Cardiovascular Program

Wayne W Ruppert, CVT, CCCC, NREMT-P
Interventional Cardiovascular Technologist
Cardiac Accreditations / Emergency Manager
Seven Rivers Regional Medical Center
ACCREDITATION PROCESS Relationship Flowchart
American College of Cardiology - Cardiovascular Accreditations

The Structural Framework Defining the Standards of Care:

- ORDER SETS
- POLICIES
- PROCEDURES
- PROTOCOLS
- BYLAWS

Improves:

- PRACTICE of MEDICINE
  - ASSESSMENT
  - DIAGNOSIS
  - TREATMENT
- EDUCATION
  - PHYSICIAN
  - NURSING
  - EMS
  - PUBLIC
- PROCESS IMPROVEMENT

RESEARCH & EVIDENCE BASED MEDICINE - SCIENTIFIC JOURNALS

GUIDELINES for PRACTICES
- AHA
- ACC
- HRS

REGULATORY BODIES
- GOVERNMENT
- TJC
- CMS
- HIPAA
- OSHA
CLASSIC SYMPTOMS OF HEART ATTACK

✓ CHEST PAIN - DESCRIBED AS...
   - "HEAVINESS, PRESSURE, DULL PAIN, TIGHTNESS"
   - CENTERED IN CHEST, SUBSTERNAL
   - MAY RADIATE TO SHOULDERS, JAW, NECK, LEFT or RIGHT ARM
   - NOT EFFECTED by:
     ▪ MOVEMENT
     ▪ POSITION
     ▪ DEEP INSPIRATION

✓ SHORTNESS OF BREATH
   - MAY or MAY NOT BE PRESENT

✓ NAUSEA / VOMITING
   - MAY or MAY NOT BE PRESENT
WOMEN'S MAJOR SYMPTOMS PRIOR TO THEIR HEART ATTACK:

- UNUSUAL FATIGUE 71%
- SLEEP DISTURBANCE 48%
- SOB 42%
- INDIGESTION 39%
- ANXIETY 36%

APPROXIMATELY 78% OF WOMEN REPORTED EXPERIENCING AT LEAST ONE OF THESE SYMPTOMS FOR MORE THAN ONE MONTH EITHER DAILY OR SEVERAL TIMES PER WEEK PRIOR TO THEIR MI.
<table>
<thead>
<tr>
<th>Symptom</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shortness of Breath</td>
<td>58%</td>
</tr>
<tr>
<td>Weakness</td>
<td>55%</td>
</tr>
<tr>
<td>Unusual Fatigue</td>
<td>43%</td>
</tr>
<tr>
<td>Cold Sweat</td>
<td>39%</td>
</tr>
<tr>
<td>Dizziness</td>
<td>39%</td>
</tr>
</tbody>
</table>

43% had no chest pain at any time during their MI!

*Circulation*, 2003;108;2619-2623

57% of women did have chest discomfort
The STAT 12 Lead EKG
Wayne W Ruppert, CVT, CCCC, NREMT-P
Interventional Cardiovascular Technologist
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Seven Rivers Regional Medical Center
The **STAT 12** Lead EKG
The **STAT** 12 Lead EKG

- Put EKG Order into Cerner
Select "Add" on the ORDERS tab ....
In the SEARCH box, type "EKG"
When you type "EKG" you'll note all of the possible EKG order selections appears in a pop-up menu. Scroll down and select the appropriate choice.

For this example, we will make this a "STAT EKG" due to the patient having chest pain . . .
After you chose the appropriate selection, this pop-up box opens.

For our example, the patient has chest pain, and we are ordering the EKG under the hospital's "Chest Pain Protocol" . . . therefore we will select "PER POLICY".
We must also enter a Physician's name before the system will allow us to click "OK."

If the patient has a cardiologist assigned for this hospital visit, enter the cardiologist's name. If there is no cardiologist, enter the admitting provider's name. In most cases, this is a Hospitalist.
Once the provider's name is entered, select "OK"
The **STAT** 12 Lead EKG

- Put EKG Order into Cerner
- Obtain the EKG
PROCESS for OBTAINING EKGs:
- Find patient's EKG ORDER in Worklist
- Select patient.
- Obtain acceptable quality EKG
- "PRINT" the EKG
- "TRANSFER" the EKG
- "CLOSE" the case

Take the PRINTED COPY and give it to the CHARGE NURSE.
OBTAINING AN EKG

1. An ORDER must be placed in Career prior to obtaining an EKG.
2. Turn EKG machine ON.

Follow these steps:

SELECT:

1. 12-Leads and standard EKG lead
2. Select "12-Leads Std" – this will allow for any new orders.
3. Select EKG in Patient Name. If patient is not known, an order will need to be placed.
4. Career prior to obtaining EKG.
5. Place patient in TEE box.
6. OK.
7. If the EKG is not a good EKG tracing - COD2, the most useful is a
   11. OK.
   6. Close EKG, return to Patient.
   11. OK.
   12. Close the EKG machine, clean the leads, and return to the nurses station or patient's floor.
   13. If an EKG is green and the EKG trace is not seen on the patient's floor.
4. Patient MUST complete the EKG on the Intensive Care Unit Chart.
!! NOTICE !!

- Patient ID, USE patient’s MRN
- Enter all other mandatory information

When ECG is completed, remember to select TRANSFER

If you don’t do all of the above steps, the ECG will NOT attach to the patients CHART in Cerner and the Doctor won’t see it!
LEAD PLACEMENT
STANDARD
12 LEAD ECG

- Patient should lay as flat as possible.
- Limb leads should be located on the limbs.
Go to “Worklist” Tab,
Select your patient . . .
Once selected, your patient is highlighted in blue.

<table>
<thead>
<tr>
<th>U</th>
<th>STAT</th>
<th>12/17/2018 2:41 PM</th>
<th>285356</th>
<th>HANKS</th>
<th>6/18/1946</th>
<th>GEORGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>STAT</td>
<td>12/19/2018 8:22 PM</td>
<td>294089</td>
<td>CANTER</td>
<td>3/19/1953</td>
<td>HASKELL</td>
</tr>
<tr>
<td>U</td>
<td>NORMAL</td>
<td>12/17/2018 7:15 AM</td>
<td>89970</td>
<td>KELLEY</td>
<td>6/10/1950</td>
<td>JAMES</td>
</tr>
<tr>
<td>U</td>
<td>NORMAL</td>
<td>12/20/2018 3:05 PM</td>
<td>37916</td>
<td>PASSALACQUA</td>
<td>12/21/1944</td>
<td>BERNADETTE</td>
</tr>
</tbody>
</table>

Then press "Select".
When the waveforms look good...

Press "ECG"
If you don't like the EKG, select **CLOSE**, (Do NOT Print !)
If you LIKE the ECG, first, “PRINT” it...
And then “TRANSFER” it........
In the EMERGENCY DEPARTMENT...

Give the PRINTED COPY to the ED Physician or Advanced Practitioner for INTERPRETATION
OUTSIDE of the ED......

• Give EKG to your CHARGE NURSE (or place EKG where you’ve been instructed to) !!
If patient is NOT on worklist, such as “STAT ECG” for chest pain . . . .

You must MANUALLY enter:
• Patient ID = MRN Number
• Last Name
• Date of Birth ( mm/dd/yyyy )
• Gender
• Your ID ( first initial, last name )

Then an ORDER must be generated in CERNER !!
!! NOTICE !!

When manually entering info into the ECG machine:
- Patient ID  USE patient's MRN
- enter all other mandatory information

When ECG is completed, remember to select TRANSFER

if you don't do all of the above steps, the ECG will NOT attach to the patients CHART in Cerner - and the Doctor won't see it!
BASIC ECG PRINCIPLES

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www.ECGtraining.org
www.practicalclinicalskills.com
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**Download Sudden Cardiac Death Prevention - ACC / SCPC 19th Congress**

**Download Initial Stabilization of the Atrial Fib Patient - SCPC 19th Congress**

**Download QTc Monitoring Policy for Patients on QT Prolonging Meds**

**Download A-Fib / Flutter ER Physician’s Order Set - BHDC**

**Download A-Fib / Flutter Flowchart Emerg Care BHDC**

**Download Team Driven Performance Improvement - SCPC 19th Congress**

**Download TDPI in Ambulance Industry Journal**

**Download TJC Sentinel Event Alert - Disruptive Physicians**

**Download ACLS 2015 Algorithm Cheat Sheets**

**Download 2015 ACLS Algorithms with ECG examples**

**Download Neighbors Saving Neighbors Program**

**Download Basic ECG Course with 2015 ACLS Algorithms**

**Download STEMI Assistant**

**Download ECG ID of SADS CONDITIONS**

**Download ECG Review of Hypertrophy**

**Download 14 Point AHA Screening Form for Genetic and Congenital Heart Conditions**
The Heart:

- Muscle cells
- Electrical system cells
- Connective tissue
FOUR CHAMBERED PUMP
FOUR CHAMBERED PUMP...

2 ATRIUM

PRIMARY JOB:
"PACK VENTRICLES FULL OF BLOOD"
FOUR CHAMBERED PUMP...

2 VENTRICLES

PRIMARY JOB:

"PUMP BLOOD TO THE LUNGS AND THE REST OF THE BODY"
WHEN FUNCTIONING PROPERLY, THE ATRIUM SUPPLY APPROXIMATELY WHAT PERCENTAGE OF THE CARDIAC OUTPUT?
THE CHAMBER MOST IMPORTANT TO KEEPING THE PATIENT ALIVE

(and the ONLY one you can't live without)

IS THE LEFT VENTRICLE WHICH WE WILL REFER TO AS THE PUMP
Sinus node
60 - 100 beats / min.

AV node

Left bundle branch

Right bundle branch

Purkinje fibers
AV node
40 - 60 beats / min.

Sinus node

Left bundle branch

Right bundle branch

Purkinje fibers
Pacemaker site in the Ventricles:
20 - 40 beats / min
NORMAL "INHERENT" RATES:

SA NODE: 60 - 100

AV NODE: 40 - 60

* VENTRICLES: 1 - 40

* Most reference sources indicate ventricular focal rates as being between "20-40" beats per minute. Since I have personally witnessed patients who have had regular, pulse-producing "idioventricular" rhythms as low as 4 - 5 beats per minute, I cannot endorse "20" as a minimum ventricular rate.
THE "SKELETON OF THE HEART"

ATRIUM

FIBROUS "SKELETON of the HEART"

PULMONARY VALVE OPENING

AORTIC VALVE OPENING

HIS BUNDLE OPENING

TRICUSPID VALVE OPENING

MITRAL VALVE OPENING

VENTRICLES
WOLFF-PARKINSON-WHITE

EKG CHARACTERISTICS

SHORTENED P-R INTERVAL
WOLFF-PARKINSON-WHITE

EKG CHARACTERISTICS

WIDENED QRS COMPLEX
WOLFF-PARKINSON-WHITE

EKG CHARACTERISTICS

DELTA WAVE
16 yr Female Caucasian
Vent. rate 92 BPM
PR interval 112 ms
QRS duration 118 ms
QT/QTc 356/440 ms
P-R-T axes 59 -22 107

Normal sinus rhythm with sinus arrhythmia
Left atrial enlargement
Anterior infarct, age undetermined
Inferior infarct, age undetermined
SR & T wave abnormality, consider lateral ischemia
Wolff–Parkinson–White
Abnormal ECG
No previous ECGs available

WOLFF-PARKINSON-WHITE
TYPE B
3. **Wolff-Parkinson-White (Type B)**
- Presence of DELTA waves
- Short P-R Interval
- Wide QRS
W-P-W patients often experience Tachycardias:
- Narrow QRS Tachycardia (SVT)
- Wide QRS Tachycardia (mimics V-Tach).

The same patient can present with narrow QRS SVT, and at another time, Wide QRS Tachycardia ……..
ATRIAL DEPOLARIZATION

P WAVE IS RECORDED ON EKG

LEAD II
THE P-R SEGMENT

ELECTRICAL ACTIVITY DURING P-R SEGMENT:

- Depolarization wave in A-V node
- Atrial Repolarization

.10 SECOND ISOELECTRIC PAUSE

LEAD II
Ventricular Depolarization

QRS Complex is recorded on EKG

Lead II
VENTRICAL REPOLARIZATION

Writes a "T" wave on the ECG

LEAD II
P wave

QRS complex

T wave
**P WAVE** =
ATRIAL DEPOLARIZATION

**QRS COMPLEX** =
VENTRICULAR DEPOLARIZATION (contracting)

**T WAVE** =
VENTRICULAR REPOLARIZATION (recharging)
CARDIAC ANATOMY and PHYSIOLOGY "101"

50% REPOLARIZATION of VENTRICULAR CELLS

T wave

RELATIVE REFRACTORY PERIOD
ELECTRICAL STIMULUS TO VENTRICLES MAY CAUSE V-FIB / V-TACH

ABSOLUTE REFRACTORY PERIOD
ELECTRICAL STIMULUS TO VENTRICLES HAS VERY HIGH PROBABILITY OF CAUSING V-FIB / V-TACH
ROUTINE TEST OF ICD
ELECTRICAL IMPULSE ADMINISTERED DURING ABSOLUTE REFRACTORY PERIOD -- INDUCES VENTRICULAR FIBRILLATION

08-Sep-2006 18:01:47
Test Started

SPECIAL THANKS TO:
Ray Heinley
Medtronic Corporation
for this contribution
ECG PAPER - THE VERTICAL AXIS:

- SMALL BOXES = 1mm SQUARES
- THE VERTICAL AXIS REPRESENTS AMPLITUDE (VOLTAGE)
- IN VERTICAL DIRECTION, THERE ARE 5 SMALL BOXES IN EACH LARGE (5mm) BOX
- 1 mv CALIBRATION SPIKE = 10 mm
ECG PAPER - THE HORIZONTAL AXIS:

THE HORIZONTAL AXIS REPRESENTS TIME.

STANDARD SPEED FOR RECORDING ADULT EKGs = 25 mm / SECOND

EACH 1mm BOX = .04 SECONDS, or 40 MILLISECONDS (40 ms)

5 SMALL BOXES = .20 SECONDS, or 200 MILLISECONDS (200 ms)
THE EKG MACHINE

STANDARD 12 LEADS - USES 10 WIRES
(6 CHEST and 4 LIMB)

- I, II, III, and V1, V2, V3, V4, V5, V6
EACH CONSIST OF:

1 POSITIVE ELECTRODE
1 NEGATIVE ELECTRODE
1 GROUND ELECTRODE
THE POSITIVE ELECTRODE

IS THE "EYE"...
CURRENT MOVING TOWARD THE EYE (POSITIVE ELECTRODE)

RECORDS AN "UPWARD" DEFLECTION
CURRENT MOVING AWAY FROM THE EYE (POSITIVE ELECTRODE)

RECORDS A "DOWNWARD" DEFLECTION

LEAD AVR
Traditional Lead Placement

5 WIRE TELEMETRY UNIT
LEAD PLACEMENT - V3

5 WIRE TELEMETRY UNIT
ESTABLISH YOUR ROUTINE
ECG EVALUATION . . . . .

☐ RATE
☐ RHYTHM
☐ INTERVALS
☐ P:QRS RATIO
ESTABLISH YOUR ROUTINE
ECG EVALUATION.

- RATE
- RHYTHM
- INTERVALS
- P:QRS RATIO
DETERMINE HEART RATE

METHOD 1:
(regular rhythm)

300 150 100 75 60 50

then too darn slow . .
DETERMINE HEART RATE

"300 Divided By _____"
(regular rhythm)

and so on . . .
DETERMINE HEART RATE

300 divided by 4 = 75

300 divided by 5 = 60

"so our patient's heart rate is between 75 & 60, closer to 75."
DETERMINE HEART RATE:

METHOD 2:

6 SECONDS

3 SEC. → 3 SEC.

HR = 70
. . . . OR MAKE IT EASY ON YOURSELF AND SIMPLY SAY . . . .

<table>
<thead>
<tr>
<th>ID:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vent. rate</td>
</tr>
<tr>
<td>PR interval</td>
</tr>
<tr>
<td>QRS duration</td>
</tr>
<tr>
<td>QT/QTc</td>
</tr>
<tr>
<td>P-R-T axes</td>
</tr>
</tbody>
</table>

"HEART RATE IS SIXTY-FIVE!"
THE CONCERNS OF ACLS

IS THE VENTRICULAR RATE:
THE CONCERNS OF ACLS

IS THE VENTRICULAR RATE:

TOO SLOW
THE CONCERNS OF ACLS

IS THE VENTRICULAR RATE:

- TOO SLOW
- TOO FAST
THE CONCERNS OF ACLS

IS THE

VENTRICULAR RATE:

TOO SLOW

TOO FAST

JUST RIGHT.
"There is NO SUCH thing as an EP (heart rate) emergency . . .

If the rate's too slow -- PACE IT

If the rate's too fast -- SHOCK IT !"

Dr. James Irwin
Electrophysiologist
St. Joseph's Hospital
Tampa, Florida
HEART RATES THAT ARE:

BELOW 50 ARE TOO SLOW AND MAY CAUSE PATIENT TO BE UNSTABLE

50 – 150 JUST RIGHT! SHOULD NOT CAUSE PATIENT TO BE UNSTABLE

ABOVE 150 ARE TOO FAST AND MAY CAUSE PATIENT TO BE UNSTABLE
CRITICAL ECG ALERT

- Immediately check patient
- Notify next “higher up” in chain of command

1. Heart rate LESS THAN 50 or GREATER THAN 150
<table>
<thead>
<tr>
<th>Heart rates that are:</th>
<th>Classified as:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 60</td>
<td>BRADYCARDIA</td>
</tr>
<tr>
<td>60 - 100</td>
<td>NORMAL</td>
</tr>
<tr>
<td>Above 100</td>
<td>TACHYCARDIA</td>
</tr>
</tbody>
</table>
ACLS TACHYCARDIA GUIDELINES

- SVT
- SINUS TACHYCARDIA
- NSR
ESTABLISH YOUR ROUTINE
ECG EVALUATION.

- RATE
- RHYTHM
- INTERVALS
- P:QRS RATIO
DETERMINE RHYTHM

"WHEN YOUR R-R INTERVALS . . ."

REGULAR ———
"ARE ALWAYS CONSISTENT"

REGULARLY ———
"FOLLOW A PATTERN"

IRREGULAR

IRREGULARLY ———
"ARE TOTALLY CHAOTIC"
DETERMINE RHYTHM

REGULAR

REGULARLY IRREGULAR

IRREGULARLY IRREGULAR
DETERMINE RHYTHM

REGULAR

REGULARLY IRREGULAR

IRRREGULARLY IRREGULAR

EXAMPLES:

- SINUS RHYTHM
- JUNCTIONAL RHYTHM
- VENTRICULAR RHYTHMS

- WENCKEBACH
  (2nd Degree Type I HB)
- BIGEMINY, TRIGEMINY, etc

- ATRIAL FIBRILLATION
- MULTIFOCAL ATRIAL RHYTHMS
ESTABLISH YOUR ROUTINE
ECG EVALUATION

- RATE
- RHYTHM
- INTERVALS
- P:QRS RATIO
NORMAL P-R INTERVAL

- .12 - .20 sec.
- or
- 120 - 200 mSEC.

MUST BE CONSISTENT FROM BEAT TO BEAT !!
P - R INTERVAL TOO SHORT...
LESS THAN 120 mSEC

THINK:

- ECTOPIC ATRIAL ACTIVITY
- PRE-EXCITATION (WPW)
- JUNCTIONAL (nearly on top of QRS, possibly inverted)
P - R INTERVAL TOO LONG
GREATER THAN 200 mSEC

THINK:
- HEART BLOCK
P - R INTERVAL INCONSISTENT
(VARIATES FROM BEAT TO BEAT)

THINK:

- 2° TYPE 1 HEART BLOCK
  (WENKEBACH)

- 3° HEART BLOCK
  (COMPLETE HEART BLOCK)
QRS INTERVAL

LESS THAN

.12

OR

120 mSEC
QRS COMPLEX TOO WIDE
WIDER THAN 120 mSEC

THINK:
- BUNDLE BRANCH BLOCK
- VENTRICULAR COMPLEX (ES)
- PACED RHYTHM
- L VENTRICULAR HYPERTROPHY
- ELECTROLYTE IMBALANCE. (↑K+ ↓Ca ++)
- DELTA WAVE (PRE-EXCITATION)
The J point is where the QRS complex ends and the S-T segment begins.
THE J POINT SHOULD BE...

WITHIN 1 mm ABOVE

OR

BELOW the ISOELECTRIC LINE

or the P-Q JUNCTION.
EKG from 13 y/o girl in ACCELERATED JUNCTIONAL RHYTHM. note: upsloping T-P interval, and P buried in T waves.
THE P-Q JUNCTION

. . . is the POINT where the P-R SEGMENT ends and the QRS COMPLEX BEGINS.

Used for POINT OF REFERENCE for measurement of the J-POINT and the S-T SEGMENT –

— as per the A.H.A., A.C.C., and WANG, ASINGER, and MARRIOTT, N.E.J.M. vol. 349:2128-2135 Nov. 27, 2003
THE ISOELECTRIC LINE

R - R INTERVAL

IS MEASURED BETWEEN T and P WAVE, or U and P WAVE
THE S-T SEGMENT

BEGINNS AT J POINT

ENDS AT BEGINNING OF T WAVE

J POINT
Q-T INTERVAL

- Varies based on heart rate and sex
THE *QTc INTERVAL

* QTc = Q-T interval, corrected for heart rate

<table>
<thead>
<tr>
<th>HEART RATE</th>
<th>MALE</th>
<th>FEMALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>0.25</td>
<td>0.28</td>
</tr>
<tr>
<td>125</td>
<td>0.26</td>
<td>0.29</td>
</tr>
<tr>
<td>100</td>
<td>0.31</td>
<td>0.34</td>
</tr>
<tr>
<td>93</td>
<td>0.32</td>
<td>0.35</td>
</tr>
<tr>
<td>83</td>
<td>0.34</td>
<td>0.37</td>
</tr>
<tr>
<td>71</td>
<td>0.37</td>
<td>0.40</td>
</tr>
<tr>
<td>60</td>
<td>0.40</td>
<td>0.44</td>
</tr>
<tr>
<td>50</td>
<td>0.44</td>
<td>0.48</td>
</tr>
<tr>
<td>43</td>
<td>0.47</td>
<td>0.51</td>
</tr>
</tbody>
</table>

Annals of Internal Medicine, 1988 109:905.
### QT CORRECTION FORMULAS:

<table>
<thead>
<tr>
<th>Method</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bazett’s</td>
<td>$QTc = \frac{QT}{\sqrt{RR}}$</td>
</tr>
<tr>
<td>Fredericia</td>
<td>$QTc = \frac{QT}{(RR)^{1/3}}$</td>
</tr>
<tr>
<td>Framingham</td>
<td>$QTc = QT + 0.154(1 - RR)$</td>
</tr>
<tr>
<td>Rautaharju</td>
<td>$QTp = \frac{656}{(1 + \frac{HR}{100})}$</td>
</tr>
</tbody>
</table>

**Manual calculation:**

Determining the QTc
DETERMINING Q-T INTERVAL LIMITS
THE "QUICK PEEK" METHOD

Relatively accurate method to quickly identify patients with abnormal QT Intervals.
- Applies to patients with normal heart rates (60-100) and narrow QRS (QRSd < 120ms)
The Q-T Interval should be LESS THAN 1/2 the R-R Interval.
The Q-T Interval should be LESS THAN 1/2 the R-R Interval.
Determining the QT / QTc

Method 1 – 12 Lead ECG Report:

Standard 12 Lead ECG printout . . .

Heart Rate = 83

QT Interval = 357

QTc = 420

Rate 83  Sinus rhythm
PR 183
QRS 88
QT 357
QTc 420

--AXIS--
P 70
QRS 41
T -1

12 Lead; Standard Placement
Determining the QTc

Method 4, Use a Smartphone App:

- **iPhone**

- **Android**
“There’s an APP for that!”
Determining the QTc
Method 3, Use a Web-based App:

Our patient's QTc = 375 ms.
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Too Short:</strong></td>
<td>&lt; 390 ms</td>
</tr>
<tr>
<td><strong>Normal</strong></td>
<td></td>
</tr>
<tr>
<td>- Males:</td>
<td>390 - 450 ms</td>
</tr>
<tr>
<td>- Females:</td>
<td>390 - 460 ms</td>
</tr>
<tr>
<td><strong>Borderline High</strong></td>
<td></td>
</tr>
<tr>
<td>- Males:</td>
<td>450 - 500 ms</td>
</tr>
<tr>
<td>- Females:</td>
<td>460 - 500 ms</td>
</tr>
<tr>
<td><strong>High (All Genders):</strong></td>
<td>500 - 600 ms</td>
</tr>
<tr>
<td><strong>Critical High</strong> (associated with TdP):</td>
<td>600 + ms</td>
</tr>
</tbody>
</table>

**SOURCE:** “ACC/AHA/HRS Recommendations for Standardization and Interpretation of the ECG, Part IV: The ST Segment, T and U Waves, and the QT Interval” Rautaharju et al 2009
WHEN THE “QUICK PEEK” METHOD for QT INTERVAL EVALUATION IS APPLIED TO THE ABOVE ECG, WHAT IS THE RESULT?
Torsades de Pointes (TdP) – **HEMODYNAMICS:**

- Decreased – to – NO Cardiac Output
- Often patient PULSELESS during episode
- Patients often report SYNCOPE when TdP self-terminates.
- May DETERIORATE into VENTRICULAR FIBRILLATION and CARDIAC ARREST. (“Sudden Death”)
ECG Characteristics of TdP: The QRS Pattern of *Torsades de Pointes* resembles a piece of Twisted Ribbon!
-- CRITICAL ECG ALERT --

- Immediately check patient
- Notify next “higher up” in chain of command

1. Heart rate LESS THAN 50 or GREATER THAN 150
2. QT INTERVAL prolonged (usually not emergent but let Dr. know)
Etiology of Long QT Syndromes:

**Congenital** (14 known subtypes)
Genetic mutation results in abnormalities of cellular ion channels

**Acquired**
- Drug Induced
- Metabolic/electrolyte induced
- Very low energy diets / anorexia
- CNS & Autonomic nervous system disorders

**Miscellaneous**
- Coronary Artery Disease
- Mitral Valve Prolapse
PROLONGED Q-T INTERVAL

THINK:

- CHECK K+ AND MAG LEVELS
- POSSIBILITY OF TORSADES
PROLONGED Q-T INTERVAL

THINK:

- CHECK K+ AND MAG LEVELS
- POSSIBILITY OF TORSADES

- QUESTION MEDS THAT PROLONG Q-T
QT Prolongation -- STAT Intervention:

Avoidance of Meds that are known to prolong the QT Interval. Click here for current list from CREDIBLEMEDS.ORG

Commonly used QT prolonging meds include:

- Amiodarone
- Procainamide
- Levaquin
- Erythromycin
- Norpace
- Tequin
- Benadryl
- Ritalin
- Pseudophedrine
- Haloperidol
- Thorazine
- Propulcid
- Zofran
- Ilbutilide

and MANY more!
PATIENT 1: NORMAL

PATIENT 2: Genetic susceptibility; sensitivity to QT prolonging drugs:

Click here for link to paper by Kannankeril et al (2010 Pharmacological Reviews) that describes genetic susceptibility described above.
U Waves

Occasionally an extra wave is noted after each T wave. It typically resembles "a secondary T wave."

When present on the ECG, this “extra” waveform is referred to as a “U Wave.”
U Waves . . .

• Common U wave Etiology:
  – Hypomagnesemia*
  – Hyperkalemia*
  – Hypocalcemia*
  – QT prolonging medications*
  – Increased intracranial pressure*
  – Hypothermia*
  – Digitalis (usually shortens the QT Interval)

* These are also causes of QT interval prolongation.
Abnormal U Waves

INCLUDE the U Wave in the QT Interval measurement when any one or more criteria are present:

• U wave 100% (or more) the size of the T wave.
• U wave is INVERTED (opposite polarity of T wave)
• U wave merged with the T wave

EVIDENCE SOURCE:
ACC/AHA/HRS Recommendations for the Standardization and Interpretation of the Electrocardiogram Part IV: The ST Segment, T and U Waves, and the QT Interval.
This ECG illustrates the degree of variation that can be noted between different leads on the 12 Lead ECG. ALWAYS measure the QT Interval in the lead with the GREATEST value.
Medication induced LQTS with TdP and Cardiac Arrest - Case Study: 56 year old male

"Syncope of Unknown Etiology"

30 days prior to this visit, patient started taking Ritalin. Since then he has reported multiple syncopal episodes. Notice the prominent U waves in Leads V1, V2 and V3.
Medication induced LQTS with TdP and Cardiac Arrest - Case Study: 56 year old male

Run of Torsades de Pointes occurred during Cardiac Catheterization...
Medication induced LQTS with TdP and Cardiac Arrest - Case Study: 56 year old male

Torsades de Pointes self-terminates just before aborted Defibrillation
Medication induced LQTS with TdP and Cardiac Arrest - Case Study: 56 year old male

Ritalin was immediately discontinued. Within 48 hours, U waves were gone. No more incidents of syncope reported.
ESTABLISH YOUR ROUTINE
ECG EVALUATION

- RATE
- RHYTHM
- INTERVALS
- P:QRS RATIO
DETERMINE $P : QRS$ RATIO

SIMPLY STATED, SHOULD ALWAYS BE $1 : 1$
$\text{P:QRS Ratio}$

If greater than $1:1$

Think:

- $2^\circ$ Heart Block (Type 1 or 2)
- $3^\circ$ Heart Block
- Atrial Flutter (Saw-toothed "F" Waves)
DIAGNOSING 2nd and 3rd DEGREE HEART BLOCK
MORE P-WAVES THAN QRS COMPLEXES PRESENT.

ARE THE P-R INTERVALS REGULAR AND CONSISTENT ??

YES.
IT'S 2nd TYPE II HB

NO.
ARE THE R-R INTERVALS REGULAR ?

NO.
IT'S 2nd TYPE I HB (Wenckebach)

YES.
IT'S 3rd DEGREE (COMPLETE) HEART BLOCK.
LET'S TEST THE PROCEDURE . . .

1

2

3
ESTABLISH YOUR ROUTINE
ECG EVALUATION.

- RATE
- RHYTHM
- INTERVALS
- P:QRS RATIO
This rhythm is: Normal Sinus Rhythm

Main identification characteristic(s): Perfectly normal in every way!

Rate: Between 60 - 100
Rhythm: Regular
P-R interval: 120 - 200 ms (0.12 - 0.20)
P:QRS ratio: 1:1
QRS interval: Normal (less than 120 ms)

Potential problems: None!
THIS RHYTHM IS:

MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE
RHYTHM
P-R INTERVAL
P: QRS RATIO
QRS INTERVAL

HR: 40
THIS RHYTHM IS: SINUS BRADYCARDIA

MAIN IDENTIFICATION CHARACTERISTIC(S): HEART RATE LESS THAN 60

RATE: LESS THAN 60
RHYTHM: REGULAR
P-R INTERVAL: NORMAL (120 - 200 ms)
P: QRS RATIO: 1:1
QRS INTERVAL: NORMAL (< 120 ms)

POTENTIAL PROBLEM(S):
- HYPOTENSION / SHOCK
- MAY HAVE OTHER SERIOUS PROBLEMS (SUCH AS ACUTE MI)
SHOCK ASSESSMENT

SHOCK = INADEQUATE TISSUE PERFUSION

- STARTS THE INSTANT YOU SEE PATIENT
- ENDS WHEN YOU REACH THE PATIENT'S SIDE
## Shock Assessment

<table>
<thead>
<tr>
<th>LOC:</th>
<th>ANXIOUS</th>
<th>RESTLESS</th>
<th>LETHARGIC</th>
<th>UNCONSCIOUS</th>
<th>AWAKE</th>
<th>ALERT &amp; ORIENTED</th>
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<tbody>
<tr>
<td>SKIN:</td>
<td>PALE / ASHEN</td>
<td>CYANOTIC</td>
<td>COOL</td>
<td>DIAPHORETIC</td>
<td>NORMAL HUE</td>
<td>WARM</td>
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<td>BREATHING:</td>
<td>TACHYPNEA</td>
<td></td>
<td></td>
<td></td>
<td>NORMAL</td>
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<tr>
<td>PULSE:</td>
<td>WEAK / THREADY</td>
<td>TOO FAST or SLOW</td>
<td></td>
<td></td>
<td>STRONG</td>
<td></td>
</tr>
<tr>
<td>STATUS:</td>
<td>🚨 SHOCK 🚨</td>
<td></td>
<td></td>
<td></td>
<td>NORMAL</td>
<td></td>
</tr>
</tbody>
</table>
THIS RHYTHM IS: SINUS BRADYCARDIA

WE MUST CONSIDER UNDERLYING CAUSES:
- INCREASED VAGAL TONE
- BLOCKED SA NODAL ARTERY (INFERIOR WALL MI)
- ELECTROLYTE IMBAL. (K+)
- HYPOTHERMIA
- ORGANOPHOSPHATE POISONING
- ATHLETIC METABOLISM (excellent health!)

AND TREAT THEM:
- ATROPINE
- CARDIAC CATH - PTCA / STENT
- THROMBOLYTICS
- CORRECT ELECTROLYTES
- WARM PATIENT
- ATROPINE
- COMPLIMENT PATIENT!
THIS RHYTHM IS:

MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE
RHYTHM
P-R INTERVAL
P: QRS RATIO
QRS INTERVAL
THIS RHYTHM IS: FIRST DEGREE HEART BLOCK

MAIN IDENTIFICATION CHARACTERISTIC(S): P-R INTERVAL TOO LONG -
(GREATER THAN 200 mSEC.)

RATE -------------- NORMAL
RHYTHM ----------- REGULAR
P-R INTERVAL ----- > 200 mSEC.
P: QRS RATIO ------ 1:1
QRS INTERVAL ----- NORMAL
THIS RHYTHM IS: FIRST DEGREE HEART BLOCK

MAIN IDENTIFICATION CHARACTERISTIC(S): P-R INTERVAL TOO LONG - (GREATER THAN 200 mSEC.)

POTENTIAL PROBLEMS:

- HR MAY BE BRADYCARDIC (< 60)
- MAY PROGRESS TO HIGHER GRADE HB (2°, 3°) with SLOWER VENTRICULAR RATE
THIS RHYTHM IS:

MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE
RHYTHM
P-R INTERVAL
P: QRS RATIO
QRS INTERVAL
When you see "extra P waves"...

**Step 1**
Evaluate P-R relationship

**Diagnosing 2nd and 3rd Degree Heart Block**

More P-waves than QRS complexes present.

Are the P-R intervals regular and consistent??

- **Yes.**
  - It's 2nd Type II HB

- **No.**
  - Are the R-R intervals regular?
    - **No.**
      - It's 2nd Type I HB (Wenckebach)
    - **Yes.**
      - It's 3rd Degree (Complete) Heart Block.
WHEN YOU SEE "EXTRA P WAVES" . . . .

STEP 1
EVALUATE P - R RELATIONSHIP

STEP 2
EVALUATE R - R INTERVALS

DIAGNOSING 2nd and 3rd DEGREE HEART BLOCK
MORE P-WAVES THAN QRS COMPLEXES PRESENT.

ARE THE P-R INTERVALS REGULAR AND CONSISTENT ??

YES.
IT'S 2nd TYPE II HB

NO.
ARE THE R-R INTERVALS REGULAR ?

YES.
IT'S 3rd DEGREE ( COMPLETE ) HEART BLOCK.

NO.
IT'S 2nd TYPE I HB ( Wenckebach )
**STEP 1**
Evaluate P-R relationship

**STEP 2**
Evaluate R-R intervals

**DIAGNOSING 2nd and 3rd Degree Heart Block**
More P-waves than QRS complexes present.

- **Are the P-R intervals regular and consistent?**
  - **Yes.**
    - It's 2nd Type II HB
  - **No.**
    - **Are the R-R intervals regular?**
      - **Yes.**
        - It's 3rd Degree (Complete) Heart Block.
      - **No.**
        - It's 2nd Type I HB (Wenckebach)
THIS RHYTHM IS: 2nd° TYPE I HB (Wenckebach)

MAIN IDENTIFICATION CHARACTERISTIC(S): P-R INTERVAL GETS PROGRESSIVELY LONGER UNTIL IT DROPS A QRS – THEN CYCLE REPEATS

RATE -------------- NORMAL or BRADYCARDIC
RHYTHM ------------- REGULARLY IRREGULAR
P-R INTERVAL ------- VARIES (regularly irregular)
P:QRS RATIO ------- VAIRES (usually 1:1 and 2:1)
QRS INTERVAL ------- NORMAL
THIS RHYTHM IS: 2nd \^0\ TYPE I HB (Wenckebach)

MAIN IDENTIFICATION CHARACTERISTIC(S): P-R INTERVAL GETS PROGRESSIVELY LONGER UNTIL IT DROPS A QRS – THEN CYCLE REPEATS

POTENTIAL PROBLEMS:

- HR MAY BE BRADYCARDIC (< 60)
- MAY PROGRESS TO HIGHER GRADE HB (2\^0\ type II, 3\^0\) WITH SLOWER VENTRICULAR RATE
- PT MAY BE SYMPTOMATIC (SHOCK) FROM ↓ CARDIAC OUTPUT
THIS RHYTHM IS:

MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE
RHYTHM
P-R INTERVAL
P: QRS RATIO
QRS INTERVAL
WHEN YOU SEE "EXTRA P WAVES" . . . .

STEP 1
EVALUATE P - R RELATIONSHIP

DIAGNOSING 2nd and 3rd DEGREE HEART BLOCK
MORE P-WAVES THAN QRS COMPLEXES PRESENT.

ARE THE P-R INTERVALS REGULAR AND CONSISTENT ??

- YES.
  - IT'S 2nd TYPE II HB
- NO.
  - ARE THE R-R INTERVALS REGULAR ?
    - NO.
      - IT'S 2nd TYPE I HB (Wenckebach)
    - YES.
      - IT'S 3rd DEGREE (COMPLETE) HEART BLOCK.
WHEN YOU SEE "EXTRA P WAVES" . . . .

STEP 1
EVALUATE P - R RELATIONSHIP

DIAGNOSING 2nd and 3rd DEGREE HEART BLOCK
MORE P-WAVES THAN QRS COMPLEXES PRESENT.

ARE THE P-R INTERVALS REGULAR AND CONSISTENT ??

- YES.
  - IT'S 2nd TYPE II HB

- NO.
  - ARE THE R-R INTERVALS REGULAR ?
    - NO.
      - IT'S 2nd TYPE I HB ( Wenckebach )
    - YES.
      - IT'S 3rd DEGREE ( COMPLETE ) HEART BLOCK.
THIS RHYTHM IS: 2nd° TYPE II HEART BLOCK

MAIN IDENTIFICATION CHARACTERISTIC(S): MORE THAN ONE P WAVE FOR EACH QRS -- BUT EVERY QRS HAS A NORMAL, CONSISTENT P-R INTERVAL

RATE ----------- USUALLY BRADYCARDIC
RHYTHM --------- USUALLY REGULAR (can be irregular)
P-R INTERVAL ---- NORMAL and CONSISTENT
P: QRS RATIO ---- ≥ 2:1
QRS INTERVAL ---- NORMAL
This rhythm is: 2nd° Type II Heart Block

Main identification characteristic(s): More than one P wave for each QRS — but every QRS has a normal, consistent P-R interval

Potential problems:

- Pt may be symptomatic (shock) from ↓ cardiac output
- Blockage may advance to ventricular standstill (Adams-Stokes syndrome) and cardiac arrest
- May progress to complete (3rd°) Heart Block
-- CRITICAL ECG ALERT --

- Immediately check patient
- Notify next “higher up” in chain of command

1. Heart rate LESS THAN 50 or GREATER THAN 150
2. QT INTERVAL prolonged (usually not emergent but let Dr. know)
3. 2nd degree type II or 3rd degree HEART BLOCK
THIS RHYTHM IS: 2nd° TYPE II HEART BLOCK

MAIN IDENTIFICATION CHARACTERISTIC(S): MORE THAN ONE P WAVE FOR EACH QRS -- BUT EVERY QRS HAS A NORMAL, CONSISTENT P - R INTERVAL

ADAMS-STOKES SYNDROME is essentially spontaneous CARDIAC ARREST -- characterized by episodes of ASYSTOLE, VENTRICULAR STANDSTILL and V-FIB. In this regard, 2nd° TYPE II HB can be more dangerous than 3rd° HB (at least 3rd° Heart Block has an ESCAPE RHYTHM)
CASE HISTORY:

72 y/o male with history of SYNCOPE OF UNKNOWN ORIGIN. While undergoing Cardiac Catherization (Left Heart Cath), pt went from NSR rate 76 - 80 to 2nd o TYPE II HEART BLOCK, which quickly deteriorated into VENTRICULAR STANDSTILL.

TX: CPR, Atropine, Transvenous Pacemaker, followed by Permanent Pacemaker Implanation. Patient experienced full recovery, was discharged.
THIS RHYTHM IS:

MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE
RHYTHM
P-R INTERVAL
P: QRS RATIO
QRS INTERVAL
This rhythm is:

Main identification characteristic(s):

Diagnosing 2nd and 3rd degree heart block:

More P-waves than QRS complexes present.

Are the P-R intervals regular and consistent??

- Yes.
  - It's 2nd type II HB

- No.
  - Are the R-R intervals regular?
    - No.
      - It's 2nd type I HB (Wenckebach)
    - Yes.
      - It's 3rd degree (complete) heart block.
DIAGNOSING 2nd and 3rd DEGREE HEART BLOCK
MORE P-WAVES THAN QRS COMPLEXES PRESENT.

ARE THE P-R INTERVALS REGULAR AND CONSISTENT??

YES.
IT'S 2nd TYPE II HB

NO.
ARE THE R-R INTERVALS REGULAR??

NO.
IT'S 2nd TYPE I HB (Wenckebach)

YES.
IT'S 3rd DEGREE (COMPLETE) HEART BLOCK.
This rhythm is: 3rd° HB ĉ JUNCTIONAL ESCAPE

Main identification characteristic(s): P - R interval inconsistent, P - P intervals regular, R - R intervals regular -- no relationship between P waves and QRS complexes.

Rate: Usually Bradycardic (40 - 60 Junctional Rate)
Rhythm: Regular
P - R interval: Inconsistent (irregularly irregular)
P: QRS Ratio: Varies - Usually > 2:1
QRS Interval: Normal (< 120 ms) unless pt has bundle branch block
THIS RHYTHM IS: 3rd^0 HB ć JUNCTIONAL ESCAPE

MAIN IDENTIFICATION CHARACTERISTIC(S): P - R INTERVAL INCOSISTENT, P - P INTERVALS REGULAR, R - R INTERVALS REGULAR -- NO RELATIONSHIP BETWEEN P WAVES AND QRS COMPLEXES.

POTENTIAL PROBLEMS:
- HYPOTENSION and SHOCK due to ↓ HEART RATE and ↓ CARDIAC OUTPUT
FAILURE AT AV NODE LEVEL
ESCAPE RHYTHM ORIGINATES JUST BELOW

A-V NODE

LEFT ANTERIOR BUNDLE BRANCH

RIGHT BUNDLE BRANCH

RV

ANTERIOR VIEW

LV
THIS RHYTHM IS:

MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE
RHYTHM
P-R INTERVAL
P: QRS RATIO
QRS INTERVAL
WHEN YOU SEE "EXTRA P WAVES"

STEP 1
EVALUATE P-R RELATIONSHIP

STEP 2
EVALUATE R-R INTERVALS

DIAGNOSING 2nd and 3rd DEGREE HEART BLOCK
MORE P-WAVES THAN QRS COMPLEXES PRESENT.

ARE THE P-R INTERVALS REGULAR AND CONSISTENT??

YES.
IT'S 2nd TYPE II HB

NO.
ARE THE R-R INTERVALS REGULAR?

NO.
IT'S 2nd TYPE I HB (Wenckebach)

YES.
IT'S 3rd DEGREE (COMPLETE) HEART BLOCK.
THIS RHYTHM IS: 3rd° HB IDIOVENTRICULAR ESCAPE

MAIN IDENTIFICATION CHARACTERISTIC(S): P - R INTERVALS INCONSISTENT, P - P INTERVALS REGULAR, R - R INTERVALS REGULAR. NO RELATIONSHIP BETWEEN P WAVES AND QRS COMPLEXES. QRS COMPLEXES are WIDER THAN 120ms, AND OF SLOW VENTRICULAR RATE (usually < 40)

RATE —— USUALLY BRADYCARDIC (< 40 VENTRICULAR RATE)
RHYTHM —— REGULAR
P-R INTERVAL —— INCONSISTENT (irregularly irregular)
P: QRS RATIO —— VARIES - USUALLY > 2 : 1
QRS INTERVAL —— WIDER THAN 120 ms
THIS RHYTHM IS: 3rd° HB IDIOVENTRICULAR ESCAPE

MAIN IDENTIFICATION CHARACTERISTIC(S): P - R INTERVALS INCONSISTENT
P - P INTERVALS REGULAR, R - R INTERVALS REGULAR. NO RELATIONSHIP BETWEEN P WAVES AND QRS COMPLEXES. QRS COMPLEXES are WIDER THAN 120ms, AND RATE (usually < 40)

POTENTIAL PROBLEMS:

HYPOTENSION and SHOCK due to ↓ HEART RATE and ↓ CARDIAC OUTPUT
SINUS ARREST.

Causes: SA Nodal disease, Increased vagal tone, SA Node ischemia / MI

Hemodynamic Concerns: Patient may experience syncope, cardiac arrest

Treatment: Atropine, CPR, Pacemaker
- Immediately check patient
- Notify next “higher up” in chain of command

1. Heart rate LESS THAN 50 or GREATER THAN 150
2. QT INTERVAL prolonged (usually not emergent but let Dr. know)
3. 2\text{nd} degree type II or 3\text{rd} degree HEART BLOCK
4. SINUS ARREST with periods of ASYSTOLE
- Symptomatic Bradycardias
- Heart Blocks with slow ventricular rates

Tx:
- ABCs
- General supportive care
- Bradycardia algorithm
SYMPTOMATIC BRADYCARDIA

- ABCs + GENERAL SUPPORTIVE CARE

- ATROPINE 0.5 mg. IV
  - MAY REPEAT 0.5 mg. DOSES IF NEEDED
  - MAXIMUM 3.0 mg.

- TRANSCUTANEOUS PACEMAKER
  - PREFERRED PRIMARY Tx FOR HIGH GRADE A-V BLOCK
SYMPTOMATIC BRADYCARDIA

- **DOPAMINE gtt.**
  2 - 10 mcg / kg. / min. INFUSION RATE IF PACING NOT AVAILABLE or EFFECTIVE

- **EPINEPHRINE gtt.**
  2 - 10 mcg / min INFUSION RATE IF PACING NOT AVAILABLE or EFFECTIVE

- **TRANSVENOUS PACEMAKER**
THIS RHYTHM IS: WANDERING ATRIAL PACEMAKER

MAIN IDENTIFICATION CHARACTERISTIC(S): P WAVES ARE OF DIFFERENT SIZES, DEFLECTIONS, and P-R INTERVALS SLIGHTLY VARY

RATE ------------ NORMAL
RHYTHM -------- NORMAL
P-R INTERVAL ---- SLIGHT VARIATION
P: QRS RATIO ---- 1:1
QRS INTERVAL ---- NORMAL (unless BBB)
THIS RHYTHM IS: WANDERING ATRIAL PACEMAKER

MAIN IDENTIFICATION CHARACTERISTIC(S): P WAVES ARE OF DIFFERENT SIZES, DEFLECTIONS, and P - R INTERVALS SLIGHTLY VARY

POTENTIAL PROBLEM(S):

- USUALLY NONE.
- THIS RHYTHM IS SEEN MOST FREQUENTLY IN HEALTHY YOUNG CHILDREN
THIS RHYTHM IS:  ATRIAL FIBRILLATION

MAIN IDENTIFICATION CHARACTERISTIC(S):  IRREGULARLY IRREGULAR R-R INTERVALS,  NO DISCERNABLE P WAVES,  FIBRILLATORY BASE-LINE.

RATE  ---------  BRADY, NORMAL, or TACHY
RHYTHM  ---------  IRREGULARLY IRREGULAR
P-R INTERVAL ----  NOT DISCERNABLE
P: QRS RATIO ----  NOT DISCERNABLE
QRS INTERVAL ----  NORMAL, (unless BBB present)
THIS RHYTHM IS: ATRIAL FIBRILLATION

MAIN IDENTIFICATION CHARACTERISTIC(S): IRREGULARLY IRREGULAR R-R INTERVALS, NO DISCERNABLE P WAVES, FIBRILLATORY BASE-LINE.

POTENTIAL PROBLEMS:

- VENTRICULAR RATE CAN BECOME TOO SLOW OR TOO FAST
- WITHOUT THE "ATRIAL KICK," CARDIAC OUTPUT DROPS 10-20%
- THROMBUS FORMATION MAY OCCUR IN THE LEFT ATRIAL APPENDAGE, PUTTING PATIENT AT HIGH RISK FOR CVA
THIS RHYTHM IS: ATRIAL FIBRILLATION

MAIN IDENTIFICATION CHARACTERISTIC(S): IRREGULARLY IRREGULAR R-R INTERVALS, NO DISCERNABLE P WAVES, FIBRILLATORY BASE-LINE.

TREATMENT / INTERVENTIONS:
- NEED FOR EMERGENCY INTERVENTION FOR A-FIB IS BASED ON PATIENT’S VENTRICULAR RATE:
  ➡ TOO SLOW - SYMPTOMATIC BRADYCARDIA ALGORITHM
  ➡ TOO FAST - TACHYCARDIA ALGORITHM
-- CRITICAL ECG ALERT --

- Immediately check patient
- Notify next “higher up” in chain of command

1. Heart rate LESS THAN 50 or GREATER THAN 150
2. QT INTERVAL prolonged (usually not emergent but let Dr. know)
3. 2nd degree type II or 3rd degree HEART BLOCK
4. SINUS ARREST with periods of ASYSTOLE
5. NEW ONSET of any DYSRHYTHMIA
LEFT ATRIUM
ANTERIOR VIEW

RIGHT SUPERIOR PULMONARY VEIN

LEFT ATRIAL APPENDAGE
SITE OF THROMBUS FORMATION

LEFT SUPERIOR PULMONARY VEIN

LEFT INFERIOR PULMONARY VEIN (hidden)
THIS RHYTHM IS:

MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE
RHYTHM
P-R INTERVAL
P: QRS RATIO
QRS INTERVAL
THIS RHYTHM IS: ATRIAL FLUTTER

MAIN IDENTIFICATION CHARACTERISTIC(S): RAPID RATE "SAW-TOOTHED" FLUTTER WAVES (F-WAVES)

RATE -------------------- ATRIAL: 200 - 300, VENT: BRADY, NORMAL or TACHY
RHYTHM ----------------- REGULAR or IRREGULAR
P-R INTERVAL ----------- USUALLY NORMAL, CONSISTENT
P: QRS RATIO ----------- VARIES (usually 3:1, 4:1, or 5:1)
QRS INTERVAL --------- NORMAL (unless BBB present)
THIS RHYTHM IS: ATRIAL FLUTTER

MAIN IDENTIFICATION CHARACTERISTIC(S): RAPID RATE "SAW-TOOTHED" FLUTTER WAVES (F-WAVES)

POTENTIAL PROBLEM(S):
- VENTRICULAR RATE CAN BE TOO RAPID or TOO SLOW
- A-FLUTTER OFTEN IS INTERMITTENT WITH A-FIB -- A-FIB PRECAUTIONS APPLY (THROMBUS RISKS)

TREATMENT / INTERVENTIONS:
- TOO SLOW - SYMPTOMATIC BRADYCARDIA ALGORITHM
- TOO FAST - TACHYCARDIA ALGORITHM
784 yr  Hispanic
Room: VAM  Loc: 23

Ven. rate: 85 BPM
PR interval: * ms
QRS duration: 100 ms
QT/QTc: 342/406 ms
P-R-T axes: 58 48

"**UNEDITED COPY: REPORT IS COMPUTER GENERATED ONLY, WITHOUT PHYSICIAN INTERPRETATION**.

- Atrial fibrillation
- Voltage criteria for left ventricular hypertrophy
- Abnormal ECG

When compared with ECG of 19-NOV-2006 07:39,
No significant change was found

Technician:

Referred by

**LOOKS LIKE A - FLUTTER**

**LOOKS LIKE A - FIB**

**LOOKS LIKE A - FLUTTER**

25mm/s  10mm/mV  40Hz  005D  12SL 235  CID: 2
55 y/o Male c/o “palpitations,”
No previous cardiac history
55 yr Male Caucasian

**VENT. RATE** 178 BPM
PR interval 90 ms
QRS duration 90 ms
QT/QTc 264/454 ms
P-R-T axes 46

**Atrial fibrillation with rapid ventricular response**
with premature ventricular or aberrantly conducted complexes
Nonspecific ST abnormality, probably digitalis effect
Abnormal ECG
When compared with ECG of 30–JUL–1998 15:14,
Atrial fibrillation has replaced Sinus rhythm
Vent. rate has increased BY 109 BPM ...

Technician:

Referred by:

Confirmed By: UNEDITED DR.

25mm/s 10mm/mV 40Hz 005C 12SL 235 CID: 2
ATRIAL FIBRILLATION
CRITICAL CONSIDERATION . . . .

COULD PATIENT HAVE BEEN IN A-FIB FOR AT LEAST 48 HOURS?  _______________  ✔  YES

IS PATIENT ON ANTICOAGULANTS?  _______________  ✔  NO

THEN RULE OUT EMBOLI IN ATRIUM WITH EITHER A STAT ECHO or T.E.E. BEFORE CONVERTING TO SINUS RHYTHM!
ATRIAL FIBRILLATION
CRITICAL CONSIDERATION

Could patient have been in A-FIB for at least 48 hours? ____________

☑️ Yes

Is patient on anticoagulants? ____________

☑️ No

Then rule out emboli in atrium with either a STAT ECHO or T.E.E. before converting to sinus rhythm!
SVT - UNSTABLE PATIENT (NARROW QRS)

ABCs + GENERAL SUPPORTIVE CARE
( OXYGEN, ECG/VS/SAO2 MONITORING, IV ACCESS )

IMMEDIATE SYNCHRONIZED CARDIOVERSION

- CONSIDER SEDATION
- ADENOSINE - IF IT DOES NOT DELAY CARDIOVERSION!
- SYNCHRONIZED CARDIOVERSION
  
  REGULAR RHYTHM: 50 - 100 j biphasic
  IRREGULAR RHYTHM: 100 - 200 j biphasic
  
  monophasic = 200 j

AHA ACLS 2015
SVT - STABLE PATIENT (NARROW QRS)

ABCs + GENERAL SUPPORTIVE CARE

REGULAR RHYTHM
- VAGAL MANEUVERS
- ADENOSINE 6 mg / 12 mg

IRREGULAR RHYTHM
- POSSIBLE ATRIAL FIB or MULTIFOCAL ATRIAL TACH

- BETA BLOCKERS
- CALCIUM CHANNEL BLOCKER
- TREAT UNDERLYING CAUSE (THE Hs and Ts)
- "EXPERT CONSULTATION"
SVT - STABLE PATIENT

ABCs + GENERAL SUPPORTIVE CARE

REGULAR RHYTHM
- VAGAL MANEUVERS
- ADENOSINE 6 mg / 12 mg

IRREGULAR RHYTHM
- POSSIBLE ATRIAL FIB or MULTIFOCAL ATRIAL TACH

- BETA BLOCKERS
- CALCIUM CHANNEL BLOCKER
- TREAT UNDERLYING CAUSE (THE Hs and Ts)
- "EXPERT CONSULTATION"
ST. JOSEPH'S HOSPITAL -

37 yr Male Caucasian

Vent. rate 180 BPM
PR interval * ms
QRS duration 148 ms
QT/QTc 284/491 ms
P-R-T axes * -77 103

WIDE QRS TACHYCARDIA - POSSIBLE VT
Right bundle branch block PATTERN
Abnormal ECG

Look for delta waves

NOTE IRREGULARITY OF RHYTHM
(SUGGESTIVE OF A FIB)
- NOTE IRREGULARITY OF RHYTHM - (SUGGESTIVE of A-FIB)
- WIDE QRS – Consider Bypass Tract (W-P-W)
- DELTA WAVES? (may or may not be visible).
CHARACTERISTICS of W-P-W with Afib & RVR:
- WIDE COMPLEX TACHYCARDIA
- IRREGULARLY IRREGULAR R–R INTERVALS !!

NOTE:
Delta Waves may not be discernable!
Wolff-Parkinson-White + A-fib
Wolff-Parkinson-White + A-fib = DISASTER
NO AV NODAL BLOCKERS 
(e.g. ADENOSINE, CALCIUM CHANNEL BLOCKERS) 
FOR WIDE COMPLEX TACHYCARDIAS THAT COULD BE ATRIAL FIBRILLATION with Pre-Excitation (W-P-W)
Atrial Fibrillation with Wolff-Parkinson White

SA NODE (not working!)

FIBROUS SKELETON of the HEART

AV NODE

ECG Trace

V4
Atrial Fibrillation with Wolff-Parkinson White
with AV NODAL BLOCKING AGENTS
e.g.: Adenosine, Ca++ Blockers

SA NODE (not working!)
FIBROUS SKELETON of the HEART
AV NODE (NO CONDUCTION)
BYPASS TRACT

ECG tracings show the electrical activity of the heart.
WIDE COMPLEX TACHYCARDIA (QRS > 120 ms)

MONOPHASIC

NO PULSE
GO TO V - FIB ALGORITHM!

PULSE - UNSTABLE
- IMMEDIATE SYNC. CARDIOVERSION:
  - 120 j biphasic
  - consider sedation
- INCREASE joules
- MEDS:
  - PROCAINAMIDE
  - AMIODARONE

PULSE - STABLE
- O2, IV-IO, EKG
- MEDS:
  - ADENOSINE 6-12 (only if PERNICIOUS)
  - PROCAINAMIDE (20-50mg/min)
  - AMIODARONE (150mg/h)
  - ILBUTILIDE
THIS RHYTHM IS:

MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE
RHYTHM
P-R INTERVAL
P: QRS RATIO
QRS INTERVAL
THIS RHYTHM IS: SINUS TACHYCARDIA

MAIN IDENTIFICATION CHARACTERISTIC(S): SINUS RHYTHM, RATE HIGHER THAN 100. (ACLS guidelines: heart rate 100 - 150)

RATE -------------- 100 - 150 (can be > 150)
RHYTHM ------------- REGULAR
P-R INTERVAL ------ NORMAL (120 - 200 ms)
P:QRS RATIO ------- 1:1
QRS INTERVAL ------ NORMAL (< 120 ms), (unless Bundle Branch Block present)
THIS RHYTHM IS: SINUS TACHYCARDIA

MAIN IDENTIFICATION CHARACTERISTIC(S): SINUS RHYTHM, RATE HIGHER THAN 100. (ACLS guidelines: heart rate 100 - 150)

POTENTIAL PROBLEMS:

- Usually none, unless pt. has severe underlying disease, such as a LOW EF (<40%).
- IN MOST CASES, the patient's UNDERLYING PROBLEM is the key issue....
THIS RHYTHM IS: SINUS TACHYCARDIA

MAIN IDENTIFICATION CHARACTERISTIC(S): SINUS RHYTHM, RATE HIGHER THAN 100. (ACLS guidelines: heart rate 100 - 150)

TREATMENT / INTERVENTIONS:

IN MOST CASES, YOU TREAT THE UNDERLYING CAUSE!
THIS RHYTHM IS: SINUS TACHYCARDIA

WE MUST CONSIDER UNDERLYING CAUSES:

- ANXIETY / FEAR
- HYPOVOLEMIA
- DEHYDRATION
- BLOOD LOSS
- MEDICATION EFFECTS
- OTHER ILLNESS

AND TREAT THEM:

- CALM PATIENT
- FLUIDS
- STOP BLEEDING
- CONSIDER MEDICAL Tx
- IDENTIFY & Tx DISORDER
ACLS TACHYCARDIA GUIDELINES

- SVT
- Sinus Tach
- NSR
SUPRAVENTRICULAR TACHYCARDIA

SVT is usually PAROXYSMAL -- i.e.: has a SUDDEN ONSET.

SINUS TACHYCARDIA usually has a "ramp-up" and "ramp-down" period -- a gradual change in HEART RATE.
THIS RHYTHM IS:

MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE
RHYTHM
P-R INTERVAL
P: QRS RATIO
QRS INTERVAL
THIS RHYTHM IS: SUPRAVENTRICULAR TACHYCARDIA (SVT)

MAIN IDENTIFICATION CHARACTERISTIC(S): HEART RATE TOO FAST, USUALLY > 150. P WAVES MAY BE "BURIED" IN THE PRECEDING T WAVES. Pt USUALLY C/O "SUDDEN ONSET of HEART RACING," or "PALPITATIONS."

RATE ----------- TACHYCARDIC (usually > 150)
RHYTHM ----------- REGULAR
P-R INTERVAL ----- NORMAL or ABNORMAL. MAY BE IMPOSSIBLE TO SEE DUE TO P WAVE BURIED IN T WAVES
P:QRS RATIO ----- 1:1
QRS INTERVAL ----- NORMAL
THIS RHYTHM IS: SUPRAVENTRICULAR TACHYCARDIA (SVT)

MAIN IDENTIFICATION CHARACTERISTIC(S): HEART RATE TOO FAST, USUALLY > 150. P WAVES MAY BE "BURIED" IN THE PRECEDING T WAVES. Pt USUALLY C/O "SUDDEN ONSET of HEART RACING," or "PALPITATIONS."

POTENTIAL PROBLEMS:

- HEART MAY BE BEATING TOO FAST TO ALLOW ADEQUATE TIME FOR VENTRICULAR FILLING, RESULTING IN ↓ CARDIAC OUTPUT AND POSSIBLE HYPTENSION AND SHOCK.

- MYOCARDIAL ISCHEMIA (and therefore CHEST PAIN) IN PATIENTS WITH SIGNIFICANT UNDERLYING HEART DISEASE.
THIS RHYTHM IS: SUPRAVENTRICULAR TACHYCARDIA (SVT)

MAIN IDENTIFICATION CHARACTERISTIC(S): HEART RATE TOO FAST, USUALLY > 150. P WAVES MAY BE "BURIED" IN THE PRECEDING T WAVES. Pt USUALLY C/O "SUDDEN ONSET of HEART RACING," or "PALPITATIONS."

TREATMENT / INTERVENTIONS:

BASED ON WHETHER PATIENT IS STABLE or UNSTABLE...
SVT - UNSTABLE PATIENT (NARROW QRS)

ABCs + GENERAL SUPPORTIVE CARE
( OXYGEN, ECG / VS / SAO2 MONITORING, IV ACCESS )

IMMEDIATE SYNCHRONIZED CARDIOVERSION

- CONSIDER SEDATION
- ADENOSINE - IF IT DOES NOT DELAY CARDIOVERSION!
- SYNCHRONIZED CARDIOVERSION

REGULAR RHYTHM: 50 - 100 J biphasic
IRREGULAR RHYTHM: 100 - 200 J biphasic

------- monophasic = 200 J -------
SVT - STABLE PATIENT (NARROW QRS)

ABCs + GENERAL SUPPORTIVE CARE

REGULAR RHYTHM
- VAGAL MANEUVERS
- ADENOSINE 6 mg / 12 mg

IRREGULAR RHYTHM
- POSSIBLE ATRIAL FIB or MULTIFOCAL ATRIAL TACH
- BETA BLOCKERS
- CALCIUM CHANNEL BLOCKER
- TREAT UNDERLYING CAUSE (THE Hs and Ts)
- "EXPERT CONSULTATION"
THIS RHYTHM IS: JUNCTIONAL RHYTHM

MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE
RHYTHM
P-R INTERVAL
P: QRS RATIO
QRS INTERVAL
THIS RHYTHM IS: JUNCTIONAL RHYTHM

MAIN IDENTIFICATION CHARACTERISTIC(S): P WAVES ABSENT, or LOCATED JUST AFTER QRS (in S-Tseg) or JUST BEFORE QRS (short P-R). WHEN P wave seen, it is INVERTED (upside-down).

- RATE .................. 40 - 60
- RHYTHM ................ REGULAR
- P-R INTERVAL ........... ABSENT or SHORT
- P:QRS RATIO ............ 1:1
- QRS INTERVAL .......... NORMAL

- HR USUALLY 40 - 60
THIS RHYTHM IS: JUNCTIONAL RHYTHM

MAIN IDENTIFICATION CHARACTERISTIC(S): P WAVES ABSENT, or LOCATED JUST AFTER QRS (in S-Tseg) or JUST BEFORE QRS (short P-R). WHEN P wave seen, it is INVERTED (upside-down).
- HR USUALLY 40 - 60

52 HR: 69
THIS RHYTHM IS: JUNCTIONAL RHYTHM

MAIN IDENTIFICATION CHARACTERISTIC(S): P WAVES ABSENT, or LOCATED
JUST AFTER QRS (in S-Tseg) or JUST BEFORE QRS (short P-R). WHEN P wave
seen, it is INVERTED (upside-down).

POTENTIAL PROBLEM(S):
- HR can be TOO FAST or TOO SLOW!! (↓ CARDIAC OUTPUT)
- COULD BE INDICATOR OF MORE SERIOUS UNDERLYING CONDITIONS:
  • M.I.
  • ELECTRICAL SYSTEM DISTURBANCES
THIS RHYTHM IS: JUNCTIONAL RHYTHM

MAIN IDENTIFICATION CHARACTERISTIC(S): P WAVES ABSENT, or LOCATED JUST AFTER QRS (in S-Tseg) or JUST BEFORE QRS (short P-R). WHEN P wave seen, it is INVERTED (upside-down).
- HR USUALLY 40-60

TREATMENT/INTERVENTION:
- CORRECT HEART RATE, if pt. symptomatic and HR too SLOW or FAST. (atropine, pacemaker - cardioversion, etc)
- FURTHER DIAGNOSTIC STUDIES to determine why SINUS NODE not working !!!
THIS RHYTHM IS: JUNCTIONAL RHYTHM

HEART RATE TOO FAST . . . .

WE MUST CONSIDER UNDERLYING CAUSES:

- AV NODAL RE-ENTRANT TACHYCARDIA (AVNRT)
  (Pt. has DUAL AV NODES)
- WPW ORTHODROMIC TACHYCARDIA

AND TREAT THEM:

- "CHEMICAL" CARDIOVERSION
- SYNCHRONIZED CARDIOVERSION
- ABLATION of "SLOW PATHWAY" (AVNRT) or ACCESSORY BYPASS TRACT (WPW) in EP LAB
ECTOPY

- ATRIAL
- JUNCTIONAL
- VENTRICULAR
CLASSIFICATIONS OF ECTOPY

1. PREMATURE
   THE ECTOPIC BEAT COMES BEFORE THE NEXT REGULARLY EXPECTED BEAT (IT's EARLY!)

2. END-DIASTOLIC, ESCAPE, or COMPENSATORY
   THE ECTOPIC BEAT COMES AFTER A REGULAR BEAT FAILS TO HAPPEN. END-DIASTOLIC BEATS MAY BE LIFE-SAVING
CAUSES OF ECTOPY

1. PREMATURE
   - HYPOXIA
   - IRRITABILITY
   - CHANGES IN SYMPATHETIC / PARASYMPATHETIC TONE
   - DAMAGE TO MYOCARDIUM CAUSING CHANGES IN AUTOMATICITY (such as from MI / NECROSIS, etc.).
   - MEDICATIONS / SUBSTANCES
   - ELECTROLYTES

2. END-DIASTOLIC, ESCAPE, or COMPENSATORY
   - FAILURE OF SA NODE
   - FAILURE OF AV NODE

   WHEN THESE FAIL TO PRODUCE OR PROPAGATE AN IMPULSE, ESCAPE FOCI MAY TAKE OVER PACING THE HEART BY PRODUCING END-DIASTOLIC BEATS
SIMPLY STATED,

1. PREMATURE BEATS ---- BAD

   IN SOME CASES WE MUST ELIMINATE PREMATURE BEATS TO PROTECT THE PATIENT

2. END-DIASTOLIC or ESCAPE BEATS ---- GOOD

   ELIMINATION OF END-DIASTOLIC BEATS COULD BE DEADLY
Premature

End Diastolic  (escape)
THIS RHYTHM IS: NSR with PAC

MAIN IDENTIFICATION CHARACTERISTIC(S): PREMATURE COMPLEX, NORMAL QRS; P-WAVE DIFFERENT THAN OTHERS; P-R INTERVAL FREQUENTLY LONGER or SHORTER THAN NORMAL; NO COMPENSATORY PAUSE

RATE -------------- NORMAL
RHYTHM ------------ IRREGULAR
P-R INTERVAL ------ NORMAL (except PAC may be LONGER or SHORTER)
P: QRS RATIO ------ 1:1
QRS INTERVAL ------ NORMAL (unless BBB present)
THIS RHYTHM IS: NSR with JUNCTIONAL ESCAPE BEAT

MAIN IDENTIFICATION CHARACTERISTIC(S): BEAT OCCURS LATER THAN NEXT EXPECTED BEAT; QRS IS NORMAL; P WAVE ABSENT or JUST IN FRONT OF or JUST AFTER QRS and is USUALLY INVERTED.

RATE -------------- NORMAL
RHYTHM ------------- IRREGULAR (because of ESCAPE BEAT)
P-R INTERVAL ------ NORMAL for NSR/ ABSENT or SHORT for ESCAPE BEAT
P:QRS RATIO ------- 1:1 for NSR / 0:1 or 1:1 for ESCAPE BEAT
QRS INTERVAL ------ NORMAL (unless BBB present)
THIS RHYTHM IS:

MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE
RHYTHM
P-R INTERVAL
P: QRS RATIO
QRS INTERVAL
THIS RHYTHM IS: NSR with UNIFOCAL PVCs

MAIN IDENTIFICATION CHARACTERISTIC(S): ECTOPIC BEATS ARE PREMATURE, AND WIDE (> 120 ms); COMPLEXES MAY BE OF ANY SHAPE or DEFLECTION, BUT ALL HAVE SAME APPEARANCE; THERE IS A COMPENSATORY PAUSE

RATE --------------- NORMAL
RHYTHM -------------- IRREGULAR (due to PVCs)
P-R INTERVAL ------- NSR BEATS - NORMAL (120 - 200 ms)  PVCs - N/A
P: QRS RATIO ------- NSR BEATS - 1:1  PVCs - N/A
QRS INTERVAL ------ NSR BEATS < 120 ms  PVCs > 120 ms
Multifocal PVCs

Multifocal Couplet PVCs
**-- CRITICAL ECG ALERT --**

- Immediately check patient
- Notify next “higher up” in chain of command

1. Heart rate LESS THAN 50 or GREATER THAN 150
2. QT INTERVAL prolonged (usually not emergent but let Dr. know)
3. 2\textsuperscript{nd} degree type II or 3\textsuperscript{rd} degree HEART BLOCK
4. SINUS ARREST with periods of ASYSTOLE
5. NEW ONSET of any DYSRHYTHMIA
6. PVCs that are MULTIFOCAL, 2 or MORE TOGETHER, R on T, greater than 6 per minute,
THIS RHYTHM IS:

MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE
RHYTHM
P-R INTERVAL
P: QRS RATIO
QRS INTERVAL
THIS RHYTHM IS: SINUS ARREST w/ VENT. ESCAPE

MAIN IDENTIFICATION CHARACTERISTIC(S): END DIASTOLIC (ESCAPE) BEAT(S); COMPLEXES WIDER THAN 120 ms; MAY BE UNIFOCAL or MULTIFOCAL; MAY or MAY NOT HAVE GOOD PULSE w/ COMPLEXES

RATE ----------- USUALLY < 40
RHYTHM --------- VENT. ESCAPE: USUALLY REGULAR
P-R INTERVAL ---- VENT. ESCAPE: N/A
P: QRS RATIO ---- VENT. ESCAPE: N/A
QRS INTERVAL ---- VENT. ESCAPE: > 20 ms
THIS RHYTHM IS: SINUS ARREST w/ VENT. ESCAPE

MAIN IDENTIFICATION characteristic(s): END DIASTOLIC (ESCAPE) BEAT(s); COMPLEXES WIDER THAN 120 ms; MAY BE UNIFOCAL or MULTIFOCAL; MAY or MAY NOT HAVE GOOD PULSE w/ COMPLEXES

PRESENTING PROBLEM(S):

- Problem is with underlying reason why sinus node and AV node having periods of arrest.
- The ventricular escape complex may be very slow, but may be only thing keeping patient perfused during periods of sinus/AV arrest.
THIS RHYTHM IS: SINUS ARREST w/ VENT. ESCAPE

TREATMENT / INTERVENTION (S):

- EMERGENT TREATMENT IS TRANSCUTANEOUS PACING.
- TREAT UNDERLYING CAUSE OF SINUS/AV ARREST
- **DO NOT** ATTEMPT TO SUPPRESS VENTRICULAR ESCAPE BEATS WITHOUT HAVING BACK-UP TRANSCUTANEOUS / TRANSVENOUS PACING ATTACHED TO PATIENT !!!
Accelerated Idioventricular Rhythm (AIVR)

No P waves
Wide QRS Complexes
Rate usually “Ventricular” - 40 or less

This may be the only RHYTHM keeping the Patient alive.
THIS RHYTHM IS: NSR with R on T PHENOMENON

MAIN IDENTIFICATION CHARACTERISTIC(S): ECTOPIC BEATS ARE WIDE (> 120 ms); ALL APPEAR TO HAVE SAME SHAPE and DEFLECTION; THERE IS A COMPENSATORY PAUSE

POTENTIAL PROBLEMS (S):
- THE UNDERLYING REASON PVCs ARE PRESENT COULD BE A CRITICAL ISSUE . . .
- PVCs MAY HAVE A WEAKER PULSE, or NO PULSE
- PVCs DURING REFRACTORY PERIOD COULD CAUSE V-FIB
- PVCs COUPLED TOGETHER COULD PRECIPITATE V-TACH
50% REPOLARIZATION of VENTRICULAR CELLS

T wave

RELATIVE REFRACTORY PERIOD
ELECTRICAL STIMULUS TO VENTRICLES MAY CAUSE V-FIB / V-TACH

ABSOLUTE REFRACTORY PERIOD
ELECTRICAL STIMULUS TO VENTRICLES HAS VERY HIGH PROBABILITY OF CAUSING V-FIB / V-TACH
THIS RHYTHM IS: NSR w/ COUPLETT and RUN of V-TACH

MAIN IDENTIFICATION CHARACTERISTIC(S): ECTOPIC BEATS ARE WIDE (> 120 ms); PVCs ARE COUPLED TOGETHER (2 = "COUPLETT"), (3 or more = RUN OF V-TACH)

POTENTIAL PROBLEMS (S):
- THE UNDERLYING REASON PVCs ARE PRESENT COULD BE A CRITICAL ISSUE . . .
- PVCs MAY HAVE A WEAKER PULSE, or NO PULSE
- PVCs DURING REFRACTORY PERIOD COULD CAUSE V-FIB
- PVCs COUPLED TOGETHER COULD PRECIPITATE V-TACH
THIS RHYTHM IS: NSR w/ COUPLETS and RUN OF V-TACH

TEXTBOOK STANDARDS:

- 3 or more PVCs IN A ROW = RUN OF VENTRICULAR TACHYCARDIA
- DEFINITION OF "SUSTAINED V-TACH" VARIES FROM "3 or more BEATS IN A ROW" to "MORE THAN 30 SECONDS OF V-TACH." ("Electrophysiologic Testing," by: Richard N. Fogoros, MD, p. 179)
- ACLS 2006 Standards DO NOT define WHEN you treat VENTRICULAR ECTOPY, or attempt to define when "RUNS OF PVCs" are to be considered as "VENTRICULAR TACHYCARDIA."
THIS RHYTHM IS:

MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE
RHYTHM
P-R INTERVAL
P: QRS RATIO
QRS INTERVAL
This rhythm is: **Monomorphic V-Tach**

Main identification characteristic(s): Wide QRS complexes (> 120 ms)

HR usually between 150 - 200; All QRS complexes appear same in shape and deflection; If P waves seen, disassociated w/ QRS

Rate: > 100 (usually 150 - 200)

Rhythm: Regular

P-R interval: N/A

P: QRS ratio: N/A

QRS interval: > 120 ms
--- CRITICAL ECG ALERT ---

- Immediately check patient
- Notify next “higher up” in chain of command

1. Heart rate LESS THAN 50 or GREATER THAN 150
2. QT INTERVAL prolonged (usually not emergent but let Dr. know)
3. 2\textsuperscript{nd} degree type II or 3\textsuperscript{rd} degree HEART BLOCK
4. SINUS ARREST with periods of ASYSTOLE
5. NEW ONSET of any DYSRHYTHMIA
6. PVCs that are MULTIFOCAL, 2 or MORE TOGETHER, R on T, greater than 6 per minute,
7. V-TACH, or WIDE QRS TACHYCARDIA of unknown origin
WIDE COMPLEX TACHYCARDIA (QRS > 120 ms)

MONOPHASIC

ABCs

NO PULSE

GO TO V-FIB ALGORITHM!

PULSE - UNSTABLE

- Immediate Sync. Cardioversion:
  - 100 j biphasic
  - consider sedation
- Increase joules
- MEDS:
  - Procaainamide
  - Amiodarone

PULSE - STABLE

- O2, IV-IO, EKG
- MEDS:
  - Adenosine 6-12-12 (only if REGULAR)
  - Procaainamide (20-50mg/min)
  - Amiodarone (150 over 10min + 1mg/ min INFUSION)
This RHYTHM is ? ?
THIS RHYTHM IS: POLYMORPHIC V - TACH

MAIN IDENTIFICATION CHARACTERISTIC(S): WIDE QRS COMPLEXES, MULTIPLE SHAPES AND FORMS, POSITIVE AND NEGATIVE DEFLECTIONS, APPEARS TO ROTATE BETWEEN NEGATIVE AND POSITIVE (TWISTING OF POINTS)

RATE -------------- 200 - 300
RHYTHM ------------  VARIES
P-R INTERVAL ------ N/A
P:QRS RATIO ------- N/A
QRS INTERVAL ------ VARIES
-- CRITICAL ECG ALERT --

- Immediately check patient
- Notify next “higher up” in chain of command

1. Heart rate LESS THAN 50 or GREATER THAN 150
2. QT INTERVAL prolonged (usually not emergent but let Dr. know)
3. 2\textsuperscript{nd} degree type II or 3\textsuperscript{rd} degree HEART BLOCK
4. SINUS ARREST with periods of ASYSTOLE
5. NEW ONSET of any DYSRHYTHMIA
6. PVCs that are MULTIFOCAL, 2 or MORE TOGETHER, R on T, greater than 6 per minute,
7. V-TACH, or WIDE QRS TACHYCARDIA of unknown origin
8. TORSADES de POINTES
WIDE COMPLEX TACHYCARDIA
TORSADES de POINTES
(QRS > 120 ms)

ABCs

NO PULSE
GO TO V - FIB ALGORITHM!

PULSE - UNSTABLE
- IMMEDIATE DEFIBRILLATION
- START IV CONSIDER SEDATION

PULSE - STABLE
- O2 / IV / EKG
- MAGNESIUM INFUSION
  1 - 2 gm OVER 5 - 60 min.

DO NOT give PROCAINAMIDE, AMIODARONE, or SOTALOL to patients with TORSADES or POLYMORPHIC VT !!!

OTHER CONSIDERATIONS:
- EVALUATE BASELINE ECG RHYTHM FOR PRONGED Q-T INTERVAL.
- EVALUATE PATIENT'S MEDS FOR Q-T PROLONGING DRUGS
  ... IF PATIENT HAS BEEN RECEIVING ANY Q-T PROLONGING DRUGS, IMMEDIATELY DISCONTINUE AND CONTACT PHYSICIAN STAT.
- EVALUATE PATIENT HISTORY FOR PREVIOUS EVENTS OF "SYNCOPE OF UNKNOWN ETIOLOGY"
- EVALUATE PATIENT FOR FAMILY HISTORY FOR SUDDEN CARDIAC DEATH

REPORT ANY ABNORMAL FINDINGS TO PHYSICIAN.
VENTRICULAR FIBRILLATION

CARDIAC ARREST RHYTHM
Ventricular Asystole

CARDIAC ARREST RHYTHM
- Immediately check patient
- Notify next “higher up” in chain of command

1. Heart rate LESS THAN 50 or GREATER THAN 150
2. QT INTERVAL prolonged (usually not emergent but let Dr. know)
3. 2nd degree type II or 3rd degree HEART BLOCK
4. SINUS ARREST with periods of ASYSTOLE
5. NEW ONSET of any DYSRHYTHMIA
6. PVCs that are MULTIFOCAL, 2 or MORE TOGETHER, R on T, greater than 6 per minute,
7. V-TACH, or WIDE QRS TACHYCARDIA of unknown origin
8. TORSADES de POINTES
9. VENTRICULAR FIBRILLATION or ASYSTOLE
If QRS complexes have a PULSE then apply PACEMAKER!!

CPR

IV / AIRWAY

EPI 1 mg
THE "H's" and the "T's"

- HYPOVOLEMIA
- HYPOXIA
- HYDROGEN ION (Ph)
- HYPOGLYCEMIA
- HYPOTHERMIA

- TOXINS
- TAMPONADE (CARDIAC)
- TENSION PNEUMOTHORAX
- THROMBOSIS (CORONARY or PULMONARY)
- TRAUMA
-- CRITICAL ECG ALERT --

- Immediately check patient
- Notify next “higher up” in chain of command

1. Heart rate LESS THAN 50 or GREATER THAN 150
2. QT INTERVAL prolonged (usually not emergent but let Dr. know)
3. 2nd degree type II or 3rd degree HEART BLOCK
4. SINUS ARREST with periods of ASYSTOLE
5. NEW ONSET of any DYSRHYTHMIA
6. PVCs that are MULTIFOCAL, 2 or MORE TOGETHER, R on T, greater than 6 per minute,
7. V-TACH, or WIDE QRS TACHYCARDIA of unknown origin
8. TORSADES de POINTES
9. VENTRICULAR FIBRILLATION or ASYSTOLE
10. PACER SPIKES WITHOUT QRS – “FAILURE TO CAPTURE”
DIAGNOSING
BUNDLE BRANCH BLOCK

- There are several methods to differentiate Right Bundle Branch Block (RBBB) from Left Bundle Branch Block (LBBB).

- Our methods use Lead V1 (or MCL 1)

METHOD 1: Rotate rhythm strip 90 degrees clockwise ("York Hospital" Method)

METHOD 2: Terminal Deflection of QRS Complex: Negative or Positive?
Simple “Turn Signal Method”

**THE "TURN SIGNAL METHOD" for identifying BUNDLE BRANCH BLOCK**

**V1**

**USE LEAD V1 for this technique**

To make a **RIGHT TURN**
you push the turn signal lever **UP** ......

THINK:

"QRS points **UP** = RIGHT BUNDLE BRANCH BLOCK"

---

To make a **LEFT TURN**
you push the turn signal lever **DOWN** ....

THINK:

"QRS points **DOWN** = LEFT BUNDLE BRANCH BLOCK"
**DIAGNOSING BUNDLE BRANCH BLOCK**

**L.B.B.B.**

**USING LEAD V1**

- **QRS WIDER THAN 120 ms**
- **BEAT IS SUPRAVENTRICULAR IN ORIGIN**
- **TERMINAL PHASE OF QRS COMPLEX (LAST DEFLECTION)**

**R.B.B.B.**

- **NEGATIVE = LEFT BUNDLE BRANCH BLOCK**
- **POSITIVE = RIGHT BUNDLE BRANCH BLOCK**
DIAGNOSING LBBB IN LEAD V1:

- QRS GREATER THAN 120 ms (.12)
- EVIDENCE THAT THIS IS NOT VENTRICULAR BEAT
- TERMINAL PHASE (LAST PART) OF QRS COMPLEX IS NEGATIVE DEFLECTION
- S-T SEGMENTS ARE ALWAYS ELEVATED!
DIAGNOSING RBBB IN LEAD V1:

- WIDER THAN 120 ms (.12) (or 3 little boxes)
- TERMINAL PHASE (LAST PART) OF QRS COMPLEX IS POSITIVE DEFLECTION
TERMINAL PHASE OF QRS IS NEGATIVE

= LEFT BUNDLE BRANCH BLOCK
TERMINAL PHASE OF QRS IS POSITIVE

= RIGHT BUNDLE BRANCH BLOCK
-- CRITICAL ECG ALERT --

- Immediately check patient
- Notify next “higher up” in chain of command

1. Heart rate LESS THAN 50 or GREATER THAN 150
2. QT INTERVAL prolonged (usually not emergent but let Dr. know)
3. 2nd degree type II or 3rd degree HEART BLOCK
4. SINUS ARREST with periods of ASYSTOLE
5. NEW ONSET of any DYSRHYTHMIA
6. PVCs that are MULTIFOCAL, 2 or MORE TOGETHER, R on T, greater than 6 per minute,
7. V-TACH, or WIDE QRS TACHYCARDIA of unknown origin
8. TORSADES de POINTES
9. VENTRICULAR FIBRILLATION or ASYSTOLE
10. PACER SPIKES WITHOUT QRS – “FAILURE TO CAPTURE”
11. CHANGES in the QRS width (new onset Bundle Branch Block)
Use of TELEMETRY MONITORING For ONGOING EVALUATION of:

- Acute Coronary Syndrome
- “Low Probability Chest Pain”
- Post PCI / STENT
Acute Coronary Syndrome (ACS) includes:

- STEMI (ST segment elev. MI)
- NSTEMI (Non-ST segment Elev. MI)
- Unstable Angina
Stay tuned for The NEXT LEVEL of ECG Monitoring . . . Coming Soon!
The ECG Markers of ACS involve the:

- J Point
- ST Segment
- T Wave

Of every lead on the 12 Lead ECG.
THE ECG should NOT CHANGE. Any changes that occur to the Patient’s ECG waveforms should be considered ABNORMAL and should be REPORTED.
When QRS complex width is NORMAL ( < 120 ms ):

NORMAL ST - T WAVES

- WHEN QRS WIDTH IS NORMAL ( < 120 ms )

ASSESS:

- J POINT: ISOELECTRIC ( or < 1 mm dev. )
- ST SEG: SLIGHT, POSITIVE INCLINATION
- T WAVE: UPRIGHT, POSITIVE

in EVERY LEAD EXCEPT aVR !!
THE J POINT SHOULD BE

WITHIN 1 mm ABOVE

OR

BELOW the ISOELECTRIC LINE

or the P-Q JUNCTION.
THE S-T SEGMENT

SHOULD HAVE A "SLIGHT POSITIVE" INCLINATION
THE S-T SEGMENT

SHOULD BE "CONCAVE" IN SHAPE . . .
THE S-T SEGMENT

AS OPPOSED TO "CONVEX" IN SHAPE

SHOULD BE "CONCAVE" IN SHAPE . . .
Normal sinus rhythm
Normal ECG
No previous ECGs available

ECG COMPUTER DOES NOT NOTICE THE CONVEX J-T APEX SEGMENTS!
CASE STUDY: 56 y/o male with INTERMITTENT "CHEST HEAVINESS"

L.A.D. SUBTOTAL PROXIMAL OCCLUSION WITH THROMBUS
RAMUS ARTERY w/ SUBTOTAL OCCLUSION
O.M.1 w/ SUBTOTAL OCCLUSION

TREATMENT PLAN: EMERGENCY CORONARY ARTERY BYPASS SURGERY (4 VESSEL)
ST SEGMENT ELEVATION:

S-T SEGMENTS ELEVATE WITHIN SECONDS OF CORONARY ARTERY OCCLUSION:

IN THIS CASE, a normal response to balloon occlusion of the RIGHT CORONARY ARTERY during PTCA in the CARDIAC CATH LAB
# EKG Patterns of ACS & Ischemia

## J Point, ST Segment, and T Wave Abnormalities

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>S-T Segment Elevation at J Point</td>
<td>Acute MI, Acute Pericarditis/Myocarditis, Early Repolarization</td>
</tr>
<tr>
<td>Flat or Convex J-T Apex Segment</td>
<td>Acute MI, Ischemia</td>
</tr>
<tr>
<td>Hyper-Acute T Wave</td>
<td>Hyperkalemia, Transmural Ischemia, Acute MI, Hypertrophy</td>
</tr>
<tr>
<td>Depressed J Point, Downsloping ST and Inverted T</td>
<td>Acute (Non-Q Wave) MI, Acute MI - (Reciprocal Changes), Ischemia</td>
</tr>
<tr>
<td>Inverted T Wave</td>
<td>Myocarditis, Electrolyte Imbal., Ischemia</td>
</tr>
<tr>
<td>Sharp S-T T Angle</td>
<td>Acute MI (Not Common), Ischemia</td>
</tr>
<tr>
<td>Bi-Phasic T Wave (Wellen's)</td>
<td>Sub-Total LAD Lesion, Vasospasm, Hypertrophy</td>
</tr>
<tr>
<td>Depressed J Point with Upsloping ST</td>
<td>Ischemia</td>
</tr>
<tr>
<td>Downsloping S-T Segment</td>
<td>Ischemia</td>
</tr>
<tr>
<td>Flat S-T Segment &gt; 120 ms</td>
<td>Ischemia</td>
</tr>
<tr>
<td>Low Voltage T Wave with Normal QRS</td>
<td>Ischemia</td>
</tr>
<tr>
<td>U Wave Polarity Opposite That of T Wave</td>
<td>Ischemia</td>
</tr>
</tbody>
</table>
-- CRITICAL ECG ALERT --

- Immediately check patient
- Notify next “higher up” in chain of command

1. Heart rate LESS THAN 50 or GREATER THAN 150
2. QT INTERVAL prolonged (usually not emergent but let Dr. know)
3. 2\textsuperscript{nd} degree type II or 3\textsuperscript{rd} degree HEART BLOCK
4. SINUS ARREST with periods of ASYSTOLE
5. NEW ONSET of any DYSRHYTHMIA
6. PVCs that are MULTIFOCAL, 2 or MORE TOGETHER, R on T, greater than 6 per minute,
7. V-TACH, or WIDE QRS TACHYCARDIA of unknown origin
8. TORSADES de POINTES
9. VENTRICULAR FIBRILLATION or ASYSTOLE
10. PACER SPIKES WITHOUT QRS – “FAILURE TO CAPTURE”
11. CHANGES in the QRS width (new onset Bundle Branch Block)
12. CHANGES to J Point, ST Segment, and/or T Waves
WHAT IS YOUR INTERPRETATION OF THIS RHYTHM STRIP?
WHAT IS YOUR INTERPRETATION OF THIS RHYTHM STRIP?

SIGNIFICANT ST SEGMENT ELEVATION, most likely patient is suffering **STEMI**
WHAT WOULD THE MOST APPROPRIATE COURSE OF ACTION BE?
WHAT WOULD THE MOST APPROPRIATE COURSE OF ACTION BE?

Immediately:
notify Charge RN
check patient
obtain 12 Lead ECG
Notify physician / Cardiologist
Activate STEMI protocol
--- CRITICAL ECG ALERT ---

- Immediately check patient
- Notify next “higher up” in chain of command

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My top two reasons for giving everything in life the best I have to offer.