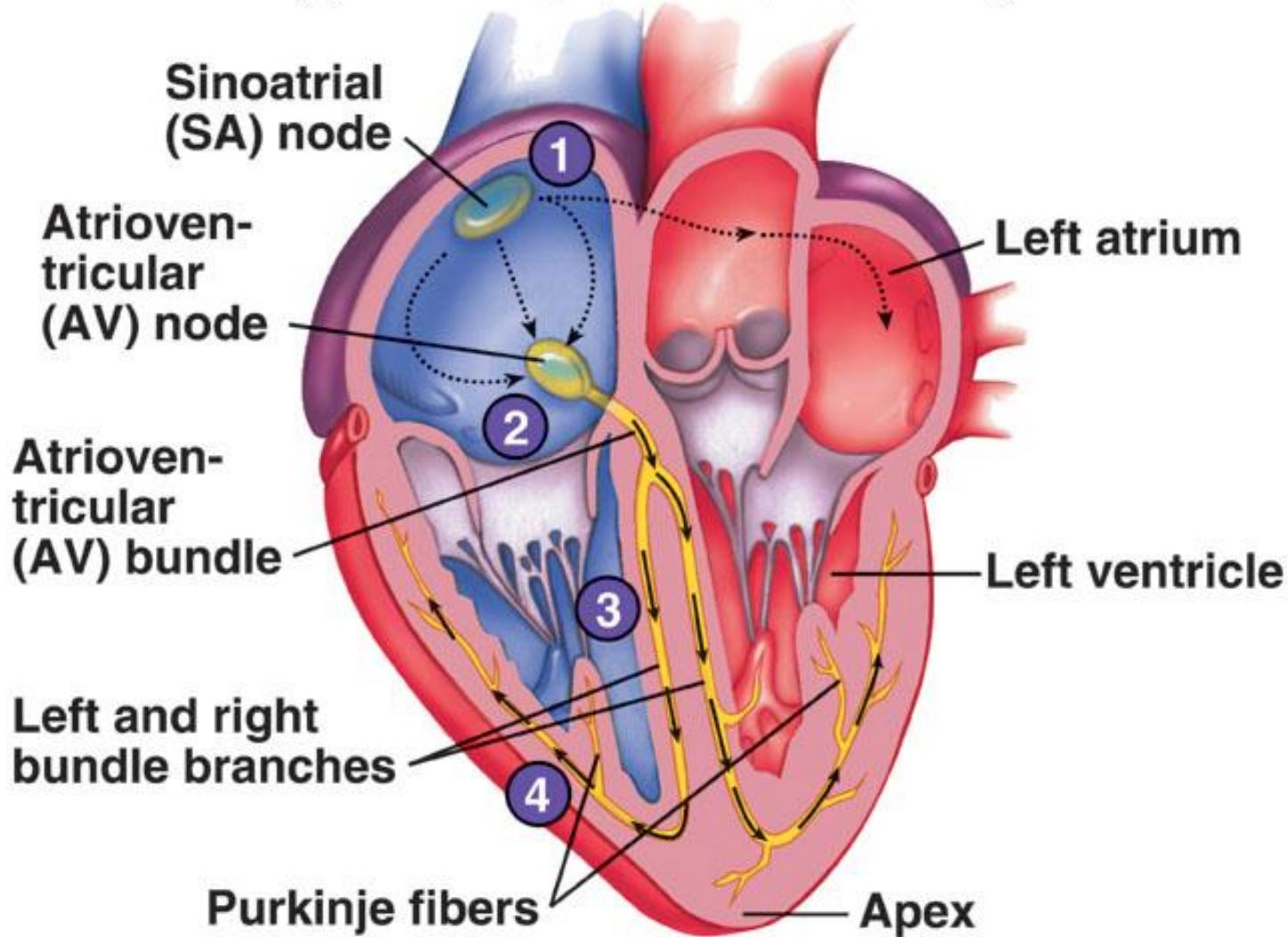


# Circulation



# Conducting system

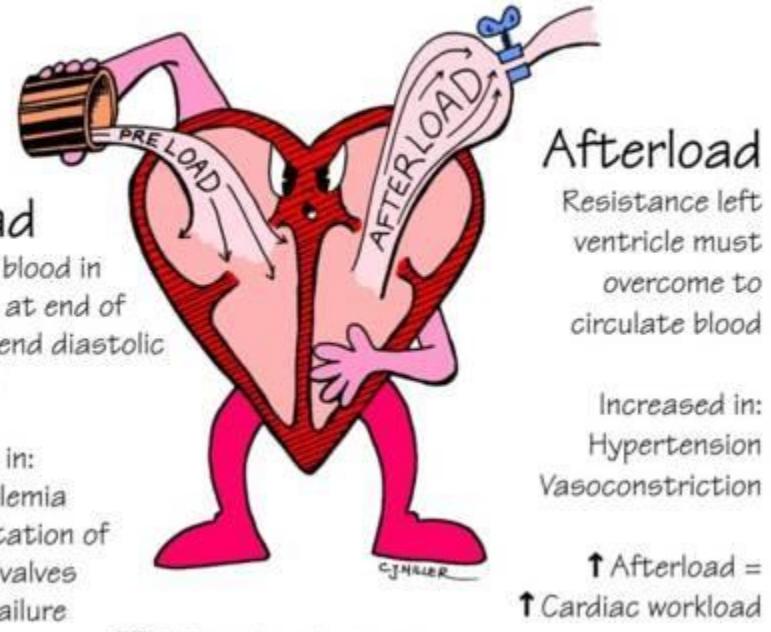
Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



# Cardiac output

- Preload
- Contractility
- Afterload
- Frequency
- Synchronisation

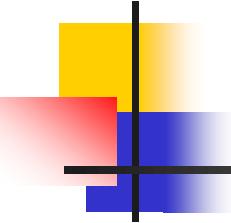
## PRELOAD AND AFTERLOAD



### Preload

Volume of blood in ventricles at end of diastole (end diastolic pressure)

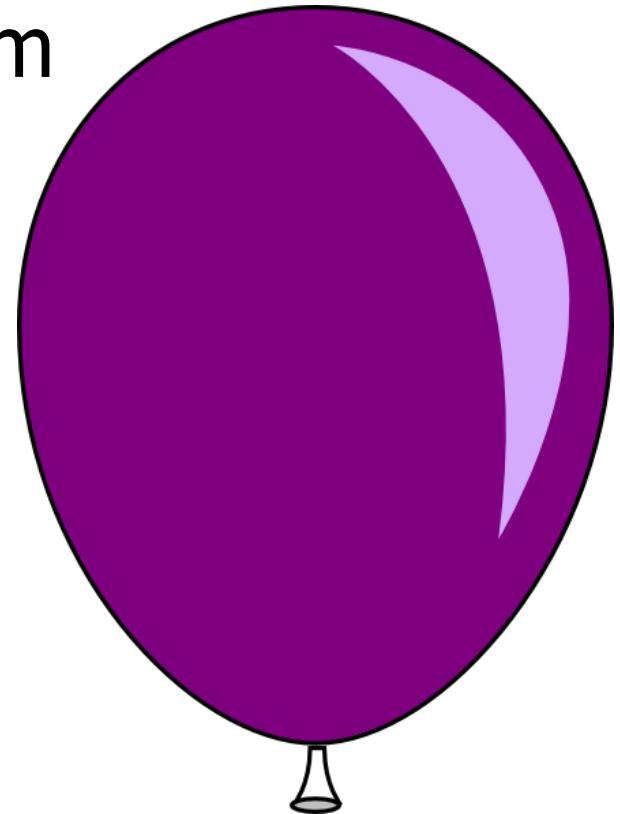
Increased in:  
Hypervolemia  
Regurgitation of cardiac valves  
Heart Failure

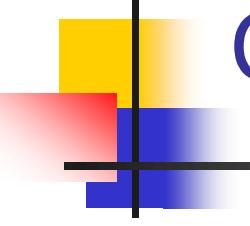


# Mechanisms of heart

- Frank-Starling mechanism

- Inotropy – lusitropy

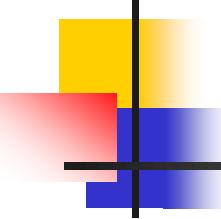




# Cardiovascular diseases

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- Hypertension
- Atherosclerosis
- Coronary artery disease
  - Angina pectoris
  - Acute myocardial infarction
- Heart failure
- Stroke

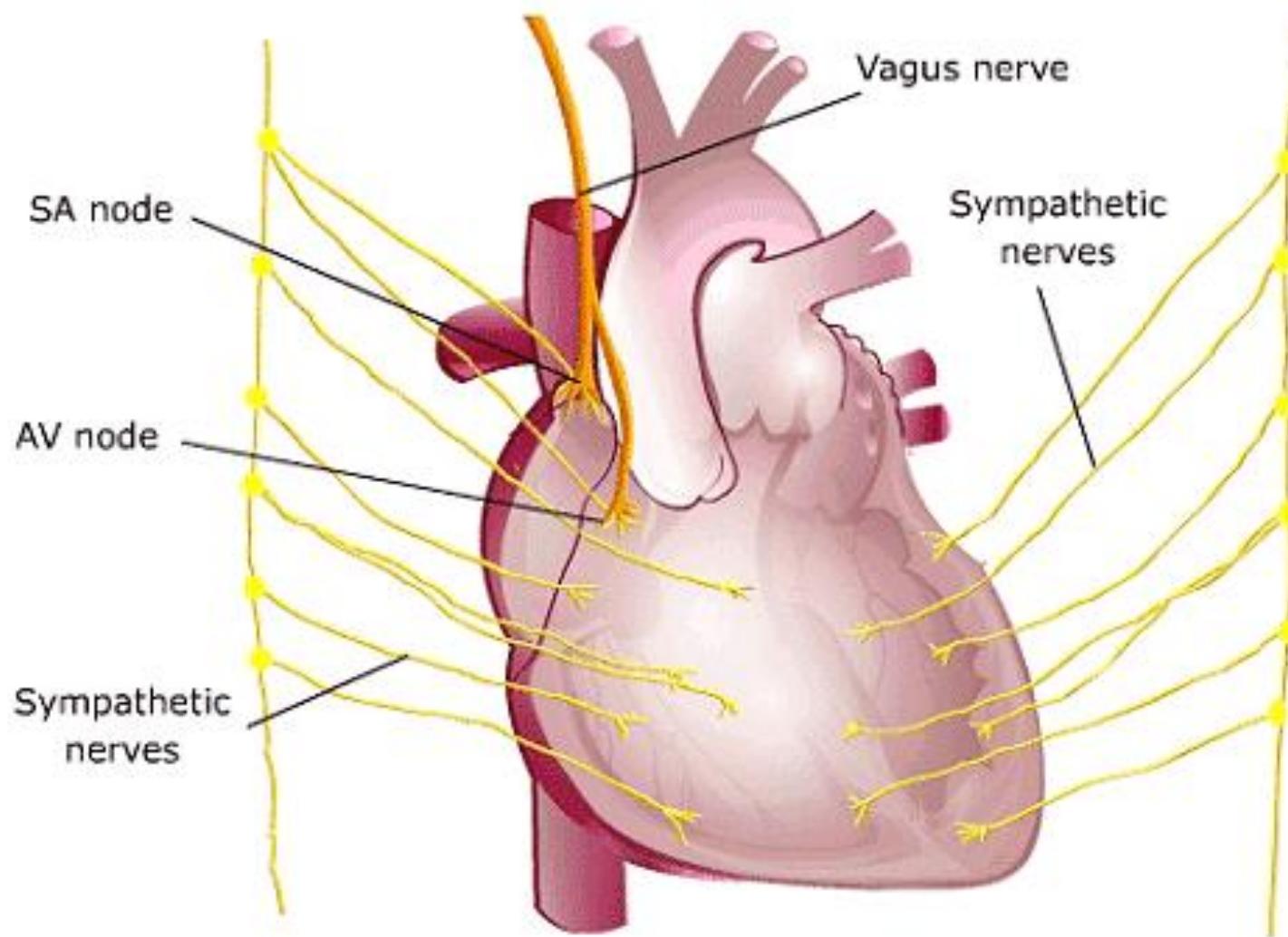


# Neurohumoral regulation

---

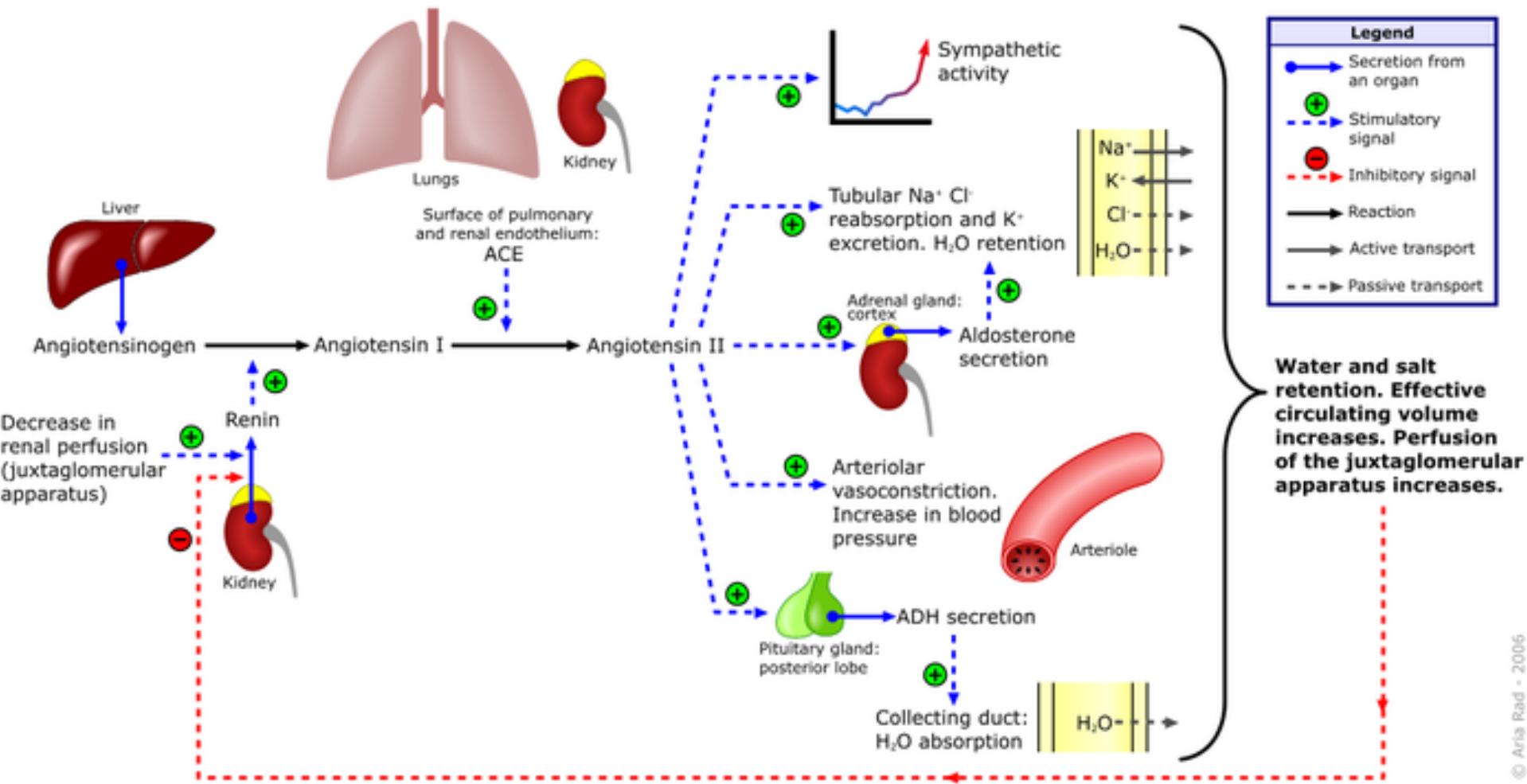
- Autonomous nervous system
- RAAS system
- Endothelin
- Natriuretic peptides
- NO

# Autonomous nervous system

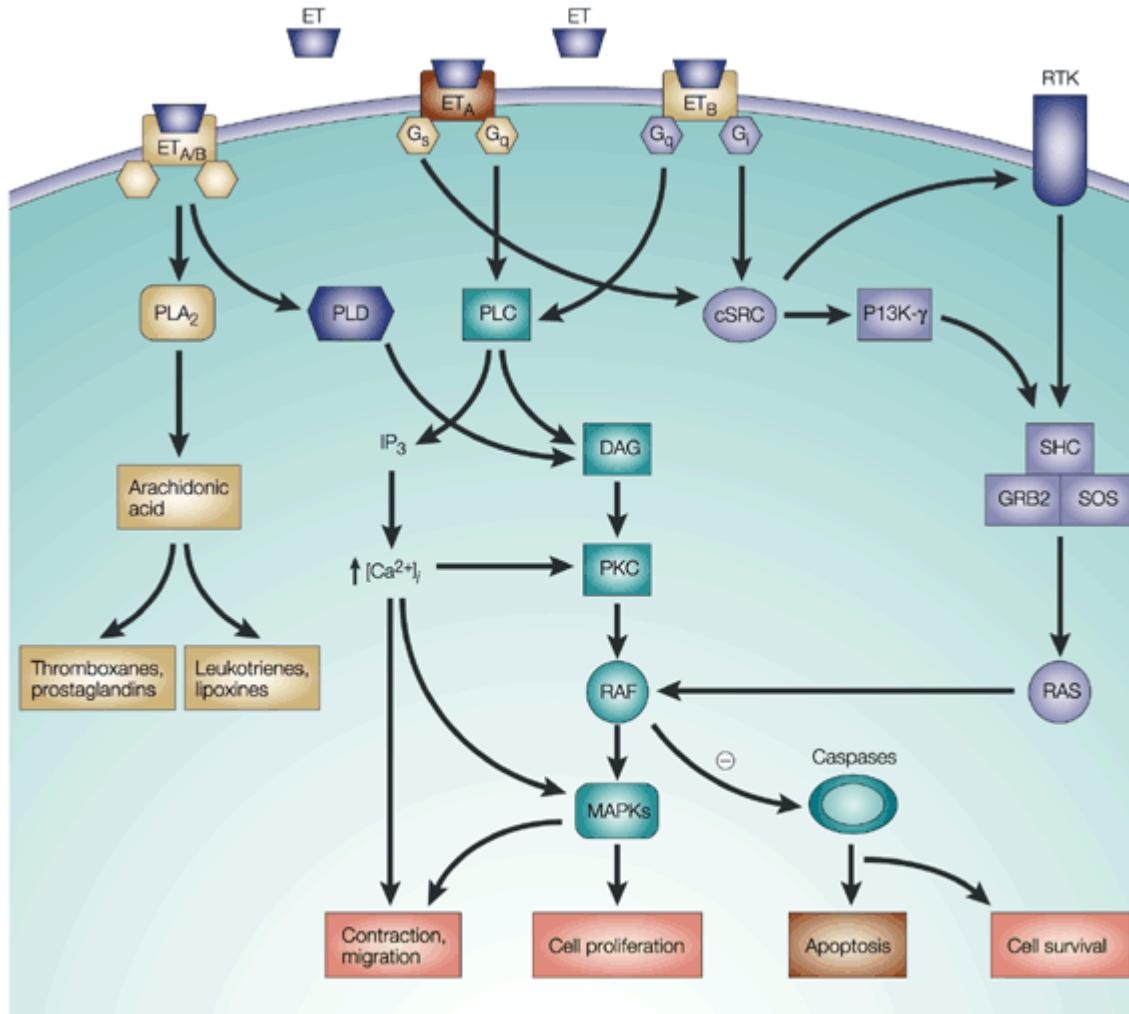


# RAAS system

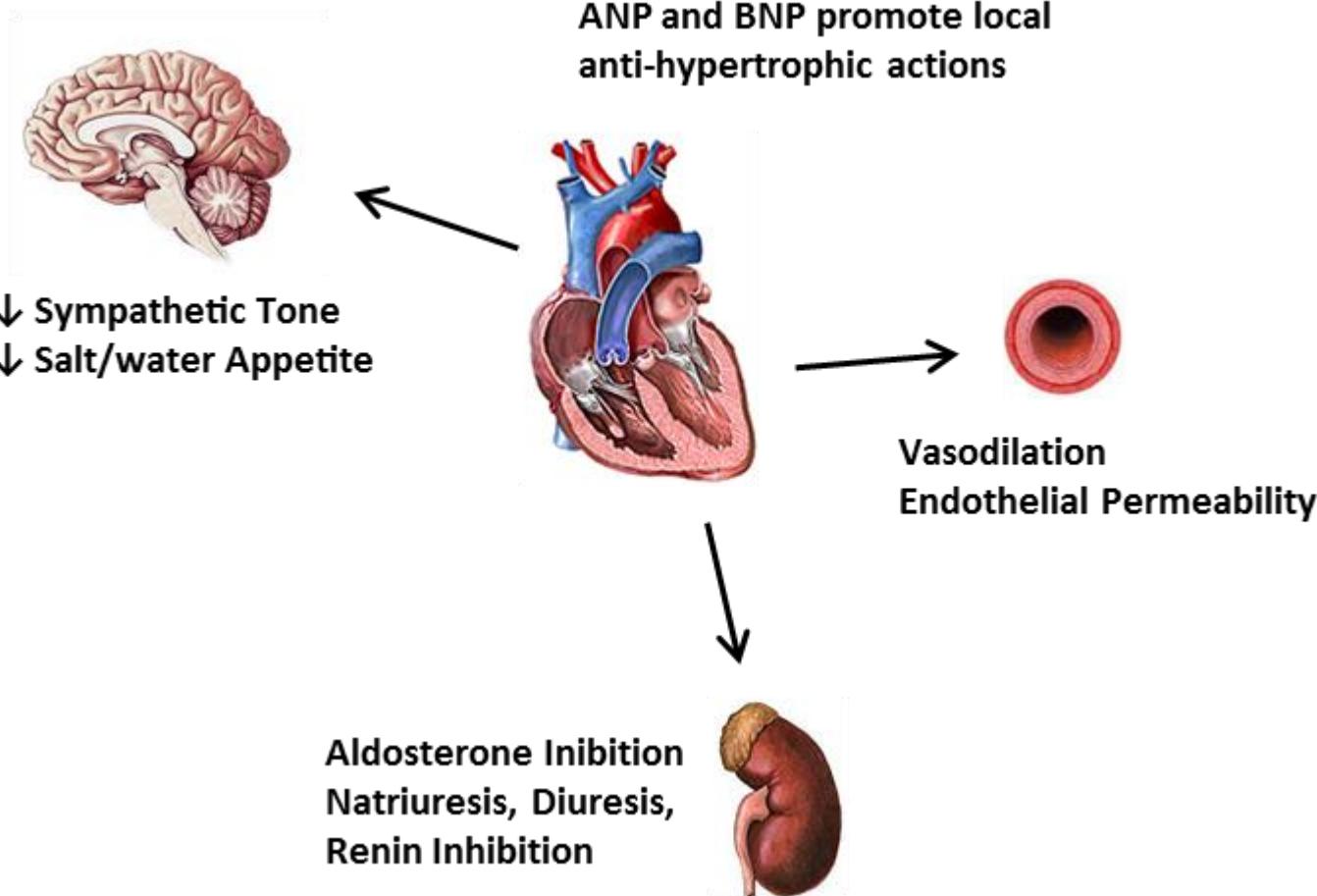
## Renin-angiotensin-aldosterone system



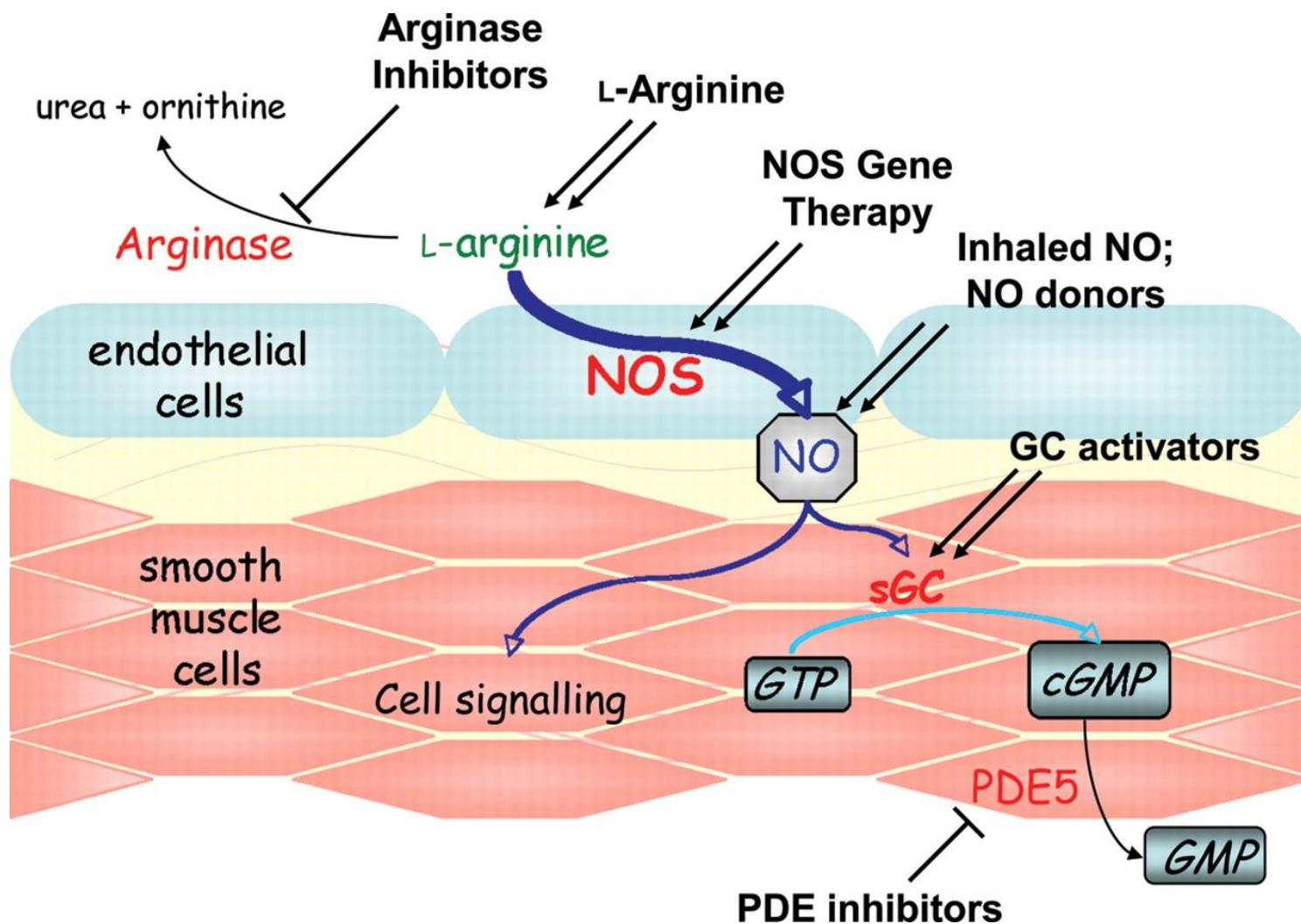
# Endothelin

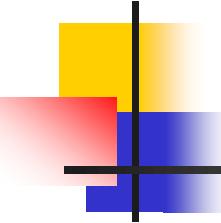


# Natriuretic hormones



# NO

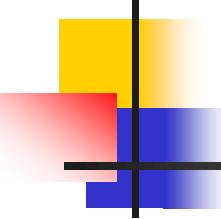




# Heart failure

---

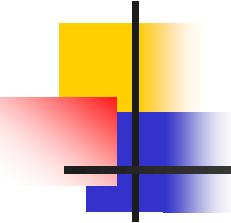
- Insufficient perfusion of tissues
  - Normal filling
- 
- Forward failure
    - Ejection fraction
  - Backward failure
    - Edema



# Heart failure

---

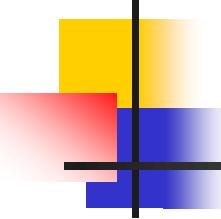
- Systolic
  - Low ejection fraction
  - Contraction failure
- Diastolic
  - Normal ejection fraction
  - Filling failure



# NYHA classification

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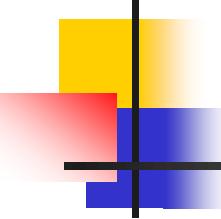
- Class I
  - No limitations of physical activity. Dyspnoe with heavy physical exertion.
- Class II
  - Some limitation of physical activity. Dyspnoe with ordinary exertion.
- Class III
  - Definite limitation of physical activity. Dyspnoe with minimal exertion.
- Class IV
  - Severe limitation of physical activity. Dyspnoe at rest.



# Heart failure

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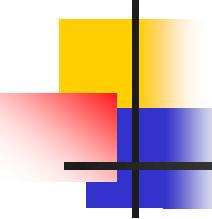
- Compensation
  - Catecholamines
  - Frank-Starling
  - Hypertrophy
  
- Decompensation



# Heart failure

---

- Epidemiology
  - 20/1000 – adult population
  - 150/1000 – over 75 years
- 5-year mortality 50%
- Therapy
  - ACE-inhibitors
  - Beta-blockers
  - Diuretics

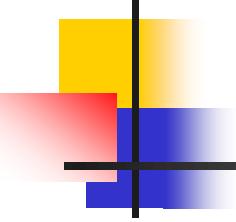


# Symptoms of heart failure

---

Think **FACES...**

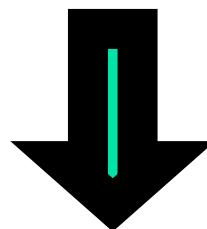
- **F**atigue
- **A**ctivities limited
- **C**hest congestion
- **E**dema or ankle swelling
- **S**hortness of breath



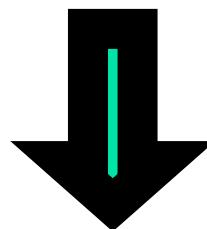
# Decompensation

---

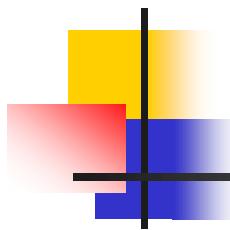
Increased pulmonary venous pressure



Insterstitial edema

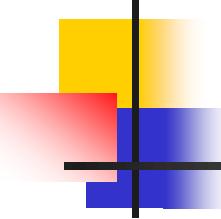


Alveolar edema



## Acute pulmonary edema





# Hypertrophy

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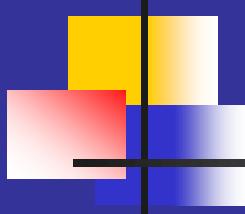
- Overload

- Pressure

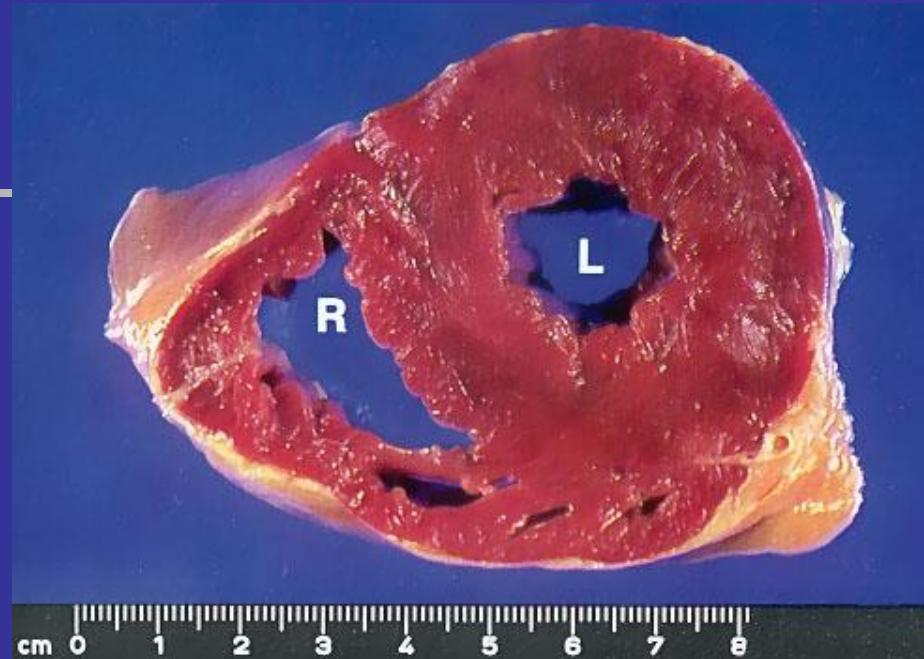
- Afterload
- Concentric hypertrophy

- Volume

- Preload
- Excentric hypertrophy

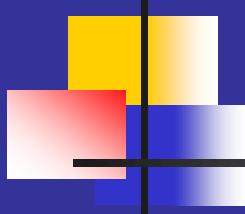


## Healthy heart

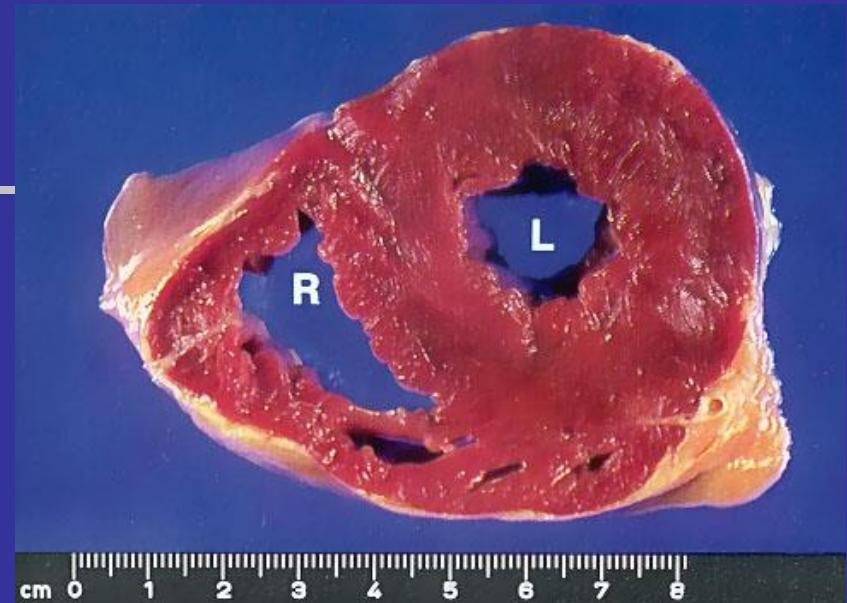


## Dilation

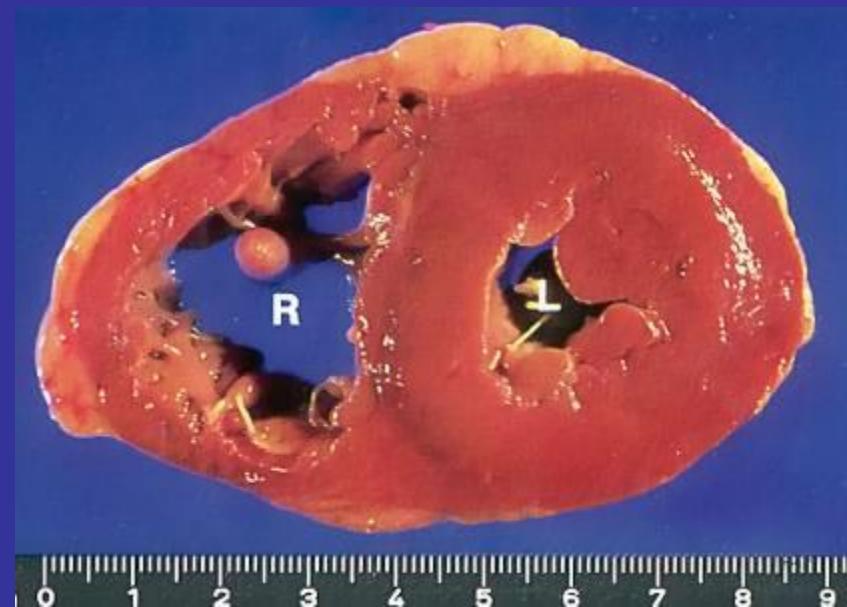


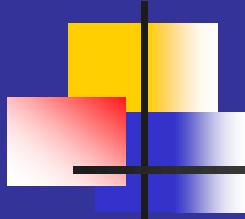


## Healthy heart

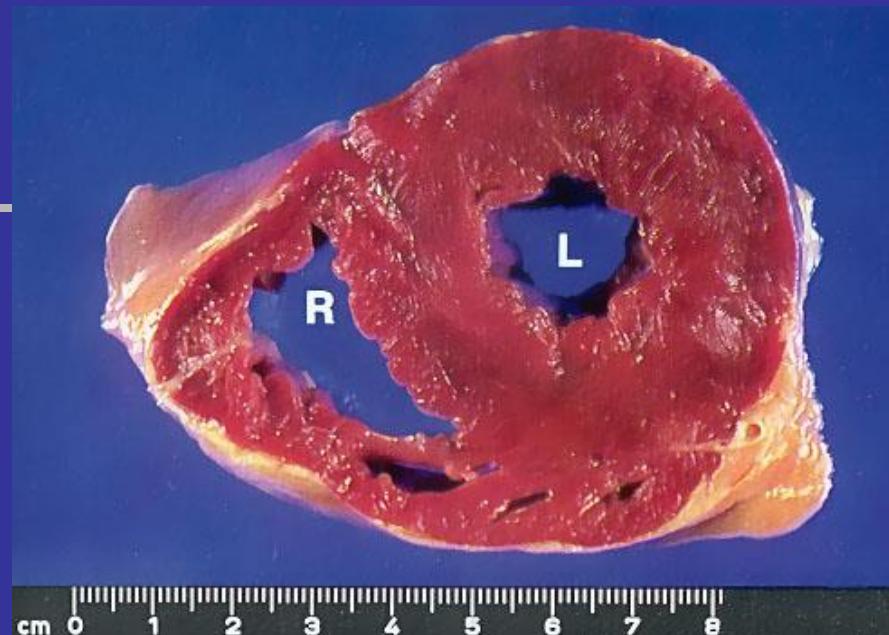


## Concentric hypertrophy





## Healthy heart

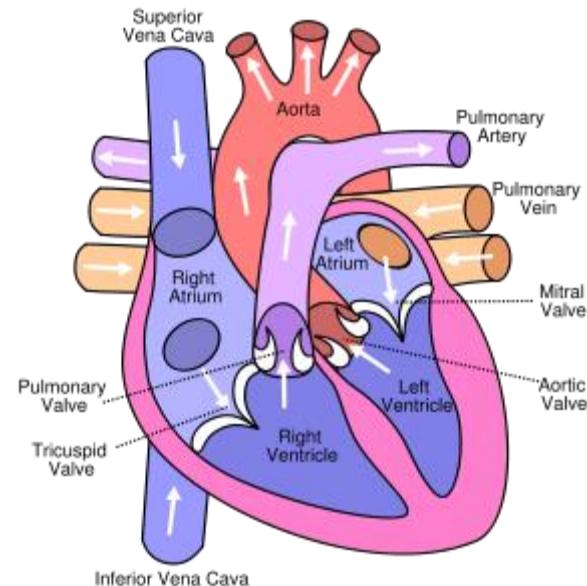
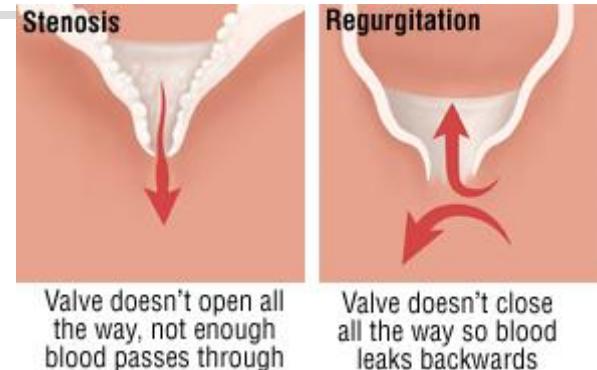


## Excentric hypertrophy



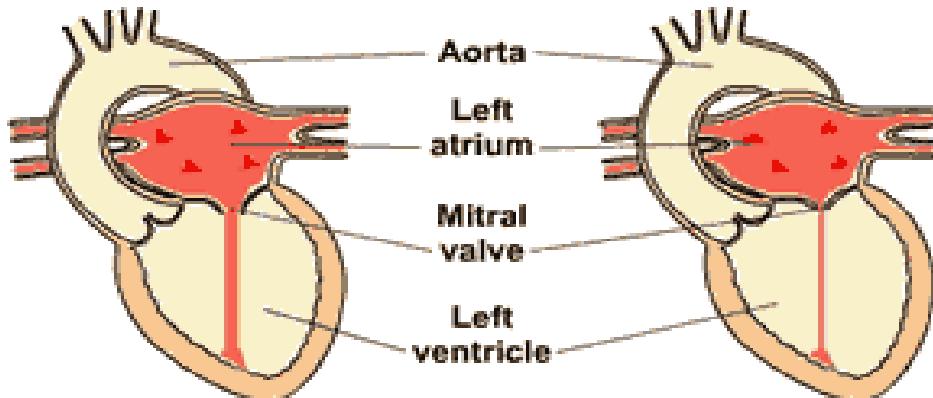
# Valvular defects

- Mitral/Tricuspidal
  - Stenosis
  - Insufficiency
  
- Aortal/Pulmonary
  - Stenosis
  - Insufficiency



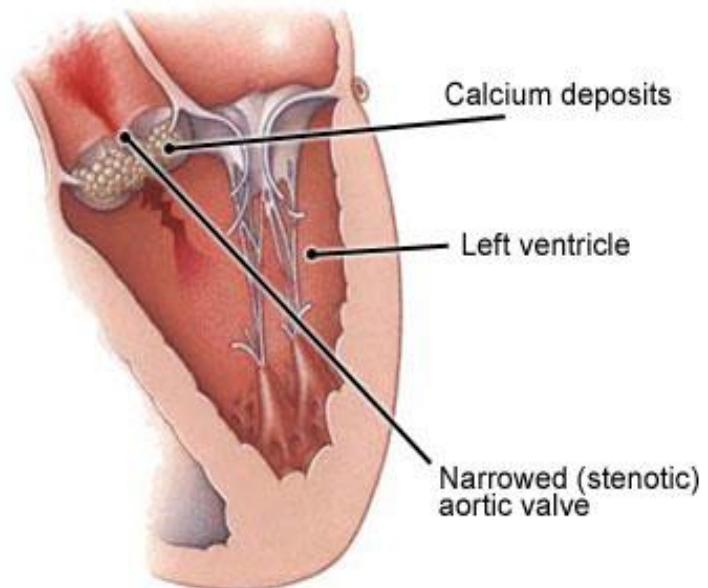
# Valvular defects

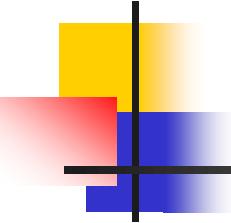
Normal Valve Mechanisms



Mitral Valve Stenosis

Calcific aortic stenosis

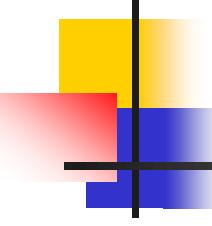




# Blood pressure

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- Hypertension
- 130/80 mm Hg, but...
- Many confounding factors
- Hypertrophy, encephalopathy, stroke, hypertensive nephropathy, retinopathy...
- Primary – essential
- Secondary
  - Renal
  - Renovascular
  - Endocrine
  - Neural, iatrogenic, gestational...

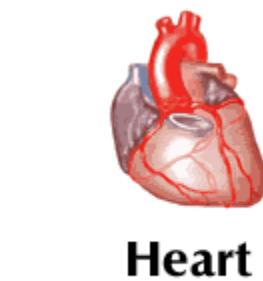


# Afterload & blood pressure

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- $\text{BP} = \text{CO} \times \text{SVR}$ 
  - Cardiac output
  - Systemic vascular resistance
- If CO is low, BP is maintained by  $\uparrow$  SVR
  - $\uparrow$  SVR =  $\uparrow$  afterload

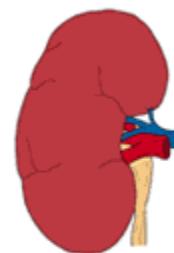
# Complications of hypertension



- Atherosclerosis
- Stroke
- AMI
- Nephropathy
- Blindness



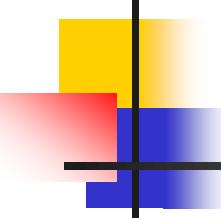
Eyes



Kidneys



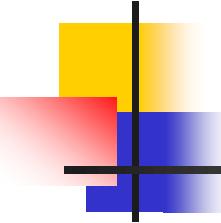
Brain



# Cardiovascular models

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- Hypertension
  - L-NAME, SHR, Dahl salt-sensitive rats
- Atherosclerosis
  - High fat diet, apoE ko mice
- AMI
  - Coronary surgery
- Heart failure
  - Isoprenalin



# Questions

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- Which genetic factors are associated with hypertension? Heritability?
- What is the evolutionary origin of the RAAS system?
- What is the effect of ACE inhibitors on mortality in hypertension and heart failure?
- Which promoters are myocardium-specific?