NARAYANA
COLLEGE OF NURSING

ECG & CARDIAC ARRHYTHMIAS

BY

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SPECIFIC LEARNING OBJECTIVES

1. INTRODUCTION
2. HISTORY
3. NORMAL ECG
4. PROCEDURE
5. LIMB LEADS

1.INTRODUCTION:

ECG

DEFINITION: It is the procedure of recording the electrical activity of the heart. The electrode combination records the difference of potential difference at two sites on the body. The potential differences are produced due to the electrical activity of the heart.

- ❑ **Electrocardiograph is the machine**
- ❑ **Electrocardiogram is the record**

❑ The characteristic shape and timing of the ECG waves are due to the spread of wave of depolarization and repolarization associated with each heart beat.

INTRODUCTION

The body acts as a conductor of electricity.

- As the wave of depolarization is transmitted throughout the heart , electrical currents spread into tissues surrounding the heart and to the surface of the body.

- The placement of electrodes on the skin on opposing sides of the heart enables the electrical current generated by the heart to be recorded.

INTRODUCTION

DEPOLARIZATION

Depolarization is a change within a cell, during which the cell undergoes a shift in electric charge distribution, resulting in less negative charge inside the cell.

REPOLARIZATION

Repolarization refers to the change in membrane potential that returns it to a negative value just after the depolarization phase of an action potential which has changed the membrane potential to a positive value.

PURPOSE

- Arrhythmias
- Myocardial ischemia and infarction
- Pericarditis
- Chamber hypertrophy / Cardiomegaly
- Electrolyte disturbances (i.e. hyperkalemia, hypokalemia)
- Drug toxicity (i.e. digoxin)
- To provide vital information regarding the patient's condition and progress(Death : flat ECG)

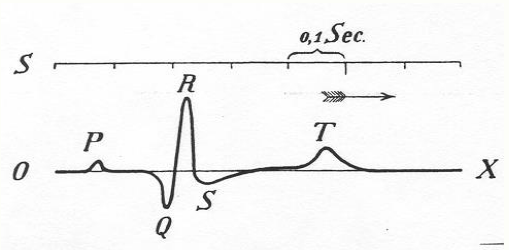
Cardio-diagnostic Investigations

1. ECG Recording
2. Cardiac Monitoring
3. TMT/Exercise ECG/Dobutamine Stress Test
4. Holter monitoring
5. Echocardiography
6. Pericardiocentesis
7. Pulse Oxymetery
8. Chest X-ray
9. Cardiac Angiography
10. Others: Pulse, BP, Heart Sound, CT, MRT etc

2.HISTORY

The Nobel Prize in Physiology or Medicine 1924

"for his discovery of the mechanism of the electrocardiogram"



Willem Einthoven

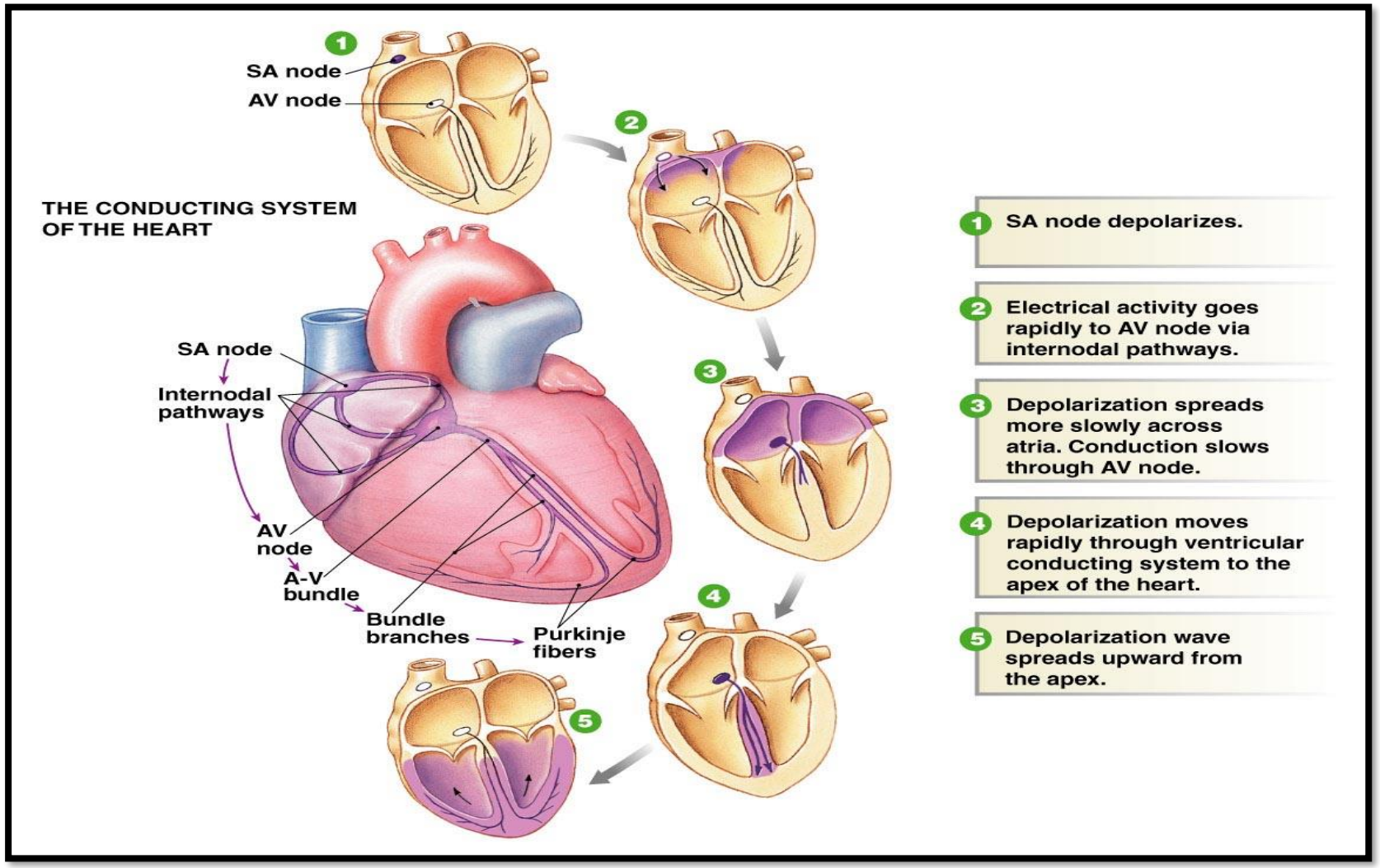
the Netherlands

Leiden University
Leiden, the Netherlands

b.1860
(in Semarang, Java, then Dutch East Indies)
d.1927

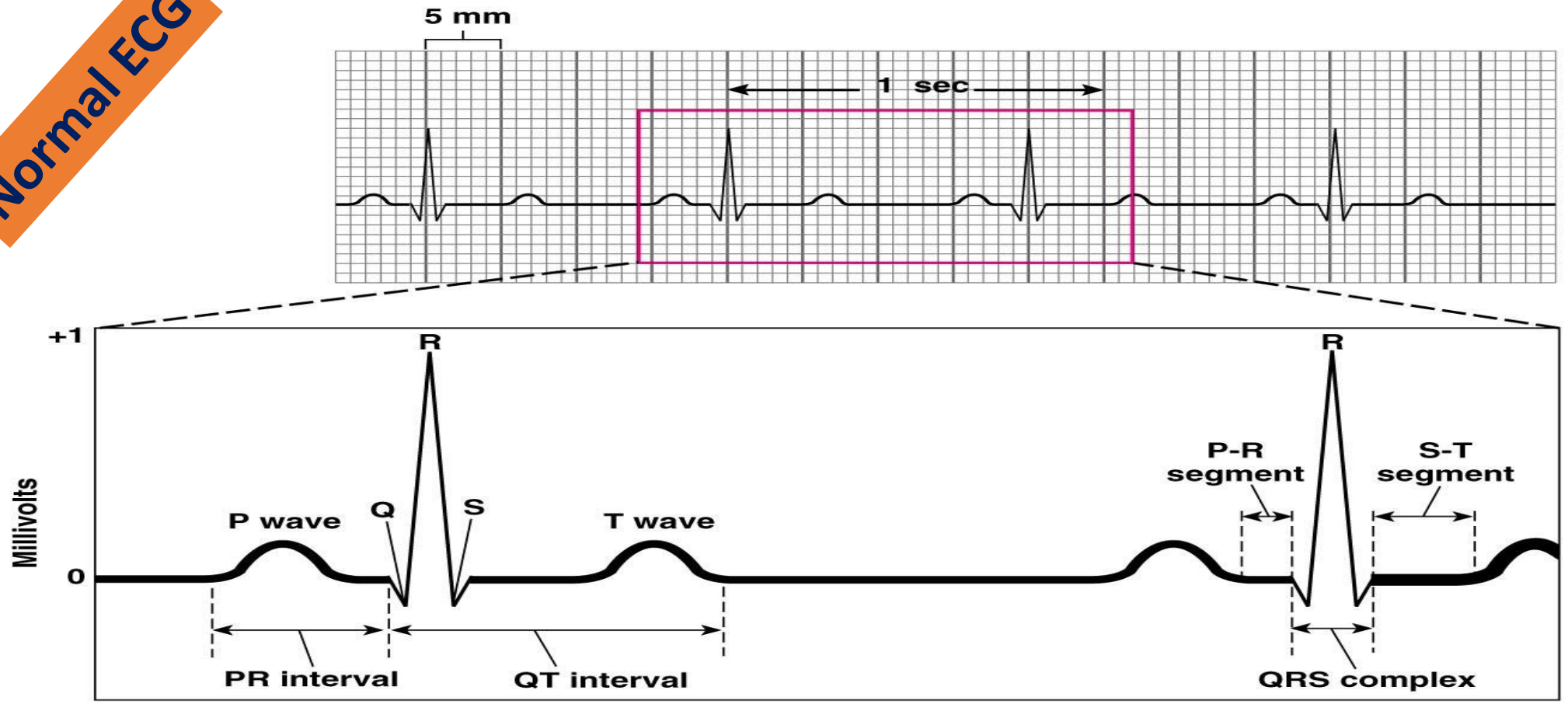
- The ECG is not only the oldest but, in fact, over 100 years after its introduction, continues as the most commonly used cardiovascular laboratory procedure.

MECHANISM OF CONDUCTING SYSTEM OF THE HEART

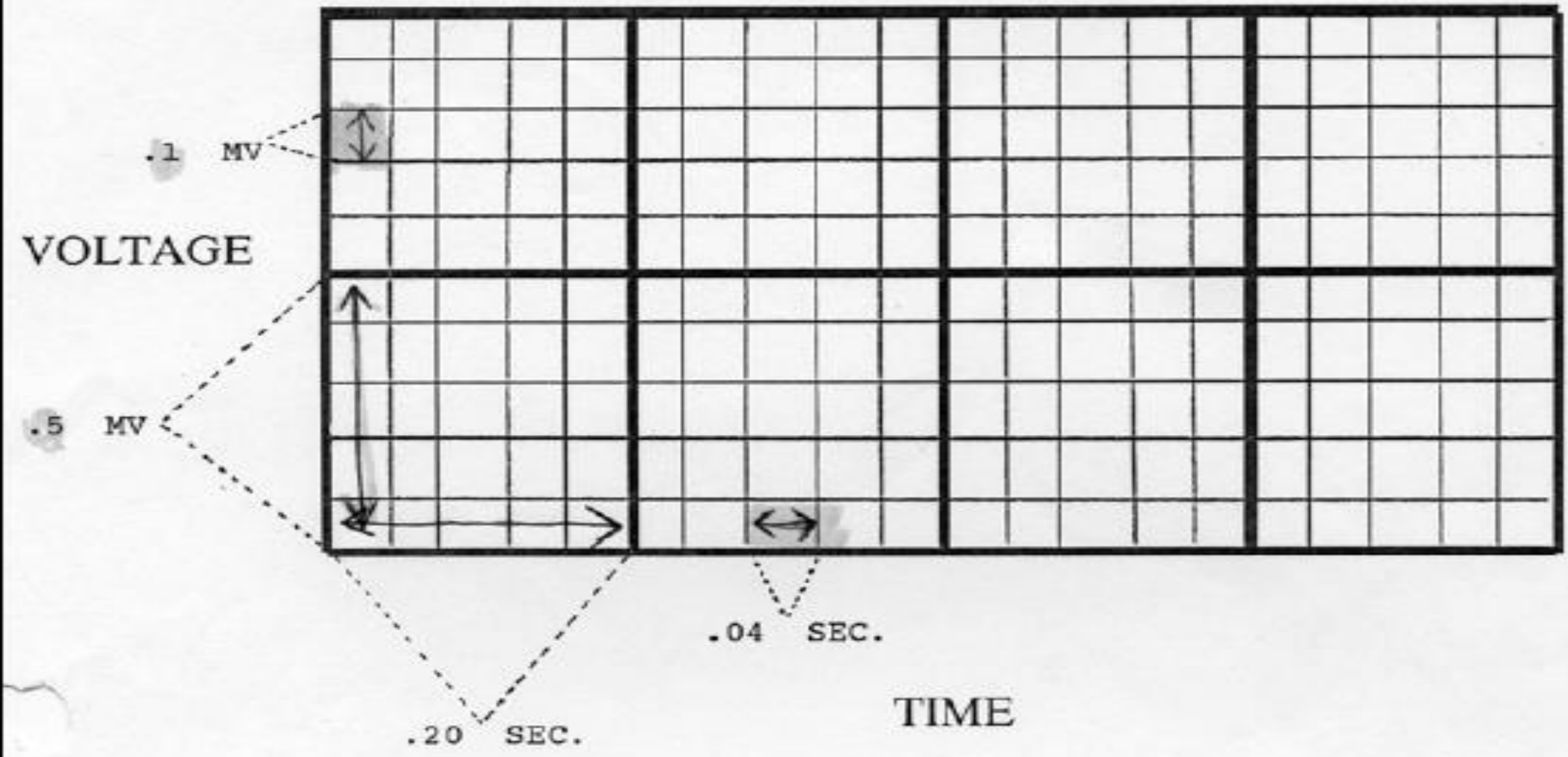


WHAT DOES THE ECG LOOK LIKE?

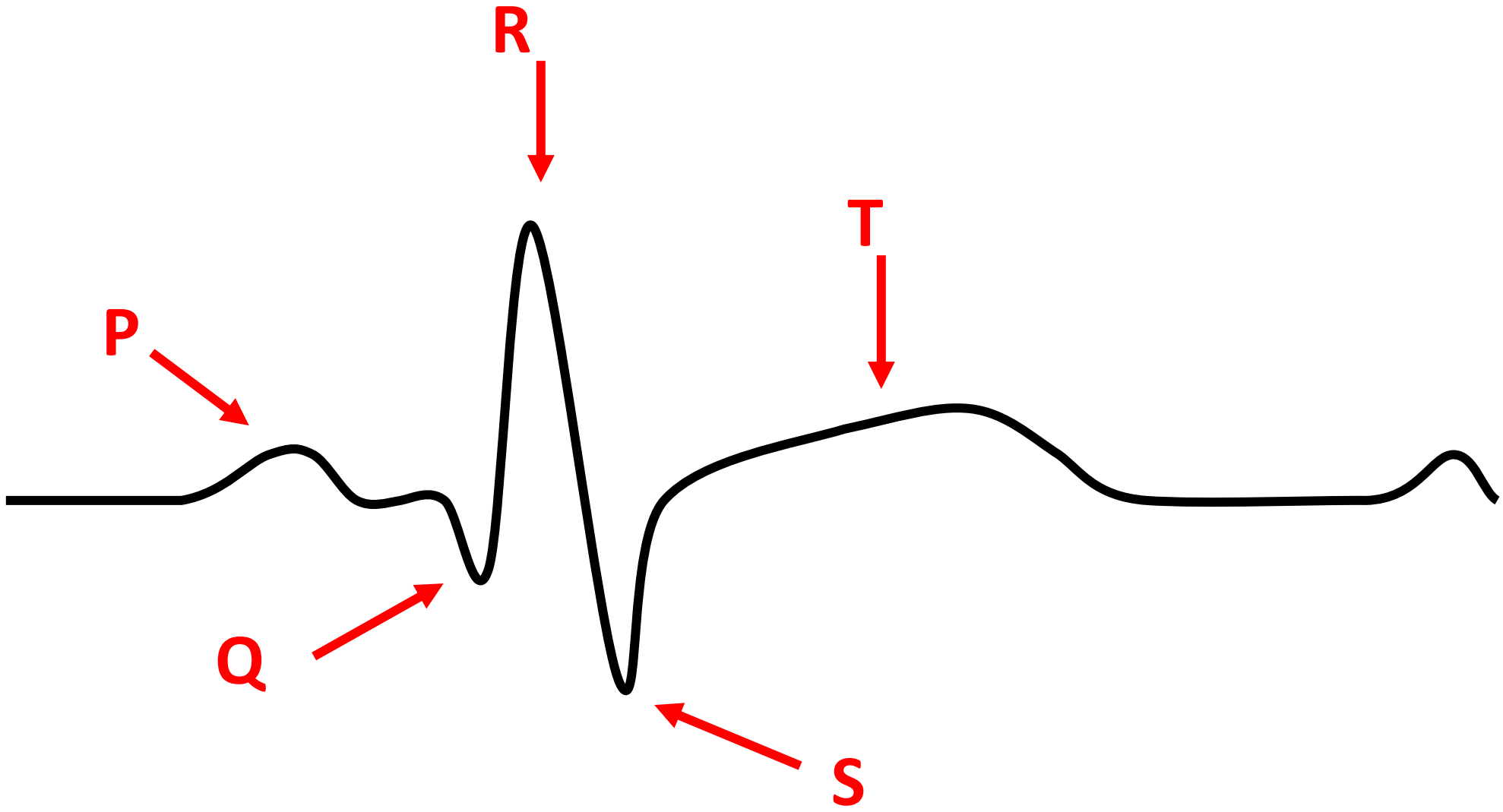
Normal ECG



ECG PAPER

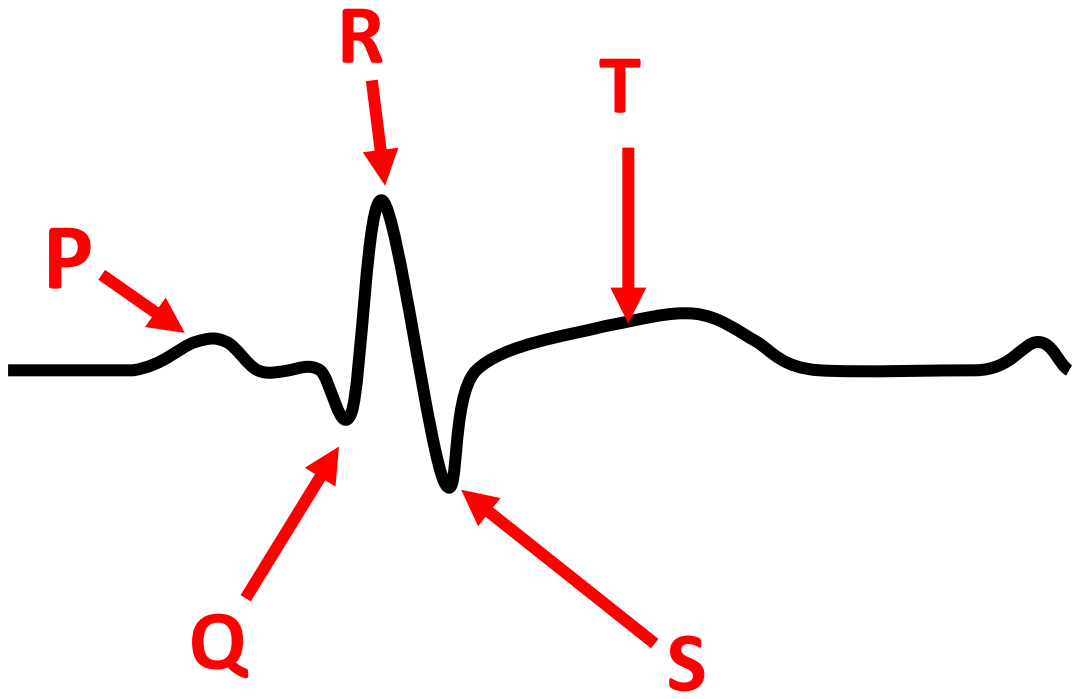


WAVES



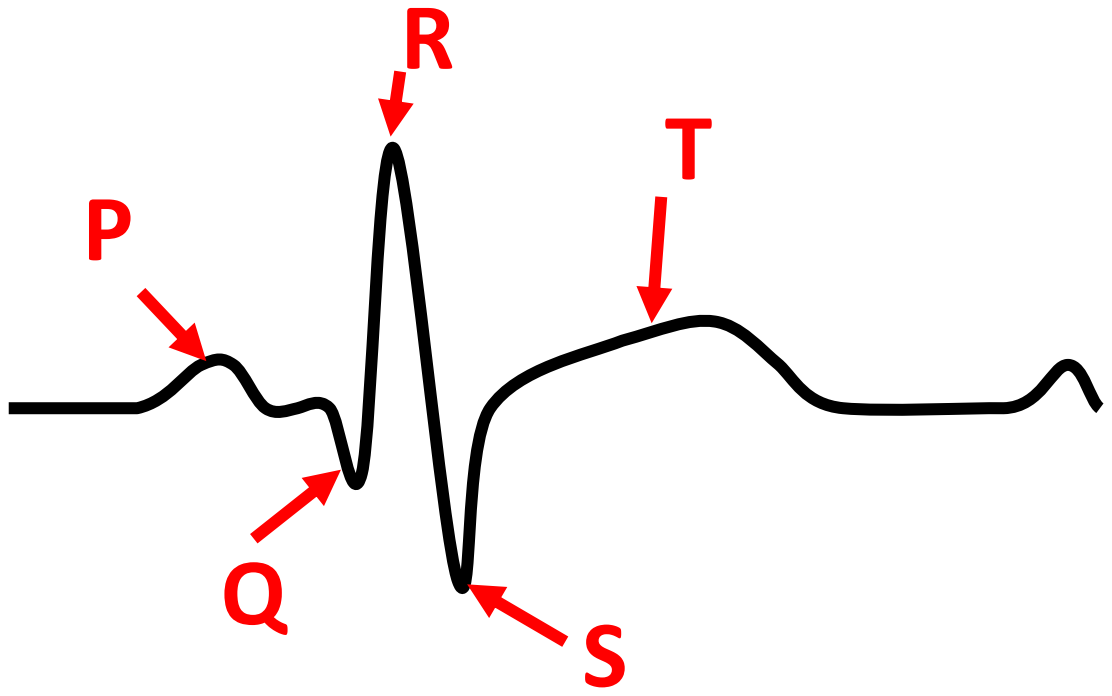
ELECTROCARDIOGRAM WAVES

- **P-wave :** **Depolarization of atria**
  - Atria begin contracting about 25msec after the start of the p-wave
- **QRS-complex** : **Ventricular Depolarization**
  - Ventricles begin contracting shortly after the peak of the **R wave**
- **T-wave** : **Ventricular Repolarization**



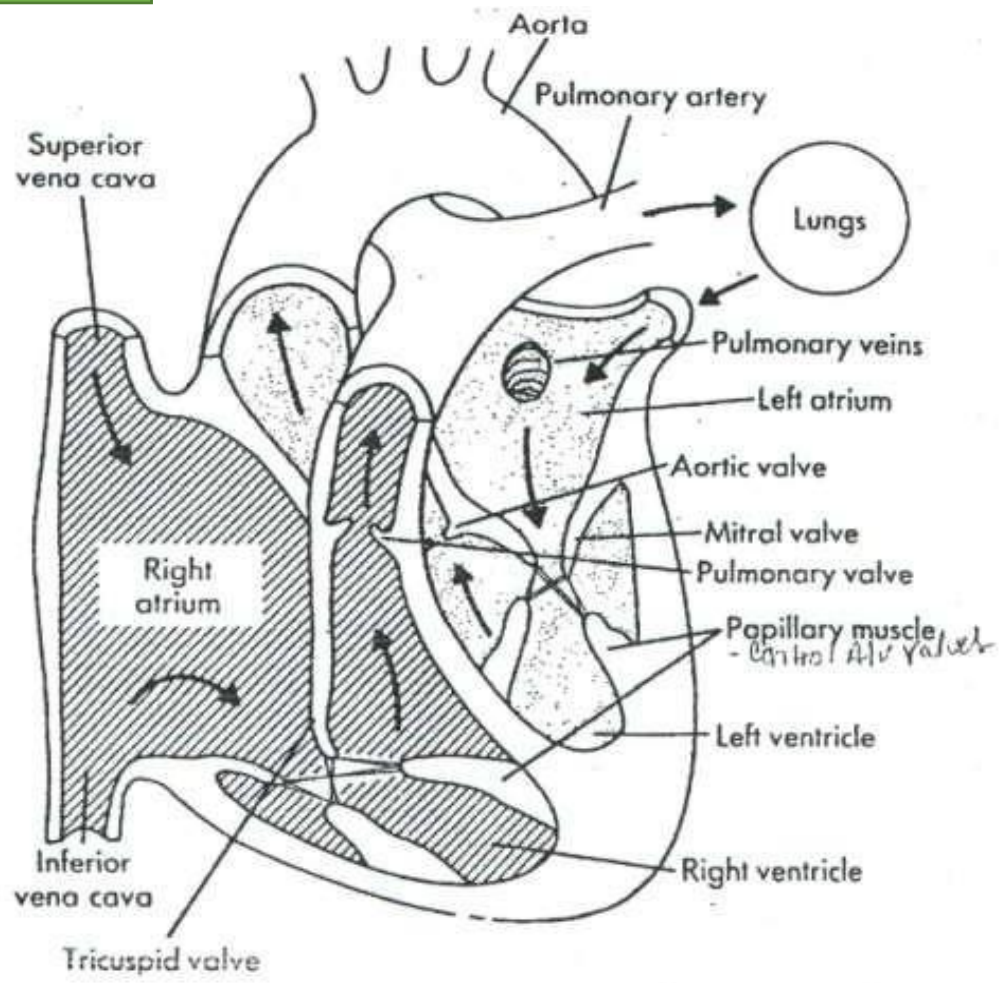
Electrocardiogram intervals/segments

- **Segments :** Extend from the end of one wave to the start of another
- **P-R interval**: Start of atrial depolarization to start of QRS
- **Q-T interval:** Time required for ventricles to undergo a single cycle of depolarization and repolarization; measured from end of P-R to end of T wave



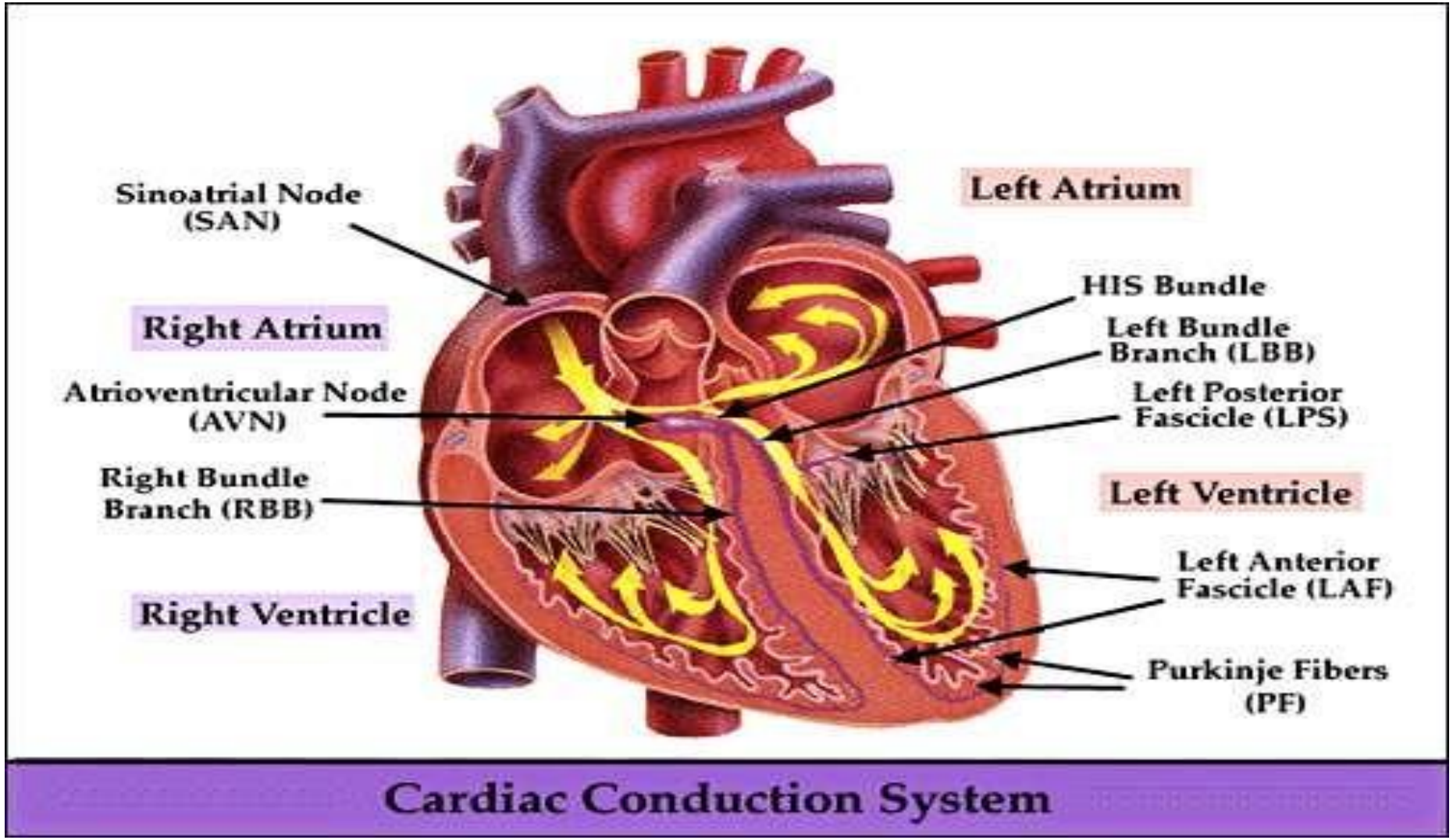
Anatomy & Physiology

- **Blood Flow through heart**
  - Superior and Inferior
    - Vena Cava
  - Right Atrium
  - Right Ventricle
  - Pulmonary Artery
  - Lungs
  - Pulmonary Vein
  - Left Atrium
  - Left Ventricle
  - Aorta
  - Body



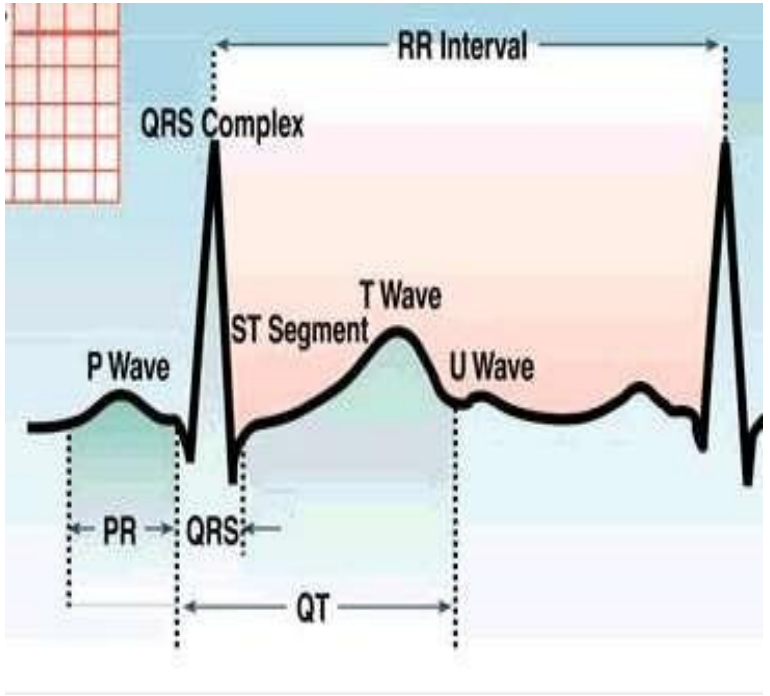
Review Basic of ECG

Conduction System



Conduction System

- The heart has a conduction system separate from any other system
- The conduction system makes up the PQRST complex we see on paper
- An arrhythmia is a disruption of the conduction system
- Understanding how the heart conducts normally is essential in understanding and identifying arrhythmias



Conduction System

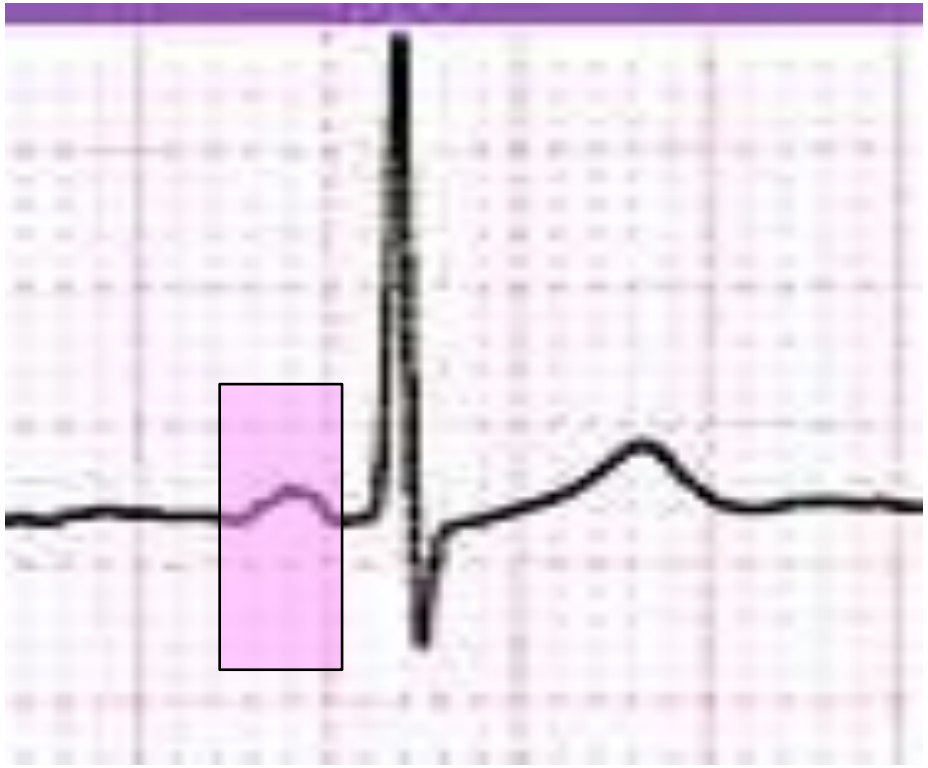
- SA Node
- Inter-nodal and inter-atrial pathways
- A-V Node
- Bundle of His
- Perkinje Fibers

SA Node

1. The primary pacemaker of the heart
2. Each normal beat is initiated by the SA node
3. Inherent rate of 60-100 beats per minute
4. Represents the P-wave in

   the QRS complex or atrial depolarization

   (firing)

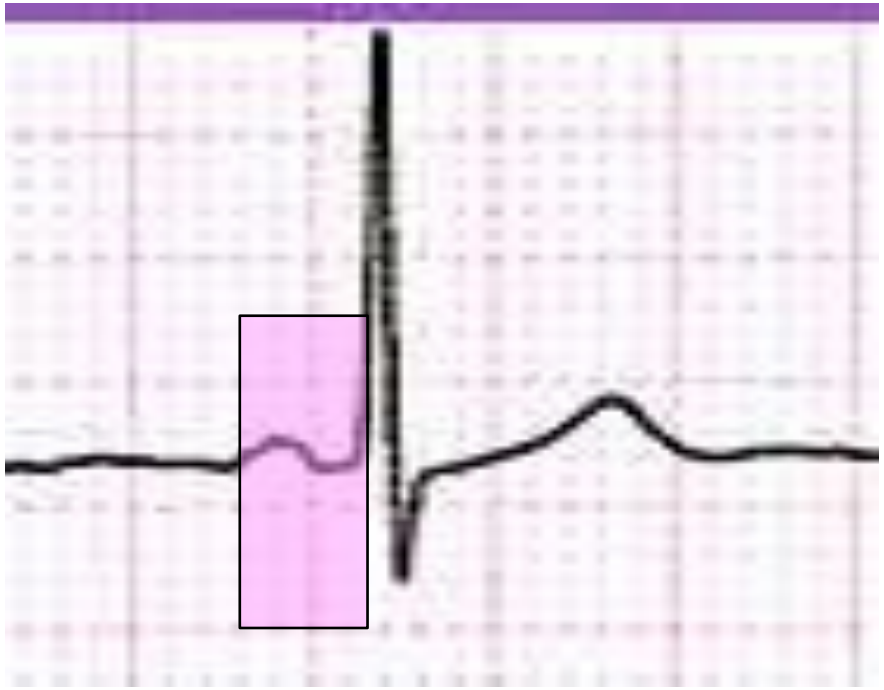


AV Node

- Located in the septum of the heart
- Receives impulse from inter-nodal pathways and holds the signal before sending on to the Bundle of His
- Represents the PR segment of the QRS complex

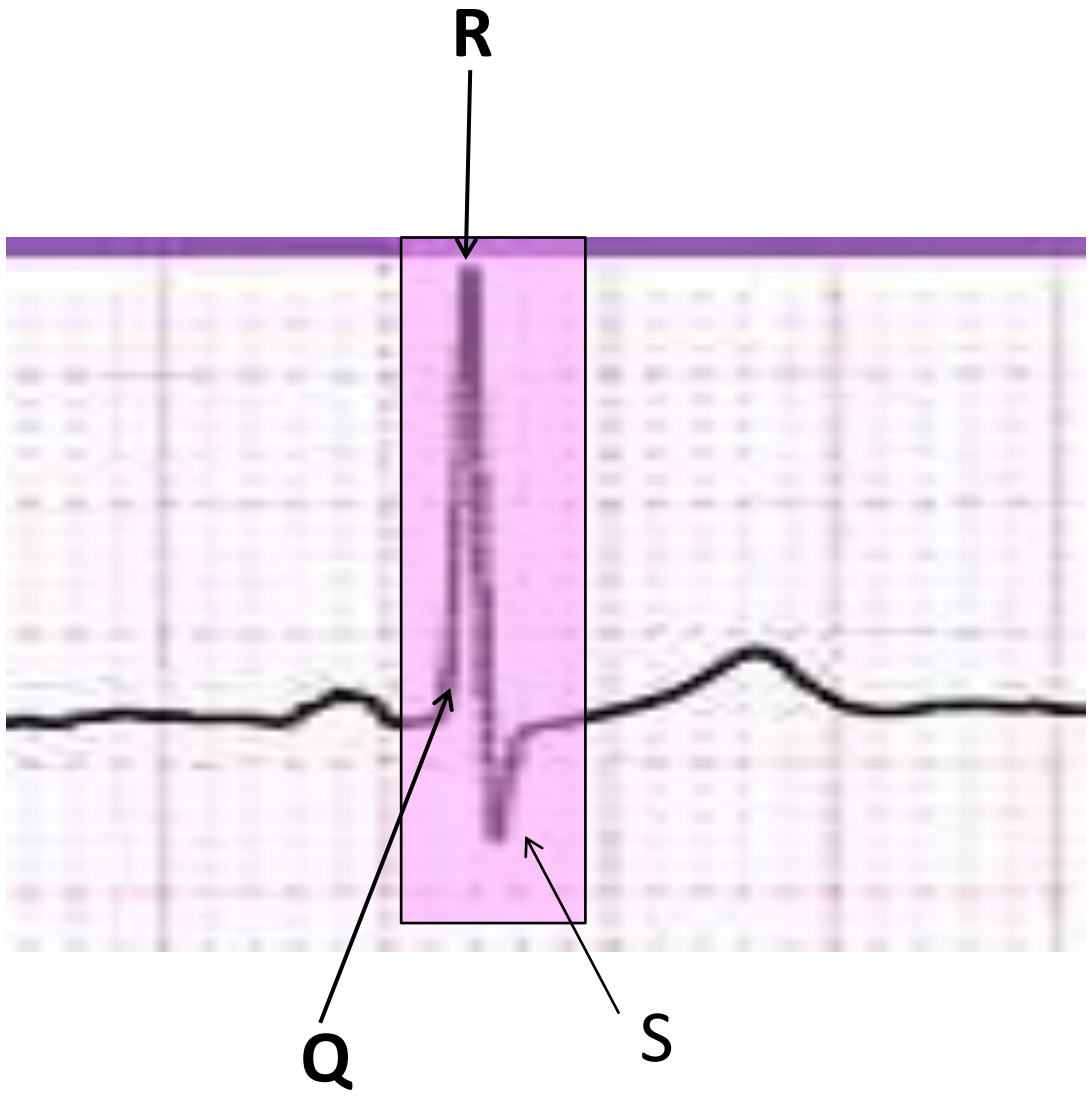
AV Node

- Represents the PR segment of the cardiac cycle
- Has an inherent rate of 40-60 beats per minute
- Acts as a back up when the SA node fails
- Where all junctional rhythms originate



QRS Complex

- Represents the ventricles depolarizing (firing) collectively. (Bundle of His and Perkinje fibers)
- Origin of all ventricular rhythms
- Has an inherent rate of 20-40 beats per minute



Normal Impulse Conduction

Sinoatrial node

↓

AV node

↓

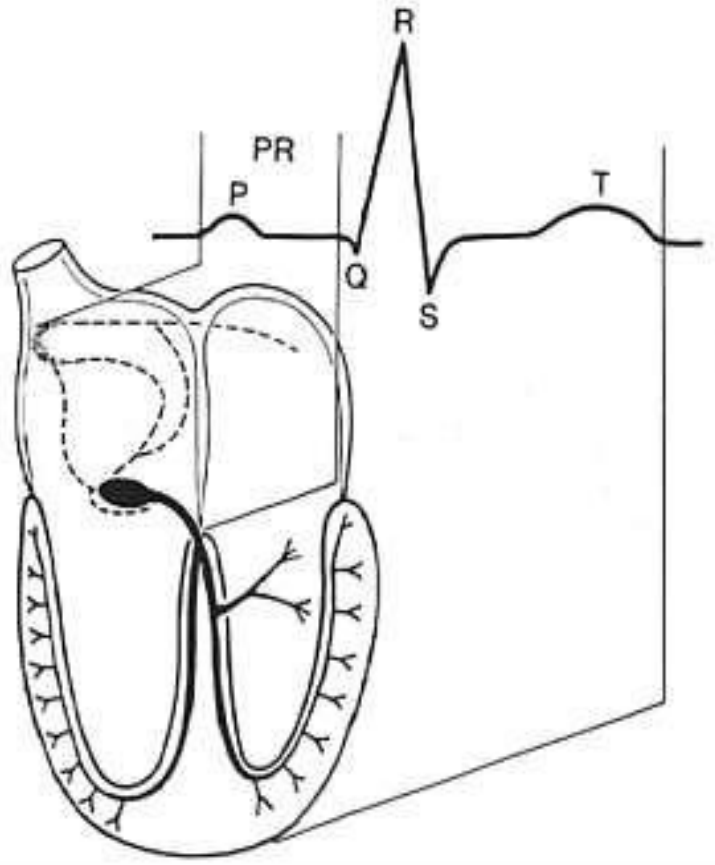
Bundle of His

↓

Bundle Branches

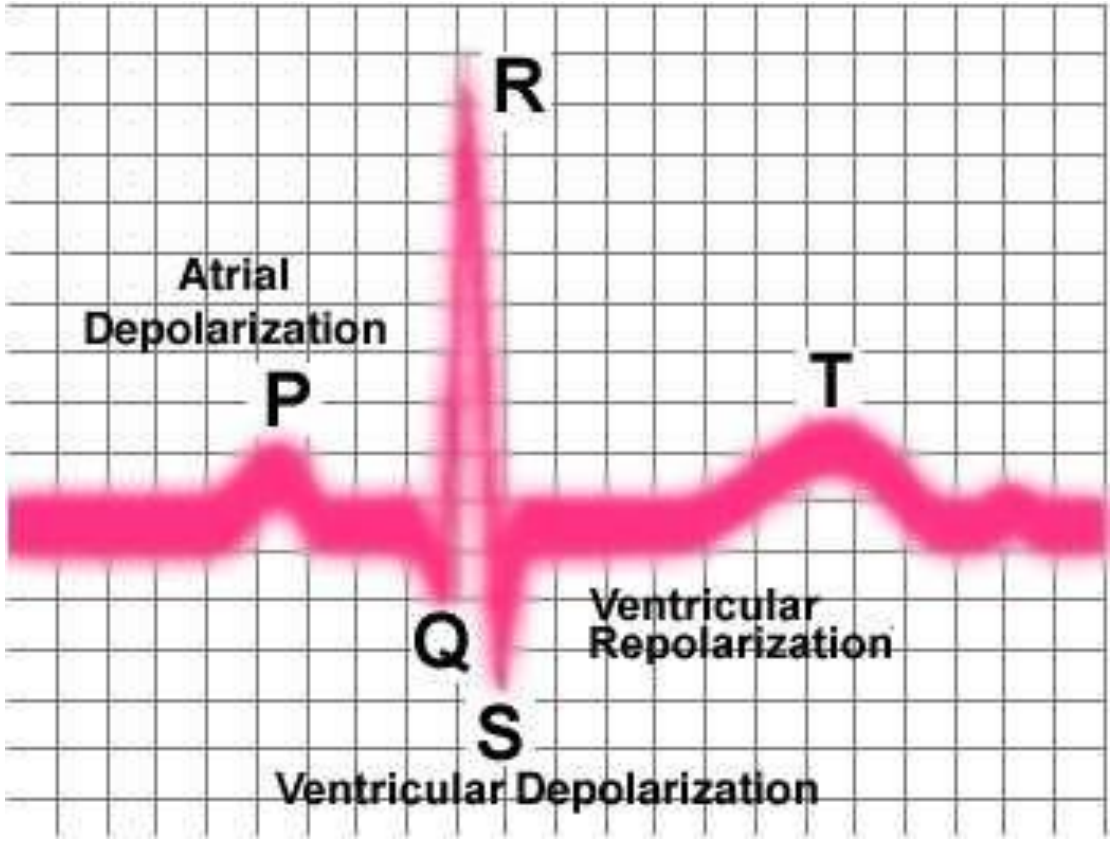
↓

Purkinje fibers



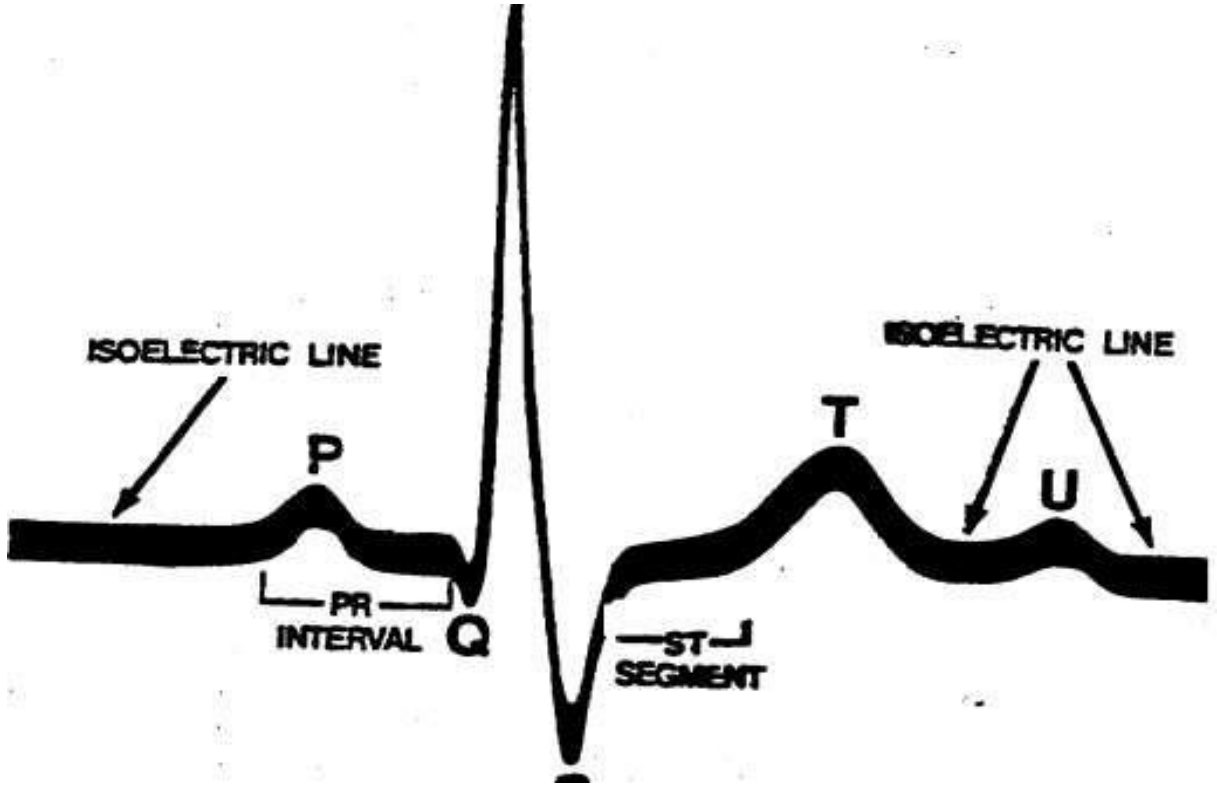
EKG Trace

- Isoelectric line (baseline)
- P-wave
  - Atria firing
- PR interval
  - Delay at AV



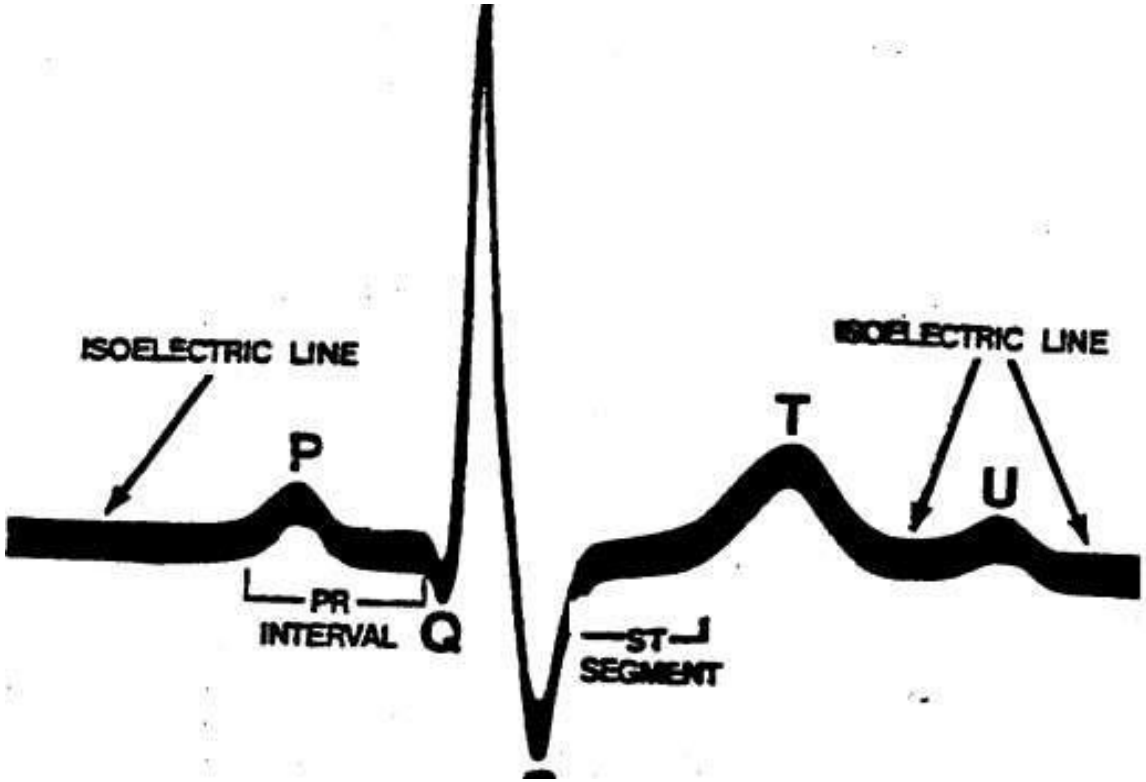
EKG Trace

- **QRS**
  - Ventricles firing
- **T-wave**
  - Ventricles repolarizing



EKG Trace

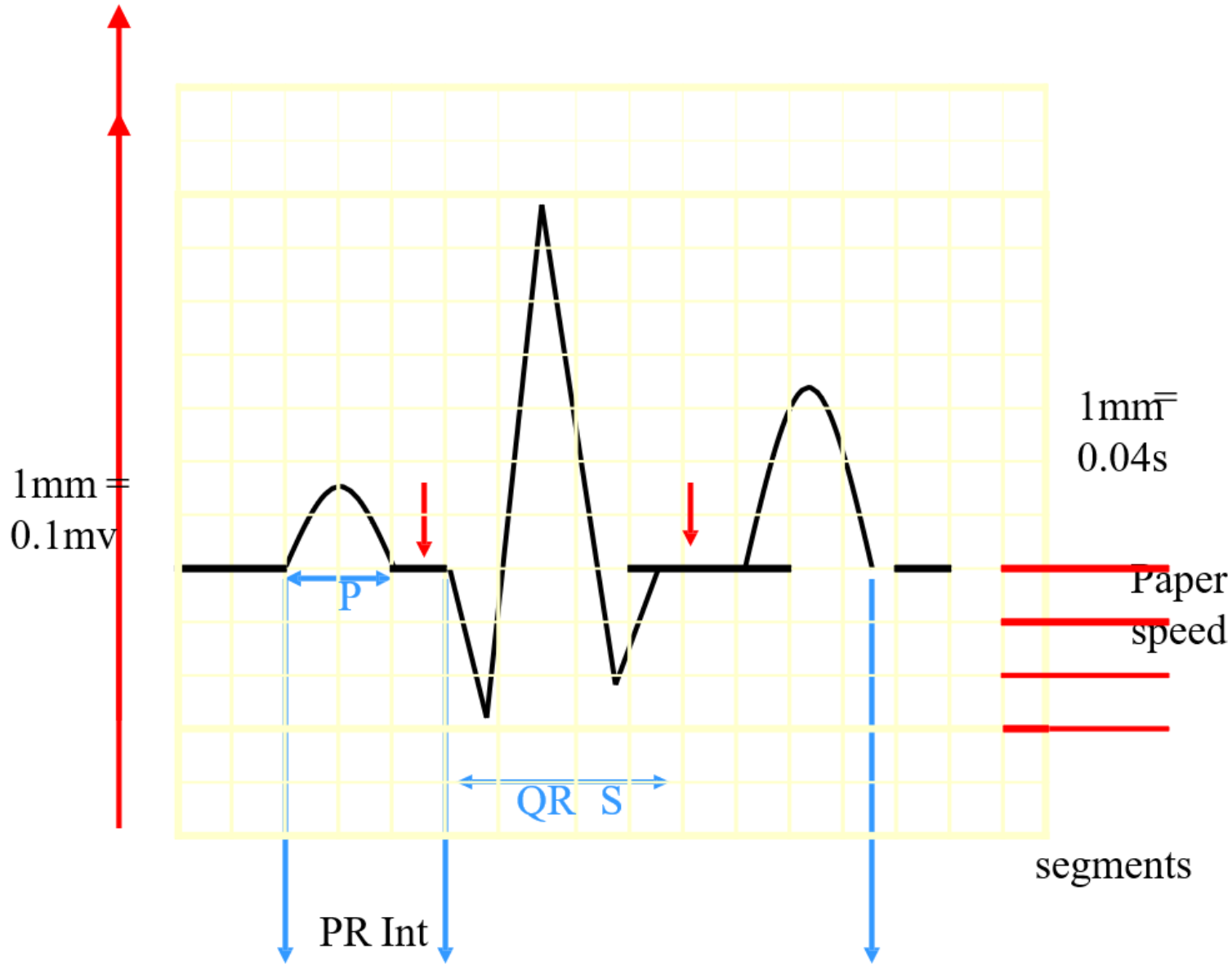
- **ST segment**
  - Ventricle contracting
  - Should be at isoelectric line
  - Elevation or depression may be important
- **U wave**
  - Perkinje fiber repolarization?



Waveform Analysis

- For each strip it is necessary to go through steps to correctly identify the rhythm

1. Is there a P-wave for every QRS?
   - P-waves are upright and uniform
   - One P-wave preceding each QRS
2. Is the rhythm regular?
   - Verify by assessing R-R interval
   - Confirm by assessing P-P interval
3. What is the rate?
   - Count the number of beats occuring in one minute
   - Counting the p-waves will give the atrial rate
   - Counting QRS will give ventricular rate


1mm =
0.1mv
1mm =
0.04s
P
QR S
PR Int
Paper
speed
segments

SUMMARY

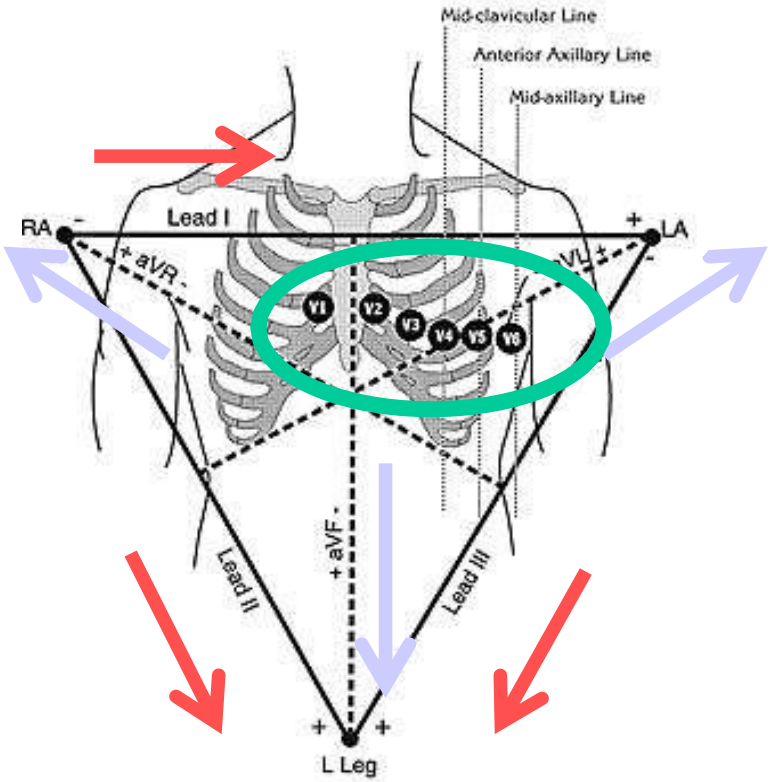
- Normal
  - Heart rate = 60 – 100 bpm
  - PR interval = 0.12 – 0.20 sec
  - QRS interval <0.12
  - SA Node discharge = 60 – 100 / min
  - AV Node discharge = 40 – 60 min
  - Ventricular Tissue discharge = 20 – 40 min

SUMMARY

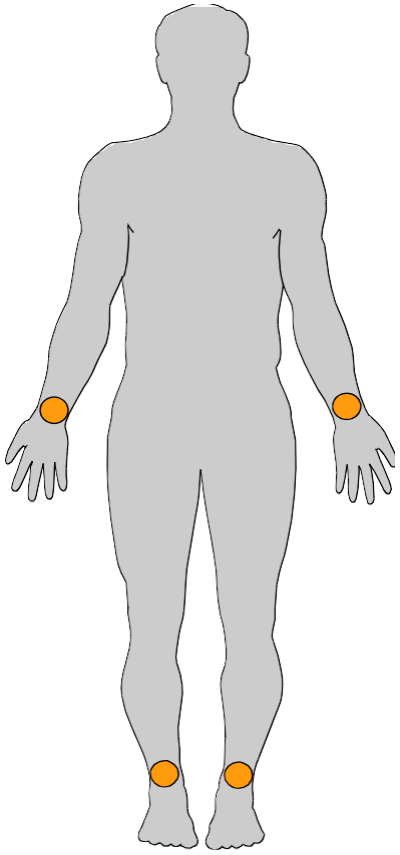
- Cardiac cycle
  - P wave = atrial depolarization
  - PR interval = pause between atrial and ventricular depolarization
  - QRS = ventricular depolarization
  - T wave = ventricular repolarization

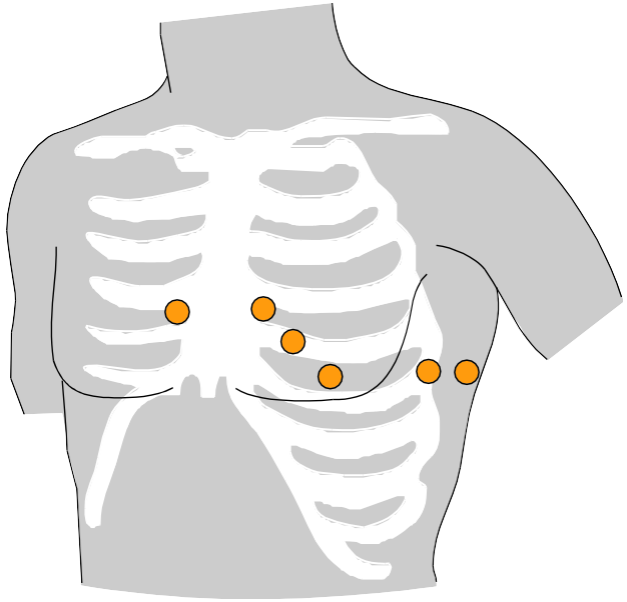
THE 12-LEADS

- The 12-leads include:
  - –3 Limb leads (I, II, III)
  - –3 Augmented leads (aVR, aVL, aVF)
  - –6 Precordial leads (V_1- V_6)



LEAD VIEWS



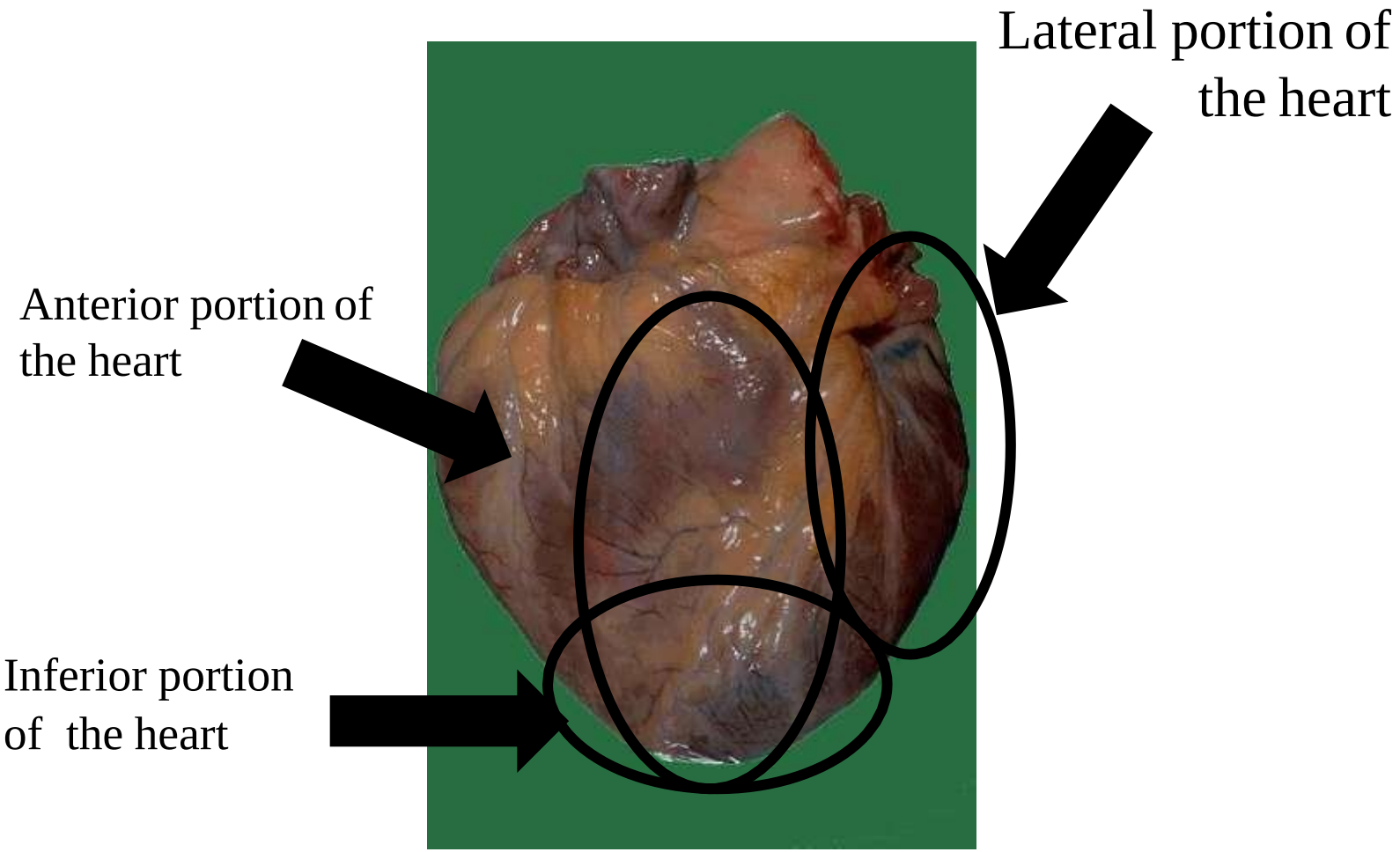


Leads paced in limbs (arm/leg) RT Minimum Muscle as to decrease muscle twitching.

Anatomic Groups (Summary)

I Lateral	aVR None	V_1 Septal	V_4 Anterior
II Inferior	aVL Lateral	V_2 Septal	V_5 Lateral
III Inferior	aVF Inferior	V_3 Anterior	V_6 Lateral

Other MI Locations



Features to Analyze on every ECG

1. Standardization / Calibration / Technical Quality
2. Heart Rate
3. Rhythm
4. PR interval
5. P-wave Size
6. QRS-width/interval
7. QT interval
8. R-wave progression in chest leads
9. Abnormal q-wave
10. ST Segment
11. T-wave
12. U- wave
13. Others-Axis, voltage etc

Determining the Heart Rate

1 Small Squire =1mm/0.04sec.

1 Large Squire =5mm/0.2sec.

5 Large Squire =25mm/1 sec.

Calibration : 25mm/sec, 25x6o=1500

: 10mm/sec, 10x60=600

: 100mm/sec, 100x60=6000

Rule of 300 (Clinical use)

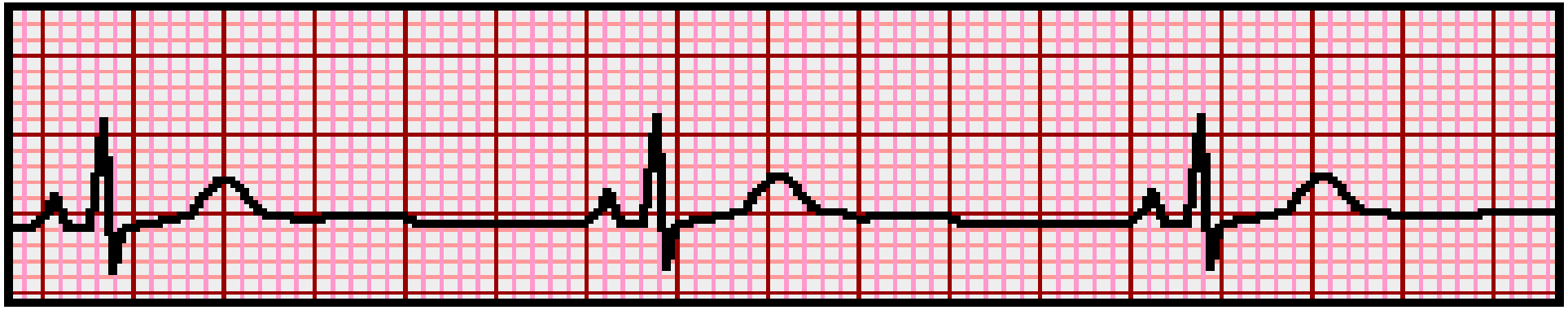
- **Take the number of "big boxes" between neighboring QRS complexes, and divide this into 300. The result will be approximately equal to the rate**

When Heart Rate Regular:

- 300/ No of large squires between 2 ‘ R ’ wave
  = HR/min (300/4=75 min)

- 1500/ No. of small squire between 2 ‘R’ wave
  =HR/min.(1500/20=75min)

What is the heart rate?



(300 / 6) = 50 bpm

What is the heart rate?

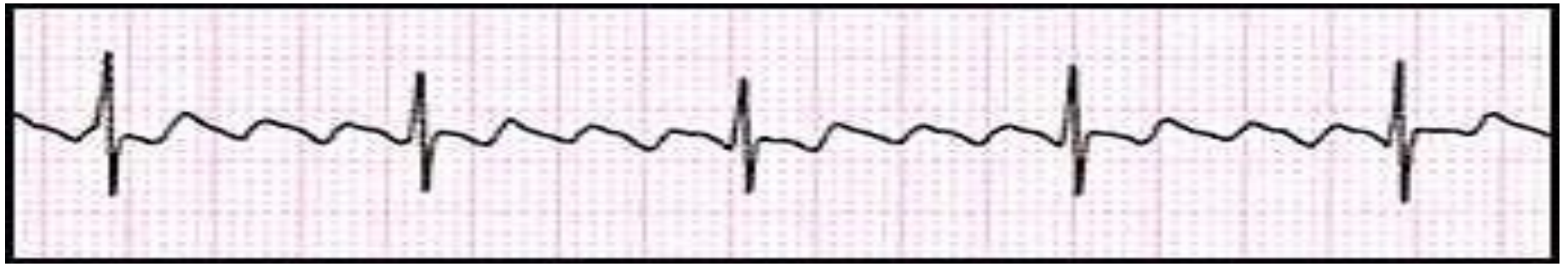
(300 / ~ 4) = ~ 75 bpm

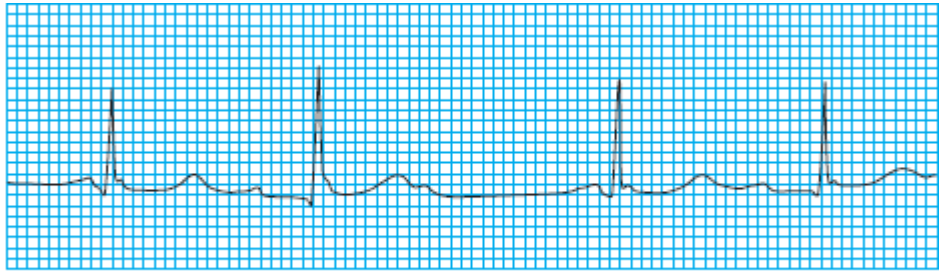
The Rule of 300

- It may be easiest to memorize the following table:

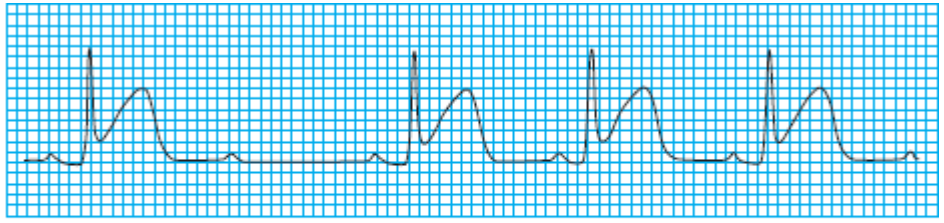
# of big boxes	Rate
1	300
2	150
3	100
4	75
5	60
6	50

RHYTHM





Mobitz type I block (Wenckebach phenomenon)

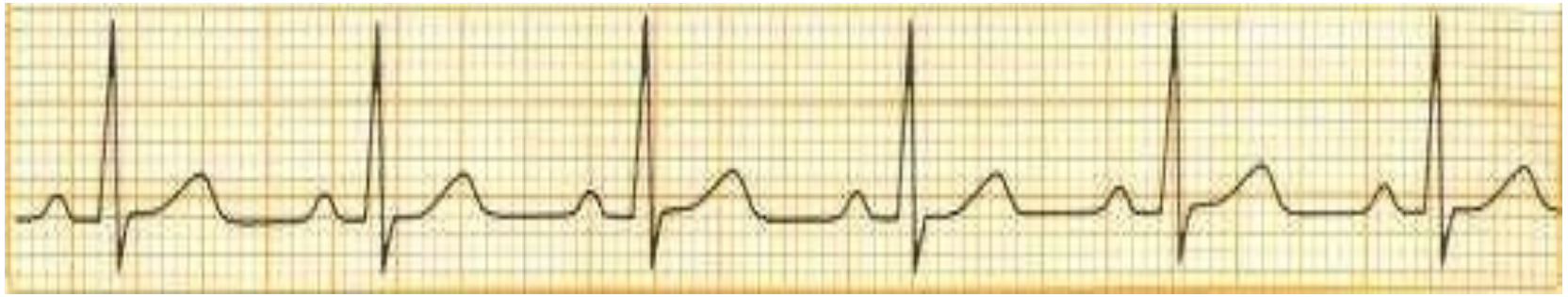


Mobitz type II block–a complication of an inferior myocardial infarction. The PR interval is identical before and after the P wave that is not conducted

COMMON ECG VIEW

Sinus Rhythms

- **Normal Sinus Rhythm**



Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
60 - 100	Regular	Before each QRS, Identical	.12 - .20	<.12

Sinus Rhythms

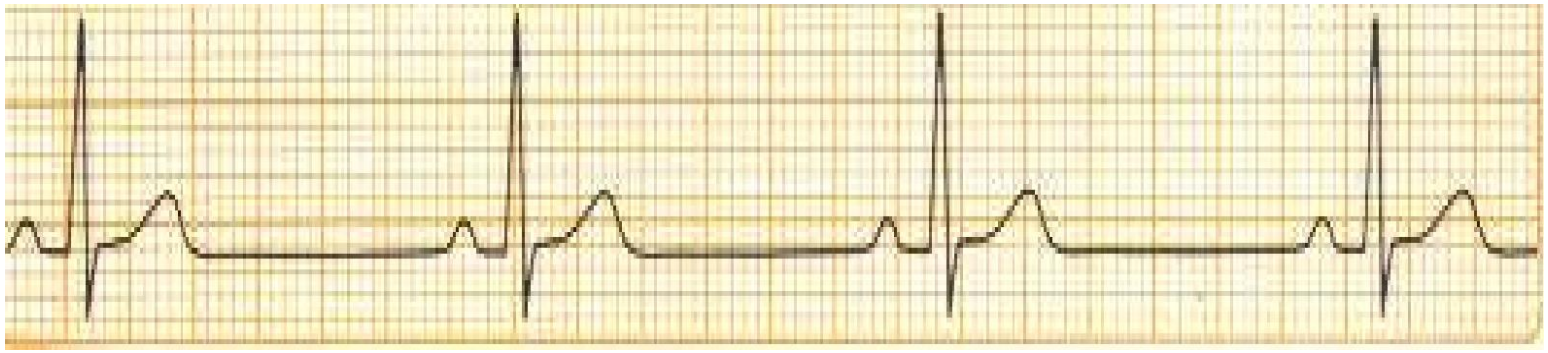
- Normal Sinus Rhythm
  - Sinus Node is the primary pacemaker
  - One upright uniform p-wave for every QRS
  - Rhythm is regular
  - Rate is between 60-100 beats per minute

Cardiac Arrhythmias

Abnormal Rhythm?

Sinus Rhythms

Sinus Bradycardia



Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
<60	Regular	Before each QRS, Identical	.12 - .20	<.12

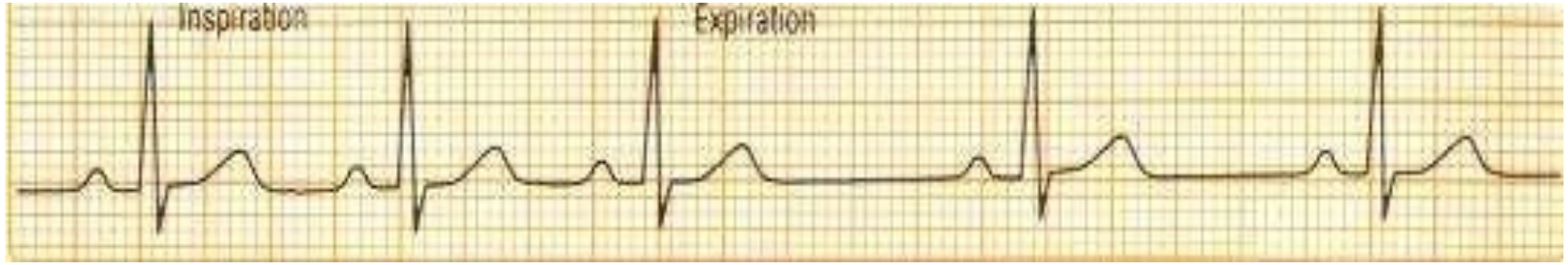
Sinus Rhythms

Sinus Tachycardia

Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
>100	Regular	Before each QRS, Identical	.12 - .20	<.12

Sinus Rhythms

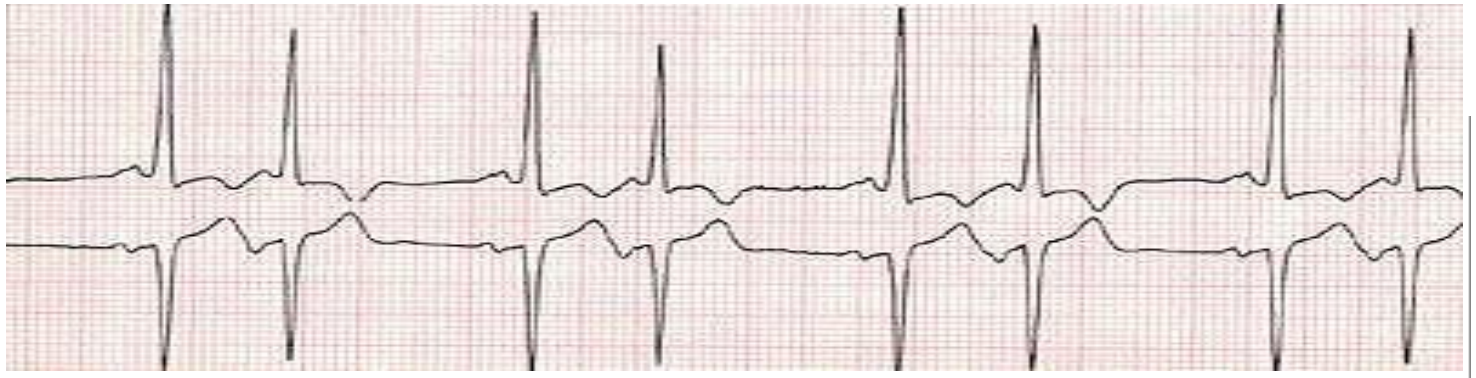
Sinus Arrhythmia



Heart Rate	**Rhythm**	P Wave	PR Interval (sec.)	QRS (Sec.)
Var.	**Irregular**	Before each QRS, Identical	.12 - .20	<.12

Atrial Rhythms

Premature Atrial Contraction (PAC)



Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
NA	Irregular	Premature & abnormal or hidden	.12 - .20	<.12

Atrial Rhythms

Atrial Fibrillation

Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
Var.	Irregular	Wavy irregular	NA	<.12

Atrial Rhythms

Atrial Flutter

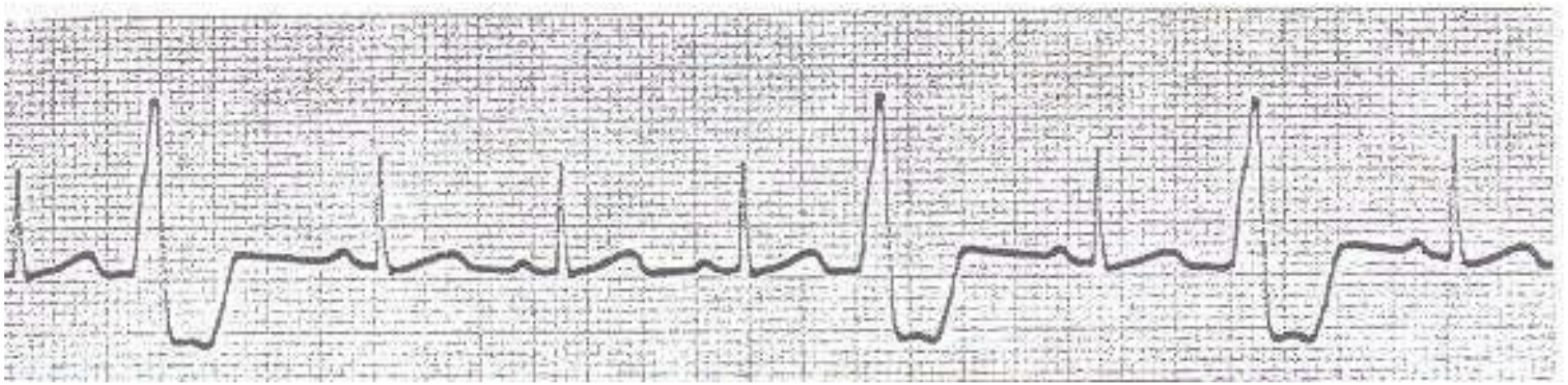
Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
Atrial=250 – 400 Ventricular Var.	Irregular	Sawtooth	Not Measur-able	<.12

Ventricular Rhythms

Premature Ventricular Contraction (PVC)

Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
Var.	Irregular	No P waves associated with premature beat	NA	Wide >.12

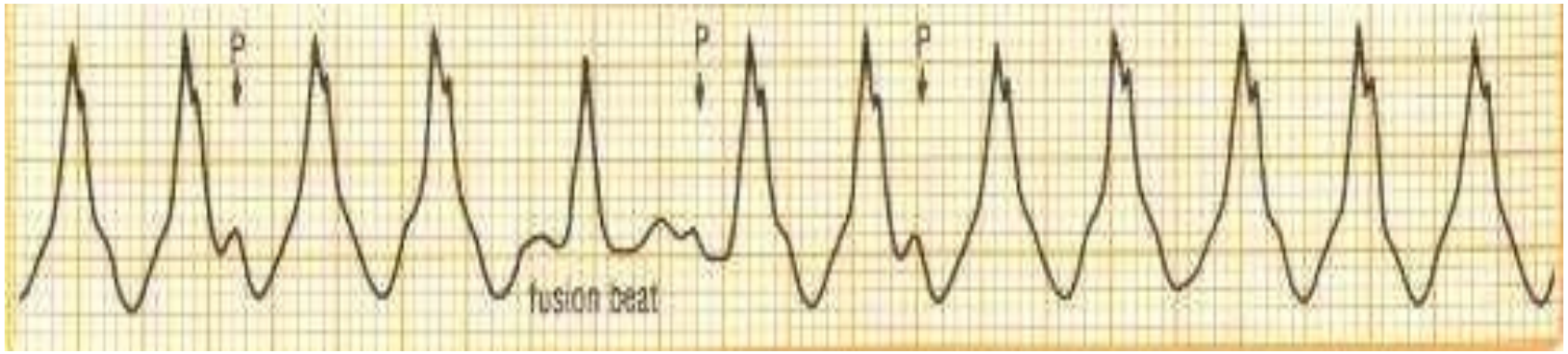
Ventricular Rhythm



PVC

Ventricular Rhythms

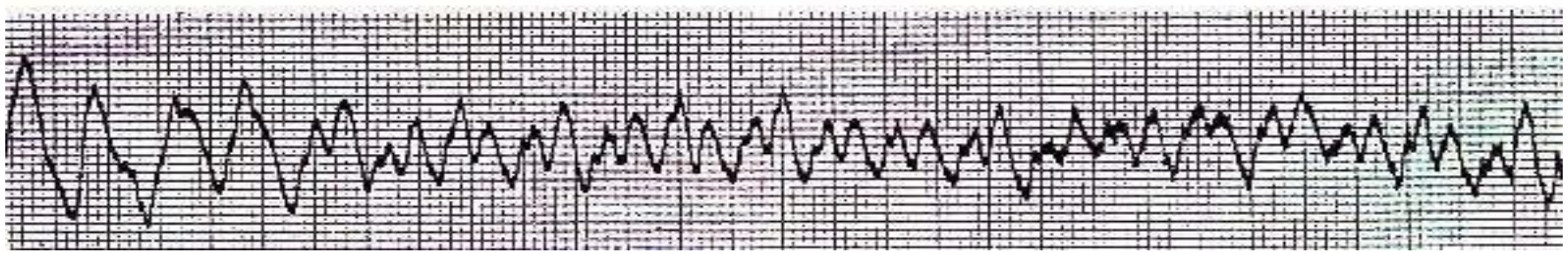
Ventricular Tachycardia



Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
100 – 250	Regular	No P waves corresponding to QRS, a few may be seen	NA	>.12

Ventricular Rhythms

Ventricular Fibrillation



Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
0	Chaotic	None	NA	None

Asystole

Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
None	None	None	None	None

Begin C P R

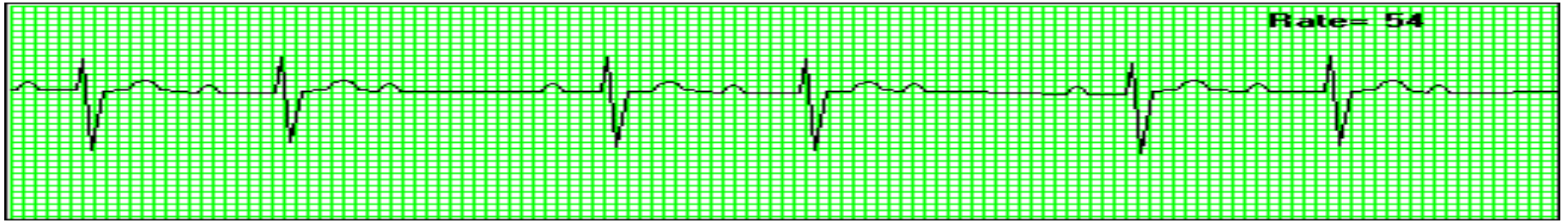
Heart Block

First Degree Heart Block

Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
Norm.	Regular	Before each QRS, Identical	> .20	<.12

Heart Block

Second Degree Heart Block Mobitz Type I (Wenckebach)



Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
Norm. can be slow	Irregular	Present but some not followed by QRS	Progressively longer	<.12

Heart Block

Second Degree Heart Block Mobitz Type II (Classical)

Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
Usually slow	Regular or irregular	2 3 or 4 before each QRS, Identical	.12 - .20	<.12 **depends**

Heart Block

Third Degree Heart Block (Complete)

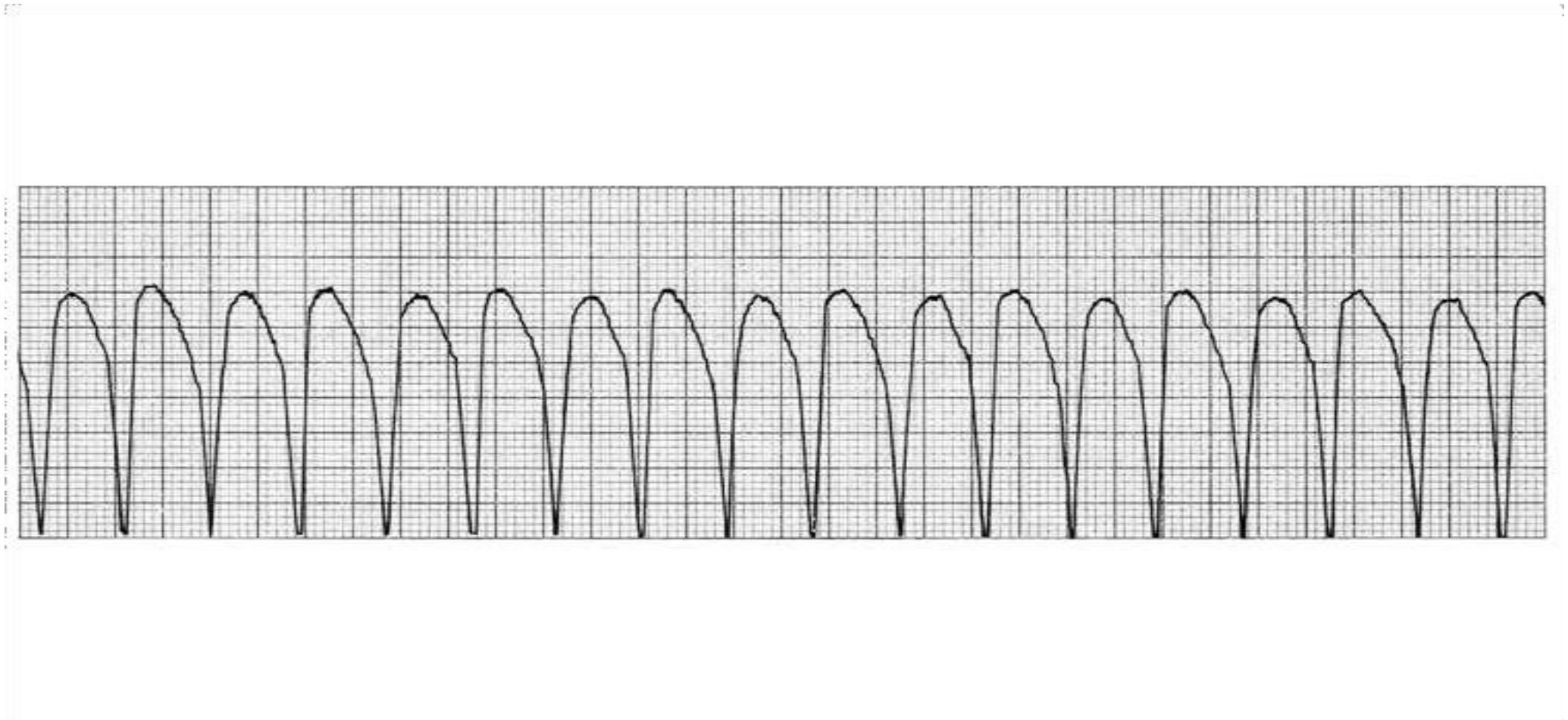
Heart Rate	Rhythm	P Wave	PR Interval (sec.)	QRS (Sec.)
30 – 60	Regular	Present but no correlation to QRS may be hidden	Varies	<.12 depends

Look Some ECGs

Normal Sinus Rhythm

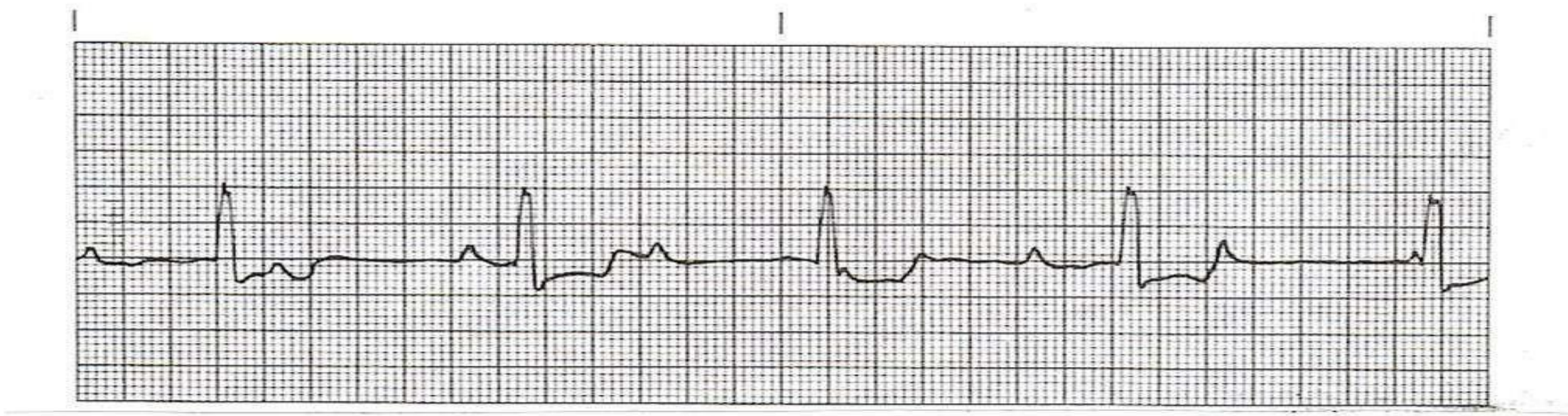
Premature Ventricular Complex

Ventricular Tachycardia

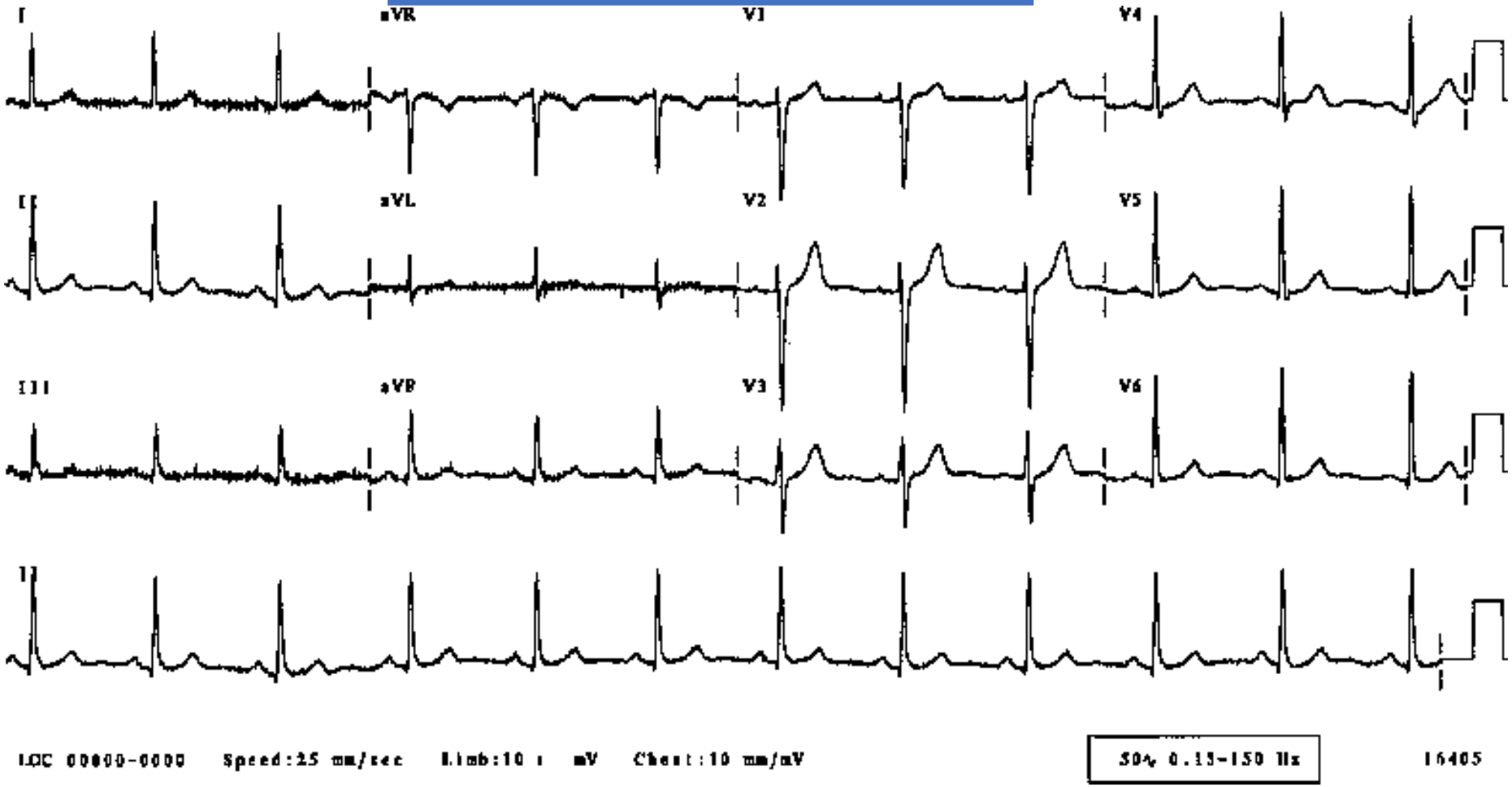


Ventricular Fibrillation Agonal Rhythm

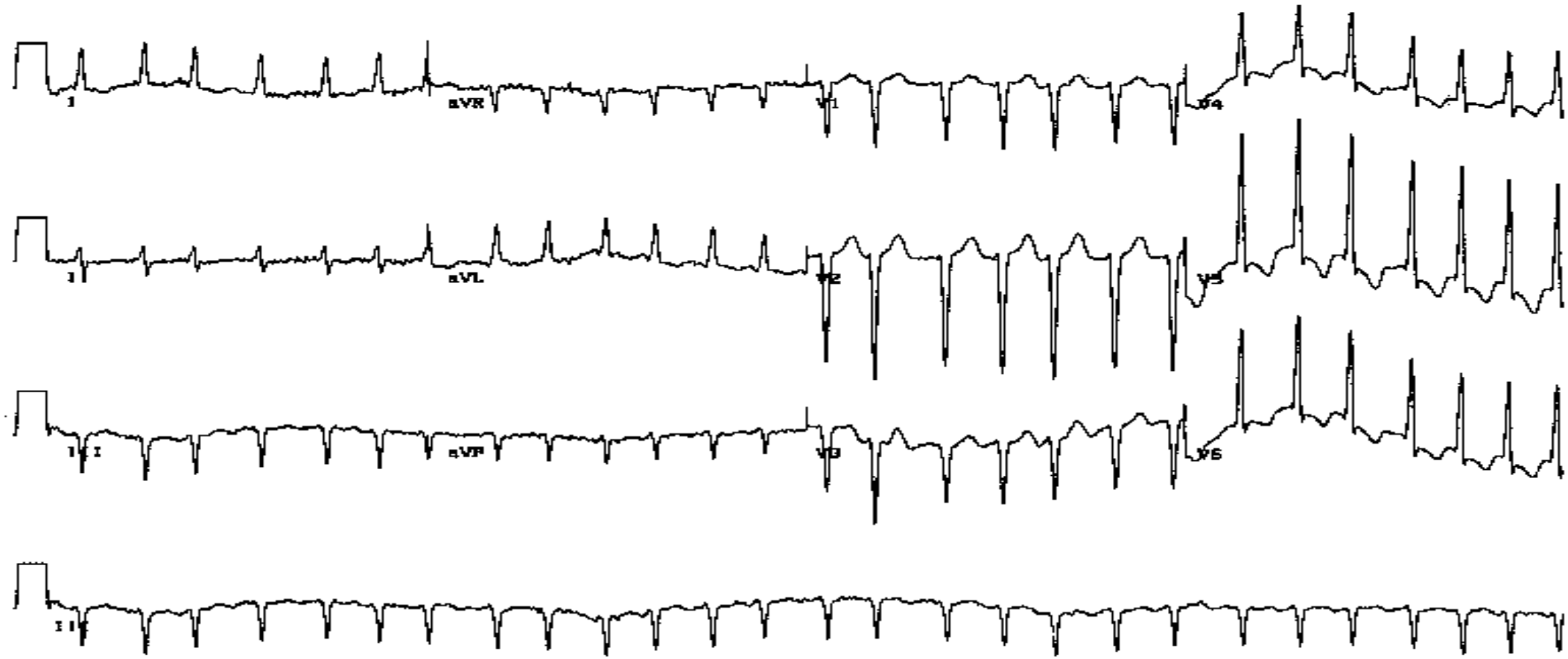
Third-Degree Heart Block



NORMAL EKG

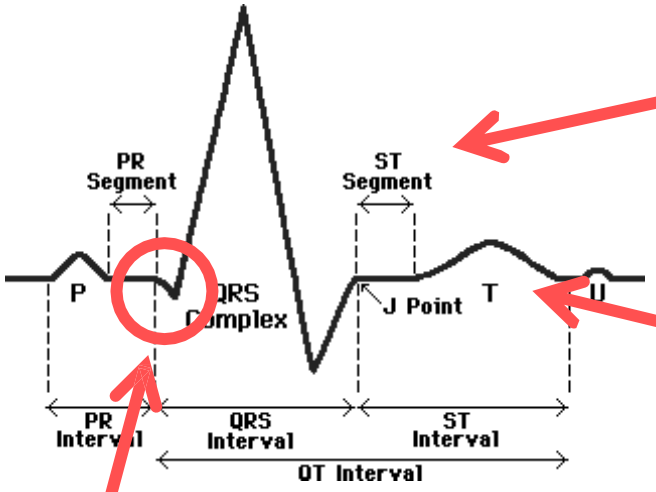

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
LOC 00000-0000
Speed:25 mm/sec
Limb:10 mV
Chest:10 mm/mV
50% 0.15-150 Hz
16405

Atrial Fibrillation with Rapid Ventricular Response



ECG CHANGES

Ways the ECG can change include:

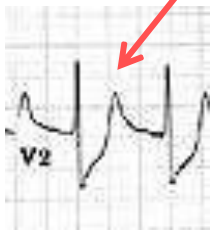


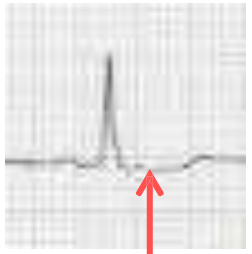
ST elevation & depression

T-waves

Appearance of pathologic Q-waves

peaked





flattened

inverted

Diagnosis of Arrhythmia

- **Medical history**
- **Physical examination**
- **ECG**
- **Laboratory test**

THERAPY PRINCIPLE

- **Pathogenesis therapy**
- **Stop the arrhythmia immediately if the hemodynamic was unstable**
- **Individual therapy**

Rx. : Commonly used drugs

1. **Lidocaine (xylocard)**
2. Procanamide
3. Mexiletine
4. Moricizine
5. Propafenone
6. **Propranolol**
7. Metoprolol
8. Verapamil
9. Diltiazen
10. Isoprenaline
11. **Epinephrine**
12. **Atropine**

DRUGS

VASOPRESER	ANTIARRYTHMIAS
Epinephrine	Amiodarone, Lidocaine
Norepinephrine	Atropine
Vasoprossine	Adenosine
Dopamine	- blockers
Dobutamine	Calcium channel blockers

Miscellaneous : Na Bicarbonate, Ca-Glucomate, Heparin

- **Drugs**
- **Cardioversoin: Low Voltage**
- **DC SHOCK: 200, 200-250, 270/360**
- **Carotid Massage**
- **Pri-cordail Thumb**
- **Artificial Pacing**

DC Cardio version

150-200, 200-250, 270-260 / 200, 250, 270

Monophasic = 360 J or Biphasic=270J Once Ok 2010 guidelines

Synchronized Cardioversion

- Shock delivery is timed with **QRS complex**
- Indications :
    - SVT reentry Atrial Flutter Atrial Fibrillation
- Energy used is lower than Defibrillation.

Precordial Thump

- Only to be executed by health care workers
- Risk of conversion of coordinated cardiac rhythm to VF/ PulselessVT/ asystole
- Not part of the training in BCLS & ACLS

SHOCKABLE

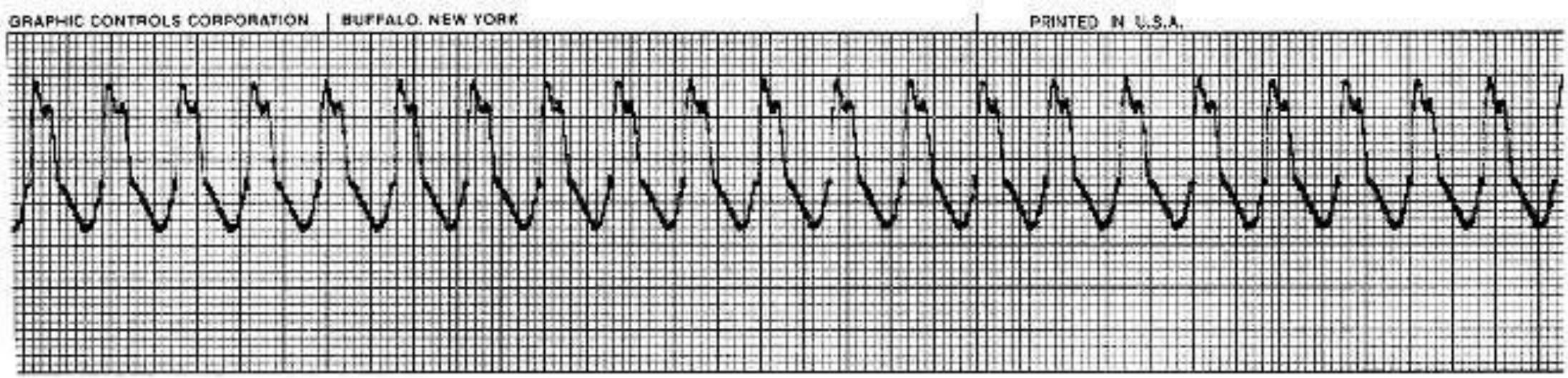


Figure 27-16 Ventricular tachycardia in lead V1.

SHOCKABLE

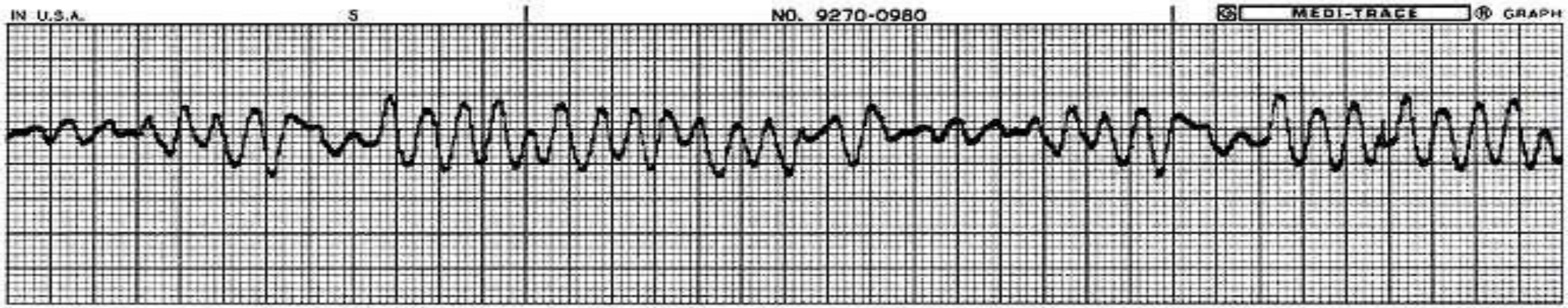


Figure 27-17 Ventricular fibrillation in lead II.

NON SHOCKABLE

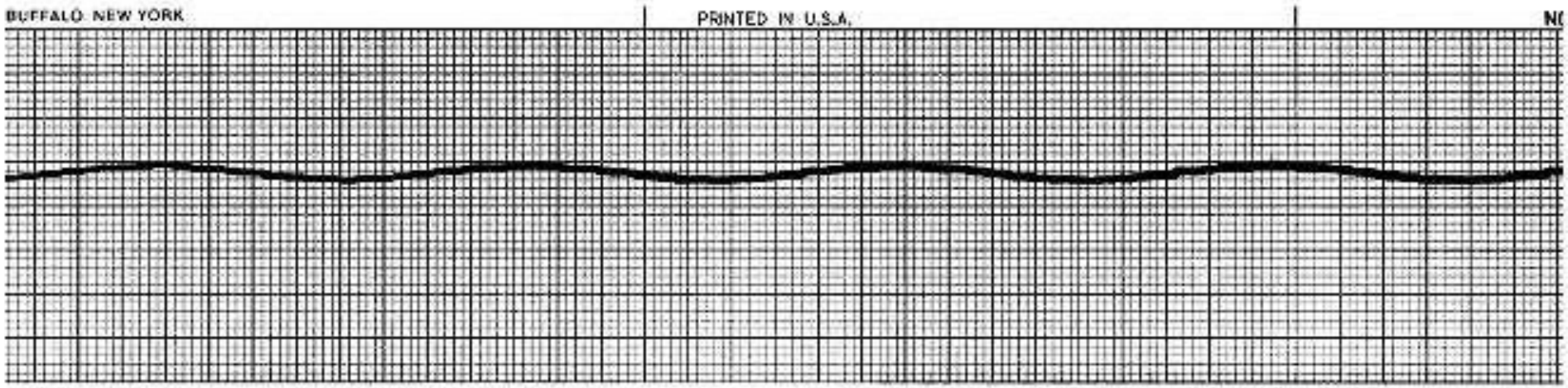


Figure 27-19 Asystole. (Always check two different leads to confirm rhythm.)

THANK YOU