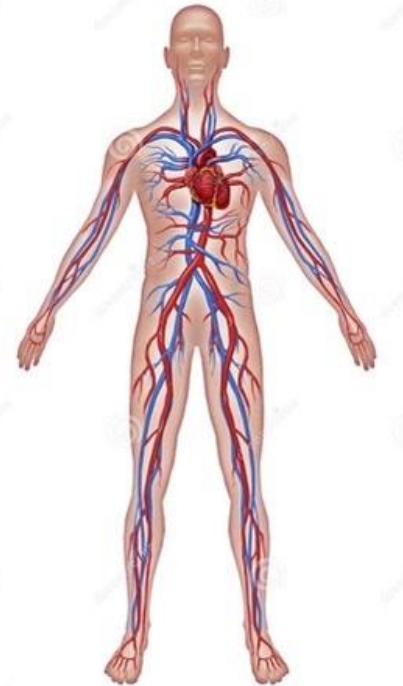


Cardiovascular Physiology

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Cardiac Arrhythmias-1

Cardiac Arrhythmias

Normal rhythm is when cardiac impulse:

- originates in SA node
- rate: 60-100 bpm
- follows the normal pathway in the conductive system.
- follows the normal velocity of conduction in different parts of the conduction system.

Cardiac Arrhythmias

Mechanisms:

- enhanced autorhythmicity
- triggered autorhythmicity
- reentry

Cardiac Arrhythmias

The causes of the cardiac arrhythmias are usually one or a combination of the following abnormalities in the rhythmicity-conduction system of the heart:

- Abnormal rhythmicity of the pacemaker.
- Shift of the pacemaker from the sinus node to another place in the heart.
- Blocks at different points in the spread of the impulse through the heart.
- Abnormal pathways of impulse transmission through the heart.
- Spontaneous generation of spurious impulses in almost any part of the heart.

Cardiac Arrhythmias

- Rhythm disturbances result from abnormalities of impulse formation, impulse conduction, or both.
- Types:
- Rate: tachyarrhythmia vs bradyarrhythmia.
- Anatomical: supraventricular vs ventricular.

Cardiac Arrhythmias

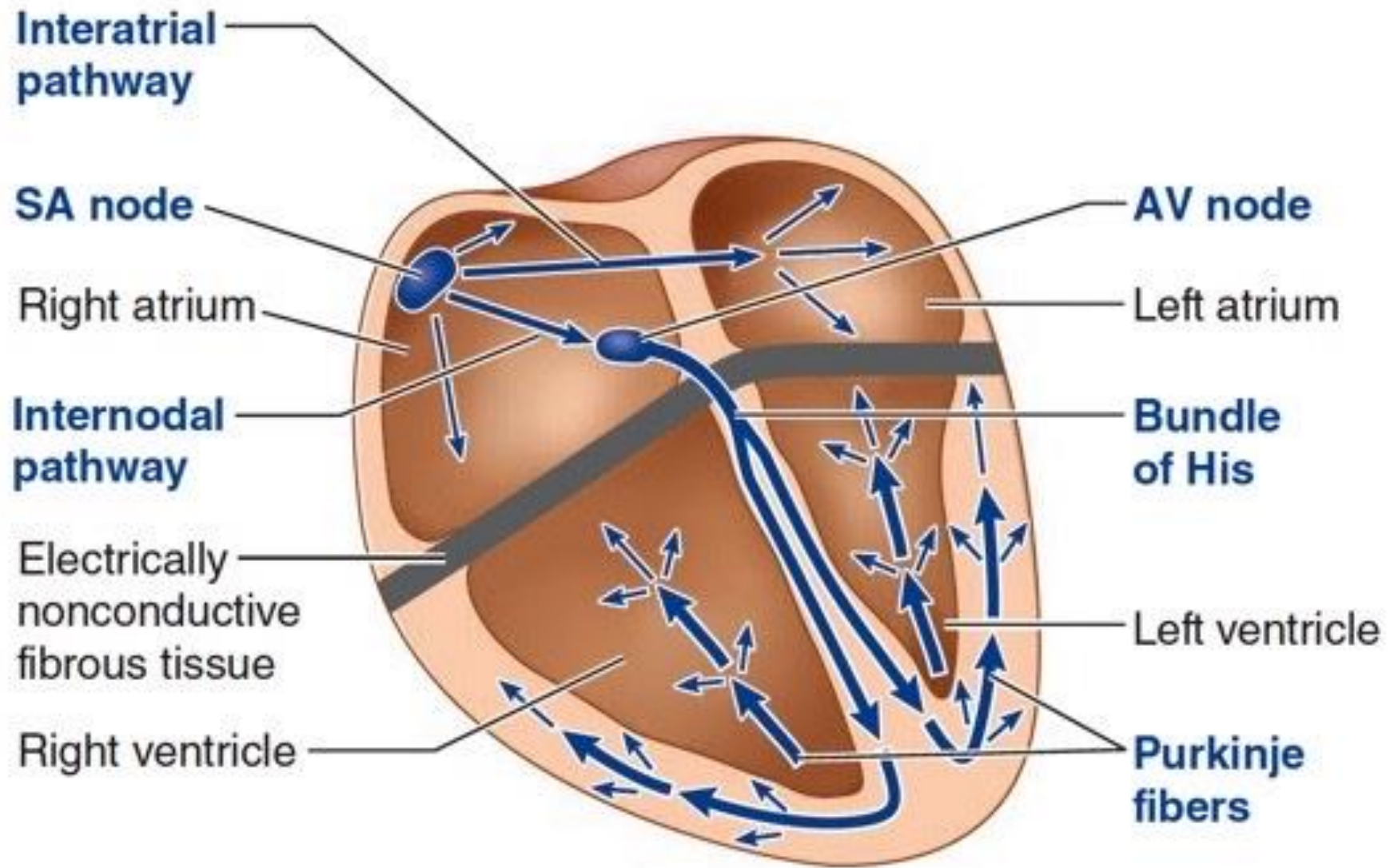
- Symptoms:
- Palpitations, dizziness or fainting, chest pain or shortness of breath, fatigue, or asymptomatic!

- Causes:
- Inherited, congenital, ischemia, aging, infiltrative diseases, infections, electrolyte disturbances, medications, iatrogenic, alcohol, nicotine and caffeine.

Cardiac Arrhythmias

- Diagnosis:
- ECG, monitors, and other diagnostic tools.

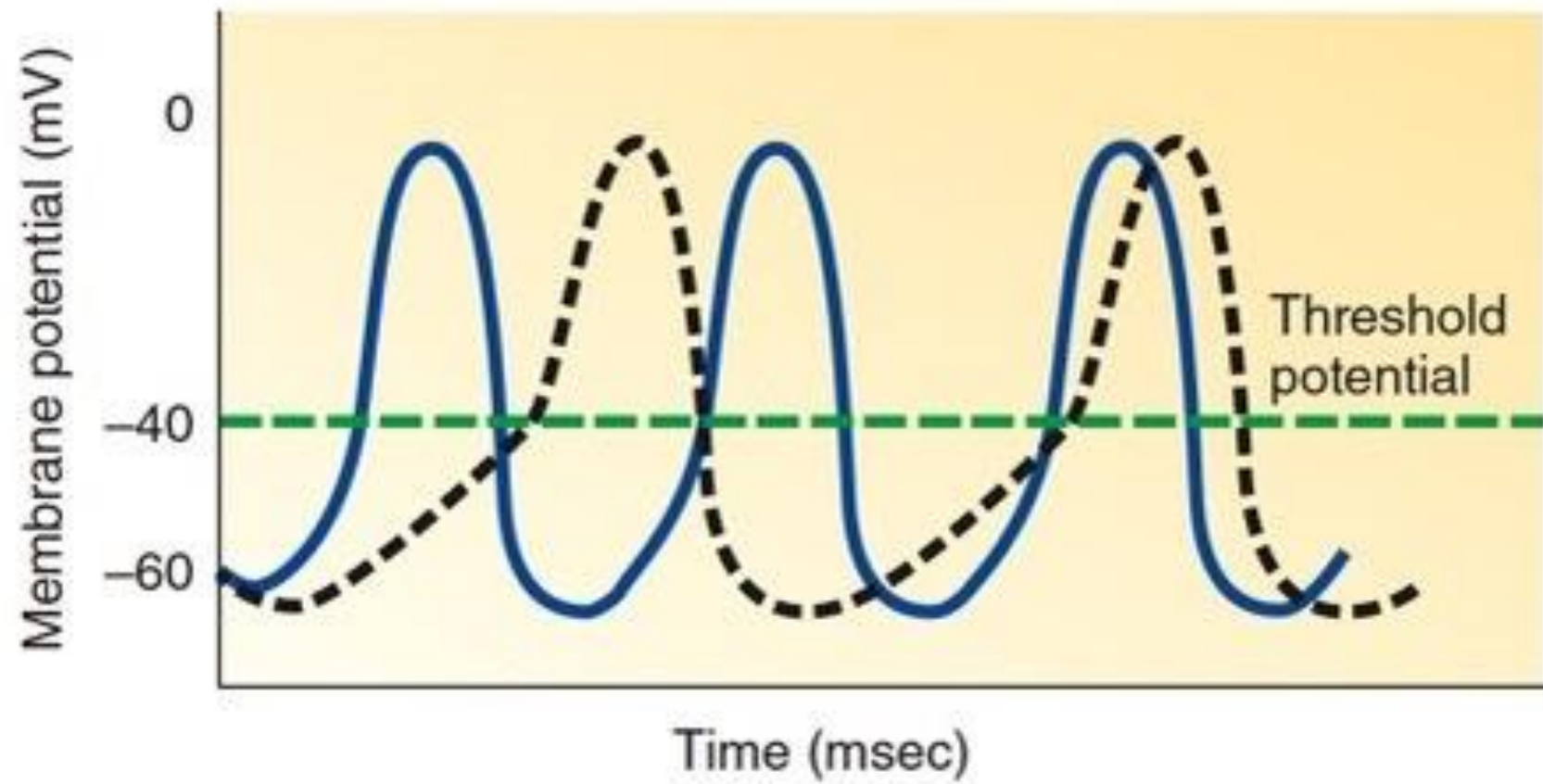
- Treatment:
- Pharmacological, catheter ablation, implantable devices such as: pacemaker or defibrillator, life style modification.



Sinus Tachycardia

- Fast heart rate: >100 beats per minute in adult.
- ECG: normal except heart rate (R-R interval) increased.
- Causes: hyperthermia, blood loss anemia, dehydration, anxiety, weak heart muscle, and toxic conditions of the heart.



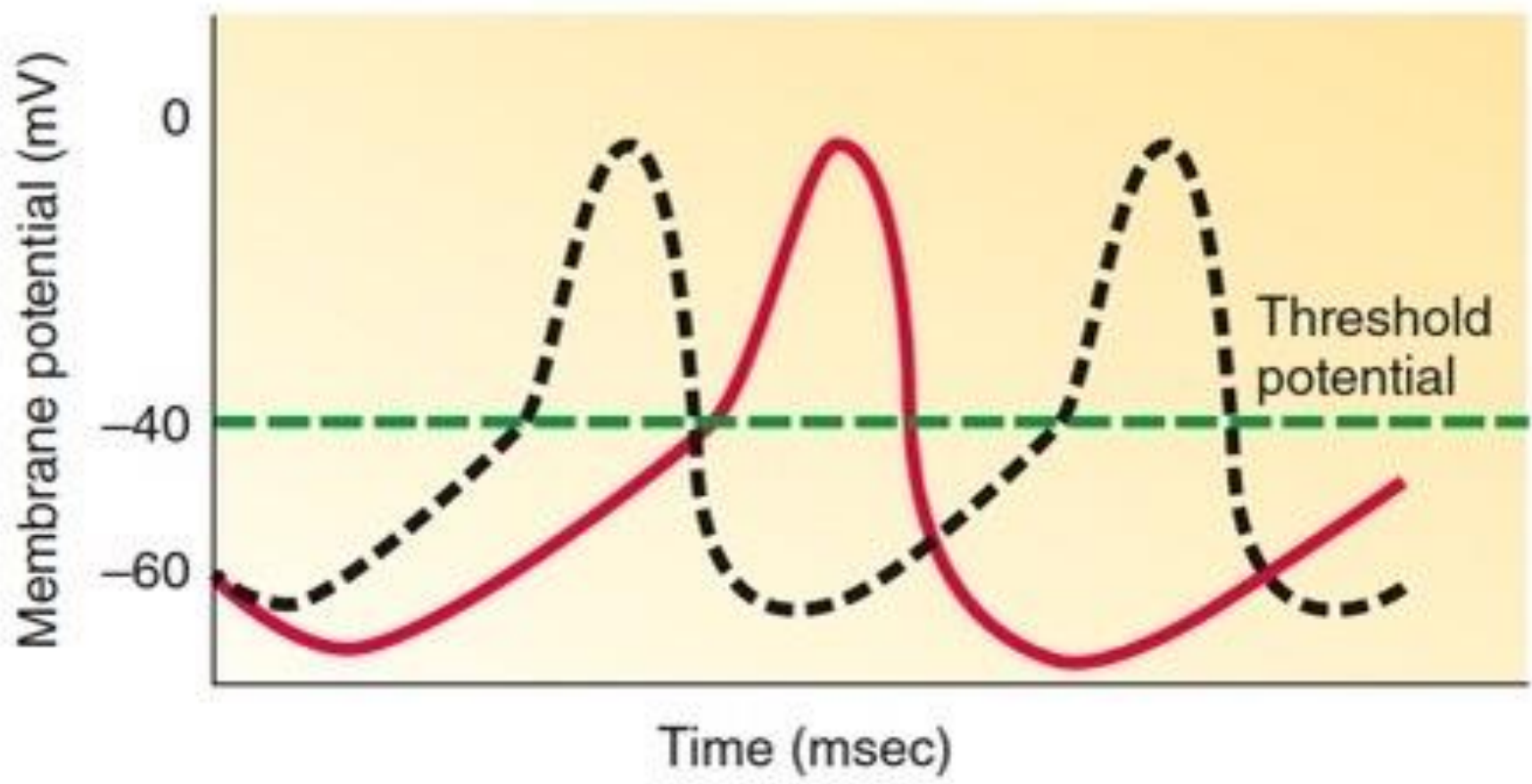


Sympathetic stimulation

- The main effect on SA node is to speed up depolarization so that threshold is reached more rapidly.
- In pacemaker cells, the rate of depolarization increases as a result of greater inward movement of Na and Ca.
- It decreases AV delay.
- In atria and ventricles, it increases strength and speed of contraction.

Parasympathetic stimulation

- It decreases HR.
- ACh slows heart rate primarily by increasing K permeability of the pacemaker cells by binding with muscarinic cholinergic receptors that are coupled directly to ACh-regulated K channels by a G protein.



Sinus bradycardia

- Slow heart rate: < 60 beats per minute.
- ECG: normal except heart rate.
- Causes: athletes, elderly, sleep, hypothermia, hypothyroidism, carotid sinus syndrome.



Sinus arrhythmia

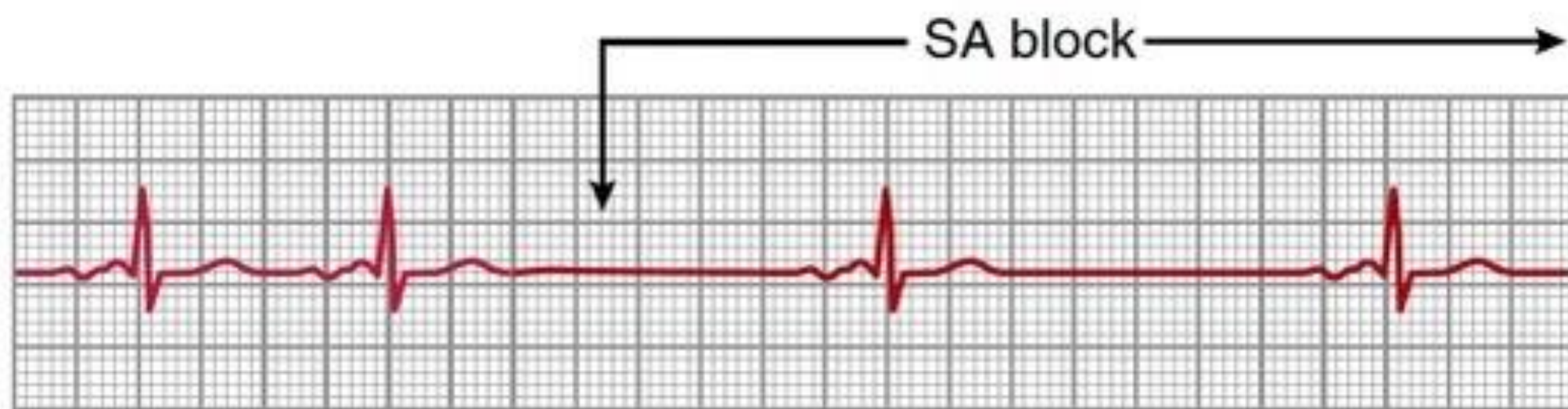
- Sinus arrhythmia can result from any condition that alter the sympathetic and parasympathetic impulses to SA node.
- The respiratory type: during inspiration HR increases.
- Heart rate variability (HRV)

Sick sinus syndrome or SA dysfunction

- is a disorder of the SA node caused by impaired pacemaker function and impulse transmission producing a constellation of abnormal rhythms.
- These include atrial bradyarrhythmias, atrial tachyarrhythmias and, sometimes, bradycardia alternating with tachycardia often referred to as “tachy-brady syndrome.”

SA block

- the impulse from the sinus node is blocked before it enters the atrial muscle, may lead to atrial asystole.
- ECG: normal QRS, slow HR.



Atrial arrhythmia

Paroxysmal tachycardia

- Some abnormalities in different portions of the heart, including the atria, Purkinje system, or ventricles, can occasionally cause rapid rhythmical discharge of impulses that spread in all directions throughout the heart.
- This phenomenon is believed to be caused most frequently by re-entry.
- Because of the rapid rhythm in the irritable focus, this focus becomes the pacemaker of the heart.

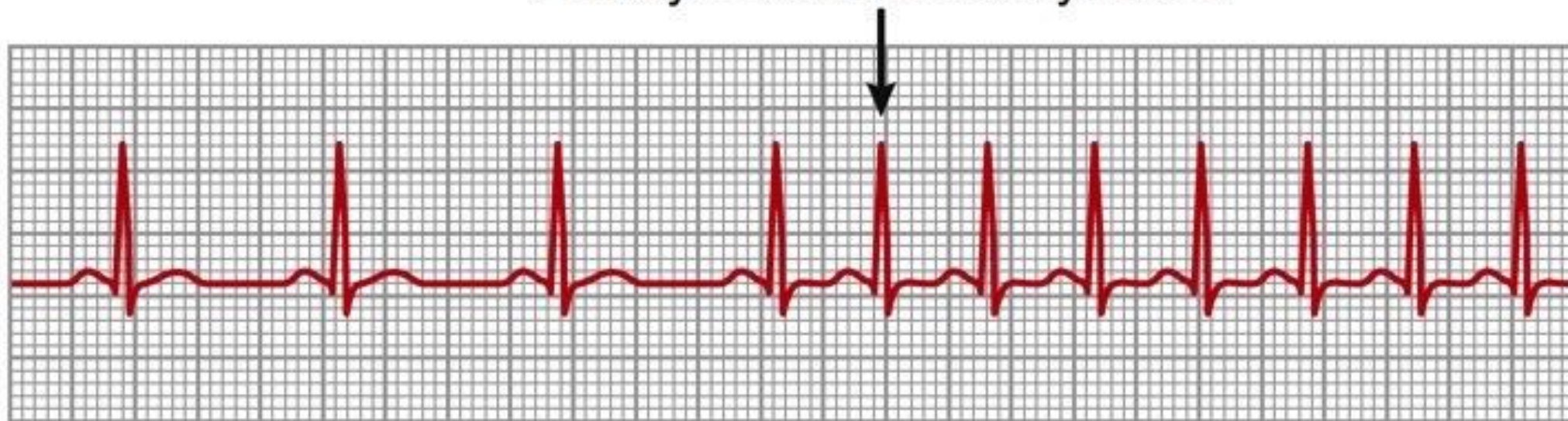
Paroxysmal tachycardia

- The term paroxysmal means that the heart rate becomes rapid in paroxysms, with the paroxysm beginning suddenly and lasting for a few seconds, a few minutes, a few hours, or much longer.
- The paroxysm usually ends as suddenly as it began, with the pacemaker of the heart instantly shifting back to the sinus node.

Paroxysmal tachycardia

- Paroxysmal tachycardia often can be stopped by eliciting a vagal reflex. A type of vagal reflex sometimes elicited for this purpose is to press on the neck in the regions of the carotid sinuses, which may cause enough of a vagal reflex to stop the paroxysm.
- Antiarrhythmic drugs may also be used to slow conduction or prolong the refractory period in cardiac tissues.

Paroxysmal atrial tachycardia



Premature contraction

- A premature contraction is a contraction of the heart before the time that normal contraction would have been expected.
- This condition is also called extrasystole, premature beat, or ectopic beat.
- Most premature contractions result from ectopic foci in the heart, which emit abnormal impulses at odd times during the cardiac rhythm.

Premature atrial contraction (PAC)

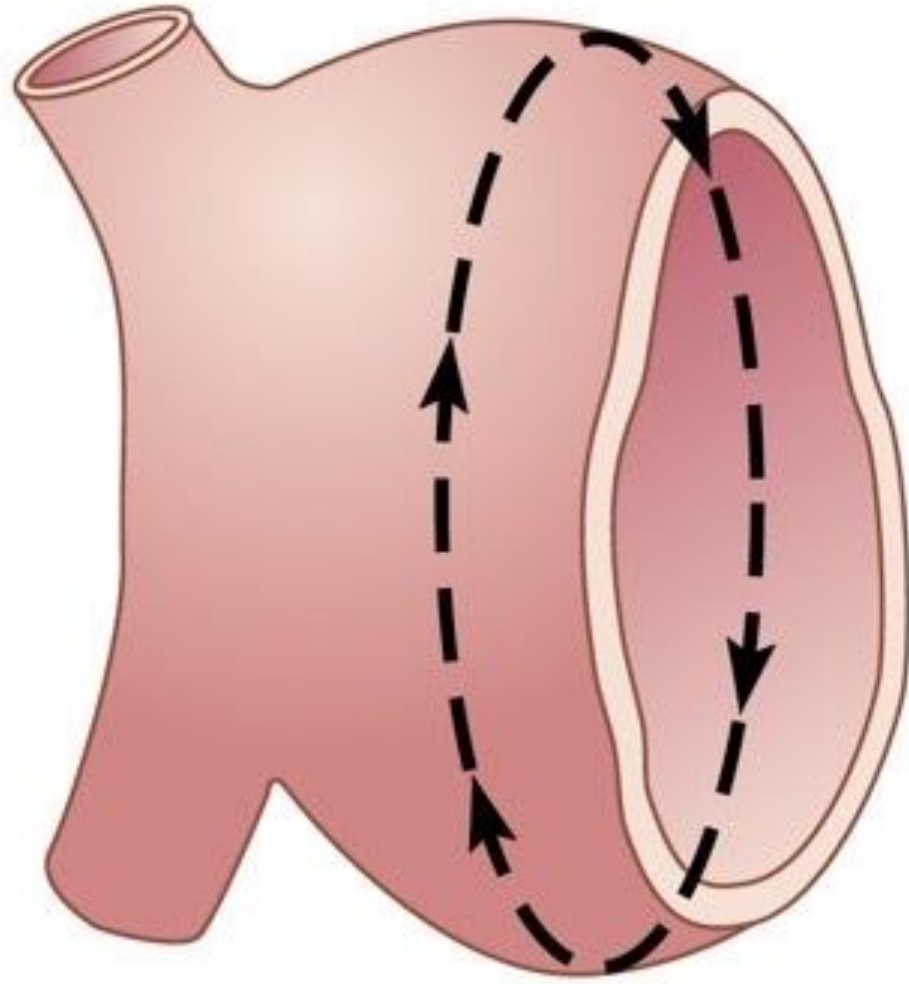
- PACs occur frequently in otherwise healthy people.
- They often occur in athletes, or in mild toxic conditions resulting from such factors as smoking, lack of sleep, ingestion of too much coffee, alcoholism, and use of various drugs.

Pulse deficit

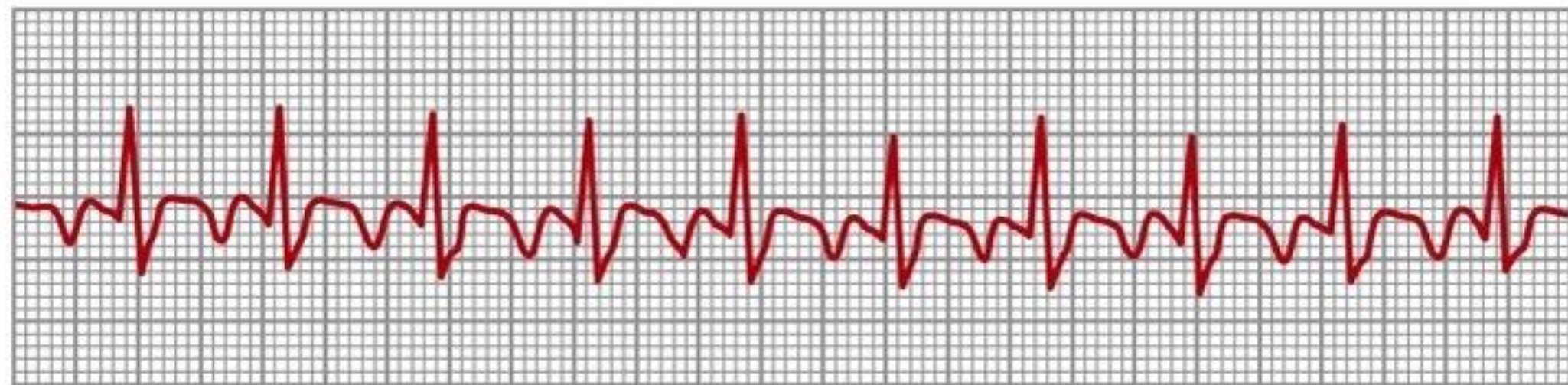
- When the heart contracts ahead of schedule, the ventricles will not have filled with blood normally, and the stroke volume output during that contraction is depressed or is almost absent.
- Therefore, the pulse wave passing to the peripheral arteries after a premature contraction may be so weak that it cannot be felt in the radial artery.
- Thus, a deficit in the number of radial pulses occurs when compared with the actual number of contractions of the heart.

Atrial flutter

- Heart rate 200-350 bpm.
- Caused by reentry in the atria.
- signals reach the AV node too rapidly for all of them to be passed into the ventricles because the refractory periods of the AVnode and AV bundle are too long to pass more than a fraction of the atrial signals.
- Therefore, there are usually two to three beats of the atria for every single beat of the ventricles.



Atrial flutter

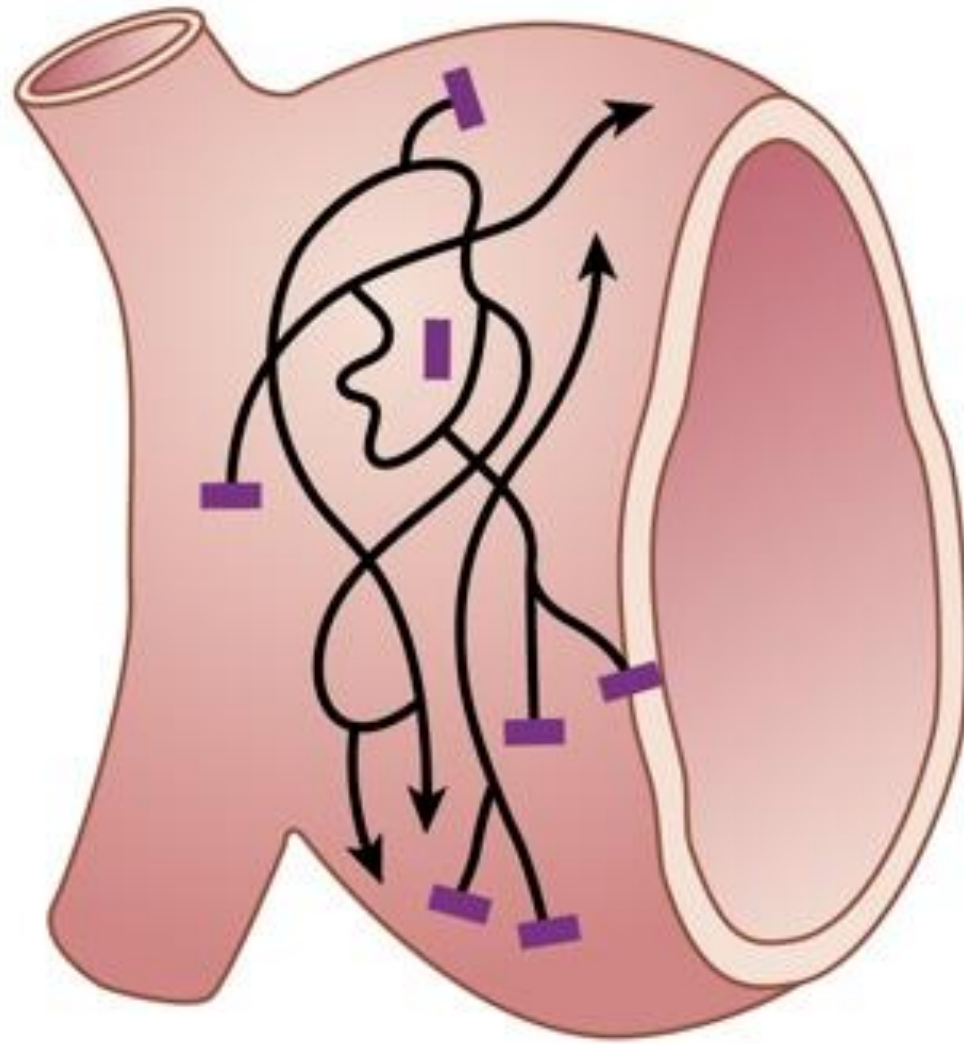


Atrial flutter

- P waves are strong because of the contraction of semicoordinated masses of muscle.
- However, note that a QRS-T complex follows an atrial P wave only once for every two beats of the atria, giving a 2:1 rhythm.

Atrial fibrillation (Afib)

- Usually in dilated atrium.
- Not life threatening. However, due to the reduced atrial contractile function, blood can stagnate, allowing blood clots to form in the atrial appendage.
- These blood clots can dislodge and travel to the brain, causing stroke, or to other parts of the body.
- Therefore, patients with atrial fibrillation are often placed on anticoagulants to reduce the risk of embolism.



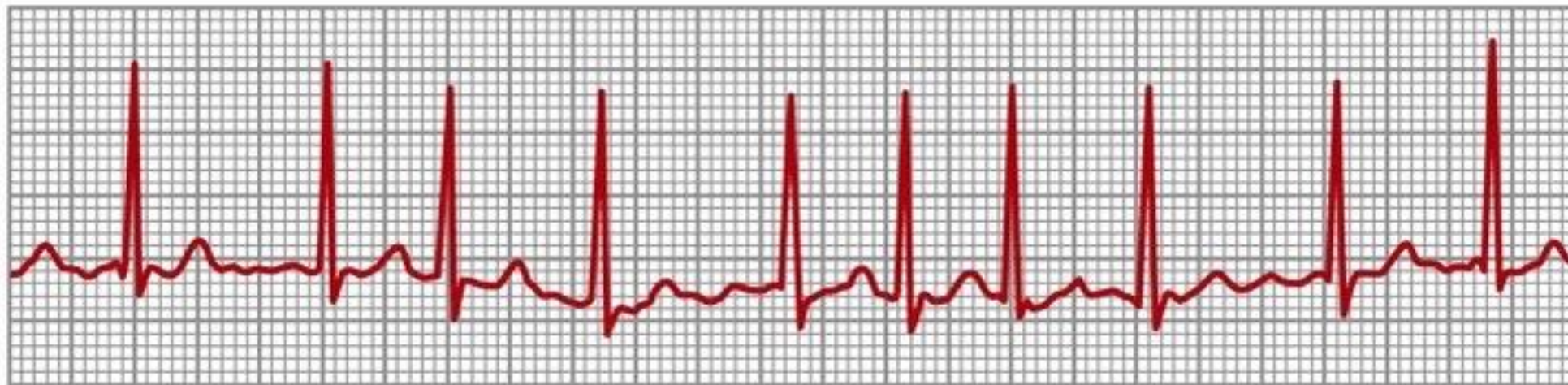
Atrial fibrillation

Atrial fibrillation (Afib)

- On ECG:
- Heart rate increased.
- Numerous small depolarization waves spread in all directions through the atria during atrial fibrillation. Because the waves are weak, and many of them are of opposite polarity at any given time, they usually almost completely electrically neutralize one another.
- Therefore, in the ECG, one can see either no P waves from the atria or only a fine, high-frequency, Very low voltage.

Atrial fibrillation (Afib)

- On ECG:
- QRS-T complexes are normal unless there is some pathology of the ventricles, but their timing is irregular.
- Treatment:
- Synchronized cardioversion: single electric shock is synchronized to fire only during the QRS complex when the ventricles are refractory to stimulation. A normal rhythm often follows if the heart is capable of generating a normal rhythm.



References

9TH Edition

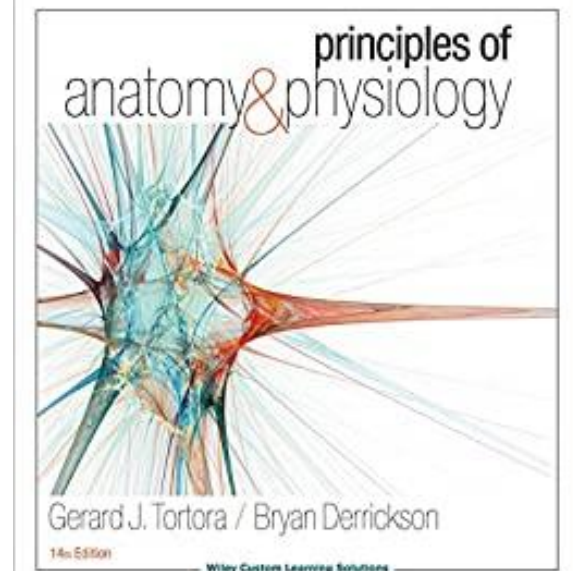
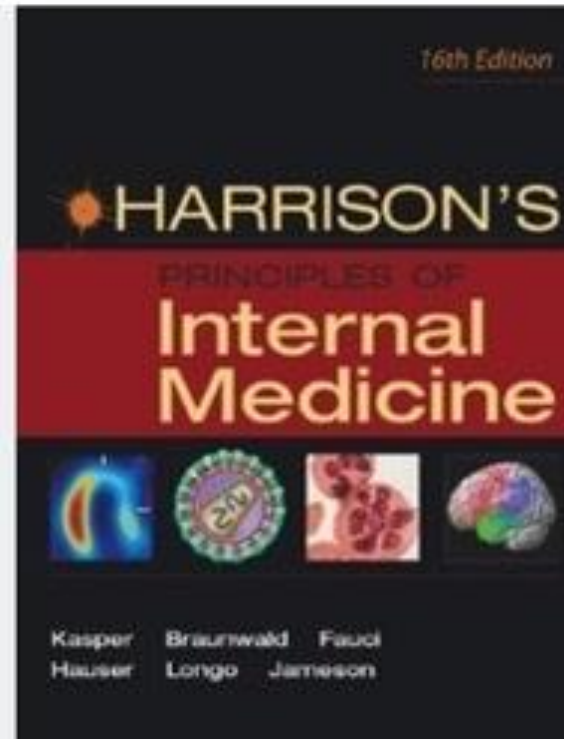
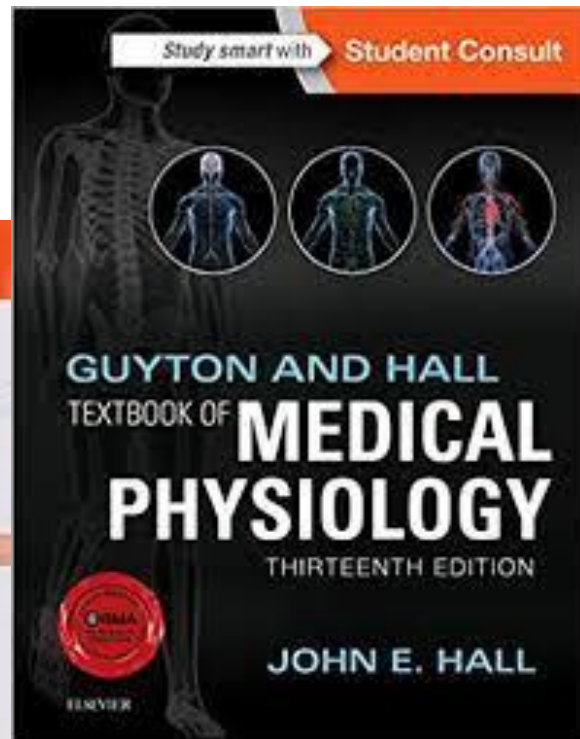
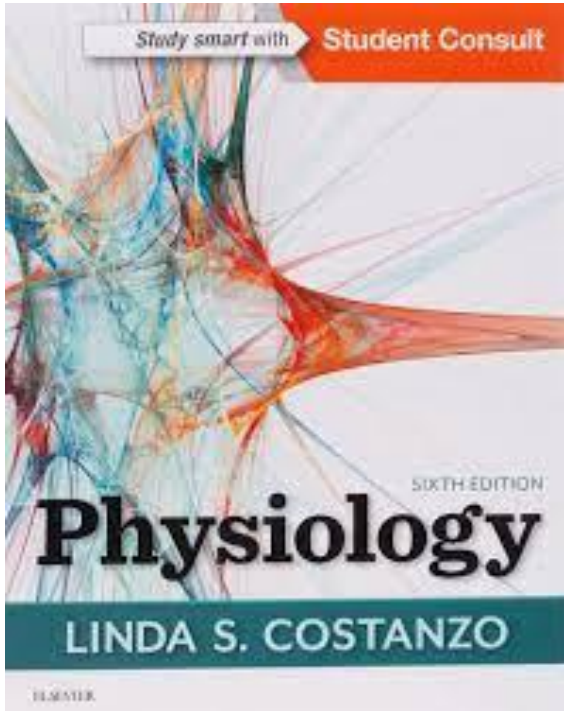
Human Physiology From Cells to Systems

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