일차 의료기관에서 놓치기 쉬운 부정맥과 심전도 판독법

- 분당차병원 심장내과 권순일 -

서 맥

증상

- 무증상
- 전신 혈액순환 감소 : 피로감, 무기력감, 위약감
- 뇌혈관 혈류의 감소 : 두통, 어지럼증, 현기증, 뇌졸중, TIA, 실신
- 심폐능력의 감소 : 호흡곤란, 흉부불편감

첫 진찰 시 꼭 확인해야할 점

- 증상의 빈도, 지속시간 : sustain vs. episodic
- 기저 병력 : heart disease, thyroid disease
- 사용 중인 약제 : BB, CCB, AAD, 한약 …

첫 진찰 시 이것 만은 꼭 확인해보세요

- 서맥과 관련된 증상이 있는지
  - 어지럼증, 숨참, 피로, 두통, 실신

- 가역적 원인이 있는지
  - 약물의 사용 (베타차단제 등)
  - 갑상선기능저하증 (갑상선수술받은 분이 최근에 복약을 못한 경우 등)
  - 고칼륨혈증 (신장질환 환자 등)

워크업

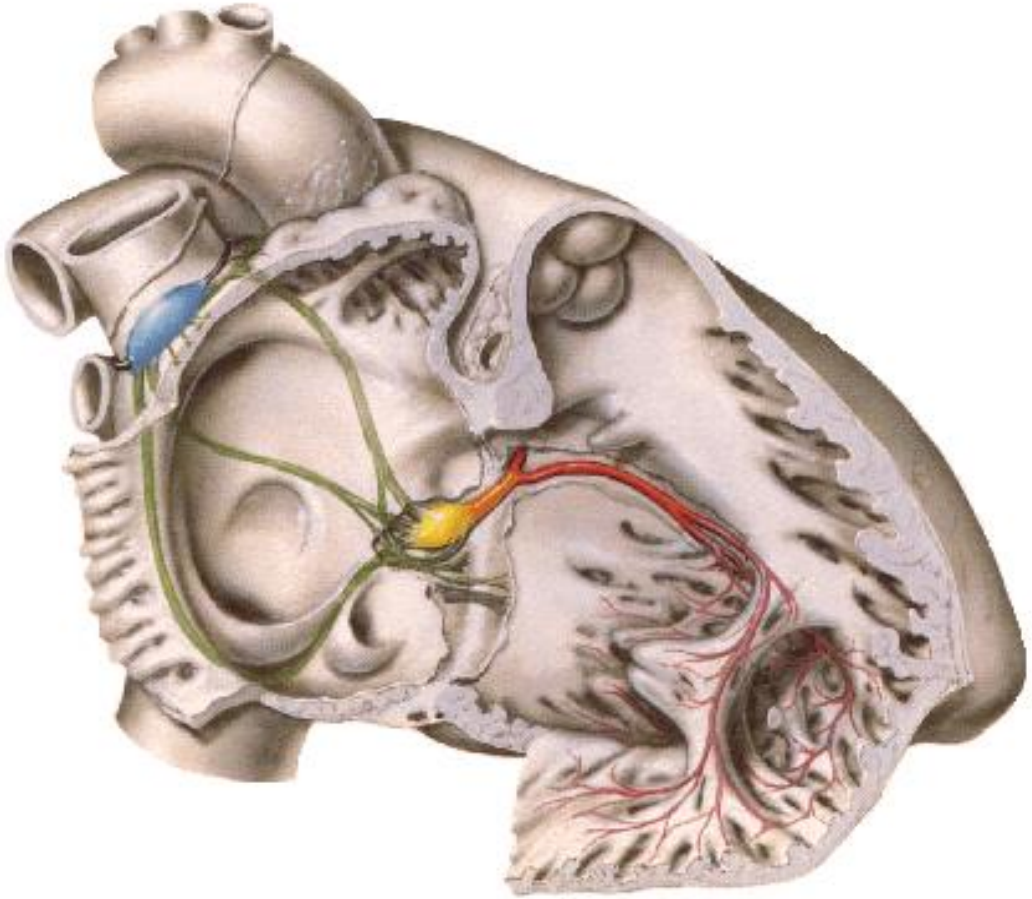
- 혈액검사: hyperK, hyperCa, hypoT …
- 12유도 표준 심전도: SSS, AVB …
- 보행심전도(홀터, 심전도패치): episodic bradycardia
- 이벤트레코더
- 삽입형루프기록기(ILR)
- 심초음파
- 심전기생리검사

서맥의 종류

- Sinus node dysfunction
  - Sinus bradycardia
  - Sinus pause or arrest
  - Sinoatrial block
  - Tachycardia-bradycardia syndrome
- Atrioventricular block
  - 2^{nd}-degree AVB (type I, II)
  - Advanced AVB
  - Complete AVB

Cardiac conduction system

SA node
↓
Atrium
↓
AV node
↓
His bundle
↓
Bundle branch
↓
Purkinje fibers
↓
Ventricle



Cardiac conduction system

SND

SA block

AV block

Suprahisian block

AV block

Infrahisian block

SA node

Atrium

AV node

His bundle

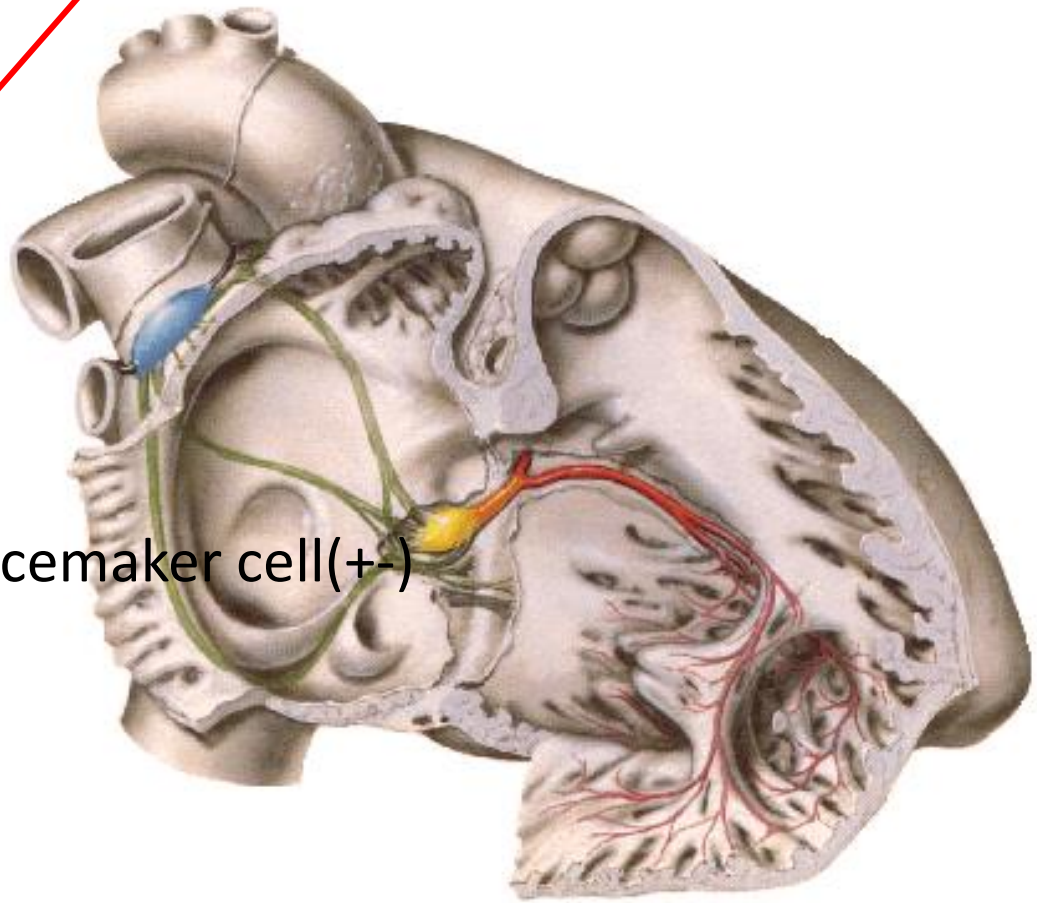
Bundle branch

Purkinje fibers

Ventricle

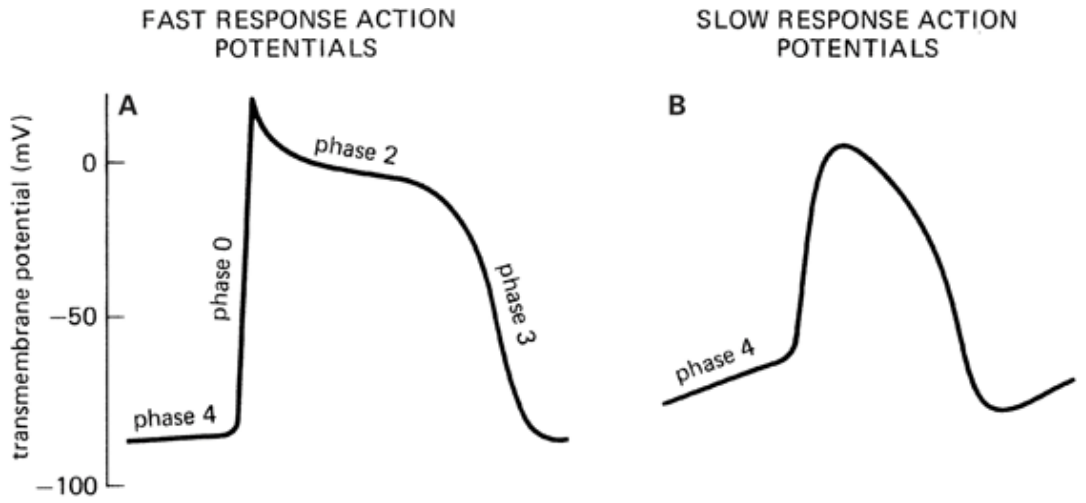
Pacemaker cell(++)

Pacemaker cell(+-)



Action potential

Fast-response tissue	Slow-response tissue
Atrium **His bundle** **Purkinje fiber** **Ventricle**	**SA node** **AV node**



Fast-response tissue: Na-channel dependent

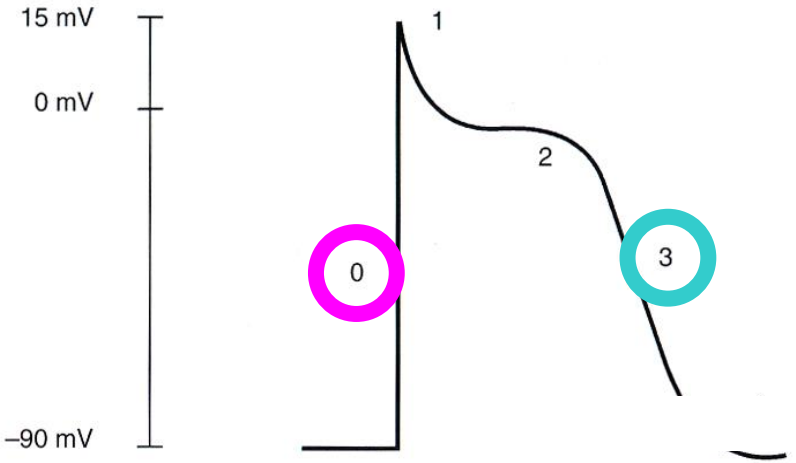
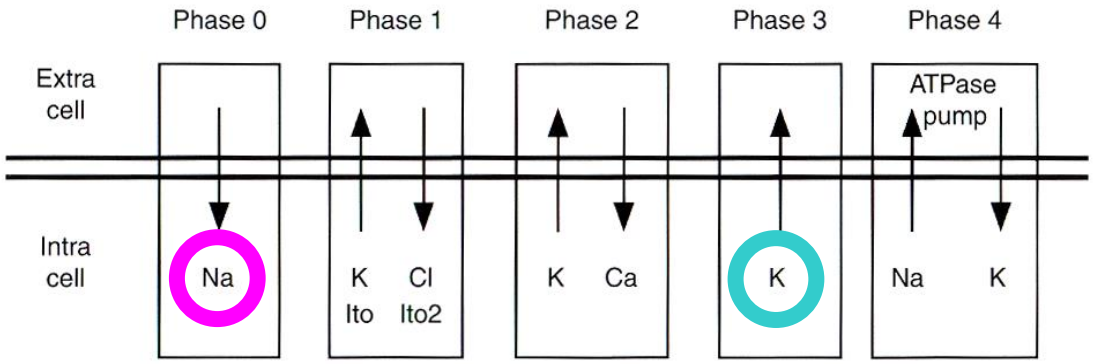
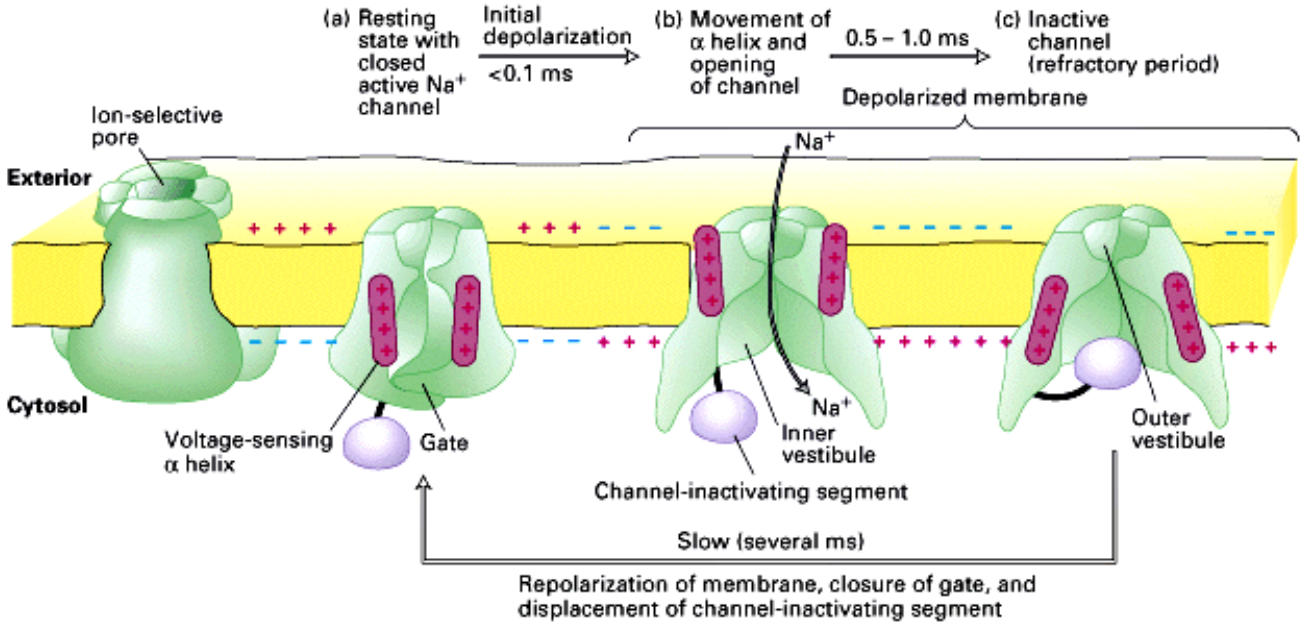


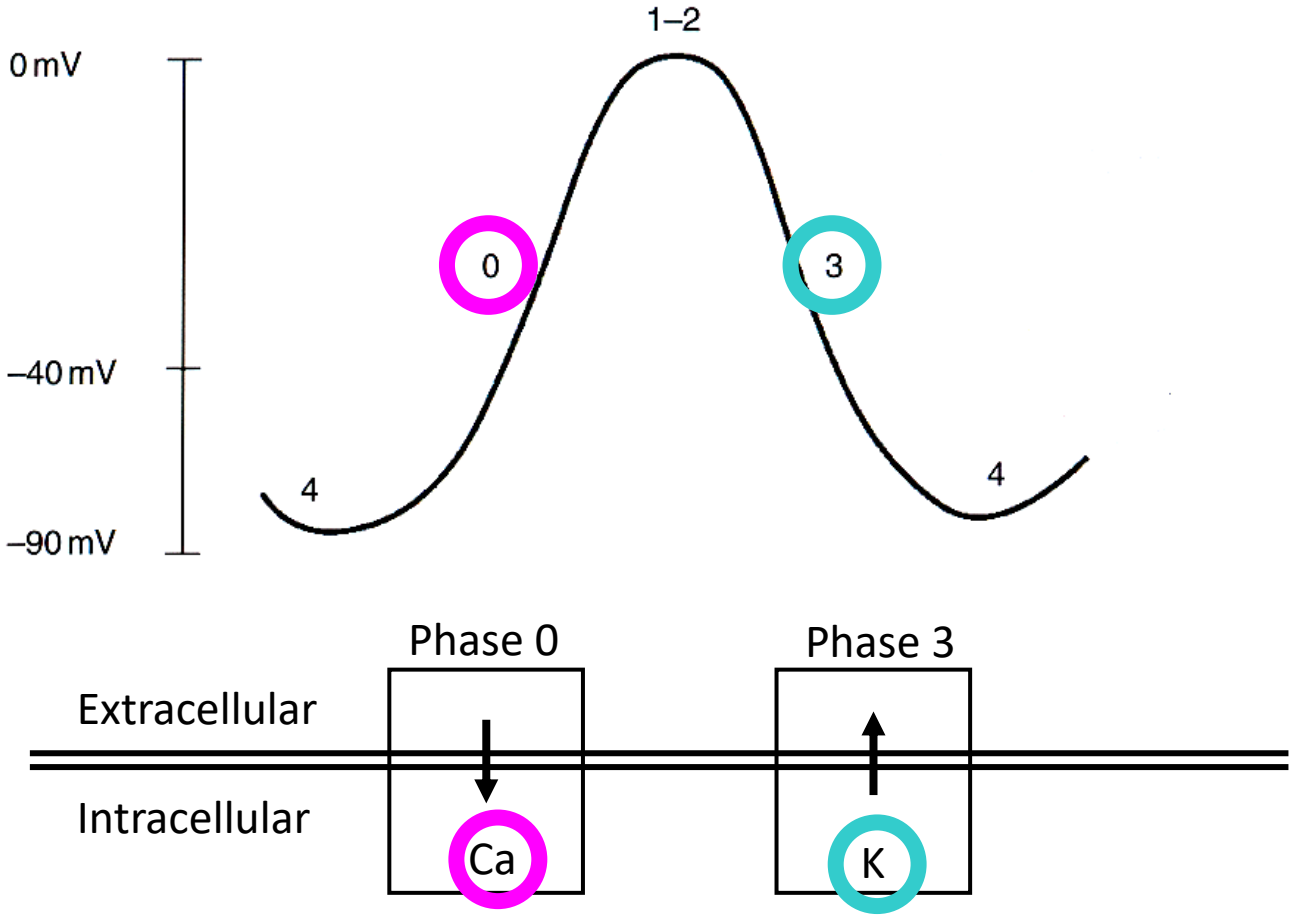
Figure 1.2 Action potential in Na-channel-dependent cells.





Atrium
His bundle
Purkinje fiber
Ventricle

Slow-response tissue: Ca-channel dependent



Spontaneous depolarization

SA node
AV node

Cardiac conduction system

SND

SA block

AV block

Suprahisian block

AV block

Infrahisian block

SA node

Atrium

AV node

His bundle

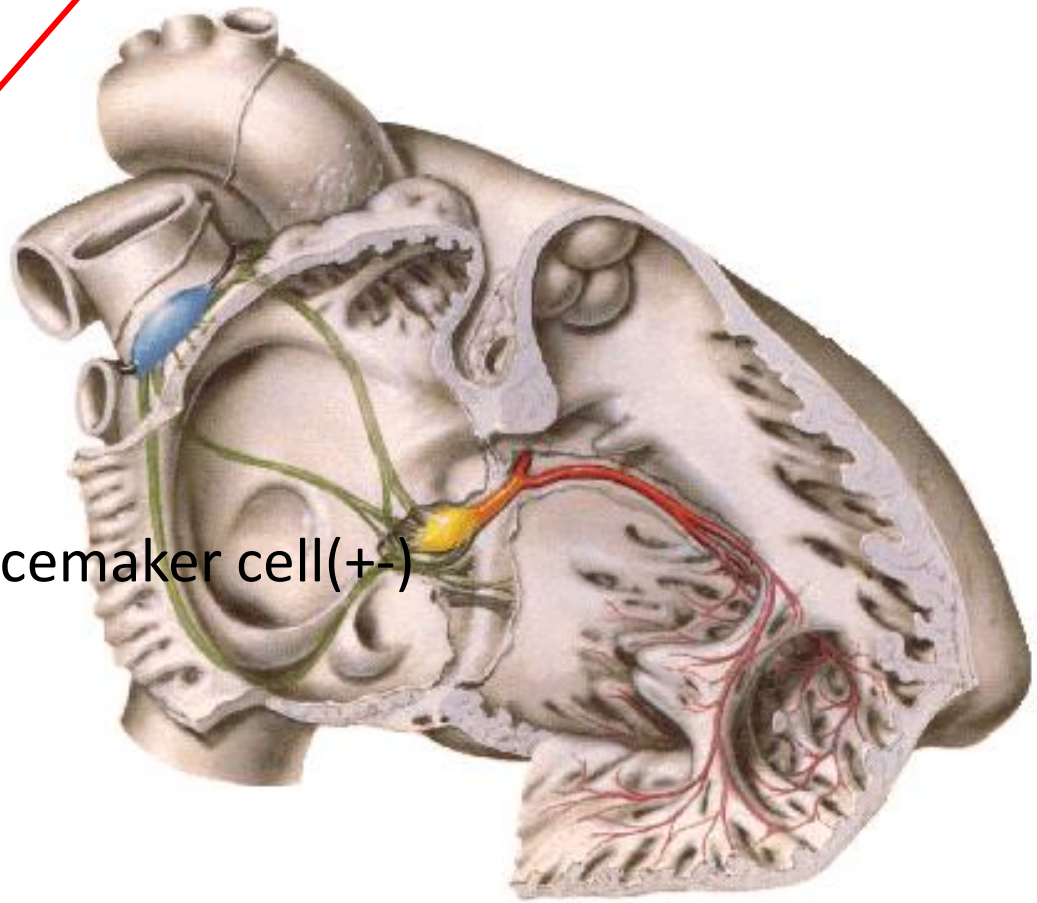
Bundle branch

Purkinje fibers

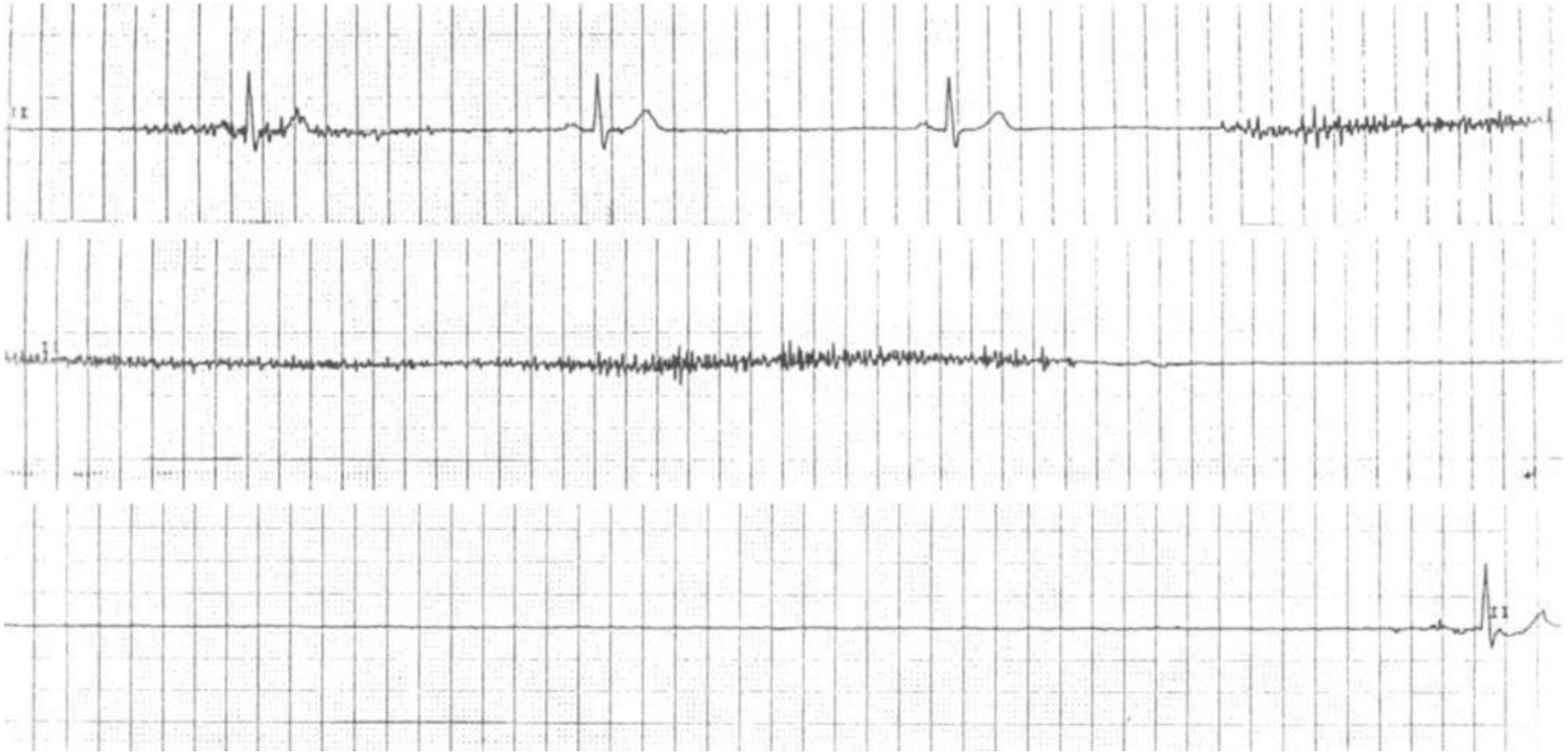
Ventricle

Pacemaker cell(++)

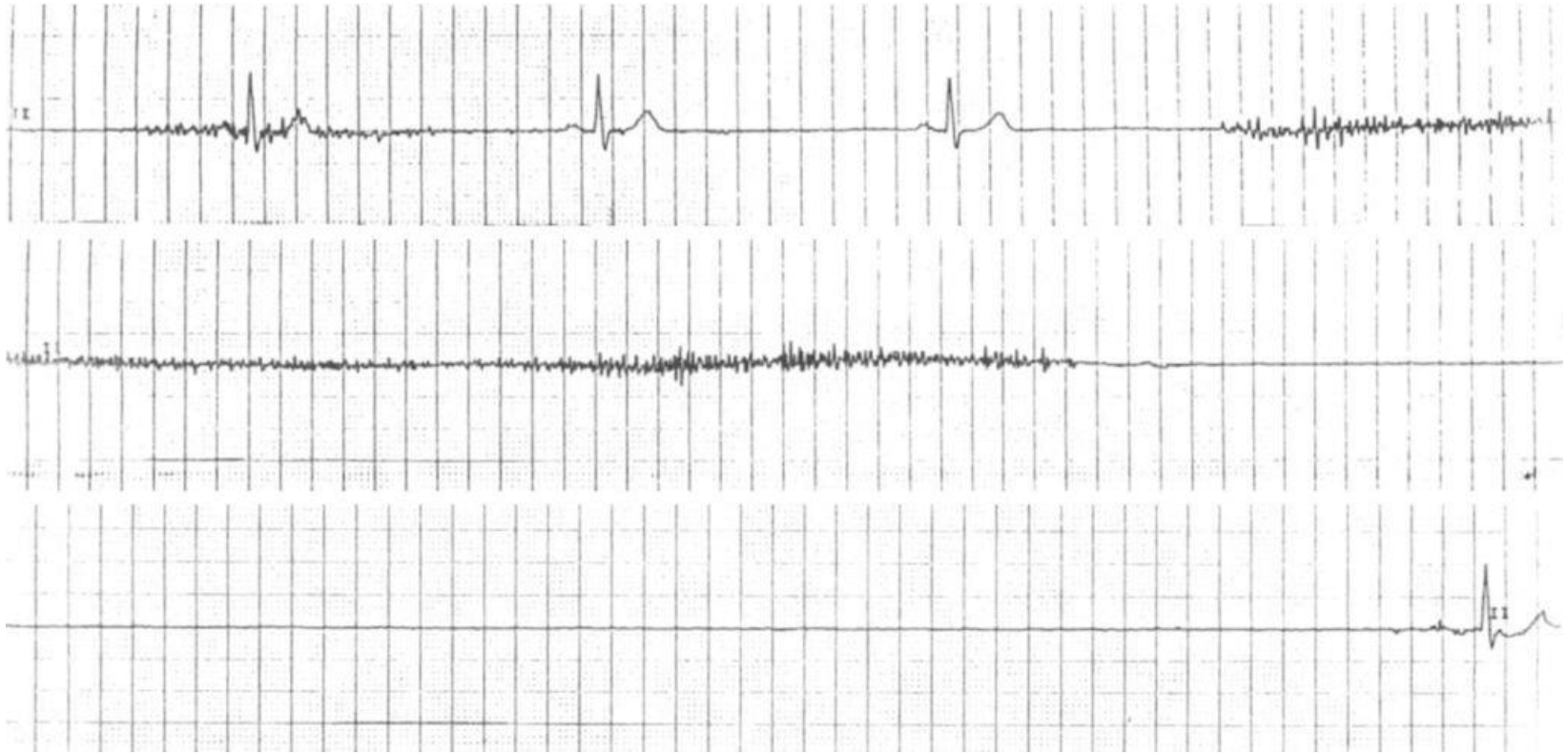
Pacemaker cell(+-)



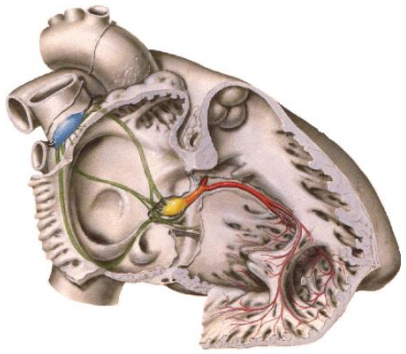
Q1



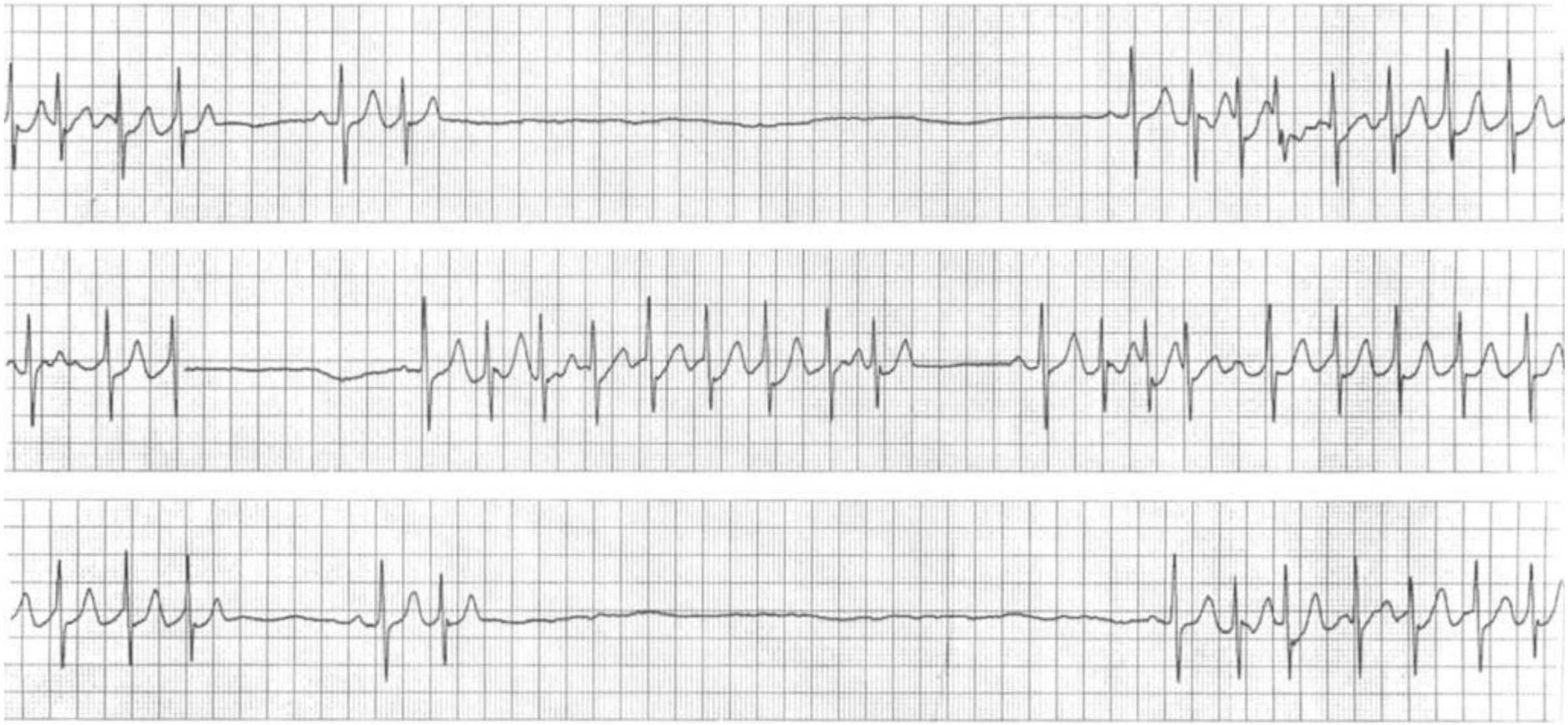
Sinus node dysfunction



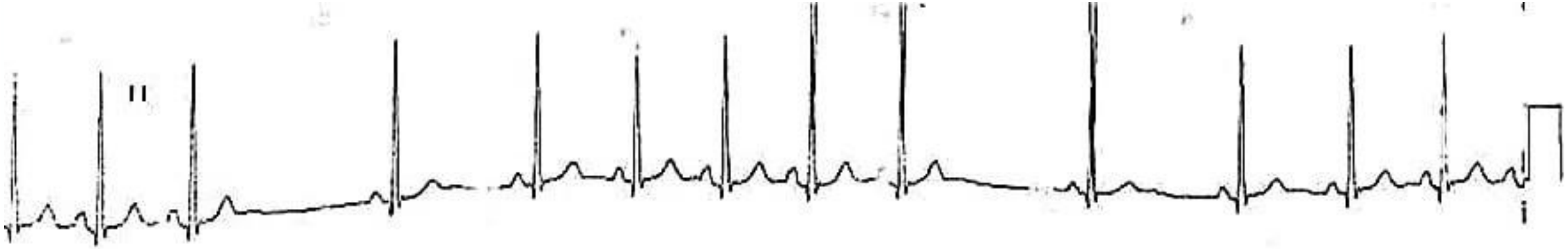
SA node
↓
Atrium
↓
AV node
↓
His bundle
↓
Bundle branch
↓
Purkinje fibers
↓
Ventricle

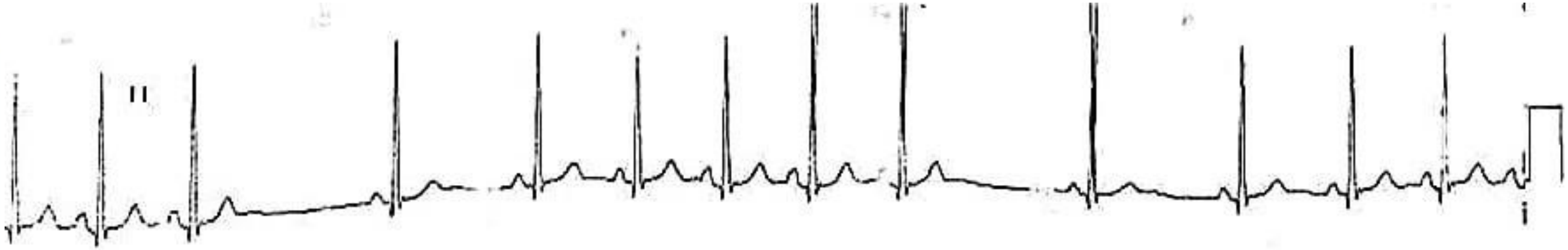


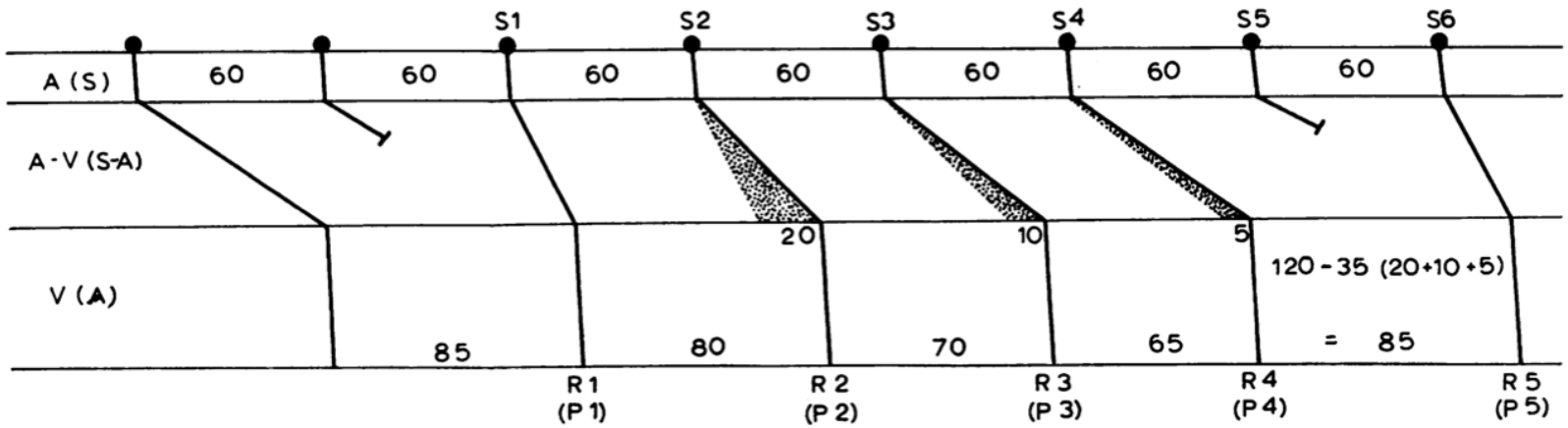
Q2

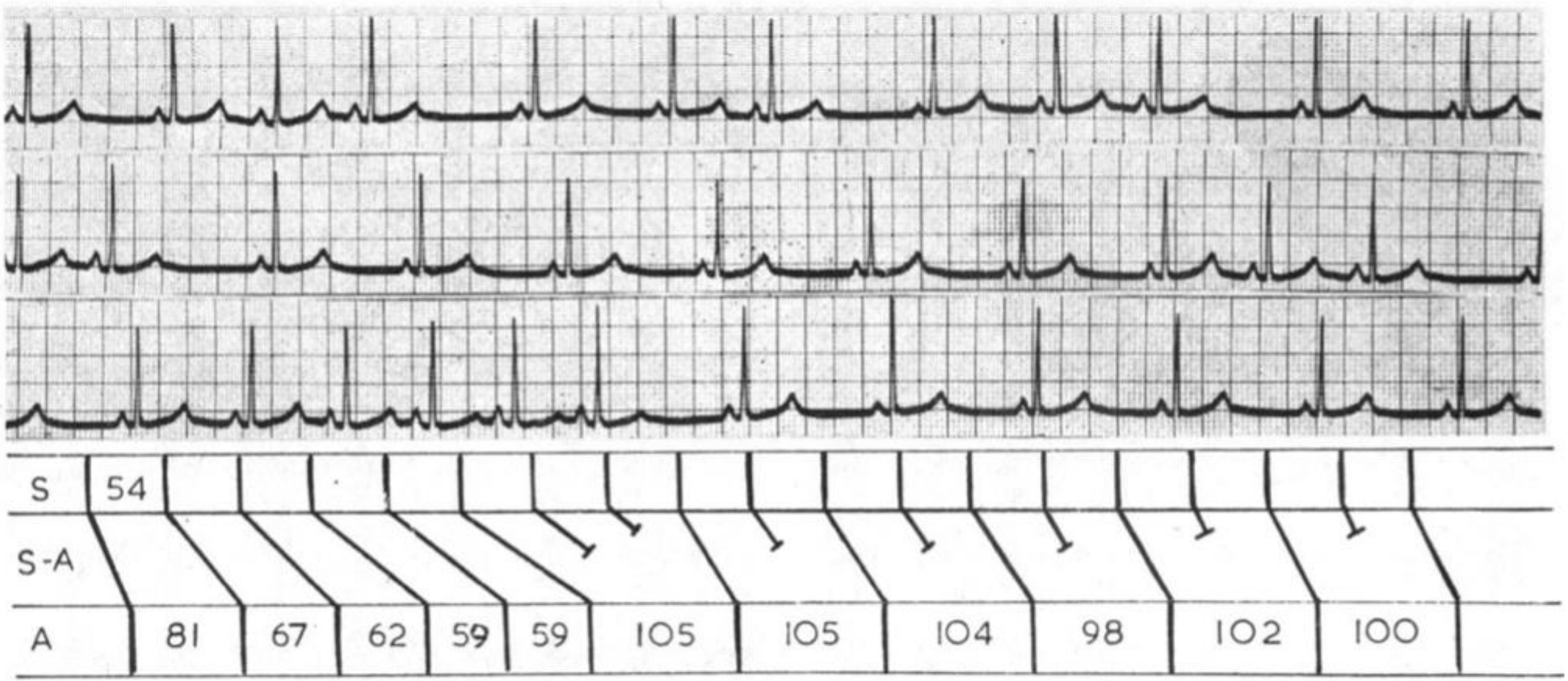


Q3

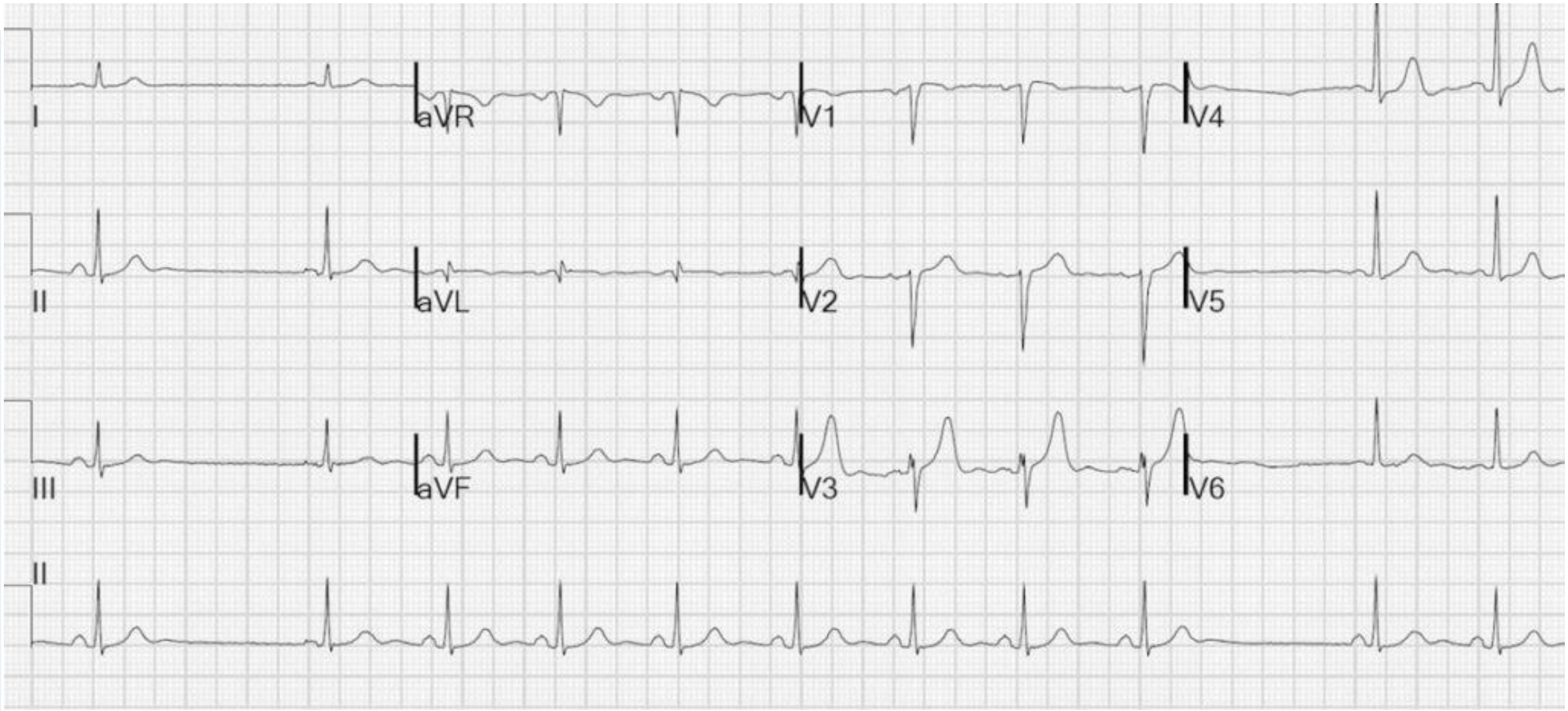


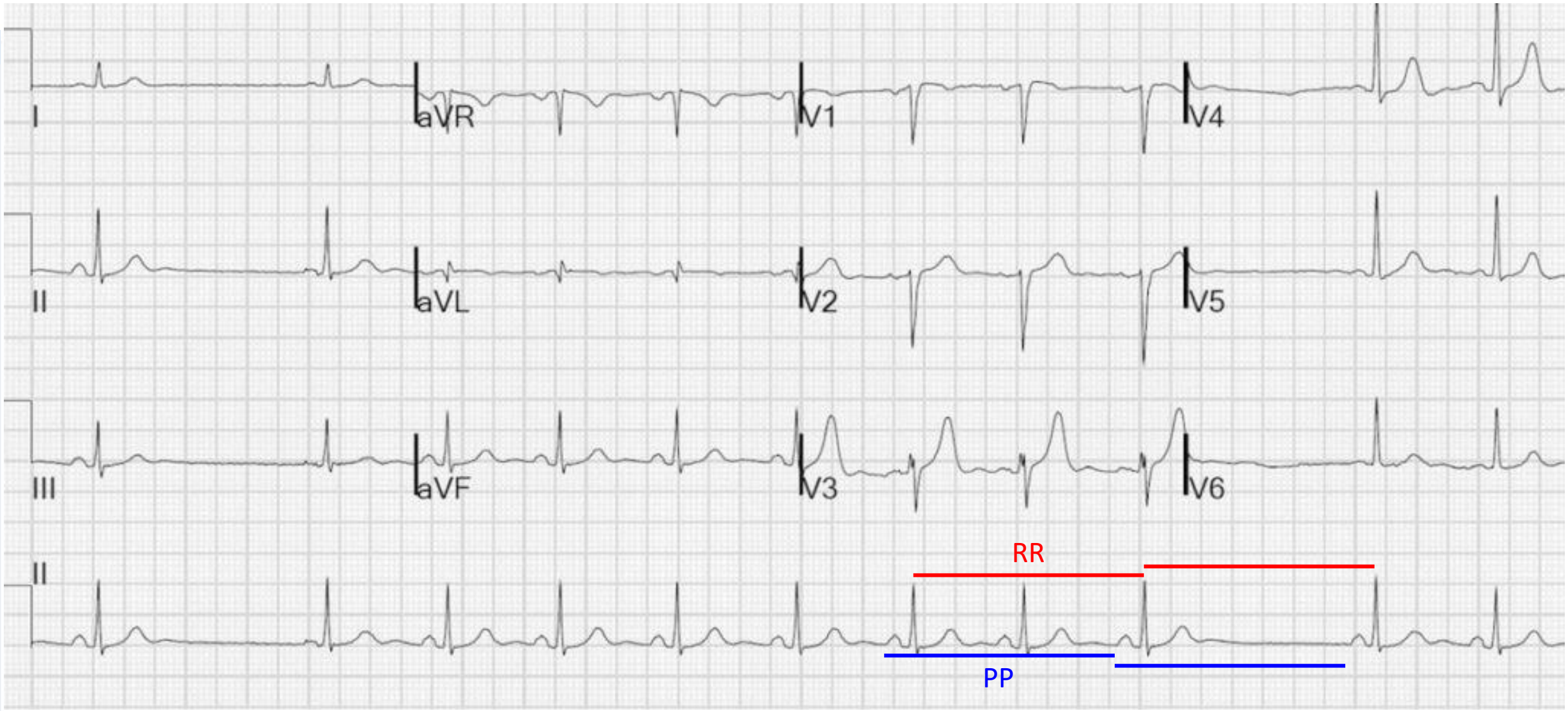

II


S1
S2
S3
S4
S5
S6
A (S)
60
60
60
60
60
60
60
A - V (S-A)
20
10
5
V (A)
120 - 35 (20+10+5)
= 85
85
80
70
65
R 1
(P 1)
R 2
(P 2)
R 3
(P 3)
R 4
(P 4)
R 5
(P 5)

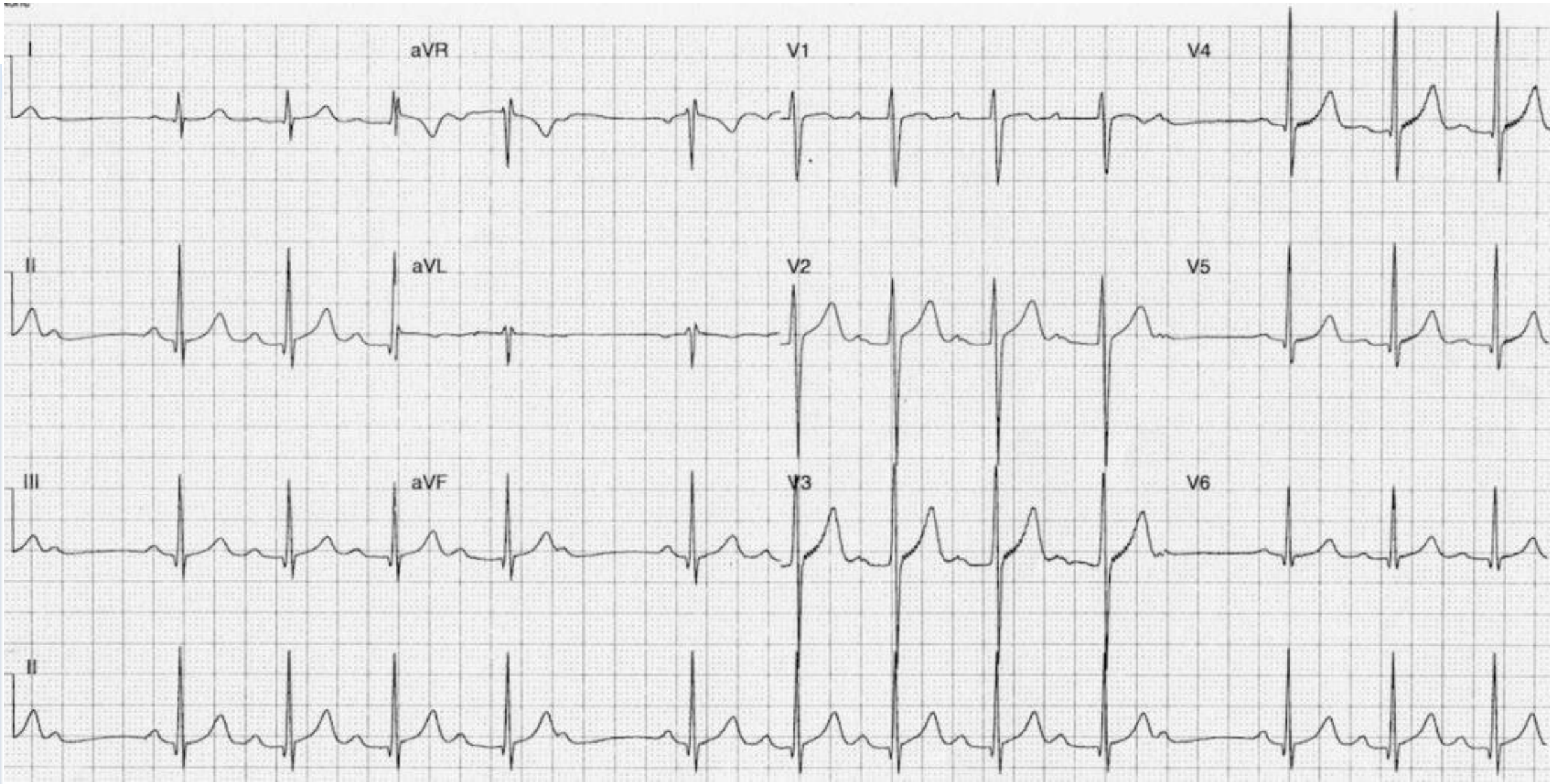

S
54
S-A
A
81
67
62
59
59
105
105
104
98
102
100

Q4

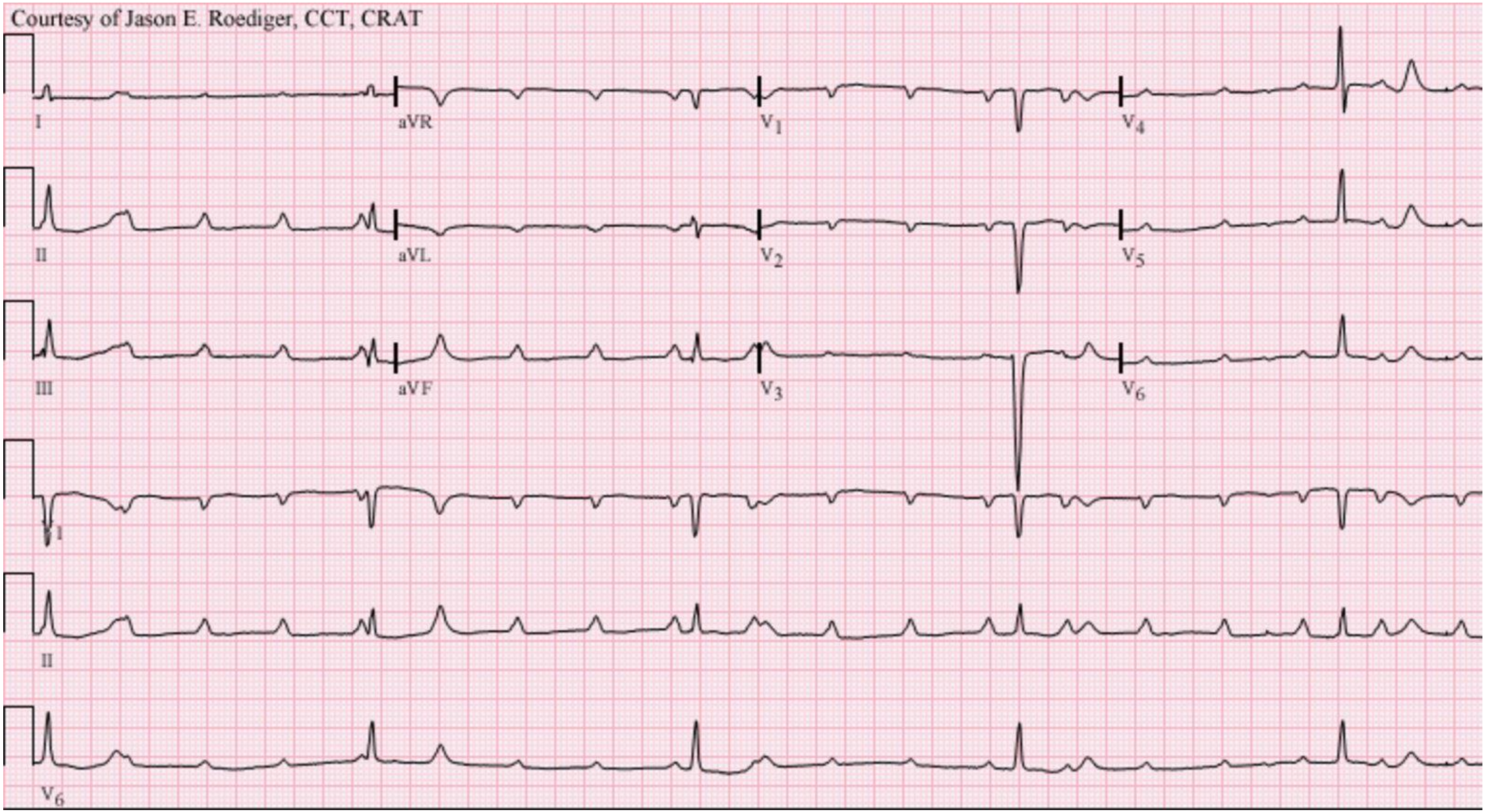



I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
RR
PP

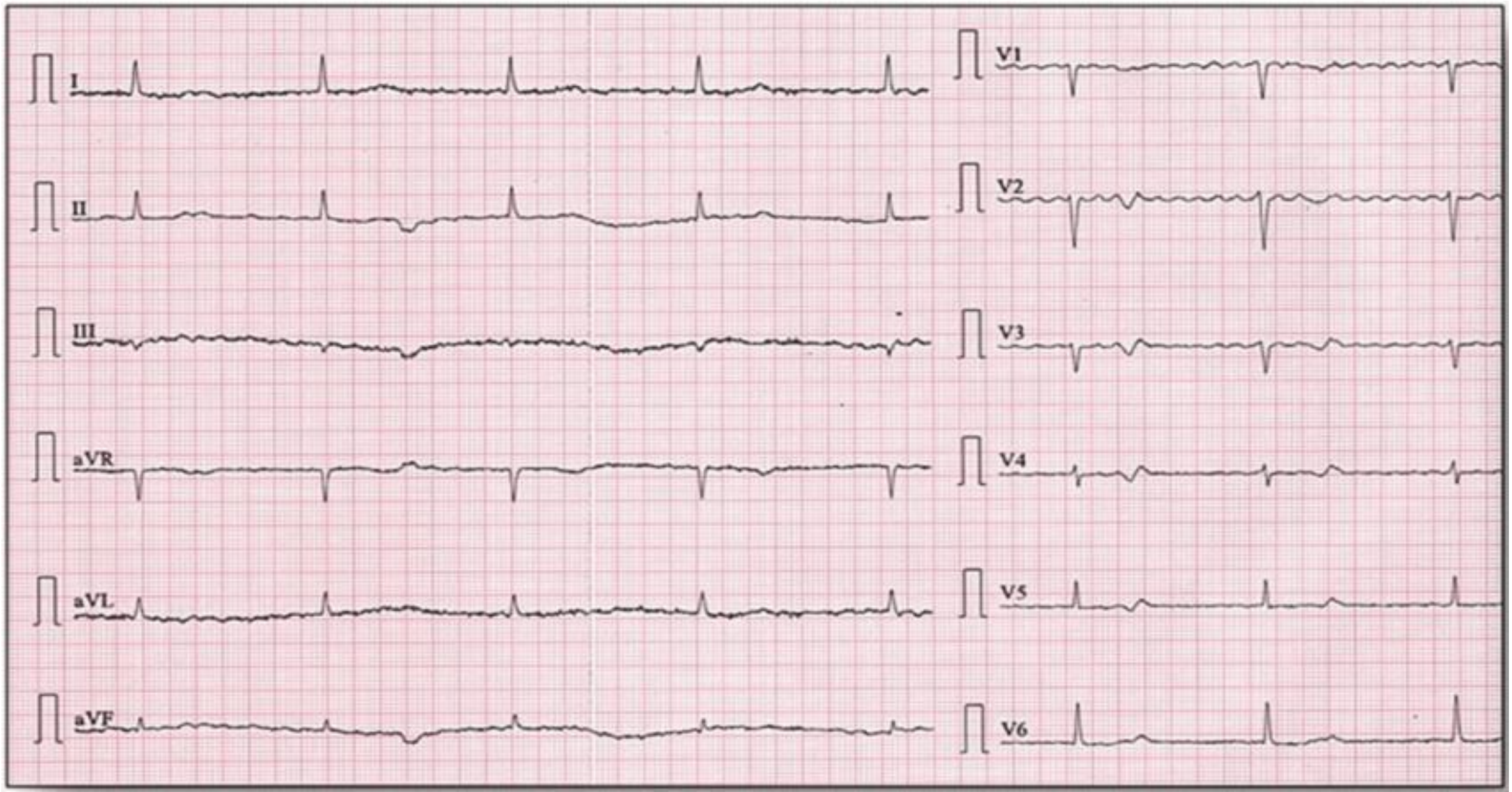
Q5



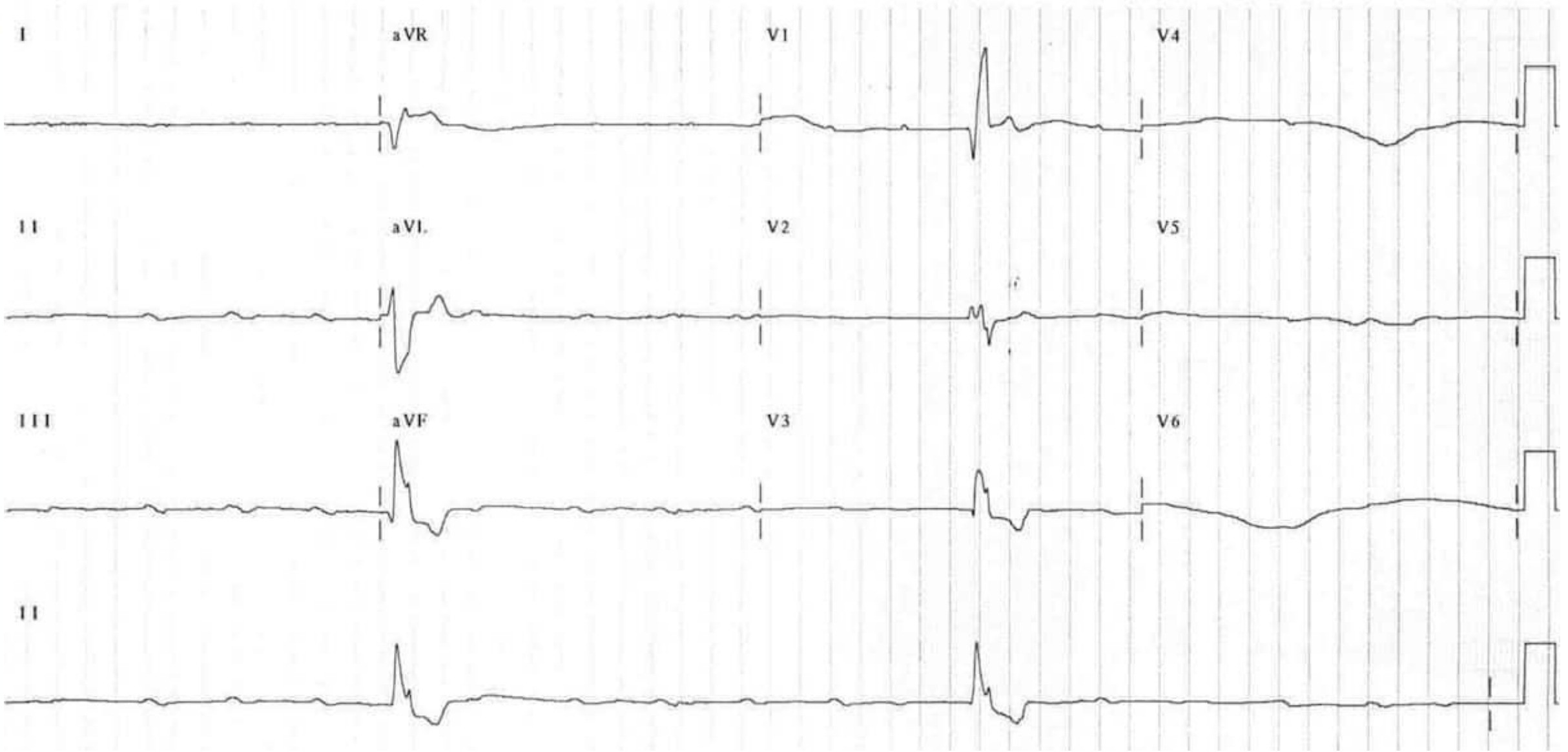
Q6


Courtesy of Jason E. Roediger, CCT, CRAT
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V6

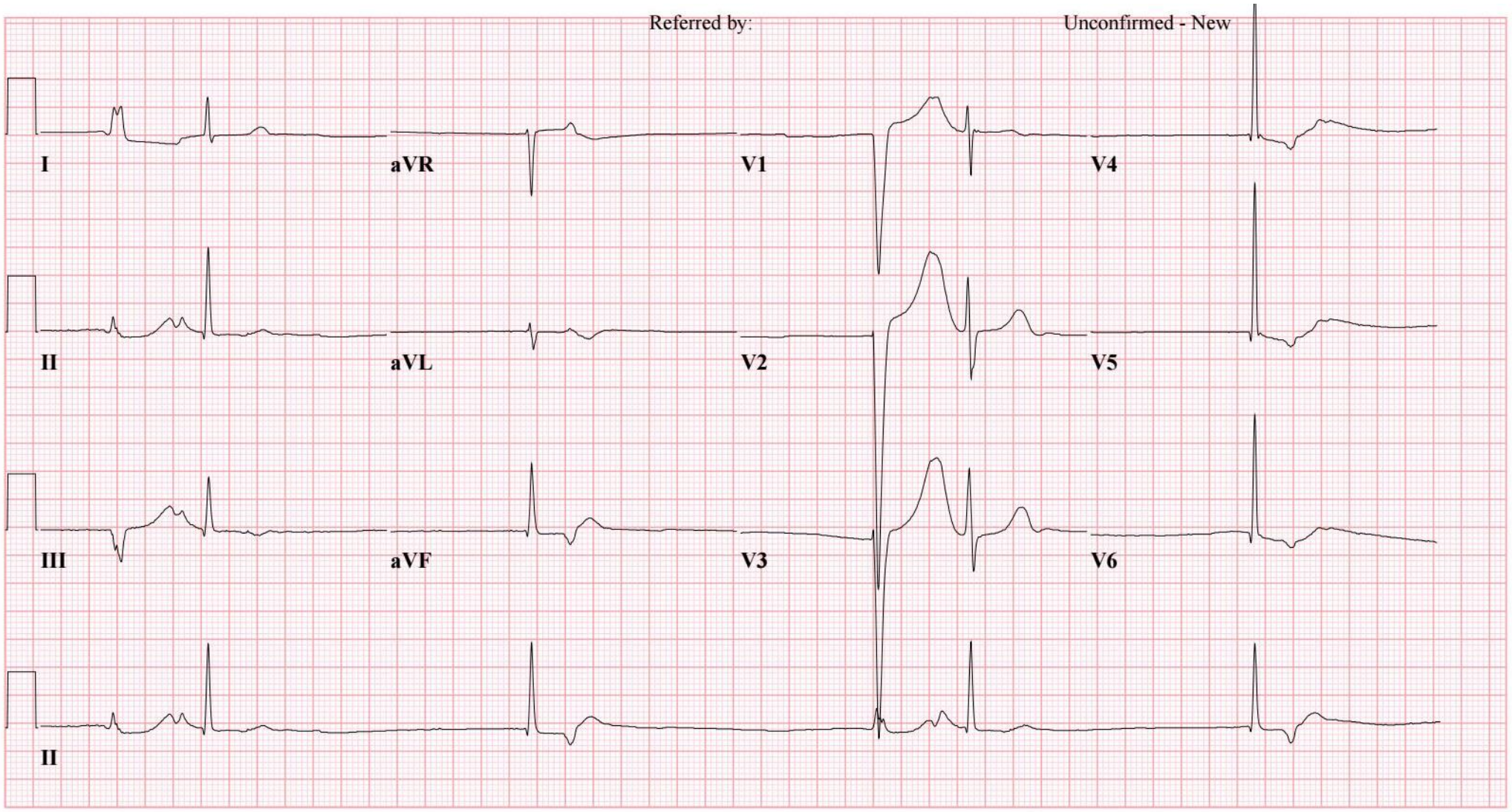
Q7



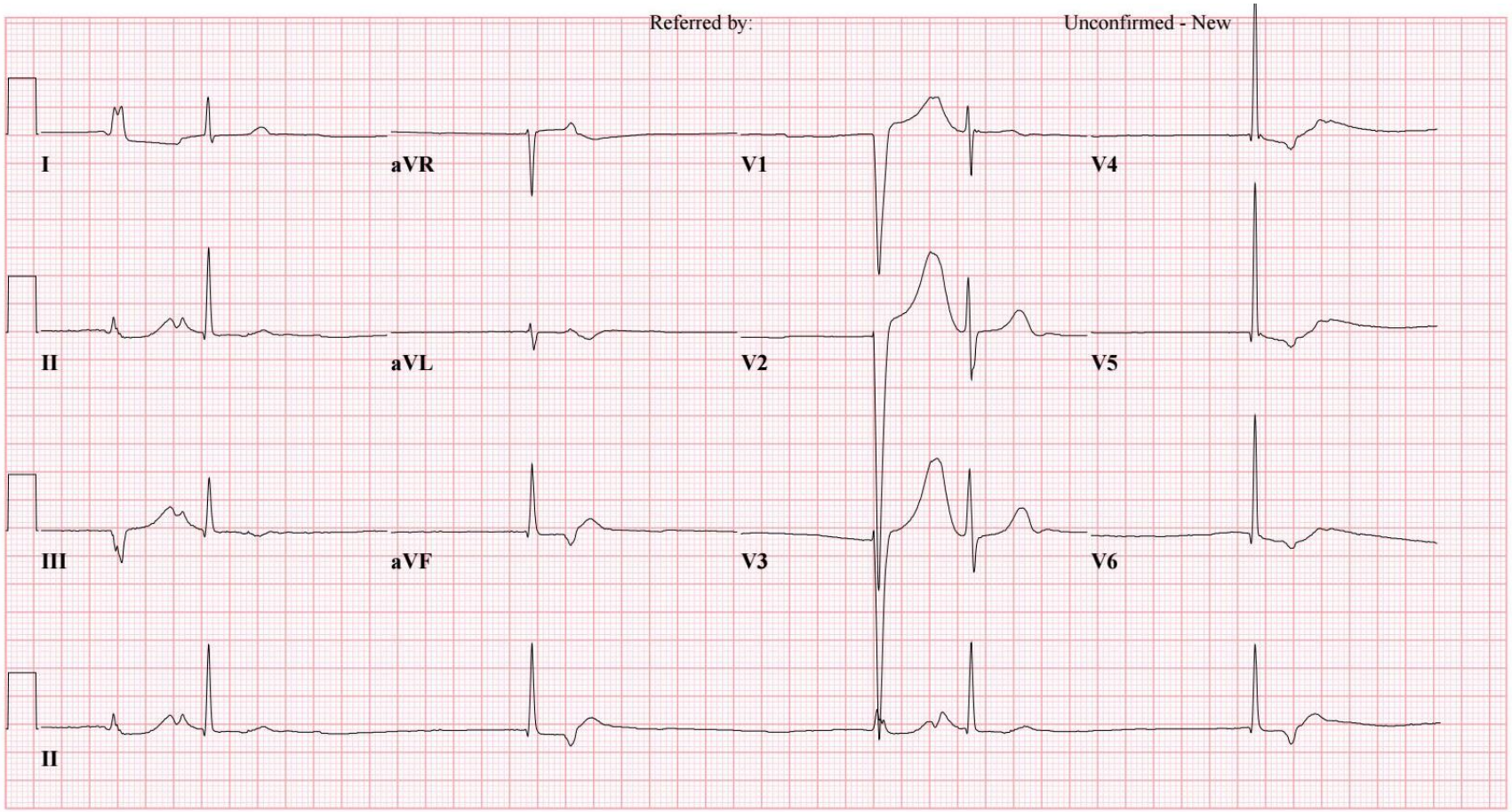
Q8



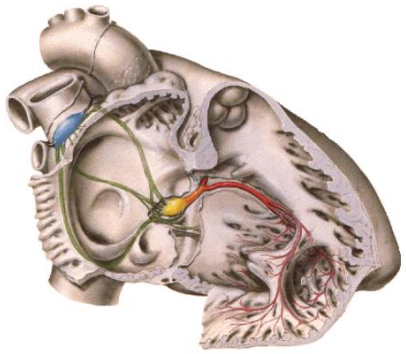
Q9


Referred by:
Unconfirmed - New
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
25mm/s 10mm/mV 40Hz 8.0.1 12SL 239 CID: 1
EID: EDT: ORDER:
Page 1 of 1

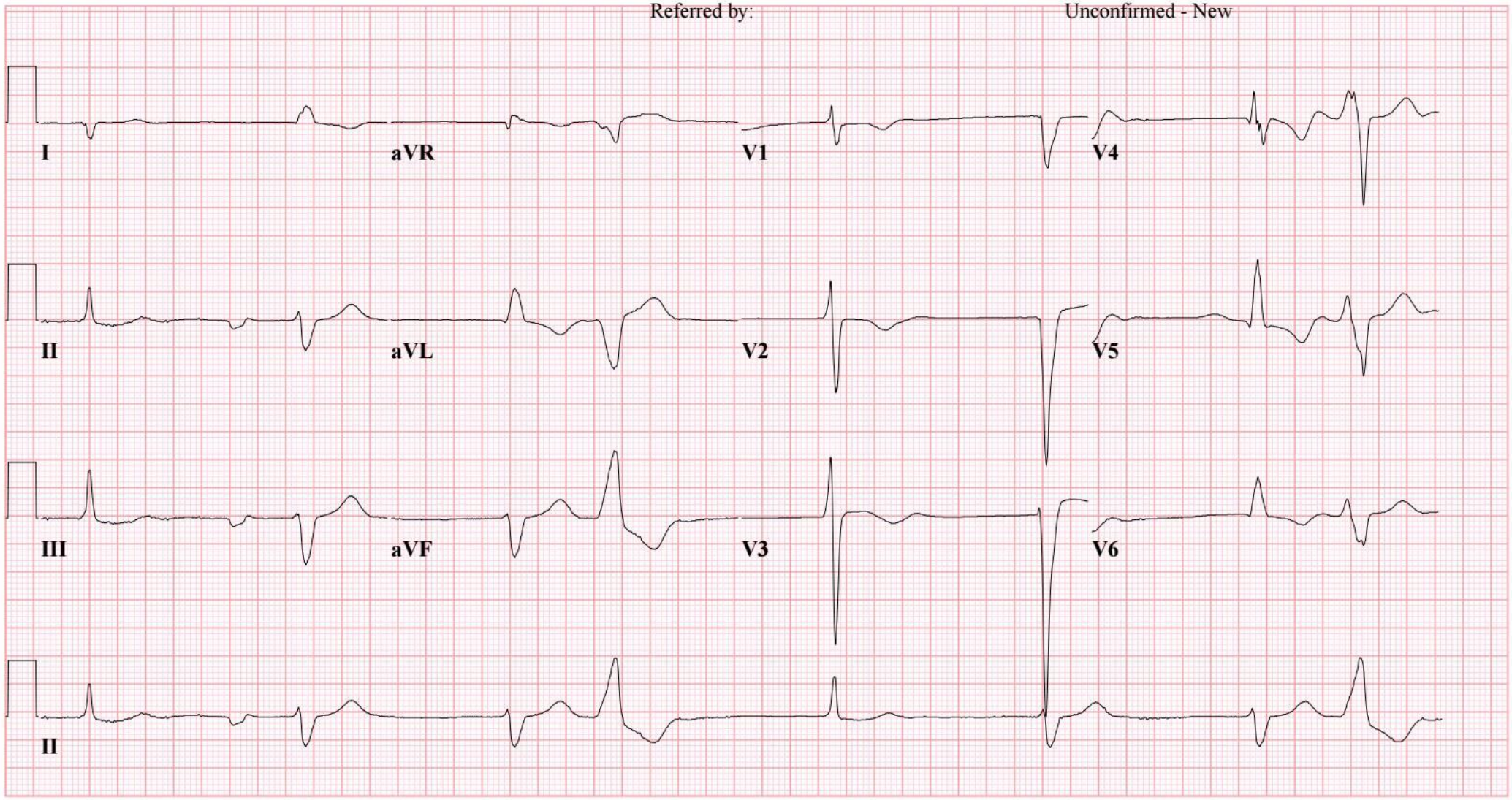
Q10



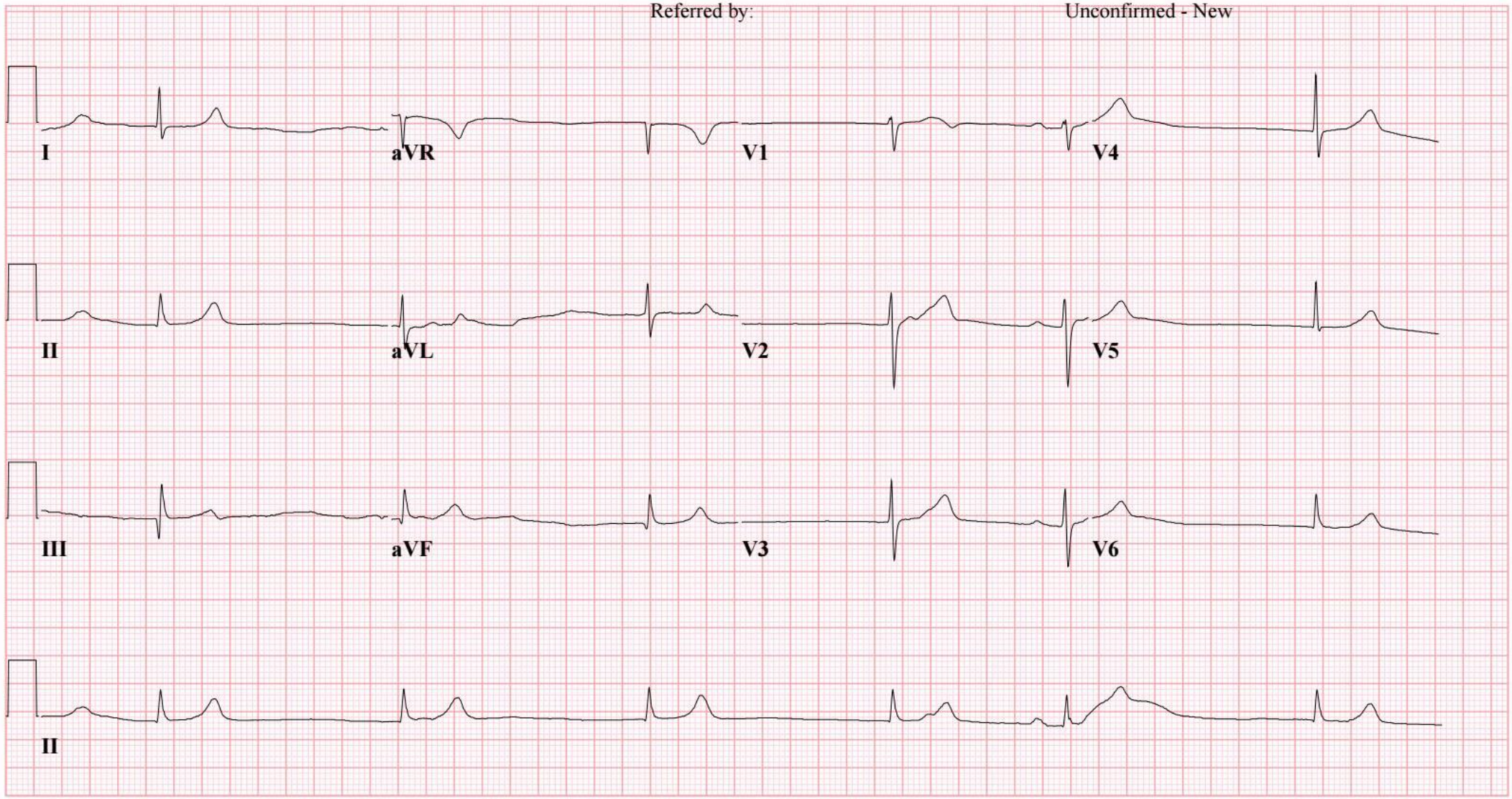
SA node
↓
Atrium
↓
AV node
↓
His bundle
↓
Bundle branch
↓
Purkinje fibers
↓
Ventricle



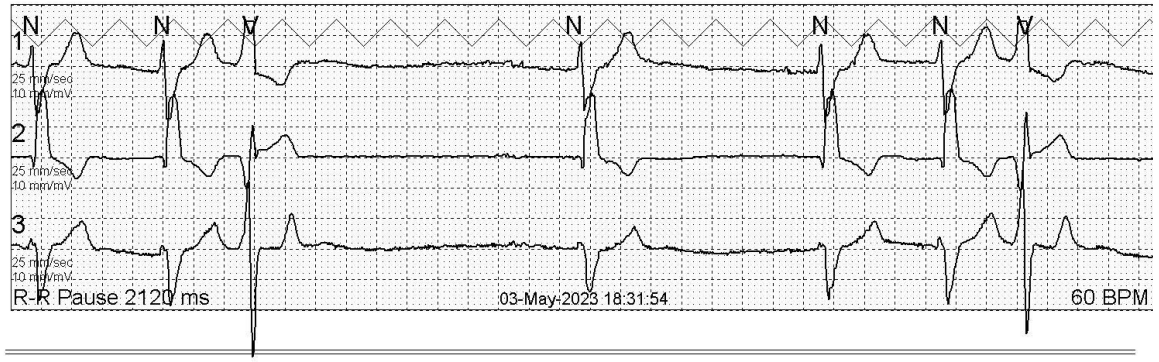
Q11

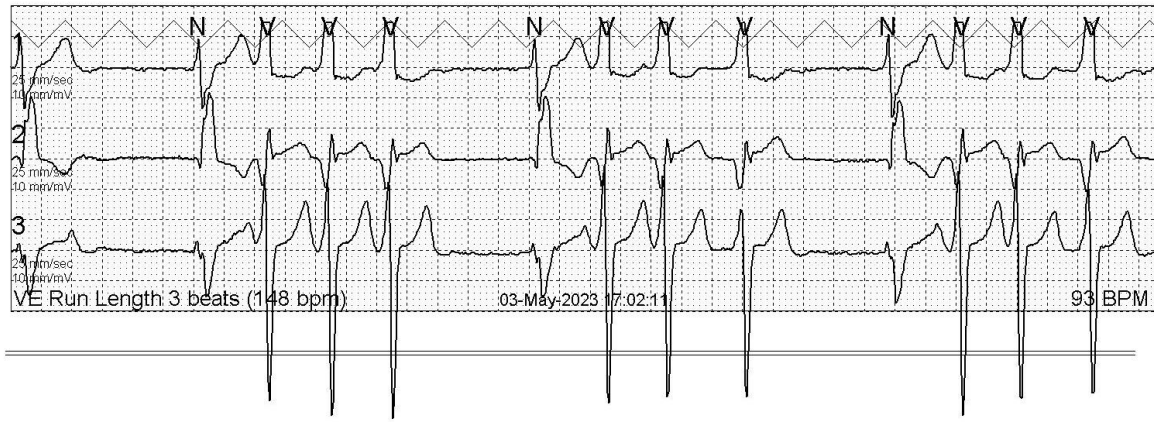

Referred by:
Unconfirmed - New
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
25mm/s 10mm/mV 40Hz 8.0.1 12SL 239 CID: 1
EID: EDT: ORDER:
Page 1 of 1

Q12


Referred by:
Unconfirmed - New
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
25mm/s 10mm/mV 40Hz 8.0.1 12SL 241 CID: 6
EID: EDT: ORDER:
Page 1 of 1

Q13

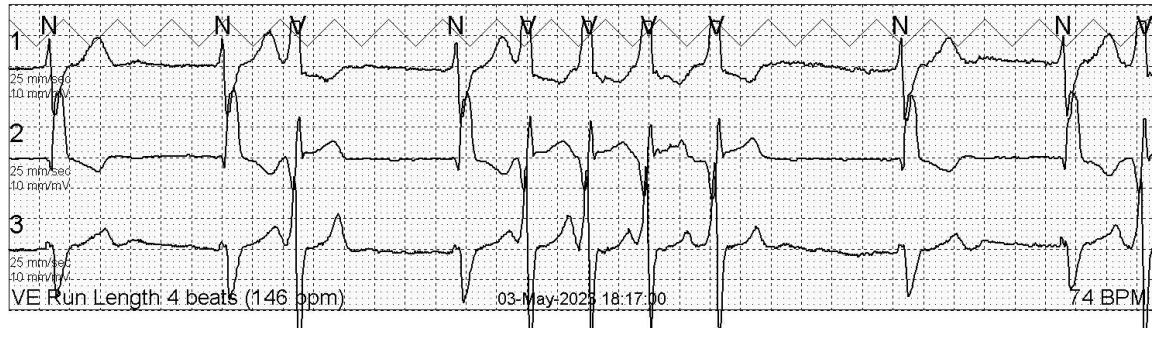

R-R Pause 2120 ms
03-May-2023 18:31:54
60 BPM


VE Run Length 3 beats (148 bpm)
03-May-2023 17:02:11
93 BPM


Atrial Fib Duration 1392:01
03-May-2023 18:52:29
80 BPM


VE Run Length 4 beats (145 bpm)
03-May-2023 17:37:16
91 BPM


Atrial Fib Duration 1392:01
03-May-2023 19:03:48
39 BPM


VE Run Length 4 beats (146 bpm)
03-May-2023 18:17:00
74 BPM

빈 맥

- NCT -

NCT types

- Sinus tachycardia
- SNRT
- Atrial tachycardia(Focal)
- Atrial tachycardia(Macroreentrant)
- Junctional tachycardia
- AF
- AFL
- AVNRT
- Orthodromic AVRT
- Orthodromic AVRT with unusual APs (atriofascicular, atrioventricular, nodofasicular, nodoventricular)
- Parahisian VT
- Fascicular VT

Tachycardia

Mechanism

- Focal
- Reentry

Tachycardia

Mechanism

- Focal (Automaticity, triggered activity, Microreentry)
- Reentry

* AF

Tachycardia

Mechanism

- Focal
- Reentry

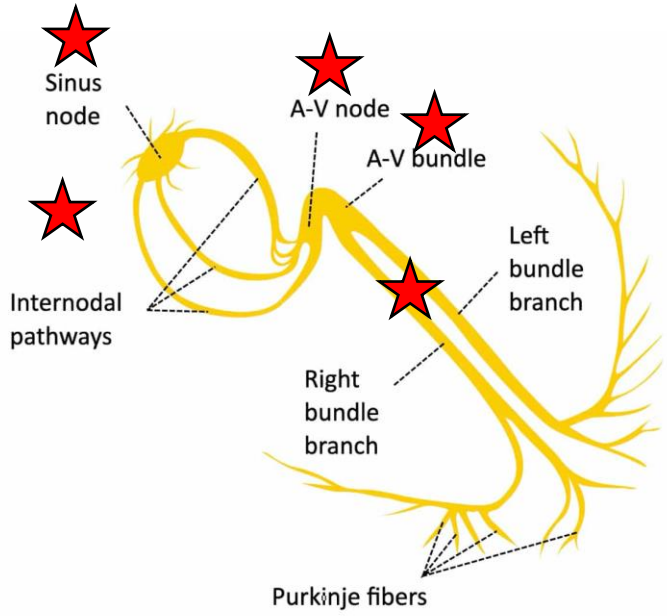
QRS complex morphology

- Narrow
- Wide

Tachycardia

Mechanism

- Focal
- Reentry



QRS complex morphology

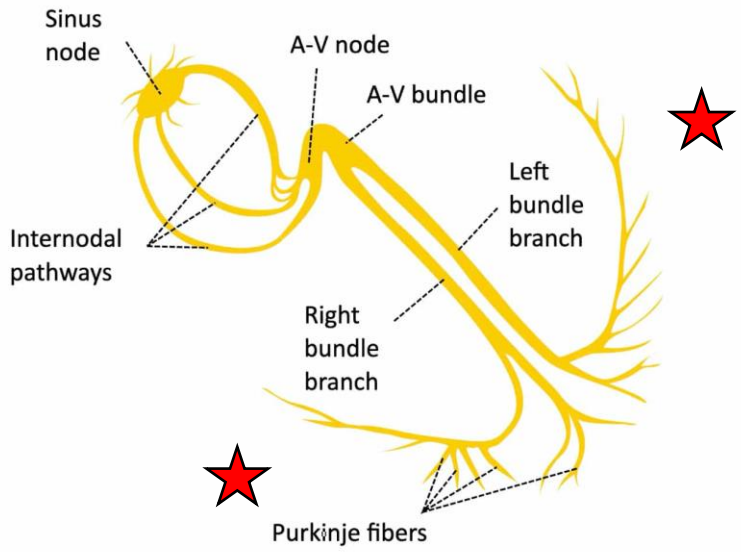
- Narrow → V-activation using His-Purkinje

  SV-origin, V near HP origin
- Wide

Tachycardia

Mechanism

- Focal
- Reentry



QRS complex morphology

- Narrow → V-activation using His-Purkinje

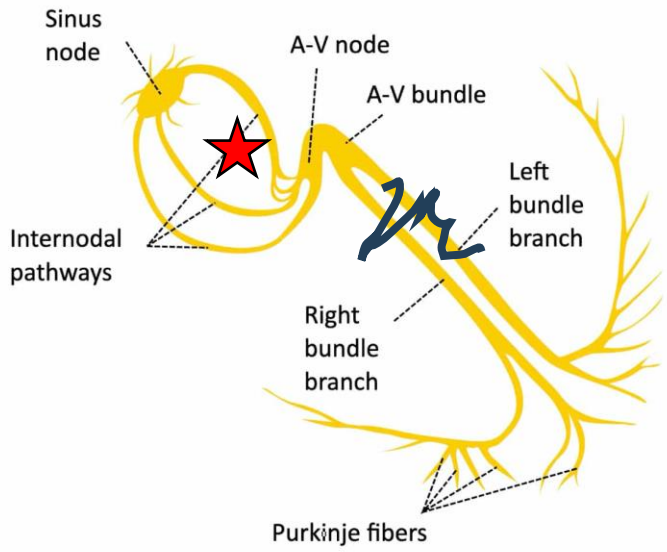
  SV-origin, V near HP origin
- Wide → V-activation via myocardium

  Aberrant conduction

Tachycardia

Mechanism

- Focal
- Reentry



QRS complex morphology

- Narrow → V-activation using His-Purkinje

  SV-origin, V near HP origin
- Wide → V-activation via myocardium

  Aberrant conduction

Tachycardia

Mechanism

- Focal
- Reentry

QRS complex morphology

- Narrow → V-activation using His-Purkinje
  SV-origin, V near HP origin
- Wide → V-activation via myocardium
  Aberrant conduction

Narrow complex tachycardia (NCT)

2 mechanisms × 2 origins

NCT

Mechanism

- Focal
- Reentry

QRS complex morphology

- Narrow → V-activation using His-Purkinje

  SV-origin, V near HP origin

- ST, AT(Focal), JT

NCT

Mechanism	QRS complex morphology	
• Focal	• Narrow →	V-activation using His-Purkinje
• Reentry		SV-origin, V near HP origin

- ST, AT(focal, macroreentrant), JT
- SNRT, AVNRT, AVRT(orthodromic), AFL

NCT

Mechanism	QRS complex morphology	
• Focal	• Narrow →	V-activation using His-Purkinje
• Reentry		SV-origin, V near HP origin

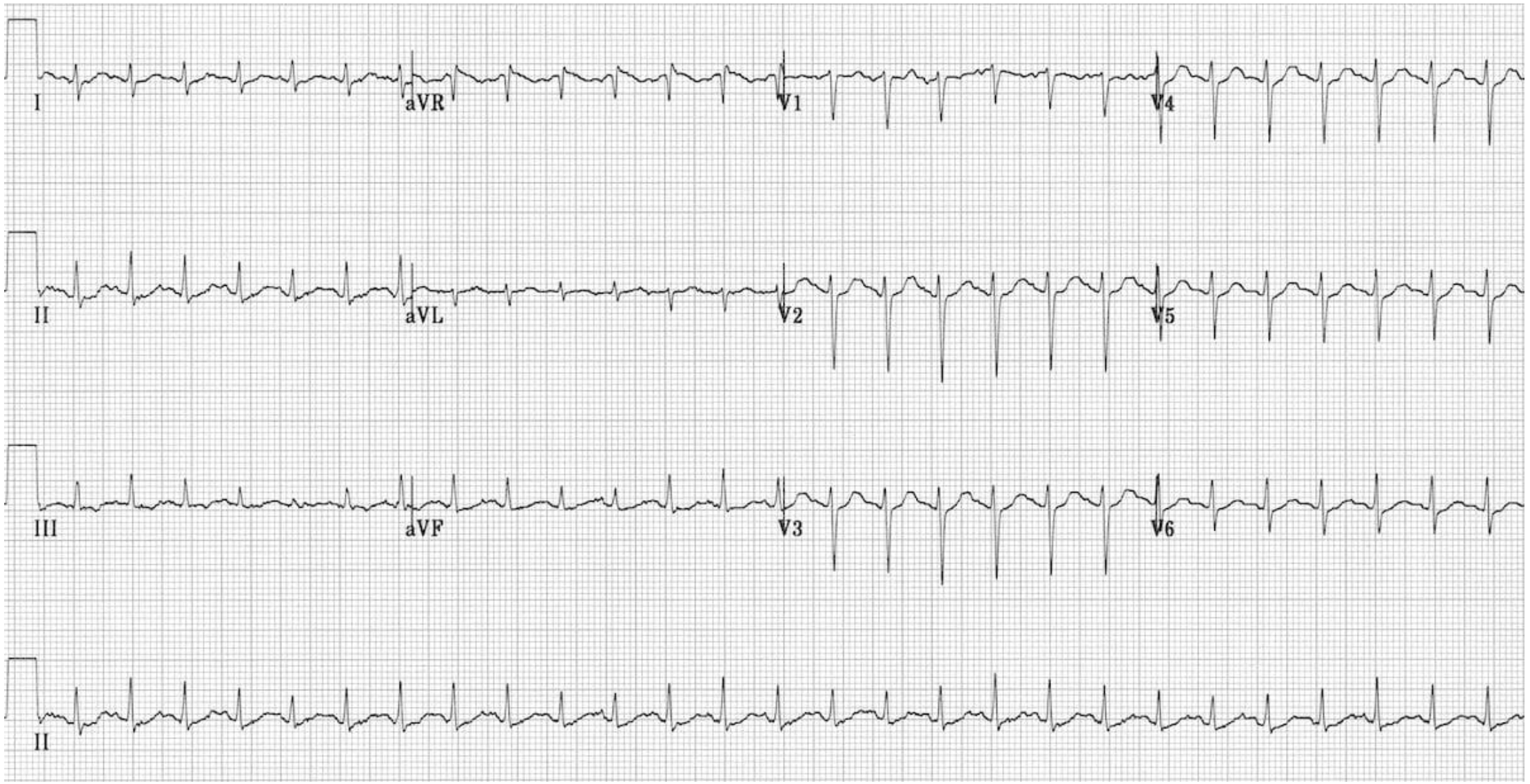
- ST, AT(focal, macroreentrant), JT
- SNRT, AVNRT, AVRT(orthodromic), AFL
- Parahisian VT

NCT

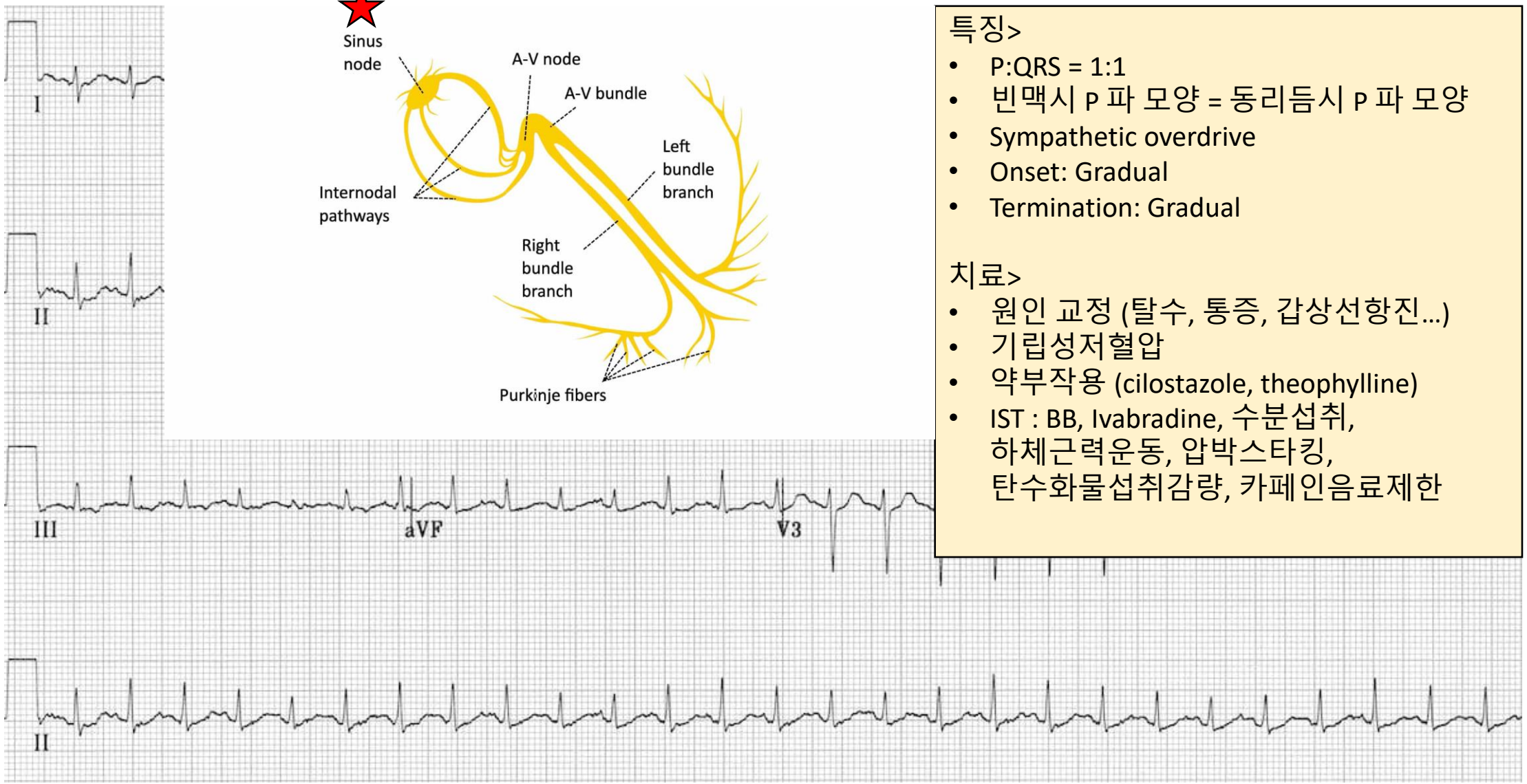
Mechanism	QRS complex morphology	
• Focal	• Narrow →	V-activation using His-Purkinje
• Reentry		SV-origin, V near HP origin

- ST, AT(focal, macroreentrant), JT
- SNRT, AVNRT, AVRT(orthodromic), AFL
- Parahisian VT, Fascicular VT

ST



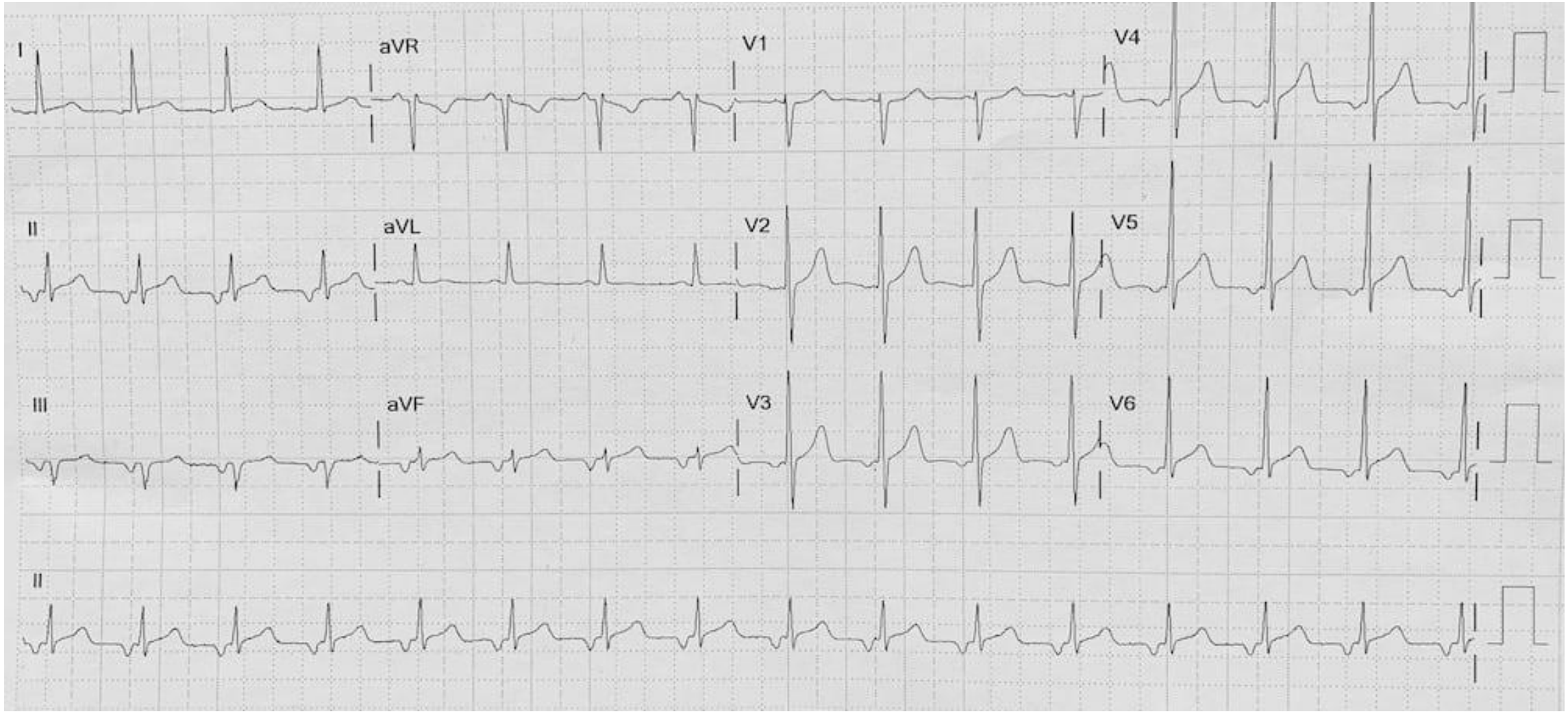
ST



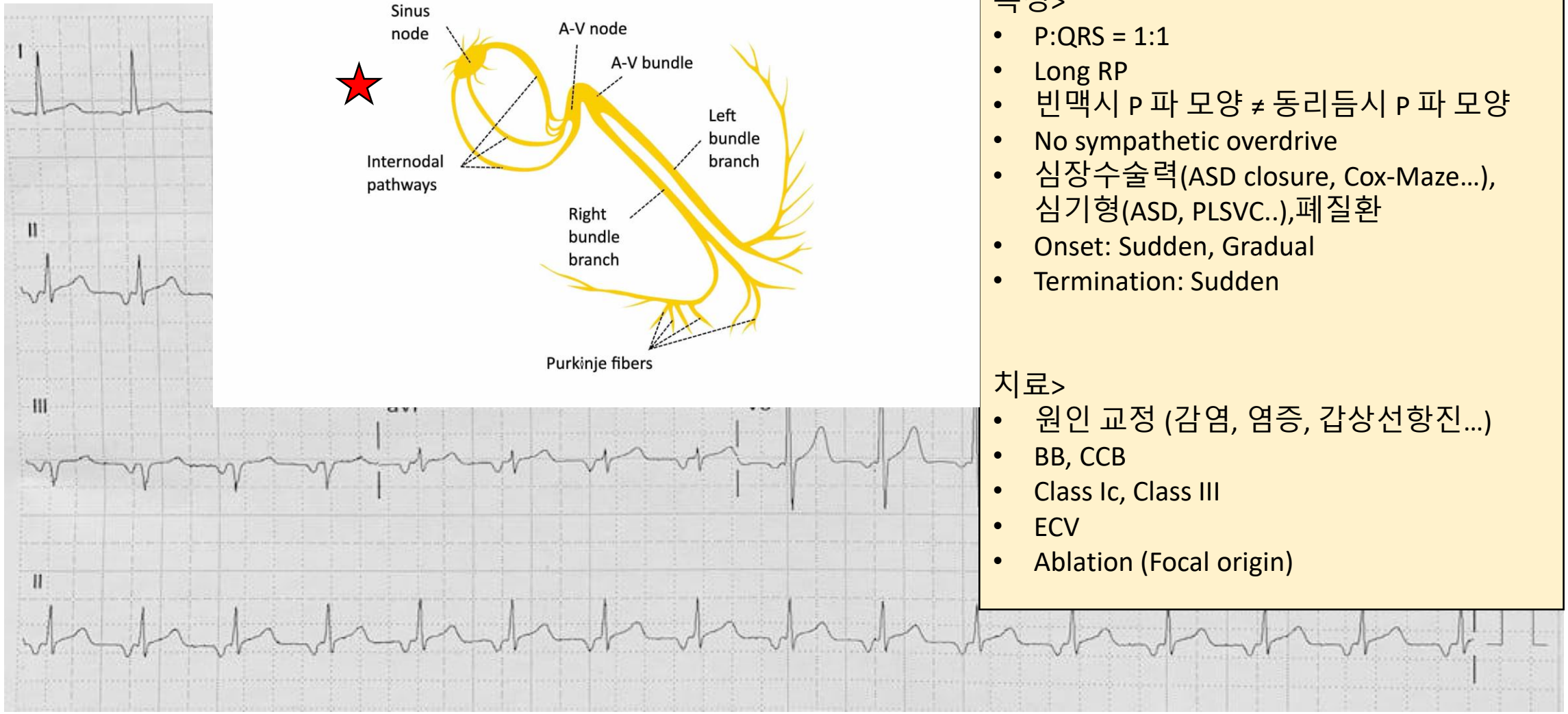
특징>
- P:QRS = 1:1
- 빈맥시 P 파 모양 = 동리듬시 P 파 모양
- Sympathetic overdrive
- Onset: Gradual
- Termination: Gradual

치료>
- 원인 교정 (탈수, 통증, 갑상선항진…)
- 기립성저혈압
- 약부작용 (cilostazole, theophylline)
- IST : BB, Ivabradine, 수분섭취, 하체근력운동, 압박스타킹, 탄수화물섭취감량, 카페인음료제한

AT(focal)



AT(focal)



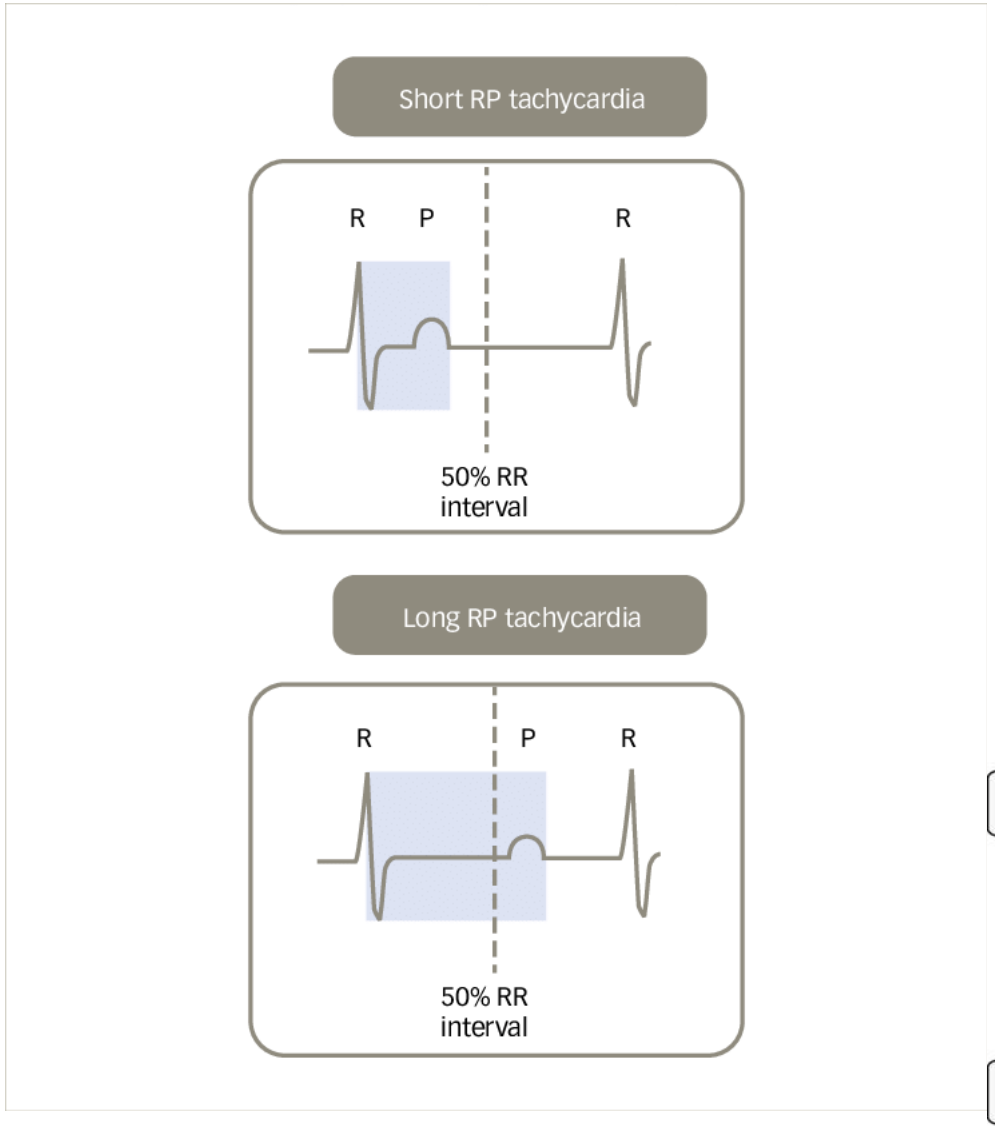
특징>

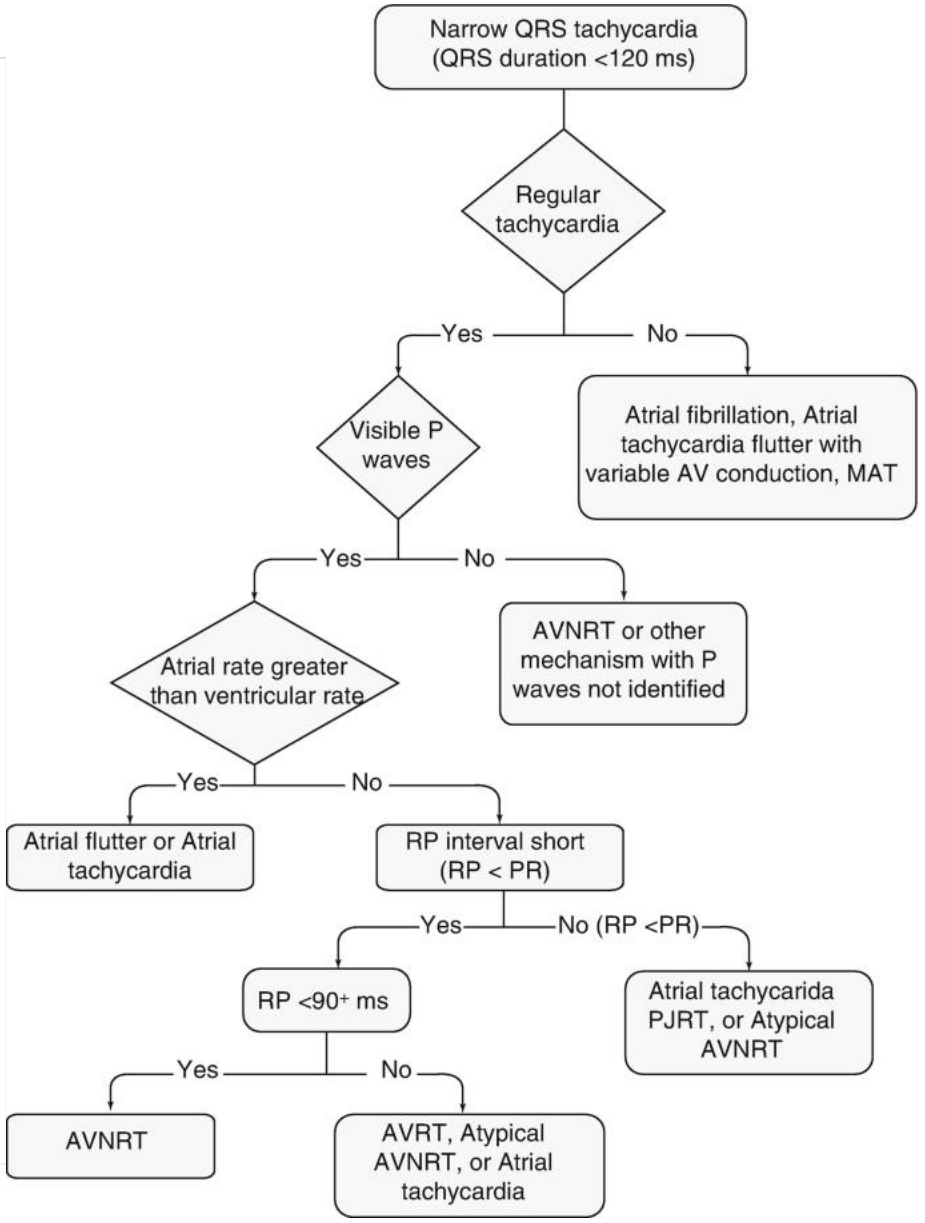
- P:QRS = 1:1
- Long RP
- 빈맥시 P 파 모양 ≠ 동리듬시 P 파 모양
- No sympathetic overdrive
- 심장수술력(ASD closure, Cox-Maze…), 심기형(ASD, PLSVC..),폐질환
- Onset: Sudden, Gradual
- Termination: Sudden

치료>

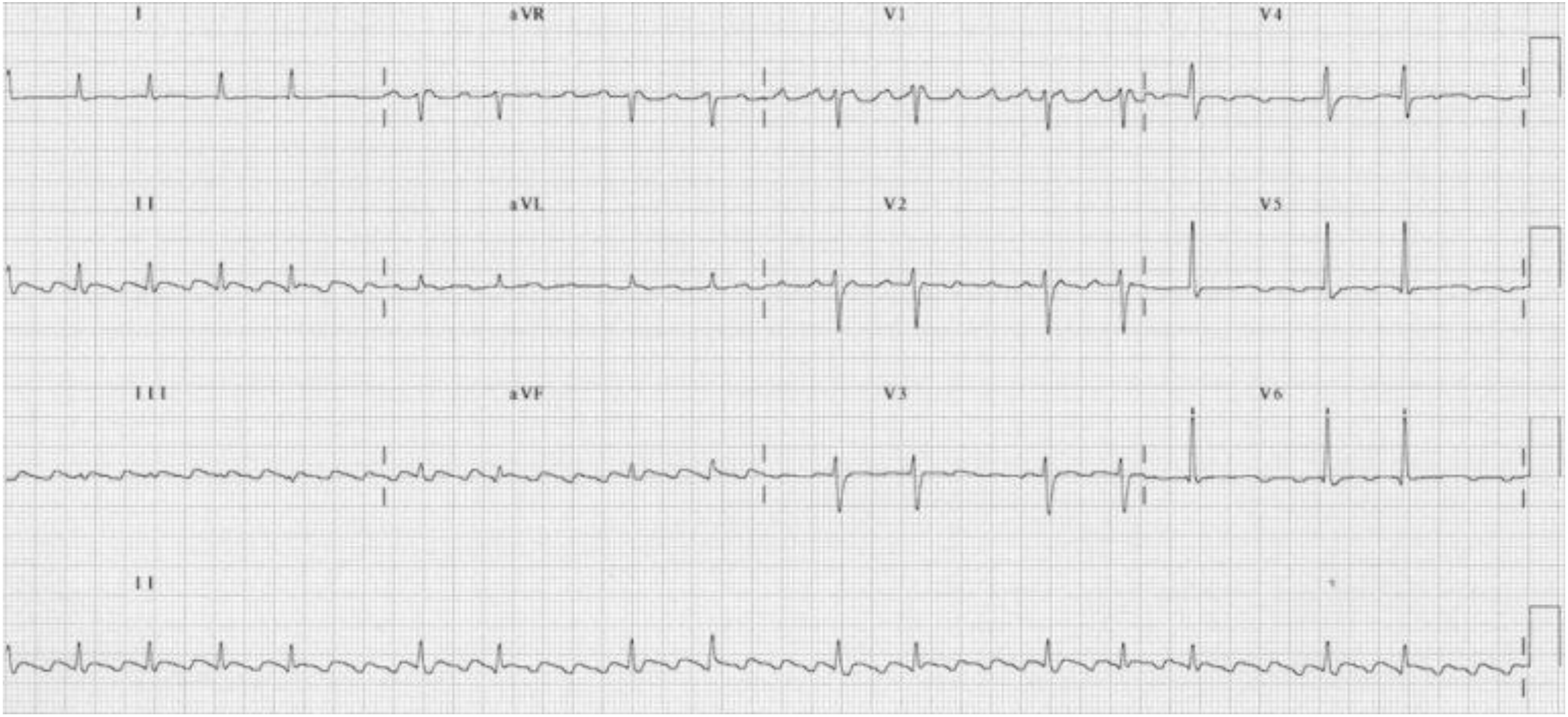
- 원인 교정 (감염, 염증, 갑상선항진…)
- BB, CCB
- Class Ic, Class III
- ECV
- Ablation (Focal origin)

Long RP vs. Short RP

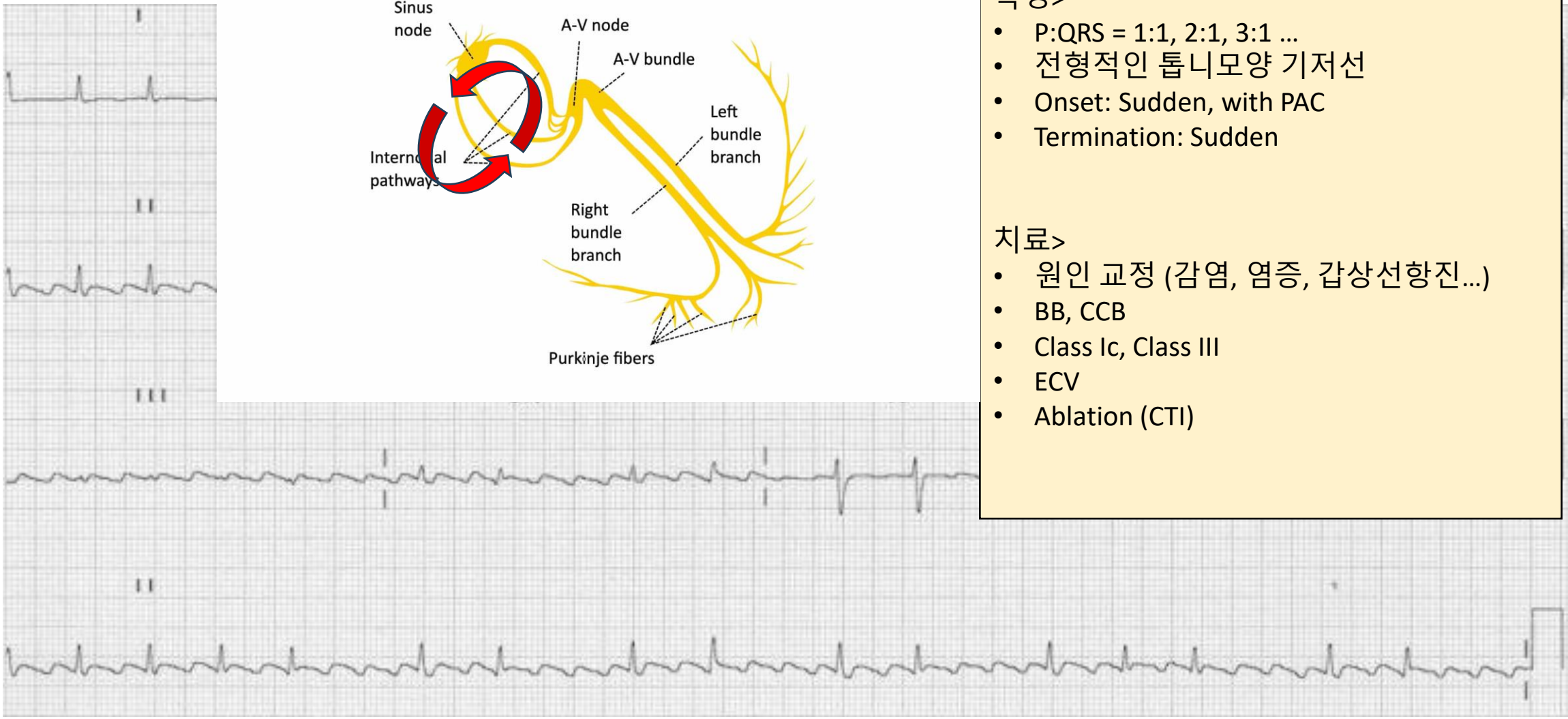




AFL



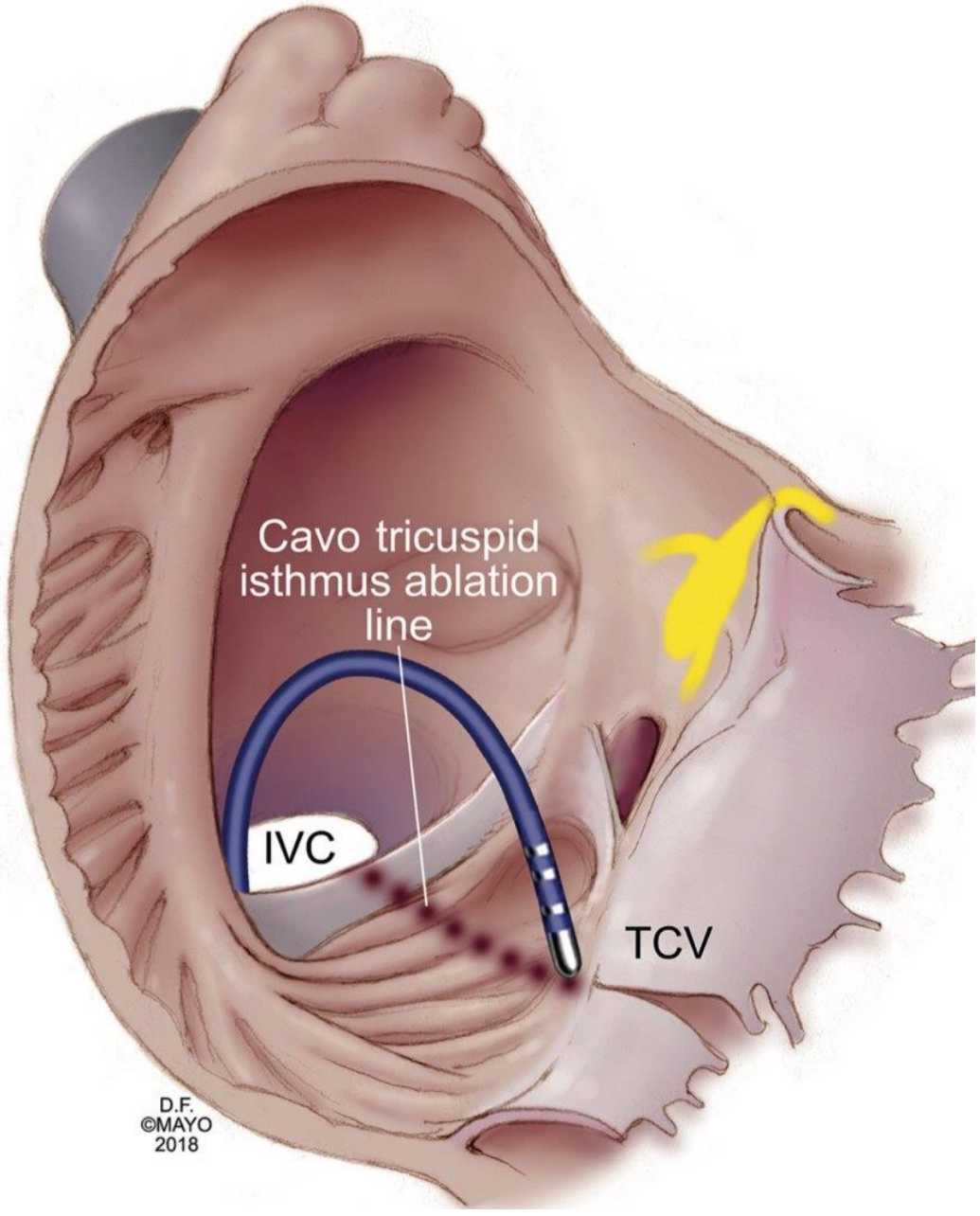
AFL



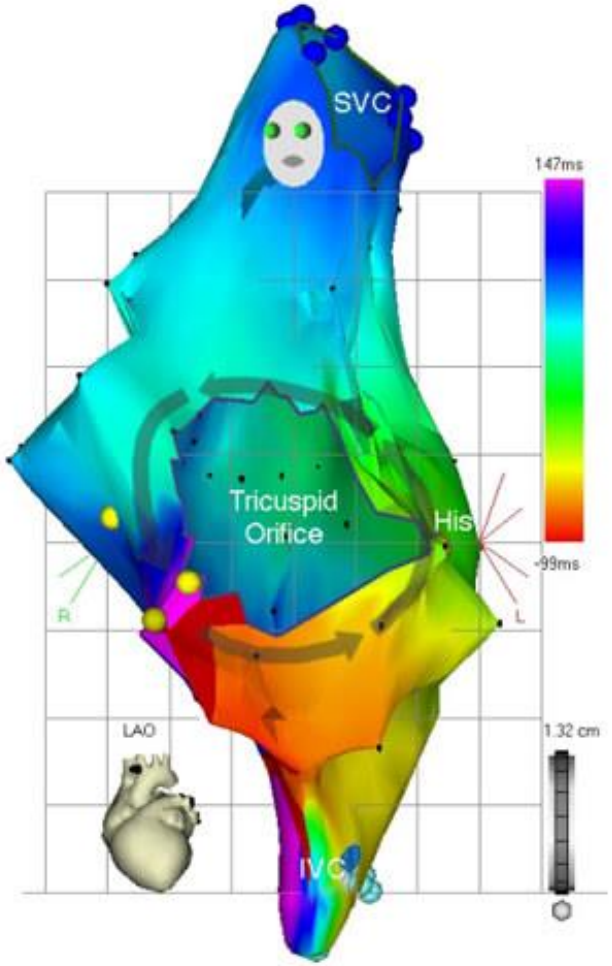
특징>
- P:QRS = 1:1, 2:1, 3:1 …
- 전형적인 톱니모양 기저선
- Onset: Sudden, with PAC
- Termination: Sudden

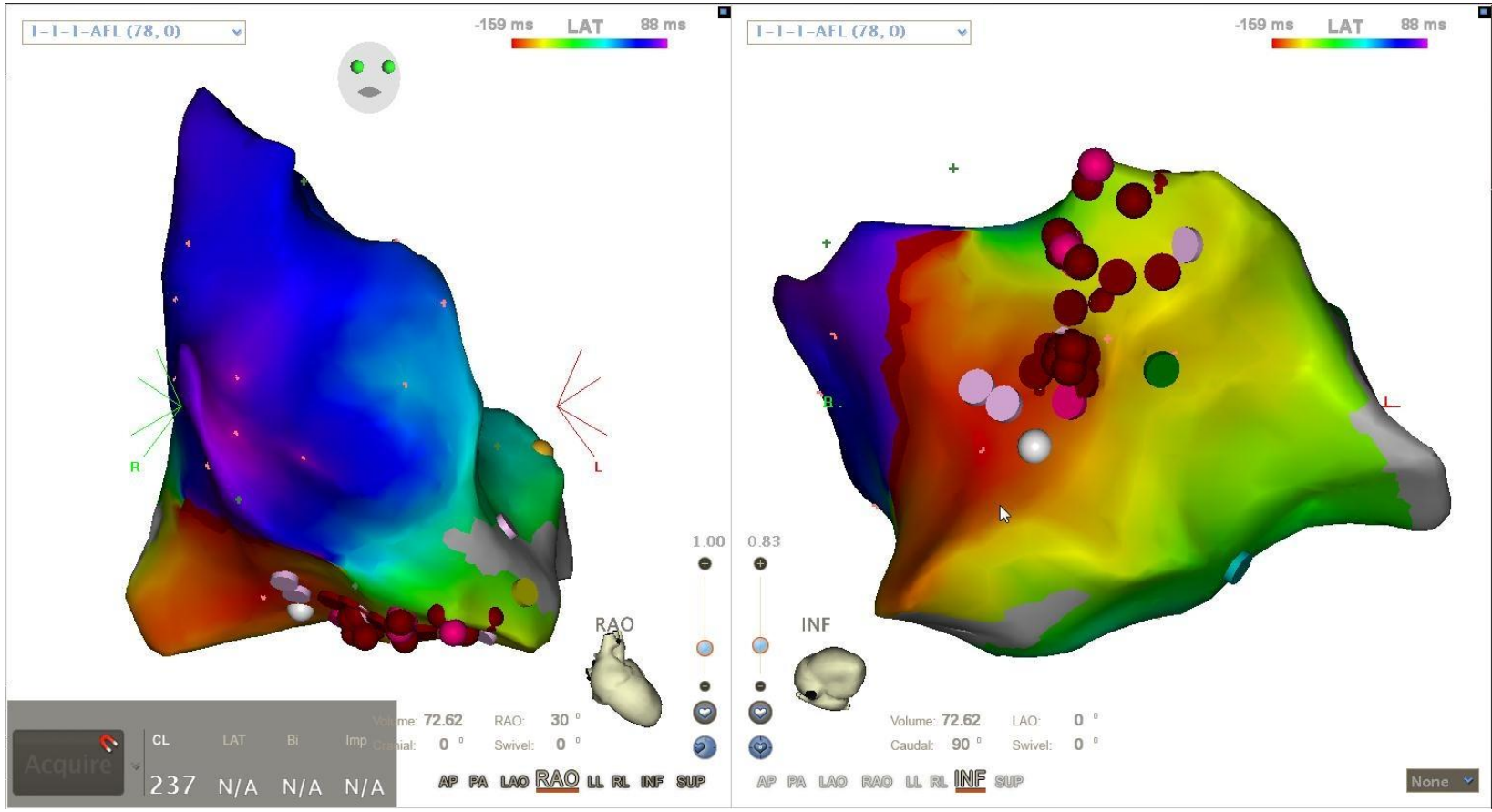
치료>
- 원인 교정 (감염, 염증, 갑상선항진…)
- BB, CCB
- Class Ic, Class III
- ECV
- Ablation (CTI)

AFL

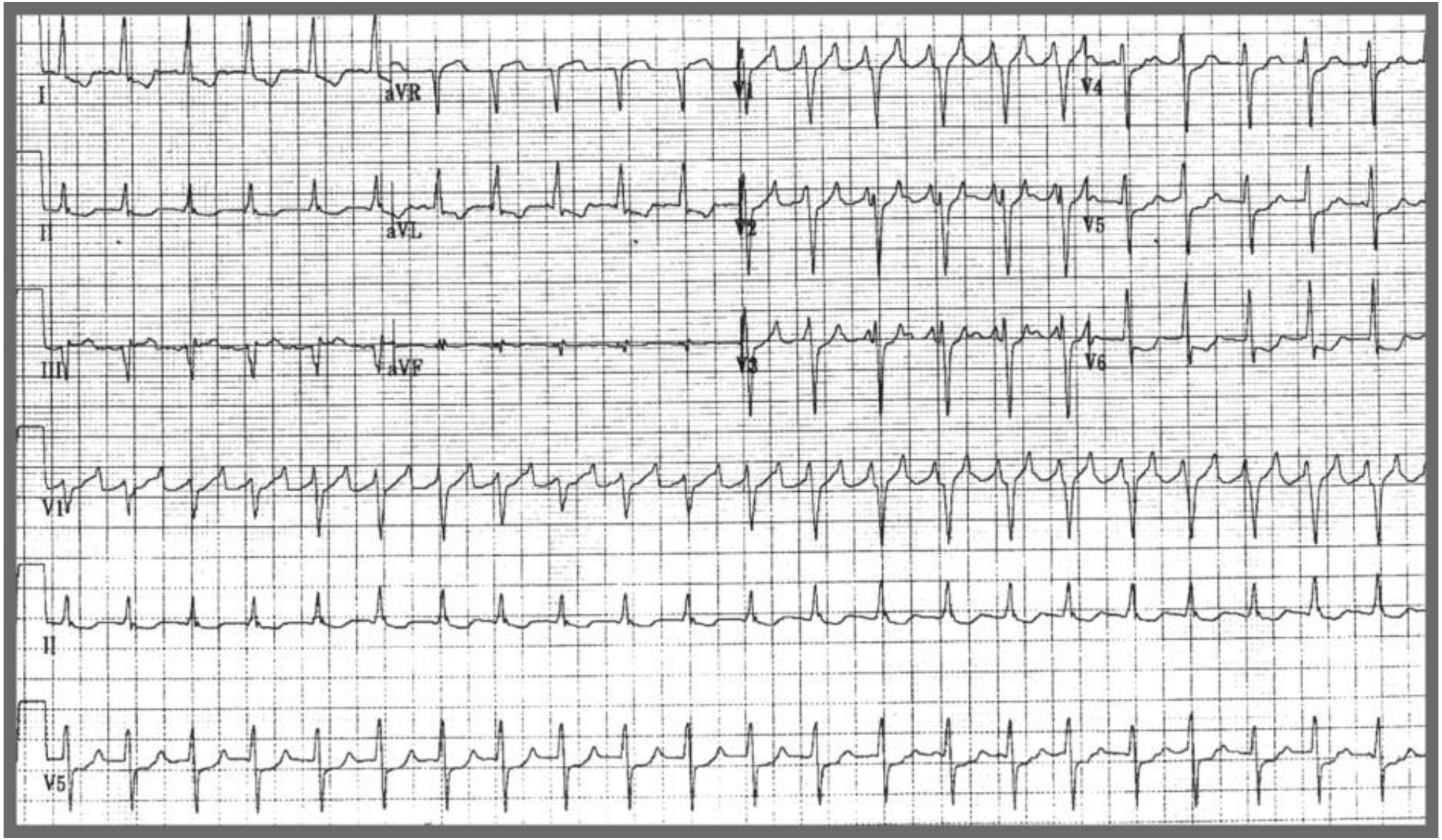


AFL

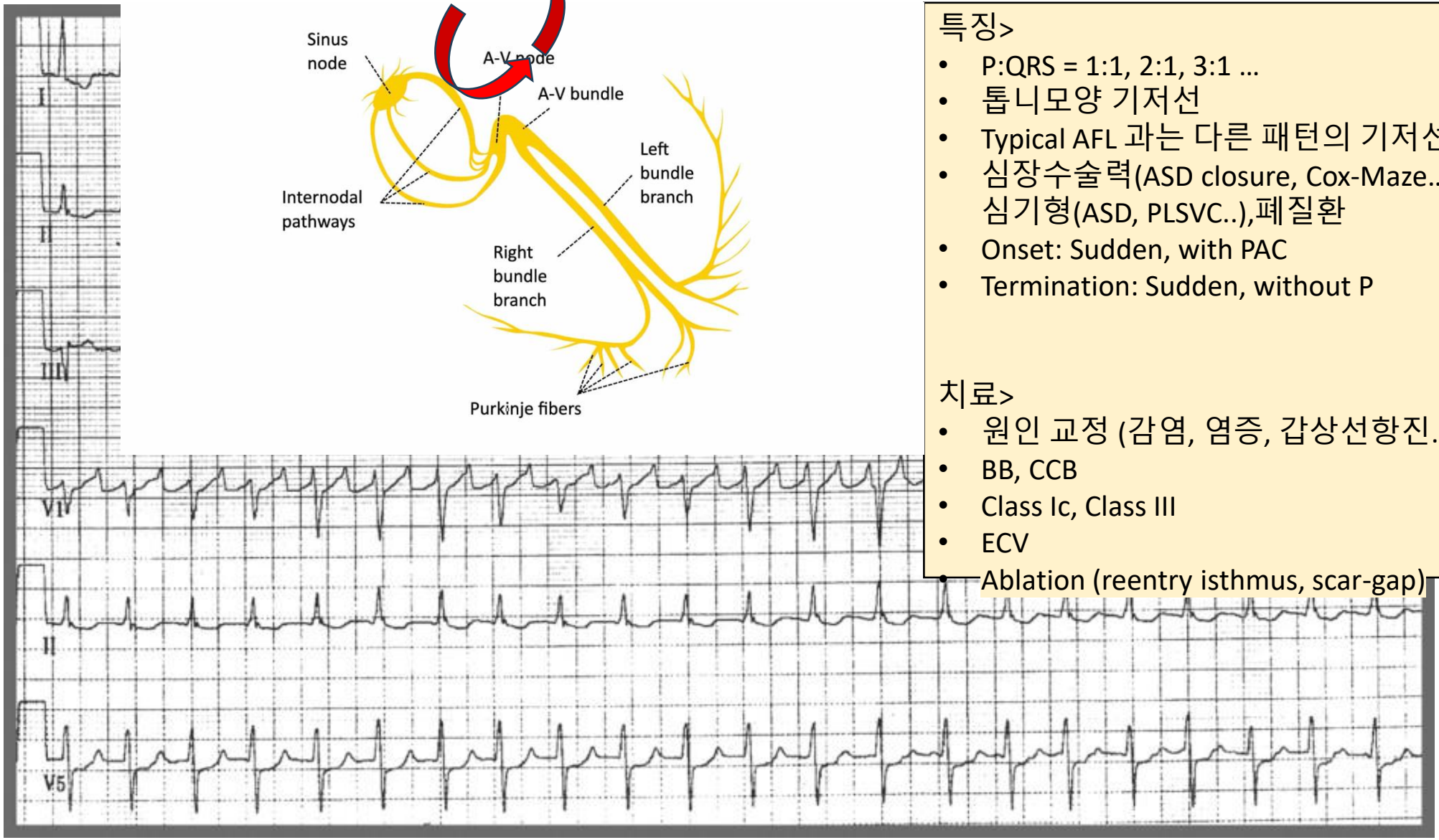

SVC
147ms
Tricuspid
Orifice
His
-99ms
R
L
LAO
1.32 cm
IVC


1-1-1-AFL (78, 0)
-159 ms
LAT
88 ms
R
L
RAO
1.00
Acquire
CL
LAT
Bi
Imp
237
N/A
N/A
N/A
Volume: 72.62
RAO: 30 °
Cranial: 0 °
Swivel: 0 °
AP PA LAO RAO LL RL INF SUP
1-1-1-AFL (78, 0)
-159 ms
LAT
88 ms
0.83
INF
Volume: 72.62
LAO: 0 °
Caudal: 90 °
Swivel: 0 °
AP PA LAO RAO LL RL INF SUP
None

AT(macroreentry; atypical AFL)



AT(macroreentry; atypical AFL)



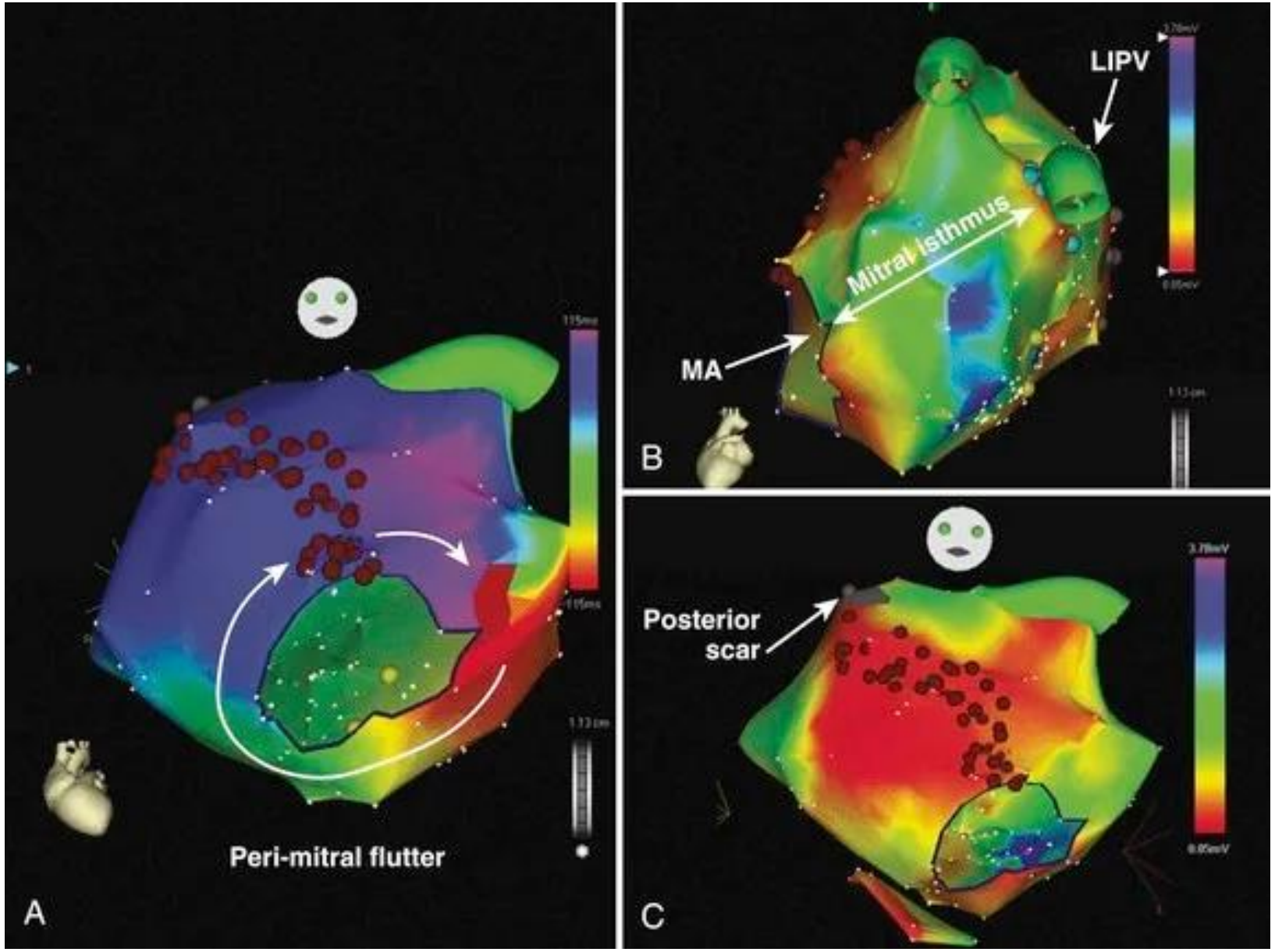
특징>

- P:QRS = 1:1, 2:1, 3:1 …
- 톱니모양 기저선
- Typical AFL 과는 다른 패턴의 기저선
- 심장수술력(ASD closure, Cox-Maze…), 심기형(ASD, PLSVC..),폐질환
- Onset: Sudden, with PAC
- Termination: Sudden, without P

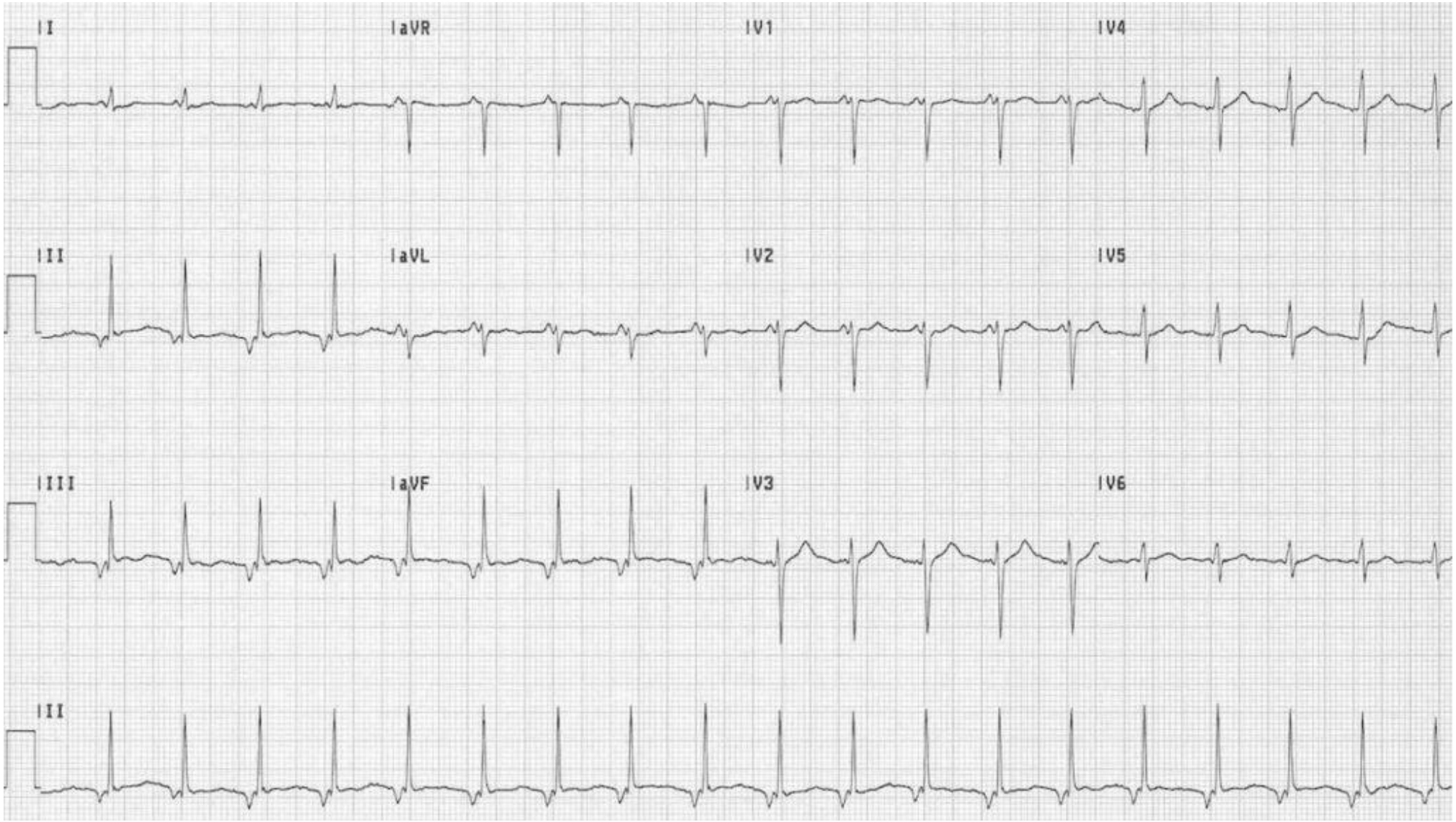
치료>

- 원인 교정 (감염, 염증, 갑상선항진…)
- BB, CCB
- Class Ic, Class III
- ECV
- Ablation (reentry isthmus, scar-gap)

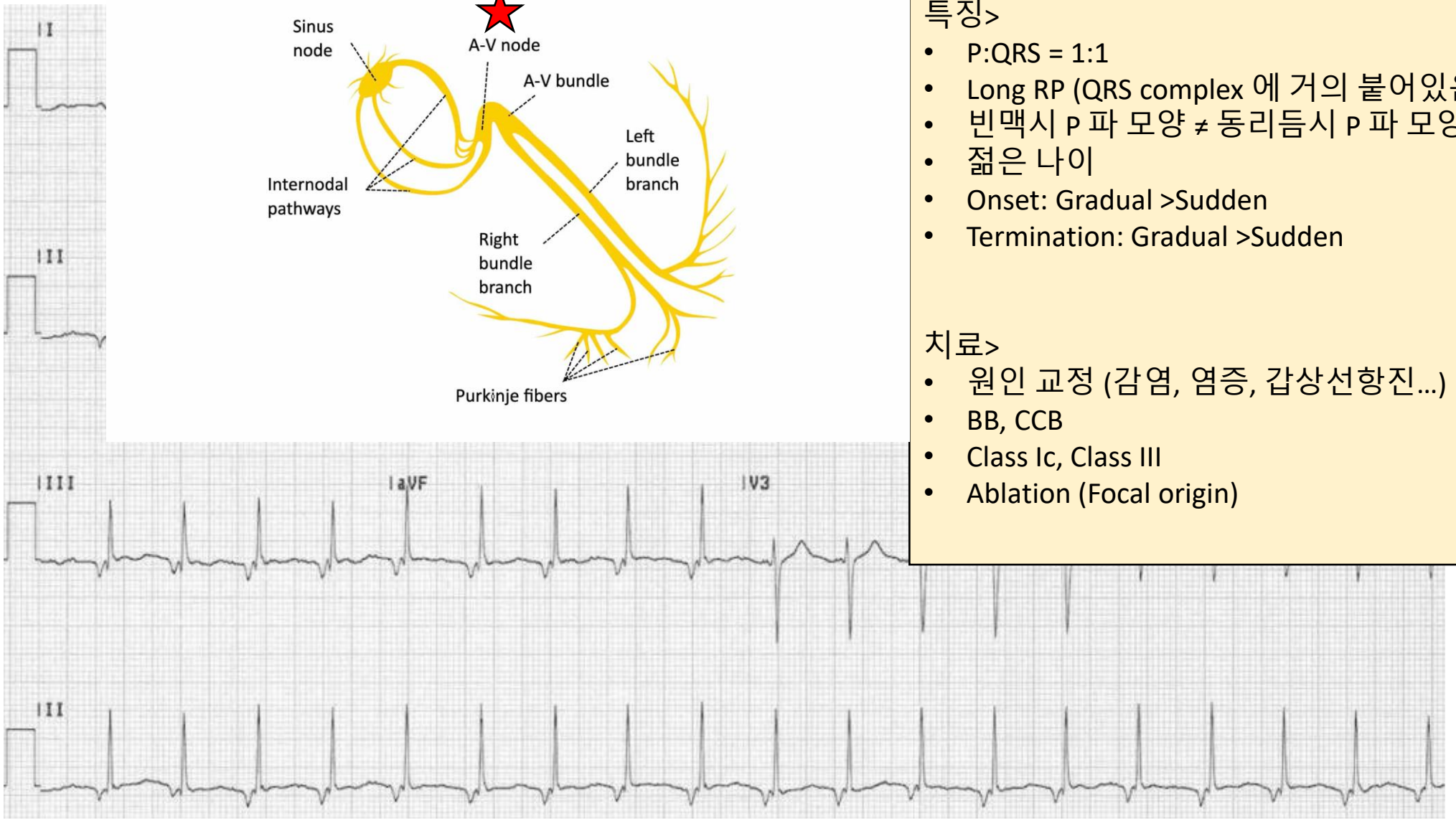
AT(macroreentry; atypical AFL)



JT



JT



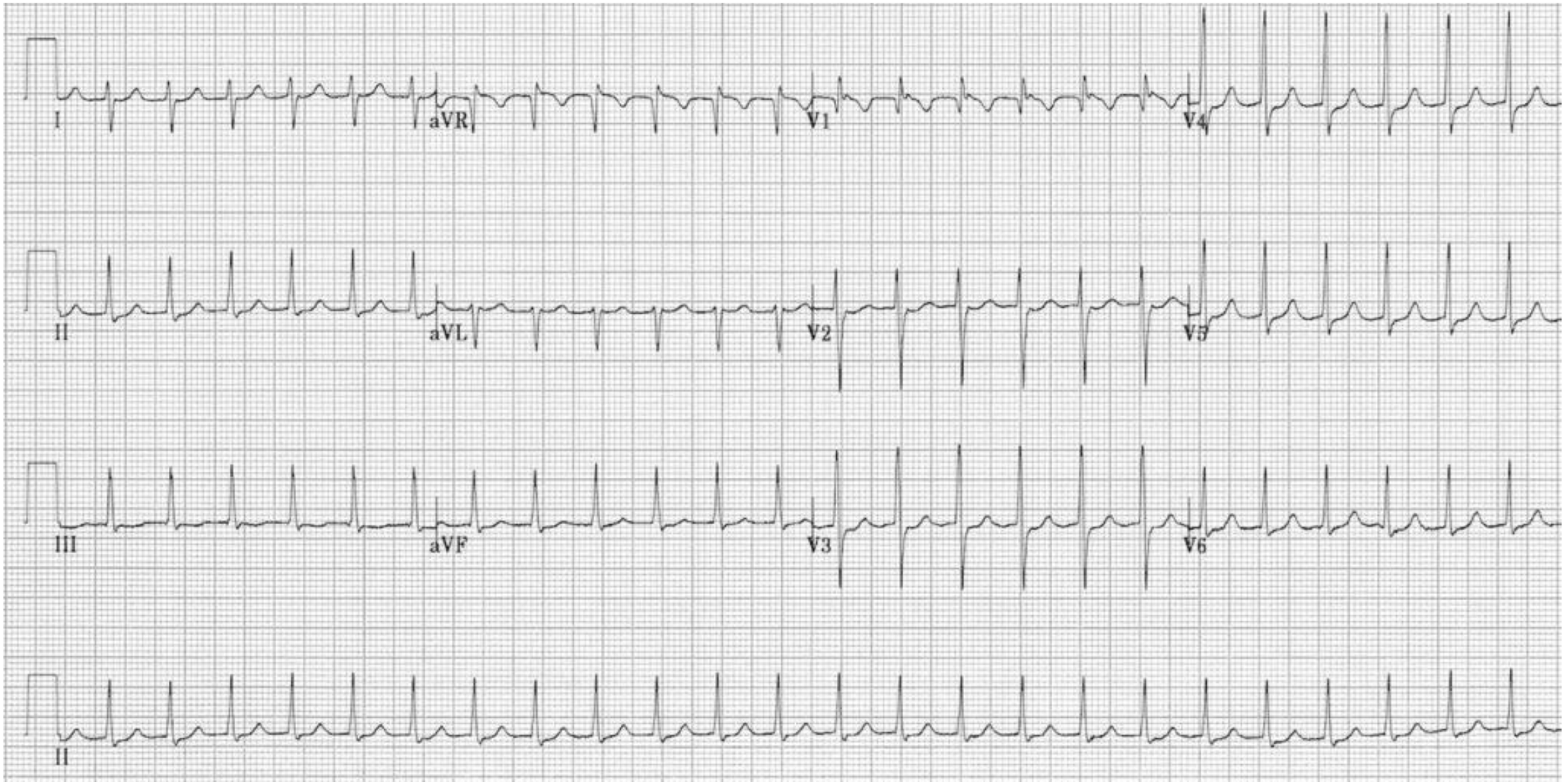
특징>

- P:QRS = 1:1
- Long RP (QRS complex 에 거의 붙어있음)
- 빈맥시 P 파 모양 ≠ 동리듬시 P 파 모양
- 젊은 나이
- Onset: Gradual >Sudden
- Termination: Gradual >Sudden

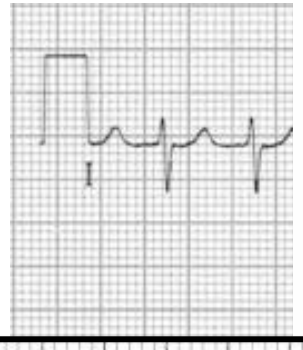
치료>

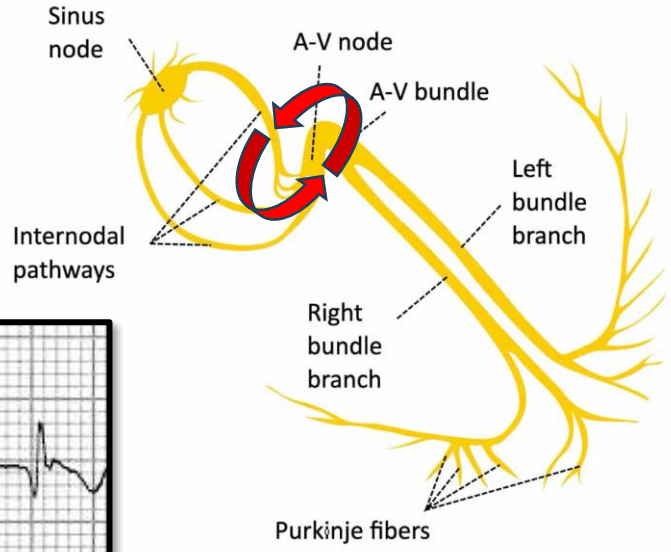
- 원인 교정 (감염, 염증, 갑상선항진…)
- BB, CCB
- Class Ic, Class III
- Ablation (Focal origin)

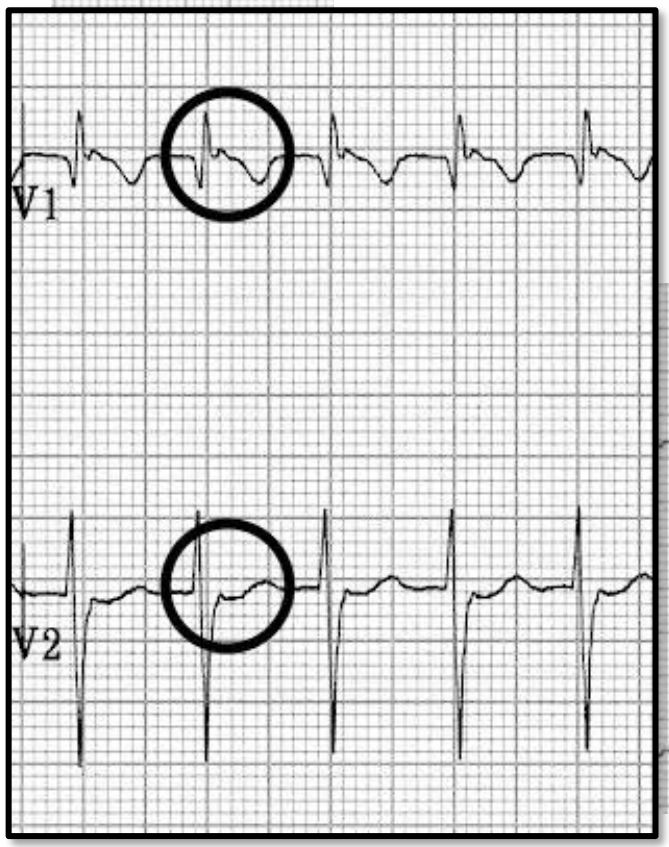
AVNRT (typical; slow-fast type)

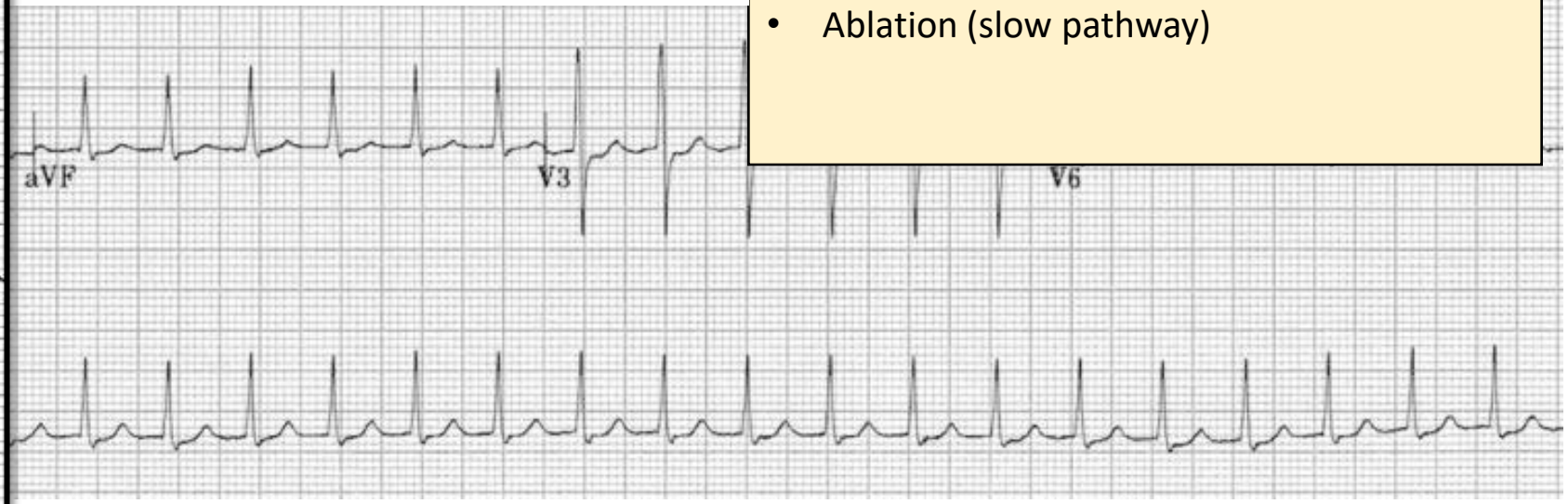


AVNRT (typical; slow-fast type)





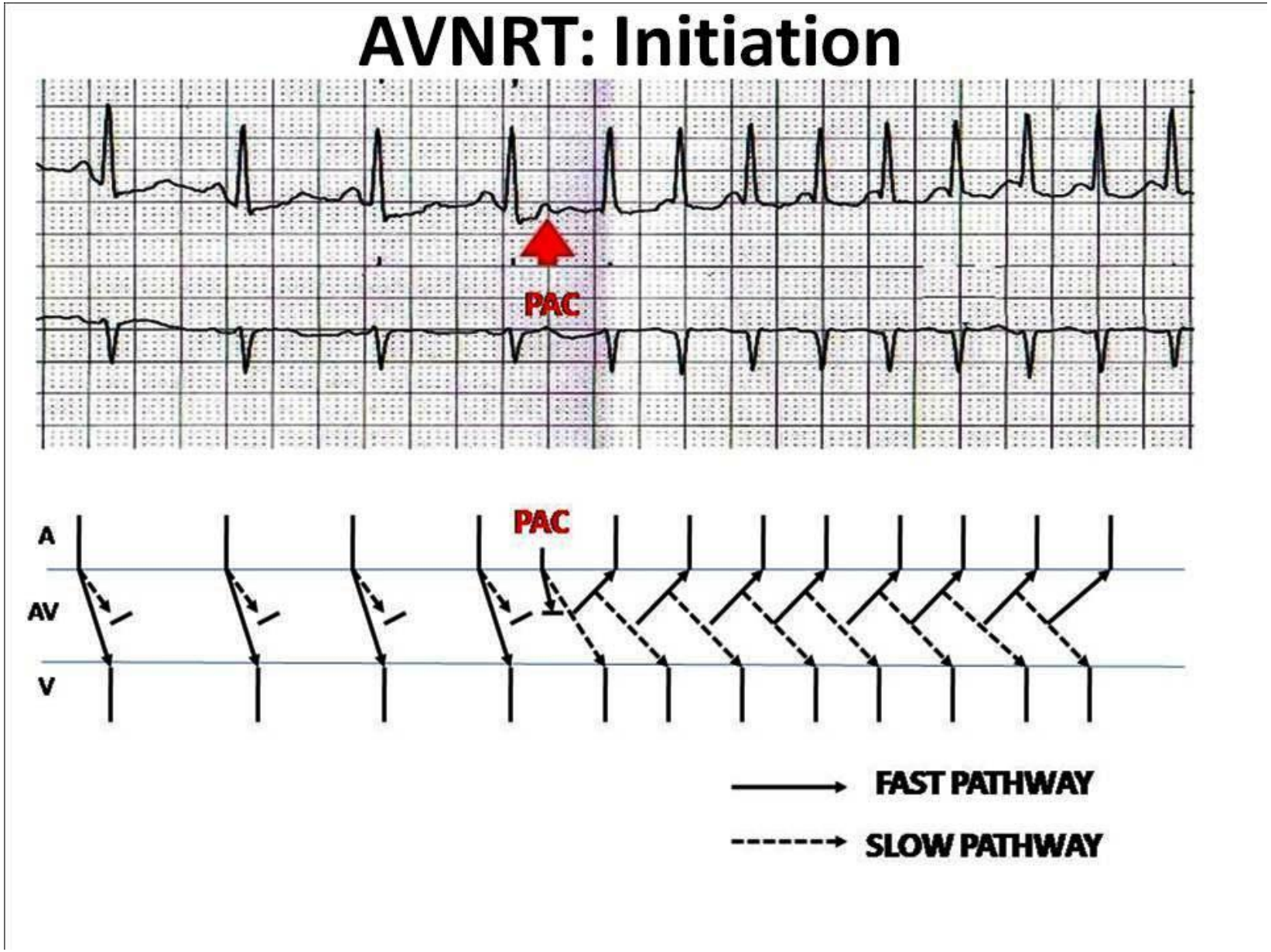




특징>
- P:QRS = 1:1
- Short RP (QRS complex 끝에 붙음)
- Retrograde P
- Onset: Sudden, with PAC
- Termination: Sudden, with retrograde P

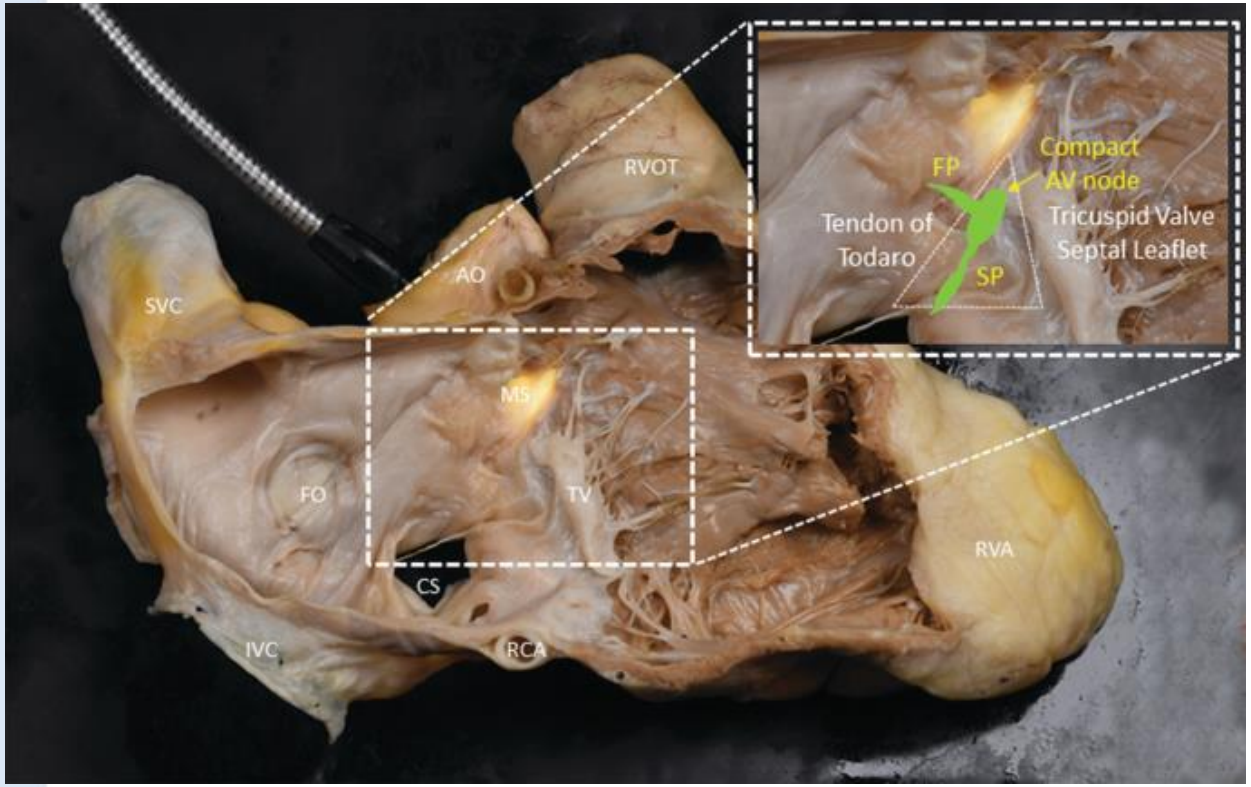
치료>
- BB, CCB
- Class Ic, Class III
- ECV
- Ablation (slow pathway)

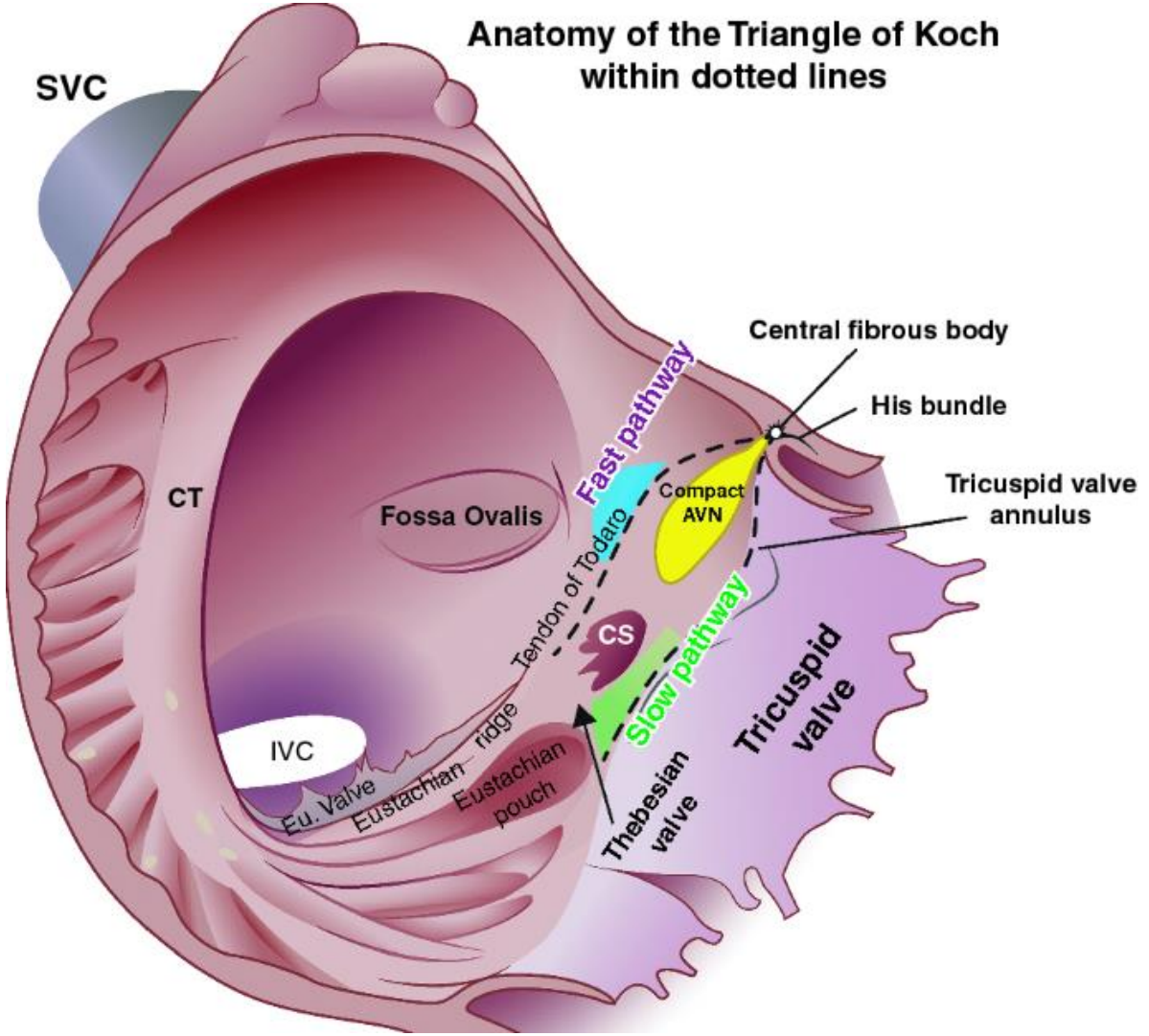
AVNRT (typical; slow-fast type)



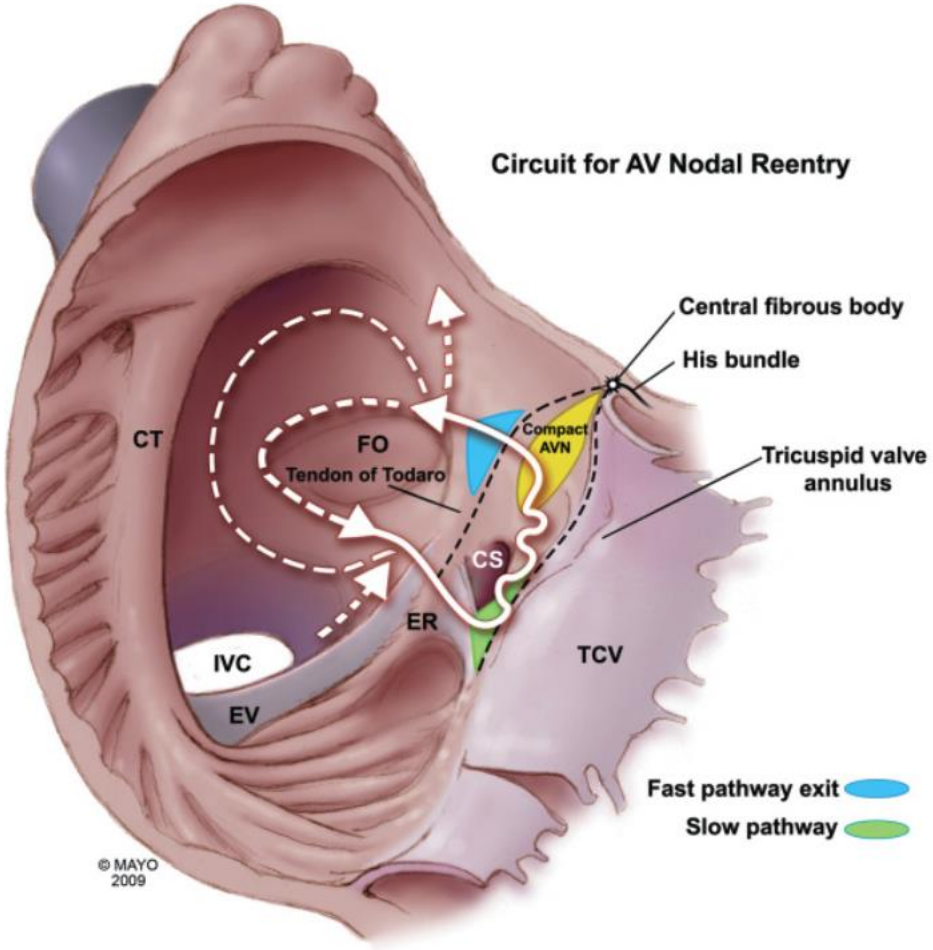
AVNRT (typical; slow-fast type)

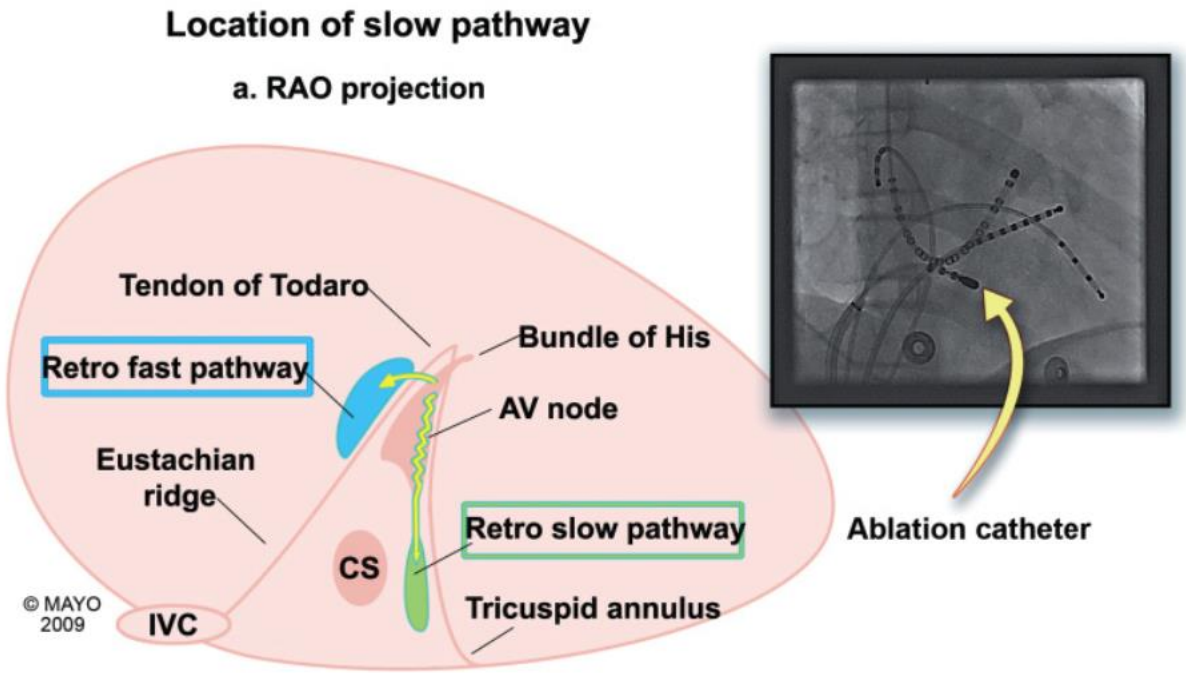
- Antegrade limb: Slow pathway
- Retrograde limb: Fast pathway



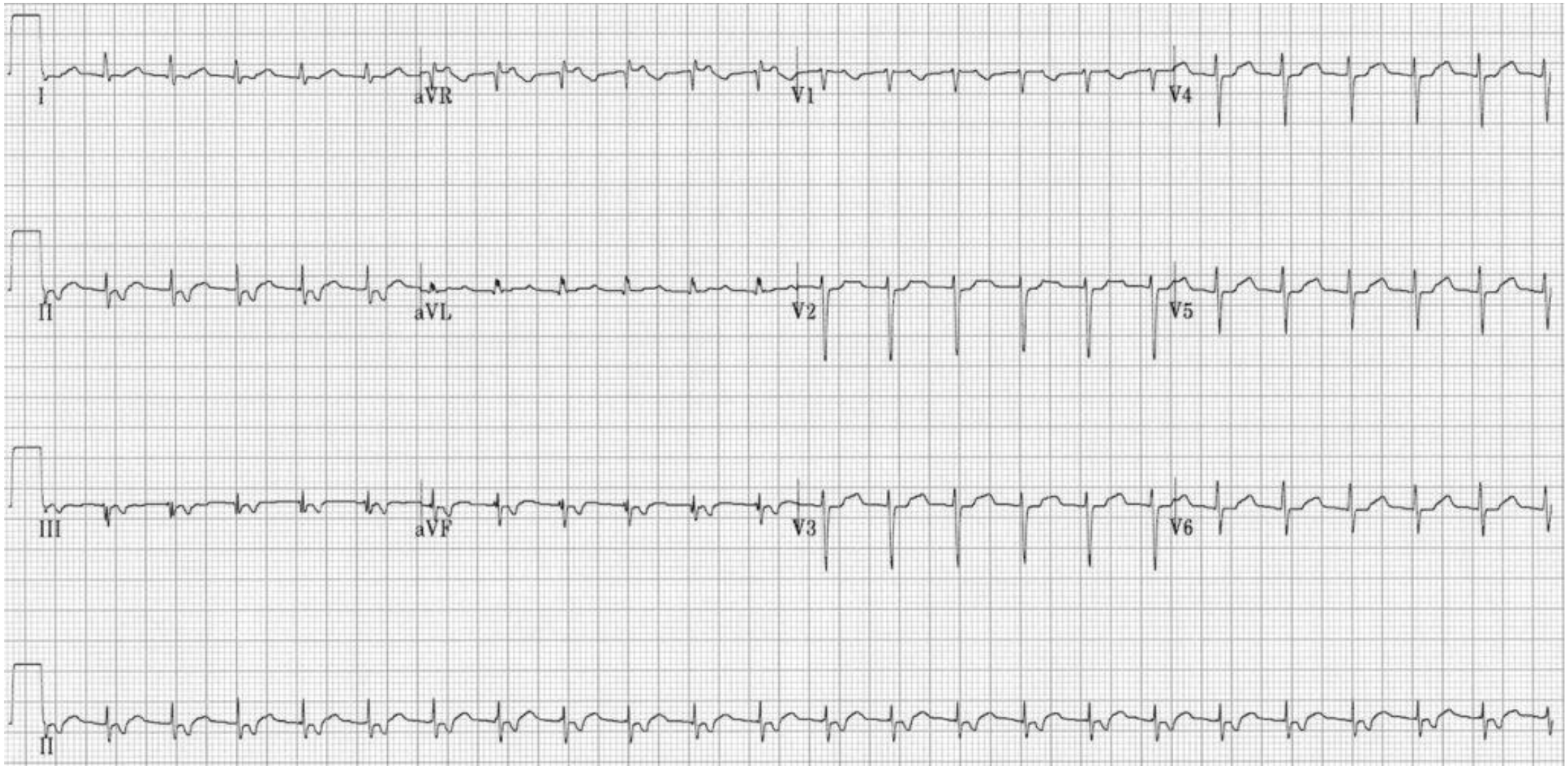


AVNRT (typical; slow-fast type)

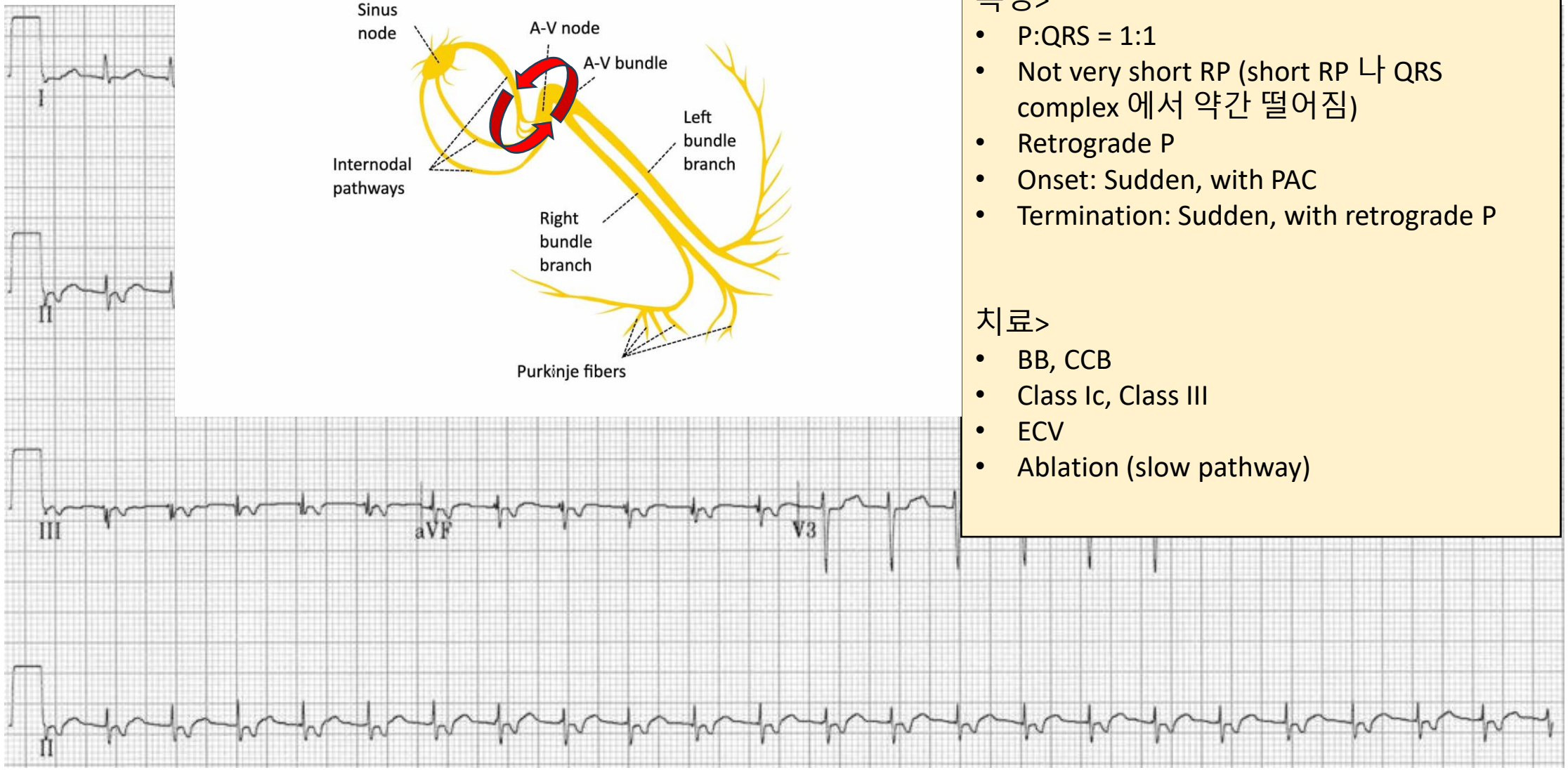




AVNRT (atypical)



AVNRT (atypical)



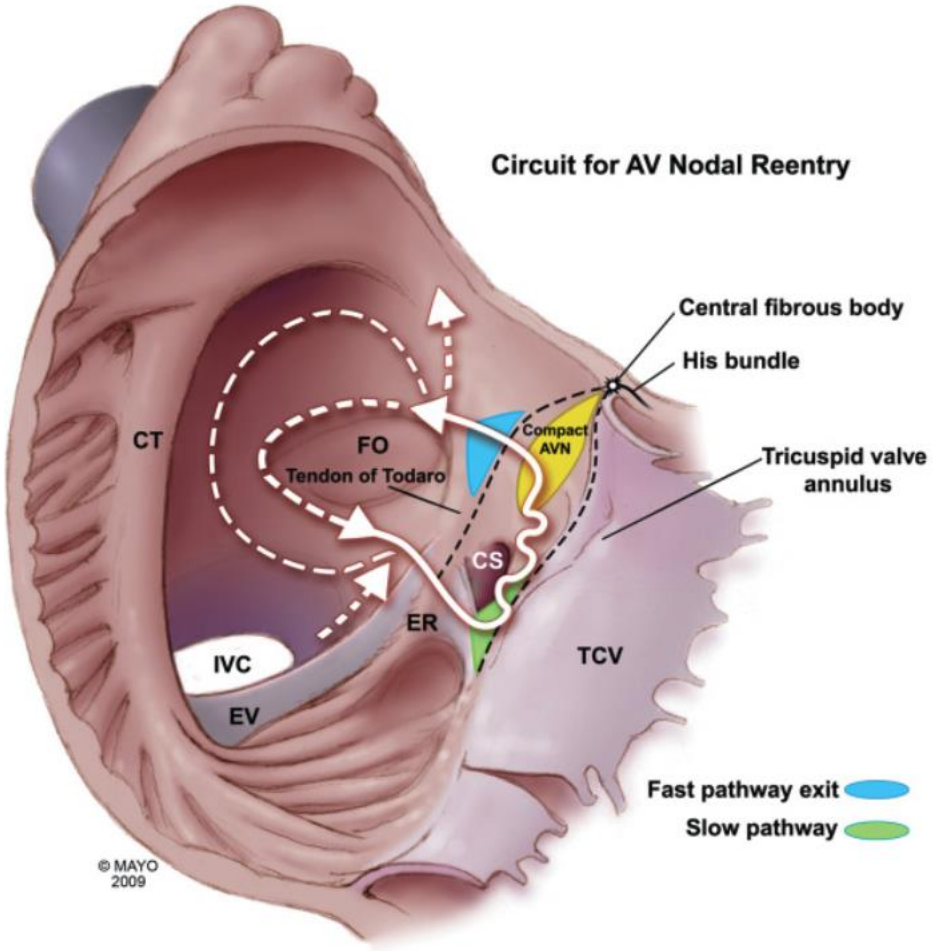
특징>

- P:QRS = 1:1
- Not very short RP (short RP 나 QRS complex 에서 약간 떨어짐)
- Retrograde P
- Onset: Sudden, with PAC
- Termination: Sudden, with retrograde P

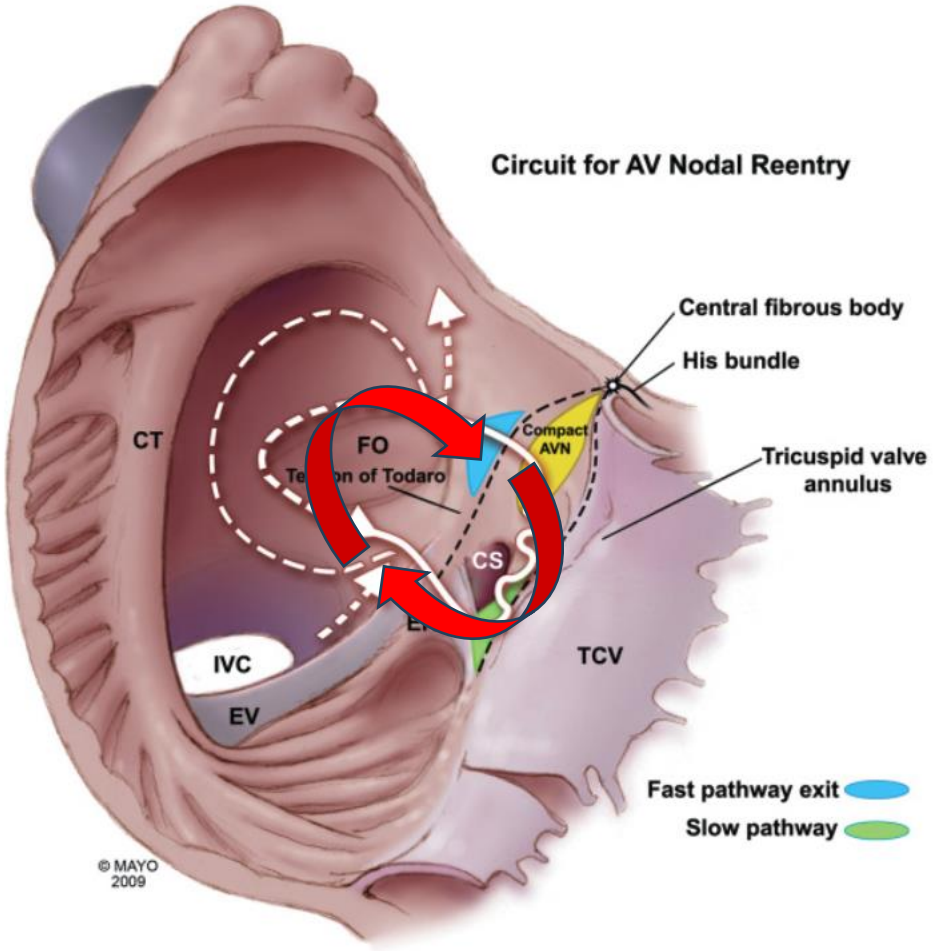
치료>

- BB, CCB
- Class Ic, Class III
- ECV
- Ablation (slow pathway)

AVNRT (atypical)



AVNRT (atypical)



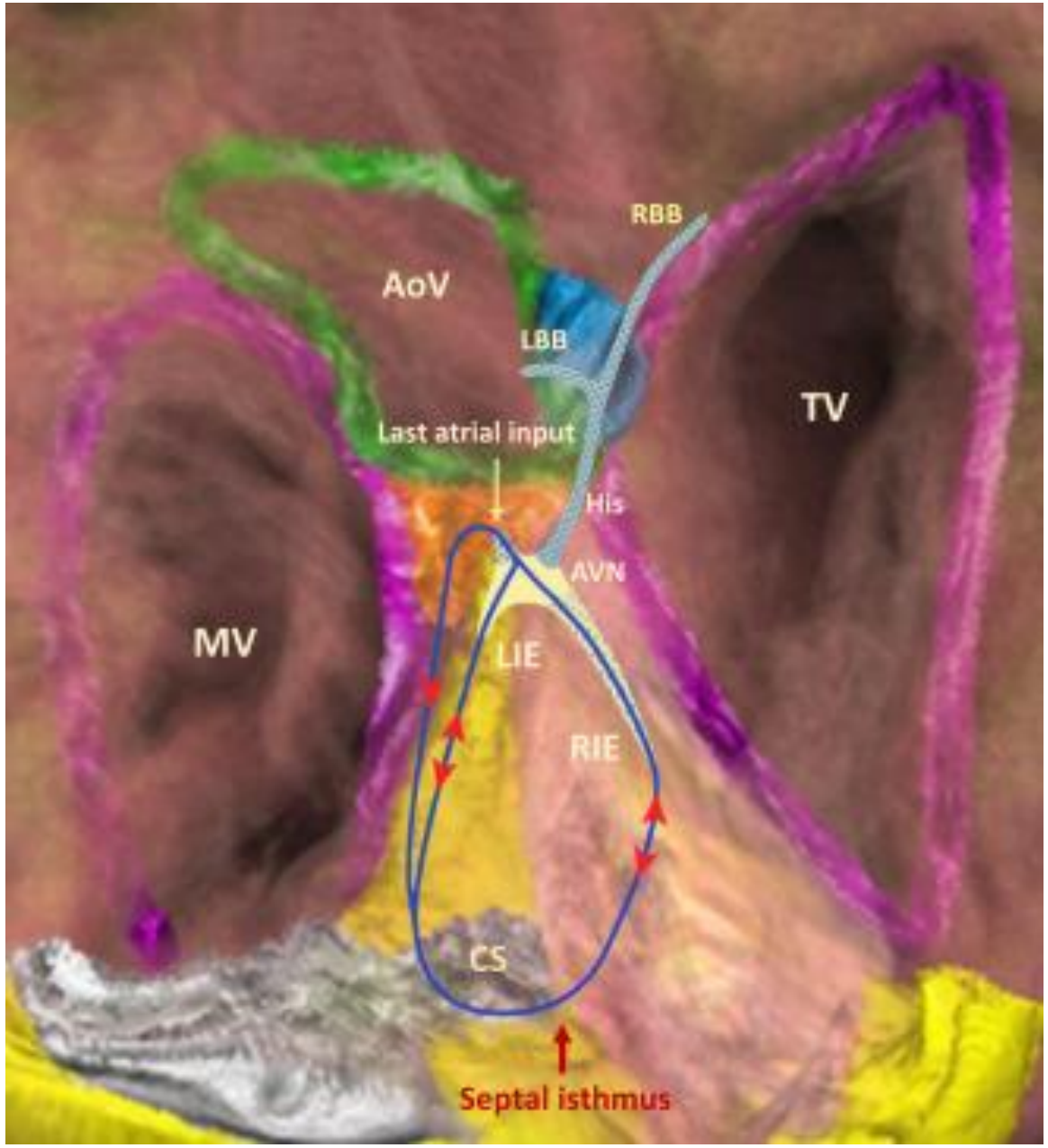
Fast-slow type>

- Antegrade limb: Fast pathway
- Retrograde limb: Slow pathway

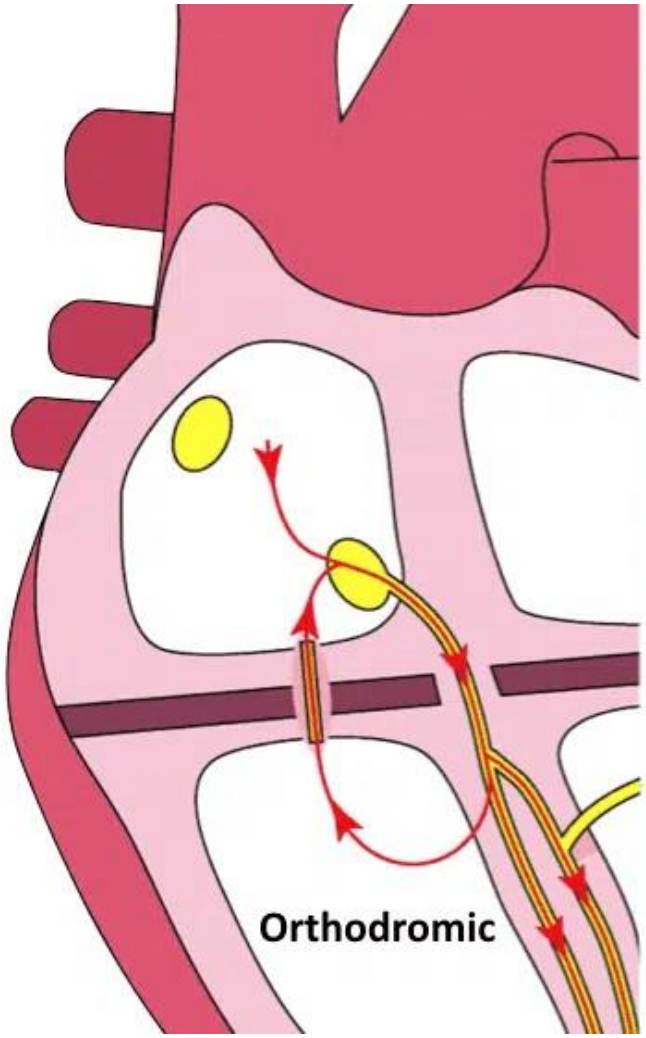
Slow-slow type>

- Antegrade limb: Slow pathway 1
- Retrograde limb: Slow pathway 2

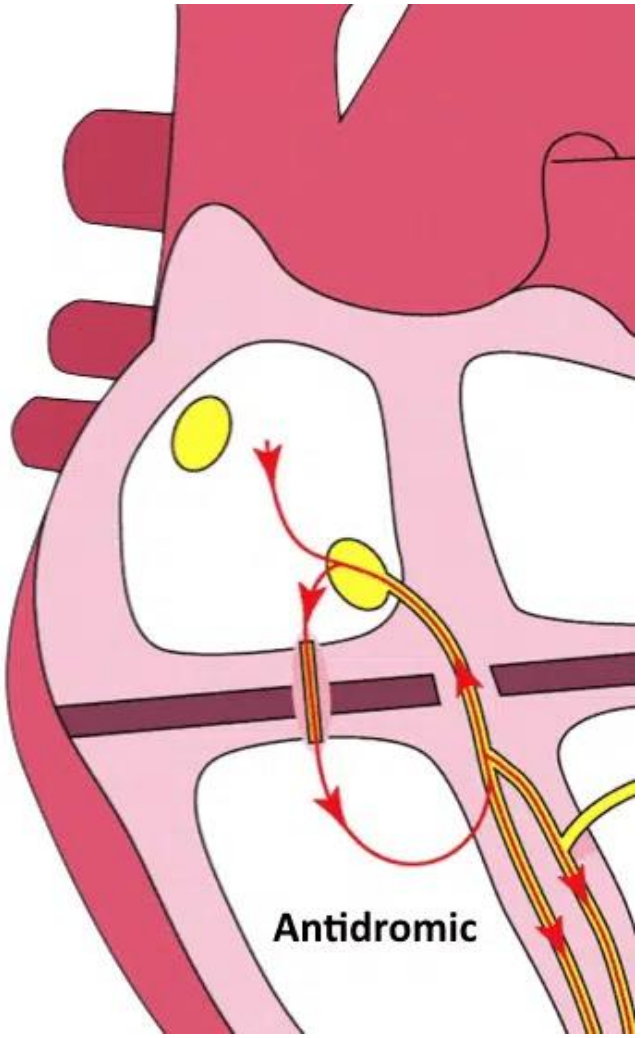
AVNRT (atypical)



AVRT (orthodromic)

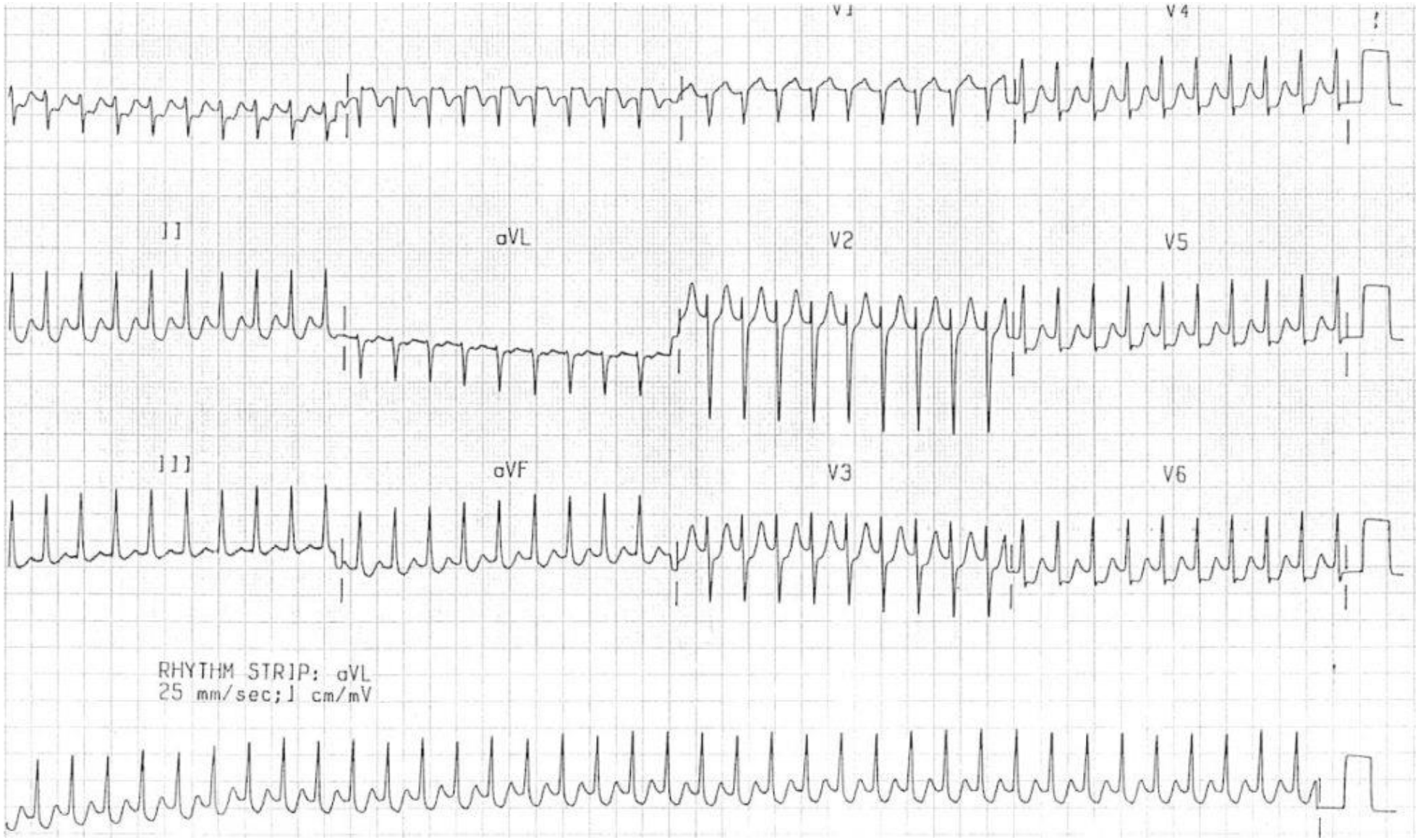


NCT

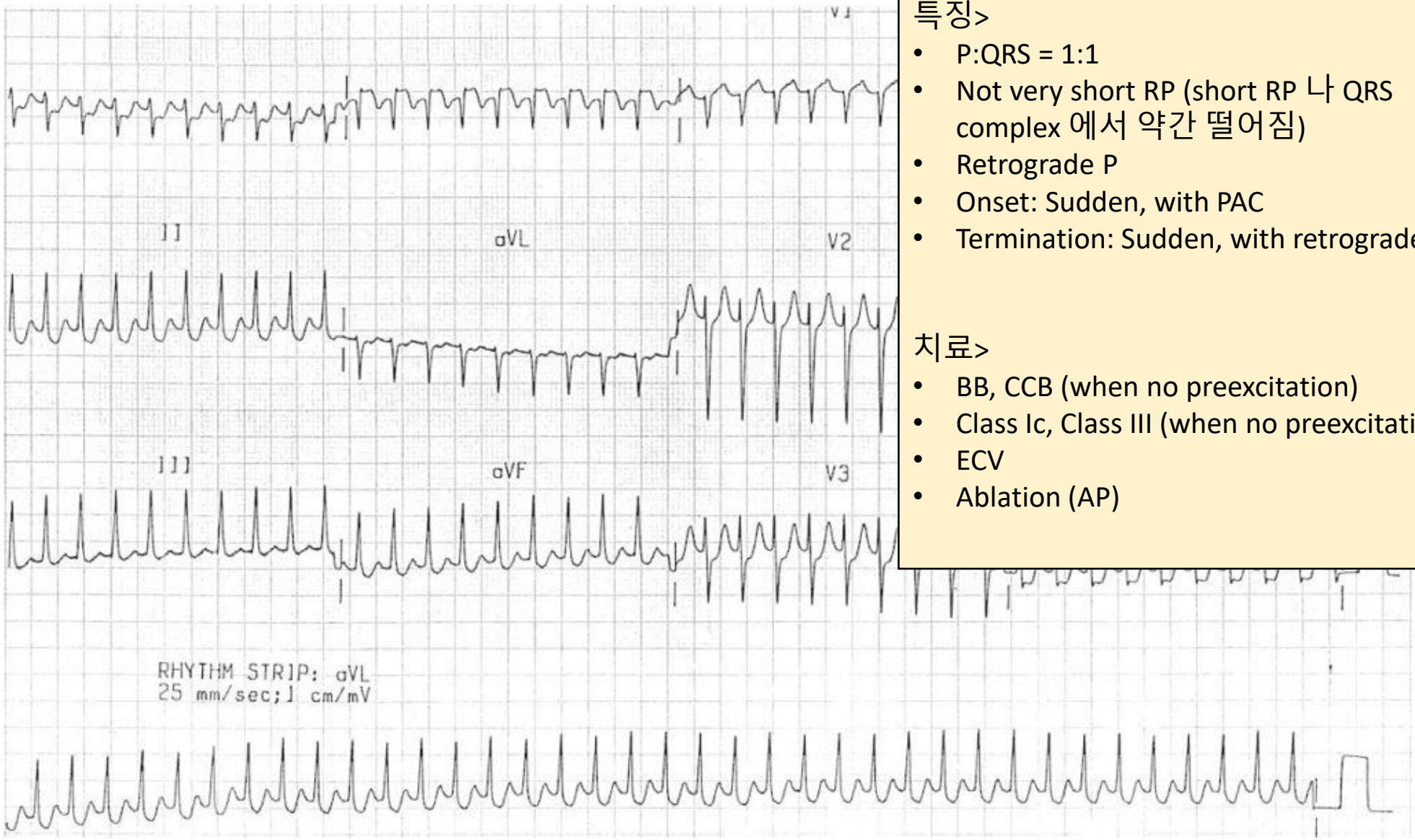


WCT

AVRT (orthodromic)



AVRT (orthodromic)



특징>

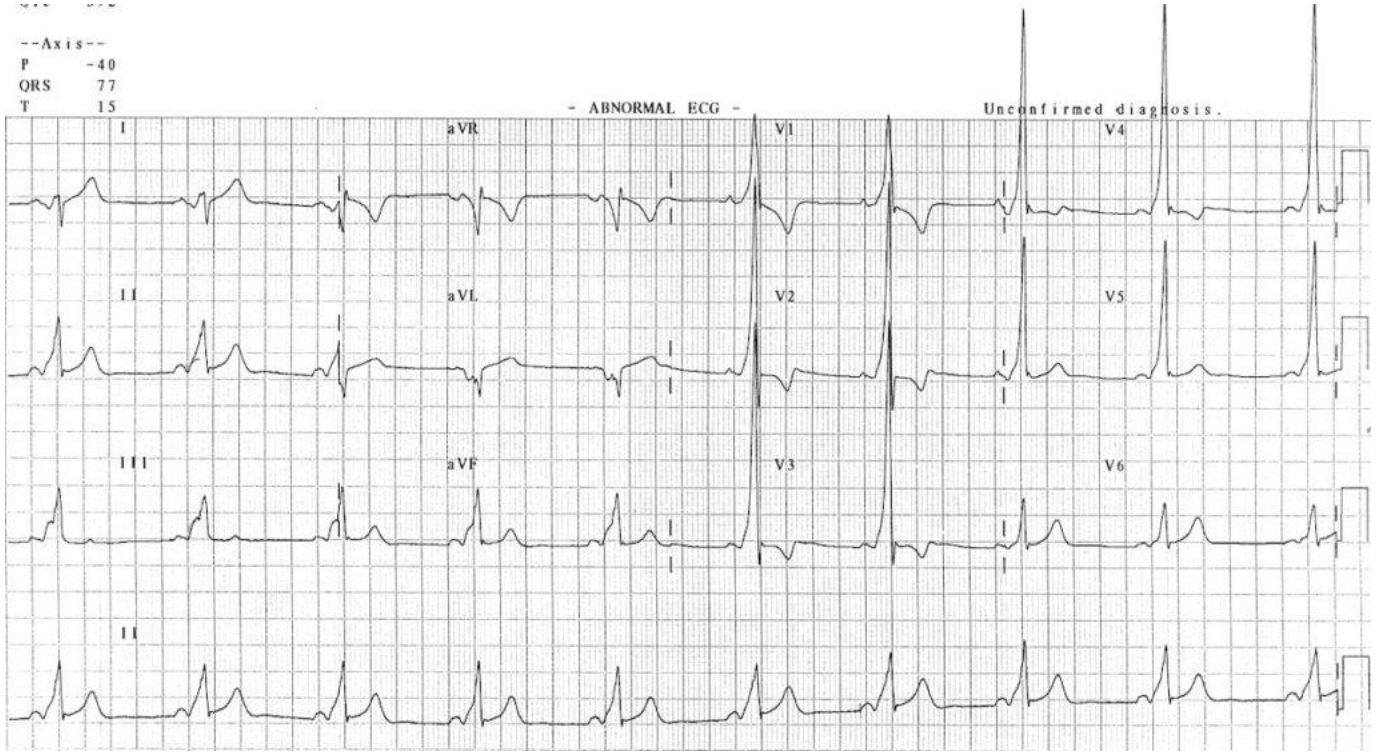
- P:QRS = 1:1
- Not very short RP (short RP 나 QRS complex 에서 약간 떨어짐)
- Retrograde P
- Onset: Sudden, with PAC
- Termination: Sudden, with retrograde P

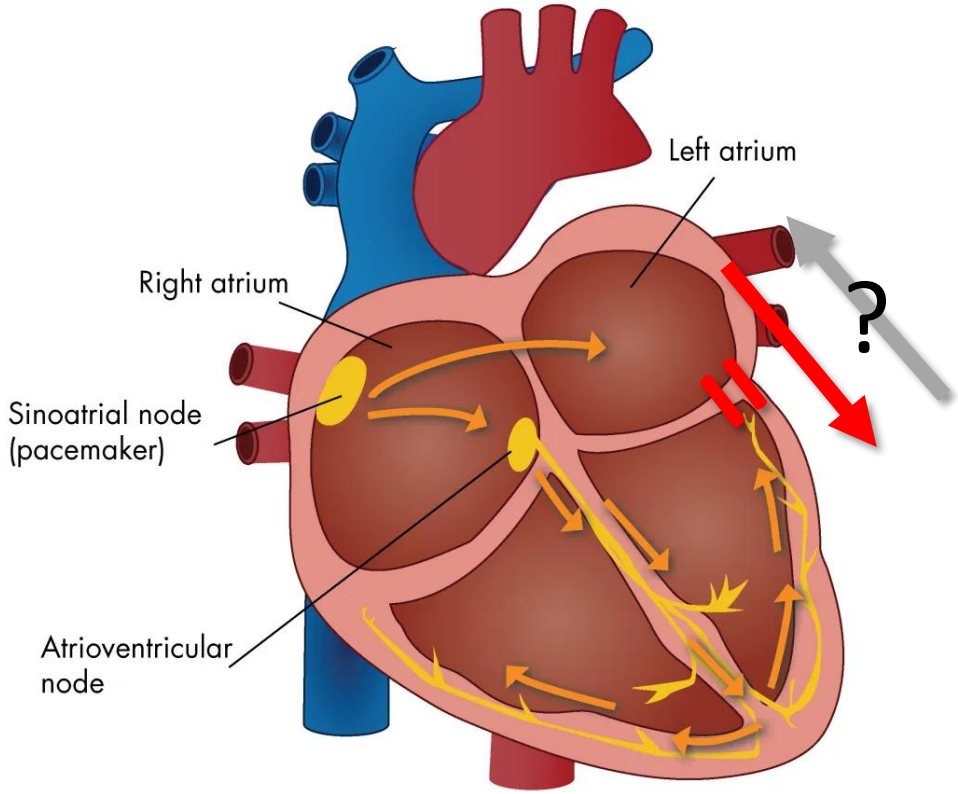
치료>

- BB, CCB (when no preexcitation)
- Class Ic, Class III (when no preexcitation)
- ECV
- Ablation (AP)

Preexcitation? WPW? AVRT?

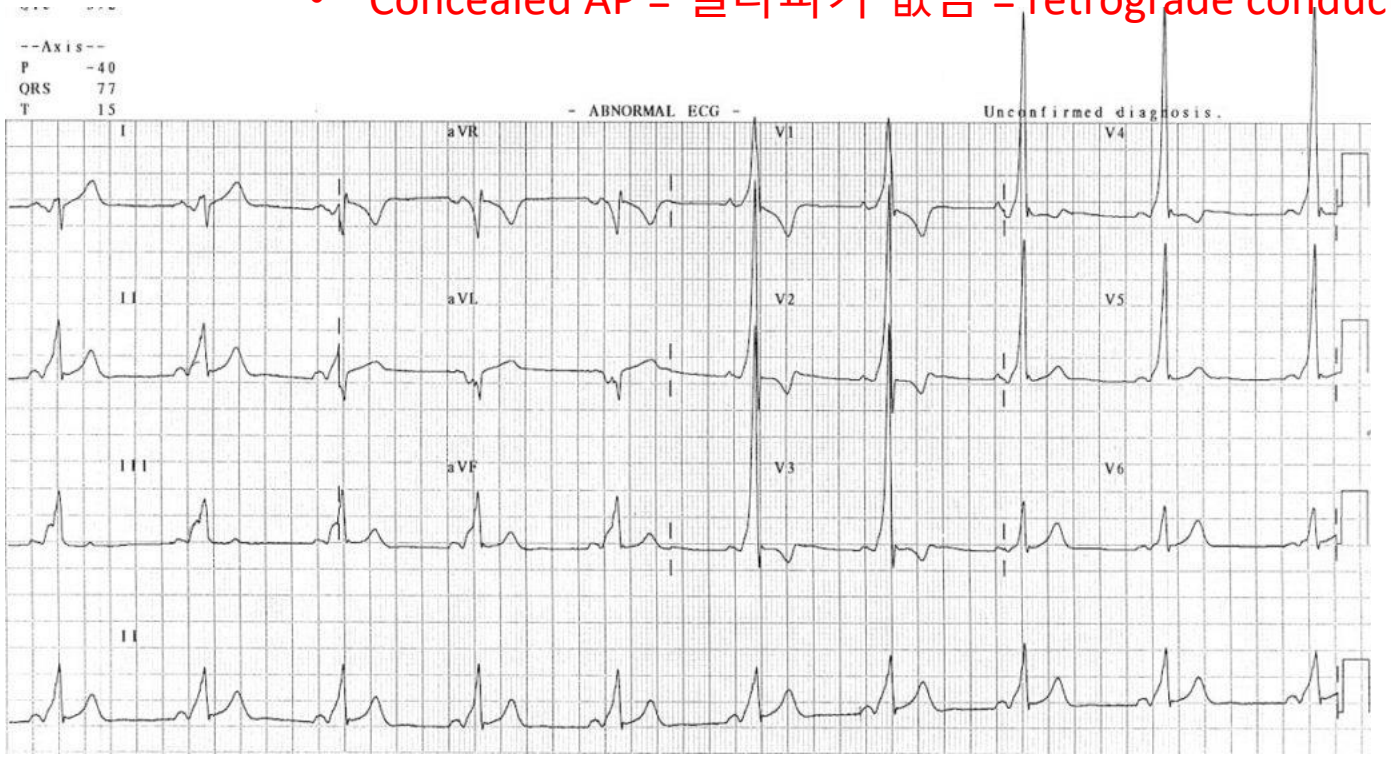
- Preexcitation = 동율동 때 델타파가 있는 것 = Antegrade conduction 이 되는 AP
  - Manifest AP = 델타파가 있음 = antegrade conduction 이 되는 AP (retro 는 될 수도 안될수도)

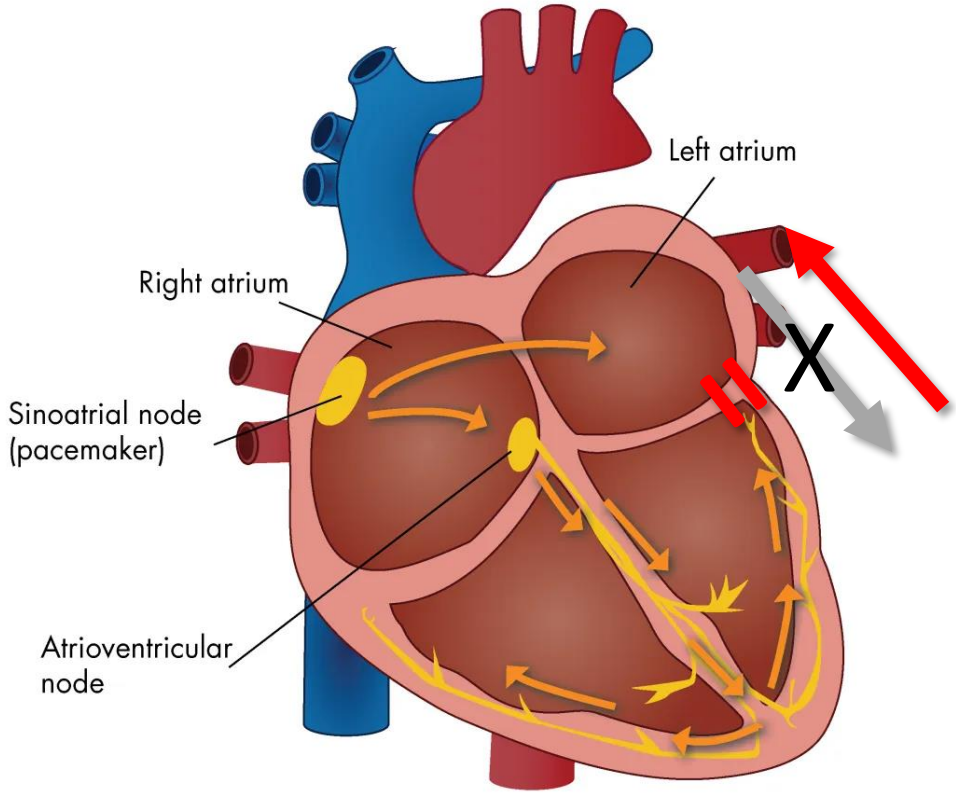




Preexcitation? WPW? AVRT?

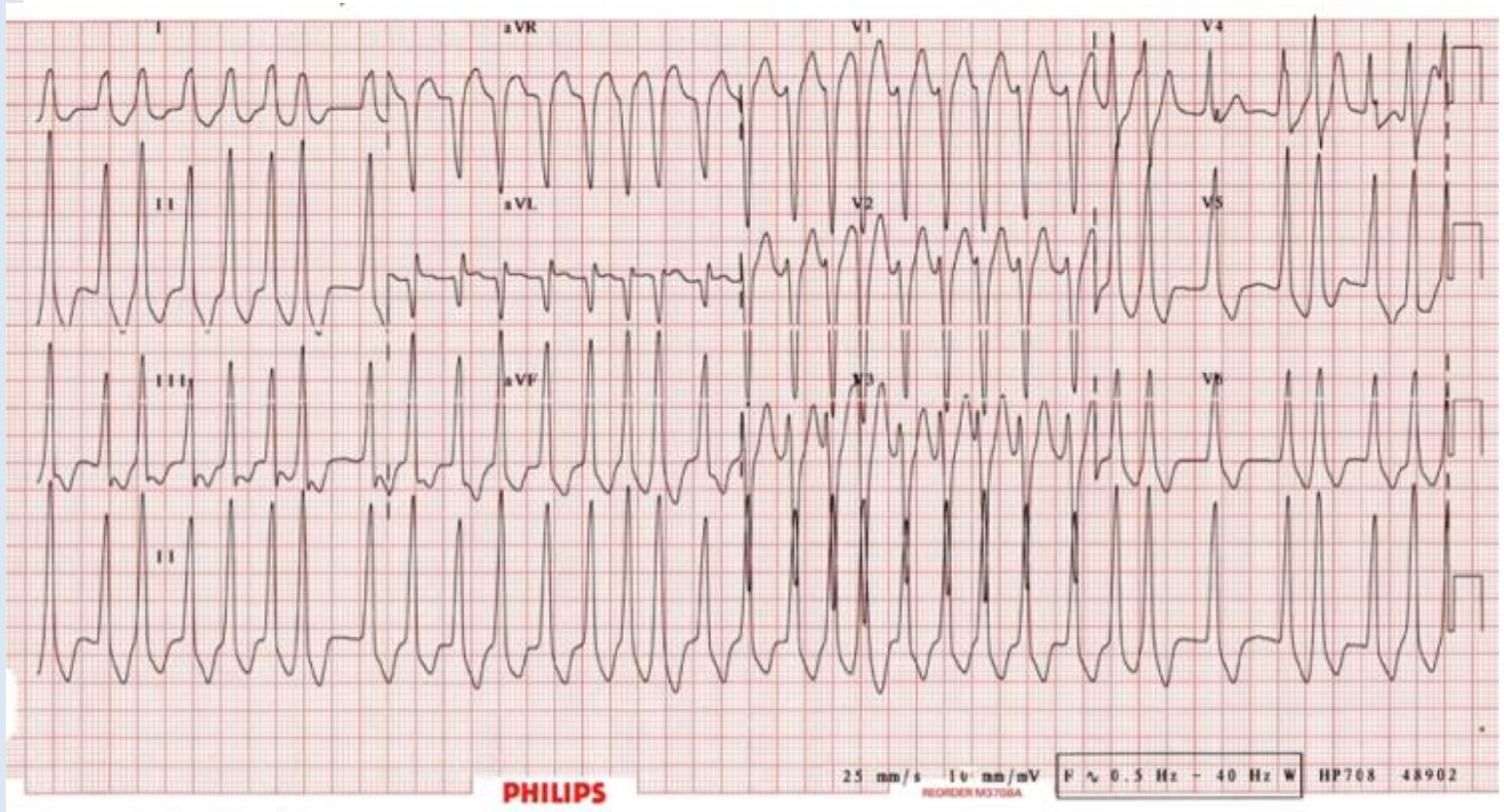
- Preexcitation = 동율동 때 델타파가 있는 것 = Antegrade conduction 이 되는 AP
  - Manifest AP = 델타파가 있음 = antegrade conduction 이 되는 AP (retro 는 될 수도 안될수도)
  - Concealed AP = 델타파가 없음 = retrograde conduction 만 되는 AP

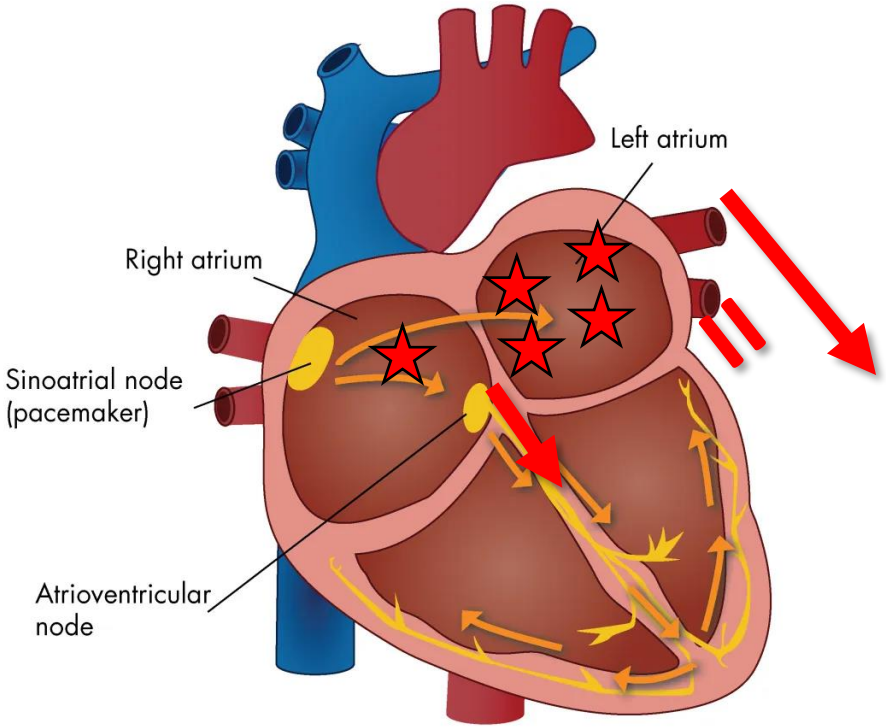




Preexcitation? WPW? AVRT?

- Preexcitation = 동율동 때 델타파가 있는 것 = Antegrade conduction 이 되는 AP
- WPW = Preexcitation + Tachycardia (AVRT or AF)

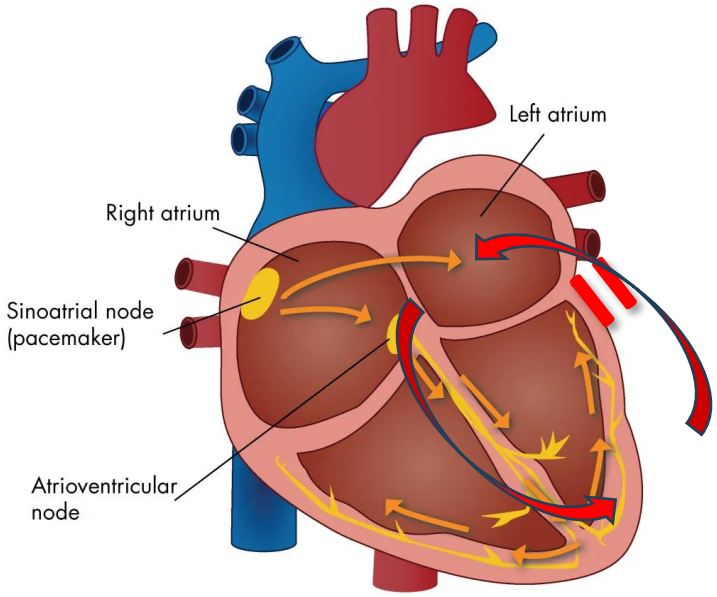




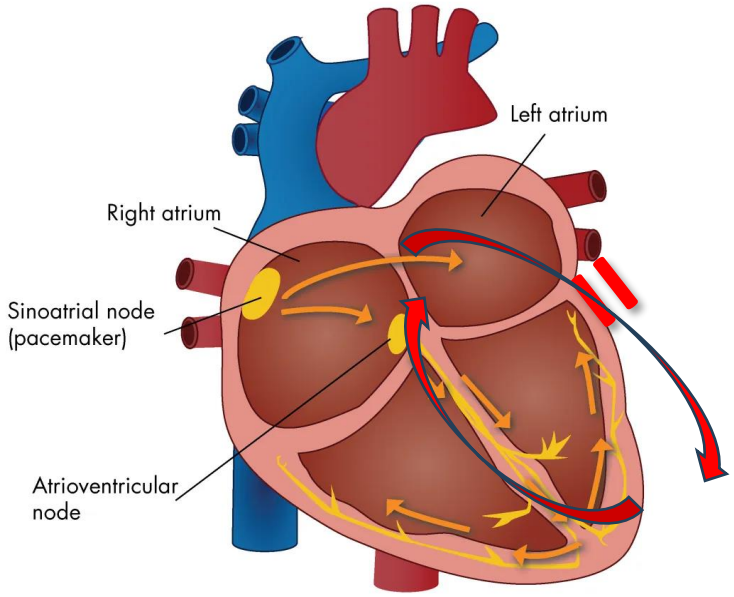
Preexcitation? WPW? AVRT?

- Preexcitation = 동율동 때 델타파가 있는 것 = Antegrade conduction 이 되는 AP
- WPW = Preexcitation + Tachycardia (AVRT or AF)
- AVRT = AP 를 이용한 회귀회로 기전의 빈맥

Orthodromic



Antidromic

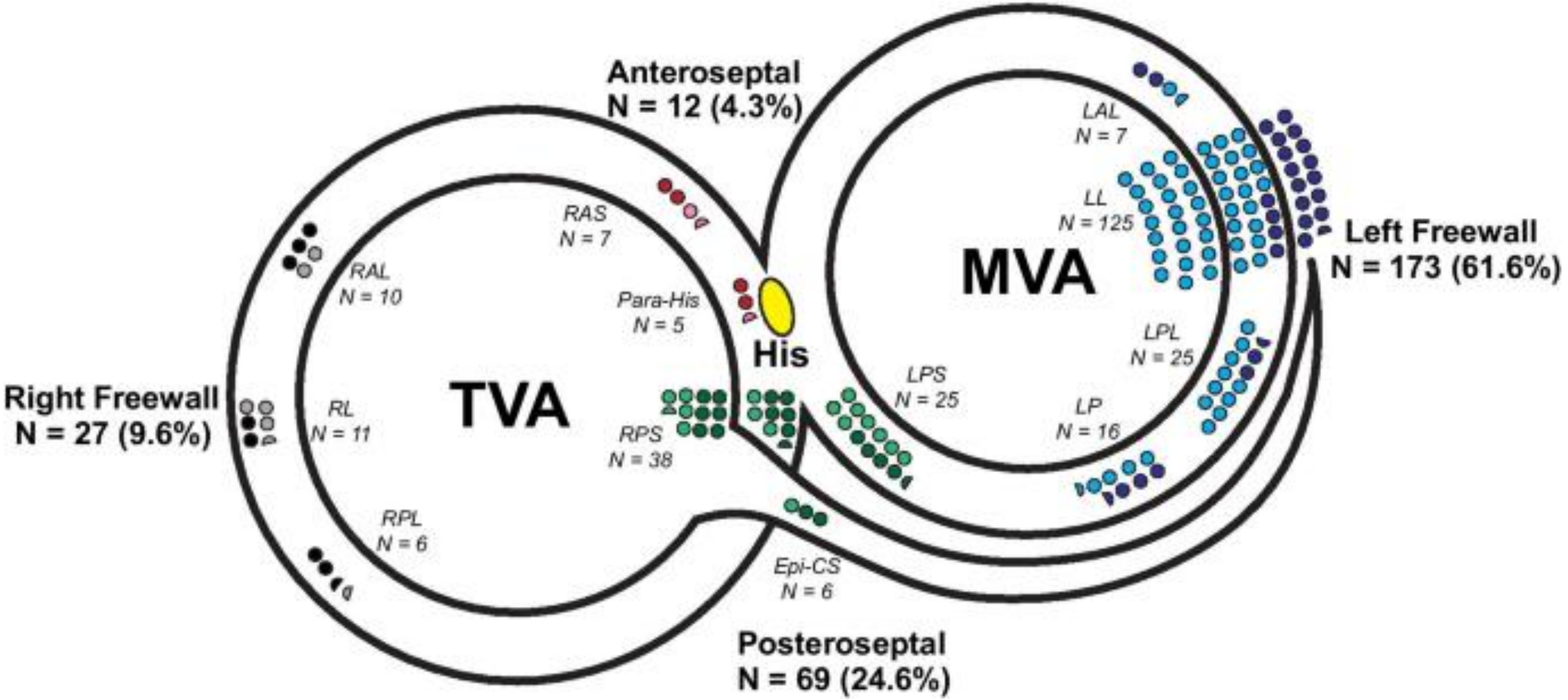


Preexcitation? WPW? AVRT?

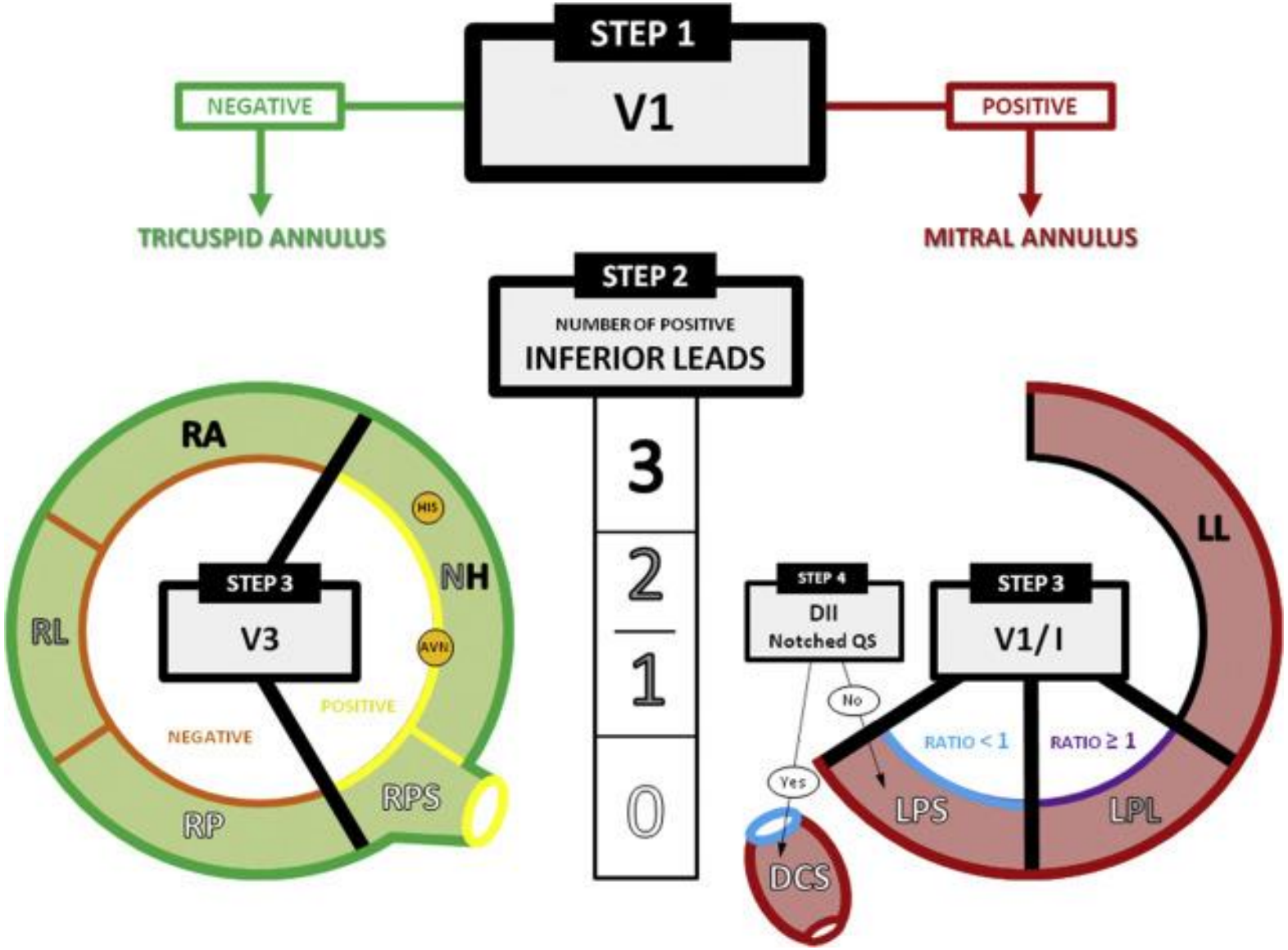
- Preexcitation = 동율동 때 델타파가 있는 것 = Antegrade conduction 이 되는 AP
- WPW = Preexcitation + Tachycardia (AVRT or AF)
- AVRT = AP 를 이용한 회귀회로 기전의 빈맥

- AP 의 antegrade conduction 이 있을 때 BB, CCB, Class Ic, Class III 를 사용하게되면 AV node 대신 AP 로만 전도되면서 심박수가 더 빨라지며 위험해질 수 있다 (특히 WPW-AF 이나 Antidromic AVRT 의 경우)

AP distribution



AP localization using 12-lead ECG



Take home message

- Cardiac conduction system 을 이해해야 심전도를 더 깊이 있게 해석할 수 있음
- 보다 정확한 심전도 진단과 해석을 위해선 꾸준한 심전도 훈련과 숙달이 필요
- 기계 판독은 오판독 비율이 높으므로 스스로 진단 및 해석을 하려는 노력이 필요