SIKLUS JANTUNG

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The Cardiac Cycle

- **Definition:**

  The cardiac events that occur from the beginning of one heartbeat to the beginning of the next

- **The cardiac cycle consists of:**

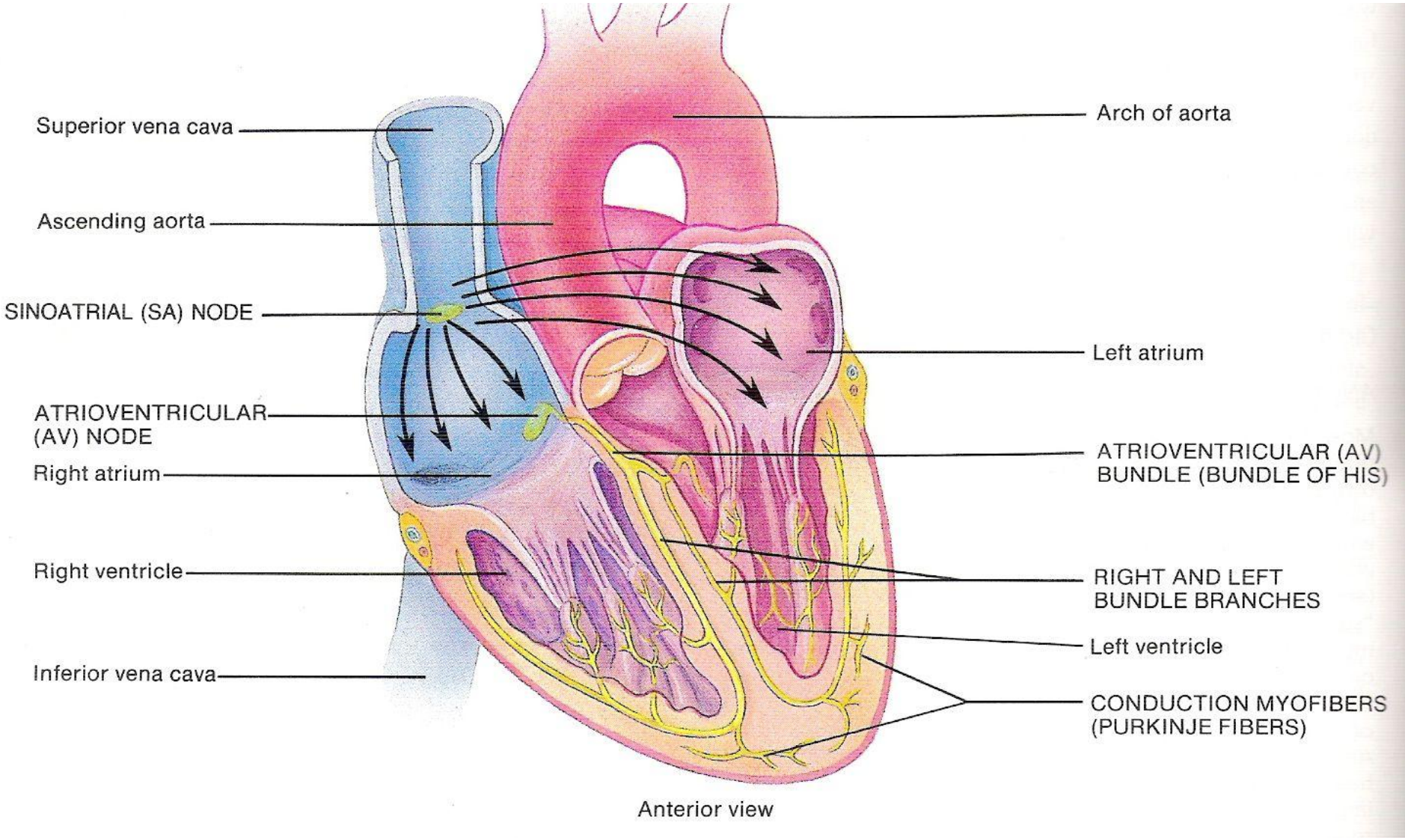
  - Diastole : period of relaxation, during which the heart fills with blood

  - Systole : period of contraction, during which the heart ejects blood from its chambers

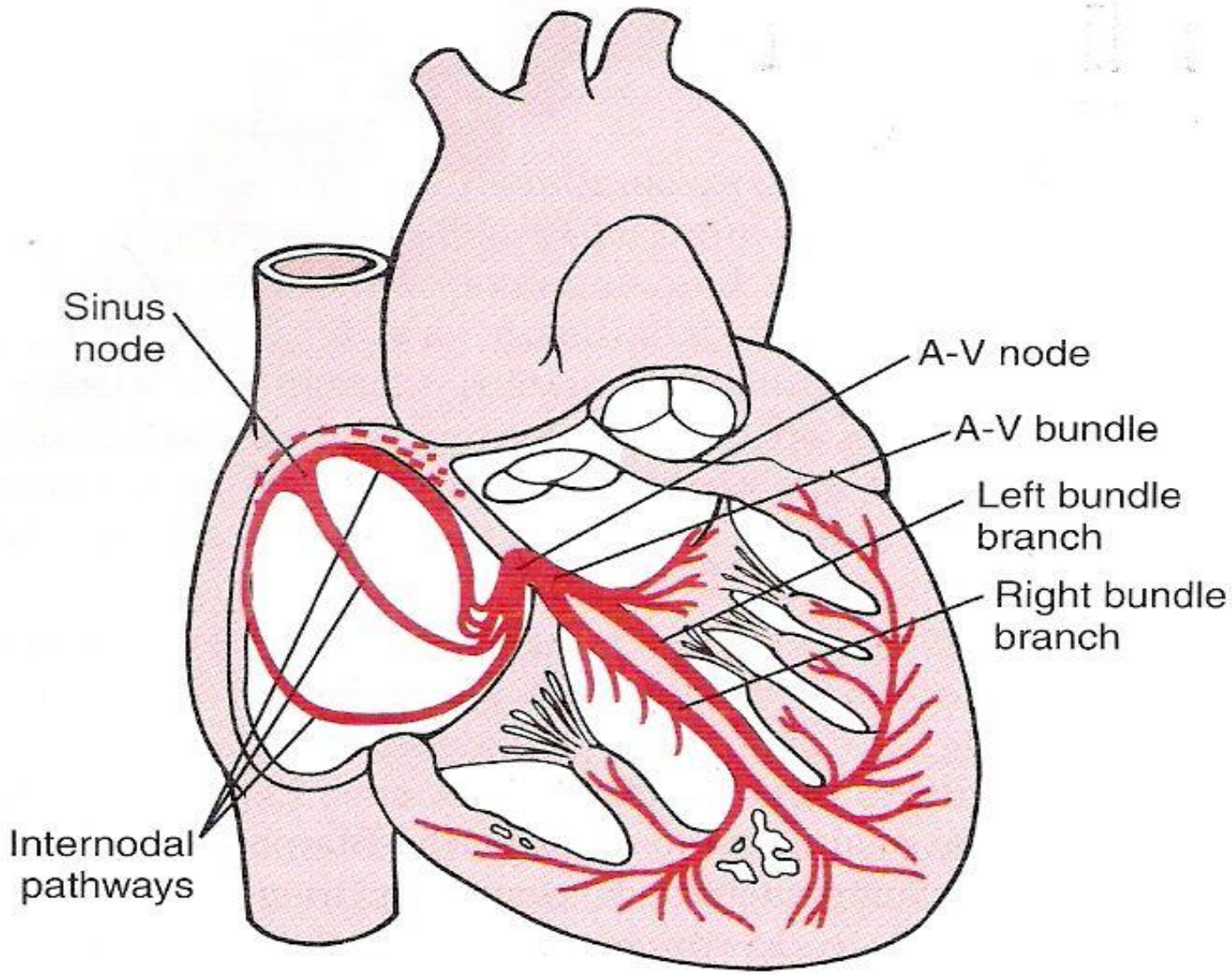
Conductive System of Heart

- **SA Node (sinoatrial node)/ sinus node :**
  - **located in the superior lateral wall of right atrium, immediately below and slightly lateral to the opening of the superior vena cava**
- **Internodal pathways:**
  - **conductive system from SA node to AV node**
- **AV node (atrioventricular node):**
  - **located in the posterior septal wall of right atrium, immediately behind tricuspid valve and adjacent to the opening of coronary sinus**
- **AV bundle/ His bundle**
- **Purkinje System**

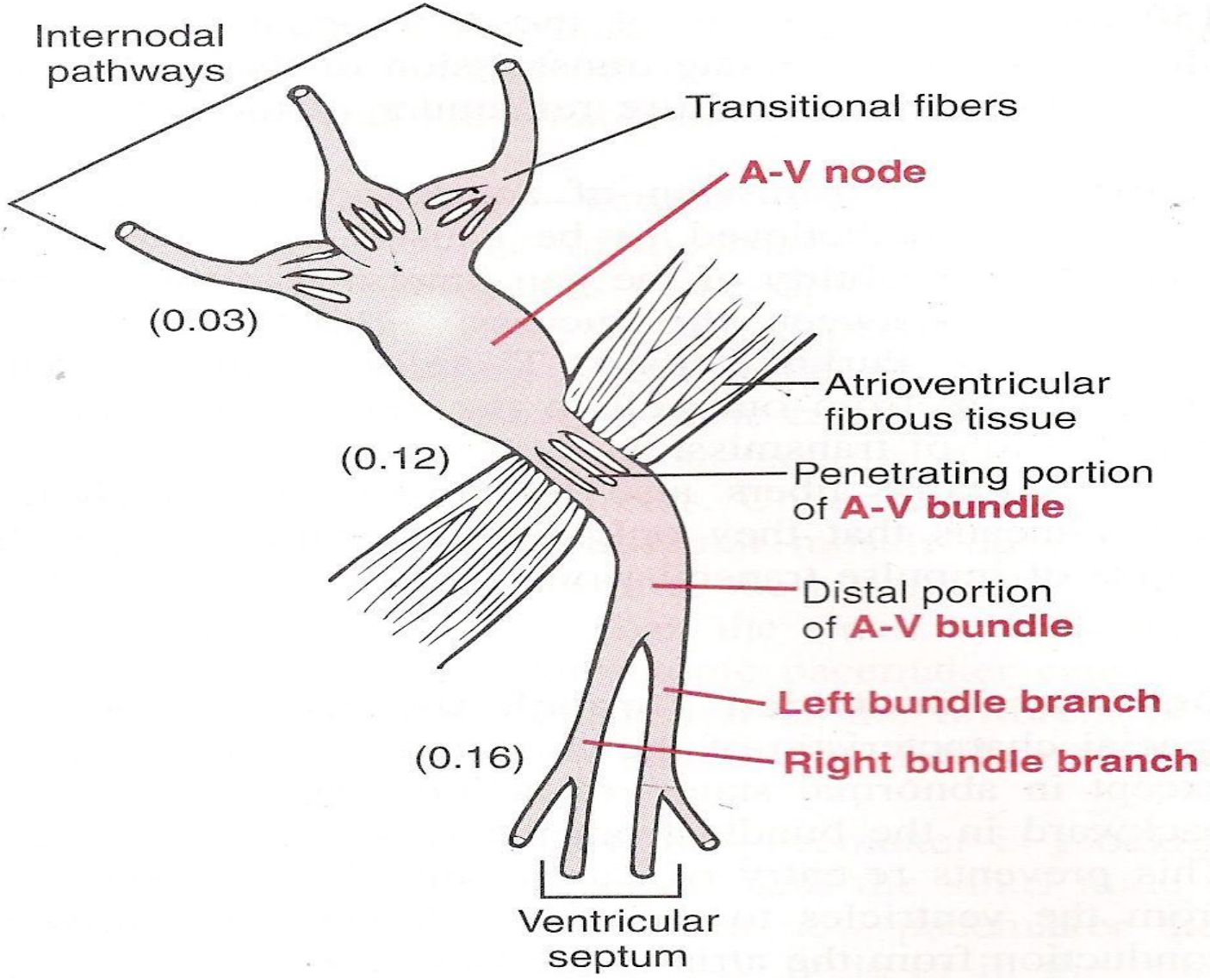
…..Conductive System of Heart



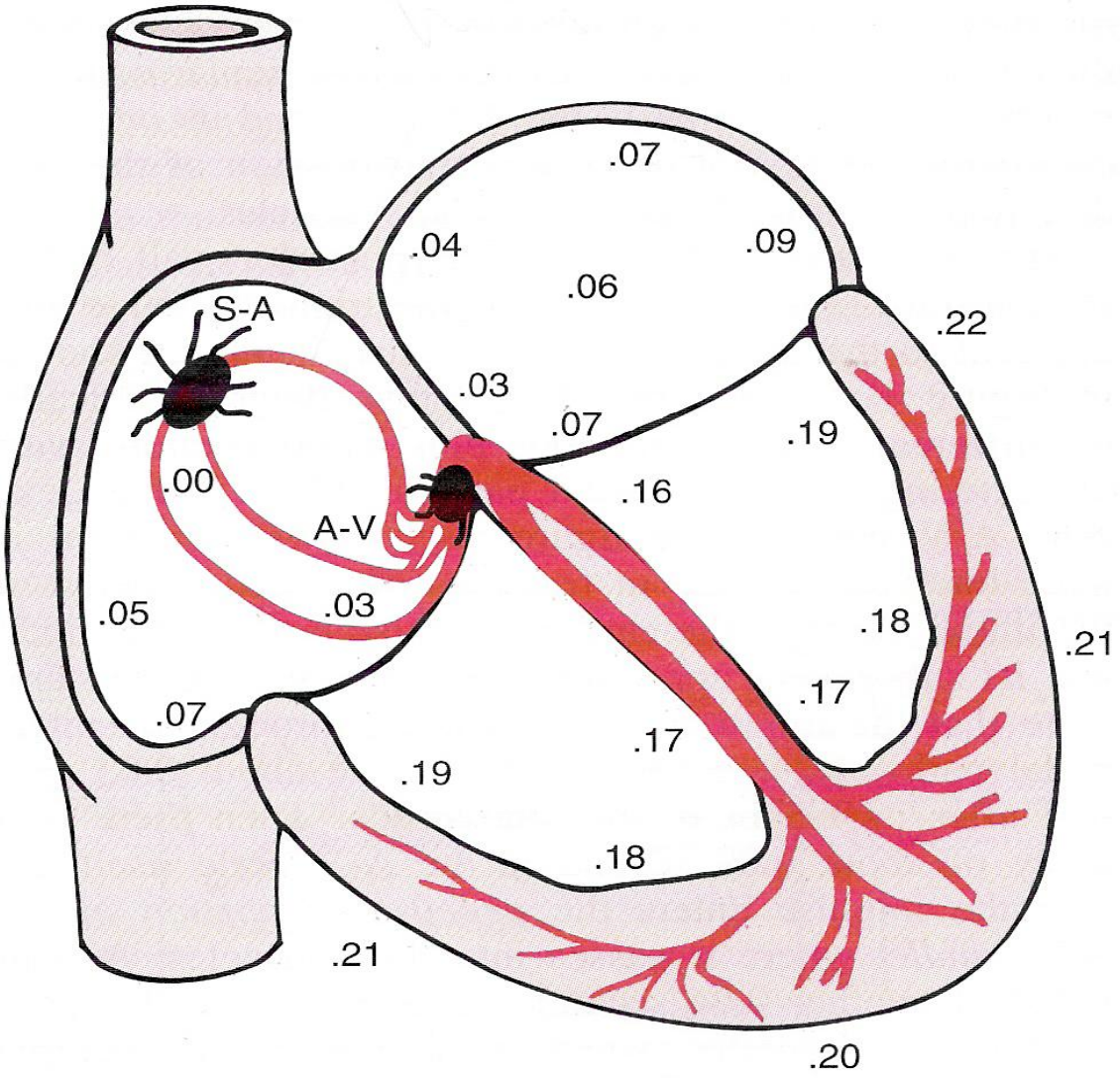
…..Conductive System of Heart



Organization of AV node



Transmission of Cardiac Impulse



Events of Cardiac Cycle

Generating and transmission of cardiac impulses:

1. **Generating rhythmical impulses in SA node**
2. **Conducting the impulses rapidly throughout atria ⇒ atria contract**
3. **Conducting impulses to AV node (delay 0,13 sec)**
4. **Conducting impulses through AV/ His bundle**
5. **Finally transmission impulses rapidly throughout ventricles through Purkinye system ⇒ ventricle contract**

.....Events of Cardiac Cycle

- Because of impulses generate in SA node and delay in transmission to ventricles → atria contract (atrial systole) prior to ventricles
- Ventricles still in relaxation period (ventricular diastole), called diastole

⇓

- AV valves open and allow blood to flow into ventricles ⇒ filling of ventricles

.....Events of Cardiac Cycle

Filling of the ventricles during diastole

- **Rapid filling:**
  - Large amount of blood that accumulate in atria because of closed of AV nodes, immediately push AV valves open and allow blood to flow rapidly into ventricles; lasts for ± the first third of diastole
- **Diastasis:**
  - During the middle third of diastole, only a small amount of blood that continues to empty into atria from veins and passes directly into ventricles
- **Atrial systole:**
  - During the last third of diastole, atria contract and give additional thrust to inflow of blood into ventricles

.....Events of Cardiac Cycle

Emptying of the ventricles during systole

- **Period of isovolemic (isometric) contraction:**
  - When ventricular contraction begins, the intra-ventricular pressures build up and causing AV valves to close, but not sufficient to push semilunar valves open
  - There is no emptying of blood from ventricles
- **Period of ejection:**
  - Immediately after semilunar valves opened, blood begins to pour out of ventricles
- **Period of isovolemic (isometric) relaxation:**
  - When ventricular relaxation begins, the intra-ventricular pressures fall rapidly, allowing semilunar valves to close, but not sufficient to cause AV valves open
  - There is no blood flow into ventricles

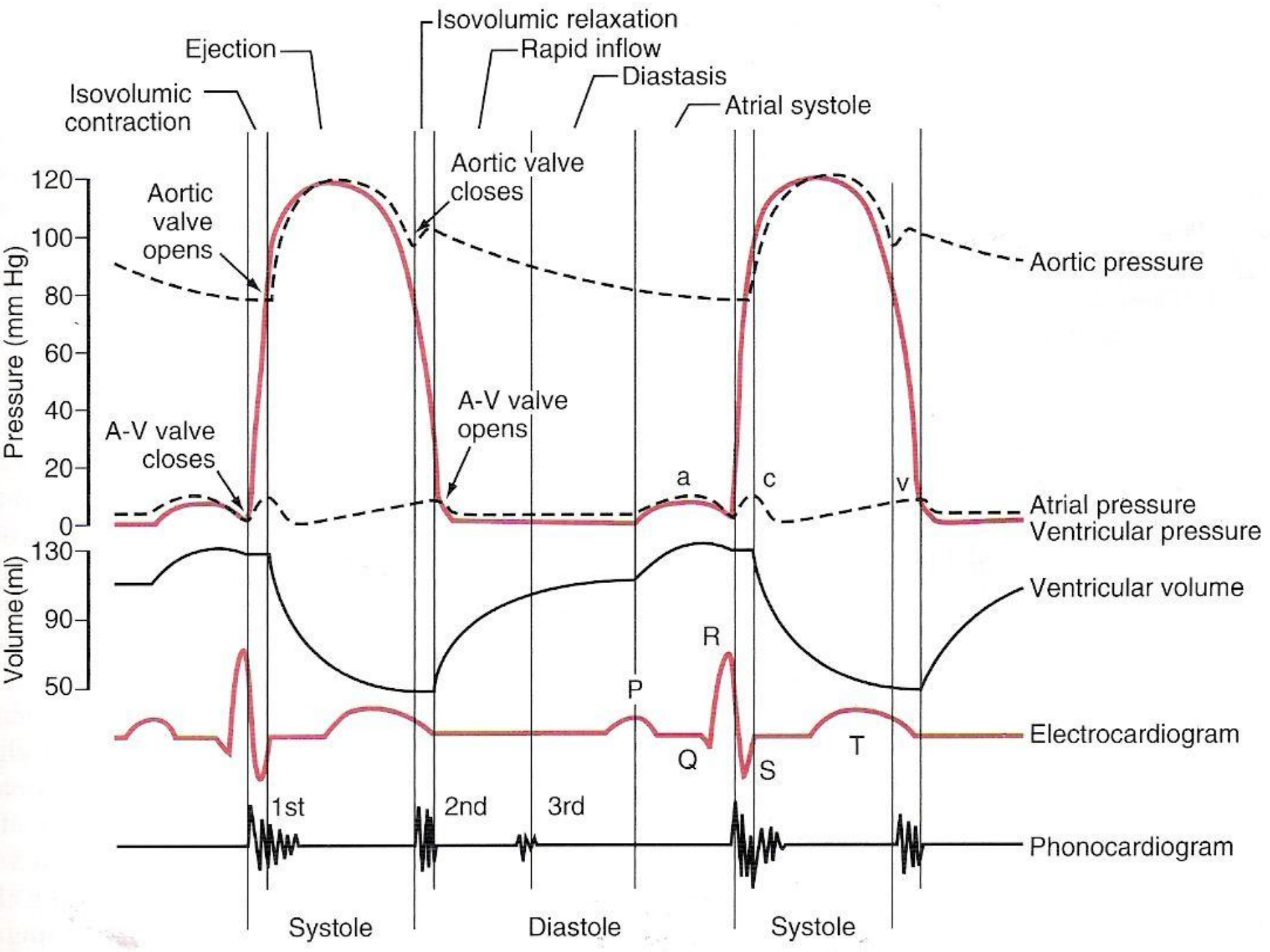
.....Events of Cardiac Cycle

- **During ventricular contraction:**
  - **Period of ejection**
  - **Ventricular pressure rise cause blood to pour from ventricles into arterial system (aorta and pulmonary trunks) ⇒ - cardiac output (volume / minute)**
    - **stroke volume (volume/ contraction)**
- **During atrial relaxation:**
  - **Atrial pressure fall and allowing blood flow from veins into atria ⇒ venous return (volume/ minute)**

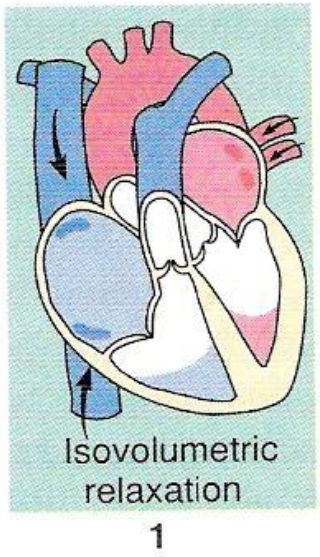
.....Events of Cardiac Cycle

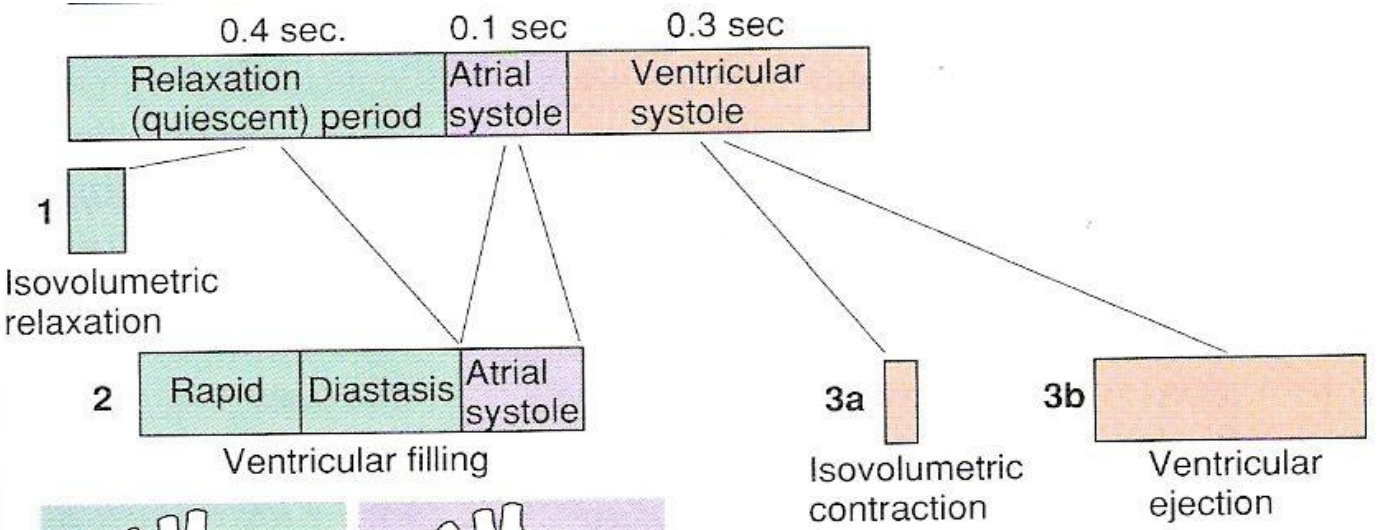
- The greater venous return, the greater the heart muscle is stretched, the greater will be the force of contraction and the greater stroke volume
- Within physiological limits, the heart pumps all the blood that comes to it without allowing excessive damming of blood in the veins

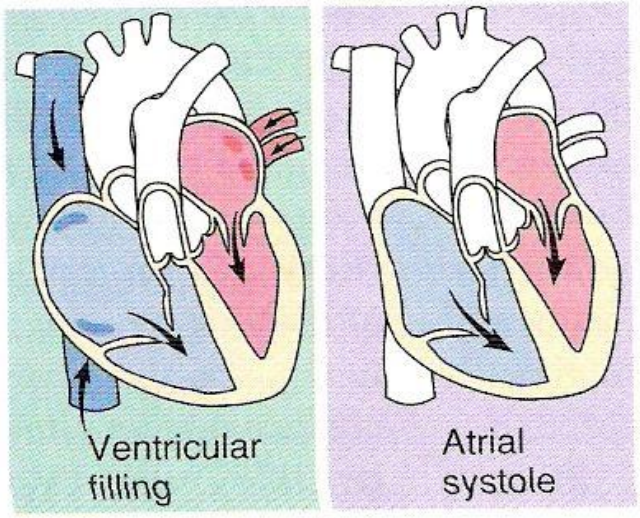
(Hukum Frank-Starling)

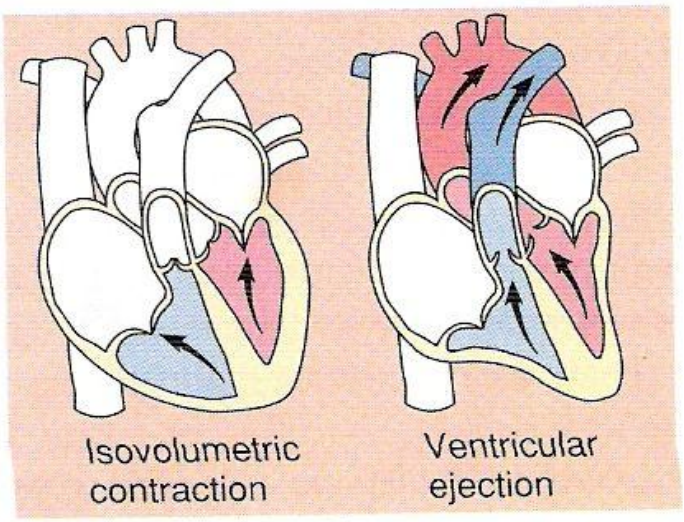

Isovolumic relaxation
Ejection
Rapid inflow
Diastasis
Isovolumic contraction
Atrial systole
Aortic valve closes
Aortic valve opens
120
100
80
60
40
20
0
Pressure (mm Hg)
Aortic pressure
A-V valve opens
A-V valve closes
a
c
v
Atrial pressure
Ventricular pressure
130
90
50
Volume (ml)
Ventricular volume
R
P
Q
S
T
Electrocardiogram
1st
2nd
3rd
Phonocardiogram
Systole
Diastole
Systole

…..Events of Cardiac Cycle





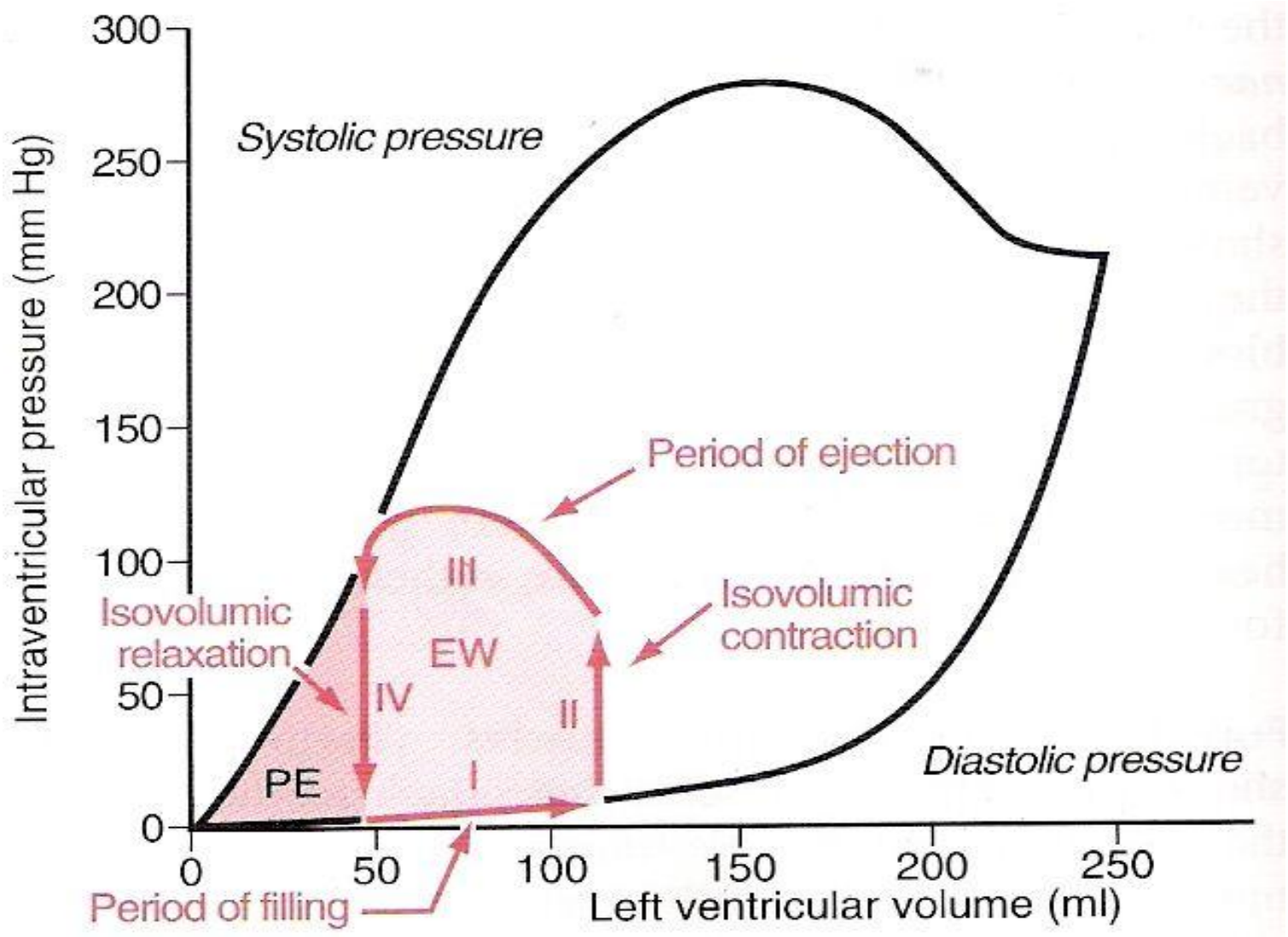




Ventricular Volume

- End diastolic volume (EDV): 110 – 120 cc,
  - Can be increased to 150 – 180 cc
- Stroke volume (SV): 70 cc
  - SV = EDV – ESV (110 cc – 40 cc)
- Ejection fraction: 60 %
  - SV/EDV x 100%
- End systolic volume (ESV): 40 – 50 cc,
  - Can be decreased to 10 – 20 cc
  - SV can be increased to 140 - 160 cc

Volume – Pressure Diagram



Concepts of Preload and Afterload

- **Preload:**

  In assessing the contractile properties of muscle, it is important to specify the degree of tension on muscle when it begins to contract

- **After load:**

  To specify the load against which the muscle exerts its contractile force

…..Concepts of Preload and Afterload

- **The importance of the concepts of preload and afterload:**

  Many abnormal function states of the heart or circulation, the pressure during filling of ventricle (the preload), the arterial pressure against which the ventricle must contract (the afterload), or both are severely altered from the normal

Thank You