순환생리기능 검사학

CHAPTER I

임상생리학의 개요

Section 01

임상생리학적 검사

학습 목표

1. 임상생리학적 검사의 업무영역을 이해할 수 있다(B).
2. 임상생리 검사의 특이성을 설명할 수 있다(B).

Section 02

임상생리학적 검사의 업무영역

Section 03

임상생리학적 검사의 특이성

표 3-1. 생리학적 검사의 주파수 영역

종류	주파수(Hz)	전압	임피던스(kΩ)
심전도(ECG)	0.1~200	1 mV 전후	1~12
뇌파(EEG)	0.5~70	수 μV~300 μV	10~50
근전도(EMG)	10~2,000	10 μV~15 mV	1~수십
피부전기반사(GSR)	0.03~15	수십 μV~수 mV	1~수십
망막전위도(ERG)	*DC~200	50 μV~1 mV	수십
세포내 활동전위	DC~3,000	수십 mV	$10\sim50\times10^{3}$

*DC(직류 direct current)

순환생리기능 검사학

CHAPTER II

NEW CLINICAL PHYSIOLOGY

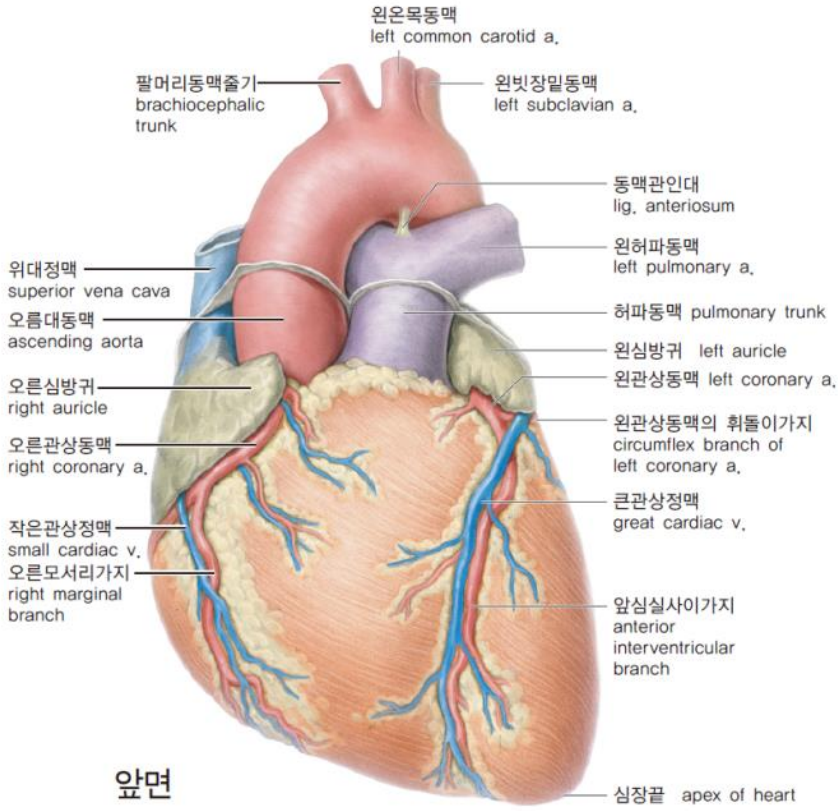
심전도

Section 04

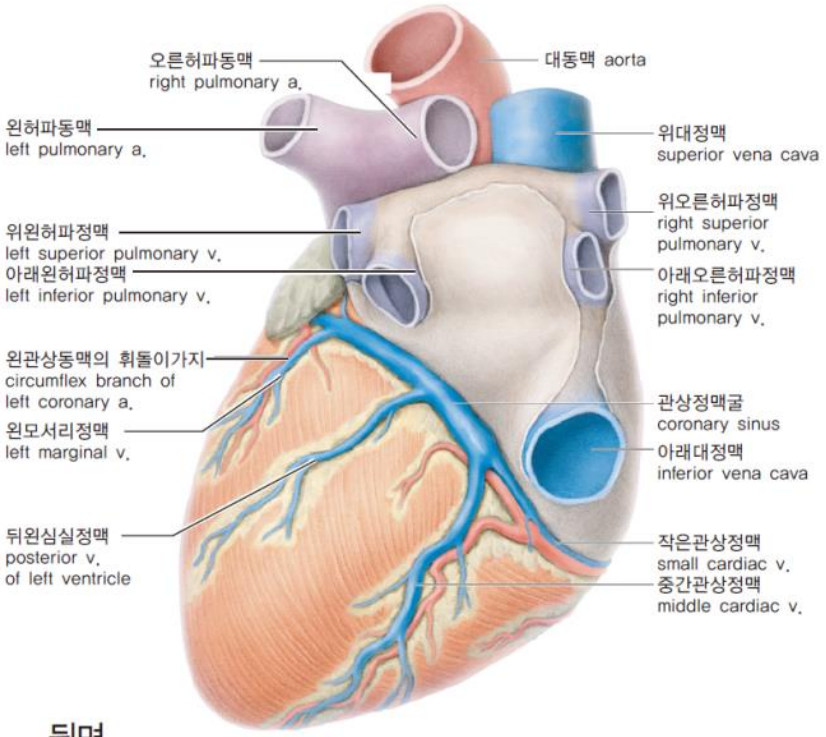
심전도 검사를 위한 해부생리

학습 목표

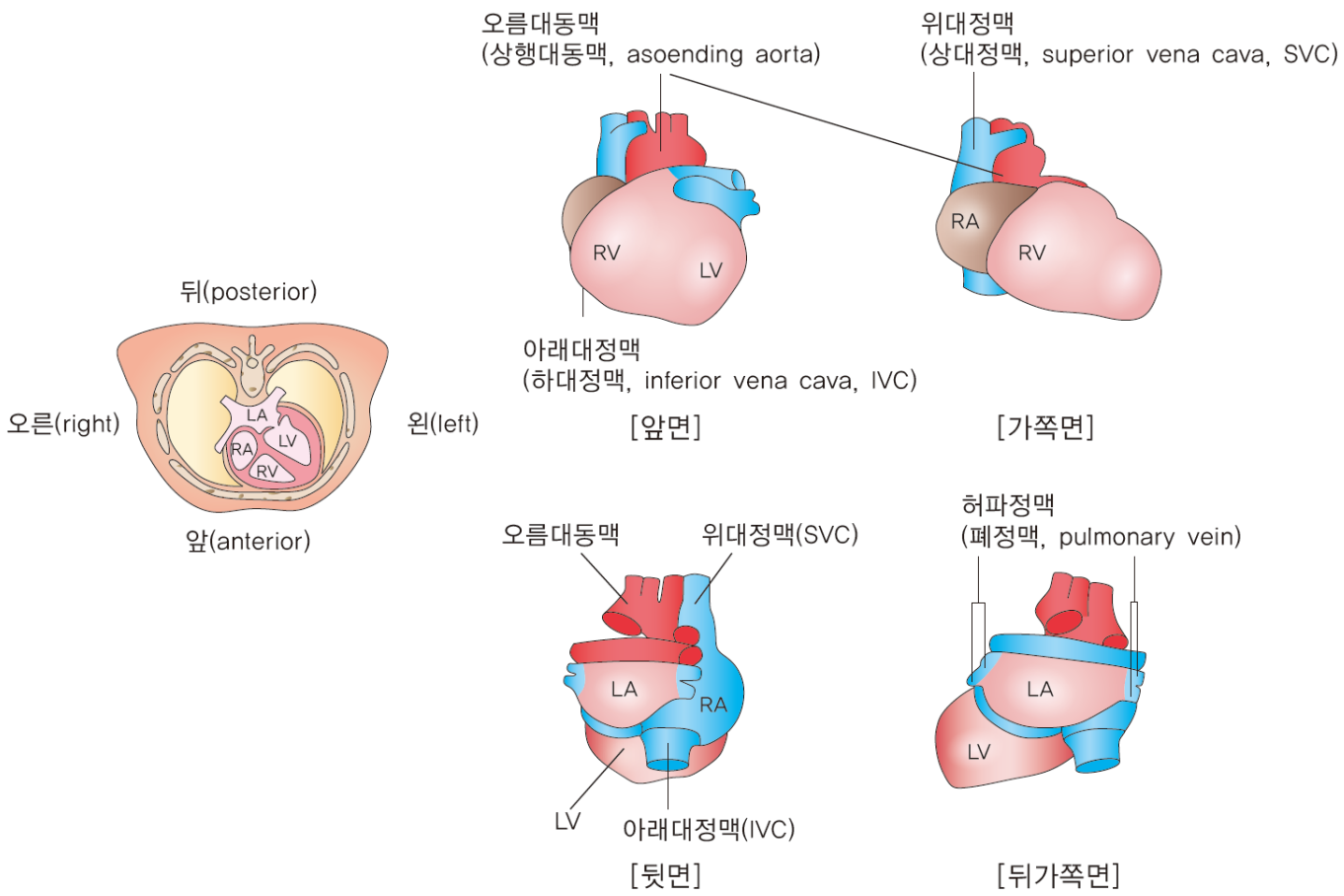
1. 심장의 해부학적 구조를 설명할 수 있다(A).
2. 심장의 생리학적 기능을 설명할 수 있다(A).
3. 심장의 심장순환을 설명할 수 있다(A).
4. 심장의 자극 전도계통을 설명할 수 있다(A).
5. 심장근육세포의 전기 생리 현상을 설명할 수 있다(A).
6. 심장의 주기를 설명할 수 있다(A).

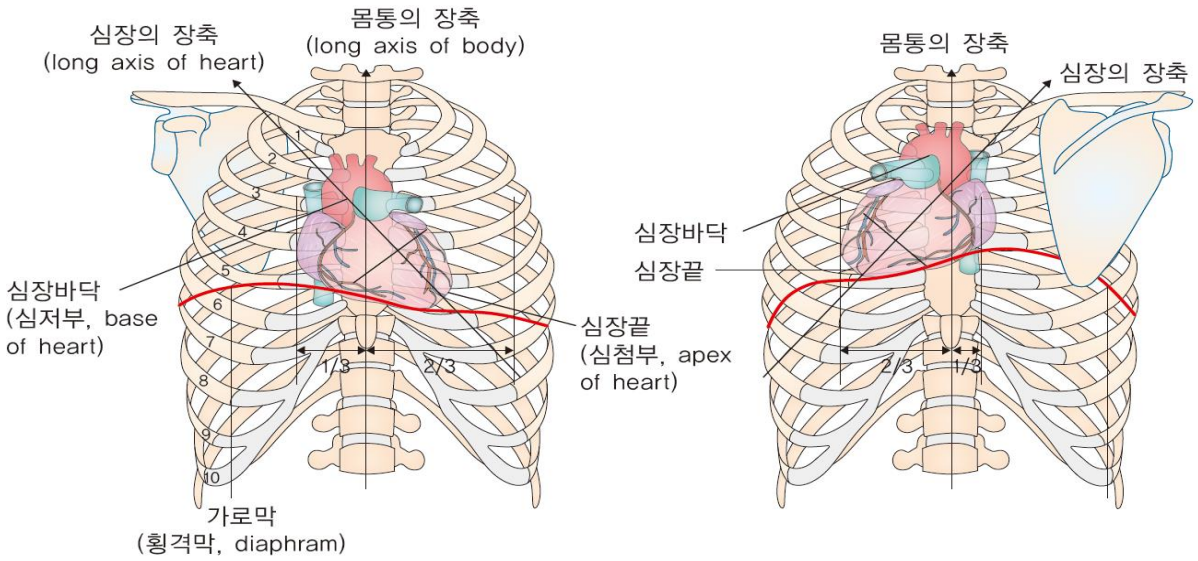

왼온목동맥
left common carotid a.
팔머리동맥줄기
brachiocephalic trunk
왼빗장밑동맥
left subclavian a.
동맥관인대
lig. anteriosum
왼허파동맥
left pulmonary a.
위대정맥
superior vena cava
허파동맥 pulmonary trunk
오름대동맥
ascending aorta
왼심방귀 left auricle
왼관상동맥 left coronary a.
오른심방귀
right auricle
왼관상동맥의 휘돌이가지
circumflex branch of left coronary a.
오른관상동맥
right coronary a.
큰관상정맥
great cardiac v.
작은관상정맥
small cardiac v.
오른모서리가지
right marginal branch
앞심실사이가지
anterior interventricular branch
심장끝 apex of heart

앞면

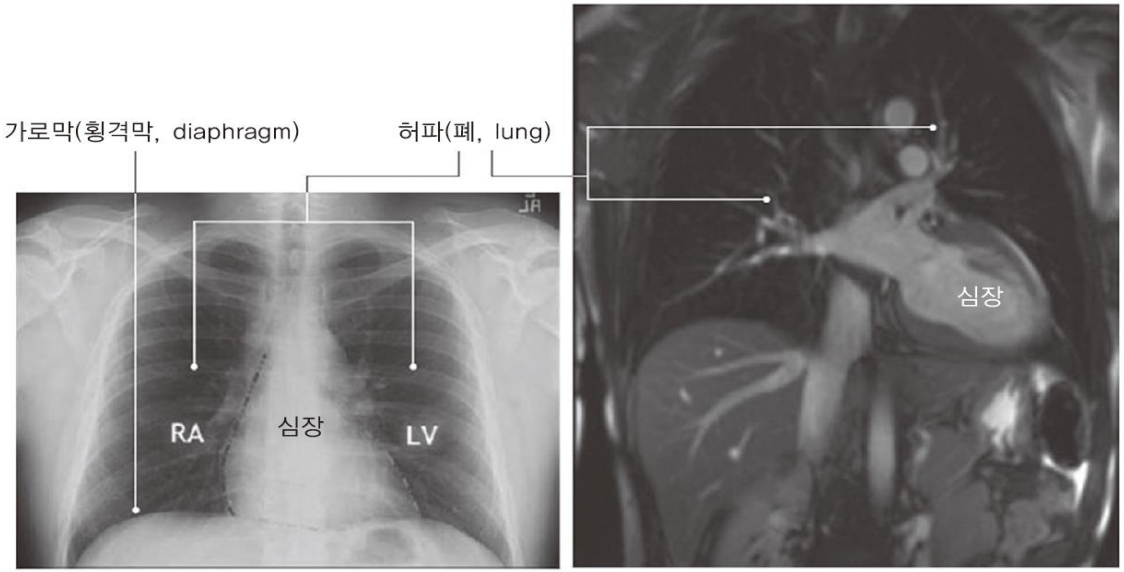

오른허파동맥
right pulmonary a.
대동맥 aorta
왼허파동맥
left pulmonary a.
위대정맥
superior vena cava
위오른허파정맥
right superior pulmonary v.
위왼허파정맥
left superior pulmonary v.
아래왼허파정맥
left inferior pulmonary v.
아래오른허파정맥
right inferior pulmonary v.
왼관상동맥의 휘돌이가지
circumflex branch of left coronary a.
관상정맥굴
coronary sinus
왼모서리정맥
left marginal v.
아래대정맥
inferior vena cava
뒤왼심실정맥
posterior v. of left ventricle
작은관상정맥
small cardiac v.
중간관상정맥
middle cardiac v.

뒷면

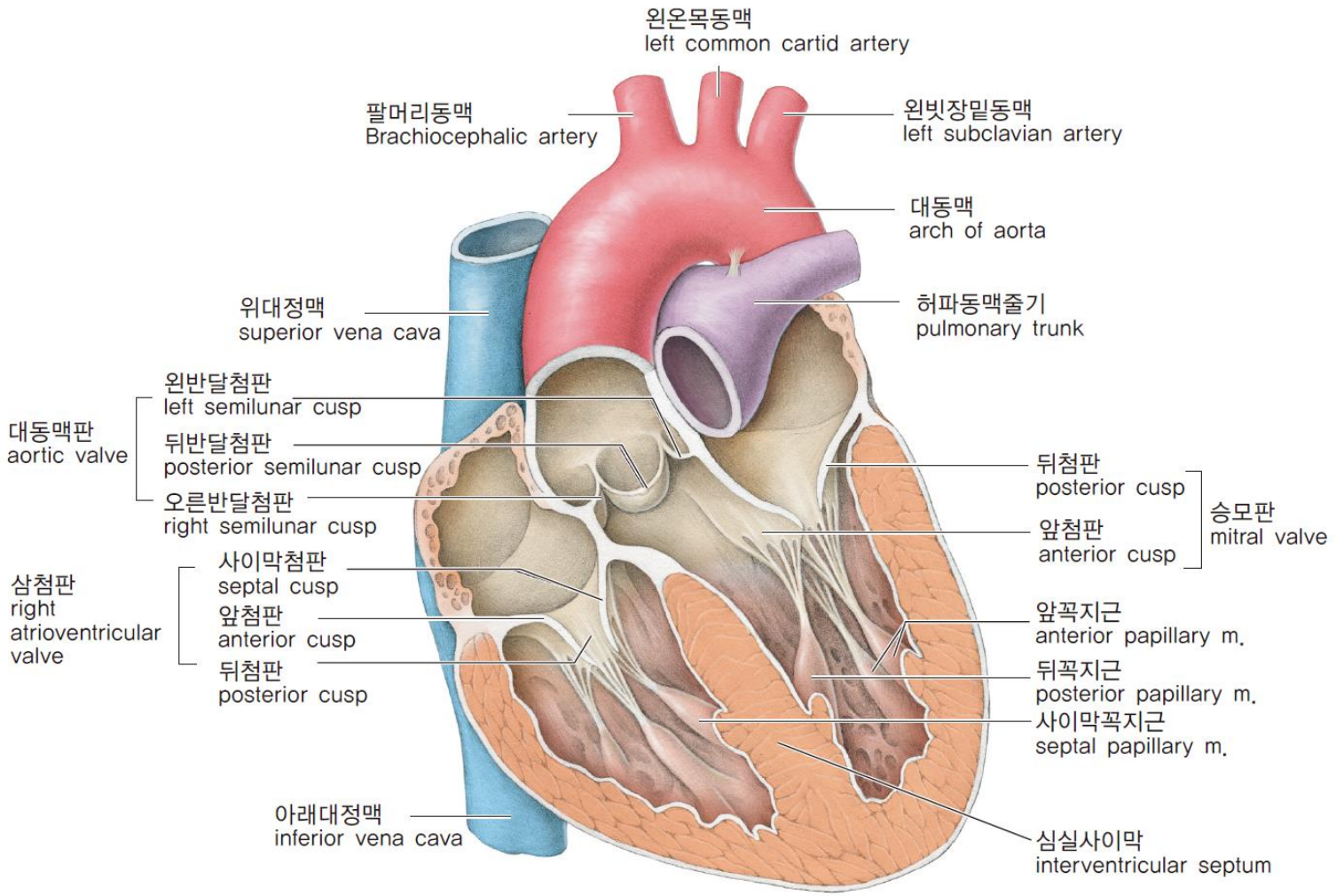

오름대동맥
(상행대동맥, asoending aorta)
위대정맥
(상대정맥, superior vena cava, SVC)
RV
LV
RA
RV
아래대정맥
(하대정맥, inferior vena cava, IVC)
[앞면]
[가쪽면]
뒤(posterior)
오른(right)
왼(left)
LA
RA
LV
RV
앞(anterior)
오름대동맥
위대정맥(SVC)
LA
RA
LV
아래대정맥(IVC)
[뒷면]
허파정맥
(폐정맥, pulmonary vein)
LA
LV
[뒤가쪽면]



[앞면] [뒷면]



X-ray MRI


왼온목동맥
left common cartid artery
팔머리동맥
Brachiocephalic artery
왼빗장밑동맥
left subclavian artery
대동맥
arch of aorta
위대정맥
superior vena cava
허파동맥줄기
pulmonary trunk
대동맥판
aortic valve
왼반달첨판
left semilunar cusp
뒤반달첨판
posterior semilunar cusp
오른반달첨판
right semilunar cusp
삼첨판
right
atrioventricular
valve
사이막첨판
septal cusp
앞첨판
anterior cusp
뒤첨판
posterior cusp
뒤첨판
posterior cusp
앞첨판
anterior cusp
승모판
mitral valve
앞꼭지근
anterior papillary m.
뒤꼭지근
posterior papillary m.
사이막꼭지근
septal papillary m.
아래대정맥
inferior vena cava
심실사이막
interventricular septum

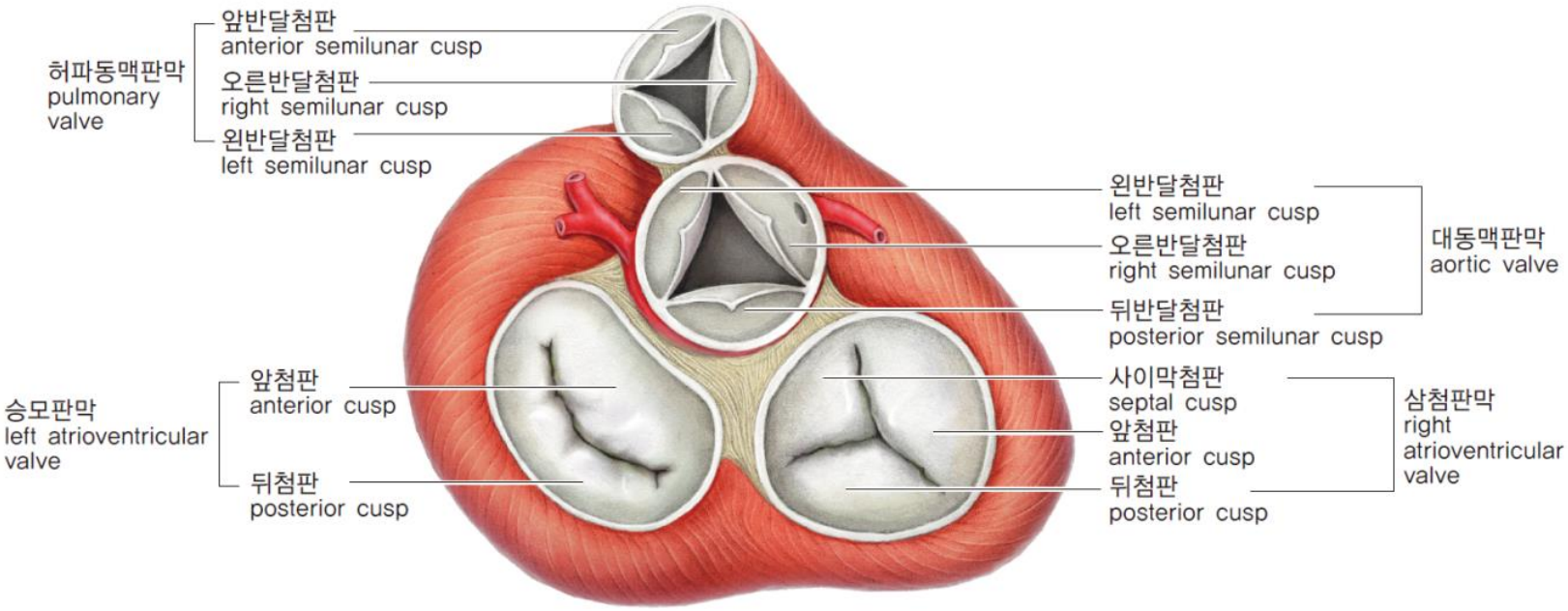
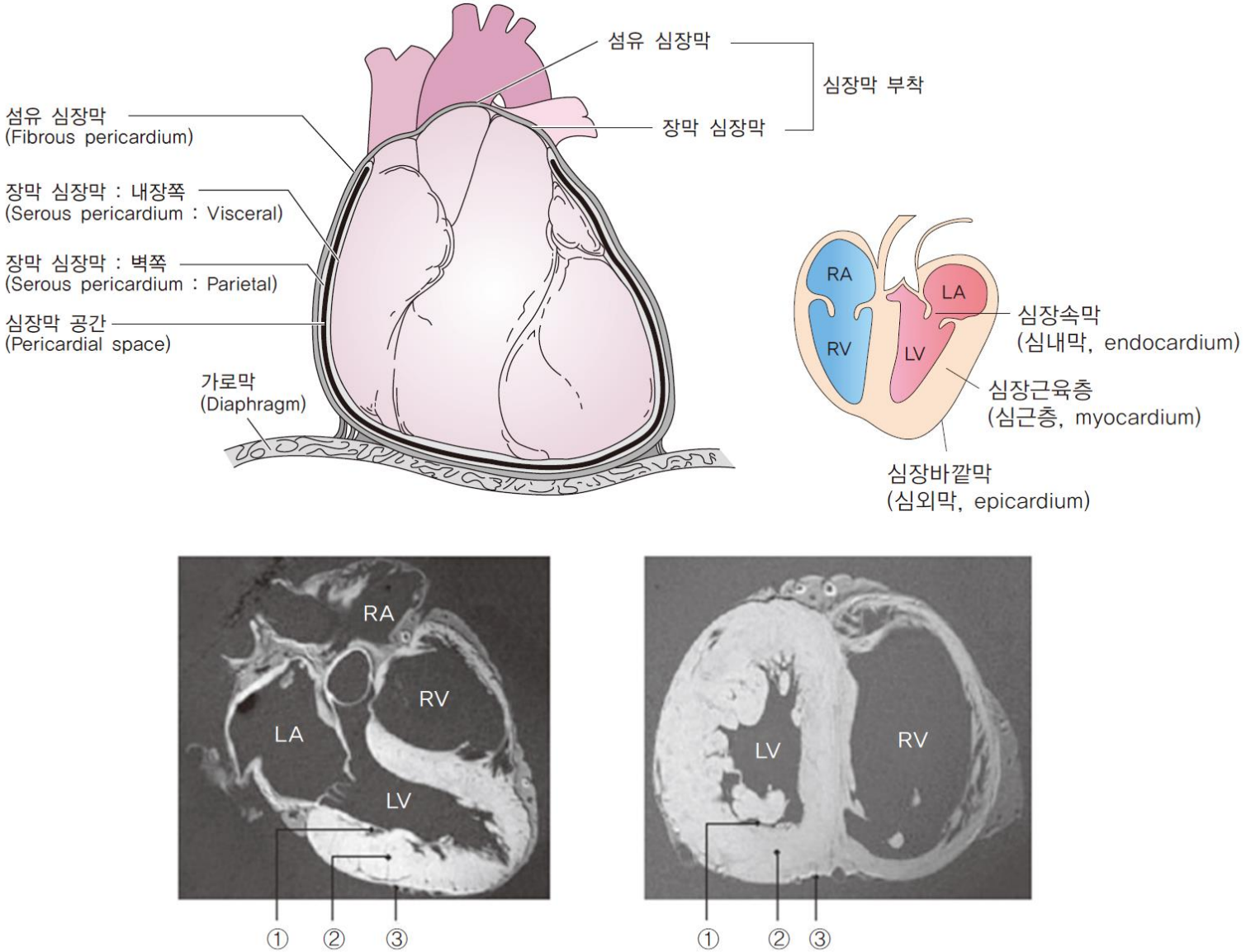
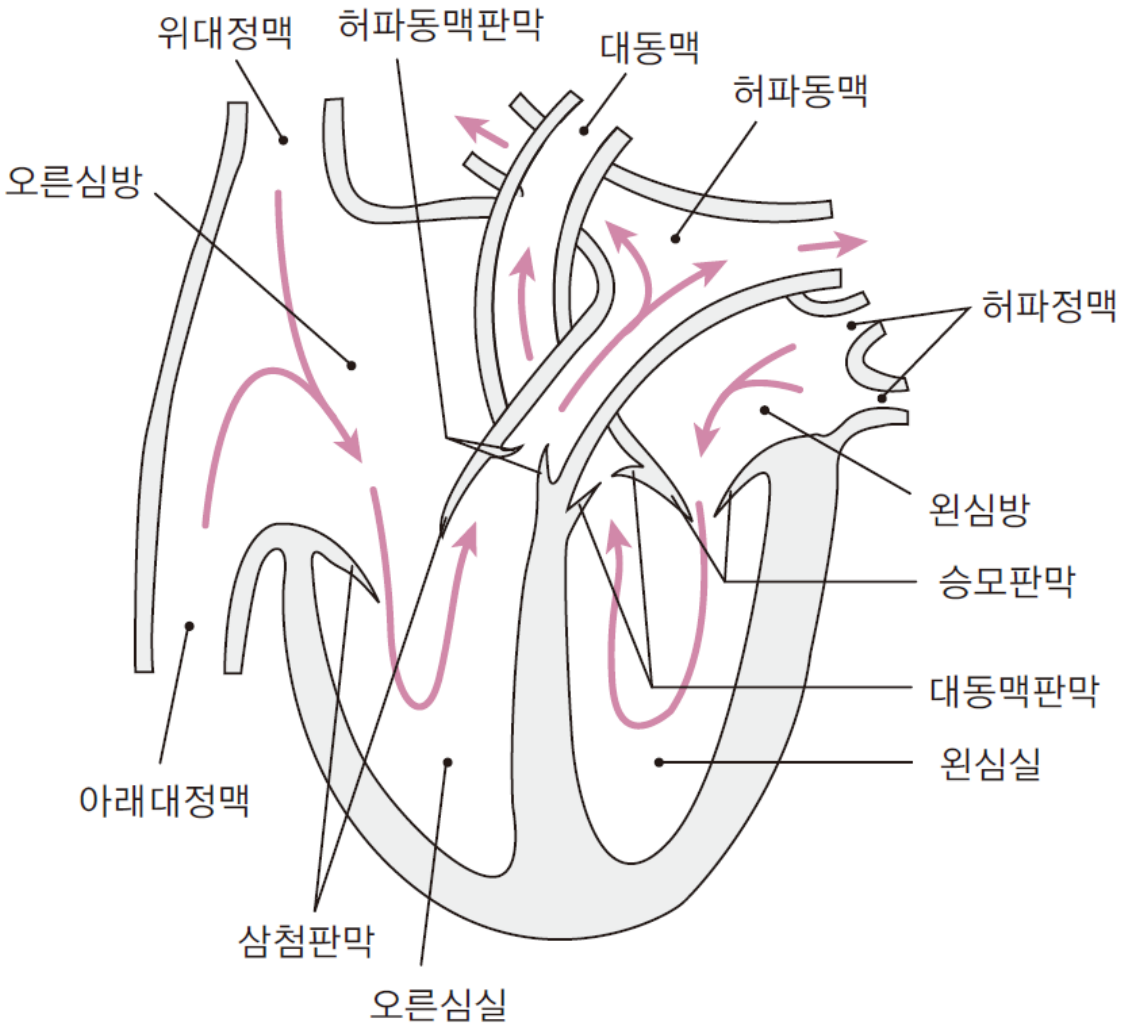
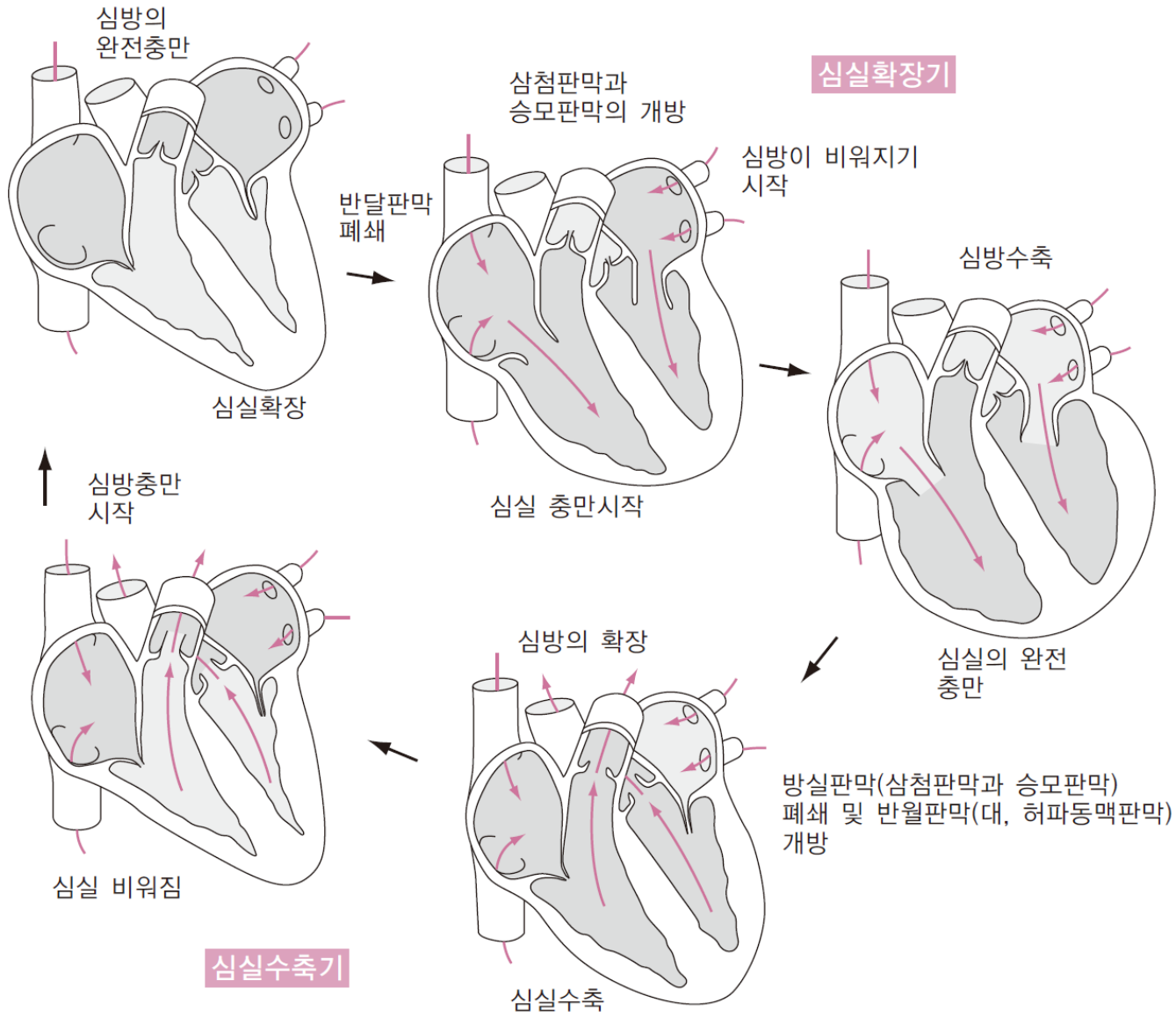

허파동맥판막
pulmonary valve
앞반달첨판
anterior semilunar cusp
오른반달첨판
right semilunar cusp
왼반달첨판
left semilunar cusp
승모판막
left atrioventricular valve
앞첨판
anterior cusp
뒤첨판
posterior cusp
왼반달첨판
left semilunar cusp
오른반달첨판
right semilunar cusp
뒤반달첨판
posterior semilunar cusp
대동맥판막
aortic valve
사이막첨판
septal cusp
앞첨판
anterior cusp
뒤첨판
posterior cusp
삼첨판막
right atrioventricular valve

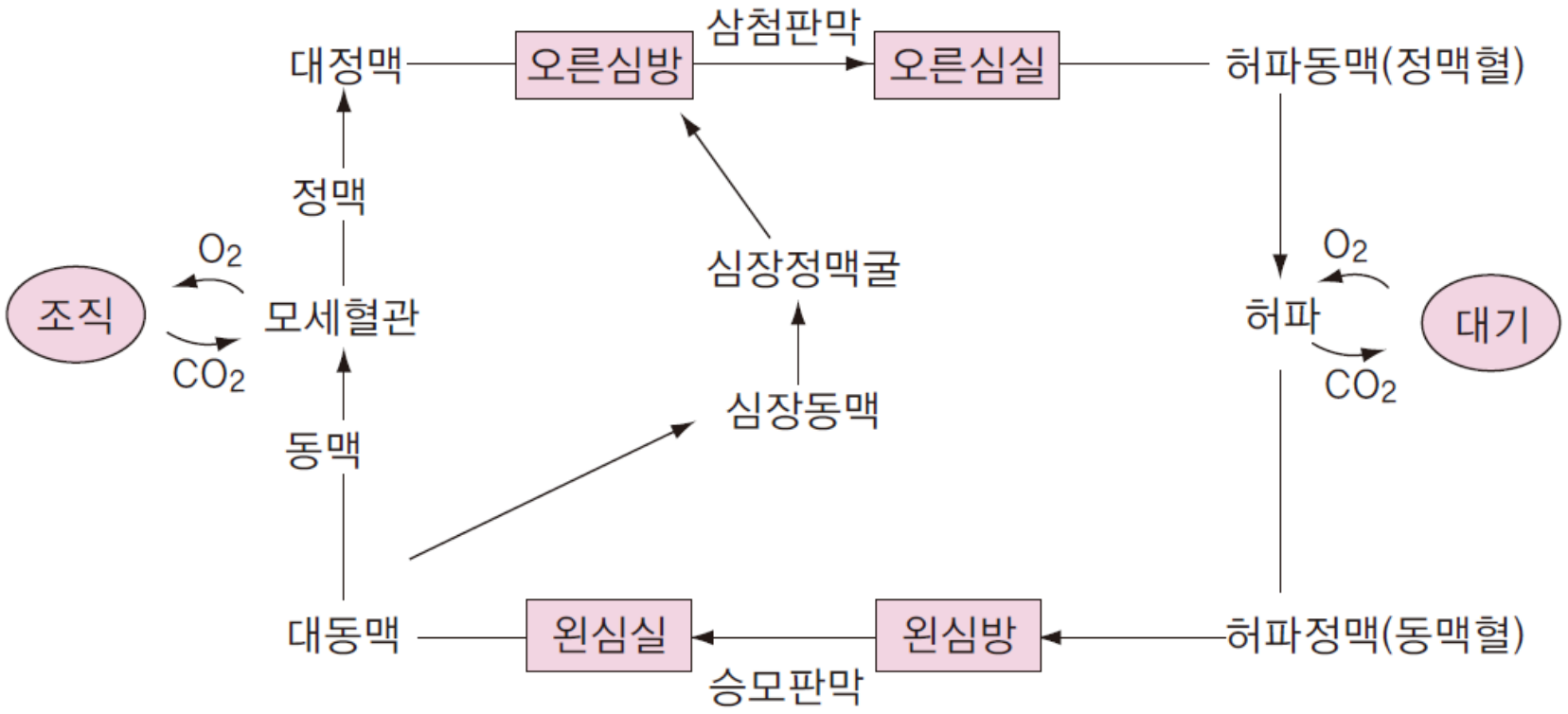
표 4-1. 심장의 판막

구분	위치	명칭
방실판막	오른심방과 오른심실 사이의 오른방실구멍(우방실구)	삼첨판막(오른방실판막)
	왼심방과 왼심실 사이의 왼방실구멍(좌방실구)	승모판막(이첨판막, 왼방실판막)
반달판막	오른심실과 허파동맥 사이의 허파동맥구멍(폐동맥구)	허파동맥판막(오른반달판막)
	왼심실과 대동맥 사이의 대동맥구멍(대동맥구)	대동맥판막(왼반달판막)


섬유 심장막
장막 심장막
심장막 부착
섬유 심장막
(Fibrous pericardium)
장막 심장막 : 내장쪽
(Serous pericardium : Visceral)
장막 심장막 : 벽쪽
(Serous pericardium : Parietal)
심장막 공간
(Pericardial space)
가로막
(Diaphragm)
RA
LA
RV
LV
심장속막
(심내막, endocardium)
심장근육층
(심근층, myocardium)
심장바깥막
(심외막, epicardium)
RA
RV
LA
LV
① ② ③
이마면
LV
RV
① ② ③
가로면


위대정맥
허파동맥판막
대동맥
허파동맥
오른심방
허파정맥
왼심방
승모판막
대동맥판막
왼심실
아래대정맥
삼첨판막
오른심실


심방의
완전충만
심실확장
반달판막
폐쇄
삼첨판막과
승모판막의 개방
심실 충만시작
심실확장기
심방이 비워지기
시작
심방수축
심실의 완전
충만
방실판막(삼첨판막과 승모판막)
폐쇄 및 반월판막(대, 허파동맥판막)
개방
심방의 확장
심실수축
심실 비워짐
심방충만
시작
심실수축기


삼첨판막
대정맥
오른심방
오른심실
허파동맥(정맥혈)
정맥
O_2
조직
모세혈관
CO_2
심장정맥굴
O_2
허파
대기
CO_2
심장동맥
동맥
대동맥
왼심실
왼심방
허파정맥(동맥혈)
승모판막

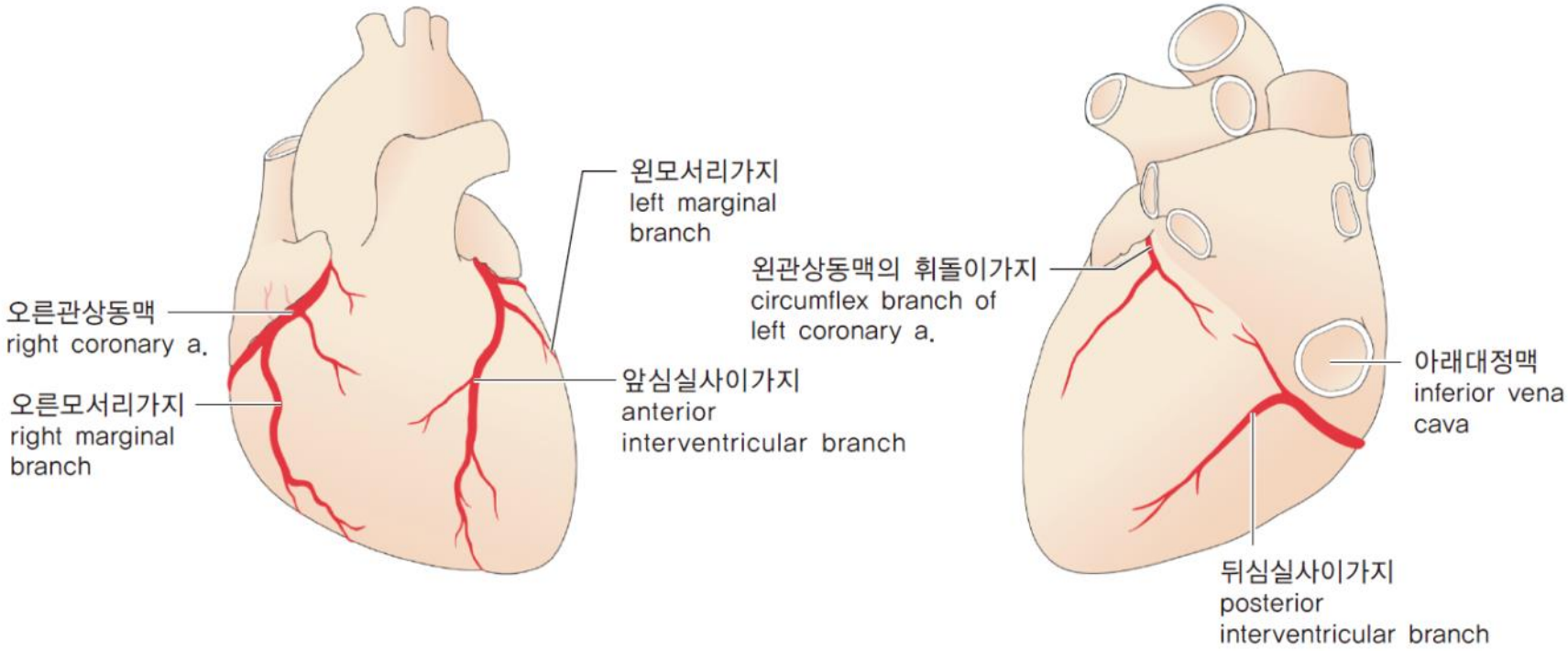
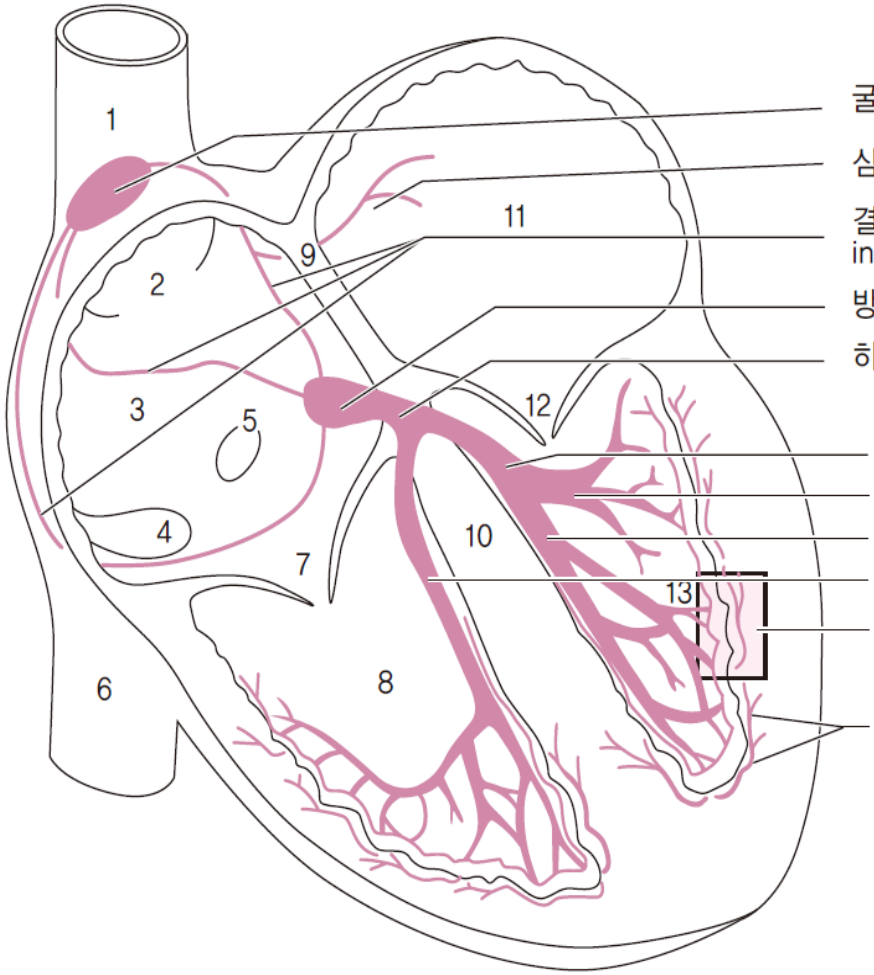

왼모서리가지
left marginal branch
왼관상동맥의 휘돌이가지
circumflex branch of left coronary a.
오른관상동맥
right coronary a.
앞심실사이가지
anterior interventricular branch
오른모서리가지
right marginal branch
아래대정맥
inferior vena cava
뒤심실사이가지
posterior interventricular branch

표 4-2. 심장의 자율신경 효과

심장기능 / 자율신경	심장박동수 (심박수)	심장전도속도 (자극전도속도)	흥분성	수축력(속도)	PR 시간
교감신경	증가	증가	증가	강함(빠름)	단축
부교감신경	감소	감소	감소	약함(느림)	연장



굴심방결절 SA Node

심방사이전도로 interatrial conduction tract

결절사이 심방전도로
internodal atrial conduction tracts

방실결절 AV node
히스다발 His bundle
방실이음부

왼다발갈래 left bundle branch
왼뒤섬유다발 left posterior fascicle
왼앞섬유다발 left anterior fascicle
오른다발갈래 right bundle branch
심장전도근육섬유그물 Purkinje's fiber network

심장전도근육섬유 purkinje's fiber

1. 위대정맥
2. 위대정맥 열림부위
3. 오른심방
4. 아래대정맥 열림부위
5. 관상정맥굴
6. 아래대정맥
7. 삼첨판
8. 오른심실
9. 심방사이막
10. 심실사이막
11. 왼심방
12. 승모판
13. 왼심실

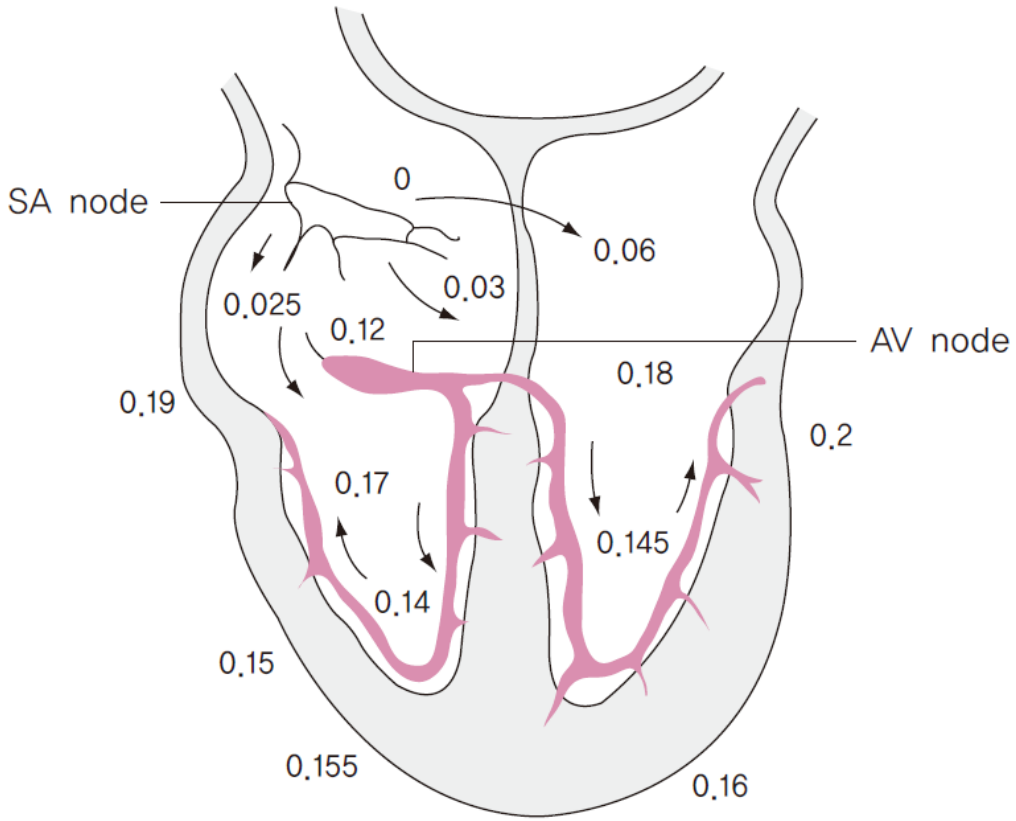
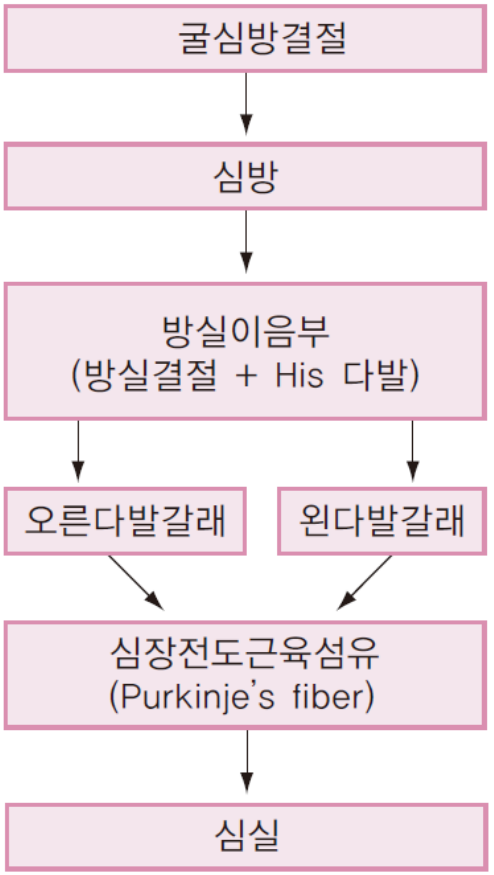
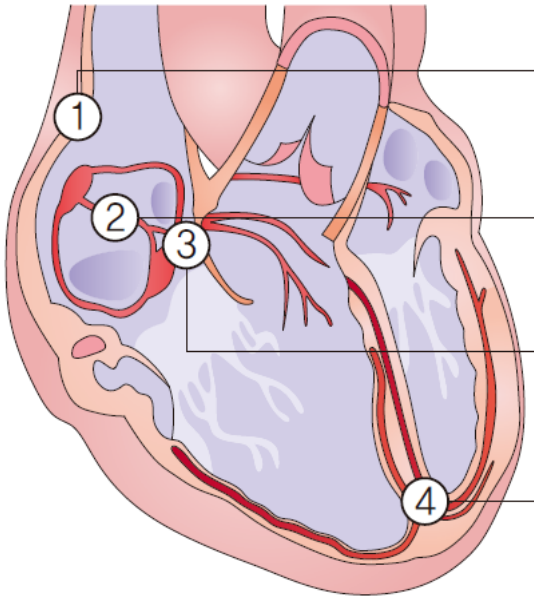


그림 4-12. 심장의 자극전도 시간

표 4-3. 심장자극계통





굴심방결절(동결절, SA node)
: 고유조율횟수 60~100/min

심방(atrium)
: 고유조율횟수 60~80/min

방실이음부(AV junction)
: 고유조율횟수 40~60/min

심실(ventricle)
: 고유조율횟수 20~40/min

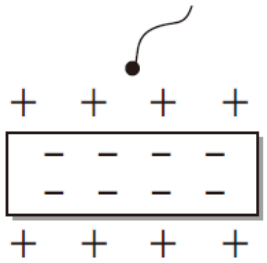
1차 박동조율기
(domianat pacemaker)
: 여러 부위의 동시다발적 흥분 방지

보조 박동조율기
(potential pacemaker)
: 비상 박동조율체계 구축

표 4-4. 세포 내 · 외의 이온농도 (단위 : mmol/L)

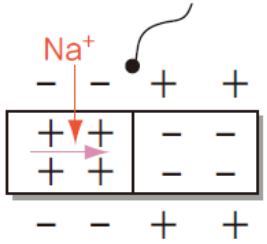
이온	세포 외	세포 내	비율
Na^+	135~145	10	14 : 1
K^+	3.5~5.0	155	1 : 30
Cl^-	95~110	10~20	4 : 1
Ca^{2+}	2	10^{-4}	2×10^4 : 1

분극상태(안정상태)



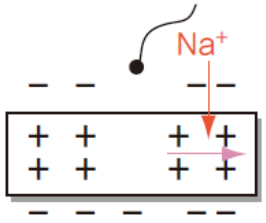
심근세포가 정지되어 있기
때문에 전류는 흐르지 않음

탈분극시작(일부분)



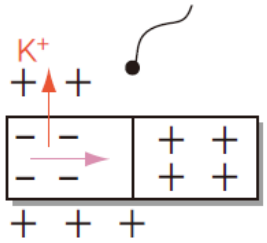
탈분극이 절반까지
진행된 상태

탈분극(완료)



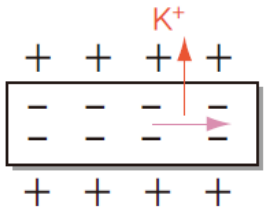
세포 전체가 탈분극을 끝내면
전류가 흐르지 않음

재분극시작(일부분)



재분극 과정이 절반
진행된 상태

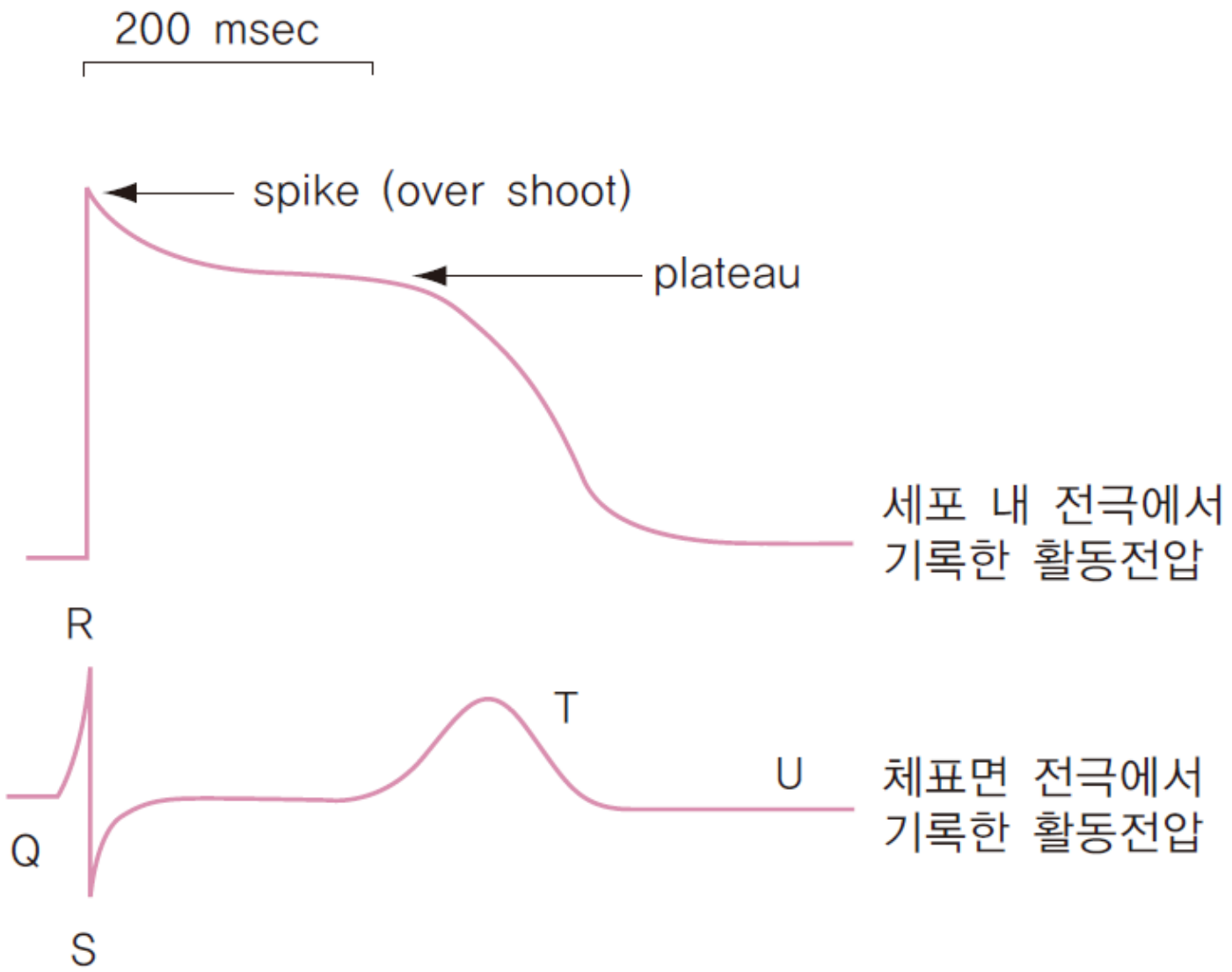
재분극완료

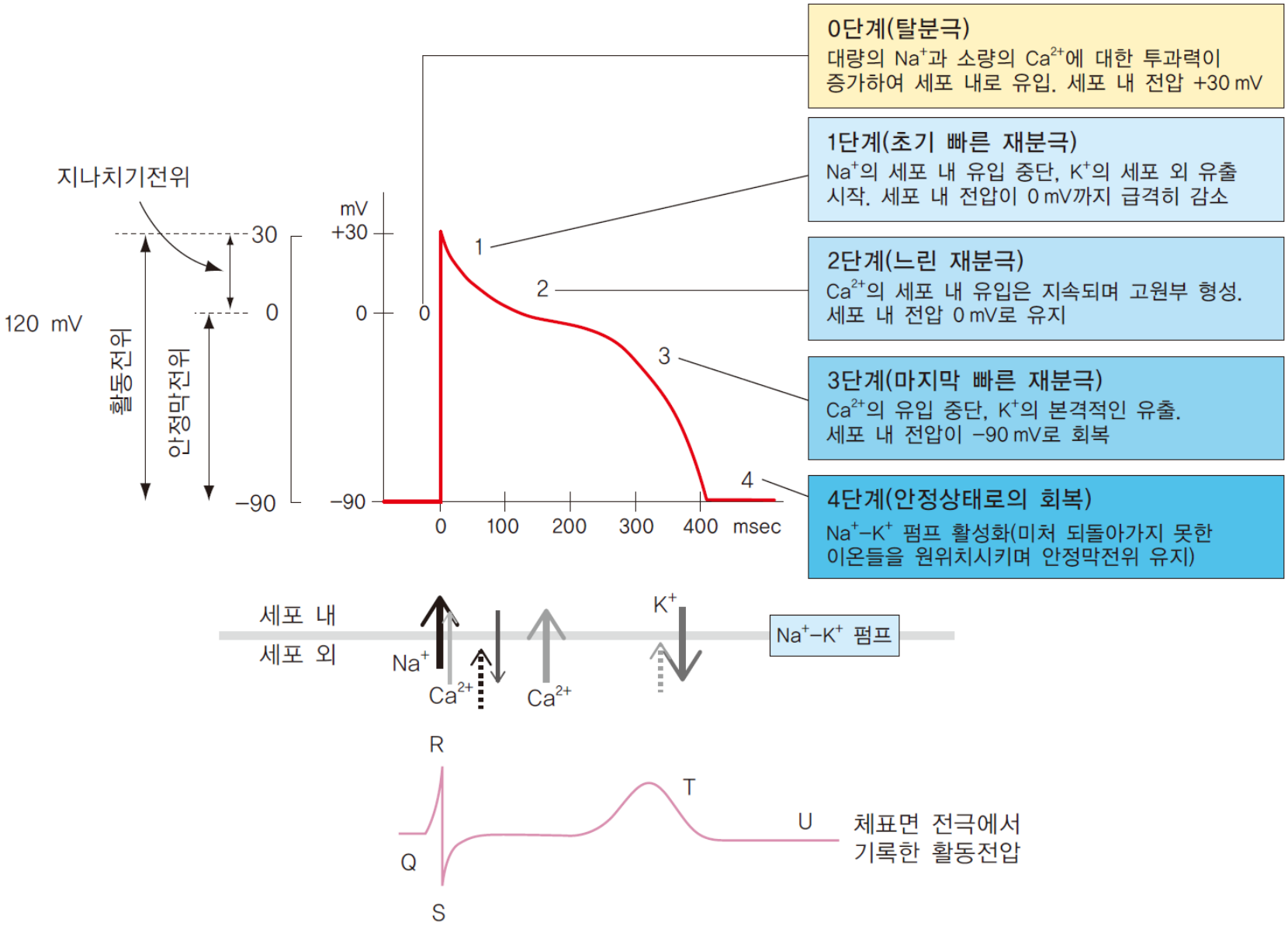


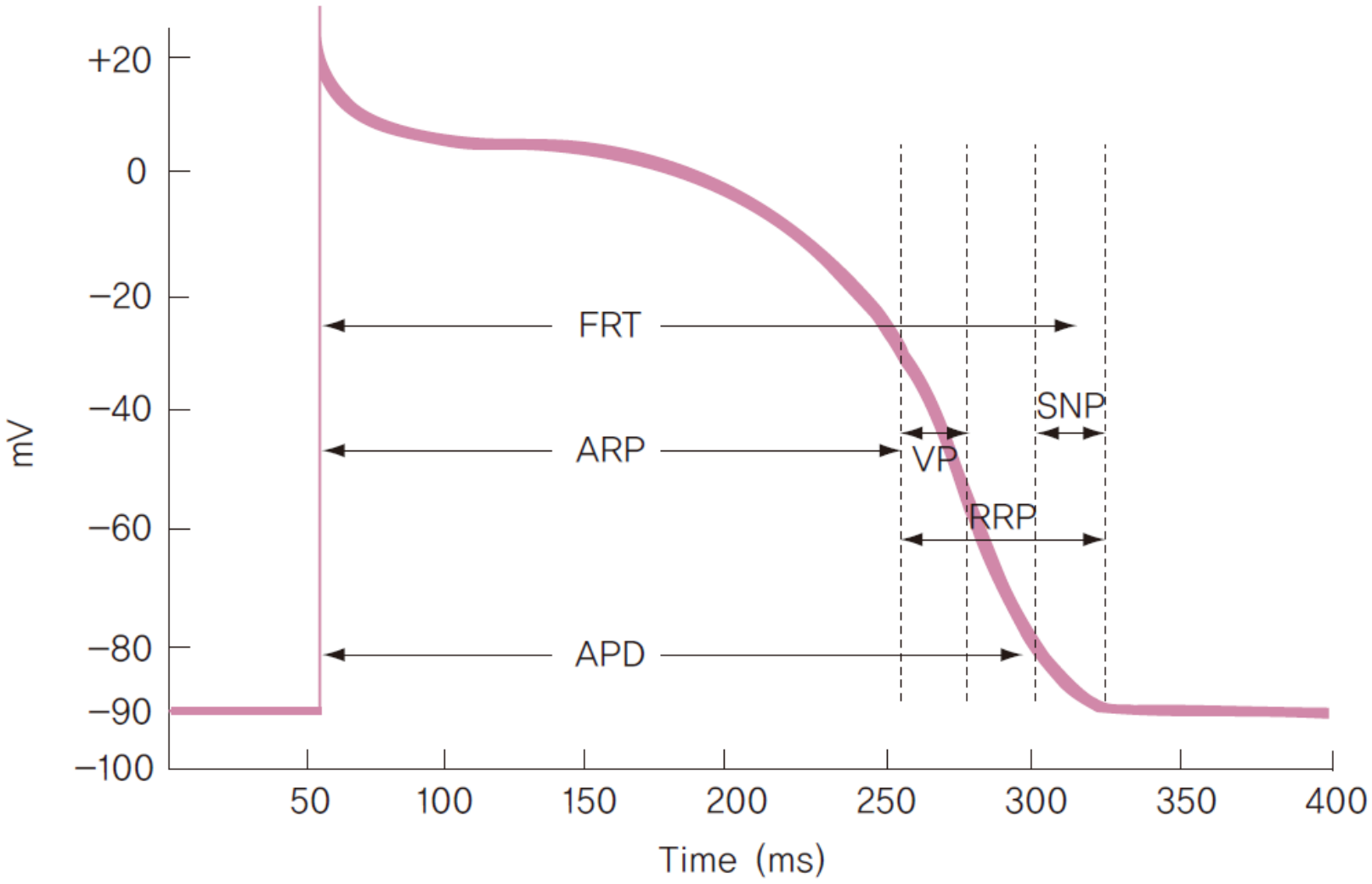
세포 전체가 분극상태에
복귀하면 전류는 흐르지 않음

표 4-5. 등가이중층

- 분극(polarization) : 세포 내(−), 세포 외(+) : 안정막전위(−90 mV)
- 탈분극(depolarization) : 세포 내(+), 세포 외(−) : 지나치기전위(+30 mV)
- 재분극(repolarization) : 세포 내(−), 세포 외(+)로 환원
- 활동전위(action potential) : 120 mV


200 msec
spike (over shoot)
plateau
세포 내 전극에서
기록한 활동전압
R
T
U
Q
S
체표면 전극에서
기록한 활동전압


지나치기전위
30
0
−90
120 mV
활동전위
안정막전위
mV
+30
0
−90
0
100
200
300
400
msec
1
2
3
4
0단계(탈분극)
대량의 Na+과 소량의 Ca2+에 대한 투과력이 증가하여 세포 내로 유입. 세포 내 전압 +30 mV
1단계(초기 빠른 재분극)
Na+의 세포 내 유입 중단, K+의 세포 외 유출 시작. 세포 내 전압이 0 mV까지 급격히 감소
2단계(느린 재분극)
Ca2+의 세포 내 유입은 지속되며 고원부 형성. 세포 내 전압 0 mV로 유지
3단계(마지막 빠른 재분극)
Ca2+의 유입 중단, K+의 본격적인 유출. 세포 내 전압이 −90 mV로 회복
4단계(안정상태로의 회복)
Na+–K+ 펌프 활성화(미처 되돌아가지 못한 이온들을 원위치시키며 안정막전위 유지)
세포 내
세포 외
Na+
Ca2+
Ca2+
K+
Na+–K+ 펌프
R
T
U
Q
S
체표면 전극에서 기록한 활동전압


+20
0
−20
−40
−60
−80
−90
−100
mV
50
100
150
200
250
300
350
400
Time (ms)
FRT
ARP
APD
VP
SNP
RRP

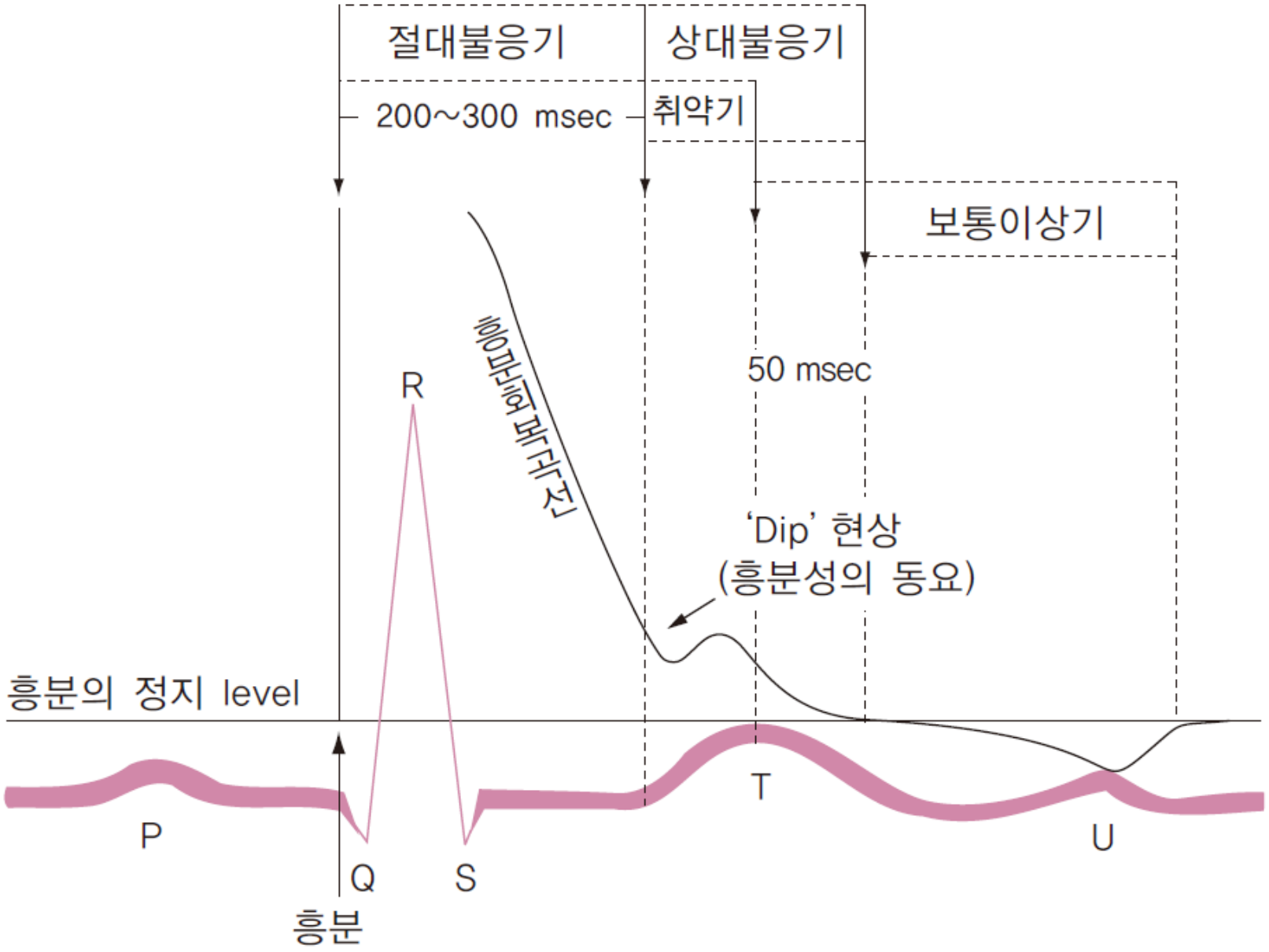
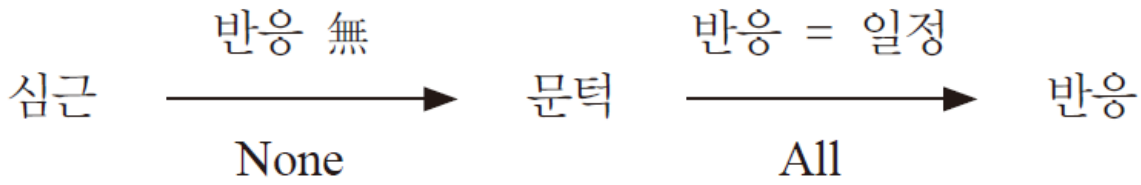
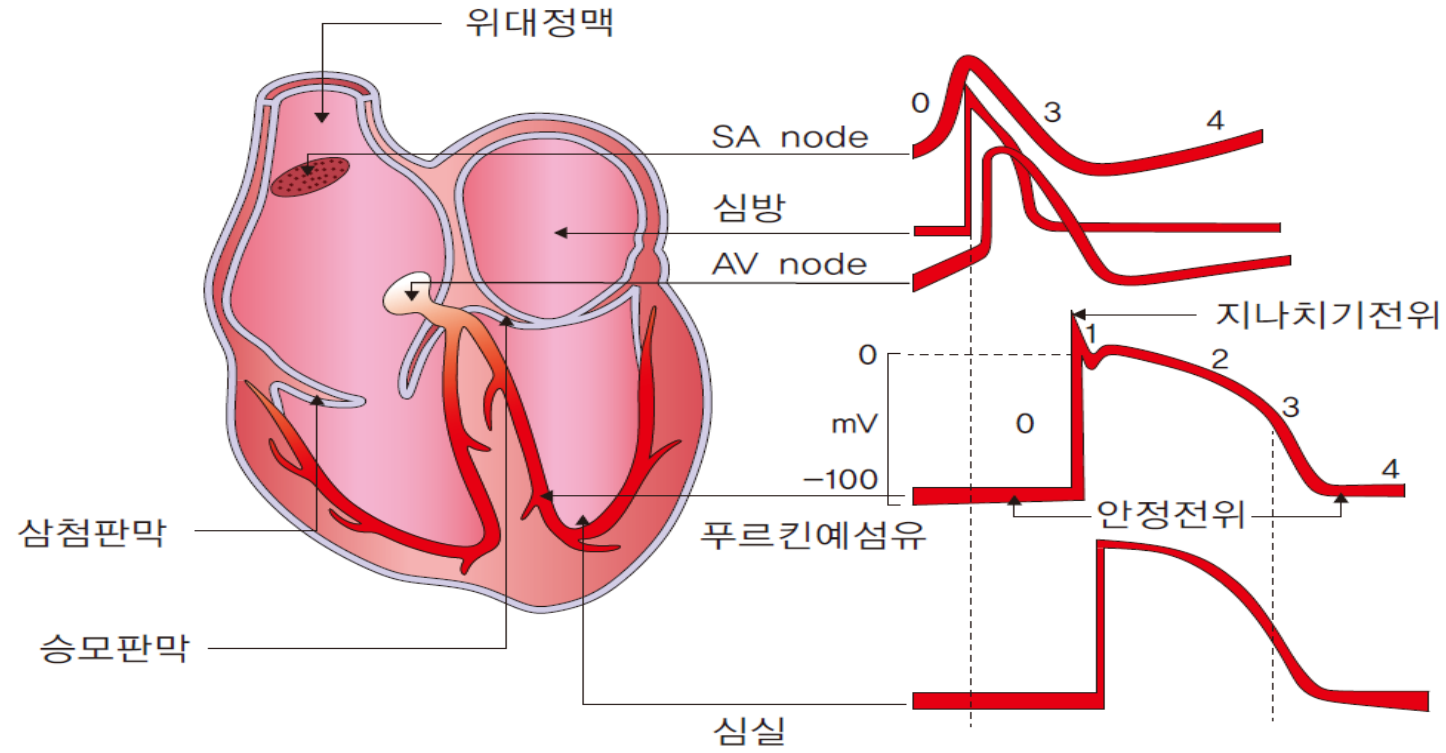
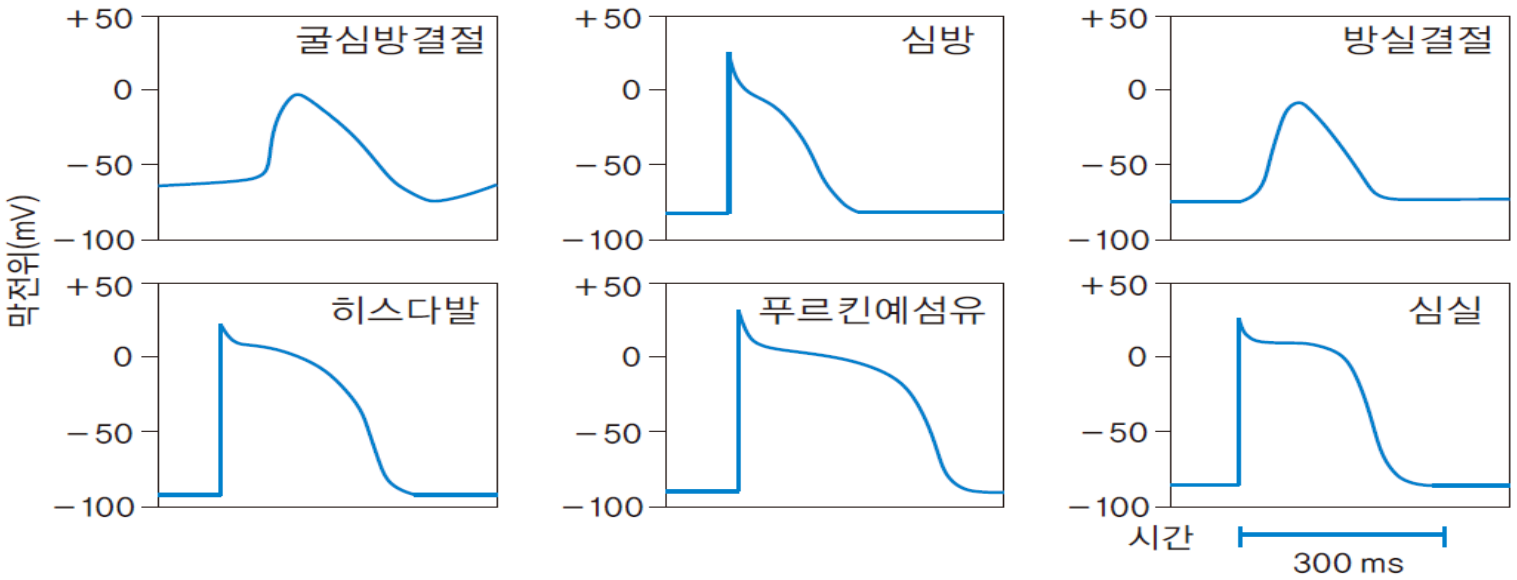
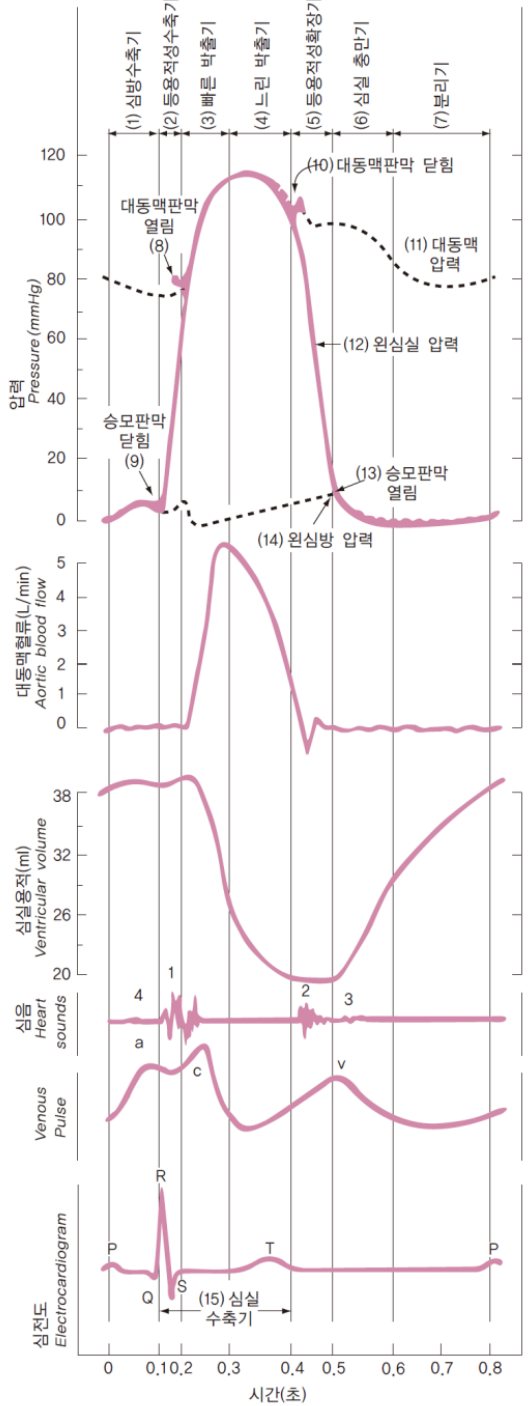

절대불응기
상대불응기
200~300 msec
취약기
보통이상기
50 msec
R
활동전위 하강선
'Dip' 현상
(흥분성의 동요)
흥분의 정지 level
P
Q
S
T
U
흥분

표 4-6. 실무율 법칙




위대정맥
SA node
심방
AV node
삼첨판막
승모판막
푸르킨예섬유
심실
0
3
4
지나치기전위
1
2
3
4
0
mV
0
−100
안정전위


굴심방결절
심방
방실결절
히스다발
푸르킨예섬유
심실
+50
0
−50
−100
막전위(mV)
시간
300 ms

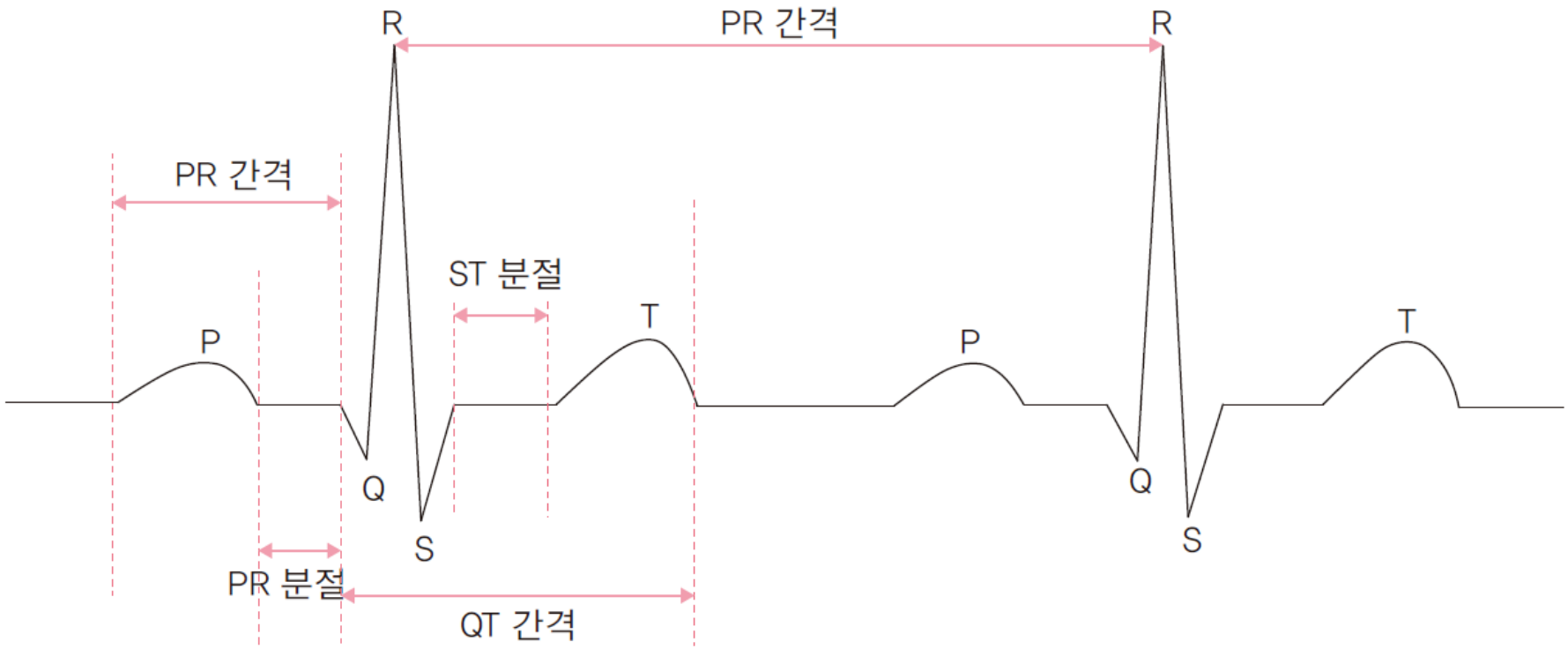

(1) 심방수축기
(2) 등용적성수축기
(3) 빠른 박출기
(4) 느린 박출기
(5) 등용적성확장기
(6) 심실 충만기
(7) 분리기
압력 Pressure (mmHg)
120
100
80
60
40
20
0
(10) 대동맥판막 닫힘
대동맥판막 열림 (8)
(11) 대동맥 압력
(12) 왼심실 압력
승모판막 닫힘 (9)
(13) 승모판막 열림
(14) 왼심방 압력
대동맥혈류(L/min) Aortic blood flow
5
4
3
2
1
0
심실용적(ml) Ventricular volume
38
32
26
20
심음 Heart sounds
1
2
3
4
Venous Pulse
a
c
v
심전도 Electrocardiogram
R
P
T
P
Q
S
(15) 심실 수축기
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
시간(초)

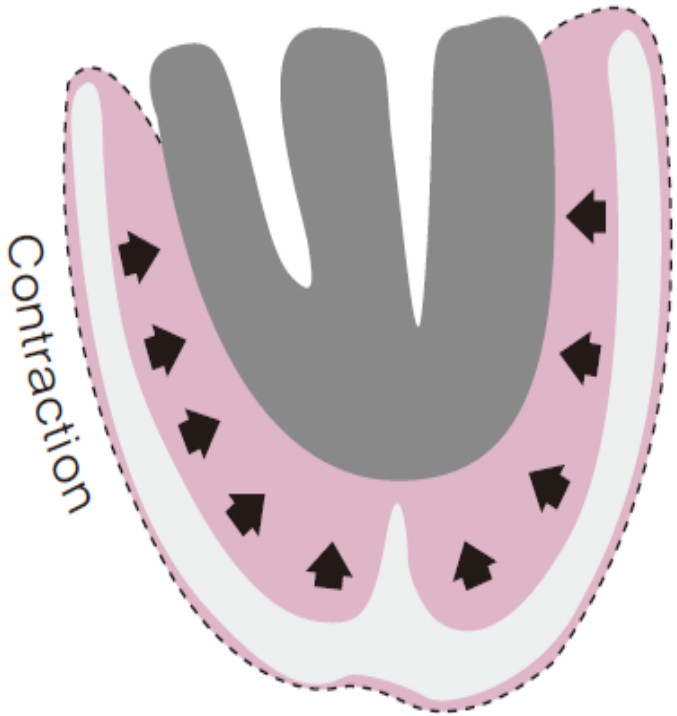
Section 05

심전도 검사의 기본개념

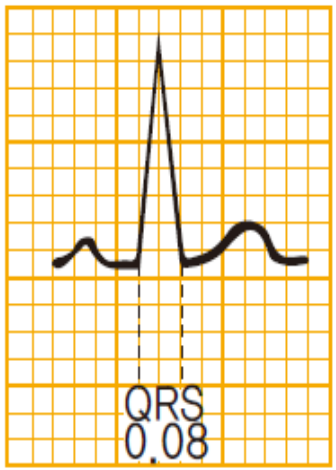
학습 목표

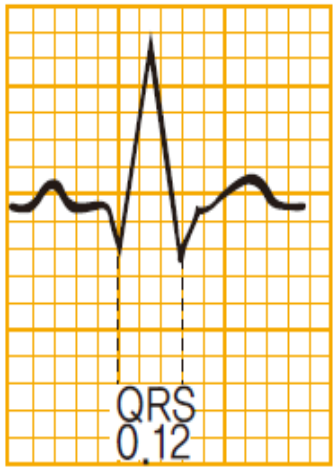
1. 심전도 검사의 임상적 의의를 설명할 수 있다(A).
2. 심전도 파형 및 정상치를 설명할 수 있다(A).
3. 심전도 파형의 여러 가지 형태를 설명할 수 있다(A).
4. 심전도 교정곡선을 설명할 수 있다(A).
5. 심전계의 기본원리를 설명할 수 있다(A).


R
PR 간격
R
PR 간격
ST 분절
P
T
P
T
Q
Q
S
S
PR 분절
QT 간격


Contraction


QRS


QRS
0.08


QRS
0.12

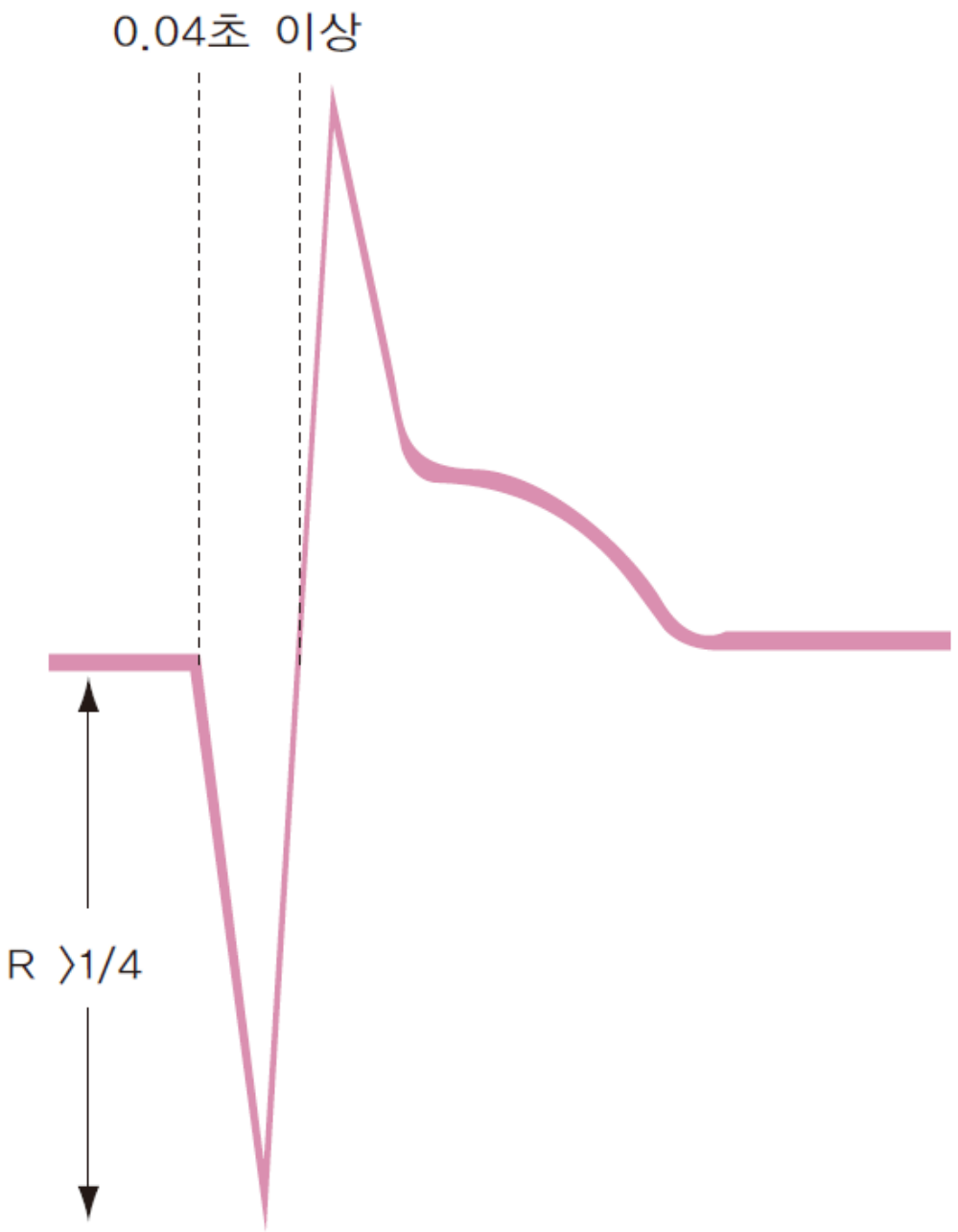
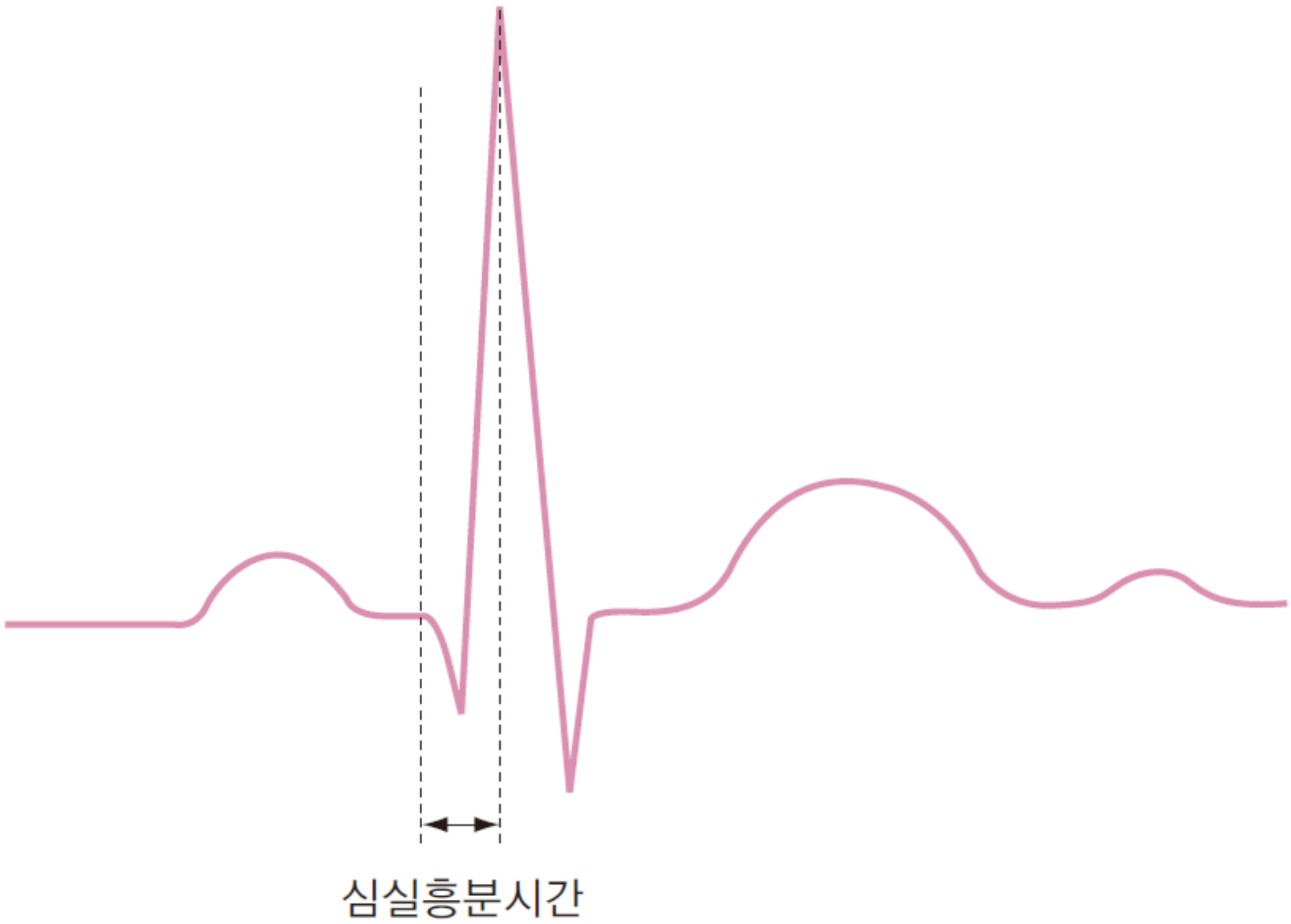

0.04초 이상
R 〉1/4

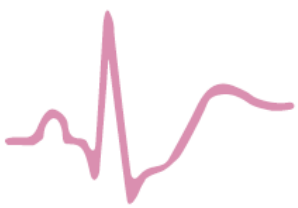
표 5-1. QTc 간격

심장박동수/분	RR 간격(초)	QT(초)와 정상치
40	1.5	0.46 (0.41~0.51)
50	1.2	0.42 (0.38~0.46)
60	1.0	0.39 (0.35~0.43)
70	0.86	0.37 (0.33~0.41)
80	0.75	0.35 (0.32~0.39)
90	0.67	0.33 (0.30~0.36)
100	0.60	0.31 (0.28~0.34)
120	0.50	0.29 (0.26~0.32)
150	0.40	0.25 (0.23~0.28)
180	0.33	0.23 (0.21~0.25)
200	0.30	0.22 (0.20~0.24)


심실흥분시간



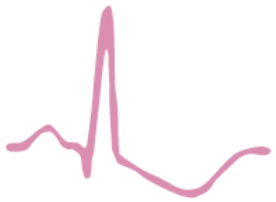
정상 ST



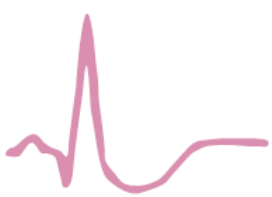
ST 저하
(이음부하강)



ST 저하
(수평하강)



ST 저하
(늘어진하강)



ST 저하
(오목하강)



ST 상승
(위로,오목)



ST 상승
(위로,볼록)

표 5-2. 심전도파형의 임상적 의의와 정상치

파형	구분	임상적 의의	정상치	
			시간	진폭
P파		심방의 탈분극	0.06~0.10초 (0.1초 이내)	0.25 mV 이하
QRS군		심실의 탈분극	0.04~0.10초 (0.1초 이내)	0.5~2.5 mV
T파		심실의 재분극	0.10~0.25초	0.5~1.0 mV
U파	T파 후에 생기는 완만한 파			0.2 mV 이하
PR (PQ) 간격	P파의 시작에서 QRS군의 시작까지의 부분	방실흥분 전도시간	0.12~0.20초	
QRS 간격	Q(R)파의 시작에서부터 R(S)의 끝	심실 내 전도시간	0.1초 이내	
ST 간격	S파의 끝에서부터 T파의 끝			
QTc 간격	QRS군의 시작에서부터 T파의 끝까지의 부분	전기적 심실 수축시간	0.35~0.45초	
RR 간격	R파의 꼭대기부터 다음 R파의 꼭대기까지	심장주기	0.6~1.0초	
ST 분절	QRS군의 끝에서부터 T파의 시작까지의 부분 (바닥선상에 있는 것이 원칙)	심실 전체의 흥분정점상태(흥분극기)	팔다리유도 : 1 mm 이하 가슴유도 : 2 mm 이하	
PR 분절	P파의 끝에서 QRS군의 시작까지		0.02~0.10초	
TP 분절	T파의 끝에서 P파의 시작까지		0.02~0.04초	



양성(positive)

음성(negative)



2상성
(biphasic, + −type)



2상성
(biphasic, − +type)



편평성(flat)



2봉성(bipeaked)



봉우리(rounded)



완만상승
(slurred on upstroke)



완만하강
(slurred on downstroke)



텐트형(peaked)



qRs



qR



Rs



R



rS



RS



rSR'



rSR's'



Qr



QS



R의 결절



rR'(R의 분열)



텐트형(peaked)



원형(rounded)



편평(flat)



저전위(low)



2상성
(biphasic, + −type)



2상성
(biphasic, − +type)



2봉성(bipeaked)



완만상승
(slurred on the upstroke)

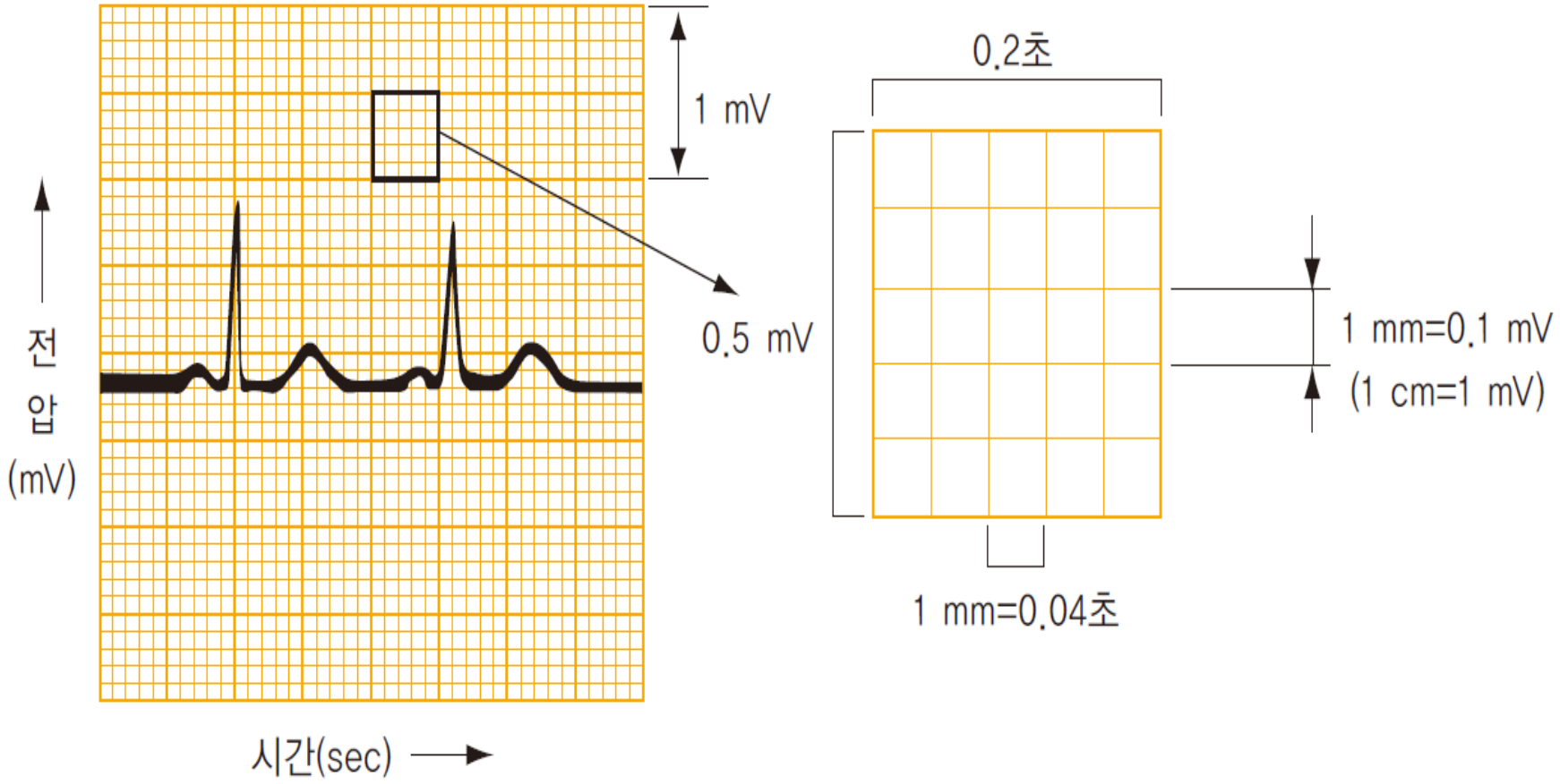


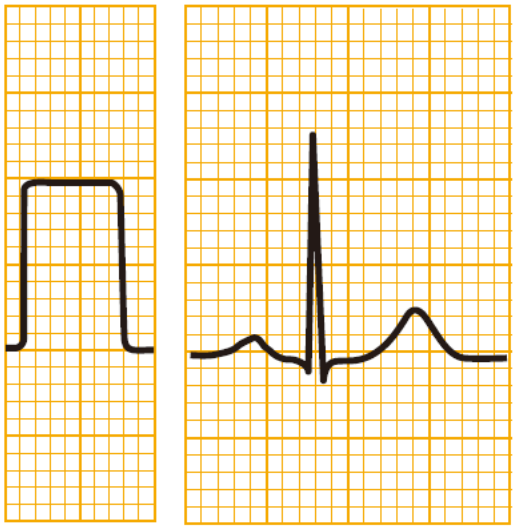
완만하강
(slurred on the downstroke)

등전위(isoelectric)

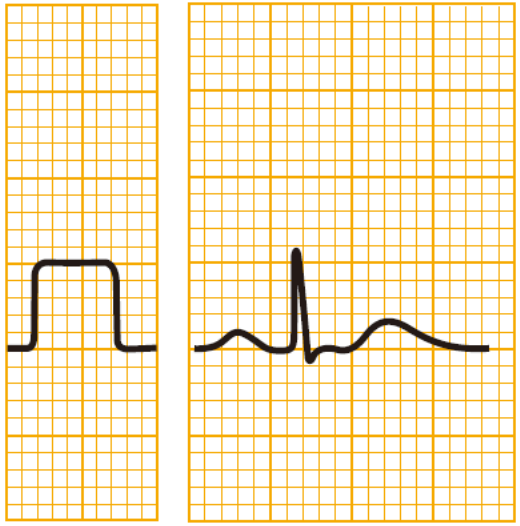


역위성(inverted)

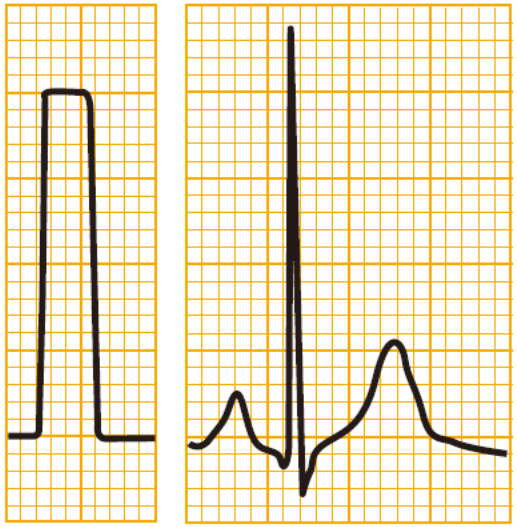

1 mV
0.5 mV
0.2초
1 mm=0.1 mV
(1 cm=1 mV)
1 mm=0.04초
전
압
(mV)
시간(sec)



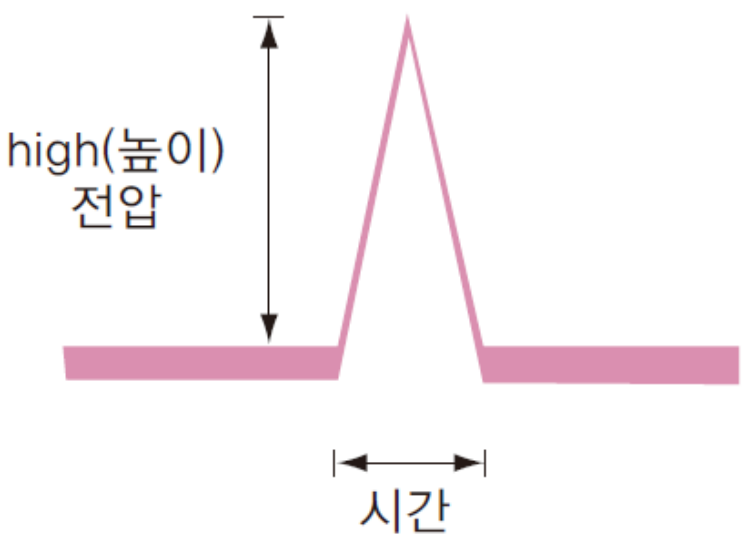
A



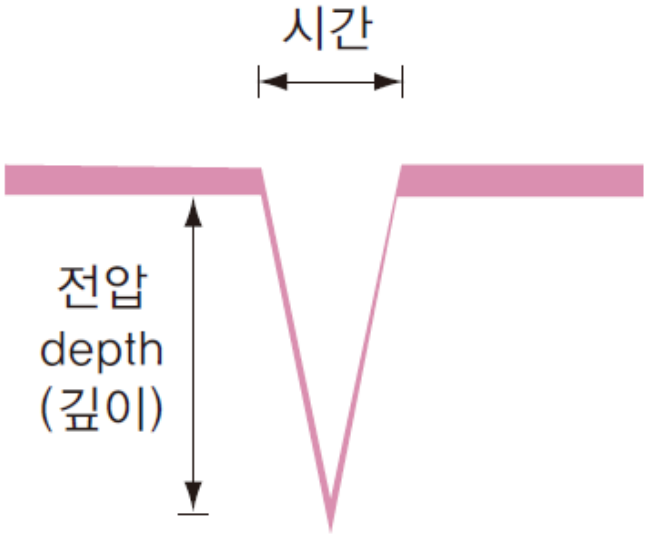
B



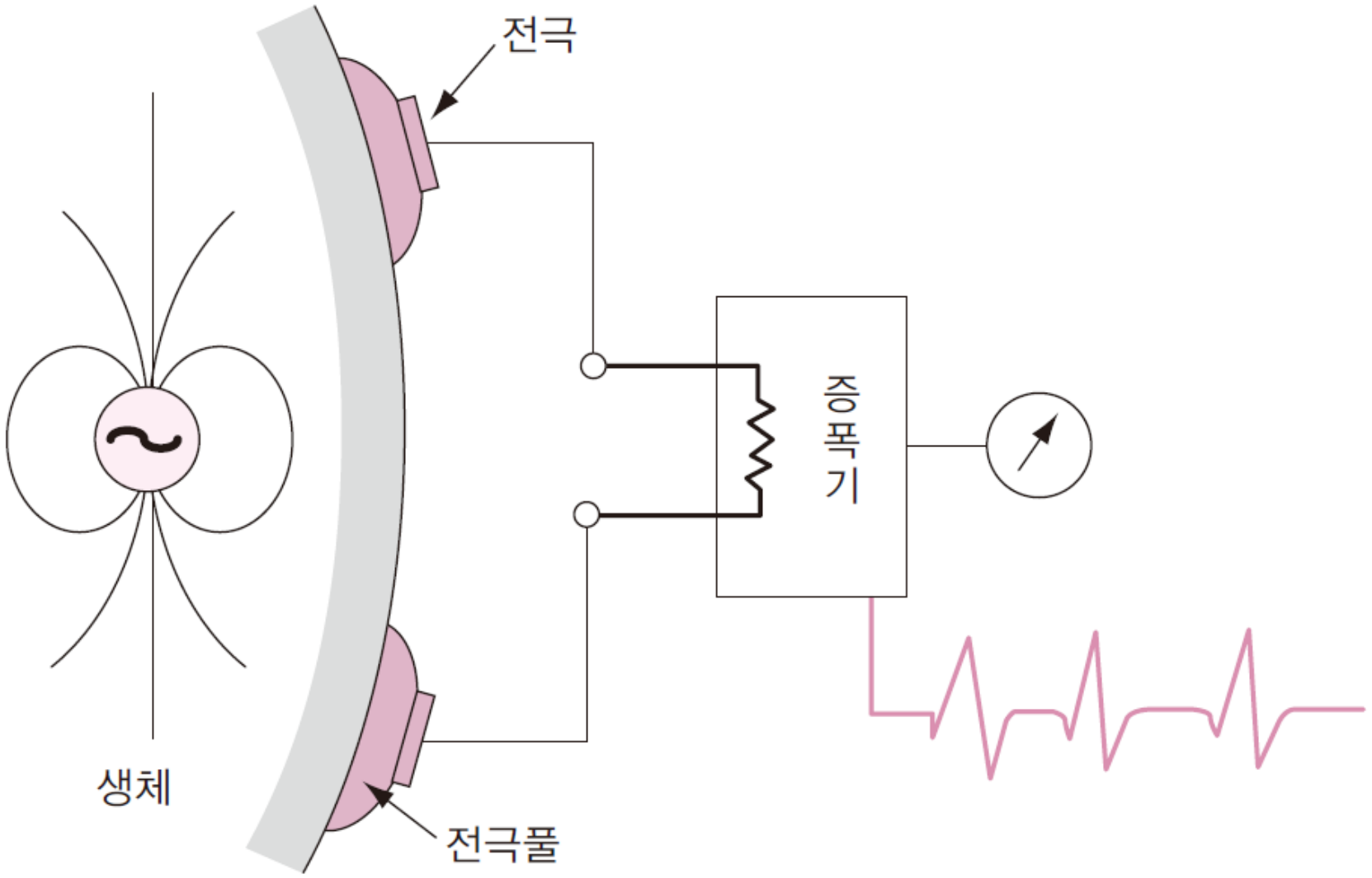
C

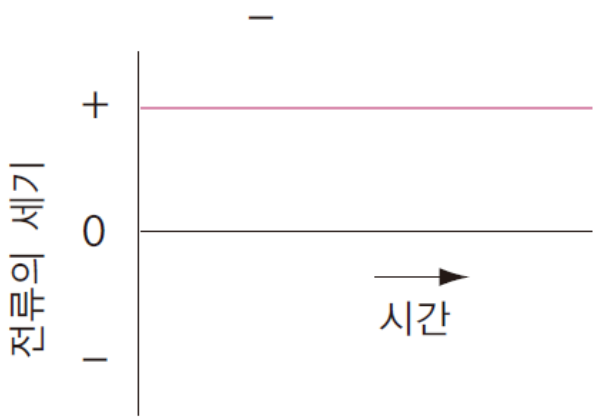


양성파

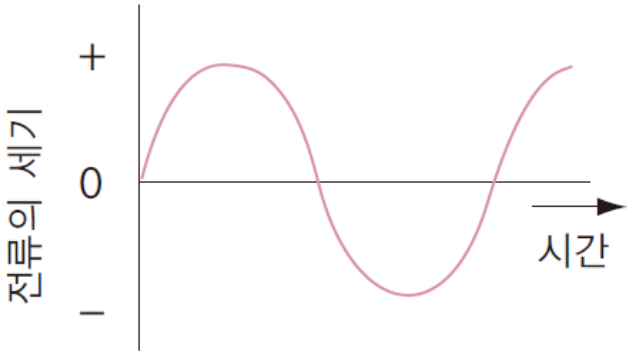


음성파

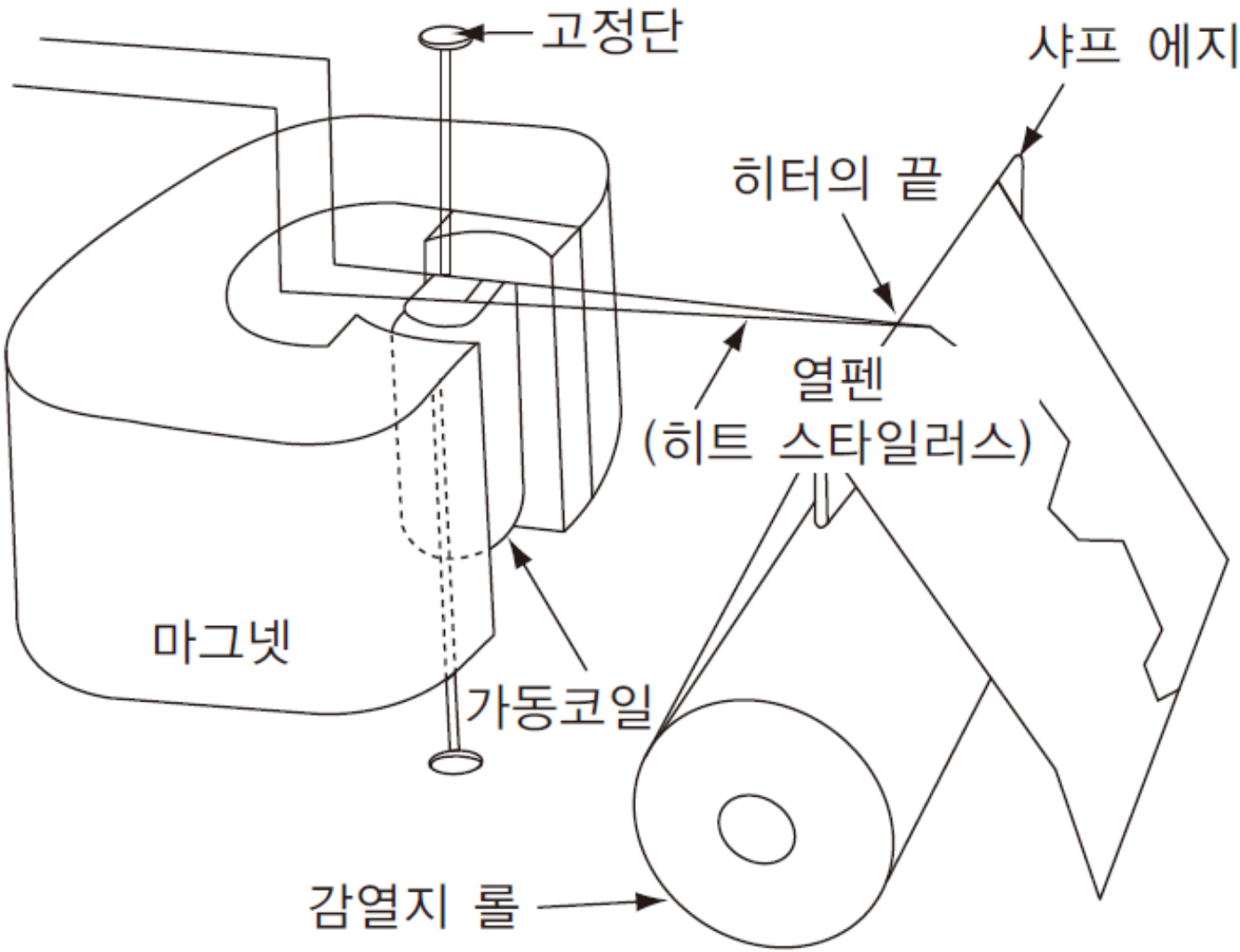

전극
증폭기
생체
전극풀



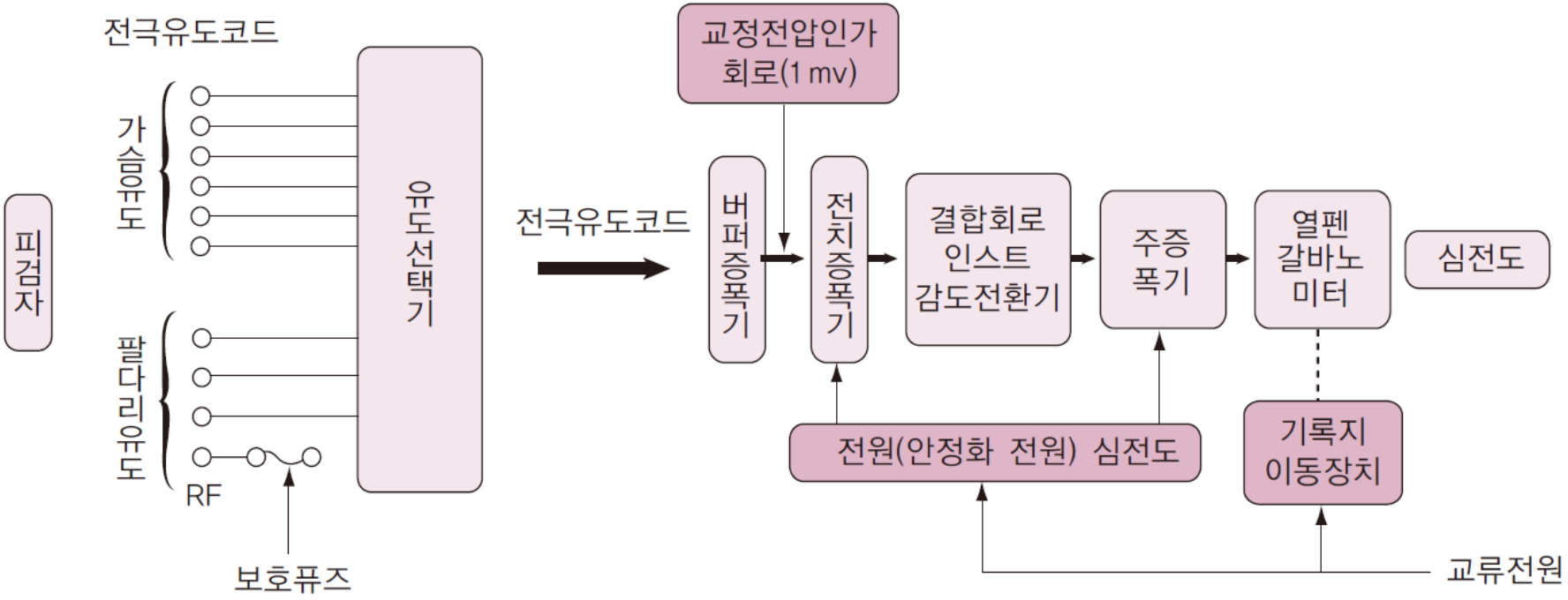
직류

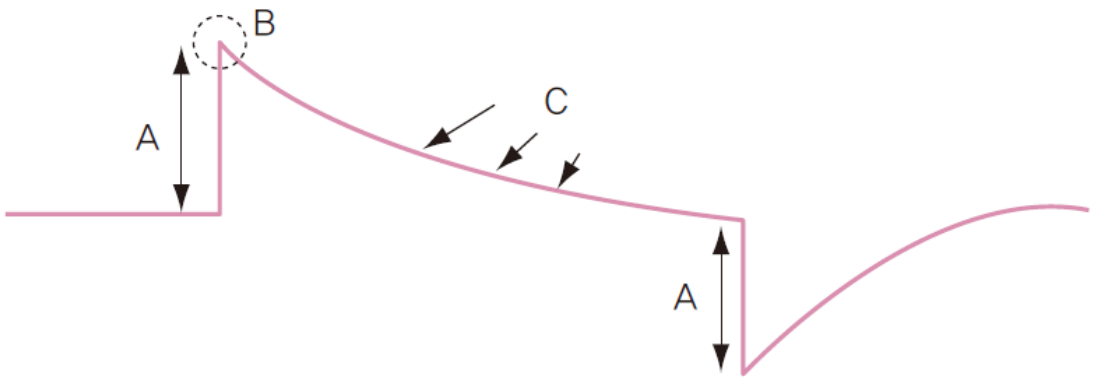


교류


고정단
샤프 에지
히터의 끝
열펜
(히트 스타일러스)
마그넷
가동코일
감열지 롤



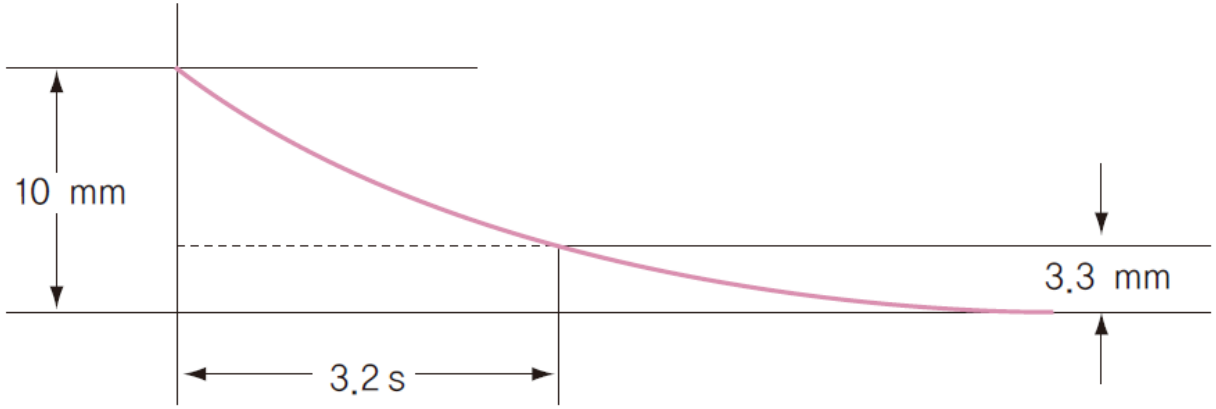

피검자
전극유도코드
가슴유도
팔다리유도
RF
보호퓨즈
유도선택기
전극유도코드
교정전압인가 회로(1 mv)
버퍼증폭기
전치증폭기
결합회로 인스트 감도전환기
주증폭기
열펜 갈바노미터
심전도
전원(안정화 전원) 심전도
기록지 이동장치
교류전원



A. 진폭 : 감도와 관계

B. 머리모양 : 제동, 고역특성, 펜압과 관계

C. 바닥선으로의 복귀 : 시정수


10 mm
3.3 mm
3.2 s

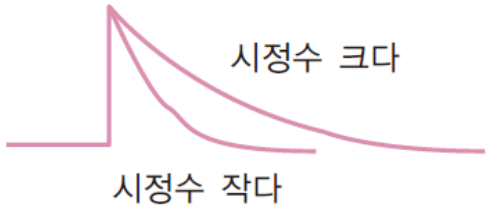
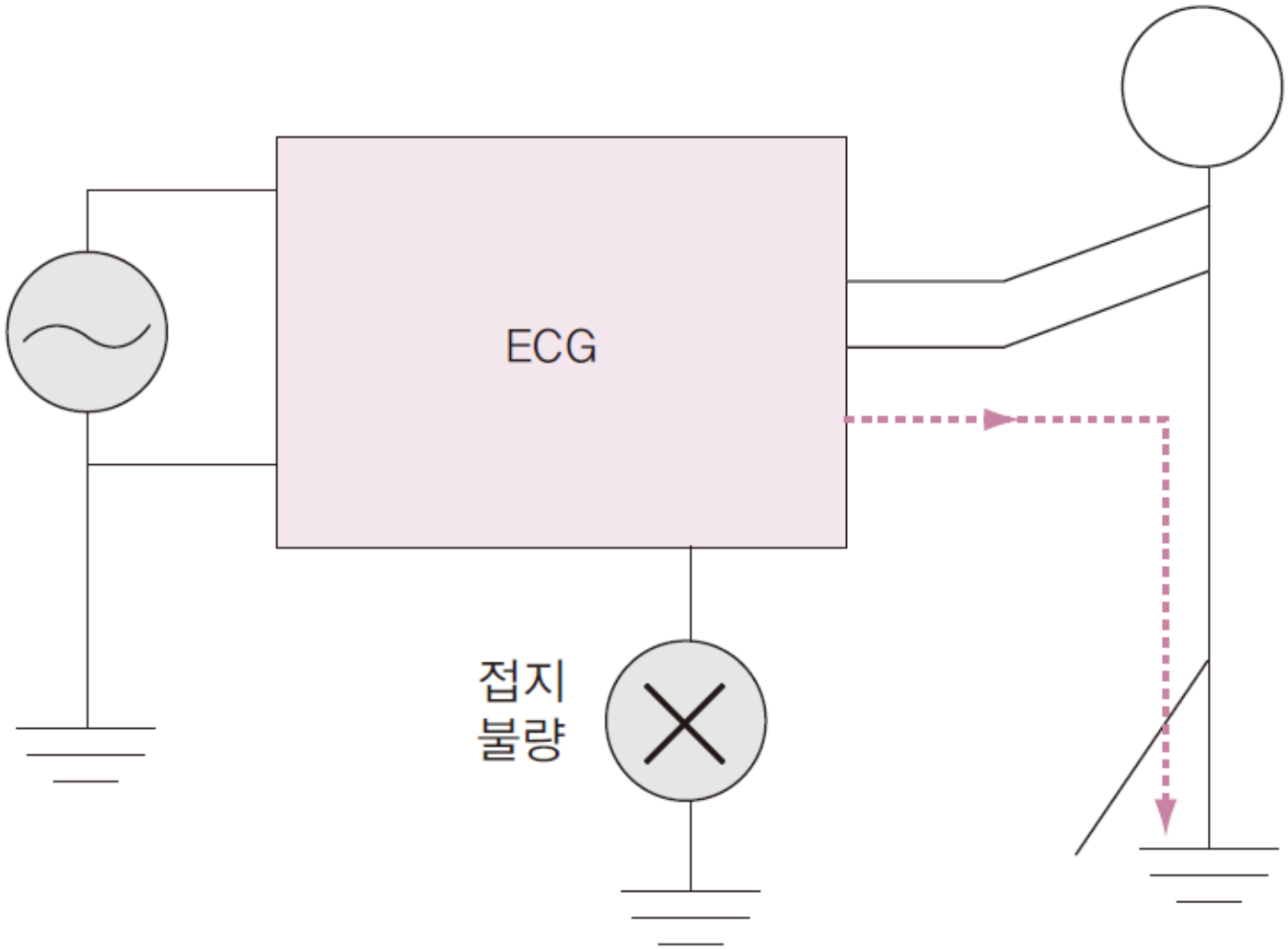
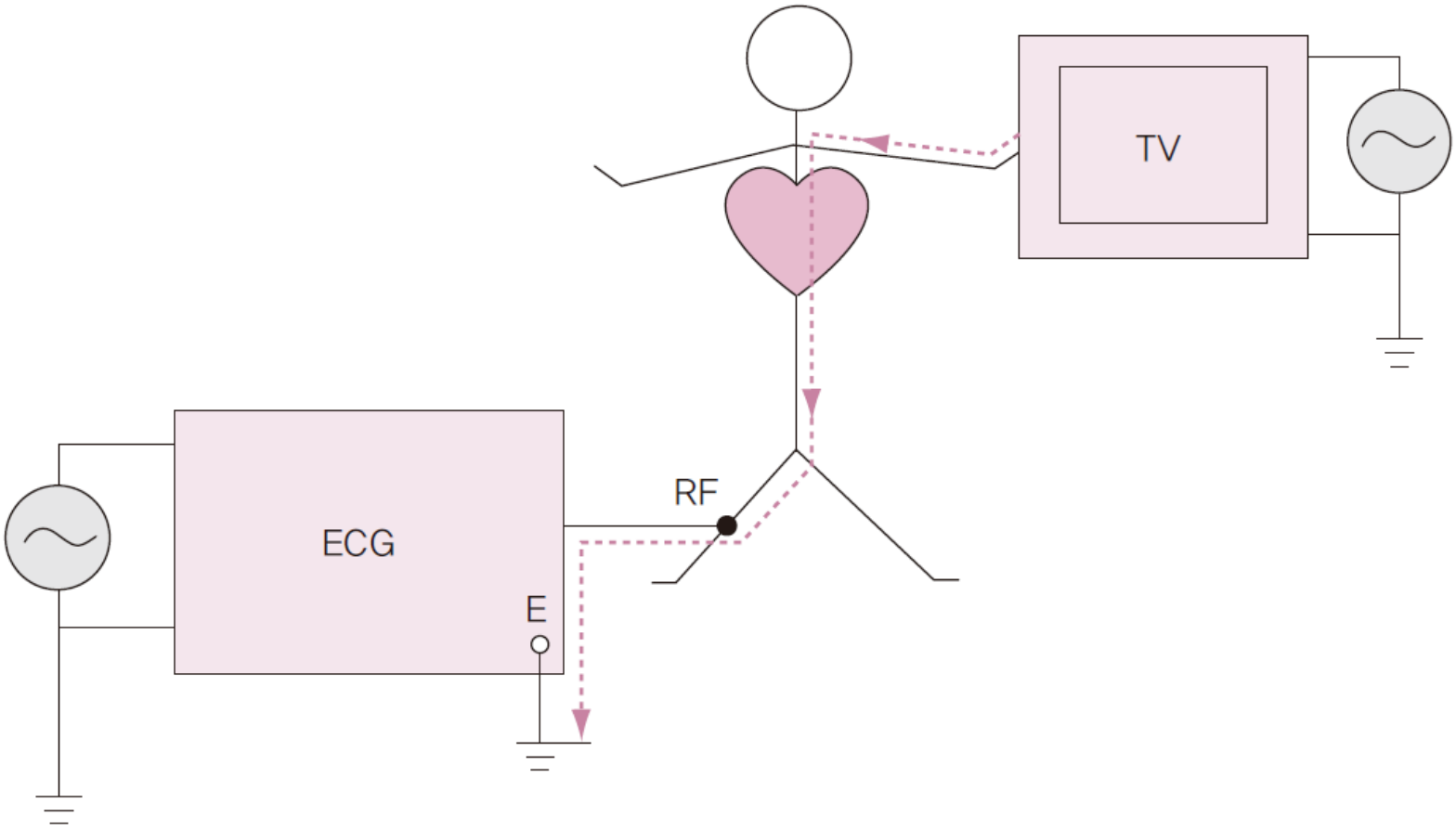

시정수 크다
시정수 작다

표 5-3. 전류에 의한 생체반응

전류치	생체반응	기기
0.01 mA (10 μA)	**microshock**의 허용전류치	CF 기기
0.1 mA (100 μA)	직접 심장에 흐르면 **심실세동**을 일으킨다.	B형 기기
	macroshock의 허용전류치	
1 mA	찌릿찌릿하게 느끼는 전류(최소감지전류)	
10 mA	근육을 자유로이 움직일 수 없는 전류(이탈전류)	
100 mA	체표를 통해 체내에 흐르면 **심실세동**을 일으킨다.	


ECG
접지
불량


TV
ECG
RF
E

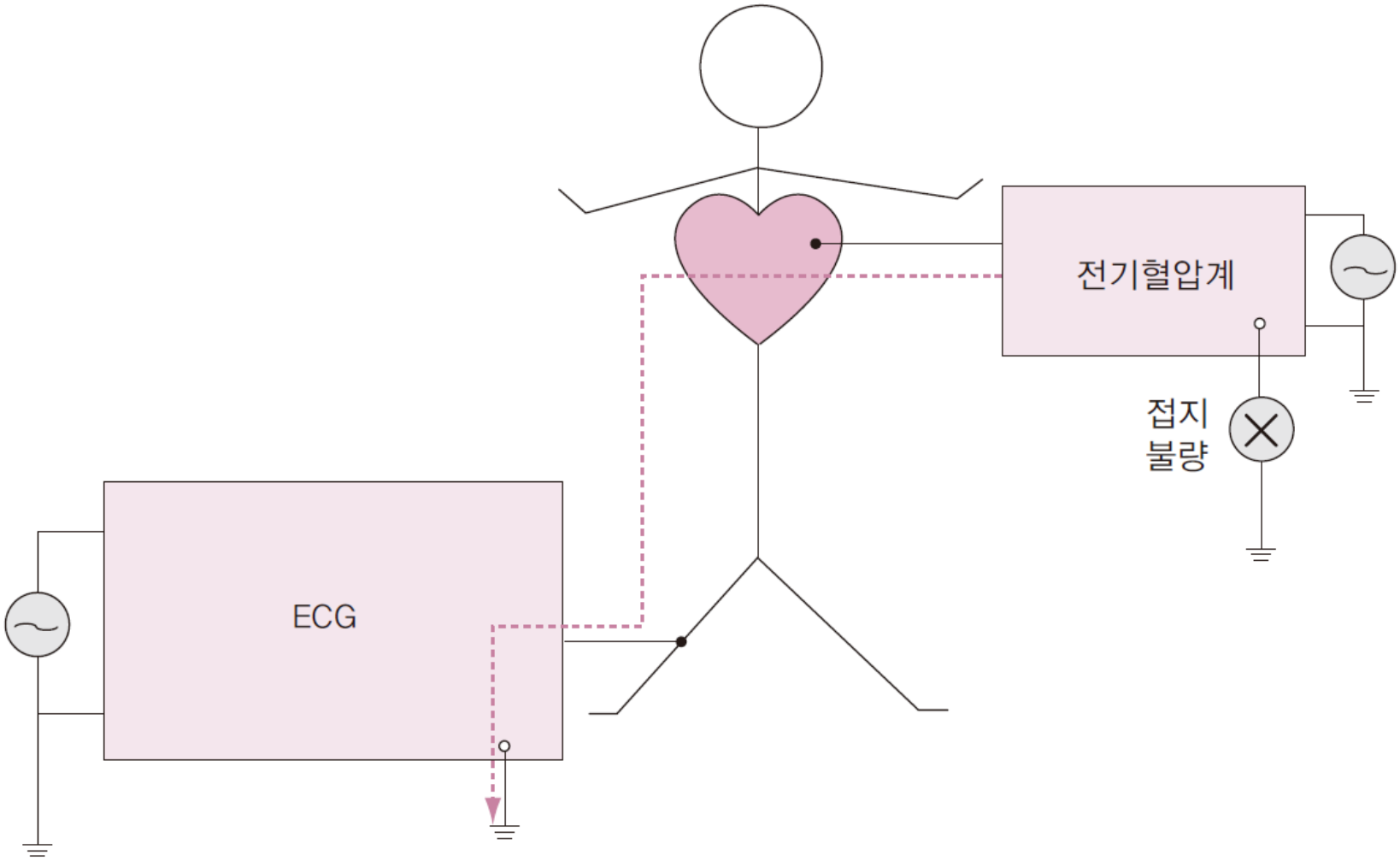

전기혈압계
접지
불량
ECG

표 5-4. 등급별 분류기기

	기초절연	추가보호수단
등급 I 기기	충전부의 절연	보호접지(고정배선, 3 P plug)
등급 II 기기	〃	보강절연(이중절연)
등급 III 기기	〃	초저압전원(교류 24 V 이하, 직류 50 V 이하)
내부전증원기기	〃	내부전증원(전지동작)

표 5-5. 표시기호

NO	기호	설 명	NO	기호	설명
1	~	교류	11	|	ON(상용전원)
2	3~	3상교류	12	⏚	보호접지(대지)
3	3N~	3상교류 중성도체	13	⏚⏚	추가보호접지
4	⎓	직류	14	⏚	접지(대지 : 가능)
5	≂	교류 및 직류	15	⏚	동전위화
6	⧈	Class II 기기	16	N	중성선 접속점
7		B형	17	⚠	주의, 부속문서 참조
8		BF형	18	⚠	주의, 추가보호접지 필요
9		CF형	19	ϟ	고전위
10	○	OFF(상용전원)	20		비전리방사선

Section 06

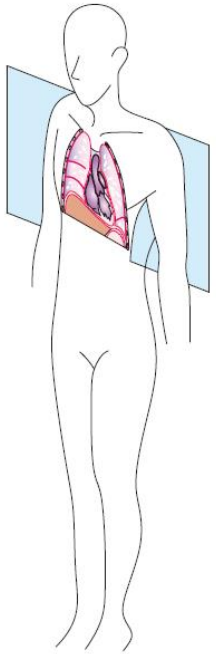
심전도 유도법

학습목표

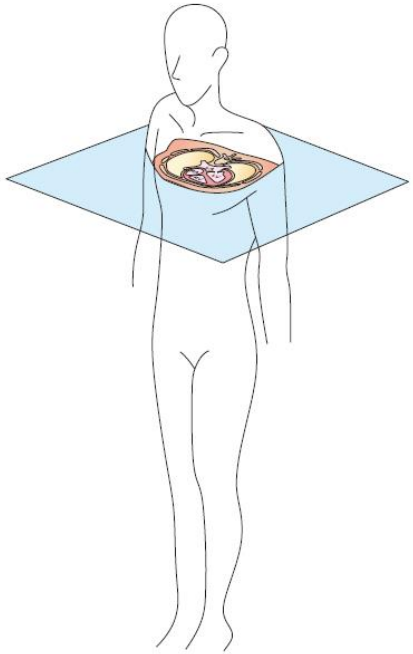
1. 표준12유도법을 설명할 수 있다(A).
2. 표준 팔다리유도를 설명할 수 있다(A).
3. 증폭단극팔다리유도를 설명할 수 있다(A).
4. 가슴유도를 설명할 수 있다(A).
5. 각 유도가 반영하는 심장 부위를 설명할 수 있다(A).

표 6-1. 표준12유도의 유도법

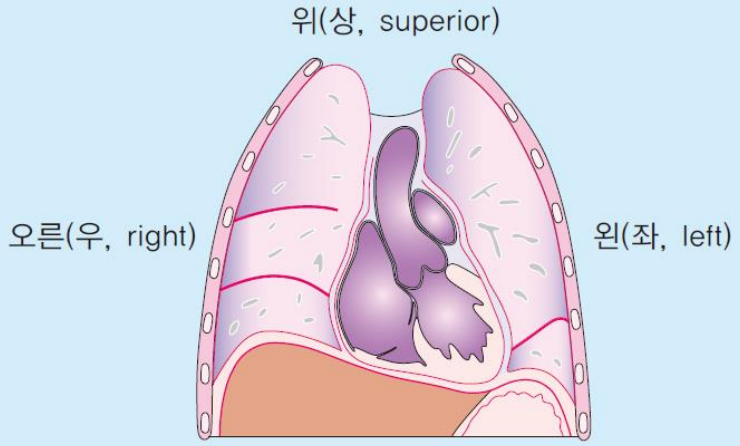
유도 기호	전극위치		유도명		
	관전극	불관전극			
I	⊕왼손(LA)과 오른손(RA)⊖	없음	표준팔다리유도 (Einthoven 유도)	쌍극 유도	이마면 유도
II	⊕왼발(LF)과 오른손(RA)⊖				
III	⊕왼발(LF)과 왼손(LA)⊖				
$_aV_R$	오른손(RA)⊕	왼손과 왼발의 중간단자⊖	증폭단극팔다리 유도 (Goldberger 유도)	단극 유도	
$_aV_L$	왼손(LA)⊕	오른손과 왼발의 중간단자⊖			
$_aV_F$	왼발(LF)⊕	오른손과 왼손의 중간단자⊖			
V_1	넷째 갈비사이공간 복장뼈 오른쪽가장자리	오른손, 왼손, 왼발의 결합점 ⊖ (Wilson의 결합단자)	단극가슴유도 (Wilson유도)	단극 유도	수평면 유도
V_2	넷째 갈비사이공간 복장뼈 왼쪽가장자리				
V_3	V_2와 V_4의 중간 부위⊕				
V_4	다섯째 갈비사이공간과 왼빗장뼈 중앙선과의 교차부위				
V_5	V_4와 같은 높이에서 왼앞겨드랑선				
V_6	V_4와 같은 높이에서 왼중간겨드랑선				

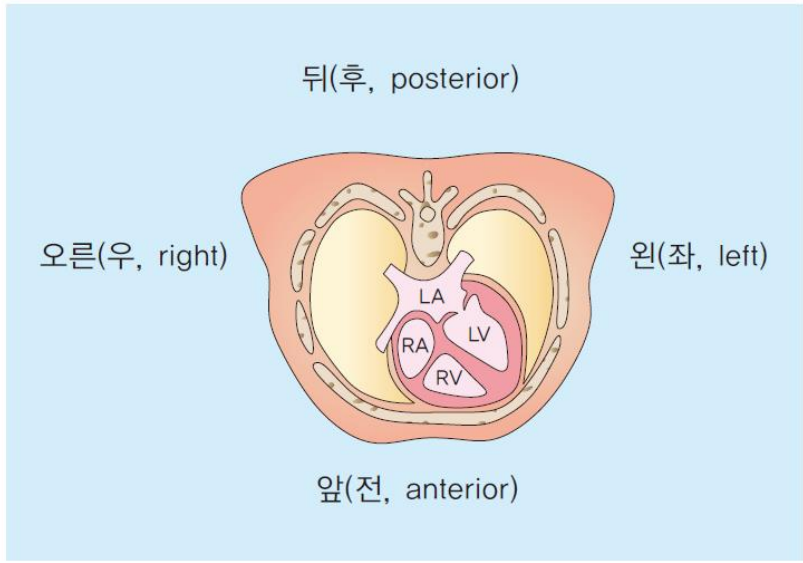


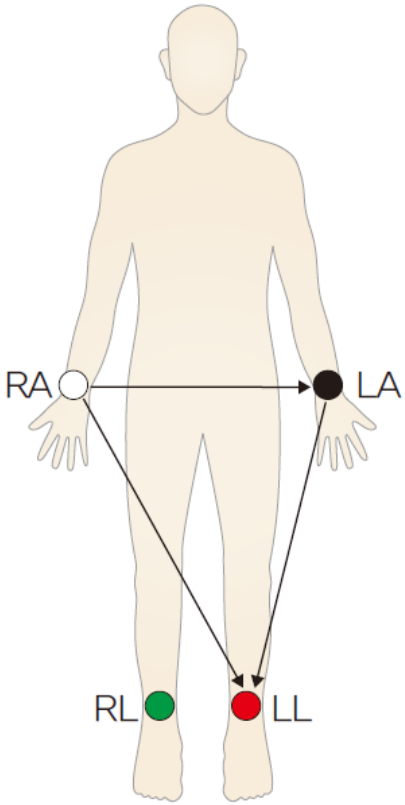
이마면 : 심장의 좌우상하 관계

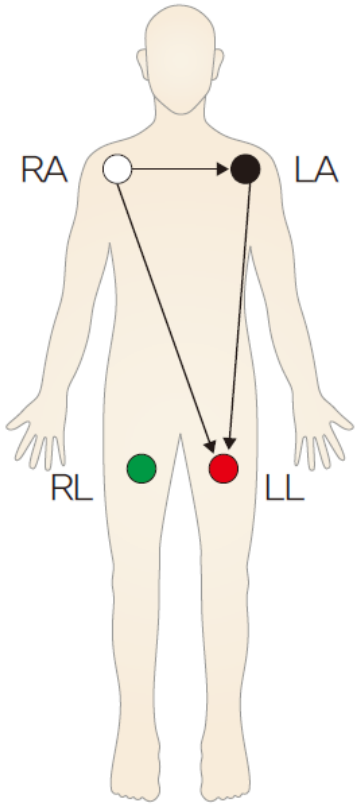


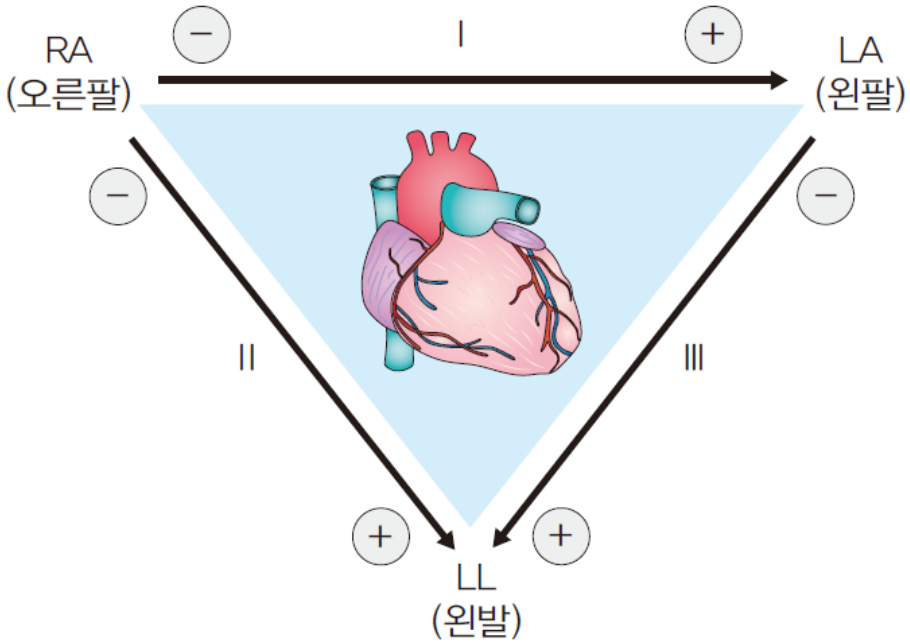
수평면 : 심장의 좌우전후 관계

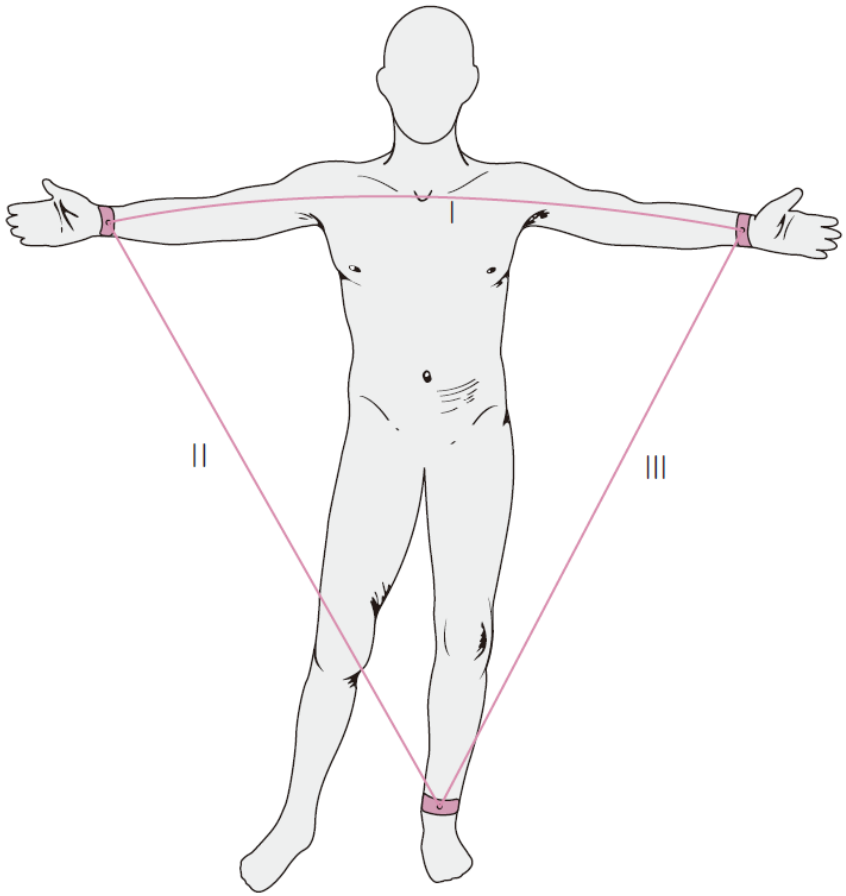


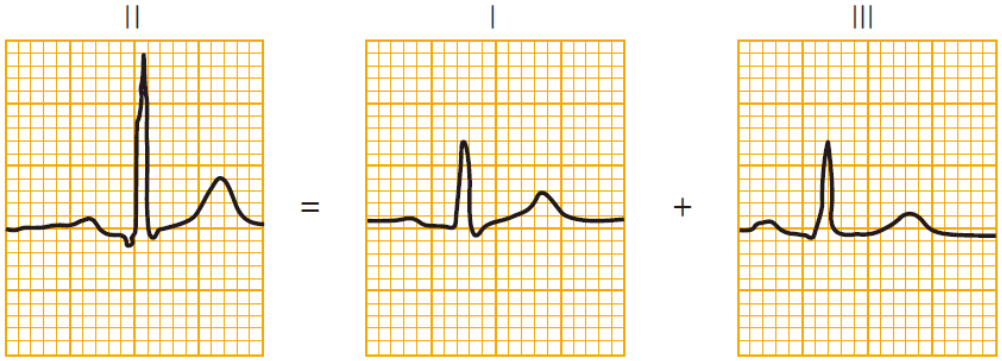


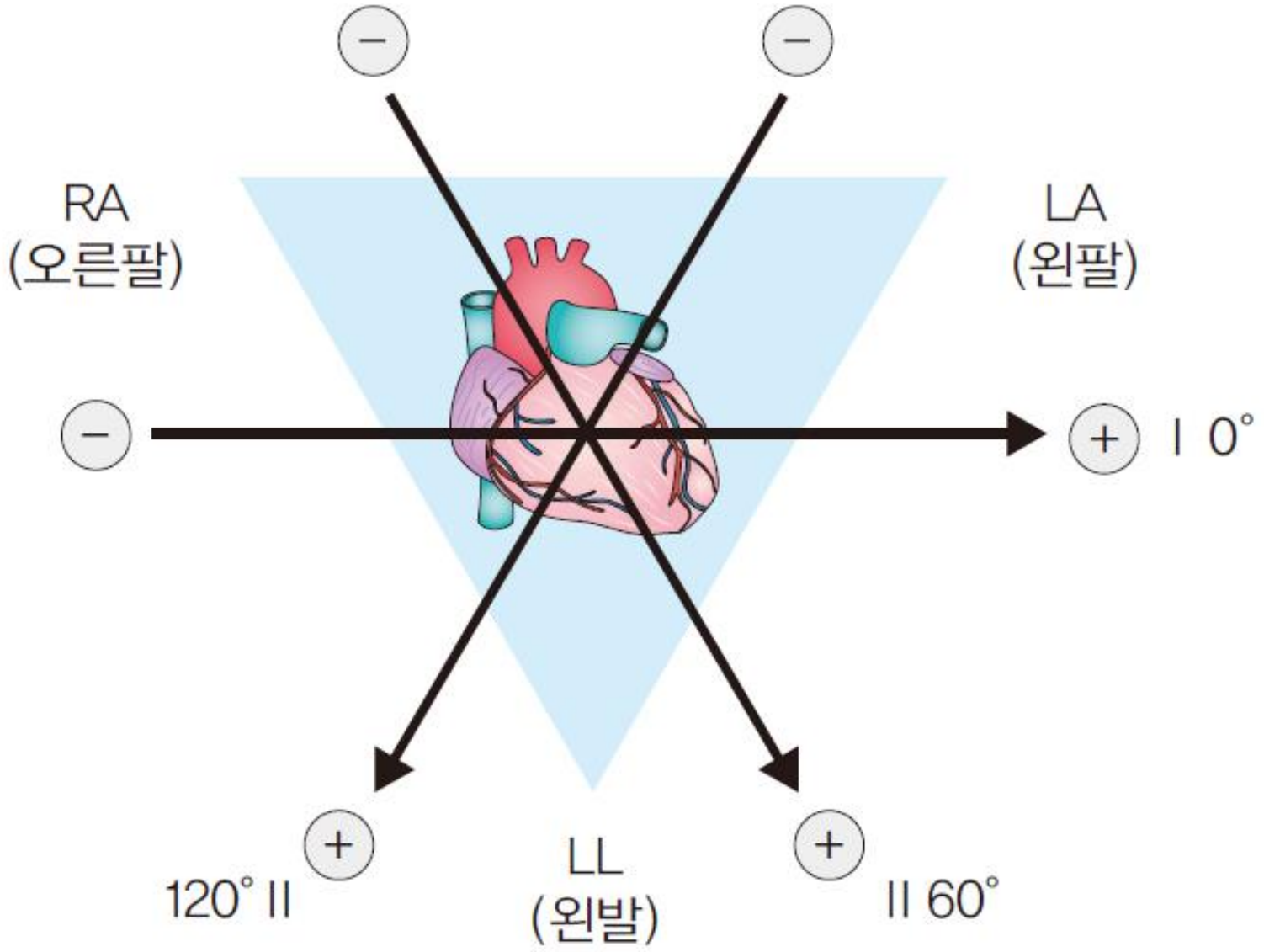

RA
LA
RL
LL

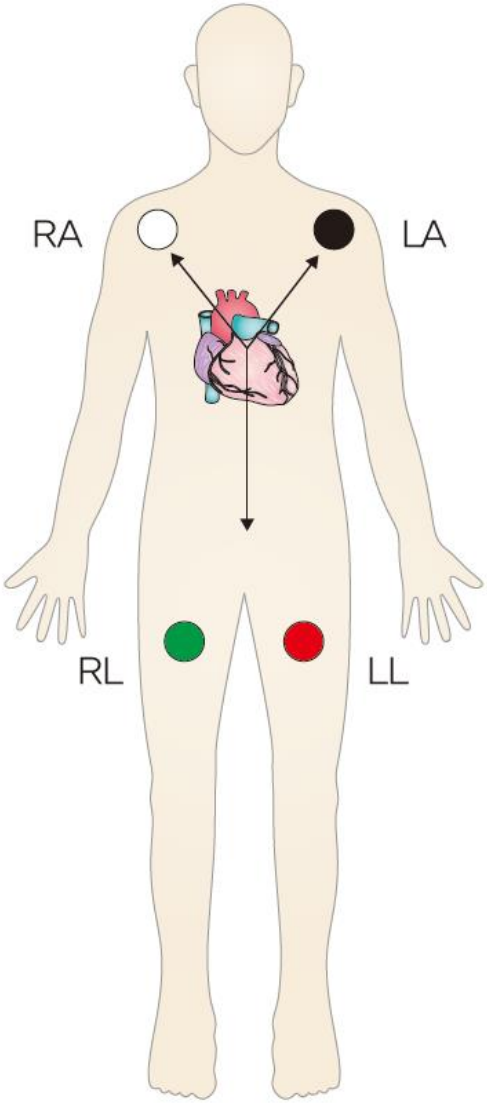

RA
LA
RL
LL

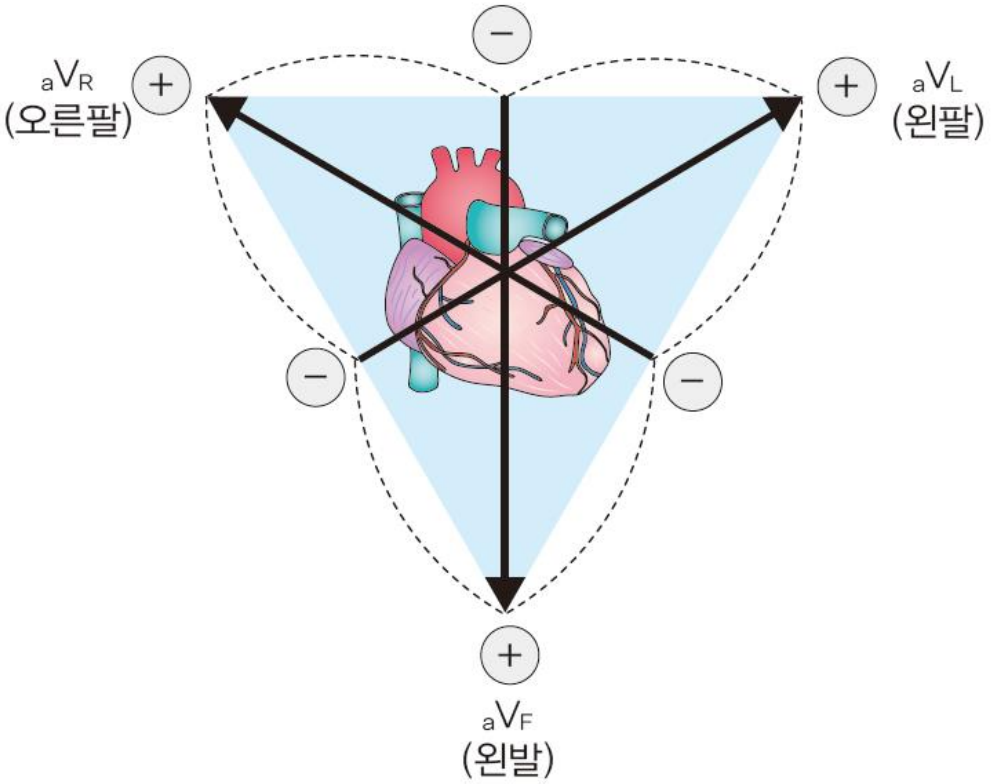

RA
(오른팔)
LA
(왼팔)
LL
(왼발)
I
II
III
−
+

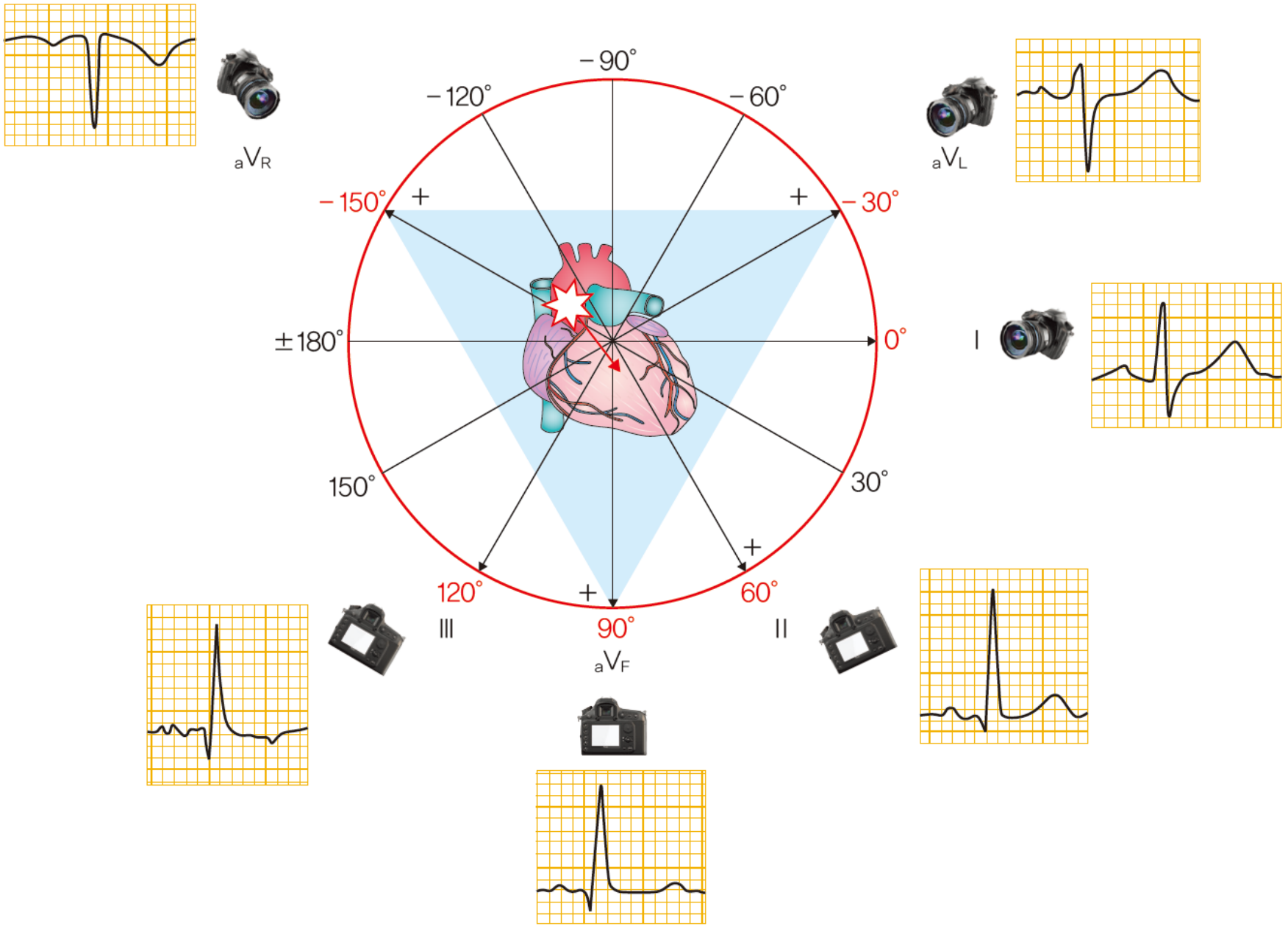

I
II
III

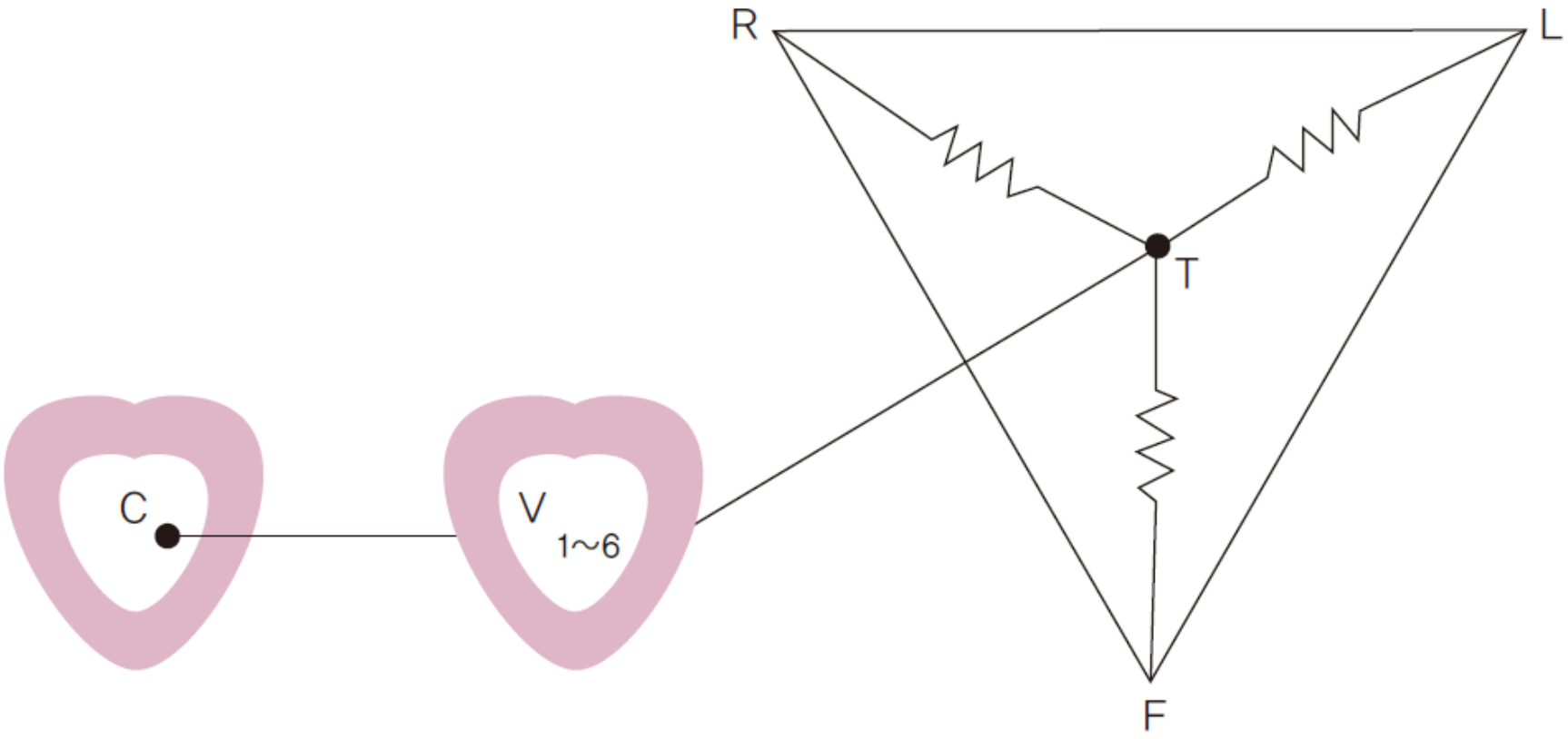

II
=
I
+
III


RA
(오른팔)
LA
(왼팔)
I 0°
120° II
LL
(왼발)
II 60°

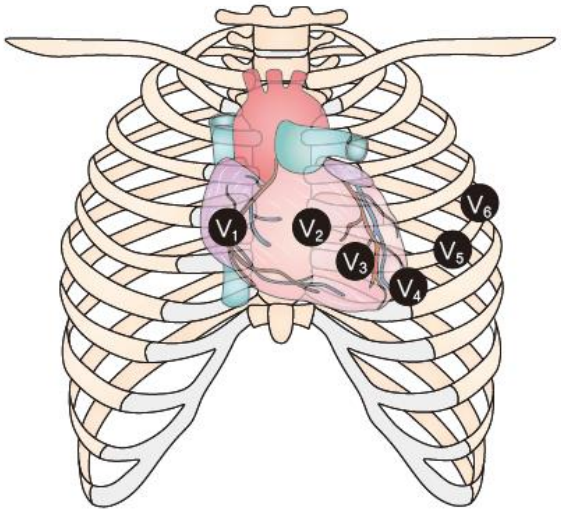

RA
LA
RL
LL

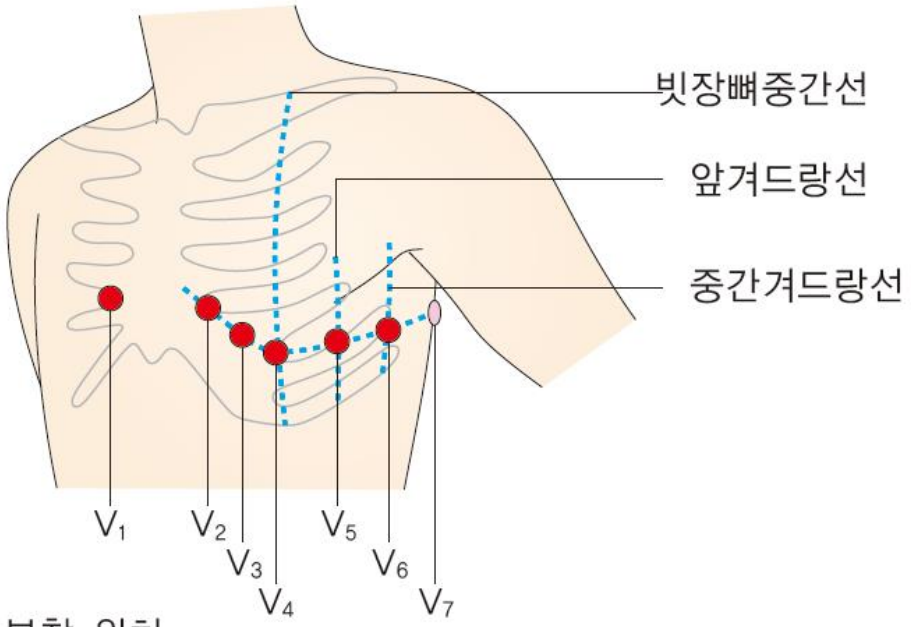

aVR
(오른팔)
aVL
(왼팔)
aVF
(왼발)


−90°
−120°
−60°
−150°
−30°
±180°
0°
150°
30°
120°
60°
90°
+
+
+
+
aVR
aVL
I
III
II
aVF

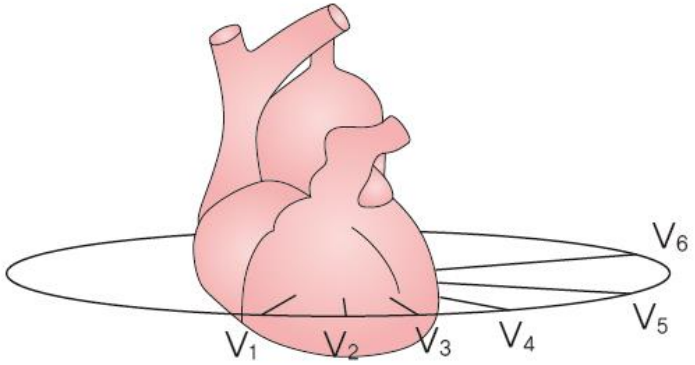


T : wilson 결합전극(불관전극)　　C : 가슴벽의 각 유도점(관전극)

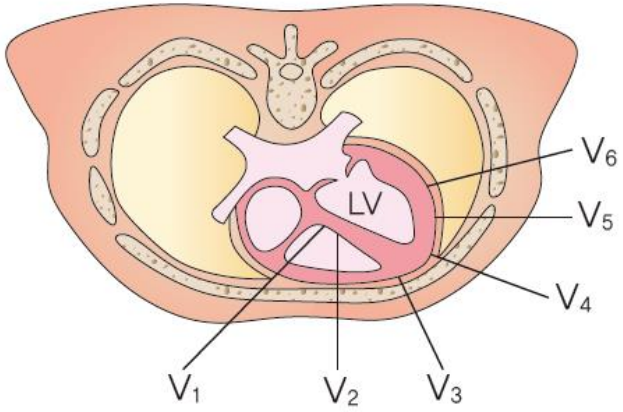




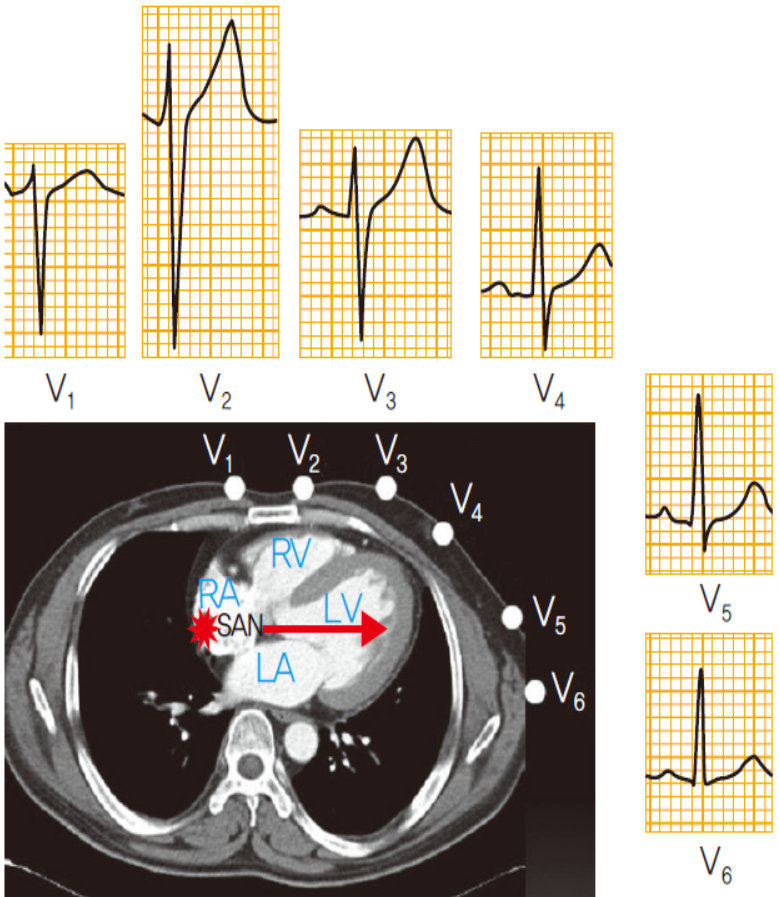
가슴유도의 전극부착 위치



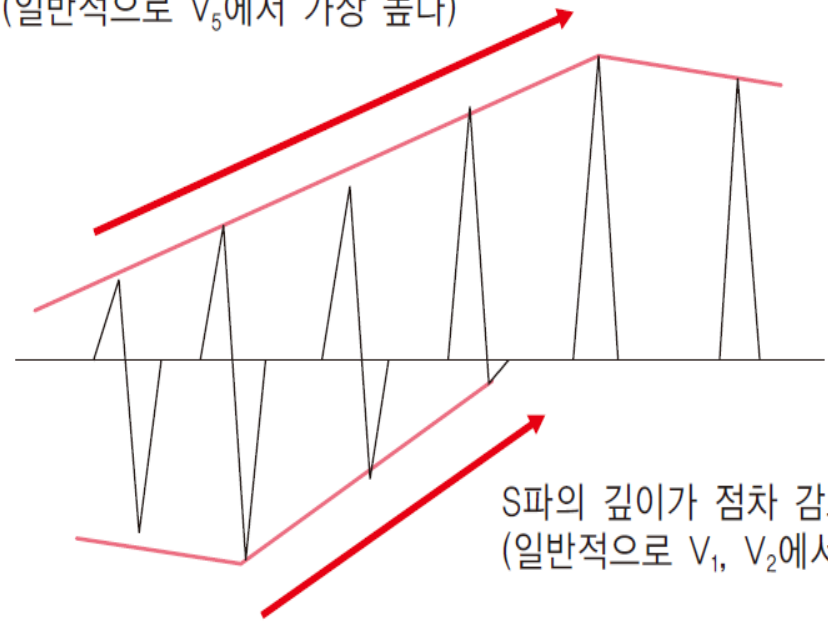
심장 외부에서 본 가슴유도



가슴면으로 본 가슴유도



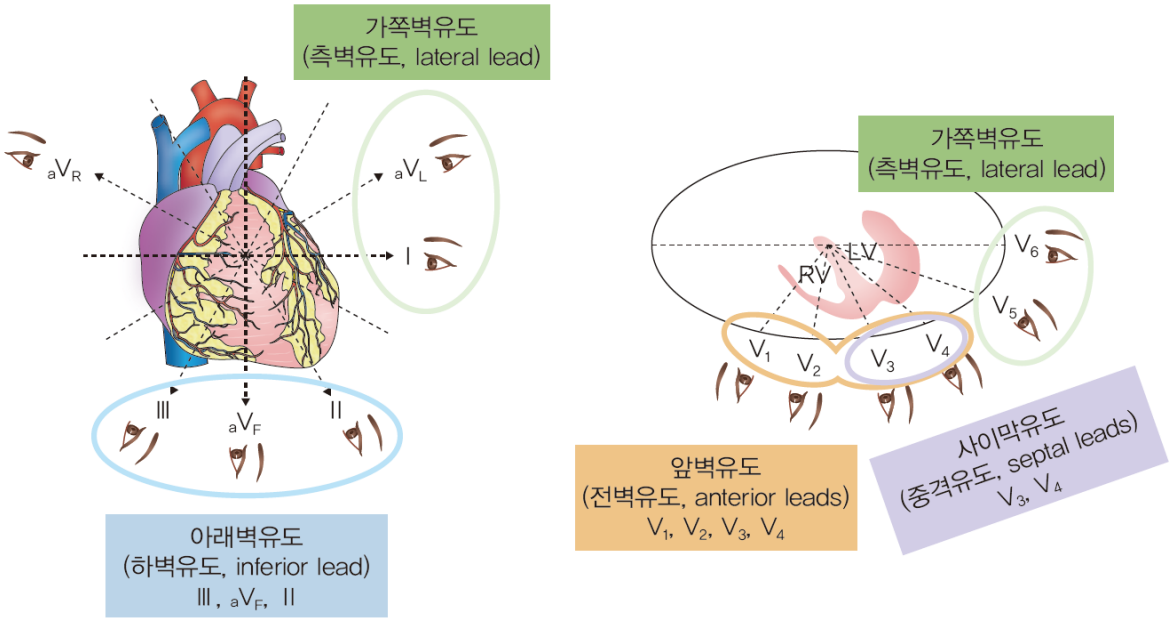
R파의 진폭(높이)이 점점 상승
(일반적으로 V_5에서 가장 높다)

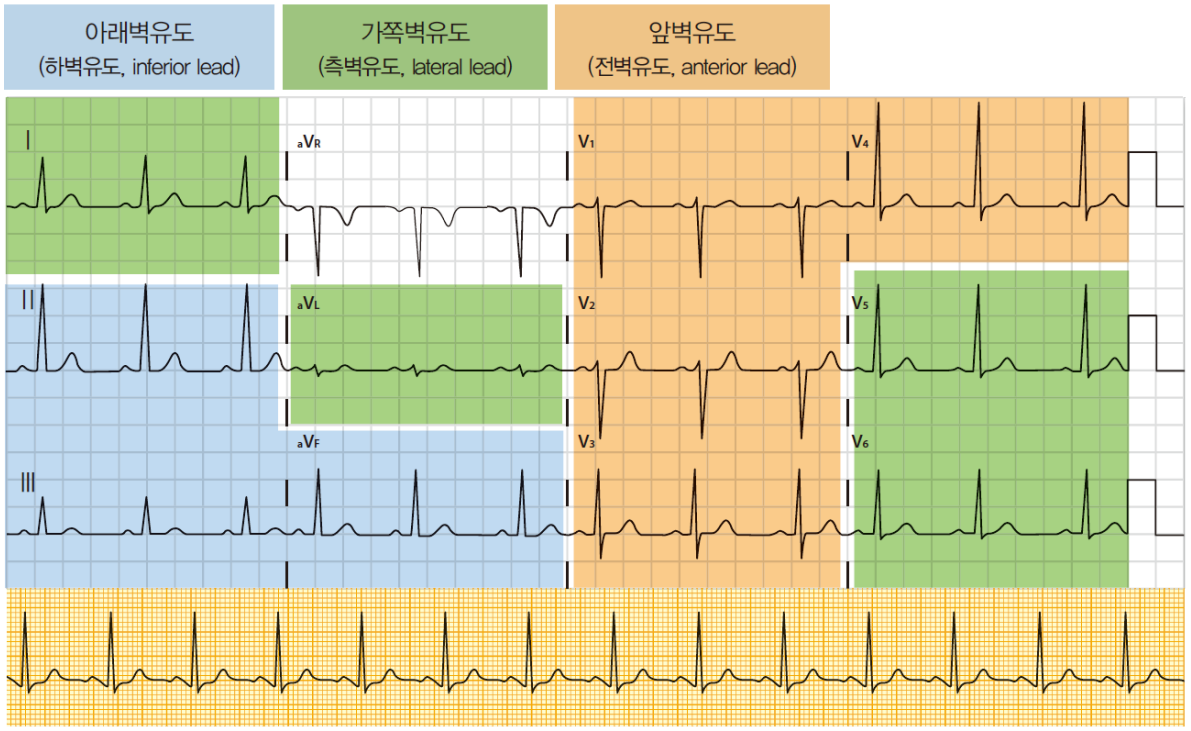


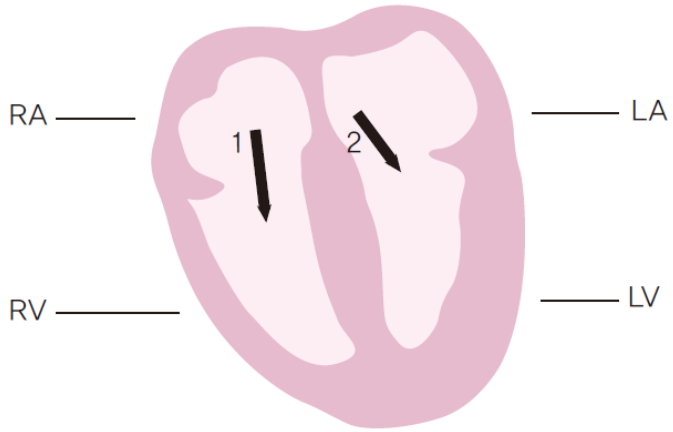
S파의 깊이가 점차 감소
(일반적으로 V_1, V_2에서 가장 깊다.)

R wave progression

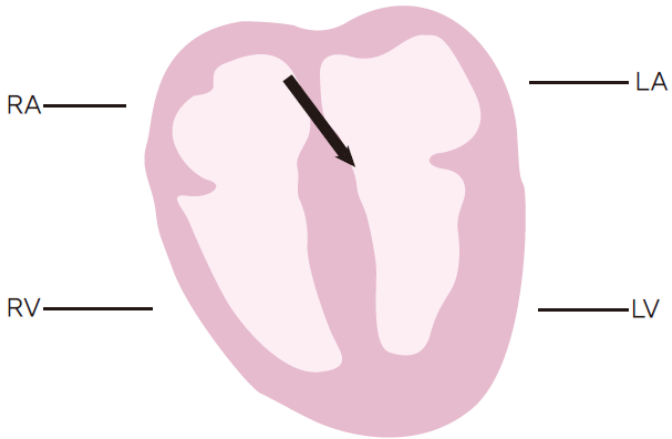
V_1에서 V_6으로 갈수록 양성인 R파는 점점 자라나는 반면 음성인 S파는 점점 줄어들다가 V_5나 V_6에 이르면 거의 보이지 않는 패턴을 나타내는 것

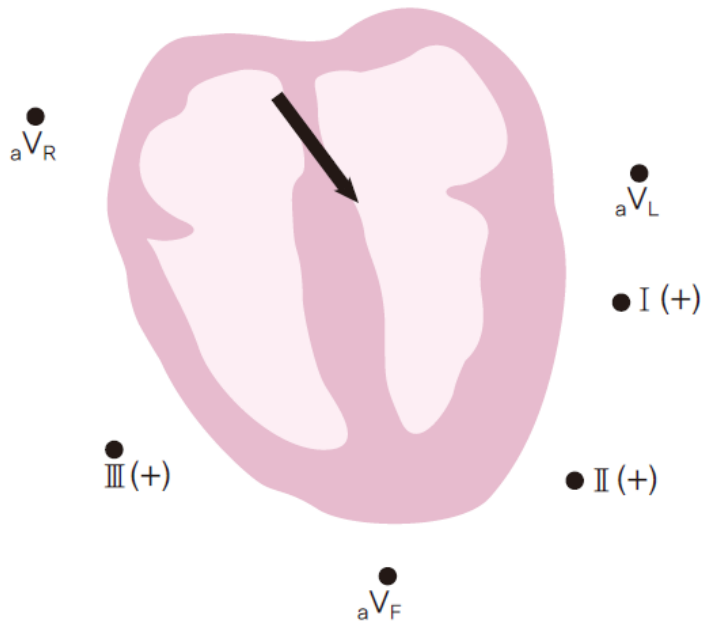

가쪽벽유도
(측벽유도, lateral lead)
aVR
aVL
I
III
aVF
II
아래벽유도
(하벽유도, inferior lead)
III, aVF, II
가쪽벽유도
(측벽유도, lateral lead)
LV
RV
V6
V5
V1
V2
V3
V4
앞벽유도
(전벽유도, anterior leads)
V1, V2, V3, V4
사이막유도
(중격유도, septal leads)
V3, V4

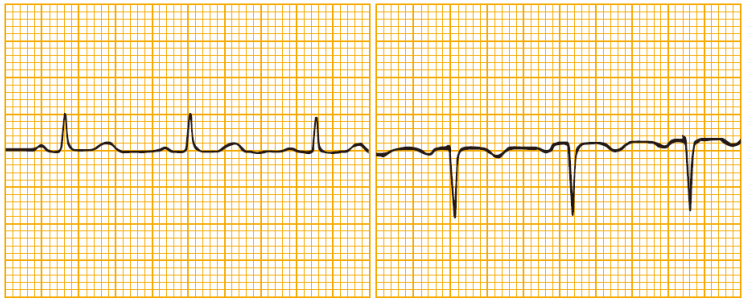

아래벽유도
(하벽유도, inferior lead)
가쪽벽유도
(측벽유도, lateral lead)
앞벽유도
(전벽유도, anterior lead)
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6



1. 오른심방의 P벡터　2. 왼심방의 P벡터


RA
LA
RV
LV


aVR
aVL
I (+)
III (+)
II (+)
aVF


I
aVR
II
aVL
III
aVF

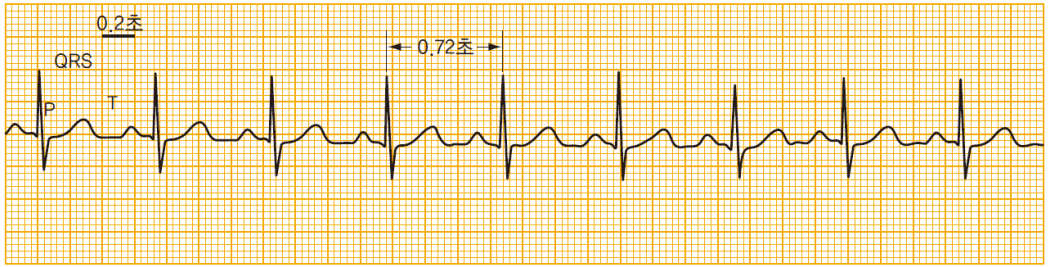
Section 07

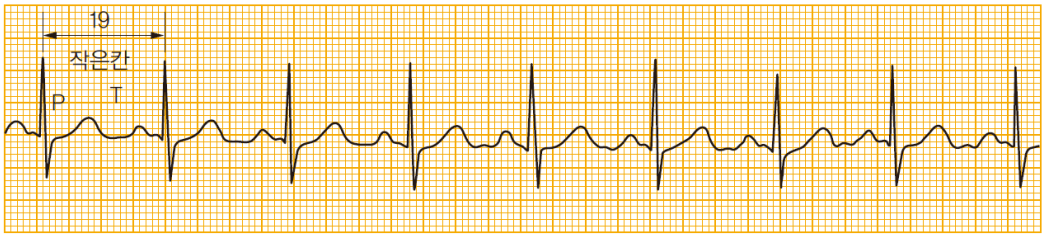
심전도 측정법

학습 목표

1. 심장박동수의 측정법을 설명할 수 있다(A).
2. 전기축 측정법을 설명할 수 있다(A).
3. 이행부위를 설명할 수 있다(A).


6 sec
기준
QRS
P
T
1
2
3
4
5


0.2초
QRS
P
T
0.72초


19
작은칸
P
T

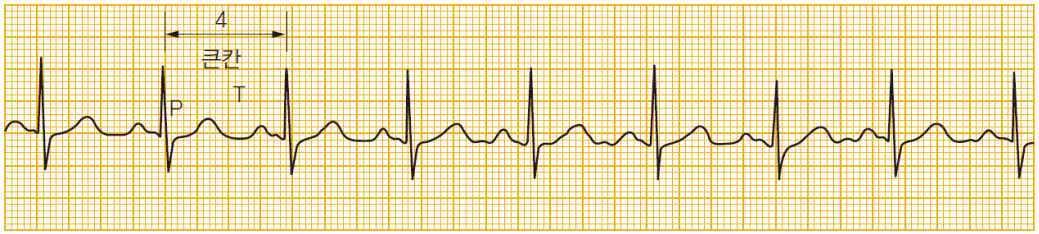
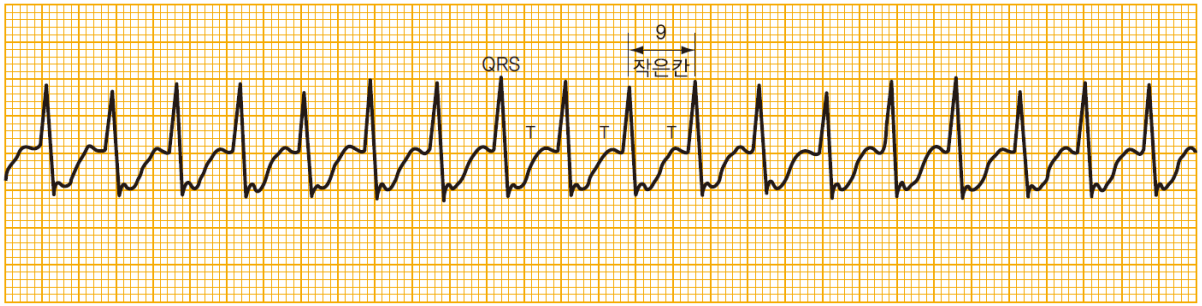
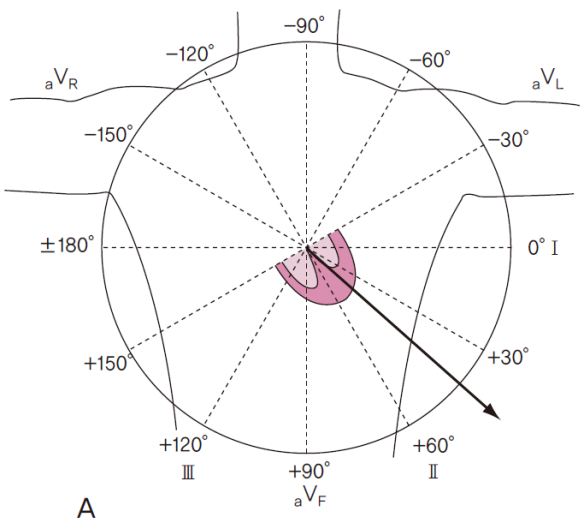

4
큰칸
T
P

표 7-1. 작은 실선을 이용한 환산표(심박수/분)

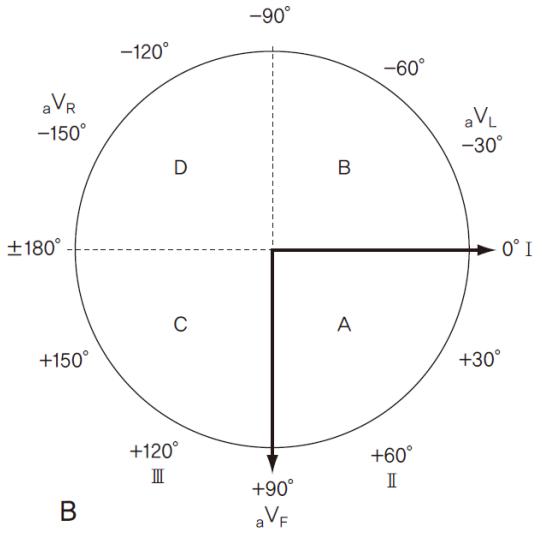
작은 실선수	심장 박동수	작은 실선수	심장 박동수	작은 실선수	심장 박동수	작은 실선수	심장 박동수
5	300	16	94	27	56	38	40
6	250	17	88	28	54	39	39
7	214	18	84	29	52	40	38
8	188	19	79	30	50	41	37
9	167	20	75	31	48	42	36
10	150	21	72	32	47	43	35
11	136	22	68	33	45	44	34
12	125	23	65	34	44	45	33
13	115	24	63	35	43	47	32
14	107	25	60	36	42	48	31
15	100	26	58	37	41	50	30


9
작은칸
QRS
T
T
T

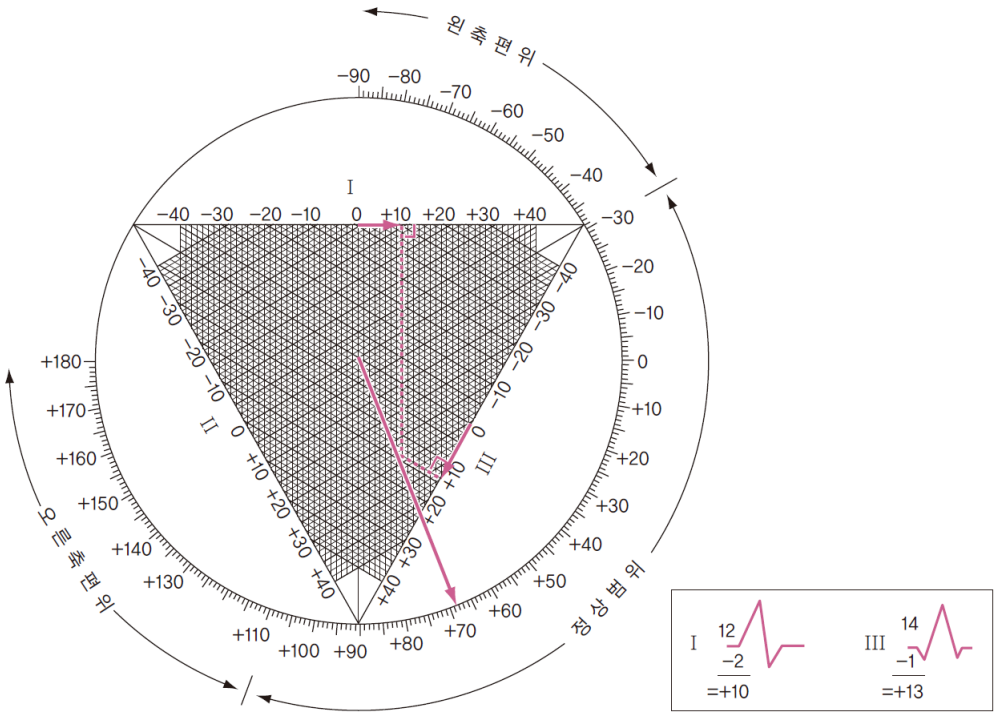

300
150
100
75
60
50
QRS
P
T
A
B

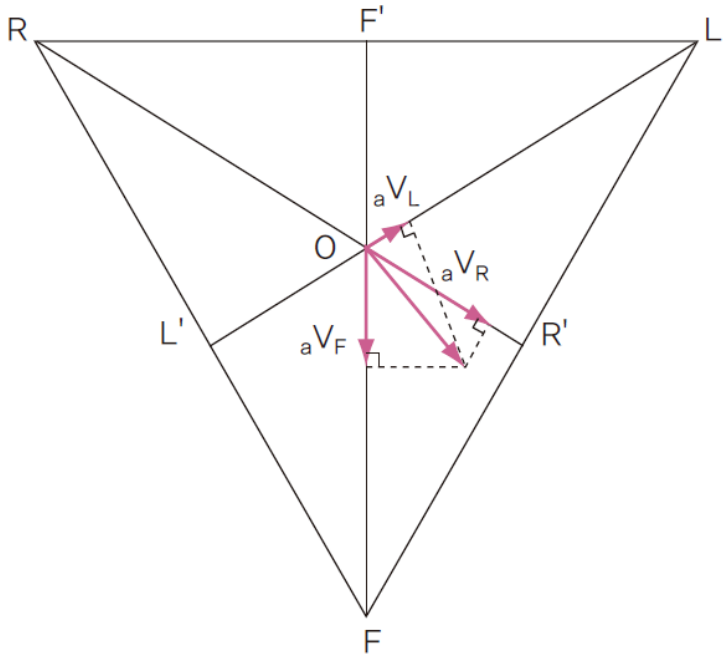

−90°
−120°
−60°
aVR
aVL
−150°
−30°
±180°
0° I
+150°
+30°
+120°
III
+90°
aVF
+60°
II

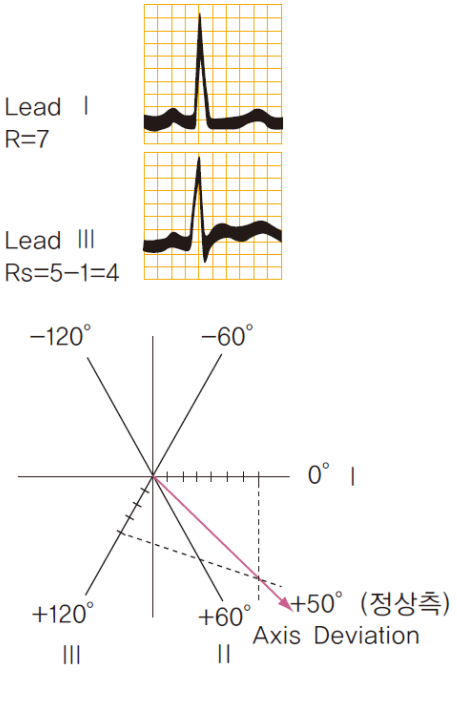
A

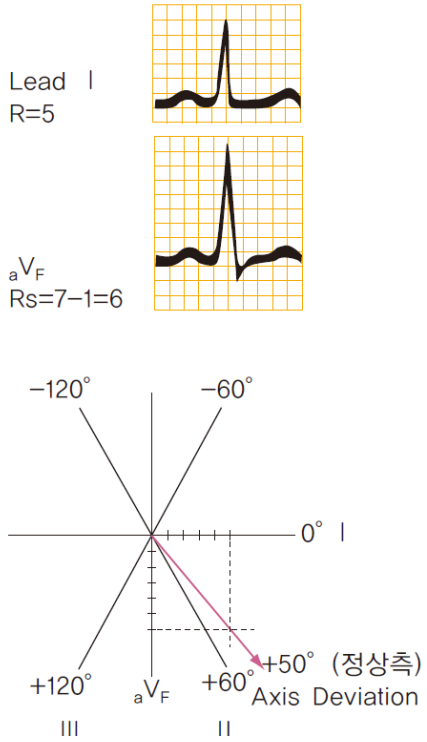

−90°
−120°
−60°
aVR
−150°
aVL
−30°
D
B
±180°
0° I
C
A
+150°
+30°
+120°
III
+90°
aVF
+60°
II

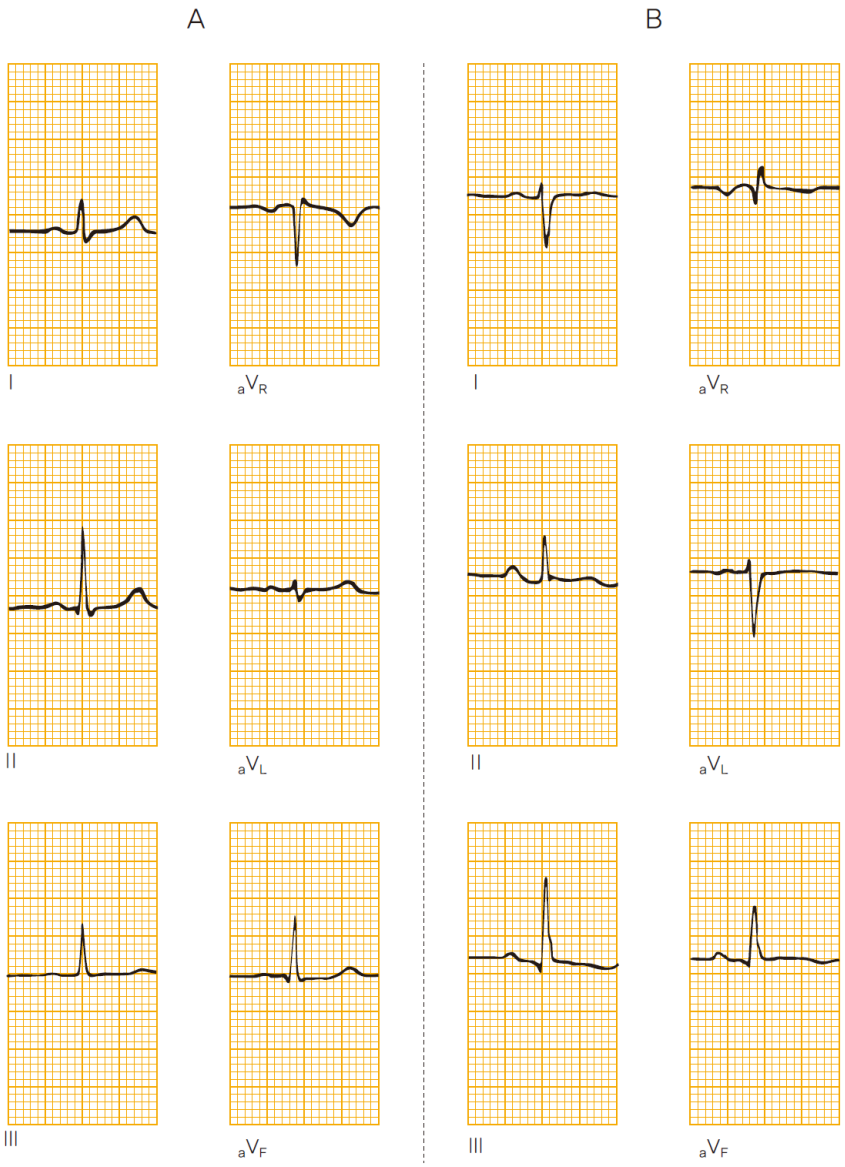
B

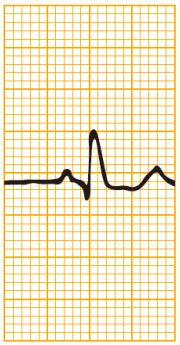

우편위
좌편위
좌편위
우편위
I
II
III
−90 −80 −70 −60 −50 −40 −30 −20 −10 0 +10 +20 +30 +40 +50 +60 +70 +80 +90 +100 +110 +120 +130 +140 +150 +160 +170 +180
I 12 −2 =+10
III 14 −1 =+13


R
F'
L
O
$_aV_L$
$_aV_R$
L'
$_aV_F$
R'
F

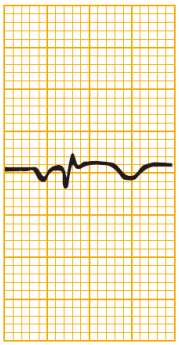

Lead Ⅰ
R=7
Lead Ⅲ
Rs=5−1=4
−120°
−60°
0° Ⅰ
+120°
Ⅲ
+60°
Ⅱ
+50° (정상측)
Axis Deviation


Lead Ⅰ
R=5
aVF
Rs=7−1=6
−120°
−60°
0° Ⅰ
+120°
Ⅲ
aVF
+60°
Ⅱ
+50° (정상측)
Axis Deviation

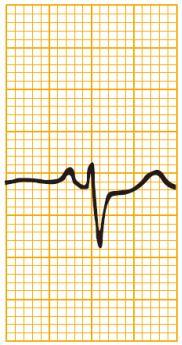

A
B
I
aVR
II
aVL
III
aVF
I
aVR
II
aVL
III
aVF



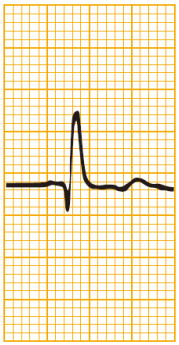
I



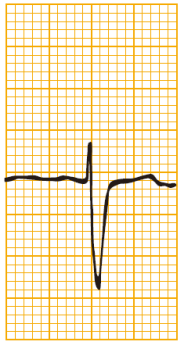
$_{a}V_{R}$



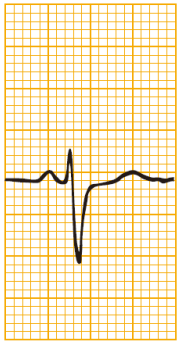
II



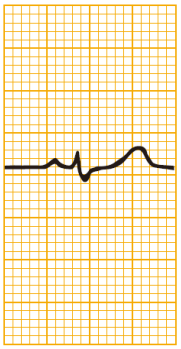
$_{a}V_{L}$



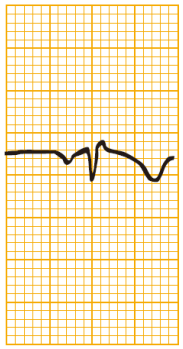
III



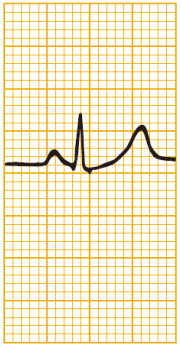
$_{a}V_{F}$



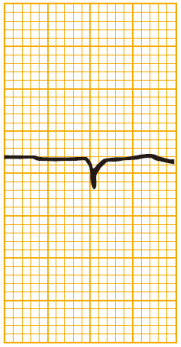
I



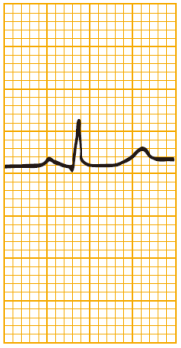
$_{a}V_{R}$



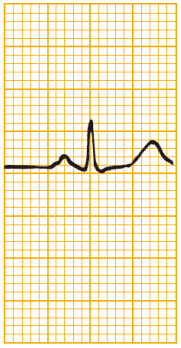
II



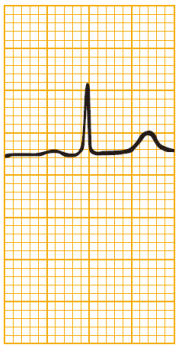
$_{a}V_{L}$



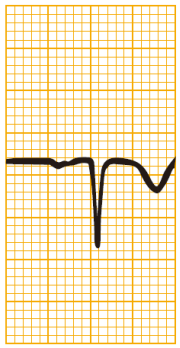
III



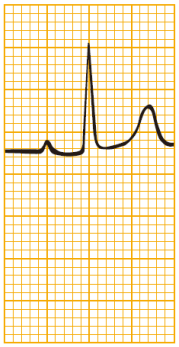
$_{a}V_{F}$



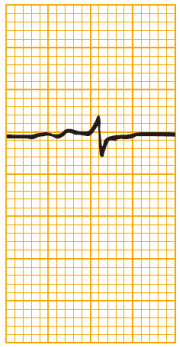
I



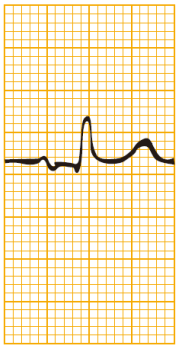
$_{a}V_{R}$



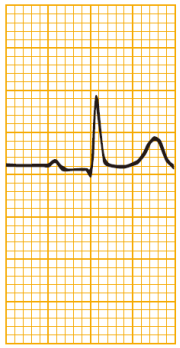
II



$_{a}V_{L}$



III



$_{a}V_{F}$

극심한 축편위가 나타나는 경우들

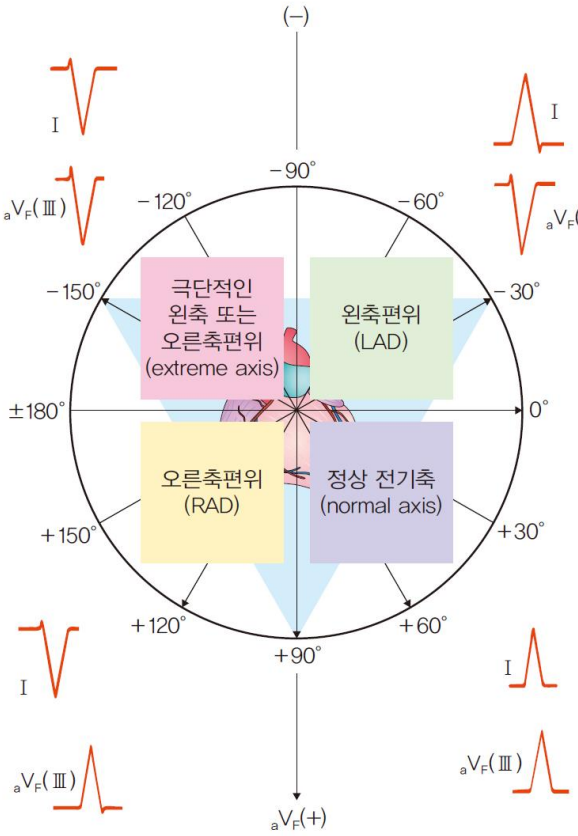
· 심실성 리듬(VT 등)
· 심한 우심실비대
(severe RVH)

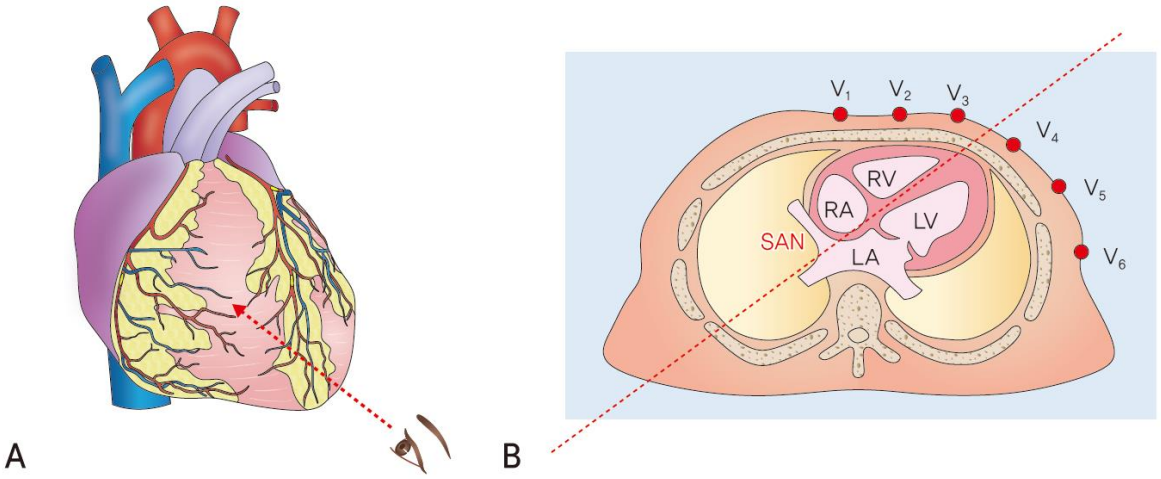
LAD가 나타나는 경우들

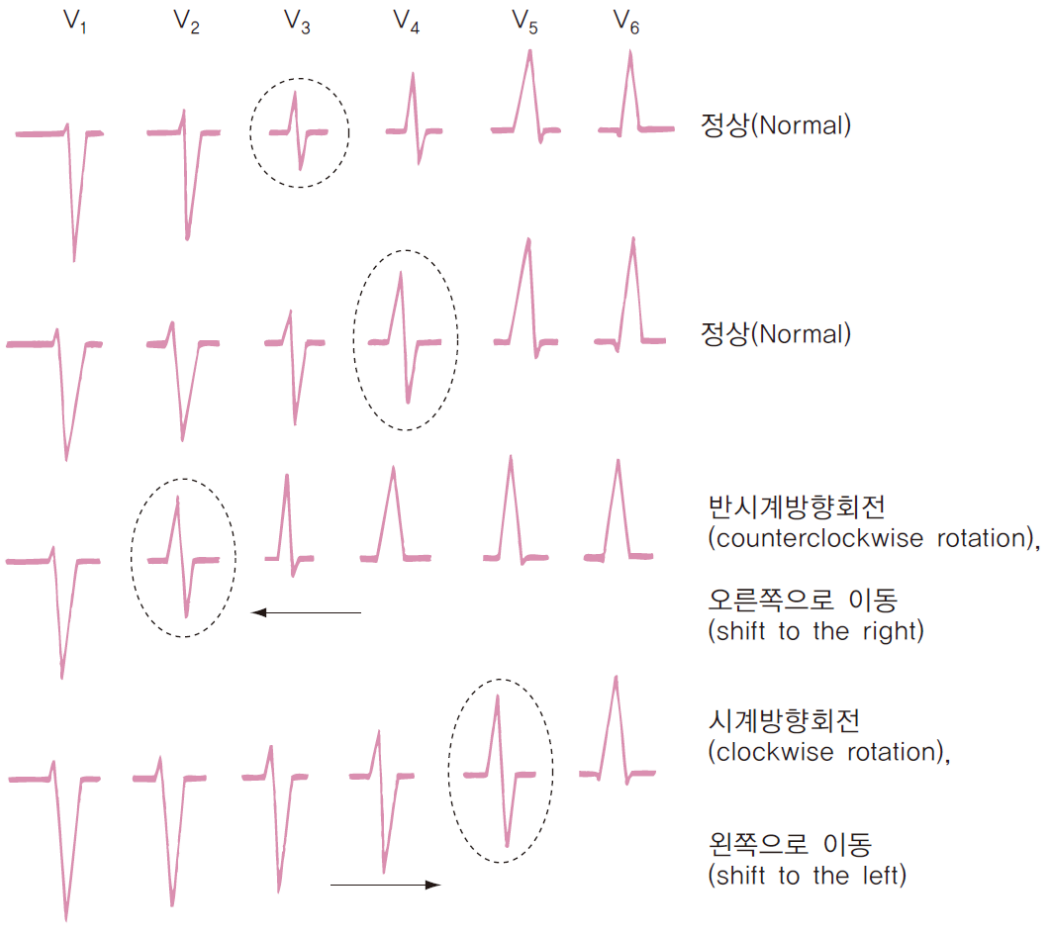
· 좌심실비대(LVH)
· 좌각차단(LBBB)
· 좌각전섬유속차단(LAFB)
· 하벽심근경색

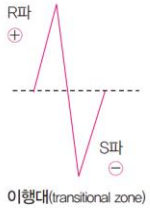
RAD가 나타나는 경우들

· 우심실비대(RVH)
· 우각차단(RBBB)
· 좌각후섬유속차단(LPFB)
· 우심증(dextrocardia)
· 측벽심근경색
· 정상 소아

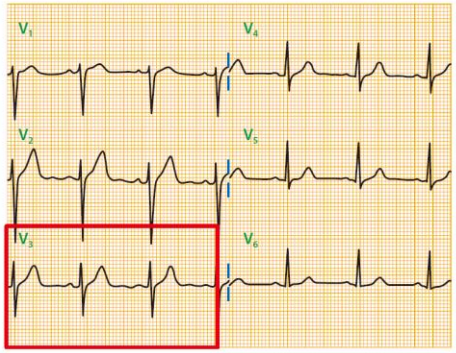



A
B
V1
V2
V3
V4
V5
V6
RV
RA
LV
SAN
LA


V1
V2
V3
V4
V5
V6
정상(Normal)
정상(Normal)
반시계방향회전
(counterclockwise rotation),
오른쪽으로 이동
(shift to the right)
시계방향회전
(clockwise rotation),
왼쪽으로 이동
(shift to the left)

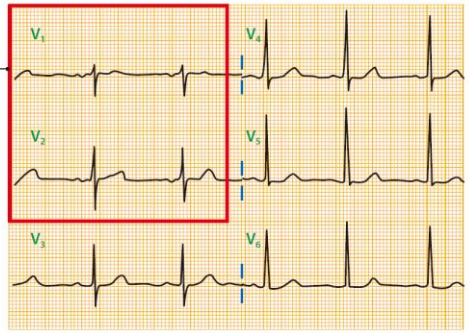


이행대(transitional zone)

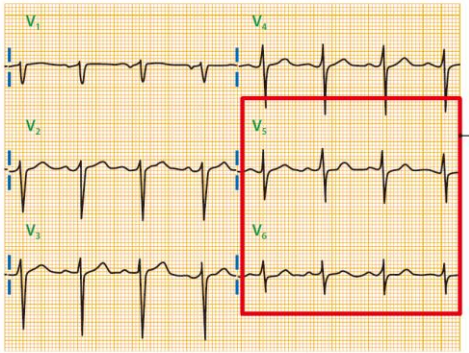


정상인 경우

이행대가 V_1이나 V_2에서 보인다.



반시계방향회전(counter clockwise rotation, CCWR)



이행대가 V_5이나 V_6에서 보인다.

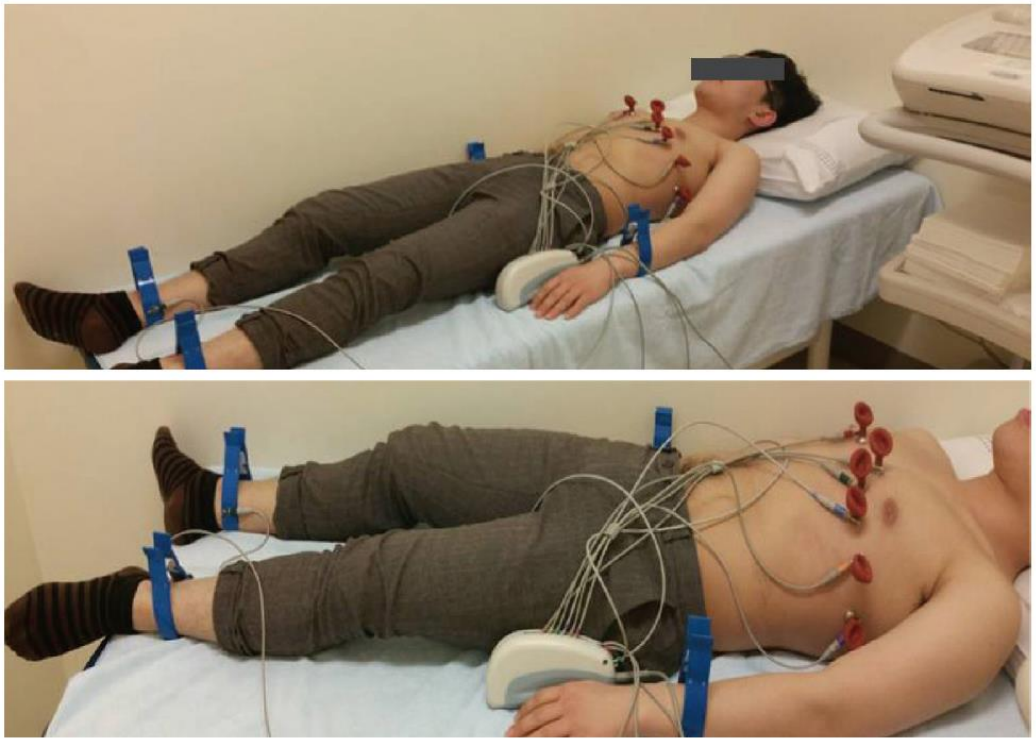
시계방향회전(clockwise rotation, CWR)

Section 08

심전도 기록

학습 목표

1. 심전도 검사 기록 시 주의사항 및 환경을 설명할 수 있다(B).
2. 인공산물의 원인 및 제거를 설명할 수 있다(A).
3. 심전도 검사실 환경을 설명할 수 있다(B).
4. 심전도 검사전 준비사항을 설명할 수 있다(A).

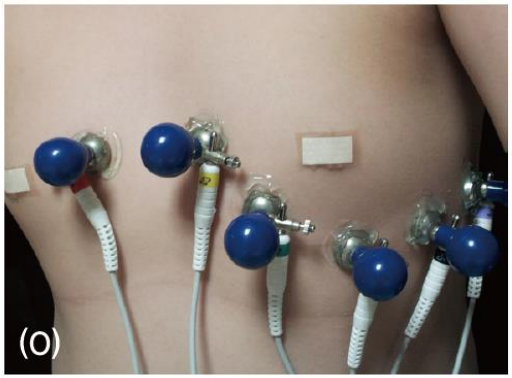


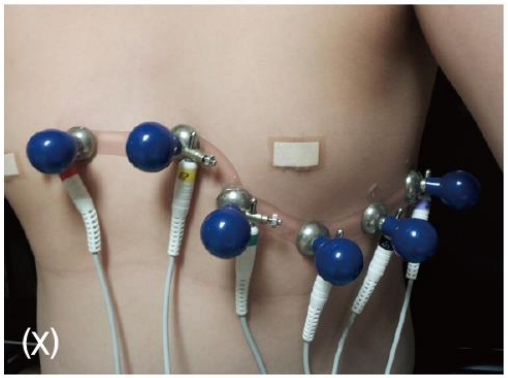

(O)

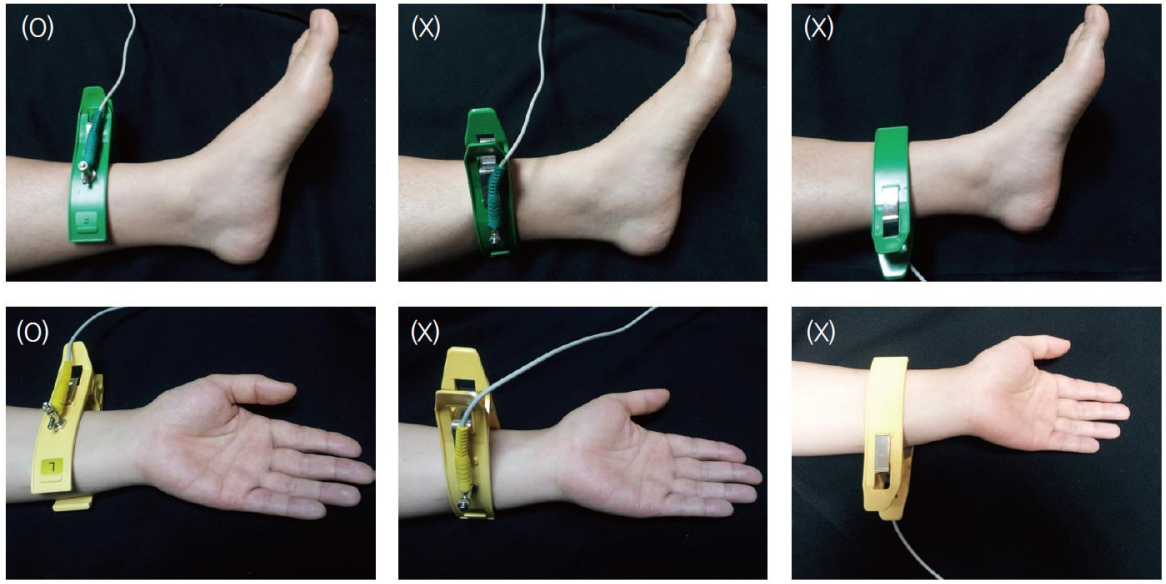

(X)


(O)


(X)


(O)


(X)

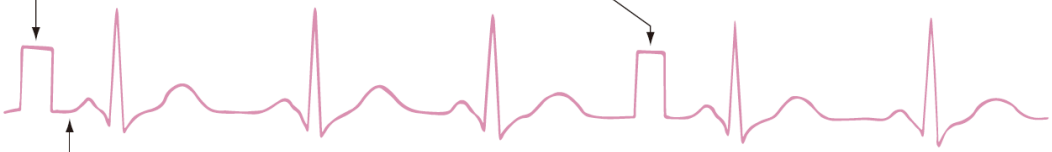

(O)
(X)
(X)
(O)
(X)
(X)


V2

올바른 기록

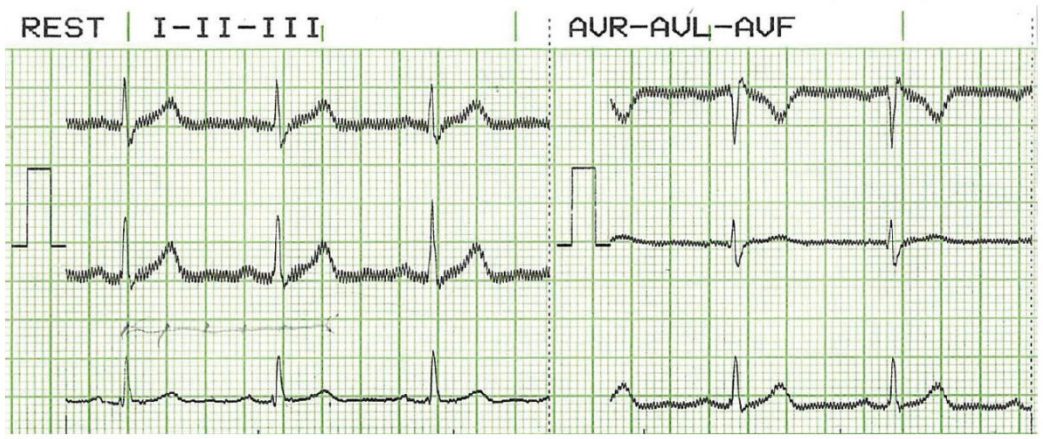
· 한개의 유도 파형을 5~6심박 정도 기록한다.
교정전압(10 mm/mV)

· T~P파 사이의 바닥선 위에 기록
· 각 유도마다 기록함

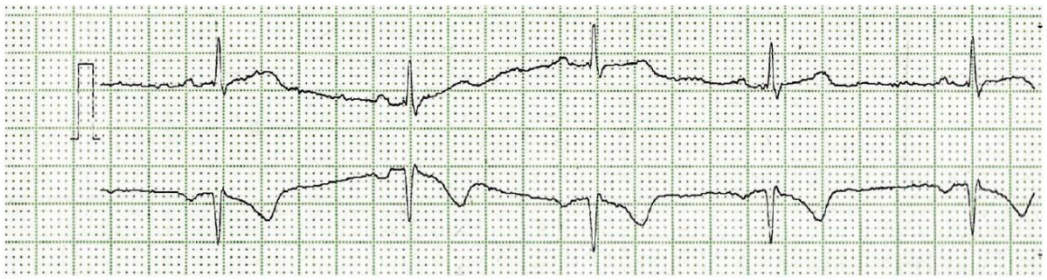


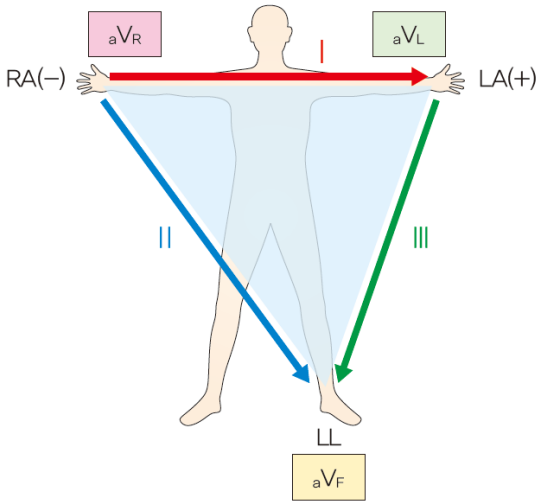
· 기록은 T~P파 사이에서 시작함
· 기록지의 중앙에 기록됨

· 교류장애, 근전도장애, 바닥선의 동요가 없음
· 파형의 선명도가 적당하며 정확함

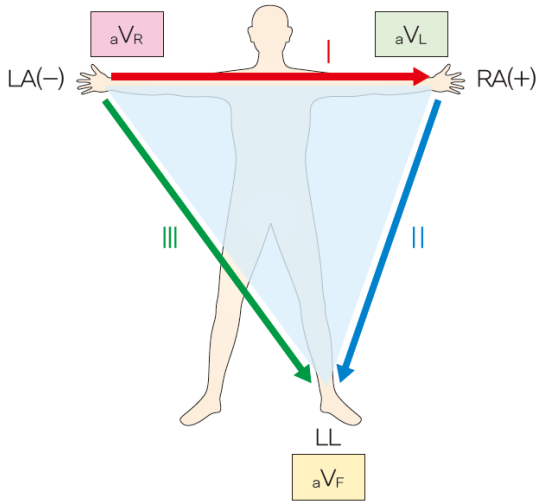

REST
I-II-III
AVR-AVL-AVF



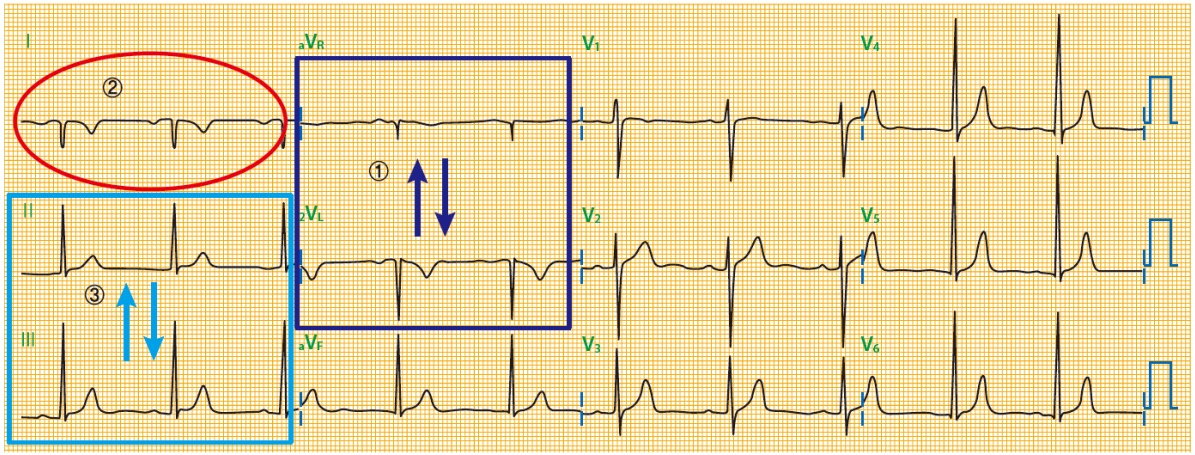


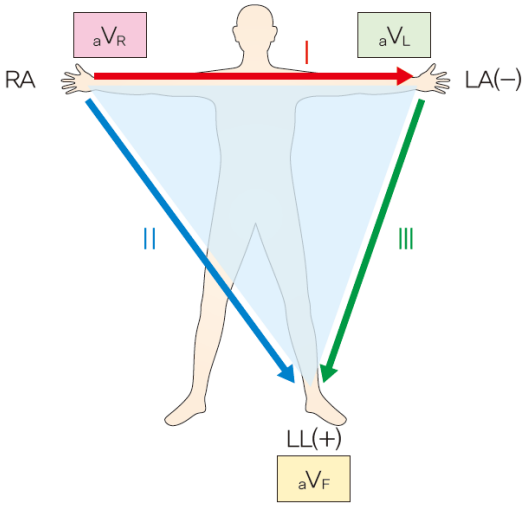


정상

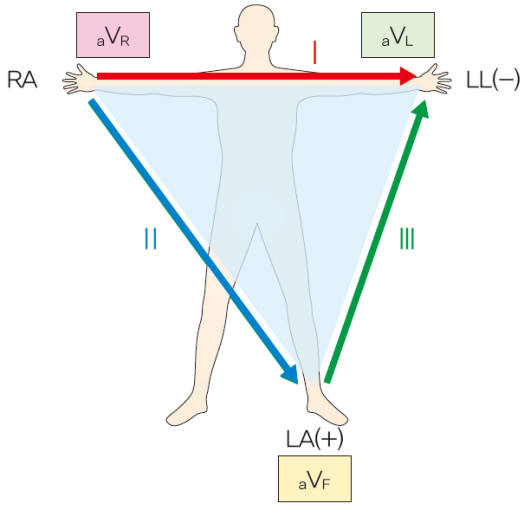


뒤바뀜

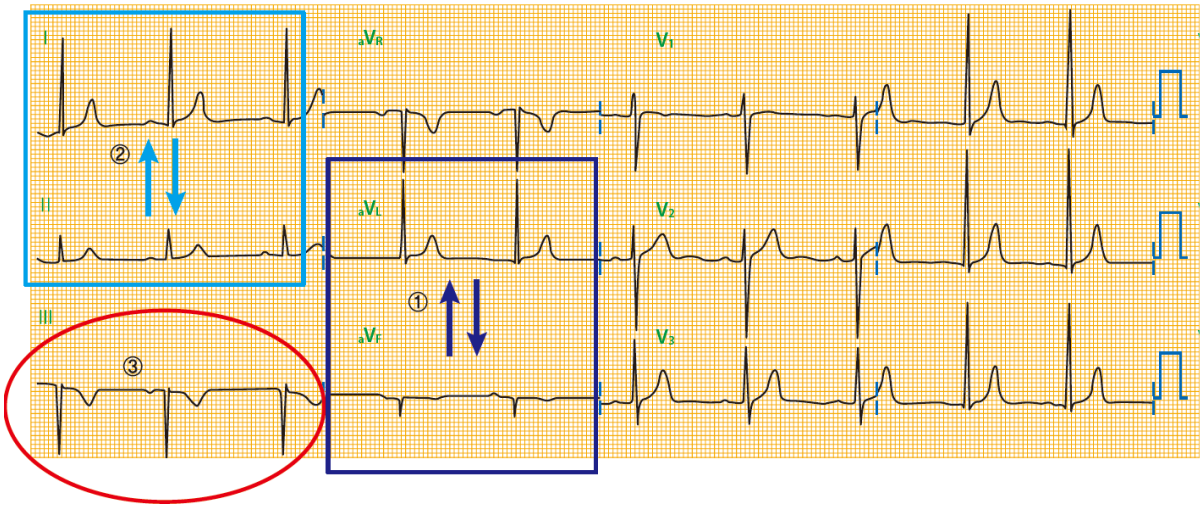

I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
①
②
③

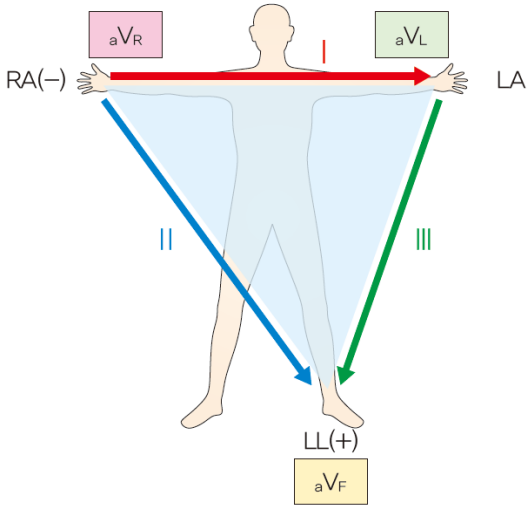


정상

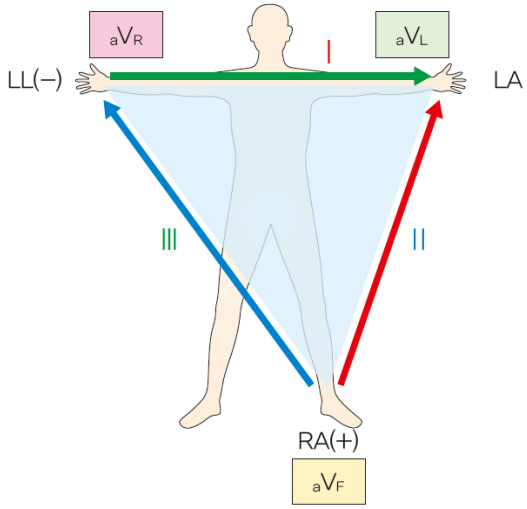


뒤바뀜

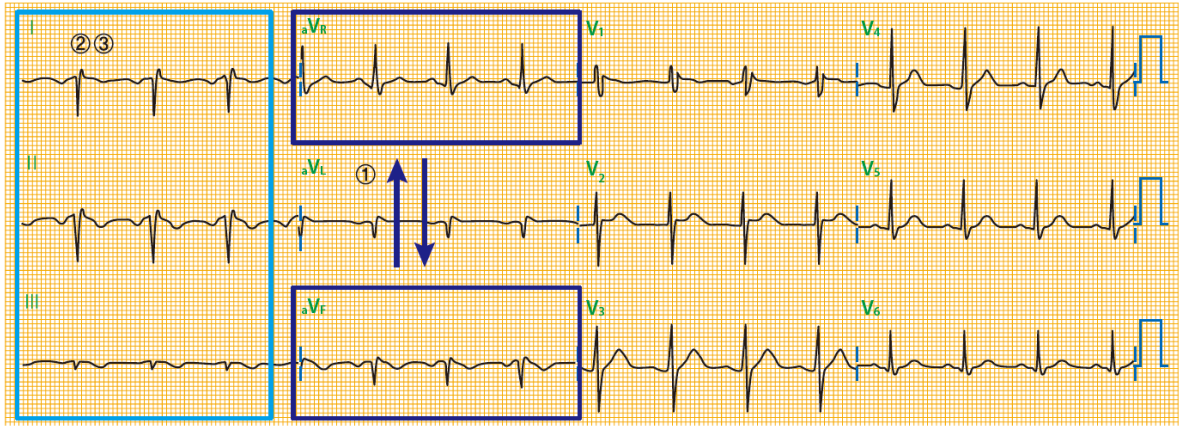

I
II
III
aVR
aVL
aVF
V1
V2
V3
①
②
③

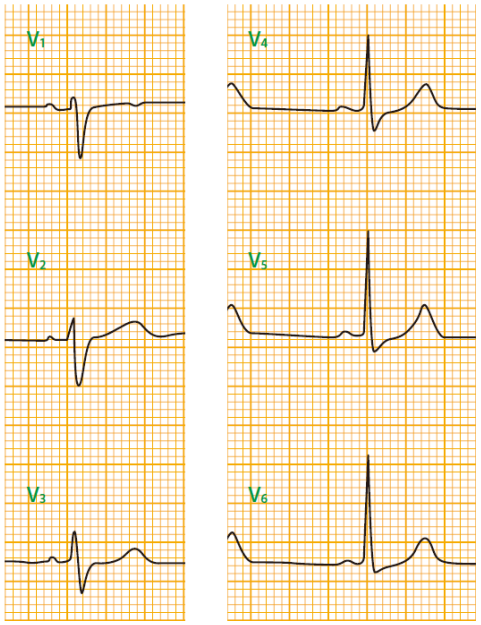


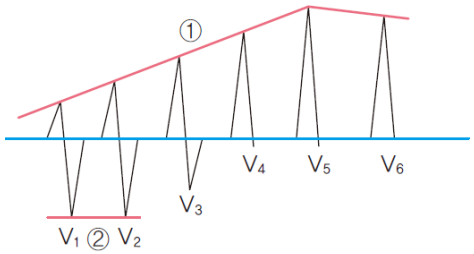
정상



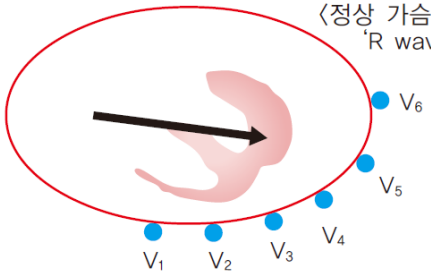
뒤바뀜

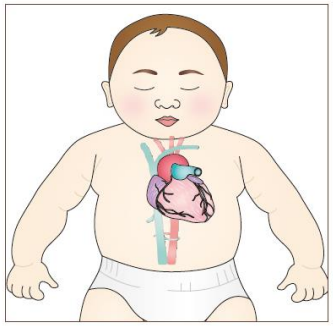

I
②③
aVR
V1
V4
II
aVL
①
V2
V5
III
aVF
V3
V6



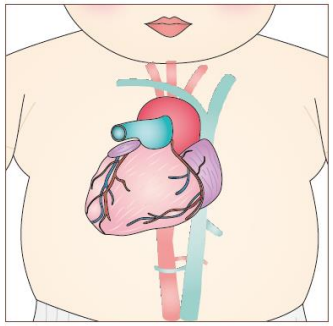


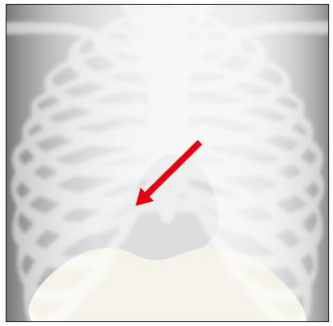
〈정상 가슴유도의 QRS 패턴〉
'R wave progression'



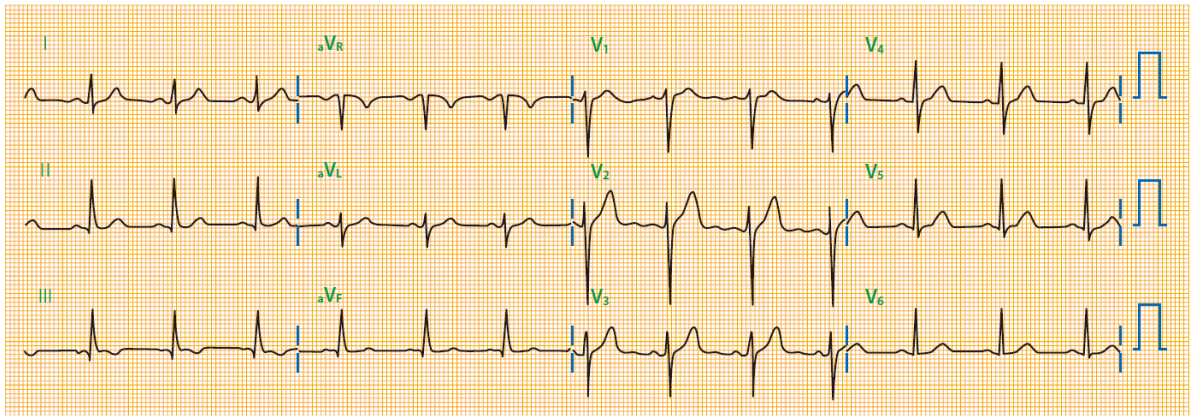


정상적인 심장의 위치

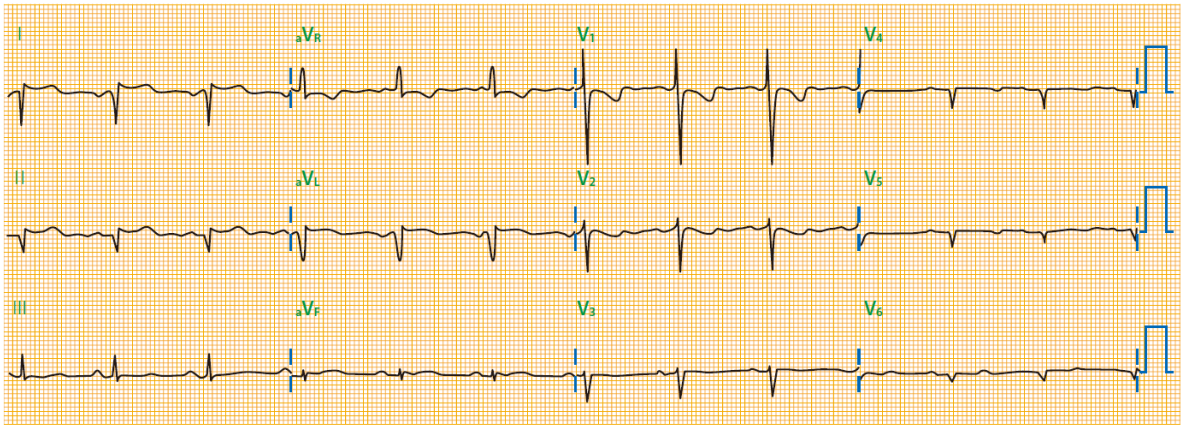




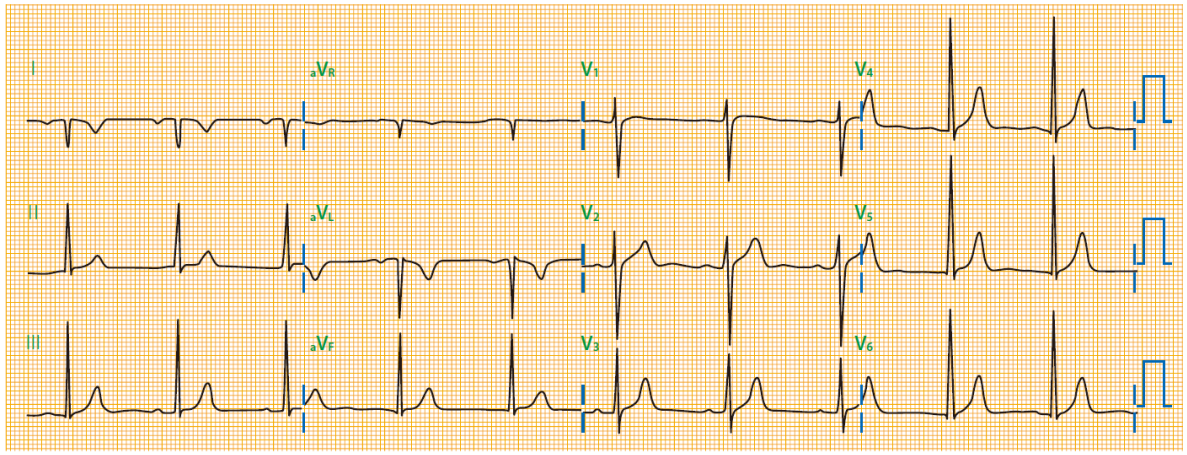
우심증

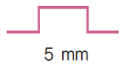
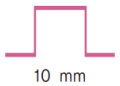
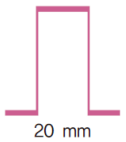


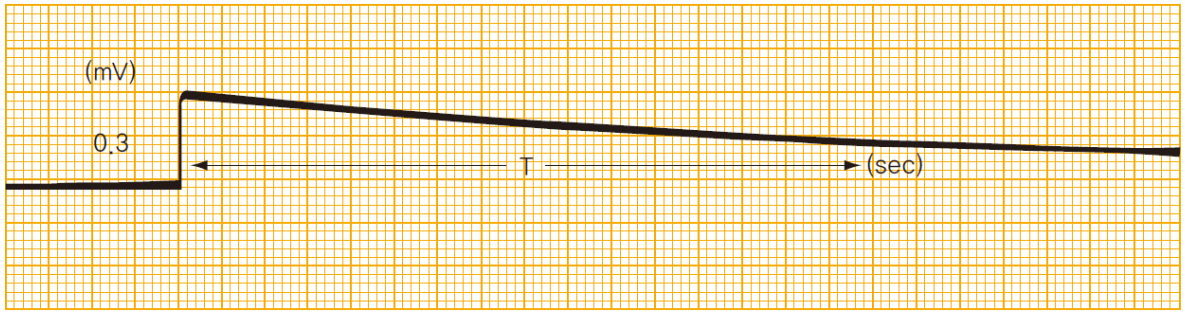
정상 심전도



우심증 심전도


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

감도	1 mV	파형	비고
0.5			1/2 축소
1.0			기준
2.0			2배 확대

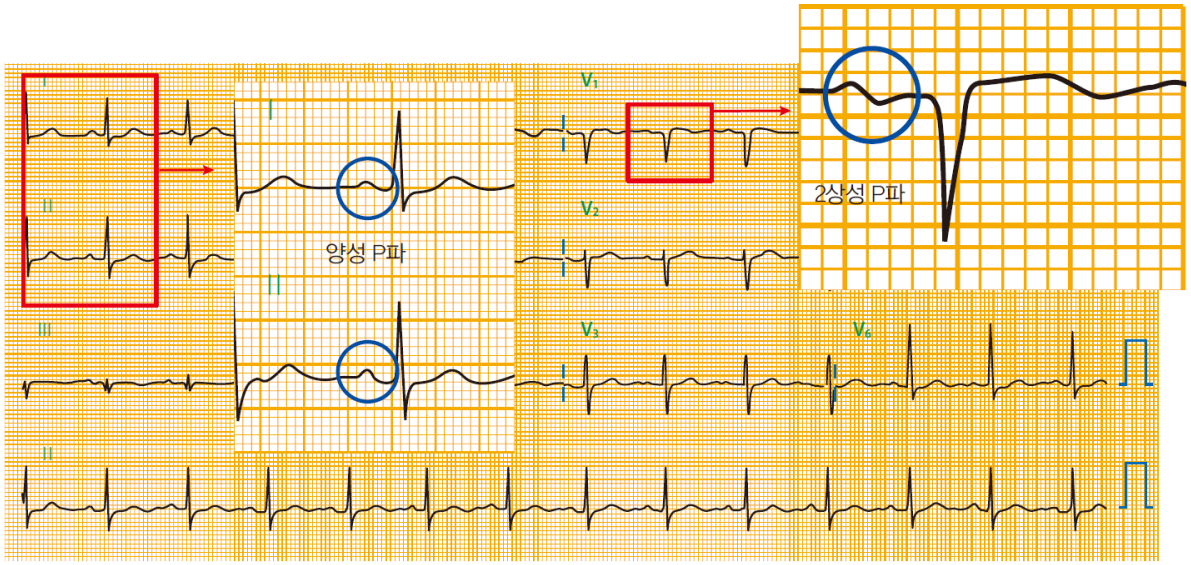

(mV)
0.3
T
(sec)

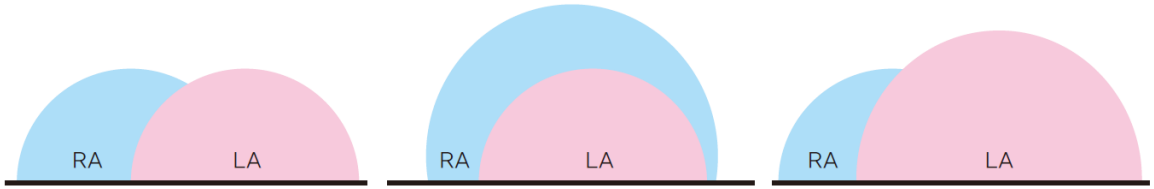
Section 09

심전도 결과해석

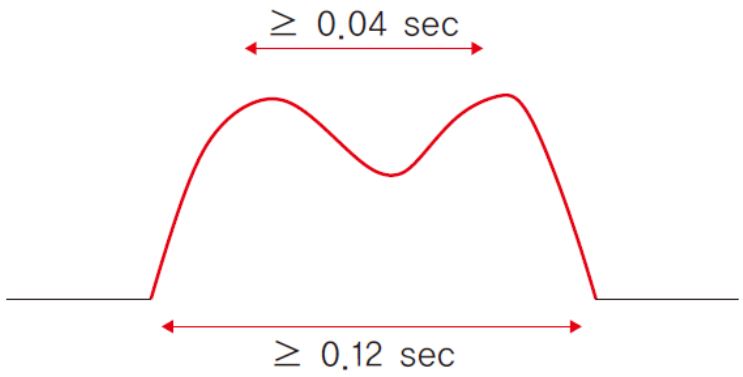
학습 목표

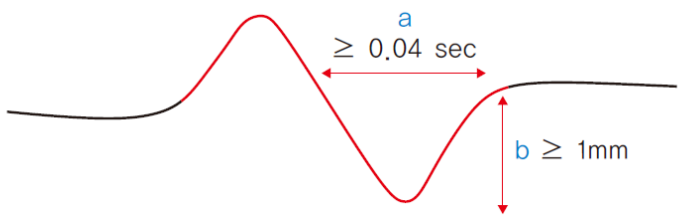
1. 정상 심전도를 설명할 수 있다(A).
2. 심장비대 심전도를 설명할 수 있다(A).
3. 심장 동맥질환 심전도를 설명할 수 있다(A).
4. 부정맥 심전도를 설명할 수 있다(A).

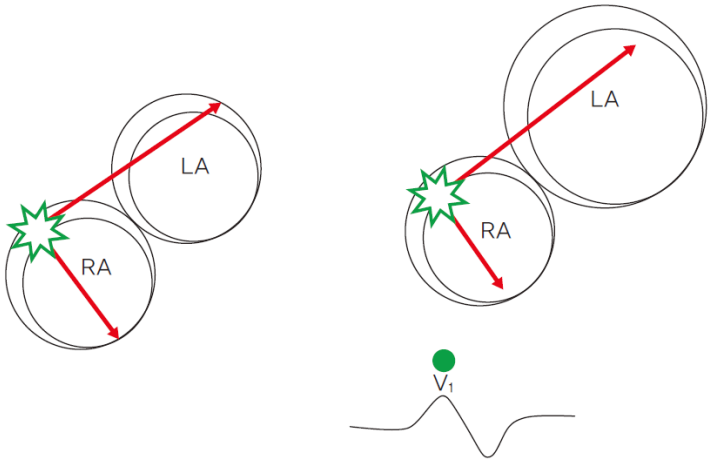

I
II
III
II
양성 P파
V1
V2
V3
V6
2상성 P파



정상 심방 우심방확대(RAE) 좌심방확대(LAE)

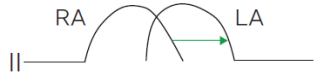

≥ 0.04 sec
≥ 0.12 sec


a
≥ 0.04 sec
b ≥ 1mm

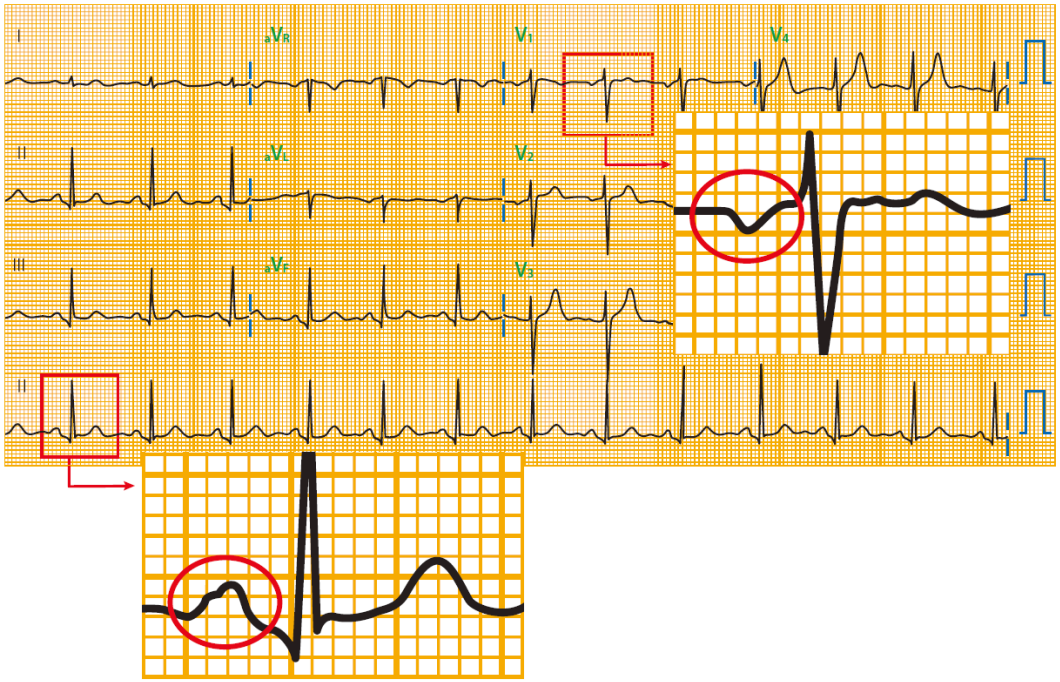


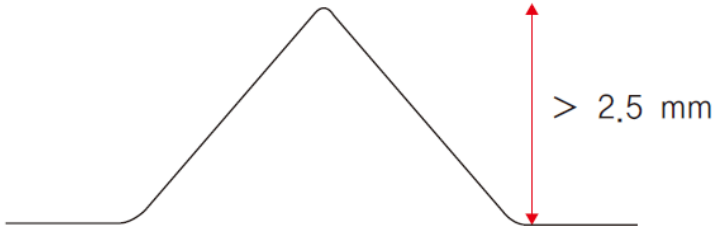


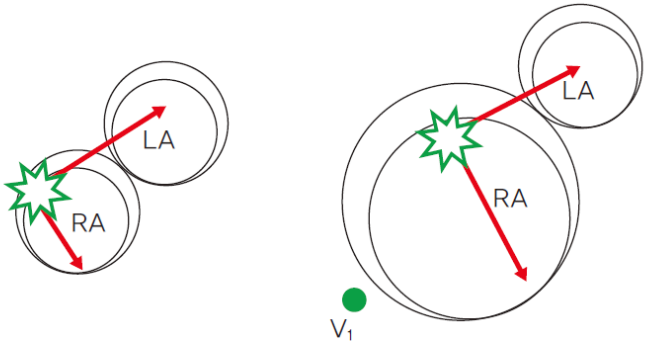
정상(nomal)

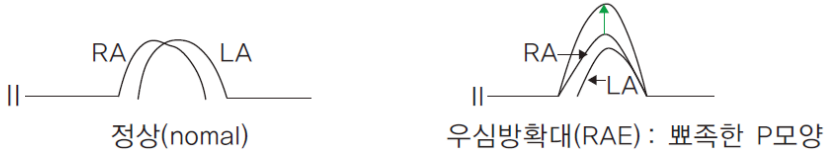


좌심방확대 LAE : M형



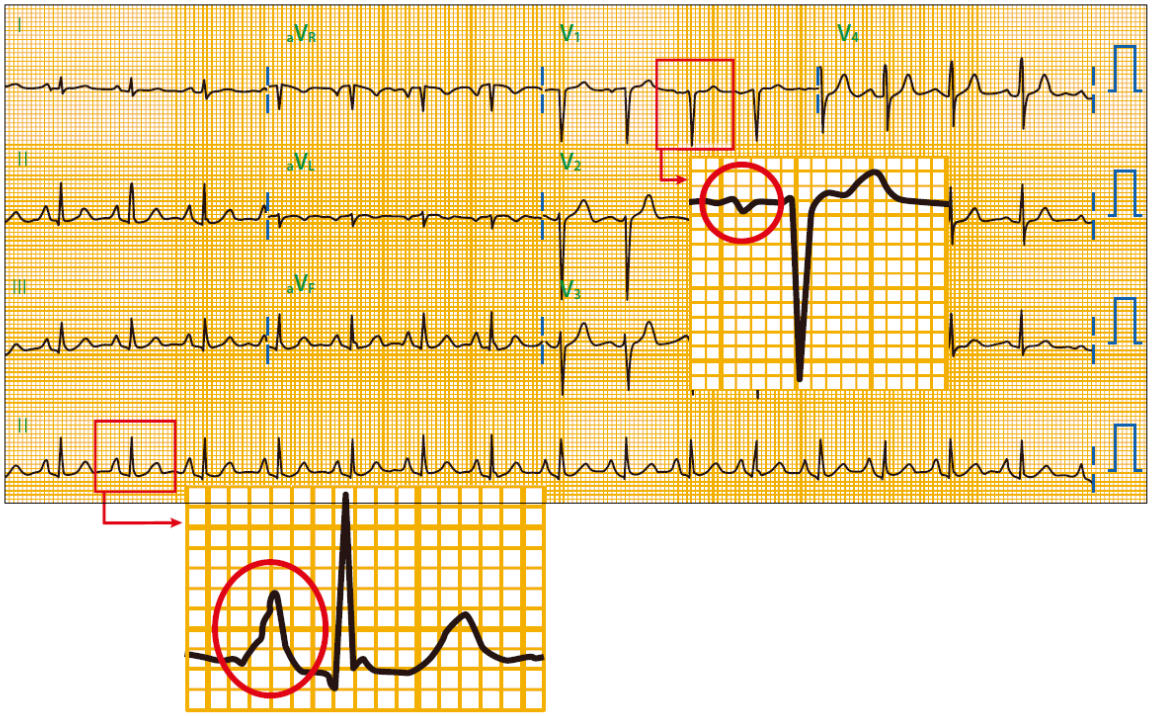

> 2.5 mm

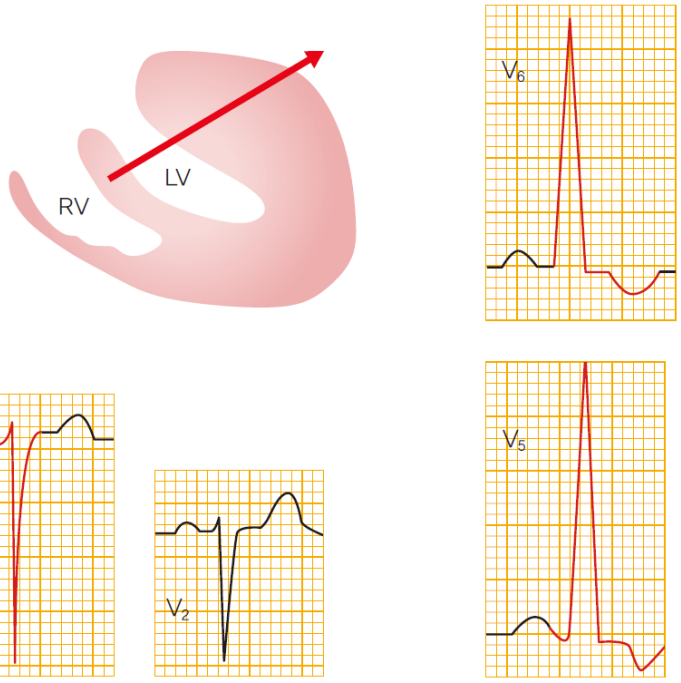


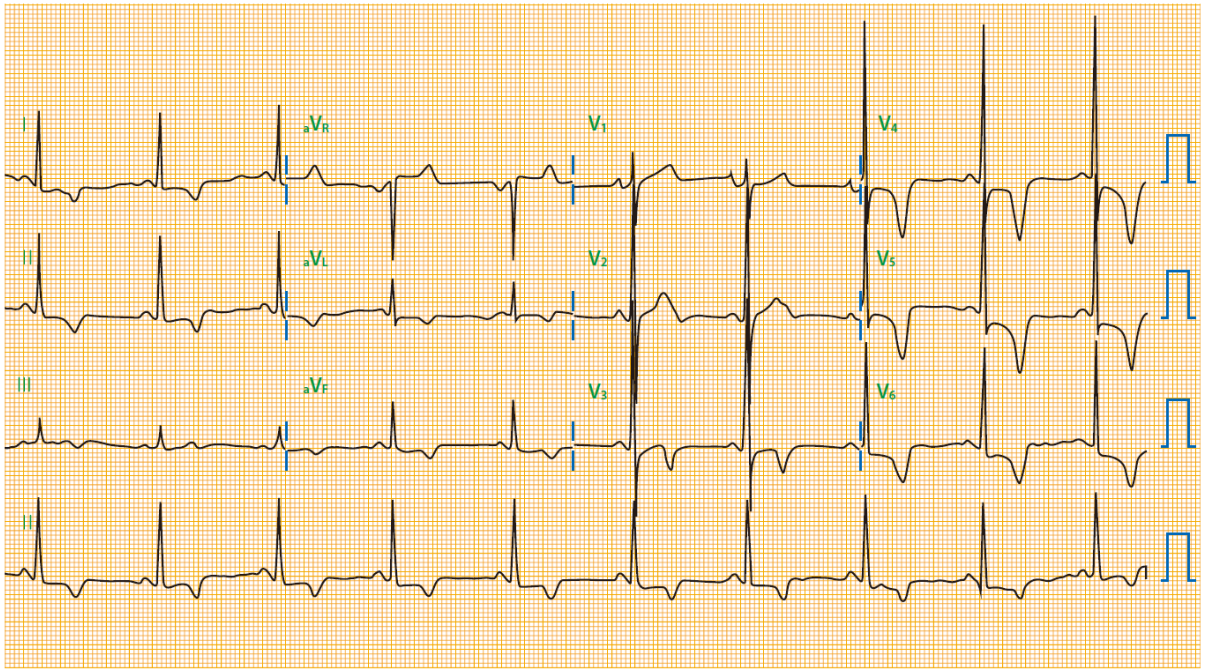


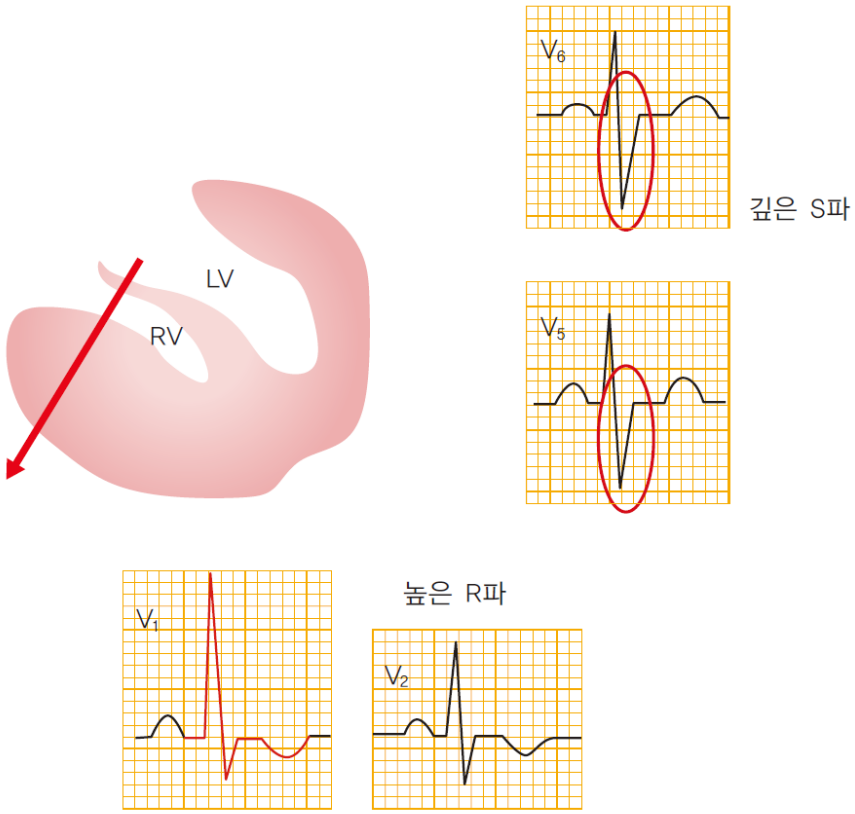
정상(nomal)

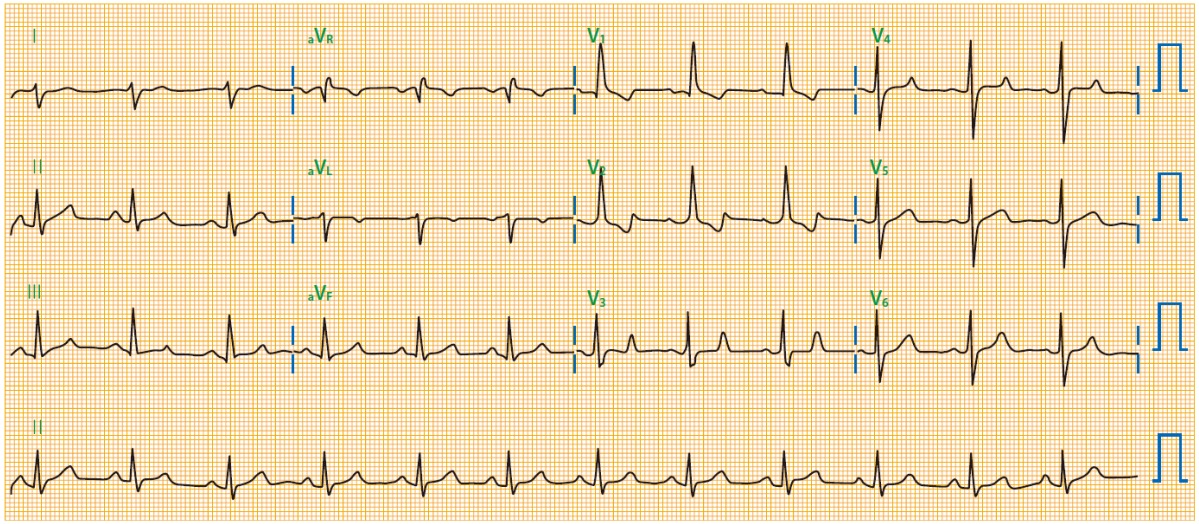
우심방확대(RAE) : 뾰족한 P모양

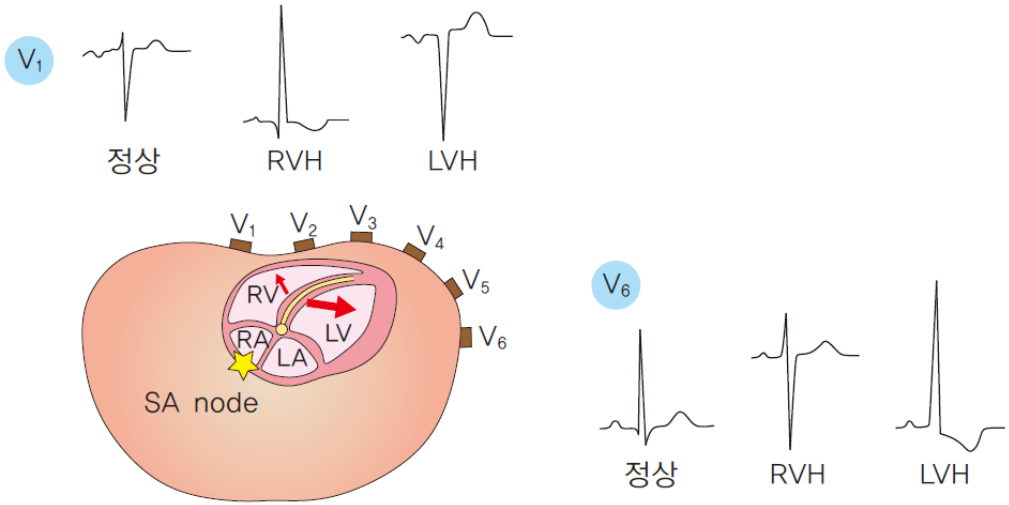


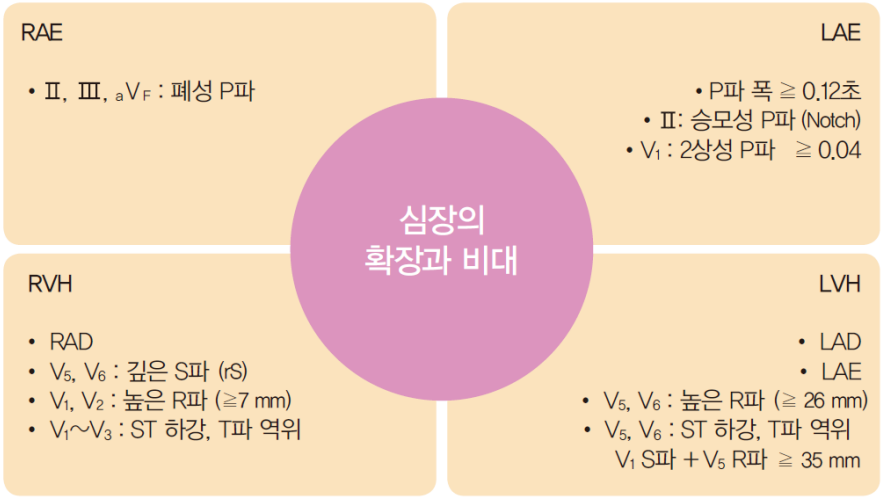

RV
LV
V6
V1
V2
V5

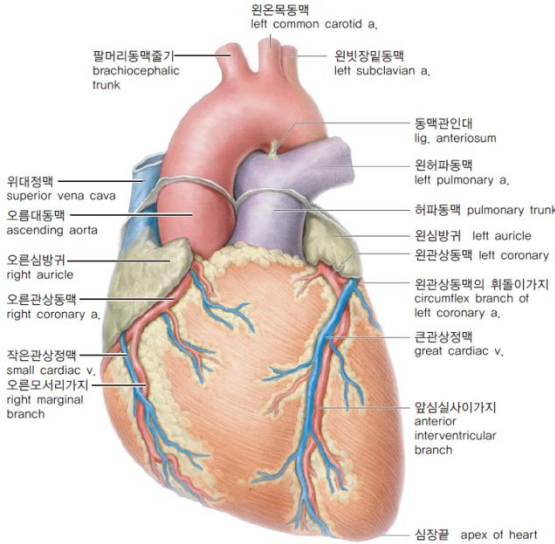

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II


LV
RV
V6
깊은 S파
V5
V1
높은 R파
V2

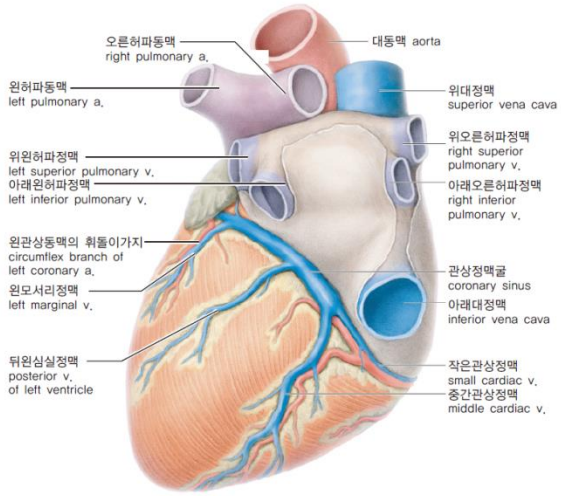

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II


V1
정상
RVH
LVH
V1
V2
V3
V4
V5
V6
RV
RA
LV
LA
SA node
V6
정상
RVH
LVH

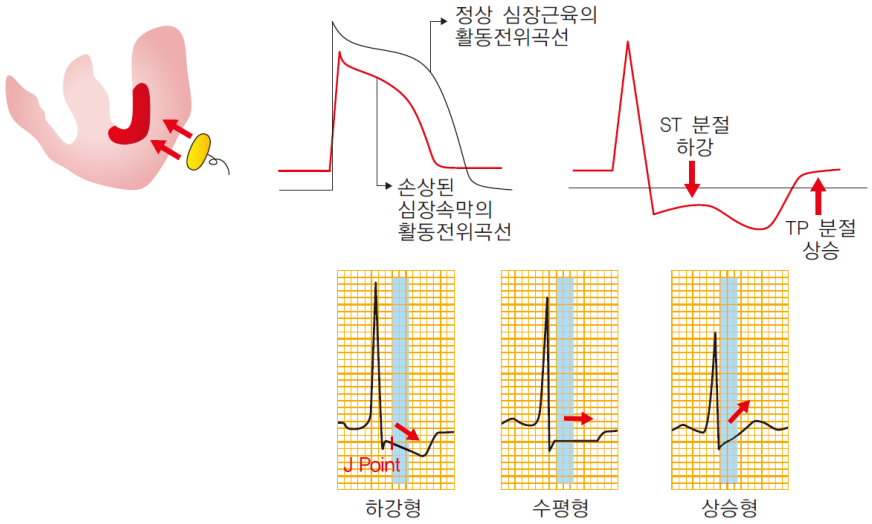

RAE
• Ⅱ, Ⅲ, aVF : 폐성 P파
LAE
• P파 폭 ≧ 0.12초
• Ⅱ: 승모성 P파 (Notch)
• V1 : 2상성 P파 ≧ 0.04
심장의
확장과 비대
RVH
• RAD
• V5, V6 : 깊은 S파 (rS)
• V1, V2 : 높은 R파 (≧7 mm)
• V1~V3 : ST 하강, T파 역위
LVH
• LAD
• LAE
• V5, V6 : 높은 R파 (≧ 26 mm)
• V5, V6 : ST 하강, T파 역위
V1 S파 + V5 R파 ≧ 35 mm

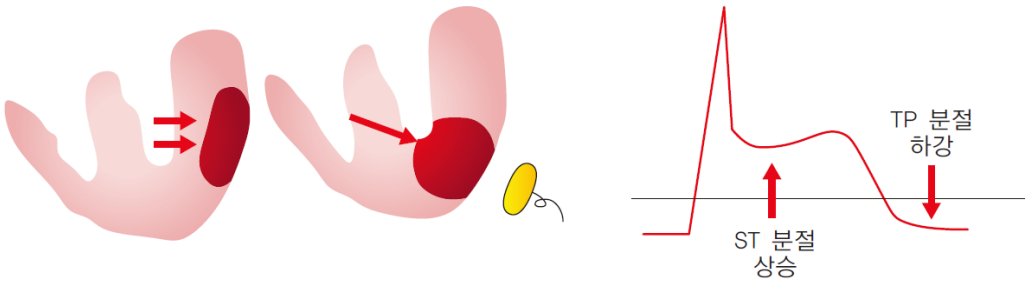

왼온목동맥
left common carotid a.
팔머리동맥줄기
brachiocephalic trunk
왼빗장밑동맥
left subclavian a.
동맥관인대
lig. anteriosum
왼허파동맥
left pulmonary a.
위대정맥
superior vena cava
허파동맥 pulmonary trunk
오름대동맥
ascending aorta
왼심방귀 left auricle
오른심방귀
right auricle
왼관상동맥 left coronary a.
왼관상동맥의 휘돌이가지
circumflex branch of left coronary a.
오른관상동맥
right coronary a.
큰관상정맥
great cardiac v.
작은관상정맥
small cardiac v.
오른모서리가지
right marginal branch
앞심실사이가지
anterior interventricular branch
심장끝 apex of heart

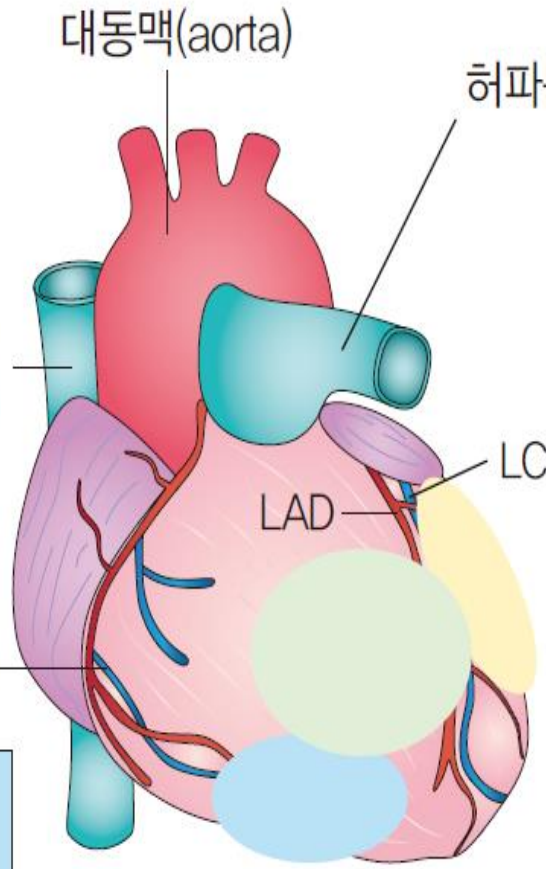
〈앞면〉


오른허파동맥
right pulmonary a.
대동맥 aorta
왼허파동맥
left pulmonary a.
위대정맥
superior vena cava
위오른허파정맥
right superior pulmonary v.
위왼허파정맥
left superior pulmonary v.
아래왼허파정맥
left inferior pulmonary v.
아래오른허파정맥
right inferior pulmonary v.
왼관상동맥의 휘돌이가지
circumflex branch of left coronary a.
관상정맥굴
coronary sinus
왼모서리정맥
left marginal v.
아래대정맥
inferior vena cava
뒤왼심실정맥
posterior v. of left ventricle
작은관상정맥
small cardiac v.
중간관상정맥
middle cardiac v.

〈뒷면〉


정상 심장근육의
활동전위곡선
손상된
심장속막의
활동전위곡선
ST 분절
하강
TP 분절
상승
J Point
하강형
수평형
상승형

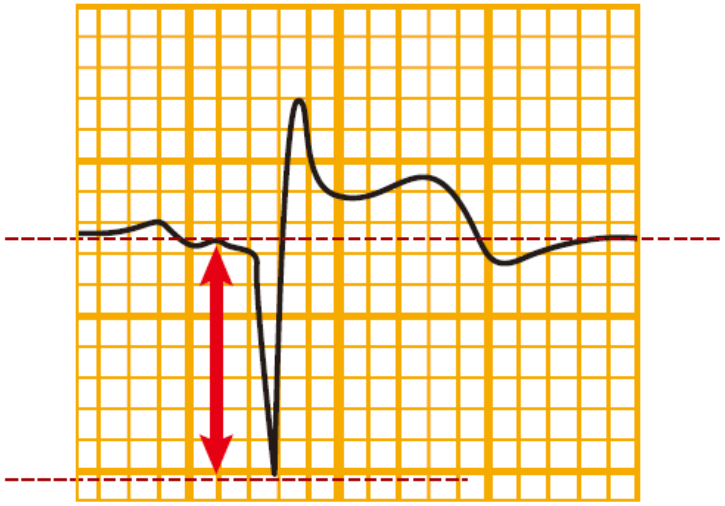

TP 분절
하강
ST 분절
상승

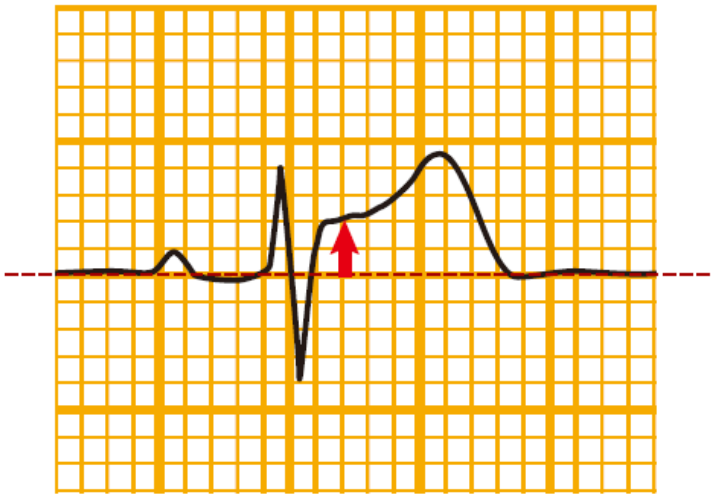


측벽경색(laterior M)
: I, $_aV_L$, V_5, V_6

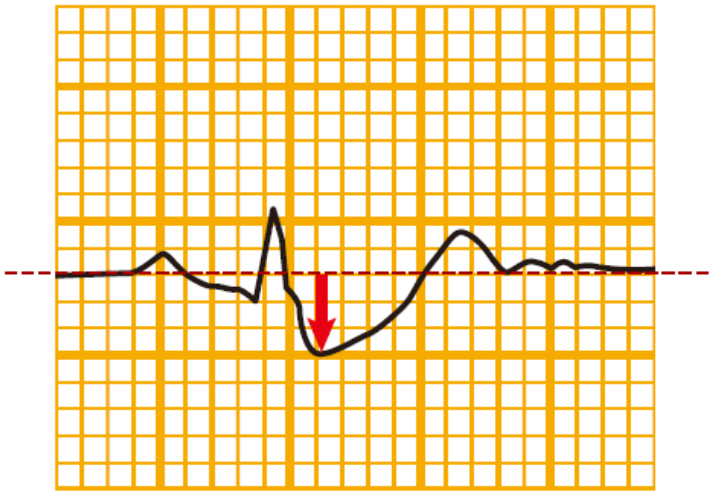
하벽경색(inferior M)
: II, III, $_aV_F$

전벽경색(anterior M)
: V_1~V_4

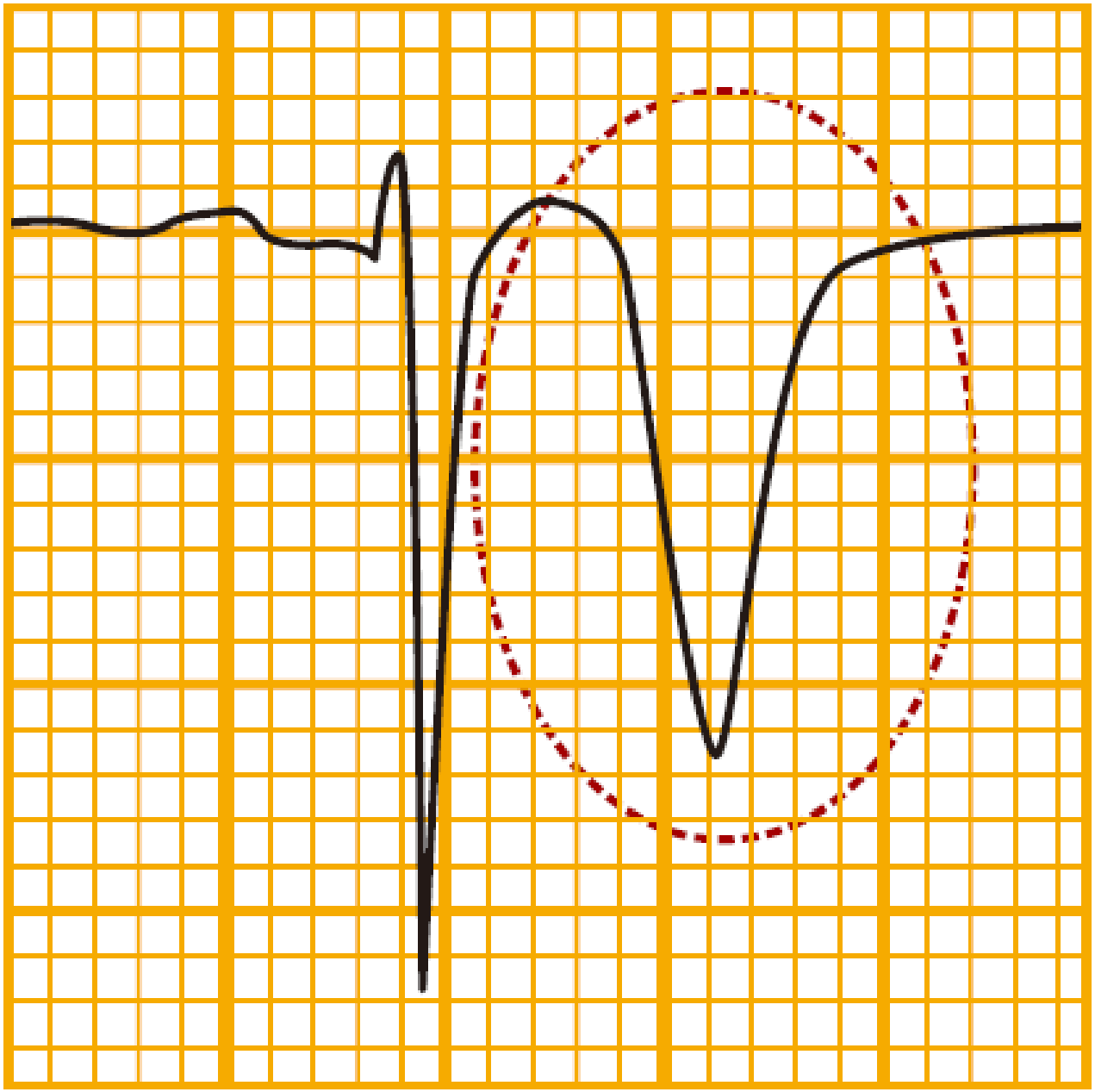


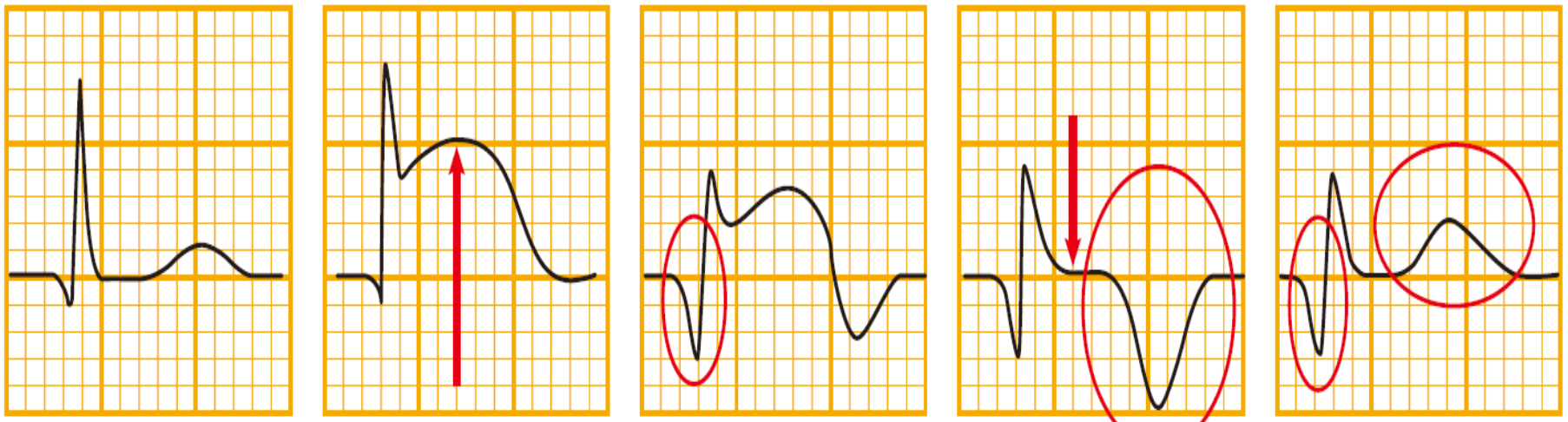


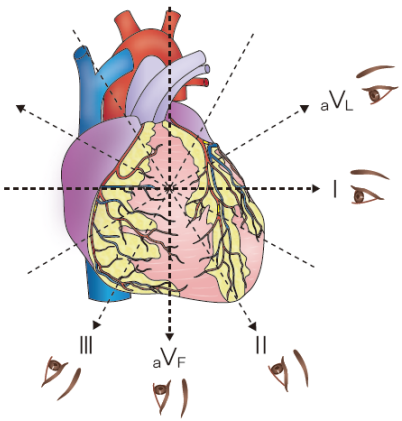
경색 부위 유도에서 ST분절 상승

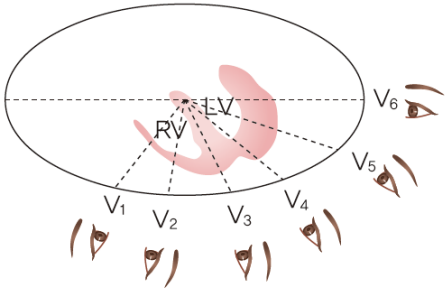


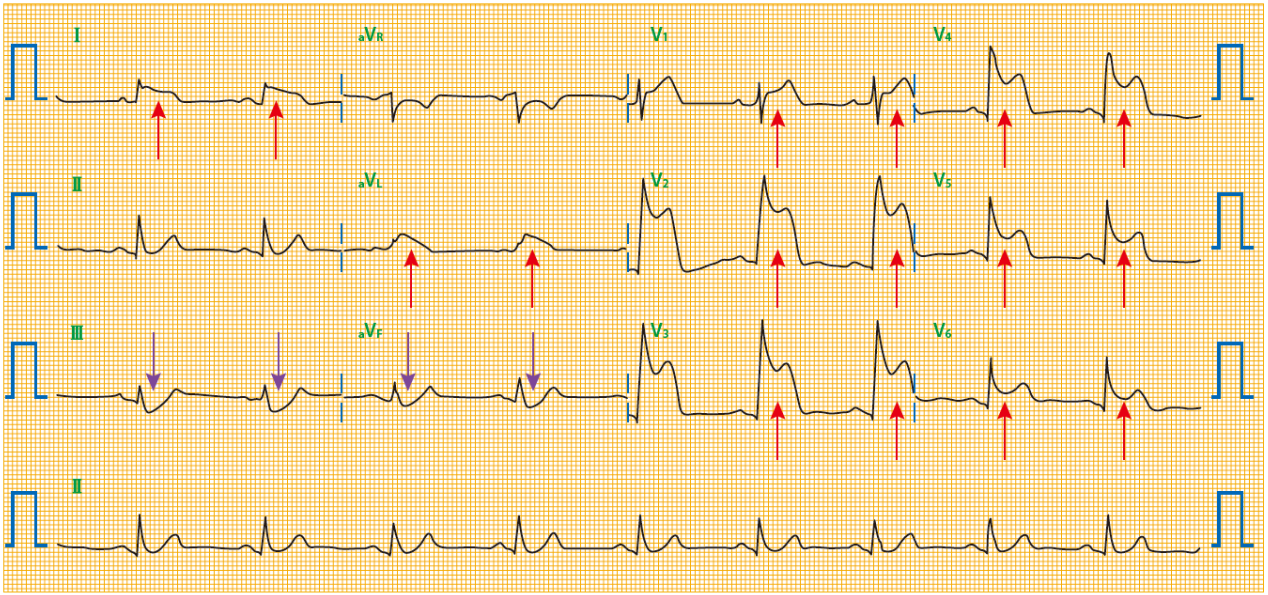
경색 반대부위 유도에서 ST분절 하강



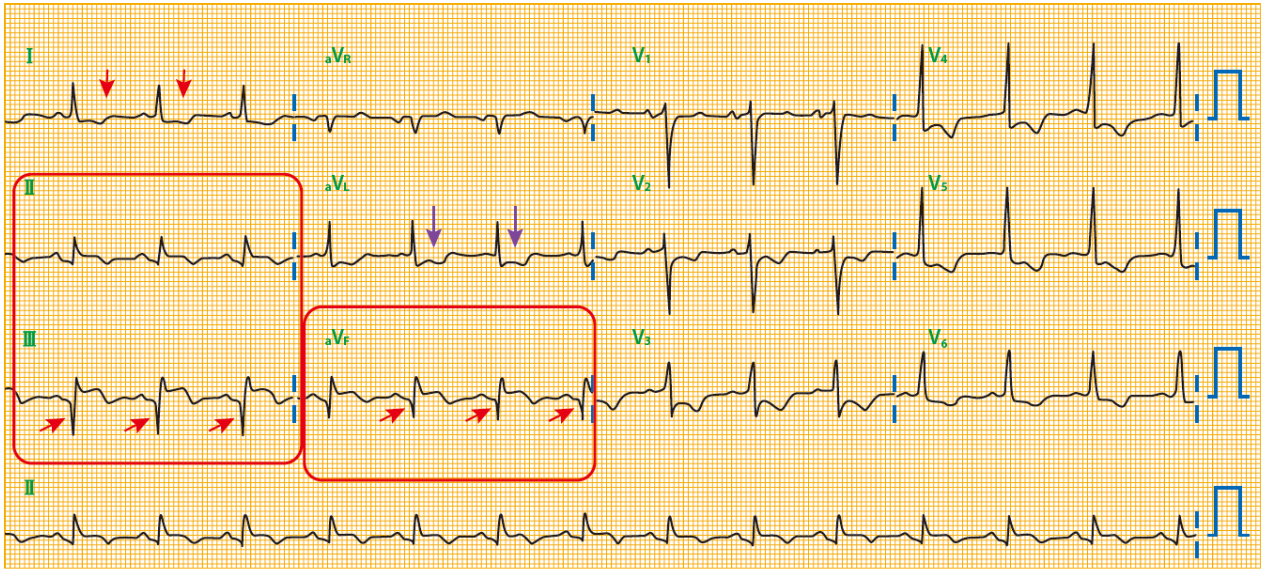

심근경색(MI) 발생 전
발생 수분~수시간 후
1일 후
1주 후
수개월 후


aVL
I
III
aVF
II

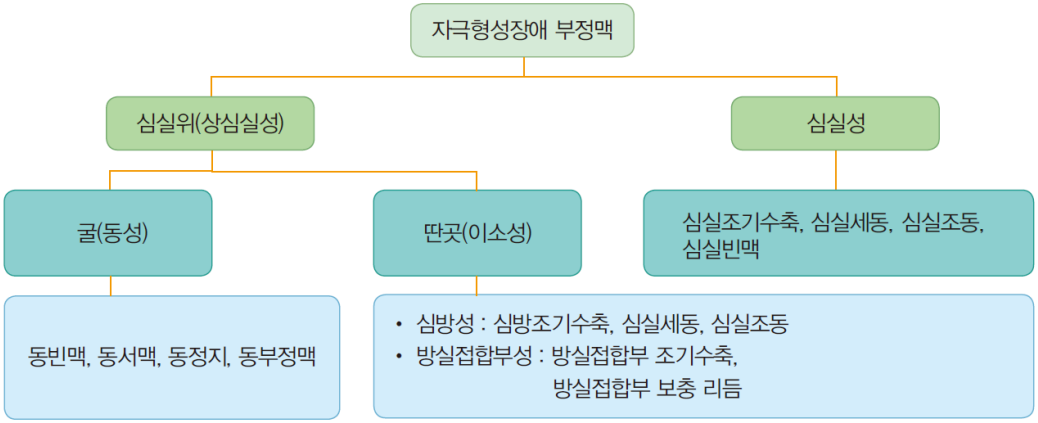

LV
RV
V1
V2
V3
V4
V5
V6

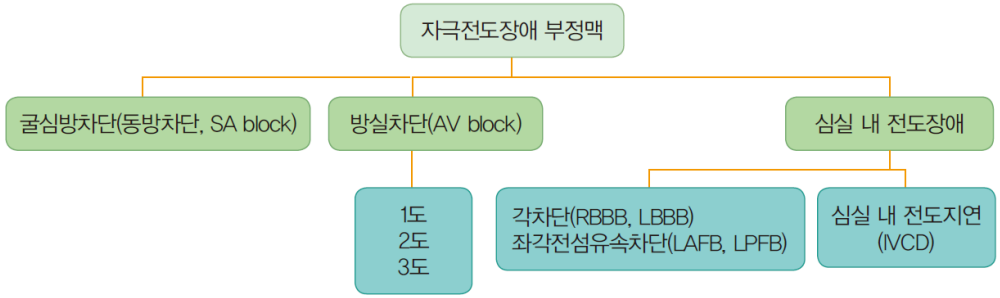


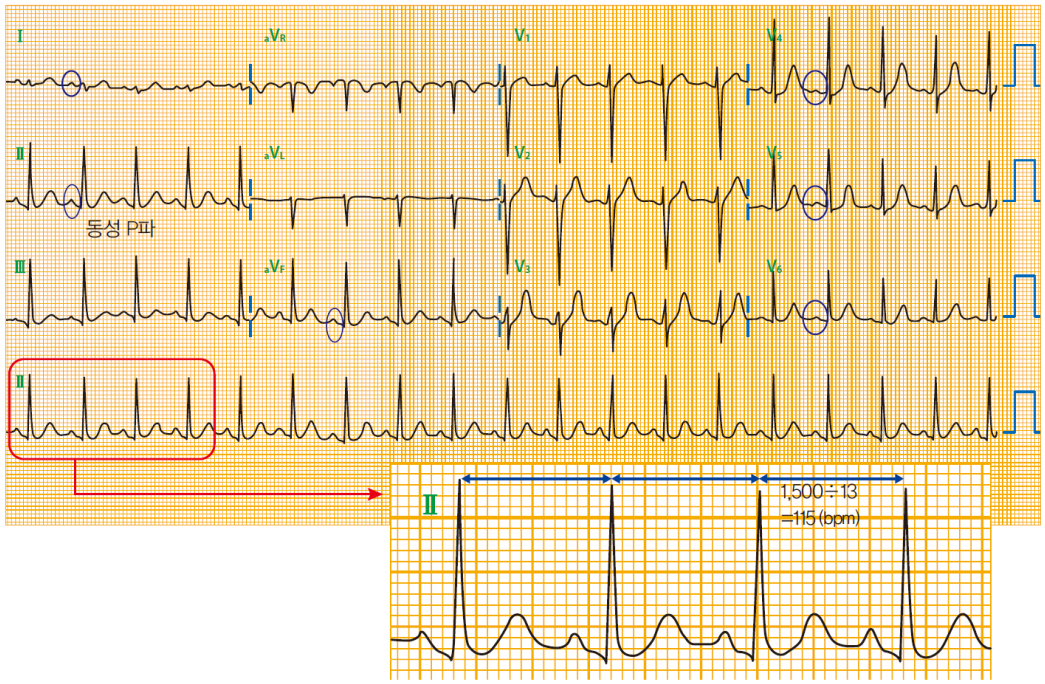
광범위한 전벽 및 측벽경색

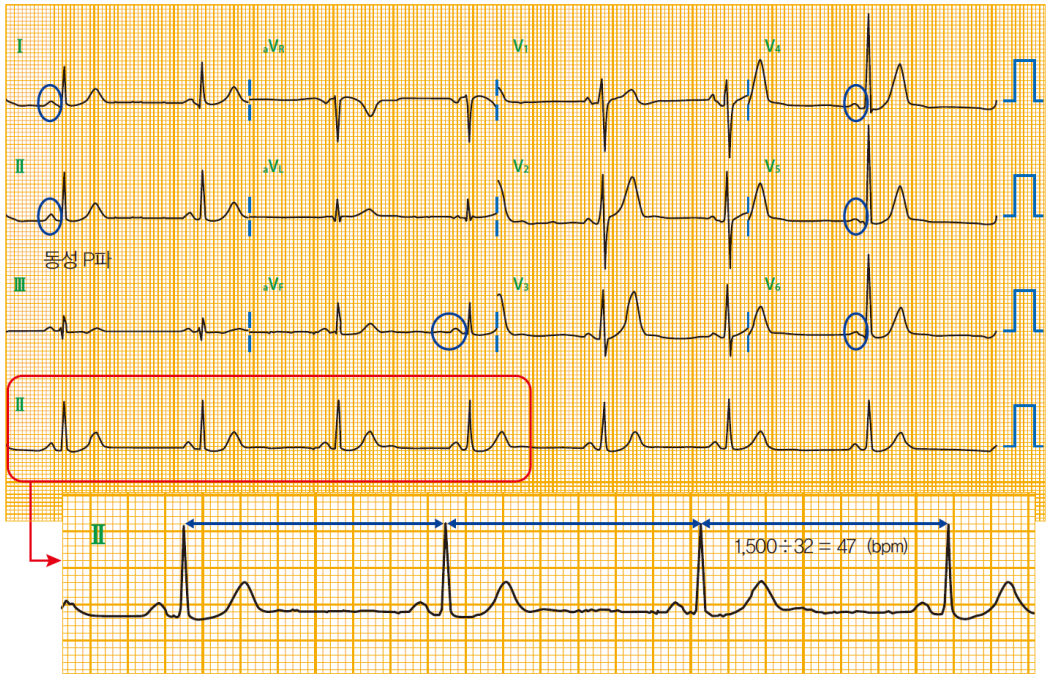


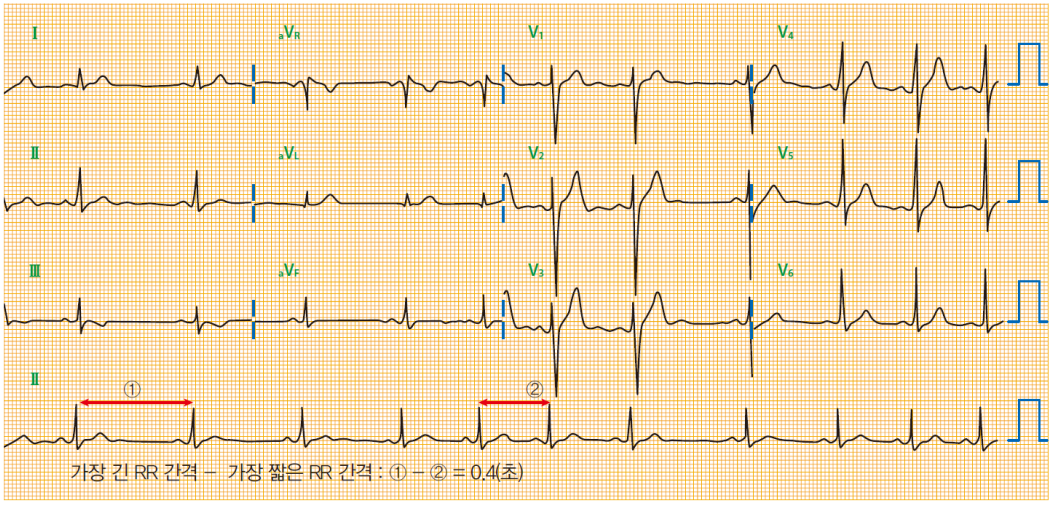
하벽(inferior wall)

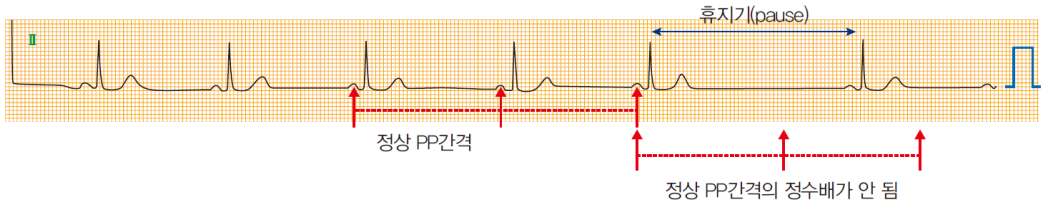

자극형성장애 부정맥
심실위(상심실성)
심실성
굴(동성)
딴곳(이소성)
심실조기수축, 심실세동, 심실조동, 심실빈맥
동빈맥, 동서맥, 동정지, 동부정맥
• 심방성 : 심방조기수축, 심실세동, 심실조동
• 방실접합부성 : 방실접합부 조기수축, 방실접합부 보충 리듬

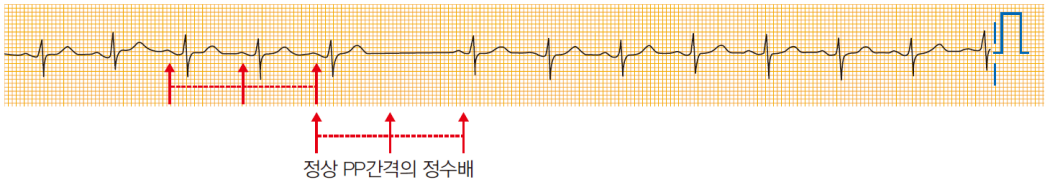

자극전도장애 부정맥
굴심방차단(동방차단, SA block)
방실차단(AV block)
심실 내 전도장애
1도
2도
3도
각차단(RBBB, LBBB)
좌각전섬유속차단(LAFB, LPFB)
심실 내 전도지연(IVCD)

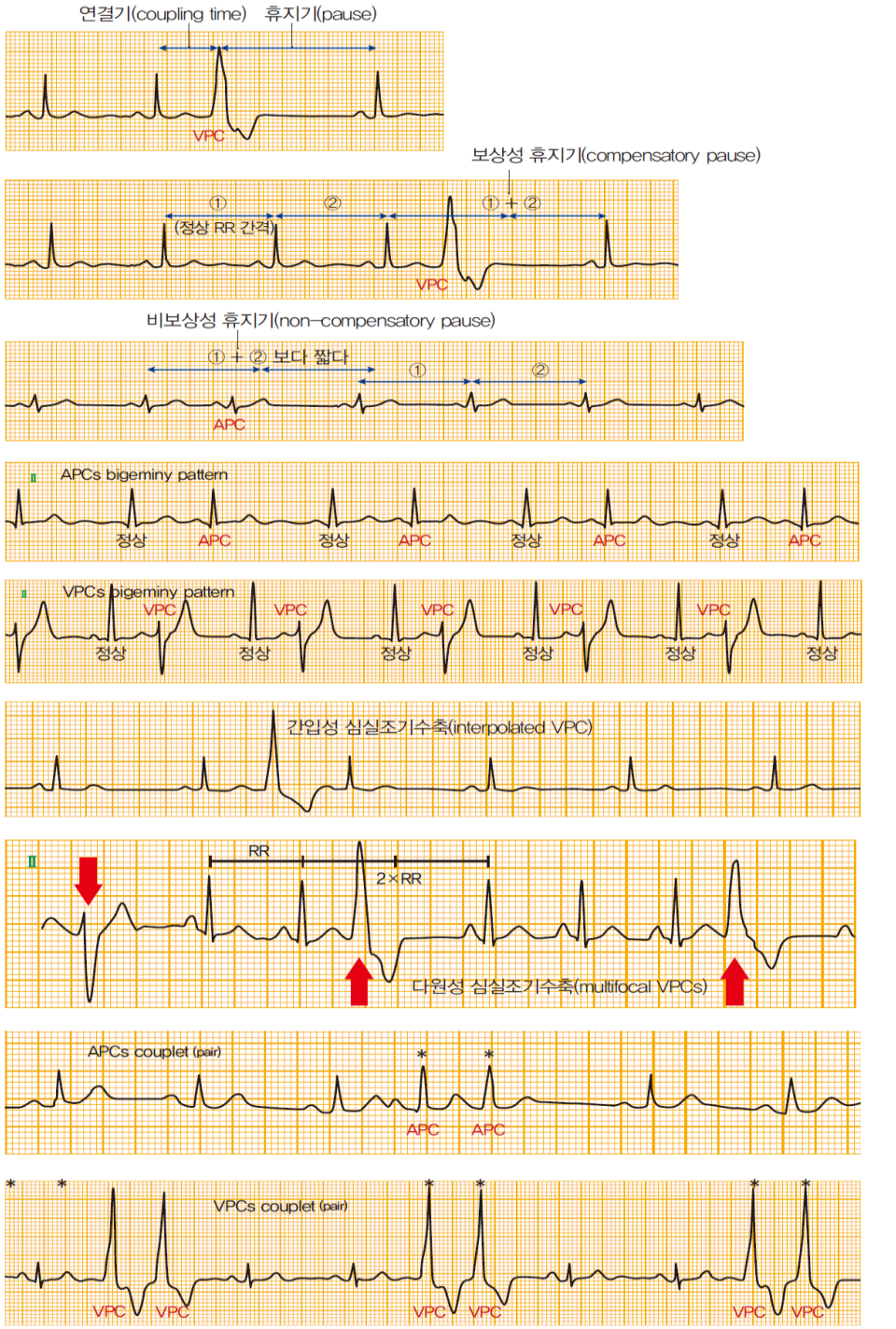

I
aVR
V1
V4
II
aVL
V2
V5
동성 P파
III
aVF
V3
V6
II
II
1,500÷13
=115 (bpm)

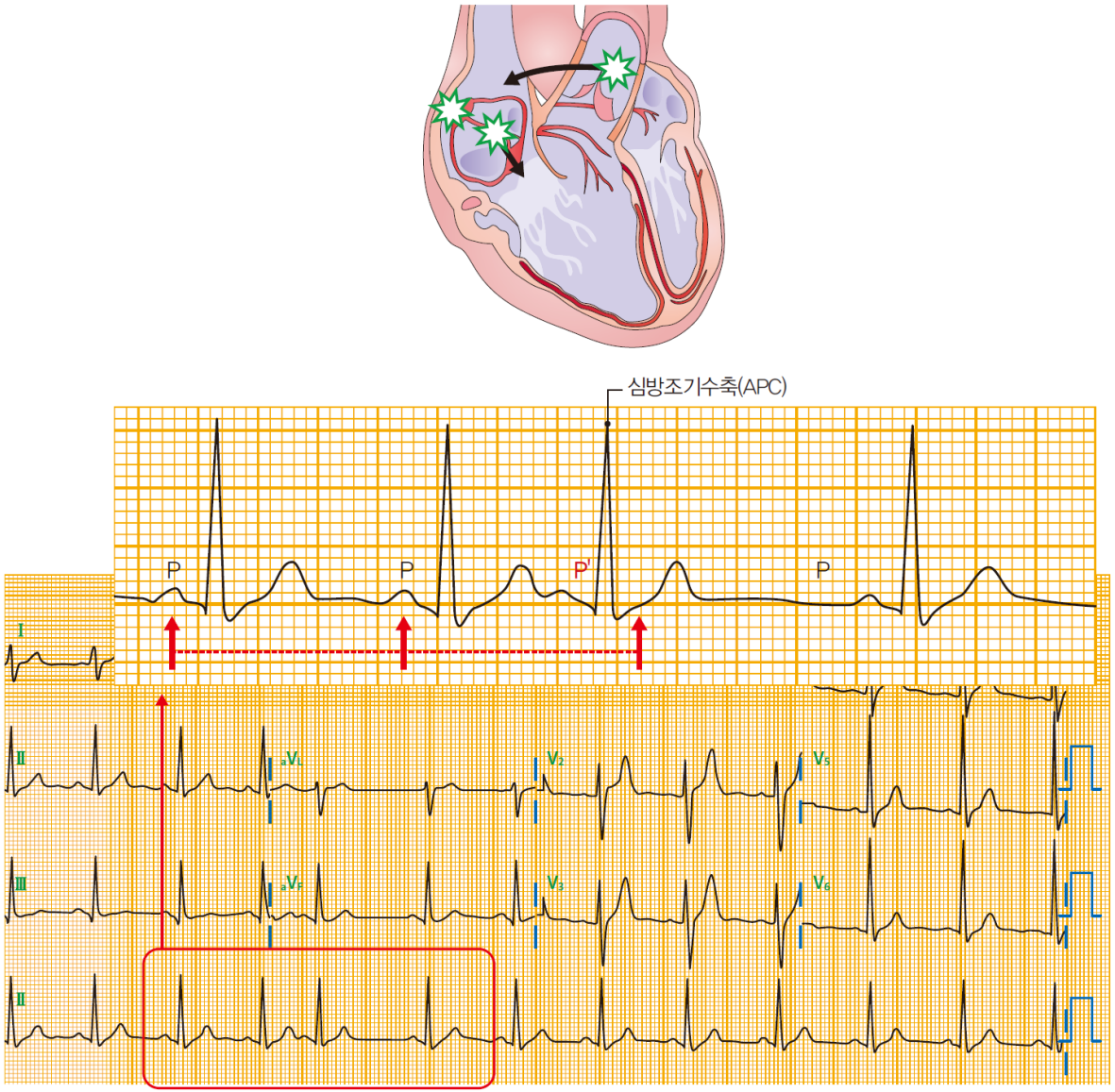

Ⅰ
aVR
V1
V4
Ⅱ
aVL
V2
V5
동성 P파
Ⅲ
aVF
V3
V6
Ⅱ
Ⅱ
1,500 ÷ 32 = 47 (bpm)

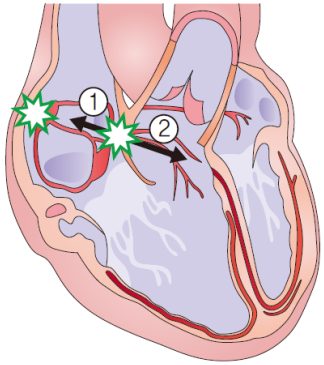

Ⅰ
aVR
V1
V4
Ⅱ
aVL
V2
V5
Ⅲ
aVF
V3
V6
Ⅱ
①
②
가장 긴 RR 간격 – 가장 짧은 RR 간격 : ① – ② = 0.4(초)

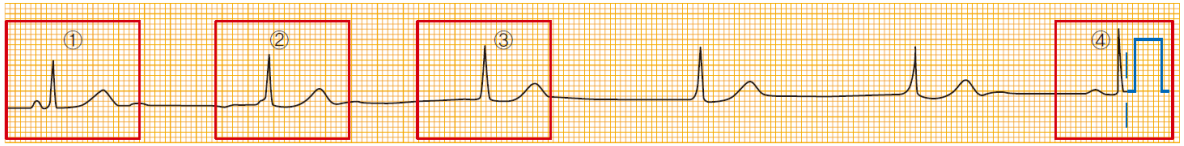

휴지기(pause)
II
정상 PP간격
정상 PP간격의 정수배가 안 됨

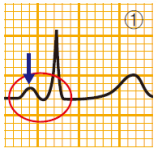

정상 PP간격의 정수배


연결기(coupling time)
휴지기(pause)
VPC
보상성 휴지기(compensatory pause)
①
②
① + ②
(정상 RR 간격)
VPC
비보상성 휴지기(non-compensatory pause)
① + ② 보다 짧다
①
②
APC
II
APCs bigeminy pattern
정상
APC
VPCs bigeminy pattern
VPC
간입성 심실조기수축(interpolated VPC)
RR
2×RR
다원성 심실조기수축(multifocal VPCs)
APCs couplet (pair)
VPCs couplet (pair)

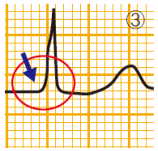

심방조기수축(APC)
P
P
P'
P
I
II
III
II
aVL
aVF
V1
V2
V3
V5
V6



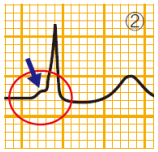




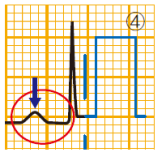
QRS군 앞에 P파가 있으나
PR 간격이 0.08초로 짧음



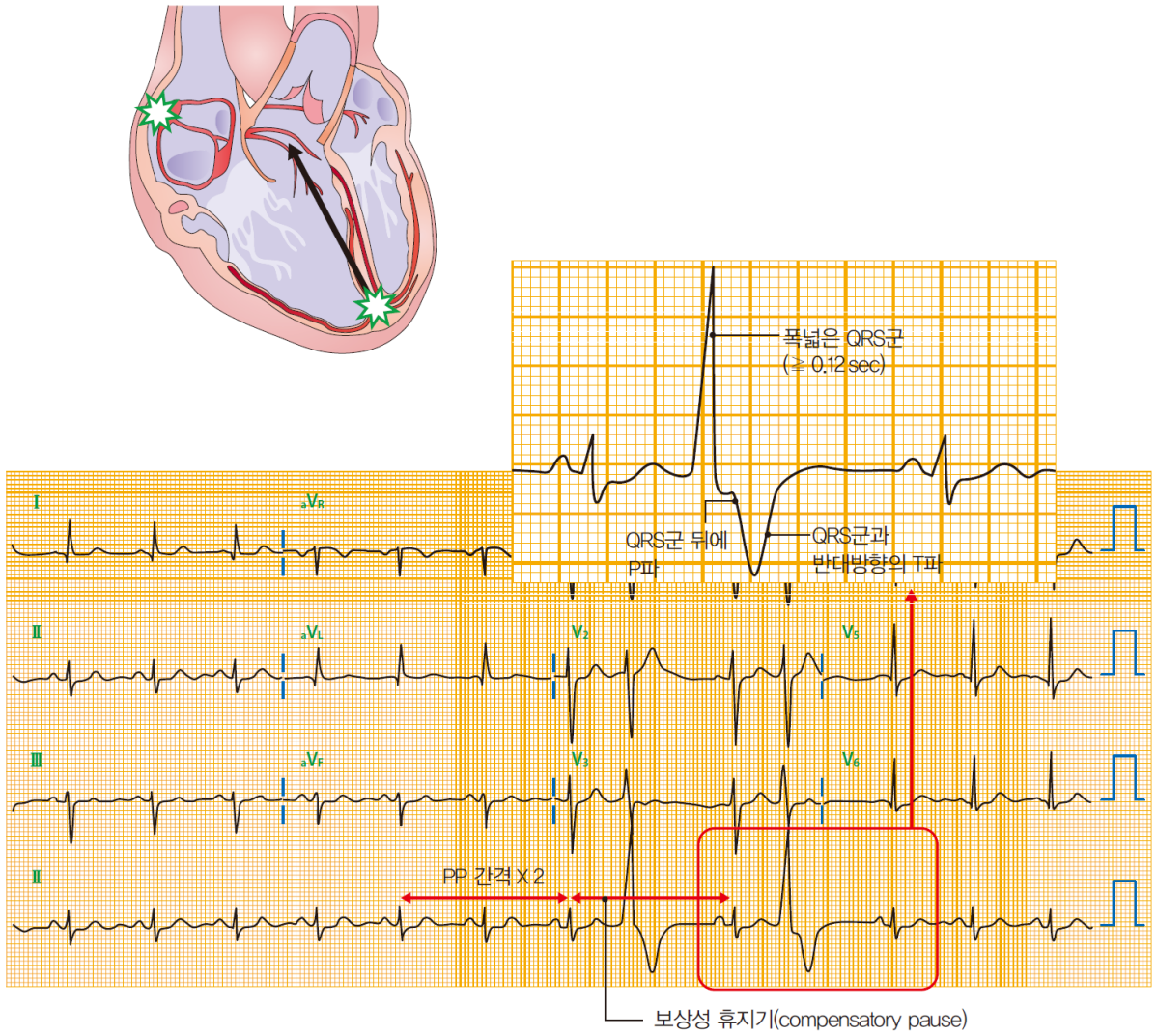
P파와 QRS군이 완전히 중첩
되어 P파가 보이지 않음

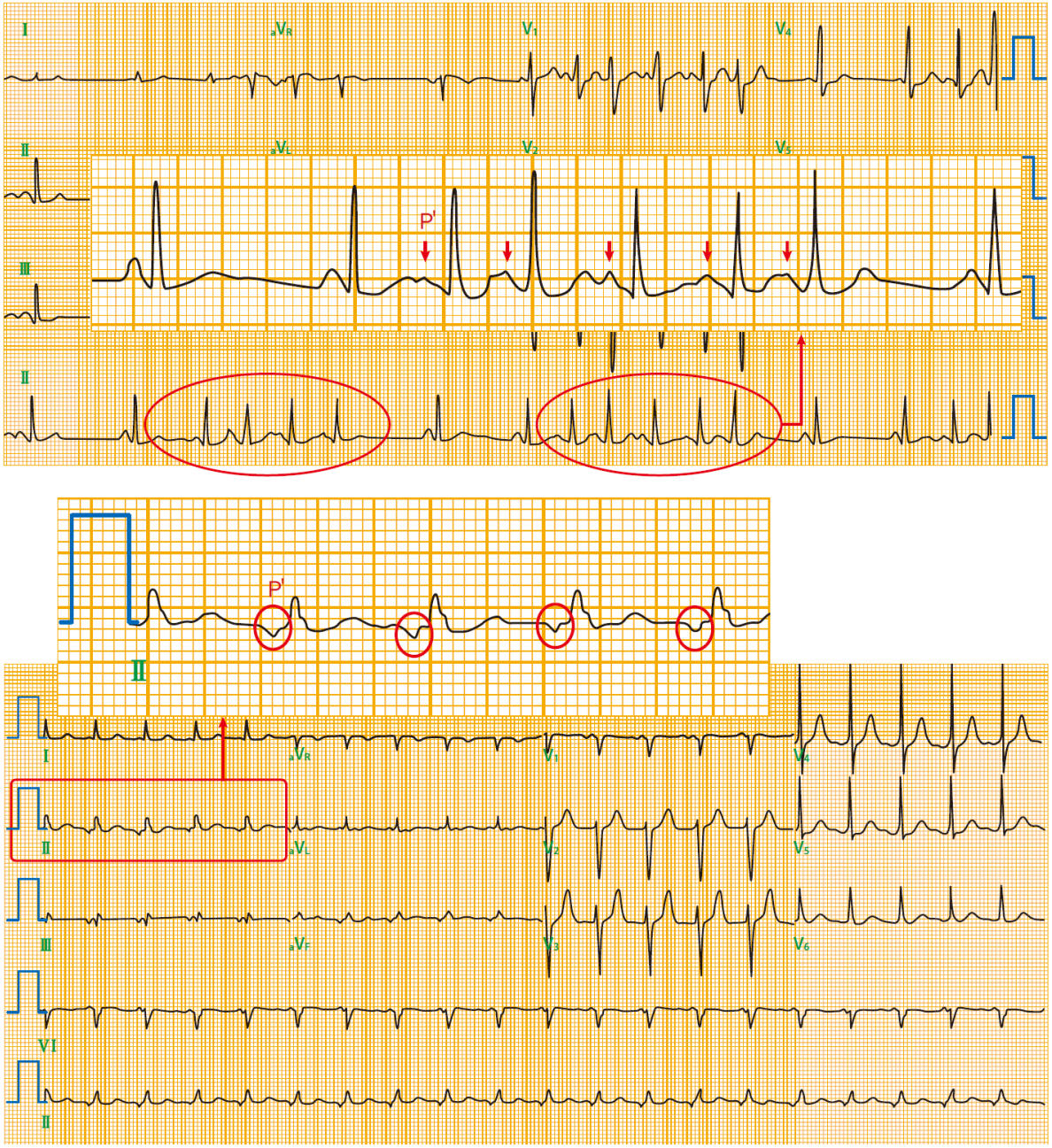


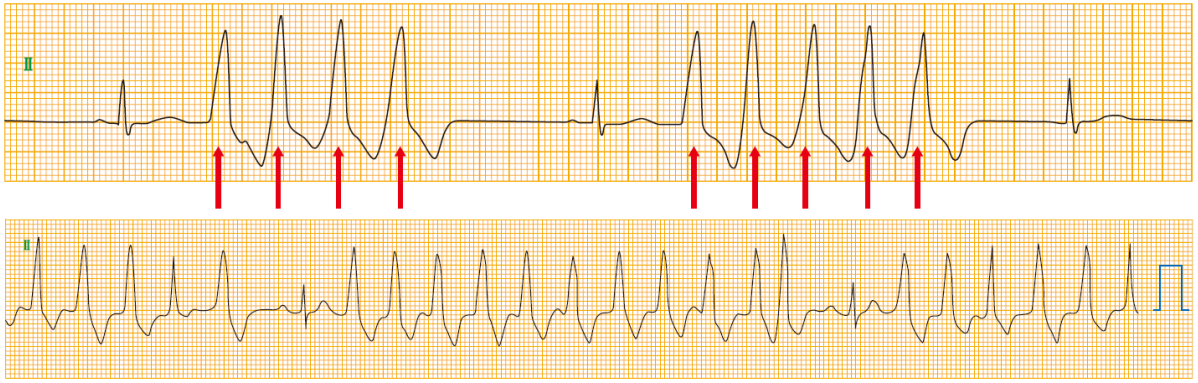
QRS군 바로 앞에 P파가 중첩

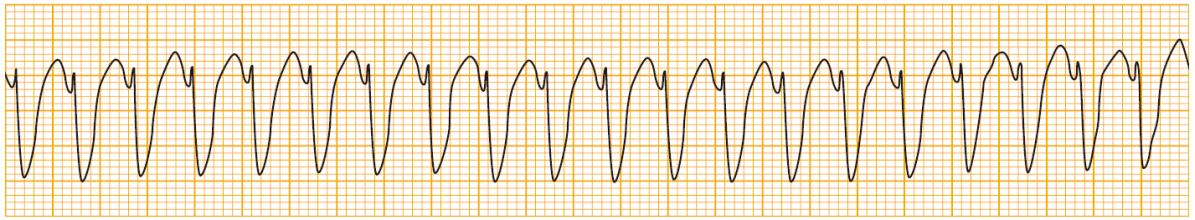


정상 PR 간격

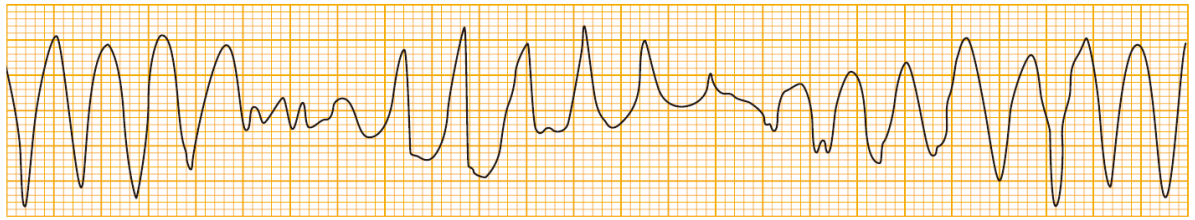

폭넓은 QRS군
(≥ 0.12 sec)
QRS군 뒤에
P파
QRS군과
반대방향의 T파
I
aVR
II
aVL
V2
V5
III
aVF
V3
V6
II
PP 간격 X 2
보상성 휴지기(compensatory pause)


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

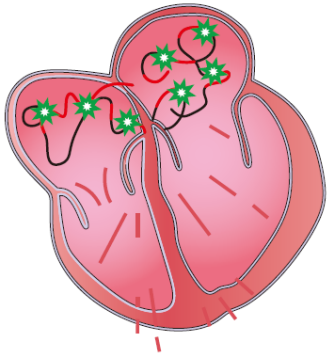


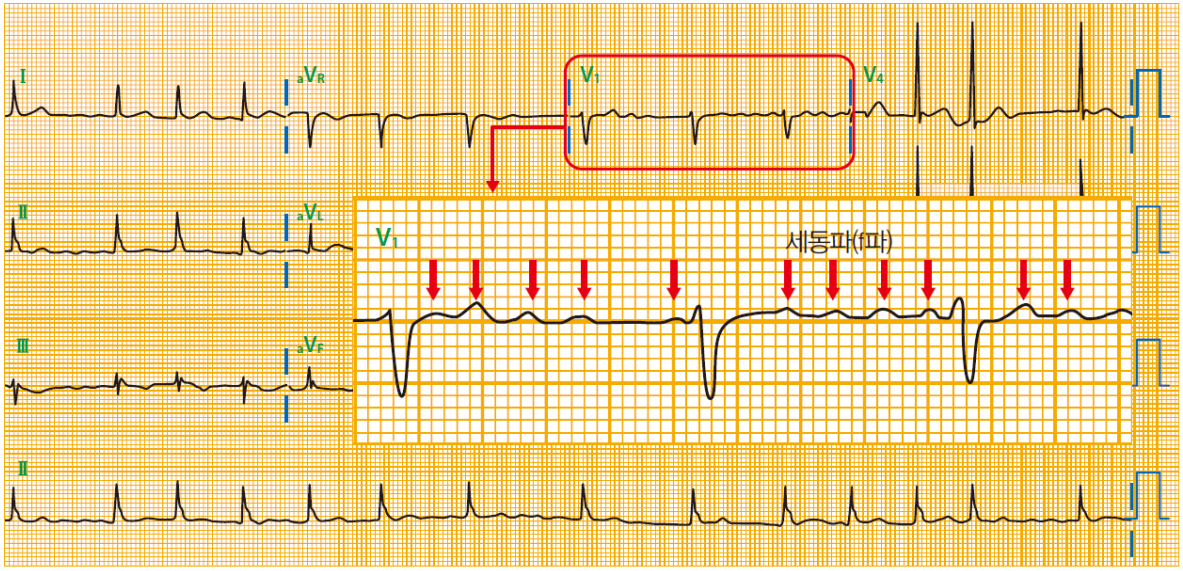


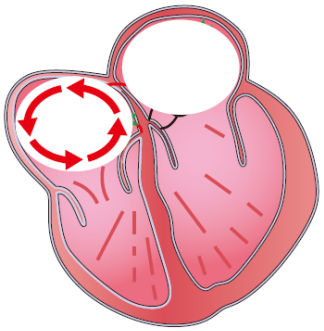
monomorphic VT



polymorphic VT




I
aVR
V1
V4
II
aVL
V1
세동파(f파)
III
aVF
II



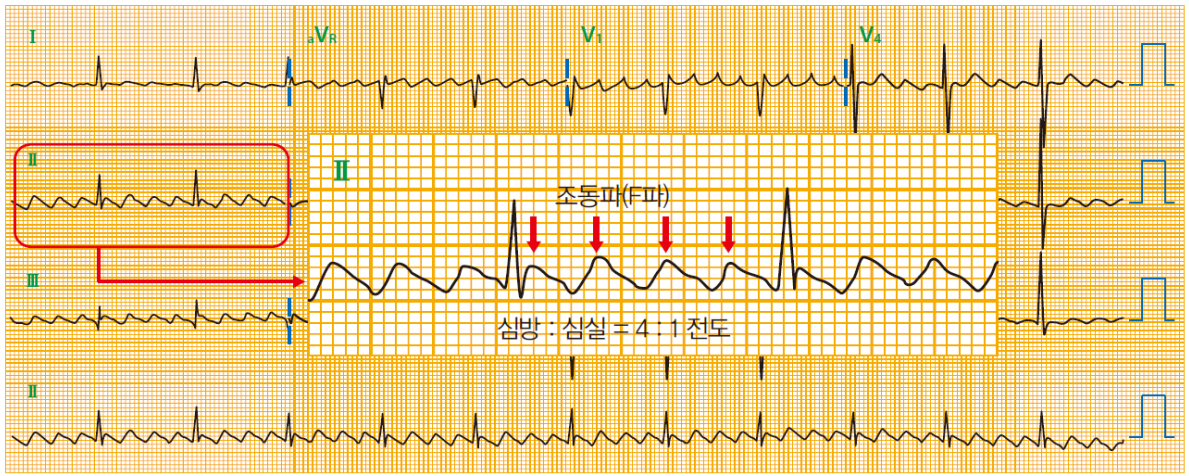
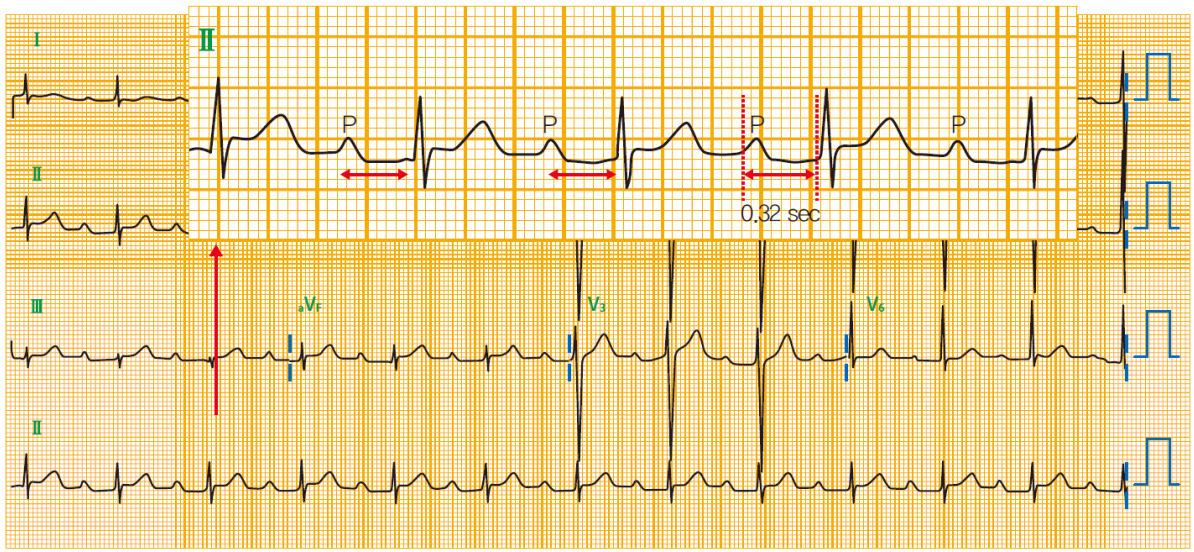
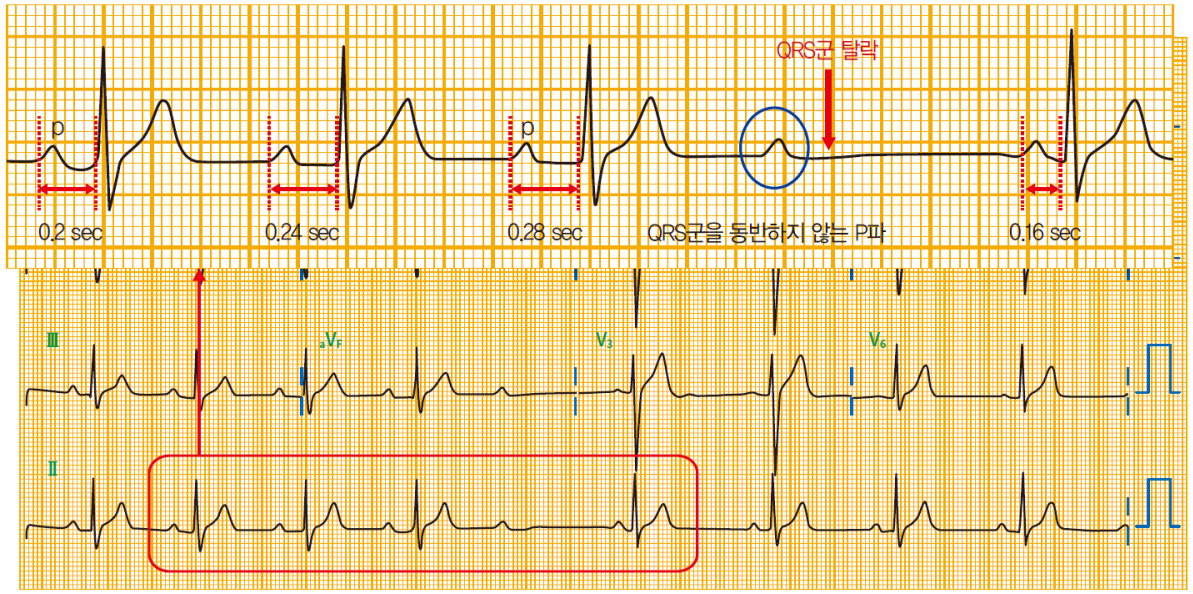

I
aVR
V1
V4
II
III
II
II
조동파(F파)
심방 : 심실 = 4 : 1 전도

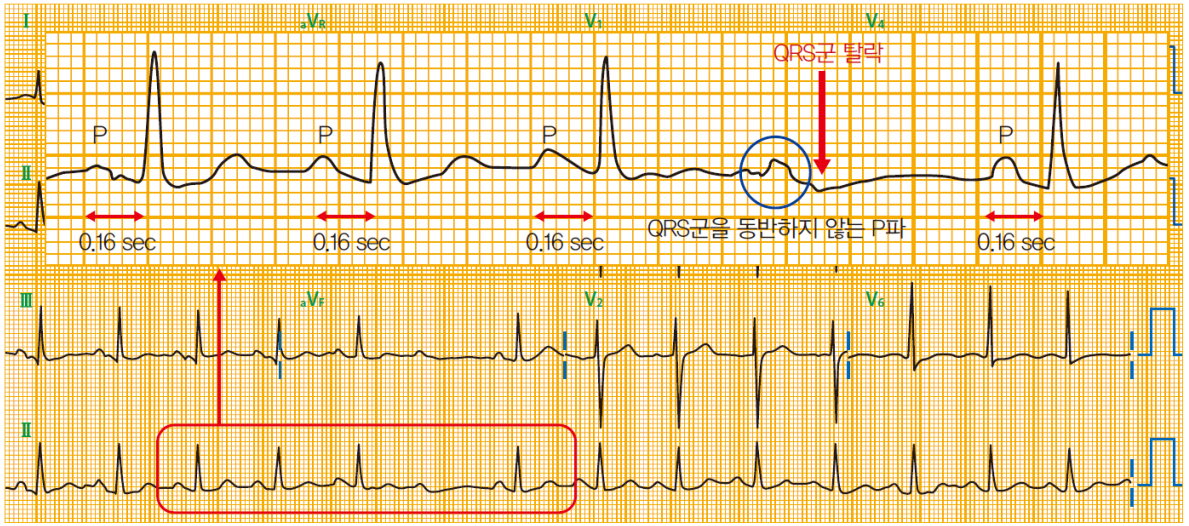
표 9-1. 방실차단의 종류

불완전 방실차단 (incomplete AV block)	1도 방실차단(1^{st} degree AV block)	
	2도 방실차단(2^{nd} degree AV block)	모비츠(Mobitz) I형(=Wenckebach)
		모비츠(Mobitz) II형
	고도 방실차단(high degree AV block)	
완전 방실차단 (complete AV block)	3도 방실차단(3^{rd} degree AV block)	


I
II
III
II
P
P
P
P
0.32 sec
aVF
V3
V6


QRS군 탈락
P
P
0.2 sec
0.24 sec
0.28 sec
QRS군을 동반하지 않는 P파
0.16 sec
Ⅲ
aVF
V3
V6
Ⅱ

갑자기 QRS군의 탈락!!


I
aVR
V1
V4
II
QRS군 탈락
P
P
P
P
0.16 sec
0.16 sec
0.16 sec
QRS군을 동반하지 않는 P파
0.16 sec
III
aVF
V2
V6
II

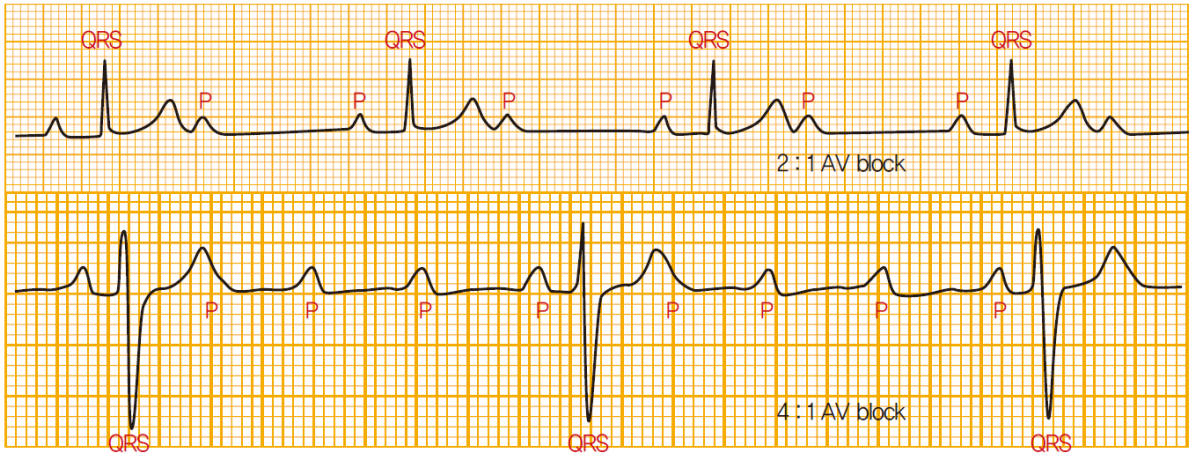
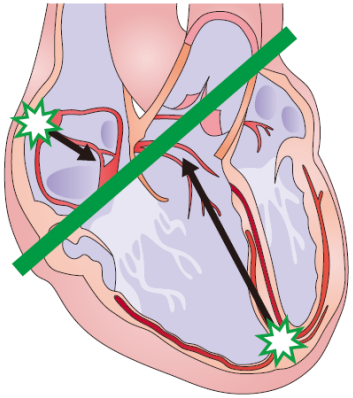
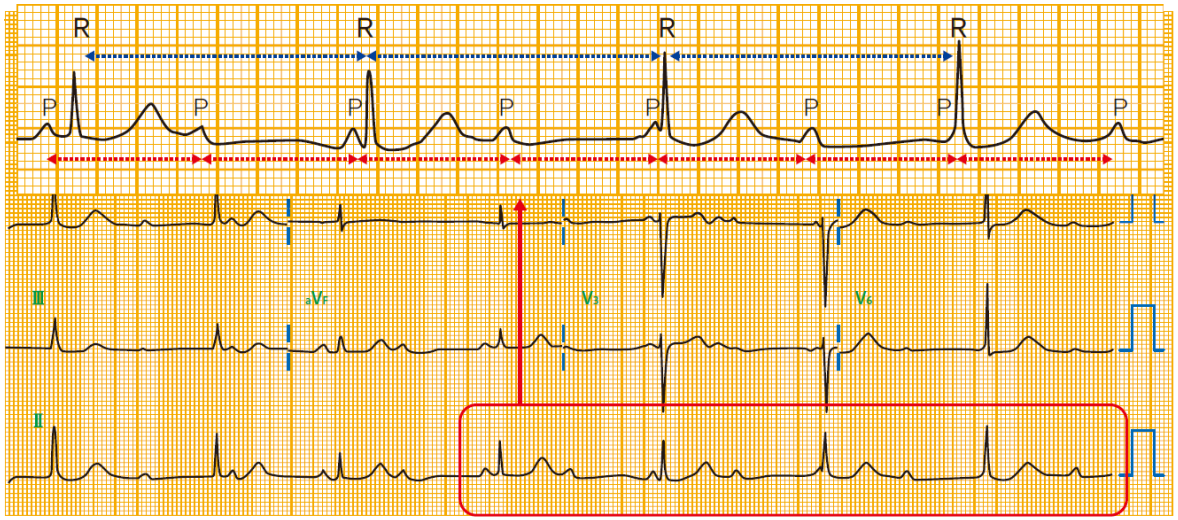

QRS
QRS
QRS
QRS
P
P
P
P
P
P
2 : 1 AV block
P
P
P
P
P
P
P
P
QRS
QRS
QRS
4 : 1 AV block

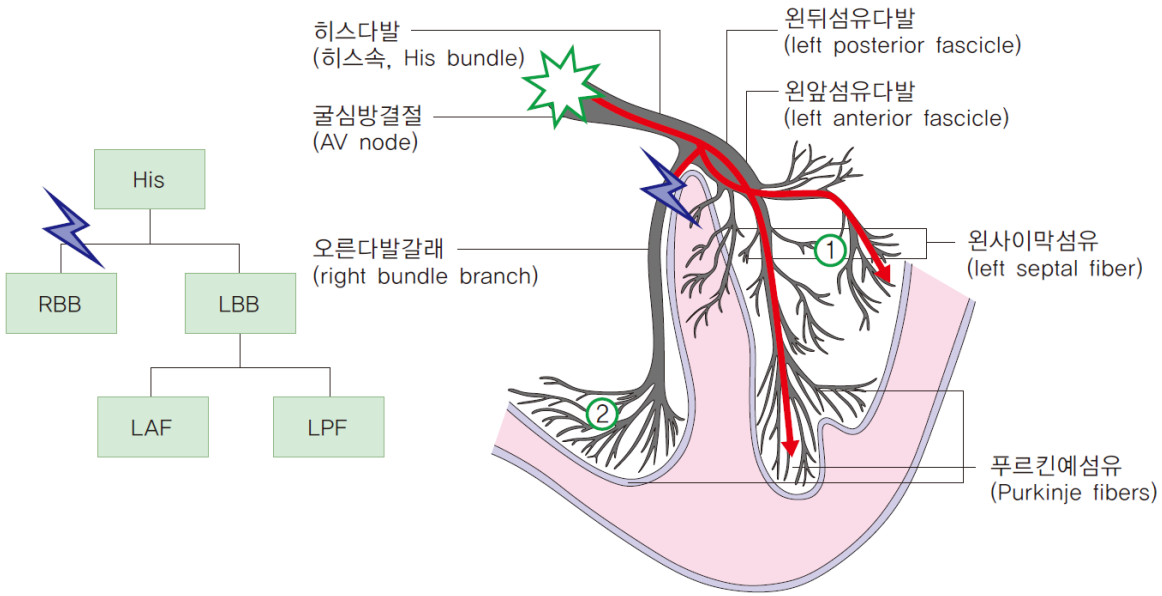
표 9-2. 완전방실차단의 차단부위

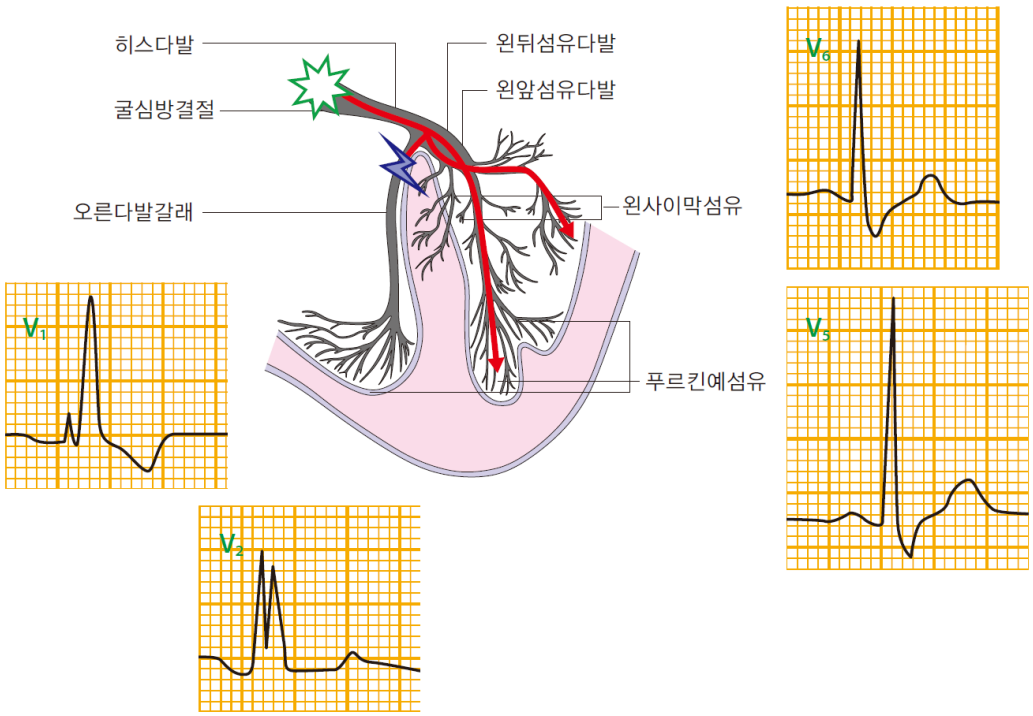
차단 부위	QRS군의 모양	심실박동수(HR)
방실결절 또는 히스다발 내	폭이 좁은 정상 모양(narrow QRS)	50회/분 이상
히스다발 아래	폭넓은 각차단 모양(wide QRS)	30회/분 이하

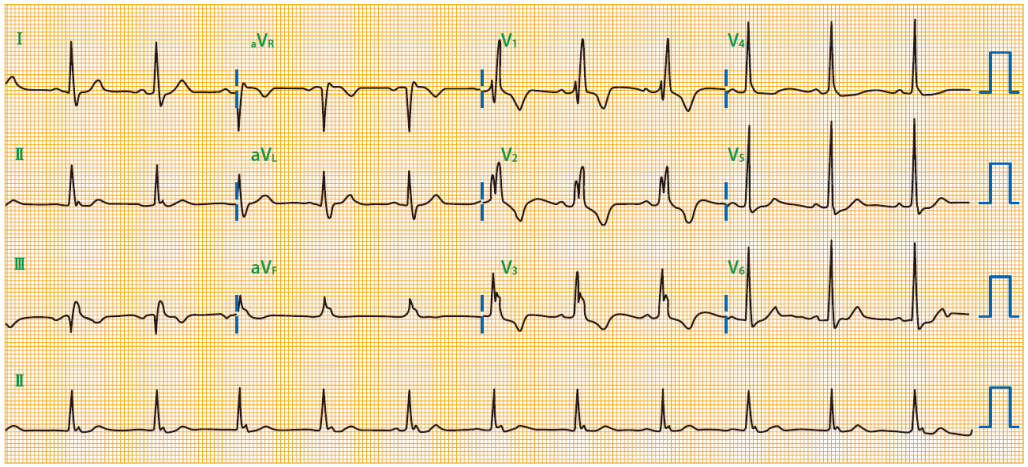


P파는 P파대로, QRS군은 QRS군대로!!




His
RBB
LBB
LAF
LPF
히스다발
(히스속, His bundle)
굴심방결절
(AV node)
오른다발갈래
(right bundle branch)
왼뒤섬유다발
(left posterior fascicle)
왼앞섬유다발
(left anterior fascicle)
왼사이막섬유
(left septal fiber)
푸르킨예섬유
(Purkinje fibers)
1
2


히스다발
굴심방결절
오른다발갈래
왼뒤섬유다발
왼앞섬유다발
왼사이막섬유
푸르킨예섬유
V1
V2
V5
V6


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

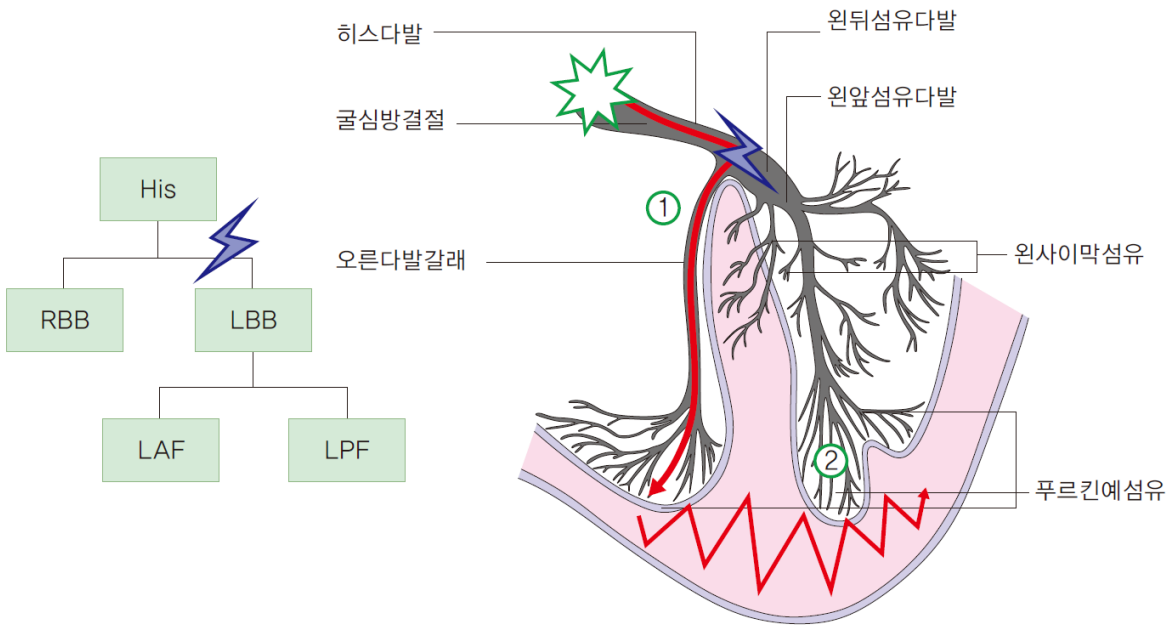
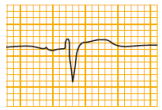
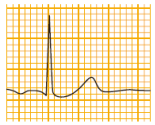
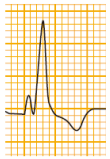
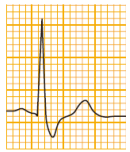
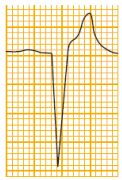
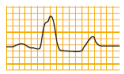
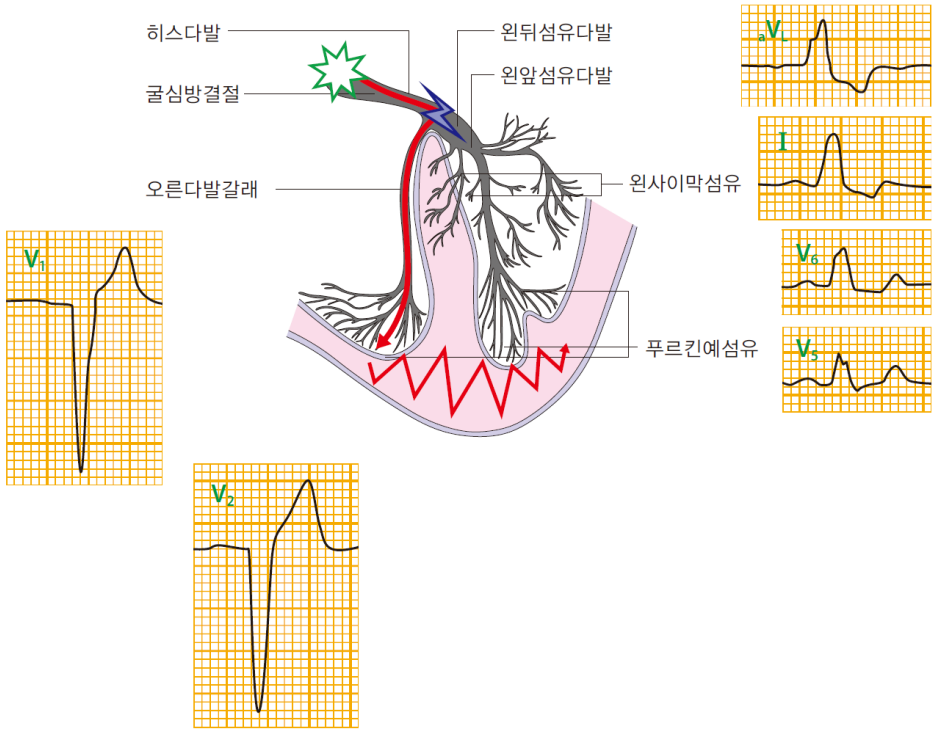
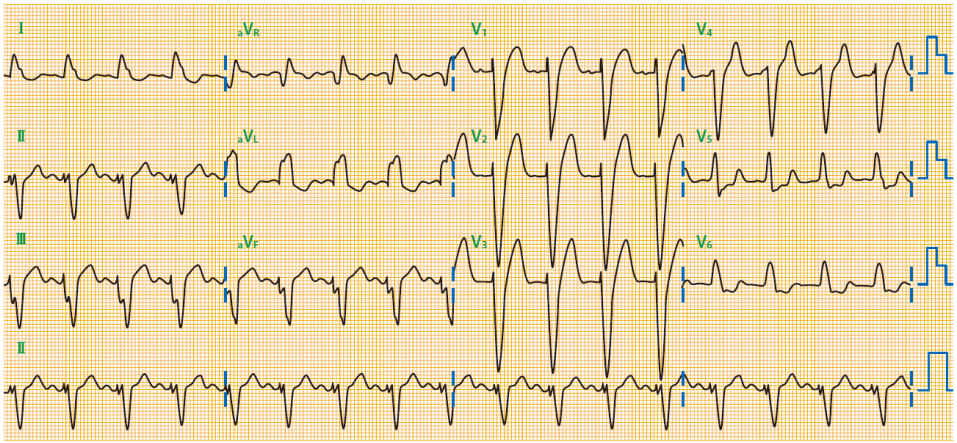
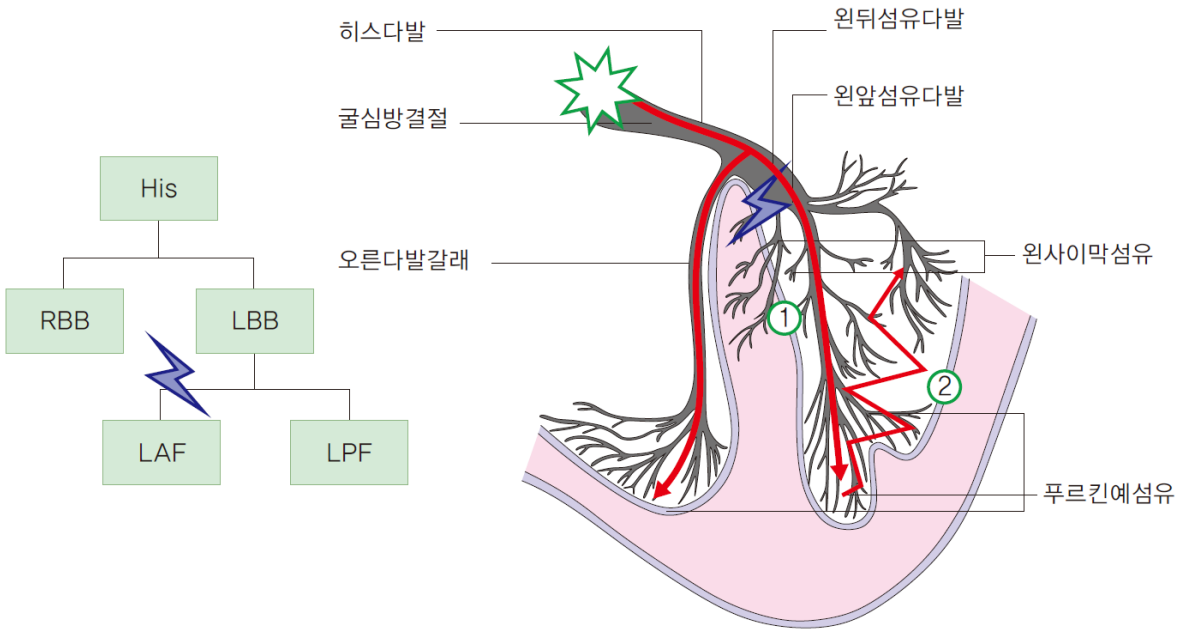

His
RBB
LBB
LAF
LPF
히스다발
굴심방결절
오른다발갈래
왼뒤섬유다발
왼앞섬유다발
왼사이막섬유
푸르킨예섬유
1
2

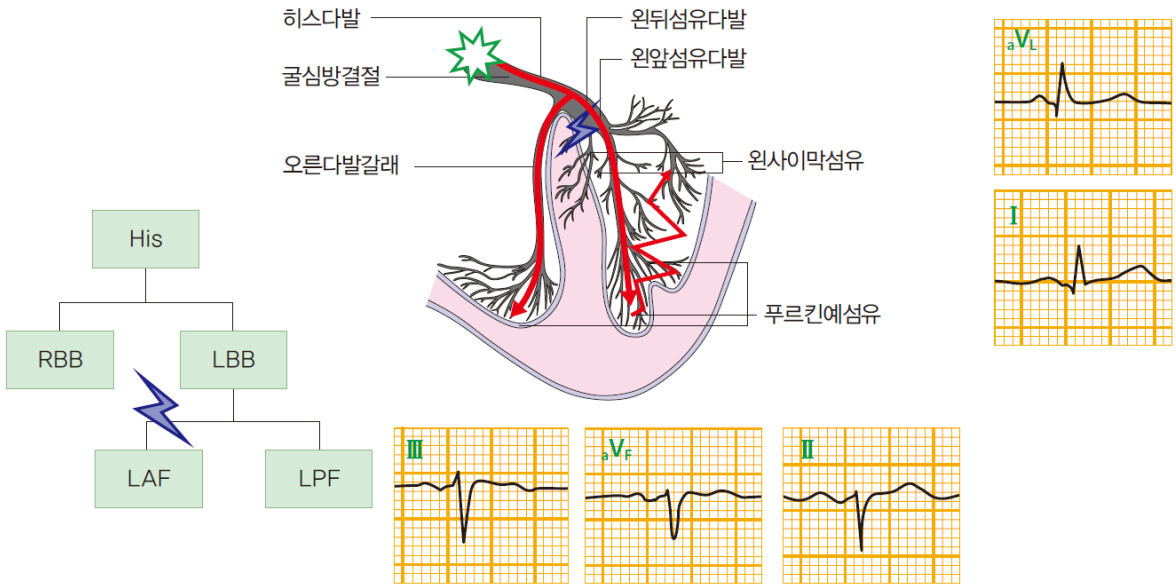
표 9-3. 정상과 각차단의 심전도 비교

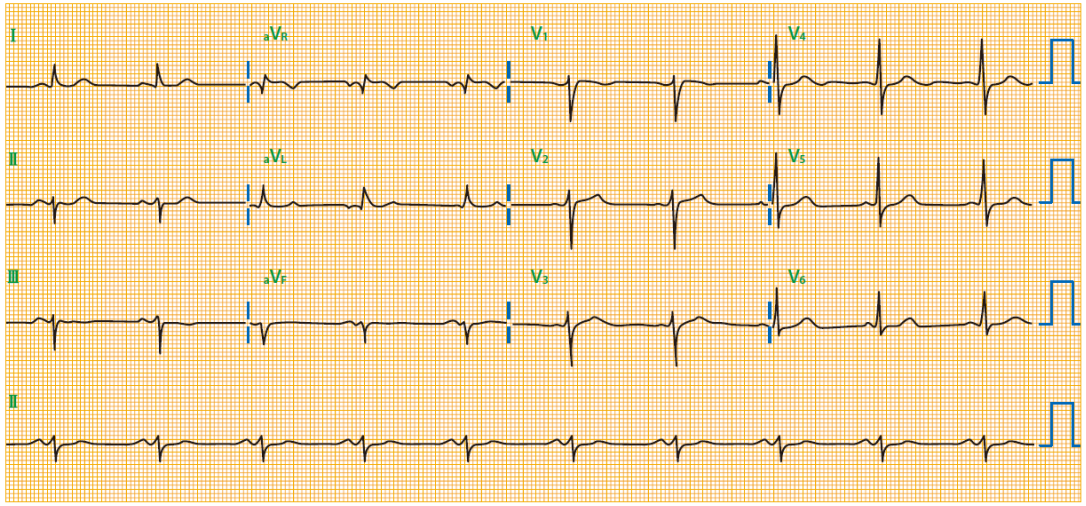
	V_1	V_6
정상		
RBBB		
LBBB		

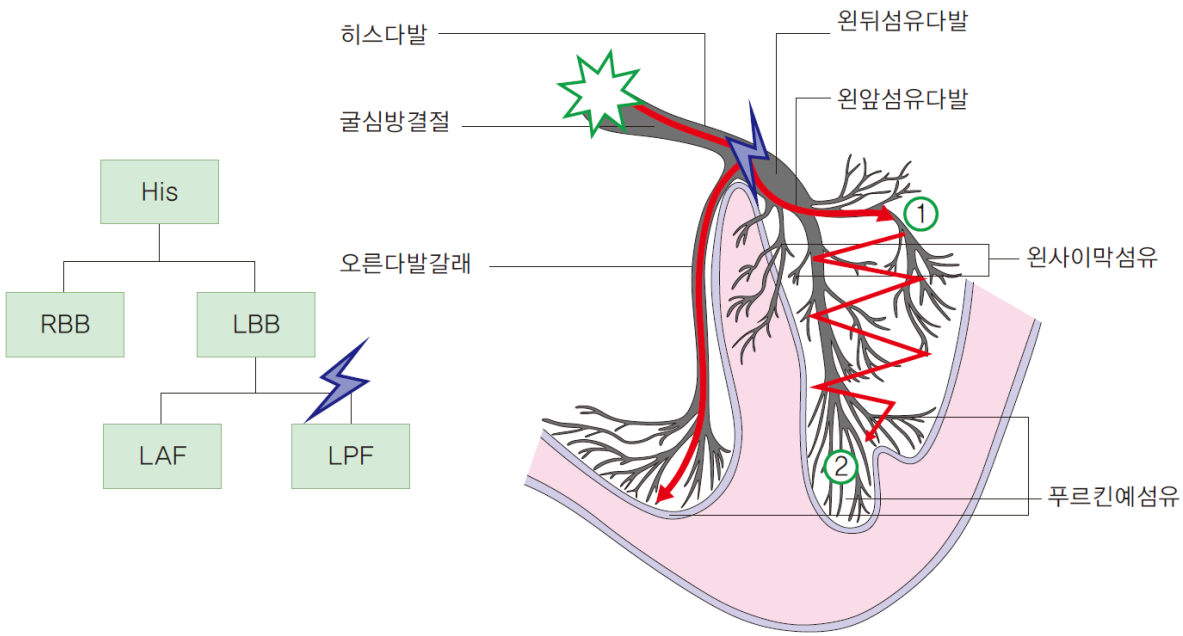

히스다발
굴심방결절
오른다발갈래
왼뒤섬유다발
왼앞섬유다발
왼사이막섬유
푸르킨예섬유
aVL
I
V6
V5
V1
V2

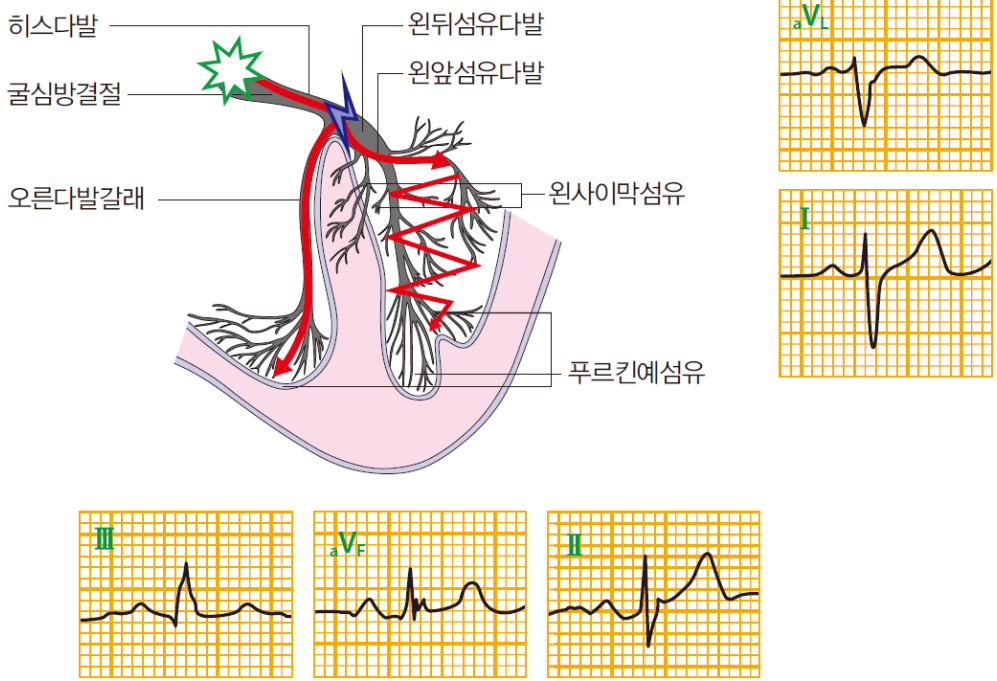

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

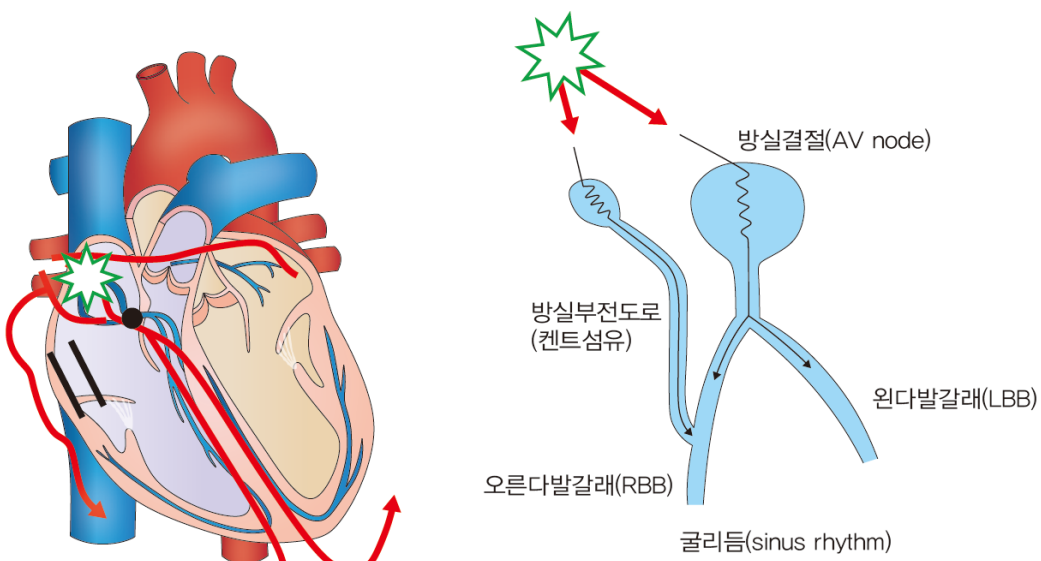

His
RBB
LBB
LAF
LPF
히스다발
굴심방결절
오른다발갈래
왼뒤섬유다발
왼앞섬유다발
왼사이막섬유
1
2
푸르킨예섬유


히스다발
굴심방결절
오른다발갈래
왼뒤섬유다발
왼앞섬유다발
왼사이막섬유
푸르킨예섬유
His
RBB
LBB
LAF
LPF
aVL
I
III
aVF
II


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


His
RBB
LBB
LAF
LPF
히스다발
굴심방결절
오른다발갈래
왼뒤섬유다발
왼앞섬유다발
왼사이막섬유
푸르킨예섬유
1
2


히스다발
굴심방결절
오른다발갈래
왼뒤섬유다발
왼앞섬유다발
왼사이막섬유
푸르킨예섬유
aVL
I
III
aVF
II
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II


방실결절(AV node)
방실부전도로
(켄트섬유)
왼다발갈래(LBB)
오른다발갈래(RBB)
굴리듬(sinus rhythm)

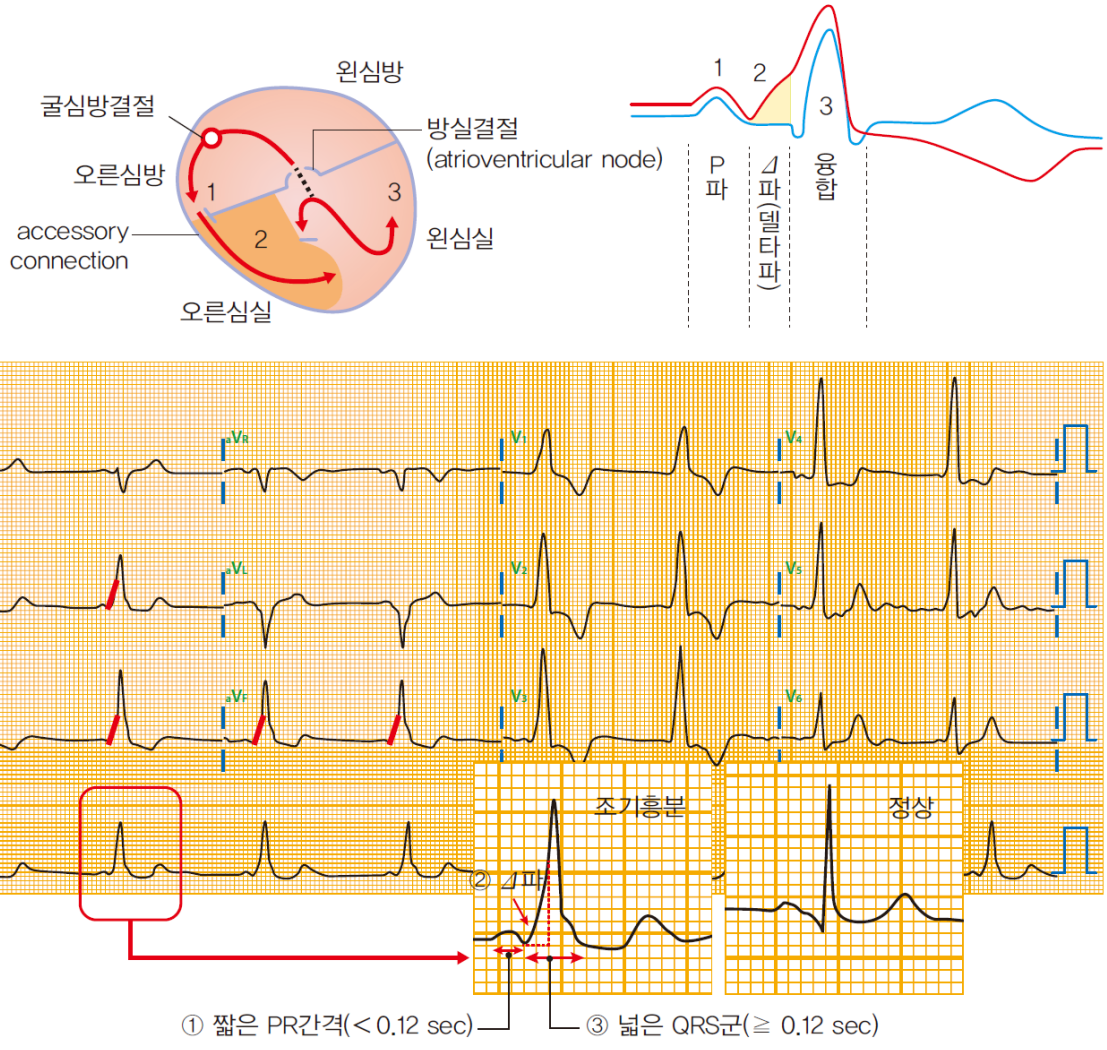
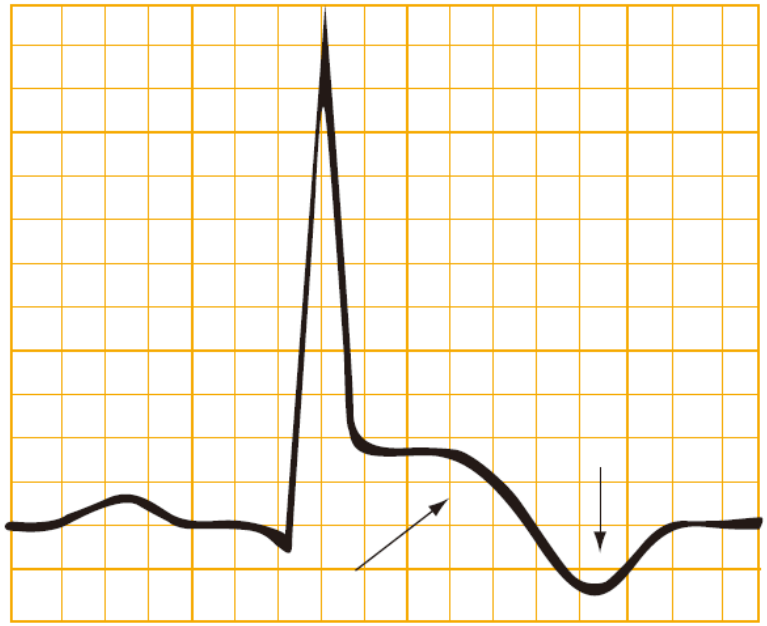
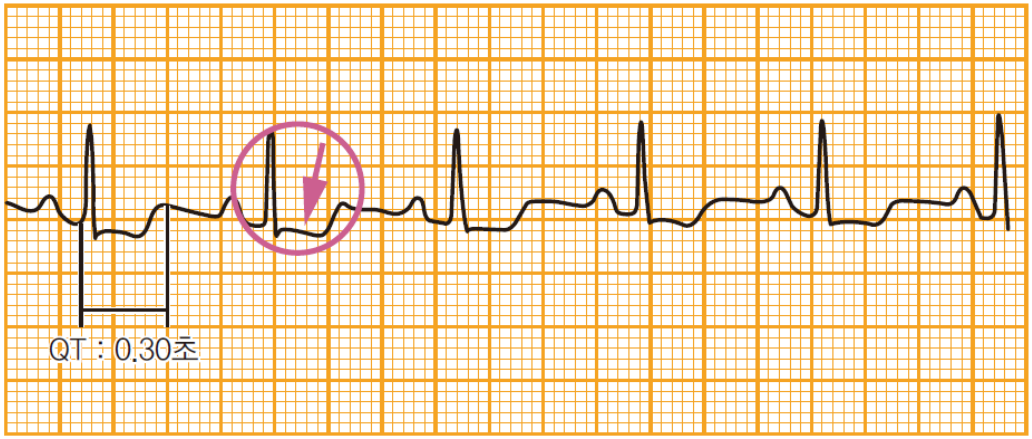

왼심방
굴심방결절
방실결절
(atrioventricular node)
오른심방
1
3
accessory
connection
2
왼심실
오른심실
1
2
3
P
파
Δ
파
(델타파)
융합
조기흥분
정상
② Δ파
① 짧은 PR간격(< 0.12 sec)
③ 넓은 QRS군(≧ 0.12 sec)

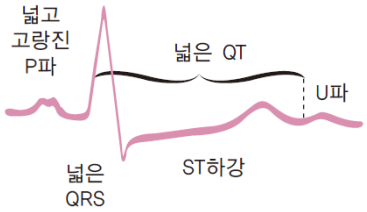
표 9-4. 급성 심막염과 급성심근경색의 심전도 비교

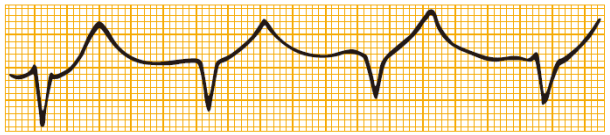
	급성 심막염	급성 심근경색
ST분절 변화	없음	있음
(유도 I과 III에서) ST분절 상승	모든 유도에서 상승	한 유도에서 상승하면 다른 유도는 하강
Q파	없음	있음
진행기간	수주	수개월
QT간격	정상	연장



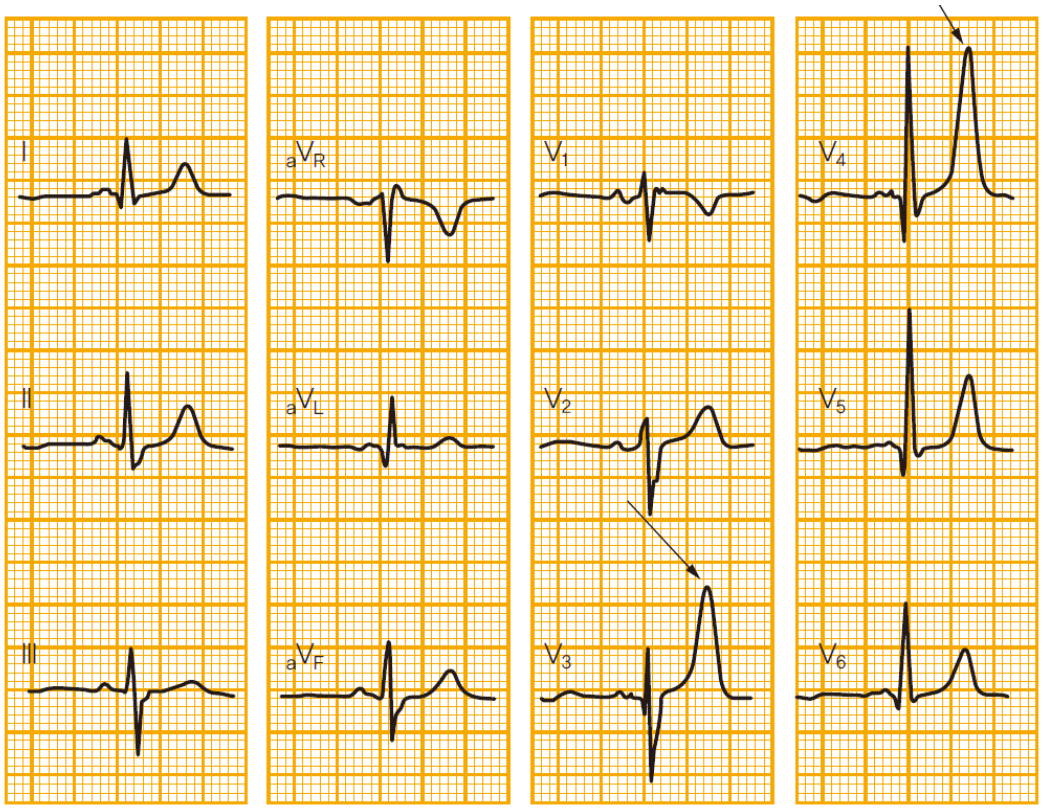
1. ST분절 상승
2. T파 역위

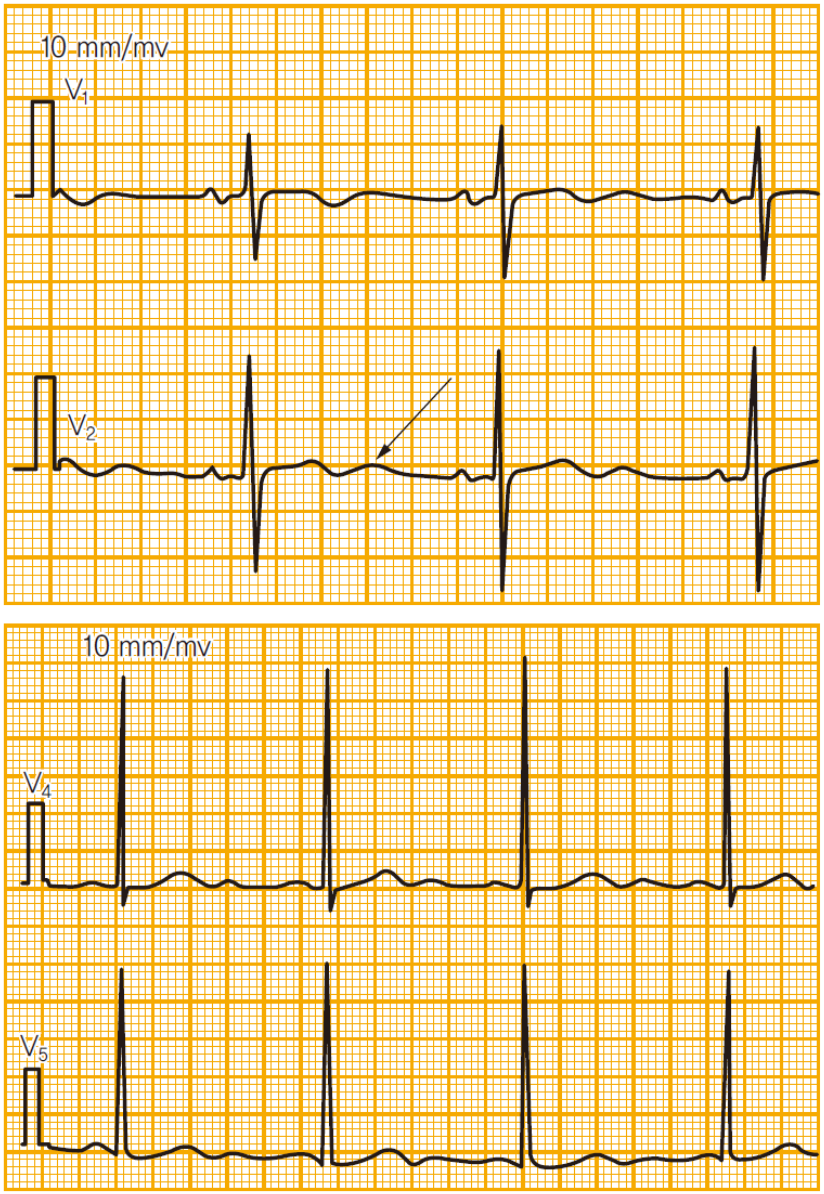

QT : 0.30초

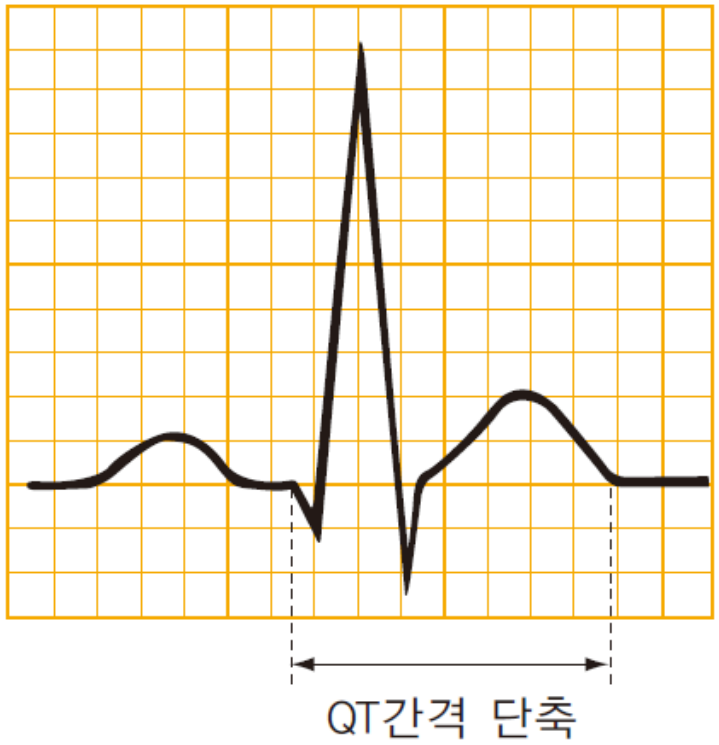


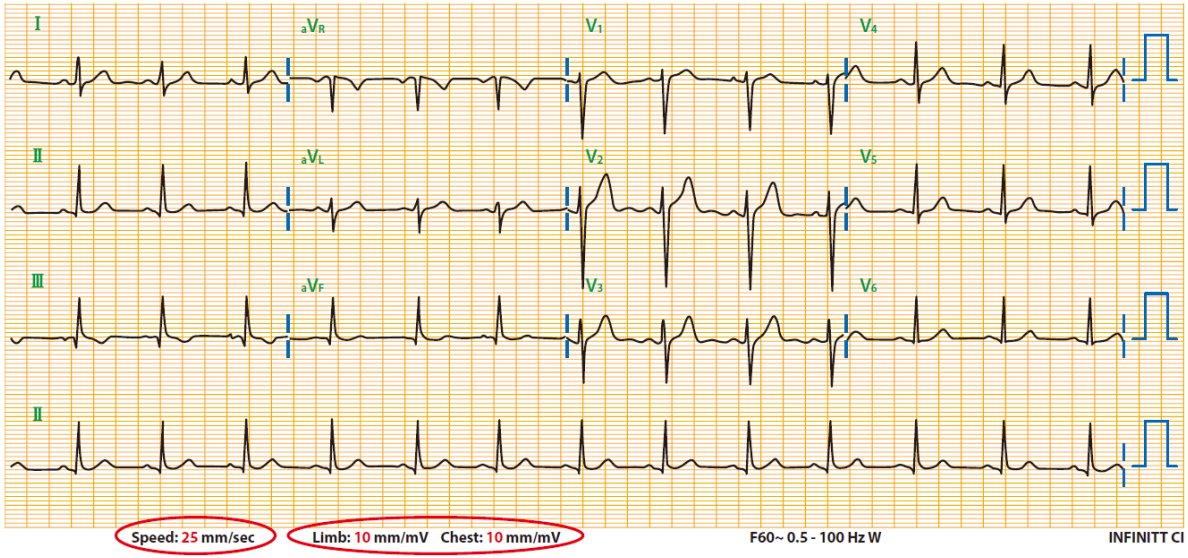


키니딘 중독의 롤러 코우스터(Roller Coaster) 형태

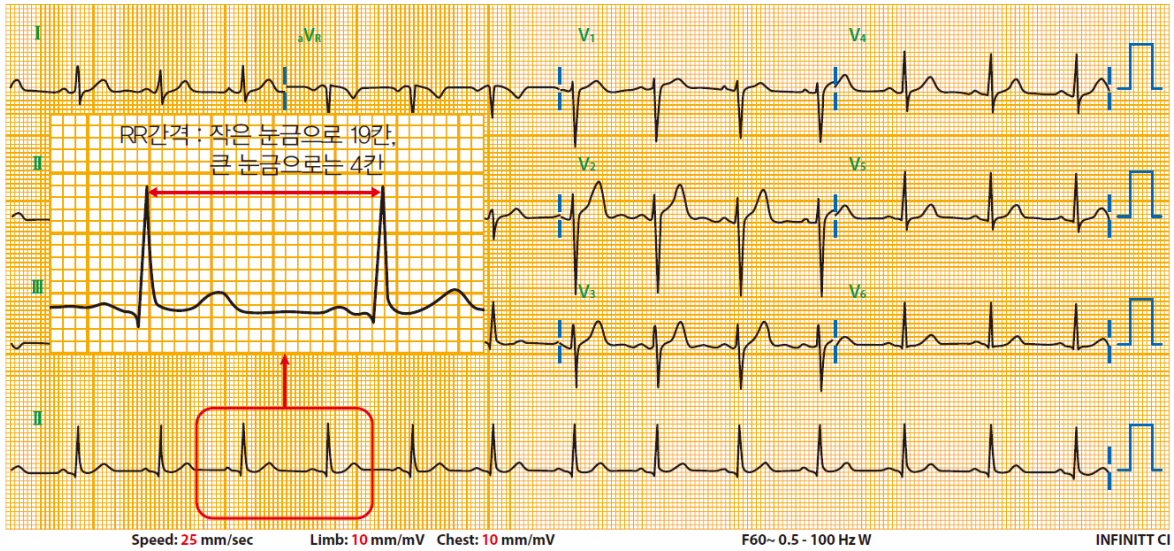

I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6


10 mm/mv
V1
V2
10 mm/mv
V4
V5

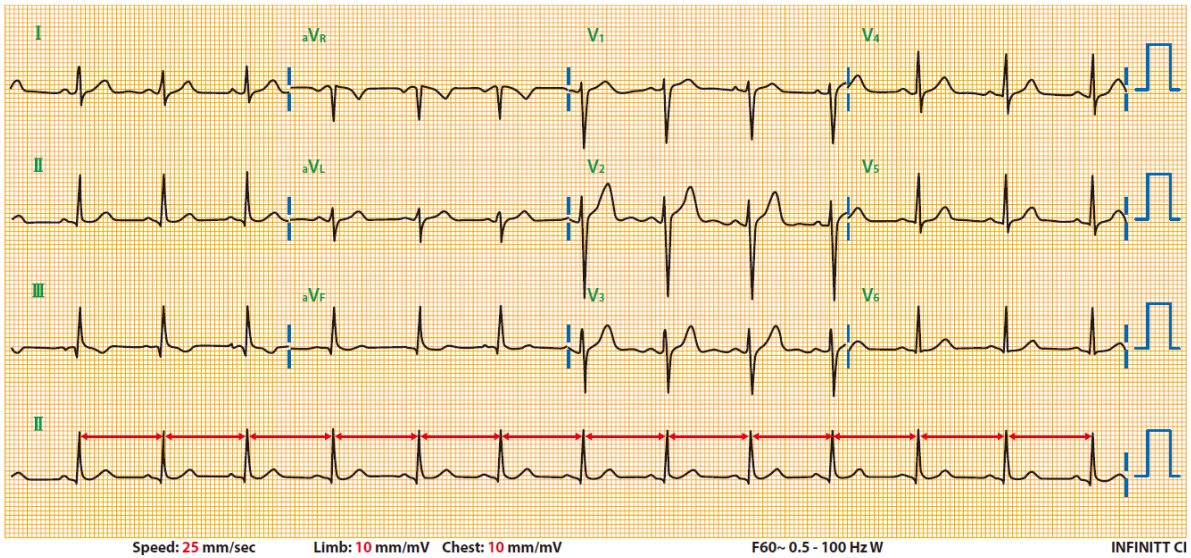

QT간격 단축


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
Speed: 25 mm/sec
Limb: 10 mm/mV Chest: 10 mm/mV
F60~ 0.5 - 100 Hz W
INFINITT CI

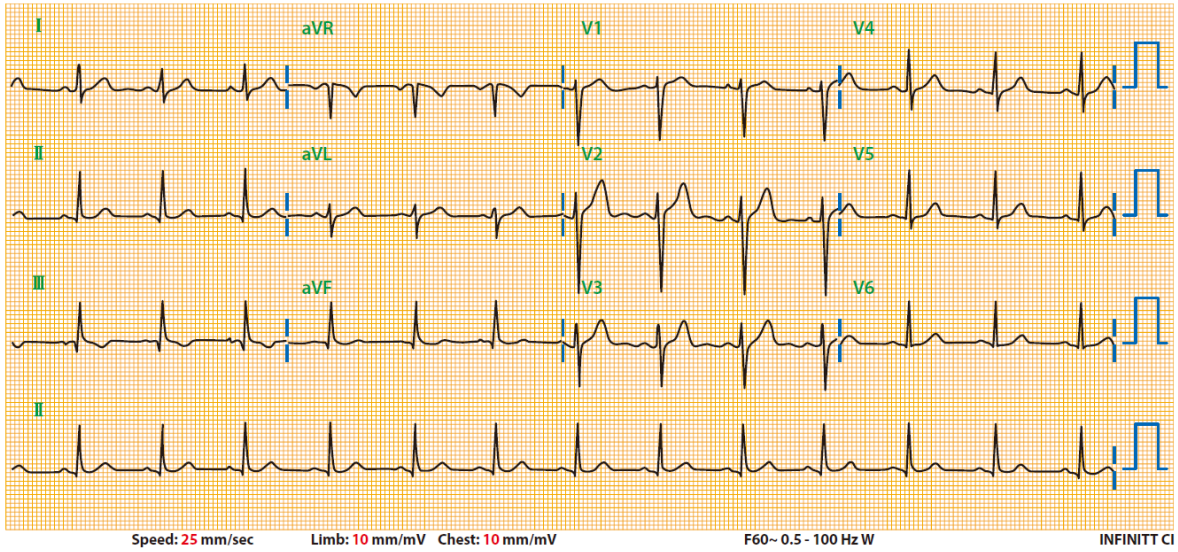
● 정상 : 60~100bpm ● < 60bpm : 느린맥(서맥, bradycardia) ● ≧ 100bpm : 빠른맥(빈맥, tachycardia)



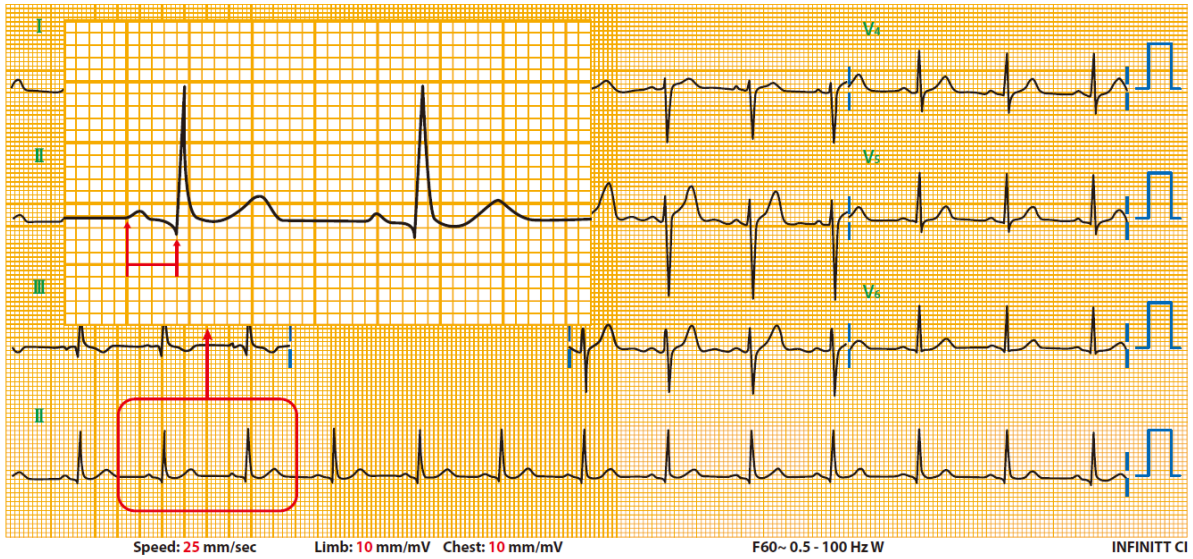
- longest RR interval – hortest RR interval
- ≧ 0.16 sec : 불규칙 리듬(irregular rhythm)
- < 0.16 sec : 규칙적 리듬(regular rhythm)



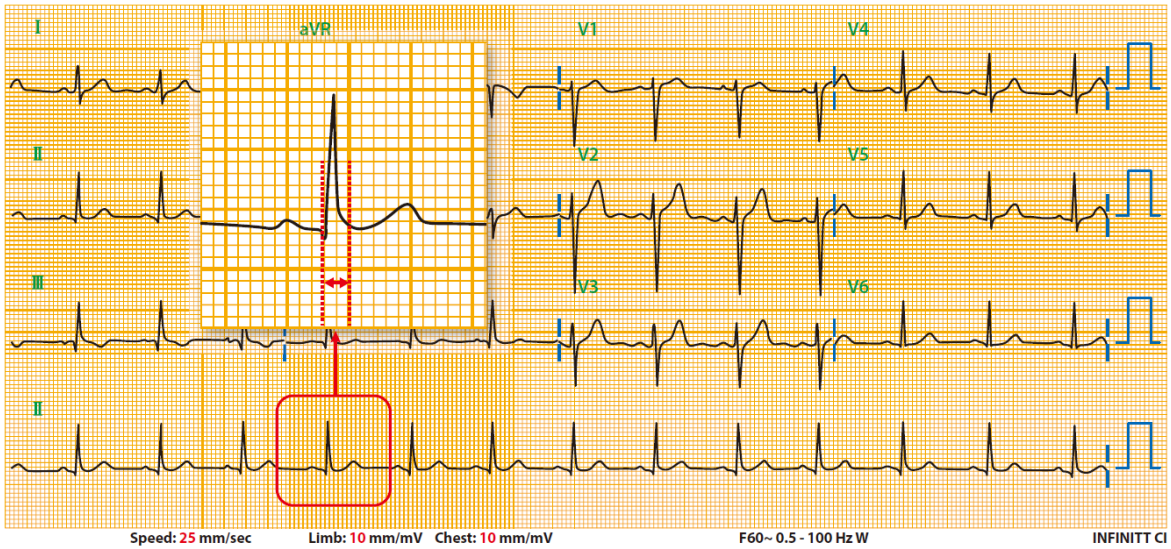
- 동성 P파(sinus P wave)
  - 같은 유도에서 P파의 모양은 모두 일정하다.
  - Ⅰ, Ⅱ, $_{a}V_{F}$, V4~6 유도에서 양성 (+), Avr 유도에서는 음성(–)
- 그렇지 않으면 이소성 P파(ectopic P wave)

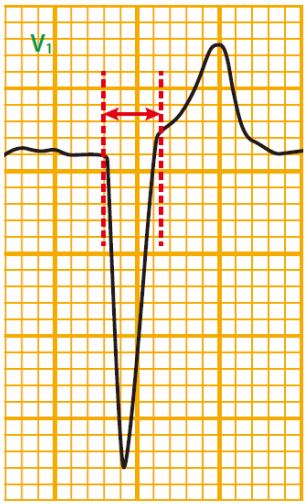


● 정상 : 0.12~0.2sec(100~200msec)　　● ≧ 0.2sec(200msec) : 1도 방실차단(1st degree AV block)

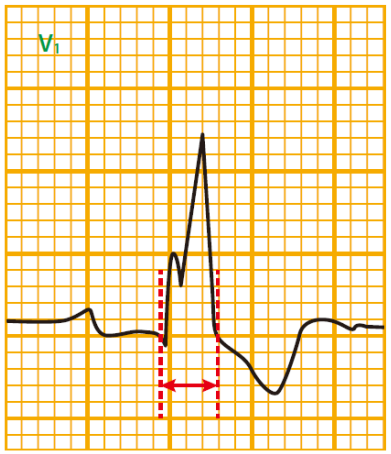


- 정상 : 0.06~0.1sec(최대 0.12sec)
- QRS폭 < 0.12sec : narrow QRS
- QRS폭 ≧ 0.12sec : wide QRS(LBBB, RBBB, 심실리듬 등)

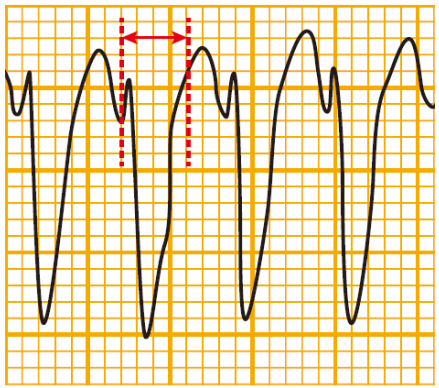




외갈래차단(LBBB)

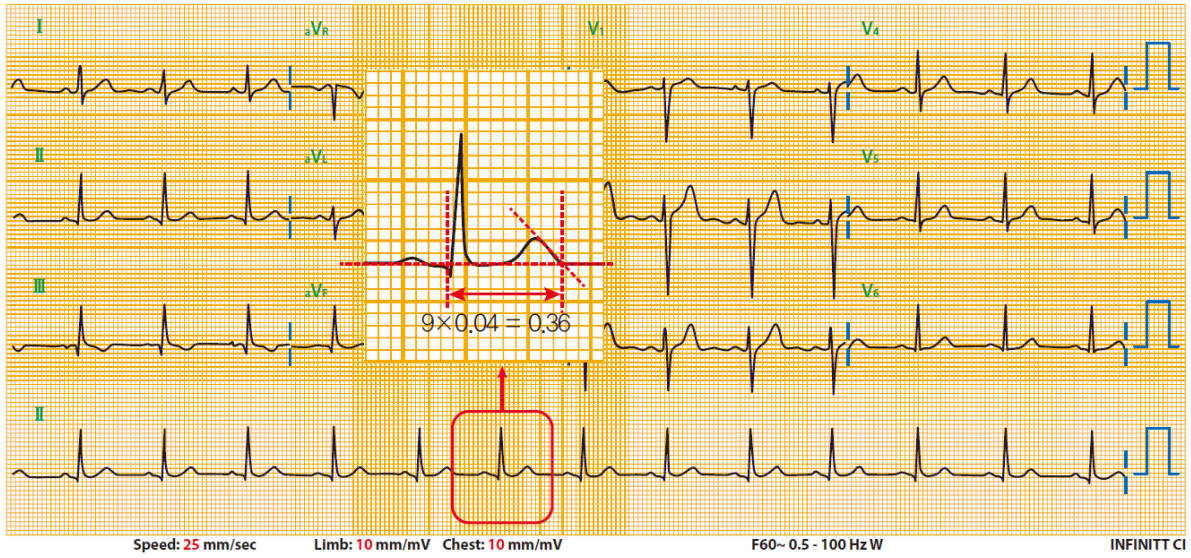


오른갈래차단(RBBB)

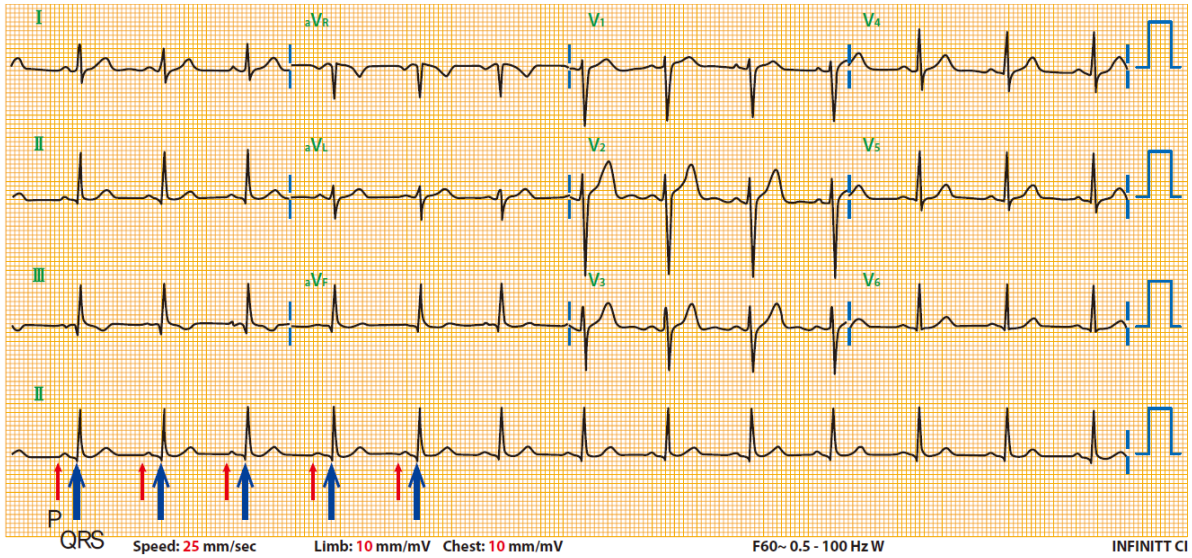


심실빠른맥(VT)

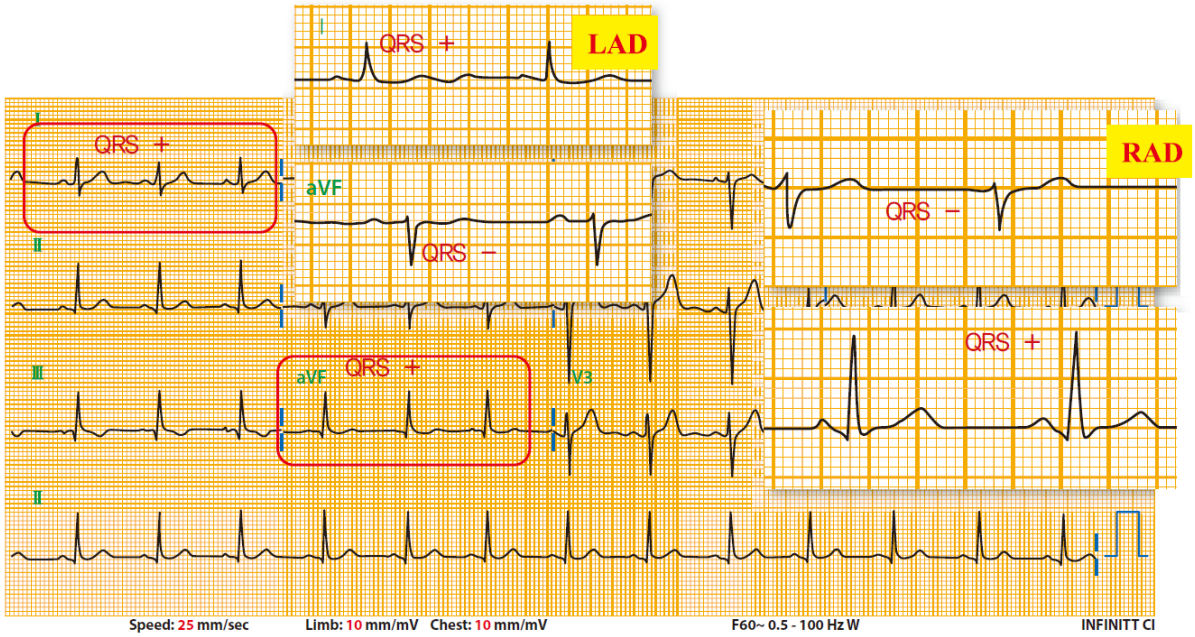
- 정상 : < 0.45sec(남), < 0.46sec(여)
- ≧ 0.45sec : QT연장(prolongation)
- ≧ 0.50sec : 심실빠른맥(VT) 위험성 증가



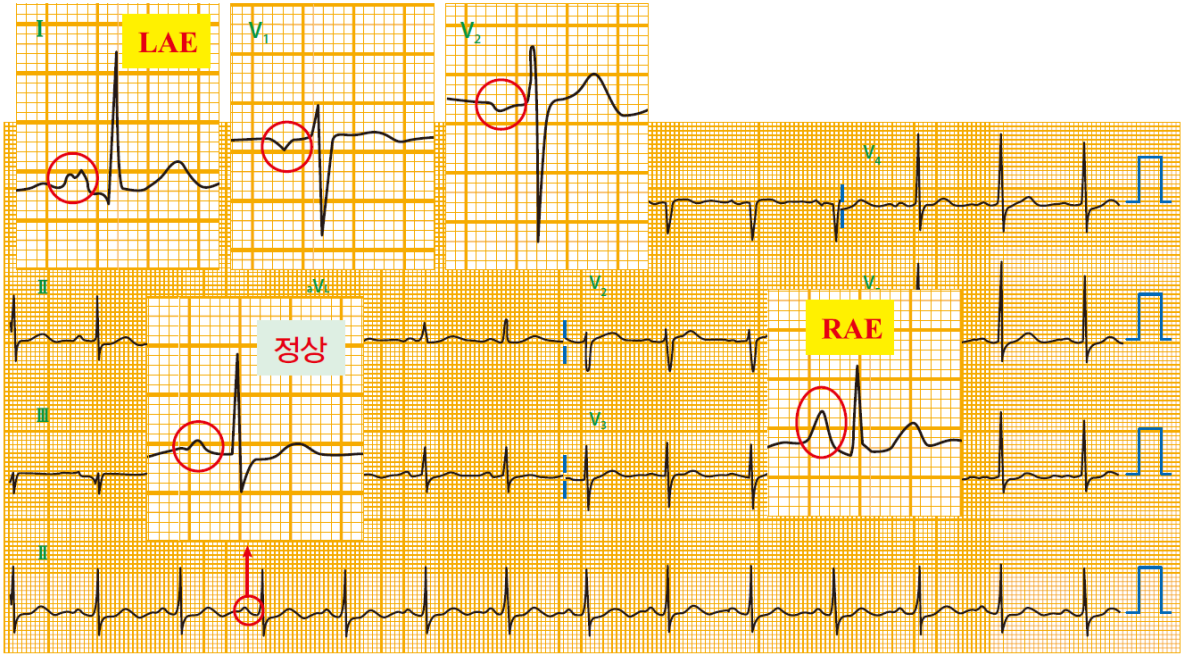
- 정상
  - P : QRS = 1 : 1로 출현할 것
  - PR간격이 일정할 것
- 그렇지 않으면 방실차단(AV block), 심방잔떨림(Afib.) 등



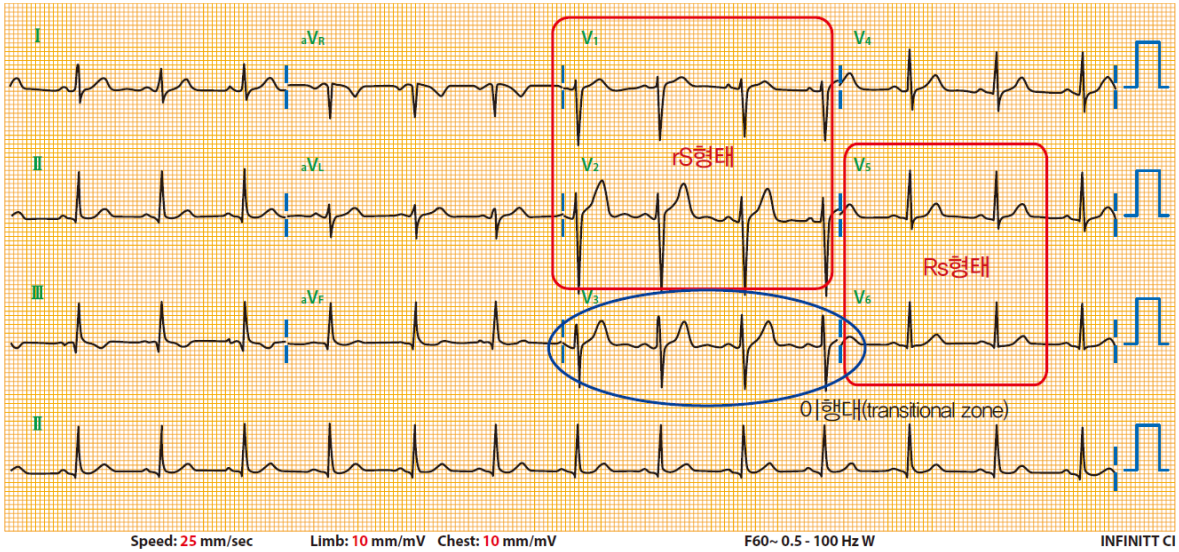
- 정상 : 0~ +90°(I 유도 +, aVF 유도 +)
- RAD : +90°~ +180°(I 유도 –, aVF 유도 +)
- LAD : 0°~ –90°(I 유도 +, aVF 유도 –)
- Extreme axis : –90°~ –180°(I 유도 –, aVF 유도 –)



- 대체로 완만하고 둥근 모양(monophasic)
- 폭 : 0.06~0.10sec(최대 0.12sec 미만)
- ≧ 0.12(P-mitral, P-terminal force) : LAE
- Ⅰ, Ⅱ, aV_F, $V_{4\sim6}$에서 상향, aV_R에서 하향
- 높이 : < 2.5 mm
- ≧ 2.5mm(P-pulmonale) : RAE



- 이상 Q파 없어야 함
- R파는 V_1에서 매우 작고(rS), $V_{5\sim6}$로 갈수록 커짐 (Rs)
- 높이 : 5~25mm(가슴유도에서 30mm 미만)
- 이행대 : V_3 또는 V_4에서 출현

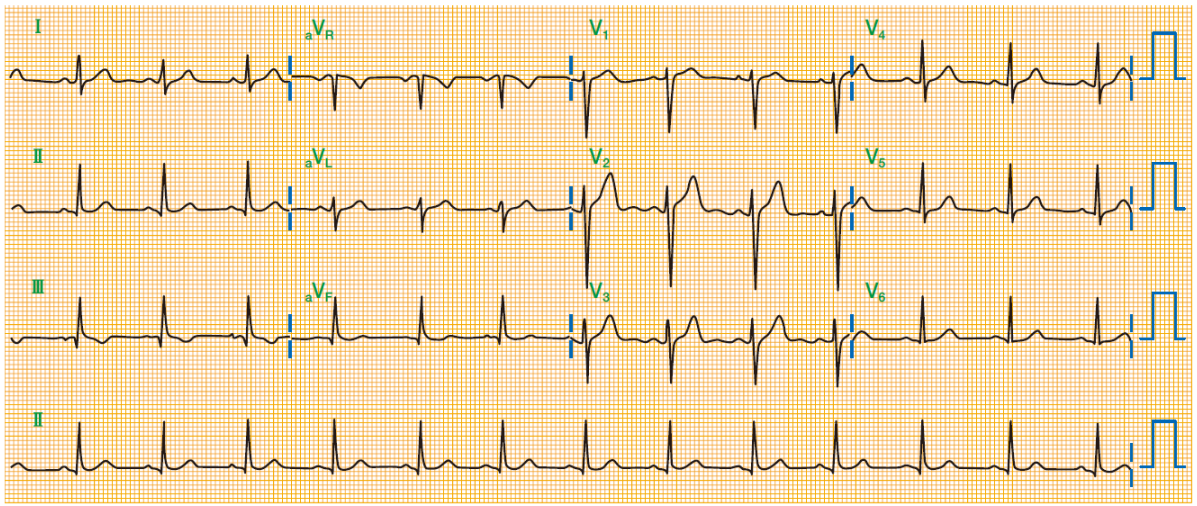


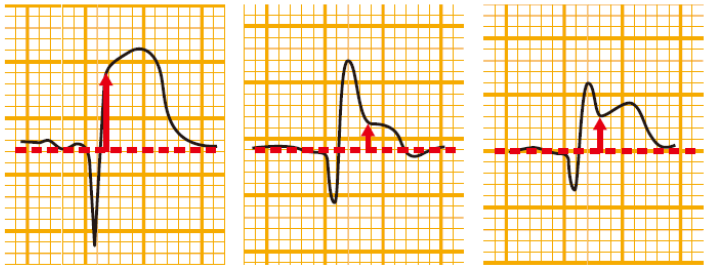
〈ST분절〉

- 팔다리유도(사지유도) : 1mm 이내
- 가슴유도(흉부유도) : −0.5~2mm 이내
- ST 상승이나 하강, T파 역전 : 심장동맥(관상동맥) 질환의 가능성이 있음

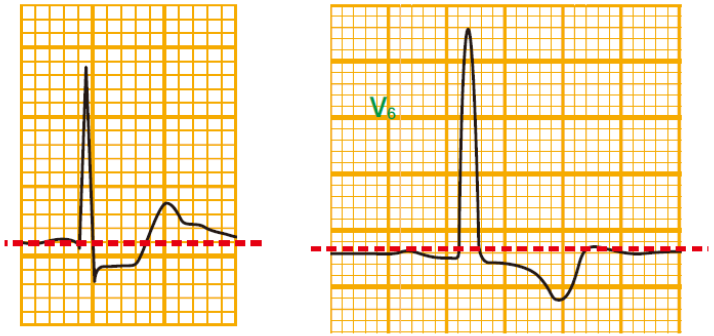
〈T파〉

- 끝이 둥글며 약간 뾰족하면서 좌우 비대칭
- Ⅰ, Ⅱ, $_aV_L$, $_aV_F$, V_3~V_6 양성, $_aV_R$ 음성. QRS와 같은 방향성
- 팔다리유도 : < 5mm, 가슴유도 : < 15 mm
- 높고 뾰족한 T파(tall T or 텐트형 T wave) : 고칼륨혈증 (hyperkalemia)

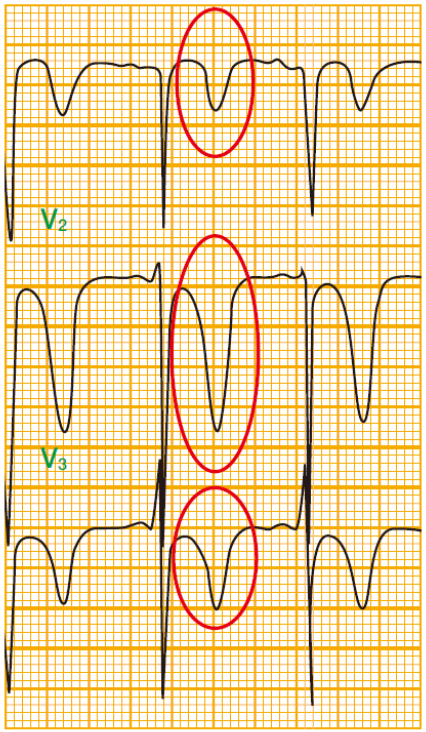




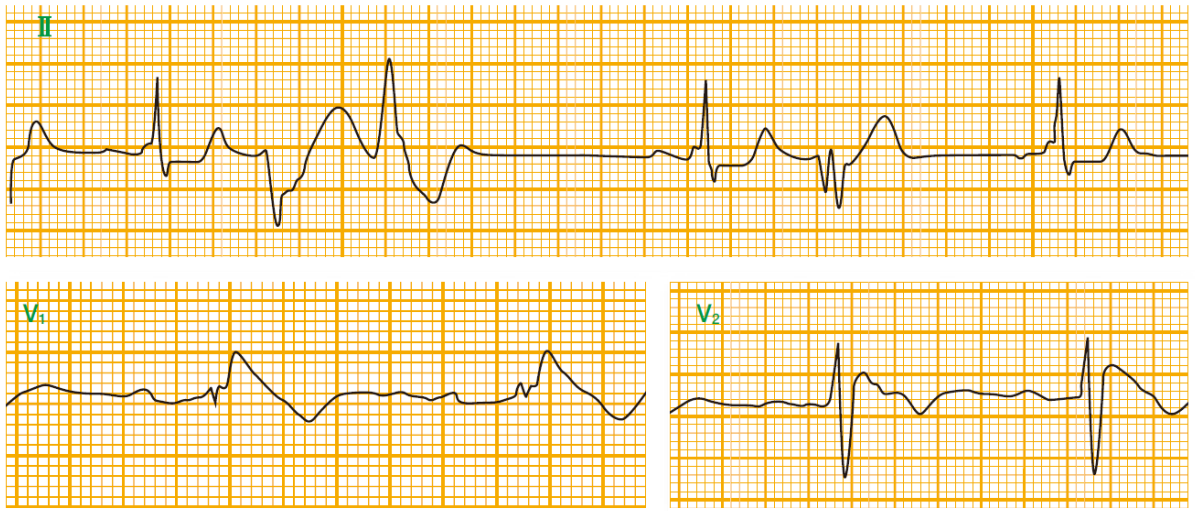
ST분절 상승 시



ST분절 하강 시



T파 역전 시


II
V1
V2

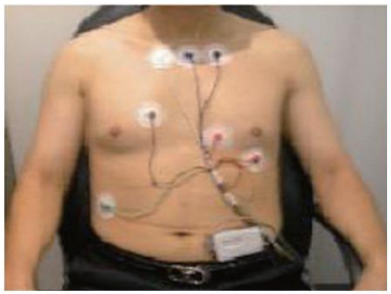
Section 10

홀터(24시간) 심전도

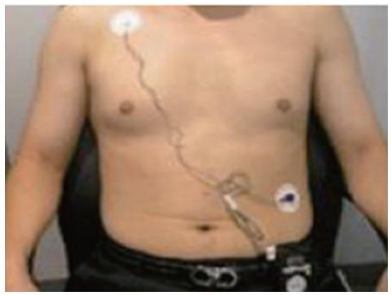
학습 목표

1. 홀터 심전도의 임상적 의의를 설명할 수 있다(A).
2. 홀터 심전도의 검사법을 설명할 수 있다(A).
3. 홀터 심전도의 결과해석을 설명할 수 있다(B).



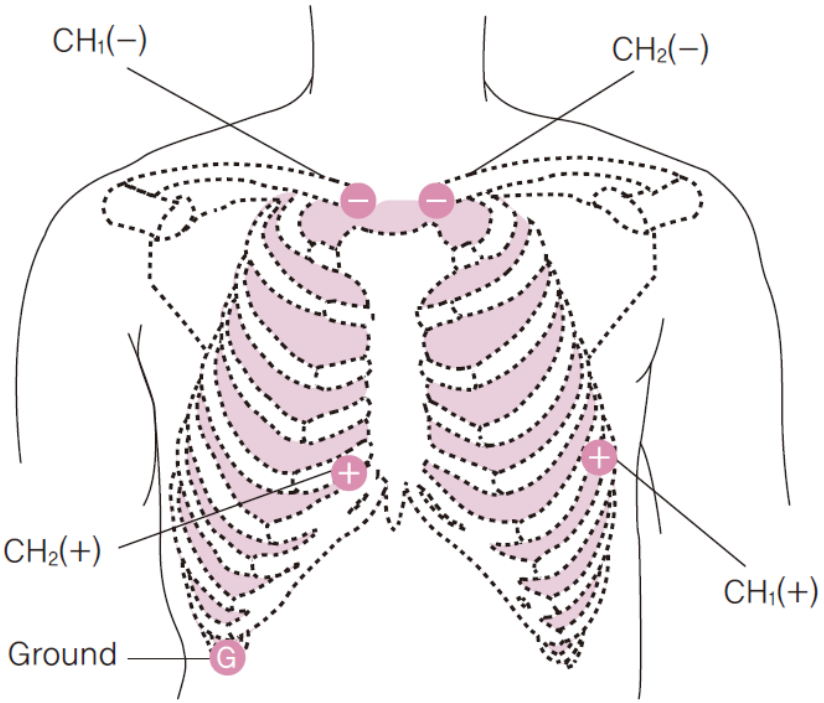


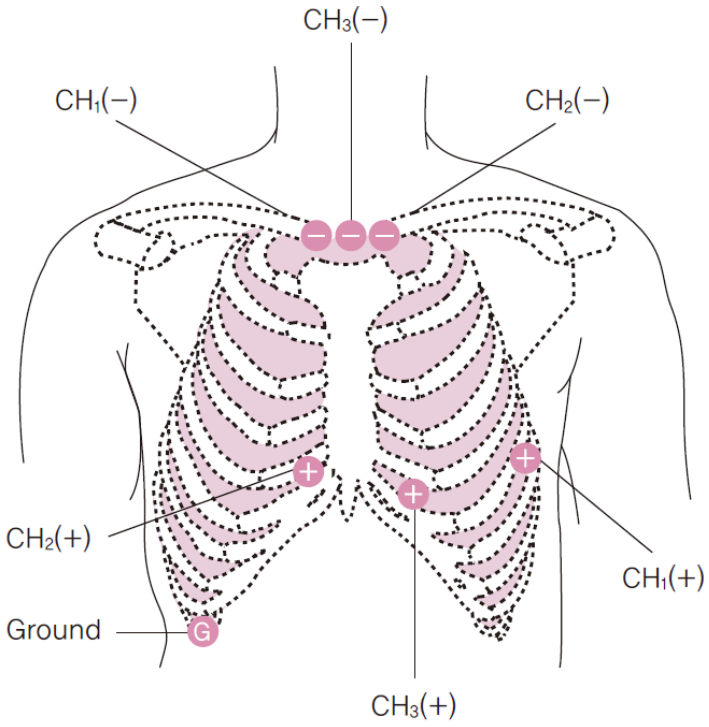
24시간 · 48시간 심전도

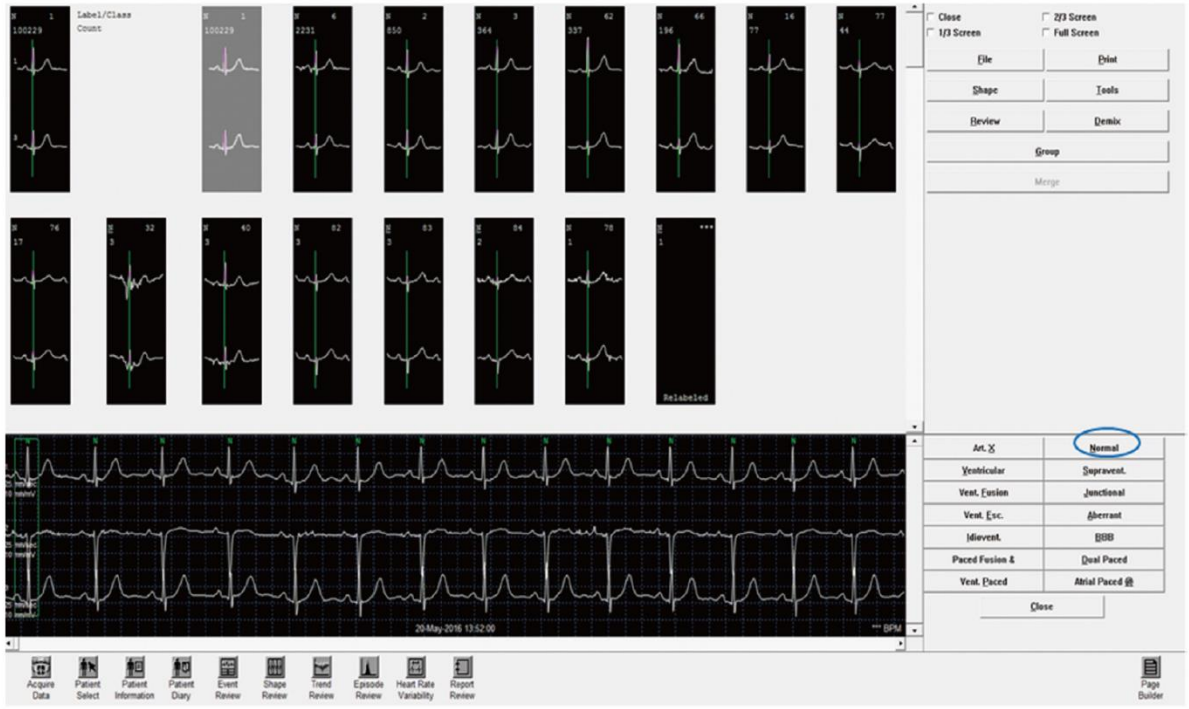



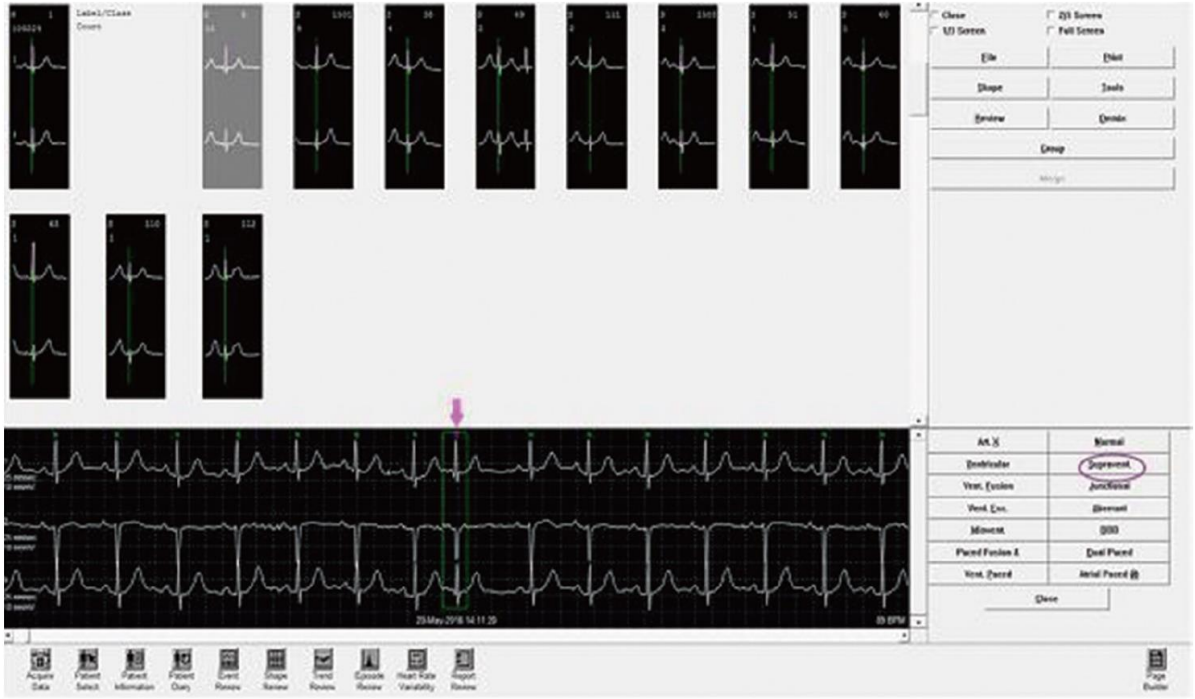

1~4주 사건기록 심전도

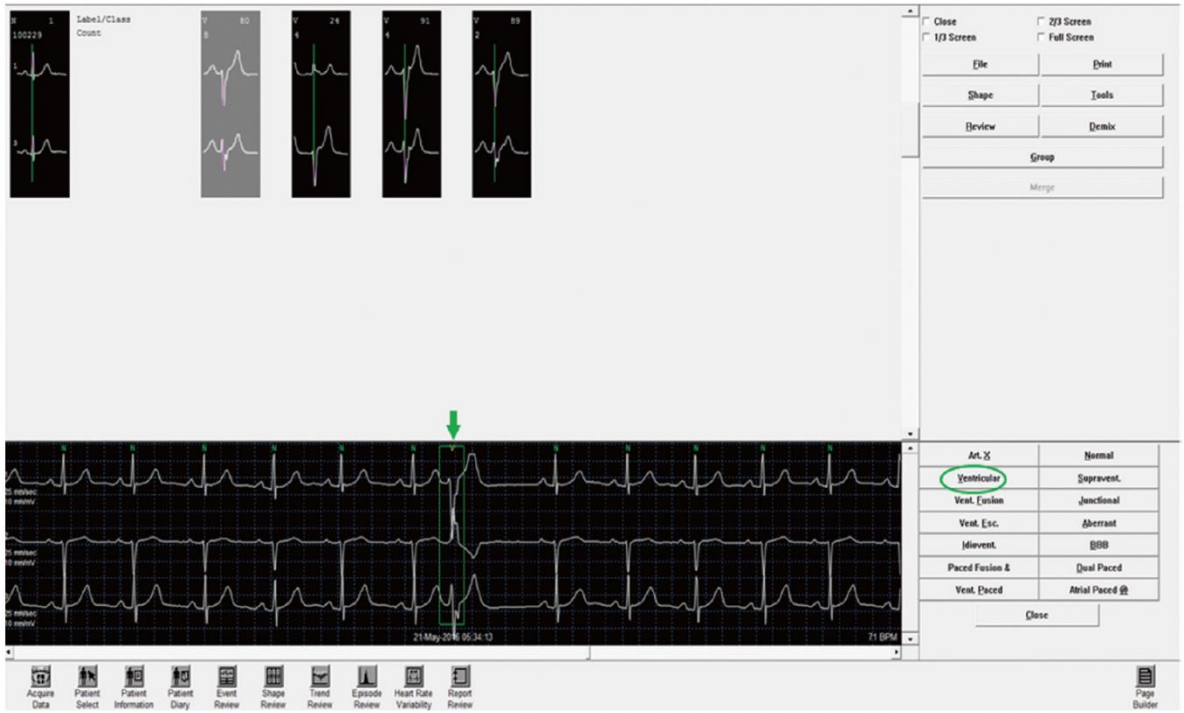


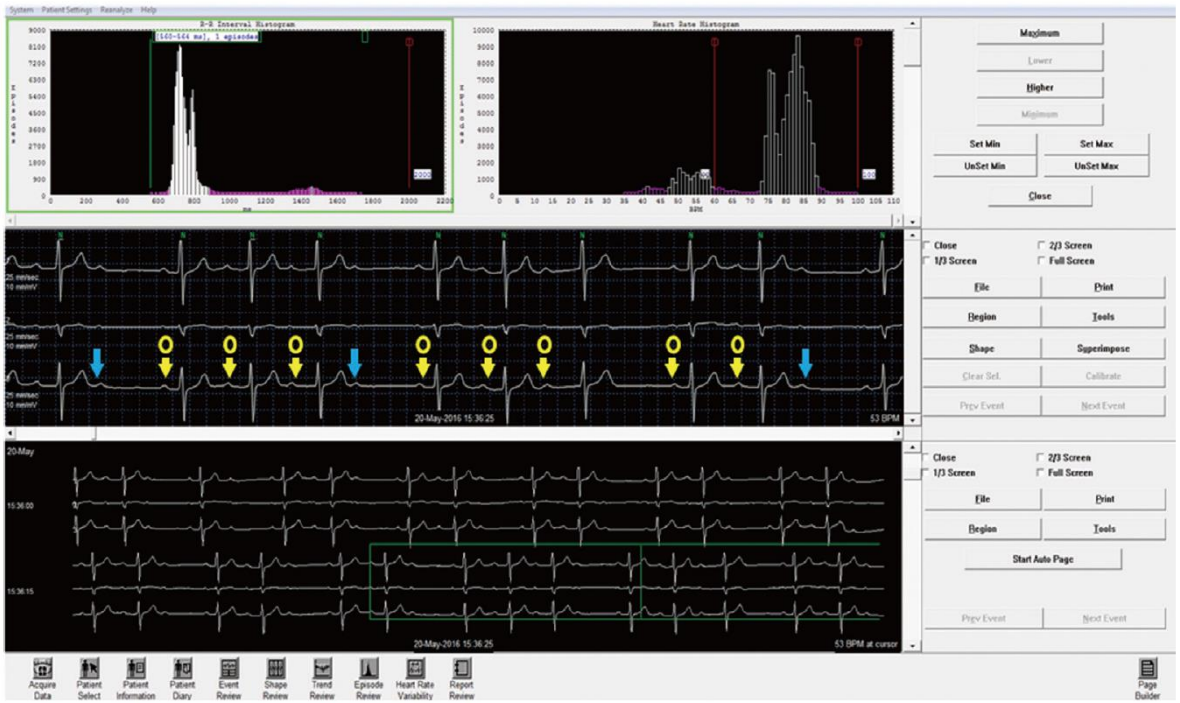

CH1(−)
CH2(−)
CH2(+)
CH1(+)
Ground
G


CH3(−)
CH1(−)
CH2(−)
CH2(+)
Ground
G
CH1(+)
CH3(+)


Label/Class
Count
100229
2231
850
364
337
196
77
44
17
3
Relabeled
Close
2/3 Screen
1/3 Screen
Full Screen
File
Print
Shape
Tools
Review
Remix
Group
Merge
Art.
Normal
Ventricular
Supravent.
Vent. Fusion
Junctional
Vent. Esc.
Aberrant
Idivent.
BBB
Paced Fusion &
Dual Paced
Vent. Paced
Atrial Paced
Close
20-May-2016 13:52:00
*** BPM
Acquire Data
Patient Select
Patient Information
Patient Diary
Event Review
Shape Review
Trend Review
Episode Review
Heart Rate Variability
Report Review
Page Builder

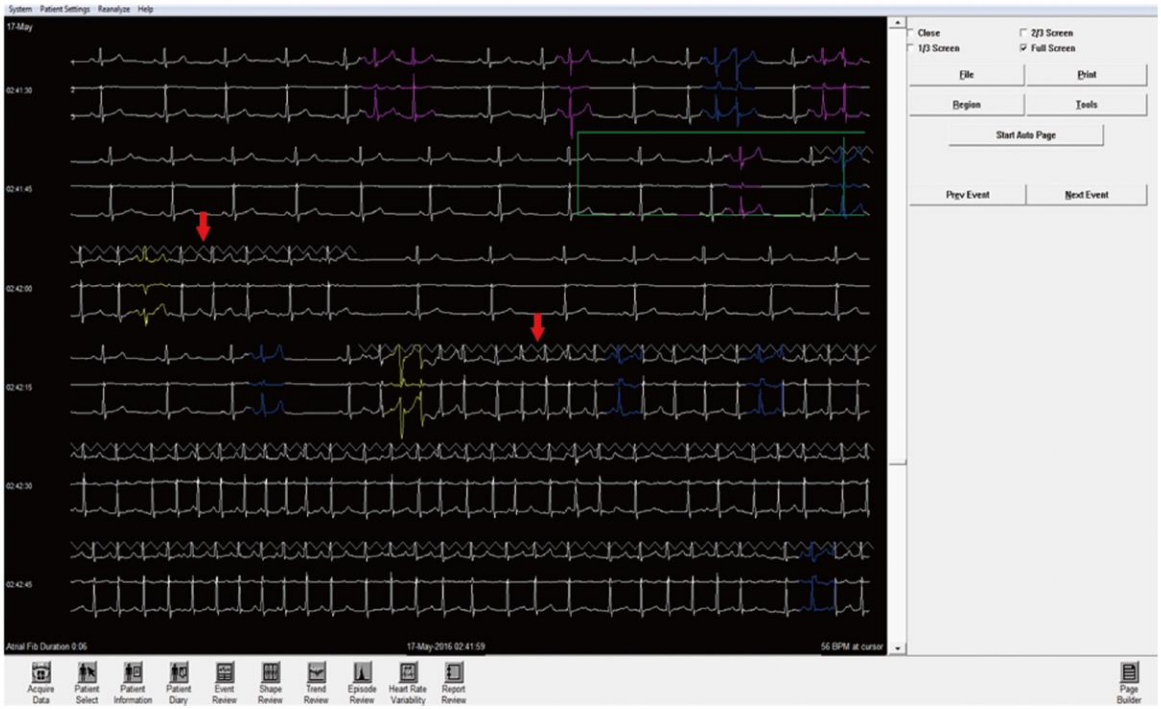

Close
2|1 Screen
1|2 Screen
Full Screen
File
Print
Shape
Tools
Review
Group
Art. X
Normal
Ventricular
Supravent.
Vent. Fusion
Junctional
Vent. Ext.
Aberrant
Idiovent.
Paced Fusion X
Dual Paced
Vent. Paced
Atrial Paced @
Close
Acquire Data
Patient Select
Patient Information
Patient Query
Event Review
Shape Review
Trend Review
Episode Review
Heart Rate Variability
Report Review
Page Builder


Label/Class
Count
Close
2/3 Screen
1/3 Screen
Full Screen
File
Print
Shape
Tools
Review
Demix
Group
Merge
Art. X
Normal
Ventricular
Supravent.
Vent. Fusion
Junctional
Vent. Esc.
Aberrant
Idiovent.
BBB
Paced Fusion &
Dual Paced
Vent. Paced
Atrial Paced
Close
71 BPM
Acquire Data
Patient Select
Patient Information
Patient Diary
Event Review
Shape Review
Trend Review
Episode Review
Heart Rate Variability
Report Review
Page Builder


System Patient Settings Reanalyze Help
R-R Interval Histogram
Heart Rate Histogram
Maximum
Lower
Higher
Minimum
Set Min
Set Max
UnSet Min
UnSet Max
Close
Close
2/3 Screen
1/3 Screen
Full Screen
File
Print
Region
Tools
Shape
Superimpose
Clear Sel.
Calibrate
Prev Event
Next Event
20-May-2016 15:36:25
53 BPM
20-May
15:36:00
15:36:15
20-May-2016 15:36:25
53 BPM at cursor
Close
2/3 Screen
1/3 Screen
Full Screen
File
Print
Region
Tools
Start Auto Page
Prev Event
Next Event
Acquire Data
Patient Select
Patient Information
Patient Diary
Event Review
Shape Review
Trend Review
Episode Review
Heart Rate Variability
Report Review
Page Builder


System Patient Settings Reanalyze Help
R-R Interval Histogram
Heart Rate Histogram
Maximum
Lower
Higher
Minimum
Set Min
Set Max
UnSet Min
UnSet Max
Close
Close
2/3 Screen
1/3 Screen
Full Screen
File
Print
Region
Tools
Shape
Superimpose
Clear Sel.
Calibrate
Prev Event
Next Event
21-May-2016 04:48:42
61 BPM
21-May
21-May-2016 04:48:42
61 BPM at cursor
Start Auto Page
Acquire Data
Patient Select
Patient Information
Patient Diary
Event Review
Shape Review
Trend Review
Episode Review
Heart Rate Variability
Report Review
Page Builder


System Patient Settings Reanalyze Help
Event Number DateTime
R-R Pause 1 of 35 10:15:46 15-Mar-2016
R-R Pause 2 of 35 10:16:01 15-Mar-2016
R-R Pause 3 of 35 10:16:07 15-Mar-2016
R-R Pause 4 of 35 10:16:09 15-Mar-2016
R-R Pause 5 of 35 10:16:43 15-Mar-2016
R-R Pause 6 of 35 10:17:24 15-Mar-2016
R-R Pause 7 of 35 10:17:31 15-Mar-2016
R-R Pause 8 of 35 10:17:38 15-Mar-2016
R-R Pause 9 of 35 10:17:55 15-Mar-2016
R-R Pause 10 of 35 10:17:58 15-Mar-2016
R-R Pause 11 of 35 10:18:00 15-Mar-2016
R-R Pause 12 of 35 10:18:54 15-Mar-2016
R-R Pause 13 of 35 10:18:58 15-Mar-2016
R-R Pause 14 of 35 10:19:10 15-Mar-2016
R-R Pause 15 of 35 10:19:25 15-Mar-2016
R-R Pause 16 of 35 10:35:44 15-Mar-2016
R-R Pause 17 of 35 10:35:56 15-Mar-2016
Close
2/3 Screen
1/3 Screen
Full Screen
File
Print
Events
Notes
Delete
R-R Pause 7896 ms
15-Mar-2016 10:15:42
28 BPM
Region
Tools
Shape
Superimpose
Clear Sel.
Calibrate
Prev Event
Next Event
15-Mar
10:15:30
10:15:45
Start Auto Page
Acquire
Patient
Event
Shape
Trend
Episode
Heart Rate
Report
Page


System Patient Settings Reanalyze Help
17-May
02:41:30
02:41:45
02:42:00
02:42:15
02:42:30
02:42:45
Close
2/3 Screen
1/3 Screen
Full Screen
File
Print
Region
Tools
Start Auto Page
Prev Event
Next Event
Atrial Fib Duration 0:06
17-May-2016 02:41:59
56 BPM at cursor
Acquire Data
Patient Select
Patient Information
Patient Diary
Event Review
Shape Review
Trend Review
Episode Review
Heart Rate Variability
Report Review
Page Builder


Atrial Fib Duration 0:04
17-May-2016 04:19:11
64 BPM

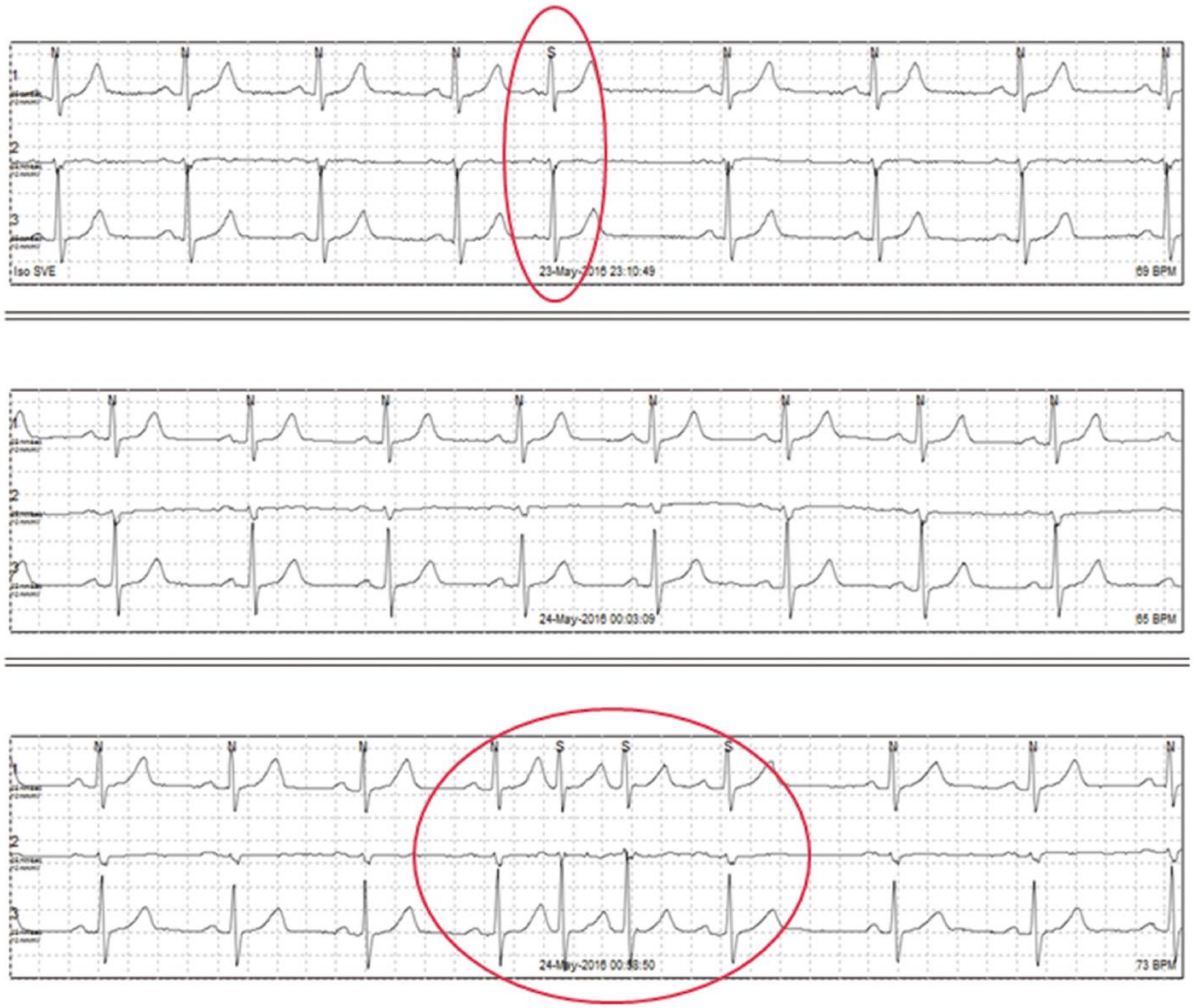

System Patient Settings Reanalyze Help
R-R Interval Histogram
Heart Rate Histogram
Close
2/3 Screen
1/3 Screen
Full Screen
File
Print
Histograms
Tools
Max/Min
Region
Shape
Superimpose
Clear Sel.
Calibrate
Prev Event
Next Event
Start Auto Page
30-Apr-2016 00:56:10
66 BPM
66 BPM at cursor
Acquire Data
Patient Select
Patient Information
Patient Diary
Event Review
Shape Review
Trend Review
Episode Review
Heart Rate Variability
Report Review
Page Builder


System
Patient Settings
Reanalyze
Help
Event
Number
Date/Time
Atrial Fib 15 of 31 00:15:46 17-May-2016
Atrial Fib 16 of 31 00:17:59 17-May-2016
Atrial Fib 17 of 31 00:18:14 17-May-2016
Atrial Fib 18 of 31 00:18:37 17-May-2016
Atrial Fib 19 of 31 00:19:45 17-May-2016
Atrial Fib 20 of 31 00:20:10 17-May-2016
Atrial Fib 21 of 31 00:21:02 17-May-2016
Atrial Fib 22 of 31 00:22:04 17-May-2016
Atrial Fib 23 of 31 02:40:43 17-May-2016
Atrial Fib 24 of 31 02:41:58 17-May-2016
Atrial Fib 25 of 31 02:42:20 17-May-2016
Atrial Fib 26 of 31 04:05:03 17-May-2016
Atrial Fib 27 of 31 04:06:25 17-May-2016
Atrial Fib 28 of 31 04:09:14 17-May-2016
Atrial Fib 29 of 31 04:09:35 17-May-2016
Atrial Fib 30 of 31 04:18:58 17-May-2016
Atrial Fib 31 of 31 04:19:09 17-May-2016
Atrial Fib Duration 0:04
17-May-2016 04:19:11
64 BPM
17-May
04:18:45
04:19:00
Atrial Fib Duration 0:02
17-May-2016 04:19:11
64 BPM at cursor
Sinus Heart Rate
Conduction/Pause
Supraventricular (S,J,A)
ST Segment
Ventricular (V,F,E,I)
Pacemaker
QT
Miscellaneous
Max per event
999
Sort
Chronological
Clear All
Set All
Close
Close
1/3 Screen
2/3 Screen
Full Screen
File
Print
Region
Tools
Start Auto Page
Prev Event
Next Event
Acquire Data
Patient Select
Patient Information
Patient Diary
Event Review
Shape Review
Trend Review
Episode Review
Heart Rate Variability
Report Review
Page Builder

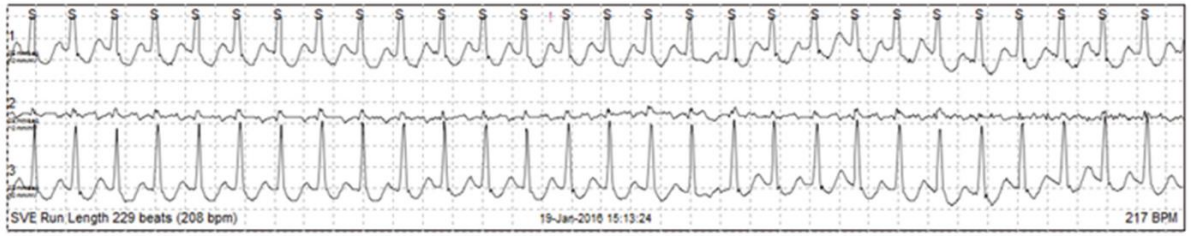

1
2
3
21-May-2016 02:28:34
72 BPM


1
2
3
21-May-2016 04:37:25
77 BPM

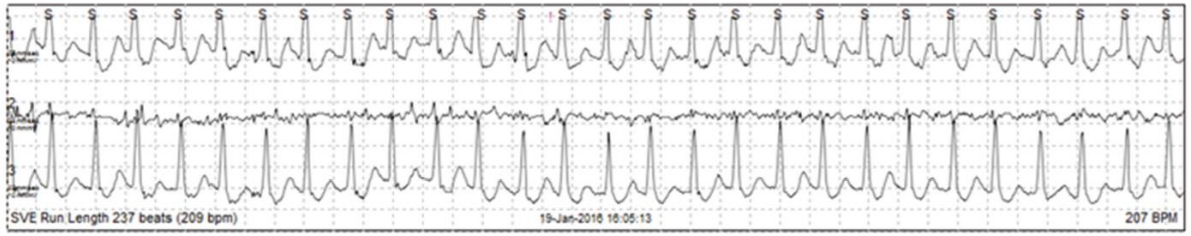

1
2
3
21-May-2016 05:38:53
87 BPM


1
2
3
Iso SVE
23-May-2016 23:10:49
69 BPM
24-May-2016 00:03:09
65 BPM
24-May-2016 00:58:50
73 BPM

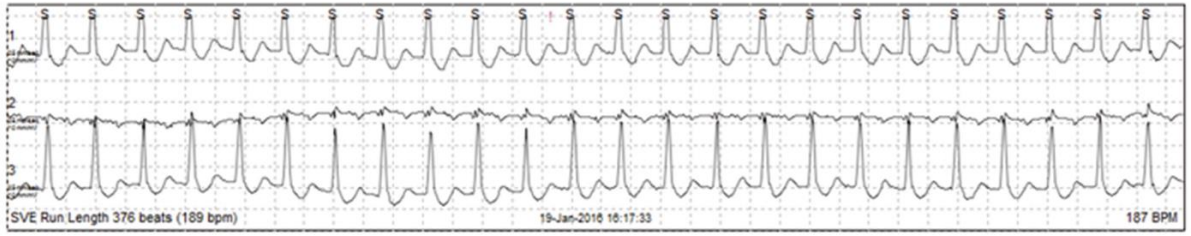
Palpitations (가슴두근거림)



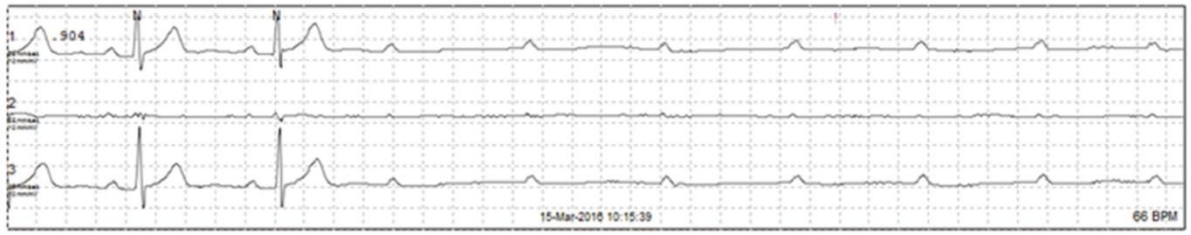
Headache (두통)



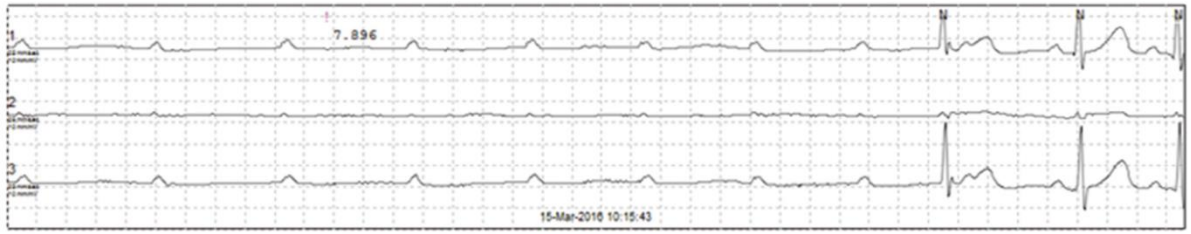
Palpitations (가슴두근거림)



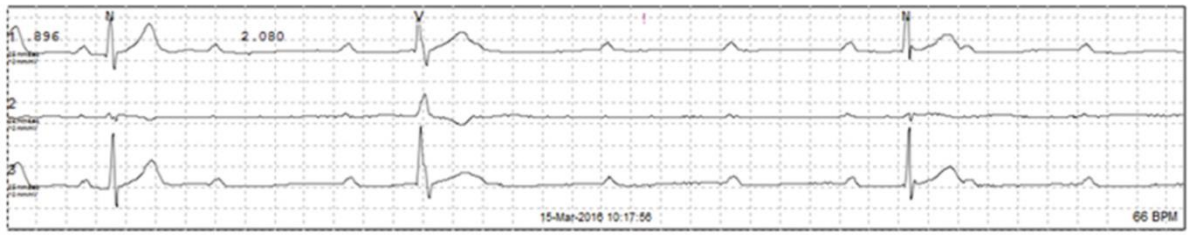
Dizziness (어지러움)



Dizziness (어지러움)



Dizziness (어지러움)

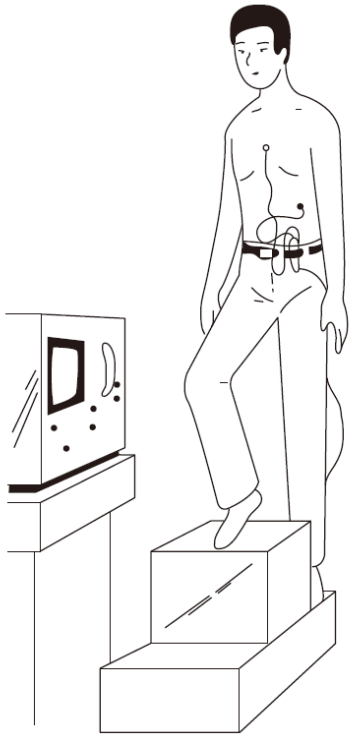


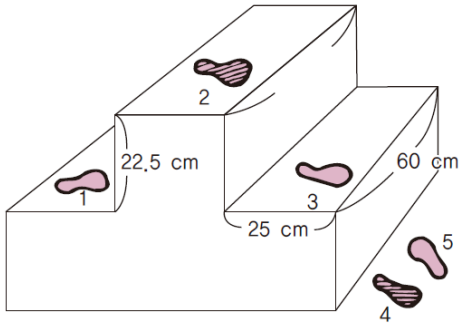
Section 11

부하 심전도

학습 목표

1. 부하 심전도의 임상적 의의를 설명할 수 있다(A).
2. 부하 심전도의 검사법을 파악한다(A).
3. 부하 심전도의 결과 해석을 분석한다(A).





· Metronome의 승강 횟수 산출방법

$$Y = M \times \frac{60}{90} \times 5$$

– Y는 metronome의 1분당 횟수
– M은 Master표의 90초간 횟수
– 5는 편도 5 스텝으로 승강했을 때의 보행수

· 이중 부하인 경우에는 Y의 2배 횟수인 3분간 승강시킨다.

표 11-1. Master's 2계단의 승강 횟수(90초간)

	5~9		10~14		15~19		20~24		25~29		30~34		35~39		40~44		45~49		50~54		55~59		60~64		65~69	
	남	여	남	여	남	여	남	여	남	여	남	여	남	여	남	여	남	여	남	여	남	여	남	여	남	여
18~22 kg	35	35	36	35	33	33																				
23~27 kg	33	33	35	33	32	32																				
28~31 kg	31	31	33	32	31	30																				
32~36 kg	28	28	32	30	30	29																				
37~40 kg	26	26	30	28	29	28	29	28	29	28	28	27	27	26	27	24	26	23	25	21	25	21	24	21	23	23
41~45 kg	24	24	29	27	28	26	28	27	28	26	27	25	27	24	26	23	25	22	25	22	24	21	23	20	22	19
46~49 kg	22	22	27	25	27	25	28	26	28	26	27	25	26	24	25	23	25	22	24	21	23	20	22	19	22	18
50~54 kg	20	20	26	23	26	23	27	25	27	25	26	24	25	23	25	22	24	21	23	20	23	19	22	18	21	18
55~59 kg	18	18	24	22	25	22	26	24	27	24	26	23	25	22	24	21	23	20	22	19	22	19	21	18	20	17
60~63 kg	16	16	23	20	24	20	25	23	26	23	25	22	24	21	23	20	23	19	22	19	21	18	20	17	20	16
64~68 kg			21	18	23	19	24	22	25	22	24	21	24	20	23	20	22	19	20	18	20	17	20	16	19	16
69~72 kg			20	17	22	17	24	21	25	20	24	20	23	19	22	19	21	18	20	17	20	16	19	16	18	15
73~76 kg			18	15	21	16	23	20	24	19	23	19	22	18	22	18	21	17	20	16	19	16	18	15	18	14
77~81 kg					20	13	22	14	23	19	23	18	22	18	21	17	20	17	19	16	18	15	18	15	17	13
82~86 kg					18	13	21	18	23	17	22	17	21	17	20	16	19	16	19	15	18	14	17	14	16	13
87~90 kg					18	17	20	17	22	16	21	16	21	16	20	15	19	15	18	14	17	13	16	13	15	12
91~95 kg							19	15	21	15	21	15	20	15	19	14	18	14	17	13	16	13	16	12	15	11
96~99 kg							18	15	21	14	20	14	19	14	17	13	17	13	17	13	16	12	15	11	14	11
100~104 kg							17	14	20	13	20	13	19	13	18	13	17	12	16	12	15	11	14	11	13	10

표 11-2. Bruce의 protocol

Stage	Speed (m.p.h.)	Grade (%)	Duration (min)	METs (units)	Total Time Elapsed (min)
1	1.7	10	3	4	3
2	2.5	12	3	6~7	6
3	3.4	14	3	8~9	9
4	4.2	16	3	15~16	12
5	5.0	18	3	21	15
6	5.5	20	3	-	18
7	6.0	22	3	-	21

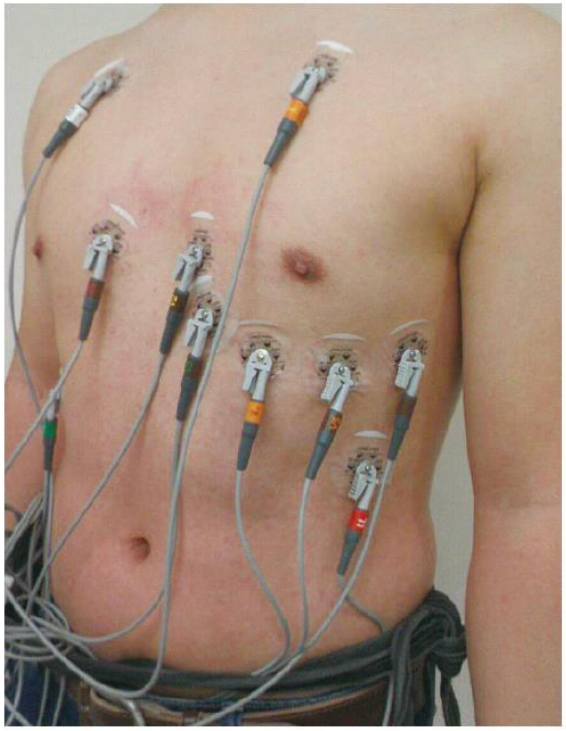
* **Metabolic eqivalants (MET)** : 기초대사의 산소 요구량을 의미한다. METs는 기초대사의 비율의 배수들이다.
* 최대 산소요구량(Vo2), 심장박동수, 혈압은 protocol의 종류와는 별로 중요한 차이가 없음
* mph : miles per hour(1 mile = 1.6 km)

표 11-3. 목표 심장박동수

Age	85~90% of Maximal Heart Rates
20~29	175~180
30~39	170~175
40~49	165~170
50~59	160~165
60~69	155~160
70 and above	150~155

(Target heart Rate = 220−Age)









순환생리기능 검사학

CHAPTER III

NEW CLINICAL PHYSIOLOGY

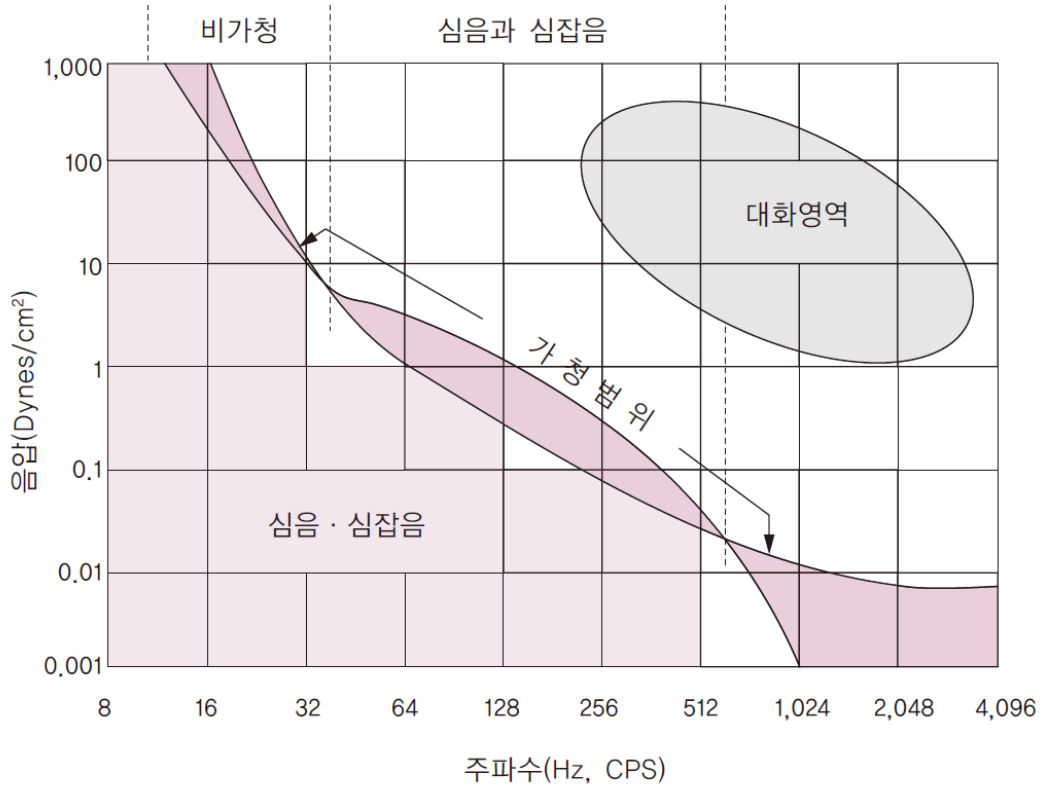
심음도

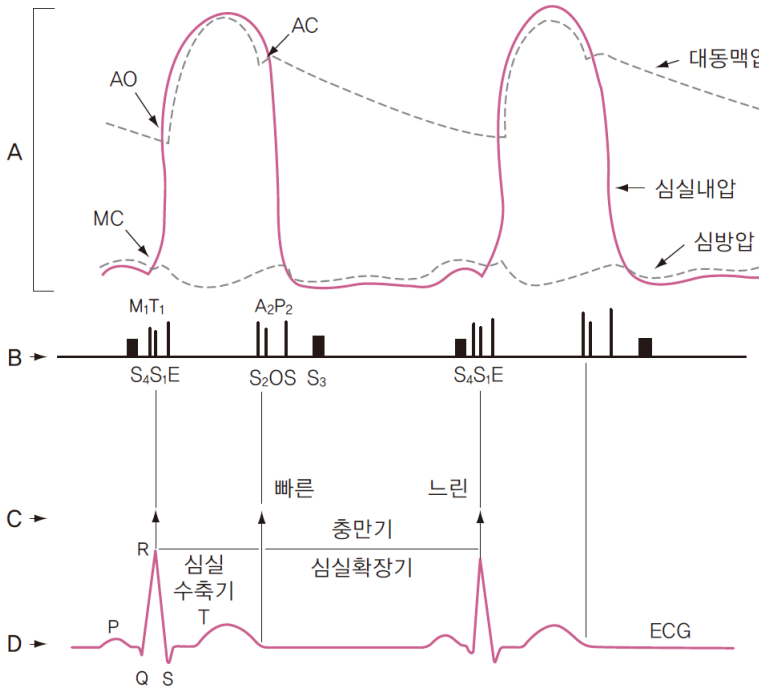
Section 12

심음도

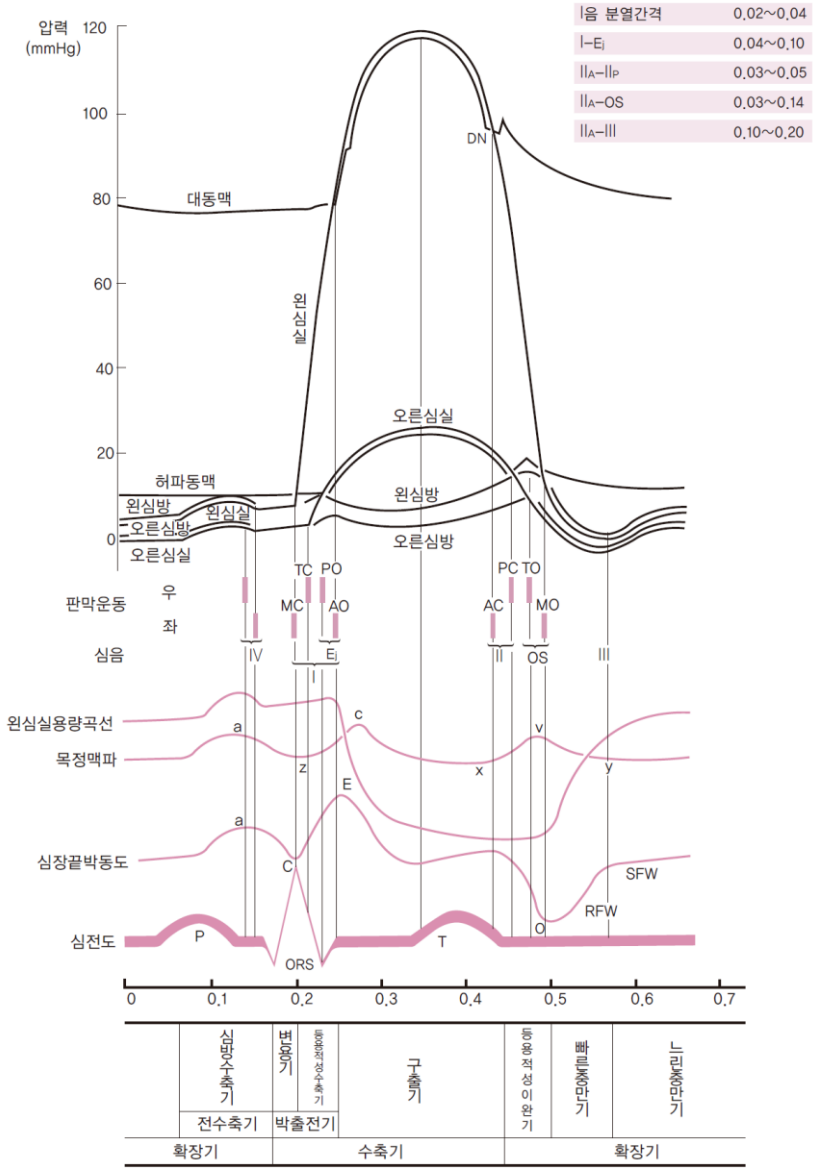
학습 목표

1. 심음도의 기본 개념을 이해할 수 있다(A).
2. 심음 · 심잡음의 발생 기전을 이해할 수 있다(A).
3. 심음도와 심전도를 비교 이해할 수 있다(A).
4. 심음도와 심장주기, 심전도의 시상 관계를 이해할 수 있다(A).

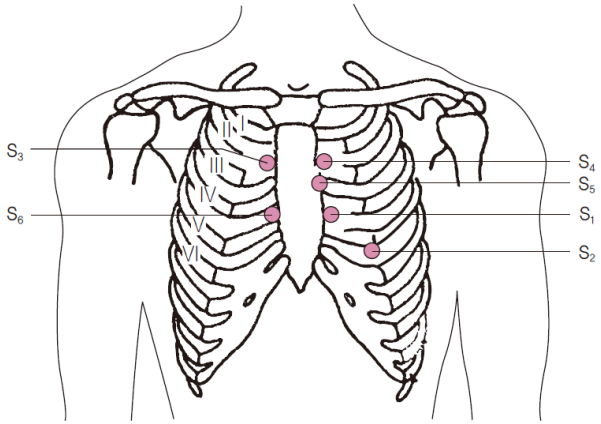

비가청
심음과 심잡음
1,000
100
10
1
0.1
0.01
0.001
음압(Dynes/cm²)
대화영역
가청범위
심음 · 심잡음
8
16
32
64
128
256
512
1,024
2,048
4,096
주파수(Hz, CPS)



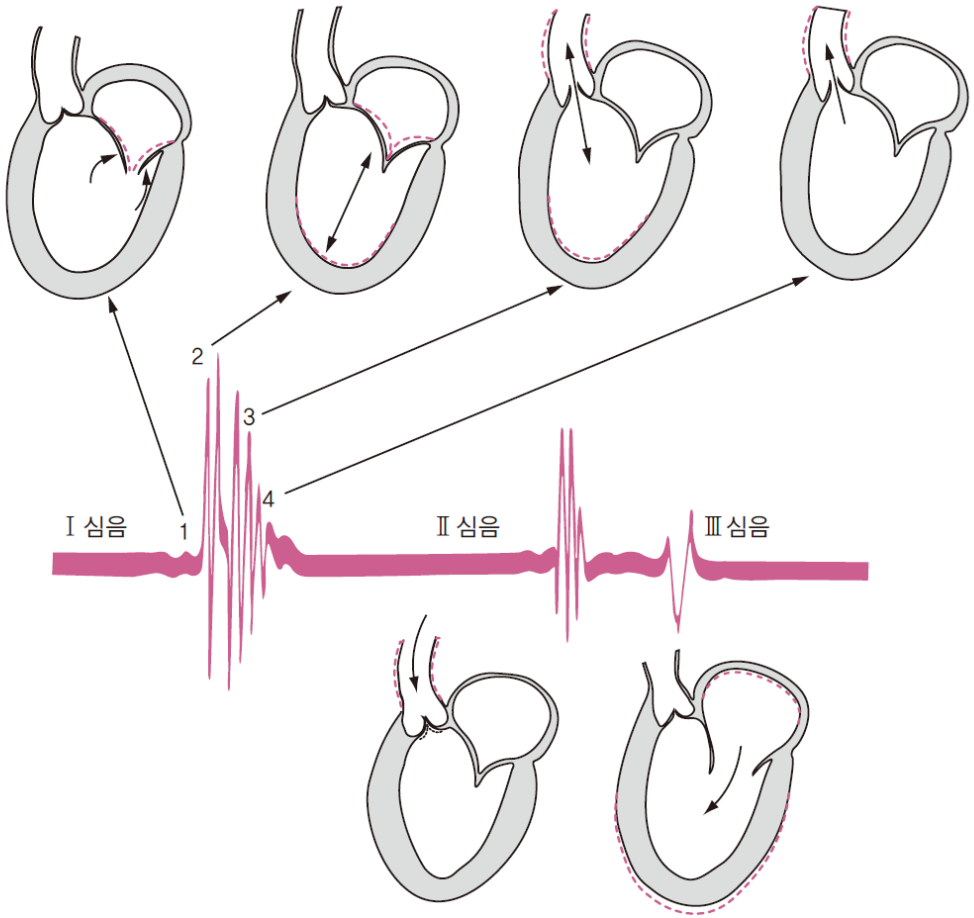
· A : 왼심실 압력곡선
· B : 심음
· C : 심장주기
· D : 심전도
· S_1(I음) : 방실판막(승모판, 삼첨판의 순서로 폐쇄) 폐쇄음(MC, TC)
· S_2(II음) : 반달판막(대동맥판, 폐동맥판의 순서로 폐쇄) 폐쇄음(AC, PC)
· S_3(III음) : 심실 빠른 유입음
· S_4(IV음) : 심방 수축음
· OS : 방실판막(승모판, 삼첨판) 개방음(MO, TO)
· E음 : 반달판막(대동맥판, 허파동맥판) 개방음(AO, PO)



I음 분열간격	0.02~0.04
I–E_j	0.04~0.10
II_A–II_P	0.03~0.05
II_A–OS	0.03~0.14
II_A–III	0.10~0.20



S_1 : 넷째갈비뼈사이 복장뼈왼쪽가장자리(승모판, 왼심실 영역)
S_2 : 심장끝부위(승모판, 왼심실 영역)
S_3 : 둘째갈비뼈사이 복장뼈오른쪽가장자리(대동맥판 영역)
S_4 : 둘째갈비뼈사이 복장뼈왼쪽가장자리(허파동맥판 영역)
S_5 : 셋째갈비뼈사이 복장뼈왼쪽가장자리(대동맥판, 허파동맥판 영역, Erb 영역)
S_6 : 넷째갈비뼈사이 복장뼈오른쪽가장자리(삼첨판, 오른심실 영역)



제Ⅰ심음의 구성 : 승모판 폐쇄음(MC), 삼첨판 폐쇄음(TC),
허파동맥판 개방음(PO), 대동맥판 개방음(AO)의 순
제Ⅱ심음의 구성 : 대동맥판 폐쇄음(AC), 허파동맥판 폐쇄음(PC),
삼첨판 개방음(TO), 승모판 개방음(MO)의 순

표 12-1. 심장주기와 심전도 비교

주기	심음	심장주기	발생 원인	심전도와의 관계	특 징
수축기	I음	박출 전기 (변용기+등용적성 수축기)	• 변용기 : 방실판막(승모판막 → 삼첨판막 순으로) 폐쇄 • 등용적성 수축기 : 반달판막(허파동맥판막 → 대동맥판막 순으로) 개방	• R파의 꼭지점과 일치(R파 이후 0.04~0.06초 뒤에 출현) • 지속시간 : 0.1~0.2초	• 심장끝, Erb에서 강하게 청취 • 주음 : 방실판막 폐쇄음
		박출기	• 심실내압 > 대동맥압력 • 큰혈관으로 박출 → 반달판막 폐쇄까지	• ST 분절 시작 이후 T파 끝부분까지	
확장기	II음	등용적성 확장기	• 반달판막(대동맥판막, 허파동맥판막 순으로) 폐쇄	• T파 끝부분과 일치심실확장 초기에 출현 • 평균 지속시간 : 0.04~0.06초	• 심장바닥 부위에서 강하게 청취 • 주음 : 반달판막 폐쇄음
	III음	빠른충만기	• 심실확장 초기 : 방실판막 개방, 혈액이 심방 → 심실로 급속 유입) • 심실근육 확장 : 심실벽 진동	• T파 이후 다음 R파 시작 전까지 • T파 이후 다음 R파 시작 전까지	• III음은 II음 시작 0.14초 후에 출현, 저진폭 저음 • 건강한 청소년, 가슴벽이 얇은 사람에서 출현 • 병적 상태에서만 출현
		느린충만기 (분리기)	• 심실확장 말기 : 심방 → 심실로 혈액이 느리게 유입		
	IV음	수축 전기 (심방수축기)	• 심방수축 → 다음 심실수축 시작까지의 시기 • 심방 수축기 : 심방음	• P파 시작 0.12초 후에 출현	• 저진폭 저음 (둔한 음) • 병적 상태에서만 출현 • 고령자에 많이 출현

Section 13

동맥경화진단 검사

학습 목표

1. 동맥경화진단 검사의 기본개념에 대해 이해할 수 있다(A).
2. 동맥경화진단 검사의 특징에 대해 설명할 수 있다(A).
3. 동맥경화진단 검사의 임상적 의의에 대해 설명할 수 있다(A).

표 13-1. 말초동맥질환의 위험요인

- 흡연이나 당뇨병
- 고혈압
- 이상지질혈증
- 70세 이상의 고령

표 13-2. 동맥경직도 측정으로 예측 가능한 예

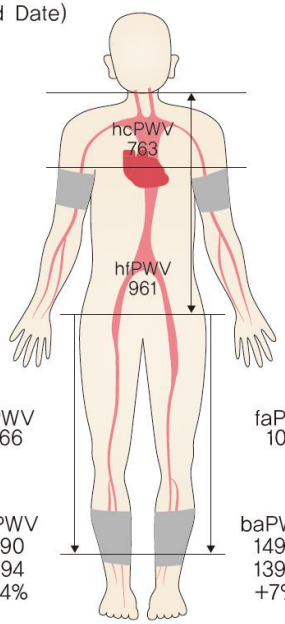
- 심혈관 질환의 발생 위험도
- 심혈관 치료 시 치료효과 판단
- 심혈관질환의 발생 및 사망률 증가의 기전 연구

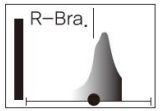
Measurement
(1st Measured Date)

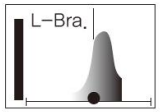
BP : mmHg PWV : cm/s

R-Bra.
SYS 129
MAP 102
DIA 80
PP 49

L-Bra.
SYS 129
MAP 100
DIA 79
PP 50

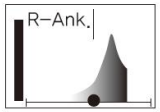


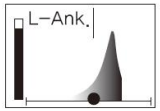




R-Ank.
SYS 138
MAP 100
DIA 78
PP 60

L-Ank.
SYS 118
MAP 94
DIA 78
PP 40





faPWV
1166

faPWV
1081

ABI 1.07

ABI 0.91

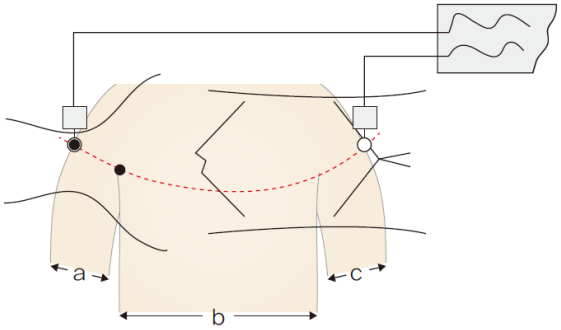
baPWV
1590
1394
+14%

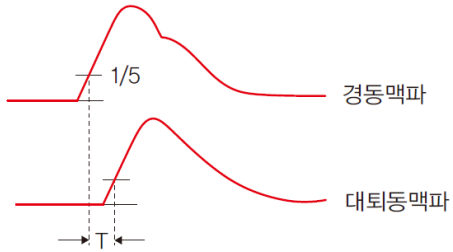
baPWV
1494
1394
+7%

Heart-Carotid 21.7
Heart-Brachial 34.6
Heart-Femoral 75.9
Heart-Ankle 148.1 (cm)

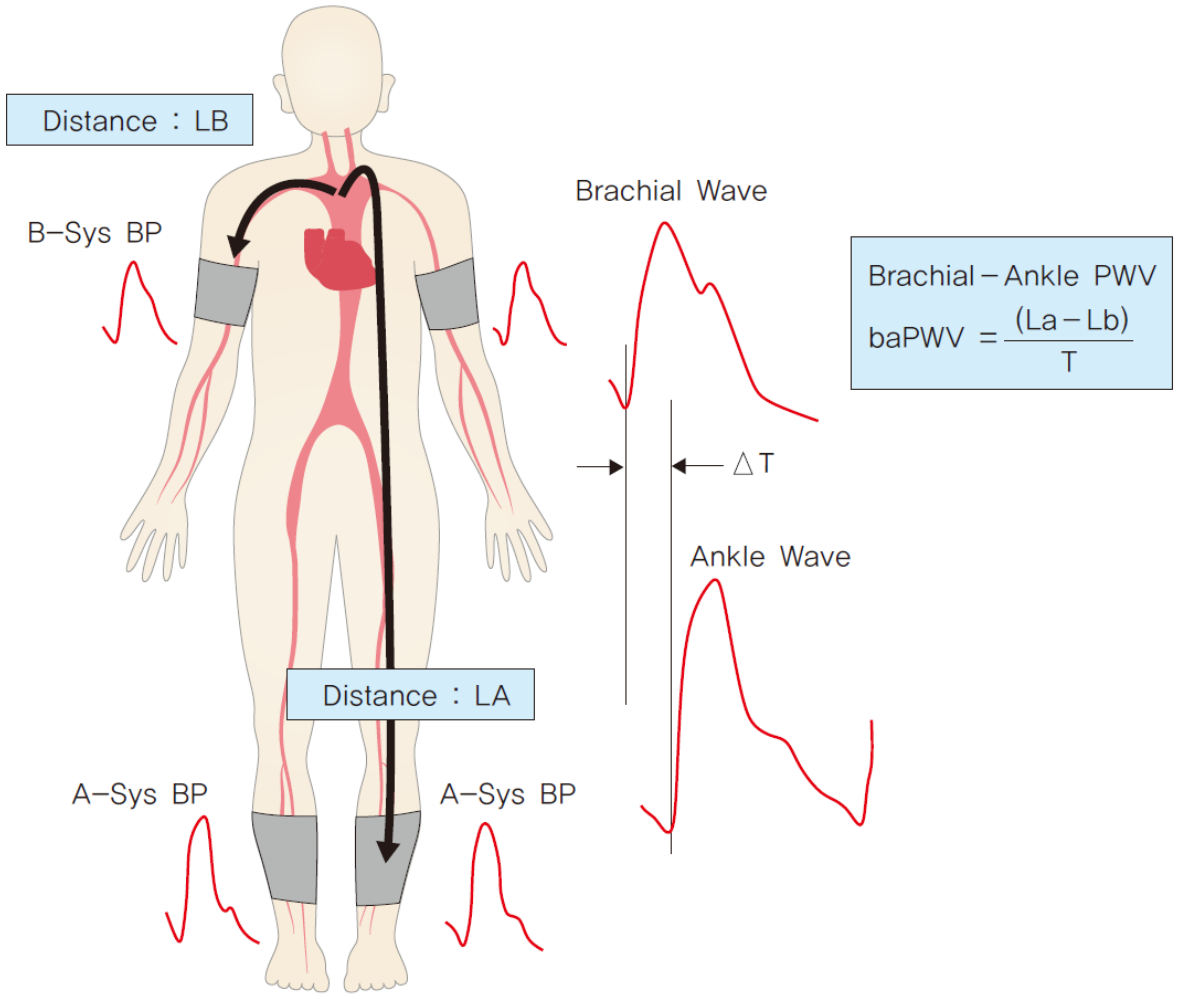








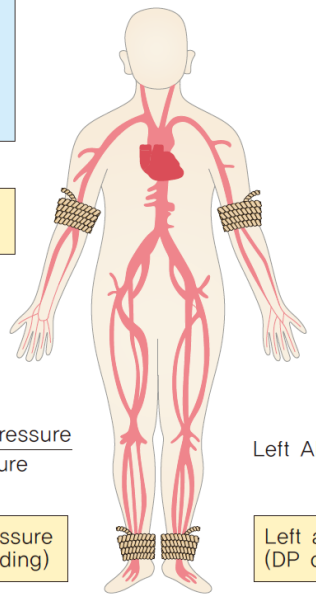
$$PWV = \frac{b+c-a}{T}$$


Distance : LB
B-Sys BP
Brachial Wave
Brachial – Ankle PWV
baPWV = (La – Lb) / T
ΔT
Ankle Wave
Distance : LA
A-Sys BP
A-Sys BP

A I interpretation
1. – oncompressi le
. 1–1. – ormal
. 1– . – Mild o struction
. 1– . – Moderate o struction
. – Severe o struction

Right brachial artery systolic pressure

Left brachial artery systolic pressure



$$\text{Right ABI} = \frac{\text{Highest right ankle pressure}}{\text{Higher arm pressure}}$$

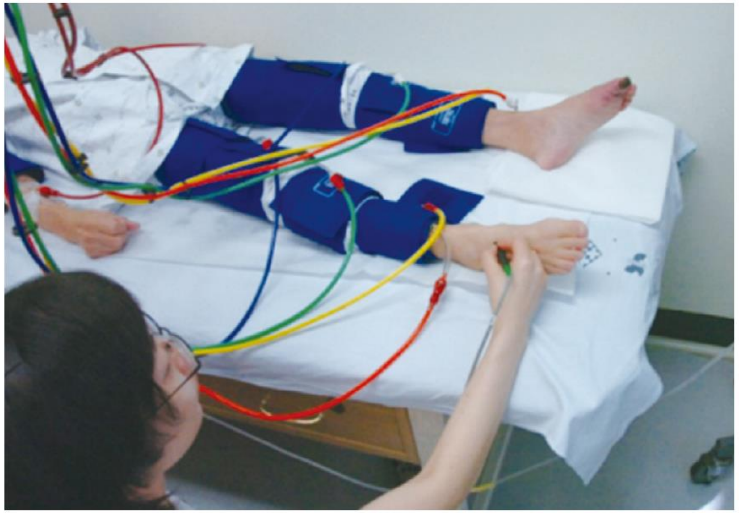
$$\text{Left ABI} = \frac{\text{Highest left ankle pressure}}{\text{Higher arm pressure}}$$

Right ankle systolic pressure (DP or PT – higher reading)

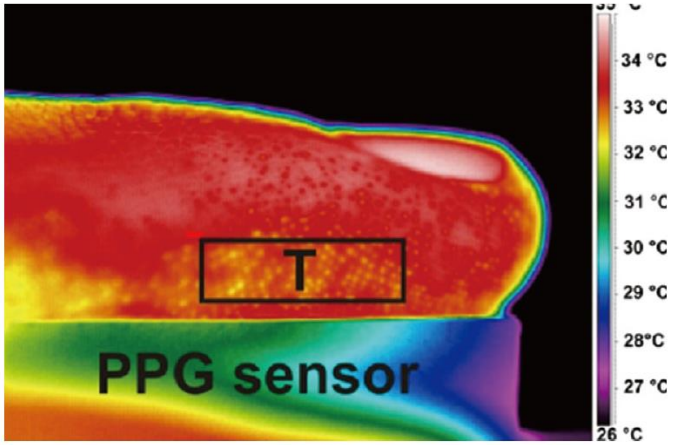
Left ankle systolic pressure (DP or PT – higher reading)

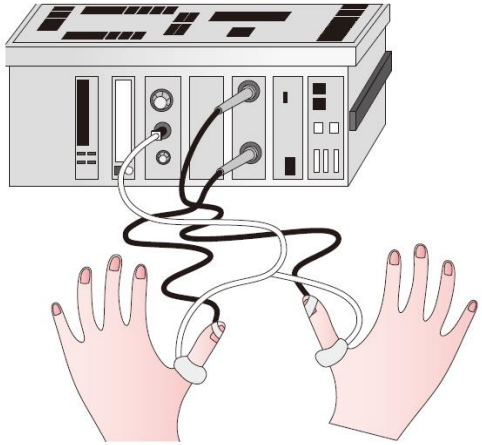
표 13-3. 위팔-발목 혈압비(ABI 검사) 기준표

ABI 수치	ABI 에 따른 말초혈관 폐색의 중증도
≥ 1.30	압박되지 않는 혈관(noncompressible vessel)
1.00~1.29	정상
0.91~0.99	경계(borderline, equivocal)
0.71~0.90	경증 말초혈관 질환
0.41~0.70	중등도 말초혈관 질환
0.00~0.40	중증 말초혈관 질환

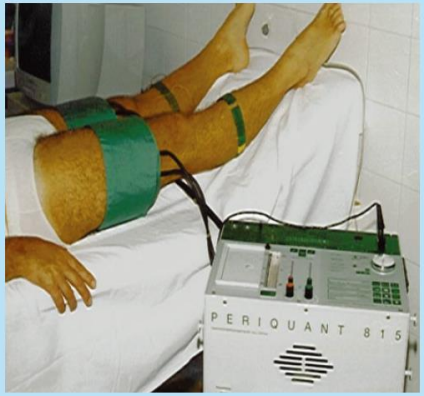


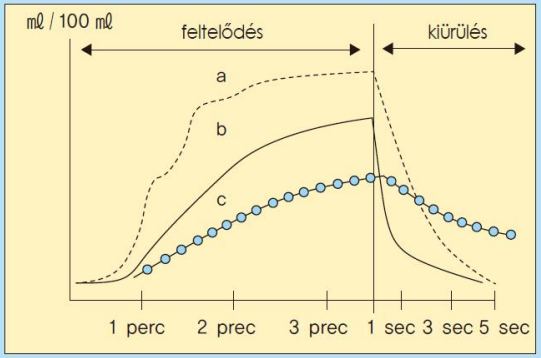



34 °C
33 °C
32 °C
31 °C
30 °C
29 °C
28°C
27 °C
26 °C
T
PPG sensor



Strain–gauge plethysmography (Occlusion)









순환생리기능 검사학 CHAPTER IV

기립경사

Section 14

기립경사

학습 목표

1. 기립경사 검사(tilt test) 검사의 목적 및 정의를 설명할 수 있다(A).
2. 기립경사 검사 방법에 대하여 설명할 수 있다(A).
3. 기립경사 검사 결과 판독 양성반응을 설명할 수 있다(A).

