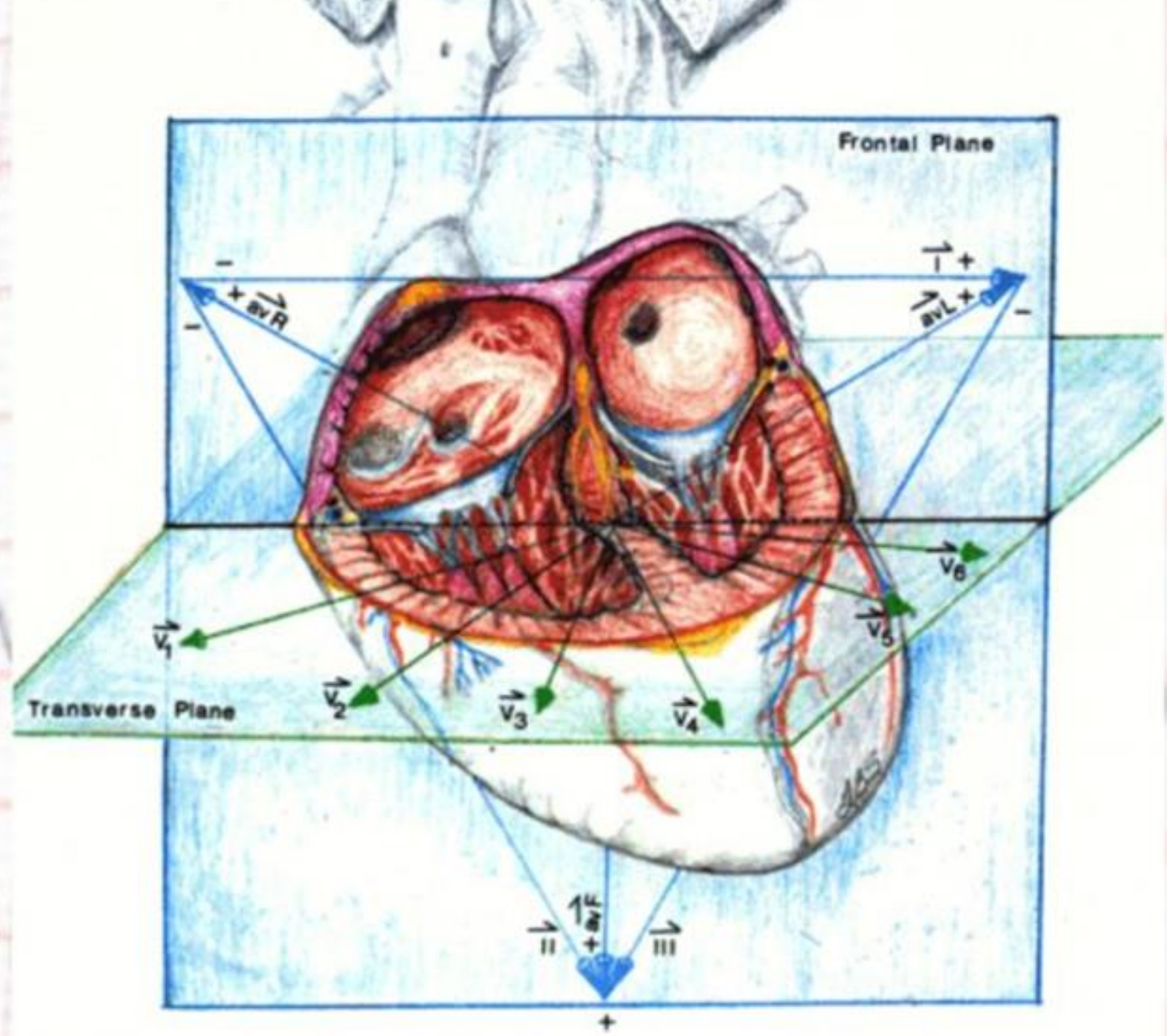
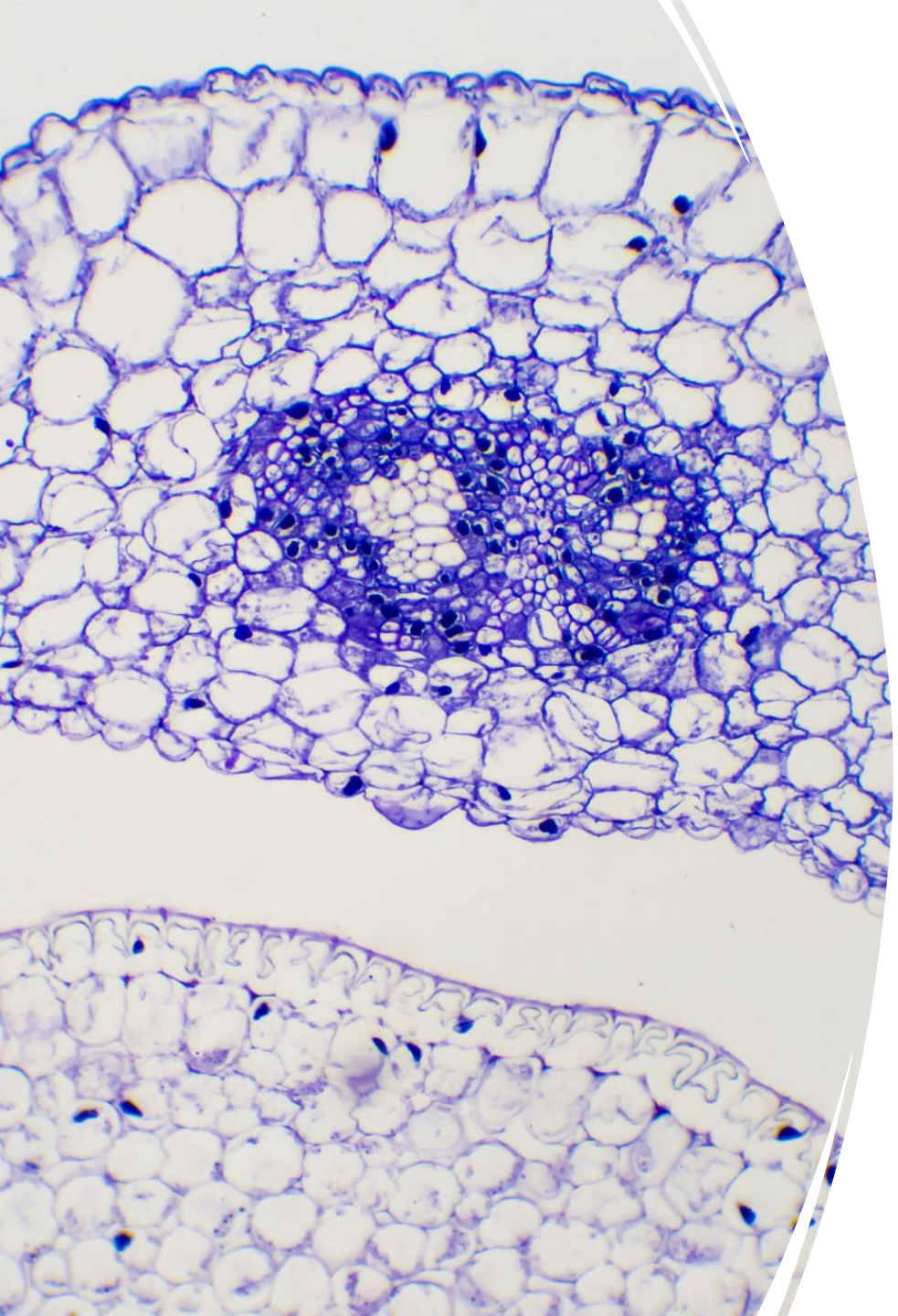


Basic ECG interpretation & Interesting ECG

พันโทหญิง จิราพร เชาว์โพธิ์ทอง
พยาบาลผู้ปฏิบัติการพยาบาลขั้นสูง
ฝวก.กพย.รพ.รร.6

สิ่งที่ควรรู้เกี่ยวกับหัวใจ

- การตรวจคลื่นไฟฟ้าหัวใจ คือ การตรวจและบันทึกกระแสไฟฟ้าที่เกิดขึ้นในหัวใจ หากมีอะไรที่เบี่ยงเบนไปจากค่าปกติ สามารถใช้เป็นเกณฑ์ในการวินิจฉัยภาวะต่างๆได้

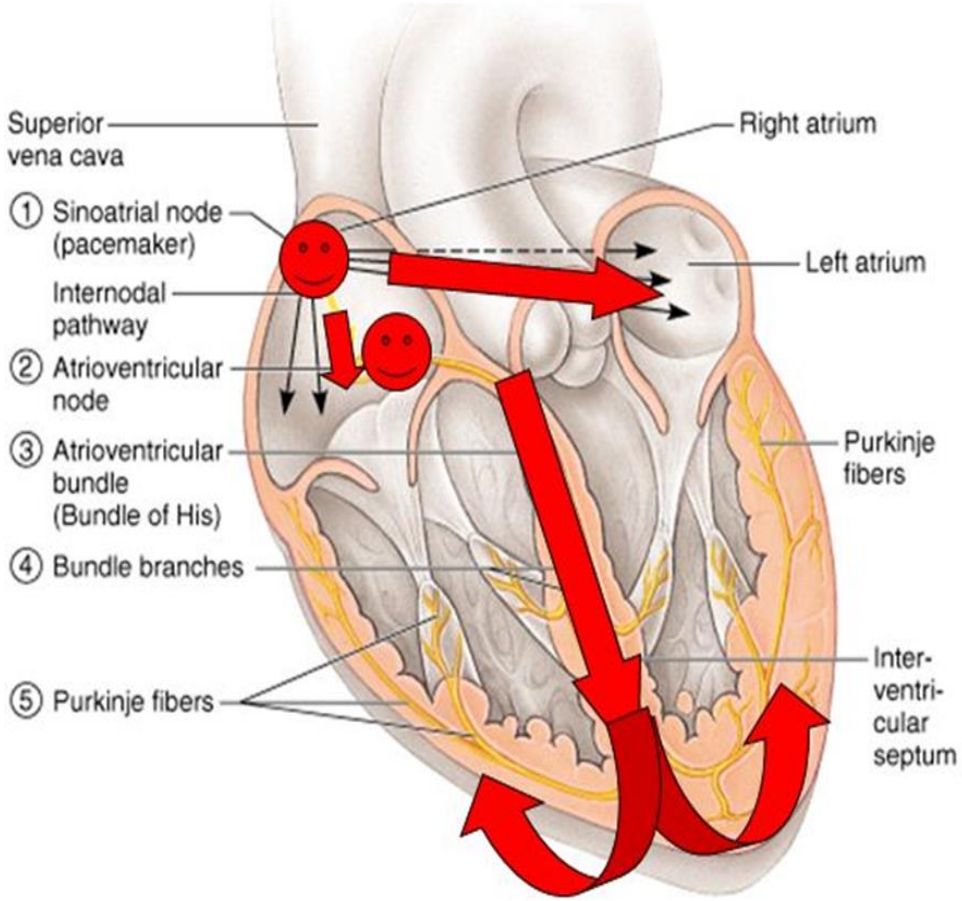


เซลล์ของหัวใจ

แบ่งเป็น 3 ประเภท ได้แก่

1. Pacemaker cell คือ เซลล์กำเนิดไฟฟ้า ได้แก่ SA-node
2. Electrical conducting cell คือ เซลล์นำไฟฟ้า ได้แก่ Purkinje system, Bachman’s bundle
3. Myocardial cell คือ เซลล์ที่ทำให้หัวใจบีบและคลายตัว

Conduction system of the HEART

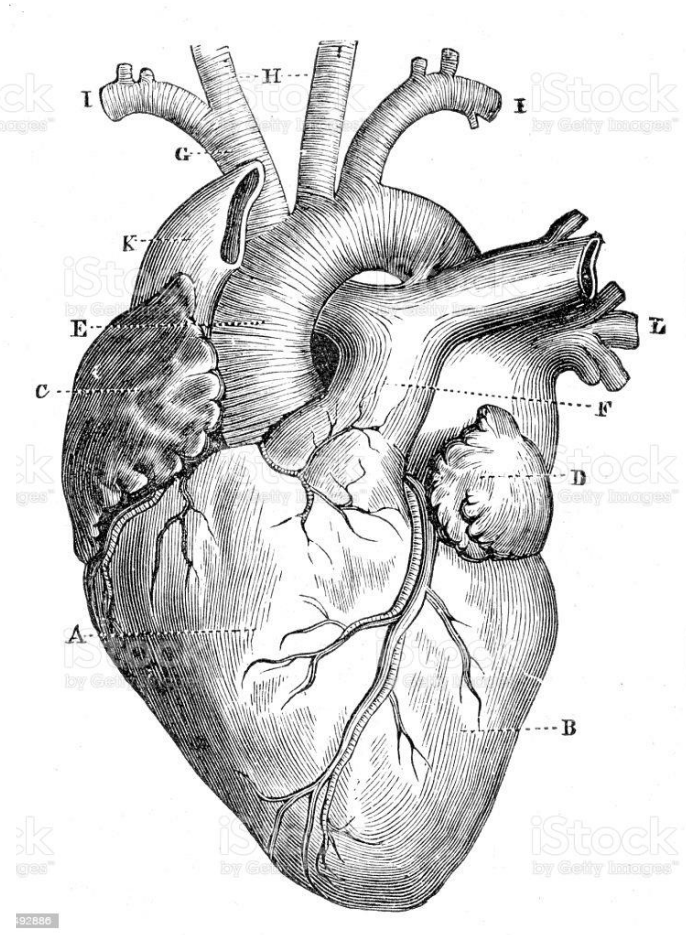


- Autorhythmic cells
  - Cardiac cells repeatedly fire spontaneous action potentials
  - Autorhythmic cells: the conduction system
  - Pacemakers
    - SA node
      - origin of cardiac excitation
      - fires 60-100/min
    - AV node
    - conduction system
      - AV bundle of His
      - R and L bundle branches
      - Purkinje fibers

It's as if the heart had only two motor units: the atria and the ventricles!

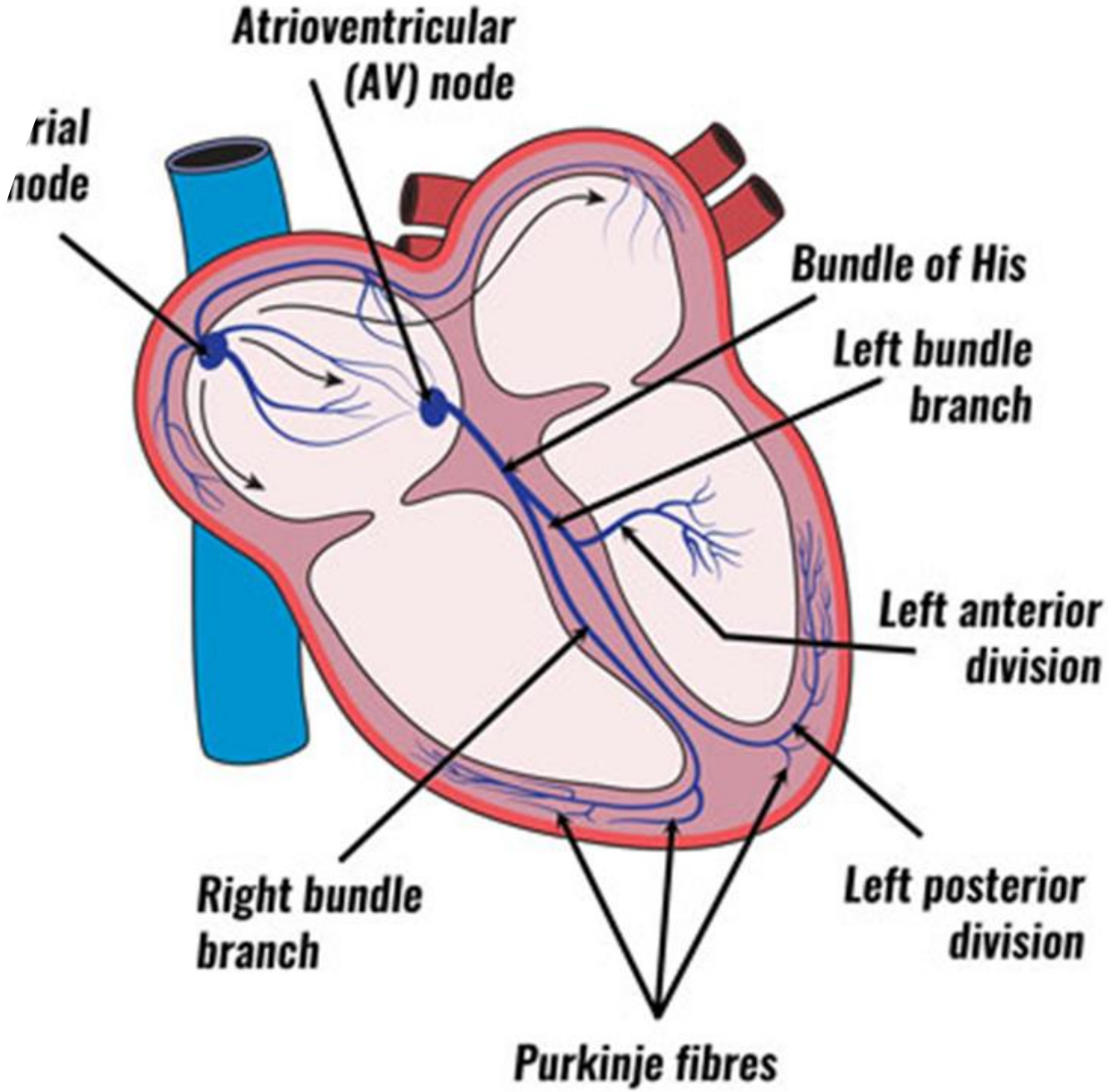
Physiological properties of Cardiac muscle

- **Excitability:** ability to respond to an electrical impulse
  - **Excitation** - the process of generation of action potential
  - **Excitability** - the ability to generate an action potential
- **Automaticity:** ability to initiate an electrical impulse
- **Conductivity:** ability to transmit an electrical impulse from one cell to another
- **Contractility** is a term used to denote the force generated by the contracting myocardium under any given condition



Inherent rate

- SA node : 60-100 bpm
- AV node : 40-60 bpm
- Bundle of His: 40-60 bpm
- Bundle branches : 20-40 bpm
- Purkinje fibers : 20-40 bpm



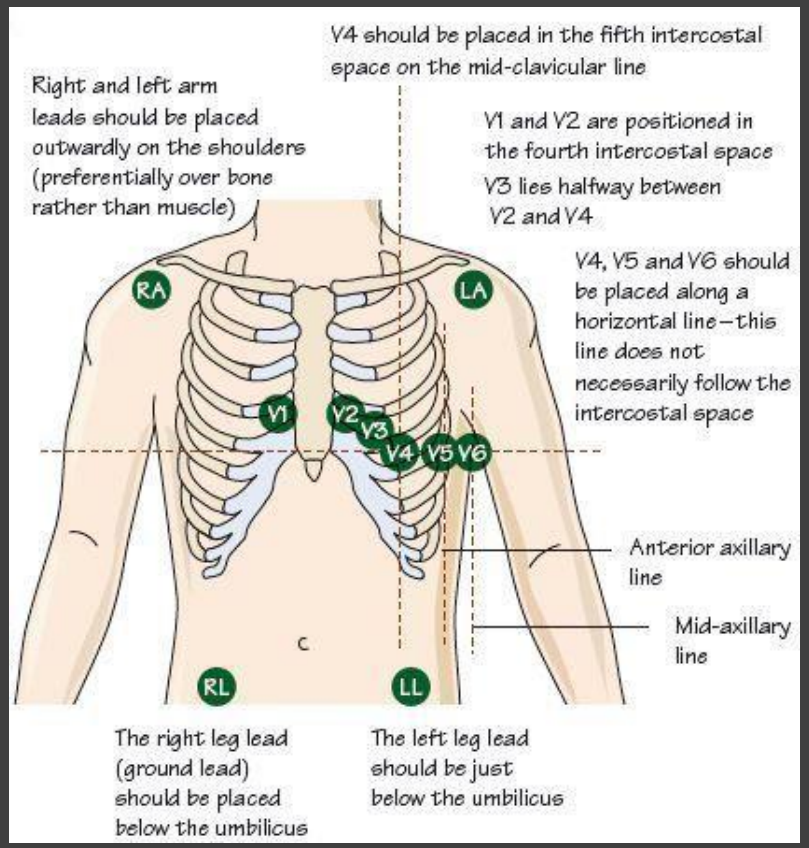
Standard 12-lead ECG

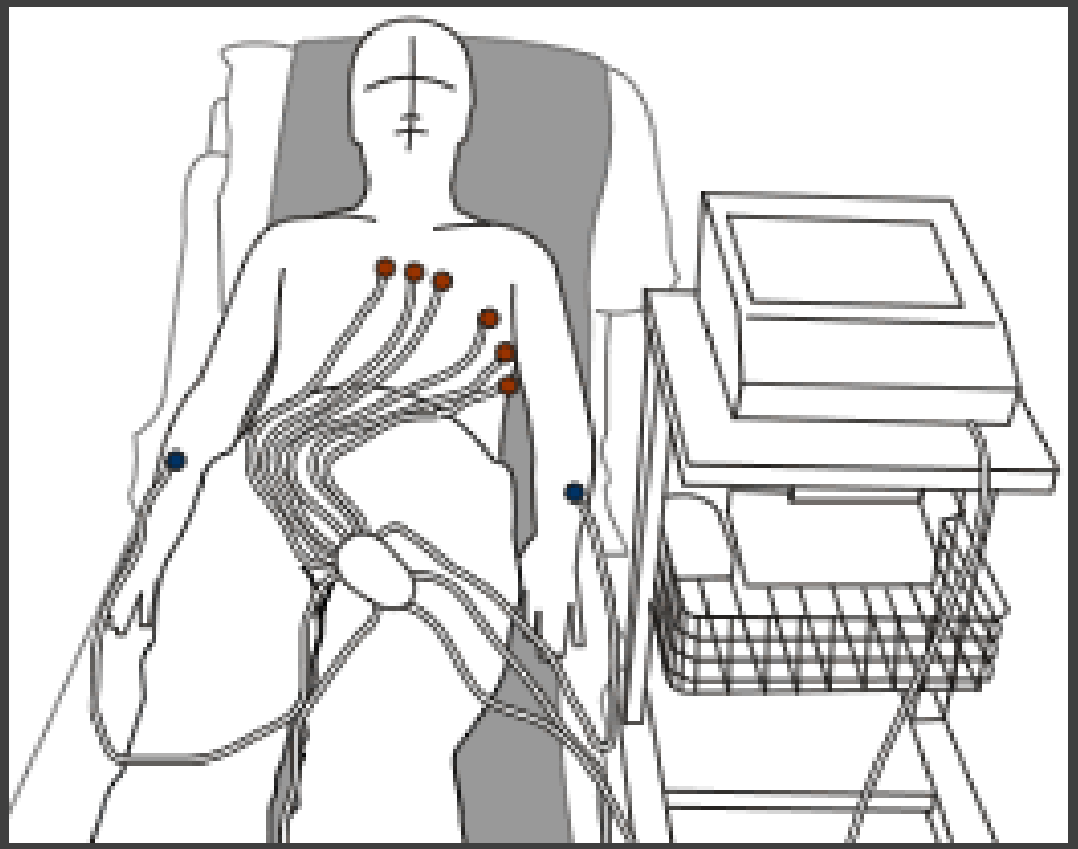
Used in a variety of clinical settings, including emergency care, pre-op & post-op assessment, & primary care to assess & diagnose pts with suspected arrhythmias, HT, CAD or HF

Correct positioning of the electrodes using anatomical landmarks is essential to ensure an accurate & high-quality ECG recording

Skin preparation is essential, since suboptimal electrode contact or electrodes being placed where there is a significant amount of dry or dead skin cells, grease, sweat or hair, can negatively affect the quality of the ECG recording

Nursing Standard. doi: 10.7748/ns.2018.e11066


V4 should be placed in the fifth intercostal space on the mid-clavicular line
Right and left arm leads should be placed outwardly on the shoulders (preferentially over bone rather than muscle)
V1 and V2 are positioned in the fourth intercostal space
V3 lies halfway between V2 and V4
V4, V5 and V6 should be placed along a horizontal line—this line does not necessarily follow the intercostal space
RA
LA
V1
V2
V3
V4
V5
V6
Anterior axillary line
Mid-axillary line
RL
LL
The right leg lead (ground lead) should be placed below the umbilicus
The left leg lead should be just below the umbilicus



12 lead ECG

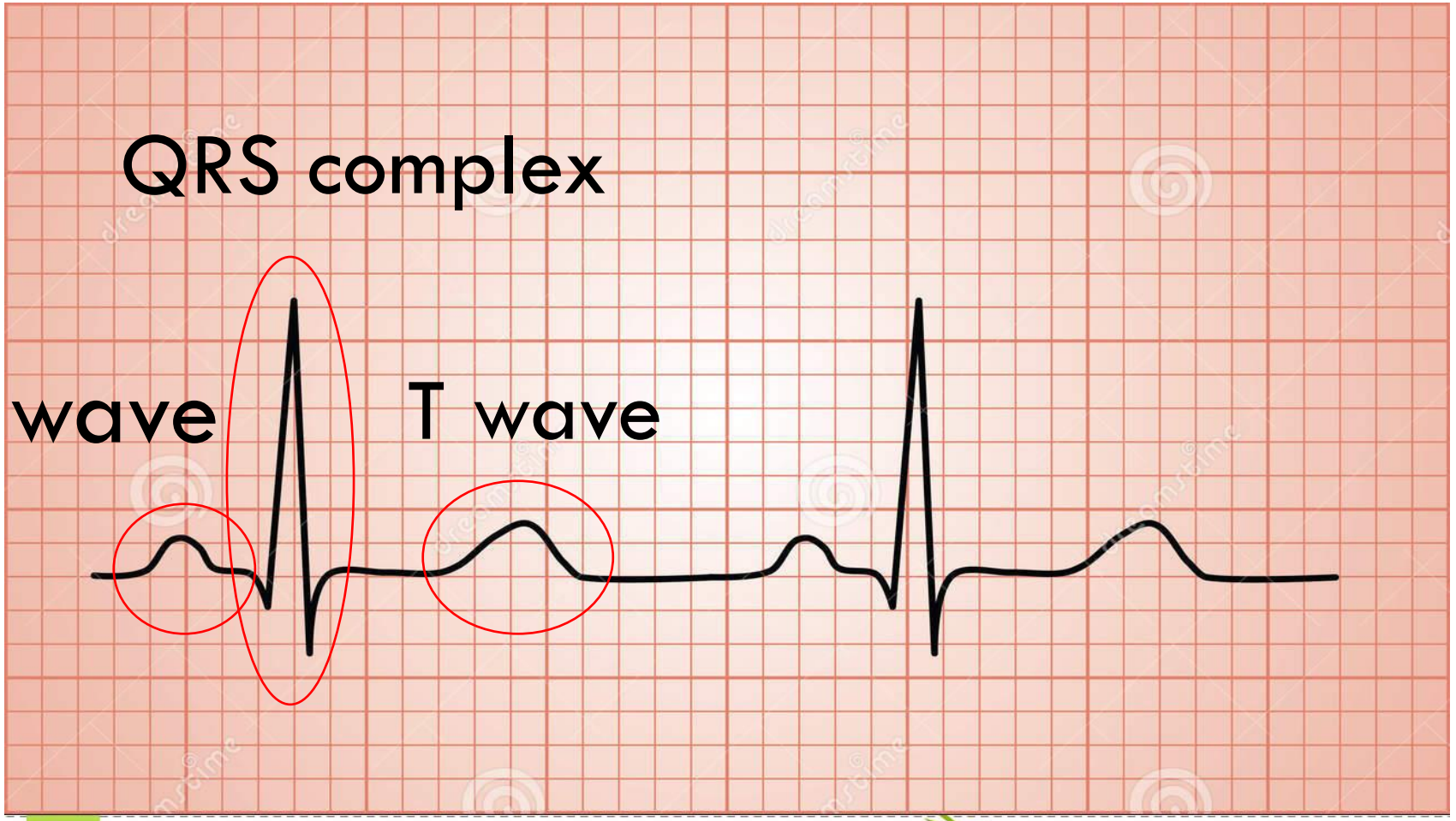
Nursing care for 12 lead ECG

- Instruct the patient to lie down on an examination table,

relax, still until the test is done

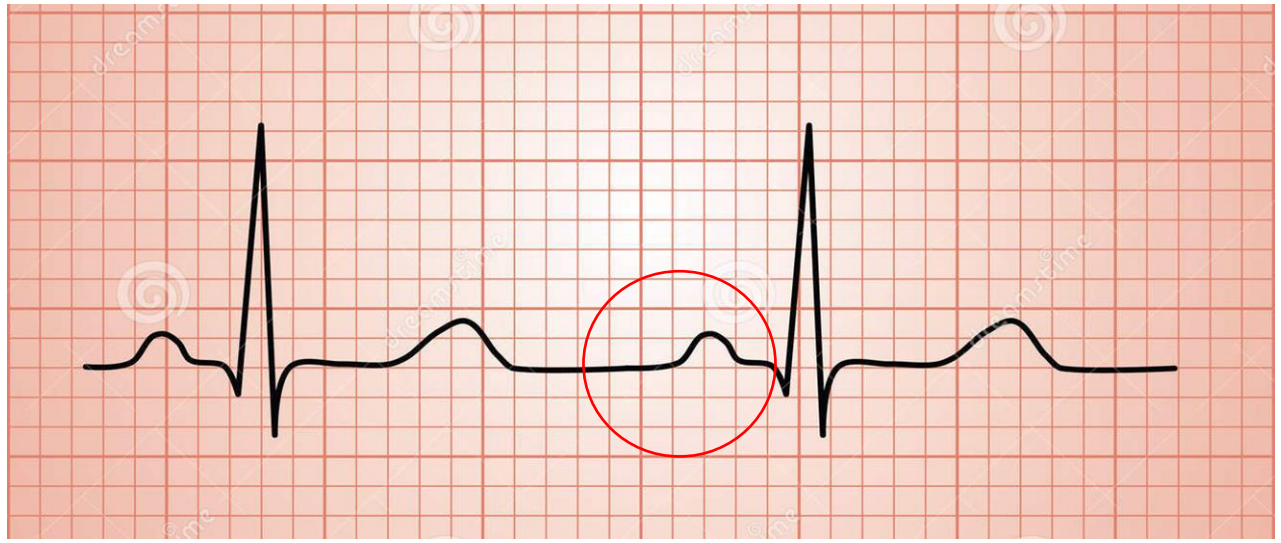
- Proper skin prep: trim or shave hair on skin
- Placement of the limb electrodes : clean the area to place leads
- Placement of the chest electrodes : clean the area to place leads

ECG



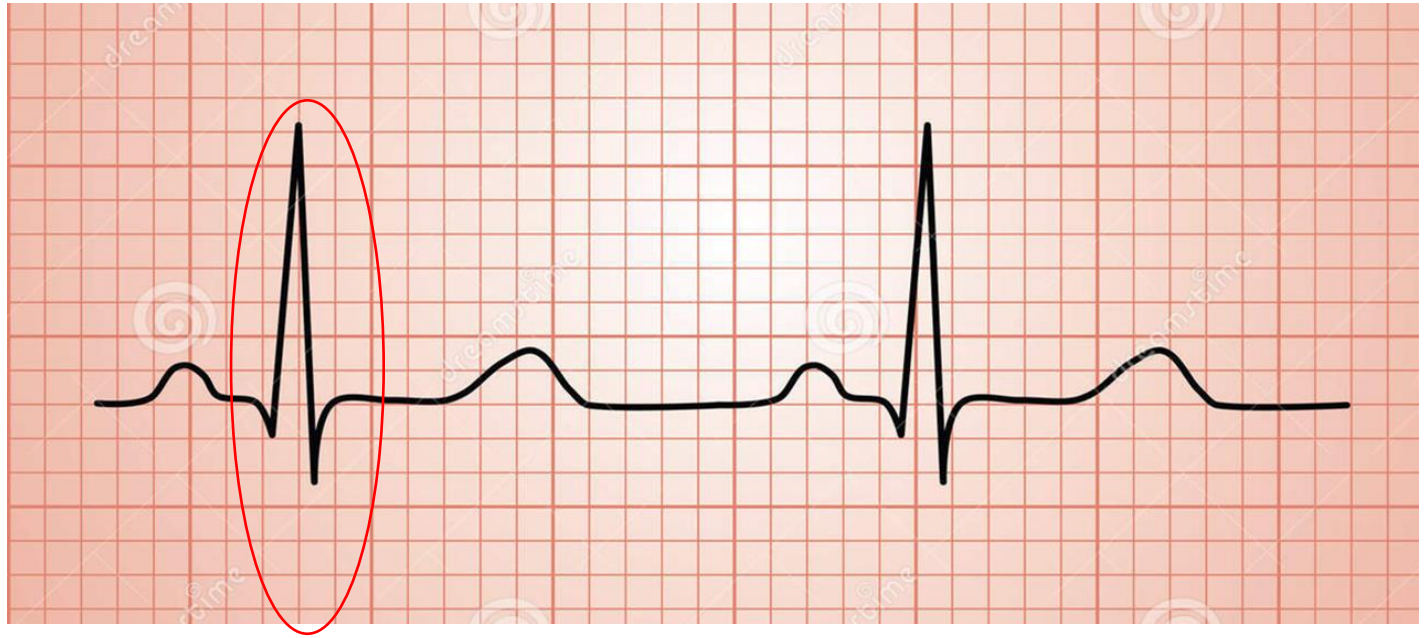
P wave

- Atrial Depolarization โดยเริ่ม จาก SA node กระจายไปทั่ว right atrium & left atrium
- ปกติกว้างไม่เกิน 0.12 sec
- ปกติหัวตั้งใน lead 1, 2, V4-V6, aVF และ หัวกลับในlead aVR
- variable in 3, aVL, other chest leads



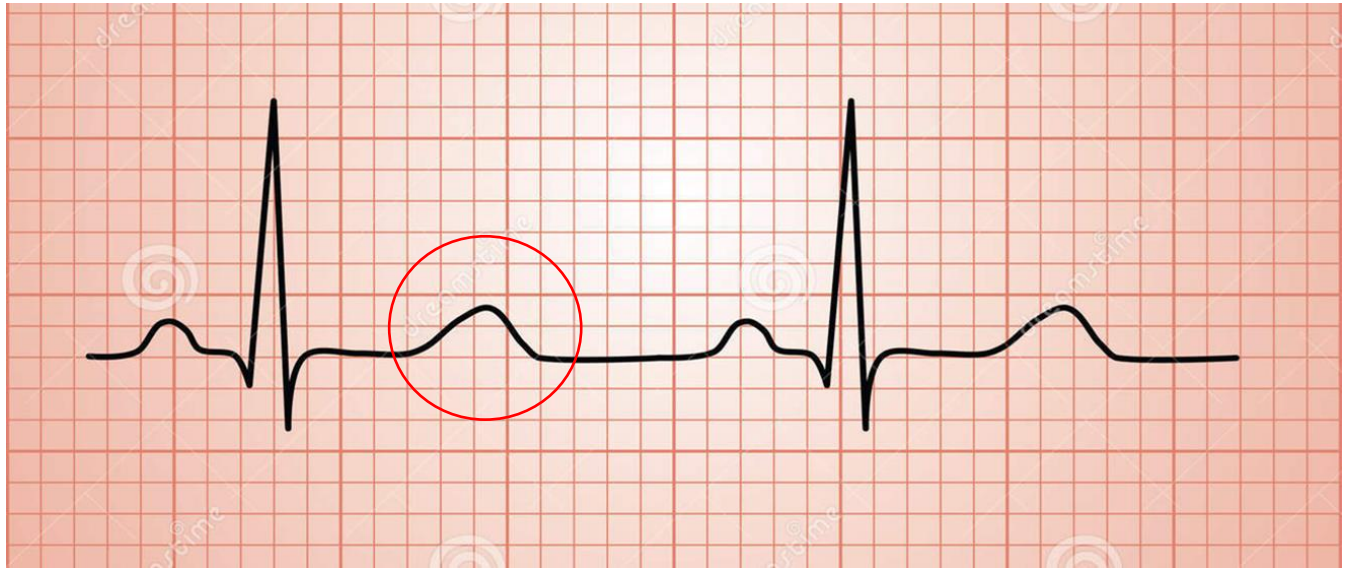
QRS complex

- เกิดจาก **ventricular depolarization**
- ปกติ 0.06-0.10 **sec** (**1**ช่องครึ่ง – 2 ช่องครึ่ง)

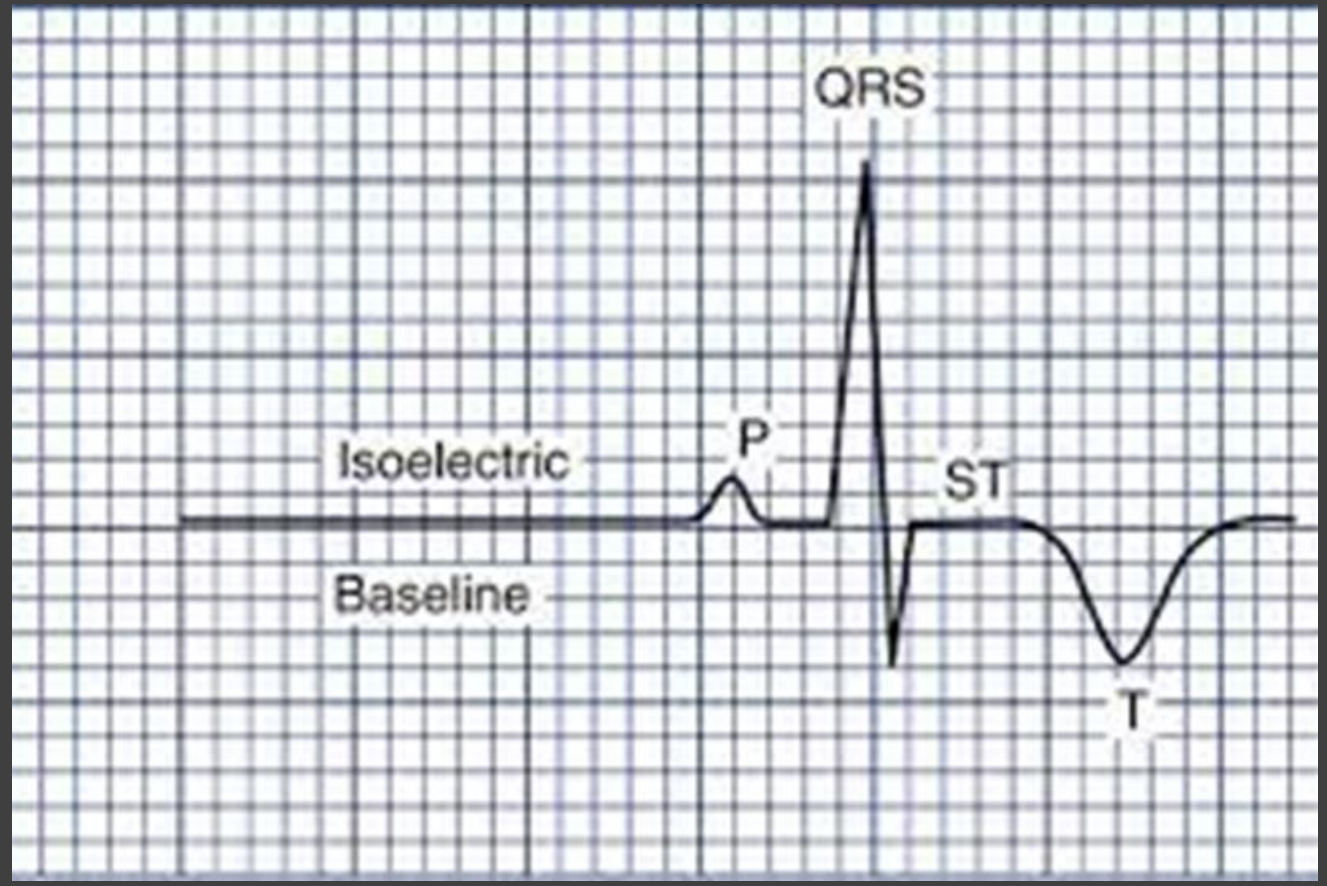


T wave

- เกิดจากventricular repolarization
- ปกติ upright ใน lead1, 2, V3 to V6, inverted in aVR, variable in lead 3, aVL, aVF, V1, V2 (inverted T in V1, V2 พบได้บ่อยรูปร่างปกติ T wave จะมนและไม่สมมาตรเล็กน้อย
- - ความสูงปกติไม่เกิน 5 mm in limb leads ไม่เกิน 10 mm in chest lead



Isoelectric Line

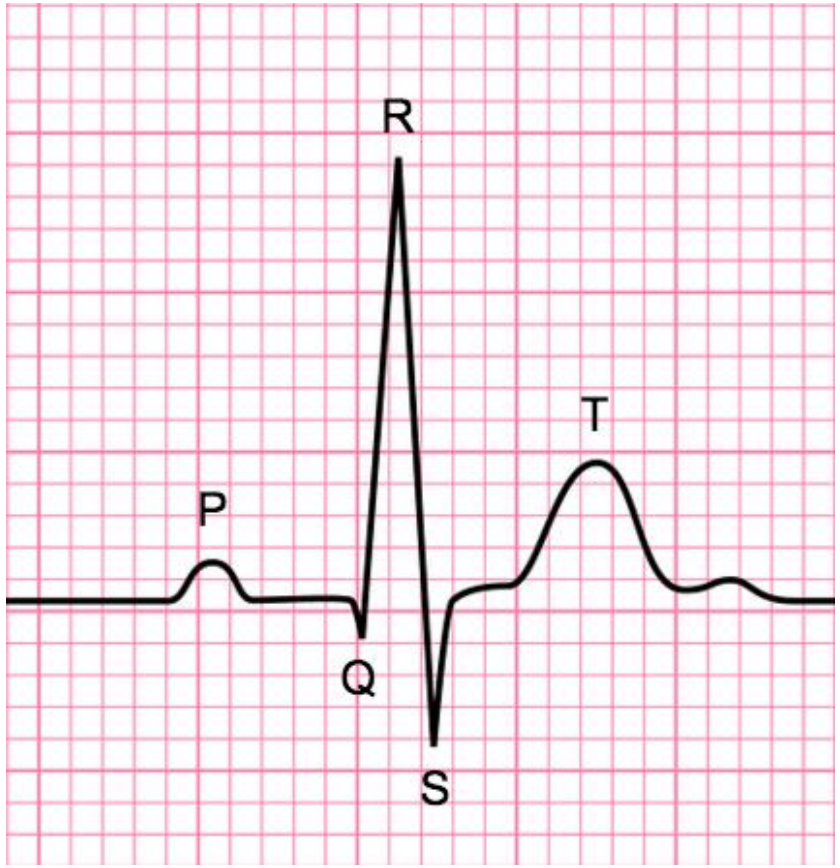


ECG wave & activity

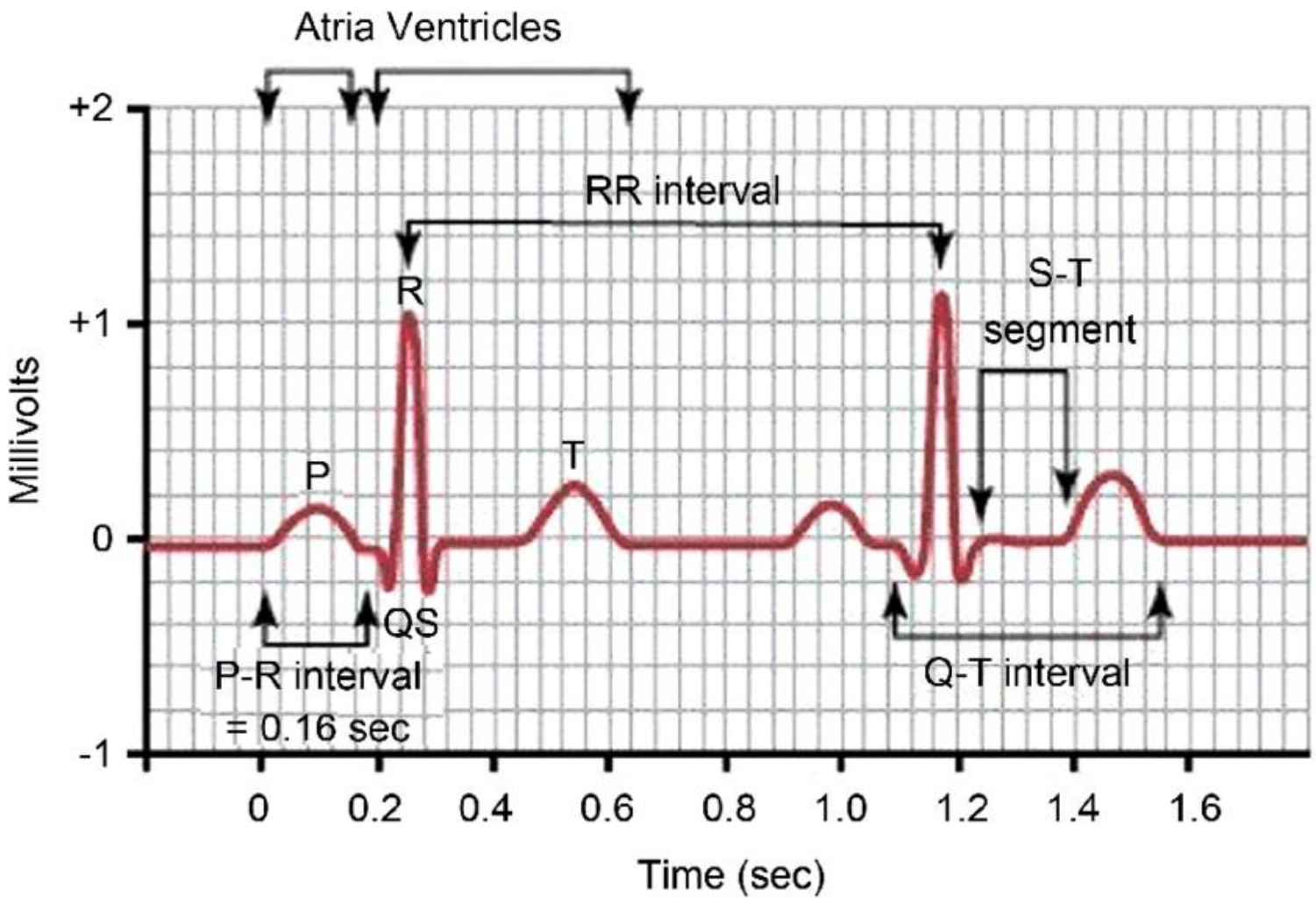
P wave : Atrial depolarization

QRS complex : Ventricular depolarization

T wave : Ventricular repolarization

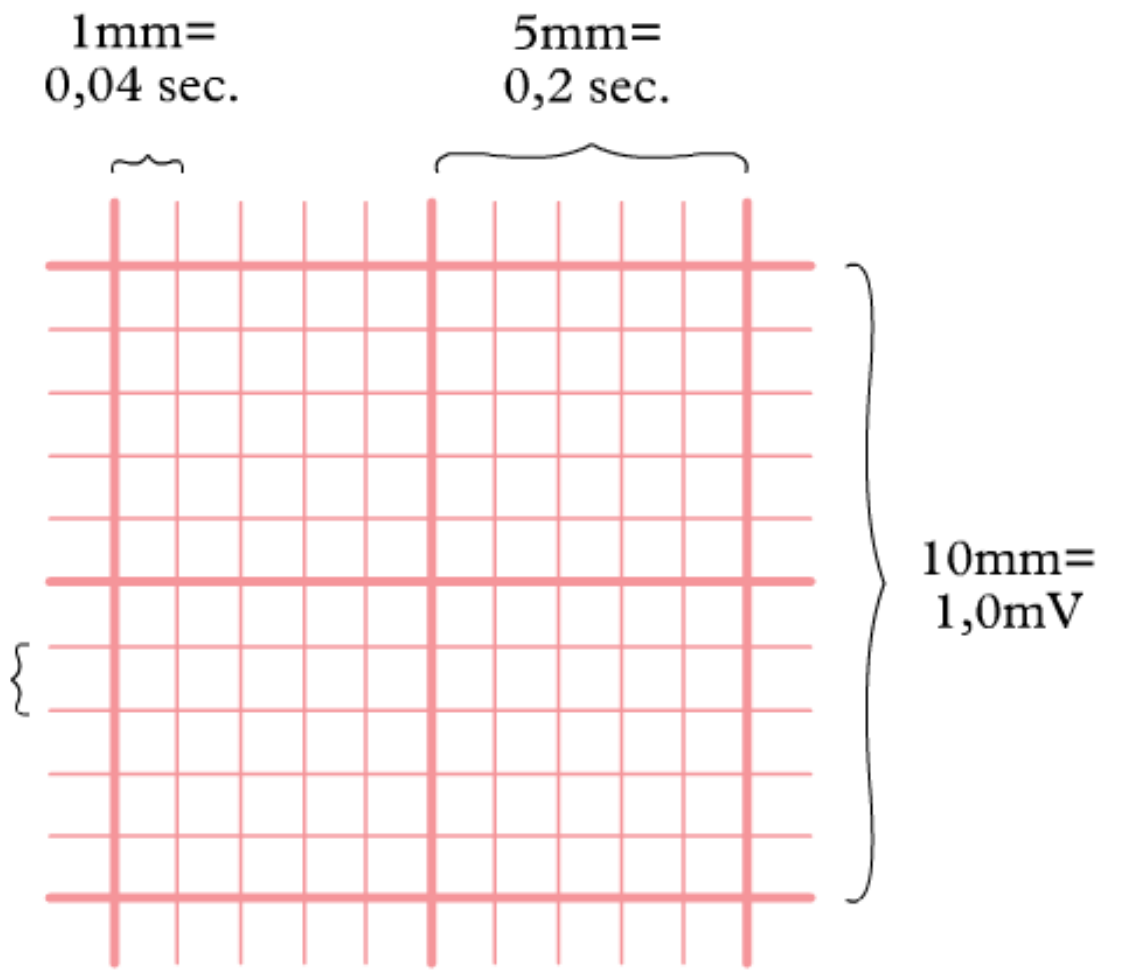


ECG Intervals & segments

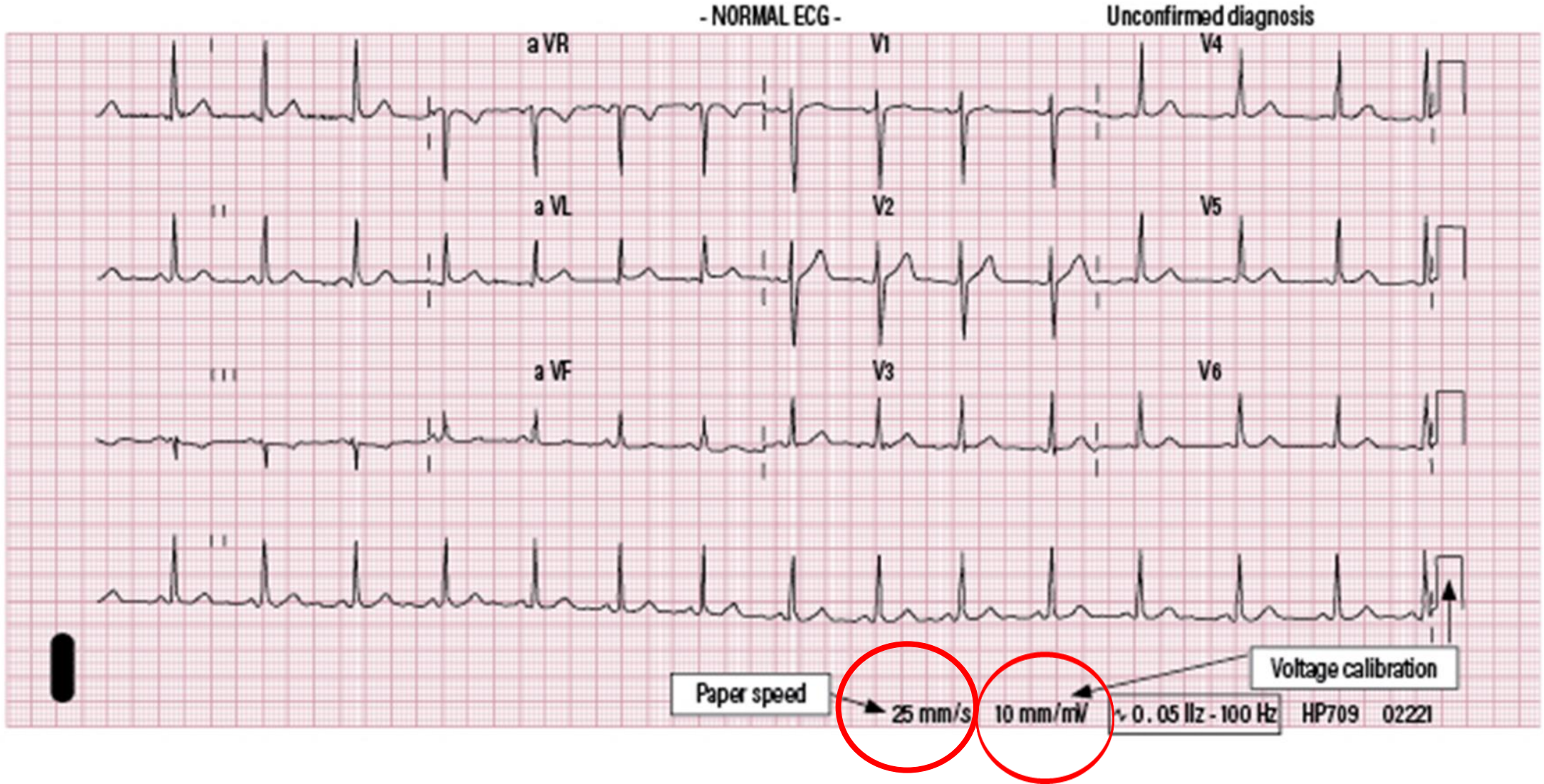


กระดาษบันทึกคลื่นไฟฟ้าหัวใจ

1 ช่องเล็ก = 1x1 mm, ความกว้างของ 1 ช่องเล็ก = 0.04 sec



A 12 -lead ECG Recording



ขั้นตอนการอ่านคลื่นไฟฟ้าหัวใจ

- ❑ Rhythm
- ❑ Rate
- ❑ ECG Wave
  - ❑ P - wave
  - ❑ PR interval
  - ❑ QRS complex
- ❑ Axis
- ❑ Hypertrophy : chamber enlargement
- ❑ ST-T change : infarction

Lead I	Lead aVF	Axis
+	+	Normal
-	+	Right axis deviation
+	-	Left axis deviation
-	-	Indeterminated axis

การคำนวน Heart Rate

Regular ECG

- Rule of 300
- RR Method

Irregular ECG

- 6, 10 - second rule

Rule of 300

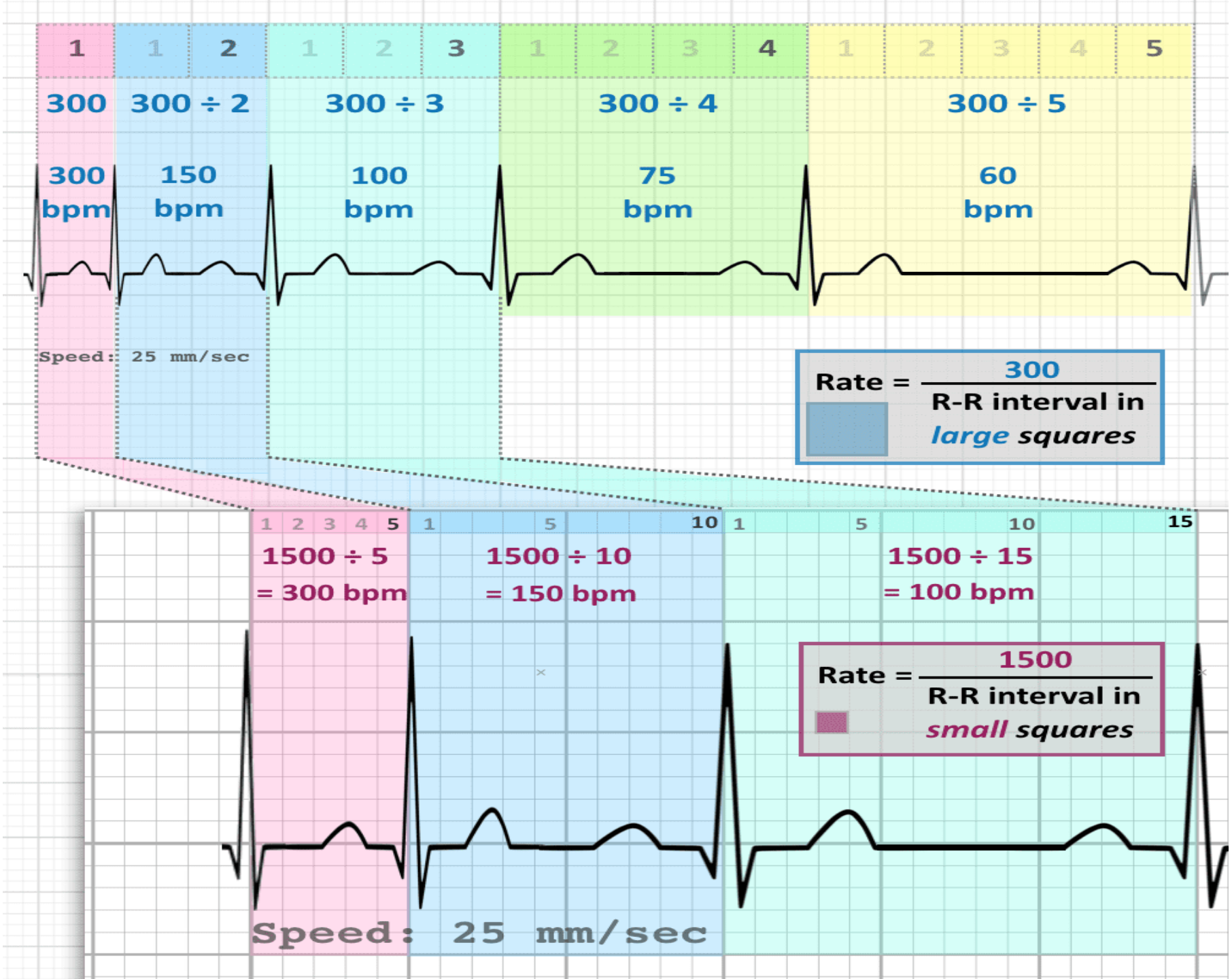
นับจำนวนช่องใหญ่ (5 mm) ระหว่าง RR interval 2 ตัวติดกัน

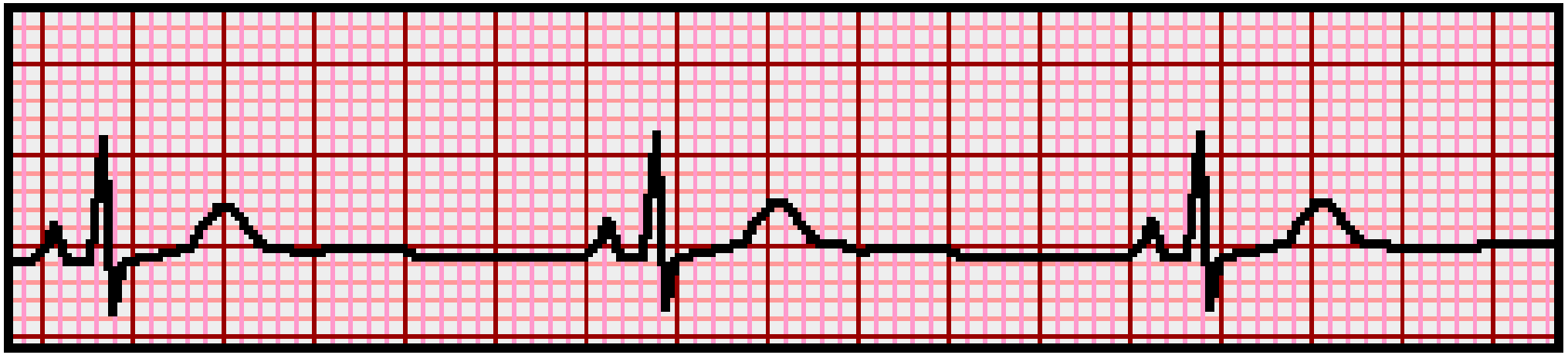
นำเลขที่ได้ไปหาร 300 (จำนวนช่องใหญ่ใน 1 นาที)

The Rule of 300

It may be easiest to memorize the following table:

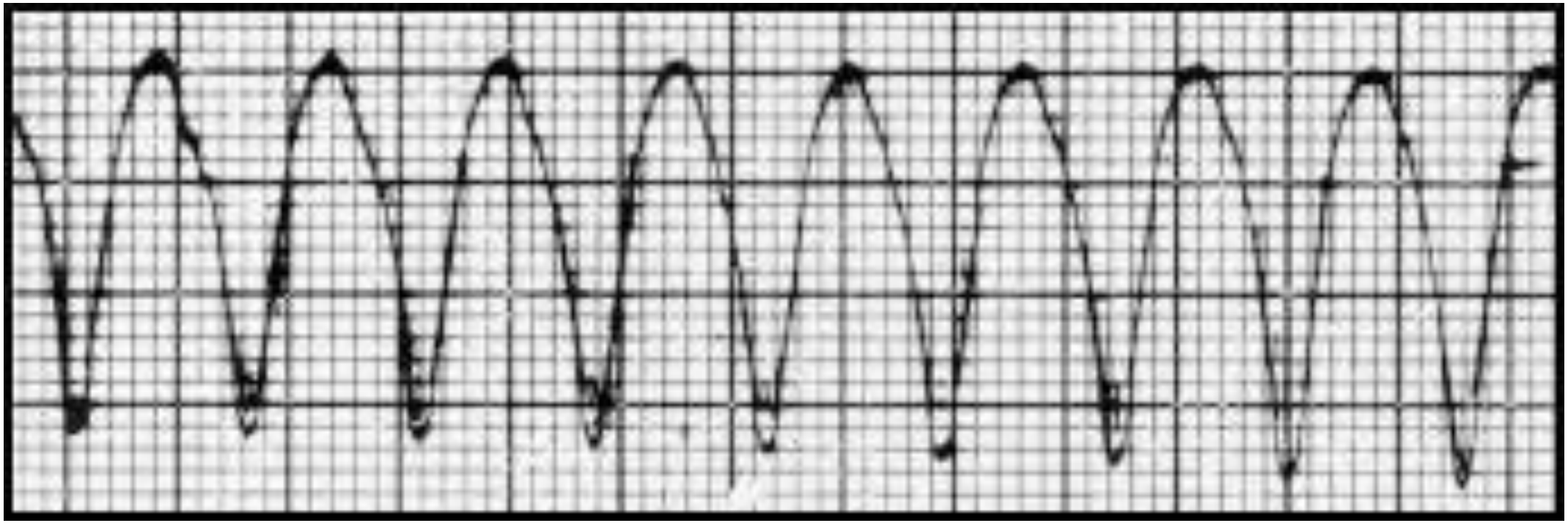
# of big boxes	Rate
1	300
2	150
3	100
4	75
5	60
6	50


1
1 2
1 2 3
1 2 3 4
1 2 3 4 5
300
300 ÷ 2
300 ÷ 3
300 ÷ 4
300 ÷ 5
300 bpm
150 bpm
100 bpm
75 bpm
60 bpm
Speed: 25 mm/sec
Rate = 300 / R-R interval in large squares
1 2 3 4 5
1 5 10
1 5 10 15
1500 ÷ 5 = 300 bpm
1500 ÷ 10 = 150 bpm
1500 ÷ 15 = 100 bpm
Rate = 1500 / R-R interval in small squares
Speed: 25 mm/sec



What is the heart rate?

(300 / 6) = 50 bpm



What is the heart rate?

(300 / 1.5) = 200 bpm

RR method

นับจำนวนช่องเล็ก ใน RR interval ที่อยู่ 2 ตัว ติดกัน

นำไปหาร 1500 (จำนวนช่องเล็กใน 1 นาที)

จะได้อัตราการเต้นของหัวใจโดยประมาณ

10 Second Rule

ใช้กับ **Irregular rhythm**

ให้นับจำนวนของ **QRS complex** หรือ **R wave** ในกระดาษบันทึกในห้วงเวลา **10 sec**

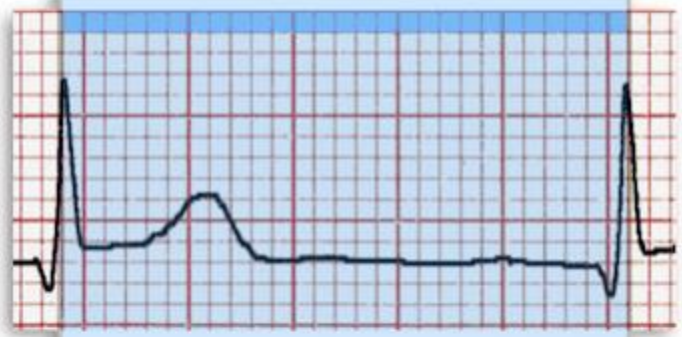
นำเลขที่นับได้ คูณด้วย 6

What is the heart rate?

- The Alan E. Lindsay ECG Learning Center ; http://medstat.med.utah.edu/kw/ecg/

33 x 6 = 198 bpm

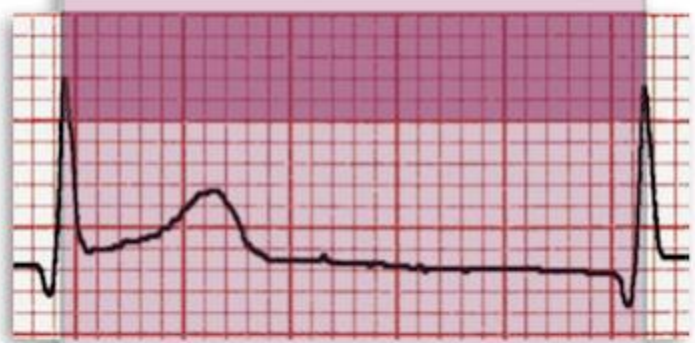
27 **SMALL** squares



$$\frac{1500}{27} = 55.6$$

= **56 bpm**

5.4 **LARGE** squares



$$\frac{300}{5.4} = 55.6$$

= **56 bpm**

9 x **R waves**

9 beats in **10 seconds**

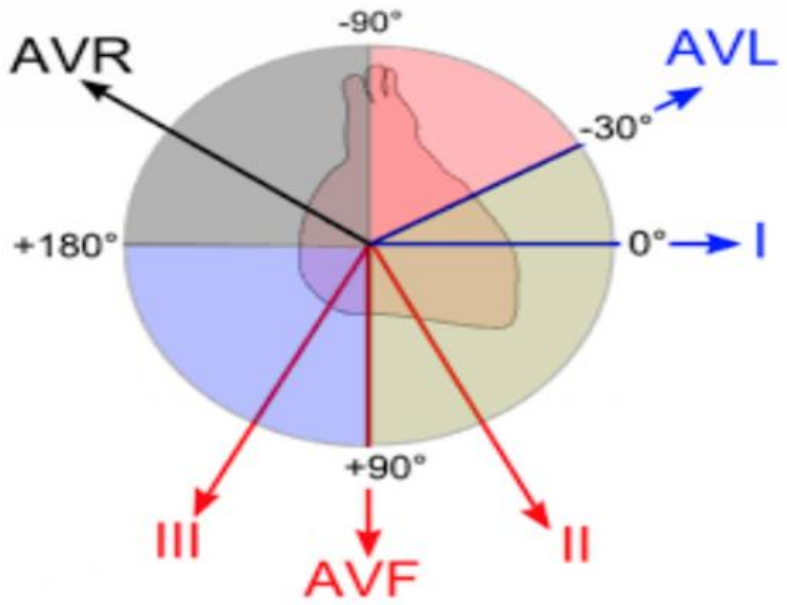
= **9** x **6** beats in **1 minute**

= **54 bpm**

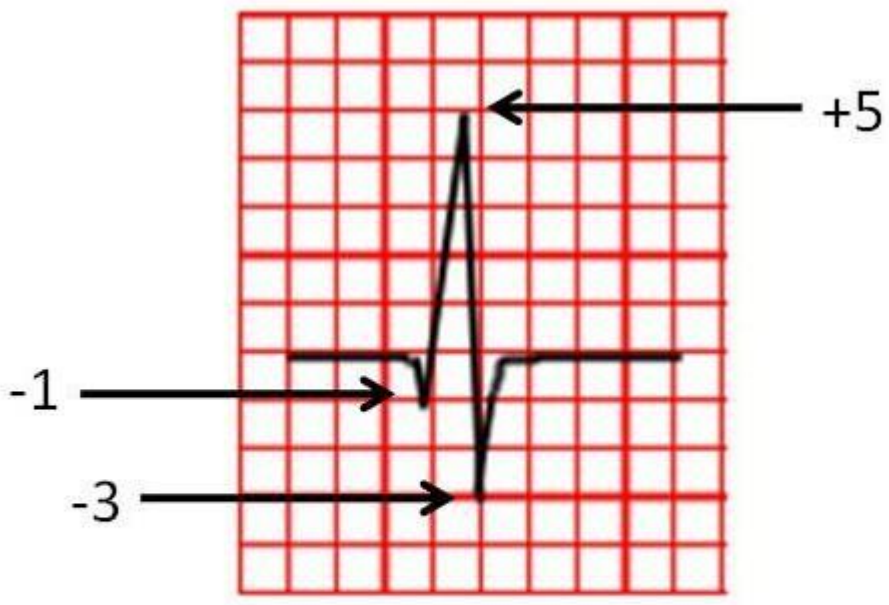
Speed: 25 mm/sec

Axis

- QRS axis normal = 0-90 degree
- QRS voltage normal > 5 mm in limb leads, > 10 mm in chest leads
- R wave progression ปกติ R และ S wave จะมีขนาดใกล้เคียงกันใน lead V3-V4

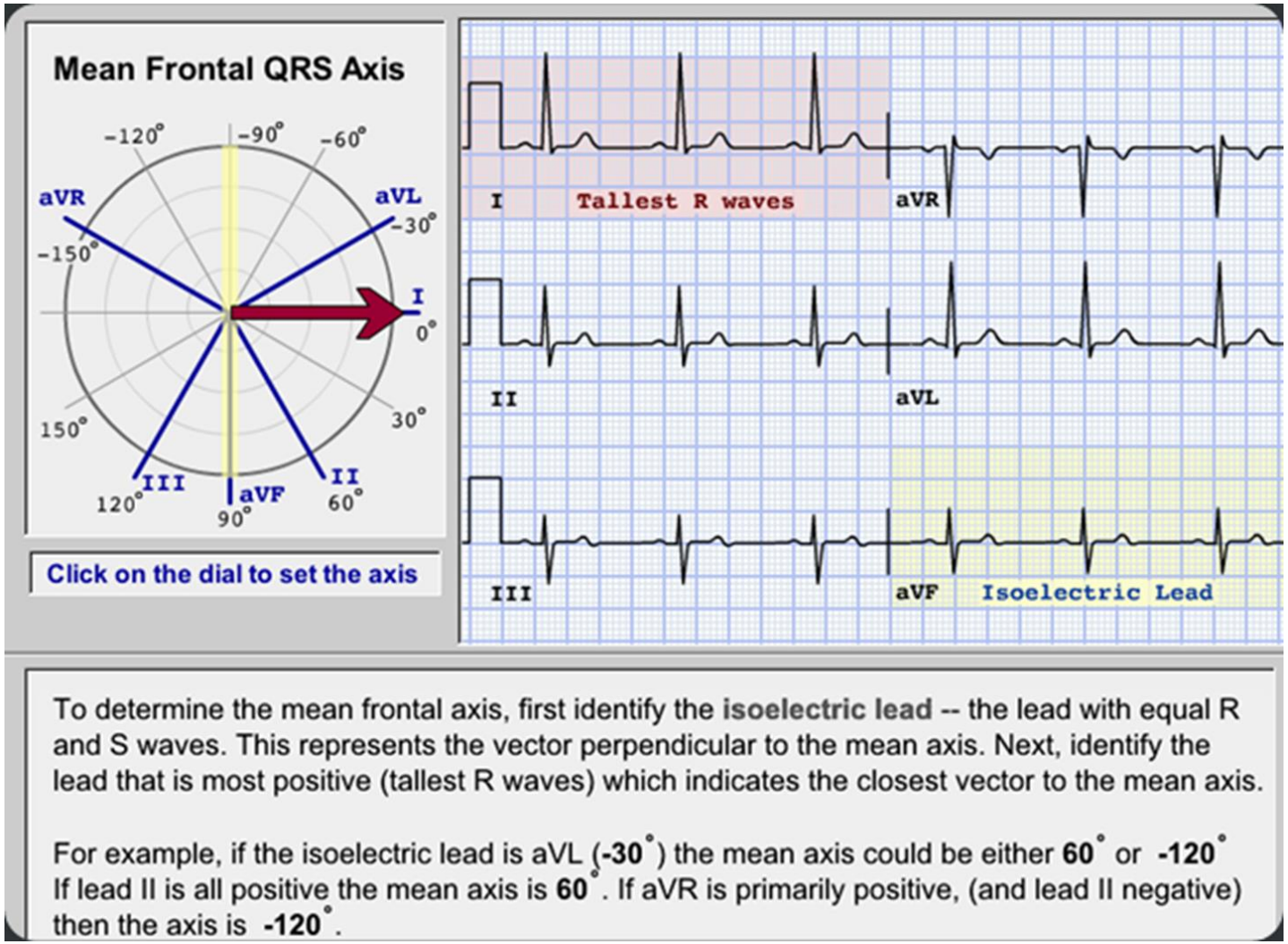


Lead I	Lead aVF	Axis
+	+	Normal
-	+	Right axis deviation
+	-	Left axis deviation
-	-	Indeterminated axis



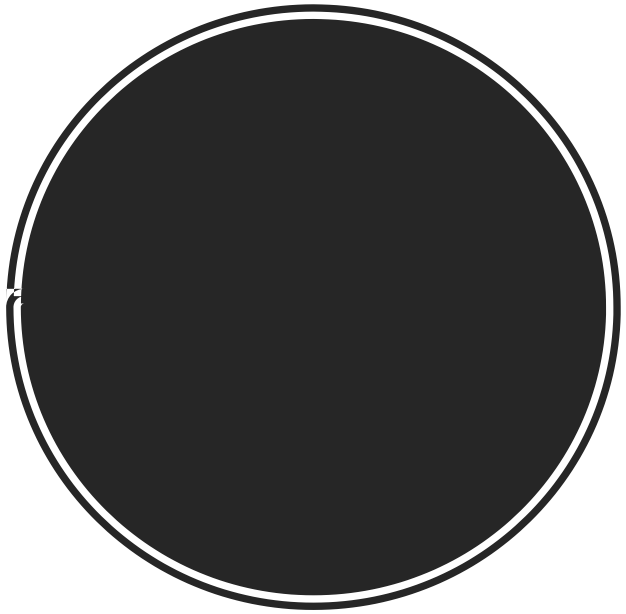
Net deflection = 5 – 1 – 3
= +1

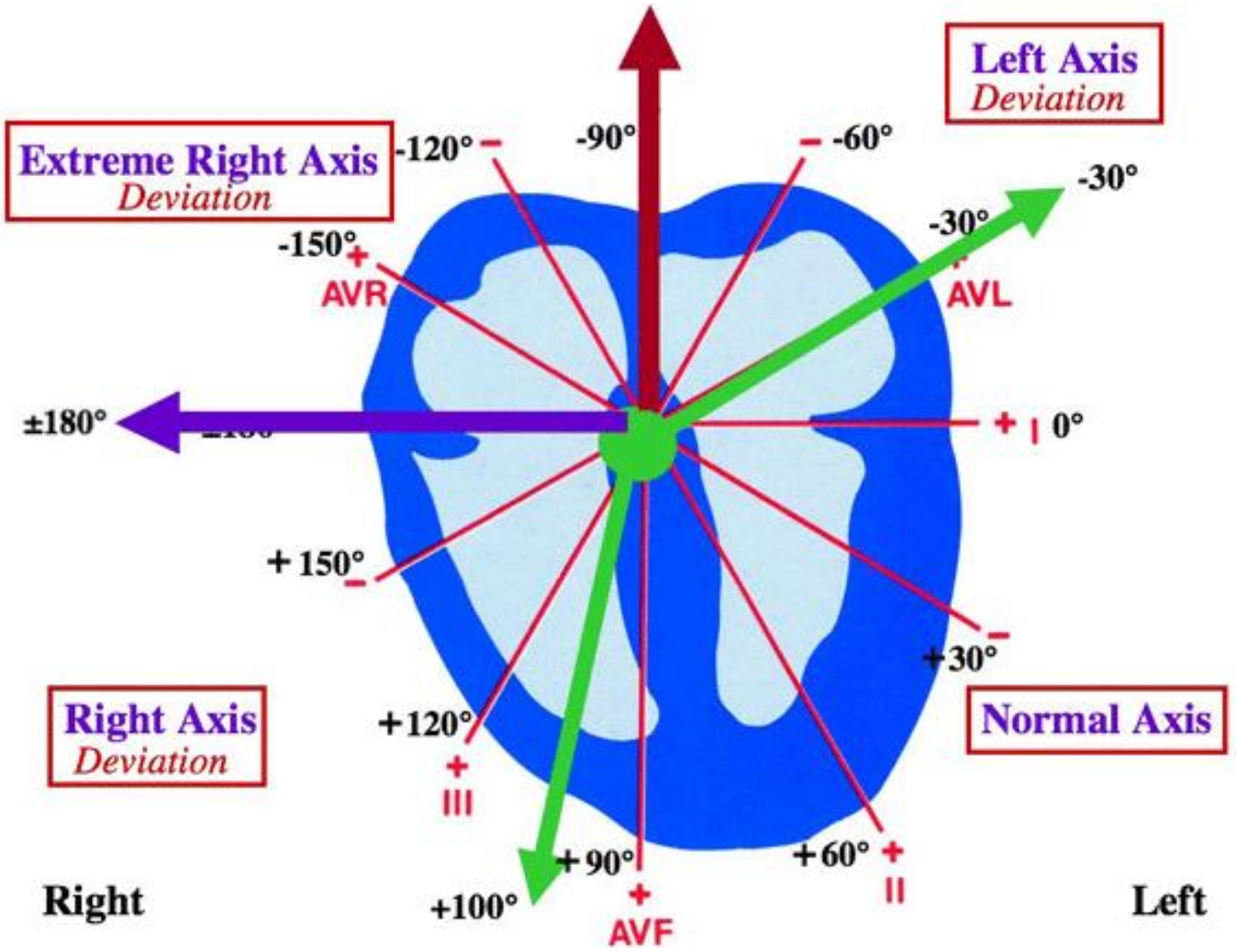
QRS Deflection		Axis
Lead I	Lead aVF	
+	+	Normal
+	-	LAD
-	+	RAD
-	-	Extreme Axis

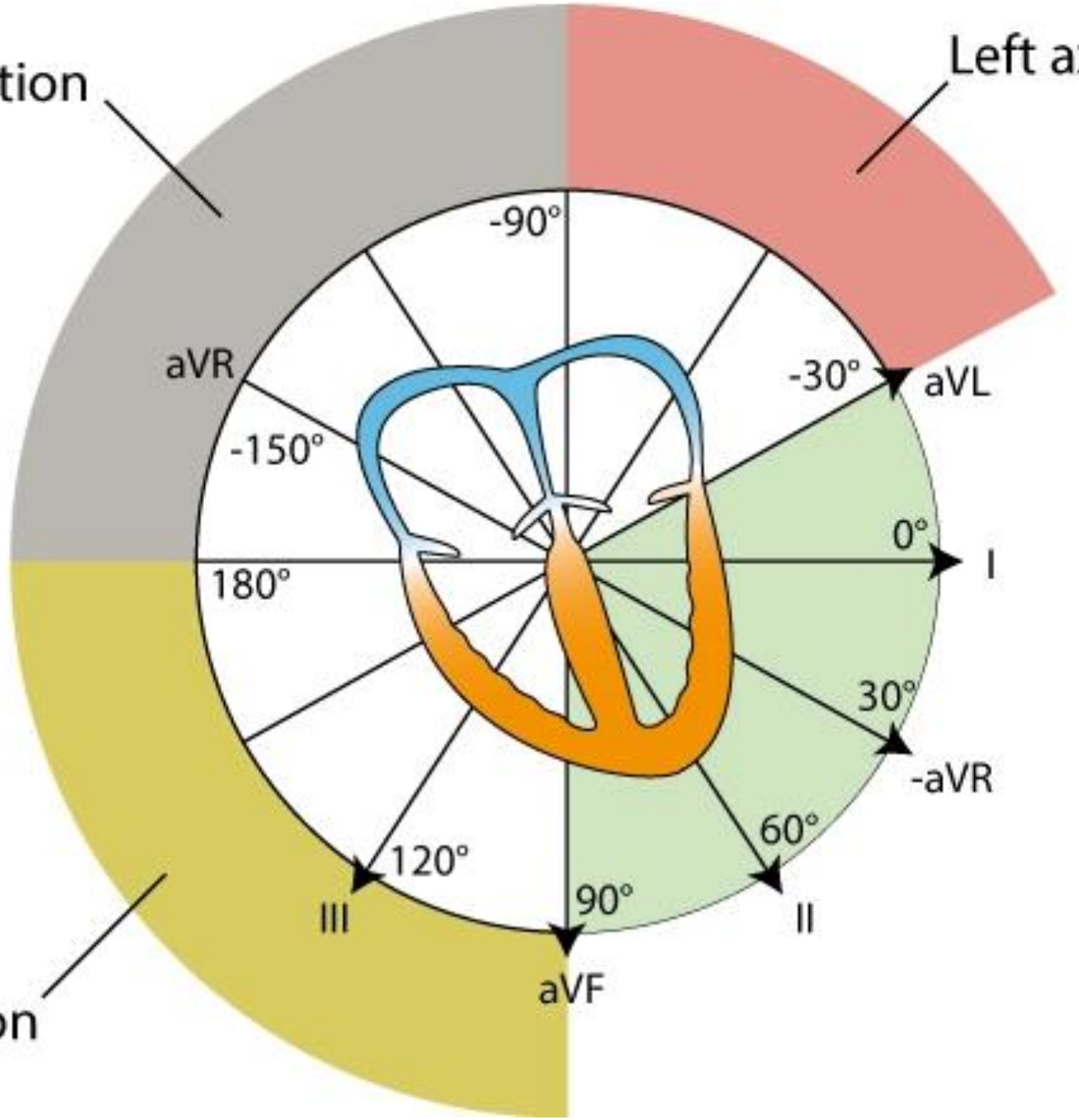


To determine the mean frontal axis, first identify the **isoelectric lead** -- the lead with equal R and S waves. This represents the vector perpendicular to the mean axis. Next, identify the lead that is most positive (tallest R waves) which indicates the closest vector to the mean axis.

For example, if the isoelectric lead is aVL (**-30°**) the mean axis could be either **60°** or **-120°**
If lead II is all positive the mean axis is **60°**. If aVR is primarily positive, (and lead II negative) then the axis is **-120°**.

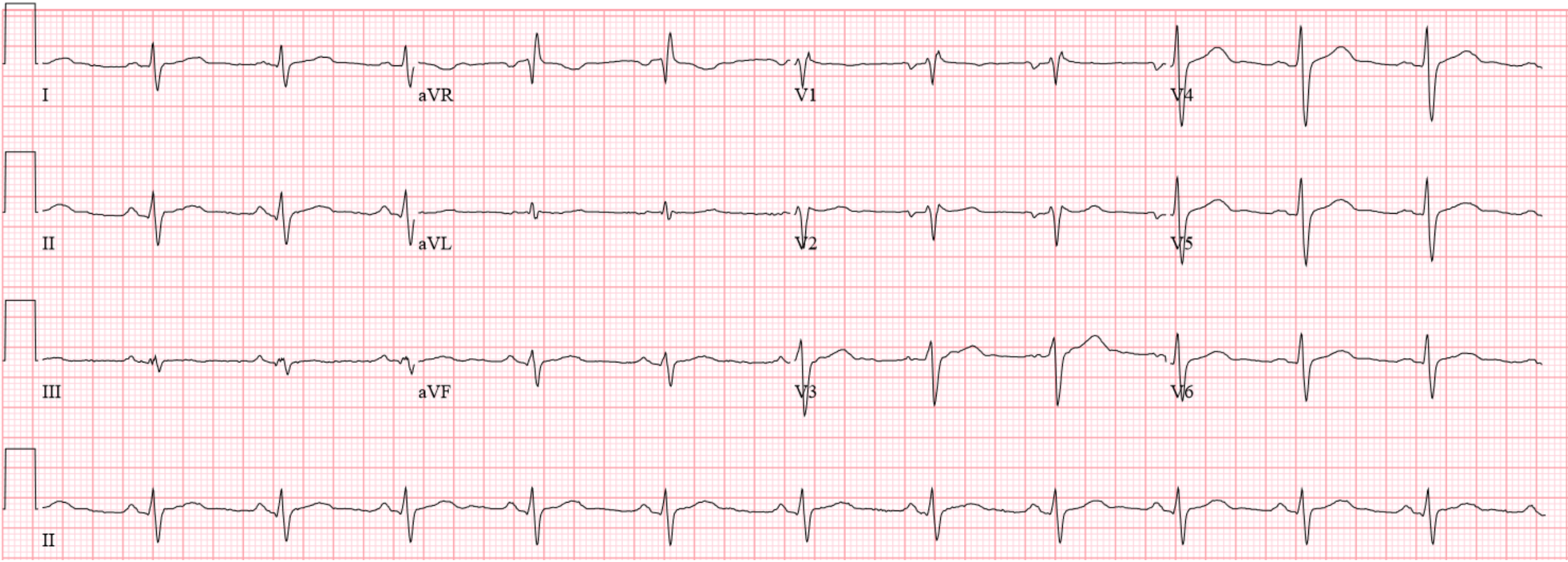



Left Axis
Deviation
Extreme Right Axis
Deviation
-120°
-90°
-60°
-30°
-150°
AVR
AVL
±180°
0°
+150°
+30°
Right Axis
Deviation
Normal Axis
+120°
III
+90°
+60°
II
+100°
AVF
Right
Left

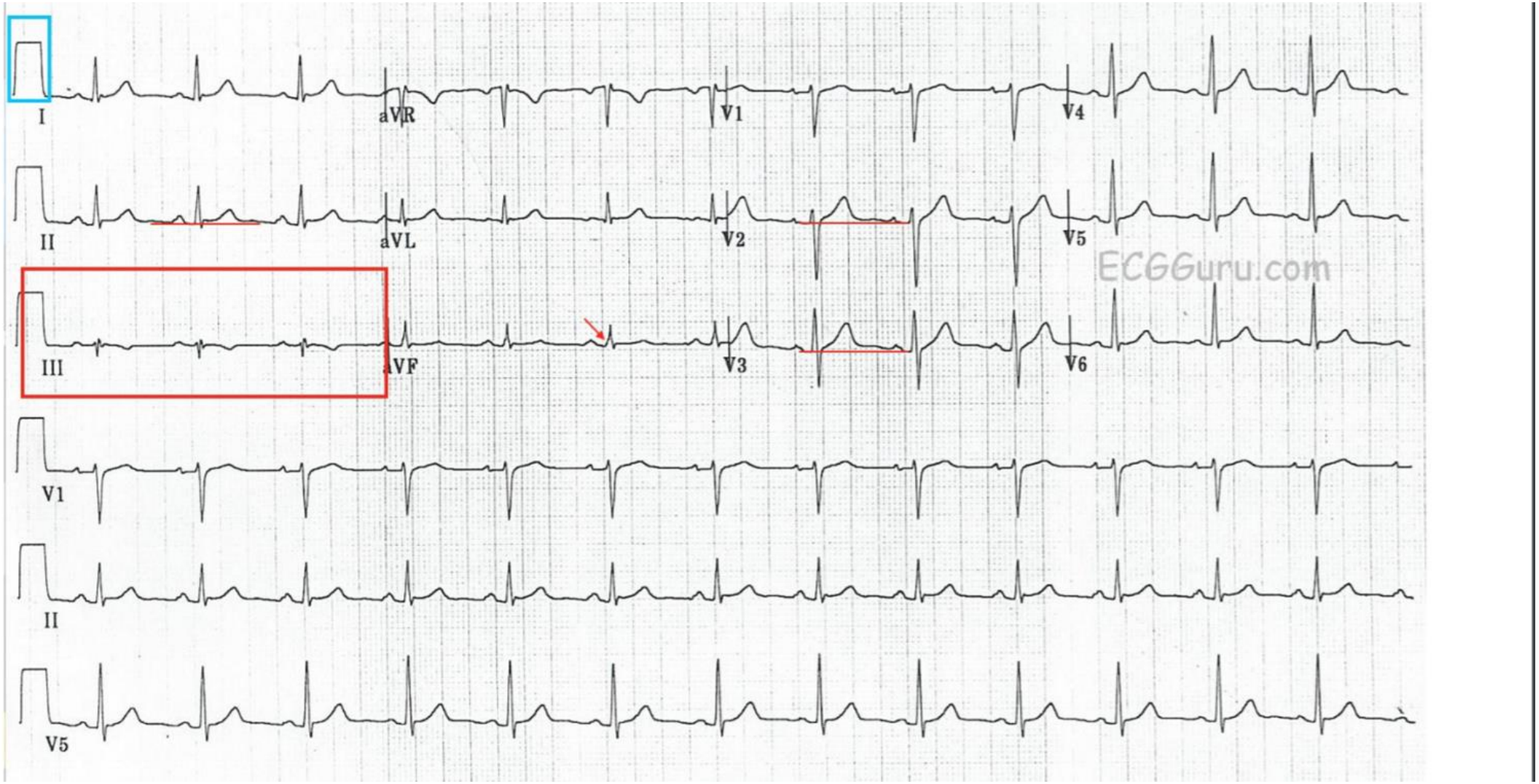


Normal electrical axis ranges between -30° to 90° (green area).

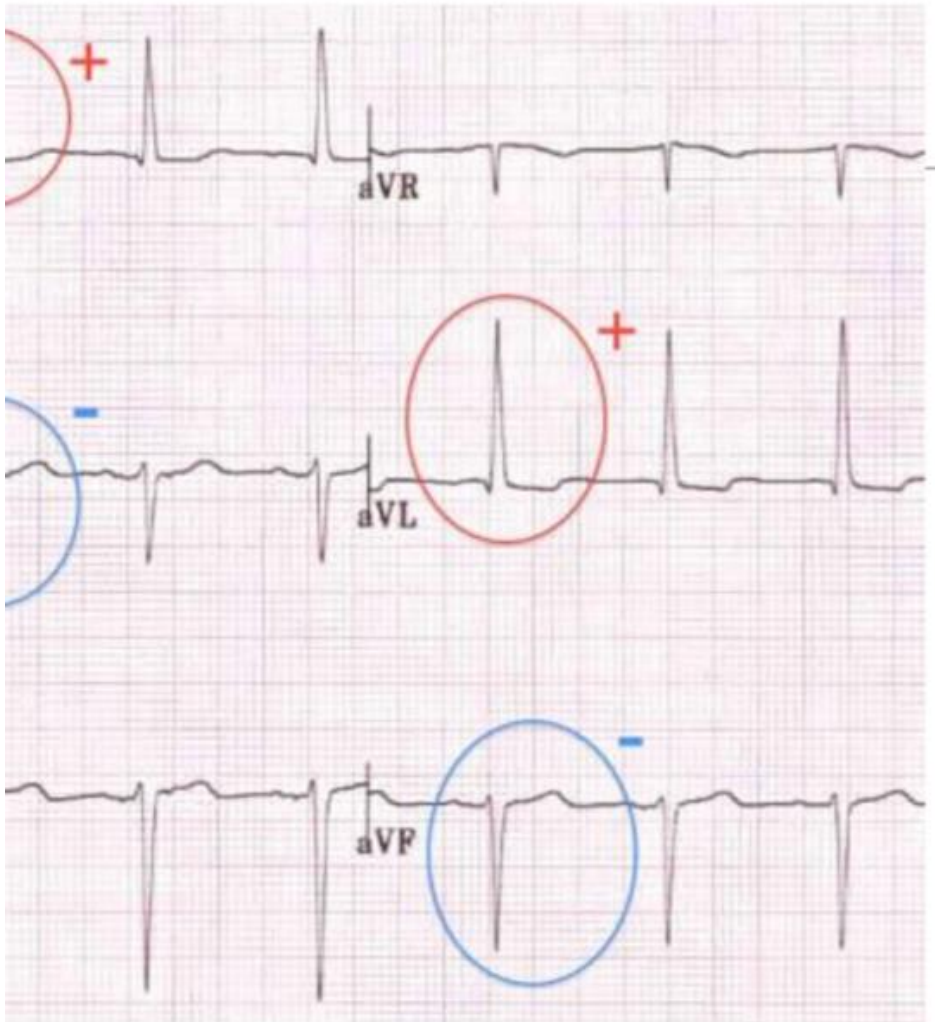
No Mans land

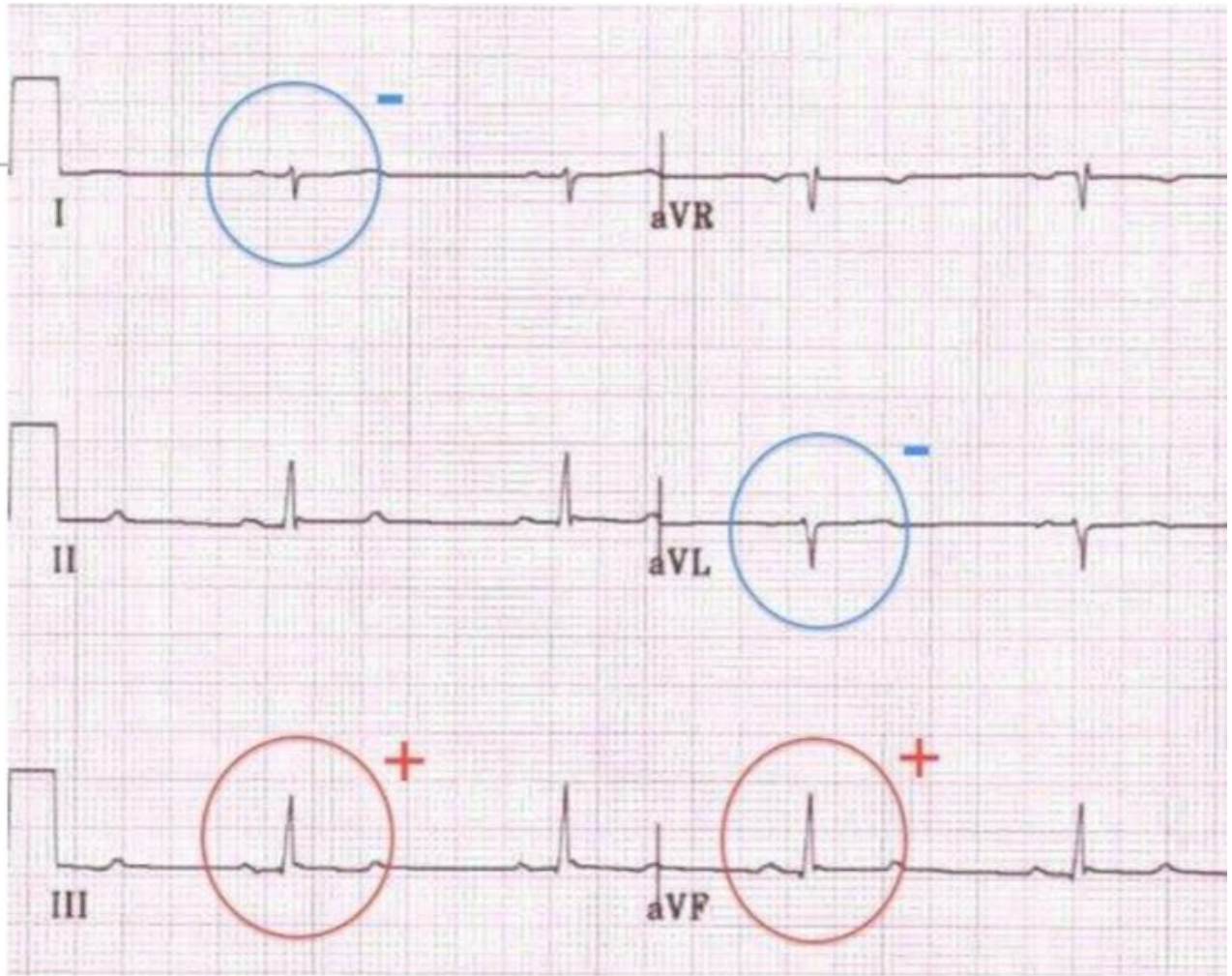


I = -, aVF = -



I = +, aVF = +, normal





LAD

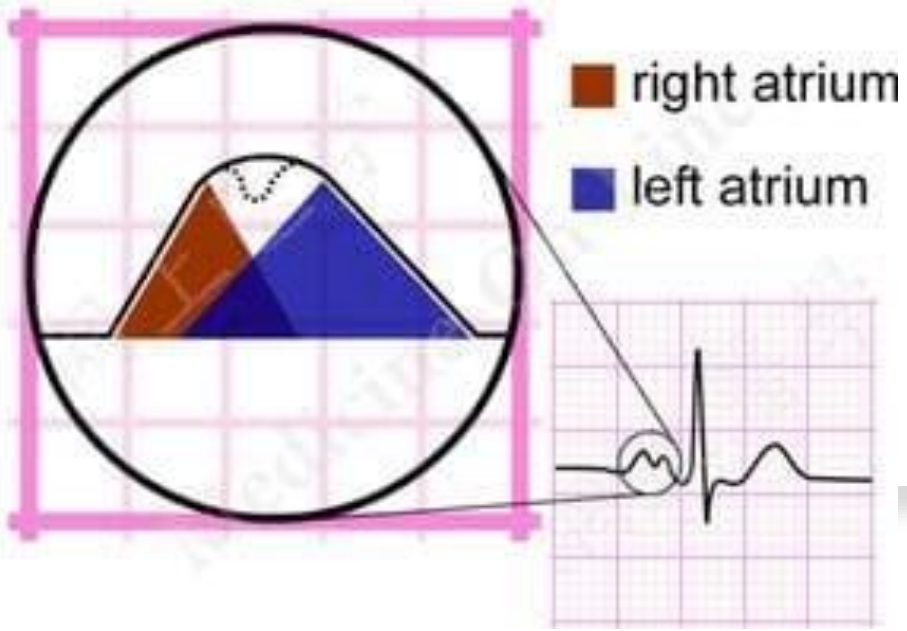
RAD

Enlargement & Hypertrophy

ECG will show changes in duration & amplitude of wave forms

Electrical activity takes longer to activate muscle

Enlargement



➢ **Enlargement**

: Occurs as result of volume overload where chamber dilates to accommodate increased blood volume

: Enlargement associated with atrial

: P wave changes used to identify atrial enlargement

Chamber enlargement

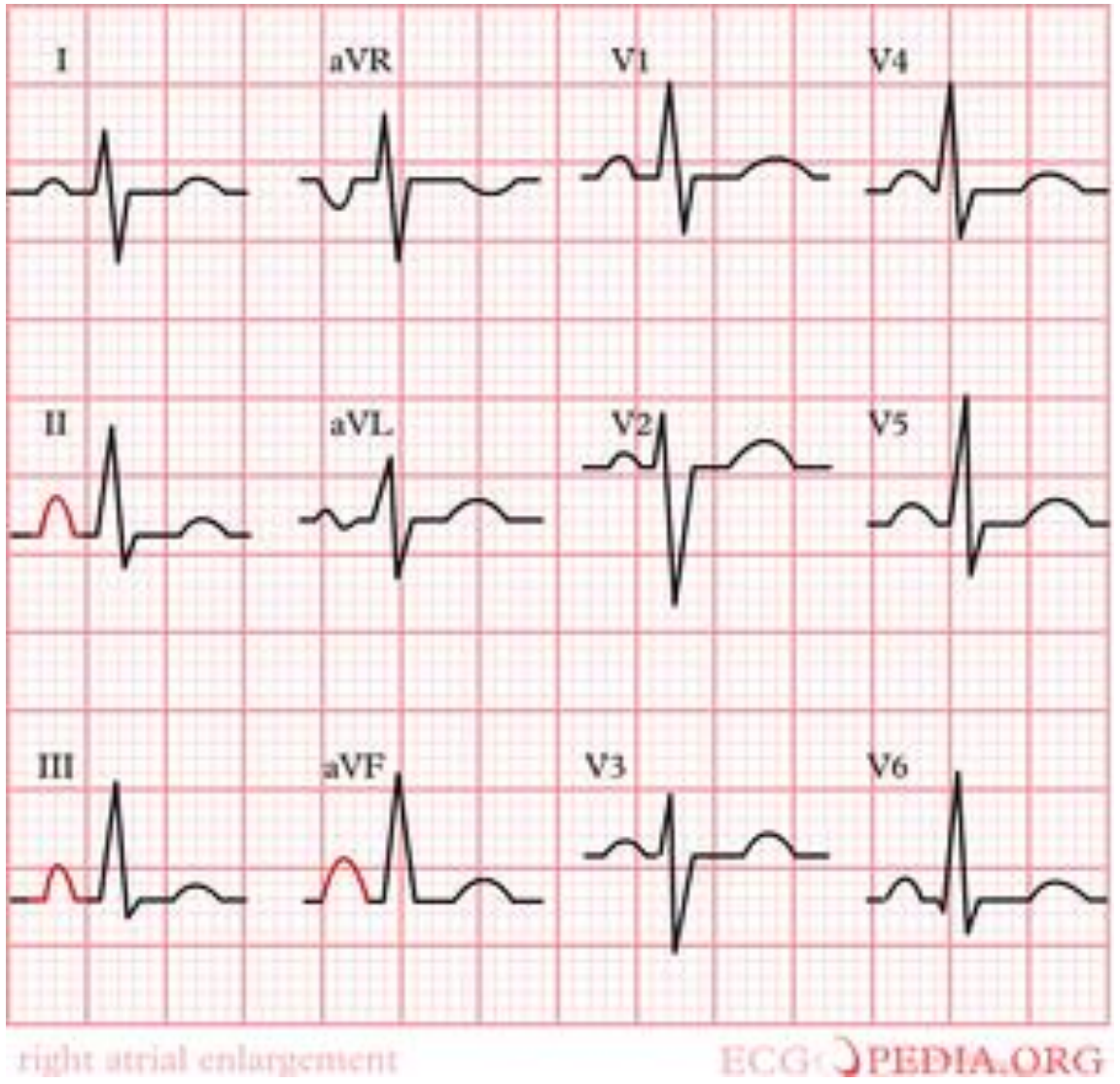
❑ ATRIAL ENLARGEMENT

➢left atrium

- P wave กว้างมากกว่า 0.12 sec (3 mm),
- notched P wave

➢Right atrium

- Peak P wave มากกว่า 2.5 mm



Abnormal P-waves

P-mitrale

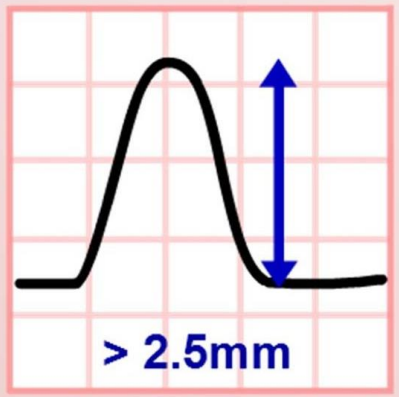
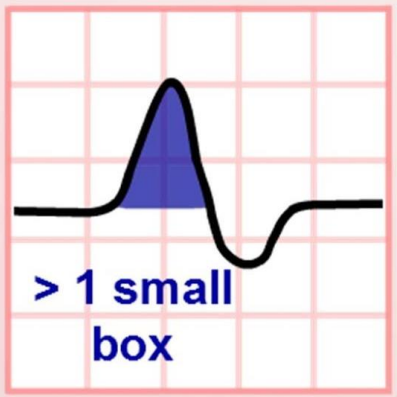
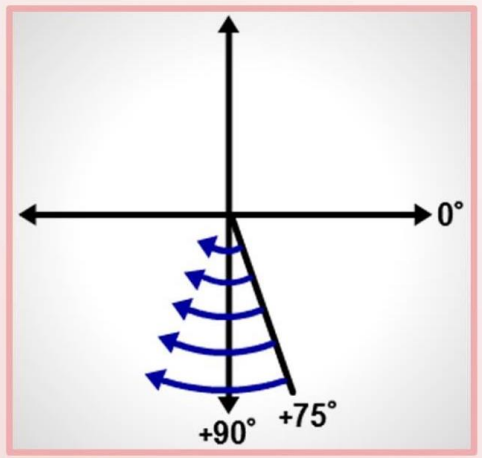
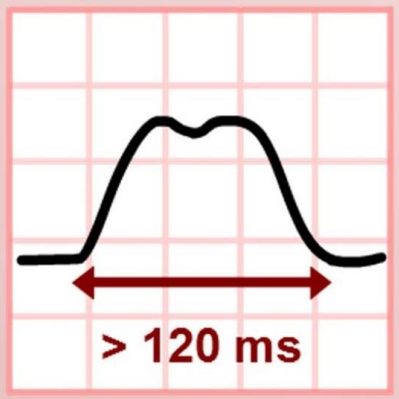
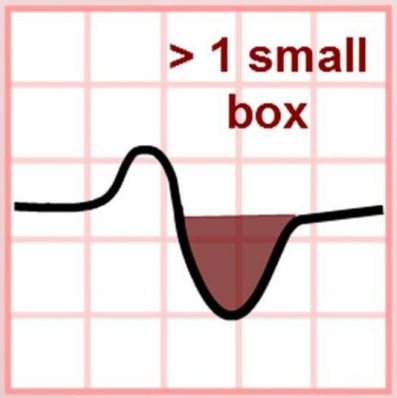
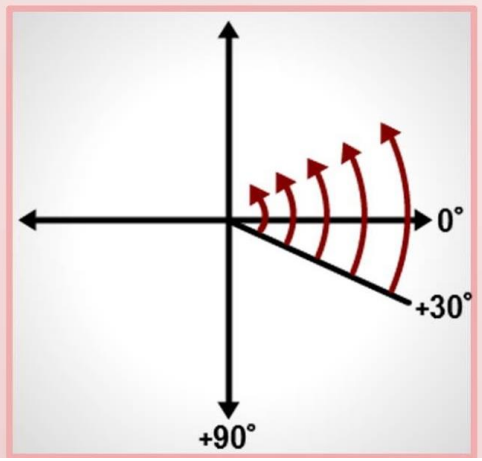
P mitrale is a consequence of left atrial enlargement (often caused by mitral stenosis). Enlargement of the left atrium amplifies its contribution to the contour of the P wave.

Enhanced second hump in lead II.

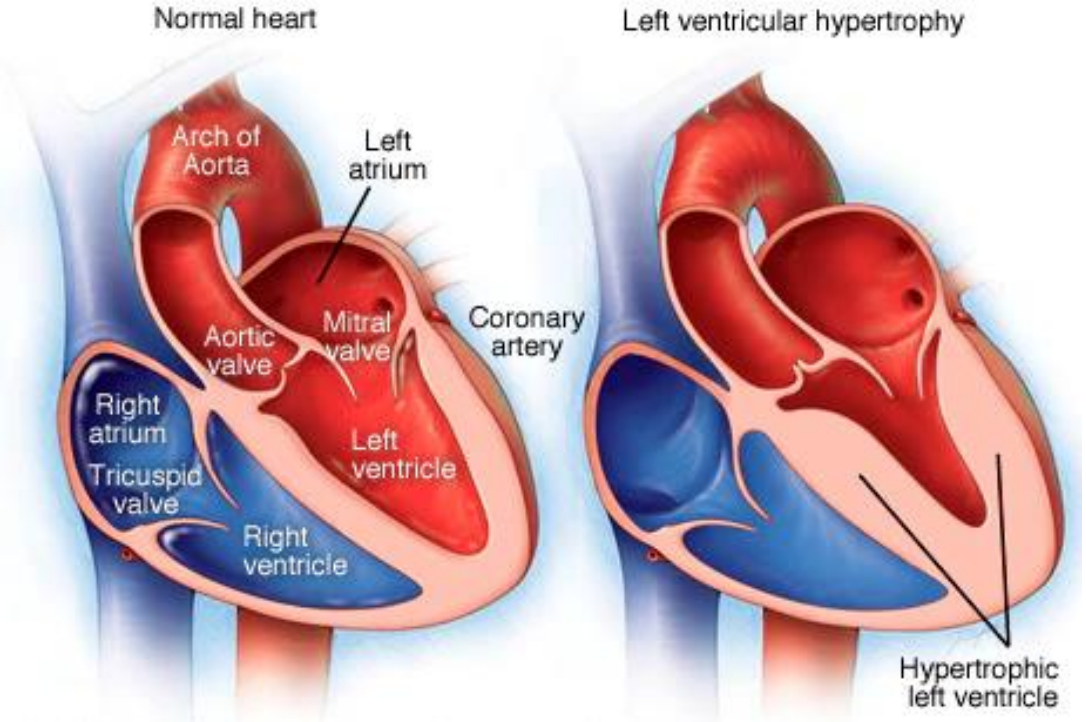
Enhanced negative deflection in V1.

P-pulmonale

P pulmonale is a consequence of right atrial enlargement. This is often a consequence of pulmonary valve stenosis or increased resistance in the pulmonary circulation. Enlargement of the right atrium causes an increased P wave amplitude in both leads.

	Lead II	Lead V_1	P wave axis
Right Atrial Enlargement			
Left Atrial Enlargement			

Hypertrophy

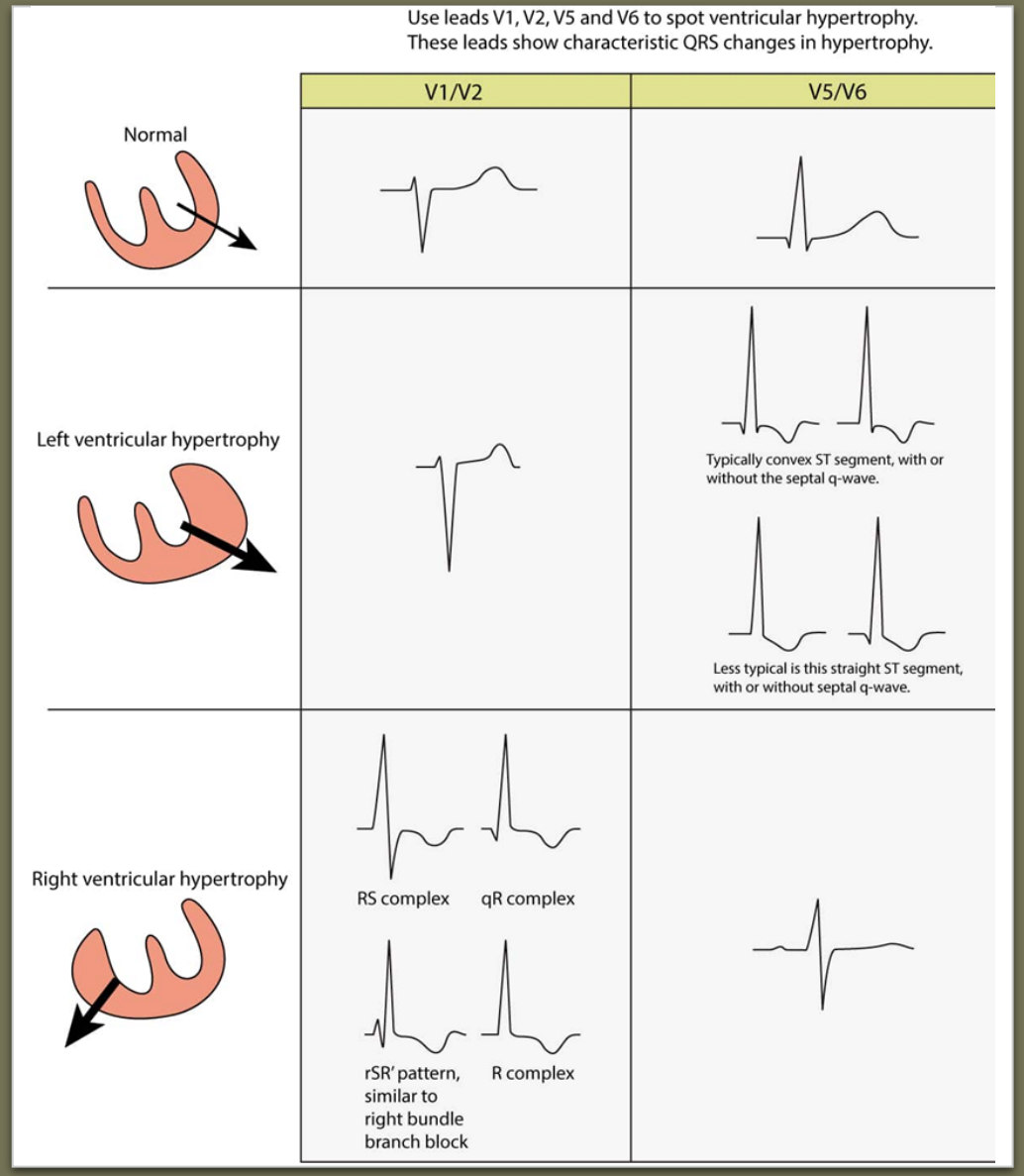


- Hypertrophy

: Condition in which muscular wall of the ventricle(s) becomes thicker than normal

: Hypertrophy associated with ventricles

: QRS complex changes used to identify ventricular hypertrophy



Hypertrophy

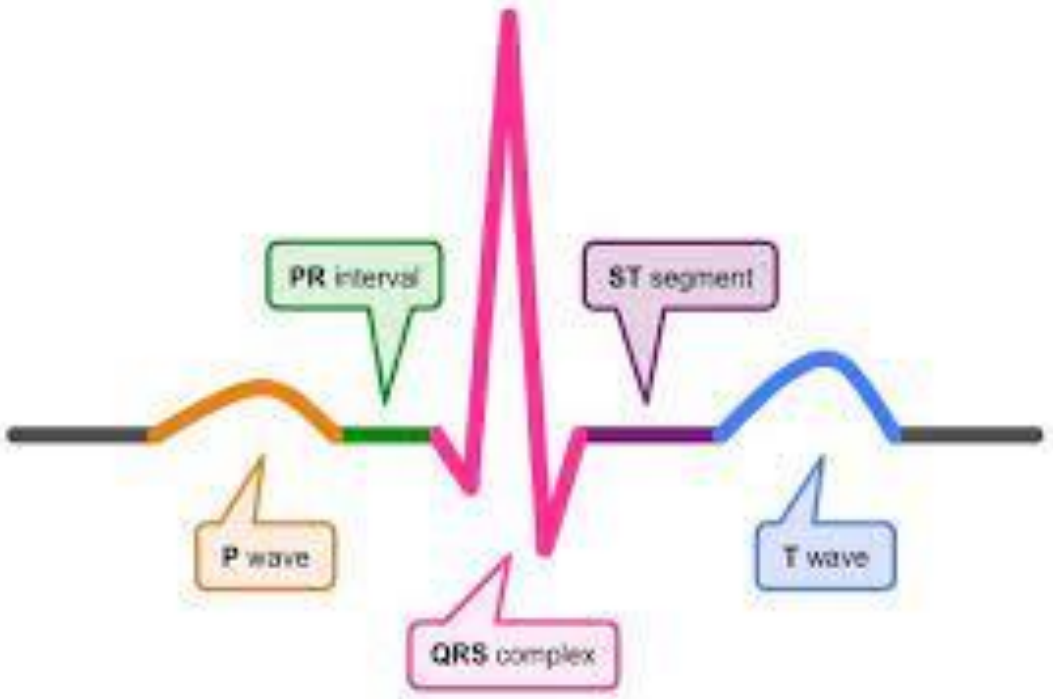
- ❑ VENTRICULAR HYPERTROPHY
  - ➢ left ventricle
    - S in V1 หรือ V2 + R in V5 หรือ V6 มากกว่า 35 mm
    - S in V1 หรือ V2 /หรือ R in V5 หรือ V6 มากกว่า 25 mm
  - ➢ right ventricle
    - Right axis deviation + R>s in V1
    - deep persistent S wave in V5, V6

Right axis deviation

Normal
RVH
Conduction disturbances
MI
Valvular Heart Disease
Pulmonary HTN
Congenital Pulmonary disease

Left Axis deviation

Normal
LVH
Conduction disturbances
MI
Valvular Heart Disease
Systemic HTN
Congenital
Other



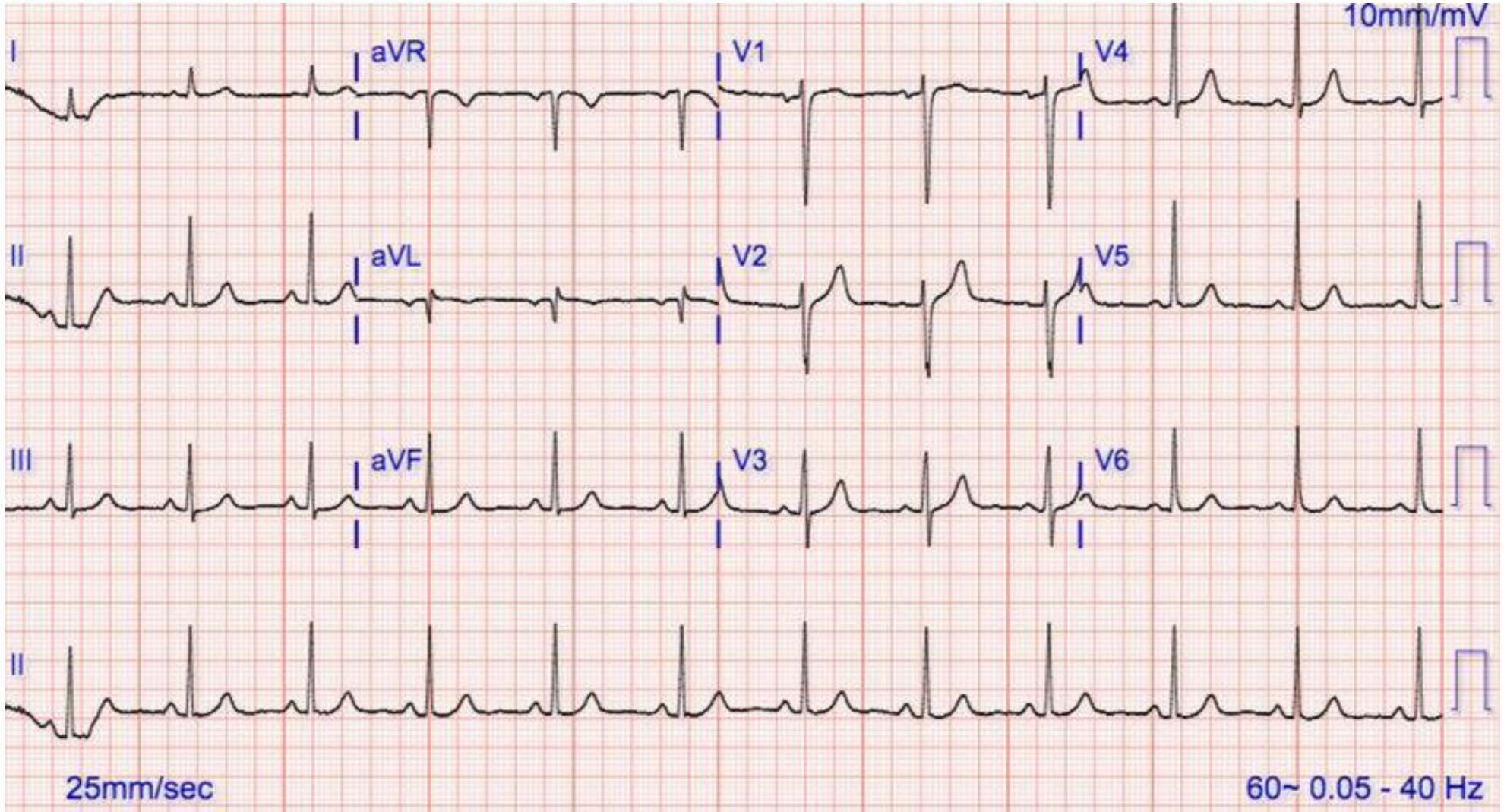
การอ่านและแปลผลคลื่นไฟฟ้าหัวใจ

Normal Sinus Rhythm (NSR)

- Rhythm: สม่ำเสมอ, Rate 60 - 100 bpm
- P wave: รูปร่างกลมมน, นำหน้า QRS complex ทุกตัว
- PR interval: ปกติ 0.12 - 0.2 sec
- QRS complex ปกติ

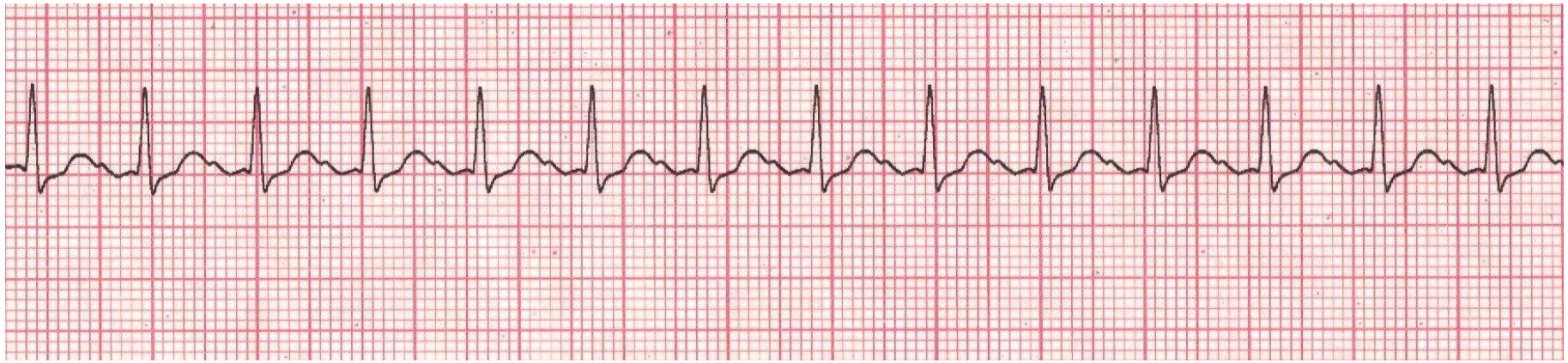
http://www.ambulancetechnicianstudy.co.uk/rhythms.html

Normal Sinus Rhythm



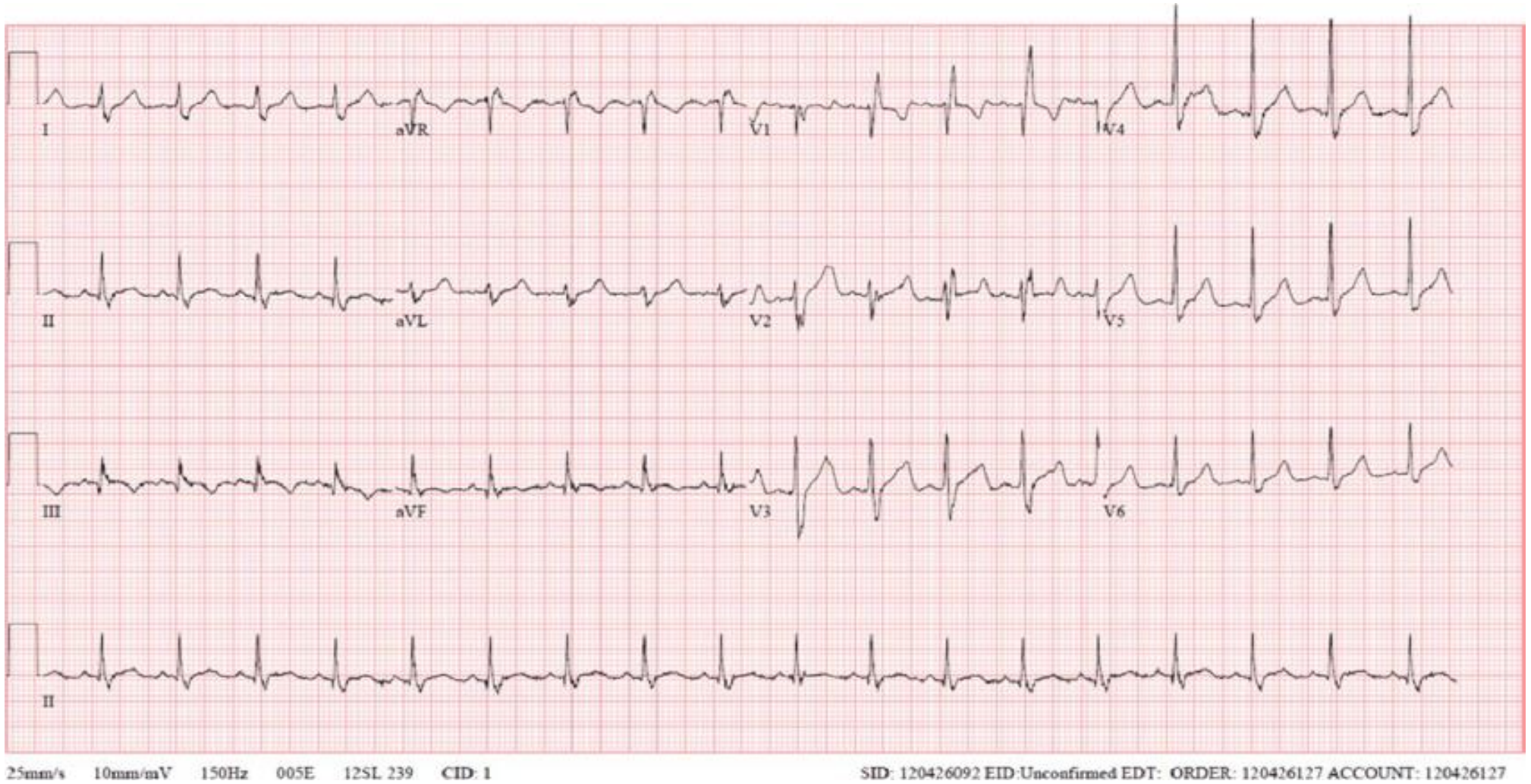
Sinus Tachycardia

- **Regularity:** R-R intervals สม่ำเสมอ, **Rate:** >100, < 170 bpm
- **P wave:** รูปร่างปกติ นำหน้า QRS ทุกตัว
- **PR interval:** 0.12 - 0.20 sec
- **QRS complex** ปกติ



http://www.12leads.com/sinustachycardia.htm

Sinus Tachycardia

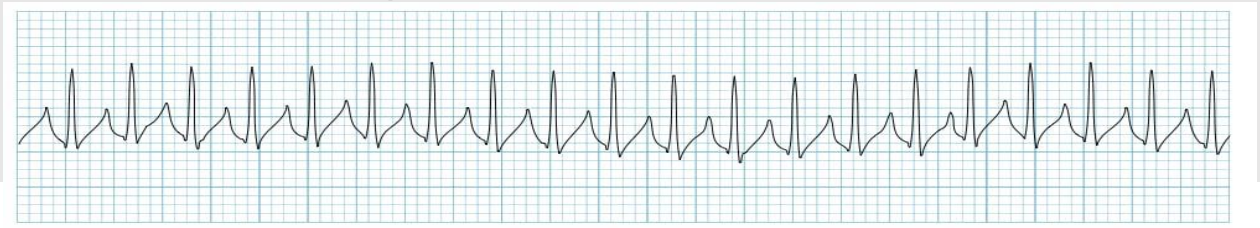


Causes

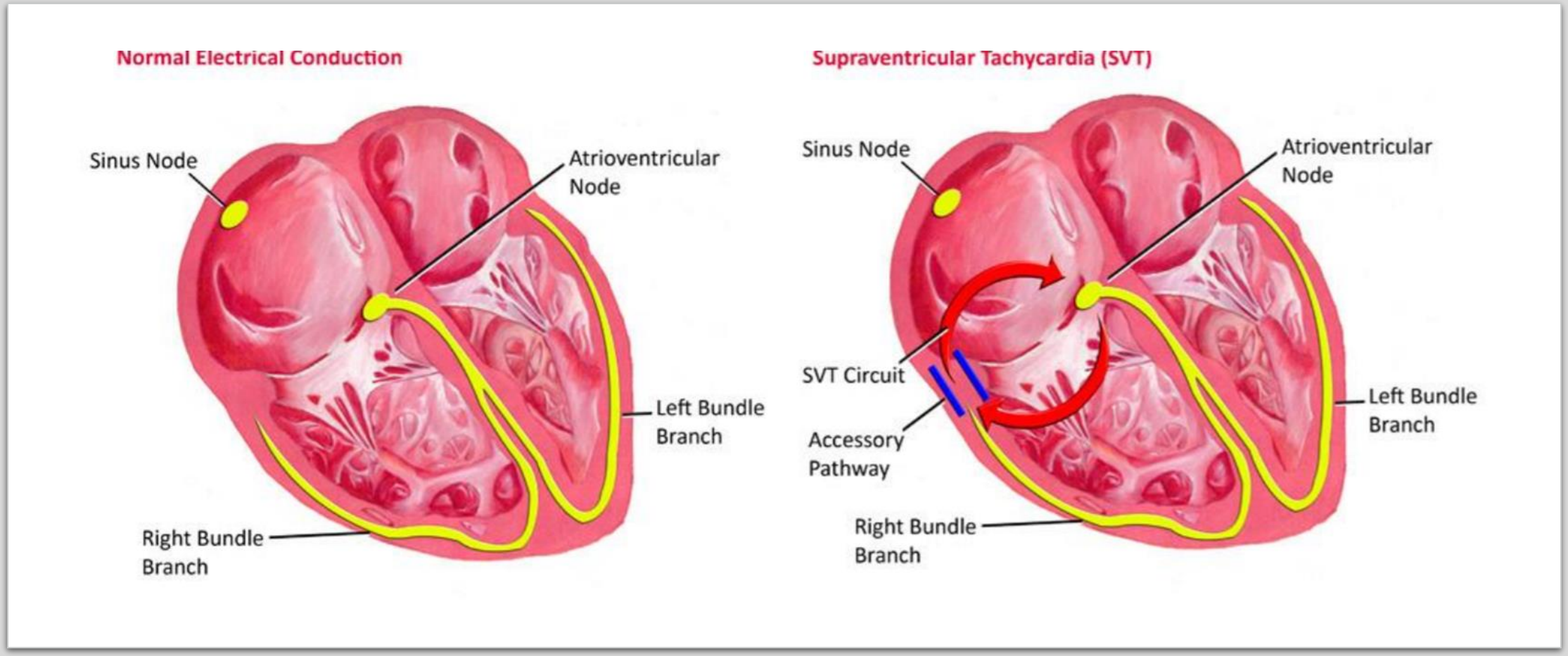
- Pain
- Fever
- Anxiety
- Dehydration
- Hypovolemia with hypotension and shock
- Anemia
- Sepsis
- Pulmonary embolism
- ACS : MI
- Heart failure
- Hyperthyroidism
- Hypoxia

Supraventricular tachycardia

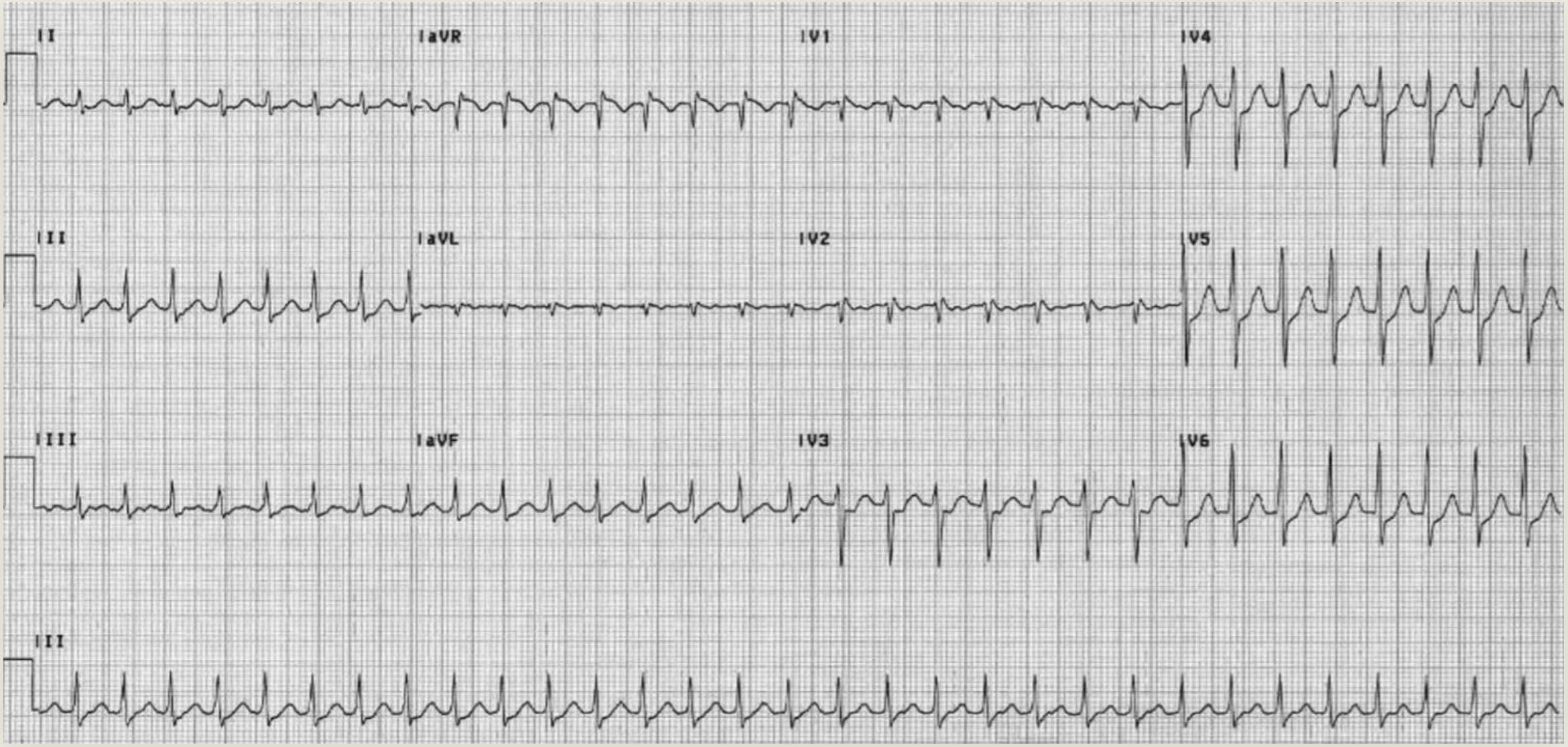
- Regularity : regular
- Rate : 130-210 bpm
- P wave : มักซ่อนใน QRS complex ทำให้มองไม่เห็น P wave ถ้าเห็นจะเป็นลักษณะหัวกลับใน lead II
- PR interval : วัดไม่ได้ถ้า P wave ซ้อนกับ QRS complex หรือถ้ามองเห็นจะเป็น RP<PR
- QRS complex : < 0.12 sec



SVT

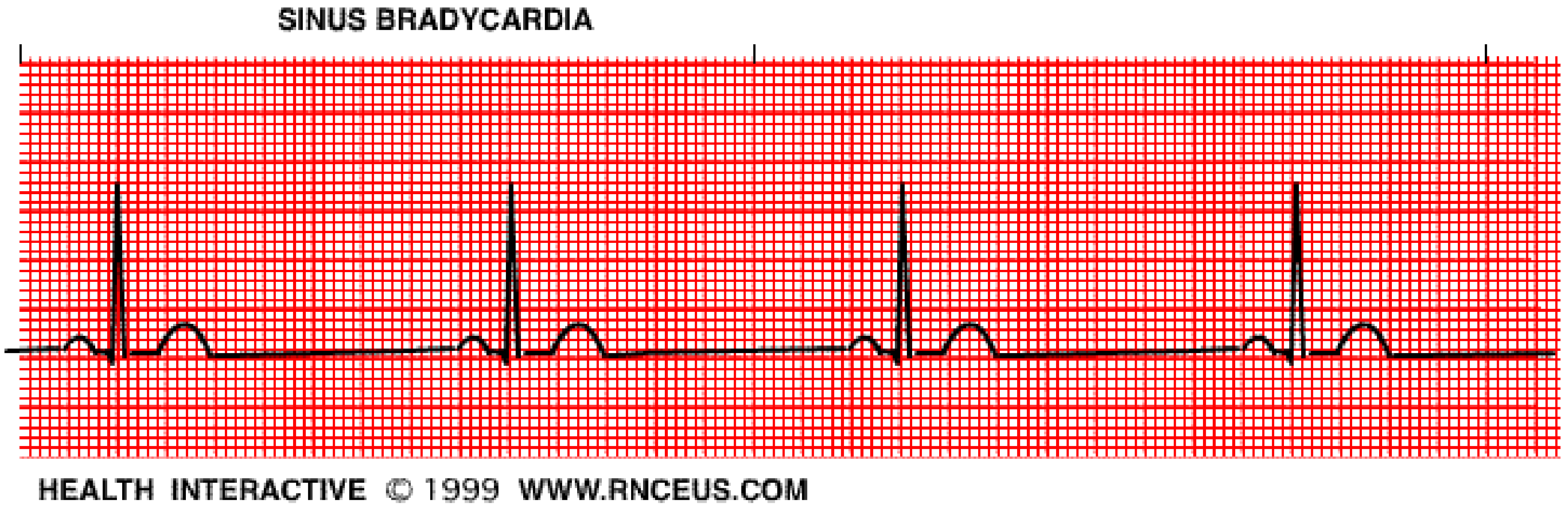

Normal Electrical Conduction
Sinus Node
Atrioventricular Node
Left Bundle Branch
Right Bundle Branch
Supraventricular Tachycardia (SVT)
Sinus Node
Atrioventricular Node
SVT Circuit
Accessory Pathway
Left Bundle Branch
Right Bundle Branch

SVT



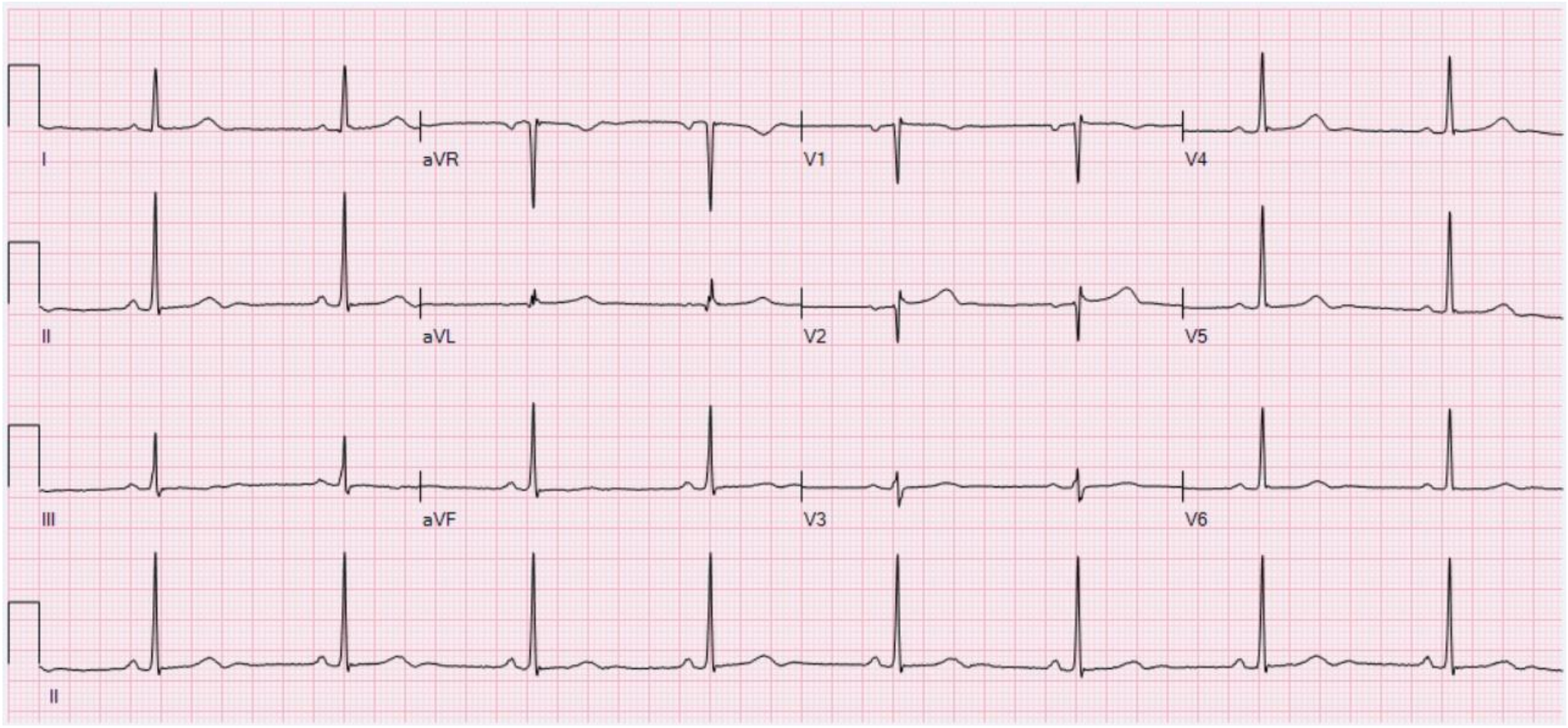
Sinus Bradycardia

- Rhythm : สม่ำเสมอ, Rate : < 60 bpm
- P-wave: รูปร่างปกติ อยู่นำหน้า QRS ทุกตัว
- PR- interval: ปกติ 0.12 - 0.20 sec, QRS complex ปกติ



http://www.rnceus.com/ekg/ekgsb.html

Sinus Bradycardia



Sinus Bradycardia

สาเหตุ

สามารถพบได้เป็นปกติใน นักกีฬา

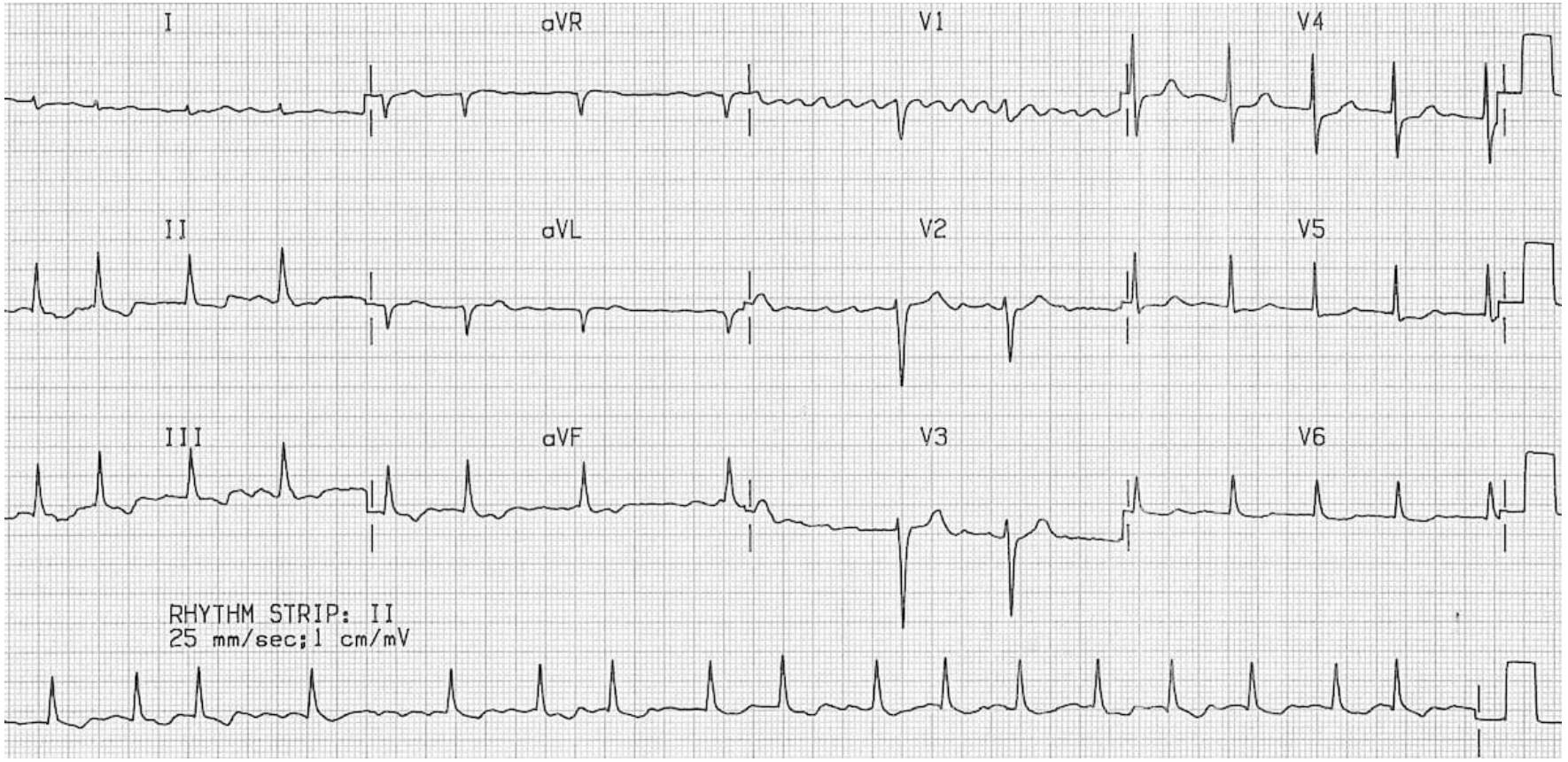
รับประทานยาบางชนิดเช่น BB, CCB, ยาจิตเวช

Atrial Fibrillation

- Rhythm: ไม่สม่ำเสมอ, Rate: 100-160 bpm
- P Wave: มองเห็นไม่ชัด เป็นรูปฟันปลา
- PR Interval - Not measurable
- QRS : ปกติ

http://www.ambulancetechnicianstudy.co.uk/rhythms.html

Atrial Fibrillation



AF

- Electrical impulses come from areas of reentry pathways or multiple ectopic foci
- Depolarization of only a small group of atrial cells not the whole
- Atrial not contracting as a whole causing similar to a bowl of jelly when shaken
- No P wave can be identified
- The waveform referred to as fibrillatory wave or “f - waves”

Conduction pathway

Sinus Rhythm

Atrial Fibrillation

Causes

- MI
- Heart failure
- Heart diseases : CAD, MR, MS, HCM, pericarditis, previous heart surgery
- Lung diseases
- Excessive alcohol consumption
- Hyperthyroidism

การรักษา

- Control resting HR < 100 bpm: BB, CCB
- Control Rhythm: Amiodarone
- Stroke prevention: Warfarin

(controlled INR 2-3), NOAC

- If hemodynamic unstable: Cardioversion

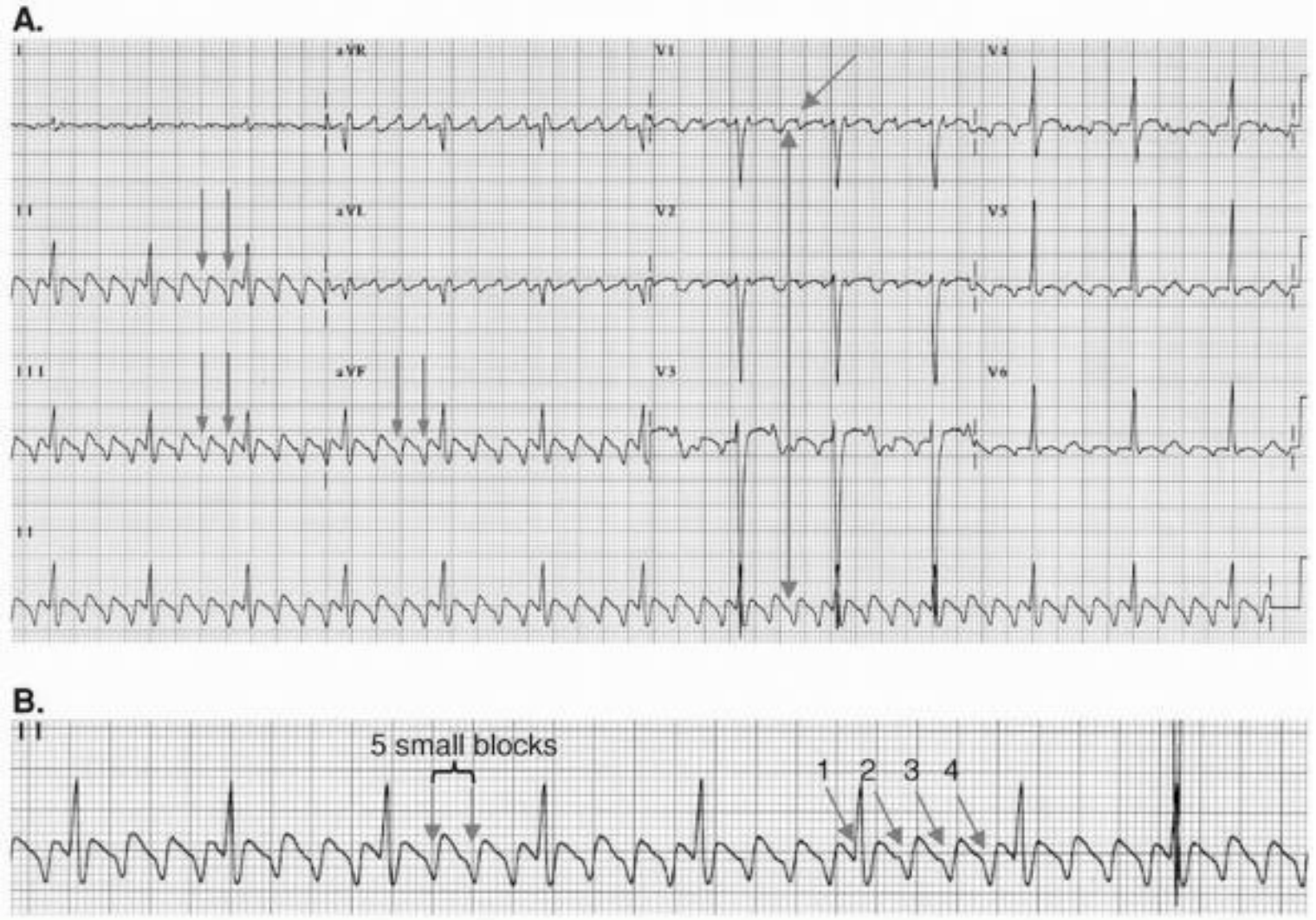
- Canadian cardiovascular society (CCS) 2010 AF Guidelines

Atrial Flutter

- Rhythm: อาจปกติ, Rate : ~ 100 bpm
- P Wave: มองเห็นไม่ชัดเจน เห็น Flutter wave เป็นรูปฟันเลื่อย บางครั้งเห็นเป็นอัตราส่วน 2:1 (2P - 1QRS) หรือ 3:1 Atrial ปล่อยกระแสไฟฟ้าด้วยอัตรา 300 bpm
- QRS: ปกติ

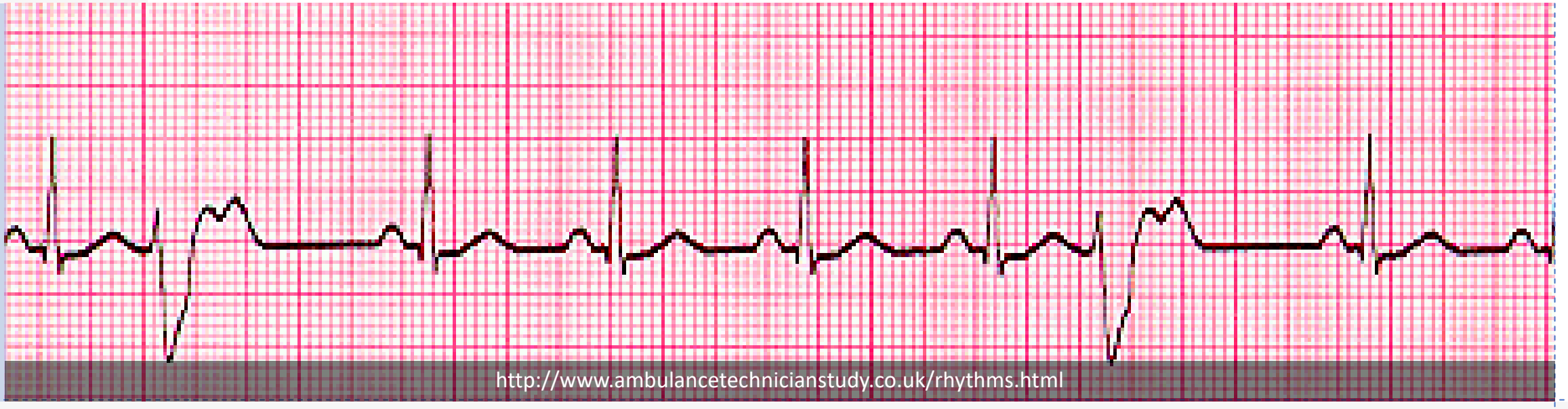
http://www.ambulancetechnicianstudy.co.uk/rhythms.html

Atrial Flutter

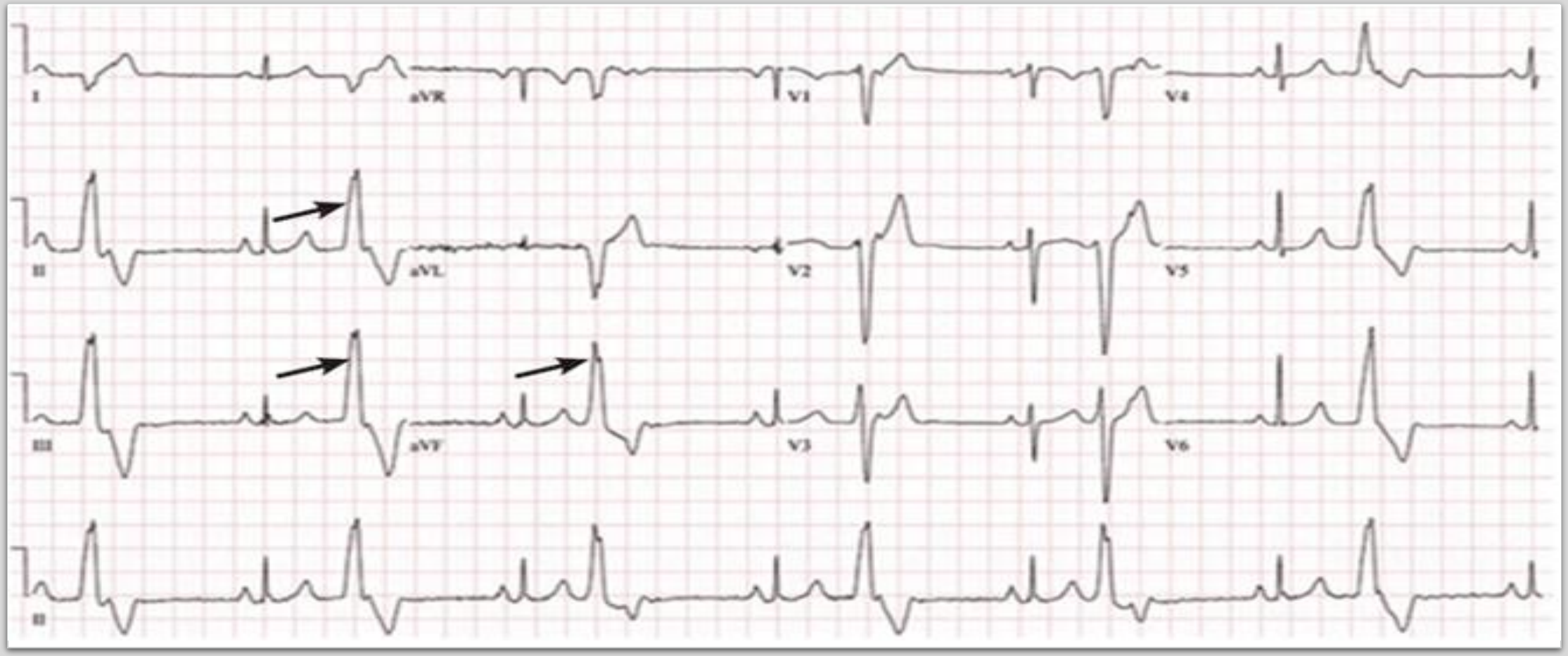


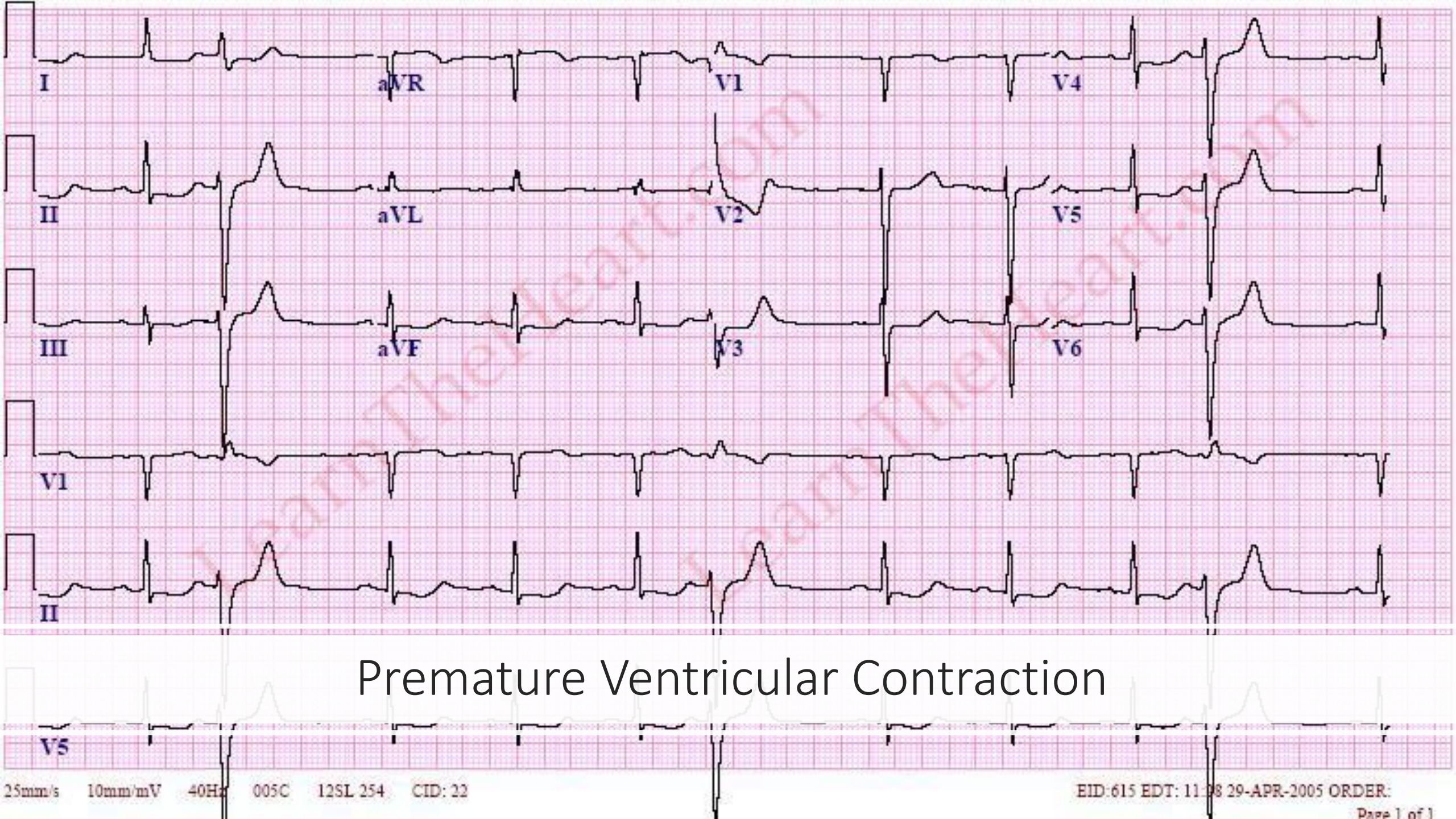
Premature Ventricular Contraction

- เกิดจาก Ventricular depolarization เร็วกว่าปกติ
- สาเหตุ: Electrolytes imbalance, Hypoxia,
- P wave ไม่มี, QRS: กว้าง, ไม่มี P-wave นำ
- Rhythm: สม่ำเสมอ, Rate: ปกติ



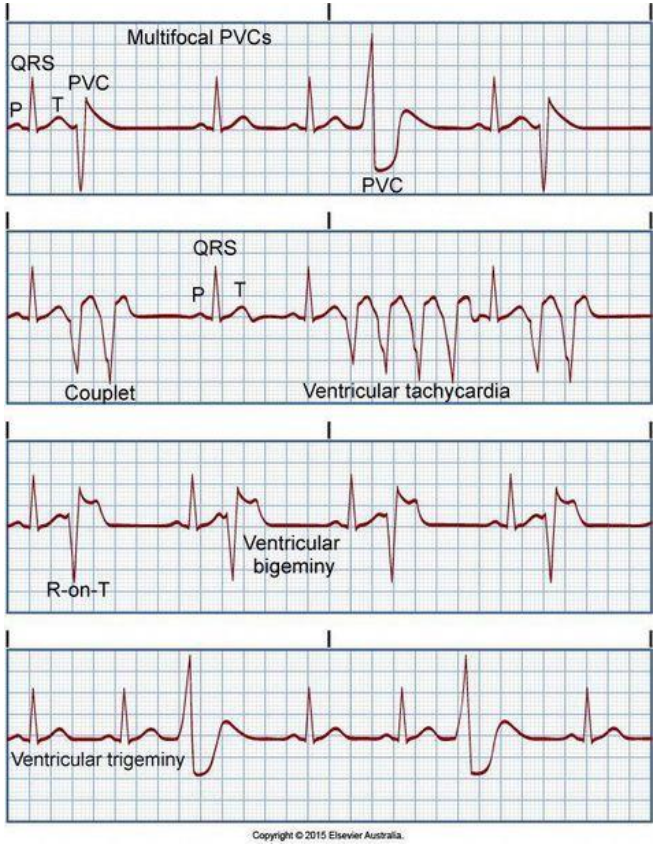
Premature Ventricular Contraction





Premature Ventricular Contraction

PVC


Multifocal PVCs
QRS
PVC
P
T
PVC
QRS
P
T
Couplet
Ventricular tachycardia
Ventricular bigeminy
R-on-T
Ventricular trigeminy
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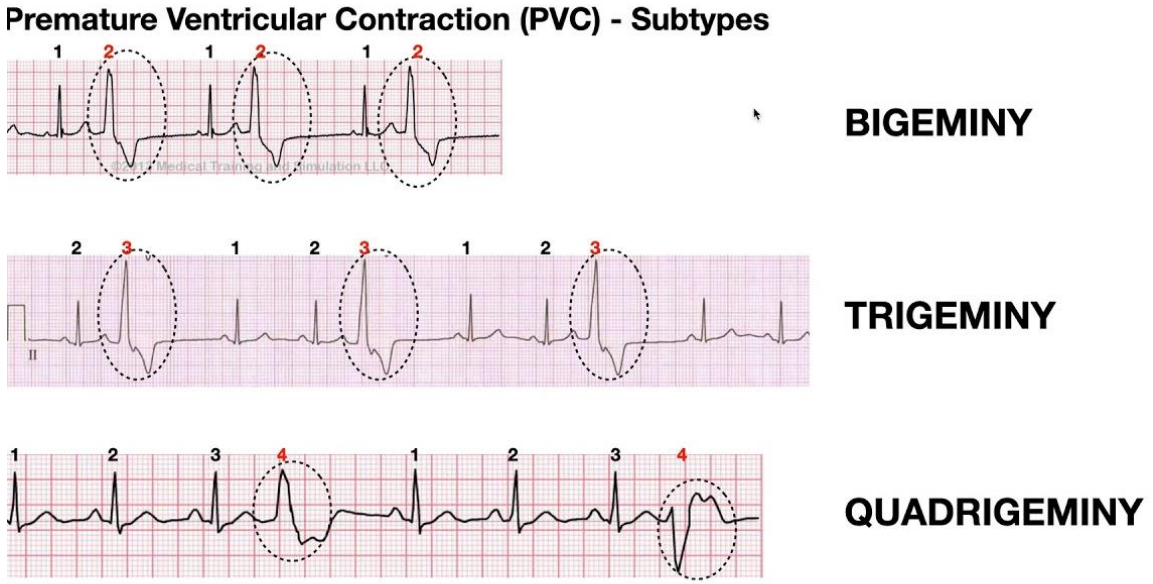

Premature Ventricular Contraction (PVC) - Subtypes
BIGEMINY
TRIGEMINY
QUADRIGEMINY

Types of PVC

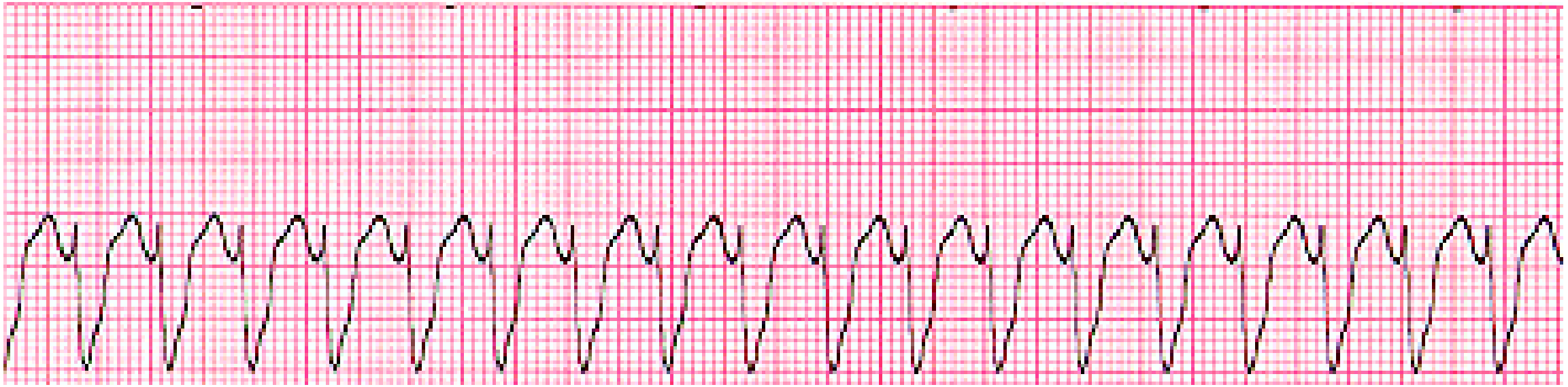
Unifocal	Early beat (has similar shape and shape suggesting only one irritable focus present)
Multifocal	Varied shapes and forms of the PVCs
Interpolated	PVC occurs during the normal R-R interval without interrupting the normal cycle
Occasional	More than one to four PVCs per minute
Frequent	More than five to seven PVCs per minute
Bigeminy	Every other beat is a PVC
Trigeminy	Every third beat is a PVC
Quadgeminy	Every fourth beat is a PVC
R on T PVCs	PVC occurs on the T wave or the vulnerable period of the ventricle refractory period
Coupling	Two PVCs occur back to back

Nursing Care

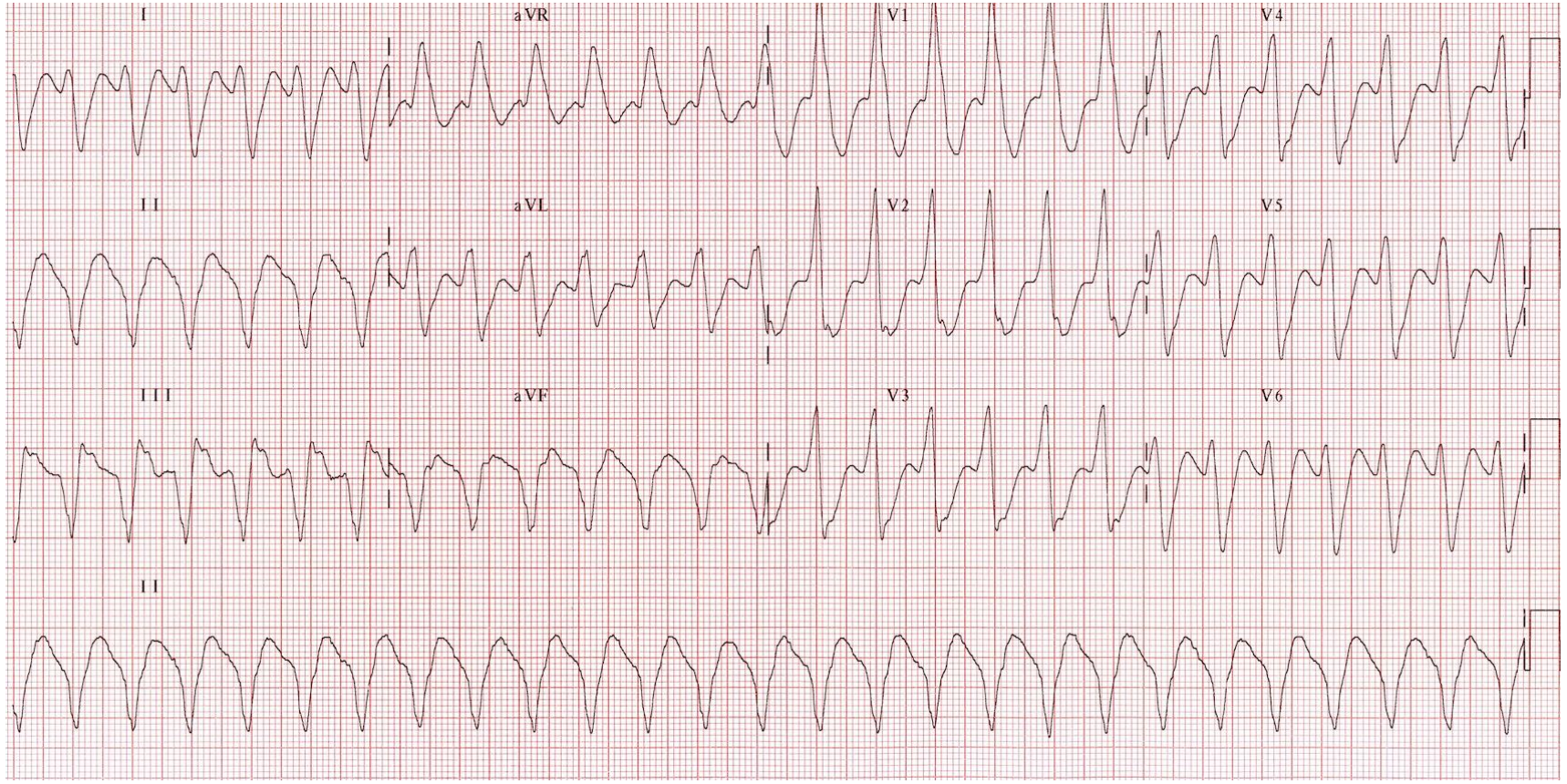
- Monitor rhythm, frequency of PVC
- Observe Pt. for symptoms of low CO
- O_2 therapy
- Lab for electrolyte: K, Ca

Ventricular Tachycardia

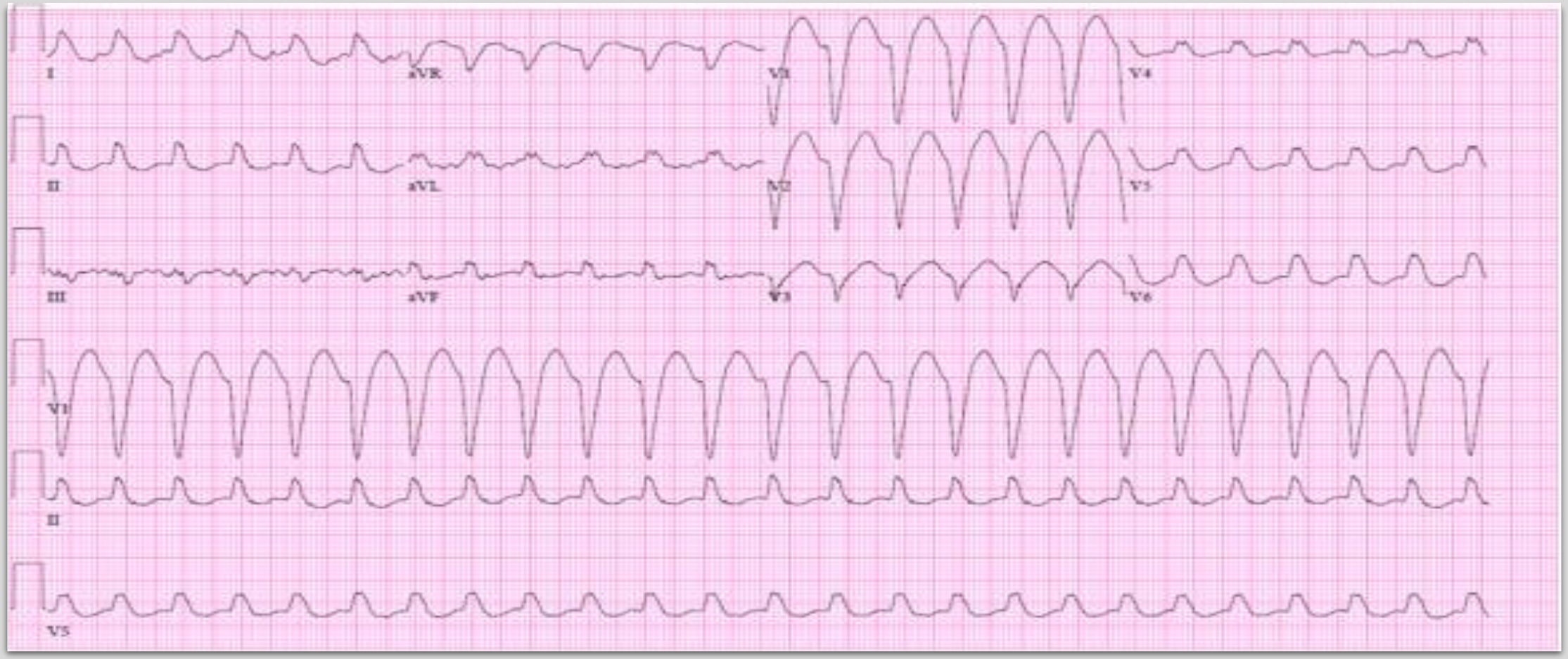
- **Rhythm: Regular, Rate: 180-190 bpm**
- **P Wave:** มองไม่เห็น
- **QRS: Prolonged**



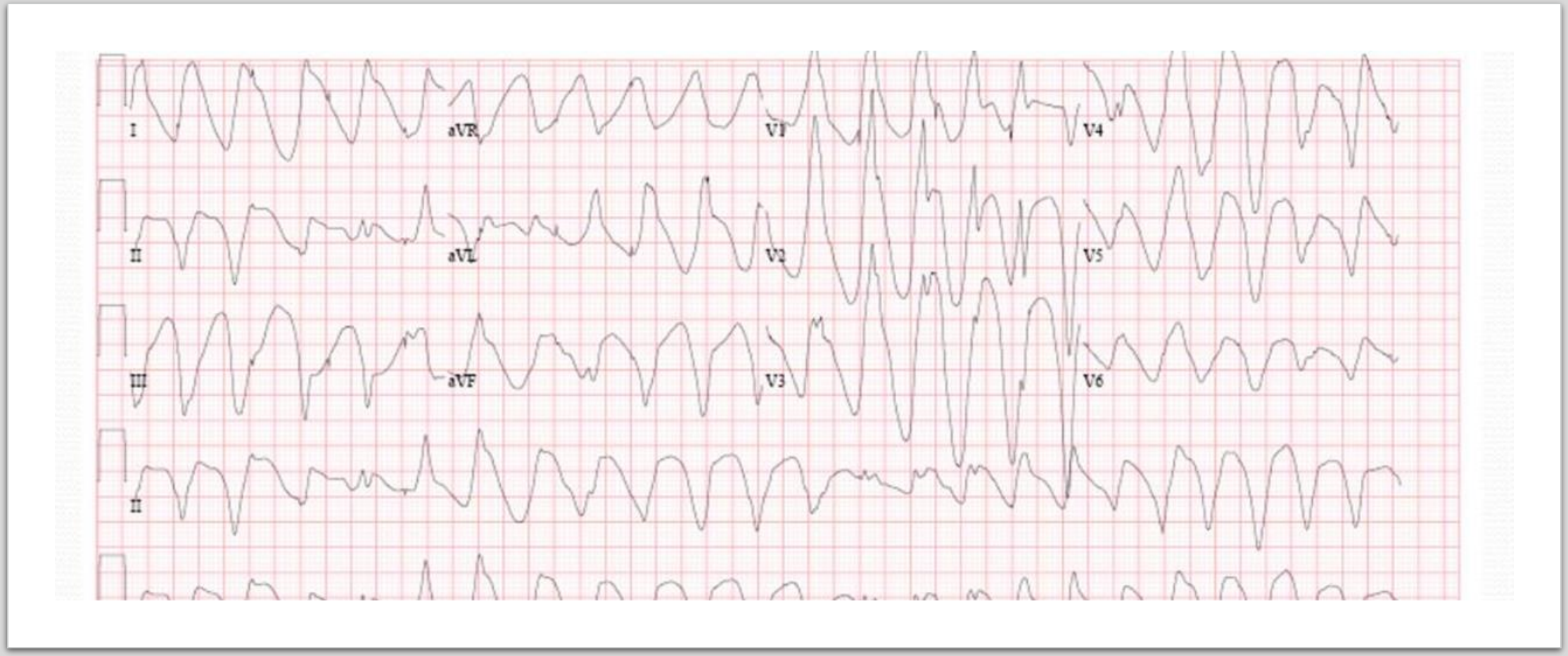
VT



Monomorphic VT

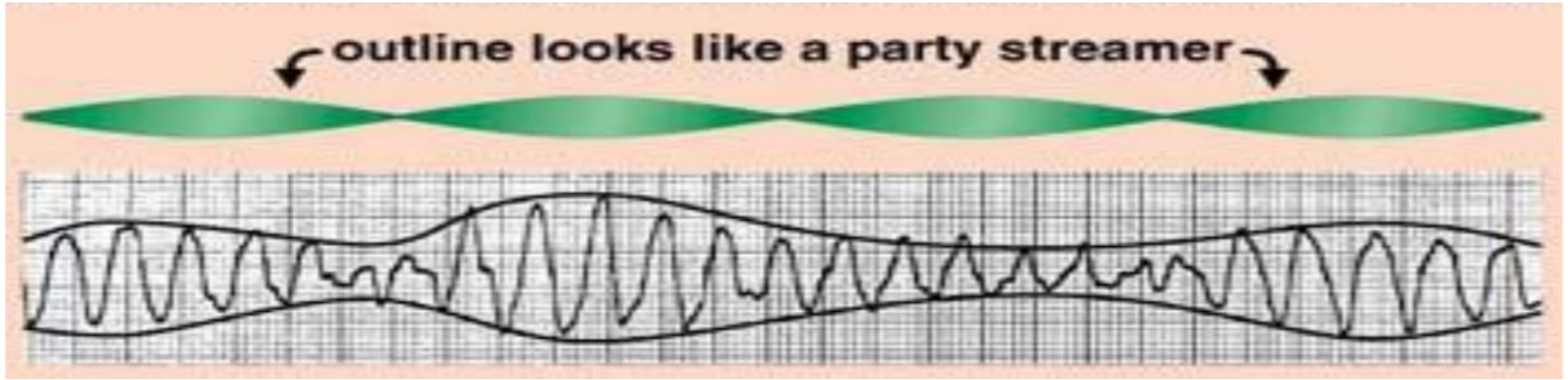


POLYMORPHIC VT



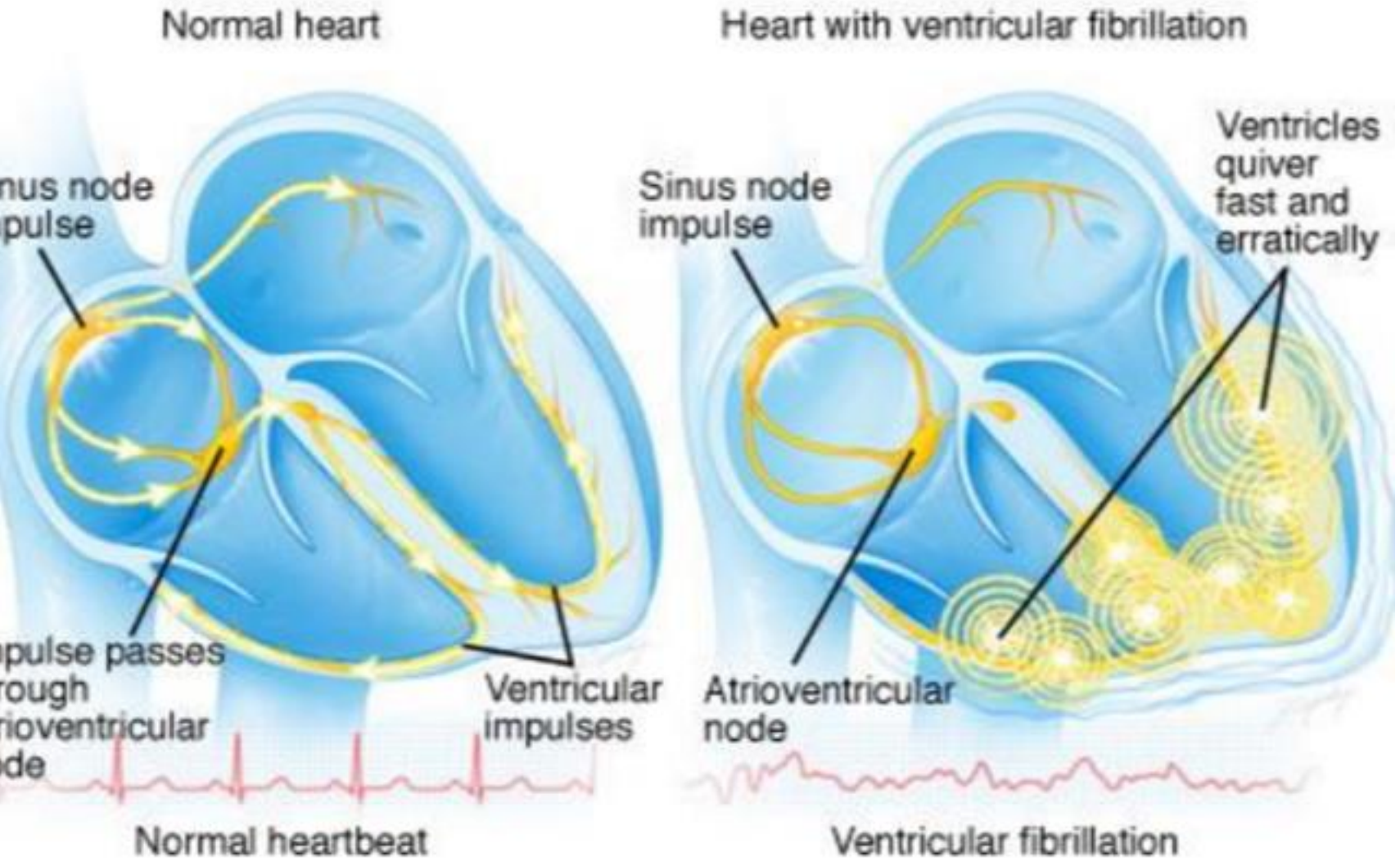
Torsade de pointes

- A specific variant of polymorphic VT in which the QRS axis swing from a positive to a negative direction in a single lead



Nursing care

- Rhythm monitored closely
- Follow ACLS Guideline for tachyarrhythmia, pulseless VT
- Prepare for medication or defibrillation
- **Report any complications or vital sign changes**
- Observe Pt. for symptoms of low CO, unconscious



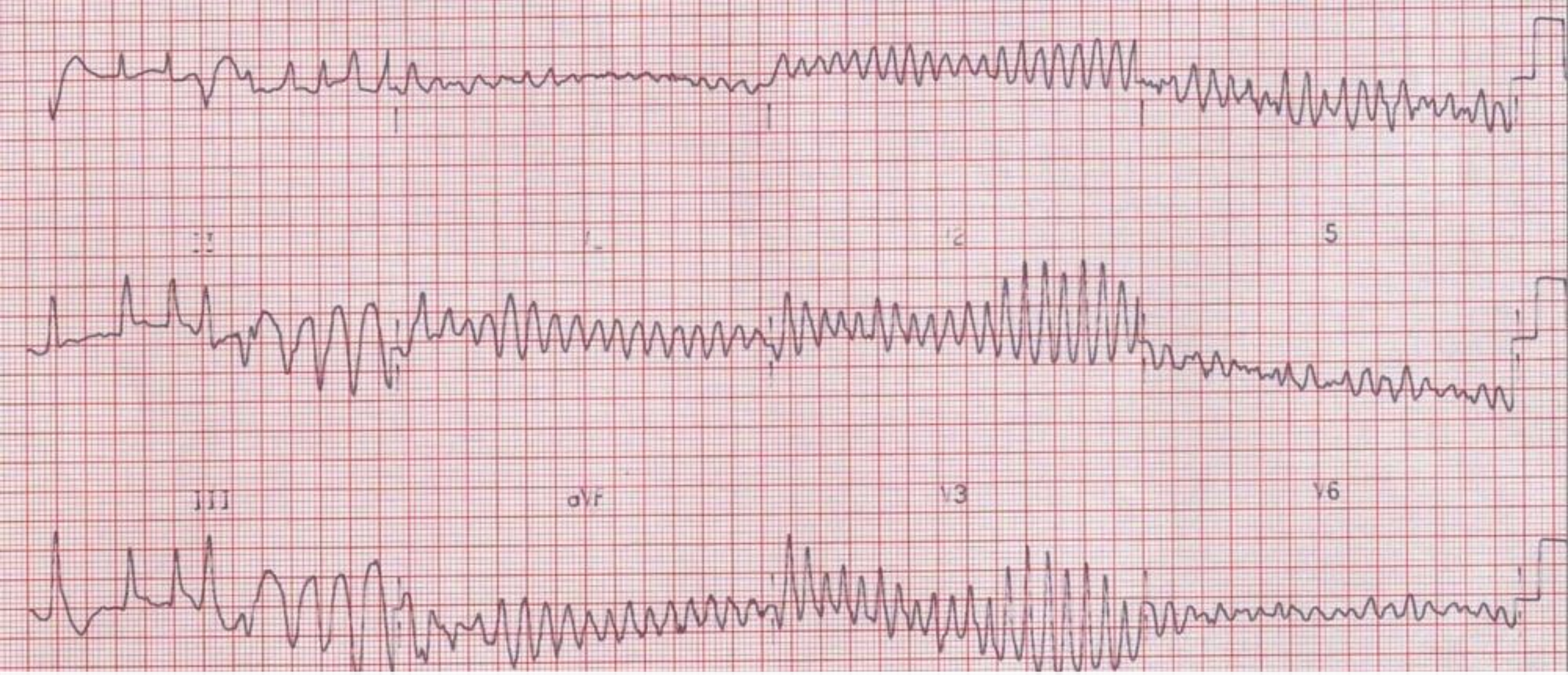
Ventricular fibrillation

- Totally disorganized depolarization & contraction of small area of ventricular myocardium
- No effective ventricular pumping activity
- Commonly in severe ischemic heart disease

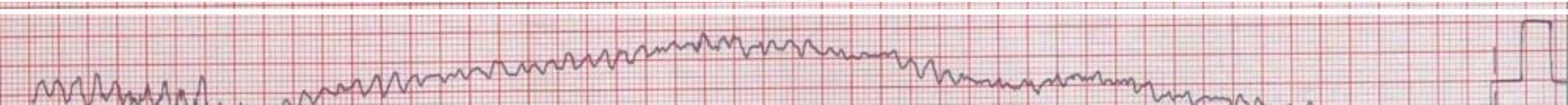
Ventricular Fibrillation

- Rhythm: Irregular, Rate: > 300 ไม่คงที่
- P Wave: มองไม่เห็น
- QRS: แยกไม่ออก มองเห็นไม่ชัด
- ต้องทำ Defibrillation ทันที

http://www.ambulancetechnicianstudy.co.uk/rhythms.html



VF

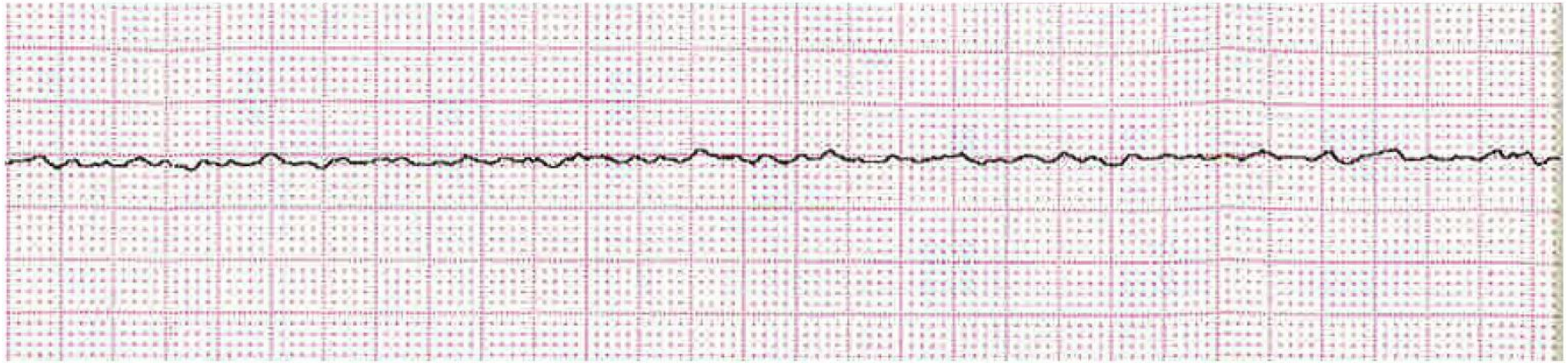


Ventricular fibrillation

A) high-voltage ventricular fibrillation

Coarse VF

B) low-voltage ventricular fibrillation



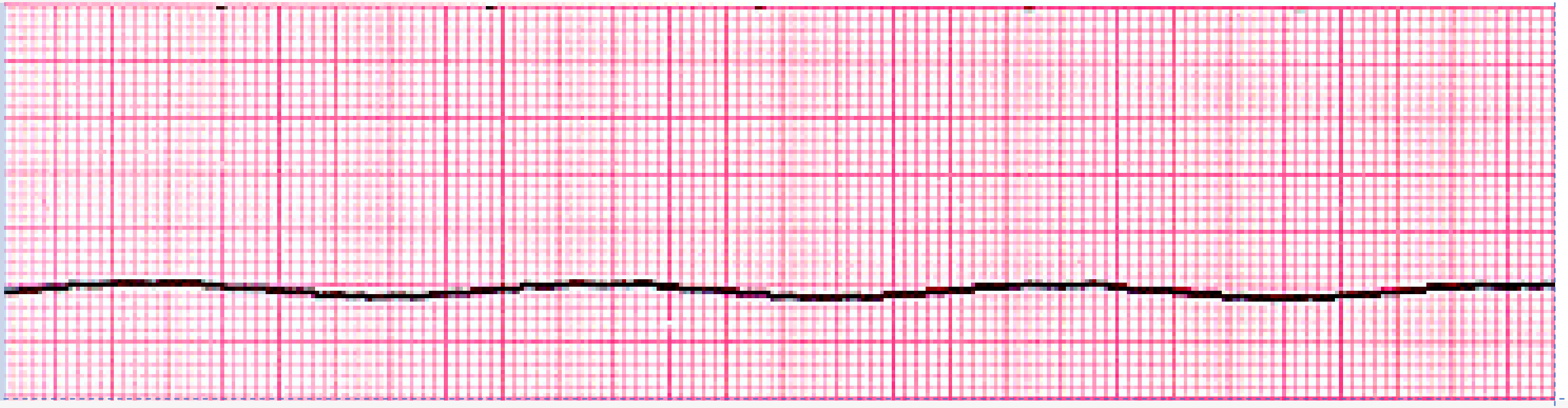
Fine VF

Nursing Care

- Flatline protocol: change, check, increase size
- VF : No CO
- Chest compression & ACLS should start immediately
- Prepare for medications & defibrillator
- Follow the ACLS guideline for VF
  - Record
  - Observe signs of ROSC
  - Monitor rhythm & Care for post cardiac arrest Pt

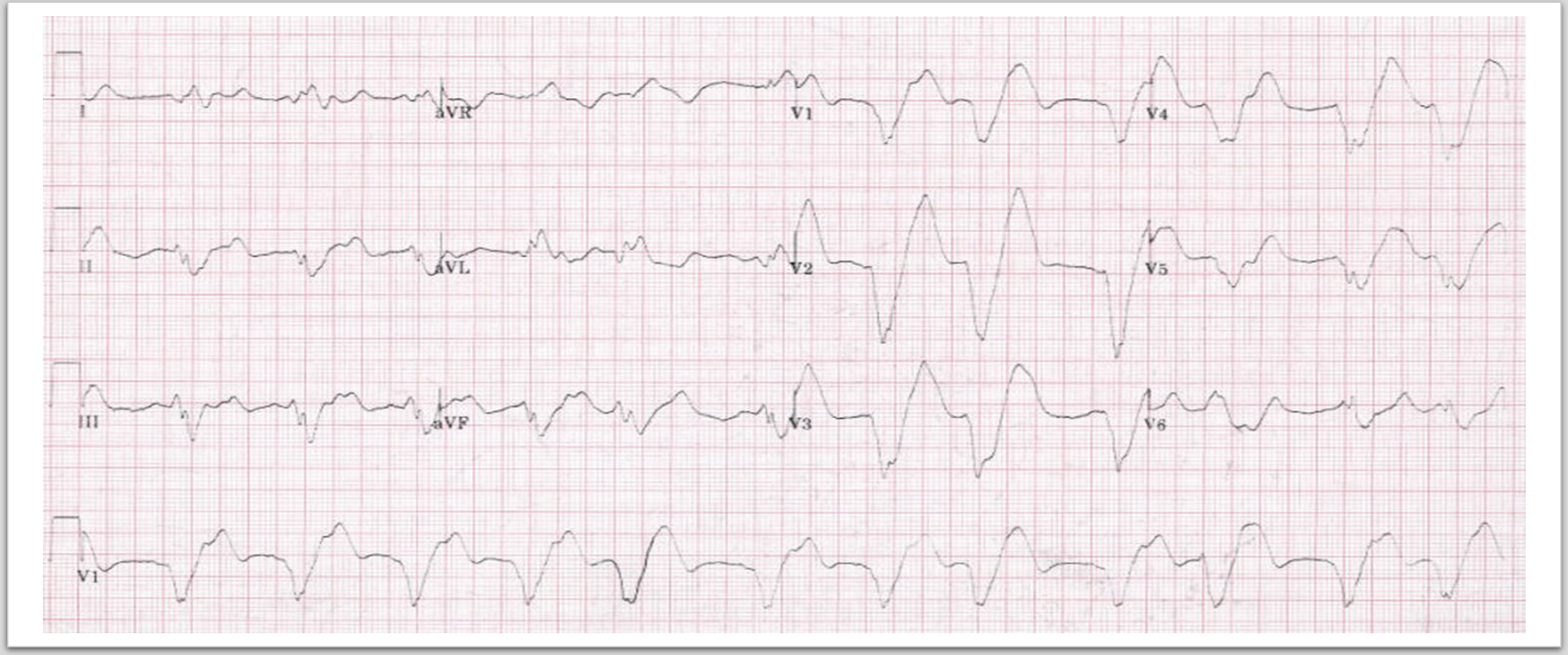
Asystole

- P Wave: ไม่มี
- QRS : ไม่มี
- Rhythm: ไม่มี , Rate: 0 bpm
- ต้องรีบทำ CPR!!



http://www.ambulancetechnicianstudy.co.uk/rhythms.html

Pulseless Electrical Activity (PEA)



http://www.nzma.org.nz/journal/122-1293/3561/

สาเหตุของ Asystole และ PEA

Damage or Impaired myocardial function

- ☐**H**ypoxia
- ☐**H**ydrogen ion (acidosis)
- ☐**H**yper-**H**ypo K
- ☐**H**ypothermia
- ☐**H**ypoglycemia
- ☐**T**oxins

Inadequate or obstructed circulation

- **H**ypovolemia
- **T**hrombosis (pulmonary)-PE
- **T**hrombosis (Coronary)-MI
- **T**ension pneumothorax
- **T**amponade (Cardiac)
- **T**rauma

6-H, 6-T

Nursing care

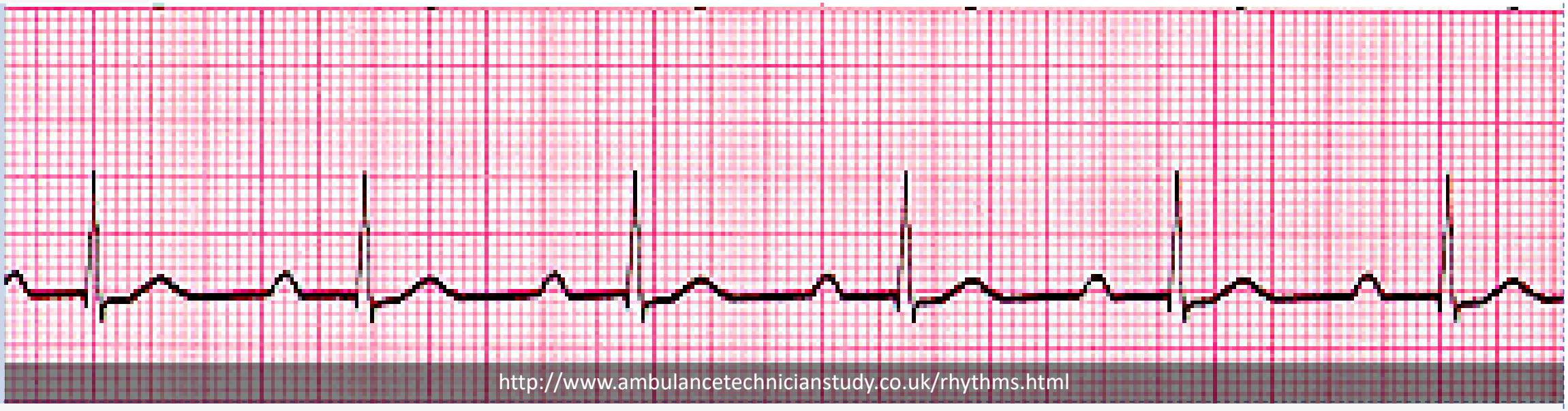
- Asystole: Flatline protocol
- Asystole/ PEA: call for help
- Start CPR
- ให้ยา Epinephrine 1 mg IV q 3-5 min
- If ROSC → Post cardiac arrest care

Atrioventricular block

- เกิดจาก supraventricular impulse ไม่สามารถผ่านลงสู่ ventricle ได้
- เนื่องจากมีความผิดปกติของการนำกระแสไฟฟ้าที่ AV node
- แบ่งเป็น 3 ชนิด
  - 1st degree AV block
  - 2nd degree AV block
  - 3rd degree(complete) AV block

1st Degree AV block

- Rhythm – Regular, Rate - Normal
- P Wave - Ratio 1:1
- P-R Interval - Prolonged (>5 small squares)
- QRS Duration - Normal

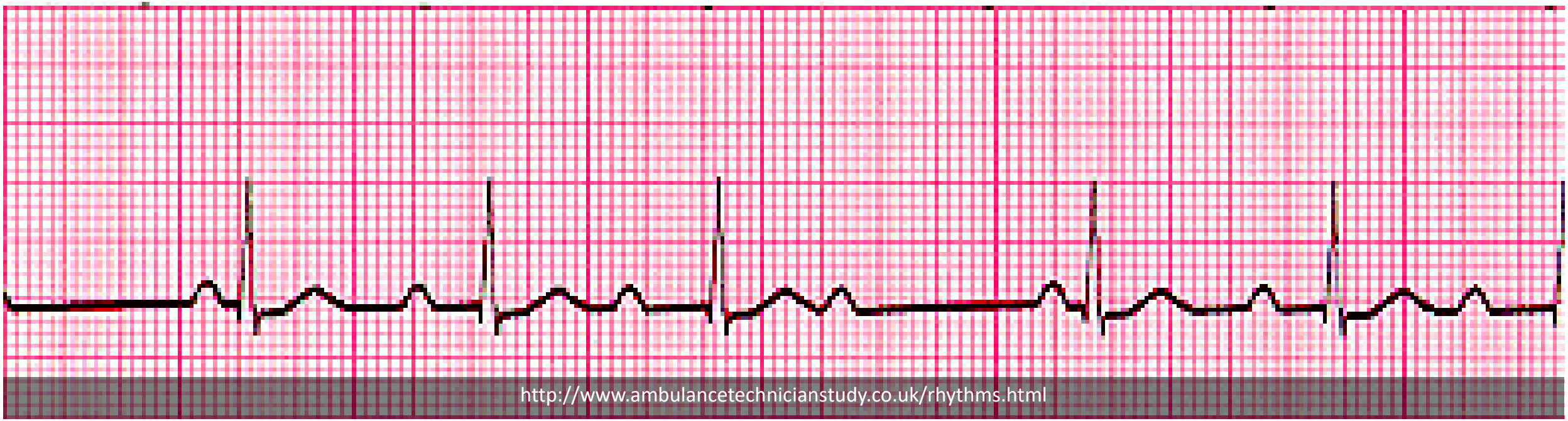


1st Degree AV block

- พบได้น้อย อาจพบได้ในผู้ใหญ่ และนักกีฬา
- พบได้ในผู้ที่มีภาวะหัวใจวาย โรคหลอดเลือดหัวใจ และผู้สูงอายุเนื่องจากมีความเสื่อมลงของระบบการนำไฟฟ้าหัวใจ
- โดยทั่วไปไม่มีอาการ ไม่ต้องรักษา

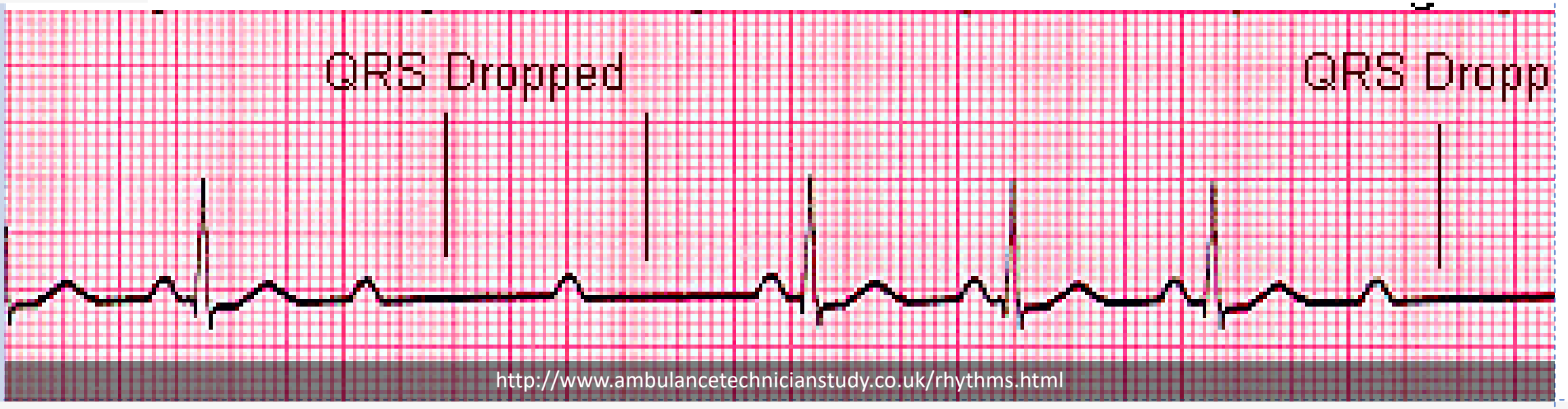
2nd Degree AV block Type I (Wenckebach)

- P wave : normal
- PR Interval: ยาวขึ้นเรื่อยๆ จนกระทั่ง P wave ตัวหนึ่งไม่มี QRS complex ตามมา
- QRS : Normal
- Rhythm : Regularly irregular, Rate : Normal or Slow



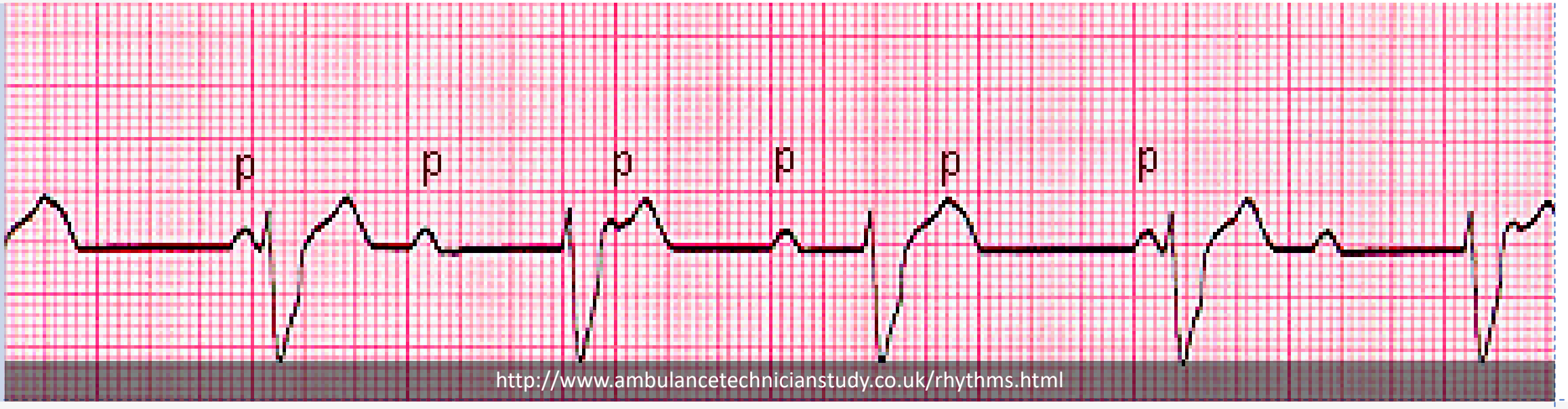
2nd Degree AV block Type II

- Rhythm : Regularly irregular, Rate : Normal or Slow
- P : QRS Ratio = 2:1, 3:1
- PR Interval: ปกติ หรือ ยาวกว่าปกติ แต่เท่ากันทุกช่วง
- QRS: normal



3rd Degree AV block

- Rhythm : ปกติ, Rate: Slow 40-60 bpm
- P Wave: ไม่ชักนำให้เกิด ORS, P-R Interval: ไม่สม่ำเสมอ
- QRS: Prolonged
- ไม่มี atrial impulses ผ่านไปที่ AV node, ventricles ทำให้เกิด their own rhythm
- AV dissociation



http://www.ambulancetechnicianstudy.co.uk/rhythms.html

3rd Degree AV block

- พบได้ตั้งแต่แรกเกิด หรือ เกิดขึ้นจากสภาวะโรคและสถานการณ์บางอย่าง เช่น หลังผ่าตัดหัวใจ

  Heart attack

  Underlying electrical disorder

  อักเสบหรือติดเชื้อของหัวใจ

  Medications S/E : BB, CCB, anti-arrhythmic
- ภาวะที่อาจพบ : heart failure, เป็นลม, lethargy, ชักและอาจเกิดภาวะ sudden death
- การรักษา : Pacemaker

Nursing care for Pt with Heart block

1

-Monitor and observe for further develop of other AVB

2

-Monitor CO parameter

3

-Stop β-blocker, Ca-Blocker, Digitalis, anti-arrhythmic drugs: Amiodarone

4

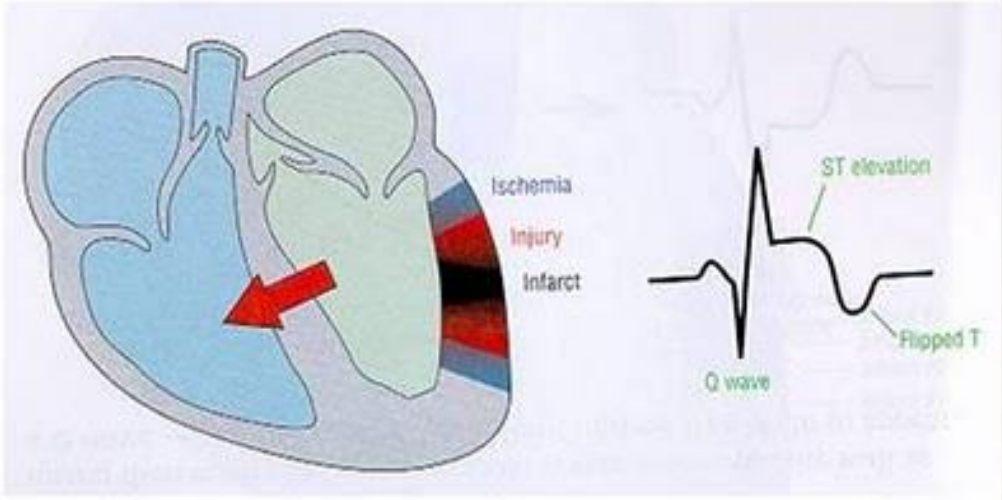
-Prepare for medication and immediate intervention : Temporary pacemaker

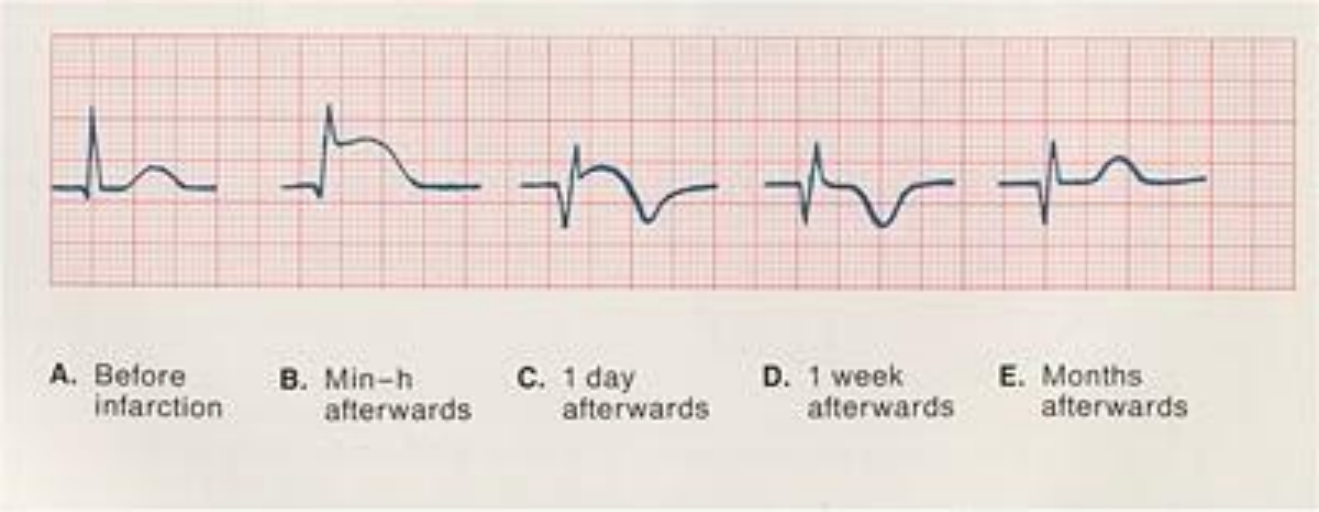
5

-Fall prevention

ECG indicators of Ischemia, Injury, & Infarction

- Ischemia : a primary T wave change
- Injury : Subepicardial = ST segment elevation
  : Subendocardial = ST segment depression
- Infarction : significant Q wave





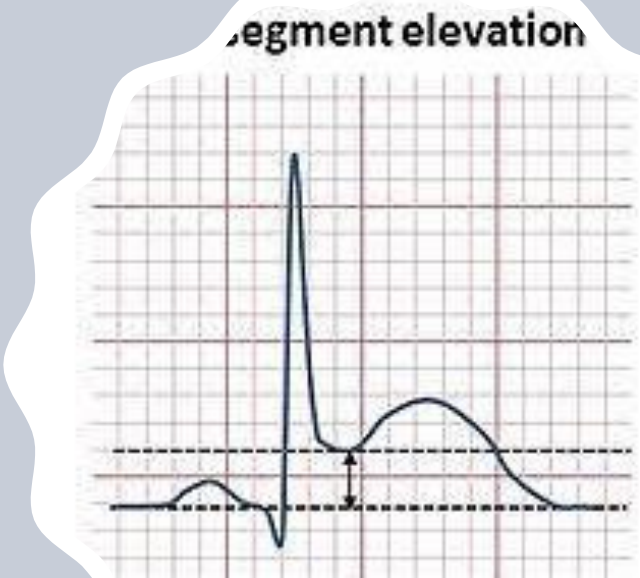
http://anaesthesia-drzek.blogspot.com/2008/06/managing-myocardial-infarction-role-of.html

ST Elevation

ST segment elevation reflects **myocardial injury**

ST elevation is a new ST segment elevation at the **J point** in two contiguous leads

Contiguous lead represents lead groups such as anterior leads (V_1-V_6), inferior leads (II, III, and aVF), or lateral/apical leads (I and aVL)

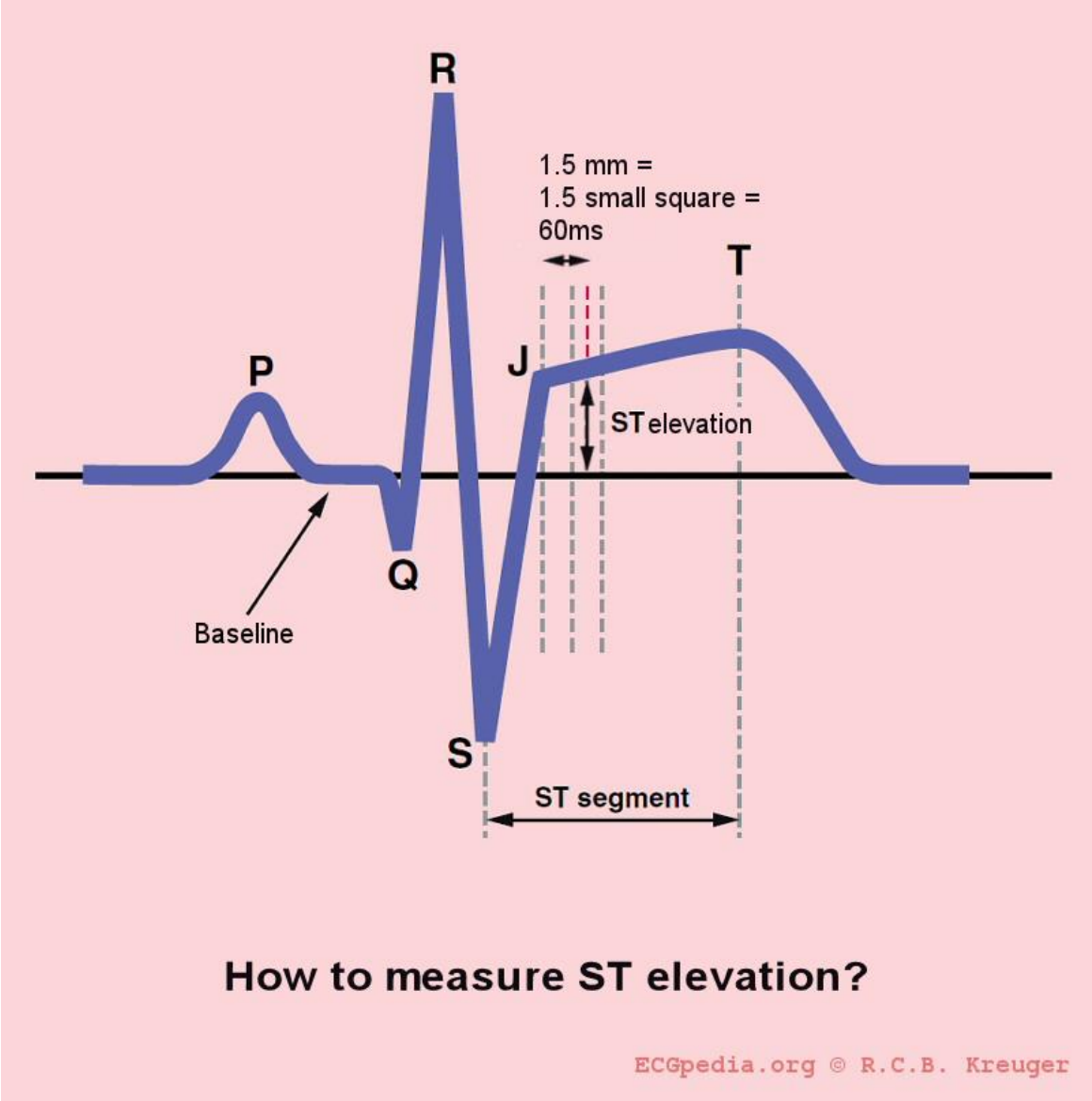


Localizing the Infarct

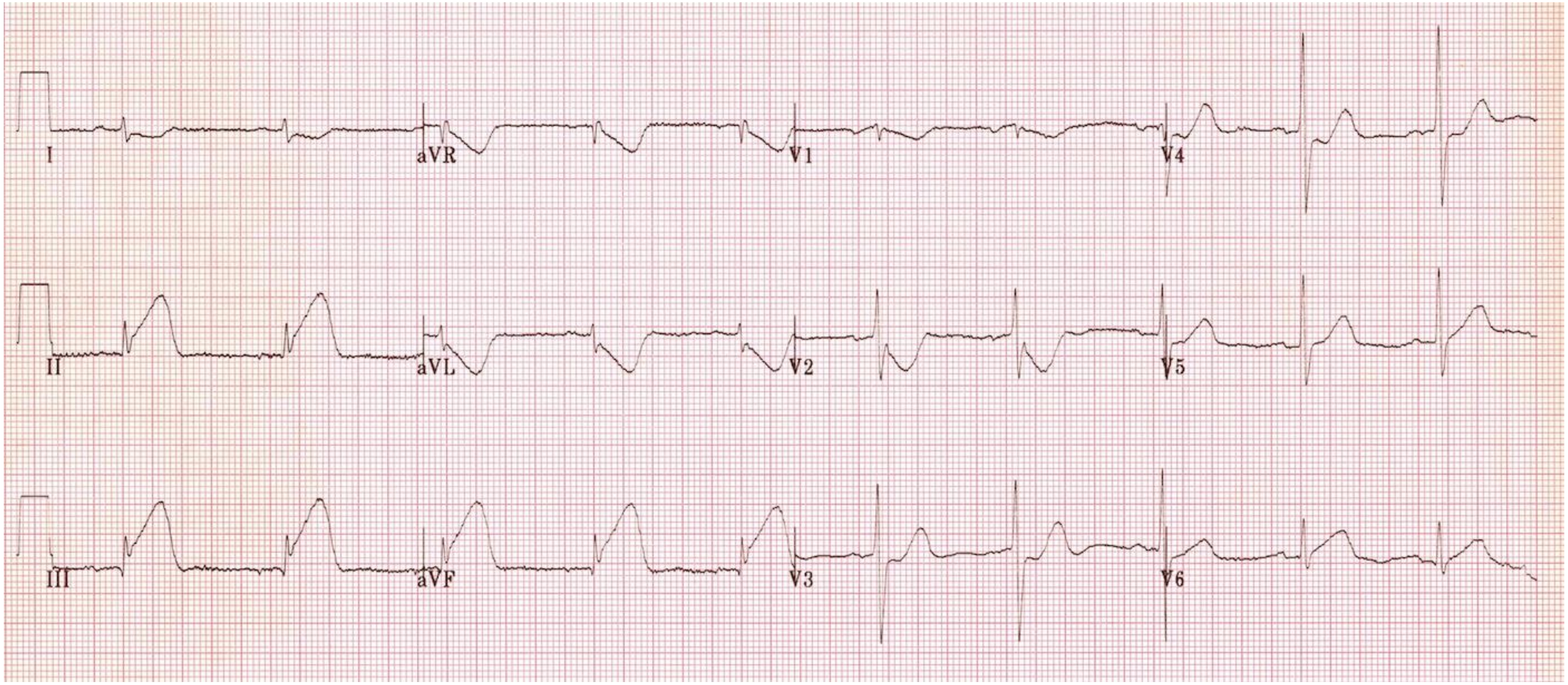
I Lateral	aVR	V1 Septal	V4 Anterior
II Inferior	aVL Lateral	V2 Septal	V5 Lateral
III Inferior	aVF Inferior	V3 Anterior	V6 Lateral

J - Point

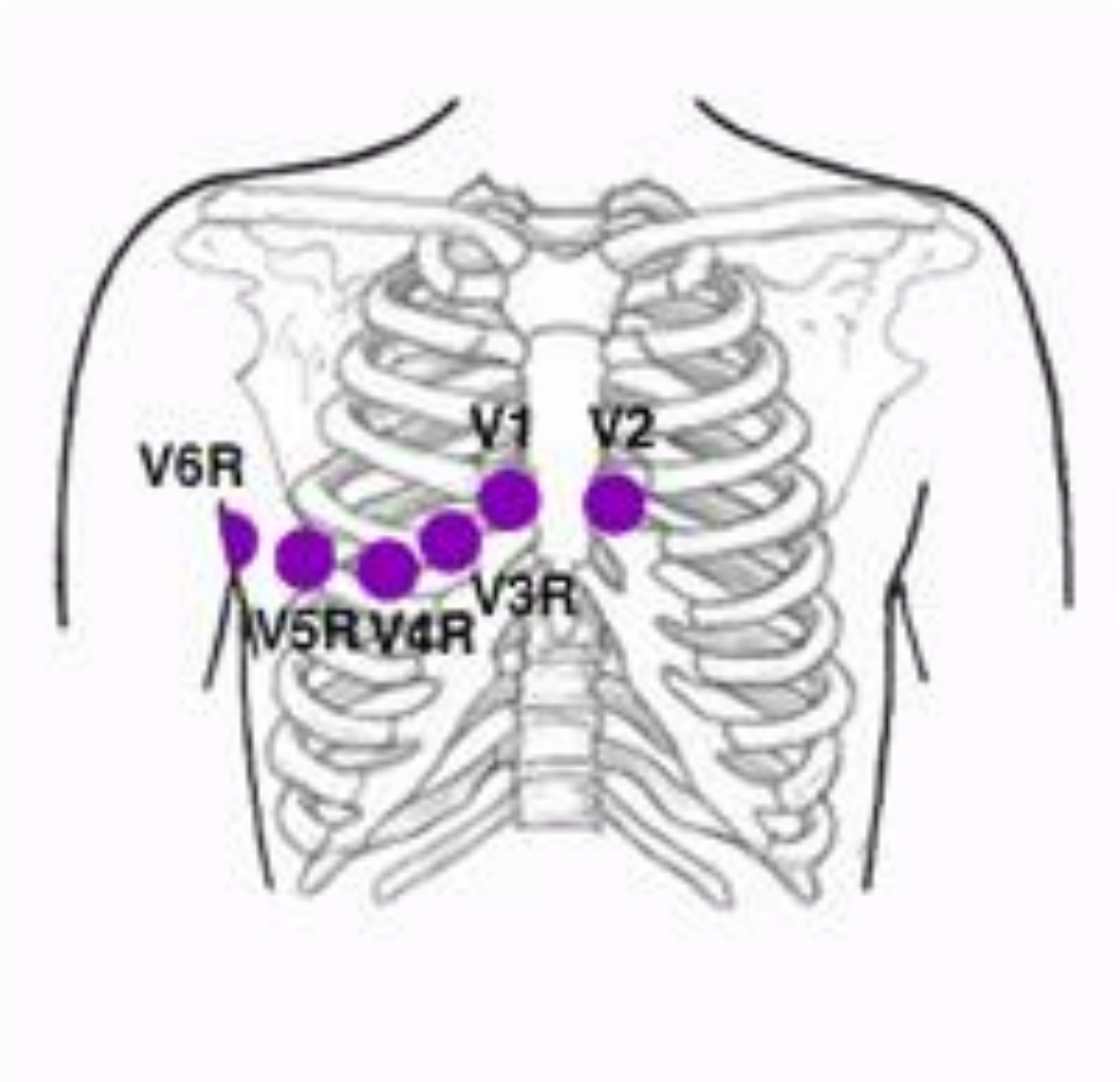
- **“J point”** คือ จุดที่ **QRS complex** เปลี่ยนไปเป็น **ST segment**
- **ST elevation is measured 40 ms or 80 ms after the J point**
- **Picture of measuring the magnitude of ST elevation 60 ms or 1.5 small boxes after the J point**



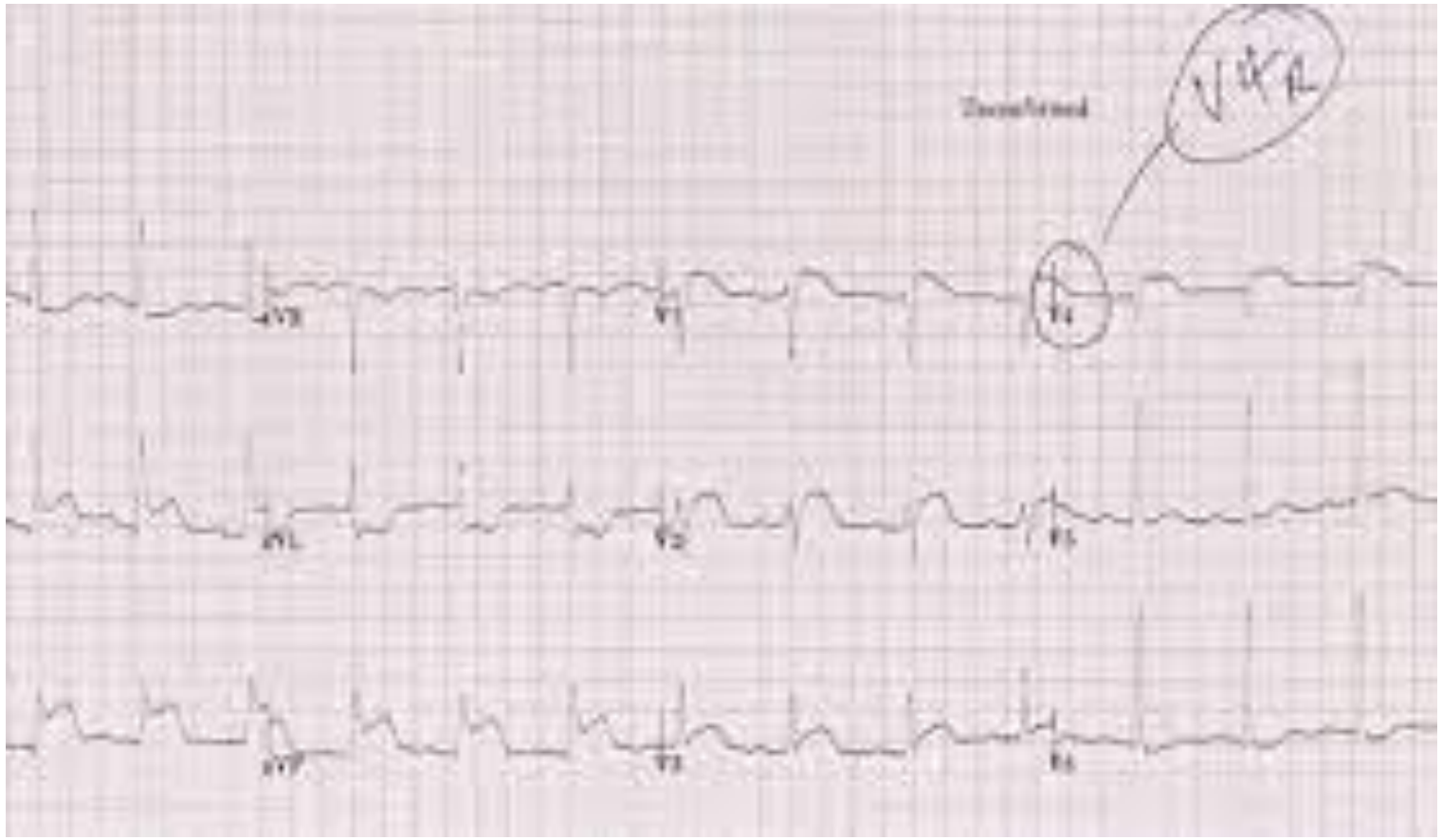
Inferior wall MI



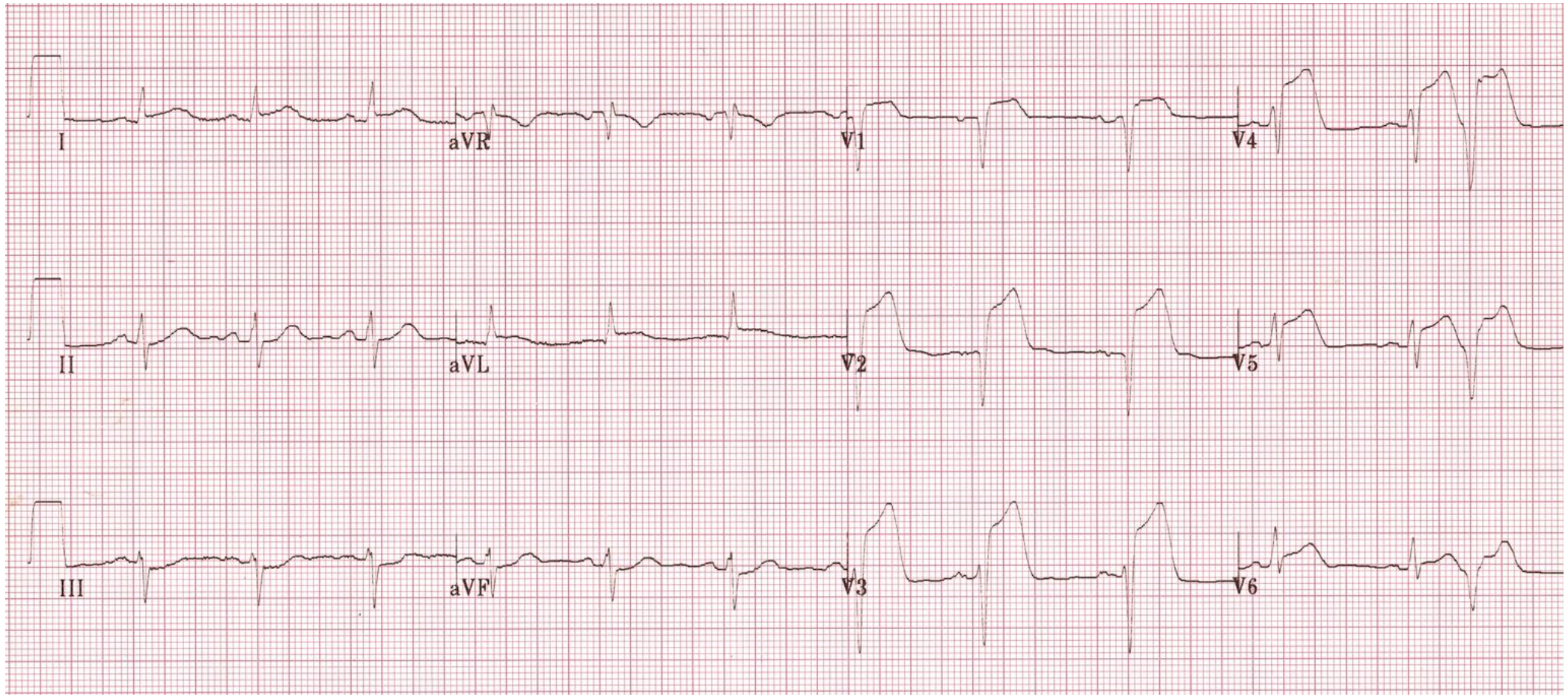
V3R, V4R ECG placement for RV infarction assessment in Acute Inferior wall MI



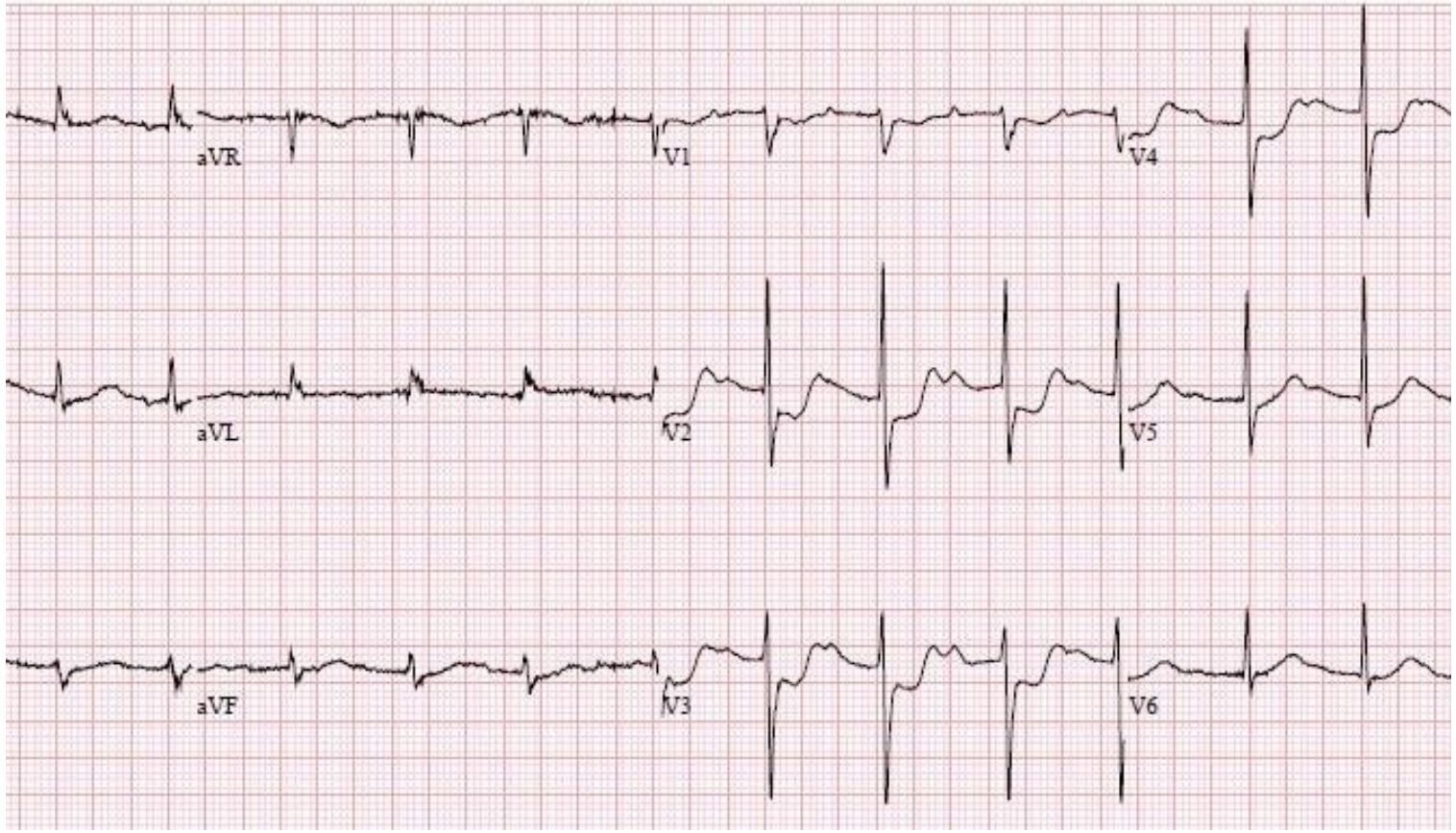
V3R, V4R 12-lead ECG



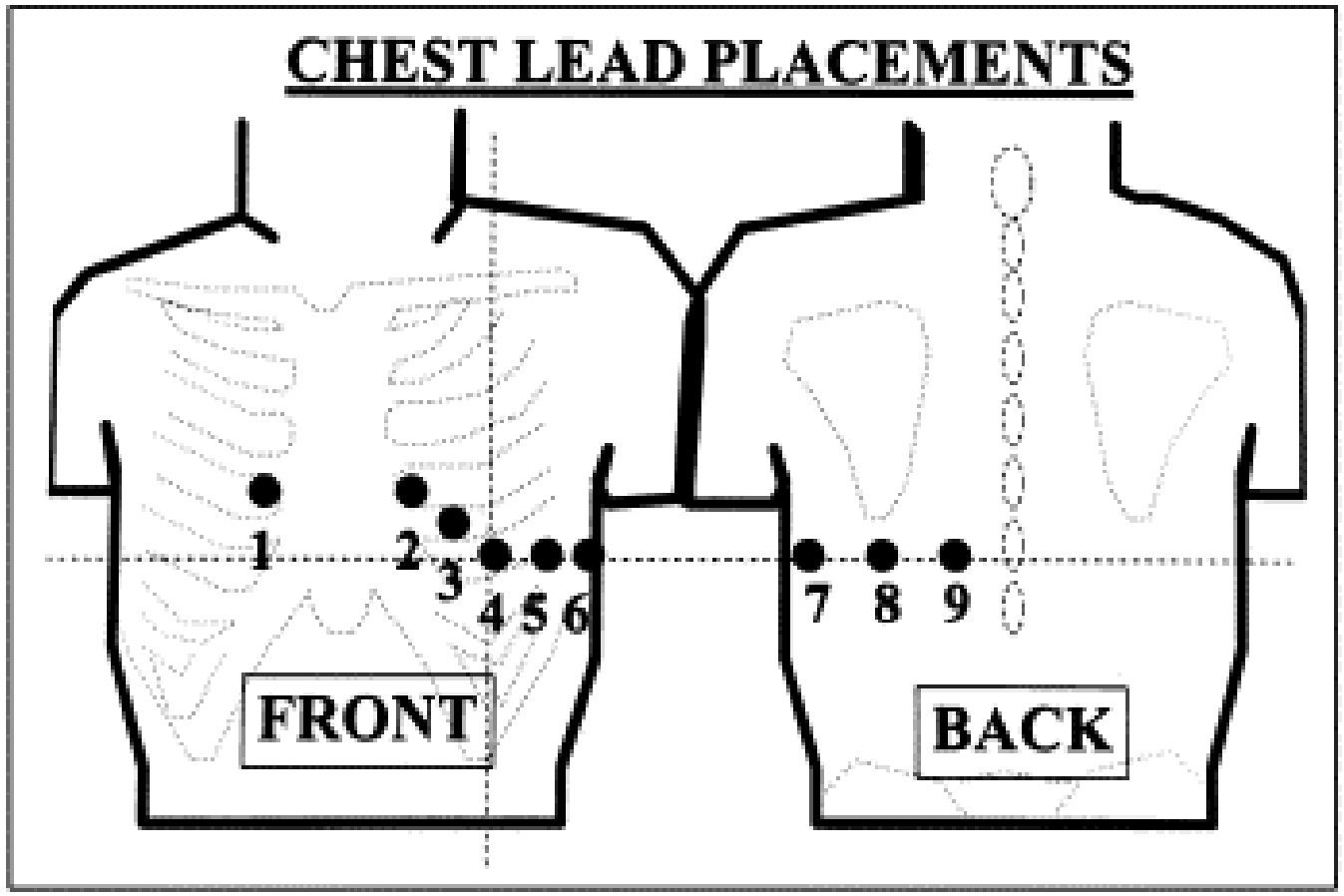
Anterior wall MI



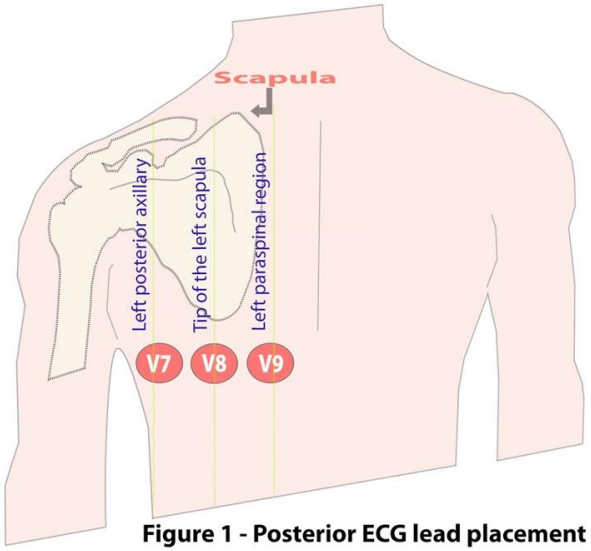
Vent. rate	94	BPM	*** Poor data quality, interpretation may be adversely affected
PR interval	296	ms	Sinus rhythm with 1st degree A-V block
QRS duration	94	ms	Marked ST abnormality, possible anteroseptal subendocardial injury
QT/QTc	374/467	ms	Abnormal ECG
P-R-T axes	* 4	38	



Posterior Wall MI



Posterior ECG lead placement



V7
Left posterior axillary line:
in the same horizontal plane as V4-V6

V8
Tip of the left midscapula:
in the same horizonal plane as V7-V9

V9
Left paraspinal region:
in the same horizonal plane as V4-V6

V1-V3
Should remain unchanged from standard 12-lead ECG

Figure 1 - Posterior ECG lead placement

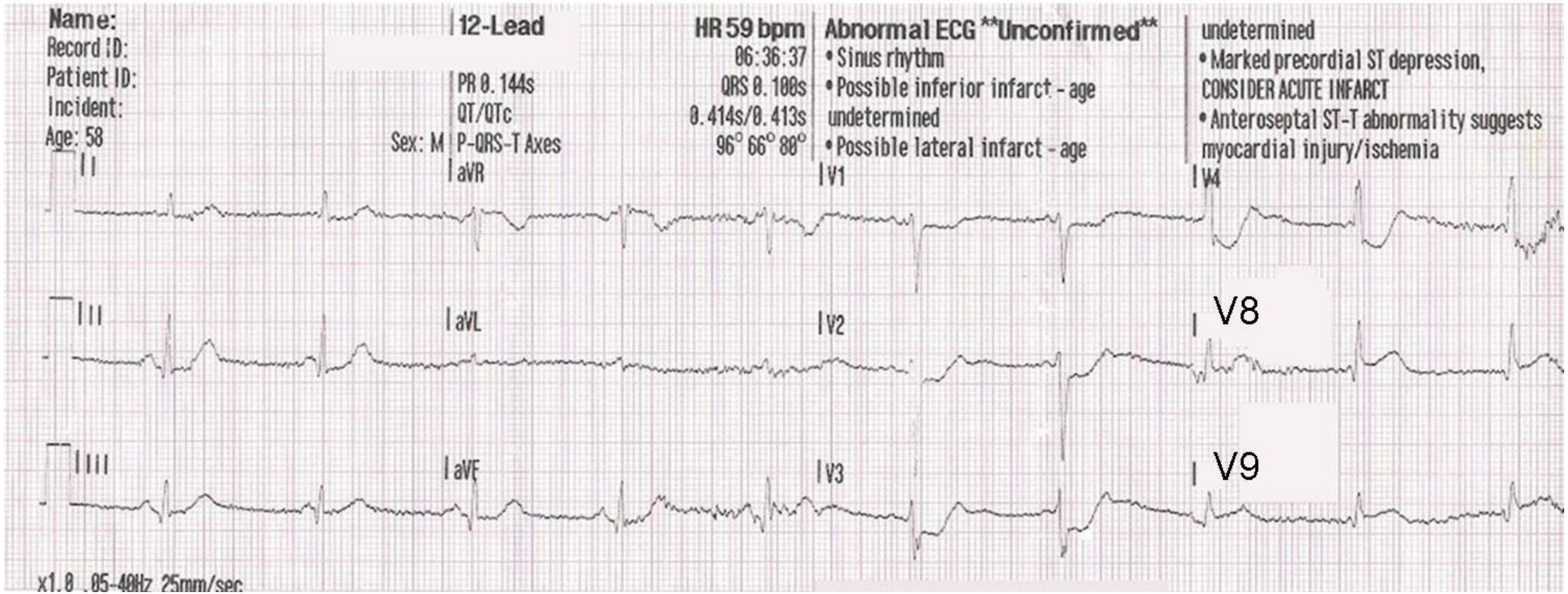
Posterior MI is suggestive by the following changes in V1-V3:

- ***Horizontal ST depression**
- ***Tall, broad R waves (>30ms)**
- ***Upright T waves**
- ***Dominant R wave (R/S ratio >1) in V2**

Please note that V6 is a good reference point for the horizontal placement of the posterior electrobes V7-9.

If you don't have access to to a 15 or 18 lead ECG machine, then leave V1-3 in their normal position and use V4-6, these leads will then become V7-9.

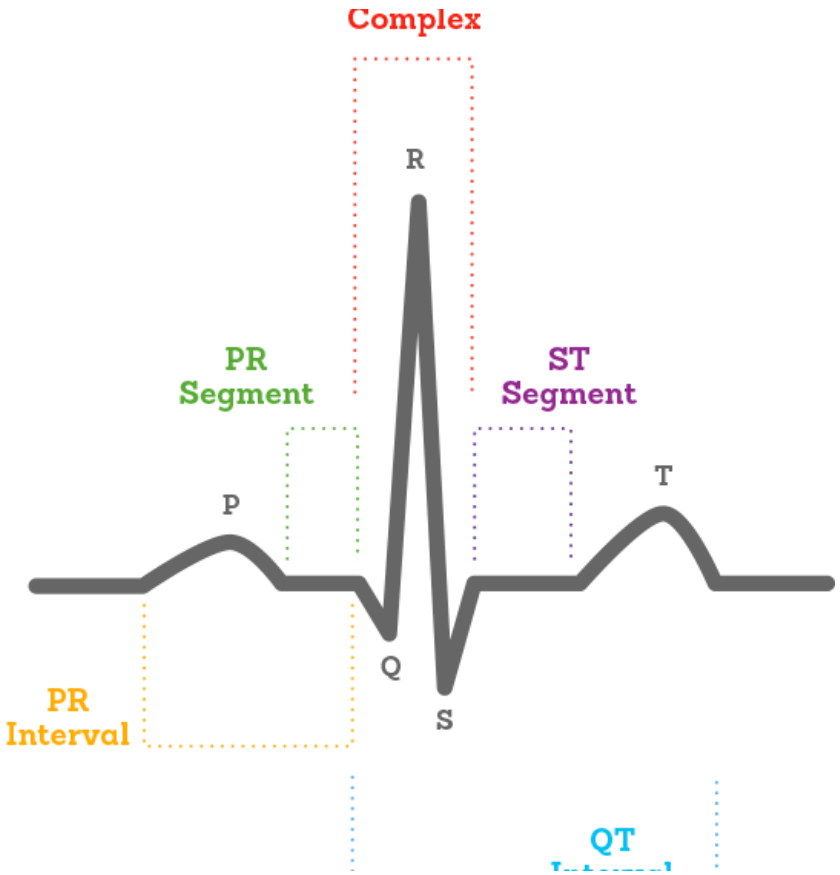
Posterior ECG Lead Placement



12-Lead ECG for Posterior wall MI

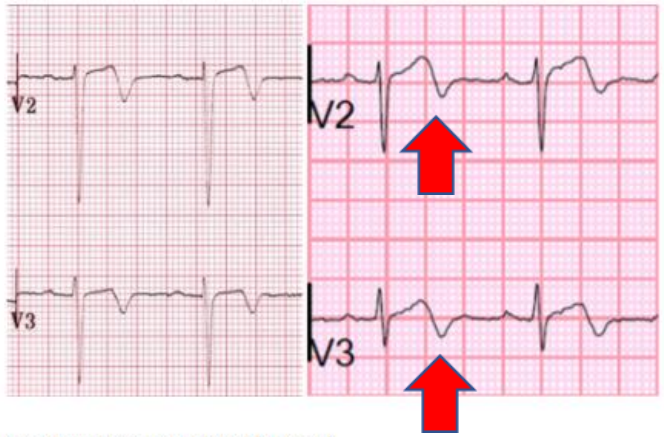
Wellens syndrome

- Wellens syndrome คือ T wave ที่มีหน้าตาที่ผิดปกติไปซึ่งอาจจะแสดงเป็น biphasic T wave (type A)หรือ เป็น Deeply T wave inversion (Type B) ได้ซึ่งจะพบได้ใน lead V2 และ V3
- อาการ และ ECG คล้ายกับ NSTEMI แต่สัมพันธ์กับการตีบอย่างรุนแรงของ Proximal LAD artery
- ผู้ป่วยจะมีประวัติชัดเจนว่า มีอาการของ typical chest pain แบบเป็นๆหายๆ มาก่อนหน้า
- เกิดได้จากการมี spontaneous reperfusion และ re-occlusion
- **การรักษา Wellens syndrome นั้นให้รักษาแบบ NSTEMI high risk คือ จำเป็นจะต้องรีบมี invasive intervention ใน 24 ชม.**

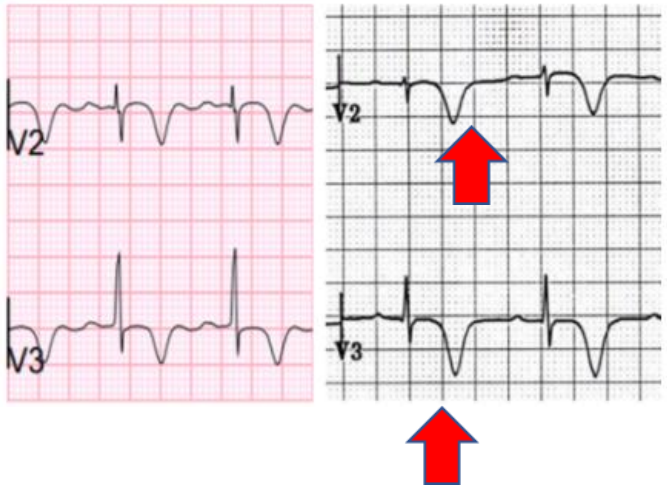


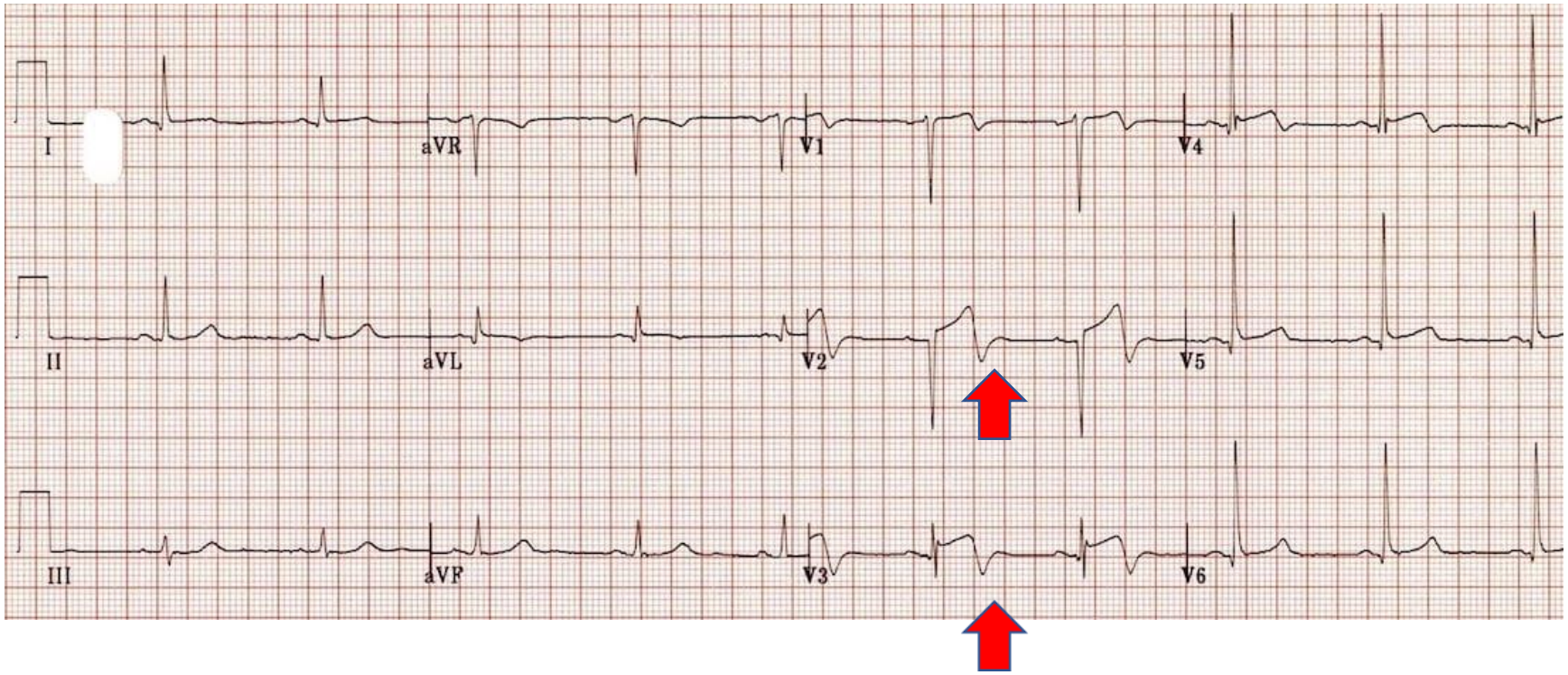
Wellens syndrome

Biphasic T Waves (Type A)

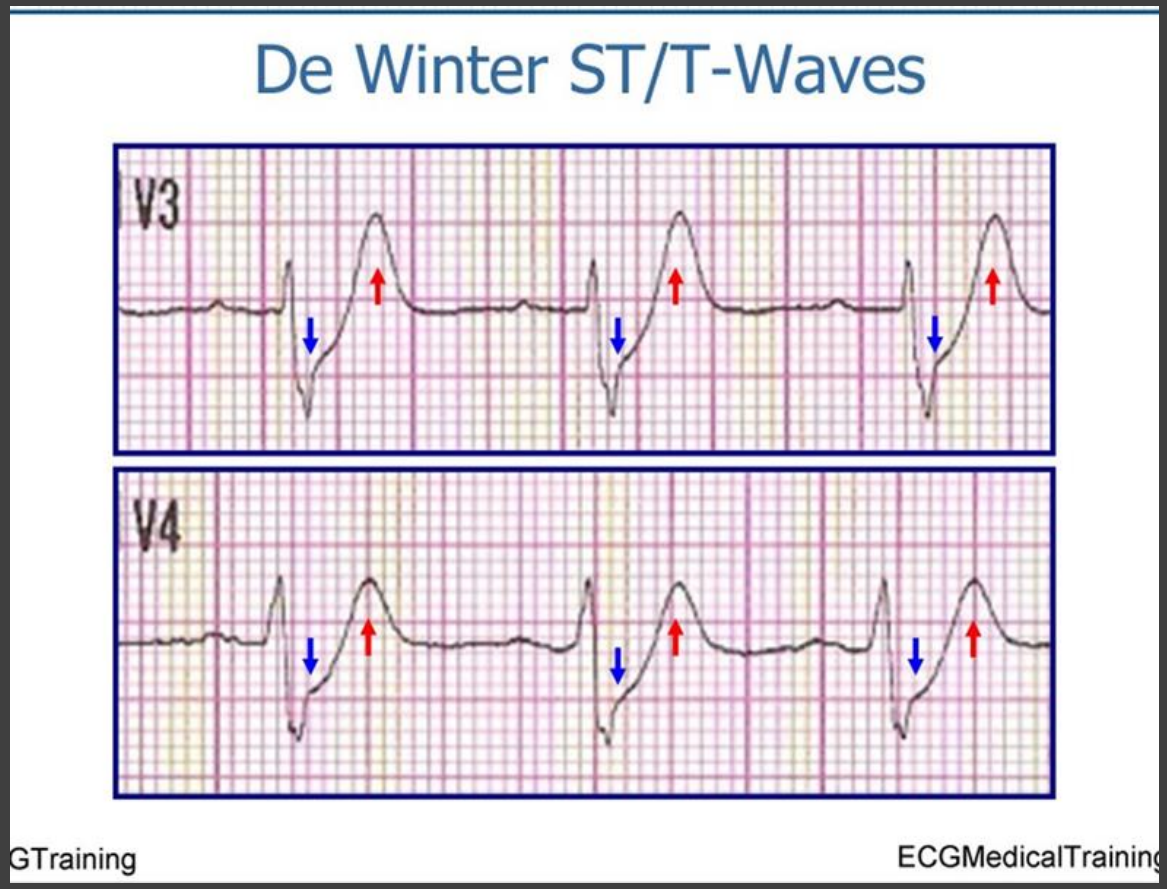


Deeply Inverted T Waves (Type B)



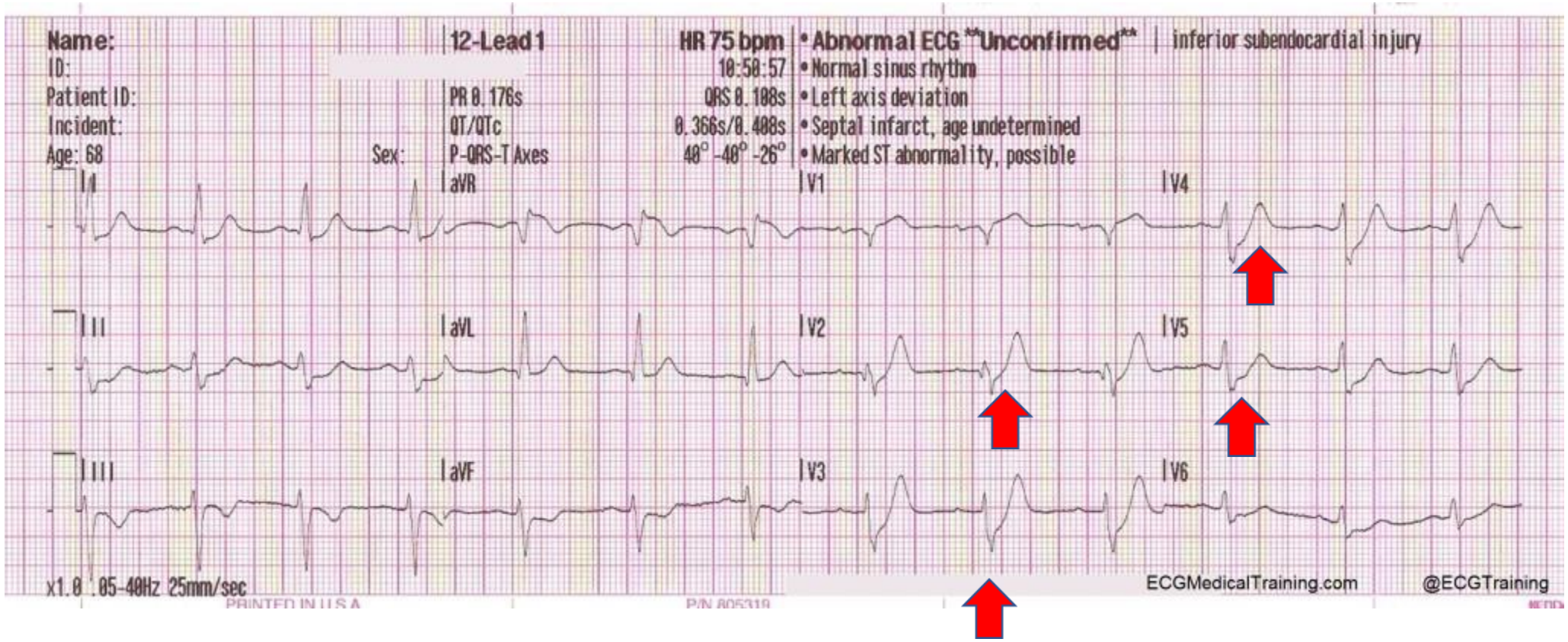


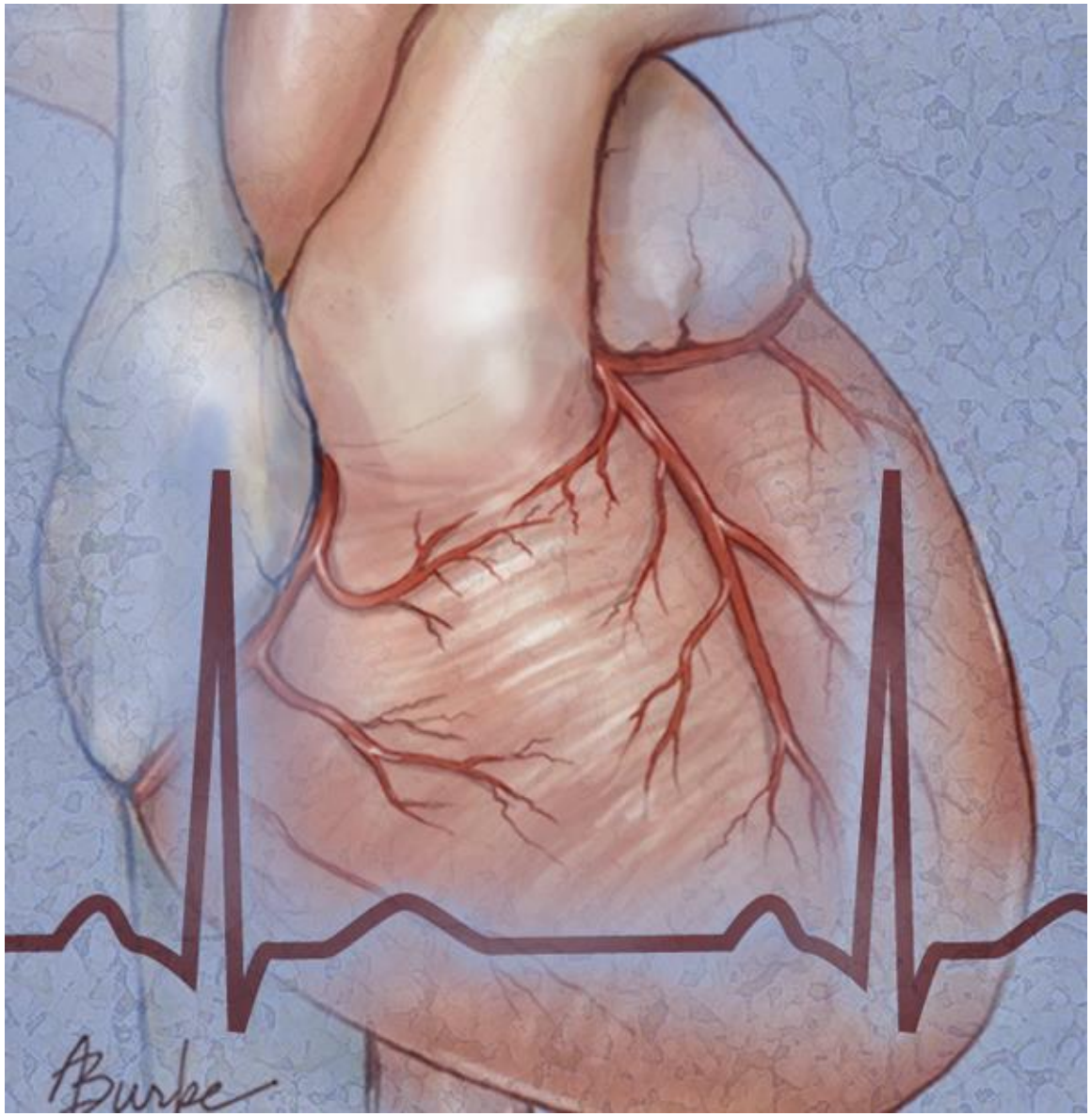
De winter ST/T-waves



- Characterized by 1-3 mm of ST-depression with upright, symmetrical T-waves
- Changes are dynamic as you would expect with ACS
- Suspicious for proximal occlusion of the LAD
- Represents approximately 2% of **LAD occlusions**
- **Recognized as a STEMI equivalent** by Rokos et al. in 2010

De winter ST/T-waves

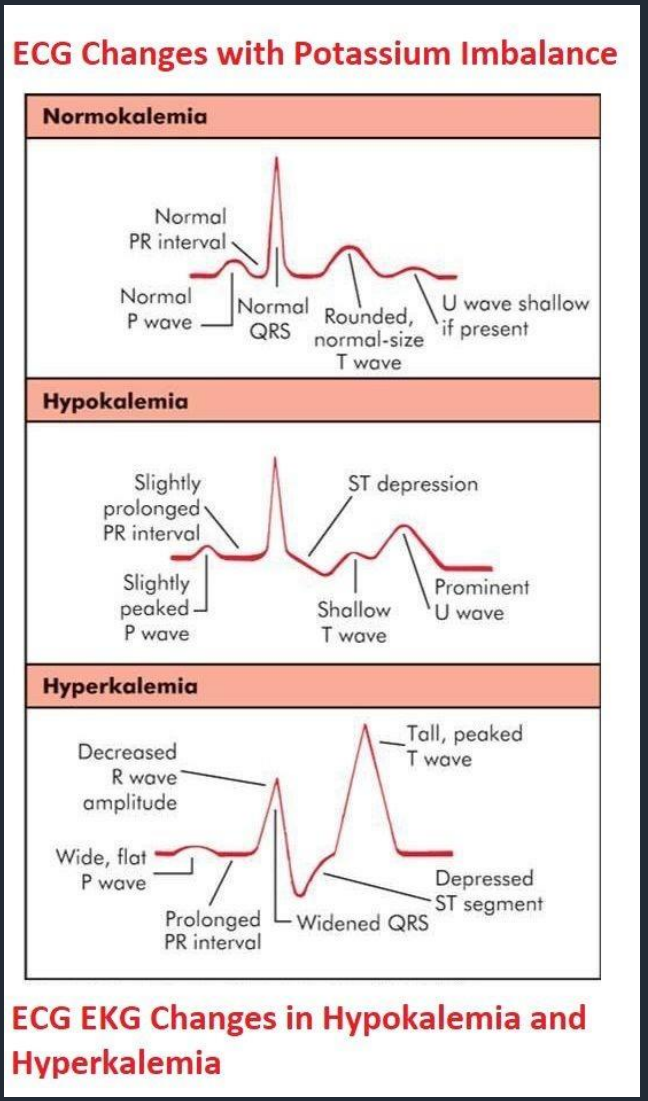




ECG in Electrolyte Imbalance

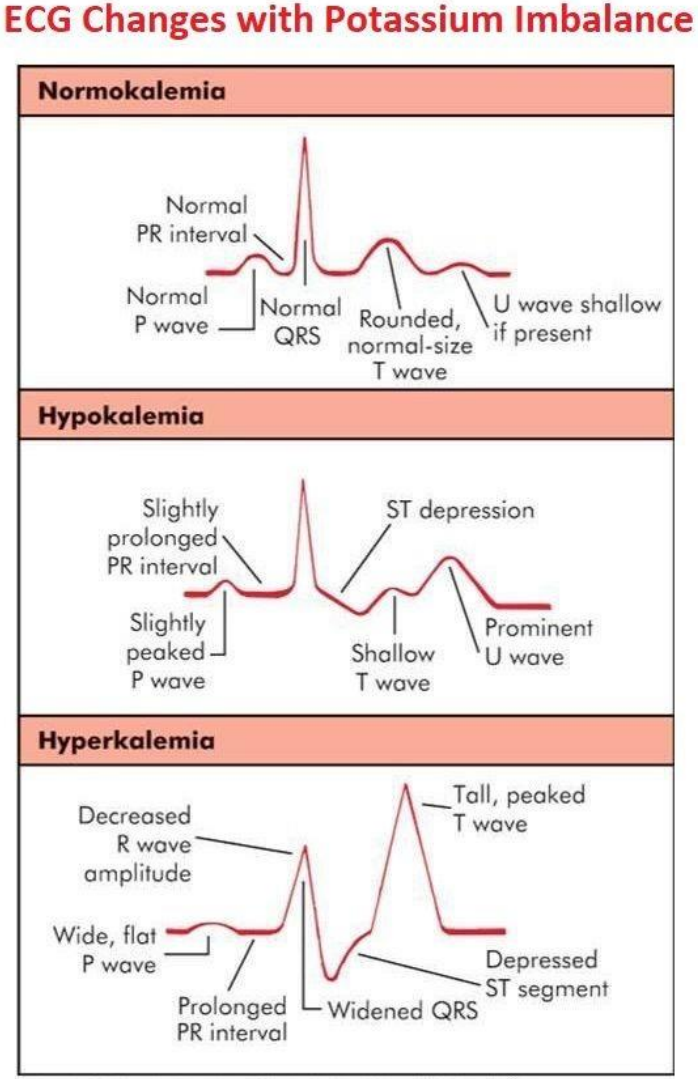
Hypokalemia

- Cardiac effects: serum K < 3 mEq/L
- Hypokalemia:
  - sagging of ST segment
  - depression of T wave
  - elevation of U wave
- With marked hypokalemia, the T wave becomes progressively smaller and the U wave becomes increasingly larger

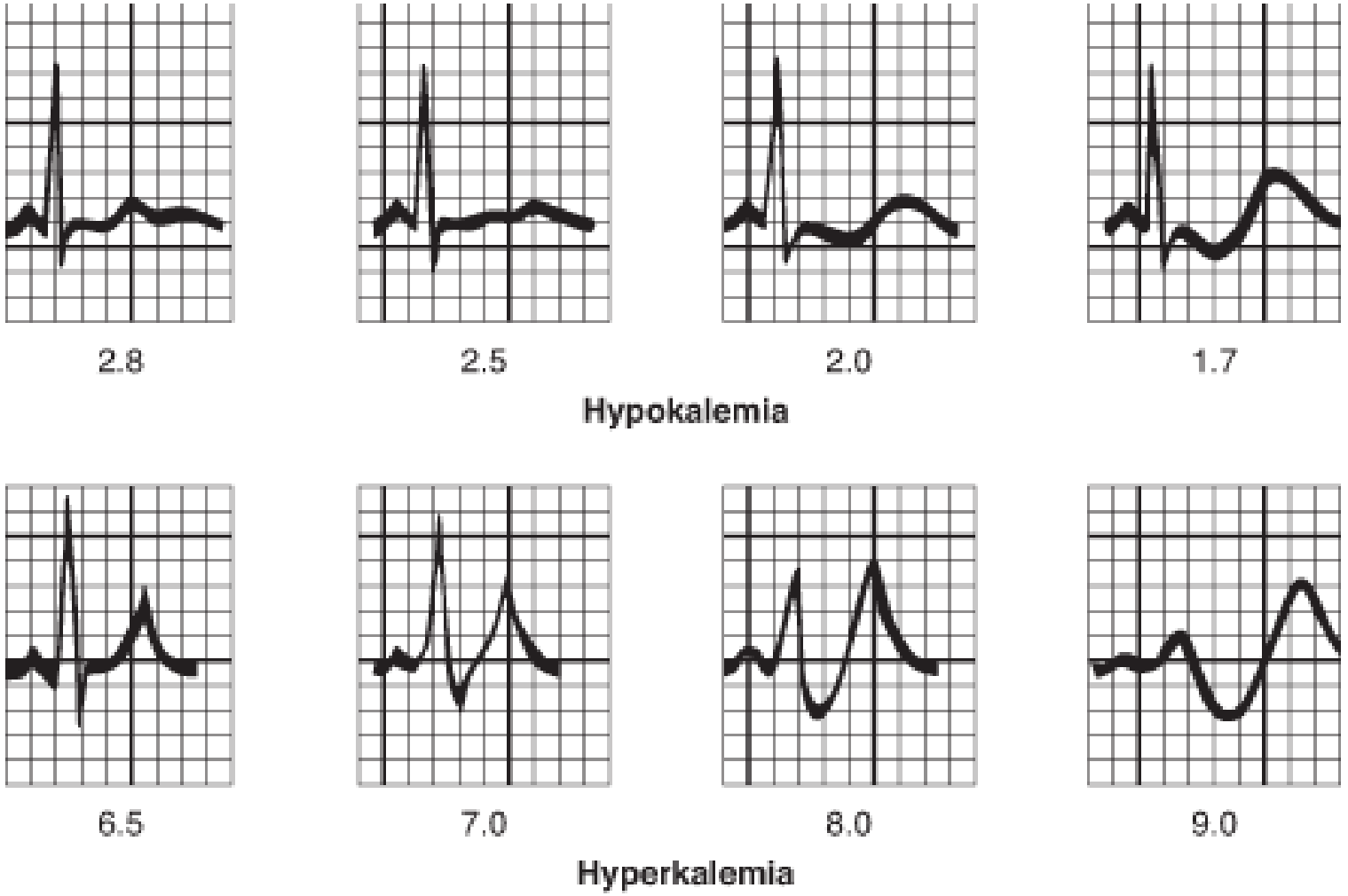


Hyperkalemia

- **K is > 5.5 mEq/L** : increased PR interval, shortening QT interval, Tall, symmetric, peaked T waves
- **K > 6.5 mEq/L** : widening of QRS interval, disappearance of the P wave, and nodal and escape ventricular arrhythmias
- Finally, the QRS complex degenerates into **a sine wave pattern**, and ventricular fibrillation or asystole



ECG EKG Changes in Hypokalemia and Hyperkalemia



Hypo-Hyper Kalemia

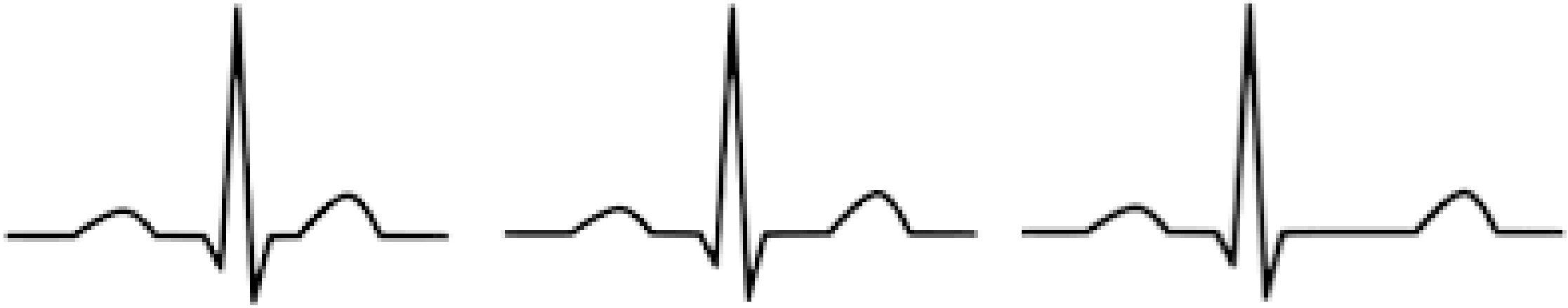
IV KCL

- Adult rate : 5-10 mEq/hr
- Monitor ECG if IV rate > 5 mEq/hr, not exceed 40 mEq/hr (C- line); usual adult max. dose: 400 mEq/day
- If K > 2.5 mEq/L; max. conc. 40 mEq/L; max. 24 hrs. dose = 200 mEq; max. IV rate = 10 mEq/ hr
- If K < 2.5 mEq/L; max. conc. 80 mEq/L; max. 24 hrs. dose = 400 mEq; max. IV rate = 40 mEq/ hr

http://www.med.cmu.ac.th/hospital/dis/2011/index.php?option=com_content&view=article&id=16:potassiumchloridehad&catid=6:high-alert-drug&Itemid=4

IV KCL

- Peripheral line : Max. conc. 80 mEq/L ; Max. rate : 10 mEq/hr
- C- line : Max. conc. 150 mEq/L
- In restrict fluid pt. (C- line) 200 mEq/L ; Max. rate: 40 mEq/hr
- Avoid glucose solutions because elevation in the serum insulin conc. result in transient worsening of hypokalemia



Hypocalcemia

- **Hypocalcemia : Ca concentration < 8.8 mg/dL (< 2.20 mmol/L)**
- **Severe Ca < 7 mg/dL (< 1.75 mmol/L) : hyperreflexia, tetany, laryngospasm, or generalized seizures**
- **Prolongation of the QTc and ST intervals**
- **T-wave peaking or inversion**
- **Arrhythmia or heart block (occasionally)**

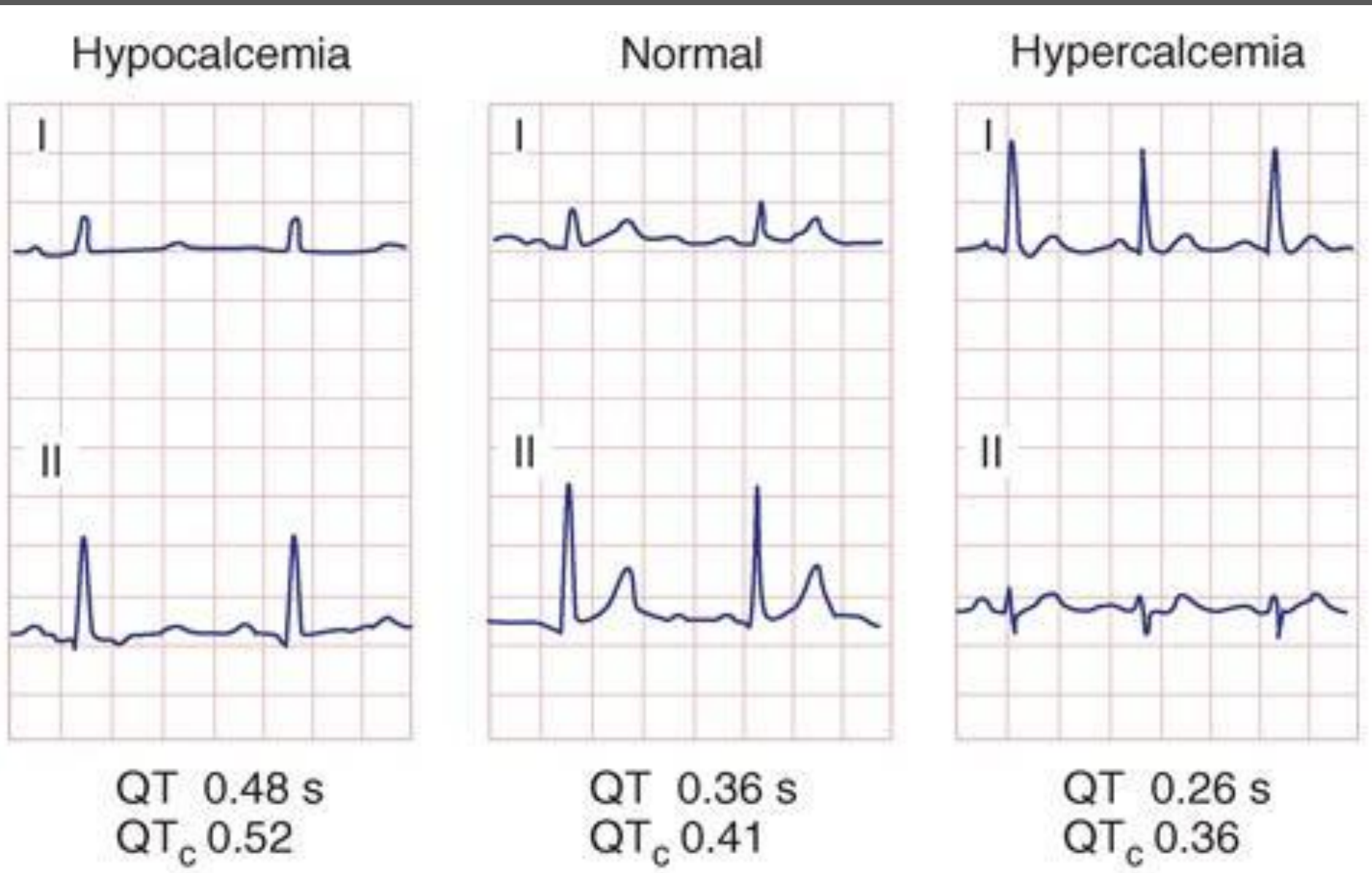
QT interval ranges

	Age 1 to 15	Adult man	Adult woman
Normal	Less than 0.44 second	Less than 0.43 second	Less than 0.45 second
Borderline	0.44 to 0.46 second	0.43 to 0.45 second	0.45 to 0.47 second
Prolonged	Greater than 0.46 second	Greater than 0.45 second	Greater than 0.47 second

Source: Jacobson C. Long and short of it: What's up with the QT interval? http://hosted.mediasite.com/mediasite/Viewer/?peid=9ed8856fcdab4bc0bb066c25a148435b1d.

Hypercalcemia

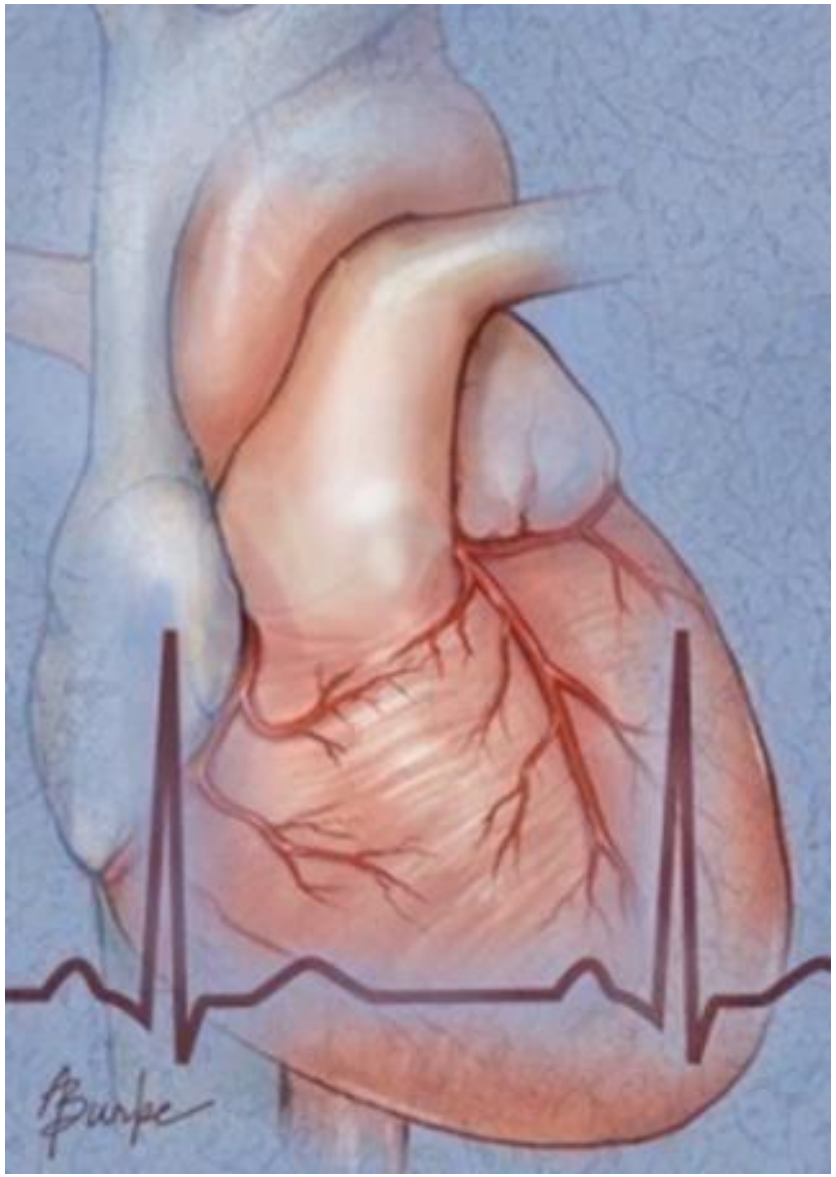
- Severe hypercalcemia shortened QT_c interval
- Arrhythmias may occur in patients taking digoxin or DIGITEK or LANOXIN
- Hypercalcemia > 18 mg/dL (> 4.50 mmol/L) may cause shock, renal failure, and death

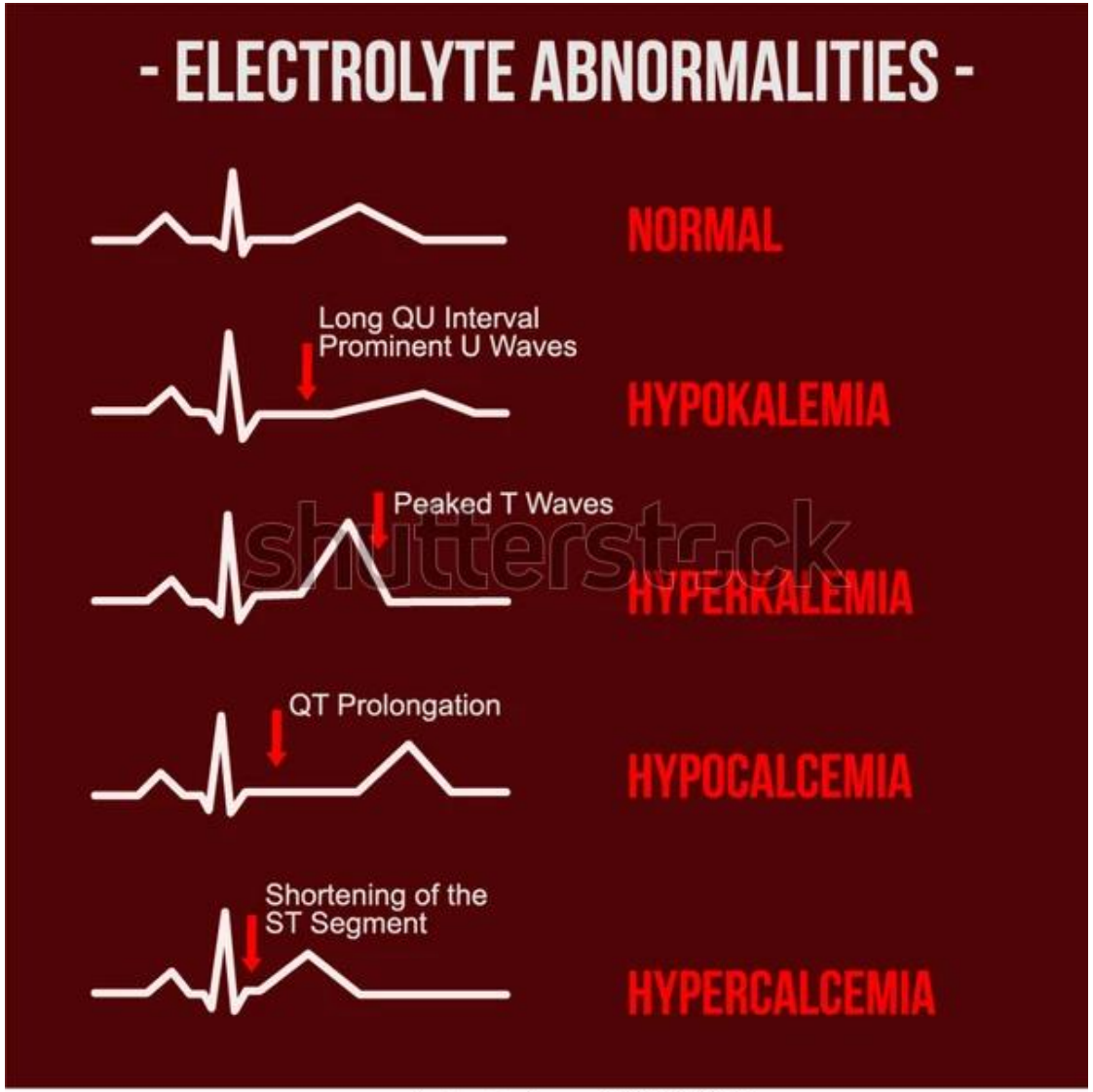

Hypocalcemia
Normal
Hypercalcemia
I
II
I
II
I
II
QT 0.48 s
QTc 0.52
QT 0.36 s
QTc 0.41
QT 0.26 s
QTc 0.36

IV Ca

- Adult: 2-15 g/24 hrs. continuously IV, or separated dose
- Dilute Calcium Gluconate with D5W
- Incompatibility with
  - Bicarbonates, carbonates, Phosphates, sulfates
  - Clindamycin phosphate, Amphotericin B,
  - Pantoprazole sodium

☻ Do not mixed with 10% fat emulsion or TPN + phosphate





www.shutterstock.com · 1036771849

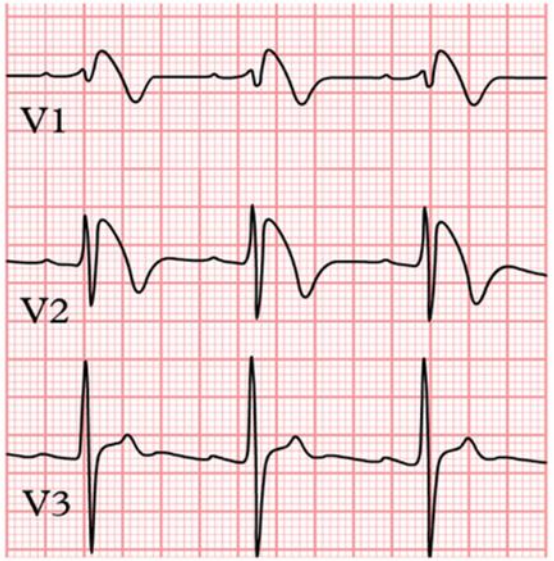
Interesting ECG

Brugada Syndrome

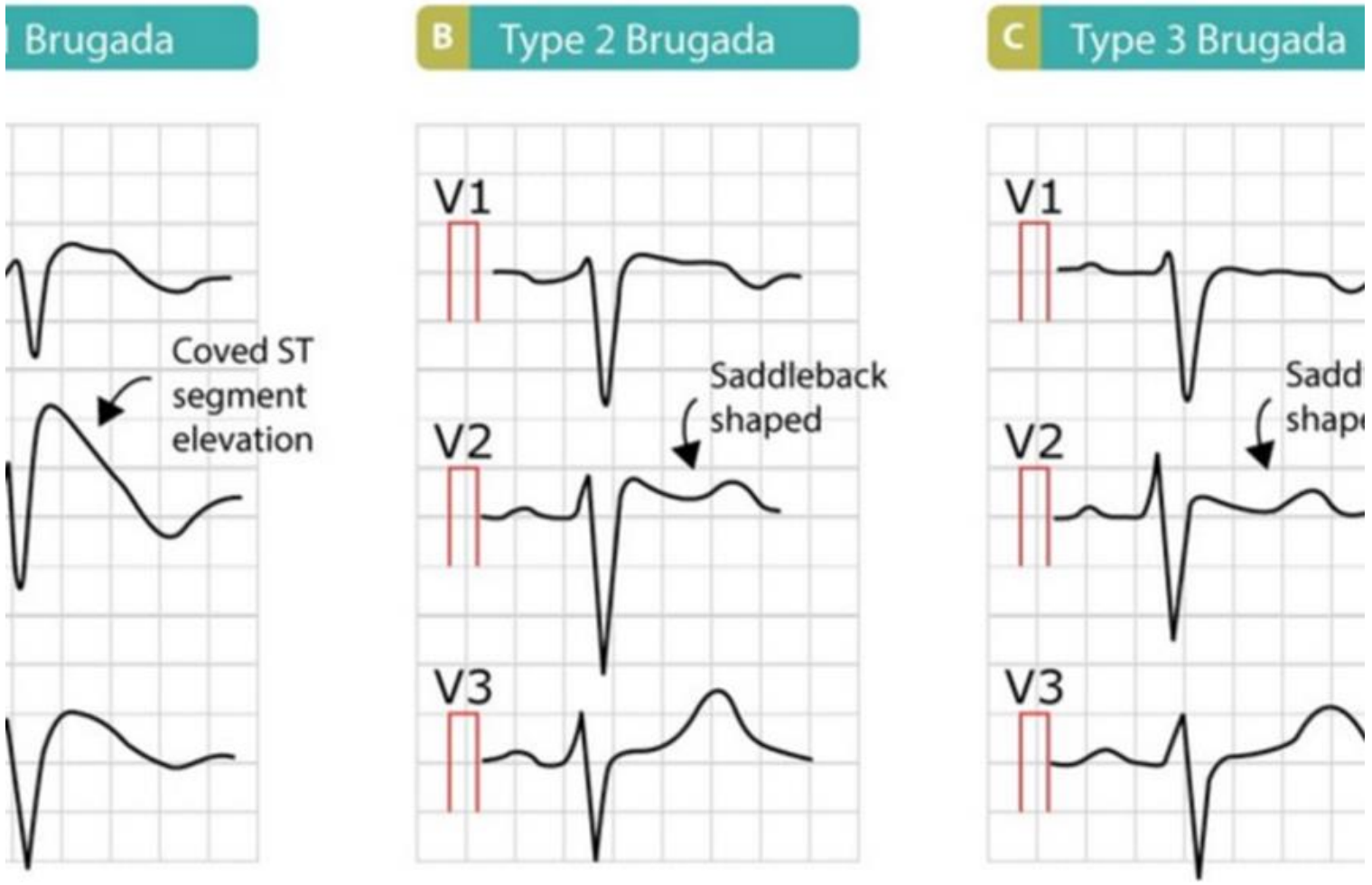
1. **Synonyms:**
   - Pokkuri Death Syndrome
   - SUNDS: Sudden Unexpected Nocturnal Death Syndrome
2. **Na channelopathy:**
   - Familial clustering, autosomal dominant inheritance
3. **Manifestations:**
   - Syncope, VT, VF, **sudden death at sleep**
4. **Treatment:**
   - ICD (implantable cardioverter-defibrillator), quinidine

5. **Diagnostic ECG**

(coved type STE & TWI in V1~3)



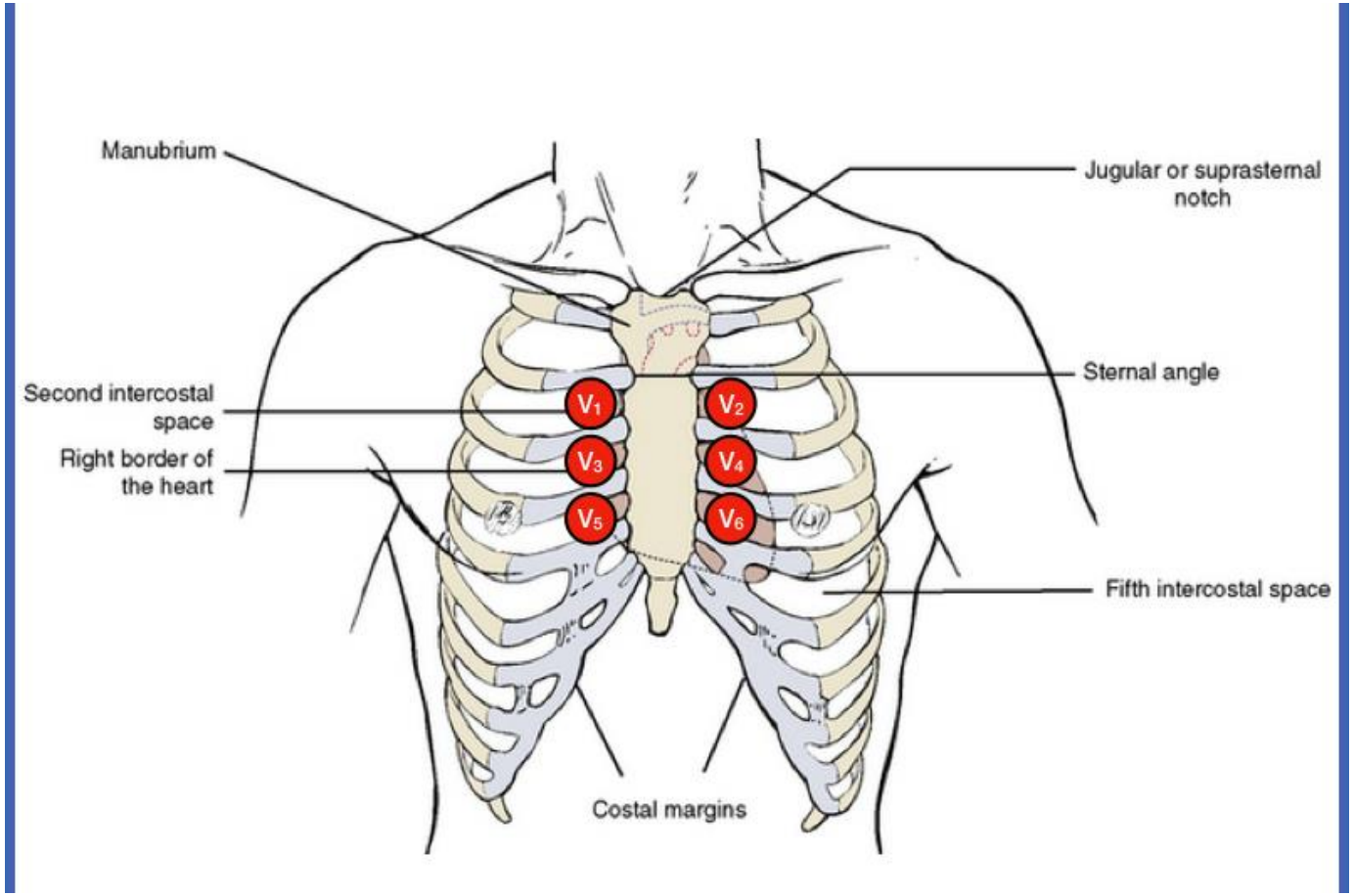
Brugada Syndrome



ECG in Brugada Syndrome

Brugada lead placement

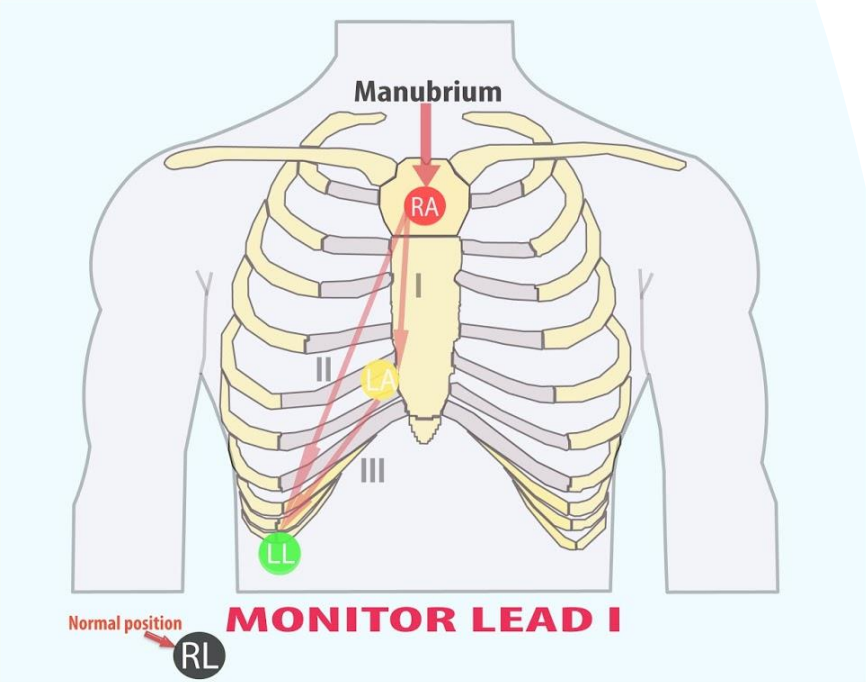
- V1-V2 ติดที่ 2nd intercostal space
- ... V3-V4 ติดที่เหมือน V1-V2 แต่ติดลงมาที่ 3rd intercostal space
- ... V5-V6 ติดที่ 4th intercostal space



https://www.ahajournals.org/doi/full/10.1161/CIRCEP.111.965947

Lewis Lead (S5-Lea

S5 Lead Placement

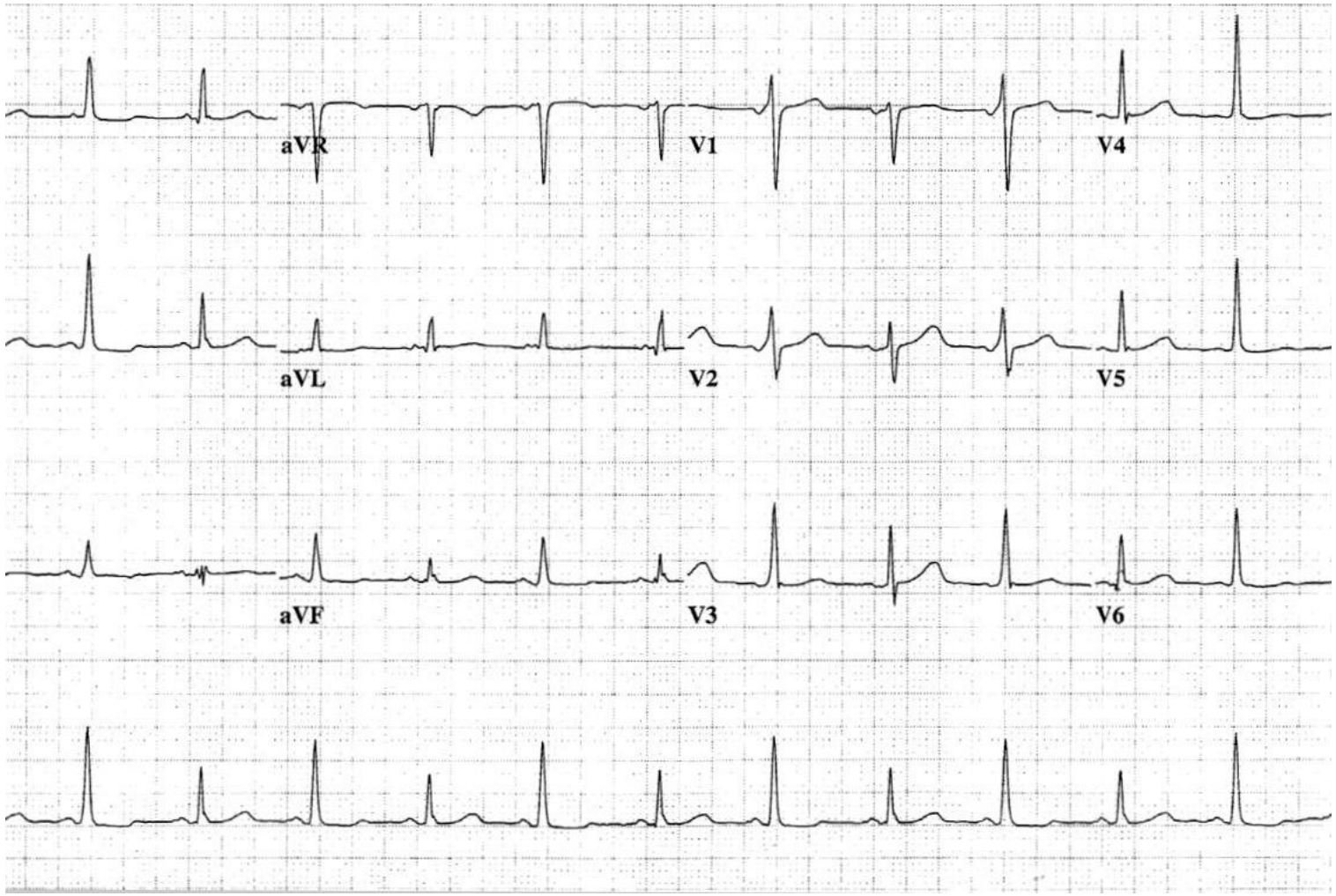


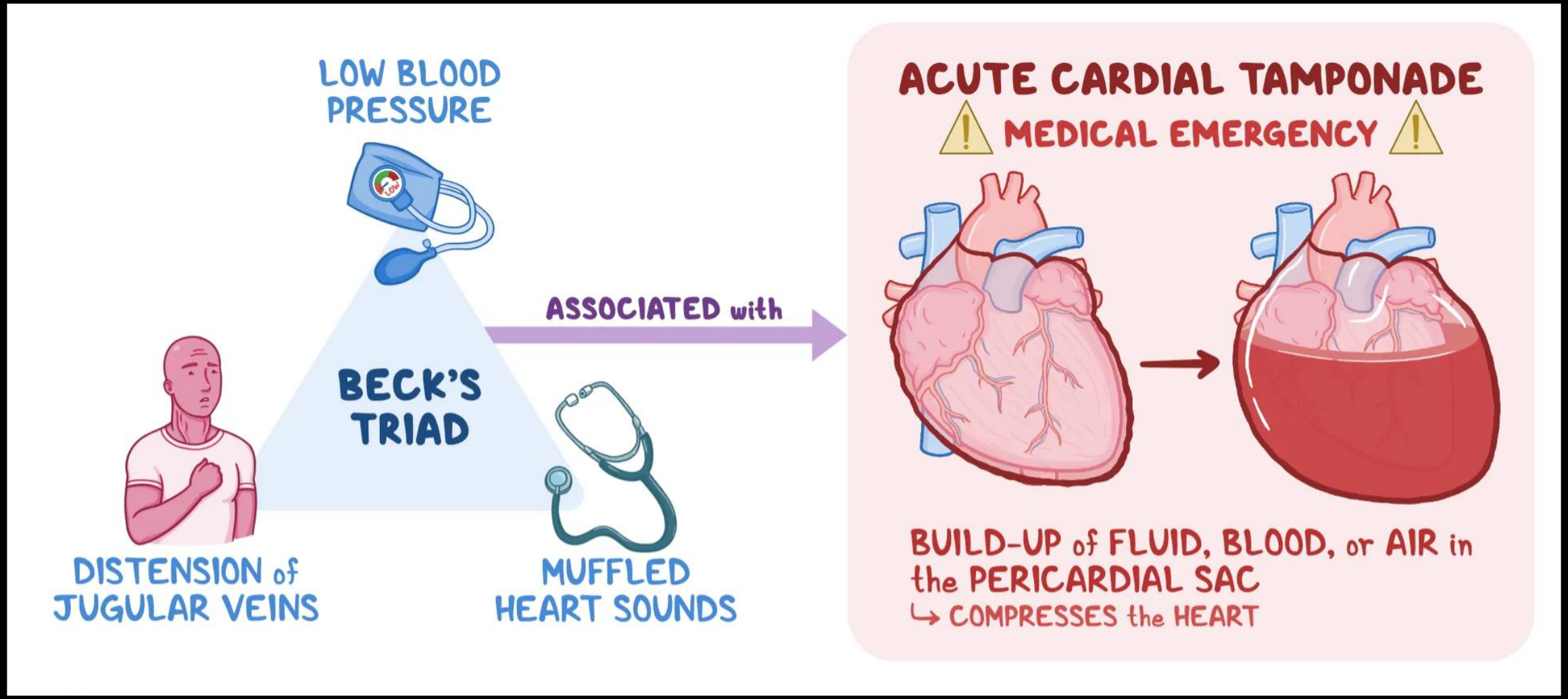
1. Right Arm (RA) electrobe is placed on the patient's manubrium.
2. Left Arm (LA) electrobe is placed on the 5th intercostal space, right sternal border.
3. Left Leg (LL) electrobe is placed on the right lower costal margin.
4. Right Leg (RL) electrobe is placed right leg.

Lewis Lead Placement

- A Lewis Lead (also called the S5 lead) is a modified ECG lead used to detect atrial flutter waves when atrial flutter is suspected clinically
- Identified P wave

Electrical Alternans in Massive Pericardial Effusion





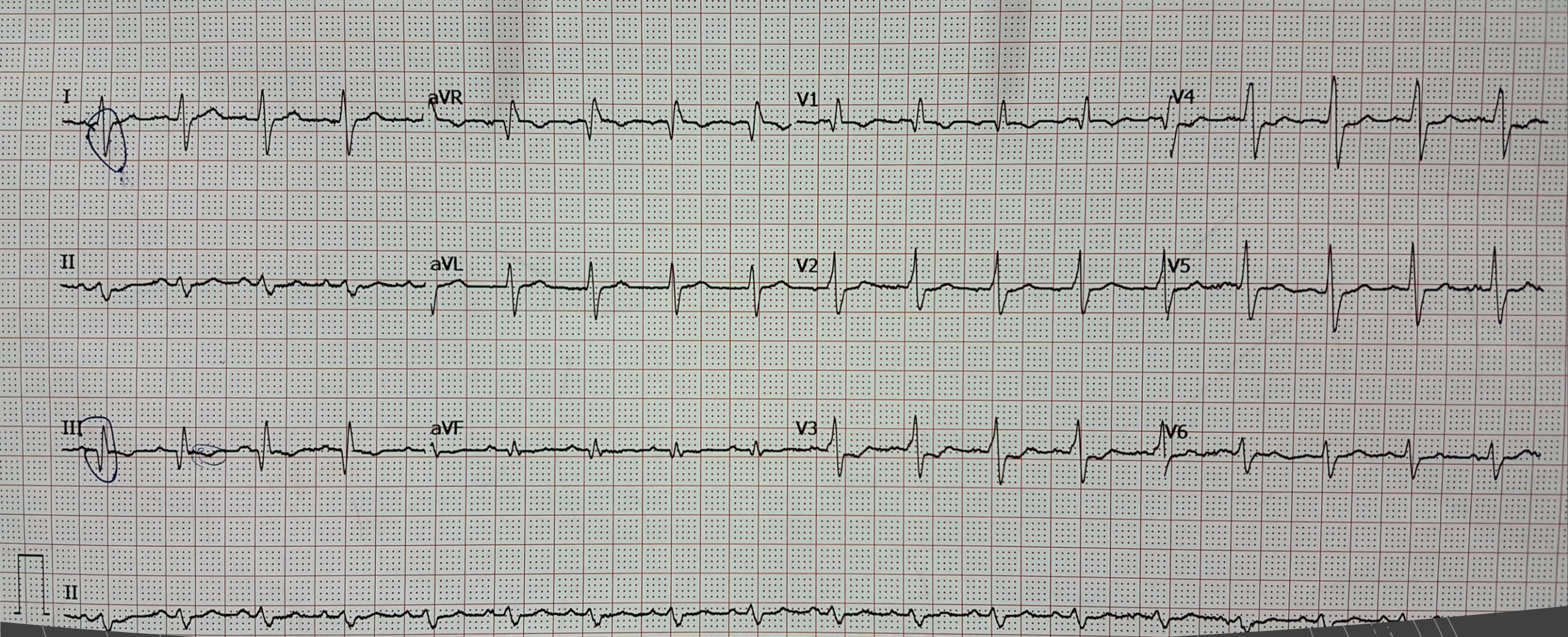
Beck's Triad: seen in Cardiac tamponade

(Not everyone will show all 3 signs, other signs may be tachycardia, SOB)

Pulmonary Embolism ECG: S1Q3T3

1. Sinus tachycardia
2. S1Q3T3 พบได้ไม่บ่อย แต่มีความจำเพาะค่อนข้างมาก ดูที่
   - **lead I มี deep S-wave** [ปกติ Lead I ไม่มี S wave]
   - **lead III มี Q-wave และ T-inversion**
3. อาจพบมี T-inversion ใน leads V1 -V3 ได้ และ right bundle branch block (CRBBB) บ่งบอกว่าหัวใจห้องล่างขวาทำงานผิดปกติ(right ventricular dysfunction)

(ปกติ II-III-avf,v1-v3 Tจะหัวตั้ง)



PE: S1Q3T3

Thank you