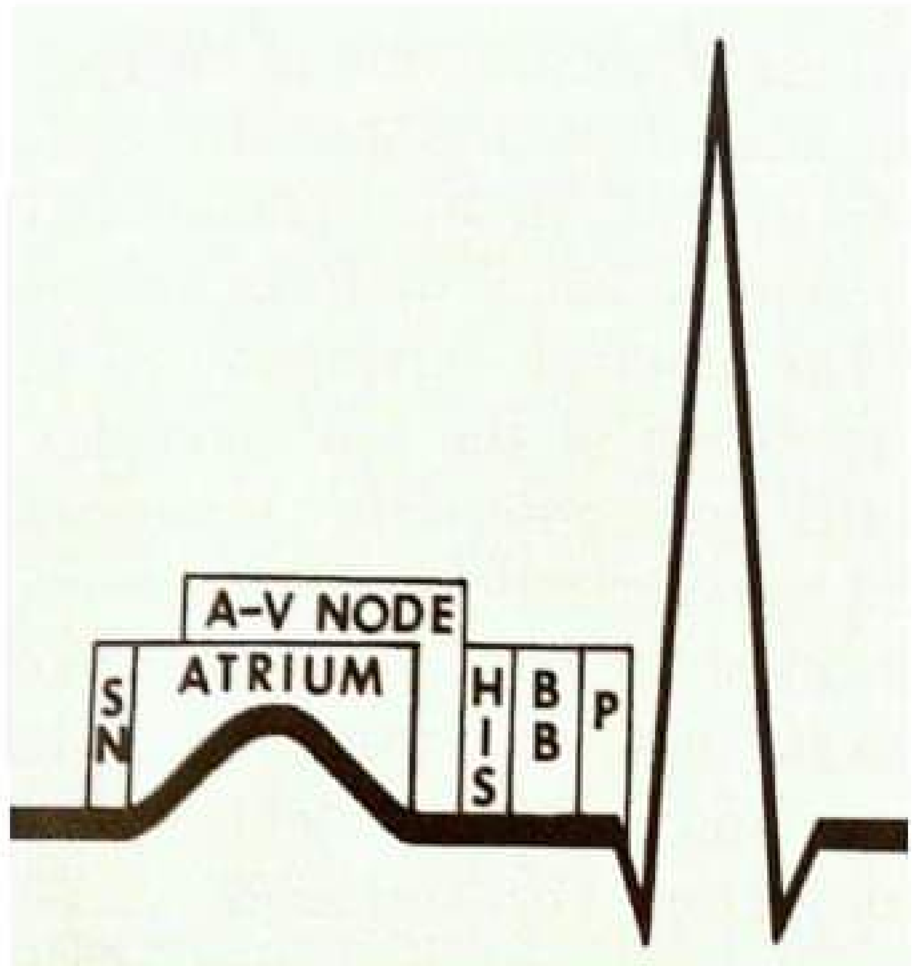
Basic Dysrhythmias

Fb/Nurse Info

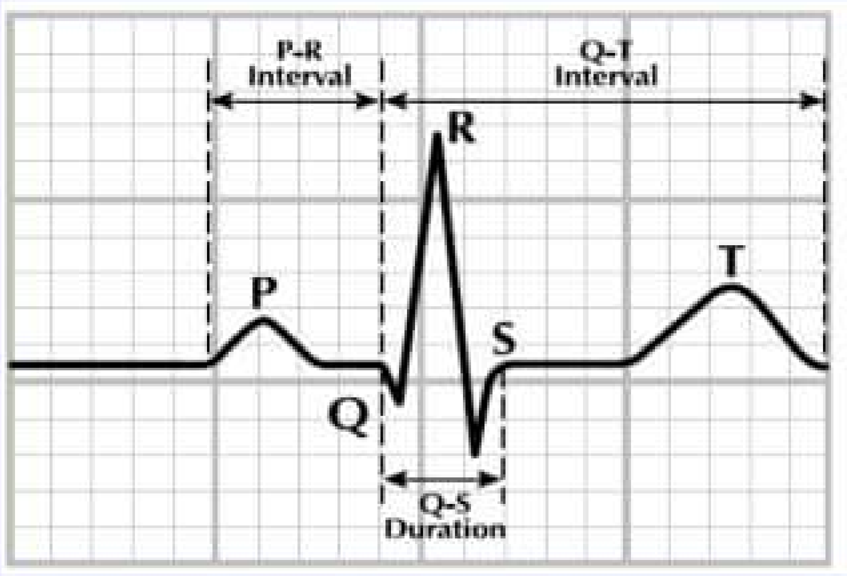
PR interval derivation

- Measured from beginning of P to beginning of QRS – more properly "PQ"
- From exiting SA node to leaving terminal perkinjie system
- Normal .12-.20 (3-5 small boxes)
- Allows atrial-assisted filling of ventricles ("timing belt of the heart")



PR INTERVAL

- Are all the PRI 's constant?
- Is the PRI measurement within normal range?
- If the PRI varies, is there a pattern to the changing measurements?



How to analyze a rhythm strip ?

- P wave : is P wave normal ?
- PR interval : is PR interval normal ?
- QRS complex : is QRS normal ?
- P-QRS relation : what is the relation between P wave and QRS ?
- Rate : what is the rate ?

Introduction to ECG Rhythm Analysis

- The analysis should begin with identifying three categories

1. **Impulse origin**
2. **Rate**
3. **Regularity**

Introduction to ECG Rhythm Analysis

1- impulse origin

(i.e., where is the abnormal rhythm coming from?)

- *Sinus Node (e.g., sinus tachycardia)*
- *Atria (e.g., PAC)*
- *AV junction (e.g., junctional escape rhythm)*
- *Ventricles (e.g., PVC)*

Introduction to ECG Rhythm Analysis

2-Rate

(i.e., relative to the "expected rate" for that pacemaker location)

- Accelerated - faster than expected (e.g., accelerated junctional rhythm @ 75bpm)
- Slower than expected (e.g., marked sinus bradycardia @ 40bpm)
- Normal (e.g., junctional escape rhythm)

- **N.B. expected rate** SA Node 60 - 100 beats/minute.

SA Node	60 - 100 beats/minute.
AV Node	40 - 60 beats/minute.
Ventricular cells	20 - 45 bpm.

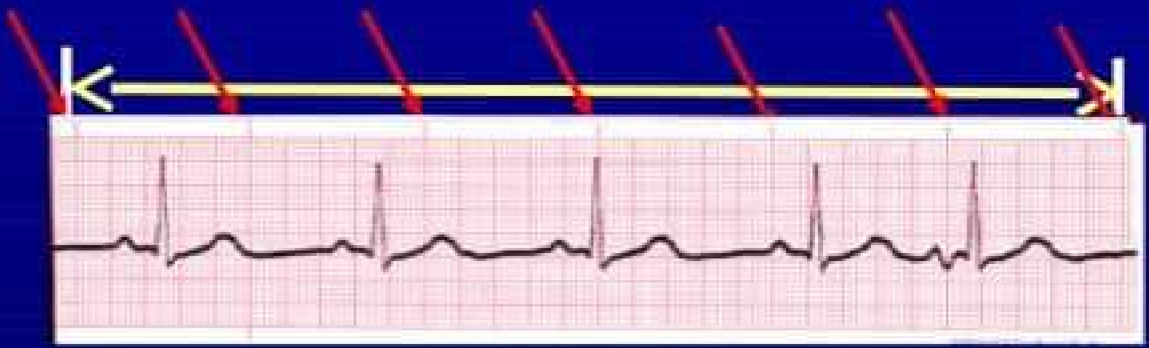
Calculate Rate

- Option 1(for regular and irregular rhythm)
  - Count the # of R waves in a 6 second rhythm strip, then multiply by 10.

Interpretation?

7 x 10 = 70 bpm

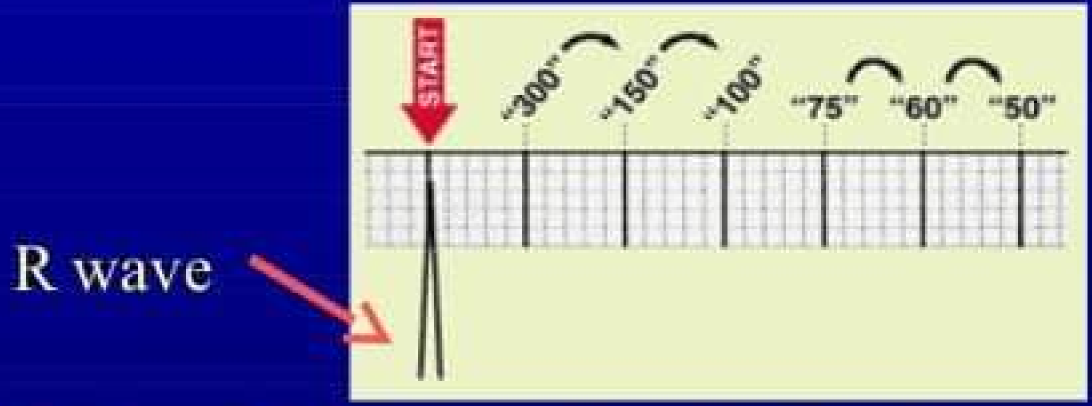
Calculate Rate



- Option 1(for regular and irregular rhythm)
  - Count the # of R waves in a 6 second rhythm strip, then multiply by 10.

Interpretation?

5 x 10 = 50 bpm



Option 2 (for regular rhythm)

- Find a R wave that lands on a bold line.
- Count the # of large boxes to the next R wave. Then calculate the rate from this equation

- OR HR = 300 / No of Large squares in RR interval

$$HR = \frac{300}{\text{No of Large squares in RR interval}}$$

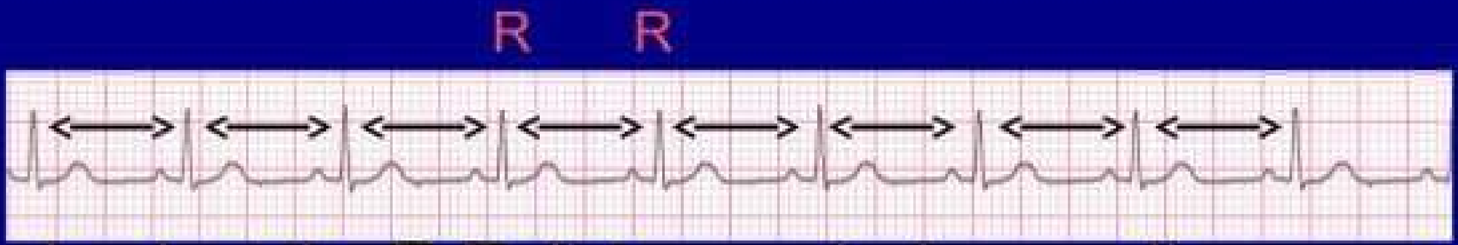
Option 2 (for regular rhythm) more accurate

- Find a R wave that lands on a bold line.
- Count the # of large boxes to the next R wave. Then calculate the rate from this equation

$$\text{OR HR} = \frac{1500}{\text{No of small squares in RR interval}}$$

In this ECG HR = 1500/16 = 93

Regularity of ventricular or atrial–3 response



- Look at the R-R distances (using a caliper or markings on a pen or paper).
- Regular (are they equidistant apart)? Occasionally irregular? Regularly irregular? Irregularly irregular?

Regular (e.g., PSVT)

Regular irregularity (e.g., ventricular bigeminy)

Irregular irregularity (e.g., atrial fibrillation or MAT)

Sinus pause

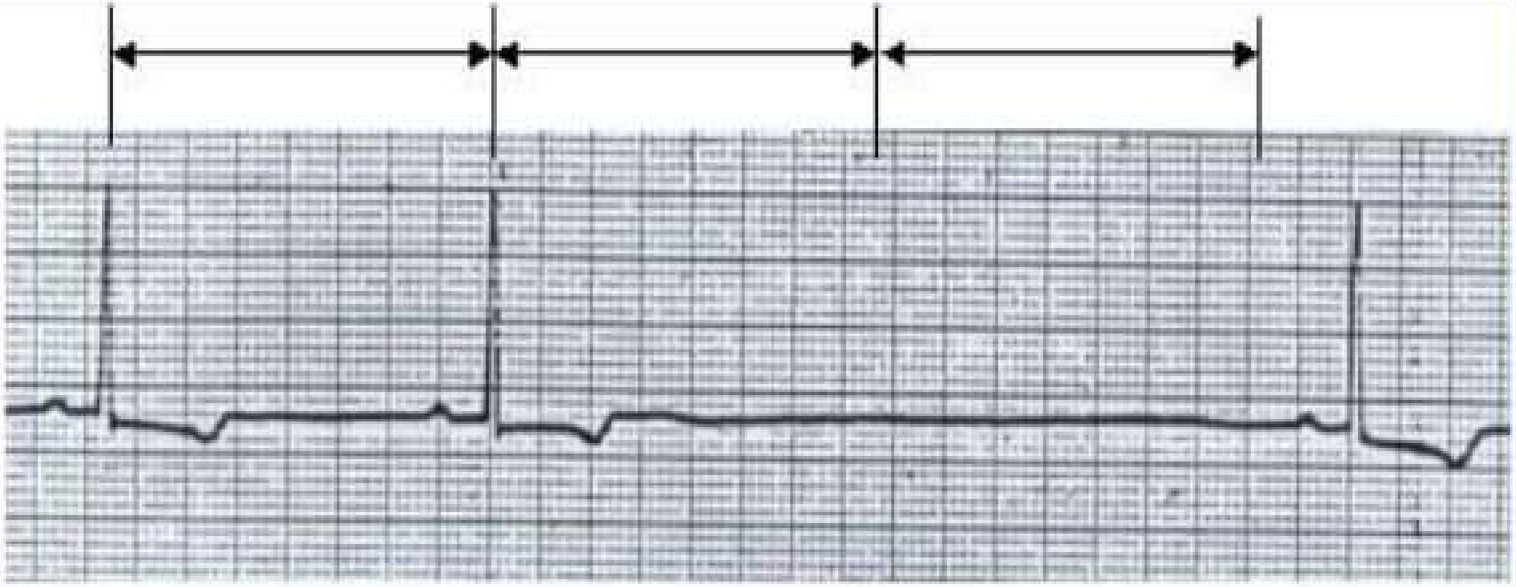
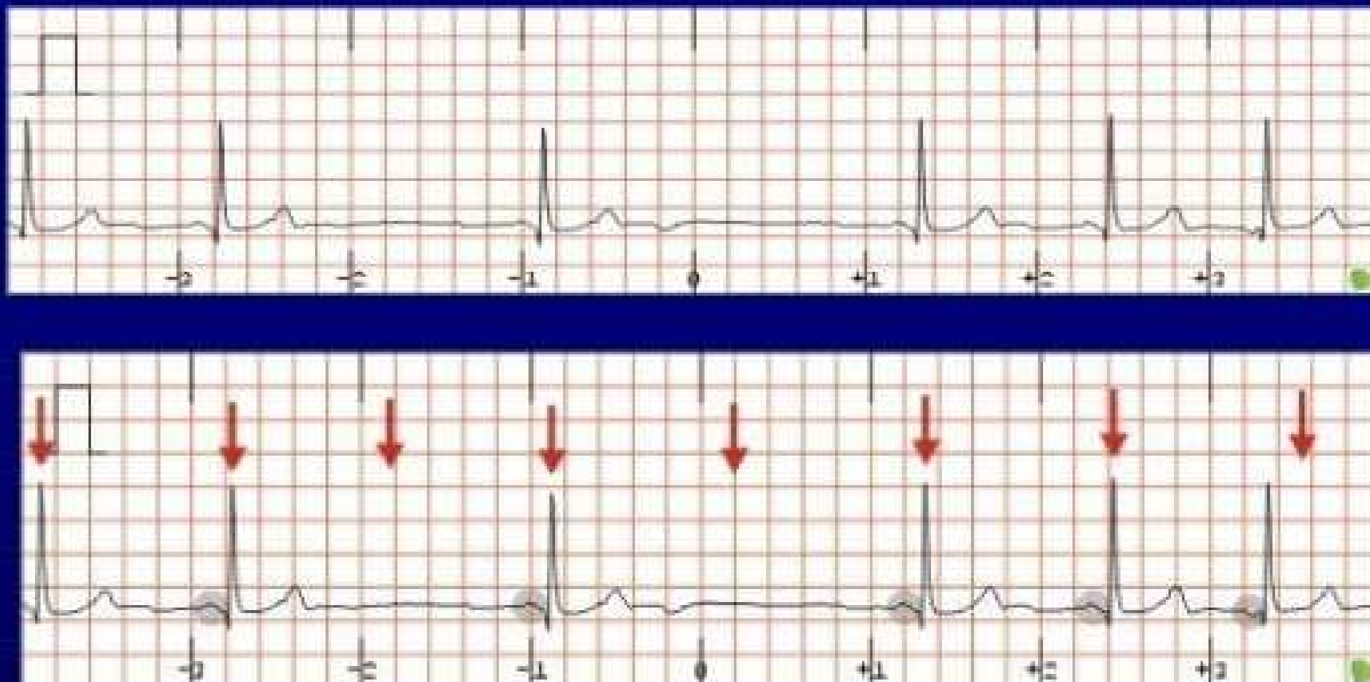


Figure 8-2

2nd degree SAN block



Electrocardiogram: Sinoatrial Exit Block

2nd degree SAN block

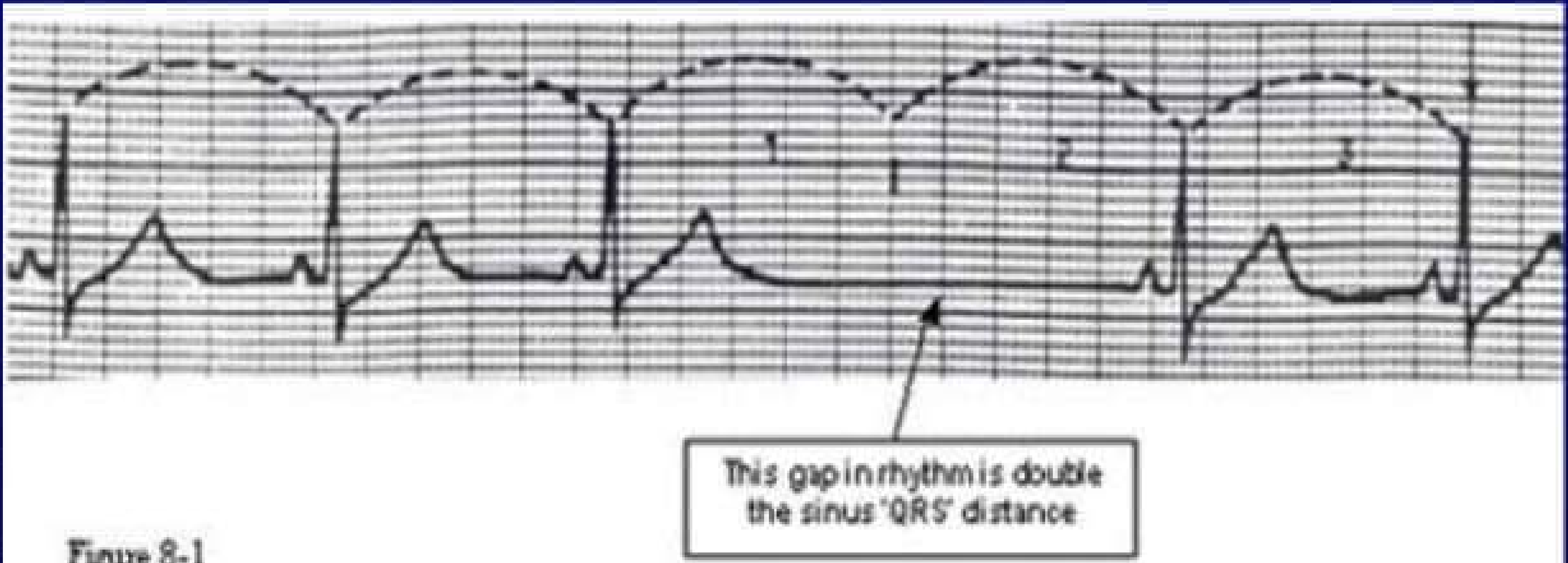


Figure 8-1

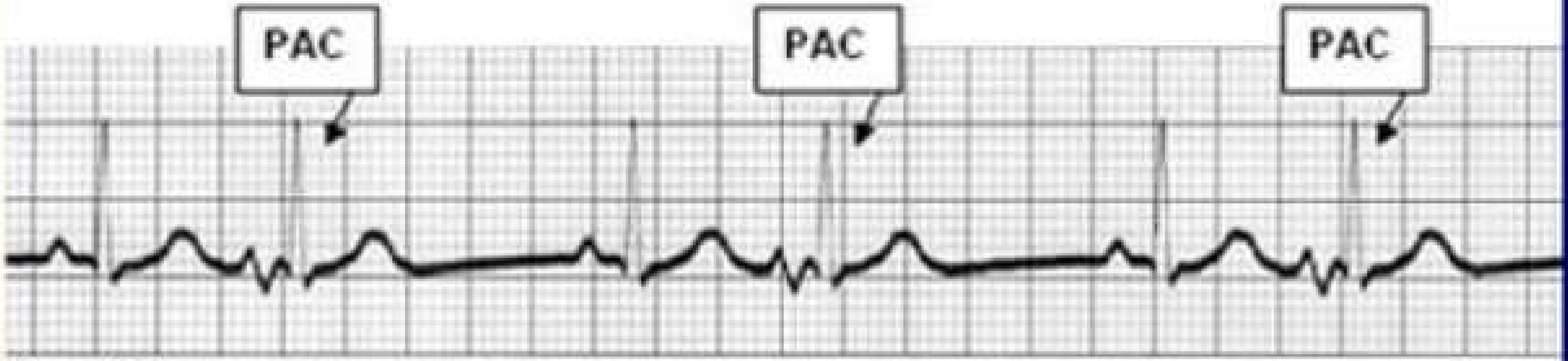
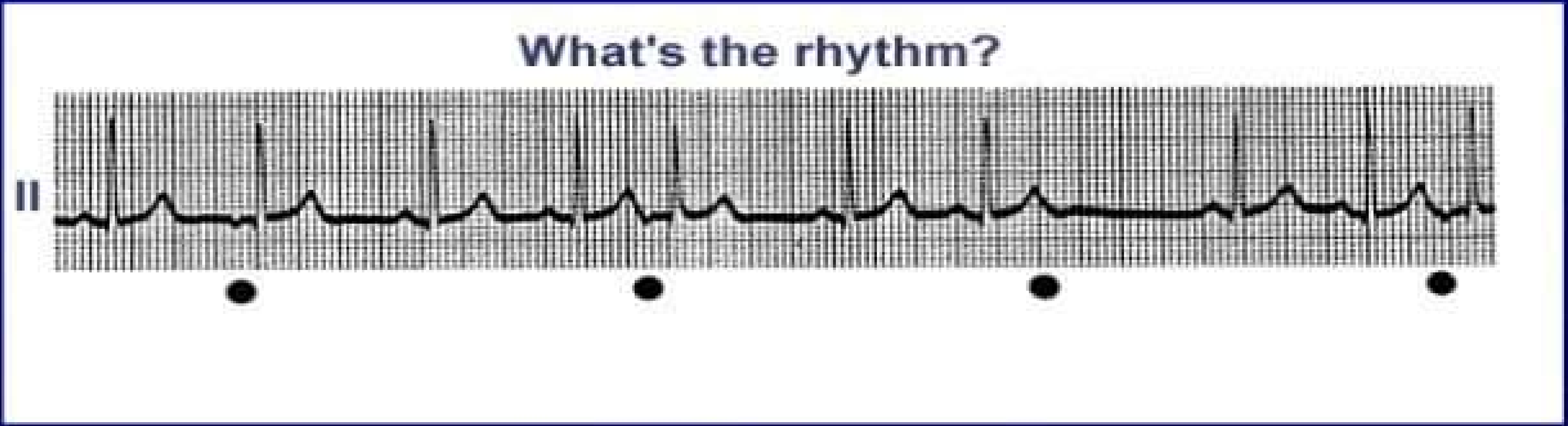
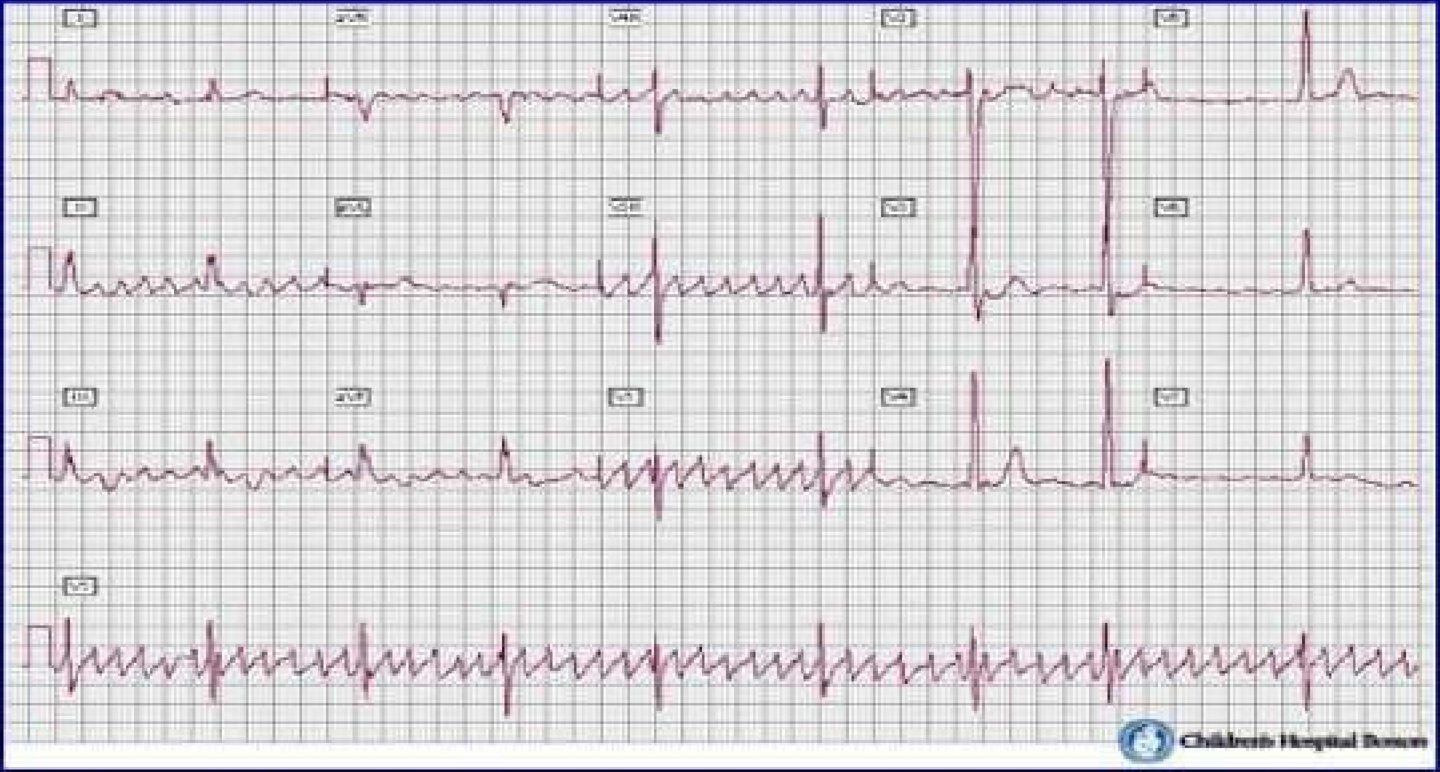


Figure 3-2

Sinus Rhythm with Atrial Bigeminy.

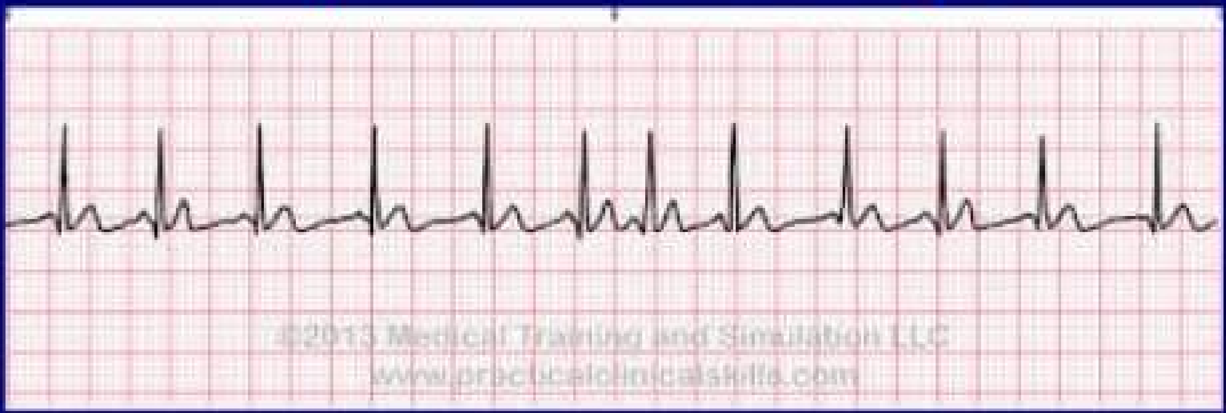


Atrial Parasystole



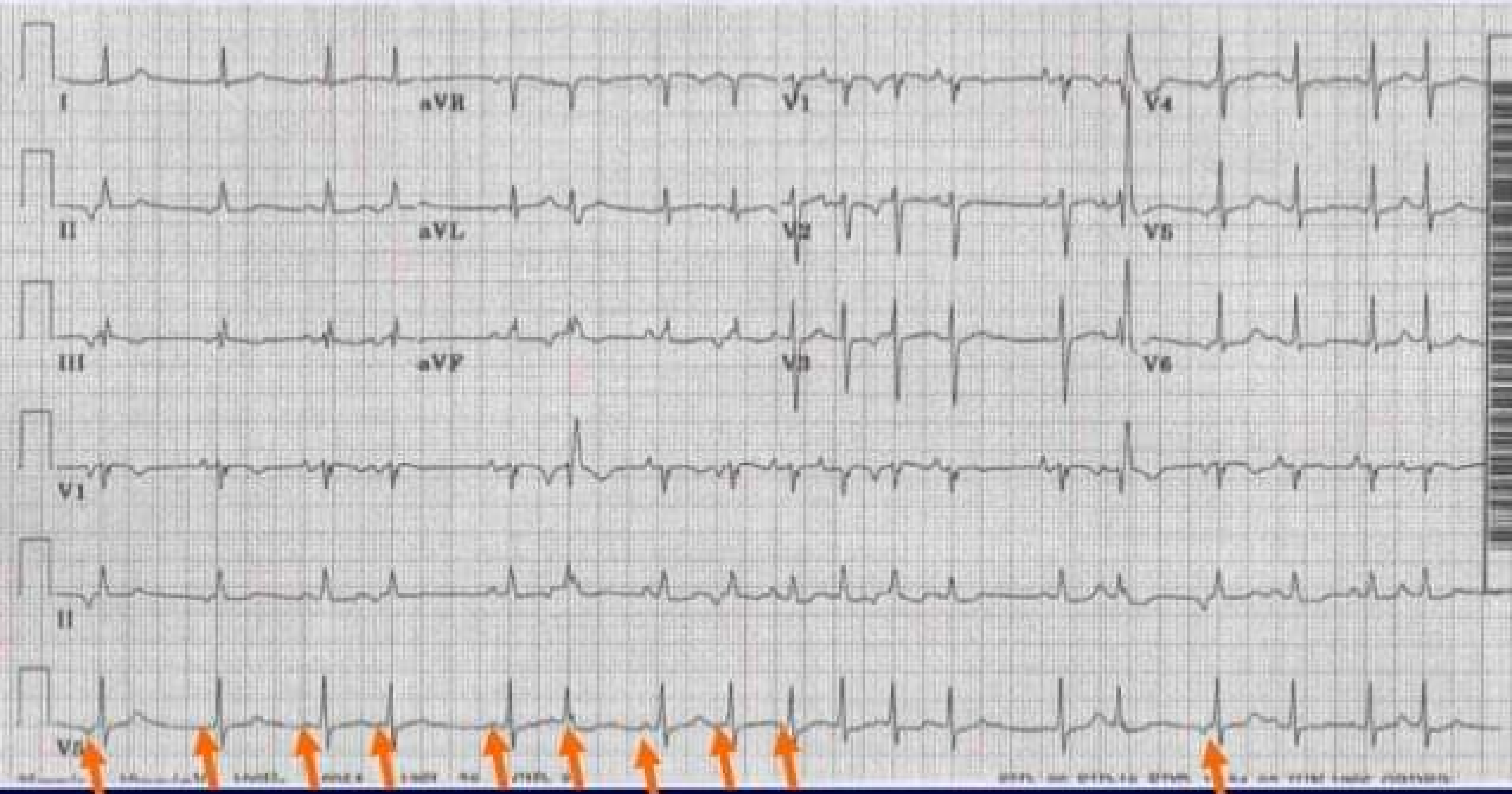
The tracing shows atrial flutter with variable block and atrial rate 300.

. Ectopic atrial tachycardia

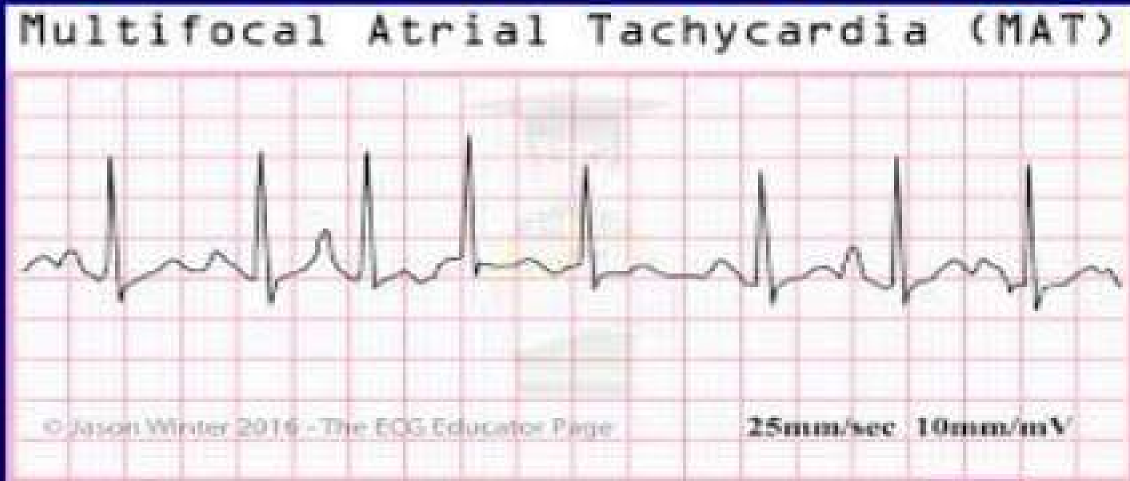


Source: Michael H. Crawford: Current Diagnosis & Treatment: Cardiology, Fifth Edition
www.cardiology.mhmedical.com

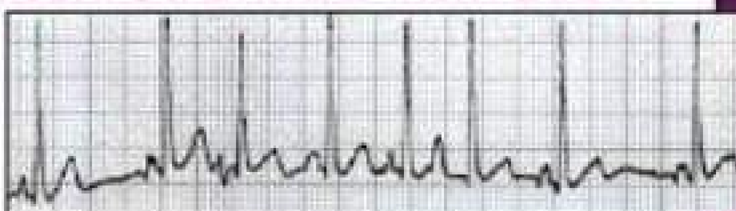
)Multifocal Atrial Tachycardia (MAT



Multifocal Atrial Tachycardia (MAT

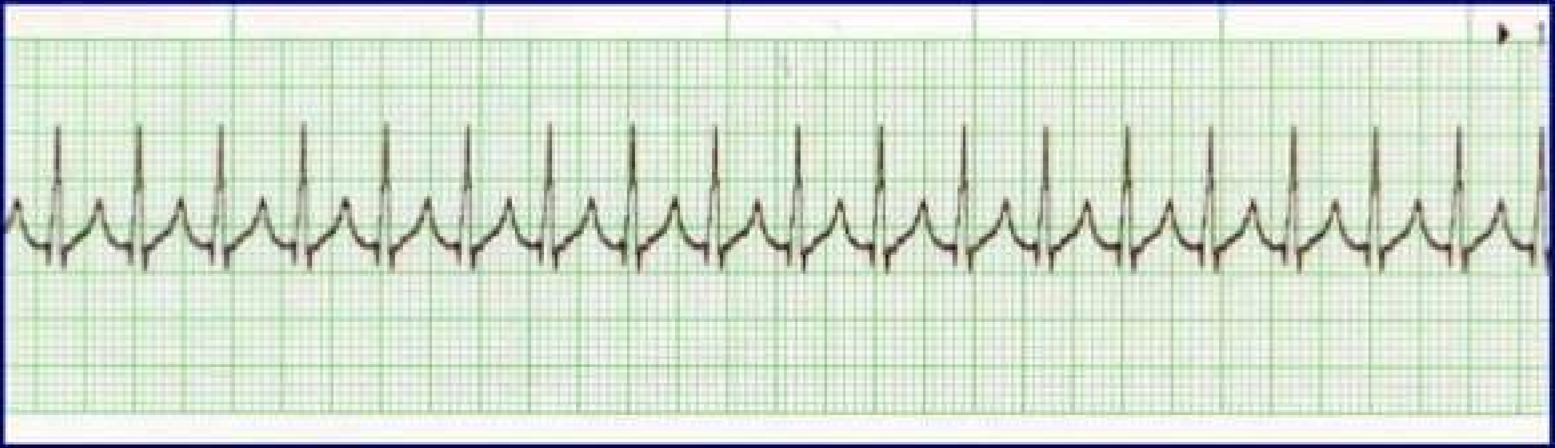


MULTIFOCAL ATRIAL TACHYCARDIA



ECG Characteristics: Discrete P waves with at least 3different morphologies.
Absence of one dominant atrial pacemaker
Atrial rate > 100 bpm

Paroxysmal Supraventricular Tachycardia)(PSVT

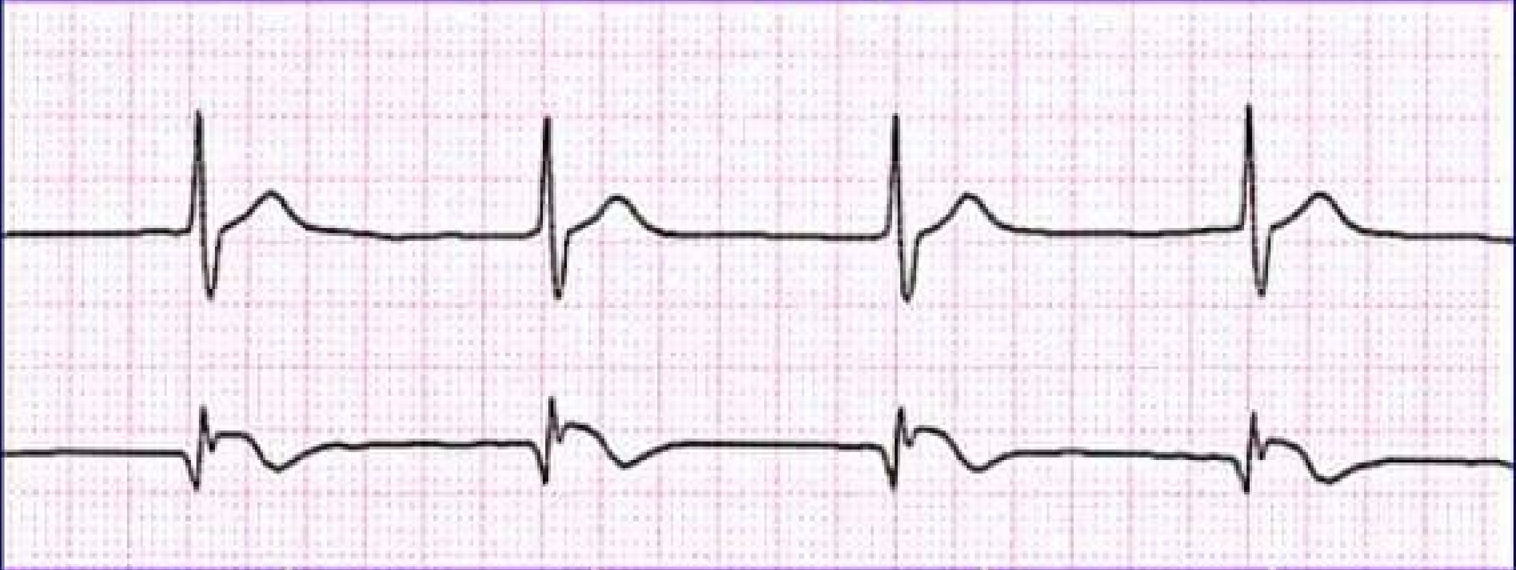


Paroxysmal Supraventricular Tachycardia)(PSVT

Paroxysmal Supraventricular Tachycardia

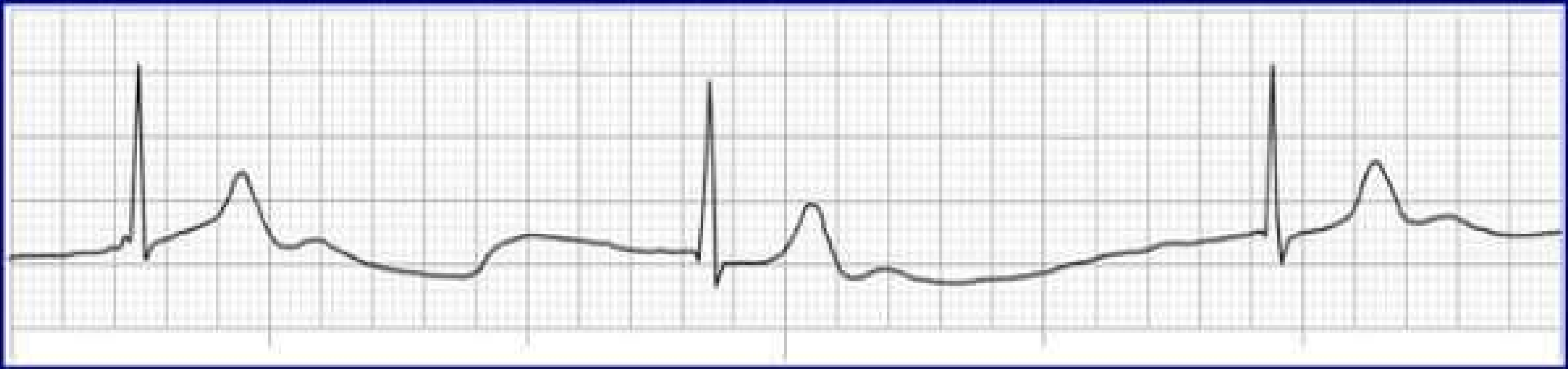
Rhythm: Both atrial and ventricular are regular
Rate: 150 to 250 beats/minute
P wave: Difficult to see also to distinguish from preceding T wave

Junctional Rhythm

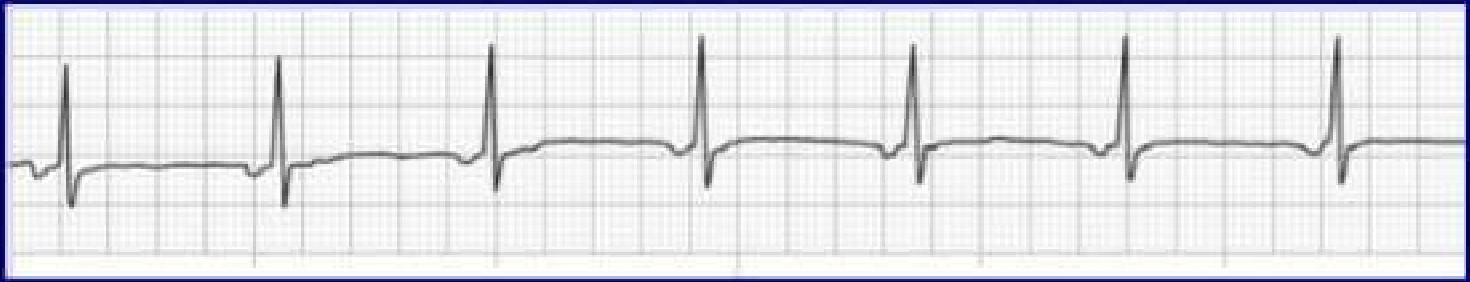


Heart Rate	Rhythm	P Wave	PR interval (in seconds)	QRS (in seconds)
40-60 bpm	Regular	Inverted, absent or after QRS	<.12	<.12

Junctional bradycardia– 15



- This rhythm originates from the AV junction. Because this rhythm occurs at a rate **slower than** the junction typically fires (40-60/minute), this ECG rhythm is called a junctional bradycardia.



- The ECG rhythm includes a series of narrow QRS complexes, *inverted* P waves and a rate of about 70/minute. This rhythm originates from the AV junction. Because this rhythm occurs at rates faster than the junction typically fires (40-60/minute) but less than a tachycardia (100/minute), this ECG rhythm is called an accelerated junctional rhythm.

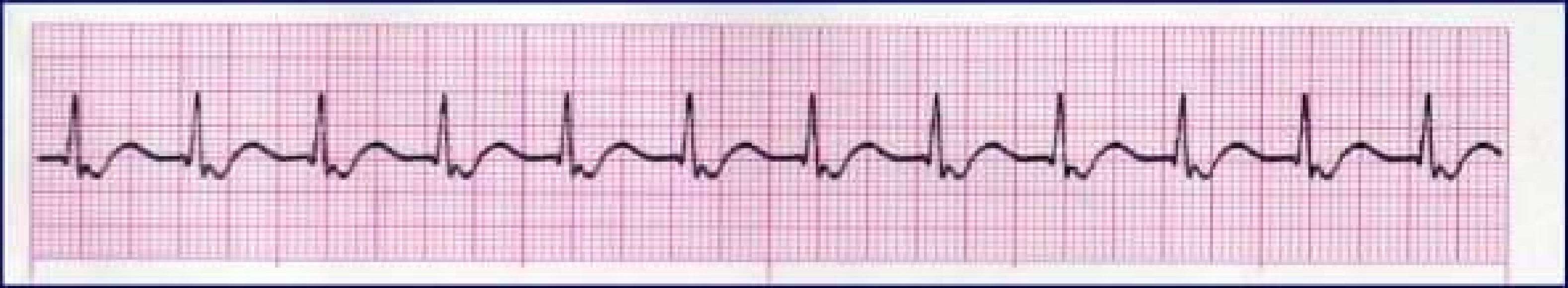
- This rapid ECG rhythm includes narrow QRS complexes, an absence of P waves prior to each QRS and a rate faster than 100/minute. This rhythm occurs at a rate of about 180- 190/minute.
- Notice the inverted waveform after many of the QRS complexes – possible further evidence for junctional tachycardia (inverted P waves).

17- Nonparoxysmal Junctional Tachycardia:

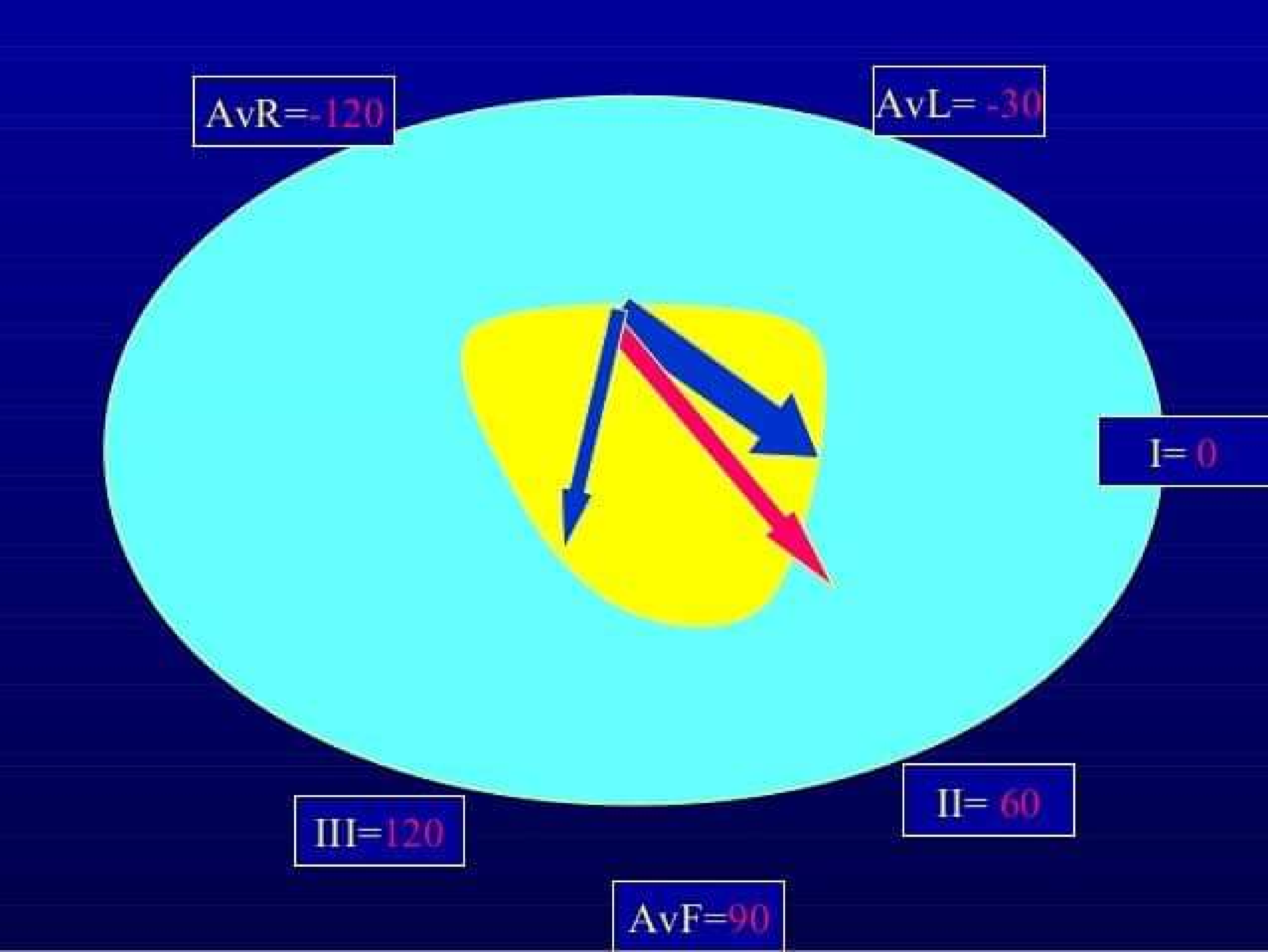
This usually begins as an accelerated junctional rhythm but the heart rate gradually increases to >100 bpm.

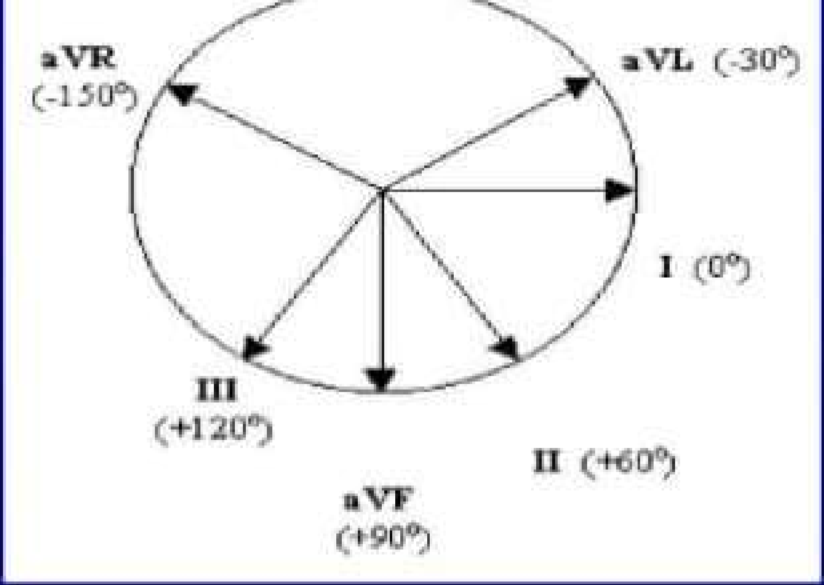
There may be AV dissociation, or retrograde atrial capture may occur.

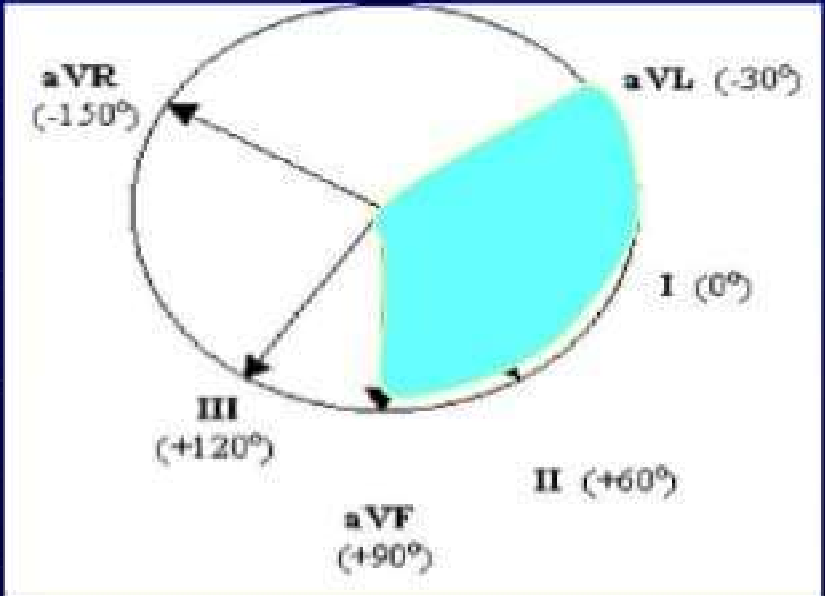
Ischemia (usually from right coronary artery occlusion) and digitalis intoxication are the two most common causes.



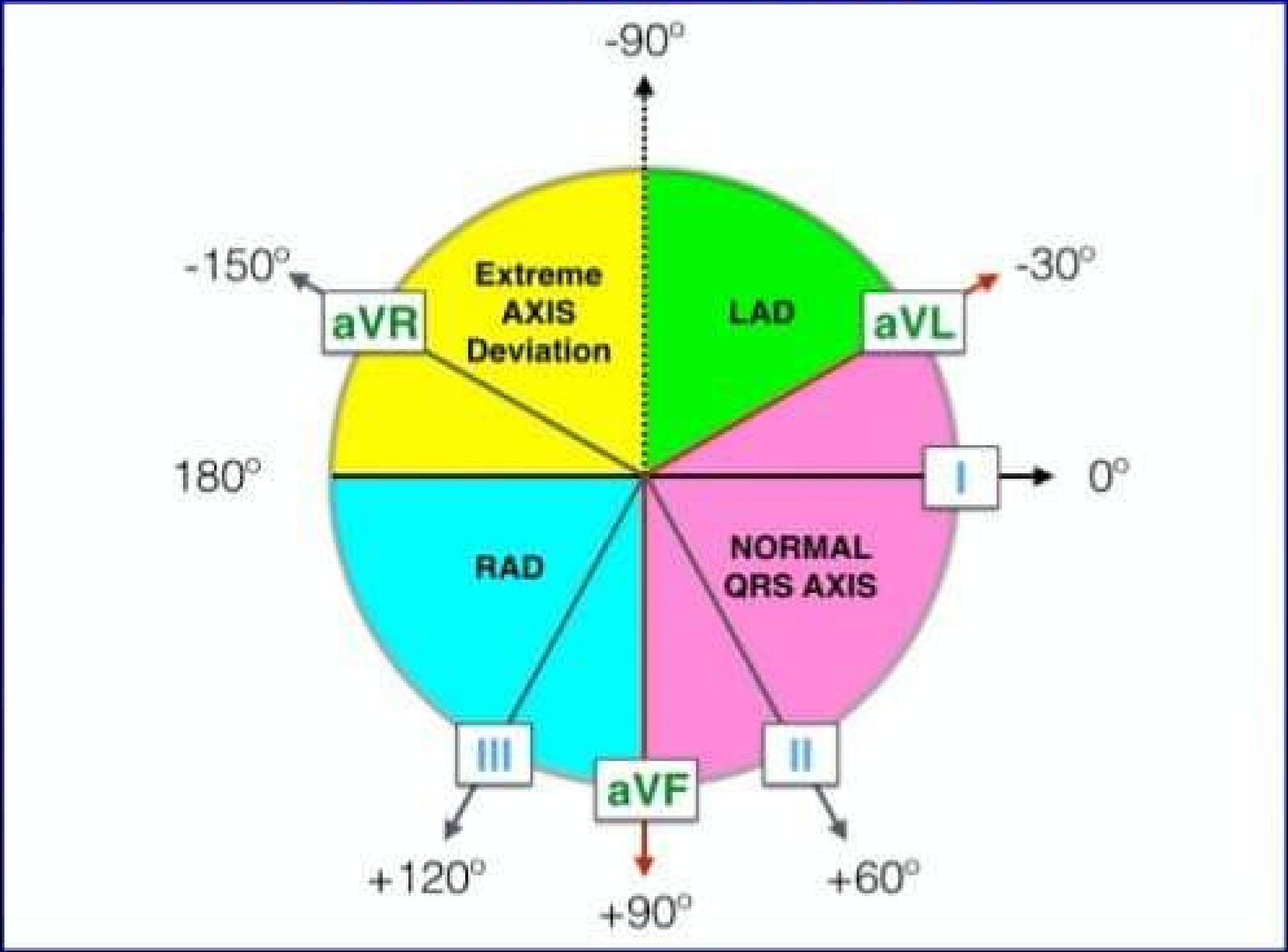
QRS axis
(cardiac axis)


AvR=-120
AvL= -30
I= 0
II= 60
III=120
AvF=90


aVR
(-150°)
aVL (-30°)
I (0°)
III
(+120°)
II (+60°)
aVF
(+90°)

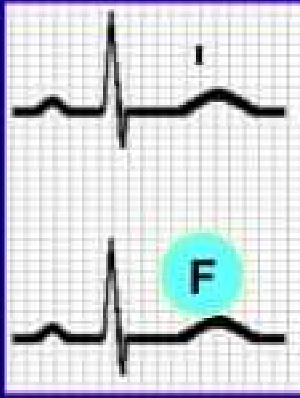

aVR
(-150°)
aVL (-30°)
I (0°)
III
(+120°)
II (+60°)
aVF
(+90°)

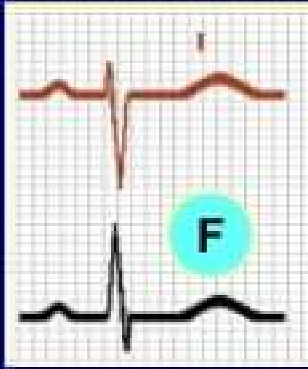
Cardiac Axis

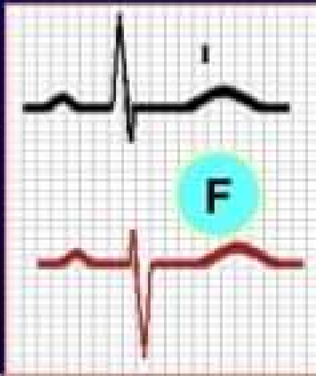


QRS Axis Determination

- **First method**: inspect QRS in Lead I and aVF
- both I and aVF +ve = normal axis
- both I and aVF -ve = axis in the Northwest Territory
- lead I -ve and aVF +ve = right axis deviation
- lead I +ve and aVF -ve
  - lead II +ve = normal axis
  - lead II -ve = left axis deviation







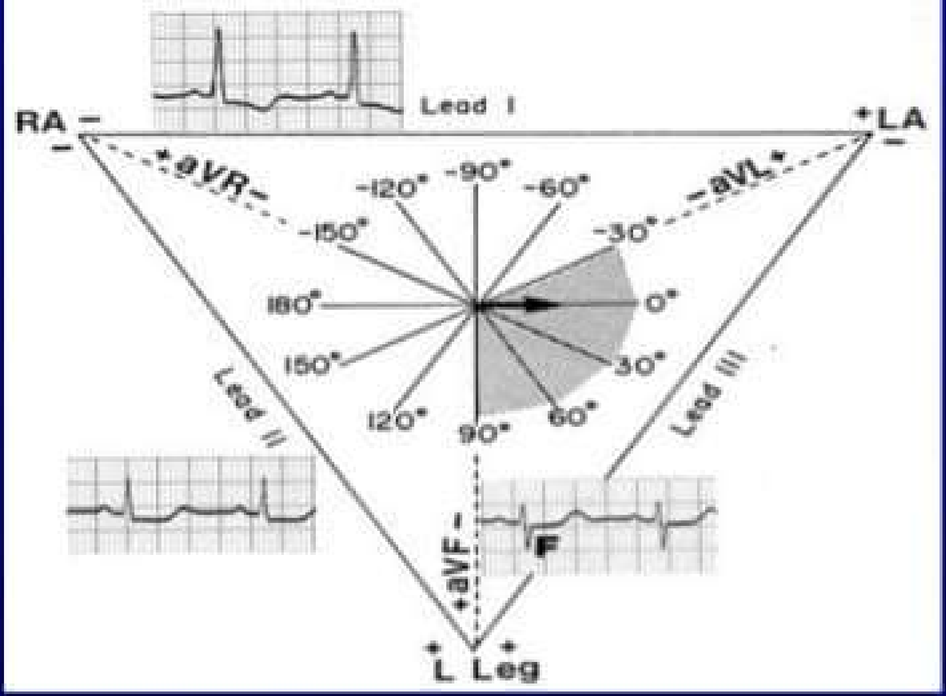
2nd method

1- find the **isoelectric limb lead** if there is one; i.e., the lead with equal forces in the positive and negative direction.

2-The QRS axis is *perpendicular* to that lead's orientation

3- Since there are two perpendiculars to each isoelectric lead, chose the perpendicular that best fits the direction of the other ECG leads.

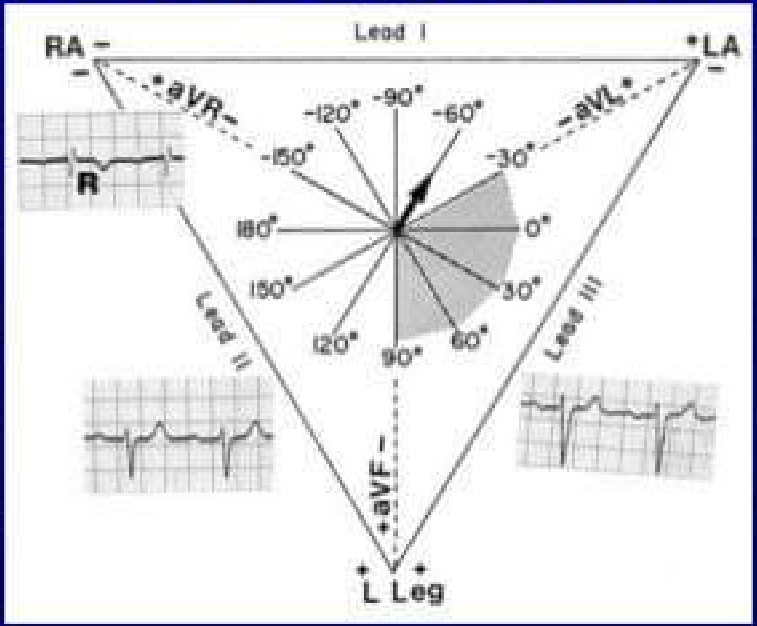
4-If there is no isoelectric lead, there are usually *two* leads that are nearly isoelectric, and these are always 30**o** apart. Find the perpendiculars for each lead and chose an approximate QRS axis within the 30**o** range.



Examples of QRS Axis

1. Lead aVF is the isoelectric lead.
2. The two perpendiculars to aVF are 0 and 180 .
3. Lead I is positive (i.e., oriented to the left).
4. Therefore, the axis has to be 0 .

Left axis deviation

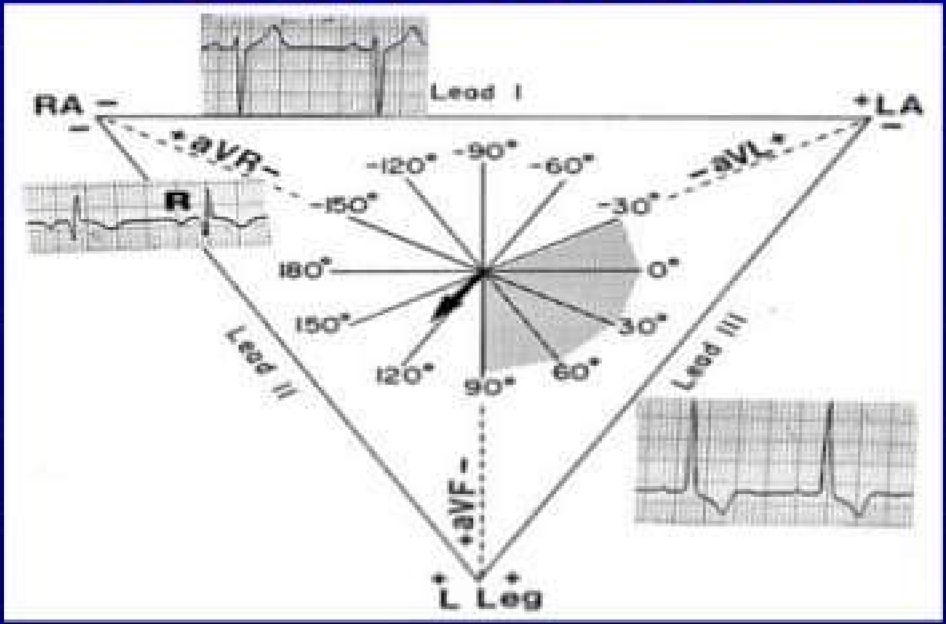


- Lead aVR is the smallest and isoelectric lead.
- The two perpendiculars are -60 and +120 .
- Leads II and III are mostly negative (i.e., moving away from it)
- The axis, therefore, is -60 .

- Left Axis Deviation (LAD): ≥ -30o (i.e., lead II is mostly 'negative')

1. Left Anterior Fascicular Block (LAFB
2. Some cases of inferior MI with Qr complex in lead II (making lead II 'negative')
3. Inferior MI + LAFB in same patient
4. Some cases of LVH
5. Some cases of LBBB
6. Some cases of WPW syndrome (right sided accessory pathway)
7. Emphysema
8. Hyperkalaemia

Right axis deviation



- Lead aVR is closest to being isoelectric (slightly more positive than negative)
- The two perpendiculars are -60 o and +120
- Lead I is mostly negative; lead III is mostly positive.
- Therefore the axis is close to +120 o. Because aVR is slightly more positive, the axis is slightly beyond +120 o (i.e., closer to the positive right arm for aVR).

- **Right Axis Deviation** (RAD): ≥ +90o (i.e., lead I is mostly 'negative')

1. Left Posterior Fascicular Block (LPFB)
2. RVH
3. High lateral wall MI with Qr or QS complex in leads I and aVL
4. Some cases of RBBB
5. Some cases of WPW syndrome (left sided accessory pathway)
6. Children, teenagers, and some young adults

Bizarre QRS axis

=Northwest axis (no man's land)

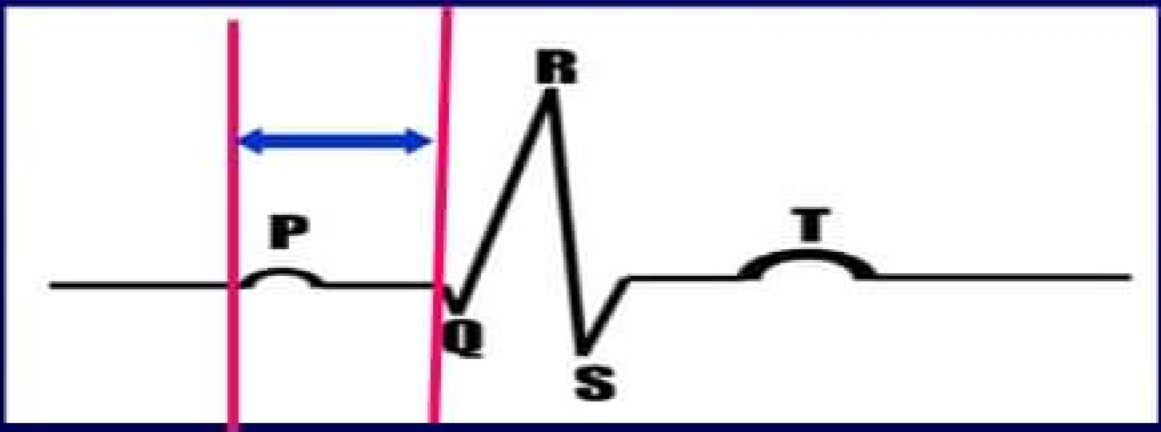
+150**o** to -90**o** (lead I <u>and</u> lead II are both negative)

1. Consider limb lead error
2. Some cases of ventricular tachycardia
3. Artificial cardiac pacing
4. Hyperkalaemia
5. Some cases of complex congenital heart disease (e.g., transposition)
6. Dextrocardia
7. Emphysema

PR interval

- Definition: from the beginning of the P-wave to the beginning of the QRS complex .
- PR = Atr Depolar + AVN Delay

  = P wave + isoelectric line



= 2.5 + (0.5-2.5) = 3-5 ss

Abnormal PR interval

- It is an interval
- So its abnormalities either

1- Shortened OR

2- Prolonged

According impulse passage through natural block (AVN)

Short PR: < 3 ss

1-Preexcitation syndromes:

- WPW (Wolff-Parkinson-White) Syndrome.
- LGL (Lown-Ganong-Levine)

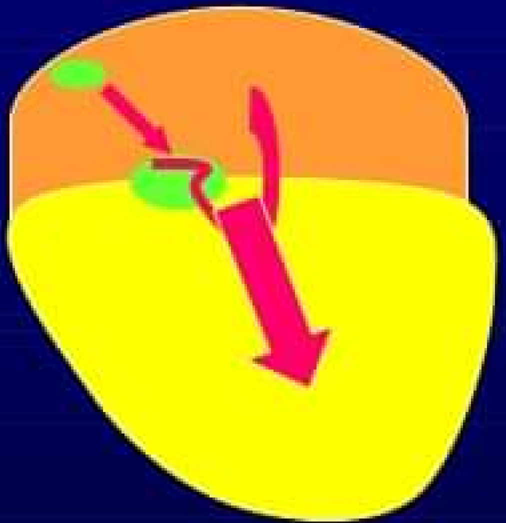
2-AV Junctional Rhythms.

3-Ectopic atrial rhythms originating near the AV node.

4-Normal variant

WPW Syndrome

- An accessory pathway (called the "Kent" bundle) connects the right atrium to the right ventricle (see diagram below) or the left atrium to the left ventricle, and this permits early activation of the ventricles causing:
- 1-short PR interval.
- 2- delta wave
- 3- Tall R wave
- 4- Wide QRS

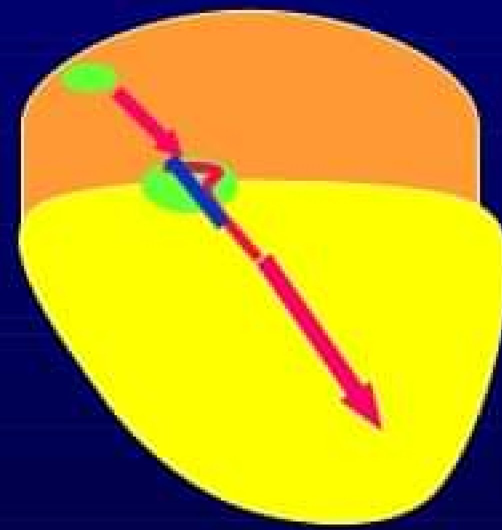


- **Localising the accessory pathway**
- An accessory pathway, bundle of Kent, exists between atria and ventricles and causes early depolarisation of the ventricle. The location of the pathway may be deduced as follows:-
-

LOCATION	V1	V2	QRS axis
left posteroseptal (type A)	+ve	+ve	left
right lateral (type B)	-ve	-ve	left
left lateral (type C)	+ve	+ve	inferior (90)
right posteroseptal	-ve	-ve	left
anteroseptal	-ve	-ve	normal

LGL (Lown-Ganong-Levine(

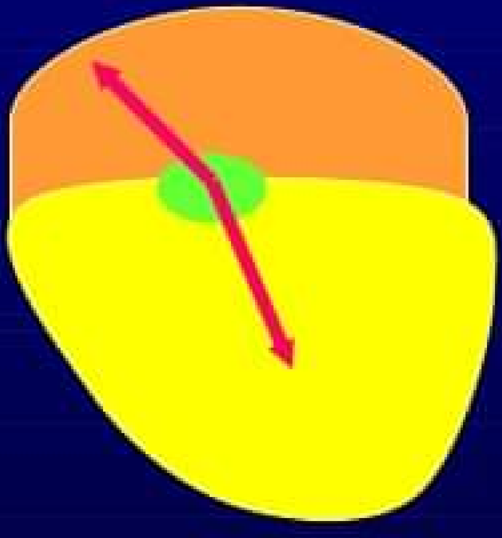
- An AV nodal bypass track into the His bundle exists, and this permits early activation of the ventricles without a delta-wave because the ventricular activation sequence is normal.



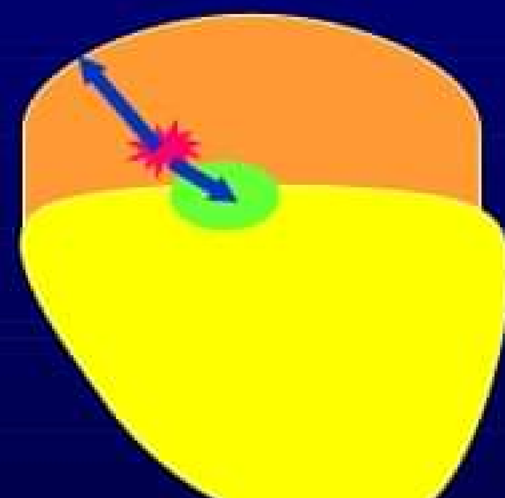
Lown Ganong Levine Syndrome

-) short PR interval, less than 3 small squares (120 ms
- delta wave no

AV Junctional Rhythms with retrograde atrial activation (inverted P waves in II, III, aVF): Retrograde P waves may occur *before* the QRS complex (usually with a short PR interval):



Ectopic atrial rhythms originating near the AV node (the PR interval is short because atrial activation originates close to the AV node; the P wave morphology is different from the sinus P)

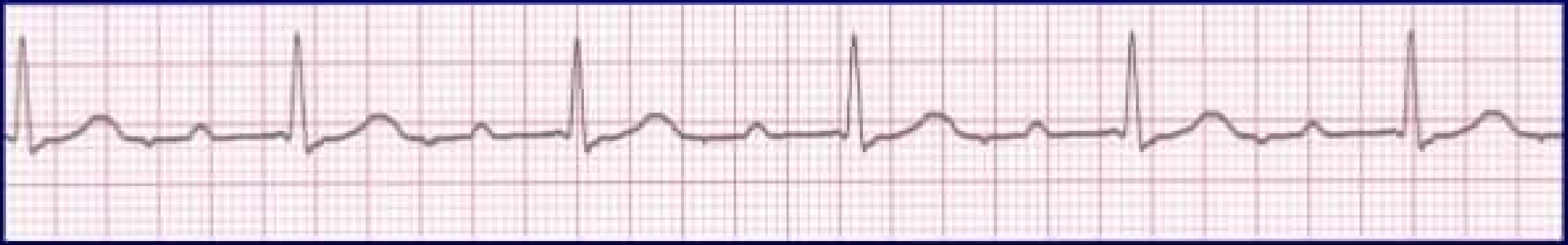


II- Prolonged PR

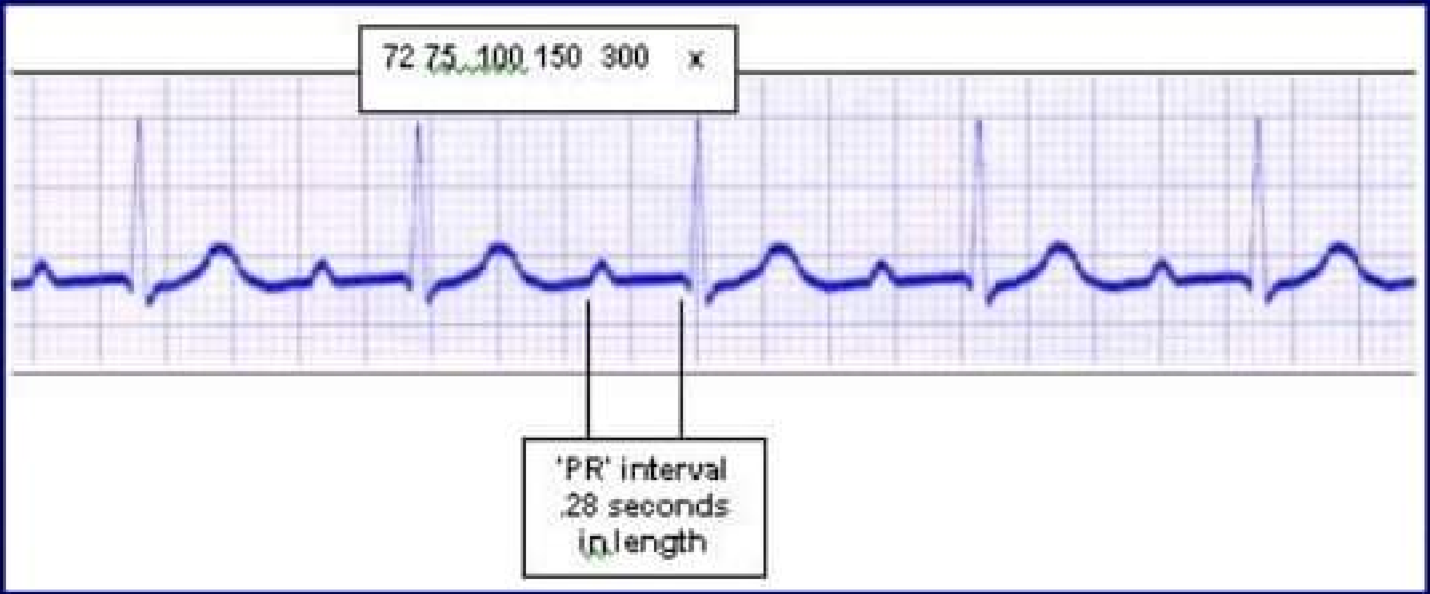
- >0.20s → > 5 ss
- In Heart block = AVN block:
- **First degree AV block**
- Second degree AV block
  - Type I (Wenckebach)
  - Type II (Mobitz)
- Third degree AV block = complete heart block

First Degree AV Block

- PR interval is constant = same delay in each one but there is still one P-wave per QRS.

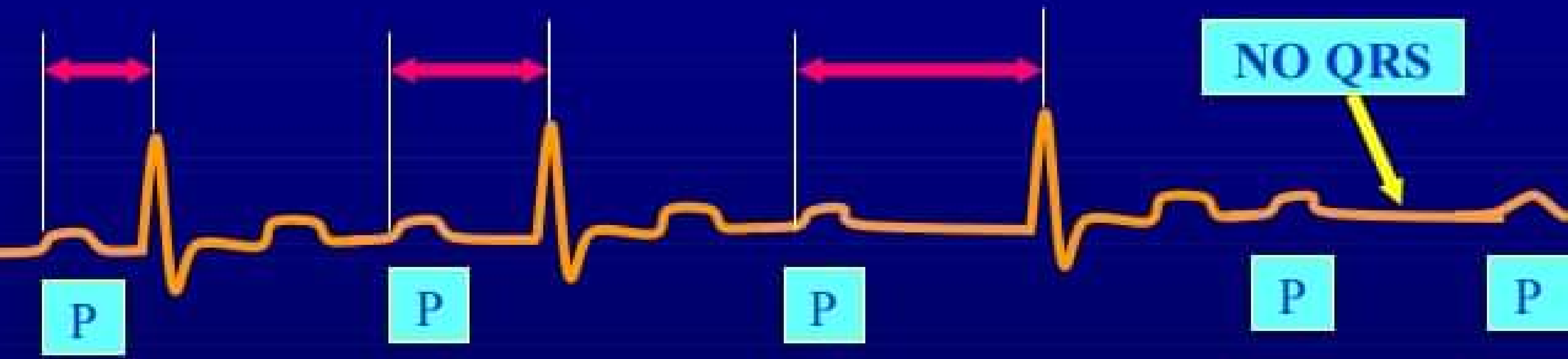


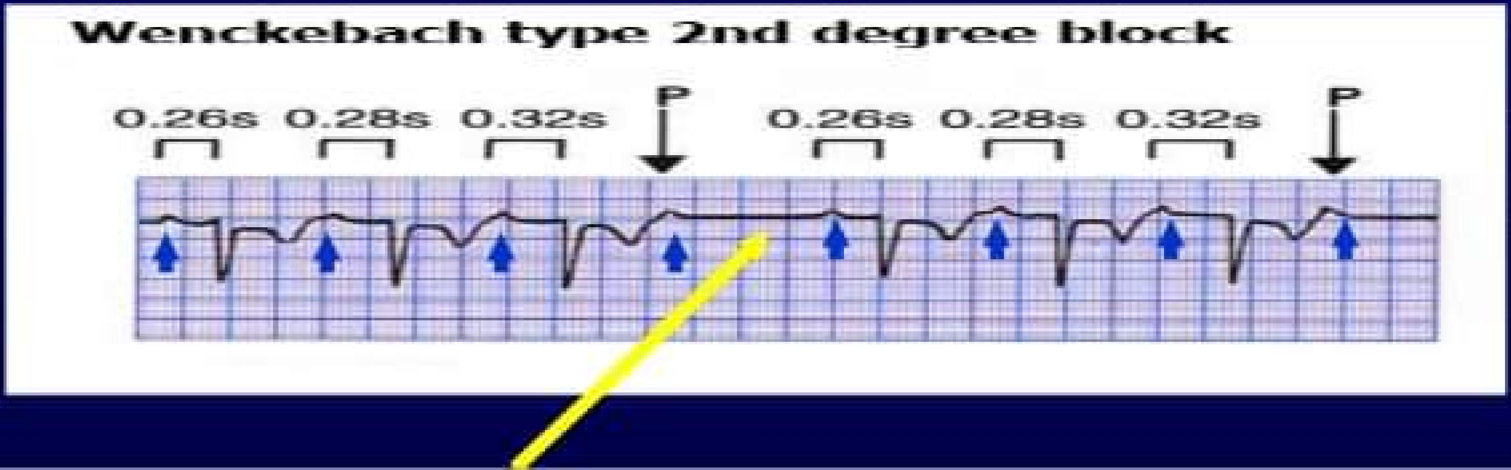
First Degree AV Block



Second degree AV Block:

- **Mobitz I Block (Wenckebach phenomenon):** Here there is progressive PR interval prolongation until a P wave fails to conduct.





Mobitz I Block

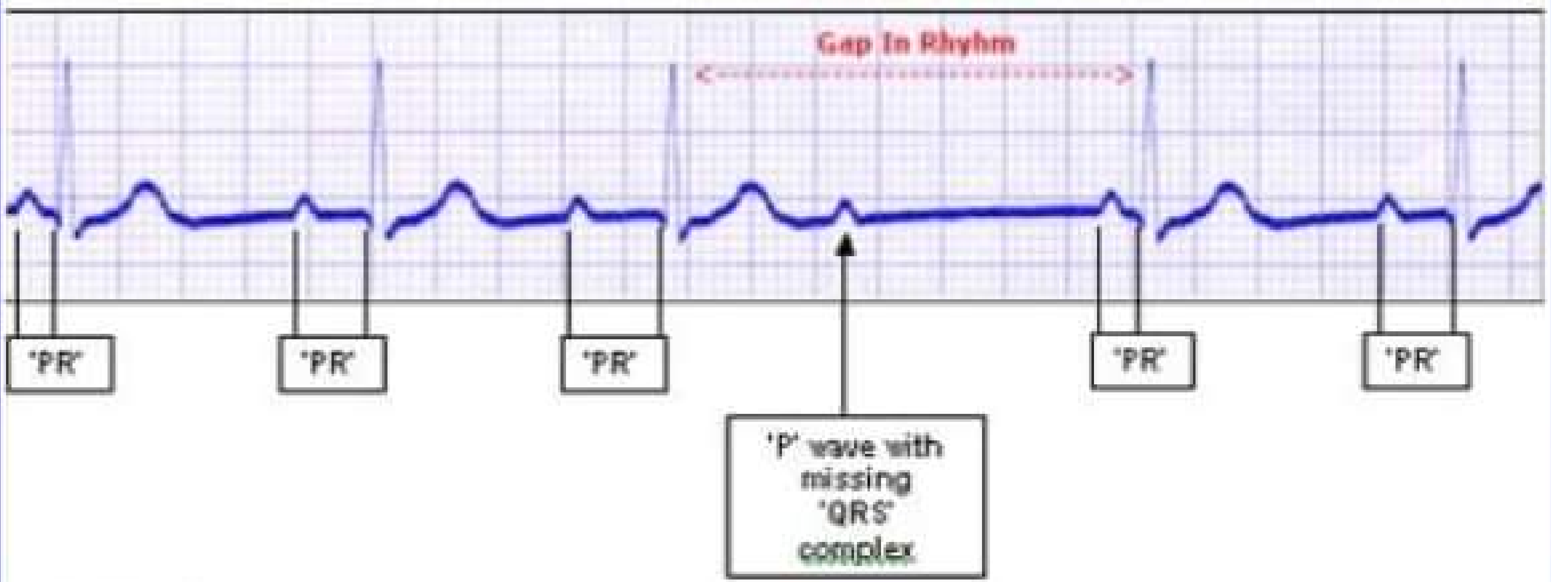
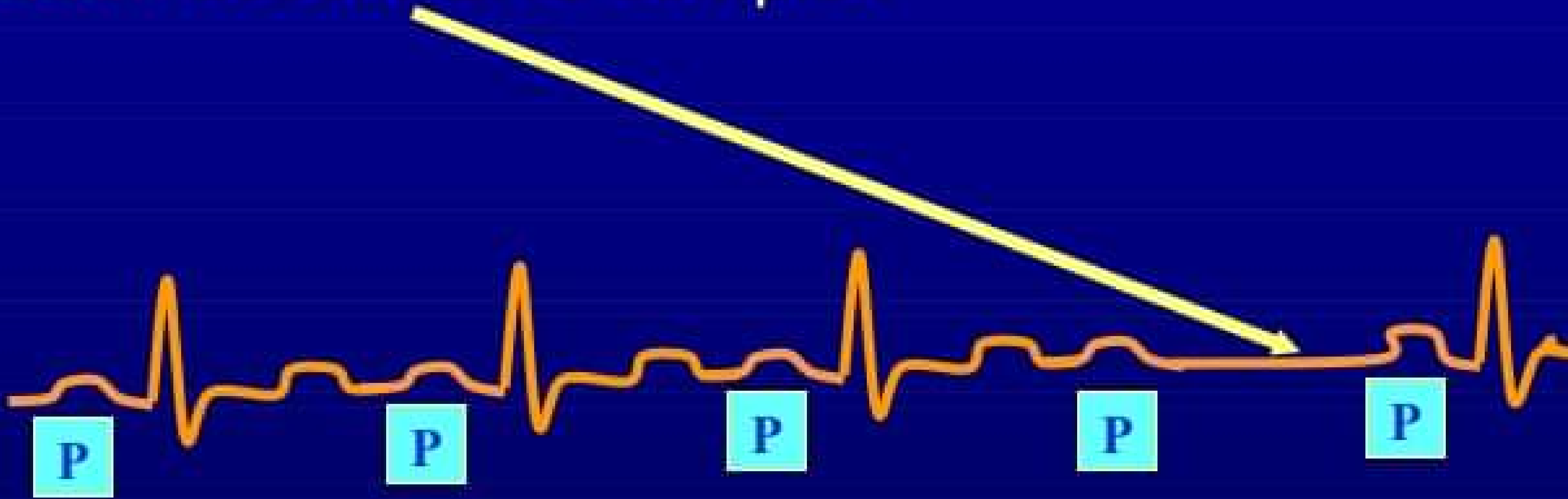
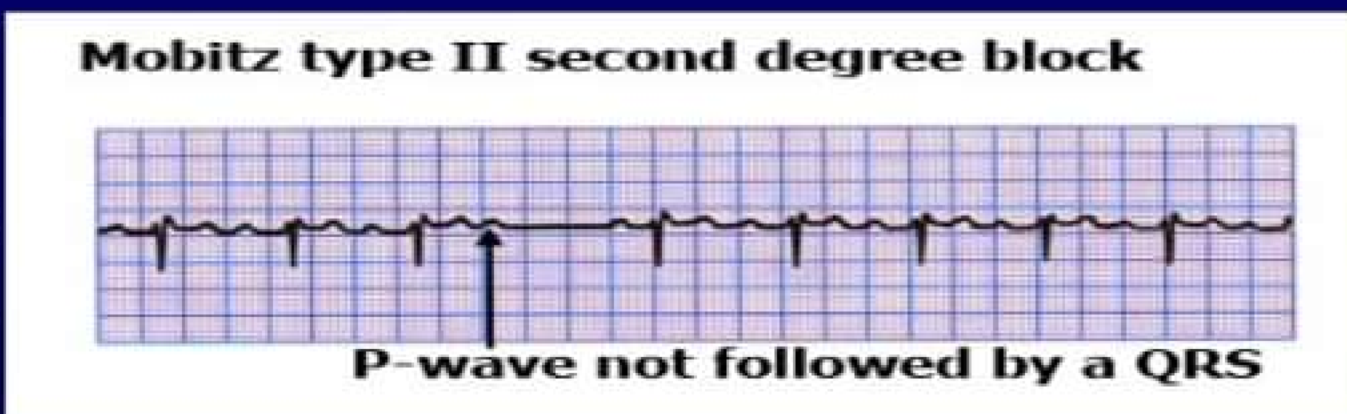


Figure 6-2

Mobitz II Block:

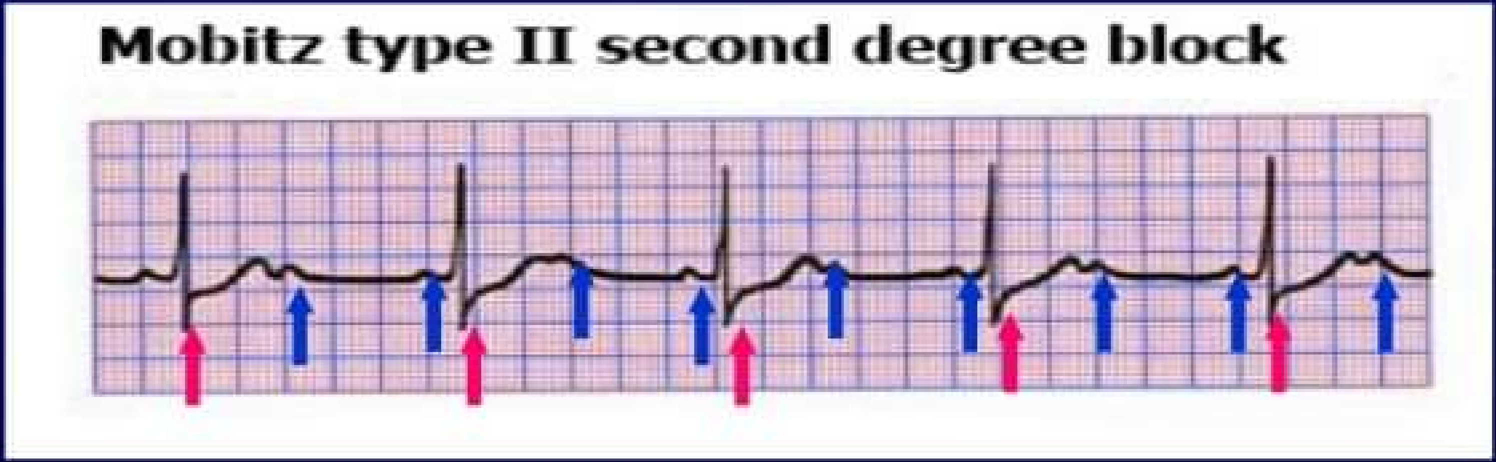
sudden absent QRS complex





Mobitz II Block

- **2:1 or 3:1 Block:** Occurs when every second or third P wave conducts to the ventricles. P-R interval remains normal in the conducted beats.



Mobitz II Block

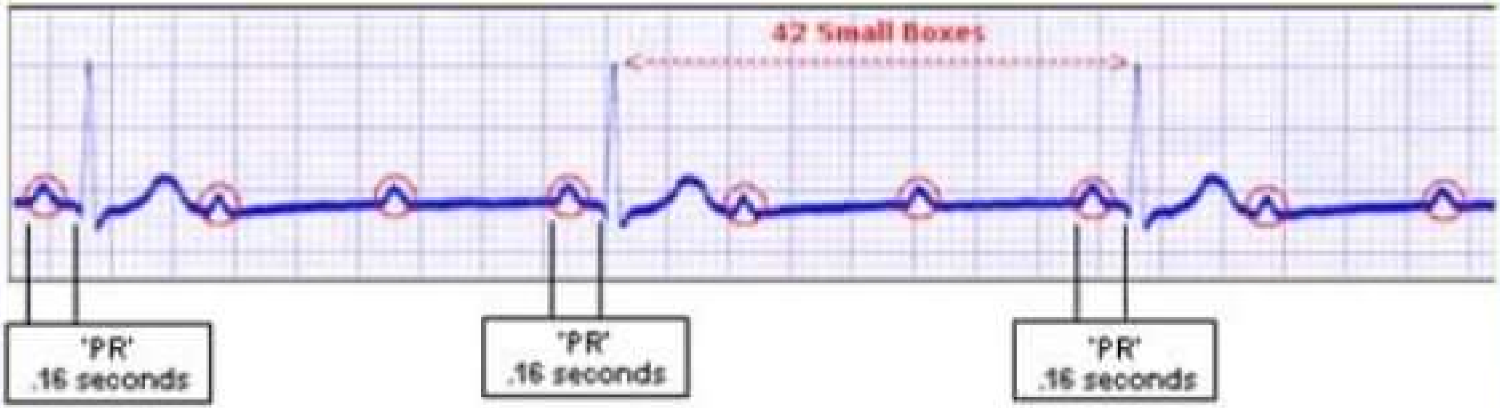
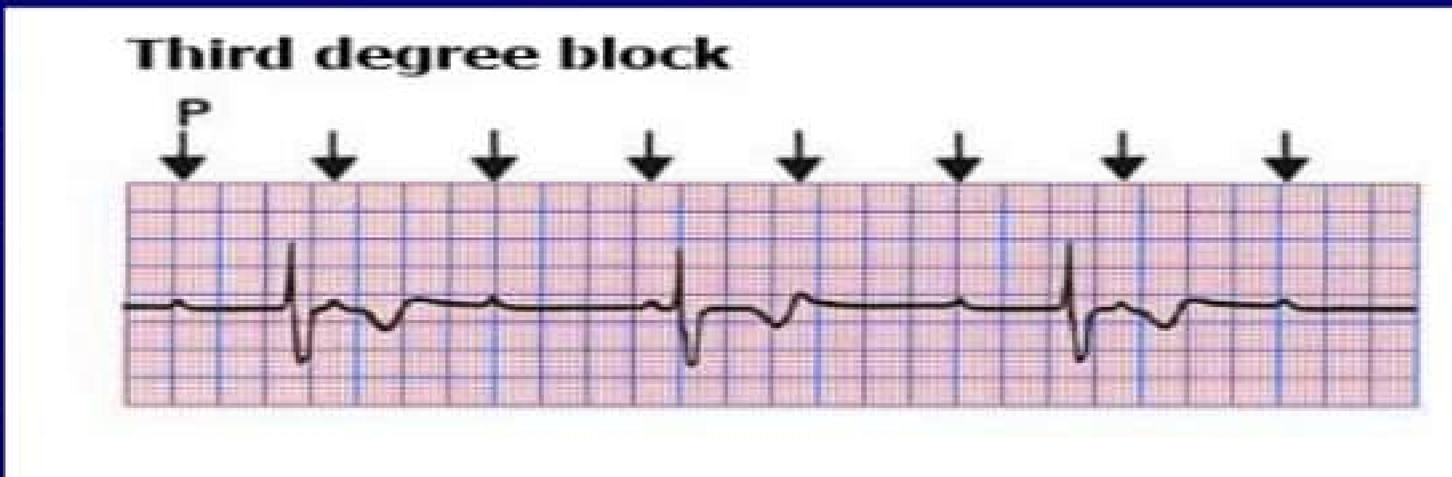


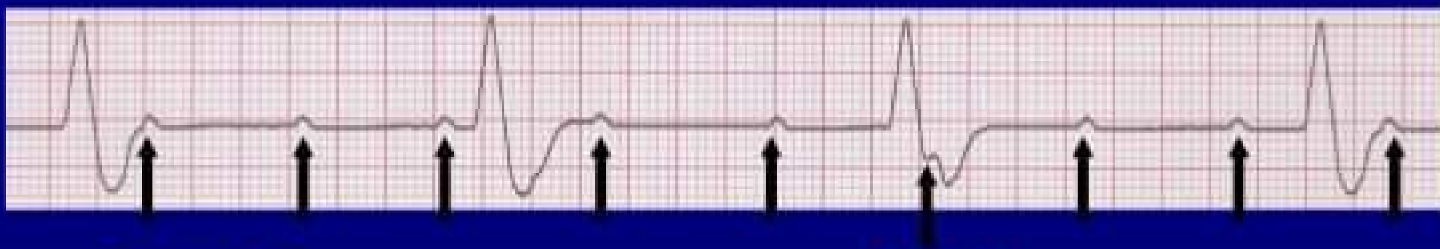
Figure 6-3

Third degree (complete) AV Block:

There will be no relationship between P-wave (atrial) rate and QRS complex (ventricular) rate (AV Dissociation).

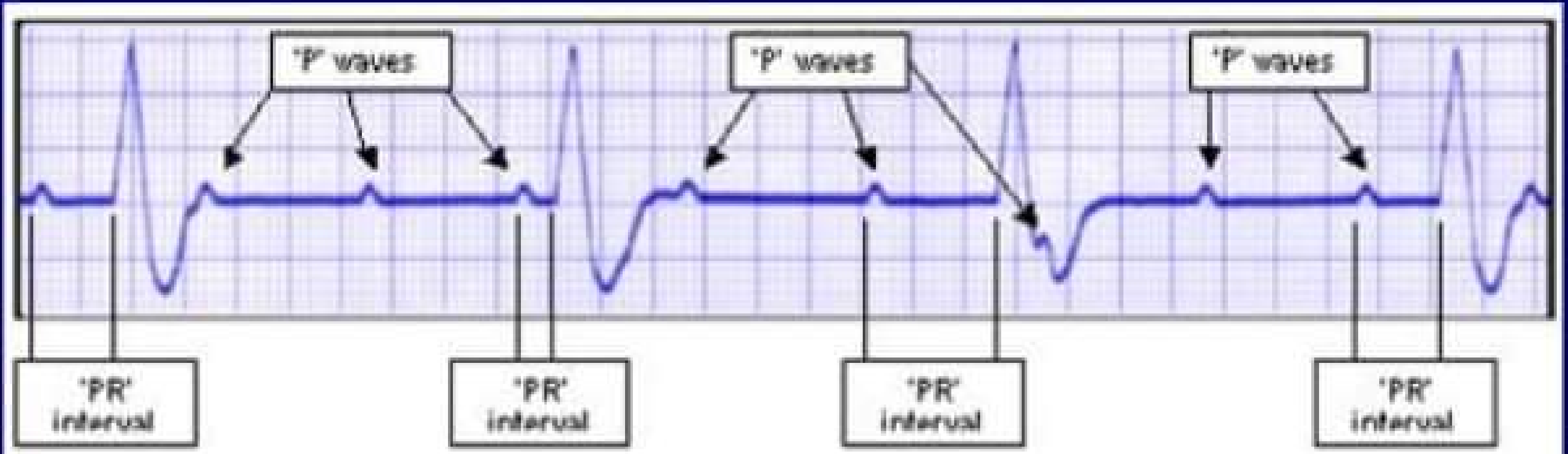
QRS complexes tend to be abnormally shaped due to abnormal spreading of depolarization across the ventricles.





- Rate? 40 bpm
- Regularity? regular
- P waves? no relation to QRS
- PR interval? none
- QRS duration? wide (> 0.12 s)

Interpretation? *3rd Degree AV Block*



'P' waves
'P' waves
'P' waves
'PR' interval
'PR' interval
'PR' interval
'PR' interval

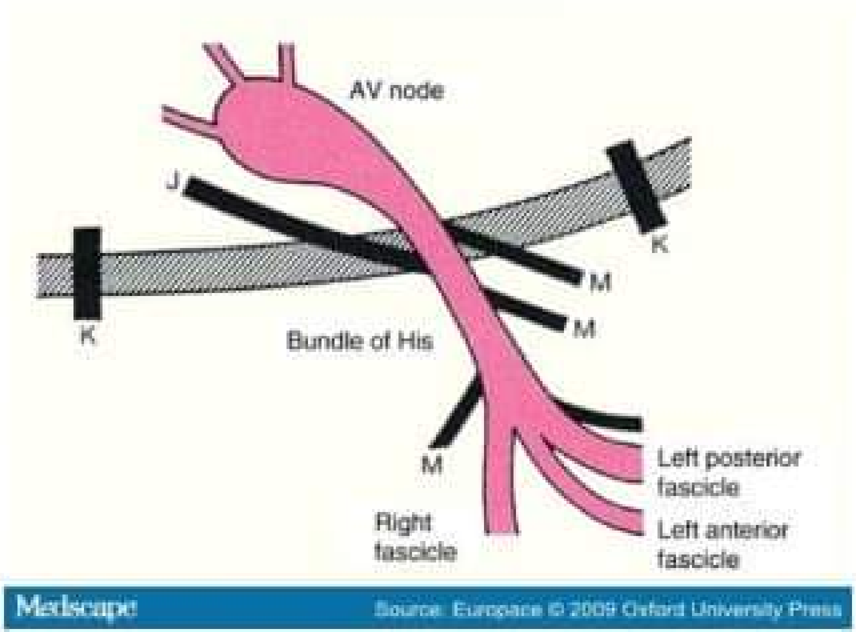
Figure 6-5

Preexcitation

- 3 variants, often simply referred to as a group as "WPW"
- All involve accessory paths that allow direct activation of ventricles without usual av-his-perkinjie delay
- 2 effects – short PR from bypassing normal delaying mechanism, and slurred initial R/S deflection from direct and dyssynchronous activation of ventricle rather than more simultaneous activation from conducting system
- Dangerous as re-entrant rhythms are much more stable at high rates than normal
- AV nodal blocking agents should be avoided, as an anti-dromic tachycardia can be induced
  - Instead of going down the "regular"path and back up the "accessory path", slow av conduction reverses the flow, so a narrow tachy becomes a wide tachy

Preexcitation – James variant

- Type 2 – James variant
  - Pathway from atria myocardium to post AV node his bundle
    - Short PR from bypassing AV node
    - No delta wave, as inserts into normal conducting system



Preexcitation – Mahaim variant

- Type 3 – Mahaim variant
  - Pathway from his to myocardium
    - Normal PR as impulse passed through AV
    - Delta wave as inserts into myocardium