Anesthesia Techniques Applied Physiology Lecture 3/grade 2 Phases of Cardiac Cycle

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Cardiac Cycle

- The cardiac cycle, a vital process in the heart, encompasses events from the start of one heartbeat to the commencement of the next. Each heartbeat is a symphony of two significant periods, systole and diastole.
- Systole: a period of ventricular contraction (ventricle contracts and ejects blood into the aorta and pulmonary artery).
- Diastole: a period of ventricular relaxation (ventricles fill with blood).

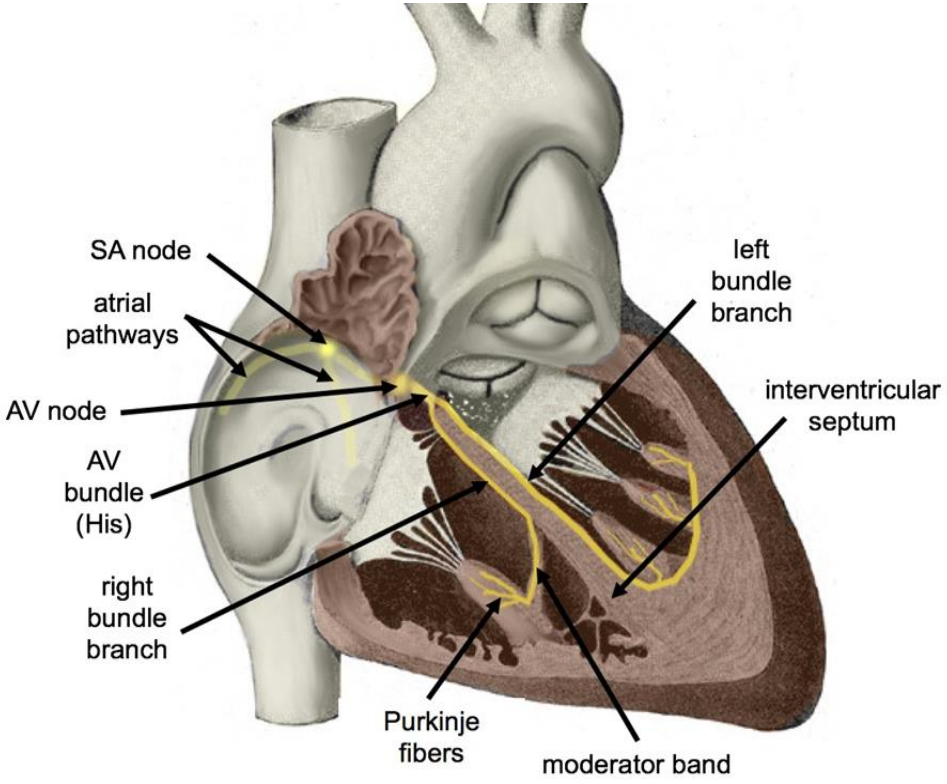
The Conducting System

Heartbeat:

- a single contraction of the heart.
- The entire heart contracts in series, first the atria, then the ventricle.

Structure of the conducting system:

- Conducting cells throughout the myocardium.
- Sinoatrial (SA) node wall of the right atrium.
- Intermodal pathway.
- Atrioventricular(AV) node-junction between atria and ventricles.
- His bundle.
- Bundle branches.
- Purkinje fibers.



The Sinoatrial Node

01

It is in the posterior wall of the right atrium.

02

It contains a pacemaker.

03

The SA node generates 80-100 action potentials per minute.

04

It's connected to the AV node by an intermodal pathway.

05

It begins atrial activation (step 1)

Intermodal Pathway

It interconnects SA and AV node.

It distributes stimulus through the myocardium in the atrium.

Atrioventricular Node

It is on the floor of the right atrium.

AV node generates 40-60 action potentials per minute.

It receives an impulse from the SA node (step 2).

It delays impulse (step 3).

It is where the atrial contraction begins.

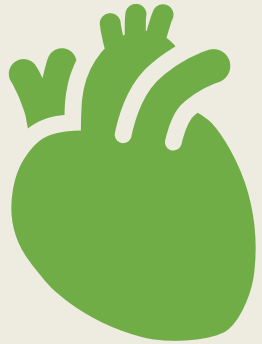
His Bundle

It is in the septum.

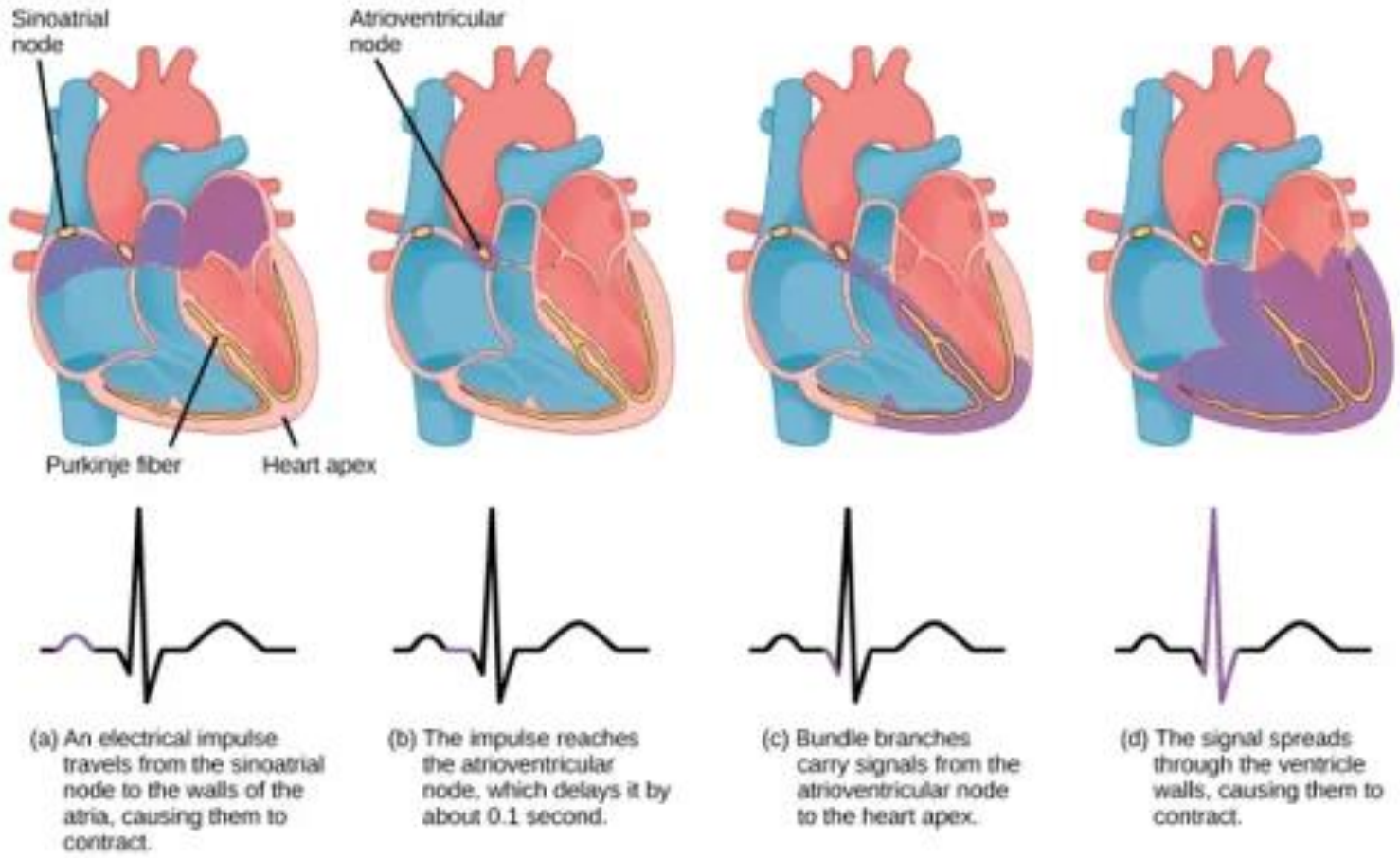
It carries impulse to left and right bundle branches which conduct to purkinje fibers (step 4) and then to the moderator band which conducts to papillary muscles

Purkinje Fibers

It distributes impulses through the ventricles (step 5).



Here where, atrial contraction is completed, and ventricular contraction begins.

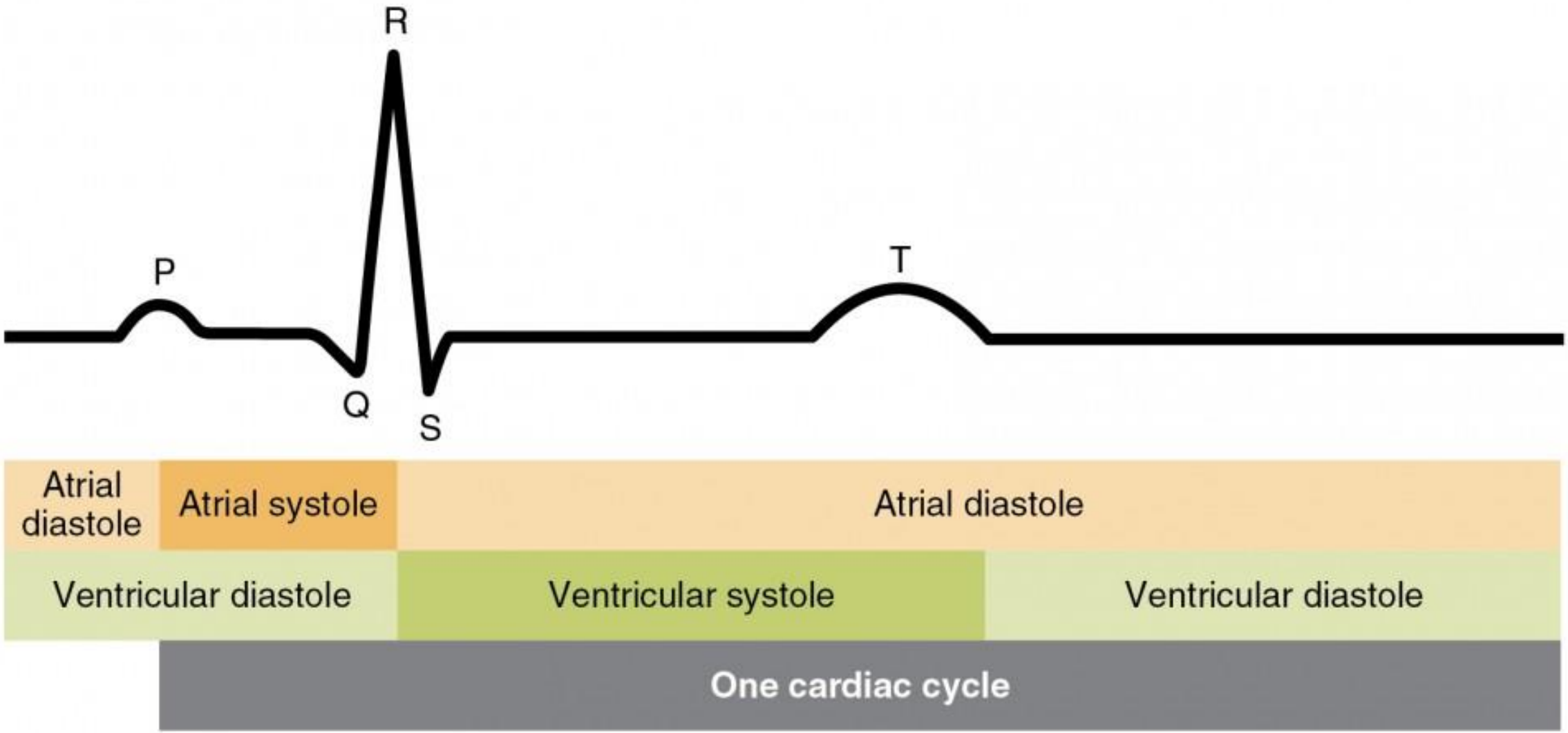


Cardiac Cycle

Phases of Cardiac Cycle

Divided into seven phases

1. Atrial systole.
2. isovolumetric ventricular contraction.
3. rapid ventricular ejection.
4. reduced ventricular ejection.
5. isovolumetric ventricular relaxation.
6. rapid ventricular filling.
7. reduced ventricular filling.


R
P
T
Q
S
Atrial diastole
Atrial systole
Atrial diastole
Ventricular diastole
Ventricular systole
Ventricular diastole
One cardiac cycle

01

Atrial systole: As the atria contract, the atrial pressure increases. This will cause the opening of the mitral valve and blood flow into the ventricles. In ECG, it is preceded by p wave.

02

Isovolumetric ventricular contraction: when the left ventricles begin to contract the mitral valve close, and this will lead to increase left ventricular pressure. IN ECG its QRS complex

03

Rapid ventricular ejection: while the ventricles still contracted, and the pressure increase inside it more than aortic pressure. The aortic valve open and most of stroke volume of blood ejected

04

Reduced ventricular ejection: During this phase ventricular pressure decrease and the volume still eject due to kinetic energy. In ECG its T wave

05

Isovolumetric ventricular relaxation: when the left atrial pressure increase the aortic valve will close and the left ventricular pressure will decrease because of the ventricular relaxation

06

Rapid ventricular filling: As the mitral valve opens, the left ventricular pressure decreases due to its relaxation while the volume increases. There is no ECG deflection.

07

Reduced ventricular filling: its the longest phase in the cardiac cycle in which the final portion of ventricular filling has occurred.

Cardiac Output (CO)

- It is the volume of the blood ejected from the heart per unit time
- the usual resting value for adults 5 to 6 L/minute
- the cardiac output is the product of heart rate (HR) and stroke volume (SV), CO=HR *SV
- SV (Stroke Volume) is the volume of blood ejected from LV per heartbeat
- LVEDV (Left Ventricle End diastolic Volume): the volume of blood in the LV before contraction
- LVESV ((Left Ventricle End systolic Volume): the volume of blood remaining in LV after contraction .
- SV=LEDV-LEDSV, SV=70 ml
- EDV=135 ml , ESV=65 ml
- SV=135-65 =70 ml , HR=72 b/min
- CO=70*72 =5 L/min, and in exercise may increase to 35 L / min

Anesthetic drugs that decrease cardiac output

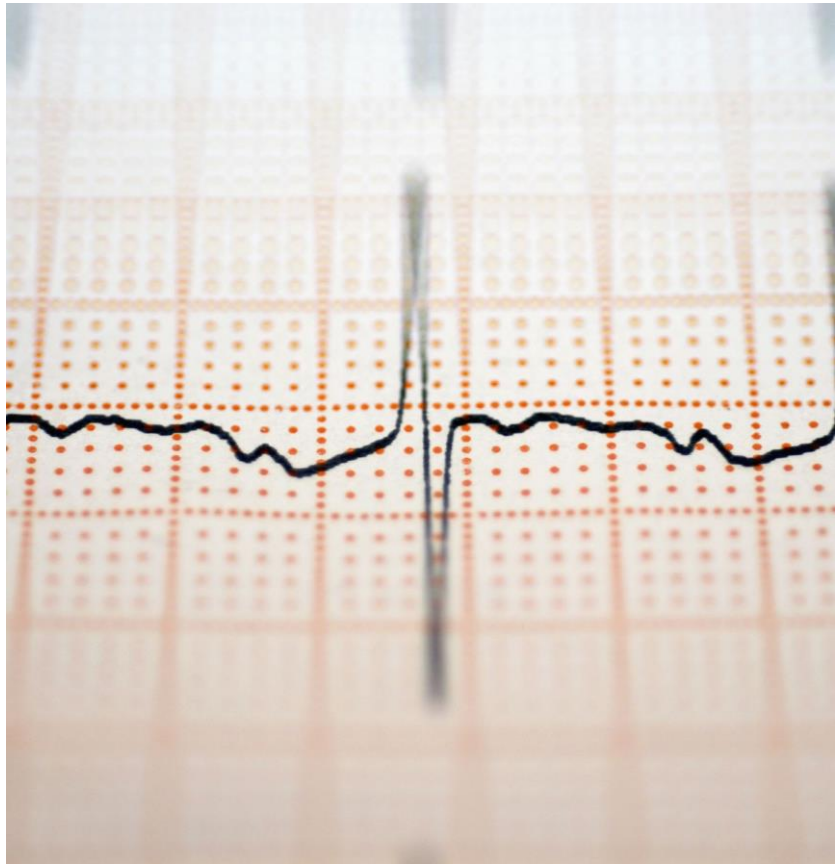
- Propofol
- Thiopental
- Etomidate
- Halothane
- Isoflurane
- Desflurane
- Sevoflurane

Ejection Fraction (EF)

- It’s the ratio of stroke volume to end-diastolic volume and is commonly used to measure cardiac performance.
- It’s expressed as a percentage %
- Normally it is more than 50%
- EF provides a non-specific index of ventricular function
- EF=SV/EDV

Heart Sounds

- 1st & 2nd heart sounds (usually heard): 1st heard sound produced by vibration generated by the closure of the mitral and tricuspid valves; it corresponds to the end of diastole and beginning of ventricular systole. 2nd heart sound is produced by the closure of the aortic and pulmonary valves.
- 3rd &4th heart sounds (sometimes detected)
- Important for diagnosis of valvular heart diseases (murmurs).



Thank you