



SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution



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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF BIOMEDICAL ENGINEERING

19BMB302 - BIOMEDICAL SIGNAL PROCESSING

III YEAR/ V SEMESTER

Unit IV : BIOSIGNALS AND THEIR CHARACTERISTICS

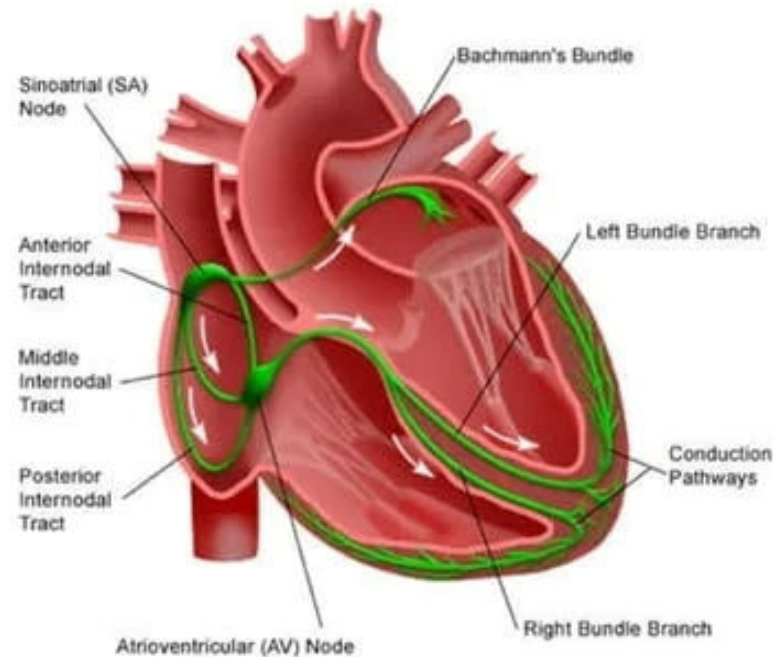


- Source of Bioelectric potential
- Resting and action potential
- Propagation of action potentials in nerves
- Characteristics of biomedical signals
- **The ECG-Cardiac electrophysiology**
- Relation of ECG components to cardiac events
- Clinical applications



Cardiac Electrophysiology

Electrical System of the Heart



The Electrical Conduction Pathway



Nervous System Stimulation

Sympathetic Nervous System: causes an increase in heart rate, increase in AV conduction , and increase in ventricular contractility

The increase is caused a release of norepinephrine
(catecholamine/neurotransmitter)



Nervous System Stimulation

Parasympathetic Nervous System: (from the vagus nerve) causes a slowing of the heart rate, a decrease in AV conduction, and a slight decrease in ventricular contractility

The decrease is caused a release of
acetylcholine
(catecholamine/neurotransmitter)



Pacemaker

Pacemaker – the SA node is the natural/normal pacemaker of the heart.

Latent Pacemaker Cells – Cells in the electrical conduction system located below the SA node with the property of automaticity

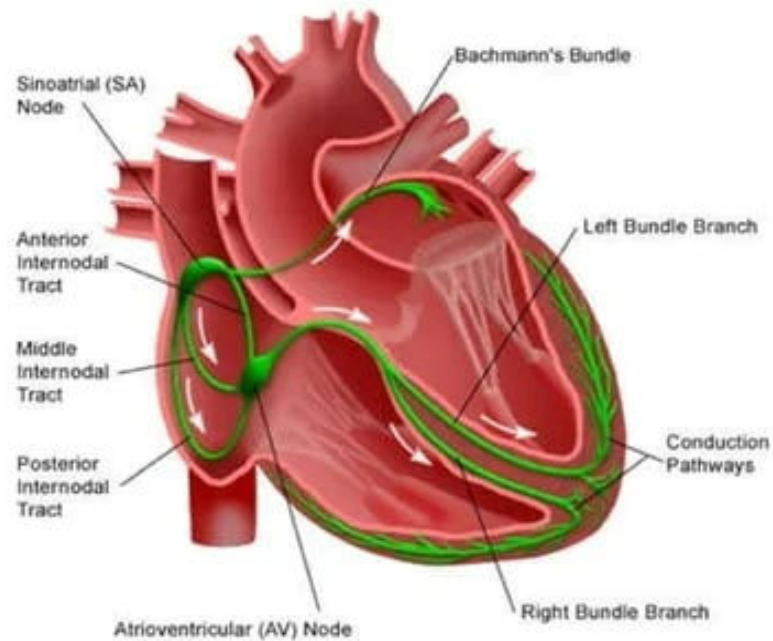
These cells hold the property of automaticity in reserve in case the SA node fails to function properly or electrical impulses fail to be conducted.

a.k.a. – *Subsidiary pacemaker cells*



The Electrical Conduction Pathway

Electrical System of the Heart





SA Node

- ie. Sinoatrial Node or Sinus Node
- Possesses the highest level of automaticity
- SA Node is the primary pacemaker of the heart
- If it fails to fire or slows down less than its inherent firing rate (60 – 100), another pacemaker that is lower in the conduction system will take over



AV Node (*The Gatekeeper*)

Three main functions:

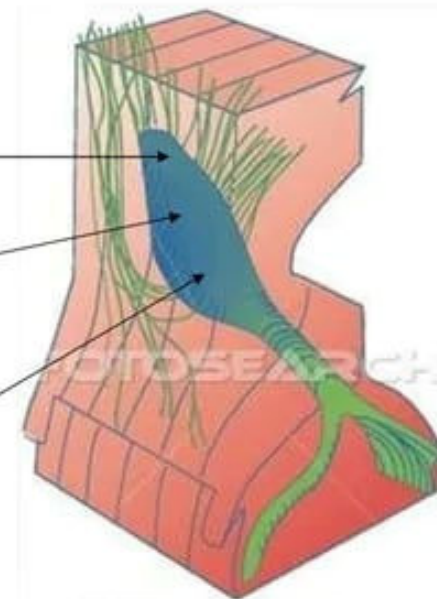
- Slows conduction to allow time for the atria to contract & empty its contents (atrial kick) before the ventricles contract
- Secondary pacemaker (40 – 59 bpm)
- Blocks some of the impulses from being conducted to the ventricles when atrial rate is rapid



AV Node (*The Gatekeeper*)

Three Regions:

- Atrial-Nodal (upper region)
Pacemaker cells
- Nodal (middle region)
No pacemaker cells (area responsible for delay)
- Nodal-His (lower region)
Pacemaker cells



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Ventricular Conduction

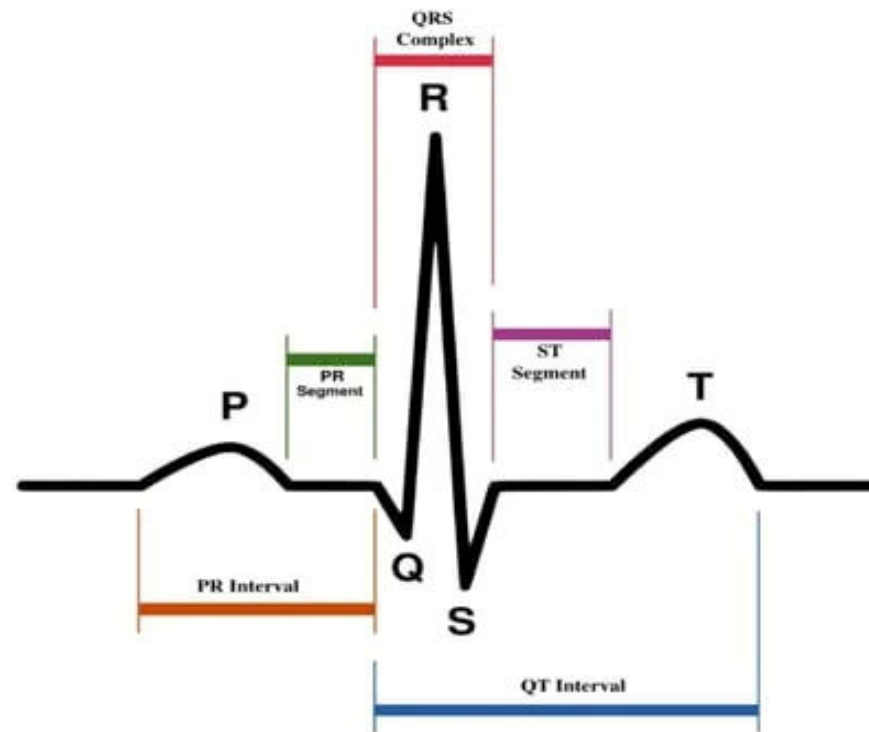
Impulses moves rapidly through the ventricles:

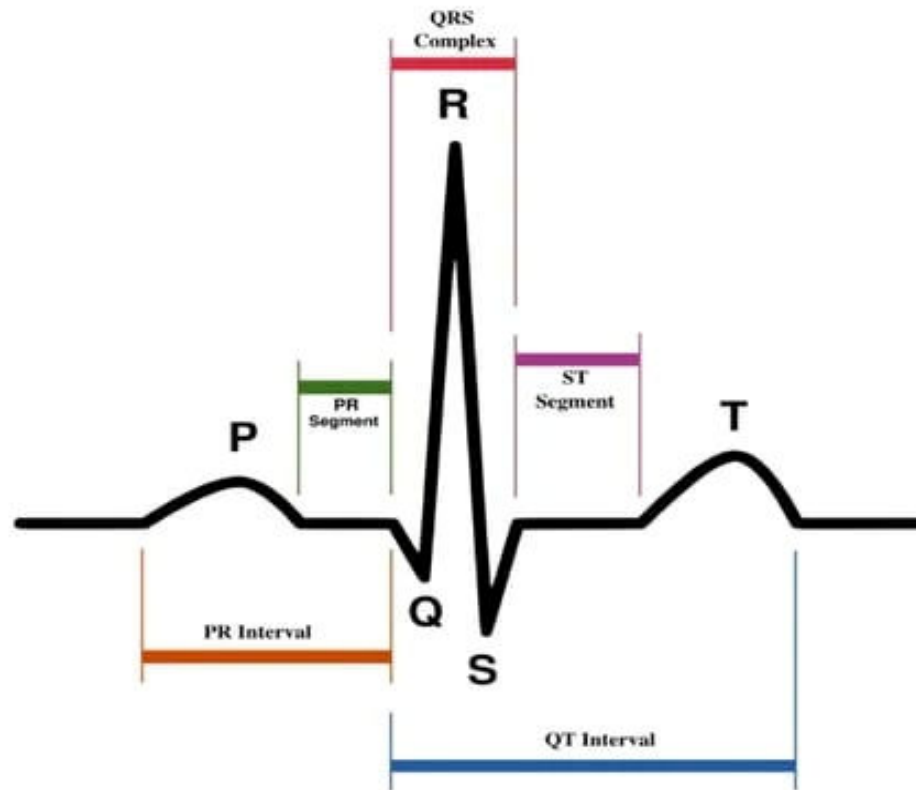
- Bundle of His
- Left & Right Bundle branches (LBB divides into the anterior fascicle and posterior fascicle)
- Purkinje fibers

Tertiary pacemaker (20 – 39)



EKG COMPLEX





PQRST = One EKG complex = One Cardiac Cycle

Total Duration of a Cardiac Cycle = _____ seconds



P Wave

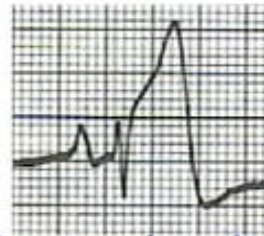
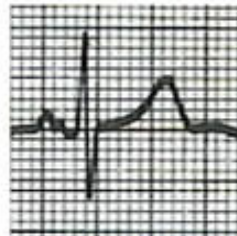
- Depicts the firing of the SA node and atrial depolarization (contraction).
- P waves are upright & rounded (in Lead II).
- Precedes a QRS
- Both atria depolarize simultaneously.





P Wave Abnormalities

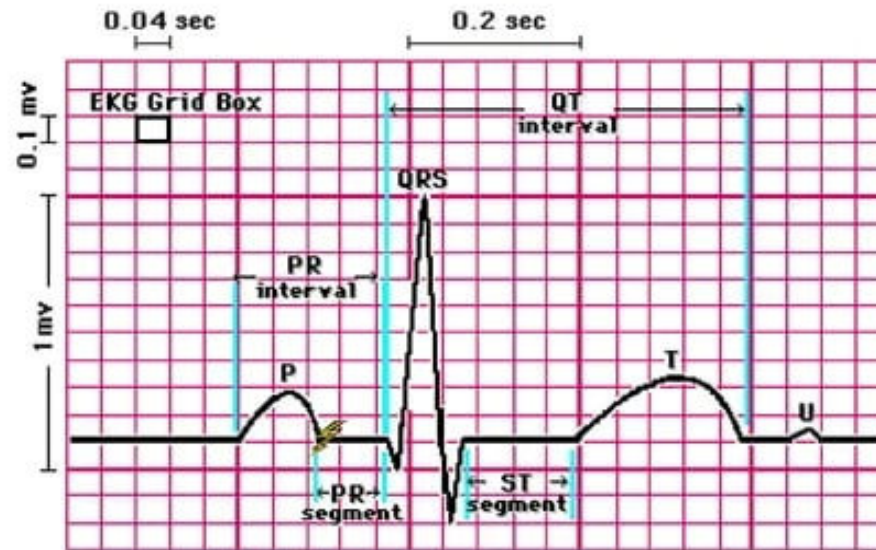
p mitrale = Wide & Notched P wave



p pulmonale = Tall, peaked P wave



PR Segment



The PR segment represents delay in the AV node

Flat = Baseline



QRS Complex

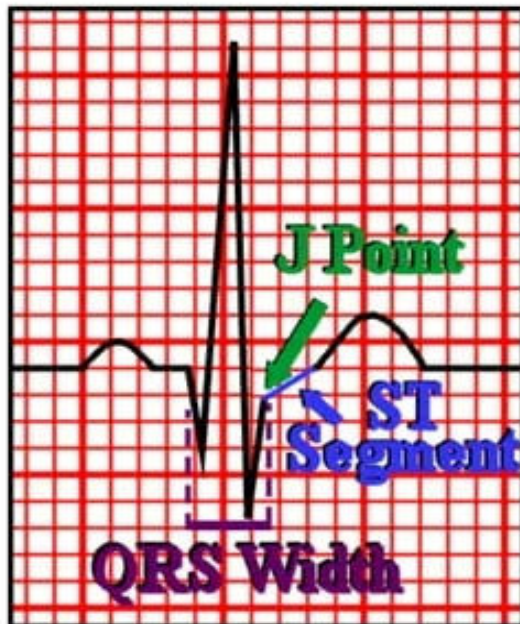


Depicts the electrical impulse traveling through the ventricles and ventricular depolarization (contraction).

Not all QRS complexes have a Q, R, and S.



QRS Complex



See Overhead Slide 1-3

Q wave is the FIRST negative deflection

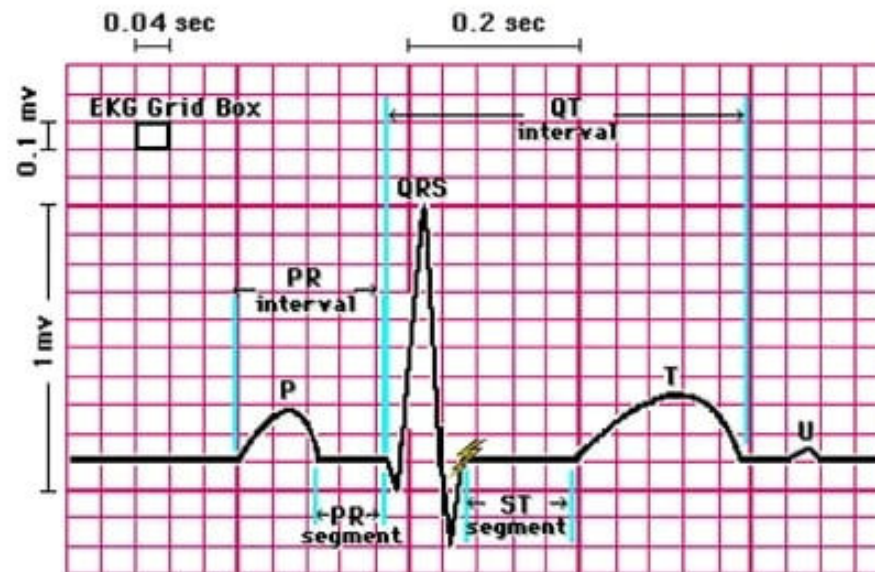
R wave is the FIRST positive deflection

S wave is the negative deflection that follows the R wave

J Point is the point where the QRS complex ends



ST-Segment

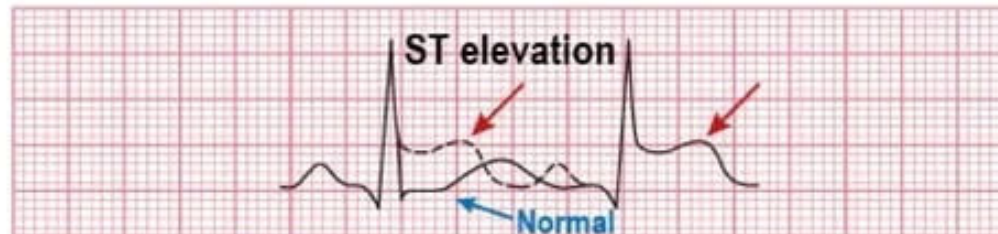


The ST-segment represents ventricular contraction and period before ventricular repolarization. No electricity is flowing. The ST segment is therefore usually even with the baseline.



ST-Segment Elevation & Depression

To be considered a significant elevation or depression the ST must deviate at least 1 mm above or below the baseline (in at least 2 or more correlating leads)



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ST-Segment Depression

Most often seen with acute myocardial ischemia

Other Causes:

Left and right ventricular hypertrophy

Left and Right BBB

Hypokalemia

Drug Effects (i.e. digitalis)



ST-Segment Elevation

Most often seen with acute myocardial injury or infarction

Other Causes:

Coronary vasospasm (Prinzmetal's Angina)

Pericarditis

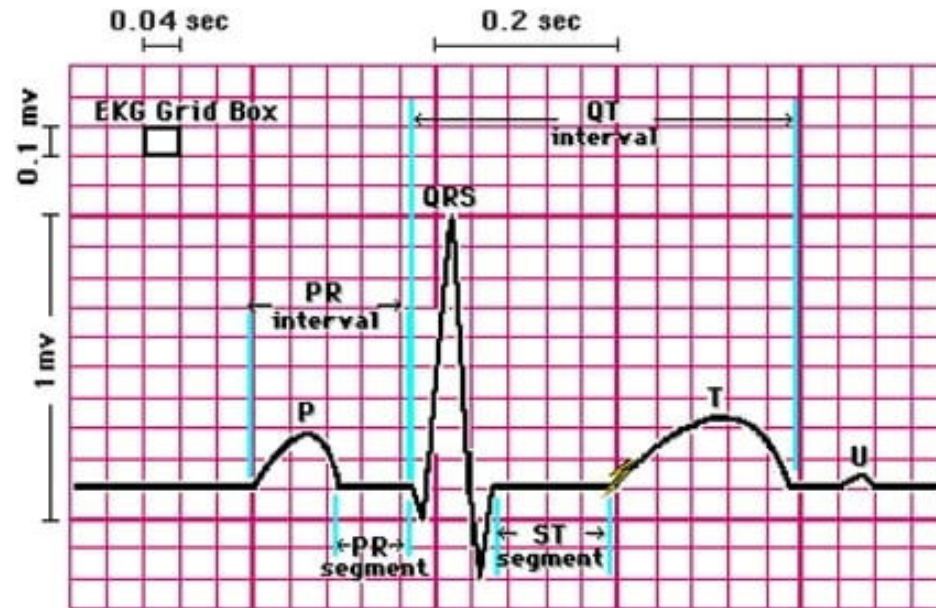
Ventricular Aneurysm

Hyperkalemia

Early repolarization (a normal variant)



T Wave



Depicts ventricular repolarization
Refractory Period



T Waves

**Positive Deflection
(above baseline < 5 mm)**

**Should appear rounded and
symmetrical**

Peak is closer to the end of the wave



Elevated T Waves

**Positive Deflection
(above baseline ≥ 5 mm)**

Tall, peaked (tented)

**HYPERKALEMIA
or MYOCARDIAL INJURY**



Inverted T Waves

Negative Deflection (below baseline)

Causes:

Myocardial Ischemia

Myocardial Infarction

Pericarditis

Ventricular Enlargement

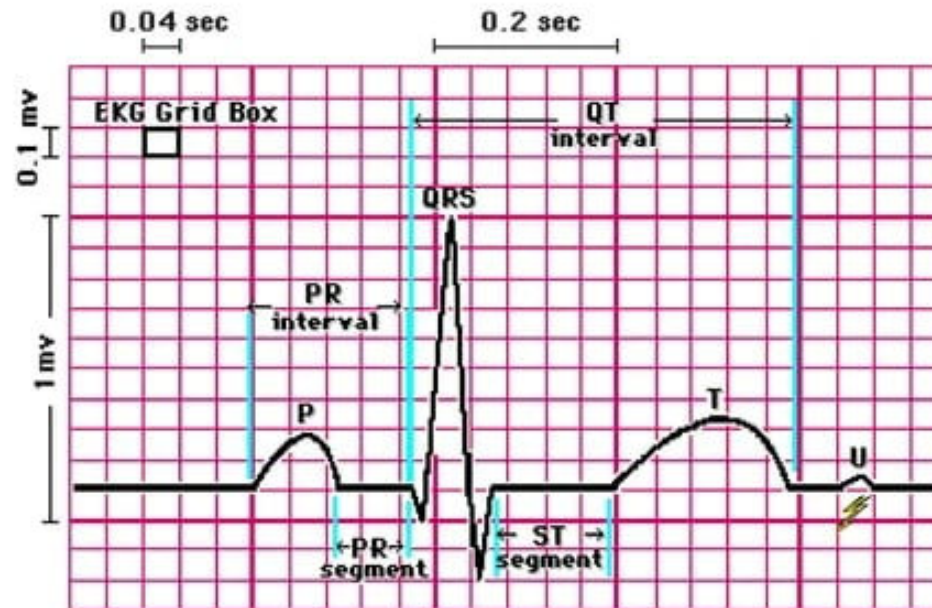
Bundle Branch Block

Subarachnoid Hemorrhage

Certain Drugs (quinidine or procainamide)



U Wave



Depicts last phase of ventricular repolarization or endocardial repolarization???



U Wave

U Wave < 2 mm

Seen most commonly with BRADYCARDIC
rate

Can cause inaccuracies when measuring QT
intervals



U Wave

U Wave < 2 mm

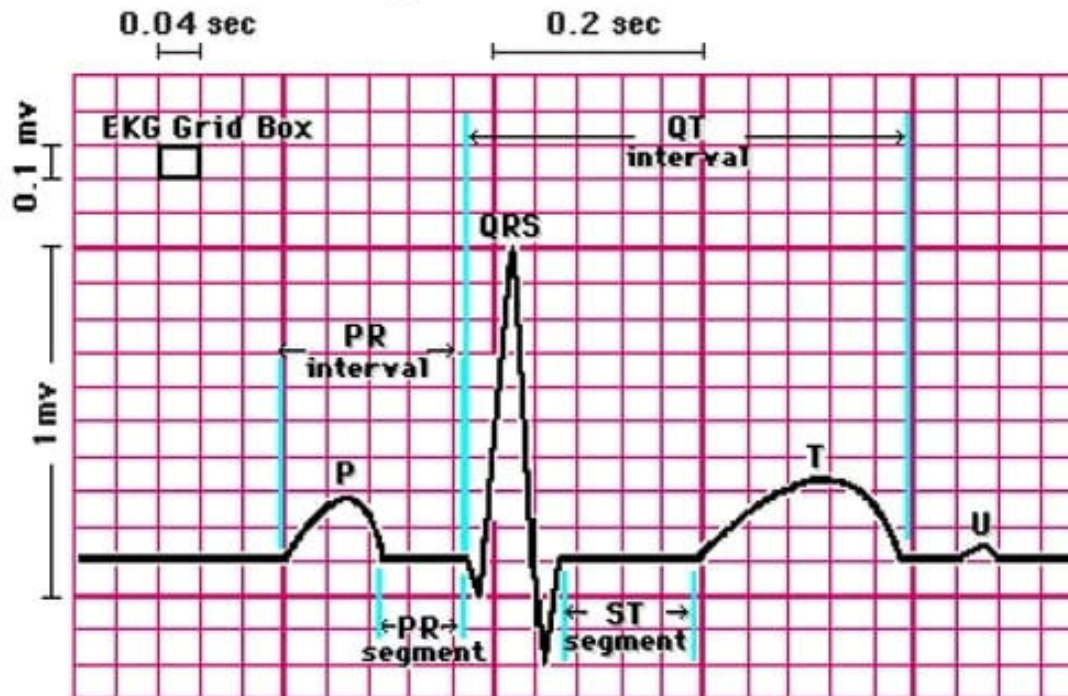
Large = hypokalemia, cardiomyopathy,
LV enlargement

Some drugs may cause a large U wave

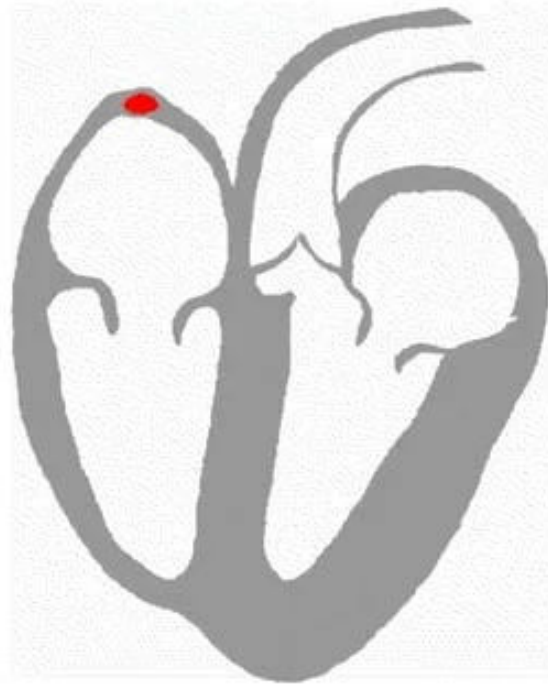
May cause Torsades de Pointes



Atrial Repolarization ???



Hidden beneath the QRS complex.





EKG Graph Paper

