

Cardiovascular Medicine

from Basic to Clinical


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Cardiovascular Medicine from Basic to Clinical

- Coronary Artery Disease
- Arrhythmias
- Valvular Heart Disease
- Heart Failure

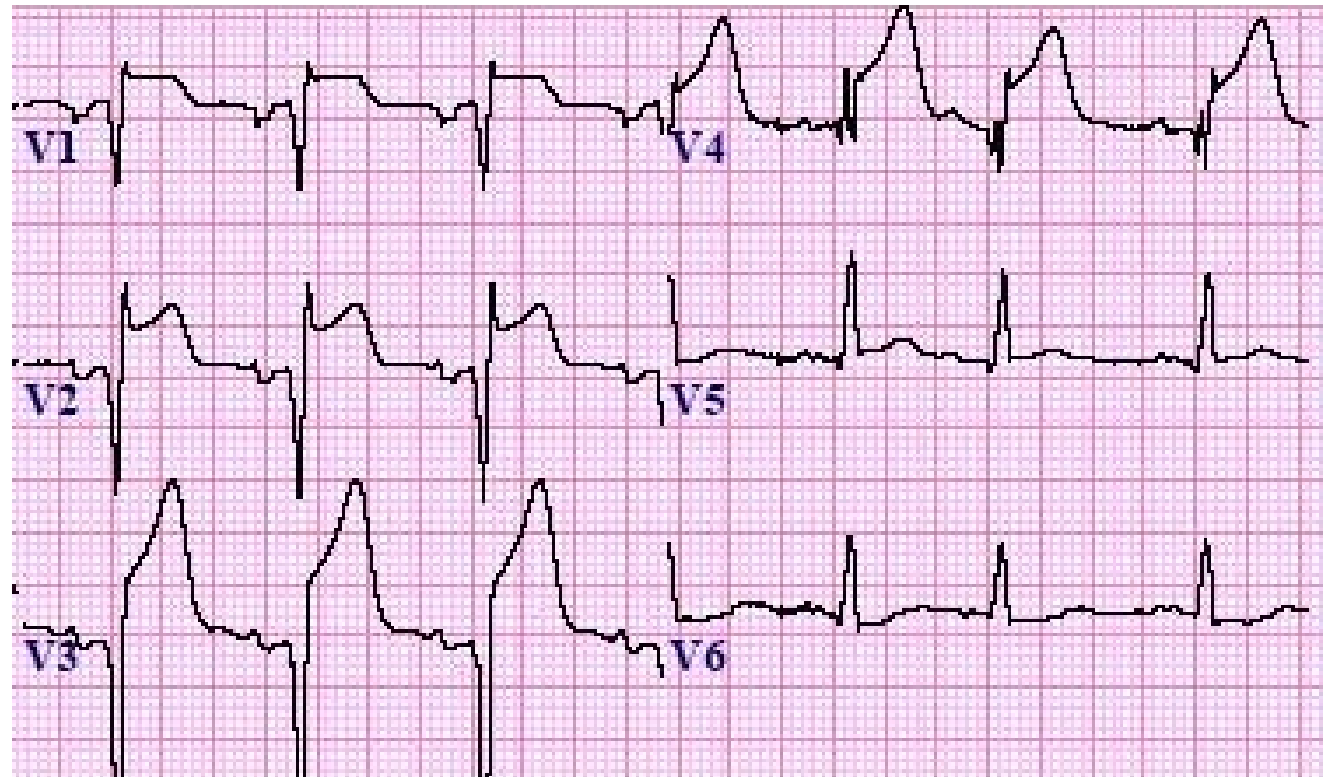


Case 1

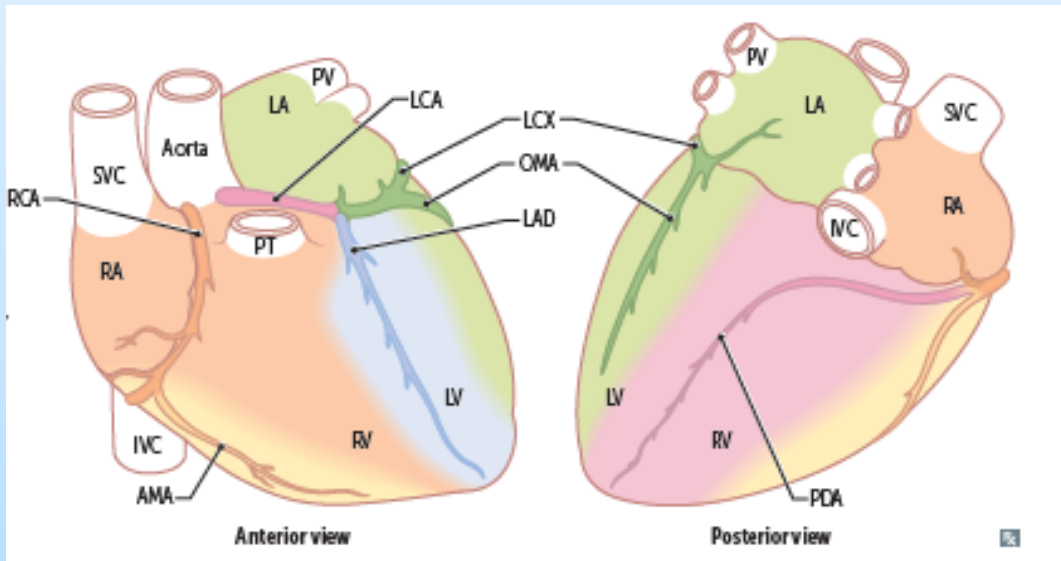
Coronary Artery Disease

Case 1

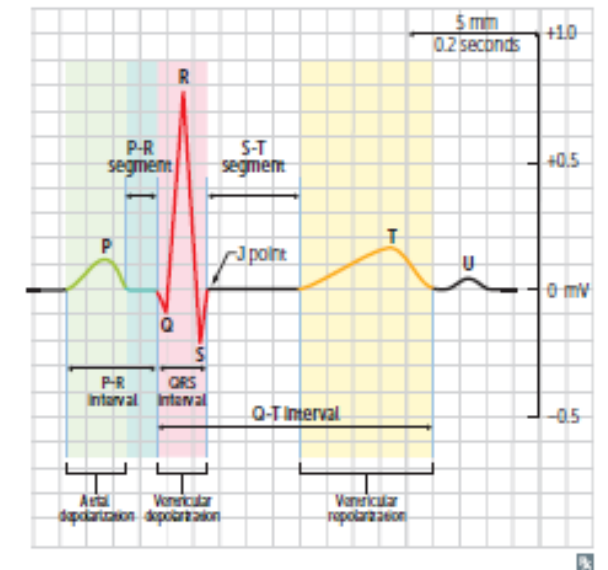
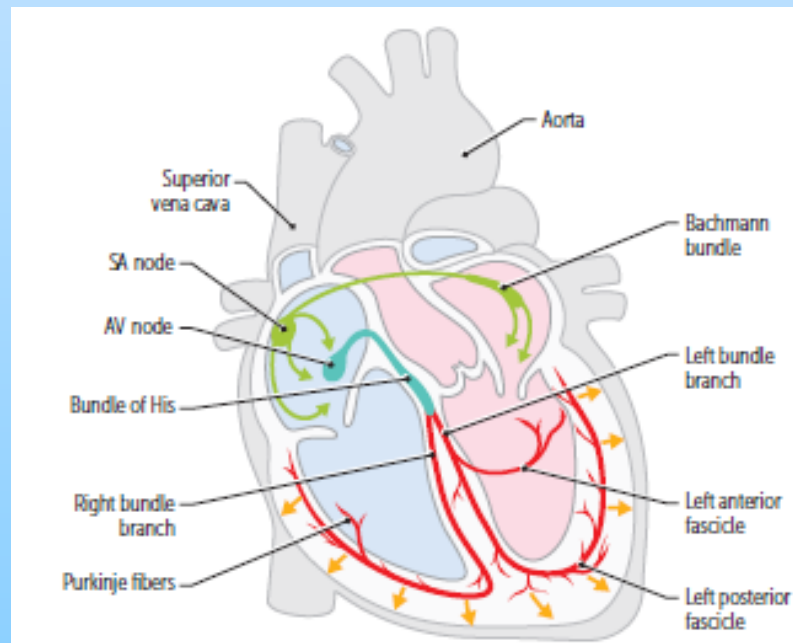
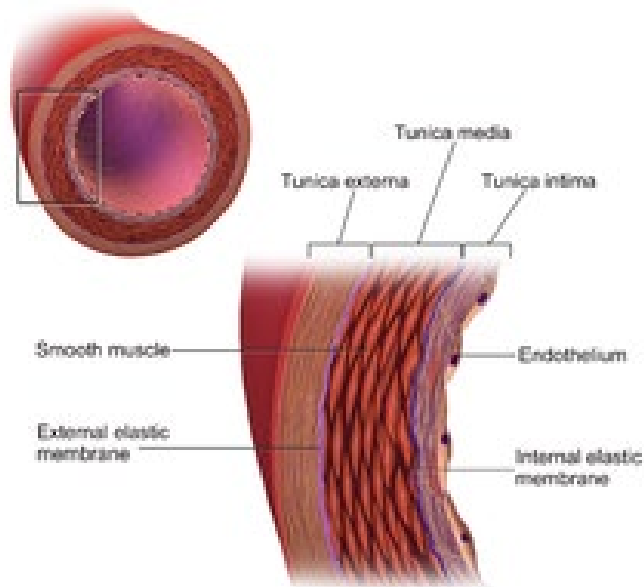
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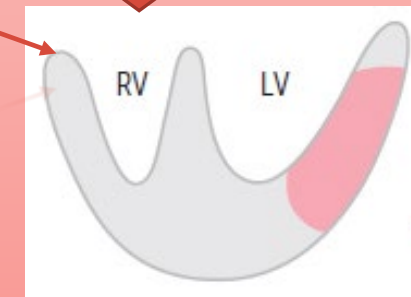
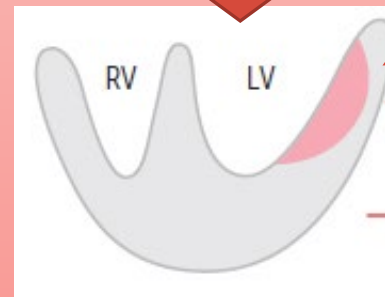
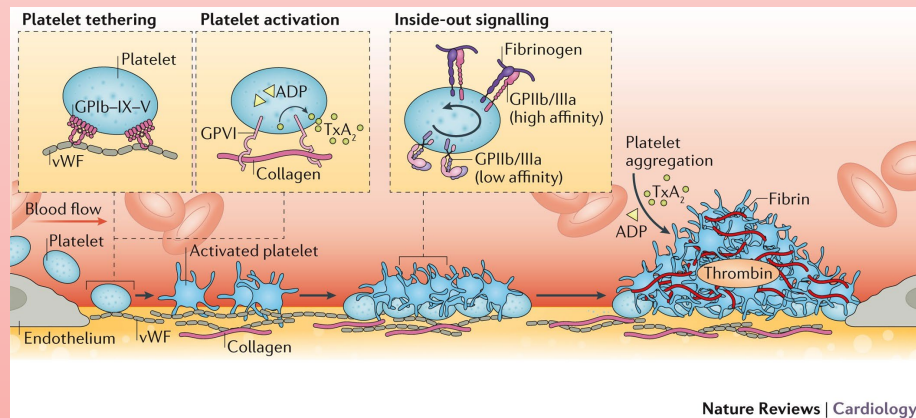
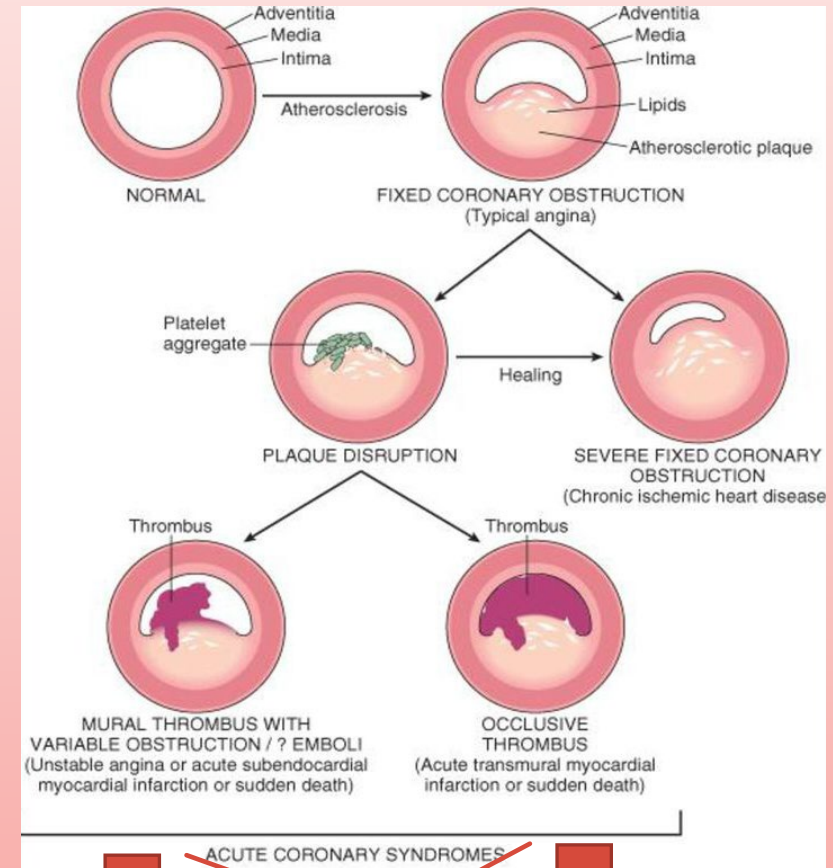
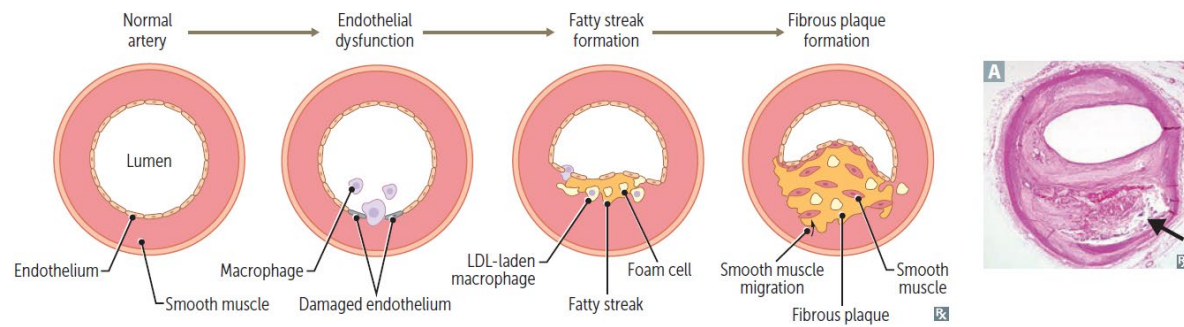
Basic – Anatomy & Physiology



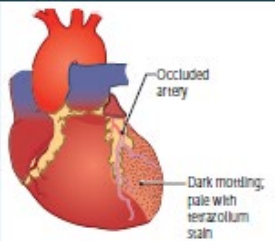
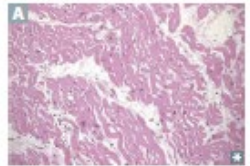
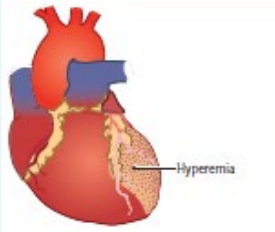
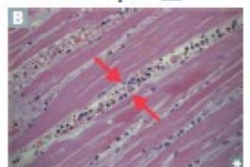
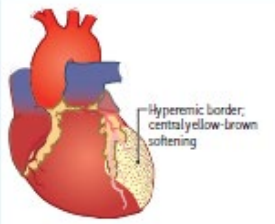
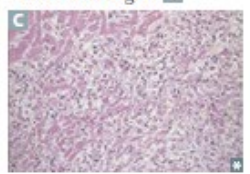
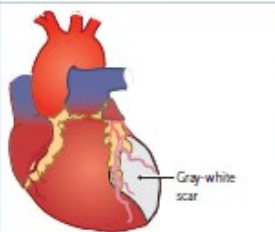
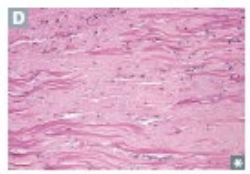
The Structure of an Artery Wall

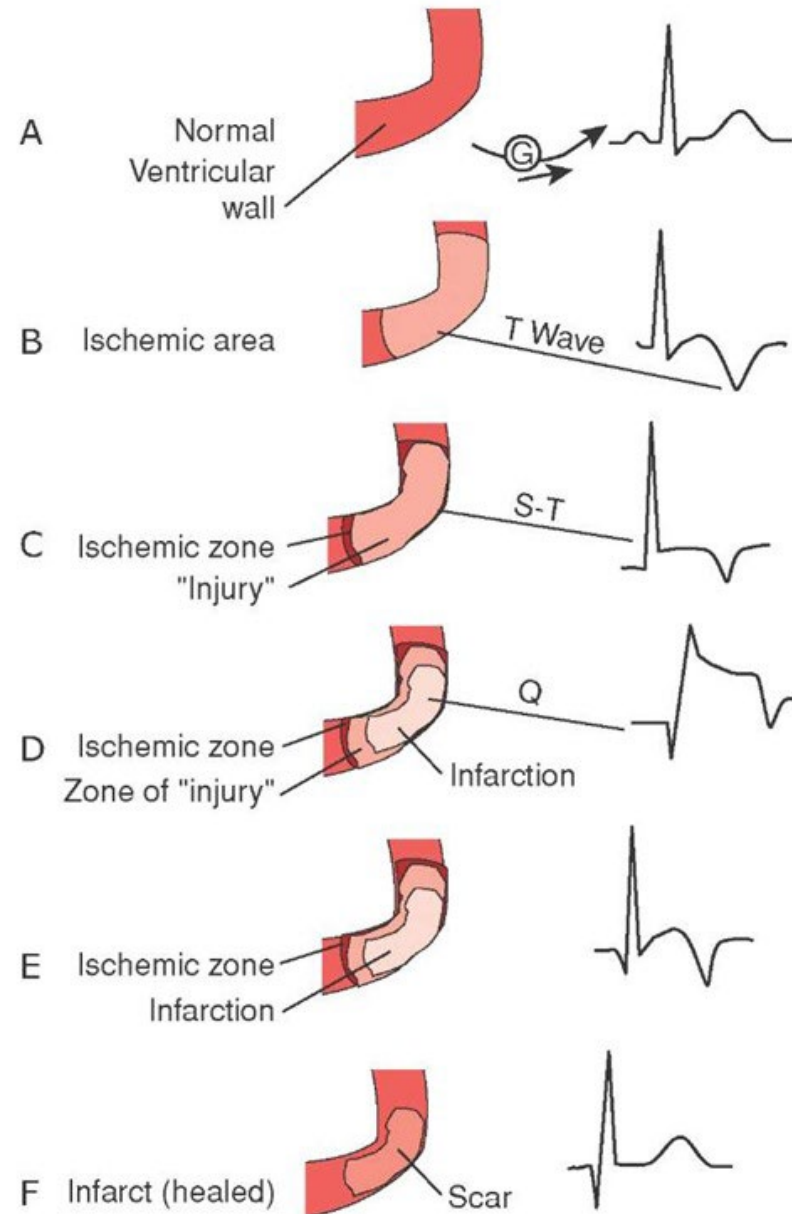


Basic – Pathology



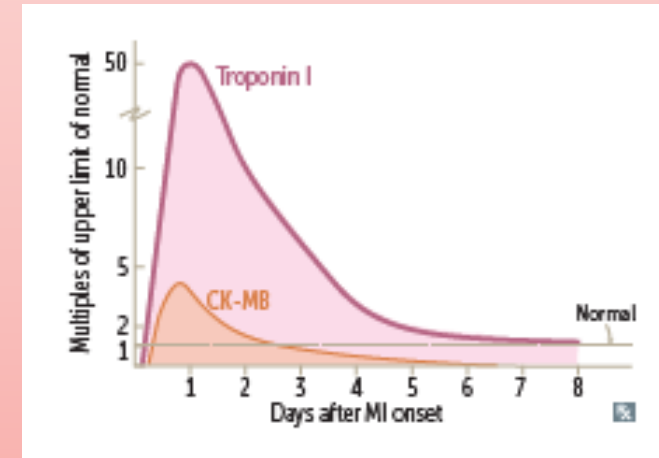
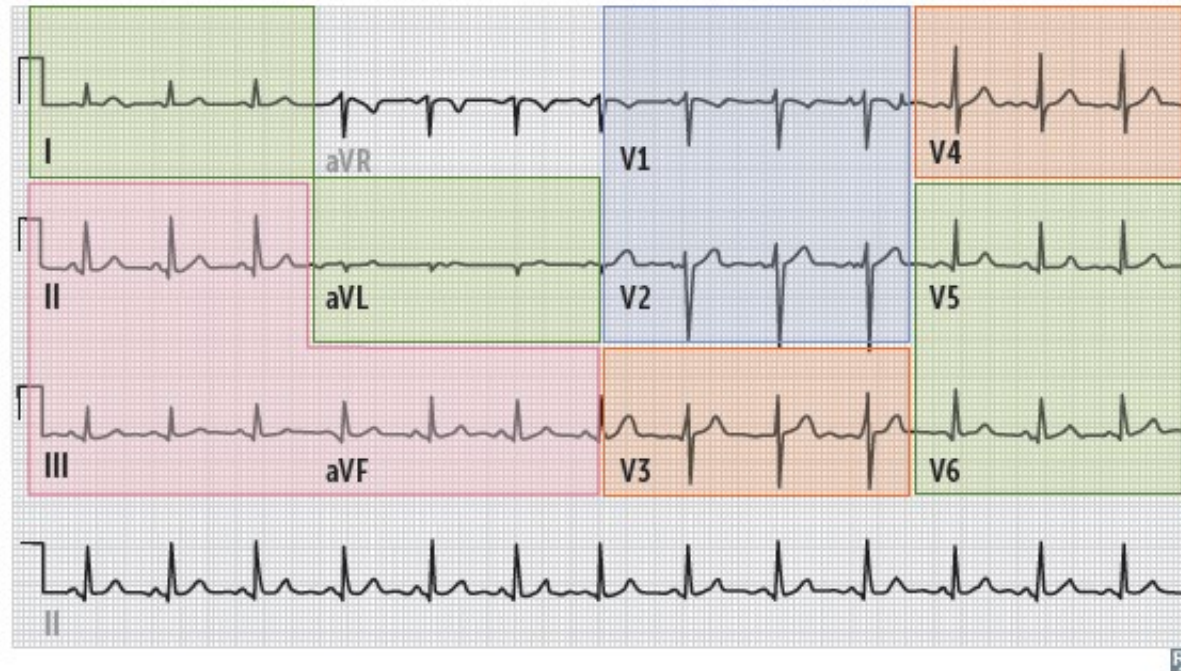
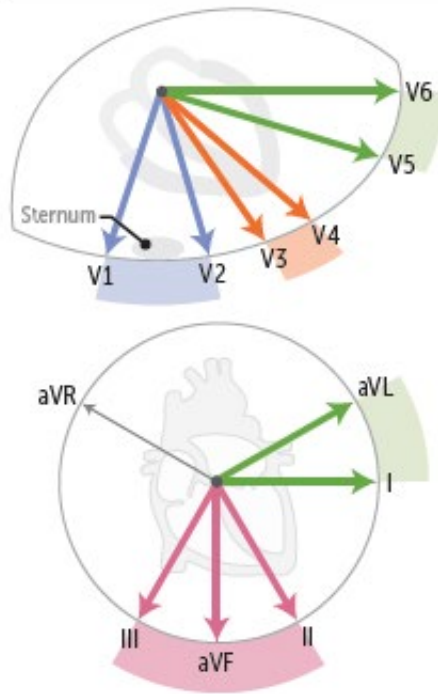
Basic – Pathology

TIME	GROSS	LIGHT MICROSCOPE	COMPLICATIONS
0–24 hours	 <p>Occluded artery</p> <p>Dark mottling; pale with tetrazolium stain</p>	<p>Wavy fibers (0–4 hr), early coagulative necrosis (4–24 hr)</p> <p>A → cell content released into blood; edema, hemorrhage</p> <p>Reperfusion injury → free radicals and ↑ Ca^{2+} influx → hypercontraction of myofibrils (dark eosinophilic stripes)</p> 	Ventricular arrhythmia, HF, cardiogenic shock
1–3 days	 <p>Hyperemia</p>	<p>Extensive coagulative necrosis</p> <p>Tissue surrounding infarct shows acute inflammation with neutrophils B</p> 	Postinfarction fibrinous pericarditis
3–14 days	 <p>Hyperemic border; central yellow-brown softening</p>	<p>Macrophages, then granulation tissue at margins C</p> 	<p>Free wall rupture → tamponade; papillary muscle rupture → mitral regurgitation; interventricular septal rupture due to macrophage-mediated structural degradation → left-to-right shunt</p> <p>LV pseudoaneurysm (risk of rupture)</p>
2 weeks to several months	 <p>Gray-white scar</p>	<p>Contracted scar complete D</p> 	Dressler syndrome, HF, arrhythmias, true ventricular aneurysm (risk of mural thrombus)

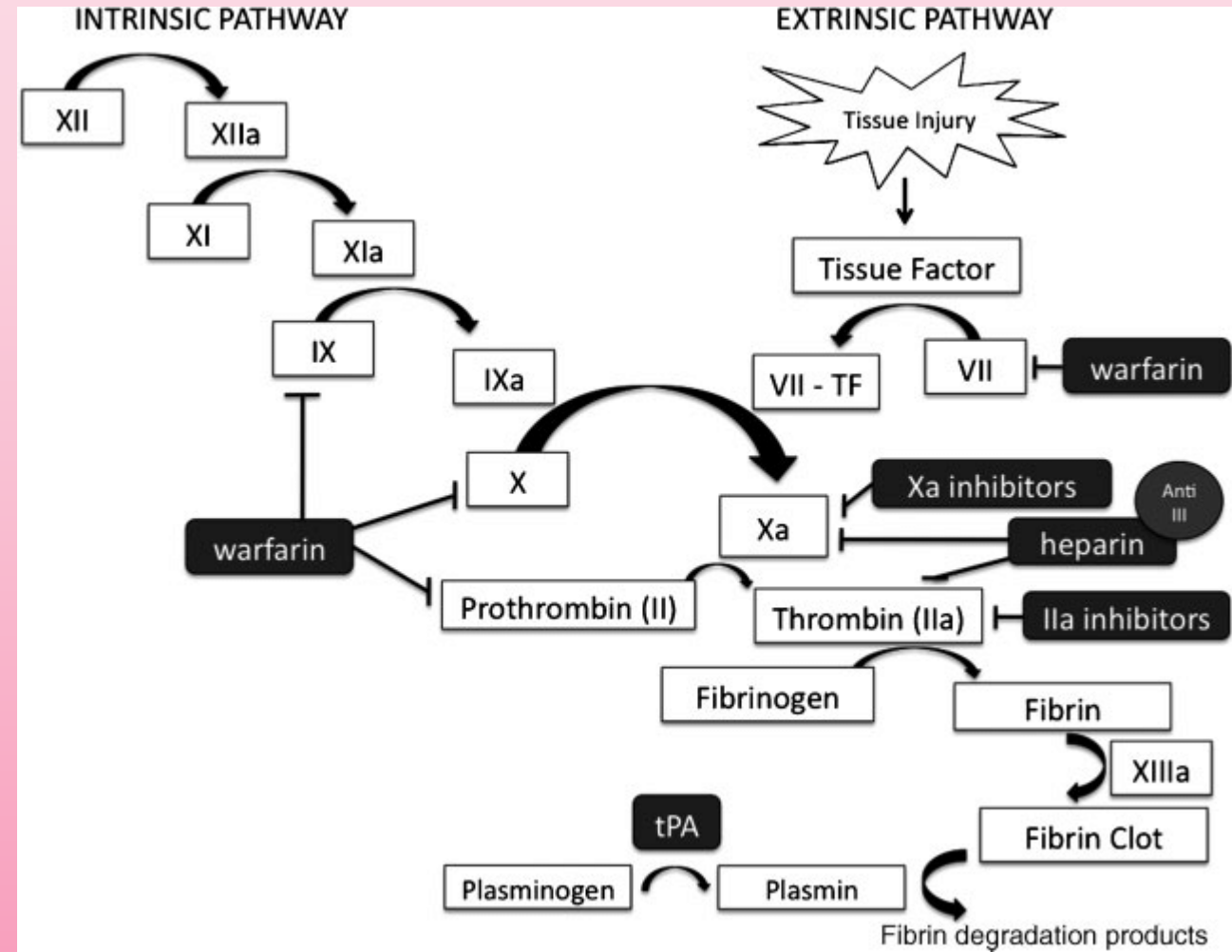
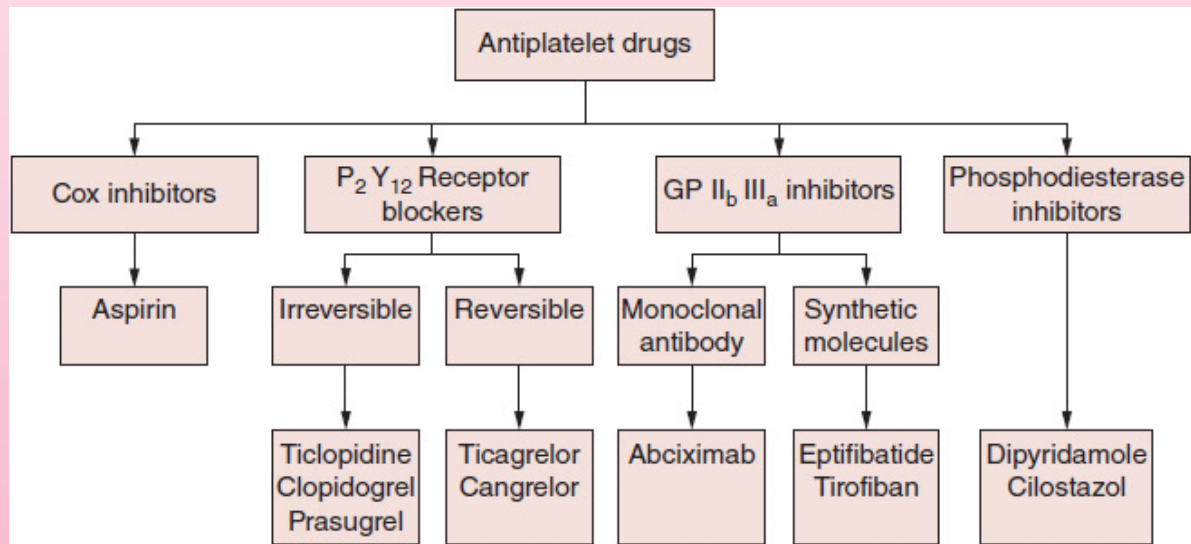


Basic – Pathology

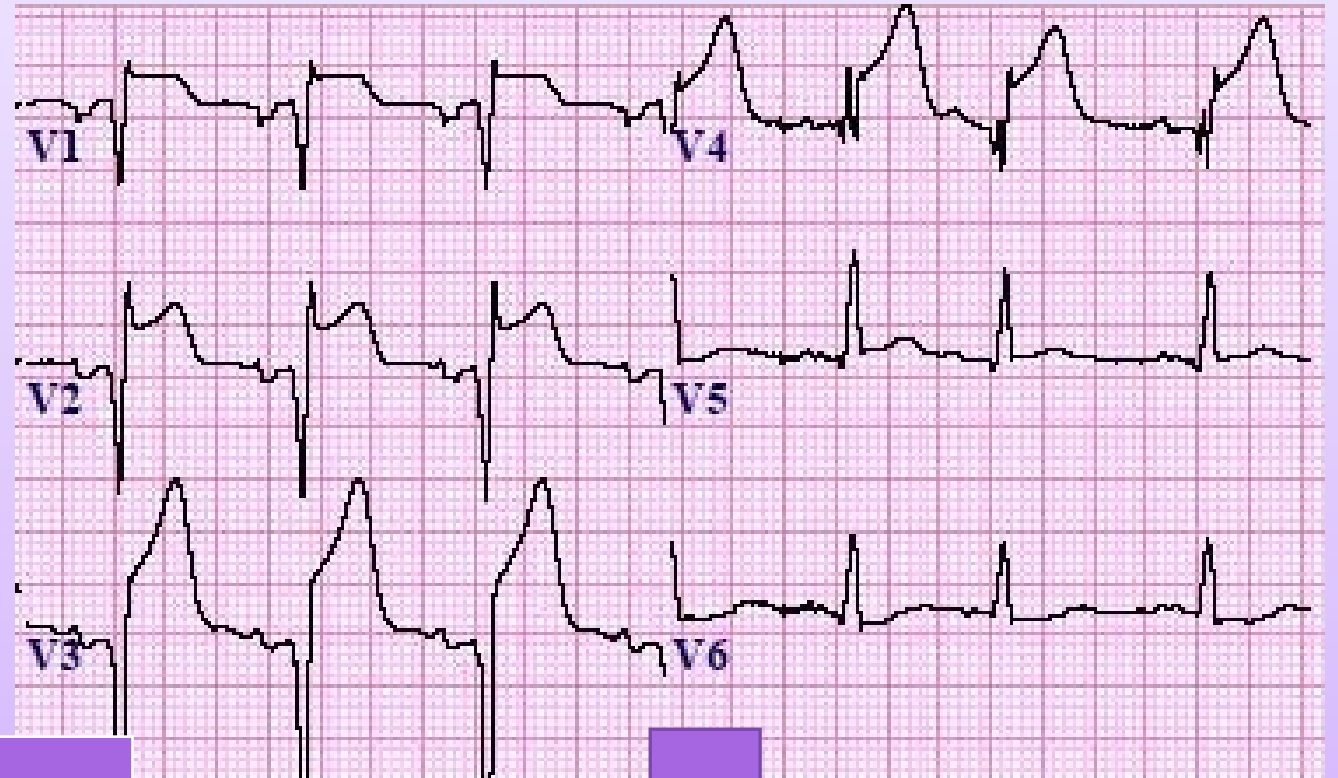
INFARCT LOCATION	LEADS WITH ST-SEGMENT ELEVATIONS OR Q WAVES
Anteroseptal (LAD)	V ₁ -V ₂
Anteroapical (distal LAD)	V ₃ -V ₄
Anterolateral (LAD or LCX)	V ₅ -V ₆
Lateral (LCX)	I, aVL
Inferior (RCA)	II, III, aVF
Posterior (PDA)	V ₇ -V ₉ , ST depression in V ₁ -V ₃ with tall R waves



Basic – Pharmacology



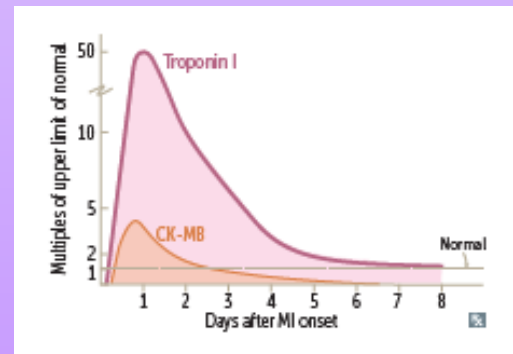
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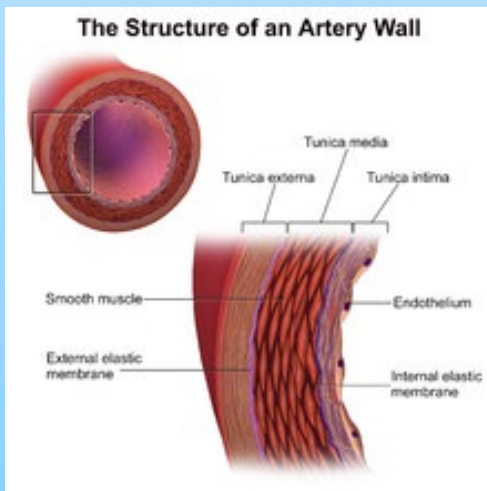
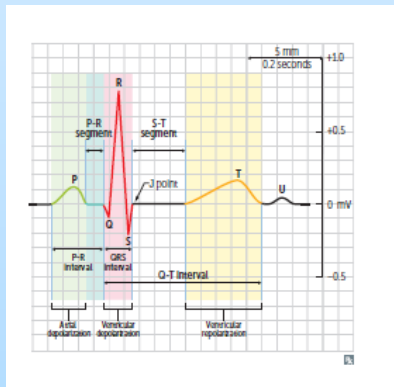
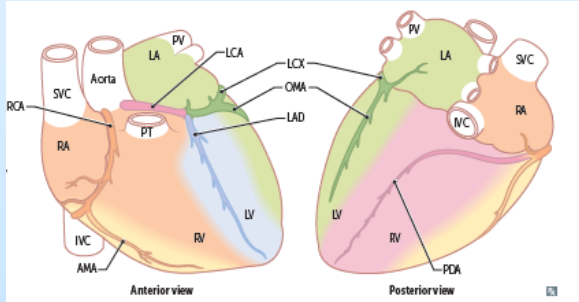
Treatment

Antiplatelet	Aspirin	P2Y ₁₂ Inhibitor
Improve Flow	Nitrates	
Decrease Demand	B-Blockers	
Plaque Stabilization	B-blockers	Statins
Anticoagulant	Heparin	LMWH
Revascularization	Fibrinolytics	PCI

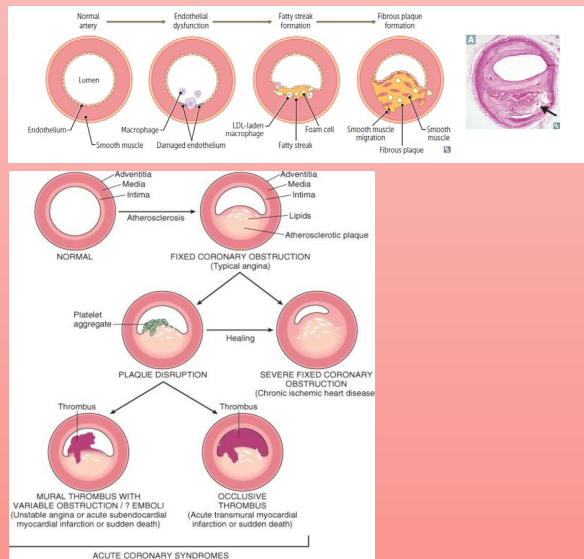
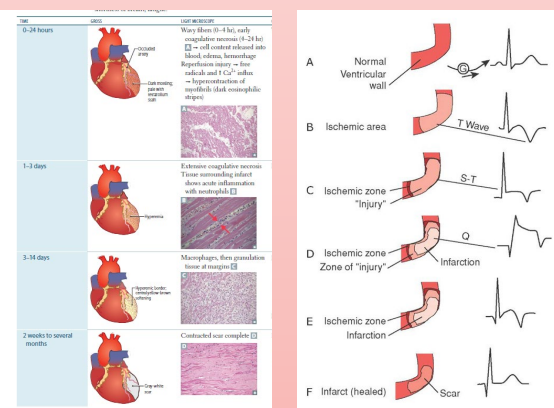
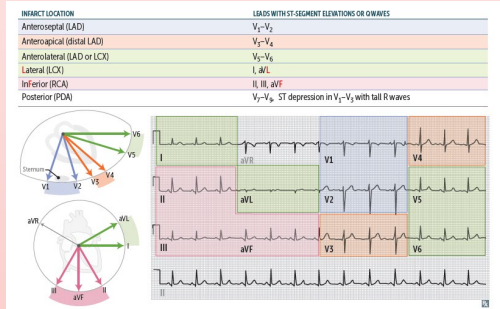
ST Elevation MI



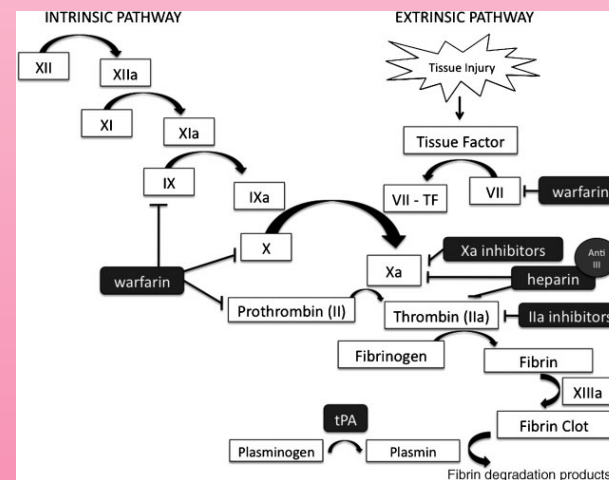
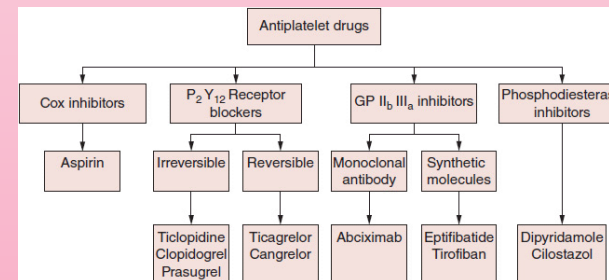
Basic - Physiology



Basic - Pathology

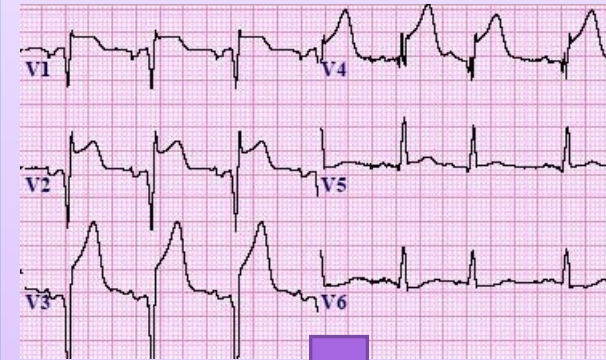


Basic - Pharmacology

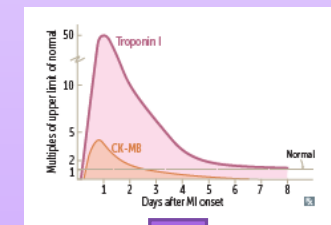


Clinical

The patient is a 65-year-old male, known case of Hypertension, Diabetes, Dyslipidemia, came to ED complaining of **Chest Pain** of 6 hours duration.



STEMI



Treatment		
Antiplatelet	Aspirin	P2Y12 Inhibitor
Improve Flow	Nitrates	
Decrease Demand	B-Blockers	
Plaque Stabilization	B-blockers	Statins
Anticoagulant	Heparin	LMWH
Revascularization	Fibrinolytics	PCI



Case 2

Arrythmias

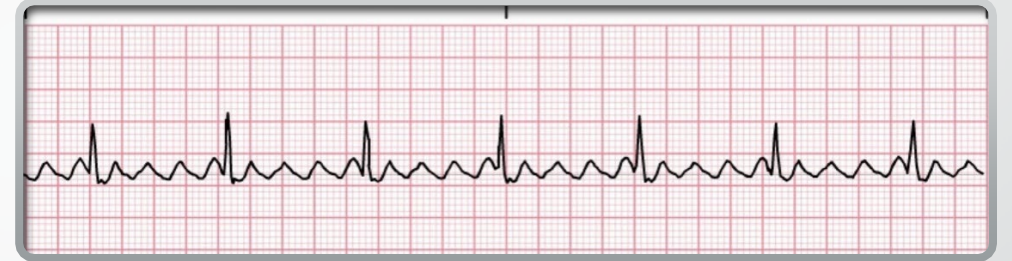
Case 2

The patient is a 38-year-old female, recent history of Bronchitis treated with Azithromycin, heavy EtOH drinker, came to ED complaining of **Palpitations** in last 2 days.

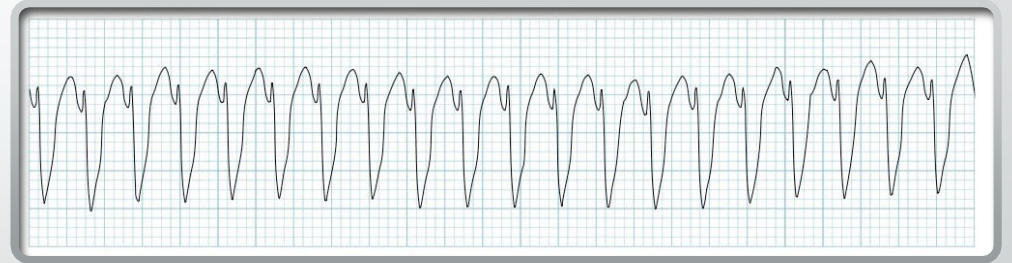
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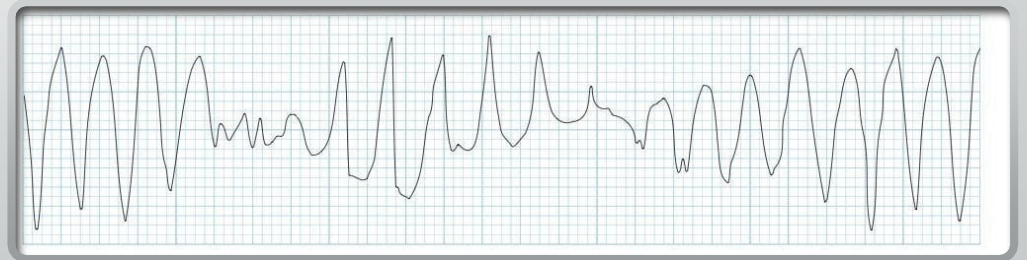
B.



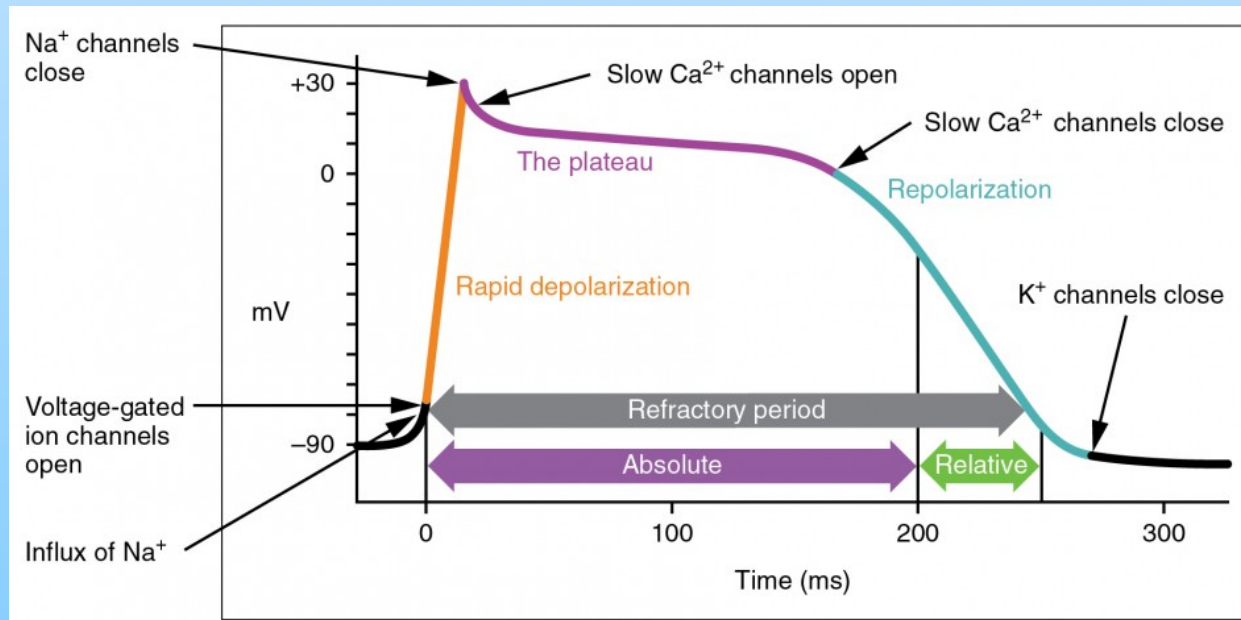
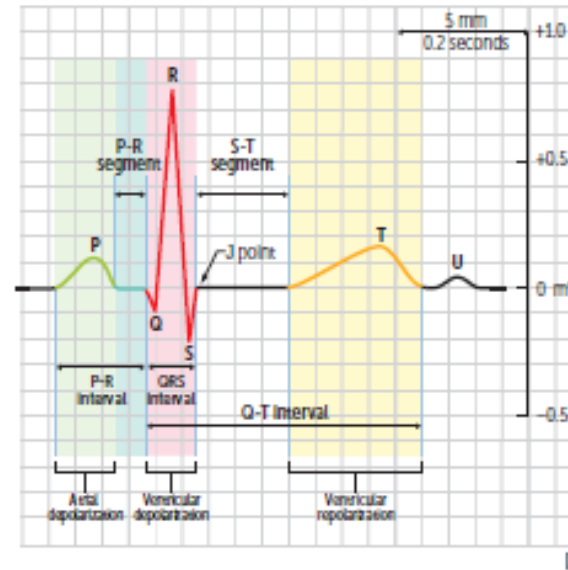
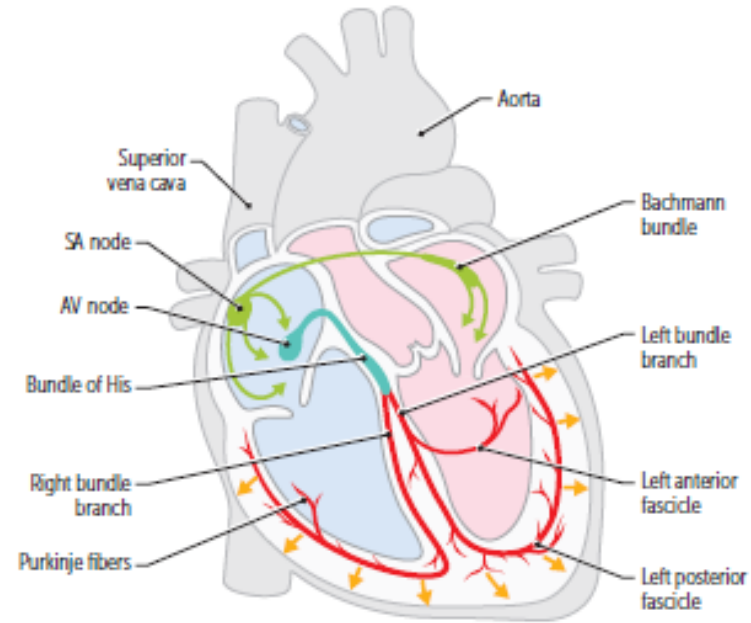
C.



D.

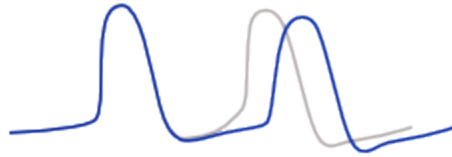


Basic – Anatomy & Physiology

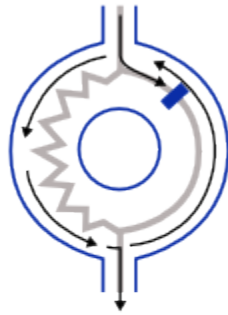


Mechanisms of Arrhythmias

Abnormal Automaticity

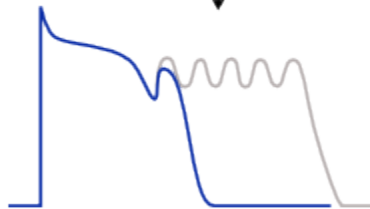


Re-entry



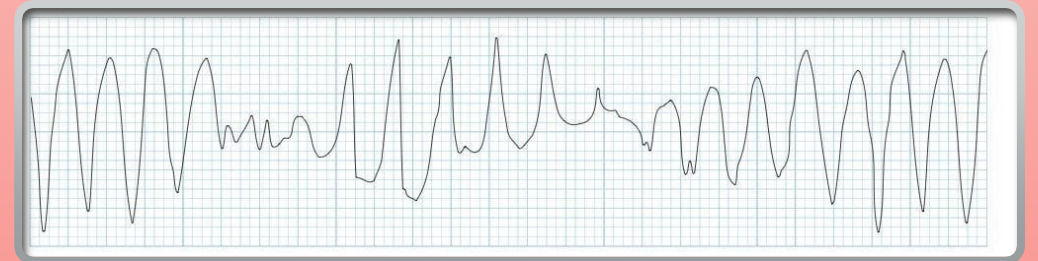
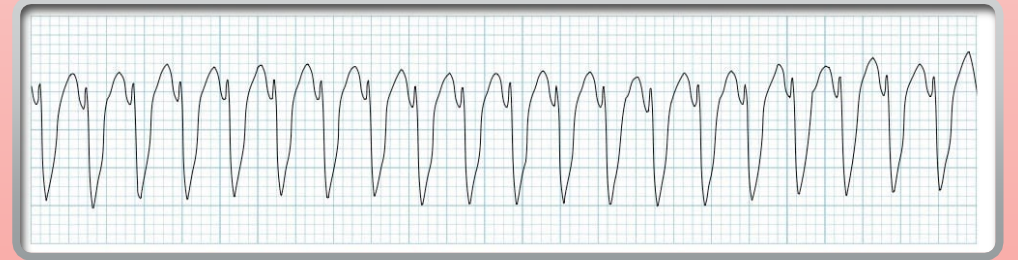
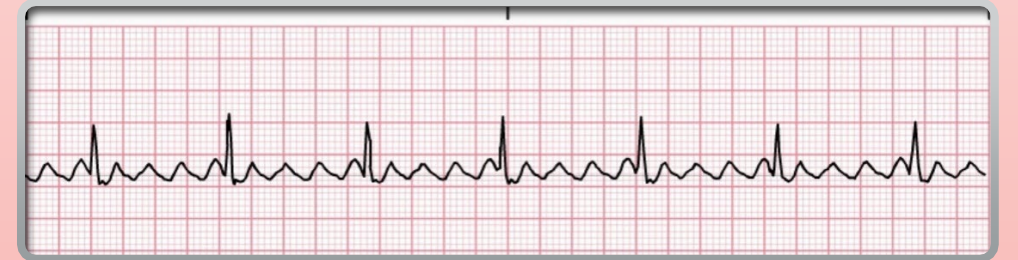
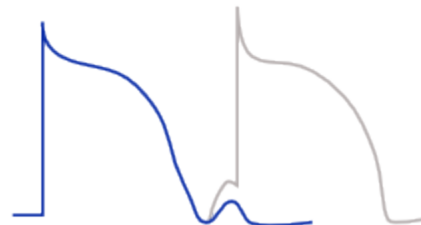
Triggered activity

Early Afterdepolarizations

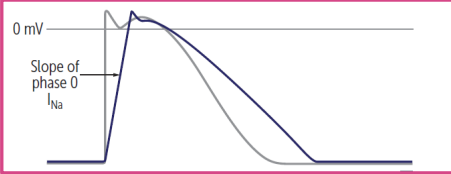
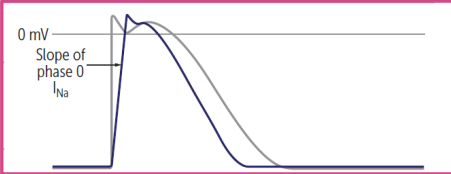
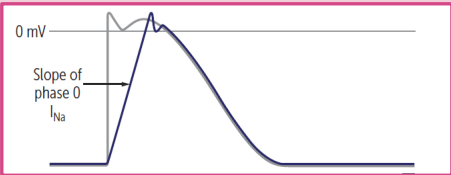
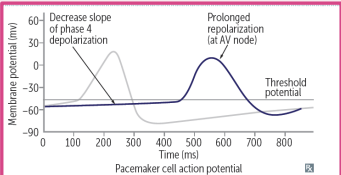
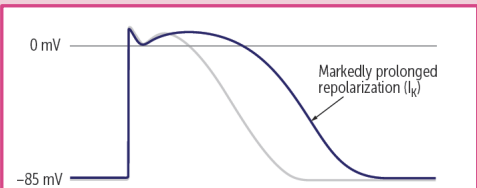
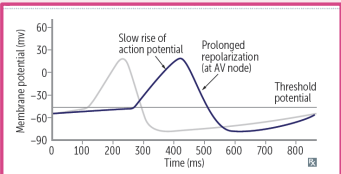


Triggered activity

Delayed Afterdepolarizations



Basic – Pharmacology

Antiarrhythmic Class	Function	Drugs	Clinical Use	Limitations
Class IA		Quinidine Procainamide Disopyramide	Re-entrant Atrial & Ventricular Arrhythmia	Cinchonism TdP SLE like S/E
Class IB		Lidocaine Phenytoin Mexiletine	Acute VT, esp. Ischemic Digoxin induced Arrhythmias	CNS Toxicity
Class IC		Flecainide Propafenone	SVT	Proarrhythmic
Class II		B-Blockers	Increased Automaticity SVT Rate Control	Bradycardia & Hypotension ED Asthma
Class III		Amiodarone Ibutilide Dofetilide Sotalol	Atrial Fibrillation / Flutter VT	TdP Amiodarone S/E
Class IV		CCB (Verapamil, Diltiazem)	SA / AV Nodal Control	Bradycardia LV Dysfunction

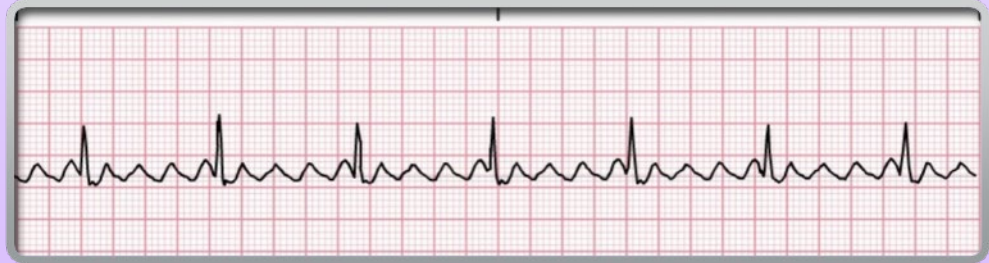
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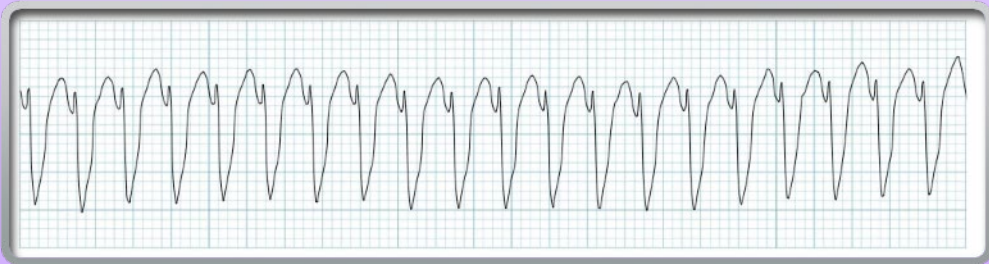
PVC

B.



Atrial Flutter

C.



Monomorphic VT

D.



Polymorphic VT
(TdP)

Treatment

B-Blockers

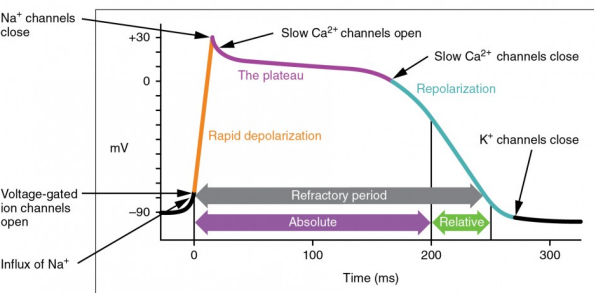
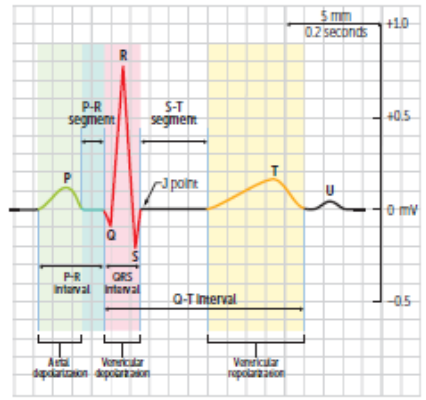
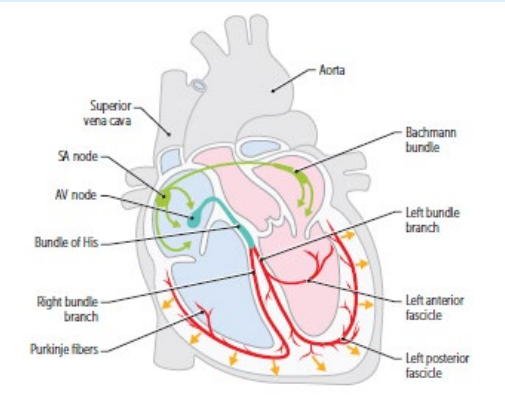
Rate Control (B-Blockers, CCB)

Rhythm Control (Class III, Class IA/IC)

Amiodarone
Class IB

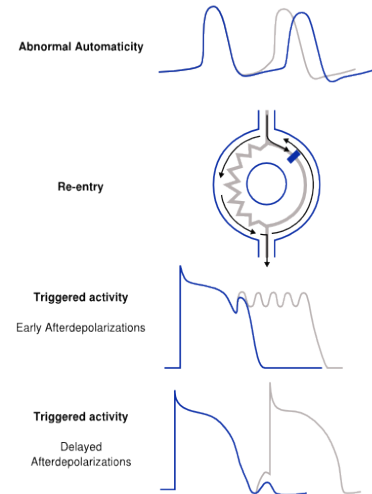
Magnesium

Basic - Physiology



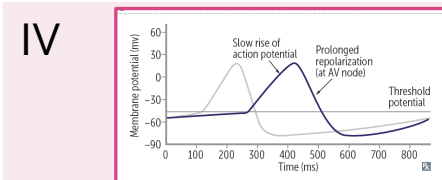
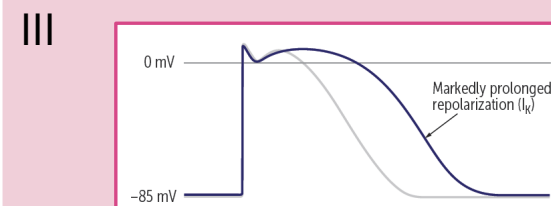
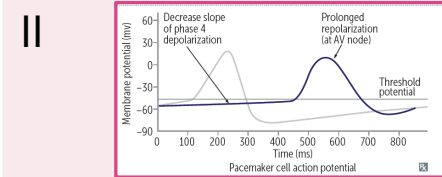
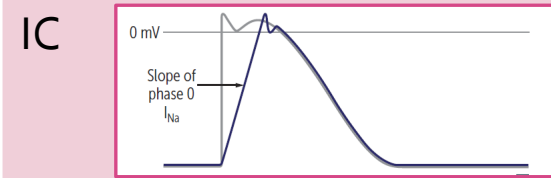
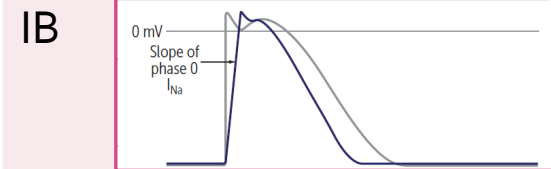
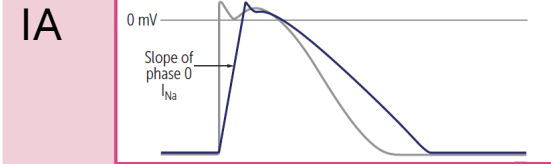
Basic - Pathology

Mechanisms of Arrhythmias



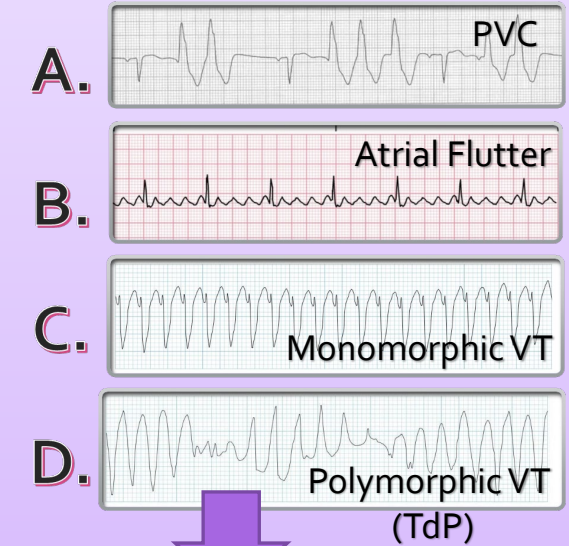
Basic - Pharmacology

Antiarrhythmic Class



Clinical

The patient is a 38-year-old female, recent history of Bronchitis treated with Azithromycin, heavy EtOH drinker, came to ED complaining of **Palpitations** in last 2 days.



Treatment

B-Blockers

Rate Control
(B-Blockers, CCB)
Rhythm Control
(Class III, Class IA/IC)

Amiodarone
Class IB

Magnesium



Case 3

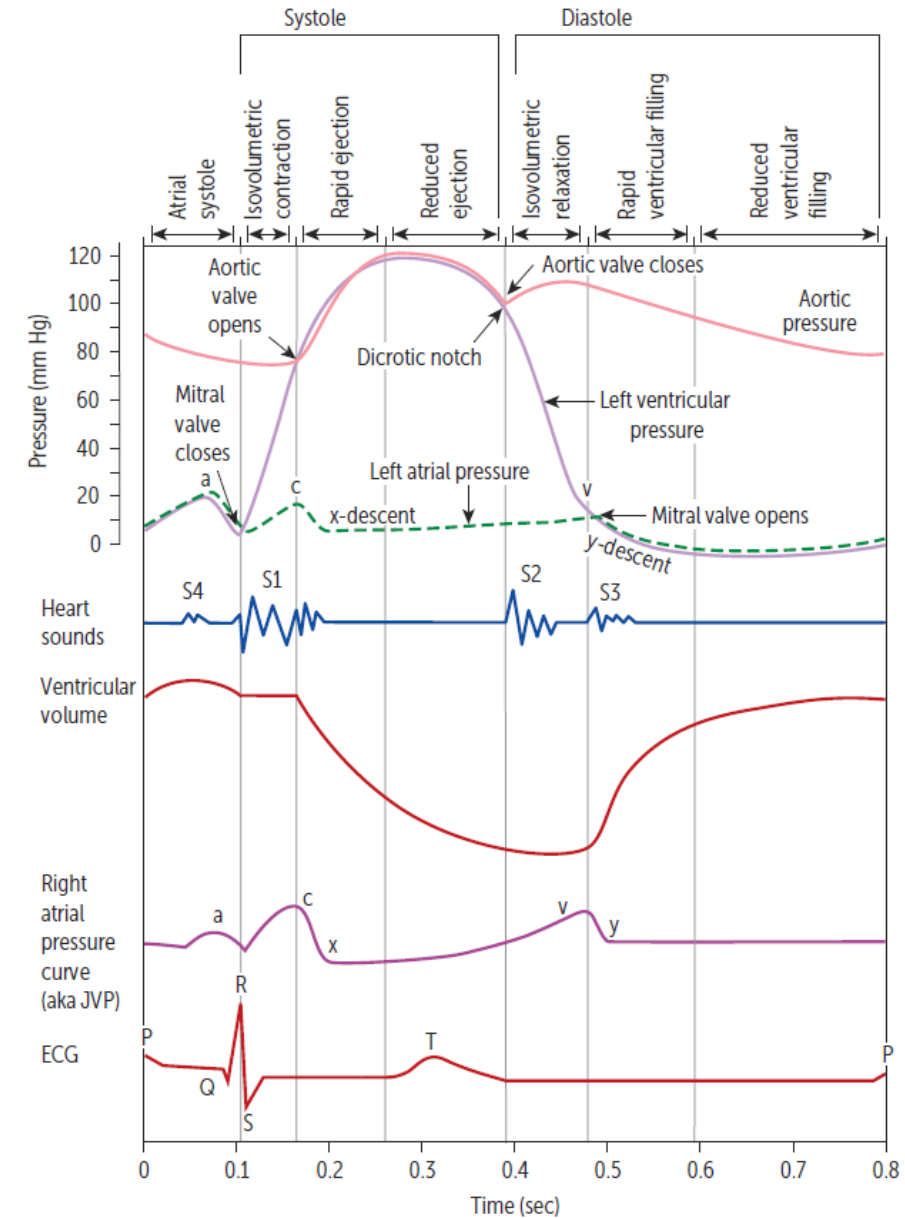
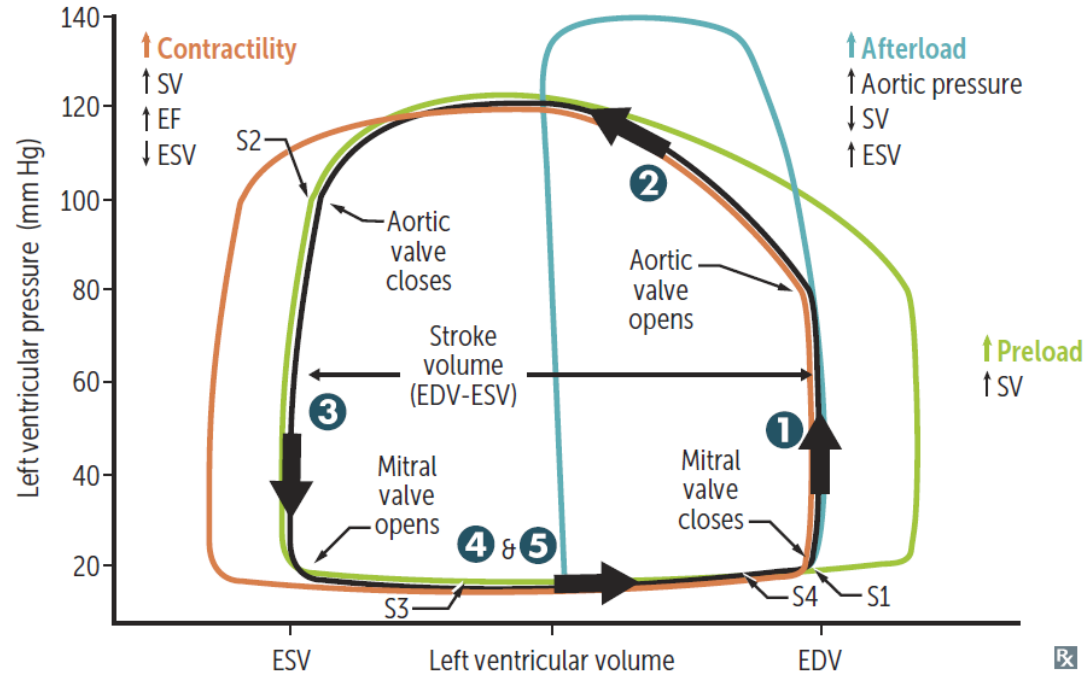
Valvular Heart Disease

Case 3

The patient is a 50-year-old male, came to clinic complaining of **Chest pain on Exertion and Recurrent Syncope** in last 2 months. On Physical Exam, he had an crescendo-decrescendo systolic murmur with ejection click.

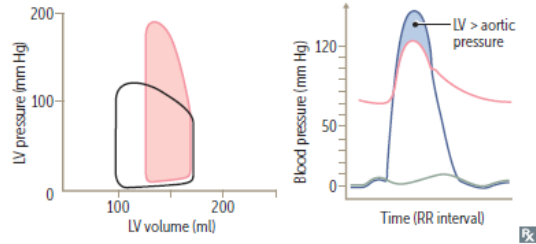
Basic – Anatomy & Physiology

Pressure-volume loops and cardiac cycle



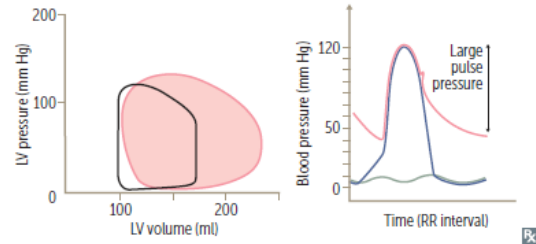
Pressure-volume loops and valvular disease

Aortic stenosis



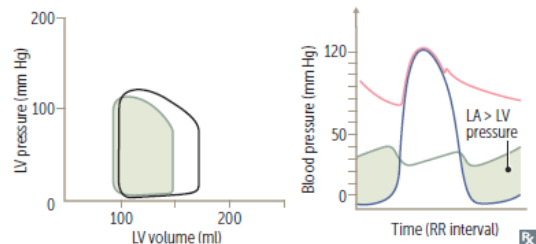
↑ LV pressure
 ↑ ESV
 No change in EDV (if mild)
 ↓ SV
 Ventricular hypertrophy → ↓ ventricular compliance → ↑ EDP for given EDV

Aortic regurgitation



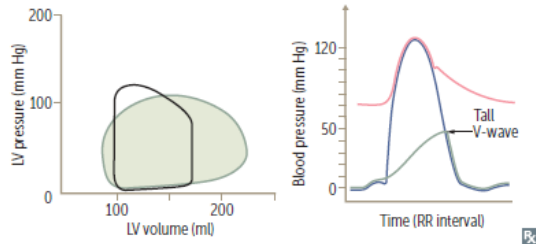
No true isovolumetric phase
 ↑ EDV
 ↑ SV
 Loss of dichrotic notch

Mitral stenosis



↑ LA pressure
 ↓ EDV because of impaired ventricular filling
 ↓ ESV
 ↓ SV

Mitral regurgitation

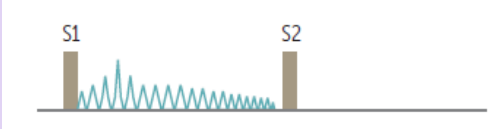
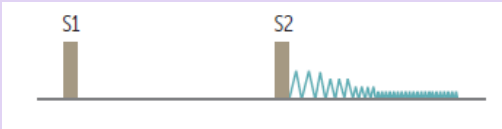
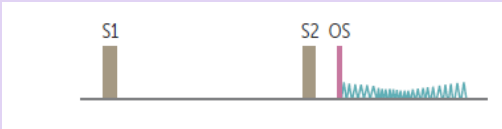
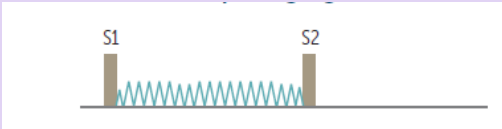


No true isovolumetric phase
 ↓ ESV due to ↓ resistance and ↑ regurgitation into LA during systole
 ↑ EDV due to ↑ LA volume/pressure from regurgitation → ↑ ventricular filling
 ↑ SV (forward flow into systemic circulation plus backflow into LA)

VHD	Key Concepts	Result	Clinical
Aortic Stenosis	↑ LVP	Subendocardial Ischemia	Angina
	↓ SV	↓ Afterload	Syncope
Aortic Regurgitation	Bradycardia	Longer Regurg. Time	↑ HF
Mitral Stenosis	Tachycardia	Shorter Filling time	Pul. Edema
Mitral Regurgitation	↑ Afterload	Increased Regurgitation	↑ HF

Clinical – Diagnosis

The patient is a 50-year-old male, came to clinic complaining of **Chest pain on Exertion and Recurrent Syncope** in last 2 months. On Physical Exam, he had a crescendo-decrescendo systolic murmur with ejection click.

Valvular Heart Disease	Symptoms	Physical Examination
Aortic Stenosis	Angina, Dyspnea, Syncope, HF	 A diagram of heart sounds for Aortic Stenosis. It shows a normal S1 (brown bar), followed by a narrow, high-pitched, crescendo-decrescendo systolic murmur (green line) that starts after S1 and ends before S2. S2 is normal (brown bar).
Aortic Regurgitation	HF	 A diagram of heart sounds for Aortic Regurgitation. It shows a normal S1 (brown bar), followed by a diastolic murmur (green line) that starts after S2 and continues through diastole. S2 is normal (brown bar).
Mitral Stenosis	Pulmonary Congestion	 A diagram of heart sounds for Mitral Stenosis. It shows a normal S1 (brown bar), followed by a diastolic murmur (green line) that starts after S2 and continues through diastole. S2 is normal (brown bar), and there is a small pink bar labeled 'OS' (opening snap) shortly after S2.
Mitral Regurgitation	HF	 A diagram of heart sounds for Mitral Regurgitation. It shows a normal S1 (brown bar), followed by a high-pitched, holosystolic murmur (green line) that starts after S1 and continues through systole. S2 is normal (brown bar).

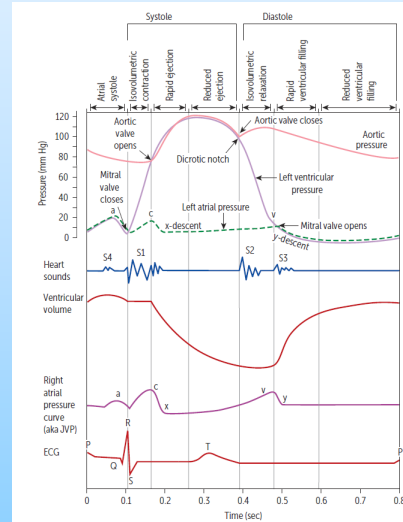
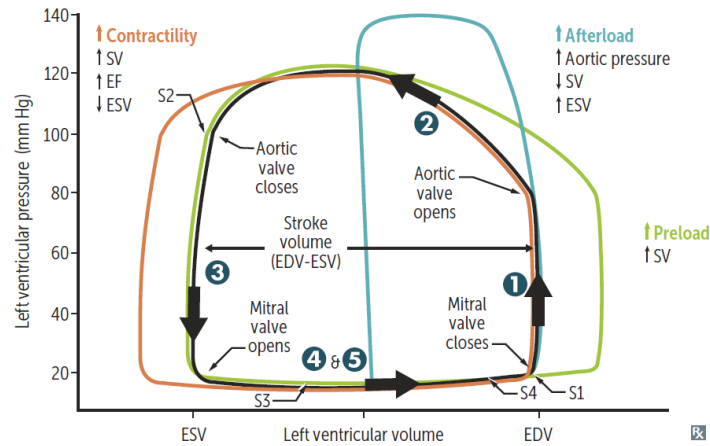
Clinical – Treatment

The patient is a 50-year-old male, came to clinic complaining of **Chest pain on Exertion and Recurrent Syncope** in last 2 months. On Physical Exam, he had an crescendo-decrescendo systolic murmur with ejection click.

Valvular Heart Disease	Symptoms	Key Treatment	Treatment
Aortic Stenosis	Angina, Dyspnea, Syncope, HF	↓ LVP Avoid ↓ Afterload	Relief Mech. Obstruction Avoid Vasodilators
Aortic Regurgitation	HF	↓ Afterload Avoid Bradycardia	Diuretics Vasodilators Avoid B-blockers, CCB
Mitral Stenosis	Pulmonary Congestion	Avoid Tachycardia	B-Blockers Diuretics
Mitral Regurgitation	HF	↓ Afterload	Vasodilators Diuretics

Basic - Physiology

Pressure-volume loops and cardiac cycle

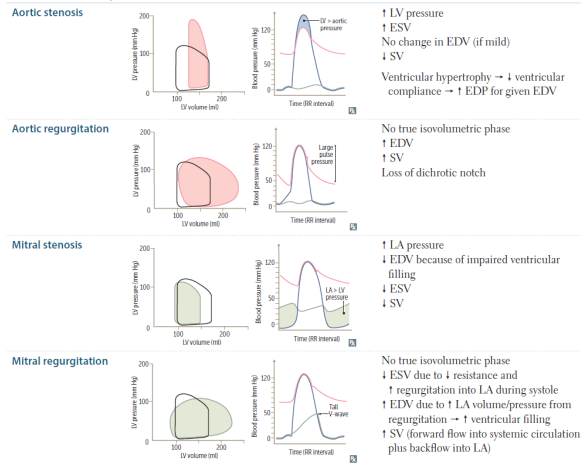


Clinical - Treatment

Valvular Heart Disease	Symptoms	Key Treatment	Treatment
Aortic Stenosis	Angina, Dyspnea, Syncope, HF	↓ LVP Avoid ↓ Afterload	Relief Mech. Obstruction Avoid Vasodilators
Aortic Regurgitation	HF	↓ Afterload Avoid Bradycardia	Diuretics Vasodilators Avoid B-blockers, CCB
Mitral Stenosis	Pulmonary Congestion	Avoid Tachycardia	B-Blockers Diuretics
Mitral Regurgitation	HF	↓ Afterload	Vasodilators Diuretics

Basic - Pathology

Pressure-volume loops and valvular disease



VHD	Key Concepts	Result	Clinical
Aortic Stenosis	↑ LVP	Subendocardial Ischemia	Angina
	↓ SV	↓ Afterload	Syncope
Aortic Regurgitation	Bradycardia	Longer Regurg. Time	↑ HF
Mitral Stenosis	Tachycardia	Shorter Filling time	Pul. Edema
Mitral Regurgitation	↑ Afterload	Increased Regurgitation	↑ HF

Clinical - Diagnosis

Valvular Heart Disease	Symptoms	Physical Examination
Aortic Stenosis	Angina, Dyspnea, Syncope, HF	
Aortic Regurgitation	HF	
Mitral Stenosis	Pulmonary Congestion	
Mitral Regurgitation	HF	



Case 4

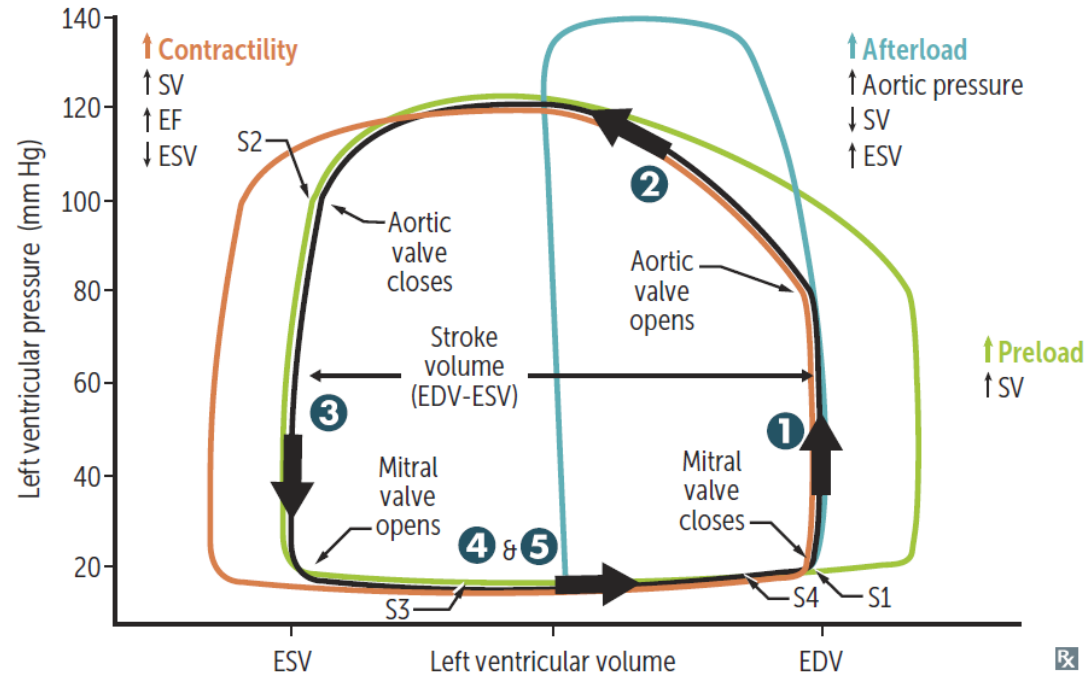
Heart Failure



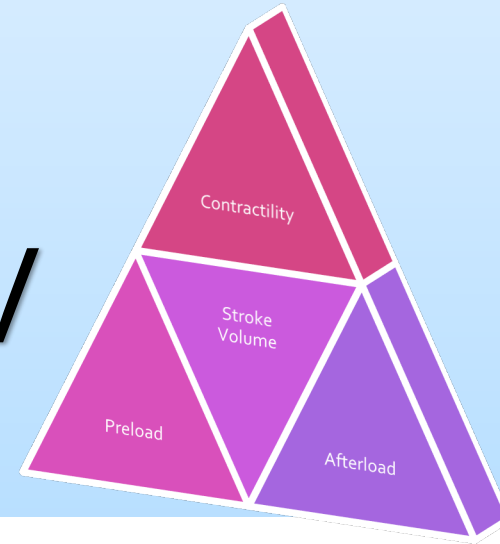
Case 4

The patient is a 55-year-old female, recent history of COVID Infection 2 weeks ago, came to ED complaining of **Dyspnea and Lower Extremity Swelling** in last week.

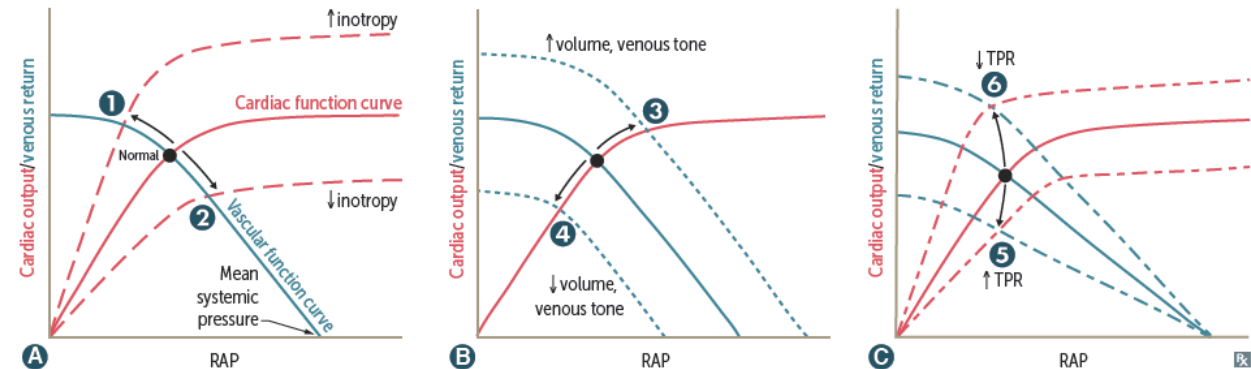
Pressure-volume loops and cardiac cycle



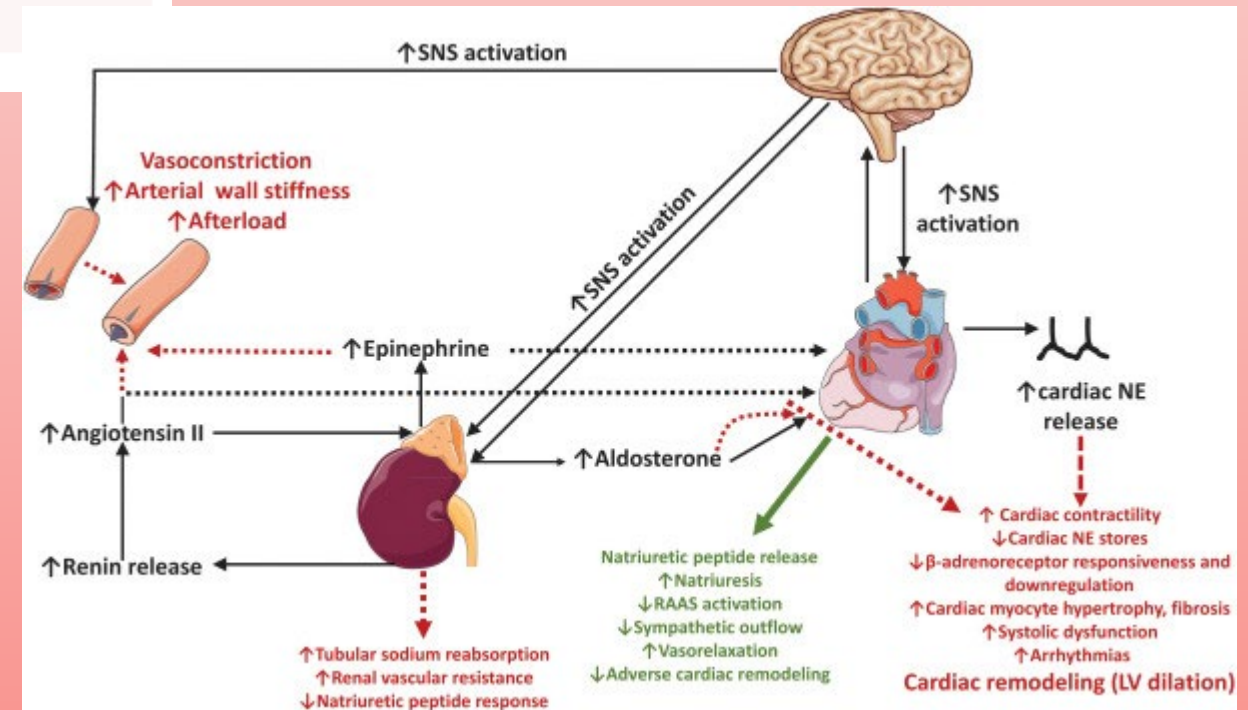
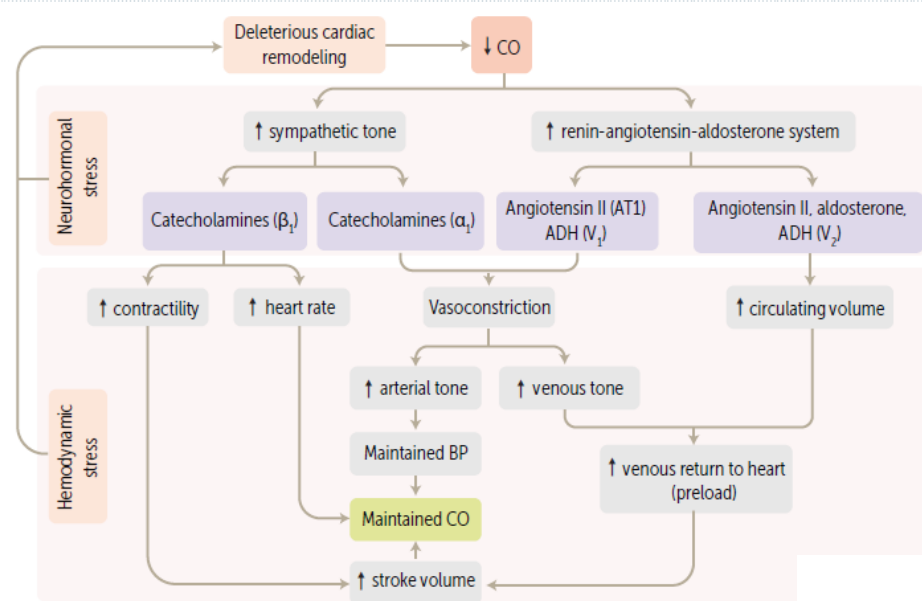
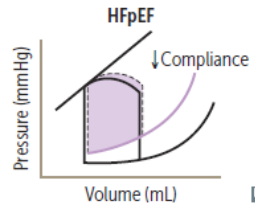
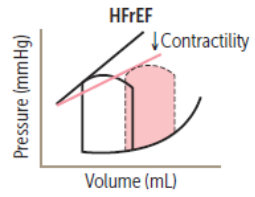
$$C.O. = HR \times SV$$

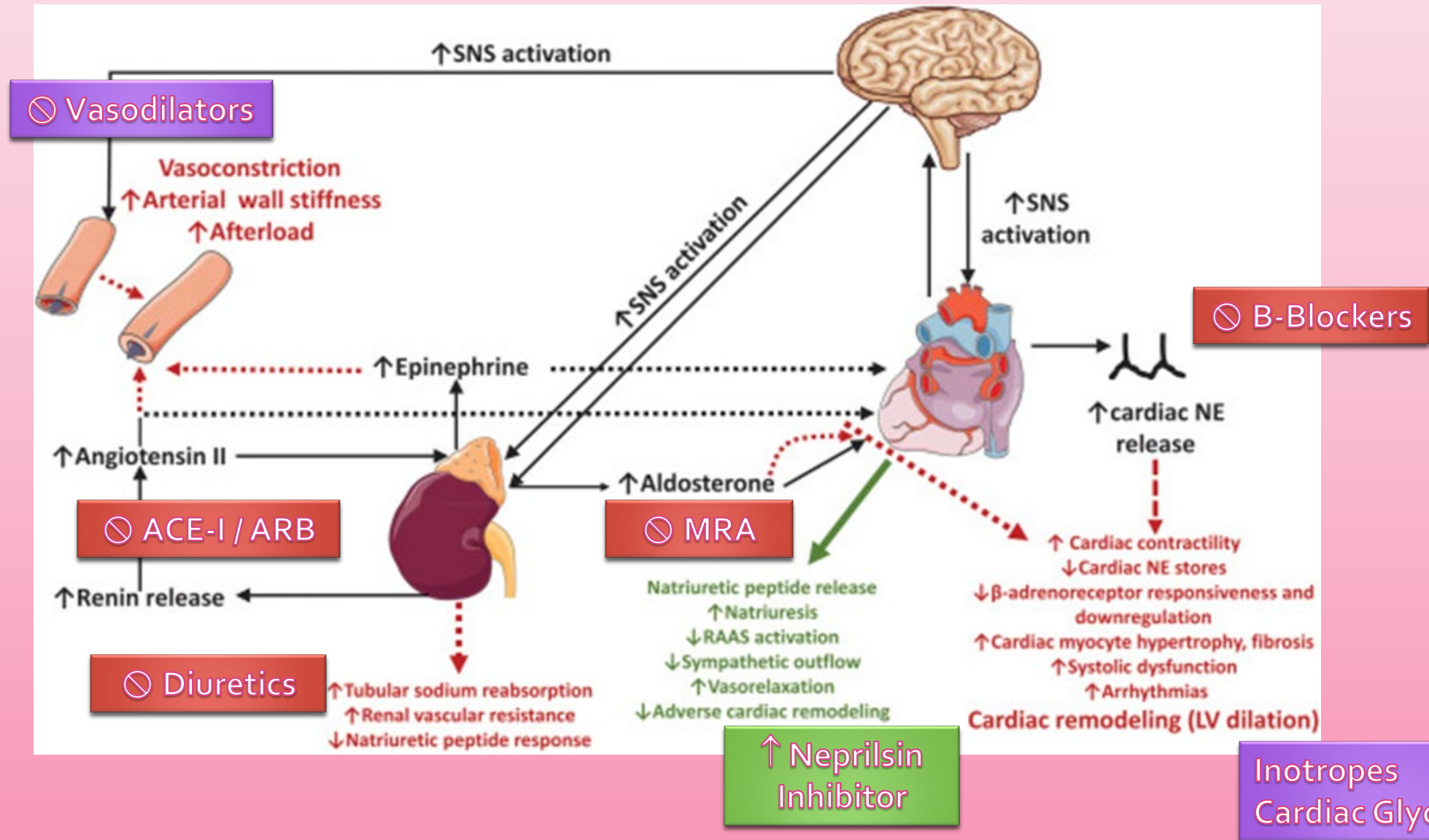


Cardiac and vascular function curves

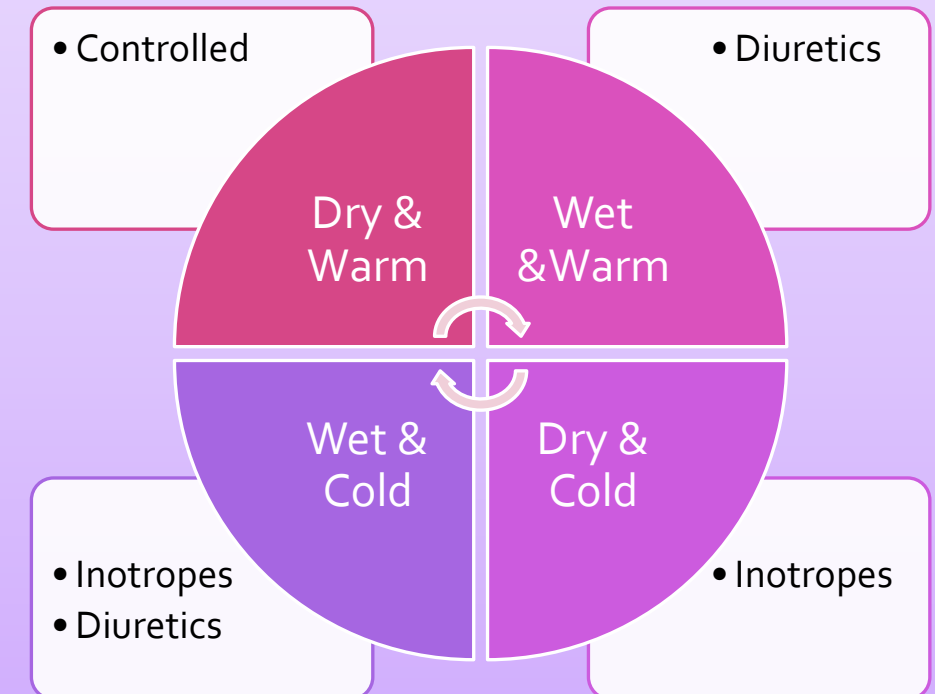
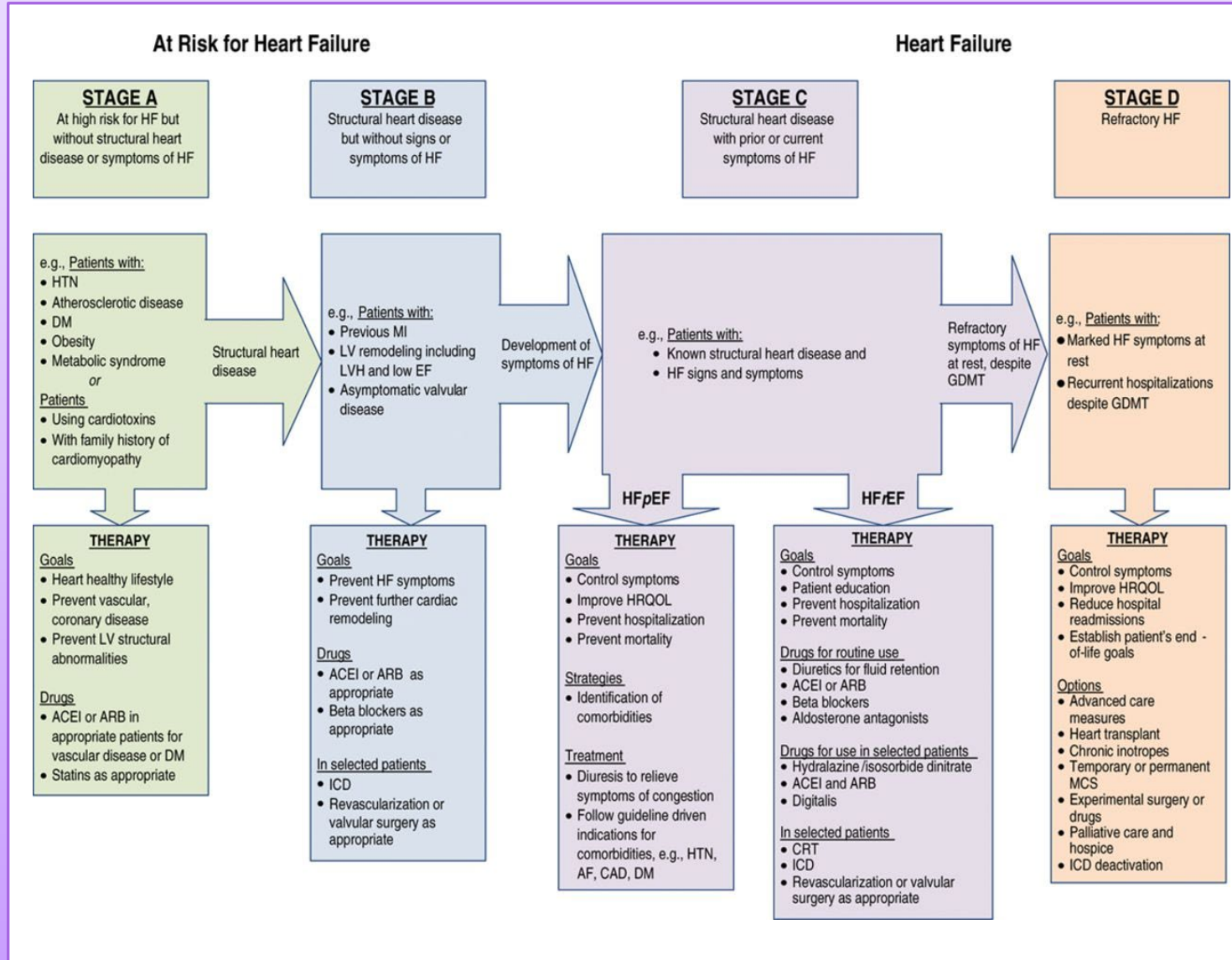


Basic – Pathology



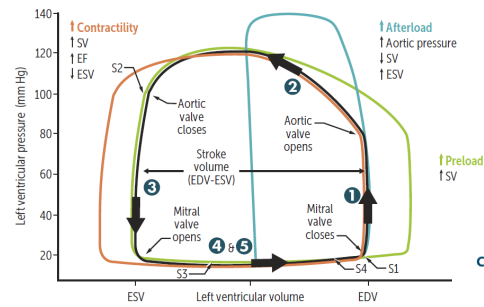


The patient is a 55-year-old female, recent history of COVID Infection 2 weeks ago, came to ED complaining of **Dyspnea** and **Lower Extremity Swelling** in last week.

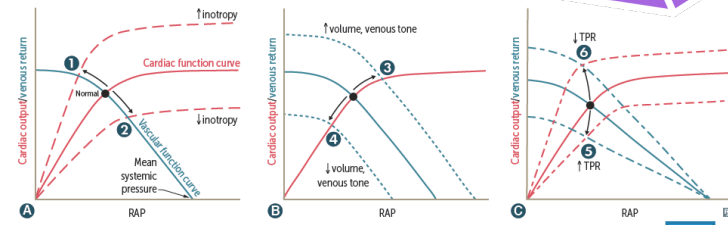


Basic - Physiology

Pressure-volume loops and cardiac cycle

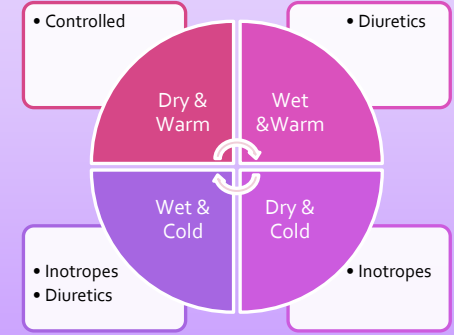
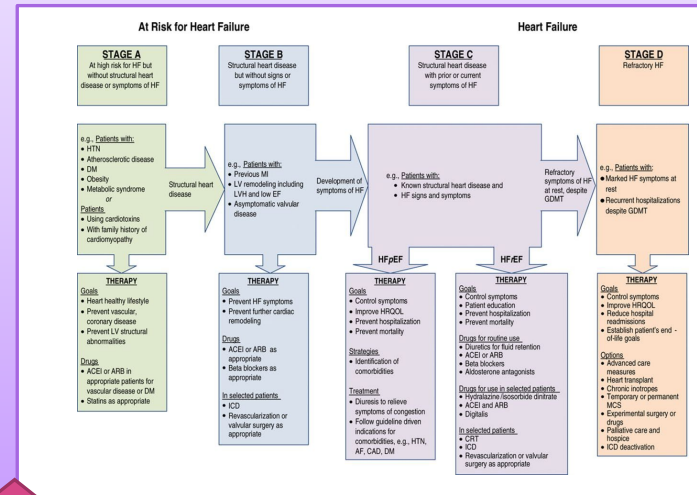


Cardiac and vascular function curves

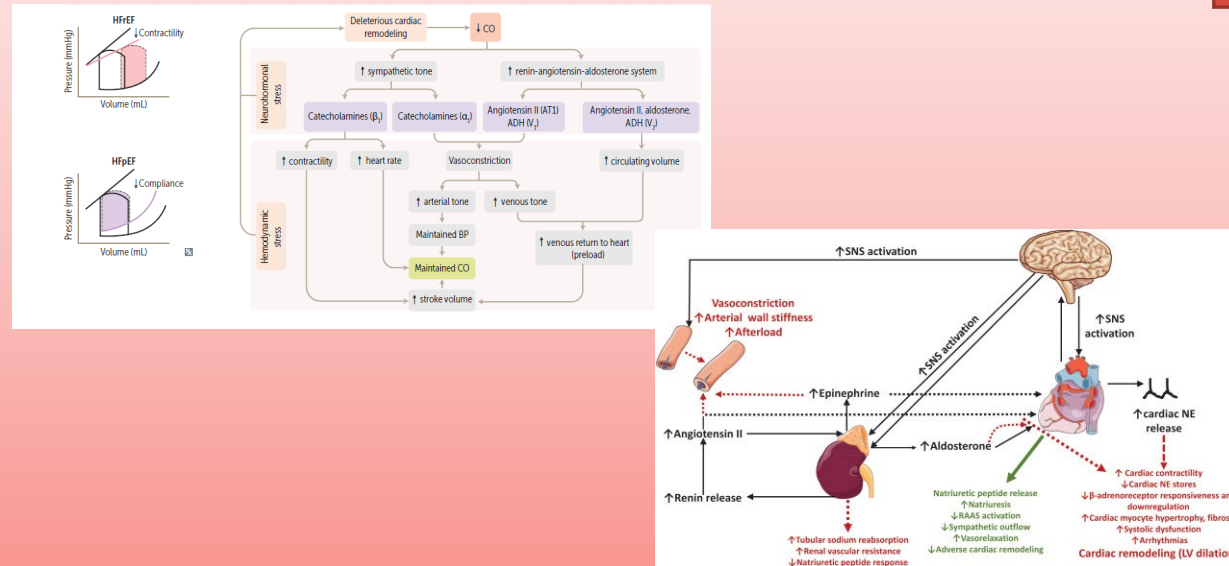


Clinical – Diagnosis & Treatment

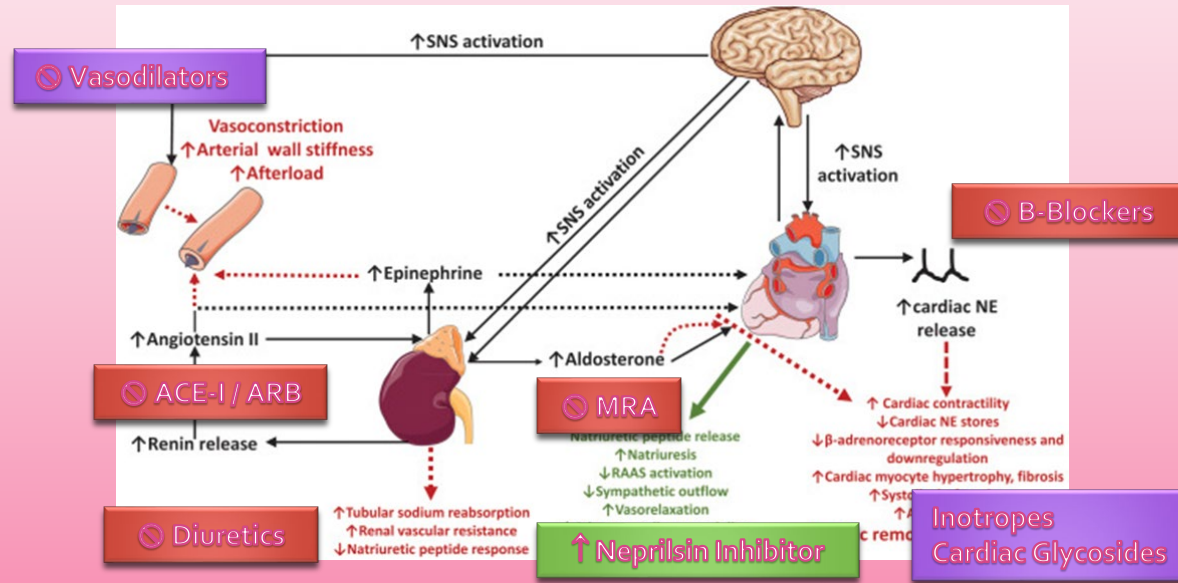
The patient is a 55-year-old female, recent history of COVID Infection 2 weeks ago, came to ED complaining of **Dyspnea and Lower Extremity Swelling** in last week.



Basic - Pathology



Basic - Pharmacology





Thank You