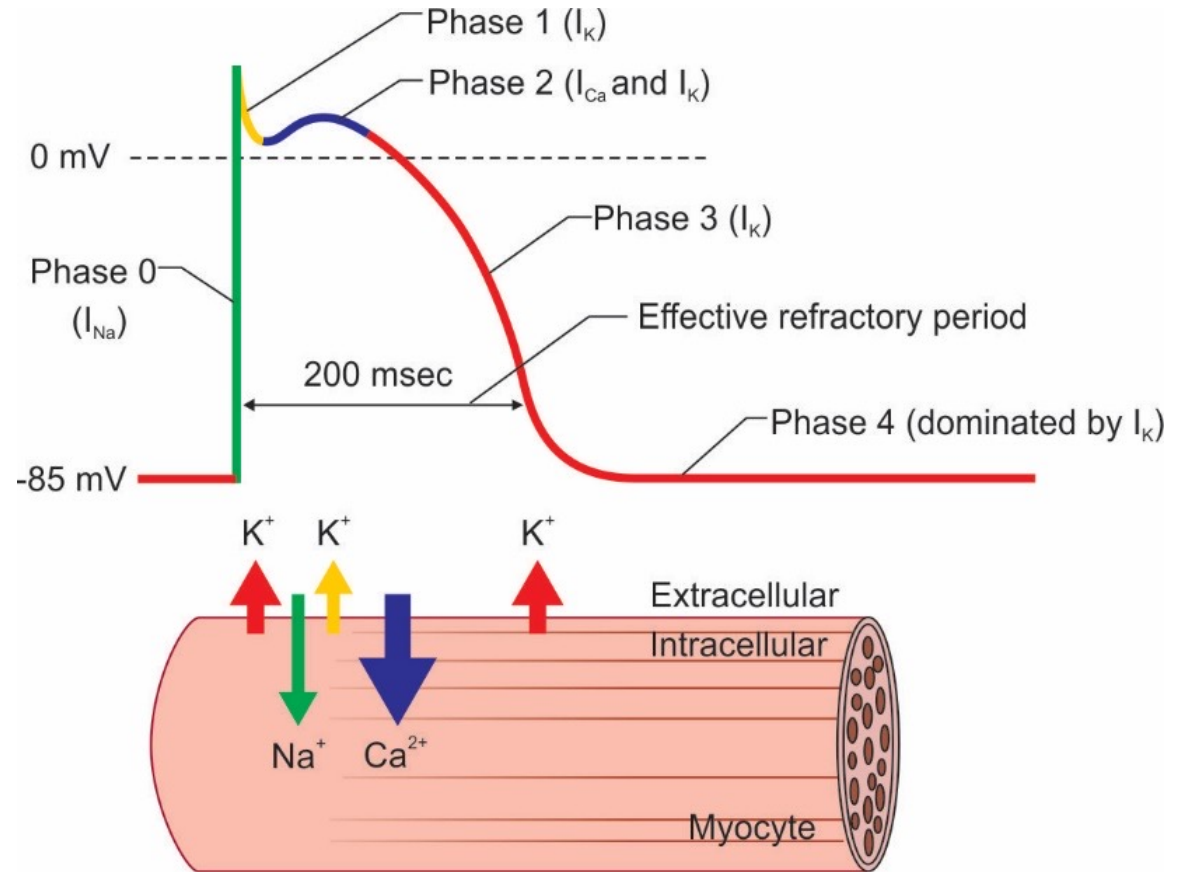
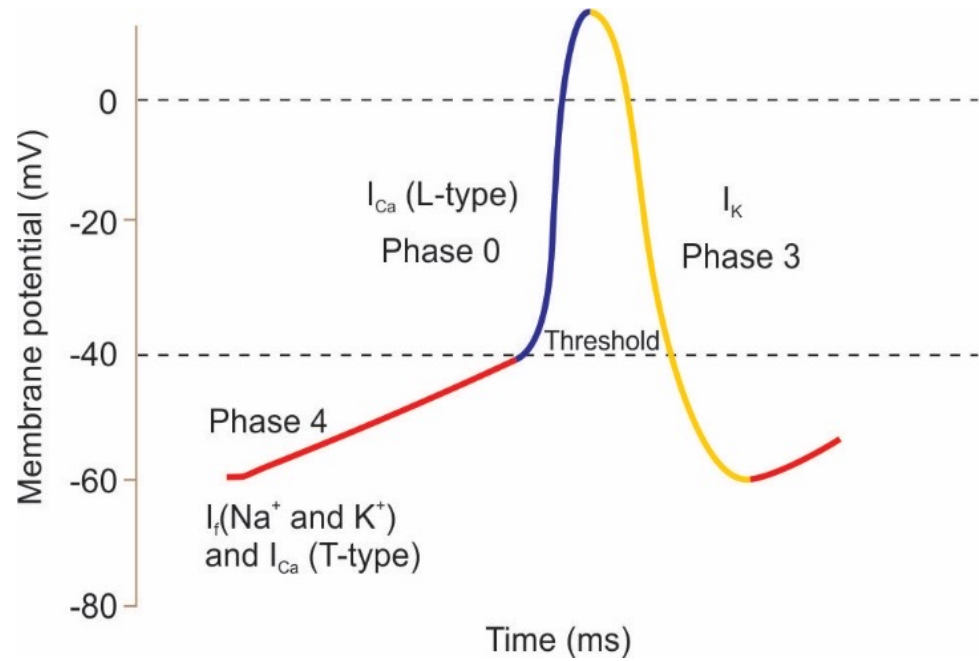


INTEGRATED CVS

Action Potential



Ach/Adenosine:
Catecholamines:
ABCD

Speed of conduction:
His-Purkinje > Atria > Ventricles > AVN

Endocardium \rightleftharpoons Epicardium

Anti-arrhythmic drugs

I (Avoid with HyperK)

IA: K⁻ : Quinidine, Procainamide, Disopyramide

IB: K⁺ : Lignocaine, Phenytoin

IC: Fleicanide, Propafenone

II

III: Amiodarone, Ibutilide Dofetilide, Sotalol (Avoid with HypoK)

IV

V: Adenosine

Dose:

Children:

Theophylline/ Caffeine:

Amiodarone: Longest T_{1/2}

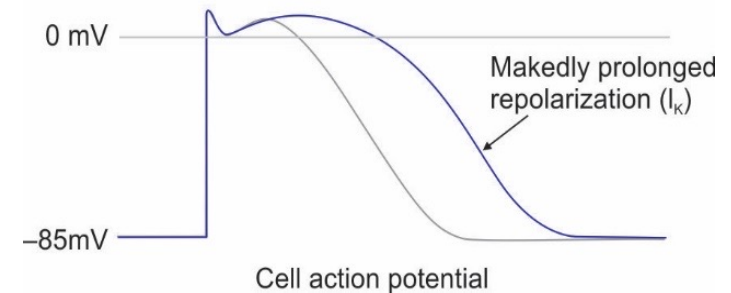
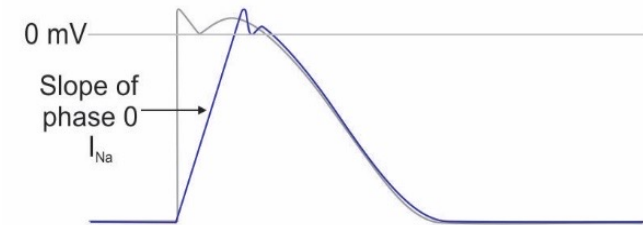
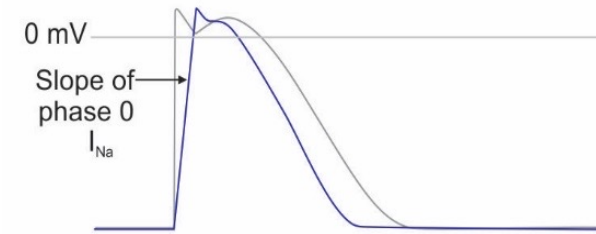
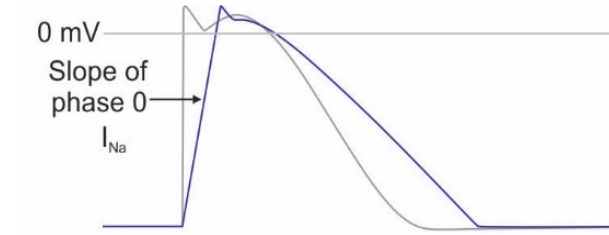
PIs

Check

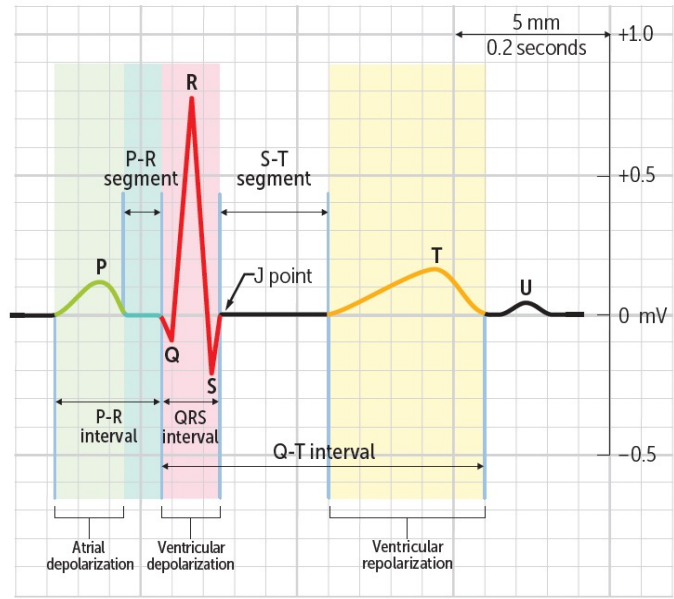
PFT

LFT

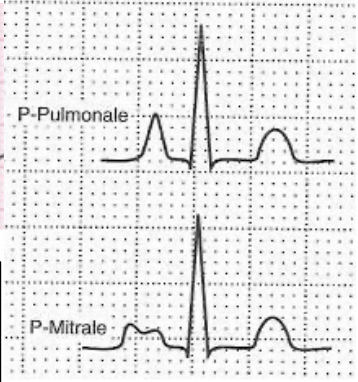
TFT



ECG

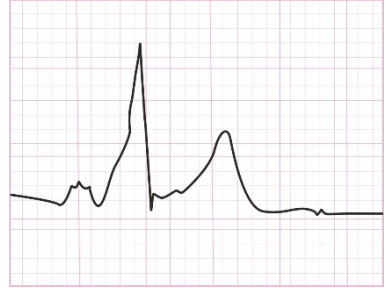


Heart rate:

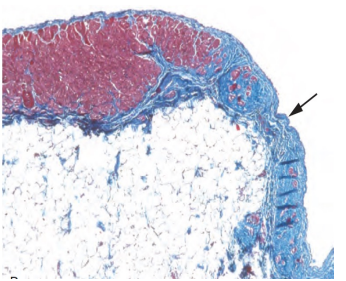
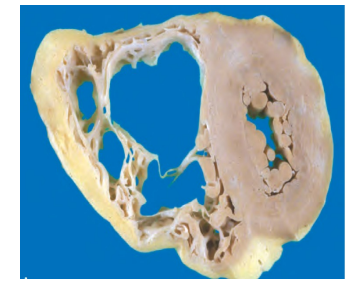
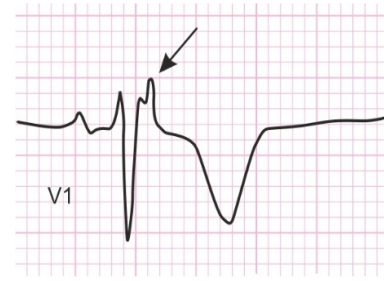
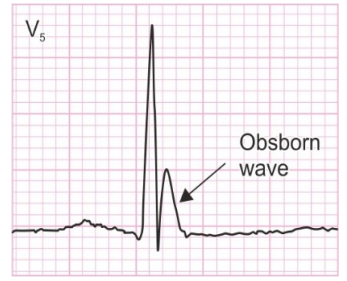


Himalayan p-waves

Pseudo-P pulmonale

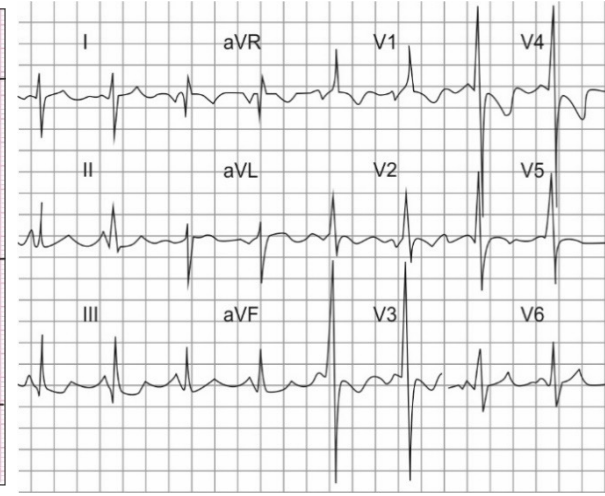
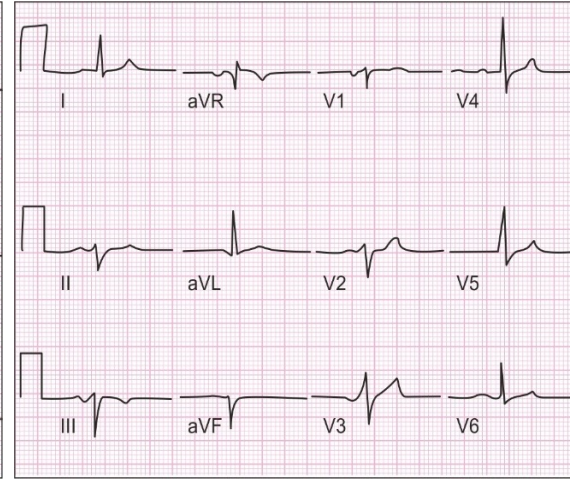
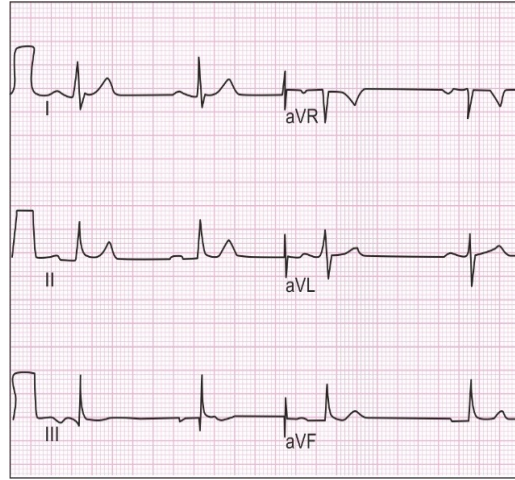


**DOC-Flecainide
TOC-RFA
Emergency-IV
procainamide**



Uhl's anomaly

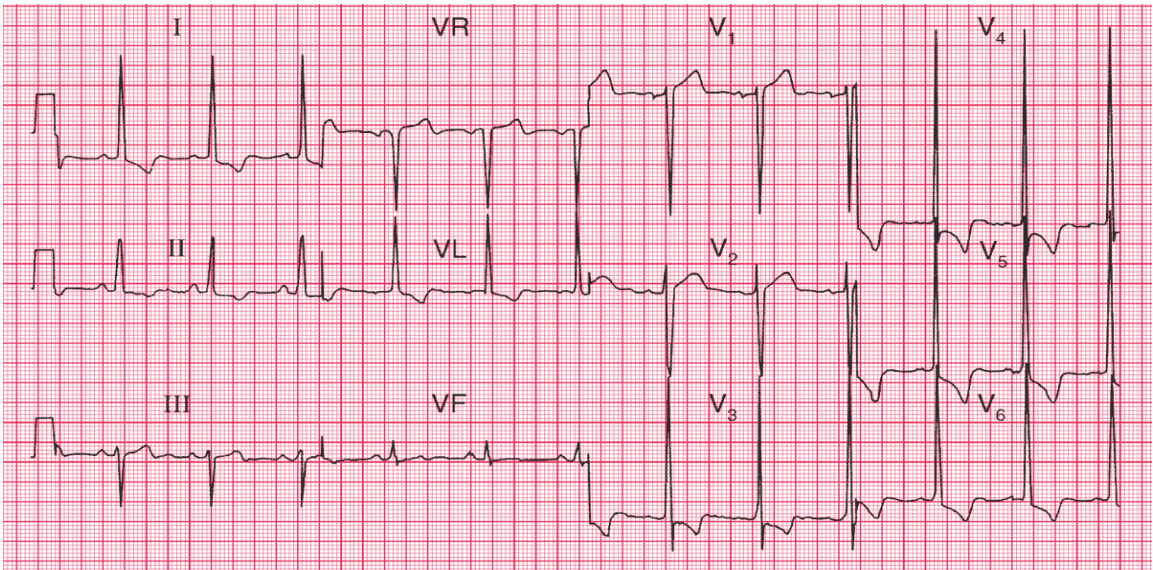
Lead 1	Lead aVF
Positive	Positive
Positive	Negative
Negative	Positive
Negative	Negative



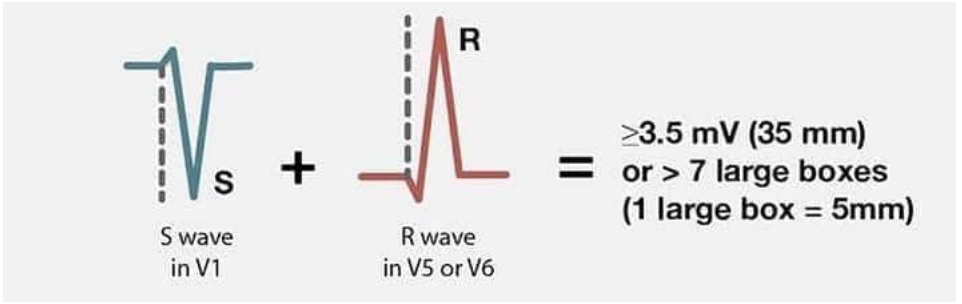
Bundle Blocks

LVH-RVH

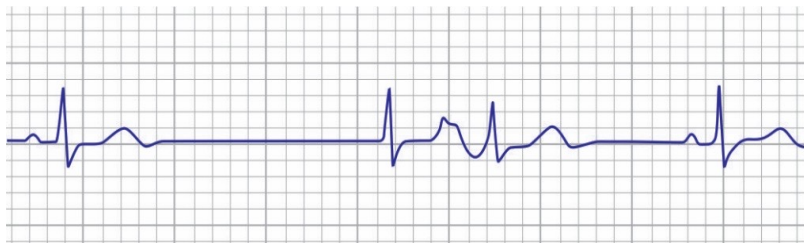
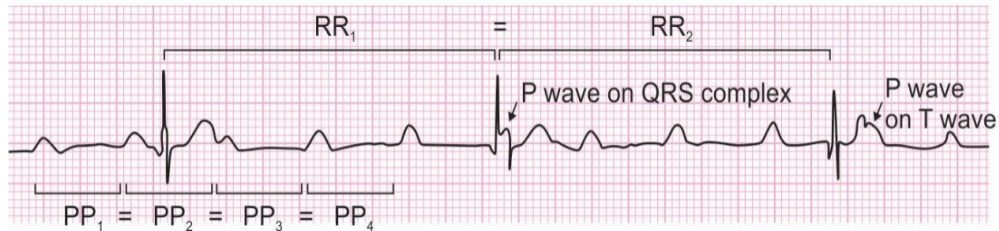
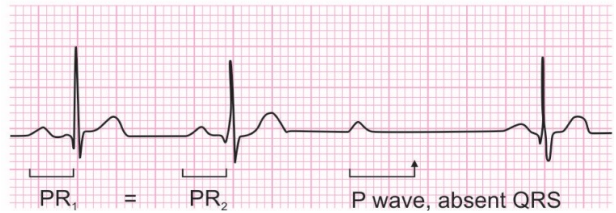
	V1	V6
Normal		
RBBB		
LBBB		



Sokolow-Lyon criteria



Heart blocks



ACLS Bradycardia protocol

Unstable/ Symptomatic with HR<50

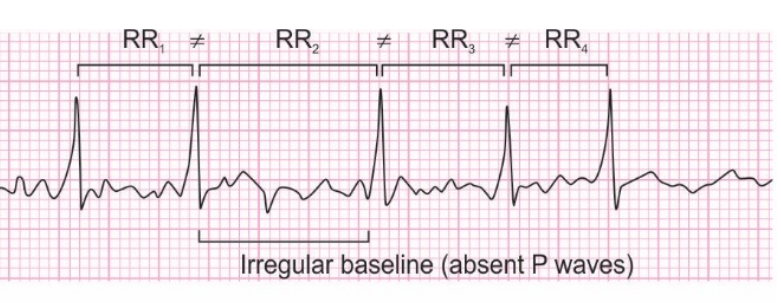
- Rx underlying cause

1st : Atropine 1mg IV bolus-1st line

↓
Dopamine
Epinephrine
Transcutaneous pacing

Stokes-Adam Sx:

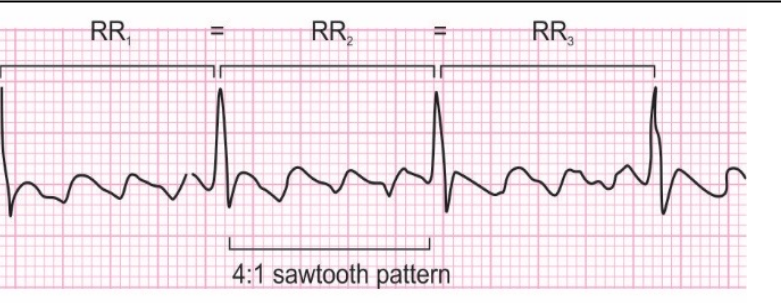
Supra-Ventricular Tachyarrhythmias



Unstable-Cardioversion 200J
Stable- RATE CONTROL:
 Esmolol/Verapamil

Acute Heart failure + Afib:

Anticoagulation



CHA ₂ DS ₂ -VASc Score		
C	Congestive Heart Failure	1 point
H	Hypertension	1 point
A ₂	Age ≥75 y	2 points
D	Diabetes	1 point
S ₂	Stroke/ TIA/	2 points
V	Thromboembolism	1 point
A	Vascular disease	1 point
Sc	Age ≥65 y	1 point
	Sex category, female	



Unstable-Cardioversion
Stable-Carotid sinus massage
 Iv adenosine > Esmolol > Verapamil
FROG SIGN

Score-1:
 Score ≥ 2:
 Moderate-severe MS
 Prosthetic Heart valve

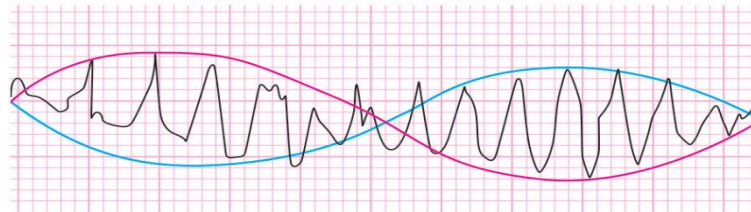
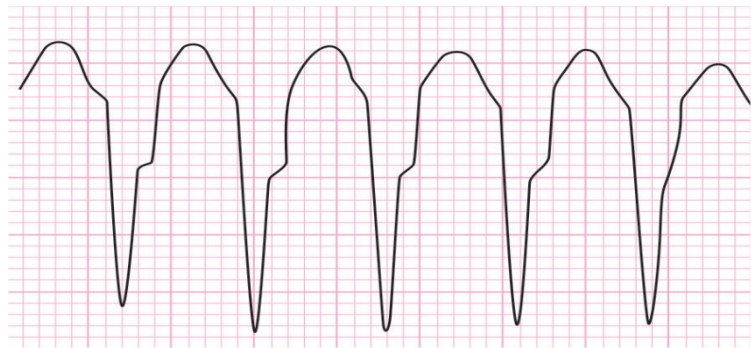


DOC-Verapamil

Ventricular Tachyarrhythmias

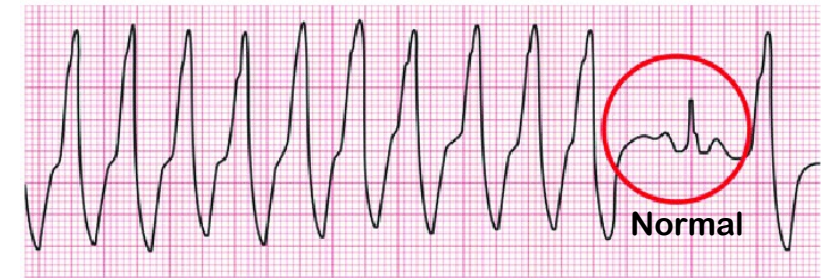


Unstable-Defibrillation
Stable-IV Amiodarone
DOC-Lignocaine

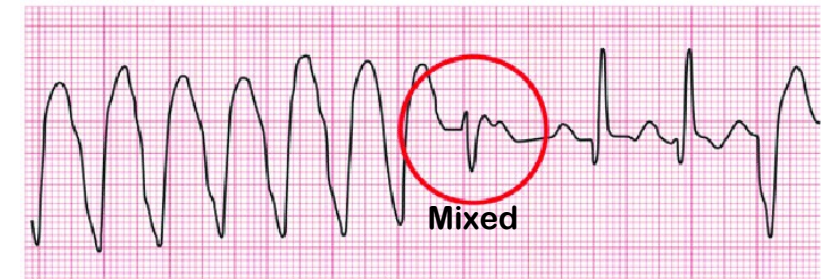


Romano-Ward (AD):
Jerwell-Lange-Nelson (AR):
DOC-

Capture beat:



Fusion beat:



anti **A**rrhythmics:

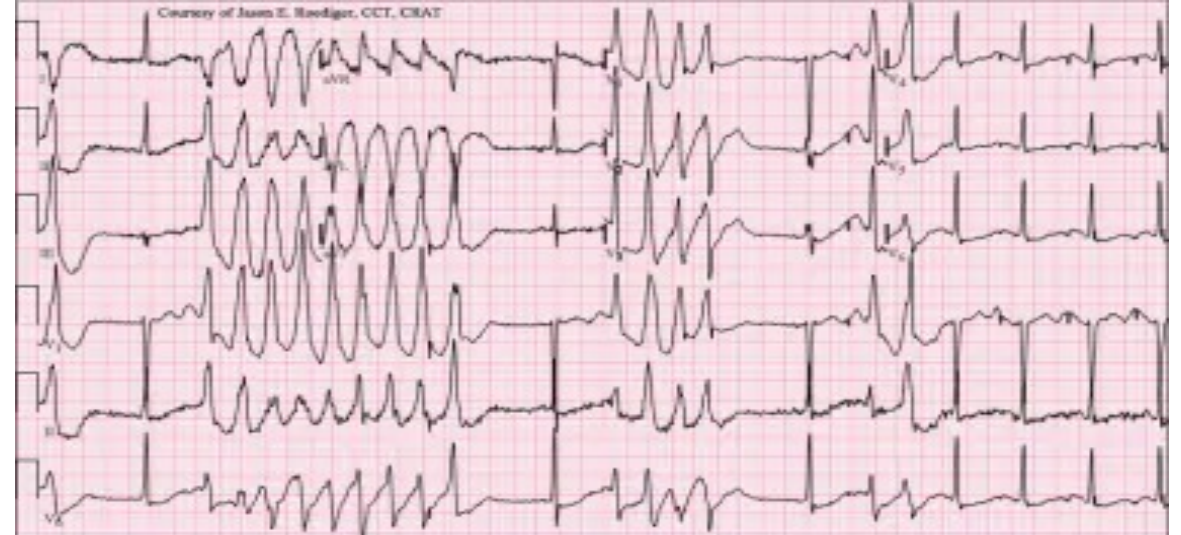
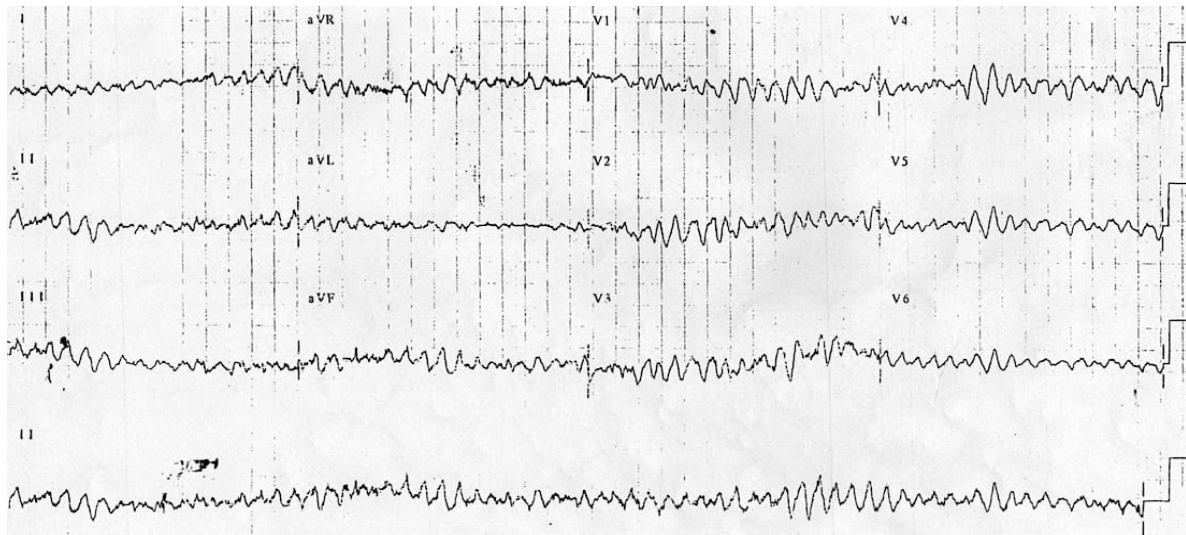
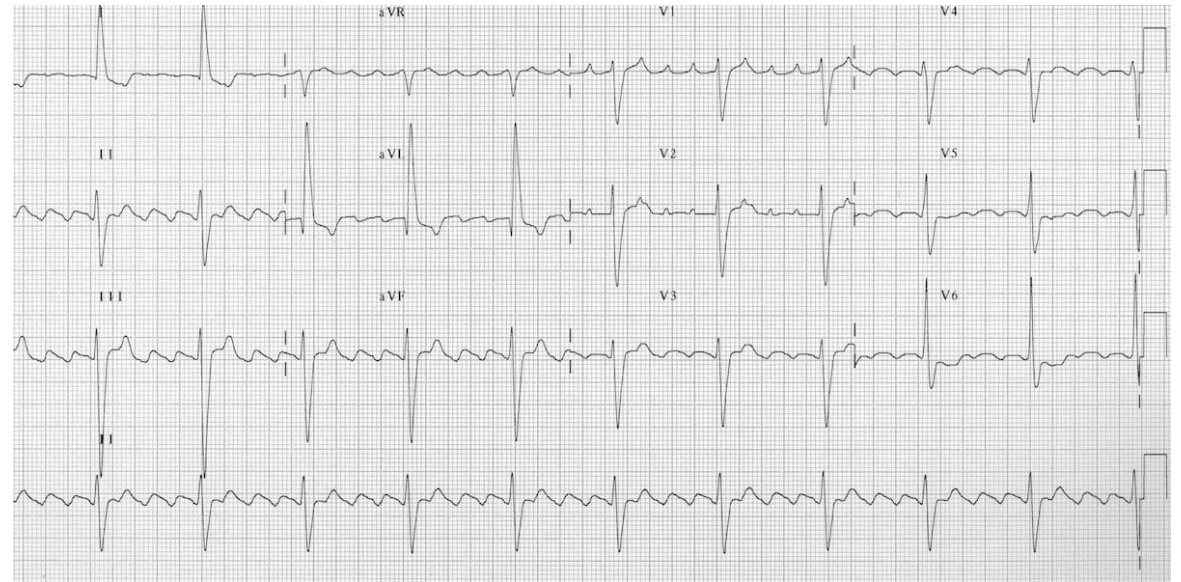
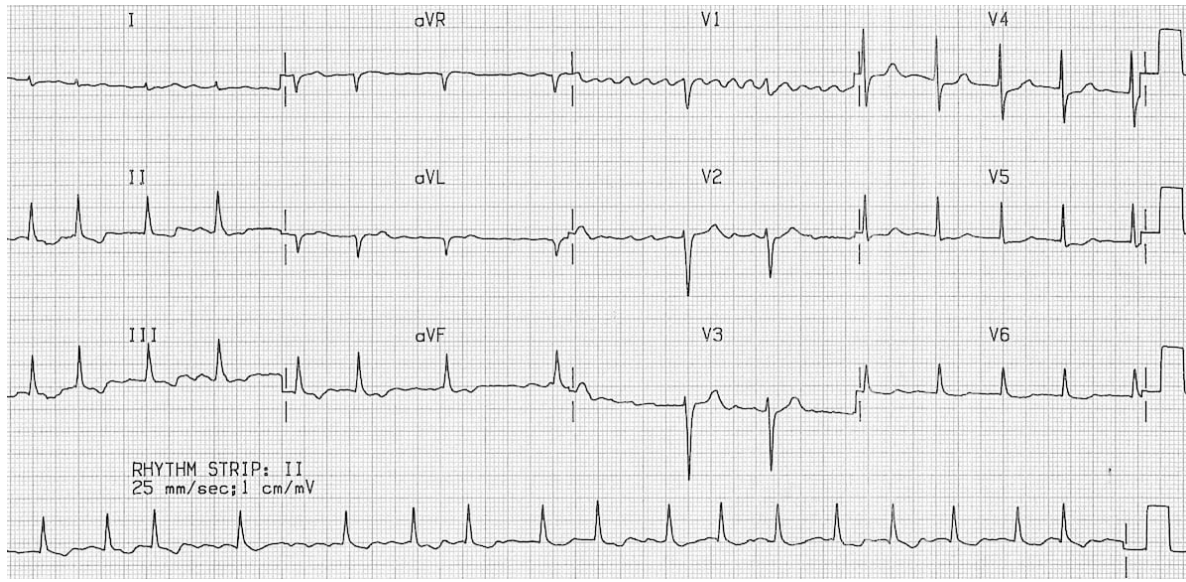
anti"**C**"ychotics:

Methadone, Chloroquine, CAT drugs, Navir (Protease inhibitors)

4 Hypo Ca/Mg/K/thermia

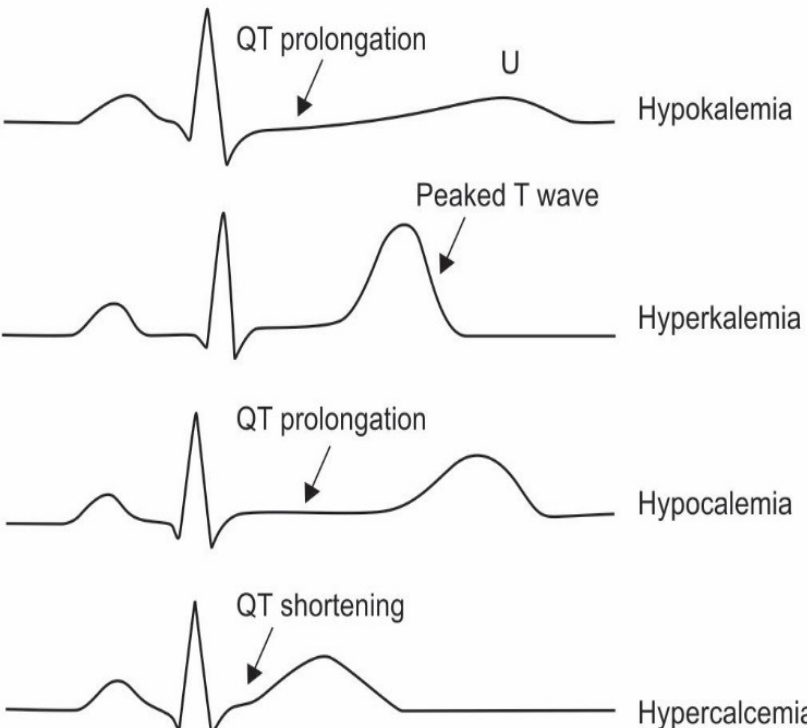
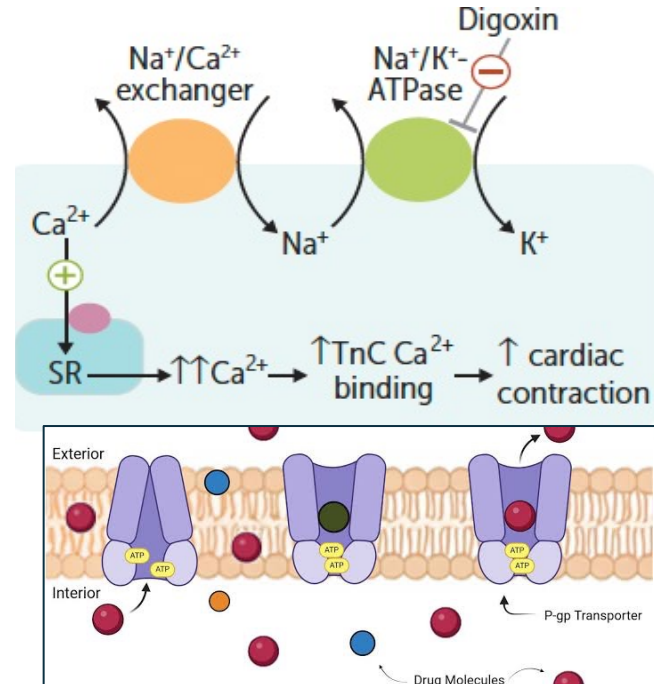
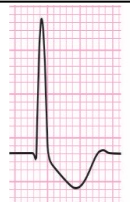
anti**B**iotics/ ATT/ Anti-fungals:

anti**D**epressants (TCA, SSRI), anti**E**metics (eg, ondansetron),

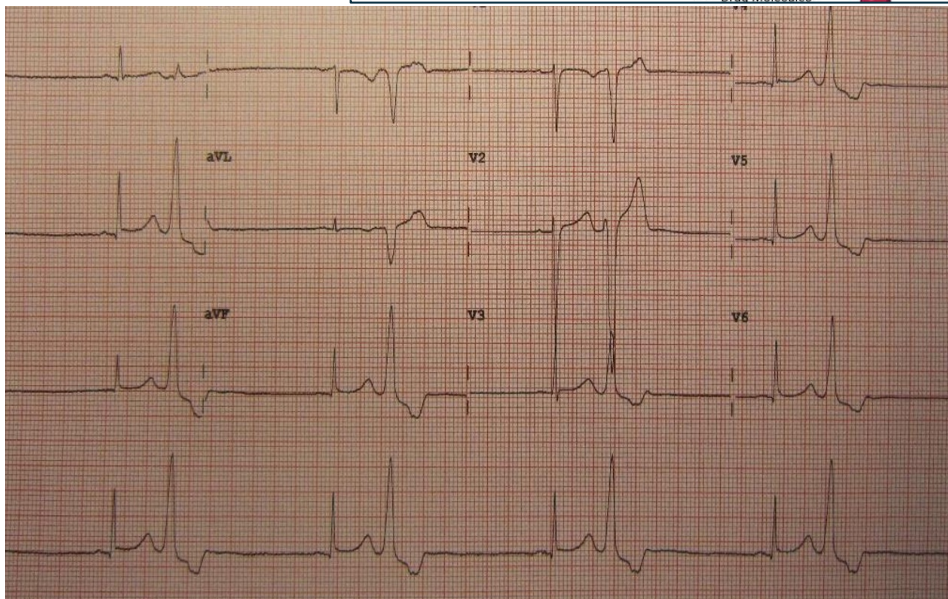


Important ECGs

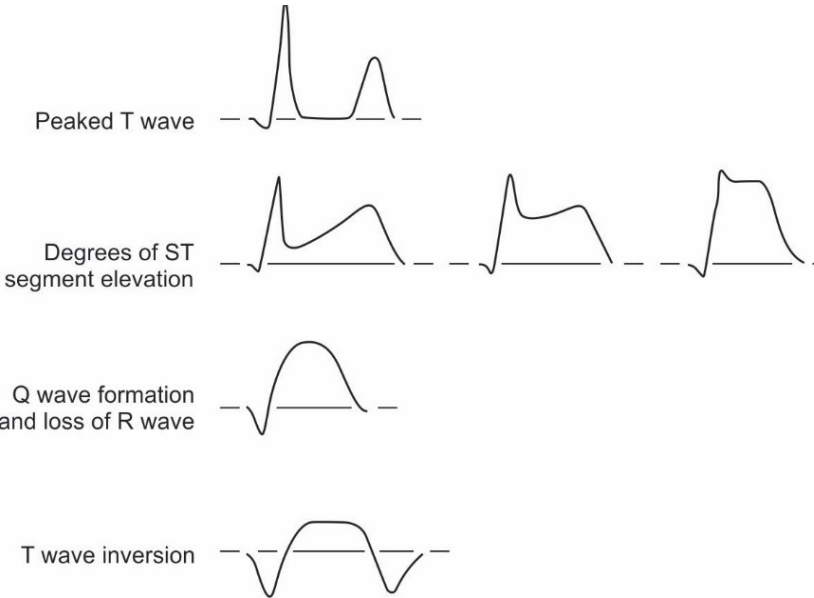
Digitalis:
S/e: Hyperkalemia, Cholinergic, Yellow vision
MC arrhythmia:
Most specific:
 Shortening of QT interval, Flattened T, Scooped ST depressions-Hockey stick/ Salvador Dali moustache, PR increased
Toxicity ppt:
 Verapamil / Amiodarone/ Clarithromycin/ Cyclosporine/ Quinidine
Rx:



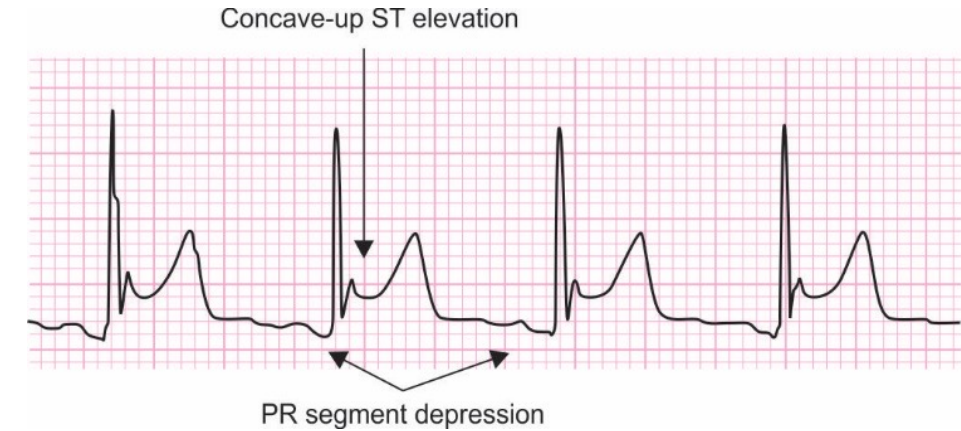
Serum potassium	ECG abnormalities
Mild (5.5-6.5 mEq/L)	Peaked T waves Prolonged PR segment
Moderate (6.5-8.0 mEq/L)	Loss of P wave ST-segment elevation Ectopic beats
Severe (>8.0 mEq/L)	Sine wave Ventricular fibrillation Asystole



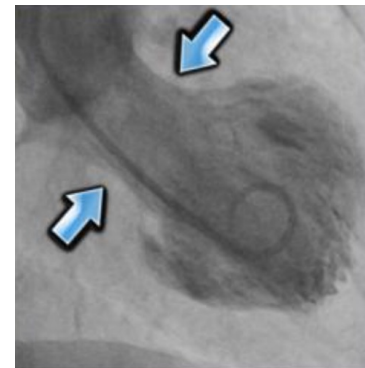
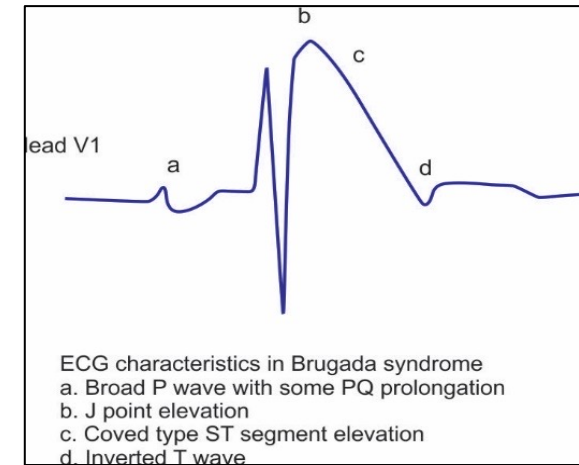
ST elevation



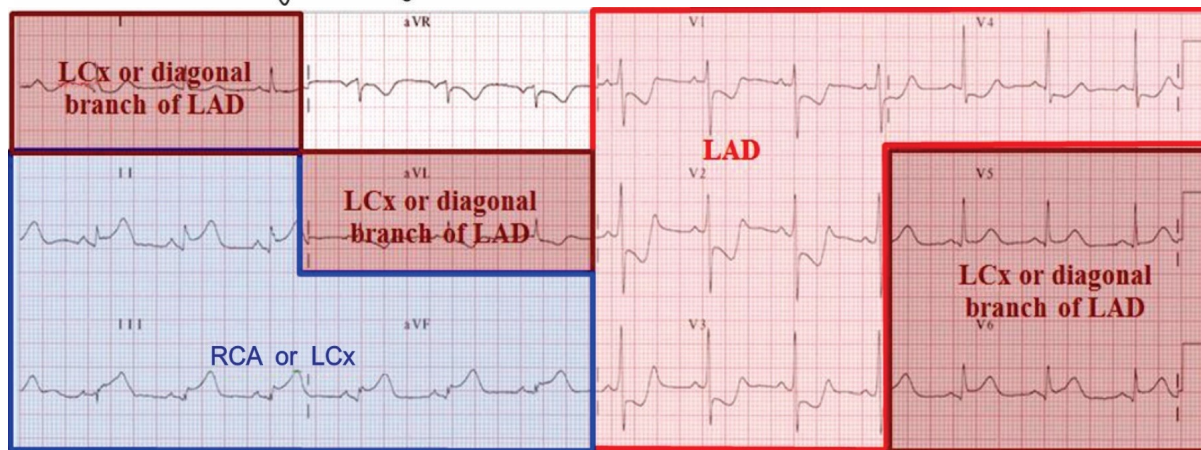
Acute chest pain + Pericardial rub



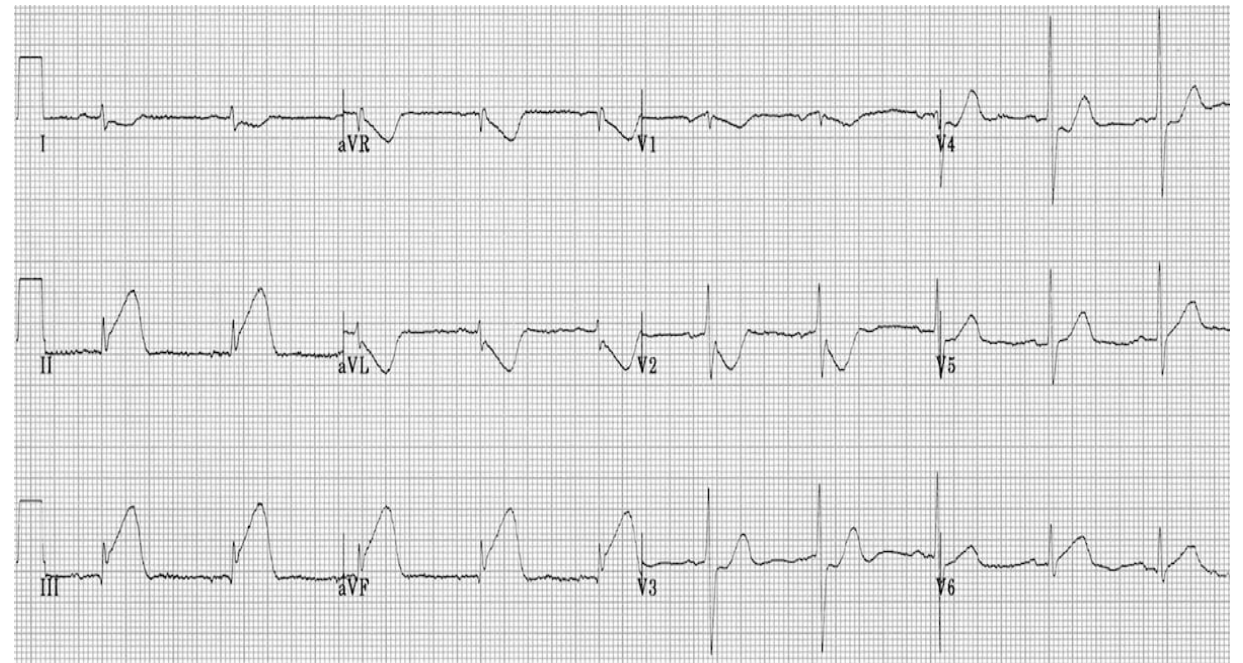
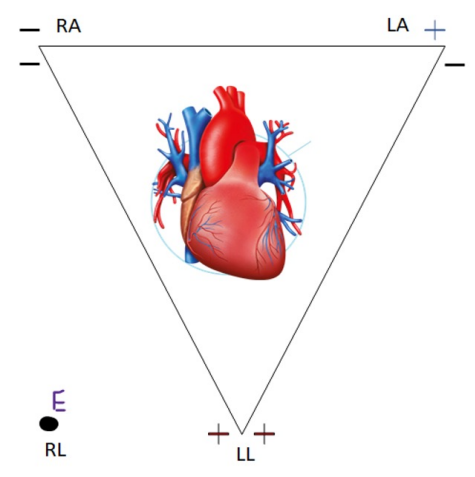
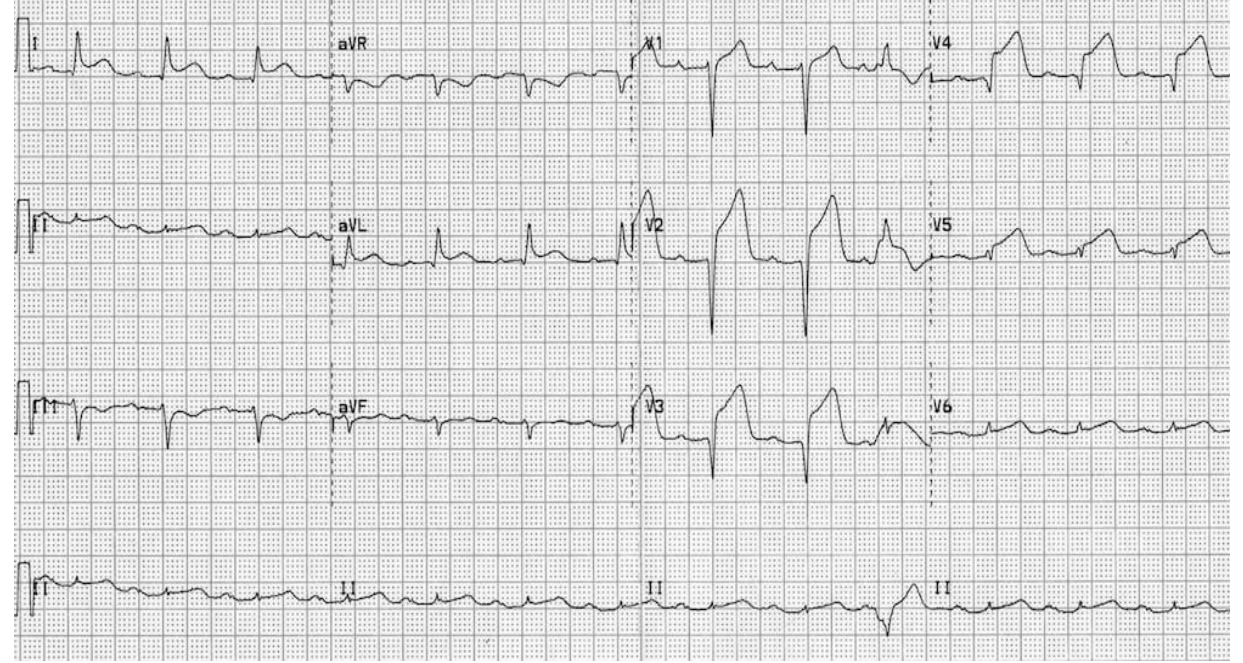
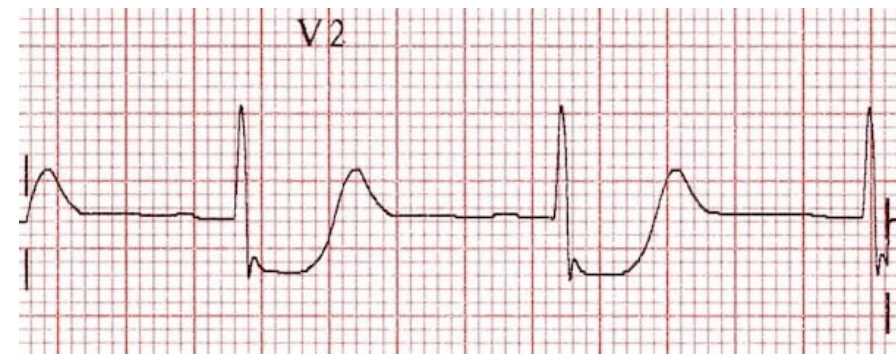
- Ventricular aneurysm
- Prinzmetal angina-transient
- Takotsubo CMP



Loss-of-function SCN5A
Pseudo-RBBB
AD

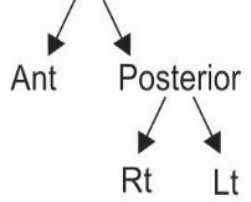


Posterior (PDA) V₇-V₉, ST depression in V₁-V₃ with tall broad R waves, upright T waves
VS NSTEMI: Inversion of T waves



Anatomy of Coronary Circulation

Aortic sinuses of VALSALA

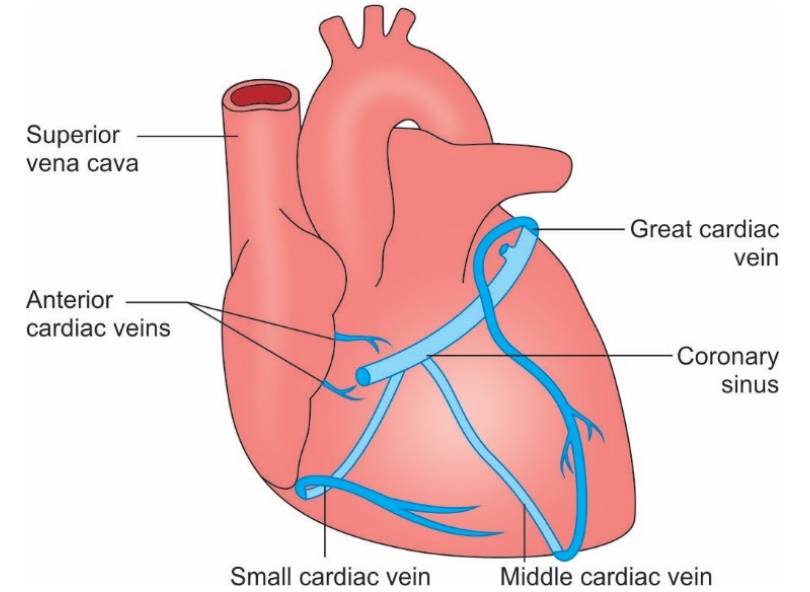


RCA:

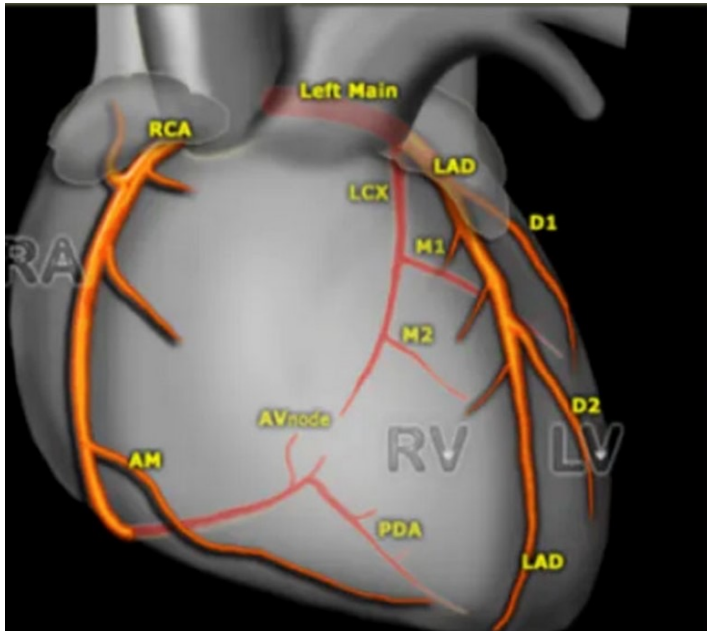
LCA

LAD:

LCX:

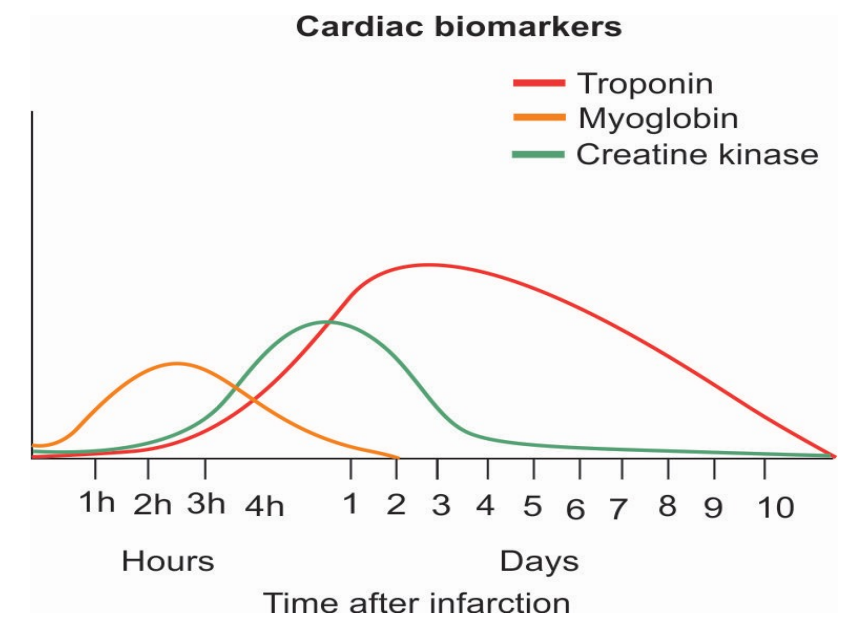


Coronary sinus except:



Myocardial Infarction

	Stable Angina	Unstable Angina	NSTEMI	STEMI	Prinzmetal angina
PAIN					
TROPONIN					
ECG					
INFARCTION					
MGT					



NSTEMI

Immediate PCI:

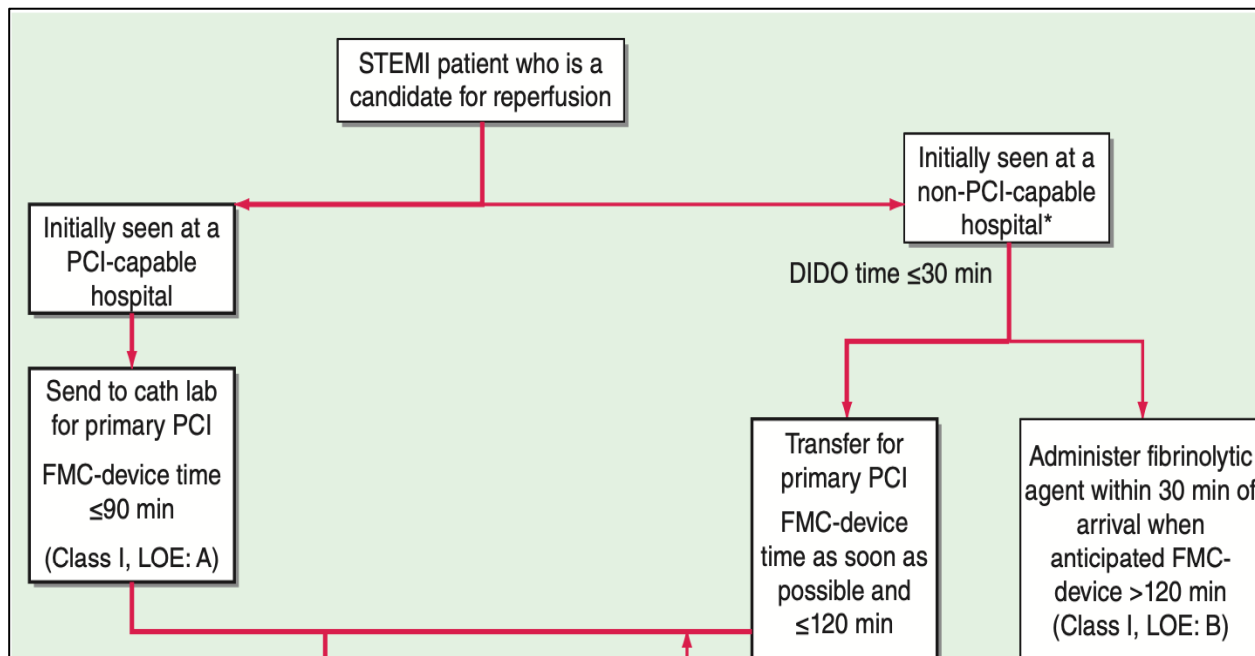
- Hemodynamic unstable
- V. tachycardia
- Heart failure

Early PCI (<24hrs)

- New ST changes, Trop ↑

Delayed PCI:

- DM
- Prior CABG /PCI



Type 1: Spontaneous MI d/t plaque erosion/ rupture, dissection

Type 2: MI due to ischemia secondary to increased demand or decreased supply

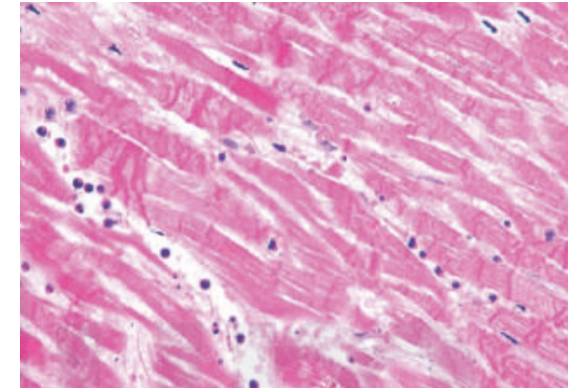
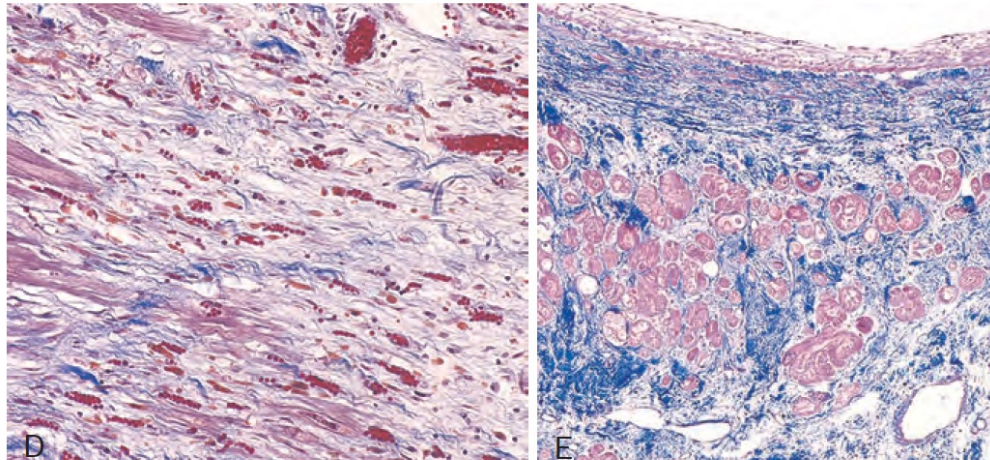
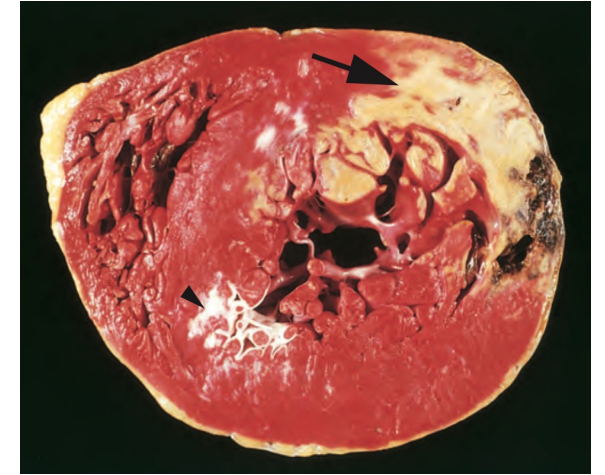
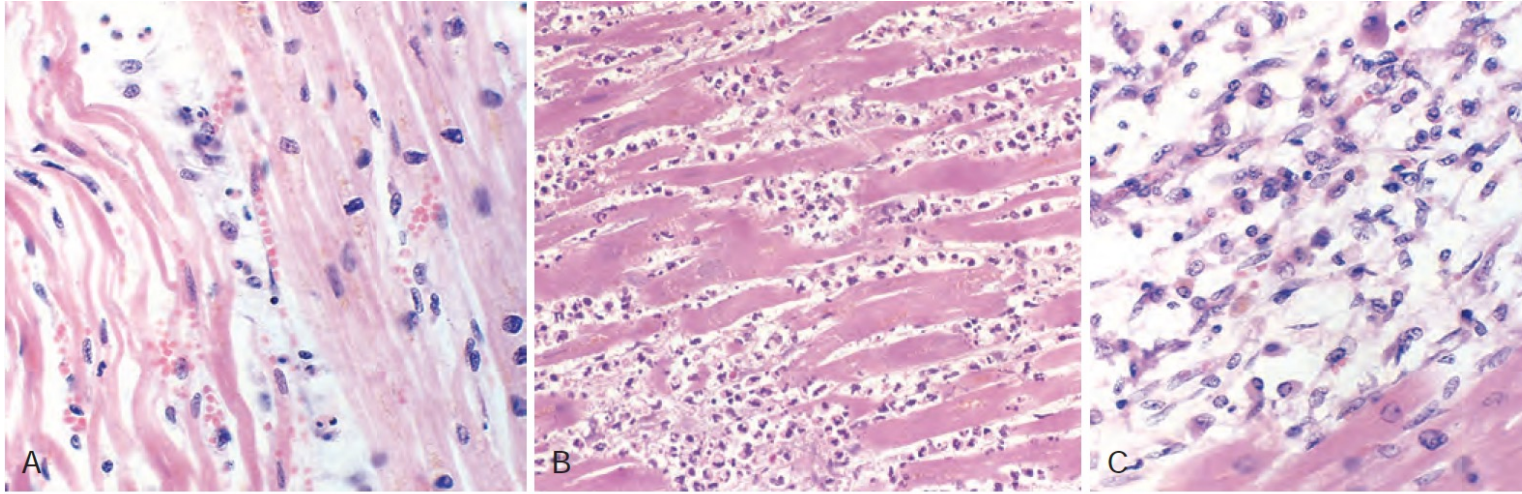
Type 3: Sudden cardiac death due to MI

Type 4: MI associated with PCI (4a) / stent thrombosis (4b)

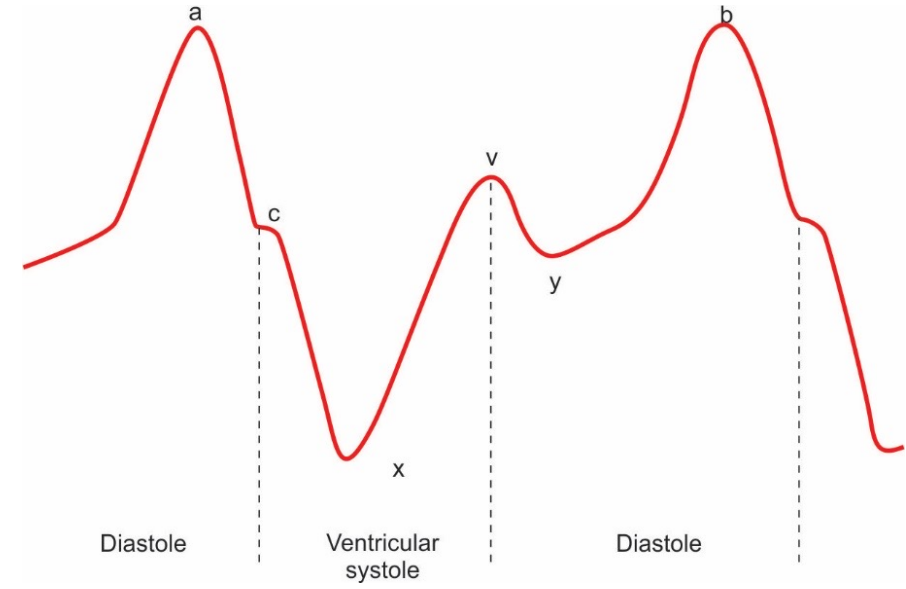
Type 5: MI associated with cardiac surgery

<u>Complications of MI</u>	<u>Timeframe</u>
Cardiac arrhythmias	MCC of death in 1st 48 hr
Peri-infarction pericarditis	1–3 days
Papillary muscle rupture Posteromedial > anterolateral papillary muscle rupture	2–7 days
Interventricular septal rupture	3–5 days
Ventricular pseudoaneurysm	3–14 days
Ventricular free wall rupture	5–14 days
True ventricular aneurysm	2 wks to several months
Post-cardiac injury syndrome (Dressler syndrome)	Weeks to several months Autoimmune
Stunning	
Hibernation	

Pathology in Myocardial Infarction

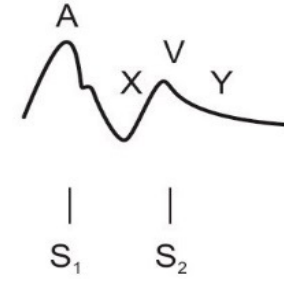


JVP

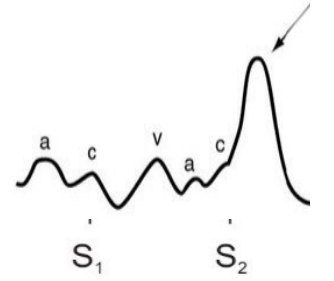


Large "V" wave

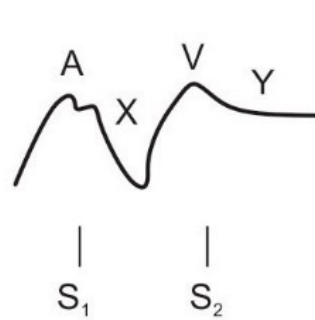
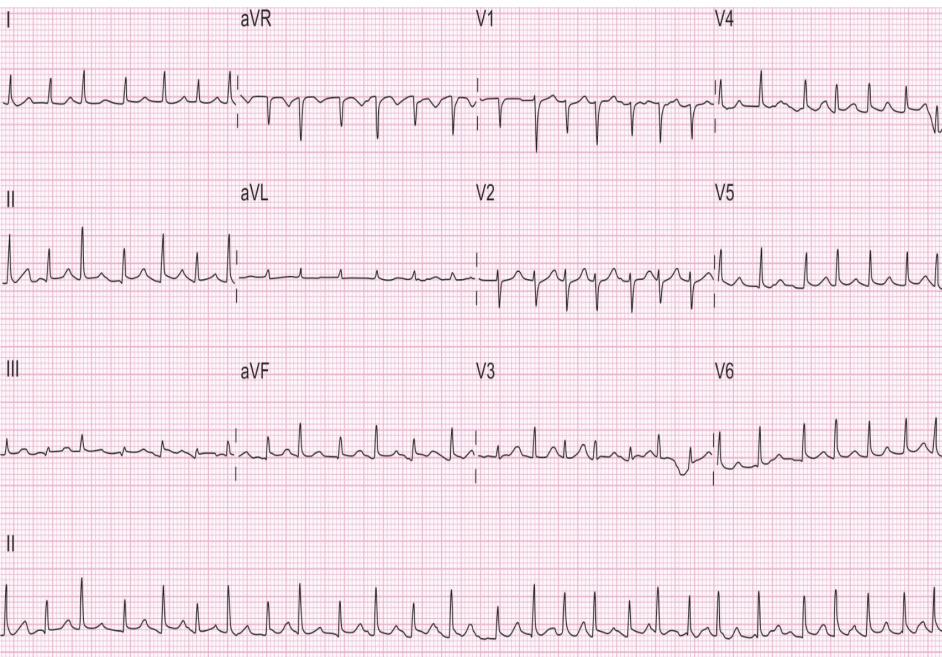
Lancisi sign



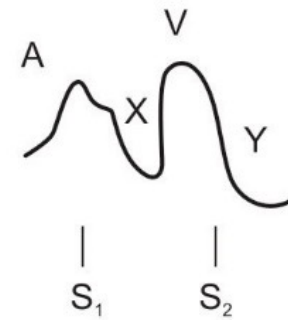
Large "A" wave



Cannon "A" wave



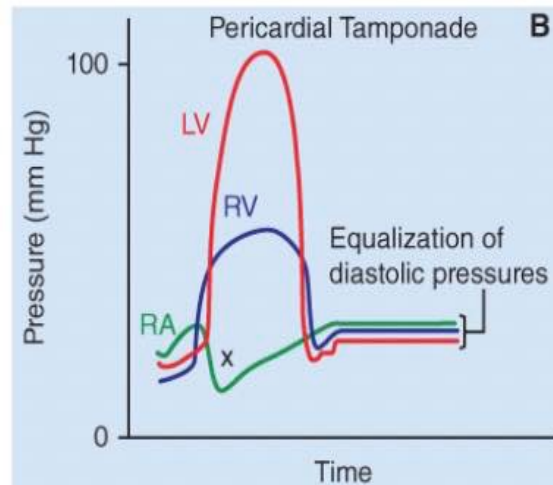
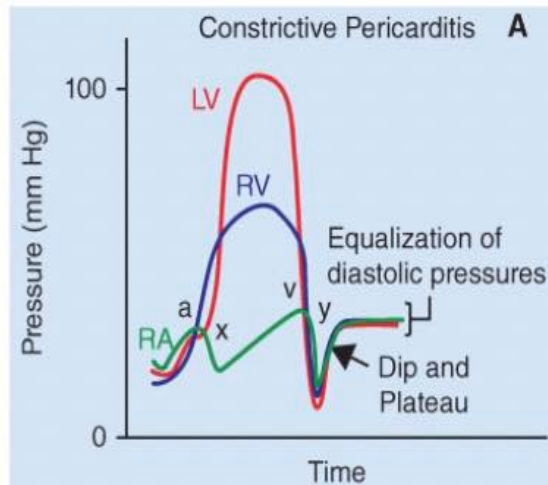
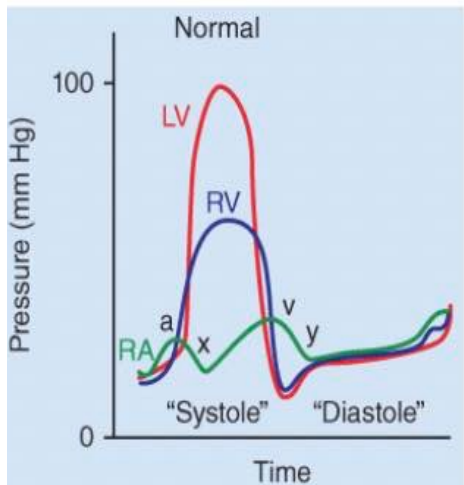
Loss or blunted "Y" descent



Prominent "X" and "Y" descent

Beck's triad
Ewart sign
Diastolic collapse
ECG:

Kussmaul sign
Pericardial knock
ECG:
Square root sign in pressure waveform



Pulsus paradoxus:
Reverse pulsus paradoxus:

Pulse



A Normal pulse



B Hypokinetic (weak) pulse



C Hyperkinetic (bounding) pulse



D Bigeminal pulse



E Pulsus alternans



F Waterhammer (collapsing) pulse



G Pulsus bisferiens

Pseudo-collapsing pulse:

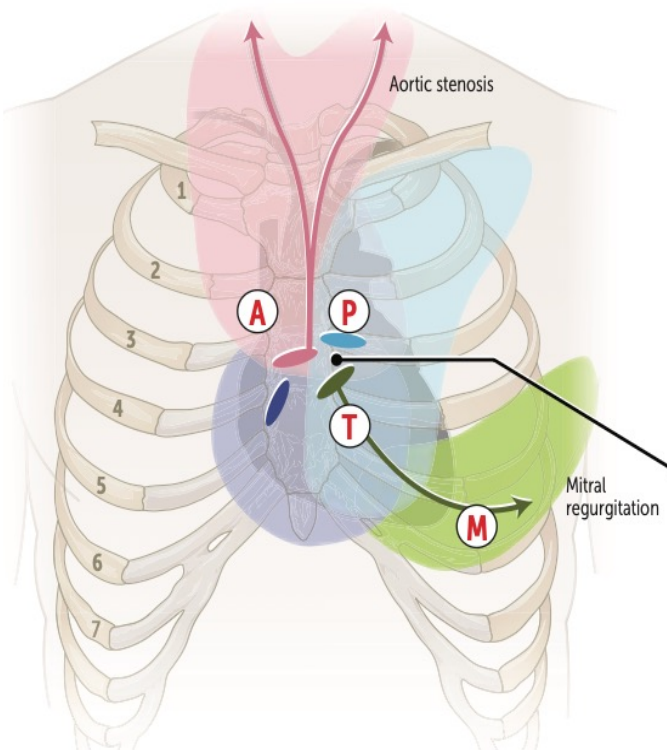
Corrigan sign
Muller sign
Landolfi sign
Quincke sign
deMusset sign
Hill sign

Heart sounds

Where to listen: **APT M**

A **Aortic area:**
Systolic murmur
 Aortic stenosis
 Flow murmur
 (eg, physiologic murmur)
 Aortic valve sclerosis

T **Tricuspid area:**
Holosystolic murmur
 Tricuspid regurgitation
 Ventricular septal defect
Diastolic murmur
 Tricuspid stenosis



P **Pulmonic area:**
Systolic ejection murmur
 Pulmonic stenosis
 Atrial septal defect
 Flow murmur

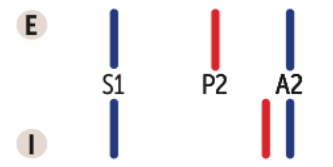
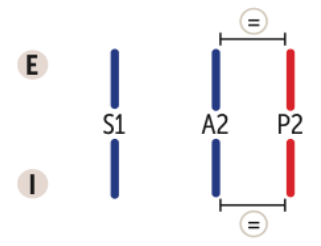
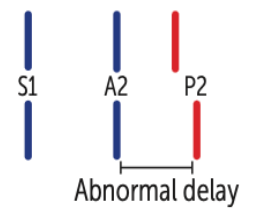
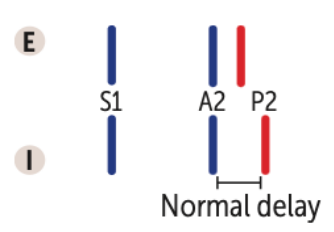
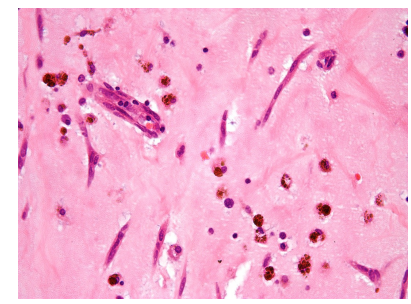
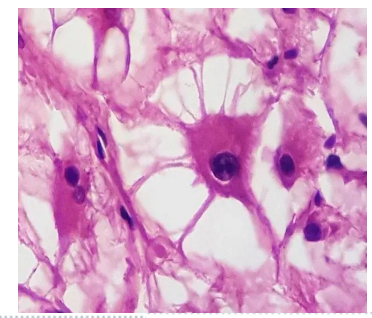
M **Mitral area (apex):**
Systolic murmur
 Mitral regurgitation
 Mitral valve prolapse
Diastolic murmur
 Mitral stenosis

Left sternal border:
Systolic murmur
 Hypertrophic cardiomyopathy
Diastolic murmur
 Aortic regurgitation
 Pulmonic regurgitation

S3, S4, Tumor plop, MS/ TS: Low pitch- Bell

Loud S1: MS, Reduced PR (WPW-Child), Hyperdynamic circulation

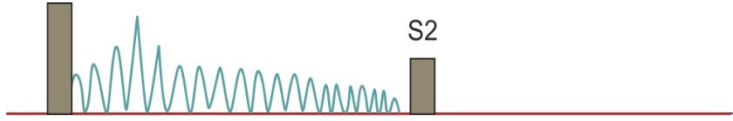
Soft S1: MR/TR, CHF, Calcified valves, Prolonged PR (1st degree heart block)



Valvular Diseases

Systolic

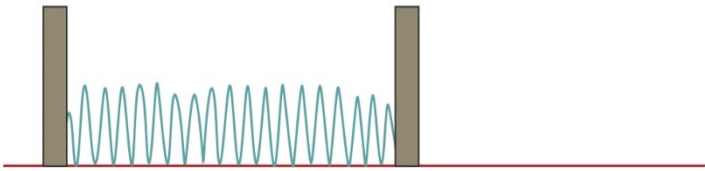
S1



- Crescendo-decrescendo ejection murmur, radiates to carotids
- Gallavardin phenomenon

Benign flow murmur due to increase CO in peds

S1



- Holosystolic, high-pitched “blowing” murmur
- MR: Loudest at apex, radiates toward axilla
- TR: loudest at tricuspid area

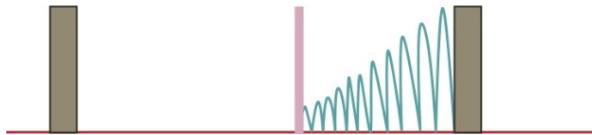
Early systolic murmur:

Early systolic in TR on deep inspiration

S1

MC

S2



- Late crescendo murmur with midsystolic click (MC) that occurs after carotid pulse
- Best heard over apex

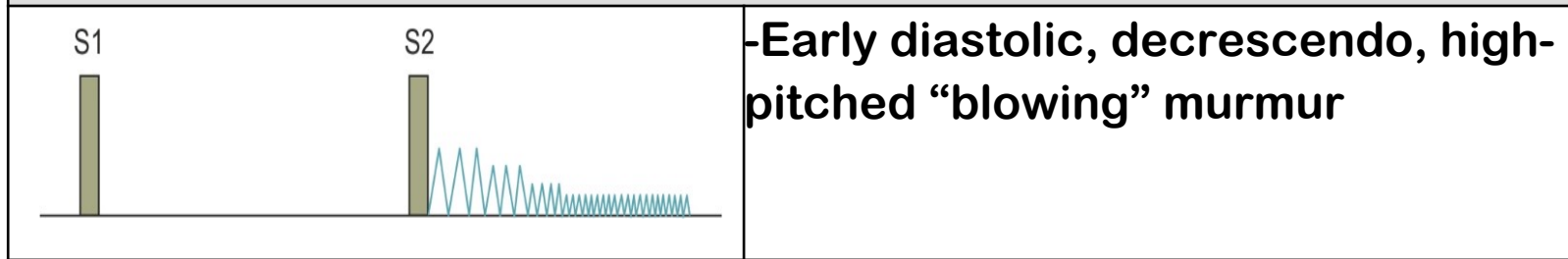
S1

S2

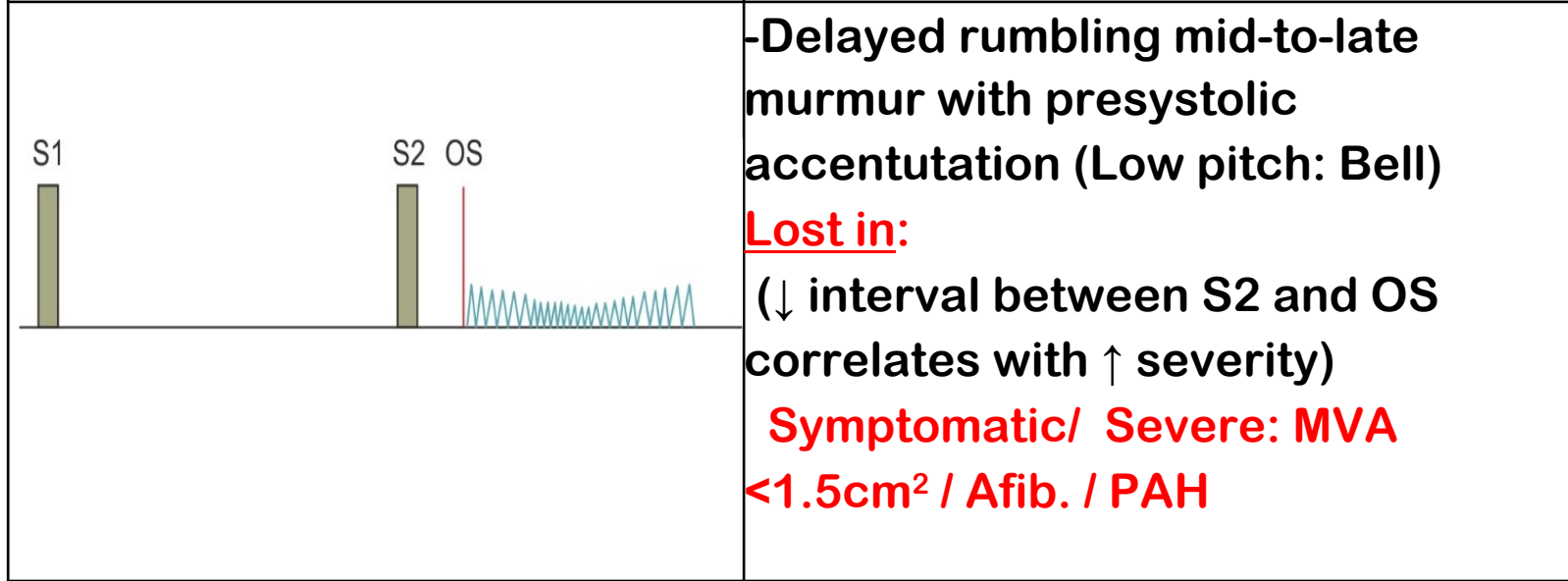


- Holosystolic, harsh-sounding
- Loudest at tricuspid area

Diastolic



Early diastolic murmur in PAH



Mid-diastolic, rumbling, low-pitched in AR

Mid-diastolic, short, ARF

Continuous



Heart Murmurs

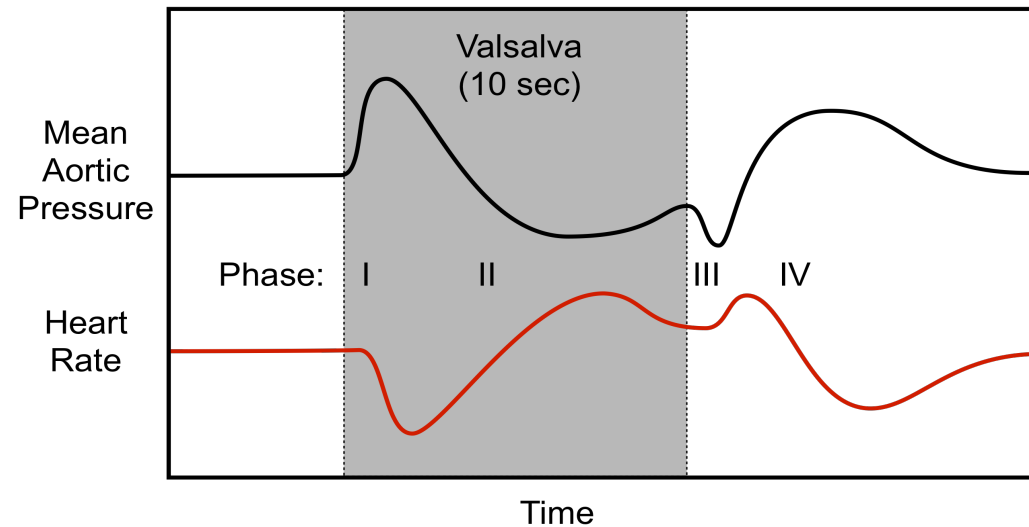
Preload reduce (Valsalva/ Standing/ Nitroglycerin):

Preload increase (Passive leg raise/ Squatting/ Phenylephrine):

Afterload reduce (Amyl Nitrite):

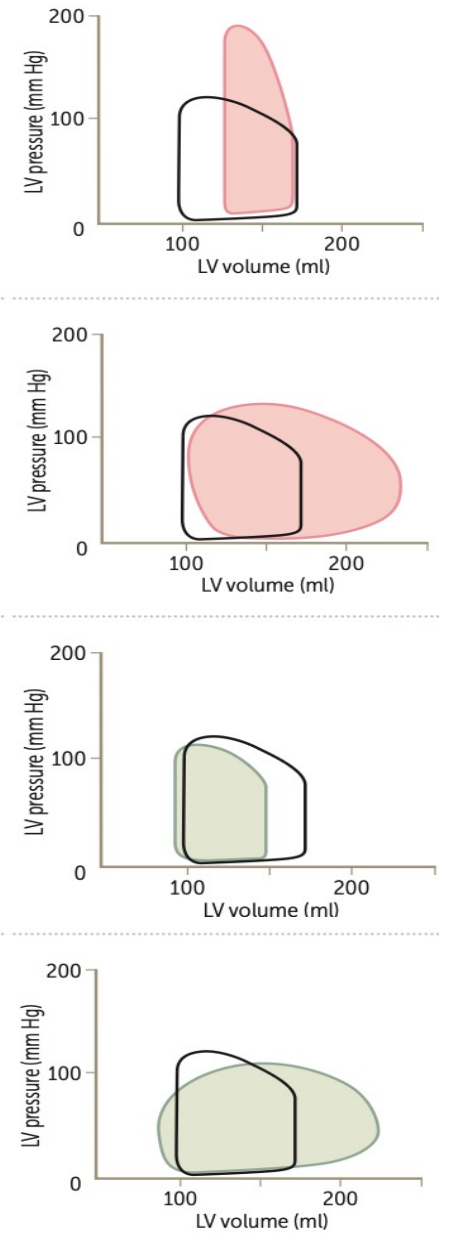
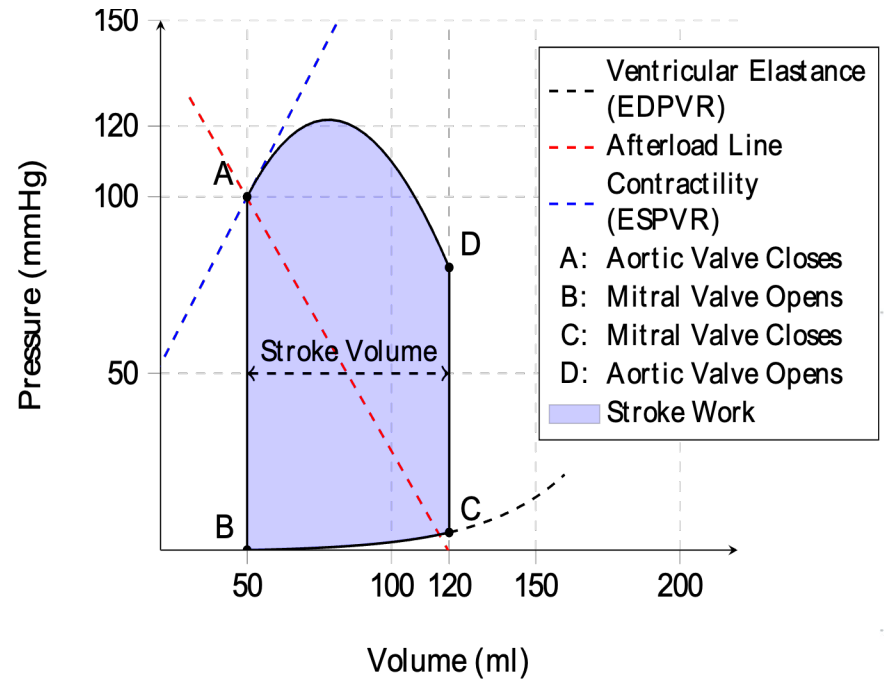
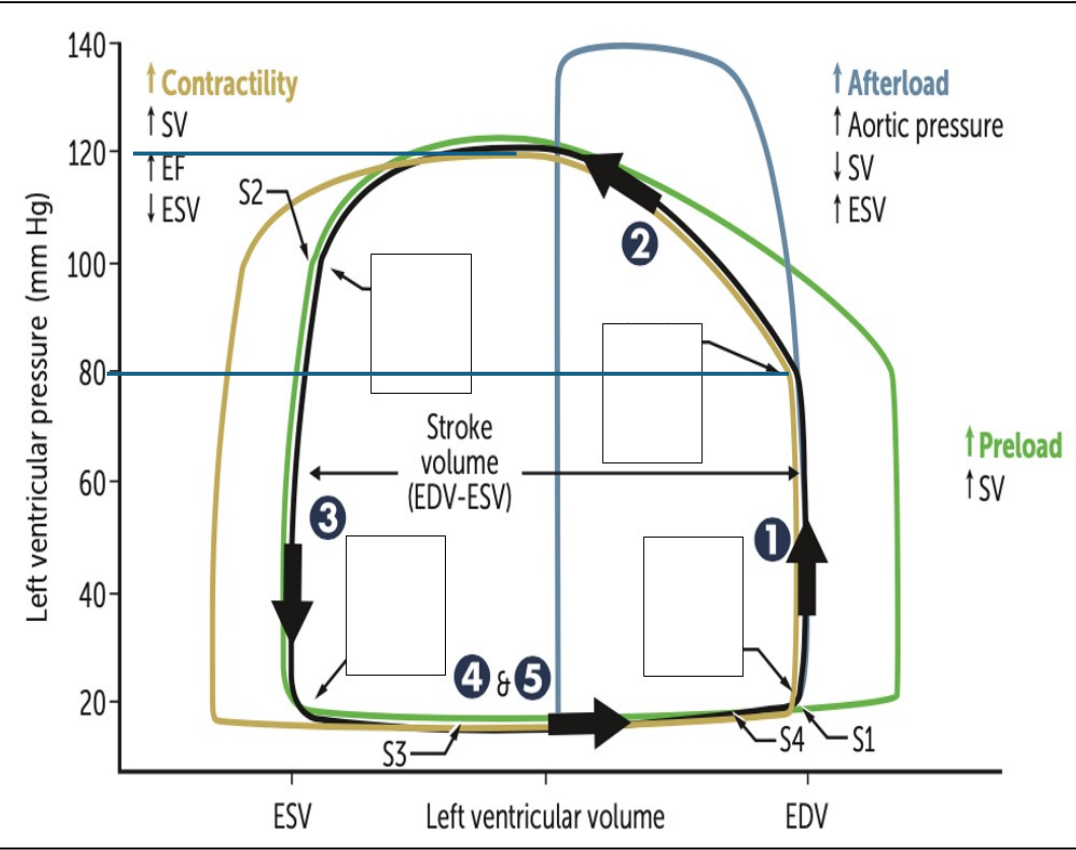
Afterload increase (Handgrip):

Inspiration:



Forceful expiration against closed glottis

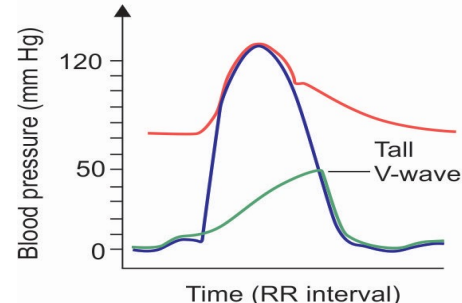
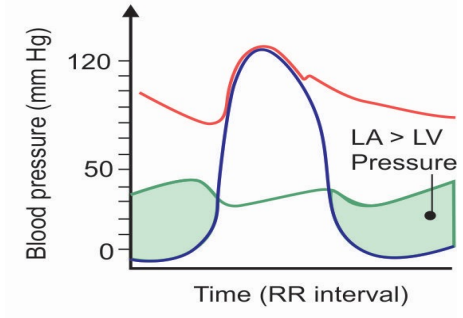
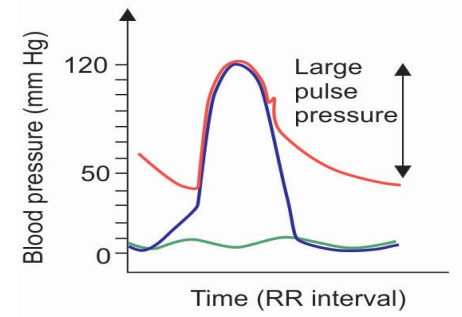
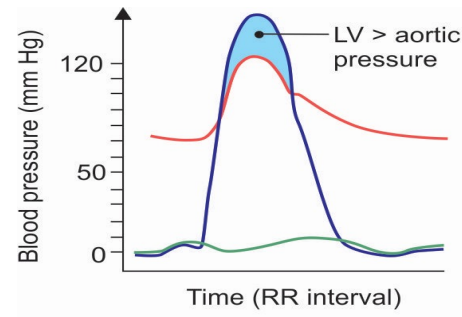
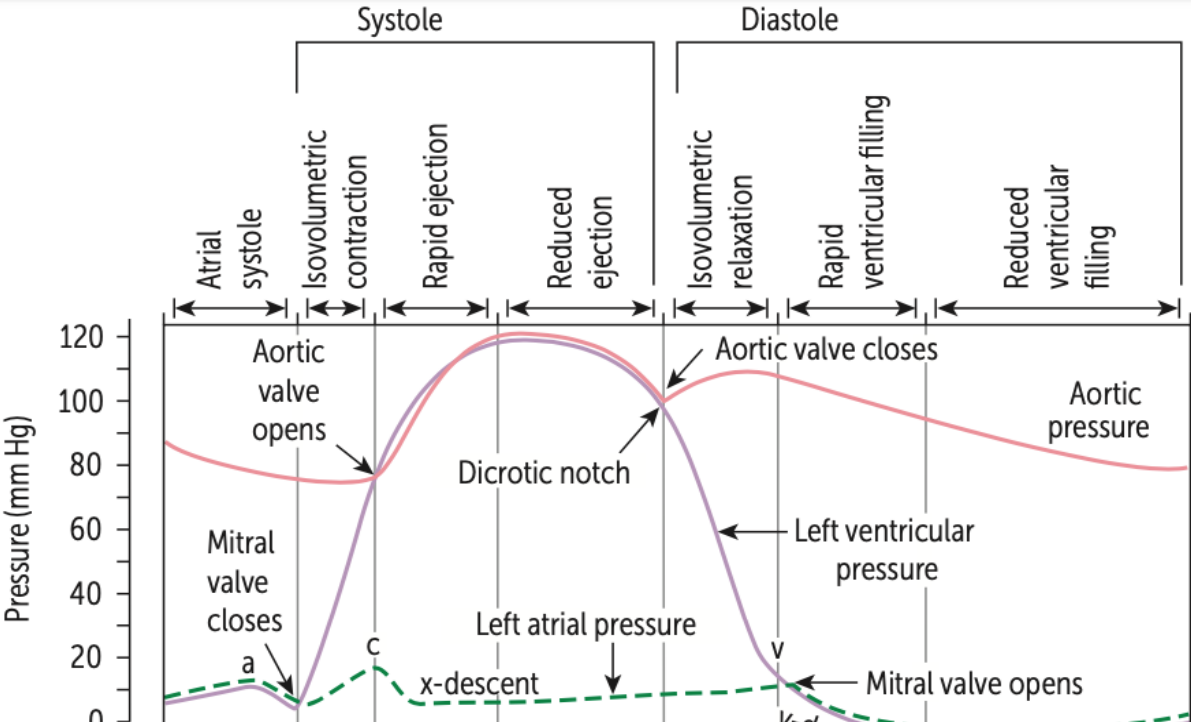
Pressure Volume Curves



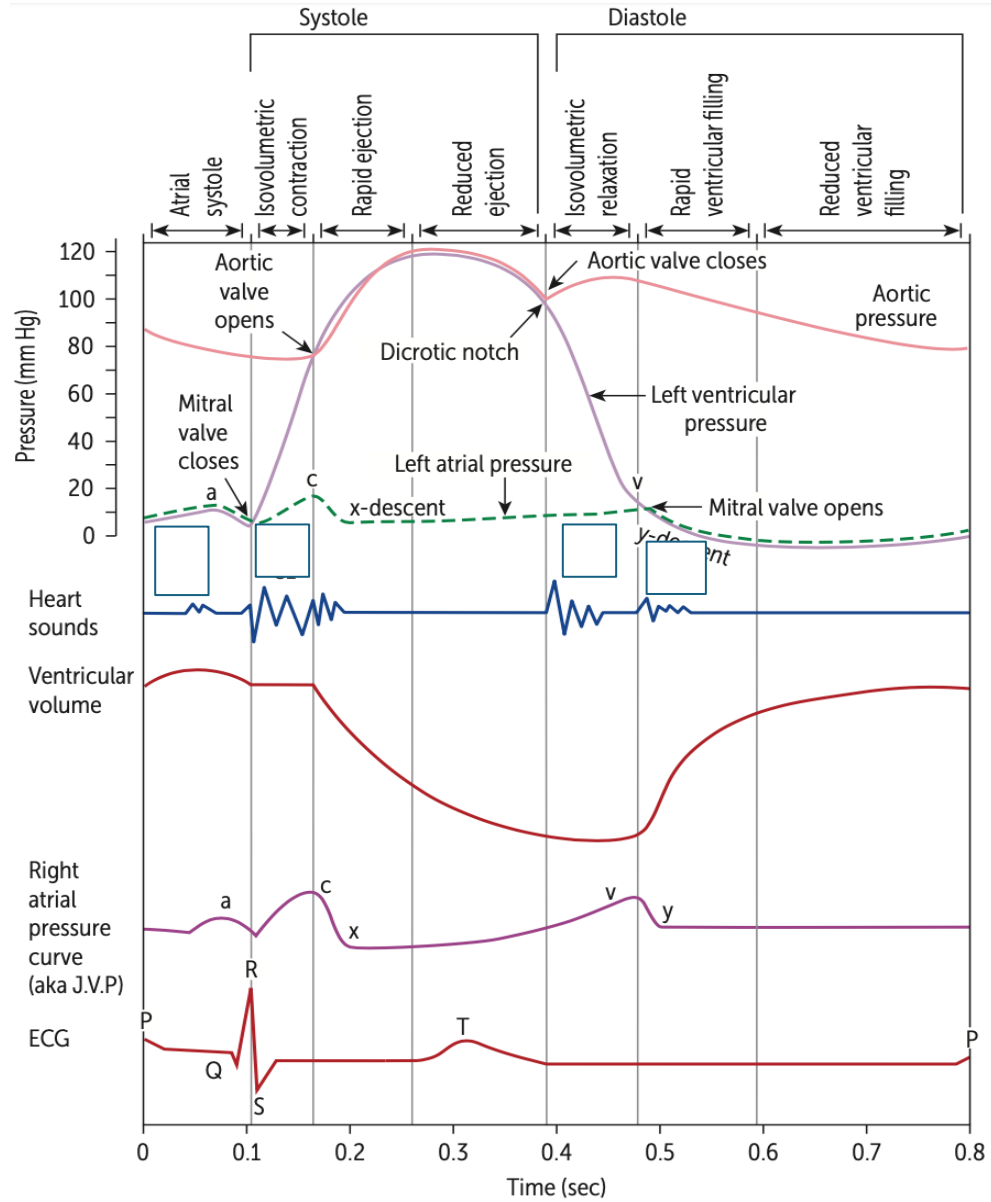
$$EF(\%) = \frac{EDV - ESV}{EDV} * 100$$

$CO = SV \times HR$
Cardiac index:

$$Cardiac\ output = \frac{Total\ O_2\ Consumption}{[O_2]_{pulmonary\ vein} - [O_2]_{pulmonary\ artery}}$$



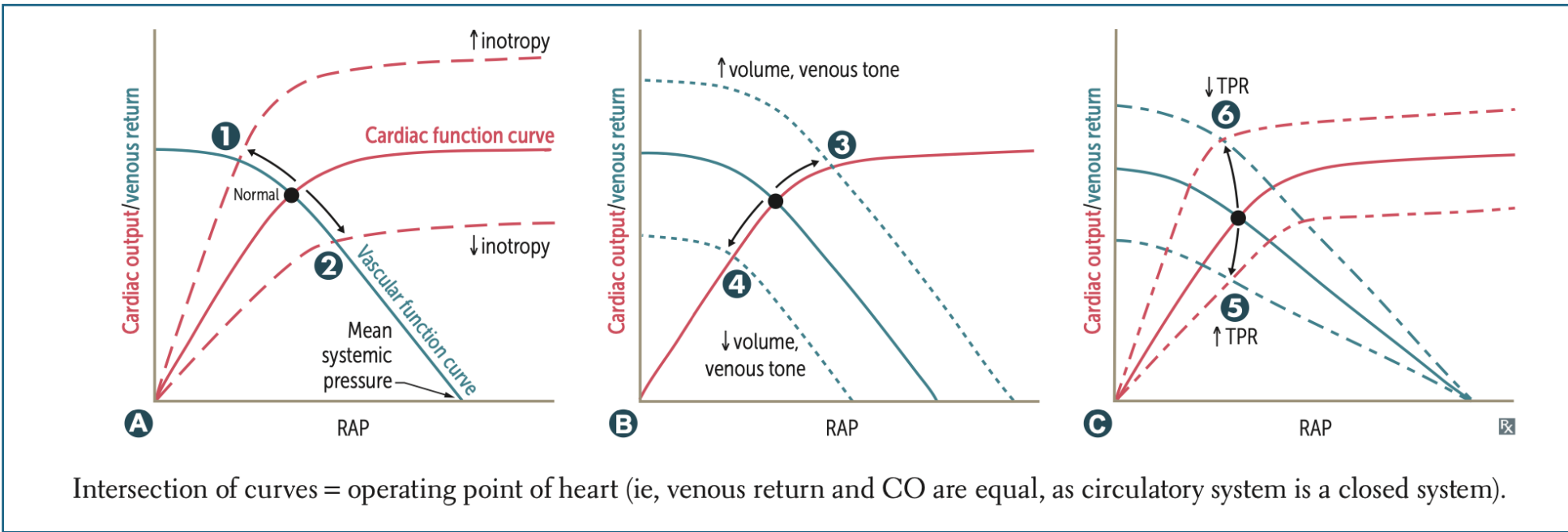
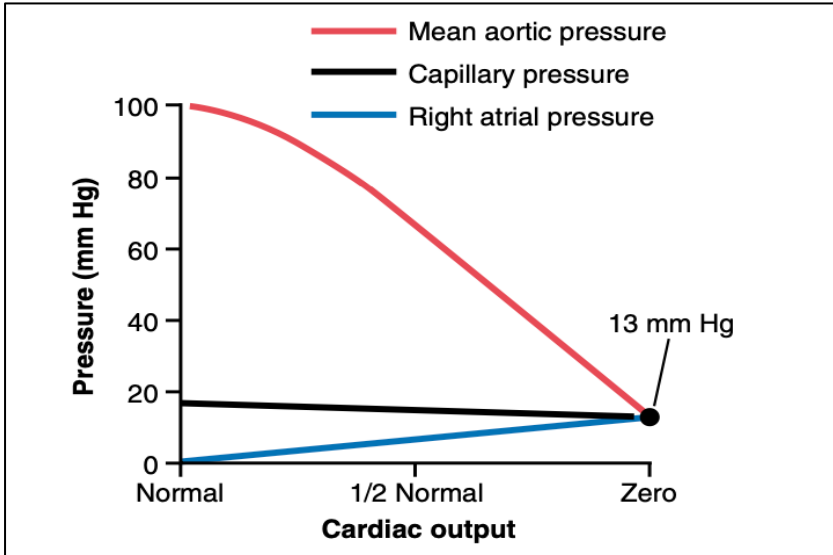
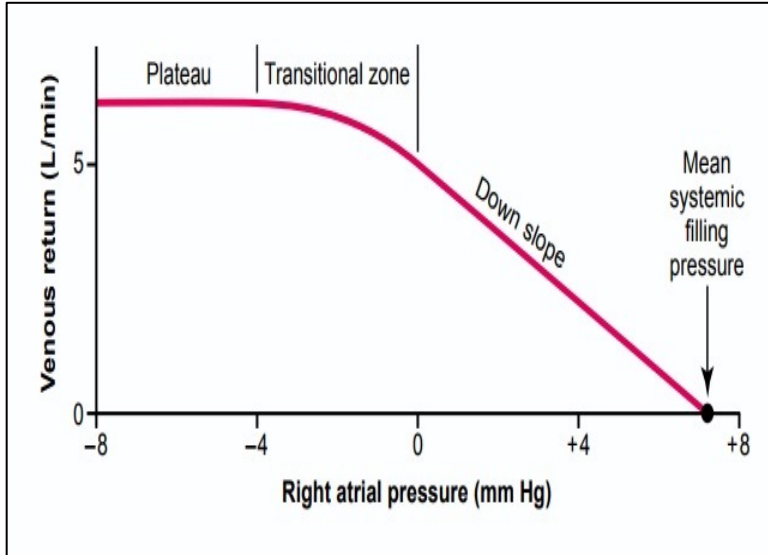
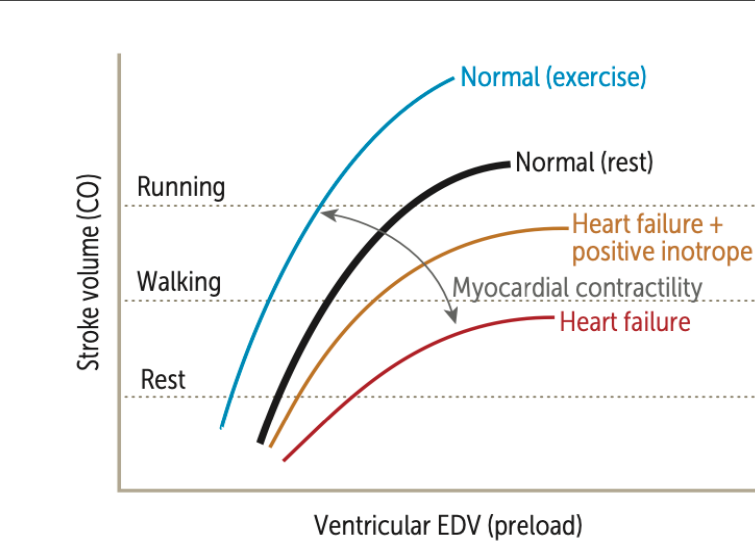
Wigger's Diagram



Cardiac cycle:		
	Atria	Ventricle
Systole	0.1s	0.3s
Diastole	0.7s	0.5s

P a4 QRS 1 cx T 2dn v 3y

Graphs



Intersection of curves = operating point of heart (ie, venous return and CO are equal, as circulatory system is a closed system).

Physiology

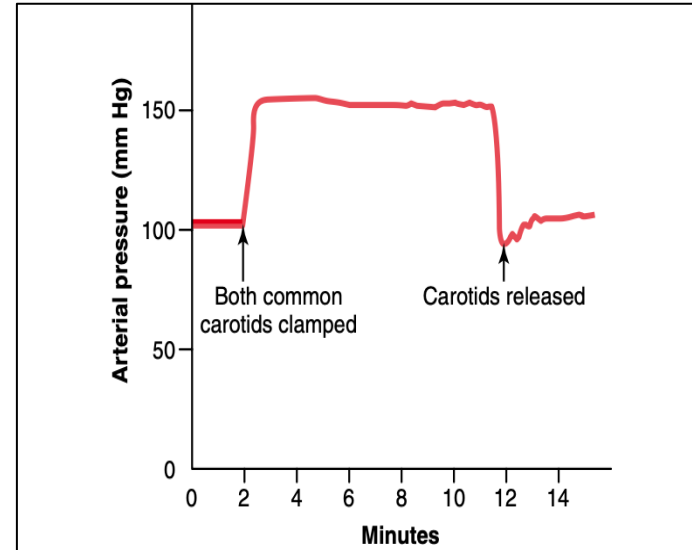
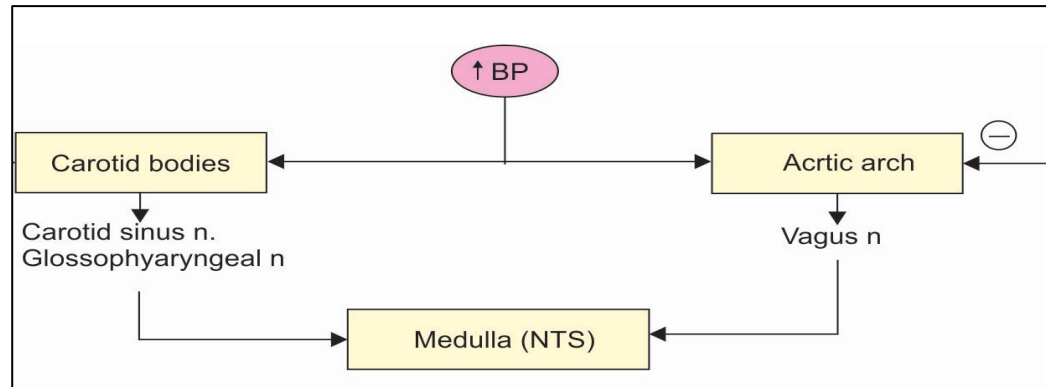
BARORECEPTOR

Spray-type nerve endings

Stretch receptors in adventitia-TRP channels

Most sensitive stimulant:

B/L Carotid clamped-effect:



Mary's law

Bainbridge reflex

Bezold-Jarisch reflex

Postural hypotension:

SBP-DBP-within 3min of standing

Coronary steal syndrome- Dipyridamole, regadenoson

- Maximum total cross-sectional area:
- Minimum blood flow velocity:
- Exchange vessels/ Min resistance/ Parallel arranged:
- Max TPR:
- Windkessel effect:
- Capacitance vessels:

Distribution of Cardiac Output (CO)

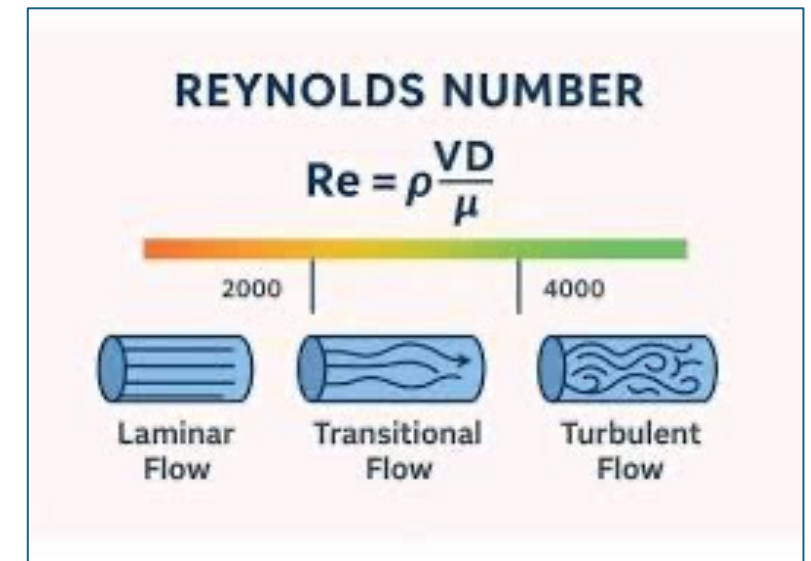
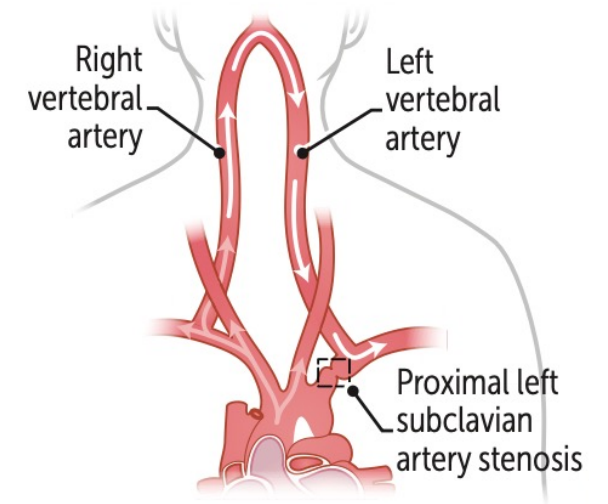
- Highest blood flow (absolute):
- Highest blood flow per 100 g tissue:

Arteriovenous (A-V) Oxygen Difference

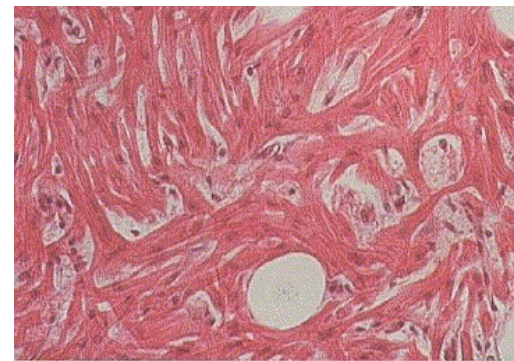
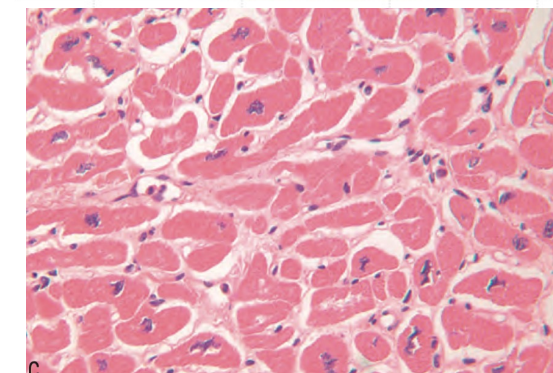
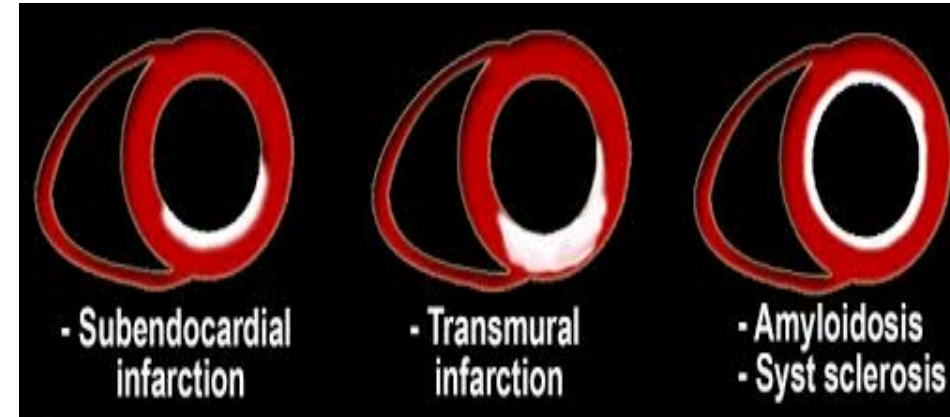
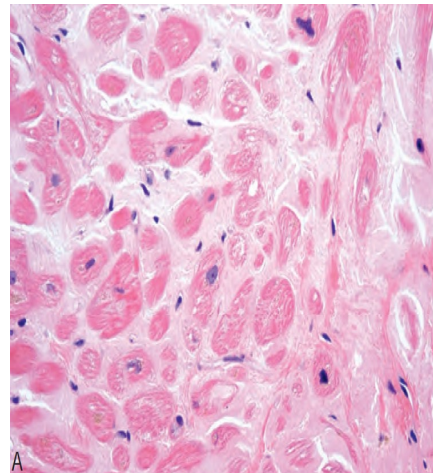
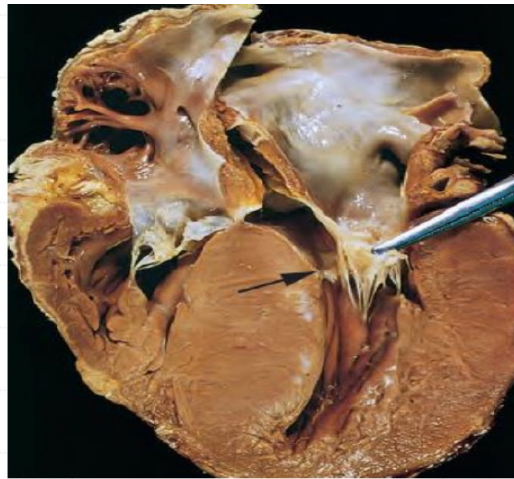
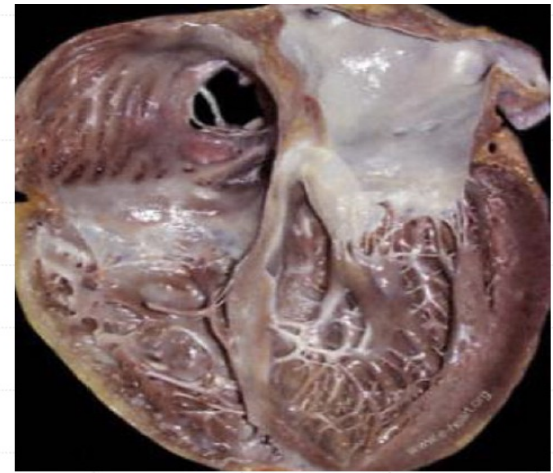
- Highest A-V O₂ difference:
- Lowest A-V O₂ difference:

Oxygen Consumption

- Highest total O₂ consumption:
- Highest O₂ consumption per 100 g tissue:

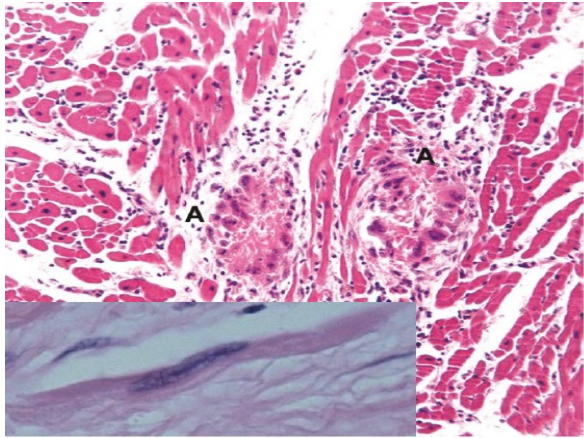


Cardiomyopathy



Postradiation fibrosis
Löffler endocarditis,
Endocardial
fibroelastosis
Amyloidosis,
Sarcoidosis,
Hemochromatosis

Acute Rheumatic Fever



Category	Duration from last attack
Rheumatic fever without carditis	5 years or until 21 years of age (whichever is longer)
Rheumatic fever with carditis but no residual heart disease	10 years or until 21 years of age (whichever is longer)
Rheumatic fever with carditis + residual heart disease	10 years or until 40 years of age (whichever is longer)

Major Criteria (JONES)

- J –
- O –
- N –
- E –
- S –

Minor Criteria

- ↑ CRP, ↑ ESR
- Arthralgia
- Fever
- Prolonged PR

im Benzathine Penicillin 0.6-1.2MU 3-4 weekly

Recent streptococcal infection PLUS either:

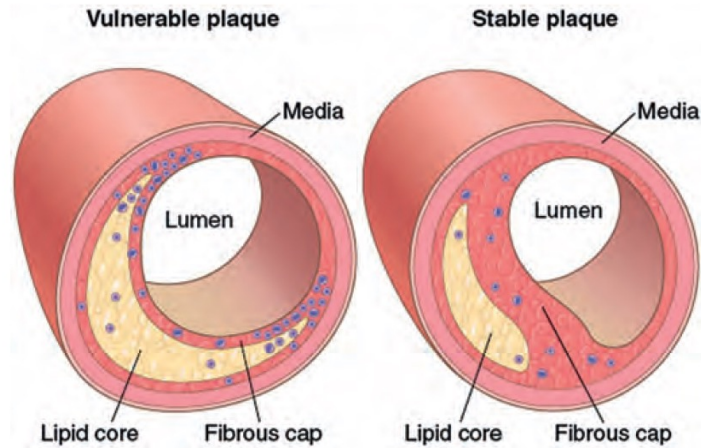
- 2 Major criteria, OR
- 1 Major + 2 Minor criteria

Indications for Endocarditis Prophylaxis Before High-Risk Dental Procedures

1. Prosthetic heart valve
2. Previous infective endocarditis
3. Unrepaired congenital heart disease
4. Completely repaired congenital heart disease with prosthetic material for first 6 months
5. Incompletely repaired congenital heart disease
6. Valvulopathy following cardiac transplantation

Atherosclerosis & Dyslipidemias

Endothelial dysfunction → Fatty streak formation →
Fibrous plaque formation



Statins-HMG coA reductase inhibitor

Pleiotropic-Antiaggregant, anti-inflammatory, NO

All cyp metabolized except:

Longest acting:

High intensity statins:

Atorvastatin 40-80 mg/ Rosuvastatin 20-40 mg

Add-on drugs:

Ezitimibe-NPCL-Absorption-

Alirocumab, Evolocumab-PCSK9- (Lp(a) lower)

Inclisiran- PCSK9 synthesis inhibitor

Bempedoic acid: ATP citrate lyase competitive-

Cholestyramine, Colestipol : BABA

Fibrates (**TG >500**)-PPAR alpha +

Icosapent: Lowers VLDL synthesis

Niacin-HSL-

S/e:

Evinacumab: ANGPTL3 - : LPL+

Lomitapide:MTTP-

Heart Failure

NYHA Functional Classification (Heart Failure)

Class I

No limitation of physical activity

Class II

Comfortable at rest- Ordinary physical activity causes fatigue, palpitations, or dyspnea

Class III

Comfortable at rest-Less than ordinary activity causes fatigue, palpitations, or dyspnea

Class IV

Symptoms present at rest

Rx of CHF

Decompensated Heart failure: CI-

Ionotropic:

P.edema:

Prevent remodeeling-Lowers mortality:

1)

2)

3)

4)

Neprilysin+ ACE inhibitor:

S/e:

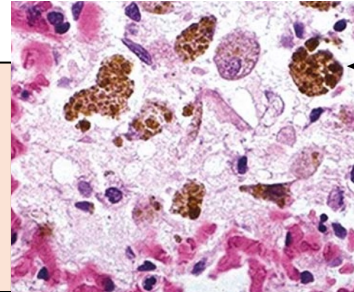
HFpEF : LVEF > 50%

HFmrEF : LVEF 41–49%

HFrEF : LVEF < 40%

Left Heart Failure

- Orthopnea / PND
- Pulmonary edema
- Hemosiderin-laden macrophages



Right Heart Failure

- Congestive hepatomegaly
- Jugular venous distention (JVD)
- Peripheral edema

Investigations:

Other drugs for HFrEF

BNP analogue:

Direct guanyl cyclase activator: Vereciguat

Calcium sensitize: Pimobendan/ Levosimendan

Direct myosin activator: Omecamtiv

Pharmacology

CCB

Amlodipine,
nifedipine,
nimodipine

Diltiazem,
verapamil

S/E:- Reflex
tachycardia
- Flushing

S/E: -AV block
-Constipation
-Pedal edema

-Gingival hyperplasia
-Hyperprolactinemia
-ATP binding cassette

Hydralazine

Nitroprusside Nitrates

ACE-:
Prodrugs
except
Captopril,
Lisinopril

ARB:
Losartan,
Valsartan

Aliskiren

S/E:
Hyperkalemia
Cough/Angioedema

PPAR-γ agonist
Uric acid excretion increase
TxA₂ inhibition

Clonidine: Rebound hypertension

CHRONIC STABLE ANGINA

Ivabradine:

Nicorandil:

s/e: Aphthous ulcer

Rho kinase inhibitor:

Metabolic modulators (PFOX-):

s/e: aggravating movement disorder

MM + Late inward Na blocker:

Beta-Blockers

BETA BLOCKERS

B1 selective:

Atenolol, Betaxolol, Bisoprolol, Esmolol, Landiolol,
Metoprolol

Nebivolol (most cardioselective):

Celiprolol:

Acebutolol:

Non-selective:

Nadolol:

Propranolol:

Timolol

Pindolol:

A + B blockers: Carvedilol, Labetalol

Tillisolol:

Sotalol:

USES:

CVS

Glaucoma

Performance anxiety

Thyroid storm

Akathisia

Migraine prophylaxis

Essential tremors

CI:

Bradycardia / AV block

Acute CHF

Asthma

PVD

DM

Prinzmetal angina

DOC for toxicity:

Bisoprolol, carvedilol, metoprolol

Nadolol, Propranolol, Carvedilol

Hypertension

Hypertension with:

1st line-Young(<55yr):

Old (>55yr):

Resistant hypertension-

DM / CKD/ Nephrotic Sx/ Scleroderma-

Gout-

Osteoporosis/ Renal stones-

Raynaud/ Cyclosporine induced/Asthma-

BPH-

Migraine/ Thyrotoxicosis/ Angina/ Tremor/Anxiety-

Emergency: Severely elevated BP with acute hypertension mediated organ damage (HMOD)

Urgency: Severely elevated BP without acute hypertension mediated organ damage (HMOD)

Category (AHA 2025)	Systolic BP (mm Hg)	Diastolic BP (mm Hg)
Normal	< 120	< 80
Elevated	120–129	< 80
Stage 1 hypertension	130–139	80–89
Stage 2 hypertension	≥ 140	≥ 90
Severe hypertension	> 180	≥ 120