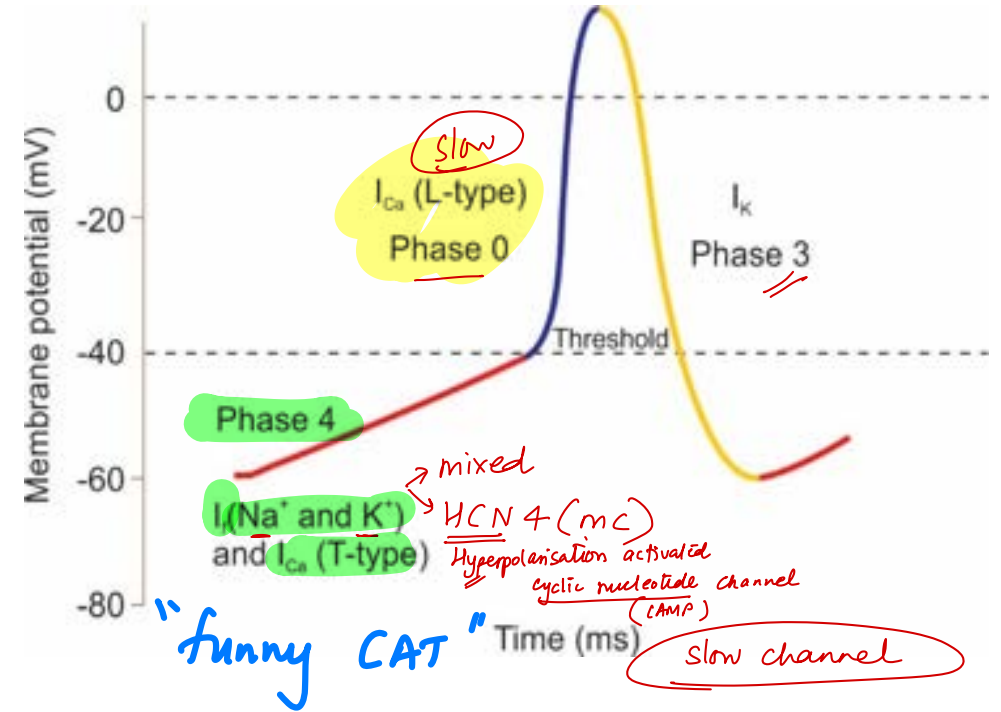
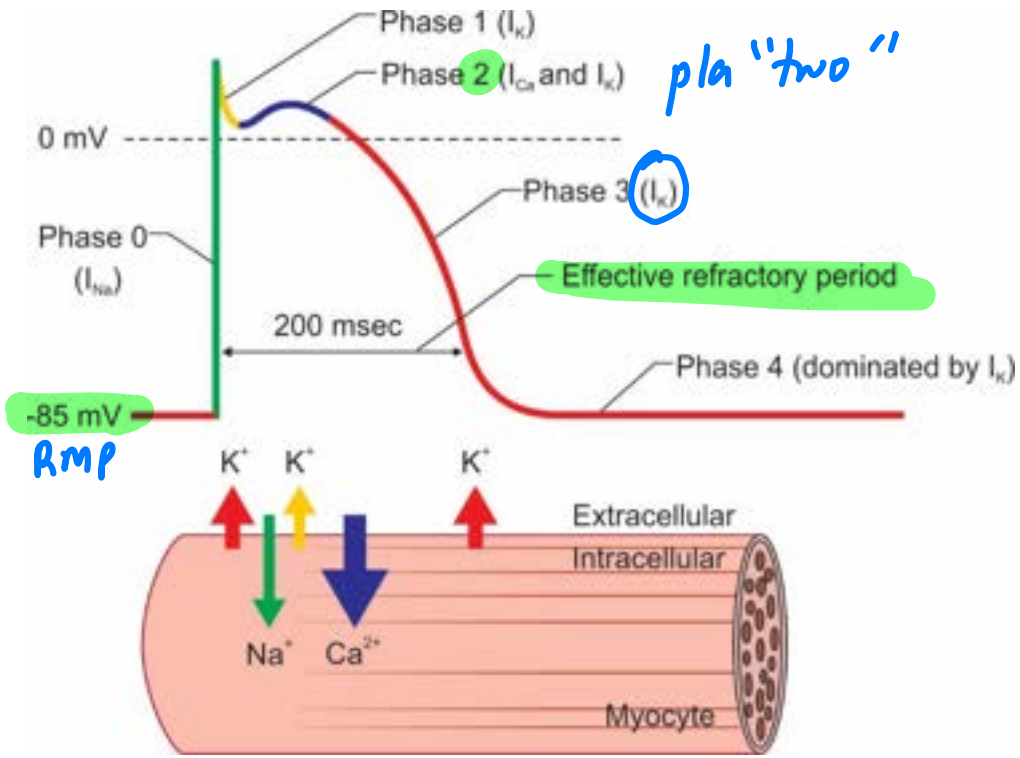


INTEGRATED CVS



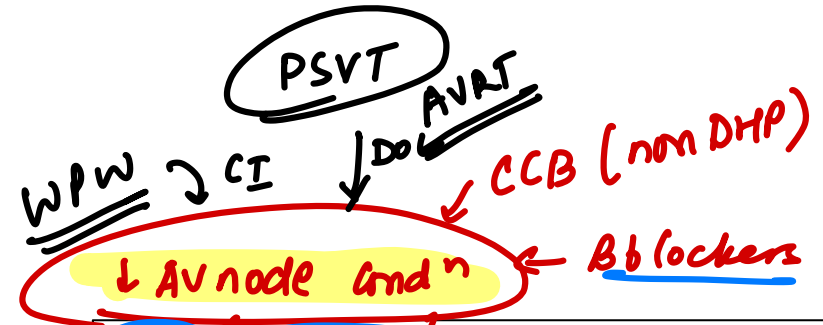
Action Potential



"Park At Ventura Avenue"

Speed of conduction:

His-Purkinje > Atria > Ventricles > AVN



Ach, Adenosine: ↓ phase 4

Catecholamines: ↑ phase 4

Antiarrhythmic drugs

I (Avoid with HyperK) Na^{\ominus}

IA: K^- : Quinidine, Procainamide, Disopyramide

IB: K^+ : Lignocaine, Phenytoin

IC: K^+ no: Flecainide, Propafenone

II - β blocker

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

IV CCB

V: Adenosine $\text{AV node cond}^n \downarrow \rightarrow$ PSVT stable

Dose: $6\text{mg} - 12\text{mg} - 12\text{mg}$ (max: 30mg)

Theophylline/ Caffeine: 12mg start E

Amiodarone: all I / II / III / IV

PIs - Photosen

Check - Corneal, Conjunctivitis (Blue man)

PFT \rightarrow Pulm fibrosis

LFT \rightarrow Hepatotoxic

TFT \rightarrow Hypo / Hyper

SHIP

drug induced

• Lupus

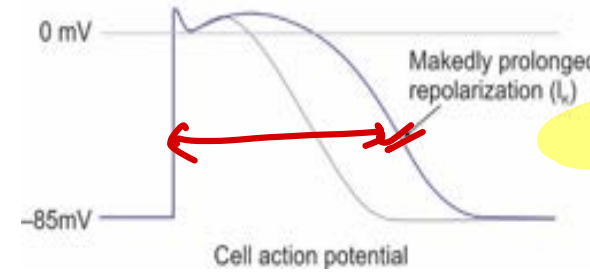
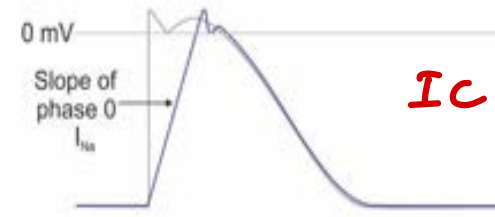
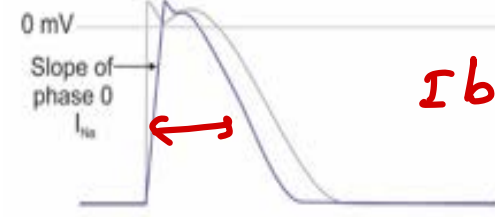
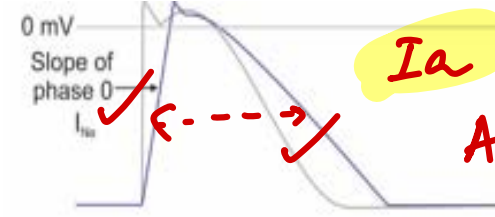
• acetylⁿ

(Phase II)

digitalis
ischemia

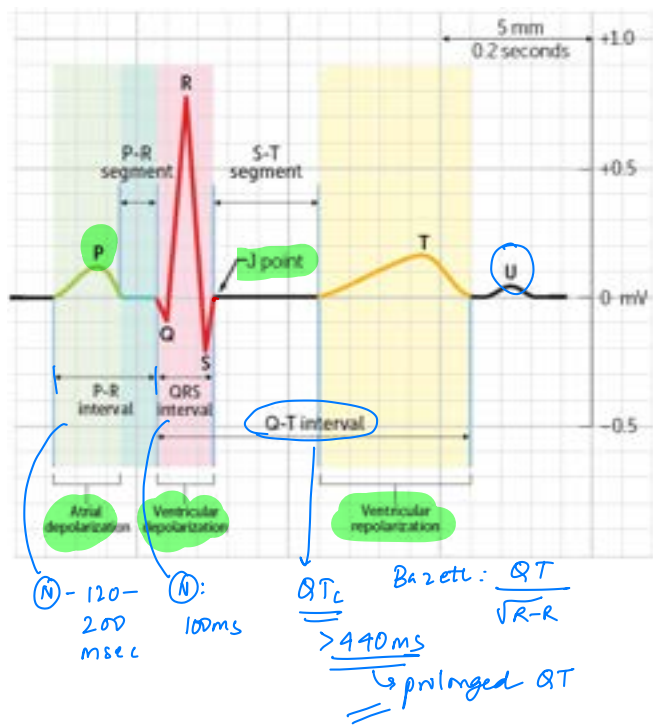
Digi-bind

K^{\ominus}

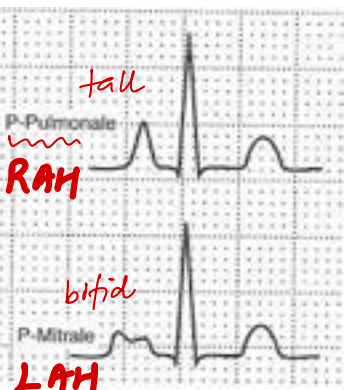


APD ↑ QT ↑

ECG



Heart rate: $\frac{300}{\text{no of large squares}}$
 (N): 60-100
 > 5 : Bradycardia
 < 3 : Tachycardia

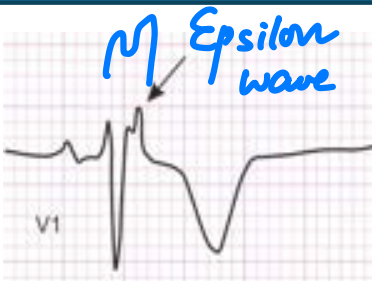
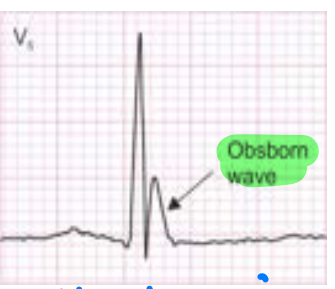


Ebstein anomaly
 Himalayan p-waves
 $\downarrow K^+$ "hypo"
 Pseudo-P pulmonale

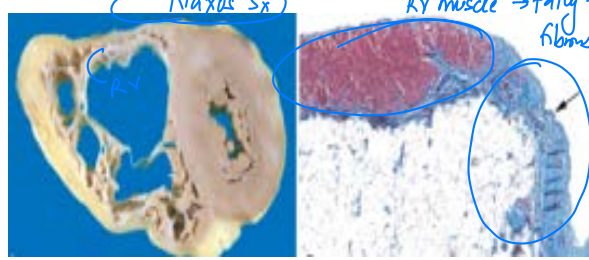


Bundle of Kent, Avoid AV node block

DOC-Flecainide
 TOC-RFA
 Emergency-IV procainamide



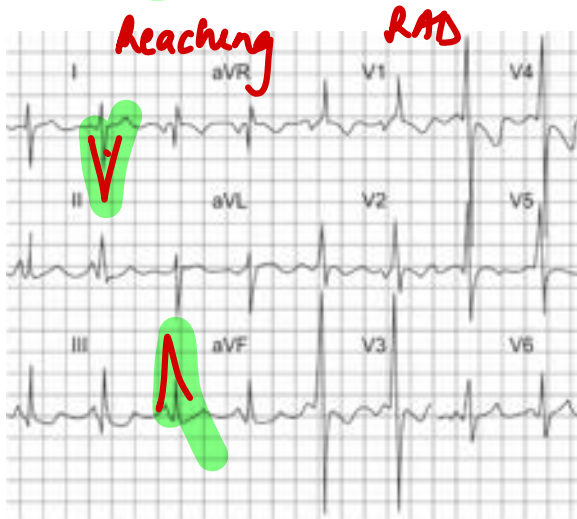
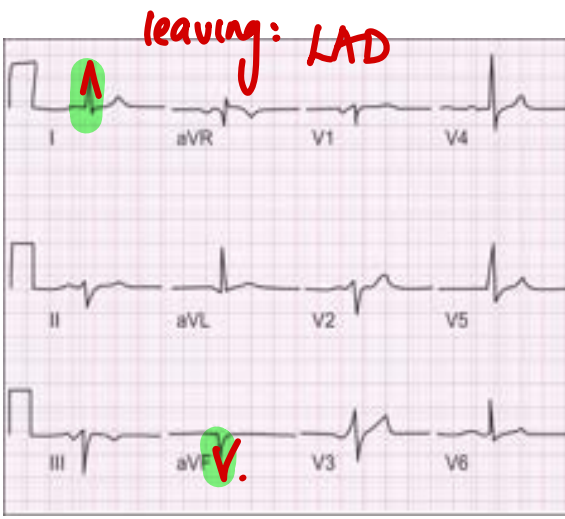
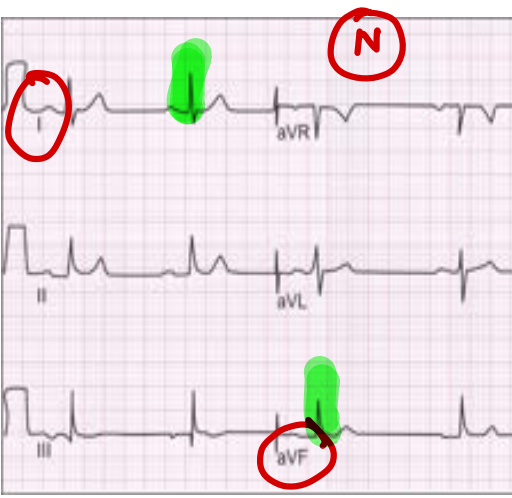
Sudden death



TOC: ICD + B-blockers

Axis deviations

Lead 1	Lead aVF
Positive \wedge	Positive \wedge (N)
Positive \wedge	Negative \vee LAD
Negative \vee	Positive \wedge RAD
Negative \vee	Negative \vee extreme

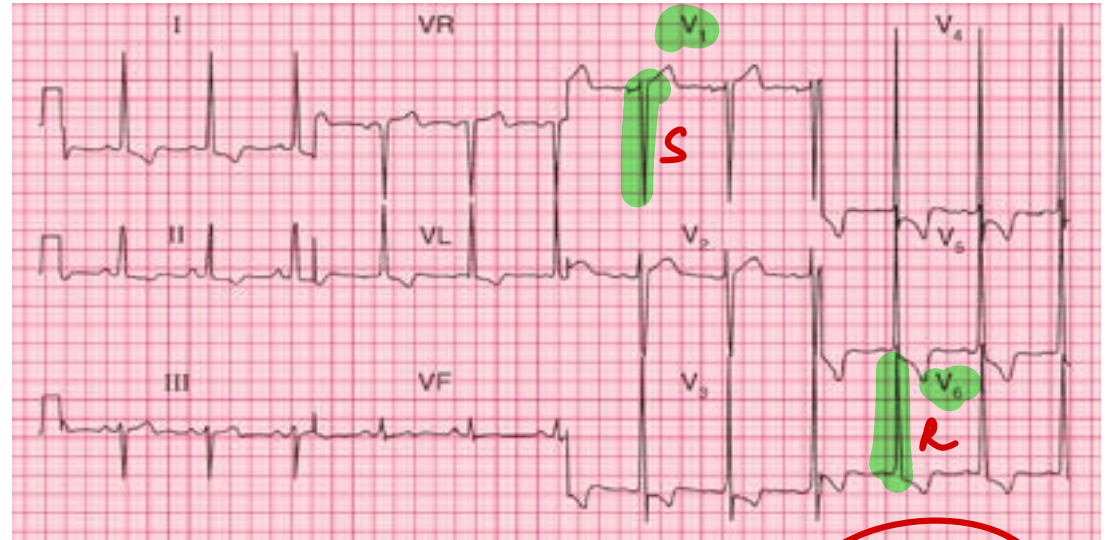


Bundle branch blocks

	V1	V6
Normal		
RBBB		
LBBB		

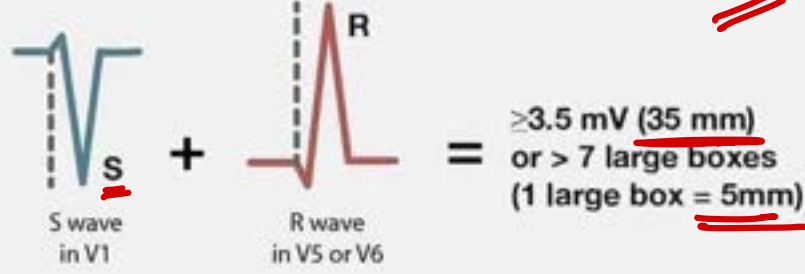
RBBB
Matter W

LBBB
William



Sokolow-Lyon criteria

LWH



RVH: $R_{V1} > 7mm$

Heart blocks



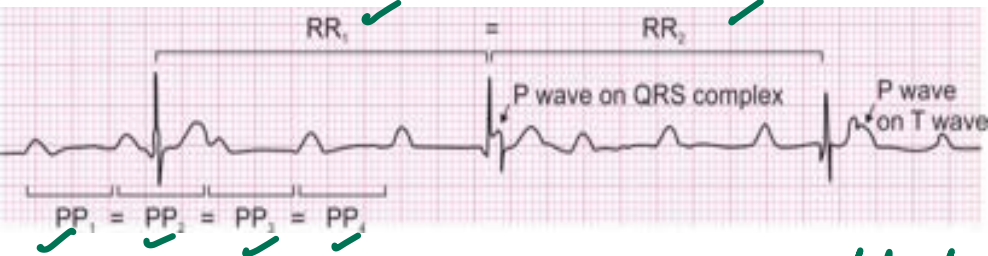
1° : PR Prolonged
but constant



2° → Mobitz type 1
Wenckebach's



2° → Mobitz type 2
PR (N)
sudden skip beat



3° → Av dissociation

Unstable/ Symptomatic

Atropine 0.5mg iv bolus-1st line

Dopamine iv infusion

Epinephrine iv infusion



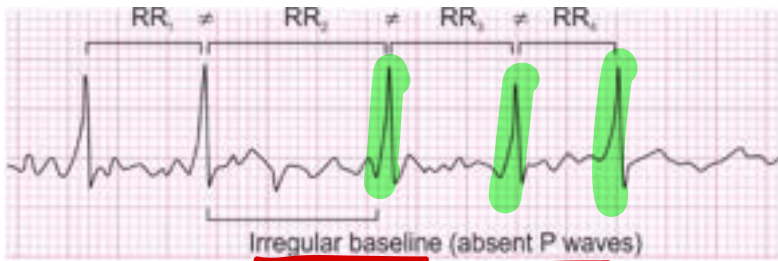
elderly
irregular

SICK SINUS Sx

Tachyarrhythmias

QRS(N) = Supravent

A-Fibrillation origin: LA-p.veins



Unstable-Cardioversion 200J
 Stable-RATE CONTROL:
 Esmolol/Verapamil /diltiazem
 Acute Heart failure + Afib: DIGOXIN^{or}
 Anticoagulation

CHA₂DS₂-VASc Score^{15,16}

C	Congestive Heart Failure	1 point
H	Hypertension	1 point
A ₂	Age ≥75 y	2 points
D	Diabetes	1 point
S ₂	Stroke	2 points
V	Vascular disease	1 point
A	Age ≥65 y	1 point
Sc	Sex category, female	1 point

Irregular



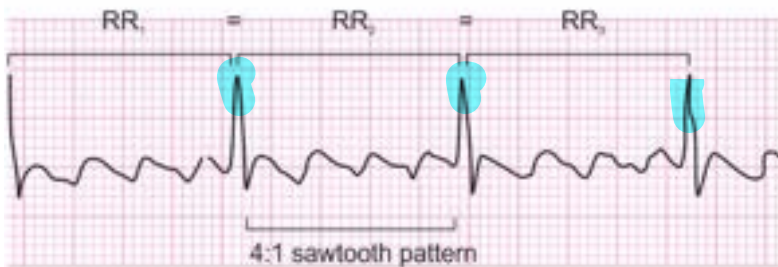
Multifocal atrial tachycardia

DOC-Verapamil

MAT

COPD / pneumonia

ESC 2010 Anticoagulation Recommendations:
 Score=1 Aspirin
 Score ≥ 2 oral anticoagulation. NOAC except



A FLUTTER origin: RA-tricuspid

Unstable-Cardioversion 25-50J
 Stable-Esmolol/Ibutilide
 Anticoagulation

WARFARIN
 Moderate-severe MS INR: 2-3
 Prosthetic Heart valve INR: 2.5-3.5

PSVT AV reentrant circuit



Carotid sinus massage (1st)
 Iv adenosine > Esmolol > Verapamil /diltiazem
 Unstable-Cardioversion
 FROG SIGN

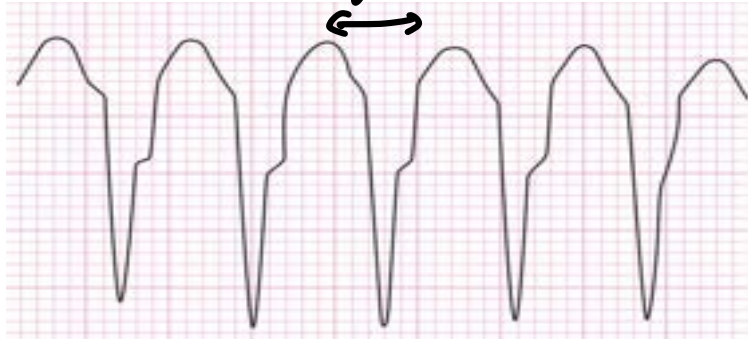
asthma / COPD

V-Fib



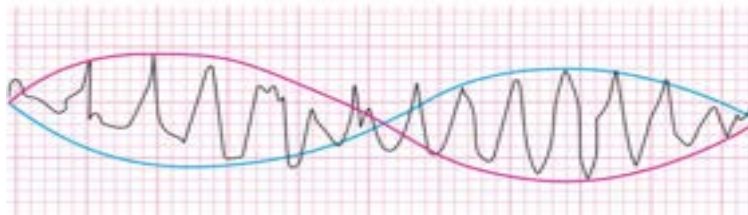
Unstable-Defibrillation
Stable-IV Amiodarone
DOC-Lignocaine

Wide QRS



V-tach

Polymorphic V-tach = Torsades de Pointes



Romano-Ward (AD):
Jerwell-Lange-Nelson (AR):
DOC-MgSO4

QT ↑

Prolonged QT

CYP ⊖

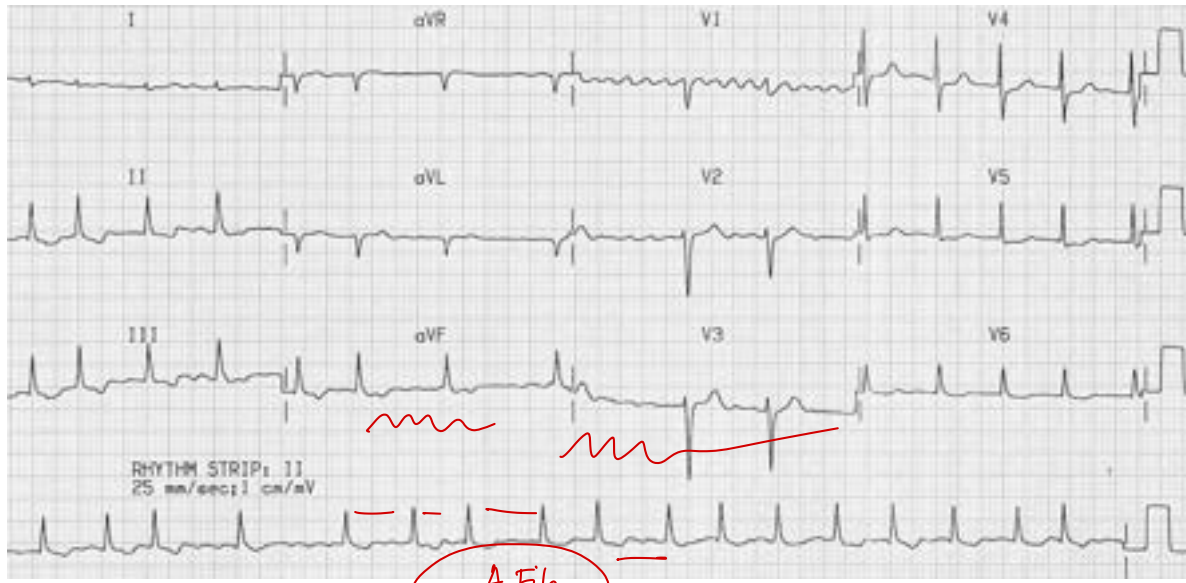
anti Arrhythmics (class IA, III) antiBiotics (e.g. macrolides, fluoroquinolones, Bedaquiline, Pretomanid)
anti "C" ychotics (eg Ziprasidone, quetiapine, thioridazine, haloperidol), antiDepresents (eg. TCA, SSRI),
antiEmetics (eg, ondansetron), antiFungals (e.g, fluconazole), Methadone Chloroquine, CAT drugs Navir
(Protease inhibitors)

4 Hypo Ca/Mg/K/thermia

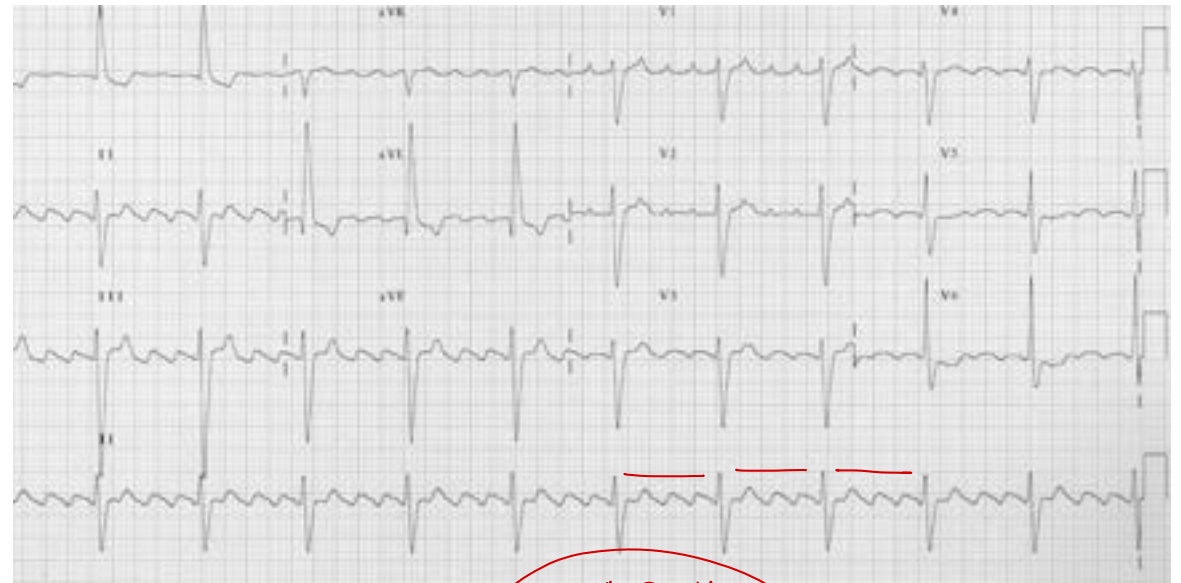
Cisapride
5HT4 ⊕

CYP3A4

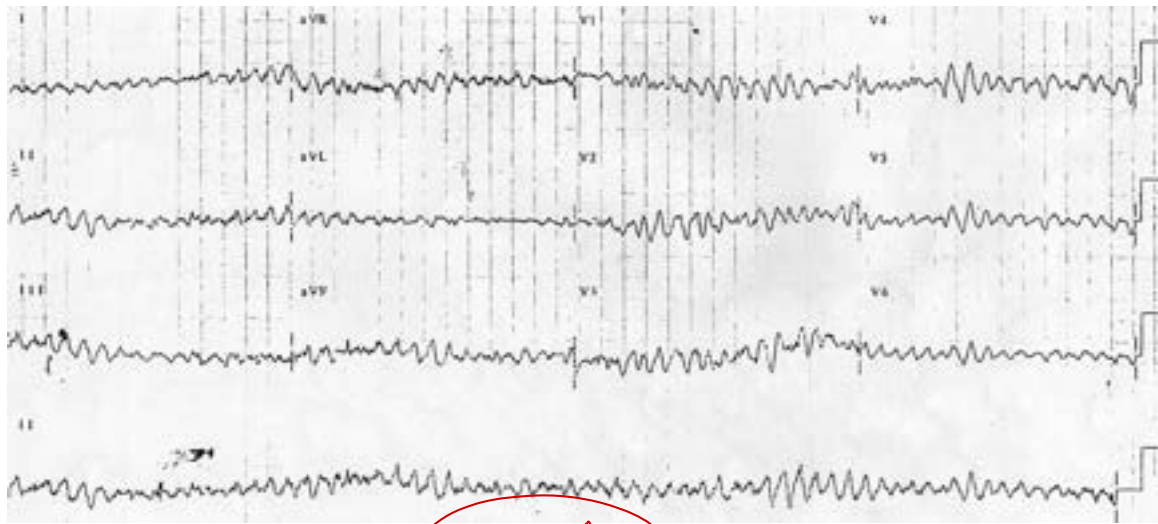
Astemizole
Terfenadine
anti-histaminica



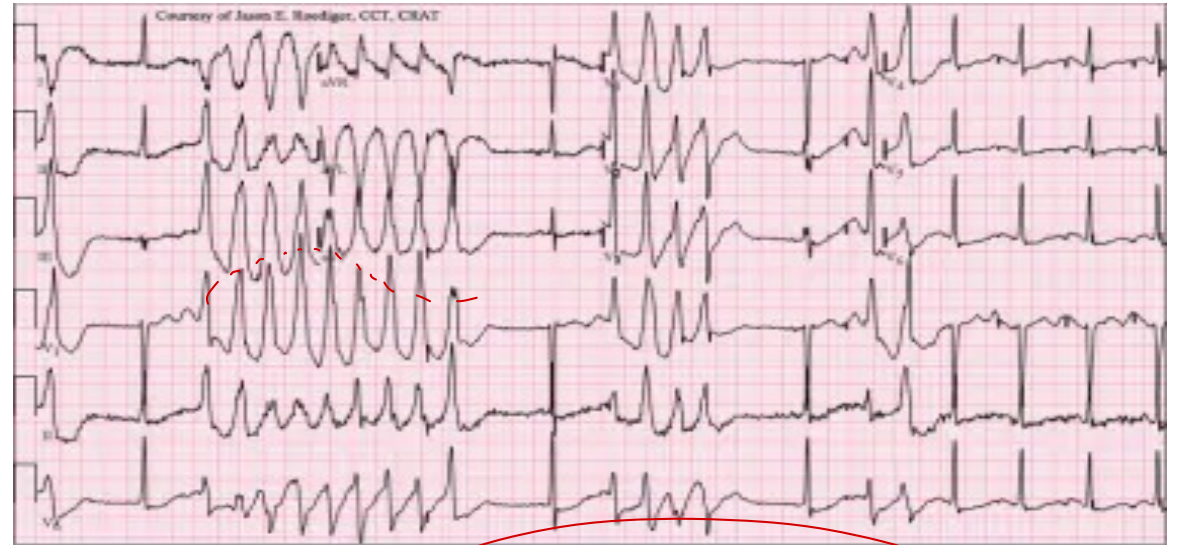
AFib



A. Flutter



V. Fib



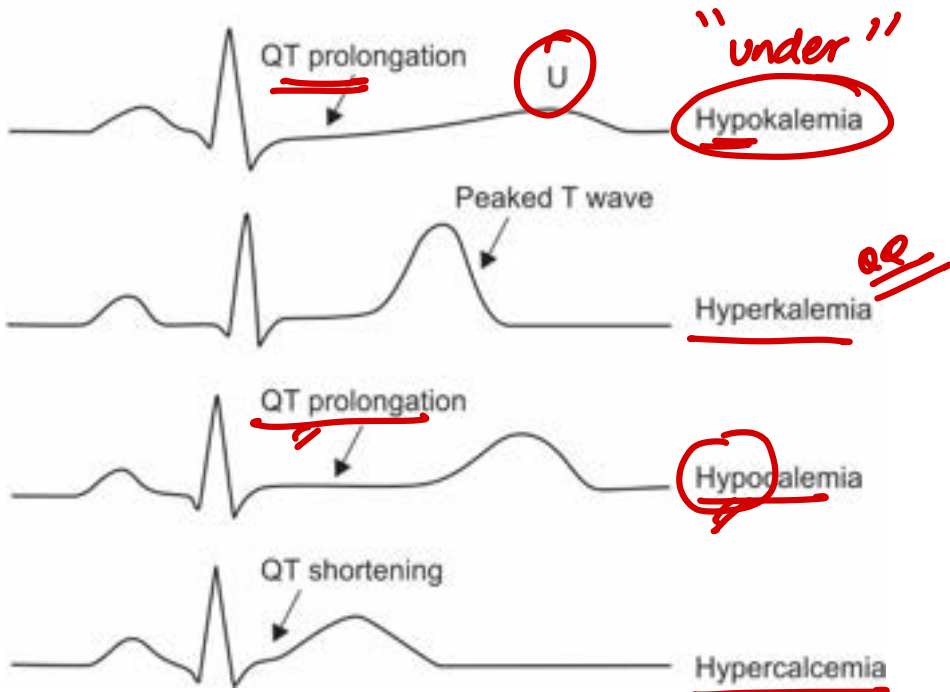
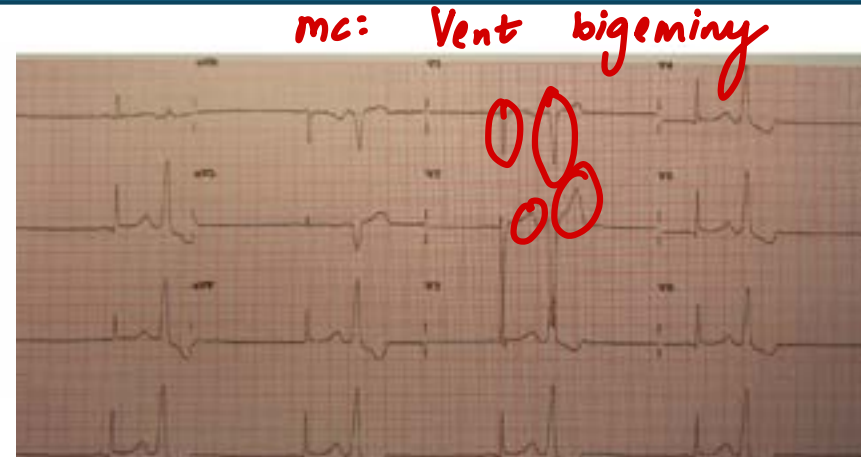
Torsades de Pointes

Important ECG

Digitalis:

QT ↓

- Shortening of QT interval, Flattened T waves
- Scooped ST depressions - Hockey stick / Salvador Dali moustache
- PR increased AV node blockers



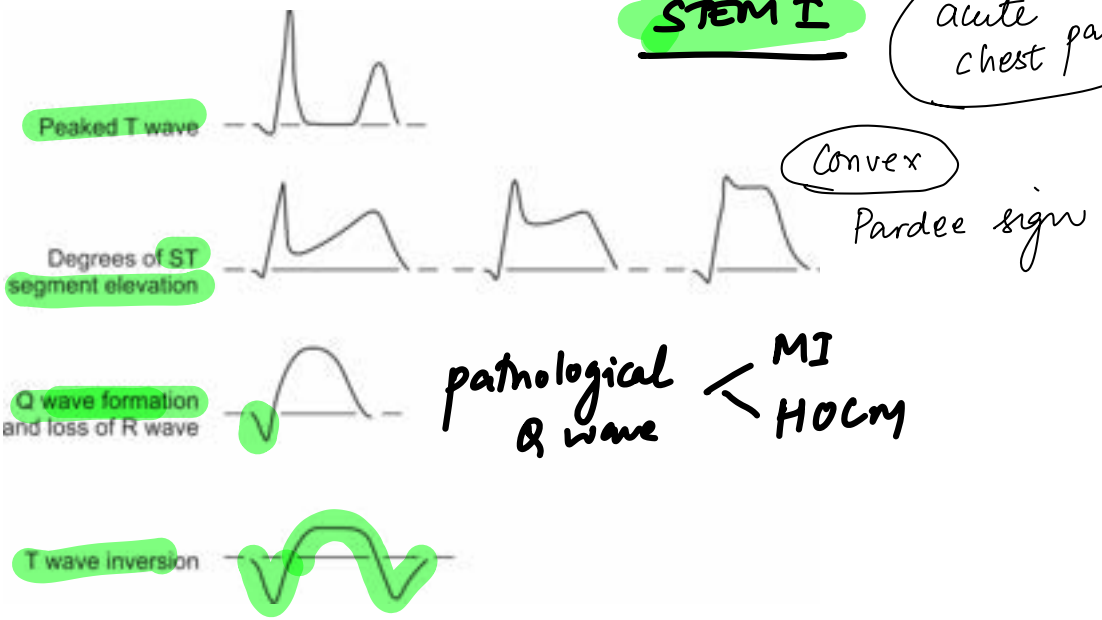
Serum potassium	Possible ECG abnormalities
Mild (5.5-6.5 mEq/L)	Peaked T waves Prolonged PR segment
Moderate (6.5-8.0 mEq/L)	Loss of P wave Prolonged QRS complex ST-segment elevation Ectopic beats
Severe (>8.0 mEq/L)	Sine wave Ventricular fibrillation Asystole

Mx:
 1st: Ca gluconate (DOC)
 CaCl₂
~~CaCO₃~~
Next: → Insulin (+ glc)
 ↓ Salbutamol
 • K⁺ binding resins
 • Hemodialysis

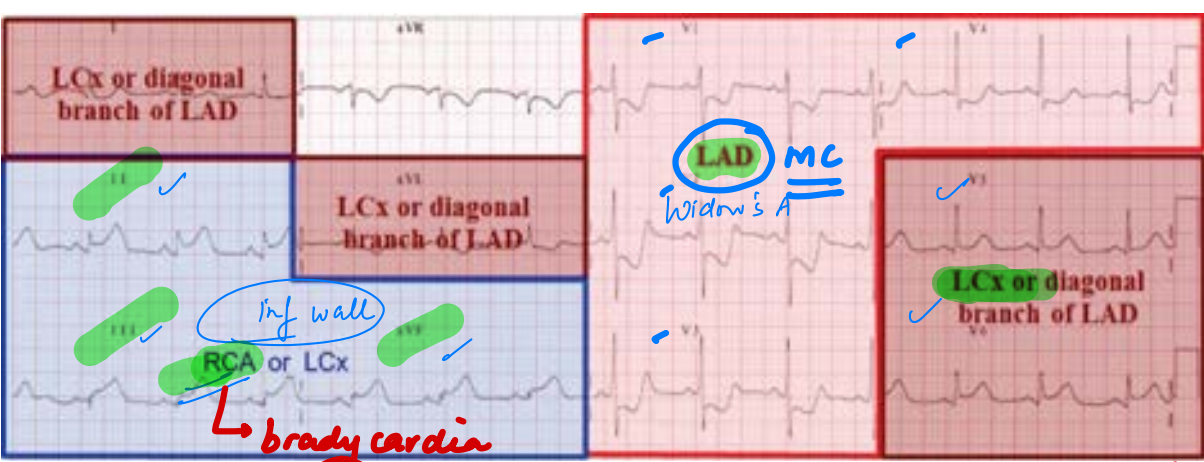
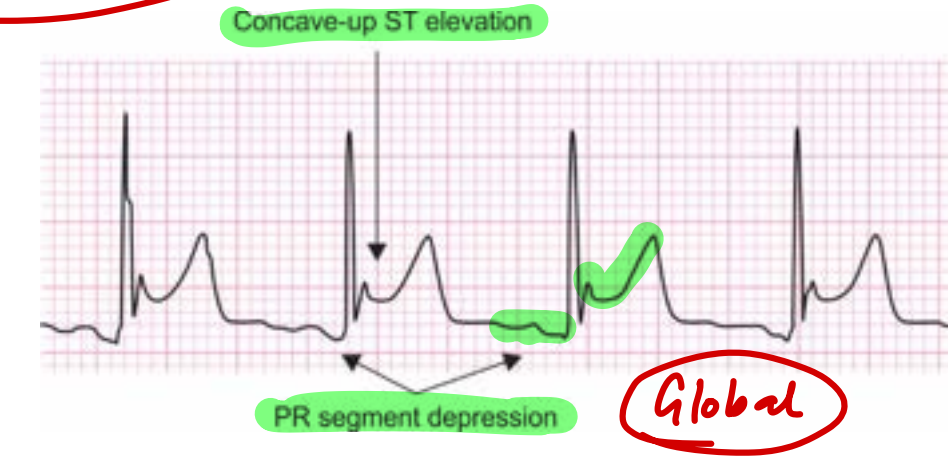
ST-elevation

mcc: viral

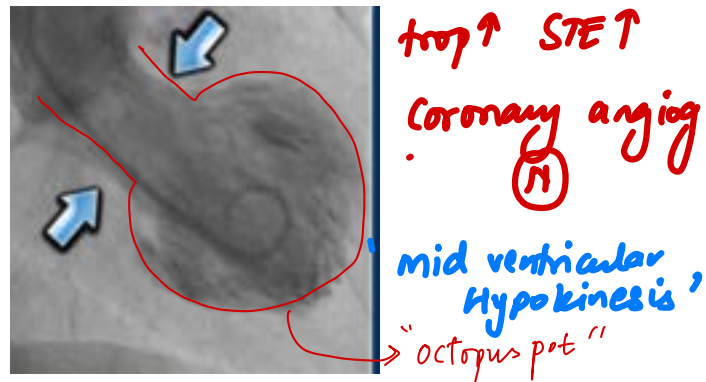
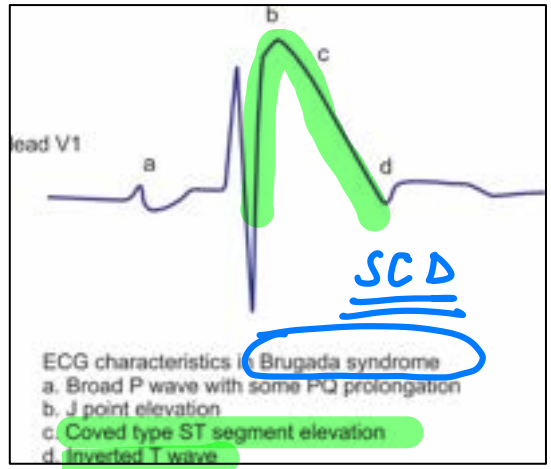
STEM I acute chest pain



PERICARDITIS Acute chest pain + Pericardial rub



- Ventricular aneurysm
- Prinzmetal angina-transient
- Takotsubo CMP "stress"



Loss-of-function SCN5A

Pseudo-RBBB

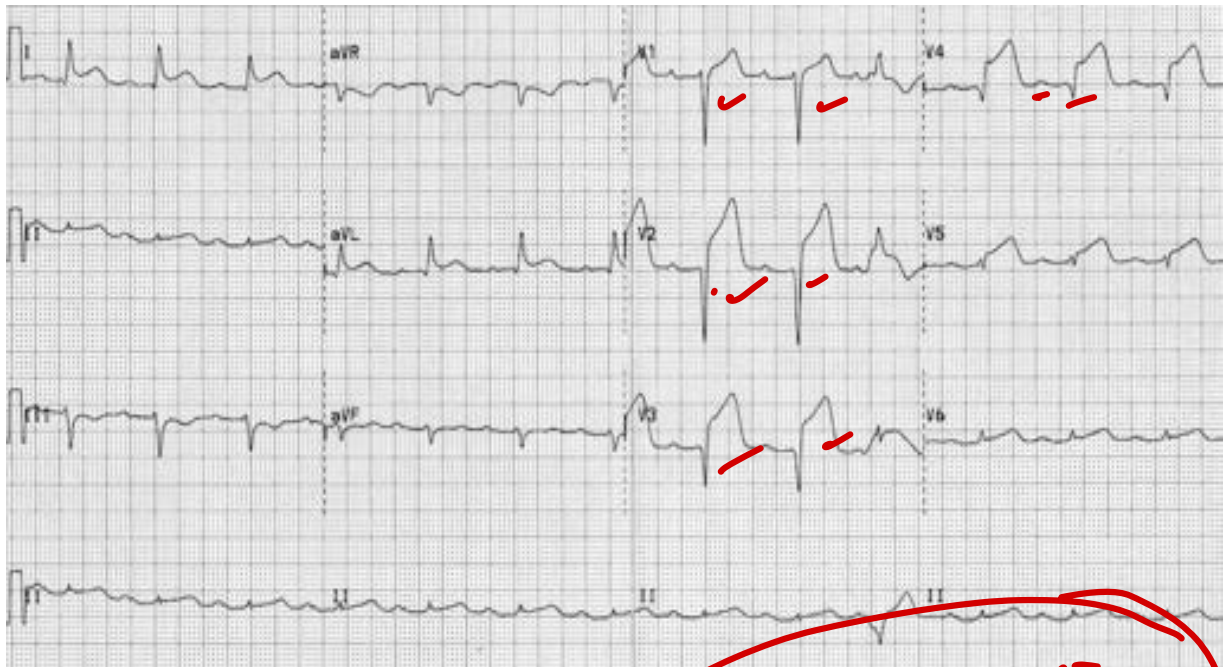
AD

R₂ = ICD

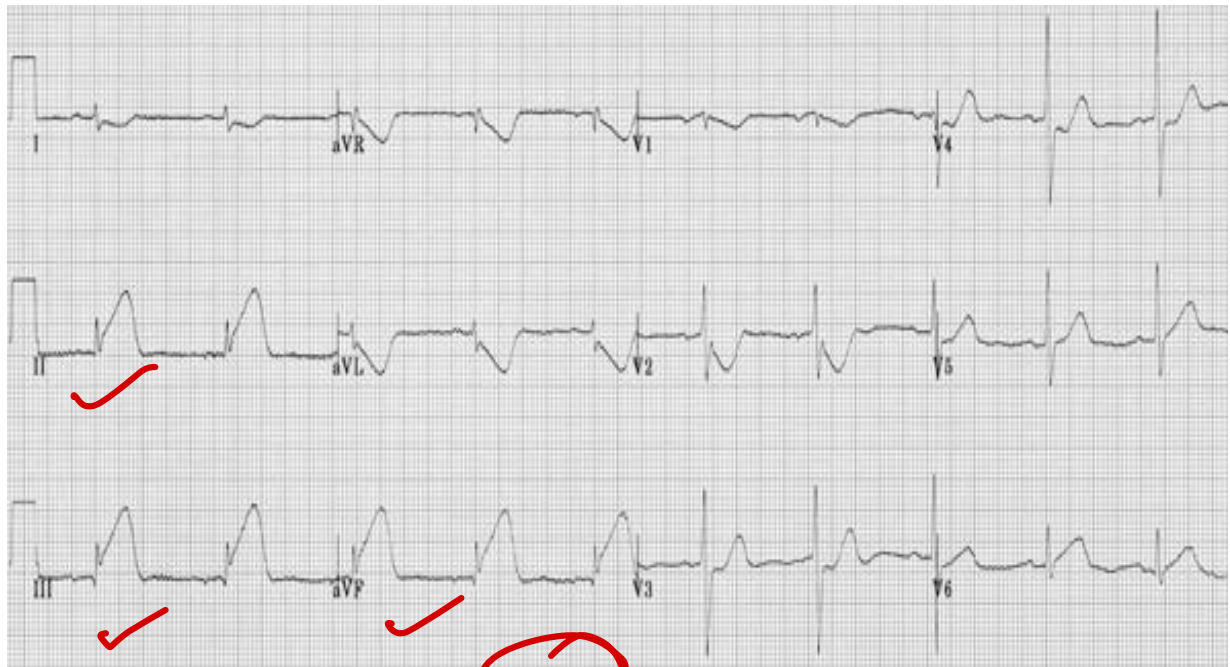
Posterior (PDA)

V₇-V₉, ST depression in V₁-V₃ with tall R waves

STE



Ant wall MI
↓
STEMI
↓
LAD



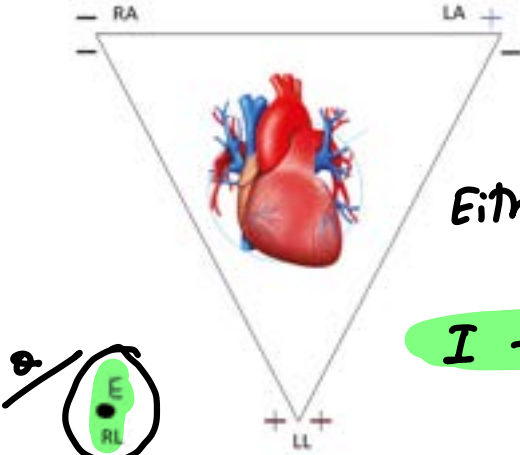
RCA → inf wall STEMI
↳ brady cardia

iv fluids

↳ pump failure

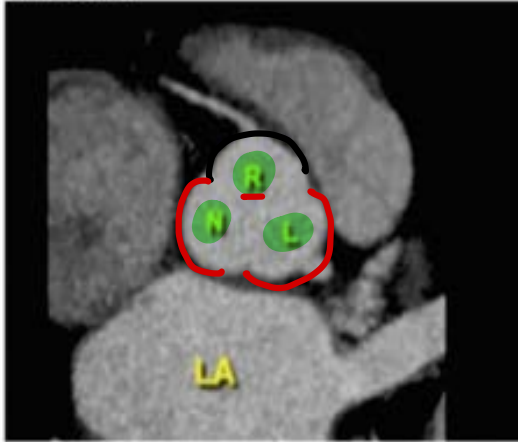
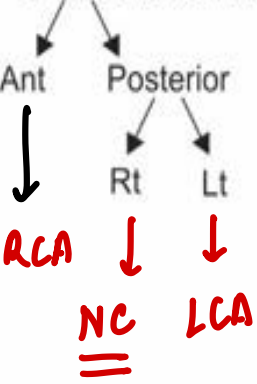
- ♥ stroke
- (X) iv fluids

Eitnowan's law:
I + IV = II

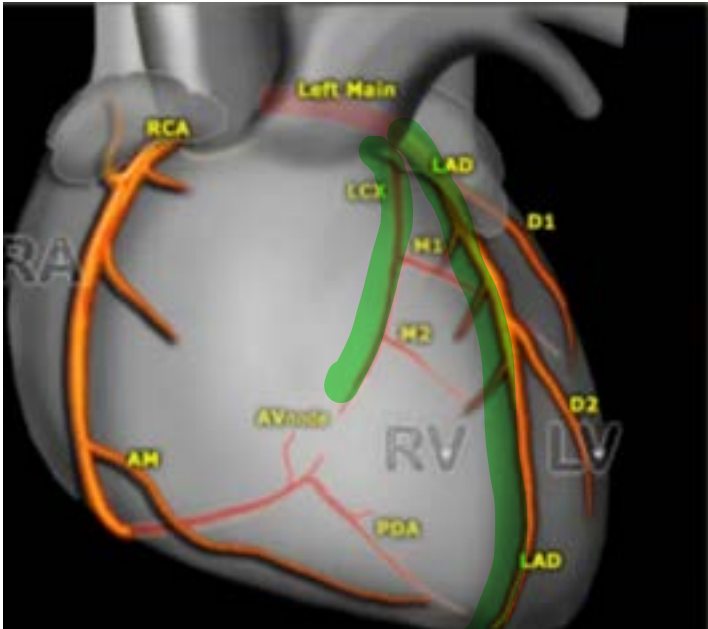
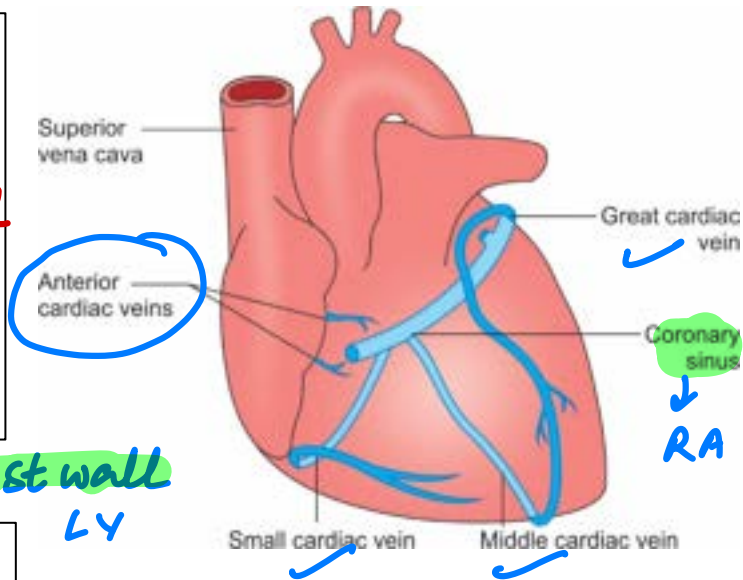


Coronary circulation-Anatomy

Aortic sinuses of VALSALA




RCA: C - Conus
 A - AVN
 M - Acute marginal free wall
 85% P → PDA → DOMINANCE
 ↳ post 1/3 septum / post wall



LCA
 LAD: diagonal } ant 2/3 septum
 septal } Ant wall Lx
 LCX: Lat wall → obtuse marginal

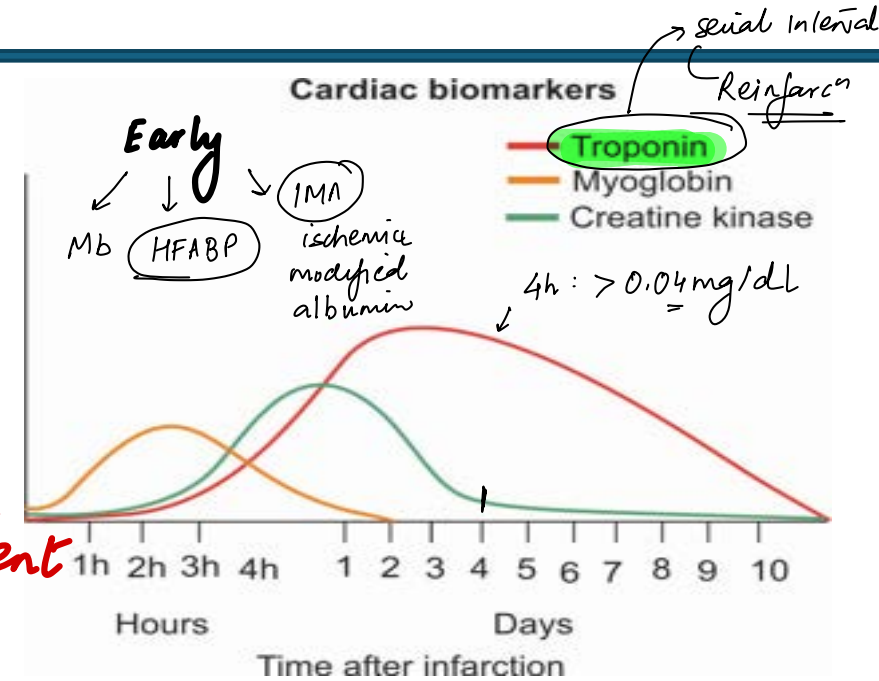
Coronary sinus except:
 ant ♡ veins → RA

Myocardial infarction

	Stable Angina	Unstable Angina	NSTEMI	STEMI	Prinzmetal angina
<u>PAIN</u> 	exertion	← Rest / any →			
TROPONIN LEVEL	—	—	↑	↑	—
ECG	(N)	ST ↓	ST ↓	ST ↑	ST ↑ transient
INFARCTION	—	—	subendoc transmural		—
Management	B blockers	Fibrinolytics CI		PCI	CCB DHPs

• LMWH DOC → Enoxaparin

• Morphine / O₂ / Nitrates /
Aspirin / Statins



NSTEMI

Immediate PCI:

- Hemodynamic unstable
- V. tachycardia
- Heart failure

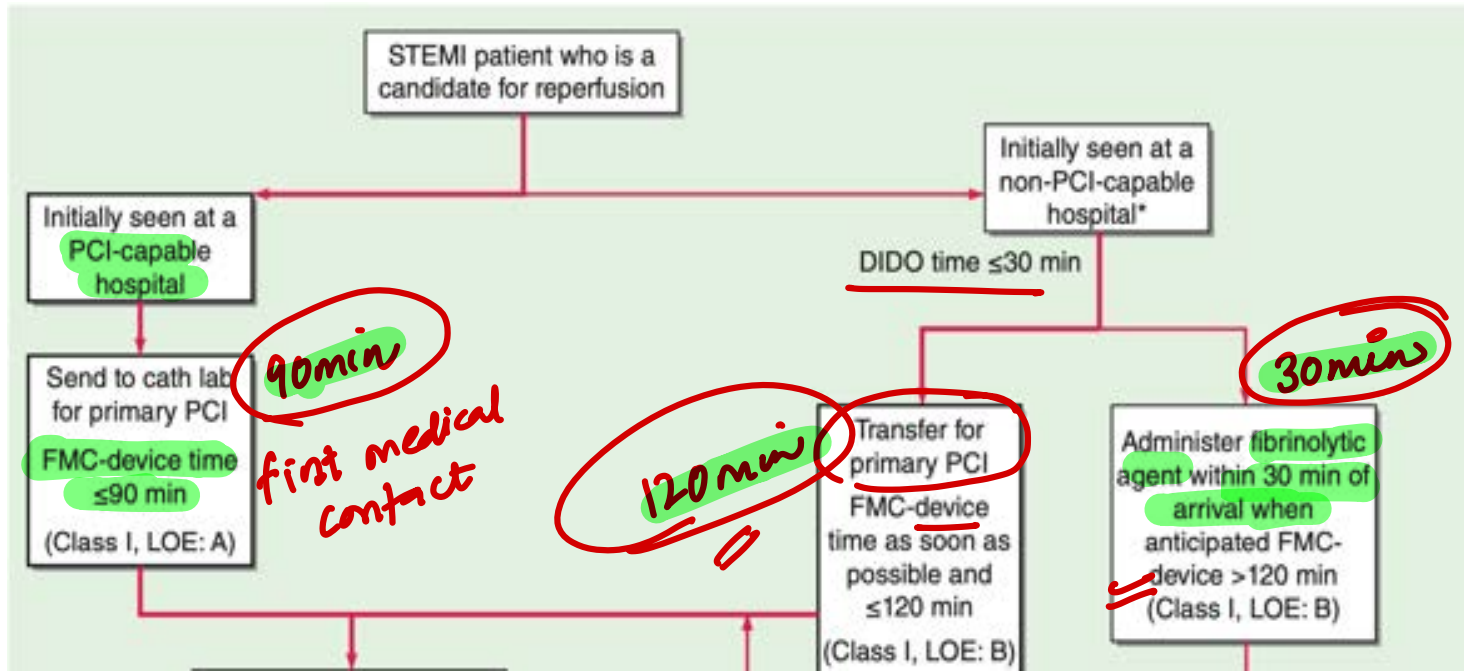
Early PCI (<24hrs) progression

- New ST changes, Trop increase

Delayed PCI:

- DM
- Prior CABG / PCI

Myocardial infarction



90min
first medical contact

120min

30min

- TYPE 1 MYOCARDIAL INFARCTION**
Spontaneous myocardial infarction related to ischaemia due to a primary coronary event such as plaque erosion and/or rupture, fissuring or dissection
 - TYPE 2 MYOCARDIAL INFARCTION**
Myocardial infarction secondary to ischaemia due to either increased oxygen demand or decreased supply
 - TYPE 3 MYOCARDIAL INFARCTION** SCD
Sudden unexpected cardiac death often with symptoms suggestive of myocardial ischaemia
 - TYPE 4 MYOCARDIAL INFARCTION**
Myocardial infarction associated with percutaneous coronary intervention (4a) or stent thrombosis (4b)
 - TYPE 5 MYOCARDIAL INFARCTION**
Myocardial infarction associated with cardiac surgery
- MYOCARDIAL INJURY**
Multifactorial aetiology; acute or chronic based on change in cardiac troponin concentrations with serial testing

Fibrinous automimmune pericarditis: Weeks to months

Dressler Sx

delayed

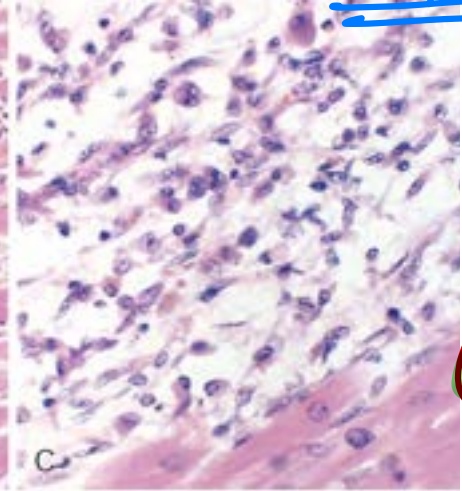
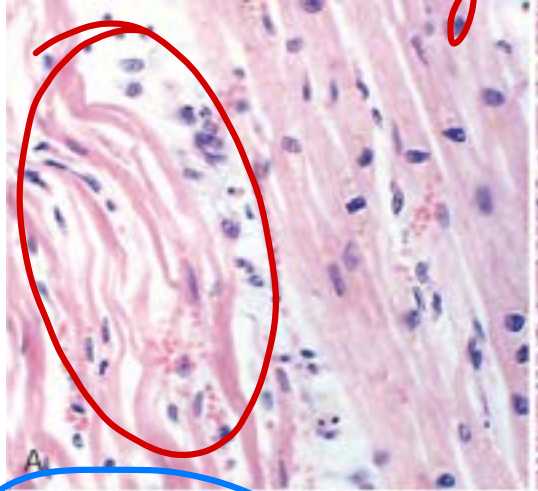
Myocardial infarction: Pathology

earliest: 4h: waviness of fibres

1-3d: neutrophils

3-7d: macrophages

TTC: Triphenyl tetrazolium Cl^-

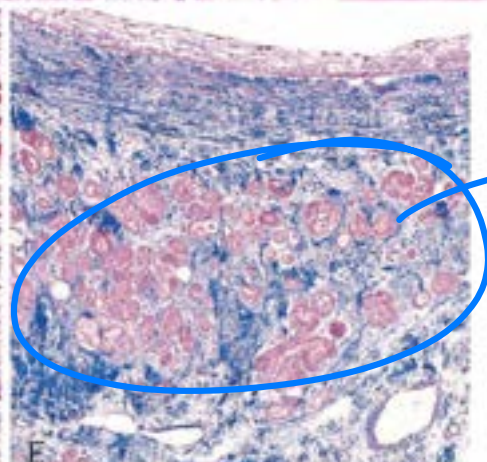
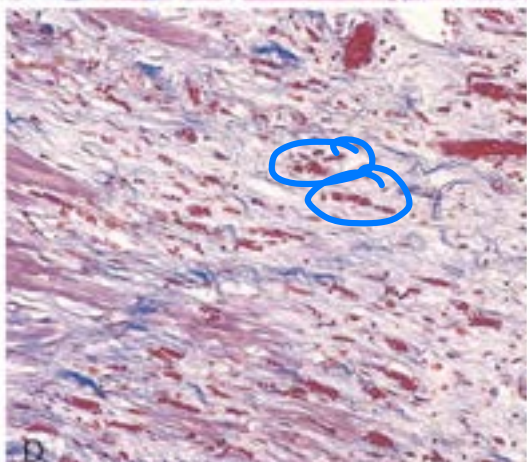


LDH

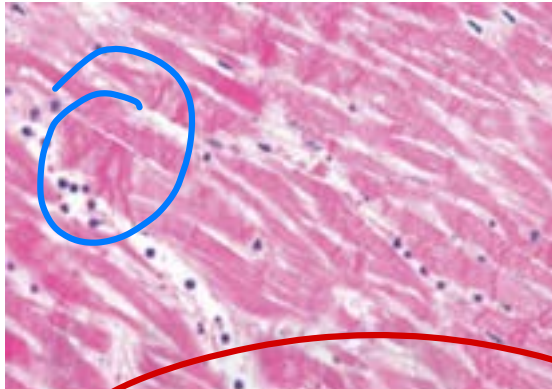
MI: LDH flipping

(N): LDH2 > LDH1

4-24hr: Coag necrosis



Masson Trichrome



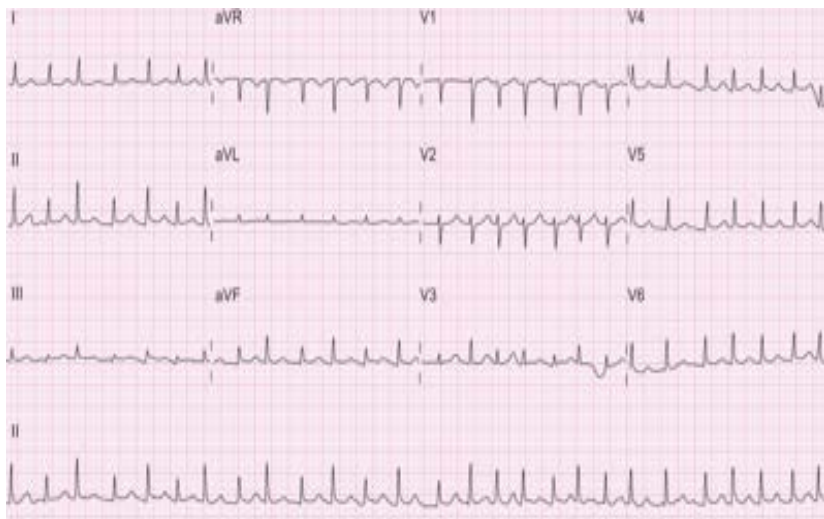
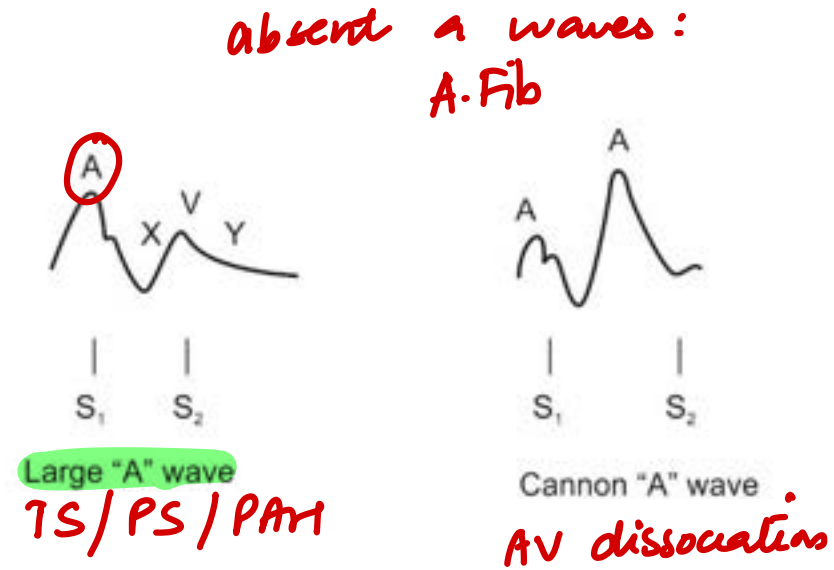
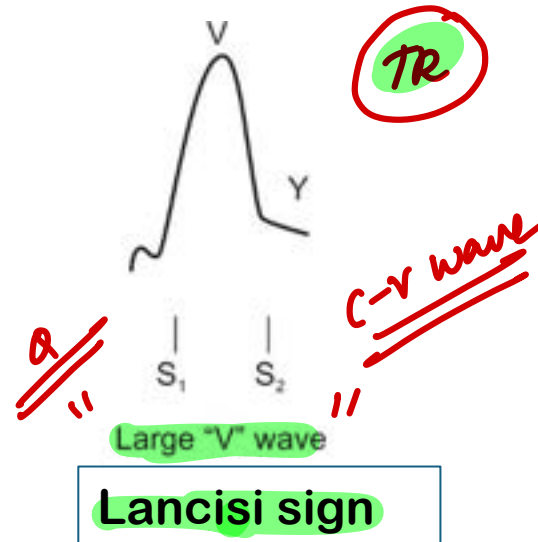
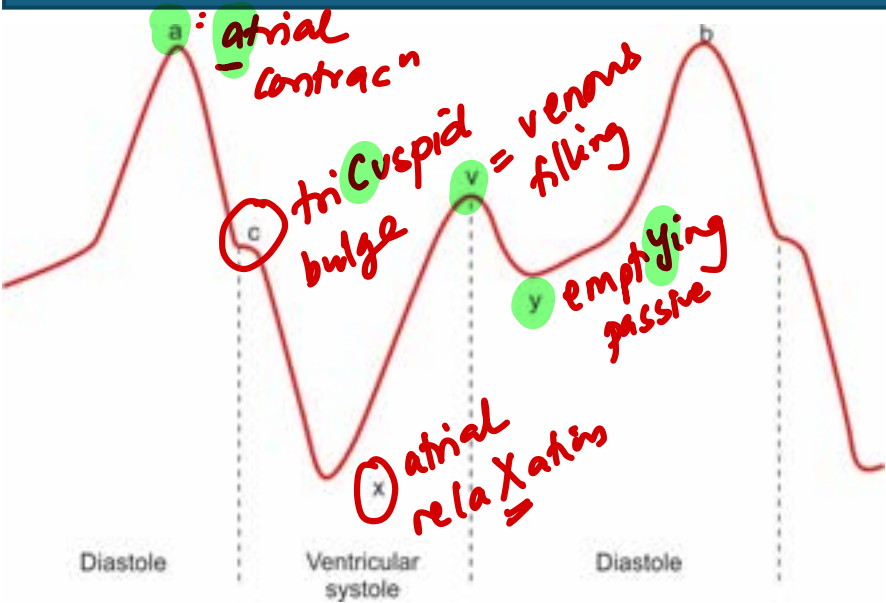
7-10d: neovascularization
granulation tissue

>14d: collagen scar

CONTRACTION BANDS

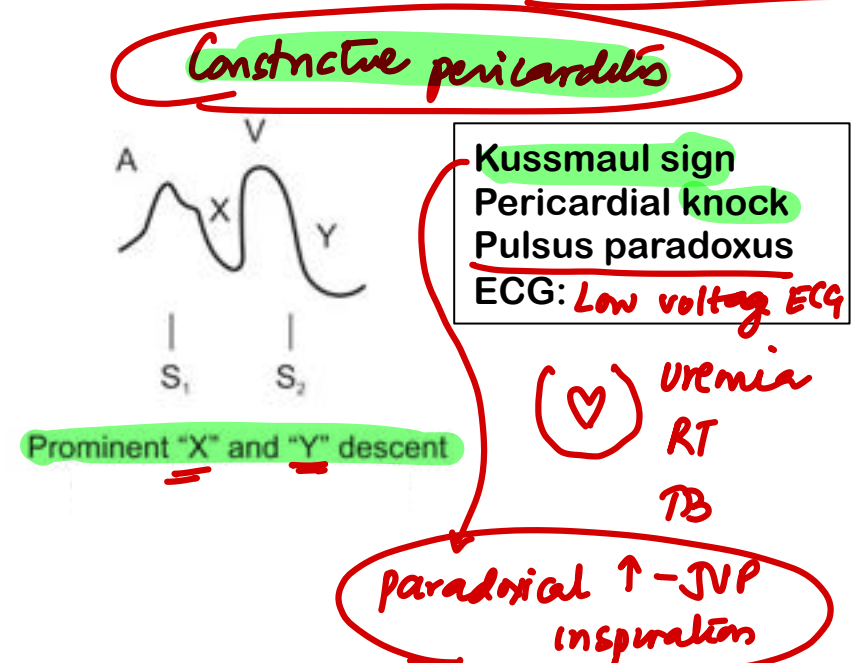
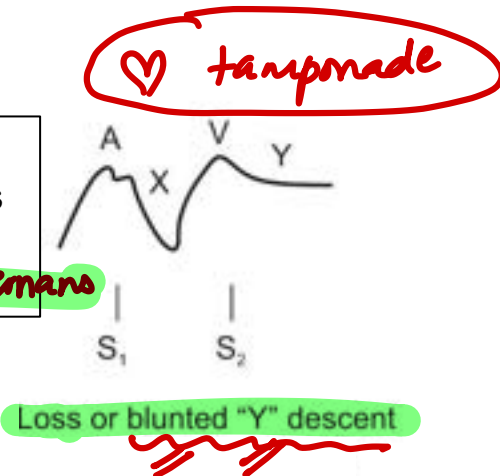
↳ reperfusion injury
• free radicals

JVP



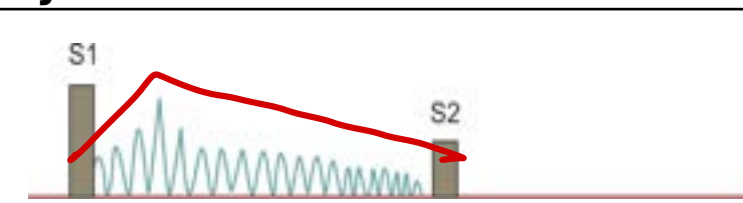
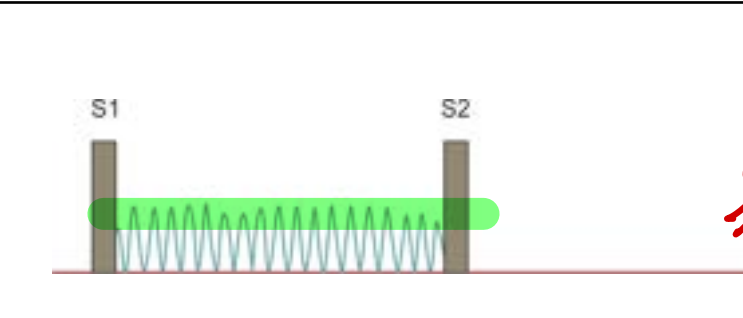
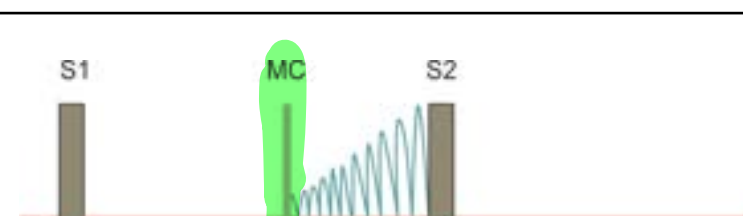
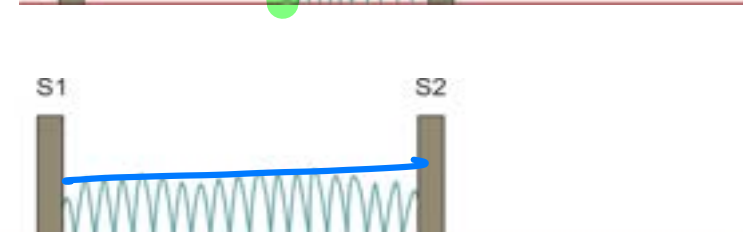
Beck's triad
Pulsus paradoxus
Ewart sign
 ECG: **electrical alternans**

inspirⁿ
 ↓ SBP > 10mm



Murmurs

A2 - P2

Systolic	
	Crescendo-decrescendo ejection murmur, radiates to carotids, Narrow/paradoxical split A5
	Holosystolic, high-pitched "blowing" murmur MR: Loudest at apex, radiates toward axilla, Soft S1, Wide split S2 TR: Loudest at tricuspid area
	Late crescendo murmur with midsystolic click (MC) that occurs after carotid pulse Best heard over apex MVP
	Holosystolic, harsh-sounding murmur Loudest at tricuspid area

VSD

Still's murmur

Benign flow murmur due to increase CO in peds
ejection systolic

MI: posteromed papillary muscle

Early systolic murmur: Acute MR
IHD

Caravello's sign

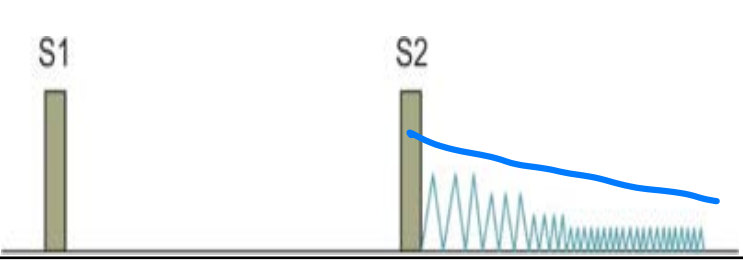
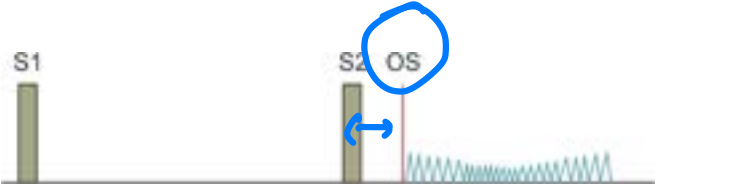
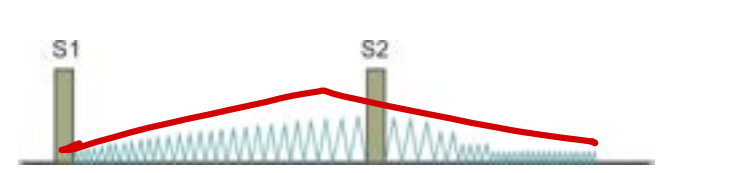
Early systolic in TR or deep inspiration

MS WPW

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

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

Murmurs

Diastolic	
	<p>Early diastolic, decrescendo, high-pitched "blowing" murmur</p> <p>AR</p>
	<p>Follows opening snap (OS), Loud S1</p> <p>Delayed rumbling mid-to-late murmur with presystolic accentuation</p> <p>Lost in: A. Fib</p> <p>(↓ interval between S2 and OS correlates with ↑ severity)</p> <p>MS</p>
Continuous	
	<p>Continuous machine like murmur, best heard at left infraclavicular area</p> <p>PDA</p>

Graham Steell

Early diastolic murmur in PAH - PR

Austin Flint

Mid-diastolic, rumbling, low-pitched in AR

CAREY-COOMB

Mid-diastolic, short, ARF

Murmurs ^{oe}

Preload reduce (Valsalva/Standing/Nitroglycerin): *murmur ↓*

Preload increase (Passive leg raise / Squatting/Phenylephrine): *murmur ↑*

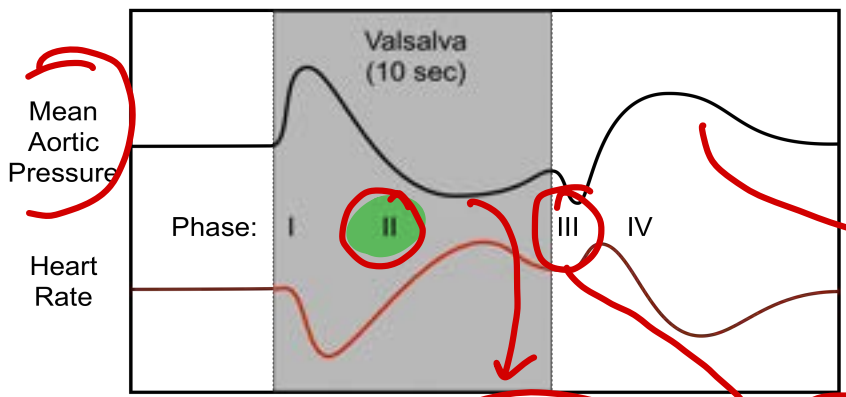
Afterload reduce (amyl nitrite): *murmur ↓*

Afterload increase (Handgrip): *murmur ↑*

Inspiration: (R) *murmur ↑* — TR ↑

except HOCM
MVP

except HOCM
AS



Forceful expiration against closed glottis

BP ↑
BP ↓
BP ↓
(+ intrathoracic) preload ↓

HOCM
improves
Contractility ↓
volume ↑
DOC: β-blocker /
CCB and/or

Pulse types



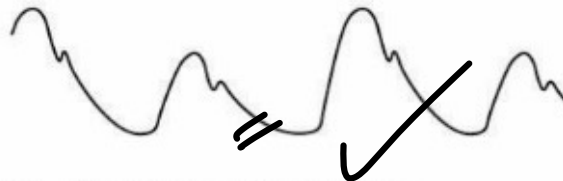
A Normal pulse

Pulsus parvus et tardus

AS



B Hypokinetic (weak) pulse

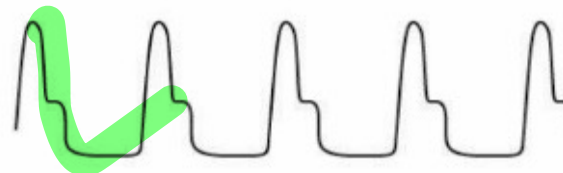


E Pulsus alternans

LVF



C Hyperkinetic (bounding) pulse



F Waterhammer (collapsing) pulse

absent dn

AR - Signs

AR /
Pregn /
Berberi /
Myxomatosis /
AVF



D Bigeminal pulse

AV dissociation

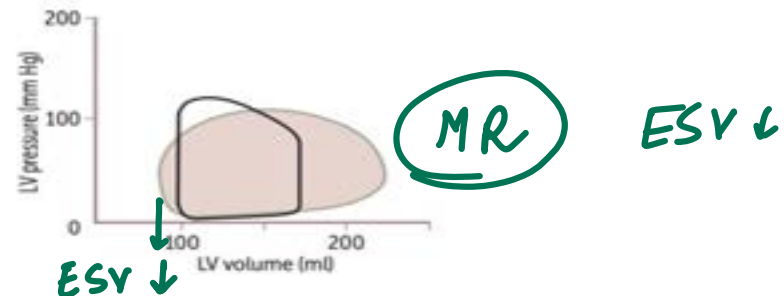
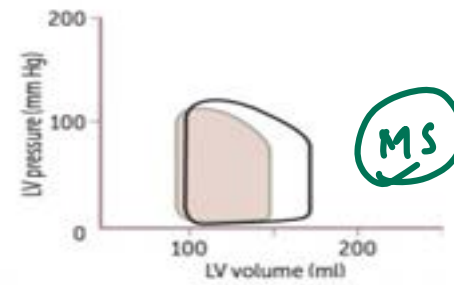
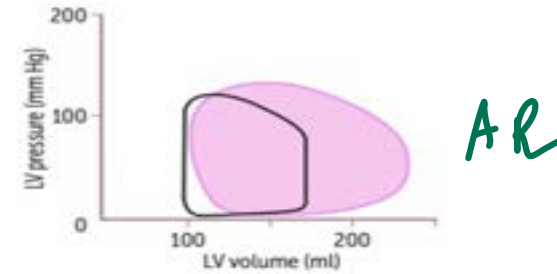
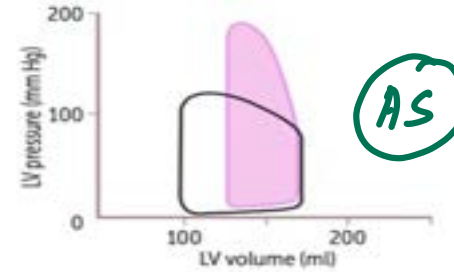
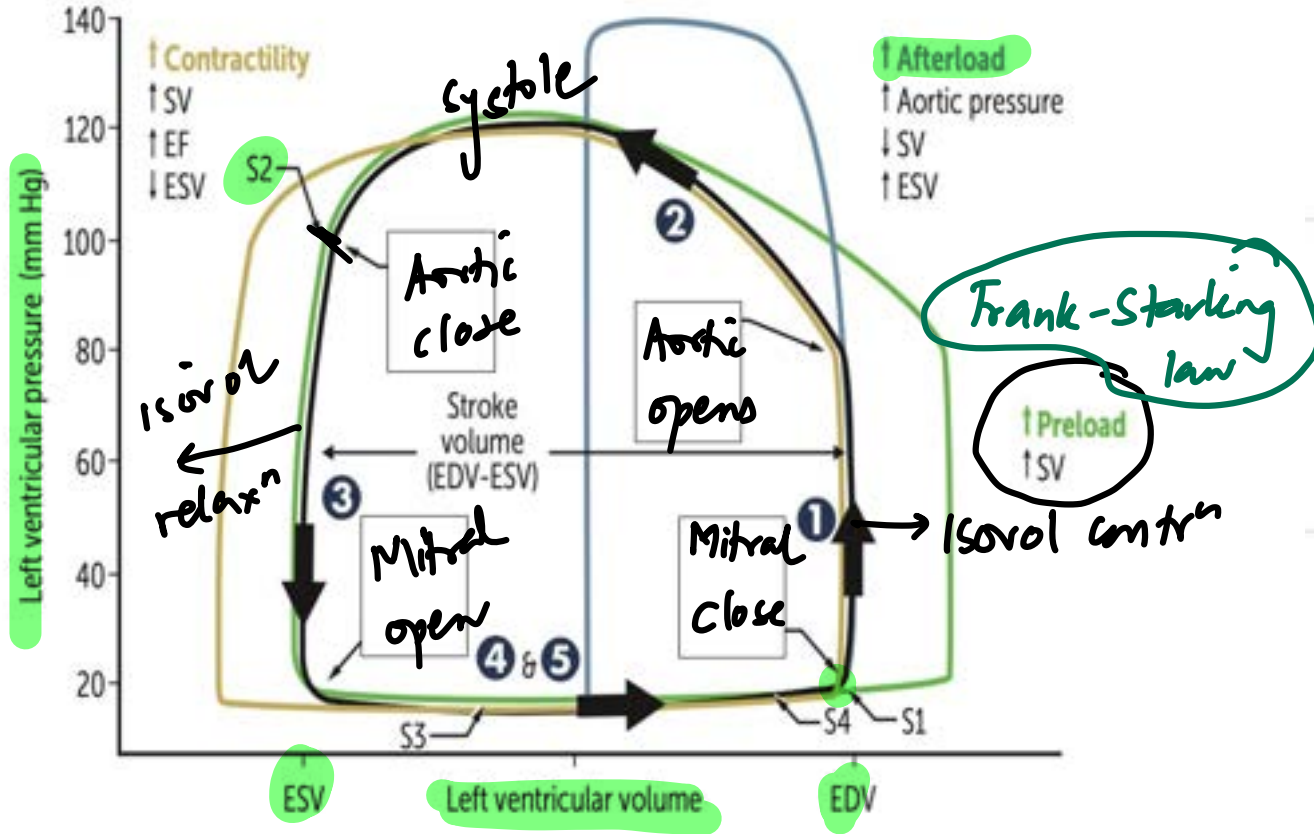


G Pulsus bisferiens

AS + AR

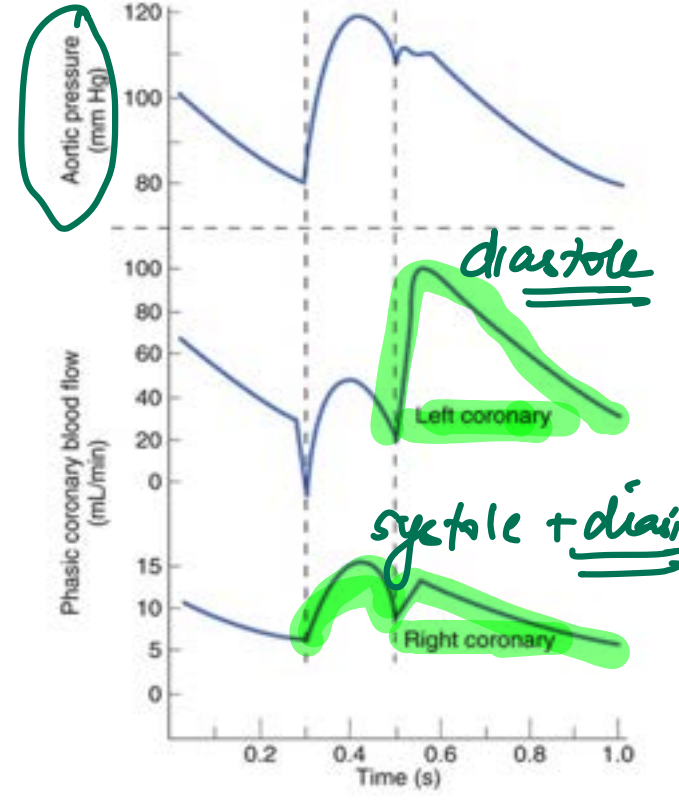
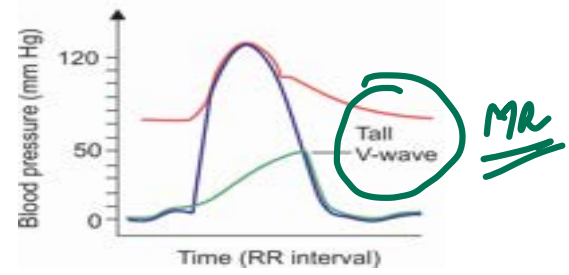
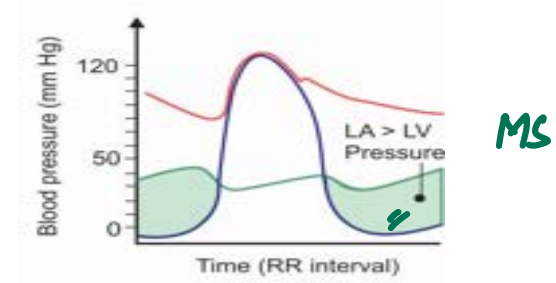
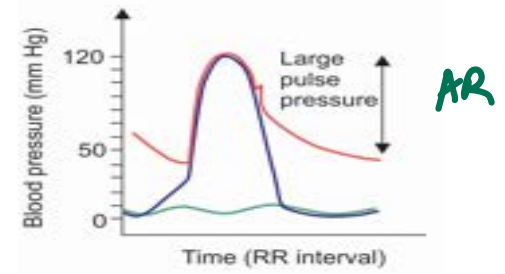
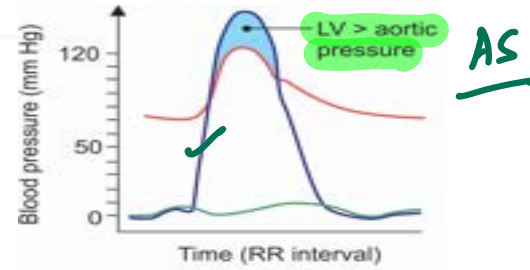
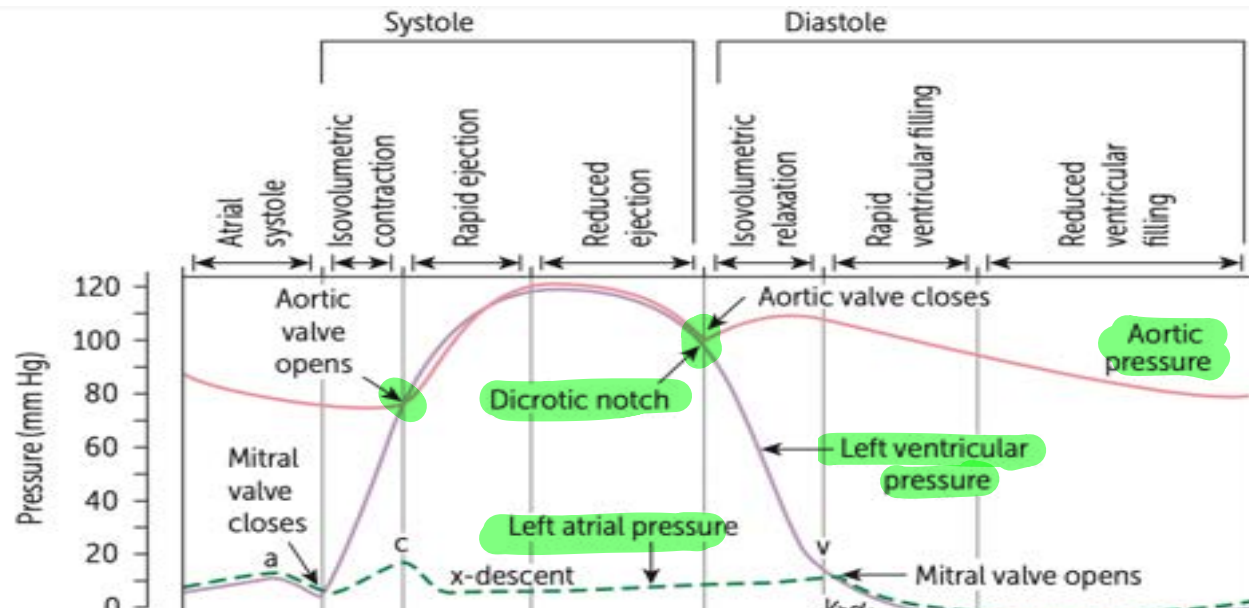
HOCM

Pressure-volume curves



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

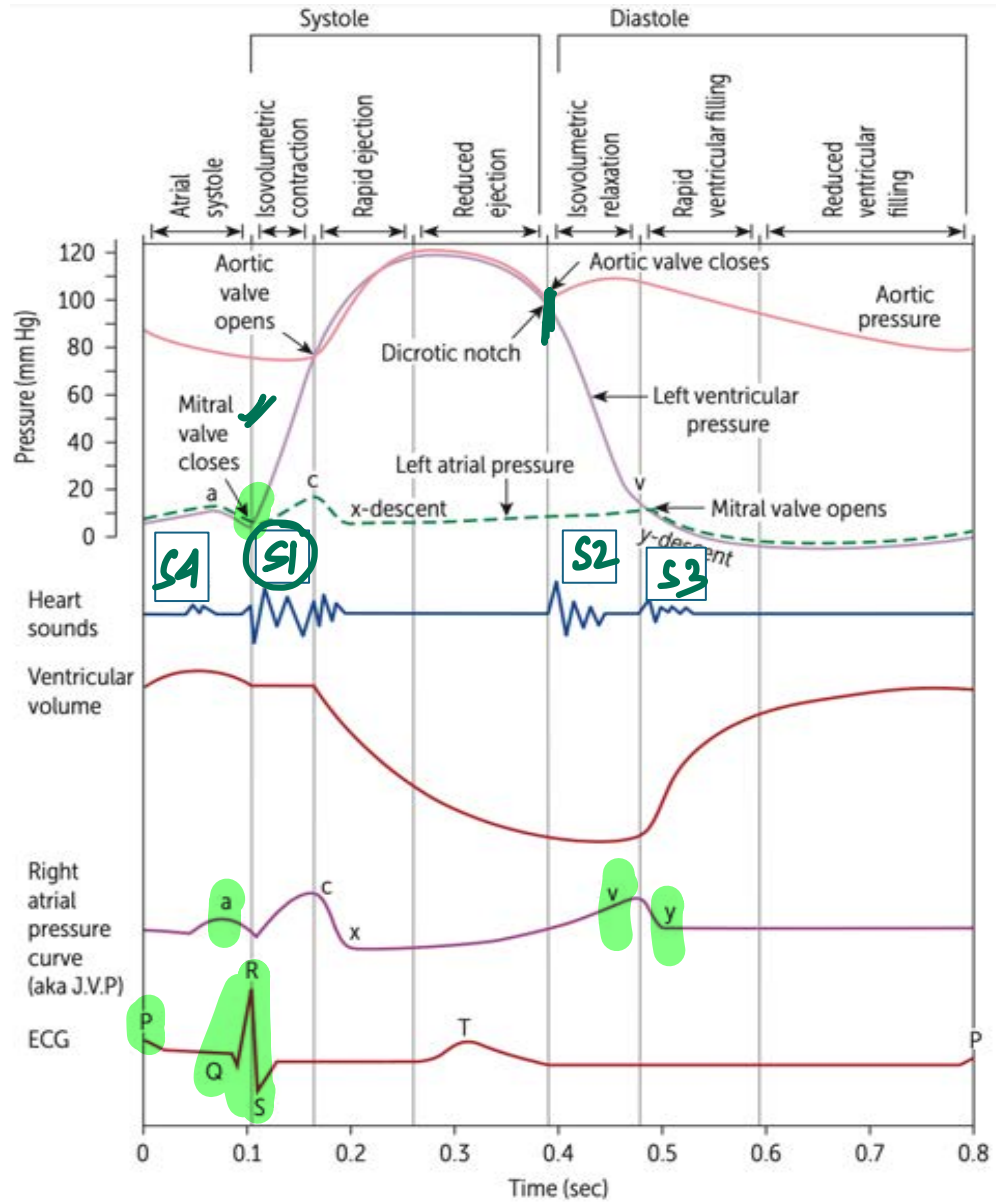
Pressure curves



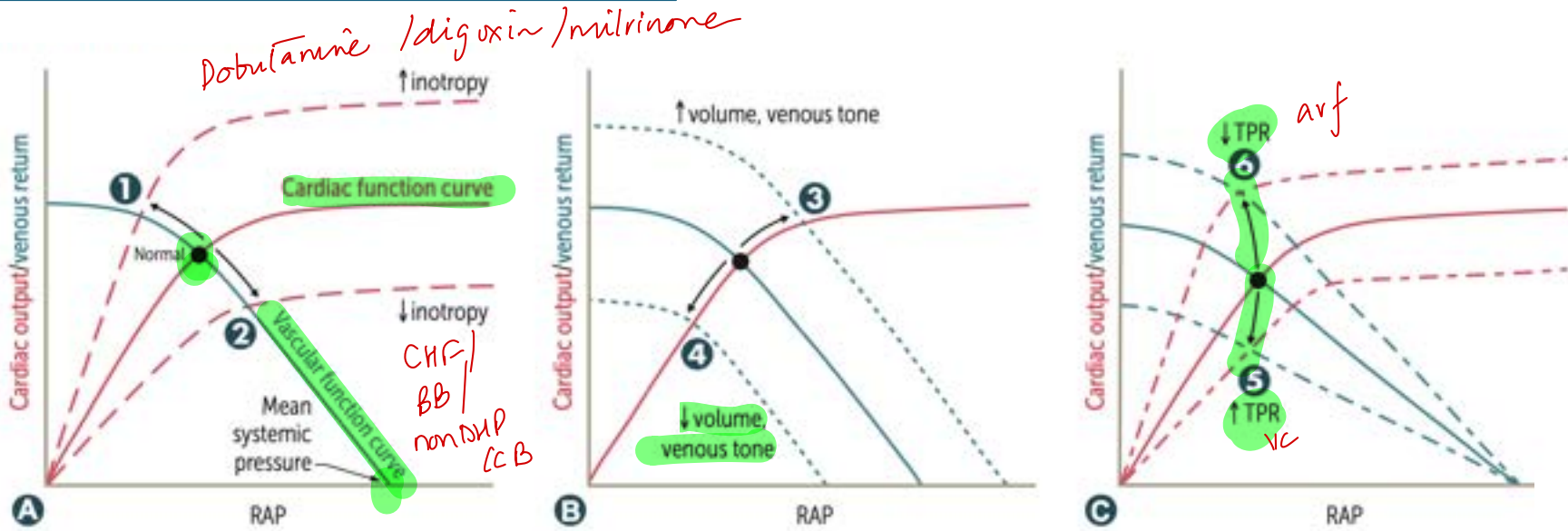
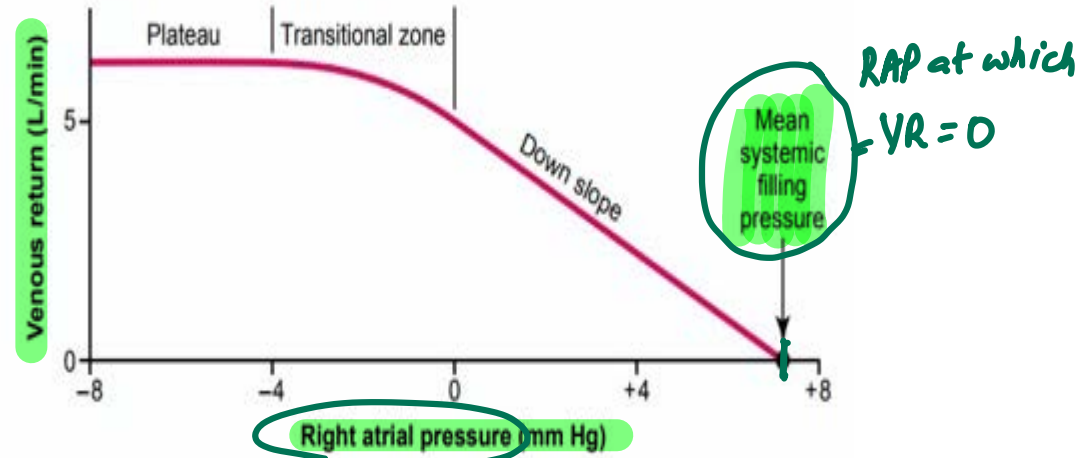
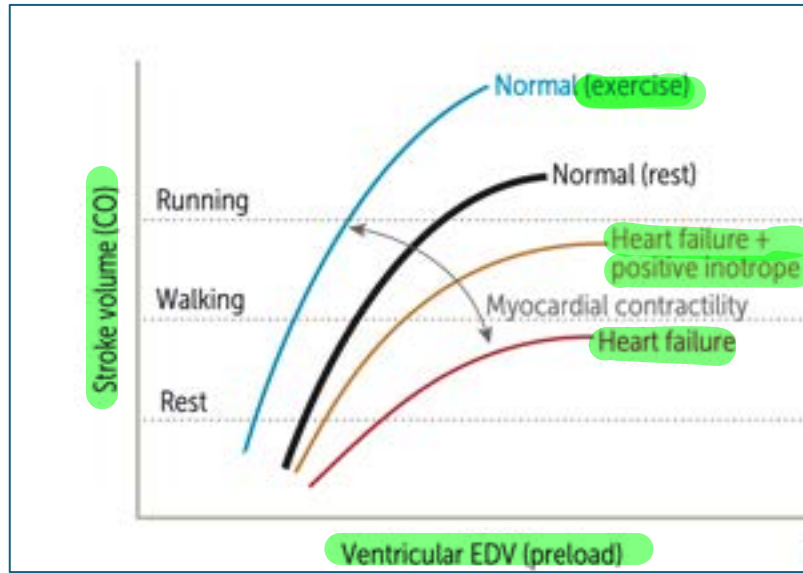
Aortic pressure : 120/80
 LV pressure : 121/0
 RV pressure : 25/0

Wiggers diagram

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**).

CVS physiology-Miscellaneous

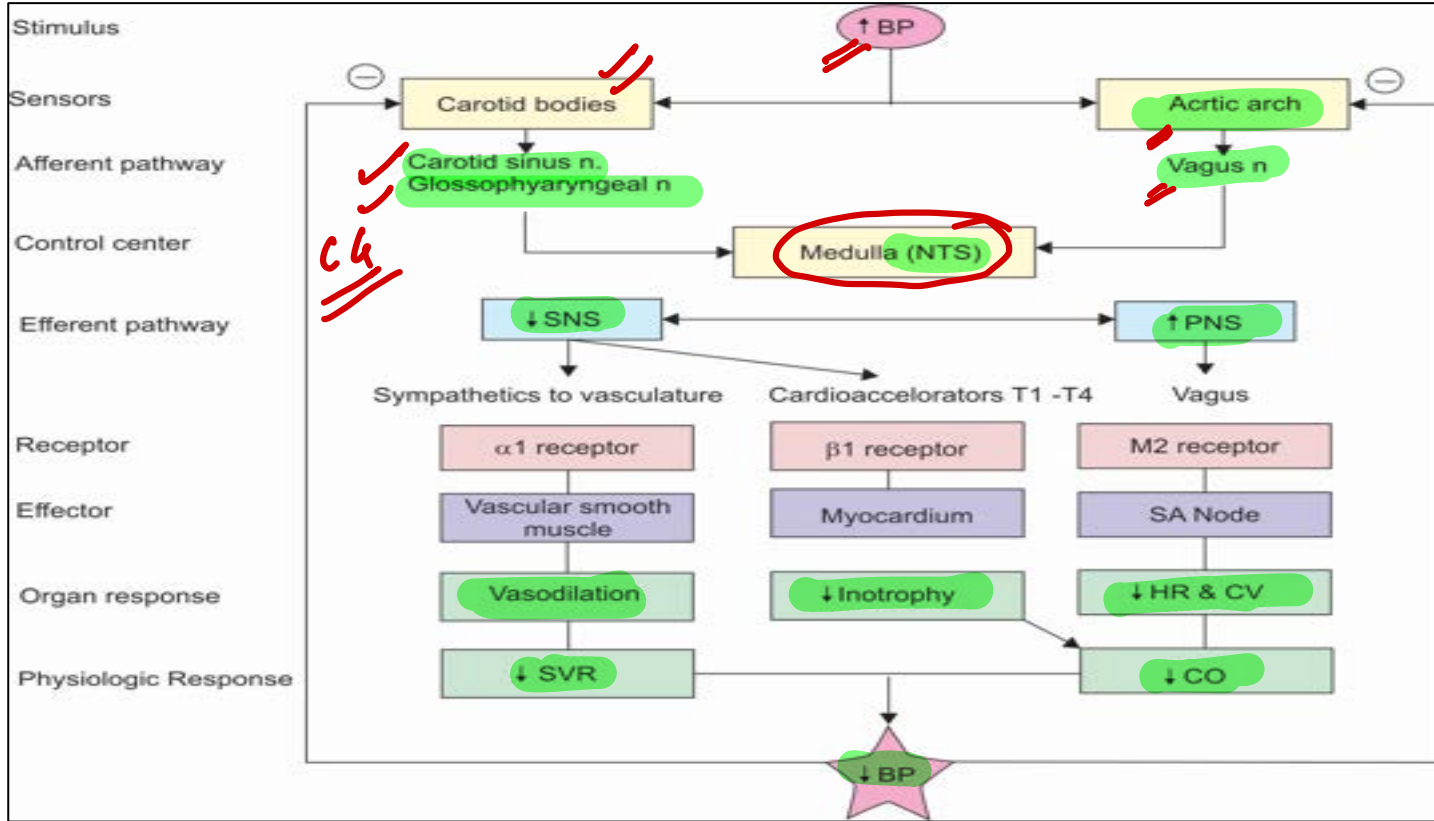
Mary's law $HR \propto 1/BP$
 Bainbridge reflex $\uparrow HR \propto$ stretch RA $\propto \uparrow HR$
 Bezold-Jarisch reflex $BP \downarrow \rightarrow HR \downarrow$
 Capsaicin/5HT alkaloids
 Baroreceptors: Stretch receptors in adventitia TRP channels
 Most sensitive stimulant: Pulse pressure $>$ MAP $\approx \frac{1}{3}DBP + \frac{1}{3}SBP$

FICK'S LAW

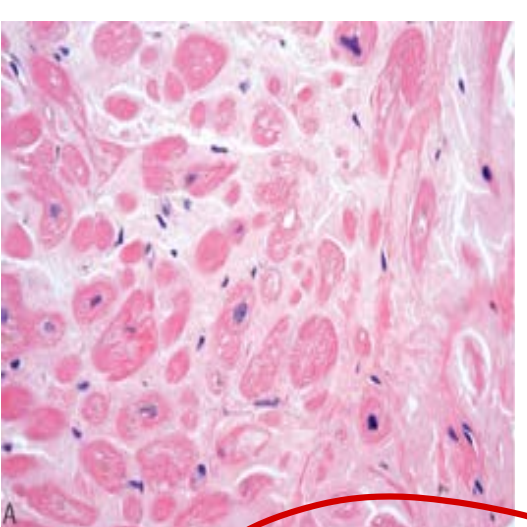
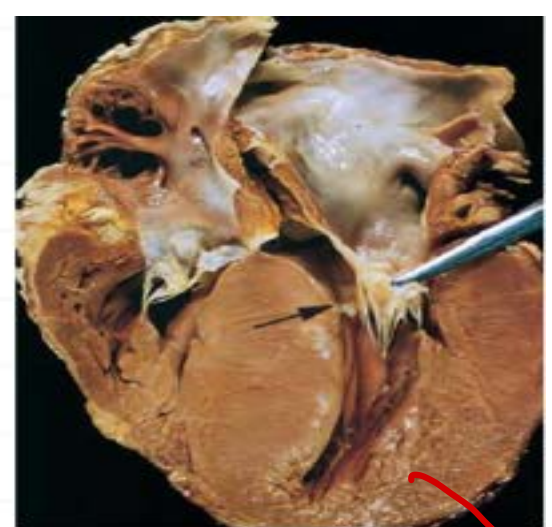
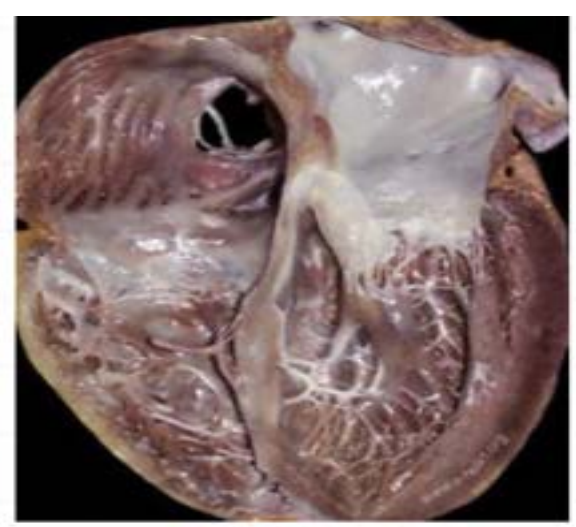
$$\text{Cardiac output} = \frac{\text{Total } O_2 \text{ Consumption}}{[O_2]_{\text{pulmonary vein}} - [O_2]_{\text{pulmonary artery}}}$$

Postural hypotension: SBP-DBP within 3min of standing

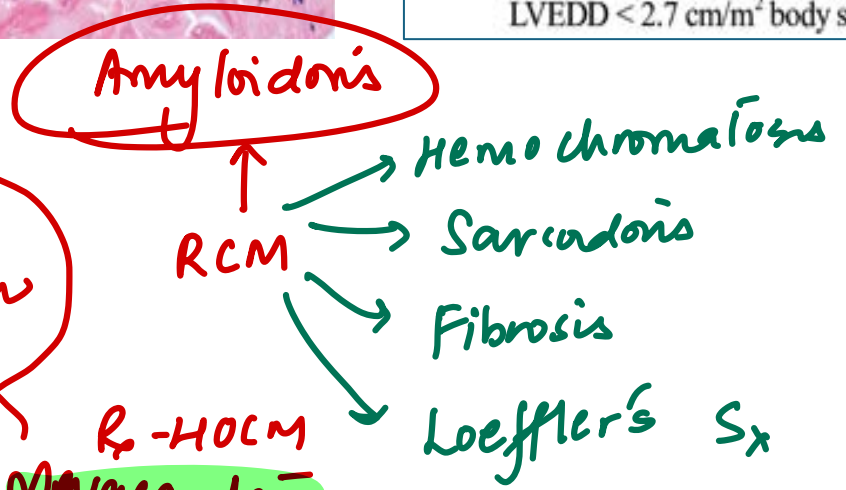
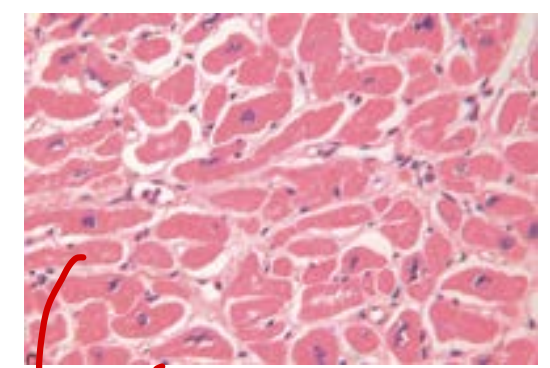
$>20mm$ $>10mm$ (down arrow)



Cardiac Pathology



Diagnostic criteria for PPCM ^{OR}	
Heart failure	within the last month of pregnancy or six month postpartum (5 months)
Absence of prior heart disease	
No determinable cause	
Echocardiographic evidence of left ventricular dysfunction:	
LVEF	< 45%
LVFS	< 30%
LVEDD	< 2.7 cm/m ² body surface area



Myosin heavy chain mutants

HOCM

R_o-HOCM
Mavacamten

myocardial disarray
Helter-skelter arrangement
moe of death: **Ventr fibrillⁿ**
SCD

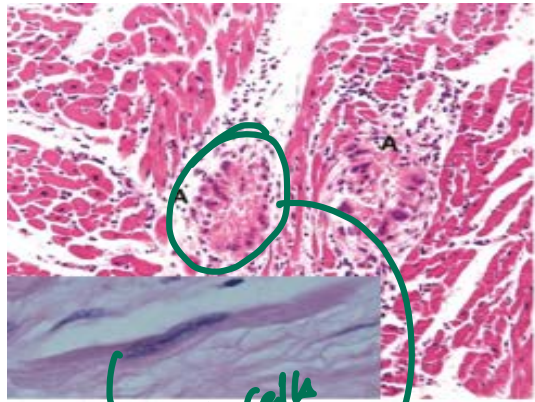
Dilated CM
Ninja Star Appearance

Causes: Alcohol / Doxorubicin / Peripartum / **TITIN**

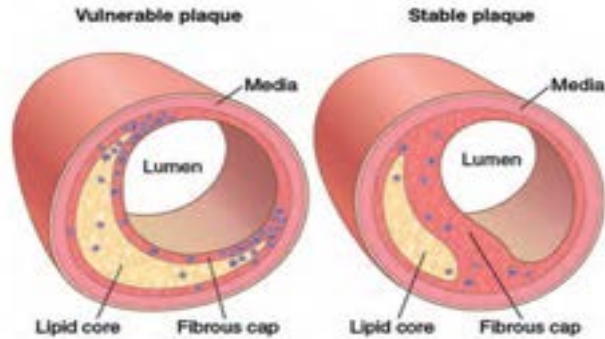
Systolic dysfn

IOC: MRI
Late Gadolinium enhancement **LGE**

Cardiac Pathology



Anitschkow cells
Aschoff bodies



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

Im Benzathine Penicillin 0.6-1.2MU 3-4 weekly

5
10
10

21
21
40

JAI VIGYAN MISSION MODE PROJECT

Major Criteria	Minor Criteria
J - Joint Involvement MC	C - CRP Increased
O - O looks like a heart = myocarditis	A - Arthralgia
N - Nodules, subcutaneous	F - Fever
E - Erythema marginatum transient	E - Elevated ESR
S - Sydenham chorea	P - Prolonged PR Interval
	A - Anamnesis of Rheumatism
	L - Leukocytosis

JONES



Indications of prophylaxis required before dental procedures at high risk of endocarditis:

1. Prosthetic heart valve
2. Prior endocarditis
3. Unrepaired congenital heart disease
4. Completely repaired congenital heart disease (<6month)
5. Incomplete repaired congenital heart disease
6. Valvulopathy after cardiac transplant

IE
amoxicillin
slat
~~ASD~~

CVS Pharmacology

Ivabradine: I_f Na^+ \ominus - luminous phenomenon s/e

Nicorandil: K^+ open

s/e: Aphthous ulcer

Rho kinase inhibitor: Fasudil

Neprilysin+ ACE inhibitor: Omapatrilat

S/e: refr cough/ angioedema

Neprilysin inhibitor: Sacubitril

Metabolic modulators (PFOX-): Trimetazine

s/e: aggravating movement disorder

MM + Late inward Na blocker: Ranolazine

Direct guanyl cyclase activator: Verciguat

Calcium sensitize: Pimobendan/ Levosimendan

Direct myosin activator: Omecamtiv

DYSLIPIDEMIC DRUGS:

Statins-HMG coA reductase inhibitor - ^{CO₂} ^{s/e} myopathy, hepatotoxic

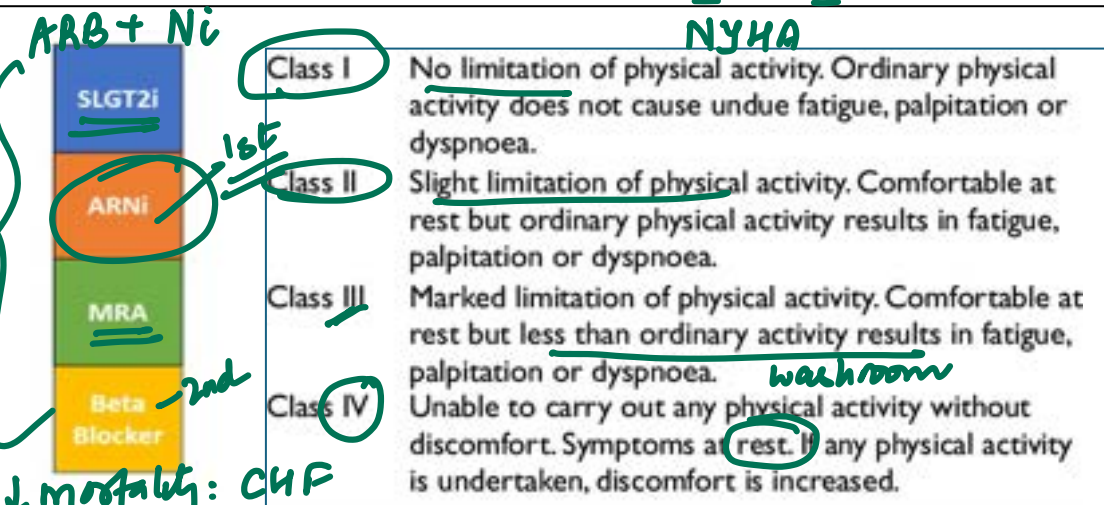
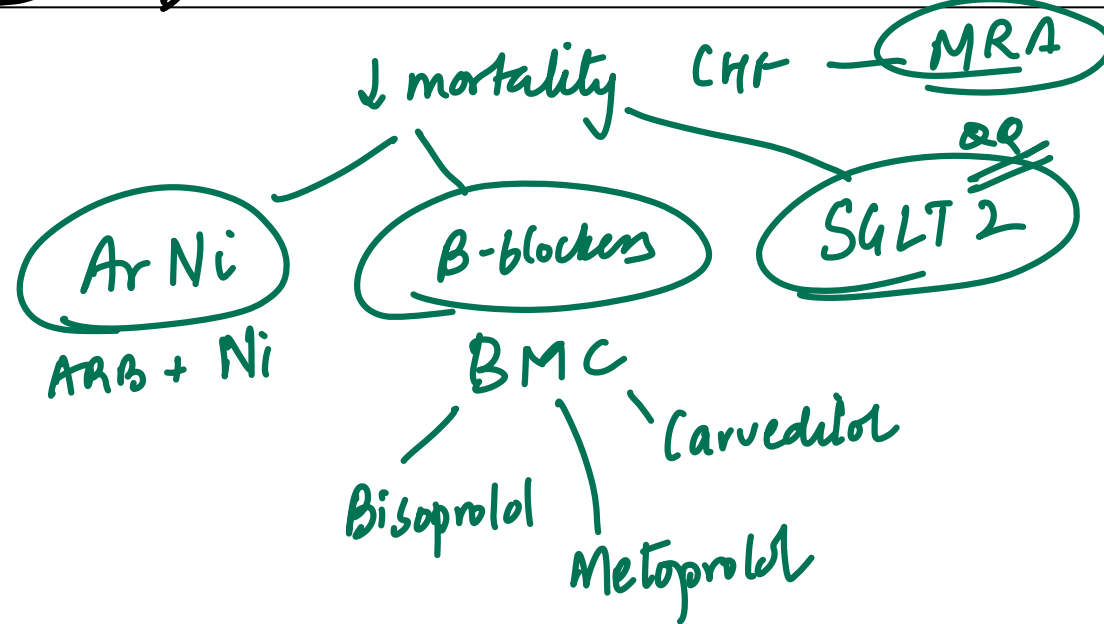
Ezetimibe-Absorption - s/e: diarrhea

Fibrates-PPAR alpha + s/e: myopathy, Gallstones

Niacin-HSL - HDL \uparrow s/e: Tunicemia, DM, FLUSHING, 7d MI^{\ominus}

Alirocumab, Evolocumab-PCSK9- P4T

Evinacumab: AL3p T LDL Rec CME



CCB

Amlodipine, nifedipine, nimodipine
DHP
 Smooth muscle

S/E: Reflex tachycardia
 Flushing

Hyln
SAH - vasospasm
prevents

Hydralazine

Diltiazem, verapamil
non DHP
 - AV node ↓

S/E: AV block
 Constipation
 Pedal edema

Arteriolar
SHIP

Nitroprusside Nitrates

MetHb / Monday
venodilators
Cyanide toxicity

S/E: Hyperkalemia
 Cholinergic
 Yellow vision
 Ventricular bigeminy MC

Digoxin

AV node
 -
PR ↑

ACE-:
 Captopril, Lisinopril, Enalapril

ARB:
 Losartan, Valsartan

S/E: Hyperkalemia
 Cough
 Angioedema } *ACE ⊖*

Verapamil:

Gingival hyperplasia
 Hyperprolactinemia
ATP binding cassette

PCY
Phenytoin
Cyclosporine

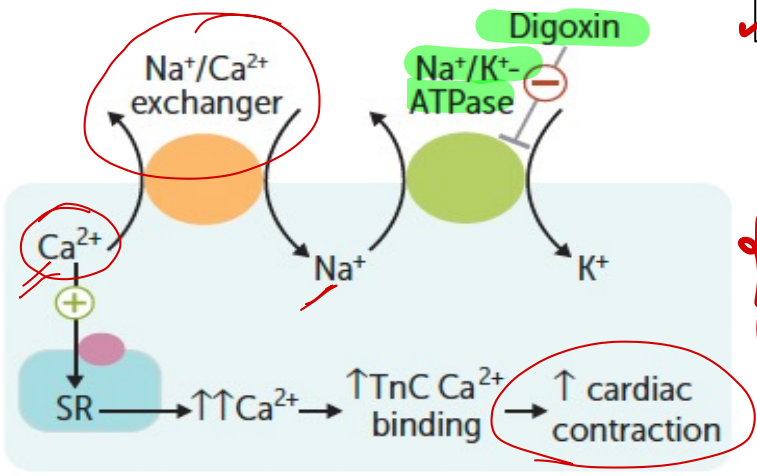
Clarithromycin

↓ insulin R

Losartan / ARB

PPAR-γ agonist : Telmisartan
 Uric acid excretion increase
 TxA2 inhibition

- K sparing diuretics
 - ACE-/ARB
 - B blockers
 - Calcineurin inhibitors *cyclosporine*
 - Digoxin
 - Pentamidine
 - NSAIDs
 - Sch
 - Heparin
 - Trimethoprim
- ↑ K⁺*



Saroglitazar: PPAR α + γ ⊕
Lanfibranor: pan PPAR ⊕
α, β, γ

NASH

presynaptic brakes

α2 ⊕

Clonidine: Rebound hypertension

Hypertension

Classification of hypertension based on Office blood pressure (BP) measurement

Category	Systolic (mmHg)	and/or	Diastolic (mmHg)
Normal BP	< 130	and	< 85
High-normal BP	130-139	and/or	85-89
Grade 1 Hypertension	140-159	and/or	90-99
Grade 2 Hypertension	≥ 160	and/or	≥ 100

International Society of Hypertension
www.ish-world.com

HMOD → Lifestyle modⁿ + Drugs

x HMOD → Lifestyle modifⁿ
R₀ ē drugs

DRUGS
 < 60yr - ACEI/ARBs
 > 60yr - Diuretics / CCB

Emergency:

- Severely elevated BP associated with acute hypertension mediated organ damage (HMOD).
- Requires immediate BP lowering, usually with IV therapy.

Urgency:

- Severely elevated BP without acute HMOD.
- Can be managed with oral antihypertensive agents.

Labetalol / Nicardipine

encephalopathy / stroke / malignant h₂

CHF / acute
 ↓
 pedem

Nitroglycerine / Nitroprusside