CVS
PHYSIOLOGY

Modified NO: 8

كتابة: ابراهيم الشوابكة و زينة ابو ذياب

تدقيق: عبدالله أبورمان

الدكتور: فاطمة ريالات

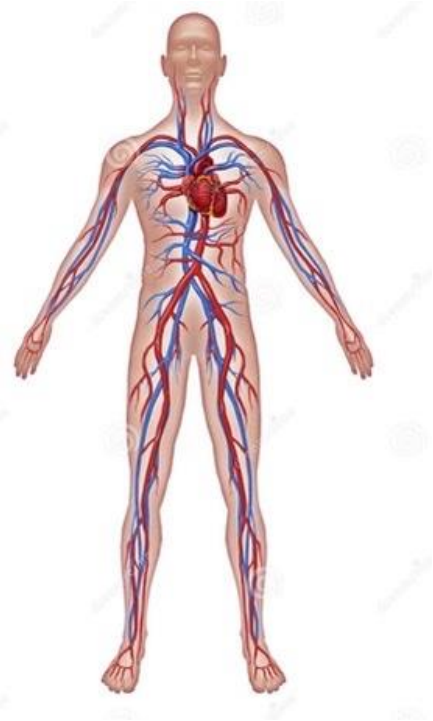
بسم الله الرحمن الرحيم

Cardiovascular Physiology

Fatima Ryalat, MD, PhD

Assistant Professor, Physiology and Biochemistry Department

School of Medicine, University of Jordan

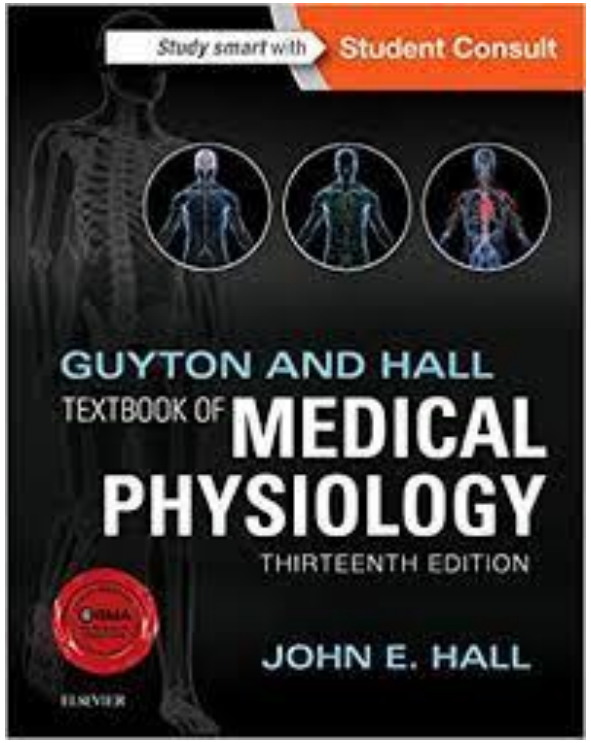


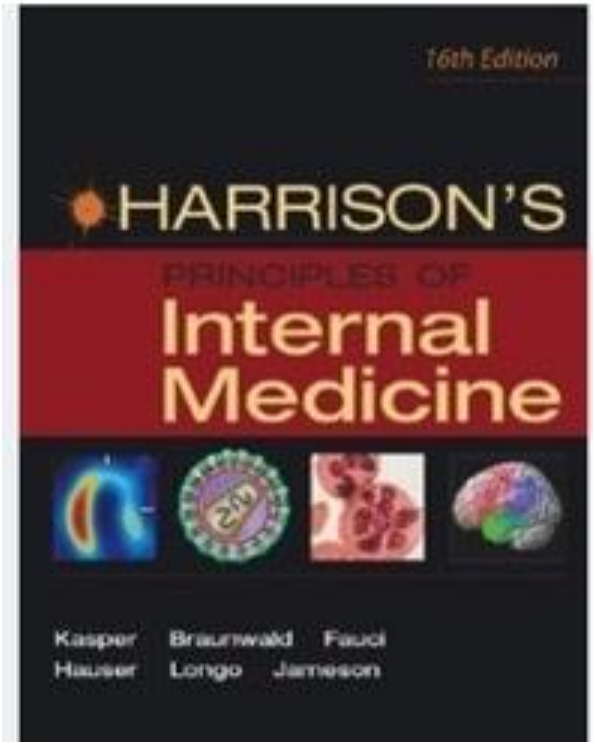
In external sources section, we added arrhythmia chapter from Guyton and hall textbook.

Color code

- Slides
- Doctor
- Additional info
- Important

References





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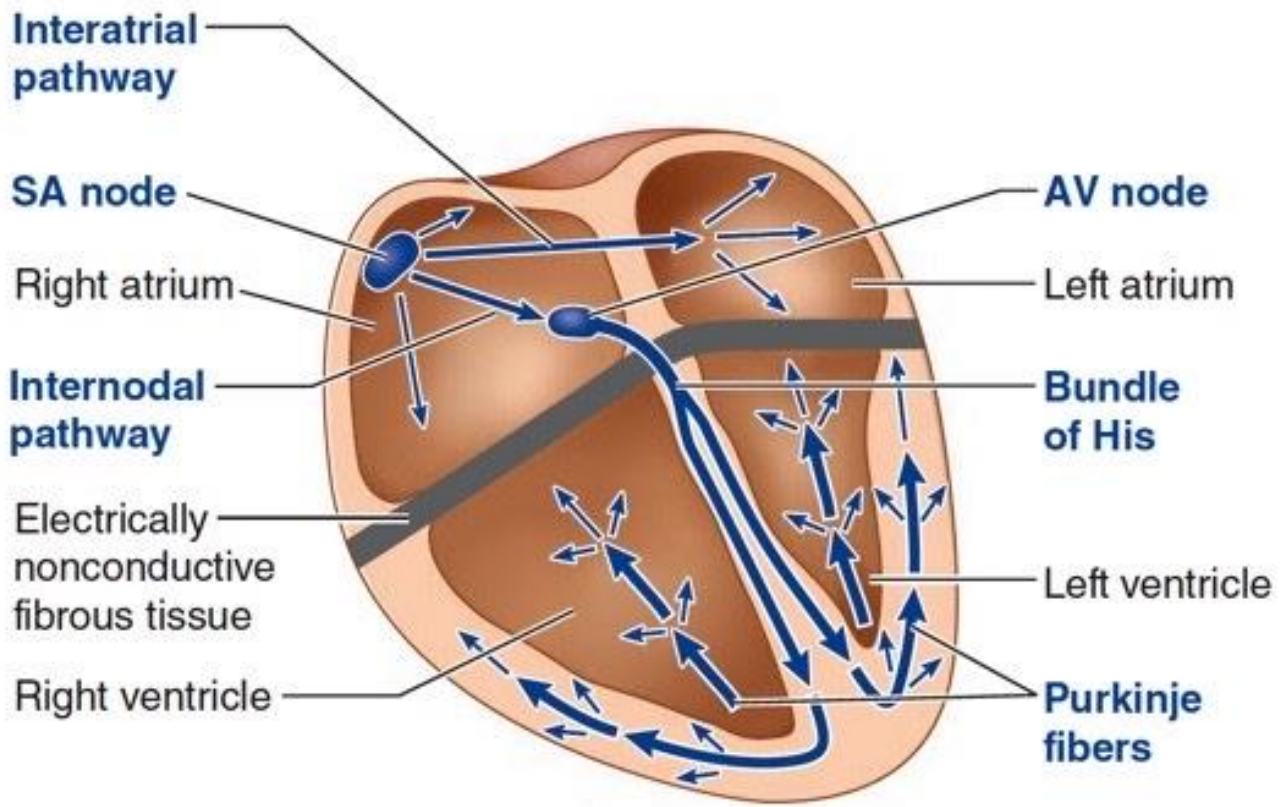
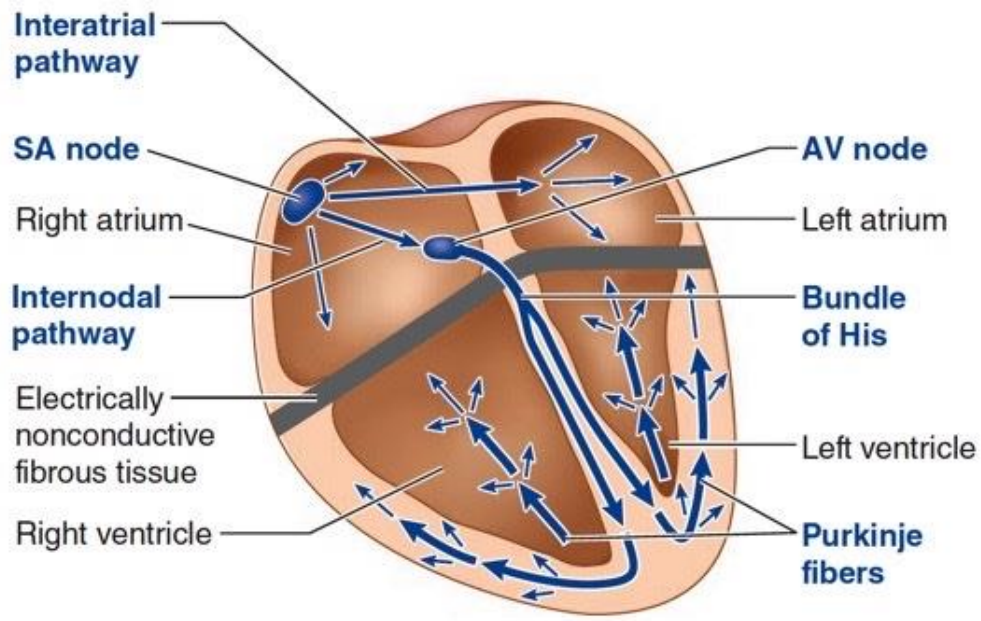
Cardiac Arrhythmias 2

- In the previous lecture we discussed cardiac arrhythmias that are related to SA nodes and atrial myocardial cells , in this lecture we will continue talking about the arrhythmia that are related to AV node and ventricular muscle cells

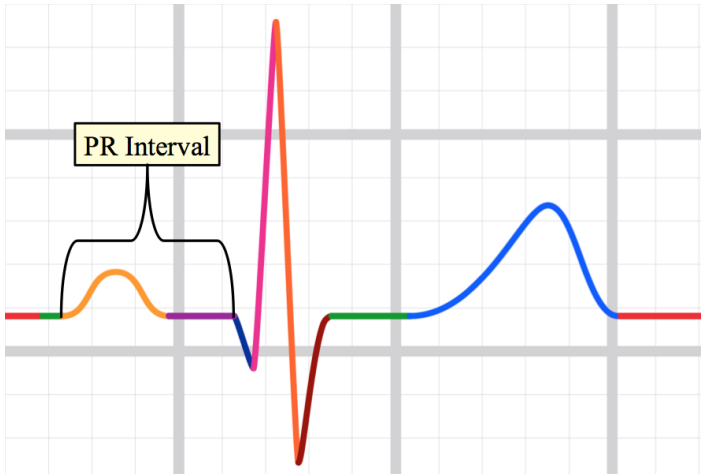
- Remember from the previous lecture that arrhythmias can result from different pathological conditions including: ischemic changes , degenerative,inflammatory,electrolytes and metabolic changes . In addition to medications, smoking and caffeine consumption.
- They can also be due to inherited or congenital factors as well as iatrogenic(induced by the physician such as during the cath) or may be due to stimulation of sympathetic and parasympathetic systems.
- So these factors will induce changes in the myocardial cells of the conductive system and in the atrium and ventricle, altering their normal function.



- So let's start talking about the AV node , Remember that the AV node is characterized by **slow conduction velocity**, which has an important function called the **AV delay** ! It insures complete atrial DEPOLARIZATION before starting the ventricular DEPOLARIZATION, and it is the only normal window for the transmission of impulses from the atrium to the ventricle.
- So in the ECG , we can see this function of the AV node as what we call PR interval , and it is normally less than 0.2 seconds .
- Now if any of the previous mentioned factors affect the AV node , it will lead to impairment in the function of delayed conduction of the electrical impulses to the ventricles , and even they may stop it ! => This is what we call the AV block or heart block.



Extra pic

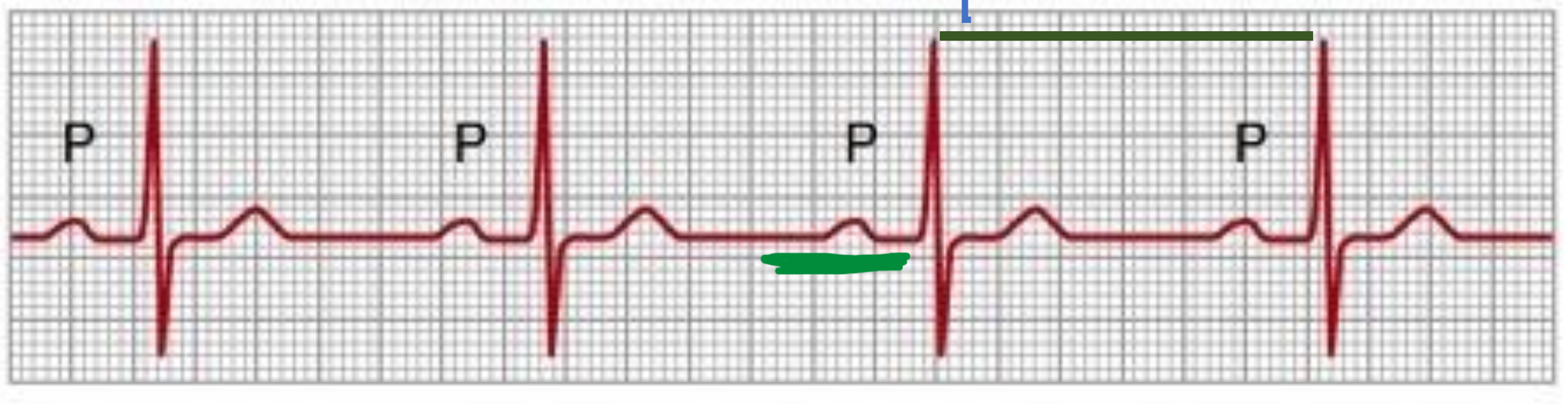


First degree AV block

- Incomplete heart block.
- Prolonged P-R interval : > 0.20 s.
- It is a delay of conduction from the atria to the ventricles but not actual blockage of conduction.

- There are three types of AV block:
- The first one is called first degree block or incomplete AV block (actually it is a further **delay rather than block** so the only finding on the ECG is prolongation of PR interval , remember the normal PR interval is less than 0.2 seconds and here you van see just a prolongation of it with no other clear pathology).

- Please note here that the heart rate is about 50 beats per minute



Second degree AV block (Intermittent AV block)

- When some atrial impulses fail to conduct to the ventricles, that is called dropped beats (P wave but no QRS-T).

- There are 2 types of second degree AV block.: Mobitz type I and Mobitz type II.

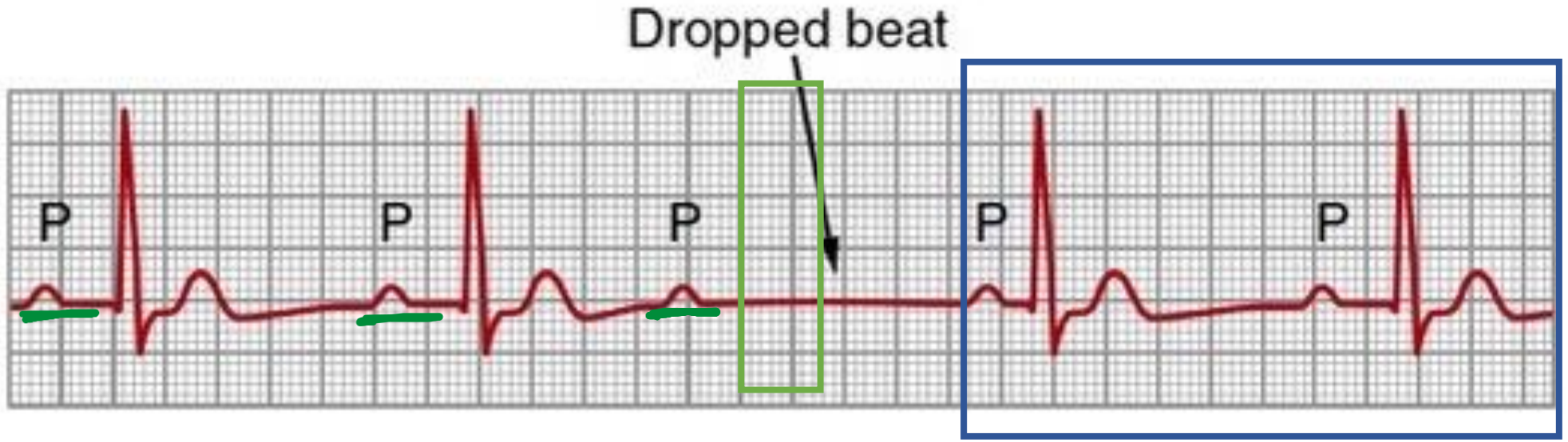
Type I Second Degree AV Block

- Mobitz type I (also known as Wenckebach periodicity).

- Progressive prolongation of the P-R interval until a ventricular beat is dropped and is then followed by resetting of the P-R interval and repeating of the abnormal cycle.

- In most cases, this type of block is benign, and no specific treatment is needed.

- The first type of second degree AV block (is also called Mobitz type I and Wenckebach periodicity) is characterized by **progressive prolongation of the PR interval before the block of the transmission of the atrial signals** (you can see below in the green rectangle there is no QRS following the P wave) .
- Otherwise this ECG (in the dark blue rectangle) looks normal with normal QRS complexes and mostly this disorder doesn't need treatment! It is localized to the AV node .

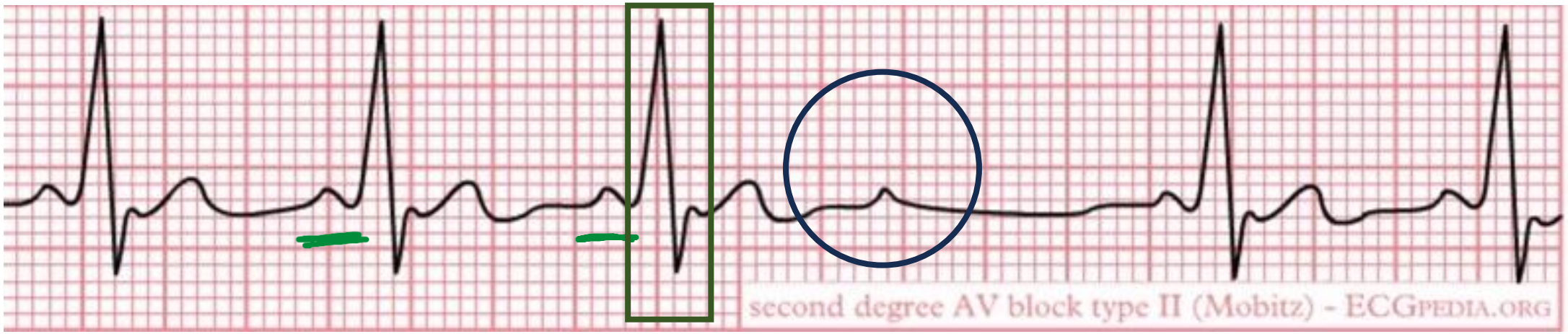


Type II Second Degree AV Block

- In contrast to type I block, with type II block the P-R interval does not change before the dropped beat; it remains fixed, then the drop happens suddenly.

- It is generally caused by an abnormality of the bundle of His–Purkinje system and may require implantation of a pacemaker to prevent progression to complete heart block and cardiac arrest.

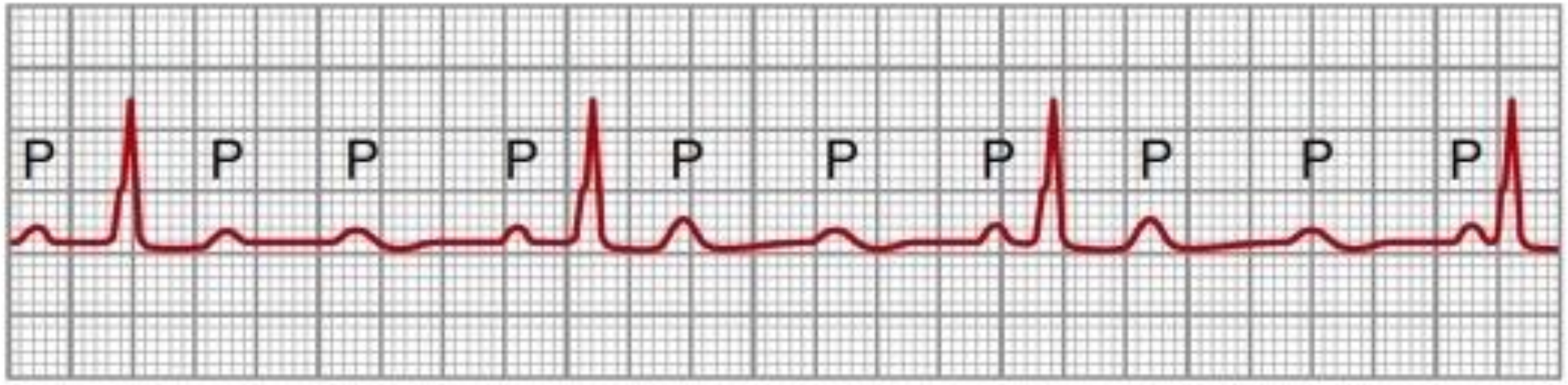
- In the second type of the second degree AV block (also called Mobitz type ll) , in this block the conduction suddenly fail (as in the circle) without a preceding change in the PR interval !
- Usually this disorder is due His – Purkinje system disorder and you can see here (in the rectangle) prolongation in the QRS complex .
- It is very important to recognize and treat this type because there is a high chance that it will progress to a complete heart block ! So once it is recognized, this patient should have pacemaker implantation .



Third Degree Block

- Complete AV block.
- P wave is dissociated from QRS complex.
- the ventricles may escape from control by the atria and start beating at their own rate, controlled most often by signals generated distal to the A-V node or A-V bundle where the block occurs.

- In the third degree AV block (also called complete AV block) , there is **no atrial impulse propagate into the ventricles** , actually the ventricles usually escape and start to beat on their own pace .



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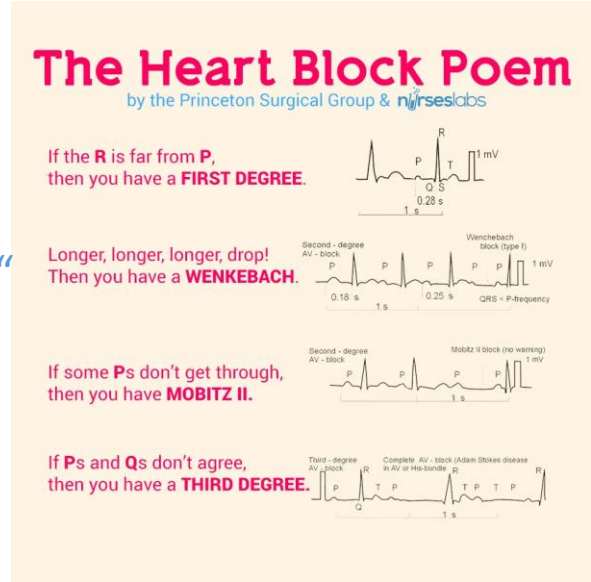


- No clear waves, very abnormal QRS complexes

Stokes Adam's Syndrome

- Each time AV conduction ceases, the ventricles often do not start their own beating until after a delay of 5 to 30 seconds.

- This delay results from the phenomenon called overdrive suppression.

- Sometimes after complete AV block , the **ventricle start to generate their own action potential** but that may take some time because of the **Overdrive suppression** which means that the ventricles that usually depends on the atrium for impulse generation since they are faster (because of the SA node) but when that impulse will stop , the ventricle will need few seconds in order to reset and start generating their action potential .
- Actually the brain may not tolerate this much , it can tolerate up to 5 seconds of blood loss , otherwise the patient will faint (feeling of **dizziness**, **weakness**, or a **loss of consciousness**, often characterized by a brief, lightheaded state. For example, someone might say they feel faint before they lose consciousness or experience a **syncope** (fainting episode)) .
- These fainting episodes are called **Stokes Adam's syndrome** , and the patients usually will have pacemakers implantation .

Stokes Adam’s Syndrome

- Overdrive suppression means that ventricular excitability is at first suppressed because the ventricles have been driven by the atria at a rate greater than their natural rate of rhythm.

- However, after a few seconds, some part of the Purkinje system beyond the block, usually in the distal part of the AV node beyond the blocked point in the node, or in the AV bundle, begins discharging rhythmically at a rate of 15 to 40 times/min, acting as the pacemaker of the ventricles.

Stokes Adam’s Syndrome

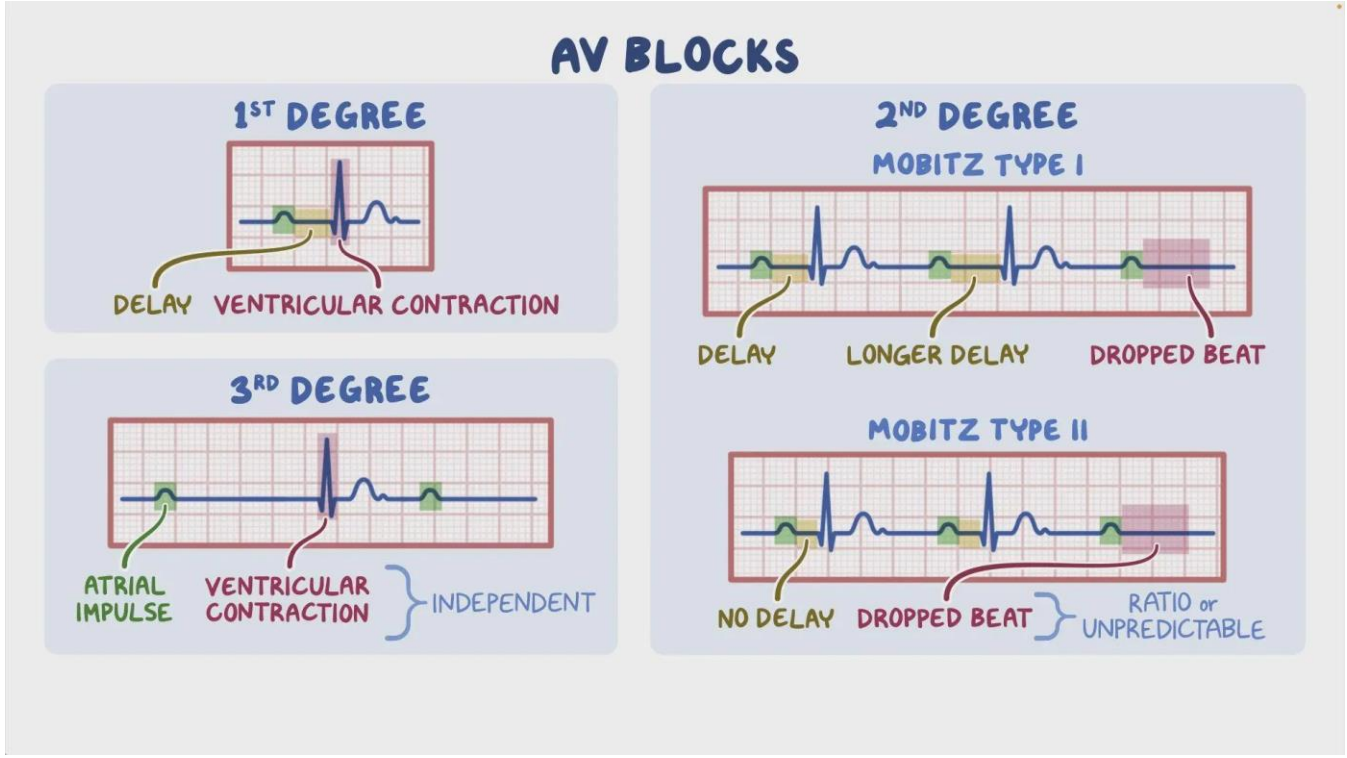
- Because the brain cannot remain active for more than 4 to 7 seconds without blood supply, most people faint a few seconds after complete block occurs because the heart does not pump any blood for 5 to 30 seconds, until the ventricles “escape.”

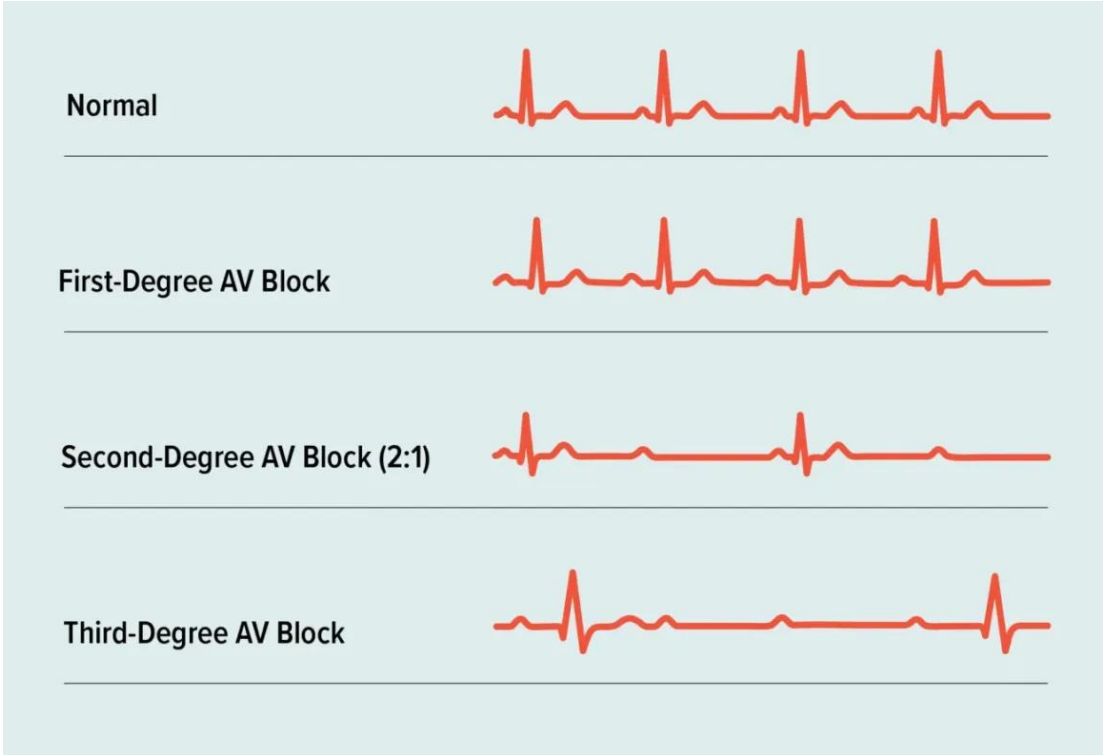
- After escape, however, the slowly beating ventricles (less than 40 beats/min) usually pump enough blood to allow rapid recovery from the faint and then to sustain the person.

- Pacemaker implantation.

- Just memorize quickly and move on !

Extra pictures





- **First-Degree**: PR interval is long but every beat gets through from atrium to ventricle .
- **Second-Degree Type I**: PR gets longer until a beat is dropped.
- **Second-Degree Type II**: Some beats drop without PR lengthening.
- **Third-Degree**: No beats pass; atria and ventricles beat independently.

Wolff-Parkinson-White Syndrome

As we mentioned previously, the AV node is the connection between the atria and the ventricles. Sometimes, there is an AV bypass tract around this AV ring in the form of atrial-like muscle, so they can conduct the impulse from the atria to the ventricles, causing what we call ventricular preexcitation and tachycardia, as seen in Wolff-Parkinson-White (WPW) syndrome. In this condition, conduction is fast, resulting in a very short PR interval. This leads to a slurred, wide QRS complex characteristic of WPW syndrome.

- Ventricular preexcitation associated with AV bypass tracts.
- Atrial-like muscle strands may occur almost anywhere around the AV rings.
- Paroxysmal tachycardia.
- Associated with congenital abnormalities.
- May develop A fib with rapid ventricular response.

Ventricular tachycardia (VT)

- Heart rate >100,
- To distinguish VT from SVT. VT shows wide QRS, may see changes in QRS morphology.

VT types:

1) Sustained ventricular contractions >30 s

The management depends on clinical context. So if this VT in a patient with structural heart disease or ischemic heart disease then the management will be different from otherwise asymptomatic or benign conditions.

2) Premature ventricular contraction (PVC)

- Very common.
- Series of PVCs alternating with normal contractions in a pattern.
- Usually benign induced by lack of sleep, smoking, caffeine, emotional stress. So if there is no structural abnormality no need to treat.

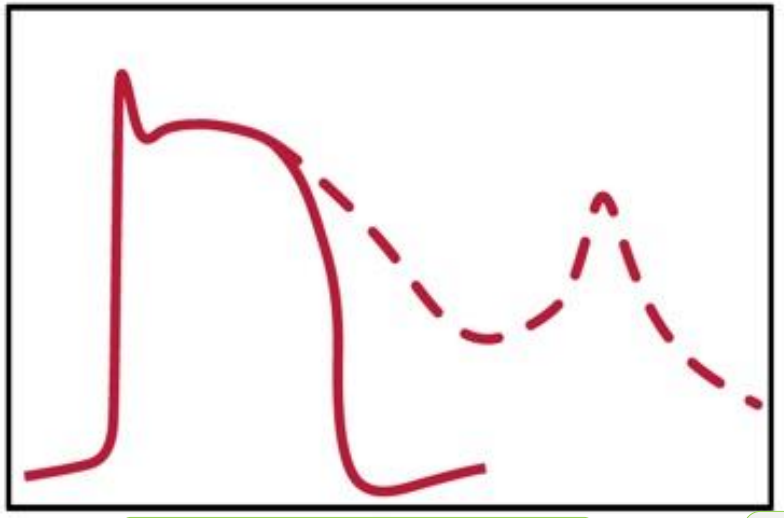
Premature ventricular contraction

- Premature ventricular contraction (PVC) another type of ventricular tachycardia, it is characterised by having premature ventricular contraction (shown in the circle) alternating with normal QRS complex, you can see that they are wide QRS complexes.

3) Torsades de pointes

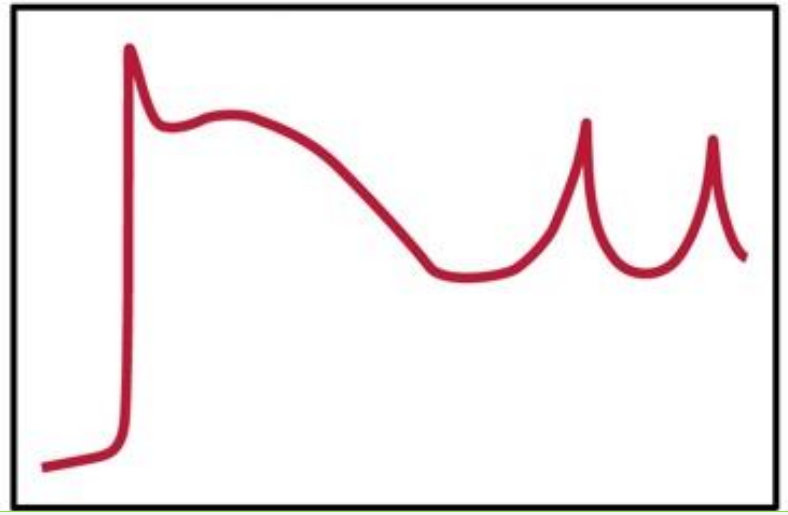
- VT with polymorphic QRS complexes that change in amplitude and cycle length, giving the appearance of oscillation (twist) around a baseline.
- associated with QT prolongation (QT syndrome), which may be congenital or induced by medications.
- ECG: polymorphic VT preceded by prolonged QT.
- May develop VF

Premature depolarization



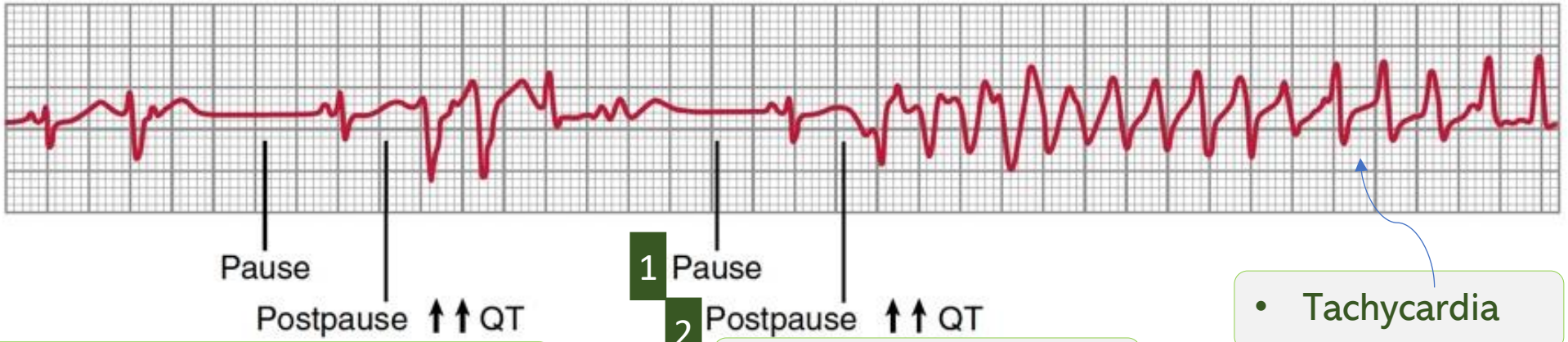
- Normal action potential

Repetitive premature depolarization



- Prolonged action potential (delayed repolarization) that will induce a premature depolarization and it can be repetitive, explained by this tachycardia (in the below ECG)

Torsades de pointes



- Tachycardia

- These patients may develop ventricular fibrillation so they should be identified and treated

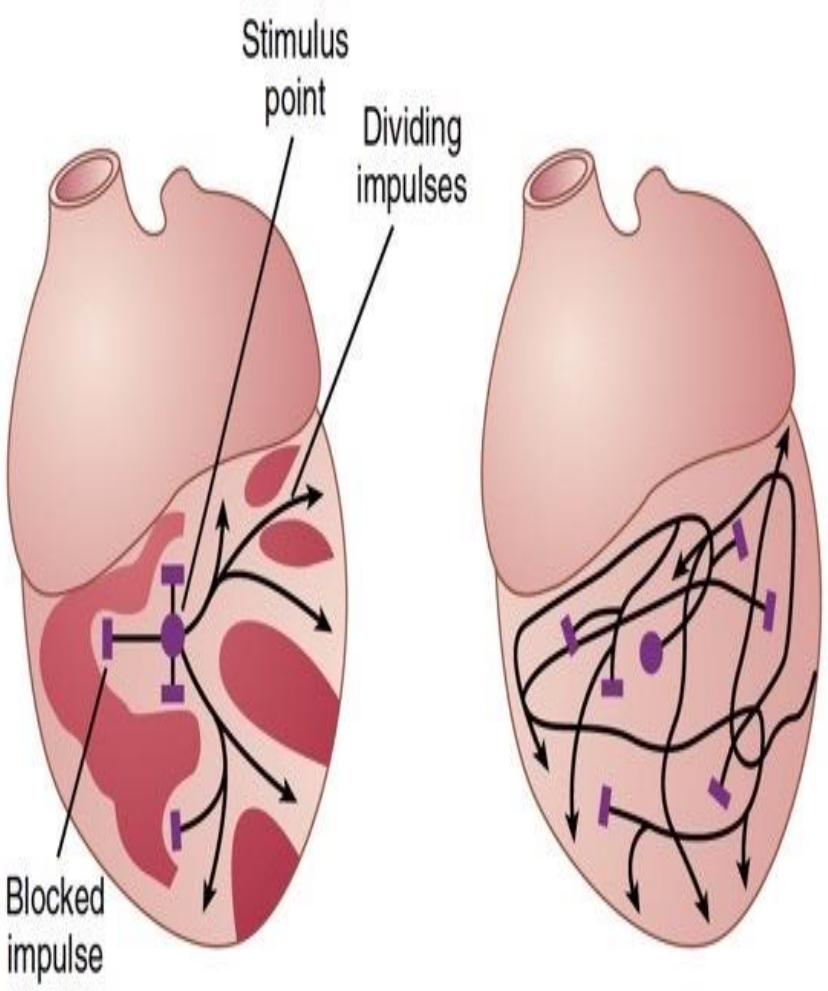
Prolonged QT interval.

Ventricular fibrillation (Vfab)

- The most serious of all cardiac arrhythmias is ventricular fibrillation, which, if not stopped within 1 to 3 minutes, is almost invariably fatal.

This is usually related to a re-entry mechanism of multiple foci in the ventricles due to structural changes in the heart, mostly resulting from ischemic changes.

- there is never a coordinated contraction of all the ventricular muscle at once, which is required for a pumping cycle of the heart.



- V fibrillation usually is related to reentry mechanical of multiple foci in the ventricle, these foci are due to structural changes in the heart, mostly due to ischemic changes.

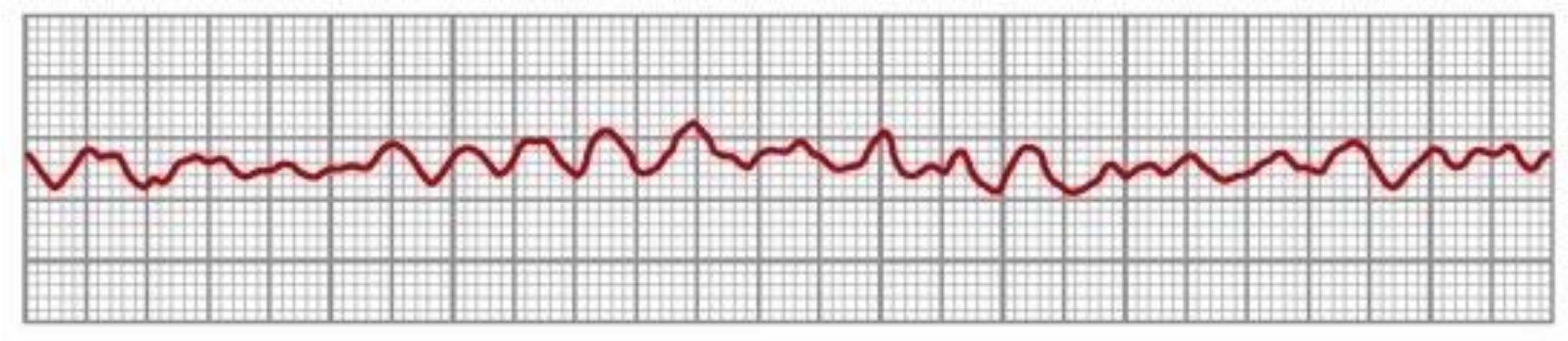
•Normally, the impulse travels along a specific pathway and when it returns to the starting point, that point is in its refractory period, causing the impulse to stop. However, if certain abnormalities occur, such as dilation of this pathway due to ventricular enlargement, the impulse may return to a point that is no longer in its refractory period, allowing re-entry and the continuous propagation of impulses.

•Re-entry can also occur if the refractory period is shortened at this point due to factors like drugs or other causes that reduce the refractory period. This situation allows the impulse to re-enter and continue moving back and forth.

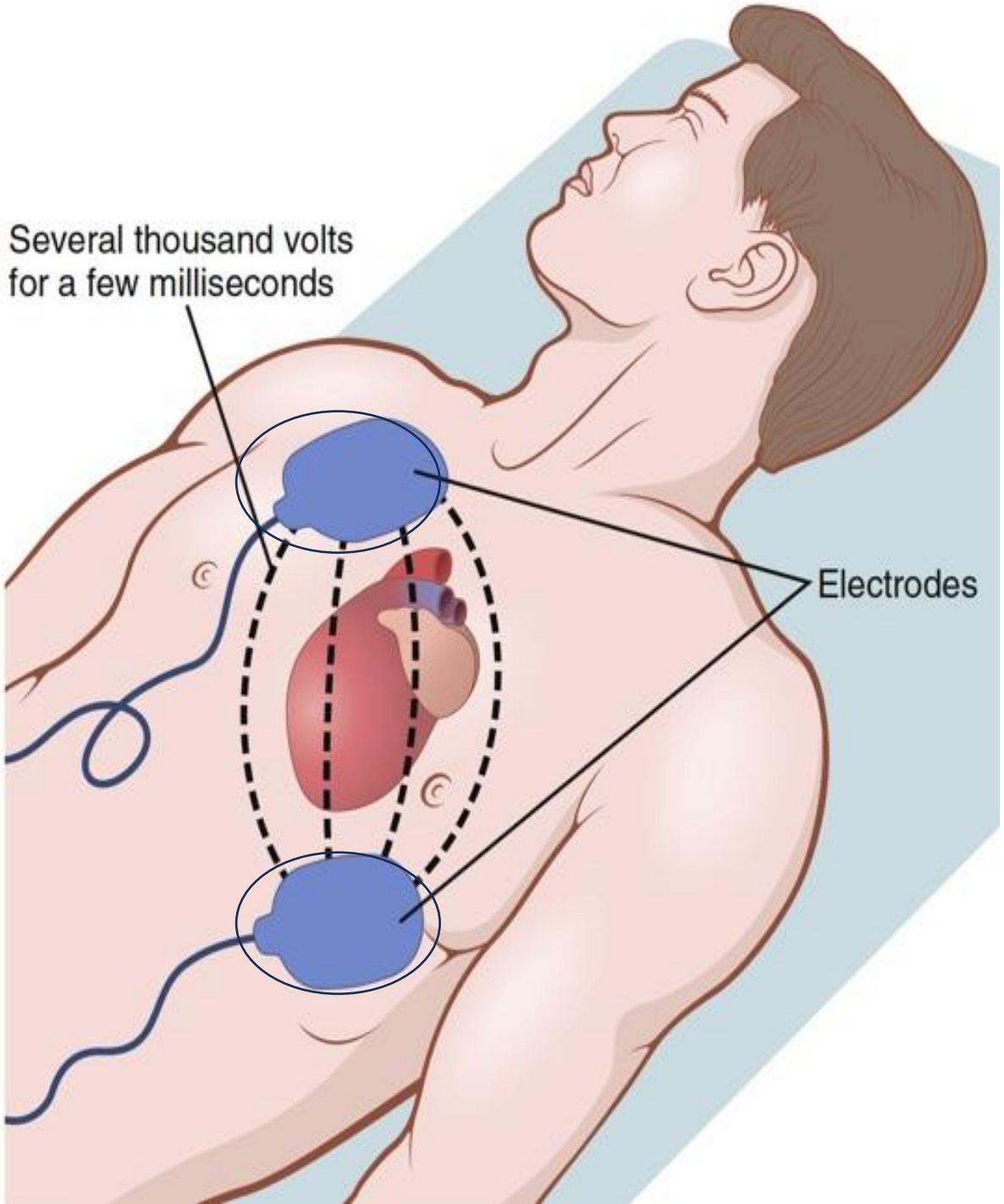
- Multiple foci can discharge in different, random directions leading to a total loss of synchronization in ventricular muscle contraction. This prevents the heart from pumping blood adequately, leading to a cessation of blood supply to all organs, most critically the brain. As a result, organs can start to deteriorate very rapidly.

Ventricular fibrillation

- After fibrillation begins, unconsciousness occurs within 4 to 5 seconds because of lack of blood flow to the brain, and irretrievable death of tissues begins to occur throughout the body within a few minutes.



On ECG:
you may observe irregular, no clear waves, abnormal QRS complexes, rapid HR, and low voltage signals.
Low voltage signals occur because numerous cells are firing asynchronously, preventing the generation of a high voltage waves.



In this situation, you should immediately use a defibrillator on the patient. The purpose of the defibrillator is to deliver a strong electrical current that will put all the cardiac cells into a refractory state for a few seconds, with the hope that this will reset the rhythm, allowing the SA node to resume normal firing.

Another way to help the patient is through CPR, which involves chest compressions. These compressions are intended to apply pressure on the heart, helping to increase blood flow, particularly coronary blood flow, to the heart .

Cardiac arrest

Most serious abnormality of cardiac conduction system.

- cessation of all electrical control signals in the heart. That is, no spontaneous rhythm remains.

Unfortunately, we lost the patient.

Thank you

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واقطف حصادك بعد طول نضال
واسلك دروبَ العارفين بهمة
والزمْ كتابَ الله غيرَ مبال

Additional sources
Arrhythmia, Physiology, Guyton and Hall

VERSIONS	SLIDE #	BEFORE CORRECTION	AFTER CORRECTION	
V1→ V2	25	depolarisation	Repolarization	
V2→V3				

امسح الرمز و شاركنا بأفكارك لتحسين أدائنا!!