ECG basic, Lead and Axis

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COI Disclosure

Name of First Author:
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The authors have no financial conflicts of interest
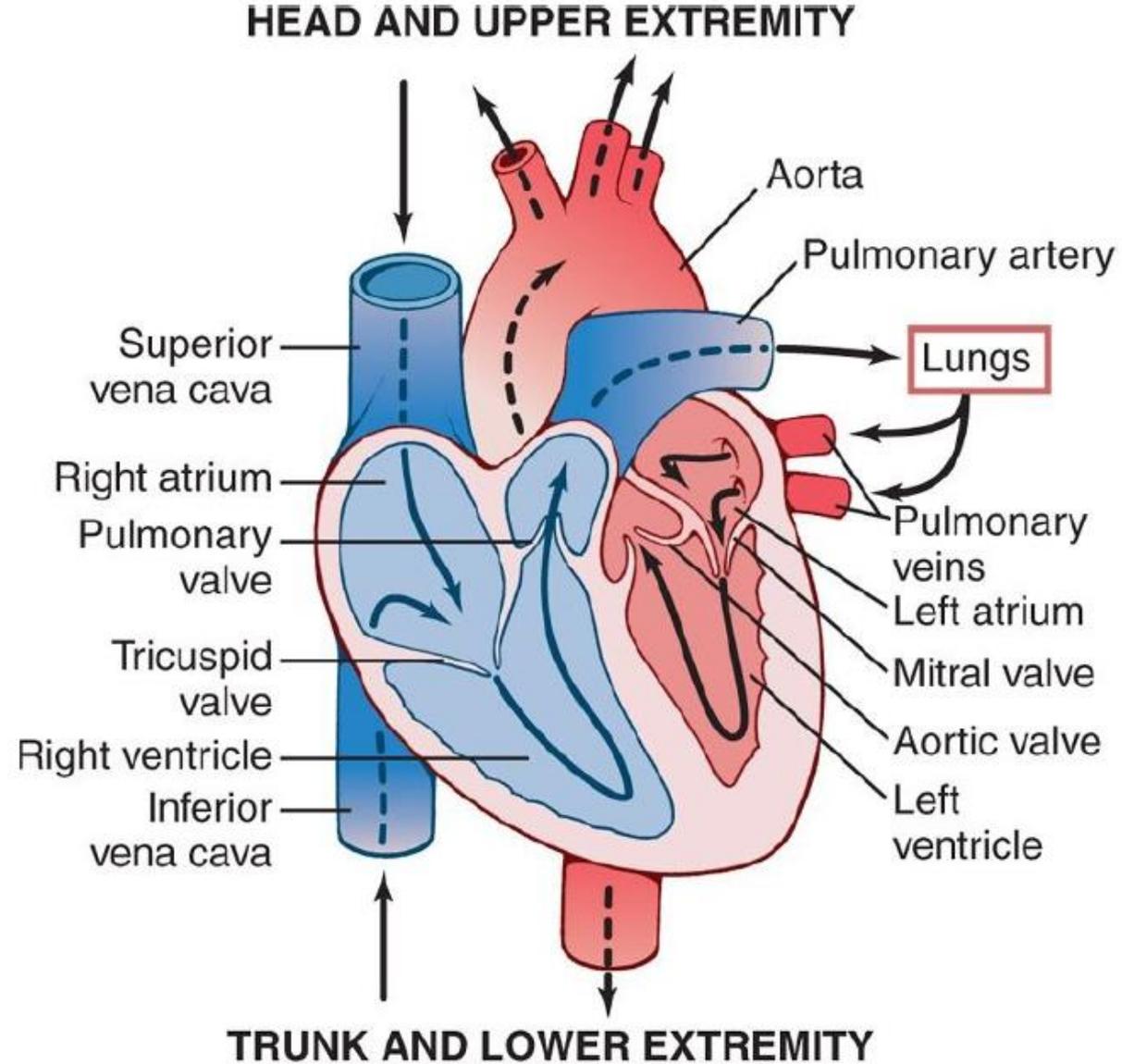to disclose concerning the presentation

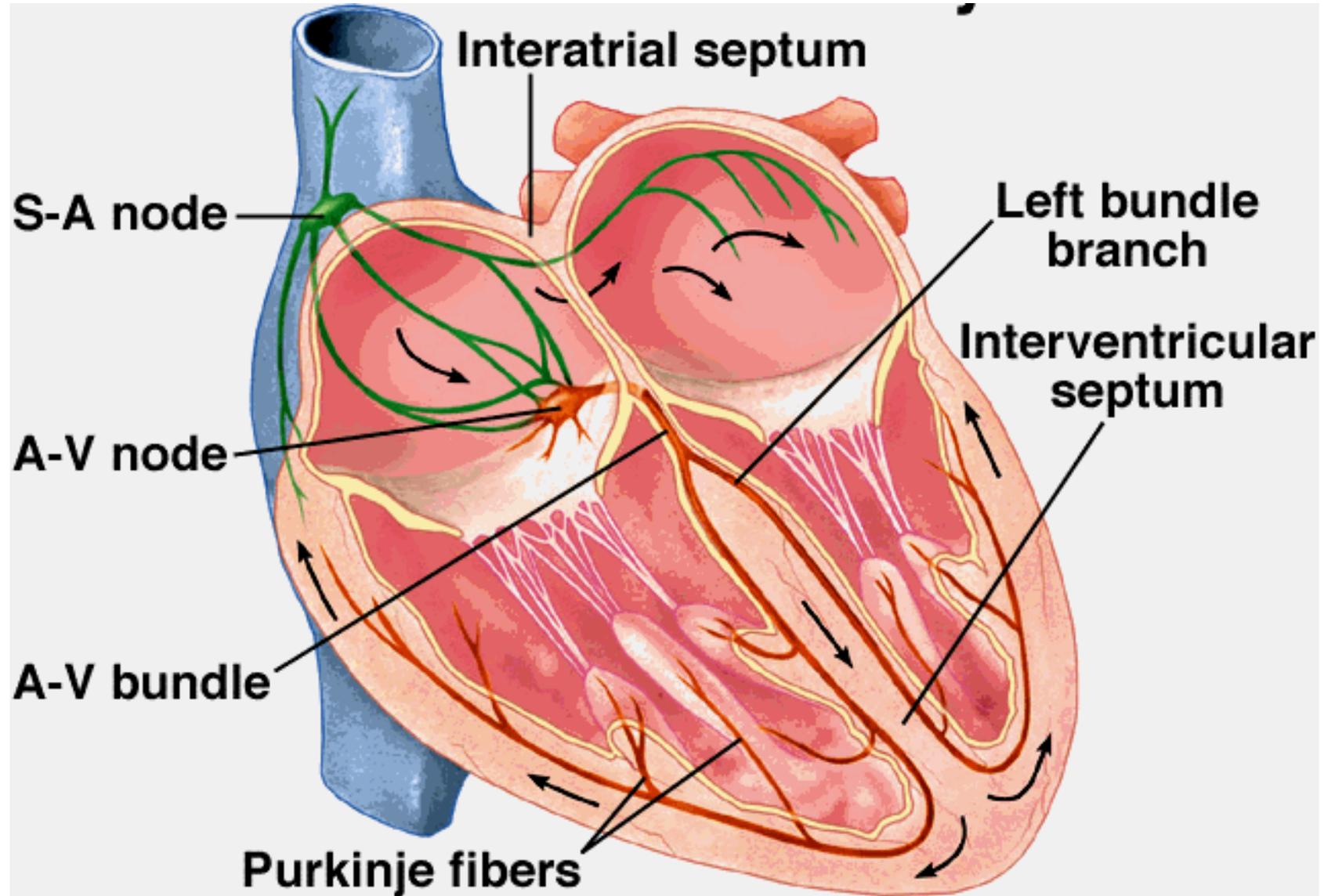# Disclosure

Relationships with commercial interests:

- Grants/Research Support: none
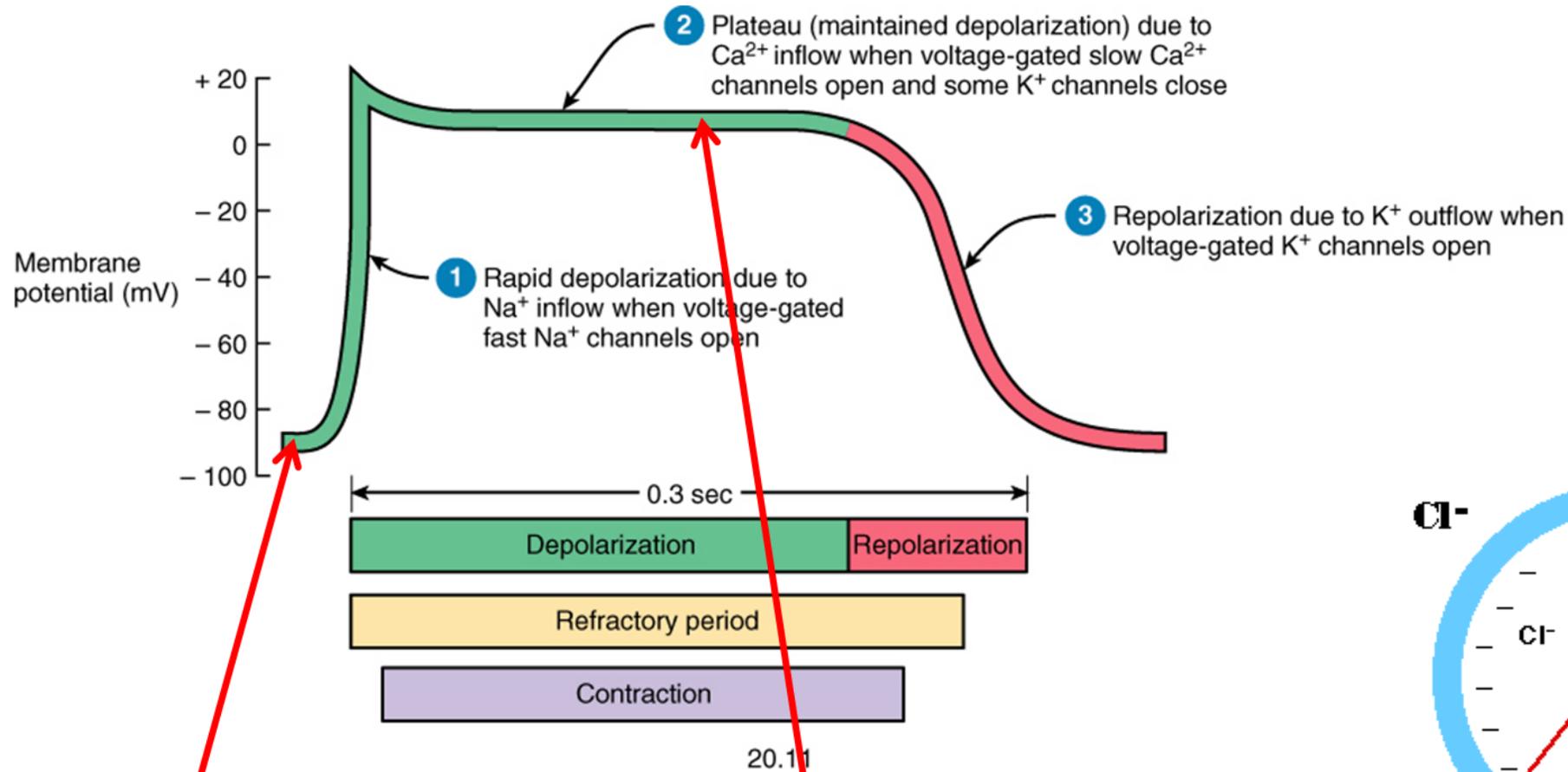- Speakers Bureau/Honoraria: none
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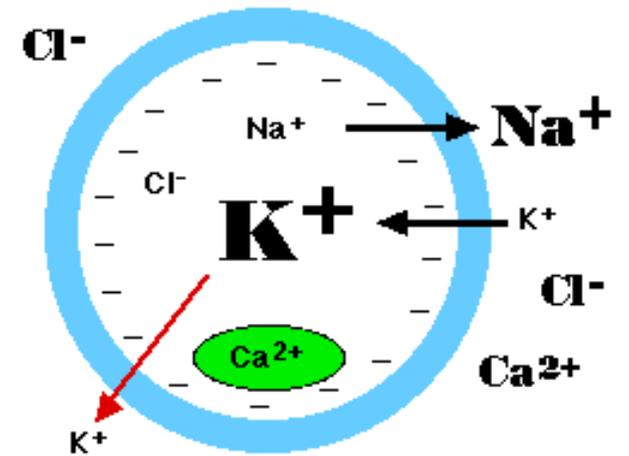
The heart

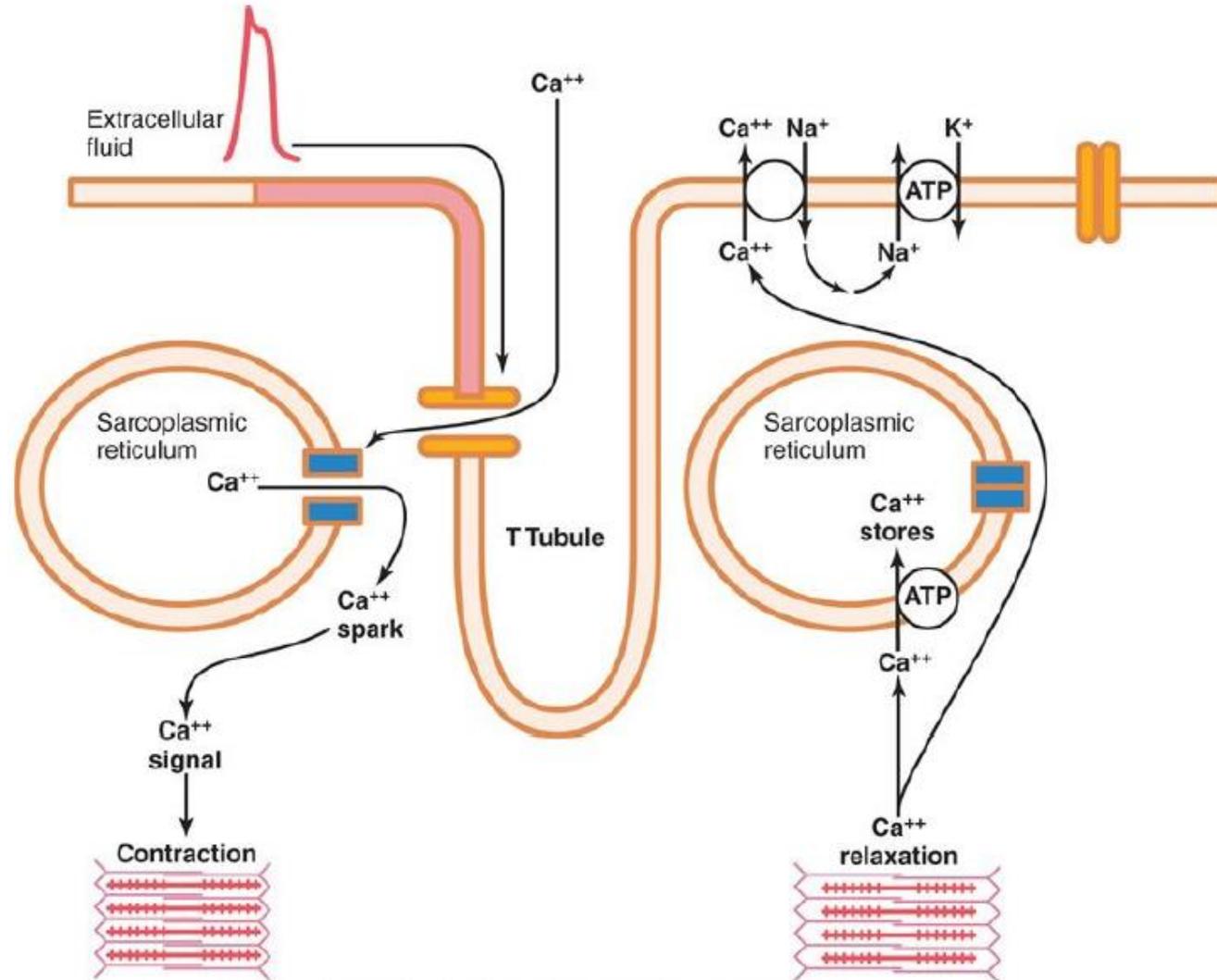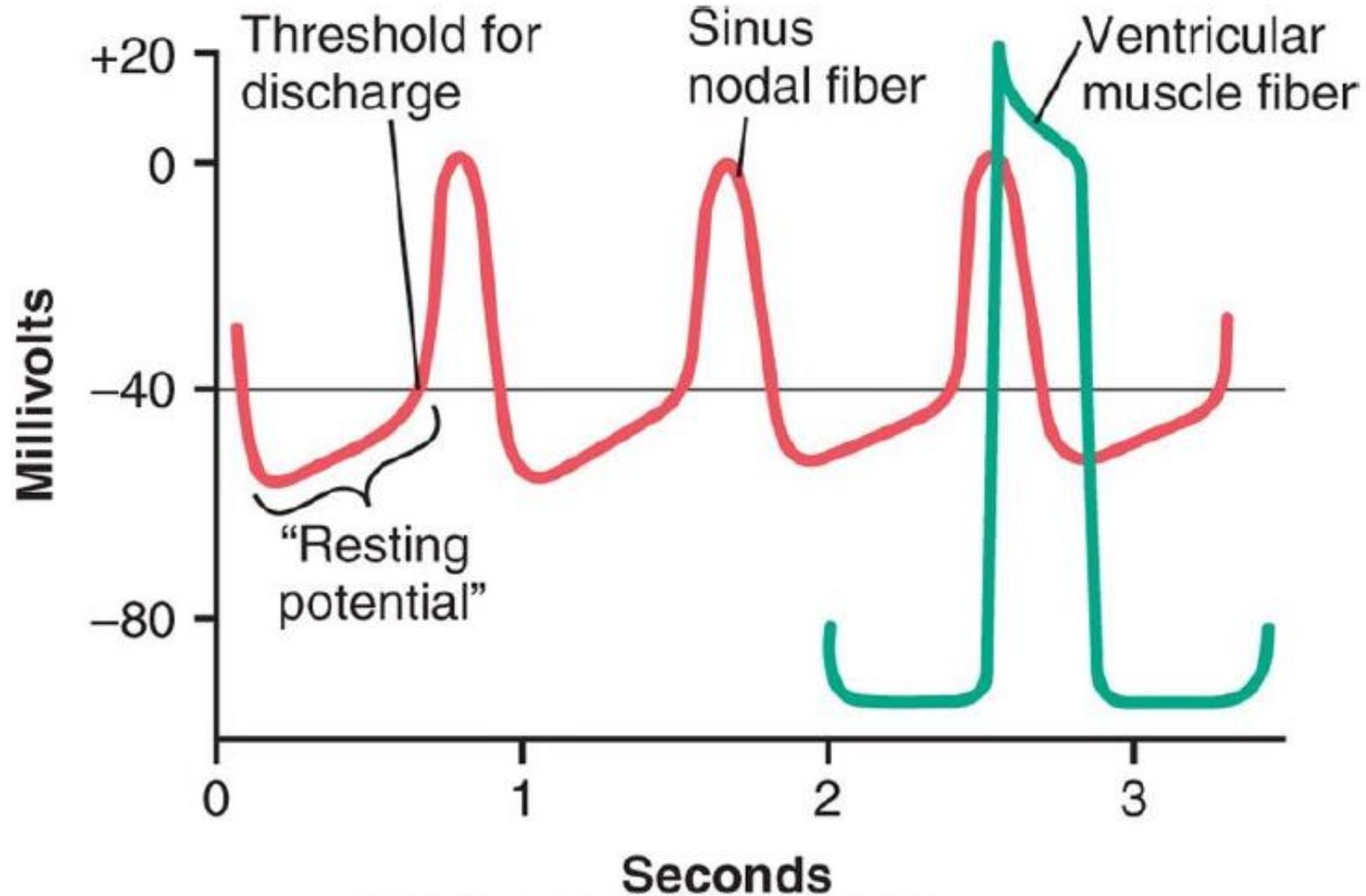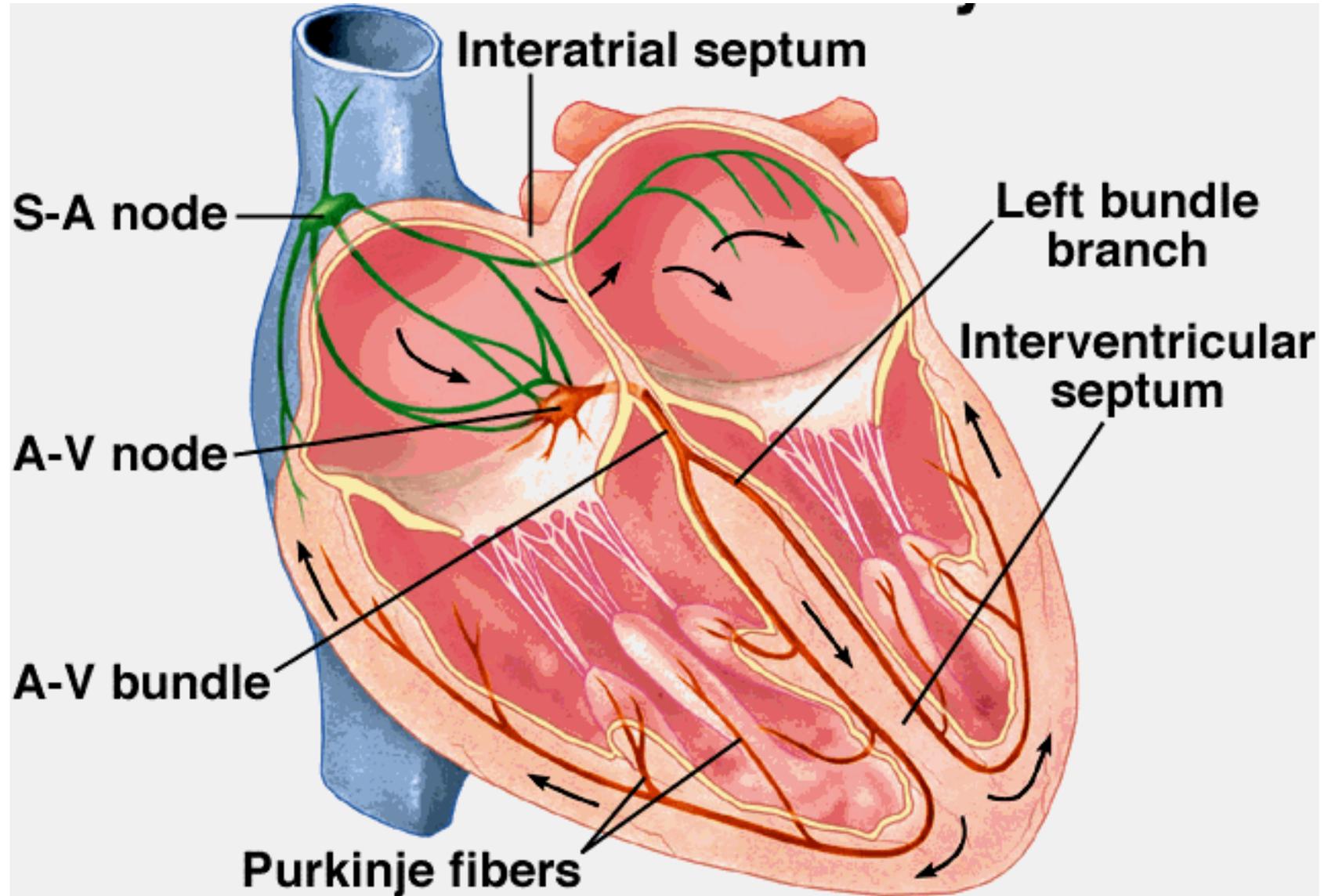# Conduction system of heart

Action potential

Action potential of cardiac tissue

Hall: Guyton and Hall Textbook of Medical Physiology, 12th Edition
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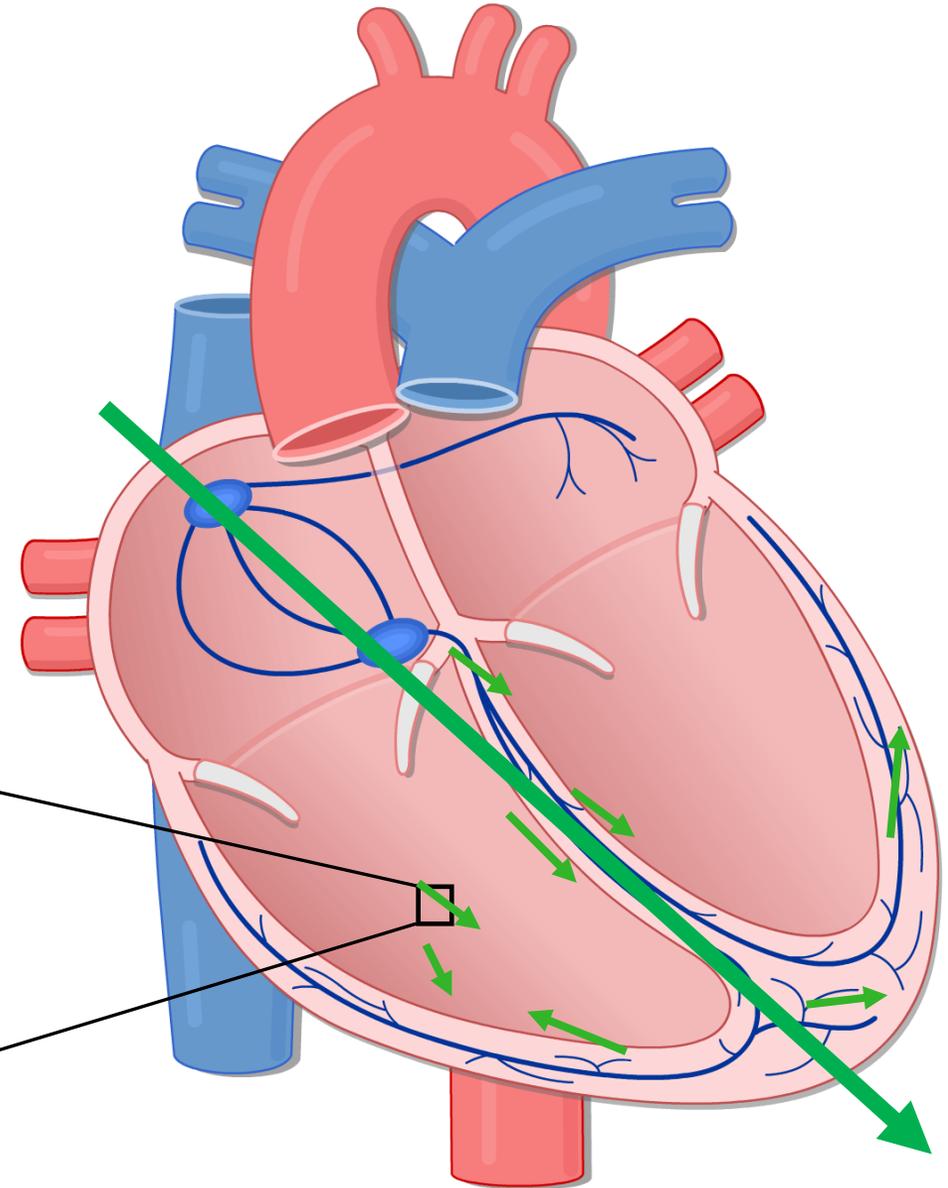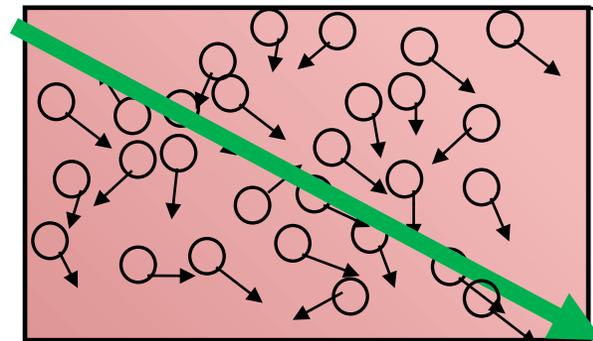
Action potential of cardiac tissue

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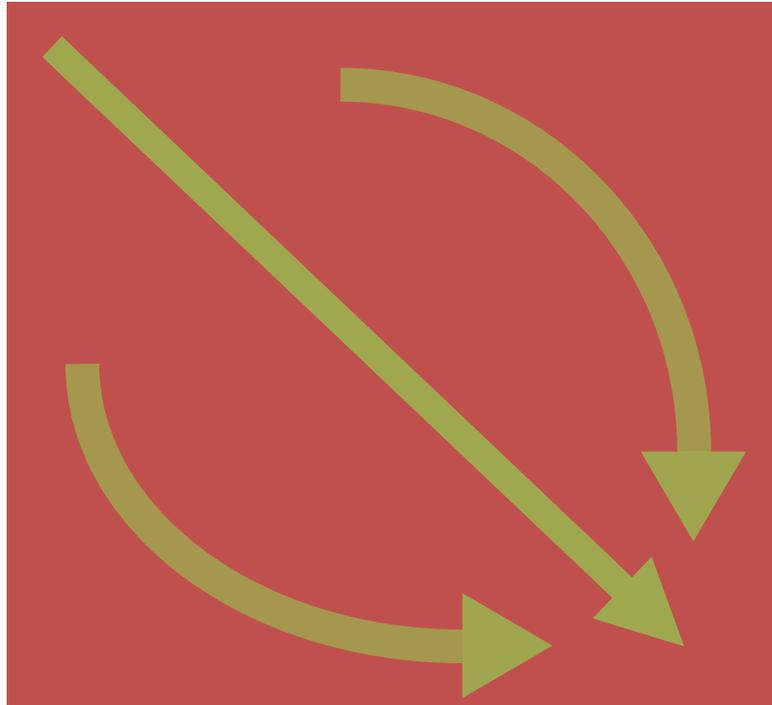# Conduction system of heart
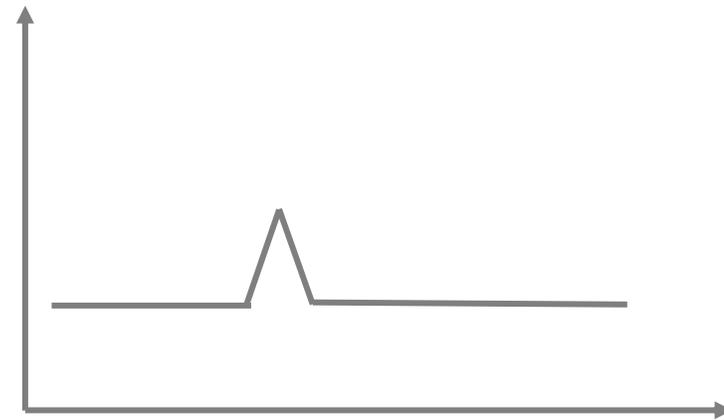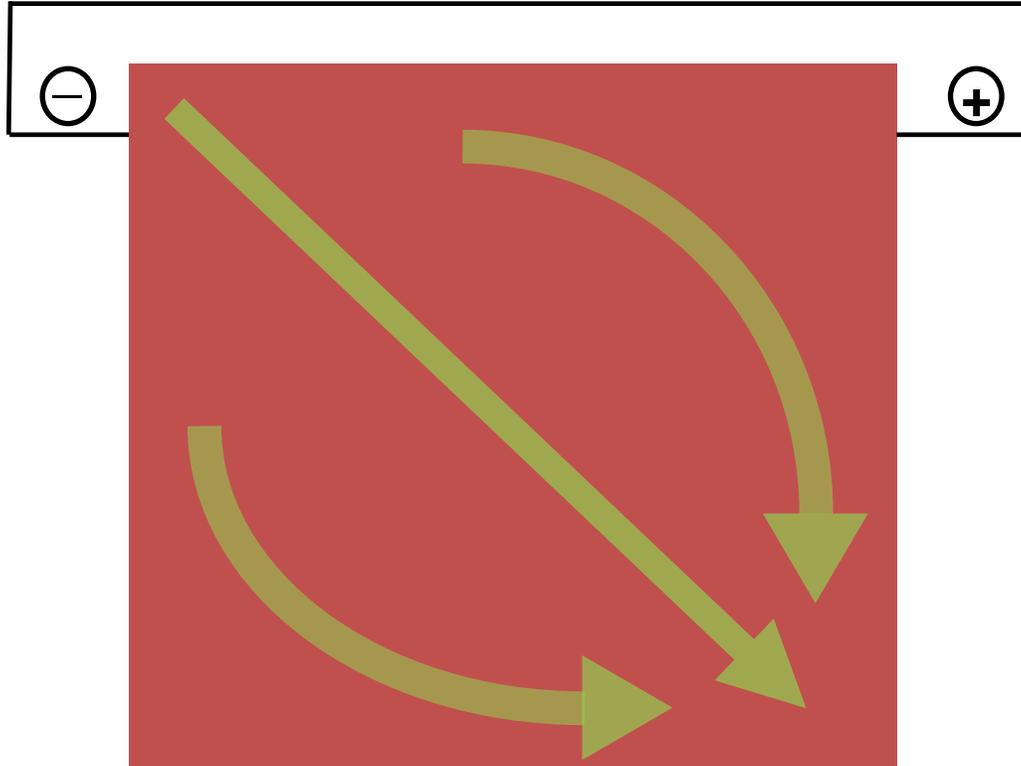
심전도 (Electrocardiogram, ECG)

- 심장의 수축에 따른 활동 전류와 활동 전위차를 곡선으로 기록한 도면

- 유도 (lead) 를 기준으로 점점 다가오는 것은 Positive (+), 멀어지는 것은 Negative (-) 로 표현된다.

심전도의 개념

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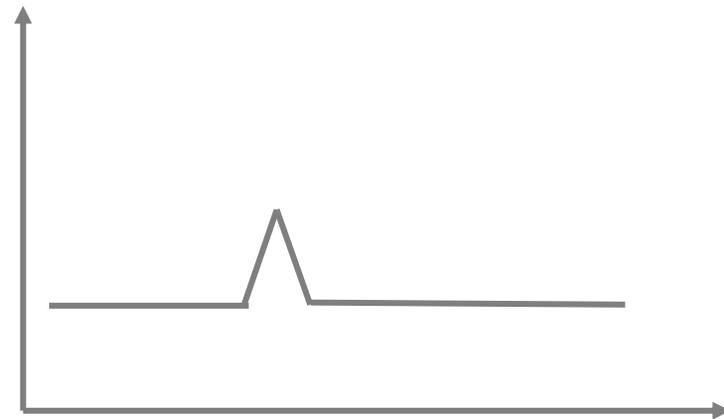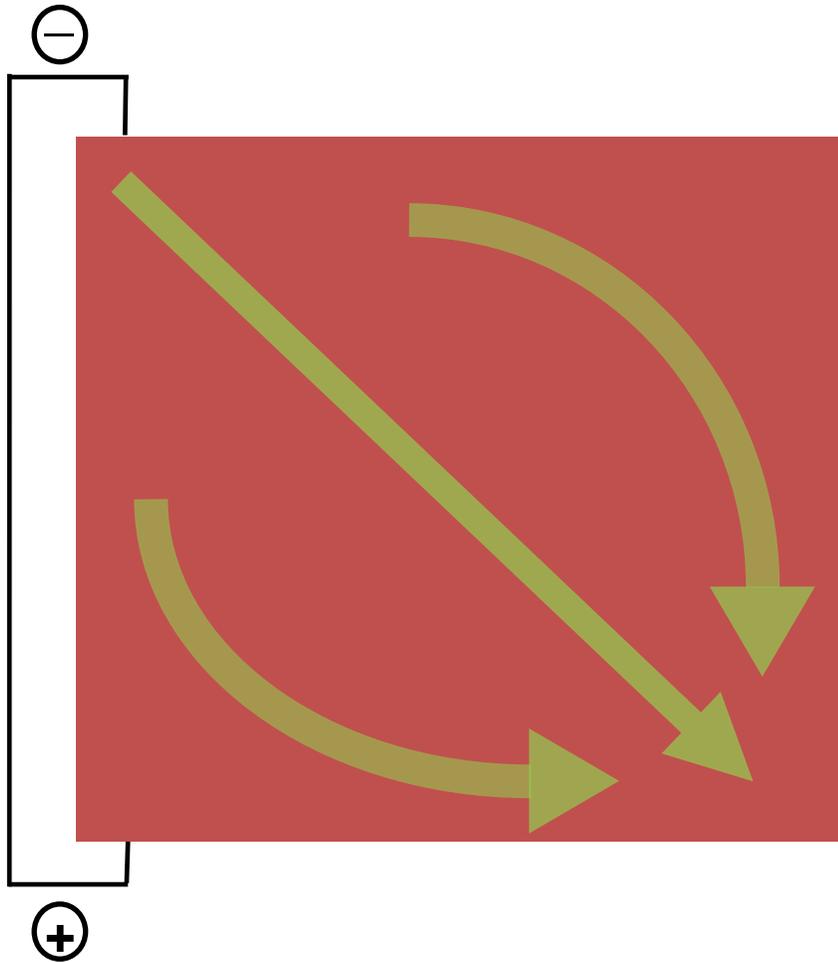
심전도의 개념

Bipolar limb leads

Lead I

Einthoven's Triangle

Lead II

Lead III
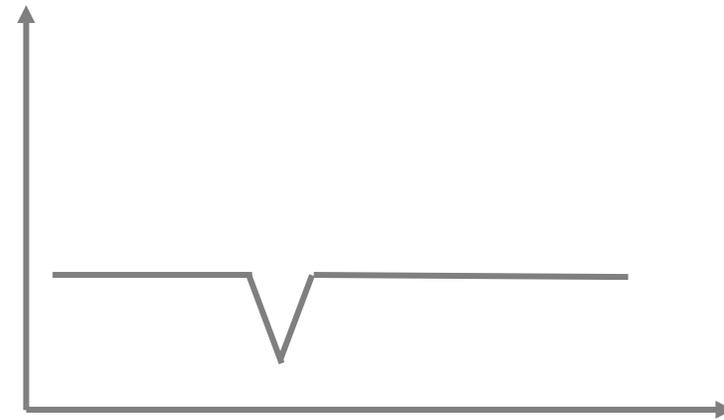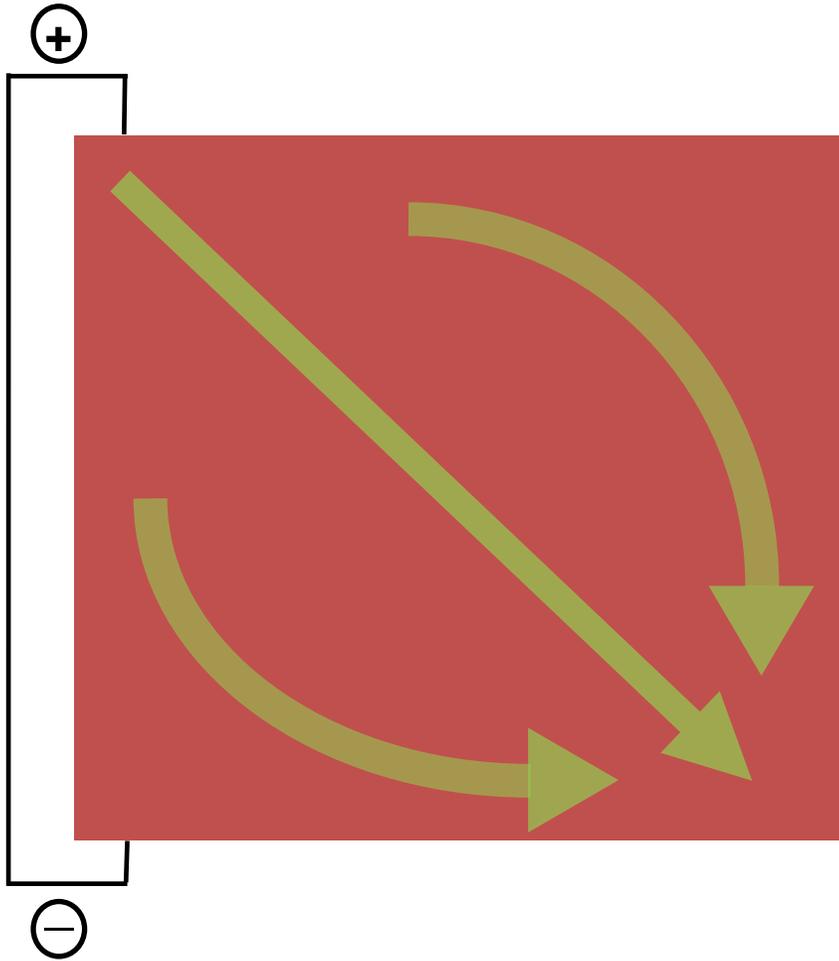
The standard (bipolar) leads and their axes
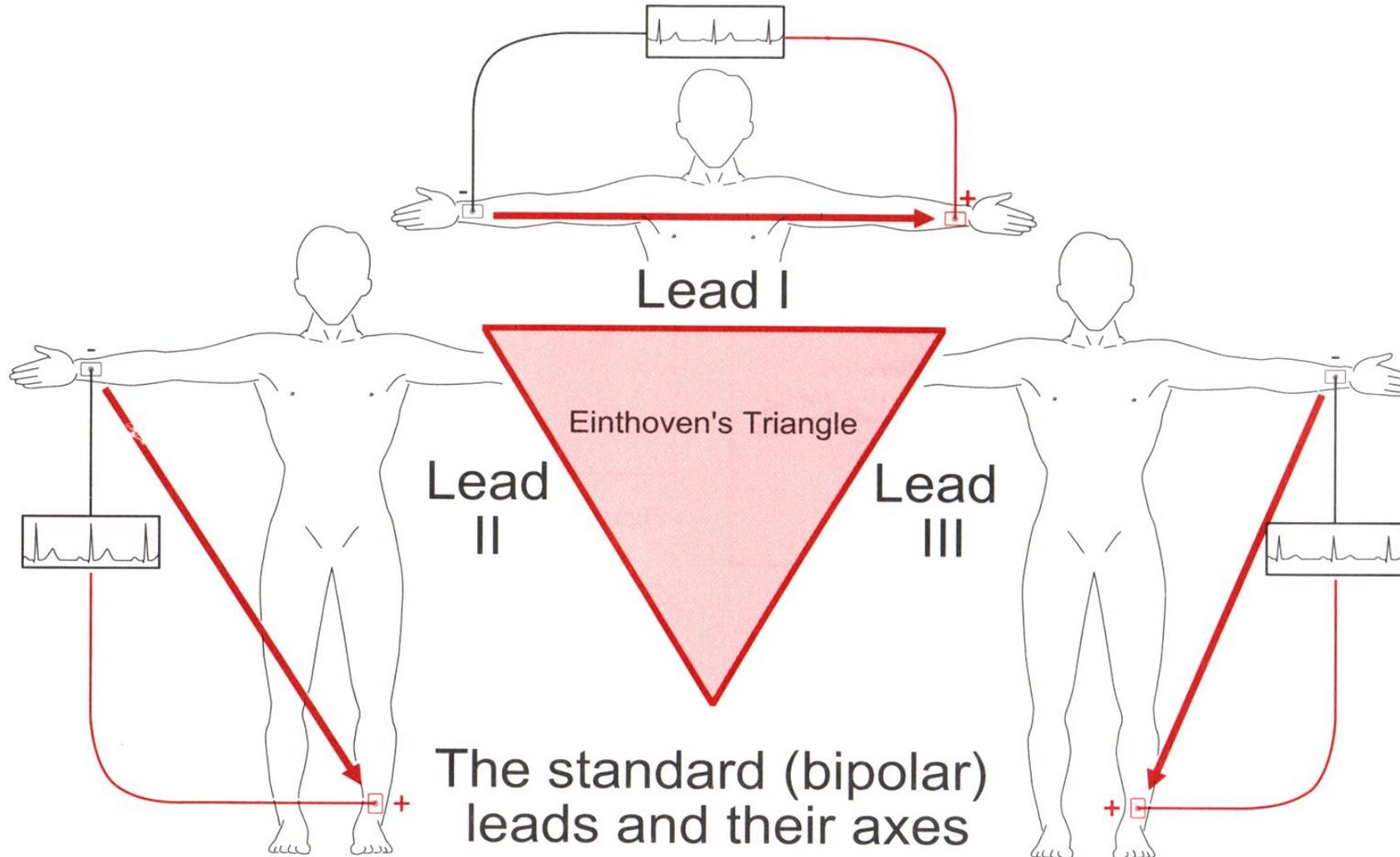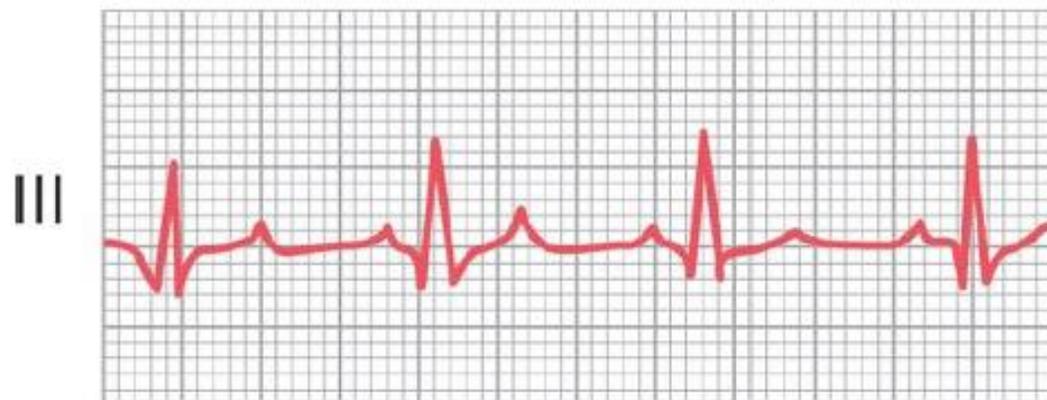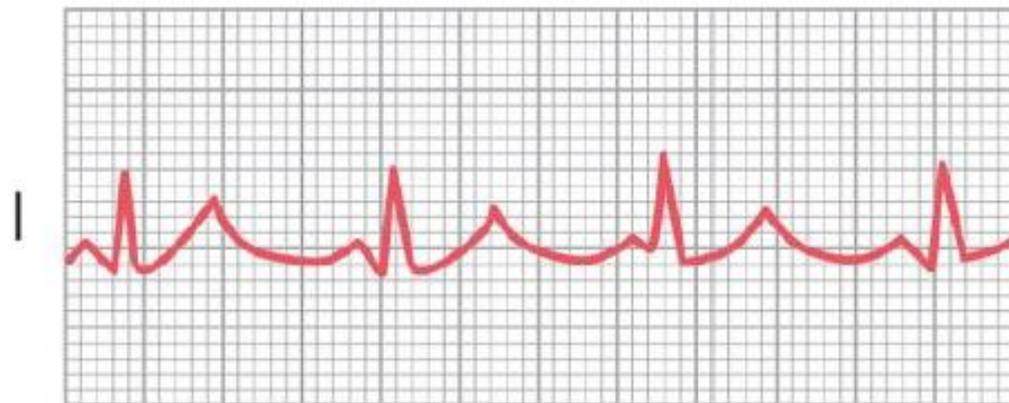
Bipolar limb leads

Unipolar limb leads

Lead aVR

Lead aVL

Lead aVF

The augmented (unipolar) leads and their axes

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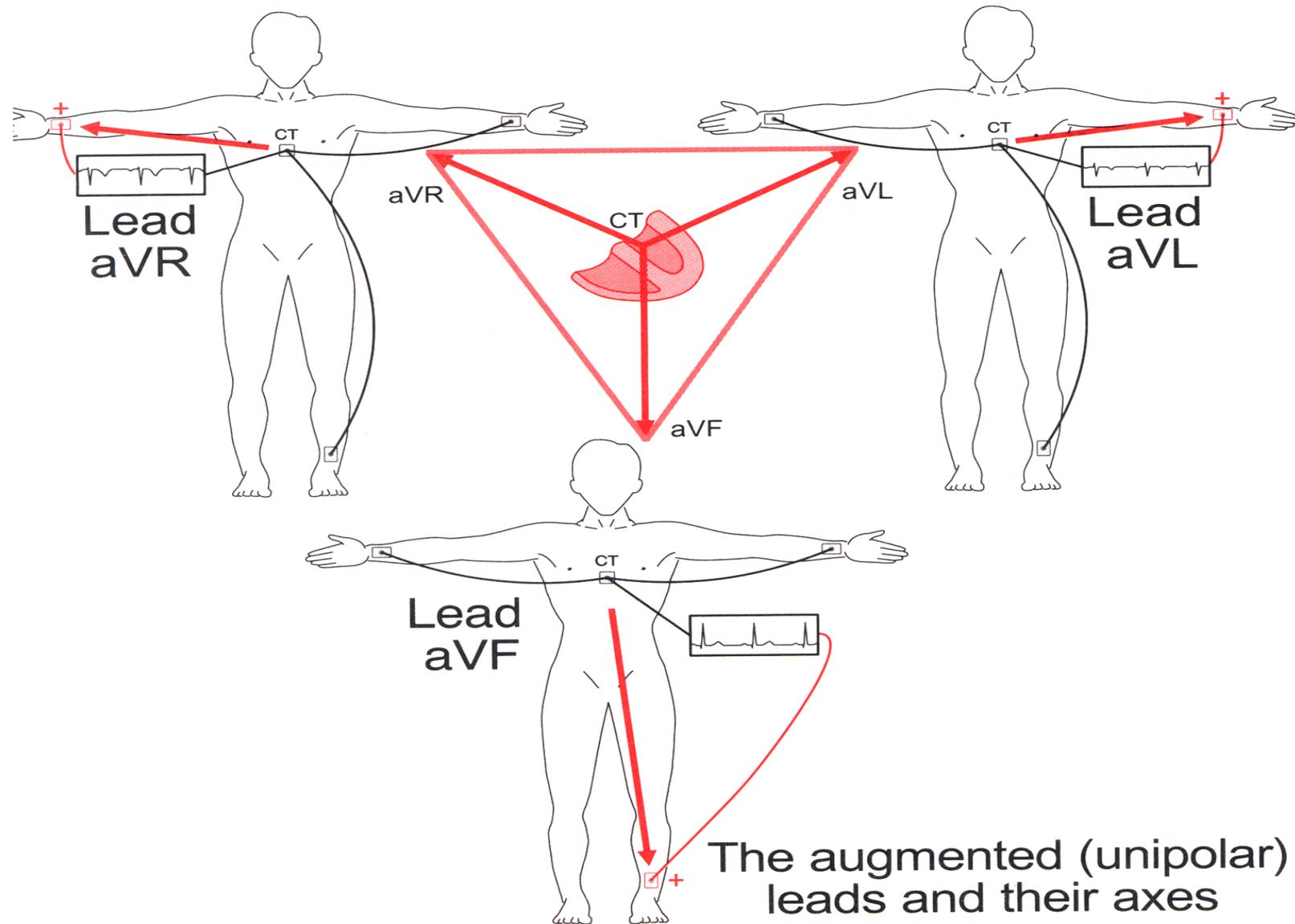
Unipolar limb leads

aVR   aVL   aVF

Precordial leads

Precordial leads

V_1 V_2 V_3 V_4 V_5 V_6
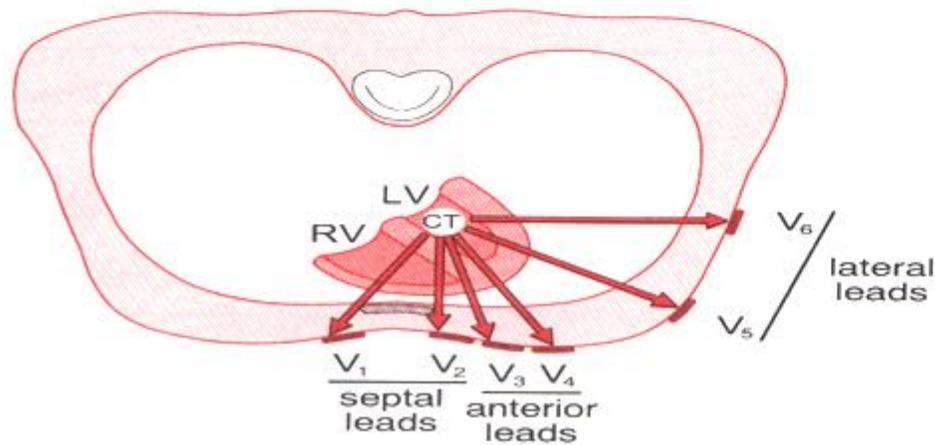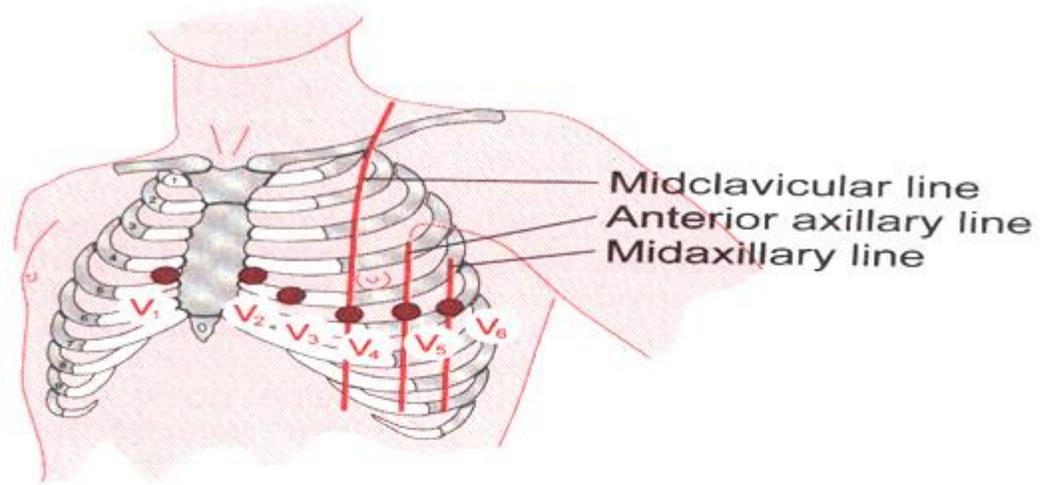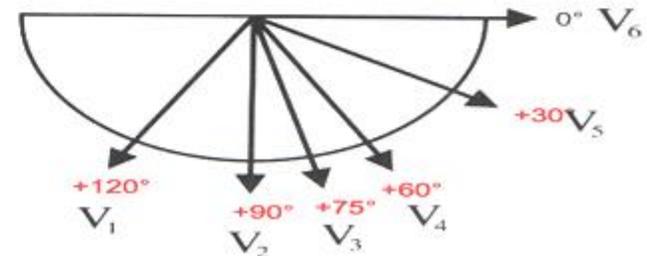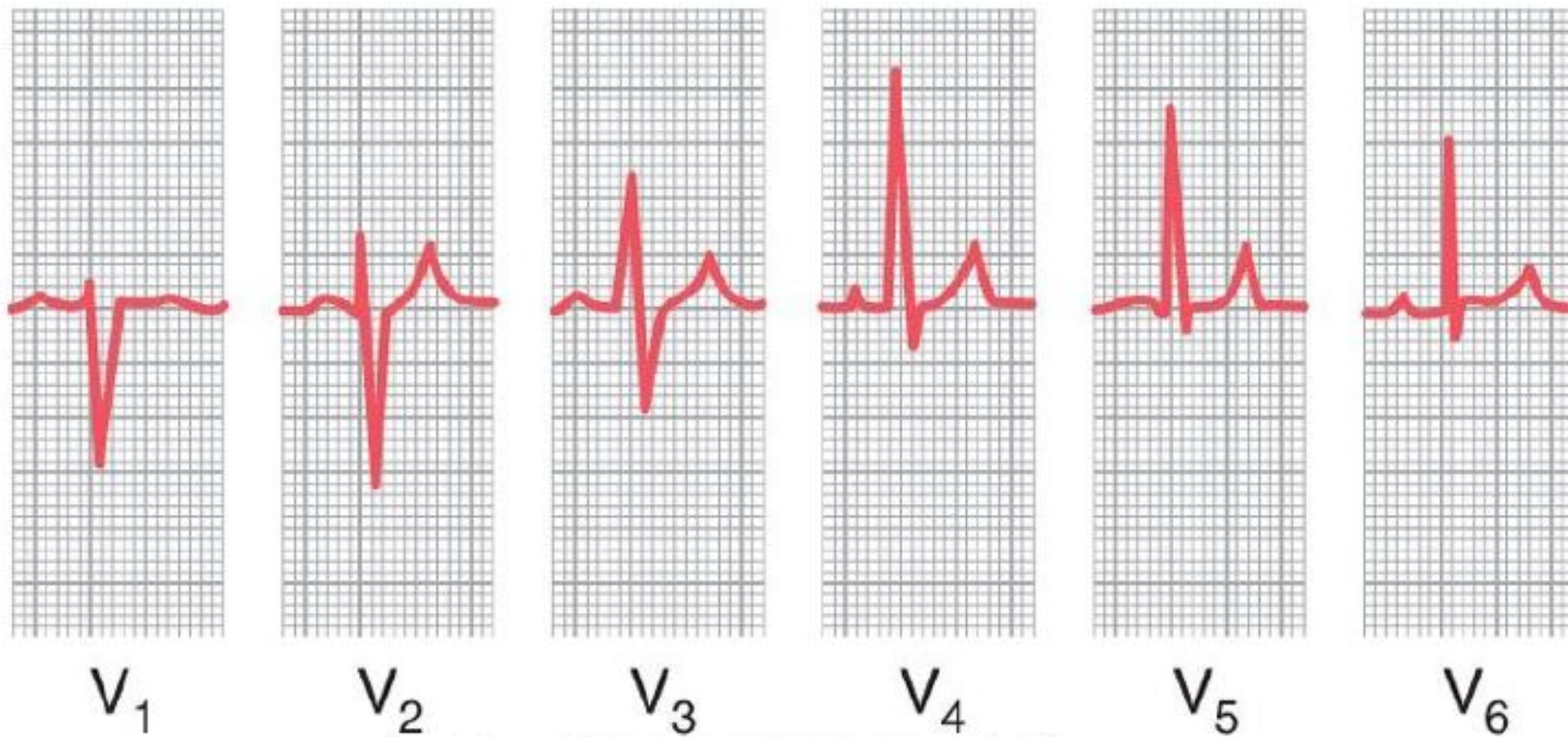
Bipolar limb leads
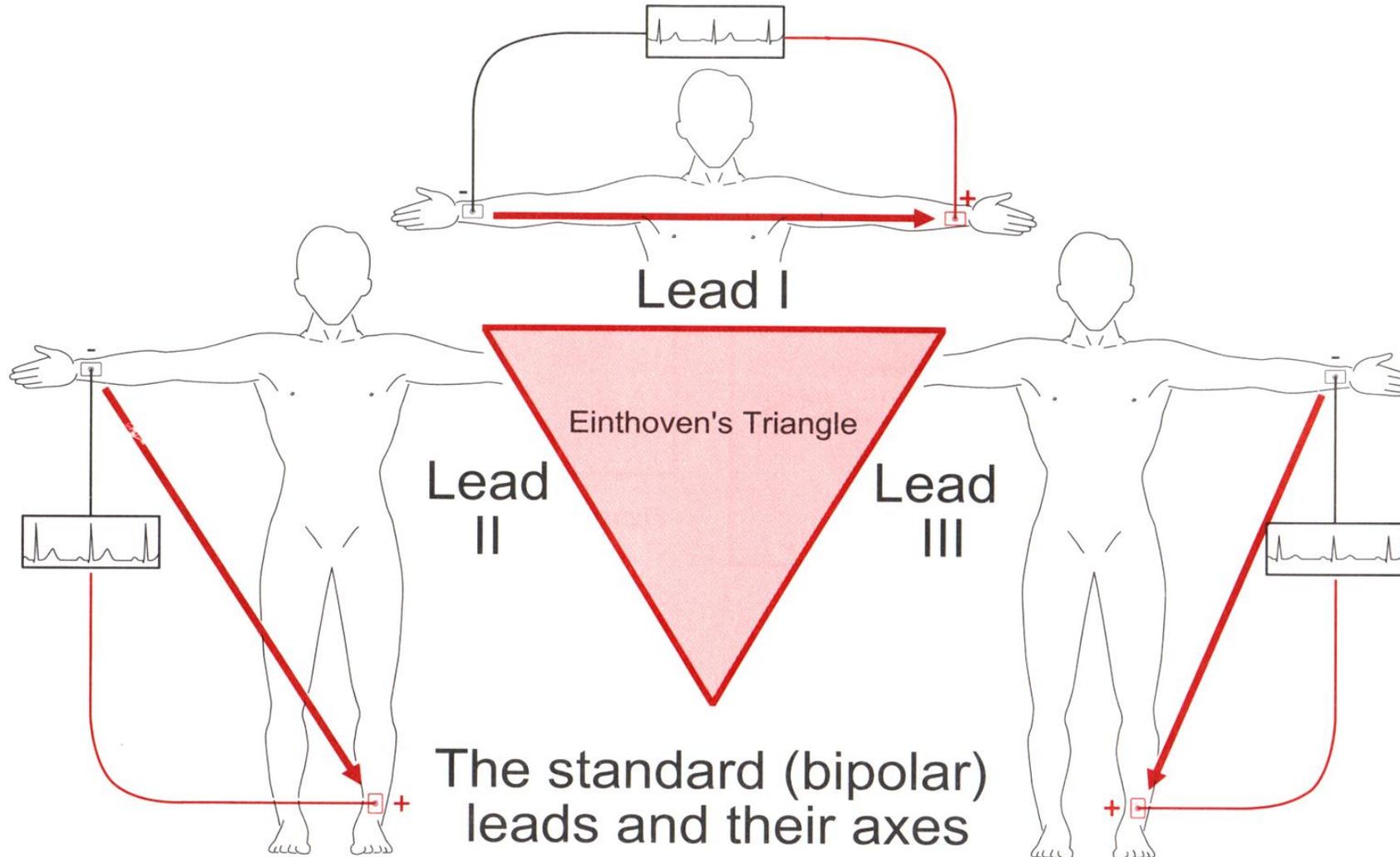
Normal ECG
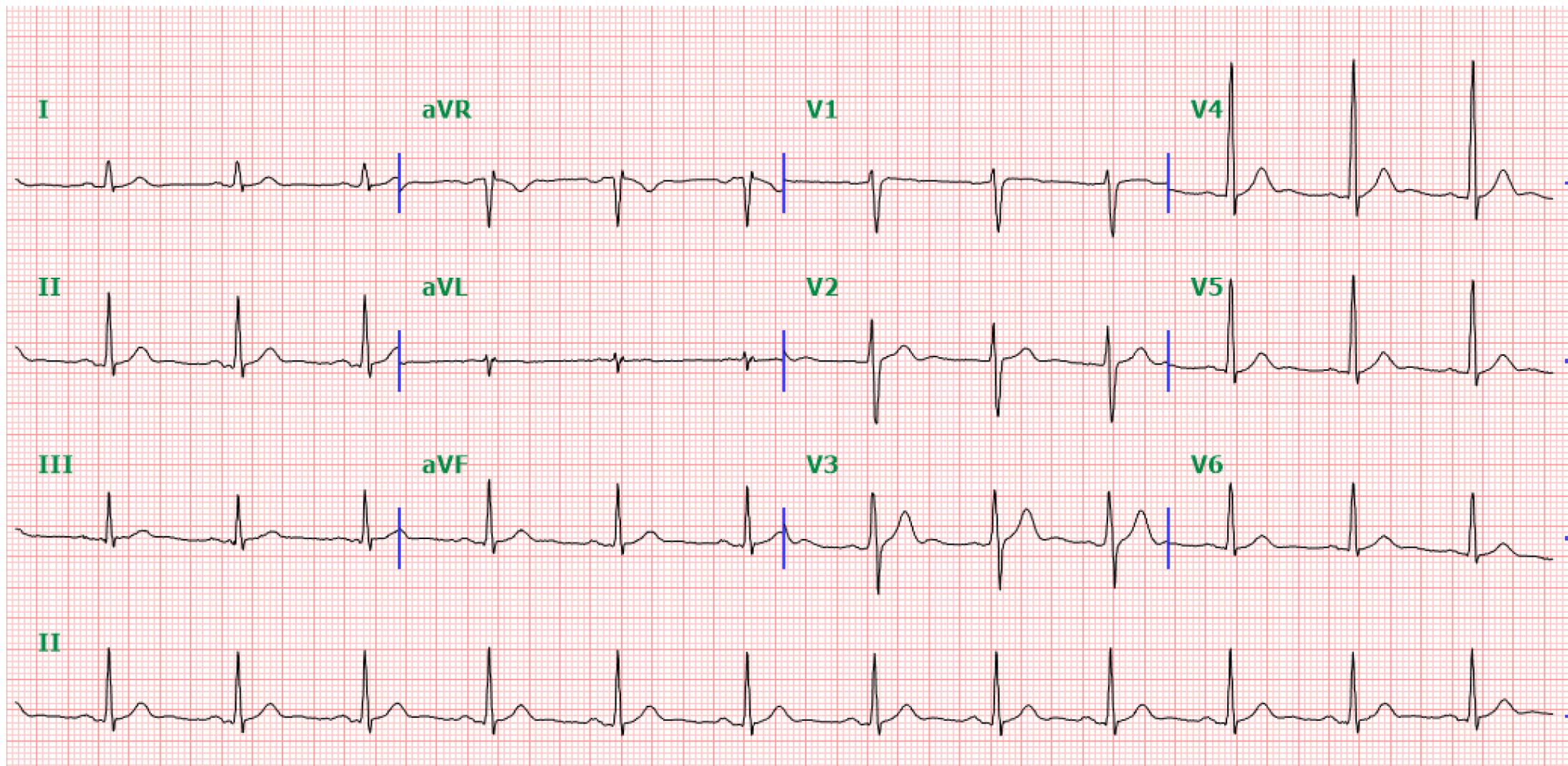
Wave, Segment, Interval
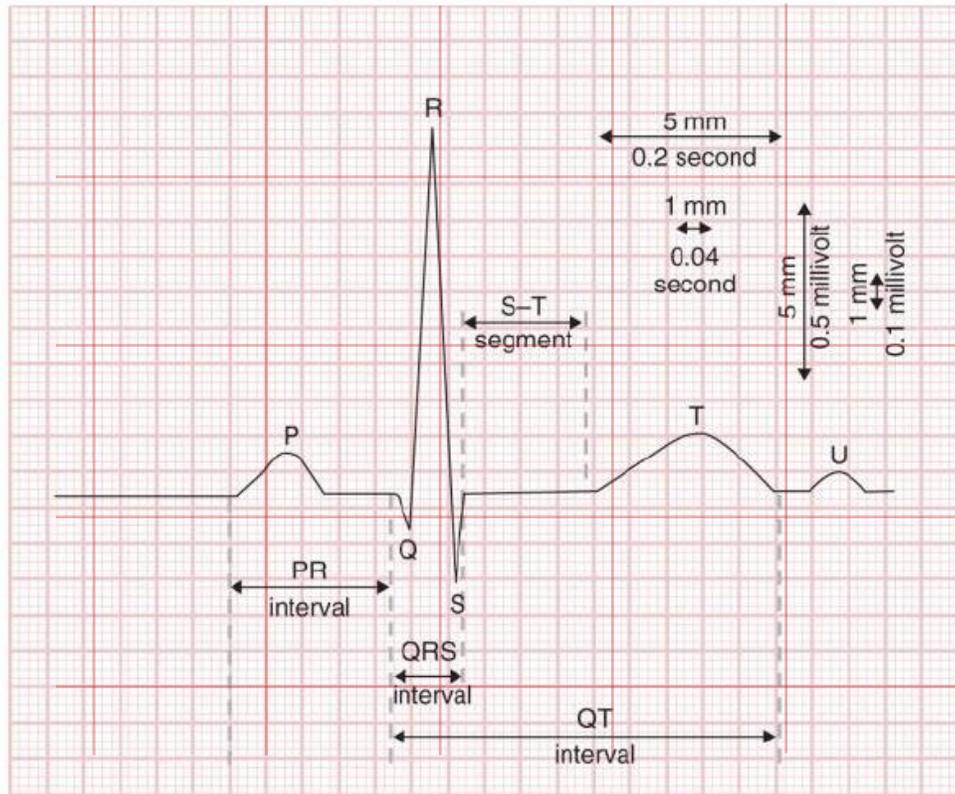
P wave: Atrial depolarization

**PR interval: Atrium → AV node
→ His bundle → Bundle branch
→ Purkinje fiber**

QRS complex: Ventricular depolarization

ST segment

T wave: Ventricular repolarization

PR interval	90~200msec (5칸 이내)
QRS duration	70~120msec (3칸 이내)
QT interval	~ 480msec

심전도 분석

1. Rhythm strip (lead II), 전반적인 rhythm 관찰.

   :HR 계산, regularity of RR interval, Presence of P wave, P-R relationship, Rhythm 의 이상, Premature beat

2. Axis: 종축 (lead I, aVF), 횡축 (R progression)

3. QRS morphology, Ischemic change? (Q wave, ST segment, T wave)

4. 종합적인 판단, 임상적인 상황에 대입, 이전 심전도와 비교

Step 1
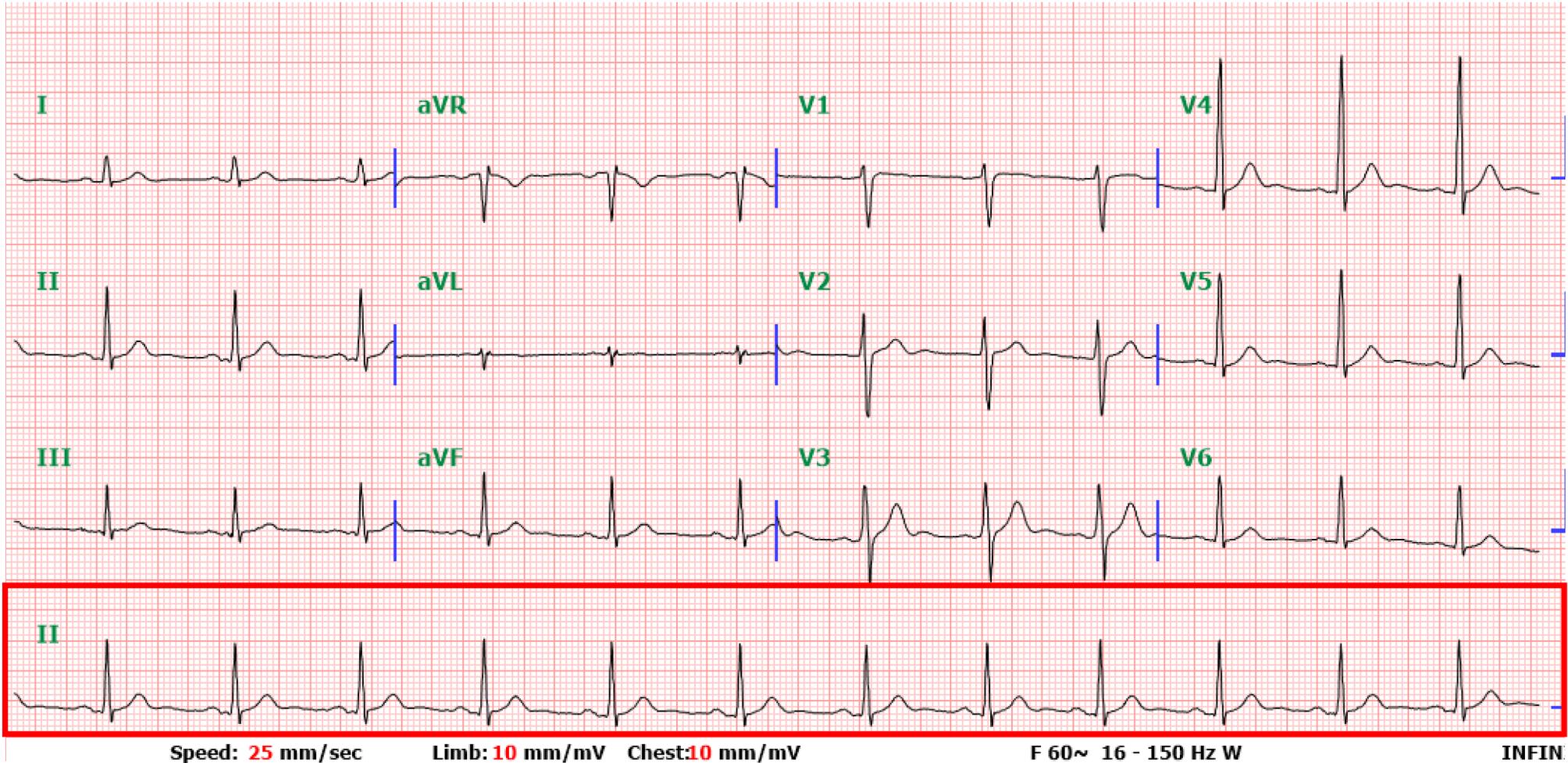
HR 계산: 300-150-100-75-60 or QRS 개수 X 6

Regularity of RR interval

P wave? P-R 관계

Premature beat, Rhythm의 이상

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Junctional bradycardia
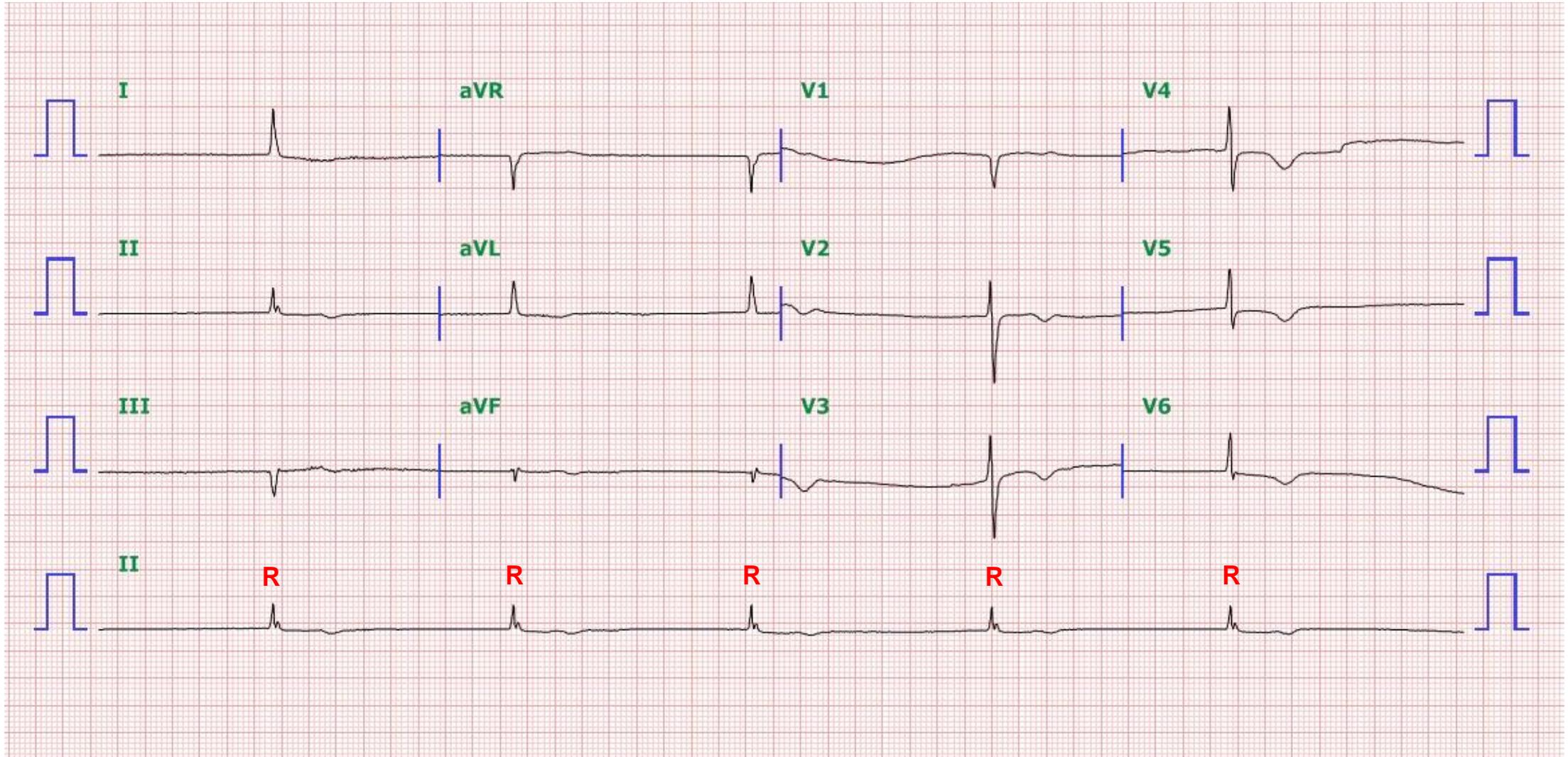
HR 계산: 5 X 6 = 30 bpm   R-R interval: 느리지만 비교적 규칙적

P wave and P-R relation: P wave 가 보이지 않음

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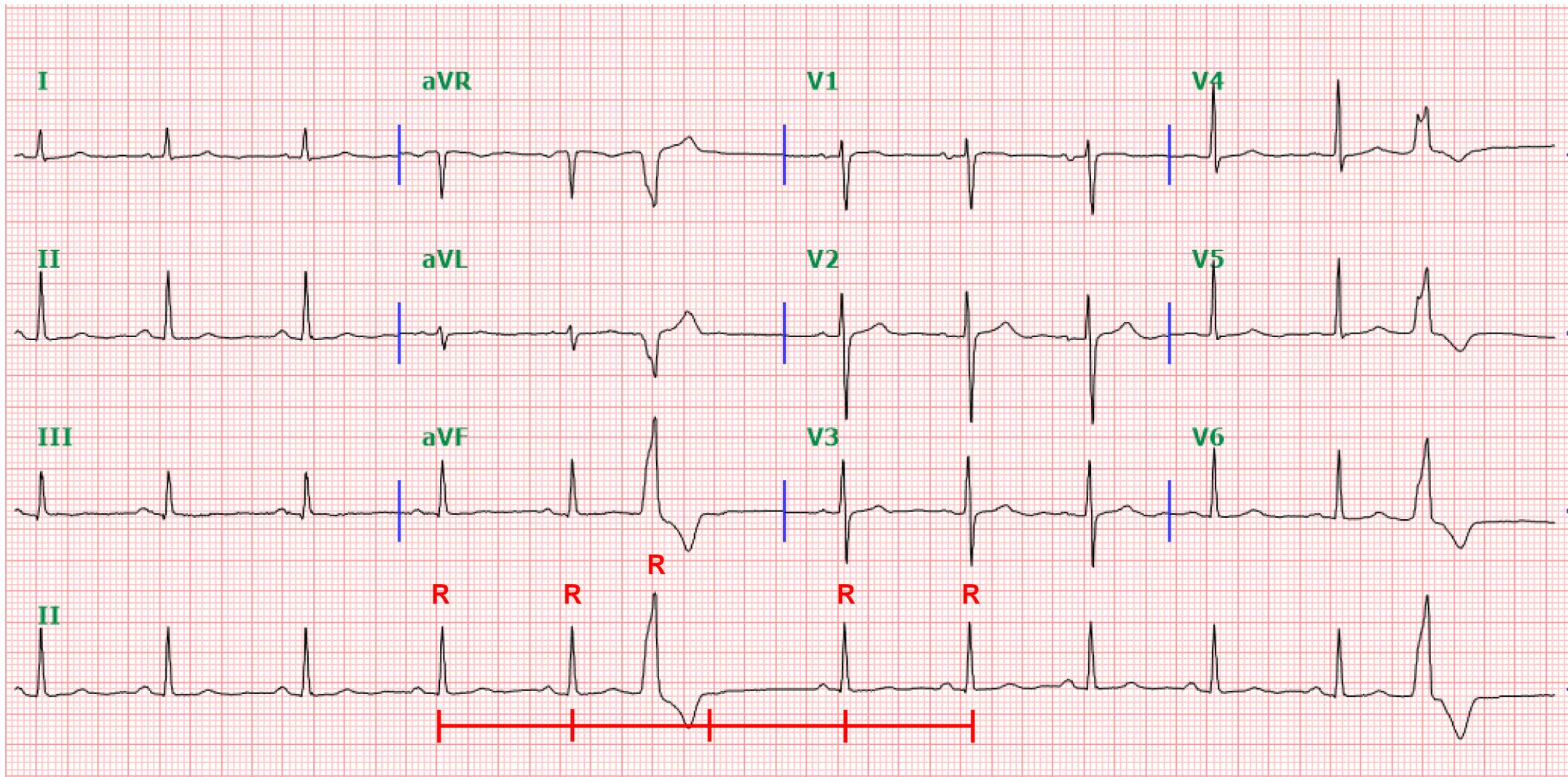
HR 계산: 75 bpm   R-R interval: 규칙적으로 나오다가 조기박동

P wave and P-R relation: P와 R 은 1:1 로 잘 대응함

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Step 2

Axis: lead I, aVF

R progression

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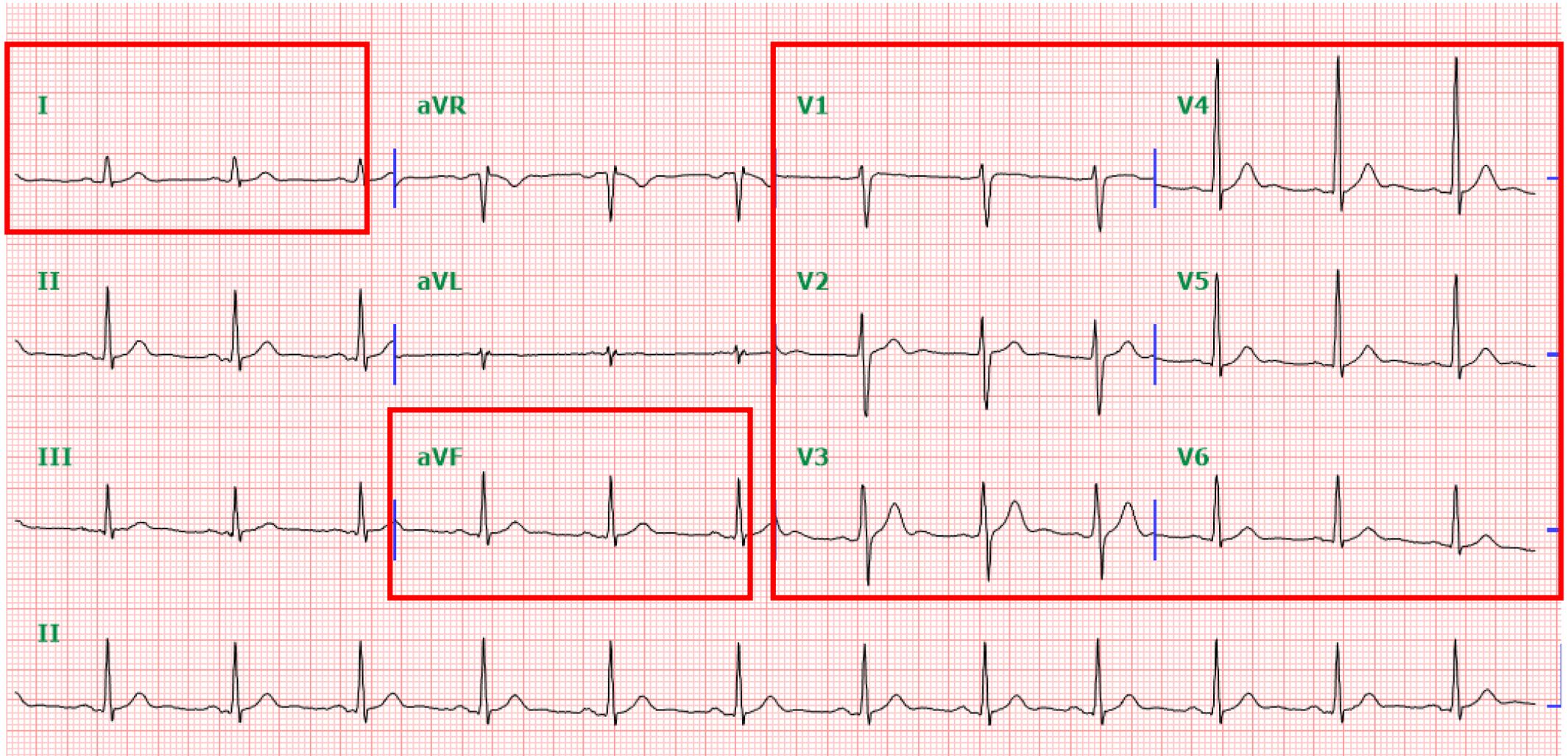
Axis and R progression

Step 2

Axis: lead I, aVF

R progression

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Right axis deviation, Right Ventricular Hypertrophy
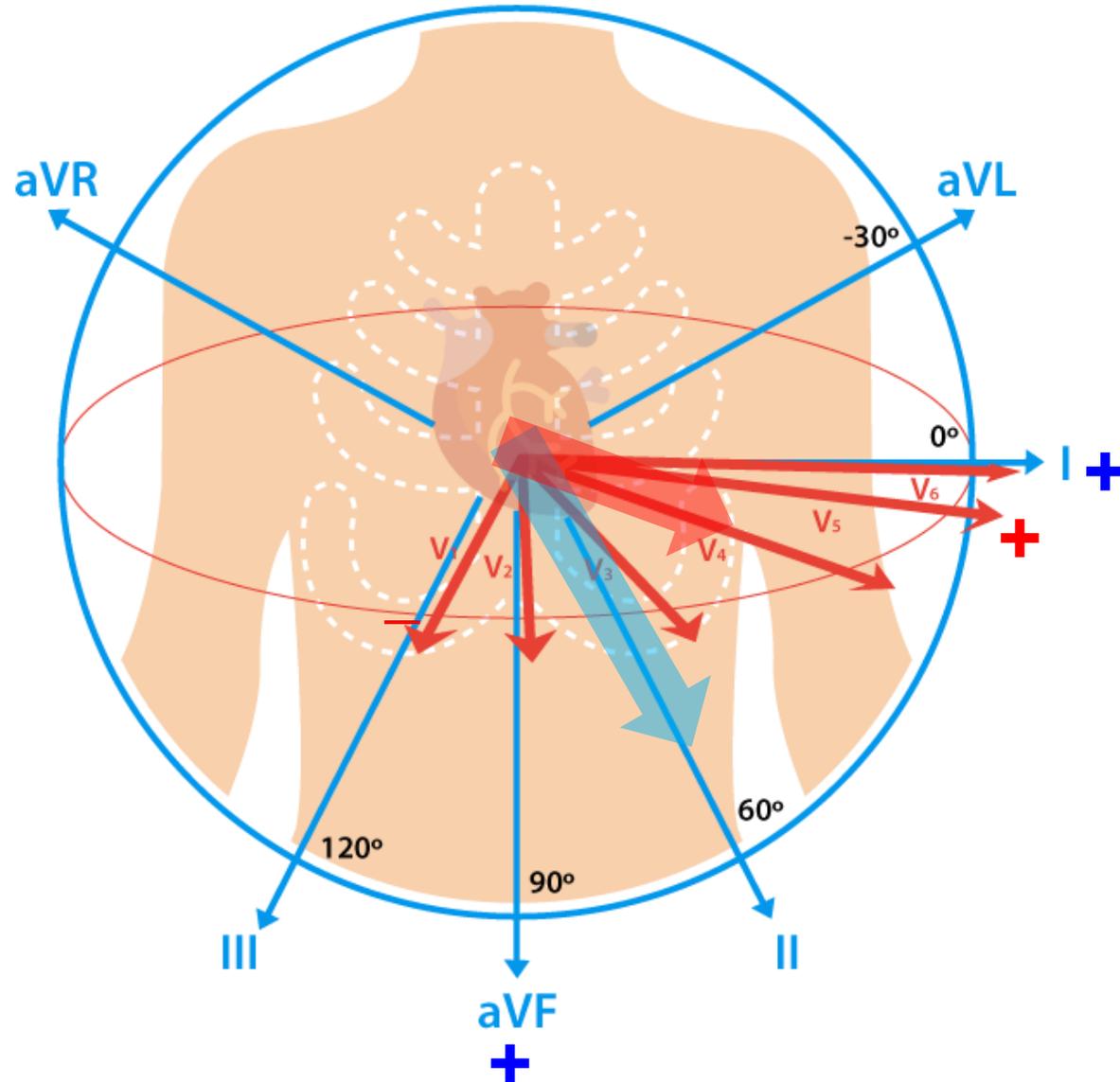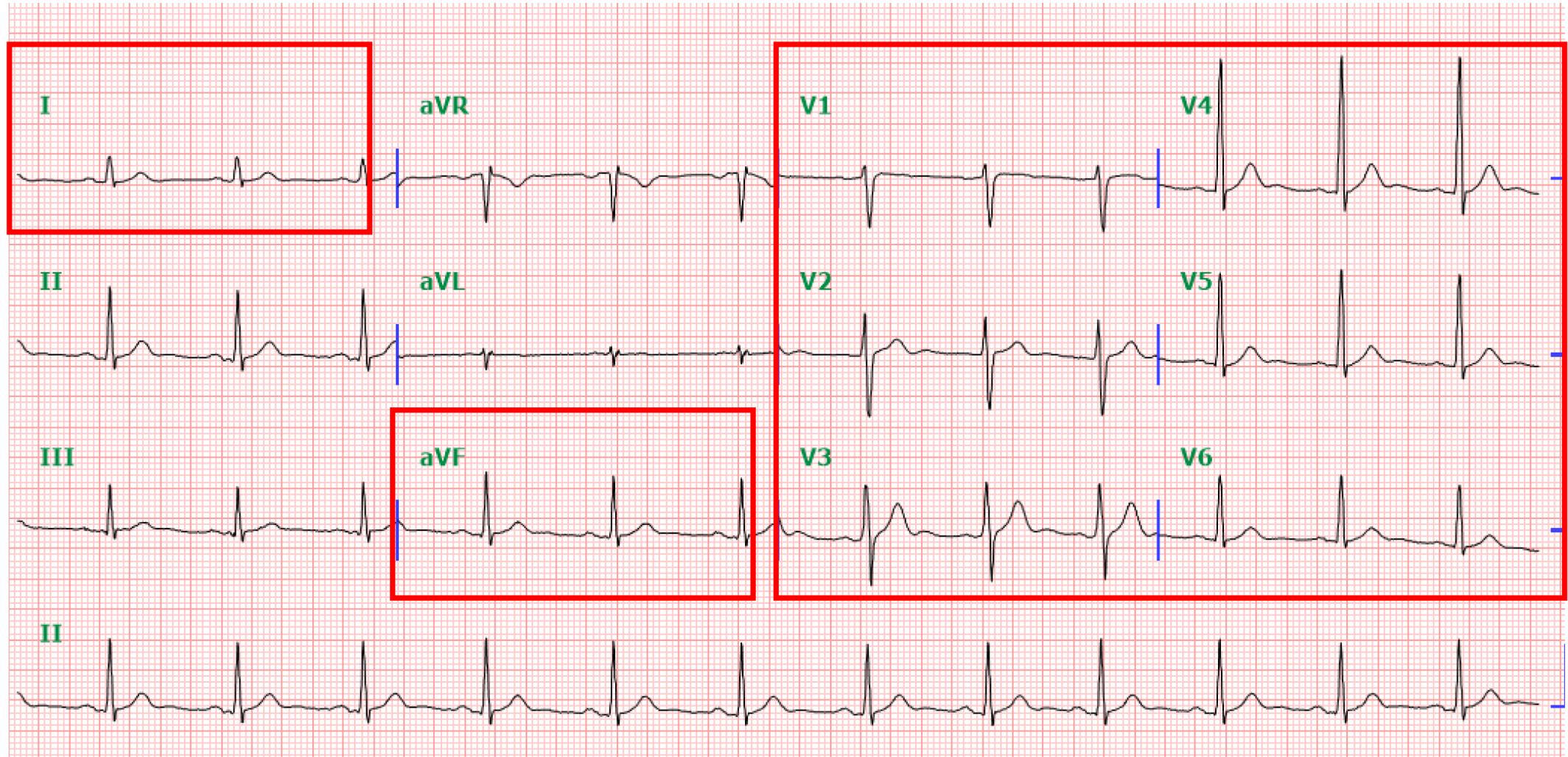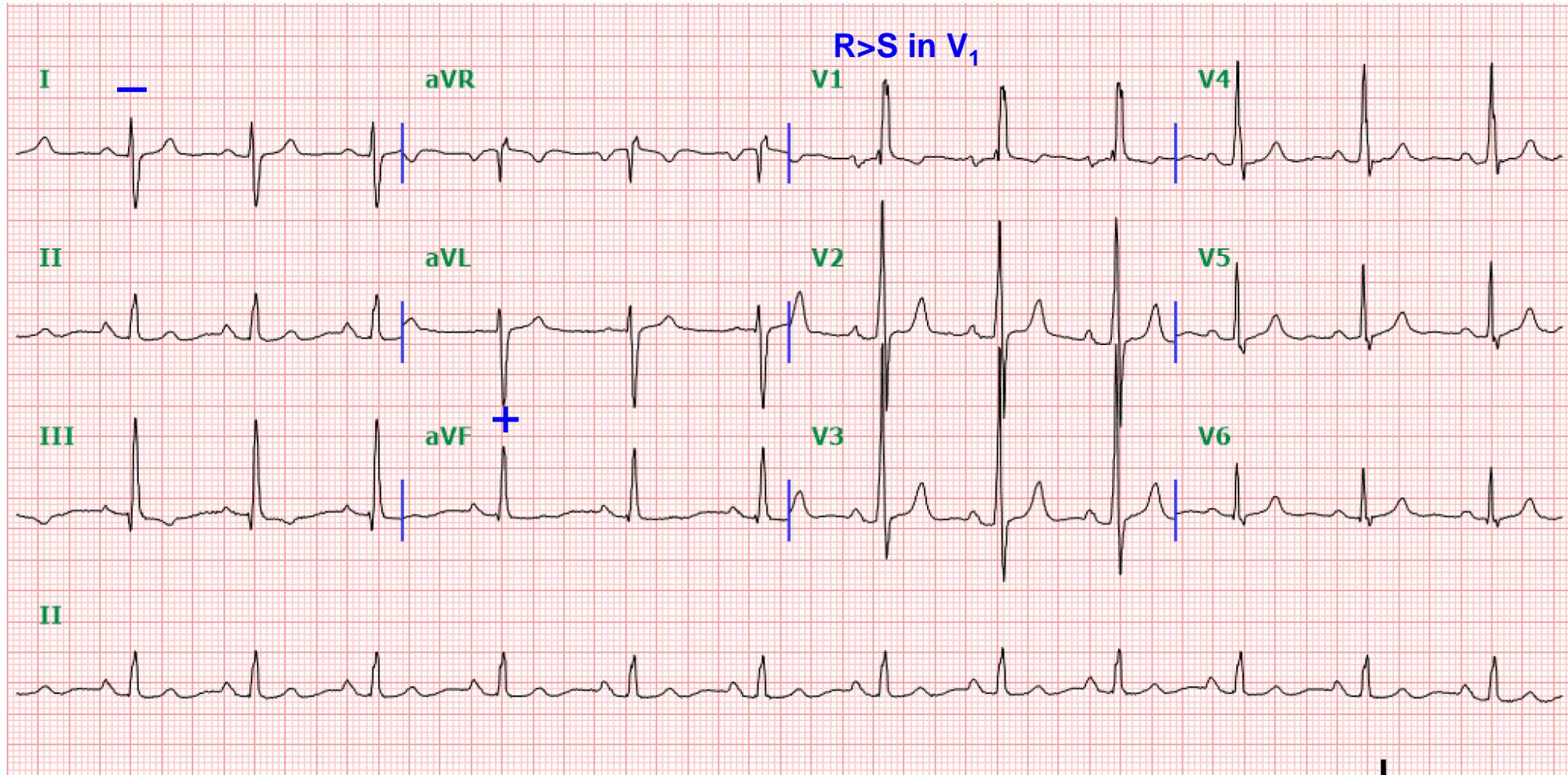
R>S in V$_1$

Axis: Right axis deviation

R progression: R progression 의 이상, R>S in V$_1$

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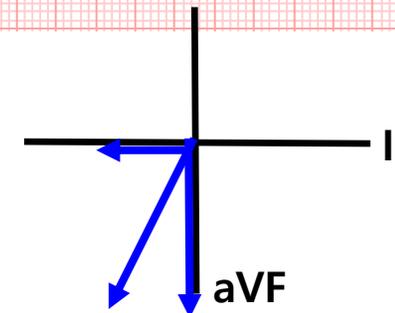
Step 3
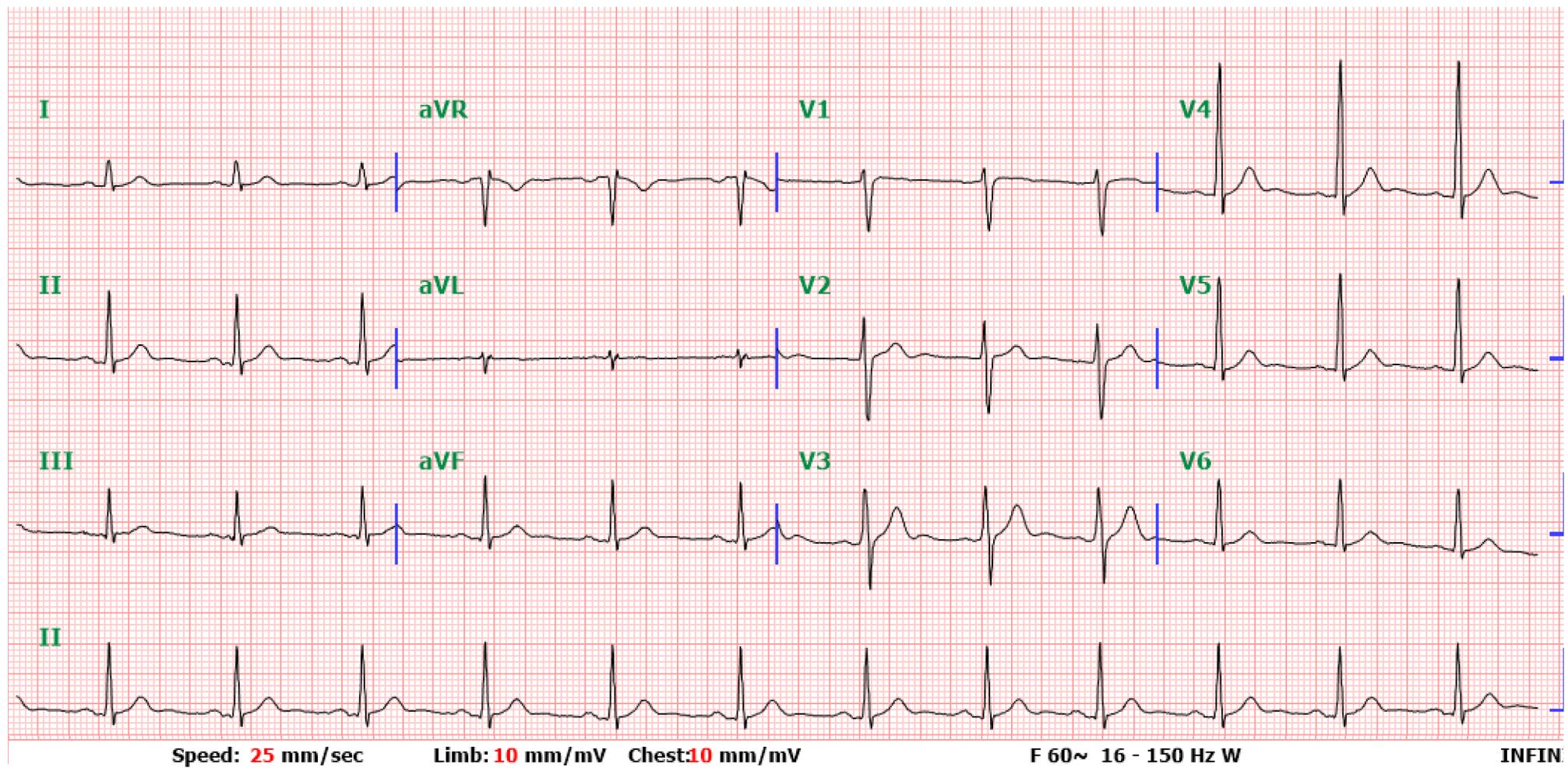
QRS morphology, duration　　　　　**Q wave?, ST segment, T wave**

QRS duration

QRS duration 이 증가되는 경우

- **Ventricular origin 의 rhythm (fast tract 를 거치지 않고 전달)**

- **Bundle branch block (한쪽 bundle 로만 전달됨)**

- **Ventricular preexcitation (WPW syndrome)**

QRS morphology

특징적인 QRS morphology 기억

- **LVH**

  : S in $V_{1,2}$ + R in $V_{5,6}$ > 35mm

- **LBBB**

  : QRS > 120msec

  Broad monophasic S in V_1

  Broad monophasic R in V_6, I

- **RBBB**

  : QRS > 120msec

  rsR' in V_1

  Slurred S in V_6, I

- **WPW syndrome**

  : Short PR interval,　Delta wave in QRS

Ischemic ECG change

Zone of ischemia

Zone of injury

Zone of infarction

Myocardial ischemia causes ST segment depression with or without T wave inversion as result of altered repolarization

Myocardial injury causes ST segment elevation with or without loss of R wave
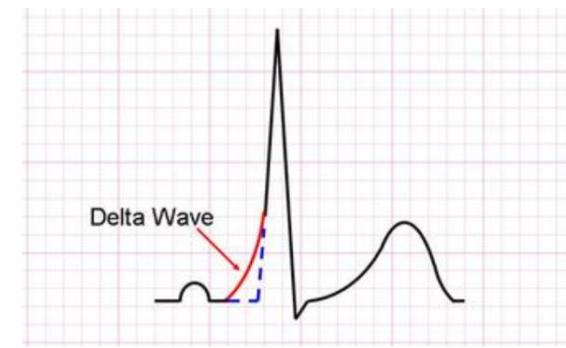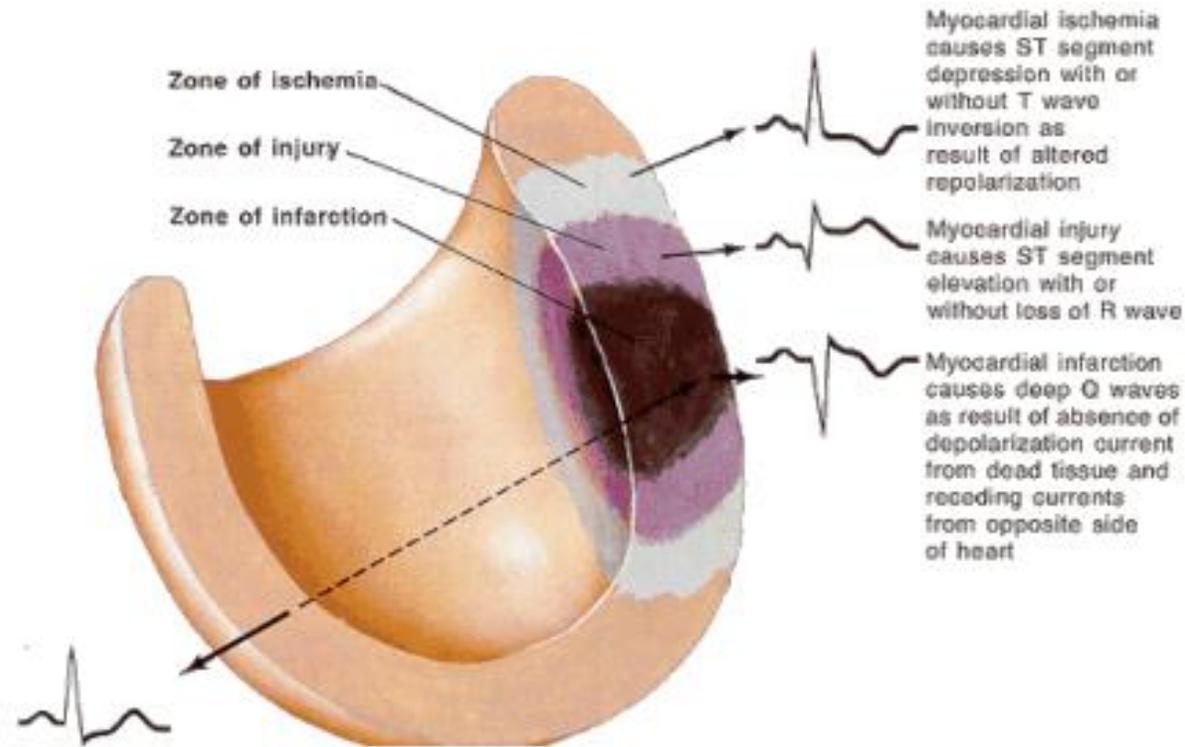
Myocardial infarction causes deep Q waves as result of absence of depolarization current from dead tissue and receding currents from opposite side of heart
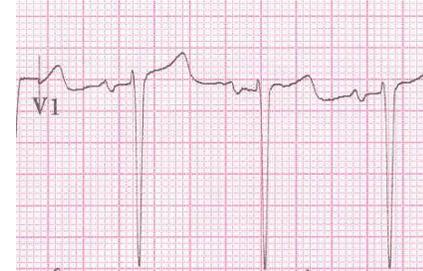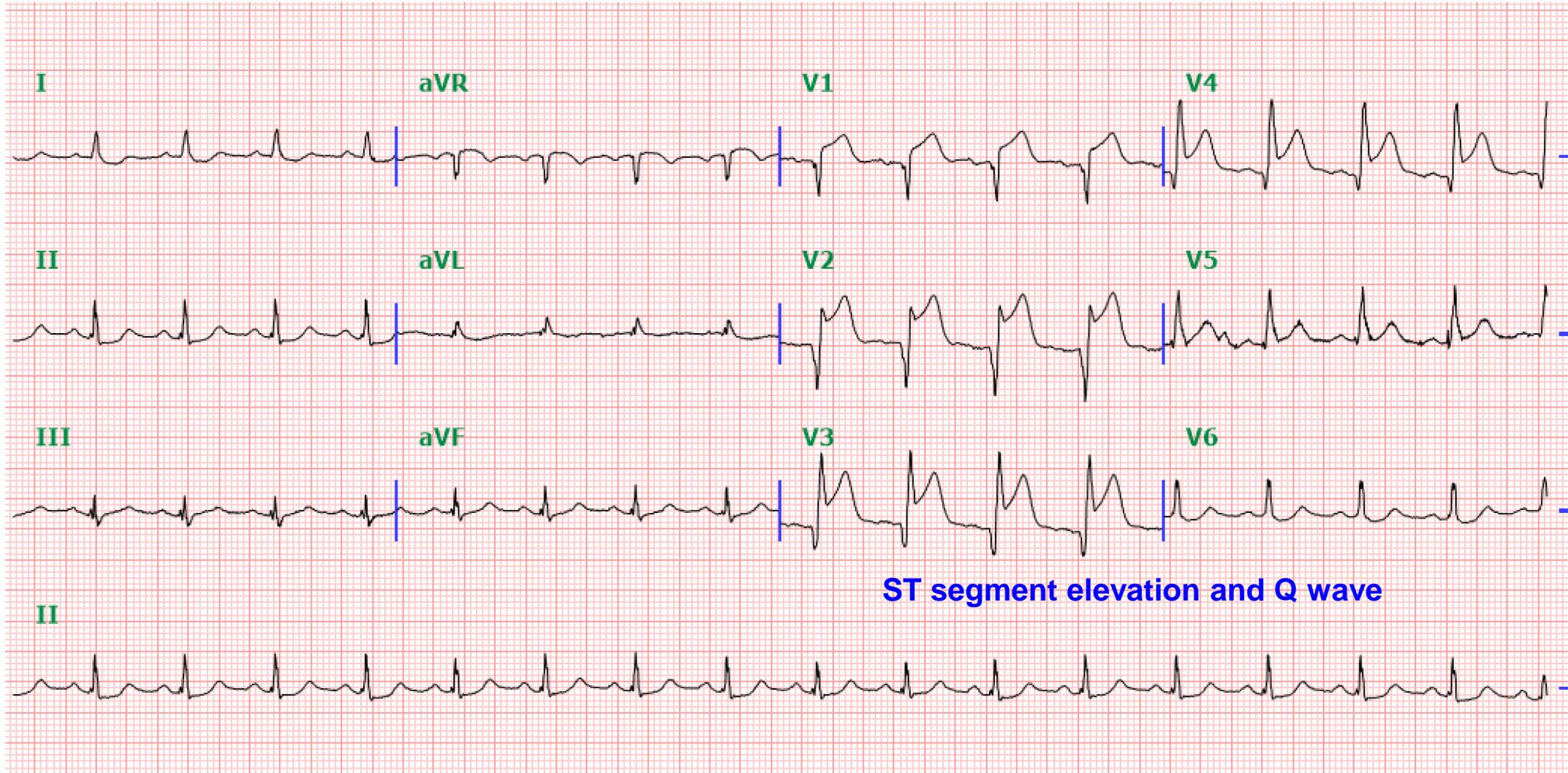
1. **Ischemia**: ST depression, +/- T wave inversion. Results from altered repolarisaiton.
2. **Injury**: ST elevation, +/- R wave.
3. **Infarction**: Deep Q wave from absence of depolarisation in dead tissue.

ST segment elevation MI (STEMI)

I aVR V1 V4

II aVL V2 V5

III aVF V3 V6

ST segment elevation and Q wave

II

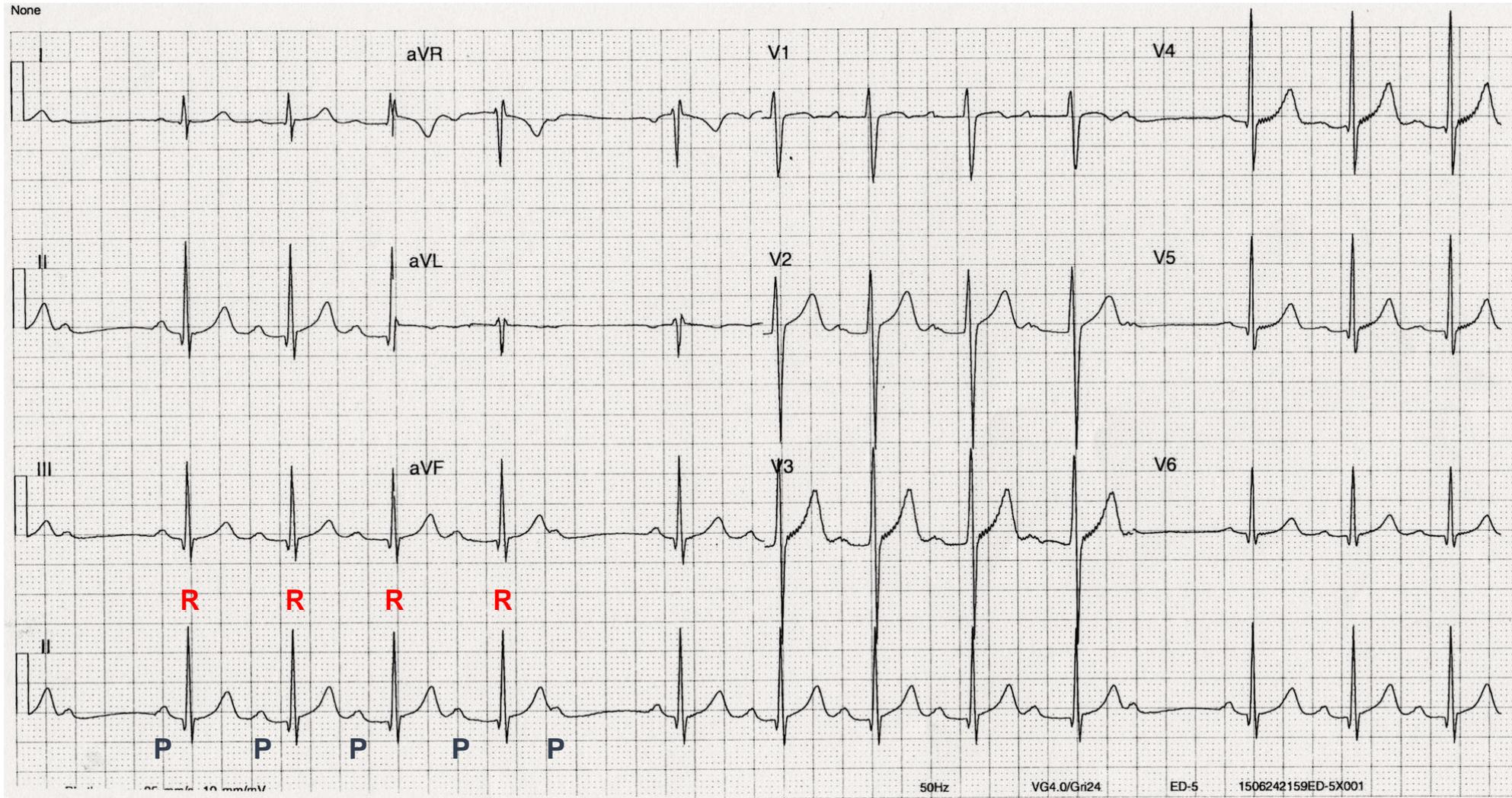**Rhythm strip:** Regular sinus rhythm   **Axis :** Normal axis (I, aVF)

Q wave?, ST segment, T wave: ST segment elevation and Q wave in anteroseptal lead
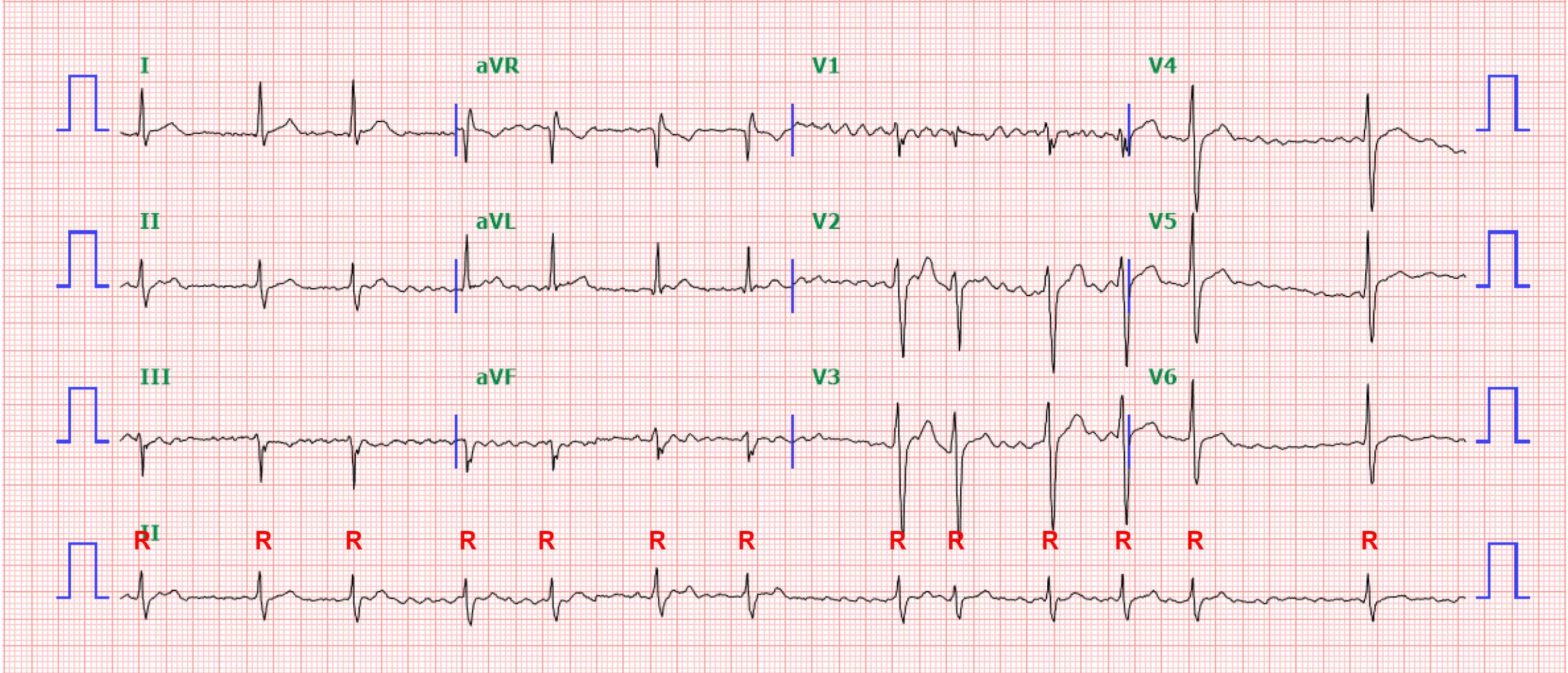
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Examples

HR 계산: 12 X 6 = 72 bpm   R-R interval: 불규칙 적인 곳이 있음

P wave and P-R relation: P 이후 R 이 나오지 않음 → AV block (2° type I)
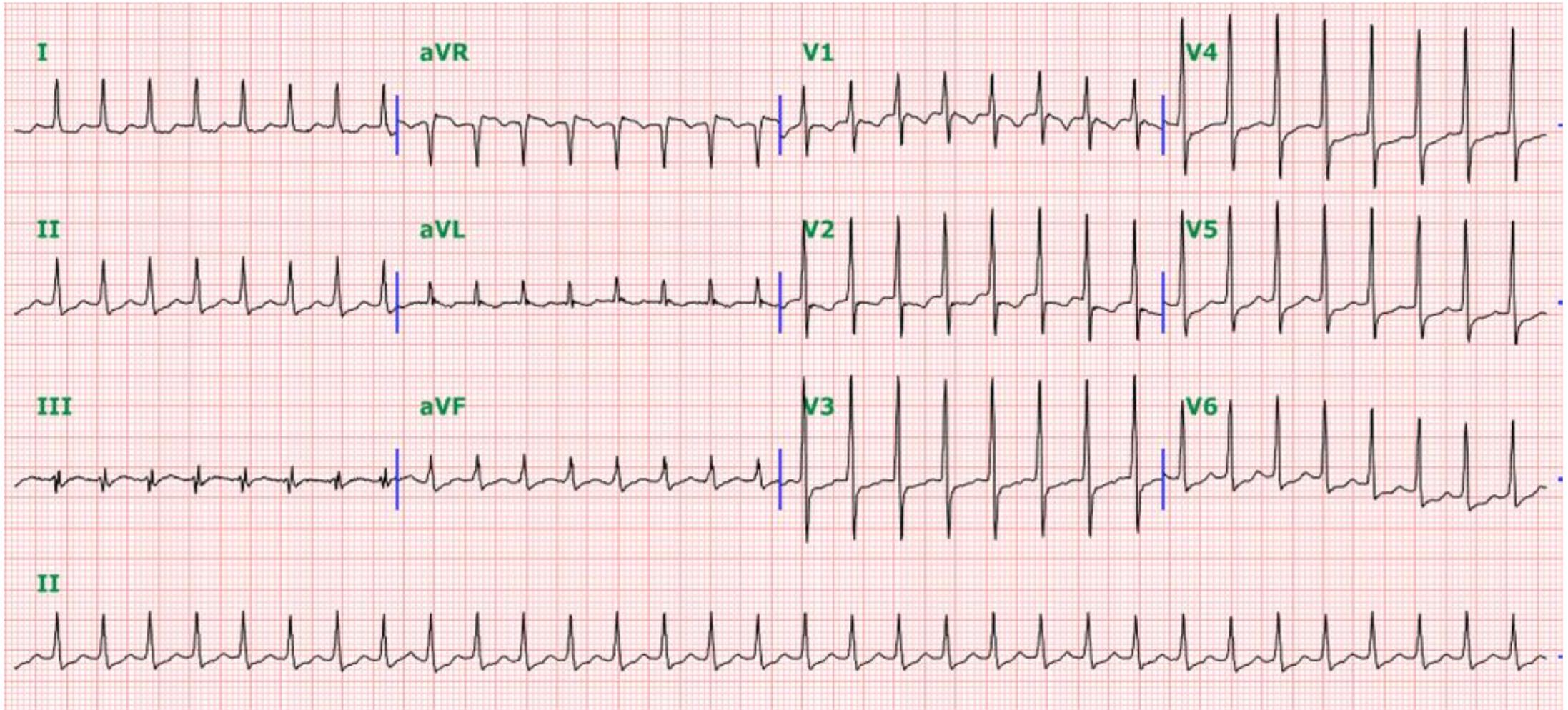
Atrial fibrillation

HR 계산: 13 X 6 = 78 bpm R-R interval: irregularly irregular

P wave and P-R relation: P wave 보이지 않음 Baseline fibrillation

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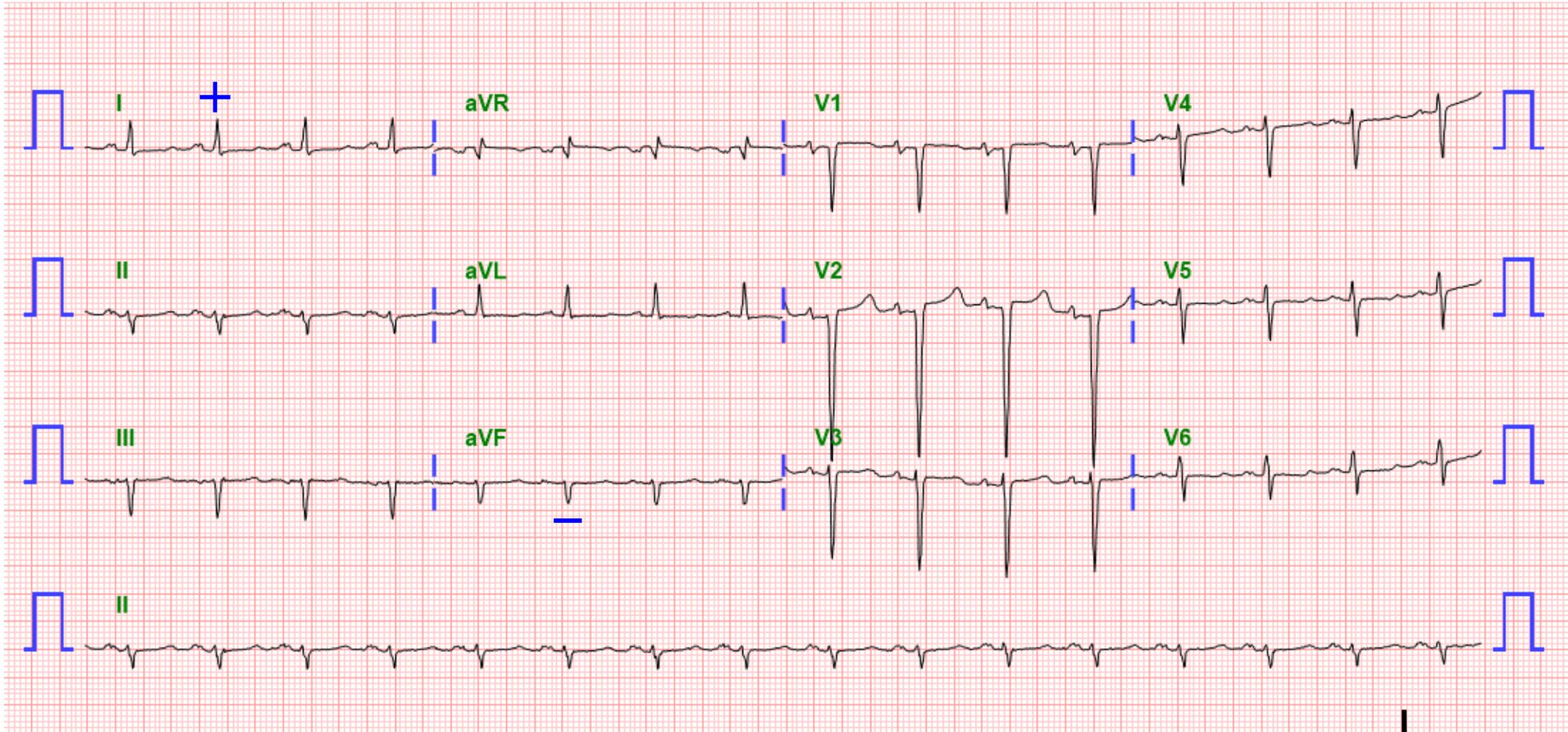**HR 계산: 150bpm 이상 빈맥**   **R-R interval: fast, regular**

P wave and P-R relation: P wave 보이지 않음   **Narrow QRS tachycardia**

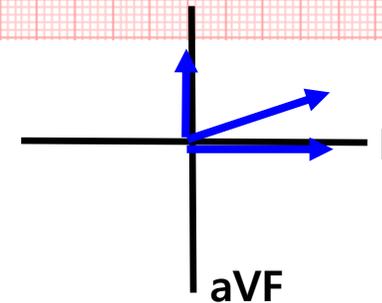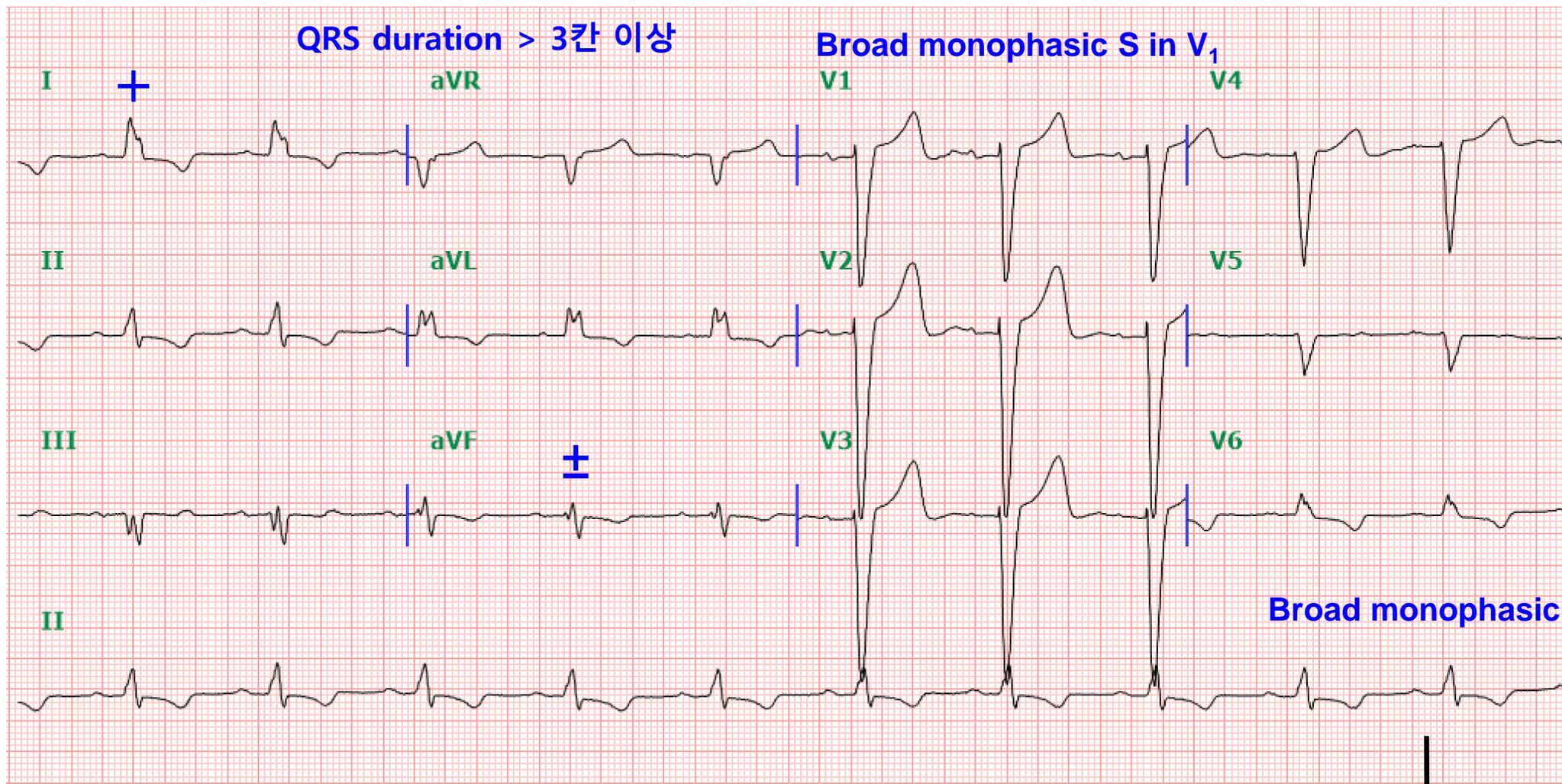**KHRS 2023**

Regular sinus rhythm, Left axis deviation, Poor R progression

Rhythm: Regular sinus rhythm with 1:1 P-R relation

Axis: Left axis deviation

R progression: Poor R progression

KHRS 2023

Case

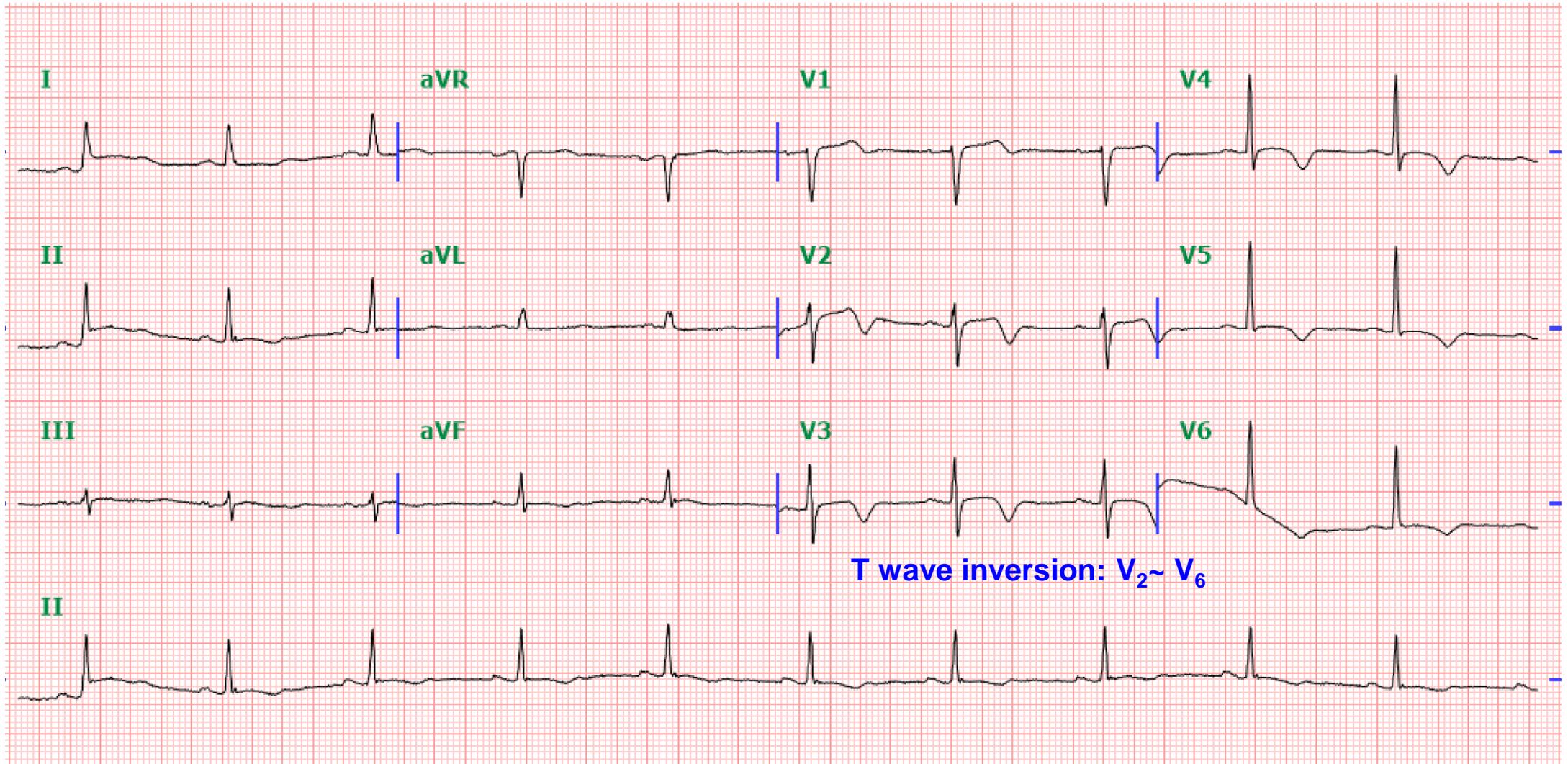T wave inversion: V$_2$~ V$_6$
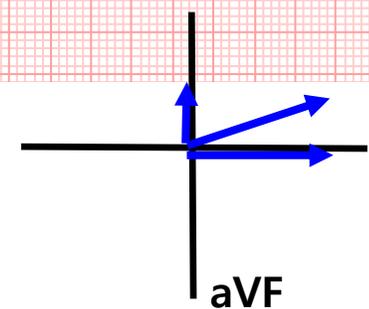
Q wave?, ST segment, T wave: T inversion in precordial lead (anterolateral)

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Thanks for your attention