ABCs of ECGs

Shelby L. Durler
KEEP CALM and...

...ok, not THAT calm!
Objectives

• Review the A&P of the cardiac conduction system
• Placement and obtaining 4-lead and 12-lead ECGs
• Overview of the basics of ECG rhythm interpretation
Electrical System of the Heart

- Sinoatrial (SA) Node
- Anterior Internodal Tract
- Middle Internodal Tract
- Posterior Internodal Tract
- Atrioventricular (AV) Node
- Bachmann's Bundle
- Left Bundle Branch
- Conduction Pathways
- Right Bundle Branch
Intrinsic Firing Rates

• SA Node
  – 60-100
• AV Node
  – 40-60
• Purkinje Fibers
  – 20-40
Limb Lead Placement

RA = Right Arm
LA = Left Arm
RL = Right Leg
LL = Left Leg
The Paper
Waveform

- **P wave**
  - 1\textsuperscript{st} deflection
  - Atrial Depolarization
Waveform

• QRS complex
  – Ventricular Depolarization
    • Q wave: 1\textsuperscript{st} deflection below IL
    • R wave: 1\textsuperscript{st} deflection above IL
    • S wave: 2\textsuperscript{nd} deflection below IL
Waveform

QRS

RS

rSR'

QS

QR

R
Waveform

• T wave
  – 1\textsuperscript{st} deflection after QRS
    – Usually positive
  – Ventricular Repolarization
Waveform

• U wave
  – 2\textsuperscript{nd} positive deflection after the QRS
    – NOT next P wave
  – Recovery of Purkinje fibers
Normal Intervals

- **PR**
  - 0.20 sec (less than one large box)
- **QRS**
  - 0.08 – 0.12 sec (1-3 small boxes)
- **QT**
  - 450 ms in men, 460 ms in women
  - Based on gender/ heart rate
  - Half the R-R interval with normal HR
Rhythm Interpretation

• Develop a systematic approach that works for you

1. Rhythm
2. Rate
3. P wave
4. PR Interval
5. QRS
6. T wave
7. QT Interval
8. Other Components
Rhythm

- Regular or Irregular
  - Atrial rhythm?
    - P-P
  - Ventricular rhythm?
    - R-R
Rhythm

- “Paper and pencil” method
- Caliper
Rhythm

Regular

Irregular

Irregular
Rate

- 10 times method
  - Number of R waves in 6 second strip X10
Rate

• 1,500 method
  – 1500 / # small squares between R-R

1500 / 20 = 75
Rate

- Sequence method
  - Large boxes between R-R
  - 300 – 150 – 100 – 75 – 60 – 50
P Wave

• Evaluate the P wave
  – Present?
  – One for every QRS?
PR Interval

- Measure the PR interval
  - 0.12 – 0.20?
  - Is it consistent?
1st Degree Heart Block

P wave precedes QRS complex but P-R intervals prolong (>5 small squares) and remain constant from beat to beat.
2nd Degree Type 1 Heart Block

1. The P-R interval successively widens until QRS fails (drops)
2. The ventricular rhythm is irregular
3. The Atrial rhythm is usually regular
2\textsuperscript{nd} Degree Type 2 Heart Block

Second degree heart block, type 2 (Mobitz 2)
3rd Degree Heart Block

No association between atria & ventricles
QRS Duration

• One after every P wave?
• End of PR interval to end of S wave
Evaluate the T wave

- Present?
- Normal Shape?
- Normal/Same Amplitude?
- Concordant with QRS?
T Wave Morphology

- Ischemia
- Electrolyte Imbalances
- Hypothermia
- Positional

- Hypertrophy
- Idiopathic
- Benign
QT Interval

- Beginning of QRS and end of T wave
Corrected QT Interval (QTc)

♀ < 460 ms

♂ < 450 ms
Other Components

• Evaluate for ectopic beats
• ST segment changes
• U wave

Determine Your Rhythm
Atrial Rhythms

• Any rhythm originating in the atria
• Generally initiated by SA node
  – Intrinsic rate of 60-100
Normal Sinus Rhythm

- Rhythm: Regular
- Rate: 60-100
- P wave: Upright; present; one for every QRS
- PR Interval: Normal
- QRS: Normal duration
- T wave: Following each QRS
- QT: Normal

[Image of an ECG trace]
Sinus Bradycardia

• Same as NSR
  – Except rate <60
Sinus Tachycardia

• Same as NSR
  – Except rate >100
Sinus Dysrhythmia

• Simply a variation in SA nodal firing times
  – Respiratory pattern
  – Normal variant
  – Deeper complications
Sinus Arrest

• Same as NSR
  – Except at some point the SA node fails to fire
Atrial Fibrillation

- Rhythm: Irregularly Irregular
- Rate: Varies
- P wave: Fibrillating
- PR Interval: None
- QRS: Normal
- T wave: Normal if present
- QT: Normal if present
Atrial Flutter

- Rhythm: Varies
- Rate: Atrial: ~ 200-300; Ventricular: varies
- P wave: F (flutter) waves
- PR Interval: Varies
- QRS: Normal
- T wave: May not be present
- QT: May not be present
Supraventricular Tachycardia

- Rhythm: Regular
- Rate: >150
- P wave: None
- PR Interval: None
- QRS: Narrow
- T wave: Normal
- QT: Usually decreased
Premature Atrial Complex (PAC)

- Ectopic beat
  - Originates somewhere other than SA node
- All components are the same at NSR
Junctional Rhythms

• Rhythms originating in the AV node (junction)
  – Intrinsic rate of 40-60
• Occurs if the SA node fails
Junctional (Escape) Rhythm

- Rhythm: Regular
- Rate: 40-60
- P wave: Absent; inverted; after QRS complex
- PR Interval: None
- QRS: Normal
- T wave: Normal
- QT: Normal
Accelerated Junctional

• Same as Junctional Rhythm
  – Except rate: 60-100
Junctional Tachycardia

• Same as Junctional Rhythm
  – Except rate: >100
Premature Junctional Complex (PJC)

• Ectopic beat
  – Junctional complex occurring outside normal expected location
Ventricular Rhythms

• Rhythms originating below the AV junction
  – Intrinsic rate of 20-40
• Occurs if the SA and AV nodes fail
• QRS complexes will be wide
Idioventricular Rhythm

- Rhythm: Regular
- Rate: 20-40
- P wave: None
- PR Interval: None
- QRS: >0.12
- T wave: Discordant to QRS
- QT: Varies if even measurable
Accelerated Idioventricular

- Same as Idioventricular
  - Except rate: 40-100
Ventricular Tachycardia

- Same as idioventricular
  - Except rate: >100
Ventricular Tachycardia

• Same as idioventricular
  – Except rate: >100
Torsades de Pointes

• “Twisting of Points”
• Type of polymorphic v-tach
• Rate: 250-350
Ventricular Fibrillation

- Rhythm: Irregular
- Rate: Impossible to determine
- P wave: None
- PR Interval: None
- QRS: None
- T wave: None
- QT: None
Premature Ventricular Complex (PVC)

• Ectopic beat
  – Ventricular complex occurring outside normal expected location
Monomorphic PVCs

Polymorphic PVCs
Couplet PVCs

Salvo
-or-
“Run” of V-tach
Asystole & Agonal Rhythm
Shelby Durler
Paramedic

DurlerS@gmail.com

Sources
• Life in the Fast Lane
• EMT Resource