



# Bayfront Health Hospitals

Bayfront Health Seven Rivers, Crystal River, FL



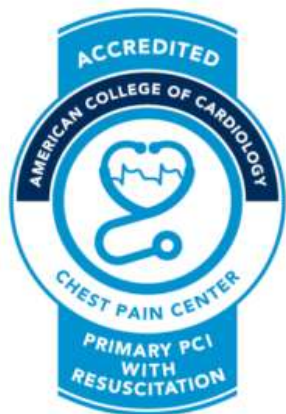
Bayfront Health Brooksville, Brooksville, FL



Seven Rivers Freestanding ED, Citrus Hills, FL



Bayfront Health Spring Hill, Spring Hill, FL



## Basic ECG Rhythms

**Wayne W Ruppert, CVT, CCCC, NREMT-P**  
**Regional Cardiovascular Coordinator**  
Chest Pain Center, Heart Failure and  
Therapeutic Hypothermia Programs



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

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

# Cardiovascular Education Resources

HOME

HEART FAILURE

CV Coordinator Resources

Chest Pain Center  
Management Resources

Resuscitation Resources

Sudden Cardiac Death  
Prevention

Clinician Education

ACCREDITATION

DOWNLOADS - PDF

HELPFUL INFORMATION

CONTACT US



Automatically Reports  
To CE BROKER

## Cardiovascular Education Resources.

Serving Patients, Clinicians and the Community.

**CLINICIAN EDUCATION:** We've been registered as a Nursing Continuing Education Provider for Registered Nurse Practitioners, Registered Nurses and Licensed Practical Nurses. We report evidence-based electrocardiographic (ECG) interpretation education reinforced with clinical case studies with Cath Lab and EP Lab case studies, our goal is to provide clinicians with education for cardiologists, therapists and paramedics - and we frequently see some of each in our community.

**PATIENT MANAGEMENT TOOLS:** This website provides resources to assist physicians, case managers and nurses. We plan to add resources for the management of patients with Cardiovascular Disease as well as Sudden Cardiac Death.

**PATIENTS:** This website provides resource to help patients and their families to better understand Cardiovascular Disease and Sudden Arrhythmia Death Syndromes (SADS) conditions in the near future. We plan to offer resources offered by the following organizations:



# Cardiovascular Education Resources

## HELPFUL PDF DOWNLOADS

[HOME](#)[HEART FAILURE](#)[CV Coordinator Resources](#)[Chest Pain Center  
Management Resources](#)[Resuscitation Resources](#)[Sudden Cardiac Death  
Prevention](#)[Clinician Education](#)[ACCREDITATION](#)[DOWNLOADS - PDF](#)[HELPFUL INFORMATION](#)[CONTACT US](#)

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[Download Basic ECG Course](#)

[Download The Lifesaving 12 Lead EKG Part 1](#)

[Download The Lifesaving 12 Lead EKG Part 2](#)

[Cerner Powerchart Users - EKG Instructions](#)

[Cerner FirstNet Users - EKG Instructions](#)

[Download 12 Lead ECG Workbook 2020](#)

[Download BHSR ED 12 Lead EKG Part 1 2020](#)

[Download BHSR ED 12 Lead EKG Part 2 2020](#)

[Download Citrus Co Fire Rescue Class Workbook](#)

[Download Citrus Co Fire Rescue 12 Lead - Morning Session](#)

[Download Citrus Co Fire Rescue 12 Lead - Afternoon Session](#)

[Download STAT 12 Lead ECG Part 1 - Basic Fundamentals](#)

[Download STAT 12 Lead ECG Part 2 - Acute Coronary Syndrome](#)

[Download Nuts & Bolts of Therapeutic Hypothermia - Bayfront Health 2019](#)

[Download EMS 12 Lead 101 - 2019](#)

[Download BHSR 2019 Basic ECG with Obtaining STAT 12 Lead](#)

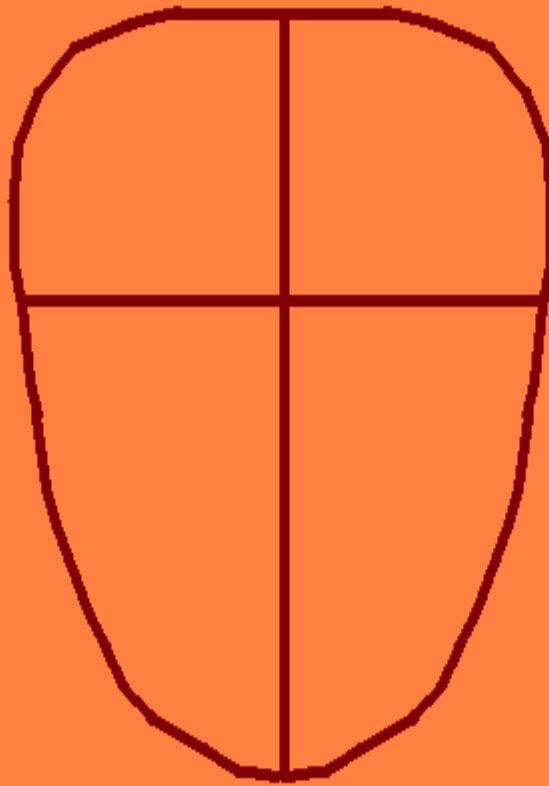
[Download Hands-Only CPR and AED Course](#)



# The Heart:

- Muscle cells
- Electrical system cells
- Connective tissue

# FOUR CHAMBERED PUMP



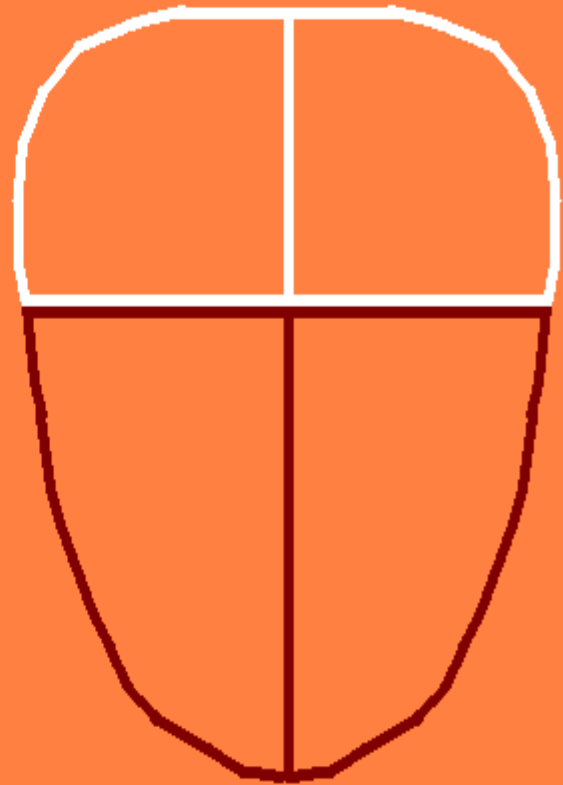
# FOUR CHAMBERED PUMP . . .

2 ATRIUM



PRIMARY JOB:

"PACK VENTRICLES  
FULL OF BLOOD"



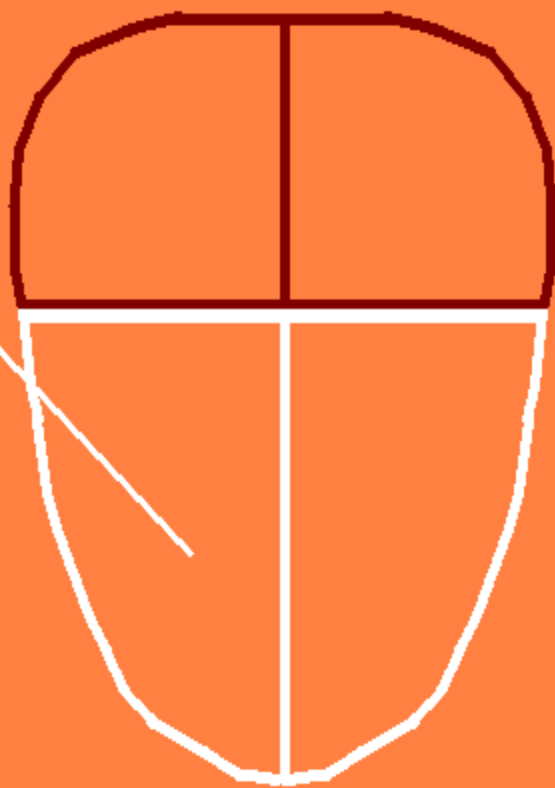


# FOUR CHAMBERED PUMP . . .

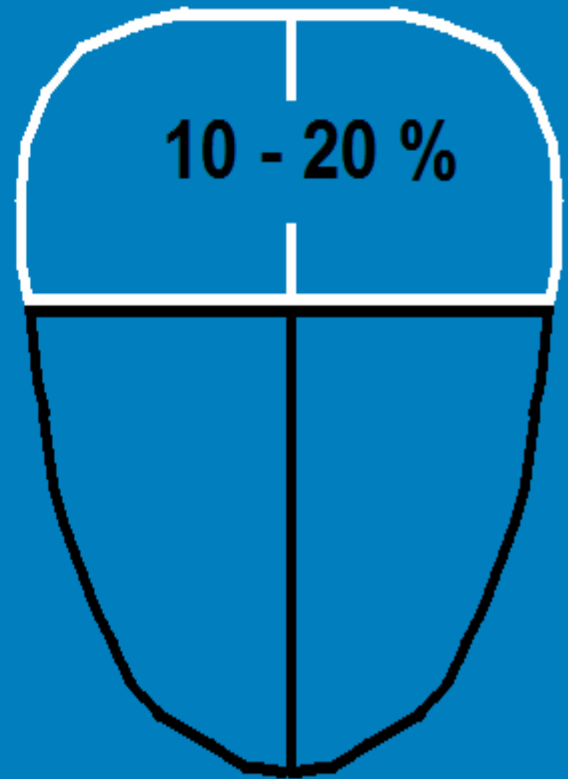
2 VENTRICLES

PRIMARY JOB:

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



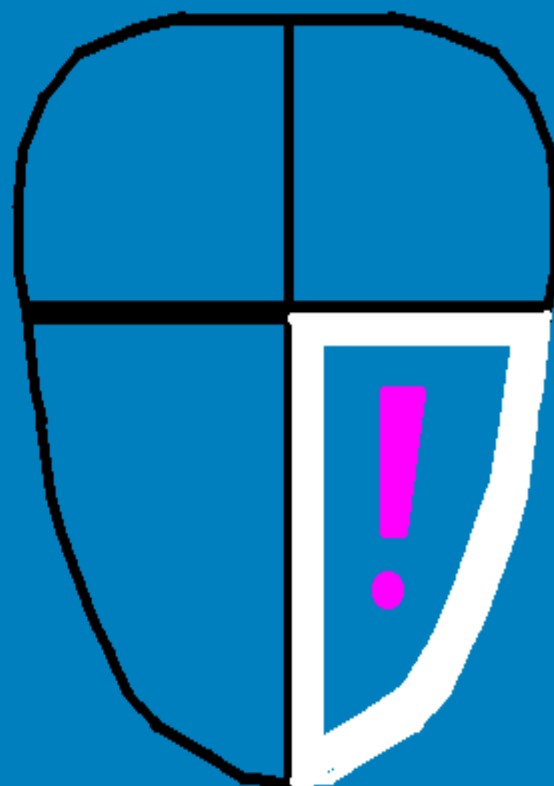
**WHEN FUNCTIONING PROPERLY,  
THE ATRIUM SUPPLY  
APPROXIMATELY  
WHAT  
PERCENTAGE  
OF THE  
CARDIAC OUTPUT ?**



THE CHAMBER MOST IMPORTANT  
TO KEEPING THE PATIENT ALIVE

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

IS THE  
LEFT VENTRICLE  
WHICH WE WILL REFER  
TO AS THE PUMP





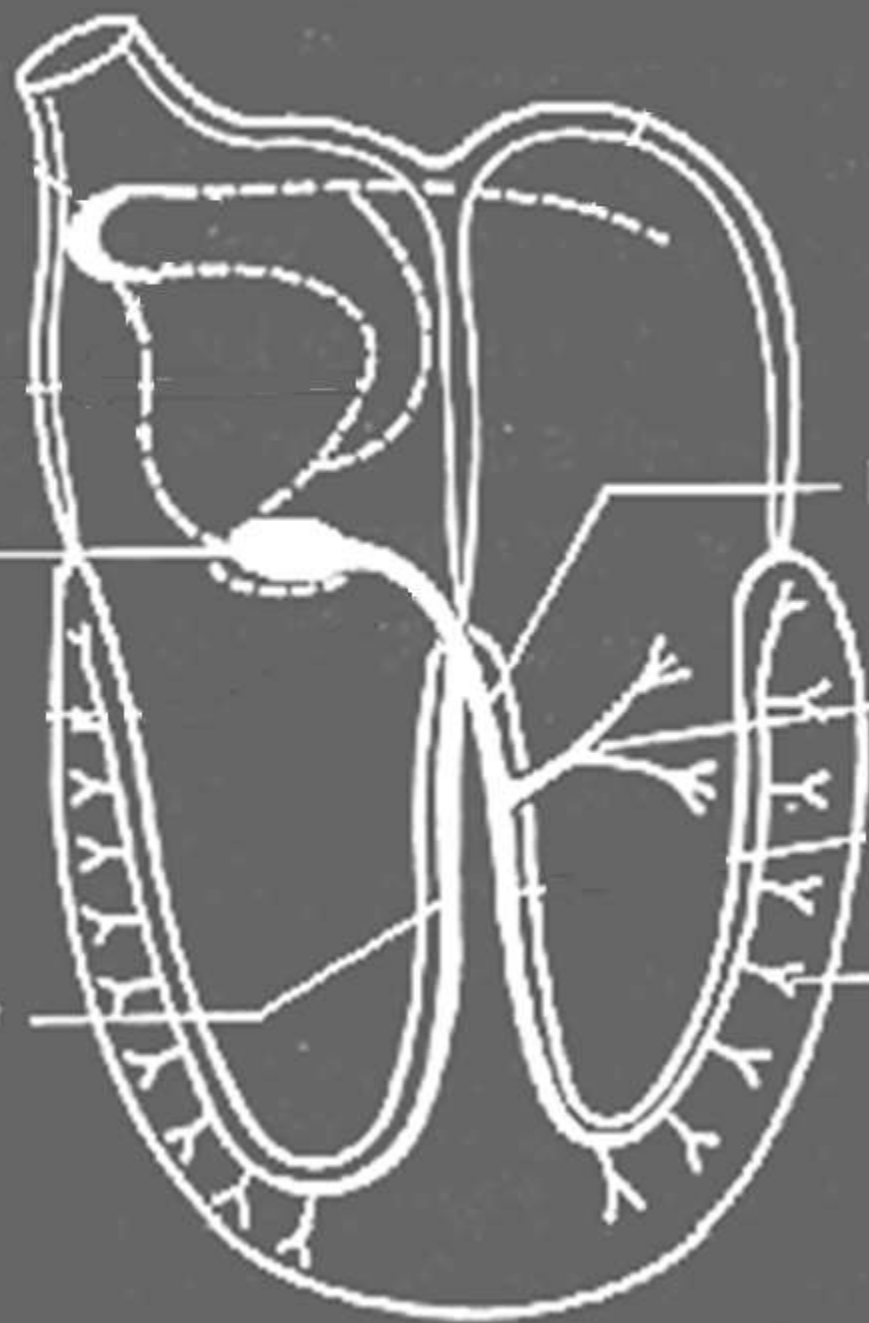
Sinus node

AV node

Right bundle  
branch

Left bundle  
branch

Purkinje fibers



Sinus node

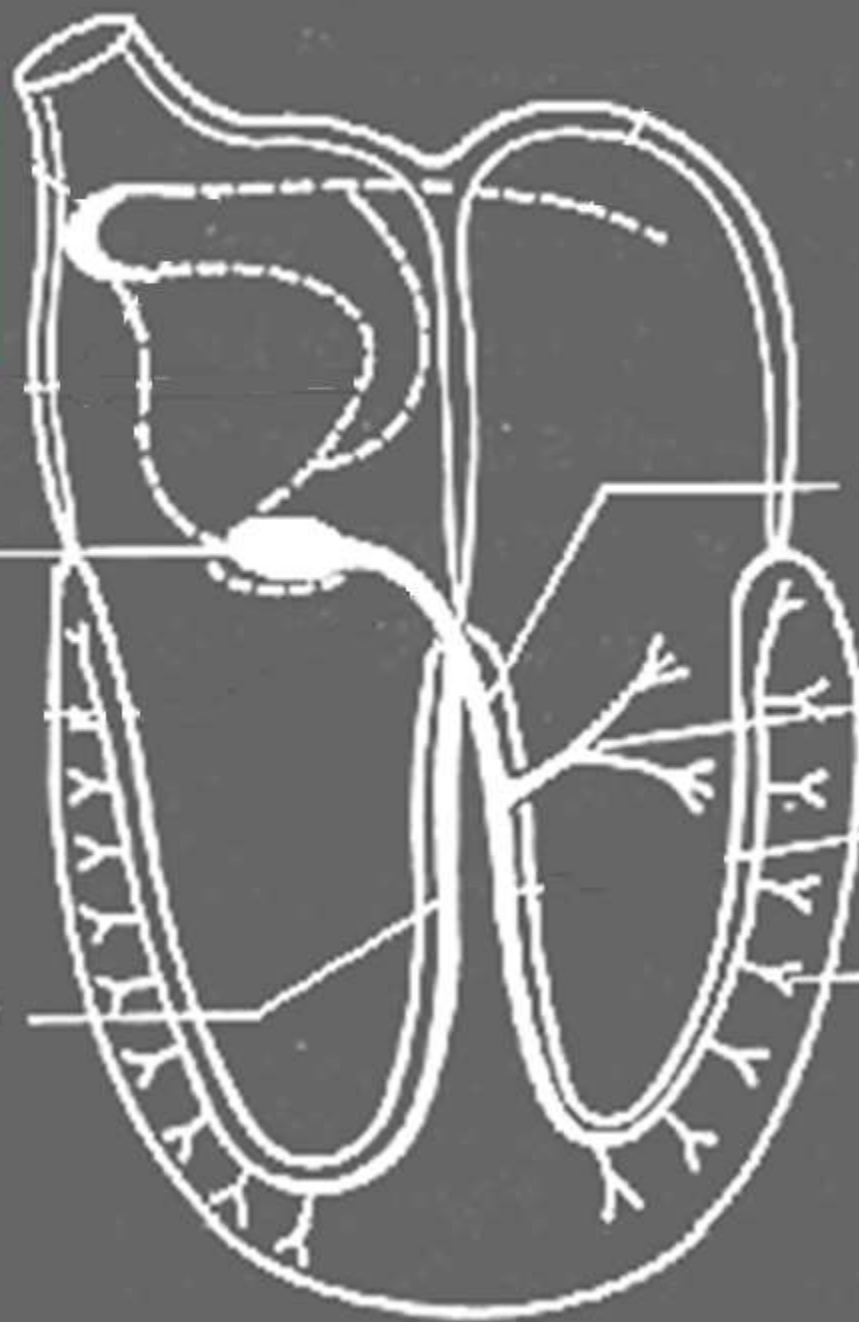
60 - 100  
beats / min.

AV node

Left bundle  
branch

Right bundle  
branch

Purkinje fibers



~~Sinus node~~

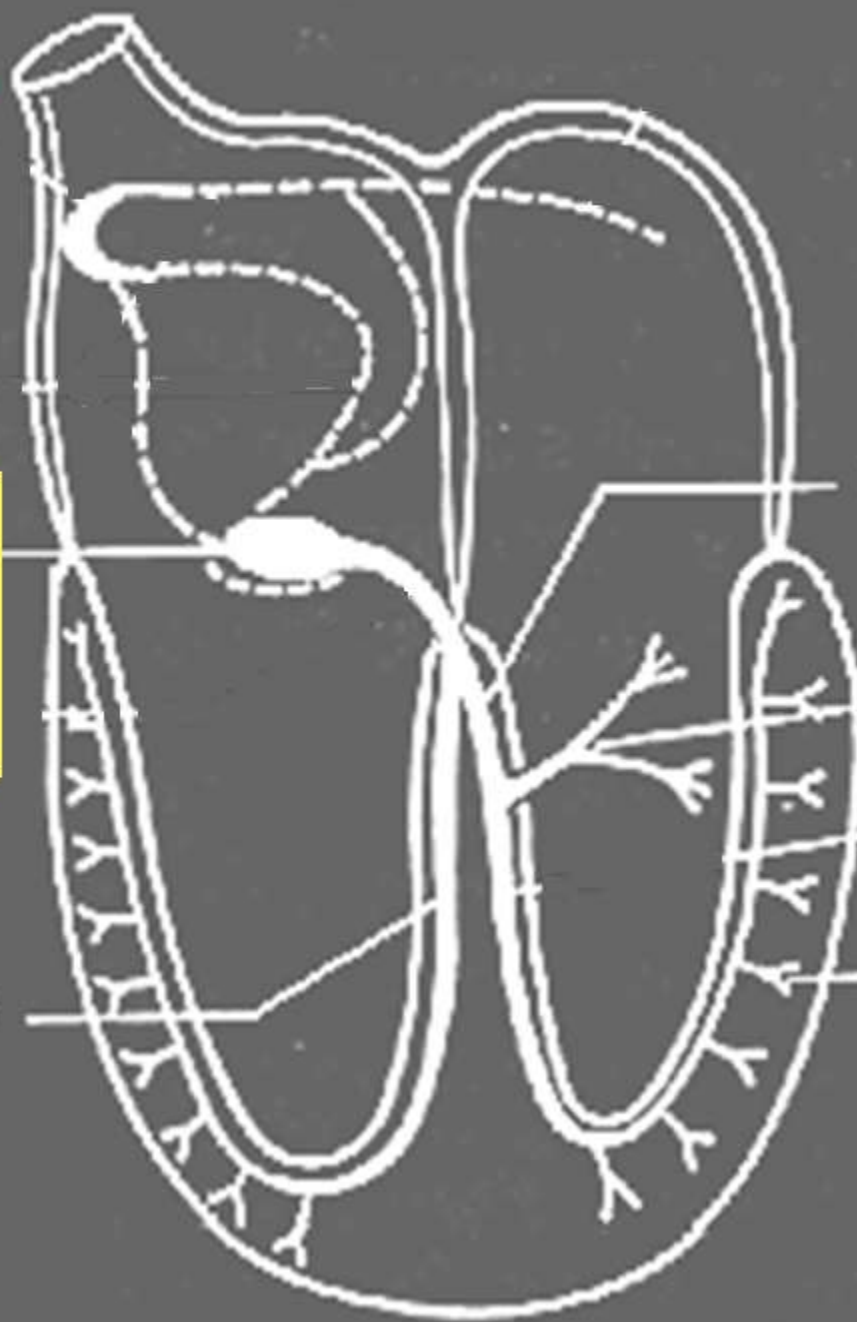
AV node

40 - 60  
beats / min.

Right bundle  
branch

Left bundle  
branch

Purkinje fibers





~~Sinus node~~

~~AV node~~

Left bundle  
branch

Right bundle  
branch

Purkinje fibers

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



# NORMAL "INHERENT" RATES:

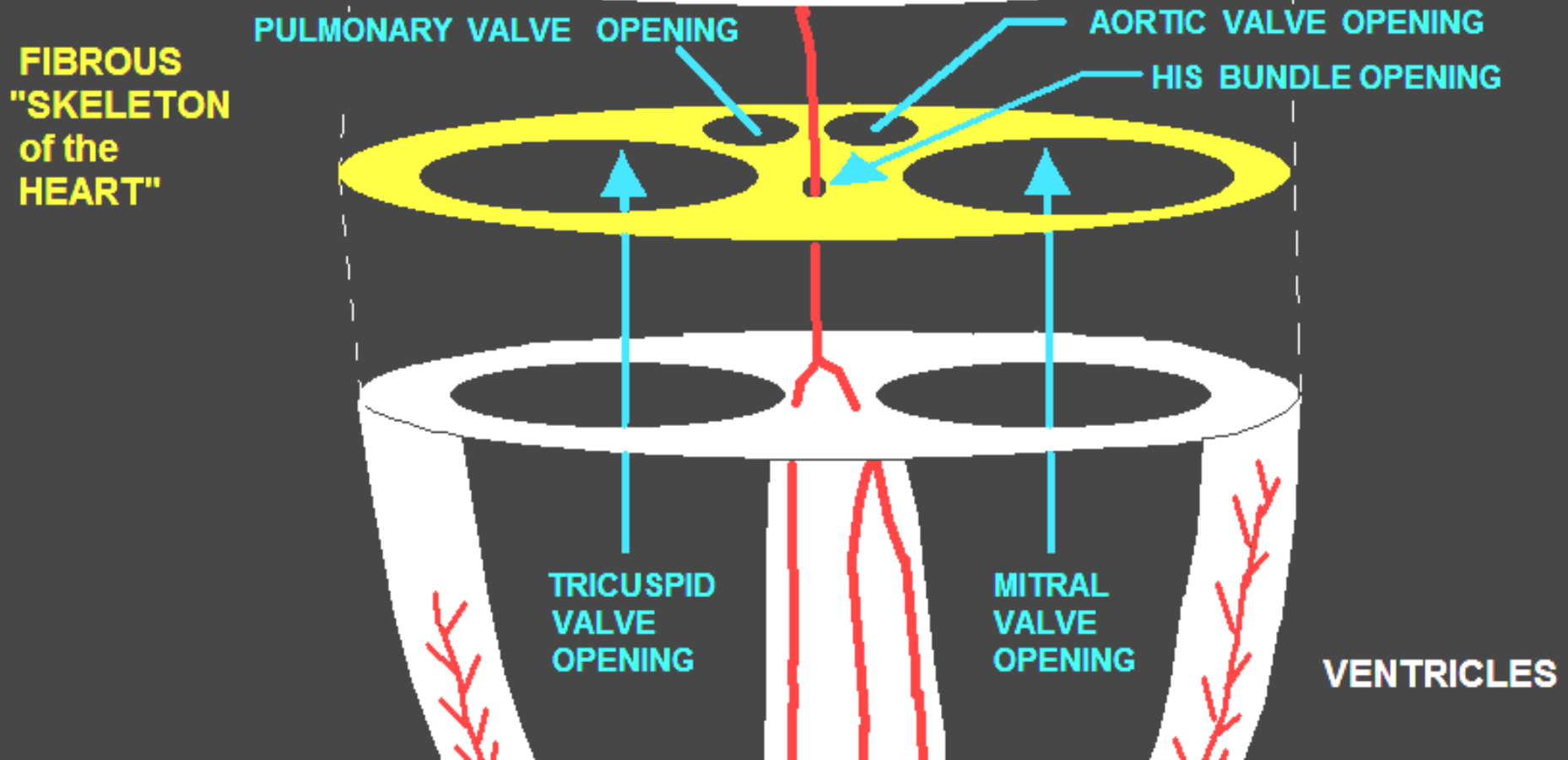
SA NODE: 60 - 100

AV NODE: 40 - 60

\* VENTRICLES: 1 - 40

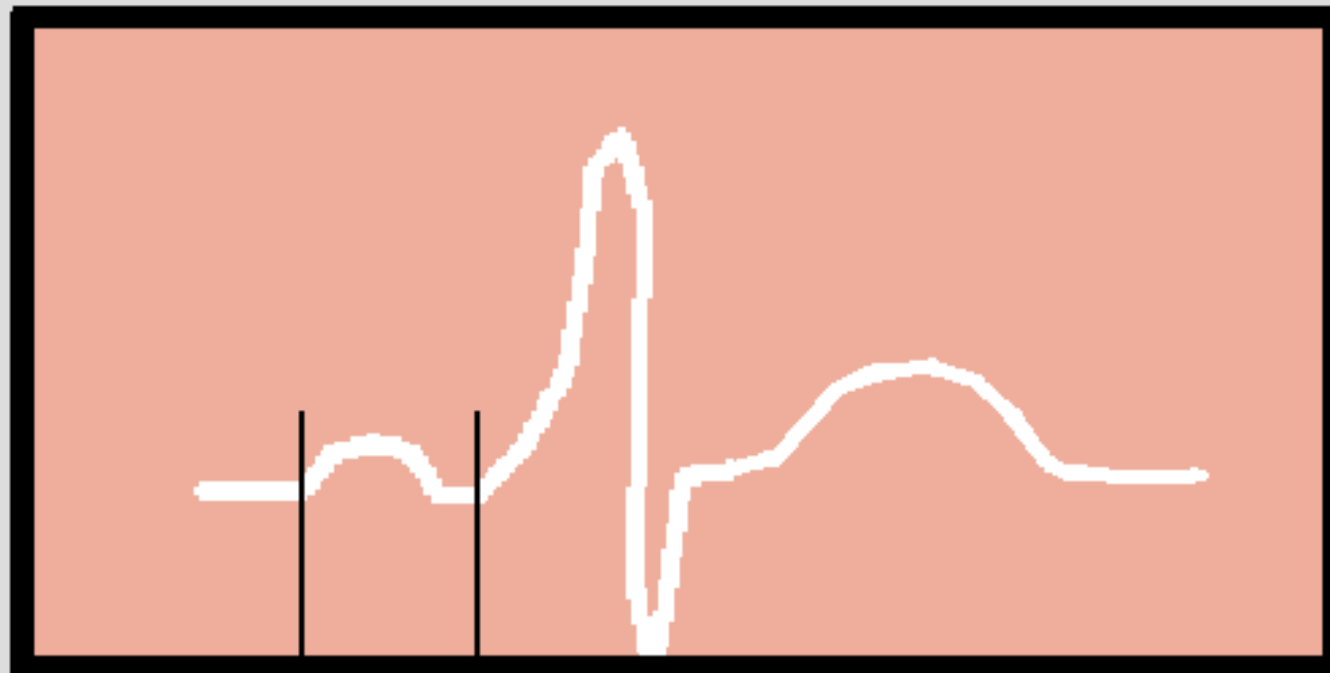
\* Most reference sources indicate ventricular focal rates as being between "20-40" beats per minute. Since I have personally witnessed patients who have had regular, pulse-producing "idioventricular" rhythms as low as 4 - 5 beats per minute, I can not endorse "20" as a minimum ventricular rate.

# THE "SKELETON OF THE HEART"



# WOLFF-PARKINSON-WHITE

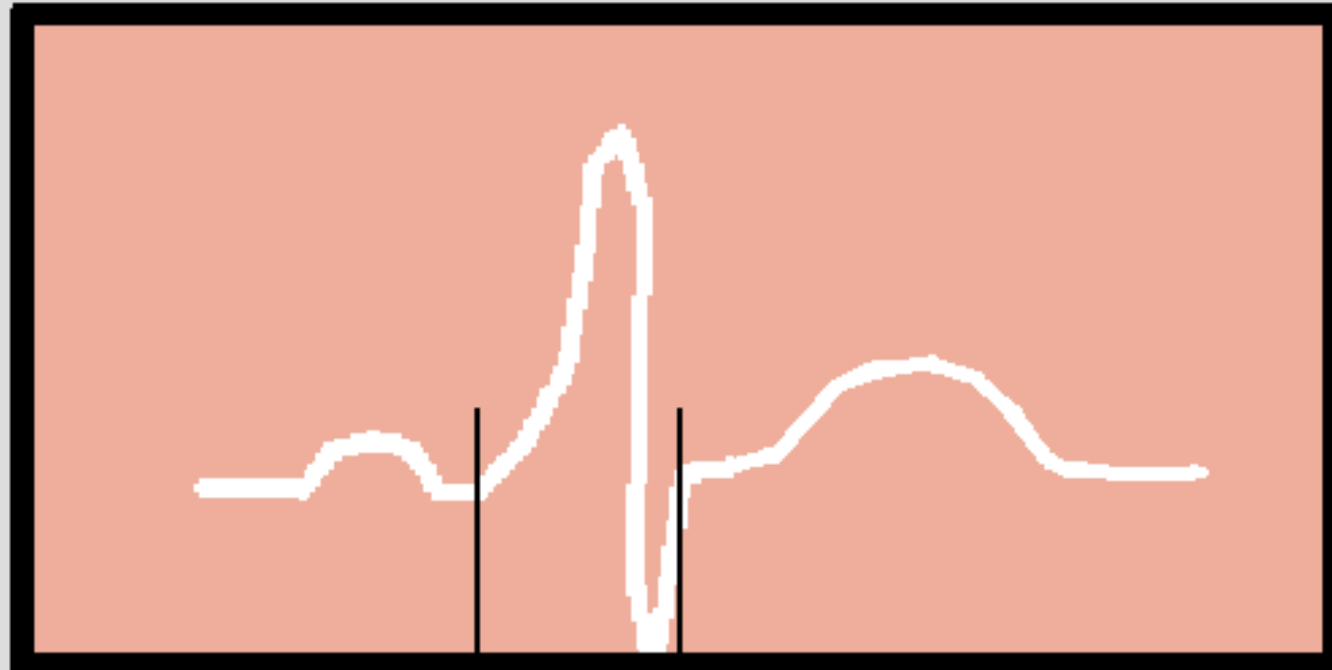
## EKG CHARACTERISTICS



SHORTENED  
P-R INTERVAL

# WOLFF-PARKINSON-WHITE

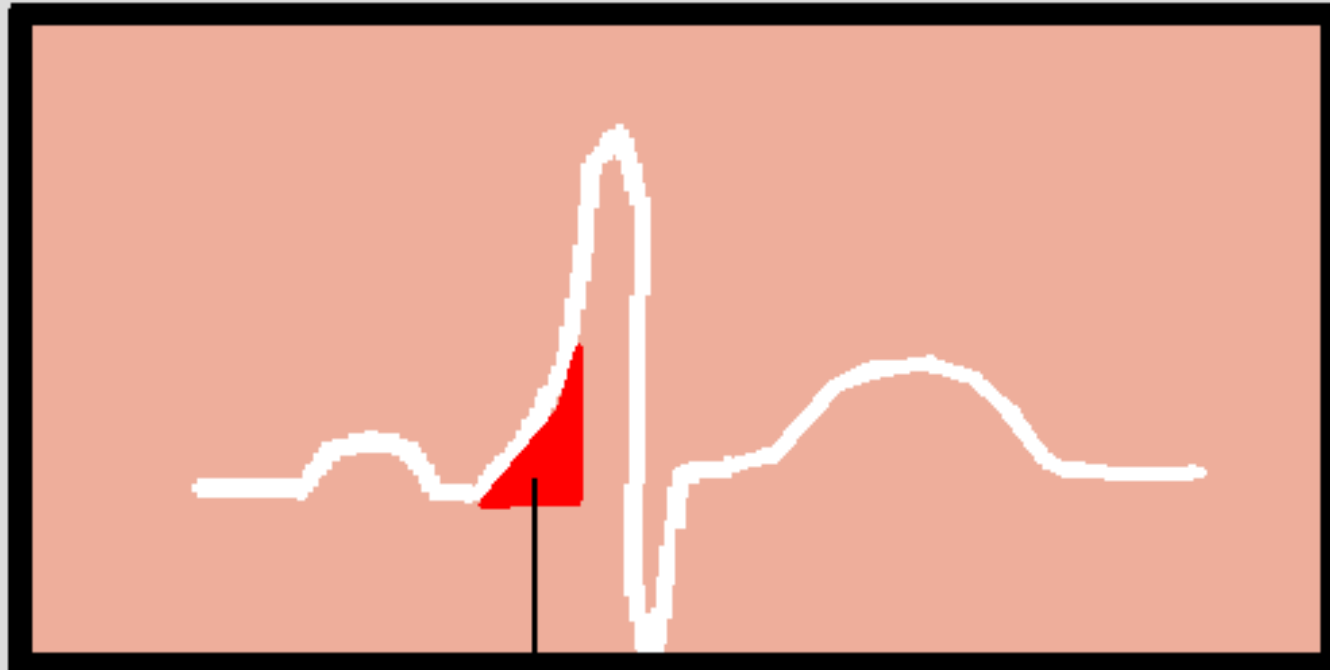
## EKG CHARACTERISTICS



WIDENED  
QRS COMPLEX

# WOLFF-PARKINSON-WHITE

## EKG CHARACTERISTICS



DELTA  
WAVE

16 yr  
Female Caucasian  
Room: REC  
Loc: 20 Option: 50

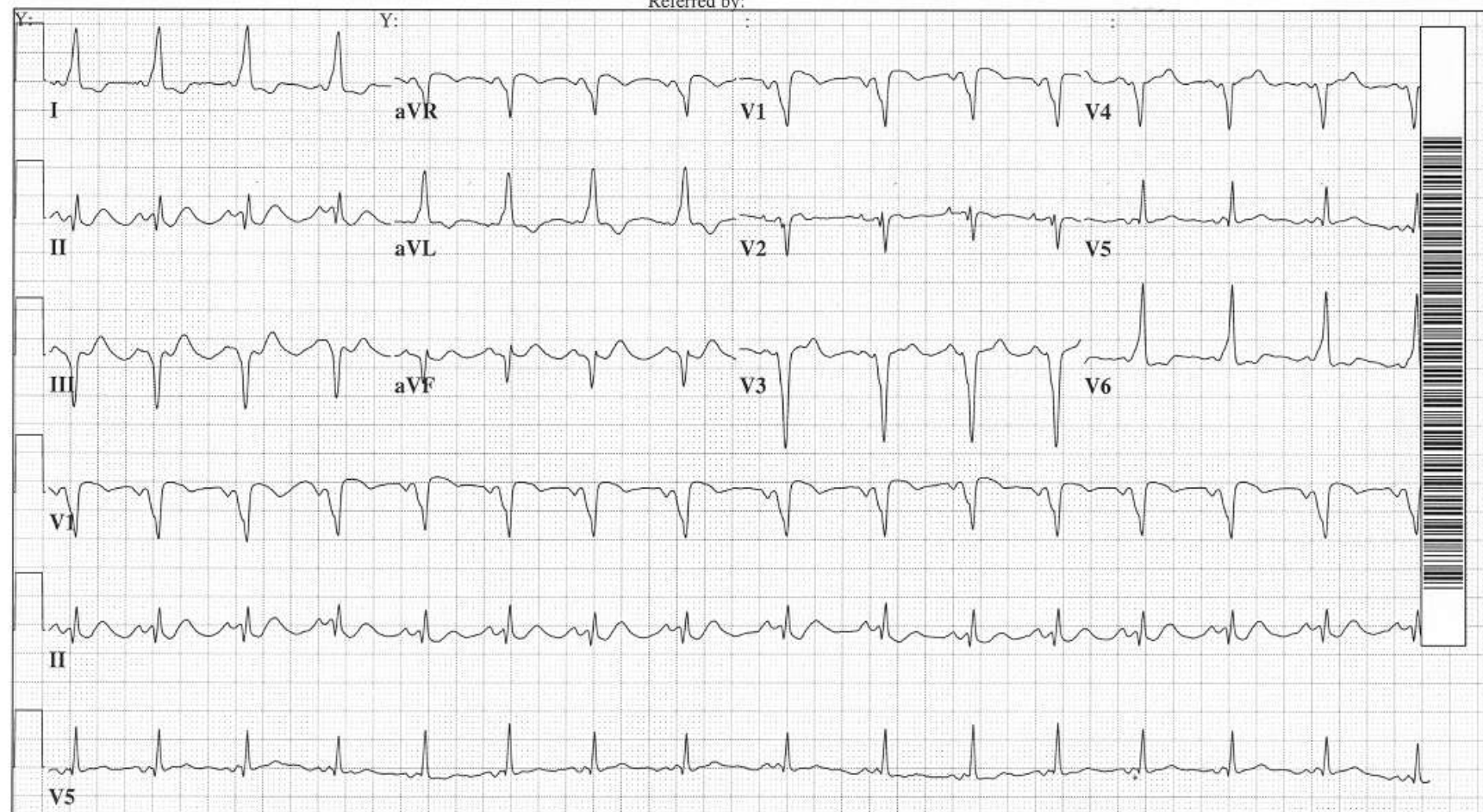
Vent. rate 92 BPM  
PR interval 112 ms  
QRS duration 118 ms  
QT/QTc 356/440 ms  
P-R-T axes 59 -22 107

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

History: Unknown  
Technician: DP  
Test ind: EKG  
**EKG CLASS #WR030100**  
**60783**

**WOLFF-PARKINSON-WHITE**  
**TYPE B**

Referred by:





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

Normal sinus rhythm with sinus arrhythmia  
**Wolff-Parkinson-White**  
 Abnormal ECG  
 No previous ECGs available

History:Unknown EKG CLASS #WR030100  
Technician: DP 60783  
Test ind:EKG

**P-R = .08**

Referred by:

Confirmed By:

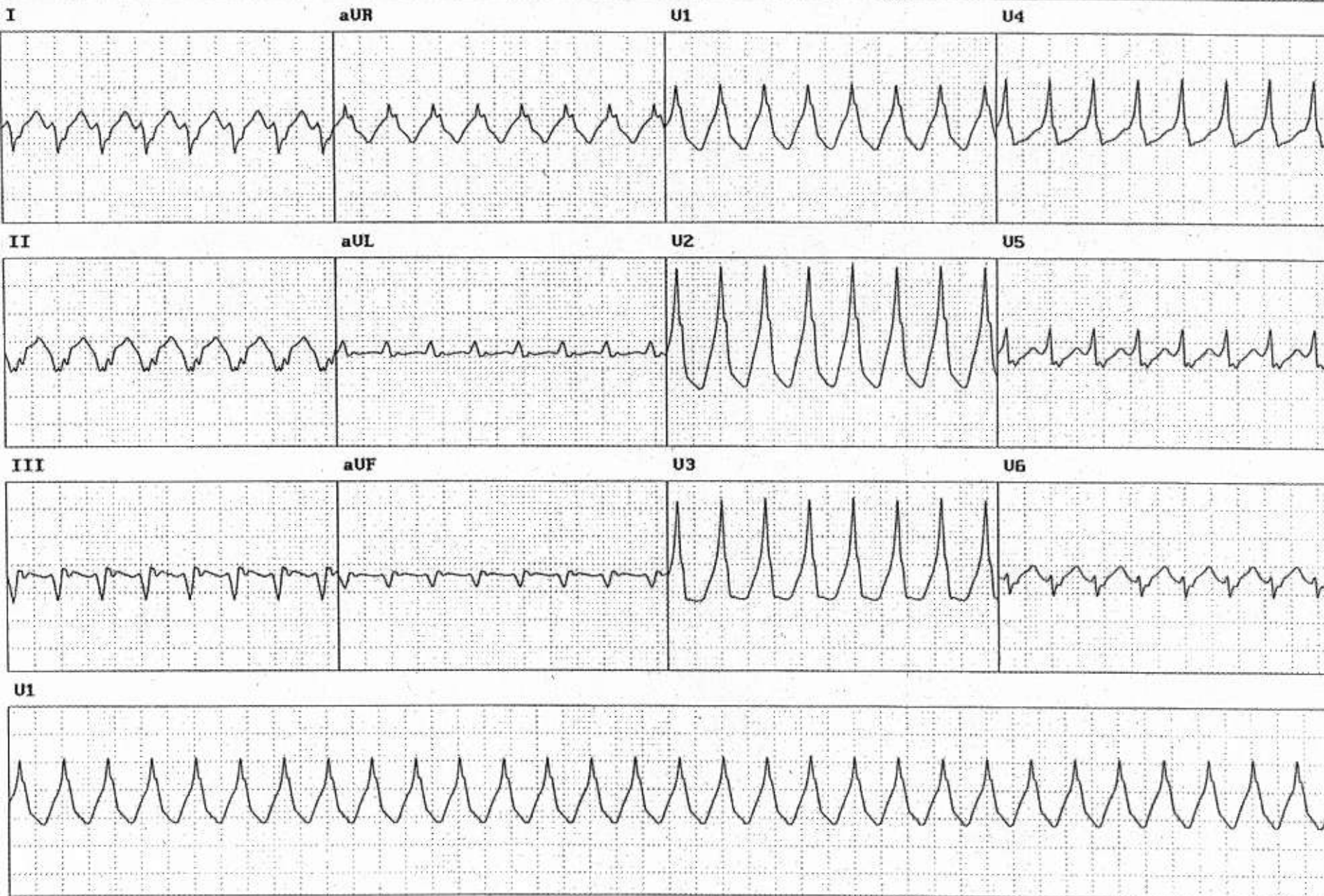
### 3. Wolff-Parkinson-White (Type B)

- Presence of DELTA waves
- Short P-R Interval
- Wide QRS

W-P-W patients often experience  
Tachycardias:

- Narrow QRS Tachycardia (SVT)
- Wide QRS Tachycardia (mimics V-Tach.

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





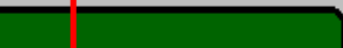


— P WAVE  
IS RECORDED  
ON EKG



## A diagram of a human torso showing the location of the heart and lungs. The heart is depicted as a red cross-like shape in the center, with blue lines representing the pulmonary arteries and veins. The lungs are shown as two large, light blue, textured areas on either side of the heart. A red arrow points to the heart area. The diagram is labeled with 'I' on the left and 'G' on the right, and a red cross symbol is located near the bottom right.

- Depolarization wave in A-V node
- Atrial Repolarization



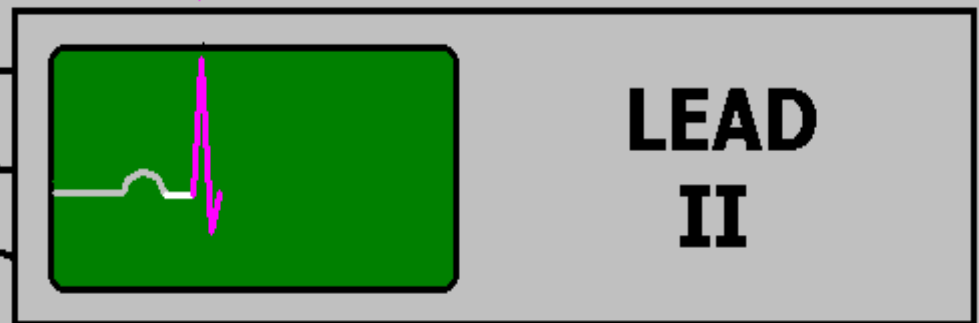
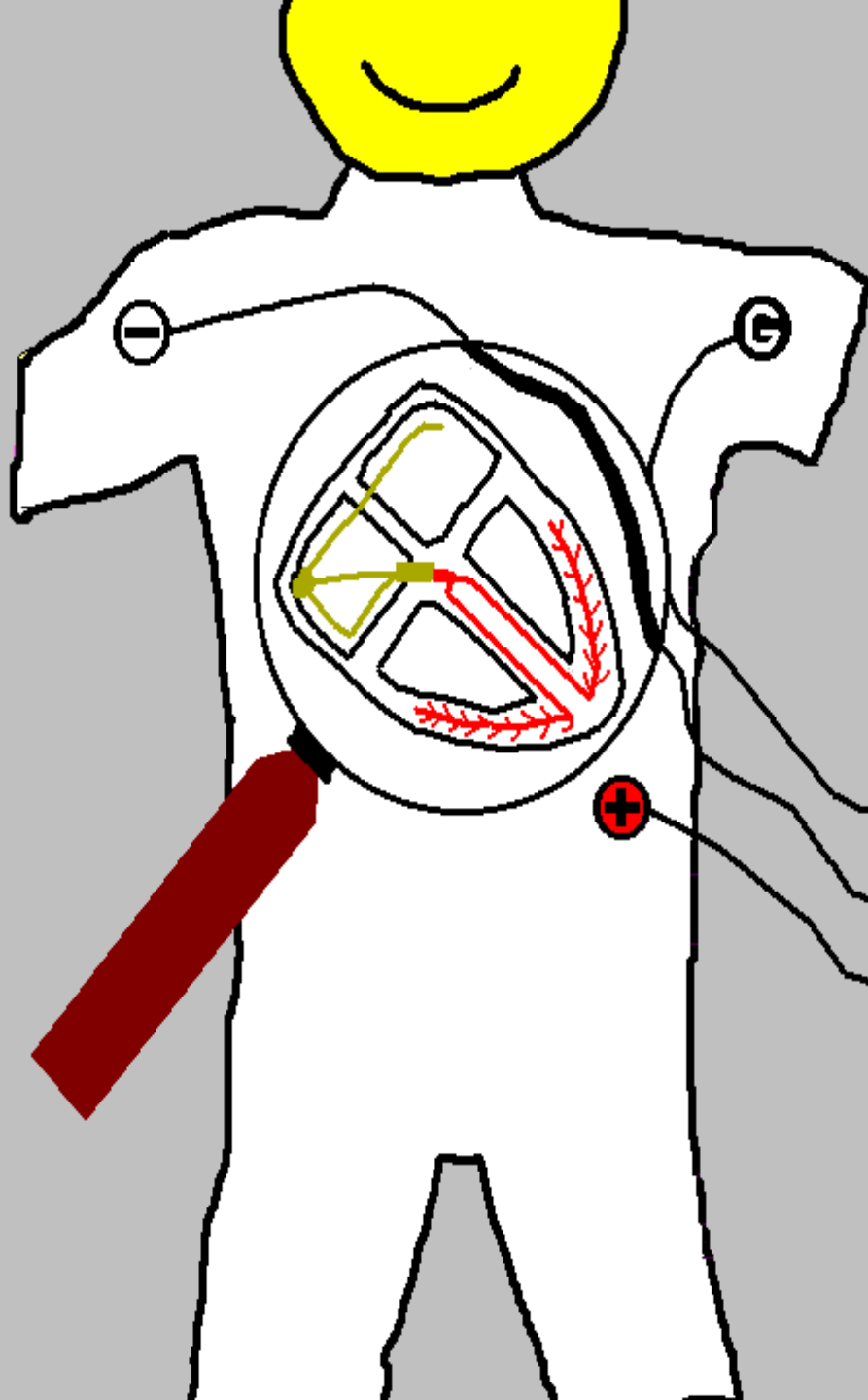
**LEAD II**

## LEAD II

# VENTRICULAR DEPOLARIZATION

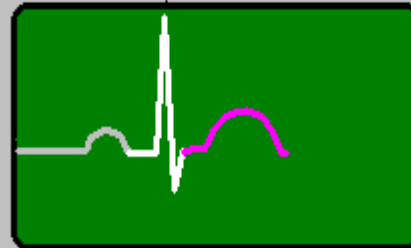
QRS COMPLEX  
IS RECORDED  
ON EKG

LEAD  
II



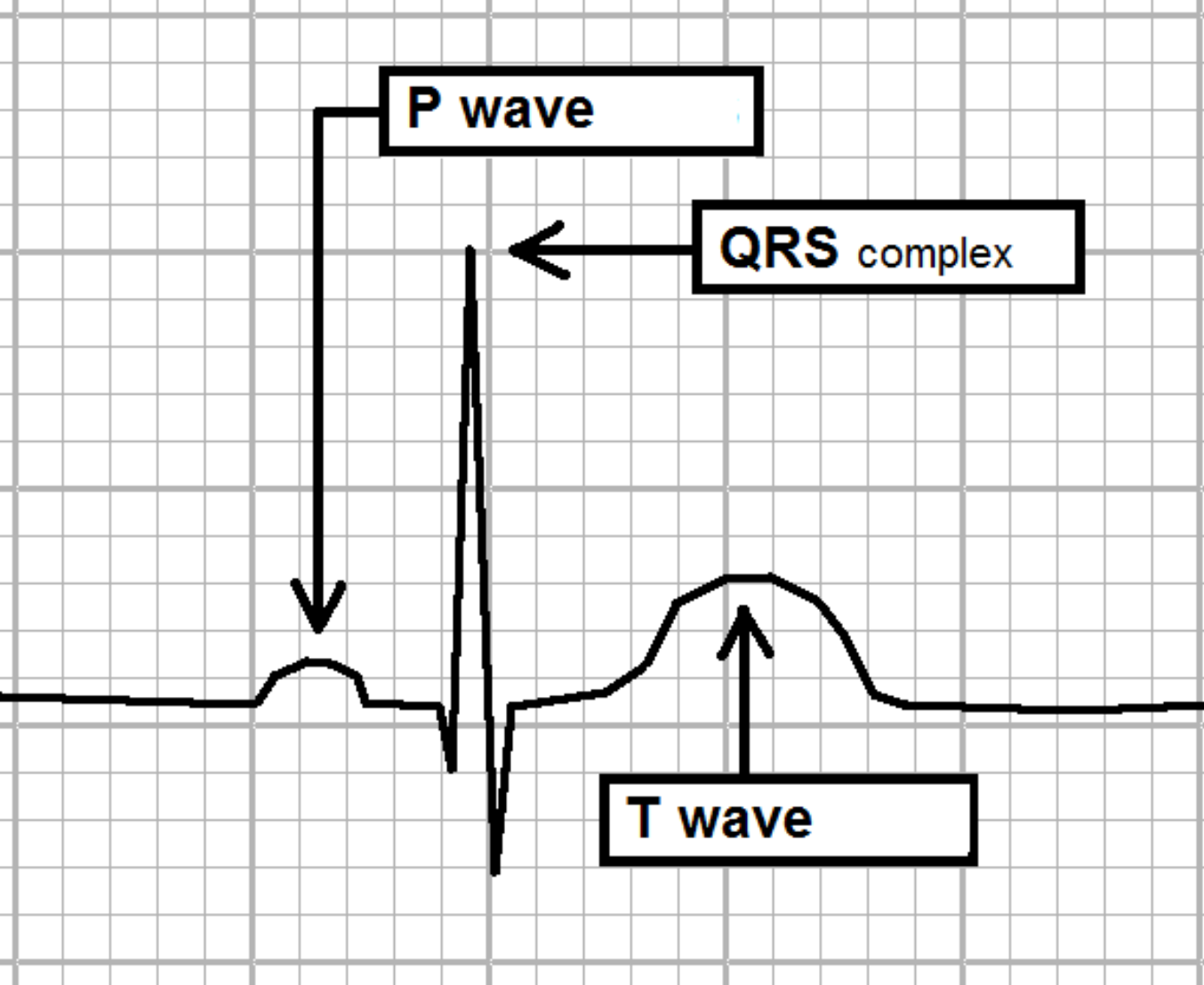
# VENTRICULAR REPOLARIZATION

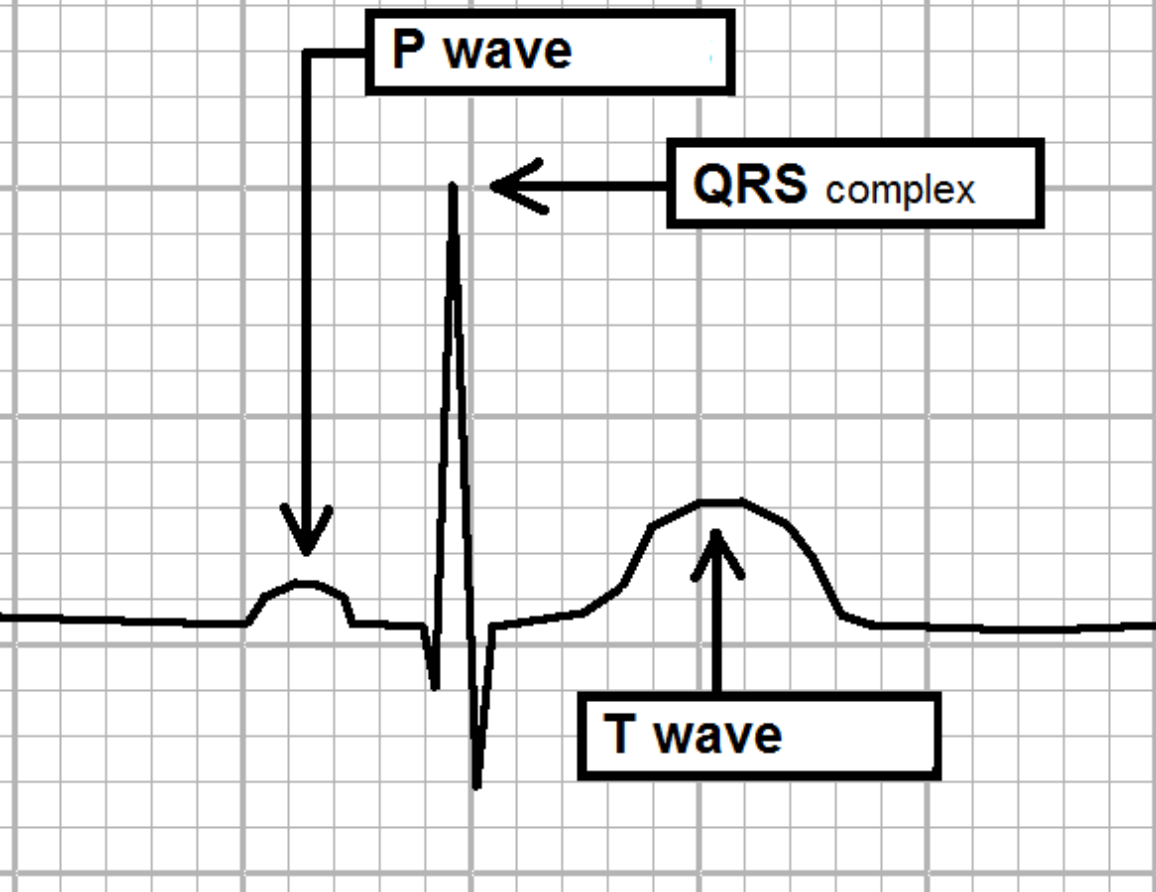
WRITES A "T"  
WAVE ON THE  
ECG



**LEAD  
II**





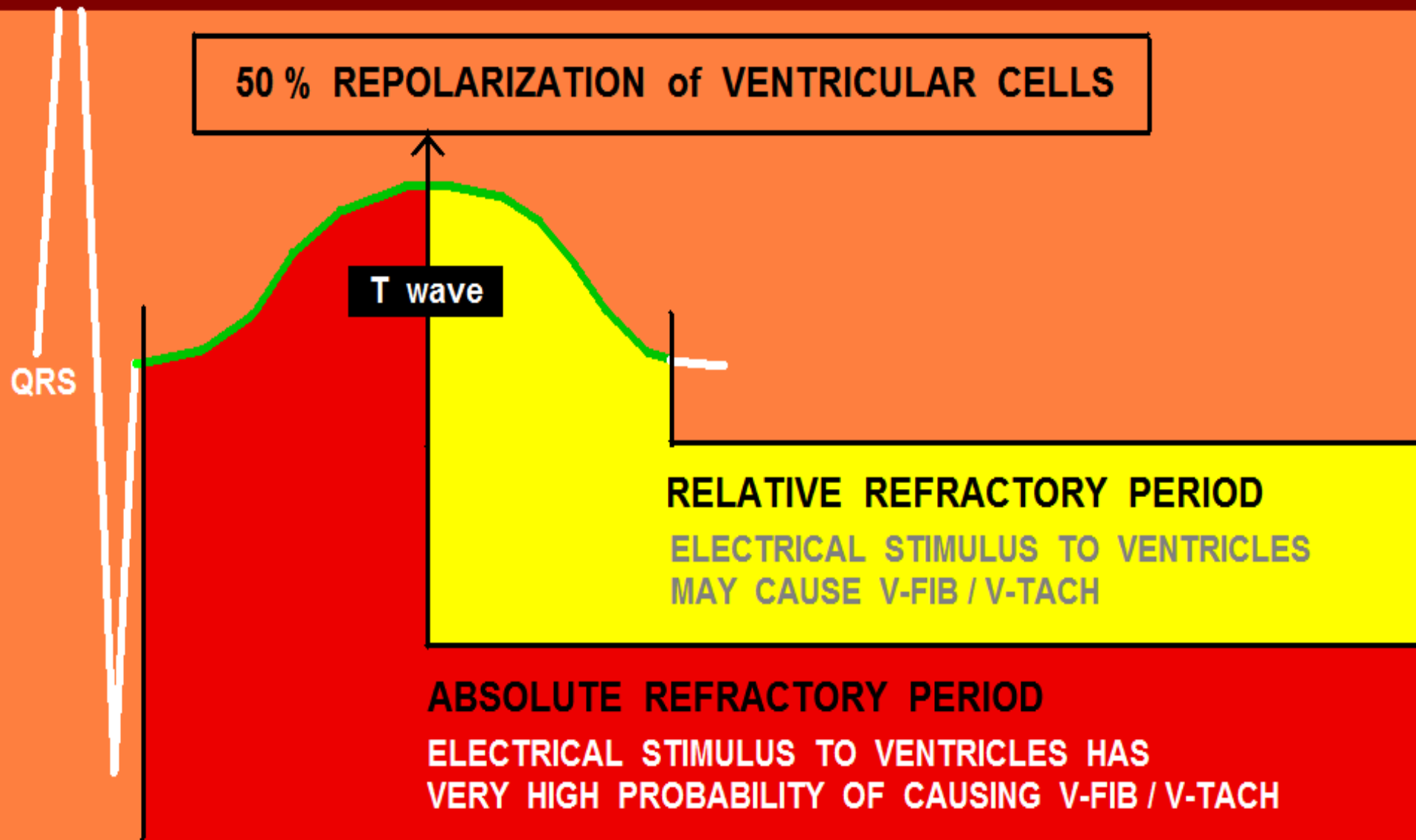


**P WAVE =**  
ATRIAL DEPOLARIZATION

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

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

# CARDIAC ANATOMY and PHYSIOLOGY "101"



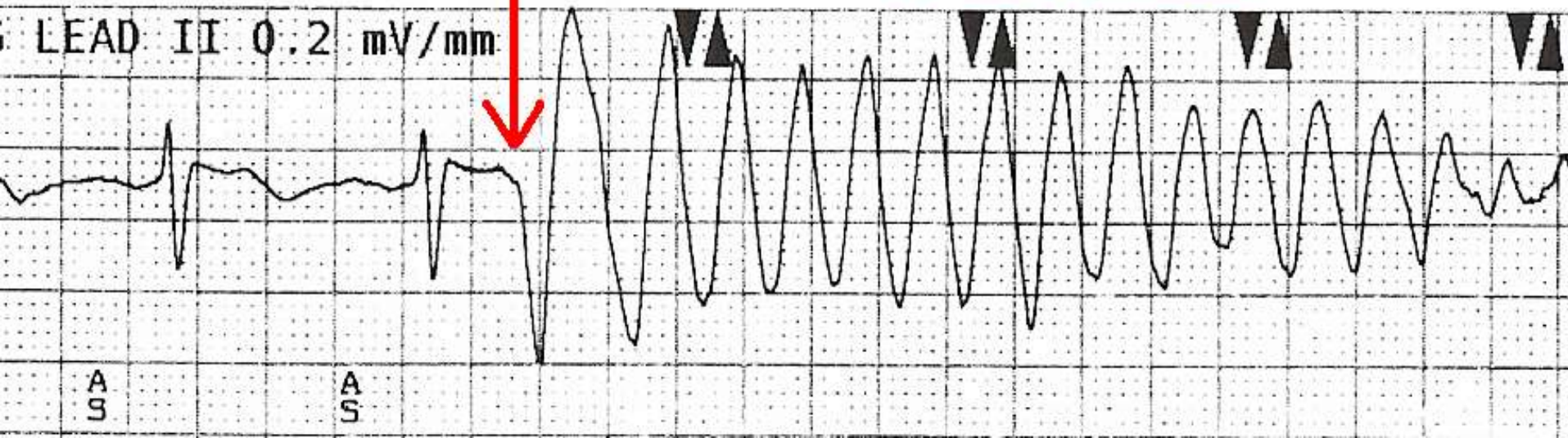
# ROUTINE TEST OF ICD

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

08-Sep-2006 18:01:47

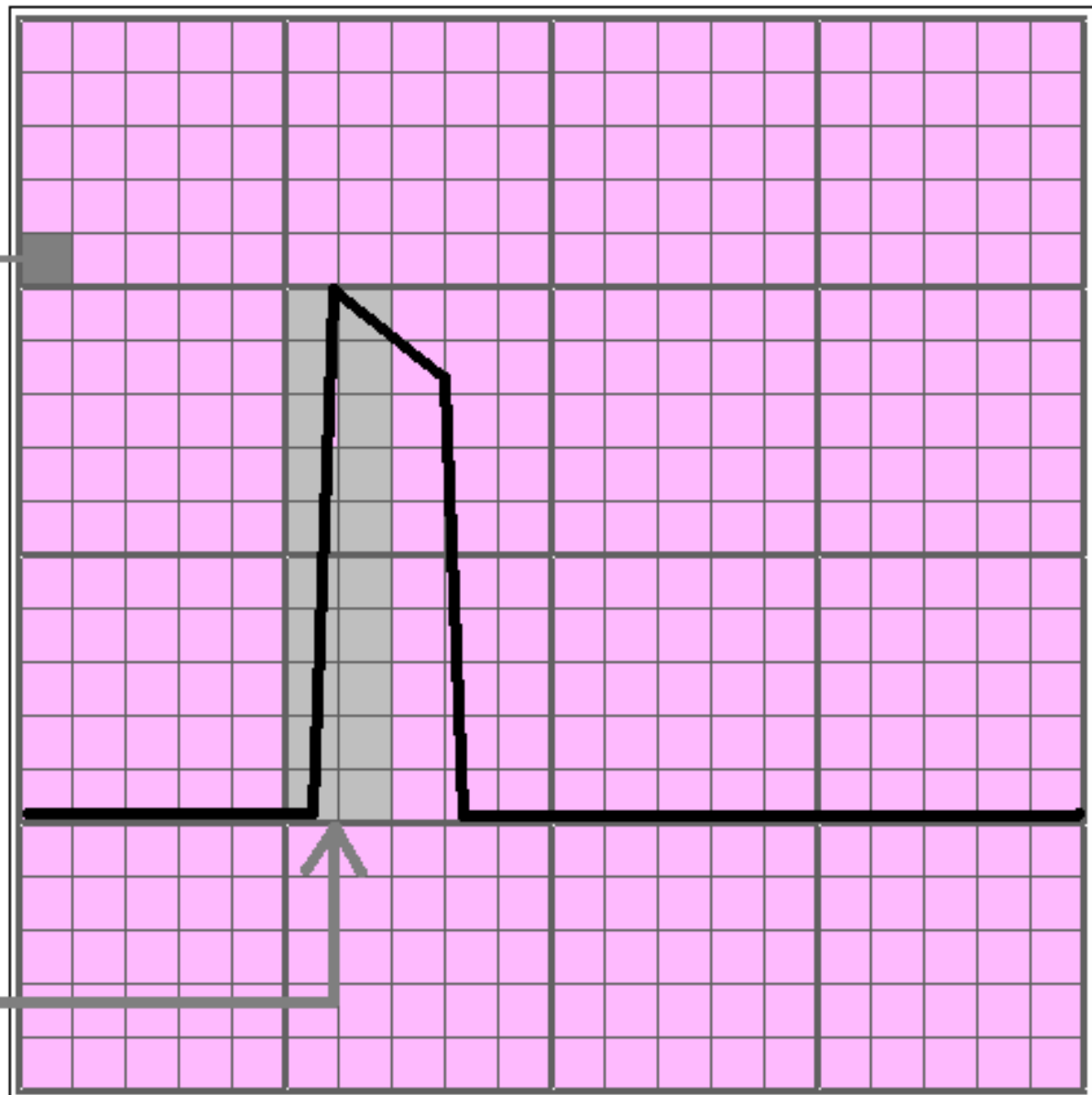
Test Started

SPECIAL THANKS TO:  
Ray Heinley  
Medtronic Corporation  
for this contribution



# ECG PAPER - THE VERTICAL AXIS:

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



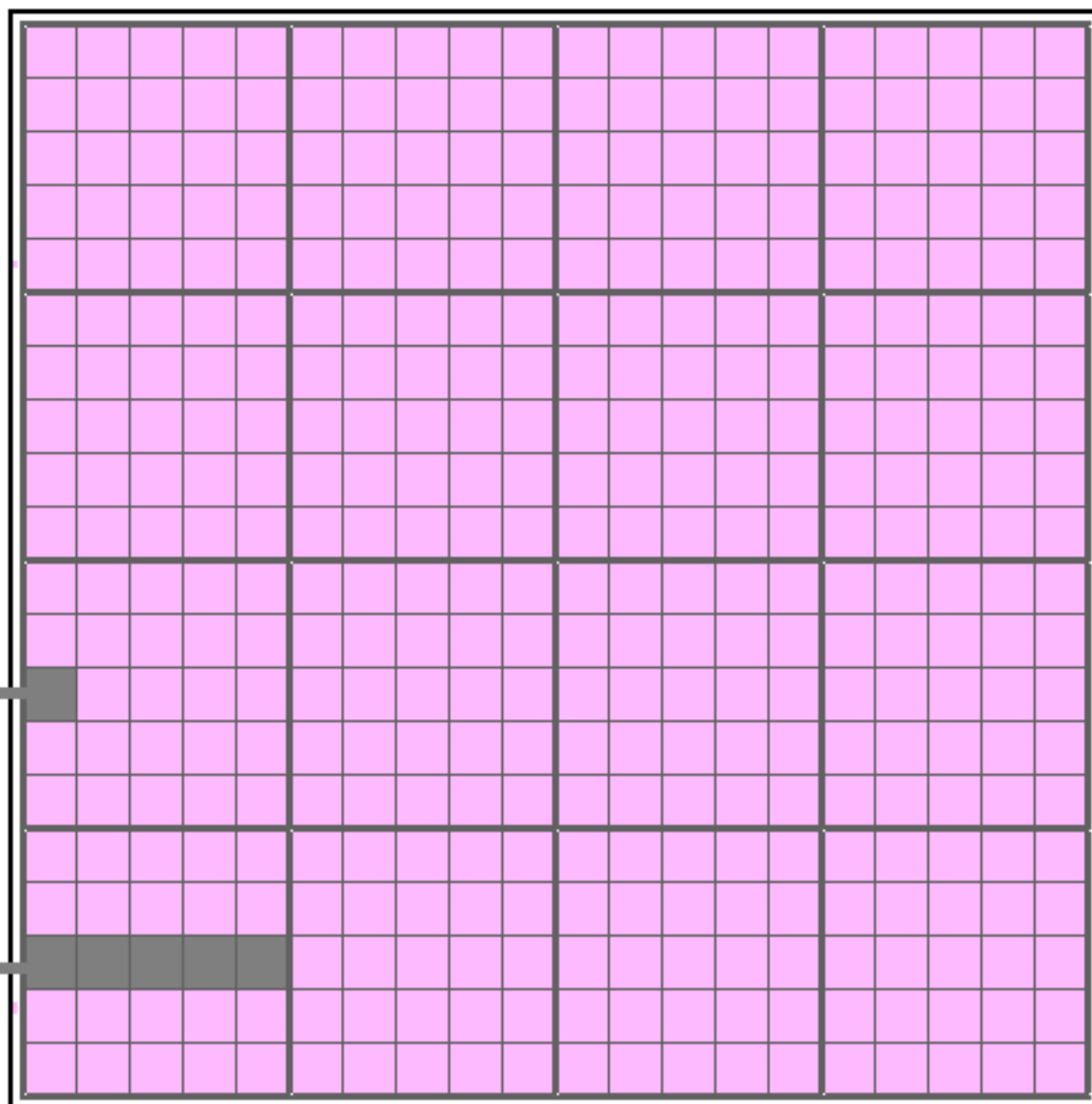
# ECG PAPER - THE HORIZONTAL AXIS:

THE HORIZONTAL  
AXIS REPRESENTS  
TIME . . .

STANDARD SPEED  
FOR RECORDING  
ADULT EKGs =  
25 mm / SECOND

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

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



# THE EKG MACHINE

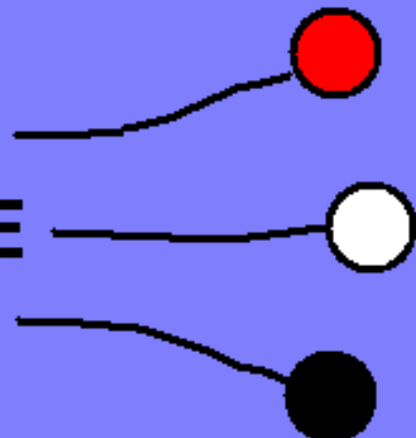
STANDARD 12 LEADS - USES 10 WIRES  
( 6 CHEST and 4 LIMB )

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

1 POSITIVE ELECTRODE

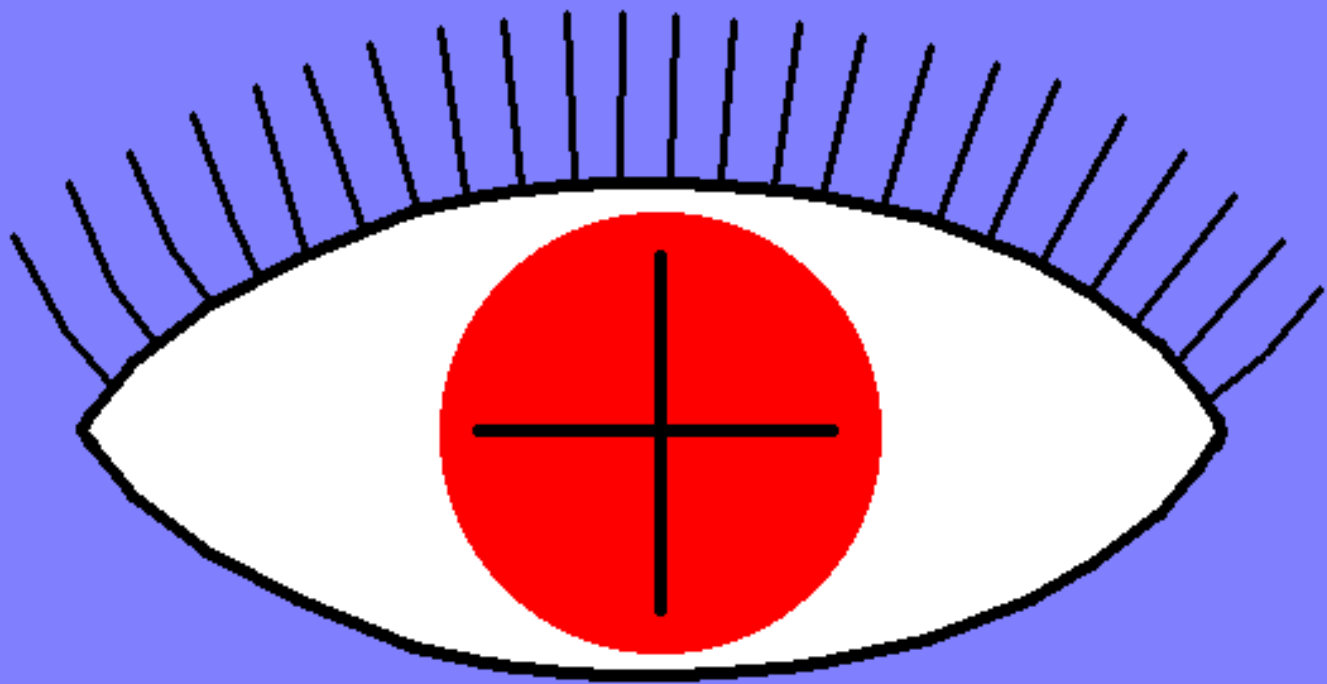
1 NEGATIVE ELECTRODE

1 GROUND ELECTRODE

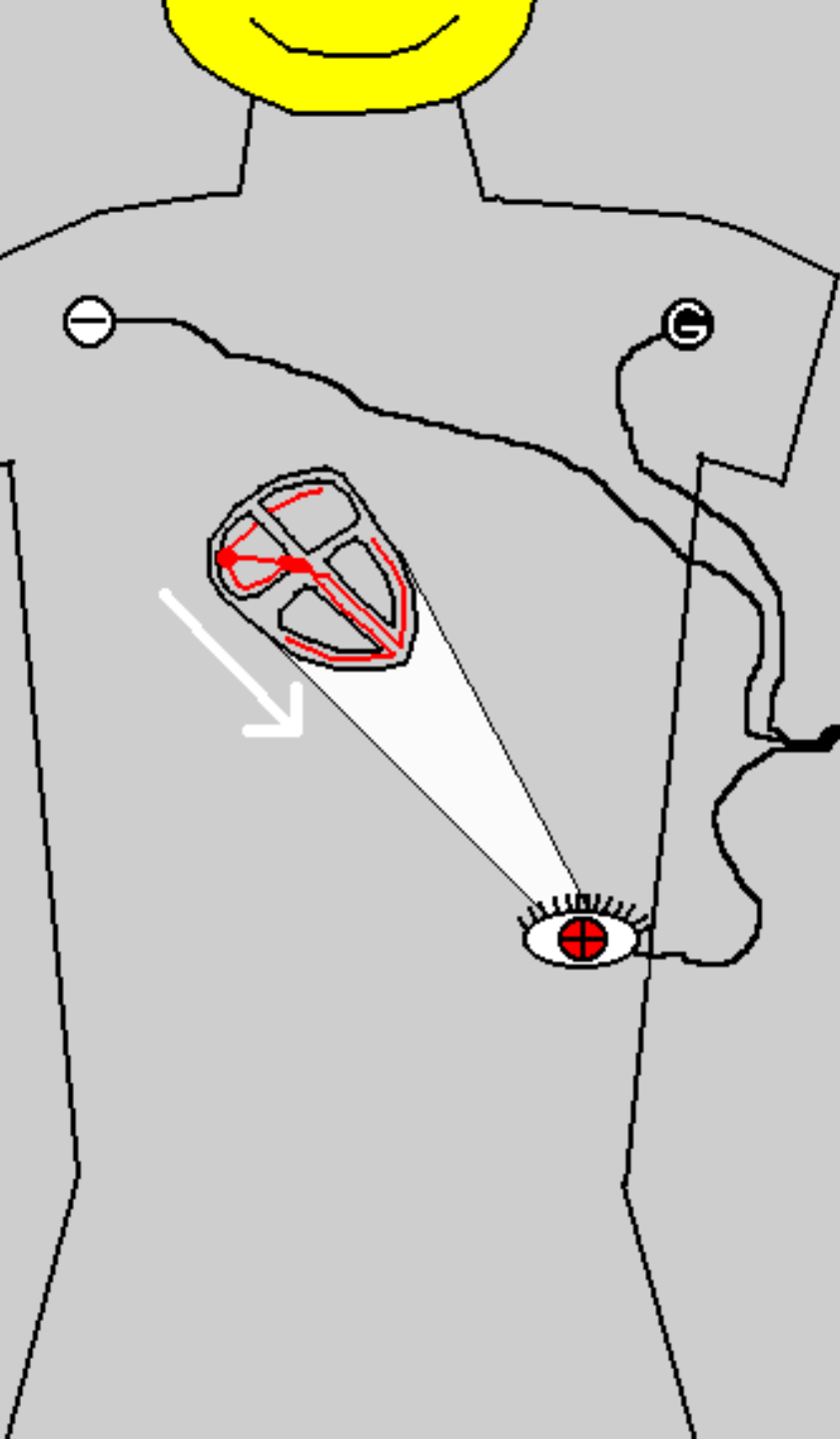




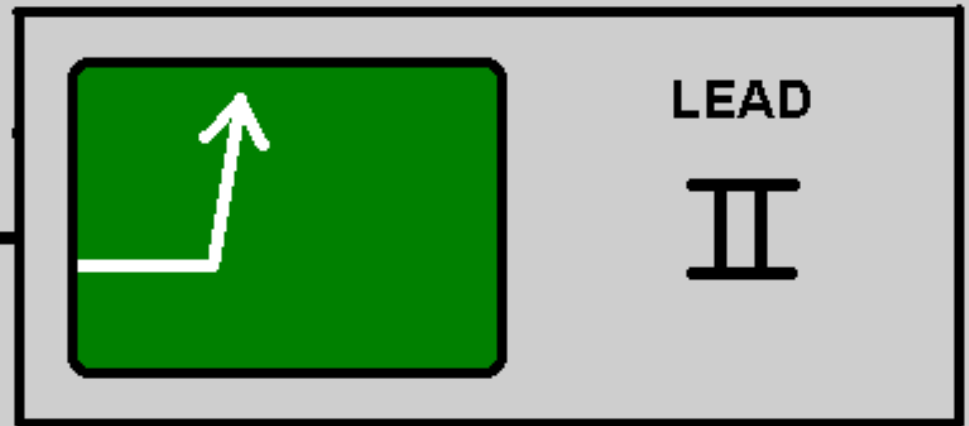
# THE POSITIVE ELECTRODE



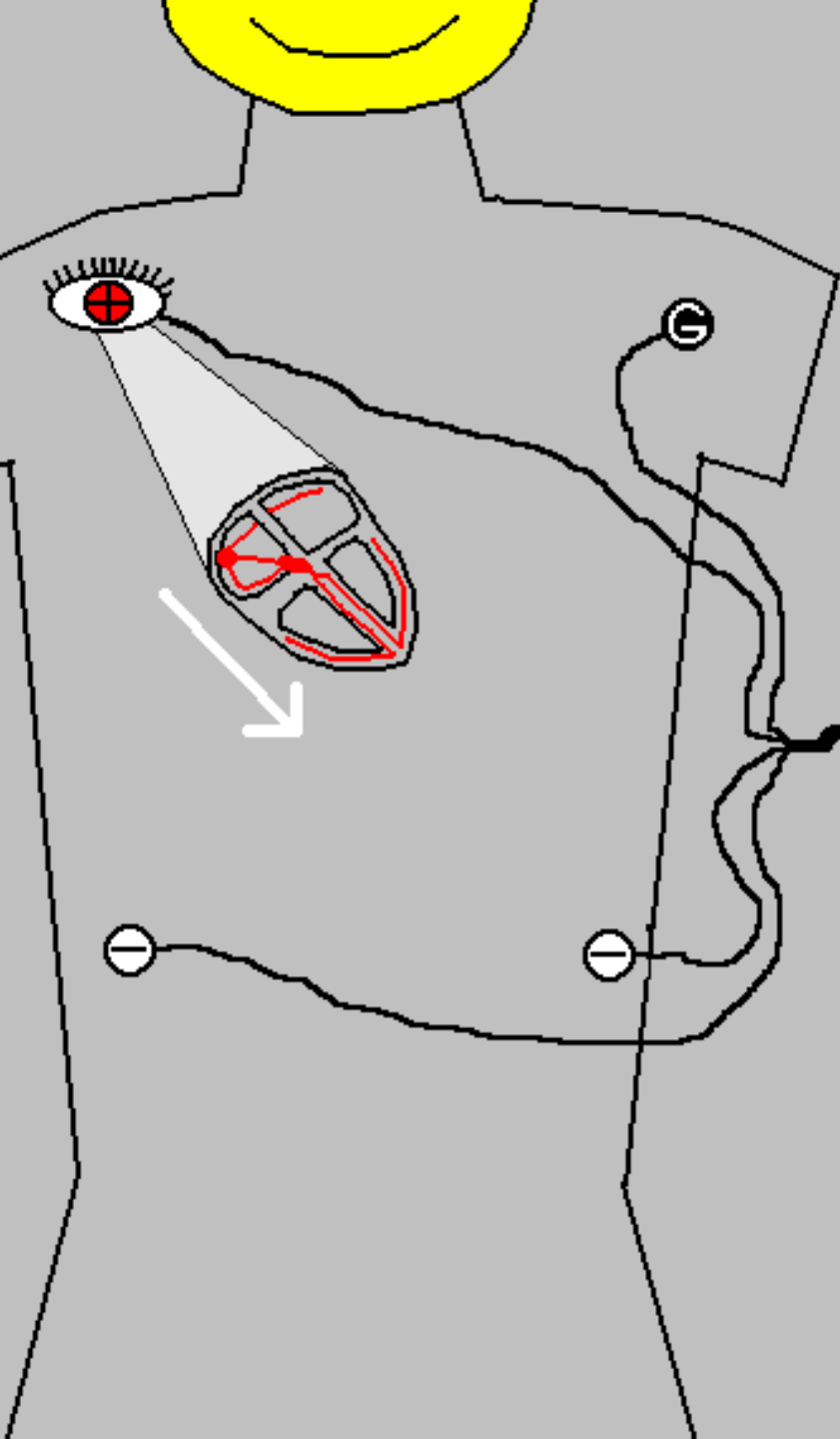
IS THE "EYE" . . .



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



**RECORDS AN  
"UPWARD"  
DEFLECTION**

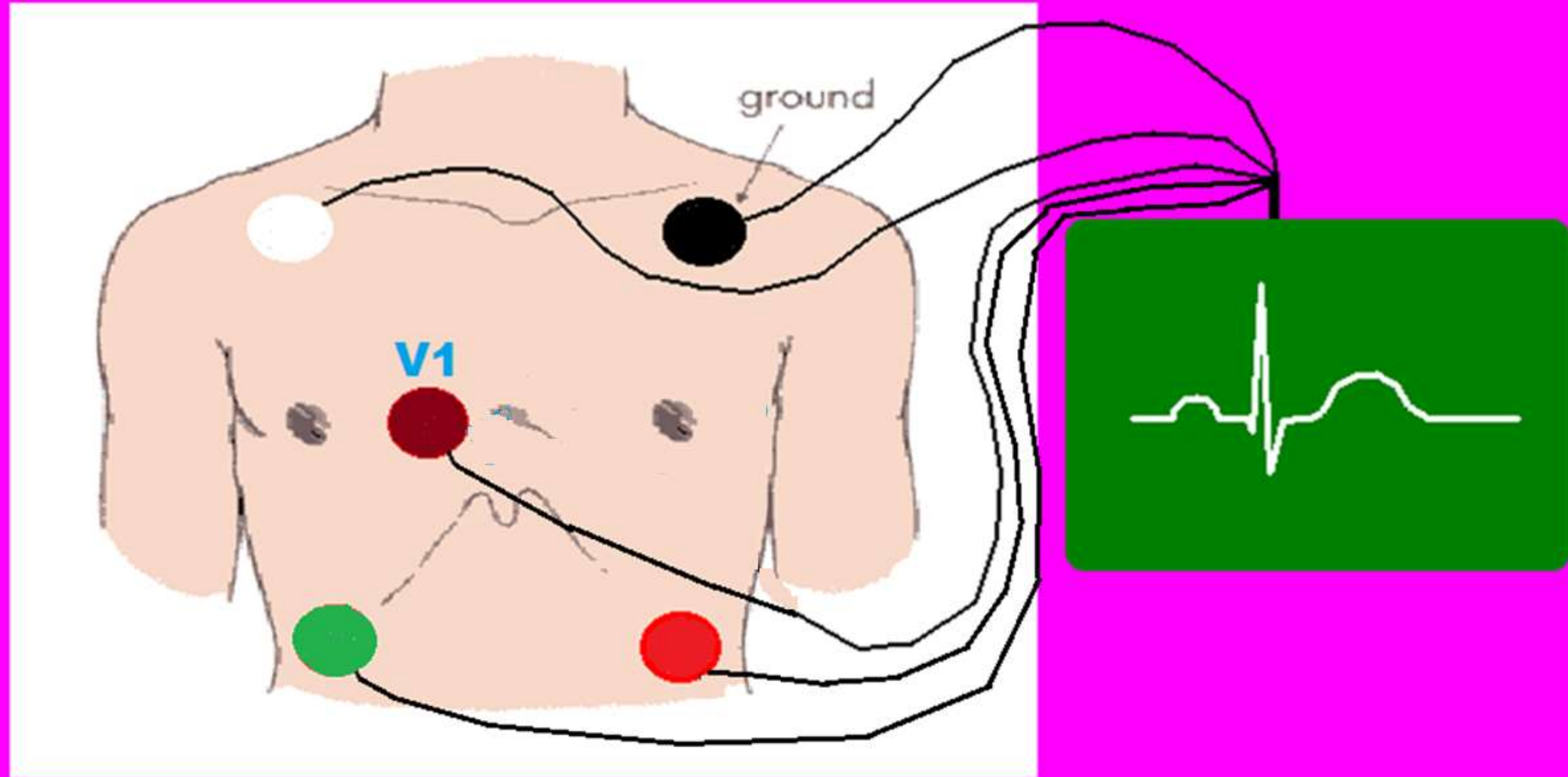


**CURRENT MOVING  
AWAY FROM  
THE EYE  
( POSITIVE ELECTRODE )**



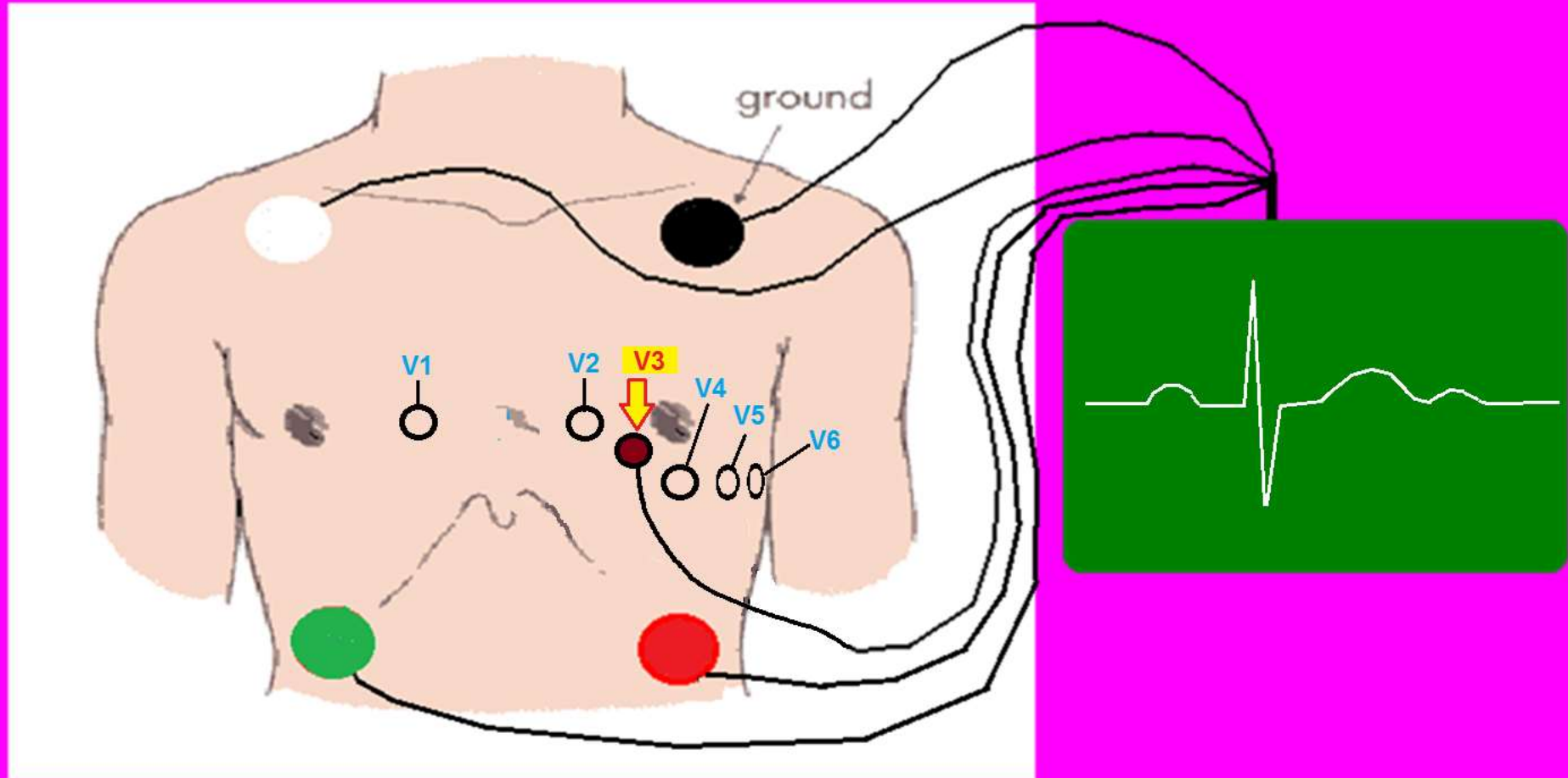
**RECORDS A  
"DOWNWARD"  
DEFLECTION**

# Traditional Lead Placement



**5 WIRE TELEMETRY UNIT**

# LEAD PLACEMENT - V3



**5 WIRE TELEMETRY UNIT**



# **ESTABLISH YOUR ROUTINE ECG EVALUATION . . . . .**

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



# ESTABLISH YOUR ROUTINE ECG EVALUATION . . . . .



RATE



RHYTHM



INTERVALS

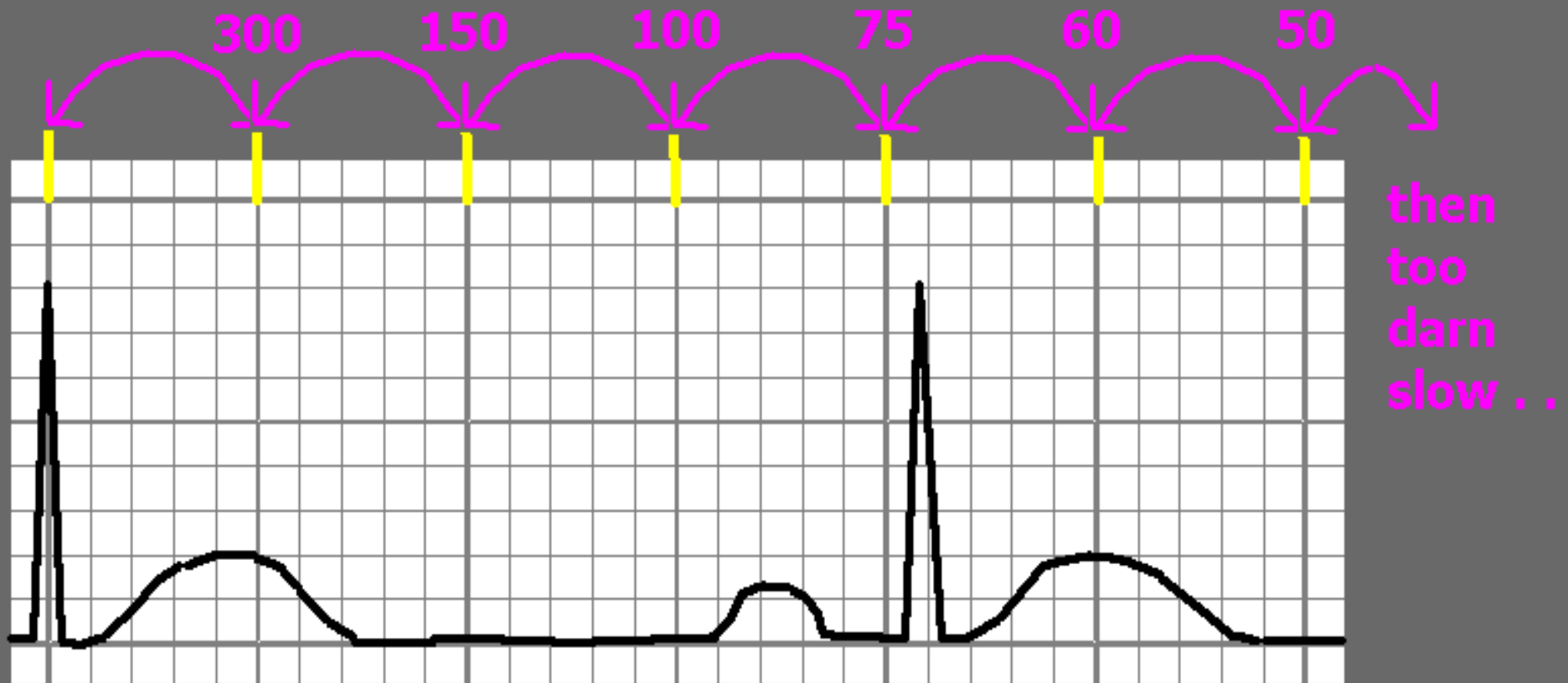


P:QRS RATIO



# DETERMINE HEART RATE

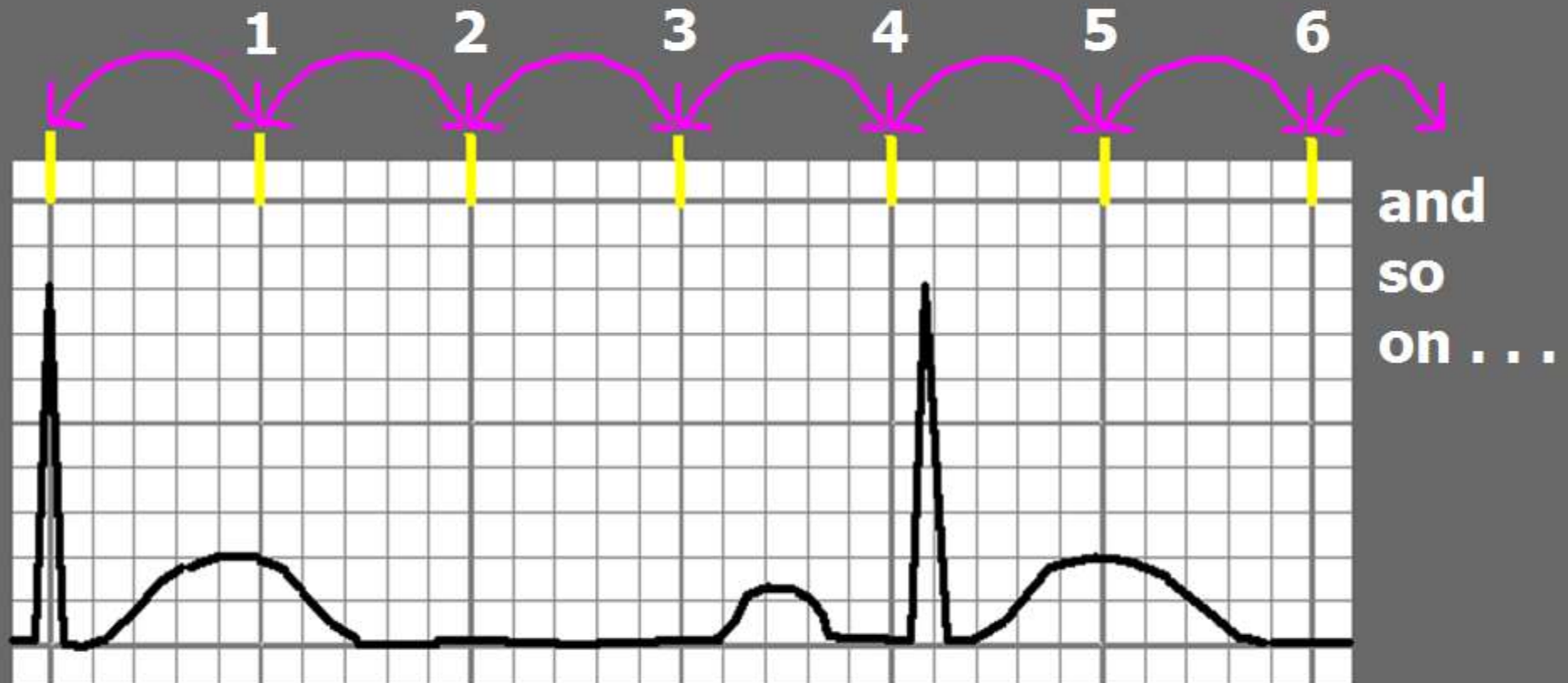
## METHOD 1: (regular rhythm)



# DETERMINE HEART RATE

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

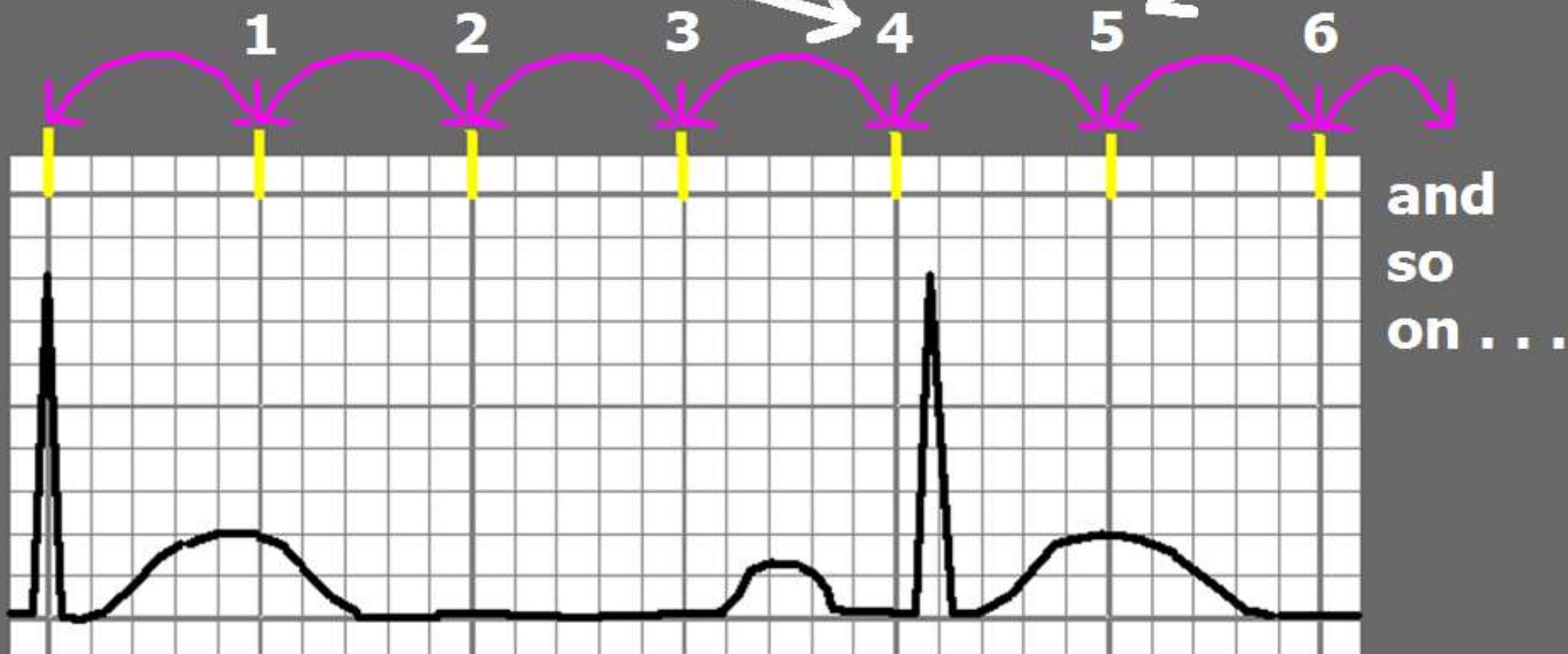
(regular rhythm)



# DETERMINE HEART RATE

300 divided by 4 = 75

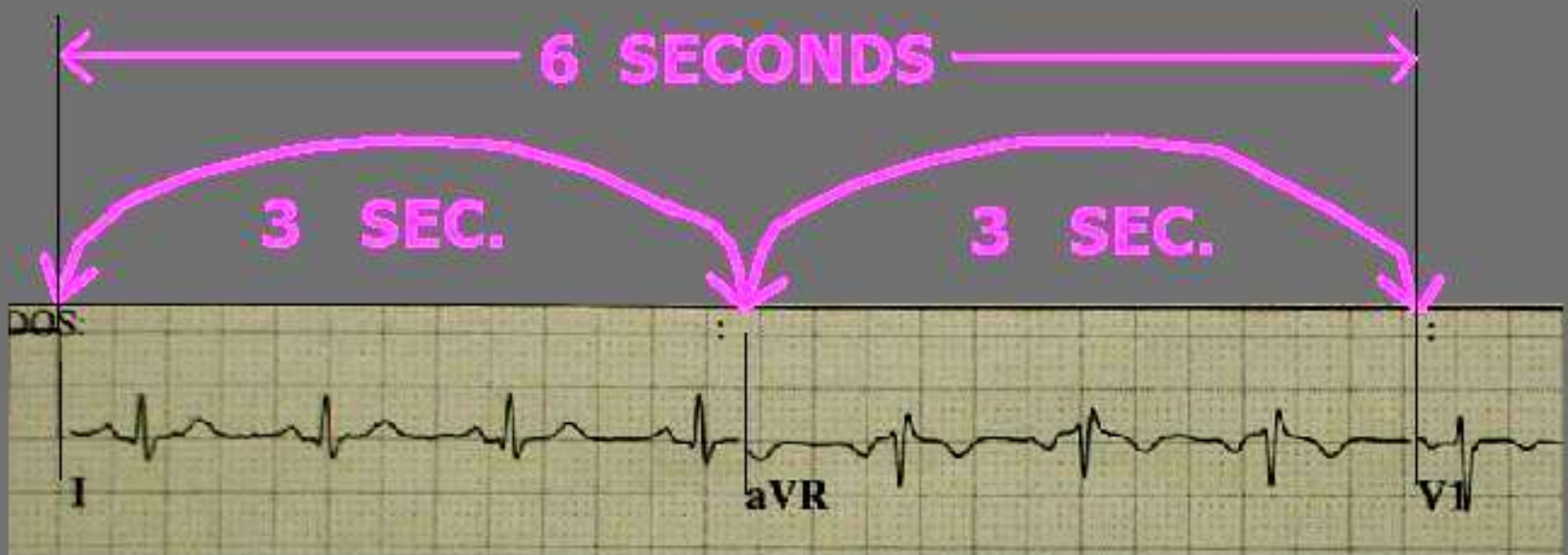
300 divided by 5 = 60



"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:**

---

# —— THE CONCERNS OF ACLS ——

IS THE

**VENTRICULAR RATE:**

---



T

O

O

S

L

O

W



# —— THE CONCERNS OF ACLS ——

IS THE

**VENTRICULAR RATE:**

---



T O O S L O W



***TOO FAST***

# —— 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**

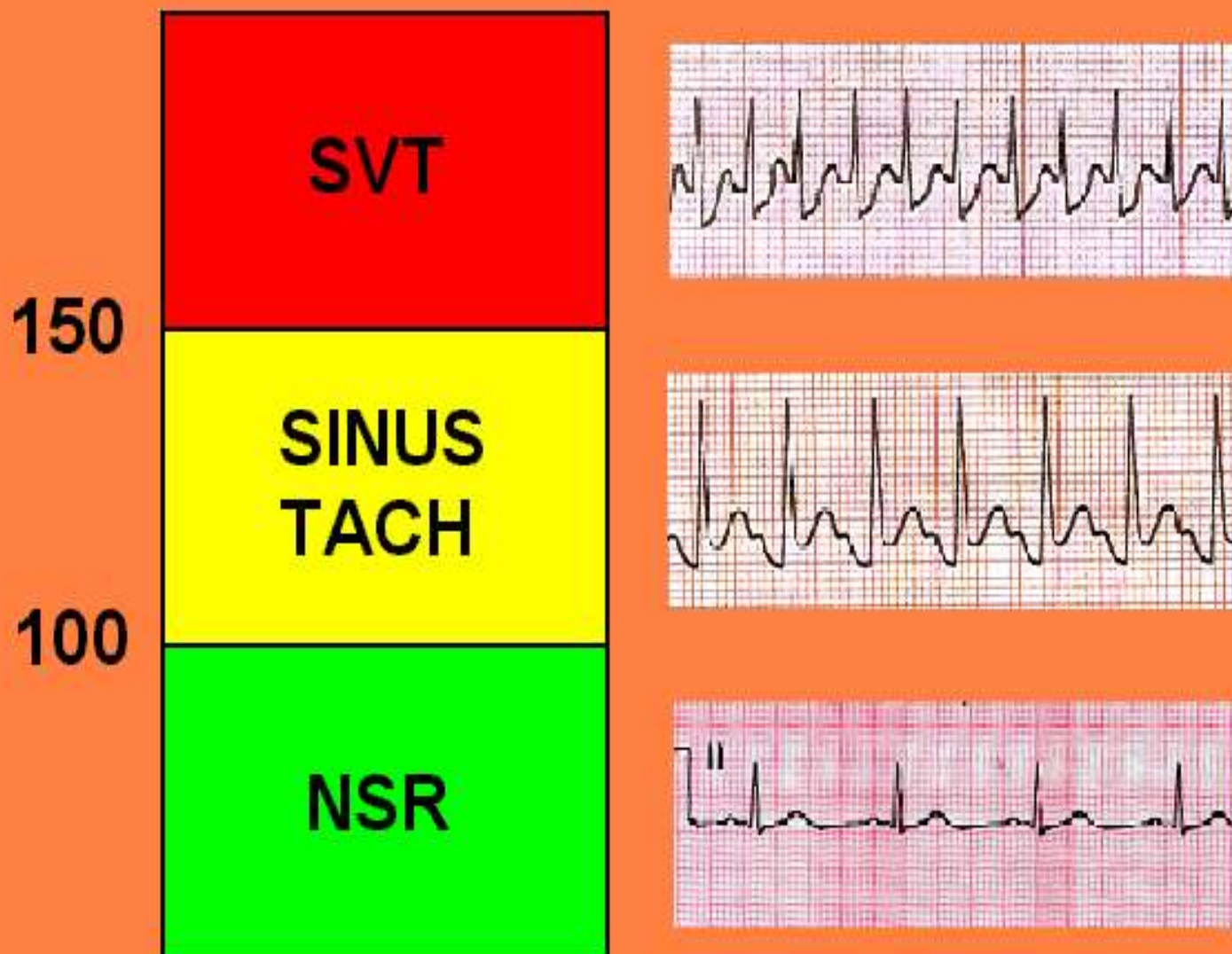
**60 - 100**

**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



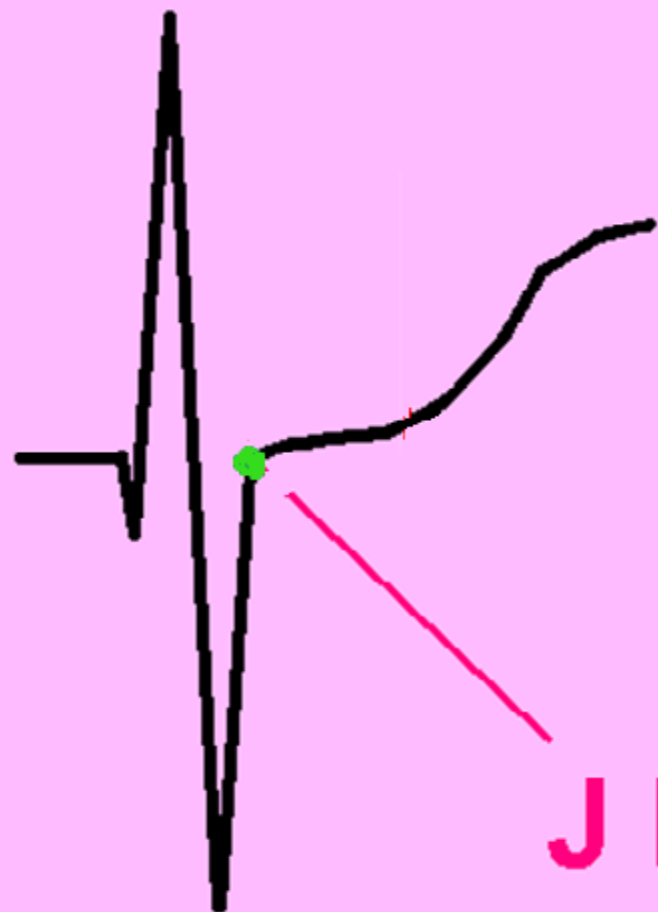
**QRS COMPLEX TOO WIDE**  
**WIDER THAN 120 mSEC**

**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

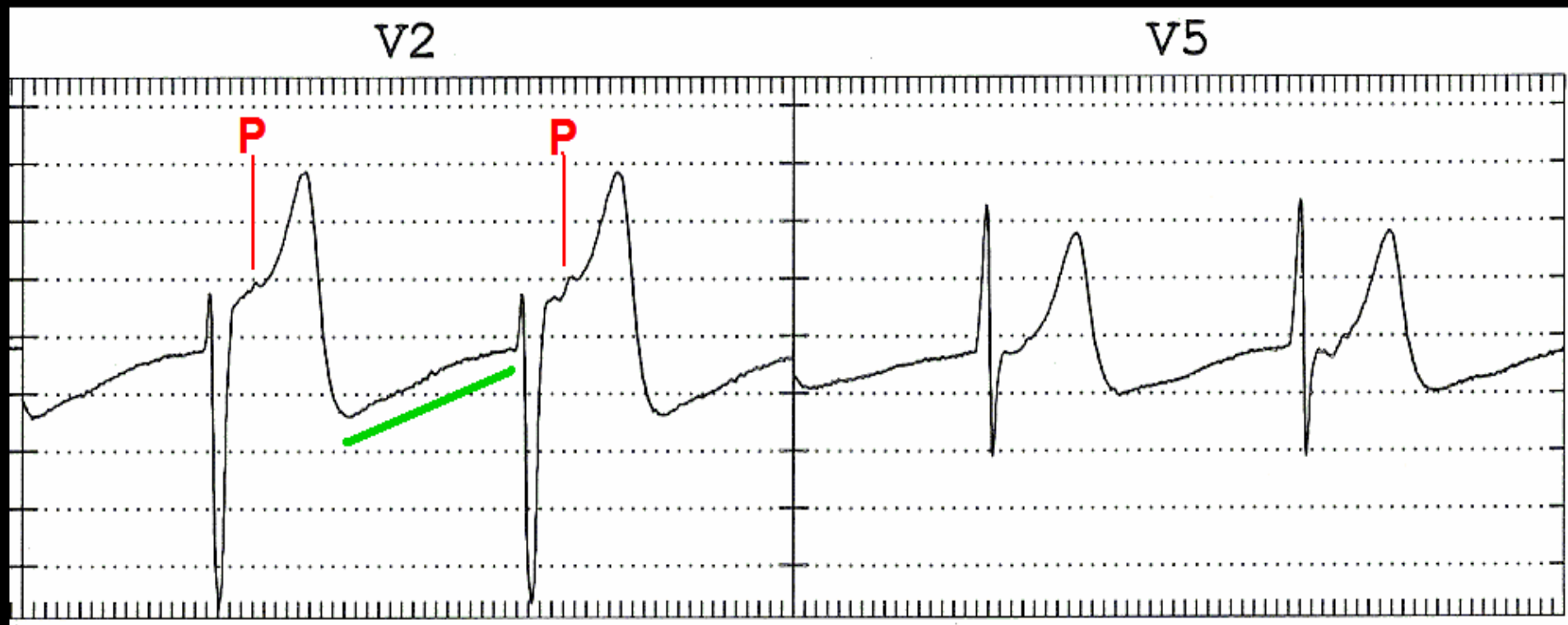
OR

BELOW  
the  
ISOELECTRIC  
LINE

or the P-Q JUNCTION.

# THE ISOELECTRIC LINE

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

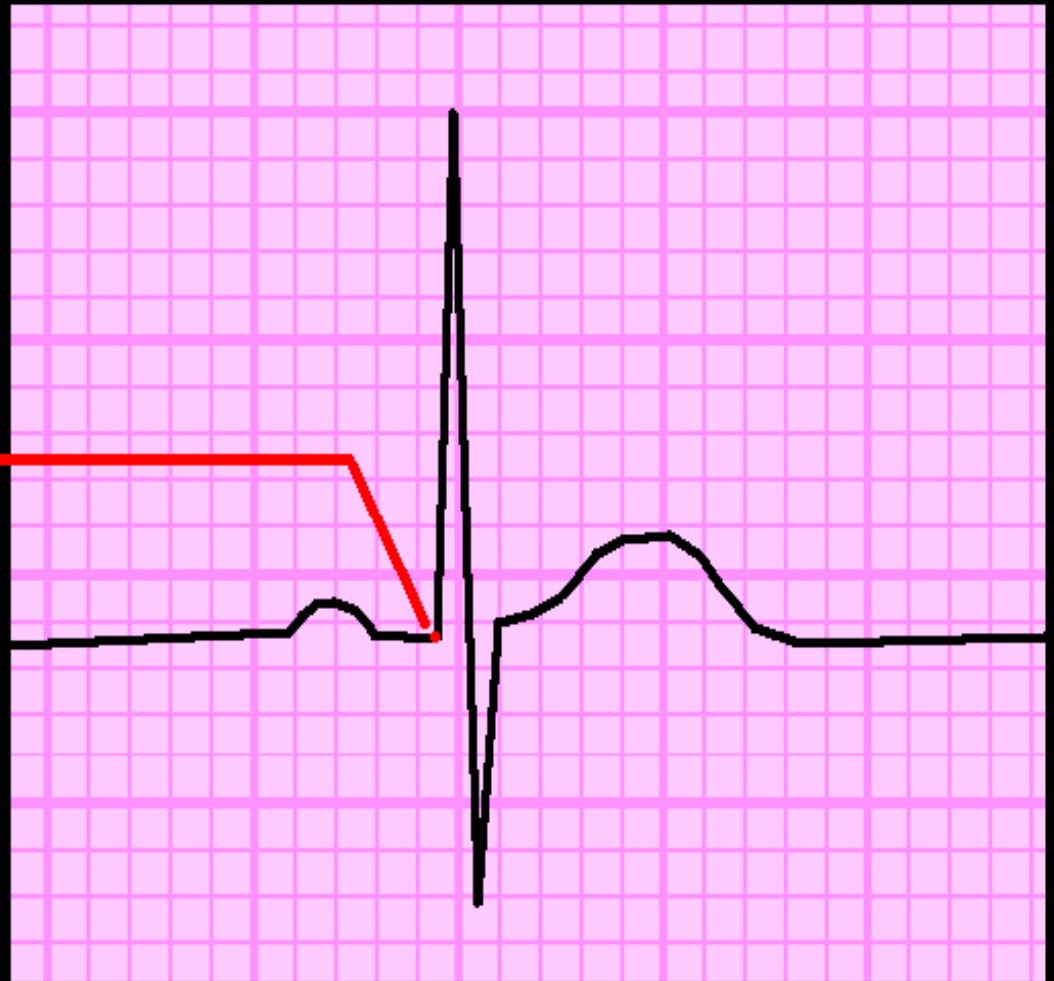




# THE P-Q JUNCTION

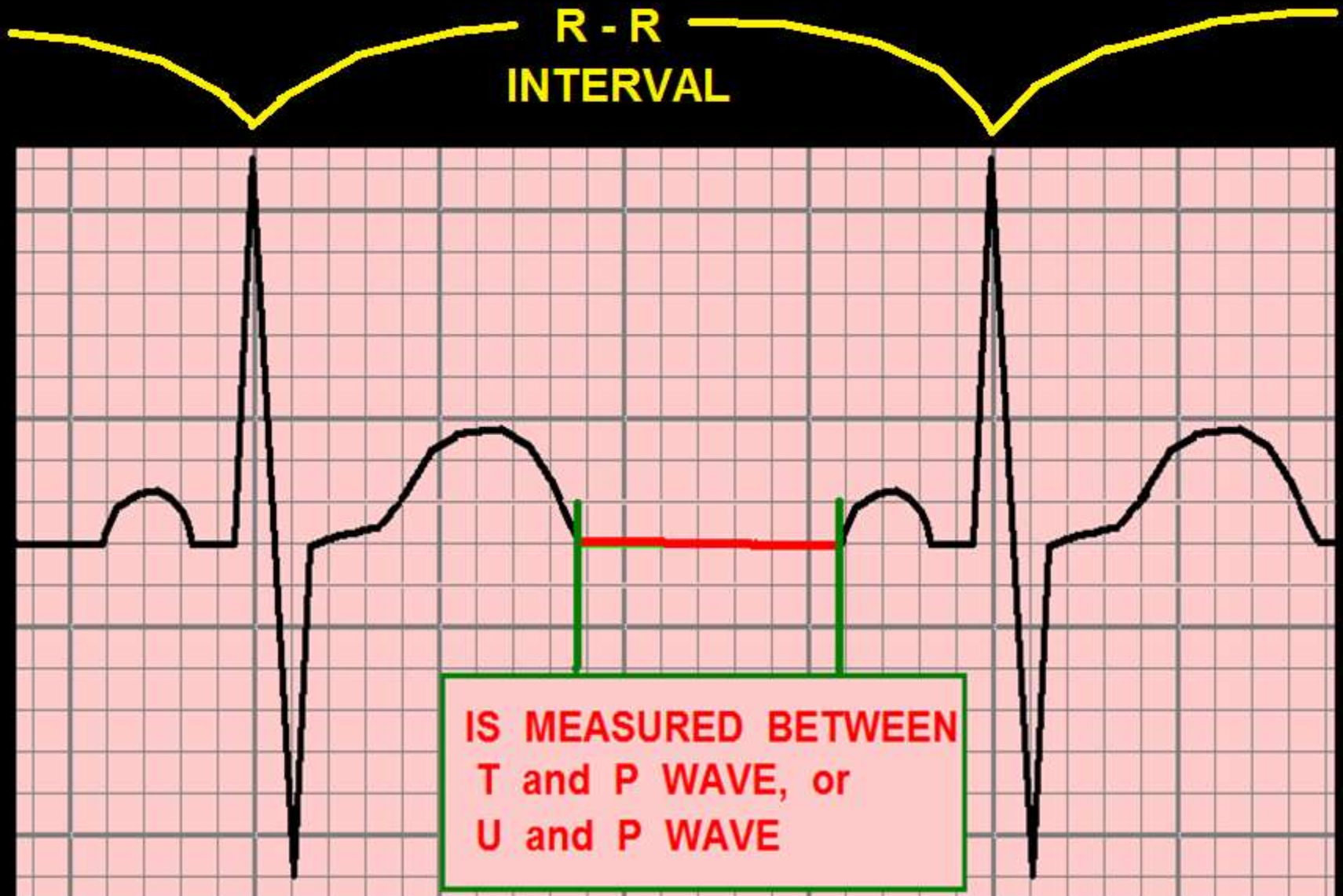
. . . is the POINT  
where the P-R  
SEGMENT ends  
and the QRS  
COMPLEX BEGINS.

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

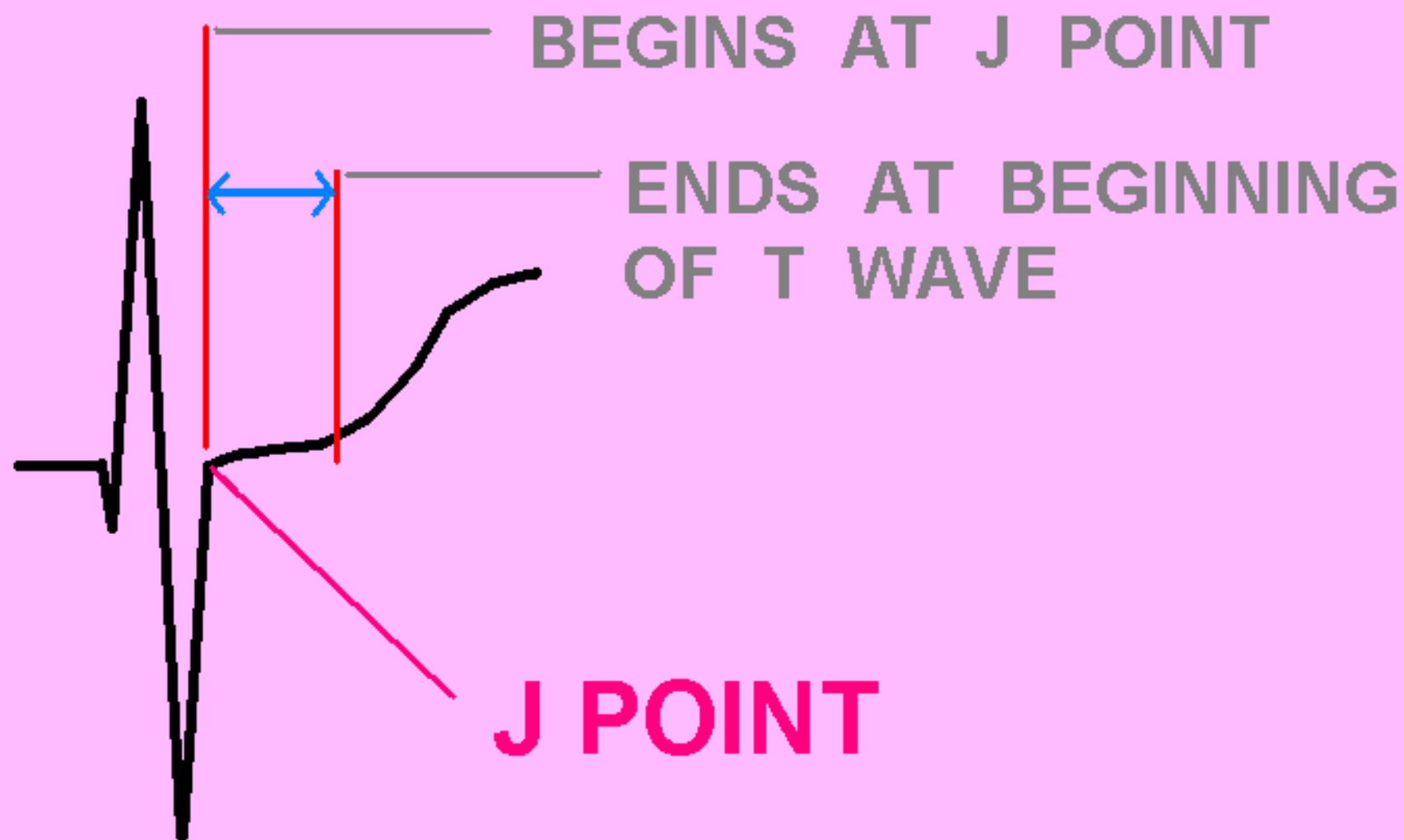


— as per the A.H.A., A.C.C., and WANG, ASINGER, and  
MARRIOTT, N.E.J.M. vol. 349:2128-2135 Nov. 27, 2003

# THE ISOELECTRIC LINE



# THE S-T SEGMENT



# Q - T INTERVAL

- VARIES BASED ON HEART RATE AND SEX



# 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 the QTc

Manual calculation:

## QT CORRECTION FORMULAS:

Bazett's

$$QTc = QT / \sqrt{RR}$$

Fredericia

$$QTc = QT / (RR)^{1/3}$$

Framingham

$$QTc = QT + 0.154(1 - RR)$$

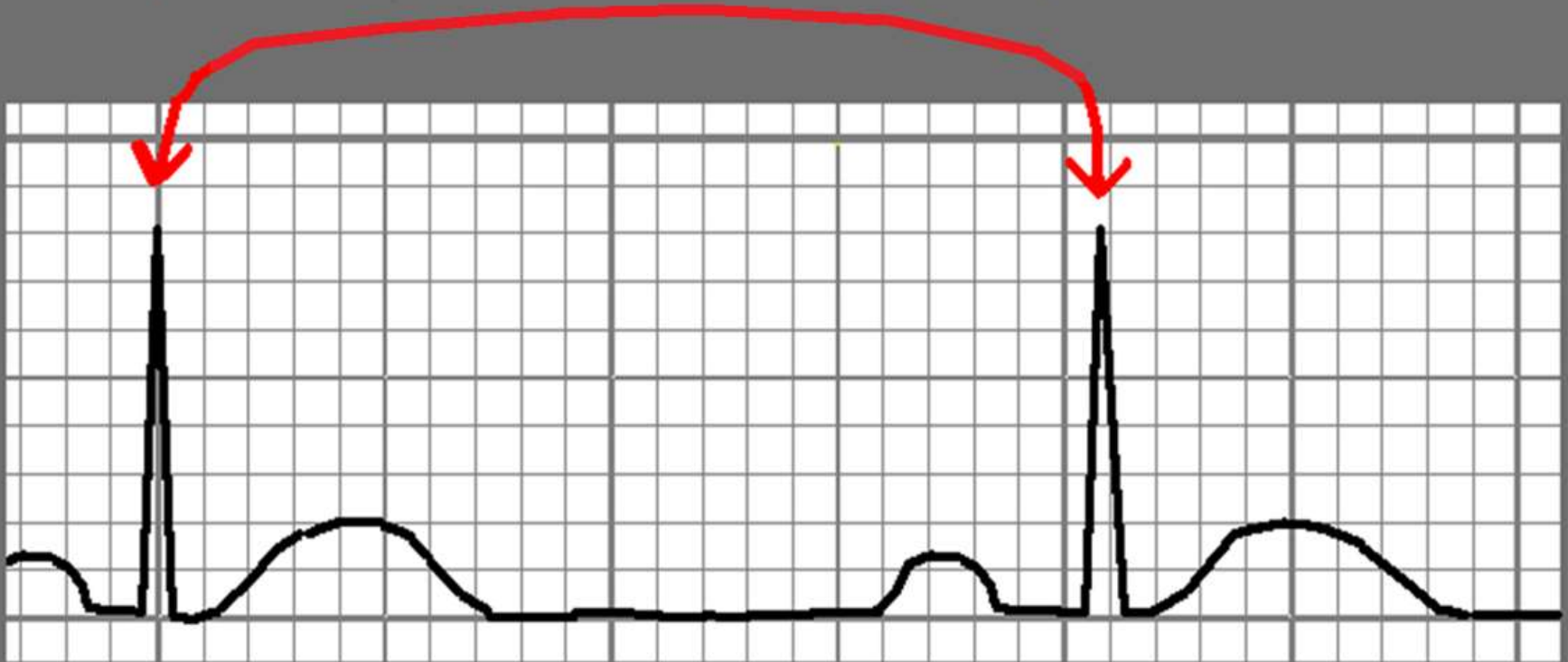
Rautaharju

$$QTp = 656 / (1 + HR/100)$$

# DETERMINING Q-T INTERVAL LIMITS

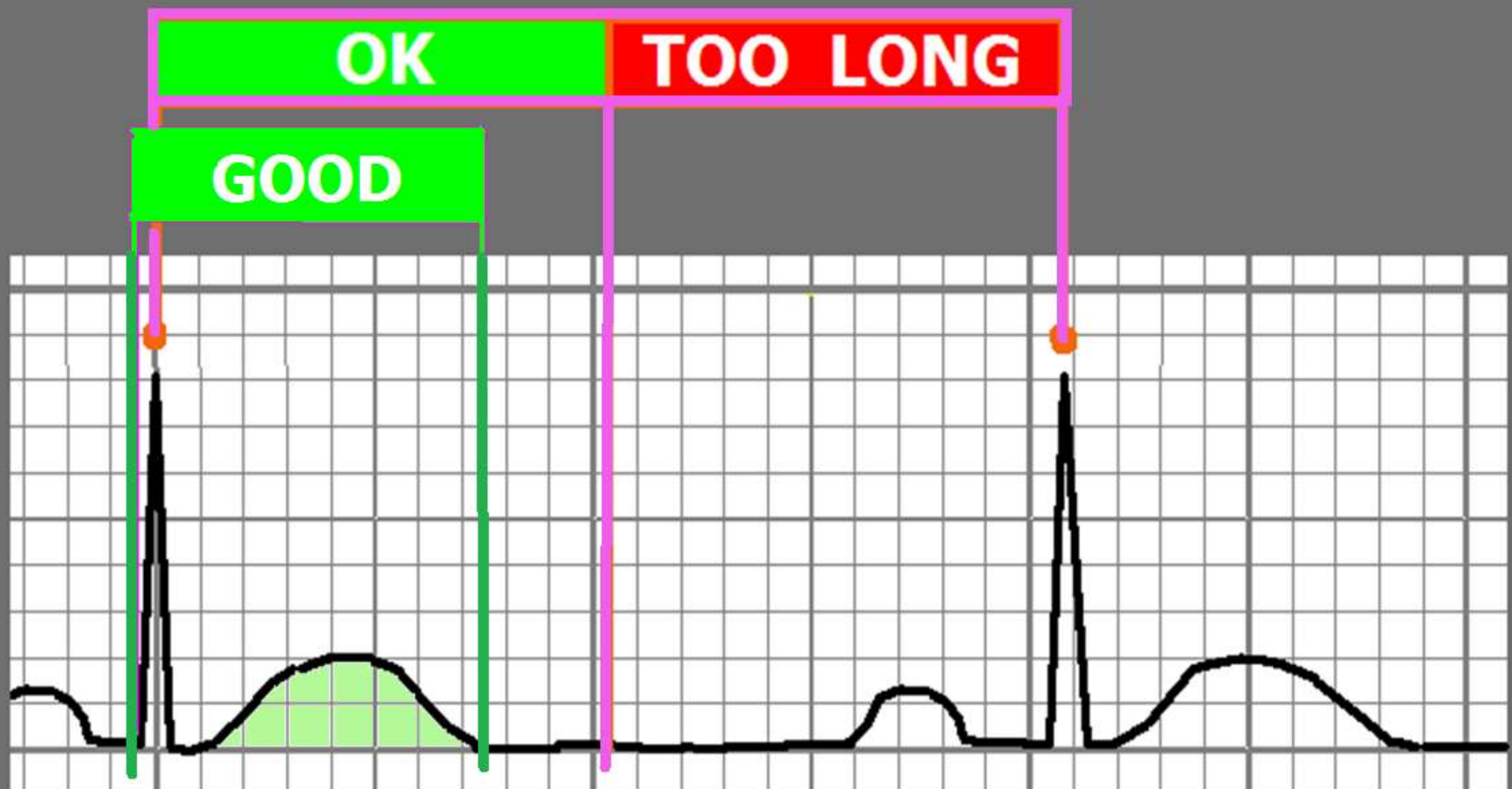
## THE "QUICK PEEK" METHOD

- ➡ 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--

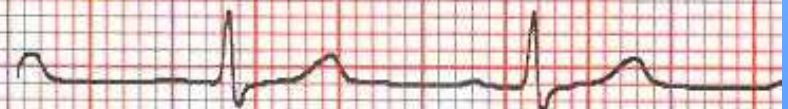
P 70

QRS 41

T -1

12 Lead; Standard Place

I



# Determining the QTc

## Method 4, Use a Smartphone App:

- **iPhone**

- <https://itunes.apple.com/us/app/corrected-qt-interval-qtc/id1146177765?mt=8>

- **Android**

- <https://play.google.com/store/apps/details?id=com.medsam.qtccalculator&hl=en>

“There’s  
an APP  
for  
that!”

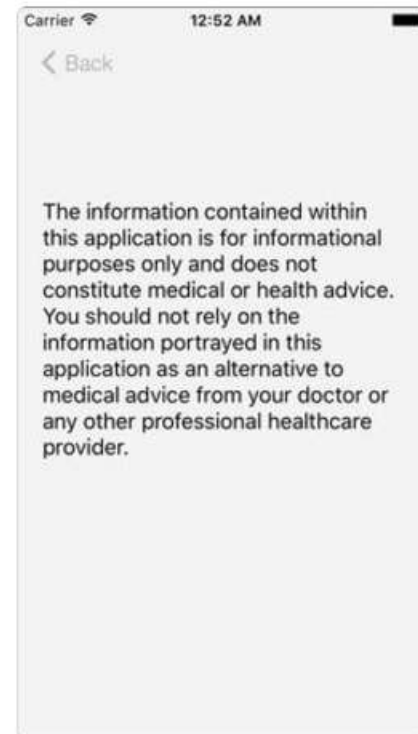
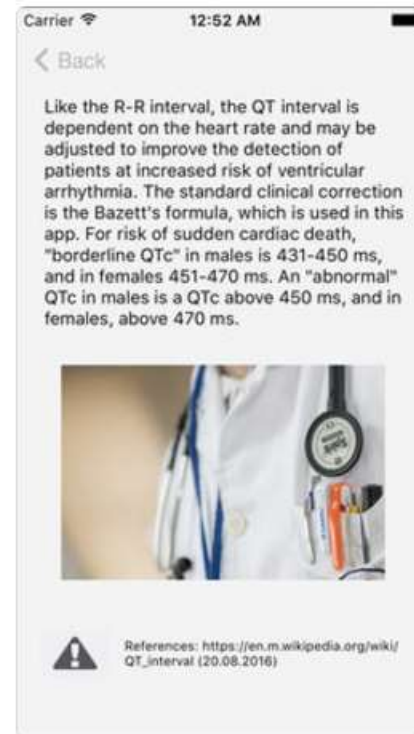
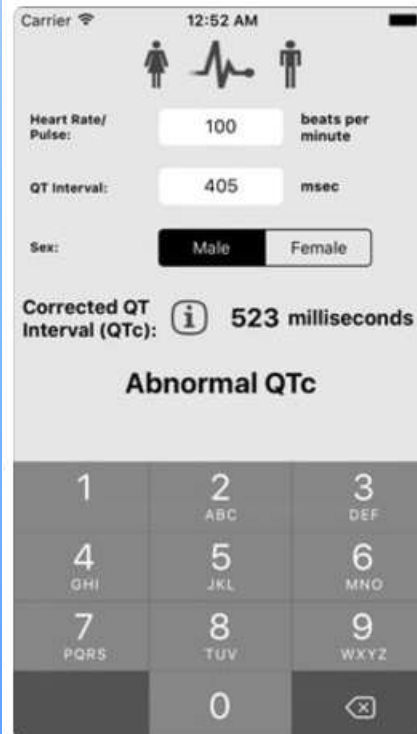


## Corrected QT Interval (QTc) 17+

Daniel Juergens

\$0.99

### iPhone Screenshots



# Determining the QTc

## Method 3, Use a Web-based App:



Calculators ▶ Heart and Chest, Critical Care

### QT Interval Correction (EKG)

Share

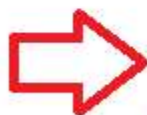
Input:

QT Interval	<input type="text" value="310"/>	<input type="text" value="msec"/>	▼
Heart Rate	<input type="text" value="88"/>	<input type="text" value="bpm"/>	▼

Results:

RR Interval	<input type="text" value="682"/>	<input type="text" value="msec"/>	▼
QTI Corrected	<input type="text" value="375"/>	<input type="text" value="msec"/>	▼

Our patient's QTc = 375 ms.



Decimal Precision:

# QTc Values:

**Too Short:**

**< 390 ms**

**Normal**

**-Males:**

**390 - 450 ms**

**-Females:**

**390 - 460 ms**

**Borderline High**

**-Males:**

**450 - 500 ms**

**-Females:**

**460 - 500 ms**

**High (All Genders):**

**500 - 600 ms**

**Critical High**

**(associated with TdP): 600 + ms**

SOURCE: "ACC/AHA/HRS Recommendations for Standardization and Interpretation of the ECG, Part IV: The ST Segment, T and U Waves, and the QT Interval" Rautaharju et al 2009



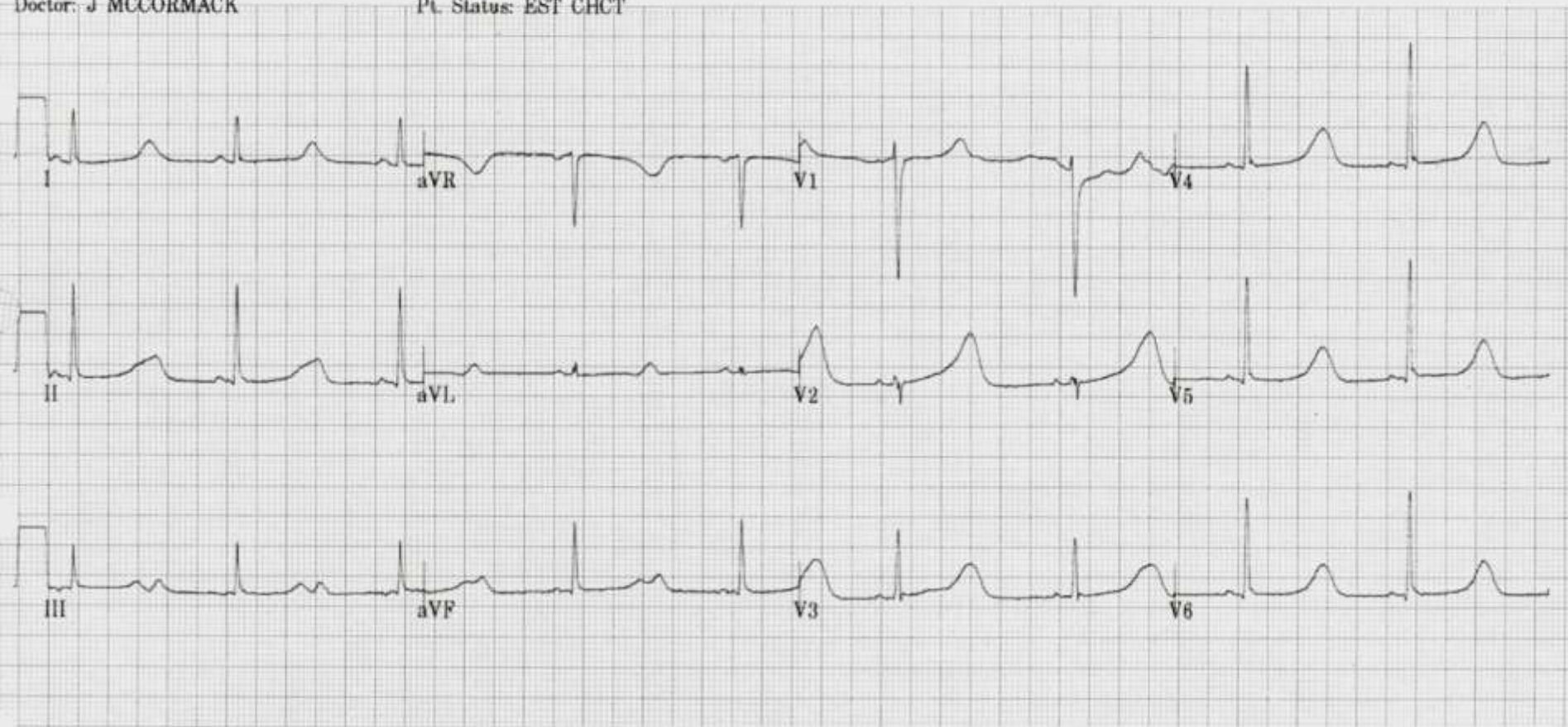
**22 y/o FEMALE**

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

PEDIATRIC CARDIOLOGY ASSOCIATES

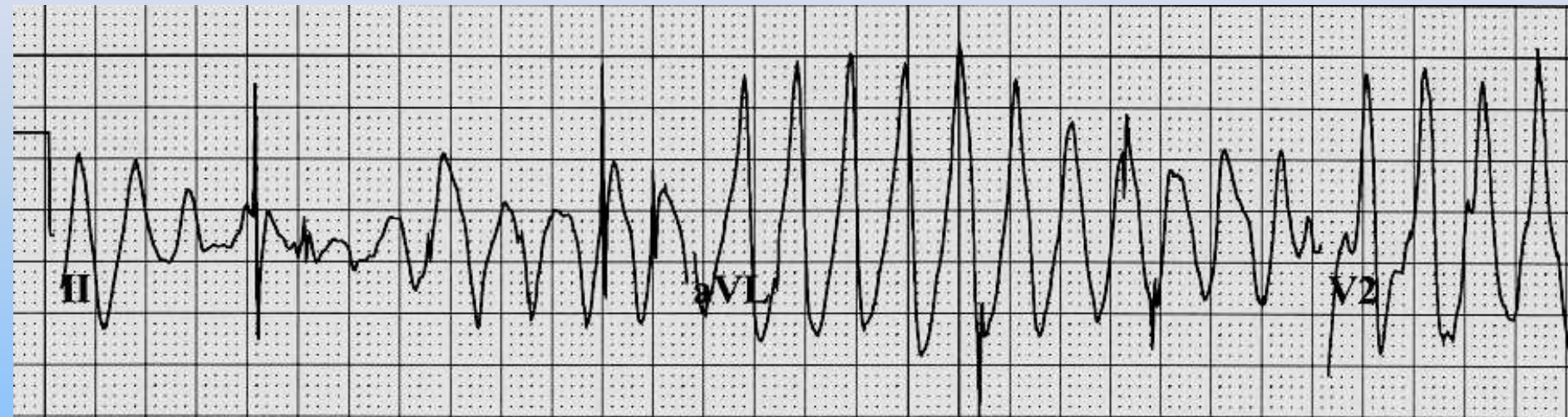
Doctor: J MCCORMACK

Pt. Status: EST CHCT



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

# Dysrhythmia Associated with Mortality, Triggered by LQTS: *Torsades de Pointes*



## Torsades de Pointes (TdP) – **HEMODYNAMICS:**

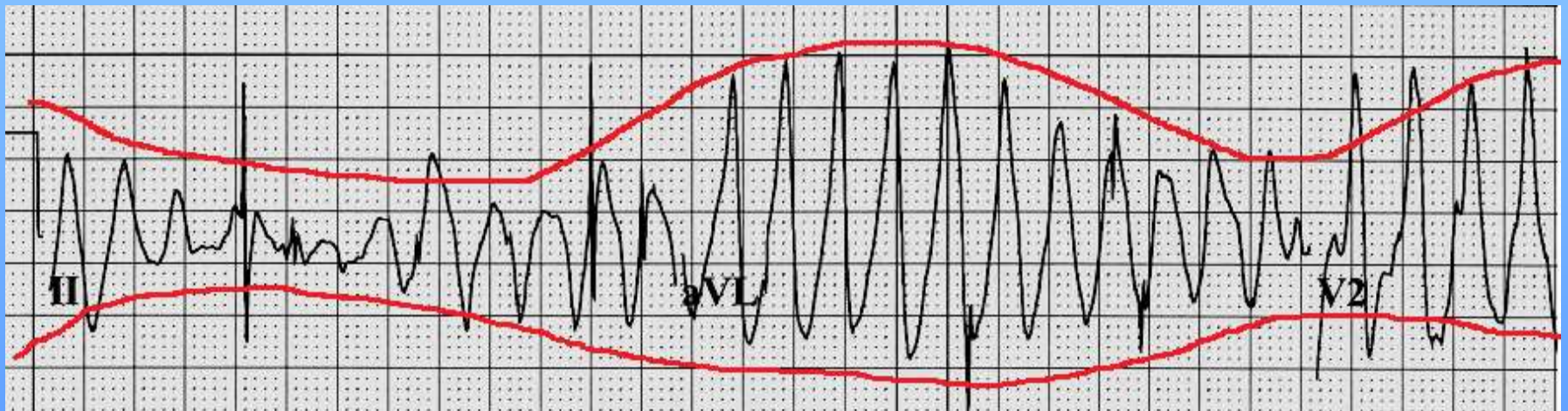
- **Decreased – to – NO Cardiac Output**
- **Often patient PULSELESS during episode**
- **Patients often report SYNCOPÉ when TdP self-terminates.**
- **May DETERIORATE into VENTRICULAR FIBRILLATION and CARDIAC ARREST. (“Sudden Death”)**



# ECG Characteristics of TdP: The QRS Pattern of *Torsades de Pointes* resembles . . . . .



*a piece of Twisted Ribbon !*



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

**-Immediately check patient**

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

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

## **Etiology of Long QT Syndromes:**

### **Congenital** (14 known subtypes)

Genetic mutation results in abnormalities of cellular ion channels

### **Acquired**

Drug Induced

Metabolic/electrolyte induced

Very low energy diets / anorexia

CNS & Autonomic nervous system disorders

### **Miscellaneous**

Coronary Artery Disease

Mitral Valve Prolapse

# PROLONGED Q - T INTERVAL

THINK:

- CHECK K<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:*

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

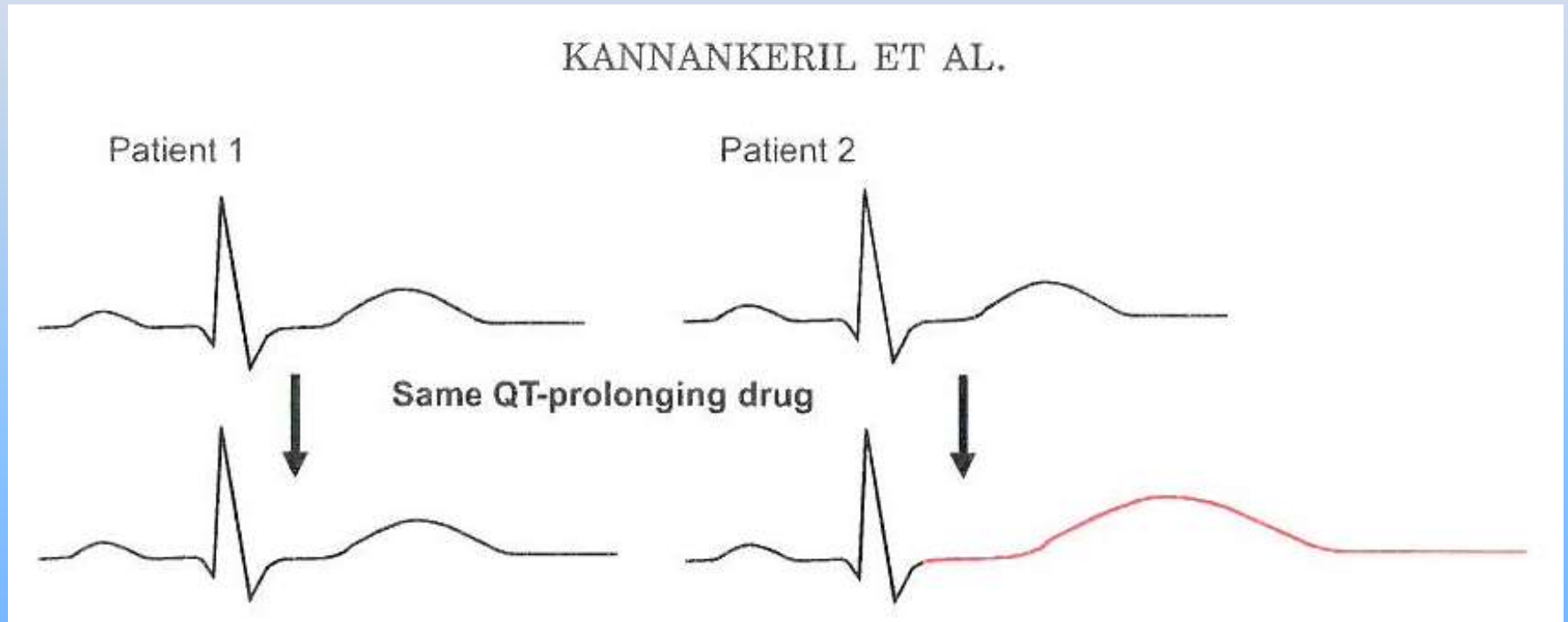
*Commonly used QT prolonging meds include:*

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

***and MANY more!***

PATIENT 1: NORMAL

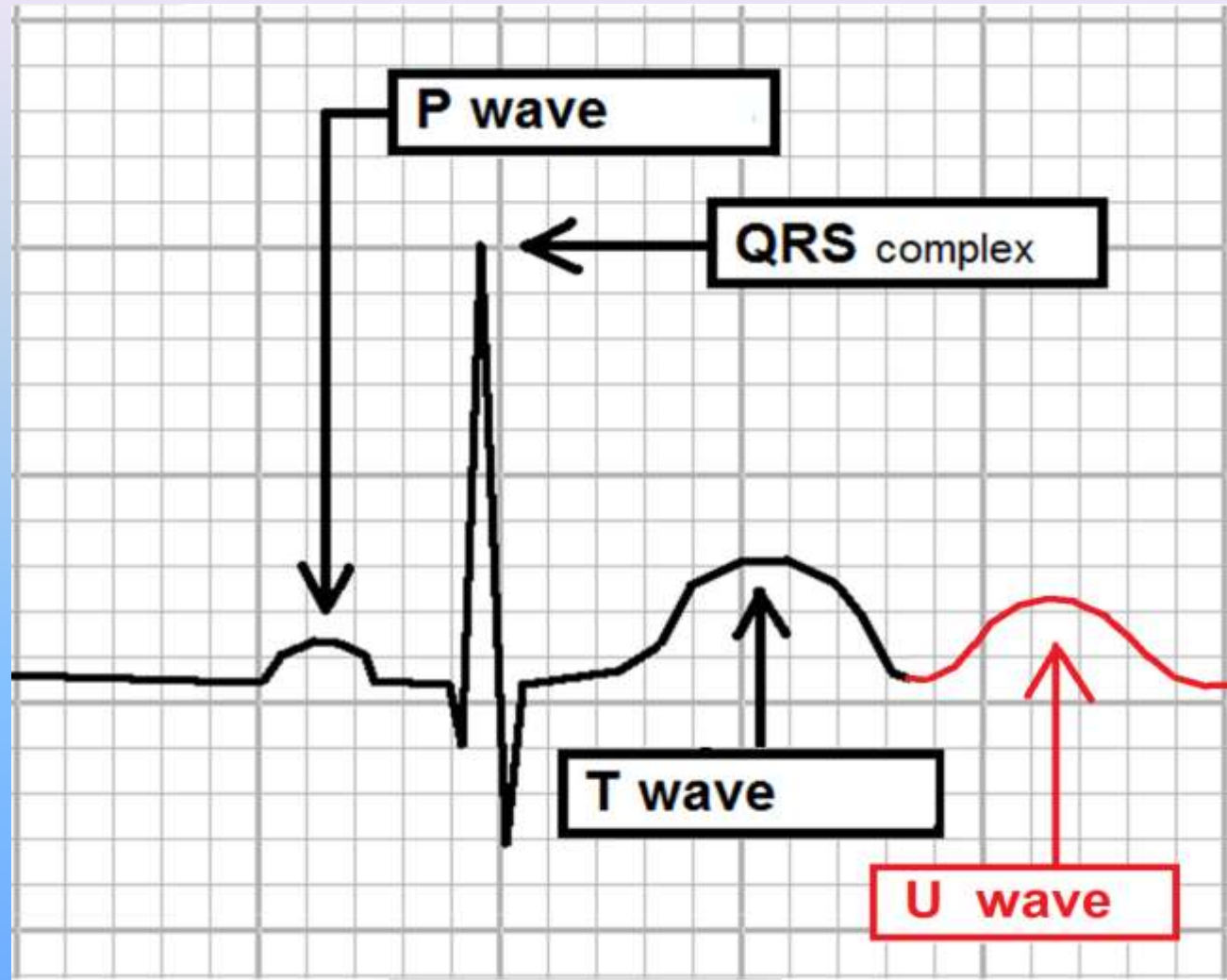
PATIENT 2: Genetic susceptibility; sensitivity to QT prolonging drugs:



[Click here for link to paper by Kannankeril et al \(2010 Pharmacological Reviews\) that describes genetic susceptibility described above.](#)

# U Waves

Occasionally an extra wave is noted after each T wave. It typically resembles *“a secondary T wave.”*



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



# U Waves . . .

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

**\* *These are also causes of QT interval prolongation.***

# Abnormal U Waves

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

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

## EVIDENCE SOURCE:

ACC/AHA/HRS Recommendations for the Standardization and Interpretation of the Electrocardiogram Part IV: The ST Segment, T and U Waves, and the QT Interval.

I

aVR

V1

V4

II

aVL

V2

V5

III

aVF

V3

V6

**QT = 500ms****(QTc = 447ms)****QT = 760ms****(QTc = 672ms !)**

**This ECG illustrates the degree of variation that can be noted between different leads on the 12 Lead ECG. ALWAYS measure the QT Interval in the lead with the GREATEST value.**



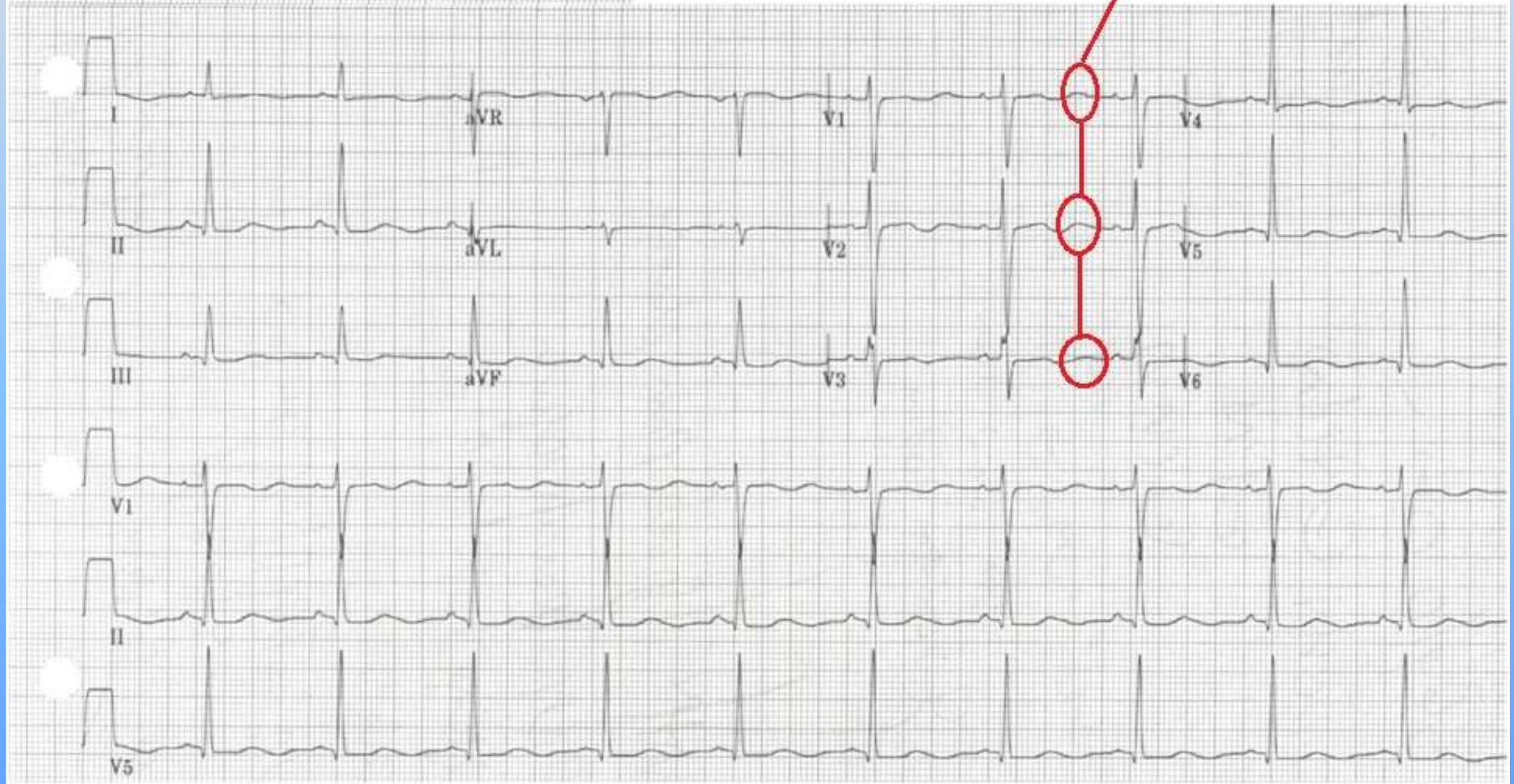
## Medication induced LQTS with TdP and Cardiac Arrest - Case Study: 56 year old male

56 years  
Male Caucasian  
Room: 3  
Loc: 3 Opt: 23  
Vent. rate 64 bpm  
PR interval 152 ms  
QRS duration 104 ms  
QT/QTc 662/682 ms  
P-R-T axes 51 64 212

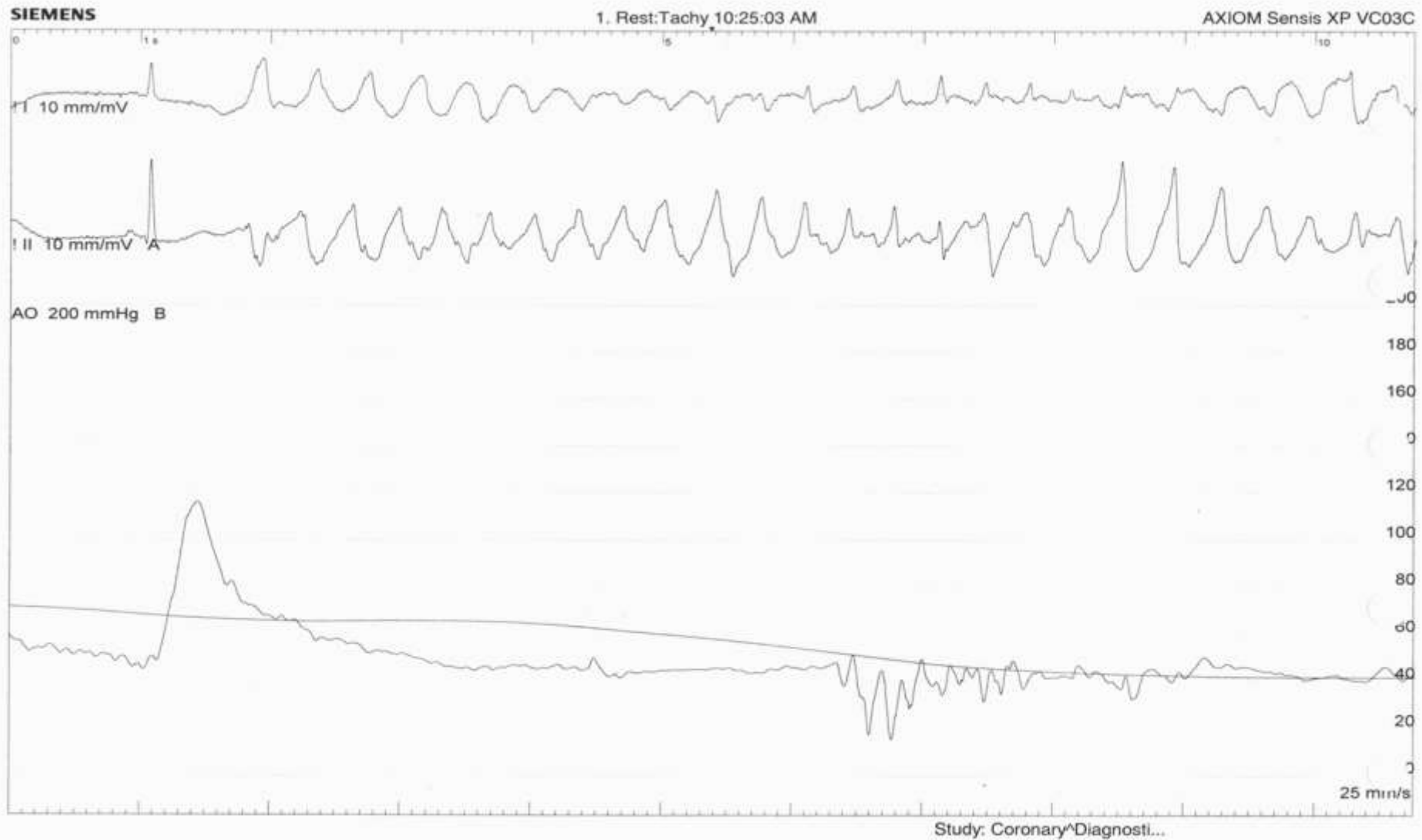
Technician:

### "Syncope of Unknown Etiology"

30 days prior to this visit, patient started taking Ritalin. Since then he has reported multiple syncopal episodes. Notice the prominent U waves in Leads V1, V2 and V3.

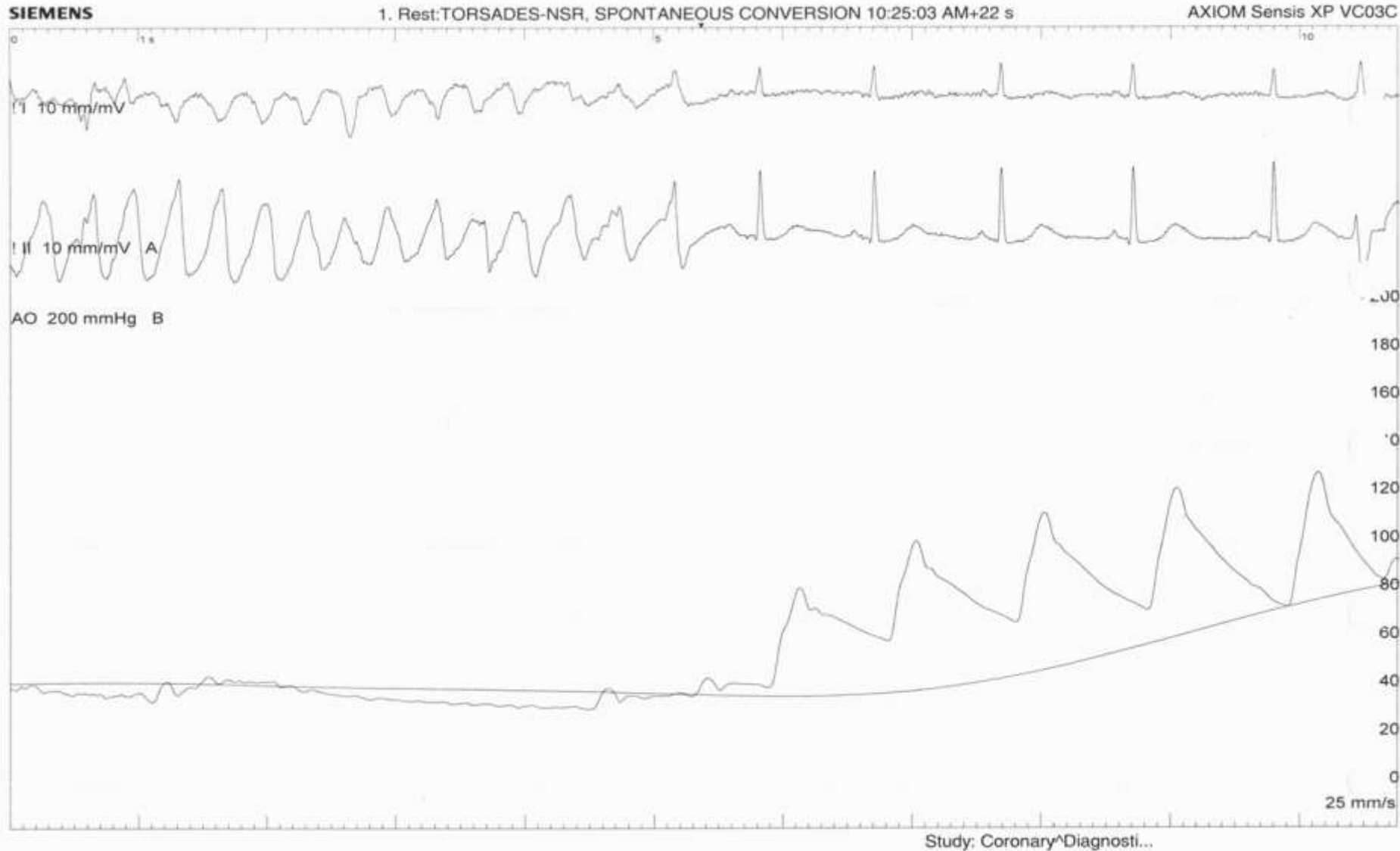


## Medication induced LQTS with TdP and Cardiac Arrest - Case Study: 56 year old male



**Run of Torsades de Pointes occurred during Cardiac Catheterization . . .**

## Medication induced LQTS with TdP and Cardiac Arrest - Case Study: 56 year old male



**Torsades de Pointes self-terminates just before aborted Defibrillation**



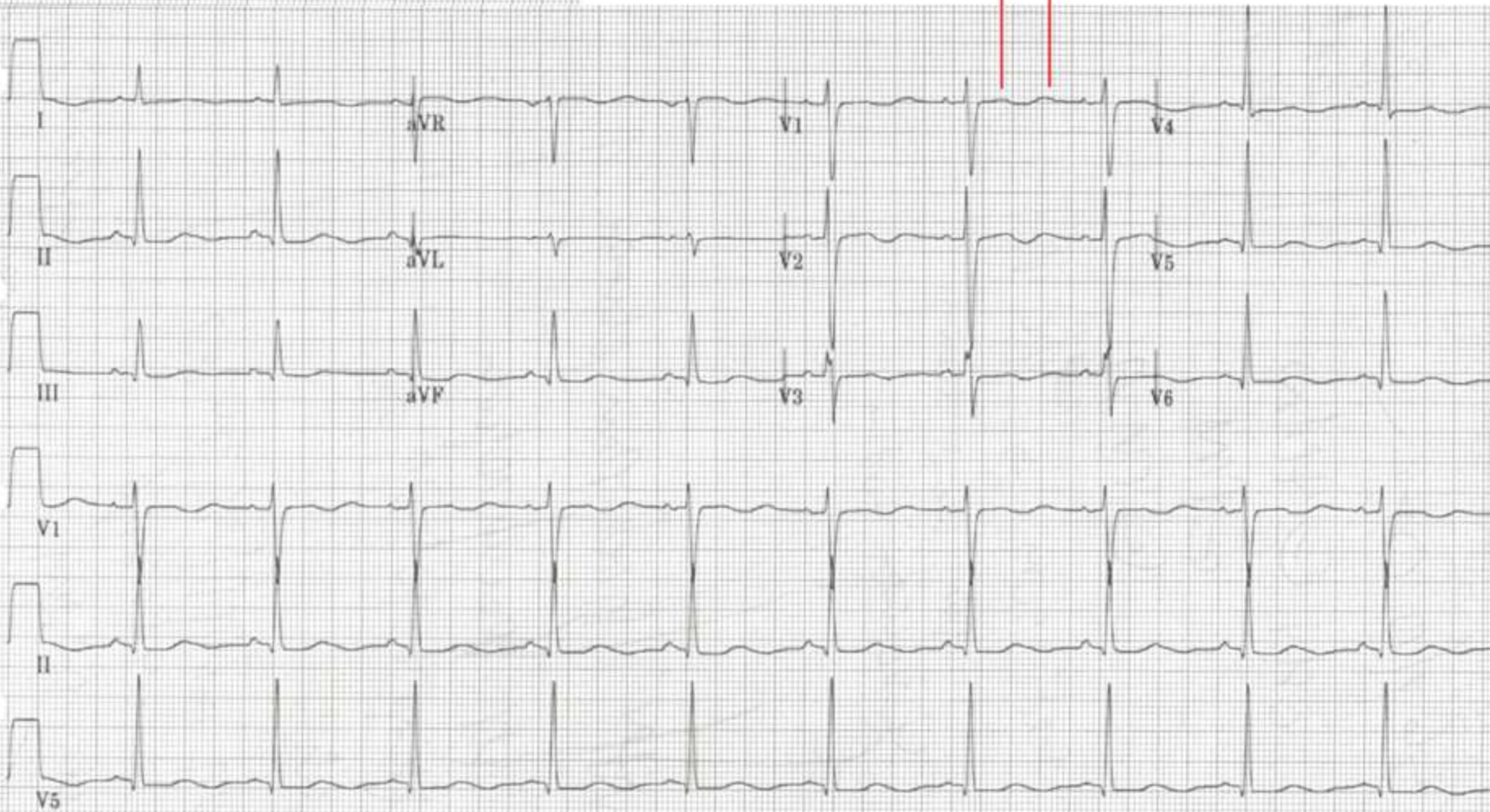
## Medication induced LQTS with TdP and Cardiac Arrest - Case Study: 56 year old male

56years  
Male      Caucasian  
Room:      Opt: 23  
Loc: 3  
Vent. rate      64 bpm  
PR interval      152 ms  
QRS duration      104 ms  
QT/QTc      662/682 ms  
P-R-T axes      51   64   212

Technician:

*Ritalin was immediately discontinued.  
Within 48 hours, U waves were gone.  
No more incidents of syncope reported.*

**T U**





# ESTABLISH YOUR ROUTINE ECG EVALUATION . . . . .



RATE



RHYTHM



INTERVALS



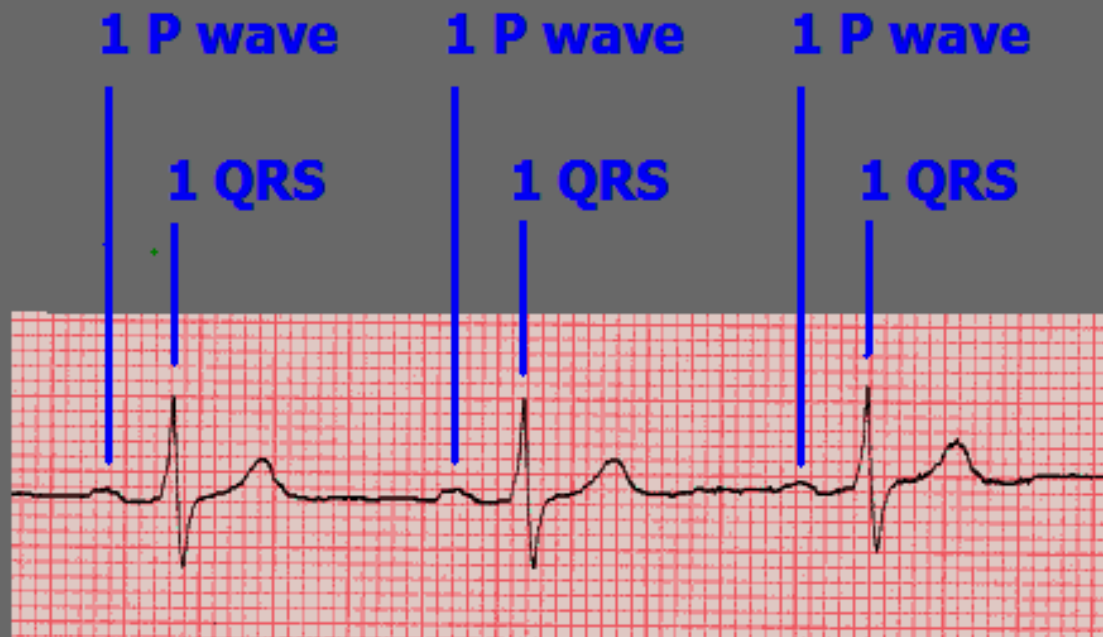
P:QRS RATIO



# DETERMINE P : QRS RATIO



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



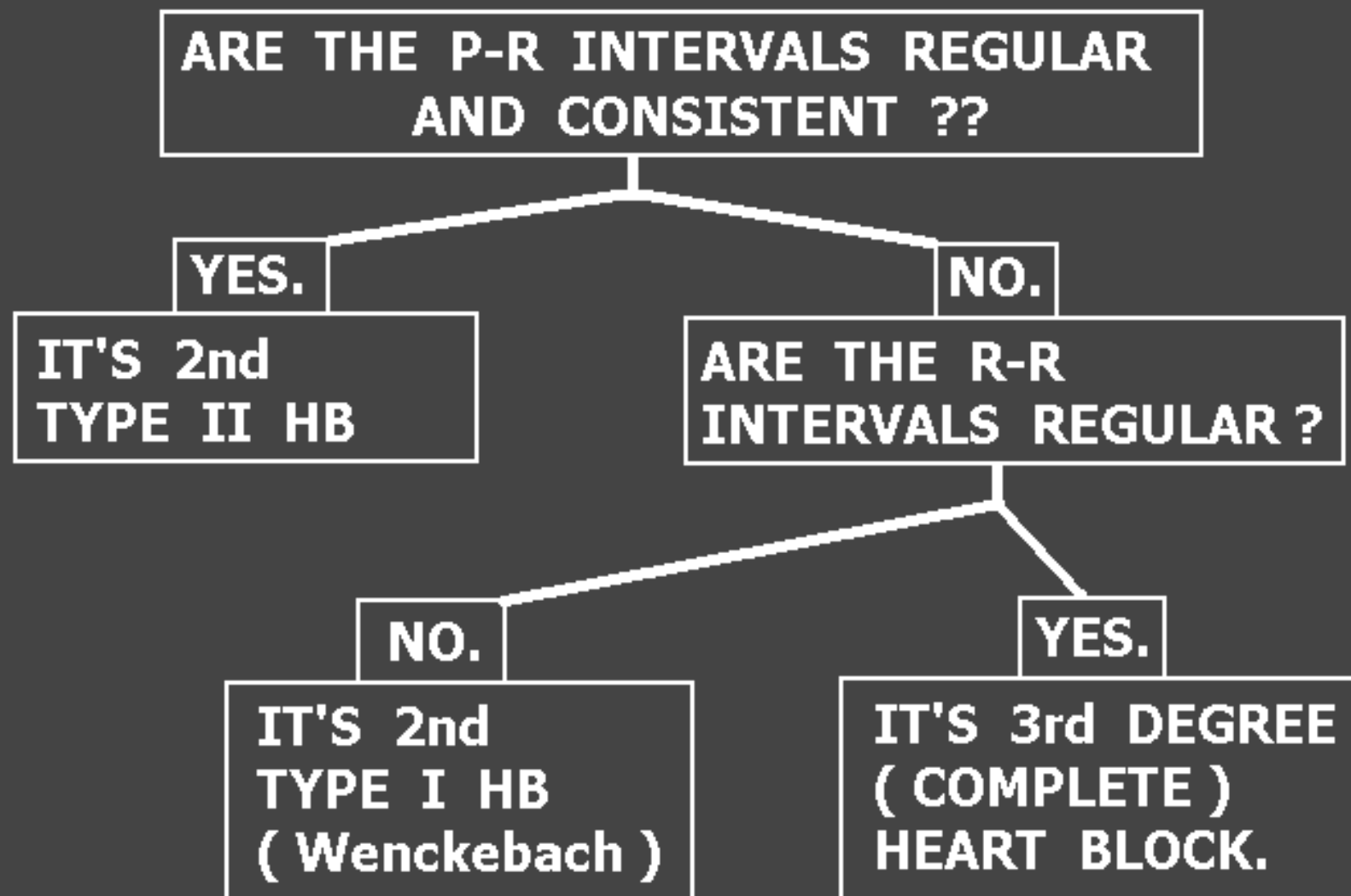
**P : QRS RATIO**  
**IF GREATER THAN 1 : 1**

**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**



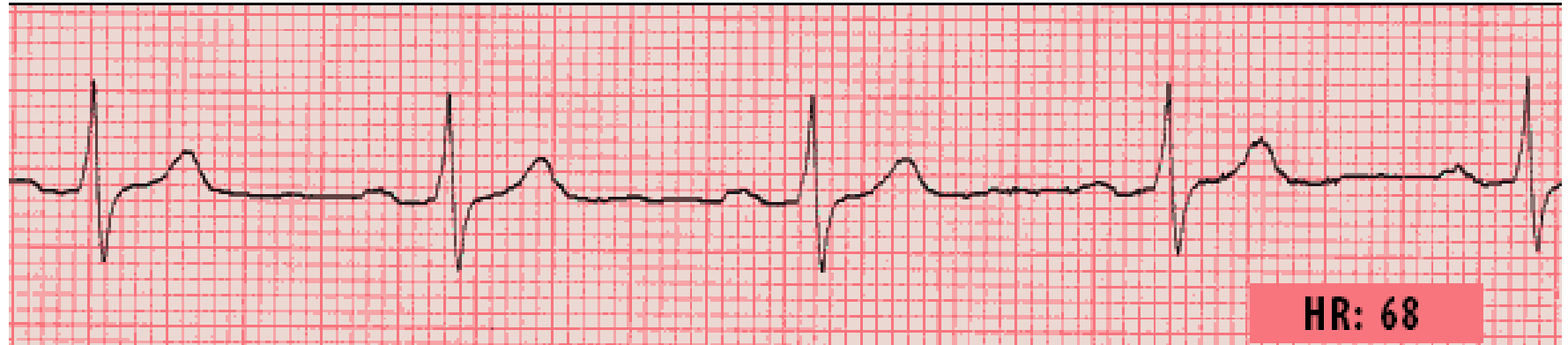


# ESTABLISH YOUR ROUTINE ECG EVALUATION . . . . .

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



# THIS RHYTHM IS: NORMAL SINUS RHYTHM



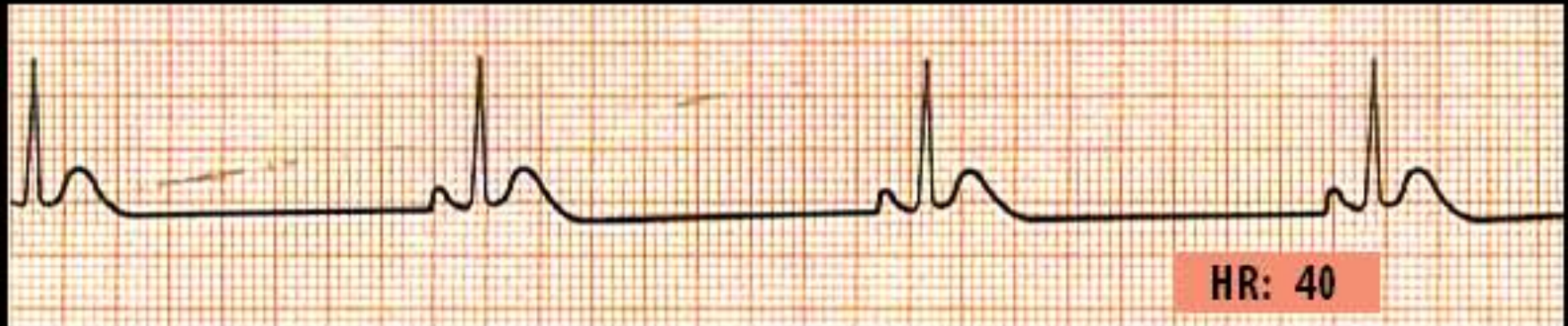
**MAIN IDENTIFICATION CHARACTERISTIC(S): PERFECTLY NORMAL IN EVERY WAY!**

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)

# SHOCK ASSESSMENT





SECONDS

SHOCK =

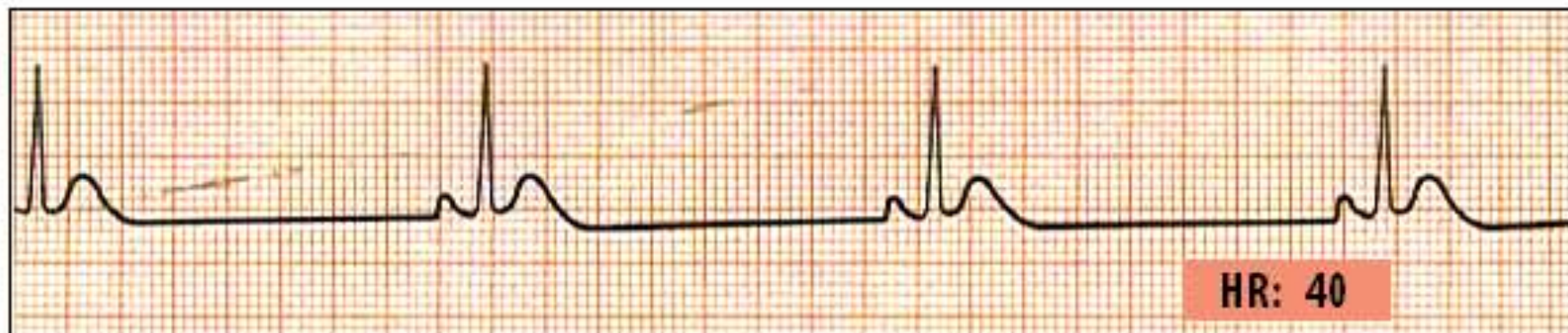
INADEQUATE TISSUE  
PERFUSION

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

# SHOCK ASSESSMENT

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

# THIS RHYTHM IS: SINUS BRADYCARDIA



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

**INCREASED VAGAL TONE** —————→  
**BLOCKED SA NODAL ARTERY** —————→  
(INFERIOR WALL MI)  
**ELECTROLYTE IMBAL. (K<sup>+</sup>)** —————→  
**HYPOTHERMIA** —————→  
**ORGANOPHOSPHATE POISONING** —————→  
**ATHLETIC METABOLISM** —————→  
(excellent health!)

## **AND TREAT THEM:**

**ATROPINE**  
**CARDIAC CATH - PTCA / STENT**  
**THROMBOLYTICS**  
**CORRECT ELECTROLYTES**  
**WARM PATIENT**  
**ATROPINE**  
**COMPLIMENT PATIENT!**



# THIS RHYTHM IS:



## MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE \_\_\_\_\_

RHYTHM \_\_\_\_\_

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

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

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

# THIS RHYTHM IS: FIRST DEGREE HEART BLOCK



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

RATE -----	NORMAL
RHYTHM -----	REGULAR
P-R INTERVAL -----	<b>&gt; 200 mSEC.</b>
P: QRS RATIO -----	1 : 1
QRS INTERVAL -----	NORMAL

# THIS RHYTHM IS: FIRST DEGREE HEART BLOCK



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

## POTENTIAL PROBLEMS:

- HR MAY BE BRADYCARDIC ( $< 60$ )
- MAY PROGRESS TO HIGHER GRADE HB ( $2^{\circ}$ ,  $3^{\circ}$ ) with SLOWER VENTRICULAR RATE

# THIS RHYTHM IS:



## MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE \_\_\_\_\_

RHYTHM \_\_\_\_\_

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

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

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



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



## STEP 1

EVALUATE P - R RELATIONSHIP

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

MORE P-WAVES THAN QRS COMPLEXES PRESENT.

ARE THE P-R INTERVALS REGULAR AND CONSISTENT ??

YES.

IT'S 2nd  
TYPE II HB

NO.

ARE THE R-R  
INTERVALS REGULAR ?

NO.

IT'S 2nd  
TYPE I HB  
( Wenckebach )

YES.

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

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



## STEP 1

EVALUATE P - R RELATIONSHIP

## STEP 2

EVALUATE R - R INTERVALS

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

MORE P-WAVES THAN QRS COMPLEXES PRESENT.

ARE THE P-R INTERVALS REGULAR AND CONSISTENT ??

YES.

IT'S 2nd  
TYPE II HB

NO.

ARE THE R-R  
INTERVALS REGULAR ?

NO.

IT'S 2nd  
TYPE I HB  
( Wenckebach )

YES.

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



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



## STEP 1

EVALUATE P - R RELATIONSHIP

## STEP 2

EVALUATE R - R INTERVALS

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

MORE P-WAVES THAN QRS COMPLEXES PRESENT.

ARE THE P-R INTERVALS REGULAR AND CONSISTENT ??

YES.

IT'S 2nd  
TYPE II HB

NO.

ARE THE R-R  
INTERVALS REGULAR ?

NO.

IT'S 2nd  
TYPE I HB  
( Wenckebach )

YES.

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

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



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

RATE -----	<b>NORMAL or BRADYCARDIC</b>
RHYTHM -----	<b>REGULARLY IRREGULAR</b>
P-R INTERVAL -----	<b>VARIES (regularly irregular)</b>
P: QRS RATIO -----	<b>VARIES (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° type II , 3° )  
with SLOWER VENTRICULAR RATE
- PT MAY BE SYMPTOMATIC (SHOCK) FROM  
↓ CARDIAC OUTPUT

# THIS RHYTHM IS:



## MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE \_\_\_\_\_

RHYTHM \_\_\_\_\_

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

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

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

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



## STEP 1

EVALUATE P - R RELATIONSHIP

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

MORE P-WAVES THAN QRS COMPLEXES PRESENT.

ARE THE P-R INTERVALS REGULAR AND CONSISTENT ??

YES.

IT'S 2nd  
TYPE II HB

NO.

ARE THE R-R  
INTERVALS REGULAR ?

NO.

IT'S 2nd  
TYPE I HB  
( Wenckebach )

YES.

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



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



## STEP 1 EVALUATE P - R RELATIONSHIP

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

ARE THE P-R INTERVALS REGULAR  
AND CONSISTENT ??

YES.

IT'S 2nd  
TYPE II HB

NO.

ARE THE R-R  
INTERVALS REGULAR ?

NO.

IT'S 2nd  
TYPE I HB  
( Wenckebach )

YES.

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

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



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

RATE	USUALLY BRADYCARDIC
RHYTHM	USUALLY REGULAR (can be irregular)
P-R INTERVAL	<b>NORMAL and CONSISTENT</b>
P: QRS RATIO	<b><math>\geq 2:1</math></b>
QRS INTERVAL	NORMAL



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



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

### POTENTIAL PROBLEMS:

- PT MAY BE SYMPTOMATIC (SHOCK) FROM ↓ CARDIAC OUTPUT
- BLOCKAGE MAY ADVANCE TO VENTRICULAR STANDSTILL (ADAMS - STOKES SYNDROME) AND CARDIAC ARREST
- MAY PROGRESS TO COMPLETE (3<sup>rd</sup> °) HEART BLOCK

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

**-Immediately check patient**

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

- 1. Heart rate LESS THAN 50 or GREATER THAN 150**
- 2. QT INTERVAL prolonged (usually not emergent but let Dr. know)**
- 3. 2<sup>nd</sup> degree type II or 3<sup>rd</sup> degree HEART BLOCK**

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



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



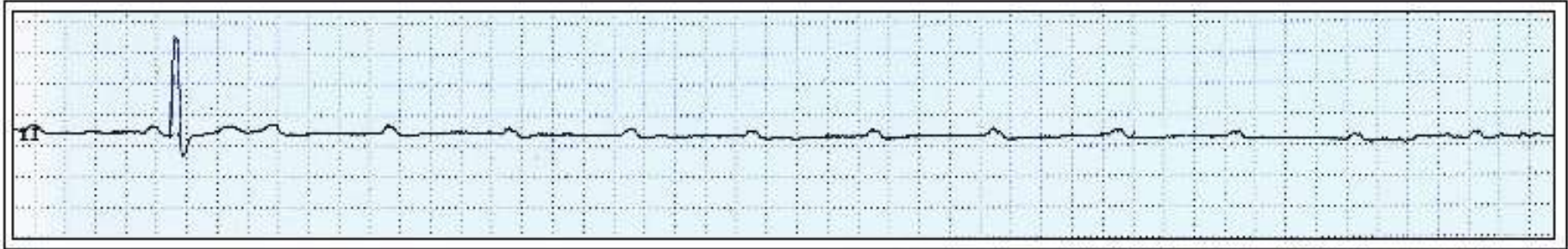
**ADAMS - STOKES SYNDROME** is essentially spontaneous **CARDIAC ARREST** -- characterized by episodes of **ASYSTOLE**, **VENTRICULAR STANDSTILL** and **V-FIB**. In this regard, 2<sup>nd</sup> ° TYPE II HB can be more dangerous than 3<sup>rd</sup> ° HB (at least 3<sup>rd</sup> ° Heart Block has an **ESCAPE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







## ADAMS - STOKES SYNDROME



### CASE HISTORY:

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

**TX: CPR, Atropine, Transvenous Pacemaker, followed by Permanent Pacemaker Implantation. Patient experienced full recovery, was discharged.**



**THIS RHYTHM IS:**



**MAIN IDENTIFICATION CHARACTERISTIC(S):**

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

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

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

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

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

# THIS RHYTHM IS:



## MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE \_\_\_\_\_

RHYTHM \_\_\_\_\_

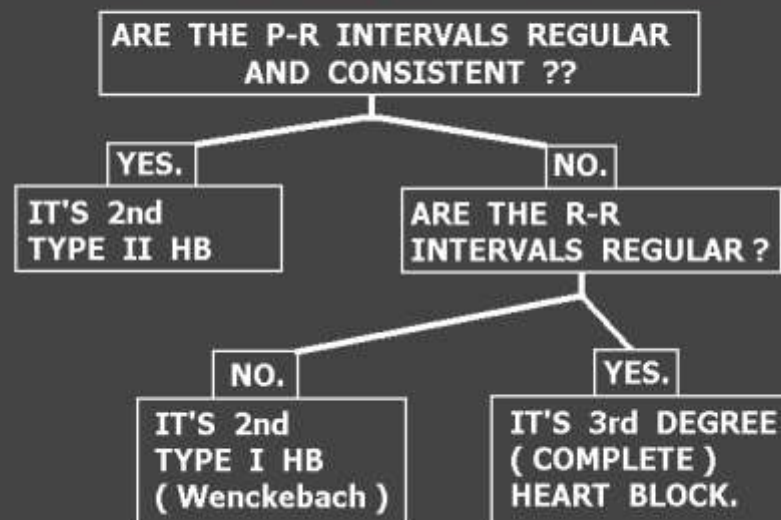
P-R INTERVAL \_\_\_\_\_

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

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

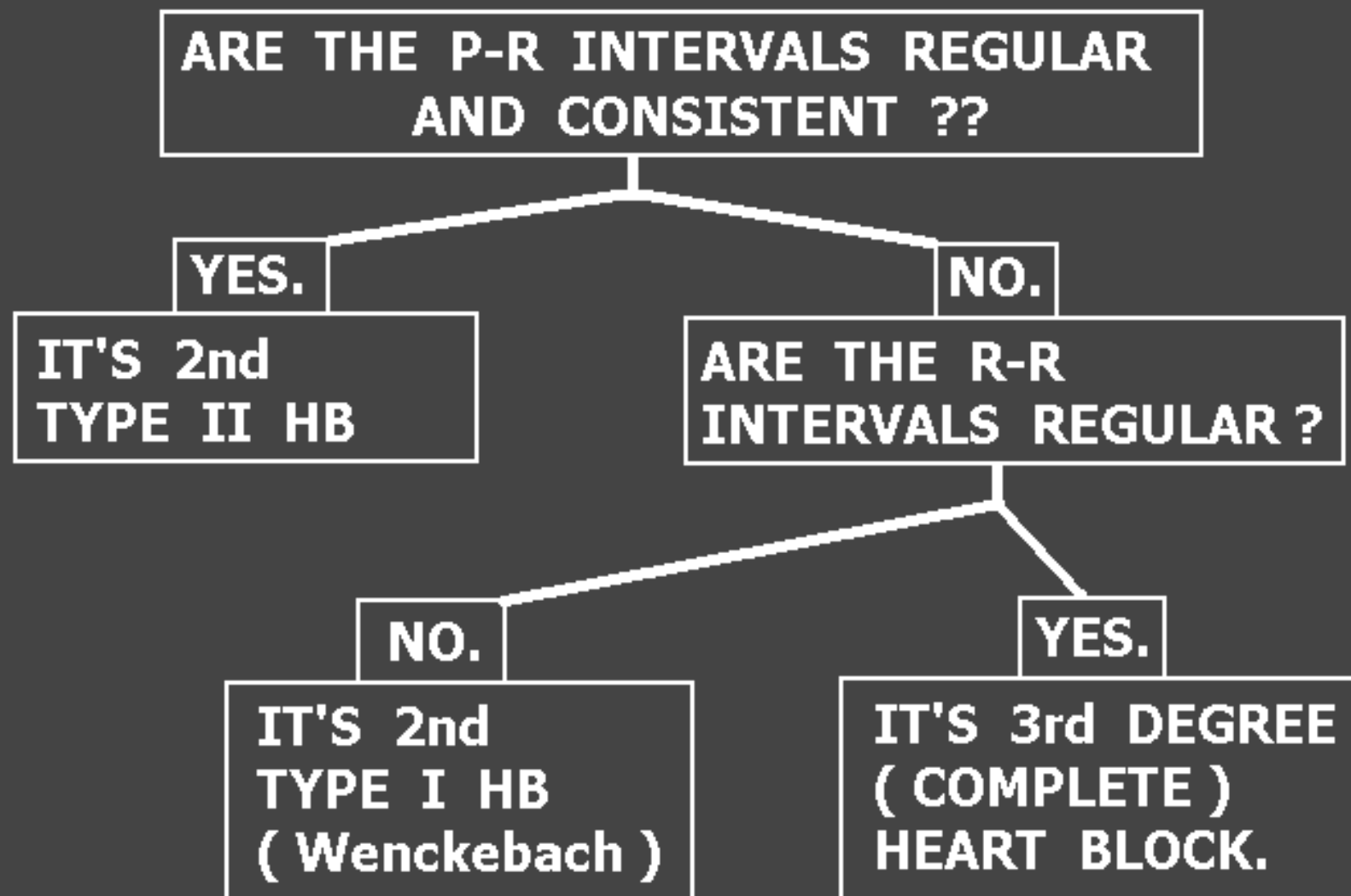
### DIAGNOSING 2nd and 3rd DEGREE HEART BLOCK

MORE P-WAVES THAN QRS COMPLEXES PRESENT.



# DIAGNOSING 2nd and 3rd DEGREE HEART BLOCK

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





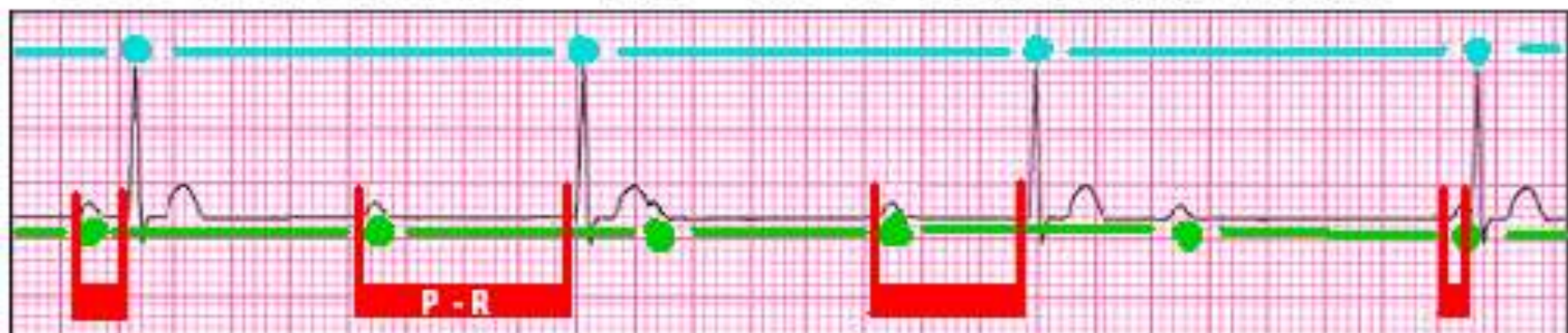
## THIS RHYTHM IS: 3rd<sup>o</sup> HB $\bar{c}$ JUNCTIONAL ESCAPE



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

**THIS RHYTHM IS: 3rd<sup>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.**

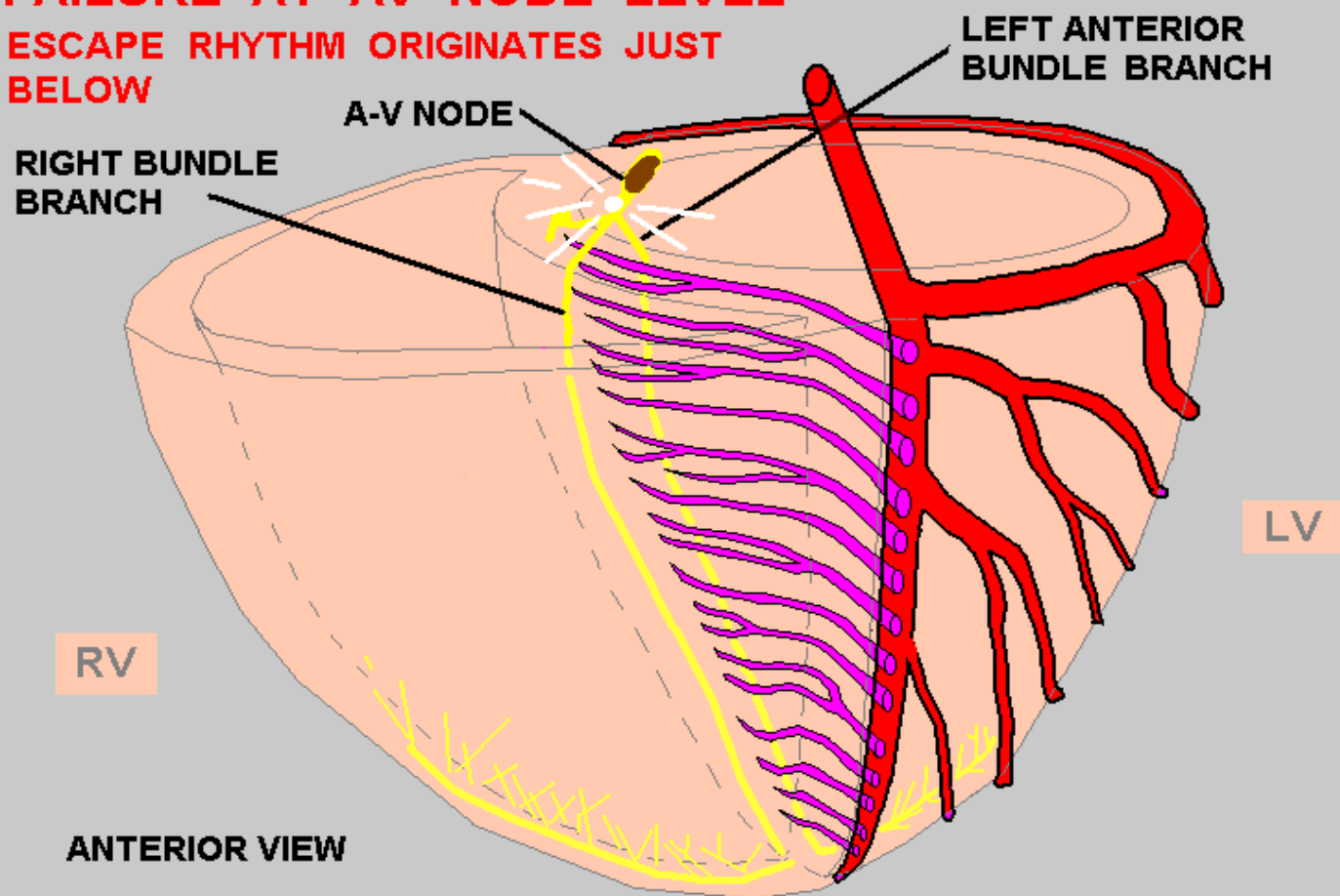
### POTENTIAL PROBLEMS:

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



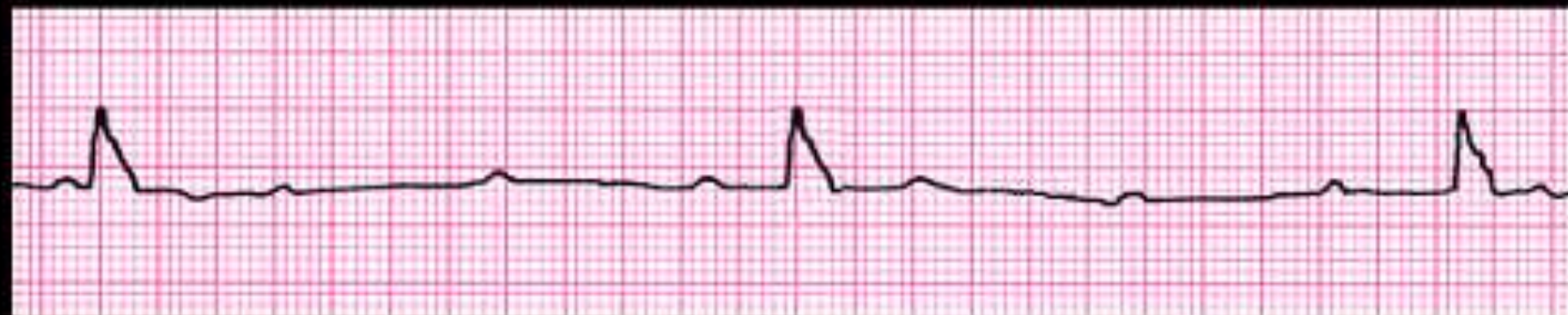


**FAILURE AT AV NODE LEVEL  
ESCAPE RHYTHM ORIGINATES JUST  
BELOW**





**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)**

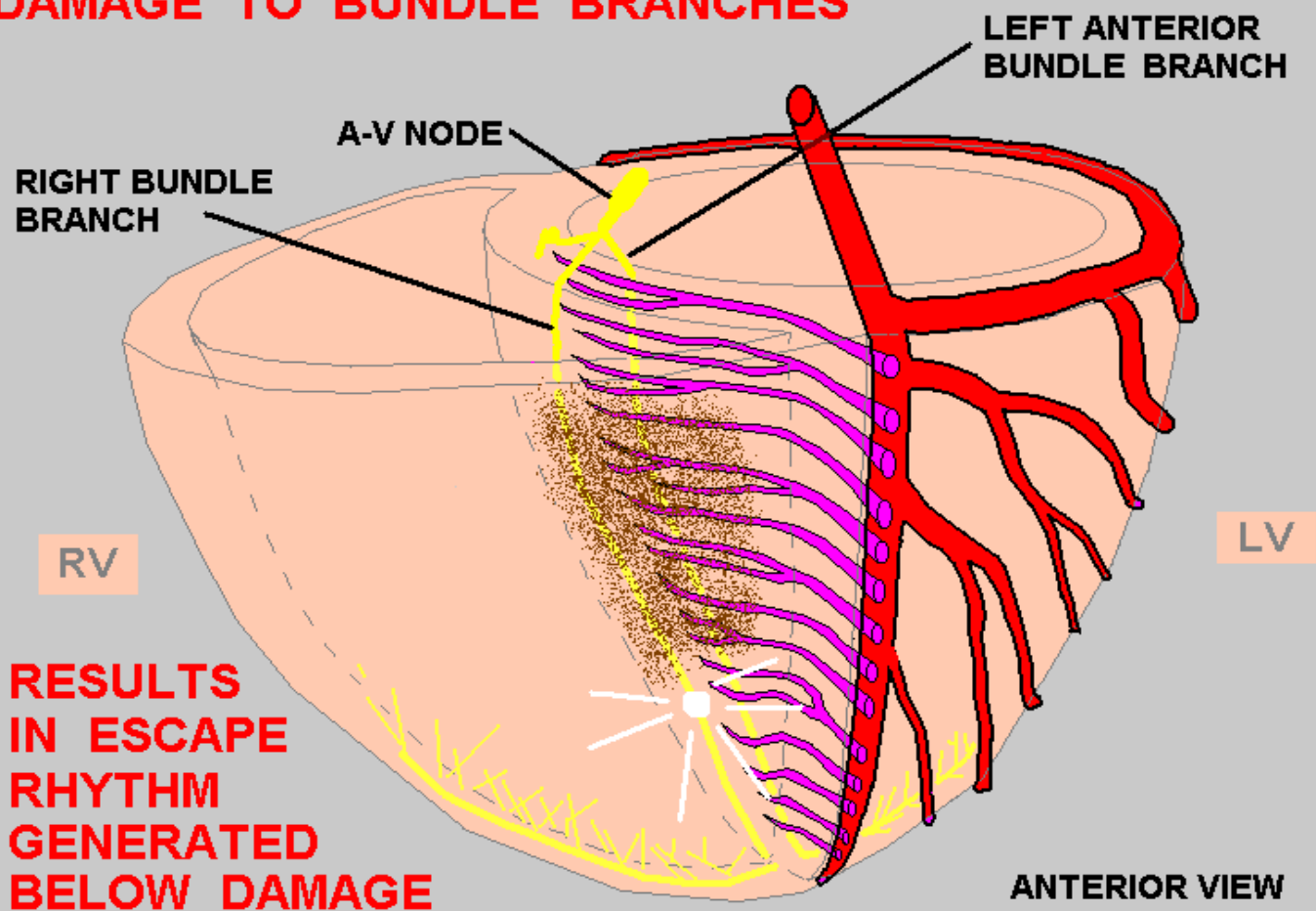
### POTENTIAL PROBLEMS:

**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

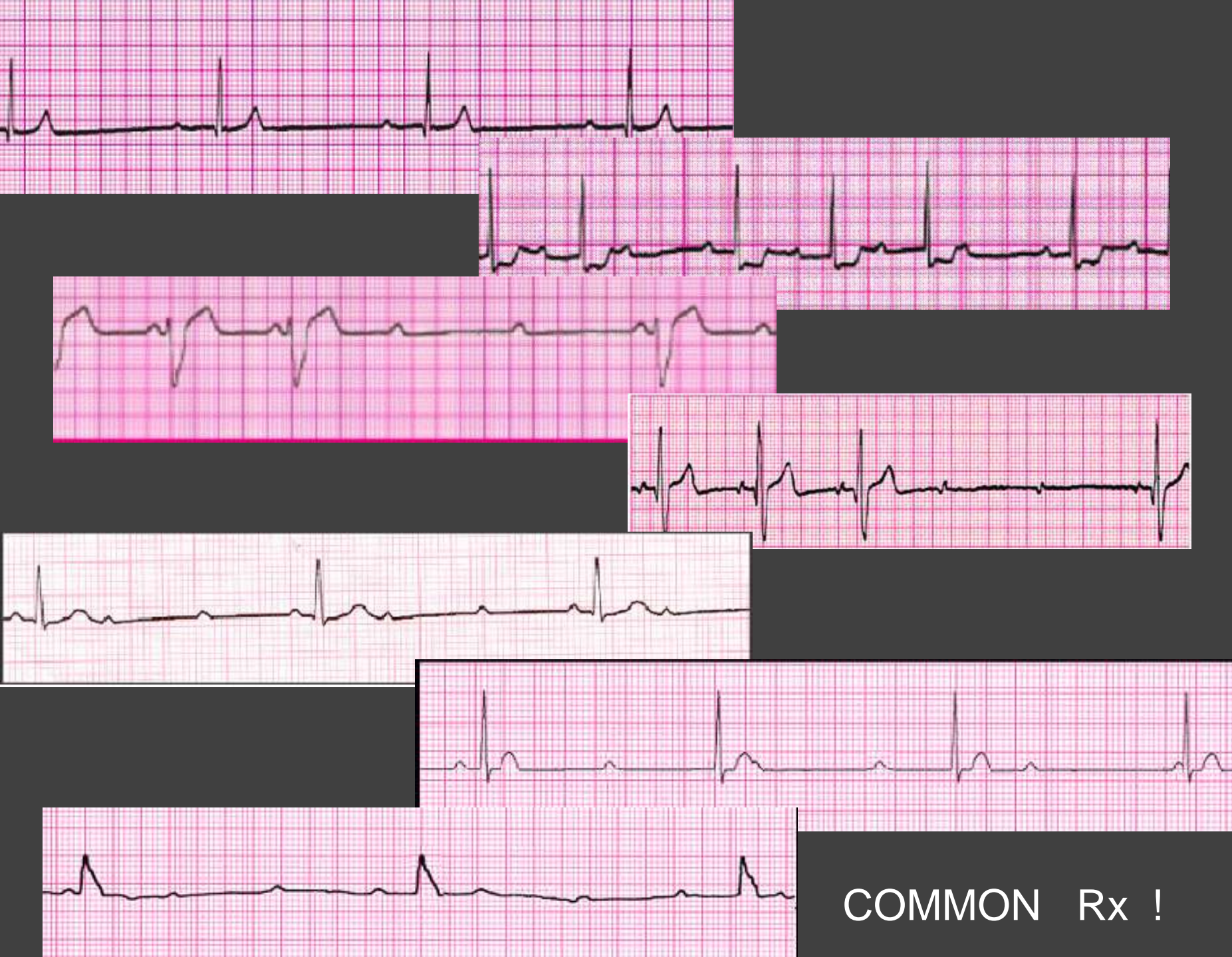
Treatment: Atropine, CPR, Pacemaker

# **-- 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**

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



# **SYMPTOMATIC BRADYCARDIA**

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

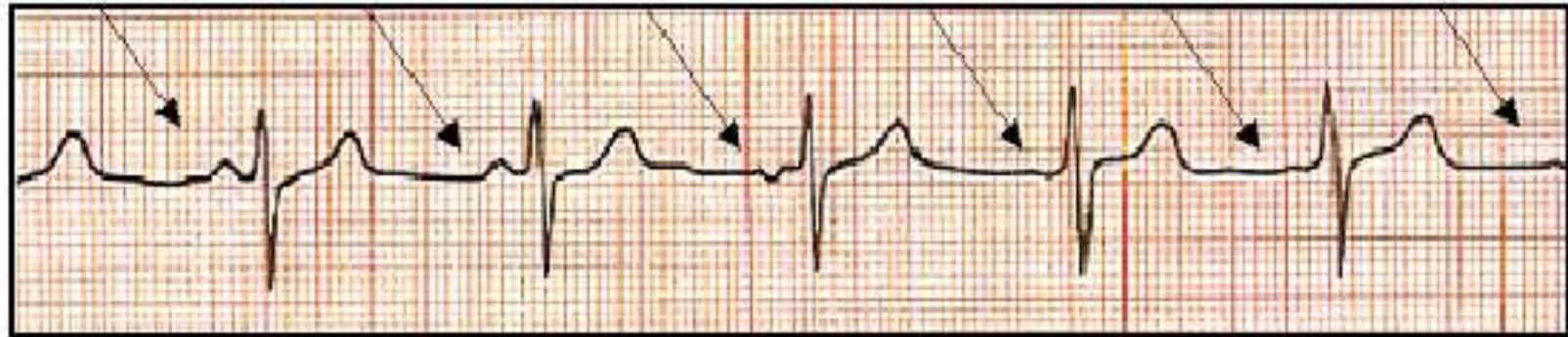
# THIS RHYTHM IS: WANDERING ATRIAL PACEMAKER



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

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

# THIS RHYTHM IS: WANDERING ATRIAL PACEMAKER



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

## POTENTIAL PROBLEM(S):

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



**THIS RHYTHM IS:**



**MAIN IDENTIFICATION CHARACTERISTIC(S):**

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

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

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

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

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

# THIS RHYTHM IS: ATRIAL FIBRILLATION



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

RATE	-----	BRADY, NORMAL, or TACHY
RHYTHM	-----	<b>IRREGULARLY IRREGULAR</b>
P-R INTERVAL	-----	<b>NOT DISCERNABLE</b>
P: QRS RATIO	-----	<b>NOT DISCERNABLE</b>
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**

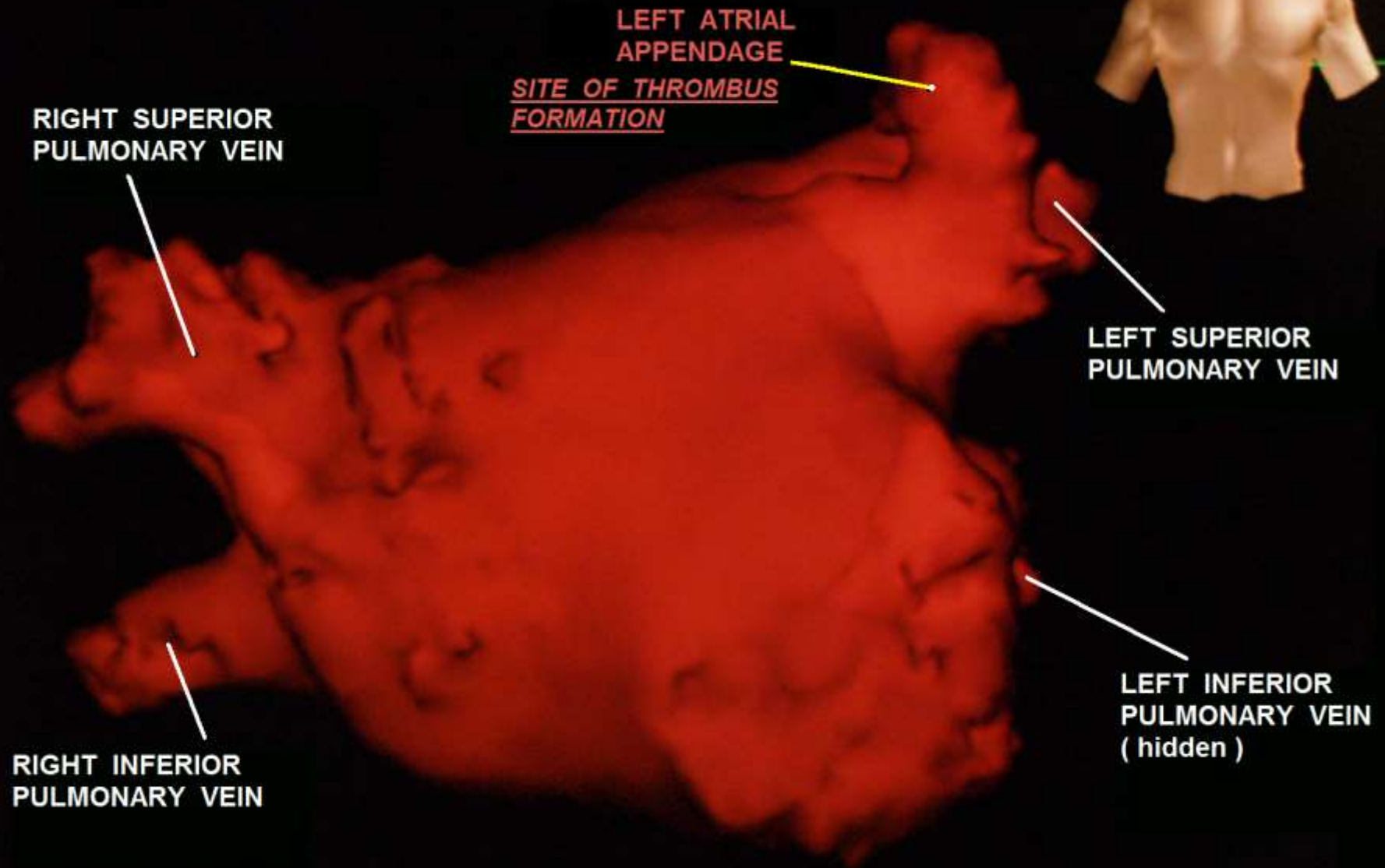
**-Notify next “higher up” in chain of command**

- 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**



# LEFT ATRIUM

ANTERIOR VIEW



# LEFT ATRIUM

LAO VIEW

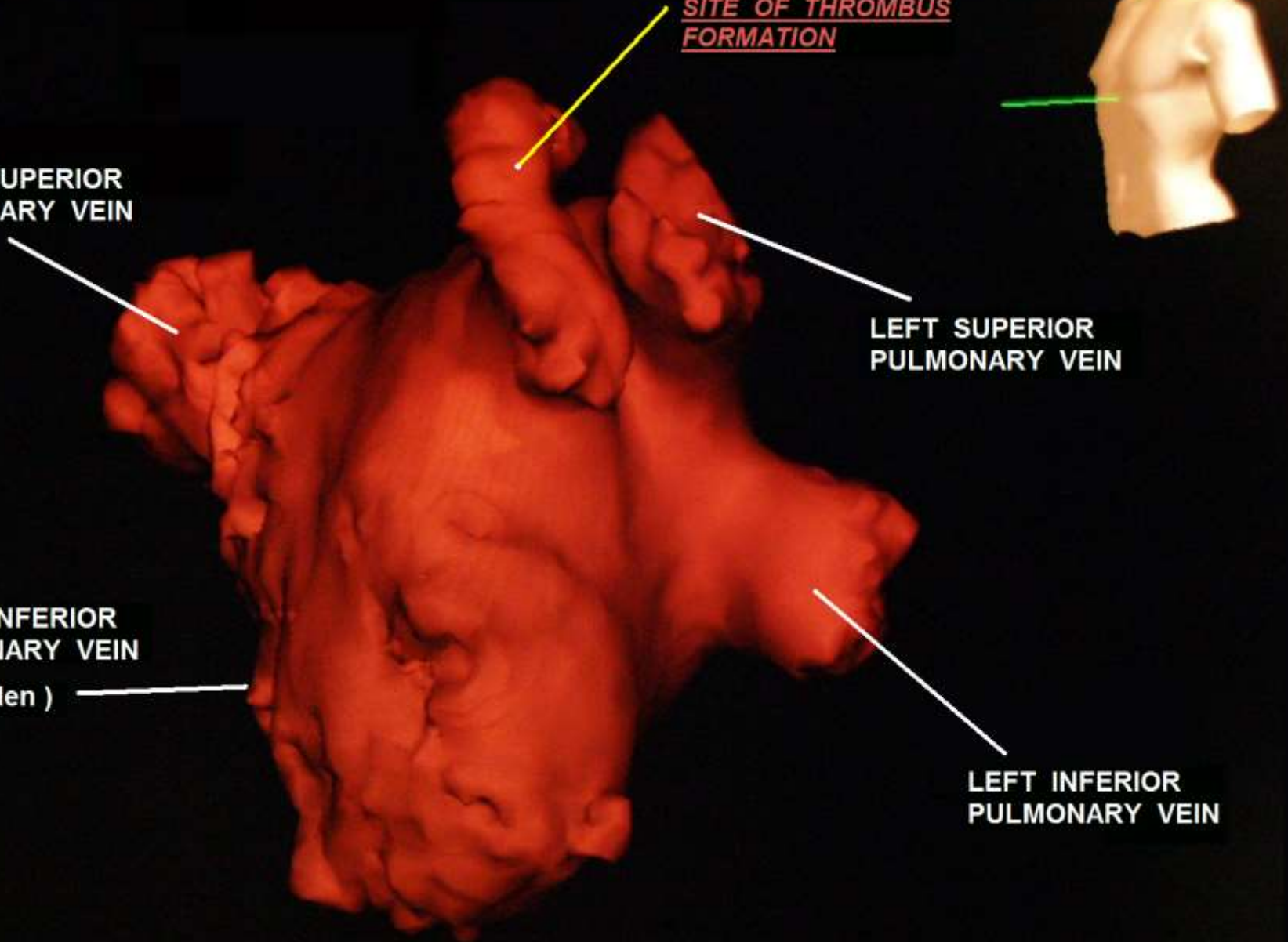
LEFT ATRIAL  
APPENDAGE  
SITE OF THROMBUS  
FORMATION

RIGHT SUPERIOR  
PULMONARY VEIN

LEFT SUPERIOR  
PULMONARY VEIN

RIGHT INFERIOR  
PULMONARY VEIN  
( hidden )

LEFT INFERIOR  
PULMONARY VEIN





# THIS RHYTHM IS:



MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE \_\_\_\_\_

RHYTHM \_\_\_\_\_

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

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

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

# THIS RHYTHM IS: ATRIAL FLUTTER



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

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

# THIS RHYTHM IS: ATRIAL FLUTTER



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

## POTENTIAL PROBLEM(S):

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

## TREATMENT / INTERVENTIONS:

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



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

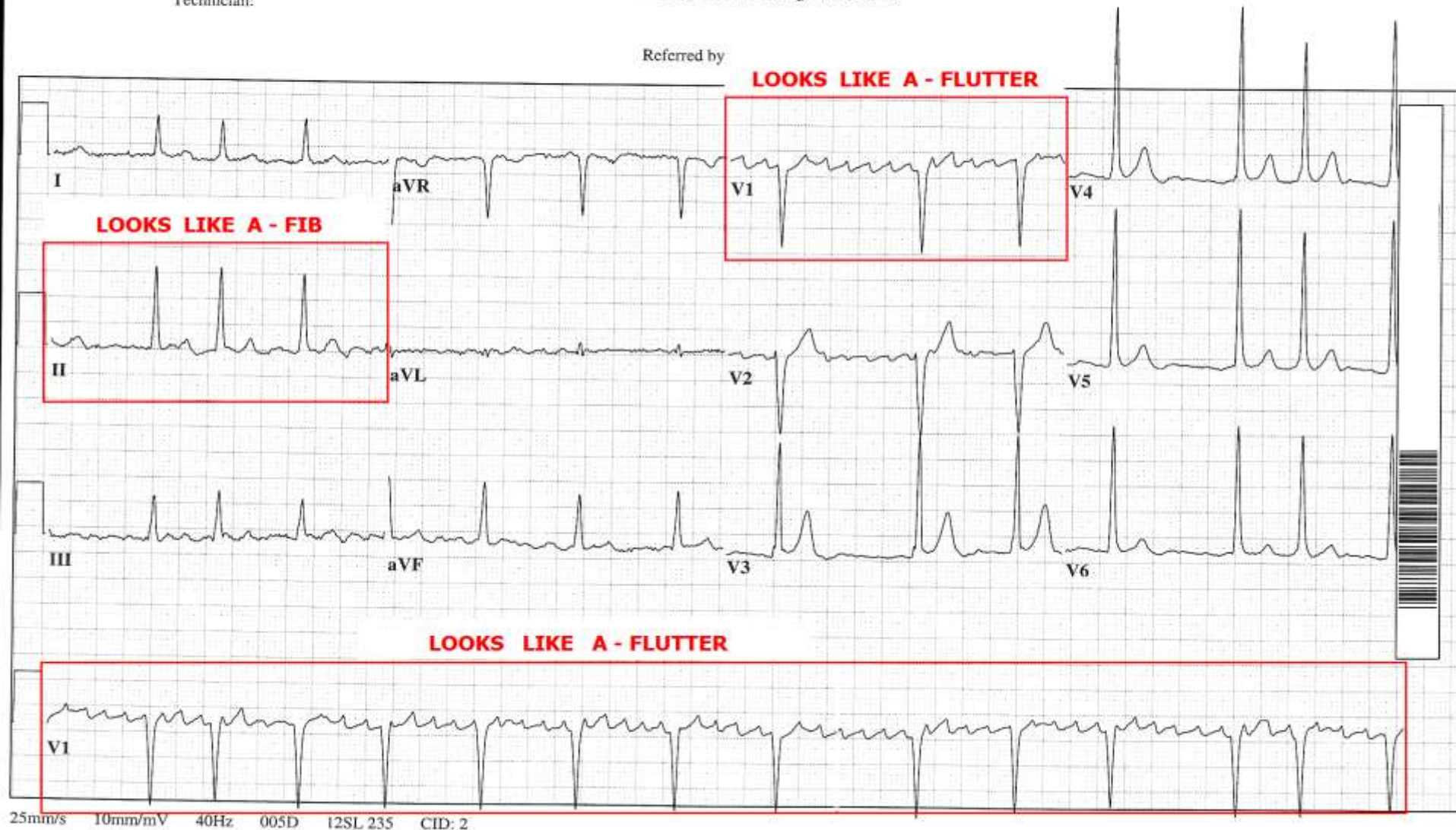
Technician:

Referred by

**LOOKS LIKE A - FLUTTER**

**LOOKS LIKE A - FIB**

**LOOKS LIKE A - FLUTTER**

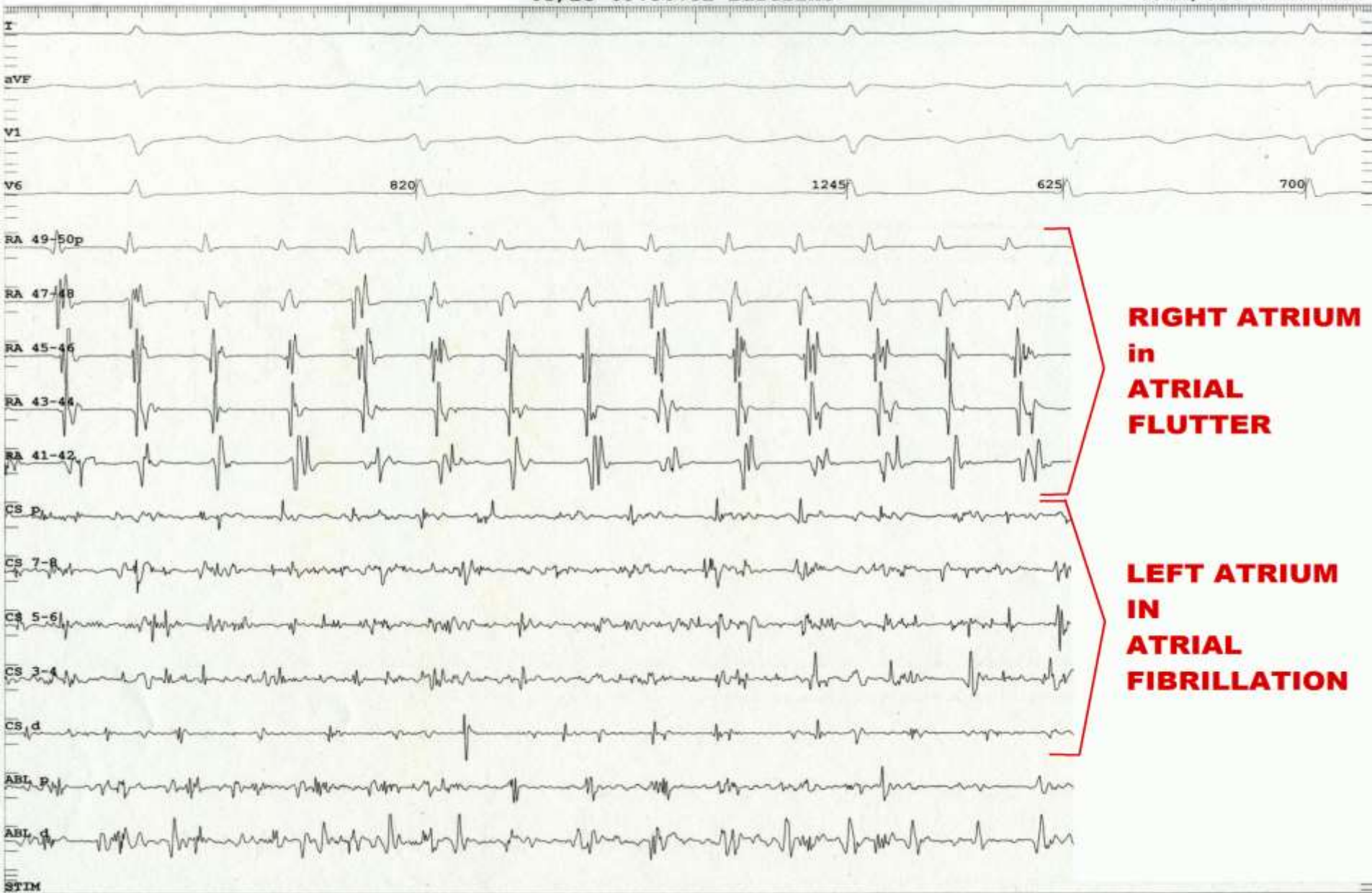


44 y/o FEMALE

# "ATRIAL FIB - FLUTTER"

03/28 09:30:52 Baseline

63mm/sec 0.400 mV



**RIGHT ATRIUM  
in  
ATRIAL  
FLUTTER**

**LEFT ATRIUM  
IN  
ATRIAL  
FIBRILLATION**





55 y/o Male c/o “palpitations,”  
No previous cardiac history

APR-2004

ST. JOSEPH'S HOSPITAL

55 yr  
Male Caucasian

Vent. rate	178	BPM
PR interval	*	ms
QRS duration	90	ms
QT/QTc	264/454	ms
P-R-T axes	* -19	46

**\*\*UNEDITED COPY - REPORT IS COMPUTER GENERATED ONLY, WITHOUT  
PHYSICIAN INTERPRETATION****Atrial fibrillation with rapid ventricular response**

with premature ventricular or aberrantly conducted complexes

Nonspecific ST abnormality , probably digitalis effect

Abnormal ECG

When compared with ECG of 30-JUL-1998 15:14,

Atrial fibrillation has replaced Sinus rhythm

Vent. rate has increased BY 109 BPM ...

Loc:3 Option:23

Technician:

Referred by:

Confirmed By: UNEDITED DR.



## **ATRIAL FIBRILLATION**

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

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



**YES**

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



**NO**



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



# **ATRIAL FIBRILLATION**

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

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



**YES**

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



**NO**

In the REAL  
world, thrombus  
has been noted in  
as little as  
6 hours !



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

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

## **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 "

# 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 "

37 yr  
Male Caucasian  
Room:OP  
Loc:8 Option:16

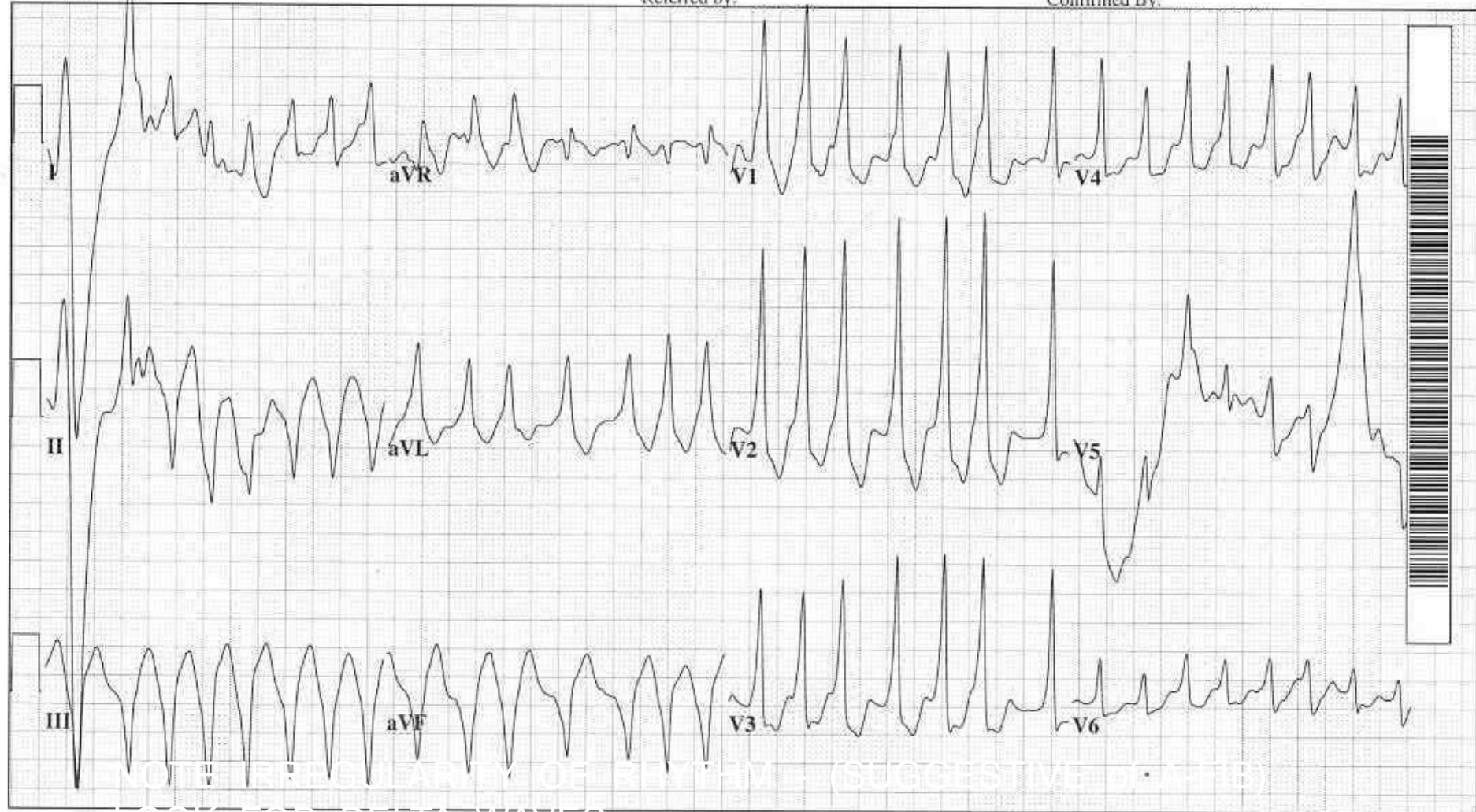
Vent. rate 180 BPM  
PR interval \* ms  
QRS duration 148 ms  
QT/QTc 284/491 ms  
P-R-T axes \* -77 103

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

Med: Unknown

Referred by:

Confirmed By:



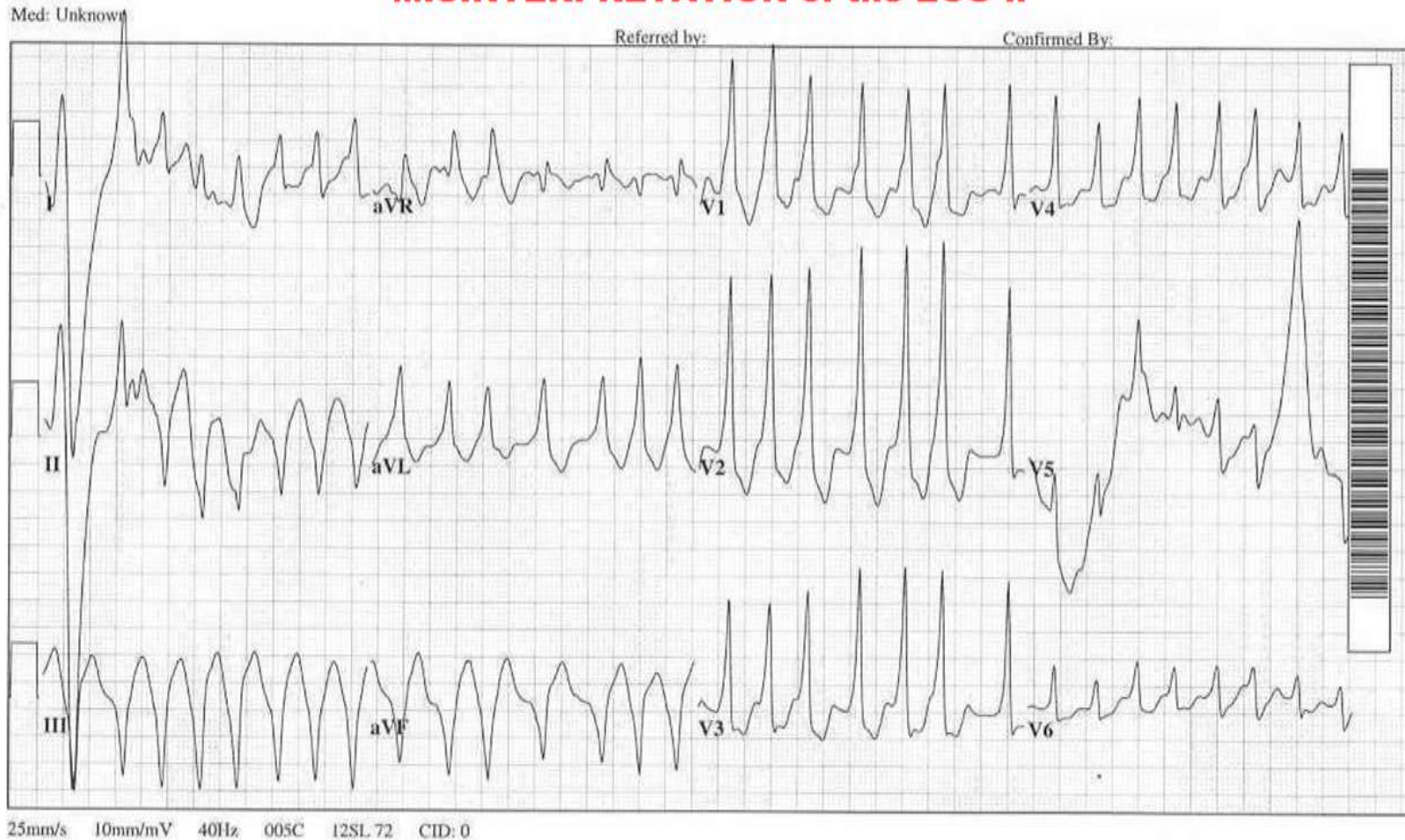


37 yr  
Male Caucasian  
Room: OP  
Loc: 8 Option: 16

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

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

**Do NOT be misled by the COMPUTER's MISINTERPRETATION of the ECG !!**



- NOTE IRREGULARITY OF RHYTHM - (SUGGESTIVE of A-FIB)
- WIDE QRS – Consider Bypass Tract (W-P-W)
- DELTA WAVES ? (may or may not be visible).

# CHARACTERISTICS of W-P-W with Afib & RVR:

- **WIDE COMPLEX TACHYCARDIA**
- **IRREGULARLY IRREGULAR R – R INTERVALS !!**

## NOTE:

**Delta Waves  
may not be  
discernable !**



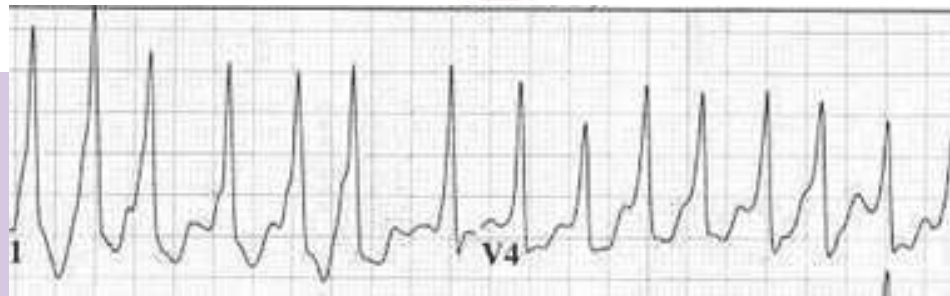
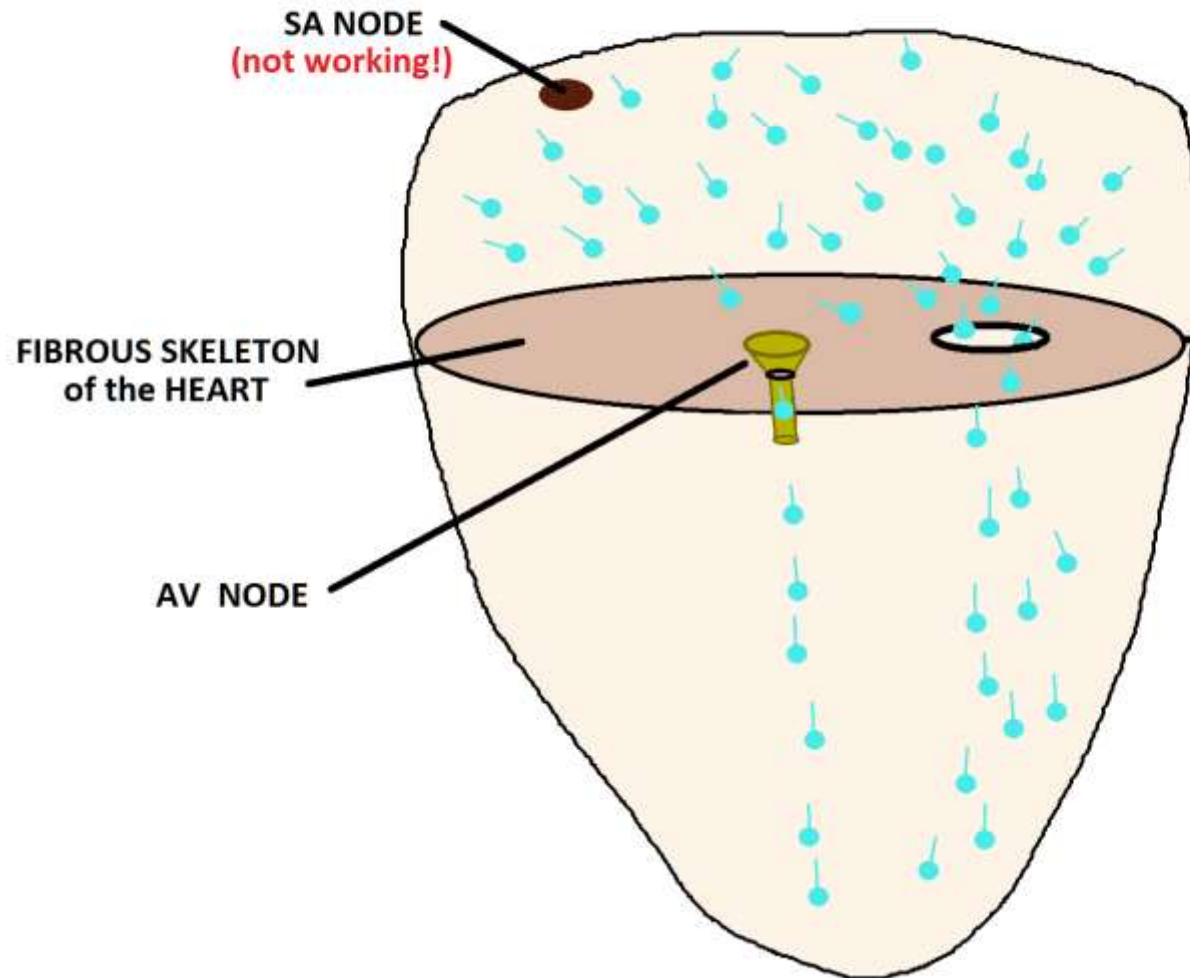


# Wolff-Parkinson-White + A-fib

**Wolff-Parkinson-White + A-fib = *DISASTER***

***NO AV NODAL BLOCKERS***  
***(e.g. ADENOSINE, CALCIUM***  
***CHANNEL BLOCKERS)***  
***FOR WIDE COMPLEX***  
***TACHYCARDIAS THAT COULD***  
***BE ATRIAL FIBRILLATION with***  
***Pre-Excitation (W-P-W)***

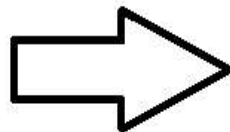
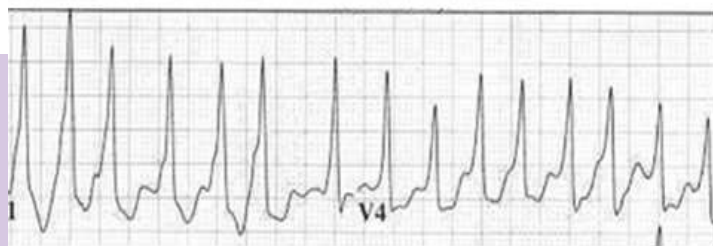
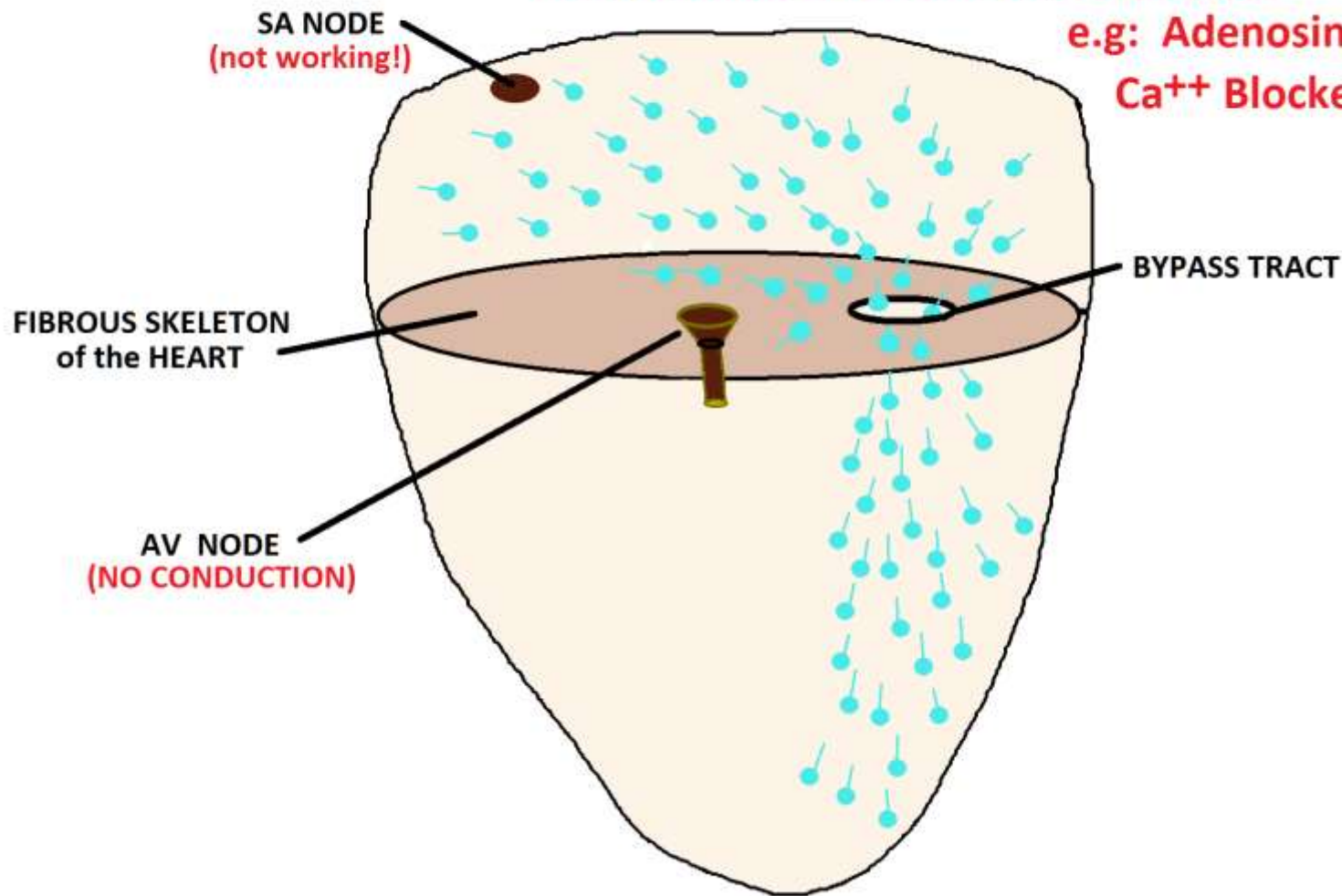
# Atrial Fibrillation with Wolff-Parkinson White



# Atrial Fibrillation with Wolff-Parkinson White

with AV NODAL BLOCKING AGENTS

e.g: Adenosine,  
Ca<sup>++</sup> Blockers





# WIDE COMPLEX TACHYCARDIA

(QRS > 120 ms)

MONOPHASIC

ABCs

NO PULSE

GO TO  
V-FIB  
ALGORITHM !

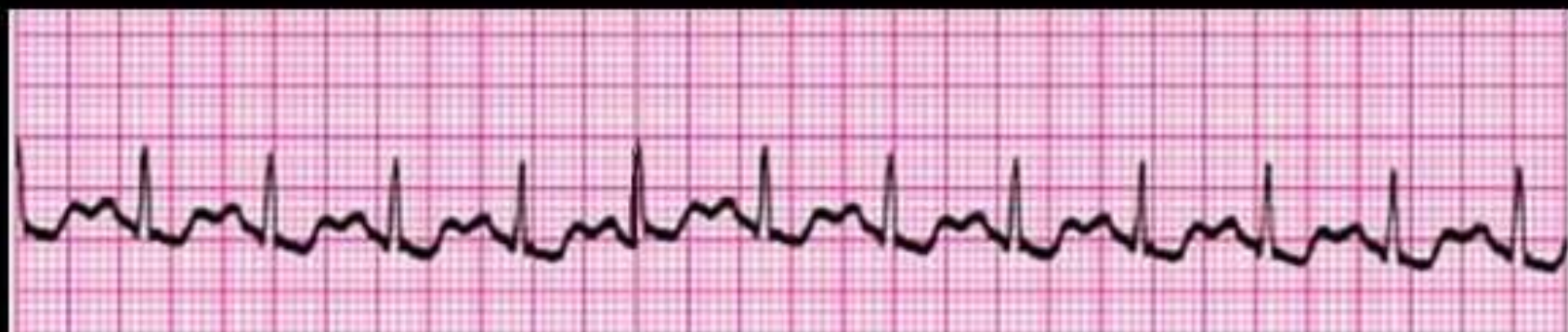
PULSE - UNSTABLE

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

PULSE - STABLE

- O2, IV-IO, EKG
- MEDS:
  - ~~• ADENOSINE 6-12 (6 mg BIVULAR)~~
  - PROCAINAMIDE (20-50mg/min)
  - ~~• AMIODARONE (150 mg)~~
  - ILBUTILIDE

**THIS RHYTHM IS:**



**MAIN IDENTIFICATION CHARACTERISTIC(S):**

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

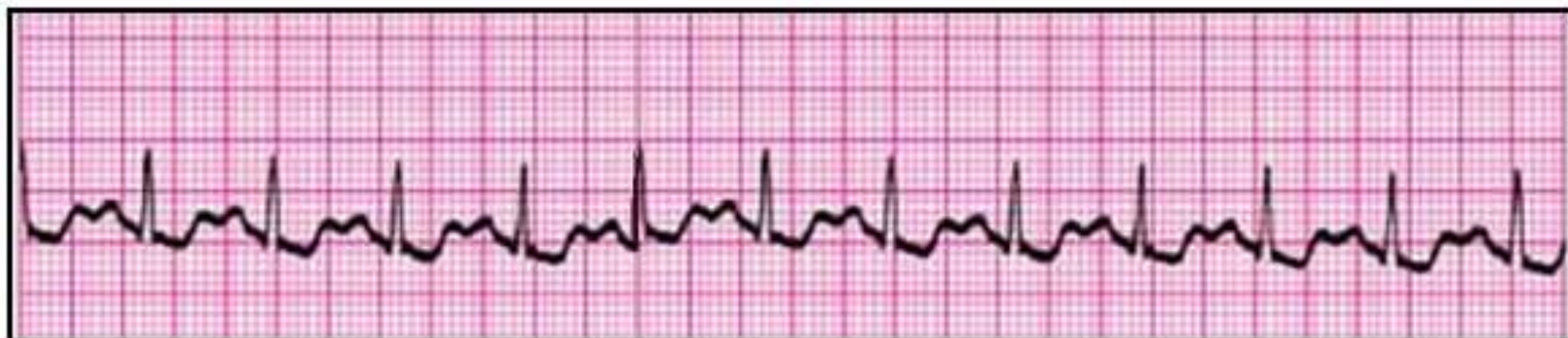
**RHYTHM** \_\_\_\_\_

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

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

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

# THIS RHYTHM IS: SINUS TACHYCARDIA



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

RATE ----- **100 - 150 ( can be > 150 )**

RHYTHM ----- **REGULAR**

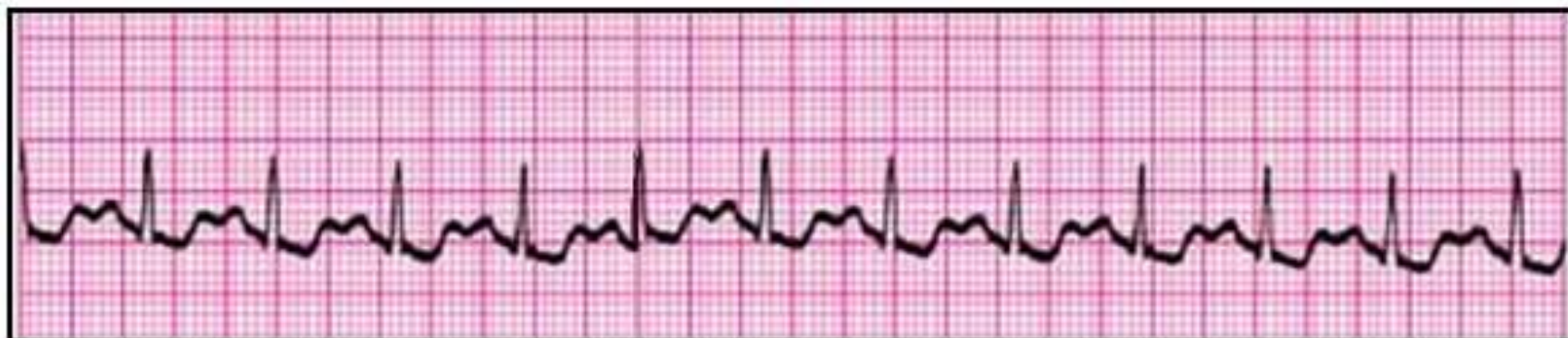
P-R INTERVAL ----- **NORMAL ( 120 - 200 ms )**

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

QRS INTERVAL ----- **NORMAL ( < 120 ms ), ( unless Bundle Branch Block present )**



## THIS RHYTHM IS: SINUS TACHYCARDIA



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

### POTENTIAL PROBLEMS :

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

# THIS RHYTHM IS: SINUS TACHYCARDIA



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

## TREATMENT / INTERVENTIONS :



**IN MOST CASES, YOU TREAT THE UNDERLYING CAUSE!**



# THIS RHYTHM IS: SINUS TACHYCARDIA



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

**ANXIETY / FEAR**  
**HYPOVOLEMIA**

**DEHYDRATION**

**BLOOD LOSS**

**MEDICATION EFFECTS**

**OTHER ILLNESS**

## **AND TREAT THEM:**

**CALM PATIENT**

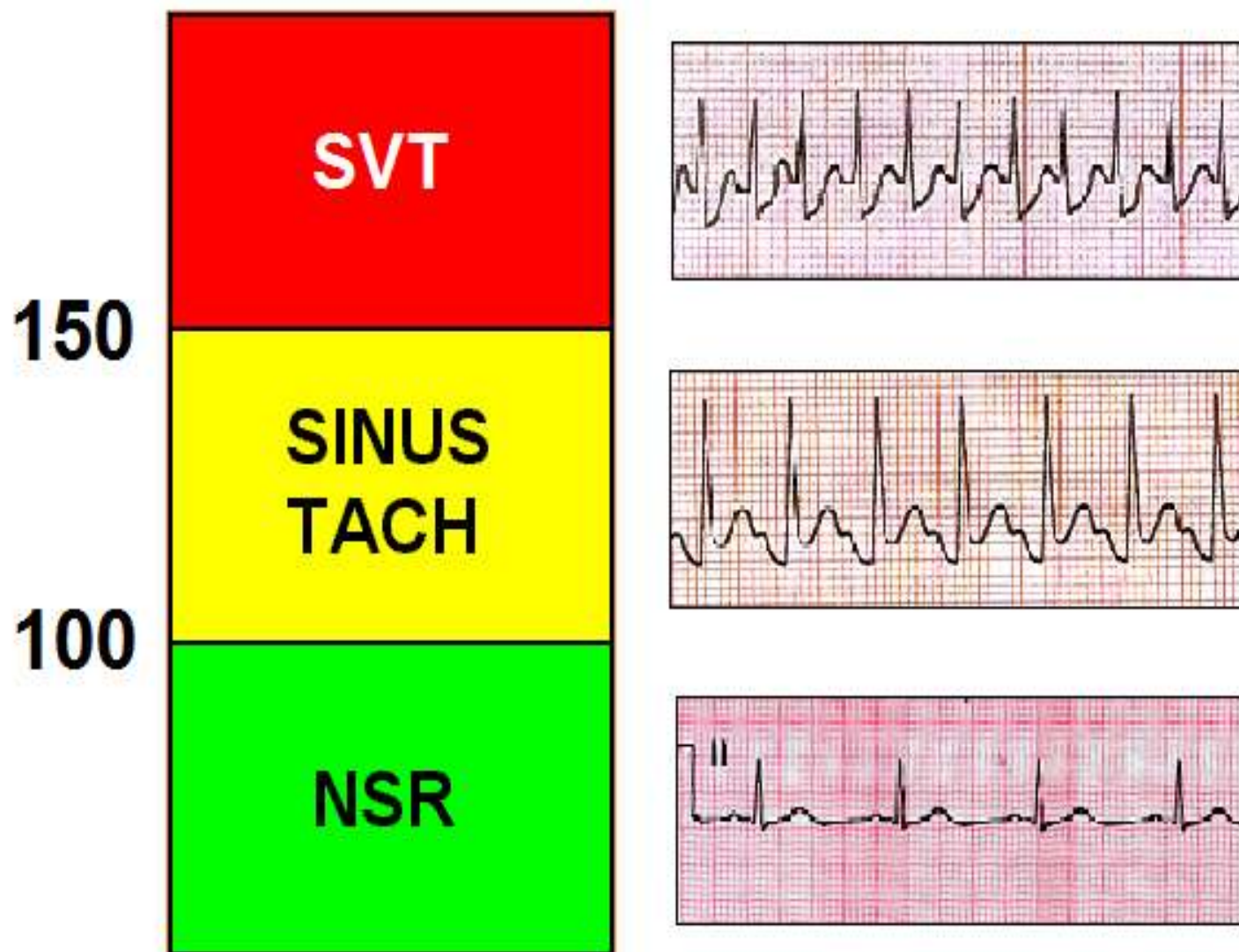
**FLUIDS**

**STOP BLEEDING**

**CONSIDER MEDICAL Tx**

**IDENTIFY & Tx DISORDER**

# ACLS TACHYCARDIA GUIDELINES





## RHYTHM CLUES . . . .



**SUPRAVENTRICULAR TACHYCARDIA**

**SVT is usually PAROXSYMAL -- ie: has a SUDDEN ONSET.**

**SINUS TACHYCARDIA usually has a "ramp - up " and "ramp - down " period -- a gradual change in HEART RATE.**

# THIS RHYTHM IS:



## MAIN IDENTIFICATION CHARACTERISTIC(S):

RATE \_\_\_\_\_

RHYTHM \_\_\_\_\_

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

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

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



# THIS RHYTHM IS: SUPRAVENTRICULAR TACHYCARDIA (SVT)



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

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



# THIS RHYTHM IS: SUPRAVENTRICULAR TACHYCARDIA (SVT)



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

## POTENTIAL PROBLEMS:

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

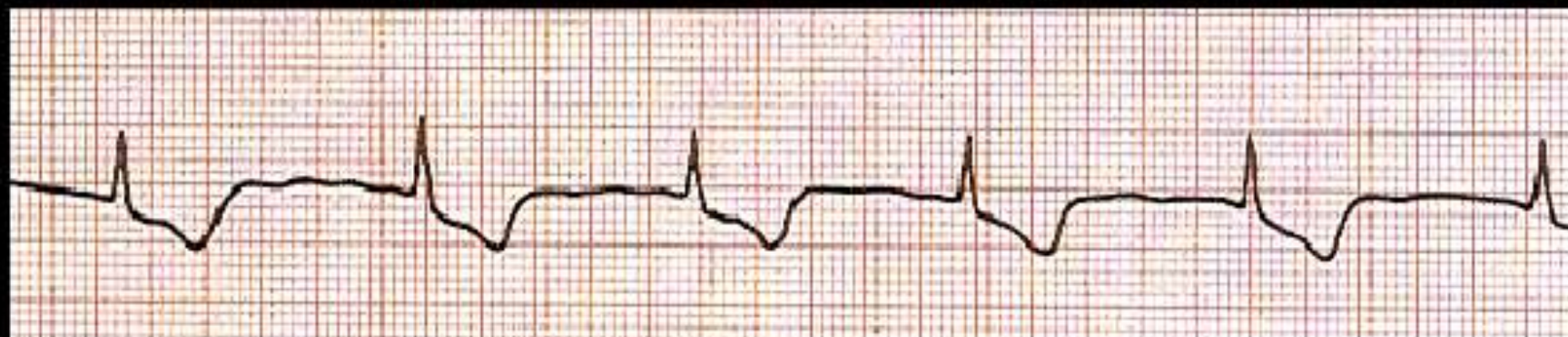
- VAGAL MANEUVERS
- ADENOSINE 6 mg / 12 mg

### **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 \_\_\_\_\_

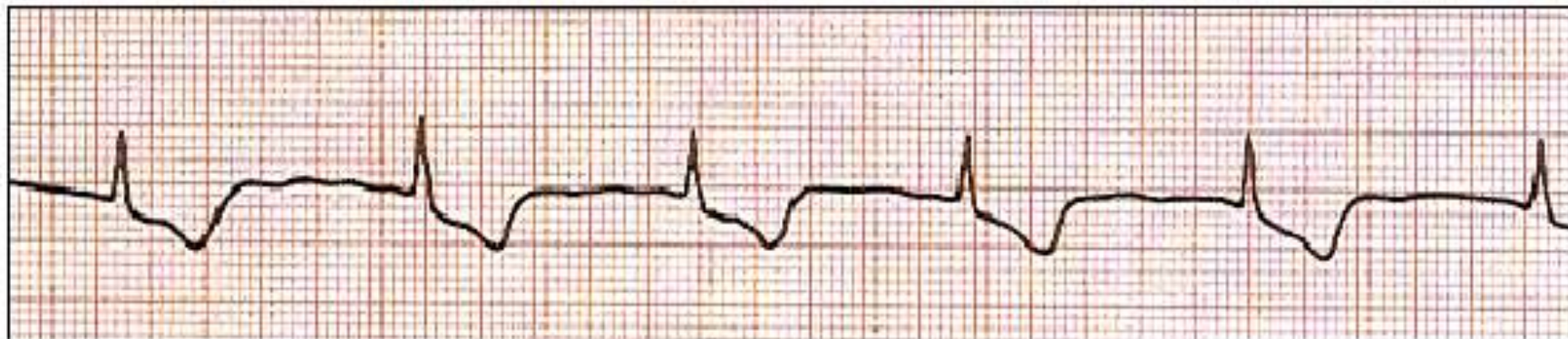
P-R INTERVAL \_\_\_\_\_

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

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



# THIS RHYTHM IS: JUNCTIONAL RHYTHM



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

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

**RATE ————— 40 -60**

**RHYTHM ————— REGULAR**

**P-R INTERVAL ——— ABSENT or SHORT**

**P: QRS RATIO ——— 1:1**

**QRS INTERVAL ——— NORMAL**

**- HR USUALLY 40 -60**

# THIS RHYTHM IS: JUNCTIONAL RHYTHM

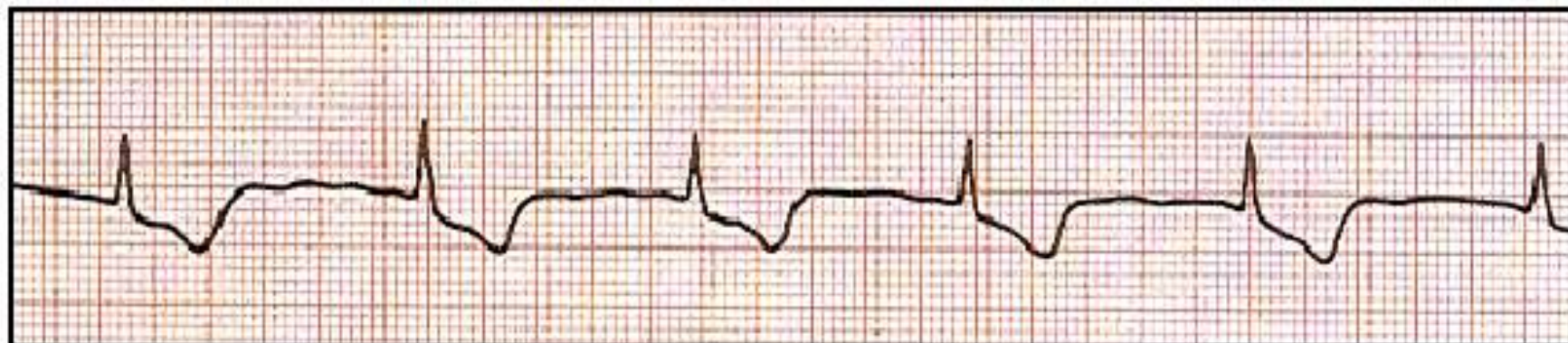


MAIN IDENTIFICATION CHARACTERISTIC(S): **P WAVES ABSENT, or LOCATED JUST AFTER QRS (in S-T seg) or JUST BEFORE QRS (short P-R).** WHEN P wave seen, it is **INVERTED (upside-down).**  
- HR USUALLY 40 - 60





# THIS RHYTHM IS: JUNCTIONAL RHYTHM



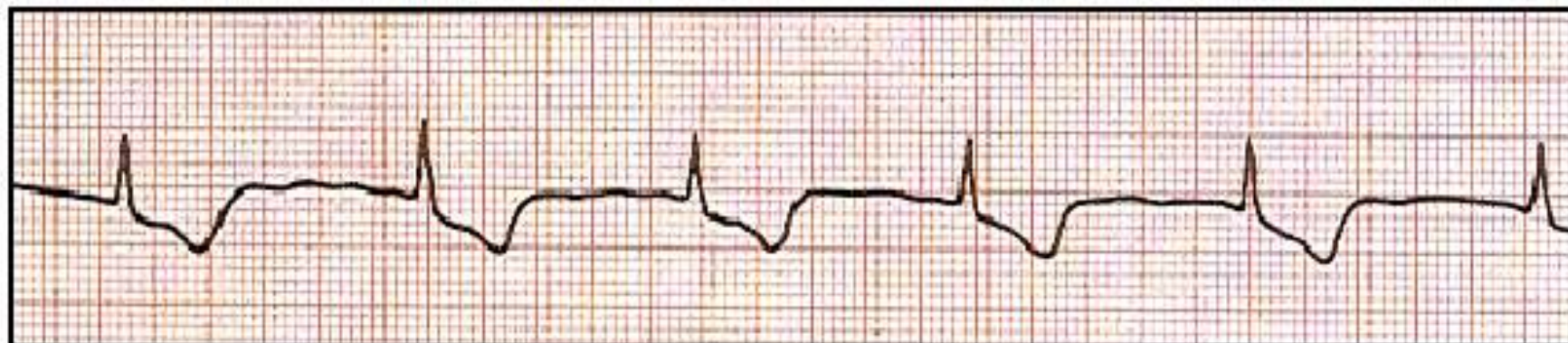
MAIN IDENTIFICATION CHARACTERISTIC(S): **P WAVES ABSENT, or LOCATED JUST AFTER QRS (in S-Tseg) or JUST BEFORE QRS (short P-R). WHEN P wave seen, it is INVERTED (upside-down).**  
- HR USUALLY 40 - 60

## 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 **FAST** . . . .

## WE MUST CONSIDER UNDERLYING CAUSES:

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

## AND TREAT THEM:

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



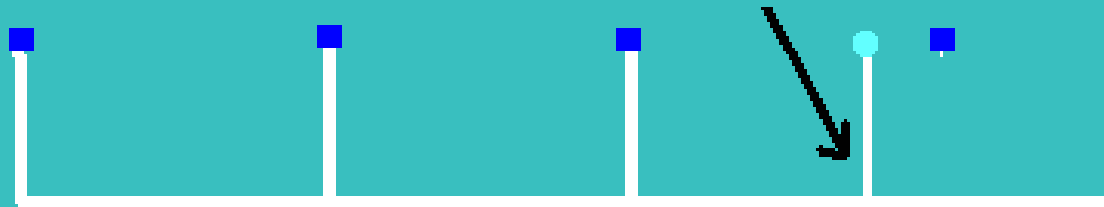
# ECTOPY

- ATRIAL
- JUNCTIONAL
- VENTRICULAR

# CLASSIFICATIONS OF ECTOPY

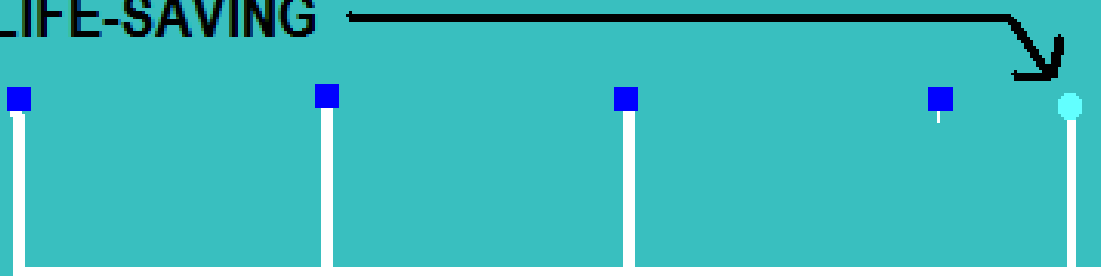
## 1. PREMATURE

THE ECTOPIC BEAT COMES BEFORE THE NEXT REGULARLY EXPECTED BEAT (IT'S EARLY!)



## 2. END-DIASTOLIC, ESCAPE, or COMPENSATORY

THE ECTOPIC BEAT COMES AFTER A REGULAR BEAT FAILS TO HAPPEN. END-DIASTOLIC BEATS MAY BE LIFE-SAVING




# CAUSES OF ECTOPY

---

## 1. PREMATURE

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

## 2. END-DIASTOLIC, ESCAPE, or COMPENSATORY

- 
- FAILURE OF SA NODE
  - FAILURE OF AV NODE

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

# SIMPLY STATED,

## 1. PREMATURE BEATS ----

**BAD**



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

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

**GOOD**



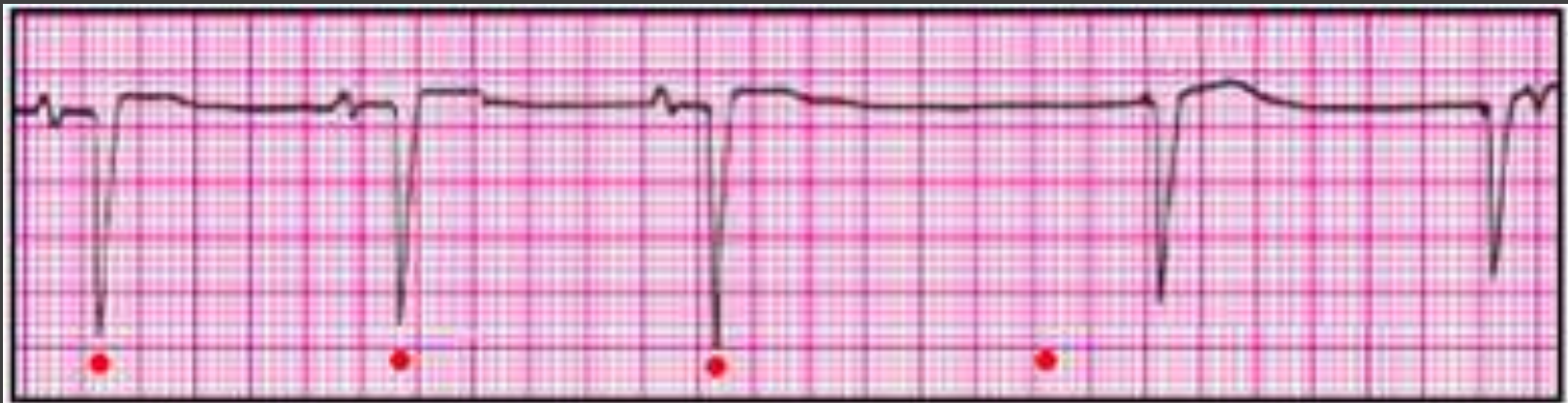
ELIMINATION OF END-DIASTOLIC  
BEATS COULD BE DEADLY



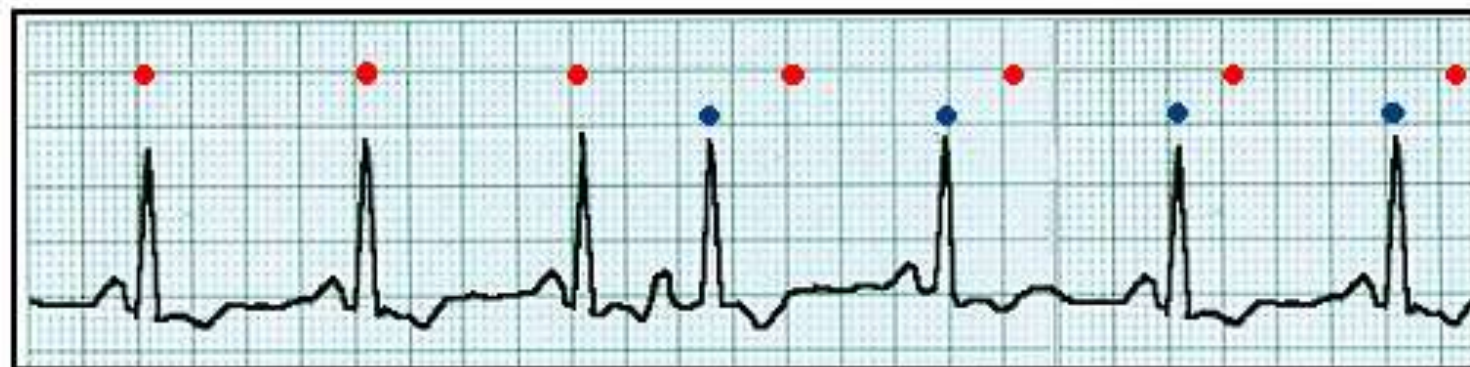
# Premature



# End Diastolic (escape)



## THIS RHYTHM IS: NSR with PAC



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

**RATE** ----- **NORMAL**

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

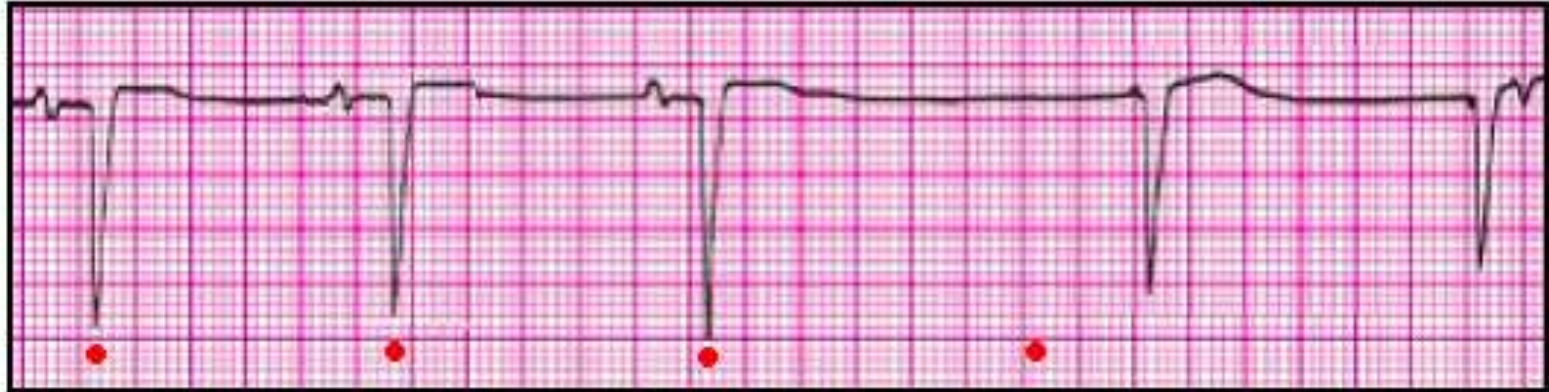
**P-R INTERVAL** ----- **NORMAL (except PAC may be LONGER or SHORTER )**

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

**QRS INTERVAL** ----- **NORMAL ( unless BBB present )**



## THIS RHYTHM IS: NSR with JUNCTIONAL ESCAPE BEAT



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

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

**THIS RHYTHM IS:**



**MAIN IDENTIFICATION CHARACTERISTIC(S):**

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

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

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

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

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

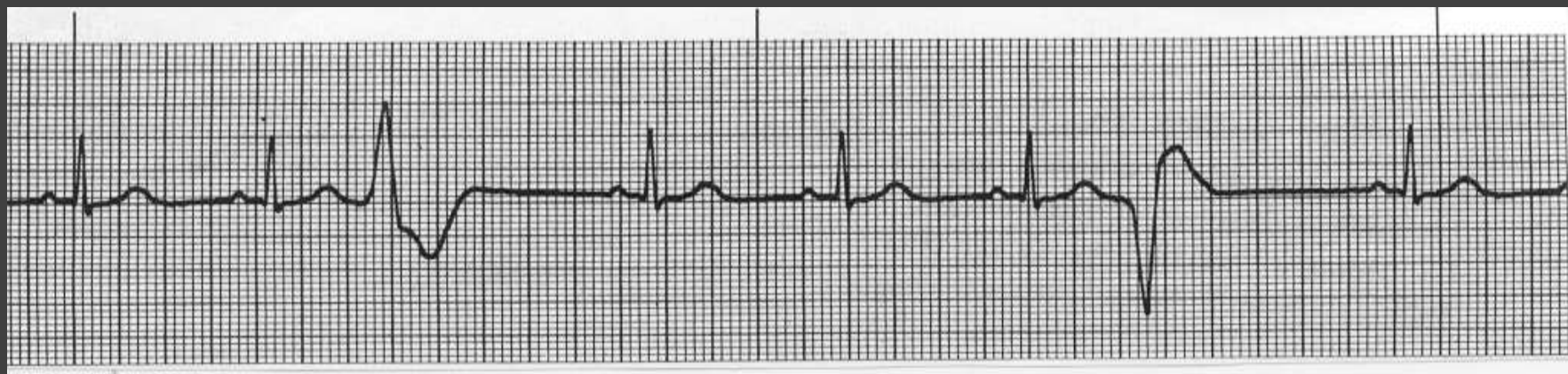


## THIS RHYTHM IS: NSR with UNIFOCAL PVCs

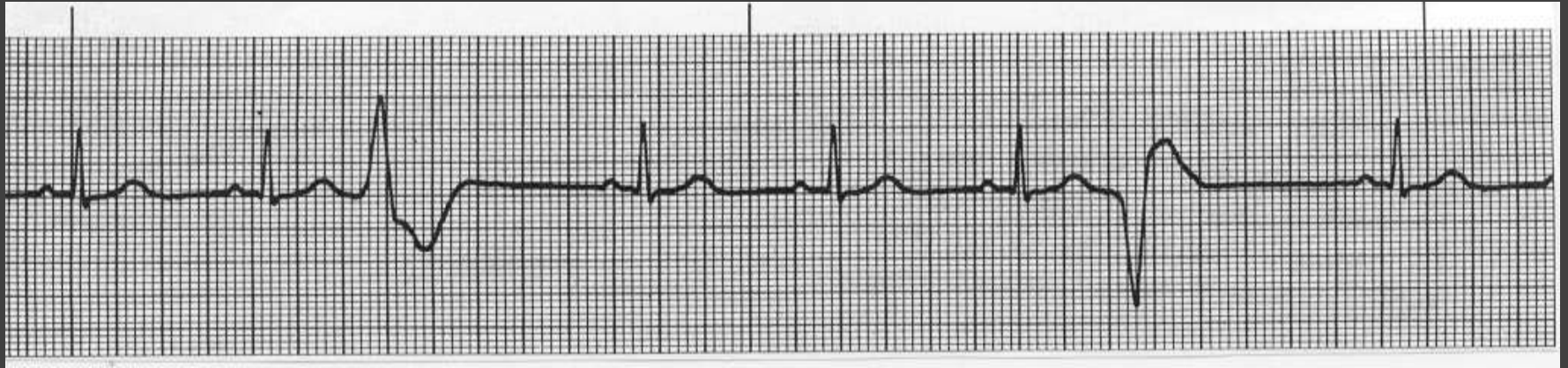


MAIN IDENTIFICATION CHARACTERISTIC(S): ECTOPIC BEATS ARE PREMATURE, AND WIDE ( $> 120$  ms); COMPLEXES MAY BE OF ANY SHAPE or DEFLECTION, BUT ALL HAVE SAME APPEARANCE; THERE IS A COMPENSATORY PAUSE

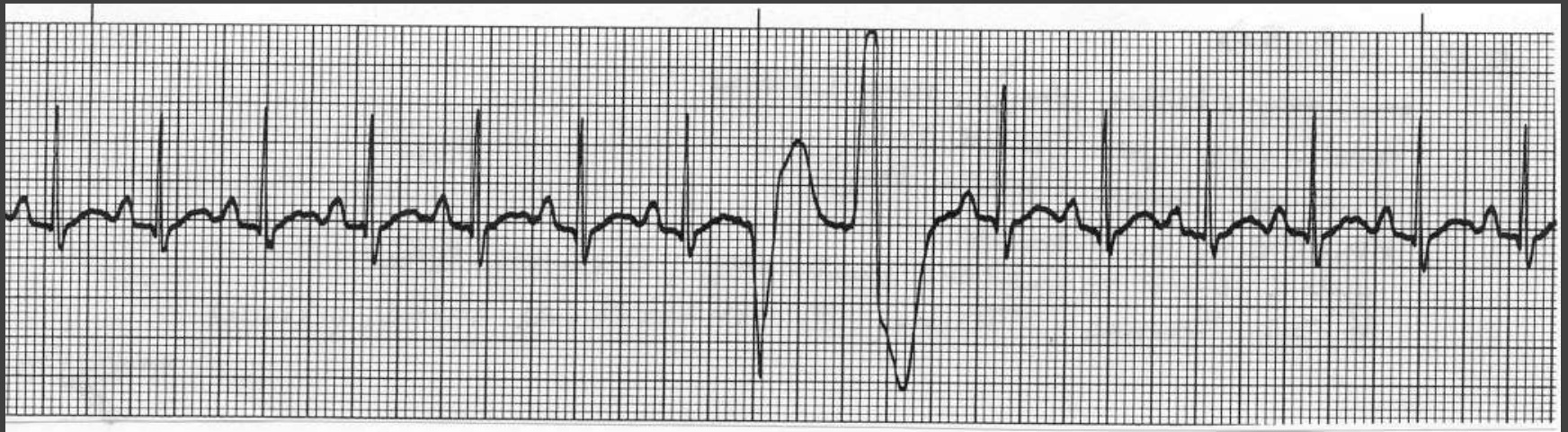
RATE	-----	NORMAL
RHYTHM	-----	IRREGULAR (due to PVCs)
P-R INTERVAL	-----	NSR BEATS - NORMAL (120 - 200 ms)    PVCs - N/A
P:QRS RATIO	-----	NSR BEATS - 1:1    PVCs - N/A
QRS INTERVAL	-----	NSR BEATS $< 120$ ms    PVCs $> 120$ ms



## Multifocal PVCs



## Multifocal Couplet PVCs



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

**-Immediately check patient**

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

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



**THIS RHYTHM IS:**



**MAIN IDENTIFICATION CHARACTERISTIC(S):**

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

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

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

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

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

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



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

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



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



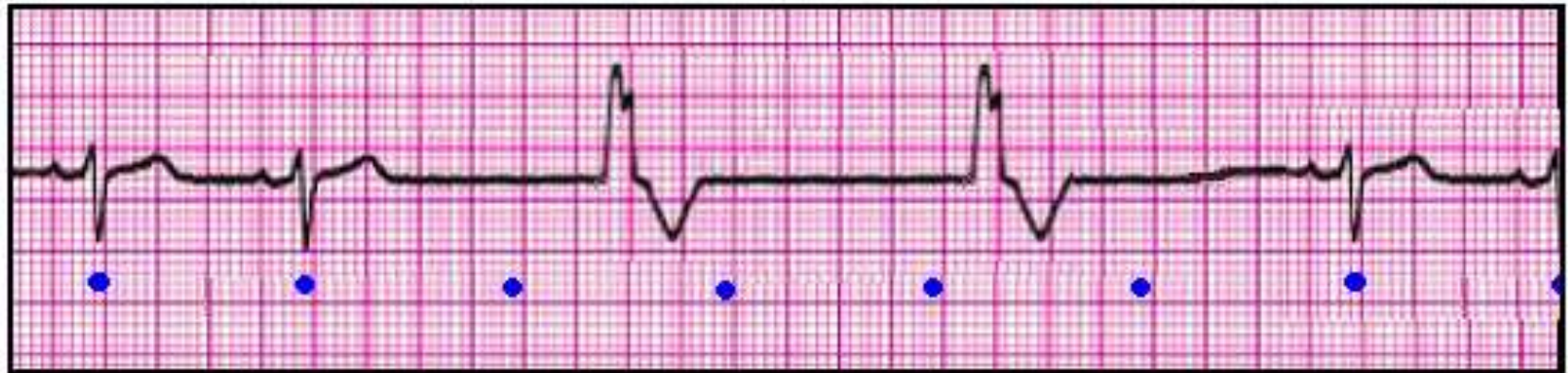
MAIN IDENTIFICATION CHARACTERISTIC(S): **END DIASTOLIC (ESCAPE) BEAT(S); COMPLEXES WIDER THAN 120 ms ; MAY BE UNIFOCAL or MULTIFOCAL; MAY or MAY NOT HAVE GOOD PULSE w/ COMPLEXES**

### PRESENTING PROBLEM(S):

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



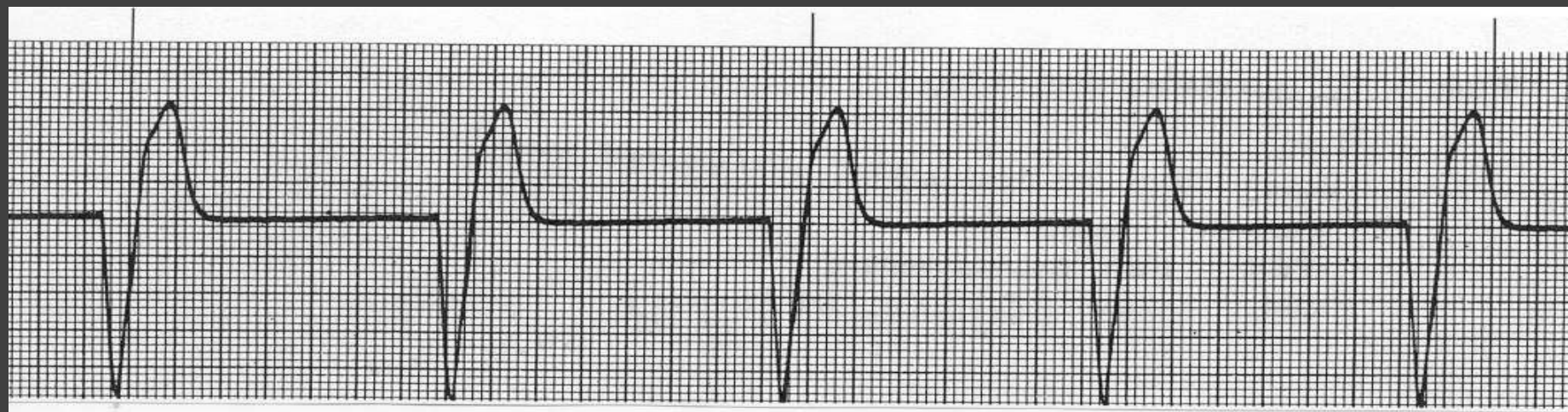
## THIS RHYTHM IS: SINUS ARREST w/ VENT. ESCAPE



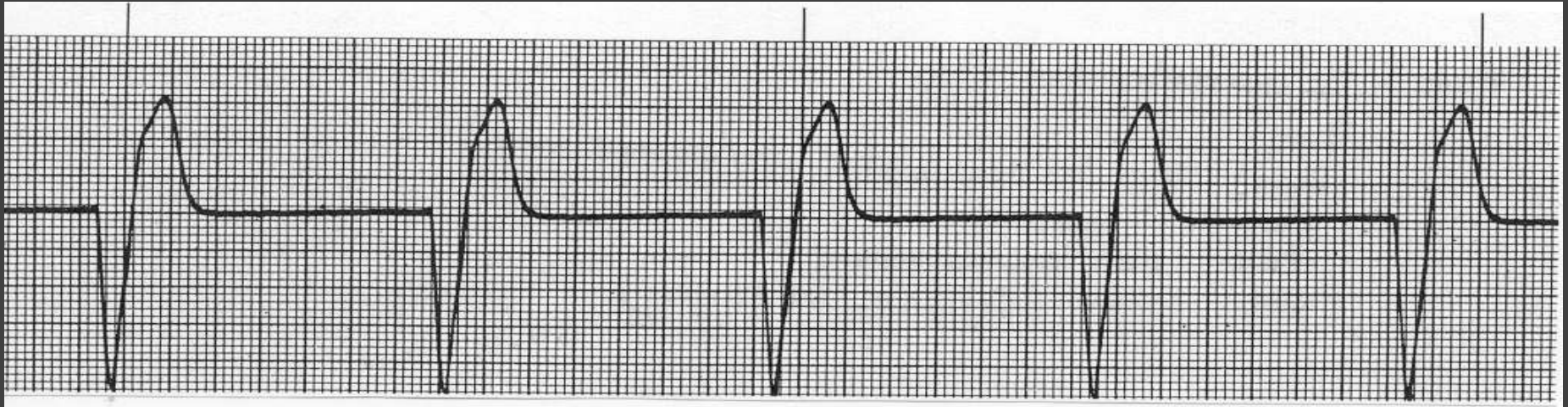
### TREATMENT / INTERVENTION (S):

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





# Accelerated Idioventricular Rhythm (AIVR)



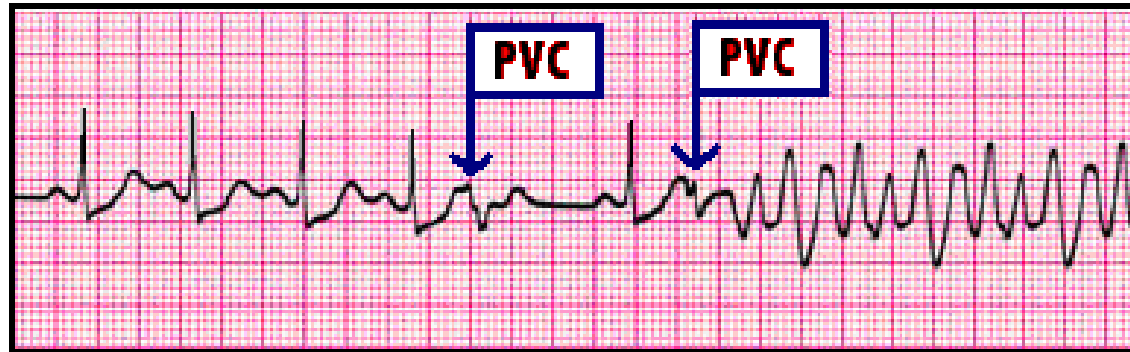
**No P waves**

**Wide QRS Complexes**

**Rate usually “Ventricular” - 40 or less**

**This may be the only RHYTHM keeping the Patient alive.**

# THIS RHYTHM IS: NSR with **R on T PHENOMENON**

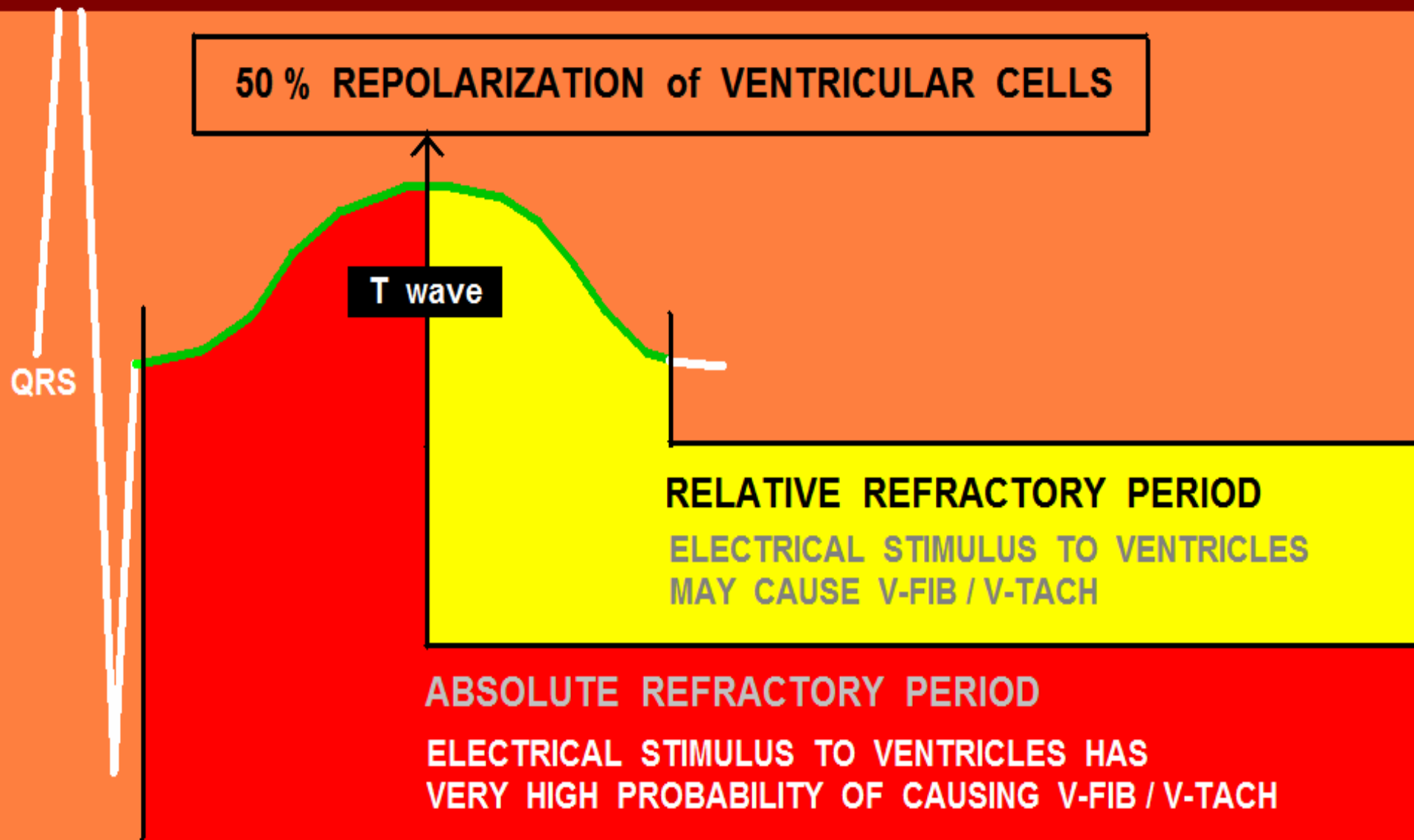


**MAIN IDENTIFICATION CHARACTERISTIC(S): ECTOPIC BEATS ARE WIDE ( $> 120\text{ ms}$ ); ALL APPEAR TO HAVE SAME SHAPE and DEFLECTION ; THERE IS A COMPENSATORY PAUSE**

## 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 ( $> 120\text{ ms}$ ); PVCs ARE COUPLED TOGETHER (2 = "COUPLET"), (3 or more = RUN OF V-TACH)

### POTENTIAL PROBLEMS (S):

- THE UNDERLYING REASON PVCs ARE PRESENT COULD BE A CRITICAL ISSUE . . .
- PVCs MAY HAVE A WEAKER PULSE, or NO PULSE
- PVCs DURING REFRACTORY PERIOD COULD CAUSE V-FIB
- PVCs COUPLED TOGETHER COULD PRECIPITATE V-TACH

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

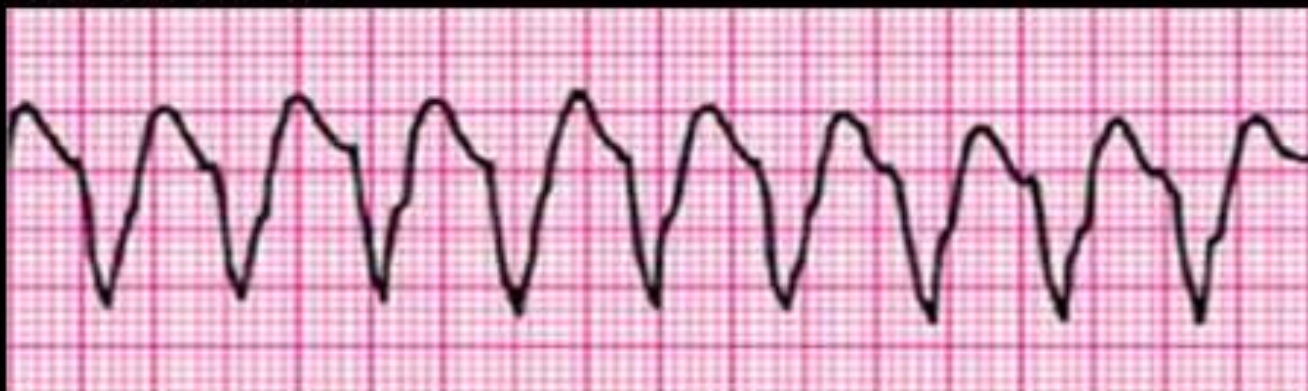


### **TEXTBOOK STANDARDS:**

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



**THIS RHYTHM IS:**



**MAIN IDENTIFICATION CHARACTERISTIC(S):**

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

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

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

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

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

## THIS RHYTHM IS: MONOMORPHIC V-TACH



**MAIN IDENTIFICATION CHARACTERISTIC(S):** WIDE QRS COMPLEXES ( $> 120$  ms)  
HR USUALLY BETWEEN 150 - 200; ALL QRS COMPLEXES APPEAR SAME IN  
SHAPE and DEFLECTION; IF P WAVES SEEN, DISASSOCIATED w/ QRS

RATE	-----	$> 100$ (usually 150 - 200)
RHYTHM	-----	REGULAR
P-R INTERVAL	-----	N / A
P: QRS RATIO	-----	N / A
QRS INTERVAL	-----	$> 120$ ms



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

**-Immediately check patient**

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

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

**WIDE COMPLEX TACHYCARDIA**

(QRS &gt; 120 ms)

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

**GO TO  
V - FIB  
ALGORITHM !**

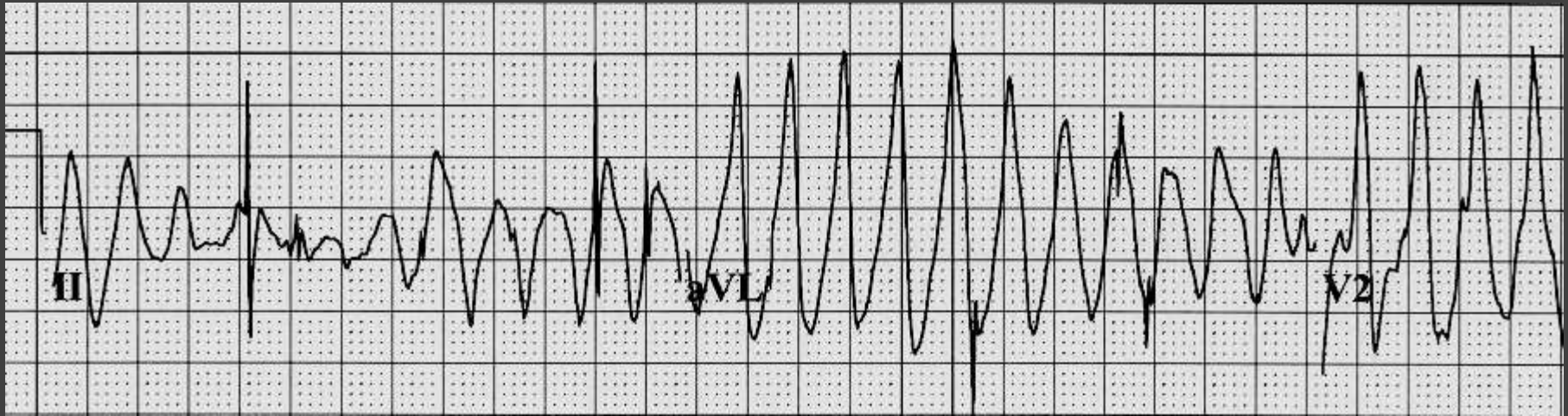
**PULSE - UNSTABLE**

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

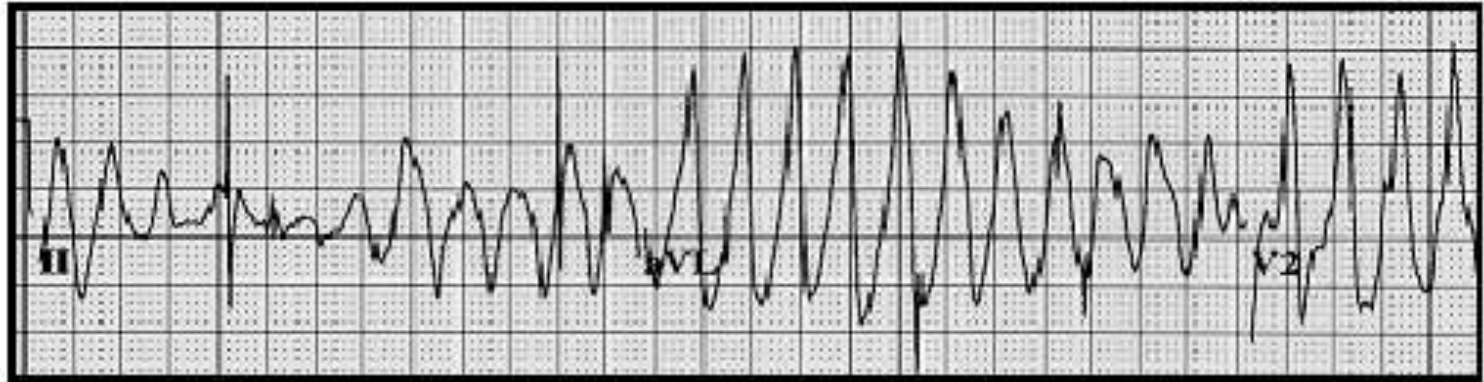
**PULSE - STABLE**

- O2, IV-IO, EKG
- MEDS:
  - ADENOSINE 6-12-12 (only if REGULAR)
  - PROCAINAMIDE (20-50mg/min)
  - AMIODARONE (150 over 10min + 1mg/ min INFUSION)

This RHYTHM is ? ?



# THIS RHYTHM IS: POLYMORPHIC V-TACH



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

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



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

**-Immediately check patient**

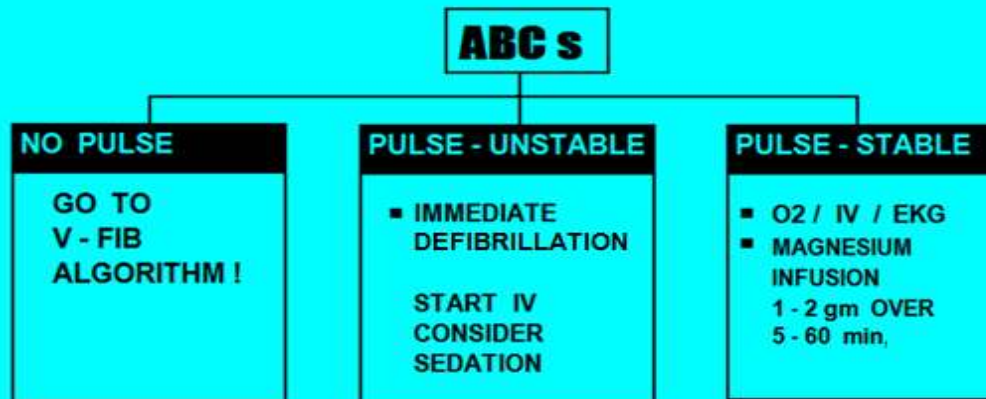
**-Notify next “higher up” in chain of command**

- 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**

# WIDE COMPLEX TACHYCARDIA

## TORSADES de POINTES

( QRS > 120 ms )



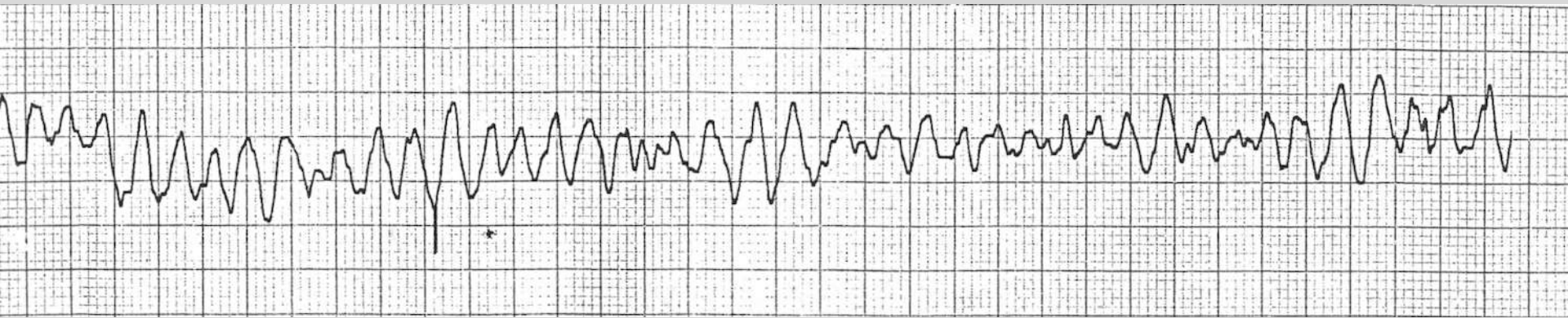
***DO NOT give PROCAINAMIDE, AMIODARONE, or SOTALOL  
to patients with TORSADES or POLYMORPHIC VT !!!***

### 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

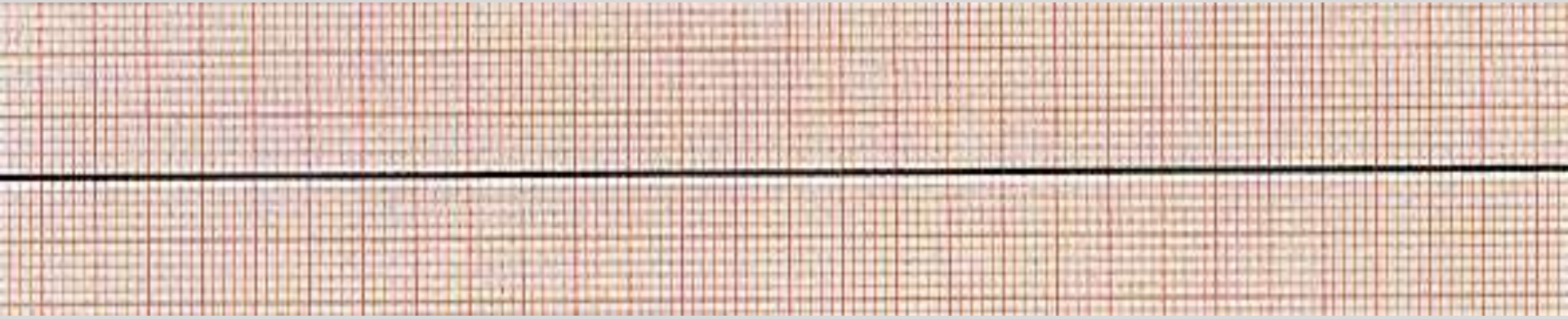
REPORT ANY ABNORMAL FINDINGS TO PHYSICIAN.

# VENTRICULAR FIBRILLATION



***CARDIAC ARREST RHYTHM***

# Ventricular Asystole



***CARDIAC ARREST RHYTHM***



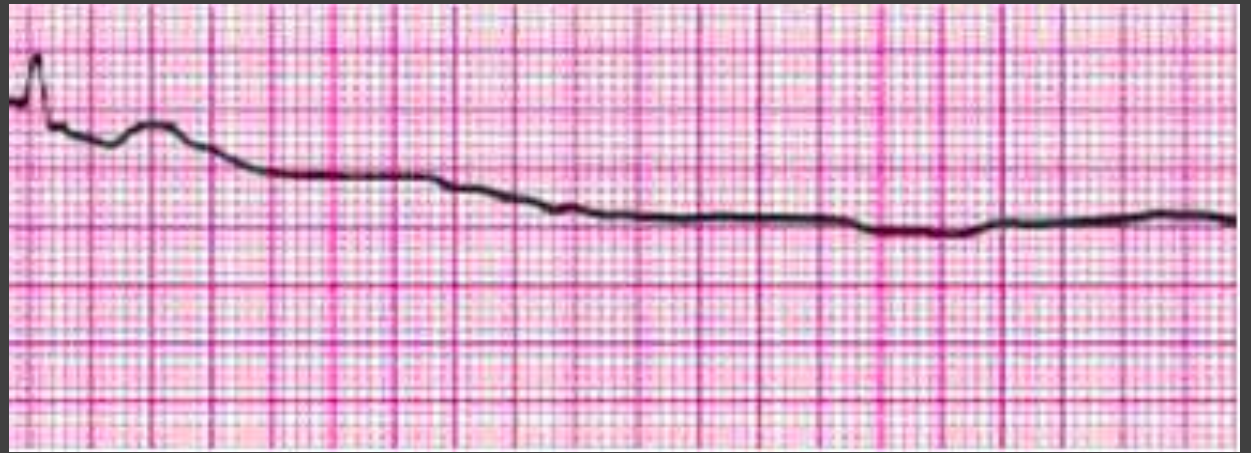
# **-- CRITICAL ECG ALERT --**

**-Immediately check patient**

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

- 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**

If QRS  
complexes  
have a  
PULSE  
then apply

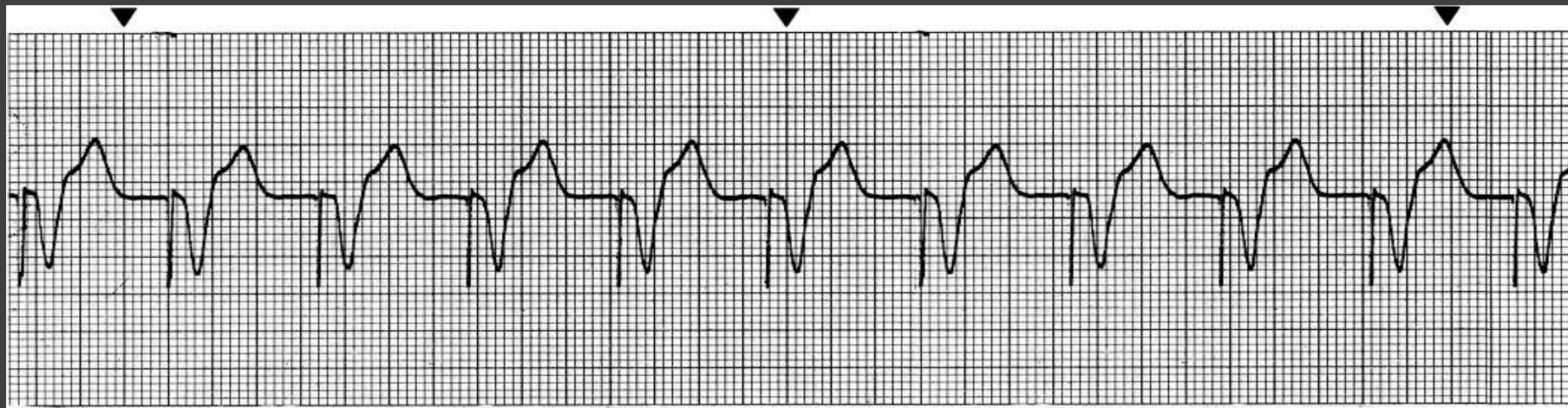


**PACEMAKER !!**

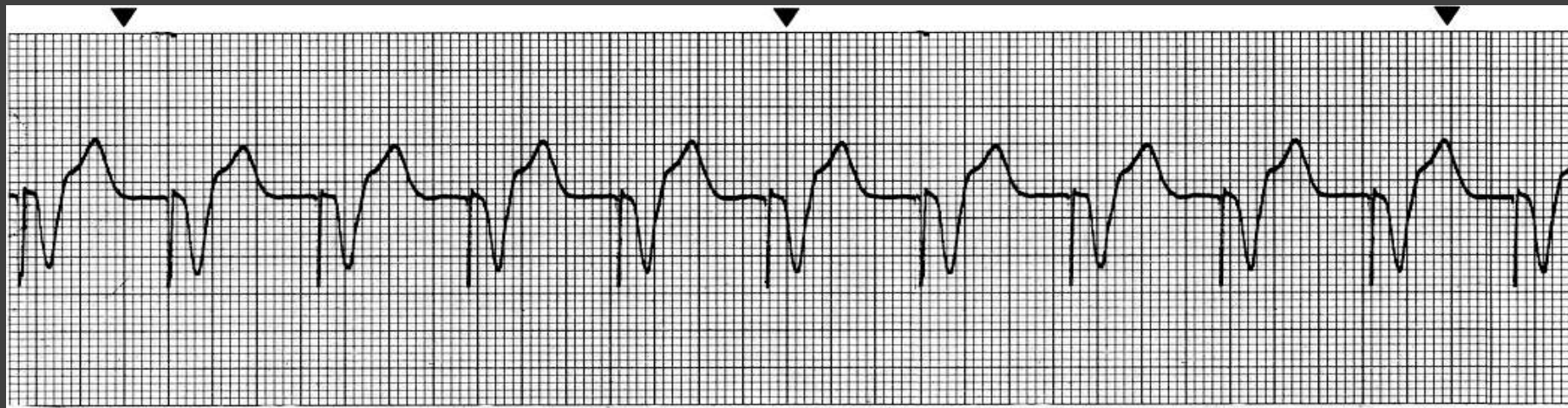
CPR  
|  
IV / AIRWAY  
|  
EPI 1 mg  
|

## THE " H's " and the " T's "

- HYPOVOLEMIA
  - HYPOXIA
  - HYDROGEN ION ( Ph )
  - HYPOGLYCEMIA
  - HYPOTHERMIA
- 
- TOXINS
  - TAMPONADE ( CARDIAC )
  - TENSION PNEUMOTHORAX
  - THROMBOSIS ( CORONARY or PULMONARY )
  - TRAUMA







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

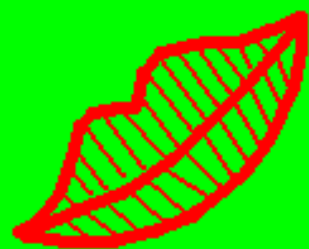
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# THE QRS COMPLEX

## 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

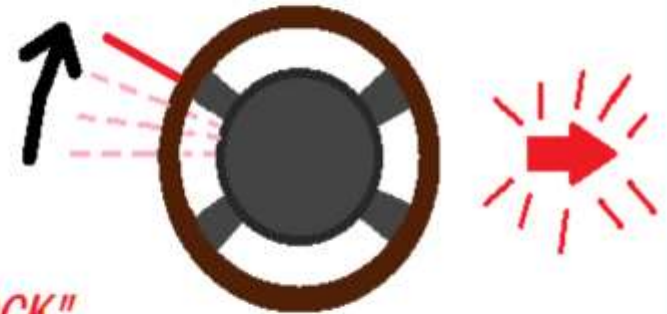
V1

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”*

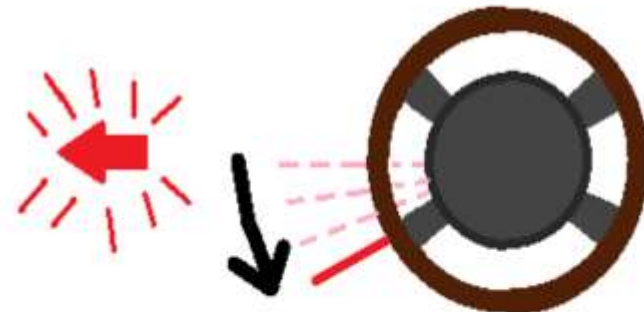


V1

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

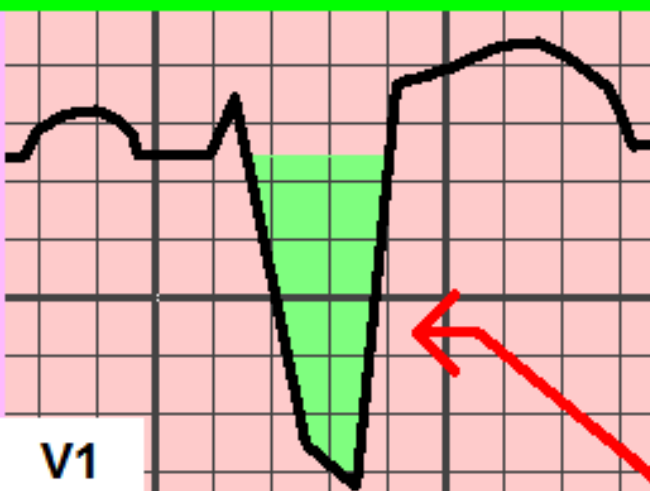
THINK:

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



# DIAGNOSING BUNDLE BRANCH BLOCK

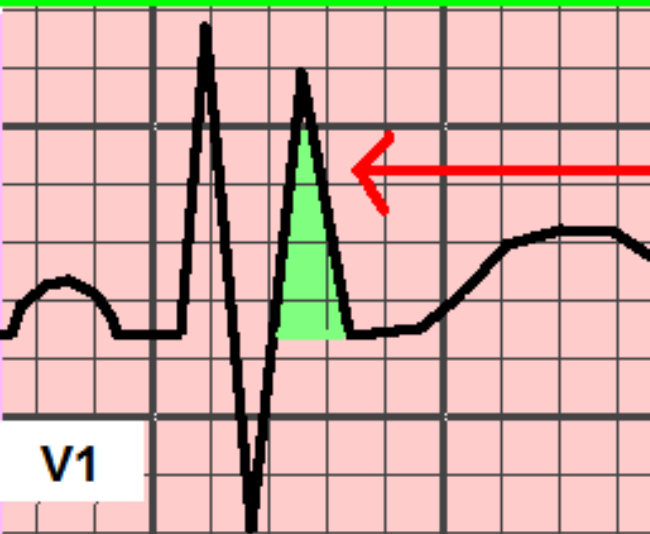
## L.B.B.B.



## USING LEAD V1

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

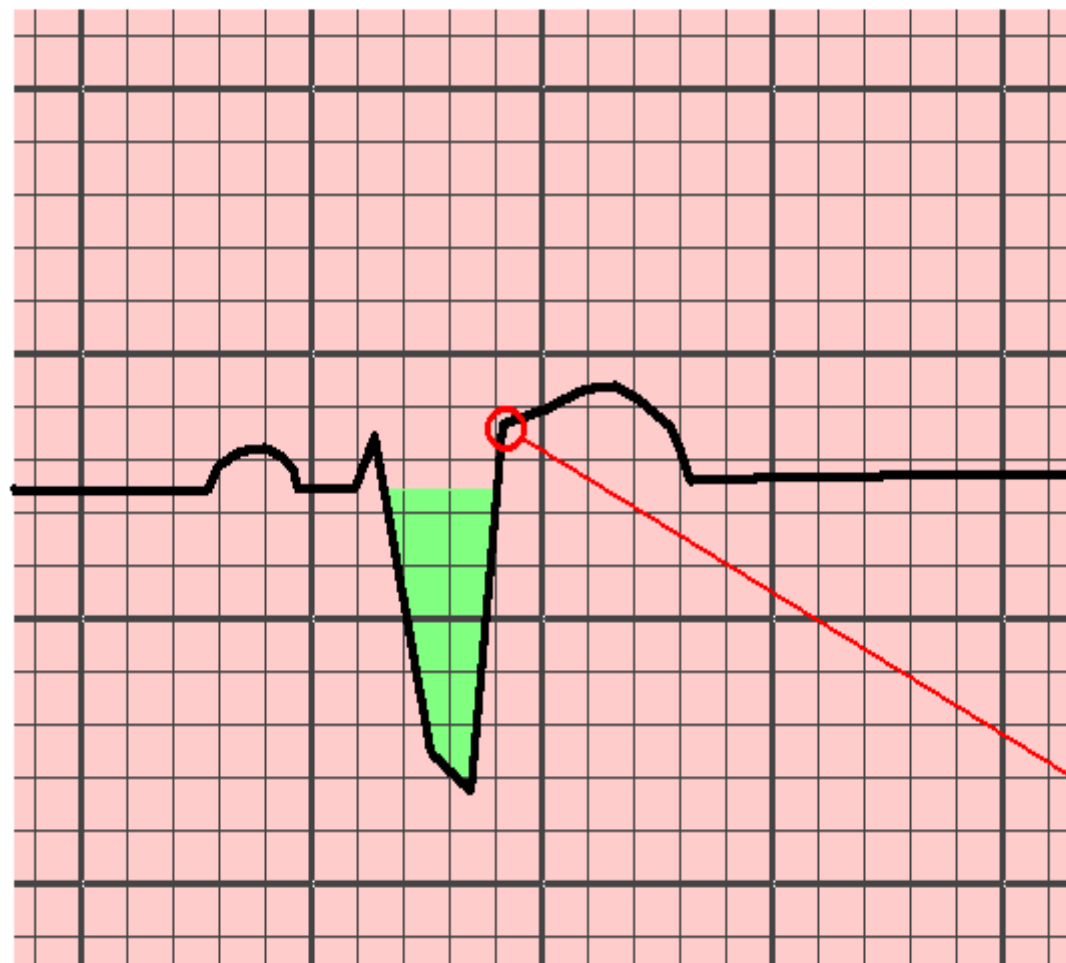
## R.B.B.B.



NEGATIVE = LEFT BUNDLE BRANCH BLOCK

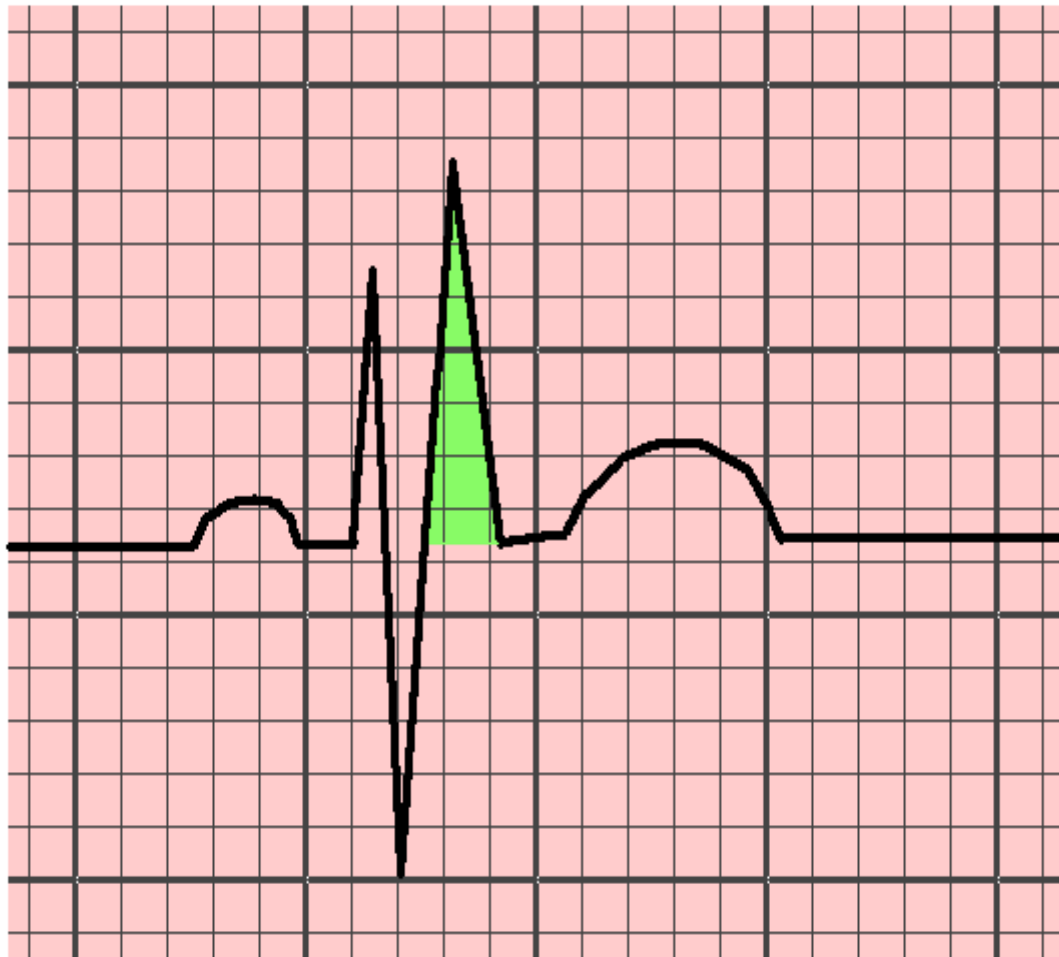
POSITIVE = RIGHT BUNDLE BRANCH BLOCK

## 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**



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- 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**

***Stay tuned for  
The NEXT  
LEVEL of ECG  
Monitoring . . .  
Coming Soon!***



The ECG Markers of ACS involve the:

- J Point
- ST Segment
- T Wave

Of every lead on the 12 Lead ECG.

***THE ECG should NOT CHANGE.*** Any changes that occur to the Patient's ECG waveforms should be considered ***ABNORMAL*** and should be ***REPORTED.***

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

# NORMAL ST - T WAVES

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

## ASSESS:



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

👉 in **EVERY LEAD EXCEPT aVR !!**

# THE J POINT SHOULD BE ..



WITHIN  
1 mm  
ABOVE

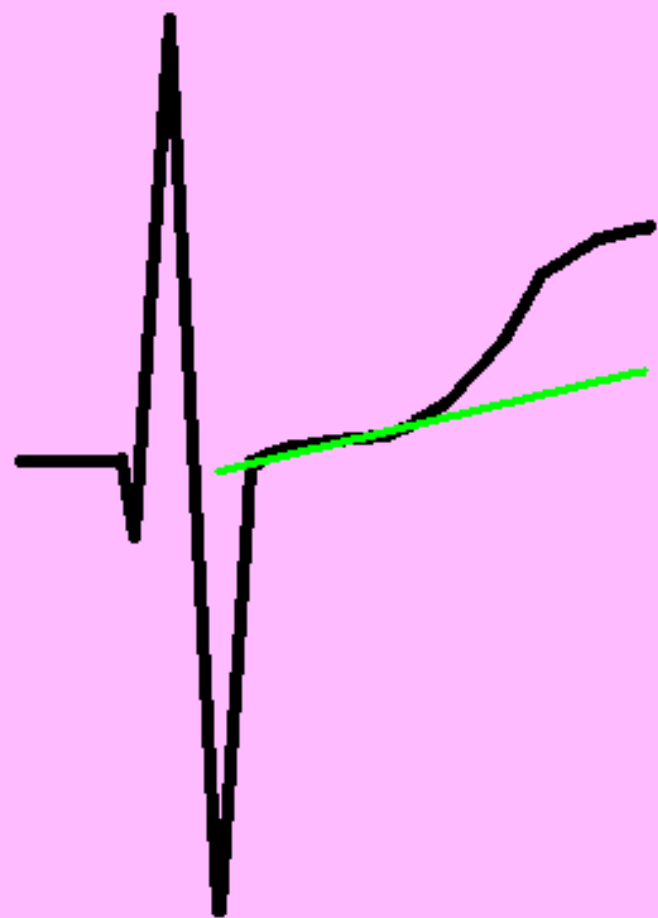
OR

BELOW  
the  
ISOELECTRIC  
LINE

or the P-Q JUNCTION.

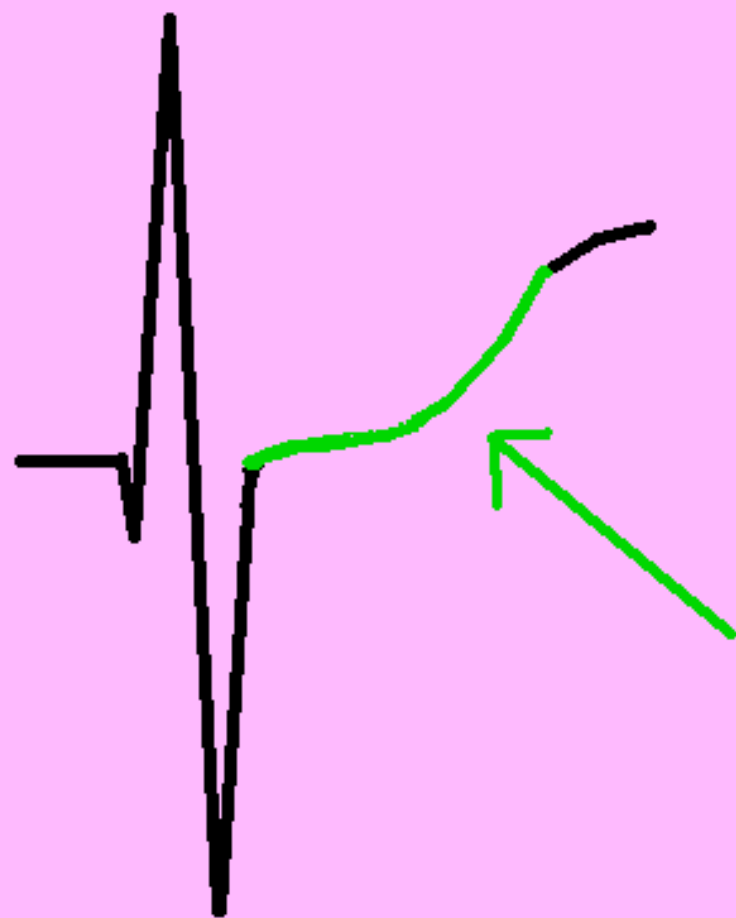


# THE S-T SEGMENT



SHOULD HAVE  
A "SLIGHT POSITIVE"  
INCLINATION

# THE S-T SEGMENT

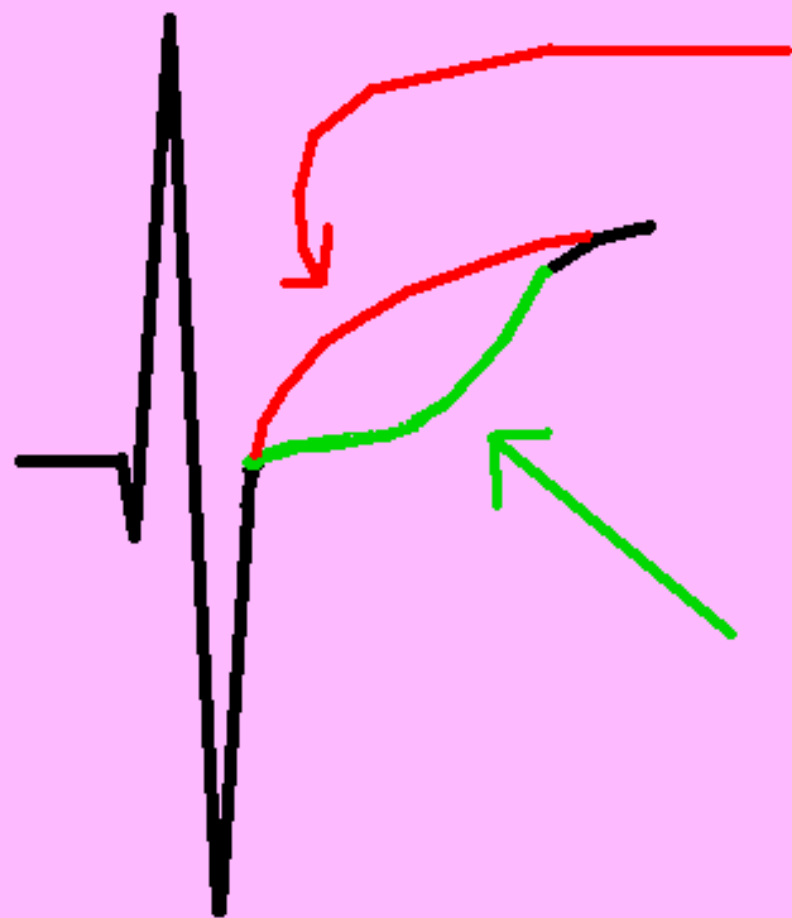


SHOULD BE  
"CONCAVE" IN  
SHAPE . . .

# THE S-T SEGMENT

AS OPPOSED TO  
"CONVEX" IN  
SHAPE

SHOULD BE  
"CONCAVE" IN  
SHAPE . . .



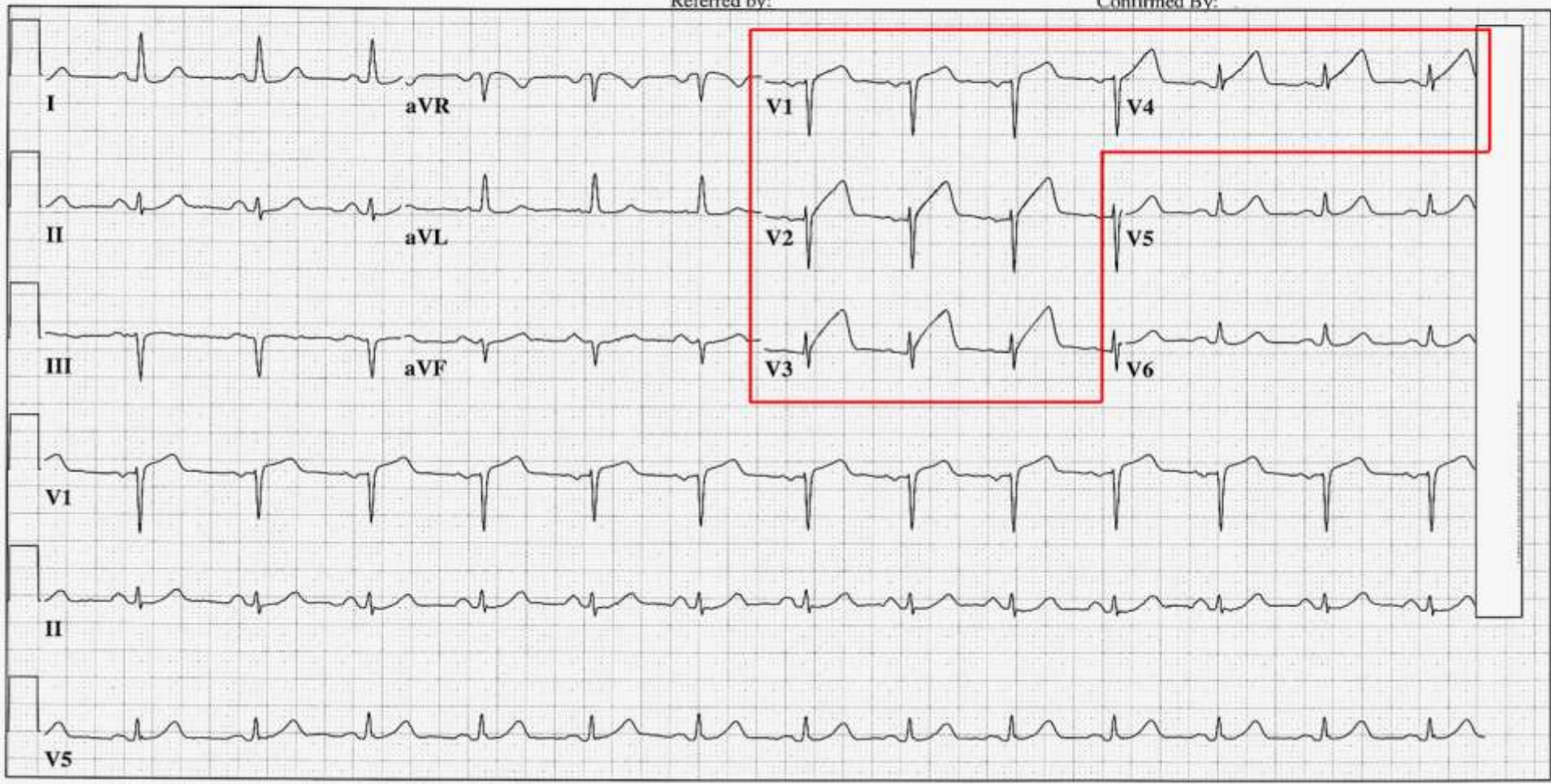
56 yr Male Caucasian  
Room: A9 Loc: 3 Option: 23  
Vent. rate 80 BPM  
PR interval 154 ms  
QRS duration 78 ms  
QT/QTc 380/438 ms  
P-R-T axes 51 -24 38

**\*\*UNEDITED COPY – REPORT IS COMPUTER GENERATED ONLY, WITHOUT  
PHYSICIAN INTERPRETATION**  
Normal sinus rhythm  
Normal ECG  
No previous ECGs available

Technician: W Ruppert

Referred by:

Confirmed By:



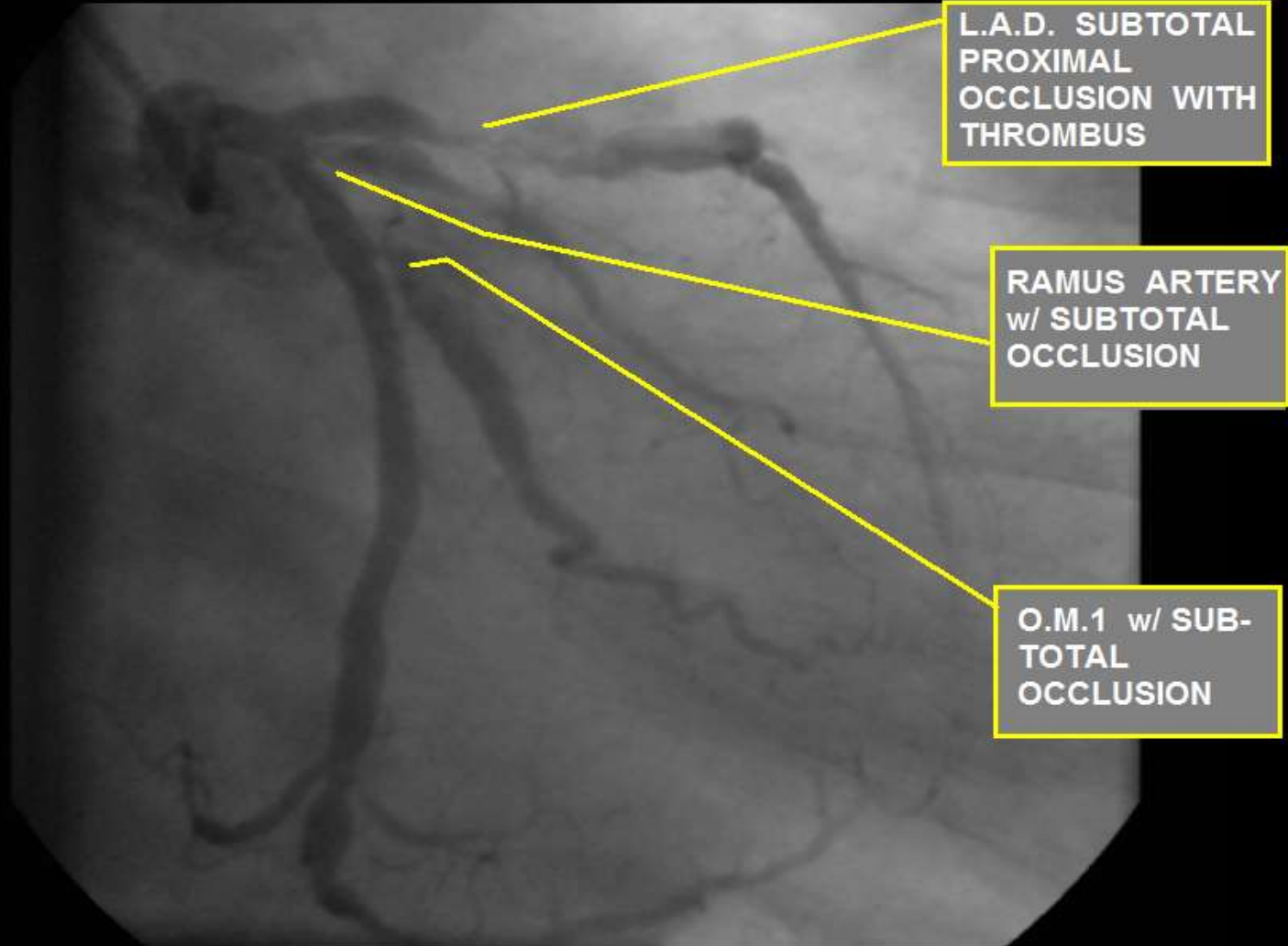
25mm/s 10mm/mV 40Hz 005C 12SL 235 CID: 3

EID:10 EDT:

**ECG COMPUTER DOES NOT NOTICE THE CONVEX J-T APEX SEGMENTS !**



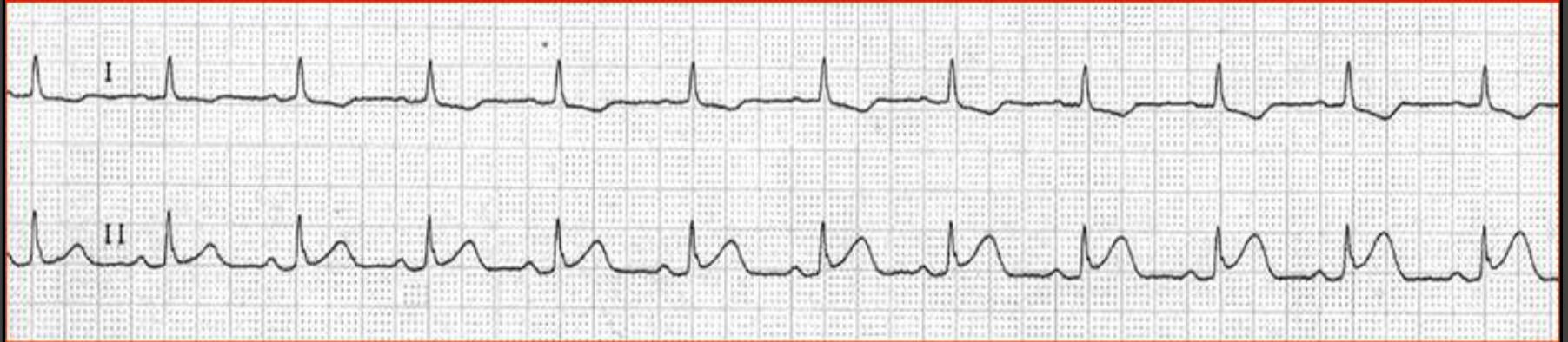
# **CASE STUDY: 56 y/o male with INTERMITTENT "CHEST HEAVINESS" . . . .**



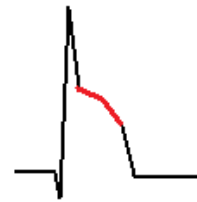
**TREATMENT PLAN : EMERGENCY CORONARY ARTERY BYPASS SURGERY ( 4 VESSEL )**

# ***ST SEGMENT ELEVATION:***

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



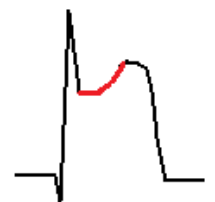
**IN THIS CASE, a normal response to balloon occlusion of the RIGHT CORONARY ARTERY during PTCA in the CARDIAC CATH LAB**



**DOWNSLOPING  
S-T SEGMENT**
















**FLAT  
S-T SEGMENT**



**UPSLOPING  
S-T SEGMENT**

# EKG PATTERNS of ACS & ISCHEMIA

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

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

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



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THIS RHYTHM STRIP ?



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

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



# WHAT WOULD THE MOST APPROPRIATE COURSE OF ACTION BE ?



## Immediately:

notify Charge RN

check patient

obtain 12 Lead ECG

Notify physician / Cardiologist

Activate STEMI protocol



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