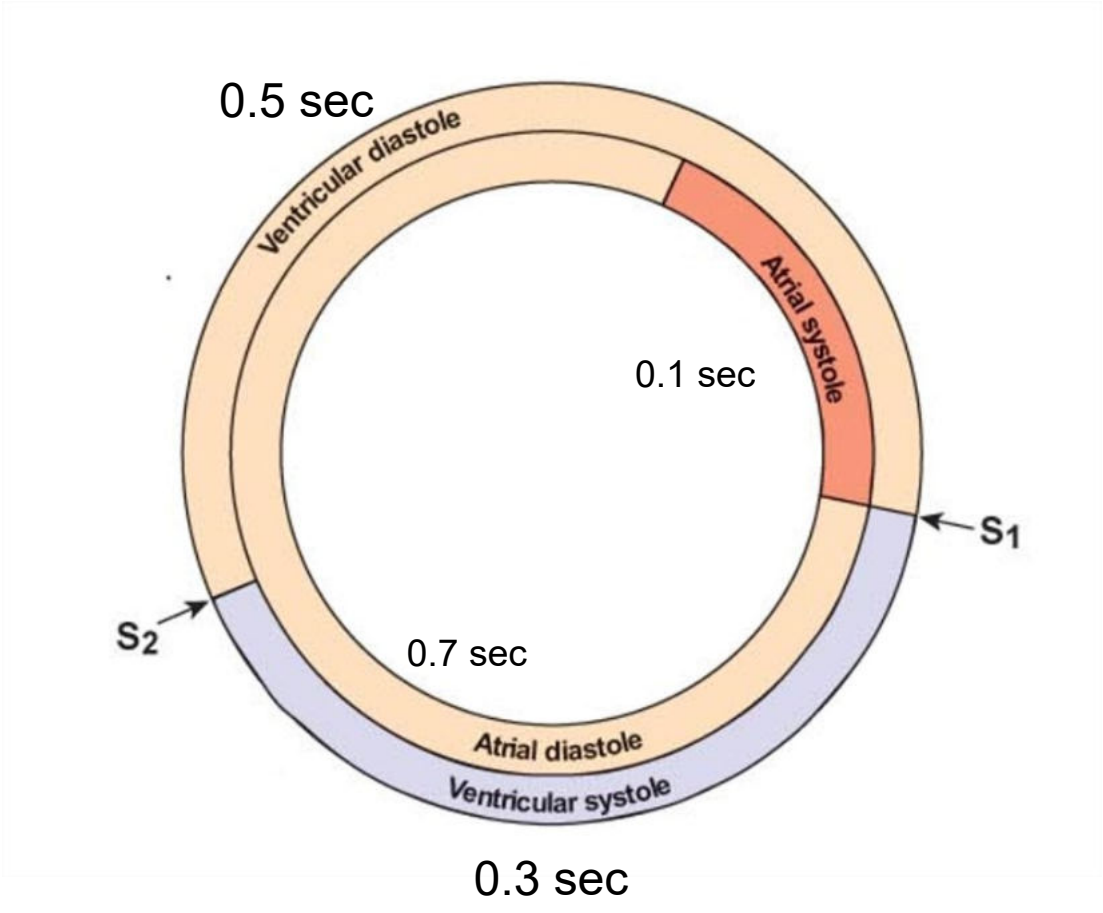
Cardiac Cycle

Cardiac Cycle

- Cardiac cycle is the mechanical sequence of events as blood enters the atria and leaves the ventricles

- The events includes
  1. Changes in the pressures in different chambers of the heart
  2. Changes in the volume in different chambers of the heart
  3. Changes in the aortic, pulmonary arteries
  4. Heart sounds
  5. ECG changes

Cardiac Cycle



Phases of Cardiac Cycle

Ventricular Systole

- Isovolumetric contraction
- Rapid ejection
- Slow ejection

Phases of Cardiac Cycle

Ventricular Systole

- Isovolumetric contraction
- Rapid ejection
- Slow ejection

Ventricular Diastole

- Isovolumetric relaxation
- Rapid filling
- Slow filling (Diastasis)
- Filling d/t Atrial Systole

Phases of Cardiac Cycle

Ventricular Systole

- Isovolumetric contraction
- Rapid ejection
- Slow ejection

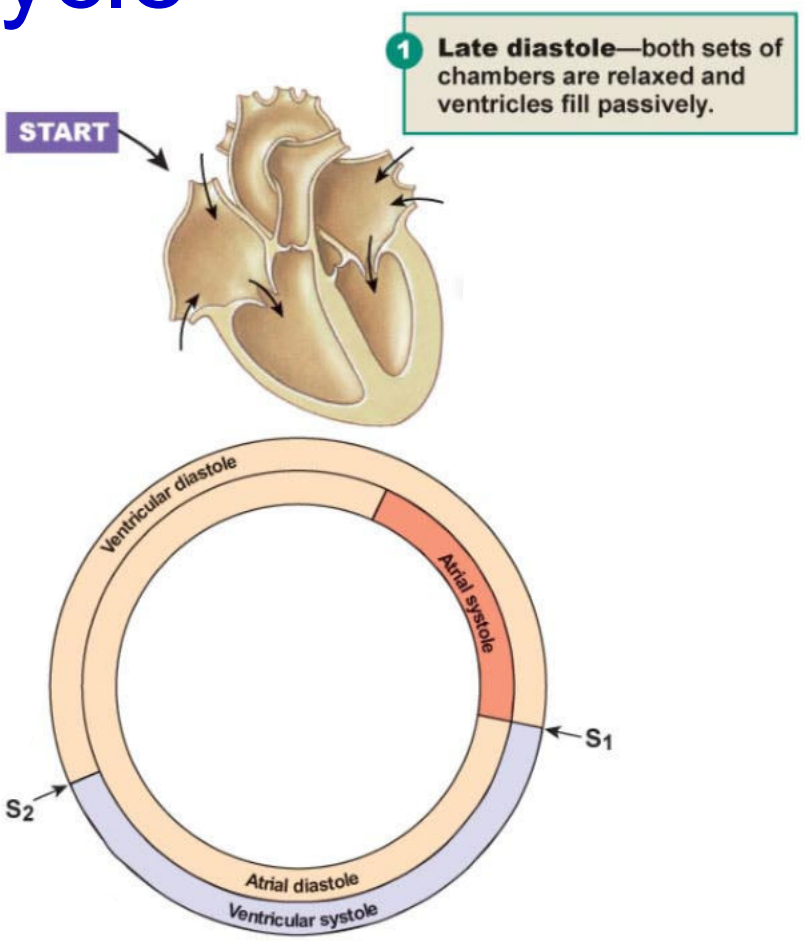
Ventricular Diastole

- Isovolumetric relaxation
- Rapid filling
- Slow filling (Diastasis)
- Filling d/t Atrial Systole

Start

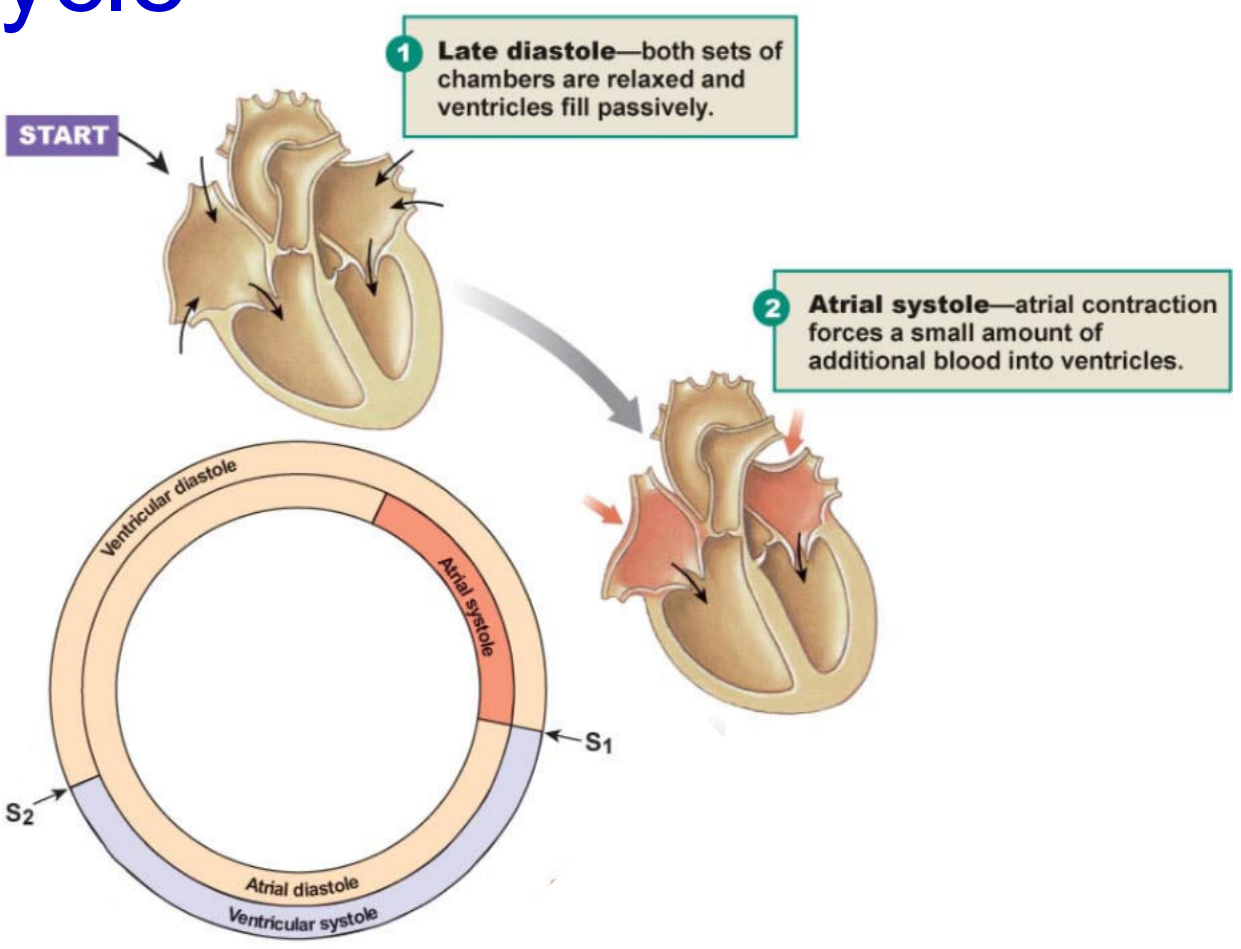
Cardiac Cycle

Phases



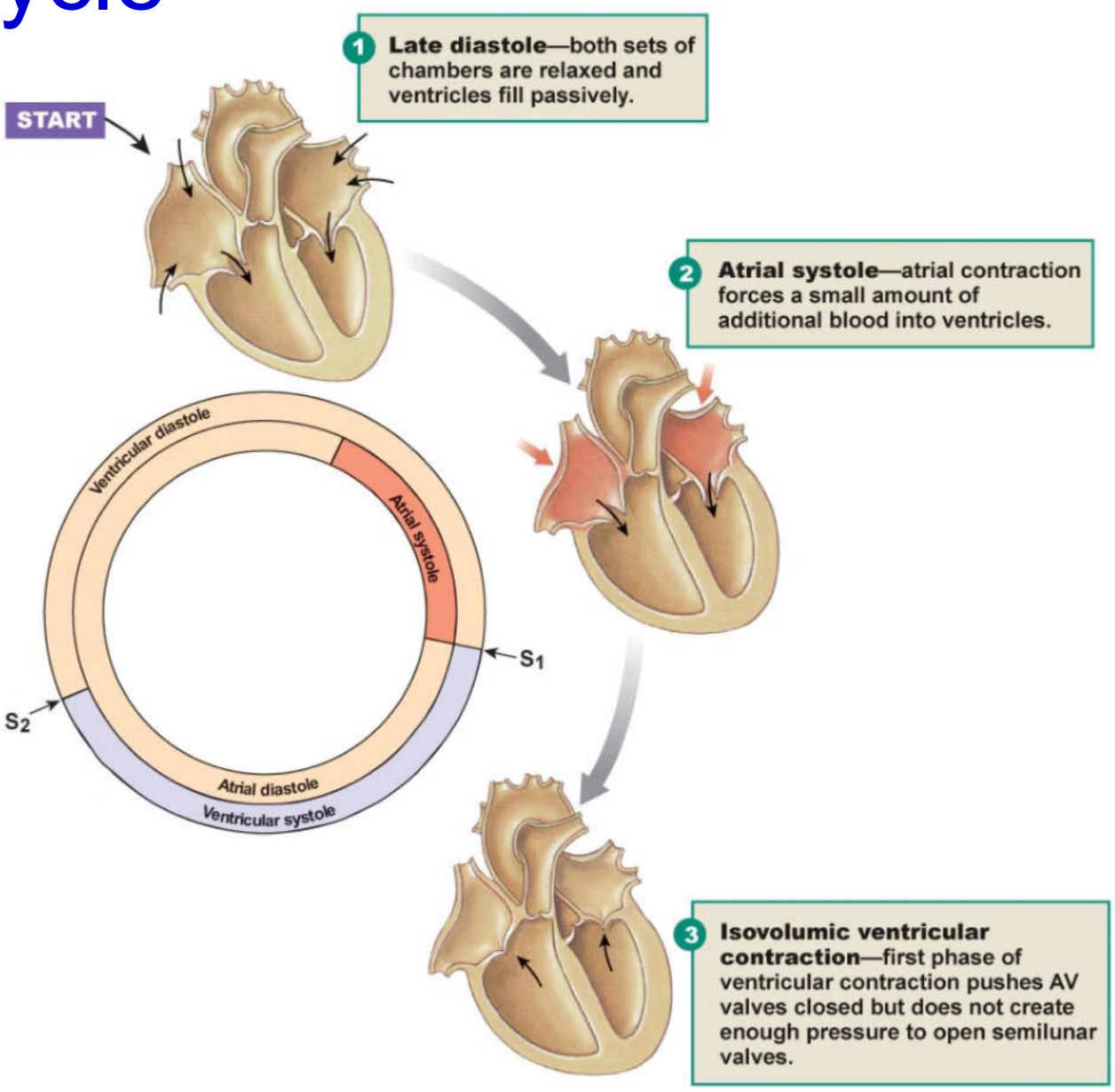
Cardiac Cycle

Phases



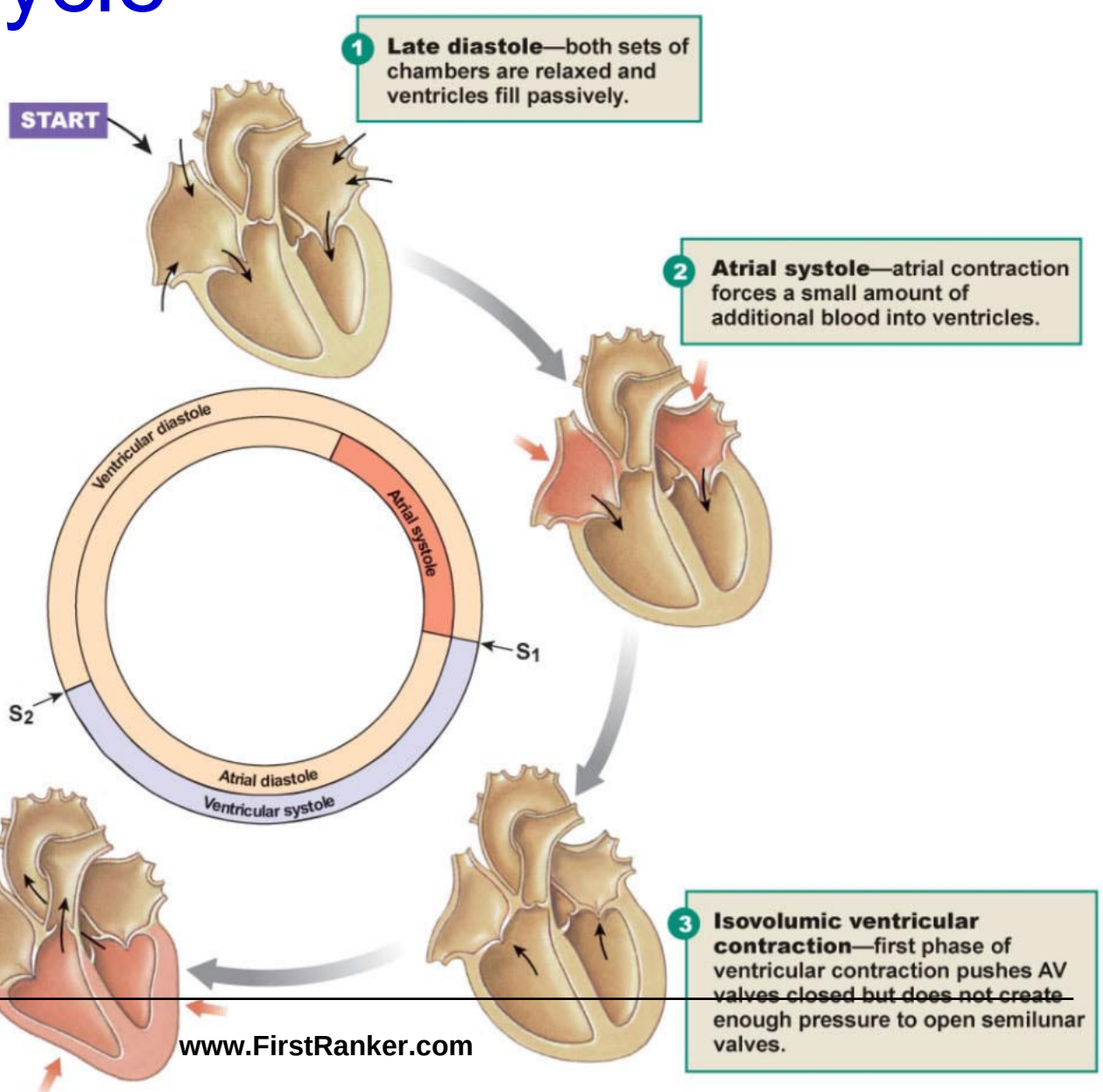
Cardiac Cycle

Phases



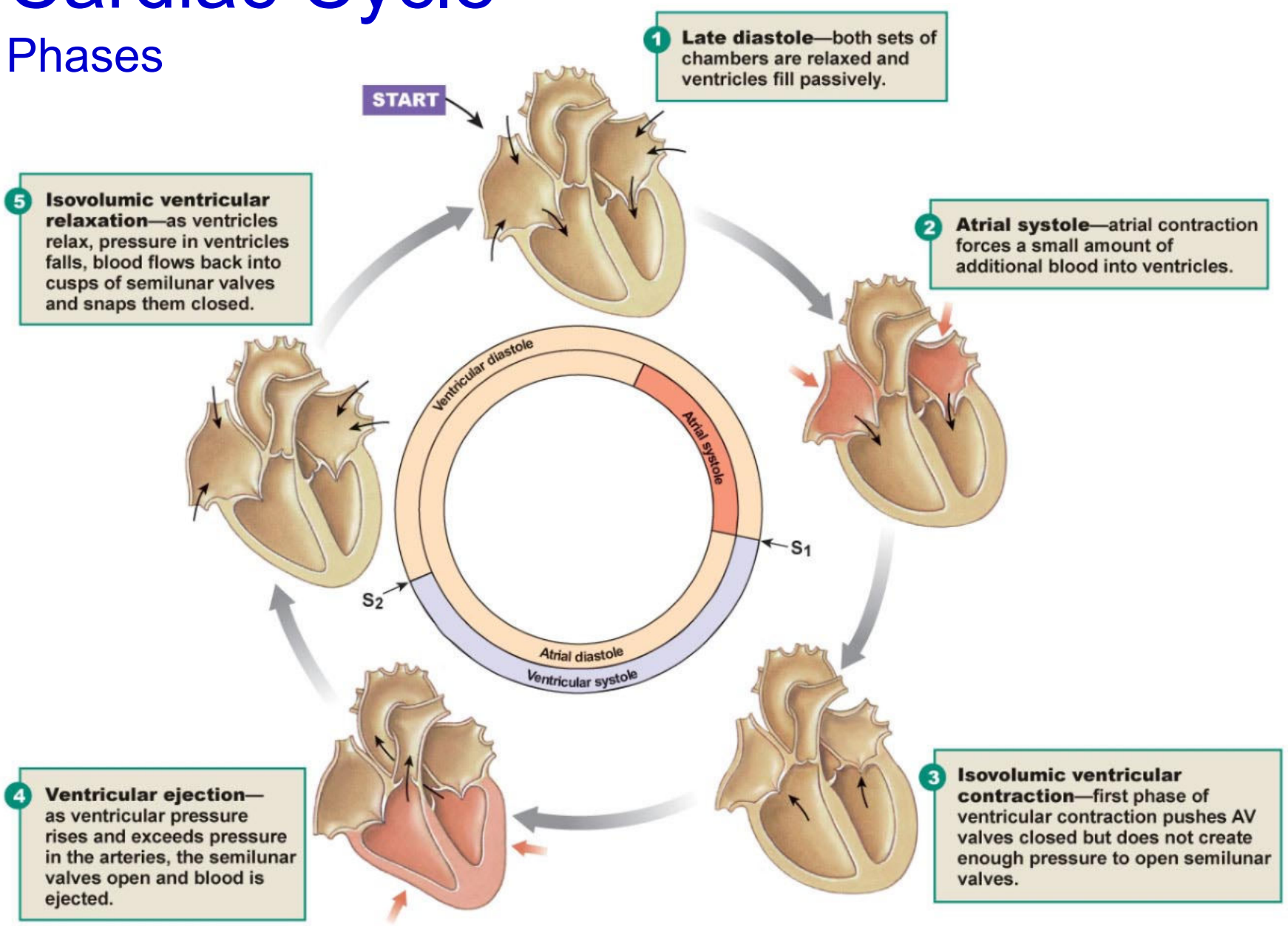
Cardiac Cycle

Phases



Cardiac Cycle

Phases



Phases of Cardiac Cycle

Ventricular Systole

- Isovolumetric contraction
- Rapid ejection
- Slow ejection

Ventricular Diastole

- Isovolumetric relaxation
- Rapid filling
- Slow filling (Diastasis)
- Filling d/t Atrial Systole

Ventricular Systole

- Isovolumetric contraction phase
  - Rising ventricular pressure results in closing of AV valves (1st heart sound – “lubb”)
  - Ventricles are contracting but no blood is leaving
  - Ventricular pressure not great enough to open semilunar valves
  - Ventricular ejection phase opens semilunar valves
- Ventricular ejection phase
  - Semilunar valves opens
  - Rapid Ejection (70% blood)
  - Slow ejection (30% blood)

Ventricular Diastole

- Isovolumetric relaxation
  - volume does not change as ventricles relax, pressure drops and AV valves open
- Ventricular filling
  - Rapid ventricular filling:as blood flows from full atria
  - diastasis: as blood flows from atria in smaller volume
  - atrial systole pushes final 20-25 ml blood

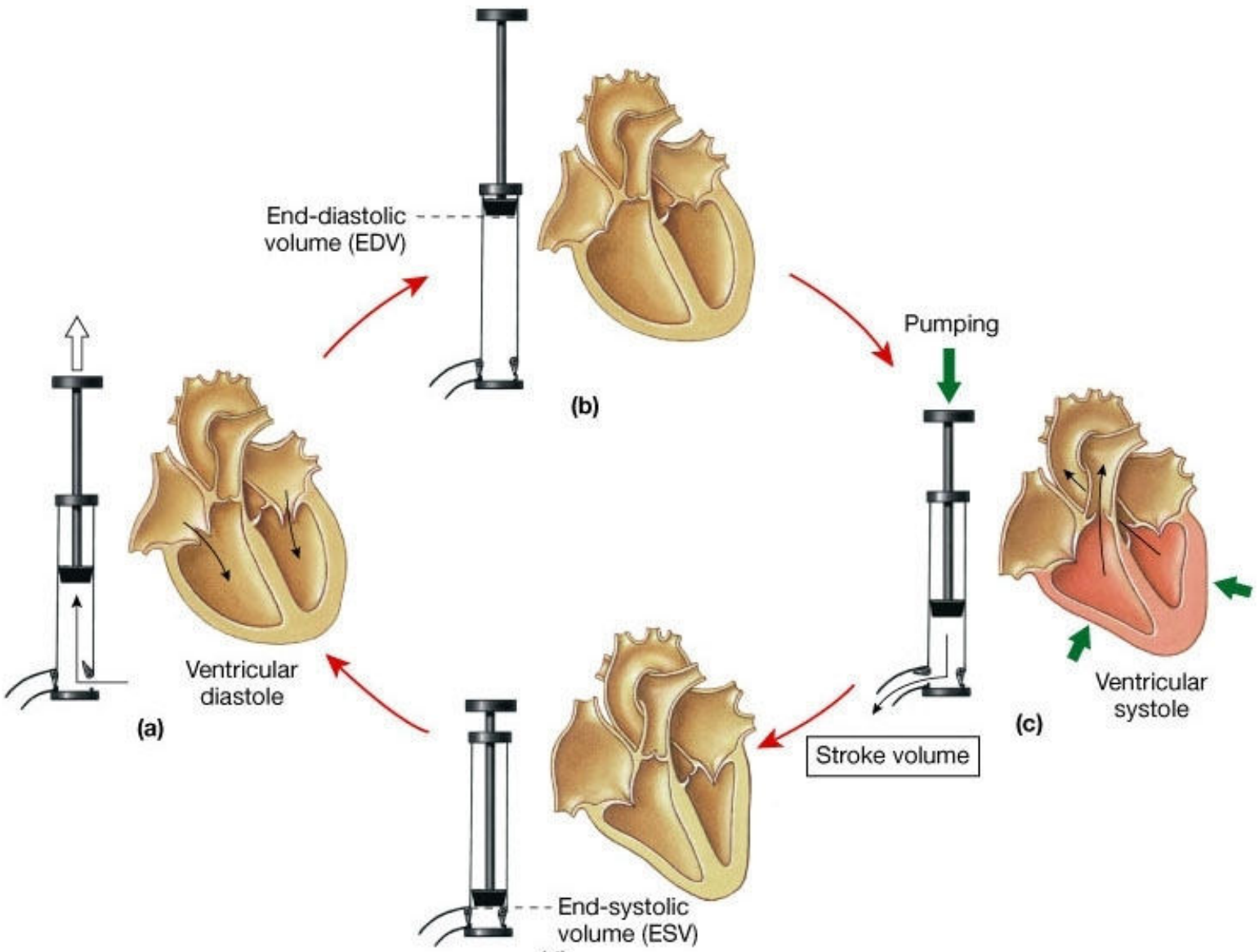
Phases of Cardiac Cycle

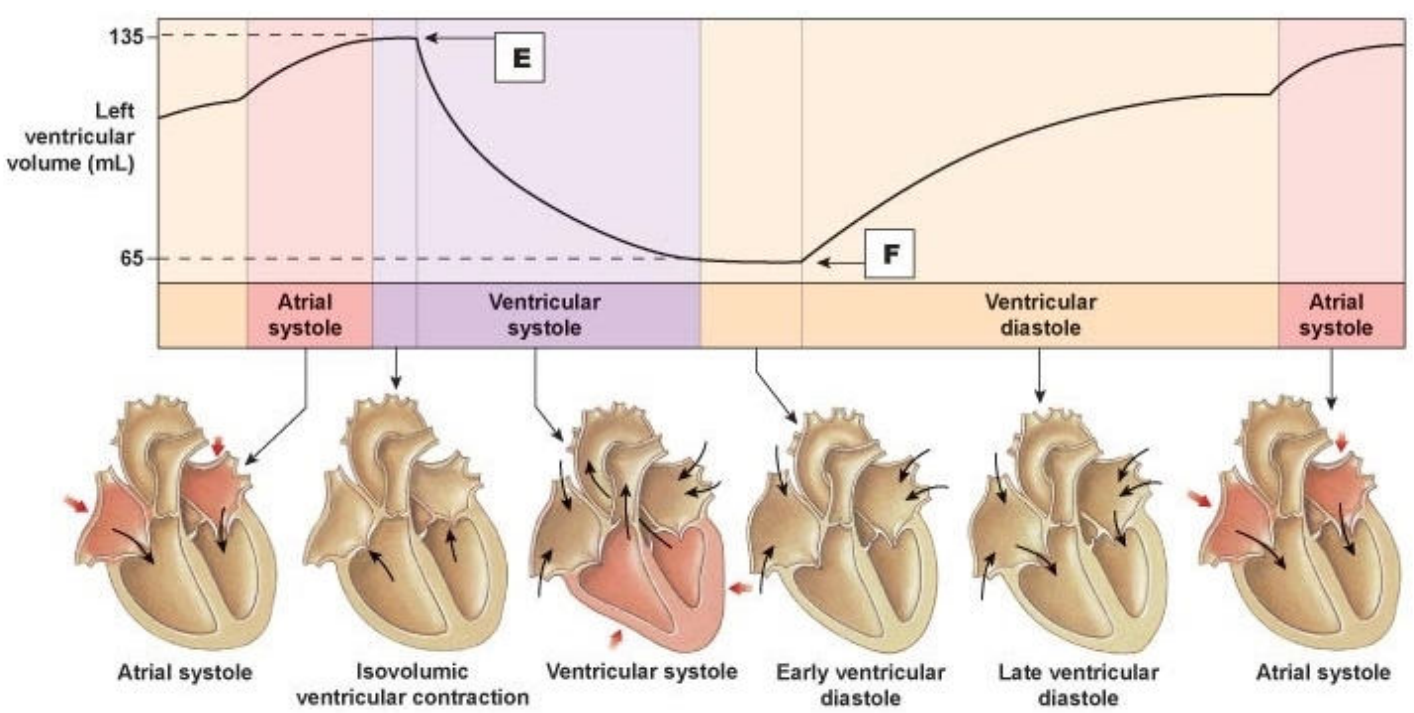
Ventricular Systole	**Duration (approximate)**
➢ Isovolumetric contraction	0.05 sec
➢ Rapid ejection	0.10 sec
➢ Slow ejection	0.15 sec
Ventricular Diastole	
➢ Isovolumetric relaxation	0.10 sec
➢ Rapid filling	0.10 sec
➢ Slow filling (Diastasis)	0.20 sec
➢ Filling d/t Atrial Systole	0.10 sec

Normal Volume of Blood in Ventricles

- Atrial systole pushes final 20-25 ml blood (20%)
- After atrial contraction, 110-120 ml in each ventricle (end-diastolic volume)
- Contraction ejects ~70 ml (stroke volume output)
- Thus, 40-50 ml remain in each ventricle (End - systolic volume)
- The fraction ejected is then ~60% (ejection fraction)

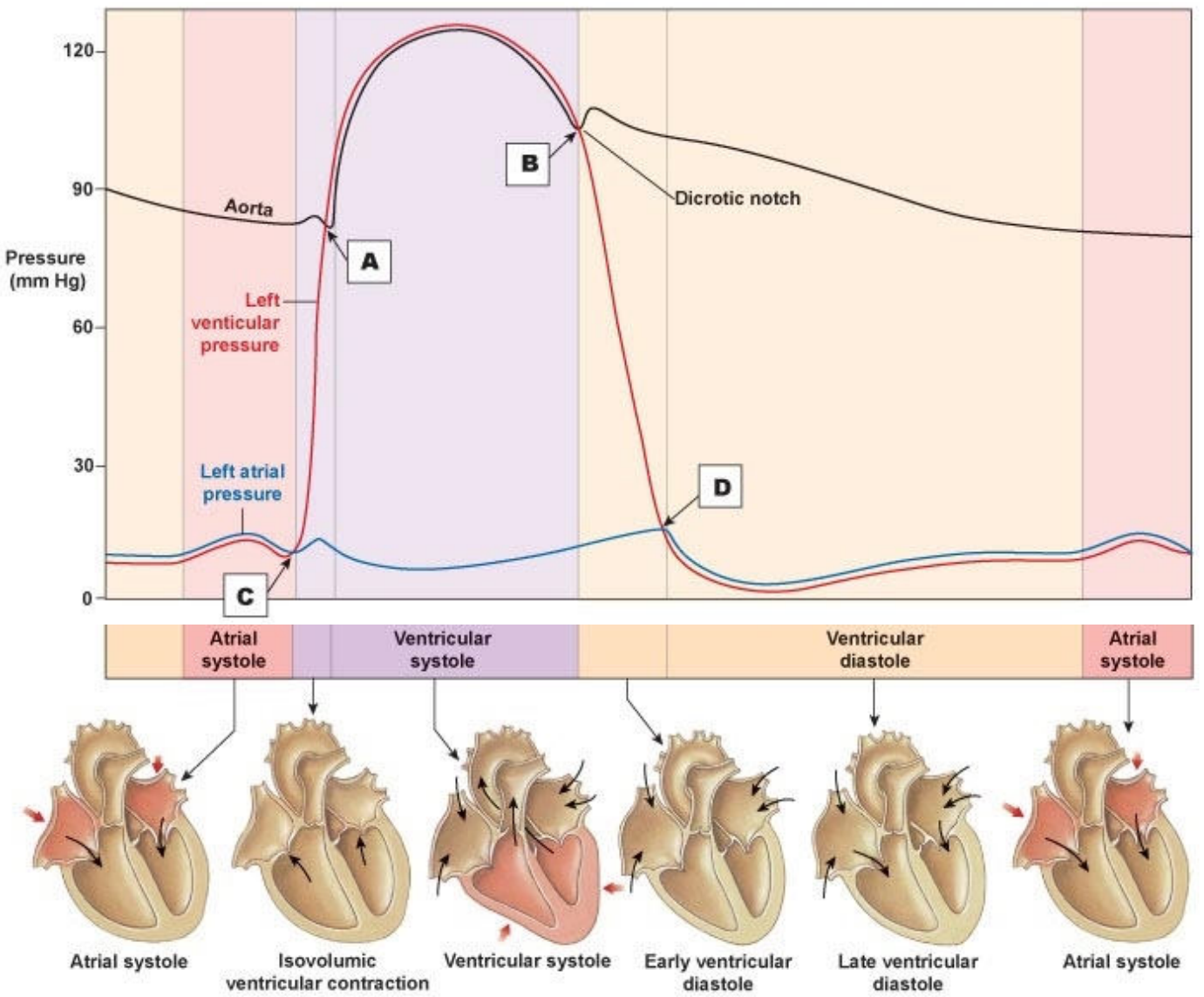
A Simple Model of Stroke Volume



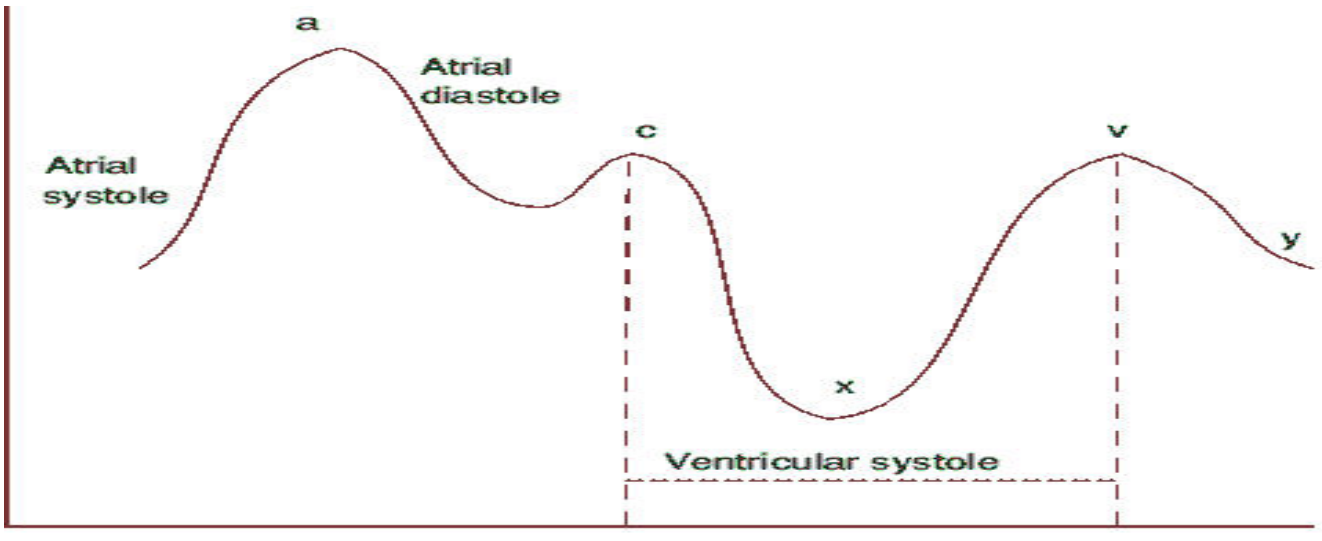


Ventricular Pressures

- Blood pressure in aorta is 120 – 80 mm Hg
- Blood pressure in pulmonary trunk is 25 – 8 mm Hg
- Ventricular pressure usually not increases during diastole
- Right Atrial pressure changes reflected in Jugular vein

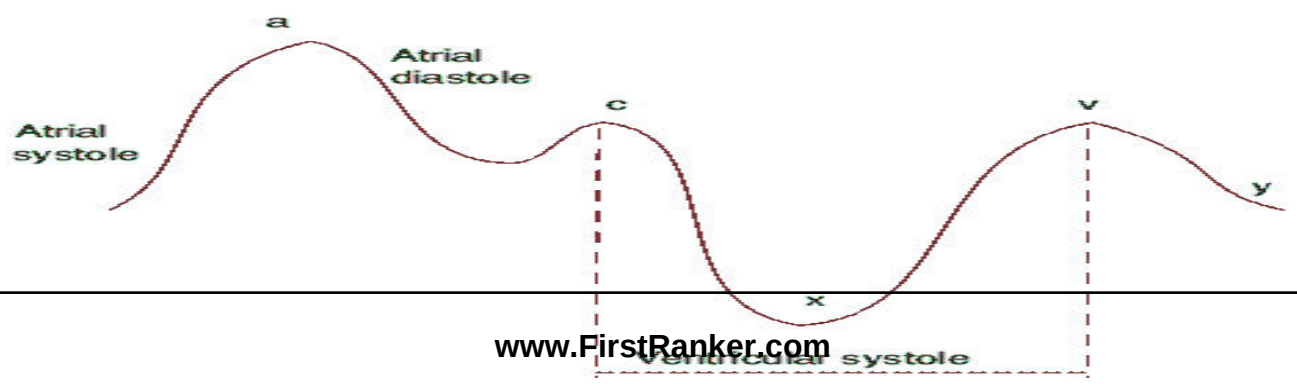


Jugular venous pulse waves



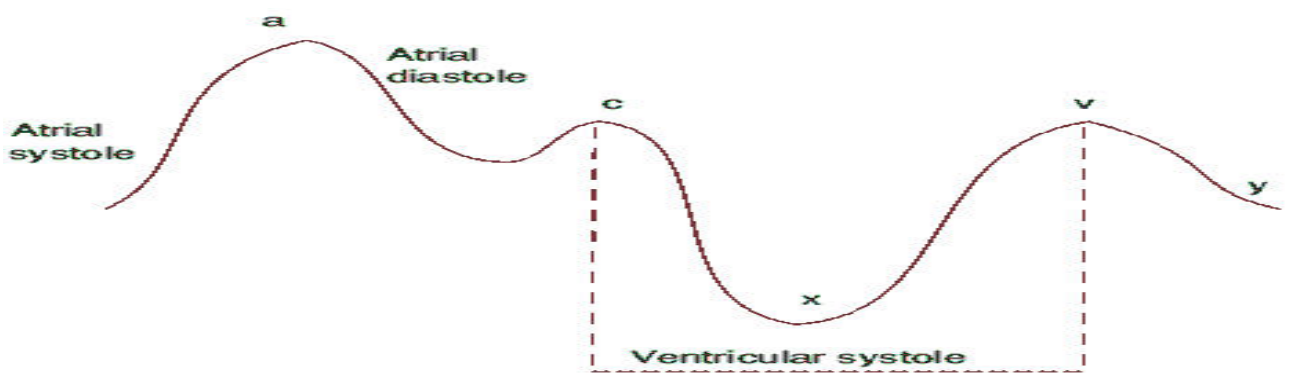
Jugular venous pulse waves

- a-wave is due to atrial systole which causes increase in the intra-atrial pressure
- C-wave occurs during the isometric contraction of the ventricles due to bulging of the tricuspid valve
- V-wave is due to accumulation of blood during late part of the ventricular systole or protodiastolic phase and isometric relaxation of the ventricles



Jugular venous pulse waves

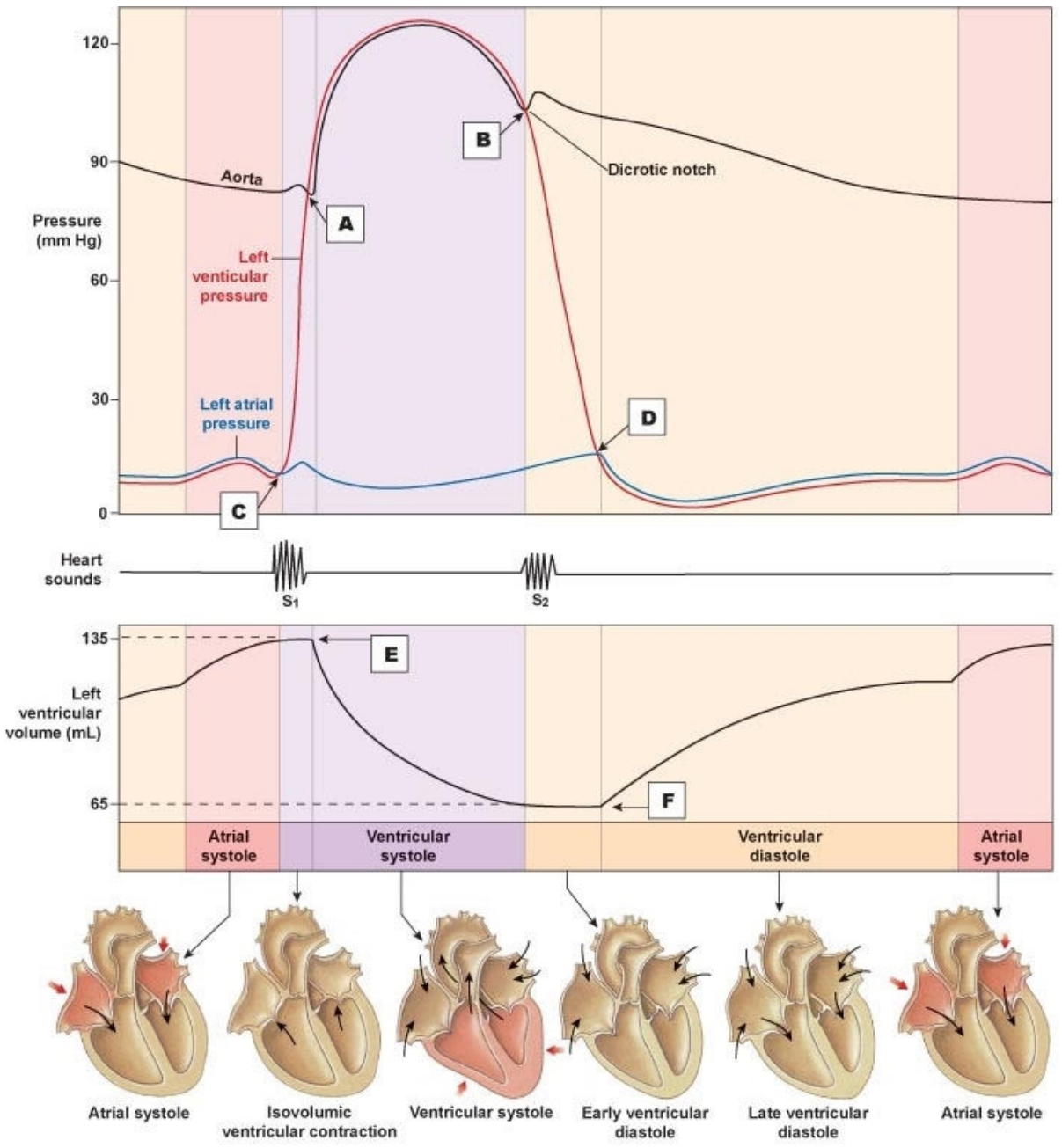
- X-wave is due to downward displacement of the A-V valve (tricuspid valve) and the AV ring during maximum ejection phase of ventricular contraction
- Y-wave is due to opening of the AV valve (tricuspid valve) during maximal ventricular filling phase



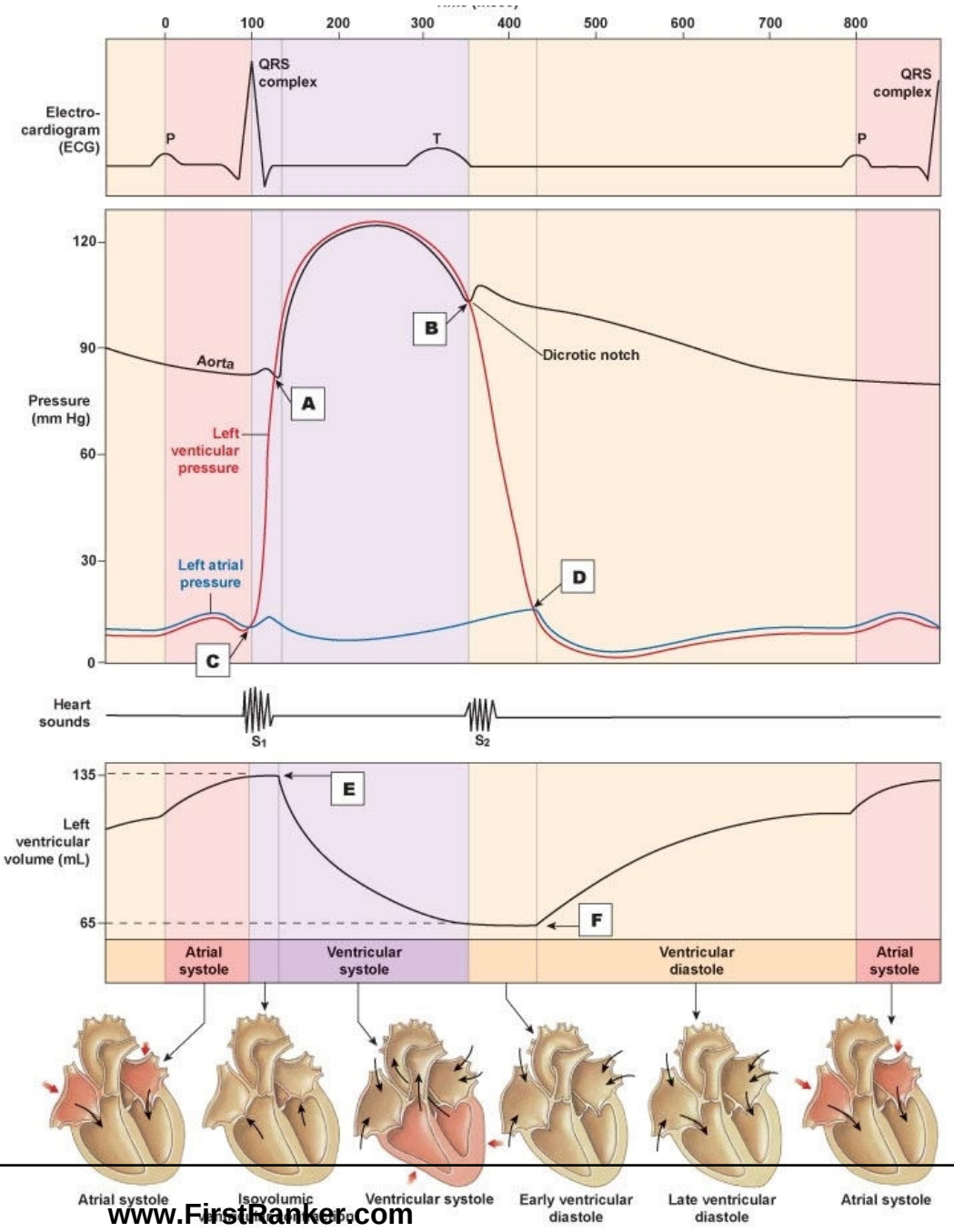
Jugular venous pulse waves

- "a-c" interval measures the time of conduction of the cardiac impulse from the right atrium to the ventricles
- The a-c interval corresponds to the P-R interval of the ECG
- The "a-c" interval is prolonged in cases of delayed conductivity in the AV bundle which is an early sign of heart block
- In partial heart block, the number of "a" waves is greater than the number of the "c" or "v" waves.
- In atrial fibrillation, the "a" wave is absent.

Putting it all together!



Putting it all together!



Thank You