Unstable Vital Signs

114/05/02

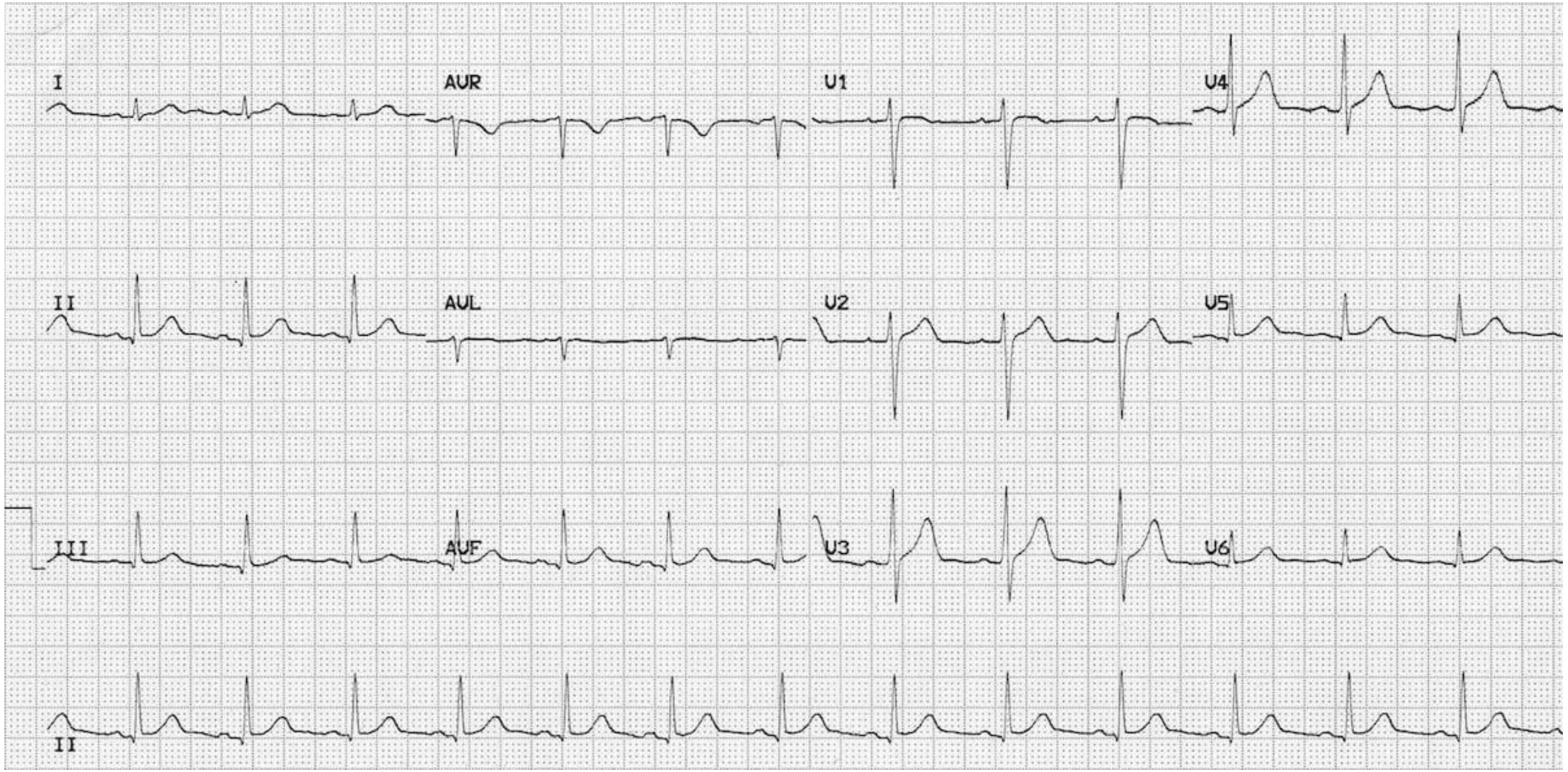
曾文濱醫師

臨床情境：

你來到七樓，正巧護理師求救說07-77病人叫不醒、摸不到脈搏！
那床剛好是你的病人，護理長已拿起電話Call 99並連絡主治醫師，此時來到床邊的你要？？

Check rhythm, 分派工作
頭側：暢通呼吸道、擠Ambu、插管
胸側：高品質CPR
藥物：Run IV、給Epinephrine
查原因：抽血、照X光
通知主治、通知家屬、通知ICU調床
紀錄給藥時間&護理紀錄

Electrocardiography (ECG or EKG)
心電圖 = 心臟電氣活動的記錄

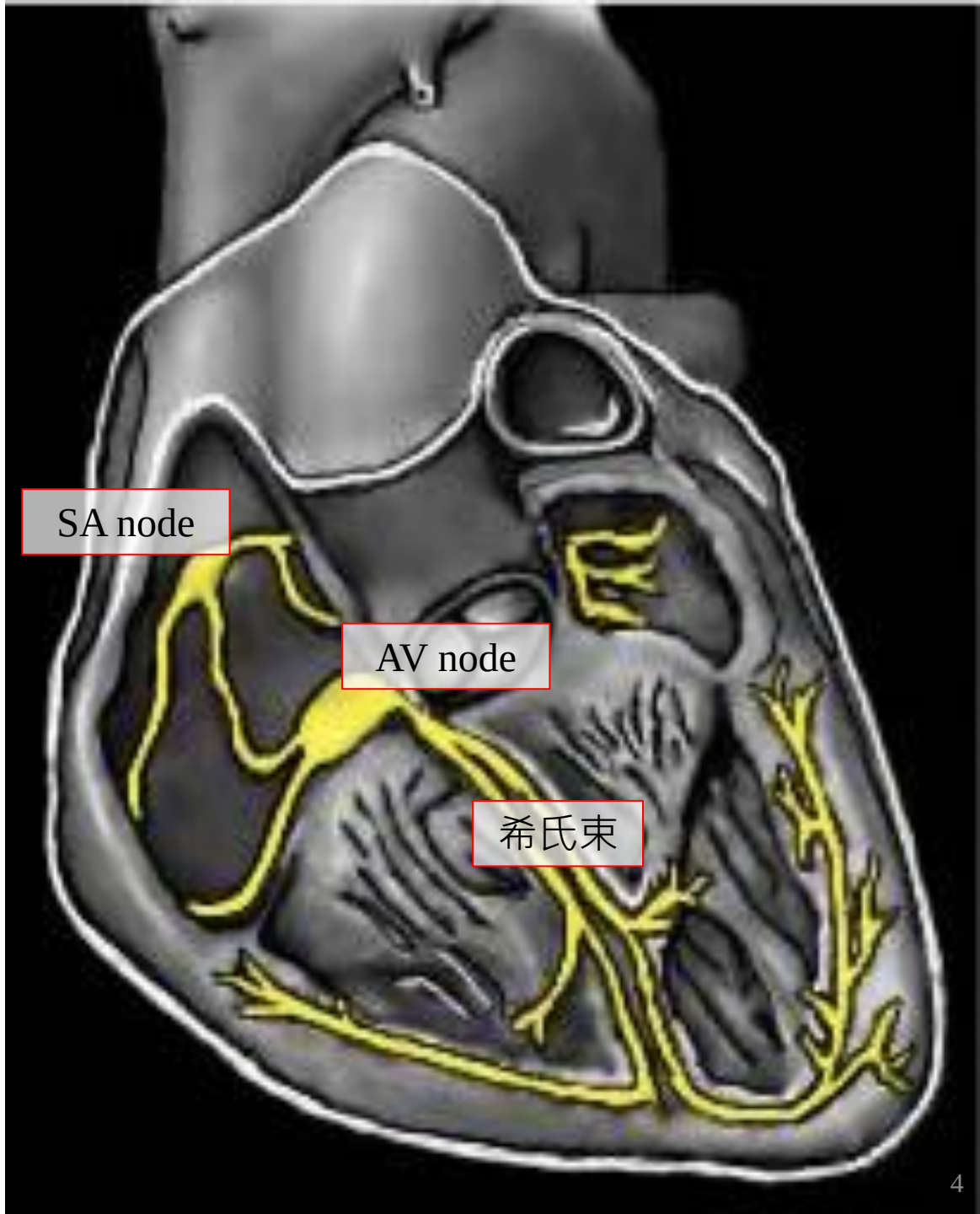


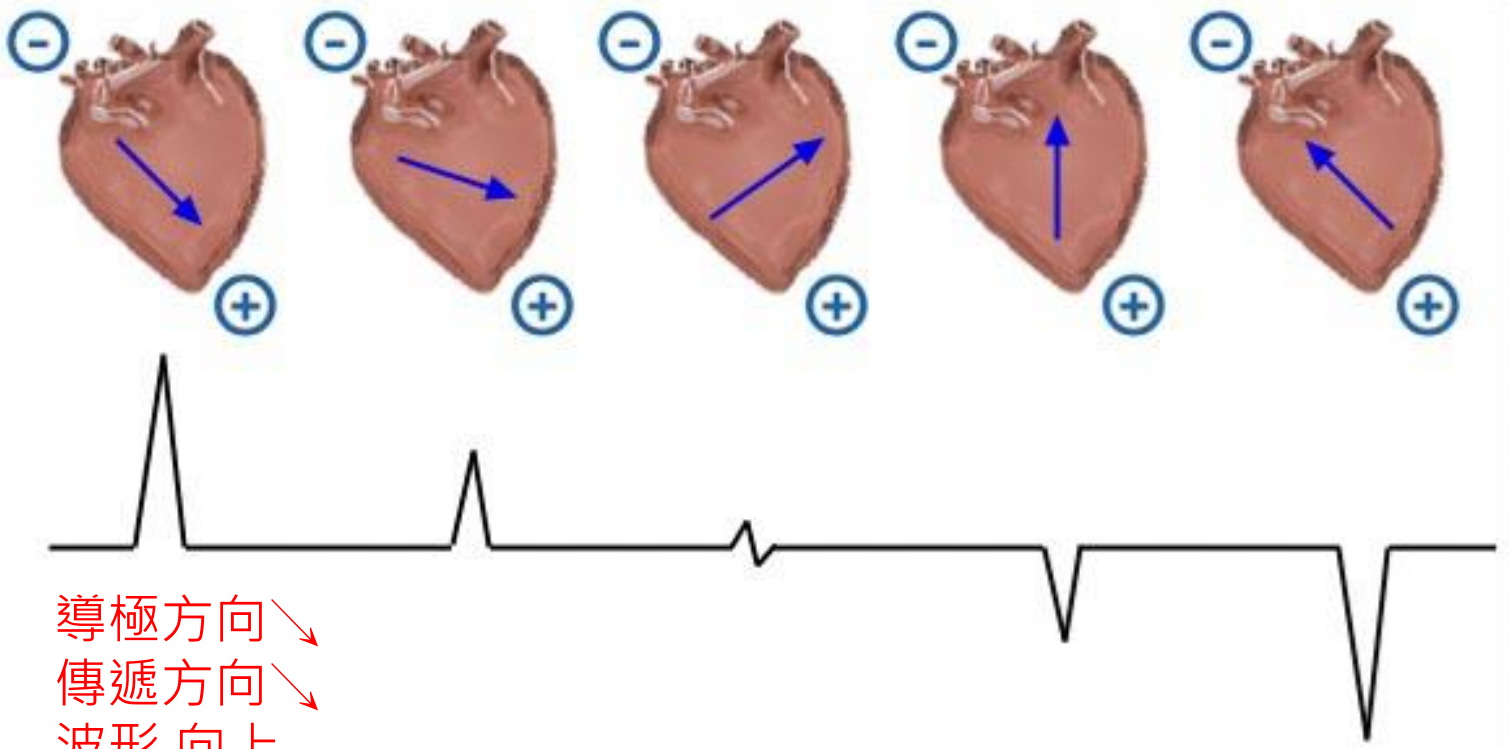
標準十二導程心電圖

Ref: LITFL-Sinus rhythm

心臟傳導系統

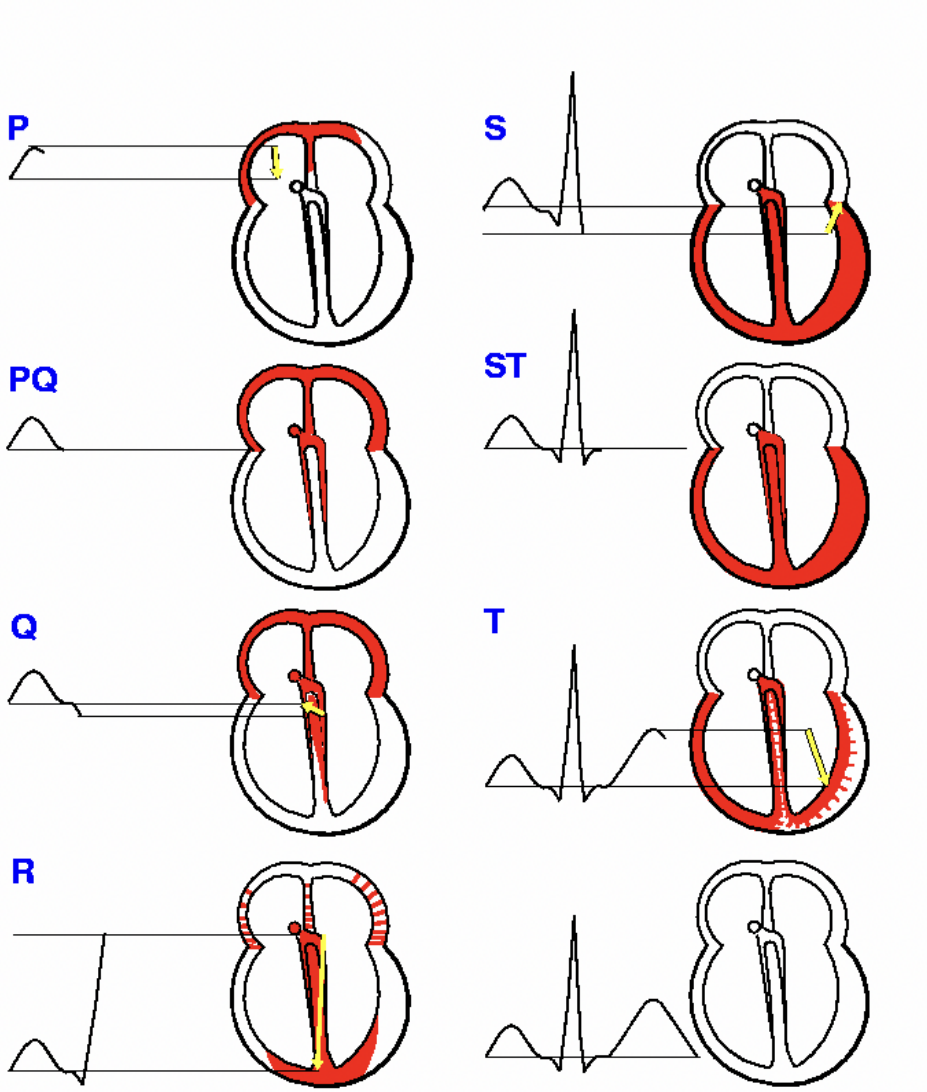
- Sinoatrial Node (SAN) 竇房節
- Internodal track
- Atrioventricular Node (AVN) 房室節
- Bundle of His 希氏束
- Bundle Branches (RBB, LBB)
- Purkinje Fibers 蒲金氏纖維





導極方向↘
傳遞方向↘
波形 向上

導極方向↘
傳遞方向↖
波形 向下

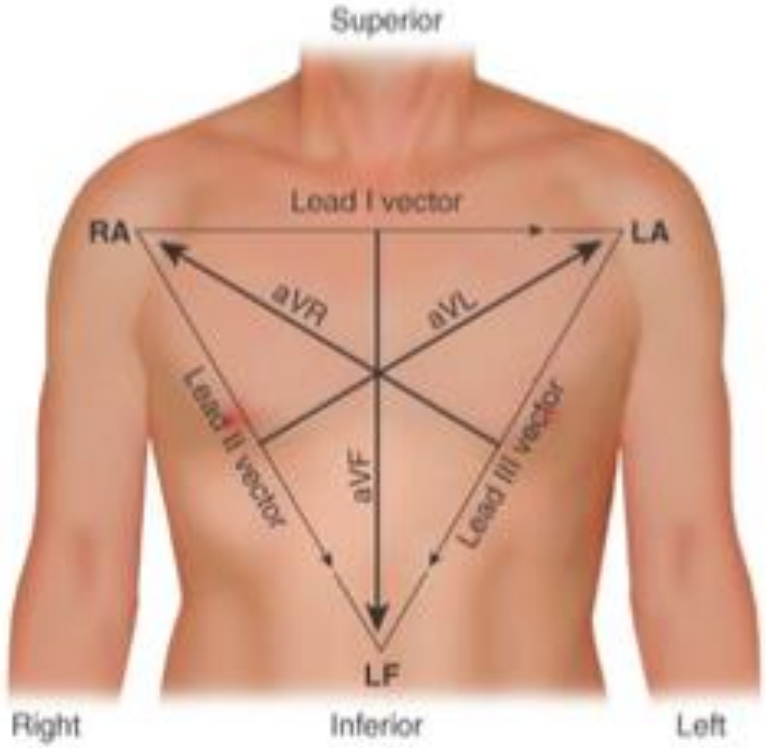


心電圖12導程

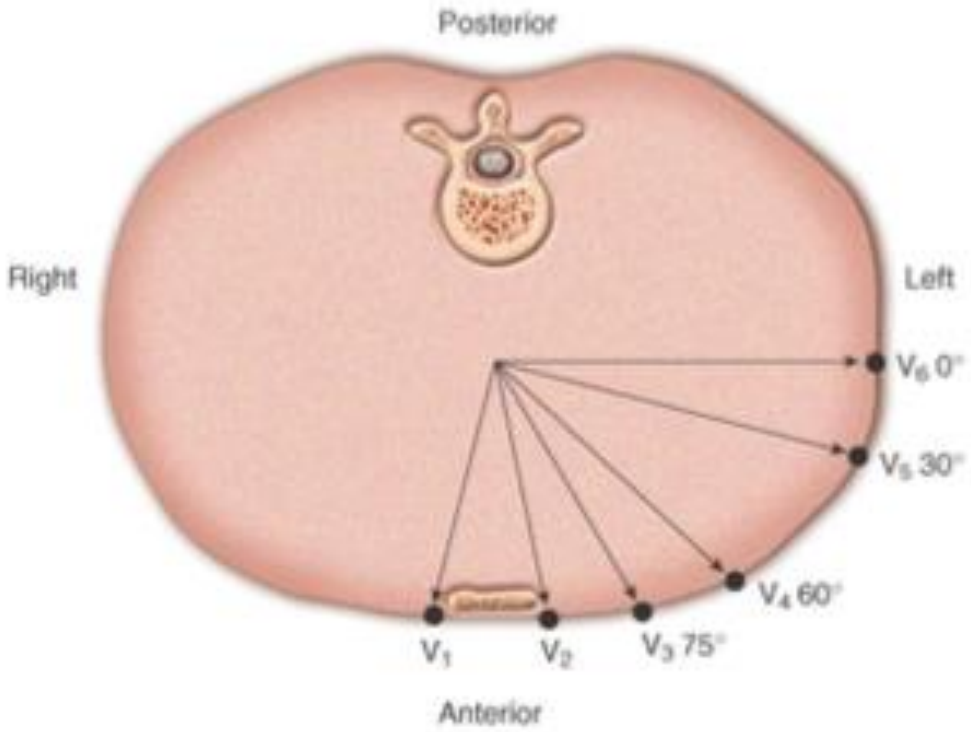
肢導程 --- 6 leads

胸前導程 --- 6 leads

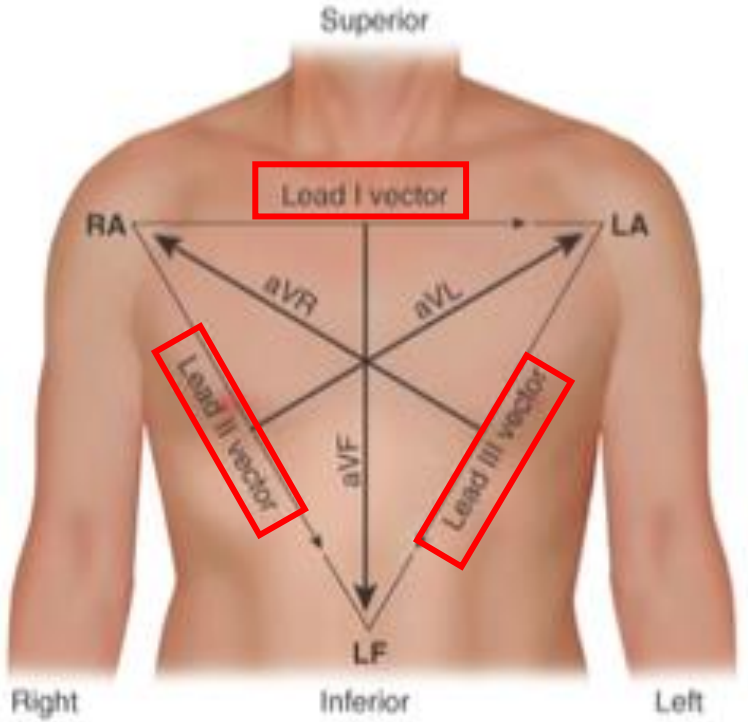
Frontal plane

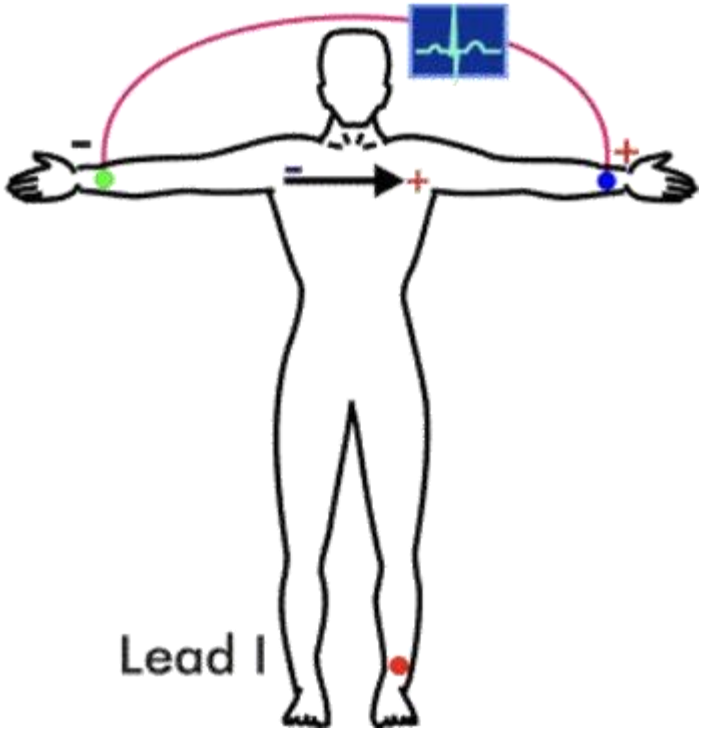


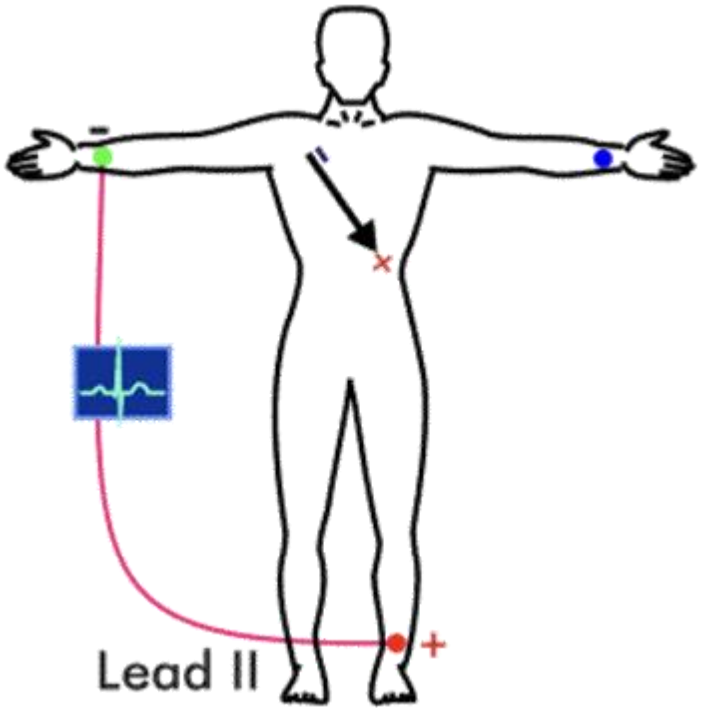
Horizontal plane

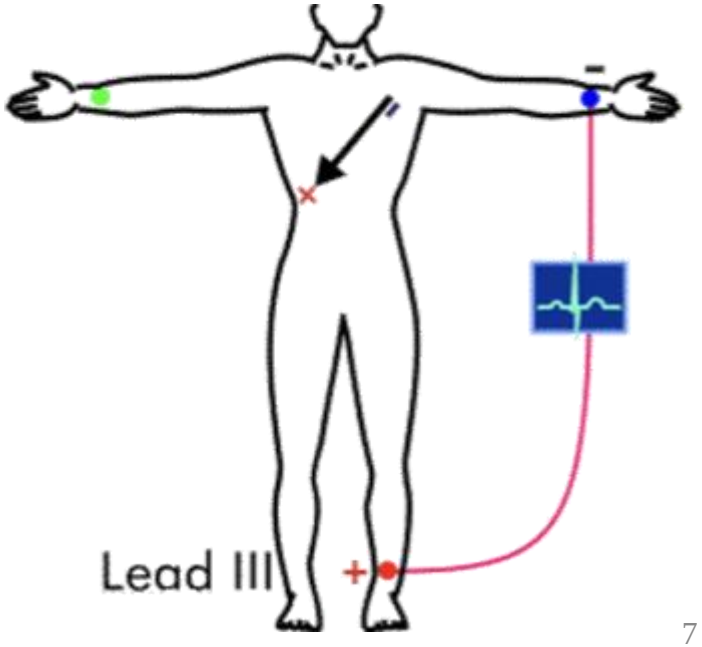


lead I, lead II, lead III

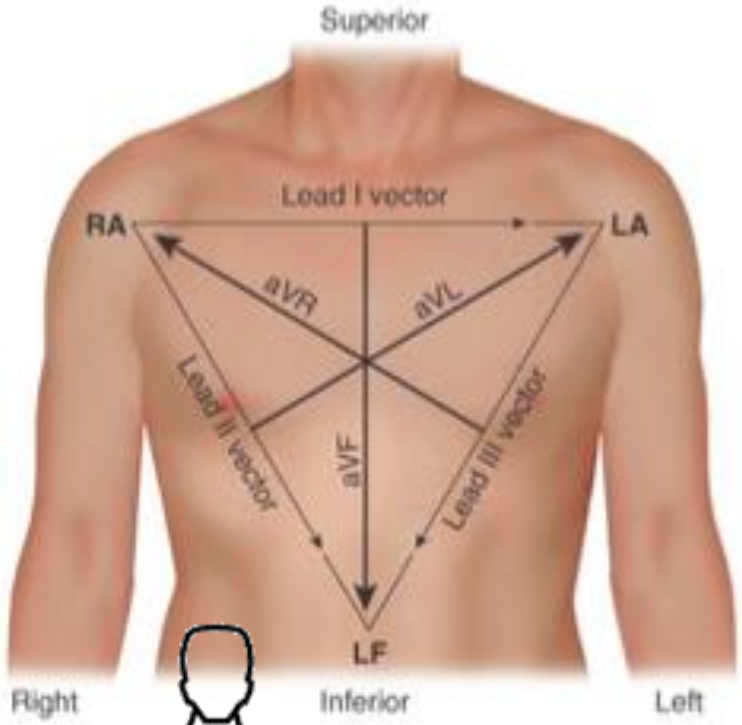


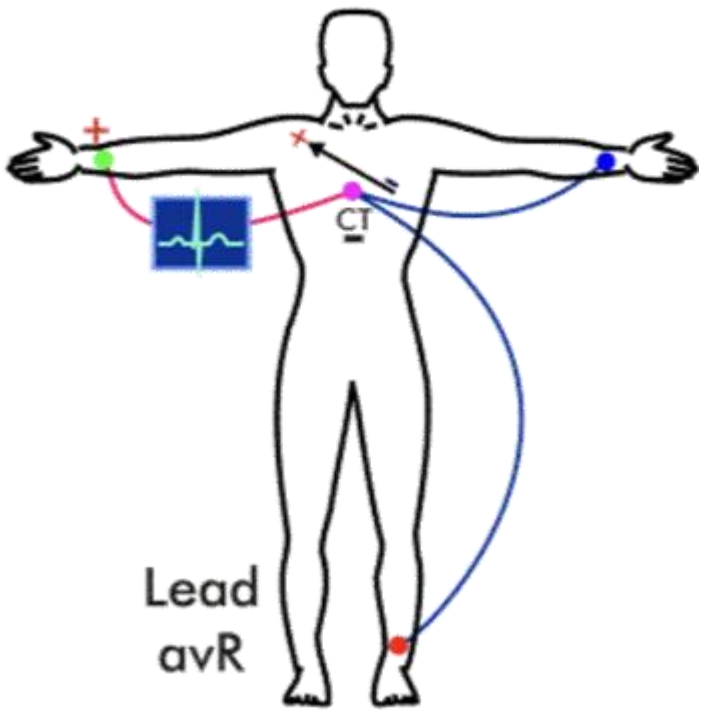


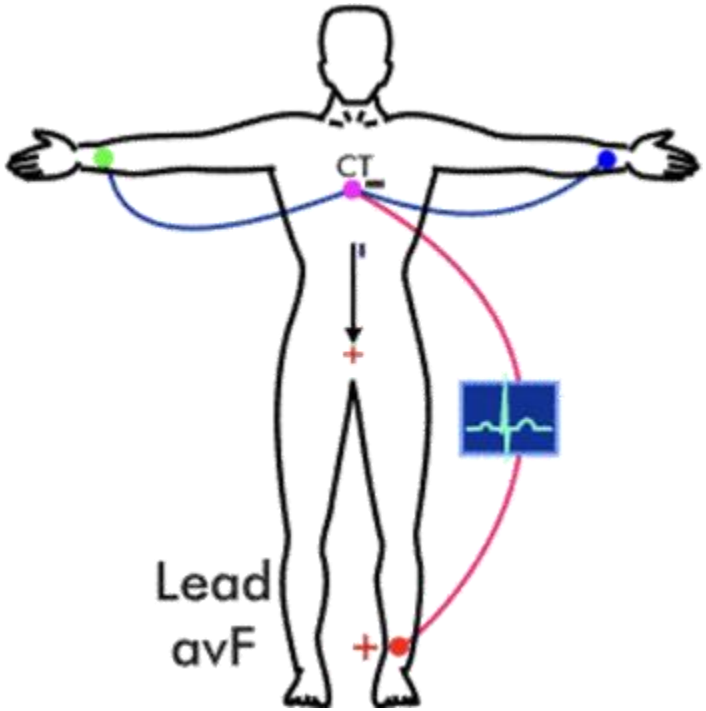


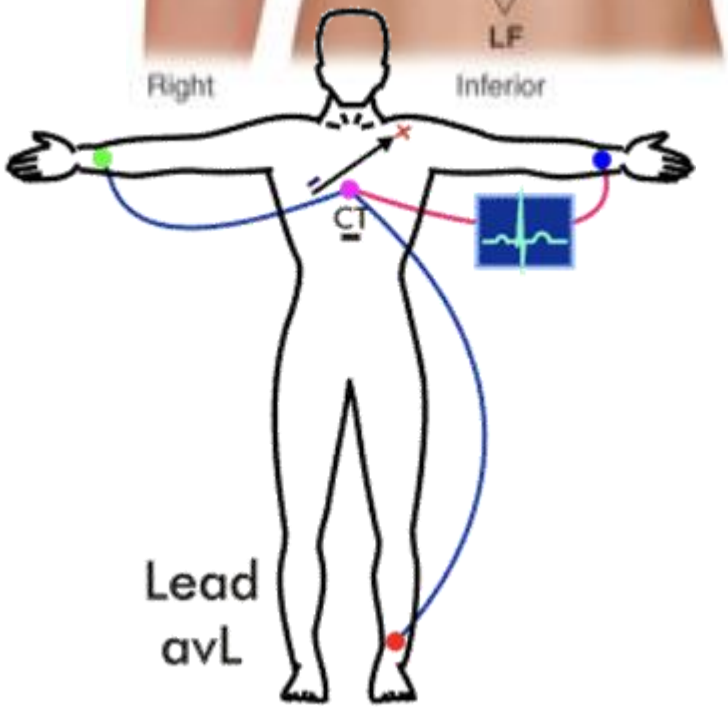


aVL, aVF, aVR


Superior
Lead I vector
RA
LA
aVR
aVL
Lead II vector
aVF
Lead III vector
LF
Right
Inferior
Left

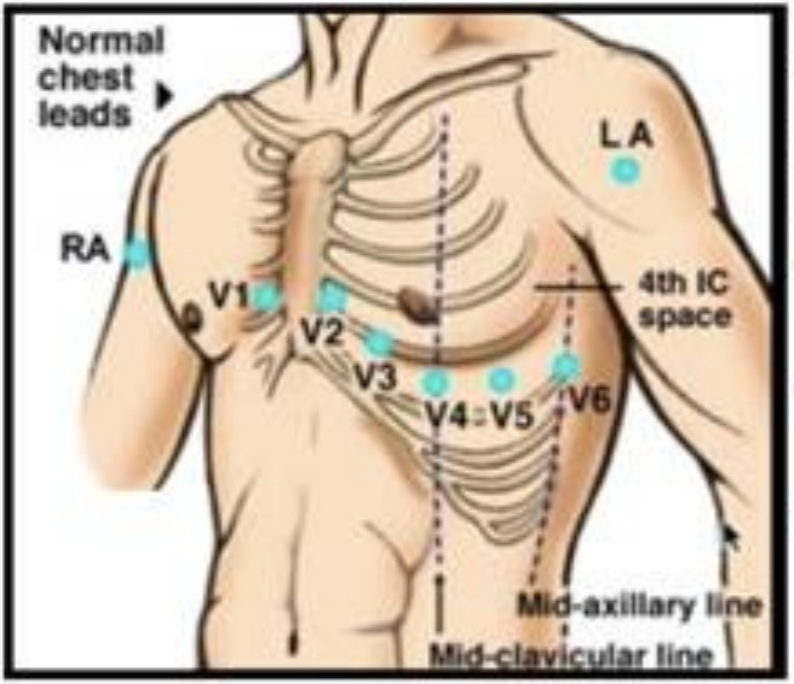

CT
Lead
avR


CT
Lead
avF

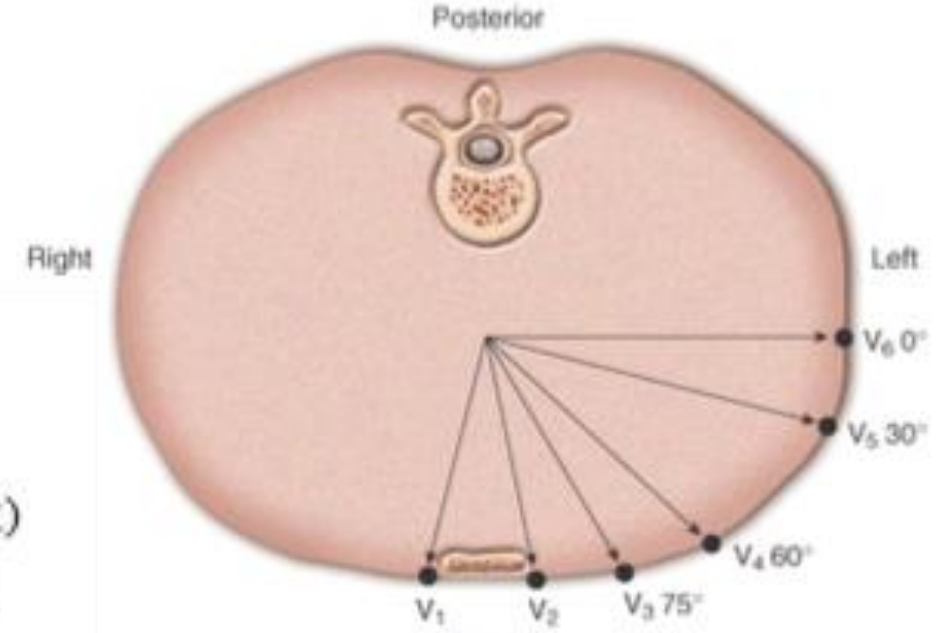

CT
Lead
avL

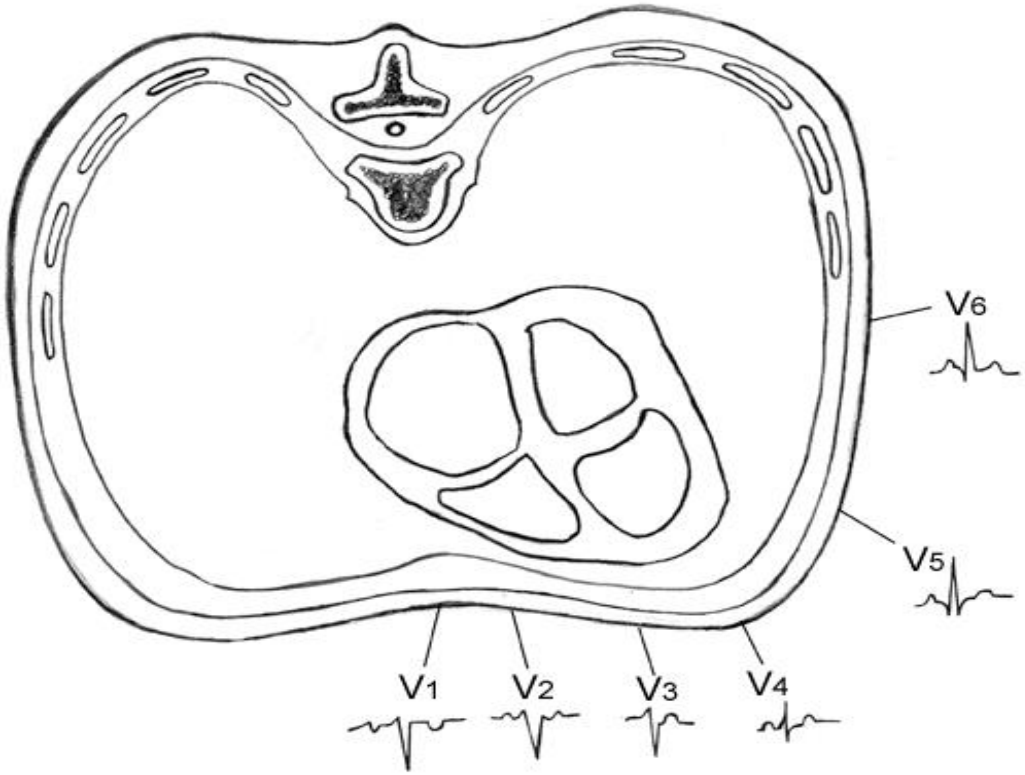
胸前導程

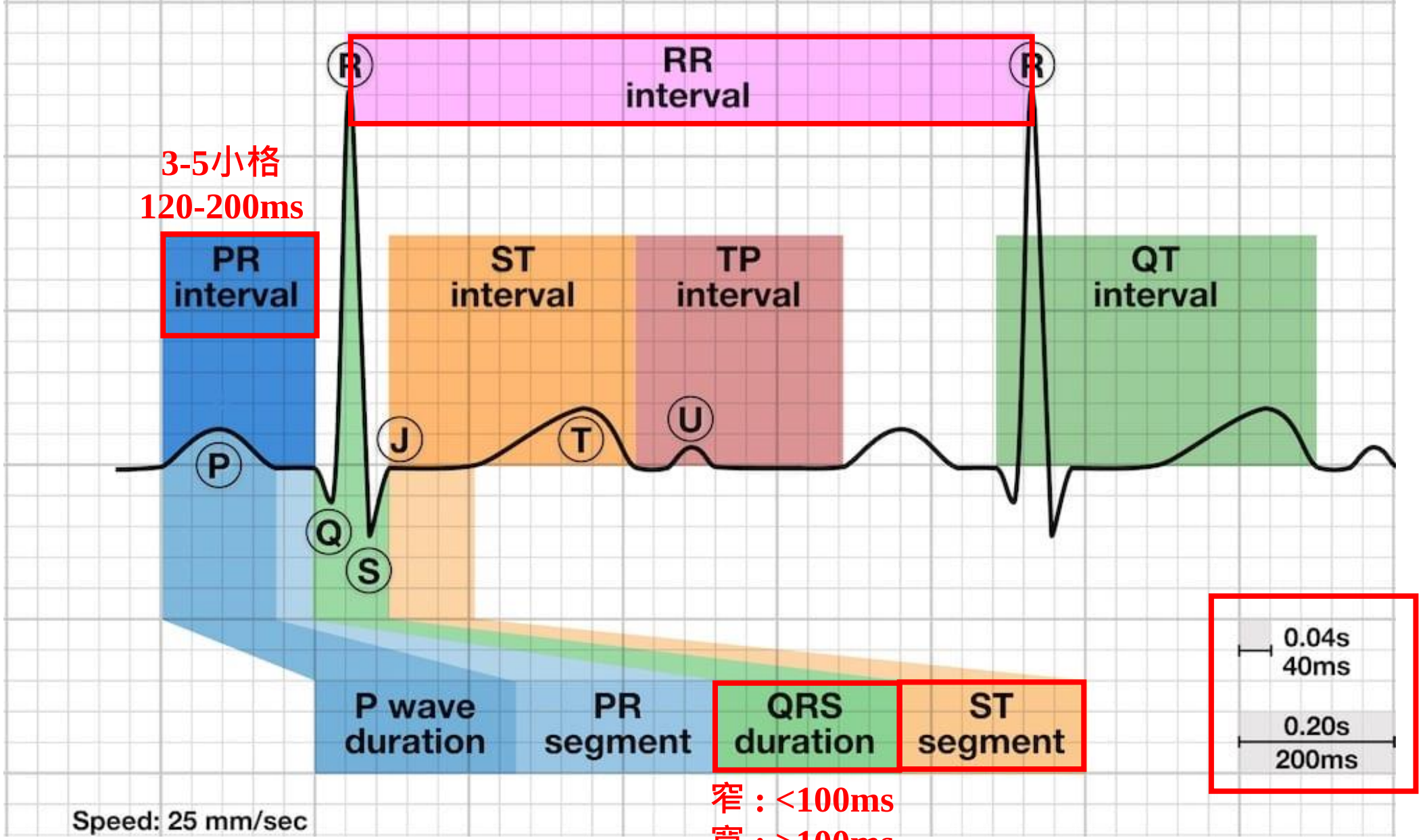
Precordial or Chest Leads



V_1	4th intercostal (right)
V_2	4th intercostal (left)
V_3	Between V_2 & V_4
V_4	Midclavicular (mid-collarbone)
V_5	5th intercostal space (anterior axillary line)
V_6	5th intercostal (midaxillary line)





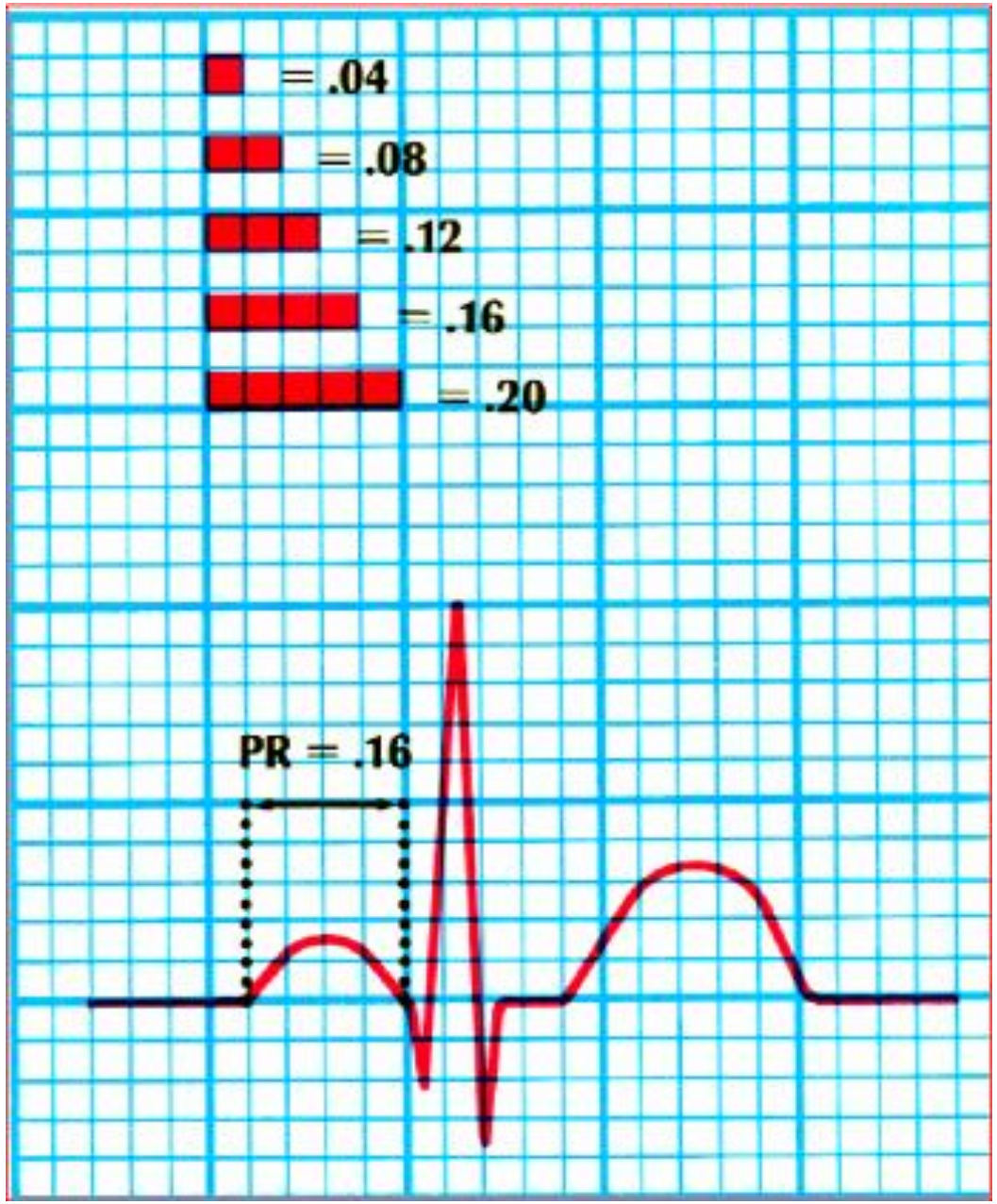


窄：<100ms

寬：>100ms

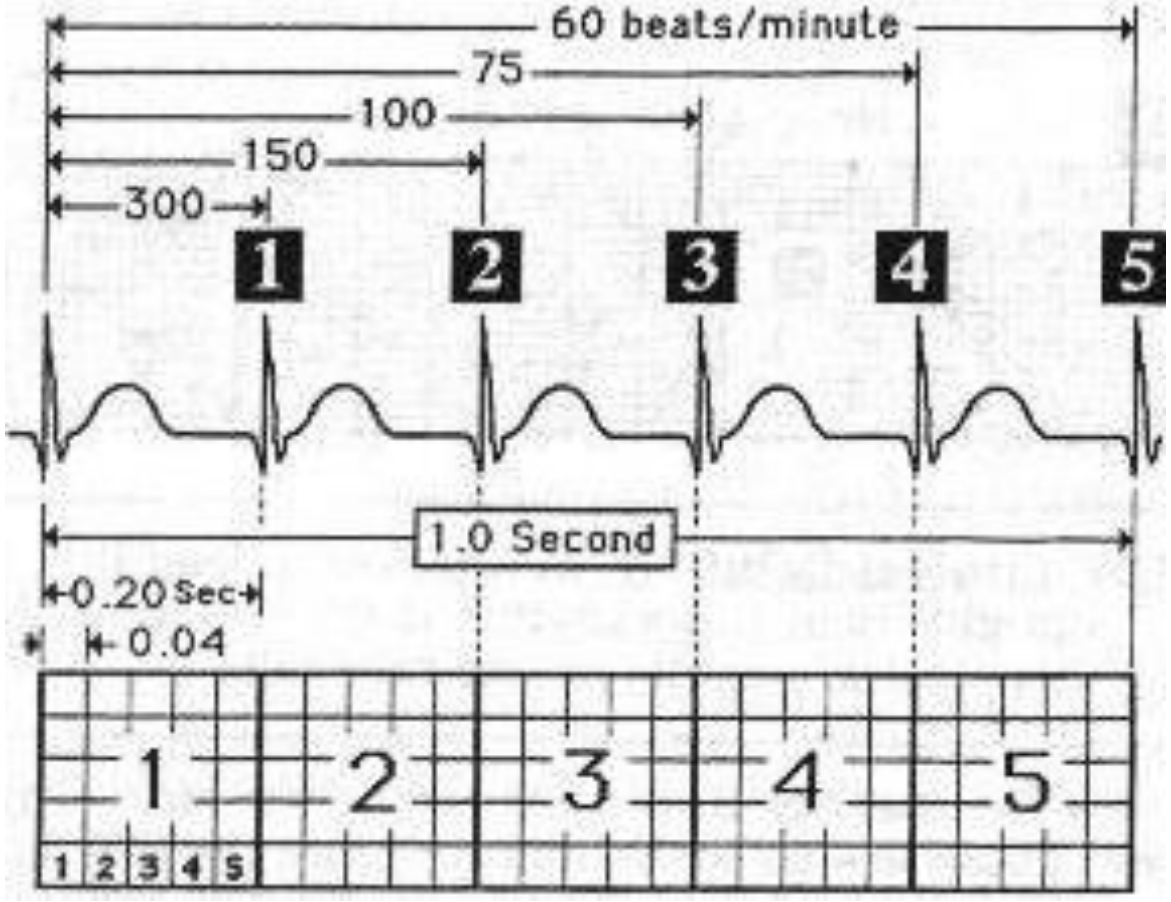
速率

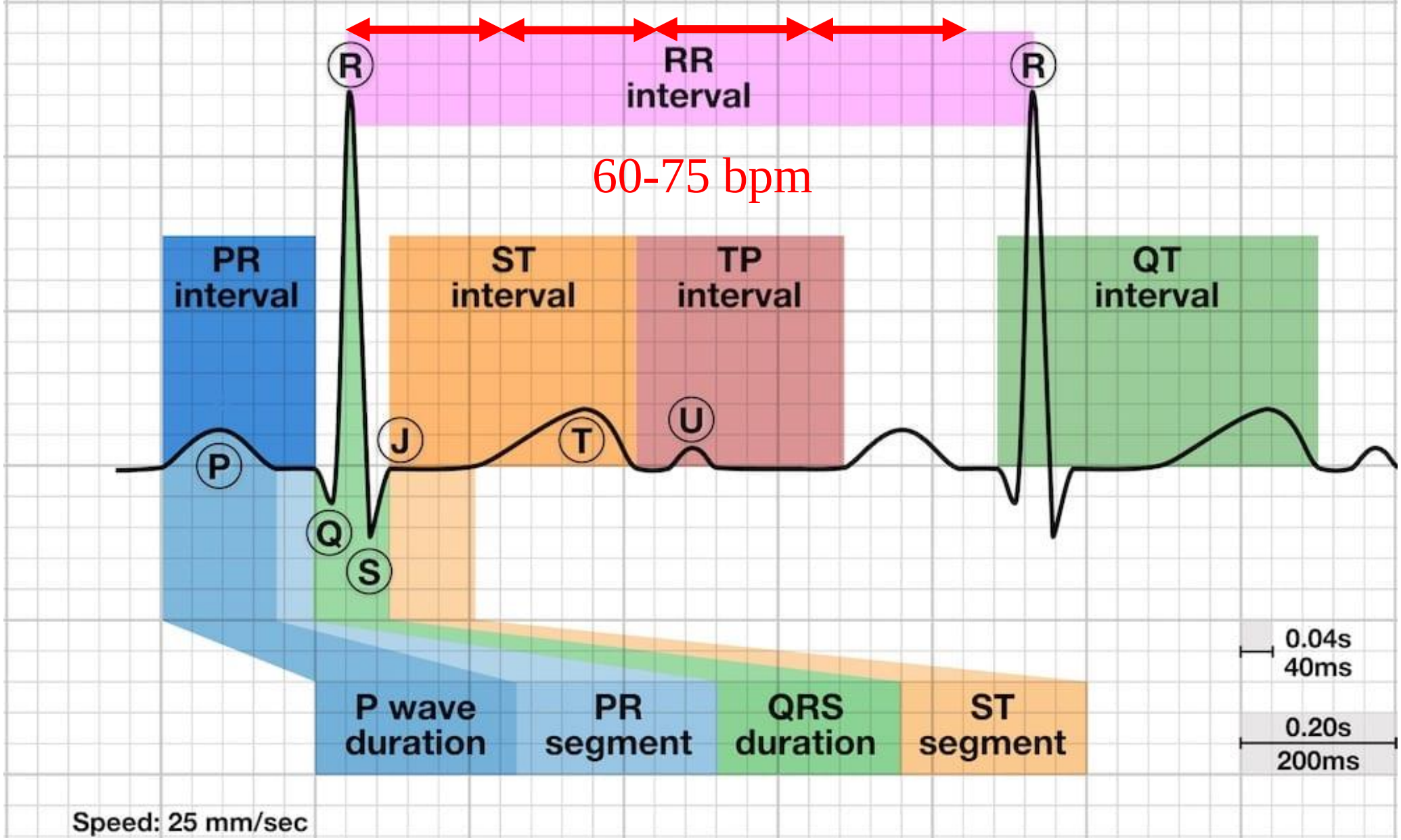
- 心電圖記錄紙
  - Speed:
    = 25 mm / sec
    = 0.04sec/mm
  - Voltage
    = 1 mV / 10 mm



估算心跳速率

- Rule of 300 (不適合心律不整)
- Six-second methods
- Ten-Second methods




R
RR
interval
R
60-75 bpm
PR
interval
ST
interval
TP
interval
QT
interval
P
Q
J
T
U
S
P wave
duration
PR
segment
QRS
duration
ST
segment
0.04s
40ms
0.20s
200ms
Speed: 25 mm/sec

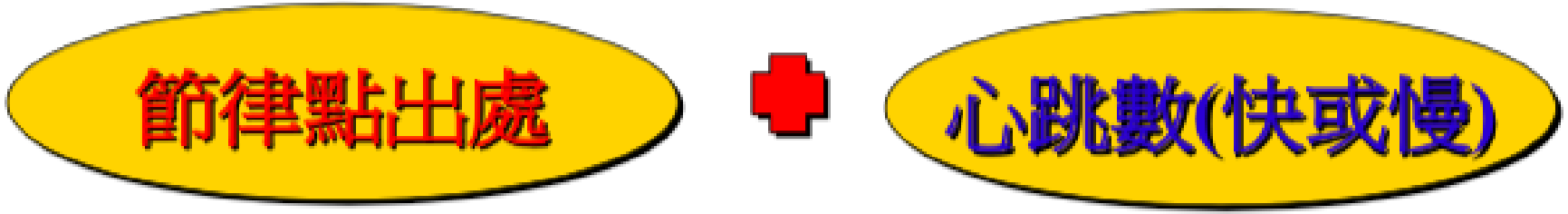
快速心律判讀

心律判讀：Sinus Tachycardia

Sinus Bradycardia

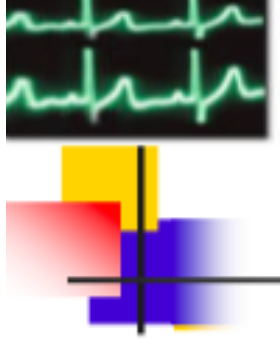
Junctional Bradycardia

Ventricular Tachycardia (VT)



心律判讀原則

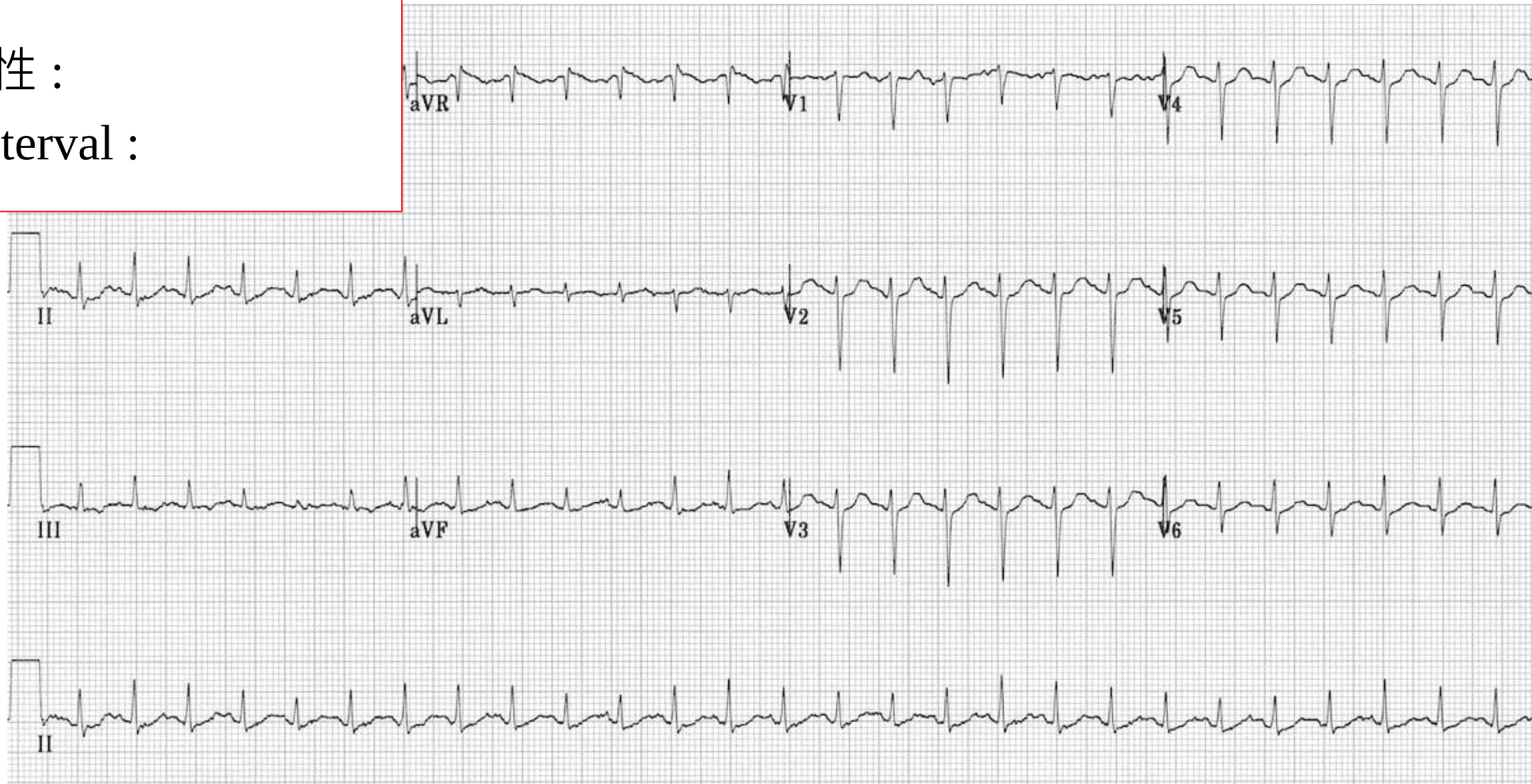
1. 心跳數 (快、慢)
2. QRS(寬、窄) (*wide or narrow QRS*)
3. P波 (P wave)
4. 規則性 (Regularity)
5. P & QRS 相關性



Rate > 100
WIDE QRS
yes
no
VT, VF
SVT + BBB
tachycardia, PSVT
AF,Af,
REGULAR QRS
REGULAR QRS
yes
no
yes
no
VT
SVT + BBB
VF
tachycardia
PSVT
AF
Af

1. 心跳數 :
2. QRS :
3. P波 :
4. 規則性 :
5. PR interval :

Sinus tachycardia

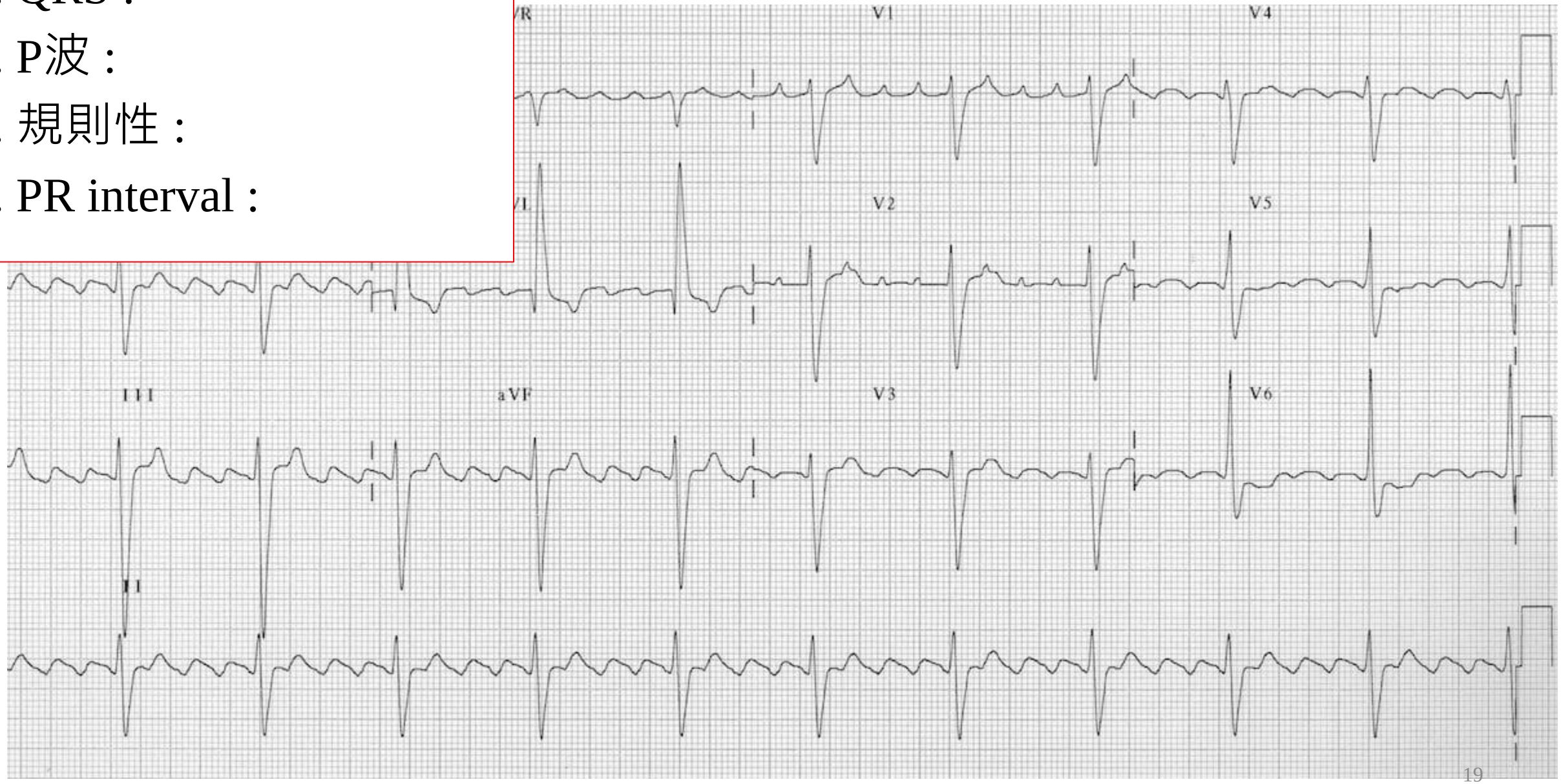


1. 心跳數 :
2. QRS :
3. P波 :
4. 規則性 :
5. PR interval :

Atrial fibrillation with rapid ventricular response (AfRVR)

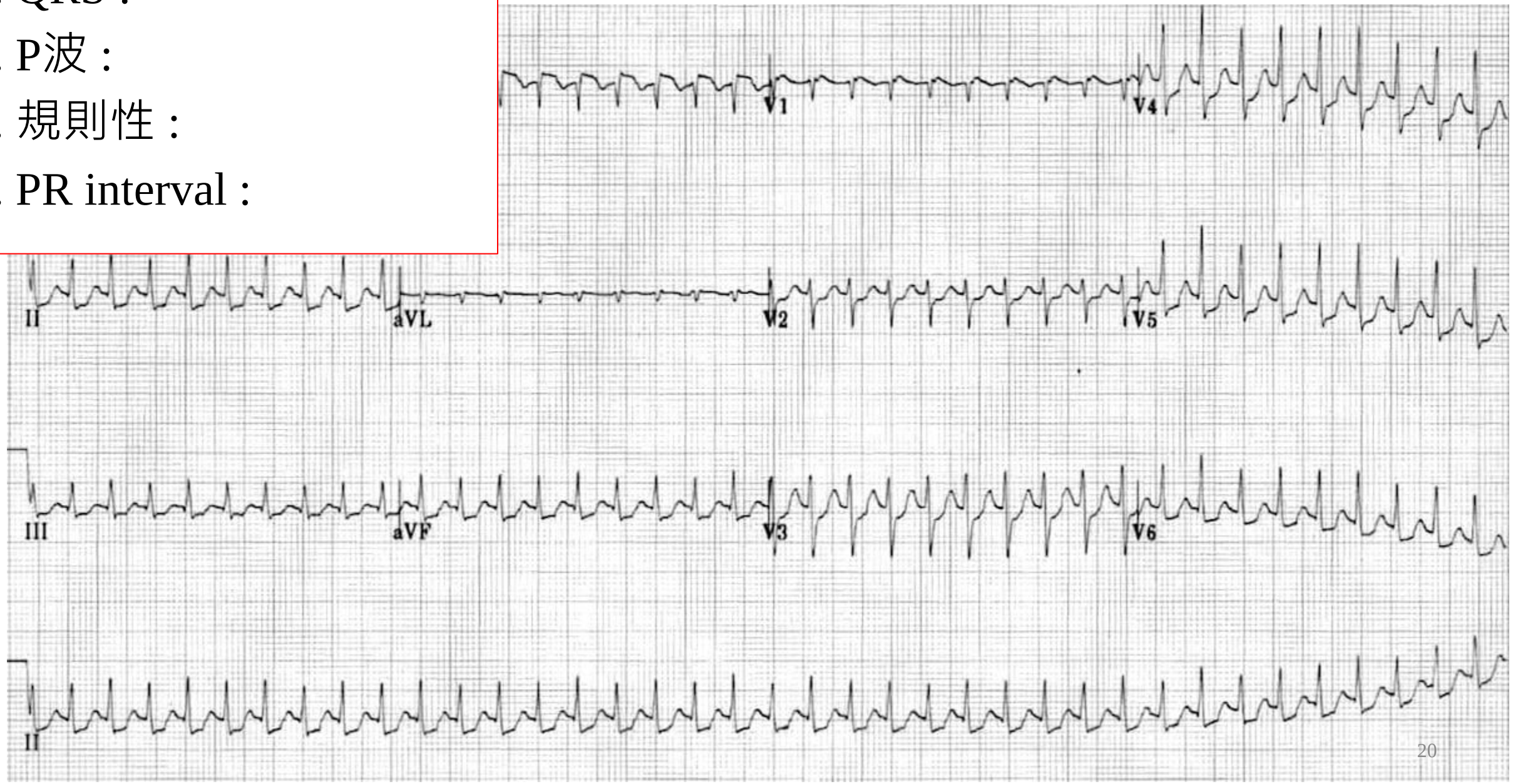
Atrial flutter

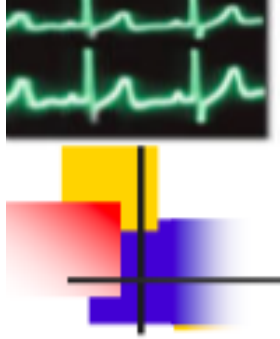
1. 心跳數 :
2. QRS :
3. P波 :
4. 規則性 :
5. PR interval :



PSVT

1. 心跳數：
2. QRS：
3. P波：
4. 規則性：
5. PR interval：

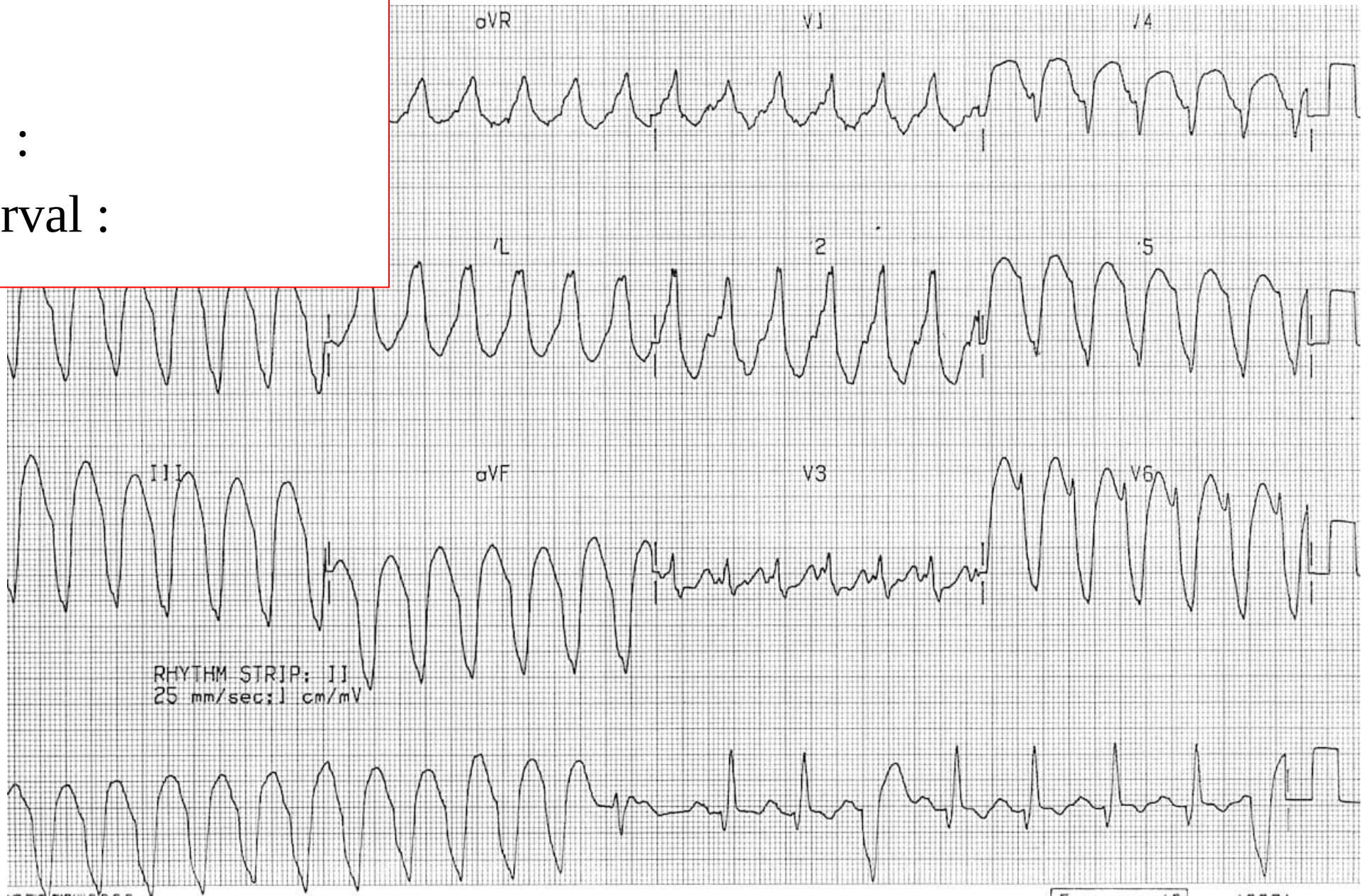




Rate > 100
WIDE QRS
yes
no
VT, VF
SVT + BBB
tachycardia, PSVT
AF,Af,
REGULAR QRS
REGULAR QRS
yes
no
yes
no
VT
SVT + BBB
VF
tachycardia
PSVT
AF
Af

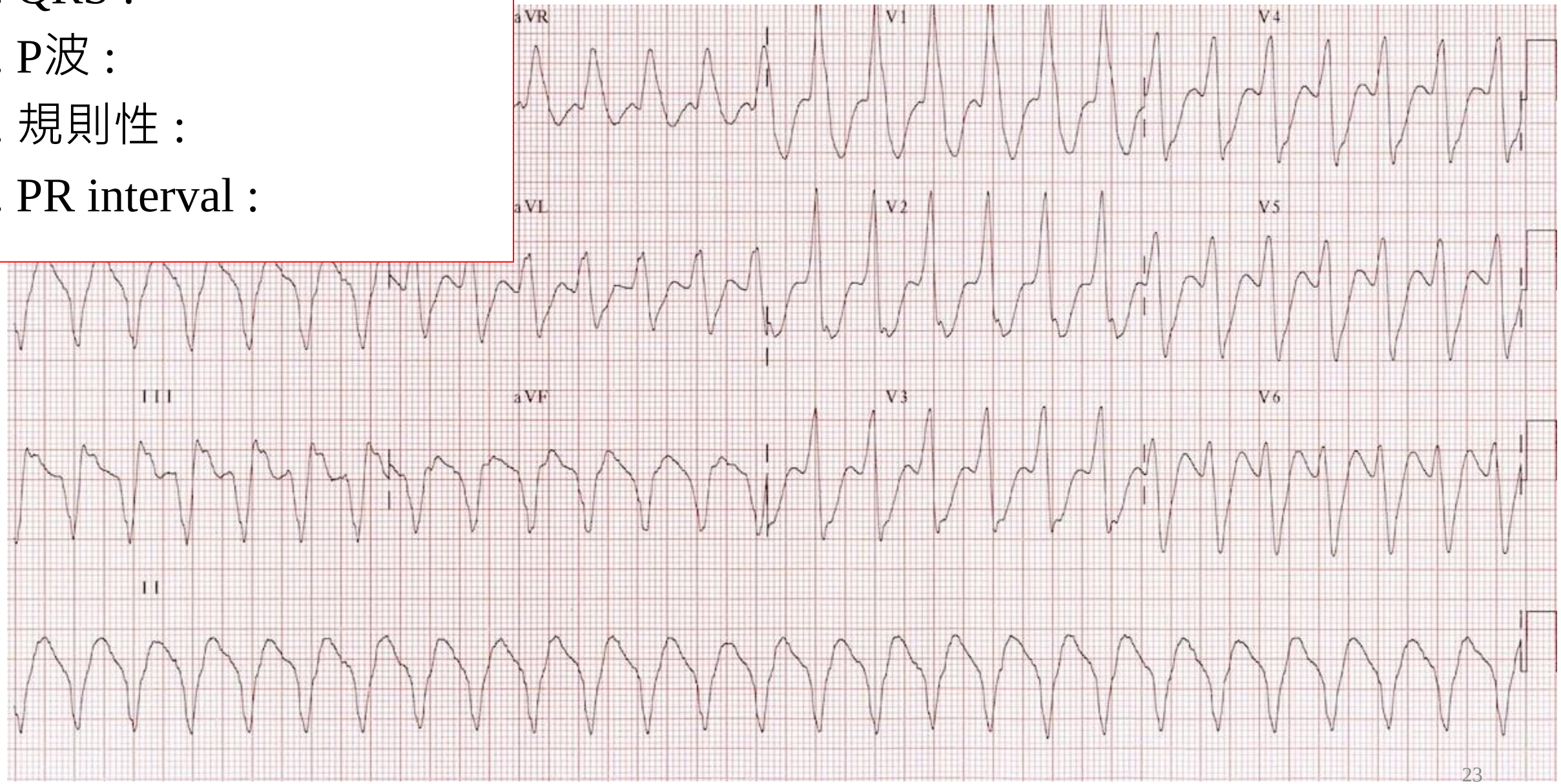
Ventricular Tachycardia

1. 心跳數：
2. QRS：
3. P波：
4. 規則性：
5. PR interval：



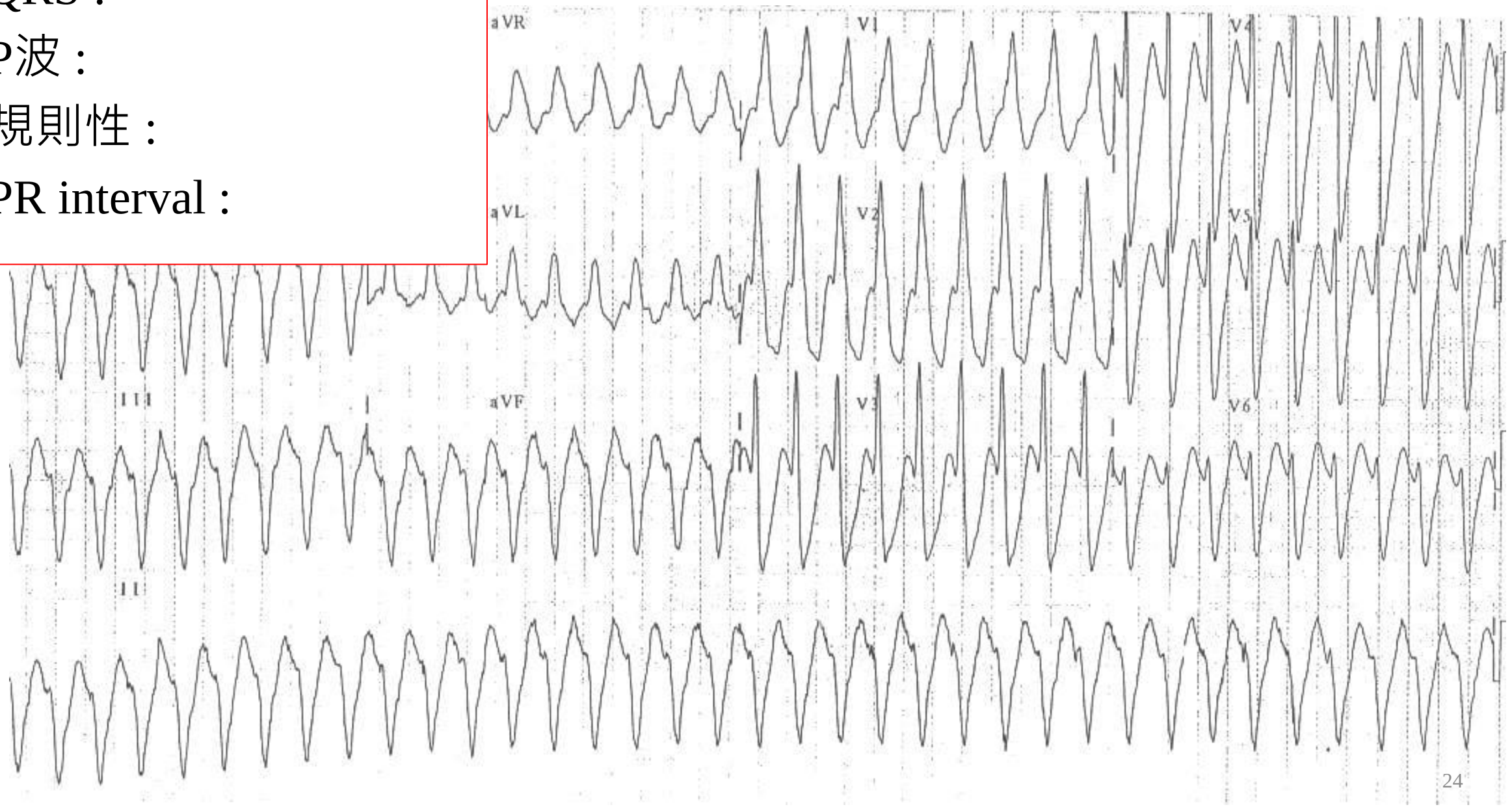
1. 心跳數：
2. QRS：
3. P波：
4. 規則性：
5. PR interval：

Ventricular Tachycardia



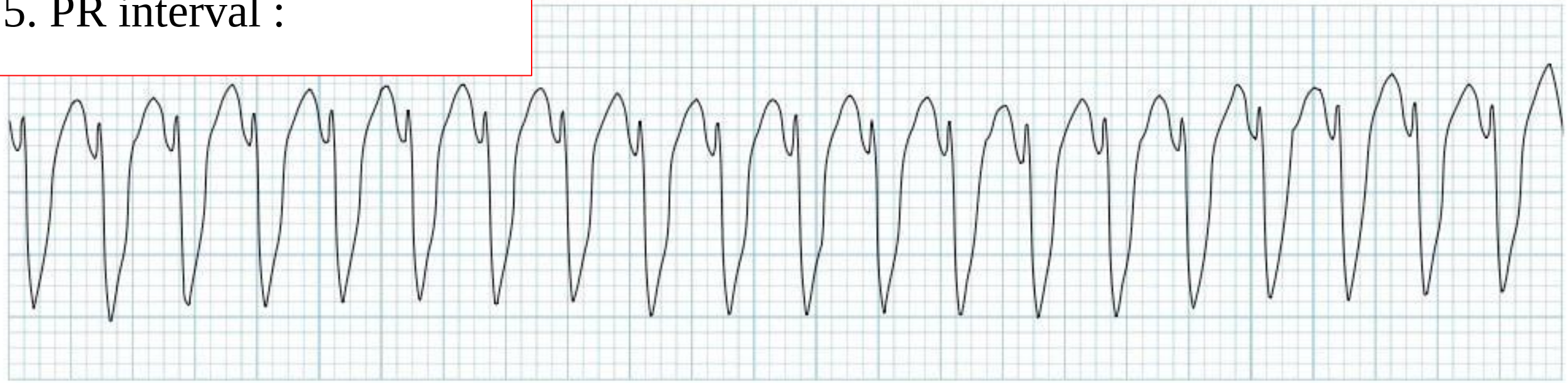
Ventricular Tachycardia

1. 心跳數：
2. QRS：
3. P波：
4. 規則性：
5. PR interval：



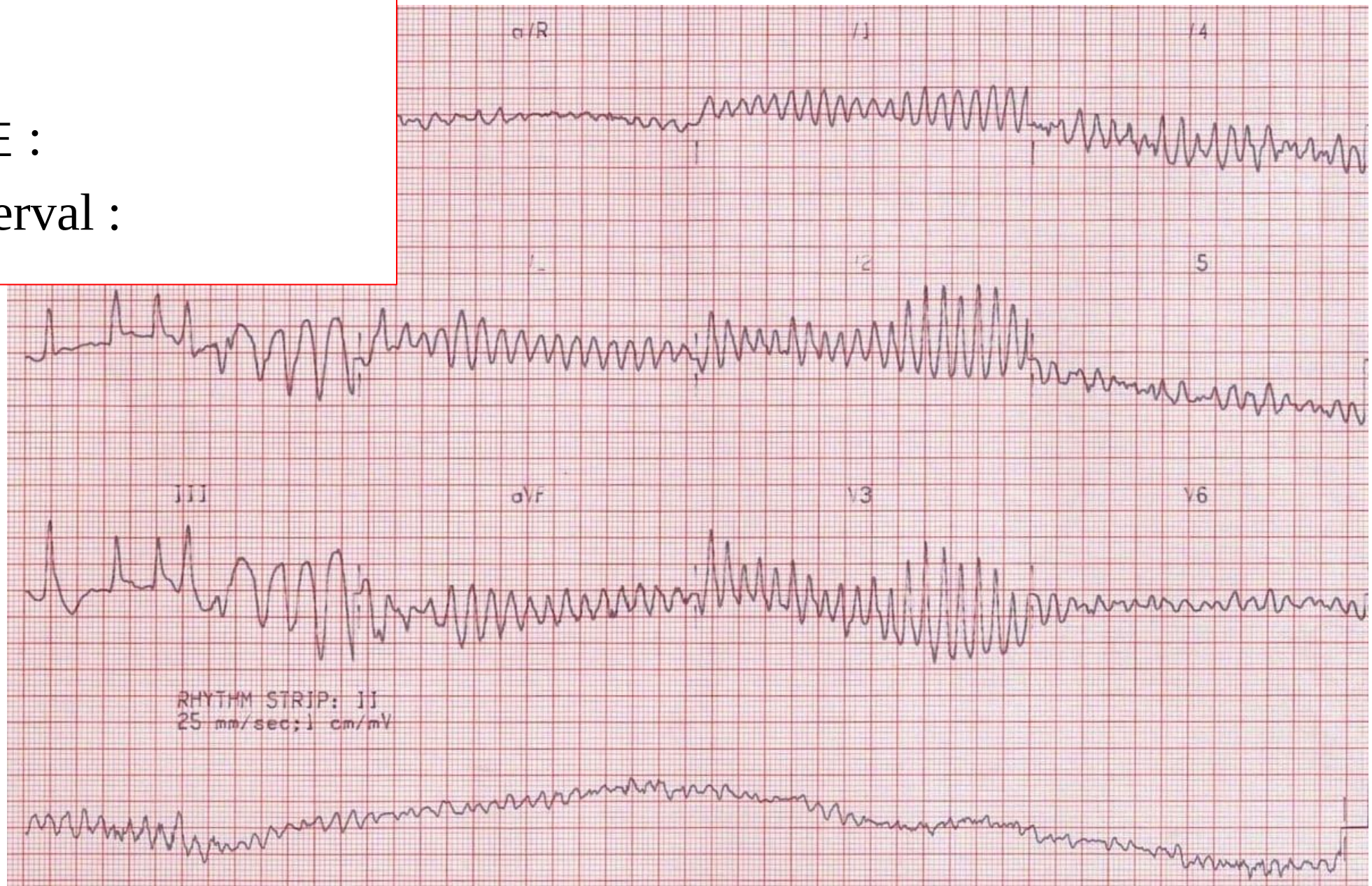
1. 心跳數 :
2. QRS :
3. P波 :
4. 規則性 :
5. PR interval :

Ventricular Tachycardia



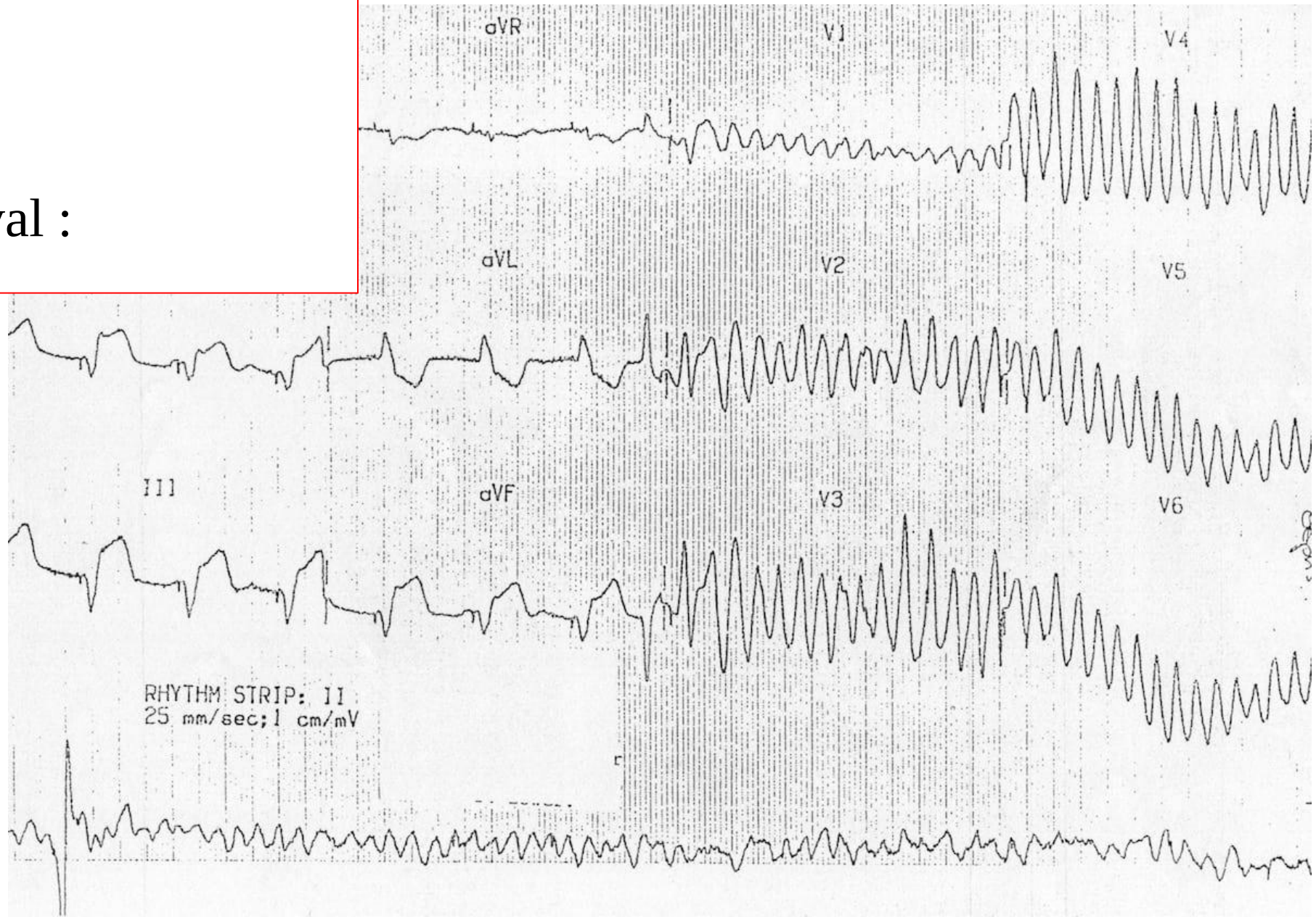
1. 心跳數 :
2. QRS :
3. P波 :
4. 規則性 :
5. PR interval :

Ventricular Fibrillation



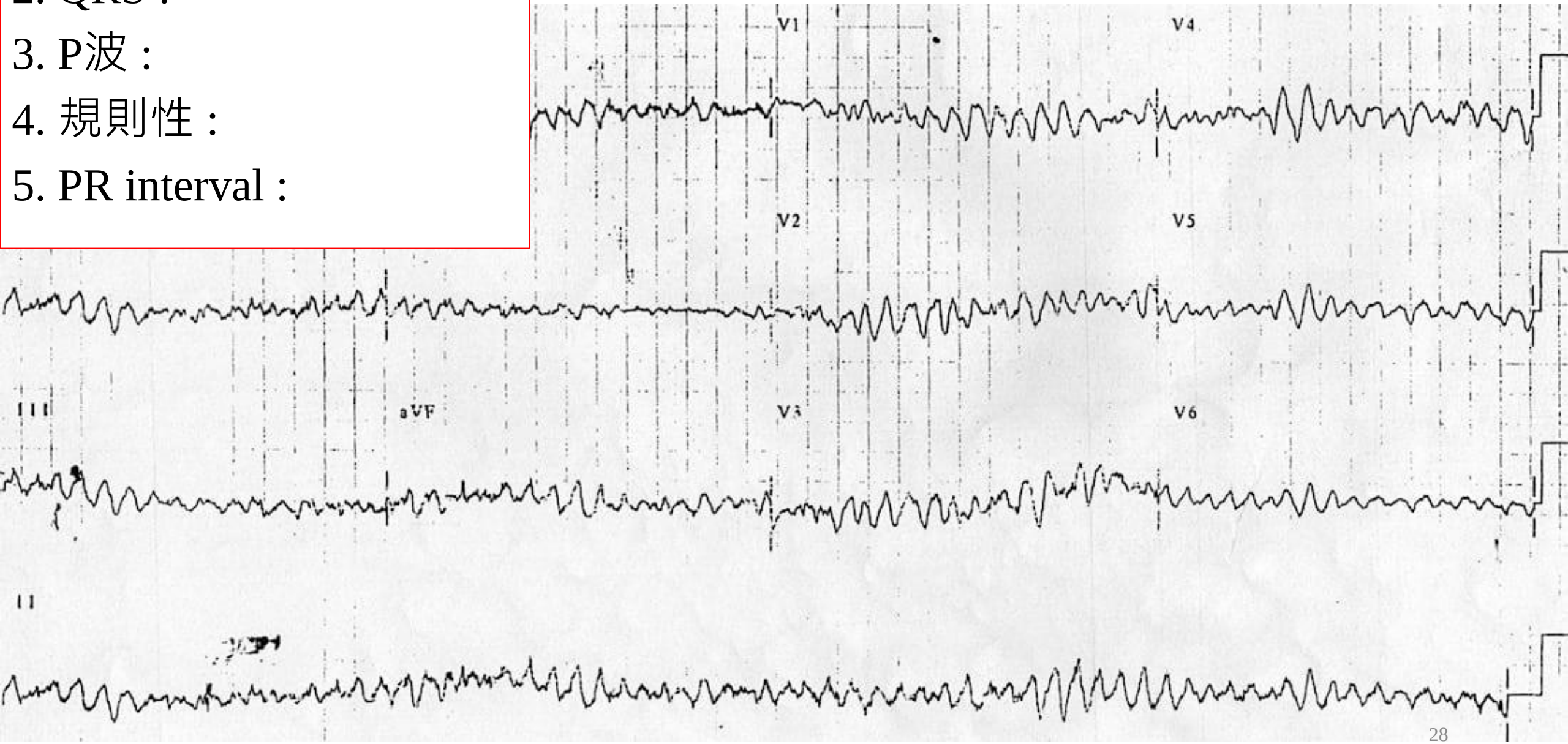
1. 心跳數：
2. QRS：
3. P波：
4. 規則性：
5. PR interval：

Ventricular Fibrillation



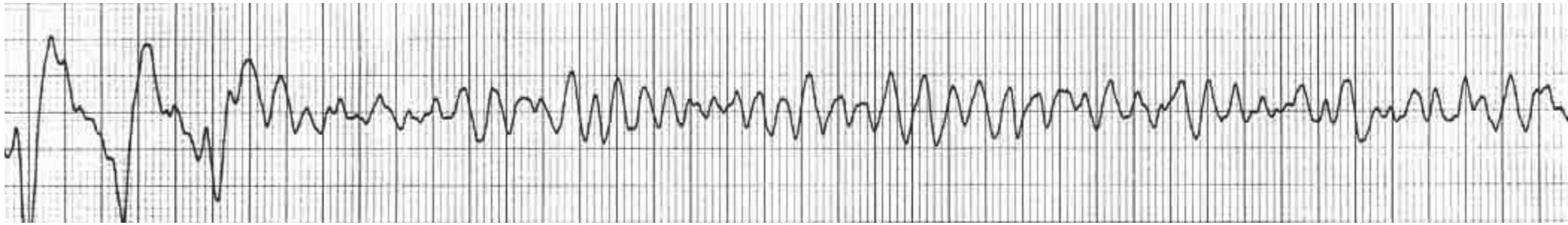
1. 心跳數：
2. QRS：
3. P波：
4. 規則性：
5. PR interval：

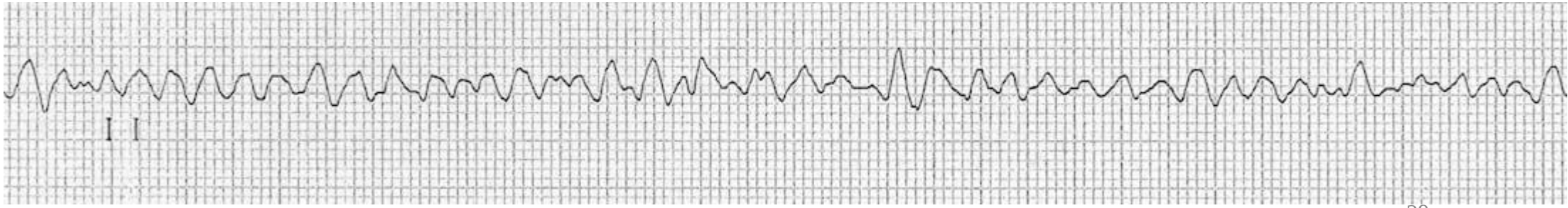
Ventricular Fibrillation



1. 心跳數 :
2. QRS :
3. P波 :
4. 規則性 :
5. PR interval :

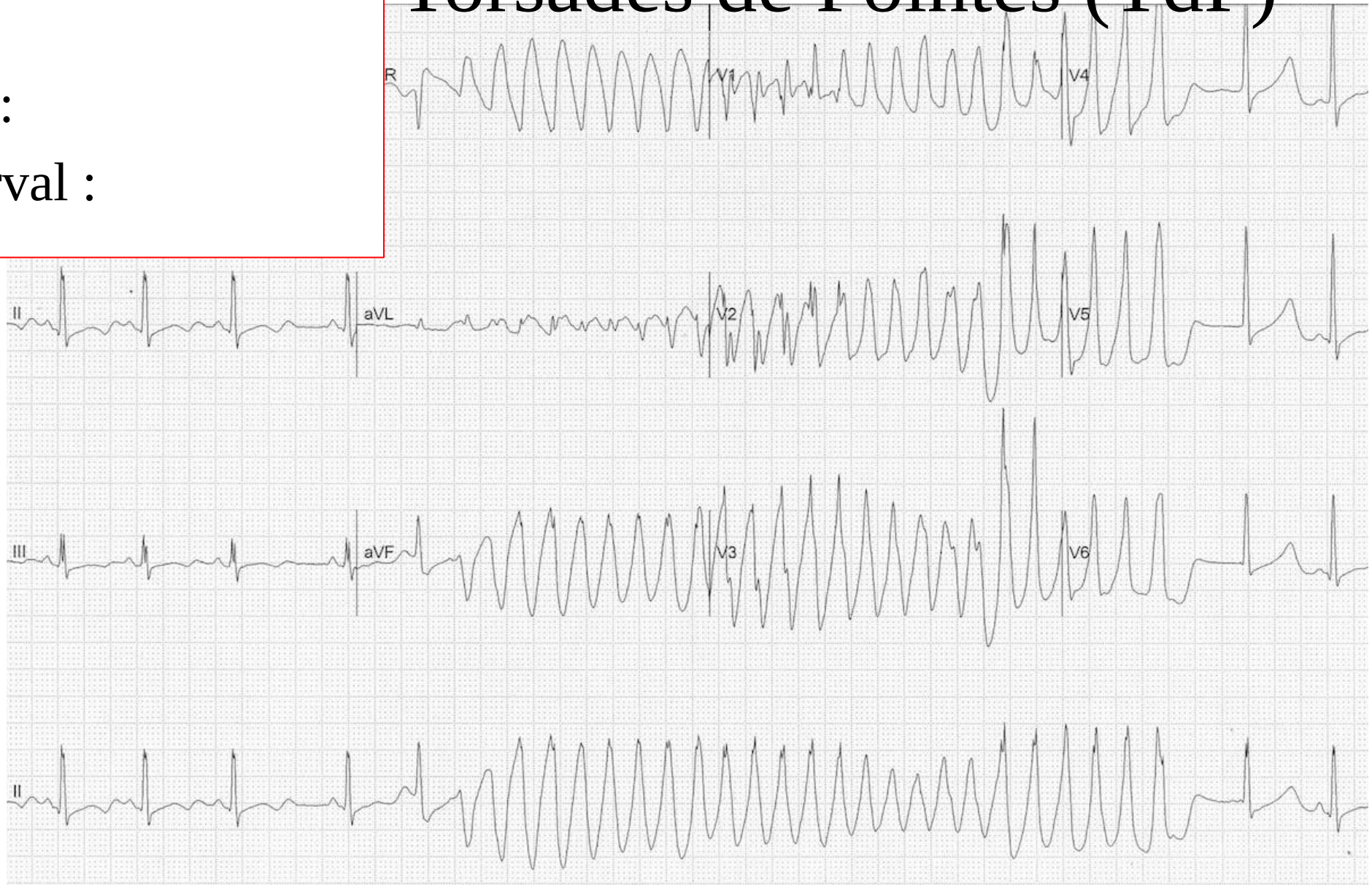
Ventricular Fibrillation





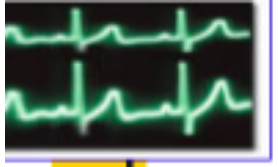
1. 心跳數：
2. QRS：
3. P波：
4. 規則性：
5. PR interval：

Polymorphic VT
Torsades de Pointes (TdP)



1. 心跳數 :
2. QRS :
3. P波 :
4. 規則性 :
5. PR interval :

Polymorphic VT
Torsades de Pointes (TdP)



Rate < 60

WIDE QRS

yes

IVR

no

bradycardia
junctional
AF,Af,

REGULAR QRS

yes

bradycardia
junctional
AF

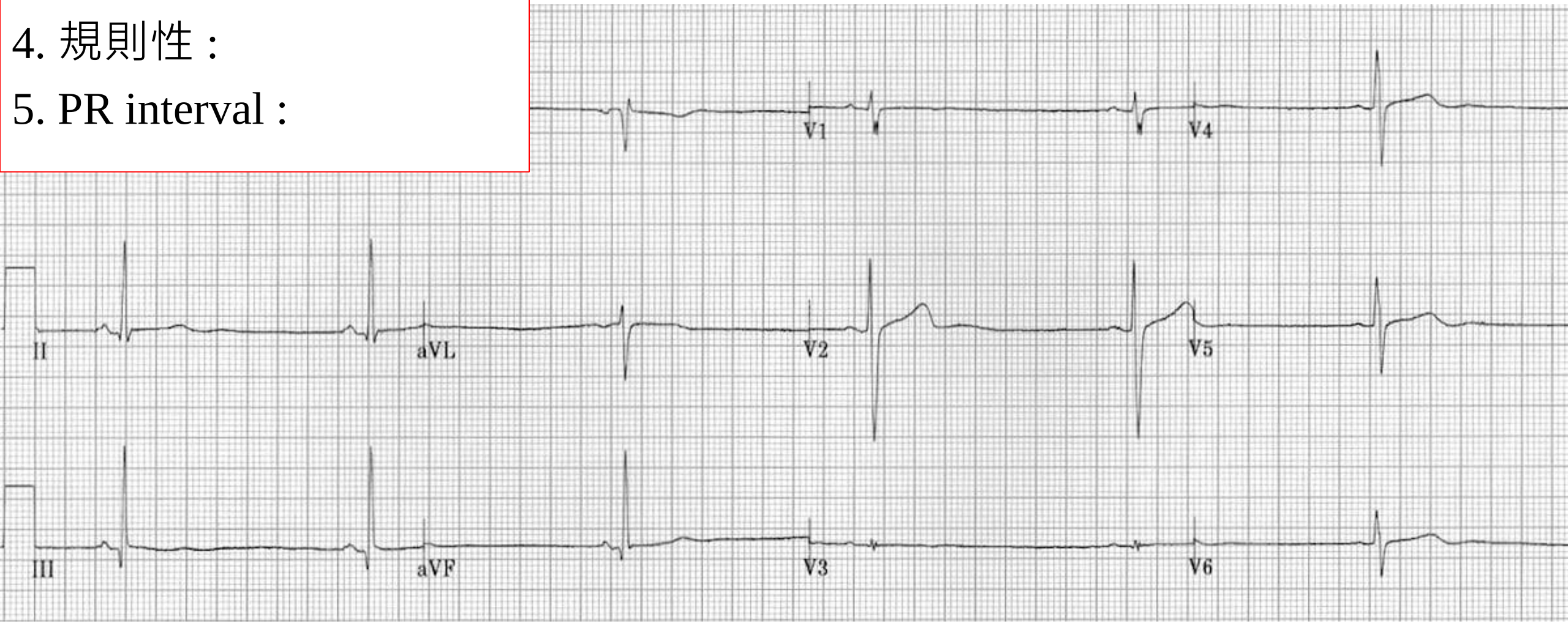
no

Af

Normal P = bradycardia
Flutter P = AF
Fibrillated baseline = Af
No P, inverted P or after QRS = junctional rhythm

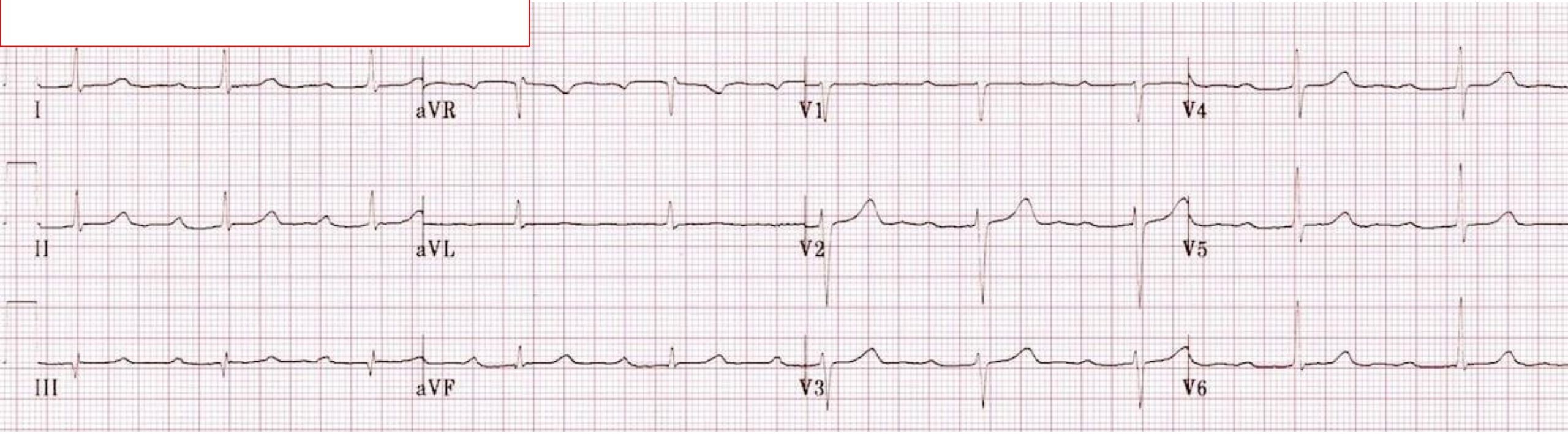
1. 心跳數 :
2. QRS :
3. P波 :
4. 規則性 :
5. PR interval :

Sinus Bradycardia



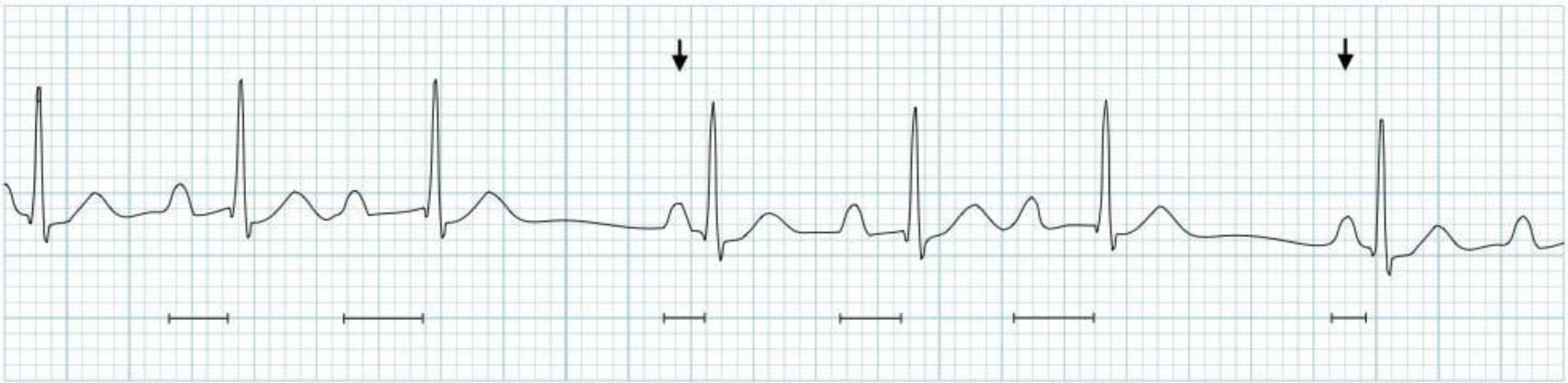
1. 心跳數 :
2. QRS :
3. P波 :
4. 規則性 :
5. PR interval :

First Degree AV Block



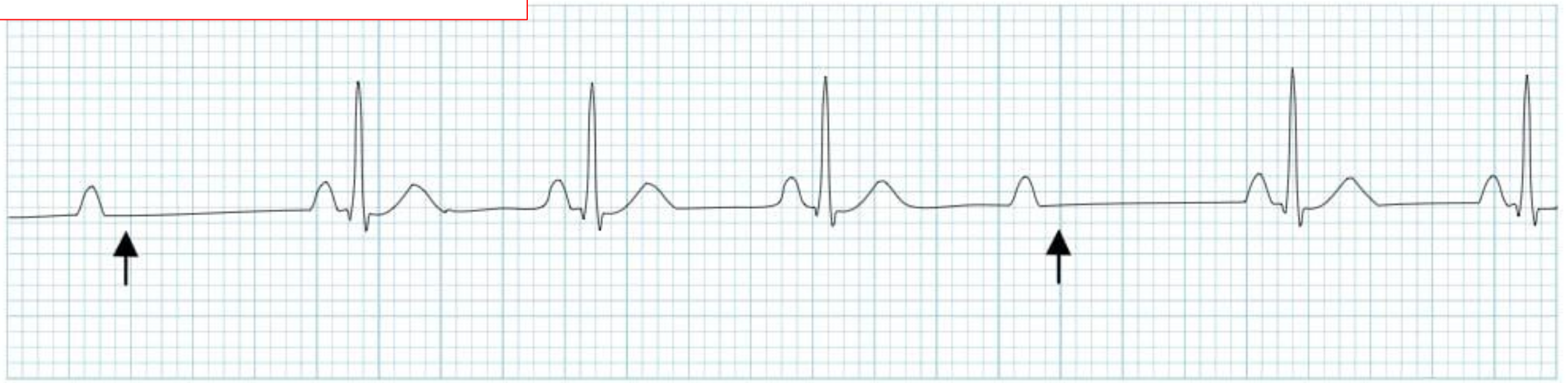
1. 心跳數 :
2. QRS :
3. P波 :
4. 規則性 :
5. PR interval :

AV Block: 2nd degree, Mobitz I



1. 心跳數 :
2. QRS :
3. P波 :
4. 規則性 :
5. PR interval :

AV Block: 2nd degree, Mobitz II

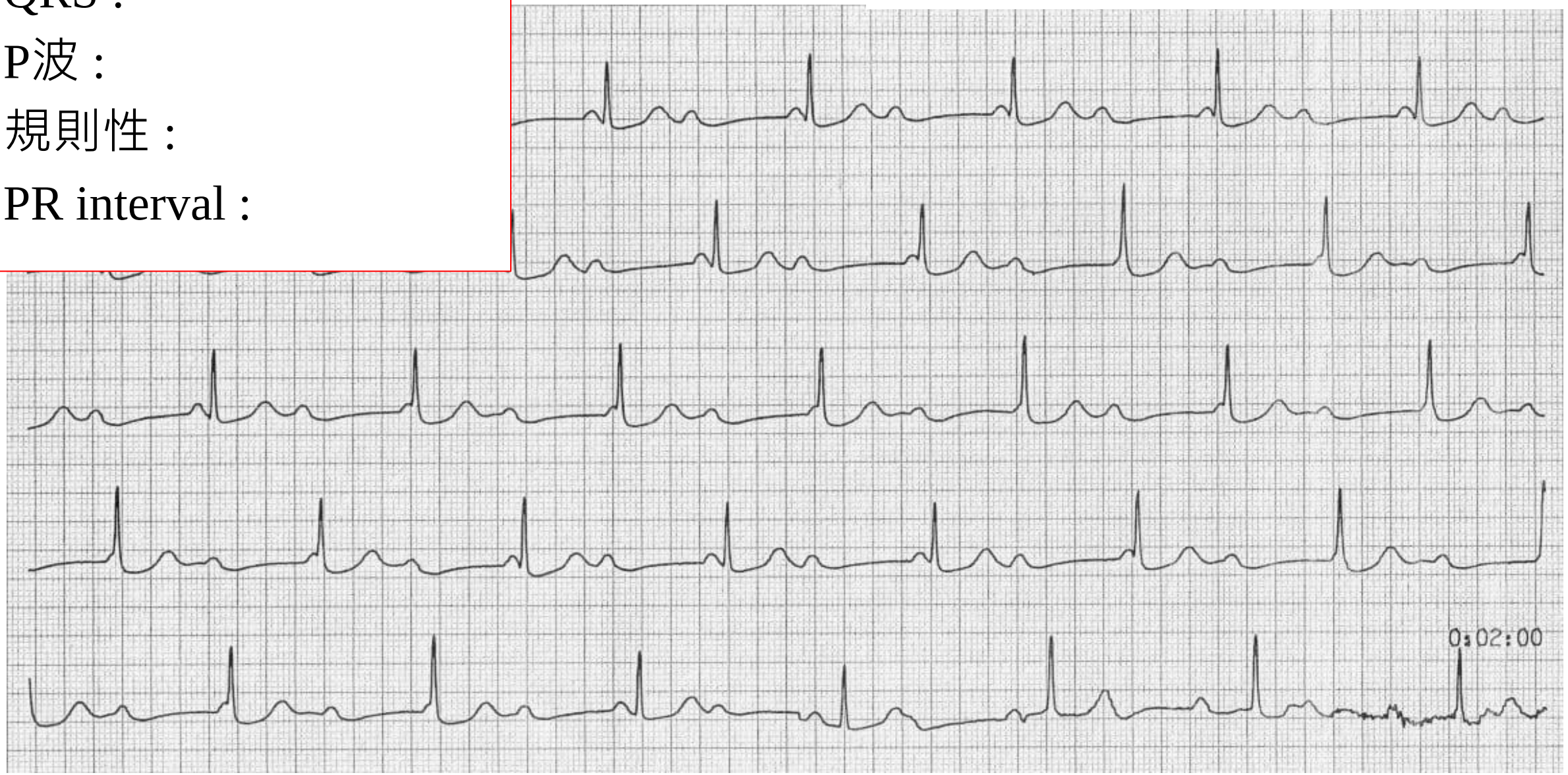


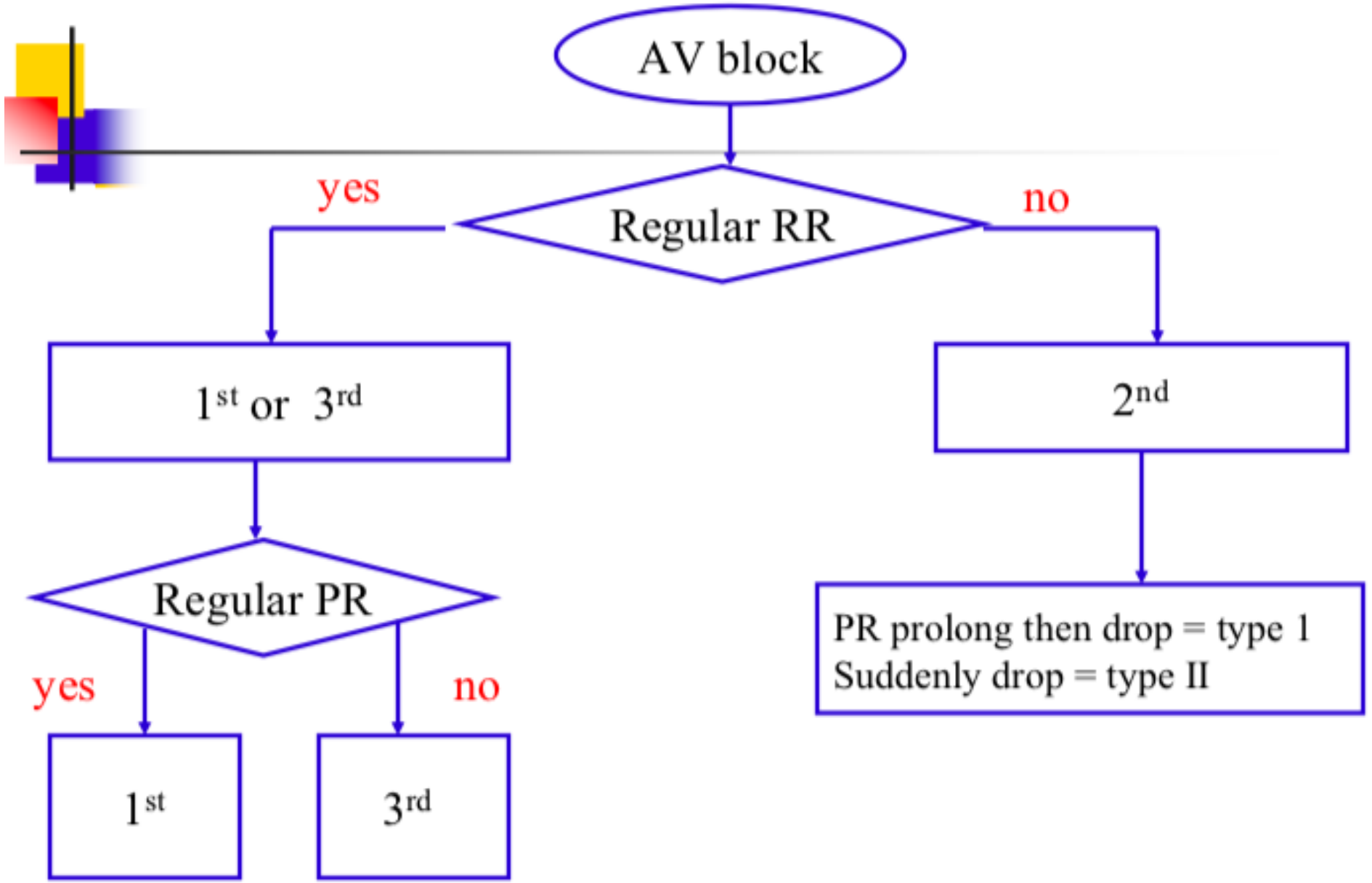
AV block: 3rd degree

1. 心跳數 :
2. QRS :
3. P波 :
4. 規則性 :
5. PR interval :

AV block: 3rd degree

1. 心跳數 :
2. QRS :
3. P波 :
4. 規則性 :
5. PR interval :




AV block
Regular RR
yes
no
1st or 3rd
2nd
Regular PR
PR prolong then drop = type 1
Suddenly drop = type II
yes
no
1st
3rd

心電圖診斷

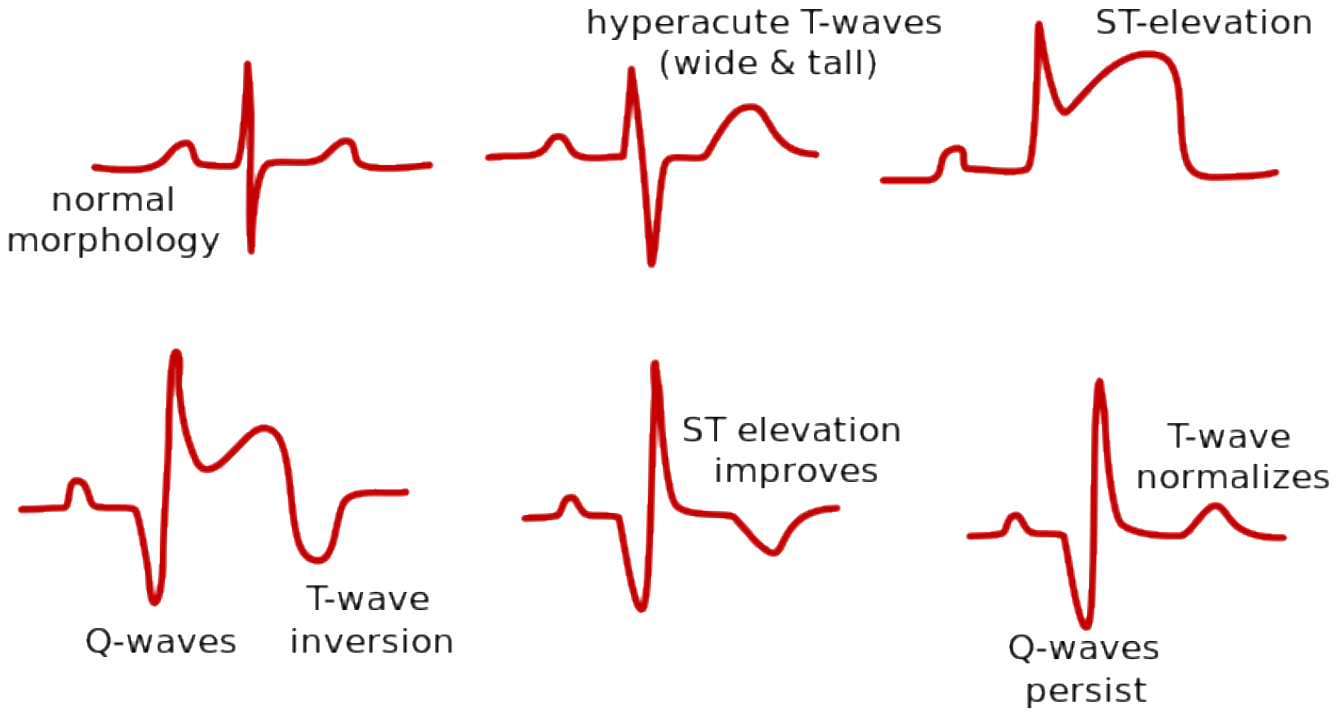
- 判讀要點:
  快慢、寬窄、 有無 P 波、規不規則、P-QRS相關性。
- 依上述五點找出心臟節律點位置後， 再加上心跳數(快或慢)即是答案!
- **Ex :** 心律名稱為 節律點出處 + 心跳數(快或慢)

Sinus Tachycardia

Ischemia/injury/infarction

MI：

- T波變高後T波倒置
- ST elevation合併鏡像反應
- 出現新的Q波



Unstable angina, NSTEMI V.S. STEMI.

急性心肌缺氧的心電圖特點 (無LVH 及LBBB之前提)

ST 上升

在 J 點有新的ST上升，出現在同組群的兩個導程上，並合乎以下條件：

(1) 所有導程：≥ 1 mm (除了V2-V3)

(2) V2-V3: ≥ 2 mV (≥40歲男性)；≥ 2.5 mV (<40歲男性)

≥ 0.15 mV (任何年齡的女性)

ST 下降及T波變化

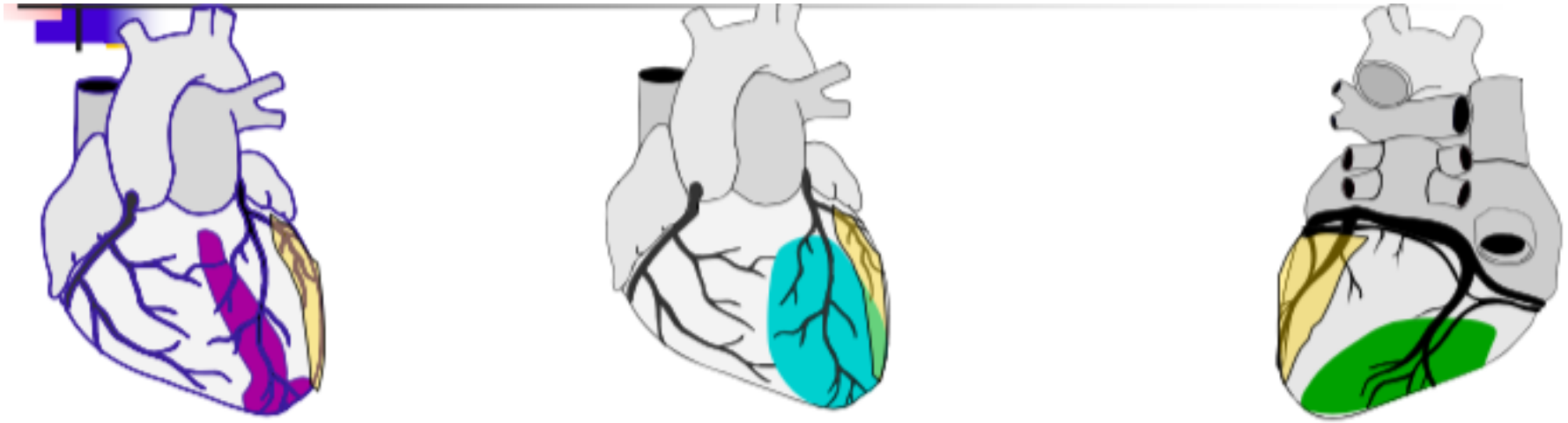
(1) 水平或往下之 ST 下降 ≥ 0.5 mm，出現在同組群兩個導程上，及/或

(2) T波倒置 ≥ 1 mm，出現在同組群兩個導程上，及突出的R波或 R/S 比 >1

European Heart Journal (2019) 40, 237–269

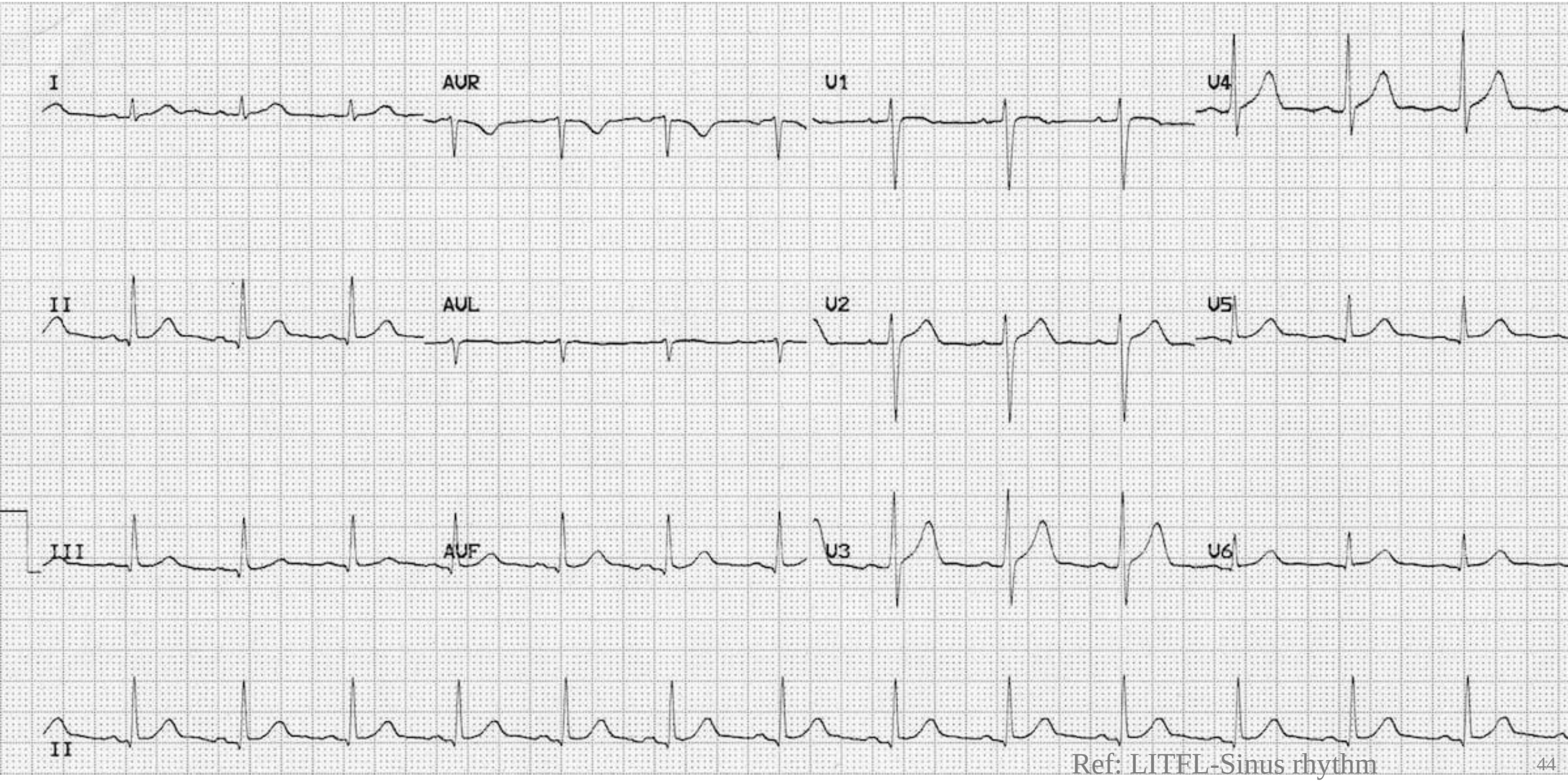
臨床筆記

Ischemia/injury/infarction

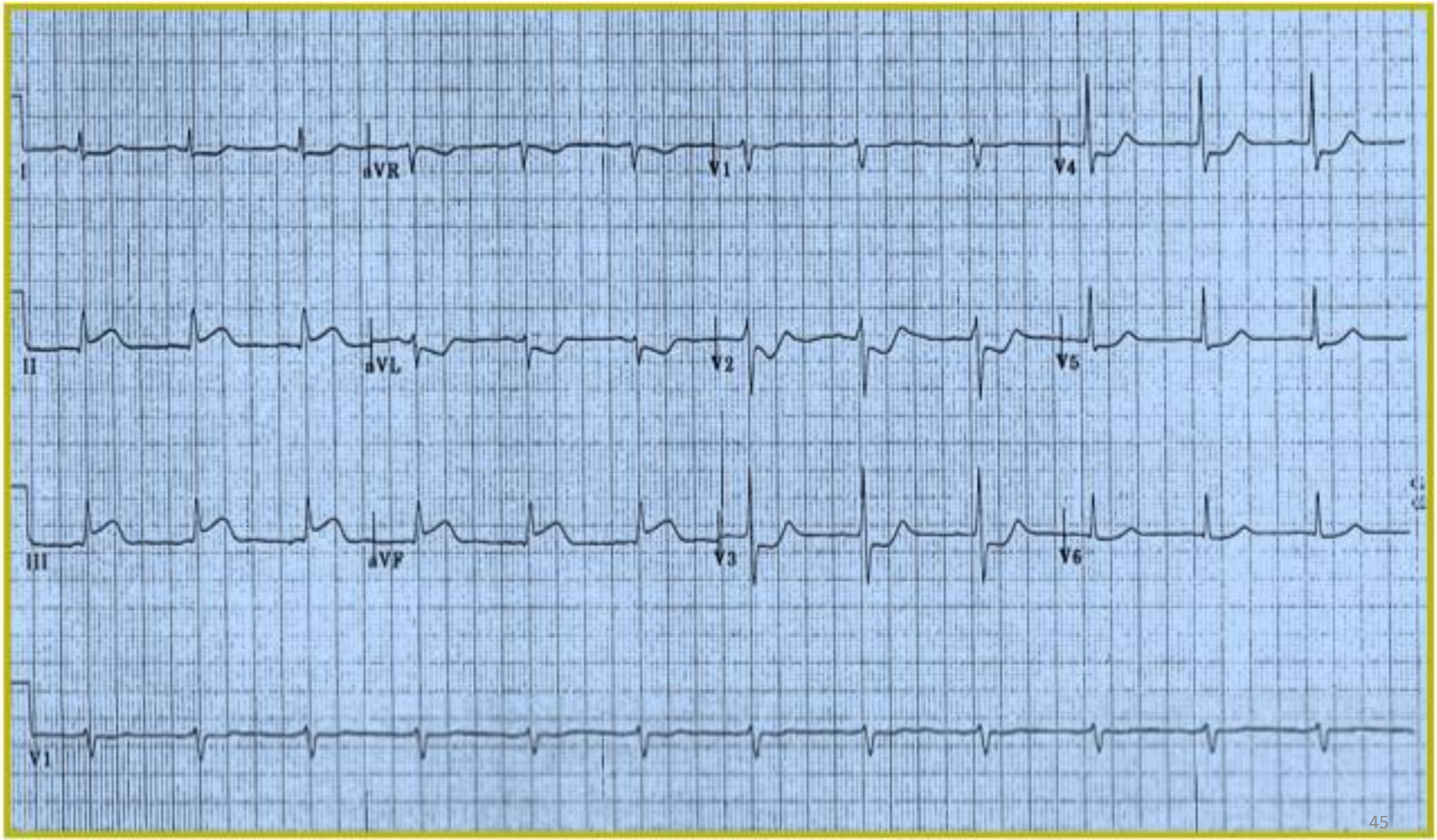


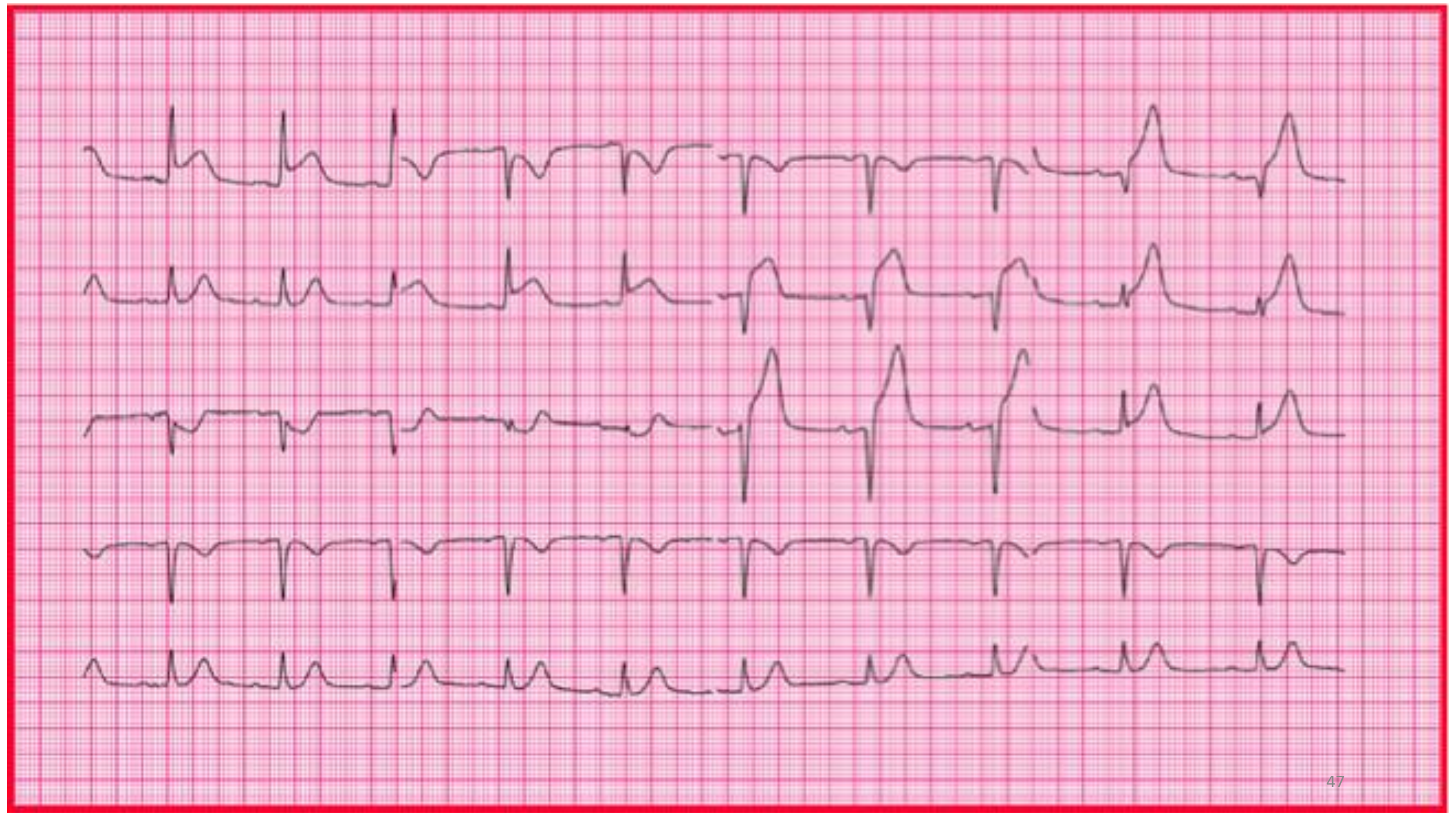
I lateral	aVR	V_1 septal	V_4 anterior
II inferior	aVL lateral	V_2 septal	V_5 lateral
III inferior	aVF inferior	V_3 anterior	V_6 lateral

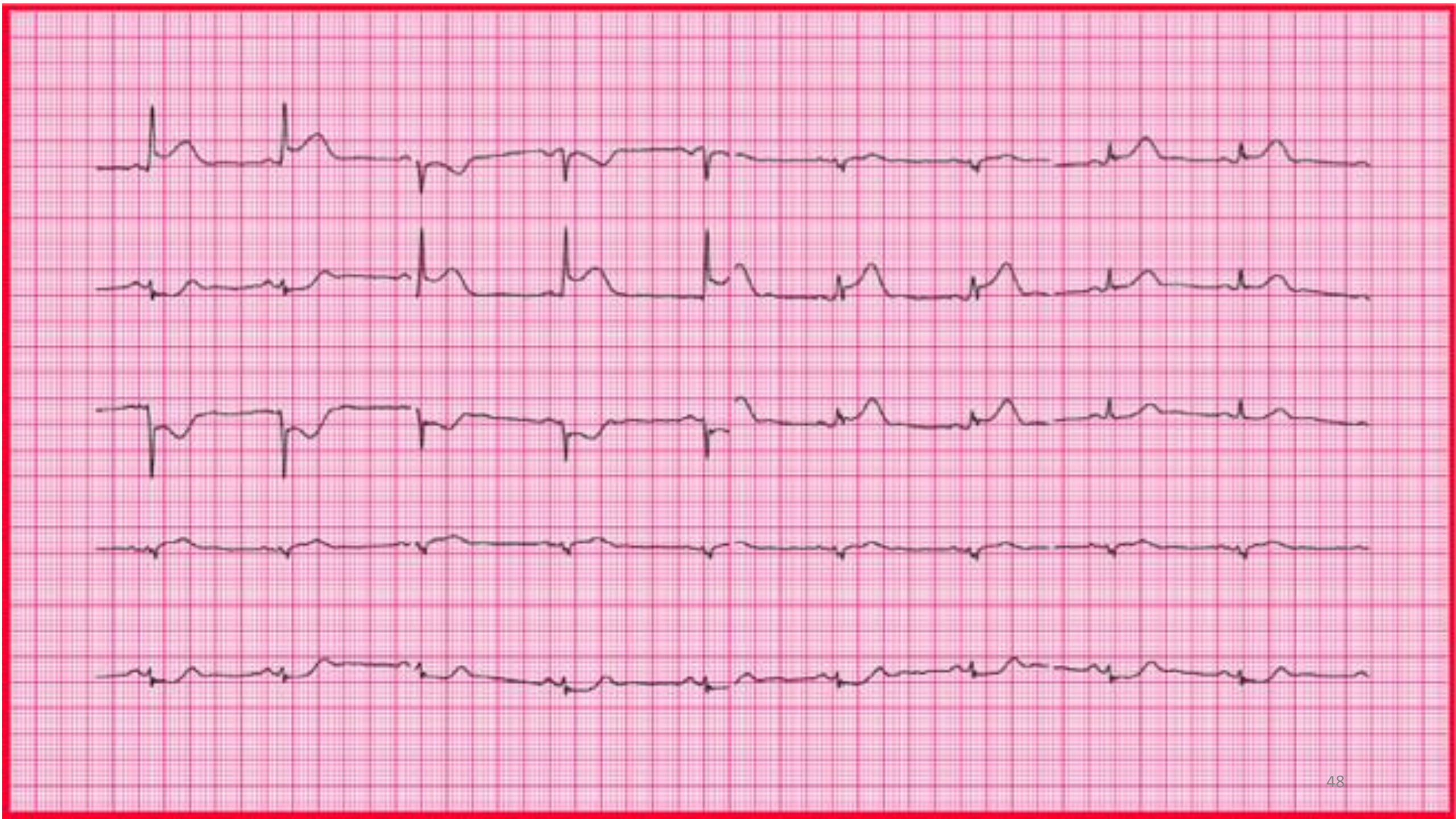
Normal Sinus Rhythm

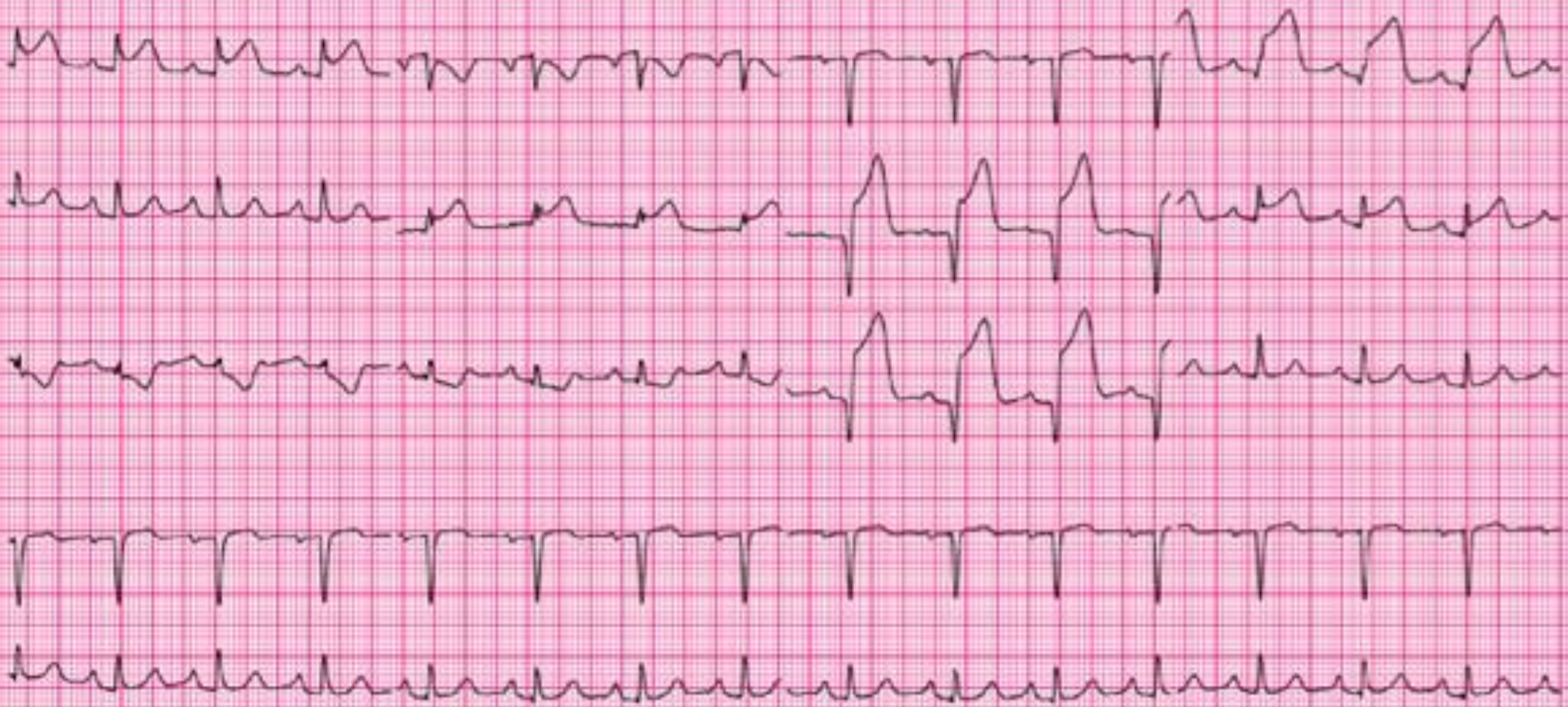


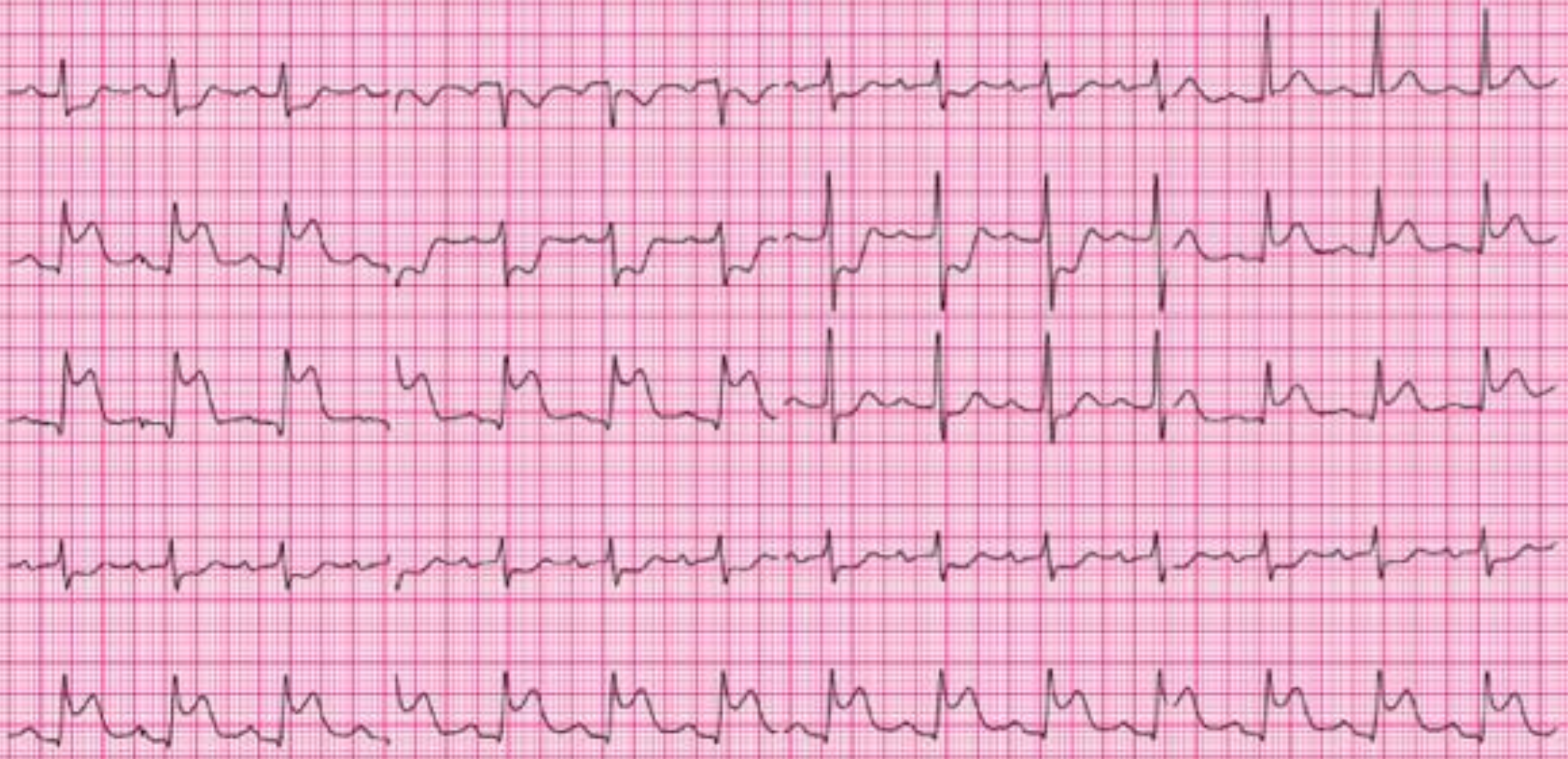
Ref: LITFL-Sinus rhythm


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1

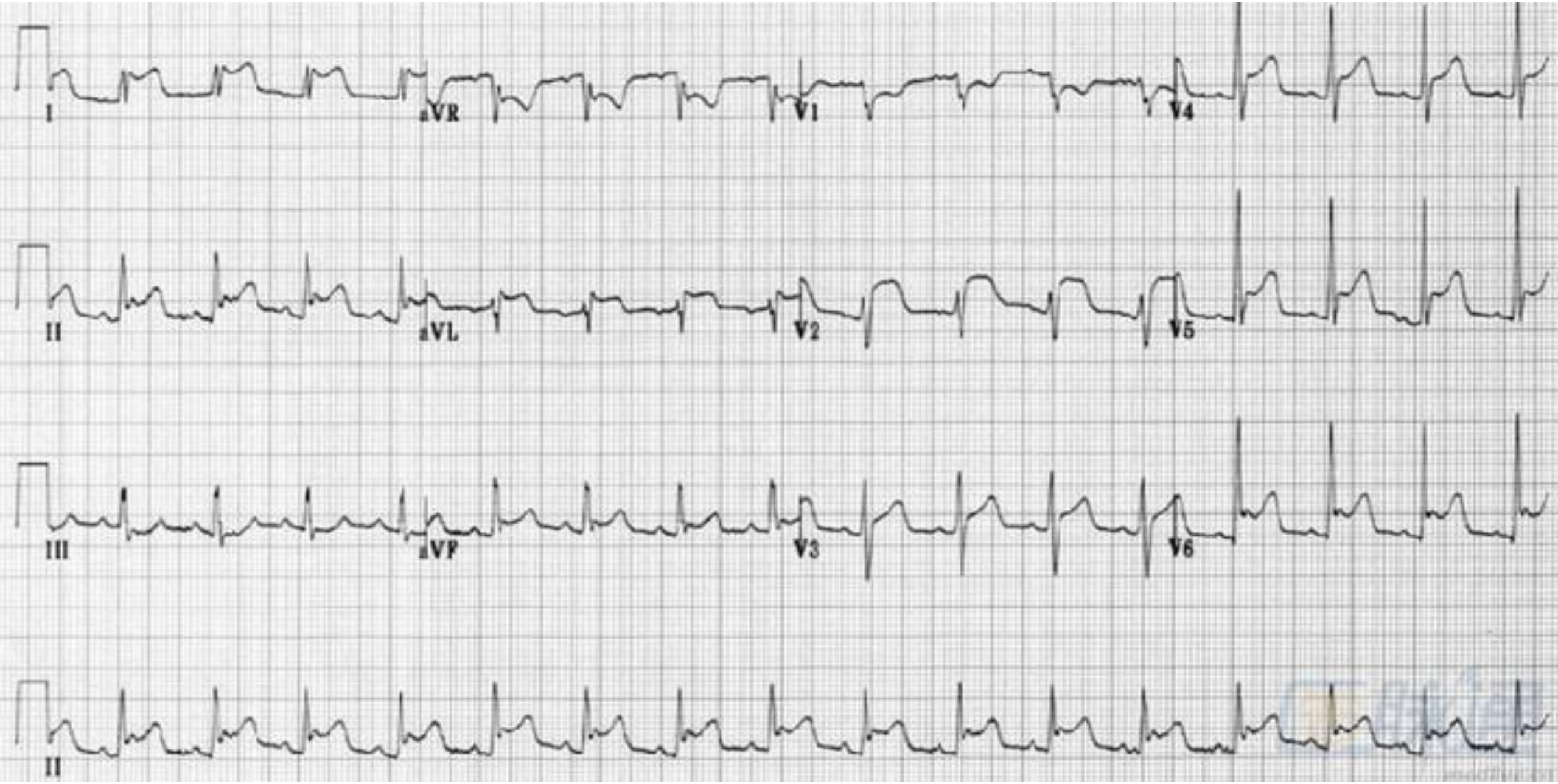


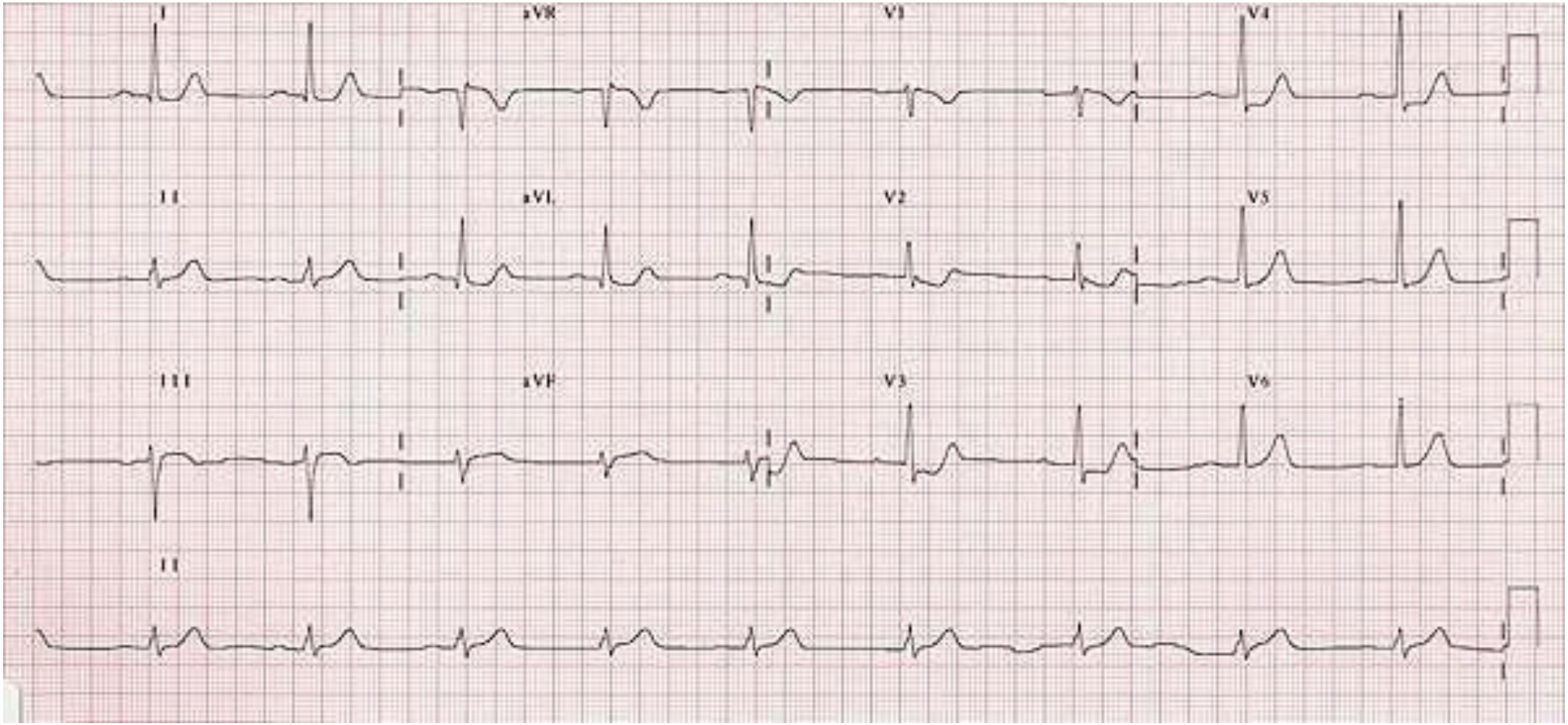


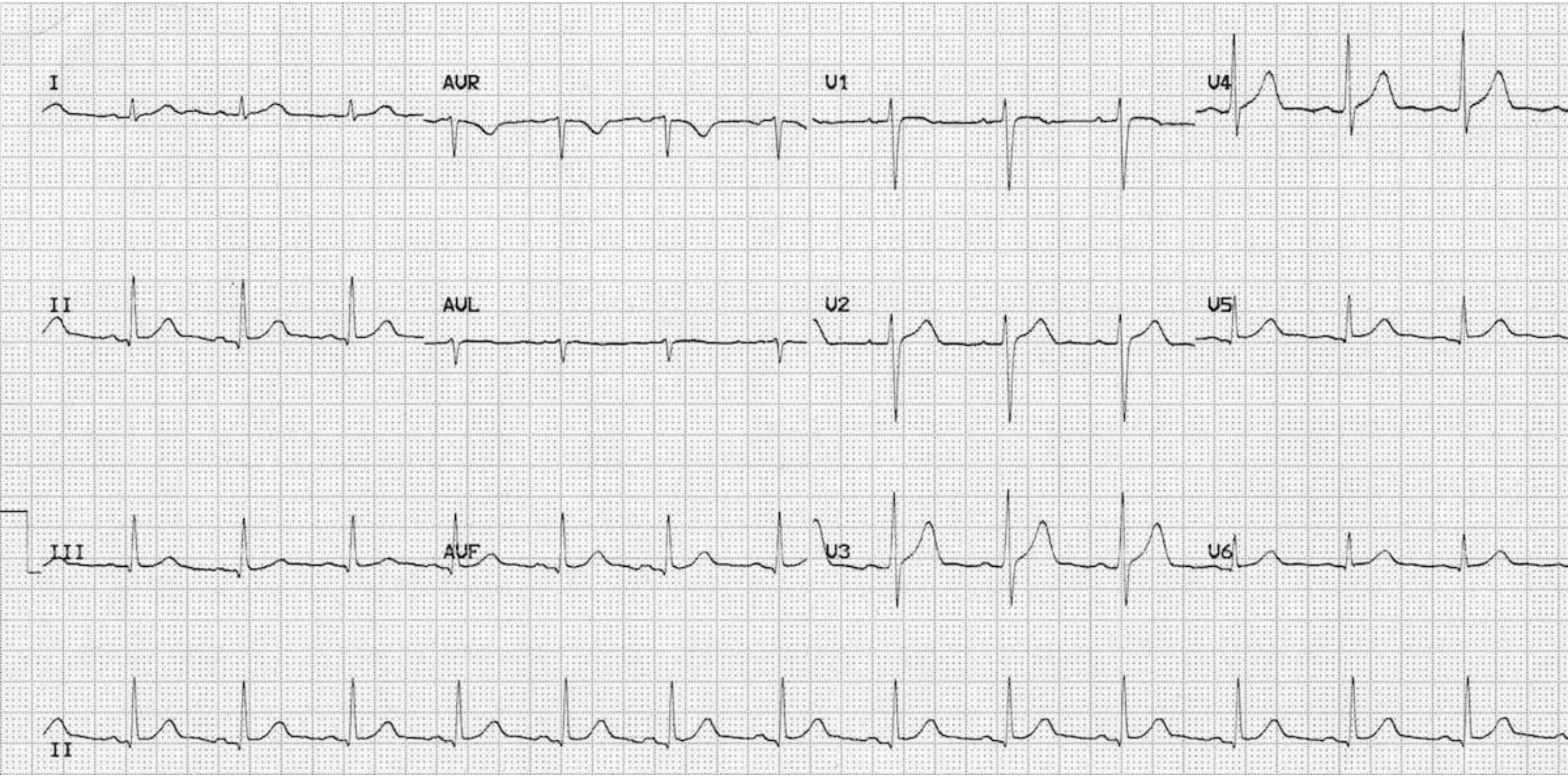





I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II


I
AUR
U1
U4
II
AUL
U2
U5
III
AUF
U3
U6
II

1. 心跳數：<60 Bradycardia；>100 Tachycardia
2. QRS：窄 From 心房；寬 From 心室
3. P波：有 Sinus
4. 規則性：P波規則？QRS規則？
5. PR interval：等距但>200mm；不規則(漸行漸遠/不告而別/各跳各的)

Sinus rhythm、Atrial fibrillation、Atrial flutter

Sinus tachycardia、PSVT、AfRVR

Sinus bradycardia、AV block 1^{st}~3^{rd} 、AfSVR

Ventricular tachycardia、Ventricular fibrillation、 Torsades de Pointes

Sinus rhythm：

60-100, 窄, P, 規則, 等距120-200mm

Atrial fibrillation：

60-100, 窄, 無P/大小P, PR不規則, RR不規則

Atrial flutter：

60-100, 窄, 多P/鋸齒狀, 不規則

Sinus tachycardia：

>100, 窄, P, 規則

PSVT：

>150, 窄, P可能藏在T, 規則

AfRVR：

>100, 窄, 無P/大小P, PR不規則, RR不規則

1. 心跳數：<60 Bradycardia；>100 Tachycardia
2. QRS：窄 From 心房；寬 From 心室
3. P波：有 Sinus
4. 規則性：P波規則？QRS規則？
5. PR interval：等距但>200mm；不規則
   (漸行漸遠/不告而別/各跳各的)

Sinus bradycardia：<60, 窄, P, 規則, 等距120-200mm

AV block 1st：　　<60, 窄, P, 規則, 等距, PR>200mm

AV block 2nd-I：<60, 窄, P, PR漸行漸遠

AV block 2nd-II：<60, 窄, P, PR大多等距, 不告而別

AV block 3rd：<60, 窄, P, PR不等距, PP等距, RR等距, 各跳各地

Af slow VR：　　<60, 窄, 無P/大小P, PR不規則, RR不規則

Ventricular tachycardia：>100, 寬, 無P, 規則

Ventricular fibrillation：>100, 寬, 無P, 像塗鴉?!!

Torsades de Pointes：　　>100, 寬, 無P, 不規則/紡錘狀

1. 心跳數：<60 Bradycardia；>100 Tachycardia
2. QRS：窄 From 心房；寬 From 心室
3. P波：有 Sinus
4. 規則性：P波規則？QRS規則？
5. PR interval：等距但>200mm；不規則
   (漸行漸遠/不告而別/各跳各的)

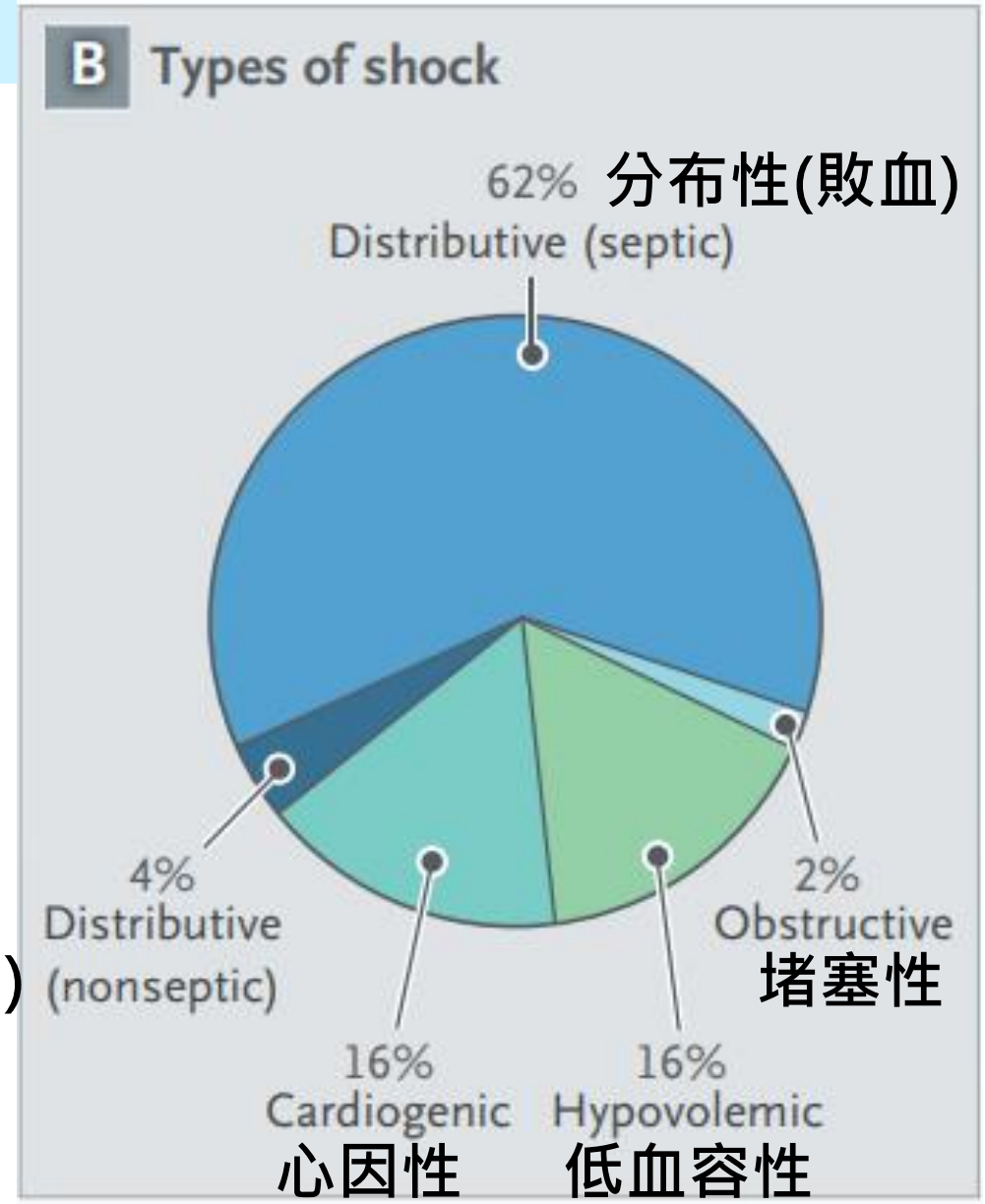
THE END

Shock

Reporter : 曾文濱

2025/05/02

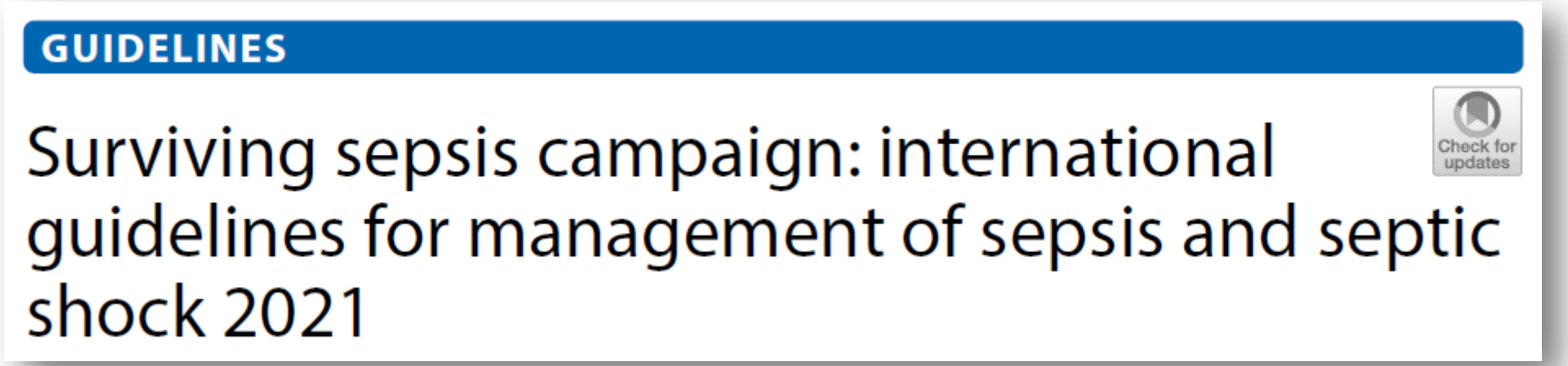
Shock



分布性
(非敗血)

Anaphylactic shock
Neurogenic shock

Ref : N Engl J Med 2013; 369:1726-1734



Septic shock

Definition of Septic shock

- Septic shock :
  - Sepsis + Cellular/Metabolic abnormalities + Circulatory

1. Sepsis
2. Serum lactate >2 mmol
3. Persisting hypotension requiring vasopressors to keep MAP≥65mmHg

- With these criteria, hospital mortality is in excess of 40%.

Screening and early treatment

Screening for sepsis and septic shock

- We recommend against using qSOFA compared to SIRS, NEWS, or MEWS as a single screening tool for sepsis or septic shock.

Against

- 補充：
  - Screen for sepsis : SIRS優於qSOFA
  - 預測Mortality : qSOFA優於SIRS
- National Early Warning Score (NEWS)
- Modified Early Warning Score (MEWS)

Box 1. SIRS (Systemic Inflammatory Response Syndrome)

Two or more of:

- Temperature >38°C or <36°C
- Heart rate >90/min
- Respiratory rate >20/min or $Paco_2$ <32 mm Hg (4.3 kPa)
- White blood cell count >12 000/mm^3 or <4000/mm^3 or >10% immature bands

From Bone et al.[9]

Box 4. qSOFA (Quick SOFA) Criteria

- Respiratory rate ≥22/min
- Altered mentation
- Systolic blood pressure ≤100 mm Hg

SOFA score 腦 心 肺 肝 腎 凝血

	Score				
System	0	1	2	3	4
Respiration					
Pao_2/Fio_2, mm Hg (kPa)	≥400 (53.3)	<400 (53.3)	<300 (40)	<200 (26.7) with respiratory support	<100 (13.3) with respiratory support
Coagulation					
Platelets, $\times 10^3/\mu L$	≥150	<150	<100	<50	<20
Liver					
Bilirubin, mg/dL (μmol/L)	<1.2 (20)	1.2-1.9 (20-32)	2.0-5.9 (33-101)	6.0-11.9 (102-204)	>12.0 (204)
Cardiovascular	MAP ≥70 mm Hg	MAP <70 mm Hg	Dopamine <5 or dobutamine (any dose)[b]	Dopamine 5.1-15 or epinephrine ≤0.1 or norepinephrine ≤0.1[b]	Dopamine >15 or epinephrine >0.1 or norepinephrine >0.1[b]
Central nervous system					
Glasgow Coma Scale score[c]	15	13-14	10-12	6-9	<6
Renal					
Creatinine, mg/dL (μmol/L)	<1.2 (110)	1.2-1.9 (110-170)	2.0-3.4 (171-299)	3.5-4.9 (300-440)	>5.0 (440)
Urine output, mL/d				<500	<200

Abbreviations: Fio_2, fraction of inspired oxygen; MAP, mean arterial pressure; Pao_2, partial pressure of oxygen.

[a] Adapted from Vincent et al.[27]

[b] Catecholamine doses are given as μg/kg/min for at least 1 hour.

[c] Glasgow Coma Scale scores range from 3-15; higher score indicates better neurological function.

Initial screen and resuscitation

- Sepsis and septic shock患者，建議立刻給予治療與輸液 Best
- 疑似Sepsis患者，建議檢驗 Blood Lactate。 Weak
- 建議輸液過程追蹤Lactate是否下降，同時也應評估其他會讓Lactate生高的可能性 Weak
- 可使用Capillary refill time來評估Perfusion是否不足 Weak
- 建議最初3小時內給予至少 30 mL/kg 的晶體溶液。 Weak
- 建議將血壓目標設定為平均動脈壓(MAP)≥65mmHg。 Strong

Infection

Initial screen and resuscitation

- 針對高度懷疑或確定Septic shock之患者，建議及早給予抗生素，最理想於1小時內給予。 Strong
- 針對疑似為Sepsis沒有休克之患者，建議快速評估感染與非感染之可能，呈建議3小時內完成 Weak
- 針對感染可能性低之患者，延遲抗生素使用並監測患者病情變化 Weak
- 建議6小時內使患者收入ICU。 Weak

Time of antibiotics

- 高度懷疑或確定Septic shock → 1小時內給予抗生素
- 疑似Sepsis沒有休克 → 3小時內給予抗生素
- 感染可能性低沒有休克 → 延遲抗生素、監測病情

Antibiotic Timing

	Shock is present	Shock is absent
Sepsis is definite or probable	Administer antimicrobials **immediately**, ideally within 1 hour of recognition	
Sepsis is possible	Administer antimicrobials **immediately**, ideally within 1 hour of recognition	Rapid assessment* of infectious vs noninfectious causes of acute illness Administer antimicrobials **within 3 hours** if concern for infection persists

*Rapid assessment includes history and clinical examination, tests for both infectious and non-infectious causes of acute illness and immediate treatment for acute conditions that can mimic sepsis. Whenever possible this should be completed within 3 hours of presentation so that a decision can be made as to the likelihood of an infectious cause of the patient's presentation and timely antimicrobial therapy provided if the likelihood is thought to be high.

Antimicrobial choice

- 針對有高度MRSA感染風險之Sepsis or septic shock患者， 建議經驗性抗生素需涵蓋MRSA。 Best

- 針對有低度MRSA感染風險之Sepsis or septic shock患者， 不建議經驗性抗生素涵蓋MRSA。 Weak

Antimicrobial choice

- 針對有高度MDR organisms感染風險之Sepsis or septic shock患者，建議合併使用兩種涵蓋Gram-Negative菌種之經驗性抗生素。

Weak

- 針對有低度MDR organisms感染風險之Sepsis or septic shock患者，不建議合併使用兩種涵蓋Gram-Negative菌種之經驗性抗生素。

Weak

Antimicrobial choice

- 針對有Sepsis or septic shock患者，一旦確定感染源或菌種，不建議持續合併使用兩種涵蓋Gram-Negative菌種之經驗性抗生素。

Weak

Antifungal therapy & Antiviral therapy

- 針對有高度黴菌感染風險之Sepsis or septic shock患者，建議使用經驗性抗黴菌藥物。 Weak
- 針對有低度黴菌感染風險之Sepsis or septic shock患者，不建議使用經驗性抗黴菌藥物。 Weak
- 對於抗病毒藥物，無任何支持或反對的建議。

Risk factors for Candida sepsis

Candida colonisation at multiple sites [177–179]
Surrogate markers such as Serum Beta-D-Glucan assay [177]
Neutropenia [180, 181]
Immunosuppression [173, 180, 181]
Severity of illness (High APACHE score) [182, 183]
Longer ICU length of stay [183]
Central venous catheters and other intravascular devices [168, 180, 181, 184]
Persons who inject drugs [185]
Total parenteral nutrition [186]
Broad spectrum antibiotics [178, 187]
Gastrointestinal tract perforations and anastomotic leaks [186, 188–190]
Emergency gastrointestinal or hepatobiliary surgery [190]
Acute renal failure and haemodialysis [186, 188]
Severe thermal injury [191–193]
Prior surgery [186]

Risk factors for endemic yeast (cryptococcus, histoplasma, blastomyces, coccidioidomycosis)

Antigen markers such as cryptococcal, histoplasma or blastomyces assays [194–196]
HIV infection [197–200]
Solid organ transplantation [199, 201–203]
High dose corticosteroid therapy [199]
Haematopoietic stem cell transplantation [204]
Certain biologic response modifiers [205, 206]
Diabetes mellitus [207]

Risk factor for invasive mold infection

Neutropenia [204, 208]
Surrogate markers such as Serum or Bronchoalveolar Lavage Galactomannan Assay [209–211]
Haematopoietic stem cell transplantation [204, 208, 212]
Solid organ transplantation [202, 212–214]
High dose corticosteroid therapy [215, 216]
Certain biologic response modifiers [206, 217, 218]

Recommendation for Infection

- 針對Sepsis or septic shock患者，建議快速找出需要緊急手術/介入治療之感染源，或者快速排除上述之可能性。 Best
  - Ex: Liver abscess, empyema, necrotizing fasciitis
- 針對Sepsis or septic shock患者，建議適時地移除可能是感染源之IV管路，在建立其他IV管路之後。 Best

Recommendation for Infection

- 針對Sepsis or septic shock患者，比起不評估、直接使用固定天數抗生素，更建議每天評估是否降階抗生素。 Weak

- 針對Sepsis or septic shock患者使用Beta-lactams類抗生素時，比起傳統Bolus滴注，更建議在起始Bolus劑量後，使用延長滴注甚至連續滴注。 Weak
  - 補充：延長滴注(≥ 給藥間隔時間的一半)或連續滴注，可使Beta-lactams持續維持足夠濃度。

Haemodynamic management

Fluid management

- 針對Sepsis or septic shock患者，建議使用晶體溶液 Crystalloids 作為第一線輸液溶液。 Strong

- 針對Sepsis or septic shock患者，比起生理食鹽水，更建議使用平衡晶體溶液Balanced Crystalloids (Lactate Ringer) Weak

- 針對Sepsis or septic shock患者，比起單用大量晶體溶液 Crystalloids ，更建議加上白蛋白Albumin。 Weak

Fluid management

- 針對Sepsis or septic shock患者，不建議使用 Starches 類溶液 作為輸液選擇。

Strong

- Ex: VOLUVEN

- 針對Sepsis or septic shock患者，不建議使用 gelatin 作為輸液選擇。

Weak

Vasoactive agents

- 針對Septic shock患者，比起其他血管升壓藥 Vasopressors，我們更建議使用Norepinephrine 作為第一線血管升壓藥。

Strong

  - 其他：Dopamine. Vasopressin. Epinephrine. Selepressin. Angiotensin II.

Vasoactive agents

- 針對使用Norepinephrine 仍無法維持MAP≥ 65mmHg之患者，比起將Norepinephrine往上調超過範圍，更建議再加上 Vasopressin 作為第二線血管升壓藥。(本院沒有此藥)

Weak

- Norepinephrine range : 0.25–0.5 μg/kg/min
- Ex : 患者64Kg 目標0.5μg/kg/min →

Vasoactive agents

- 針對已經使用 Norepinephrine 以及 Vasopressin 仍無法維持MAP≥ 65mmHg之患者，建議再加上 Epinephrine 作為第三線血管升壓藥。

Weak

Inotropes

- 針對Septic shock合併Cardiac dysfunction 之患者，在給予適當水份仍無法維持血壓者，建議： Weak
  - 併用 Dobutamine及Norepinephrine
  - 或者Epinephrine alone
  - 針對Septic shock或者Cardiogenic shock **單用**Dobutamine **皆無益**

Monitoring and intravenous access

- 針對Septic shock患者，比起單純用PE、Vital signs(NIBP)，更建議使用 Invasive monitoring of ABP 以及Dynamic measures 來評估輸液治療 Weak

- Dynamic measure : Response to a passive leg raise or a fluid bolus, using stroke volume (SV), stroke volume variation (SVV), pulse pressure variation (PPV), or echocardiography.

- FloTrac (左)
- LiDCO (右)

Monitoring and intravenous access

- 針對Septic shock患者，比起因為沒有中央靜脈導管而延誤使用血管升壓藥之時機，更建議直接從周邊靜脈給予血管升壓藥，以維持MAP≥65mmHg。 Weak

- 補充：僅限於「短時間」且建議肘前窩或更近端的血管。

Additional Therapy

Additional Therapy

- 針對Sepsis合併中重度 ARDS患者，建議間歇式使用Boluses 神經肌肉阻斷劑 ，而**非**持續性使用Continuous infusion。 Weak
- Septic shock且持續進展、需要血管升壓藥者，建議使用 IV Hydrocortisone 200mg/day (50 mg Q6H或Continuous infusion) Weak
  - 升壓劑使用4小時，且劑量≥0.25 mcg/kg/min時，才使用Hydrocortisone。
- 針對有高度風險腸胃道出血之Sepsis or septic shock患者，建議使用 PPI預防Stress ulcer Weak

Red blood cell transfusion targets

- 針對Sepsis or septic shock患者，建議嚴格的輸血策略(Hb>7mg/dL)

  Strong

  - 輸血與否應綜合評估而非單純看Hb數值，如有無AMI、嚴重低血氧、急性出血等等。

IVIG

- 針對Sepsis or septic shock患者，不建議常規使用Intravenous immunoglobulins

Weak

- 搜尋 2 new RCTs + 3 meta-analyses
  - Meta-analyses 顯示IVIG可以降低mortality
  - High risks of bias！需要更多multi-center, RCT！
  - Expensive, not cost-effective !
- 避免常規使用IVIG

Venous thromboembolism prophylaxis

- For adults with sepsis or septic shock, we recommend using pharmacologic VTE prophylaxis unless a contraindication to such therapy exists — Strong
- For adults with sepsis or septic shock, we recommend using LMWH over unfractionated heparin (UFH) for VTE prophylaxis. — Strong
- For adults with sepsis or septic shock, we suggest against using mechanical VTE prophylaxis in addition to pharmacological prophylaxis, over pharmacologic prophylaxis alone — Weak

想想NOAC告訴我們什麼：

東方人易出血、西方人怕栓塞。

Glucose control

- 針對Sepsis or septic shock之患者，建議起初血糖控制在≥ 180 mg/dL
- 後續血糖策略則建議控制在144–180 mg/dL

Strong

Bicarbonate therapy

- 針對Septic shock合併 Lactic acidemia之患者，不建議為了維持血壓穩定或下調血管升壓藥，而常規使用Sodium bicarbonate

  Weak

- 嚴重代謝性酸血症 (pH ≤ 7.2)合併AKI之患者，建議使用 Sodium bicarbonate therapy.

  Weak

- 針對Sepsis or septic shock之患者，若可以使用腸胃道營養，則建議及早(within 72Hr)建立腸胃道營養，而非依賴靜脈營養。

  Weak

Take Home Message

- Sepsis and septic shock建議立刻給予治療與輸液，最初3小時內給予至少 30 mL/kg 的晶體溶液。
- 比起單純用PE及Vital signs，更建議使用 Dynamic measures 來評估輸液治療。
- 建議將血壓目標設定為平均動脈壓(MAP)≥65mg。
- 建議及早給予抗生素，最理想於1小時內給予。快速找出需要緊急手術/介入治療之感染源。每天評估是否降階抗生素。
- 建議使用晶體溶液Crystalloids 作為第一線輸液溶液，平衡晶體溶液更好。
- 用上大量晶體溶液Crystalloids患者，建議加上白蛋白Albumin。

Take Home Message

- 建議使用Norepinephrine (0.25–0.5 μg/kg/min)作為第一線血管升壓藥。
- 建議再加上 Vasopressin 作為第二線血管升壓藥。(本院沒有此藥)
- 建議再加上 Epinephrine 作為第三線血管升壓藥。
- Septic shock合併Cardiac dysfunction，建議併用Dobutamine及Norepinephrine，或者Epinephrine alone。
- 建議直接從周邊靜脈短期給予血管升壓藥，勿因為沒有中央靜脈管路而延誤使用血管升壓藥之時機。
- 針對Septic shock且持續進展、需要血管升壓藥之患者，建議使用IV Hydrocortisone 200mg/day 。

Hypovolemic shock

Etiology of Hypovolemic Shock

- Hemorrhagic

Gastrointestinal losses

(eg, diarrhea, vomiting, external drainage)

Skin losses

(eg, heat stroke, burns, severe dermatologic conditions)

- Nonhemorrhagic

Renal losses

(eg, excessive drug-induced or osmotic diuresis, salt-wasting nephropathies, hypoaldosteronism)

Third space losses

(eg, postoperative and trauma, intestinal obstruction, crush injury, pancreatitis, cirrhosis)

Table 2. Classification of Hemorrhagic Shock.*

Shock Class	Blood Loss†	Heart Rate	Blood Pressure	Pulse Pressure	Respiratory Rate	Mental Status
	ml (%)	*beats/min*			*breaths/min*	
I	<750 (15)	<100	Normal	Normal	14–20	Slightly anxious
II	750–1500 (15–30)	100–120	Normal	Narrowed	20–30	Mildly anxious
III	1500–2000 (30–40)	120–140	Decreased	Narrowed	30–40	Anxious, confused
IV	>2000 (>40)	>140	Decreased	Narrowed	>35	Confused, lethargic

* Data are from the American College of Surgeons Committee on Trauma.[42]
† Blood-loss volume and percentage of total blood volume are for a male patient with a body weight of 70 kg.

Principles of management

- Identify and treat the etiology
- Identify electrolyte and acid-base disturbances
- Replacement fluids
  - Crystalloid solutions
  - Colloid-containing solutions
  - Blood products (1:1:1) for hemorrhagic shock

To avoid

- Hyperoncotic starch solutions not recommended
- Vasopressors (eg, norepinephrine) should not be administered
  - Not correct the primary problem
  - Absence of adequate resuscitation
  - Reduce tissue perfusion
- If Refractory shock, vasopressors may be administered

Cardiogenic shock

Etiology of Cardiogenic shock - Cardiomyopathic

- Myocardial infarction (involving >40% of the LV or with extensive ischemia)
- Severe RV infarction
- Acute exacerbation of severe heart failure
- Stunned myocardium from prolonged ischemia
  (eg, cardiac arrest, hypotension, cardiopulmonary bypass)
- Stress-induced cardiomyopathy (eg, Takesubo cardiomyopathy)
- Myocarditis
- Myocardial contusion
- Drug-induced (eg, beta blockers)

Etiology of Cardiogenic shock – Mechanical & Arrhythmogenic

- Tachyarrhythmia: Af, AF, reentrant tachycardia, VT, Vf
- Bradyarrhythmia: Complete AV block, Mobitz type II

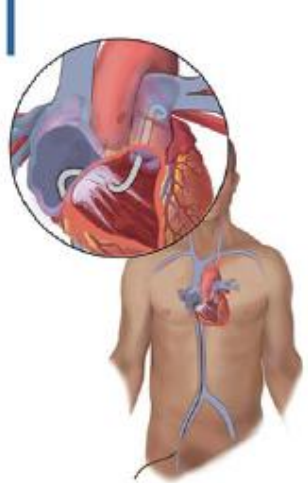
- Acute valvular rupture
  (papillary or chordae tendineae rupture, valvular abscess)
- Critical valvular stenosis
- Acute or severe ventricular septal wall defect
- Ruptured ventricular wall aneurysm
- Atrial myxoma

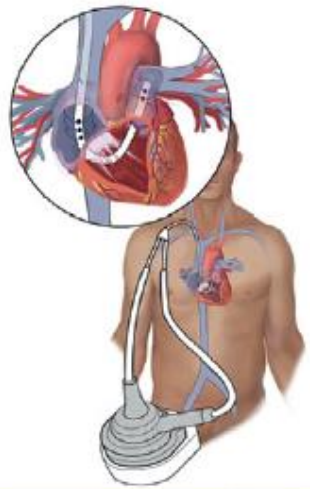
Management

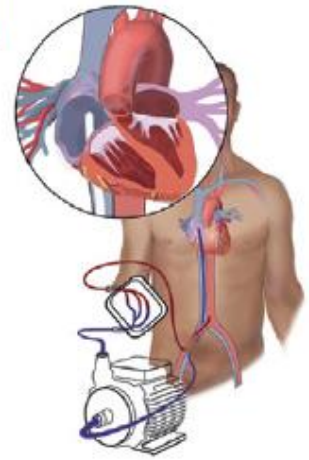
- Consult CV & CVS doctor
- First Line : Norepinephrine pump
- Temporary mechanical circulatory support

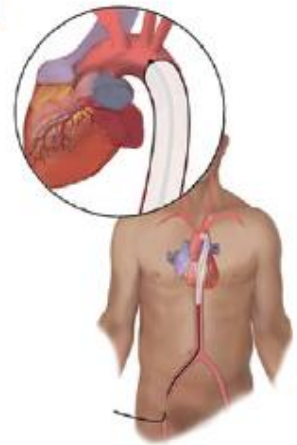
Right ventricular support

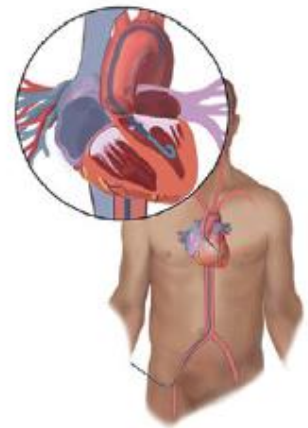
Left ventricular support

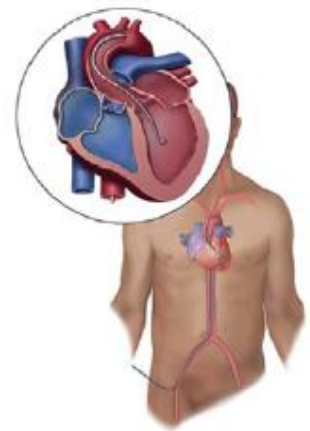












	Impella RP Flex	RA-PA pVAD	VA-ECMO	IABP	Impella CP	Impella 5.5
Max flow	3.0 - 4.0 L/min	4.0 - 5.0 L/min	5.0 - 7.0 L/min	0.5 - 1.0 L/min	3.0 - 4.3 L/min	5.0 - 6.0 L/min
Max pump speed	33,000 rpm	7,500 rpm	6,000 rpm	NA	46,000 rpm	33,000 rpm
Mechanism	Axial flow continuous pump (RA-to-PA)	Centrifugal flow continuous pump (RA-to-PA)	Centrifugal flow continuous pump (RA-to-AO)	Balloon inflation-deflation (AO)	Axial flow continuous pump (LV-to-AO)	Axial flow continuous pump (LV-to-AO)
Sheath size	23 F venous peel-away	29 or 31 F venous (inflow)	15-24 F arterial 19-25 F venous	7-8 F arterial	14 F arterial peel-away	23 F arterial peel-away
Typical insertion/ placement	Internal jugular vein	Internal jugular vein	Femoral vein (drain) Femoral artery (return)	Femoral artery or Axillary artery	Femoral artery or Axillary artery	Axillary artery
Direct LV unloading	-	-	-	-	+++	+++
Direct RV unloading	+	+	+	-	-	-
Afterload	-	-	↑↑↑	↓↓	↓	↓
Coronary perfusion	-	-	↑↑	↑↑	↑↑	↑↑

Obstructive shock

Etiology

- Tension pneumothorax
- Pulmonary embolism
- Severe pulmonary hypertension
- High-PEEP ventilation
- Vena cava compression syndrome
- Aortic dissection
- Abdominal compartment syndrome
- Aorto-caval compression

- Aortic stenosis
- Cardiac tamponade
- Constrictive pericarditis
- Hypertrophic cardiomyopathy

Neurogenic shock

- Interruption of autonomic pathways
- Vascular resistance ↓
- Altered vagal tone

→ Bradycardia & Shock

Management of Neurogenic shock

- Nonpenetrating traumatic spinal cord injury, Within 8 hours
- IV Methylprednisolone : 30 mg/kg IV bolus,
  followed by an infusion of 5.4 mg/kg per hour for 23 hours

- Do not use :
  - Penetrating injury, Multisystem trauma, Moderate to severe TBI,
    other comorbid conditions with risk of complications from glucocorticoid

Anaphylactic shock

Acute management

- Epinephrine, 0.3-0.5mg IM
- Repeat every 5-15 mins (1-3 doses)
- If not responding to epinephrine injections

  → 0.1 microgram/kg/min by infusion pump
- Steroid, airway management, fluid hydration…

Assess shock in ICU

Monitoring and intravenous access

- 針對Septic shock患者，比起單純用PE、Vital signs(NIBP)，更建議使用 Invasive monitoring of ABP 以及Dynamic measures 來評估輸液治療 Weak

- Dynamic measure : Response to a passive leg raise or a fluid bolus, using stroke volume (SV), stroke volume variation (SVV), pulse pressure variation (PPV), or echocardiography.

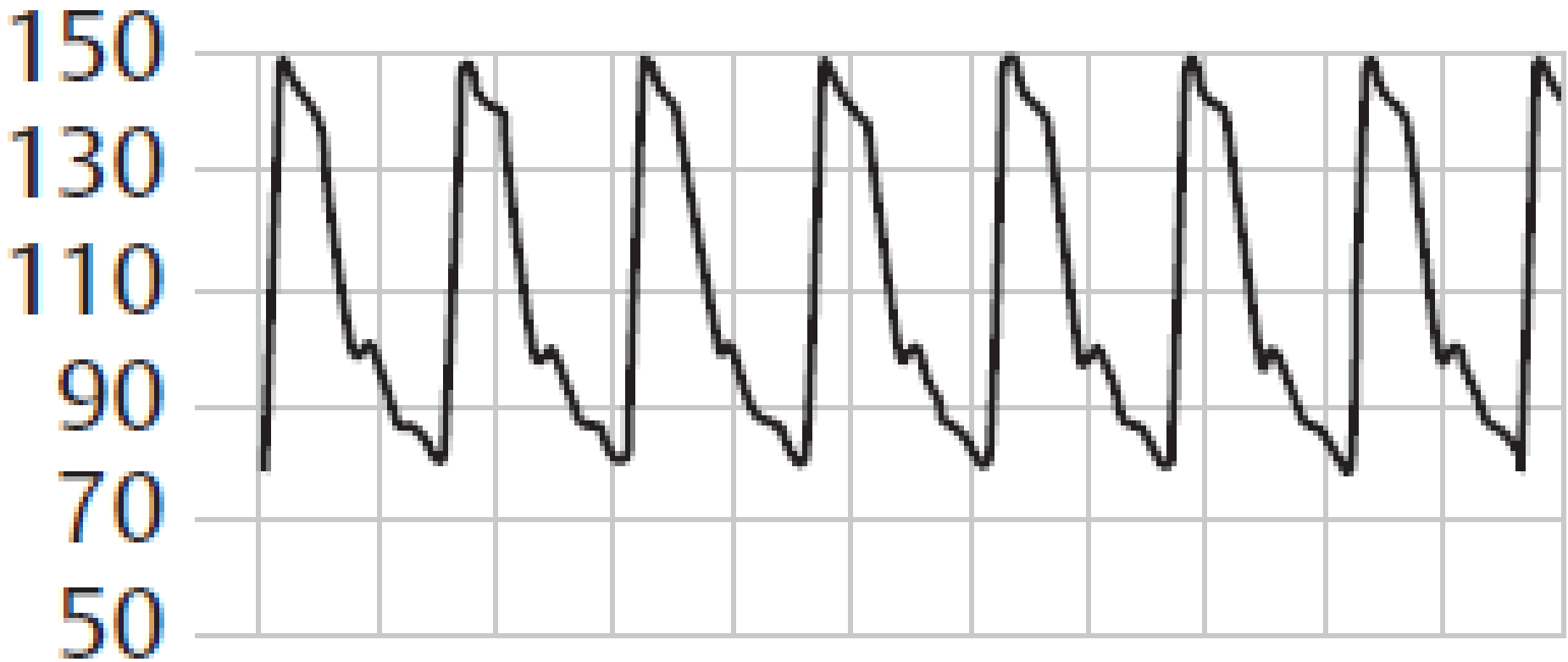
- FloTrac (左)
- LiDCO (右)

- Continuous Cardiac Output (CCO, CCI) 心輸出量
  - Cardiac output 心輸出量 = HR 心跳 x SV 心搏量
  - Cardiac index 心指數 = CO 心輸出量/ BSA 體表面積
- Stroke Volume (SV, SVI) 心搏量
  - Stroke Volume Index = SV / BSA

- Stroke Volume Variation (SVV)心搏量變異率
- Systemic Vascular Resistance (SVR, SVRI) 周邊血管阻力

	BP	HR	CO	SVR	SVV
Hypovolemic	↓	↑	↓	↑	↑
Cardiogenic	↓	- ↑	↓	↑	-
Distributive Septic, Neurogenic, Anaphylaxis	↓	- ↓ ↑	↓ ↑	↓	↑
Obstructive	↓	↑	↓	↑	↑

SVV心搏量變異率

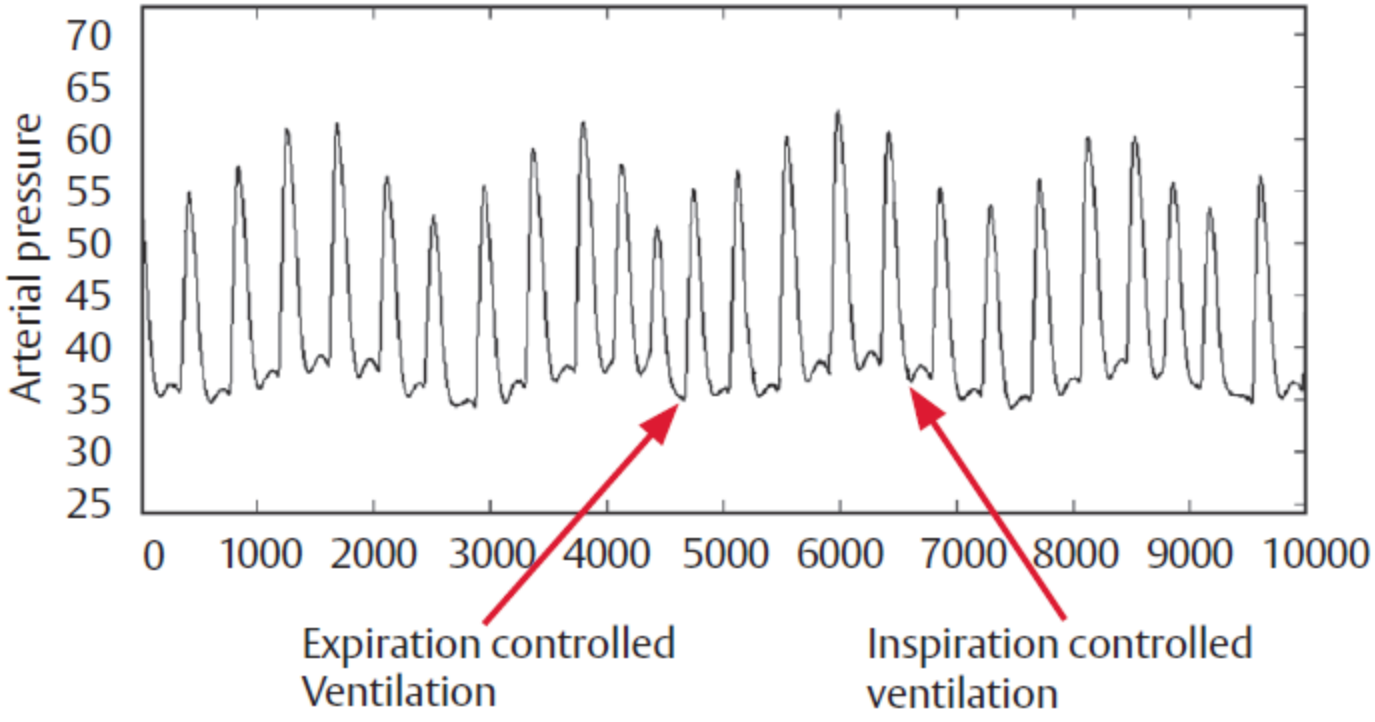


- 正常: 輸出 100ml, 回心 100ml, 每次Stroke Volume皆均量且規則
- 失血: 輸出 100ml, 回心 60ml, 每次Stroke Volume不均量,變異率上升

- SVV上升表示Volume不足

- Calculate LV SV to perform beat-to-beat analysis over the course of a breath

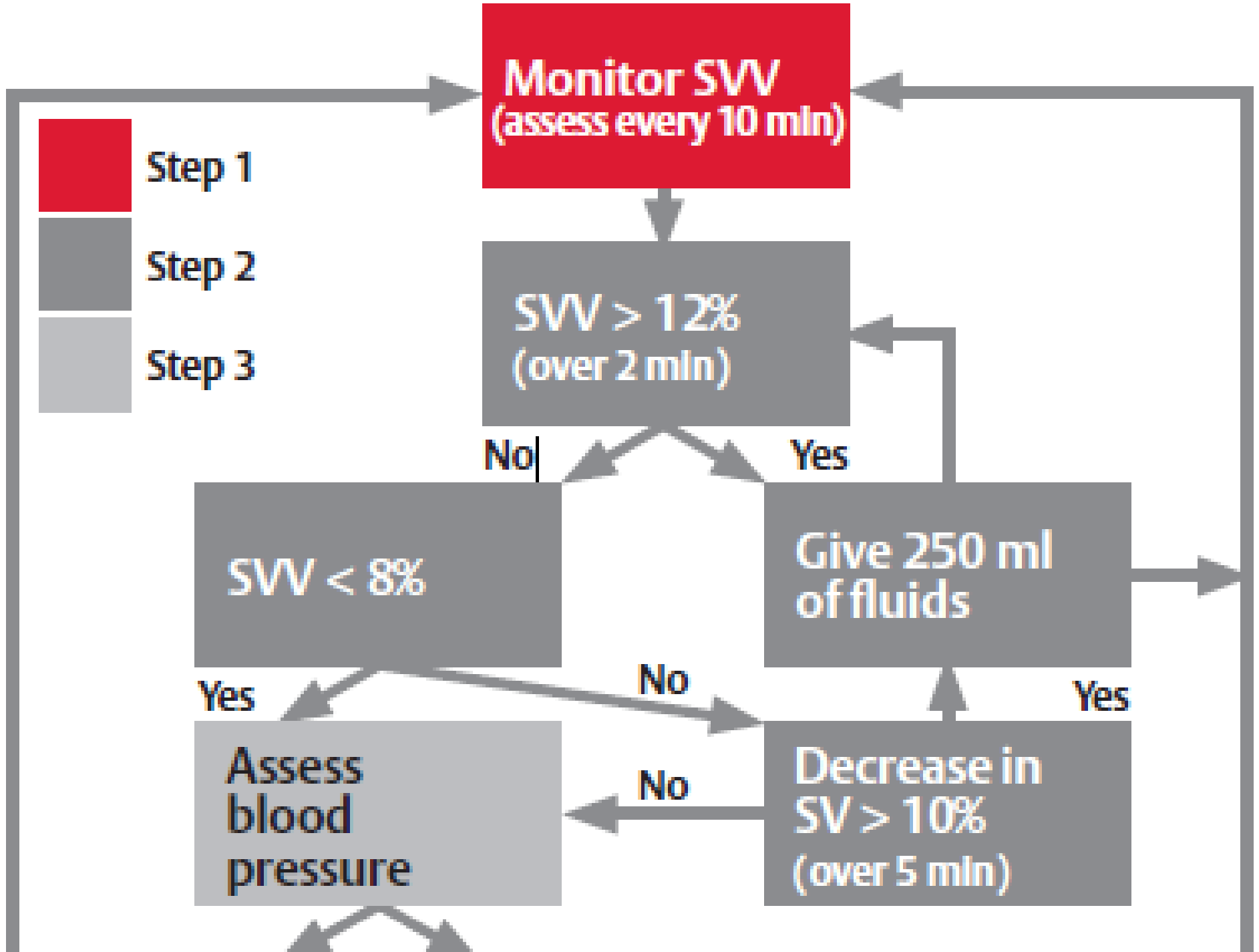
- Normal range of variation in spontaneously breathing : Between 0-10 mmHg



Limitations to the use of SVV

- Low HR/RR ratio 喘
- Irregular heart beats (not including APCs, VPCs)* 不規則心率
- Mechanical ventilation with low tidal volume 低tidal volume
- Increased abdominal pressure 腹壓很高
- Thorax open 胸腔被打開
- Spontaneous breathing 自主呼吸

- Increasing PEEP may cause an increase in SVV
- Vasodilatation therapy may increase SVV


Monitor SVV
(assess every 10 mln)
Step 1
Step 2
Step 3
SVV > 12%
(over 2 mln)
No
Yes
SVV < 8%
Give 250 ml
of fluids
Yes
No
Yes
Assess
blood
pressure
No
Decrease in
SV > 10%
(over 5 mln)

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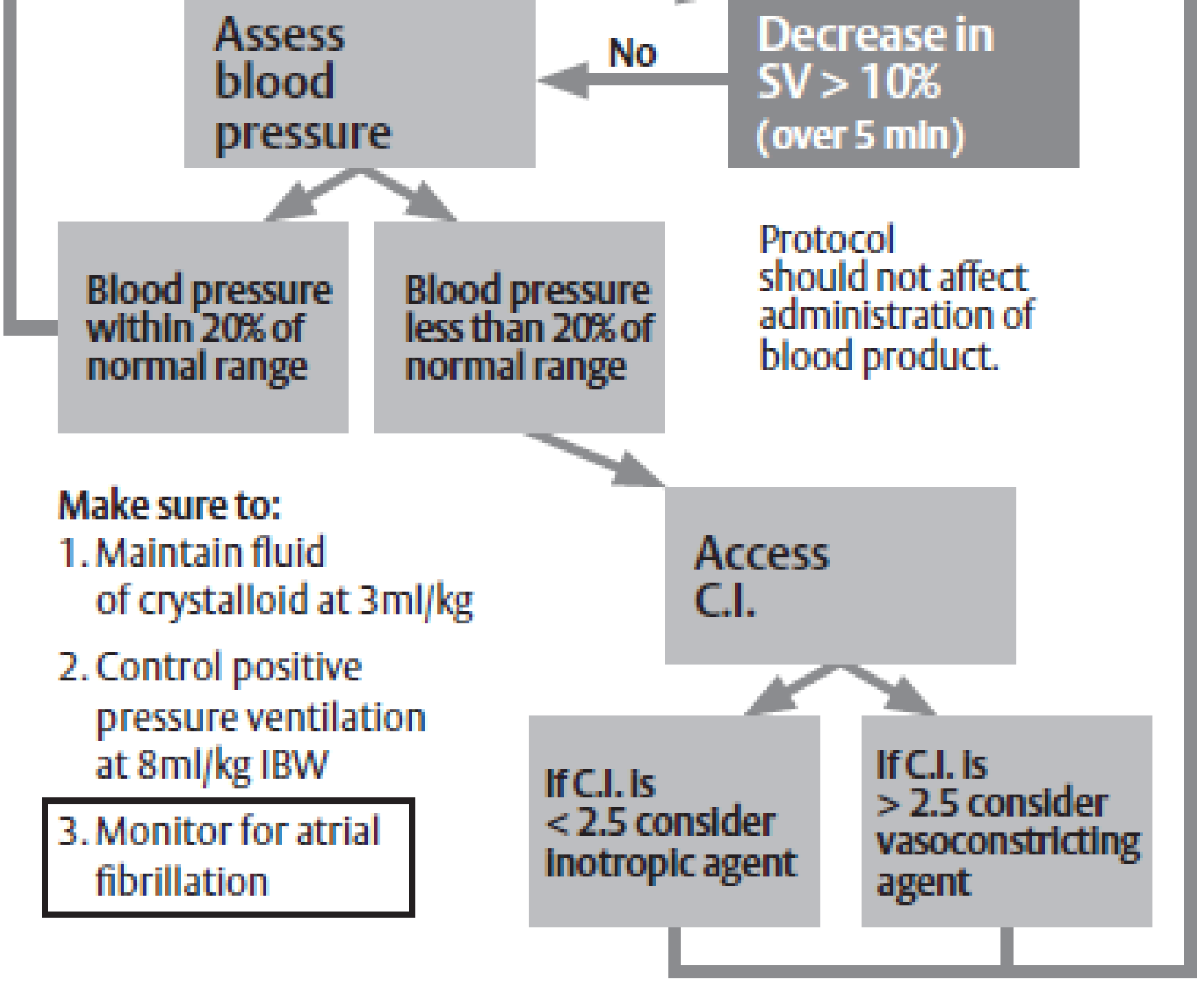
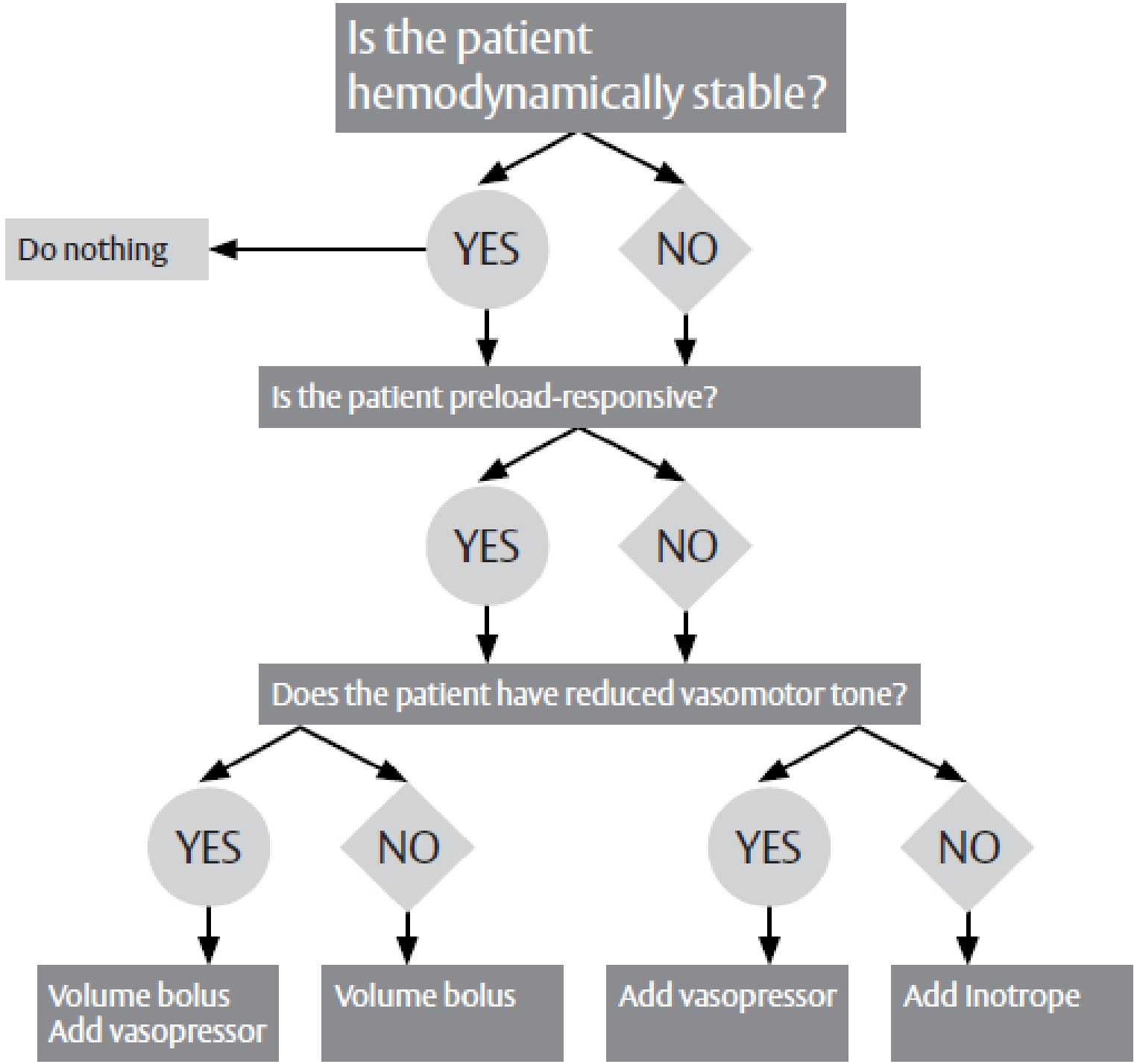

Assess blood pressure
No
Decrease in SV > 10% (over 5 min)
Blood pressure within 20% of normal range
Blood pressure less than 20% of normal range
Protocol should not affect administration of blood product.
Make sure to:
1. Maintain fluid of crystalloid at 3ml/kg
2. Control positive pressure ventilation at 8ml/kg IBW
3. Monitor for atrial fibrillation
Access C.I.
If C.I. Is < 2.5 consider Inotropic agent
If C.I. Is > 2.5 consider vasoconstricting agent


Is the patient hemodynamically stable?
YES
NO
Do nothing
Is the patient preload-responsive?
YES
NO
Does the patient have reduced vasomotor tone?
YES
NO
YES
NO
Volume bolus Add vasopressor
Volume bolus
Add vasopressor
Add Inotrope

Thank you !