Cardiovascular system (PART 3)

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Lec. 7

Interpretation of Normal and Abnormal Cardiac Rhythms from the ECG

- One important use of the **ECG i**s to *enable a physician to evaluate abnormally slow, rapid, or irregular cardiac rhythms.*
- **In a normal ECG**, a consistent, one-to-one correspondence exists between P waves and the QRS complex; that is, each P wave is followed by a QRS complex.
- This correspondence indicates that ventricular depolarization is being triggered by atrial depolarization.
- Under these **normal conditions**, the heart is said to be in **sinus rhythm**, *because the SA node is controlling the cardiac rhythm.*
- Normal sinus rhythm can range from 60 to 100 beats/min.

- **Abnormal rhythms (arrhythmias)** *can be caused by abnormal formation of action potentials.*
- A sinus rate <60 beats/min is termed **sinus bradycardia.**
- A sinus rate of 100 to 180 beats/min, called **sinus tachycardia.**
- ***It*** *is an abnormal condition for a person at rest.*

❑NOTE:

- *Some people, especially highly conditioned **athletes**, may have normal resting heart rates that are significantly <60 beats/min.*

- however, **sinus tachycardia** is a normal response when a person **exercises** or becomes **excited**.

❑**In a normal ECG**,

➢a QRS complex **follows each** P wave.

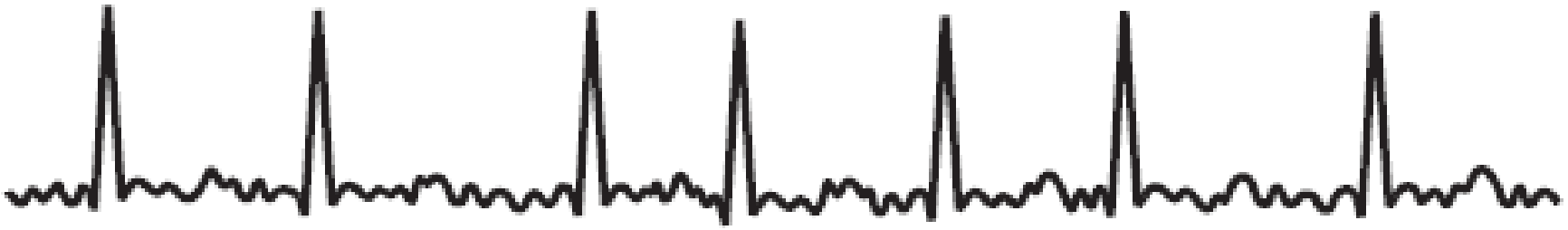
❑atrial flutter

- (250 to 350 beats/min) that **not all** of the *impulses are conducted* **through** the AV node.
- therefore, the **ventricular rate** may be **less than half** of the **atrial rate**.

Atrial Flutter

❑In atrial fibrillation

- the **SA node** **does not trigger** the atrial depolarizations.
- Instead, *depolarization currents arise from many sites throughout the atria*, **leading to** *uncoordinated*, *low voltage*, *high-frequency depolarizations* ***with no discernable*** *P waves*.
- In this condition, **the ventricles rate** is irregular and usually rapid.



Atrial Fibrillation

- Atrial fibrillation and flutter **illustrate** an important function of the **AV node.**
- **It limits** the *frequency of impulses* that it **conducts**, there by *limiting ventricular rate*.
- This feature is very important **because** *when ventricular rates become very high (e.g.,>200 beats/min), cardiac output falls* **because of** *inadequate time for ventricular filling between contraction.*

❑AV block

- It is a form of arrythmia in which the atrial rate is **greater than** ventricular rate.
- This is an example of an arrythmia caused by abnormal (depressed) impulse conduction.
- With AV block, *atrial rate is normal*, **but every** *atrial depolarization* **may not** be *followed by a ventricular depolarization*.
- **There are three types of AV block**; *first-degree AV block*, *second-degree AV block*, *third-degree AV block*.

➢ **First-degree AV block**,

- a consistence one-to-one correspondence remains between the P waves and QRS complexes.

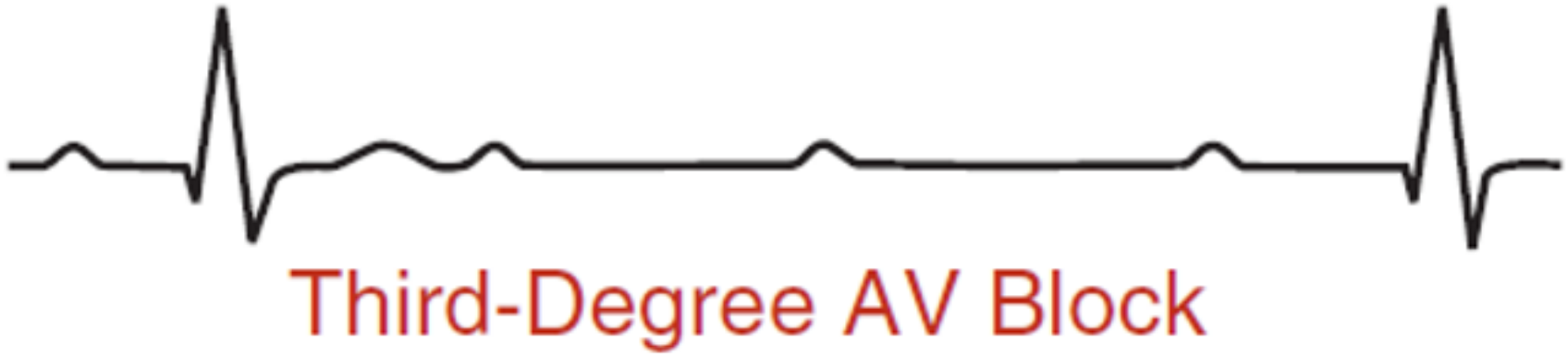
❖A second-degree AV block

- may have two or three **P waves**
- the **AV node** dose not successfully **conduct every impulse**.
- In a less severe form of **AV block**, *the conduction through the AV node is delayed*, **but the impulse** *is* ***still able pass*** *through the* ***AV node*** *and* ***excite the ventricles.***

Second-Degree AV Block (2:1)

❑third-degree AV block

- It is an extreme form of AV nodal blockade.
- no atrial depolarizations are conducted through AV node into the **ventricles.**
- and **P wave** and **QRS complexes** are *completely dissociated*.



❖NOTE:-

- ✓The ventricles **still undergo depolarization** *because of expression of secondary, latent pacemaker site* (e.g., within the AV junction or from ectopic foci within the ventricles); however, the **ventricular rate** is generally **slow** (<40 beats/min).
- ✓**Ventricular bradycardia** occurs *because the intrinsic firing rate of secondary, latent pacemakers is* ***much slower than*** *in the SA node*.

❑ventricular tachycardia or ventricular flutter (>200 beats/min).

- A condition can arise in which ventricular rate is **greater than** atrial rate.
- that is, the frequency of QRS complexes is **greater than** the frequency of P waves.

Ventricular Tachycardia

❖NOTE:-

✓With ventricular tachycardia, there is a complete dissociation between atrial and ventricular rates **because** ventricular depolarization **are not triggered** by atrial sites.

✓**Both** *ventricular tachycardia* and *flutter* are serious clinical conditions **because** the impaired ventricular filing, reduce stroke volume, and can lead to ventricular fibrillation.

❑ventricular fibrillation

- It is condition seen in the ECG as *rapid*, *low-voltage*, *uncoordinated depolarization*.
- Having **no** discernable QRS complex, which *results in cardiac output going to zero.*

❑**The ECG can reveal another type of arrhythmia**,

❑**premature depolarization**.

➢These depolarization can occur within either the atria (premature atrial complex) or the ventricles (premature ventricular complex).

Premature Ventricular Complex

- They are usually caused by ectopic pacemaker sites within these cardiac regions and appear as extra (and early) P waves or QRS complexes.

- These premature depolarizations are often *abnormally shaped*, particularly in ventricle, *because the impulses generated by the ectopic site are not conducted through normal pathways*.

Events of the Cardiac Cycle

- **The cardiac cycle is divided into:**

A. systole (ventricular contraction) blood ejection

B. diastole (ventricular relaxation). Blood filling

A. At the onset of systole

- ventricular pressure rapidly exceeds atrial pressure and
- the AV valves close.
- The aortic and pulmonary valves are **not yet open**,
- however, so no ejection occurs. This called **isovolumetric ventricular contraction.**

- When **ventricular pressures** exceed **aortic** and **pulmonary** trunk **pressures**, the aortic and pulmonary **valves** open and the ventricles eject the blood.

B. When the ventricles relax at the beginning of diastole

- the **ventricular pressures** decrease significantly **below those** in the aorta and pulmonary trunk **and** *the aortic and pulmonary valves* ***close***.

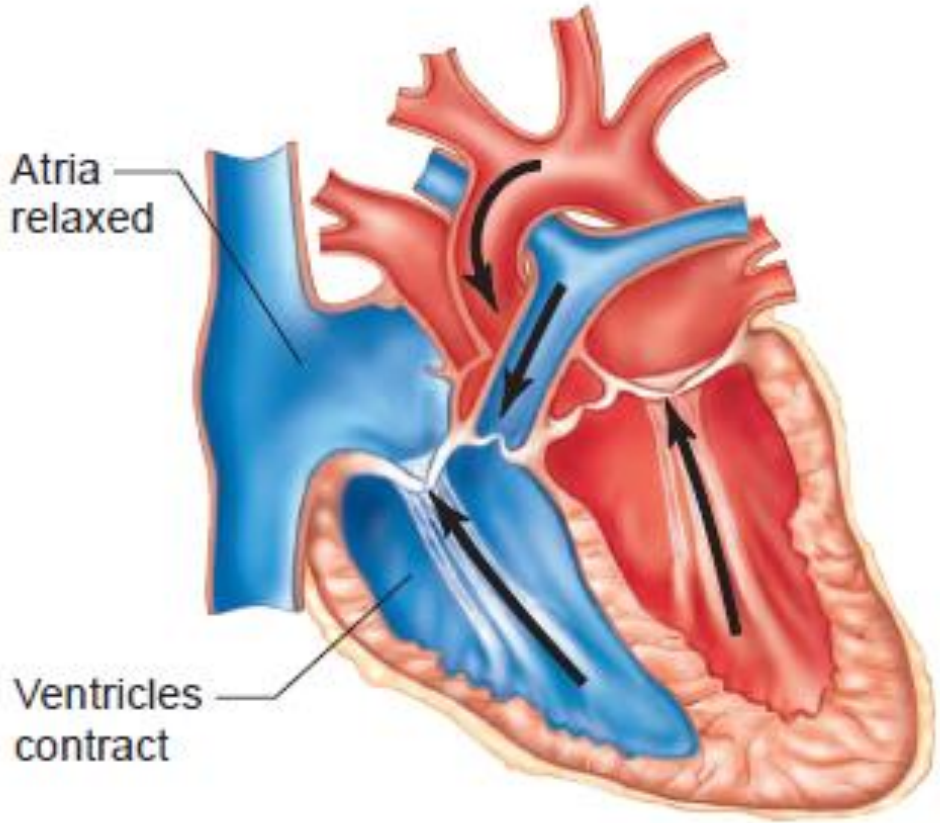
- **Because the AV valves** are also still closed, no change in ventricular volume occurs. This called **isovolumetric ventricular relaxation**.

- When *ventricular pressures decrease* **below the pressures** in the right and the left atria, the AV valves open and the ventricular filling phase of diastole begins.

- Filling occurs very rapidly at first so that atrial contraction, which occurs at the very end of diastole, *usually adds only a small amount of additional blood to the ventricles*.

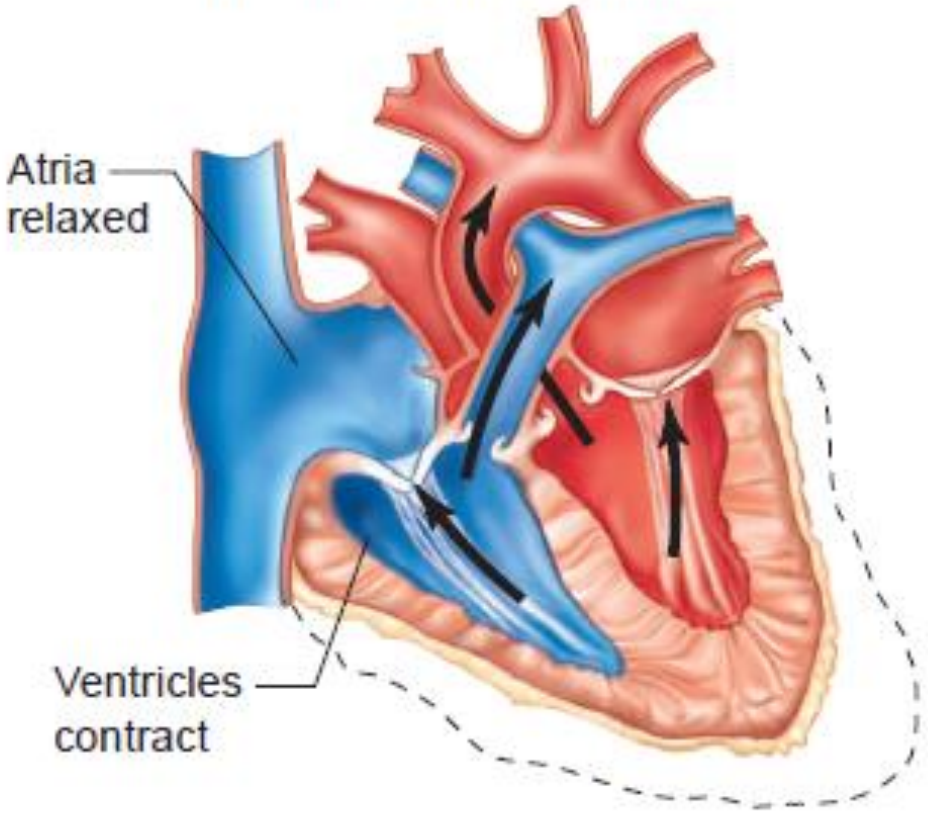
(a) Systole

Isovolumetric ventricular contraction



Ventricular ejection

Blood flows out of ventricle



AV valves:	Closed	Closed
Aortic and pulmonary valves:	Closed	Open

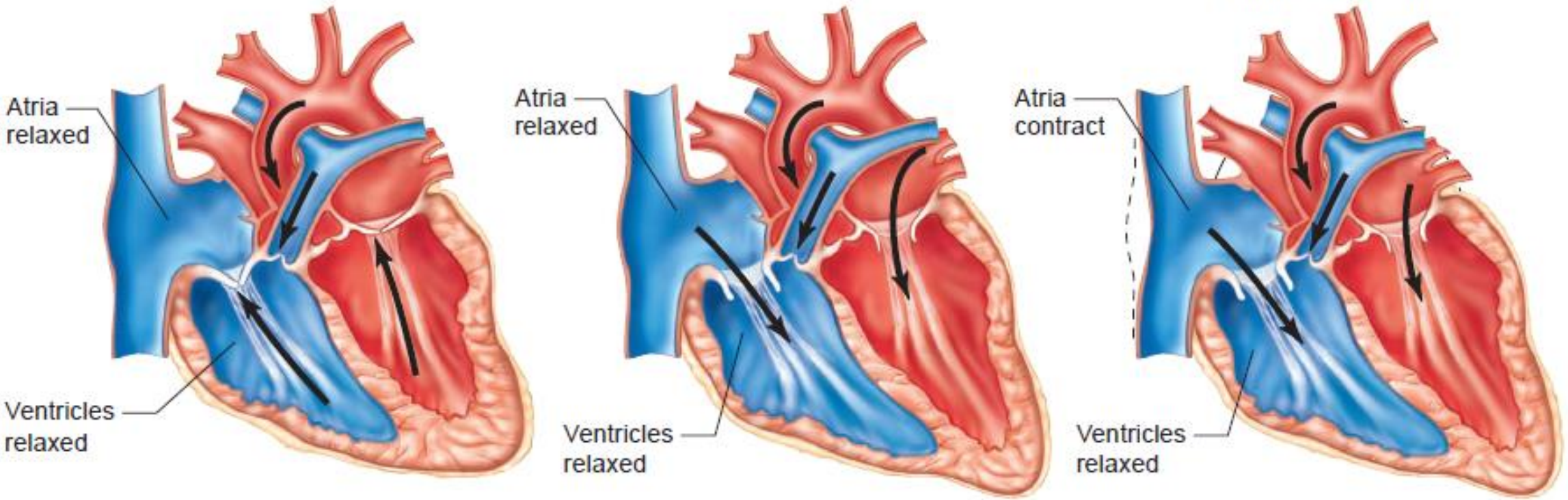
(b) Diastole

Isovolumetric ventricular relaxation

Ventricular filling

Blood flows into ventricles

Atrial contraction



AV valves:	Closed	Open	Open
Aortic and pulmonary valves:	Closed	Closed	Closed