Dyspnea

CARDIAC	RESPIRATORY	METABOLIC	OTHERS
Heart failure	Asthma	DKA	High output states
	COPD	Lactic acidosis	
	ILD	Uremia	
	Pneumothorax	Salicylate poisoning	
	ARDS	Ethylene glycol poisoning	
	Pulmonary Embolism		

NYHA Functional Classification

Class I
- No limitation of physical activity
- No symptoms with ordinary exertion

Class II
- Slight limitation of physical activity
- Ordinary activity causes symptoms

Class III
- Marked limitation of physical activity
- Less than ordinary activity causes symptoms
- Asymptomatic at rest

Class IV
- Inability to carry out any physical activity without discomfort
- Symptoms at rest

Modified Medical Research Council Scale

GRADE OF DYSPNEA	DESCRIPTION
0	Not troubled by breathlessness, except with strenuous exercise
1	Shortness of breath walking on level ground or with walking up a slight hill
2	Walks slower than people of similar age on level ground due to breathlessness, or has to stop to rest when walking at own pace on level ground
3	Stops to rest after walking 100 m or after walking a few minutes on level ground
4	Too breathless to leave the house, or breathless with activities of daily living (e.g., dressing/undressing)

Acute Onset Breathlessness

- Acute LV Dysfunction
- Pneumothorax
- Pulmonary embolism
- A/c exacerbation of bronchial asthma
- A/c exacerbation of COPD
- Foreign body inhalation

Palpitations

CARDIAC	NON CARDIAC
Tachyarrhythmias	Anemia
Bradyarrhythmias	Thyrotoxicosis
Ectopic beats	Fever
Valvular regurgitation	Hypoglycemia
	Pheochromocytoma
	Drugs-Aminophylline

Syncope

Cardiovascular

Rhythm abnormalities
- Tachyarrhythmias
- Bradyarrhythmias

Anatomic abnormalities
- Aortic stenosis
- Severe mitral stenosis
- HOCM
- Pulmonary hypertension
- Pulmonary embolism
- Atrial myxoma
- Myocardial infarction

Disorders of vascular tone or blood volume

Vasovagal syncope

Orthostatic hypotension

Cerebrovascular

VB insufficiency

Cyanosis

- Bluish color of the skin and mucous membranes
- Increased quantity of reduced haemoglobin or of haemoglobin derivatives
- SaO_2 -
- PaO_2 -

Central

SaO_2 is _____ or an abnormal haemoglobin derivative is present
Mucous membranes and skin are both _____

- High altitude
- Cyanotic CHD
- COPD
- Pickwickian syndrome
- Pulmonary AV Fistula

Peripheral

Slowing of blood flow and abnormally _____ extraction of O_2
Results from vasoconstriction & diminished peripheral blood flow
Mucous membranes of the oral cavity, including the sublingual mucosa and tongue is _____

- Reduced cardiac output
- Cold exposure
- Arterial obstruction
- Venous obstruction

Edema

Right heart failure	Hypothyroidism
Nephrotic syndrome	DVT
Liver cirrhosis	Cellulitis
Hypoalbuminemia	Filariasis
Drug induced	

lumina blood - 0.5-1m/sec
expansile wave - 5m/sec

expansile wave of impulse transmitted along the vessel wall when blood is ejected from left ventricle to a partially filled aorta

PULSE

- Rate
- Rhythm
- Volume
- Character
- Condition of vessel wall
- Radio-femoral & Radio-radial delay
- Pulse-apex deficit
- Palpation of peripheral vessels

60 - 100

Rate

Tachycardia >100

PHYSIOLOGICAL	PATHOLOGICAL
Infants Anxiety Exercise	**Cardiovascular** - Tachyarrythmias - Anterior wall MI
	Non cardiovascular - Fever - Thyrotoxicosis - Drugs - Bagonist, Theophylline Anemia Pregnancy

Bradycardia

Reduced vagel tone

PHYSIOLOGICAL	PATHOLOGICAL
Athletes Elderly Sleep	**Cardiovascular** - Brady arrythemia - Inferior wall MI
	Non cardiovascular - Drug - Betablocker, CCB - non DHP, Digoxin. - Raised ICT - Hypothyroidism - Hypothermia

RELATIVE BRADYCARDIA

- Normal individual - For every 1°C (1.8°F) ↑ in core temperature, heart rate ↑ by 15–20 / min.
- Causes

Enteric fever
Dengue fever.
Q fever, Leogionella
malignant lymphoma
Drug B blocker
↳ Verapamil
Diltiazem

raised ICT - cushig's reflex — Bradycardia
Hypertension
Irregular respiration

Rhythm

Regularity with which one beat follows another

- **RHYTHM ABNORMALITIES**

  - Physiological : Sinus arrhythmia

    Inspiration – inhibit vagus – ↑ PR
    expiration – stimulate vagus – ↓ PR

  - Pathological : Arrhythmias

    Irregularly irregular – AF
    Regularly irregular – Wenckebach phenomena
    ventricular bigemeny.

Volume

→ subjective
→ objective.

- Pulse pressure : SBP - DBP = 30-60mmHg
  SBP - determined by Cardiac Output
  DBP - determined by Peripheral resistance
- Causes of low volume pulse – Dehydration, shock
- Causes of high volume pulse → Cardiovascular – AR, MR, PDA (→ high volume collapsing pulse)
  → Non cardiovascular
  – Fever
  – anemia
  – thyrotoxicosis
  – Beri Beri

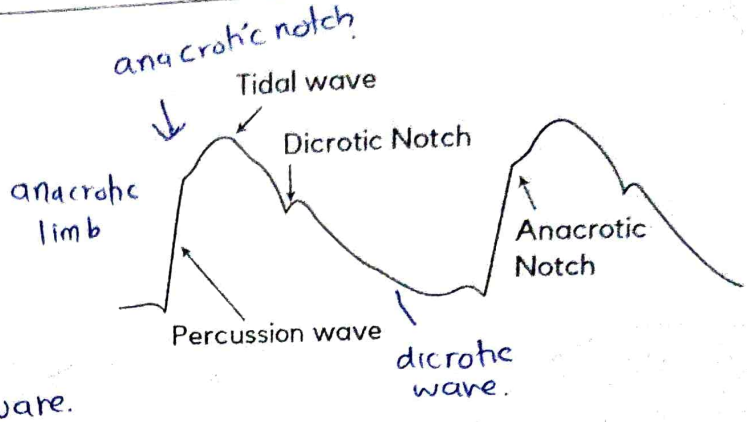
  pseudo collapsing pulse
  - High volume with normal pulse pressure.

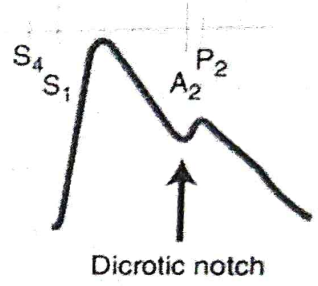
Wave-form of pulse. → carotid

Character

ejection of blood from LV to aorta.

- Systolic waves – Percussion wave, Tidal waves
  - reflected waves from arteries of upper body.
- Diastolic wave – Dicrotic ware.
  - reflected wave from arteries of lower body.
- Dicrotic notch – aortic valve closure.
- ~~Dicrotic wave –~~.

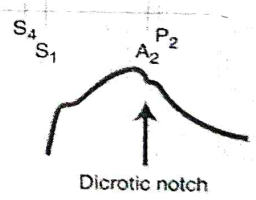




Pulsus parvus et tardus → low volume, late peaking / Anacrotic pulse

low volume late peaking pulse

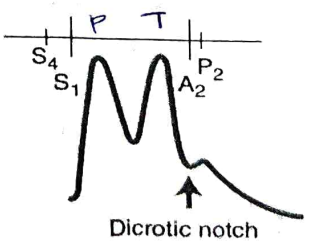
Aortic stenosis

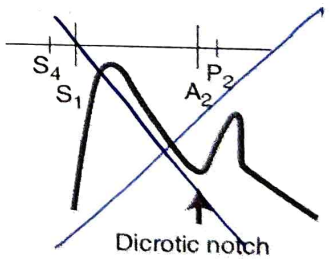


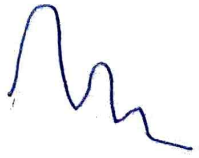
Bisferiens pulse

2 peak in systole

- Aortic regurgitation
- AR + AS
- HOCM (Both peak not same amplitude) – camel Hump configuration.

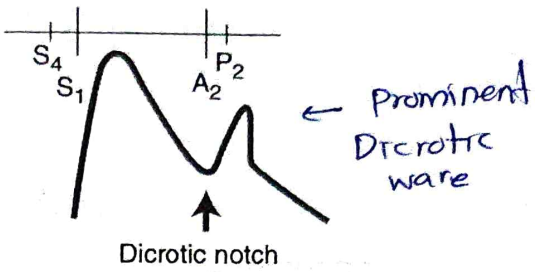






Dicrotic pulse

- Dilated Cardiomyopathy
- Sepsis
- shock
- patients on IABP



← Prominent Dicrotic wave

Water Hammer pulse – Corrig an pulse / High volume collapsing pulse



Rapid upstroke, ill sustained peak
rapid downstroke.

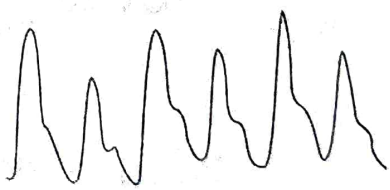
→ seen in AR.

Pulsus paradoxus

- Inspiratory fall of systolic BP > 10mmHg

Cardiac tamponade
constrictive pericarditis
Acute exacerbation of Asthma, COPD, SVC obstruction
Tension pneumothorax

Pulsus alternans



- Beat-to-beat variability of pulse amplitude
- Seen in patients with LV dysfunction.

Condition of vessel wall

Monckeberg medial sclerosis

- calcifications of the medial walls of muscular arteries
- Age group elderly

Radio femoral delay

Coarcation of aorta.

R-R delay → Takayasu arteritis
Pre subclavian COA

Pulse-Apex deficit

- Pulse deficit = Heart rate − ~~Apex~~ pulse rate

Heart rate - ventricular contraction

Pulse rate - ~~Pals~~ · Transmission of pressure waves

- Causes - AF (10 >) , PVC (<10)

Palpation of peripheral vessels

PVD - absent peripheral pulses

Arterial pressure depended on → cardiac output – systolic BP
→ peripheral resistance – Diastolic BP

BLOOD PRESSURE

Lateral pressure that is exerted by the blood column on vessel wall ISH

HYPERTENSION

- Essential (Primary HTN – multifactorial)
- Secondary

CATEGORY	SYSTOLIC BP	DIASTOLIC BP
Normal	<130 &	<85
High normal	130–139 & / or	85–89
Grade I	140–159 & / or	90–99
Grade II	≥160 & / or	≥100 mmHg

Isolated systolic HTN: Arterio sclerosis, Fever, (systolic <90 - hypo)
thyrotoxicosis, Aortic regurgitation, AV Fistula
(These are high output states)

Stepwise management

Non-pharmacological management – weight reduction (BMI <25 kg/m²)
– Physical activity (Brisk walking · 30 minutes/day)
– DASH diet (Dietary approach to stop hypertension) (rich in Fruit, vegetables and low fat dairy products reduced saturated & total fats)
– salt restriction

- Step 1 – A+C low dose (40mg Telmi + 5mg Amlo dipin) eg:
- Step 2 – A+C high dose (80mg Telmi + 10mg Amlo) eg:
- Step 3 – A+C+D → Thiazide diuretics
  - Hydrochlorothiazide
  - thiazide like – chlorthalidone
- Step 4 – A+C+D+MRA – spironolactone (Resistant hypertension)

6 major classes
ACEI
ARB
CCB
Thiazide diuretics
β Blocker
α Blocker

(>140/90 mmHg & Patient on 3 anti hypertensive one of them is diuretic)

* Diabetes patients – ACEI/ARB → retards albuminaria
* AF → Beta blockers, non DHP CCB
* CKD → ACE I / ARB, DHP CCB, Thiazide like diuretics, loop diuretics
  ↳ Avoid spironolactone
* CAD – Bblocker, ACEI / ARB remodelling

* Pregnancy – Labetalol, Nifidipine, Alpha methyl dopa (* preferred)

SECONDARY HYPERTENSION

- Renal parenchymal disease
  - Atherosclerosis
- Renovascular disease
  - Takayasu Arthritis
  - Fibromuscular dysplasia
- Primary aldosteronism
- Obstructive sleep apnea
- Pheochromocytoma
- Cushing's syndrome
- Coarctation of aorta – m.c congenital cardiovascular cause of HTN
- Hypothyroidism → diastolic hypertension
- Hyperthyroidism – systolic hypertension
- Acromegaly

HYPERTENSIVE CRISIS

- Systolic BP > 180 (AHA) / 200 (ESH) & Diastolic BP > 120 mmHg.

Hypertensive urgency	Hypertensive emergency
Asymptomatic No organ impairment	Acute impairment in ≥ one organ. (End organ Damage or Hypertension mediated organ damage.) Heart – MI, LVH. Kidney – AKI. Brain – stroke, hypertensive encephalopathy Large artery – Aortic dissection.

Malignant HTN / Accelerated hypertension.

High BP + hypertensive retinopathy → Arteriolar spasm
hemorrhage
exudate
papilledema.

Hypertensive urgency, malignant HTN – Oral / drug.
emergency – Parentral.

$MAP = DBP + \frac{1}{3}PP$

(SBP – DBP)

Management

- Timeline & target BP

Hypertensive encephalopathy – within 2Hours
BP – 160/100-110
Do not reduce MAP by >25% in 2hour.
(↓ CCP)

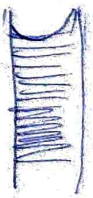
- Preferred drugs

Nitroprusside
Nicardipine
Labetalol
} Stroke, hypertensive encephalopathy.

Nitroglycerin – Myocardial infarction. Acute LV Failure
phentolamine – Adrenergic crisis
↳ Pheochromocytoma

JVP

Jugular venous pressure – Pressure of column of blood in Right internal jugular valve



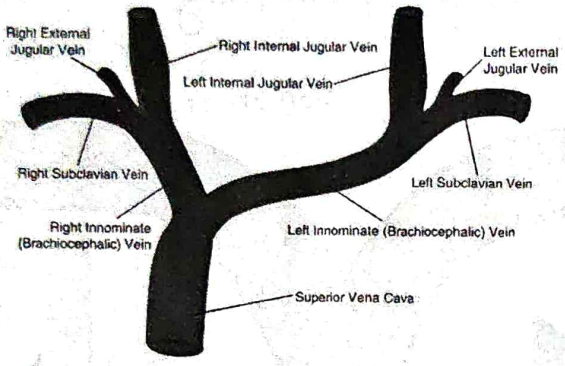
Jugular venous pulse – waveform created by pulsation at top of venous coloumn. in Rt IJV

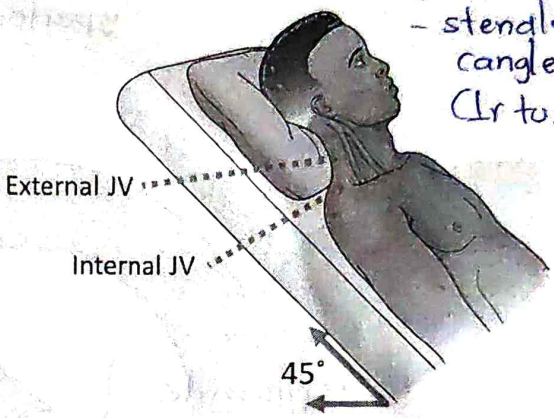
1.36 cmH_2O = 1 mmHg

From angle of Louie to centre of rt atrium - 5cm

45° propped up position

2 object method
- sternal angle (angle of Louie)
(Ir to ground)





raised JVP: RHF, cardiac tamponade, constrictive pericarditis

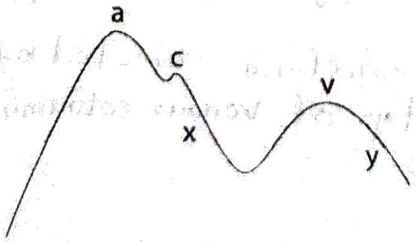
~~SVC~~: SVC obstruction
↳ raised non pulsatile

5cm H_2O from centre of Rt atrium
≥ 9 cm H_2O from centre of Rt atrium
(≥ 3 cm H_2O from angle of louie)

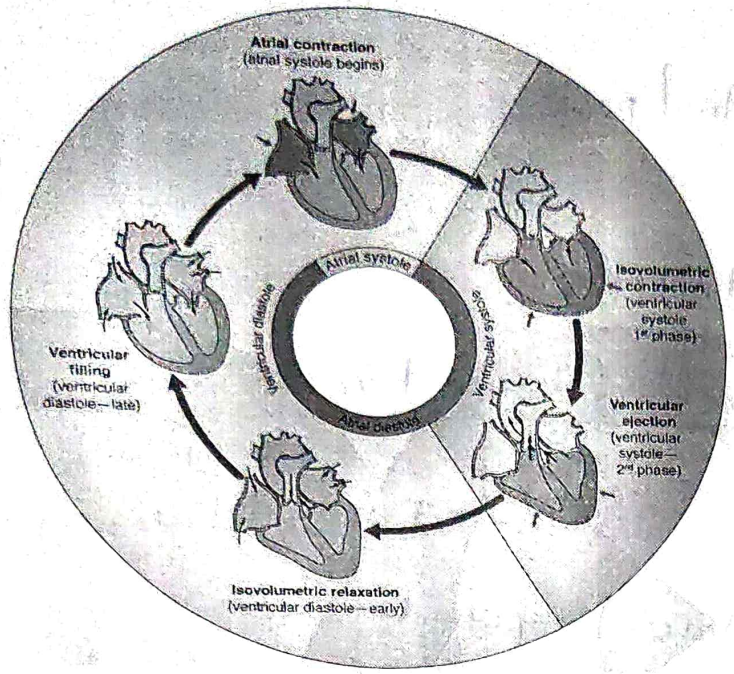
(Not conventionsly preferred - But in sitting - get JVP when severely much elevated)

Waves of Jugular Venous Pulsations

- 3 (a c v) positive waves and 2 negative waves descent
- Waves reflect pressure changes in the _____



a wave



C wave. - cusp wave.

X descent

V wave.

a wave

- Due to Right atrial contraction; during atrial systole
- Absent a wave - Atrial Fibrilation
- Giant a wave - Right ventricular hypertrophy - Pulmonary hypertension.
  Increased force ful contraction.
- Cannon a wave - Right atrium contract against closed tricaspid valve
  - Juactional rhythm - regular
  - complete heart block - irregular.

(relaX)

x descent

- Reflects the fall in Right atrial pressure after the a wave peak
- Due to two factors

Atria is in the diastole

Downward movement of tricuspid valve during ejection phase.

- Decreased or absent x descent – Tricuspid regurgitation
- Prominent x descent – Cardrac tamponade.
  Augmented Rv contractions

↑ venous Return.

v wave

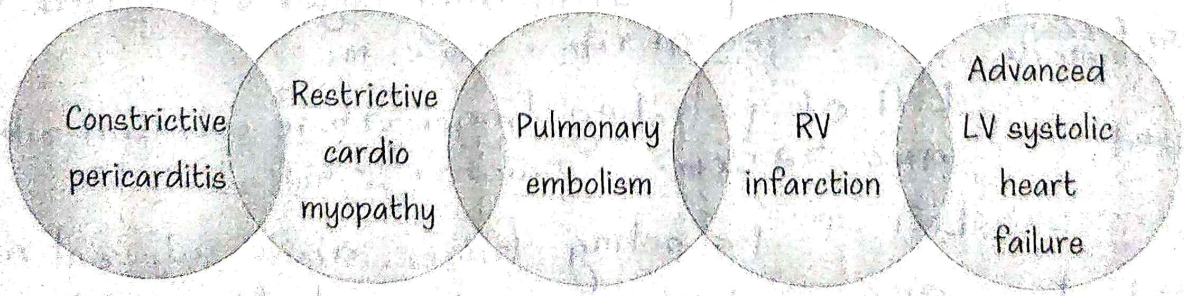
- Due to – venous return to Rt atrium
- Absent v wave – Hypovolemia.
- Prominent v wave – Hypervoluemia.
- Giant v wave – Tricuspid Regurgitation.
- Lancisi sign – Tricuspid Regurgitation (c-v wave)

y descent

- Due to - Rapid flow of blood from RA to RV
- Prominent y descent - Tricuspid Regurgitation
  constrictive pericarditis (fibrosed pericardium will limit the filling during 2nd phase of ventricular diastole, hence most blood come from RA to RV during early phase of ventricular filling)
- Friedreich's sign -
  ↳ sharp & deep y descent . W sign 
- Slow y descent - Tricuspid stenosis, Rt atrial myxoma.
- Absent y descent - Cardiac tamponade.

Kussmaul's sign

- Normally JVP should fall by at least 3 mm Hg with inspiration
- Kussmaul's sign - Rise of JVP with inspiration
- Causes



→ Impending Rt heart failure

Hepatojugular reflux – supine

- Firm and consistent pressure over upper abdomen – 10 seconds
- Positive – Rise >3cm H_2O in JVP sustained for atleast 15 seconds
- Implication – impending RHF

APEX BEAT

Contraction of LV apex.
5th ICS just medial to MCL (midclavicular line)
Area <2.5cm². Duration – less than half of systole

Hyperdynamic apex

- Tapping apex – Definite Tap. Palpating finger is not lifted above adjecent rib. cause: MS.

Eccentric (ventricular freewall) ↑ ventricle.
Volume overload
[MR, AR]

- Forceful apex – Lift of palpating finger above adjacent rib area >2.5cm². Duration < half of systole
- Heaving apex – Lift of palpating finger above adjacent rib area > 2.5cm². Duration > half of systole

Pressure overload.
AS
→ concentric type hypertrophy
(Uniform type of hypertrophy)

Left Parasternal Heave

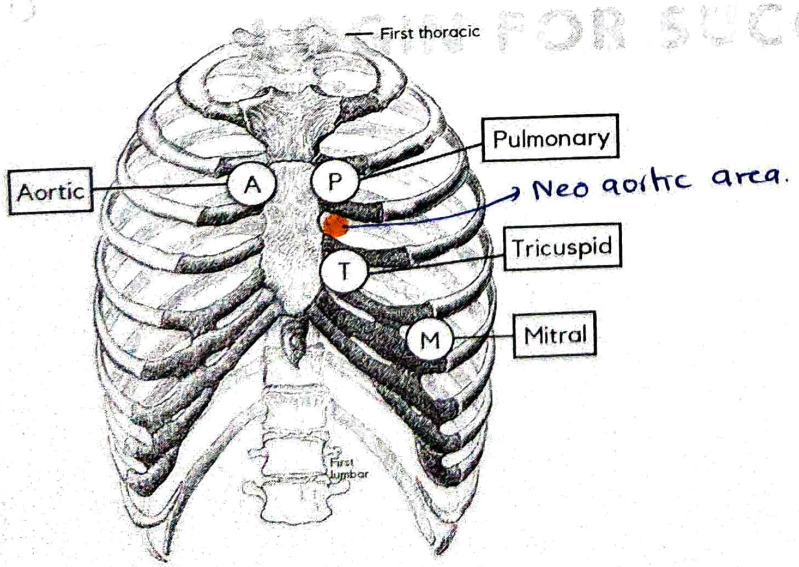
- Ulnar border of hand in left parasternal region over lower costal cartilages
- Due to Right Ventricular hypertrophy

Thrills

- Palpable Murmur over precordium
- Using base of fingers

HEART SOUNDS

Auscultatory areas



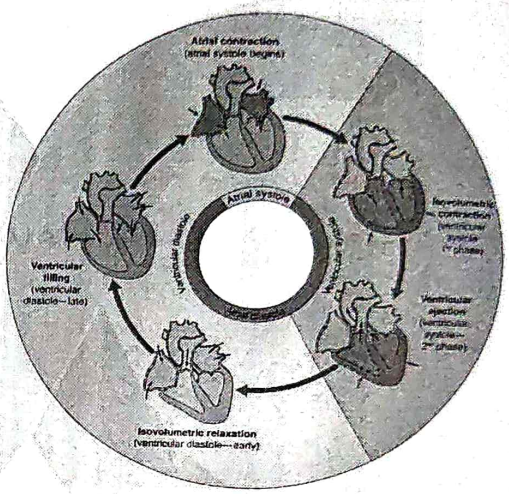
High pitch

High frequency sounds

- S1
- S2
- Opening snap
- Pericardial knock
- Ejection click
- Prosthetic valve sounds

Low frequency sounds

- S3
- S4
- Tumor plop



First Heart Sound

At the onset of ventricular systole.

Results from closure of the mitral and tricuspid valves (tensing involved in the valve leaflet producing the sound)

Coincides with Carotid pulse

Abnormalities : Loud S1, Soft S1, Variable S1

shorten the systole & diastole (effect diastolic filling).

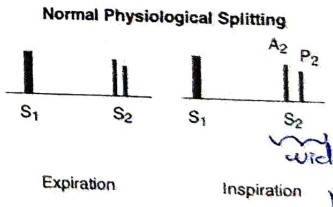
Better conductance

Loud S1	Soft S1
Tachycardia	Obesity, emphysema
Thin chest wall	Low cardiac output
Increased cardiac output	Long PR interval
Short PR interval	Rheumatic MR
Mitral stenosis	Acute aortic regurgitation
Left atrial myxoma	Myocarditis

Second Heart Sound

closure of semilunar valves

- A2 is heard widely all over the chest
- P2 is soft and only heard at the pulmonary area.
- Pulmonary hangout interval b/w pressure equalisation and pulmonic valve closure. normal : 30-120 ms
  - measure of impedance of pulmonary circulation
  - increases in inspiration
  - shortens in pulmonary hypertension



(Inspiration - intra thoracic pressure -ve, ↑ blood to right side, ↑ venous return — more blood right — P_2 delayed)

Loud A_2 Loud P_2

- Loud S2 - Systemic hypertension, Pulmonary hypertension.
- Wide fixed split - Atrial septal defect $A_2 \longrightarrow P_2$
  No respiratory variation.
- Wide non-fixed split - Right bundle branch block.
- Paradoxical split - LBBB, Aortic stenosis, ✱LVF (very severe)
- Single S2 - Aortic stenosis
  - calcific aortic stenosis

Third Heart Sound

Gallop rhythm.

Abrupt deceleration ~~after~~ ventricular filling

Normal finding in children, young adults & pregnancy.

RV S3	LV S3
Tricuspid area	Mitral area
Increases on inspiration	Increases on expiration

LVF, MR.

(above 40 year 3rd heart sound is pathological)

Fourth Heart Sound

- Occurs just before S_1
- Always pathological

↓

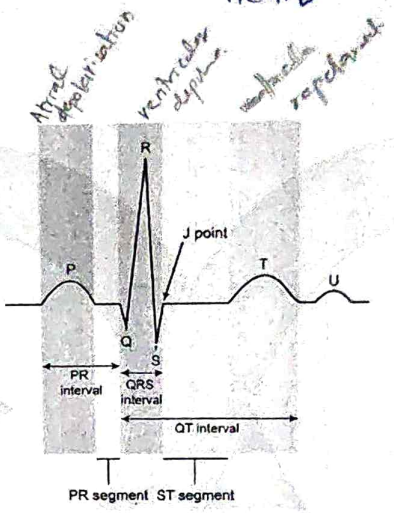
Forceful atrial contraction against a stiff, noncompliant ventricle).

systemic hypertension, As - LVS_4

pulmonary HTN - RVS_4

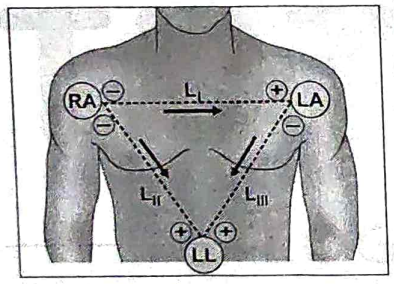
ECG

- Electrocardiogram - Graphical representation of electrical activity of heart
- Electrocardiograph - Instrument



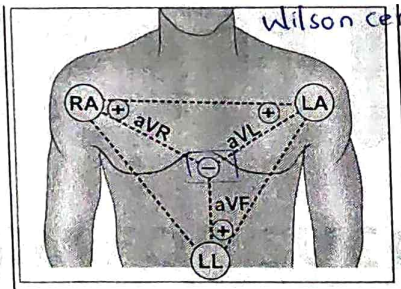
- Indications
  - Anginal ₹ chest pain
  - Palpitations (subjective awarness of one's own heartbeat)
  - Breathlessness
  - Syncope (Transient loss of conciousness that occur due cerebral hypoperfusion)
  - Stroke
  - Pre op work up

Conventional 12 lead ECG system



3 Bipolar limb leads

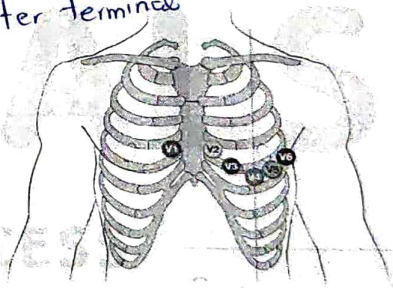
L I
L II
L III



Wilson center terminal

3 Unipolar limb leads

aVR
aVL
aVF



6 unipolar chest leads

V_1 - 4th right intercostal space just to the right of sternum

V_2 - 4th Lt ICS just to the left of sternum

V_4 - 5th Lt ICS at mid clavicular line

V_3 - Midway b/w V_2 & V_4

V_5 - Anterior axillary line at same level of V_4

V_6 - Mid axillary line at same level of V_4 & V_5

II, III, aVF - inferior Leads

I, aVL, V_5, V_6 - Lateral leads

V_1, V_2 - septal leads

V_3, V_4 - Anterior leads

PWMI

V_7 - Lt posterior axillary line, same level of V_6

V_8 - Tip of scapula, same level of V_6

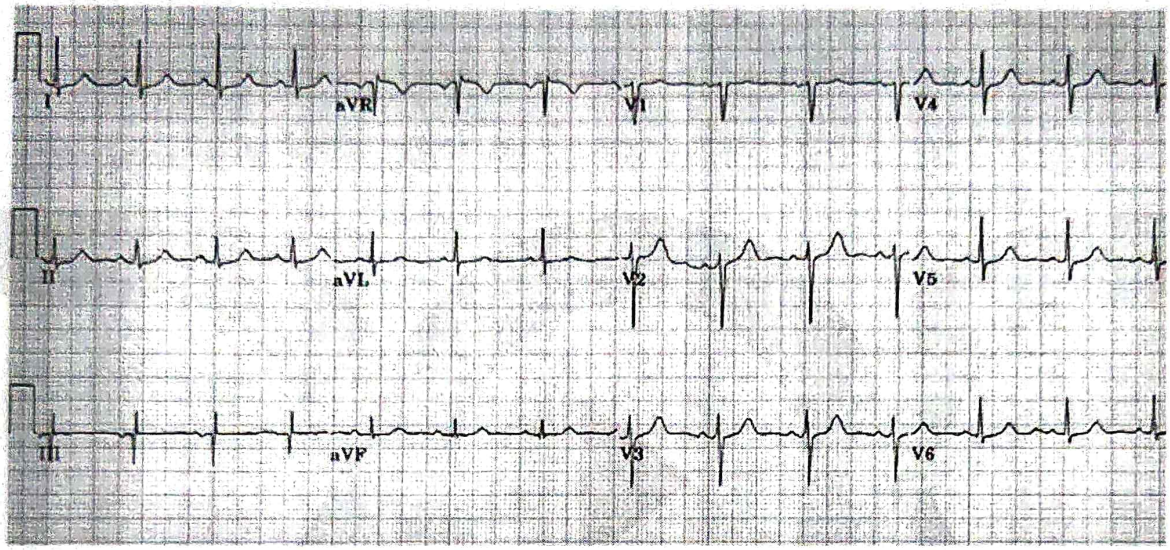
V_9 - Lt paraspinal region, same level of V_4

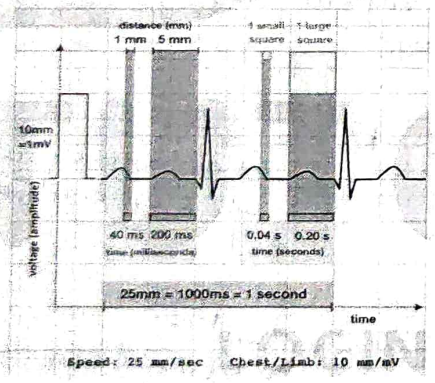
(heated stylus become decolourise the paper → otherwise no ink inside it)

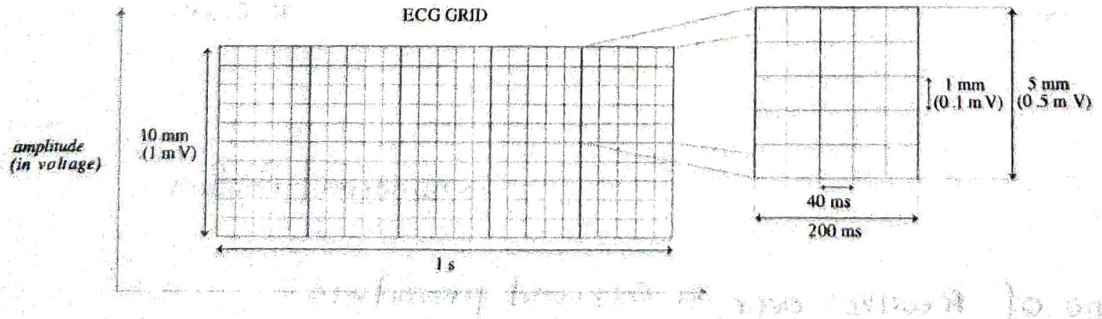
RVMI

V_{3R}, V_{4R}.

Standard 12 Lead ECG



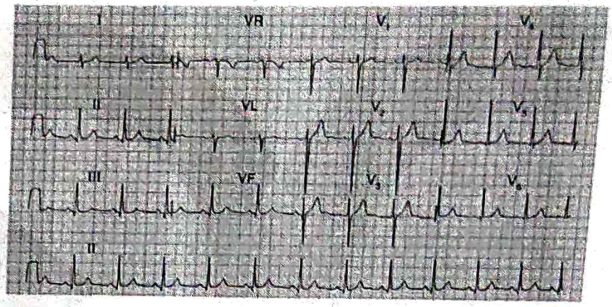




twice standardization - Pericardial effusion

Steps of ECG Interpretation

1. Standardization
2. Rate
3. Rhythm
4. Axis
5. P wave
6. PR interval
7. QRS complex
8. ST segment
9. T Wave
10. QT interval

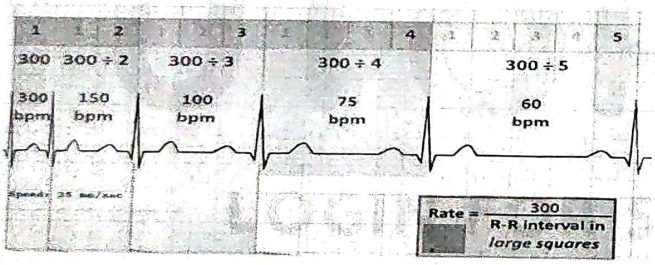


1. Standardization

- Calibration signal
- 1 millivolt current produces → 10 mm vertical deflection

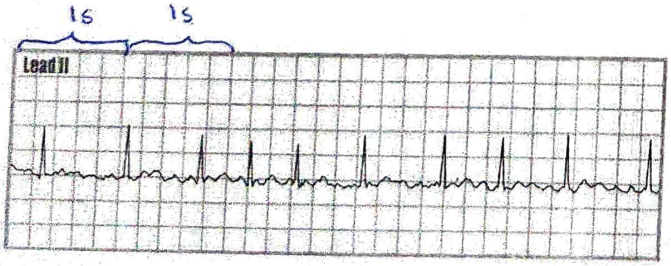
Standard 12 lead ECG with rhythm strip.

2. Rate



$$\text{Rate} = \frac{300}{\text{no. of large squares b/w 2 consequtive R waves}}$$

$$= \frac{1500}{\text{no. of small square b/w 2 consequ. R-waves}}$$

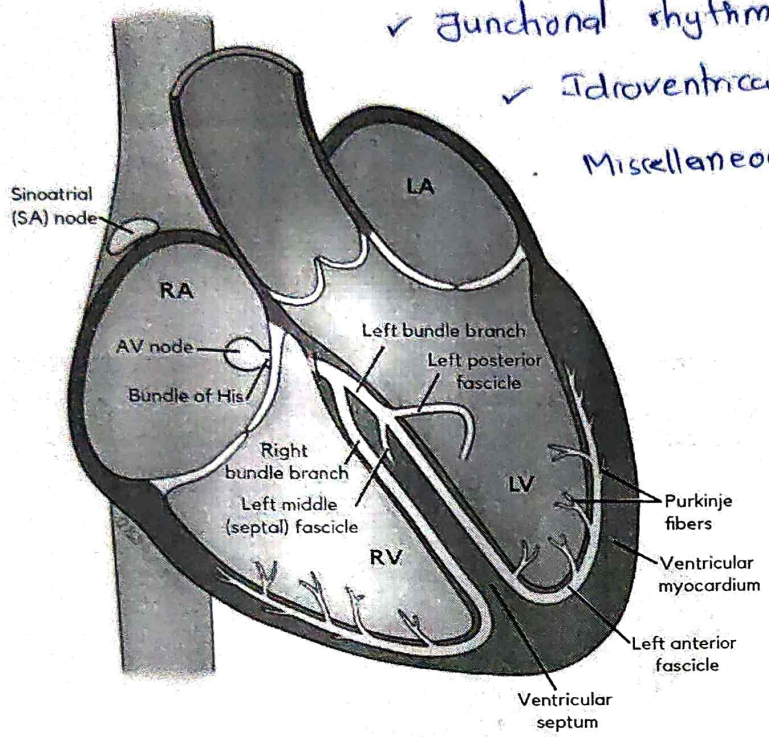


→ Abnormal rhythm.

no. of R waves over a 6 second period x10

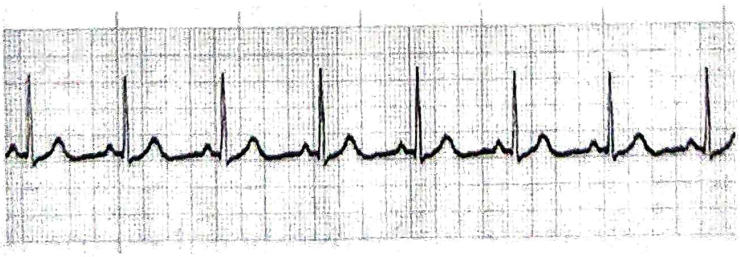
3. Rhythm – Pacemaker

- ✓ Sinus rhythm – SA Node
- ✓ Junctional rhythm – AV node
- ✓ Idroventricular rhythm → Below Bundle of His.
- Miscellaneous.



Sinus Rhythm – Normal morphology P wave followed by normal QRS duration (<3 small square. (less than 120 ms)

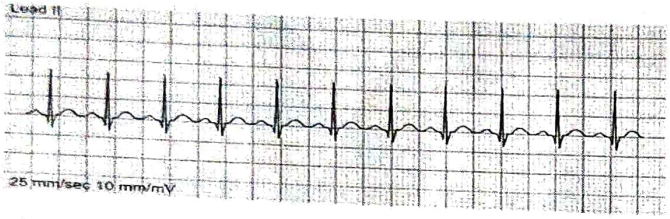
- NSR – Normal sinus rhythm 60–100
- Sinus tachycardia >100
- Sinus Bradycardia <60





rate = 50

→ sinus bradycardia



→ sinus tachycardia.

Junctional Rhythm

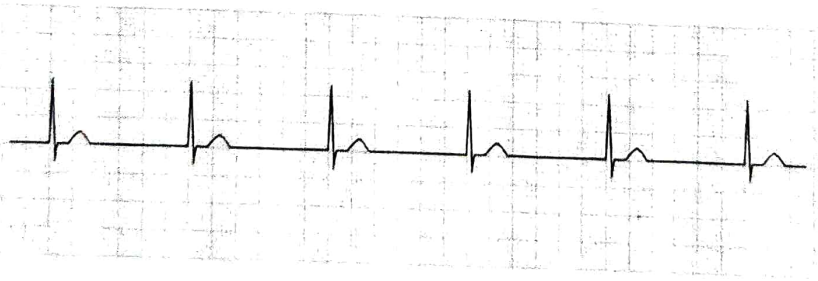
Pacemaker = Av node

Absent P wave

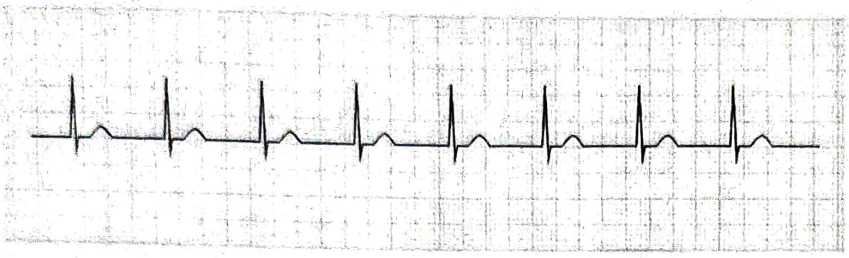
inverted P wave just before QRS

inverted P wave after QRS

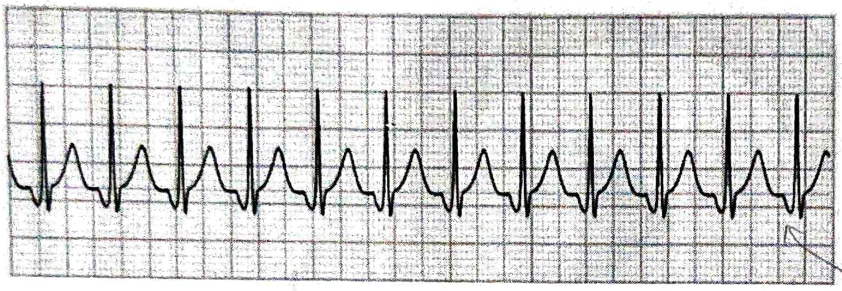
- Junctional escape rhythm 40-60
- Accelerated Junctional rhythm 60-100
- Junctional tacchycardia > 100



↳ Junctional escape rhythm



→ Accelerated junctional rhythm

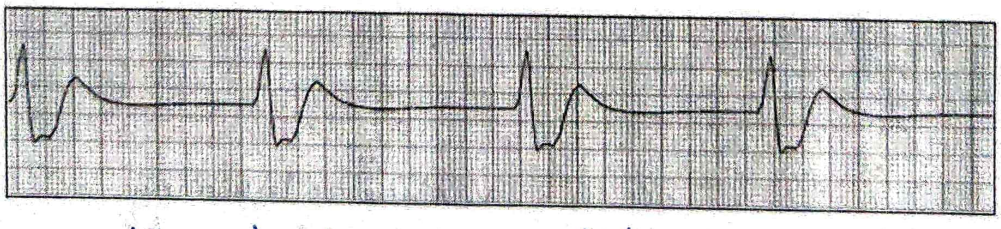


→ Junctional tachycardia.

Idioventricular Rhythm

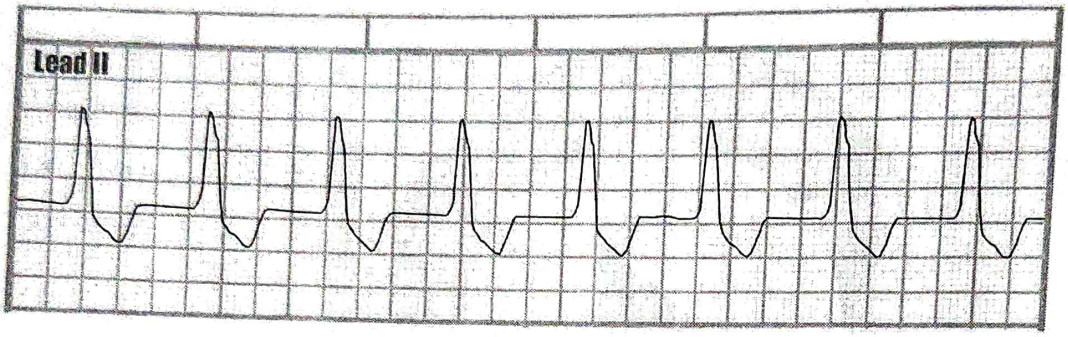
→ Absent P wave. → wide QRS

- Idioventricular escape rhythm <40
- Accelerated idioventricular rhythm 40-100
- ventricular tachycardia. >100



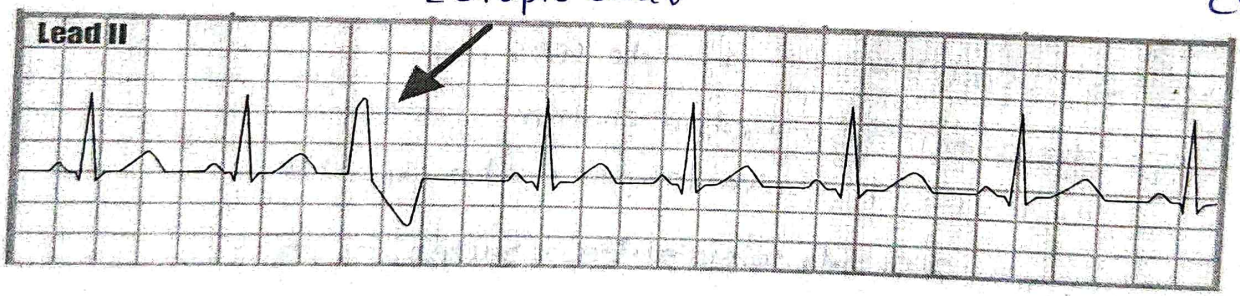
Idioventricular escape rhythm

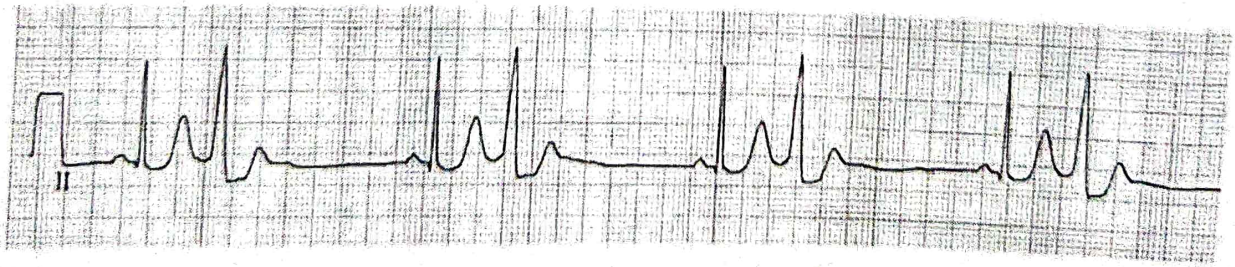
Accelerated idioventricular rhythm.



ventricular ectopic beat /
ventricular premature contracture.
(VPC)

Ectopic beat





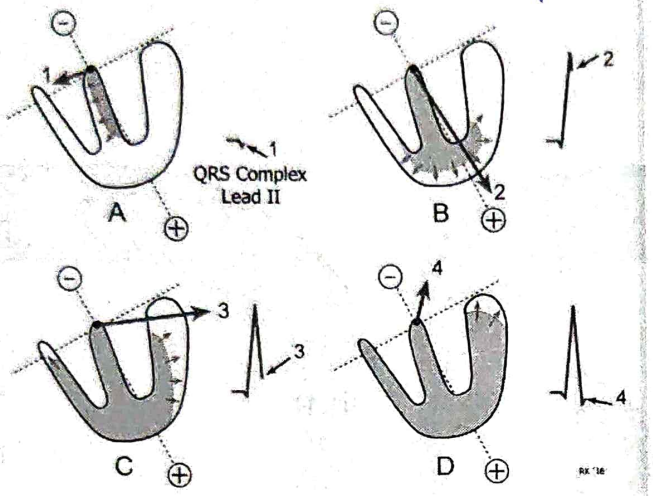
ventricular bigeminy.
(Digoxin toxicity)

Average direction of spread of depolarization
11'o clock to 5'oclock

4. Axis

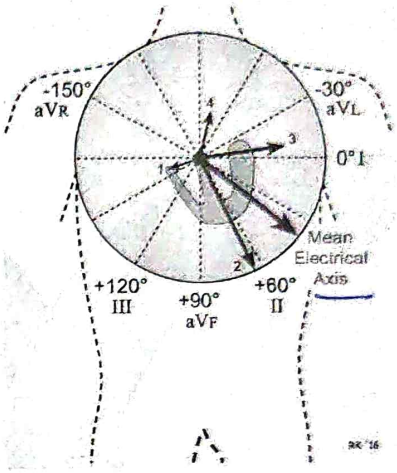
septal

paraseptal



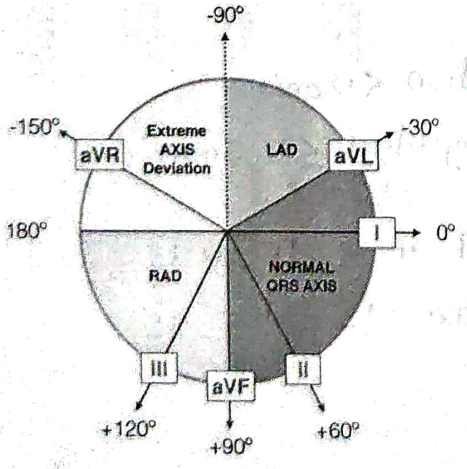
endo - epicardium.

apex - base.



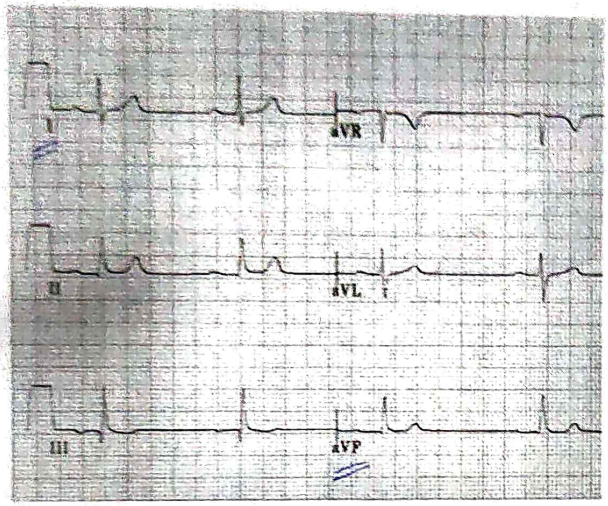
RAD – RVH
LAD – LVH

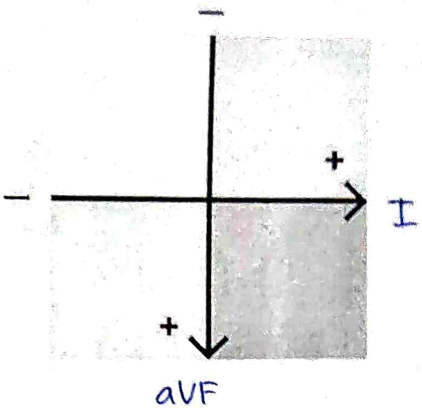
Quadrant Method of Axis Determination



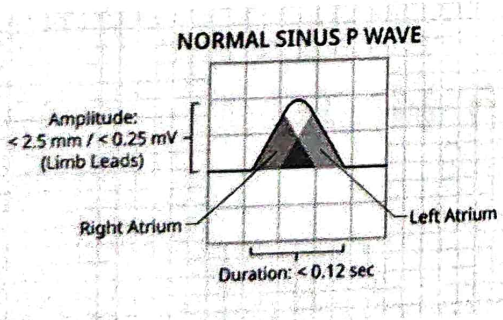
R – S deflection

height of R wave – depth of S wave.





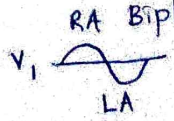
5. p wave – Atrial depolarisation



- It is a smooth dome shaped wave
- Duration < 120ms
- Amplitude < 2.5mm

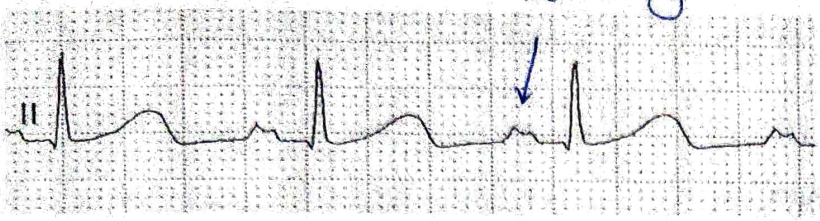
Upright in most leads

Negative in aVR



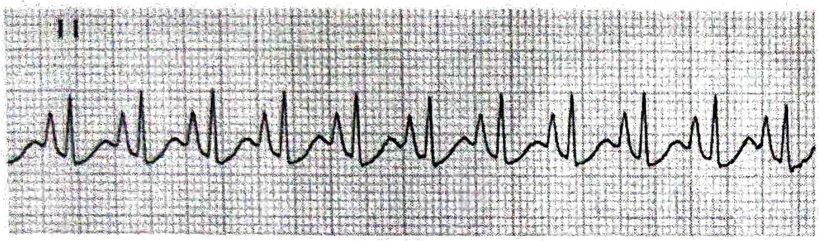
P-mitrale - mitral stenosis

notching



Duration > 120 ms
LA overload

P- Pulmonale - Palmonary HTN, Pulmonary embolism.



Amplitude > 2.5mm.
RA overload.

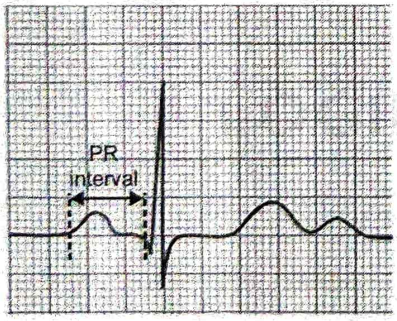
(Rhythm strip) ← (Lead II)

6. PR interval

Begining of Pware to begining of QRScomplex

120 – 200ms

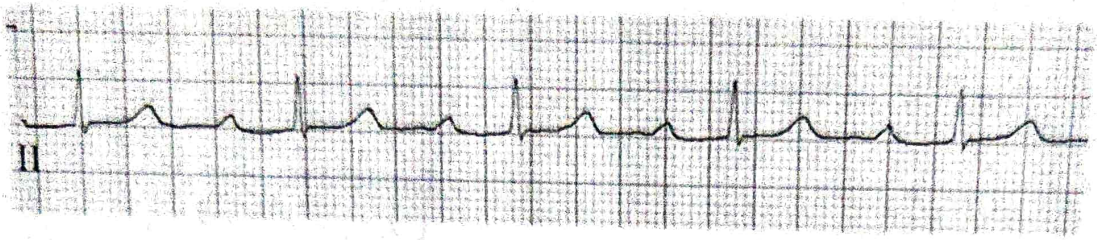
3–5 small. Square.



Abnormalities - Prolongation
shortening
varying

B – Betablockers
C – calcium channel blockers (non DHP – verapamil, Diltiazem)
D – Digoxin

Prolongation



Shortening

- Preexcitation syndromes
- Junctional rhythm
- Atropine

WPW syndrome

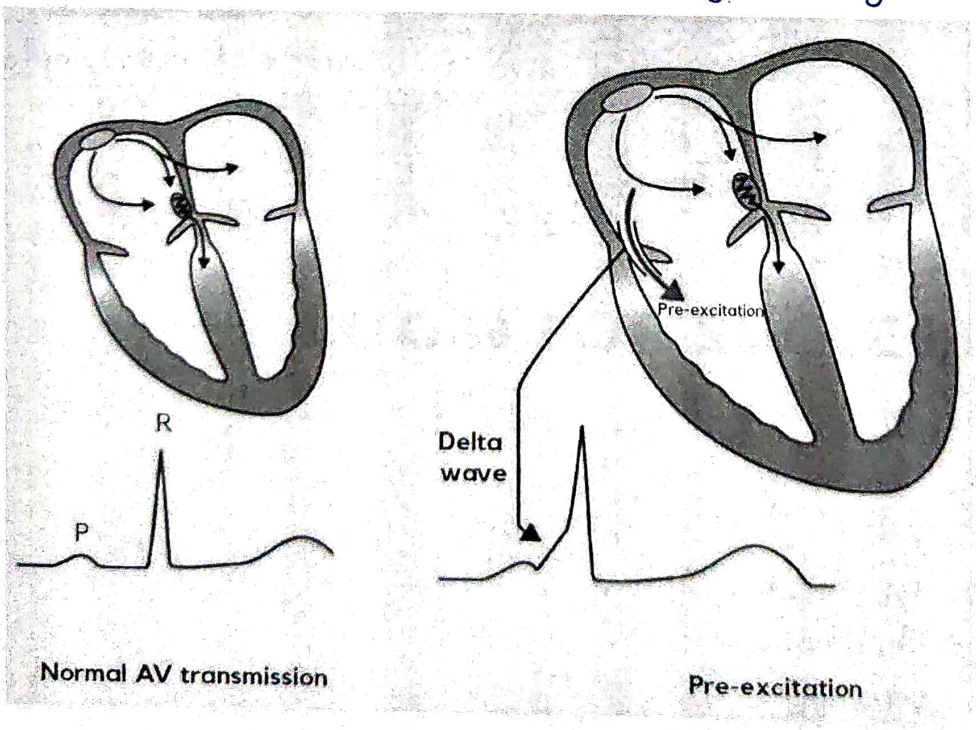
WPW pattern

→ accessory pathway (Bundle of kent)

(Bundle of kent)

- connect atria and ventricles
- By pass AV node (No av nodal delay)

Type A WPW – Lt sided Accessory pathway
Type B WPW – Rt sided Accessory pathway.

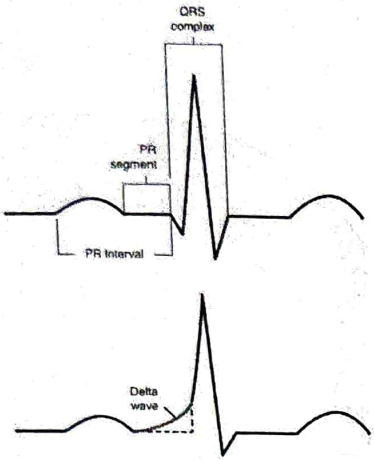


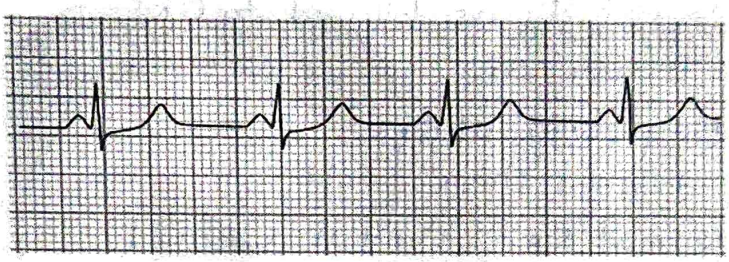
① short PR interval
② Absent Q wave
③ Delta waves
④ wide QRS complex.

WPW pattern + Tachyarrhythemia. = WPW Syndrome

AVRT
Atrioventricular Re enterant tachycardia.

Atrial Fibrillation





Slurred upstroke ~~of~~ – Delta waves

AVRT

Orthodromic
Forward conduction through AV node

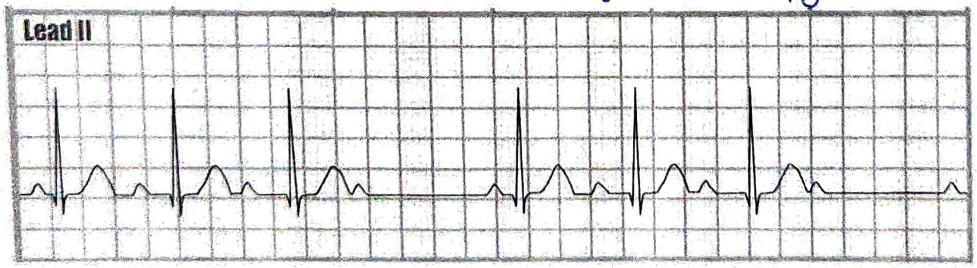
Antidromic
Retrograde conduction through AV node.

Treatment of WPW Syndrome

- Hemodynamically unstable
  ↳ DC shock / DC cardioversion
- Hemody. stable:
  - WPW with AF – Avoid AV nodal blocking agent
    Procainamide, Ibutilide.

AVRT → Antidromic
Procainamide
orthodromic
- Adenosine, Bblocker
  CCB.

preventon – catheterad ablation of accessory pathway.
- pharmacological therapy - Flecainide, propafenone.



Wenkebach phenomenon – progressive prolongation of PR interval followed by a non conducted P wave.

– 2nd degree AV blocks · Mobitz type I

7. QRS complex

q → septal depolarisation.

Q → >2mm deep, >25% of height of subsequent QRS

Pathological ↳ MI

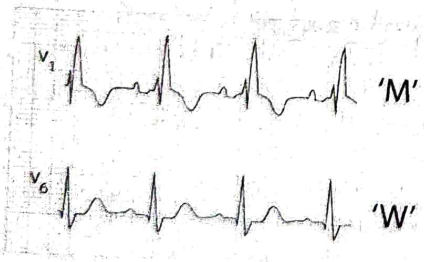
① Relation of QRS complex to P wave.
- Is each P wave followed by QRS
- Is each QRS preceeded by P wave.

② Morphology of QRS
Width, shape, height

Normal QRS · Duration < 120 ms
Wide QRS Duration > 120 ms

Right bundle branch block.
- Duration of QRS complex more than 120 ms ; wide QRS

causes :- Physiological, Pulmonary embolism, Ischemic heart disease, myocarditis, cardiomyopathy.

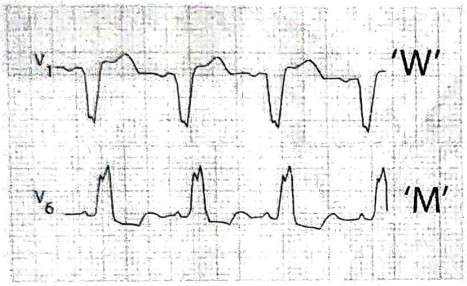


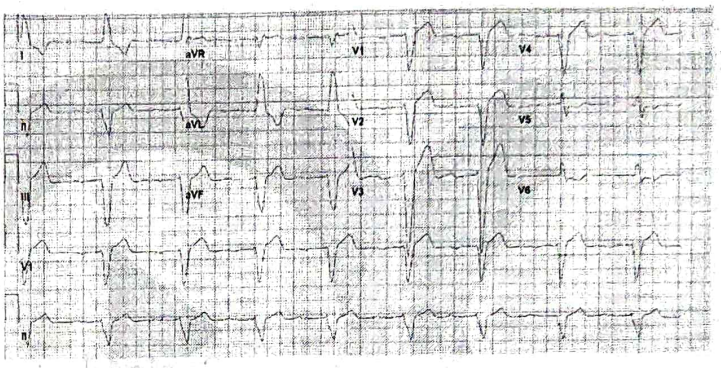


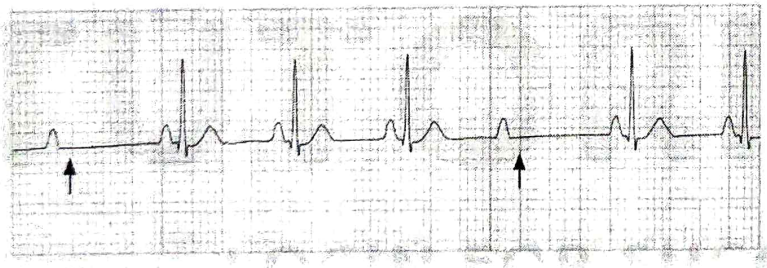
LBBB

- duration more than 120ms ; wide QRS
- causes: (Always pathological) ischemic heart disease, Aortic stenosis, Hypertension, cardiomyopathy.

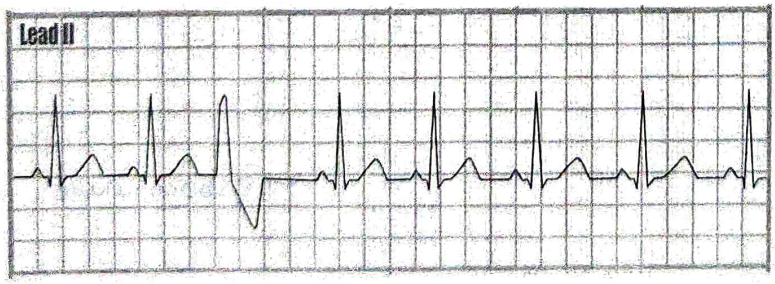
qs complex







2° AV block Mobitz type II

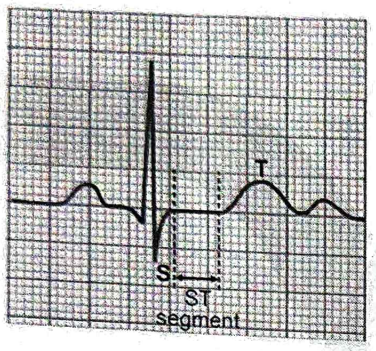


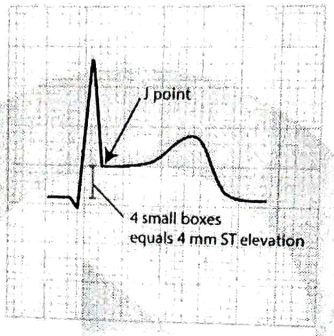
- Isoelectric

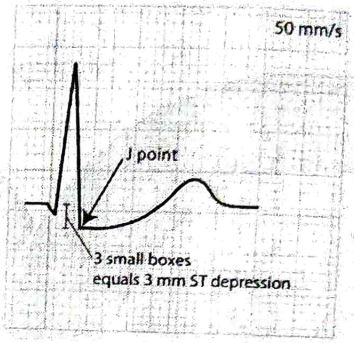
Termination of S wave to onset of T wave.

8. ST segment

Termination of S wave - J point







ST elevation : ≥ 1mm,

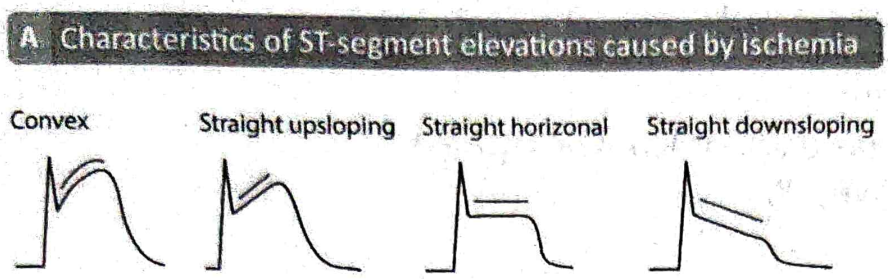
$V_2 - V_3$ → male → ≥ 40 years ≥ 2mm
↳ female → < 40 years ≥ 2.5m
- ≥ 1.5 mm

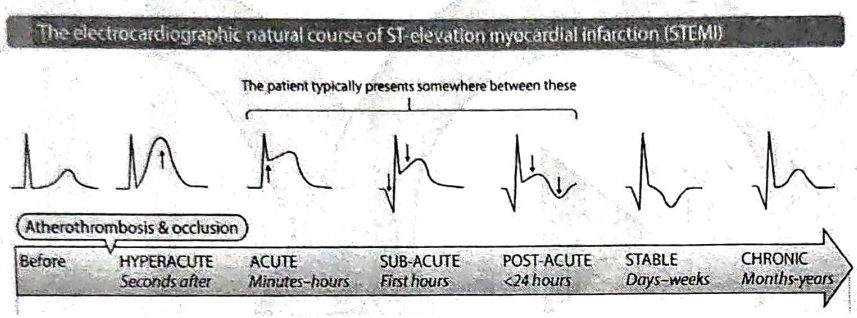
Differential Diagnosis of ST Elevation

- STEMI
- LV aneurysm
- Acute pericarditis
- Benign early repolarization variant
- LVH
- LBBB
- Brugada syndrome
- Hypercalcemia
- Hyperkalemia
- Hypothermia
  ↳ Osborn wave.



seen in pericarditis





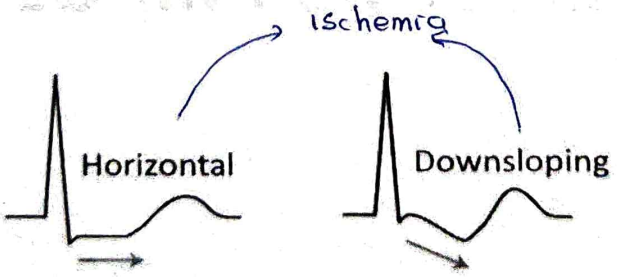
* hyperacute T wave

STEMI- mainly Transmural entire thickness involved

NON STEMI - subacute.

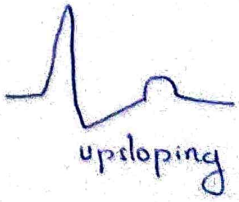
ST Depression

- Ischemia
- Drugs





upslopping – tachycardia



diwenter sign

upslopping ST depression + tall T waves

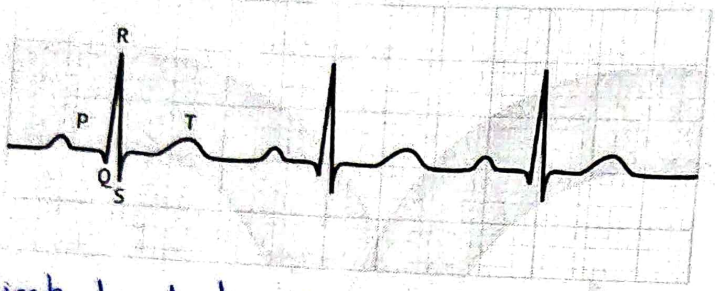
Proximal LAD occlusion

9. T wave —Ventricular repolarisation

Rounded peak

limb leads, precardial leads - upright

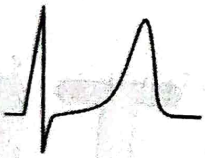
inverted - aVR, V_1



limb lead height < 5mm

Precordial lead height < 10mm

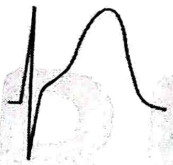
Tall peaked Twave.



Hyperkalemia

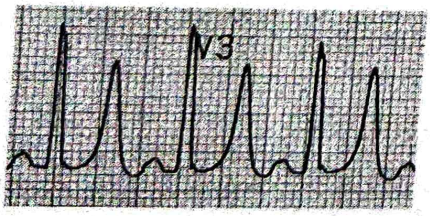
Narrow base and pointed apex.

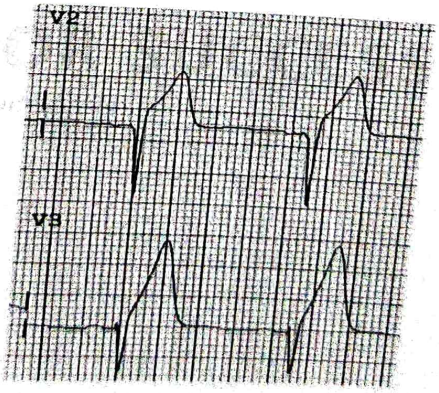
Hyperacute t wave.



Hyperacute T wave

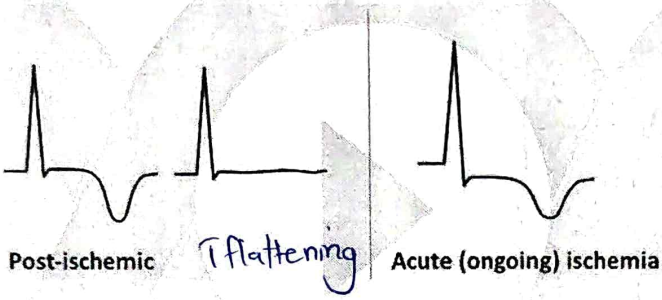
wide base round apex





T inversion – Ischemia, hypokalemia, Digoxin, Myocarditis
- New
- old

– Subarachinoid Hemorrhage } cerebral T inversions

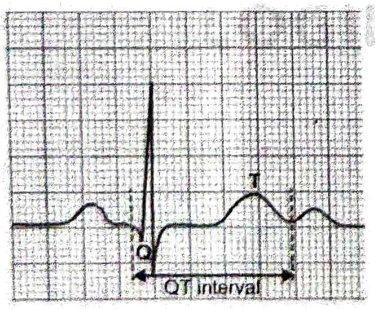


→ J point also depressed.

10. QT interval

Begining of QRS to End of T wave.

Varies with heart rate - HR ↑ – QT shorten
HR ↓ – QT longher.



Bazett's formula.

$$QTc = \frac{QT\ duration}{\sqrt{RR\ interval}}$$

Upper limit < F 460ms
M 450ms

Lower limit 390ms.

QT < 50% of preceeding RR interval.

QT_c > 550ms → ICD implantable cardiac Defibrilator.

Long QT Interval

- Congenital - Romano ward syndrome (AD), nodeafness, Jarvell Lange Nelson syndrome (AR), Deafness
  - D.o.c Bblocker ← prevent arrythemia
- Drugs - Quinidine, Amiodarone.
- Electrolyte abnormalities - Hypokalemia, Hypocalcemia, Hypomagnesemx.
  - D.o.c for aquired long QT → IV $MgSO_4$.

Short QT Interval

- Hyperkalemia
- Hypercalcemia
- Digoxin

Miscellaneous

U wave - delayed depolarization of papillary muscle
- Prominant U wave in hypokalemia.

Step 1: Heart rate >100

Step 2: Supra ventricular or ventricular.

Step 3: Regular or irregular.

Step 4: P wave — Present → Normal morphology or Abnormal morphology. (All P wave looking same / P wave looking different.)
Absent

above Bundle of His — Below Bundle of His

QRS <120ms

TACHYARRHYTHMIAS

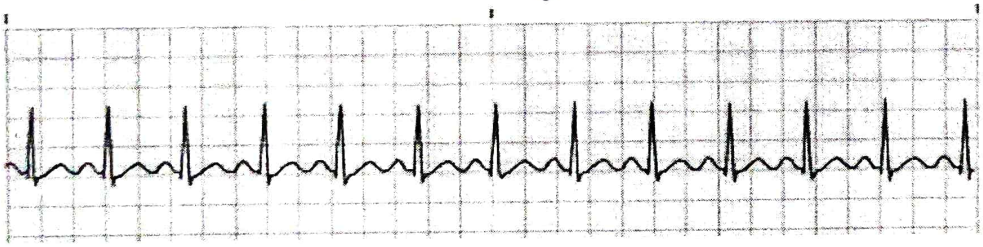
QRS >120ms

* Narrow complex tachy

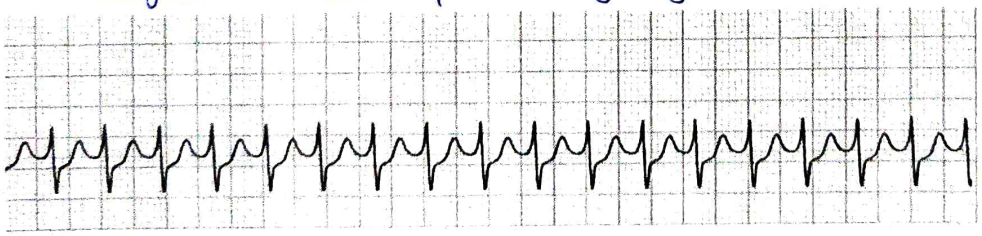
* wide complex tachy

Supraventricular		Ventricular	
Regular	Irregular.	Regular	Irregular.
- Sinus tachycardia - Paroxysmal supra ventricular tachy cardia (PSVT) - Atrial flutter - Focal atrial tachycardia	- Multifocal atrial tachy-cardia Atrial - Fibrillation	Monomorphic ventricular tachycardia	Polymorphic Ventricular tachy cardia.

↳ Sinus tachycardia.



Regular narrow complex tachyarrythimia with absent P wave → PSVT.



AVNRT AVRT

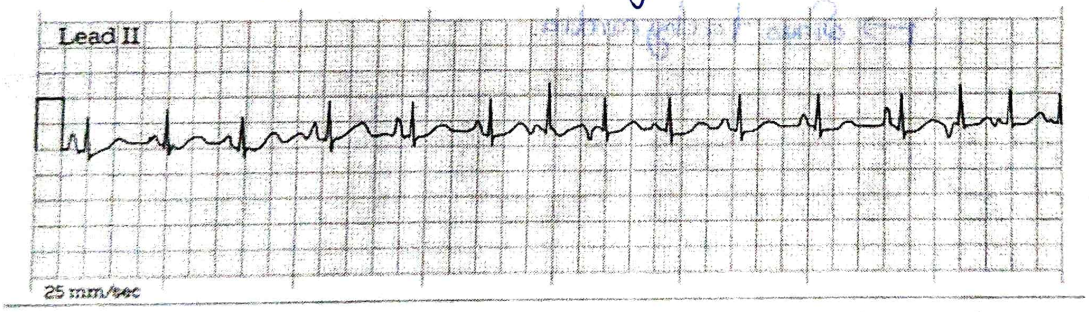
PSVT → hemodynamically unstable
→ stable — vagal maneuver.

line joining centre of Angle of mandible & upper border of thyroid cartilage)

carotid sinus massage 3-10 sec.
(before assure there is no carotid bruit)

- IV adenosine - 6mg I.V 10ml saline push
  12mg I.V 1-2 minute
- either β blocker - I.V metaprolol, non DHP CCB, I.V verapamil, Diltiazem
  Amiodarone.
  all fails
- DC shock

Multifocal Atrial tachycardia (MAT)



↳ MAT



Focal atrial tachycardia

- Single ectopic focus within the atria but outside of the sinus node
- All p waves identical, but with an abnormal morphology.

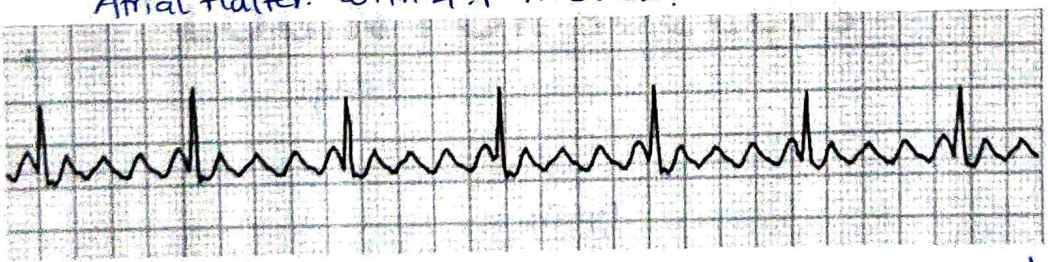
Multifocal atrial tachycardia (COPD)

- Irregularly irregular rhythm
- At least **3 distinct P-wave morphologies** in the same lead

↳ Atrial fibrilation.



Atrial flutter. with 4:1 AV block.



Saw tooth P wave

AV BLOCK 2:1
3:1
4:1

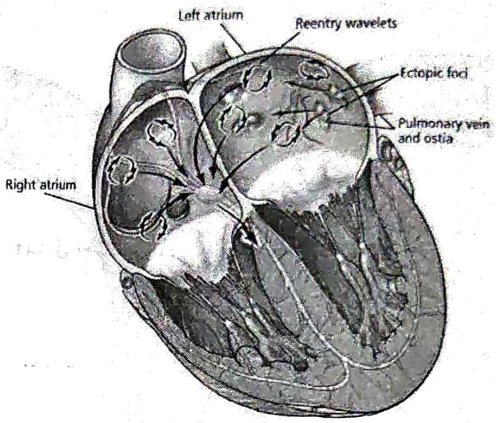
Ventricular rate = $\frac{300}{4}$ = 75

Atrial rate = $\frac{300}{1}$ = 300.

Most common sustained cardiac arrythemias

Atrial fibrillation

- Abnormal bursts of automatic ectopic firing
- Multiple reentry circuits within atria



Types of AF

Paroxysmal	Occur spontaneously and terminate within 7 days
Persistent	Fails to terminate within 7 days
Long standing persisting	Lasting > 1 years

Causes

- Ischemic Heart Disease
- Rheumatic mitral valve disease MS, MR
- Hypertension
- Sinoatrial disease
- Hyperthyroidism
- Obstructive sleep apnea
- Alcohol
- Cardiomyopathies
- Chest infection
- Pulmonary embolism
- Idiopathic

Clinical features

- Palpitations
- Fatigue
- Syncope
- Breathlessness
- Polyuria (dlt ANP)
- Chest pain
- Stroke - embolism

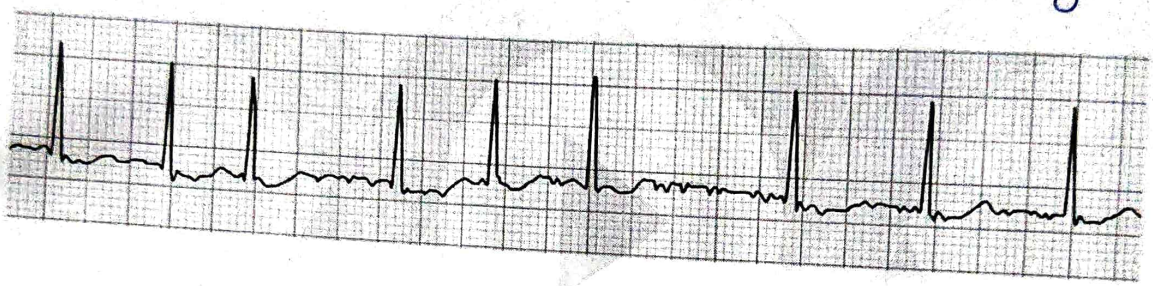
Examination

- Pulse - irregularly irregular
- Pulse-apex deficit ->10/min
- JVP - absent 'a' wave
- S1 - variable intensity

Investigations

- ECG - Narrow complex irregular tachyarrythemia with absent P wave
- Echocardiography → Fibrilating atrium.
  → underlying heart disease.
- Holter monitoring -
- Thyroid Function Test -

Other test
- Blood
- chest x-ray



Acute management

Hemodynamically stable	Hemodynamically unstable
Rate control / Rhythm control	DC shock.
~~Rate control~~ ↑ses diastolic Filling time	Electrical cardioversion / chemical cardioverrion.
Beta blocker -IV non DHP CCB-IV	DC shock ① AF > 48hr ② AF < 48hr
WPW with AF - donot give Beta blocker & non DHP CCB.	- Ibutilide - procainamide - Amiodarone - Flecainide.

① AF > 48hour -
Anticoagulation x3weeks.
DC shock

② AF < 48hour
DC shock

Atrial stunning - anticoagulation. x4 weeks.

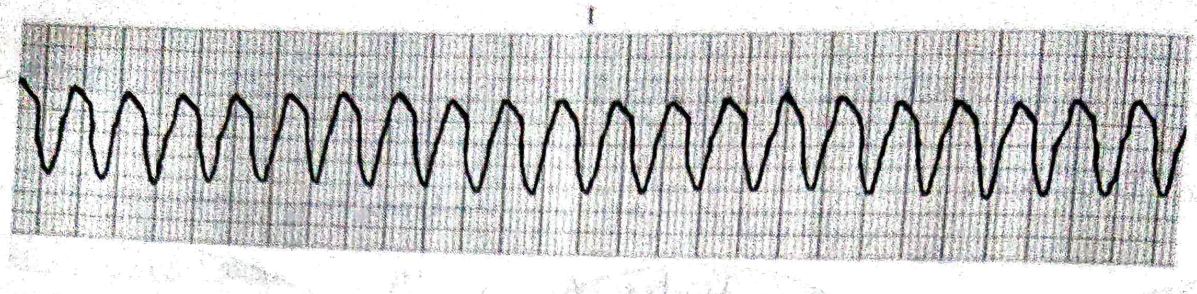
Long term management

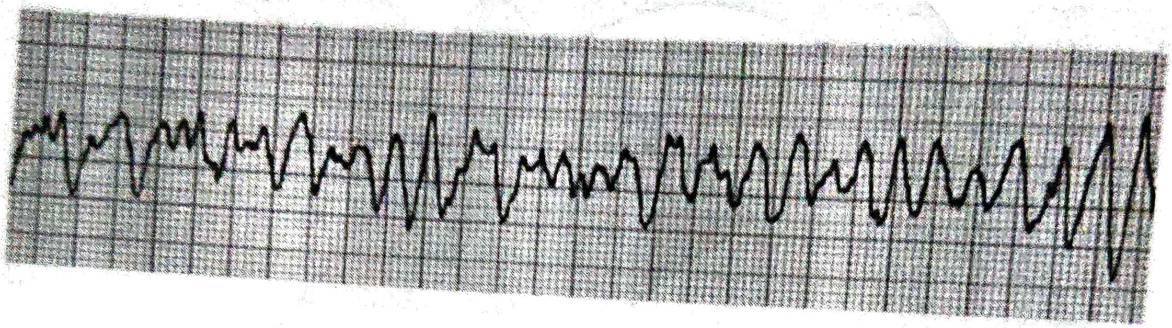
- chronic rate control - Beta blockers, non DHP CCB, Amiodarone
- Prevent Stroke:
  - valuvular AF → life~~time~~long anticoagulation
  - Non valvular AF → CHA_2DS_2 VASc

Atrial Flutter

- Regular atrial activity at ~ 300 bpm
- Saw tooth pattern of p waves
- Ventricular rate is determined by the AV conduction ratio (most commonly 2:1)
- Loss of isoelectric baseline

Treatment: similar to AF





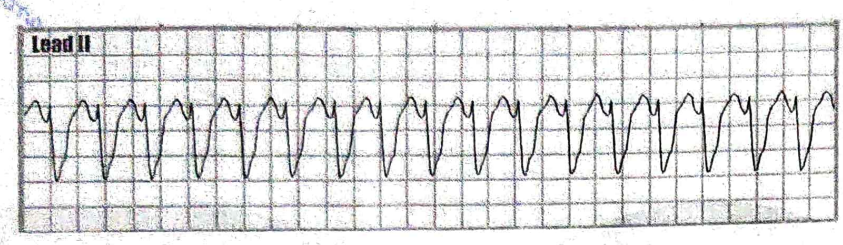
VENTRICULAR TACHYCARDIA

- Three or more consecutive premature ventricular beats at a rate faster than 100 beat/minute

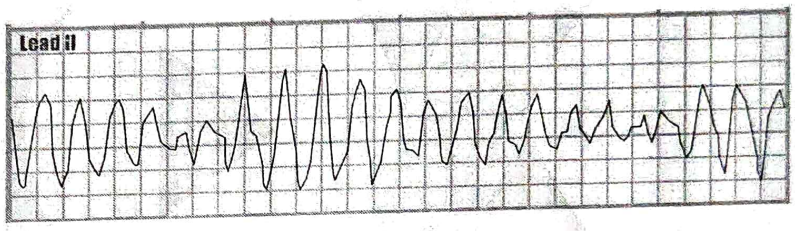
  - Sustained · ≥30sec
  - Nonsustained · <30seconds

Causes: Ischemic heart disease
electrolyte imbalence (hyperkalemia)
cardiomyopathies
chamelopathies (Brugada syndrome)
↳ Na^+ channel.

MONOMORPHIC VT



POLYMORPHIC VT



Management of VT

- Unstable ⇒ DC shock.
- Hemodynamically stable — Amiodarone.

150mg iv bolus over 10minute,
followed by infusion

1mg /min for first 6 hour
Followed by 0.5mg/min for next 18hour.

— fails ⟶ DC shocks

Follow up: lifelong Amiodarone – 100–200mg twice daily.

⊕ pulse → Tachyarrhythmias
↙ Hemodynamically unstable → DC shocks
↘ Stable

Adult Tachycardia With a Pulse Algorithm

Assess appropriateness for clinical condition.
Heart rate typically ≥150/min if tachyarrhythmia.

↓

Identify and treat underlying cause
- Maintain patent airway, assist breathing as necessary
- Oxygen (if hypoxemic)
- Cardiac monitor to identify rhythm; monitor blood pressure and oximetry
- IV access
- 12-lead ECG, if available

↓

Persistent tachyarrhythmia causing:
- Hypotension?
- Acutely altered mental status?
- Signs of shock?
- Ischemic chest discomfort?
- Acute heart failure?

Yes → Synchronized cardioversion
- Consider sedation
- If regular narrow complex, consider adenosine

No ↓

Wide QRS? ≥0.12 second

Yes → Consider
- Adenosine only if regular and monomorphic
- Antiarrhythmic infusion
- Expert consultation

No ↓

- Vagal maneuvers (if regular)
- Adenosine (if regular)
- β-Blocker or calcium channel blocker
- Consider expert consultation

If refractory, consider
- Underlying cause
- Need to increase energy level for next cardioversion
- Addition of anti-arrhythmic drug
- Expert consultation

Doses/Details
Synchronized cardioversion:
Refer to your specific device's recommended energy level to maximize first shock success.
Adenosine IV dose:
First dose: 6 mg rapid IV push; follow with NS flush.
Second dose: 12 mg if required.
Antiarrhythmic Infusions for Stable Wide-QRS Tachycardia
Procainamide IV dose:
20-50 mg/min until arrhythmia suppressed, hypotension ensues, QRS duration increases >50%, or maximum dose 17 mg/kg given.
Maintenance infusion: 1-4 mg/min. Avoid if prolonged QT or CHF.
Amiodarone IV dose:
First dose: 150 mg over 10 minutes. Repeat as needed if VT recurs.
Follow by maintenance infusion of 1 mg/min for first 6 hours.
Sotalol IV dose:
100 mg (1.5 mg/kg) over 5 minutes. Avoid if prolonged QT.

Narrow regular (50-100J)
narrow irregular (120-200J)
wide regular (100J)

Amiodarone - Adenosine

SVT with aberrancy
SVT + RBBB / LBBB

Defibrilator
- Cardioversion → synchronized DC shock → depolarization QRS complex
- Defibrillation → not synchronized → ventricular fibrilation, pulseless VT (indefinite)

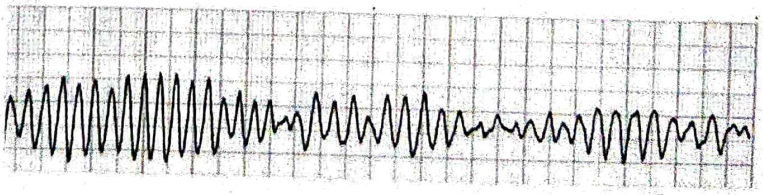
Torsades de Pointes

Polymorphic VT

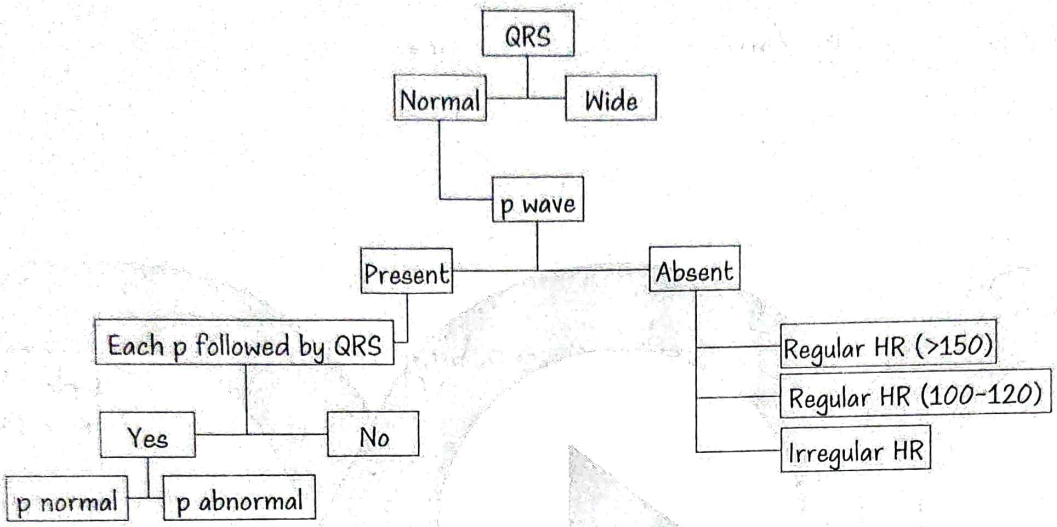
Congenital or acquired prolongation of QT interval

Treatment

1.V mgso4 2g stat
Followed by infusion if required.



Polymorphic VT - oscillatory changes,
- with twisting of axis
- called Torsades de pointes



Sick sinus syndrome
Symptomatic sinus node dysfunction

Presyncope
Syncope
chest pain
altered consorium.
palpitation

BRADYARRHYTHMIAS

SINUS NODE DYSFUNCTION

- Sinus bradycardia
- Sinus pause (arrest)
- Sinoatrial exit block
- Tachycardia - bradycardia syndrome

AV CONDUCTION ABNORMALITIES

- 1st degree
- 2nd degree
- 3rd degree

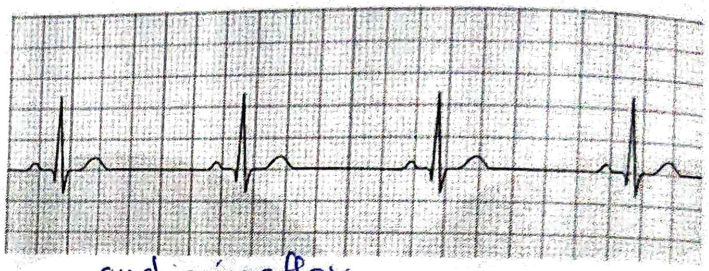
- Idiopathic degenerative fibrosis
- Ischemic
- Cardiomyopathies
- Infiltrative disease - amyloidosis, sarcoidosis, hemochromatosis
- Drugs - Betablockers, Digoxin. CCB - non DHP.

Hypothyroidism, hypokalemia.

cushing's reflex Bradycardia, Hypertension, irregular respiration

Sinus bradycardia

Heart rate less than 60/min with Sinus rhythm



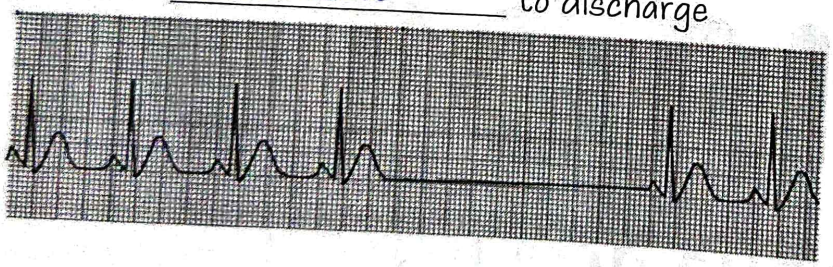
Causes

cushing's reflex

- Athletes
- Sleep
- Raised ICT
- Drugs → Beta blockers, nonDHP, Digoxin CCB.
- Hypothermia
- Hypothyroidism
- Cholestatic jaundice
- Inferior wall Myocardial infarction

Sinus pause or arrest

Failure of sinus node to discharge

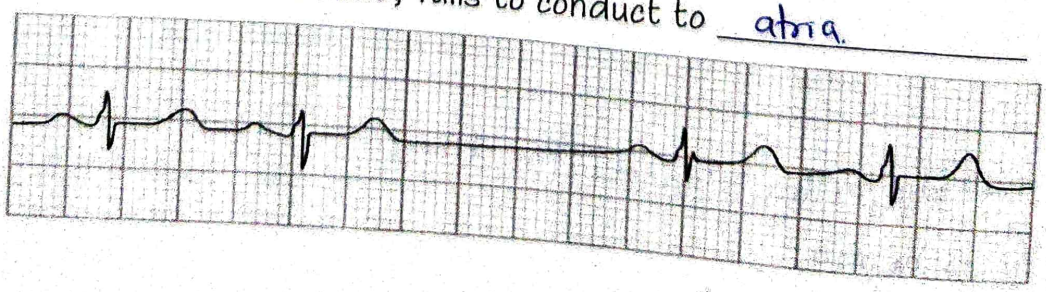


- Pre syncope
- Syncope

} ↓ cerebral perfusion.

Sinoatrial exit block

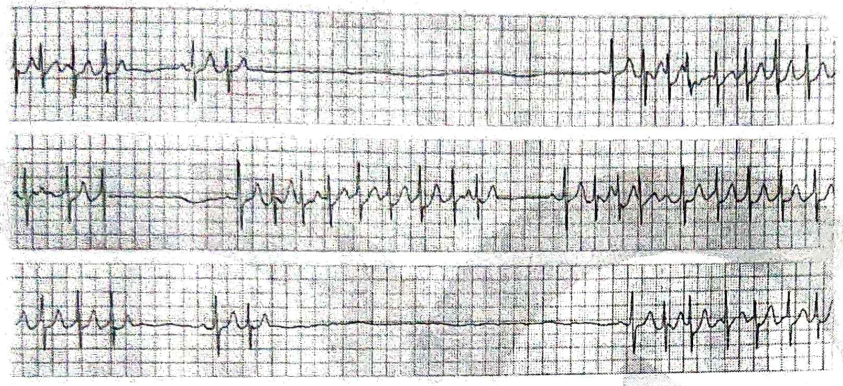
Impulse is formed in sinus node, fails to conduct to atria.



AF, PSVT

Tachycardia Bradycardia syndrome

Episodes of tachycardia and bradycardia



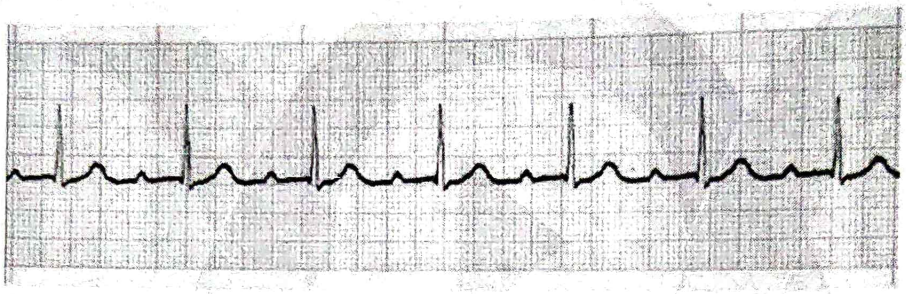
AV BLOCK (HEART BLOCK)

Atrial impulse is conducted with delay or is not conducted at all to the ventricle

REVERSIBLE CAUSES	IRREVERSIBLE CAUSES
Drug induced	Senile degeneration of conducting system
Hyperkalemia	Calcification of aortic valve annulus
Hypermagnesemia	Iatrogenic
Acute MI	Congenital AV block
Lyme carditis	Amyloidosis
Viral myocarditis	Sarcoidosis

1st degree AV block

- All atrial impulses are conducted to ventricles
- PR interval more than 200ms — constant prolongation



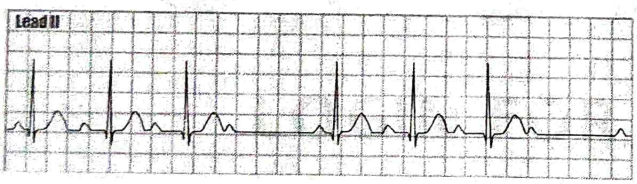
All atrial impulse are not conducted to ventricle (non conducted p wave)

2nd degree AV block

Mobitz type I - Wenkebach phenomenon

Progressive prolongation of PR interval

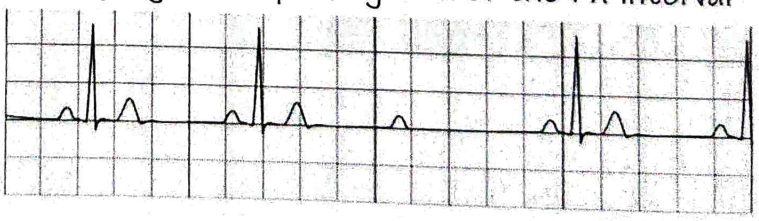
Non-conducted P wave



Mobitz type II

Non-conducted P waves

Without progressive prolongation of the PR interval



* 2:1 AV Block → Pattern of non conducted P wave where every 2nd P wave not conducted.

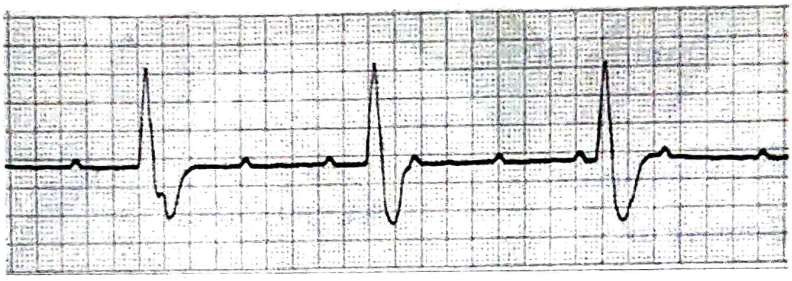
Transcutaneous pacing - pacing patches placed anterior over cardiac apex (cathode) & posteriorly b/w the spine and scapula or above right nipple (anode)

— Delivering pulses of electric current through the patient chest stimulating the heart to contract.

3rd degree AV block - complete Heart Block.

- Atria and ventricles beat independently
- Complete AV dissociation

P-P interval - constant
RR interval - constant
PR interval - varying



Treatment of Bradyarrhythmias

Assess appropriateness for clinical condition
Heart rate typically < 50/min if bradyarrhythmia.

↓

Identify & treat underlying causes

↓

Persistent Bradyarrhythemia cause
- Hypotension - Acutely Altered mental status
- signs of shock - chest discomfort - Acute heart failure

yes

↓ Atrophine — First dose IV dose: 1 mg bolus. Repeat every 3 to 5 minutes

If atrophine ineffective
- Transcutaneous pacing and/or
- Dopamine infusion or
- Epinephrine infusion.

(other modality) consider → - Transvenous pacing : pacing ~~wire~~
- Expert consultation

No → Reversible causes - Rx

↓ monitor and observe.

→ permanent pacemaker
- patient with mobitz type II AV block, third degree AV block

DISEASES OF PERICARDIUM

- Acute pericarditis
- Pericardial effusion & tamponade
- Constrictive pericarditis

ACUTE PERICARDITIS

Etiologies

- Idiopathic
- Inflammatory – SLE
- Infectious – viral
- Drug – drug used in cancer therapy.
- Renal failure
- Acute MI
- Post MI → Dressler's syndrome → 1-3 weeks following MI
- Cancer Radiation induced

A post MI pericarditis → Autoimmune reaction against antigen in the damage pericardium.

- Autoimmune
- Fever
- chest pain
- leucocytosis

Clinical features

- Most common symptom – chest pain
- Nature of chest pain – Pleuritic chest pain (increase on inspiration & coughing)
  ↑ on lying supine
  ↓ on sitting up on leaning forward
- Pathognomonic physical sign – Pericardial rub.

Fall in systolic BP during inspiration ~~dilatation~~
① ↑ pulmonary vascular capacitance
② RV dilatation

Diagnosis and treatment

- ECG - Concave ST segelevation, PR segment depression
- Chest Xray - } To r/o pericardial effusion.
- Echocardiography - }
- **Treatment** - NSAID's steroids } Better avoid Dresseler's syndrom → give Aspirin - interfere with healing of MI
  treat underlying cause.

CARDIAC TAMPONADE

an acute 2° to pericarditis

- Accumulation of pericardial fluid under pressure
- Leads to impaired cardiac filling & hemodynamic compromise

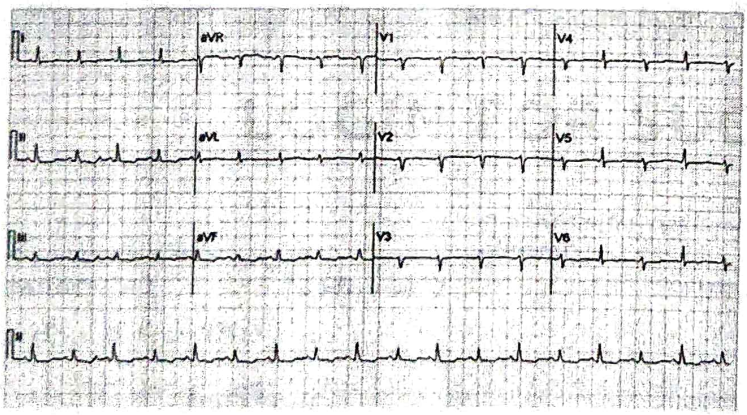
Clinical features

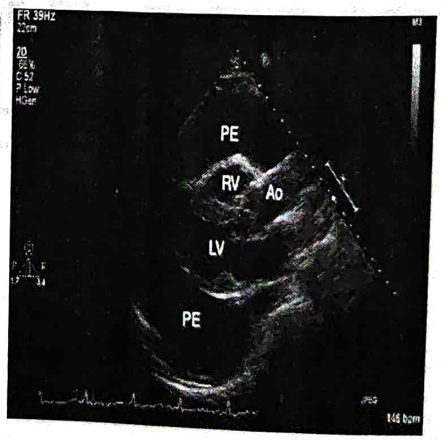
- Symptoms - Dyspnea.
- Pulse - Pulsus paradoxus (exaggerated BP on inspiration > 10mmHg.)
- BP - Hypotension
- JVP - Elevated — prominent X descent (augmented RV contra) - Absent y descent
- Heart sounds - muffled

Hypotension + muffled Heart sounds + Elevated JVP } Beck's triad.

Investigations and treatment

- ECG - Low voltage complexes, electrical alternans
- Chest X-ray - cardiomegaly
- Echo - Effusion.
- **Treatment -**





HEART FAILURE

Biventricular failure

Acute heart failure, chronic
Left sided, Right sided, congestive cardiac failure
systolic heart failure, Diastolic HF
Heart failure with reduced Ejection fraction (HFrEF), HFmrEF, HFpEF
(mild mid range) (preserved)
Ejection fraction ≤40% 41-49% EF ≥ 50%

Etiologies

- Coronary artery disease
- Hypertension
- Regurgitant valvular lesions (AR, MR)
- Obstructive valvular lesions (AS)
- Arrhythmias
- Cor-Pulmonale
- Cardiomyopathies
- Myocarditis
- Pericarditis with effusion
- Collagen vascular disease
- Endocrine conditions - Thyroid abnormalities
- Obstructive sleep apnea
- Fluid overload anemia, fever, thyrotoxicosis, CKD., Beri beri, Pregnancy.

→ Right ventricular dilatation or dysfunction that occur 2° to disease of
- lung parenchyma (COPD)
- interstitium (ILD)
- pulmonary vasculature (pulmonary HTN)
- skeletal system (kyphoscoliosis)

ARDS - Non cardiogenic pulmonary edema

Clinical features

Fatigue
Dyspnea (Pink Frothy sputum + dyspnea -> cardiogenic pulmonary edema)
orthopnea
PND
Swelling of legs

O/E
- Pedal edema
- Elevated JVP
- S3 → HFpEF (Restrictive cardiomyopathy)
- S4
- Rales/crepitation (LVHF)
- Hepatomegaly (congestive hepatomegaly)
- Ascites
-

Investigations

- ECG - Myocardial infarction, Arrythemia.
- Chest X-ray - cardiomegaly, pulmonary venous HTN, pleural effusion, Bat wing sign (Transudative)
- NT-Pro BNP → Prognostic marker (Acute HF)
- Troponin I/T → MI
- Echo - EF (ejection fraction) Systolic HF / Diastolic HF causes
- Holter monitoring - Arrhythemia
- MRI - Amylodosis, Hemochromatosis
- Cardiac CT angio
- Nuclear imaging

Treatment of chronic heart failure

- General measures → salt restriction

- Pharmacologic therapies
- Cardiac Resynchronization Therapy
- Mechanical Circulatory Support Devices
- Cardiac Transplantation

Angiotension Receptor blocker + Neprilysin inhibitor (vasoactive protein)

Pharmacologic therapies

- ARNI - Sacubitril + Valsartan
- ACEI/ARB
- Beta blocker
- Loop diuretic
- Aldosterone antagonist
- Hydralazine
- SGLT2 inhibitor
- Isosorbide dinitrate
- Ivabradine

Four pillars of HFrEF

Initial therapy →
- ARNI/ACEI/ARB — 1st
- + Diuretic — 2nd
- + Beta blocker — MBC

MRA - Spirinolactone (mineralocorticoid receptor)

Metaprolol, Bisoprolol + carvedilol

$SGLT_2$ inhibitor - Dapaglifozin

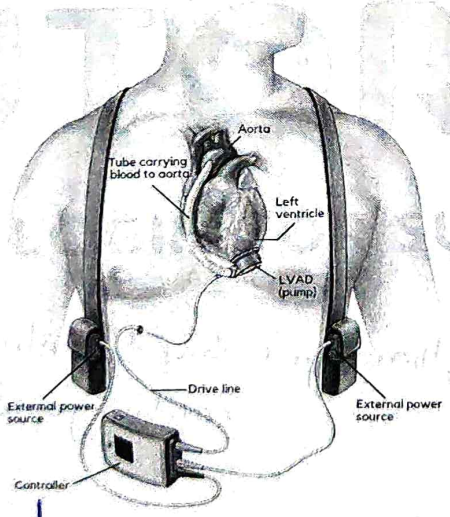
- HFrEF + A.F → Digoxin
- ✓ DCM

HFpEF eg: RCM

$SGLT_2$ inhibitor + Diuretics to treat fluid overload + Treat co morbidities.



Biventricular pacing.





Diastole



Systole

Non pharmacological

ICD - Implantable Cardioverter Defibrillator.

CRT - Cardiac Resynchronization therapy.

VAD - ventricular Assist device,

IABP - Intra aortic Baloon pulsation - during diastole baloon dilated ↑coronary pressure.

Advance HF - Cardiac ↑ transplantation.

Treatment of acute heart failure

Propped up position.

O_2 delivery – Nasal prongs (4%), Mask (60%) → CPAP, Mechanical ventilation (100%)
(Hadson's oxygen mask) NRBM

IV morphine – ↑ venous capacitance, ↓ LA pressure, ↓ anxiety.

IV Diuretic – ⁂ loop diuretics

Vasodilators – Nitroglycerin, Nitroprusside, Nesiritide

Inotropes – Norepinephrine, Dopamine, Dobutamine
(BP കുറവാണെങ്കിൽ)

CARDIOMYOPATHIES

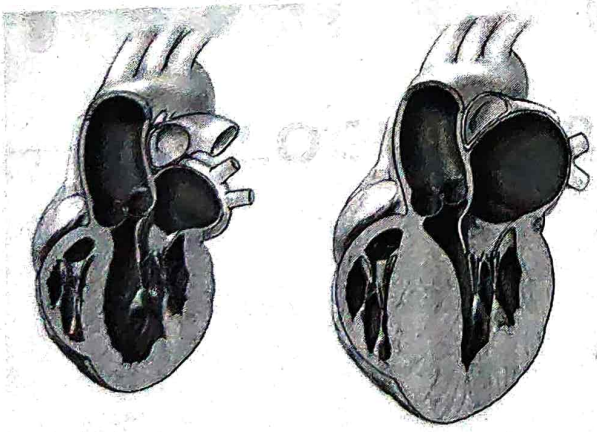
- Hypertrophic Cardiomyopathy
- Dilated Cardiomyopathy
- Restrictive Cardiomyopathy
- Miscellaneous – Takotsubo cardiomyopathy
  ARVC (Arrhythmogenic Right ventricular cardiomyopathy)

HYPERTROPHIC CARDIOMYOPATHY

- Most common genetic cardiac disorder
- Most common cause of sudden death in young adults
- Genetic : Autosomal dominant, Sarcomere genes MYH 7, MYBPC3
- Hypertrophy of ventricles LV & RV, LV >> RV.
  - Asymmetric septal hypertrophy (ASH)
  - Hypertrophic obstruction. cardiomyopathy (obstruction in the Left ventricular outflow tract)
  - Dynamic LVOTO
  - Idiopathic hypertrophic subaortic Stenosis

DYNAMIC LVOTO

Normal HCM



SAM. (systolic anterior motion) during systole anterior motion of mitral leaflet

"Banana shaped Heart"

Clinical features

- Asymptomatic
- D.O.E
- Fatigue
- Palpitations
- Angina
- Pre-syncope
- Syncope
- Arrhythmia
- Sudden Cardiac Death

- Pulse - Pulsus bisferiens
- Apex - Double apical Impulse
- S2 - Paradoxycal A_2 split
- S4 - Present
- Murmurs - MSM over aortic area.
  PSM over apex (Becz MR)

Investigations

- Echocardiography LV>RV, ASH
  Diastolic heart failure.
- ECG
  LVH, T inversion
- Holter monitoring
  (sudden cardiac death)
- Cardiac MRI

Autopsy - (histopathology) myofiber disarry

RISK FACTORS FOR SCD

- VT on Holter monitoring
- Aborted Cardiac arrest
- Maximum LV wall thickness > 30mm
- Unexplained syncope
- Family history of SCD

Treatment

Enhance diastolic filling — Betablocker, non DHP-CCB.

Negative inotropic action — ~~Be~~ Disopyramide

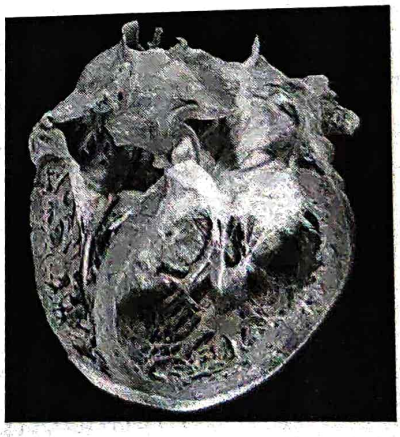
High risk for sudden cardiac death — ICD.

Significant symptoms - despite medical medrcal therapy.
↳ surgical myectomy
Alcohol based septal ablation.

Drugs to be avoided
Drug decreasing preload — Nitrate, diuretics, ACE I/ARB.
Drug decreasing afterload — amlodipine.
Drug increasing myocardial contractility - digoxin.

DILATED CARDIOMYOPATHY

- Ventricular dilatation (Lt > Rt)
- Thinning of myocardial wall
- Flabby, dilated and globular
- Gene mutation Titin



Etiologies

- Myocarditis
  - Bacterial: diphtheria.
  - Viral cause: covid-19, coxsakie.
  - Parasitic: chaga's disease
- Toxins & drugs – chemotherapy, Alcohol
- Nutritional – selenium def., Thiamine.
- Endocrine – Pheochromocytoma, Hyper / Hypothyroidism
- Hemochromatosis
- Sarcoidosis
- Peripartum cardiomyopathy
  - Last trimester – 6 month postpartum.

Clinical features

- Exertional dyspnea
- Palpitations
- Pedal edema
- Ascites

→ HF rEF → Right, left, CHF

- Sudden cardiac death → Arrythemia.
- Pulse - Dicrotic pulse
- Apex - hypokinetic diffuse.
- Cardiomegaly
- S1 - Soft
- S3 - Present
- Murmur - MR – PSM

Investigations

- ECG – non specific
- Chest X-ray – cardiomegally.
- Echocardiography
  - LV > RV
  - systolic HF – Reduced EF
- Cardiac MRI
- Endomyocardial biopsy

Diagnostic dilemma, Hemochromatosis.

Ninjastar nuclear

Treatment

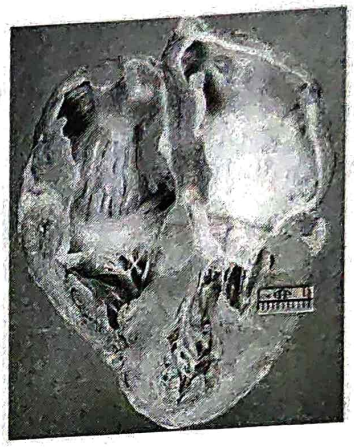
Heartfailure similar with reduced ejection fraction

RESTRICTIVE CARDIOMYOPATHY

- Prominent diastolic dysfunction
- Stiff non-compliant ventricles

Etiologies

- Idiopathic
- Amyloidosis
- Endomyocardial fibrosis — RV EMF (right ventricular)
- Hemochromatosis
- ~~Endomyocardial fibrosis~~ Sarcoidosis



RV > LV.

massive atrial enlargement → 'AF' (Atrial fibrilation)

Clinical features

HFpEF Rt > Lt

O/E - Pedal edema.
JVP ↑
RVS3
RVS4
AFI

Investigations

- ECG – nonspecific
- Echocardiography
  - Diastolic HF
  - EF – (N)

LV wall thickness, cavity dimension (N)

- Cardiac MRI
- Endomyocardial biopsy

Treatment

HFpEF

Broken heart syndrome

TAKOTSUBO CARDIOMYOPATHY

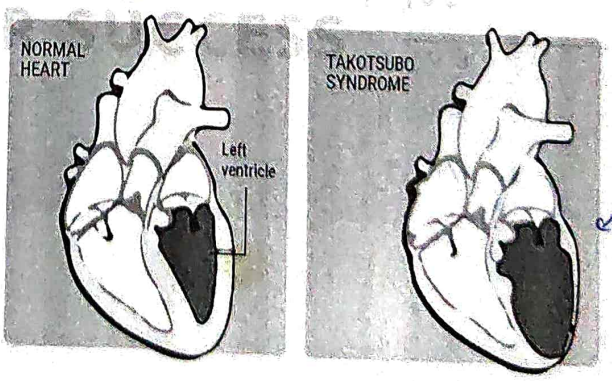
- Intense physical or emotional stress
- Surge of Catecholamine release
- Acute LV systolic failure → pulmonary edema → mimic MI

Investigation

↑ cardiac biomarkers

ECG – ST elevation.

Echo



↙ Basal contraction

↖ Apical Ballooning

Rx

Most are reversible

Supportive management

ARVC

RV muscle – replaced by fat
Autosomal dominant
Mutation of Desmosomal protein – Plakoglobulin.

C/f - RHF
- Arrythemias. → Palpitation, Syncope

Investigation: ECG: Epsilon wave.

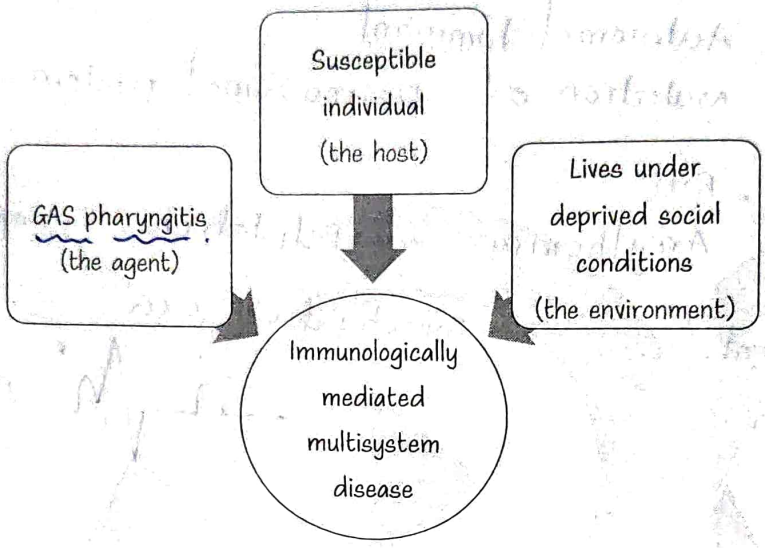


Treatment:
ICD
€

DISEASES OF ENDOCARDIUM

- Acute Rheumatic Fever
- Valvular heart diseases
- Infective endocarditis

ACUTE RHEUMATIC FEVER



Agent

- Throat infection with Group A Bhemolytic streptococci
- Molecular mimicry between streptococcal and human antigens
- Streptococcal group A carbohydrate epitope : N-acetyl B-D glucosamine
- Streptococcal M protein

Pathology

- **Aschoff bodies** - granulomas composed of T lymphocytes, plasma cells, & plump activated macrophages called **Anitschkow cells**
- Chromatin condensed into long, wavy ribbons **(Caterpillar cells)**
- **RHD** - Fibrinoid necrosis in valve cusps and chordae tendineae
- **MacCallum's patch** - mural endocarditis. Left atrium

Clinical features

- Age group - 5-14 years
- Latent period - 2-3 weeks.

ARTHRITIS

- Asymmetric & Migratory polyarthritis
  - sequential involvement of joints (large joints)
  - Jaccoud's arthopathy.

CARDITIS

- Pan carditis

Endocardium		Myocardium			Pericardium		
Murmur	Heart failure	Cardiomegaly	CHF	Heart block	Chest pain	Pericardial friction rub	Pericardial effusion

Mitral valve - Mitral Regurgitation

RHD - Mitral stenosis

- Aortic valve
- Tricuspid valve
- Pulmonary valve.

SYDENHAM CHOREA

- St Vitus dance
- Latent period- 6 - 8 weeks

✓ milk maid grip
✓ Jack in the box phenomenon } motor impersistence
↳ Lizard tongue
Darting tongue

ERYTHEMA MARGINATUM

- Painless, maculopapular, non pruritic rash
- Serpiginous borders with central clearing — Trunk, UL, LL

SUBCUTANEOUS NODULES

- Round, firm, non-tender, mobile nodular lesions
  - extensor aspect over bony prominence

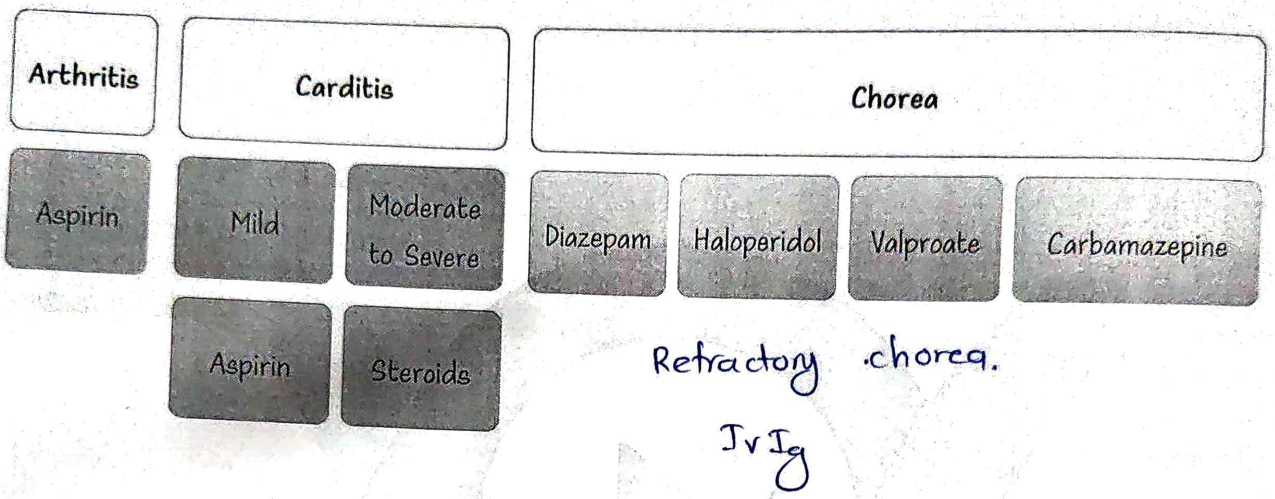
Diagnosis

- Jones criteria
- Evidence of preceding Group A streptococcal infection → ↑ titre of ASO, anti DNAase B
  → Throat swab culture
  ↳ Positive rapid antigen group A streptococcal carbohydrate antigen test.

MAJOR CRITERIA	MINOR CRITERIA
Carditis	Arthralgia
Arthritis	Fever
Chorea	↑ ESR, CRP
Erythema marginatum	Prolonged PR interval
SC Nodules	

Definite ARF – 2 major or
1 major + 2 minor

Treatment



Primary prophylaxis

- Drug of choice : Penicillin
- Oral Penicillin V , IM Benzathine penicillin
- Penicillin allergy : Cephalosporin, Azithromycin, Clarithromycin, Clindamycin

Secondary prophylaxis

- Patients with ARF are at risk of recurrence following GABHS pharyngitis

AHA.

CATEGORY OF PATIENT	DURATION OF PROPHYLAXIS
Rheumatic fever without carditis	For 5 years after the last attack or 21 years of age (whichever is longer)
Rheumatic fever with carditis but no residual valvular disease	For 10 years after the last attack, or 21 years of age (whichever is longer)
Rheumatic fever with persistent valvular disease, evident clinically or on echocardiography	For 10 years after the last attack, or 40 years of age (whichever is longer); sometimes lifelong prophylaxis

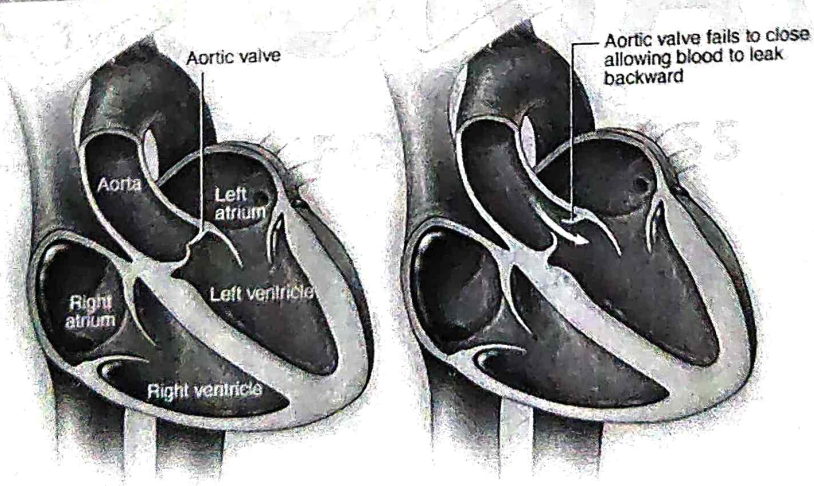
Oral penicillin V - 250 mg twice daily
or
Inj. Benzathine penicillin 1.2 million units every 2-4 weeks.

WHO

CATEGORY OF PATIENT	DURATION OF PROPHYLAXIS
Patient without proven carditis	For 5 years after last attack or until 18 years of age (whichever is longer)
Patient with carditis (mild mitral regurgitation or healed carditis)	For 10 years after last attack or at least until 25 years of age (whichever is longer)
More severe valvular disease	Lifelong
After valve surgery	Lifelong

VALVULAR HEART DISEASES

Aortic Regurgitation



Causes

Disease of aortic valve

- RHD
- Congenital bicuspid aortic valve
- Infective Endocarditis

Dilatation of aortic root

- Syphilis
- Ankylosing Spondylitis
- Aortic dissection
- Marfan syndrome
- Takayasu arteritis

Pathophysiology of chronic AR

Diastolic overfilling of LV

↓

LV dilatation & eccentric hypertrophy — EDV↑

↓

Increase in Systolic BP — baroreceptor → reflex vasodilatation

↓

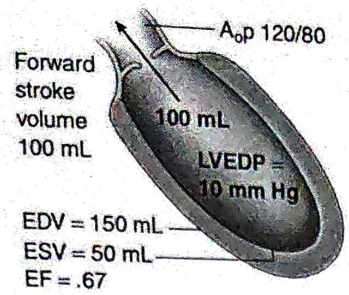
Decreased Diastolic BP

↓

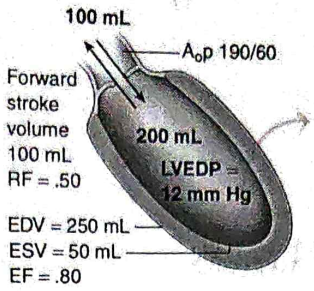
Pulse pressure increased — peripheral runoff

↓

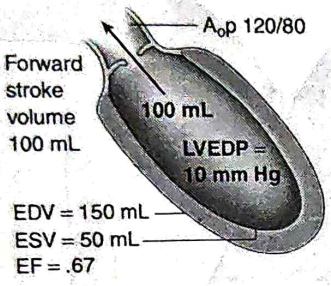
Compensated stage : Volume overload is accommodated



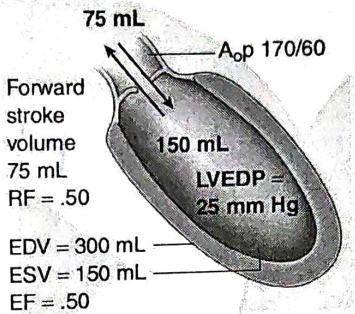
(N)



chronic compensated AR



(N)

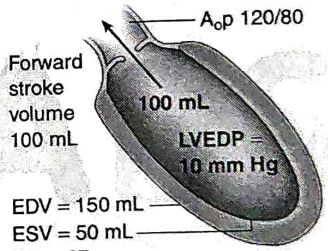


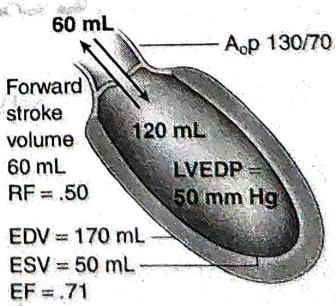
chronic decompensated AR

Pathophysiology of acute AR

- Normal sized left ventricle
- LV is unprepared for the regurgitant volume load
- LV diastolic pressures rise rapidly
- Decreased cardiac output
- Back pressure transmitted to left atrium
- Pulmonary congestion

↓ cardiogenic pulmonary edema





Symptoms >50 years

- Exertional Dyspnea
- Palpitations
- Angina – Nocturnal

Examination findings

- Peripheral signs – Wide pulse pressure.
- Precordial signs

Peripheral signs

- Corrigan pulse - High volume collapsing pulse / waterhammer pulse.
- Dancing carotids -
- Bisferiens pulse - 2 peak in systole
- De Musset sign - bobbing of head with each heartbeat
- Muller sign - Systolic pulsation over Uvula.
- Rosenbach sign - " over liver
- Gerhardt's sign - " over spleen

TUTORIALS

- Hills sign - LLBP − ULBP > 20mmHg. (used to assess severity of AR)
  - mild AR 20–40mmHg
  - mod AR 40–60 mmHg
  - severity AR >60mmHg
- Traube sign - Booming systolic sound over femoral artery.
- Duroziez sign - diastolic murmur on distal femoral artery compression.
  systolic murmur - on proximal femoral (")
- Locomotor brachii -
- Quincke sign - capillary pulsations over nail bed when compression.
- Becker sign - Retinal artey pulsations.
- Landolfi sign - alternate systolic constriction & diastolic dilatation of papil

Precordial signs

- Apex - Forceful apex
  Cardiomegely.
- S1 - soft
- S2 -
  Loud in Root cause
  Soft in valve caus
- S3

- Murmurs

  Early diastolic murmur (EDM) highpitch, best heard with diaphram, Aortic area
  Patient sitting up and leaning Forward.
  Breath held in expiration.

Severity of AR correlate with duration of murmur.

In the aortic Regurgitation, Blood Regurgitate from aorta to LV becz of mitral valve goes to higher position. during ventrical filling a functional MS get a MDM.

Austin flint murmur. - MDM. over apex

Investigations

ECG	LVH
Chest X-ray	Cardiomegaly, aneurysmal dilation of the aorta
Echocardiography with Color Doppler	Cause & severity of AR
Cardiac catheterization	When non-invasive tests are inconclusive

Treatment of acute AR

- Immediate stabilization : IV Diuretics & vasodilators
- Surgery : within 24 hours of diagnosis

Aortic valve replacement → Bioprosthetic
↓ metallic valve → lifelong anticoagulation.

Treatment of chronic AR

- Asymptomatic with normal systolic function : wait & watch.

Indications of Aortic valve replacement

- Symptomatic severe AR (NYHA class II, III and IV)
- Asymptomatic severe AR with LV dysfunction

LVEF ≤ 55%.
or
LV end diastolic dimension >65mm.
or
Lv end systolic dimension >50mm.

Aortic Stenosis

- Valvular AS
- Supravalvular AS – Williams Syndrome.
- Subvalvular AS

- Most common – valvular AS
- Rheumatic fever – RHD. , congenital bicaspid valve.
- LV outflow tract obstruction (LV–aortic pressure gradient ↑)

due to stenosis → create a LV–aortic pressure gradient

↓

LVH – to maintain cardiac output

↓

LV dysfunction

↓

Features of heart failure

Clinical features

- Age group – > 50 years
- Cardinal features
  - exertional dyspnea
  - " chest pain.
  - " syncope
- Heyde syndrome

Aortic stenosis with GI bleeding → ↓ acquired von willibrand disease. → Angiodysplasia

(VWF – multimers normally ↓ become monomers) breakdown into through stenosed valve

- Pulse – Pulsus parvus et tardus
- BP – systolic decapitation.
- Systolic thrill over carotid
- Apex beat – heaving apex
- Systolic thrill over aortic area

S1

- Normal

S2

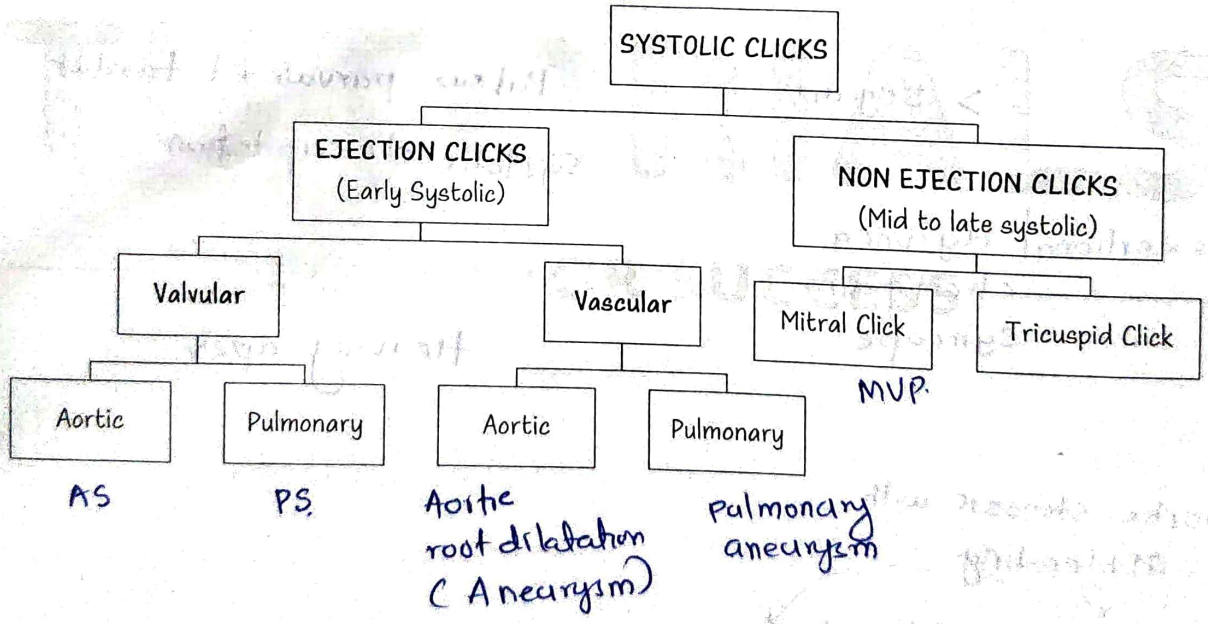
- Abnormal in significant AS
- Paradoxical split of S2
- Single S2

Aortic Ejection Sound

- High frequency clicky early systolic sounds
- Sudden cessation of opening of abnormal aortic valve
- Disappears when valve is calcified and rigid

S3 only decompensated aortic stenosis

LVS4 present.



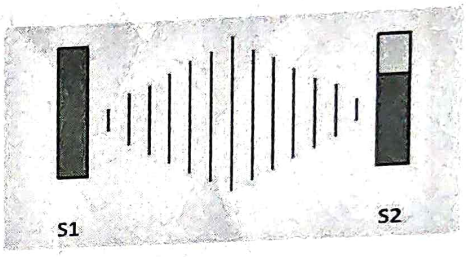
Gallavardin phenomenon → if it radiated to apex

→ normaly radiated to carotid.

Murmur of Aortic Stenosis

high pitched
draphram of rthet.
sitting up & leaning forward

- Ejection (mid) systolic murmur in aortic area
- Starts shortly after S_1
- Increases in intensity & reaches peak at mid systole
- Ends before S_2
- crescendo - decrescendo in configuration



Investigations

- ECG - LVH
- Chest X-ray - mild cardiomegaly
- Echocardiography - assessing EF, LVH, valve area, calcification & thickening
- Cardiac catheterization - only when non invasive test are inconclusive.

Medical management

Diuretics
ACE inhibitors
} decompensated stage.

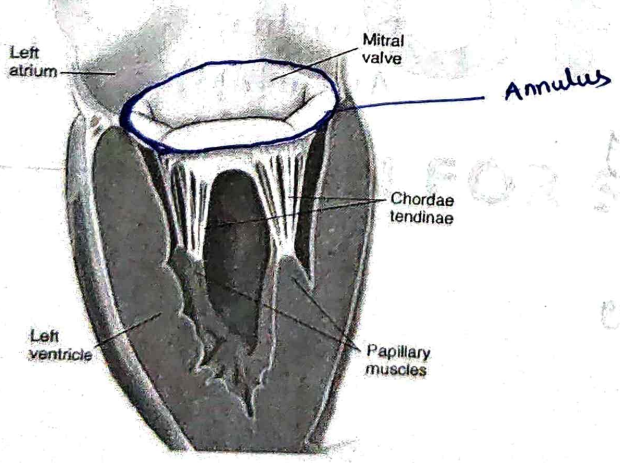
Surgical management

- Aortic valve replacement
- Newer procedure - TAVI - Trans catheter Aortic valve implantation.
  or
  TAVR
- Indications

Asymptomatic : Severe AS with LV systolic dysfunction (EF<50%)
Transvalvular pressure gradient > 60 mmHg
Abnormal exercise treadmill test

Symptomatic AS

MITRAL VALVE APPARATUS



Mitral Stenosis

Normal mitral valve area in adults - 4-6 cm^2

Mild MS - 2-4 cm^2

Severe MS - < 1.5 cm^2

critical MS < 1 cm^2

Causes

mlc
- Rheumatic heart disease
- Congenital MS
- Mitral annular calcification extending to the leaflets
- Cortriatriatum
- Left atrial myxoma

Pathophysiology

- Increase LA pressure
- Pulmonary Hypertension
- Decrease LV filling } severe mitral stenosis
- Low cardiac output

Triggers

Exercise, Anemia, Pregnancy, Thyrotoxicosis, Infections, Atrial Fibrillation

(compensatory response ↑ Intravascular volume & blood)

decompensated → sign of heart failure

Clinical features

- Age group - 20-40years
- Exertional Dyspnea
- Hemoptysis - Bronchial rupture - vein
- Palpitations - AF
- Pulmonary edema
- Right heart failure dlt Pulmonary HTN
- Ortner's syndrome - hoarseness of voice (RLN - compression)
- Mitral facies (rare) - low cardiac output

Examination findings

- Pulse - AF
- BP - Normal bp to elevated.
- JVP - elevated. - Absent 'a' wave. - Giant 'a' wave.
- Apex → Tapping apex
- LPH (left parasternal heave)
- Palpable P2 (dlt PAH)
- Loud S1
- Loud P2 → (PAH)
- MDM
- Opening snap
- RVS4

(may not indicate severity of MS)

- Mechanism of Loud S1 - Longer distance for valve closure.
- Soft S1 - degenerated & calcific MS, Associated MR
- Variable S1 - Atrial fibrilation.
- Characteristics of murmur - Low pitched rough rumbling MDM
  Best heard over apex. with bell of stethescope with patient in left lateral position.
  Presystolic Accentuation. (AF absent)
- Mechanism of Opening snap - snaping sound is heard dlt opening of mitral valve.
  Forceful opening of mitral valve across a pressure gradient.

A_2O_S gap indirectly proportional to severity of MS

Investigations

- ECG - (AF, P-mitrale / RVH. >120ms
- Echocardiography - Dilated LA
  Mitral valve area
  valve degeneration, calcification.
- Chest Xray



Straightening of left heart border
(dlt LA appandage enlargement)

- double density sign (Carina on atria)
- elevation of left main bronchous
- splaying of carina



Barium swallow

Posterior displacement of narrowed esophagus

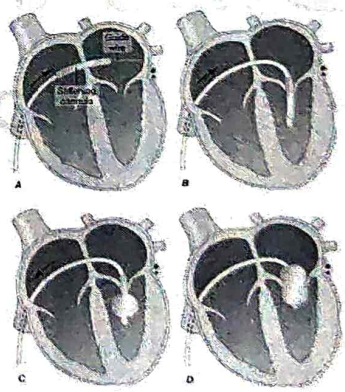
↓

Radiological Finding of Pulmonary HTN
- upper lobe diversion (cephalisation)
- Prominant pulmonary artery
- Kerley B lines (Interstitial edema)
- Bat wing opacities

Treatment

Medical management
- Heart failure, AF

Intervention.



- PMBC or PMBV
- MVR mitral valve replacement

Per cutaneous Baloon
commessotomy
Valvaloplasty

Indications for intervention:
Symptoms & mitral valve orifice area ≤ 1.5cm²
↓
NYHA II, III & IV

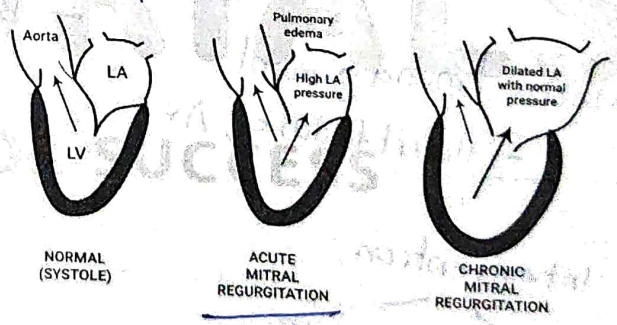
Mitral Regurgitation

- Acute MR — IE, MI
- Chronic MR
  - **Primary (Organic/Degenerative) MR** (Leaflets and/or chordae tendineae dysfunction) — RHD
  - **Secondary (Functional) MR** Leaflets and chordae tendineae are usually normal (Disease of Left ventricle or mitral annulus) — Dilated Cardiomyopathy

Pathophysiology

compensated MR state

- Diastolic overload of LV
- LVH → eccentric → down & out apex beat
- LV dysfunction
- Left heart failure
- LA enlargement
- Pulmonary hypertension
- Right heart failure



I.E ↓

Rapid ↑ in LA pressure & pulmonary edema

(murmur : early systolic)

Clinical findings

- Symptoms — Dyspnea (on exertion)
  Palpitation
- Pulse — high volume pseudo collapsing pulse
  AF
- BP — Normal
- JVP — PAH - RVH - RVF → ↑ JVP
  Cannon aware / Absent a wave
- Apex — Hyperdynamic or forceful apex

Auscultatory findings

- S1 — soft
- S2 — wide split S_2 (A_2 early) because effective stroke volume less
  loud P_2
- S3 — present
- Murmur — Pan systolic murmur
  — Holosystolic murmur
  high pitched, best heard at apex with diaphragm with patient in left lateral position radiates to left axilla.

Diagnosis & treatment

- ECG — P mitrale, AF, LVH
  RVH (when PAH)
- Chest Xray — LA enlargement + LV enlargement
  cardiomegaly
  ± Pulmonary hypertension
- Echocardiography — Dilated LA & LV, Regurgitation jet, cause and severity of MR
- Medical management — Diuretics, ACE inhibitors, manage AF
- Indications for MVR/repair — Symptoms or progressive LV dysfunction (NYHA II, III, IV)
  — LVEF ≤ 60%; End systolic LV diameter ≥ 40mm

Mitral Valve Prolapse

Floppy valve syndrome
Barlow syndrom
Billowing mitral leaflet syndrome

- Most common cause of Primary mitral regurgitation and systolic click murmar syndrome.
- Myxomatous degeneration of Mitral valve leaflets
- Thick elongated mitral valve which has a tendency to prolapse
- Associated conditions - Marfans syndrome
  Osteogenesis Imperfecta.
  Ehlers Danlos Syndrome

Clinical findings

- Age group - 15- 30 year
- Most patients are asymptomatic, vague - chestpain palpitation.

Auscultation

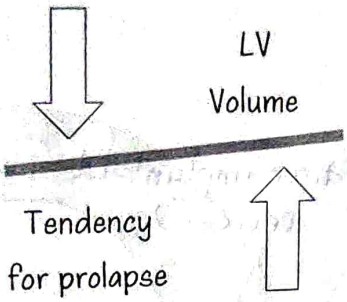
- Most common auscultatory feature - mid or late systolic click

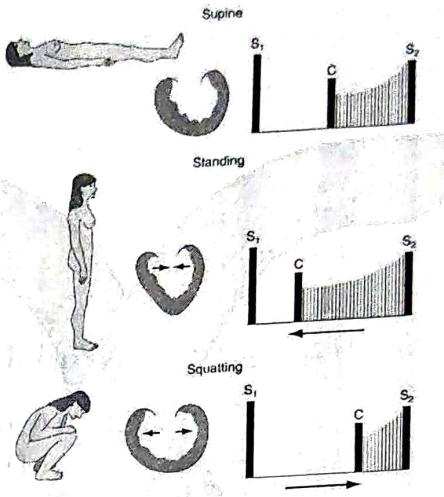
Mechanism - During systole, sudden tensing & snapping of the elongated chordae tendinea and the prolapsing leaflets

↓ LV volume (standing & valsalva)
- exaggeration of tendancy to prolapse
- click & murmur more close to S_1

↑ LV volume (squatting & isometric exercise)
- ↓ in tendancy to prolapse.
- click & murmur close to S_2.

Dynamic auscultation in MVP





Any condition that ↓ LV volume will increase the tendency to prolapse.

Diagnosis and treatment

I.O.C - Echo

ECG - non specific changes.

Treatment: chest pain, palpitation - Bblocker.

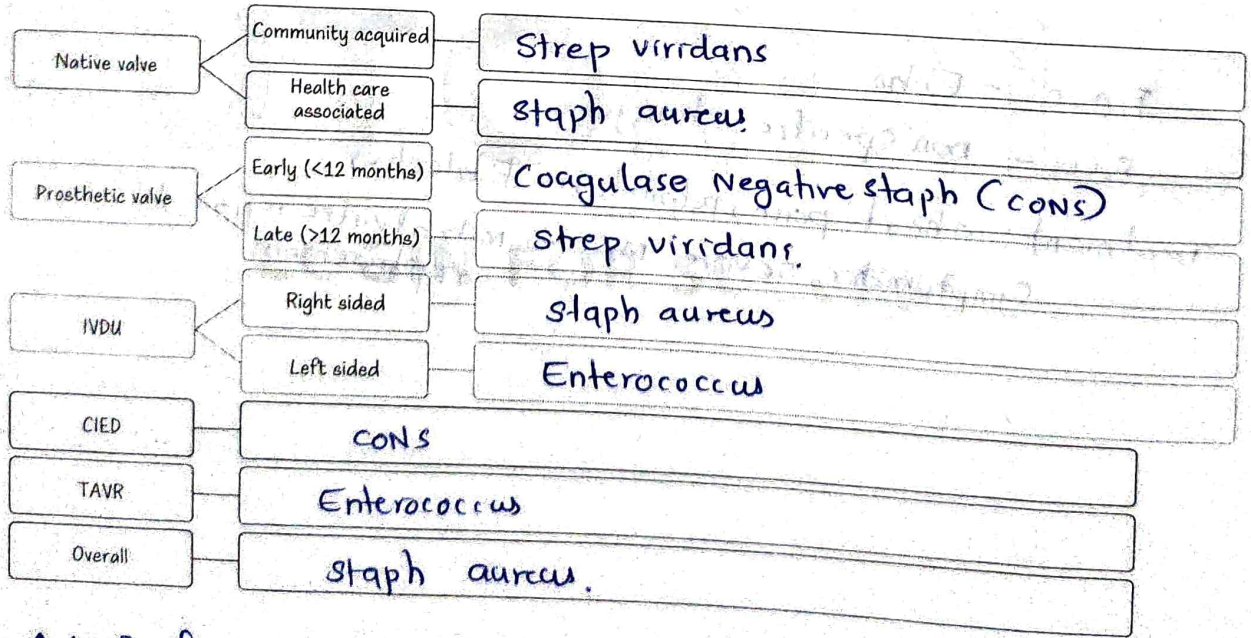
Symptomatic severe MR. - mitral valve repair / replacement

INFECTIVE ENDOCARDITIS

- Infection involving endocardial surface of heart
  - valvular endocardium
  - mural endocardium
  - congenital heart defect — VSD
  - indwelling cardiac devices - CIED (cardiac implantable electronic devices)

- Prototype lesion - Vegetation
  - Fibrin
  - Inflammatory cells
  - Platelets
  - Microorganism

Microbiology



Atypical Organsim: HACEK, Coxiella, Brucella, Bartonella, Hemophillus, Aggregatibacter, Cardiobacterium, T. whippeli
Eikenella, kingella

Clinical features

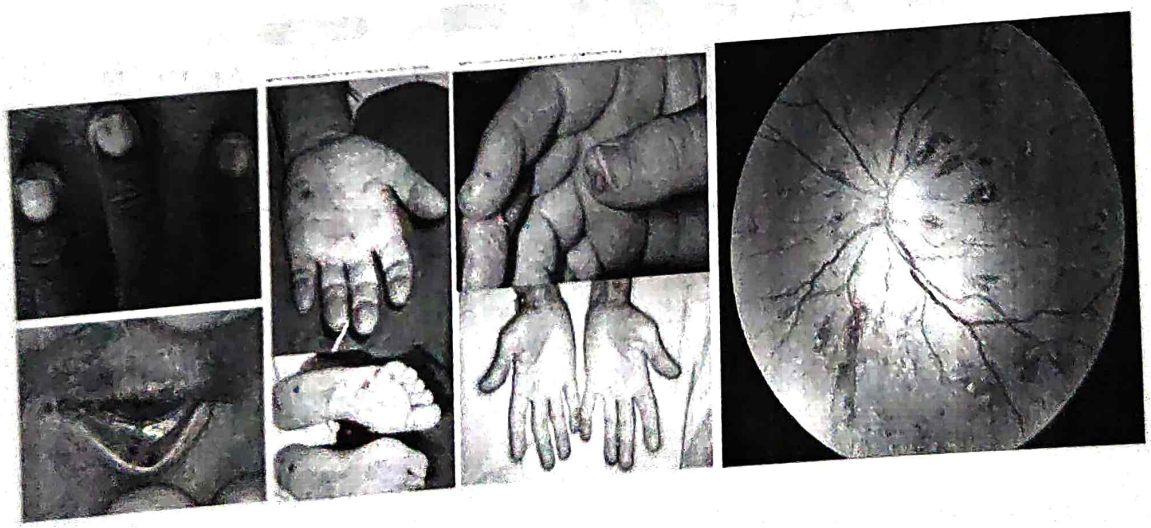
Prolonged

- Fever
- Chills & sweats
- Myalgia, arthralgia
- Heart murmur
- New or worsened regurgitant murmur
- Splenomegaly
- Clubbing
- Neurologic manifestations → stroke
- Peripheral manifestations
  - Osler's nodes, Subungual hemorrhages, Janeway lesions, Roth spots

Osler's nodes: Painful nodes over pulp of toes and fingers

Janeway lesions: Painless hemorrhagic lesion over palms and soles

Roth spots: pale centres



Investigations

- Anemia
- Leukocytosis
- Microscopic hematuria
- Elevated ESR
- Elevated CRP
- Decreased serum complement

- Blood culture – 3set of sample
  each set having → 1 aerobic bottle – 10ml
  \ 1 anerobic bottle – 10ml
  24 hours minimum of 2 hour gap b/w each set of collection
- Echocardiography

Diagnostic criteria – 2023 Duke Criteria

MAJOR CRITERIA

- **Microbiologic**
  - +ve blood cultures → Typical – 2, Atypical – 3
  - +ve lab tests – PCR – coxella, bartonella
- **Imaging**
  - ECHO &/ CT
  - (18F)FDG PET/CT
- **Surgical**
  - Direct inspection during heart surgery

MINOR CRITERIA

- **Predisposition** → AR, MR, MVP with MR, VSD more MS, ASD
- **Fever**
- **Vascular phenomena** → conjunctival hemorrhage, janeway, septic pulmonary infarct, lesion, mycotic aneurysm, roth spots
- **Immunologic phenomena** → oslers node, glomerular nephritis
- **Microbiologic**
- **Imaging**
- **Physical examination criteria**

eg: New MR murmur

Definite IE – 2 major or
1 major + 3 minor.
or 5 minor.

Parenteral + High dose + Bactericidal
+ Prolonged duration.

6 weeks

Empiric antibiotic therapy

- Native valve endocarditis

(Days-6week) Acute - Vancomycin + cefipime / Gentamycin.

(6week-3month) Subacute - Vancomycin + ceftriaxone.

- Prosthetic valve endocarditis

< 1 year - vancomycin + cefipime + Gentamicin.

Late PVE - similar to NVE

CIED - antibiotic + if possible remove device

surgery - Refractory heart failure,
valvular abscess

High risk cardiac lesions
Prophylaxis before dental procedures

- Prosthetic heart valves or material
- Left ventricular assist devices or implantable heart
- Prior endocarditis
- Unrepaired cyanotic congenital heart disease
- Completely repaired congenital heart defects during the 6 months after repair
- Repaired congenital heart disease with residual defects adjacent to prosthetic material
- Surgical or transcatheter pulmonary artery valve or conduit placement
- Valvulopathy developing after cardiac transplantation

Antibiotic Regimens for IE Prophylaxis

- Oral regimen : Amoxicillin 2gm Orally 1hour before procedure.

- Inability to take oral medication

Ampicillin 2g iv 1 hour before procedure.

Penicillin allergy → Azithromycin / Doxy Ceftriaxone.

Aortic dissection

Standford
A - involves Ascending aorta
B - involve transverse/descending only.

DeBakey
Type I
Type II
Type III

DISEASES OF AORTA

Aortic Dissection

Risk factors

Connective tissue disease - marfans osteogenesis imperfecta
Bicuspid aortic valve
Pregnancy
Hypertension

- Tear in the intima
  Blood dissect into media
- Sudden onset tearing or ripping type of pain
  m.c - Right lateral wall of ascending aorta
  6th - 7th decade ♂ M > F
  Diminshed / unequal pulses. ↑BP or ↓BP ↑sod risk of stroke, MI

Ascending aortic dissection	Anterior chest pain
Descending aortic dissection	interscapular pain

Diagnosis & Treatment

- Investigations - Stable patient : CT/MRI with contrast.
  unstable - Echocardiography
- Type A dissection - urgent surgical intervention
  diseased part of aorta replaced by prosthetic graft
- Type B dissection - without organ mal perfusion - Aggressive BP control (Target SBP - 100-120mmHg) - Sodium Nitroprusside + Betablocker/CCB.
  with organ mal perfusion - Surgical intervention

Hydralazine never used.

PULMONARY HYPERTENSION

- Progressive increase in total pulmonary vascular resistance
- Mean pulmonary artery pressure > 20mmHg

Etiologies

- Idiopathic - BMPR2 genemutation
- Connective tissue disease → SLE, Systemic sclerosis
- Left heart disease → M.S
- Lung disease → COPD, ILD
- Chronic thromboembolism
  CTEPH
  (chronic thrombo embolic pul. HTN)

Miscellaneous:
Sickle cell anemia
Sarcoidosis

Clinical features

Symptoms Dyspnea on exertion
Fatigue, chest pain, presyncope
syncope
+ symptoms of underlying disorder

Signs

RHF:
- Hepatomegaly
- Pedal edema
- Ascitis
- Elevated JVP

- Left parasternal heave
  ↳ RVH

- Palpable P2
- Loud P2
- RVS3
- Wide split S2
- PSM of TR

TENSION

Diagnosis & treatment

- ECG → RVH
  → RA enlargement
- chest x-ray - enlarged central P.A
- Echocardiography
  RVH, RA enlargement
- Cardiac catheterization

CT chest

ANA

Drugs used in treatment

- Endothelin receptor antagonist - Bosentan, Ambrisentan
- PDE-5 inhibitors - Sildenafil, Tadalafil
- Prostacyclin analogs - Epoprostenol, Iloprost, Treprostinil
- Soluble guanylate cyclase stimulator - Riociguat
- Prostacyclin receptor agonist - Selexipag.

Interventional therapy

Severe PAH and intractable syncope

- Atrial septostomy

  Unloads the RV, improves left heart preload

- Other option - Heart lung transplantation.