

Cardiac Emergencies

Zoom Echo 4/2/24

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Disclosure

Dr. Root, faculty for this educational event, has received an educational grant from the National Association of EMS Physicians and the Stryker Corporation.

I have received compensation from the SSCOR corporation for performing technical writing.

All relevant financial relationships have been mitigated.

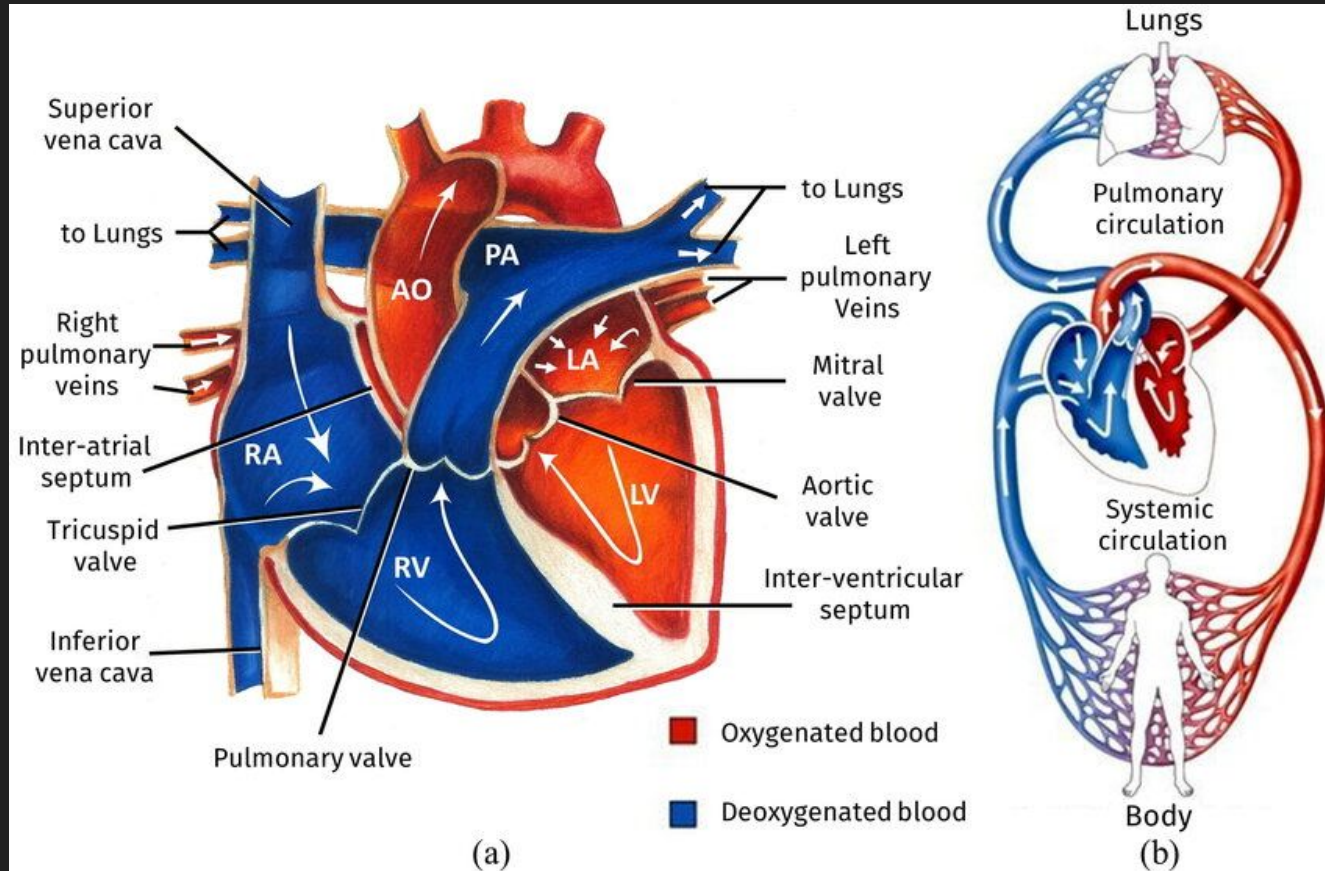
Objective

Review basic cardiac anatomy and physiology

Review the pathophysiology of common cardiac emergencies

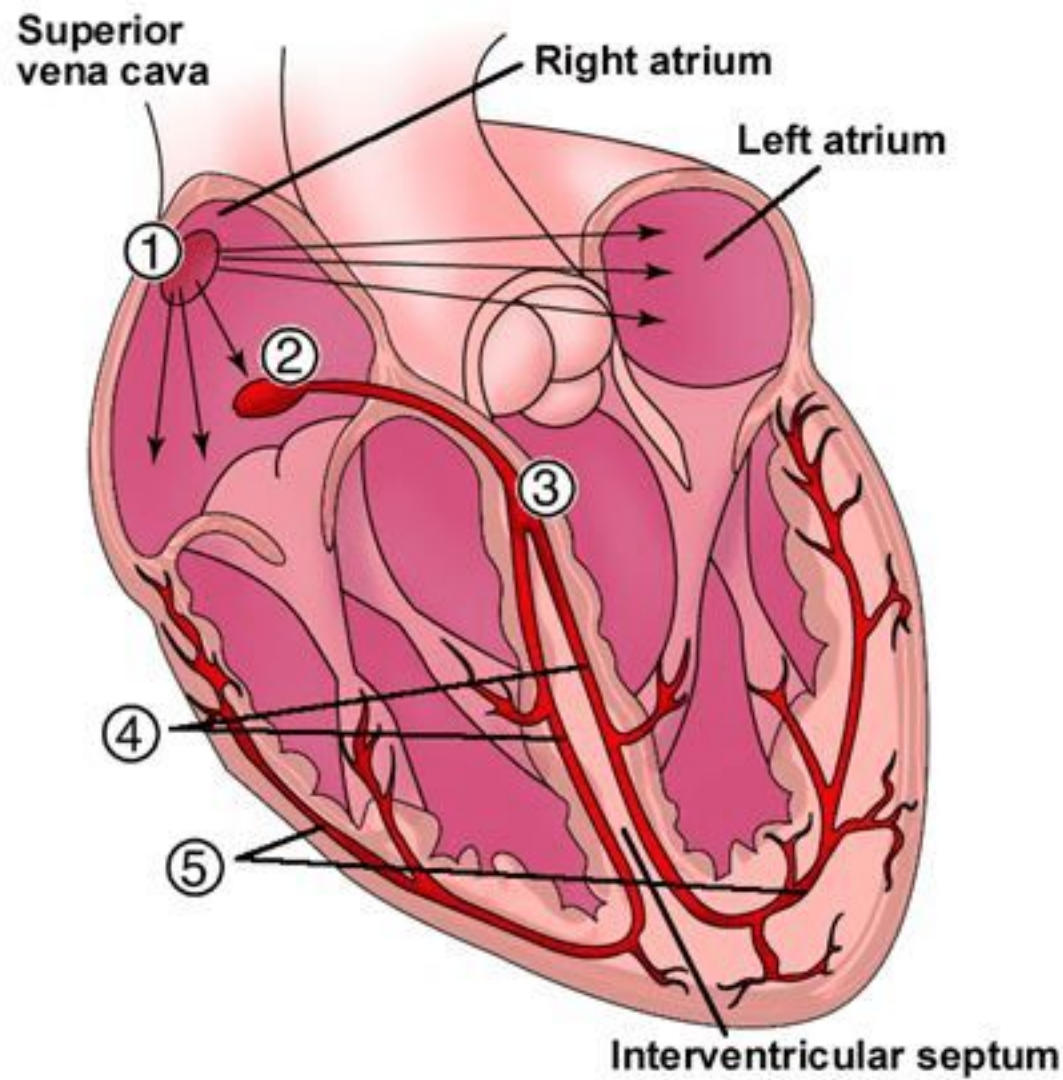
Review the pharmacology of prehospital cardiac medications

Plumbing



Electrical

- 1) SA Node
- 2) AV Node
- 3) Bundle of His
- 4) Bundle Branches
- 5) Purkinje Fibers



Normal Heart Rates

Younger patients will have higher resting HRs

-Can tolerate higher HRs during exertion

If patients HR > (220 - age) = consider pathologic rhythm.

Average heart rates by age		
Age in years	Average maximum heart rate in beats per minute	Target heart rate range in beats per minute
40	180	90 to 153
45	175	88 to 149
50	170	85 to 145
55	165	83 to 140
60	160	80 to 136
65	155	78 to 132
70	150	75 to 128

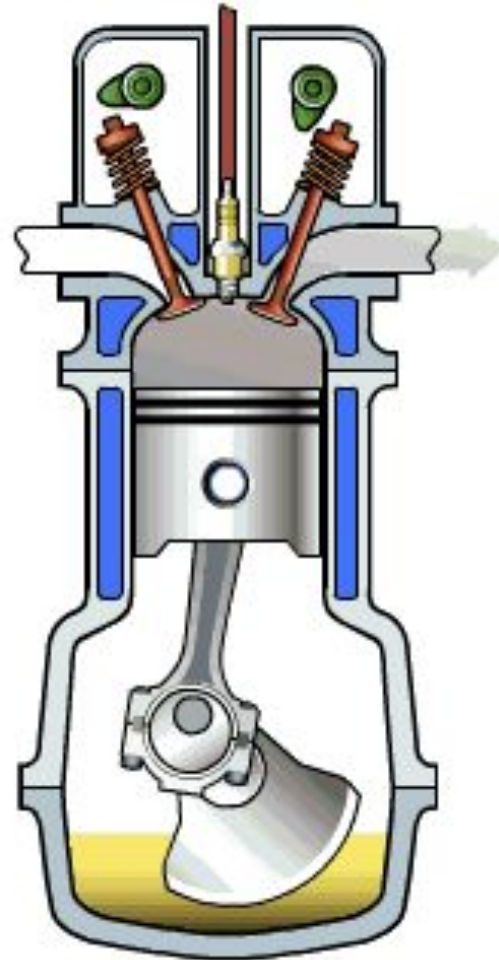
Source: American Heart Association.

Cardiac Output

$$CO = \text{Heart Rate} \times \text{Stroke Volume}$$

How Engines Work

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📍 Top Dead Center

⚡ Spark

- 1 INTAKE
- 2 COMPRESSION
- 3 COMBUSTION
- 4 EXHAUST

RESET

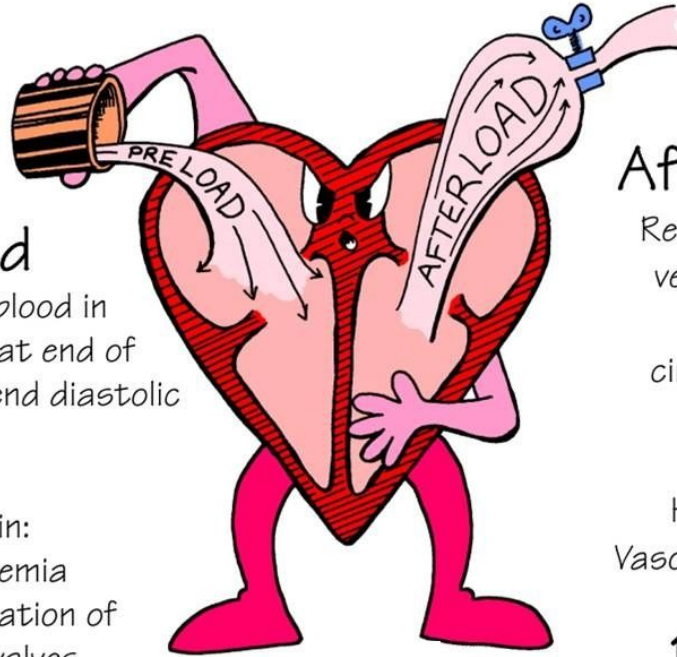
Preload vs Afterload

PRELOAD AND AFTERLOAD

Preload

Volume of blood in ventricles at end of diastole (end diastolic pressure)

Increased in:
Hypervolemia
Regurgitation of cardiac valves
Heart Failure



Afterload

Resistance left ventricle must overcome to circulate blood

Increased in:
Hypertension
Vasoconstriction

↑ Afterload =
↑ Cardiac workload

Systole vs Diastole

When is blood pumped to the body?

When do the ventricles fill?

When do the coronary arteries fill?

What pressure does the body spend more time in?



Mean Arterial Pressure

$$\text{MAP} = [2 * \text{Diastolic} + \text{Systolic}] / 3$$



Pathophysiology



"I have to tell you, I got a totally different diagnosis from someone named PookyPoo on medi-answer.com."

Hx

O: exertion vs rest, gradual vs sudden

P: positioning, resting, breathing

Q: sharp vs dull vs pressure

R: L arm, R arm, Back Jaw

S: 1-10, "Just like the last one"

T: How long? Constant or intermittent

Physical Exam

Vitals

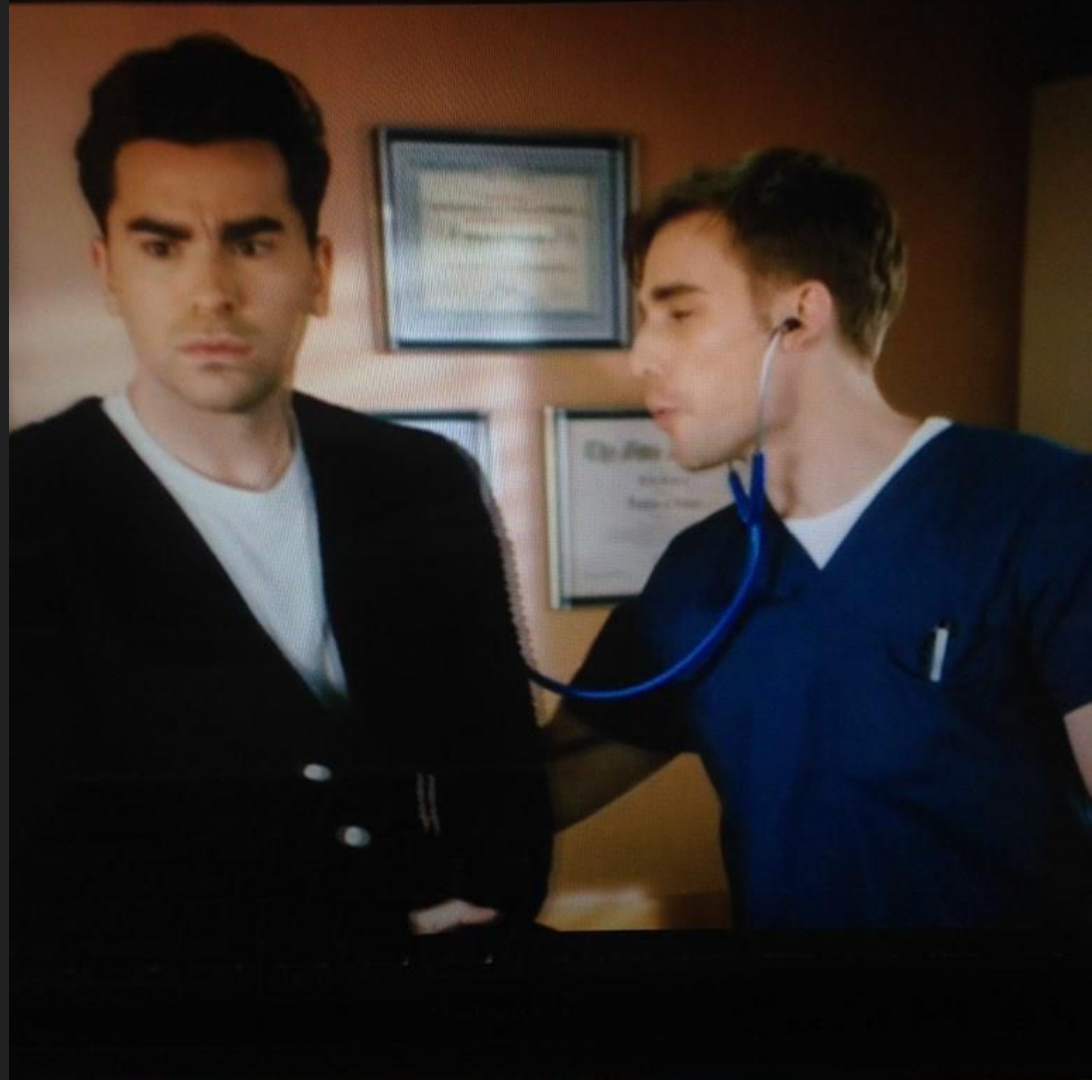
General: sick/not sick

Skin: color, temp, condition

Cardio: Heart sounds, pulses,
JVD

Pulm: Lung sounds, RR

Extremities: edema?



Tachycardia

HR > 100

Normal response to need for increased CO

Can be pathologic

What causes of tachycardia can you think of?

Why would tachycardia cause problems?



Syncope

Body's response to
inadequate cerebral blood
flow

Plumbing or electrical

What causes of syncope
can you think of?



Acute Coronary Syndrome

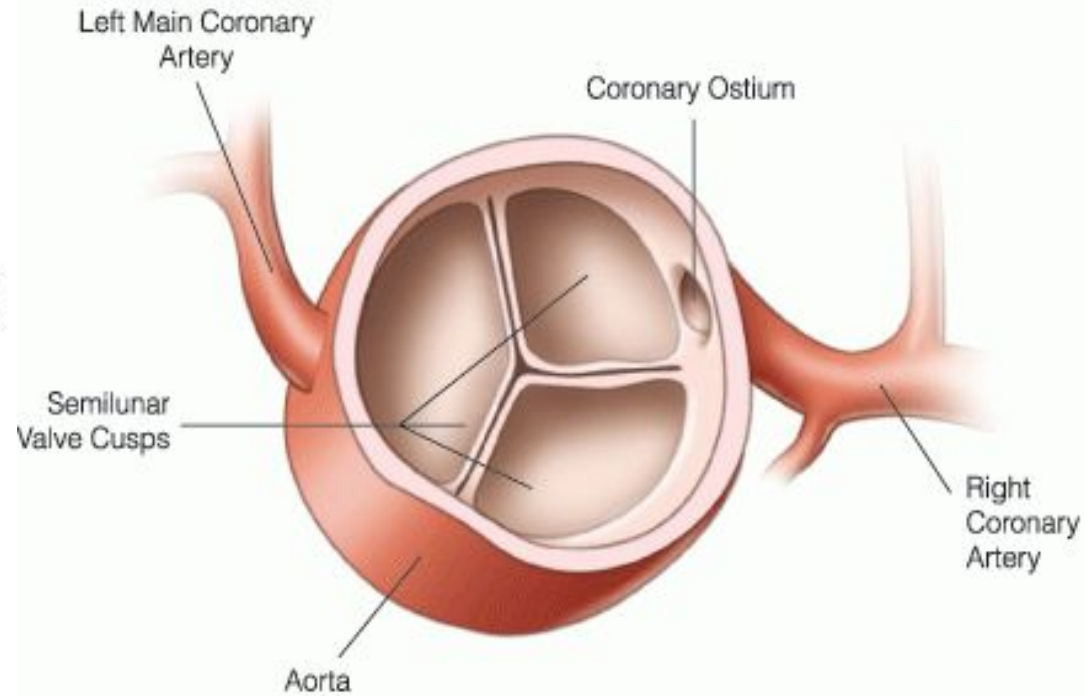
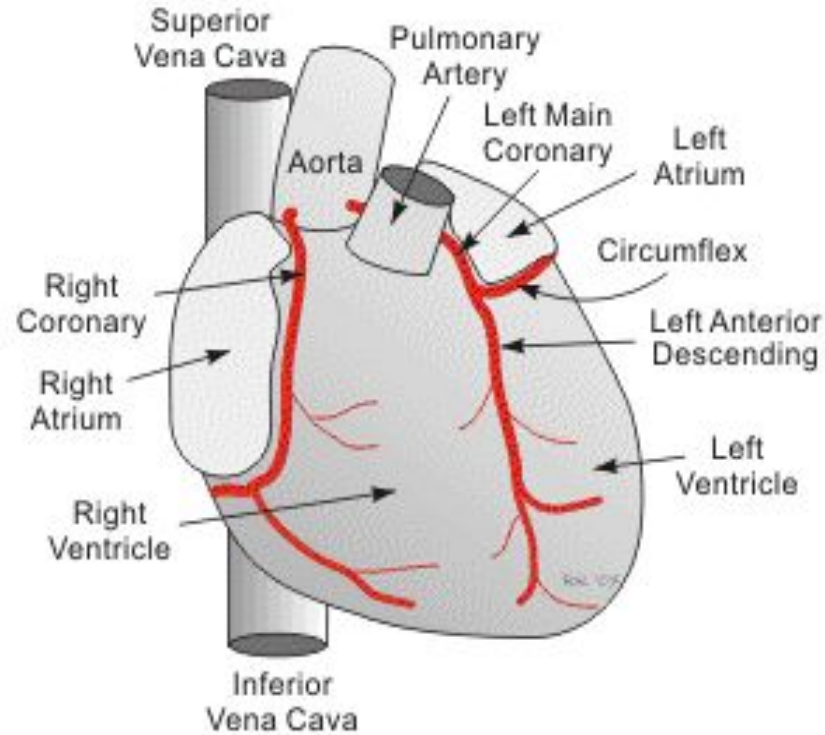
A sudden decrease in flow through the coronary arteries leading to myocardial ischemia.

Injury: Damage to cardiac myocytes

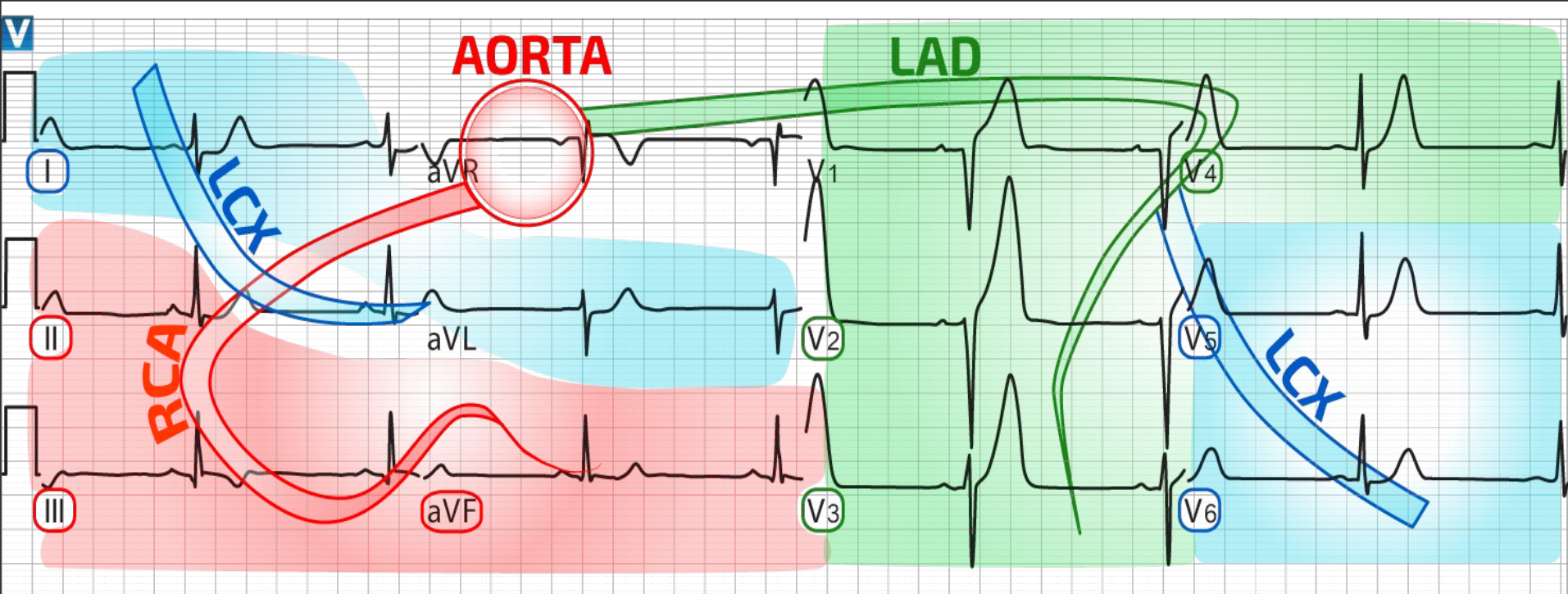
Ischemia: Injury due to hypoxia

Infarction: irreversible cell death due to ischemia

Coronary Arteries



Coronary Arteries



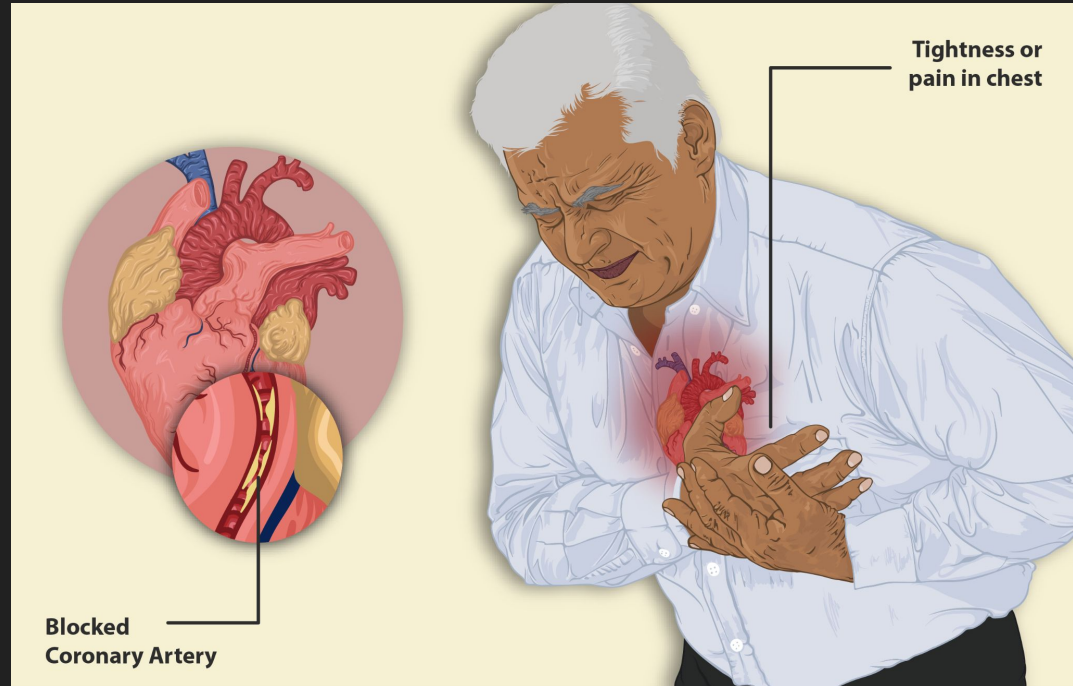
Angina

Angina indicates stenosis of coronary arteries.

Decrease blood flow to myocardium causes pain.

Stable vs unstable

Tx?

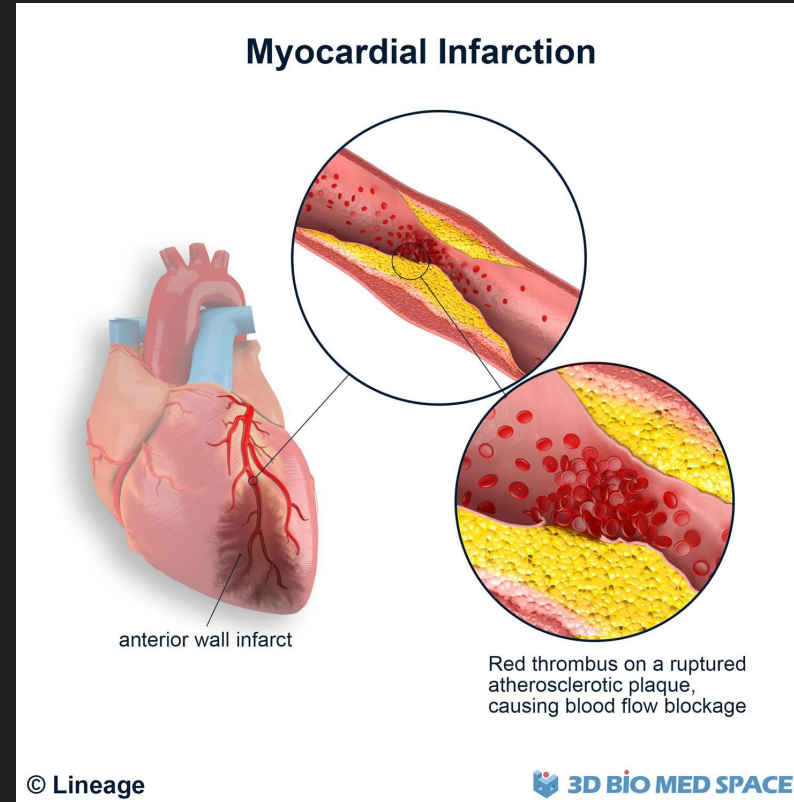


Myocardial Infarction

Complete occlusion of a coronary artery causes cessation of blood flow to an area of myocardium.

Injury + ischemia = infarction

Requires specialized plumbers



Myocardial Infarction



What symptom is most predictive of MI?

- A) Pain Radiating to the R arm
- B) Pain radiating to the L arm
- C) Pain Radiating to Bilat arms**
- D) Pain in the chest alone

FPIN's Help Desk Answers

Predictors of Acute Myocardial Infarction

JARED WEST, DO, and SARAH DALY, DO, FAAFP, *Utah Valley Family Medicine Residency, Provo, Utah*

Radiation to both arms

(LR+ = 7.1; 95% CI, 3.6 to 14),

Radiation to the right shoulder

(LR+ = 2.9; 95% CI, 1.4 to 6.0),

pain in the chest or left arm

(LR+ = 2.7; CI not reported),

radiation to the left arm

(LR+ = 2.3; 95% CI, 1.7 to 3.1).

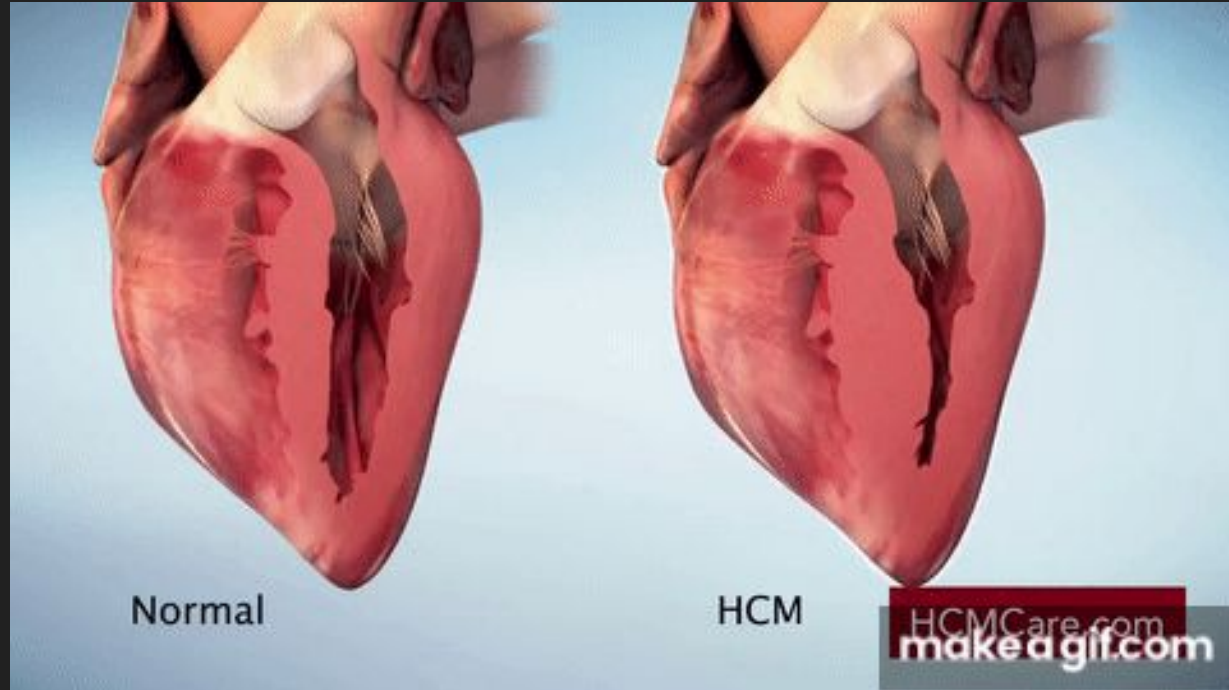
Hypertrophic Obstructive Cardiomyopathy

Congenital issue

LV is too thick

Tachycardia leads to inadequate filling and potential outflow obstruction.

Syncope or sudden death in athletes.



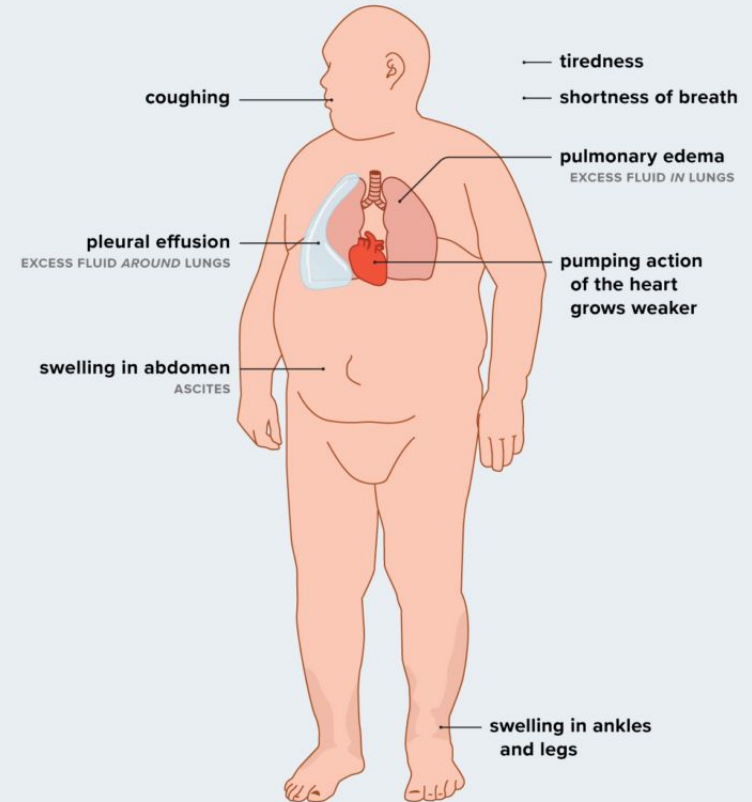
Congestive Heart Failure

Heart can no longer pump effectively

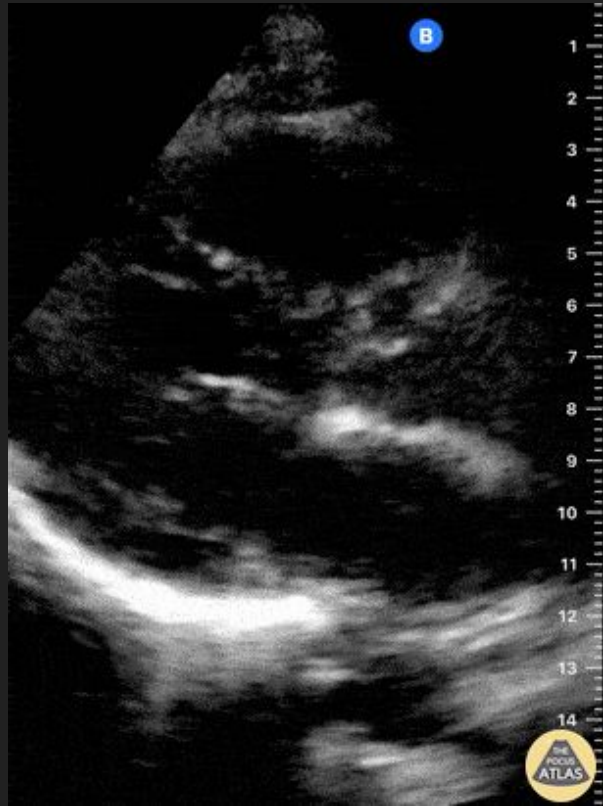
Why do CHF patients need to avoid salt?

What does CHF exacerbation look like?

EFFECTS OF CONGESTIVE HEART FAILURE ON THE BODY



Congestive Heart Failure

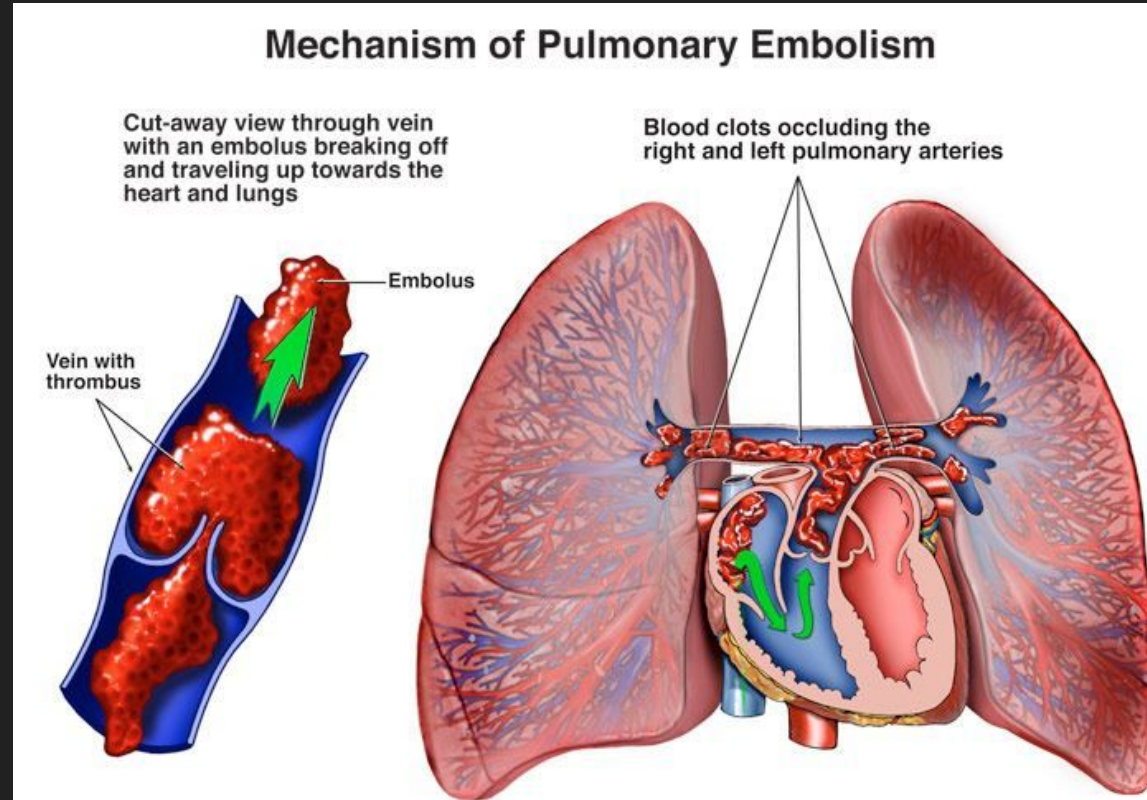


Pulmonary Embolism

Caused by a blood clot in the pulmonary circulation.

Risk factors are recent fracture, recent surgery, smoking, Long travel, cancer, OCPs

Tachypnea, dyspnea, hemoptysis

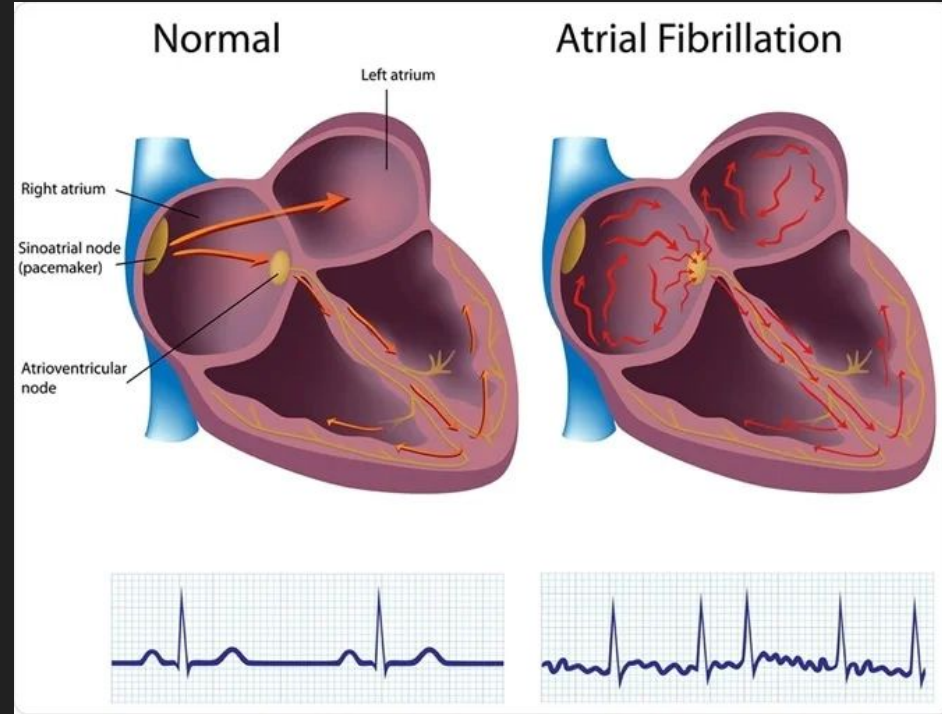


Atrial Fibrillation

Conduction system fails over time

More common in older adults

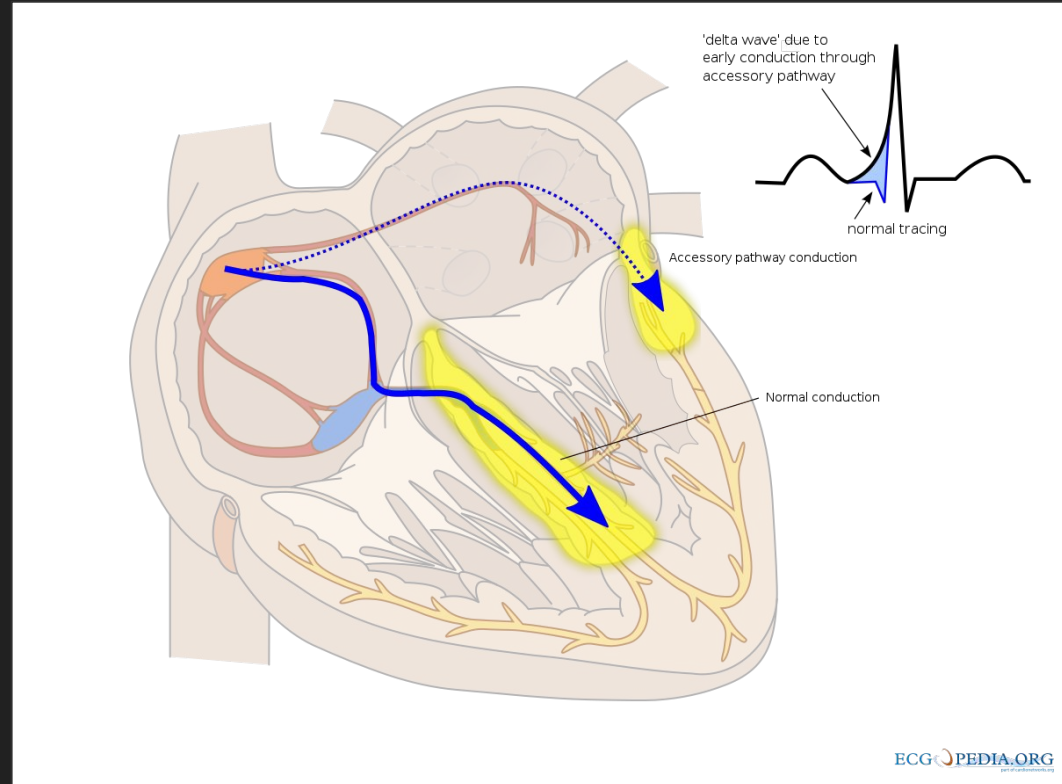
Why do A fib patients need anti-coagulation?



Wolff-Parkinson-White

Congenital abnormality

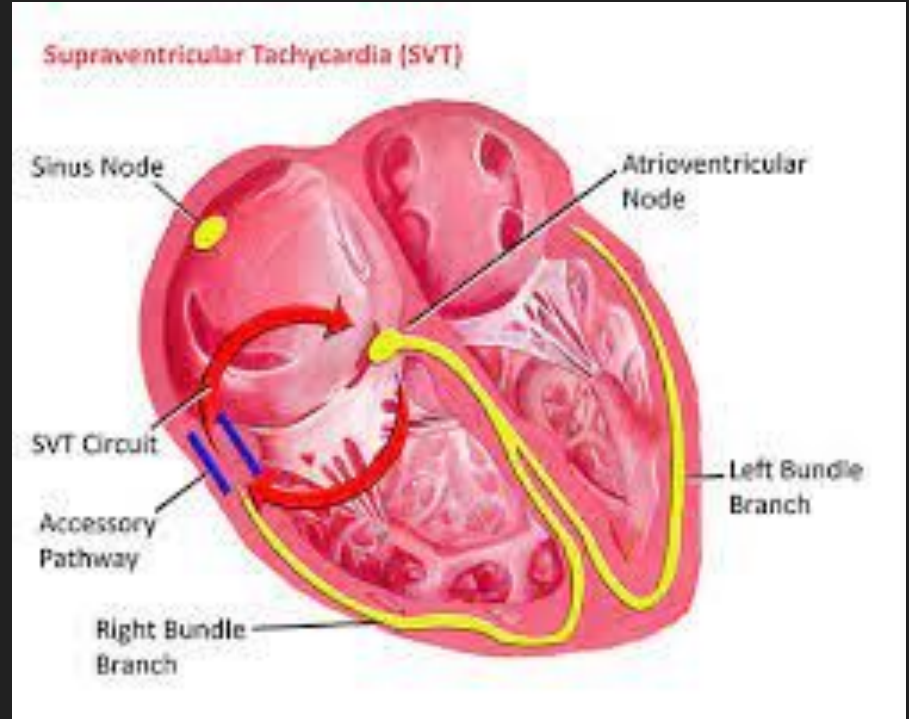
Accessory conduction pathway
can lead to uncontrolled
tachycardia



SVT

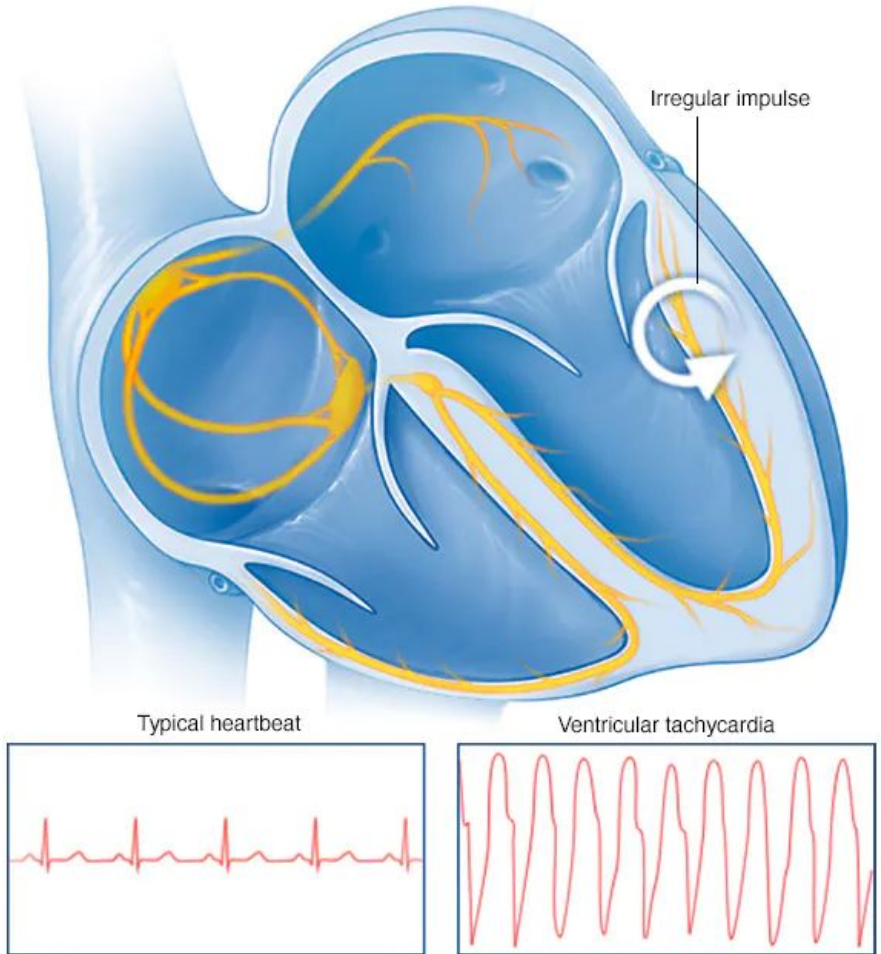
Abnormal conduction through
other accessory pathways

Can lead to uncontrolled
tachycardia



Ventricular Tachycardia

Ventricles become the dominate electrical signal.



Cardiac Arrest

Complete pump failure

What are the only two things that help people survive cardiac arrest?

What is different about traumatic cardiac arrest?



Pharmacology



Oxygen

Class: Medical gas

MOA: Increases oxygen concentration to enhance tissue level oxygenation

Contraindications: None

Notes: Use humidified O₂ if possible for transport times > 1 hr



New Four Way Oxygen Therapy Mask



It's a universal mask because it can be used four ways: 1. *Reservoir* type mask; 2. *Straight Rebreathing* mask, by removing center valve cover between bag and face piece; 3. *Positive Pressure* mask, with accessory positive pressure valve; 4. *Supersaturated* oxygen therapy mask, with large bore tubing, no bag.

Fits any size face; imbedded wire inserts adapt mask to all facial contours. Has interchangeable valves, detachable bag, seamless reinforcements, exhalation shield for eyeglass wearers, stomach tube orifice. And the mask can be completely disassembled for sterilizing. Write for prices and descriptive literature.

Above, with accessory positive pressure valve.

Below, with large bore tubing, no bag.



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Branches in 56 Cities

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Oxygen

If patient is experiencing cardiac chest pain titrate SpO₂ to 90%. If 90% or greater, do NOT administer oxygen, but never withhold oxygen from dyspneic patients.



Aspirin

Class: NSAID, Platelet inhibitor

MOA: inhibits prostaglandin and inhibits platelet aggregation

Duration of action: 1-4 hours
analgesia, 10 days anti-platelet

Contraindications: Allergy, Hx of bleeding disorder, active uncontrolled bleeding.



Demand

**B
A
BAYER
E
R**

ASPIRIN

SAY "BAYER ASPIRIN" - *Genuine*

Unless you see the "Bayer Cross" on tablets, you are not getting the genuine Bayer Aspirin prescribed by physicians and proved safe by millions over 25 years.

DOES NOT AFFECT THE HEART

Safe → Accept only "Bayer" package which contains proven directions.
Handy "Bayer" boxes of 12 tablets
Also bottles of 24 and 100—Druggists.

for Colds
Pain
Headache
Neuritis
Toothache
Neuralgia
Lumbago
Rheumatism

Aspirin is the trade mark of Bayer Manufacture of Monoaceticacidester of Salicylicacid

Nitroglycerin

Class: Nitrate, vasodilator

MOA: Releases cGMP, which leads to vasodilation, decreases preload, afterload and dilates coronary arteries

Duration of action: 10-30 min for spray

Contraindications: SBP <100, ED drug use in last 24 hrs, cerebral edema, or raised ICP

Side effects: Headache, hypotension, tachycardia, flushing, dizziness, diaphoresis, rash.



Morphine

Class: opiate analgesic

MOA: binds to opiate receptors producing analgesia and euphoria

Duration of action: 3-4 hours

Contraindications: Allergy, hypotension (SBP < 100), AMS

Side effects: hypoventilation, hypotension, nausea vomiting, more likely than with fentanyl I



Fentanyl

Class: opioid analgesic

MOA: binds to opiate receptors producing analgesia and euphoria

Duration of action: 30 min - 1 hr

Contraindications: Allergy, hypotension (SBP < 100), AMS

Side effects: hypoventilation, hypotension, nausea vomiting, less likely than with morphine.



Which of the following provides the greatest benefit for patients experiencing MI?

- A) Oxygen
- B) Aspirin
- C) Nitroglycerin
- D) Fentanyl
- E) Morphine

Only aspirin has been shown to have a mortality benefit. 23% mortality reduction at 5 weeks

Conclusions

The heart is just a pump

Problems are plumbing or mechanical

Basics matter more than fancy interventions