



## **BASIC ECG PRINCIPLES**

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**Cardiac Accreditations / Emergency Manager**  
**Bayfront Health Dade City**



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12 LEAD ECG IN ACS

STEMI ASSISTANT

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TESTIMONIALS

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HELPFUL INFORMATION

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# The Heart:

- Muscle cells
- Electrical system cells
- Connective tissue

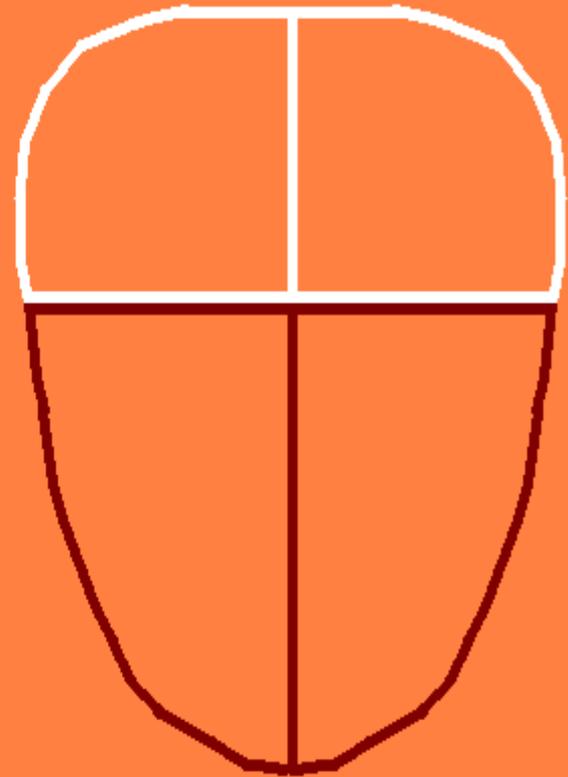
# FOUR CHAMBERED PUMP . . .

2 ATRIUM



PRIMARY JOB:

"PACK VENTRICLES  
FULL OF BLOOD"

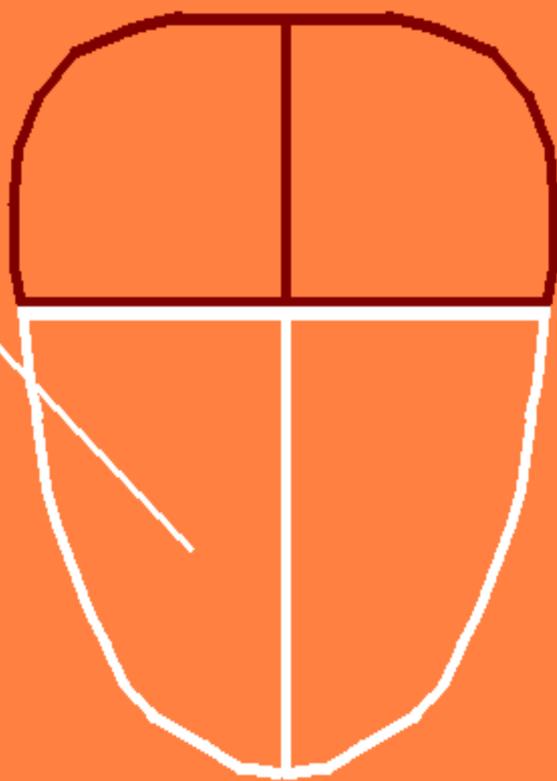


# FOUR CHAMBERED PUMP . . .

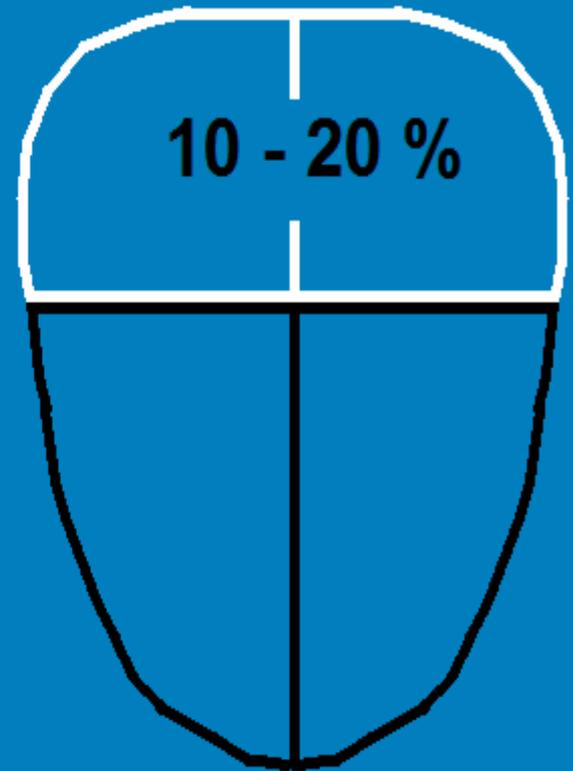
2 VENTRICLES

PRIMARY JOB:

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



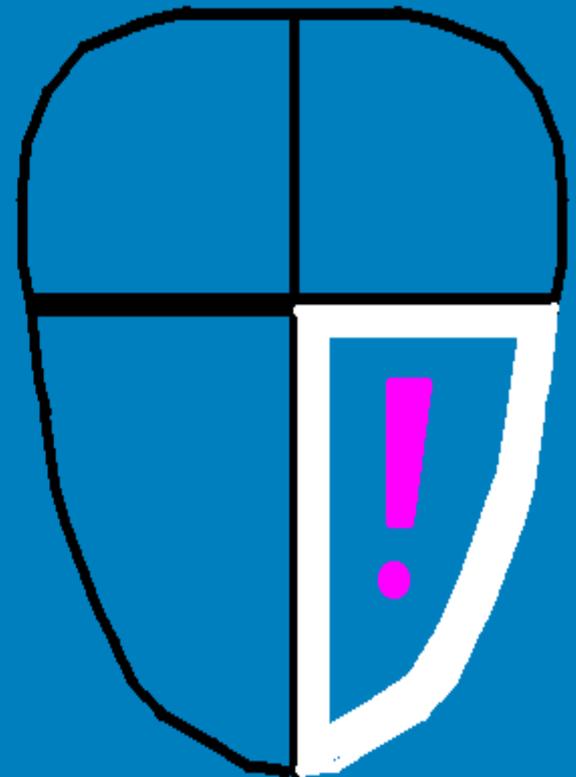
**WHEN FUNCTIONING PROPERLY,  
THE ATRIUM SUPPLY  
APPROXIMATELY  
WHAT  
PERCENTAGE  
OF THE  
CARDIAC OUTPUT ?**



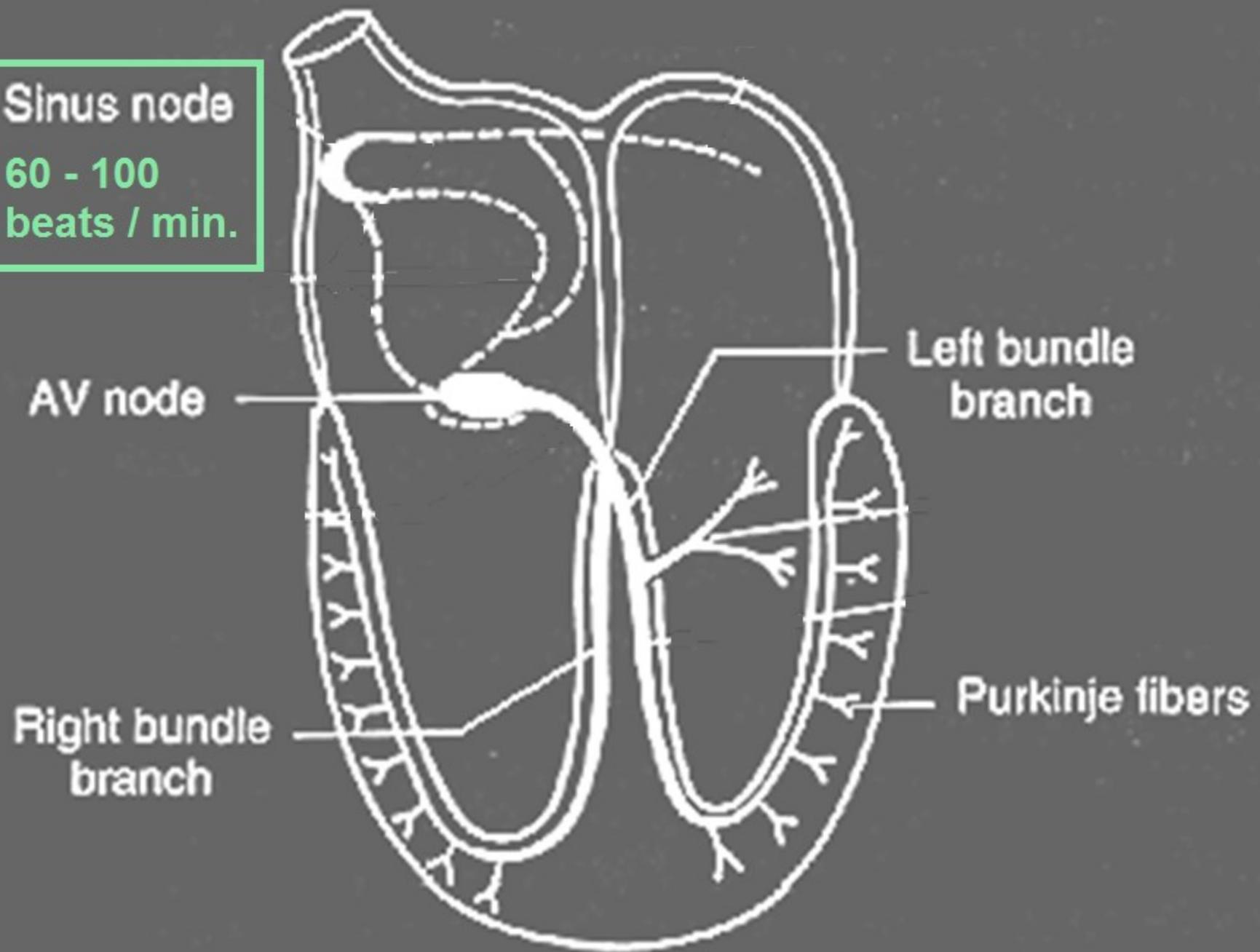
**THE CHAMBER MOST IMPORTANT  
TO KEEPING THE PATIENT ALIVE**

**(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.



~~Sinus node~~

AV node

40 - 60  
beats / min.

Right bundle  
branch

Left bundle  
branch

Purkinje fibers



~~Sinus node~~

~~AV node~~

Right bundle branch

Left bundle branch

Purkinje fibers

Pacemaker site in the Ventricles:  
20 - 40 beats / min



# NORMAL "INHERENT" RATES:

SA NODE: 60 - 100

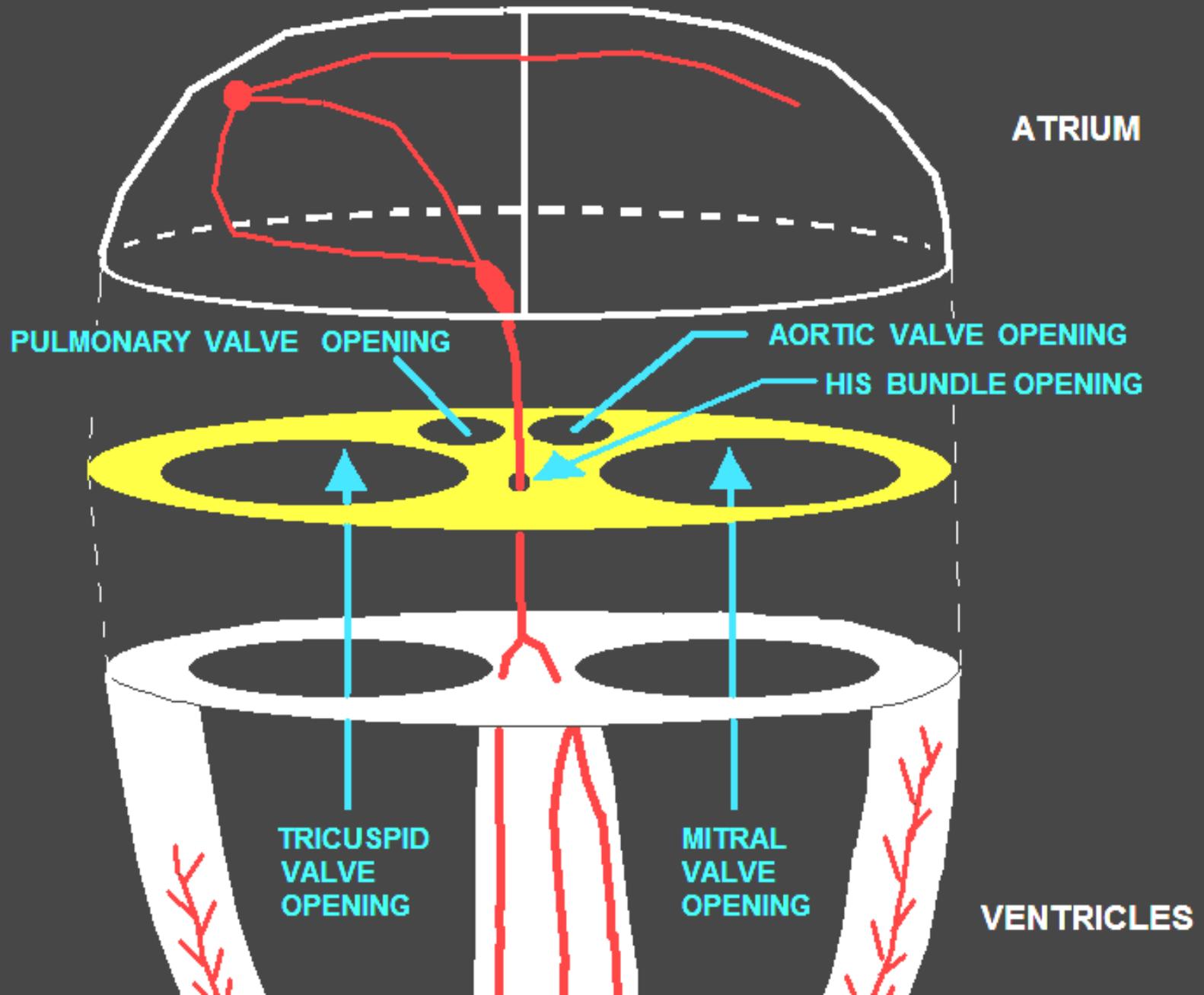
AV NODE: 40 - 60

\* 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"

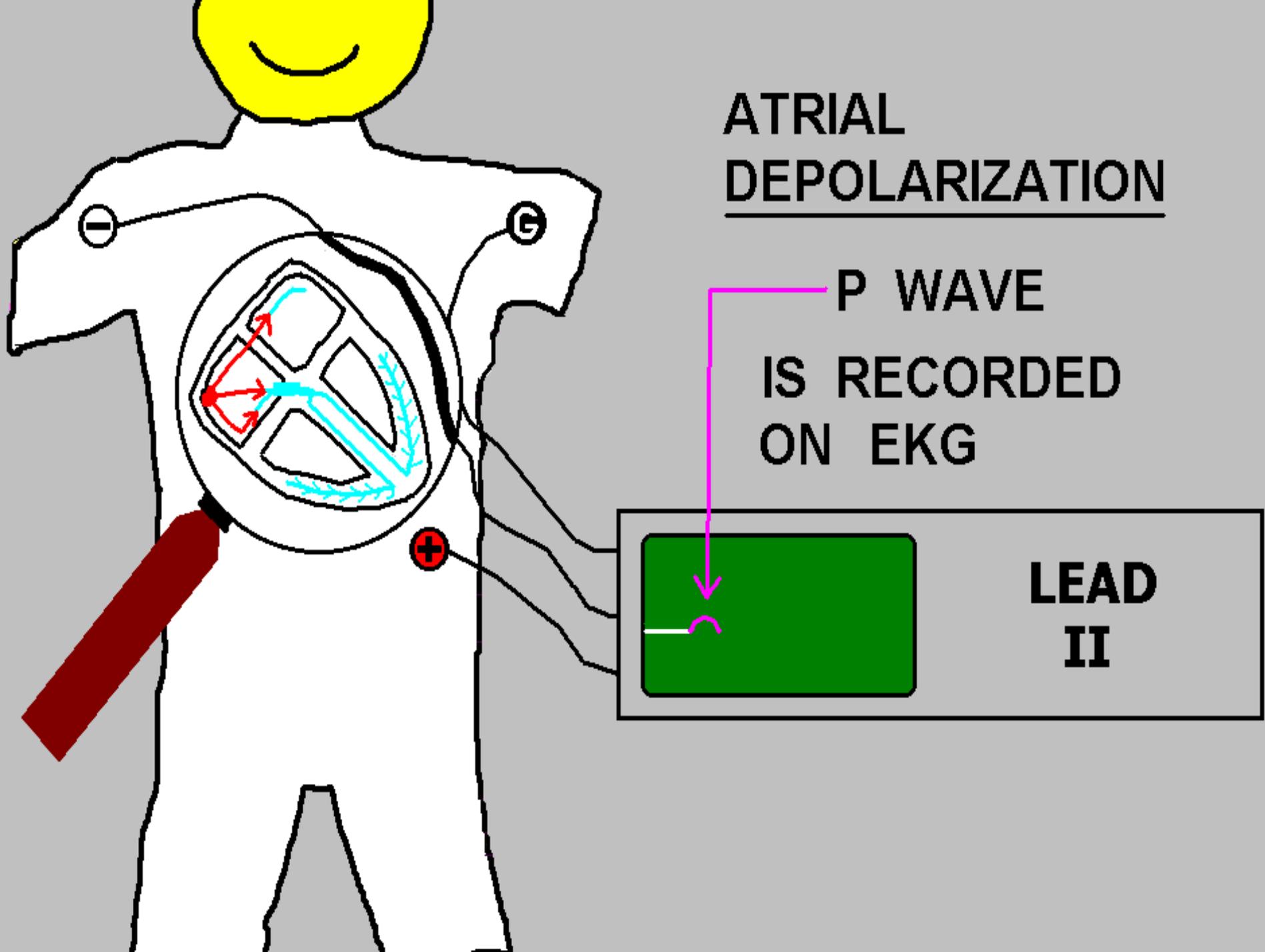
**FIBROUS  
"SKELETON  
of the  
HEART"**



# ATRIAL DEPOLARIZATION

P WAVE  
IS RECORDED  
ON EKG

LEAD  
II

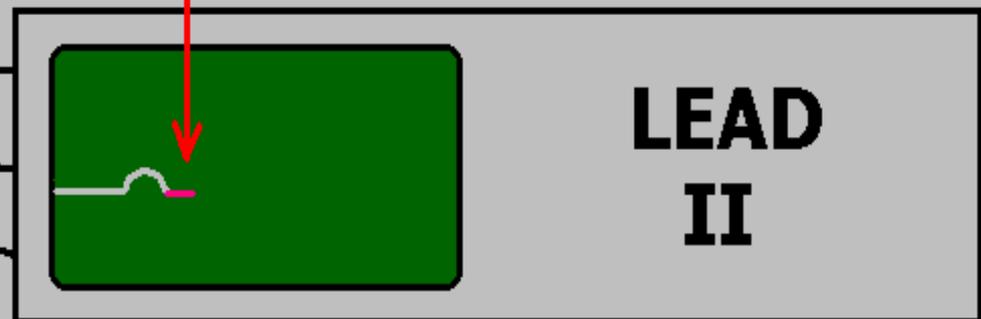


# THE P-R SEGMENT

ELECTRICAL ACTIVITY  
DURING P-R SEGMENT:

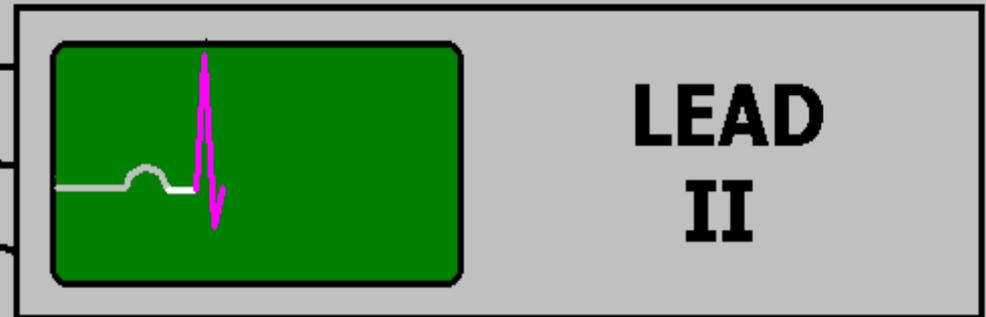
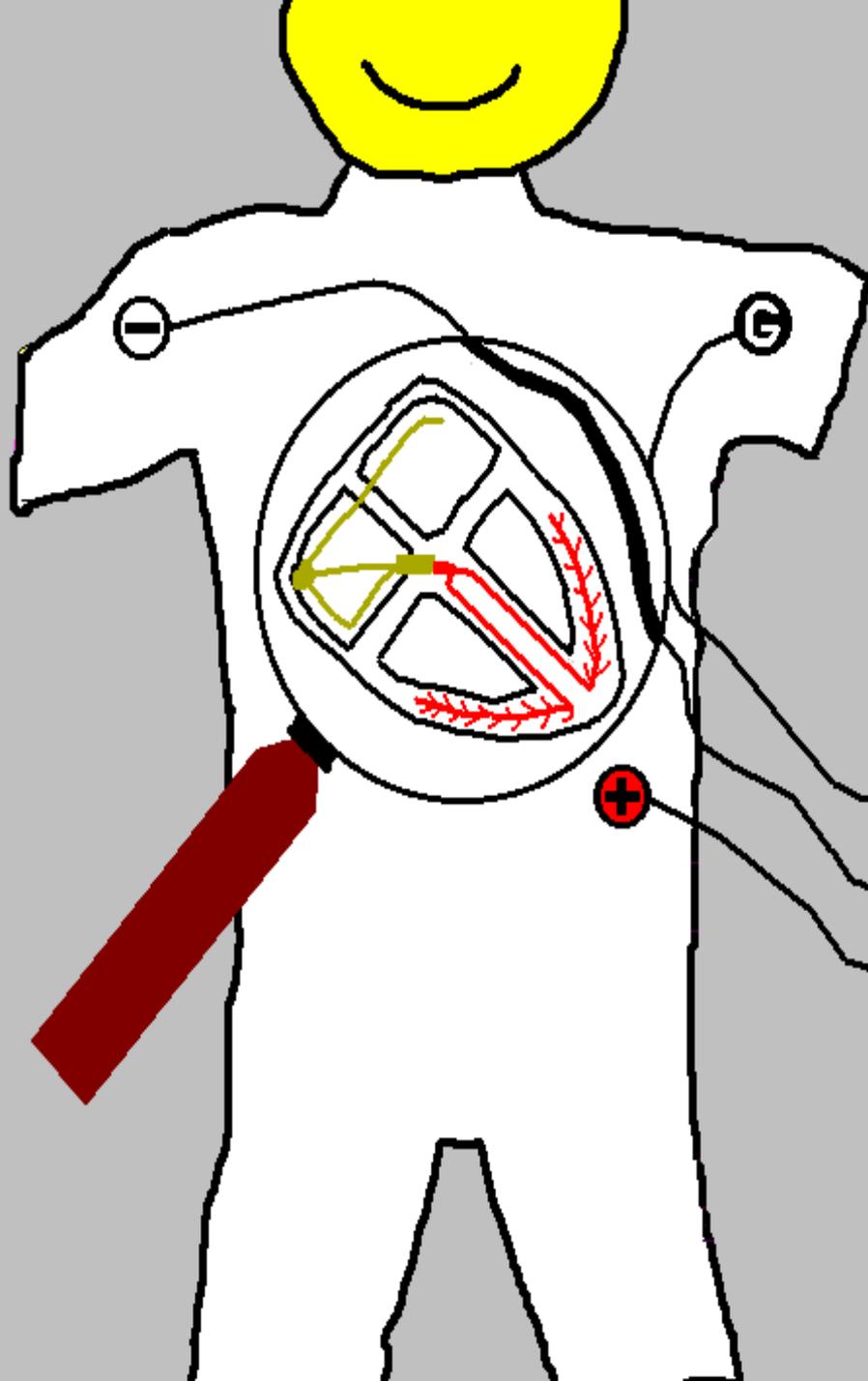
- Depolarization wave in A-V node
- Atrial Repolarization

.10 SECOND  
ISOELECTRIC PAUSE



# VENTRICULAR DEPOLARIZATION

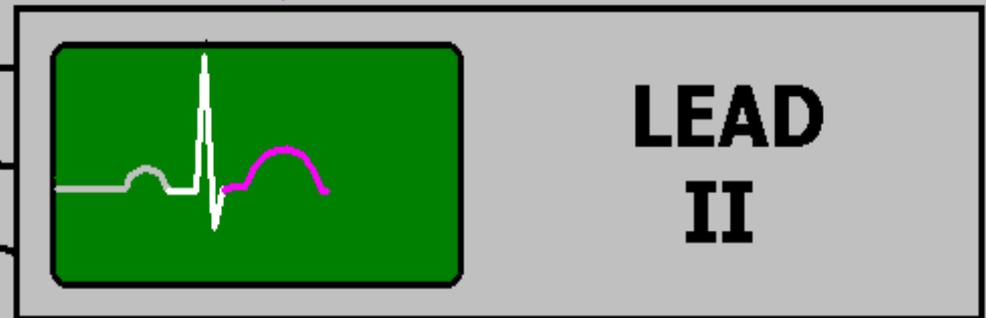
QRS COMPLEX  
IS RECORDED  
ON EKG

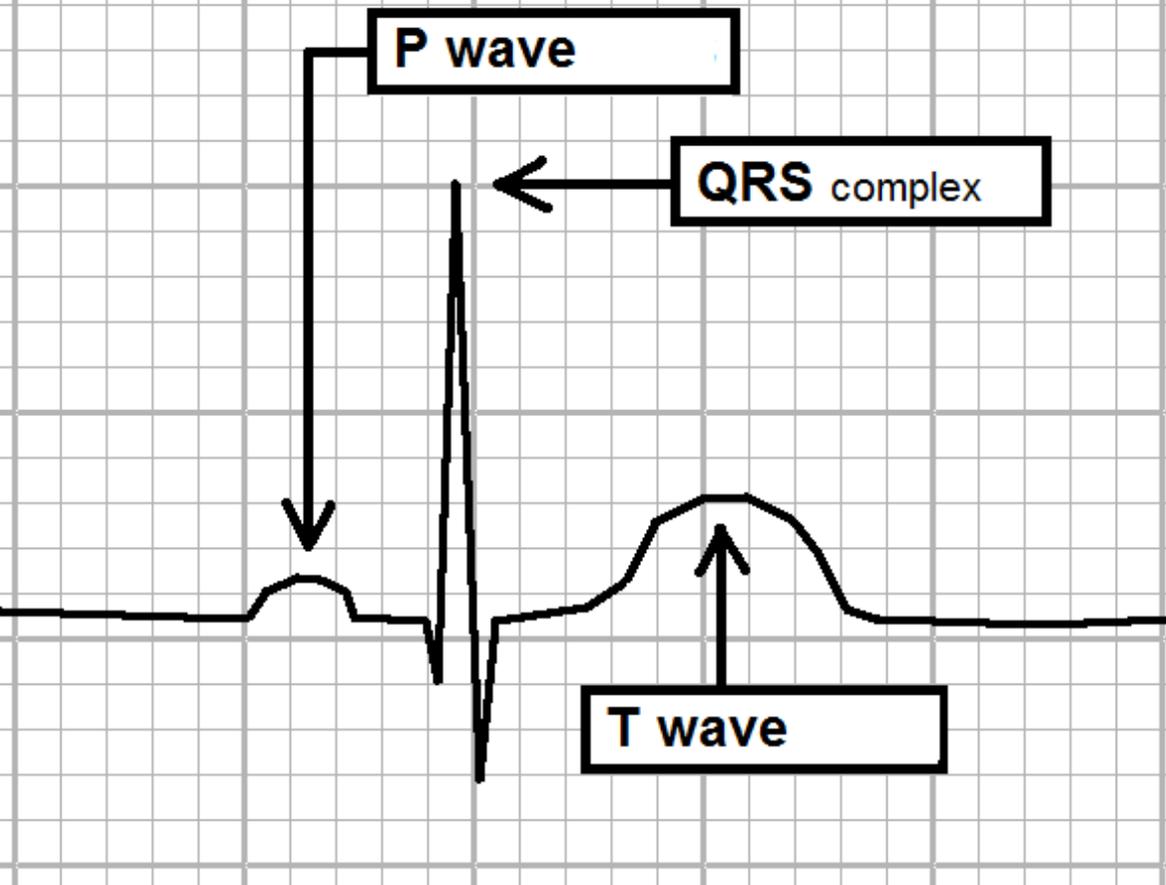


**LEAD  
II**

# VENTRICULAR REPOLARIZATION

WRITES A "T"  
WAVE ON THE  
ECG



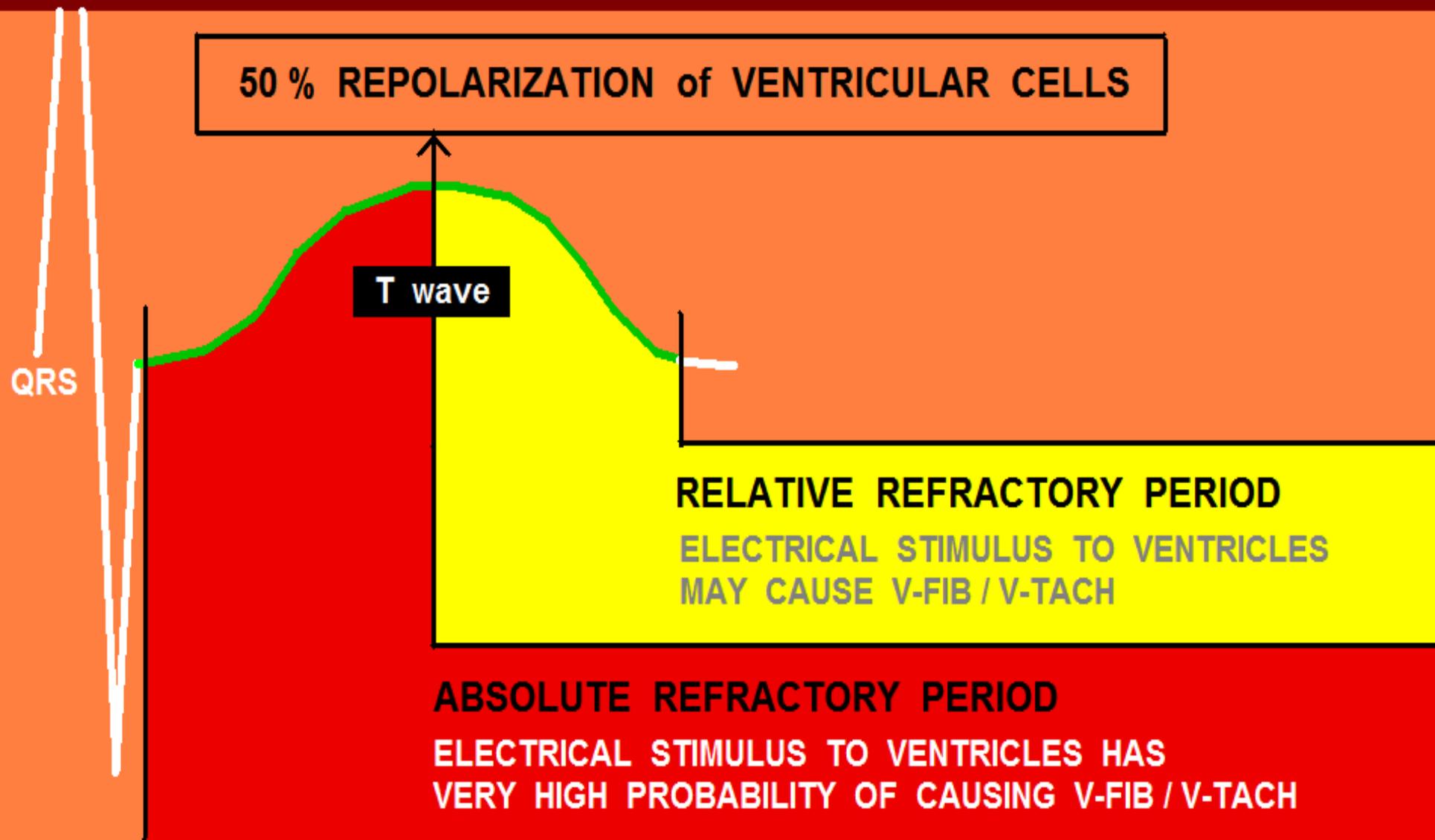


**P WAVE =**  
ATRIAL DEPOLARIZATION

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

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

# CARDIAC ANATOMY and PHYSIOLOGY "101"



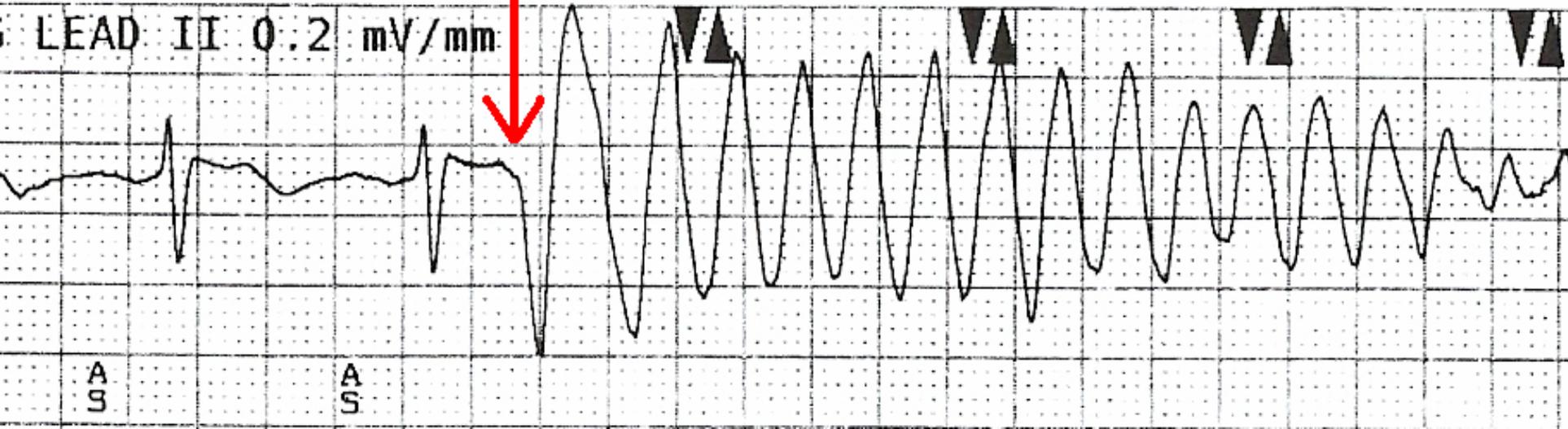
# ROUTINE TEST OF ICD

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

08-Sep-2006 18:01:47

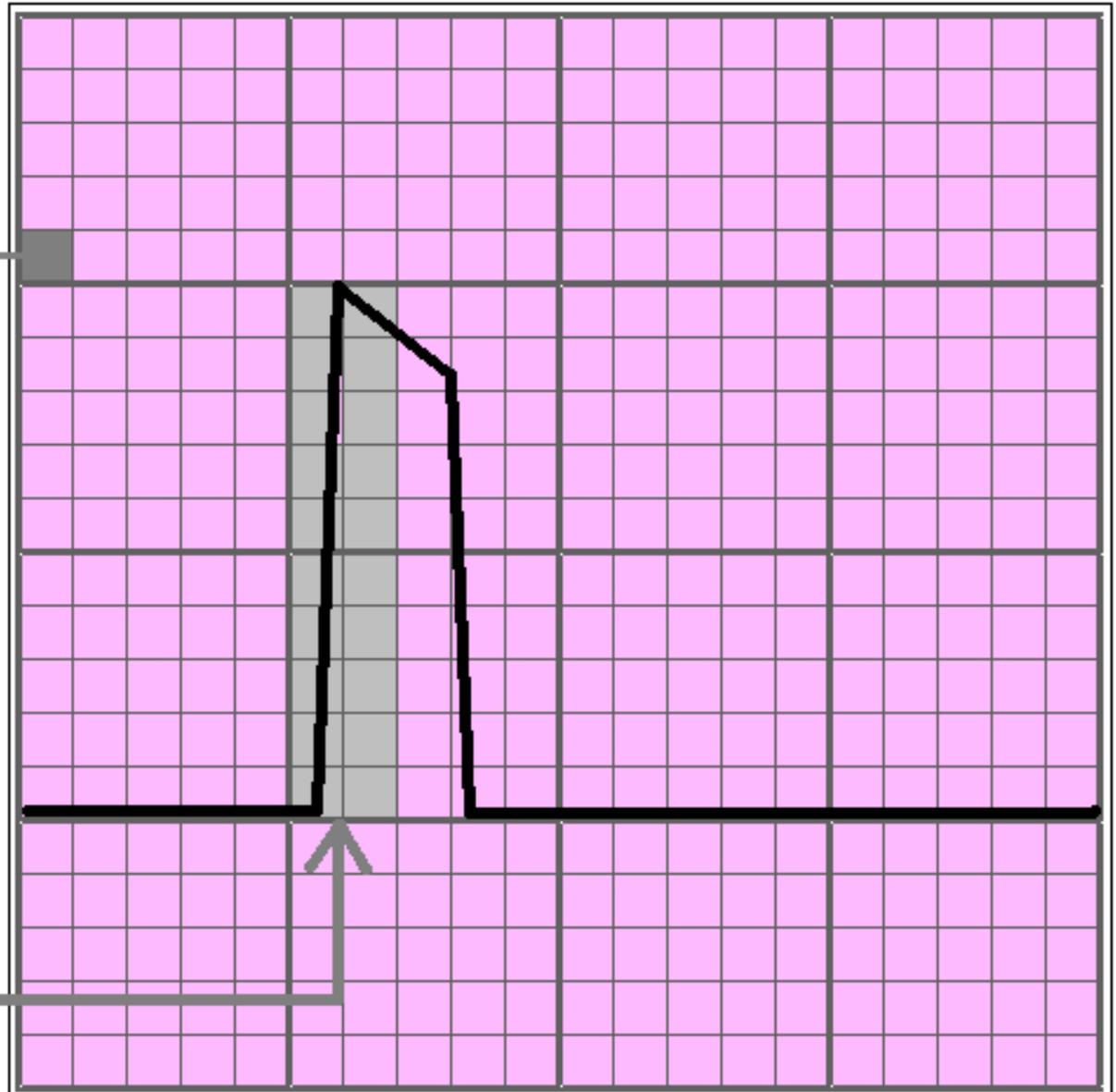
Test Started

**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



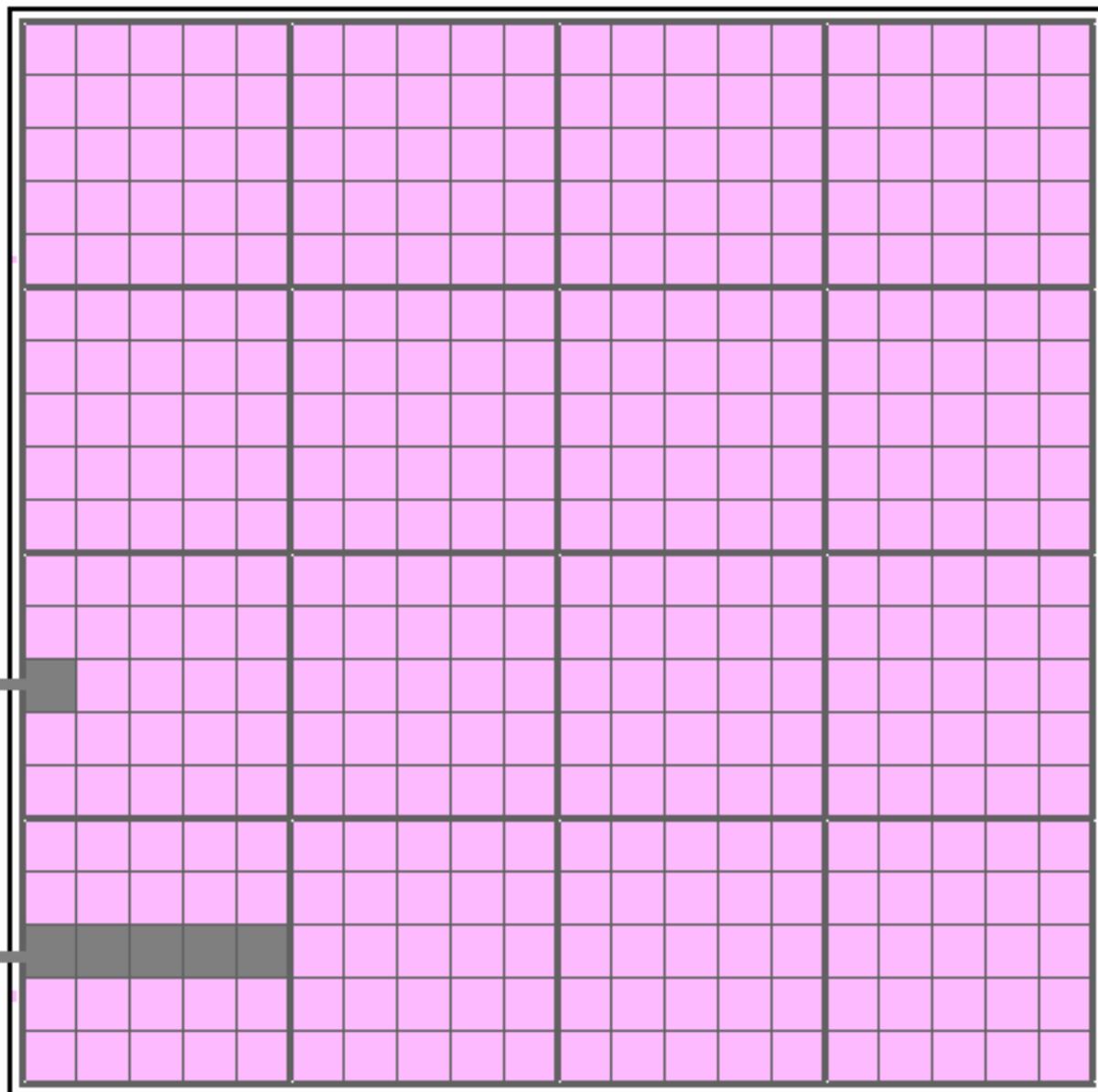
# ECG PAPER - THE HORIZONTAL AXIS:

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

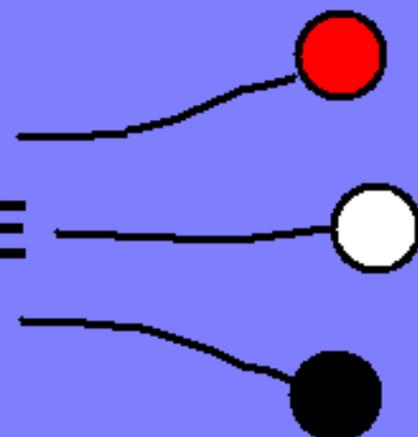
STANDARD 12 LEADS - USES 10 WIRES  
( 6 CHEST and 4 LIMB )

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

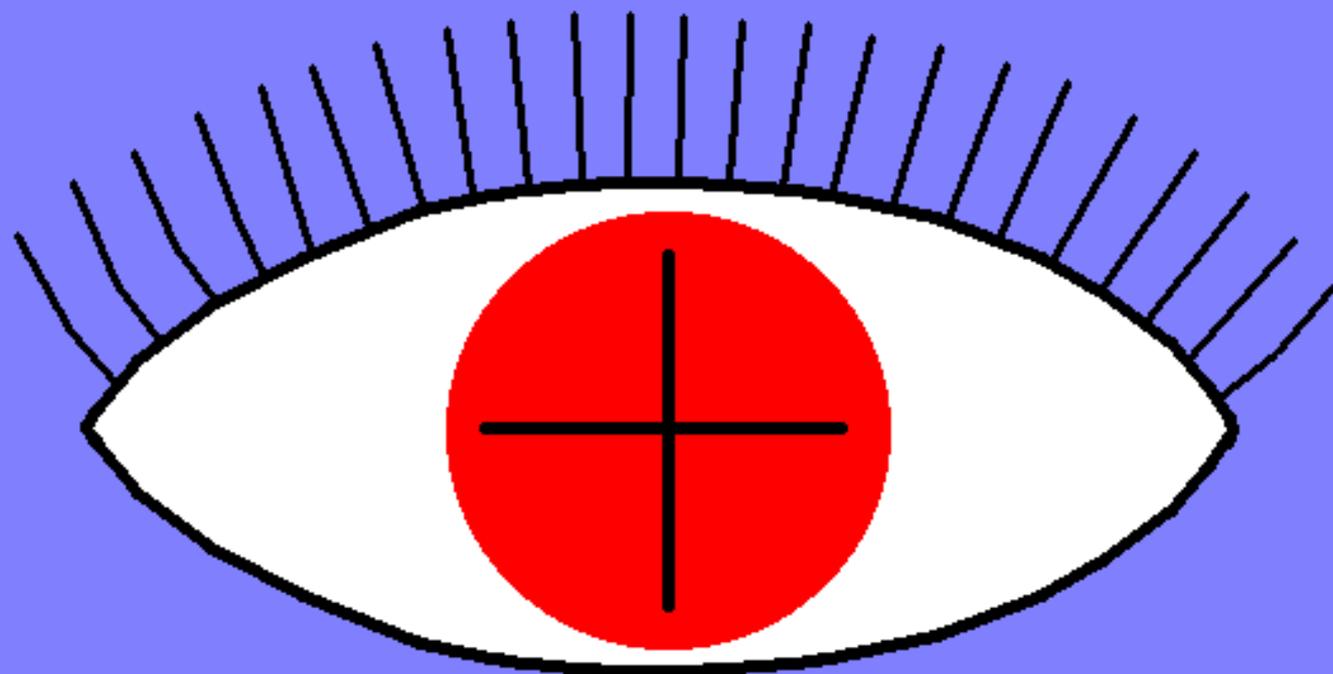
1 POSITIVE ELECTRODE

1 NEGATIVE ELECTRODE

1 GROUND ELECTRODE

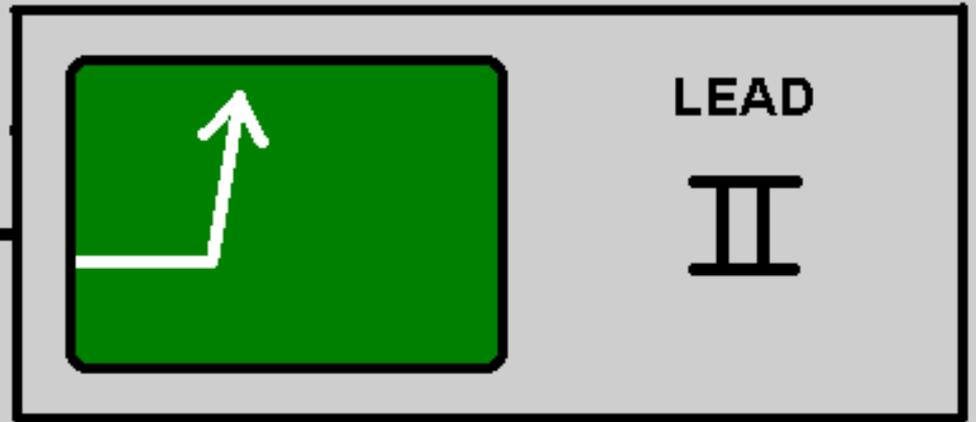
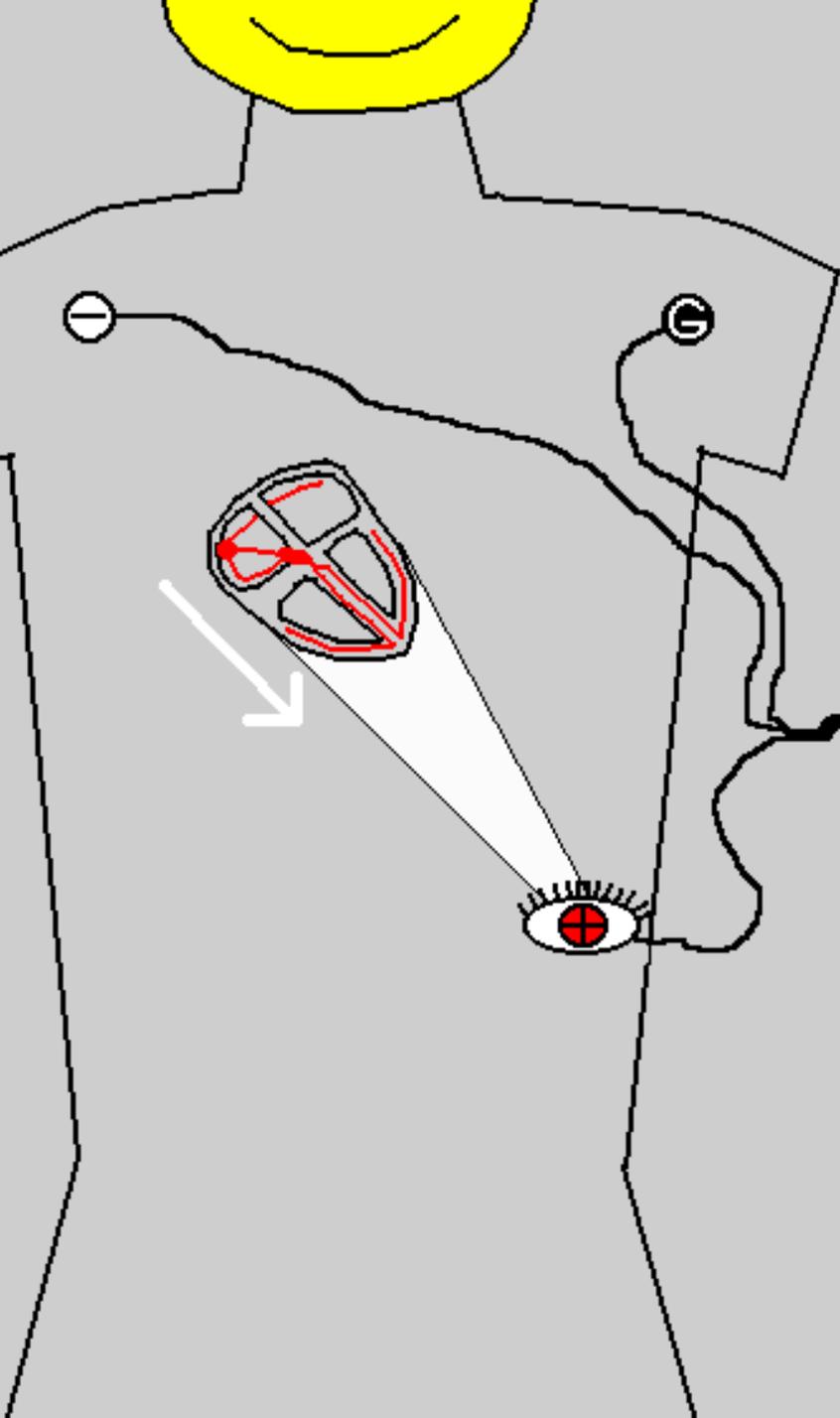


# THE POSITIVE ELECTRODE

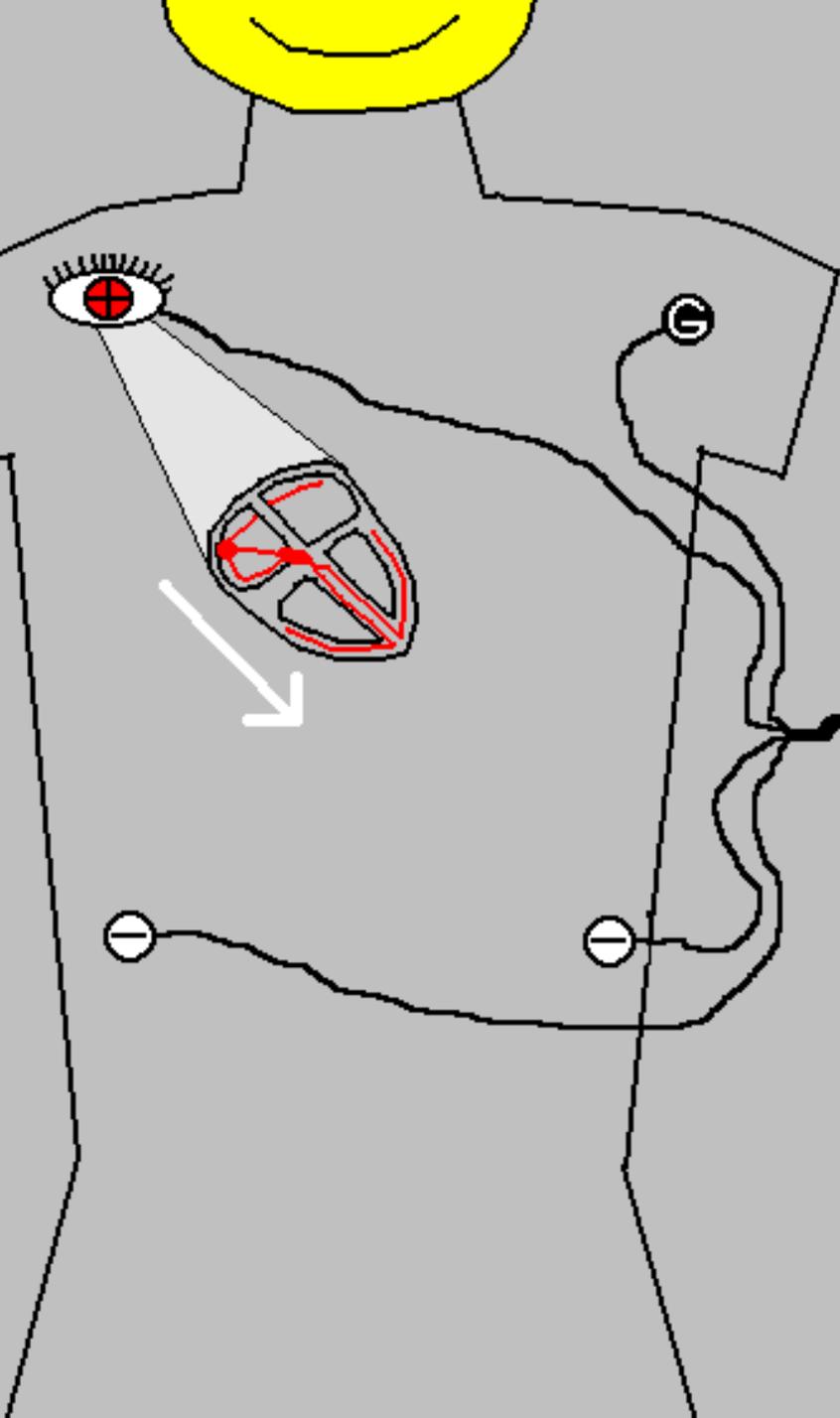


IS THE "EYE" . . .

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



**RECORDS AN  
"UPWARD"  
DEFLECTION**

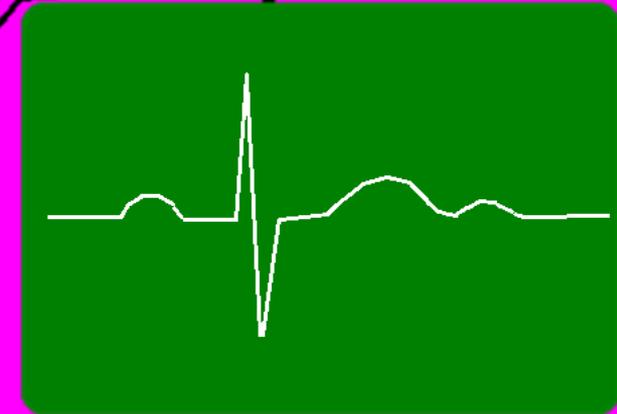
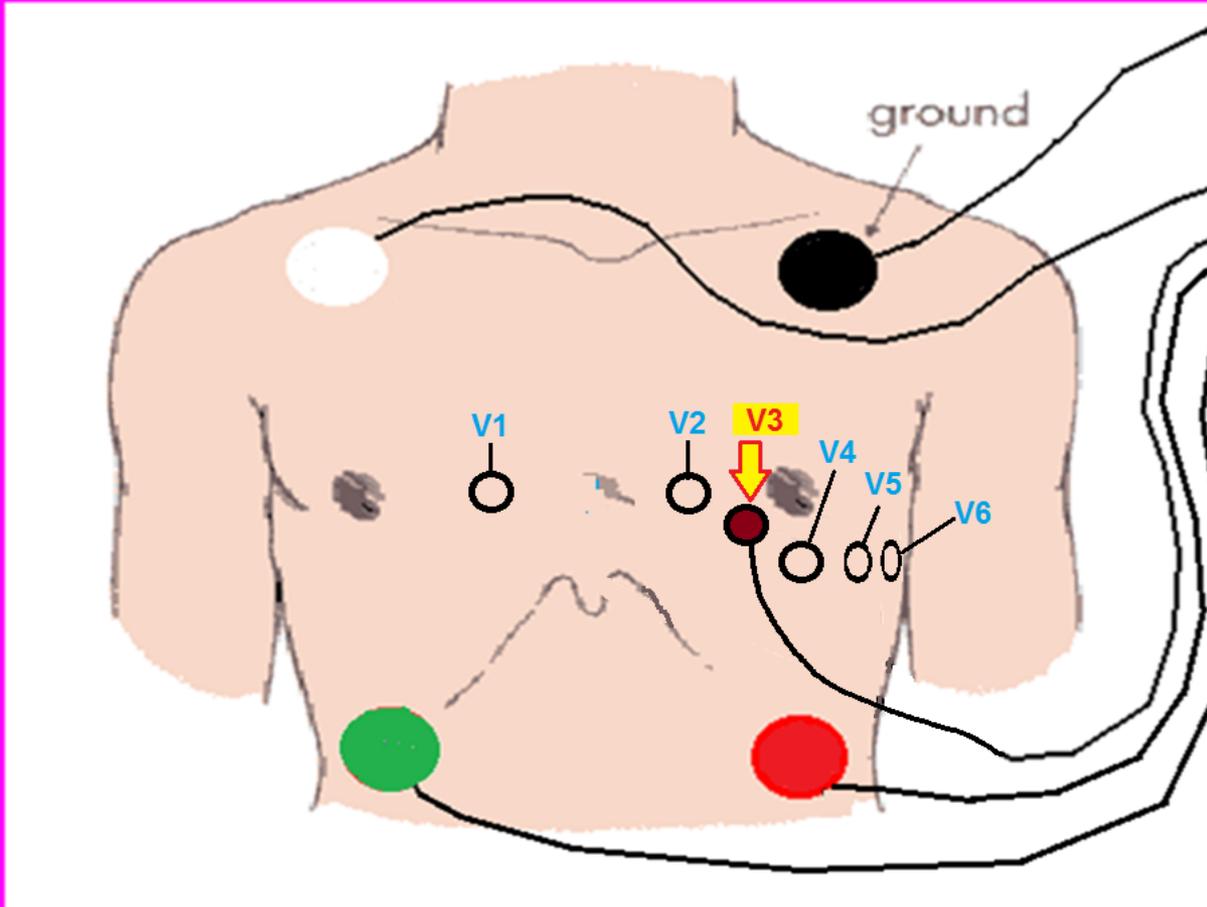


**CURRENT MOVING  
AWAY FROM  
THE EYE  
( POSITIVE ELECTRODE )**



**RECORDS A  
"DOWNWARD"  
DEFLECTION**

# LEAD PLACEMENT - V3



**5 WIRE TELEMETRY UNIT**



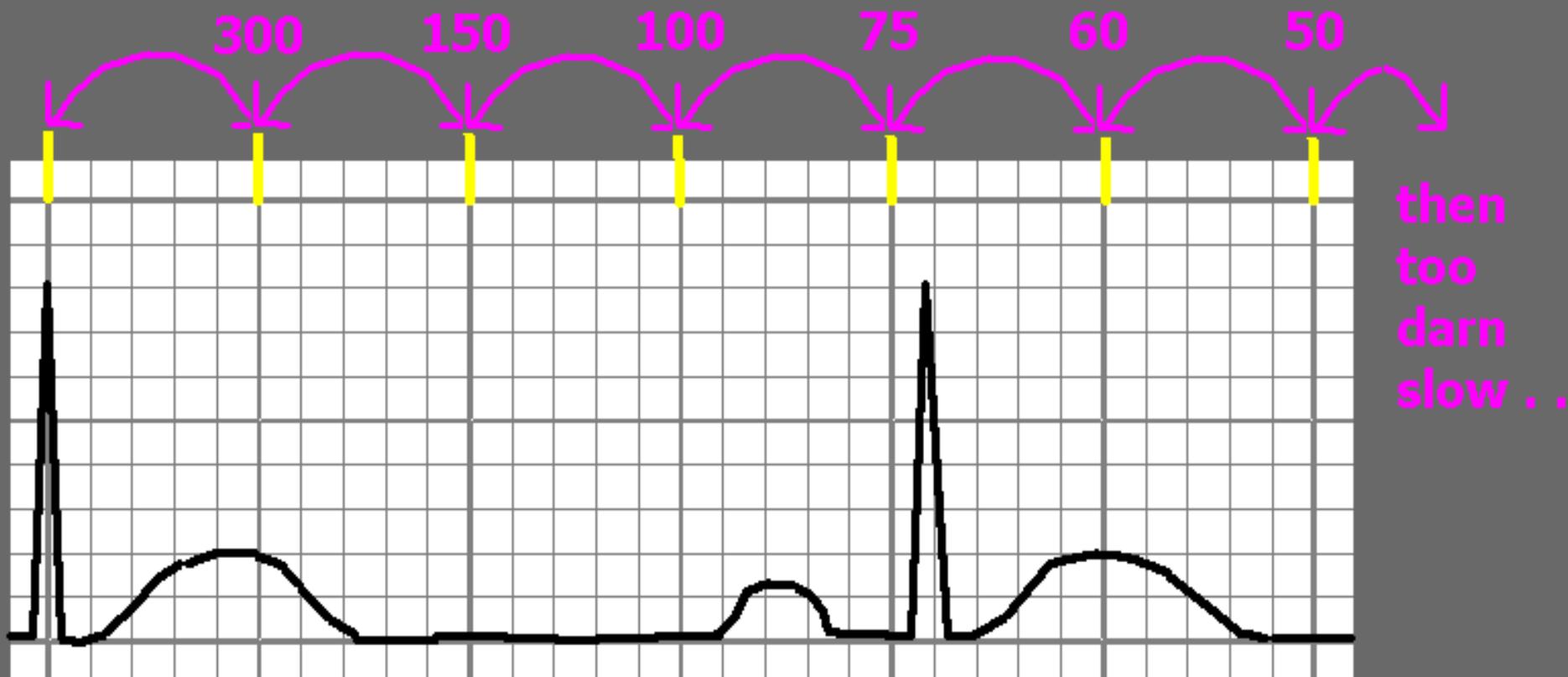
# ESTABLISH YOUR ROUTINE ECG EVALUATION . . . . .



- RATE
- RHYTHM
- INTERVALS
- P:QRS RATIO

# DETERMINE HEART RATE

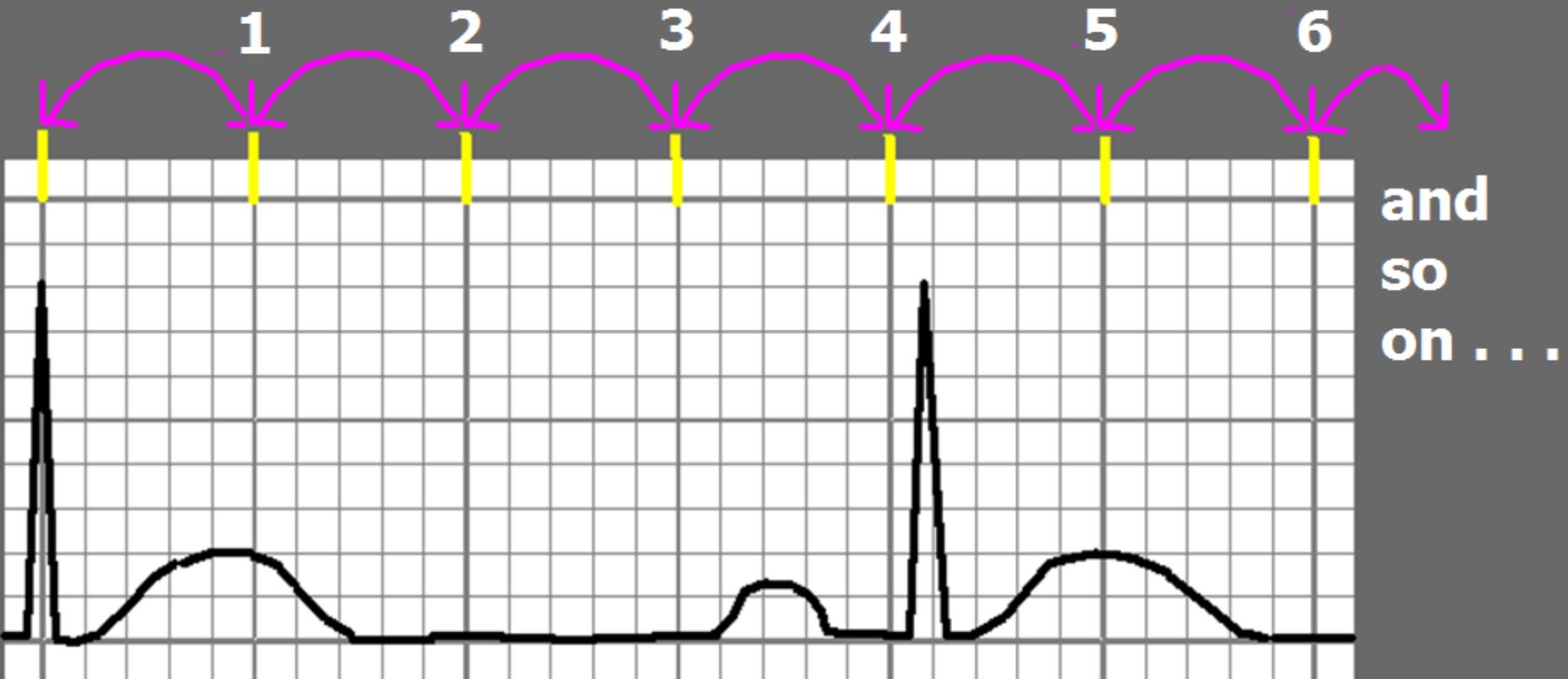
## METHOD 1: (regular rhythm)



# DETERMINE HEART RATE

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

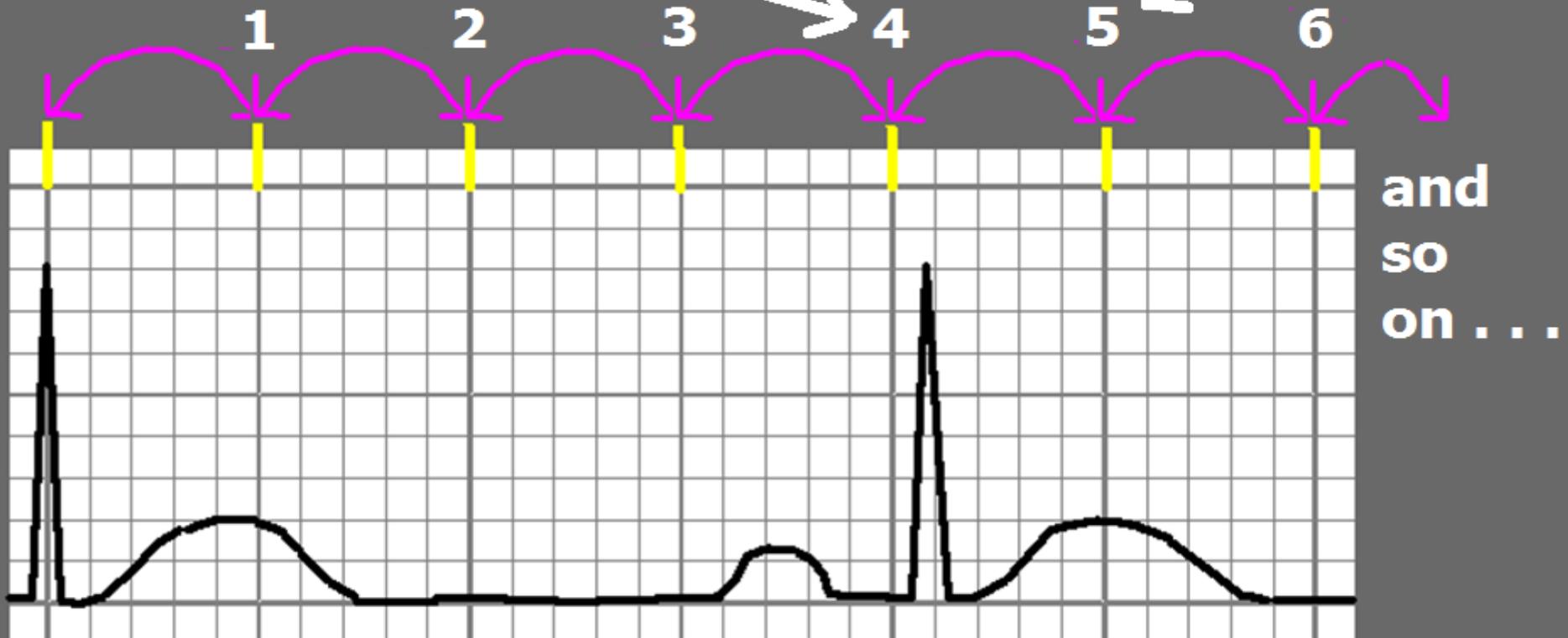
(regular rhythm)



# DETERMINE HEART RATE

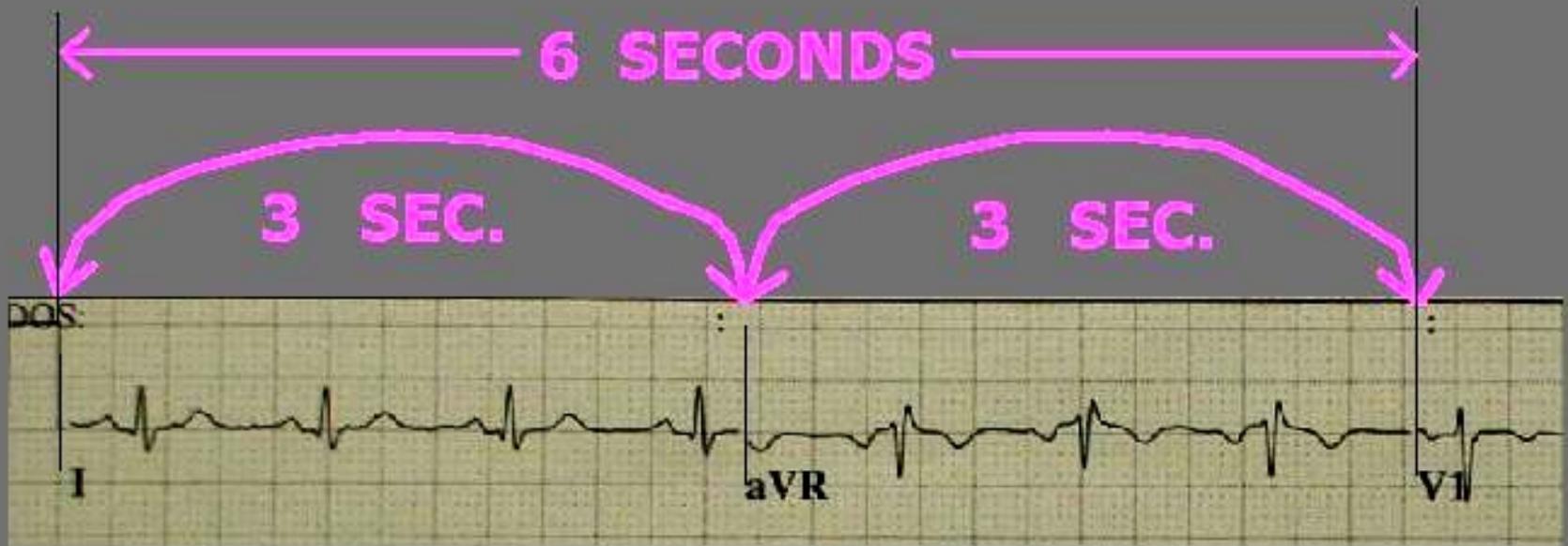
300 divided by 4 = 75

300 divided by 5 = 60



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

# DETERMINE HEART RATE: METHOD 2:

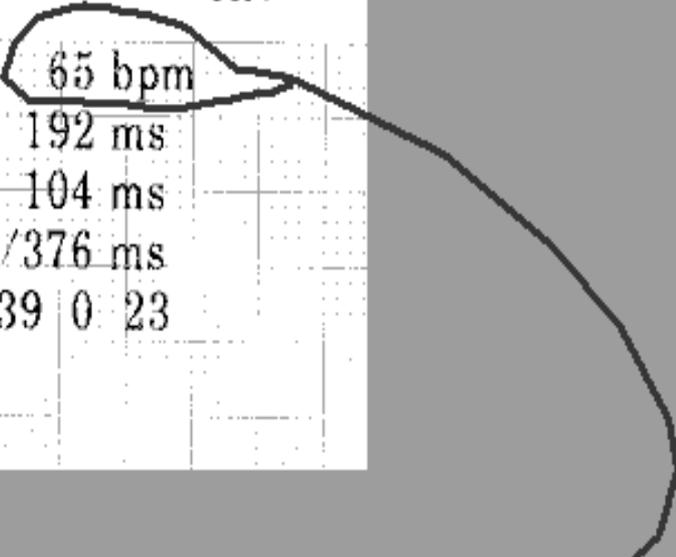


**HR = 70**

. . . . 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

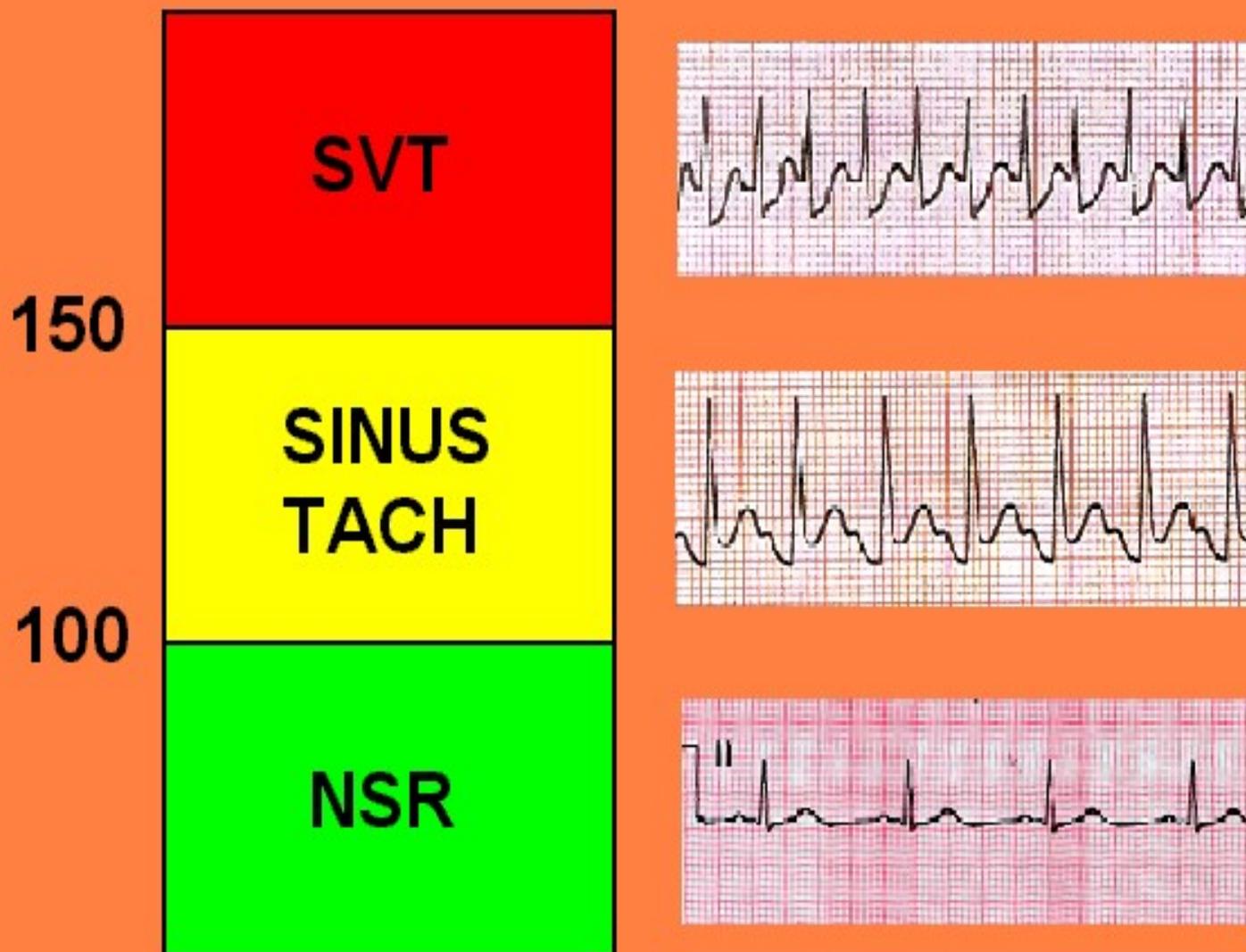
60 - 100

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

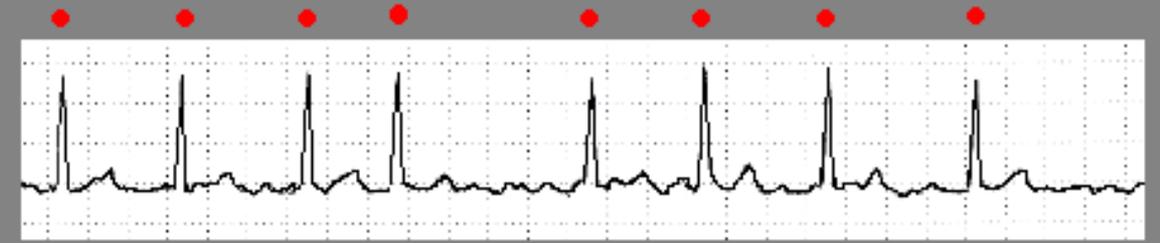
**REGULAR**



**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



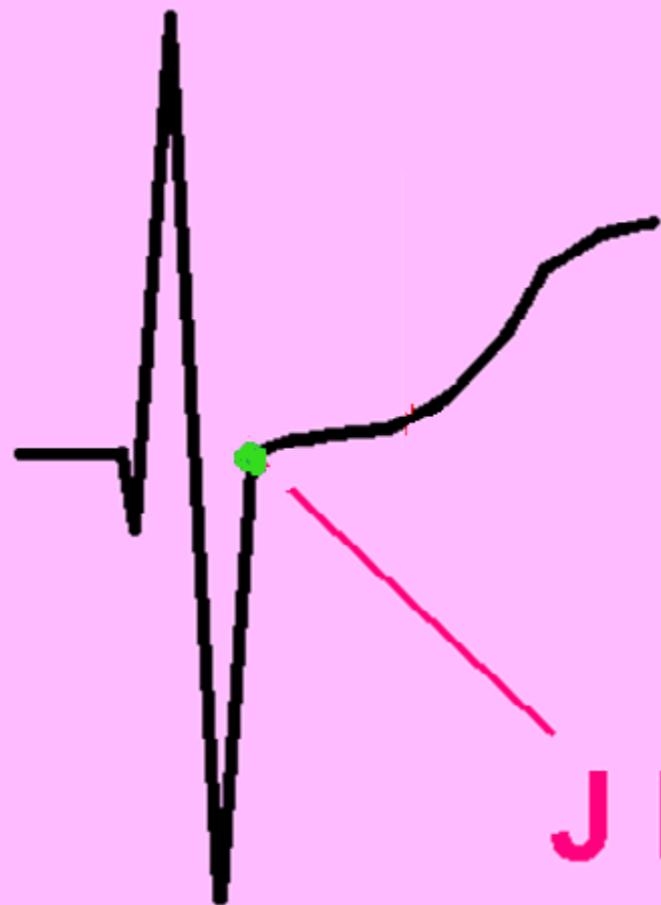
**QRS COMPLEX TOO WIDE**  
**WIDER THAN 120 mSEC**

**THINK:**

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

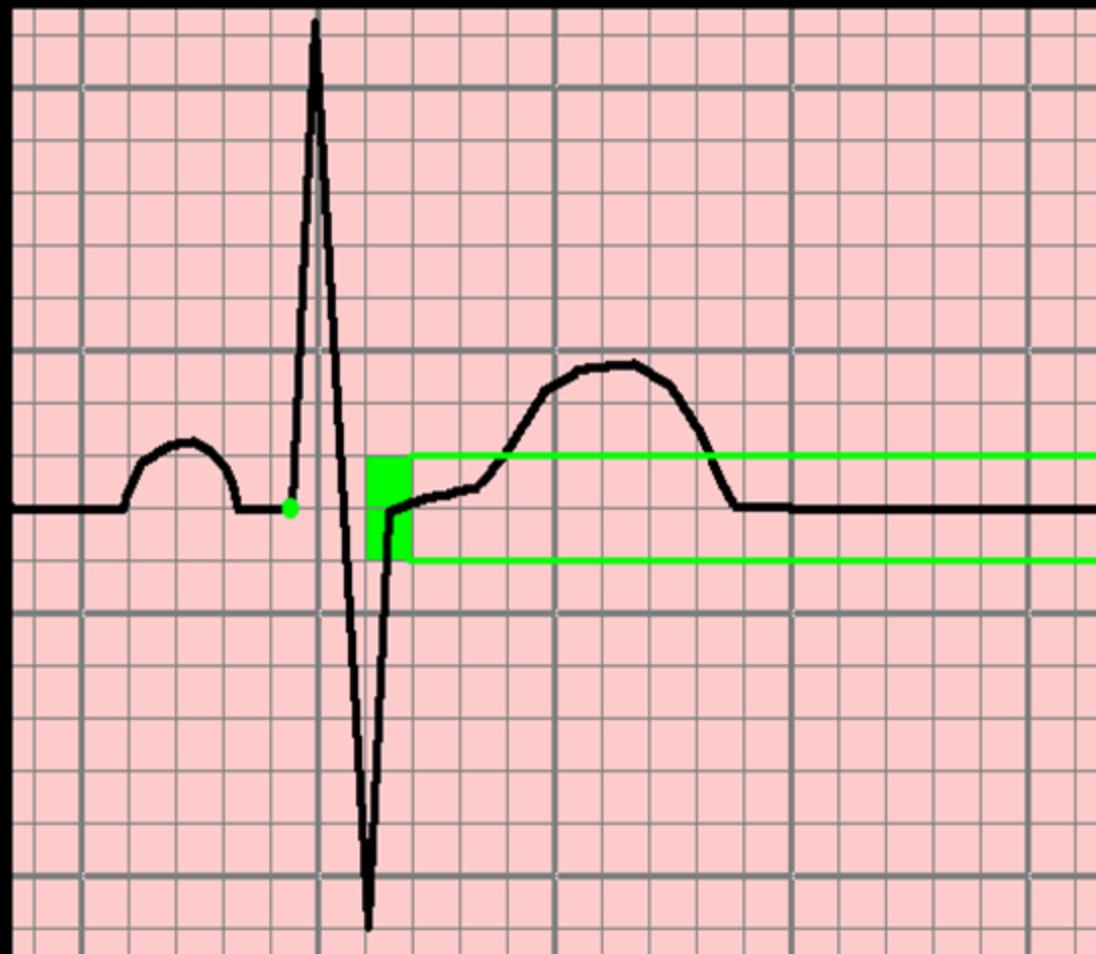
# THE J POINT

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



J POINT

# THE J POINT SHOULD BE ..



WITHIN  
1 mm  
ABOVE

OR

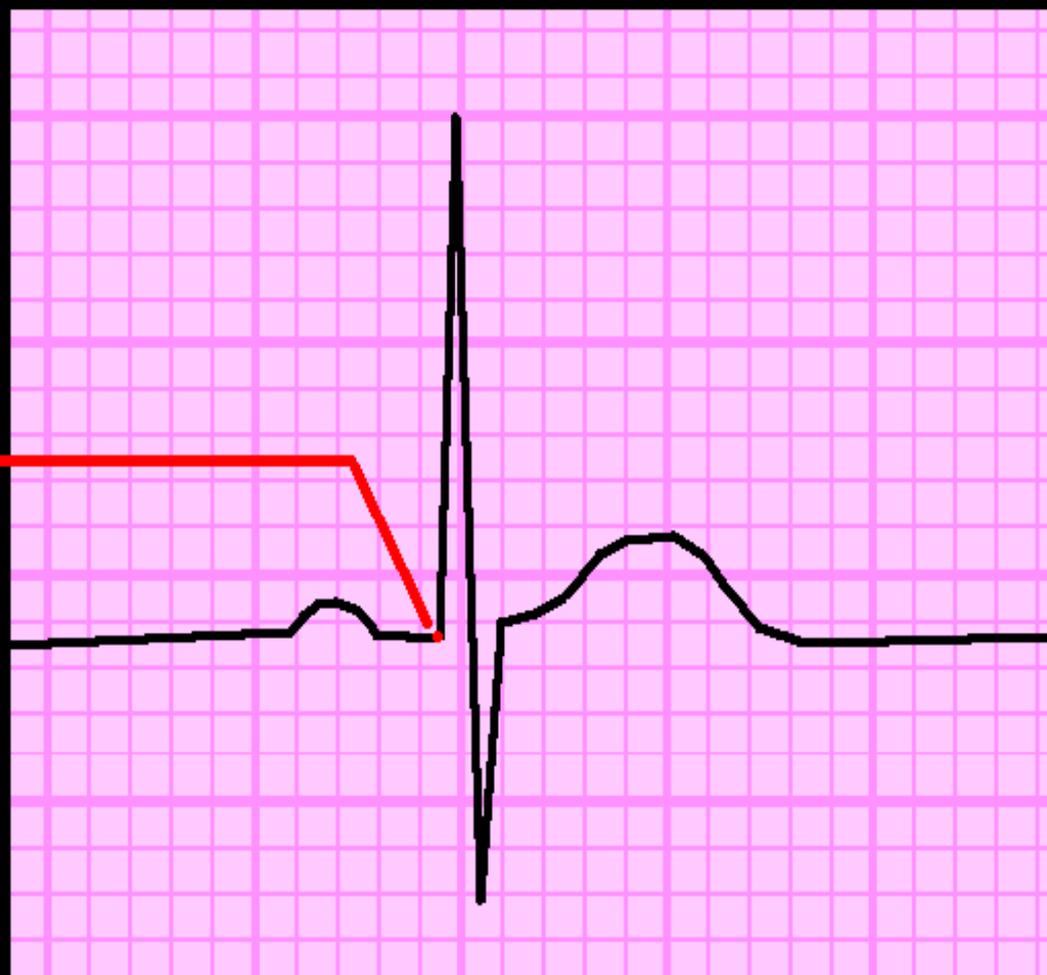
BELOW  
the  
ISOELECTRIC  
LINE

or the P-Q JUNCTION.

# THE P-Q JUNCTION

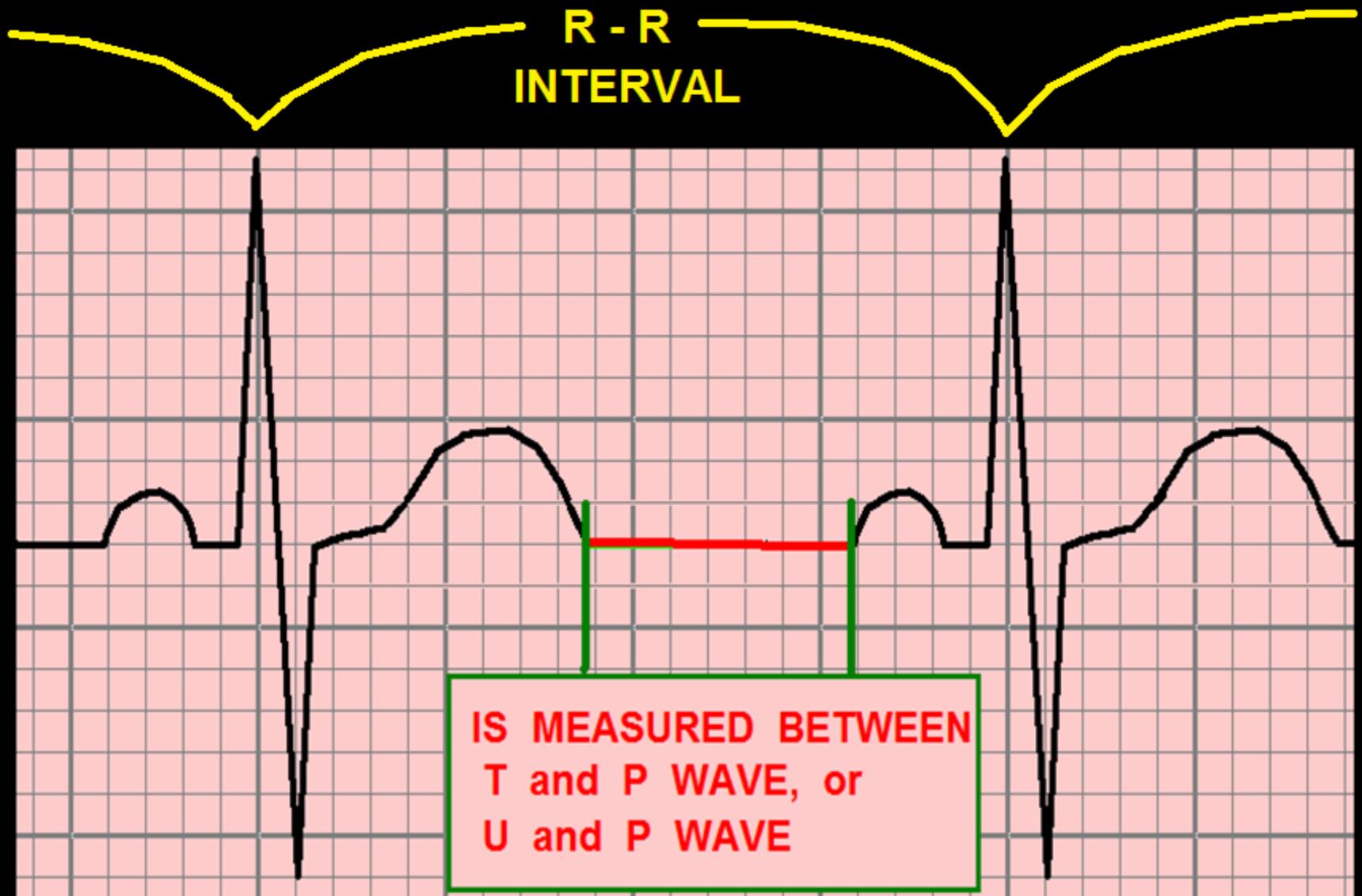
. . . is the POINT where the P-R SEGMENT ends and the QRS COMPLEX BEGINS.

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

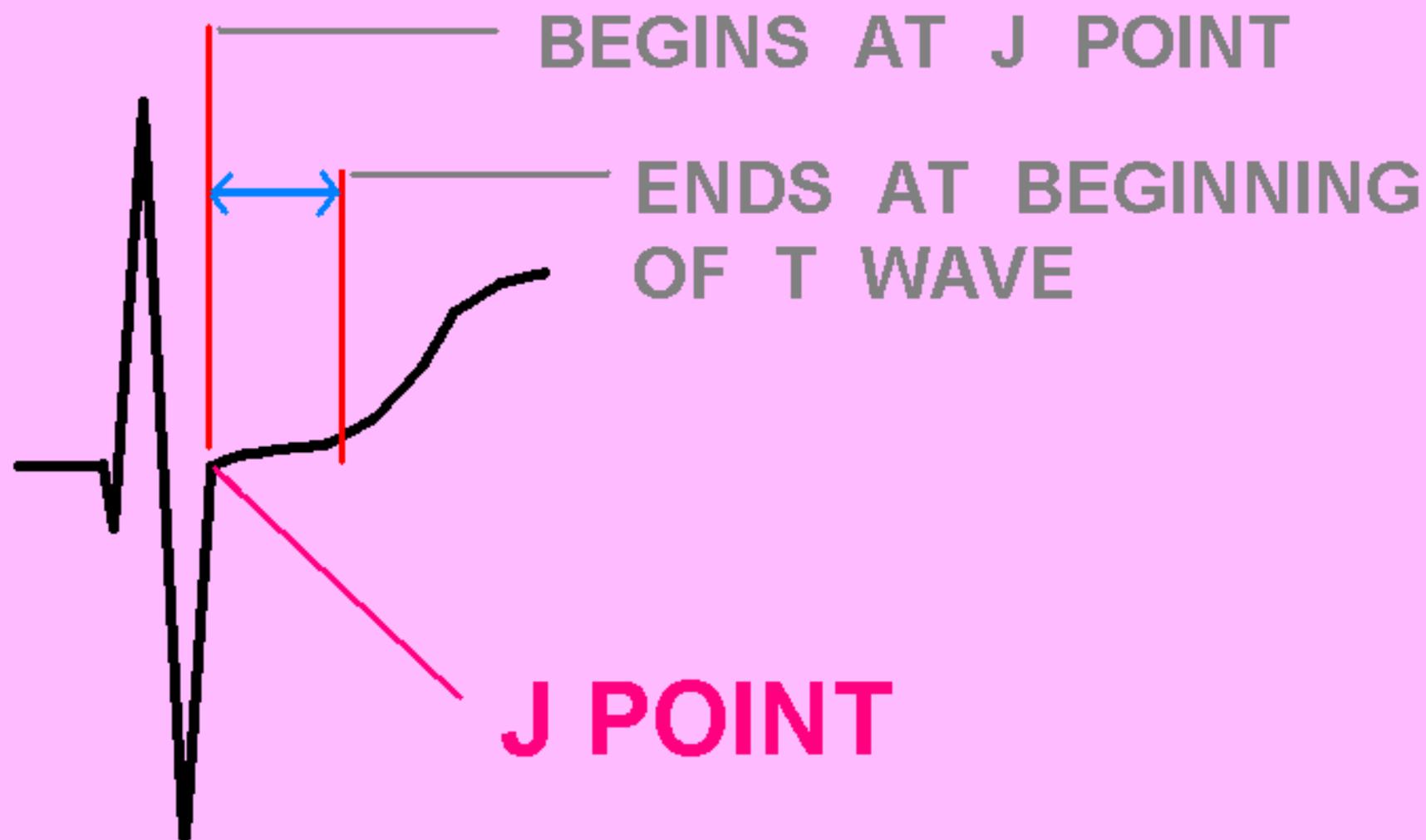


— as per the A.H.A., A.C.C., and WANG, ASINGER, and MARRIOTT, N.E.J.M. vol. 349:2128-2135 Nov. 27, 2003

# 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

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

- REQUIRES CALCULATOR  
WITH SQUARE ROOT FUNCTION

## THE \*QTc INTERVAL

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

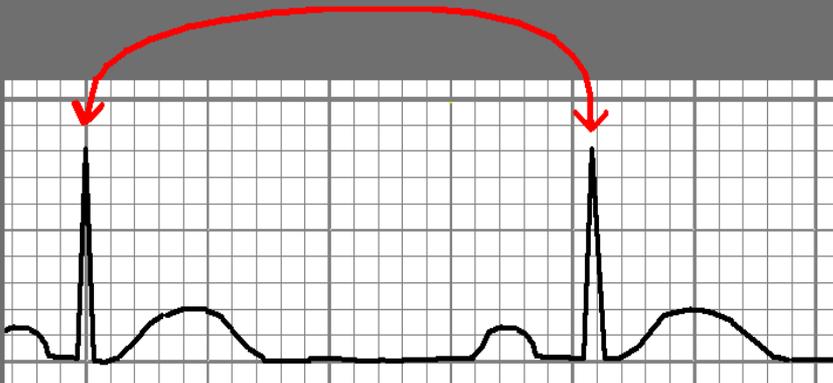
HEART RATE	MALE	FEMALE
150	0.25	0.28
125	0.26	0.29
100	0.31	0.34
93	0.32	0.35
83	0.34	0.37
71	0.37	0.40
60	0.40	0.44
50	0.44	0.48
43	0.47	0.51

*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

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

- ACCURATE AT ALL RATES

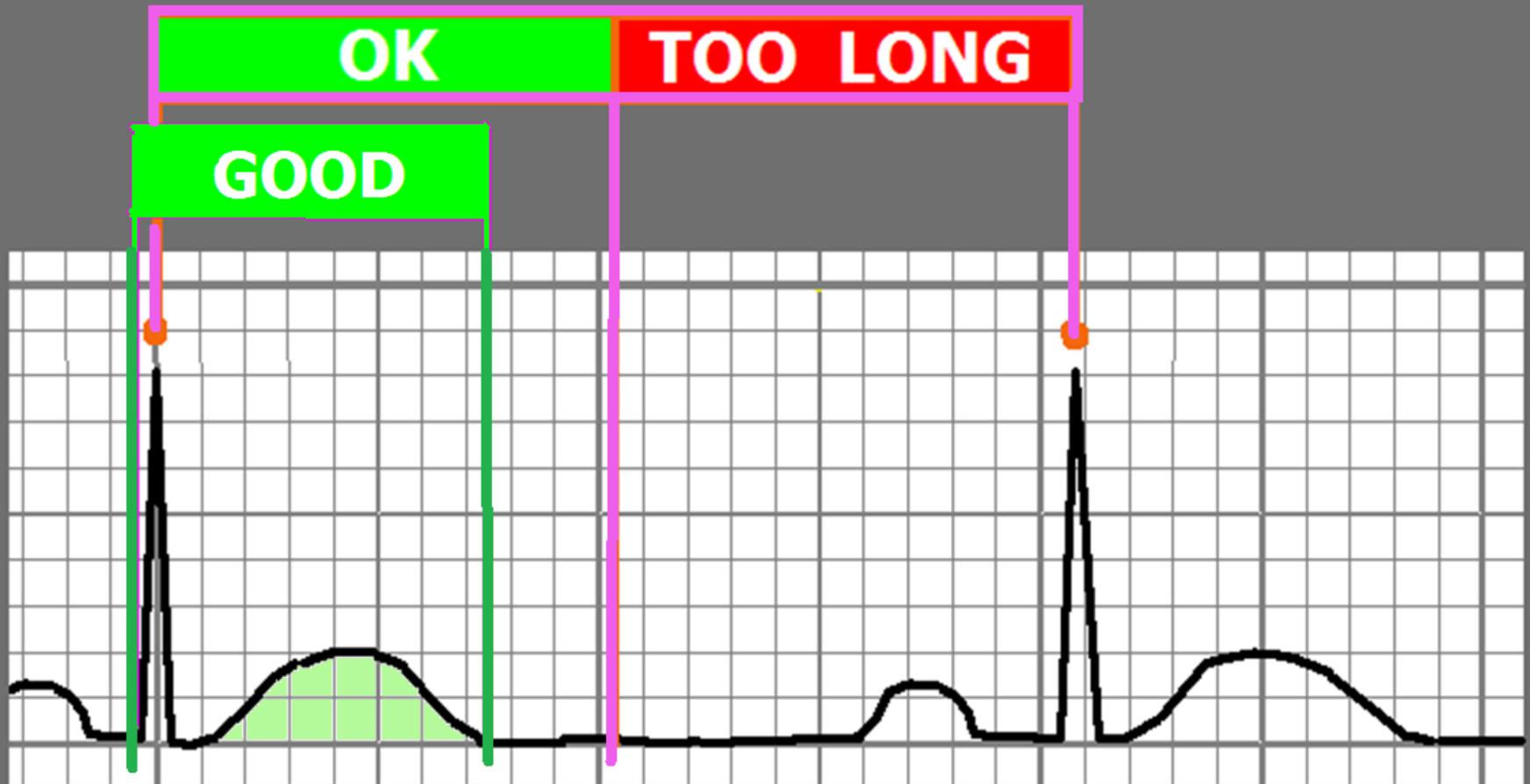
# DETERMINING Q-T INTERVAL LIMITS

## THE "QUICK PEEK" METHOD

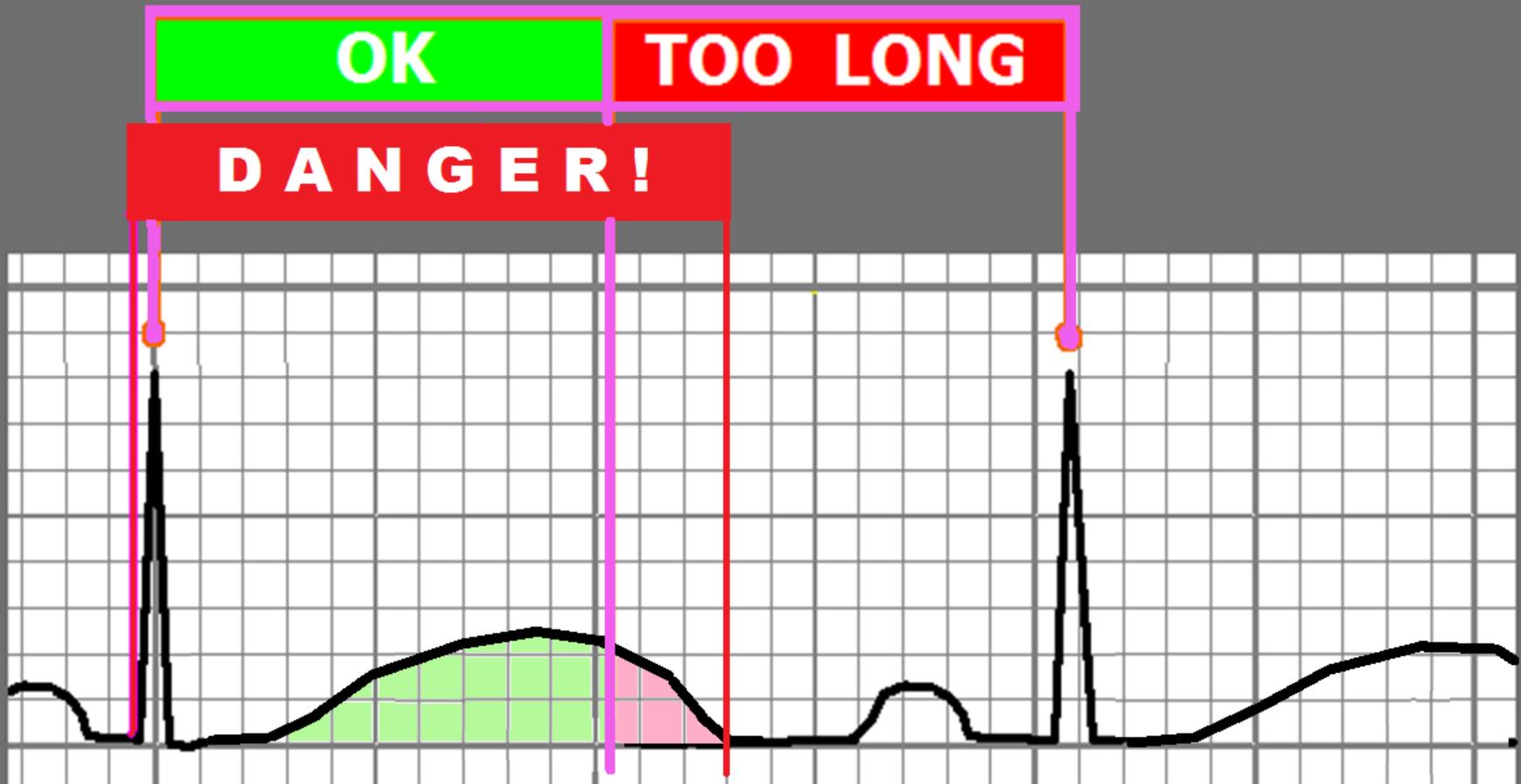
- ☞ Relatively accurate method to quickly identify patients with abnormal QT Intervals.
- Applies to patients with normal heart rates (60-100) and narrow QRS (QRSd < 120ms)



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 . . .

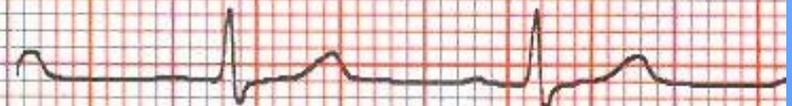
Heart Rate = 83

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:

Too Short:	<390 ms
Normal:	390 - 450 ms
Borderline High:	450 - 500 ms
Critical High:	> 500 ms

## Females:

Too Short:	<390 ms
Normal:	390 - 460 ms
Borderline High:	460 - 500 ms
Critical High:	> 500 ms

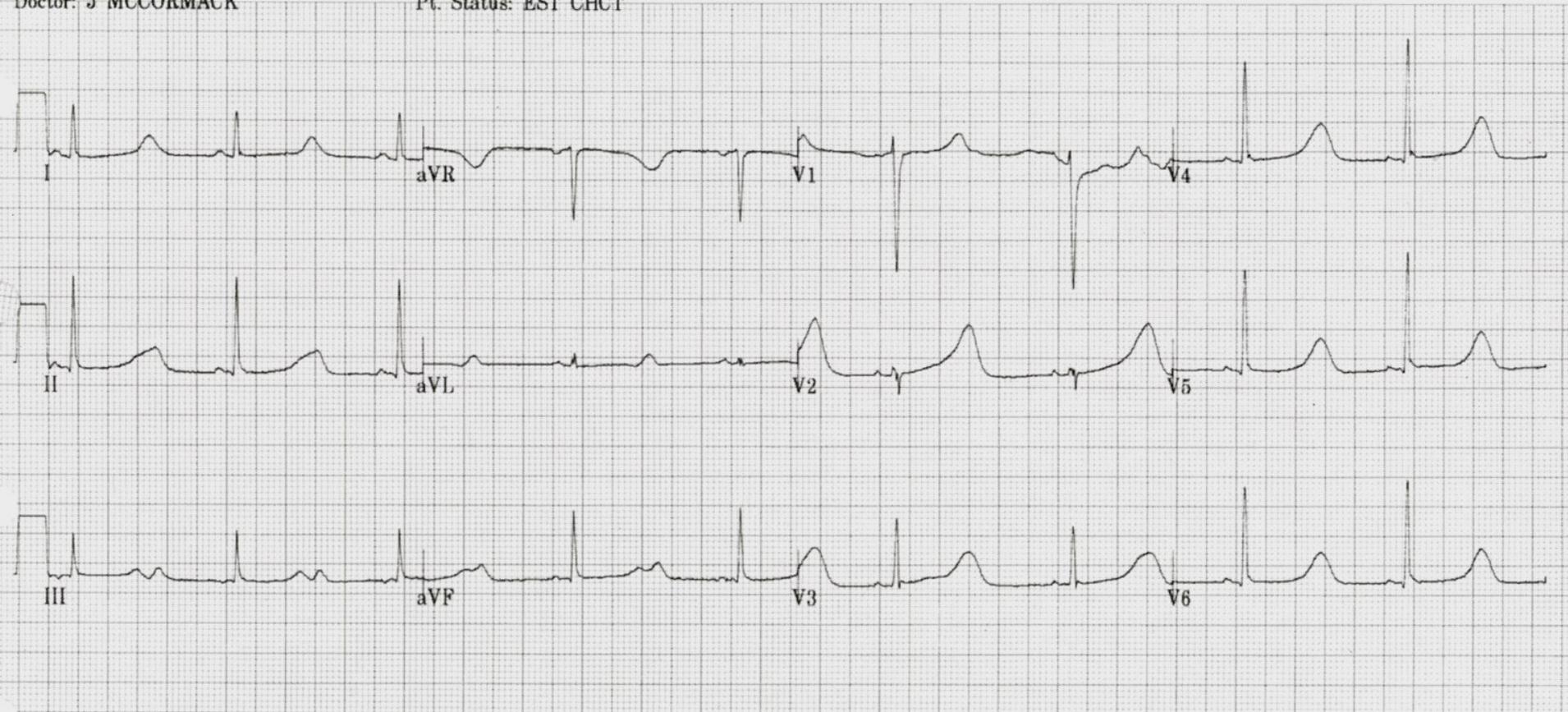
**22 y/o FEMALE**

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:*

**-Amiodarone**

**-Ritalin**

**-Procainamide**

**-Pseudoephedrine**

**-Levaquin**

**-Haloperidol**

**-Erythromycin**

**-Thorazine**

**-Norpace**

**-Propulcid**

**-Tequin**

**-Zofran**

**-Benadryl**

**-Ilbutilide**

***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

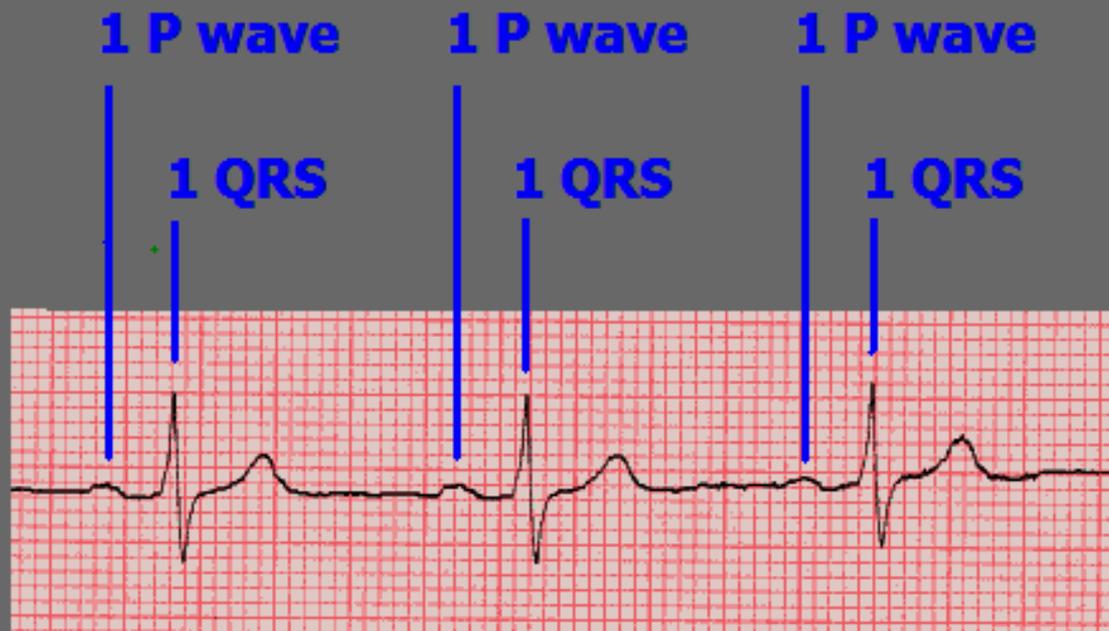


P:QRS RATIO

# DETERMINE P : QRS RATIO



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



# **P : QRS RATIO**

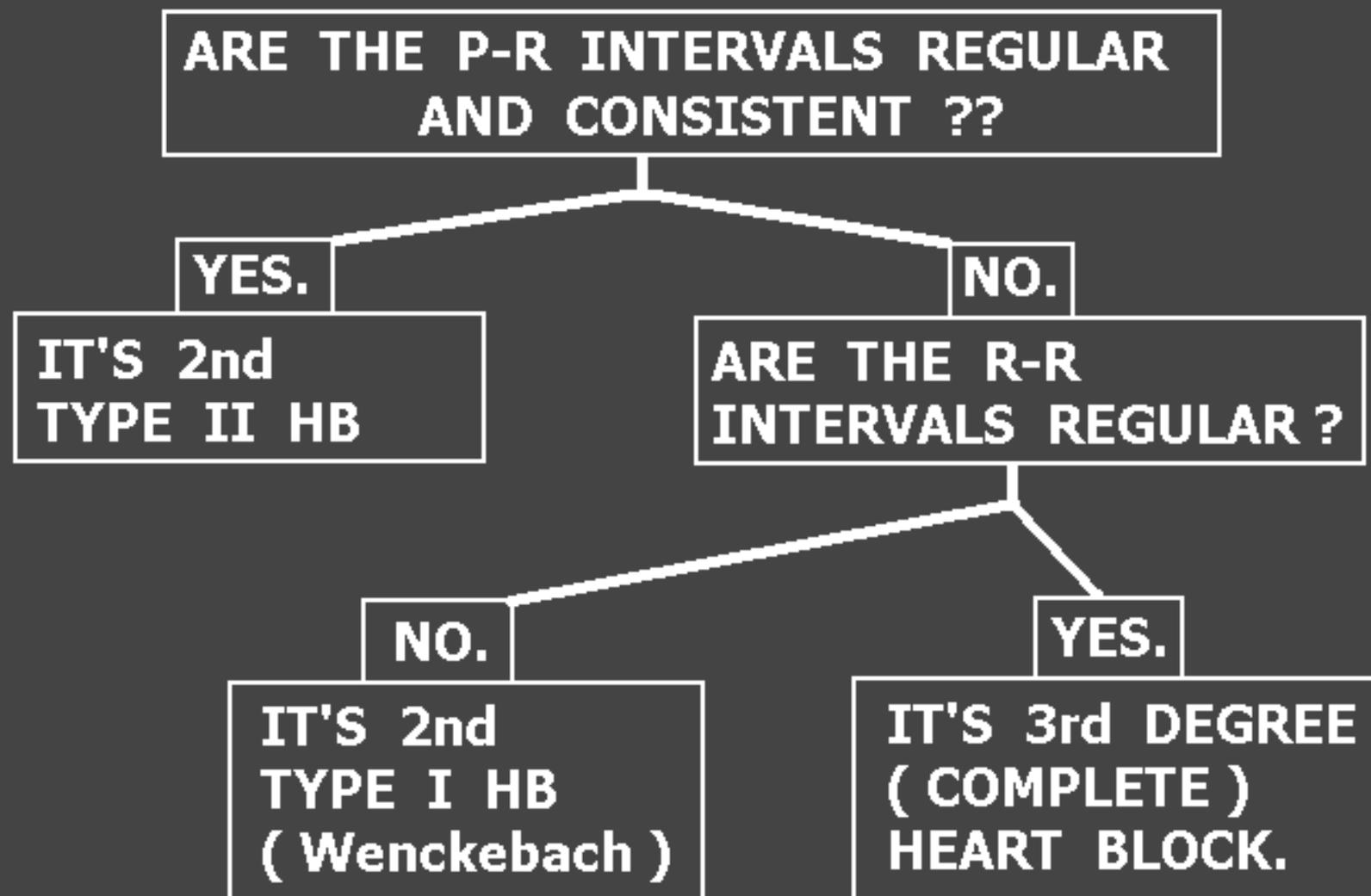
**IF GREATER THAN 1 : 1**

**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



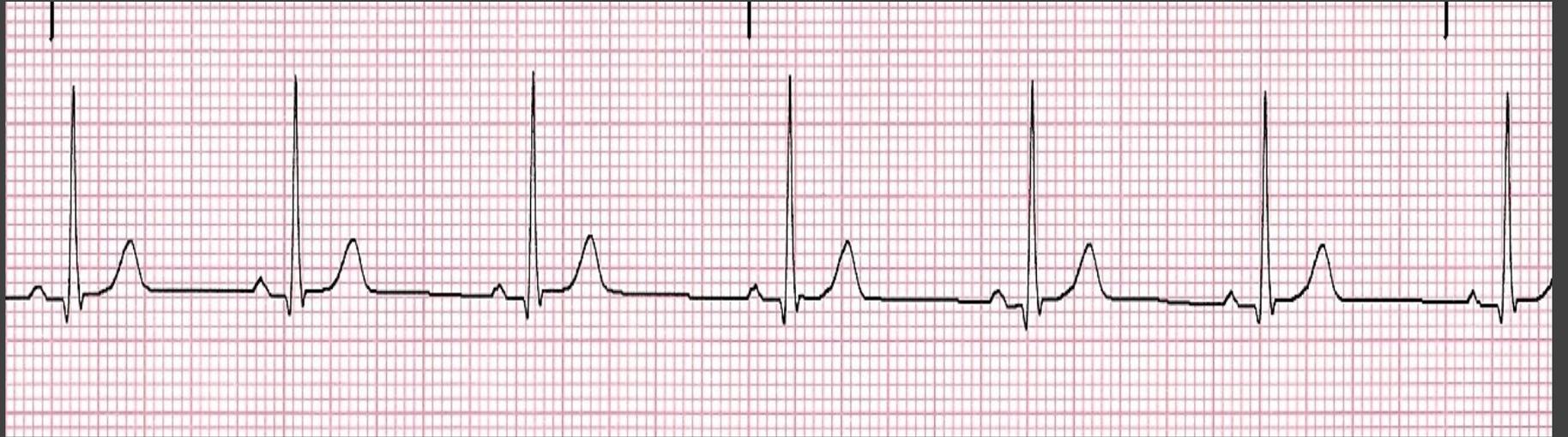
3





# ESTABLISH YOUR ROUTINE ECG EVALUATION . . . . .

- RATE
- RHYTHM
- INTERVALS
- P:QRS RATIO



# THIS RHYTHM IS: NORMAL SINUS RHYTHM

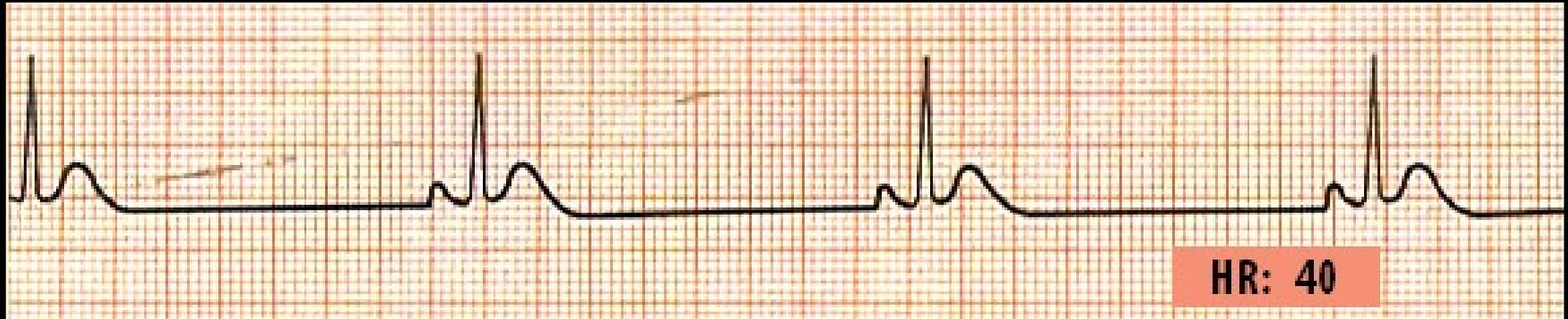


**MAIN IDENTIFICATION CHARACTERISTIC(S): PERFECTLY NORMAL IN EVERY WAY!**

**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 -----

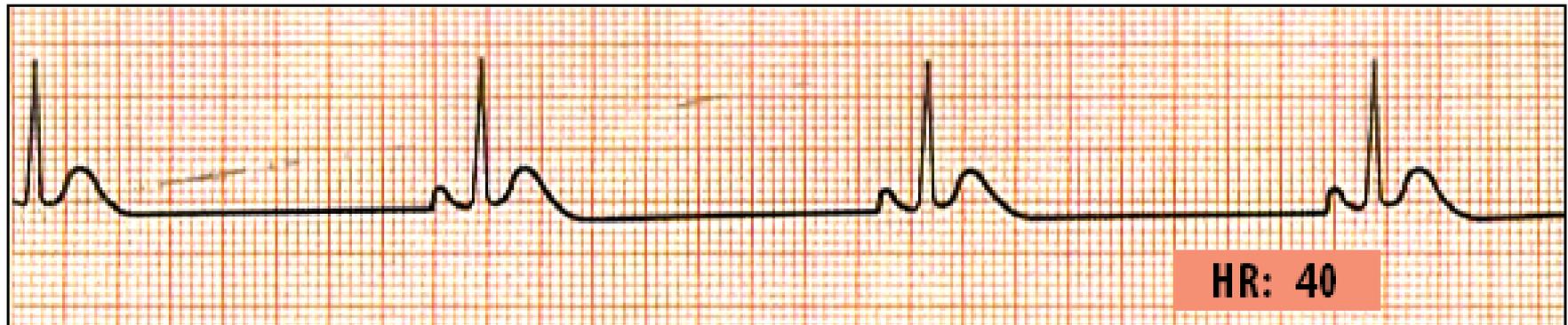
RHYTHM -----

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 =

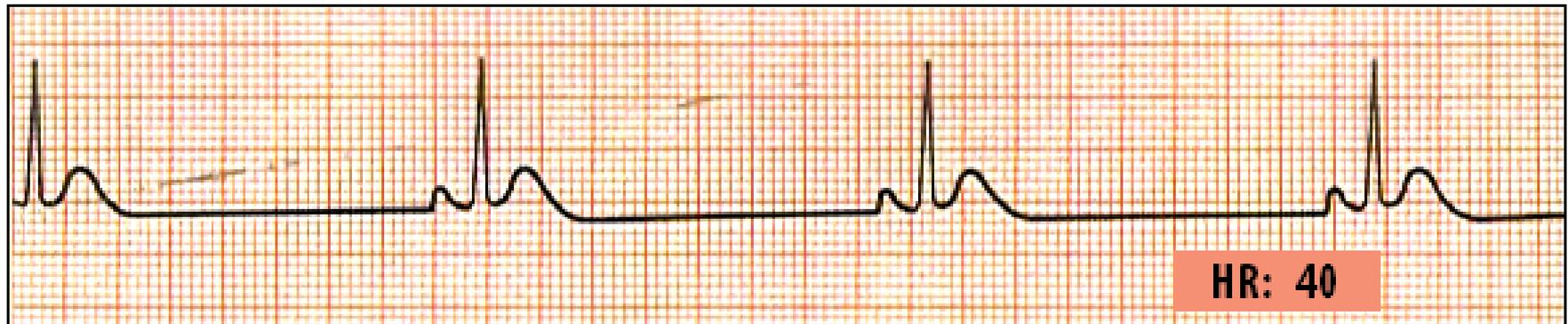
INADEQUATE TISSUE  
PERFUSION

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

# SHOCK ASSESSMENT

<b>LOC:</b>	<b>ANXIOUS RESTLESS LETHARGIC UNCONSCIOUS</b>	<b>AWAKE ALERT &amp; ORIENTED</b>
<b>SKIN:</b>	<b>PALE / ASHEN CYANOTIC COOL DIAPHORETIC</b>	<b>NORMAL HUE WARM DRY</b>
<b>BREATHING:</b>	<b>TACHYPNEA</b>	<b>NORMAL</b>
<b>PULSE:</b>	<b>WEAK / THREADY TOO FAST or SLOW</b>	<b>STRONG</b>
<b>STATUS:</b>	 <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 -----	<b>NORMAL</b>
RHYTHM -----	<b>REGULAR</b>
P-R INTERVAL -----	<b>&gt; 200 mSEC.</b>
P: QRS RATIO -----	<b>1:1</b>
QRS INTERVAL -----	<b>NORMAL</b>

# 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 -----

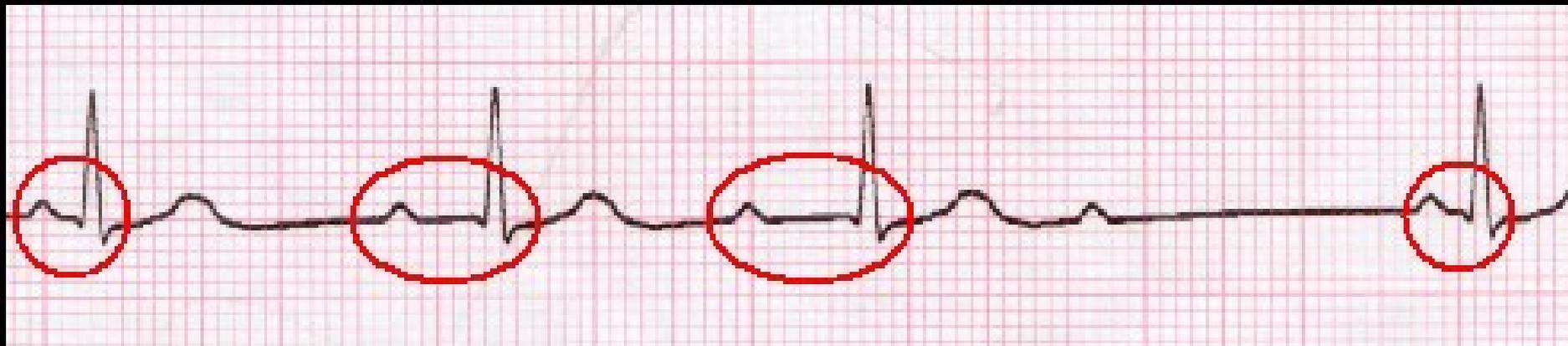
RHYTHM -----

P-R INTERVAL -----

P:QRS RATIO -----

QRS INTERVAL -----

# WHEN YOU SEE "EXTRA P WAVES" . . . .



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

## STEP 1

EVALUATE P - R RELATIONSHIP

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" . . . .



## 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

# 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.

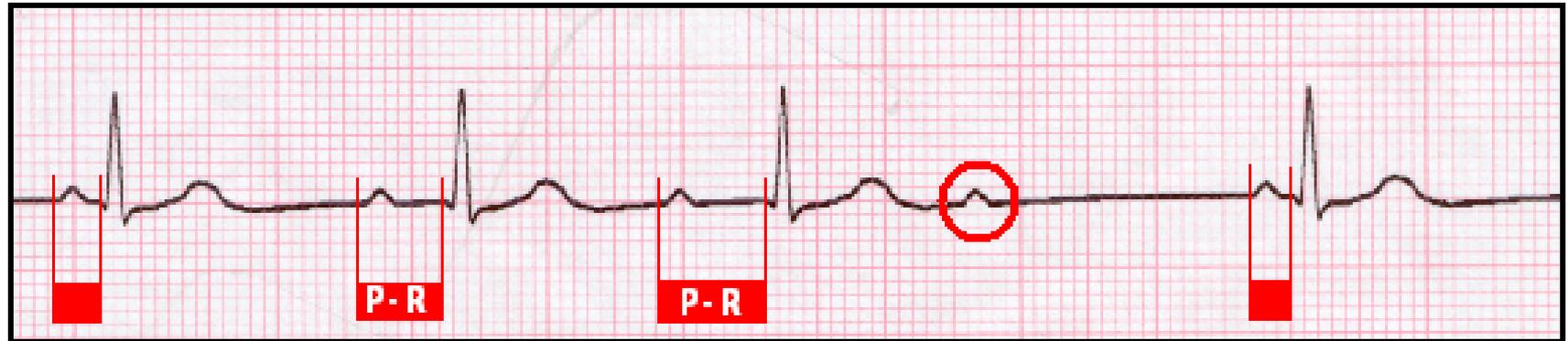
### STEP 1

EVALUATE P - R RELATIONSHIP

### STEP 2

EVALUATE R - R INTERVALS

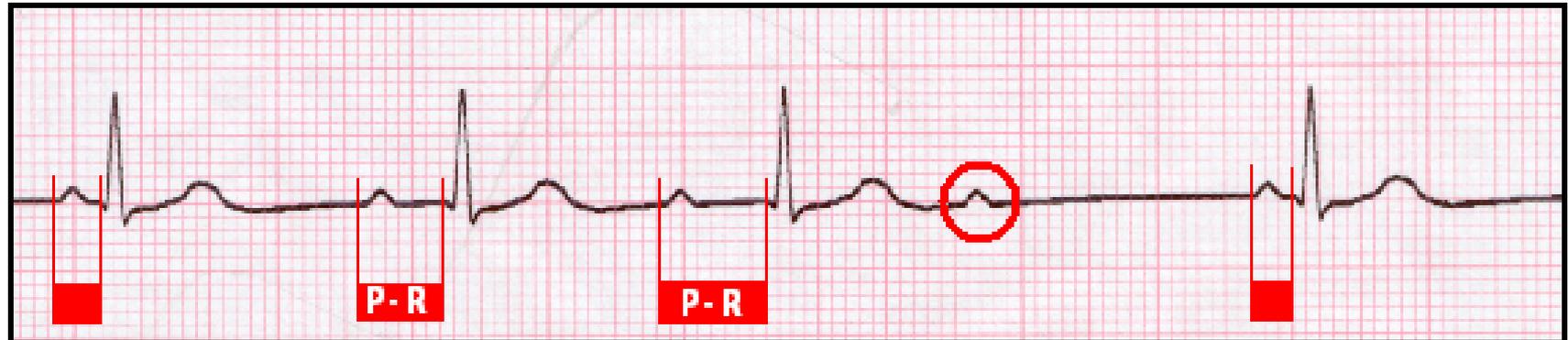
# THIS RHYTHM IS: 2nd<sup>o</sup> TYPE I HB (Wenckebach)



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

RATE -----	<b>NORMAL or BRADYCARDIC</b>
RHYTHM -----	<b>REGULARLY IRREGULAR</b>
P-R INTERVAL -----	<b>VARIES (regularly irregular)</b>
P: QRS RATIO -----	<b>VAIRES (usually 1:1 and 2:1)</b>
QRS INTERVAL -----	<b>NORMAL</b>

# THIS RHYTHM IS: 2<sup>nd</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" . . . .



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

## STEP 1

EVALUATE P - R RELATIONSHIP

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" . . . .



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

## STEP 1

EVALUATE P - R RELATIONSHIP

ARE THE P-R INTERVALS REGULAR AND CONSISTENT ??

YES.

IT'S 2nd  
TYPE II HB

NO.

ARE THE R-R  
INTERVALS REGULAR ?

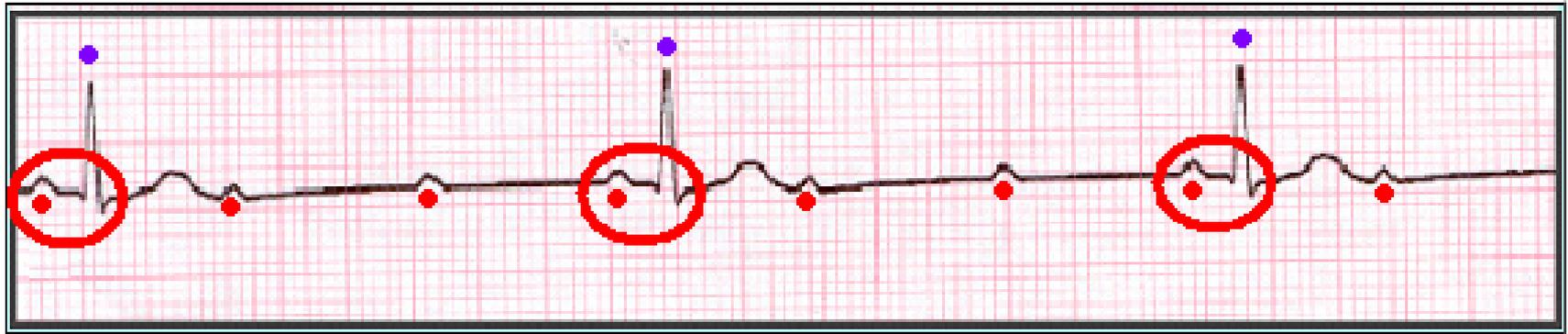
NO.

IT'S 2nd  
TYPE I HB  
( Wenckebach )

YES.

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

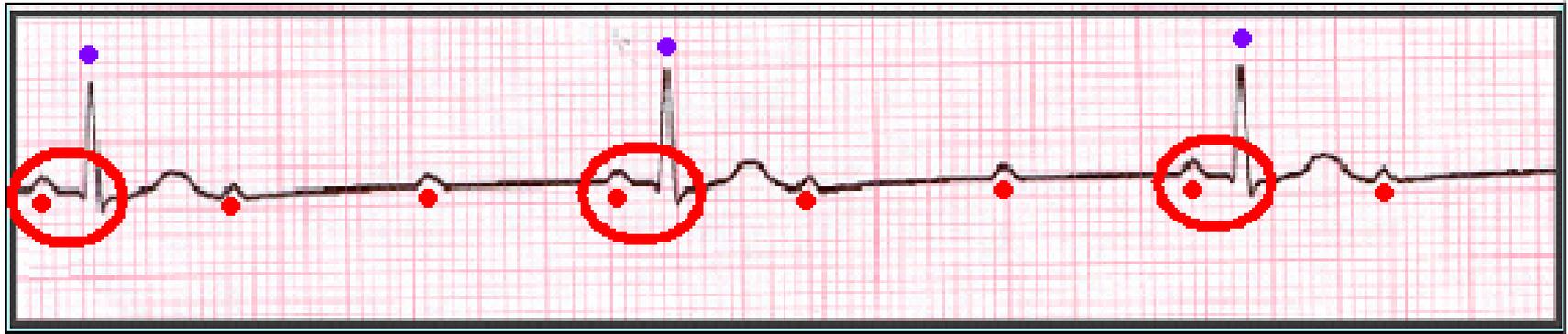
# THIS RHYTHM IS: 2nd<sup>o</sup> TYPE II HEART BLOCK



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

- RATE ----- **USUALLY BRADYCARDIC**
- RHYTHM ----- **USUALLY REGULAR (can be irregular)**
- P-R INTERVAL ----- **NORMAL and CONSISTENT**
- P:QRS RATIO -----  **$\geq 2:1$**
- 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

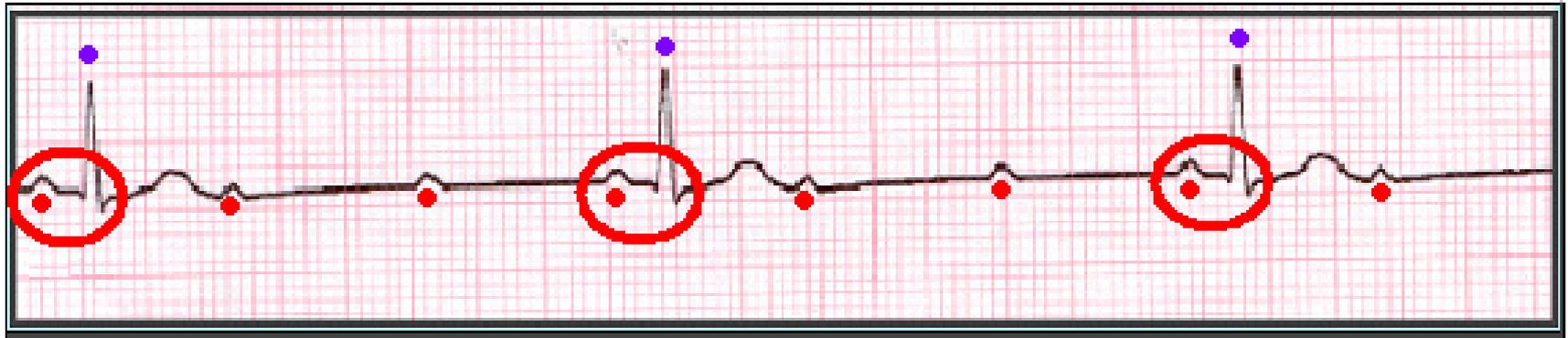
# **-- CRITICAL ECG ALERT --**

**-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**

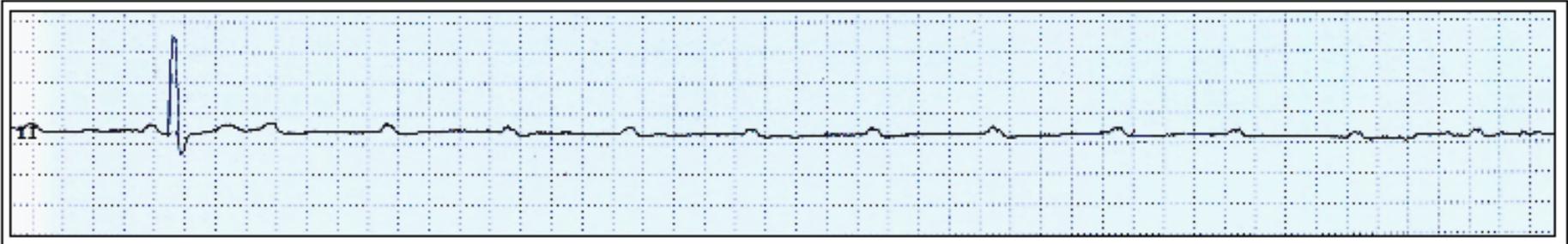


**ADAMS - STOKES SYNDROME** is essentially spontaneous **CARDIAC ARREST** -- characterized by episodes of **ASYSTOLE**, **VENTRICULAR STANDSTILL** and **V-FIB**. In this regard, 2<sup>nd</sup> ° TYPE II HB can be more dangerous than 3<sup>rd</sup> ° HB (at least 3<sup>rd</sup> ° Heart Block has an **ESCAPE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

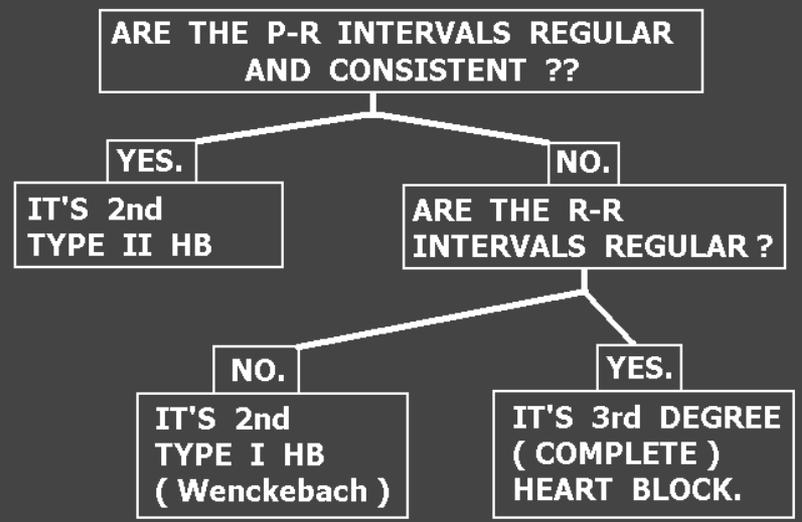
# THIS RHYTHM IS:



## MAIN IDENTIFICATION CHARACTERISTIC(S):

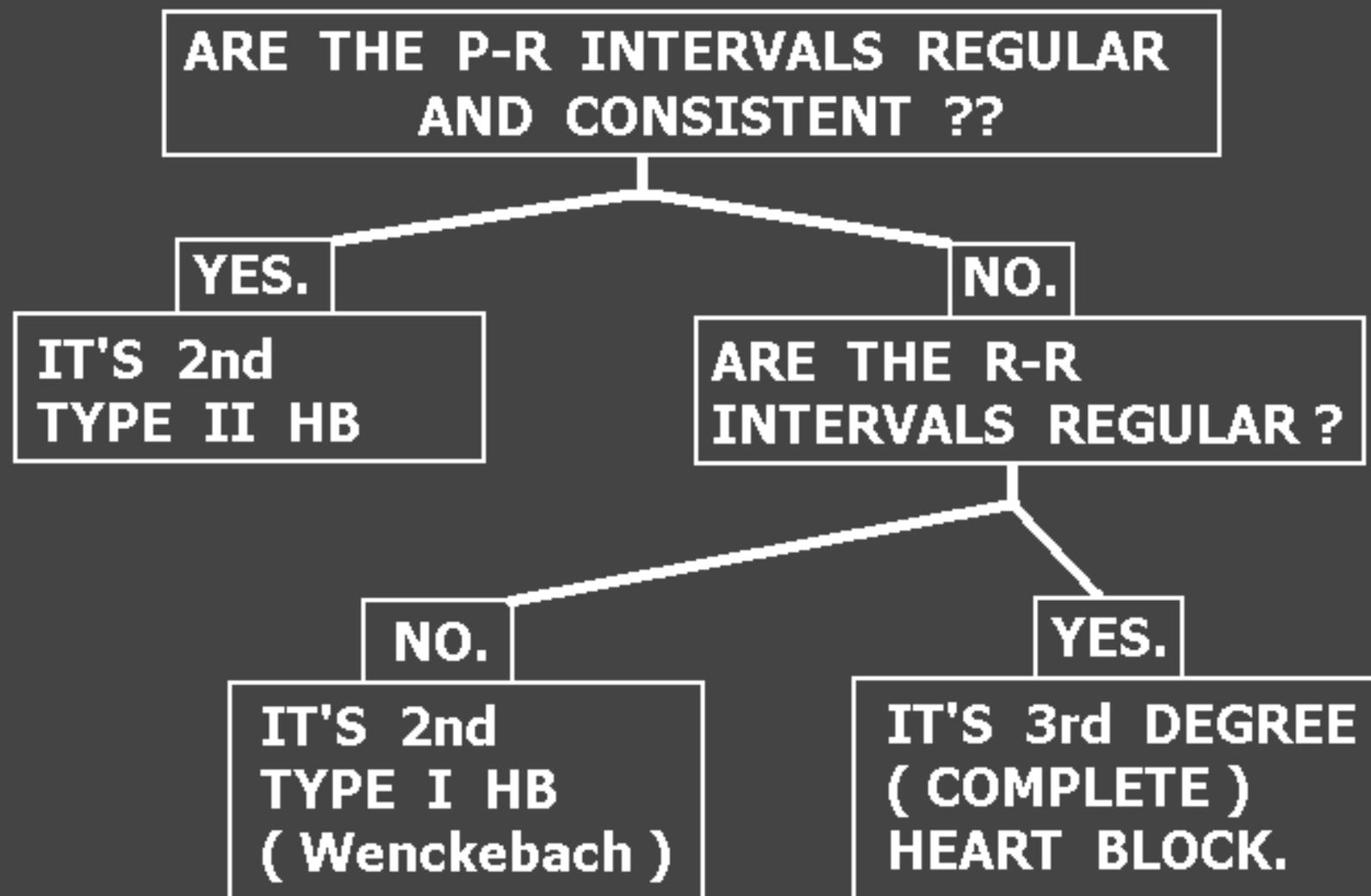
RATE -----  
RHYTHM -----  
P-R INTERVAL ----  
P:QRS RATIO ----  
QRS INTERVAL ----

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

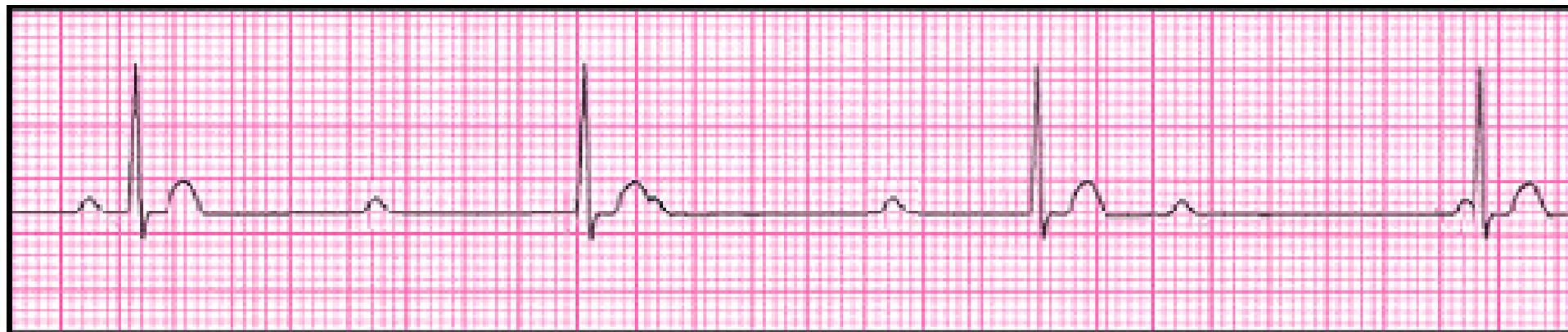


# DIAGNOSING 2nd and 3rd DEGREE HEART BLOCK

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



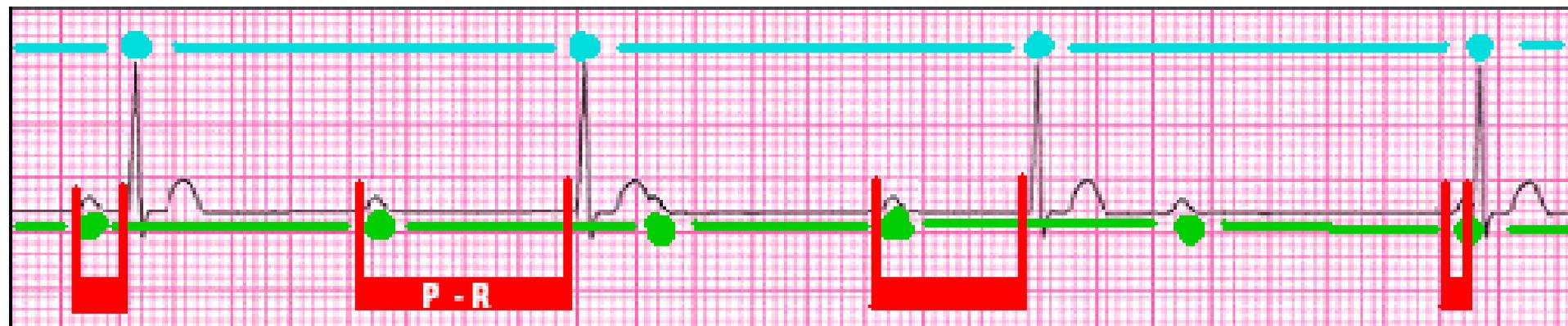
# THIS RHYTHM IS: 3rd<sup>o</sup> HB $\bar{c}$ JUNCTIONAL ESCAPE



**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 -----	<b>USUALLY BRADYCARDIC (40 -60 JUNCTIONAL RATE)</b>
RHYTHM -----	<b>REGULAR</b>
P-R INTERVAL ----	<b>INCONSISTENT (irregularly irregular)</b>
P:QRS RATIO ----	<b>VARIES - USUALLY &gt; 2:1</b>
QRS INTERVAL ----	<b>NORMAL (&lt; 120 ms) UNLESS PT HAS BUNDLE BRANCH BLOCK</b>

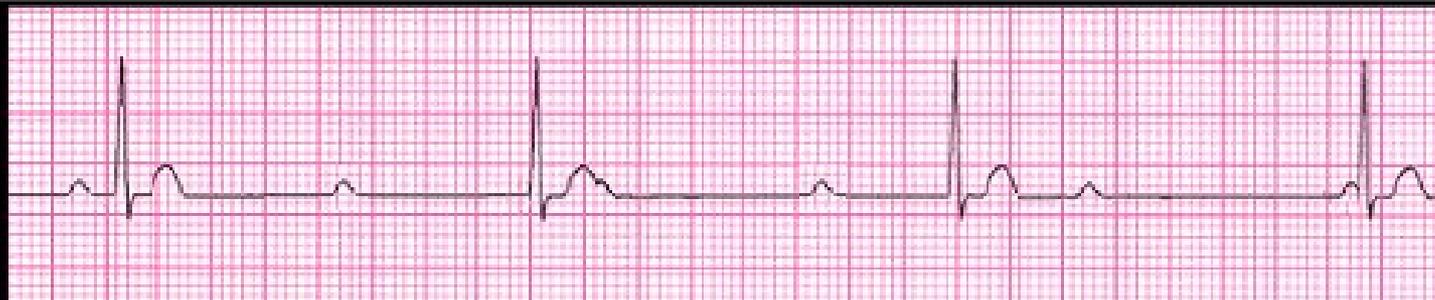
# THIS RHYTHM IS: 3rd<sup>o</sup> HB $\bar{c}$ JUNCTIONAL ESCAPE



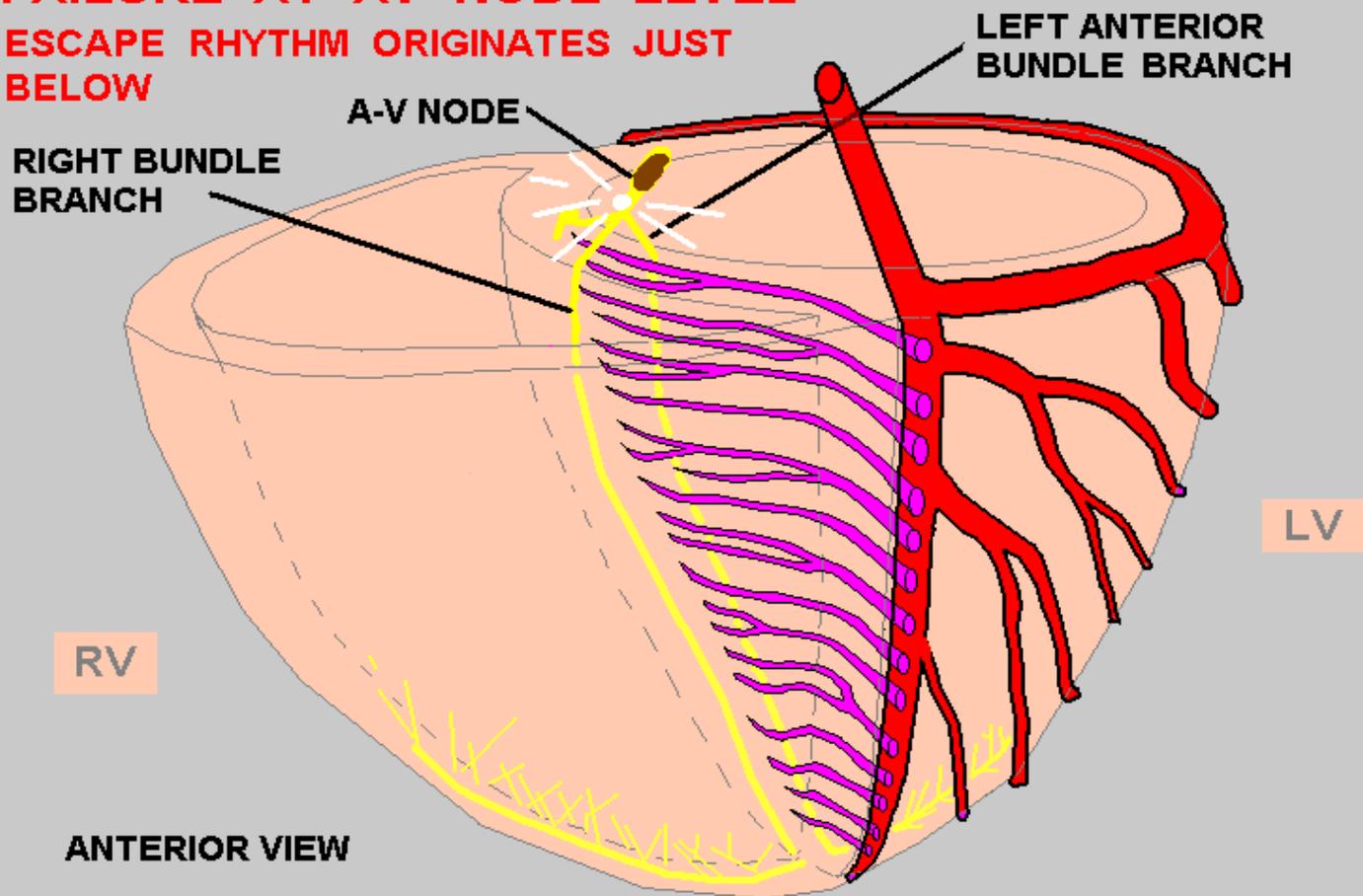
MAIN IDENTIFICATION CHARACTERISTIC(S): **P - R INTERVAL INCOSISTENT, P - P INTERVALS REGULAR, R - R INTERVALS REGULAR -- NO RELATIONSHIP BETWEEN P WAVES AND QRS COMPLEXES.**

## 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>o</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 )**

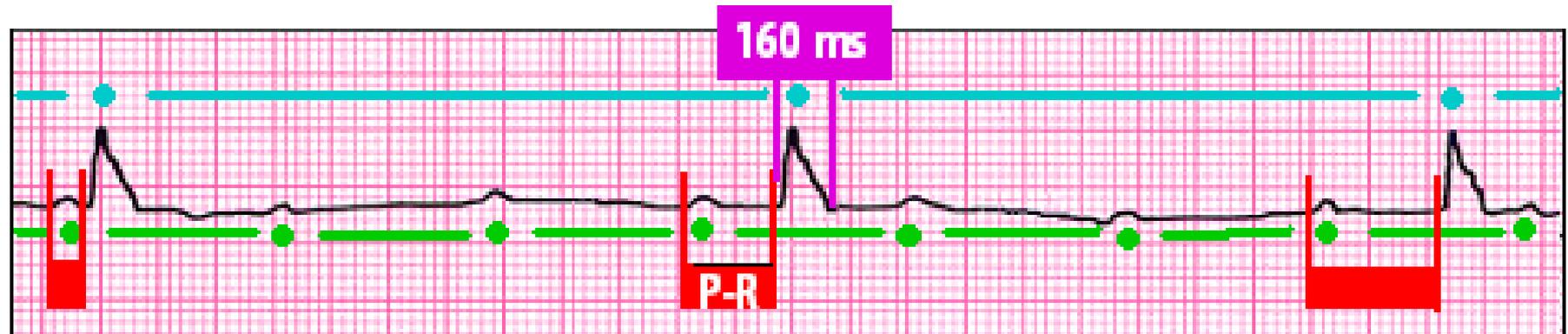
**RHYTHM ----- REGULAR**

**P-R INTERVAL ---- INCONSISTENT ( irregularly irregular )**

**P:QRS RATIO ---- VARIES - USUALLY > 2:1**

**QRS INTERVAL ---- WIDER THAN 120 ms**

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



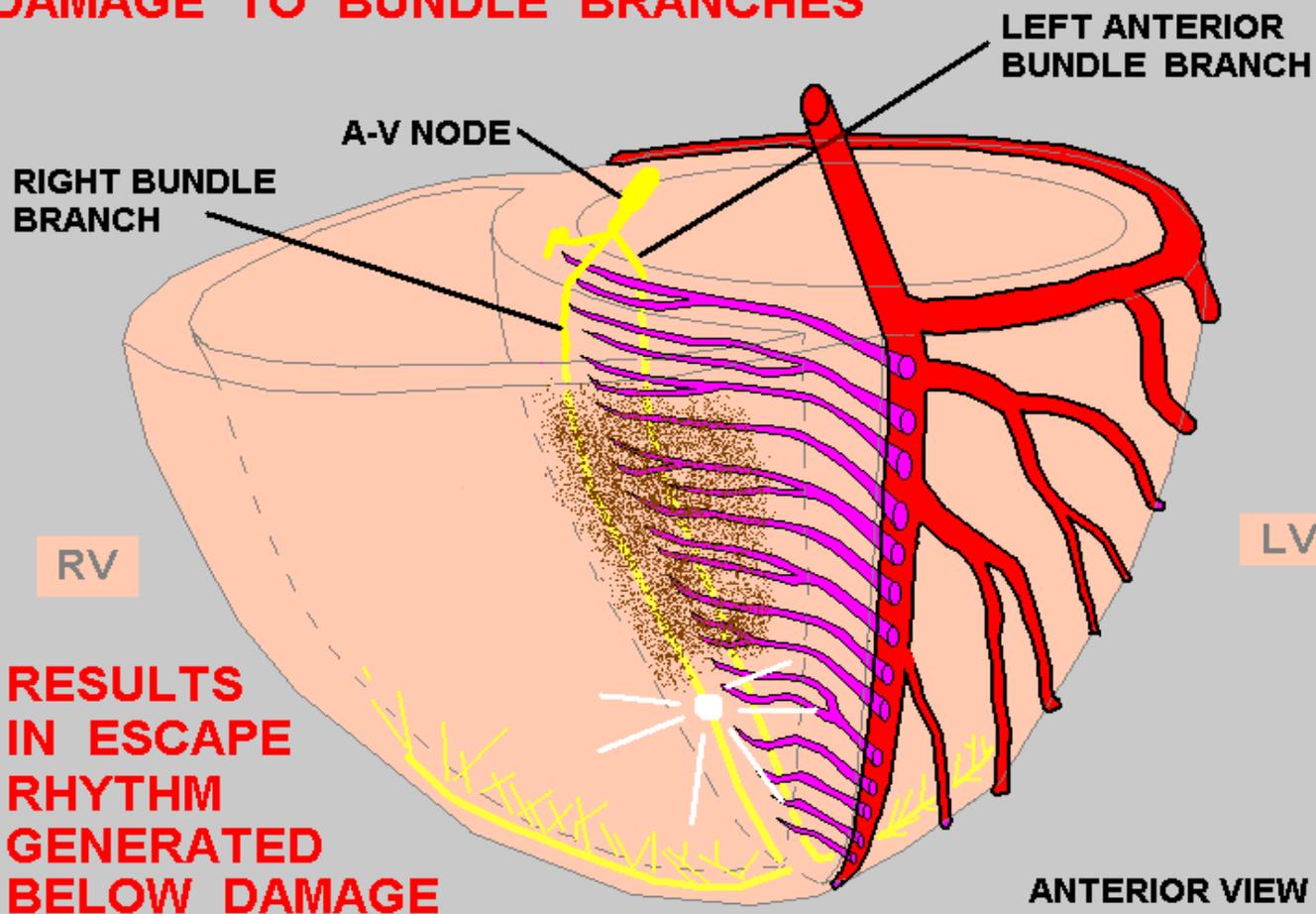
MAIN IDENTIFICATION CHARACTERISTIC(S): **P - R INTERVALS INCONSISTENT**  
**P - P INTERVALS REGULAR, R - R INTERVALS REGULAR. NO**  
**RELATIONSHIP BETWEEN P WAVES AND QRS COMPLEXES. QRS**  
**COMPLEXES are WIDER THAN 120ms, AND RATE (usually < 40)**

## POTENTIAL PROBLEMS:

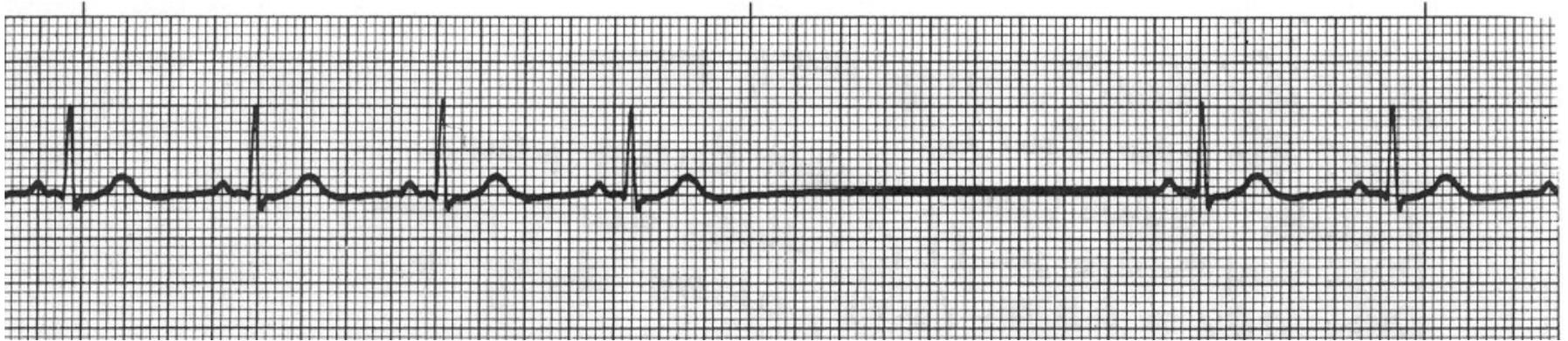
**HYPOTENSION and SHOCK due to ↓ HEART RATE and**  
**↓ CARDIAC OUTPUT**



## 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

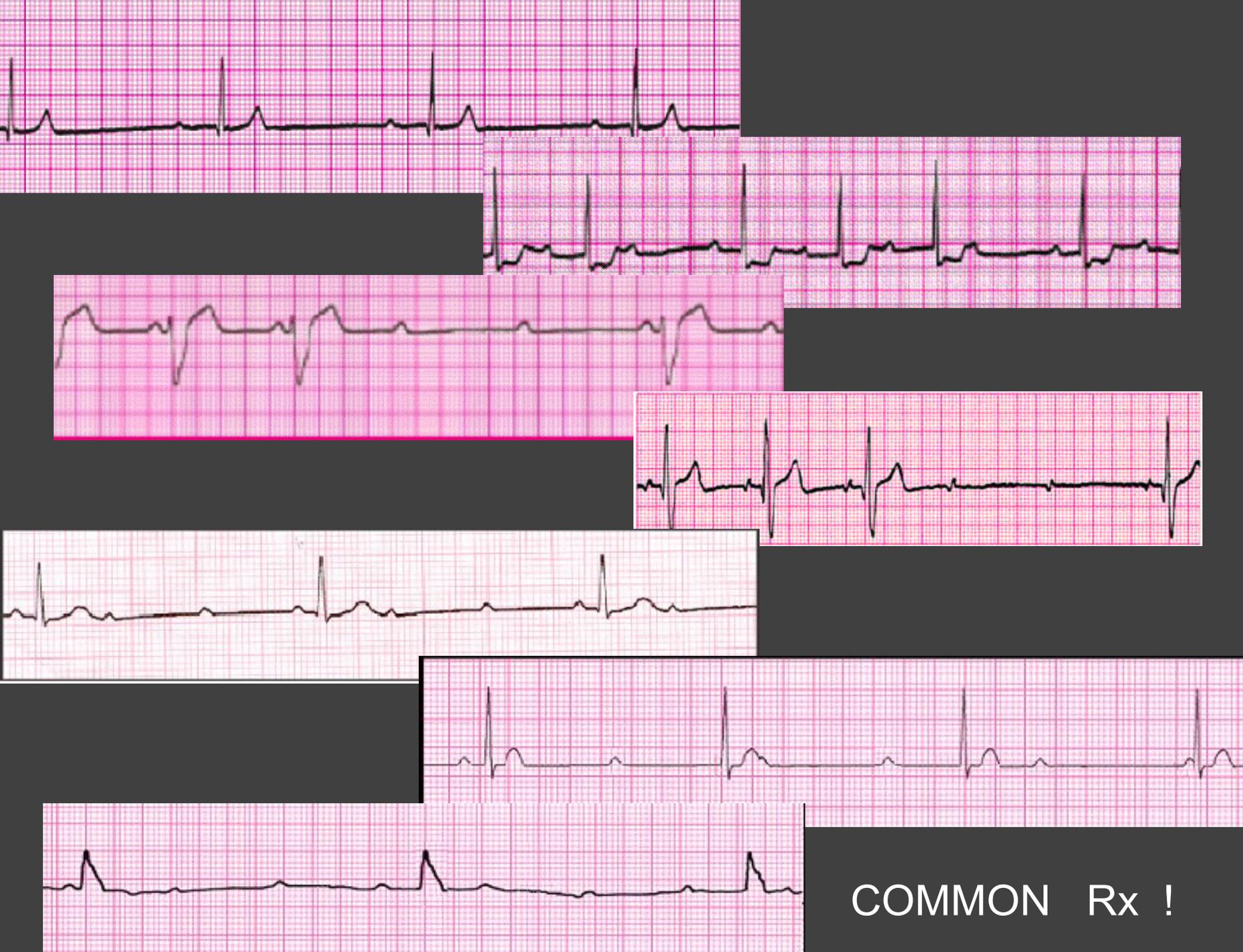
Treatment: Atropine, CPR, Pacemaker

# **-- 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**



COMMON Rx !

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



**Tx:**



**ABC s**



**GENERAL SUPPORTIVE CARE**



**BRADYCARDIA ALGORITHM**

# **SYMPTOMATIC BRADYCARDIA**

- **ABCs + GENERAL SUPPORTIVE CARE**
- **ATROPINE 0.5 mg. IV**
  - MAY REPEAT 0.5 mg. DOSES IF NEEDED
  - MAXIMUM 3.0 mg.
- **TRANSCUTANEOUS PACEMAKER**
  - PREFERRED PRIMARY Tx FOR HIGH GRADE A-V BLOCK

# **SYMPTOMATIC BRADYCARDIA**

---

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

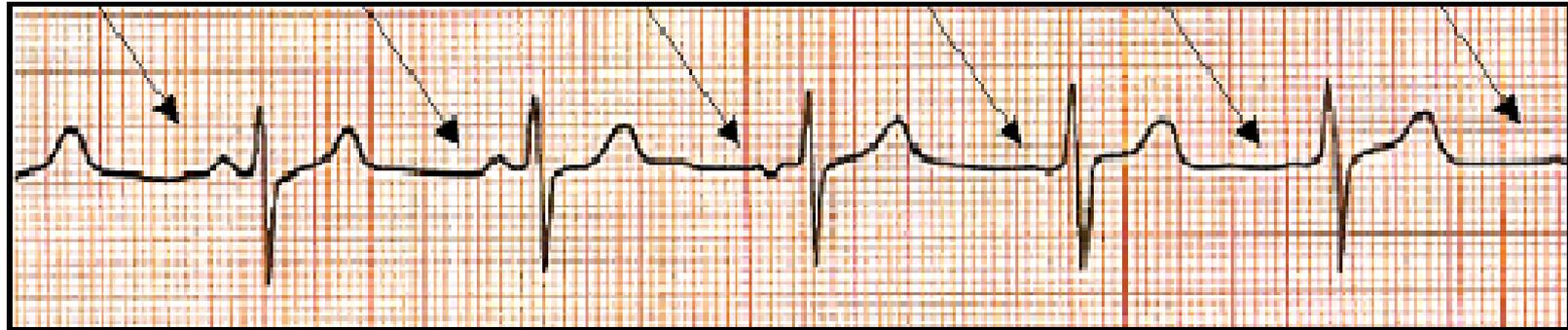
# THIS RHYTHM IS: WANDERING ATRIAL PACEMAKER



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

RATE -----	<b>NORMAL</b>
RHYTHM -----	<b>NORMAL</b>
P-R INTERVAL ----	<b>SLIGHT VARIATION</b>
P:QRS RATIO ----	<b>1:1</b>
QRS INTERVAL ----	<b>NORMAL (unless BBB)</b>

# 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 -----

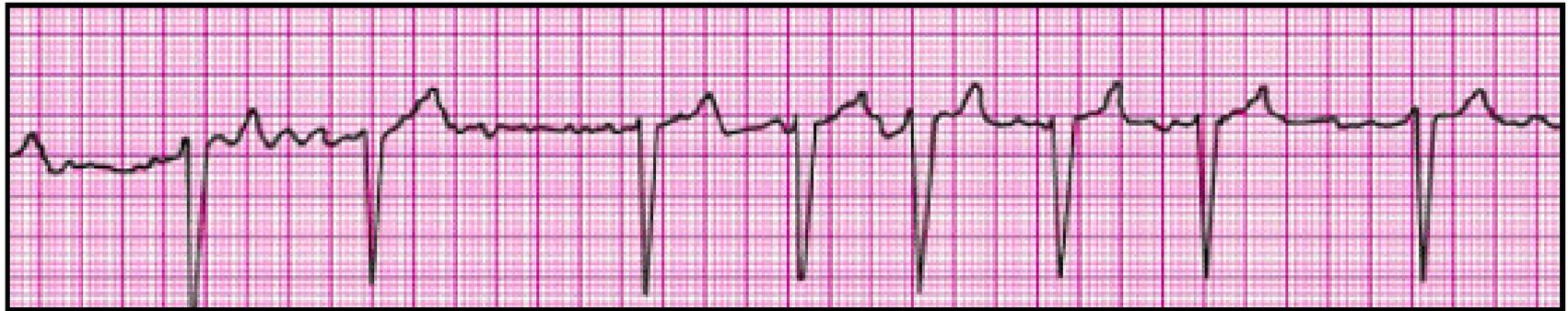
# THIS RHYTHM IS: ATRIAL FIBRILLATION



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

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

# THIS RHYTHM IS: ATRIAL FIBRILLATION



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

## POTENTIAL PROBLEMS:

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

# THIS RHYTHM IS: ATRIAL FIBRILLATION



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

## TREATMENT / INTERVENTIONS:

**- NEED FOR EMERGENCY INTERVENTION FOR A-FIB IS BASED ON PATIENT'S VENTRICULAR RATE:**

**☞ TOO SLOW - SYMPTOMATIC BRADYCARDIA ALGORITHM**

**☞ TOO FAST - TACHYCARDIA ALGORITHM**

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

**-Immediately check patient**

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

- 1. Heart rate LESS THAN 50 or GREATER THAN 150**
- 2. QT INTERVAL prolonged (usually not emergent but let Dr. know)**
- 3. 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)

## **ABCs + GENERAL SUPPORTIVE CARE**

### **REGULAR RHYTHM**

- VAGAL MANEUVERS
- ADENOSINE 6 mg / 12 mg

### **IRREGULAR RHYTHM**

POSSIBLE ATRIAL FIB or  
MULTIFOCAL ATRIAL TACH

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

# **SVT - 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 ATRIAL  
APPENDAGE

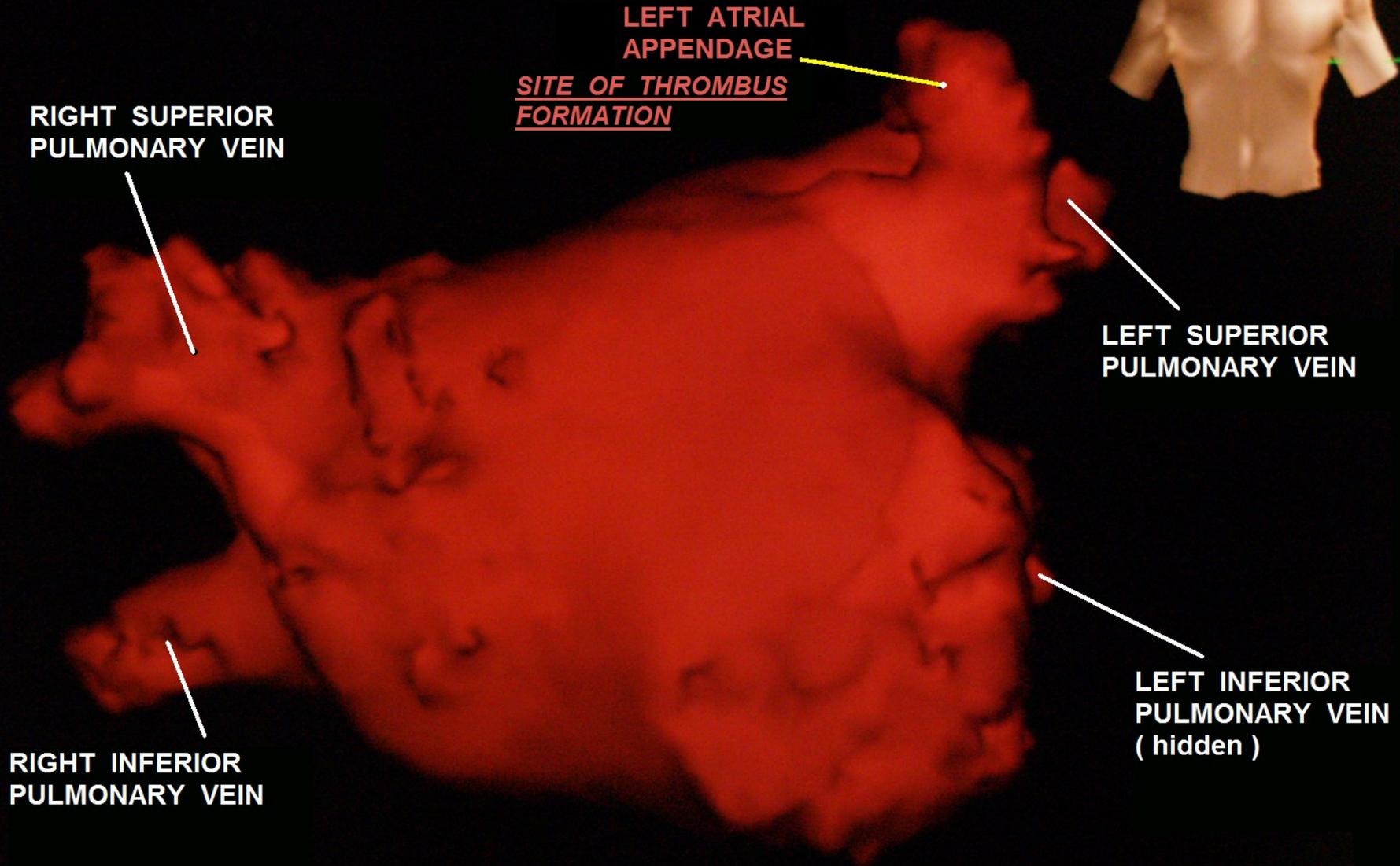
SITE OF THROMBUS  
FORMATION

RIGHT SUPERIOR  
PULMONARY VEIN

LEFT SUPERIOR  
PULMONARY VEIN

RIGHT INFERIOR  
PULMONARY VEIN

LEFT INFERIOR  
PULMONARY VEIN  
( hidden )



# LEFT ATRIUM

LAO VIEW

LEFT ATRIAL  
APPENDAGE  
SITE OF THROMBUS  
FORMATION

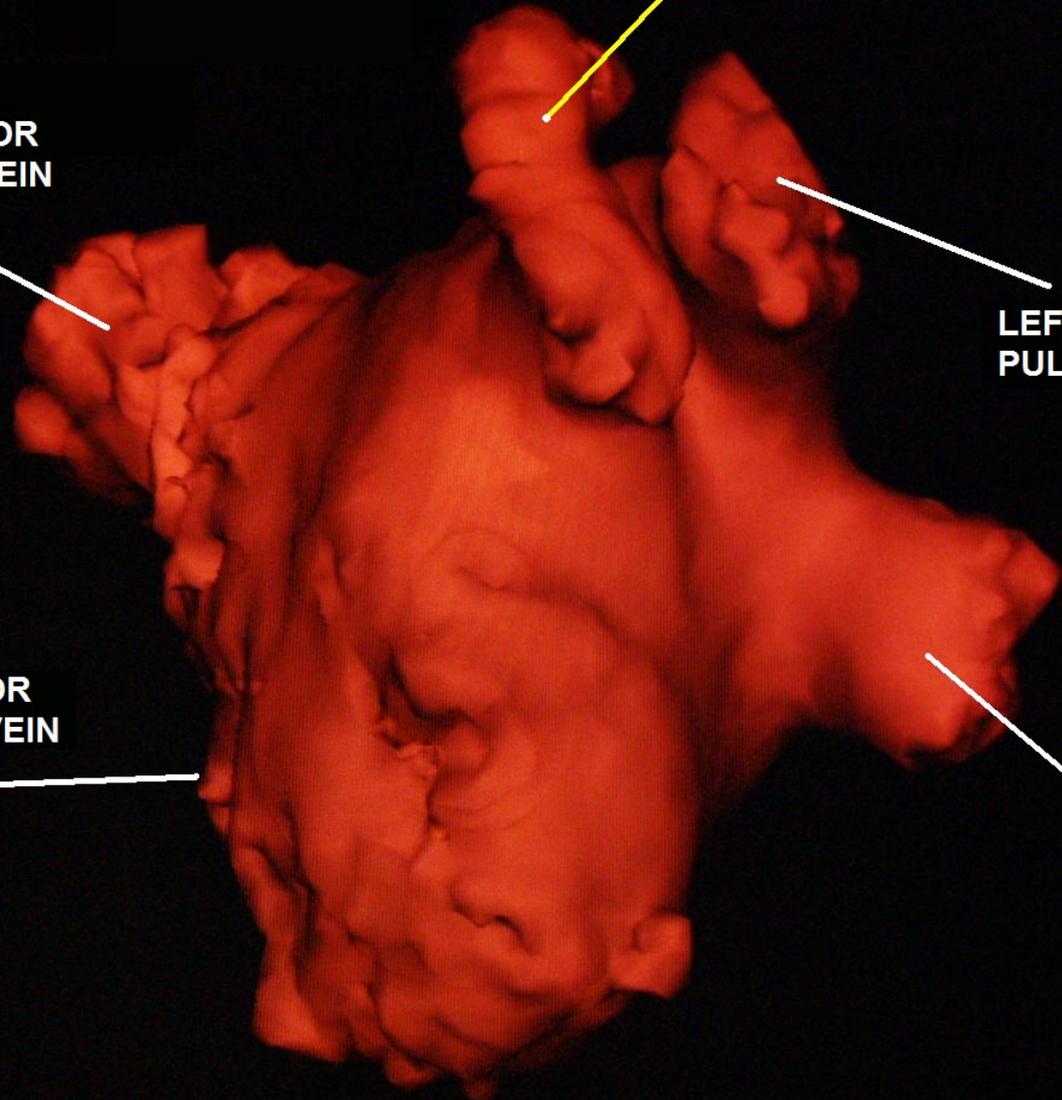
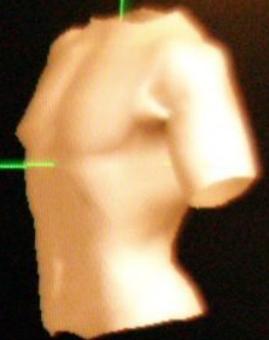
RIGHT SUPERIOR  
PULMONARY VEIN

LEFT SUPERIOR  
PULMONARY VEIN

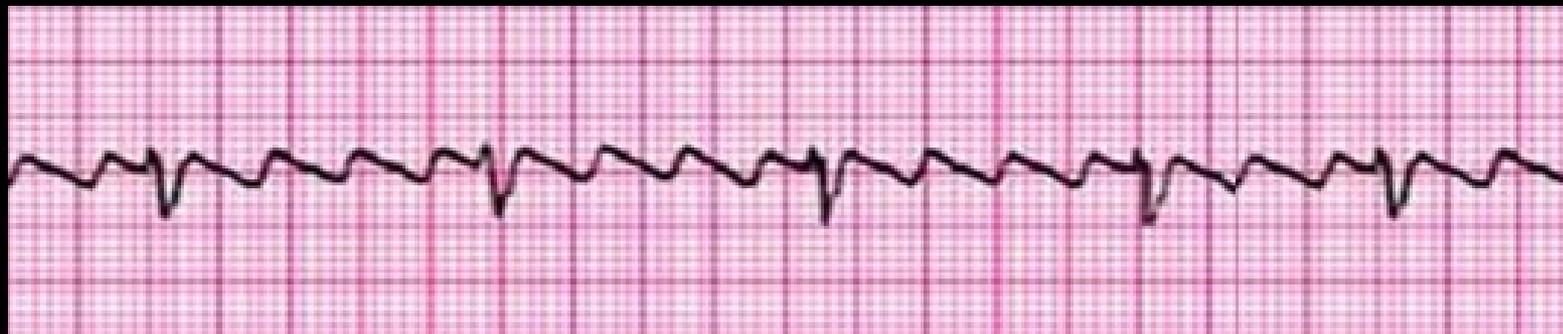
RIGHT INFERIOR  
PULMONARY VEIN

( hidden )

LEFT INFERIOR  
PULMONARY VEIN



# THIS RHYTHM IS:



## MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE -----

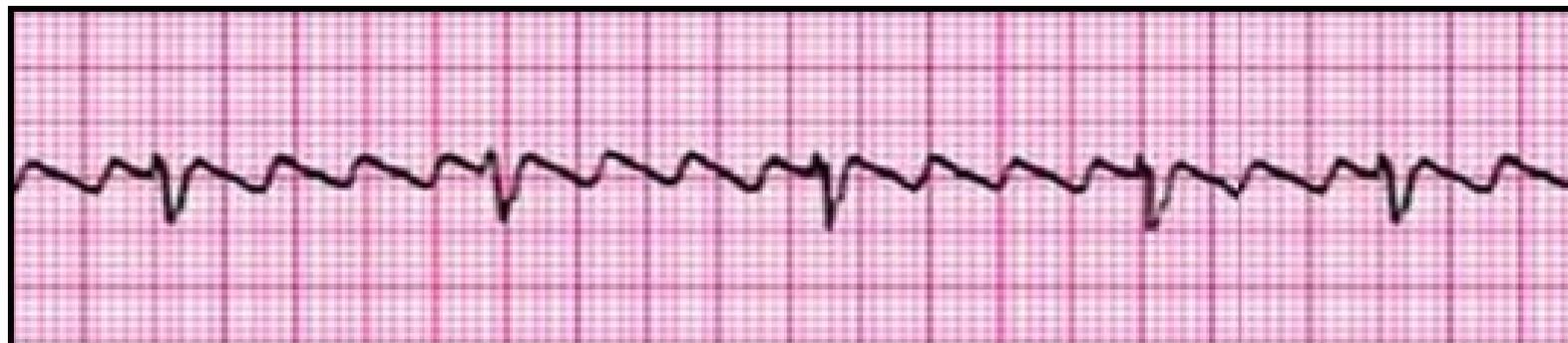
RHYTHM -----

P-R INTERVAL -----

P:QRS RATIO -----

QRS INTERVAL -----

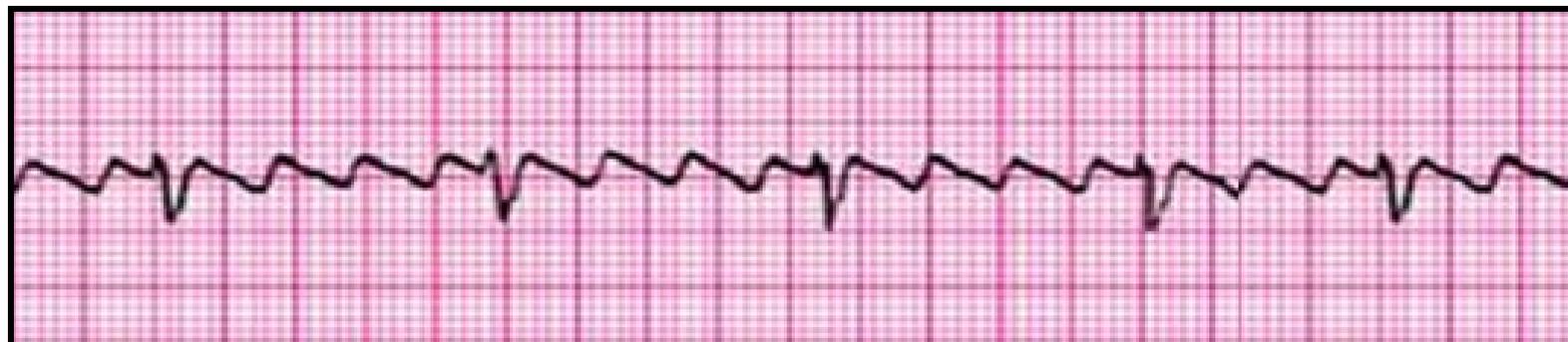
# THIS RHYTHM IS: ATRIAL FLUTTER



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

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

# THIS RHYTHM IS: ATRIAL FLUTTER



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

## POTENTIAL PROBLEM(S):

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

## TREATMENT / INTERVENTIONS:

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

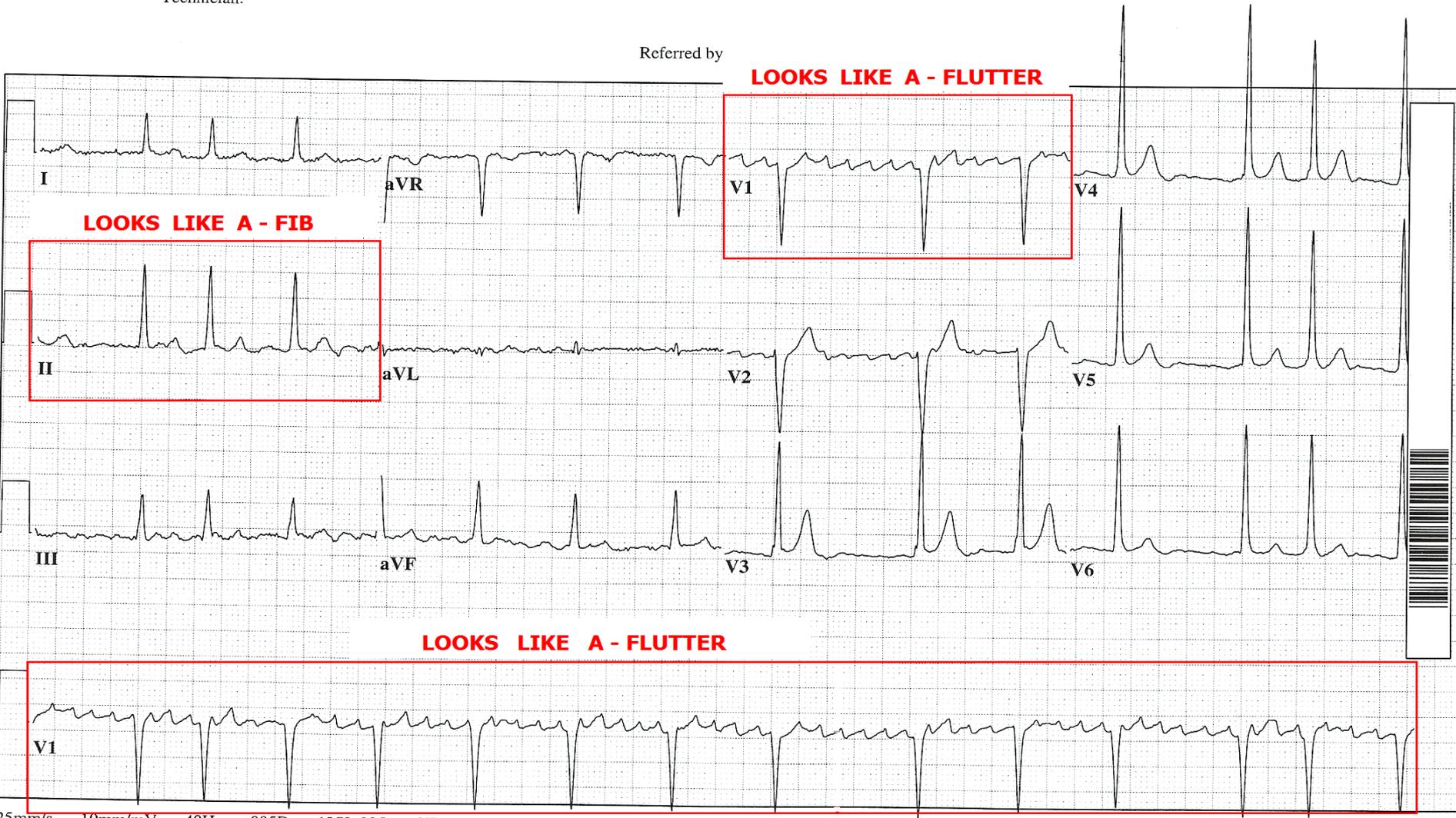
68 yr  
Male Hispanic  
Room: VAM  
Loc: 3 Option: 23

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



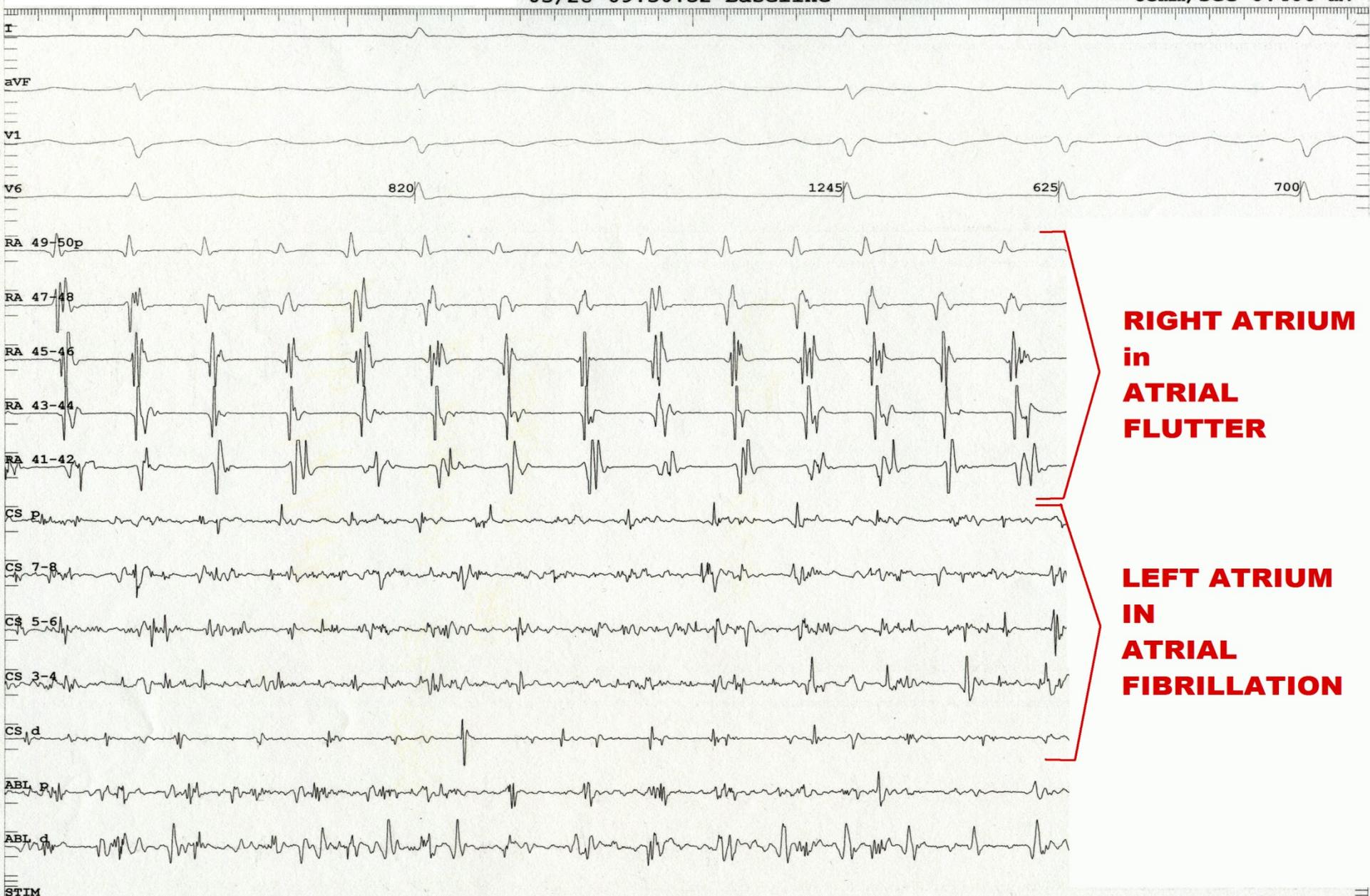
25mm/s 10mm/mV 40Hz 005D 12SL 235 CID: 2

44 y/o FEMALE

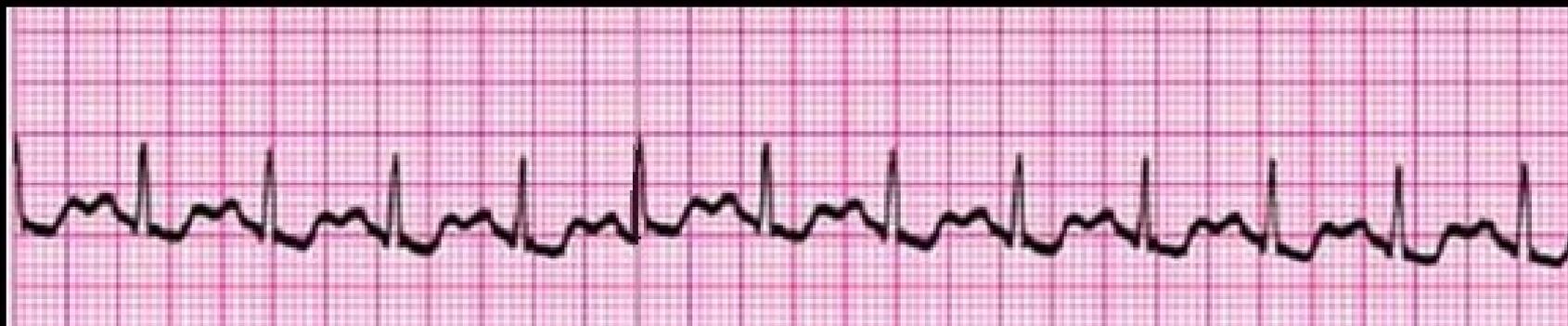
# "ATRIAL FIB - FLUTTER"

03/28 09:30:52 Baseline

63mm/sec 0.400 mV



# THIS RHYTHM IS:



## MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE -----

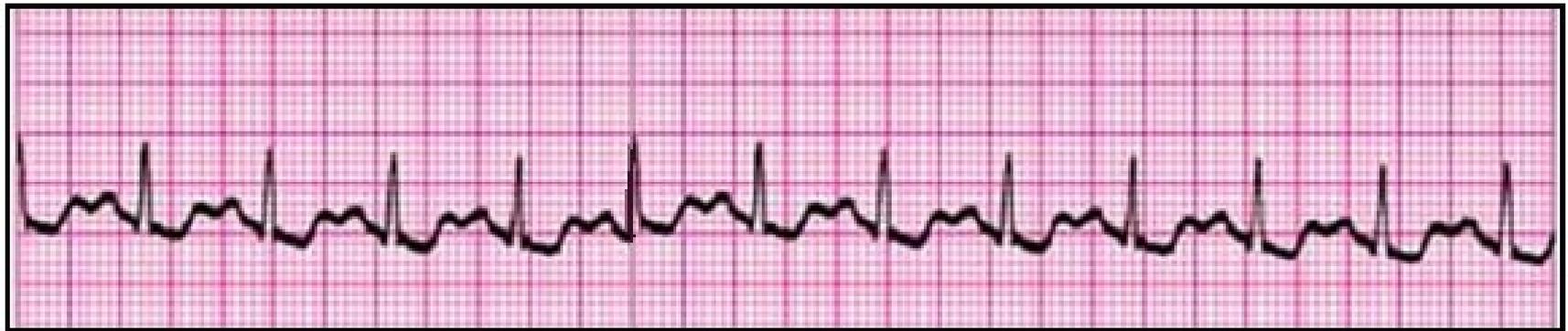
RHYTHM -----

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 )**

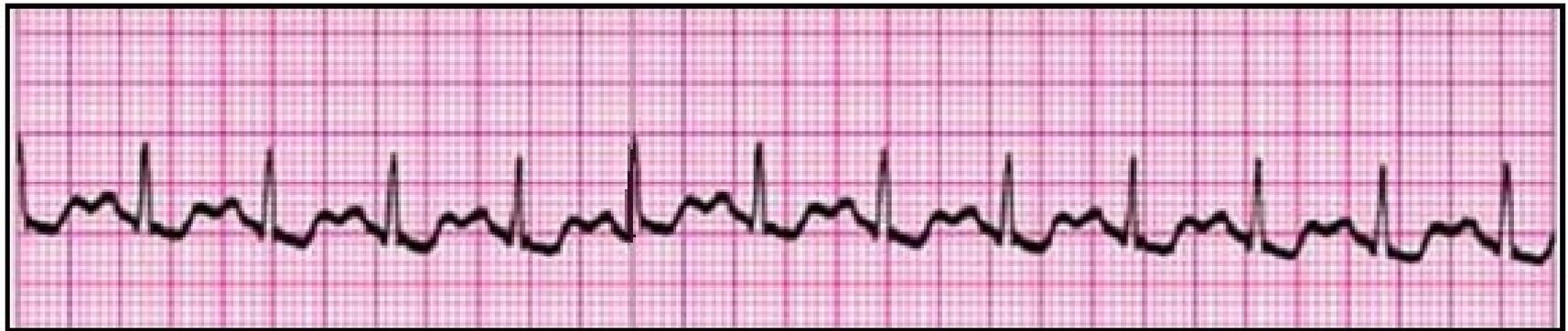
**RHYTHM ----- REGULAR**

**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

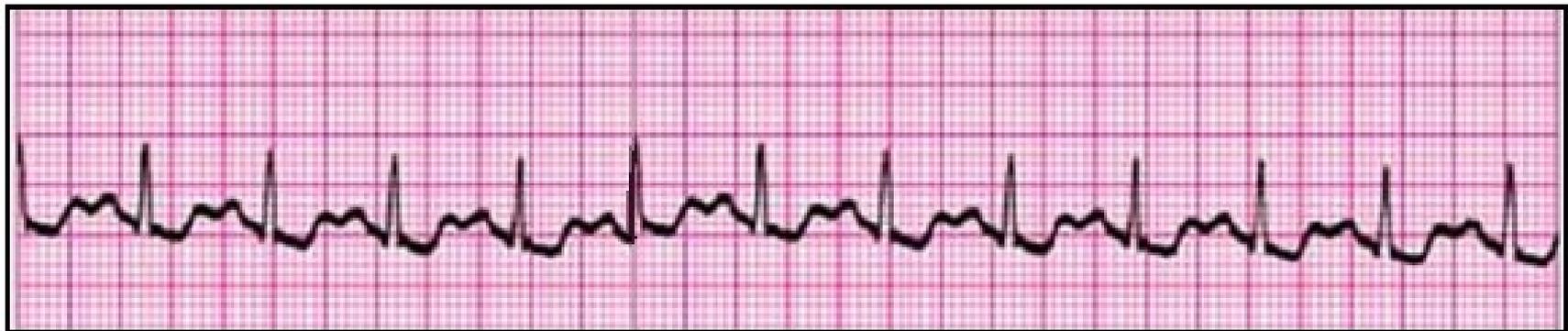


**MAIN IDENTIFICATION CHARACTERISTIC(S): SINUS RHYTHM, RATE HIGHER THAN 100. (ACLS guidelines: heart rate 100 - 150 )**

## 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:**

**AND TREAT THEM:**

**ANXIETY / FEAR**



**CALM PATIENT**

**HYPOVOLEMIA**

**DEHYDRATION**



**FLUIDS**

**BLOOD LOSS**



**STOP BLEEDING**

**MEDICATION EFFECTS**



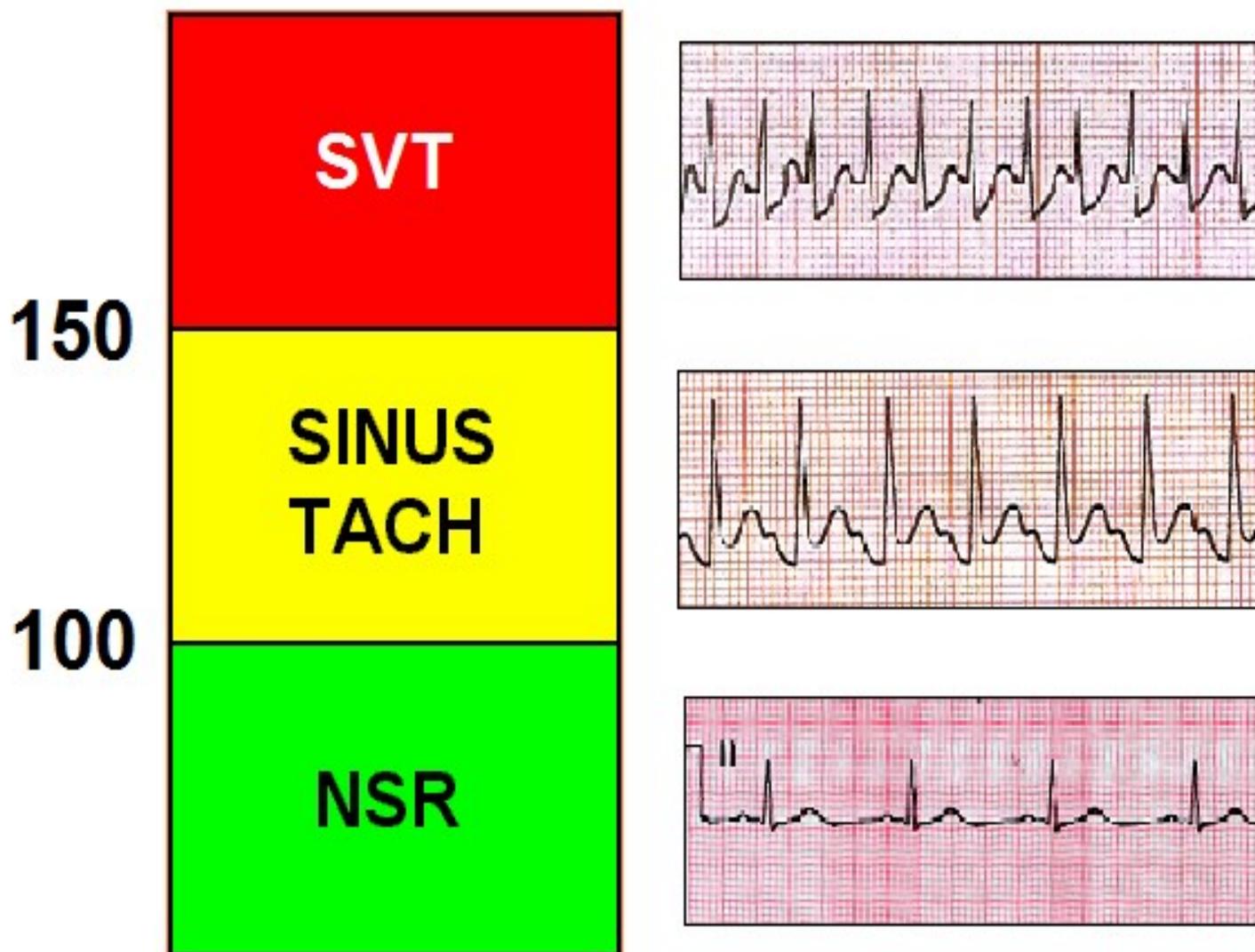
**CONSIDER MEDICAL Tx**

**OTHER ILLNESS**



**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 -----

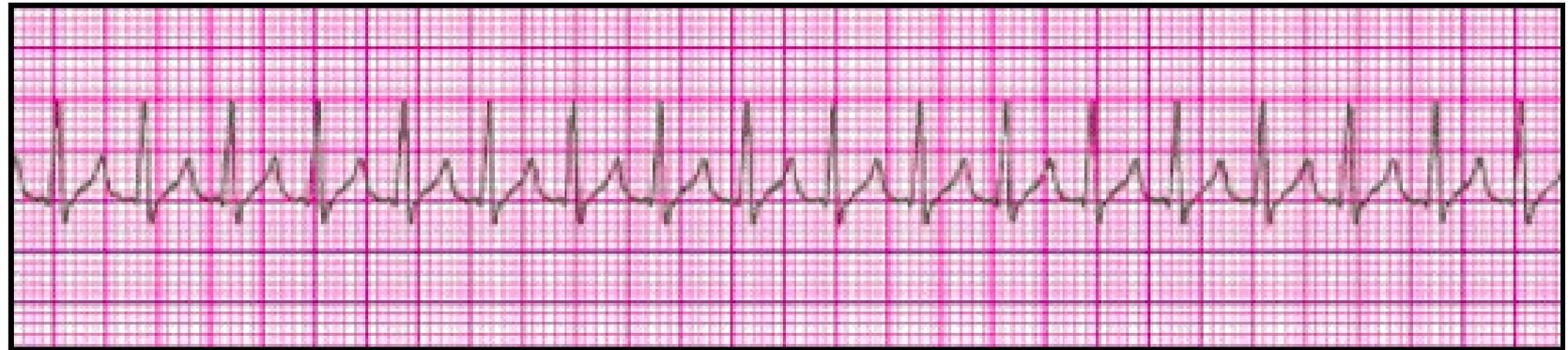
RHYTHM -----

P-R INTERVAL -----

P:QRS RATIO -----

QRS INTERVAL -----

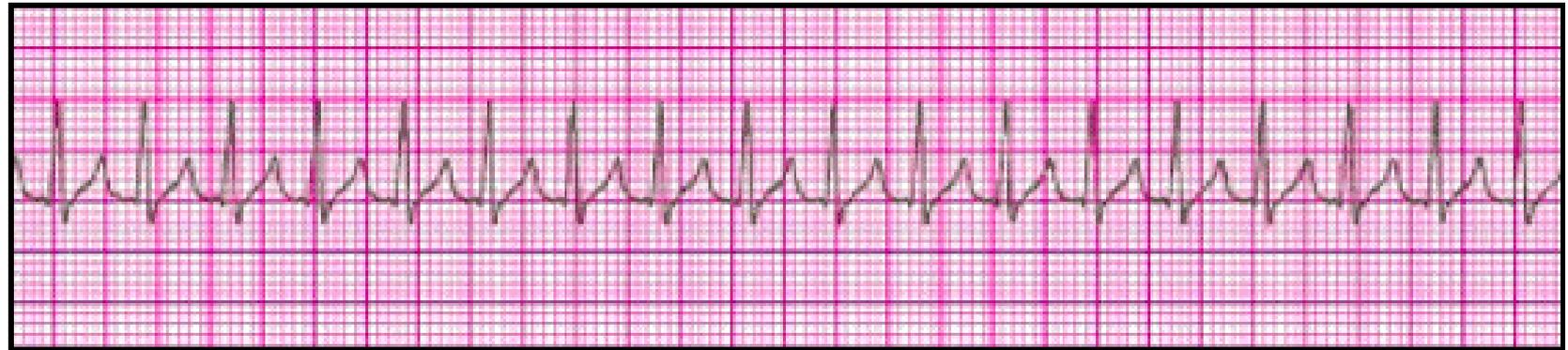
# THIS RHYTHM IS: SUPRAVENTRICULAR TACHYCARDIA (SVT)



**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."**

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

# THIS RHYTHM IS: SUPRAVENTRICULAR TACHYCARDIA (SVT)

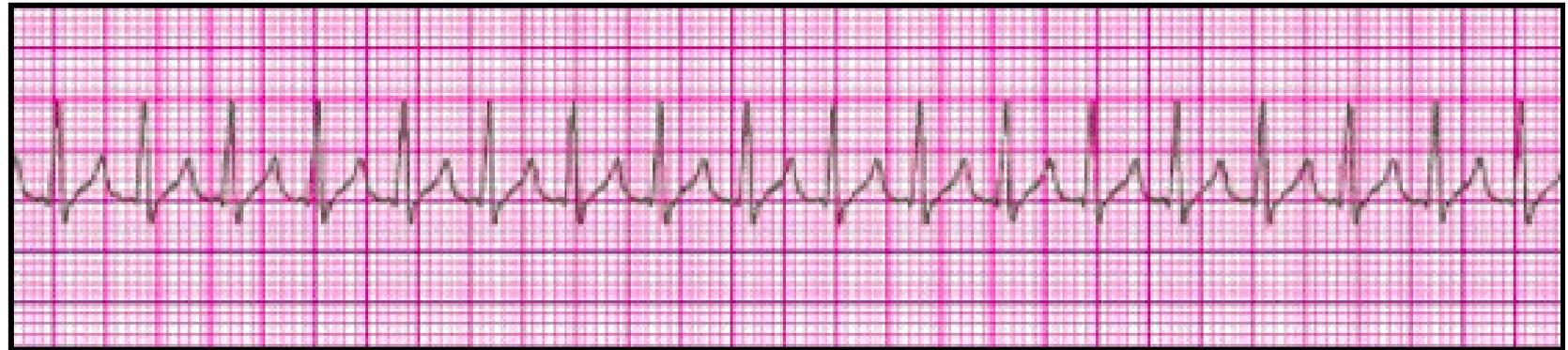


**MAIN IDENTIFICATION CHARACTERISTIC(S): HEART RATE TOO FAST, USUALLY > 150. P WAVES MAY BE "BURIED" IN THE PRECEDING T WAVES. Pt USUALLY C/O "SUDDEN ONSET of HEART RACING," or "PALPITATIONS."**

## 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 )

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

### **REGULAR RHYTHM**

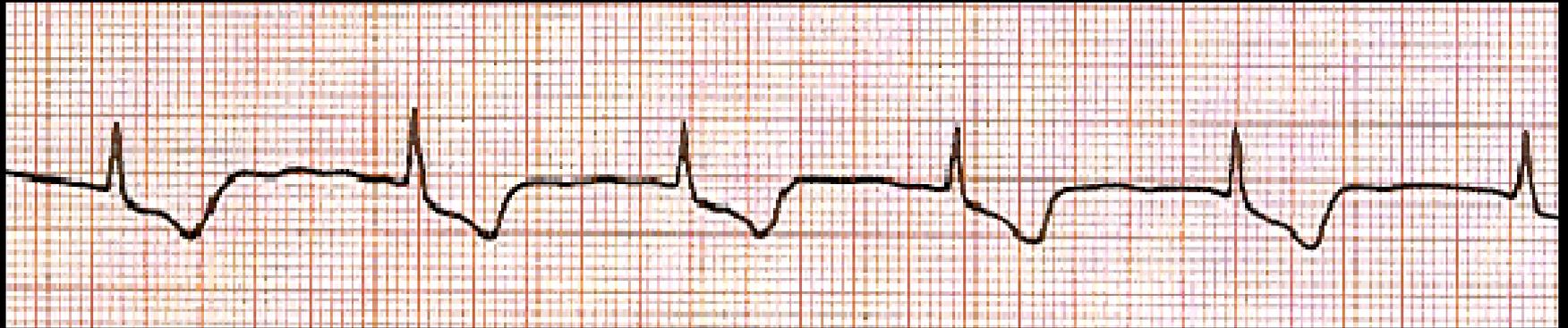
- VAGAL MANEUVERS
- ADENOSINE 6 mg / 12 mg

### **IRREGULAR RHYTHM**

POSSIBLE ATRIAL FIB or  
MULTIFOCAL ATRIAL TACH

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

# THIS RHYTHM IS: JUNCTIONAL RHYTHM



## MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE -----

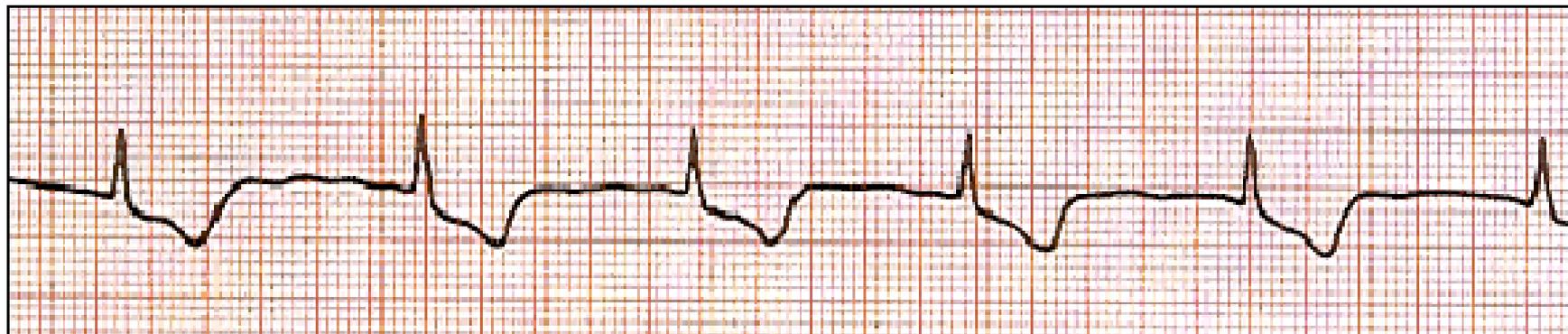
RHYTHM -----

P-R INTERVAL -----

P:QRS RATIO -----

QRS INTERVAL -----

# THIS RHYTHM IS: JUNCTIONAL RHYTHM



**MAIN IDENTIFICATION CHARACTERISTIC(S): P WAVES ABSENT, or LOCATED JUST AFTER QRS (in S-Tseg) or JUST BEFORE QRS (short P-R). WHEN P wave**

**seen, it is INVERTED (upside-down).**

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

**- HR USUALLY 40 - 60**

**RHYTHM ----- REGULAR**

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

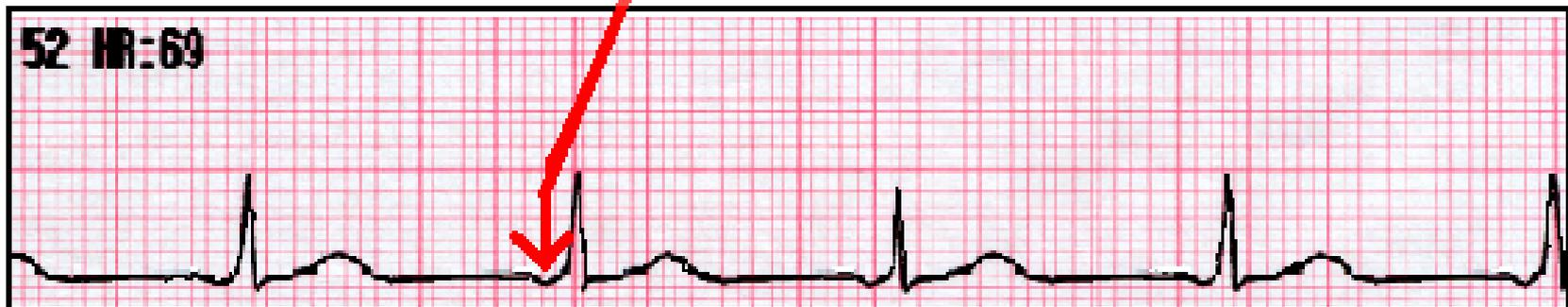
**P:QRS RATIO ----- 1:1**

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

# THIS RHYTHM IS: JUNCTIONAL RHYTHM



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

## TREATMENT / INTERVENTION:

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

# THIS RHYTHM IS: JUNCTIONAL RHYTHM



HEART RATE TOO SLOW . . . .

**WE MUST CONSIDER  
UNDERLYING CAUSES:**

INCREASED VAGAL TONE →

BLOCKED SA NODAL ARTERY →  
(ACUTE INFERIOR MI ?)

ELECTROLYTE IMBAL. (K+) →

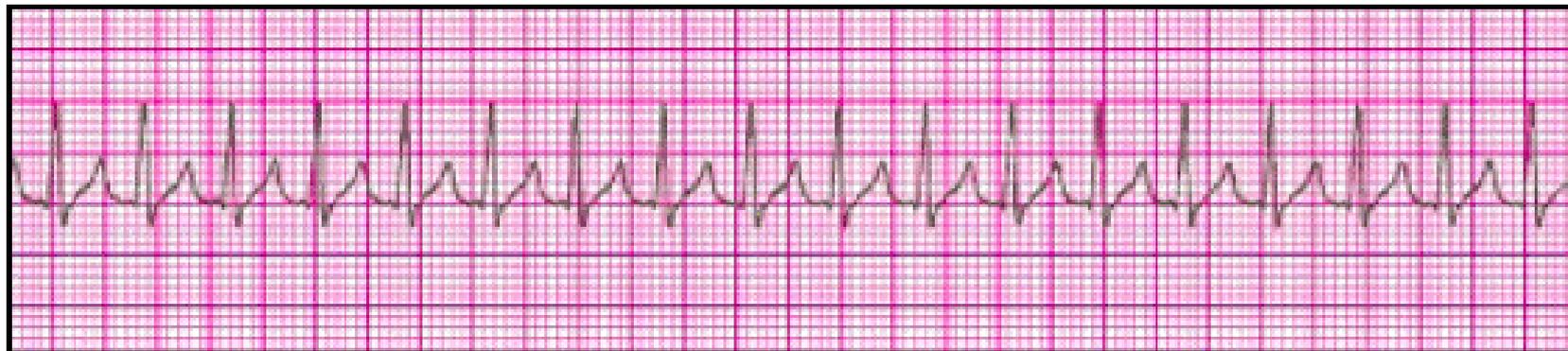
**AND TREAT THEM:**

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

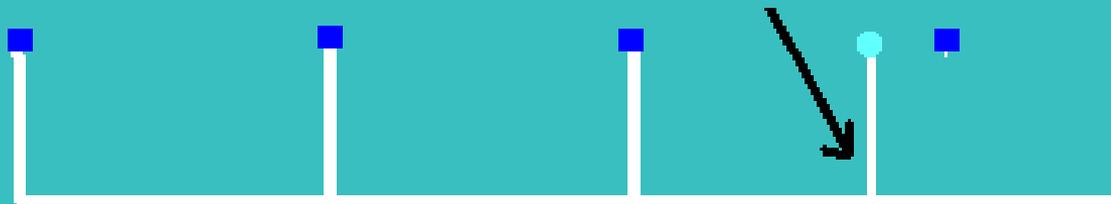
# ECTOPY

- ATRIAL
- JUNCTIONAL
- VENTRICULAR

# CLASSIFICATIONS OF ECTOPY

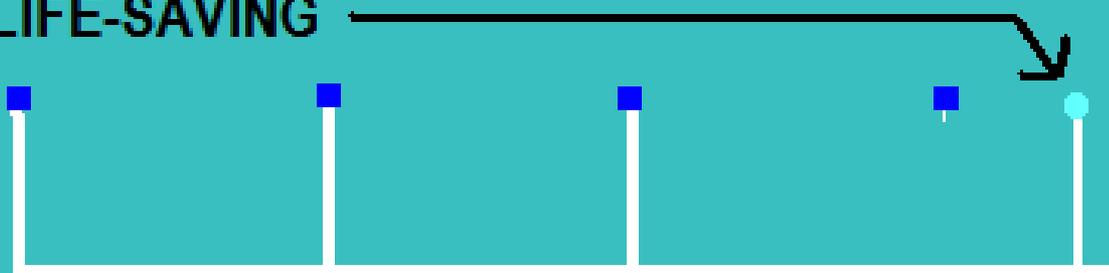
## 1. PREMATURE

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

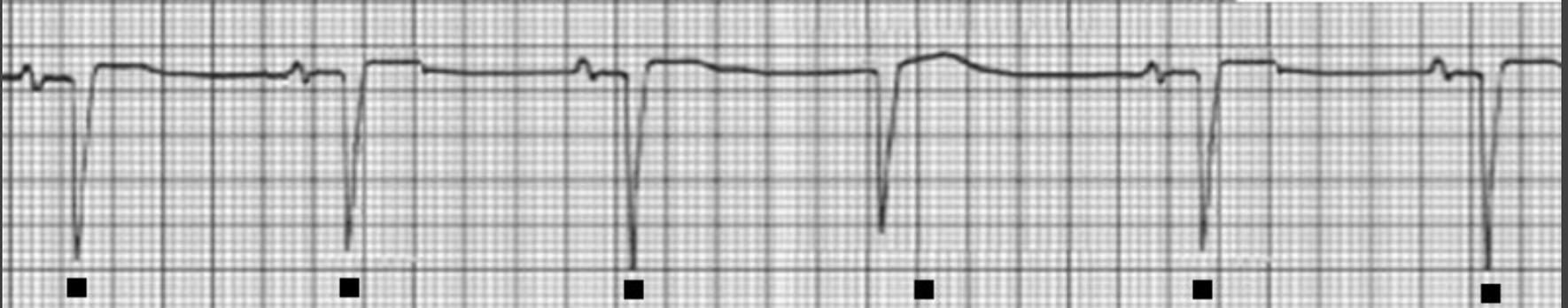
## 2. END-DIASTOLIC or ESCAPE BEATS ----

**GOOD**

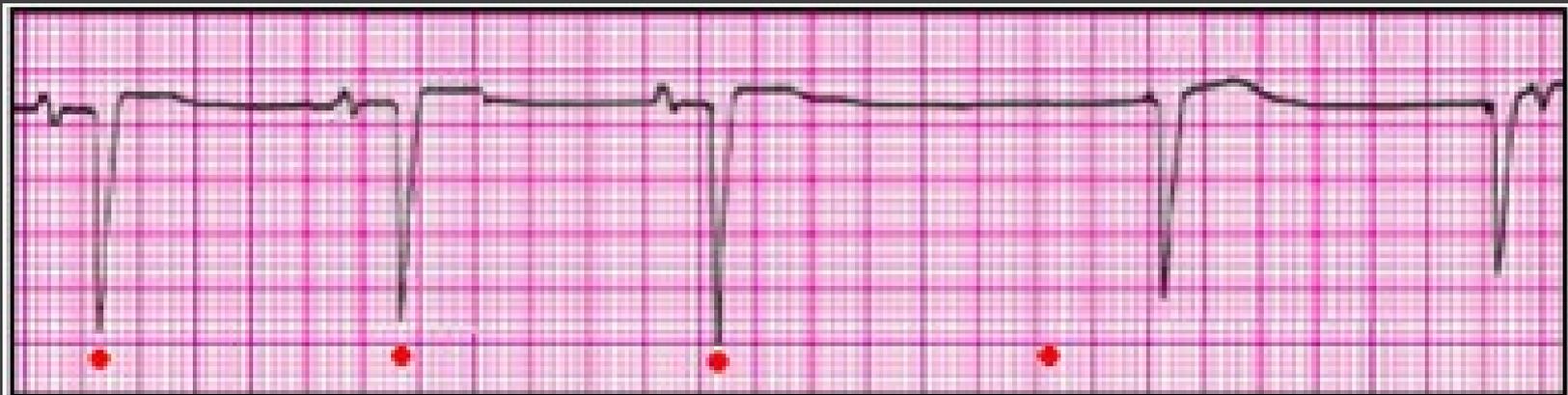


ELIMINATION OF END-DIASTOLIC BEATS COULD BE DEADLY

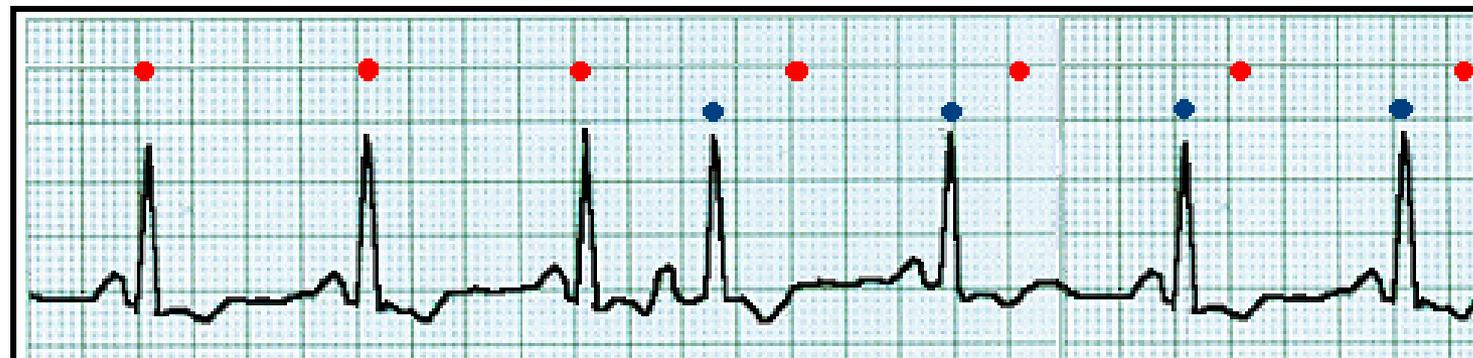
# Premature



# 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**

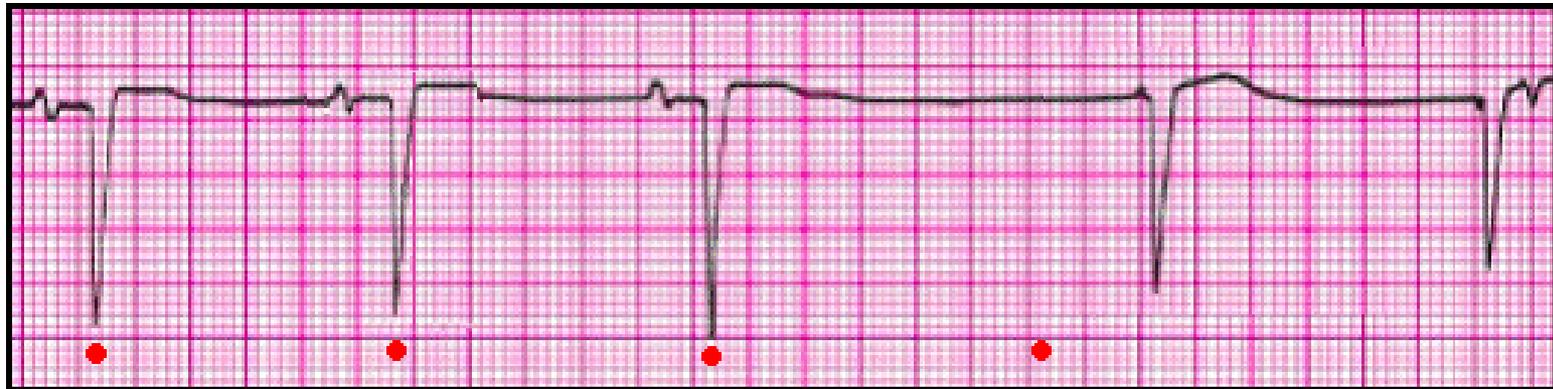
**RHYTHM** ----- **IRREGULAR**

**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 -----

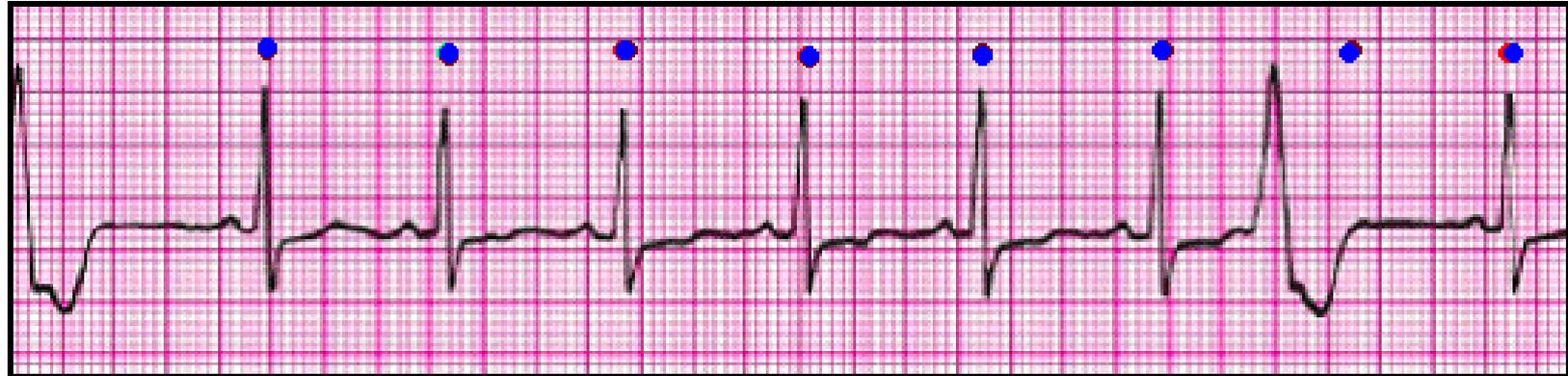
RHYTHM -----

P-R INTERVAL -----

P:QRS RATIO -----

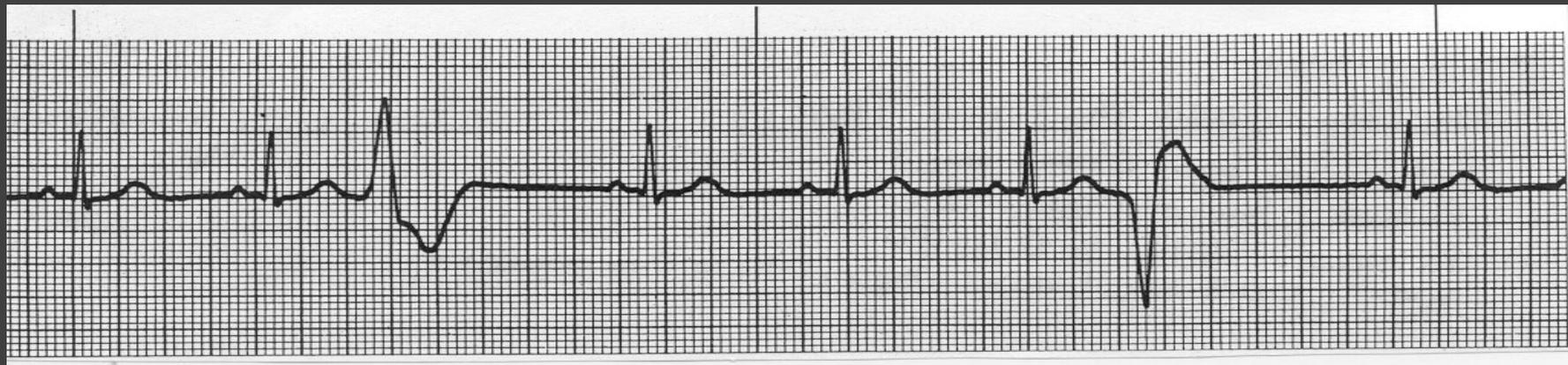
QRS INTERVAL -----

# THIS RHYTHM IS: NSR with UNIFOCAL PVCs

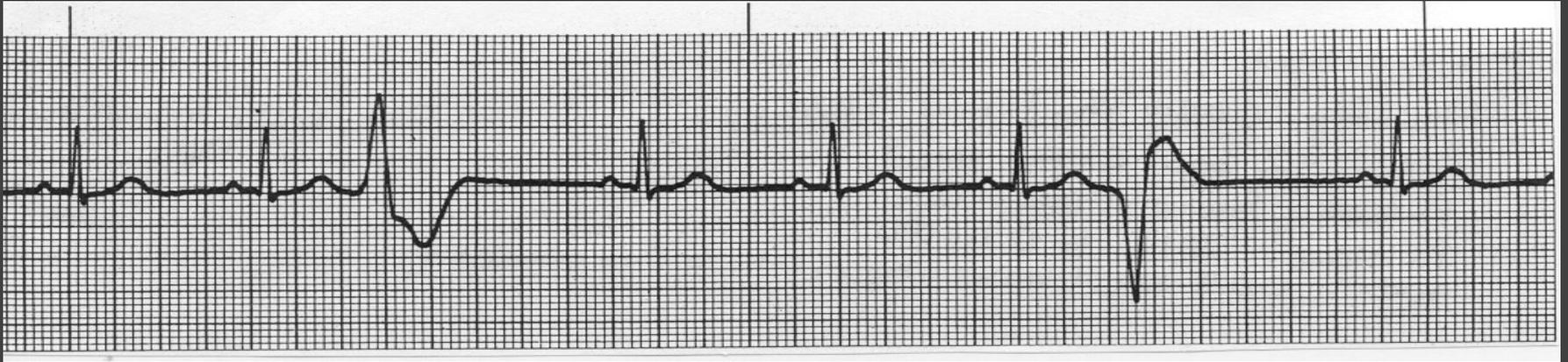


**MAIN IDENTIFICATION CHARACTERISTIC(S):** ECTOPIC BEATS ARE PREMATURE, AND WIDE ( $> 120$  ms); COMPLEXES MAY BE OF ANY SHAPE or DEFLECTION, BUT ALL HAVE SAME APPEARANCE; THERE IS A COMPENSATORY PAUSE

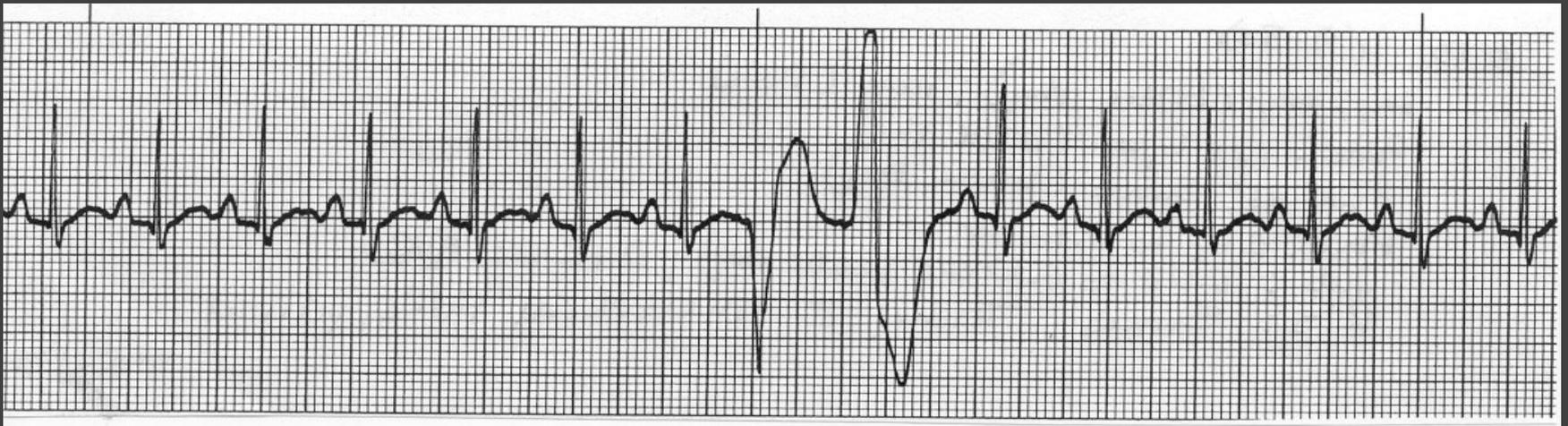
RATE -----	NORMAL
RHYTHM -----	IRREGULAR (due to PVCs)
P-R INTERVAL ----	NSR BEATS - NORMAL (120 - 200 ms)    PVCs - N/A
P:QRS RATIO ----	NSR BEATS - 1:1    PVCs - N/A
QRS INTERVAL ----	NSR BEATS $< 120$ ms    PVCs $> 120$ ms



## 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 -----

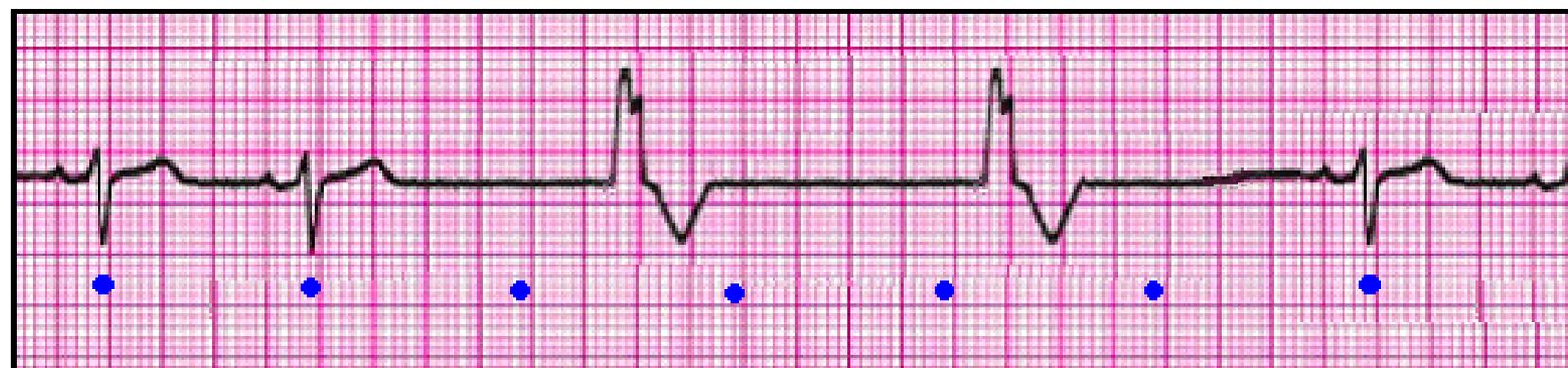
RHYTHM -----

P-R INTERVAL -----

P:QRS RATIO -----

QRS INTERVAL -----

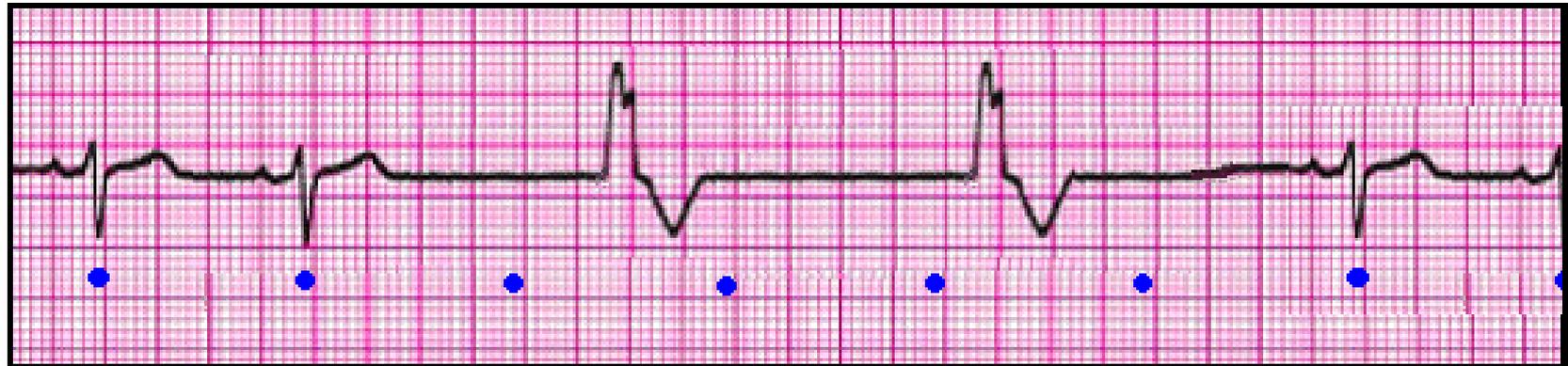
# THIS RHYTHM IS: SINUS ARREST w/ VENT. ESCAPE



**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

<b>RATE</b> -----	<b>USUALLY &lt; 40</b>
<b>RHYTHM</b> -----	<b>VENT. ESCAPE: USUALLY REGULAR</b>
<b>P-R INTERVAL</b> -----	<b>VENT. ESCAPE: N/A</b>
<b>P:QRS RATIO</b> -----	<b>VENT. ESCAPE: N/A</b>
<b>QRS INTERVAL</b> -----	<b>VENT. ESCAPE: &gt; 20 ms</b>

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

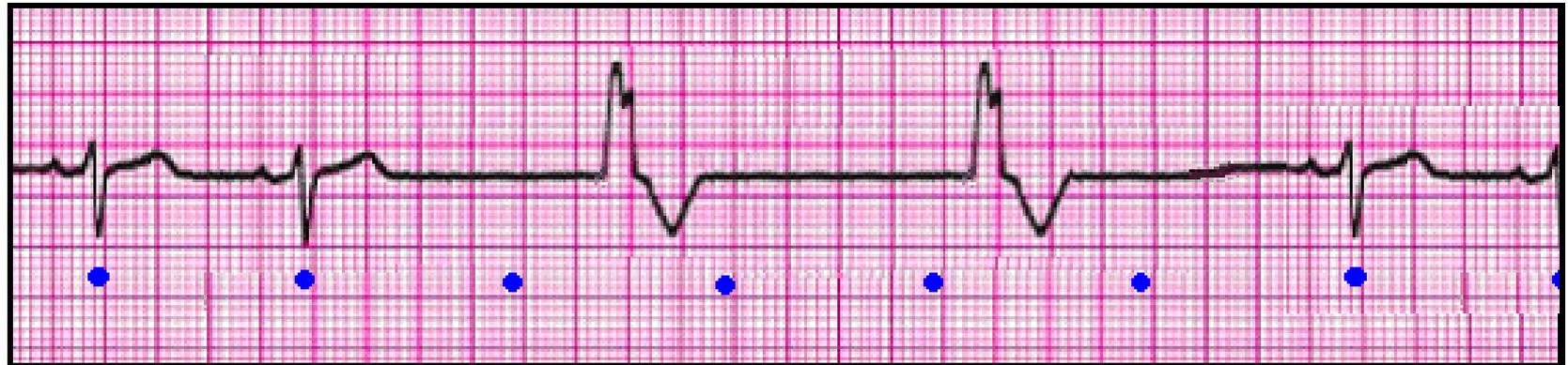


**MAIN IDENTIFICATION CHARACTERISTIC(S):** END DIASTOLIC (ESCAPE) BEAT(S); COMPLEXES WIDER THAN 120 ms ; MAY BE UNIFOCAL or MULTIFOCAL ; MAY or MAY NOT HAVE GOOD PULSE w/ COMPLEXES

## PRESENTING PROBLEM(S):

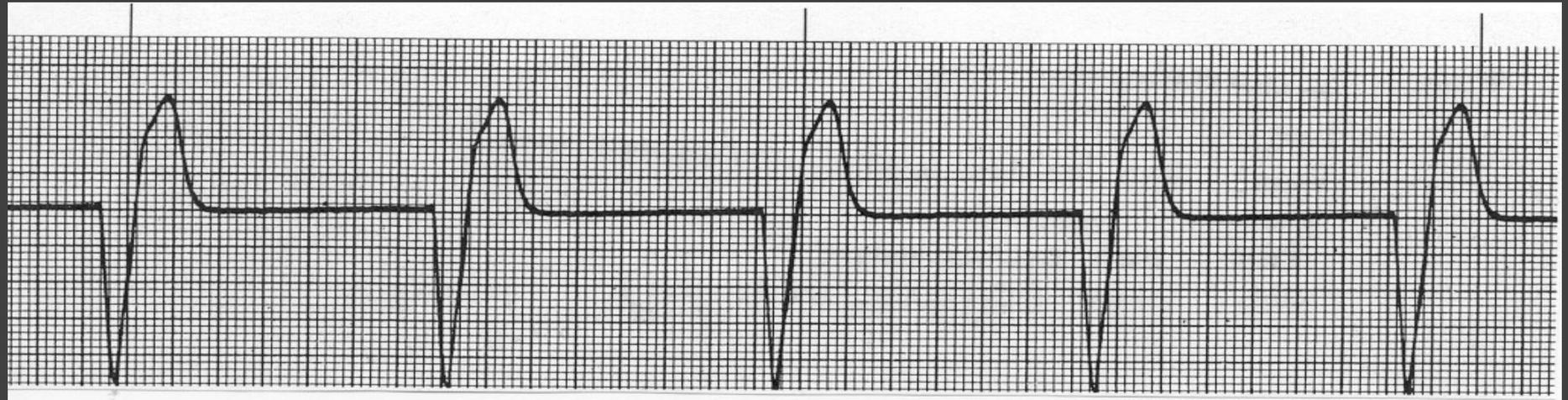
- PROBLEM IS WITH UNDERLYING REASON WHY SINUS NODE and AV NODE HAVING PERIODS OF ARREST.
- THE VENTRICULAR ESCAPE COMPLEXES MAY BE VERY SLOW, BUT MAY BE ONLY THING KEEPING PATIENT PERFUSED DURING PERIODS OF SINUS/AV ARREST.

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

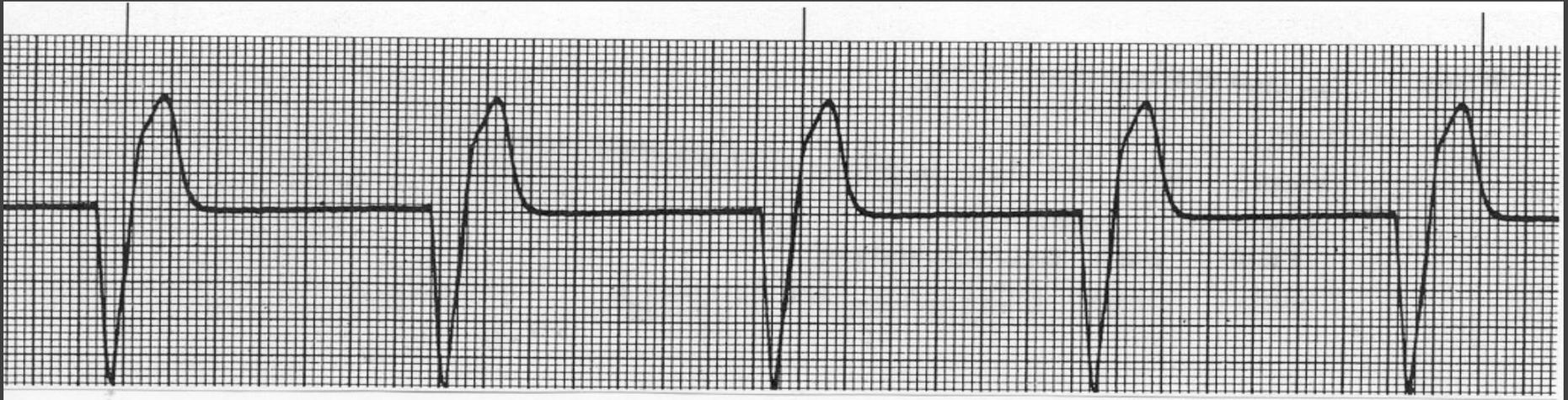


### TREATMENT / INTERVENTION (S):

- 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)



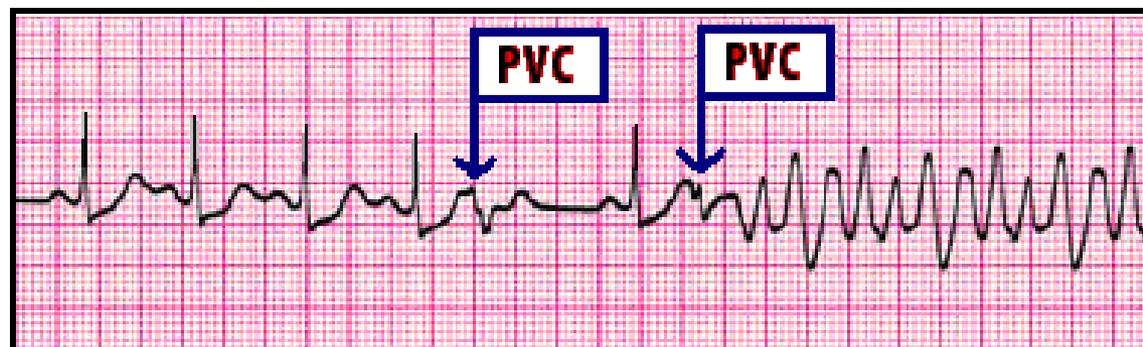
**No P waves**

**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

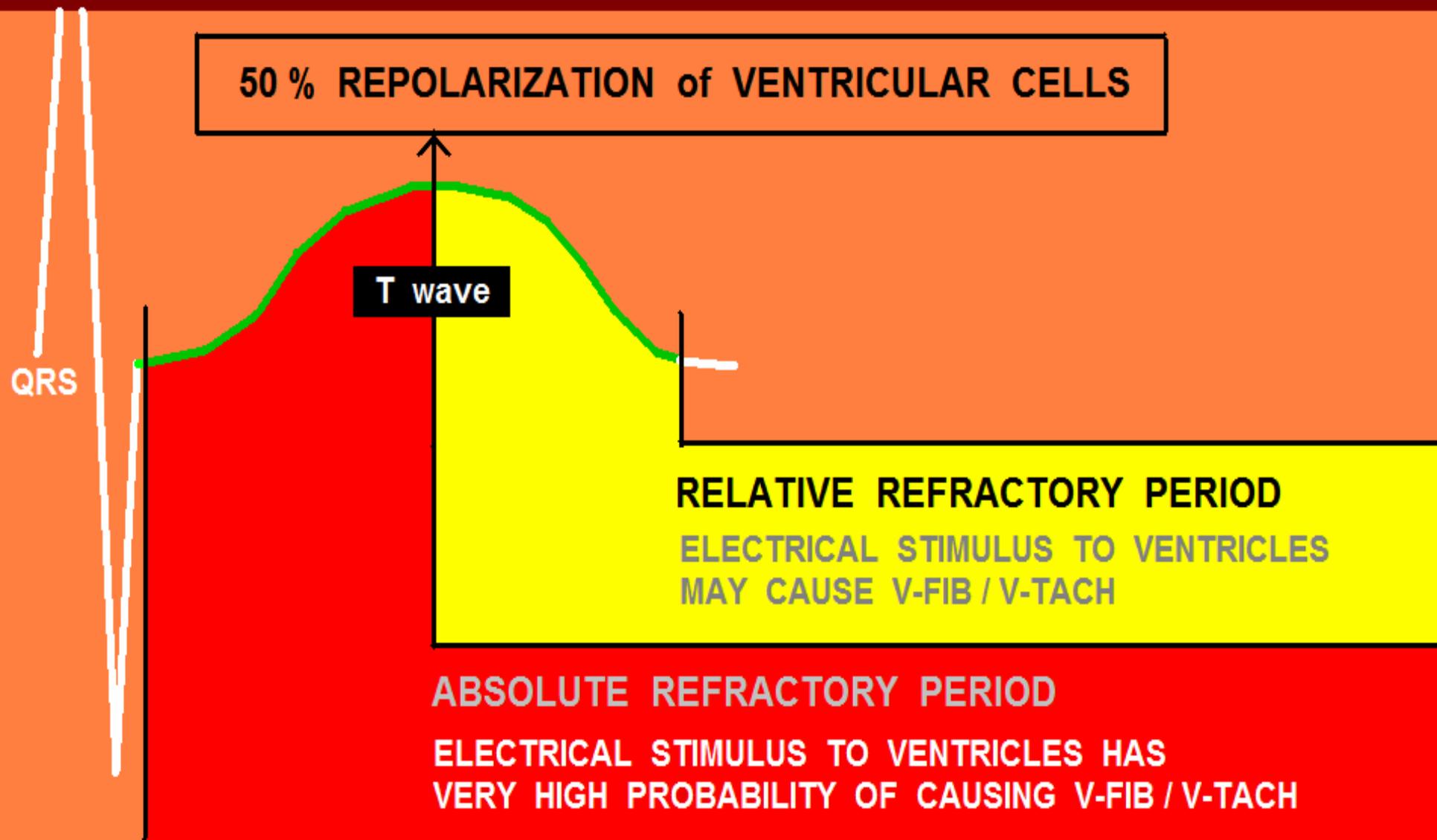


**MAIN IDENTIFICATION CHARACTERISTIC(S):** ECTOPIC BEATS ARE WIDE ( $> 120$  ms); ALL APPEAR TO HAVE SAME SHAPE and DEFLECTION ; THERE IS A COMPENSATORY PAUSE

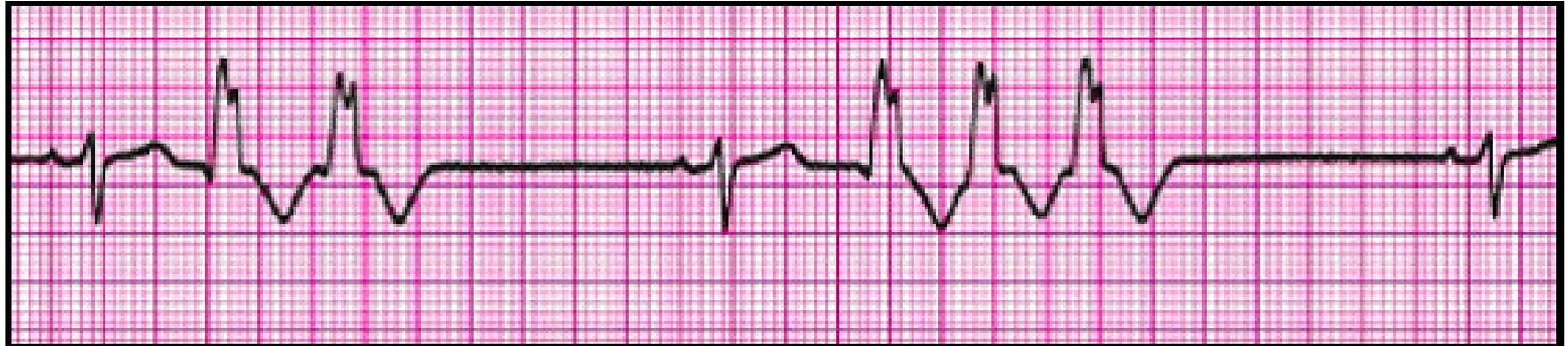
## POTENTIAL PROBLEMS (S) :

- 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

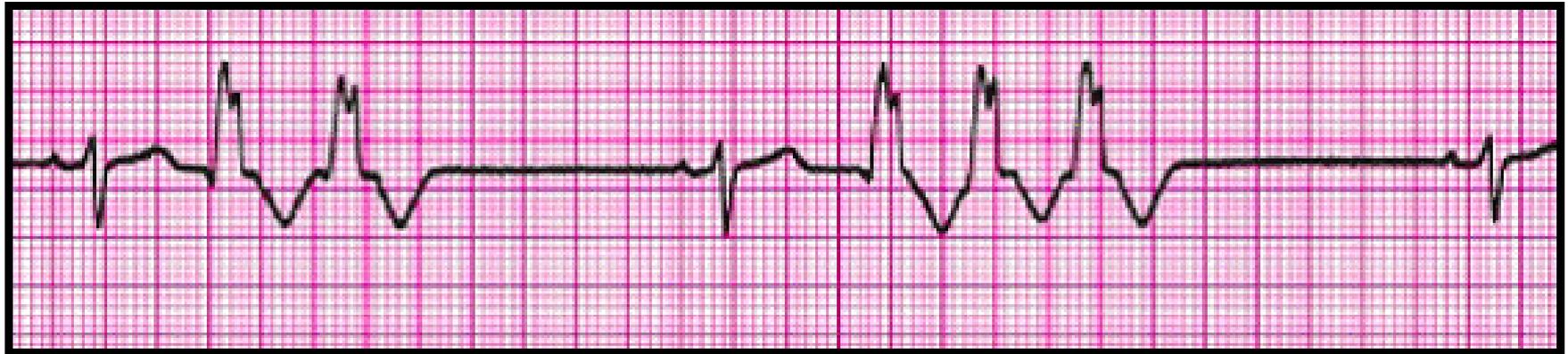


**MAIN IDENTIFICATION CHARACTERISTIC(S):** ECTOPIC BEATS ARE WIDE ( $> 120$  ms); PVCs ARE COUPLED TOGETHER (2 = "COUPLET"), (3 or more = RUN OF V-TACH)

## 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

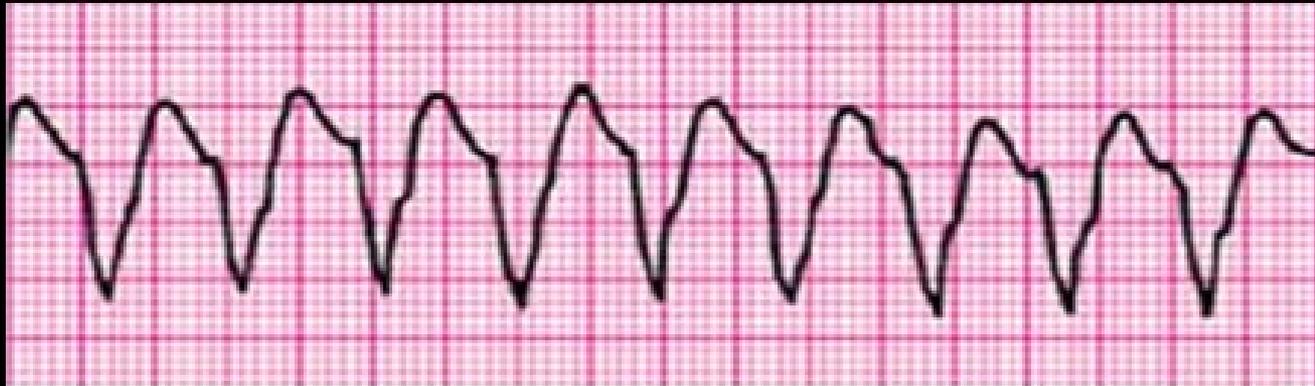
# **THIS RHYTHM IS: NSR w/ COUPLET and **RUN OF V-TACH****



## **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 > 120 ms )

MONOPHASIC

**ABC s**

## NO PULSE

GO TO  
V - FIB  
ALGORITHM !

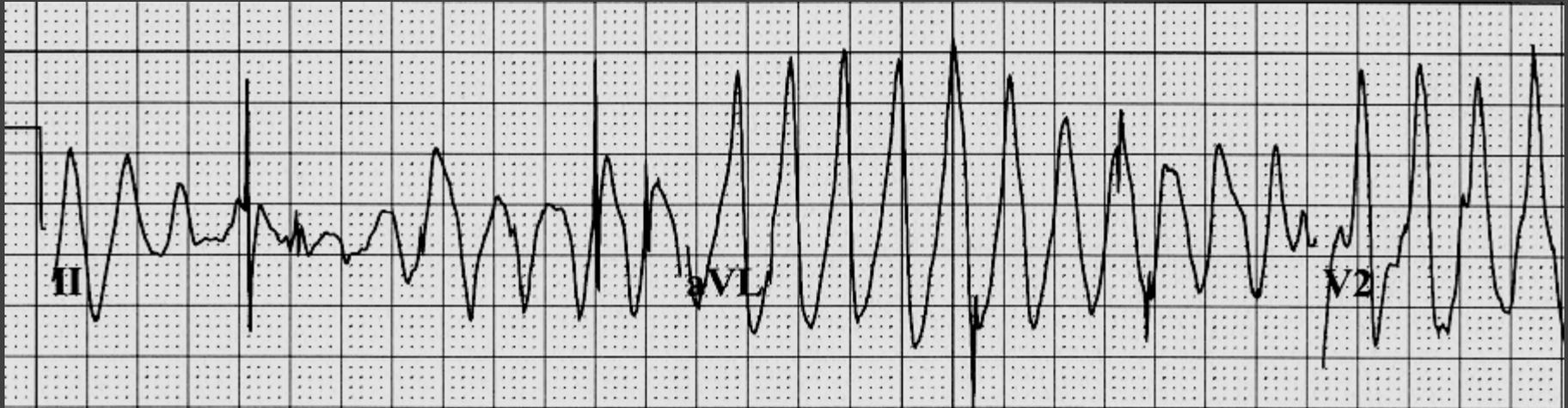
## PULSE - UNSTABLE

- IMMEDIATE SYNC. CARADIOVERSION:
  - 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)**

<b>RATE</b> -----	<b>200 - 300</b>
<b>RHYTHM</b> -----	<b>VARIES</b>
<b>P-R INTERVAL</b> -----	<b>N/A</b>
<b>P:QRS RATIO</b> -----	<b>N/A</b>
<b>QRS INTERVAL</b> -----	<b>VARIES</b>

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

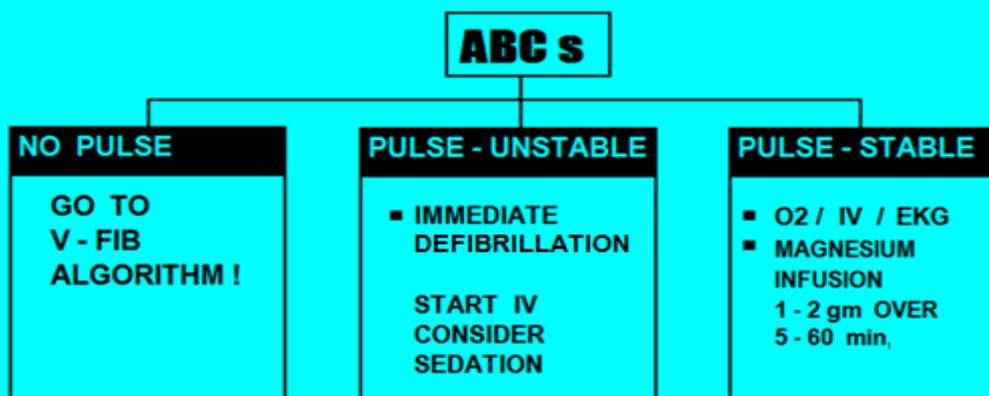
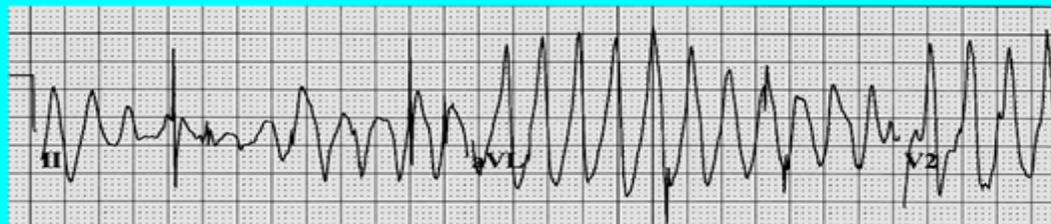
**-Immediately check patient**

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

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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**
- 5. NEW ONSET of any DYSRHYTHMIA**
- 6. PVCs that are MULTIFOCAL, 2 or MORE TOGETHER, R on T, greater than 6 per minute,**
- 7. V-TACH, or WIDE QRS TACHYCARDIA of unknown origin**
- 8. TORSADES de POINTES**

# WIDE COMPLEX TACHYCARDIA TORSADES de POINTES

( QRS > 120 ms )

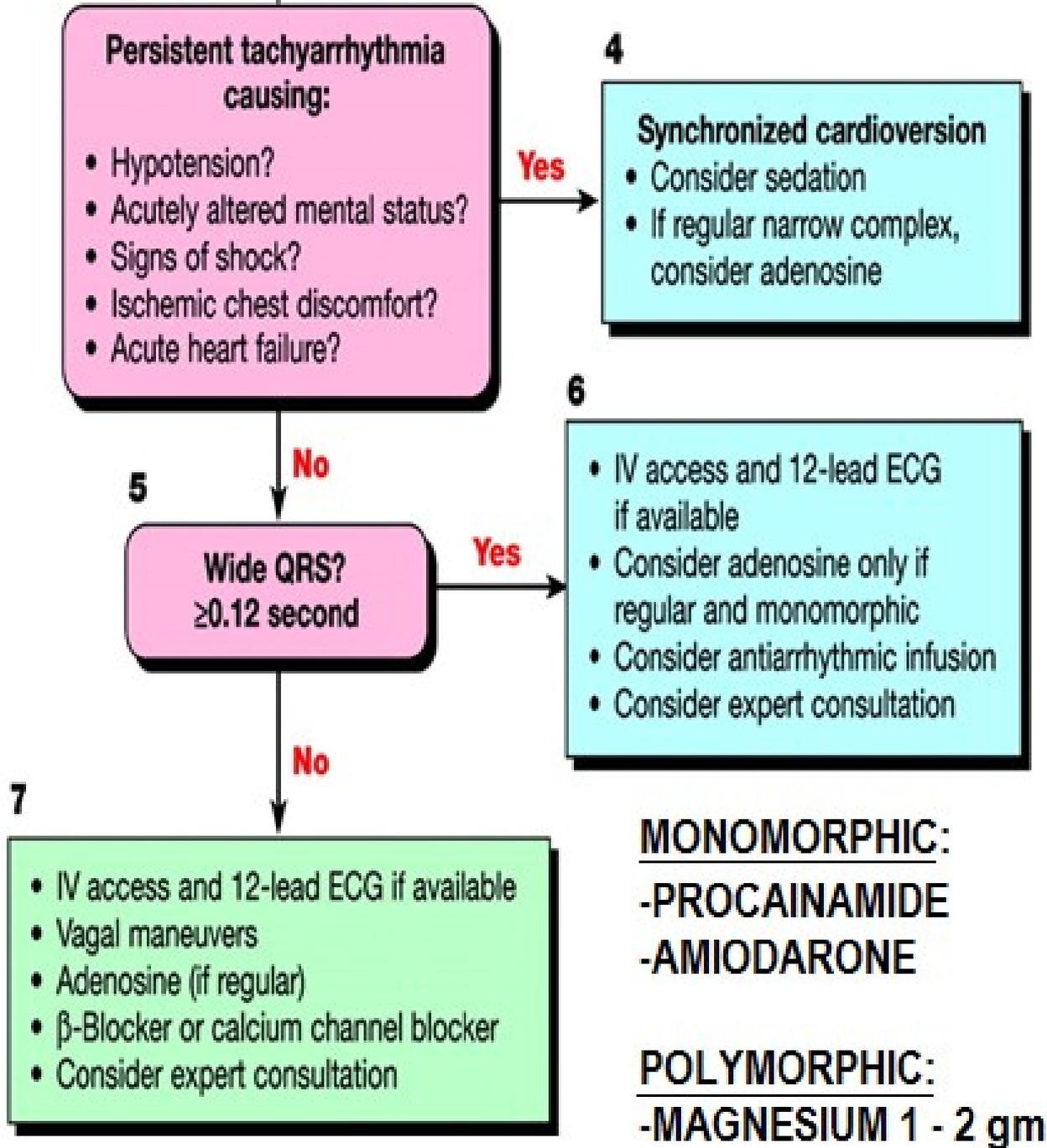


***DO NOT give PROCAINAMIDE, AMIODARONE, or SOTALOL  
to patients with TORSADES or POLYMORPHIC VT !!!***

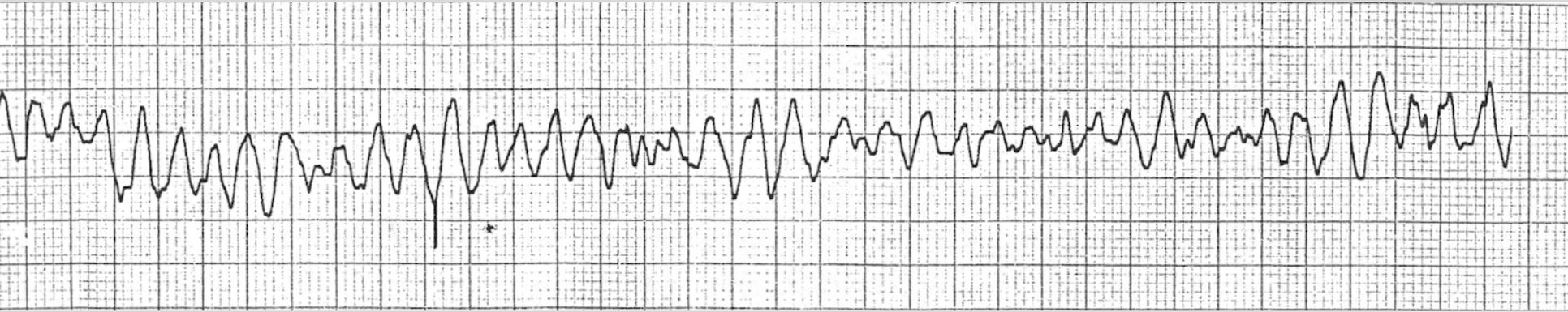
## OTHER CONSIDERATIONS:

- 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.

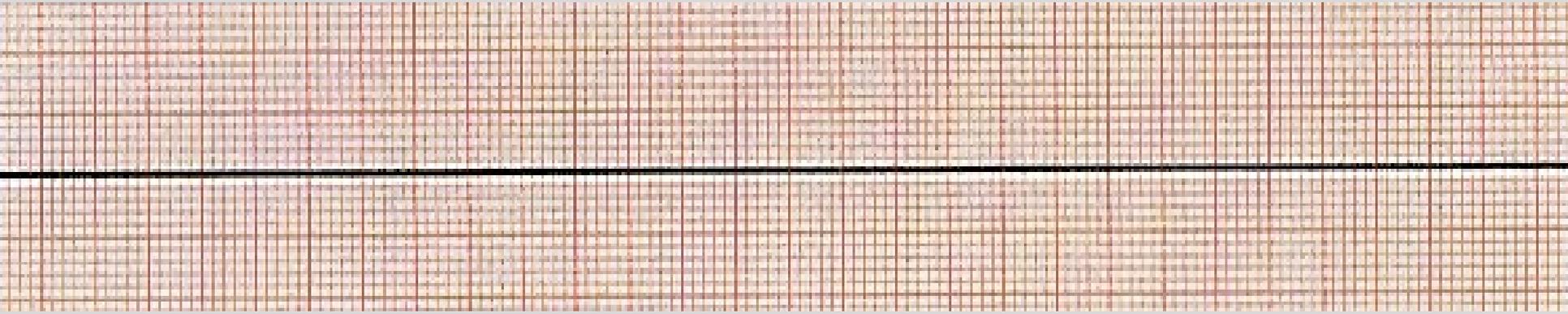


# VENTRICULAR FIBRILLATION



***CARDIAC ARREST RHYTHM***

# Ventricular Asystole



***CARDIAC ARREST RHYTHM***

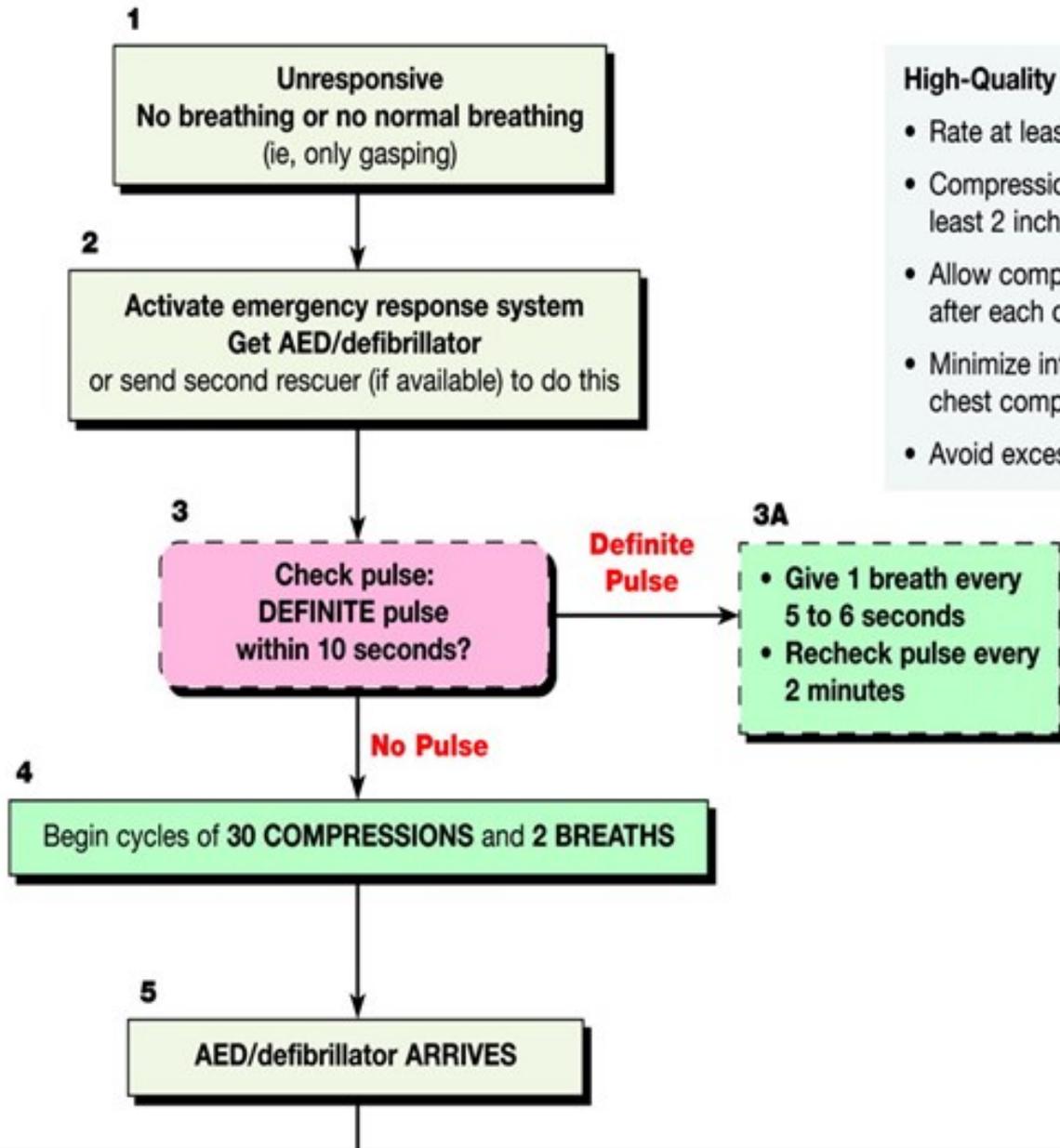
# **-- CRITICAL ECG ALERT --**

**-Immediately check patient**

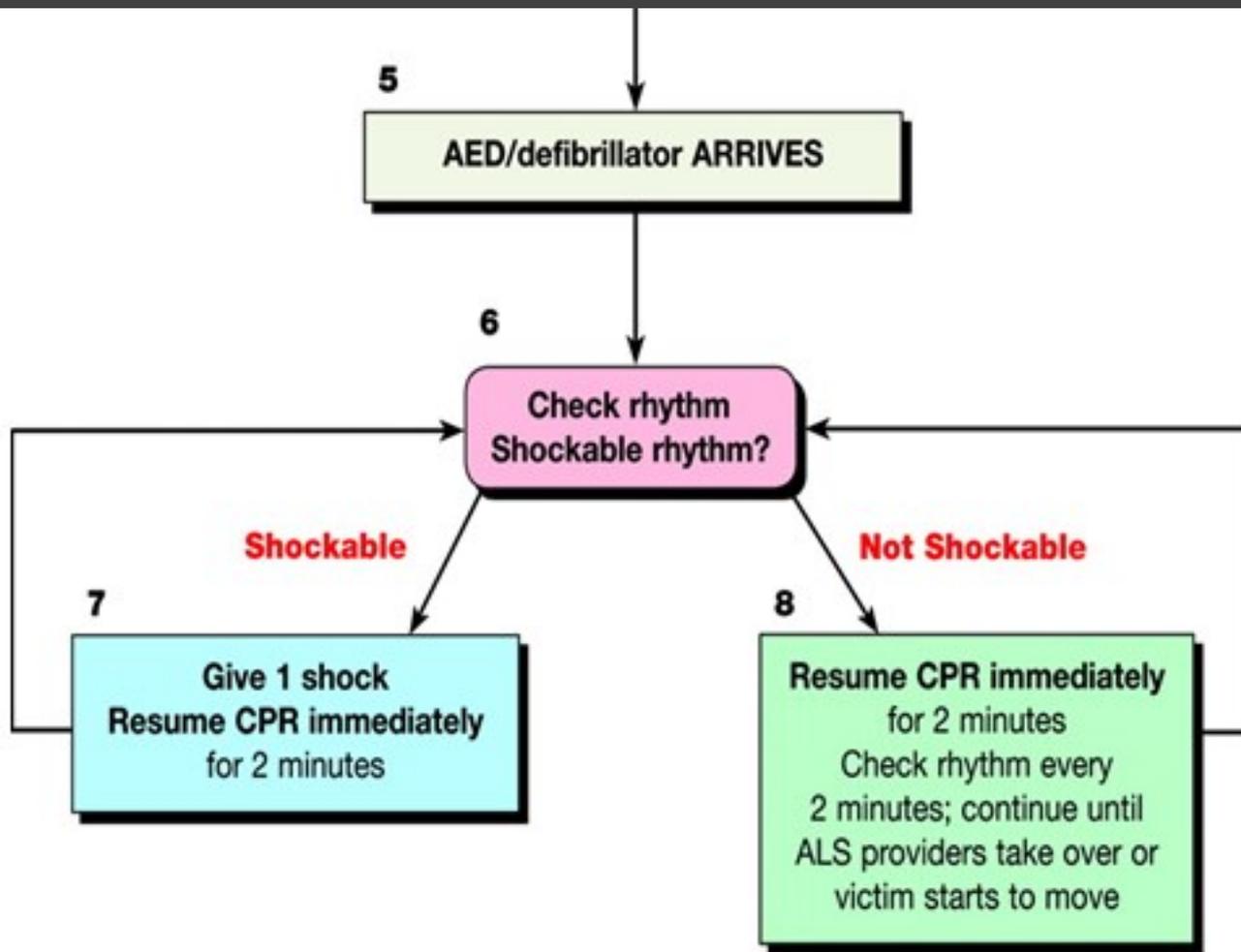
**-Notify next “higher up” in chain of command**

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- 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**

# Adult BLS Healthcare Providers



- ### High-Quality CPR
- Rate at least 100/min
  - Compression depth at least 2 inches (5 cm)
  - Allow complete chest recoil after each compression
  - Minimize interruptions in chest compressions
  - Avoid excessive ventilation





**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 ( $\geq 100$ /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  $PETCO_2 < 10$  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  $PETCO_2$  (typically  $\geq 40$  mm Hg)
  - Spontaneous arterial pressure waves with intra-arterial monitoring

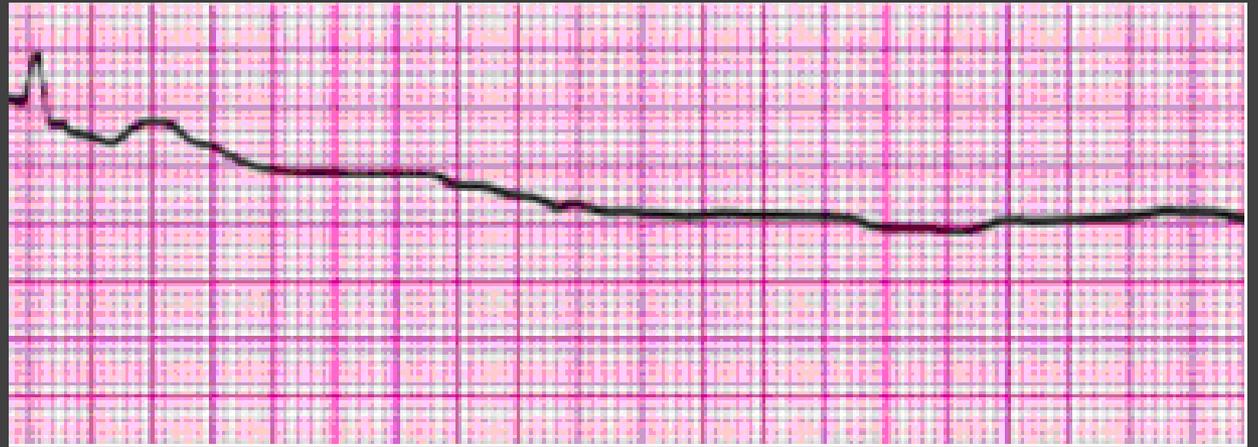
- Shock Energy**
- **Biphasic:** Manufacturer recommendation (120-200 J); if unknown, use maximum available. Second and subsequent doses should be equivalent, and higher doses may be considered.
  - **Monophasic:** 360 J

- 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

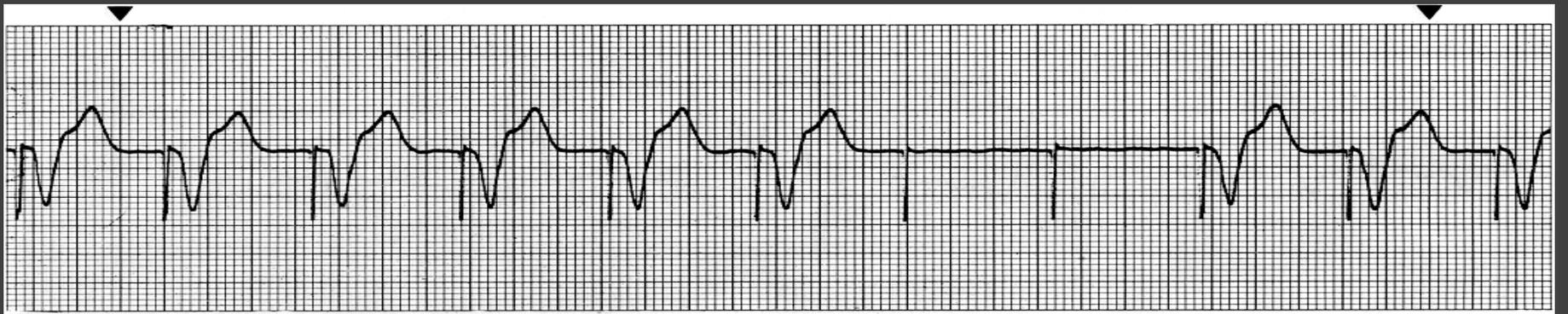


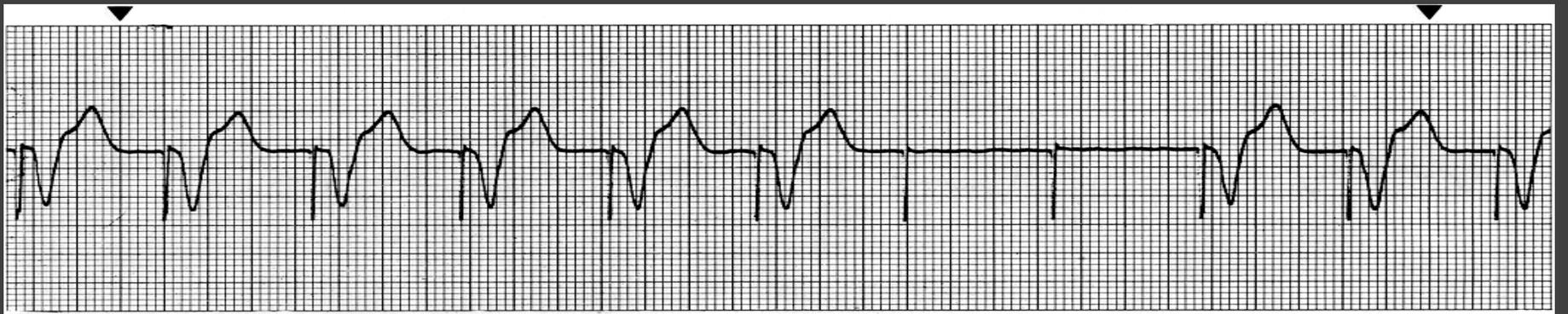
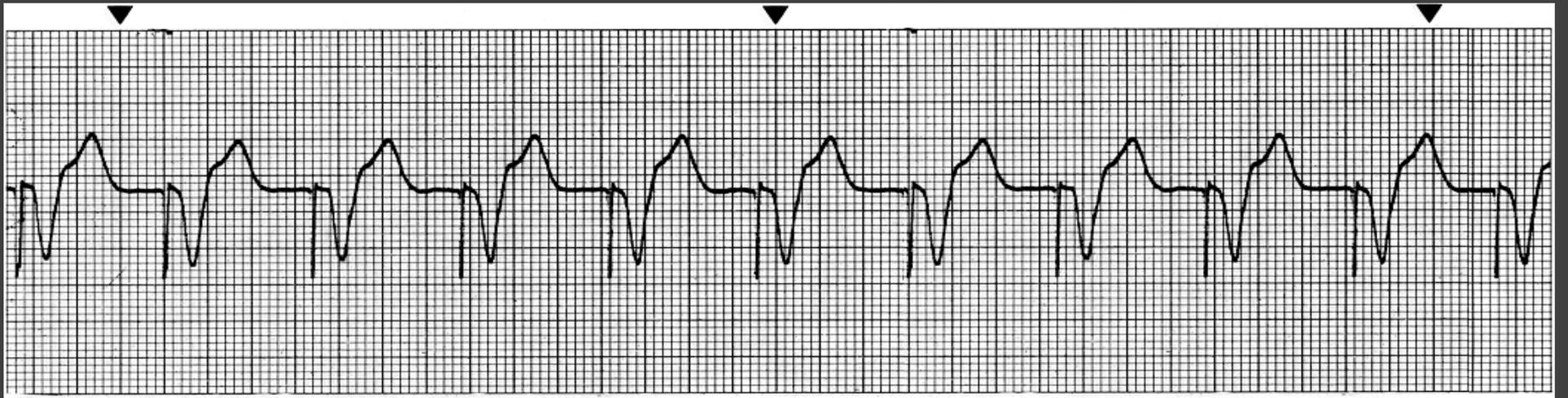
**PACEMAKER !!**

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 --**

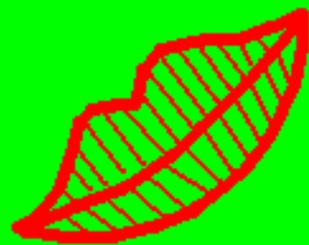
**-Immediately check patient**

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

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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

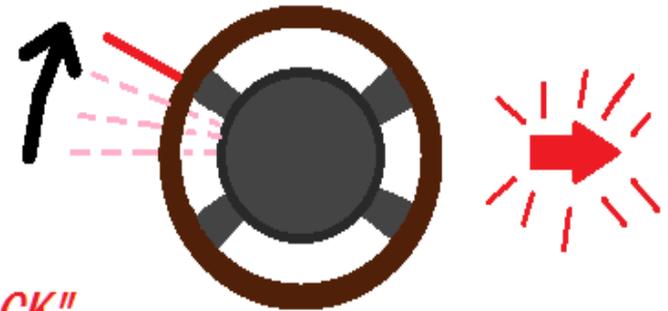
V1

**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”*

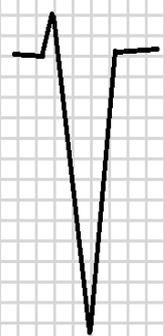
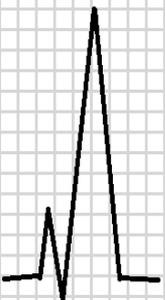
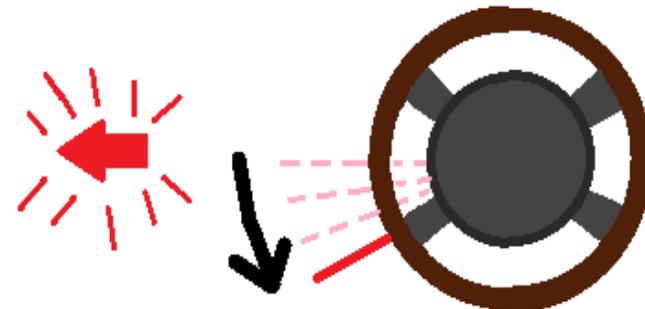


V1

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

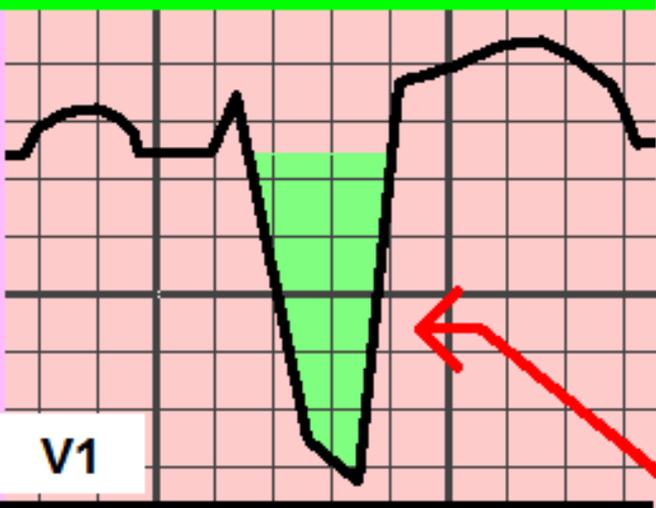
THINK:

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



# DIAGNOSING BUNDLE BRANCH BLOCK

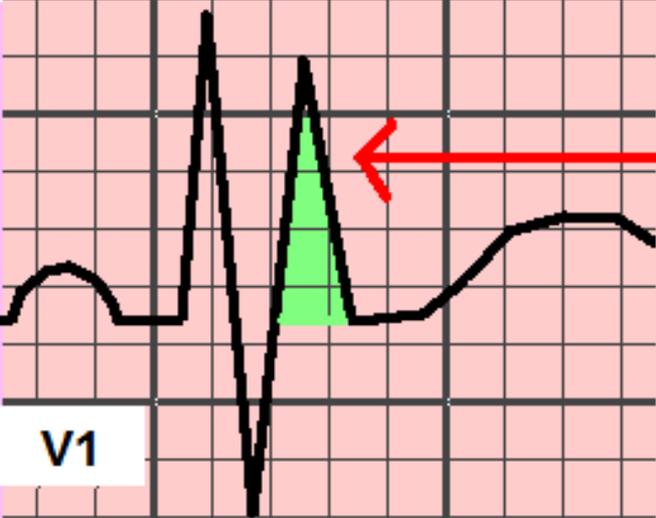
## L.B.B.B.



## 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

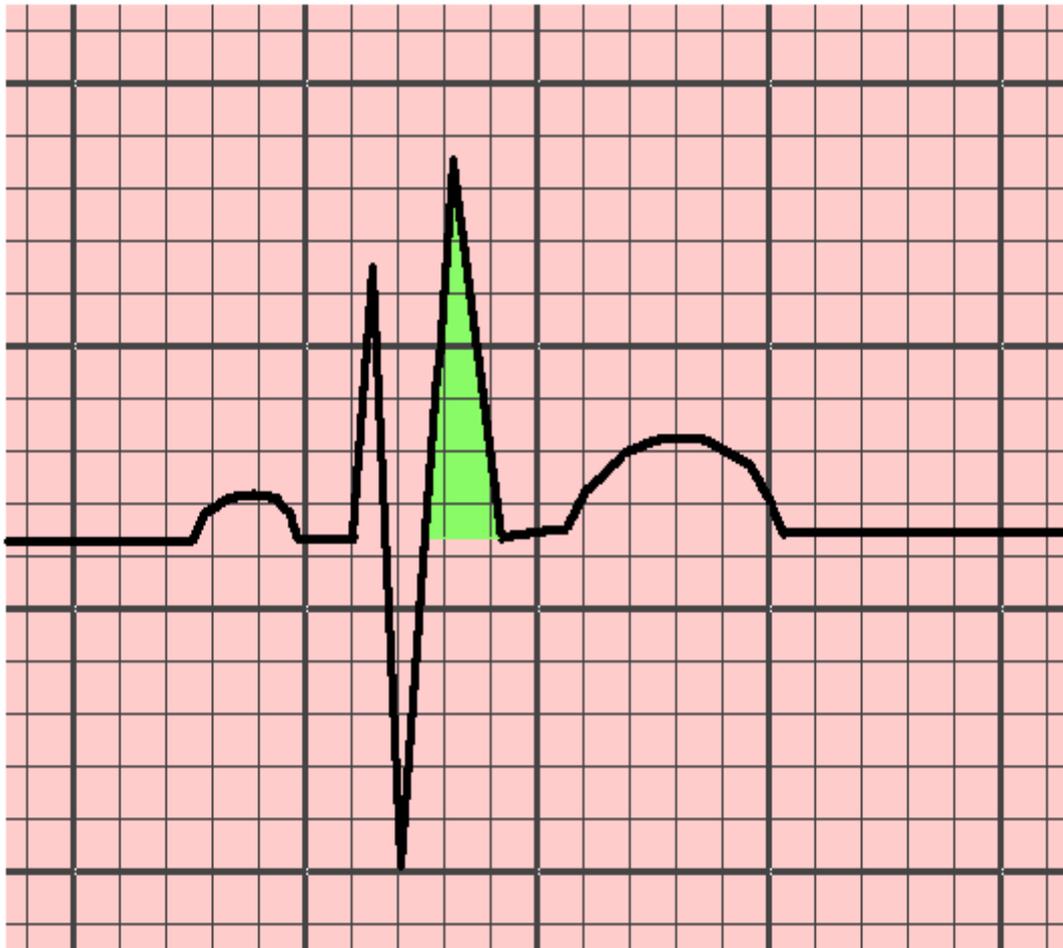
POSITIVE = RIGHT BUNDLE BRANCH BLOCK

## 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 !

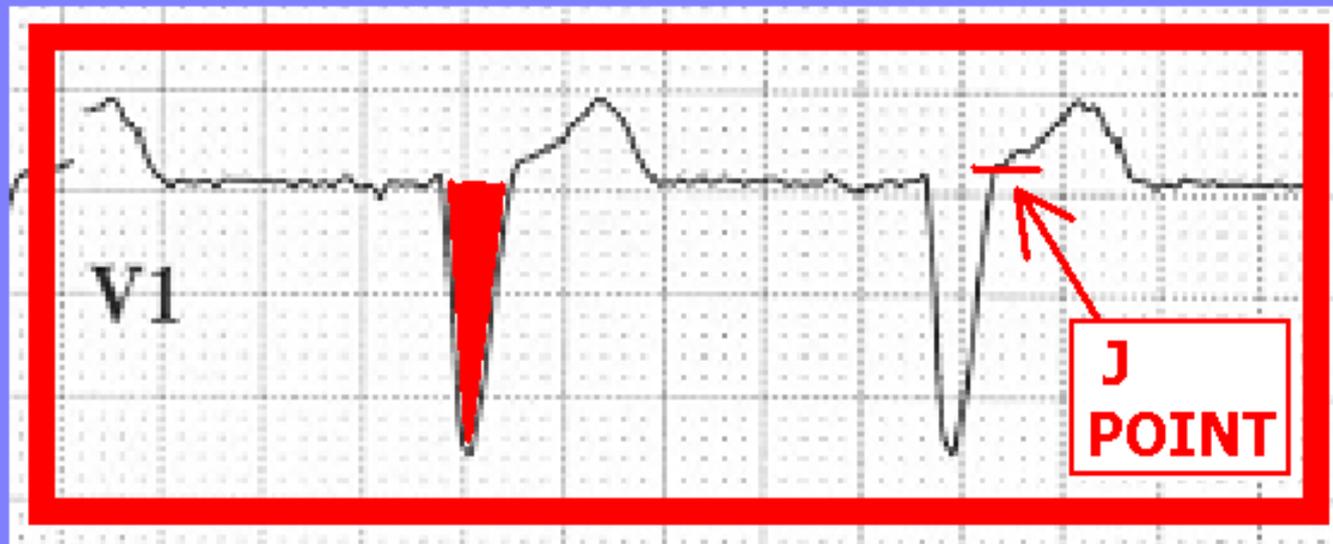
## DIAGNOSING RBBB IN LEAD V1:



- **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**
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- 6. PVCs that are MULTIFOCAL, 2 or MORE TOGETHER, R on T, greater than 6 per minute,**
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- 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.**

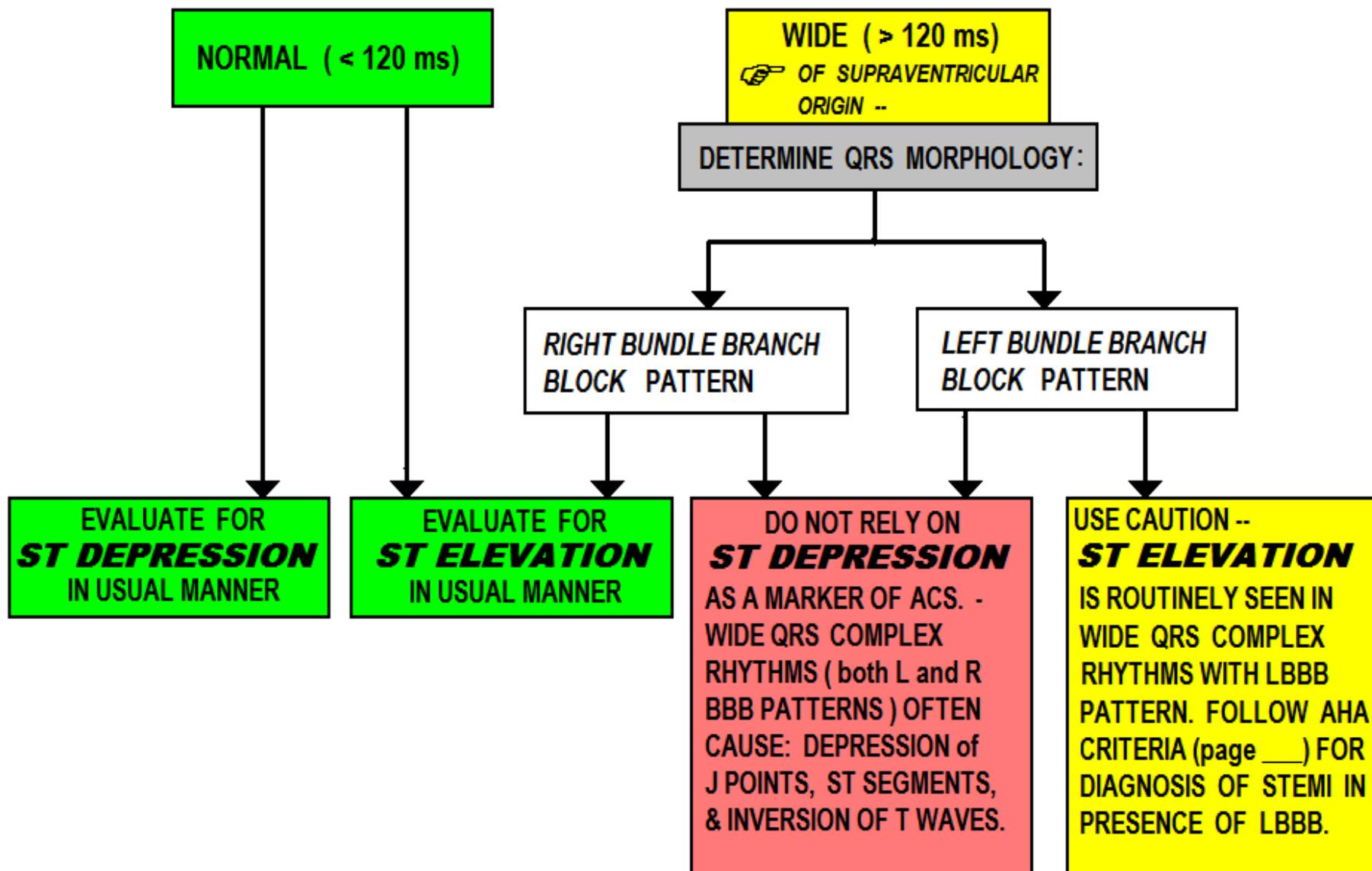
The ECG Markers of ACS involve the:

- 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:



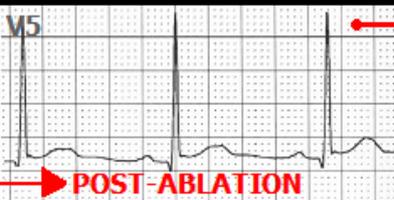
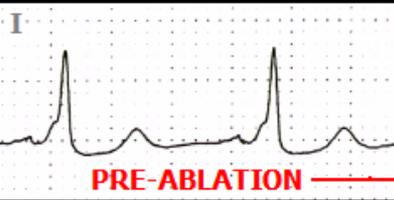
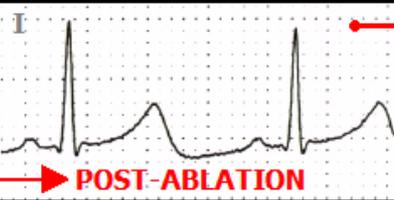
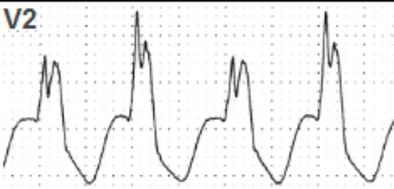
If the QRS complexes  
Are WIDE ( $> 120\text{ms}$ )  
COMPARE J POINTS,  
ST SEGMENTS and  
T WAVES of OLDER  
RHYTHM STRIPS to  
NEWER ONES !!

# CONDITIONS WHICH ALTER THE ECG MARKERS of ACUTE CORONARY SYNDROME

WIDE QRS  
COMPLEXES  
ALTER THE

-J POINTS  
-ST SEGMENTS  
-T WAVES

Of the ECG ...

<p><b>RIGHT BUNDLE BRANCH BLOCK</b></p>			<p><b>LEFT BUNDLE BRANCH BLOCK</b></p>
<p><b>W-P-W BYPASS TRACT, LEFT LATERAL WALL 49 y/o MALE</b></p>	 <p style="text-align: center; color: red;">PRE-ABLATION</p>	 <p style="text-align: center; color: red;">POST-ABLATION</p>	<p><b>SAME PATIENT AS ON LEFT - IMMEDIATELY AFTER RF ABLATION OF BYPASS TRACT</b></p>
<p><b>W-P-W BYPASS TRACT, RIGHT ANTERIOR/ LATERAL WALL 14 y/o MALE</b></p>	 <p style="text-align: center; color: red;">PRE-ABLATION</p>	 <p style="text-align: center; color: red;">POST-ABLATION</p>	<p><b>SAME PATIENT AS ON LEFT - IMMEDIATELY AFTER RF ABLATION OF BYPASS TRACT</b></p>
<p><b>PACEMAKER - RIGHT VENTRICULAR APEX</b></p>			<p><b>PACEMAKER TURNED OFF HERE</b></p>
<p><b>RIGHT VENTRICULAR HYPERTROPHY ( Strain Pattern )</b></p>			<p><b>LEFT VENTRICULAR HYPERTROPHY ( Strain Pattern )</b></p>
<p><b>VENTRICULAR TACHYCARDIA FOCUS: LEFT FASCICULAR, 17 y/o FEMALE</b></p>			<p><b>VENTRICULAR TACHYCARDIA- FOCUS: RIGHT VENTRICULAR APEX</b></p>

# 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)

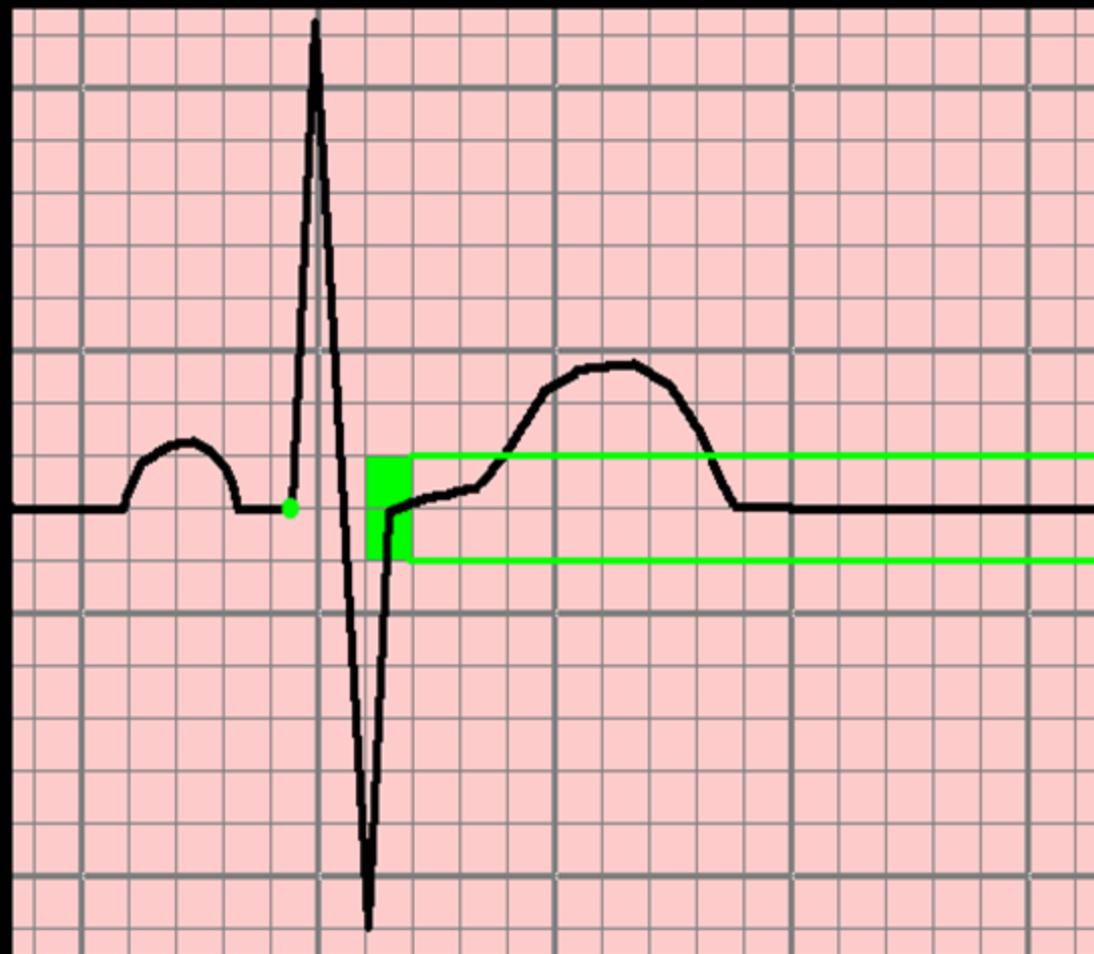
## ASSESS:

- 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 ..



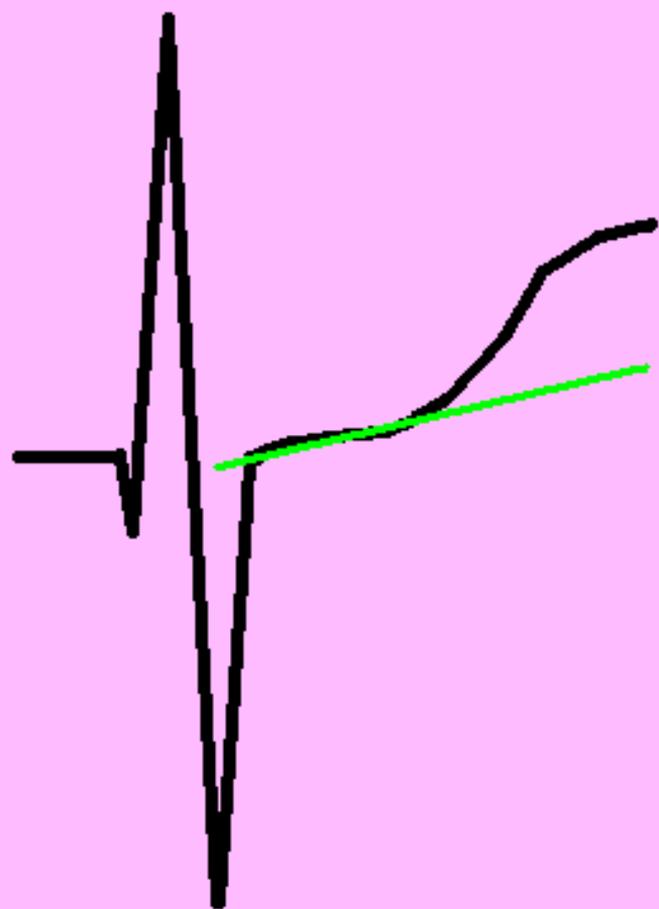
WITHIN  
1 mm  
ABOVE

OR

BELOW  
the  
ISOELECTRIC  
LINE

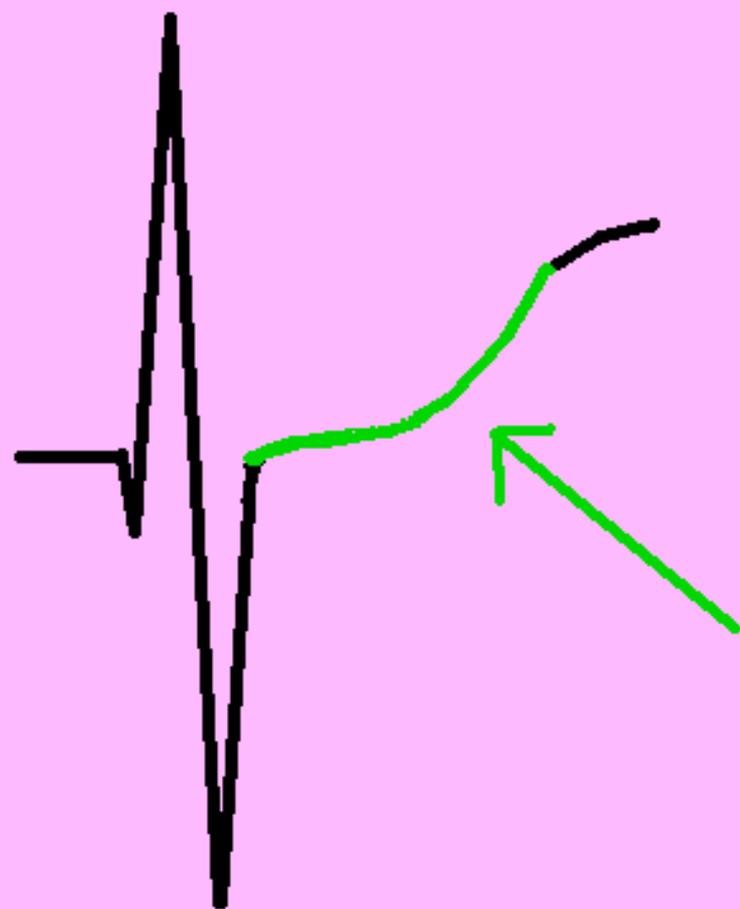
or the P-Q JUNCTION.

# THE S-T SEGMENT



**SHOULD HAVE  
A "SLIGHT POSITIVE"  
INCLINATION**

# THE S-T SEGMENT

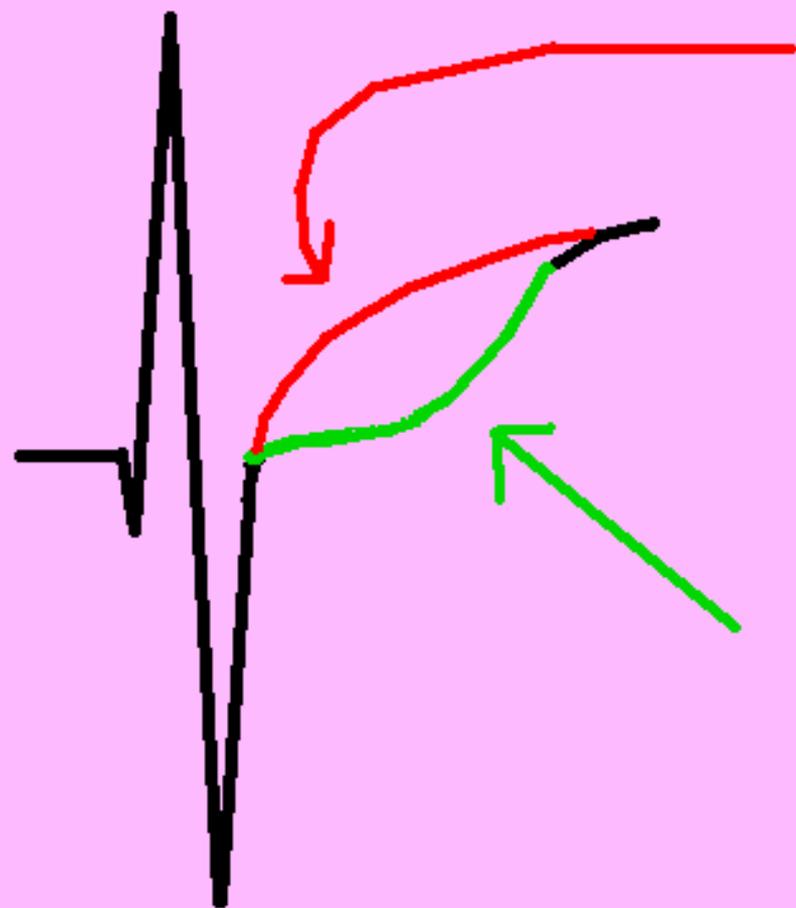


SHOULD BE  
"CONCAVE" IN  
SHAPE . . .

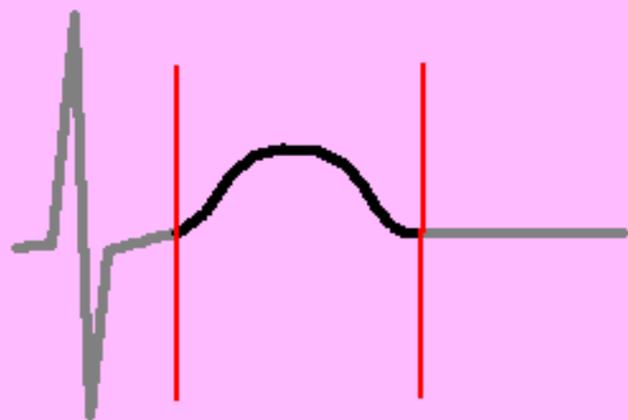
# THE S-T SEGMENT

AS OPPOSED TO  
"CONVEX" IN  
SHAPE

SHOULD BE  
"CONCAVE" IN  
SHAPE . . .



# THE T WAVE

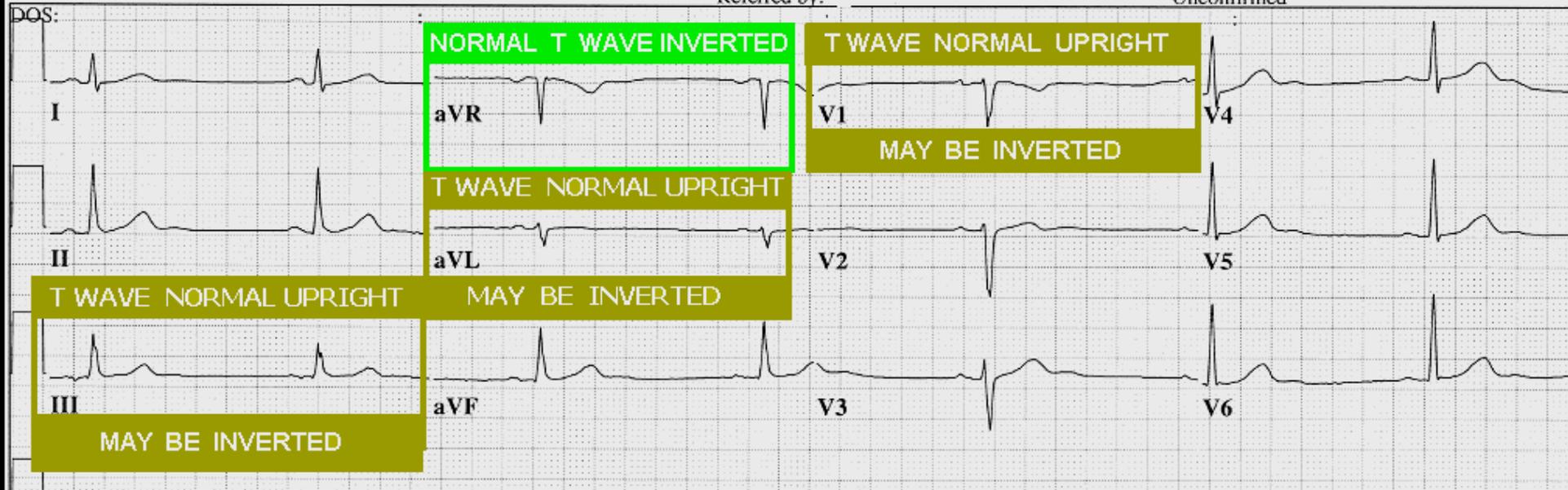


- SHOULD BE A "NICE," ROUNDED, CONVEX SHAPE
- SHOULD BE SYMMETRICAL
- SHOULD BE UPRIGHT IN ALL LEADS, EXCEPT AVR
- MAY BE INVERTED IN LEADS AVL, III, and V1

# Leads where the T WAVE may be INVERTED:

Referred by:

Unconfirmed



# 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

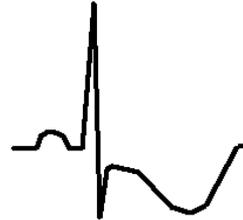
EKG: J POINT ISOELECTRIC, ST SEG "SLIGHT, POSITIVE INCLINATION, T WAVE POSITIVE, UPRIGHT.



## 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

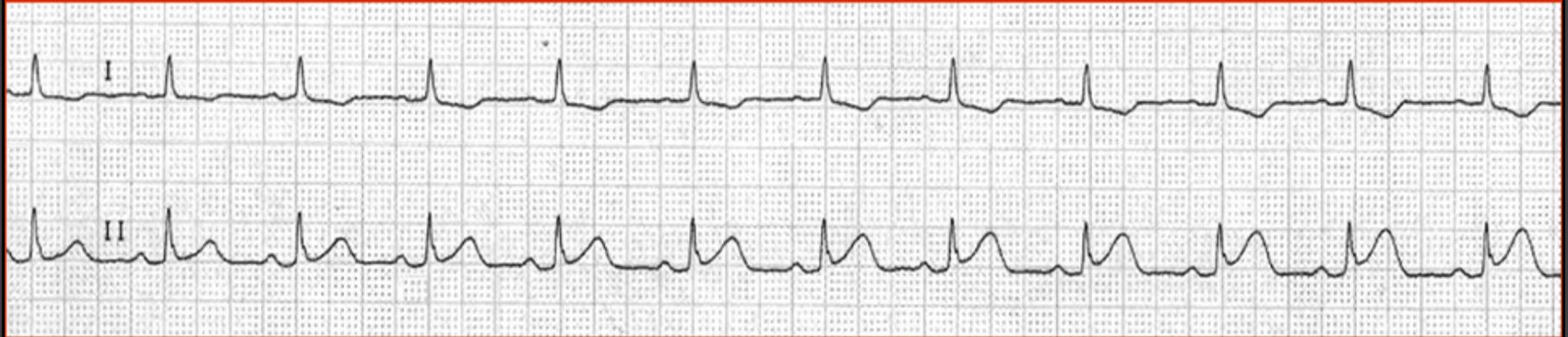
ARTERIAL BLOCKAGES → TOTAL OBSTRUCTION  
 CELLULAR OXYGENATION → NONE  
 CELLULAR METABOLISM → CELL DIES WHEN GLYCOGEN RESERVES DEPLETED.  
 CELLULAR FUNCTION → NONE. CELL DEAD.  
 PATIENT SYMPTOMS → POSS. HYPOTENSION, DEATH

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

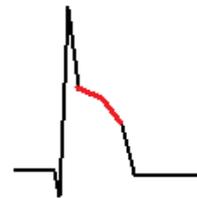


# ***ST SEGMENT ELEVATION:***

**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**



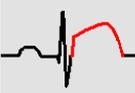
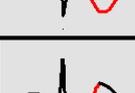
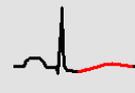
**FLAT  
S-T SEGMENT**



**UPSLOPING  
S-T SEGMENT**

# EKG PATTERNS of ACS & ISCHEMIA

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

! S-T SEGMENT ELEVATION at J POINT		- ACUTE MI - ACUTE PERICARDITIS / MYOCARDITIS - EARLY REPOLARIZATION
! FLAT or CONVEX J-T APEX SEGMENT		- ACUTE MI - ISCHEMIA
! HYPER-ACUTE T WAVE		- HYPERKALEMIA - TRANSMURAL ISCHEMIA - ACUTE MI - HYPERTROPHY
! DEPRESSED J pt. DOWNSLOPING ST and INVERTED T		- ACUTE (NON-Q WAVE) MI - ACUTE MI - (RECIPROCAL CHANGES) - ISCHEMIA
INVERTED T WAVE		- MYOCARDITIS - ELECTROLYTE IMBAL. - ISCHEMIA
SHARP S-T T ANGLE		- ACUTE MI (NOT COMMON) - ISCHEMIA
BI-PHASIC T WAVE (WELLEN'S)		- SUB-TOTAL LAD LESION - VASOSPASM - HYPERTROPHY
DEPRESSED J POINT with UPSLOPING ST		- ISCHEMIA
DOWNSLOPING S-T SEGMENT		- ISCHEMIA
? FLAT S-T SEGMENT > 120 ms		- ISCHEMIA
? LOW VOLTAGE T WAVE WITH NORMAL QRS		- ISCHEMIA
? U WAVE POLARITY OPPOSITE THAT OF T WAVE		- ISCHEMIA

# **-- 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)**
- 12. CHANGES to J Point, ST Segment, and/or T Waves**

**WHAT IS YOUR INTERPRETATION OF THIS RHYTHM STRIP ?**



# WHAT IS YOUR INTERPRETATION OF THIS RHYTHM STRIP ?



SIGNIFICANT ST SEGMENT ELEVATION, most likely patient is suffering ***STEMI***

**WHAT WOULD THE MOST APPROPRIATE COURSE OF ACTION BE ?**



# WHAT WOULD THE MOST APPROPRIATE COURSE OF ACTION BE ?



## Immediately:

notify Charge RN

check patient

obtain 12 Lead ECG

Notify physician / Cardiologist

Activate STEMI protocol

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

**-Immediately check patient**

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

- 1. Heart rate LESS THAN 50 or GREATER THAN 150**
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*My top two reasons for giving everything in life the best I have to offer.*