

# SEVEN RIVERS

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REGIONAL MEDICAL CENTER



## BASIC ECG PRINCIPLES

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**Interventional Cardiovascular Technologist**  
**Cardiac Accreditations / Emergency Manager**  
**Bayfront Health Dade City**



[www.ECGtraining.org](http://www.ECGtraining.org)

[www.practicalclinicalskills.com](http://www.practicalclinicalskills.com)

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# The Heart:

- Muscle cells
- Electrical system cells
- Connective tissue



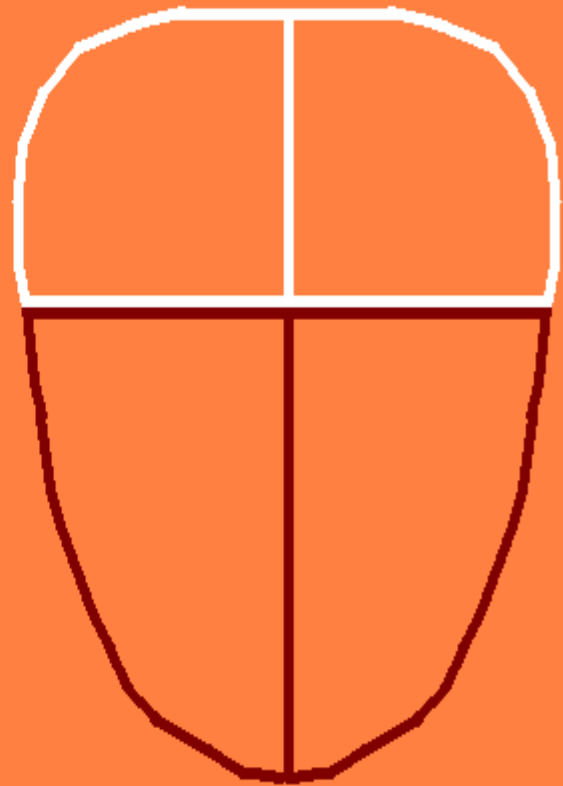
# FOUR CHAMBERED PUMP . . .

2 ATRIUM



PRIMARY JOB:

"PACK VENTRICLES  
FULL OF BLOOD"

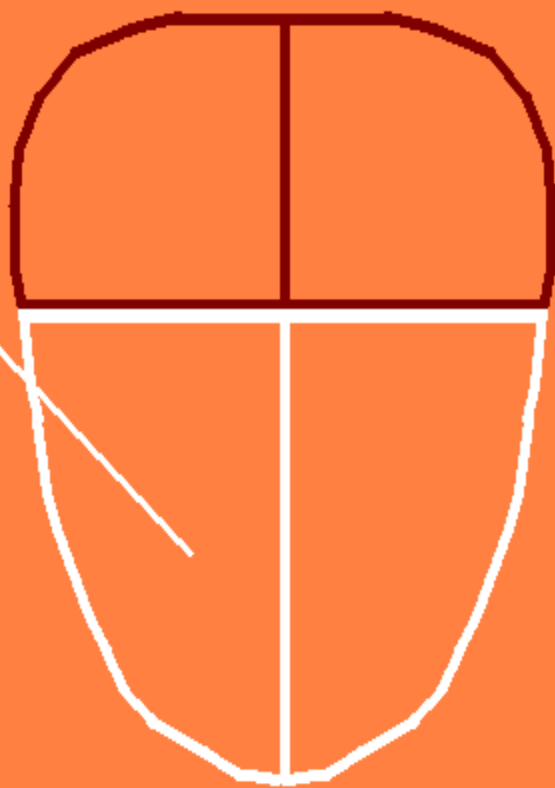


# FOUR CHAMBERED PUMP . . .

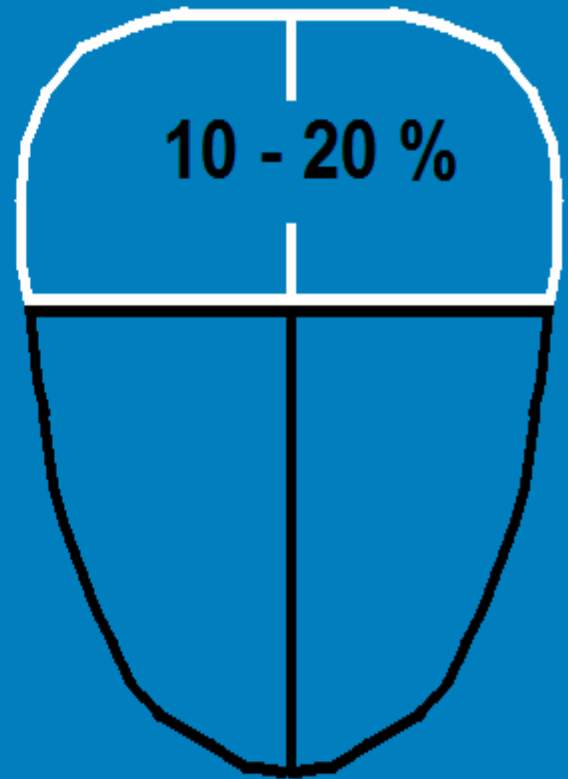
2 VENTRICLES

PRIMARY JOB:

"PUMP BLOOD TO THE  
LUNGS AND THE  
REST OF THE BODY"



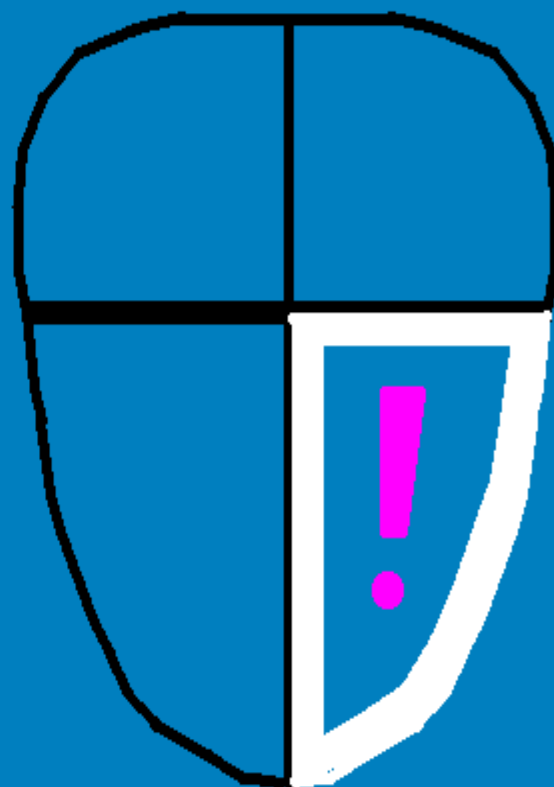
**WHEN FUNCTIONING PROPERLY,  
THE ATRIUM SUPPLY  
APPROXIMATELY  
WHAT  
PERCENTAGE  
OF THE  
CARDIAC OUTPUT ?**



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



~~Sinus node~~

AV node

40 - 60  
beats / min.

Right bundle  
branch

Left bundle  
branch

Purkinje fibers



~~Sinus node~~

~~AV 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

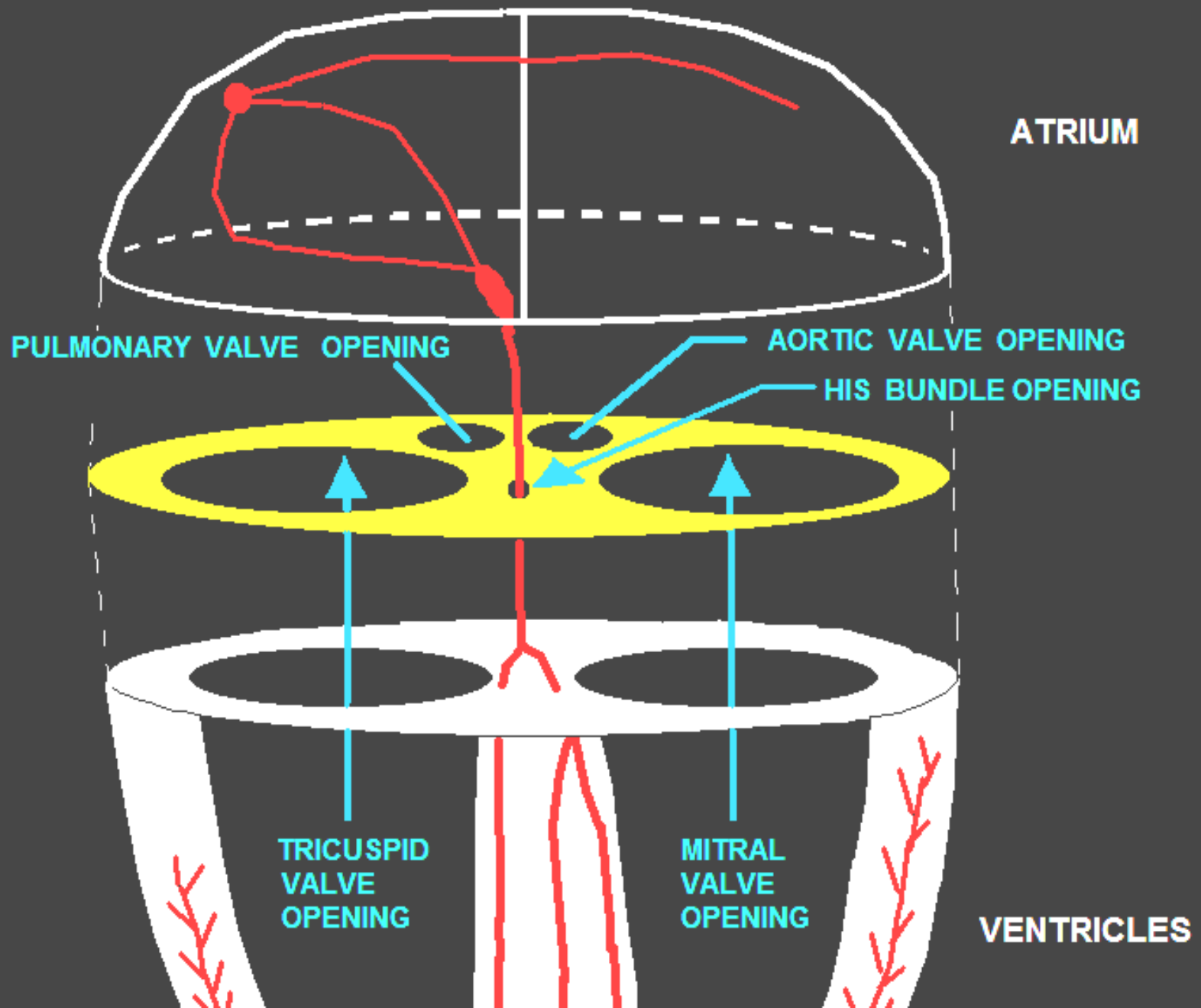
\* VENTRICLES: 1 - 40

\* 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 can not endorse "20" as a minimum ventricular rate.



# THE "SKELETON OF THE HEART"

**FIBROUS  
"SKELETON  
of the  
HEART"**





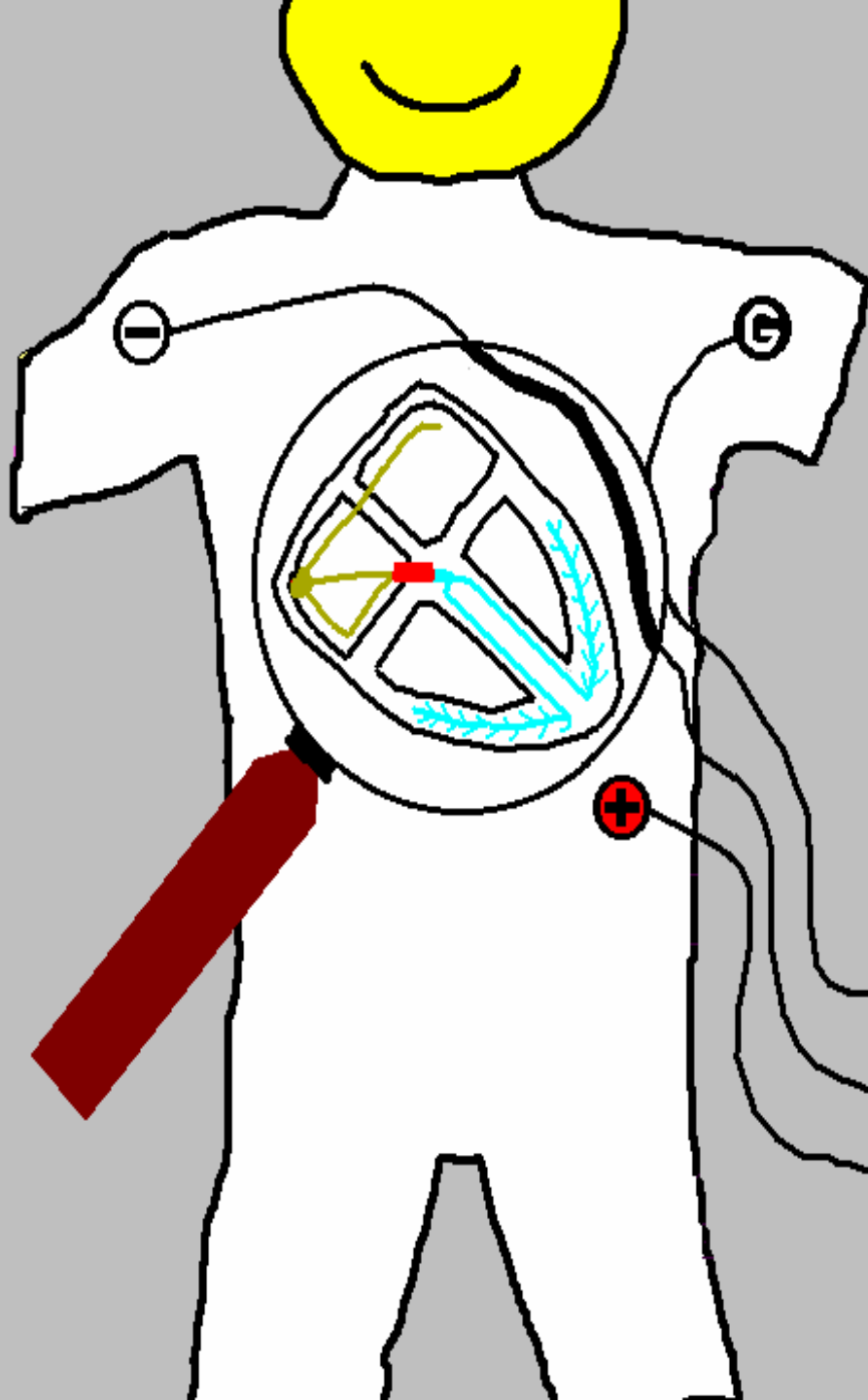
# THE P-R SEGMENT

ELECTRICAL ACTIVITY  
DURING P-R SEGMENT:

- Depolarization wave in A-V node
- Atrial Repolarization

.10 SECOND  
ISOELECTRIC PAUSE

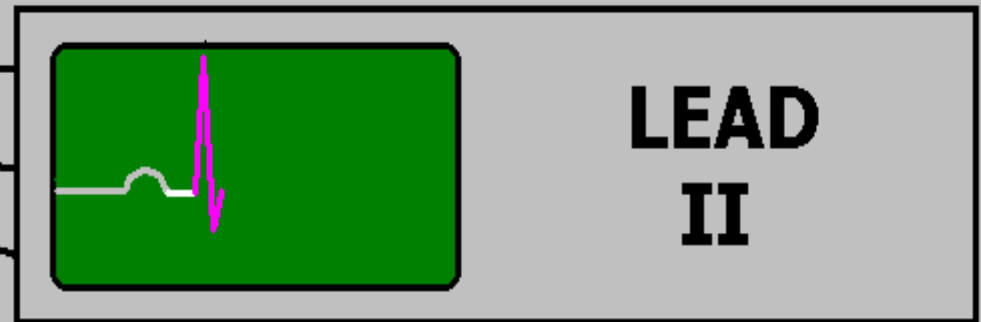
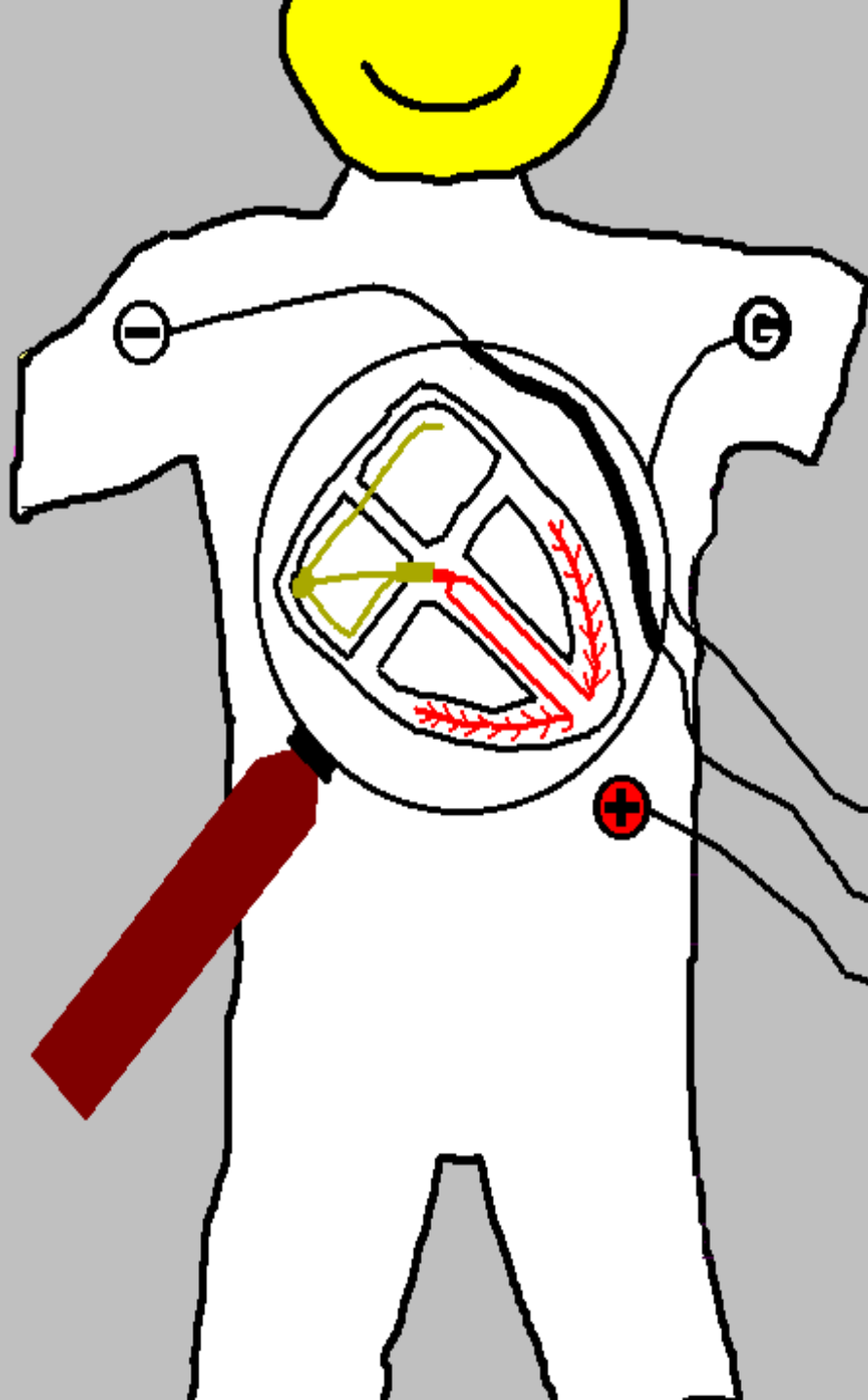
**LEAD  
II**



# VENTRICULAR DEPOLARIZATION

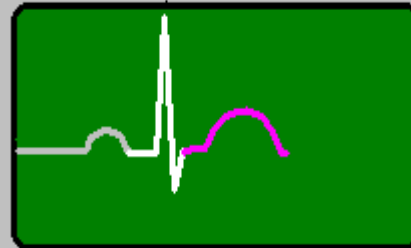
QRS COMPLEX  
IS RECORDED  
ON EKG

LEAD  
II

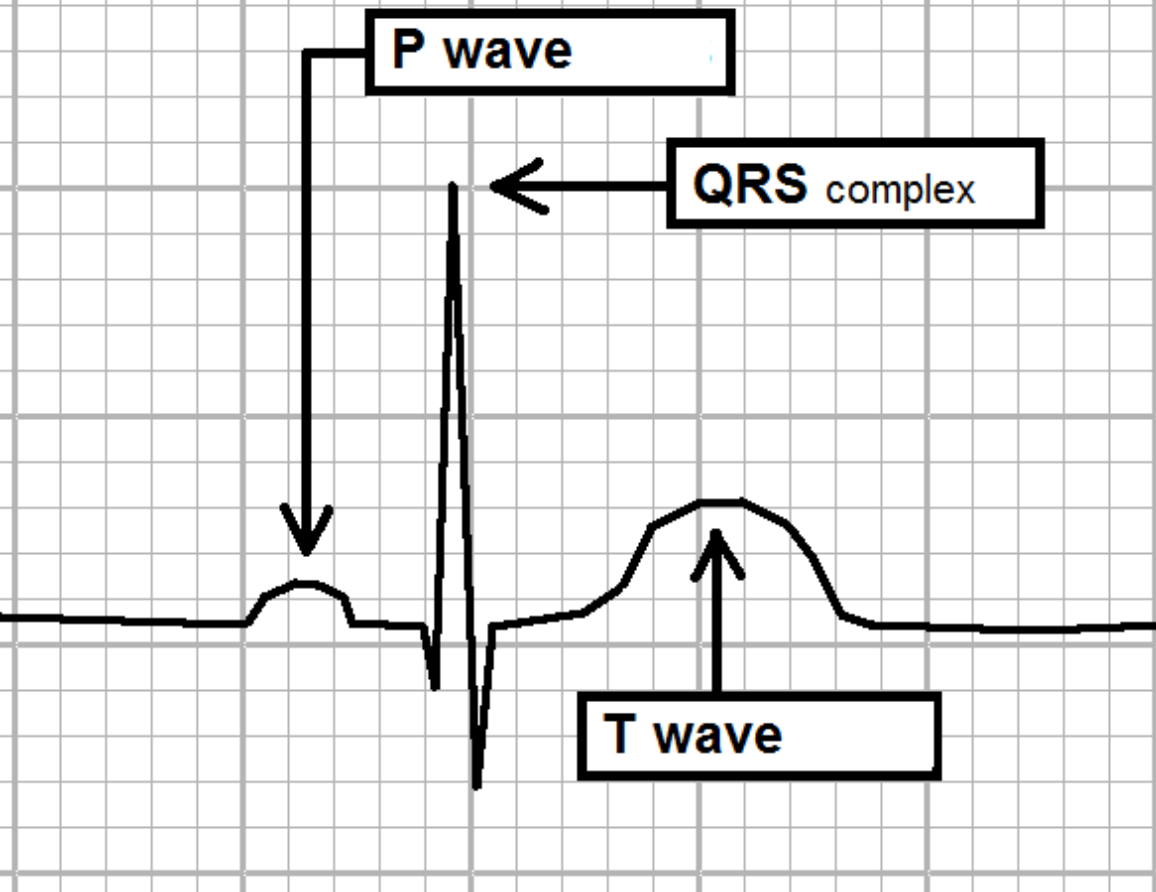


# VENTRICULAR REPOLARIZATION

WRITES A "T"  
WAVE ON THE  
ECG



**LEAD  
II**

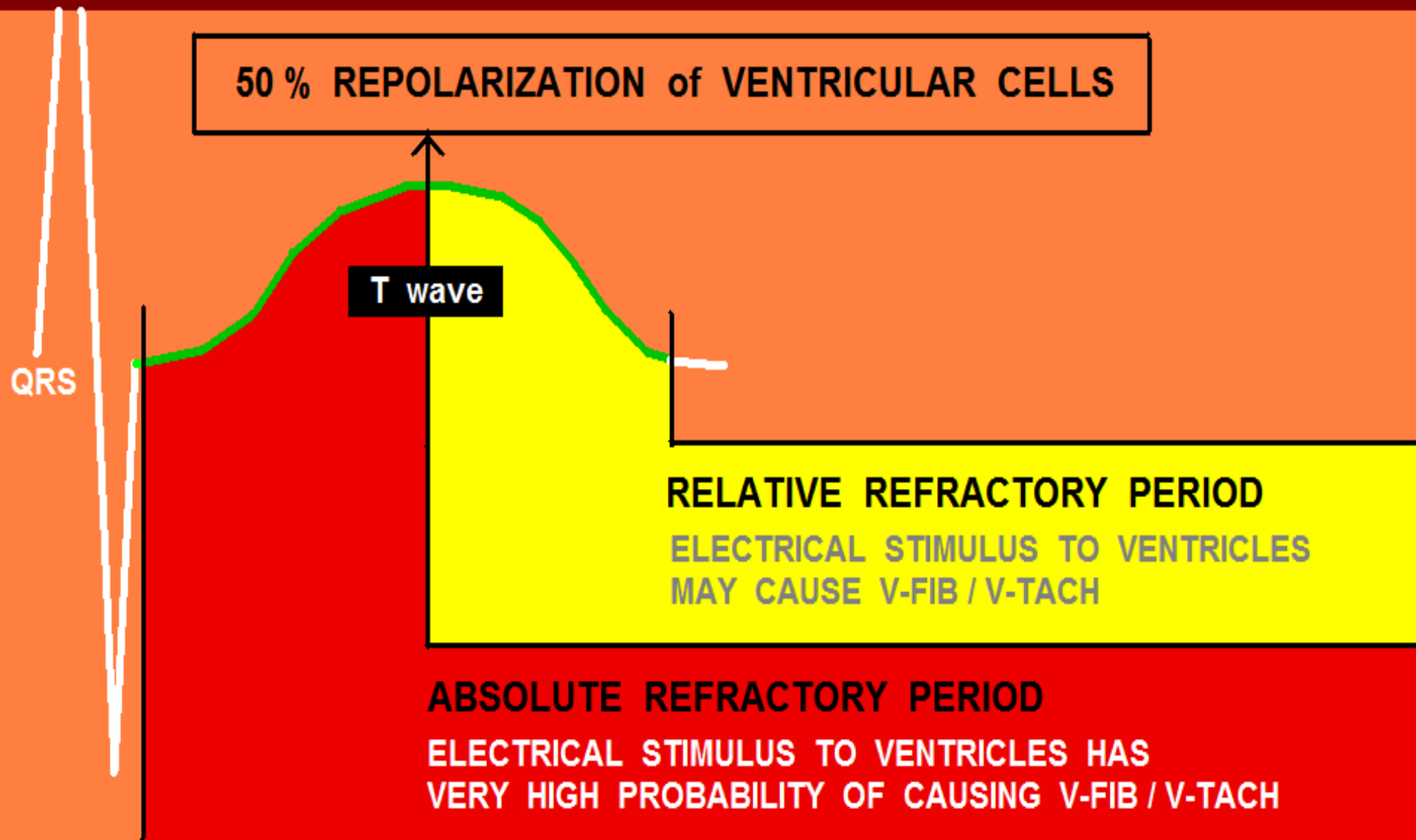


**P WAVE =**  
ATRIAL DEPOLARIZATION

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

**T WAVE =**  
VENTRICULAR  
REPOLARIZATION  
(recharging)

# CARDIAC ANATOMY and PHYSIOLOGY "101"



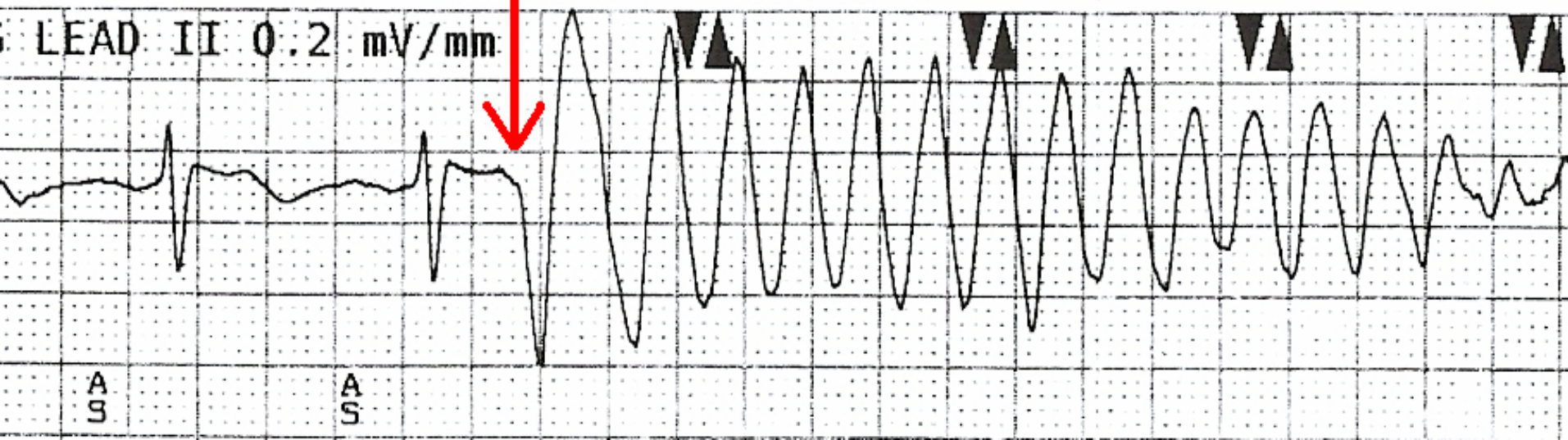
# ROUTINE TEST OF ICD

ELECTRICAL IMPULSE  
ADMINISTERED DURING ABSOLUTE  
REFRACTORY PERIOD -- INDUCES  
VENTRICULAR FIBRILLATION

08-Sep-2006 18:01:47

Test Started

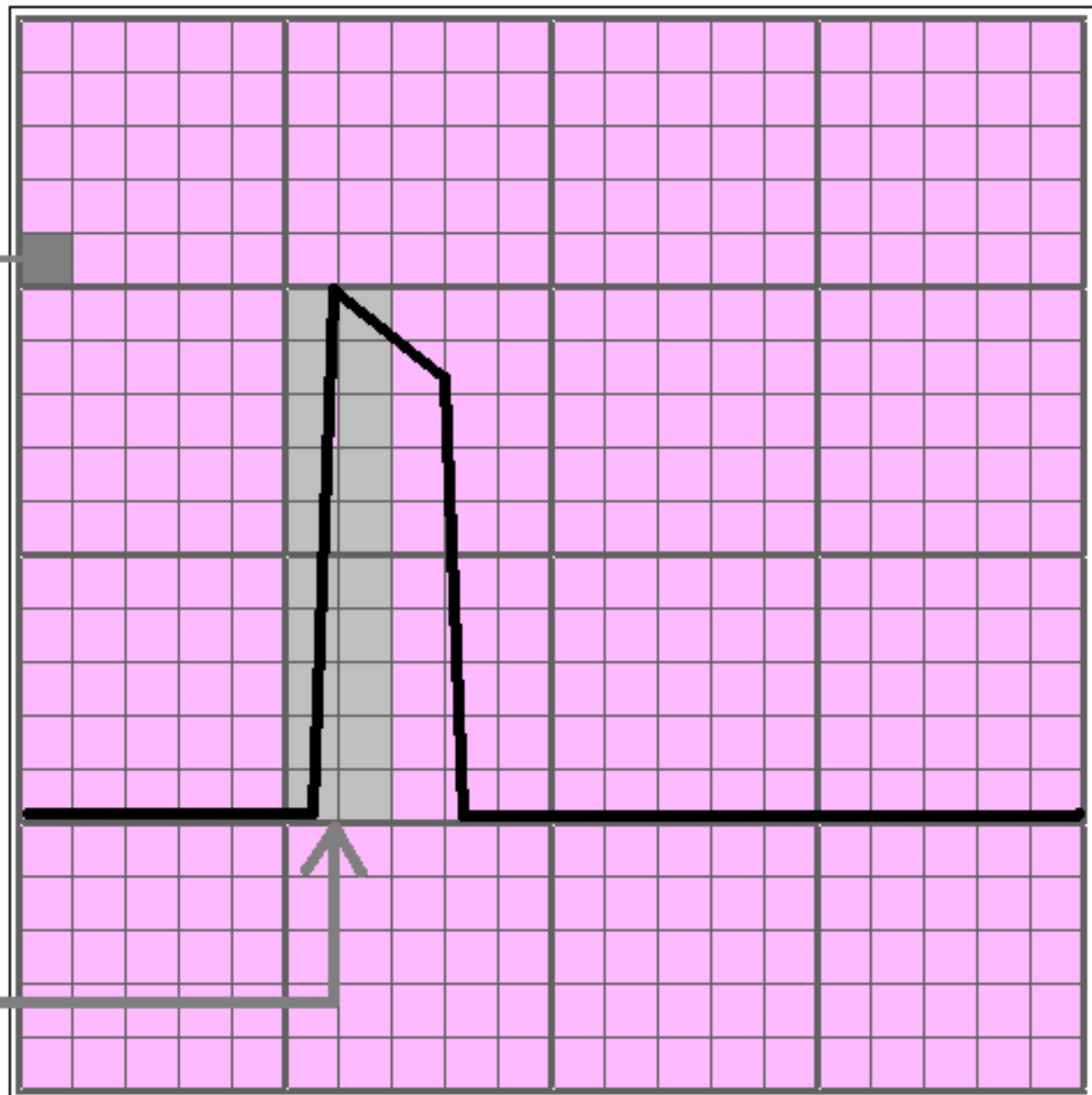
SPECIAL THANKS TO:  
Ray Heinley  
Medtronic Corporation  
for this contribution





# 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



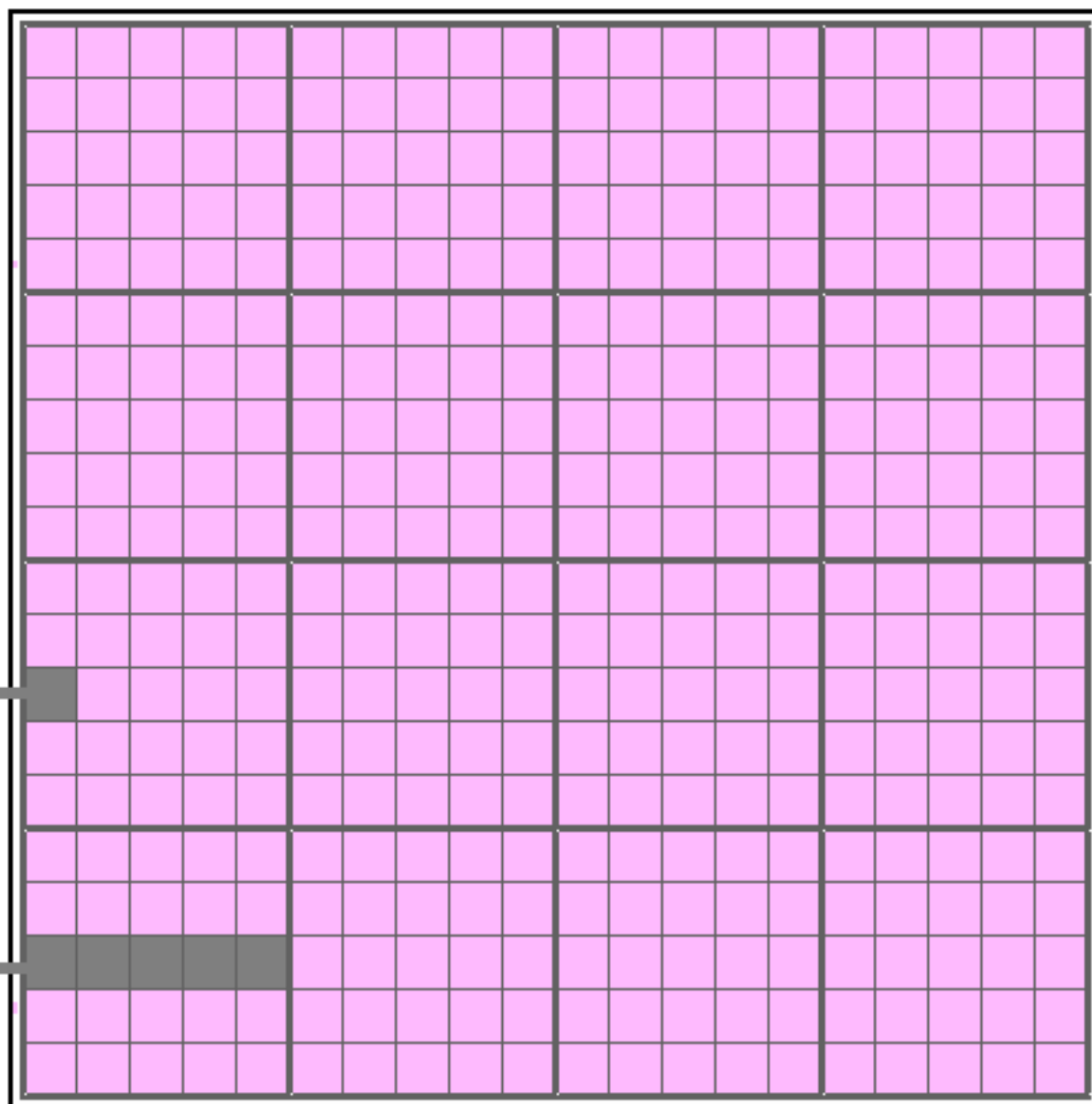
# ECG PAPER - THE HORIZONTAL AXIS:

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

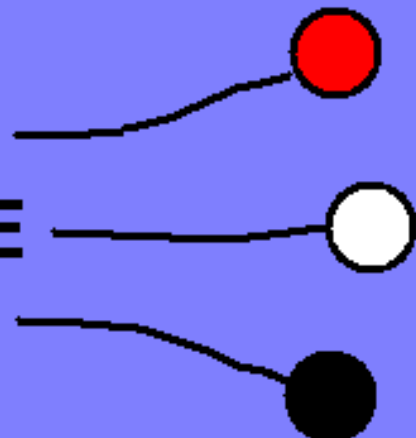
STANDARD 12 LEADS - USES 10 WIRES  
( 6 CHEST and 4 LIMB )

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

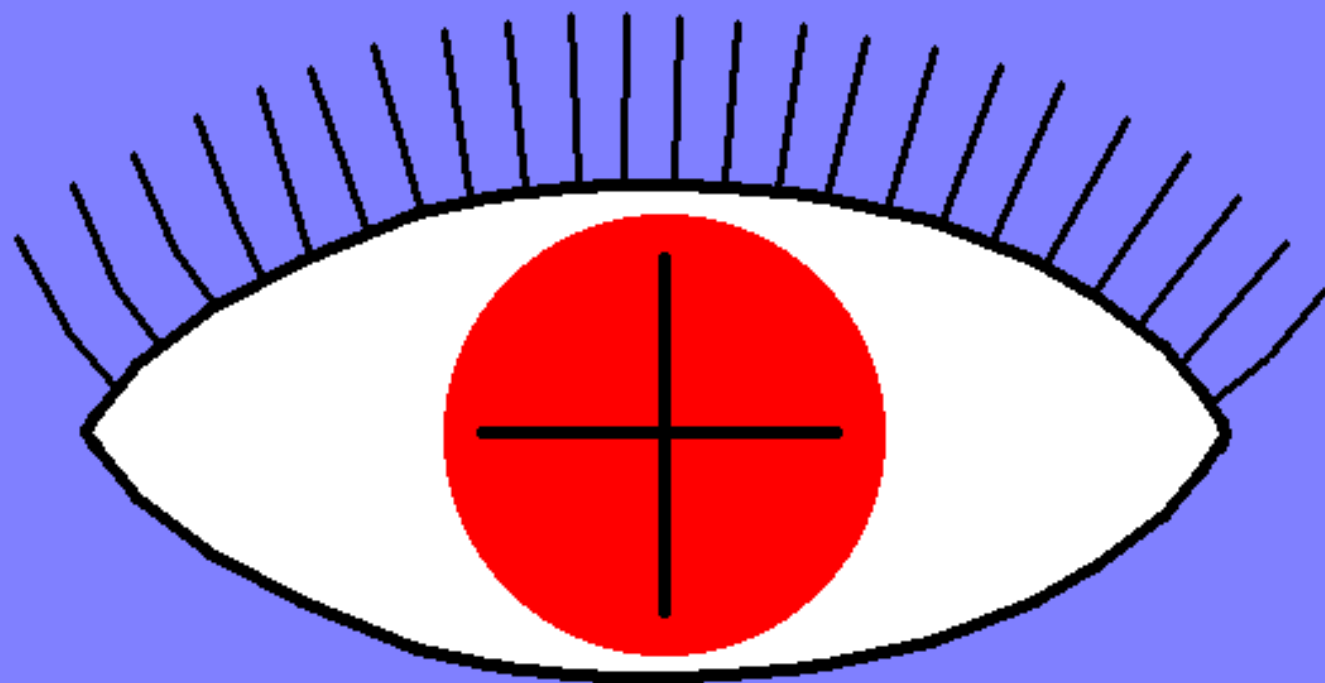
1 POSITIVE ELECTRODE

1 NEGATIVE ELECTRODE

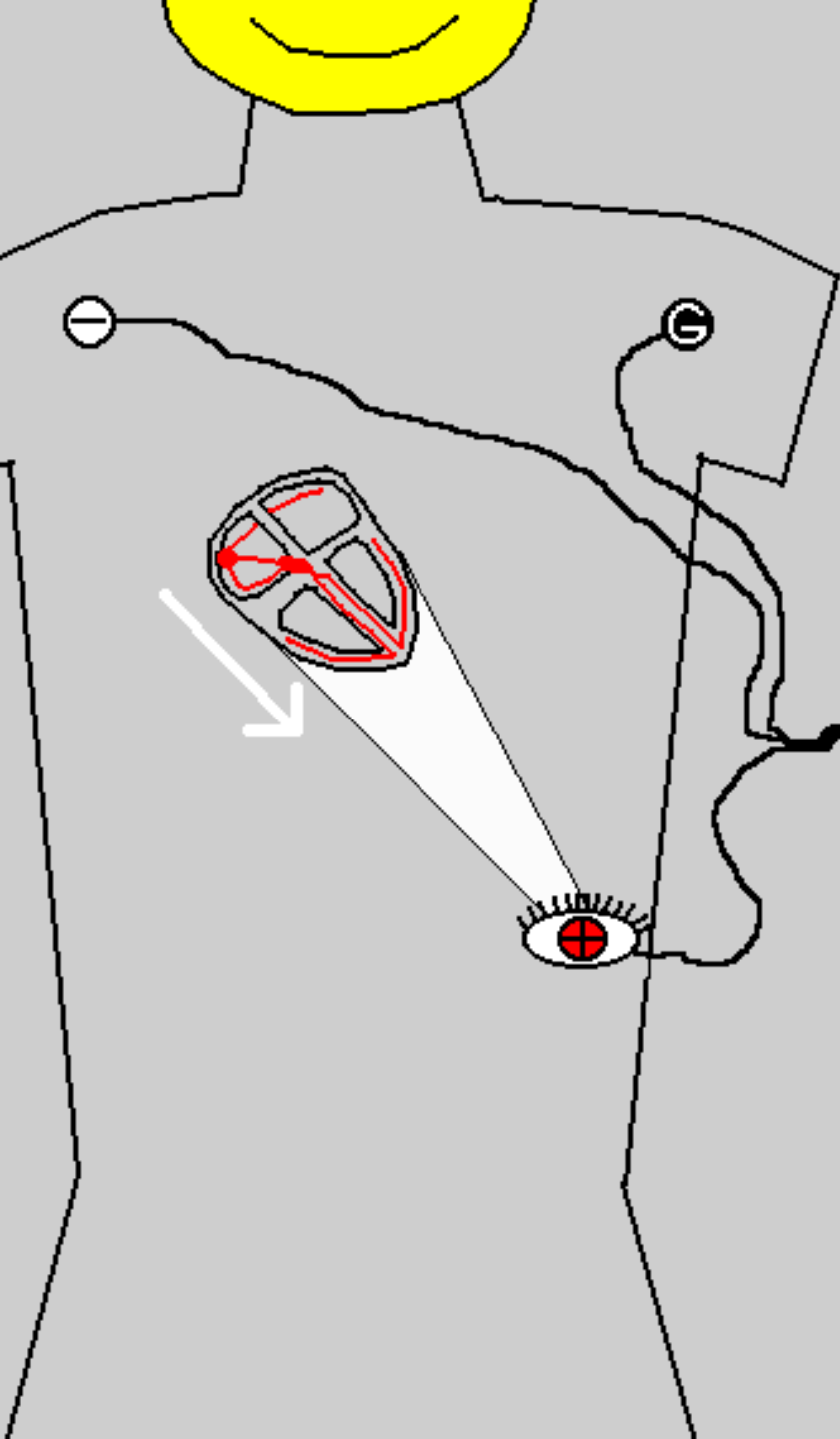
1 GROUND ELECTRODE



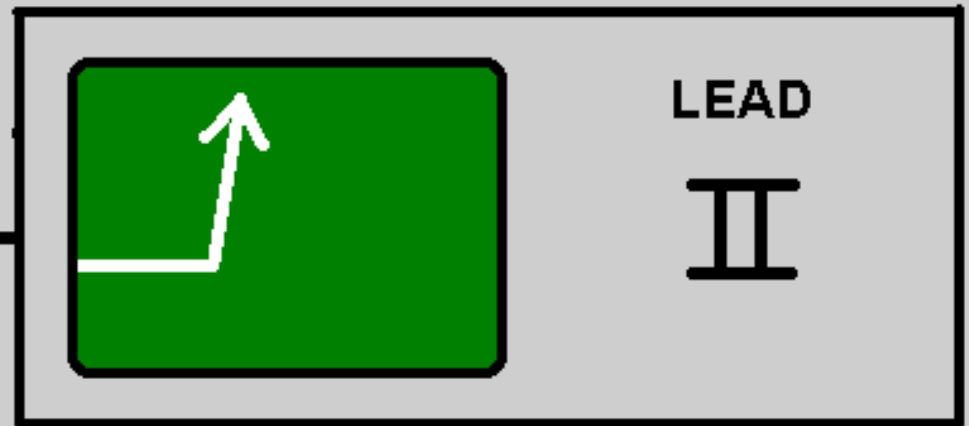
# THE POSITIVE ELECTRODE



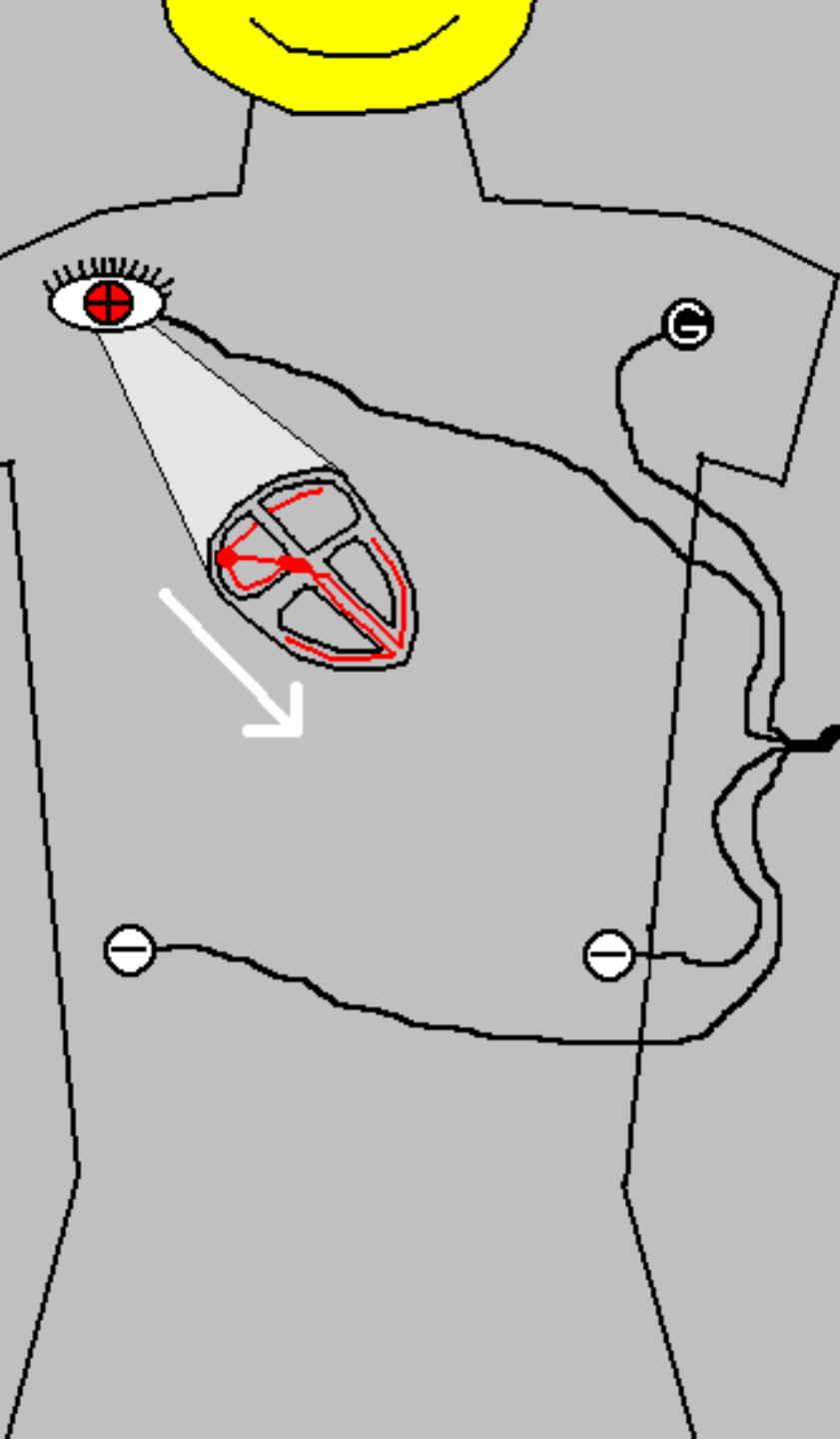
IS THE "EYE" . . .



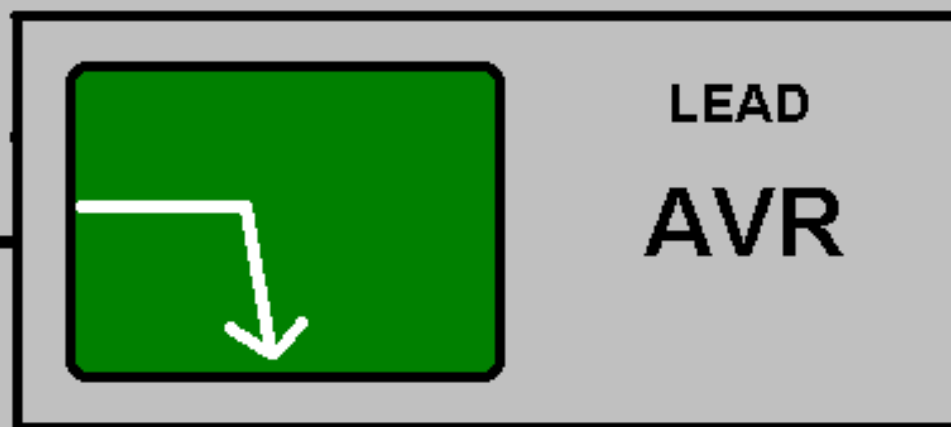
**CURRENT MOVING  
TOWARD THE EYE  
(POSITIVE ELECTRODE)**



**RECORDS AN  
"UPWARD"  
DEFLECTION**



**CURRENT MOVING  
AWAY FROM  
THE EYE  
( POSITIVE ELECTRODE )**



**RECORDS A  
"DOWNWARD"  
DEFLECTION**

The diagram illustrates the placement of electrodes for a 12-lead ECG. The torso is shown with electrodes V1 through V6. V1, V2, and V3 are precordial leads, while V4, V5, and V6 are limb leads. A red arrow points to V3. A green box on the right displays a sample ECG waveform.

## 5 WIRE TELEMETRY UNIT



# ESTABLISH YOUR ROUTINE ECG EVALUATION . . . . .



RATE



RHYTHM



INTERVALS

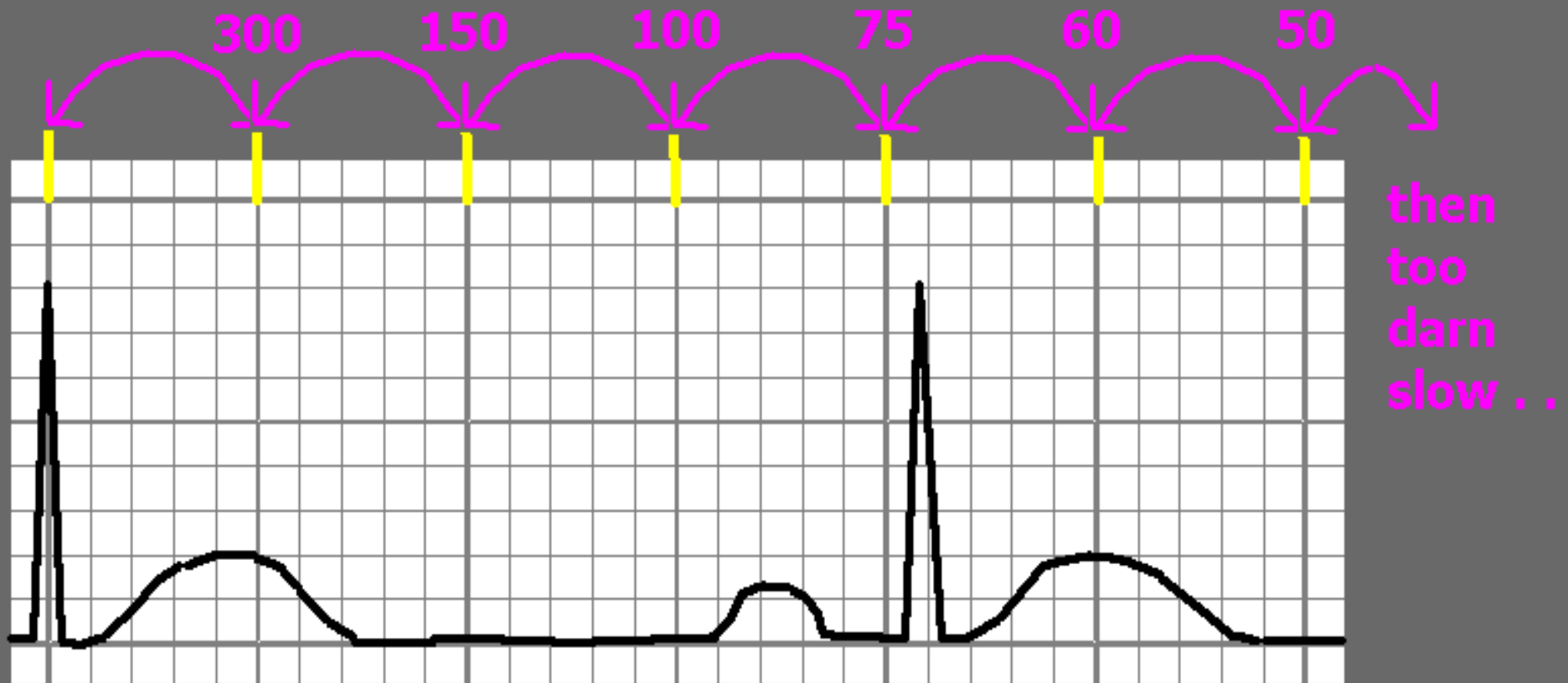


P:QRS RATIO



# DETERMINE HEART RATE

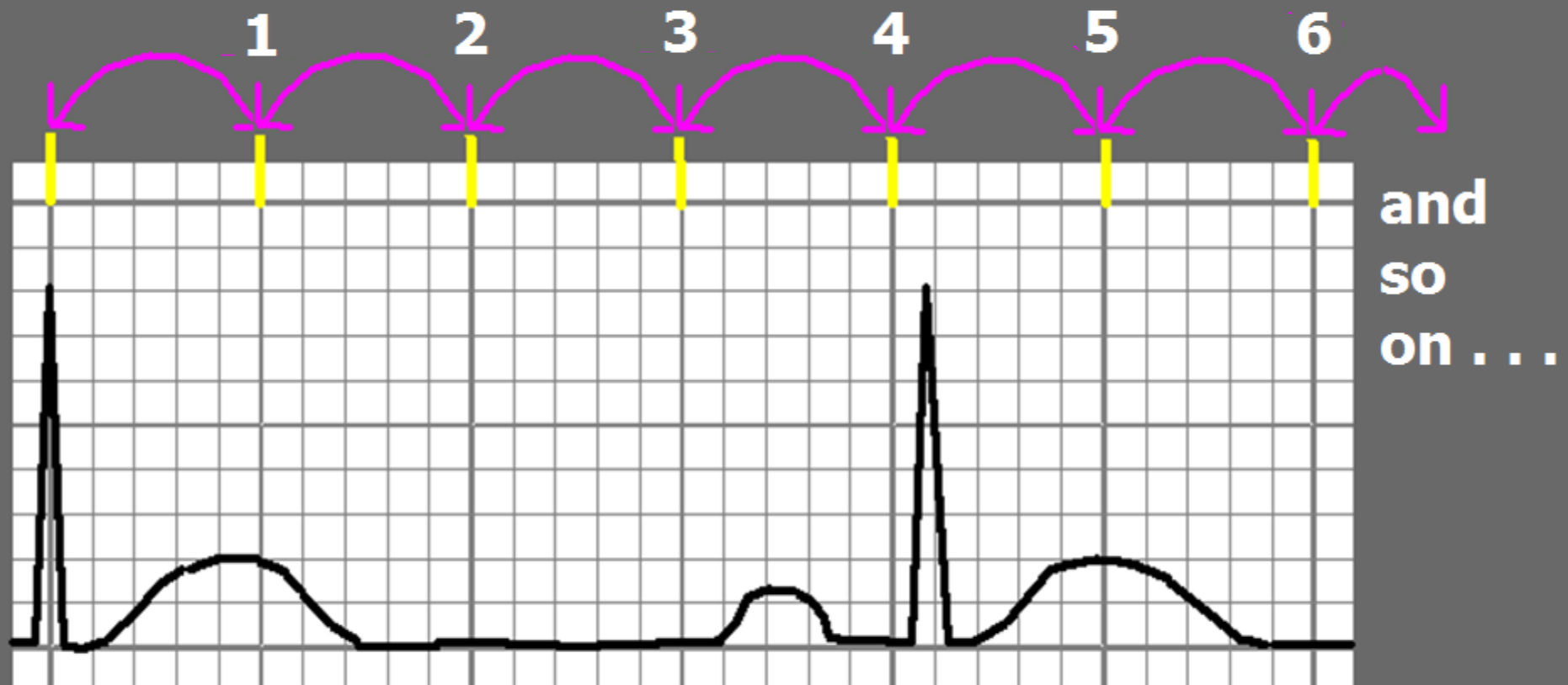
## METHOD 1: (regular rhythm)



# DETERMINE HEART RATE

"300 Divided By \_\_\_\_"

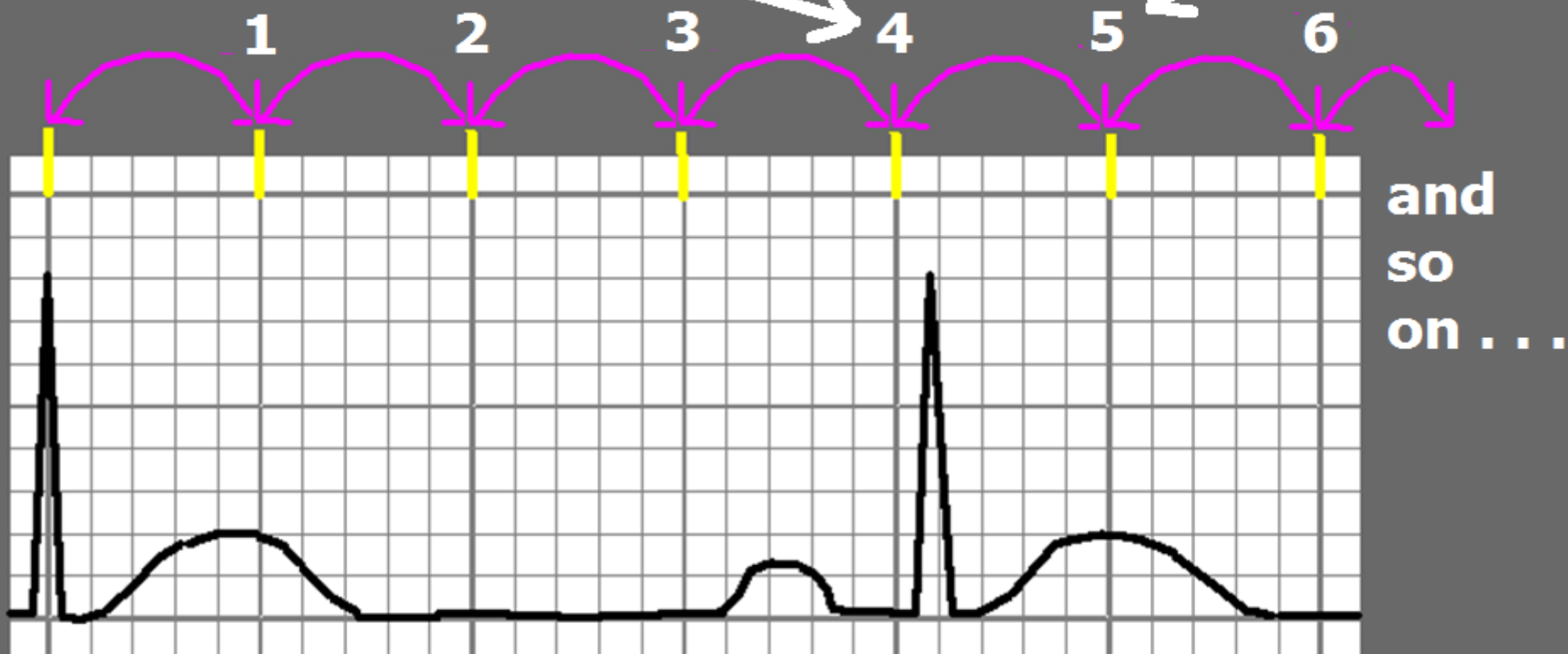
(regular rhythm)



# DETERMINE HEART RATE

300 divided by 4 = 75

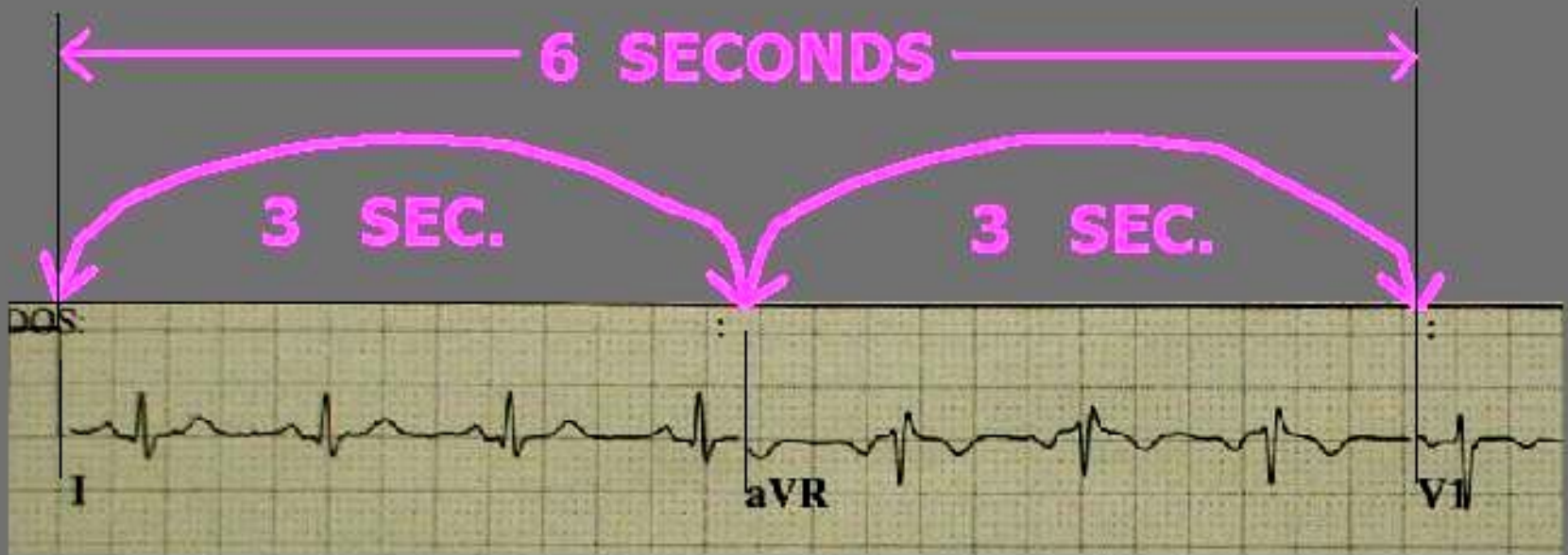
300 divided by 5 = 60



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

# DETERMINE HEART RATE:

## METHOD 2:



**HR = 70**

. . . . . OR MAKE IT EASY ON YOURSELF  
AND SIMPLY SAY . . . . .

ID:

|              |            |
|--------------|------------|
| Vent. rate   | 65 bpm     |
| PR interval  | 192 ms     |
| QRS duration | 104 ms     |
| QT/QTc       | 362/376 ms |
| P-R-T axes   | 39 0 23    |

" HEART RATE IS SIXTY- FIVE ! "

# —— THE CONCERNS OF ACLS ——

IS THE

**VENTRICULAR RATE:**

---



T O O S L O W



***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**

# HEART RATE CLASSIFICATIONS

Heart rates  
that are:

CLASSIFIED AS:

Below 60

BRADYCARDIA

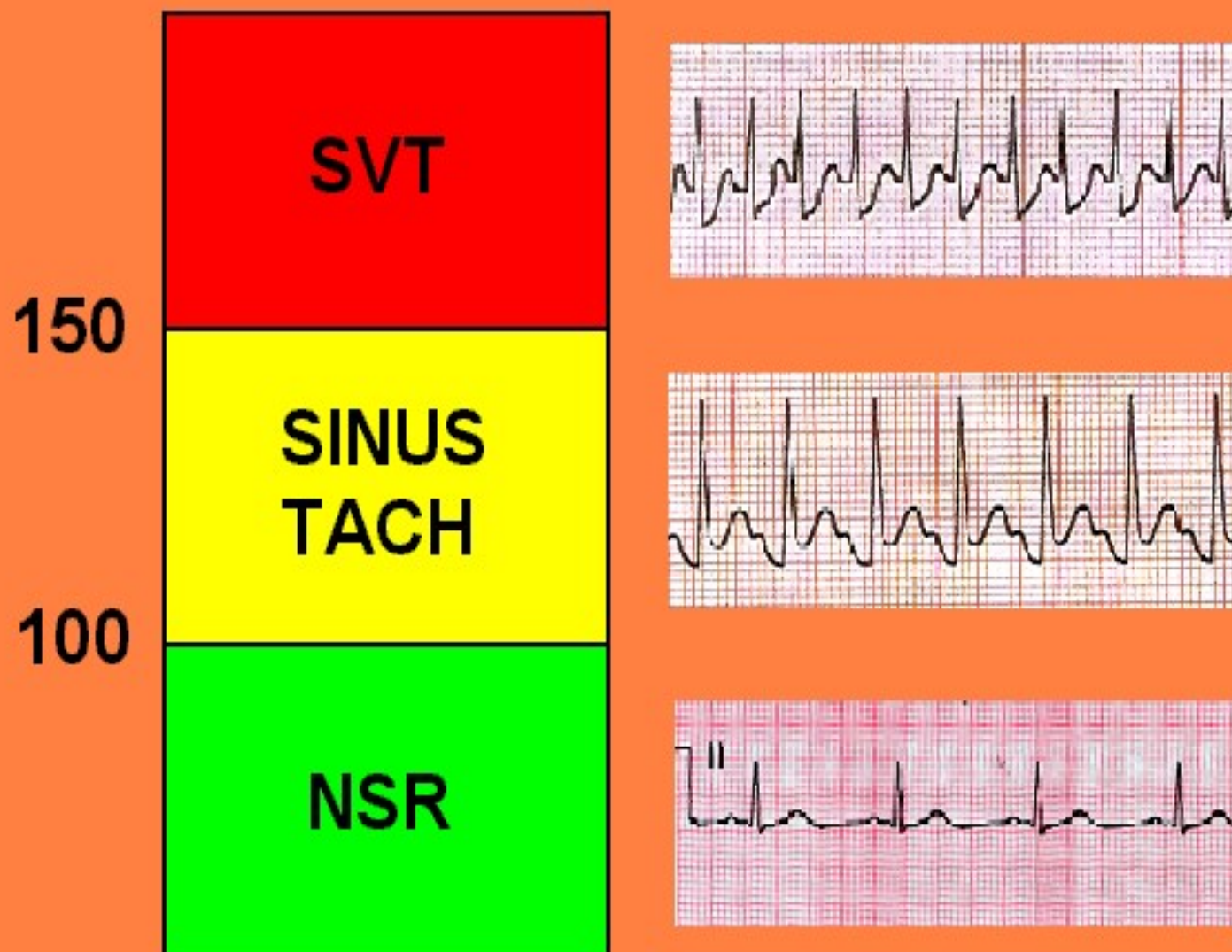
60 - 100

NORMAL

Above 100

TACHYCARDIA

# ACLS TACHYCARDIA GUIDELINES





# ESTABLISH YOUR ROUTINE ECG EVALUATION . . . . .

- ☒ RATE
- ☐ RHYTHM
- ☐ INTERVALS
- ☐ P:QRS RATIO

# DETERMINE RHYTHM

" WHEN YOUR R - R INTERVALS . . . "

REGULAR —



" ARE ALWAYS CONSISTENT "

REGULARLY —



IRREGULAR

" FOLLOW A PATTERN "

IRREGULARLY -

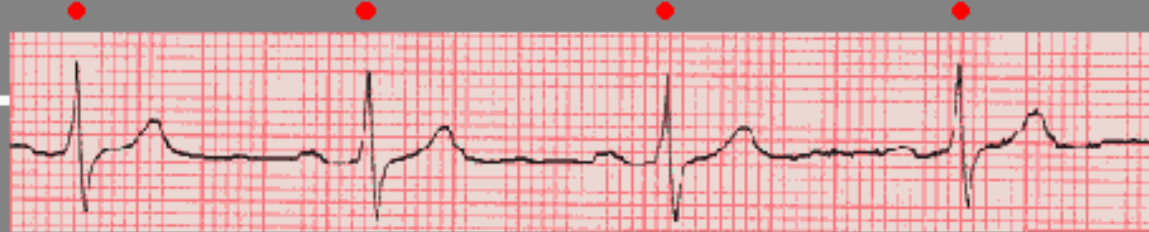


IRREGULAR

" ARE TOTALLY CHAOTIC "

# DETERMINE RHYTHM

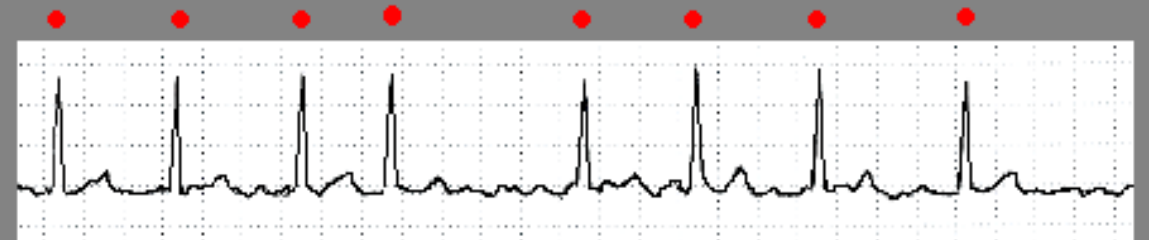
**REGULAR**



**REGULARLY  
IRREGULAR**



**IRREGULARLY  
IRREGULAR**



# DETERMINE RHYTHM

## EXAMPLES :

**REGULAR**

- **SINUS RHYTHM**
- **JUNCTIONAL RHYTHM**
- **VENTRICULAR RHYTHMS**

**REGULARLY  
IRREGULAR**

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

**IRREGULARLY  
IRREGULAR**

- **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**

**( VARIES FROM BEAT TO BEAT )**

**THINK:**

- 2° TYPE 1 HEART BLOCK**  
**( WENKEBACH )**
- 3° HEART BLOCK**  
**( COMPLETE HEART BLOCK )**

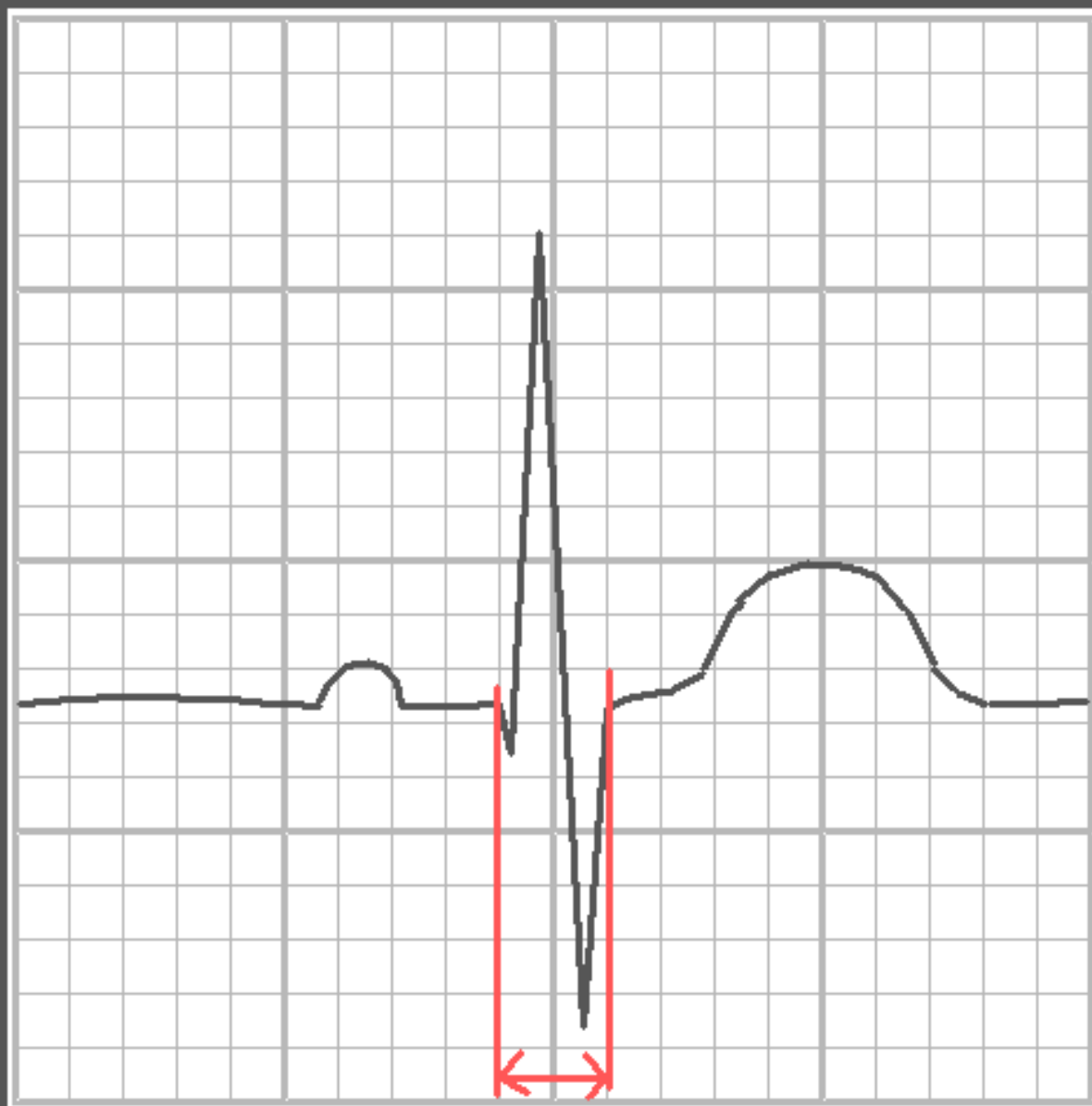
# QRS INTERVAL

LESS THAN

.12

OR

120 mSEC



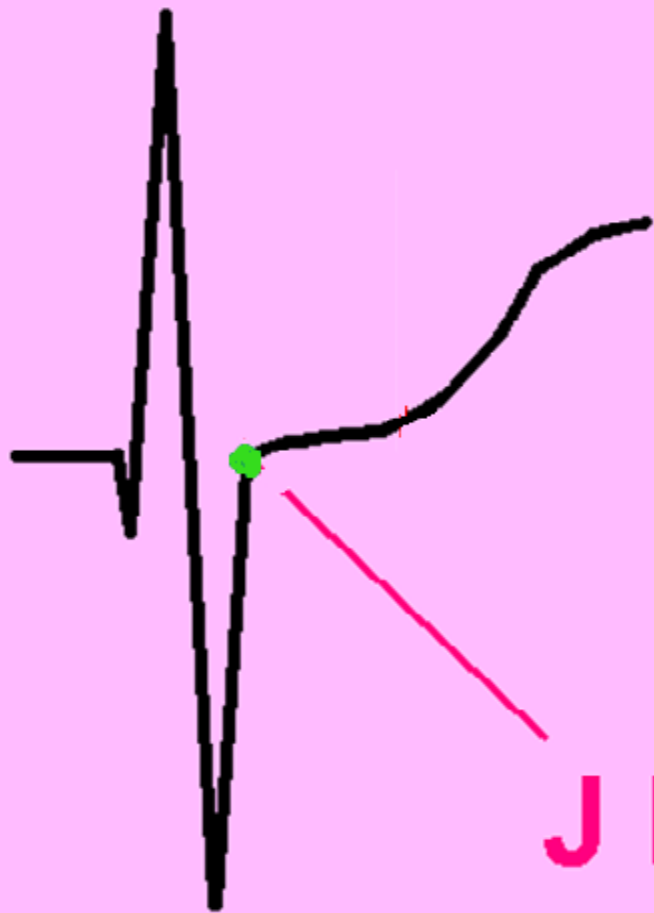
**QRS COMPLEX TOO WIDE**  
**WIDER THAN 120 mSEC**

**THINK:**

- **BUNDLE BRANCH BLOCK**
- **VENTRICULAR COMPLEX (ES)**
- **PACED RHYTHM**
- **L VENTRICULAR HYPERTROPHY**
- **ELECTROLYTE IMBAL. (  $\uparrow K^+$   $\downarrow Ca^{++}$  )**
- **DELTA WAVE (PRE-EXCITATION)**

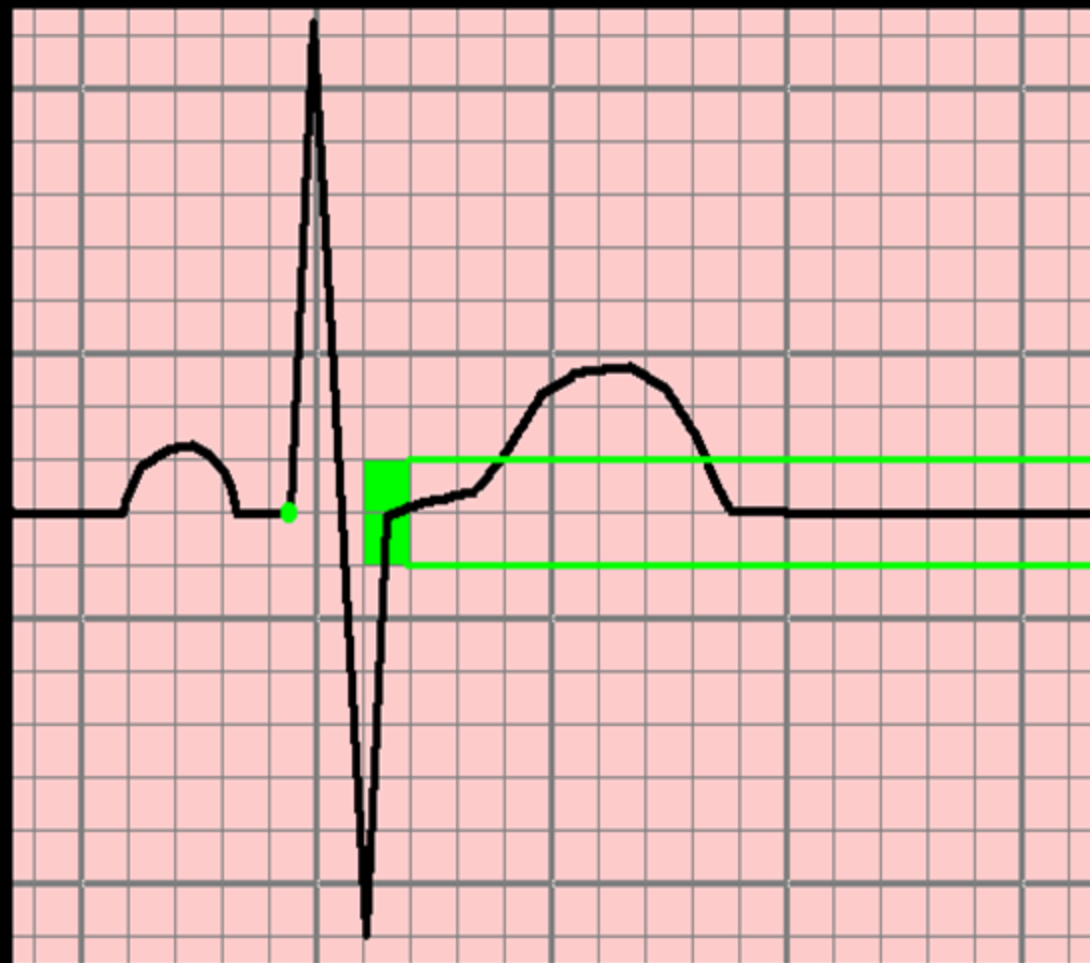
# THE J POINT

is where the QRS complex ends and the S-T Segment begins.



J POINT

# THE J POINT SHOULD BE ..



WITHIN  
1 mm  
ABOVE

OR

BELOW  
the  
ISOELECTRIC  
LINE

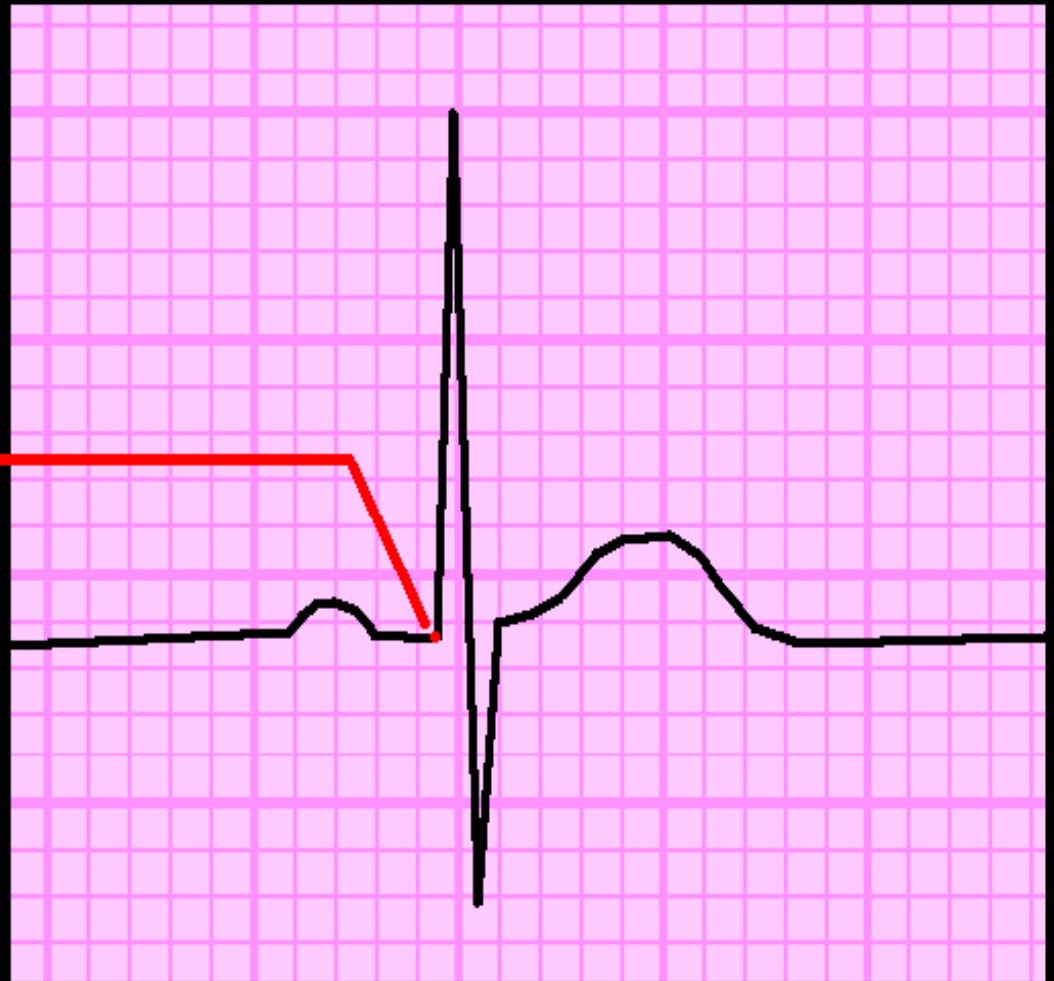
or the P-Q JUNCTION.



# THE P-Q JUNCTION

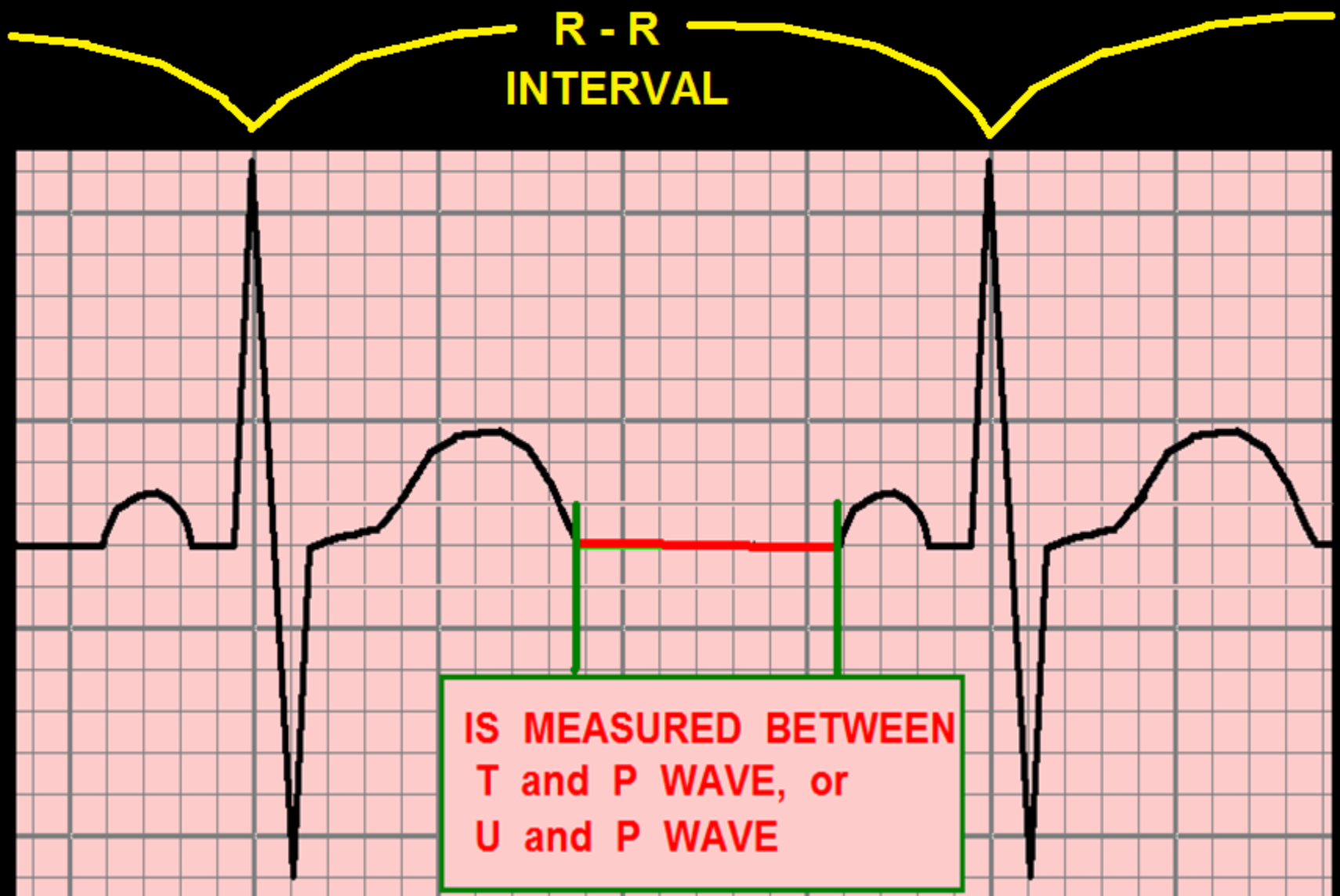
. . . is the POINT  
where the P-R  
SEGMENT ends  
and the QRS  
COMPLEX BEGINS.

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

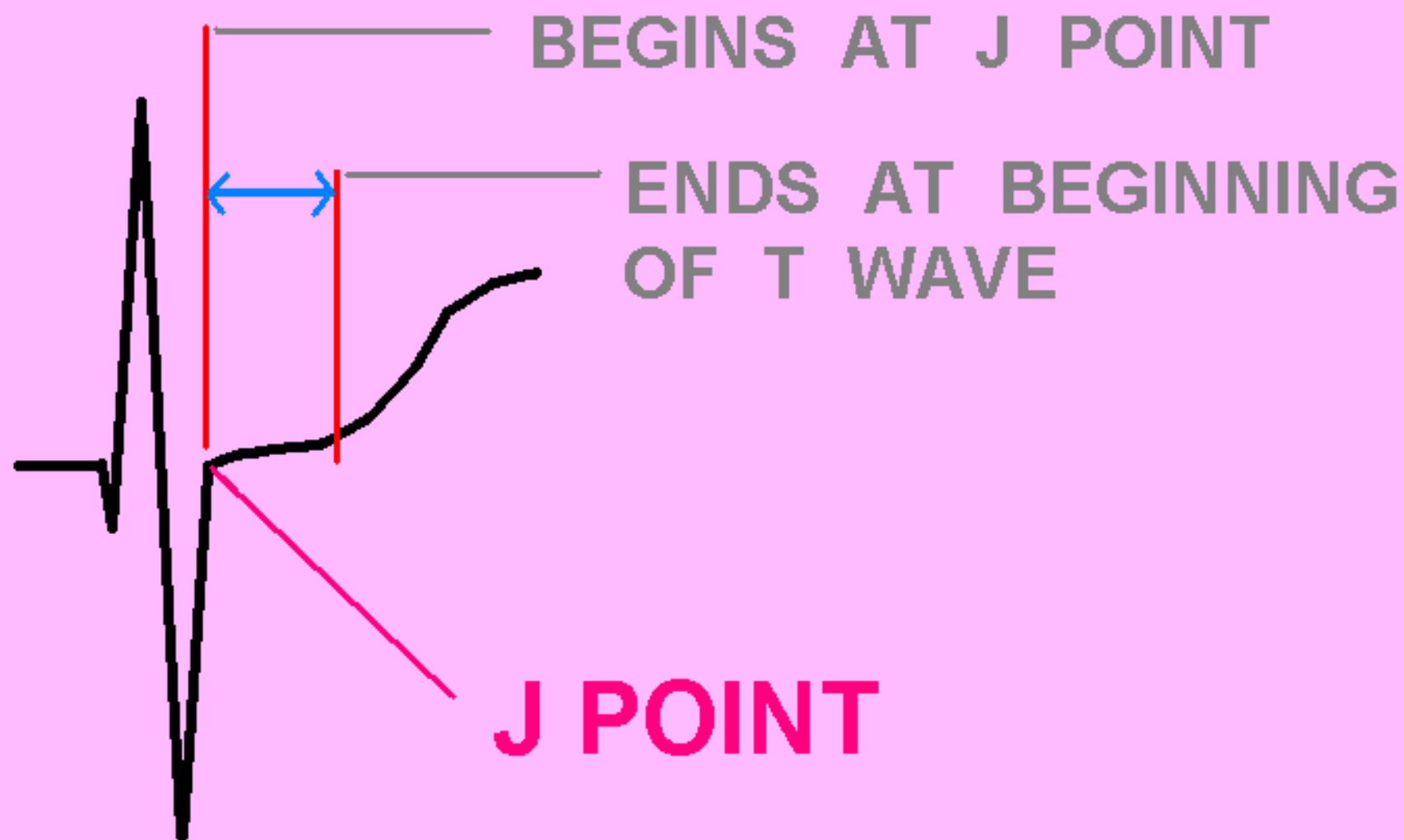


— as per the A.H.A., A.C.C., and WANG, ASINGER, and  
MARRIOTT, N.E.J.M. vol. 349:2128-2135 Nov. 27, 2003

# THE ISOELECTRIC LINE



# THE S-T SEGMENT



## Q - T INTERVAL

- VARIES BASED  
ON HEART RATE  
AND SEX



## DETERMINING Q-T INTERVAL LIMITS

### BAZETT'S FORMULA

$$QT_c = \frac{QT}{\sqrt{R - R}}$$

- **REQUIRES CALCULATOR  
WITH SQUARE ROOT FUNCTION**

## THE \*QT<sub>c</sub> INTERVAL

\* QT<sub>c</sub> = Q-T interval,  
corrected for heart rate

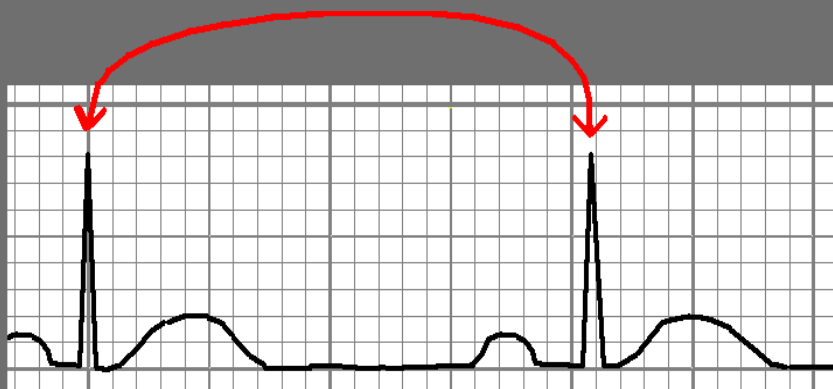
| HEART<br>RATE | MALE | FEMALE |
|---------------|------|--------|
| 150           | 0.25 | 0.28   |
| 125           | 0.26 | 0.29   |
| 100           | 0.31 | 0.34   |
| 93            | 0.32 | 0.35   |
| 83            | 0.34 | 0.37   |
| 71            | 0.37 | 0.40   |
| 60            | 0.40 | 0.44   |
| 50            | 0.44 | 0.48   |
| 43            | 0.47 | 0.51   |

*Annals of Internal Medicine, 1988 109:905.*

## DETERMINING Q-T INTERVAL LIMITS

### THE "QUICK PEEK" METHOD

( for Heart Rates 60 - 100 )



## DETERMINING Q-T INTERVAL LIMITS

### RAUTAHARJU FORMULA

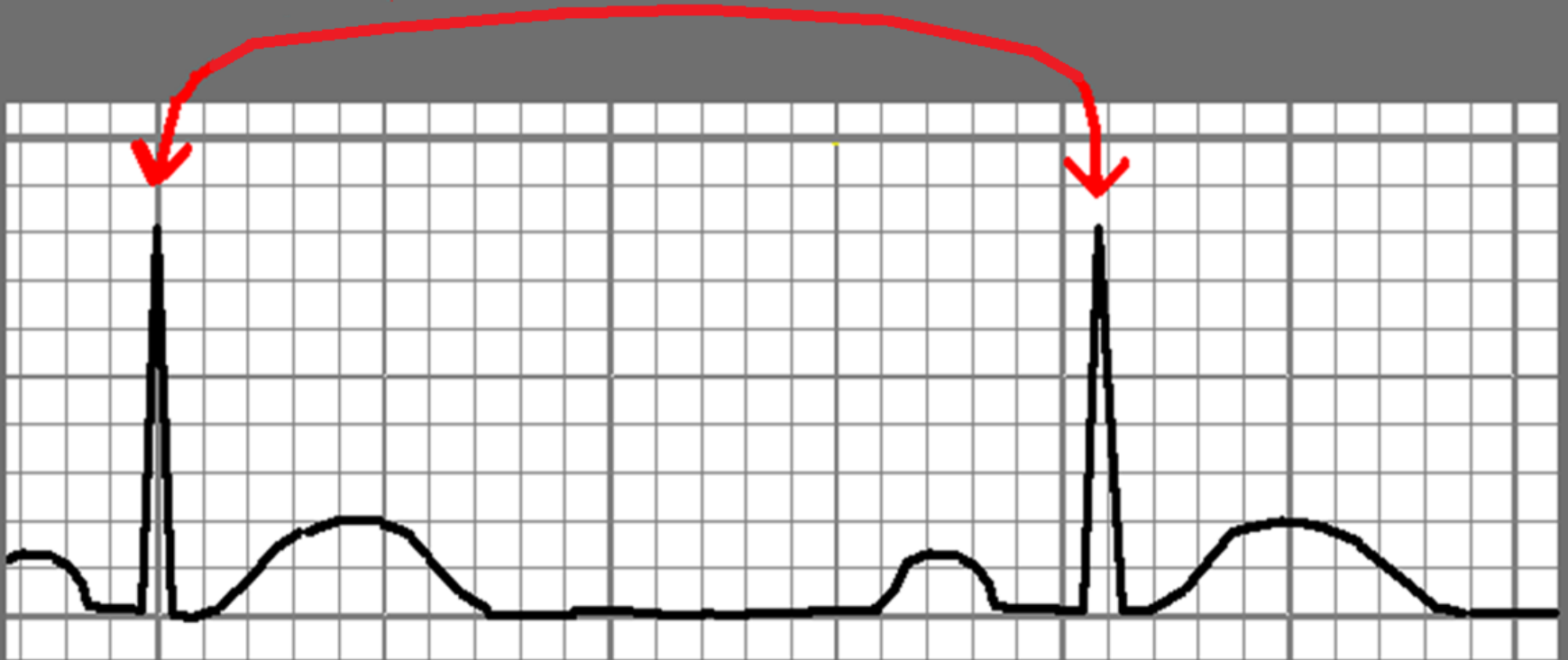
$$QT_c = \frac{656}{1 + \frac{HR}{100}}$$

- **ACCURATE AT ALL RATES**

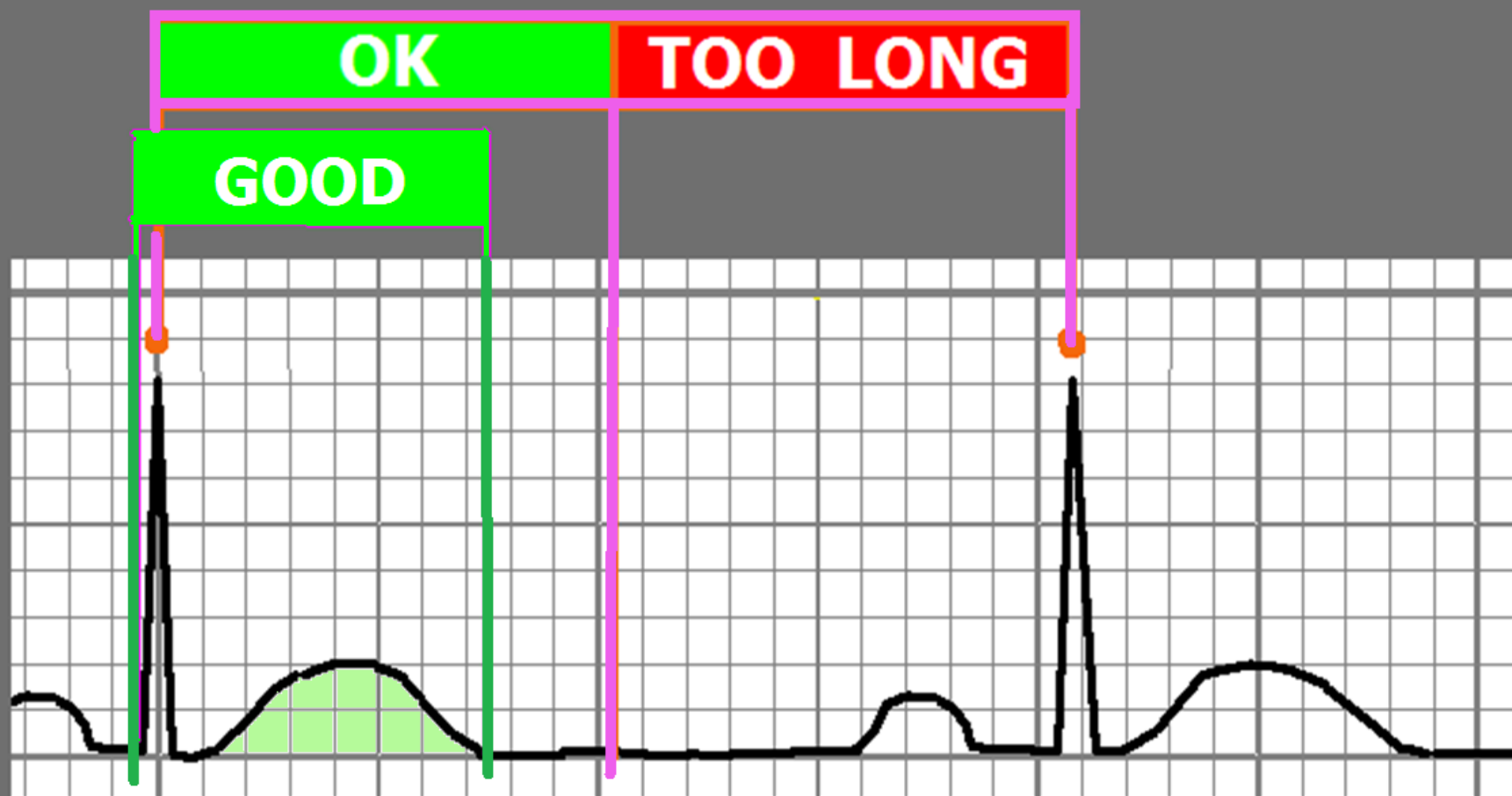
# DETERMINING Q-T INTERVAL LIMITS

## 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  $\frac{1}{2}$  the  
R - R Interval



The Q - T Interval  
should be LESS THAN  $\frac{1}{2}$  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 rhy  
. Borderlin

PR 183

QRSD 88

QT 357

QTc 420

--AXIS--

P 70

QRS 41

T -1

12 Lead; Standard Place

I



# QTc Values:

## Males:

|                         |                     |
|-------------------------|---------------------|
| <b>Too Short:</b>       | <b>&lt;390 ms</b>   |
| <b>Normal:</b>          | <b>390 - 450 ms</b> |
| <b>Borderline High:</b> | <b>450 - 500 ms</b> |
| <b>Critical High:</b>   | <b>&gt; 500 ms</b>  |

## Females:

|                         |                     |
|-------------------------|---------------------|
| <b>Too Short:</b>       | <b>&lt;390 ms</b>   |
| <b>Normal:</b>          | <b>390 - 460 ms</b> |
| <b>Borderline High:</b> | <b>460 - 500 ms</b> |
| <b>Critical High:</b>   | <b>&gt; 500 ms</b>  |

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

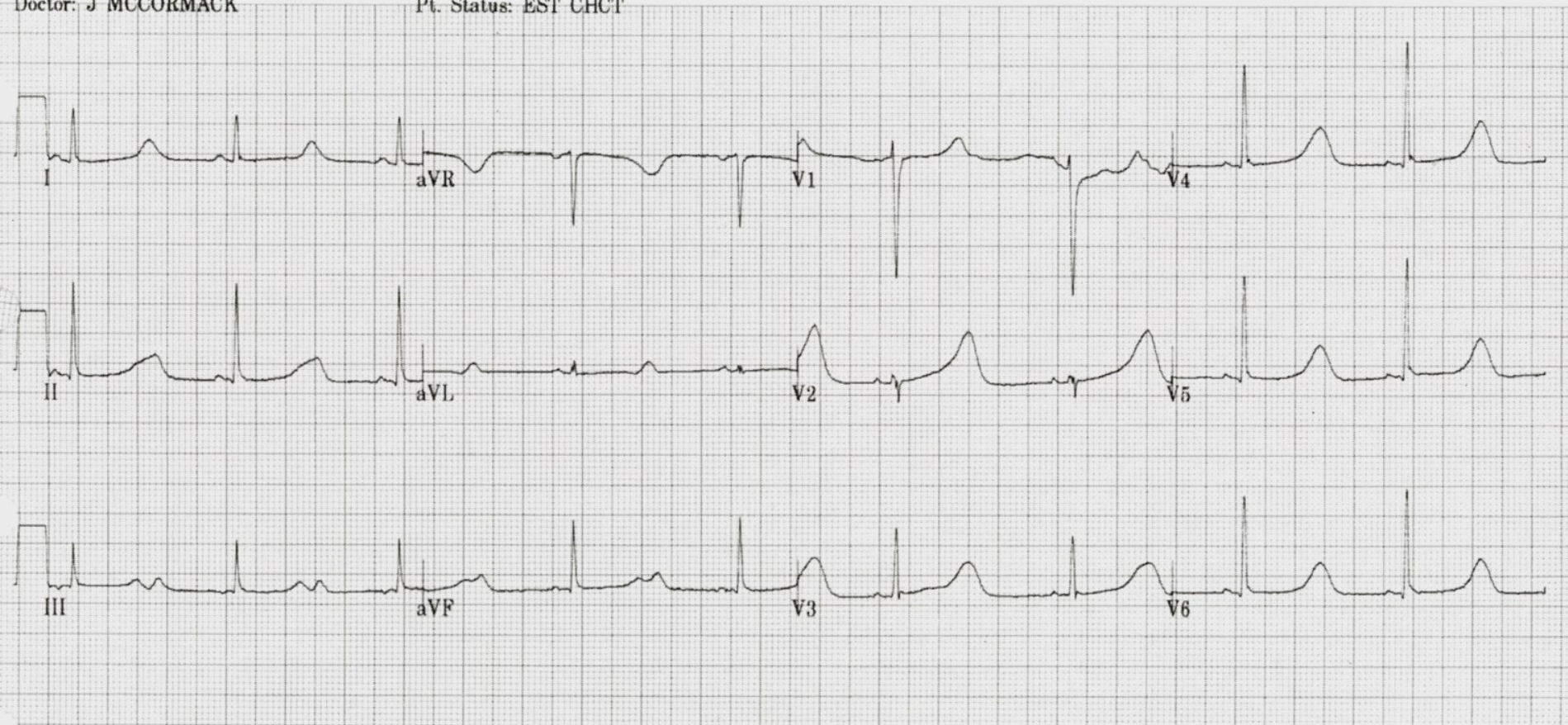
**22 y/o FEMALE**

Vent. rate 53 bpm  
PR interval 110 ms  
QRS duration 84 ms  
QT/QTc 678/636 ms  
P-R-T axes 25 60 48

PEDIATRIC CARDIOLOGY ASSOCIATES

Doctor: J MCCORMACK

Pt. Status: EST CHCT



WHEN THE “QUICK PEEK” METHOD for QT INTERVAL EVALUATION IS APPLIED TO THE ABOVE ECG, WHAT IS THE RESULT?

# **-- 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<sup>+</sup> AND MAG LEVELS
- POSSIBILITY OF TORSADES

# PROLONGED Q - T INTERVAL

THINK:

- CHECK K<sup>+</sup> AND MAG LEVELS
- POSSIBILITY OF TORSADES


***- QUESTION MEDS THAT PROLONG Q-T***

## QT Prolongation -- *STAT Intervention:*

- Evaluate patient's meds list for meds that prolong the QT Interval.
- Discontinue any medication(s) known to prolong the QT Interval
- Consult pharmacist and the patient's physician to determine alternate medications that do not prolong the QT interval.
- Obtain a thorough patient history, to rule out incidence of syncope, seizures (of unknown etiology), and family history of sudden death/ near sudden death.
- Rule out hypothermia
- Rule out CVA / intracranial bleed
- Evaluate the patient's electrolyte levels
- **Continuously *MONITOR PATIENT'S ECG FOR RUNS OF TORSADES***
- Consider "expert consult" (electrophysiologist) to rule out LQTS



# 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:*

- |                      |                        |
|----------------------|------------------------|
| <b>-Amiodarone</b>   | <b>-Ritalin</b>        |
| <b>-Procainamide</b> | <b>-Pseudophedrine</b> |
| <b>-Levaquin</b>     | <b>-Haloperidol</b>    |
| <b>-Erythromycin</b> | <b>-Thorazine</b>      |
| <b>-Norpace</b>      | <b>-Propulcid</b>      |
| <b>-Tequin</b>       | <b>-Zofran</b>         |
| <b>-Benadryl</b>     | <b>-Ilbutilide</b>     |

***and MANY more!***

# From: What Clinicians Should Know About the QT Interval

JAMA. 2003;289(16):2120-2127. doi:10.1001/jama.289.16.2120

**Table.** Pharmacokinetic Interactions With Selected QT-Prolonging Drugs\*

| QT-Prolonging Drugs | Drugs Possibly Affecting Pharmacokinetics   |
|---------------------|---|
| Antiarrhythmics     |   |
| Disopyramide        | Erythromycin  |
| Dofetilide          | Cimetidine, ketoconazole, megestrol, prochlorperazine, trimethoprim, verapamil, thiazide diuretics      |
| Procainamide        | Amiodarone, cimetidine, trimethoprim  |
| Quinidine           | Amiodarone, cimetidine, possibly erythromycin and verapamil   |
| Antipsychotics      |   |
| Haloperidol         | Fluoxetine, venlafaxine   |
| Pimozide            | Erythromycin  |
| Thioridazine        | Paroxetine  |
| Ziprasidone         | Fluconazole, itraconazole, ketoconazole   |
| Antidepressants     |   |
| Amitriptyline       | Cimetidine, fluconazole, fluoxetine, ritonavir  |
| Desipramine         | Venlafaxine   |
| Anti-infectives     |   |
| Erythromycin        | Ritonavir   |
| Sparfloxacin        | Cisapride   |
| Other               |   |
| Bepidil             | Ritonavir   |
| Cisapride           | Clarithromycin, erythromycin, fluconazole, indinavir, itraconazole, ketoconazole, nefazodone, ritonavir |

\*Drugs from the "very probable," "probable," and "possible in high-risk patients" categories of the Box are included in this table. This is not an all-inclusive list of all pharmacokinetic drug-drug interactions with these agents but, rather, some interactions that could lead to increased serum concentrations of the QT-prolonging drug. New drug-drug interactions may be identified in the future. Pharmacodynamic interactions are not included in this table; however, combinations of QT-prolonging drugs such as macrolide antibiotics and quinolones are strongly discouraged.<sup>39-42</sup>



# ESTABLISH YOUR ROUTINE ECG EVALUATION . . . . .



RATE



RHYTHM



INTERVALS

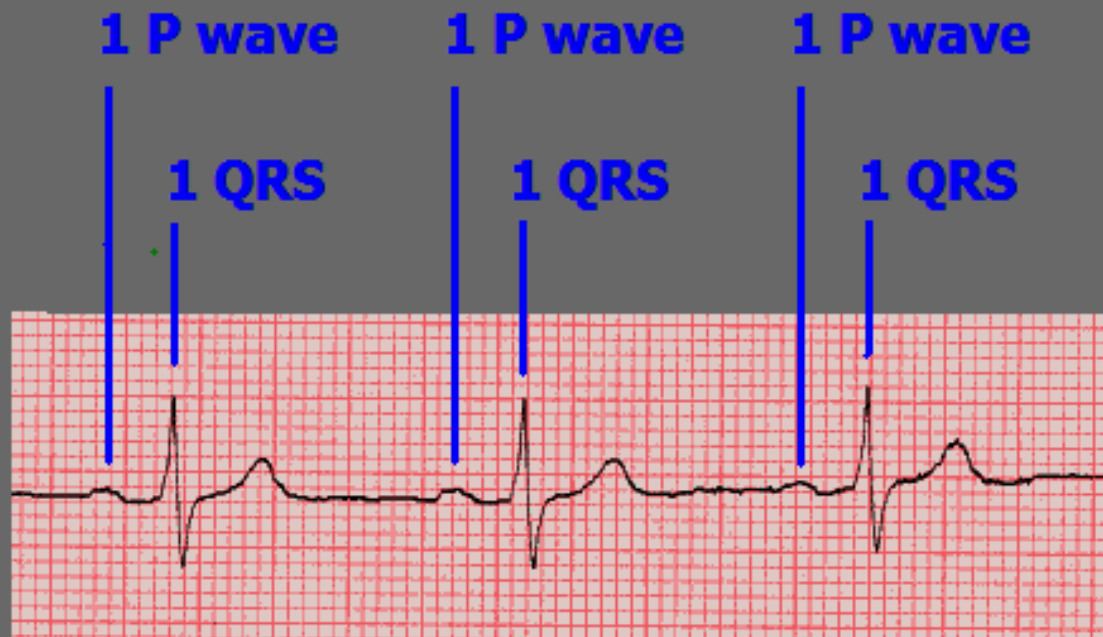


P:QRS RATIO

# DETERMINE P : QRS RATIO



**SIMPLY STATED, SHOULD  
ALWAYS BE 1 : 1**



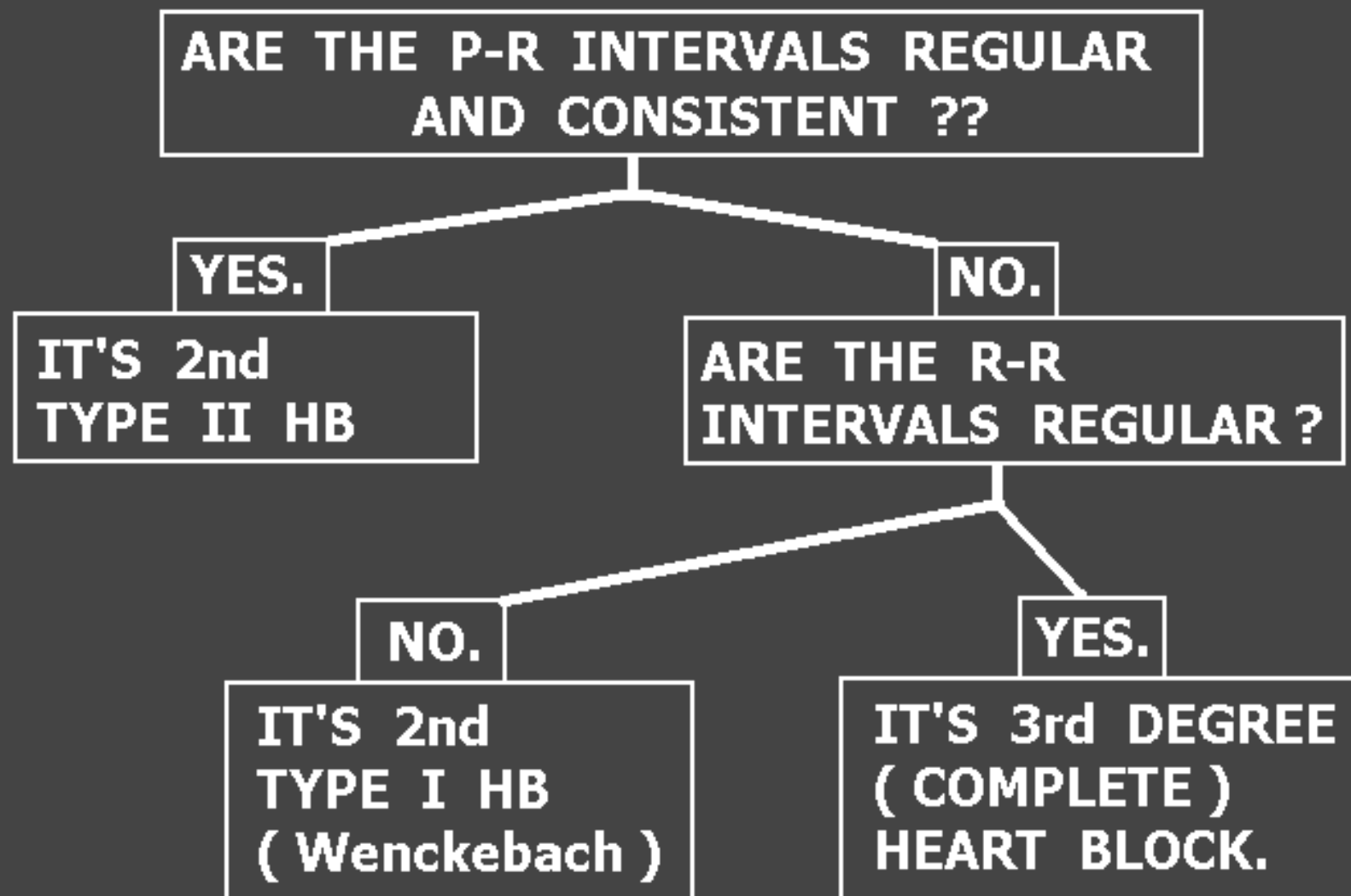
**P : QRS RATIO**  
**IF GREATER THAN 1 : 1**

**THINK:**

- **2° HEART BLOCK**  
**( TYPE 1 or 2 )**
- **3° HEART BLOCK**
- **ATRIAL FLUTTER**  
**( SAW-TOOTHED "F" WAVES )**

# DIAGNOSING 2nd and 3rd DEGREE HEART BLOCK

**MORE P-WAVES THAN QRS COMPLEXES PRESENT.**



# LET'S TEST THE PROCEDURE . . .

1



2



3





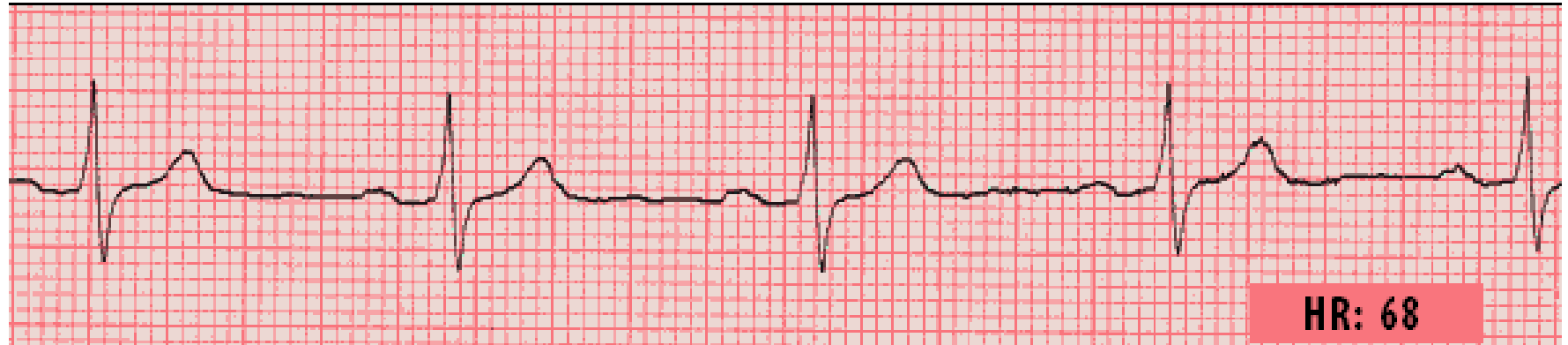
# ESTABLISH YOUR ROUTINE ECG EVALUATION . . . . .

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





# THIS RHYTHM IS: NORMAL SINUS RHYTHM

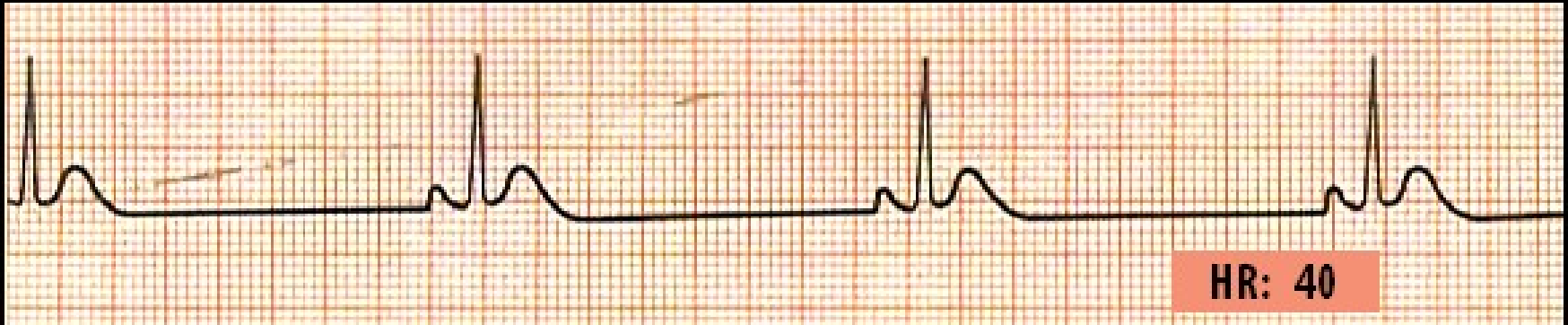


**MAIN IDENTIFICATION CHARACTERISTIC(S): PERFECTLY NORMAL IN EVERY WAY!**

|              |                           |
|--------------|---------------------------|
| RATE         | BETWEEN 60 - 100          |
| RHYTHM       | REGULAR                   |
| P-R INTERVAL | 120 - 200 ms (.12 - .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 -----

# 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)

## ***-- CRITICAL ECG ALERT --***

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

**1. Heart rate LESS THAN 50 or GREATER THAN 150**

***AND WHEN YOU'RE AT THE NURSES STATION AND  
YOU SEE A PATIENT'S HEART RATE IS TOO  
SLOW OR TOO FAST, WHAT SHOULD YOU DO ? ?***

# SHOCK ASSESSMENT





SECONDS

SHOCK =

INADEQUATE TISSUE  
PERFUSION

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

# SHOCK ASSESSMENT

|            |  |                              |
|------------|--|------------------------------|
| LOC:       | ANXIOUS<br>RESTLESS<br>LETHARGIC<br>UNCONSCIOUS  | AWAKE<br>ALERT &<br>ORIENTED |
| SKIN:      | PALE / ASHEN<br>CYANOTIC<br>COOL<br>DIAPHORETIC  | NORMAL HUE<br>WARM<br>DRY    |
| BREATHING: | TACHYPNEA  | NORMAL                       |
| PULSE:     | WEAK / THREADY<br>TOO FAST or SLOW   | STRONG                       |
| STATUS:    |  <b>SHOCK</b>  | <b>NORMAL</b>                |

# THIS RHYTHM IS: SINUS BRADYCARDIA



## **WE MUST CONSIDER UNDERLYING CAUSES:**

**INCREASED VAGAL TONE** —————→  
**BLOCKED SA NODAL ARTERY** —————→  
(INFERIOR WALL MI)  
**ELECTROLYTE IMBAL. (K<sup>+</sup>)** —————→  
**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 ----- | <b>&gt; 200 mSEC.</b> |
| 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 ( $2^{\circ}$ ,  $3^{\circ}$ ) with SLOWER VENTRICULAR RATE

# THIS RHYTHM IS:



## MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE \_\_\_\_\_

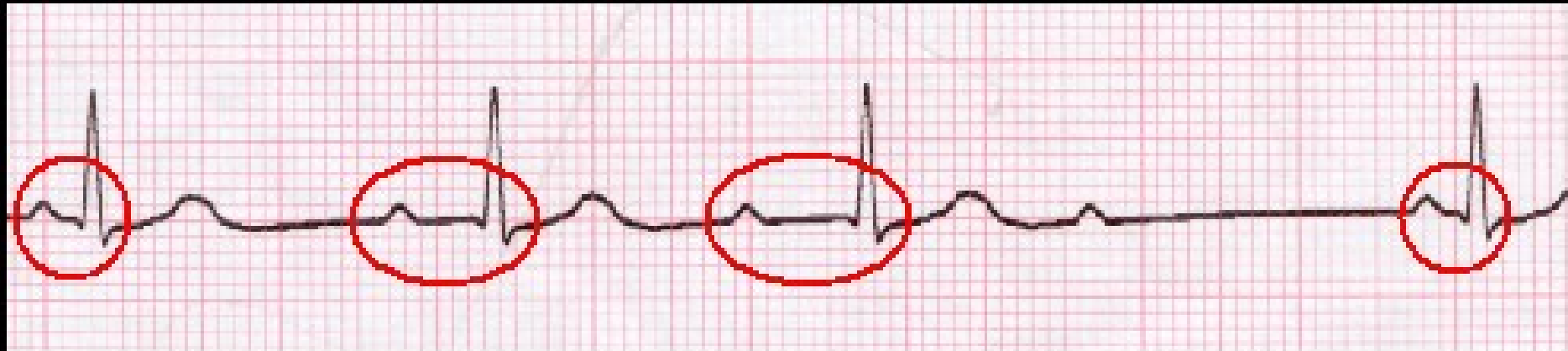
RHYTHM \_\_\_\_\_

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 ?

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?

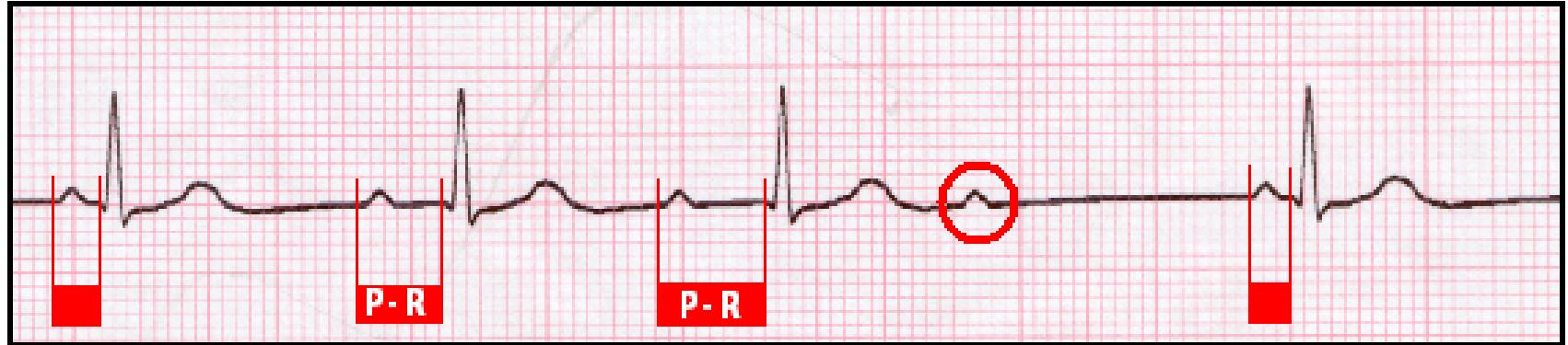
NO.

IT'S 2nd  
TYPE I HB  
( Wenckebach )

YES.

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

# THIS RHYTHM IS: 2nd<sup>o</sup> TYPE I HB (Wenckebach)

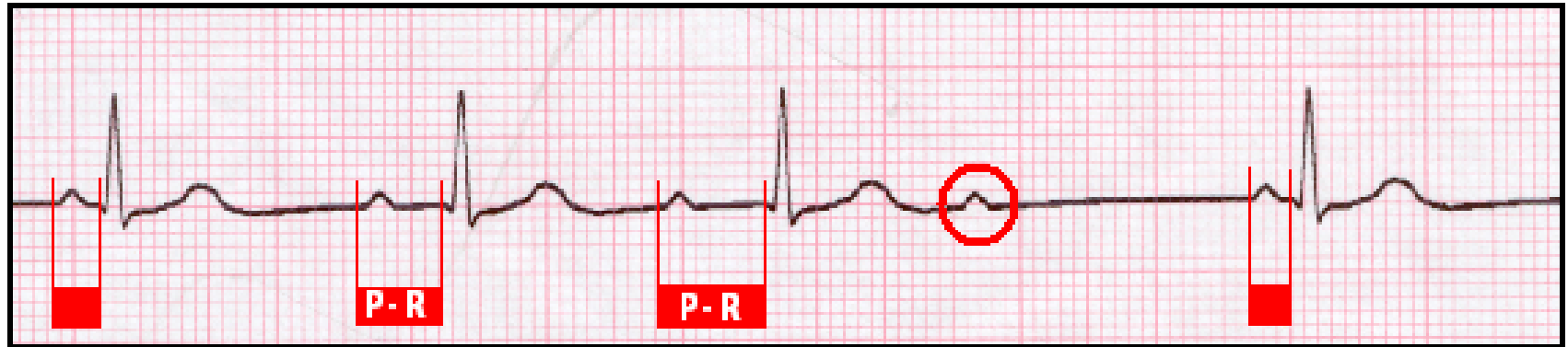


MAIN IDENTIFICATION CHARACTERISTIC(S): **P - R INTERVAL GETS PROGRESSIVELY LONGER UNTIL IT DROPS A QRS – THEN CYCLE REPEATS**

|              |                              |
|--------------|------------------------------|
| RATE         | NORMAL or BRADYCARDIC        |
| RHYTHM       | REGULARLY IRREGULAR          |
| P-R INTERVAL | VARIES (regularly irregular) |
| P: QRS RATIO | VARIES (usually 1:1 and 2:1) |
| QRS INTERVAL | NORMAL                       |



# THIS RHYTHM IS: 2nd<sup>o</sup> 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<sup>o</sup> type II , 3<sup>o</sup> )  
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 ?

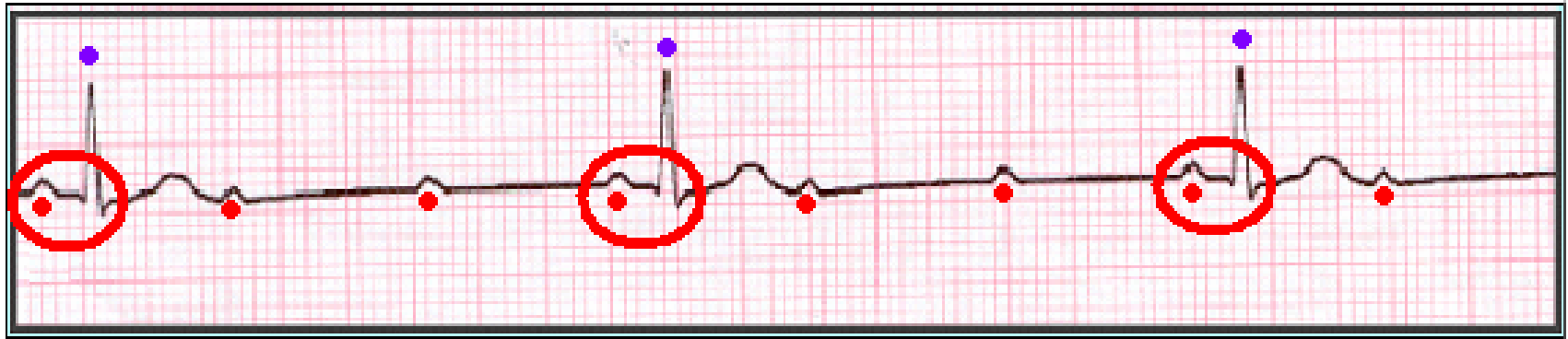
NO.

IT'S 2nd  
TYPE I HB  
( Wenckebach )

YES.

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

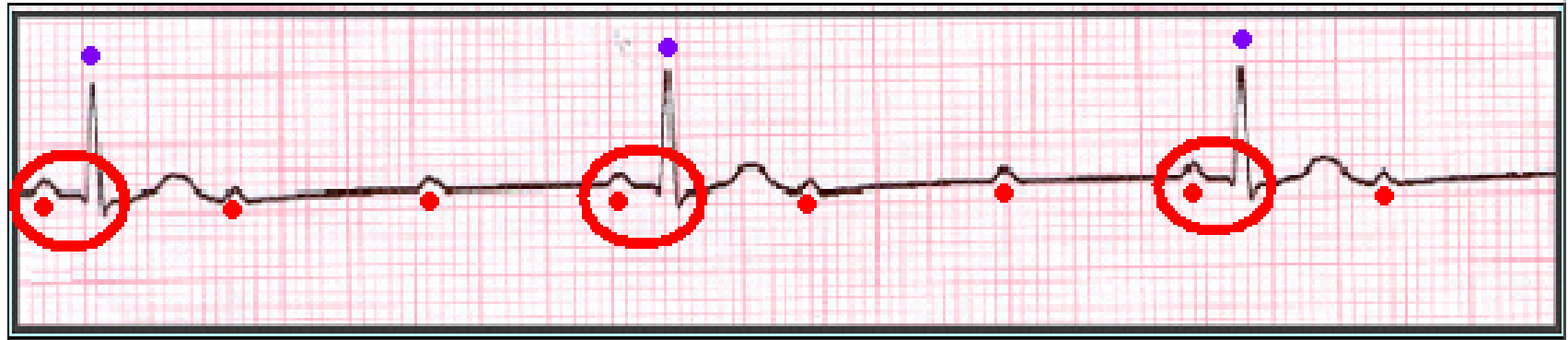
# THIS RHYTHM IS: 2<sup>nd</sup> ° TYPE II HEART BLOCK



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 | <b>NORMAL and CONSISTENT</b>       |
| P: QRS RATIO | <b><math>\geq 2:1</math></b>       |
| QRS INTERVAL | NORMAL                             |

# THIS RHYTHM IS: 2<sup>nd</sup> ° 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 (3<sup>rd</sup> °) HEART BLOCK

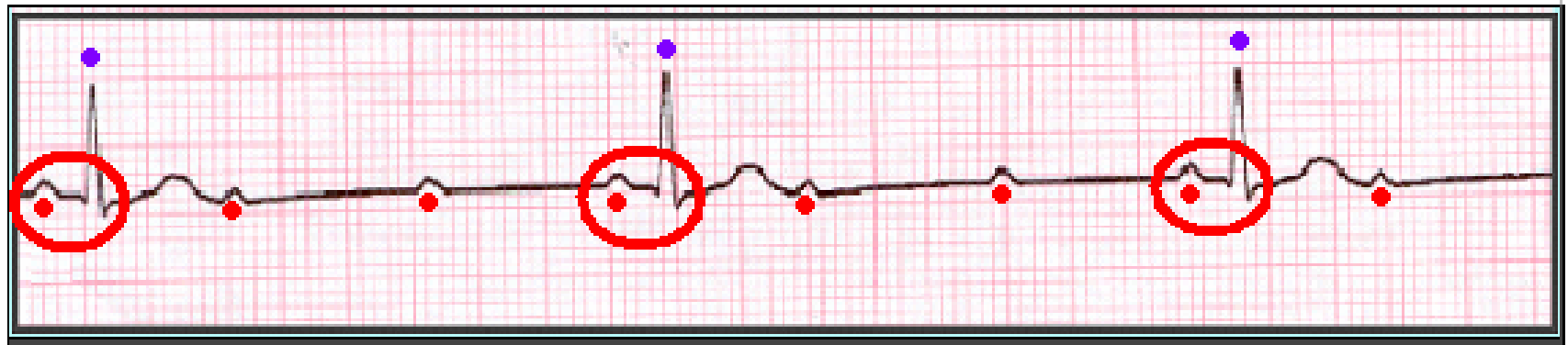
# **-- CRITICAL ECG ALERT --**

**-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. 2<sup>nd</sup> degree type II or 3<sup>rd</sup> degree HEART BLOCK**

# THIS RHYTHM IS: 2<sup>nd</sup> ° 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**



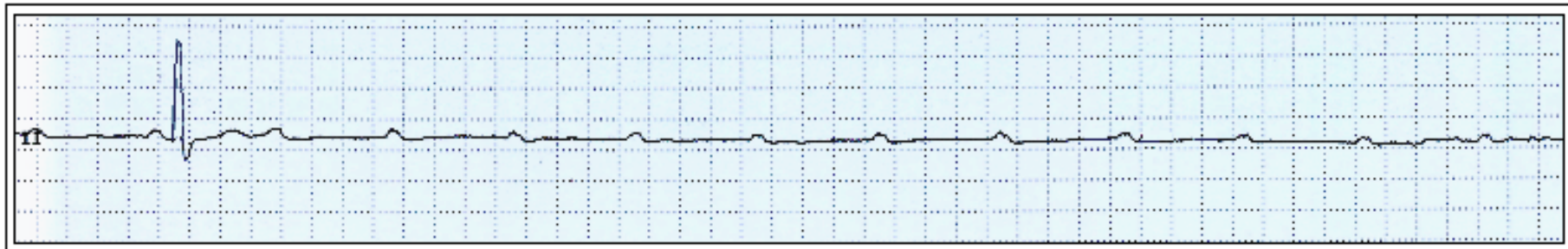
**ADAMS - STOKES SYNDROME** is essentially spontaneous **CARDIAC ARREST** -- characterized by episodes of **ASYSTOLE**, **VENTRICULAR STANDSTILL** and **V-FIB**. In this regard, 2<sup>nd</sup> ° TYPE II HB can be more dangerous than 3<sup>rd</sup> ° HB (at least 3<sup>rd</sup> ° Heart Block has an **ESCAPE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







## ADAMS - STOKES SYNDROME



### CASE HISTORY:

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

**TX: CPR, Atropine, Transvenous Pacemaker, followed by Permanent Pacemaker Implantation. 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):

RATE -----

RHYTHM -----

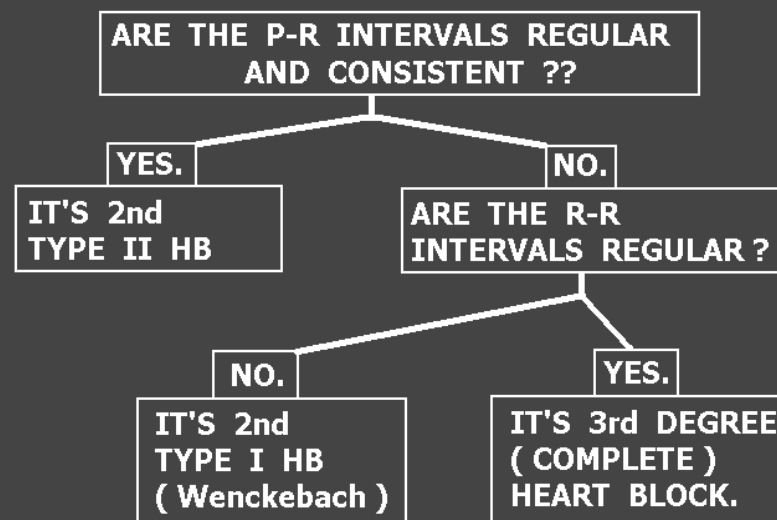
P-R INTERVAL -----

P:QRS RATIO -----

QRS INTERVAL -----

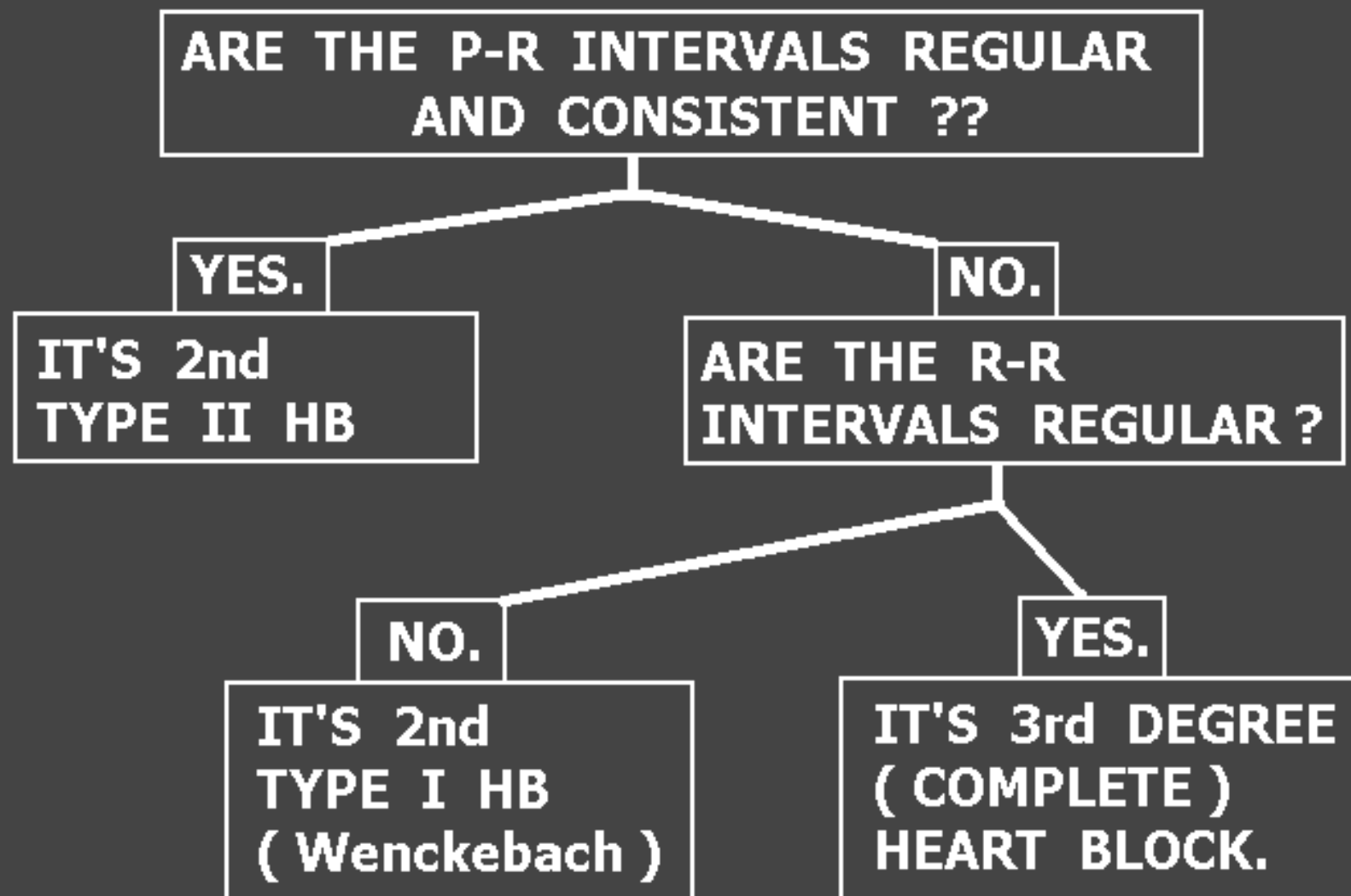
### DIAGNOSING 2nd and 3rd DEGREE HEART BLOCK

**MORE P-WAVES THAN QRS COMPLEXES PRESENT.**

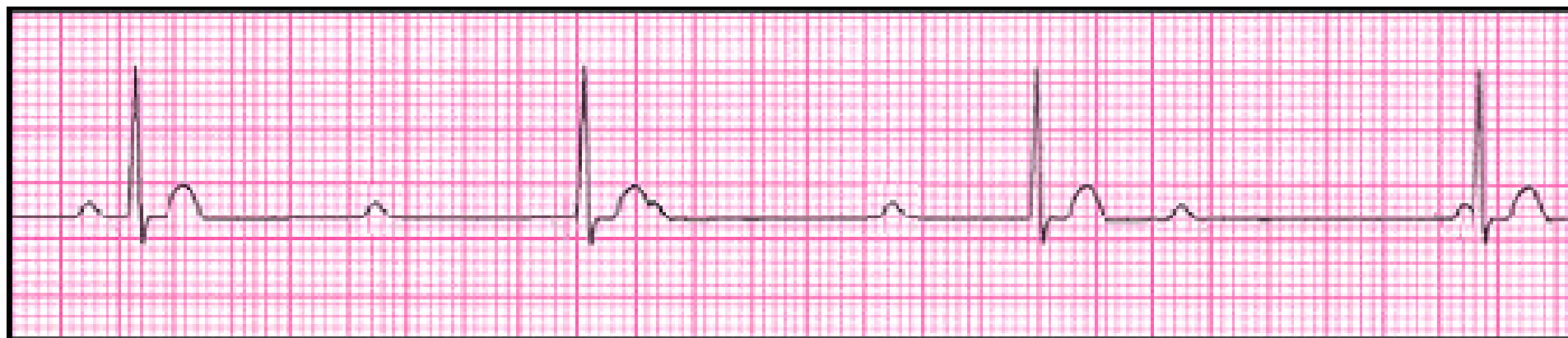


# DIAGNOSING 2nd and 3rd DEGREE HEART BLOCK

**MORE P-WAVES THAN QRS COMPLEXES PRESENT.**



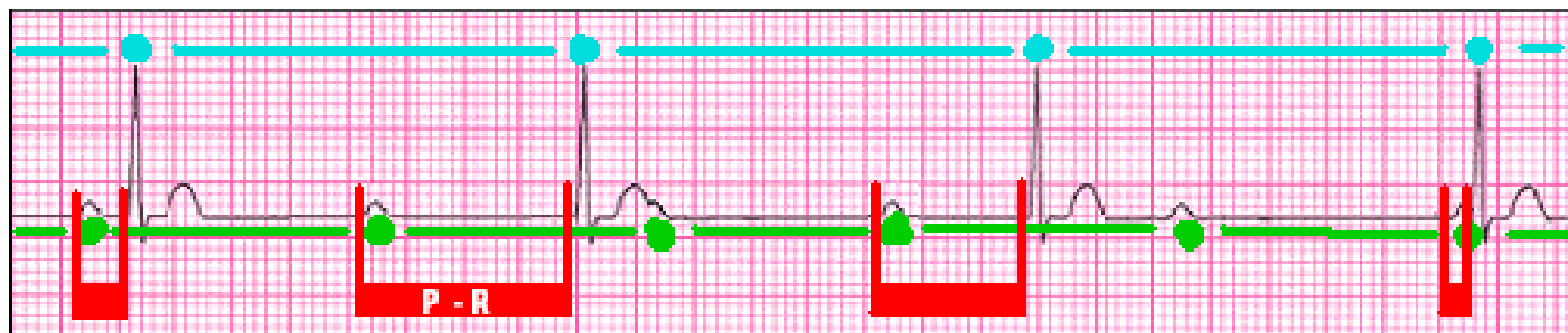
## THIS RHYTHM IS: 3rd<sup>0</sup> HB $\bar{c}$ JUNCTIONAL ESCAPE



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

|                   |   |
|-------------------|---|
| 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<sup>0</sup> HB  $\bar{c}$  JUNCTIONAL ESCAPE**



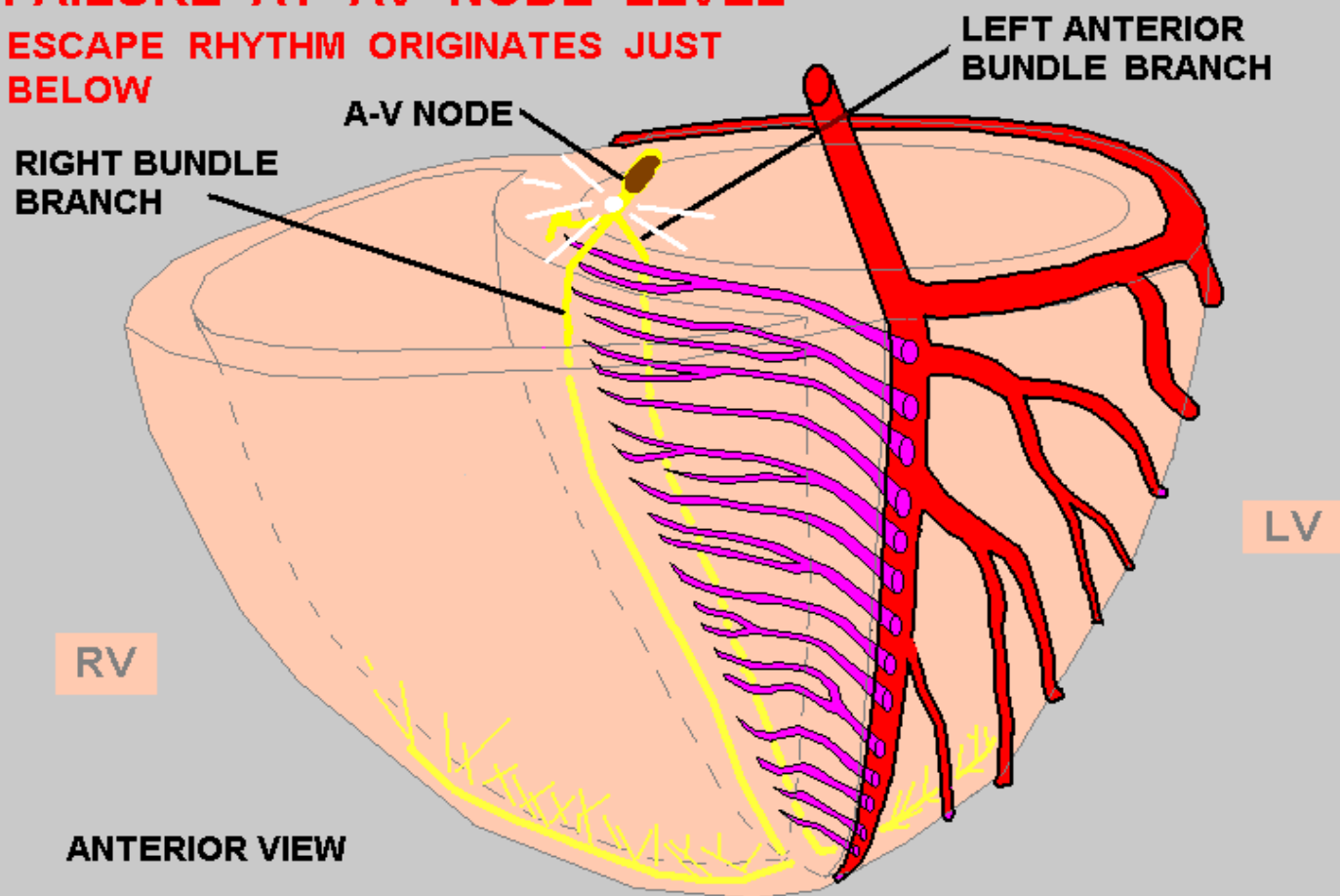
**MAIN IDENTIFICATION CHARACTERISTIC(S): P - R INTERVAL INCOSISTENT, P - P INTERVALS REGULAR, R - R INTERVALS REGULAR -- NO RELATIONSHIP BETWEEN P WAVES AND QRS COMPLEXES.**

### **POTENTIAL PROBLEMS:**

**- HYPOTENSION and SHOCK due to ↓ HEART RATE and ↓ CARDIAC OUTPUT**



**FAILURE AT AV NODE LEVEL  
ESCAPE RHYTHM ORIGINATES JUST  
BELOW**



**THIS RHYTHM IS:**



**MAIN IDENTIFICATION CHARACTERISTIC(S):**

**RATE** \_\_\_\_\_

**RHYTHM** \_\_\_\_\_

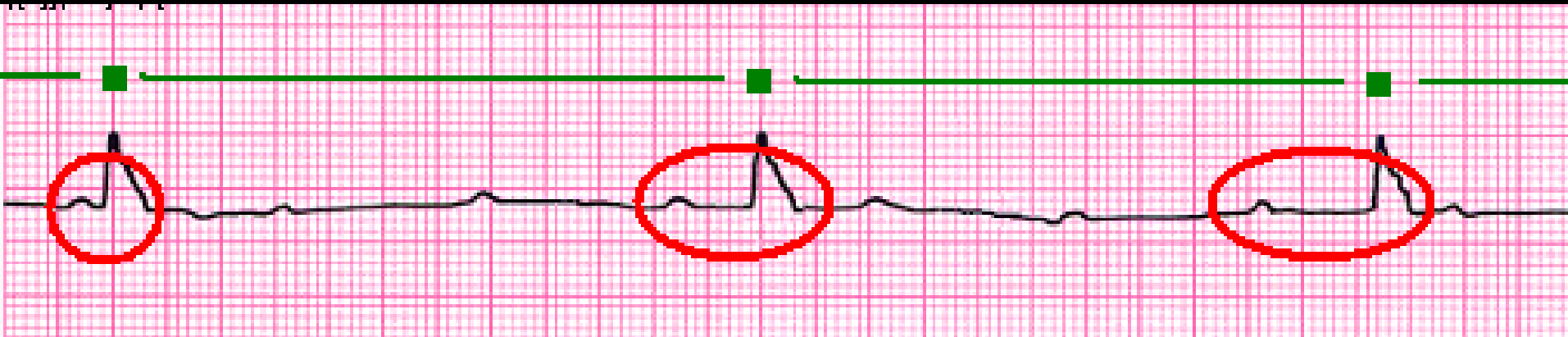
**P-R INTERVAL** \_\_\_\_\_

**P:QRS RATIO** \_\_\_\_\_

**QRS INTERVAL** \_\_\_\_\_



# WHEN YOU SEE "EXTRA P 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.

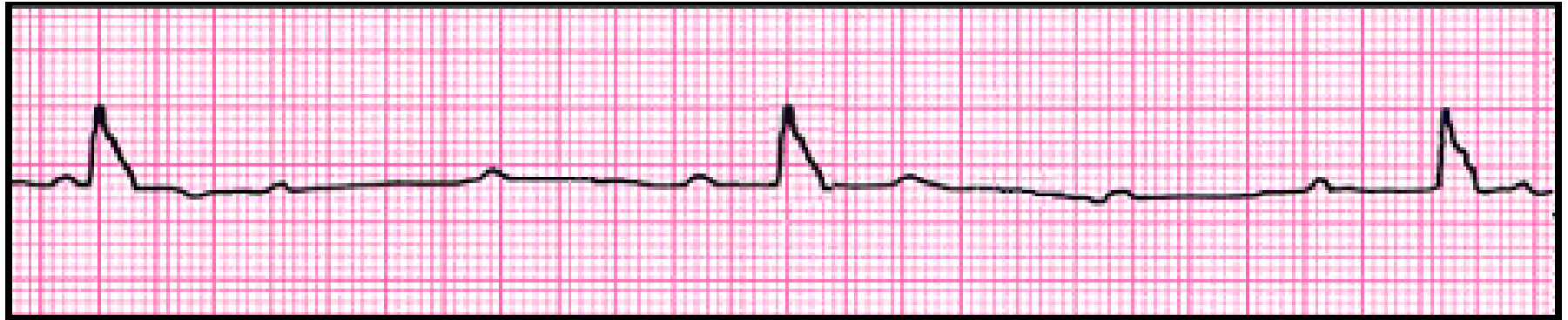
### STEP 1

EVALUATE P - R RELATIONSHIP

### STEP 2

EVALUATE R - R INTERVALS

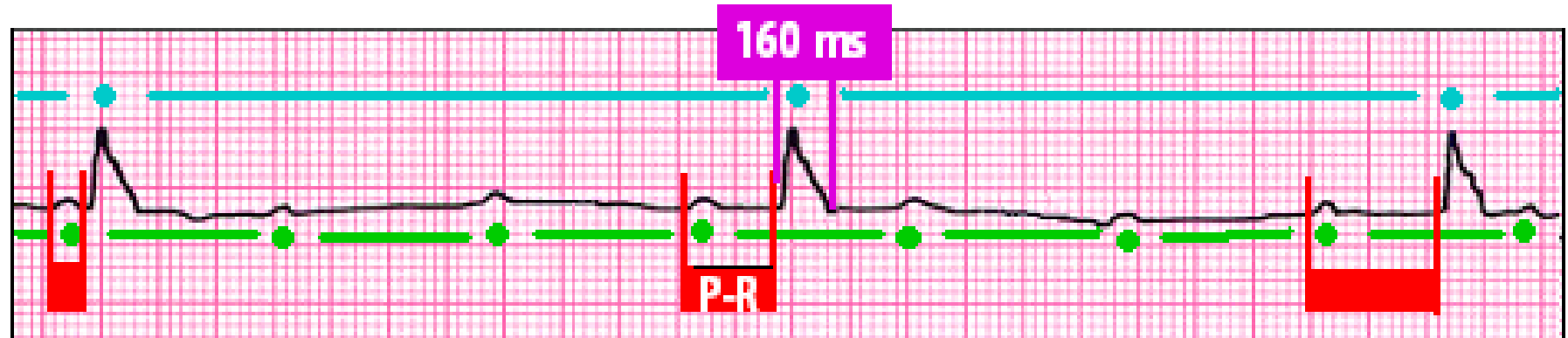
# THIS RHYTHM IS: 3rd<sup>0</sup> HB $\bar{c}$ IDIOVENTRICULAR ESCAPE



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<sup>0</sup> HB $\bar{c}$ IDIOVENTRICULAR ESCAPE



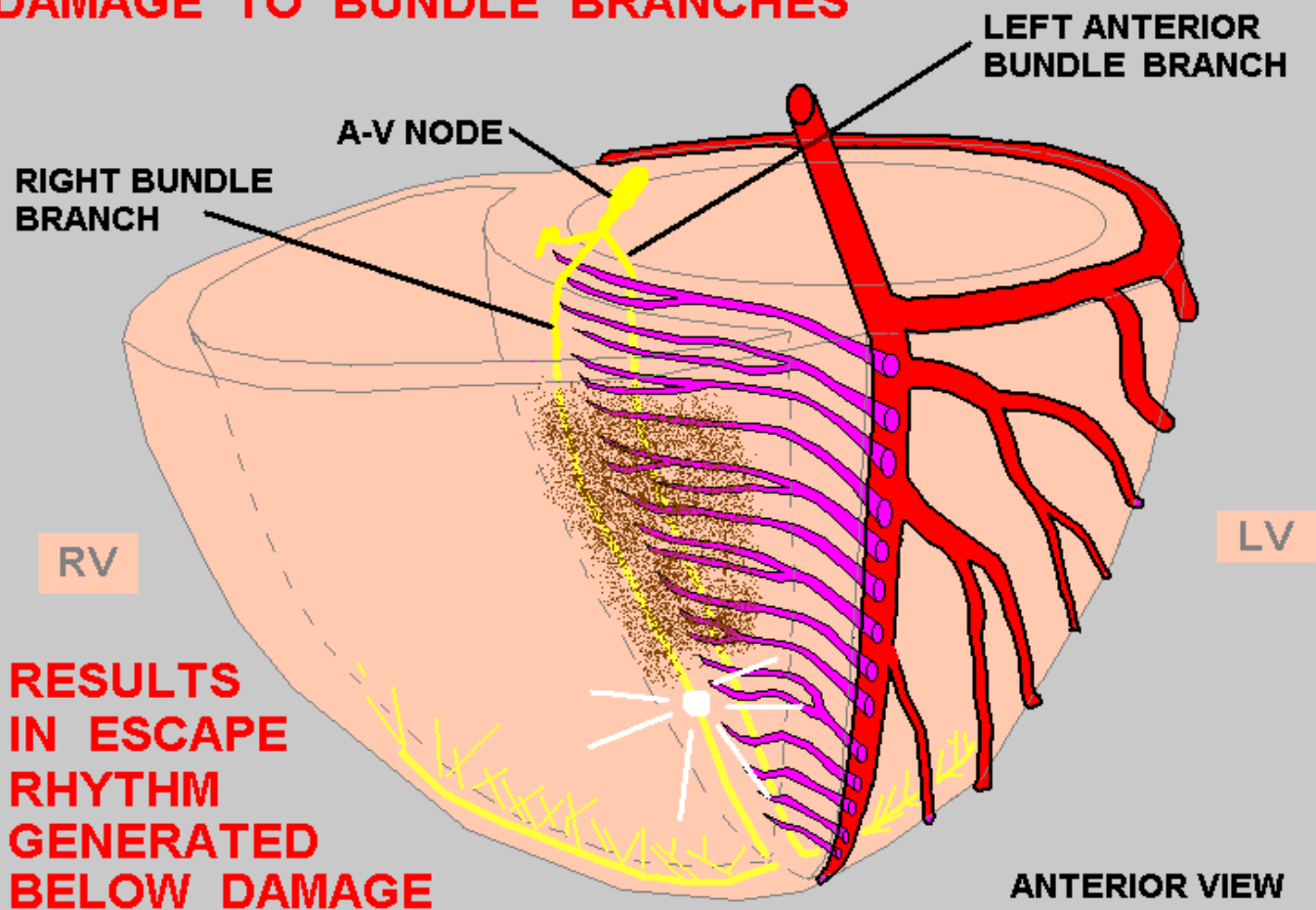
MAIN IDENTIFICATION CHARACTERISTIC(S): **P - R INTERVALS INCONSISTENT**  
**P - P INTERVALS REGULAR, R - R INTERVALS REGULAR. NO**  
**RELATIONSHIP BETWEEN P WAVES AND QRS COMPLEXES. QRS**  
**COMPLEXES are WIDER THAN 120ms, AND RATE ( usually < 40 )**

## POTENTIAL PROBLEMS:

**HYPOTENSION and SHOCK due to ↓ HEART RATE and**  
**↓ CARDIAC OUTPUT**



## DAMAGE TO BUNDLE BRANCHES







## **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

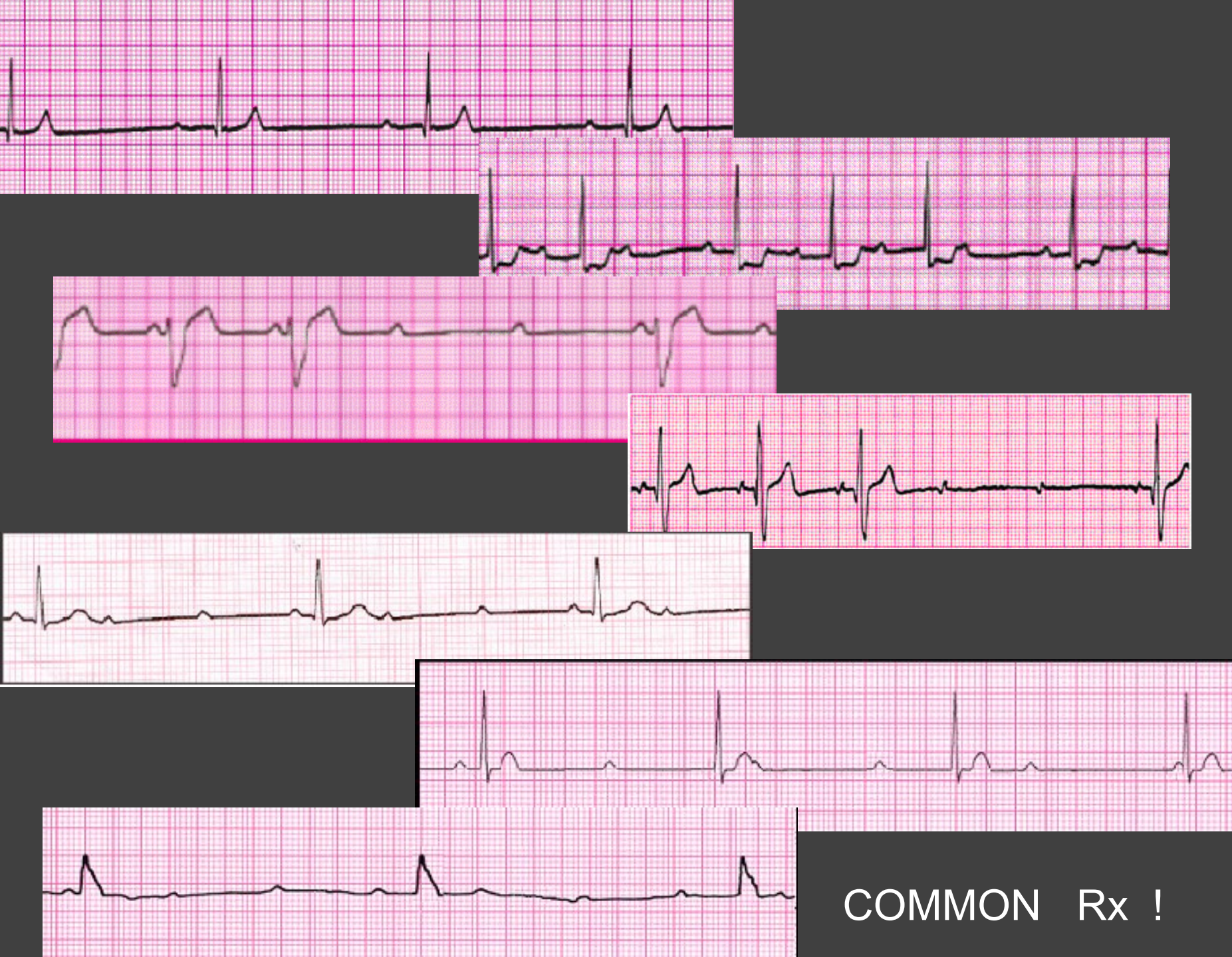
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- 2. QT INTERVAL prolonged (usually not emergent but let Dr. know)**
- 3. 2<sup>nd</sup> degree type II or 3<sup>rd</sup> degree HEART BLOCK**
- 4. SINUS ARREST with periods of ASYSTOLE**







- **SYMPTOMATIC BRADYCARDIAS**
- **HEART BLOCKS with SLOW VENTRICULAR RATES**  
( patient symptomatic )



**Tx:**



**ABC s**



**GENERAL SUPPORTIVE CARE**



**BRADYCARDIA ALGORITHM**

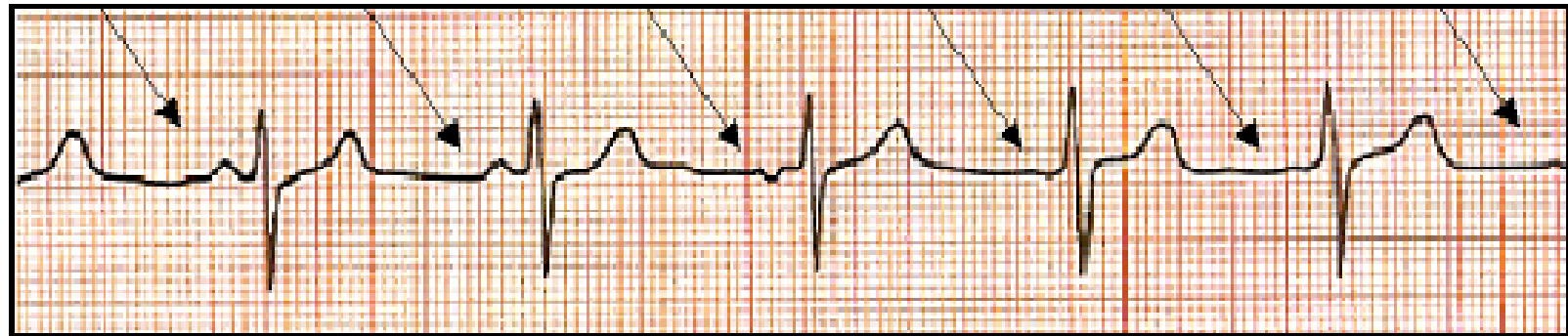
# **SYMPTOMATIC BRADYCARDIA**

- **ABC s + 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**

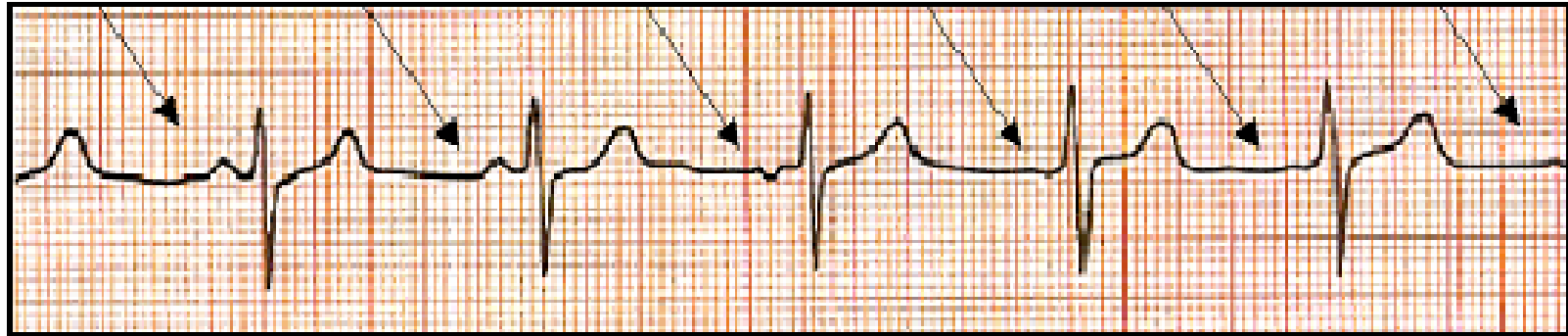
# THIS RHYTHM IS: WANDERING ATRIAL PACEMAKER



**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:**



**MAIN IDENTIFICATION CHARACTERISTIC(S):**

**RATE** -----

**RHYTHM** -----

**P-R INTERVAL** -----

**P: QRS RATIO** -----

**QRS INTERVAL** -----

# THIS RHYTHM IS:     **ATRIAL FIBRILLATION**



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

|                           |                                      |
|---------------------------|--------------------------------------|
| <b>RATE</b> -----         | <b>BRADY, NORMAL, or TACHY</b>       |
| <b>RHYTHM</b> -----       | <b>IRREGULARLY IRREGULAR</b>         |
| <b>P-R INTERVAL</b> ----- | <b>NOT DISCERNABLE</b>               |
| <b>P: QRS RATIO</b> ----- | <b>NOT DISCERNABLE</b>               |
| <b>QRS INTERVAL</b> ----- | <b>NORMAL, (unless BBB present )</b> |

# 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. 2<sup>nd</sup> degree type II or 3<sup>rd</sup> degree HEART BLOCK**
- 4. SINUS ARREST with periods of ASYSTOLE**
- 5. NEW ONSET of any DYSRHYTHMIA**

# **SVT - STABLE PATIENT** ( NARROW QRS )

## **ABC s + GENERAL SUPPORTIVE CARE**

### **REGULAR RHYTHM**

- VAGAL MANEUVERS
- ADENOSINE 6 mg / 12 mg ( 100% )

### **IRREGULAR RHYTHM**

POSSIBLE ATRIAL FIB or  
MULTIFOCAL ATRIAL TACH

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

# **SVT - UNSTABLE PATIENT** ( NARROW QRS )

## **ABC s + 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 -----

## **ATRIAL FIBRILLATION**

### **CRITICAL CONSIDERATION . . . .**

COULD PATIENT HAVE BEEN  
IN A - FIB FOR AT LEAST  
48 HOURS ? \_\_\_\_\_



**YES**

IS PATIENT ON  
ANTICOAGULANTS ? \_\_\_\_\_



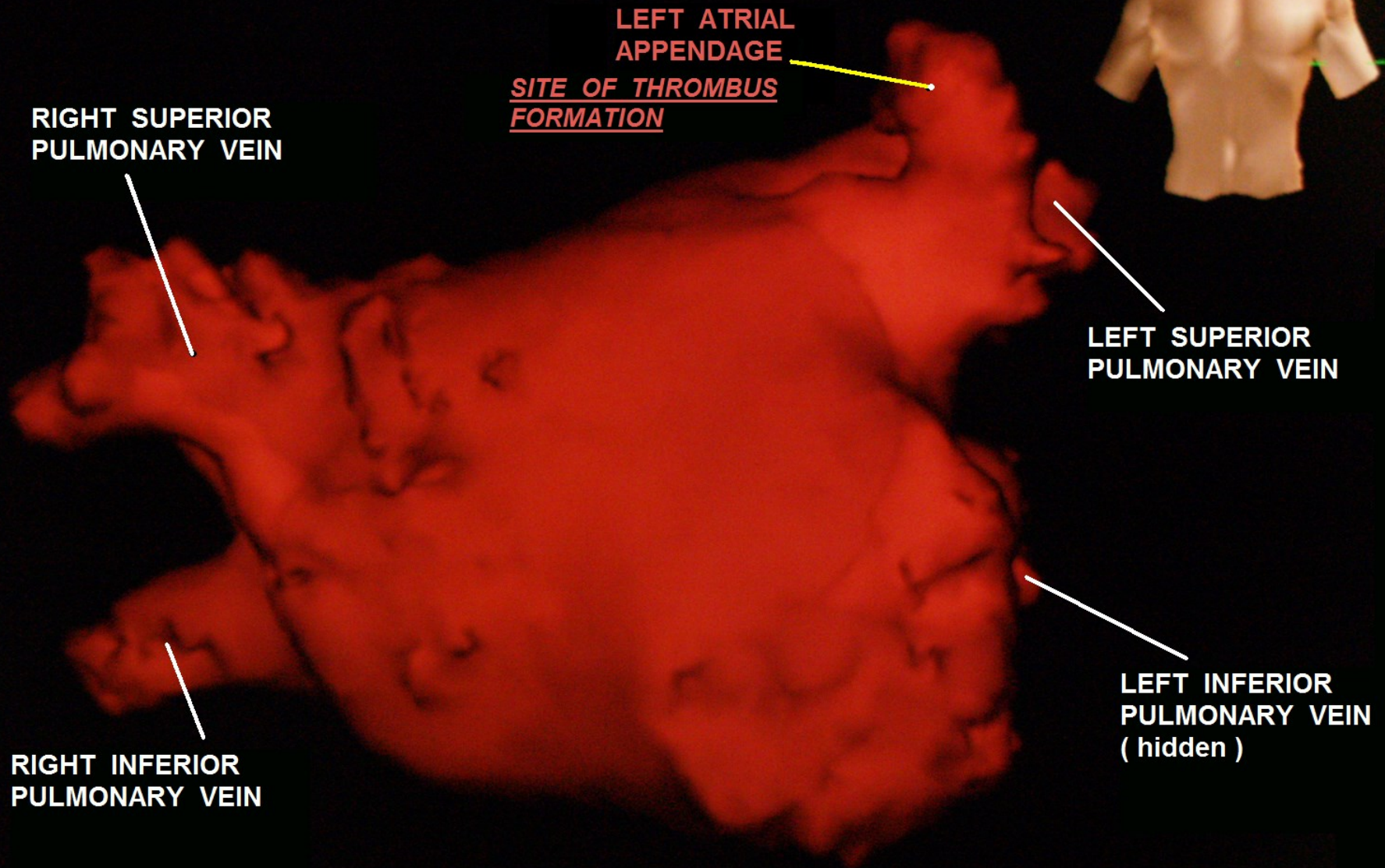
**NO**



**RULE OUT EMBOLUS IN ATRIA  
WITH ECHO / TEE  
BEFORE CONVERTING TO SINUS  
RHYTHM !**

# LEFT ATRIUM

ANTERIOR VIEW





# LEFT ATRIUM

LAO VIEW

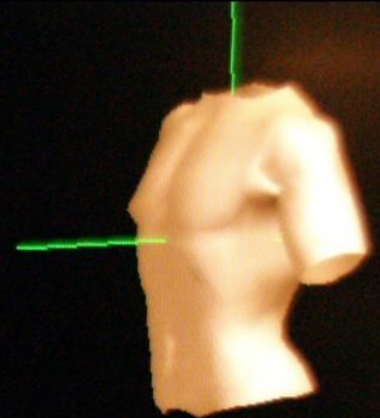
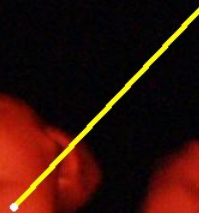
LEFT ATRIAL  
APPENDAGE  
SITE OF THROMBUS  
FORMATION

RIGHT SUPERIOR  
PULMONARY VEIN

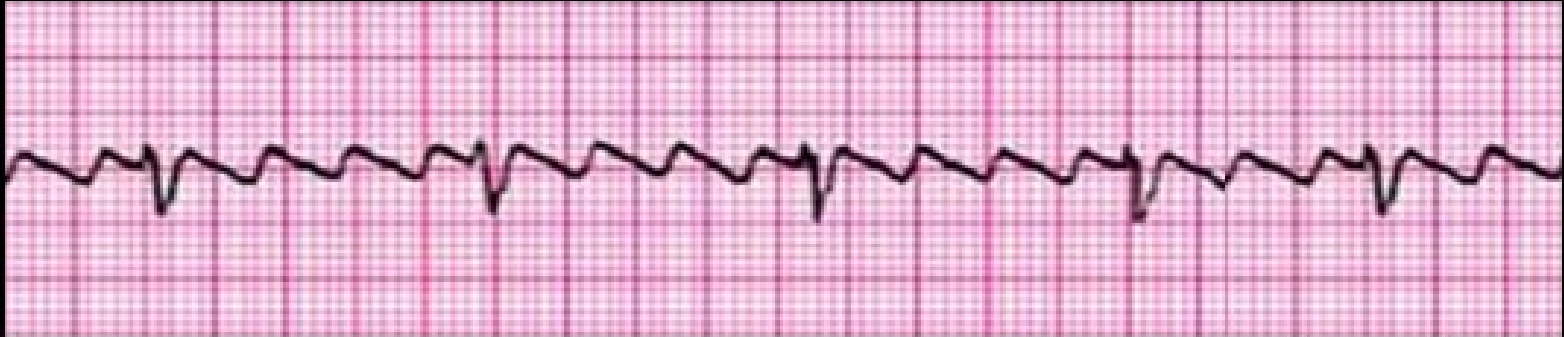
LEFT SUPERIOR  
PULMONARY VEIN

RIGHT INFERIOR  
PULMONARY VEIN  
( hidden )

LEFT INFERIOR  
PULMONARY VEIN



# THIS RHYTHM IS:



## MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE -----

RHYTHM -----

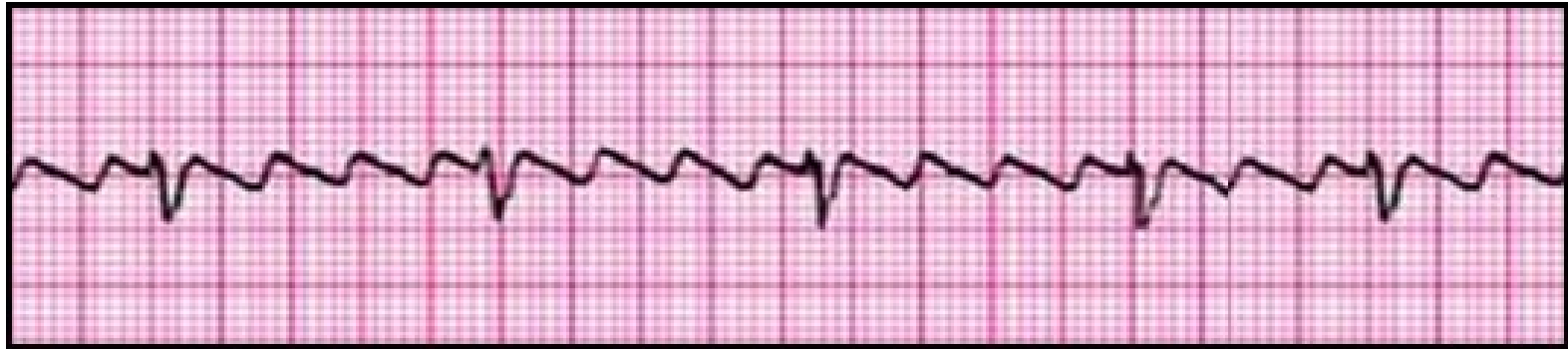
P-R INTERVAL -----

P:QRS RATIO -----

QRS INTERVAL -----



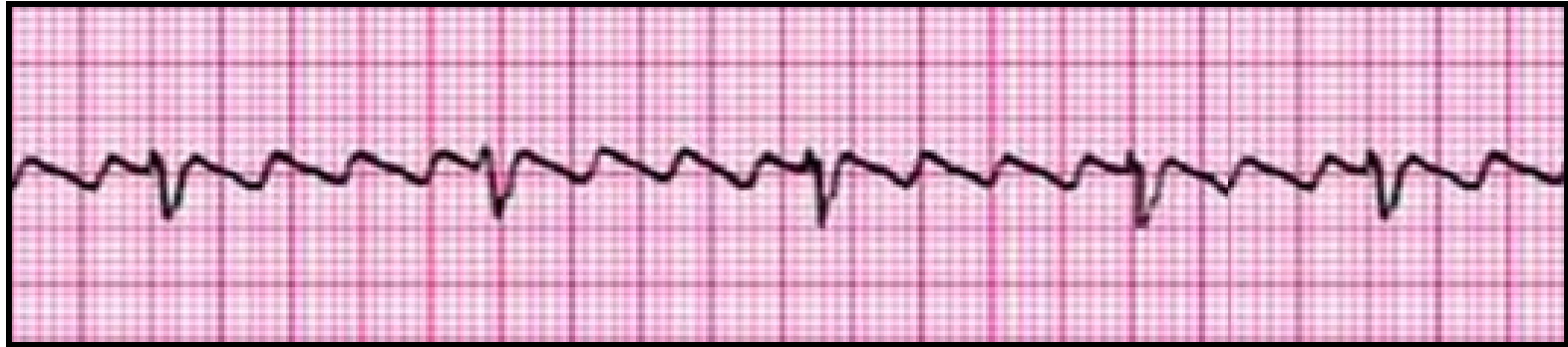
# THIS RHYTHM IS:     ATRIAL FLUTTER



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

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

# 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:

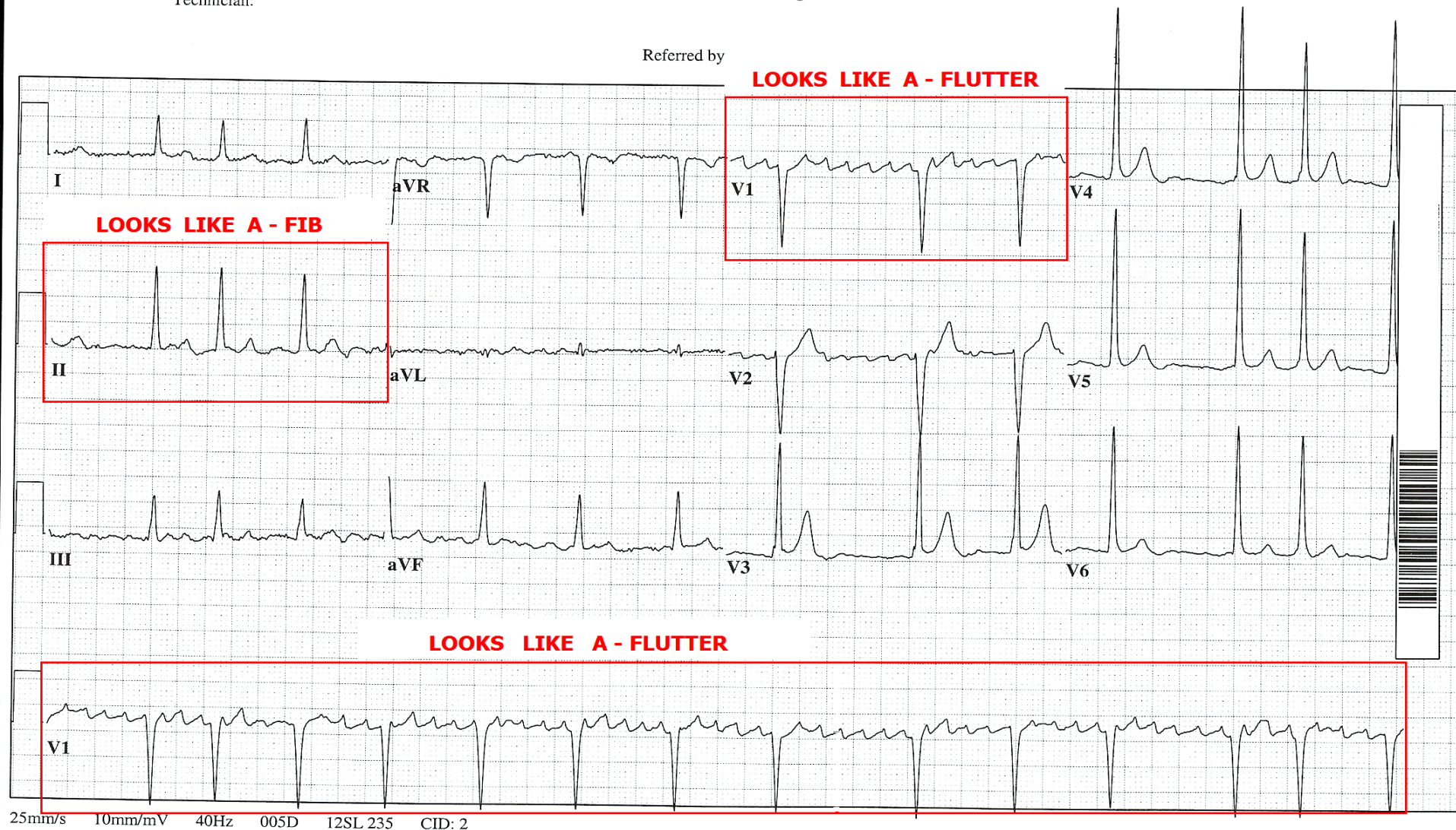
- ☞ TOO SLOW - SYMPTOMATIC BRADYCARDIA ALGORITHM
- ☞ TOO FAST - TACHYCARDIA ALGORITHM

|              |         |     |
|--------------|---------|-----|
| Vent. rate   | 85      | BPM |
| PR interval  | *       | ms  |
| QRS duration | 100     | ms  |
| QT/QTc       | 342/406 | ms  |
| P-R-T axes   | * 58    | 46  |

"\*\*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



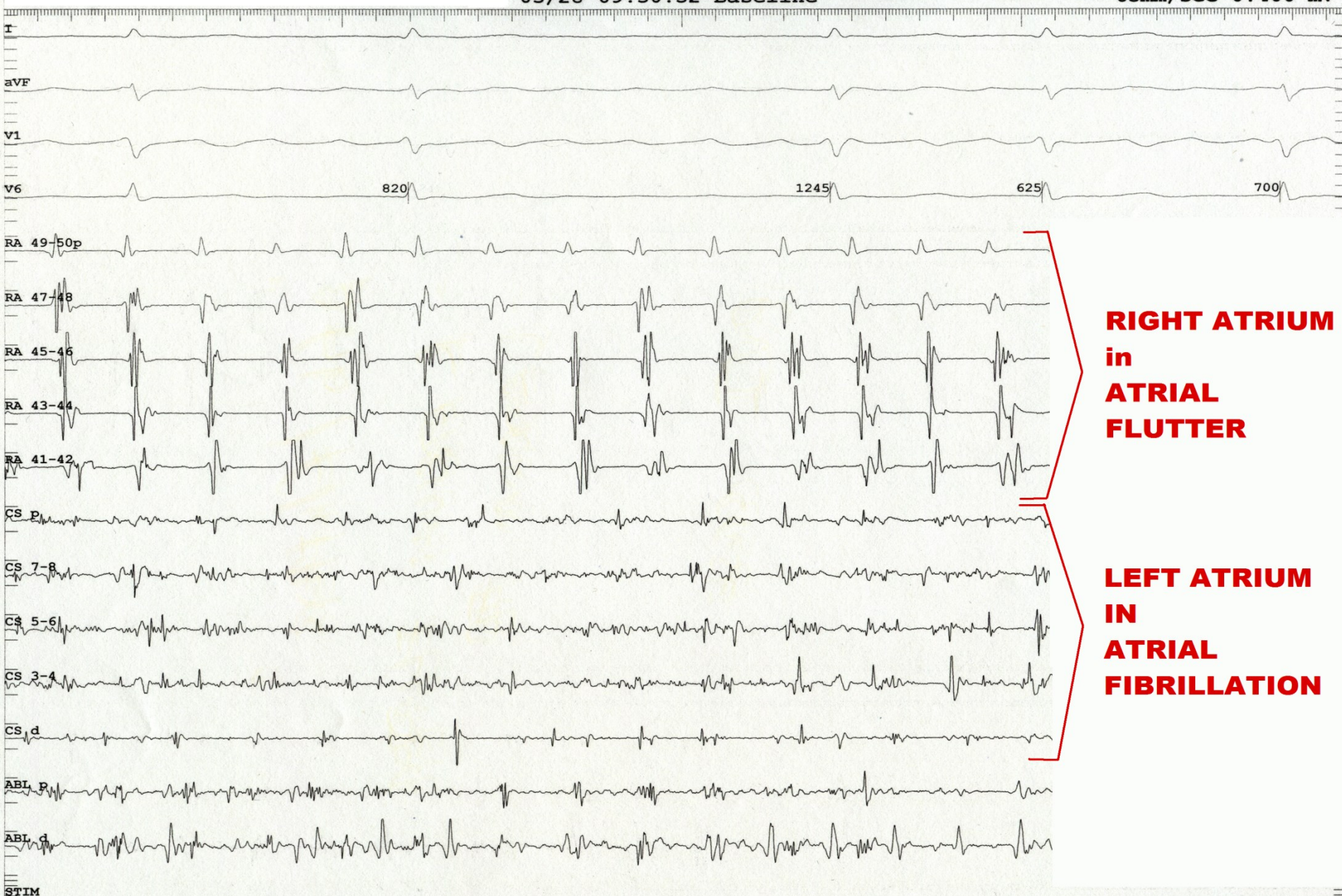


44 y/o FEMALE

# "ATRIAL FIB - FLUTTER"

03/28 09:30:52 Baseline

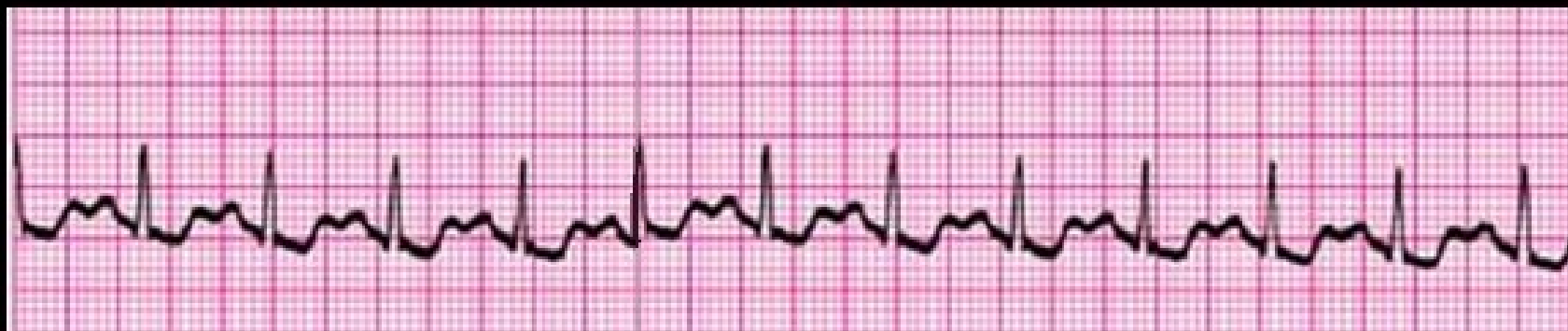
63mm/sec 0.400 mV



**RIGHT ATRIUM  
in  
ATRIAL  
FLUTTER**

**LEFT ATRIUM  
IN  
ATRIAL  
FIBRILLATION**

**THIS RHYTHM IS:**



**MAIN IDENTIFICATION CHARACTERISTIC(S):**

**RATE** -----

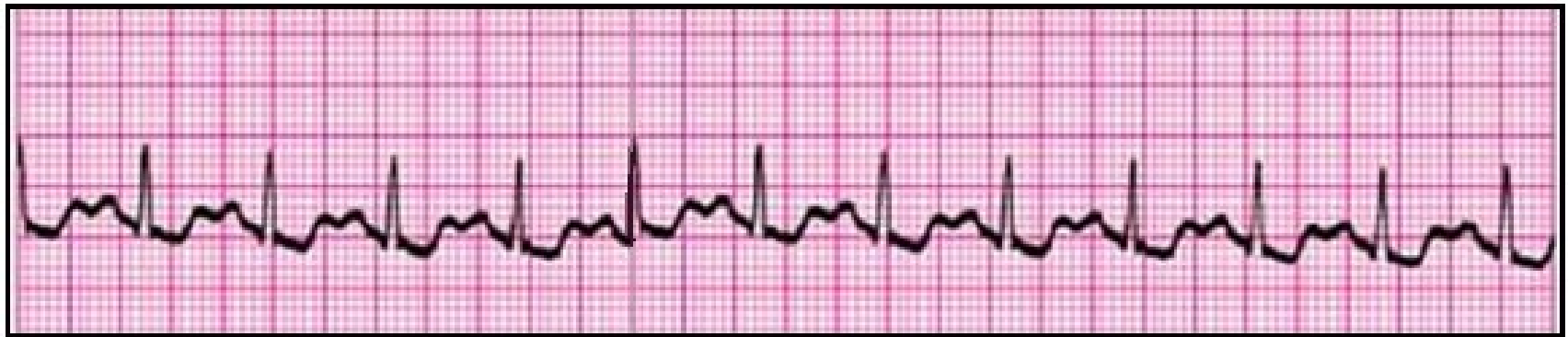
**RHYTHM** -----

**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 )**

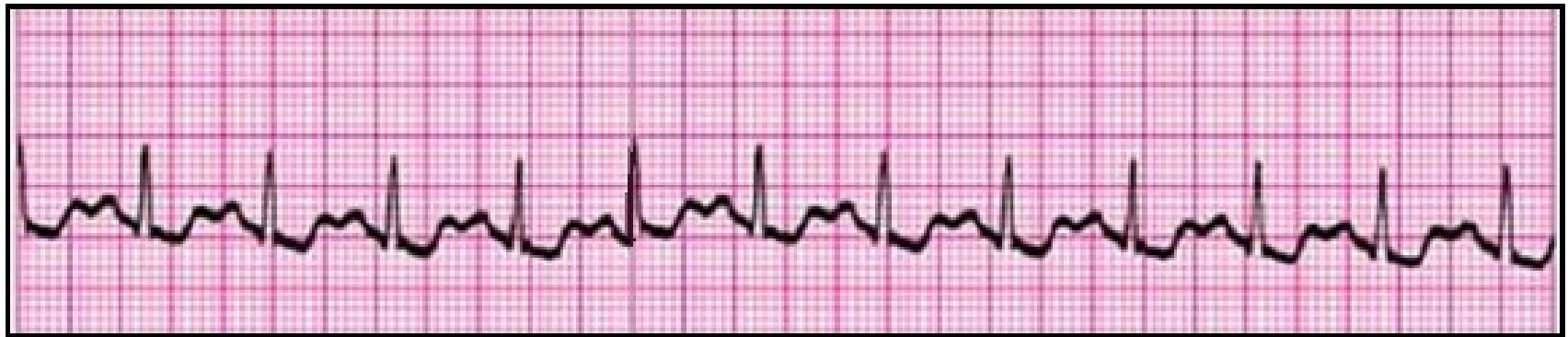
RHYTHM ----- **REGULAR**

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



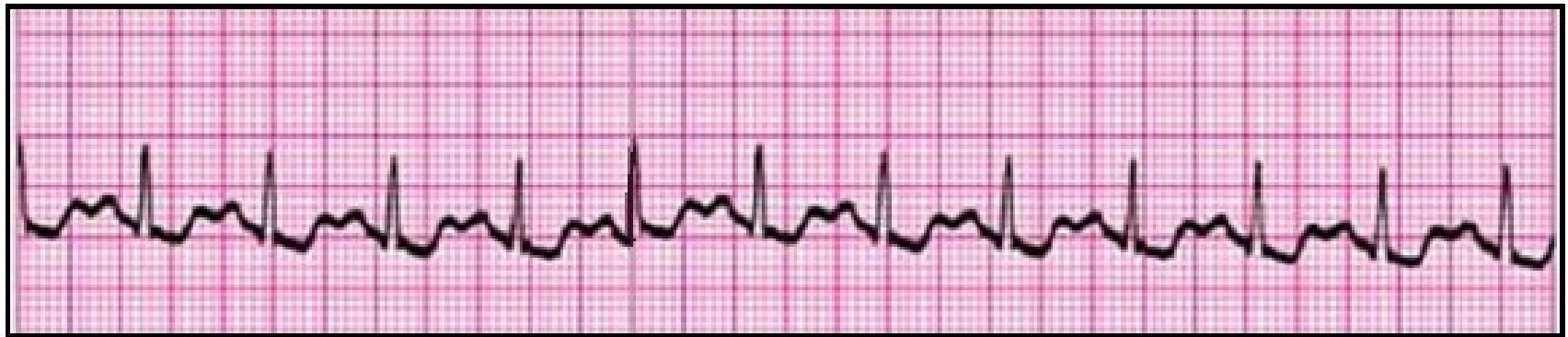
MAIN IDENTIFICATION CHARACTERISTIC(S): **SINUS RHYTHM, RATE HIGHER THAN 100. (ACLS guidelines: heart rate 100 - 150 )**

## 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



## **WE MUST CONSIDER UNDERLYING CAUSES:**

**ANXIETY / FEAR**



**HYPOVOLEMIA**

**DEHYDRATION**



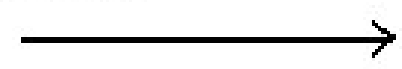
**BLOOD LOSS**



**MEDICATION EFFECTS**



**OTHER ILLNESS**



## **AND TREAT THEM:**

**CALM PATIENT**

**FLUIDS**

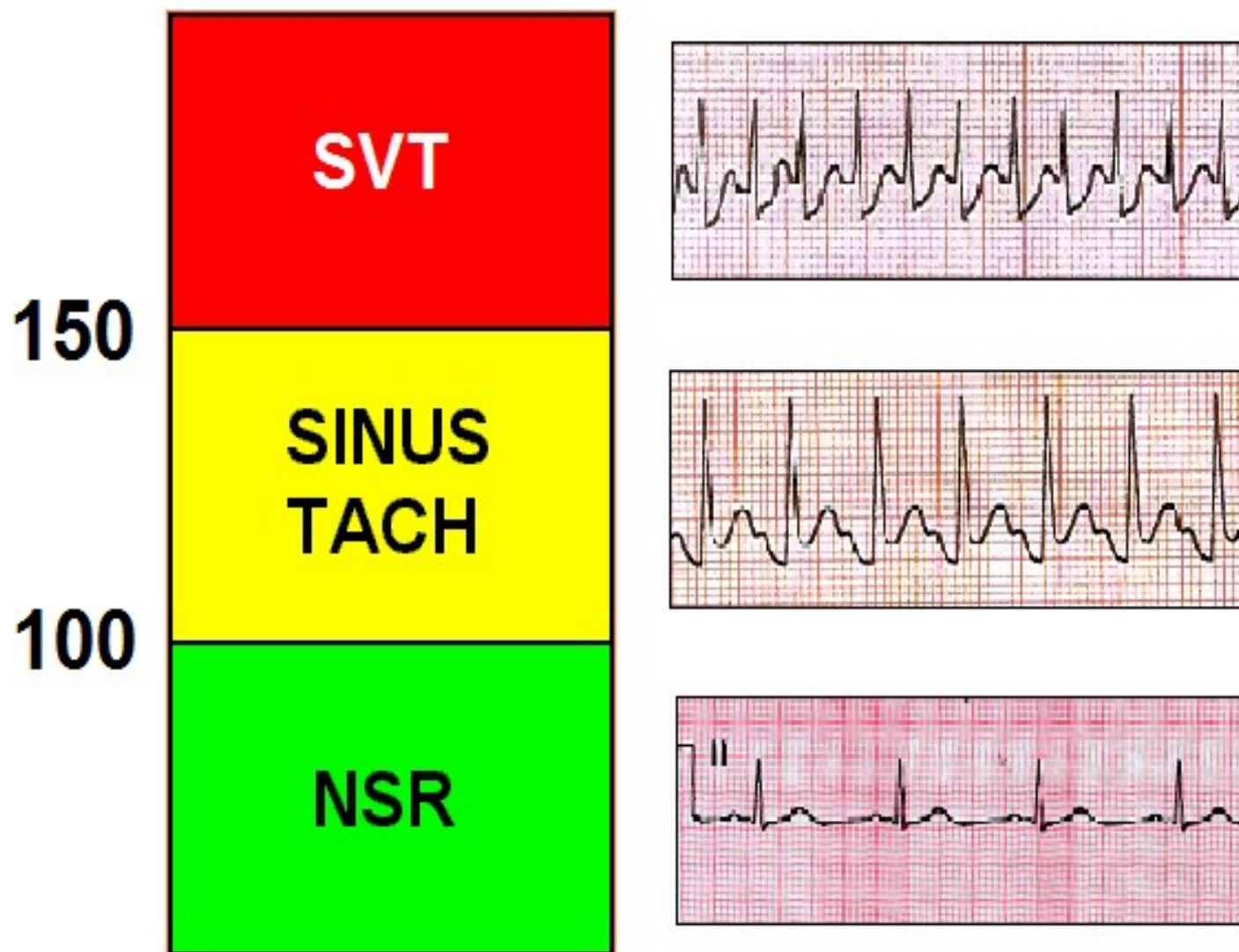
**STOP BLEEDING**

**CONSIDER MEDICAL Tx**

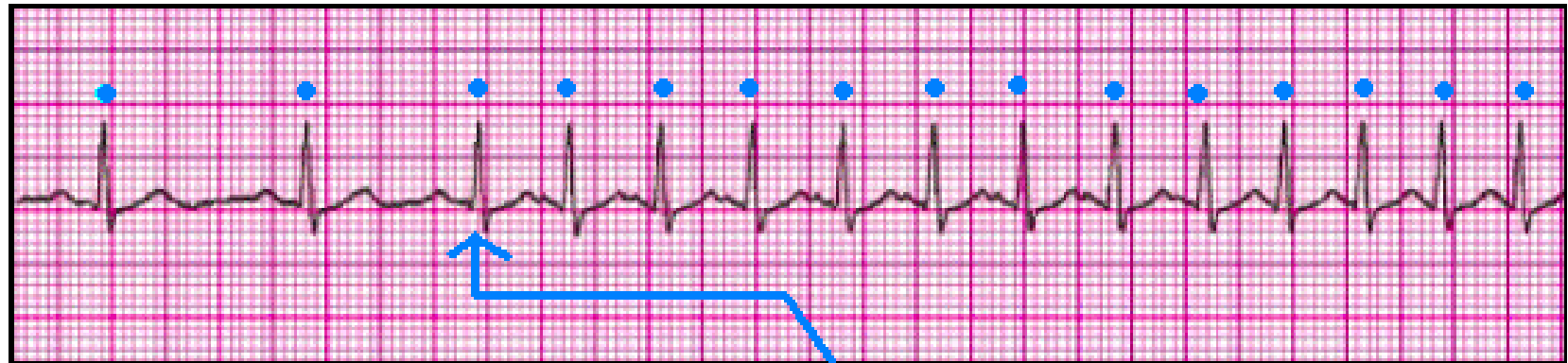
**IDENTIFY & Tx DISORDER**



# ACLS TACHYCARDIA GUIDELINES



# RHYTHM CLUES . . . .

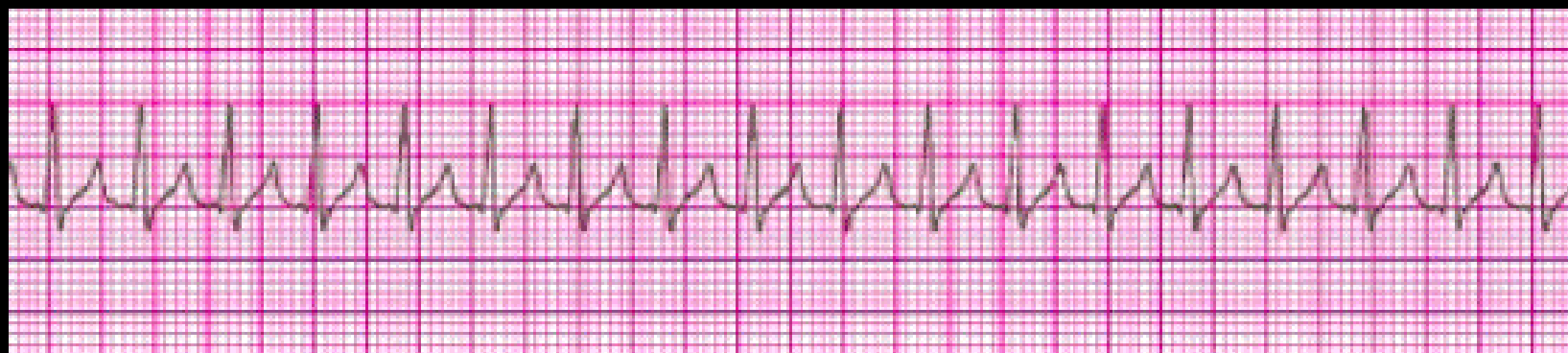


**SUPRAVENTRICULAR TACHYCARDIA**

**SVT is usually PAROXYSMAL -- ie: 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 \_\_\_\_\_

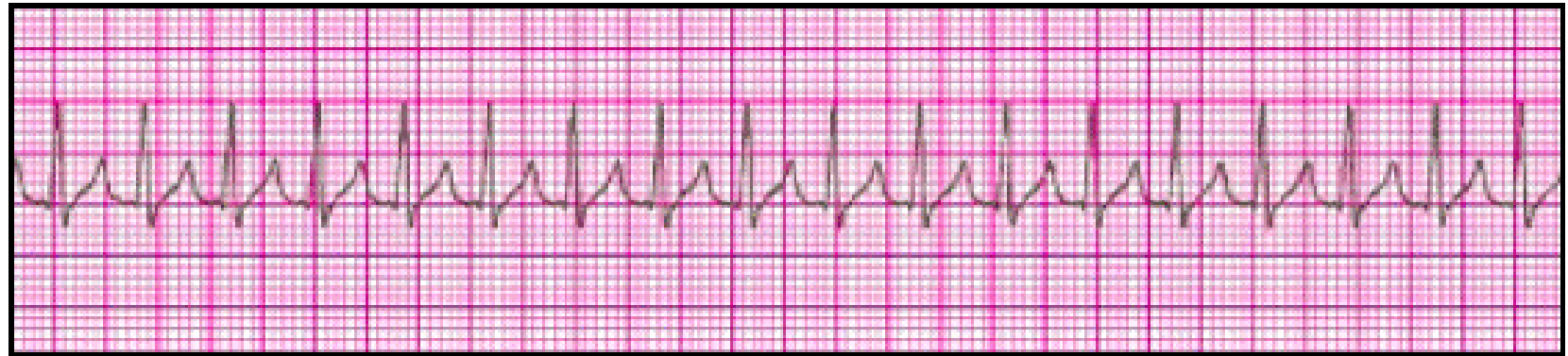
RHYTHM \_\_\_\_\_

P-R INTERVAL \_\_\_\_\_

P:QRS RATIO \_\_\_\_\_

QRS INTERVAL \_\_\_\_\_

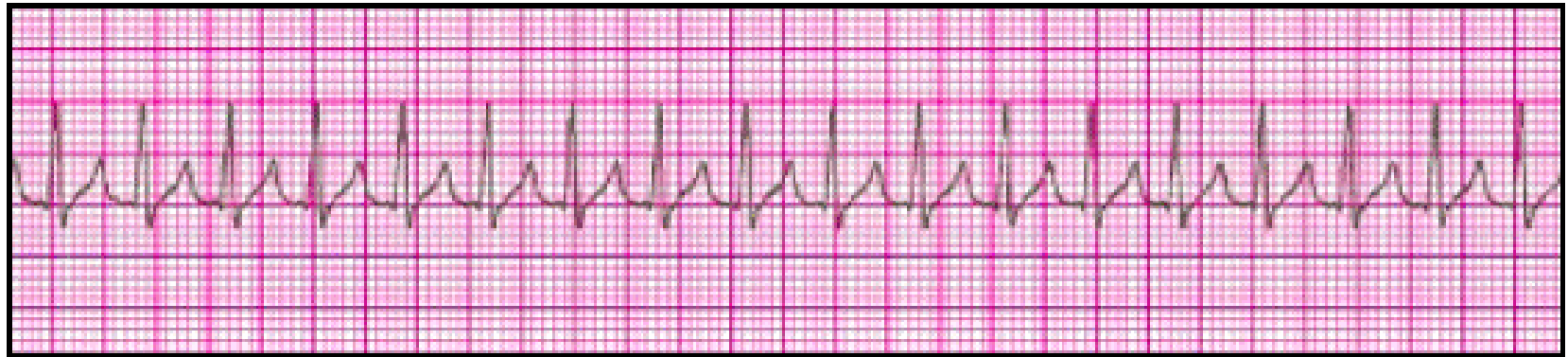
# THIS RHYTHM IS: SUPRAVENTRICULAR TACHYCARDIA (SVT)



**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 -----         | <b>TACHYCARDIC (usually <math>&gt; 150</math>)</b>      |
| RHYTHM -----       | <b>REGULAR</b>  |
| P-R INTERVAL ----- | <b>NORMAL or ABNORMAL. MAY BE IMPOSSIBLE TO SEE DUE</b> |
| P:QRS RATIO -----  | <b>1:1 TO P WAVE BURIED IN T WAVES</b>                  |
| QRS INTERVAL ----- | <b>NORMAL</b>   |

# THIS RHYTHM IS: SUPRAVENTRICULAR TACHYCARDIA (SVT)

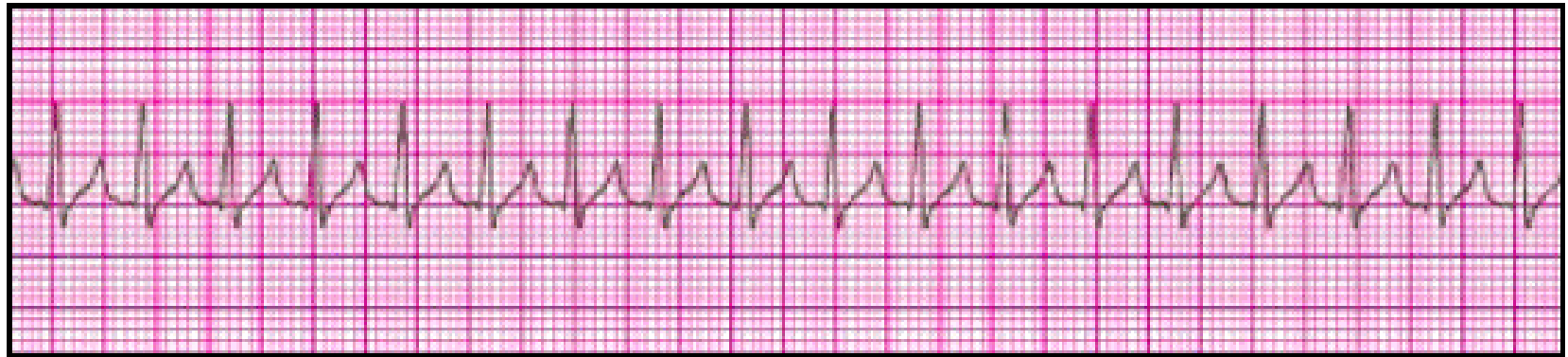


**MAIN IDENTIFICATION CHARACTERISTIC(S):** HEART RATE TOO FAST, USUALLY  $> 150$ . P WAVES MAY BE "BURIED" IN THE PRECEDING T WAVES. Pt USUALLY C/O "SUDDEN ONSET of HEART RACING," or "PALPITATIONS."

## POTENTIAL PROBLEMS:

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

## **ABC s + 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

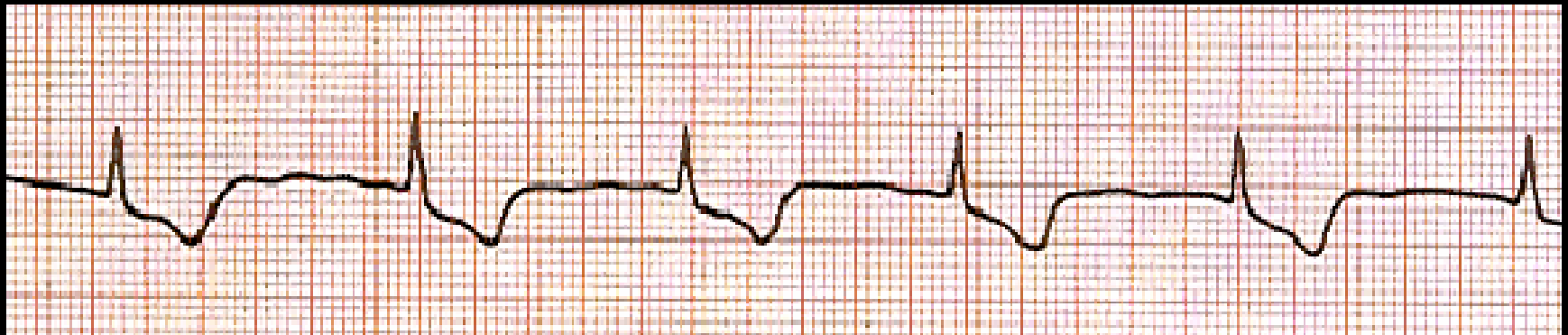
### **IRREGULAR RHYTHM**

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 -----

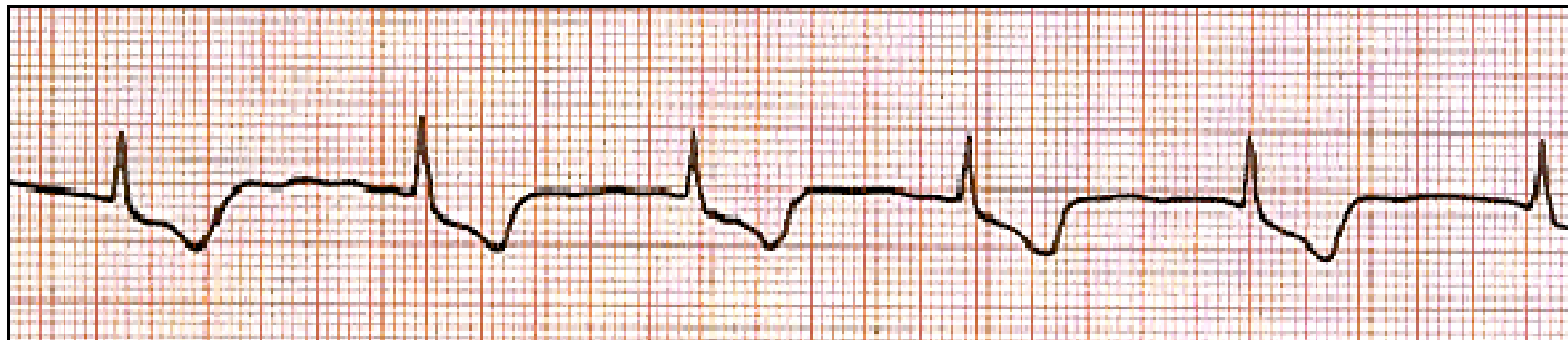
RHYTHM -----

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-T seg) or JUST BEFORE QRS (short P-R). WHEN P wave

seen, it is INVERTED (upside-down).

- HR USUALLY 40 -60

**RATE** ----- 40 -60

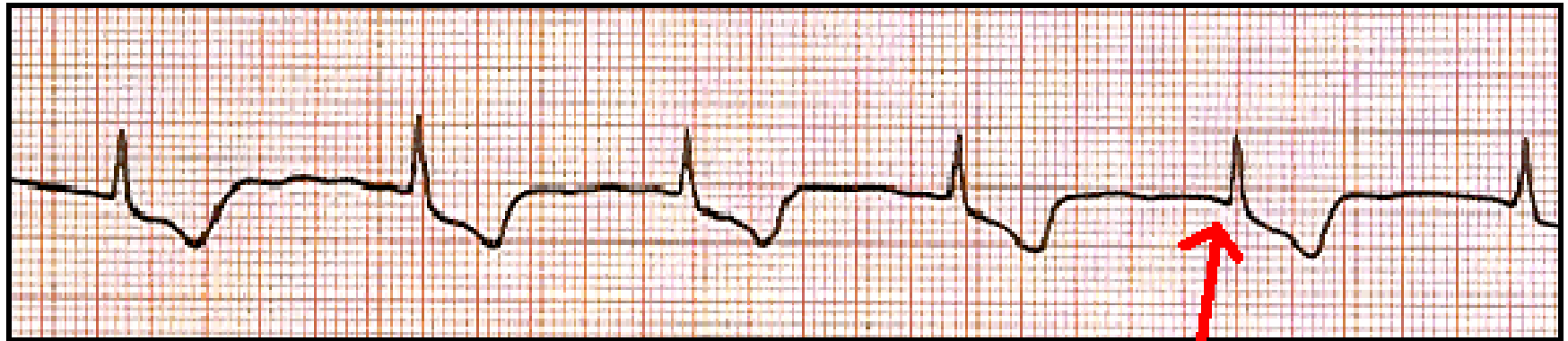
**RHYTHM** ----- REGULAR

**P-R INTERVAL** ----- ABSENT or SHORT

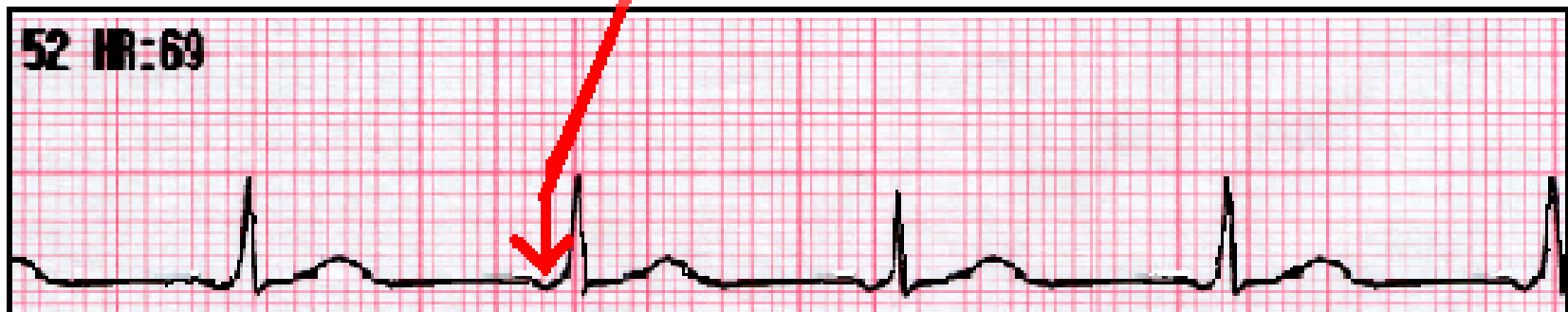
**P:QRS RATIO** ----- 1:1

**QRS INTERVAL** ----- NORMAL

# THIS RHYTHM IS: JUNCTIONAL RHYTHM



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



# THIS RHYTHM IS: JUNCTIONAL RHYTHM



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

- HR USUALLY 40 - 60

## 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-T seg) 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 SLOW . . . .

## WE MUST CONSIDER UNDERLYING CAUSES:

INCREASED VAGAL TONE —————→

BLOCKED SA NODAL ARTERY —————→  
(ACUTE INFERIOR MI ?)

ELECTROLYTE IMBAL. (K+) —————→

## AND TREAT THEM:

ATROPINE

CARDIAC CATH - PTCA / STENT  
THROMBOLYTICS

CORRECT ELECTROLYTES

# 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

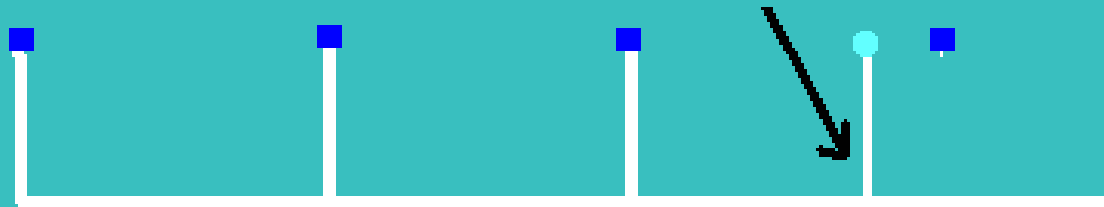
- ATRIAL
- JUNCTIONAL
- VENTRICULAR



# CLASSIFICATIONS OF ECTOPY

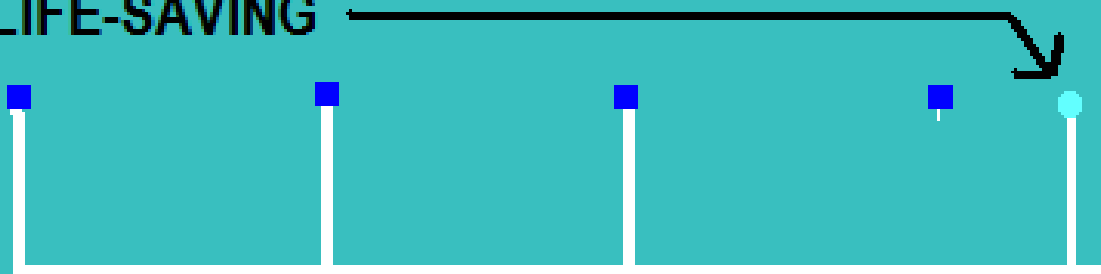
## 1. PREMATURE

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 PROPOGATE 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

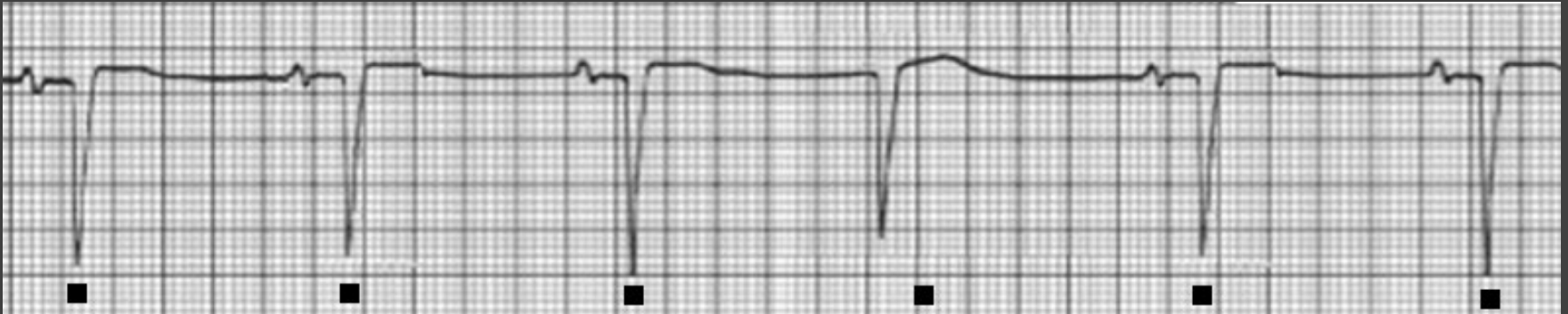
## 2. END-DIASTOLIC or ESCAPE BEATS ----

**GOOD**

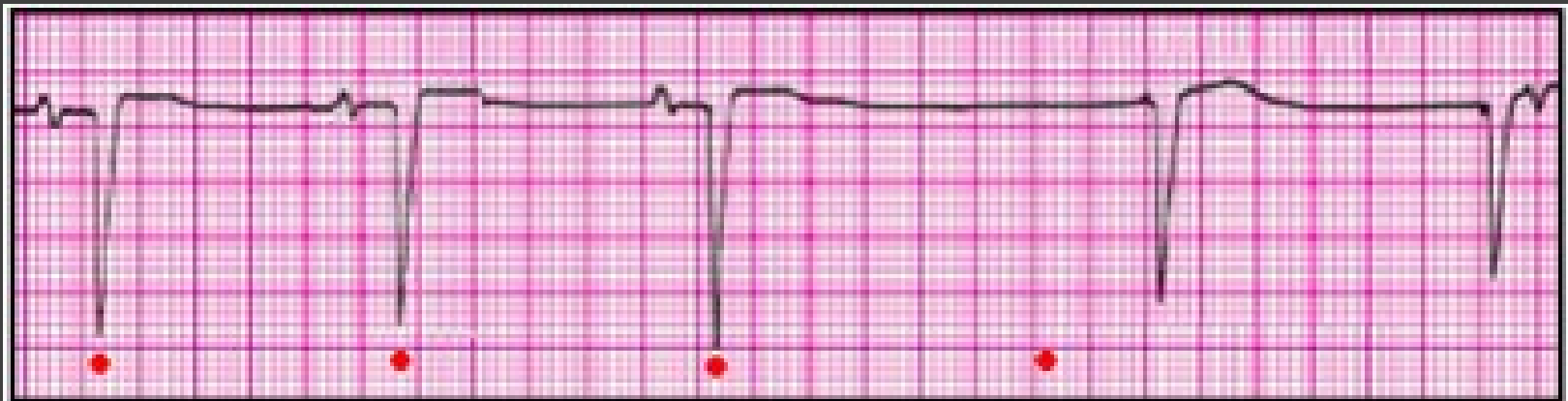


ELIMINATION OF END-DIASTOLIC  
BEATS COULD BE DEADLY

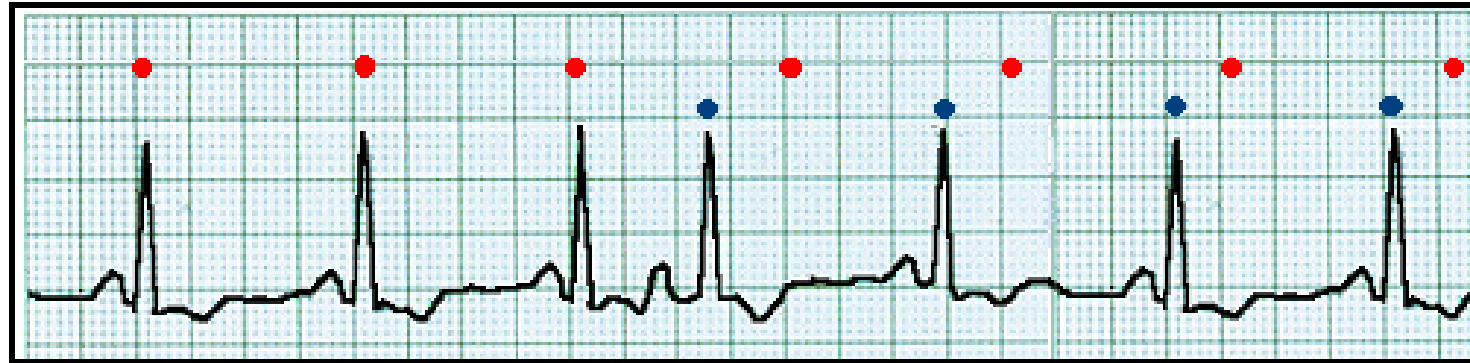
# Premature



# 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**

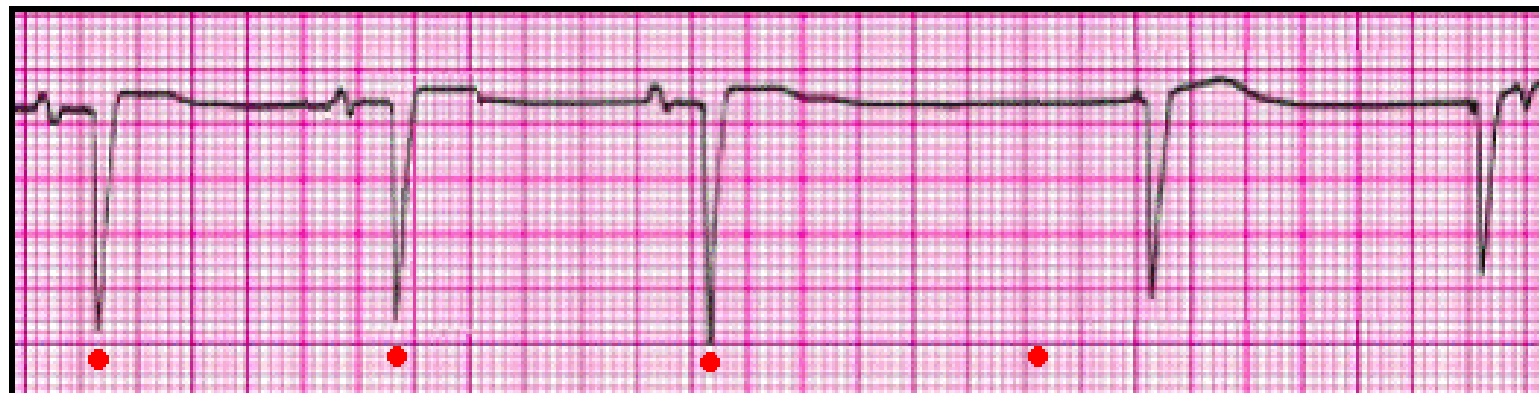
**RHYTHM** ----- **IRREGULAR**

**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 -----

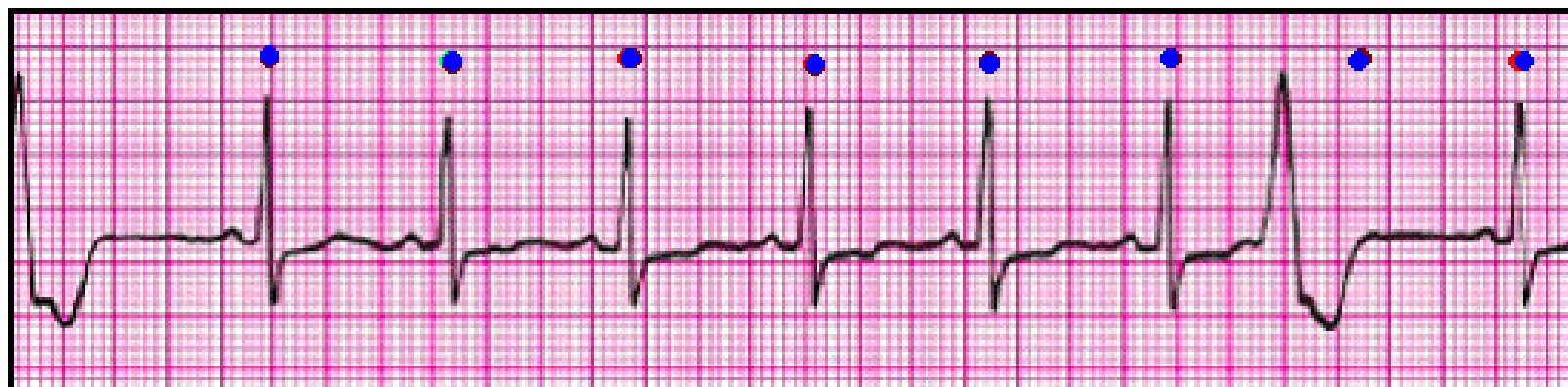
RHYTHM -----

P-R INTERVAL -----

P:QRS RATIO -----

QRS INTERVAL -----

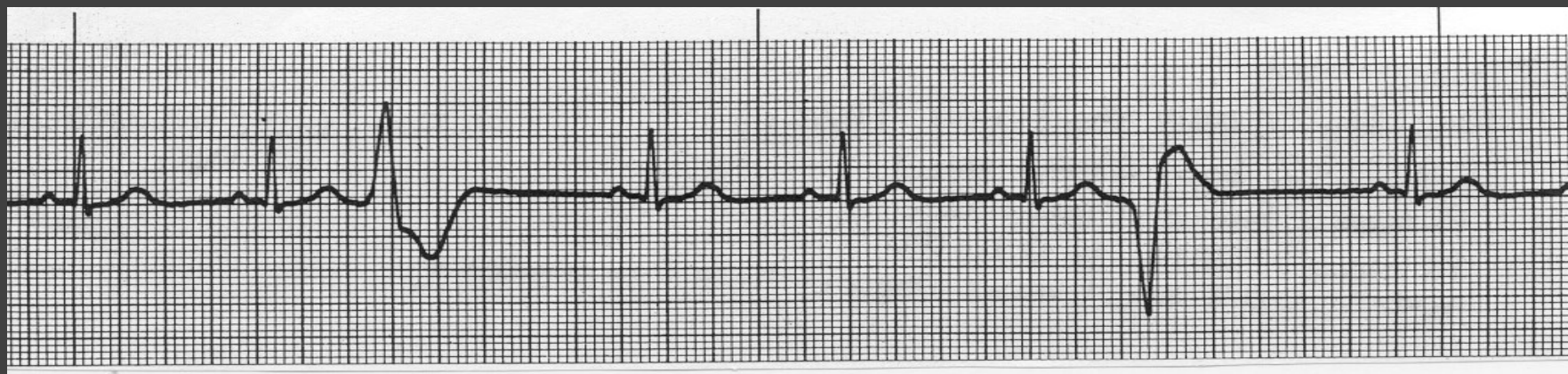
## THIS RHYTHM IS: NSR with UNIFOCAL PVCs



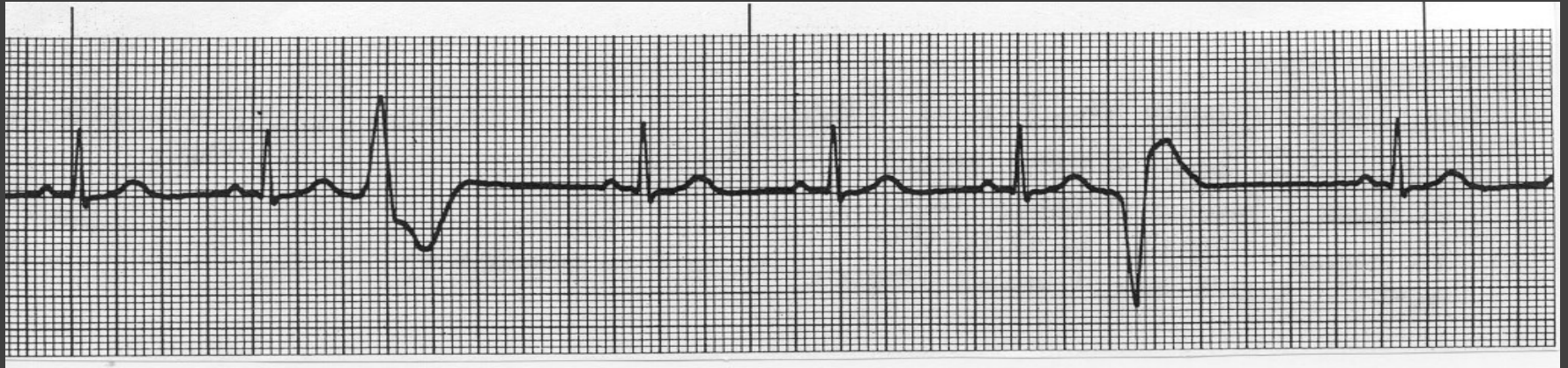
MAIN IDENTIFICATION CHARACTERISTIC(S): **ECTOPIC BEATS ARE PREMATURE, AND WIDE ( $> 120$  ms); COMPLEXES MAY BE OF ANY SHAPE or DEFLECTION, BUT ALL HAVE SAME APPEARANCE; THERE IS A COMPENSATORY PAUSE**

|                    |   |
|--------------------|---|
| 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



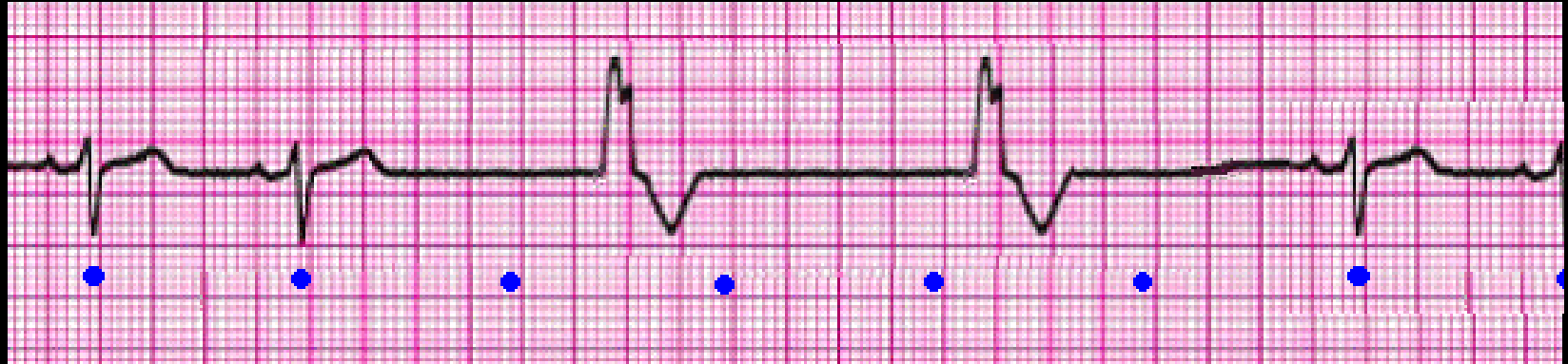
# **-- CRITICAL ECG ALERT --**

**-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<sup>nd</sup> degree type II or 3<sup>rd</sup> 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 -----

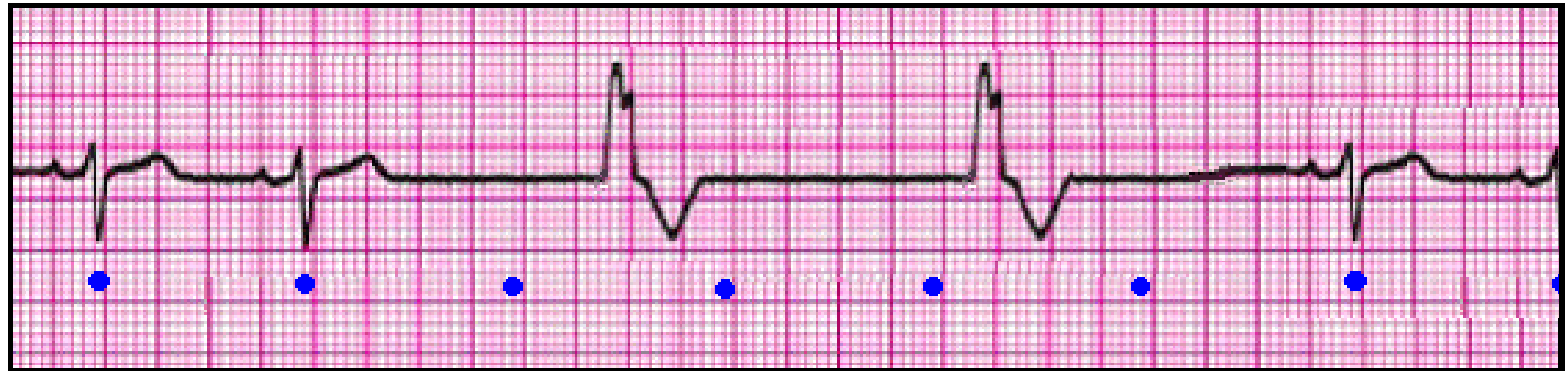
RHYTHM -----

P-R INTERVAL -----

P:QRS RATIO -----

QRS INTERVAL -----

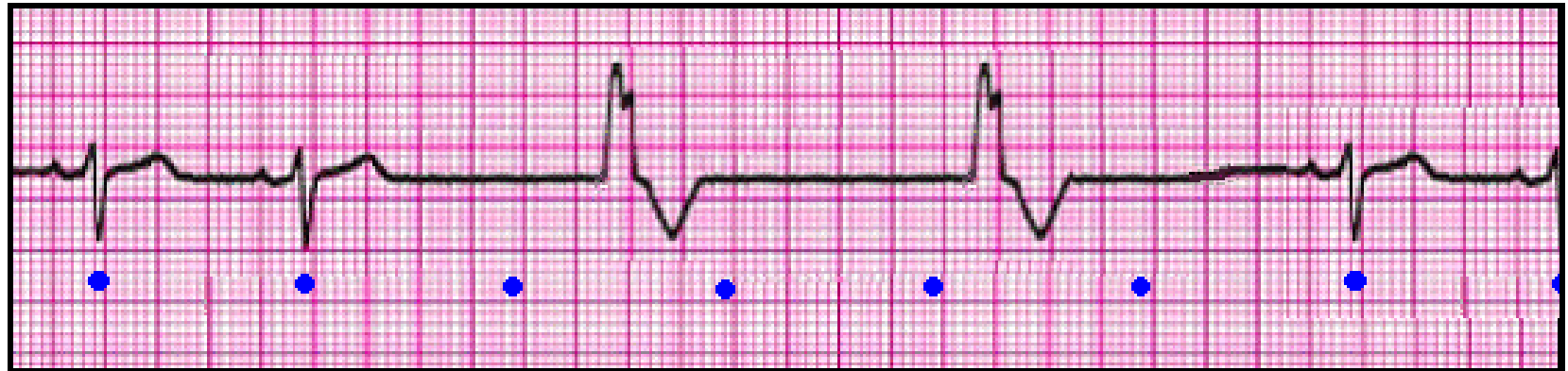
# THIS RHYTHM IS: SINUS ARREST w/ VENT. ESCAPE



**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

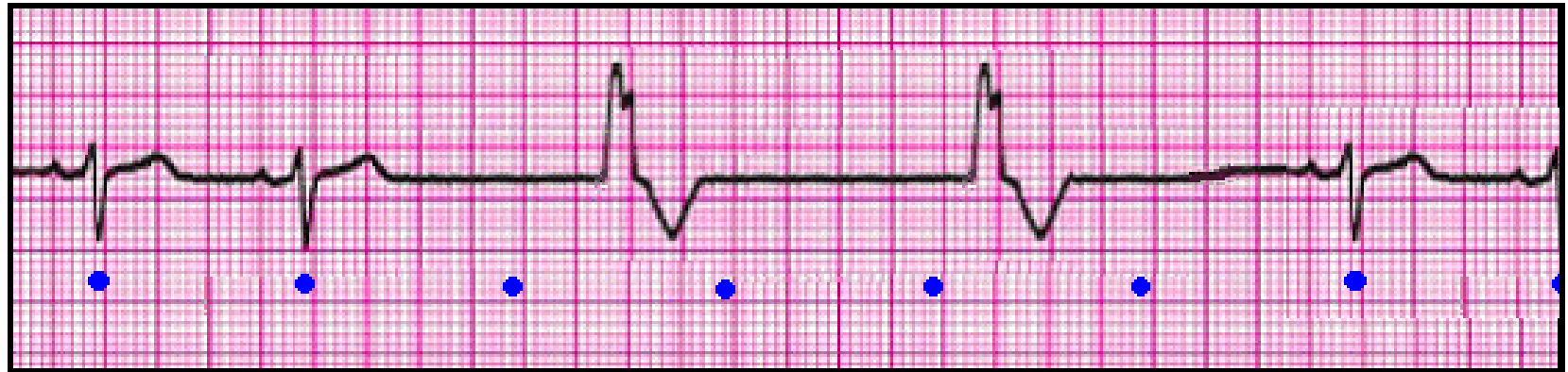


MAIN IDENTIFICATION CHARACTERISTIC(S): **END DIASTOLIC (ESCAPE) BEAT(S); COMPLEXES WIDER THAN 120 ms ; MAY BE UNIFOCAL or MULTIFOCAL; MAY or MAY NOT HAVE GOOD PULSE w/ COMPLEXES**

## PRESENTING PROBLEM(S):

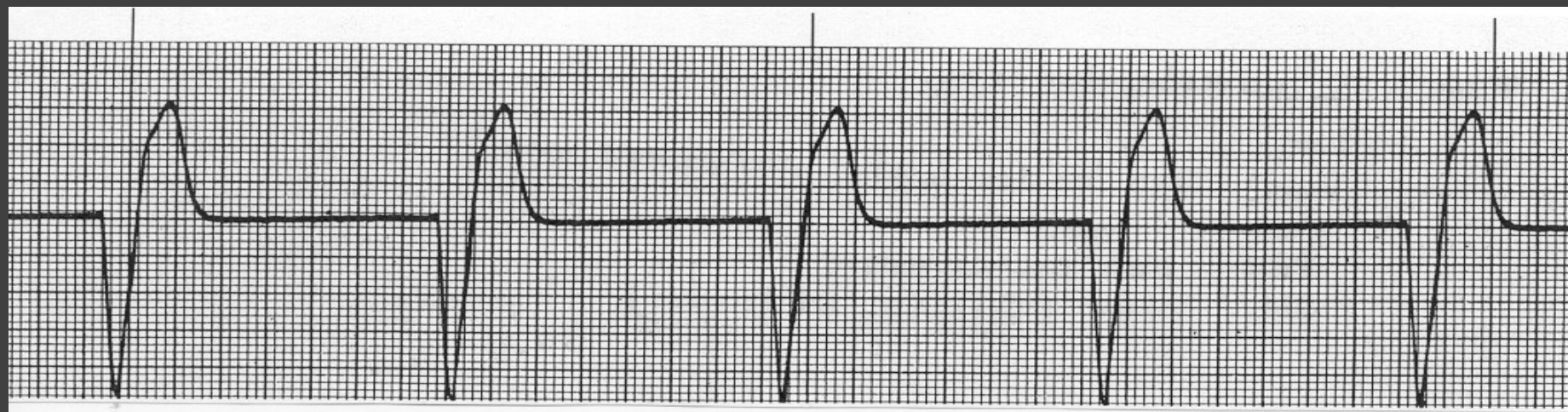
- **PROBLEM IS WITH UNDERLYING REASON WHY SINUS NODE and AV NODE HAVING PERIODS OF ARREST.**
- **THE VENTRICULAR ESCAPE COMPLEXES MAY BE VERY SLOW, BUT MAY BE ONLY THING KEEPING PATIENT PERFUSED DURING PERIODS OF SINUS/AV ARREST.**

## THIS RHYTHM IS: SINUS ARREST w/ VENT. ESCAPE



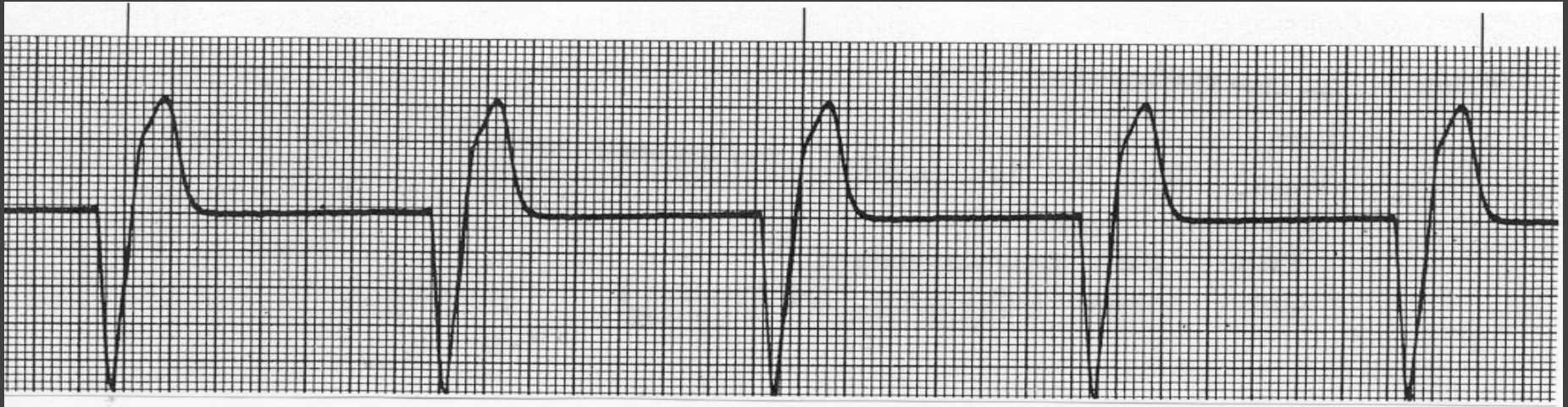
### TREATMENT / INTERVENTION (S):

- 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)



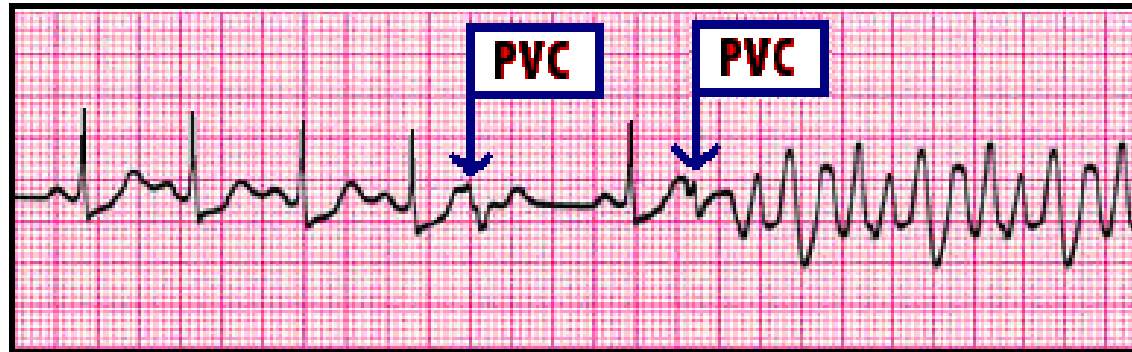
**No P waves**

**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

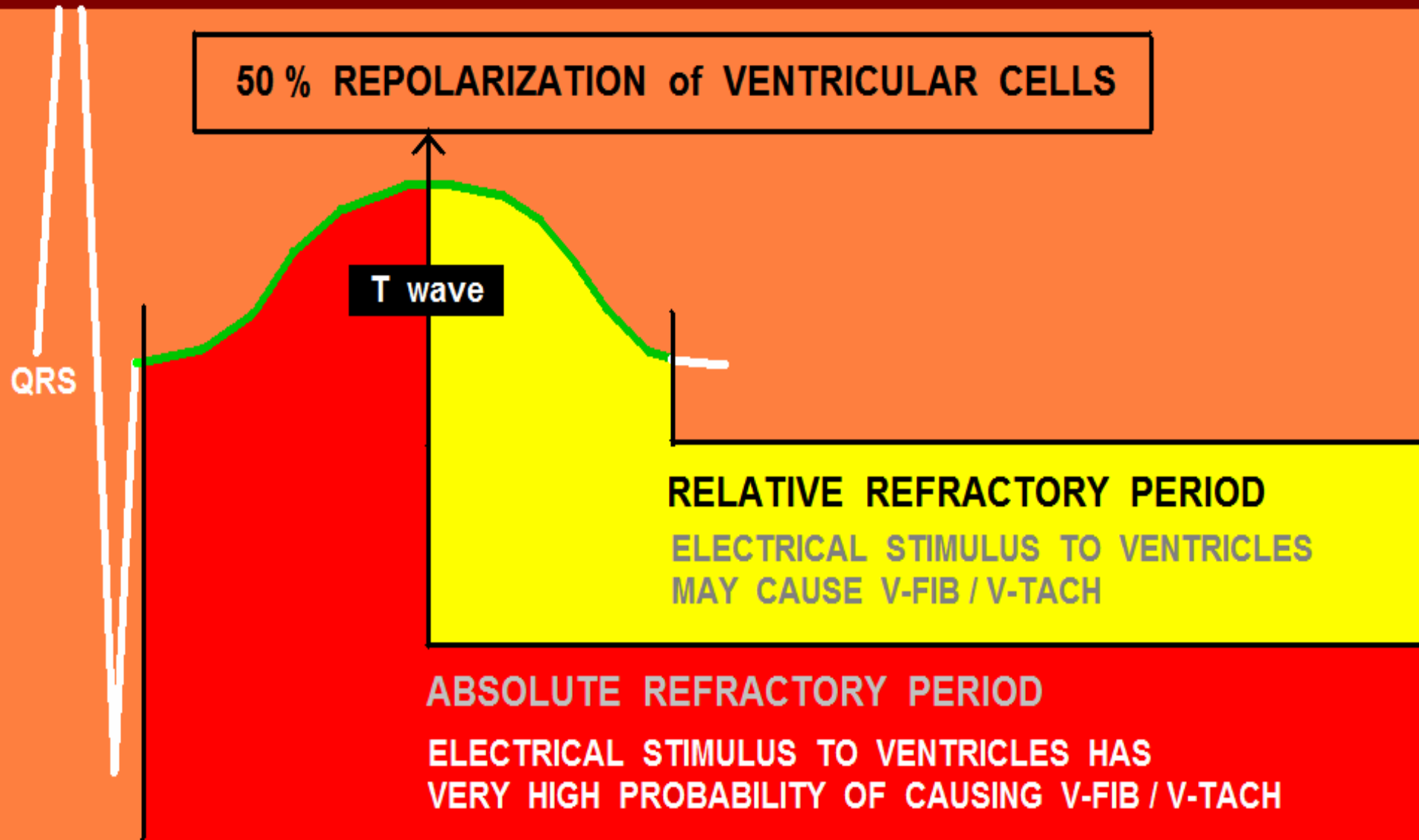


MAIN IDENTIFICATION CHARACTERISTIC(S): **ECTOPIC BEATS ARE WIDE ( $> 120$  ms); ALL APPEAR TO HAVE SAME SHAPE and DEFLECTION ; THERE IS A COMPENSATORY PAUSE**

### 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

# CARDIAC ANATOMY and PHYSIOLOGY "101"



# THIS RHYTHM IS: NSR w/ COUPLET and RUN of V-TACH

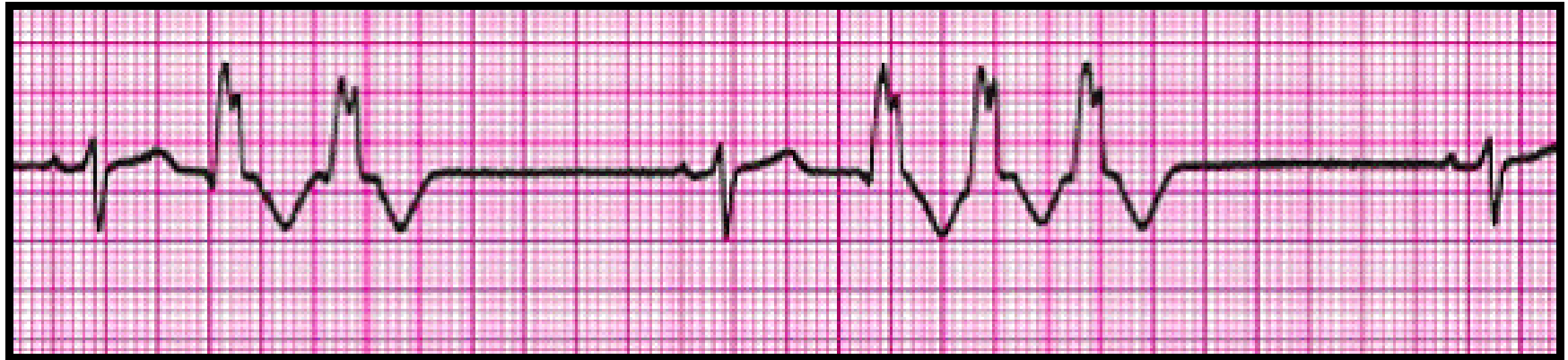


**MAIN IDENTIFICATION CHARACTERISTIC(S):** ECTOPIC BEATS ARE WIDE ( $> 120$  ms); PVCs ARE COUPLED TOGETHER (2 = "COUPLET"), (3 or more = RUN OF V-TACH)

## 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

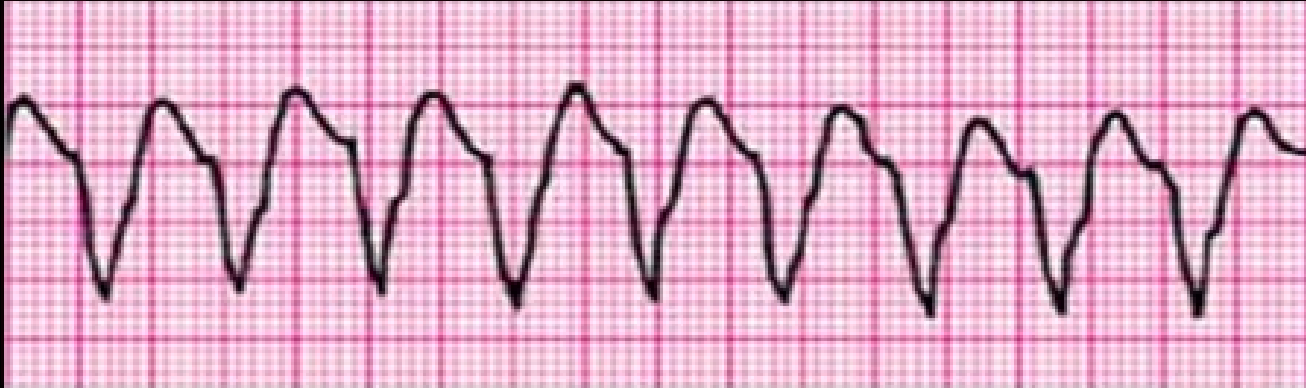
# **THIS RHYTHM IS: NSR w/ COUPLET and **RUN OF V-TACH****



## **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** -----

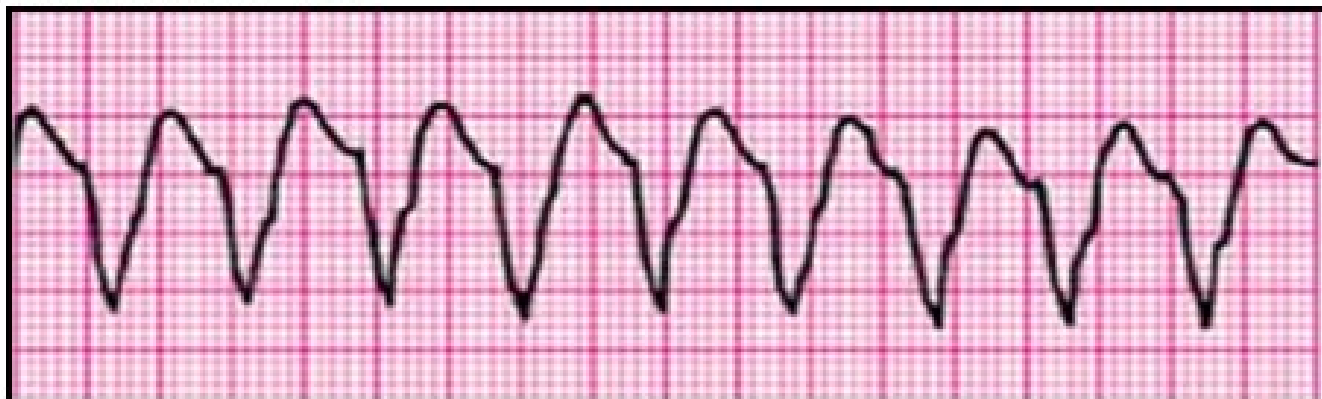
**RHYTHM** -----

**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<sup>nd</sup> degree type II or 3<sup>rd</sup> 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 &gt; 120 ms)

**MONOPHASIC****ABCs****NO PULSE**

**GO TO  
V-FIB  
ALGORITHM !**

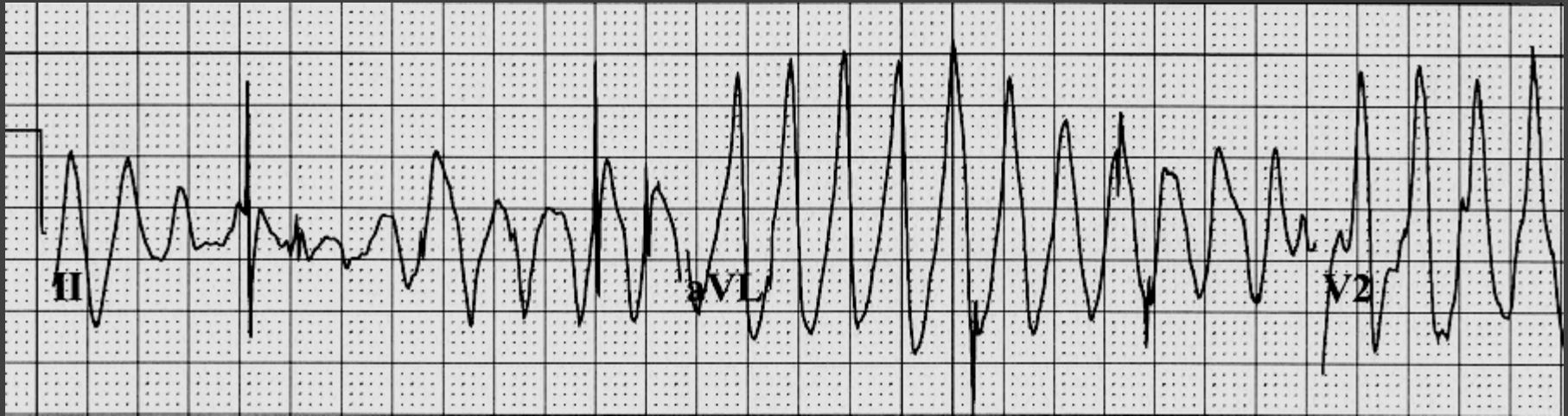
**PULSE - UNSTABLE**

- IMMEDIATE SYNC. CARDIOVERSION:
  - 100 j biphasic
  - consider sedation
- INCREASE joules
- MEDS:
  - PROCAINAMIDE
  - AMIODARONE

**PULSE - STABLE**

- O2, IV-IO, EKG
- MEDS:
  - ADENOSINE 6-12-12 (only if REGULAR)
  - PROCAINAMIDE (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**

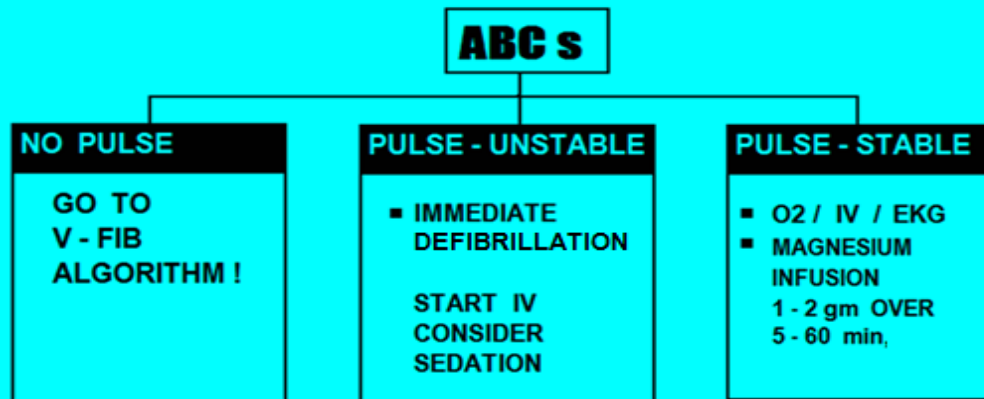
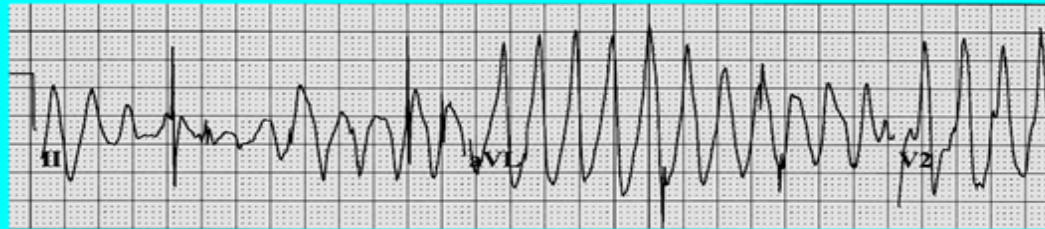
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- 8. TORSADES de POINTES**

# WIDE COMPLEX TACHYCARDIA

## TORSADES de POINTES

( QRS > 120 ms )

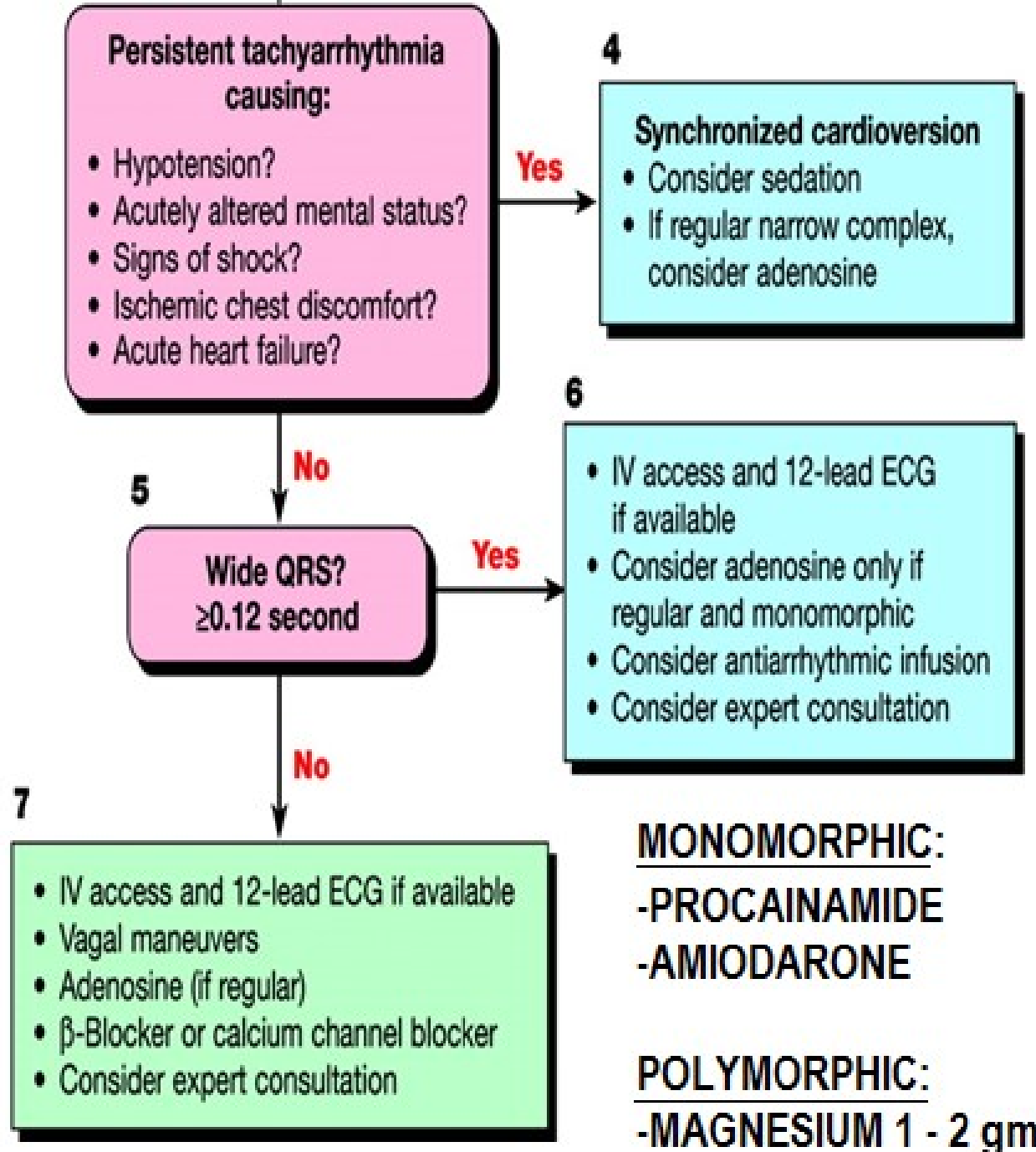


***DO NOT give PROCAINAMIDE, AMIODARONE, or SOTALOL to patients with TORSADES or POLYMORPHIC VT !!!***

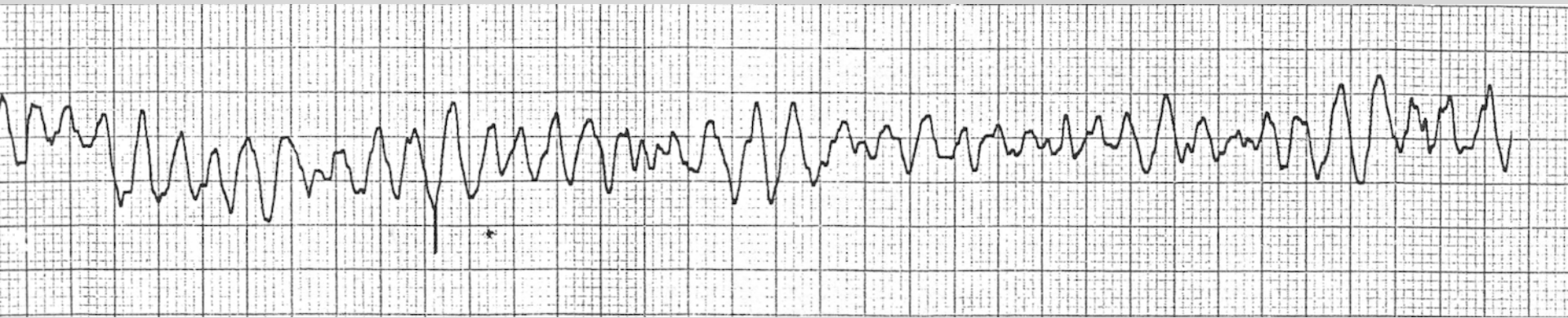
### OTHER CONSIDERATIONS:

- 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 UNKOWN ETIOLOGY"
- EVALUATE PATIENT FOR FAMILY HISTORY FOR SUDDEN CARDIAC DEATH

REPORT ANY ABNORMAL FINDINGS TO PHYSICIAN.

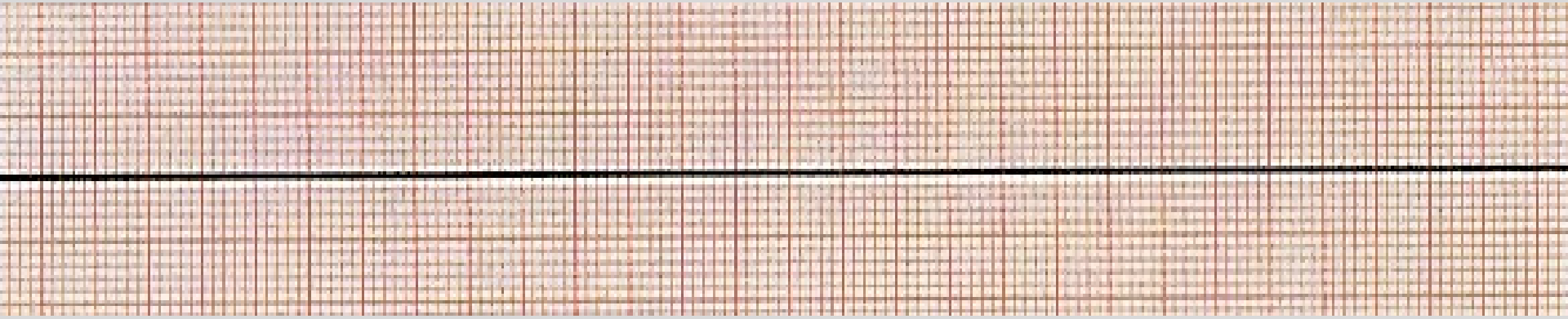


# VENTRICULAR FIBRILLATION



***CARDIAC ARREST RHYTHM***

# Ventricular Asystole



***CARDIAC ARREST RHYTHM***



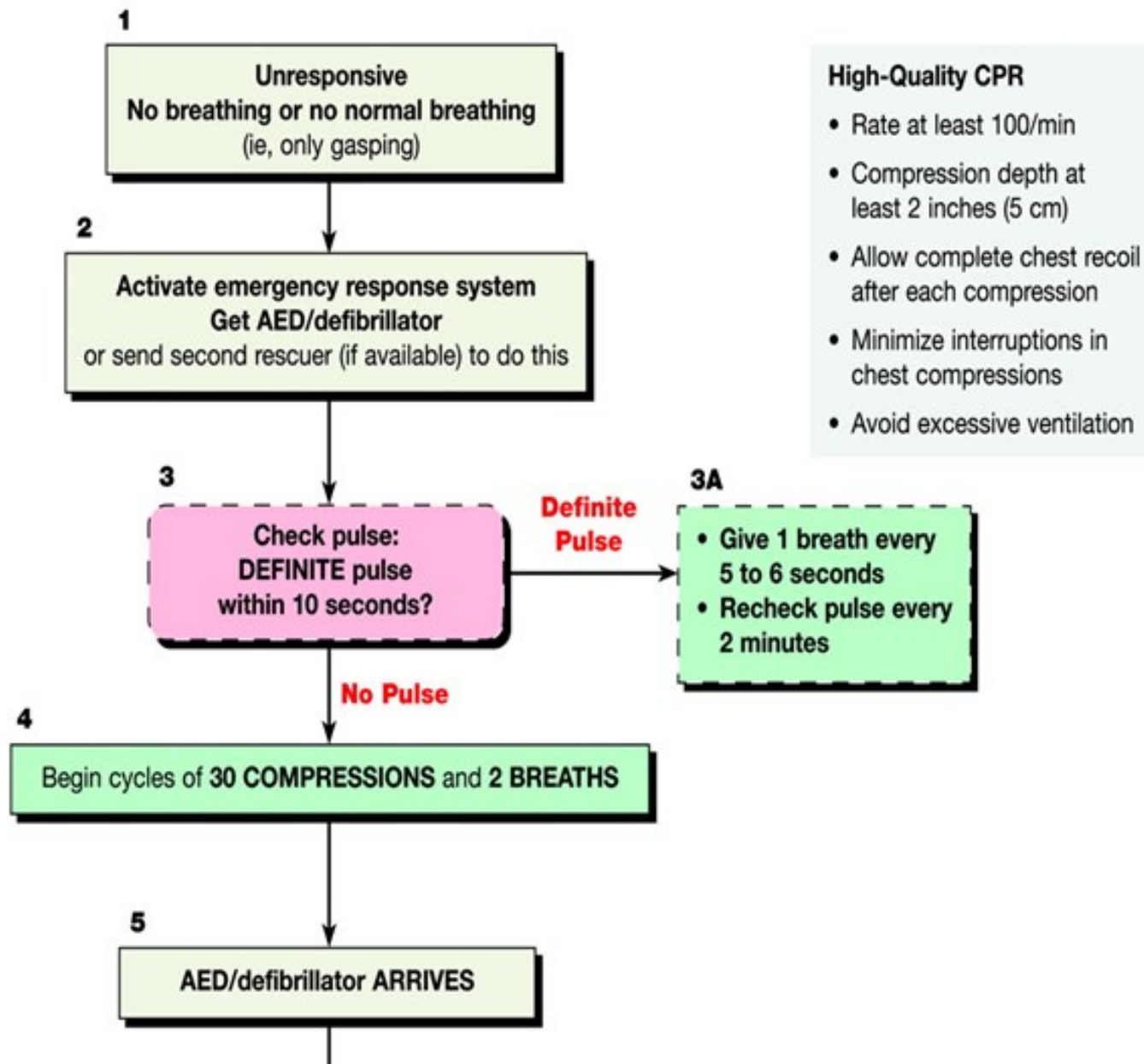
# **-- CRITICAL ECG ALERT --**

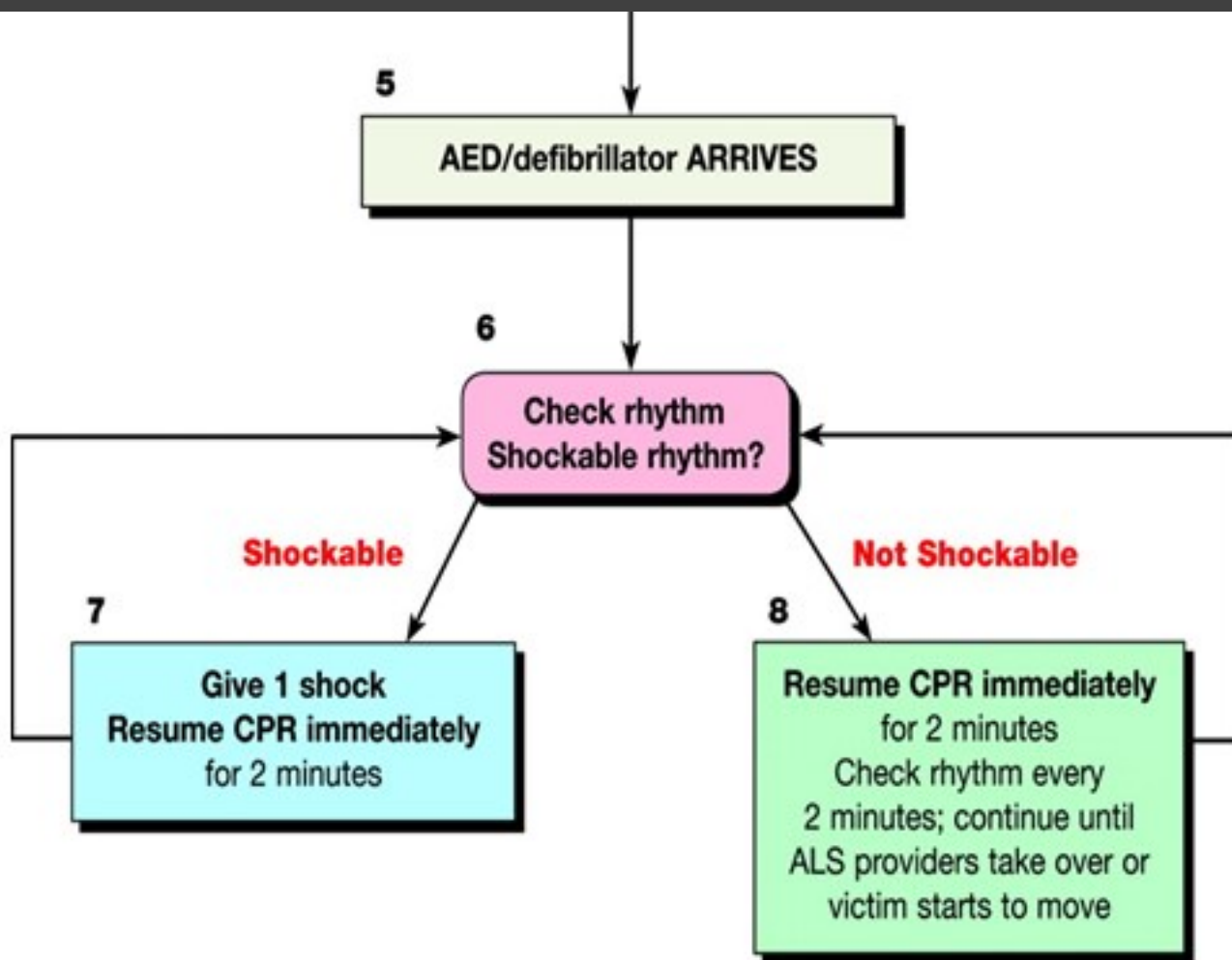
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- 9. VENTRICULAR FIBRILLATION or ASYSTOLE**

## Adult BLS Healthcare Providers





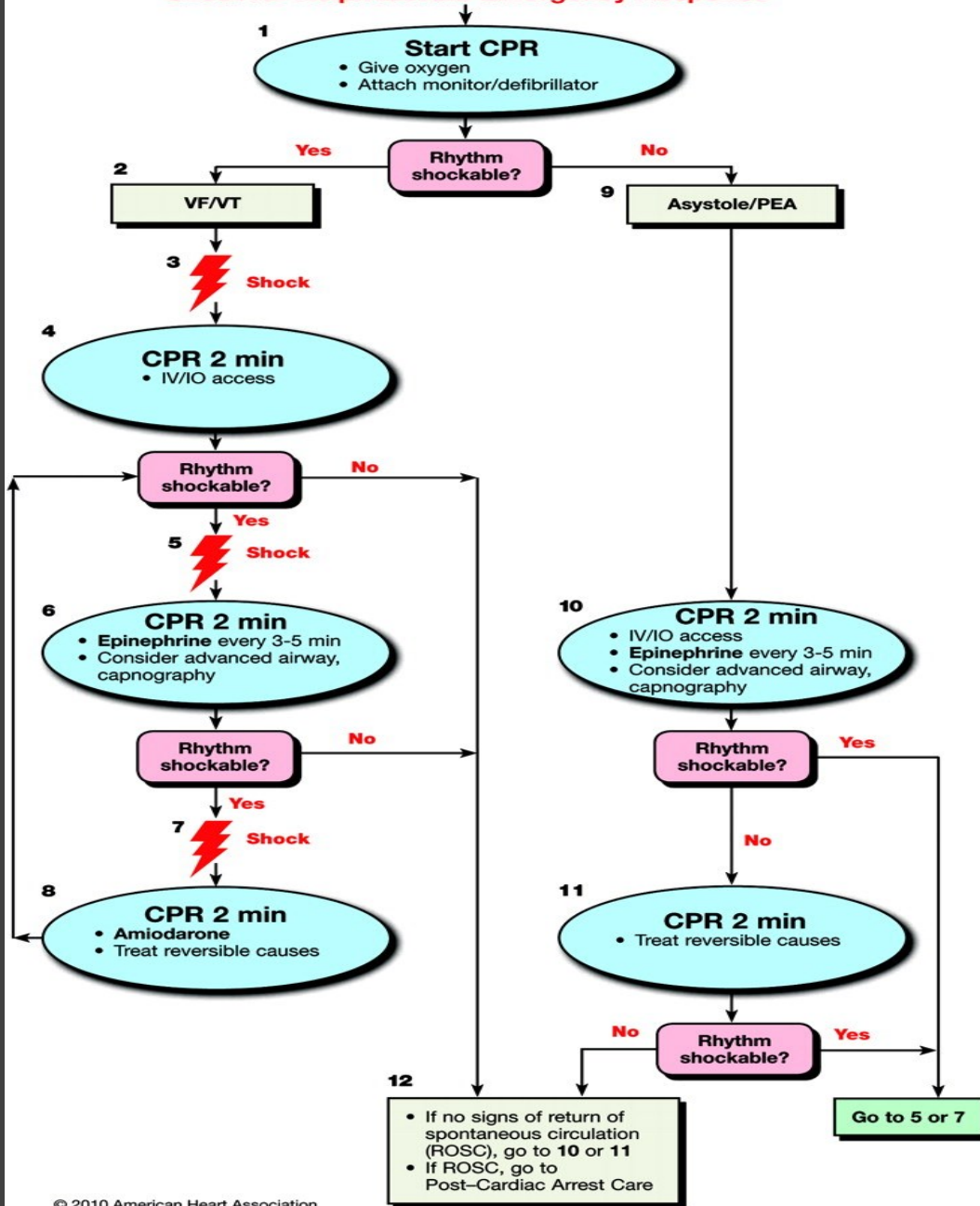


**IF NOPULSE WITH THIS RHYTHM?**



## Adult Cardiac Arrest

Shout for Help/Activate Emergency Response



### CPR Quality

- Push hard ( $\geq 2$  inches [5 cm]) and fast ( $\geq 100/\text{min}$ ) and allow complete chest recoil
- Minimize interruptions in compressions
- Avoid excessive ventilation
- Rotate compressor every 2 minutes
- If no advanced airway, 30:2 compression-ventilation ratio
- Quantitative waveform capnography
  - If  $\text{PETCO}_2 < 10$  mm Hg, attempt to improve CPR quality
- Intra-arterial pressure
  - If relaxation phase (diastolic) pressure  $< 20$  mm Hg, attempt to improve CPR quality

### Return of Spontaneous Circulation (ROSC)

- Pulse and blood pressure
- Abrupt sustained increase in  $\text{PETCO}_2$  (typically  $\geq 40$  mm Hg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

### Shock Energy

- **Biphasic:** Manufacturer recommendation (120-200 J); if unknown, use maximum available. Second and subsequent doses should be equivalent, and higher doses may be considered.
- **Monophasic:** 360 J

### Drug Therapy

- **Epinephrine IV/IO Dose:** 1 mg every 3-5 minutes
- **Vasopressin IV/IO Dose:** 40 units can replace first or second dose of epinephrine
- **Amiodarone IV/IO Dose:** First dose: 300 mg bolus. Second dose: 150 mg.

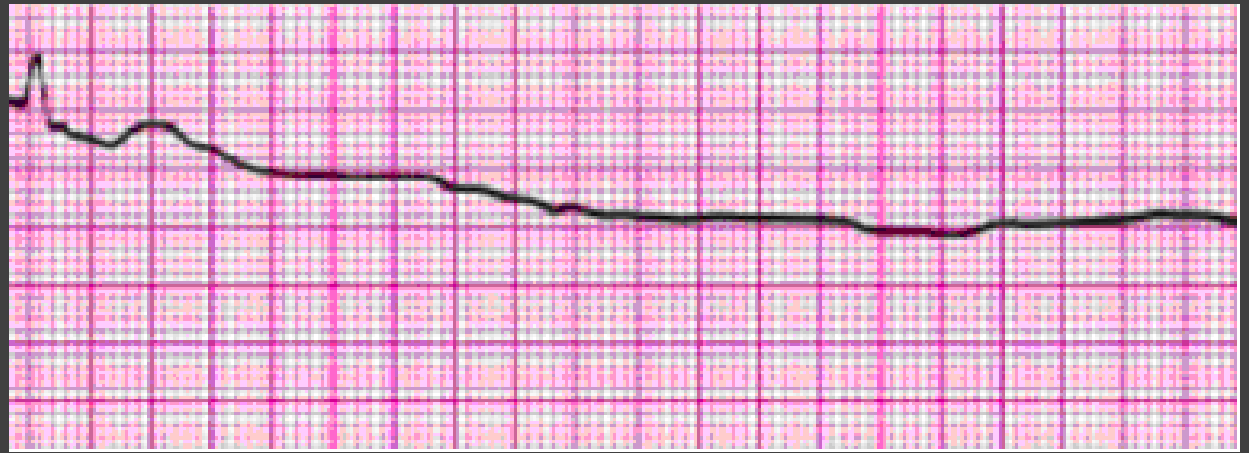
### Advanced Airway

- Supraglottic advanced airway or endotracheal intubation
- Waveform capnography to confirm and monitor ET tube placement
- 8-10 breaths per minute with continuous chest compressions

### Reversible Causes

- Hypovolemia
- Hypoxia
- Hydrogen ion (acidosis)
- Hypo-/hyperkalemia
- Hypothermia
- Tension pneumothorax
- Tamponade, cardiac
- Toxins
- Thrombosis, pulmonary
- Thrombosis, coronary

If QRS  
complexes  
have a  
PULSE  
then apply

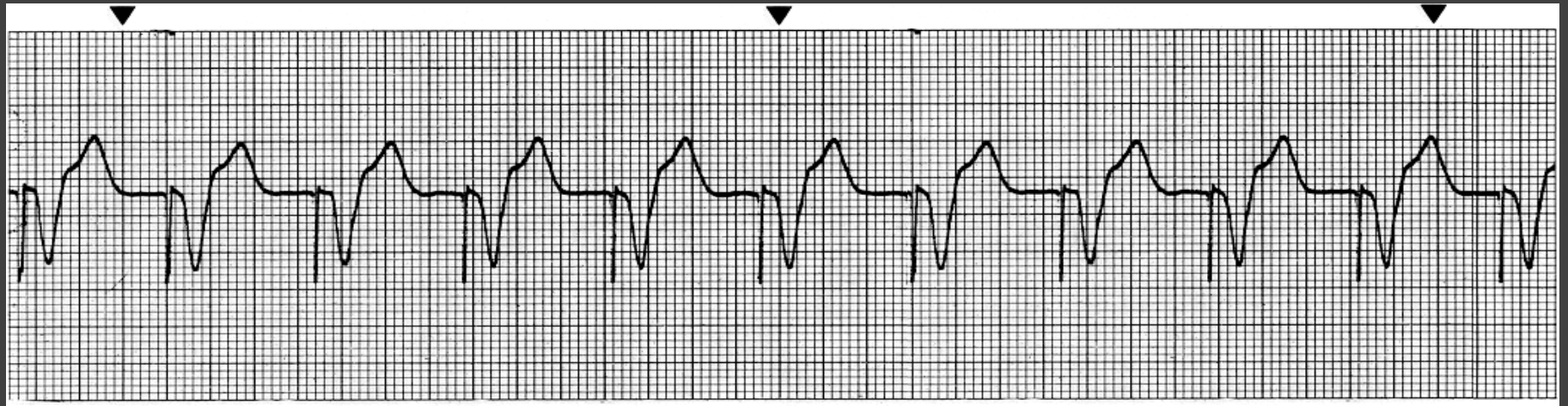


**PACEMAKER !!**

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 --**

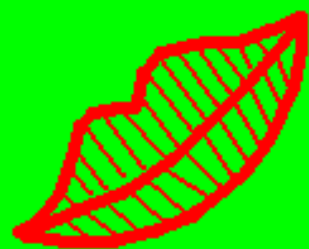
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- 7. V-TACH, or WIDE QRS TACHYCARDIA of unknown origin**
- 8. TORSADES de POINTES**
- 9. VENTRICULAR FIBRILLATION or ASYSTOLE**
- 10. PACER SPIKES WITHOUT QRS – “FAILURE TO CAPTURE”**

# THE QRS COMPLEX

## DIAGNOSING BUNDLE BRANCH BLOCK



K.I.S.S.  
THEORY

# **THE QRS COMPLEX**

## **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

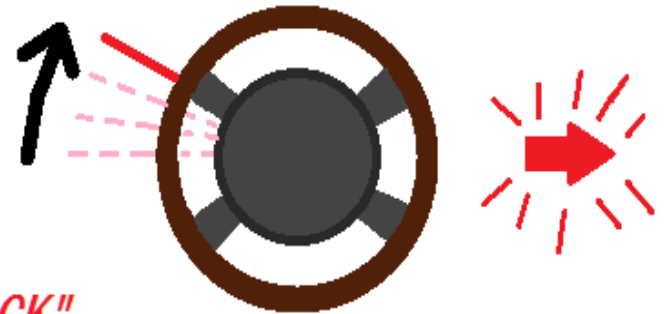
V1

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”*

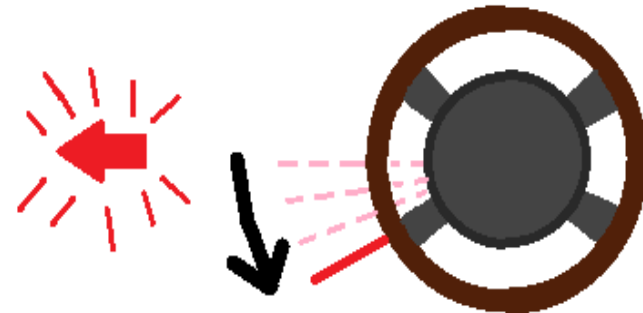


V1

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

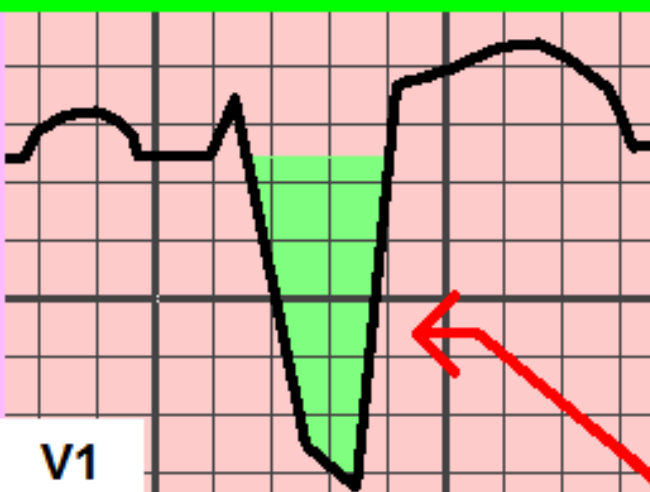
THINK:

*“QRS points DOWN = LEFT BUNDLE BRANCH BLOCK”*



# DIAGNOSING BUNDLE BRANCH BLOCK

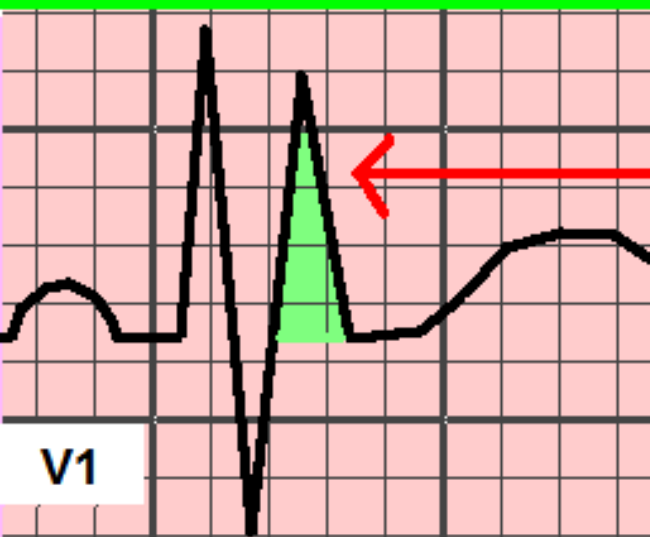
## L.B.B.B.



## USING LEAD V1

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

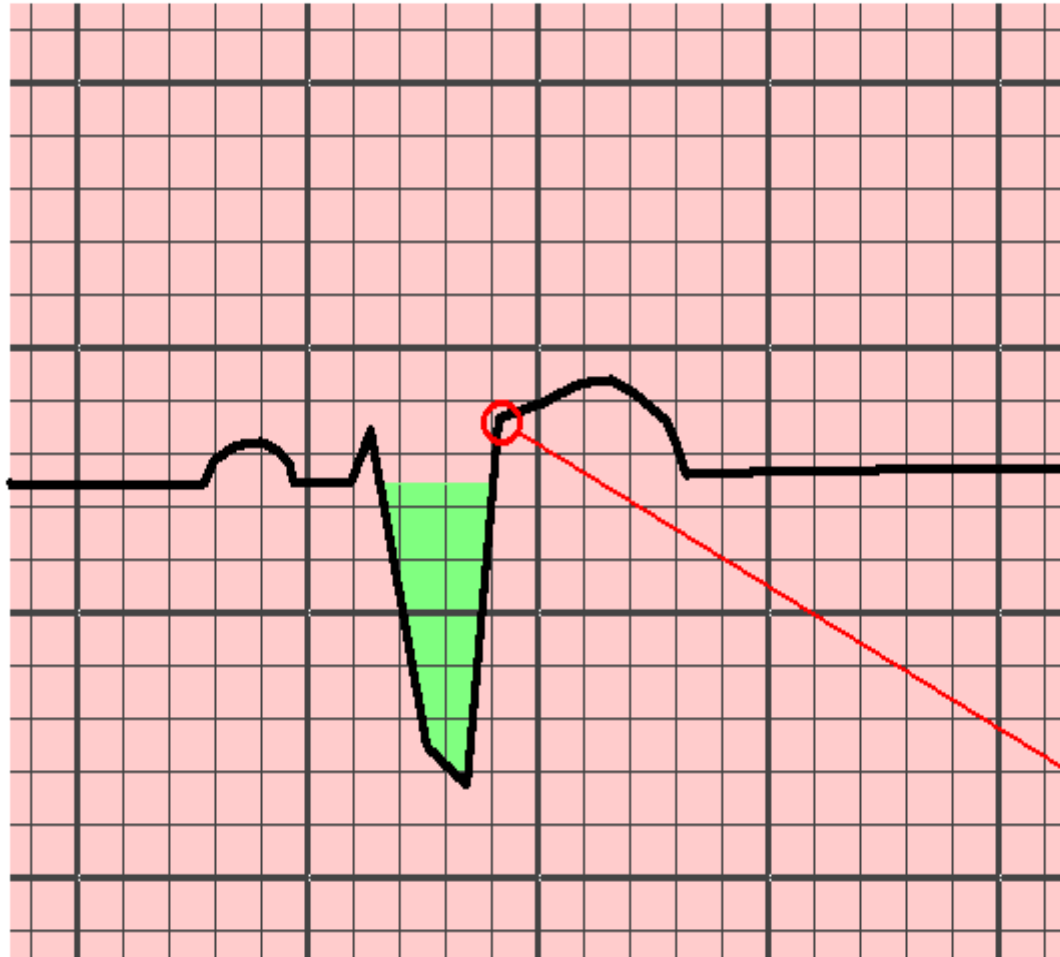
## R.B.B.B.



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 NORMALLY 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. 2<sup>nd</sup> degree type II or 3<sup>rd</sup> 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 seg. Elev. MI)
- **Unstable Angina**

# *Acute Coronary Syndrome* (**ACS**):

**12 Lead ECG “mapping” of  
the ischemic region of  
myocardium with continuous  
ST Segment Monitoring . . .  
Coming up in the next level  
ECG monitoring course.**



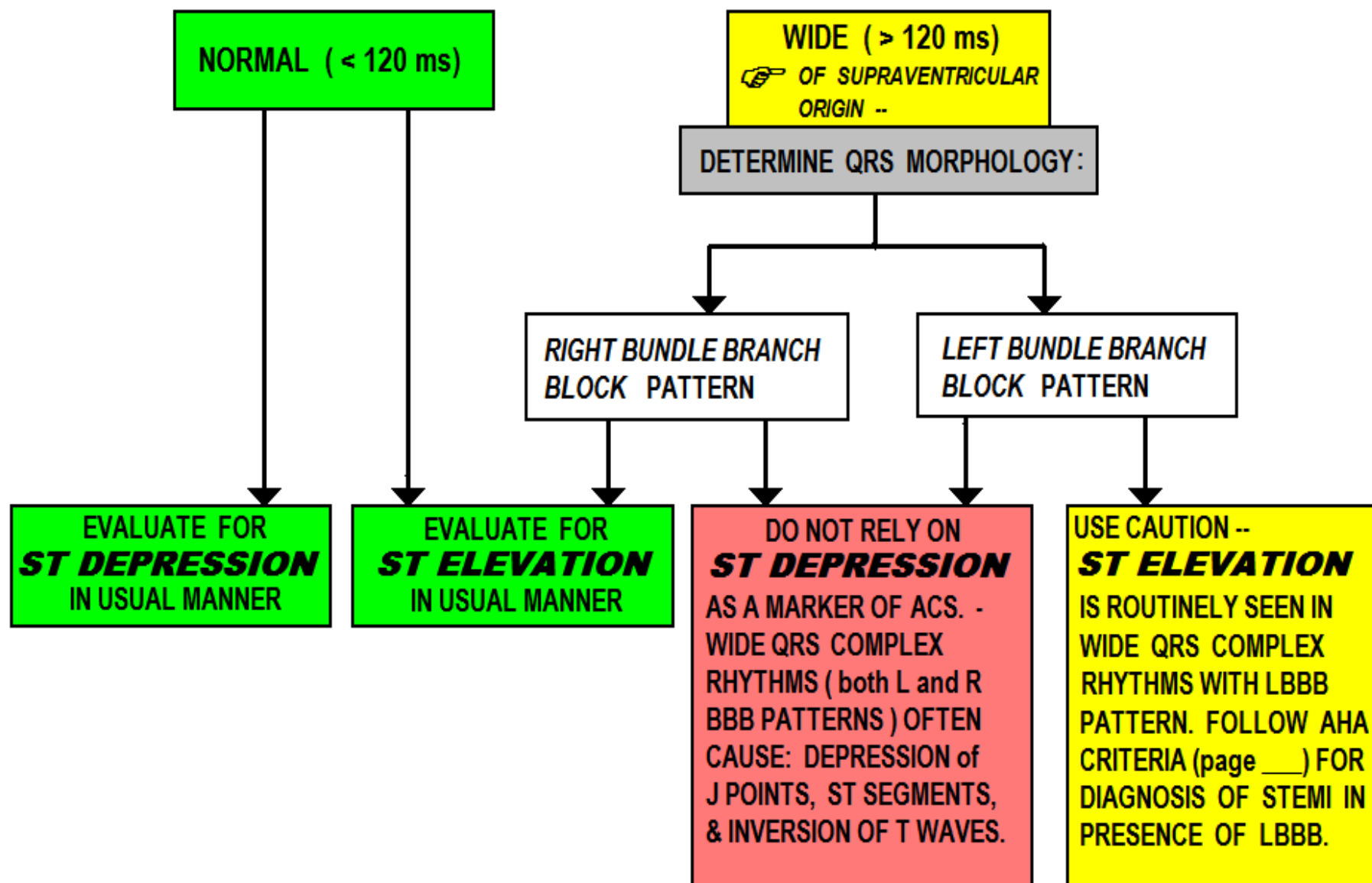
# The ECG Markers of ACS involve the:

- 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.***

# STEP 1 - EVALUATE WIDTH OF QRS:





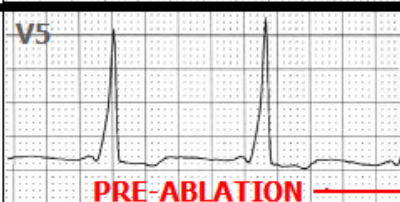

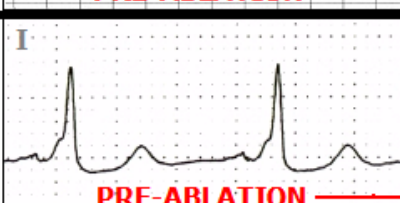
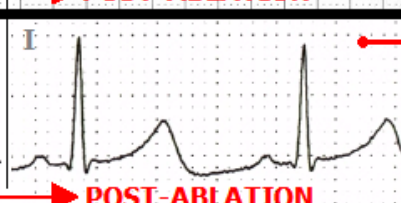
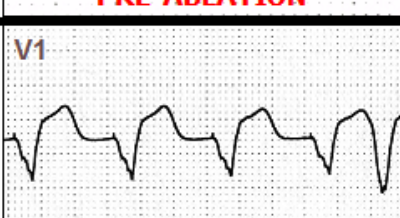
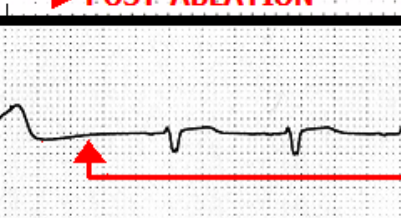
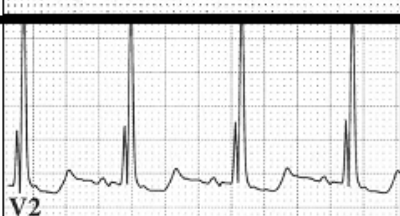

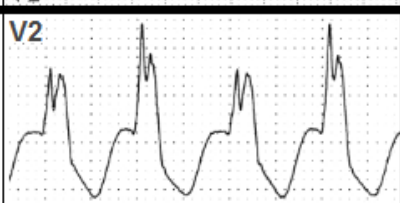
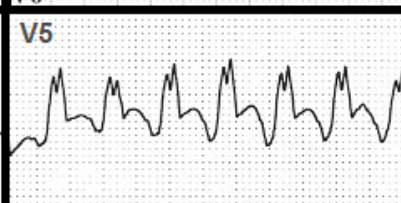
If the QRS complexes  
Are WIDE ( $> 120\text{ms}$ )  
COMPARE J POINTS,  
ST SEGMENTS and  
T WAVES of OLDER  
RHYTHM STRIPS to  
NEWER ONES !!

# CONDITIONS WHICH ALTER THE ECG MARKERS of ACUTE CORONARY SYNDROME

WIDE QRS  
COMPLEXES  
ALTER THE

-J POINTS  
-ST SEGMENTS  
-T WAVES

Of the ECG ...

|   |  |   |   |
|---|--|---|---|
| RIGHT BUNDLE BRANCH BLOCK                                       |    |    | LEFT BUNDLE BRANCH BLOCK  |
| W-P-W BYPASS TRACT, LEFT LATERAL WALL<br>49 y/o MALE            |    |    | SAME PATIENT AS ON LEFT - IMMEDIATELY AFTER RF ABLATION OF BYPASS TRACT |
| W-P-W BYPASS TRACT, RIGHT ANTERIOR/ LATERAL WALL<br>14 y/o MALE |    |    | SAME PATIENT AS ON LEFT - IMMEDIATELY AFTER RF ABLATION OF BYPASS TRACT |
| PACEMAKER - RIGHT VENTRICULAR APEX                              |   |   | PACEMAKER TURNED OFF HERE   |
| RIGHT VENTRICULAR HYPERTROPHY ( Strain Pattern )                |  |  | LEFT VENTRICULAR HYPERTROPHY ( Strain Pattern )                         |
| VENTRICULAR TACHYCARDIA FOCUS: LEFT FASCICULAR, 17 y/o FEMALE   |  |  | VENTRICULAR TACHYCARDIA- FOCUS: RIGHT VENTRICULAR APEX                  |

# IF THE QRS COMPLEXES ON THE EKG ARE OF NORMAL WIDTH (<120 ms) :

## STEP 2 - EVALUATE the EKG for ACS

THE EKG MARKERS USED FOR DETERMINING THE PRESENCE OF ACUTE CORONARY SYNDROME INCLUDE:

- J POINTS
- ST SEGMENTS
- T WAVES

CAREFULLY SCRUTINIZE THESE MARKERS IN EVERY LEAD OF THE 12 LEAD EKG, TO DETERMINE IF THEY ARE *NORMAL* or *ABNORMAL*.

When QRS complex width is NORMAL ( $< 120$  ms):

# NORMAL ST - T WAVES

- WHEN QRS WIDTH IS NORMAL ( $< 120$  ms)

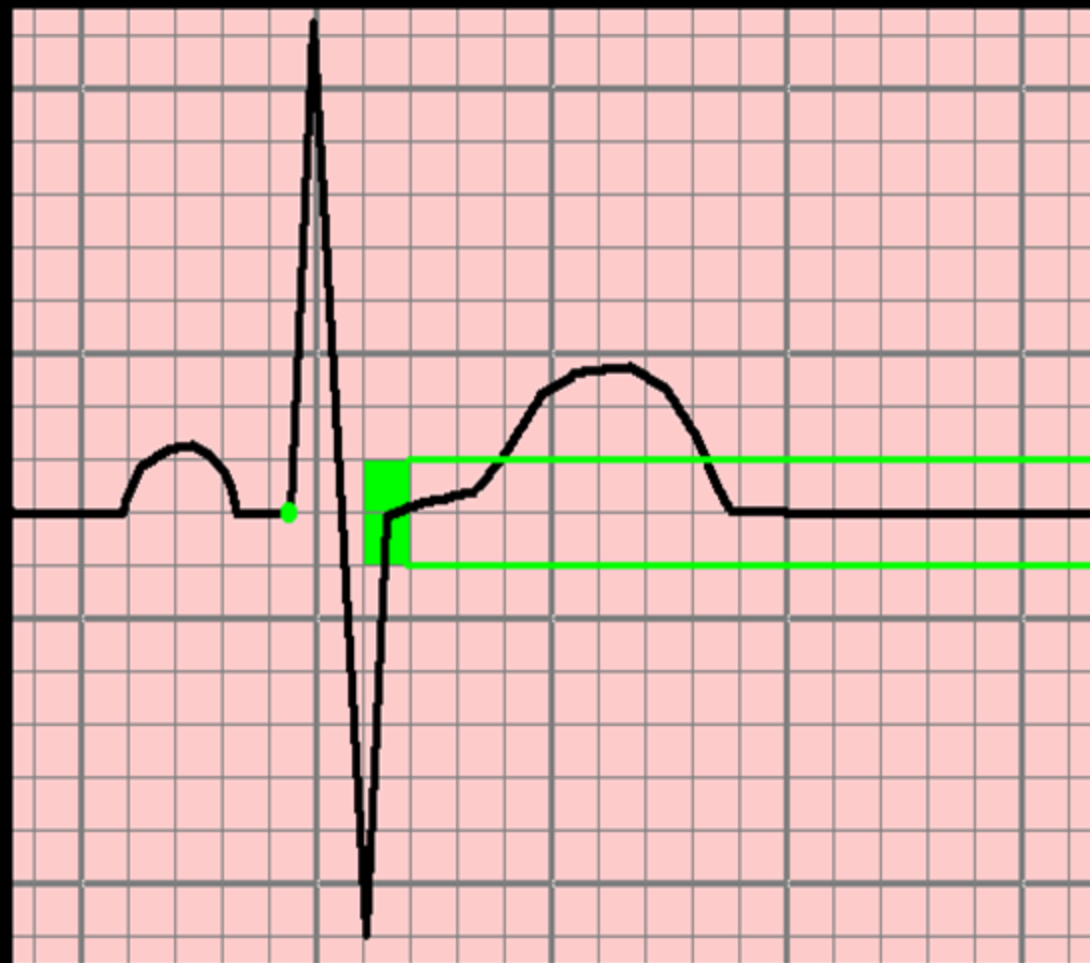
## ASSESS:



- 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

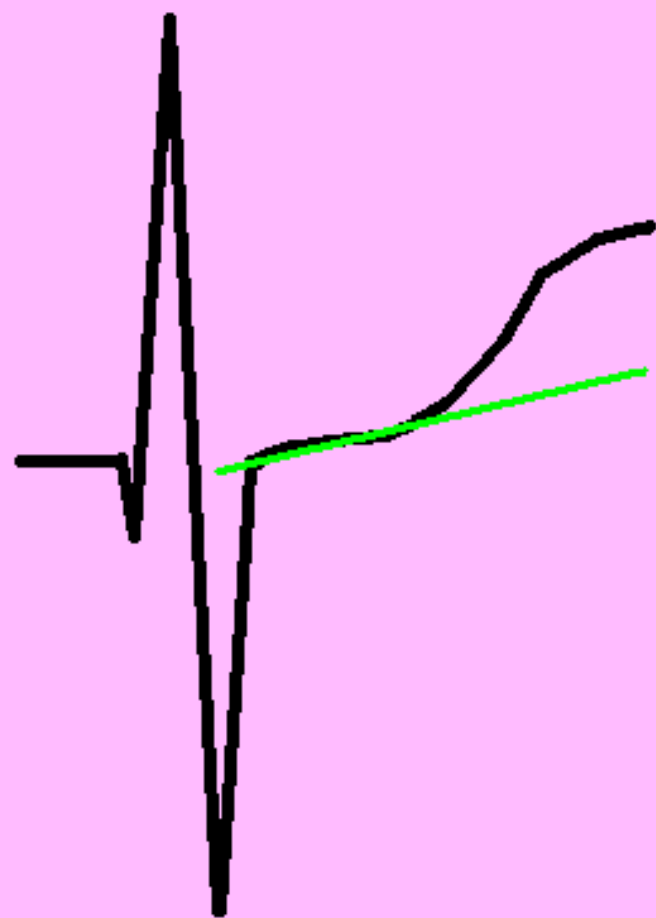
OR

BELOW  
the  
ISOELECTRIC  
LINE

or the P-Q JUNCTION.

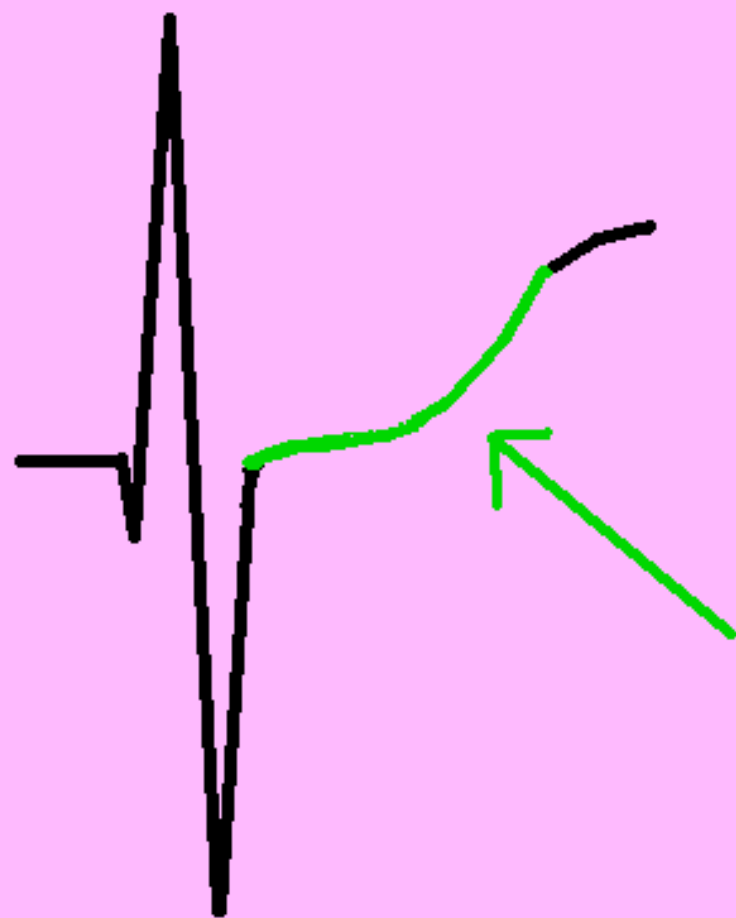


# THE S-T SEGMENT



SHOULD HAVE  
A "SLIGHT POSITIVE"  
INCLINATION

# THE S-T SEGMENT

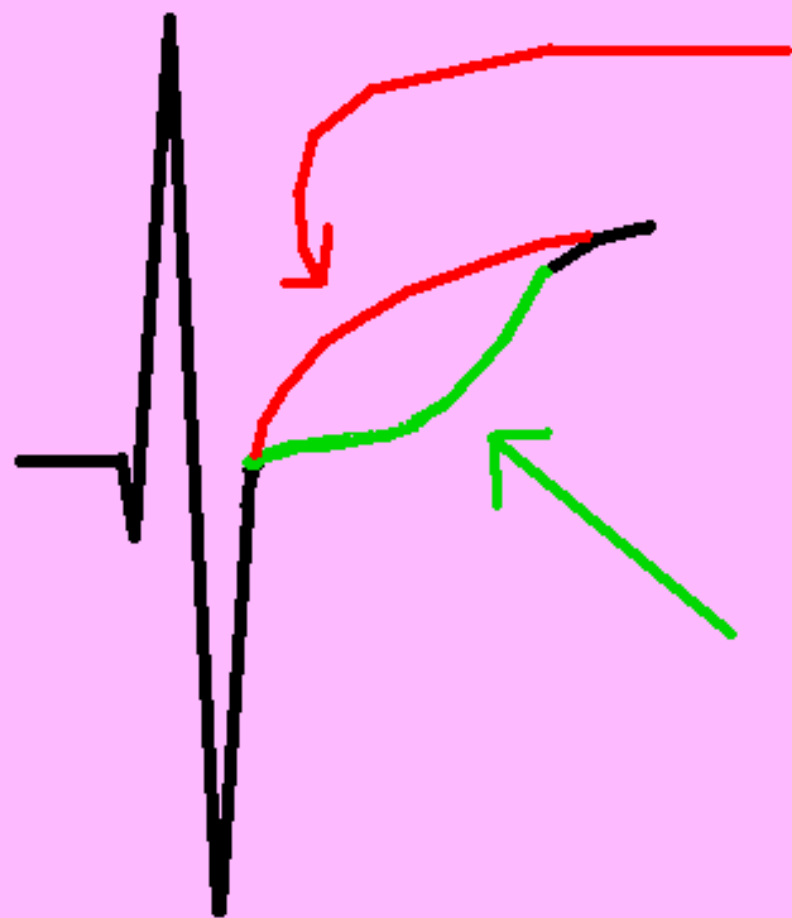


SHOULD BE  
"CONCAVE" IN  
SHAPE . . .

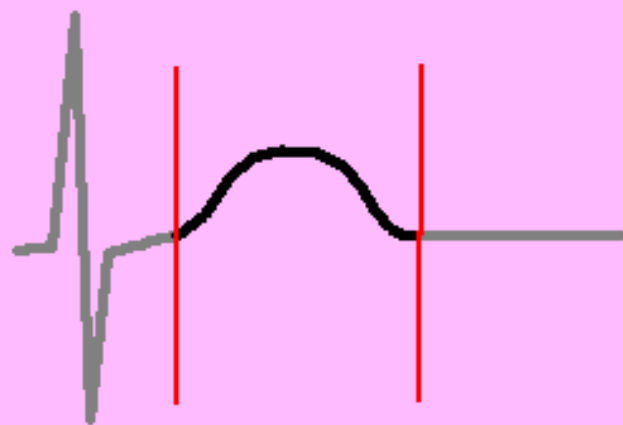
# THE S-T SEGMENT

AS OPPOSED TO  
"CONVEX" IN  
SHAPE

SHOULD BE  
"CONCAVE" IN  
SHAPE . . .

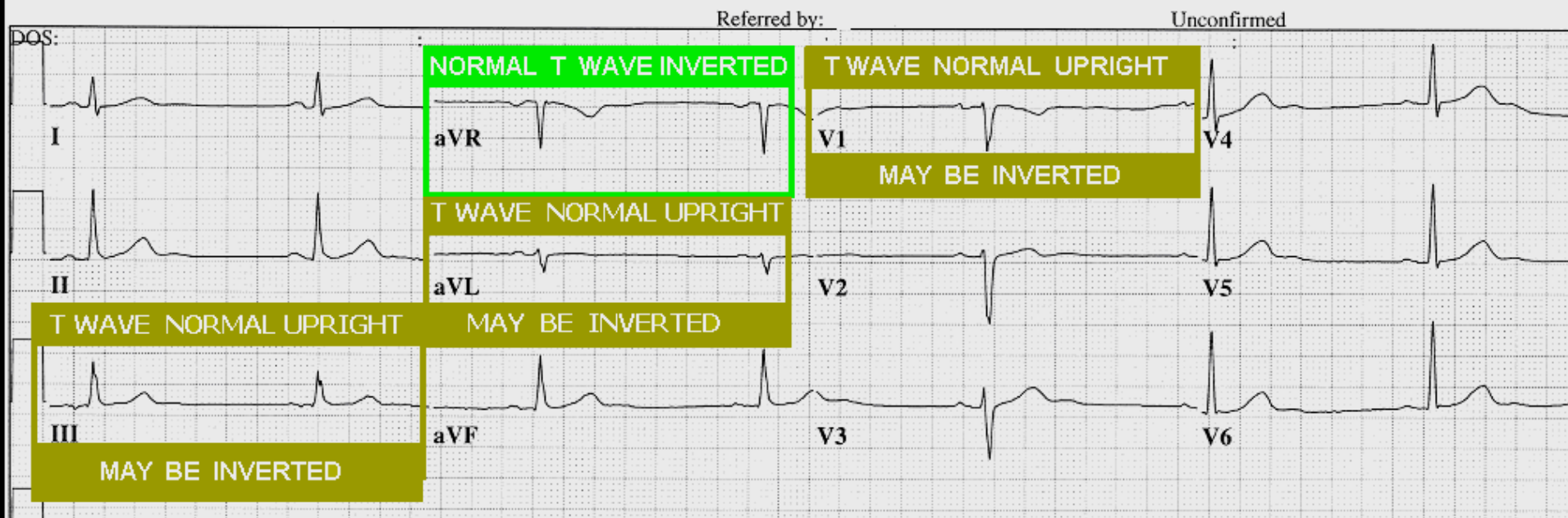


# THE T WAVE



- SHOULD BE A "NICE," ROUNDED, CONVEX SHAPE
- SHOULD BE SYMMETRICAL
- SHOULD BE UPRIGHT IN ALL LEADS, EXCEPT AVR
- MAY BE INVERTED IN LEADS AVL, III, and V1

# Leads where the T WAVE may be INVERTED:



# CHANGES ASSOCIATED WITH CELLULAR PERFUSION INVOLVING THE:

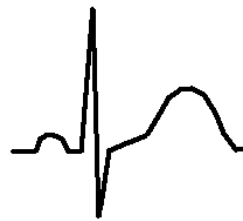
- QRS
- J POINT
- ST SEGMENT
- T WAVE

C  
A  
R  
D  
I  
A  
C  
  
C  
E  
L  
L  
  
P  
E  
R  
F  
U  
S  
I  
O  
N  
  
S  
T  
A  
T  
E  
S

## NORMAL STATE OF PERFUSION

ARTERIAL BLOCKAGES → NONE SIGNIFICANT  
CELLULAR OXYGENATION → NORMAL  
CELLULAR METABOLISM → AEROBIC  
CELLULAR FUNCTION → NORMAL CONTRACTION

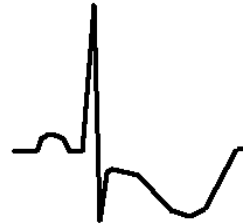
EKG: J POINT ISOELECTRIC, ST SEG "SLIGHT, POSTIVE INCLINATION, T WAVE POSITIVE, UPRIGHT.



## ISCHEMIA

ARTERIAL BLOCKAGES → PARTIAL OBSTRUCTION  
CELLULAR OXYGENATION → INSUFFICIENT  
CELLULAR METABOLISM → AEROBIC  
CELLULAR FUNCTION → REDUCED CONTRACTION  
PATIENT SYMPTOMS → POSSIBLE, WITH EXERTION

EKG: J POINT DEPRESSED, ST SEGMENT VARIES, T WAVE VARIES



## INFARCTION

ARTERIAL BLOCKAGES → TOTAL OBSTRUCTION  
CELLULAR OXYGENATION → NONE  
CELLULAR METABOLISM → ANAEROBIC CELL BEGINS TO BURN GLYCOGEN RESERVES  
CELLULAR FUNCTION → STOPS CONTRACTING  
PATIENT SYMPTOMS → TYPICAL or ATYPICAL ACS Sx

EKG - INDICATIVE: J POINT ELEVATES, ST SEGMENT CONVEX, T WAVE POSITIVE, MAY ENLARGE  
EKG - RECIPROCAL: J POINT DEPRESSES, ST SEGMENT DOWNSLOPING, T WAVE INVERTED



## NECROSIS

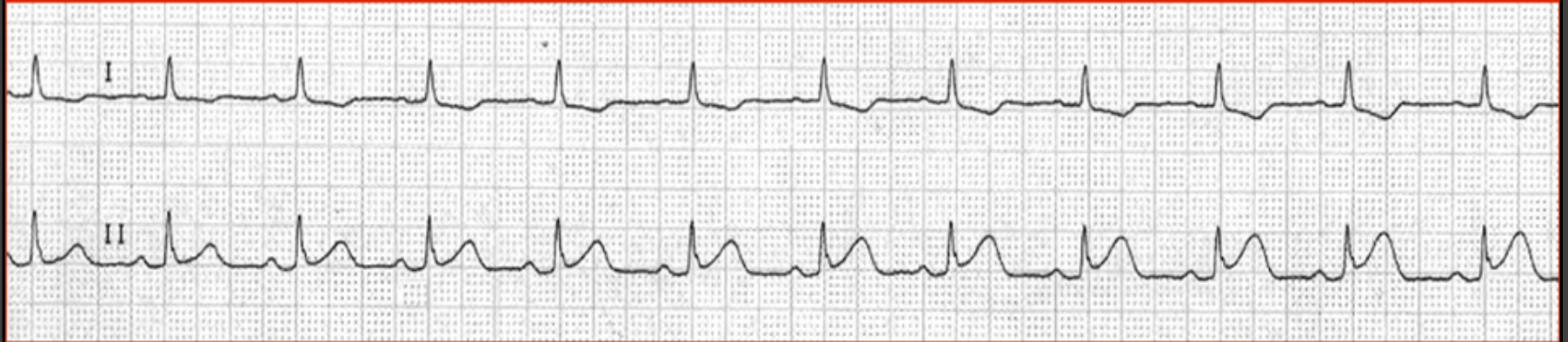
ARTERIAL BLOCKAGES → TOTAL OBSTRUCTION  
CELLULAR OXYGENATION → NONE  
CELLULAR METABOLISM → CELL DIES WHEN GLYCOGEN RESERVES DEPLETED.  
CELLULAR FUNCTION → NONE. CELL DEAD.  
PATIENT SYMPTOMS → POSS. HYPOTENSION, DEATH

EKG - INDICATIVE: J POINTS, ST SEGMENTS NORMALIZE; ABNORMAL Q WAVES FORM  
EKG - RECIPROCAL: J POINTS, ST SEGMENTS NORMALIZE; ABNORMAL TALL R WAVES FORM

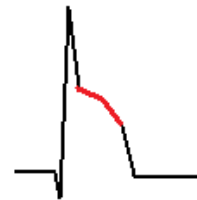


# ***ST SEGMENT ELEVATION:***

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



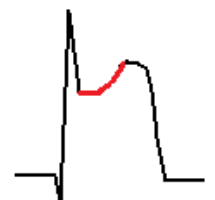
**IN THIS CASE, a normal response to balloon occlusion of the RIGHT CORONARY ARTERY during PTCA in the CARDIAC CATH LAB**



**DOWNSLOPING  
S-T SEGMENT**



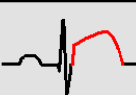
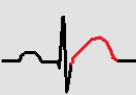
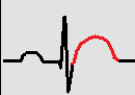
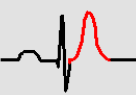
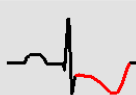
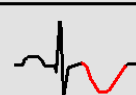
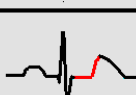
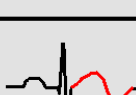

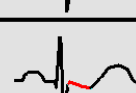
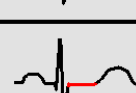
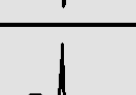

**FLAT  
S-T SEGMENT**



**UPSLOPING  
S-T SEGMENT**

# EKG PATTERNS of ACS & ISCHEMIA

-- J POINT, ST SEGMENT, and T WAVE ABNORMALITIES --

|   |   |   |
|---|---|---|
| ! S-T SEGMENT ELEVATION at J POINT              |    | <ul style="list-style-type: none"> <li>- ACUTE MI</li> <li>- ACUTE PERICARDITIS / MYOCARDITIS</li> <li>- EARLY REPOLARIZATION</li> </ul>                            |
| ! FLAT or CONVEX J-T APEX SEGMENT               |    |  <ul style="list-style-type: none"> <li>- ACUTE MI</li> <li>- ISCHEMIA</li> </ul> |
| ! HYPER-ACUTE T WAVE                            |    | <ul style="list-style-type: none"> <li>- HYPERKALEMIA</li> <li>- TRANSMURAL ISCHEMIA</li> <li>- ACUTE MI</li> <li>- HYPERTROPHY</li> </ul>                          |
| ! DEPRESSED J pt. DOWNSLOPING ST and INVERTED T |    | <ul style="list-style-type: none"> <li>- ACUTE (NON-Q WAVE) MI</li> <li>- ACUTE MI - ( RECIPROCAL CHANGES )</li> <li>- ISCHEMIA</li> </ul>                          |
| INVERTED T WAVE                                 |    | <ul style="list-style-type: none"> <li>- MYOCARDITIS</li> <li>- ELECTROLYTE IMBAL.</li> <li>- ISCHEMIA</li> </ul>   |
| SHARP S-T T ANGLE                               |    | <ul style="list-style-type: none"> <li>- ACUTE MI (NOT COMMON)</li> <li>- ISCHEMIA</li> </ul>   |
| BI-PHASIC T WAVE ( WELLEN'S )                   |    | <ul style="list-style-type: none"> <li>- SUB-TOTAL LAD LESION</li> <li>- VASOSPASM</li> <li>- HYPERTROPHY</li> </ul>  |
| DEPRESSED J POINT with UPSLOPING ST             |    | <ul style="list-style-type: none"> <li>- ISCHEMIA</li> </ul>  |
| DOWNSLOPING S-T SEGMENT                         |   | <ul style="list-style-type: none"> <li>- ISCHEMIA</li> </ul>  |
| ? FLAT S-T SEGMENT > 120 ms                     |  | <ul style="list-style-type: none"> <li>- ISCHEMIA</li> </ul>  |
| ? LOW VOLTAGE T WAVE WITH NORMAL QRS            |  | <ul style="list-style-type: none"> <li>- ISCHEMIA</li> </ul>  |
| ? U WAVE POLARITY OPPOSITE THAT OF T WAVE       |  | <ul style="list-style-type: none"> <li>- ISCHEMIA</li> </ul>  |



# **-- CRITICAL ECG ALERT --**

**-Immediately check patient**

**-Notify next “higher up” in chain of command**

- 1. Heart rate LESS THAN 50 or GREATER THAN 150**
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**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

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