ECG Course Level I

Boone County Fire Protection District
EMS Education
Units in this Course

- Fundamentals
- Rate
- Regularity
- P-Waves

- Measurements
- Rhythm Interpretation
- Conduction Defects
- STEMI Identification

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Measurements Unit

- PRI Lesson
- QRS Lesson
- QTc Lesson
PRI Lesson
Avoid Decimals

.12 sec → 0.120. → 120 ms

.08 sec → 0.080. → 80 ms

.20 sec → 0.200. → 200 ms
Remember...

- The PRI represents the time during which:
  - The atria depolarize and contract.
  - The impulse pauses in the AV Node so that the atria can pump and stretch the ventricle.
What is the PRI?

- Intervals include a wave and a segment.
- Segments are the space between waves.
- The PRI (PR Interval) contains the P-wave and the PR Segment.
- The PRI begins at the start of the P-wave and ends at the start of the QRS.
Normal PRI Length

- Remember, time is measured in length and we like to use milliseconds to avoid decimals.
- Normal PRI is between 120 and 200 milliseconds.
  - 3 little boxes = 120 milliseconds
  - 5 little boxes = 200 milliseconds
Short PRI

- Short PRI = less than 120 milliseconds

- Indicates that the normal pause of the impulse in the AV Node did not occur—the impulse paused for a shorter time than expected.

- This usually indicates that a “short circuit” occurred in the conduction—an “accessory pathway” is present.

- Could be a “junctional rhythm”.

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Long PRI

- Long PRI = more than 200 milliseconds

- Indicates that the normal pause of the impulse in the AV Node did not occur—the impulse paused for a longer time than expected.

- This is the definition of a 1st Degree AV Block.

- Usually no big deal but may indicate a conduction system problem that might worsen.
PR Interval (PRI)

- Normal range of length measured in milliseconds is 120-200
- Short PRI = accessory pathway
- Long PRI = 1st Degree AV Block
QRS Lesson
Normal QRS Width

- Remember, time is measured in length and we like to use milliseconds to avoid decimals.

- Normal QRS is less than 120 milliseconds.

  - 3 little boxes = 120 milliseconds

- QRS’s are either “normal” or “wide” although sometimes we use “narrow” to mean “normal” or “not wide”.

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Wide QRS Causes

- Impulse originated in the Ventricles
- Bundle Branch Block
- Accessory Pathway
- Hyperkalemia
- Tri-Cyclic Antidepressant Poisoning
**Which Lead?**

- QRS width may vary in different leads.
- Use the lead with the widest QRS to determine width.
- As a practical matter, the 12-Lead EKG machine measurement is the best option.
IMPULSES FROM THE VENTRICLES

- Ectopic beat from the ventricles—PVC
- Idioventricular—“3rd string pacemaker”
- Ventricular Tachycardia (V-Tach or VT)
PVC’s

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Ventricular Tach
Bundle Branch Block

- Remember, the atrial impulse transmits through the AV Node to the Bundle of His.

- The His Bundle splits into two branches.

- Delay in one branch causes the ventricles to depolarize at different times.

- Wide QRS results from long ventricular depolarization time.
Another Term

- Aberrant Conduction
- Sometimes abbreviated “AC” or “A/C”
- “Not Normal” Conduction
- Same as BBB more or less
Accessory Pathway

“Short circuit” allows atrial impulse to bypass the AV Node and jump to the ventricles.

Impulse is then transmitted from cell to cell through one ventricle. (slowwww)

Meanwhile, the atrial impulse that goes through the AV Node speeds down the normal conduction pathway.

The ventricles depolarize at different times.
Other Causes

- Hyperkalemia (potentially life threatening)
- Tri-Cyclic Antidepressant (TCA) overdose
  - amitriptyline
  - nortriptyline
QTc Lesson
What is the QT Interval?

- Remember...intervals include a wave and a segment.

- In this case, the QT Interval begins at the start of the QRS and goes through the end of the T-wave.

- This represents the total time for ventricular depolarization and repolarization.
**QT Interval**

The QT interval encompasses the QRS complex, ST-segment, and T wave and represents total ventricular activity—the time from ventricular depolarization (activation) to repolarization (recovery). The QT interval is measured from the beginning of the QRS complex to the end of the T wave. In the absence of a Q wave, the QT interval is measured from the beginning of the R wave to the end of the T wave.

The duration of the QT interval varies according to age, gender, and particularly heart rate. To determine the QT interval quickly, measure the interval between two consecutive R waves (R-R interval) and divide the number by two. Measure the QT interval. If the measured QT interval is less than half the R-R interval, it is probably normal. A QT interval that is approximately half the R-R interval is considered borderline. A QT interval that is more than half the R-R interval is considered prolonged (Figure 2-23).

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**Did You Know?**

A prolonged QT interval indicates a lengthened relative refractory period, which puts the ventricles at risk for life-threatening dysrhythmias, such as Torsade de Pointes.

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*Figure 2-23* Measuring the QT interval. This example shows a prolonged QT interval in a patient taking quinidine.
**So...what is the “QTc”?**

- The “c” in QTc stands for “corrected”.

- The EKG machine “adjusts” the measurement to compensate for expected delays or shortening depending on heart rate.
And...Mrs. Smith Cares Why?

- If her ventricles are taking too long to depolarize and then reset, that indicates an abnormality in the cardiac conduction system.

- Cardiac conduction system issues can turn into lethal cardiac rhythms.

- Prolonged QTc is associated with a risk for the potentially deadly rhythm Torsades de Pointes.
Long QT Risks

Drugs / Electrolytes / CNS catastrophes are causes---Torsades de pointes is the RISK!
More Cautions

- Some medications that paramedics use prolong the QTc...

- Example: Amiodarone
Long QTc

- QTc is prolonged if > 440ms in men or > 460ms in women
- QTc > 500 is associated with increased risk of torsades de pointes
- A useful rule of thumb is that a normal QT is less than half the preceding RR interval
Long QTc Causes

- Low calcium levels
- Some “Type I antiarrhythmic” such as Amiodarone
- Tricyclic Antidepressants
- Hypokalemia
- Low magnesium levels
Short QTc (<300ms)

- May spontaneously go into A-Fib or V-fib so the first indication may be cardiac arrest
- Young patients possibly including infants (median age 30)
- Congenital defect usually although hypocalcemia can be a cause