

Non-invasive study for arrhythmia patients

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Symptom

“두근거린다”

“목 혹은 가슴이 짹 메인다”

“맥이 건너 뛴다”

“호흡곤란”

“어지럽다”

Non-invasive study

12 Channel ECG(파형분석, 부정맥 감별)

심전도 파형 생성의 원리와 정상 심전도

Holter ECG(일과성 부정맥 진단)

홀터 분석시 주의 할점

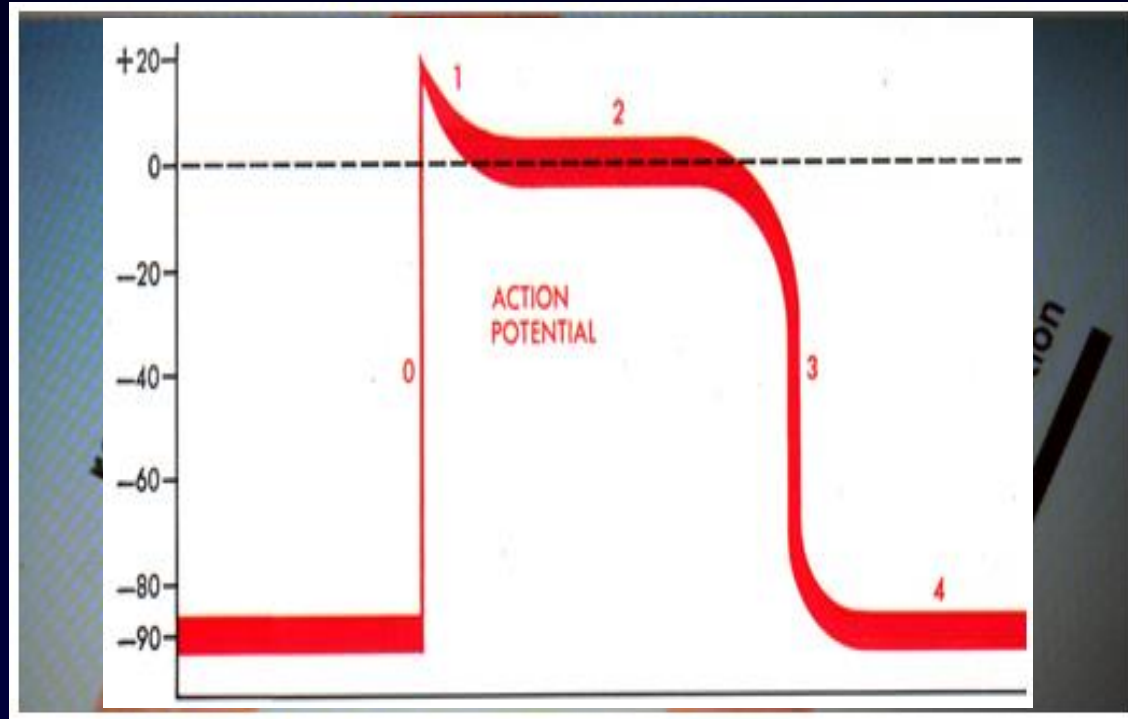
Exercise ECG(운동 유발성 부정맥 진단)

운동부하 검사시 부정맥이 유발된 case

12 Channel ECG

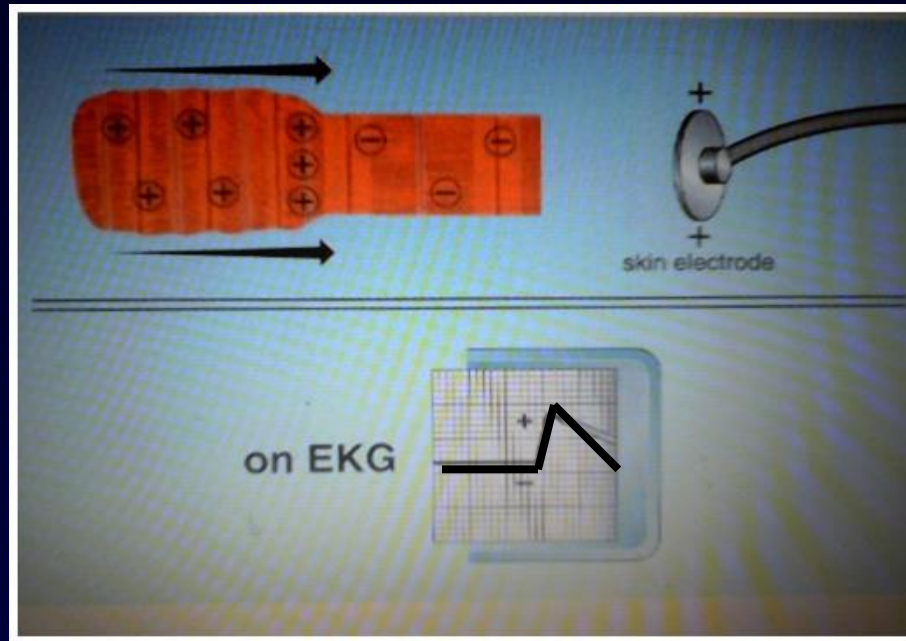


Depolarization



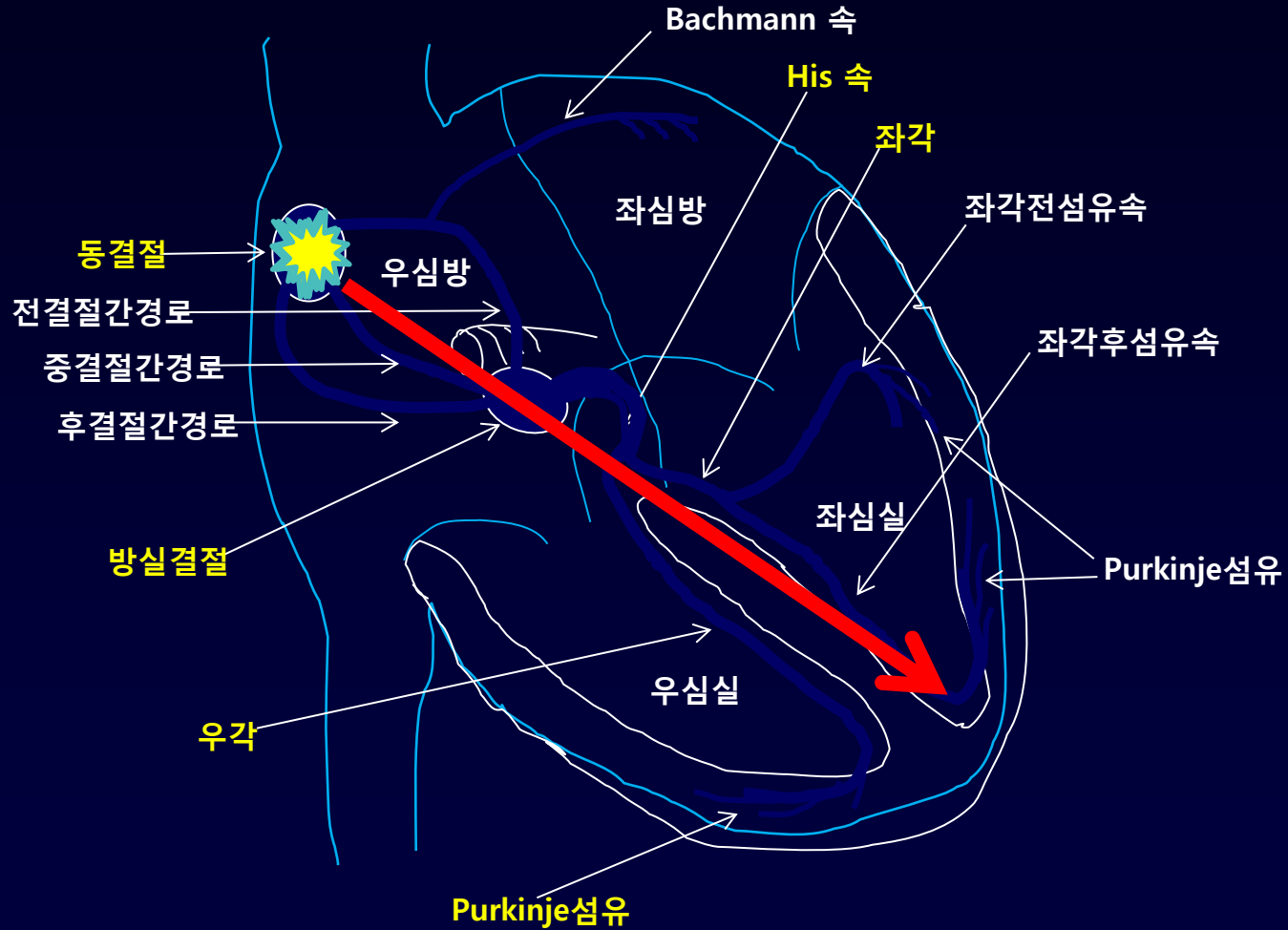
세포가 자극을 받으면 양이온이 세포안으로 들어가면서 수축을 하게된다.

심전도의 원리

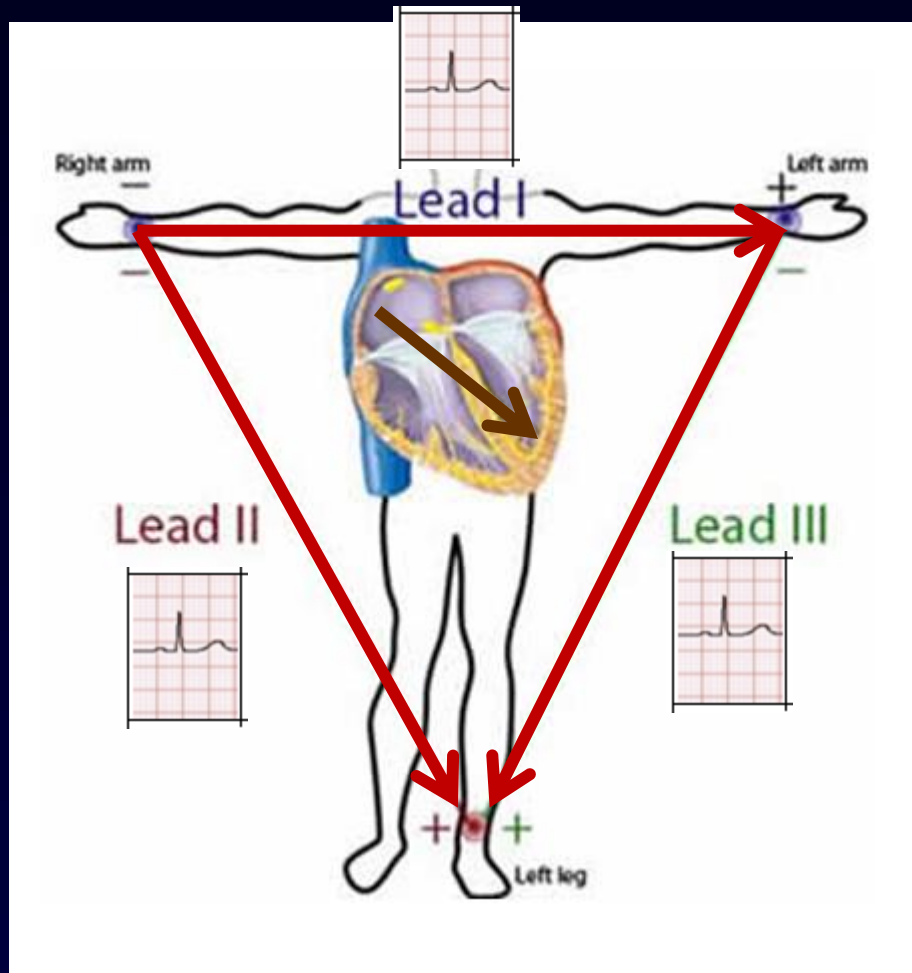


전기가(탈분극이) + 전극을 향해 올때 심전도에는 상향 파가 그려진다.

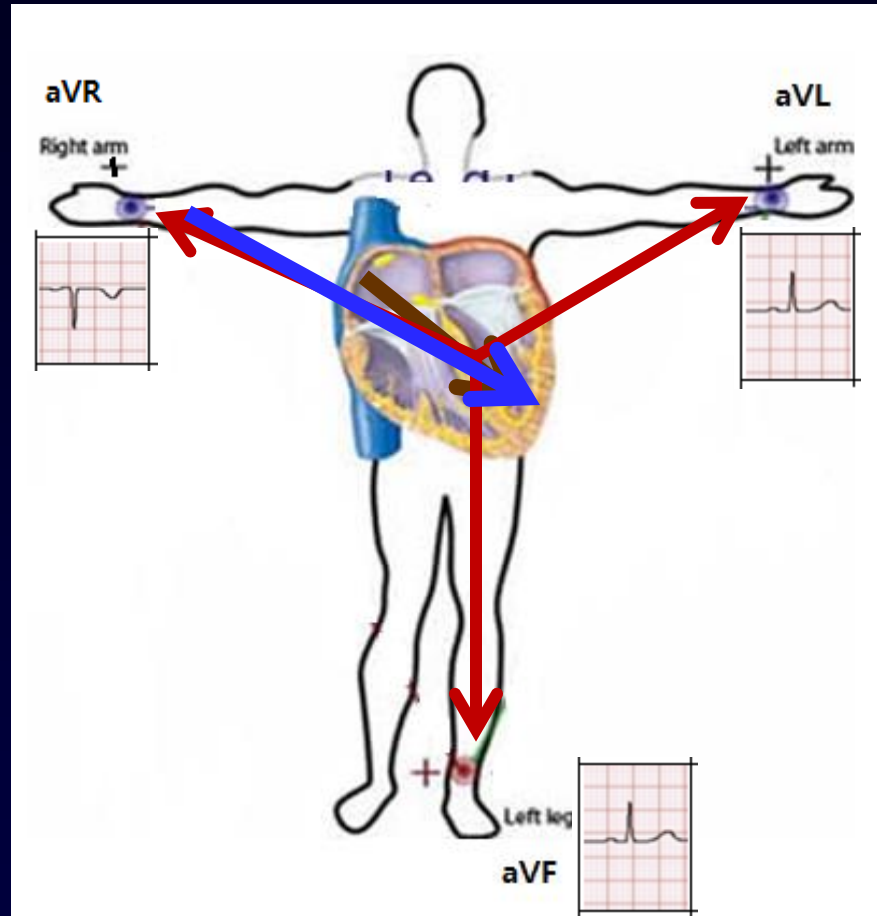
Conduction system



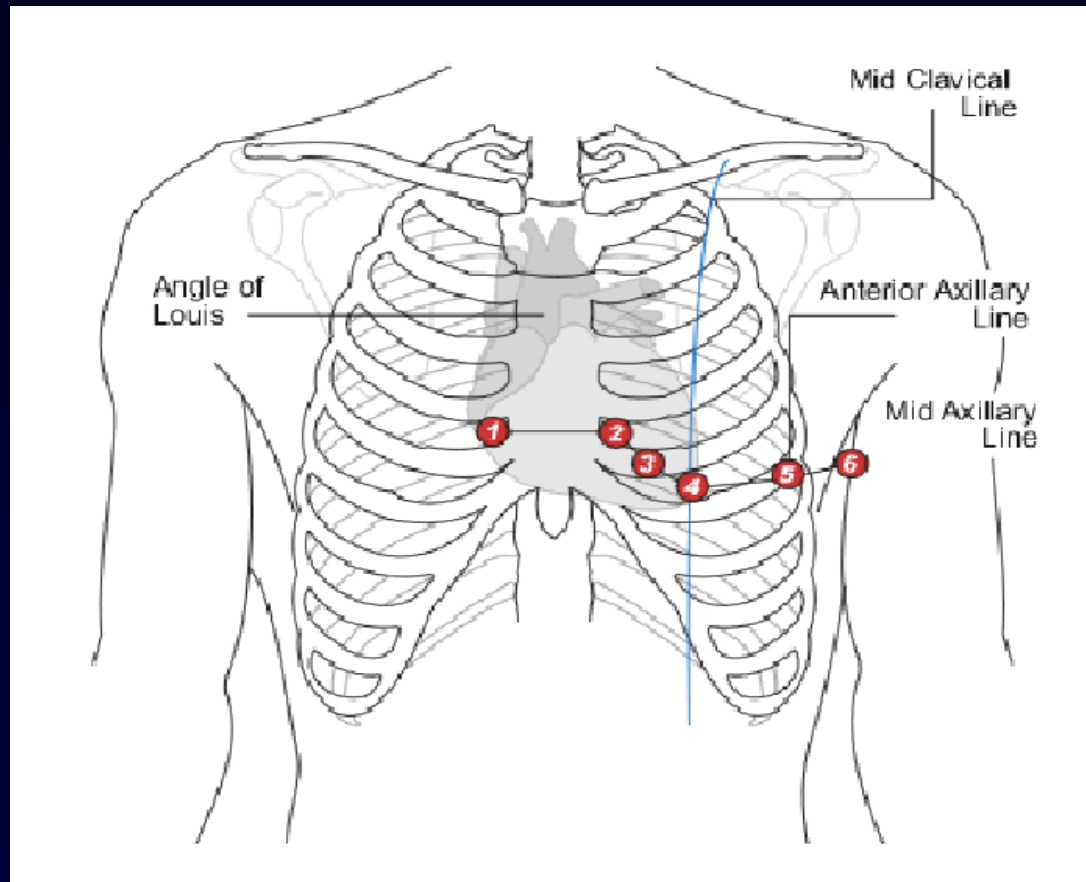
Standard lead



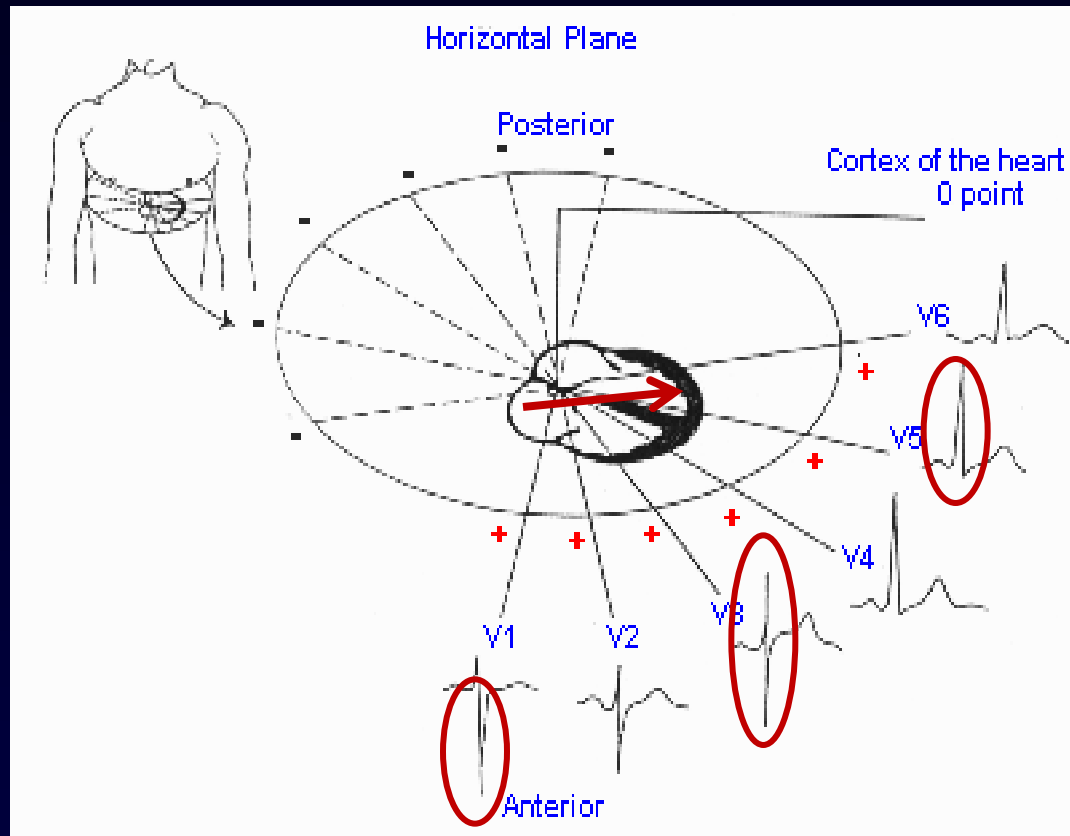
Extremity lead



Chest lead

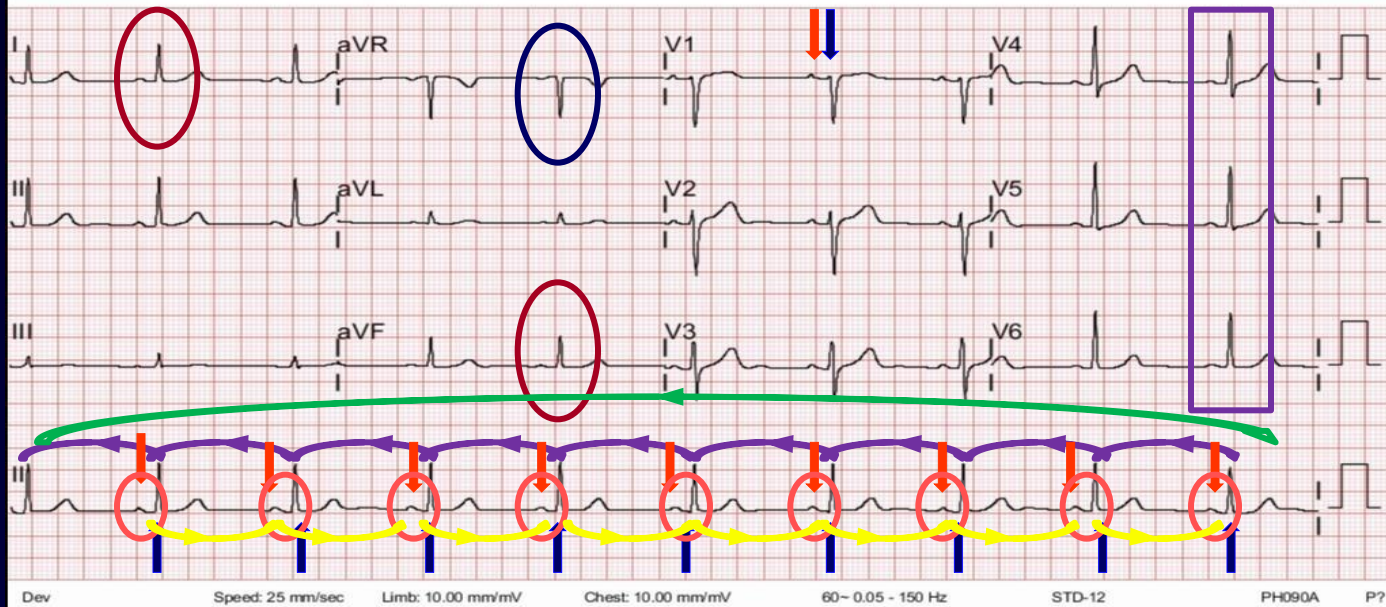


Chest lead



Normal sinus rhythm

- | | | |
|---------|-----------------------------------|---|
| Rate 58 | 1) HR 60~100회(II의 QRS갯수x6=1분간 HR) | 5) PR interval 0.12~0.20 sec |
| PR 168 | 2) Regular Rhythm(R-R, P-P) | 6) Axis 는I, aVF 가 둘다 상향
aVR 은 하향, V4~V6 상향 |
| QRSd 86 | 3) 동일한 P wave (2.5mm, 0.12 sec) | 7) PR relation 은 1:1 관계 |
| QT 428 | 4) Narrow QRS 0.06~0.10 sec | |
| QTc 421 | | |
| Axes | | |
| P 35 | | |
| QRS 38 | | |
| T 35 | | |



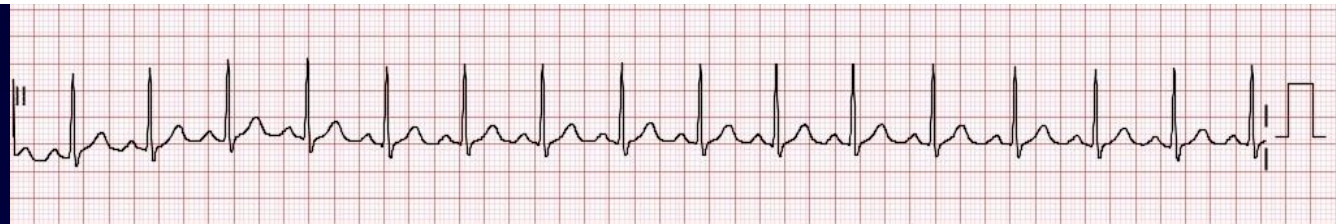
Rate 95
PR 188
QRSd 98
QT 380
QTc 478

Axes
P 69
QRS 57
T 60

“가슴이 덜컹 내려앉는다”

Unconfirmed Diagnosis

- BORDERLINE ECG -

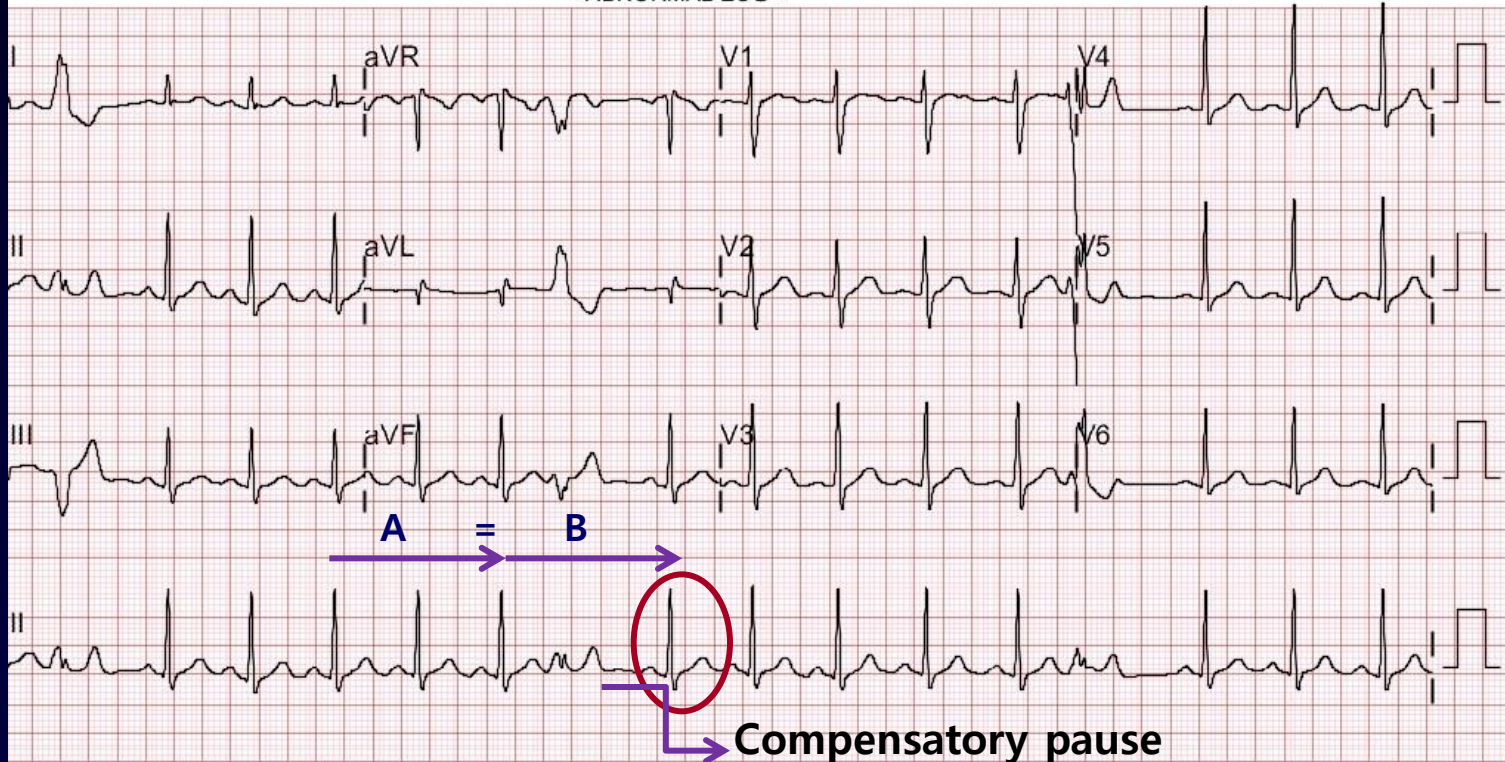


Rate 100
PR 180
QRSd 96
QT 368
QTc 475

Axes
P 66
QRS 57
T 62

“가슴이 덜컹 내려앉는다”

- ABNORMAL ECG -

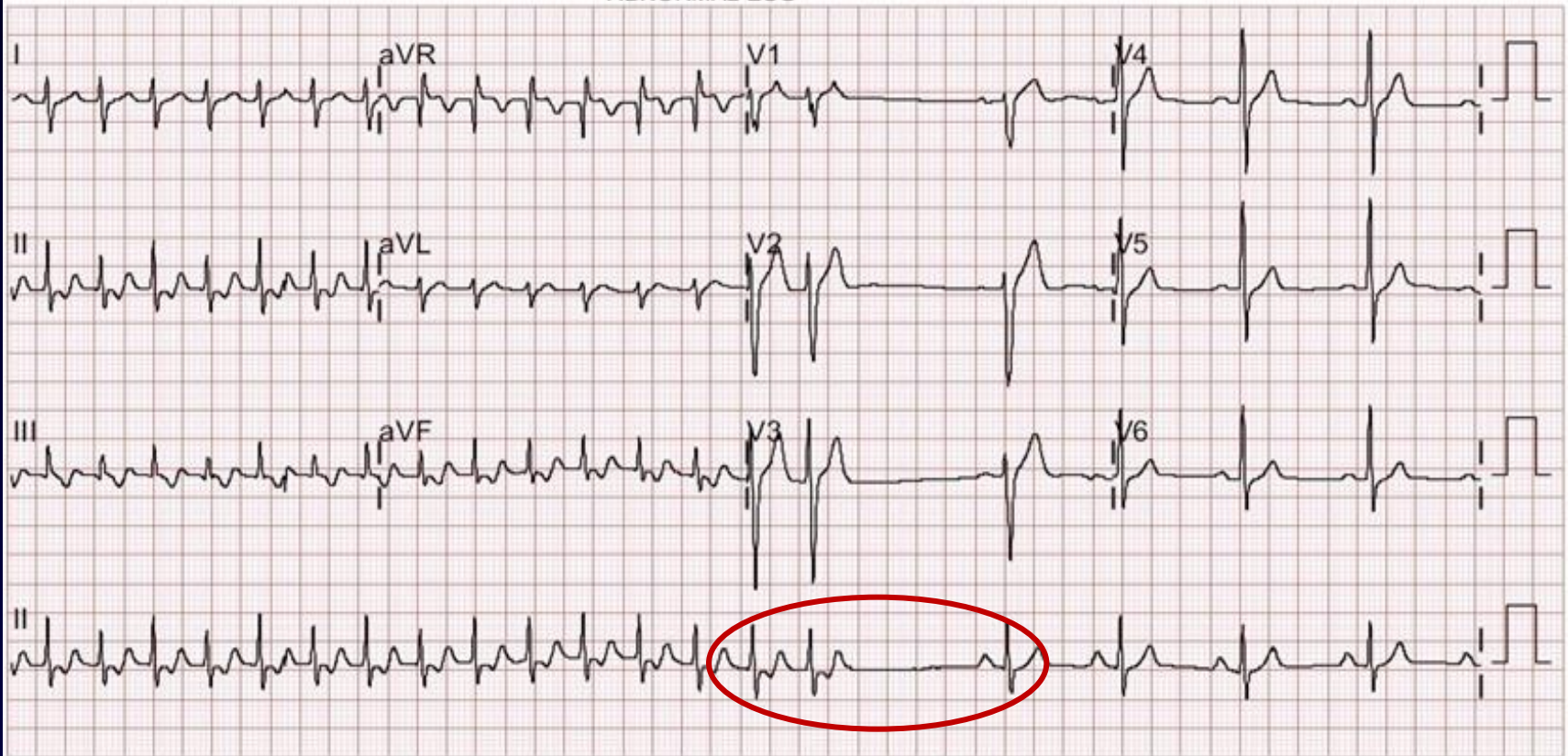


Data 434
Rate 140
PR 177
QRSd 100
QT 328
QTc 501

Axes
P 71
QRS 102
T 63

Unconfirmed Diagnosis

- ABNORMAL ECG -



Dev Speed: 25 mm/sec Limb: 10.00 mm/mV Chest: 10.00 mm/mV 60~0.05 - 150 Hz STD-12 PH090A P?

12 Channel ECG

증상이 있을때 심전도 검사는 부정맥 진단에 결정적
역할을 하므로 아직도 매우 중요한 비관혈적 검사이므로
검사자는 이상소견을 인지하면서 검사하여야 합니다.

Holter ECG





•In 1964, he became a full professor at the University of California in San Diego, coordinating activities at the Institute of Geophysics and Planetary Physics. In 1979, the Association for the Advancement of Medical Instrumentation (AAMI) awarded Holter with the AAMI Foundation Laufman-Greatbatch Prize for his contributions to medical technology.

•Starting in radio telemetry and research towards EEG, he later switched to the ECG recording, working together with Joseph A Gengerelli

**NORMAN JEFFERIS "JEFF" HOLTER
(FEBRUARY 1, 1914 – JULY 21, 1983)**

APC



Non-conducted APC



VPC



Premature beats(APC, VPC)

홀터 검사는 Premature beat 을 정량화 할 수 있다.

빈도나 양상이 심정지 위험을 높이지 않는다.

일시적인 경우가 많아 증상과의 관계를 연관지어 보는
것이 중요하다.

PSVT





Ventricular Events

V Tach

Runs : 0

Longest

Max. Rate

AIVR/IVR

Runs : 0

Longest

Min. Rate

Total VEs	% VEs	Couplets	Triplets	VBG Runs	VTG Runs
245	0.22	0 <input checked="" type="checkbox"/>	0 <input checked="" type="checkbox"/>	0 <input checked="" type="checkbox"/>	0 <input checked="" type="checkbox"/>

Supra Ventricular Events

SVT

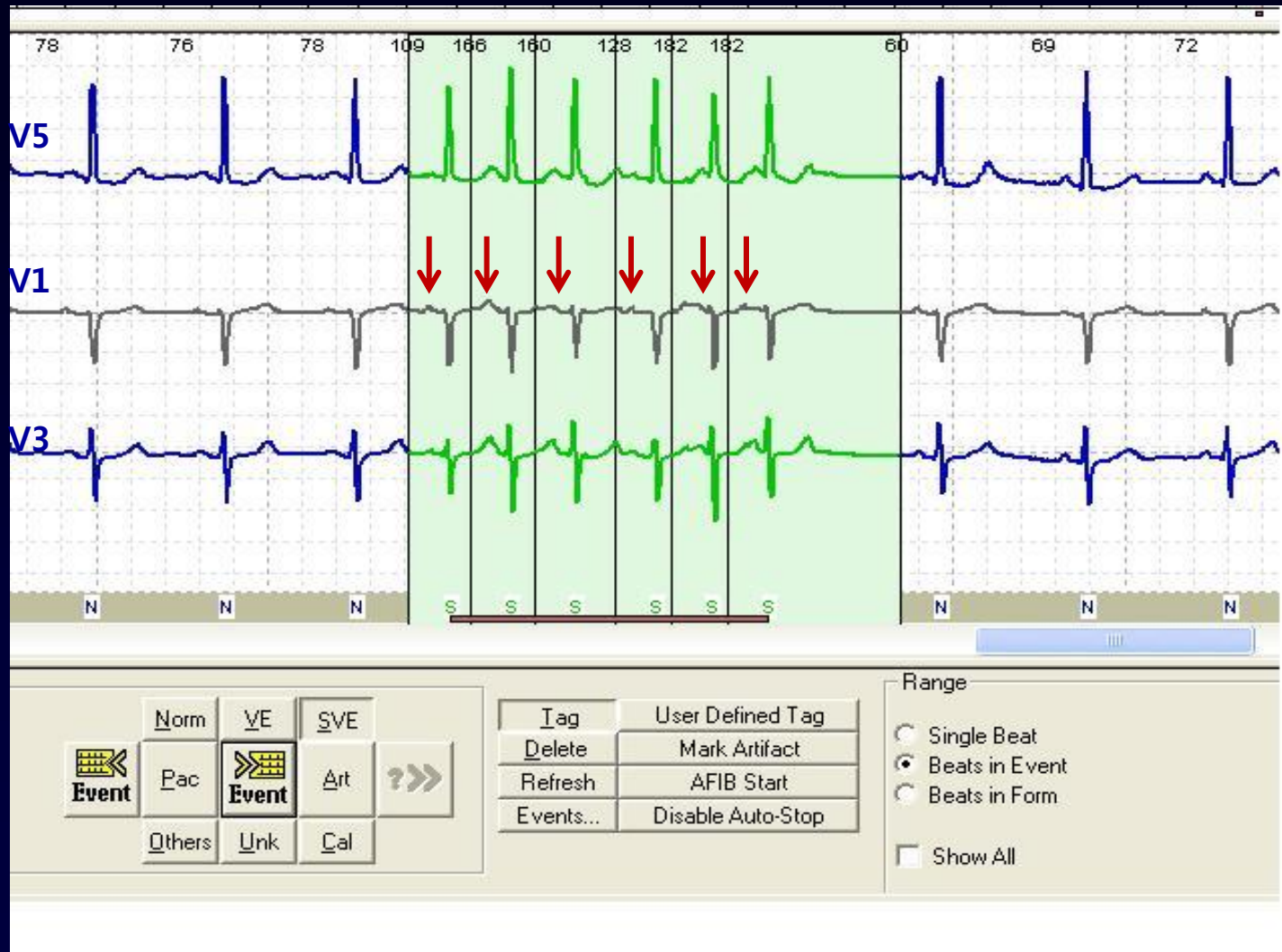
Runs : 13

Longest 376 bts: 23:44:50 d1

Max. Rate 197 bpm: 23:53:45 d1

Total SVEs	% SVEs	Couplets
735	0.67	5 <input checked="" type="checkbox"/>

Atrial tachycardia



Paroxysmal A fib





Summary Report			
Report Number : 8A931C7DE0F312E	Start Time : 8:58:00 AM	Total Beats : 105782	
Test Date : 3/27/2014	Hours Analyzed : 23 : 49 : 49	Unknown Beats : 12	
Report Date : 3/28/2014	Artifact : 0 : 01 : 08	Other Beats : 0	
		Percent AFIB : 4	
Heart Rates		Rate Dependent Events	
Min : 52 BPM at 09:24:30-1	Bradycardia Runs : 0	Pauses : 1	
Max : 137 BPM at 11:55:50-1	Longest : 0 beats at	Longest : 2.3 secs	
Avg : 74 BPM	Min rate : 0 BPM at	at 12:52:35-1	
Ventricular Events		Supraventricular Events	
Total Beats : 1	Couplets : 0	Total Beats : 9	Couplets : 0
% Beats : 0.00	Triplets : 0	% Beats : 0.01	
Forms : 1	Bigeminy Runs : 0		
AIVR/IVR Runs : 0		SVTach Runs : 0	
Longest : 0 beats at		Longest : 0 beats at	
Min Rate : 0 BPM		Max Rate : 0 BPM at	
V Tach Runs : 0		Max SVE/Minute : 3 beats at 18:02:00-1	
Longest : 0 beats at		Max SVE/Hour : 3 beats 18:00:00-1	
Max Rate : 0 BPM		Mean SVE/Hour : 0.4	
Max VE/Minute : 1 beats at 11:48:00-1		SVE/1000 : 0.1	
Max VE/Hour : 1 beats 11:00:00-1			
Mean VE/Hour : 0.0			
VE/1000 : 0.0			
Impressions and Findings			
<ol style="list-style-type: none"> 1. Rhythm analysis revealed paroxysmal atrial fibrillation. (percent A fib 4%). 2. There were 2 episode of patient's markers (palpitation) correlated with Paroxysmal A fib. 			

Atrial fibrillation



Summary Report

Report Number	: 8A94157DC0F211D	Start Time	: 5:17:00 PM	Total Beats	: 102108
Test Date	: 4/19/2012	Hours Analyzed	: 23 : 50 : 51	Unknown Beats	: 0
Report Date	: 4/23/2012	Artifact	: 0 : 02 : 44	Other Beats	: 0
				Percent AFIB	: 100

Heart Rates		Rate Dependent Events			
Min	: 46 BPM at 01:21:40-2	Bradycardia Runs	: 81	Pauses	: 0
Max					secs
Avg					

증상이 있는 환자에서 Rate control

- Resting : HR 70~90 BPM

- Mild exertion : less than 110BPM

Most of the rhythm was atrial fibrillation with **controlled** ventricular response. (average HR 71 BPM).

Most of the rhythm was atrial fibrillation with **slow** ventricular response. (average HR less than 60 BPM).

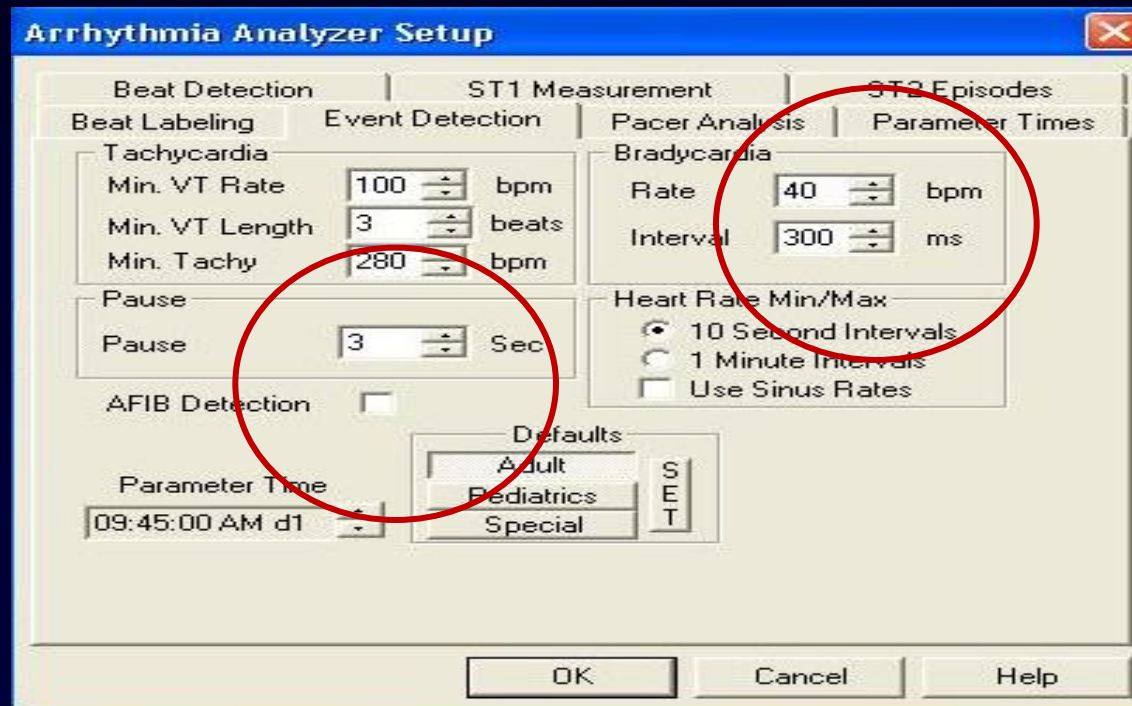
Most of the rhythm was atrial fibrillation with **rapid** ventricular response. (average HR more than 100 BPM).

Tachycardia(PSVT, AT, A fib)

Atrial fibrillation , Atrial tachycardia 같은 빈맥의 특성 분석에
홀터의 중요성이 커지고 있다.

영구적 심방세동 환자에서 약물 치료로 rate control 하는 환자들
의 HR 분석에 도움을 줄 수 있다.

Bradycardia(sss, block)



Indication(C-AV block):

Class I : 무증상의 각성상태에서 심정지기간이 3초이상, 이탈박동이 40회 미만인경우

Sinus bradycardia



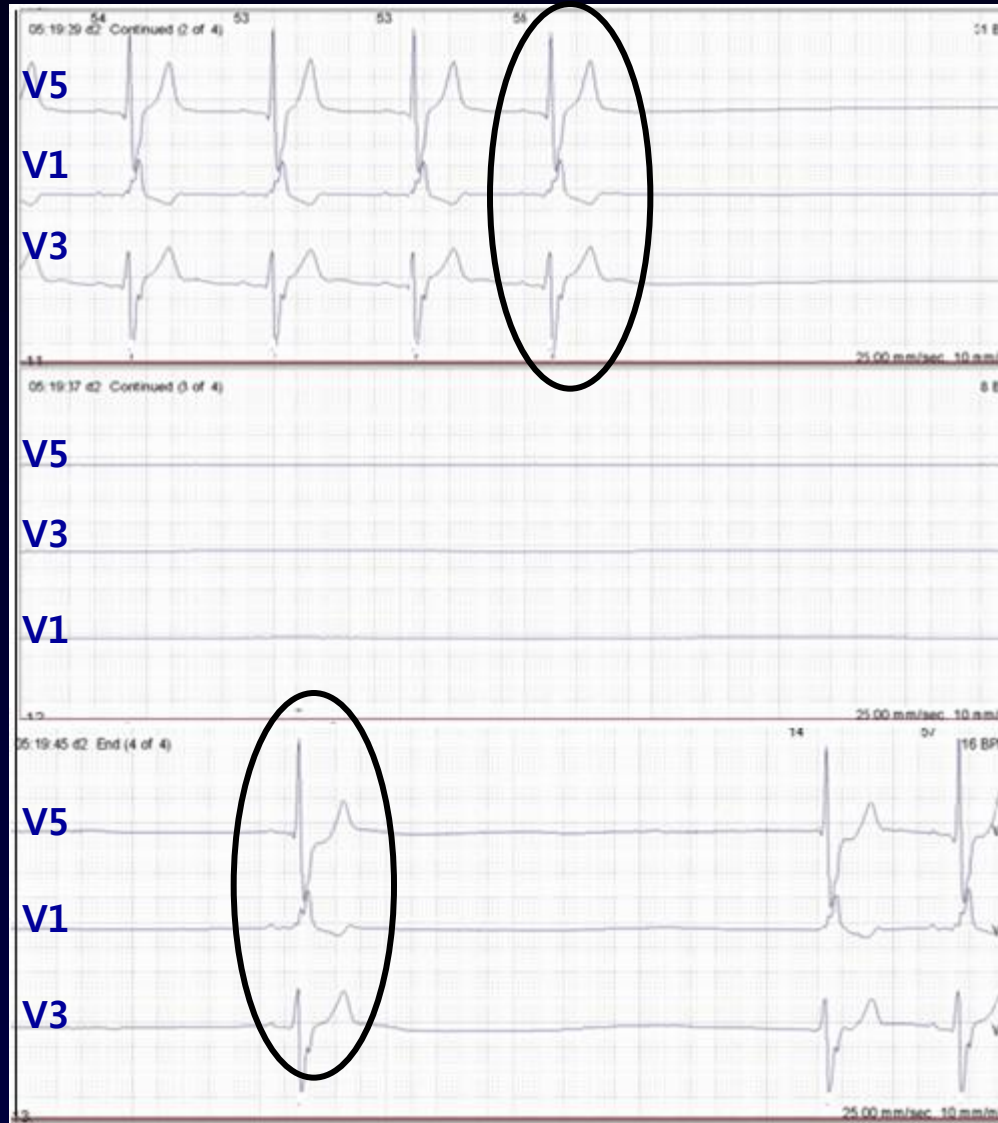
Summary Report					
Report Number	: 8A91127DC110637	Start Time	: 11:35:00 AM	Total Beats	: 77344
Test Date	: 1/17/2012	Hours Analyzed	: 21 : 28 : 55	Unknown Beats	: 0
Report Date	: 1/18/2012	Artifact	: 0 : 02 : 00	Other Beats	: 0
				Percent AFIB	: 0
Heart Rates		Rate Dependent Events			
Min	: 35 BPM at 13:04:20-1	Bradycardia Runs	: 323	Pauses	: 39
Max	: 92 BPM at 17:53:20-1	Longest	: 730 beats at 07:03:17-2	Longest	: 2.5 secs
Avg	: 60 BPM	Min rate	: 27 BPM at 13:04:35-1		at 11:54:51-1
Ventricular Events			Supraventricular Events		
Total Beats	: 10	Couplets	: 0	Total Beats	: 345
% Beats	: 0.01	Triplets	: 0	% Beats	: 0.45
Forms	: 2	Bigeminy Runs	: 0		
AJVR/IVR Runs	: 0				
Longest	: 0 beats at				
Min Rate	: 0 BPM				
V Tach Runs	: 0			SVTach Runs	: 6
Longest	: 0 beats at			Longest	: 11 beats at 08:59:10-2
Max Rate	: 0 BPM			Max Rate	: 122 BPM at 16:57:26-1
Max VE/Minute	: 1 beats at 11:58:00-1			Max SVE/Minute	: 14 beats at 17:52:00-1

1. Symptomatic bradycardia with min HR was 35BPM while awake.
2. The patient's markers (dizziness) were correlated with sinus bradycardia.

Conc> Symptomatic sick sinus syndrome.

Sinus pause





Summary Report			
Report Number : 8A9C067DB161A1D	Start Time : 2:28:00 PM	Total Beats : 101576	
Test Date : 12/5/2011	Hours Analyzed : 23 : 55 : 24	Unknown Beats : 0	
Report Date : 12/6/2011	Artifact : 0 : 00 : 31	Other Beats : 0	
		Percent AFIB : 0	
Heart Rates		Rate Dependent Events	
Min : 23 BPM at 06:12:20-2	Bradycardia Runs : 121	Pauses : 14	
Max : 111 BPM at 16:56:40-1	Longest : 266 beats at 16:50:10-1	Longest : 21.9 secs	
Avg : 70 BPM	Min rate : 6 BPM at 02:38:38-2		
Ventricular Events		Supraventricular Events	
Total Beats : 16	Couplets : 0	Total Beats : 4550	Couplets : 92
% Beats : 0.02	Triplets : 0	% Beats : 4.48	
Forms : 2	Bigeminy Runs : 0		
A/VR/IVR Runs : 0			
Longest : 0 beats at			
Min Rate : 0 BPM			
V Tach Runs : 0		SVTach Runs : 163	
Longest : 0 beats at		Longest : 1345 beats at 23:06:51-1	
Max Rate : 0 BPM		Max Rate : 111 BPM at 16:56:01-1	
Max VE/Minute : 3 beats at 13:17:00-2		Max SVE/Minute : 110 beats at 16:59:00-1	
Max VE/Hour : 9 beats 13:00:00-2		Max SVE/Hour : 1112 beats 17:00:00-1	
Mean VE/Hour : 0.7		Mean SVE/Hour : 197.8	
VE/1000 : 0.2		SVE/1000 : 44.8	

1. There were 14 episode of pause more than 3.0 sec, longest pause 21.9 sec.
2. The patient's markers(dizziness, chest tightness) were correlated with sinus pause.

Conc> Symptomatic sick sinus syndrome.

Sick sinus syndrome

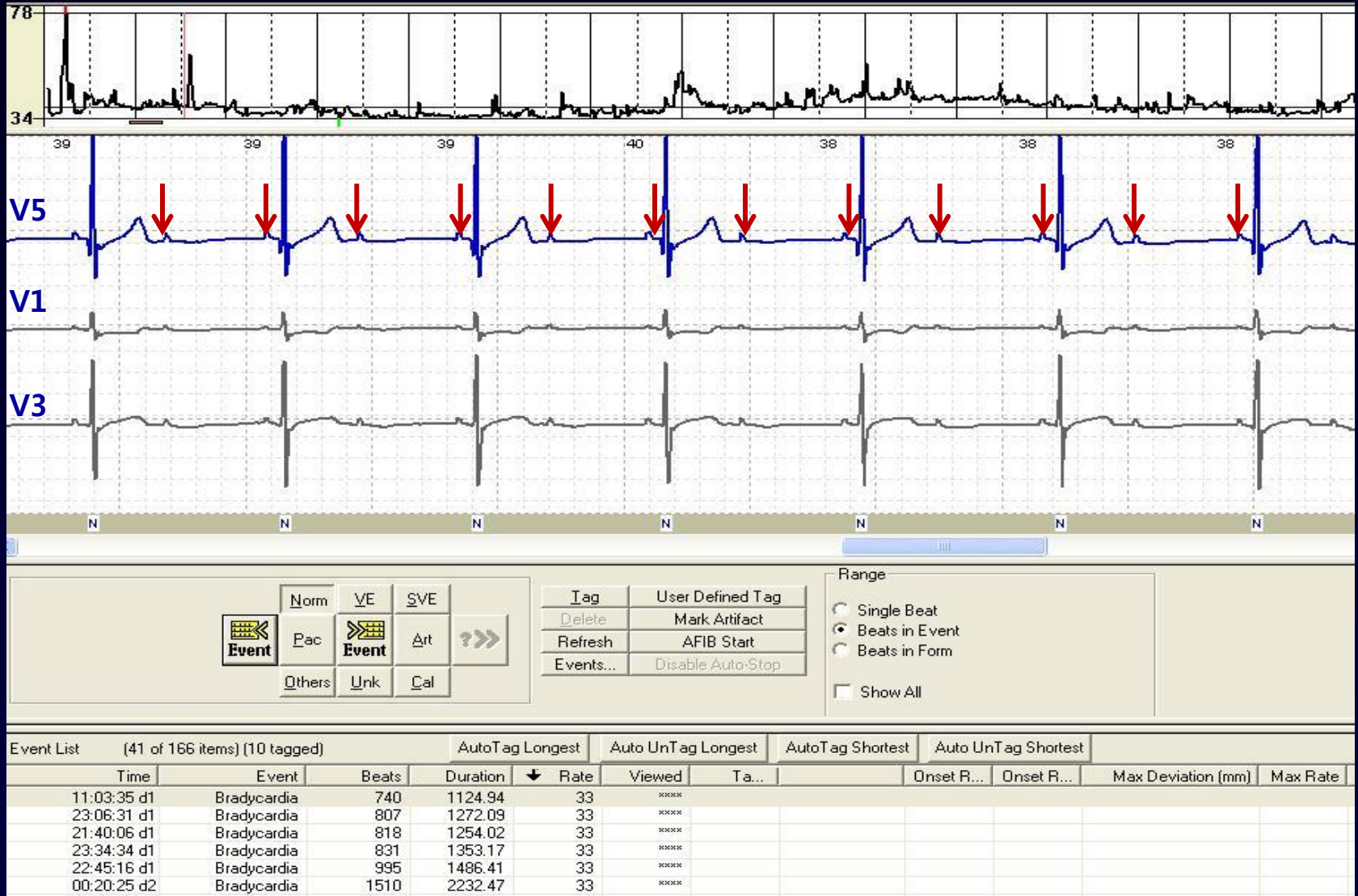
수면 중 분당 35~40회의 sinus bradycardia, 3초 전 후의 pause
등이 있는 경우 반드시 이상을 의미하지는 않는다.

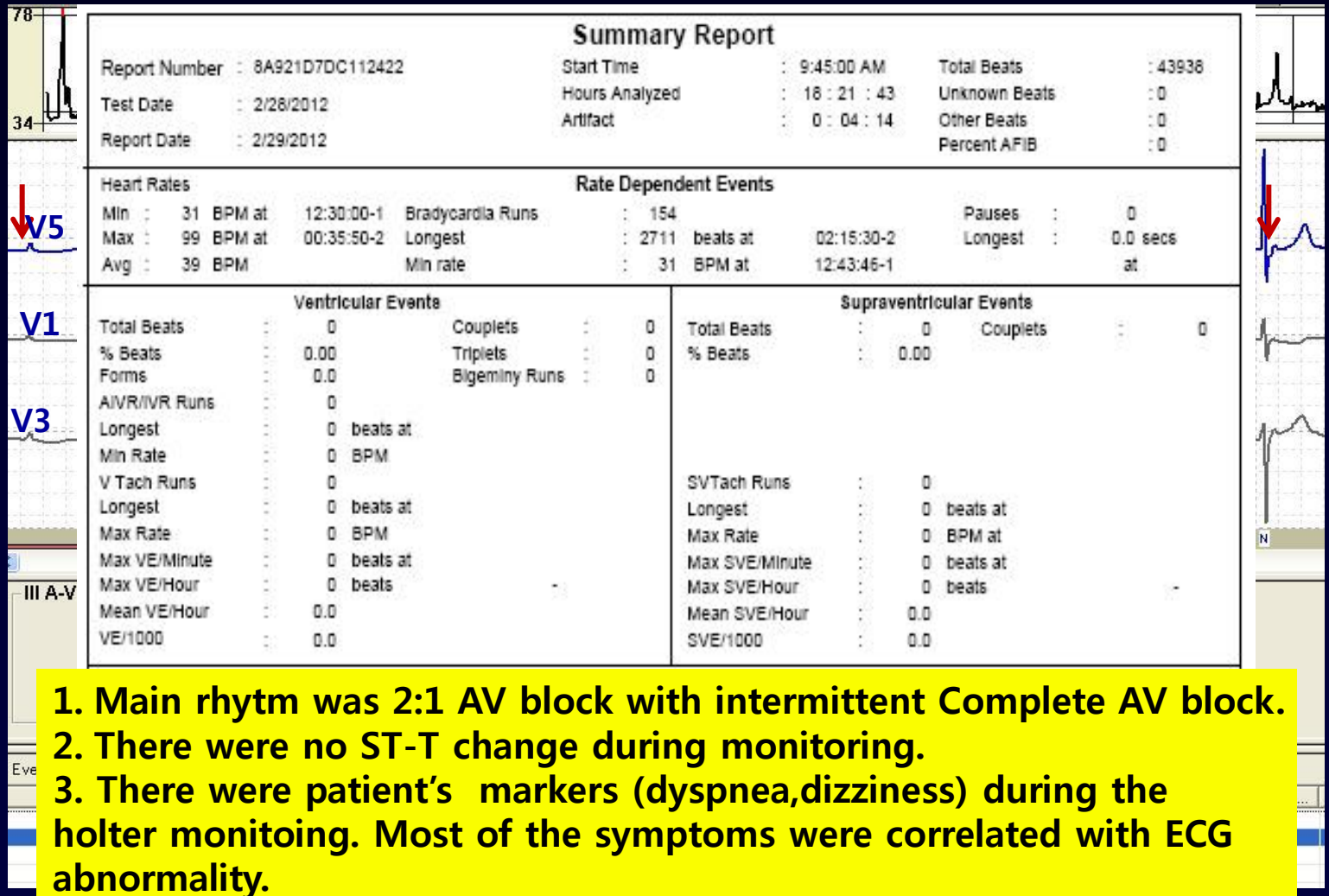
증상과 연관이 있을 경우만이 심박동기 치료술의 대상이 된다.

Second degree AV block



2:1 AV block





Summary Report

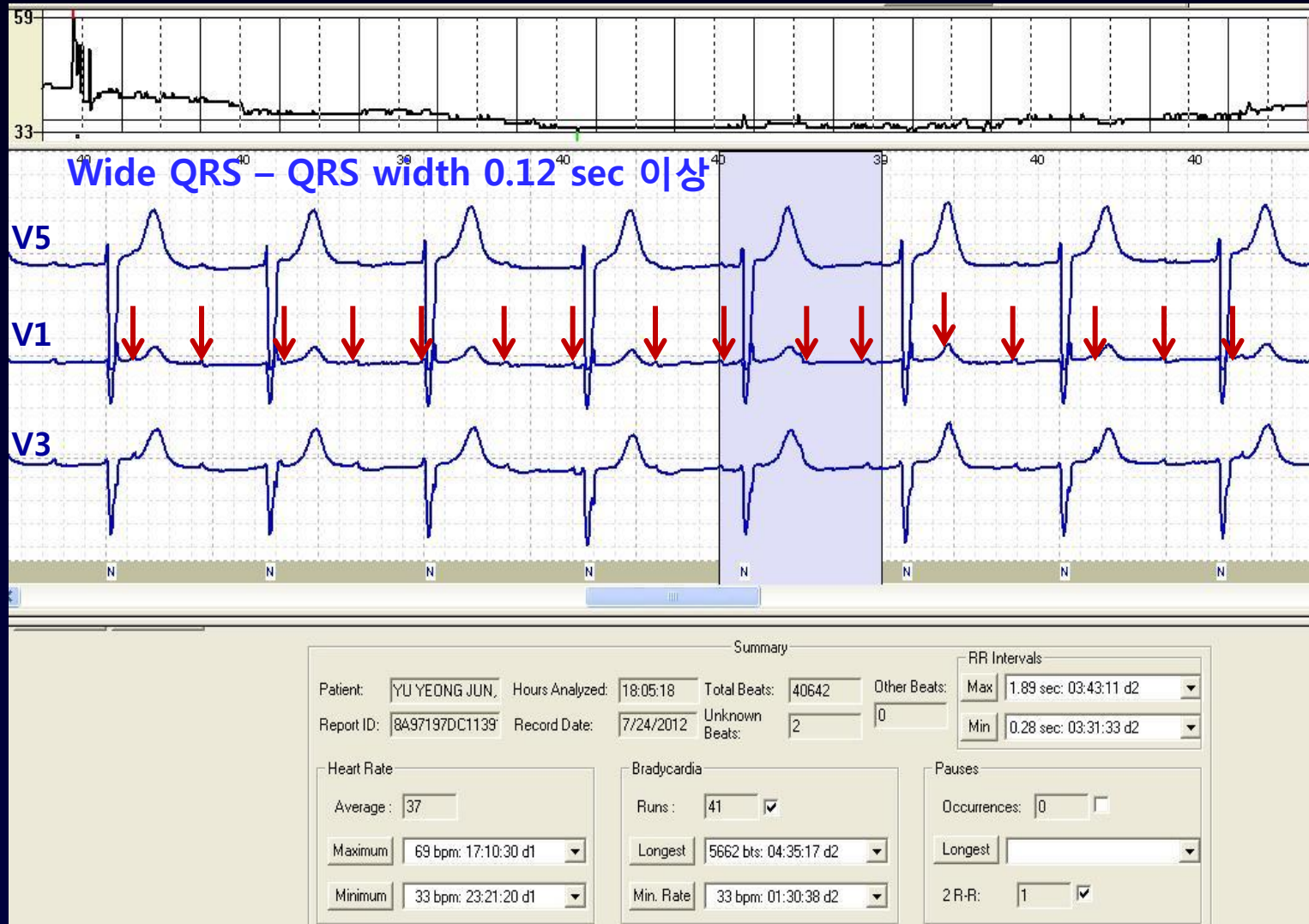
Report Number : 8A921D7DC112422	Start Time : 9:45:00 AM	Total Beats : 43936
Test Date : 2/26/2012	Hours Analyzed : 18 : 21 : 43	Unknown Beats : 0
Report Date : 2/29/2012	Artifact : 0 : 04 : 14	Other Beats : 0
		Percent AFIB : 0

Heart Rates		Rate Dependent Events	
Min : 31 BPM at 12:30:00-1	Bradycardia Runs : 154	Pauses : 0	
Max : 99 BPM at 00:35:50-2	Longest : 2711 beats at 02:15:30-2	Longest : 0.0 secs	
Avg : 39 BPM	Min rate : 12:43:46-1		

Ventricular Events		Supraventricular Events	
Total Beats : 0	Couplets : 0	Total Beats : 0	Couplets : 0
% Beats : 0.00	Triplets : 0	% Beats : 0.00	
Forms : 0.0	Bigeminy Runs : 0		
AIVR/IVR Runs : 0			
Longest : 0 beats at			
Min Rate : 0 BPM			
V Tach Runs : 0		SVTach Runs : 0	
Longest : 0 beats at		Longest : 0 beats at	
Max Rate : 0 BPM		Max Rate : 0 BPM at	
Max VE/Minute : 0 beats at		Max SVE/Minute : 0 beats at	
Max VE/Hour : 0 beats		Max SVE/Hour : 0 beats	
Mean VE/Hour : 0.0		Mean SVE/Hour : 0.0	
VE/1000 : 0.0		SVE/1000 : 0.0	

1. Main rhythm was 2:1 AV block with intermittent Complete AV block.
2. There were no ST-T change during monitoring.
3. There were patient's markers (dyspnea,dizziness) during the holter monitoring. Most of the symptoms were correlated with ECG abnormality.

C-AV block with wide QRS



Block site

-Narrow QRS-

Supra His block

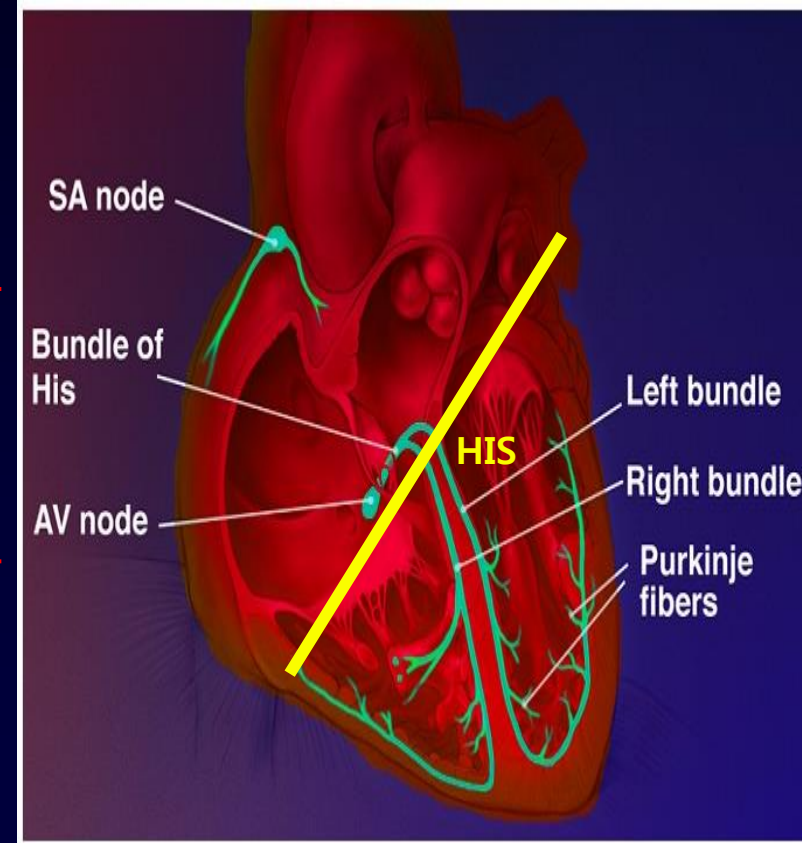
잠재적 pacemaker 는 AV node(40~60bpm/min)

-Wide QRS-

Infra His block

잠재적 pacemaker는 ventricle(20~40bpm/min)

90% 이상에서 pacemaker 시술



Summary Report

Report Number : 8A95167DD102805	Start Time : 9:38:00 AM	Total Beats : 48418
Test Date : 5/21/2013	Hours Analyzed : 23 : 53 : 35	Unknown Beats : 0
Report Date : 5/22/2013	Artifact : 1 : 18 : 37	Other Beats : 0
		Percent AFIB : 0

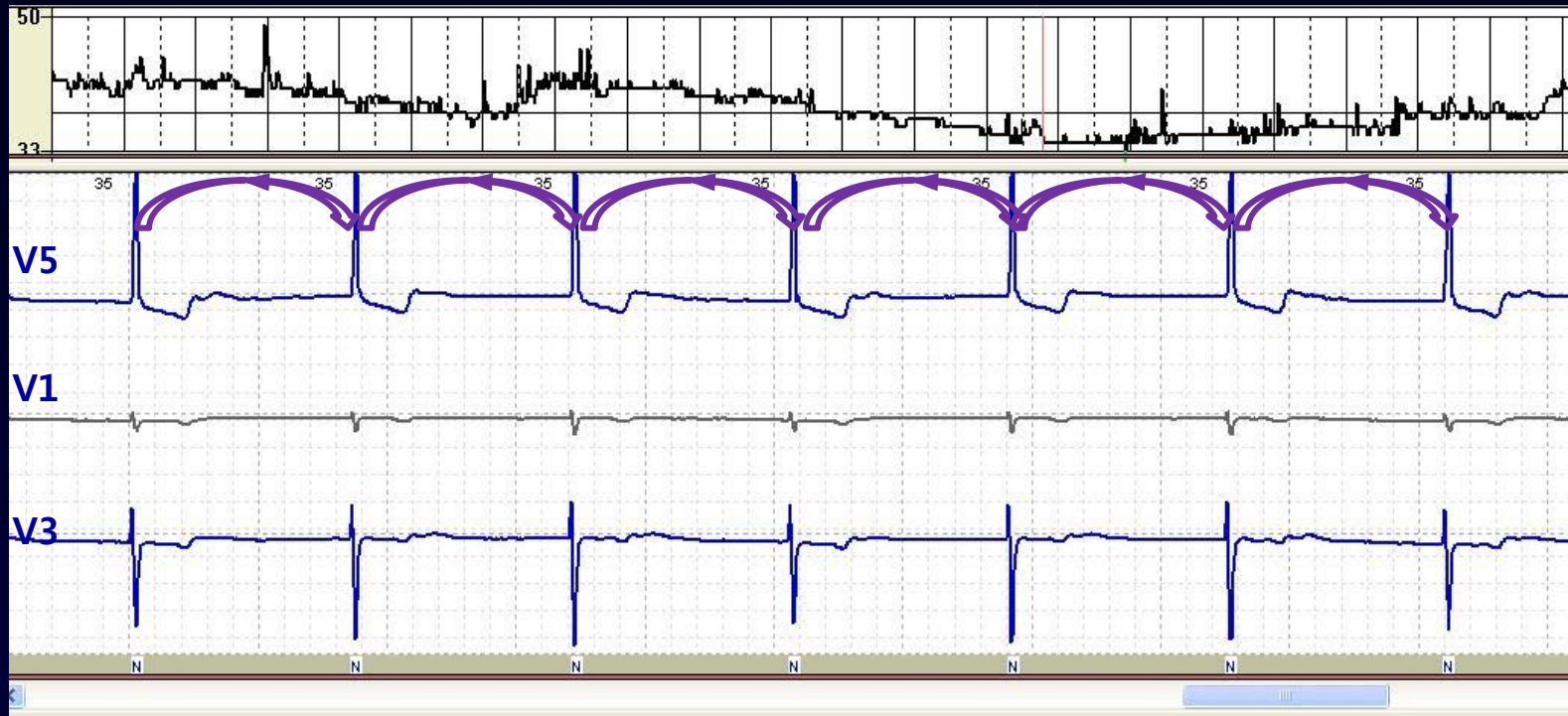
Heart Rates		Rate Dependent Events		Pauses :	0
Min :	25 BPM at 07:37:40-2	Bradycardia Runs :	2100	Longest :	0.0 secs
Max :	55 BPM at 05:32:20-2	Longest :	1370 beats at 07:27:34-2		
Avg :	34 BPM	Min rate :	25 BPM at 07:38:10-2		

Ventricular Events		Supraventricular Events	
Total Beats :	0	Couplets :	0
% Beats :	0.00	Triplets :	0
Forms :	0.0	Bigeminy Runs :	0
AJVR/IVR Runs :	0		
Longest :	0 beats at		
Min Rate :	0 BPM		
V Tach Runs :	0	SVTach Runs :	0
Longest :	0 beats at	Longest :	0 beats at
Max Rate :	0 BPM	Max Rate :	0 BPM at
Max VE/Minute :	0 beats at	Max SVE/Minute :	0 beats at
Max VE/Hour :	0 beats	Max SVE/Hour :	0 beats
Mean VE/Hour :	0.0	Mean SVE/Hour :	0.0
VE/1000 :	0.0	SVE/1000 :	0.0

1. Complete AV block with wide QRS morphology(infra-his block).
2. Symptomatic bradycardia (Avg HR 34 BPM)
3. The patient's markers (dizziness, chest tightness, dyspnea) were correlated 24 hours ECG.

Conc> Complete AV block with ventricular escape rhythm (Infra His block).

A fib with C-AV block



S-T Pacer The first maximum heart rate Percent AFIB 100

Summary

Patient: BAEG LANG JA, I Hours Analyzed: 24:02:08 Total Beats: 56443 Other Beats: 0

Report ID: 8A9B057DB1226 Record Date: 11/4/2011 Unknown Beats: 0

RR Intervals
Max 1.83 sec: 01:55:34 d2
Min 0.53 sec: 08:02:03 d2

Heart Rate
Average: 39
Maximum 58 bpm: 14:00:10 d1
Minimum 33 bpm: 00:22:40 d2

Bradycardia
Runs: 26
Longest 18182 bts: 02:29:07 d2
Min. Rate 33 bpm: 02:29:07 d2

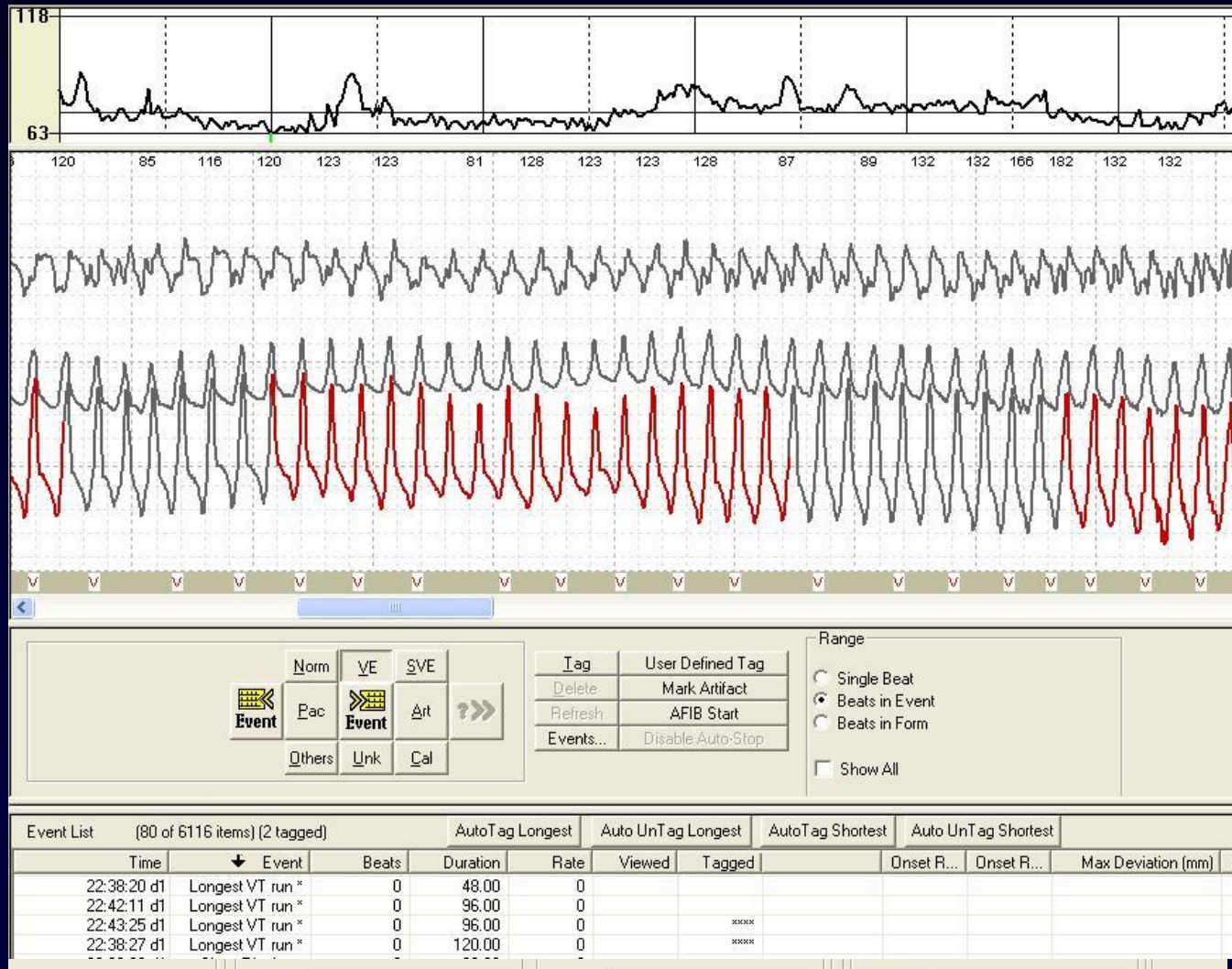
Pauses
Occurrences: 0
Longest
2 R-R: 0

Summary Report			
Report Number : 8A9B057DB12263B	Start Time : 11:02:00 AM	Total Beats : 56443	
Test Date : 11/4/2011	Hours Analyzed : 24 : 02 : 05	Unknown Beats : 0	
Report Date : 11/5/2011	Artifact : 0 : 00 : 05	Other Beats : 0	
		Percent AFIB : 0	
Heart Rates		Rate Dependent Events	
Min : 33 BPM at 00:22:30-2	Bradycardia Runs : 26	Pauses : 0	
Max : 56 BPM at 14:01:00-1	Longest : 1515 beats at 02:29:05-2	Longest : 0.0 secs at	
Avg : 39 BPM	Min rate : 33 BPM at 02:29:05-2		
Ventricular Events		Supraventricular Events	
Total Beats : 30	Couplets : 2	Total Beats : 14	Couplets : 2
% Beats : 0.05	Triplets : 0	% Beats : 0.02	
Forms : 4	Bigeminy Runs : 0		
AJVR/IVR Runs : 0			
Longest : 0 beats at			
Min Rate : 0 BPM			
V Tach Runs : 0		SVTach Runs : 0	
Longest : 0 beats at		Longest : 0 beats at	
Max Rate : 0 BPM		Max Rate : 0 BPM at	
Max VE/Minute : 2 beats at 21:36:00-1		Max SVE/Minute : 2 beats at 06:02:00-2	
Max VE/Hour : 7 beats 10:00:00-2		Max SVE/Hour : 11 beats 06:00:00-2	
Mean VE/Hour : 1.3		Mean SVE/Hour : 0.6	
VE/1000 : 0.5		SVE/1000 : 0.2	

1. Most of the rhythm was atrial fibrillation with slow ventricular response (avg HR 39 BPM) & complete AV block.
2. The patient's markers (dizziness) were associated 24 hours ECG

Conc> Symptomatic atrial fibrillation with complete AV block.

MI with VT



Low grade 분류(MI후 돌연사 위험성 판정)

0도 VPC가 없음

1도 1A - VPC가 30개/시간 미만, 1개/분 이하
1B - VPC가 30개/시간 미만, 가끔 2개/분 이상

2도 VPC 30개/시간 이상

3도 Multifrom VPC

4도 4A - pair 혹은 couple
4B - VT(연속적인 3개이상의 VPC)

5도 R-on-T 현상

Summary Report			
Report Number	: 8A931C7DE100A08	Start Time	: 3:03:00 PM
Test Date	: 3/27/2014	Hours Analyzed	: 7 : 40 : 20
Report Date	: 3/28/2014	Artifact	: 0 : 00 : 50
Total Beats	: 33804	Unknown Beats	: 94
Other Beats	: 0	Percent AFIB	: 0
Heart Rates		Rate Dependent Events	
Min	: 58 BPM at 16:04:10-1	Bradycardia Runs	: 0
Max	: 133 BPM at 22:39:10-1	Longest	: 0 beats at
Avg	: 73 BPM	Min rate	: 0 BPM at
Ventricular Events		Supraventricular Events	
Total Beats	: 10888	Couplets	: 708
% Beats	: 32.21	Triplets	: 137
Forms	: 113	Bigeminy Runs	: 228
AVR/VR Runs	: 880		
Longest	: 8 beats at 15:09:02-1		
Min Rate	: 65 BPM 22:22:56-1		
V Tach Runs	: 228		
Longest	: 10 beats at 18:35:00-1		
Max Rate	: 156 BPM 15:21:47-1		
Max VE/Minute	: 115 beats at 22:40:00-1		
Max VE/Hour	: 1526 beats 16:00:00-4		
Mean VE/Hour	: 1555.4		
VE/1000	: 322.1		
Total Beats	: 81	Couplets	: 5
% Beats	: 0.24		
SVTach Runs	: 2		
Longest	: 4 beats at 15:28:18-1		
Max Rate	: 142 BPM at 16:28:30-1		
Max SVE/Minute	: 9 beats at 15:28:00-1		
Max SVE/Hour	: 19 beats 16:00:00-1		
Mean SVE/Hour	: 11.6		
SVE/1000	: 2.4		

1. Rhythm was revealed frequent VPCs (low grade 5)
2. Polymorphic VT was induced with R-on-T phenome none.
3. The patient's symptom not analysis due to CPR state.

MI with VT

MI후 심실빈맥과 심실세동으로 인한 급성 심장사의 위험을 (1년내의 위험율 5%).

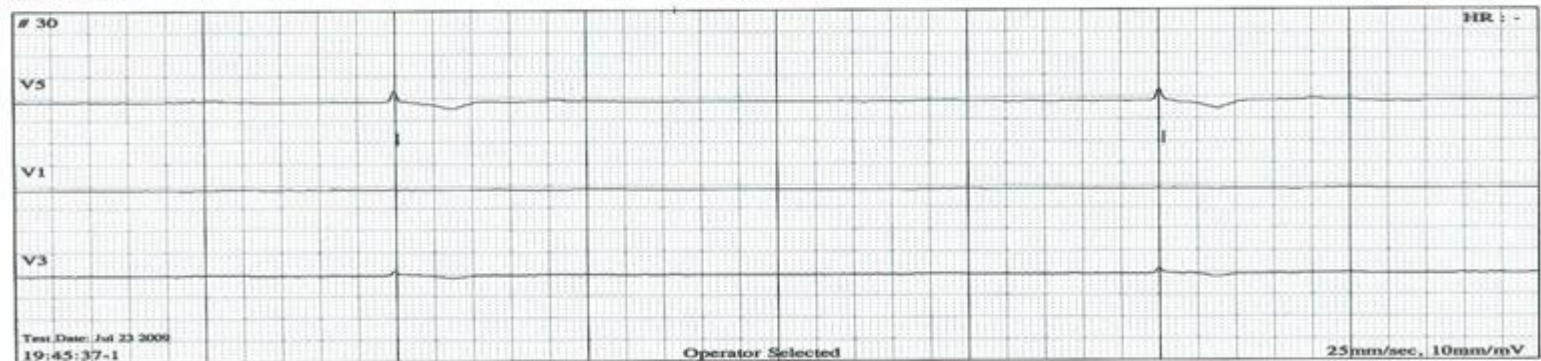
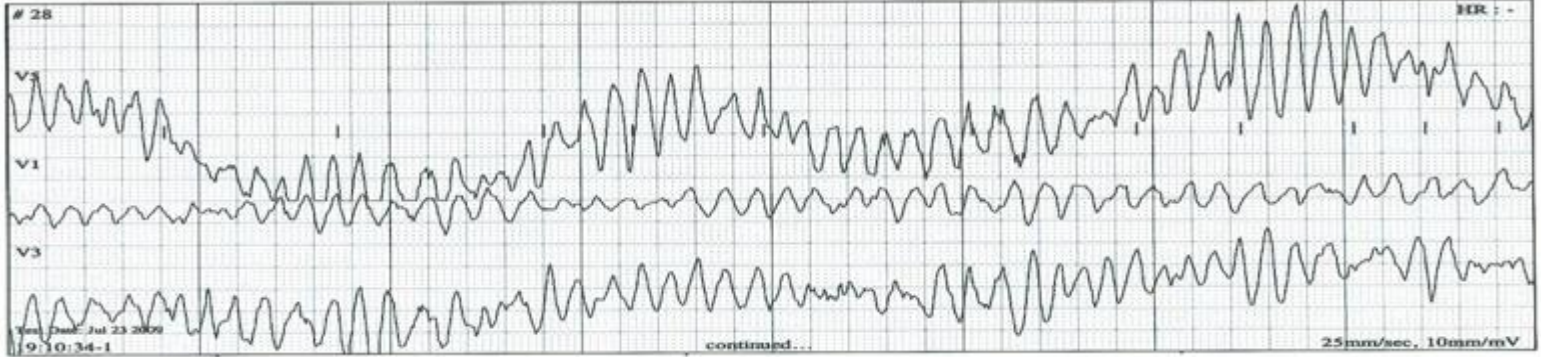
홀터에서 시간당 10회 이상의 VPC나 high grade 의 ventricular ectopy beat는 높은 사망률과 관련이 있다.



Patient :

Event Strip - Ch : 1 & 2 & 3

Report Date :



Printed Jul 31 2009 08:31:08

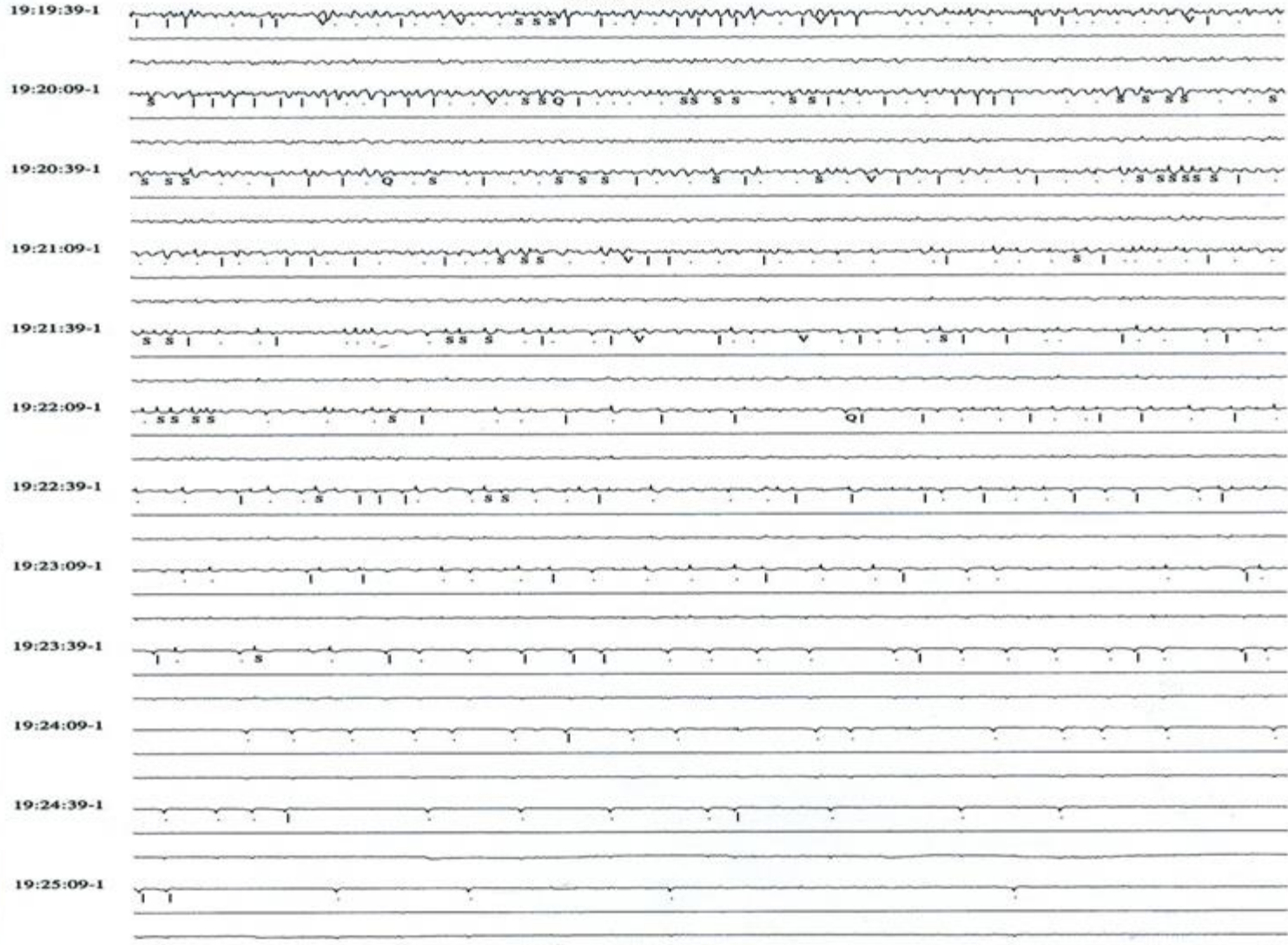
Min VT rate: 100 bpm
 Min SVT rate: 30 bpm
 SVE prearrhythmia: 0.20 %
 Bradycardia rate: 30 bpm
 Bradycardia interval: 300 msec

atient :

Event Page - Ch: 1 & 2 & 3

Report Date :

Operator Selected



Test Date: Jul 23 2009

Holter ECG

홀터 검사는 조기수축을 정량화 할 수 있고,

빠른 혹은 느린 부정맥의 시작과 끝에 대한 정보를 얻을 수 있다.

특히 심박동기 시술 예정인 환자는 심박동기 Indication에 해당되는

비정상 소견을 꼭 출력해주어야 하며 환자의 증상 관련 여부를

반드시 확인하여야 한다.

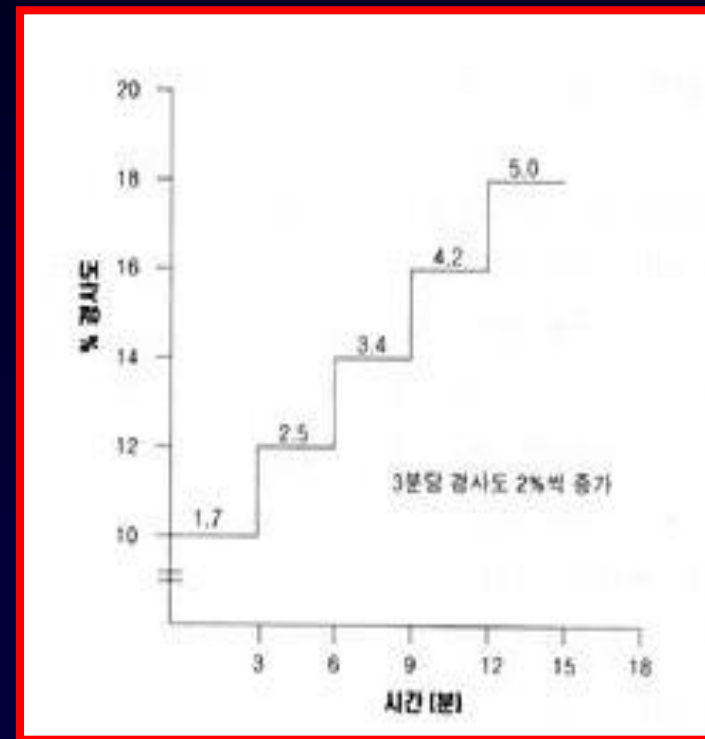
EXERCISE ECG



최초 운동시작의 부하를 경사도 10%에서 1.7mph로 3분 동안 실시하며

이후 매 3분마다 경사도 2%, 속도는 0.8~0.9mph씩 증가시킨다

단계별로 약 2~3 mets 씩 증가해서 피검자가 최대에 도달할때 까지 수행





답차→발로 밟아서 강물을 땅위로 퍼올리는기구, 19세기 영국 죄인 처벌하는 용도로 쓰임, 에드워드 스미스가 운동부하 검사에 처음 이용함

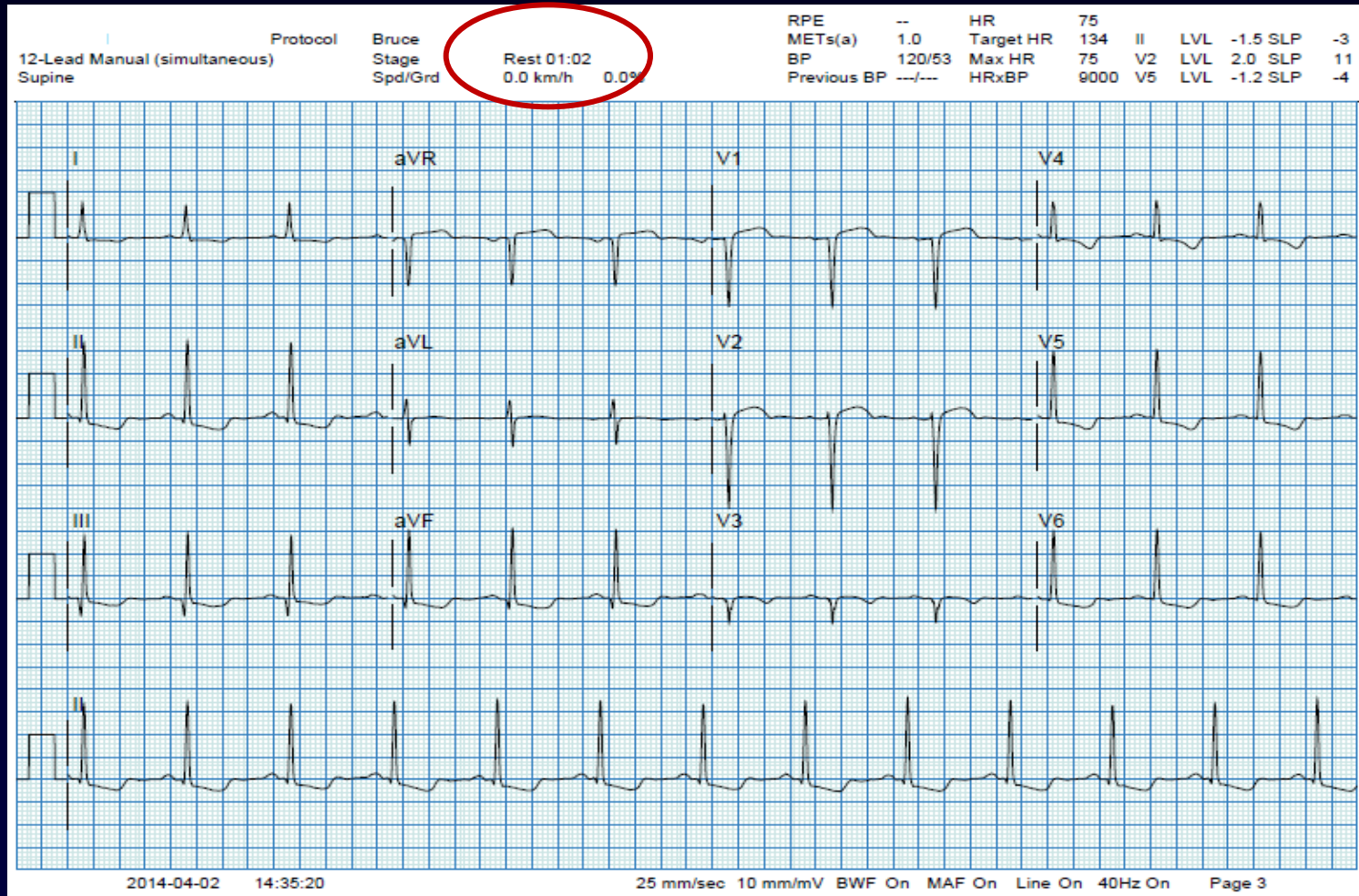
Indication

운동은 교감신경(카테콜아민상승)을 흥분시키고, 심근허혈을 발생시키며, 심박동수를 증강시켜 이들 기전에 의해 발생하는 부정맥을 진단할 수 있다.

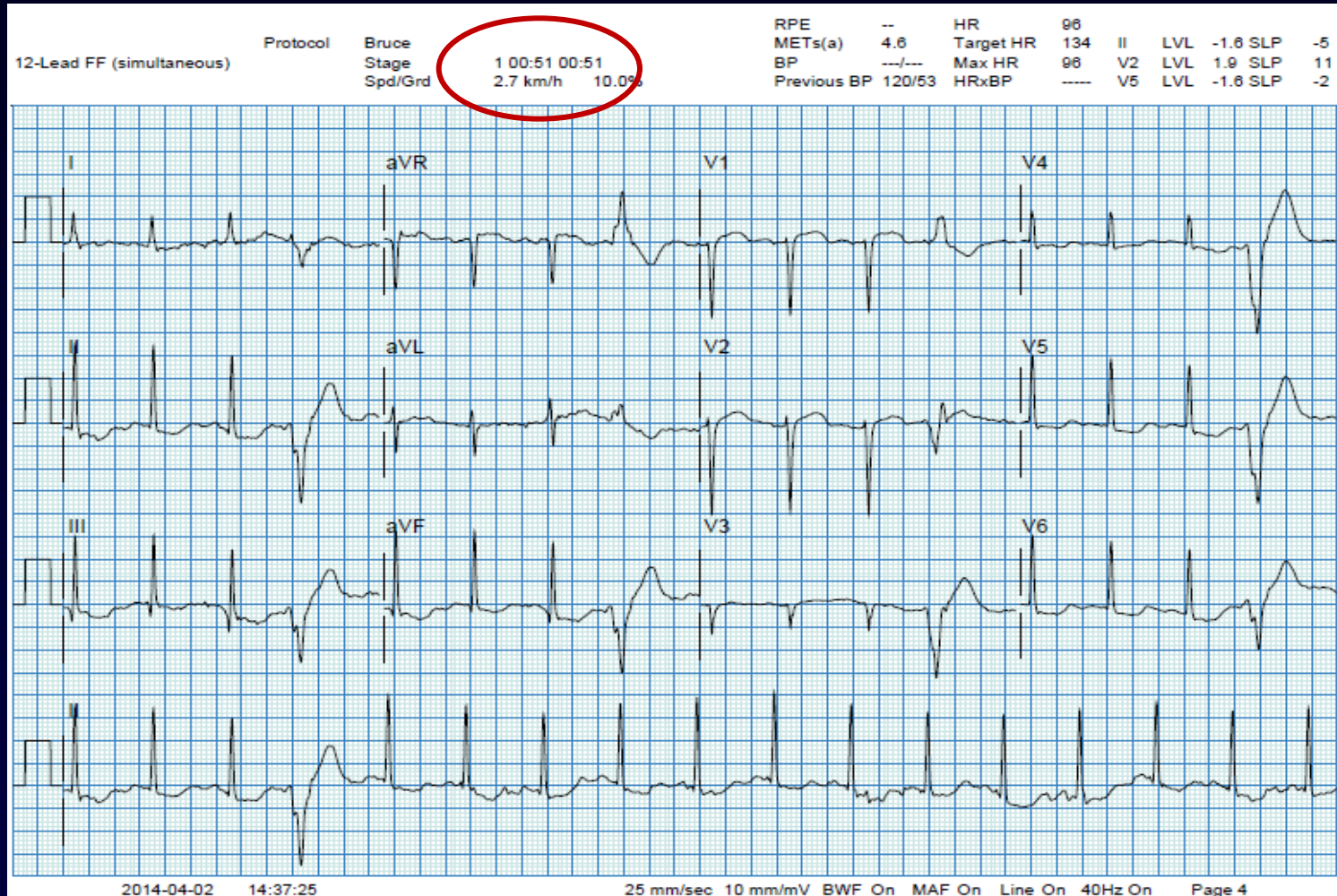
1. 관상동맥 질환 진단의 확인
2. 흉통의 감별진단
3. 잠복기 관상동맥질환의 조기 발견
4. 심장 부정맥의 운동과의 관련성 평가
5. 운동과 관련된 증상(의식혼절, 심계항진, 흉통 등)의 평가
6. 불안정성 고혈압(labile hypertension)의 조기 발견

유발될 수 있는 부정맥-VPC, VT, PSVT, Atrial fibrillation, Pause

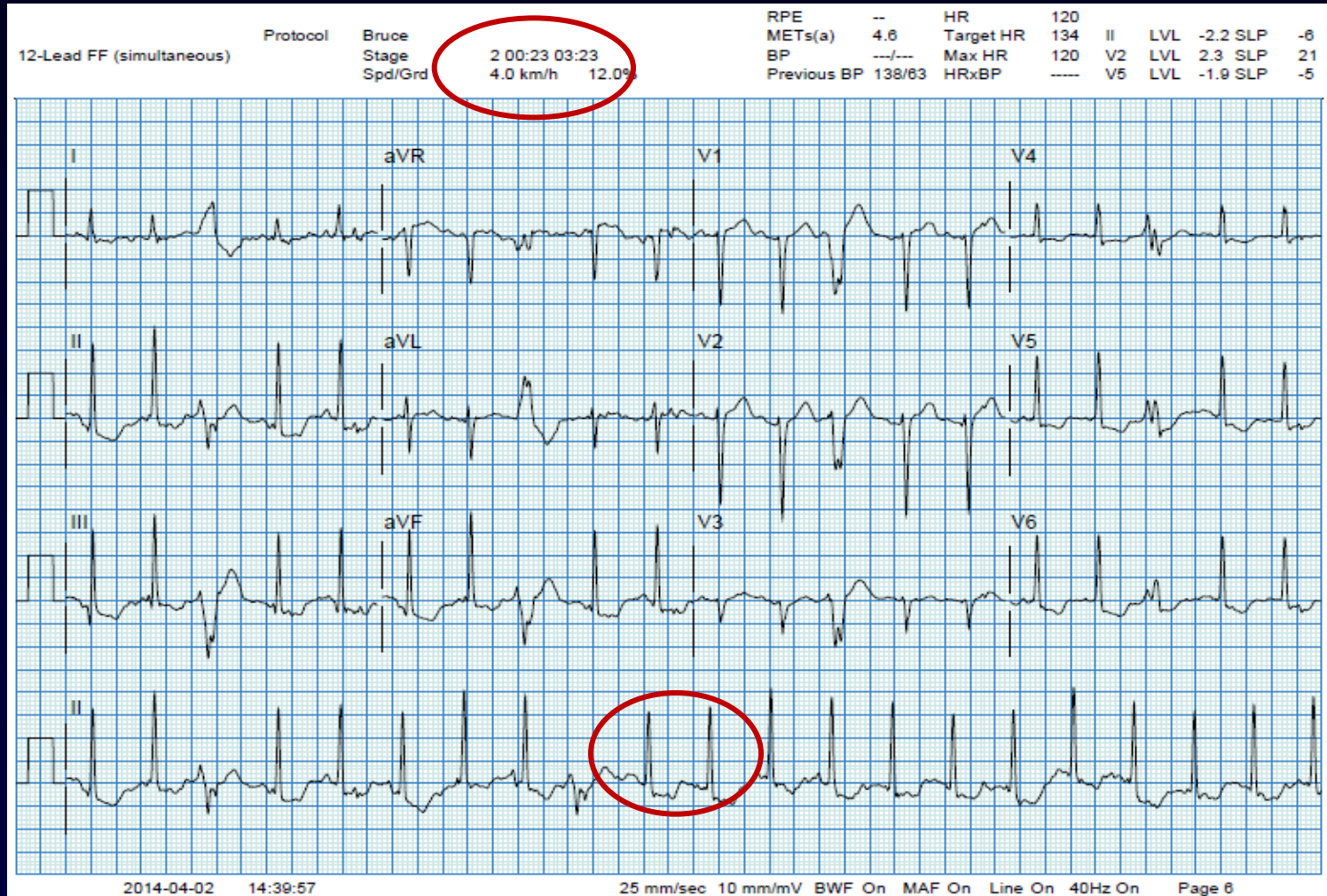
62/M 걸을때 dyspnea, OMI



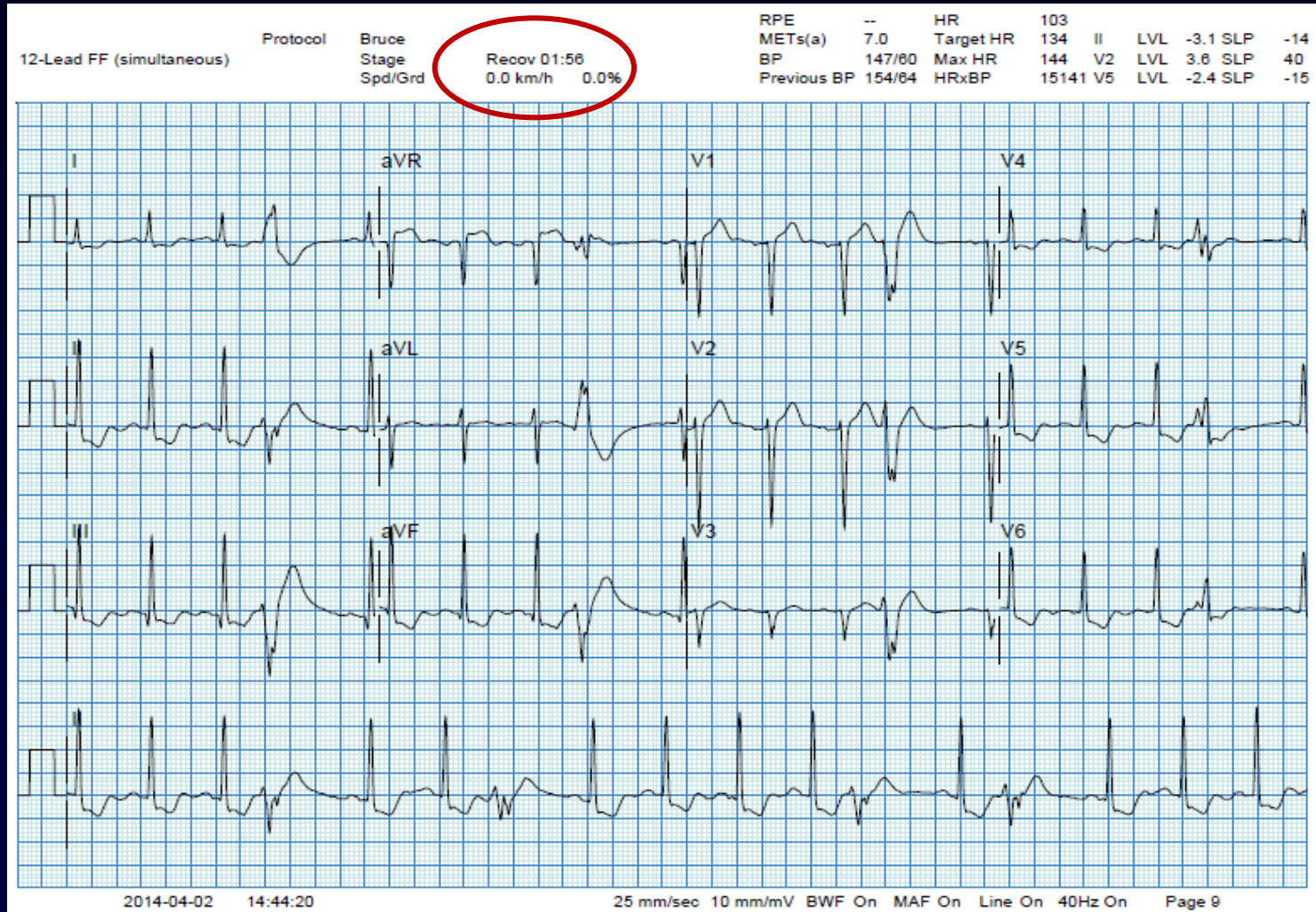
VPC



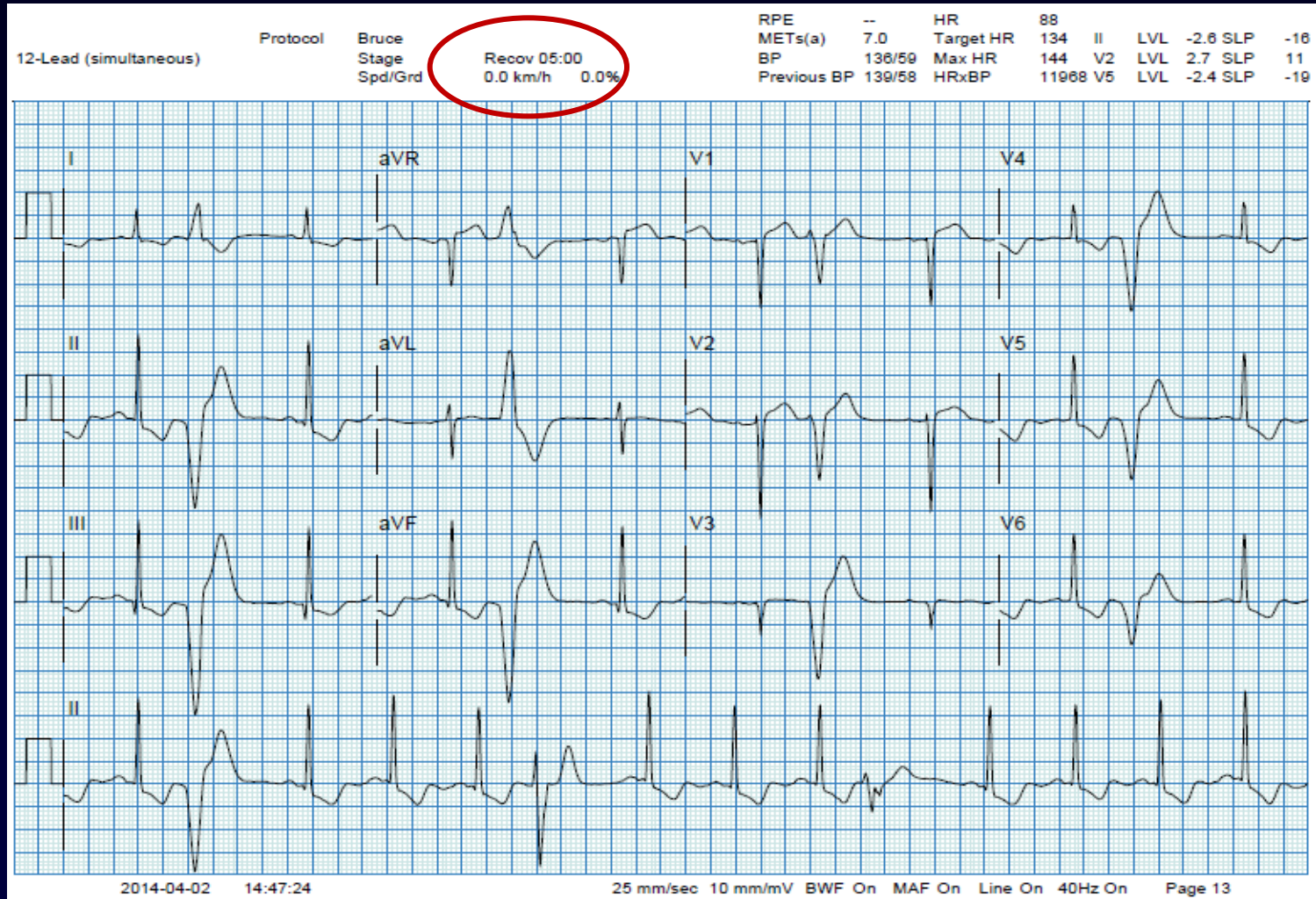
VPC



VPC



VPC

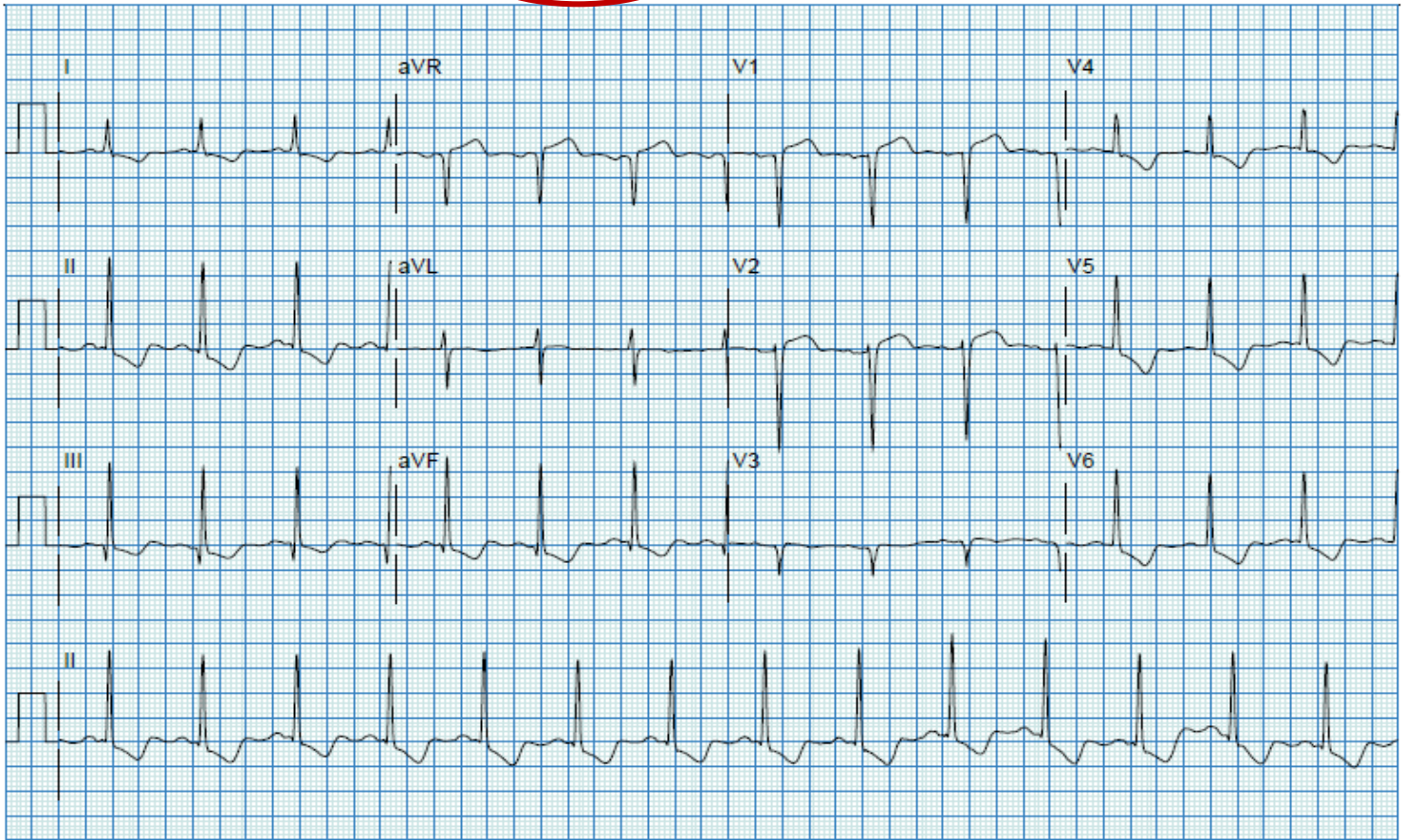


12-Lead (simultaneous)

Protocol Bruce
Stage
Spd/Grd

Recov 07:00
0.0 km/h 0.0%

RPE	--	HR	87				
METs(a)	7.0	Target HR	134	II	LVL	-2.3	SLP -15
BP	129/60	Max HR	144	V2	LVL	2.5	SLP 10
Previous BP	136/59	HRxBP	11223	V5	LVL	-2.0	SLP -15



2014-04-02 14:49:24

25 mm/sec 10 mm/mV BWF On MAF On Line On 40Hz On Page 15

VPC

관상동맥 질환 환자의 50% 에서 운동시 발생하며,
정상인 보다 낮은 맥박수(<130회/분)에서 잘 유발되며
recovery때 발생하는 VPC는 예후가 나쁘다.

56/M 계단 오를때 chest tightness

12-Lead Manual(simultaneous)
Supine

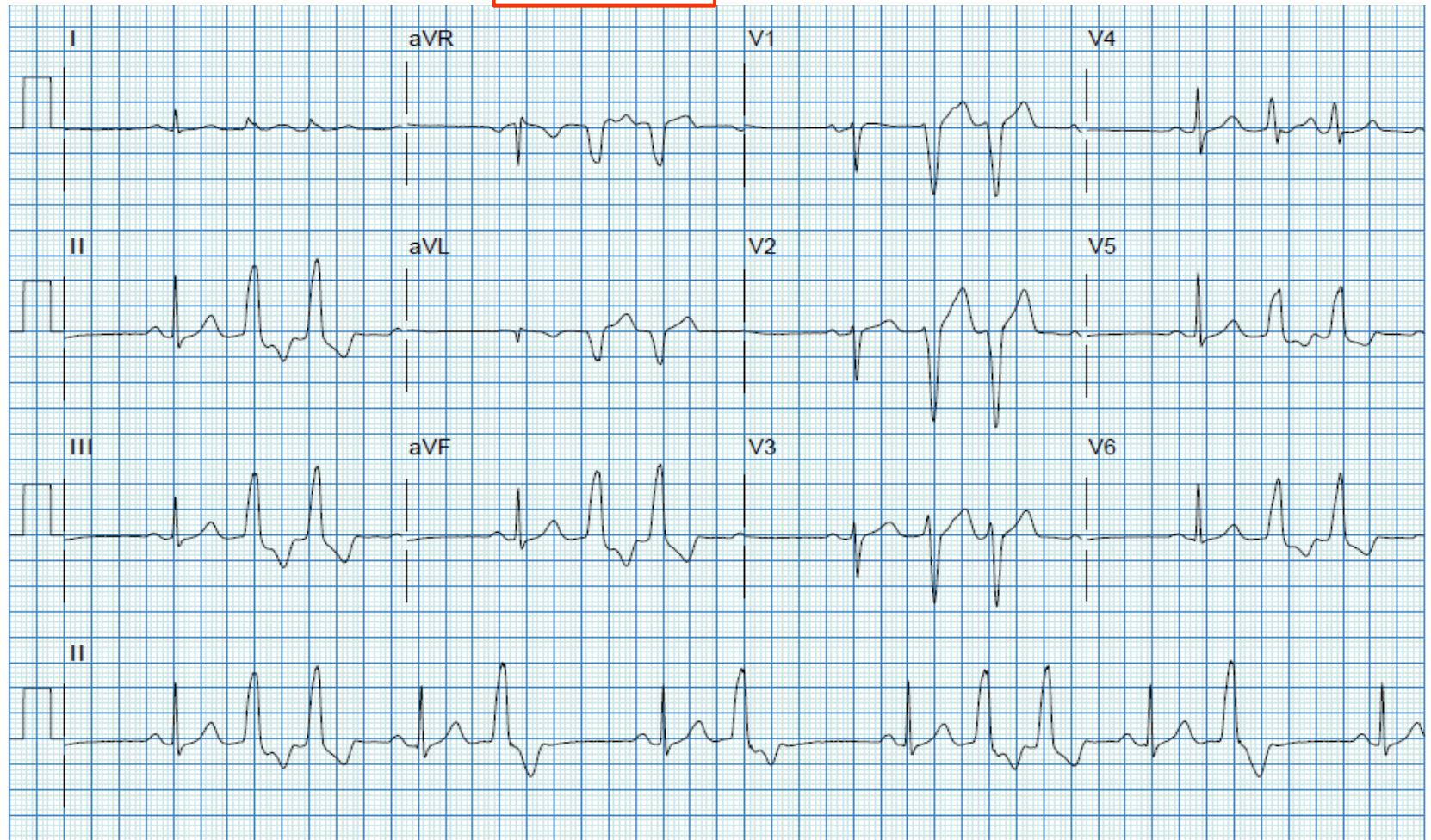
Protocol

Bruce
Stage
Spd/Grd

Rest 05:11
0.0 km/h 0.0%

RPE	--	HR	76
METs(a)	1.0	Target HR	139
BP	116/70	Max HR	76
Previous BP	--/--	HRxBP	8816

II	LVL	0.4	SLP	11
V2	LVL	1.3	SLP	6
V5	LVL	0.3	SLP	8



12-Lead Manual(simultaneous)

Protocol

Bruce

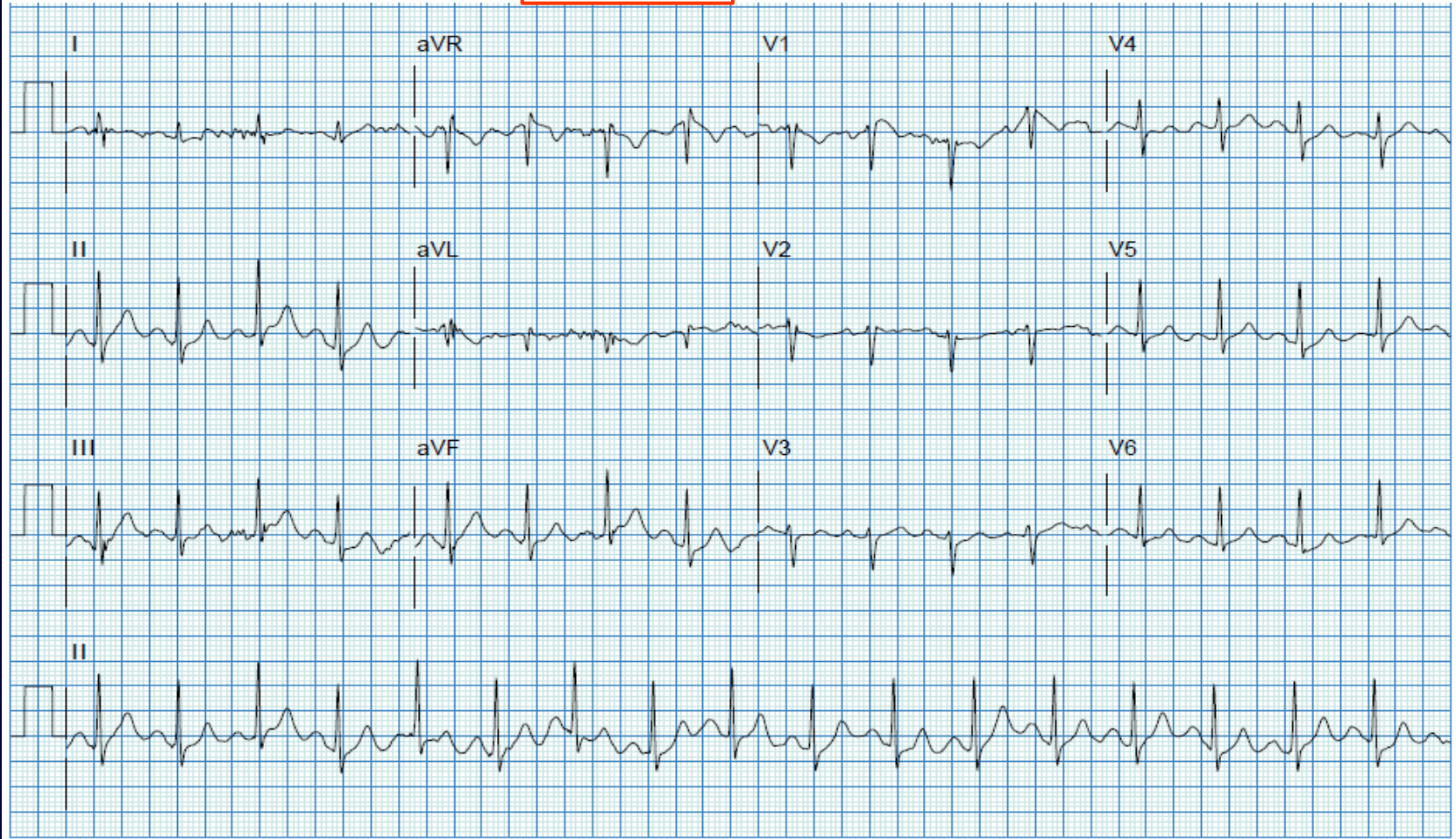
Stage

Spd/Grd

2 00:59 03:59

4.0 km/h 12.0%

RPE	-	HR	105	II	LVL	0.6	SLP	17
METs(a)	7.0	Target HR	139	V2	LVL	0.0	SLP	-3
BP	--/--	Max HR	110	V5	LVL	0.3	SLP	10
Previous BP	150/72	HRxBP	----					



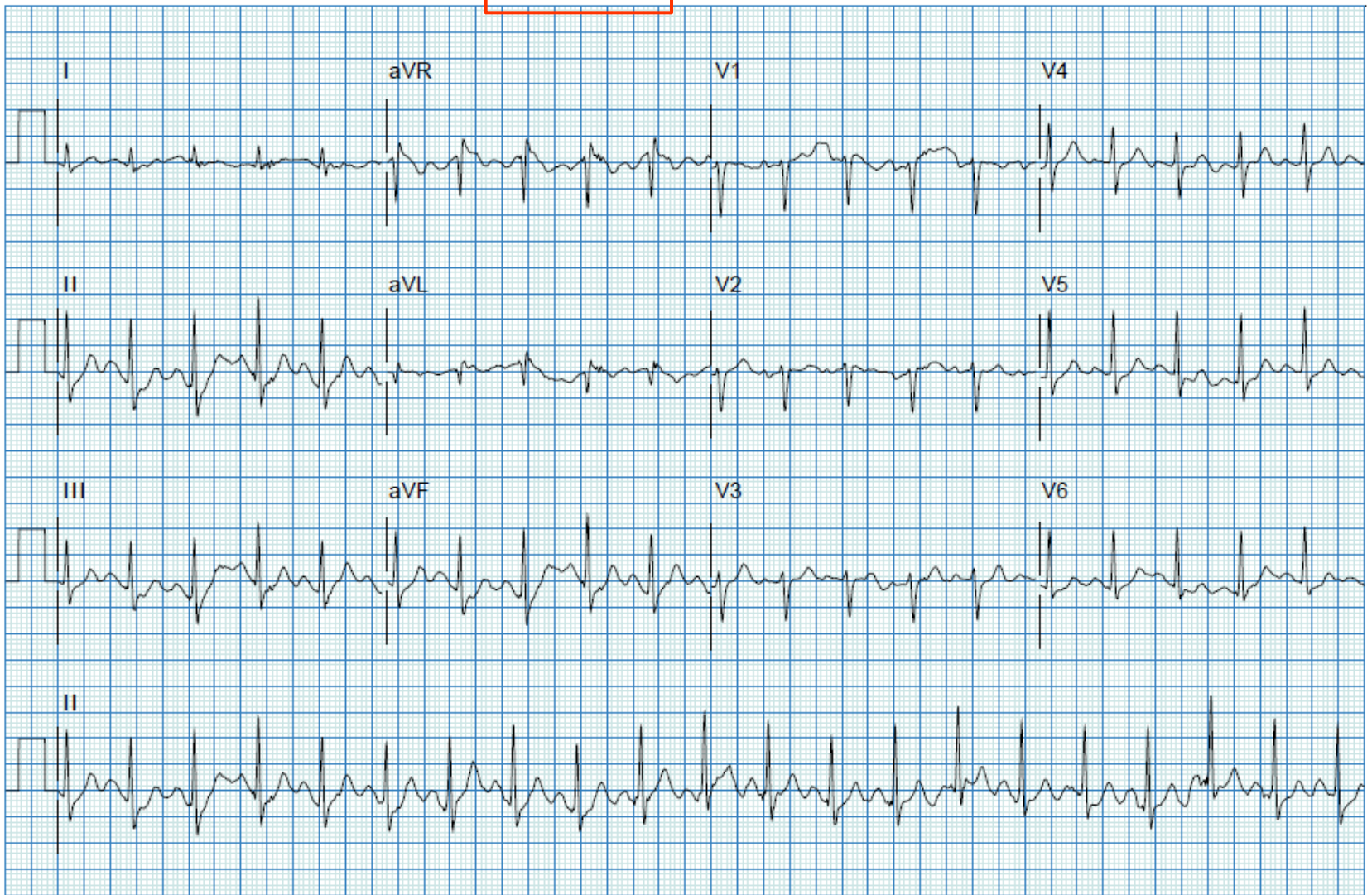
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

3 02:50 08:50
5.4 km/h 14.0%

METs(a)	10.1	Target HR	139	II	LVL	0.0	SLP	26
BP	174/82	Max HR	124	V2	LVL	0.5	SLP	5
Previous BP	161/73	HRxBP	21576	V5	LVL	0.1	SLP	18



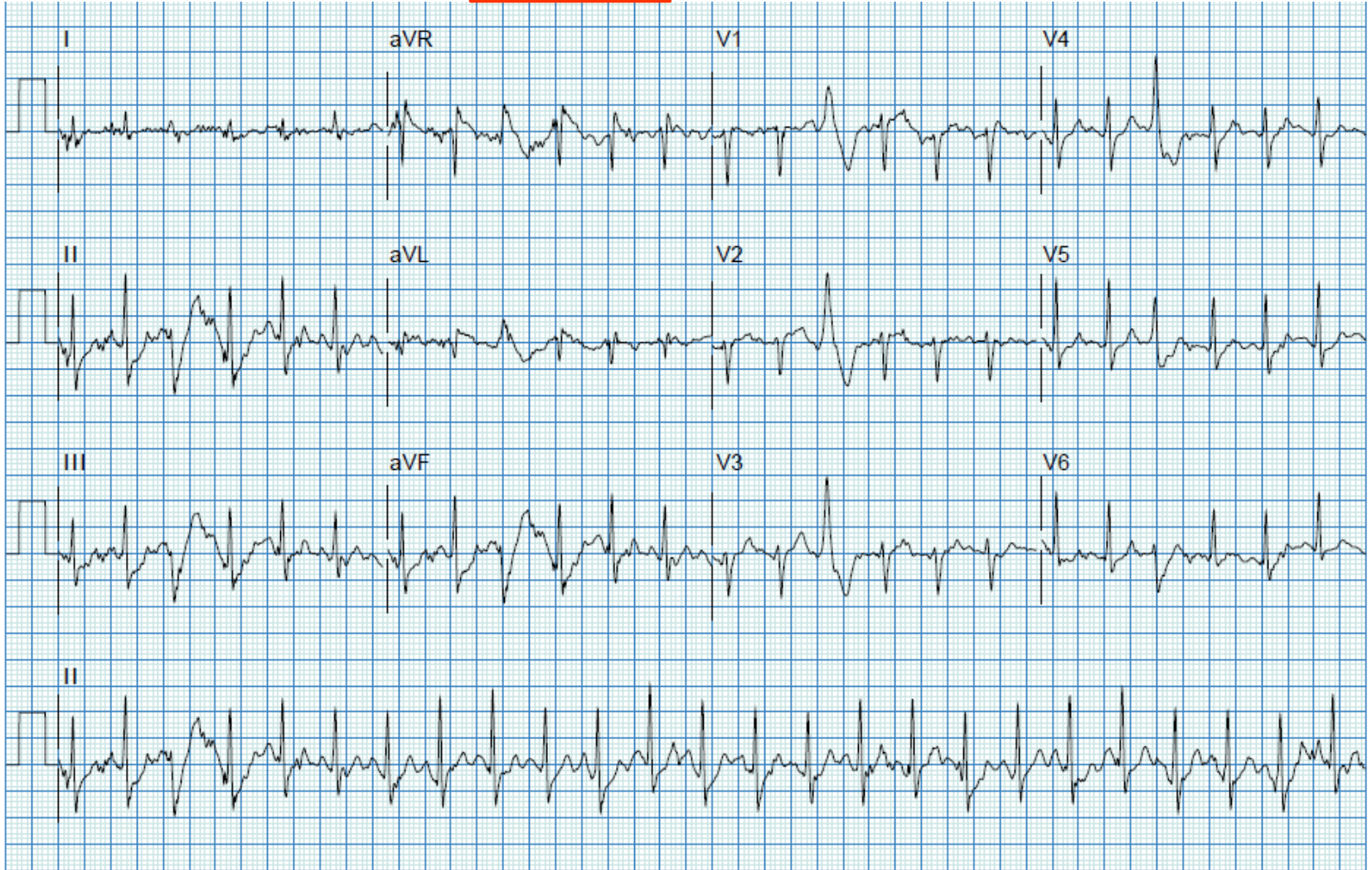
12-Lead FF(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

4 01:36 10:36
6.7 km/h 16.0%

RPE	--	HR	148	II	LVL	0.0	SLP	32
METs(a)	12.8	Target HR	139	V2	LVL	0.7	SLP	11
BP	--/--	Max HR	148	V5	LVL	0.1	SLP	22
Previous BP	174/82	HRxBP	----					



12-Lead FF(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

Recov 02:06
0.0 km/h 0.0%

RPE	-	HR	83	II	LVL	1.0	SLP	30
METs(a)	12.8	Target HR	139	V2	LVL	0.8	SLP	11
BP	178/84	Max HR	150	V5	LVL	0.5	SLP	21
Previous BP	174/82	HRxBP	14774					

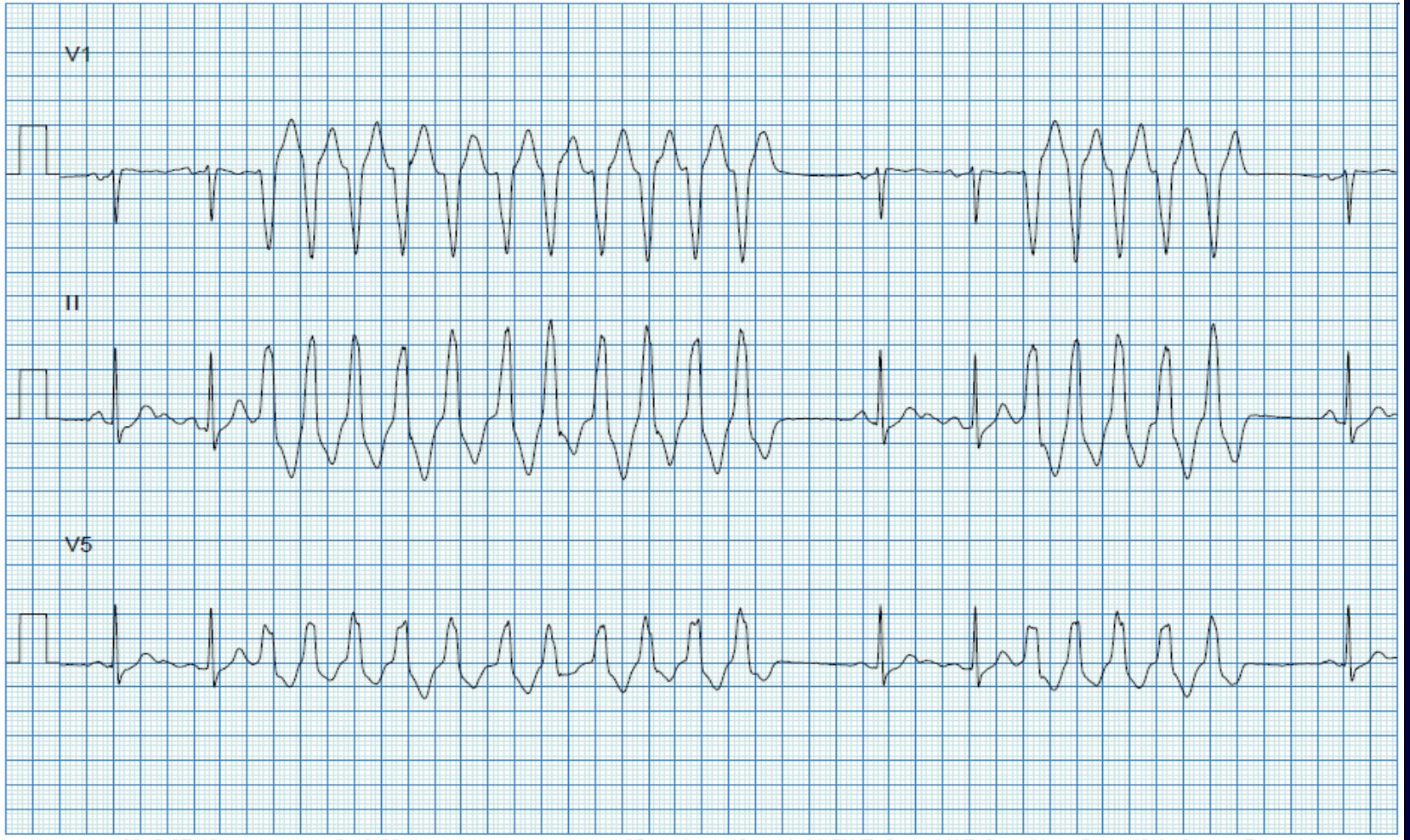


10-second Rhythm FF

Protocol Bruce
Stage
Spd/Grd

Recov 02:31
0.0 km/h 0.0%

RPE	--	HR	134
METs(a)	12.8	Target HR	139
BP	178/84	Max HR	150
Previous BP	174/82	HRxBP	23852
II	LVL 0.4	SLP	24
V2	LVL 0.8	SLP	6
V5	LVL 0.2	SLP	17



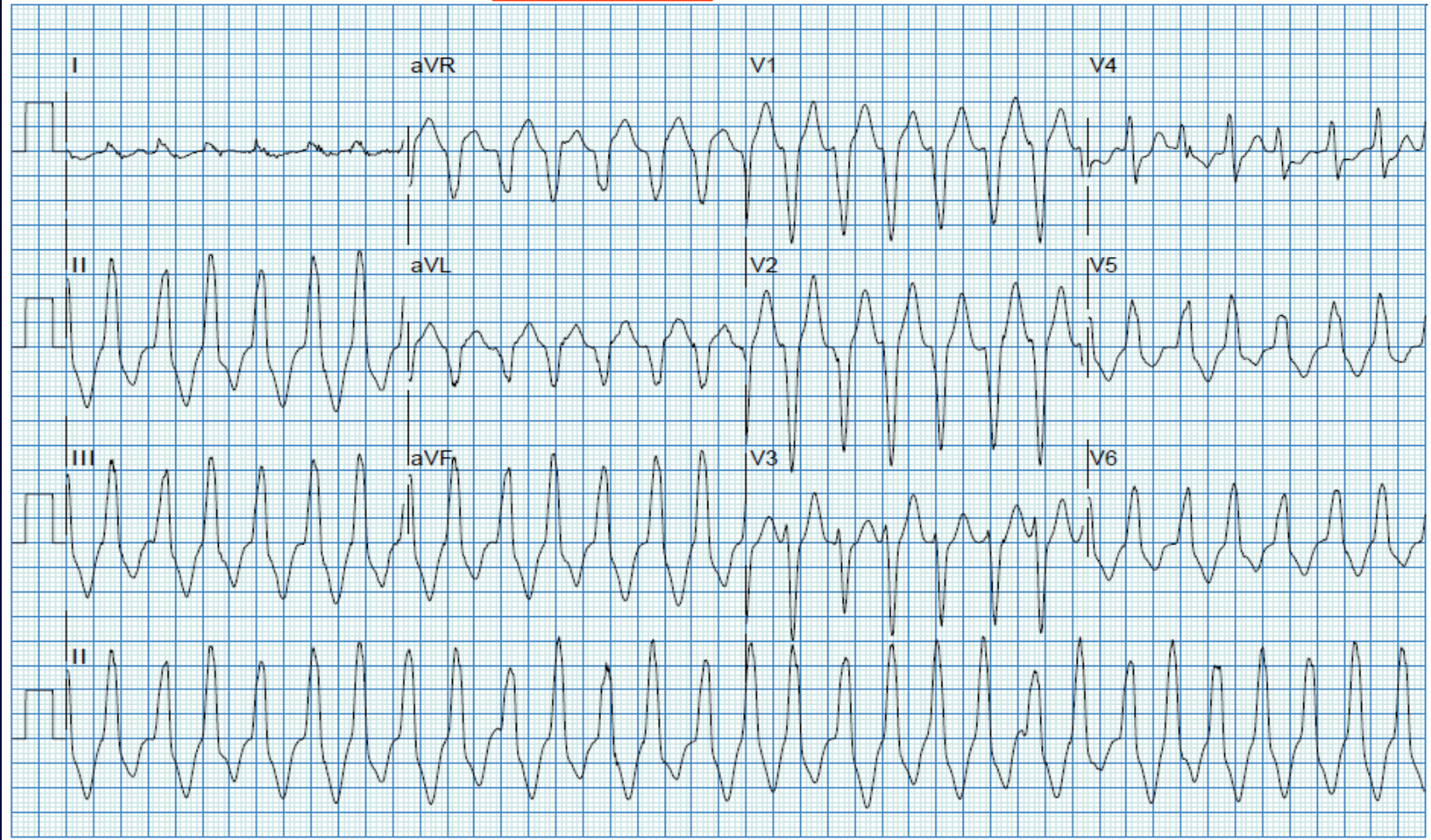
12-Lead FF(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

Recov 02:36
0.0 km/h 0.0%

RPE	--	HR	146						
METs(a)	12.8	Target HR	139	II	LVL	0.4	SLP	21	
BP	178/84	Max HR	150	V2	LVL	0.6	SLP	3	
Previous BP	174/82	HRxBP	25988	V5	LVL	0.1	SLP	15	



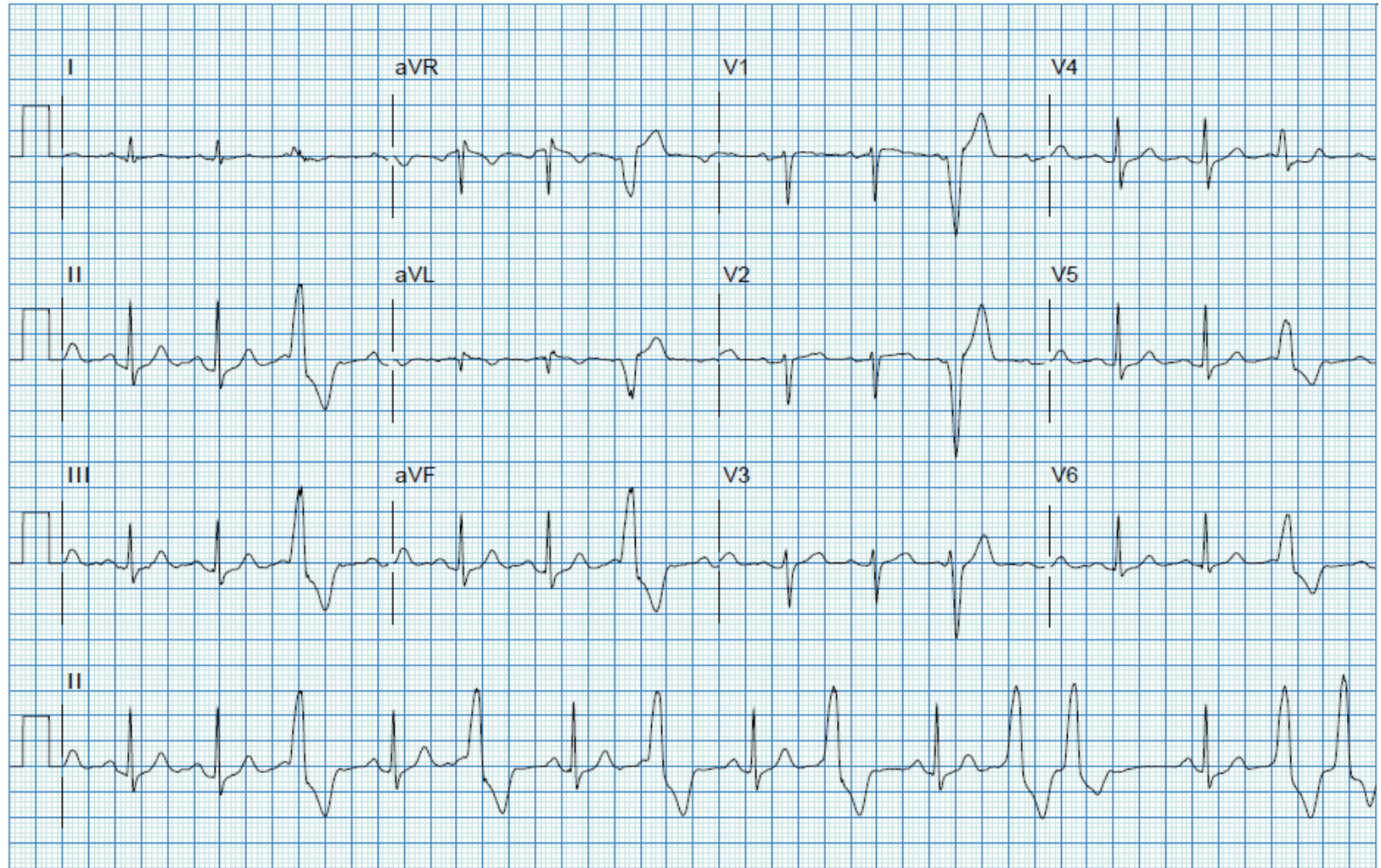
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

Recov 07:00
0.0 km/h 0.0%

RPE	-	HR	94						
METs(a)	12.8	Target HR	139	II	LVL	-7.0	SLP	-50	
BP	123/70	Max HR	181	V2	LVL	5.3	SLP	50	
Previous BP	115/69	HRxBP	11562	V5	LVL	-3.5	SLP	-26	



Idiopathic RVOT VT

RVOT VT는 운동과 연관이 많으며, 운동검사로 비교적 잘 유발되어 대부분이 운동부하 심전도 검사로 심실빈맥을 증명할 수 있다.

52/M 산에 오를때, 목욕탕에서 더우면 palpitation

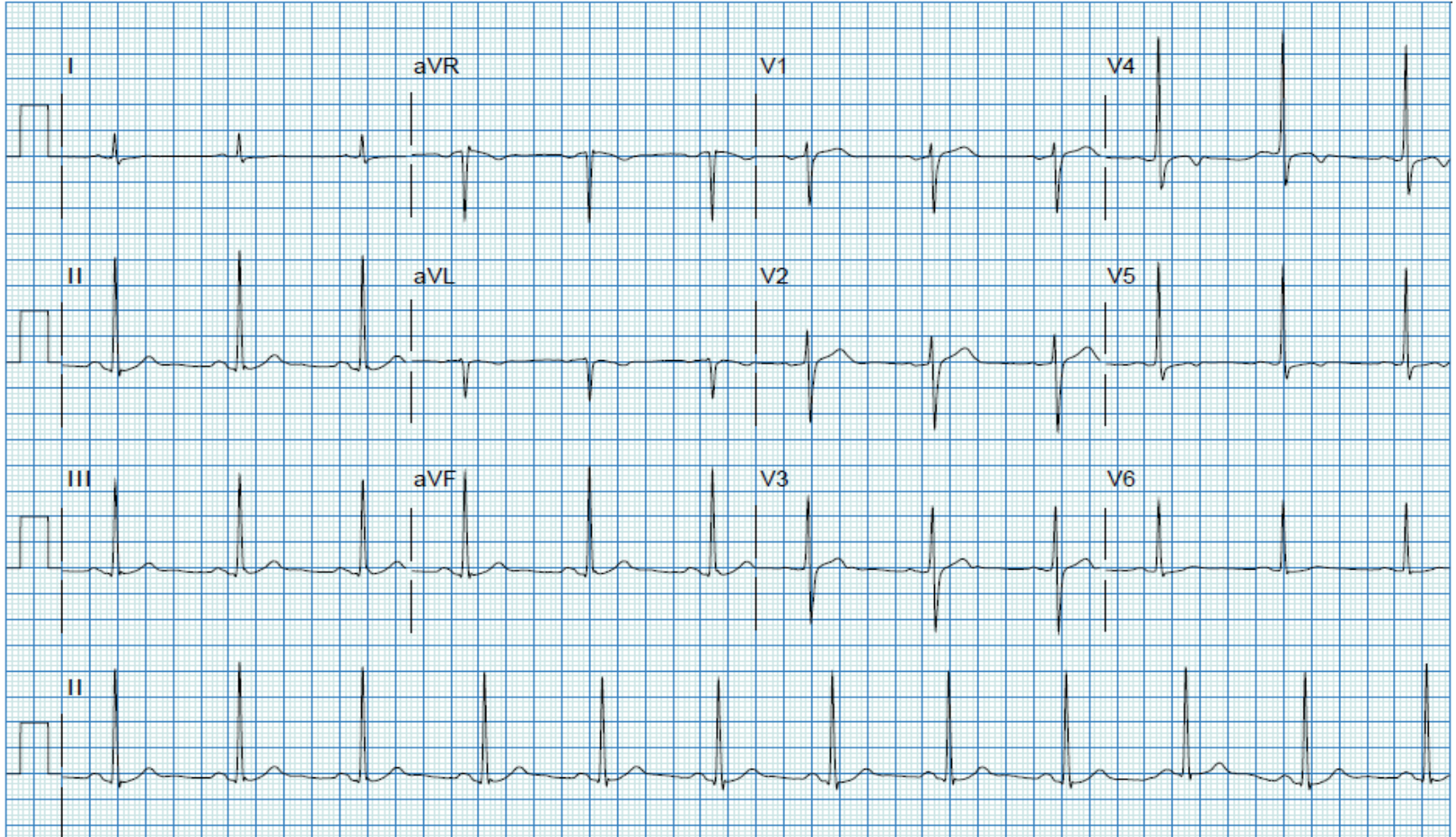
12-Lead Manual(simultaneous)
Supine

Protocol

Bruce
Stage
Spd/Grd

Rest 00:55
0.0 km/h 0.0%

RPE	--	HR	67	II	LVL	0.2	SLP	8
METs(a)	1.0	Target HR	127	V2	LVL	1.5	SLP	13
BP	119/71	Max HR	67	V5	LVL	0.0	SLP	5
Previous BP	---/---	HRxBP	7973					



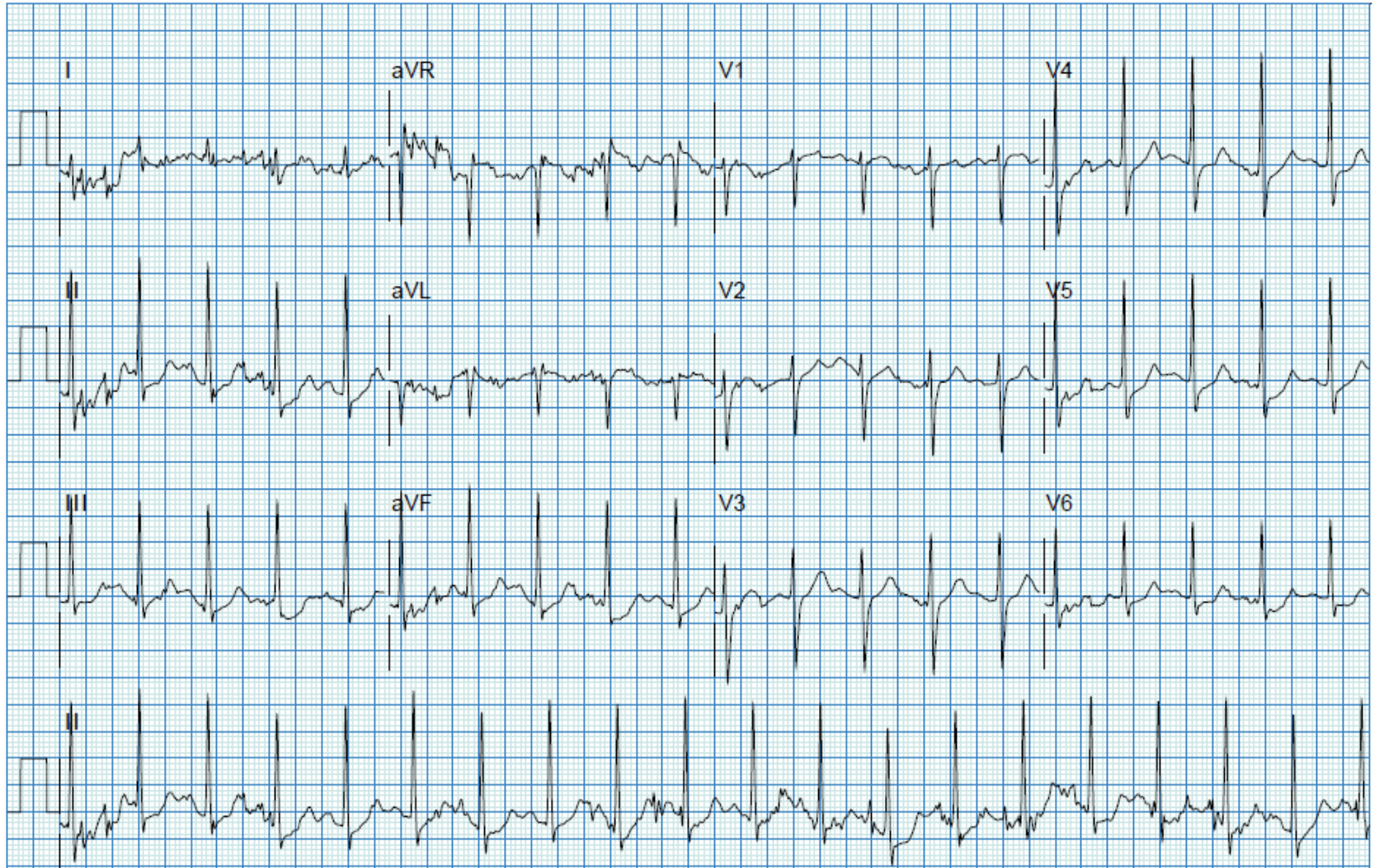
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

1 02:50 02:50
2.7 km/h 10.0%

RPE	--	HR	113	II	LVL	-0.8	SLP	15
METs(a)	4.6	Target HR	127	V2	LVL	1.1	SLP	12
BP	142/59	Max HR	114	V5	LVL	-0.5	SLP	11
Previous BP	119/71	HRxBP	16046					



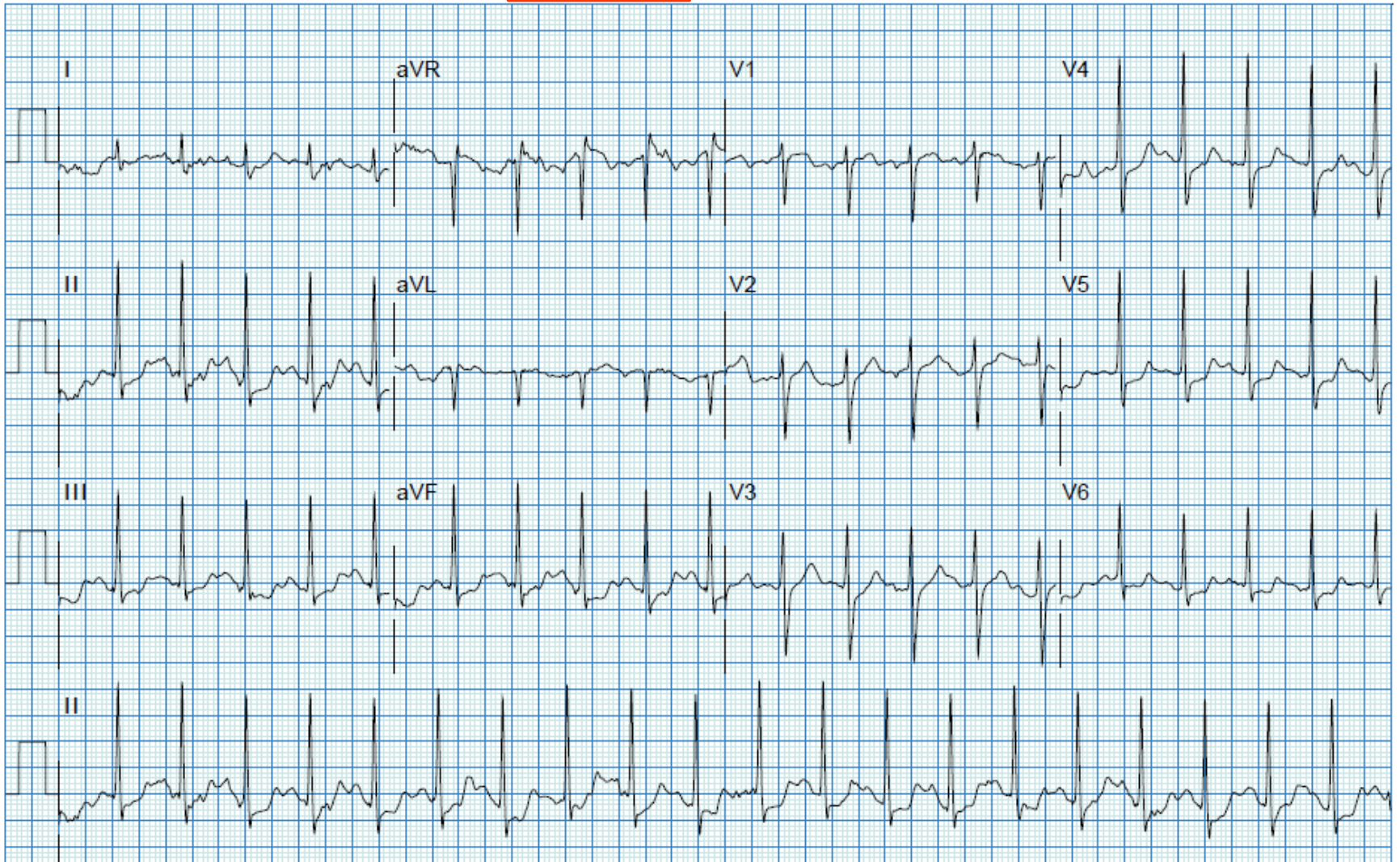
12-Lead Manual(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

2 00:32 03:32
4.0 km/h 12.0%

RPE	-	HR	126	II	LVL	-1.6	SLP	14
METs(a)	4.6	Target HR	127	V2	LVL	1.1	SLP	15
BP	---/---	Max HR	126	V5	LVL	-1.2	SLP	8
Previous BP	142/59	HRxBP	---					

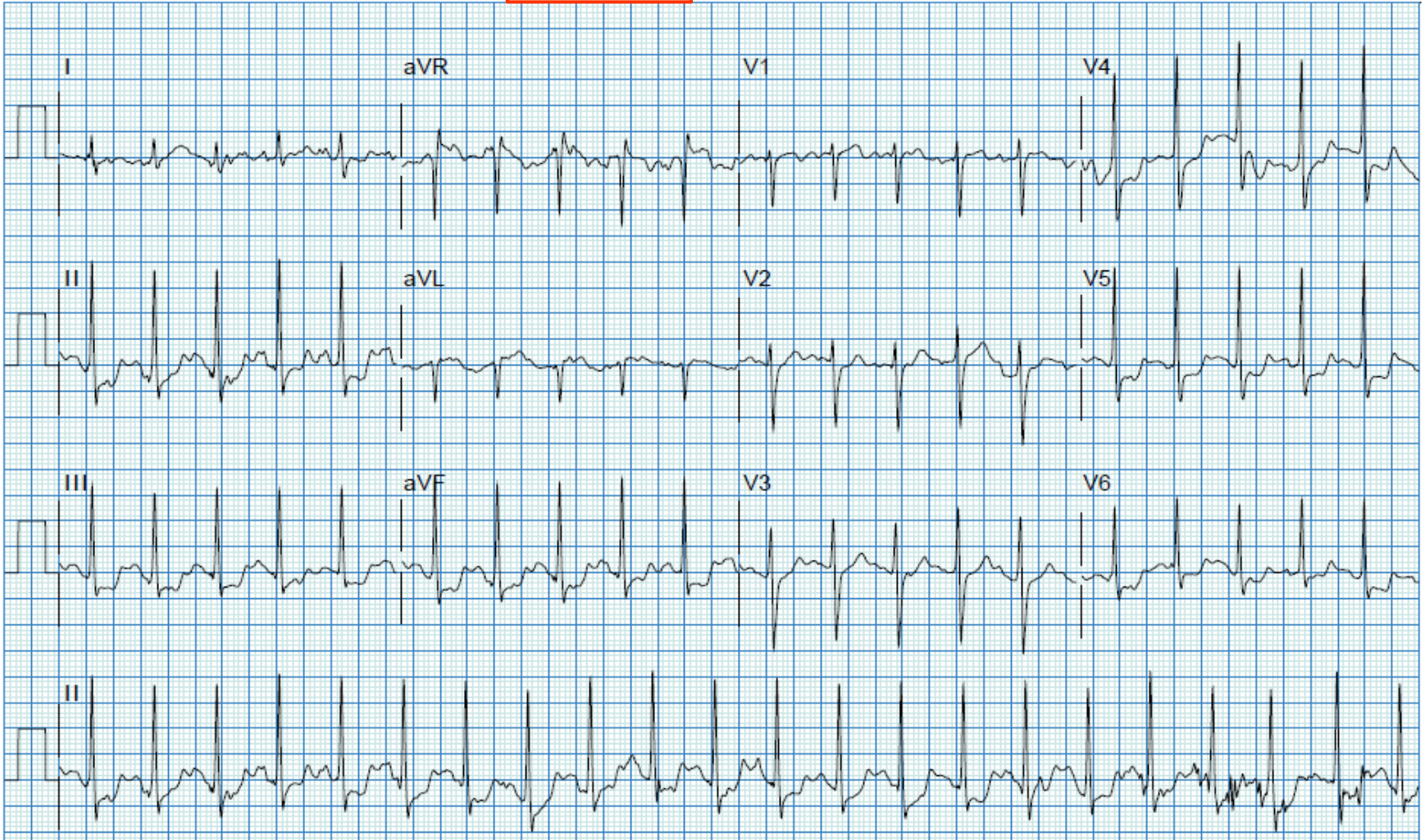


12-Lead Manual(simultaneous)

Protocol
Bruce
Stage
Spd/ Grd

2 01:26 04:26
4.0 km/h 12.0%

RPE	--	HR	130	II	LVL	-1.6	SLP	9
METs(a)	7.0	Target HR	127	V2	LVL	0.9	SLP	17
BP	--/--	Max HR	130	V5	LVL	-1.4	SLP	4
Previous BP	142/59	HRxBP	----					



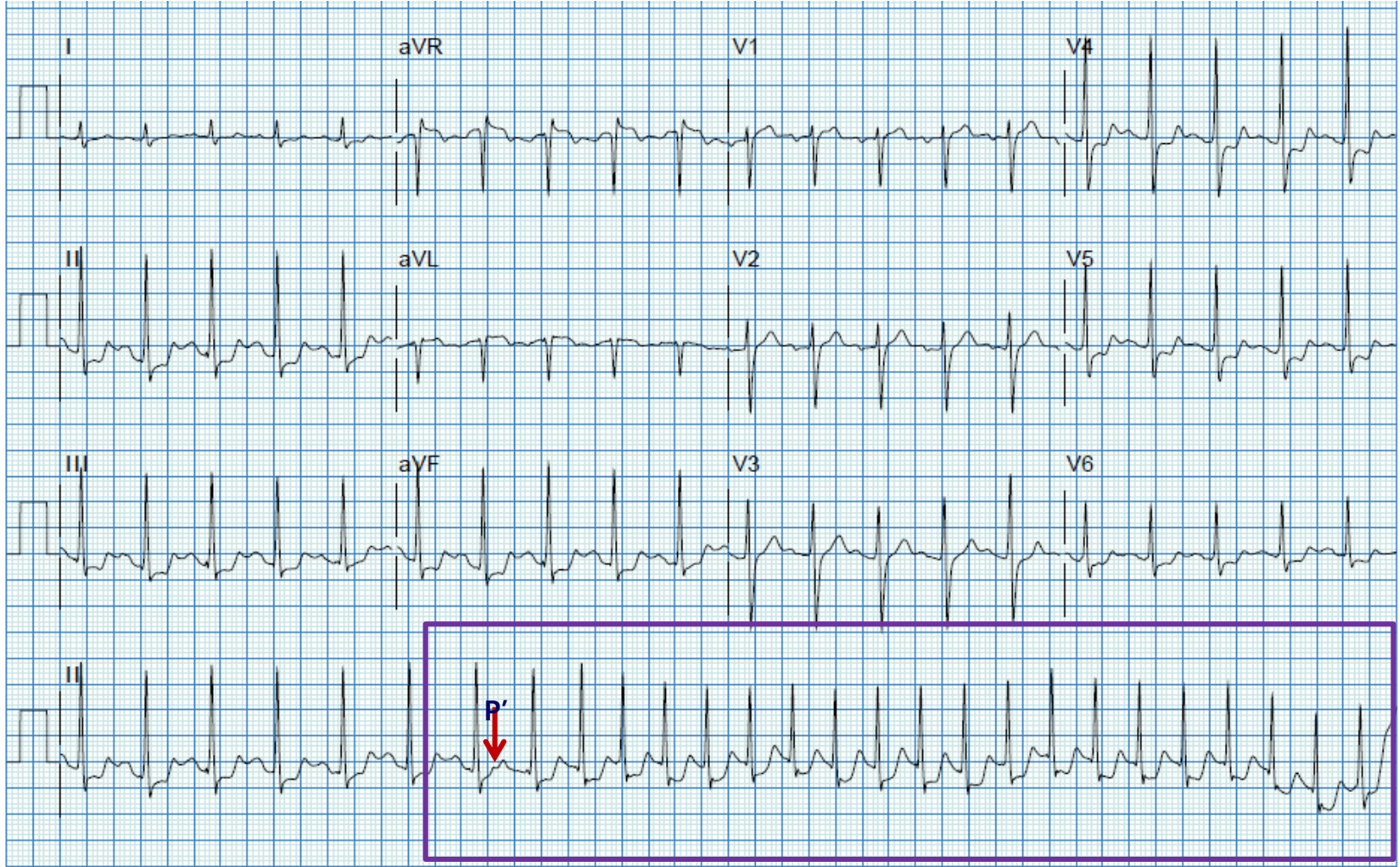
12-Lead FF(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

Recov 00:50
0.0 km/h 0.0%

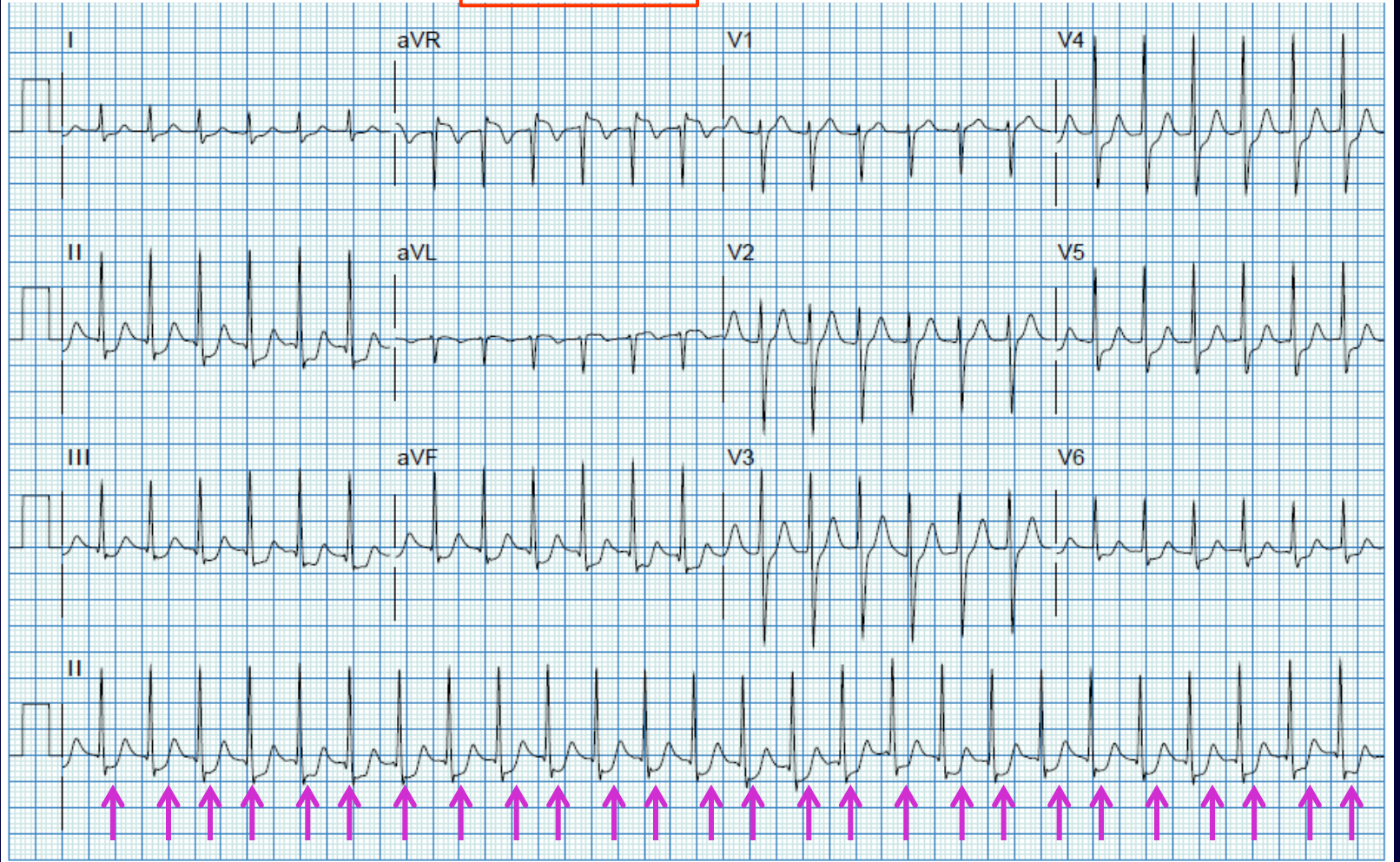
RPE	--	HR	125						
METs(a)	10.1	Target HR	127	II	LVL	-1.3	SLP	1	
BP	166/62	Max HR	145	V2	LVL	1.8	SLP	32	
Previous BP	155/60	HRxBP	20750	V5	LVL	-1.2	SLP	-4	



PSVT

12-Lead FF(simultaneous)	Protocol	Bruce	RPE	--	HR	162					
	Stage		METs(a)	10.1	Target HR	127	II	LVL	-2.6	SLP	29
	Spd/Grd		BP	166/62	Max HR	185	V2	LVL	2.6	SLP	50
			Previous BP	155/60	HRxBP	26892	V5	LVL	-1.6	SLP	30

Recov 02:10
0.0 km/h 0.0%

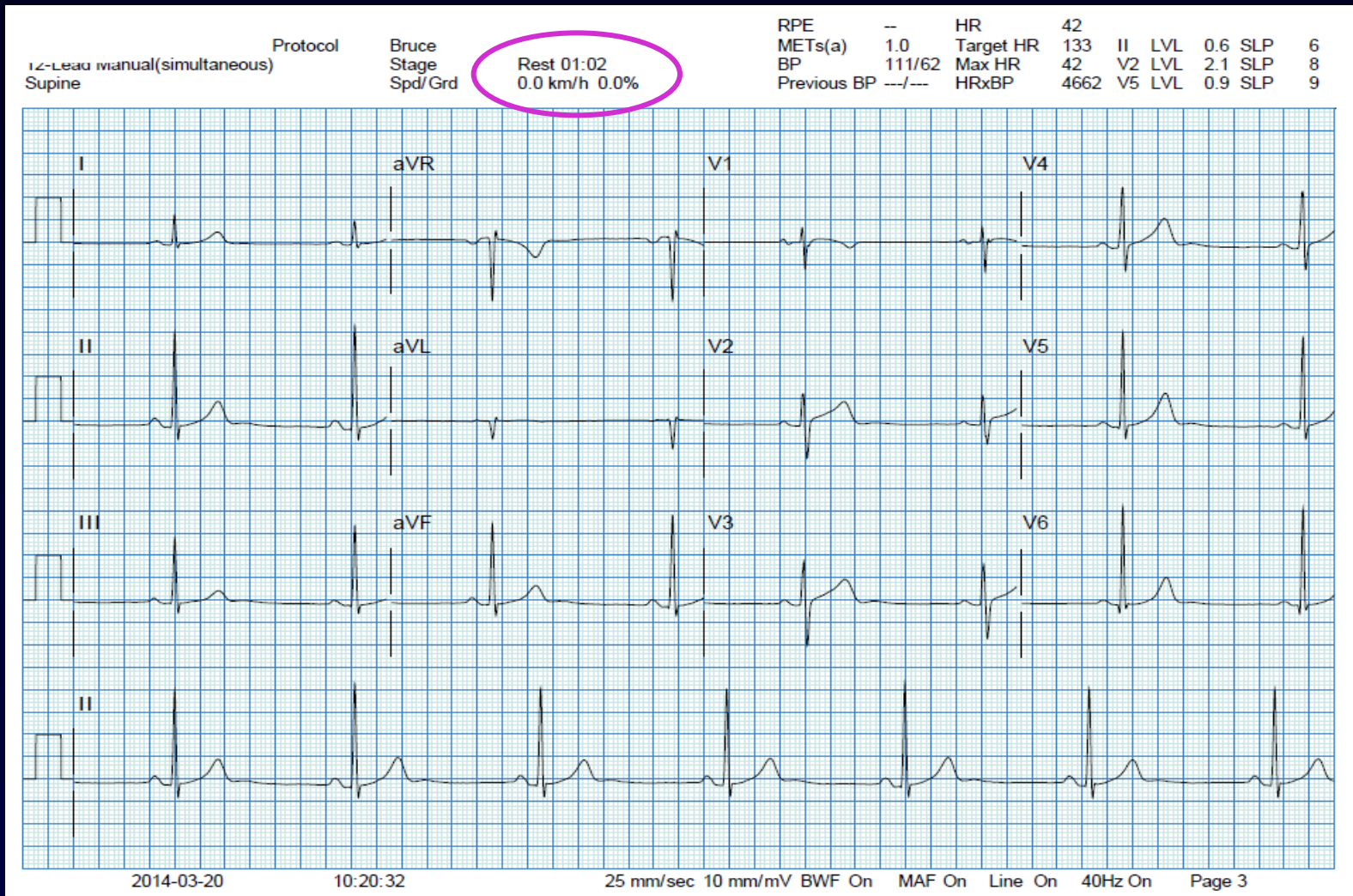


PSVT

Sustained supraventricular premature beat는 운동시

1~2%의 환자에서 유발이 가능하다고 한다.

64/M Chest pain을 동반하지 않은 palpitation



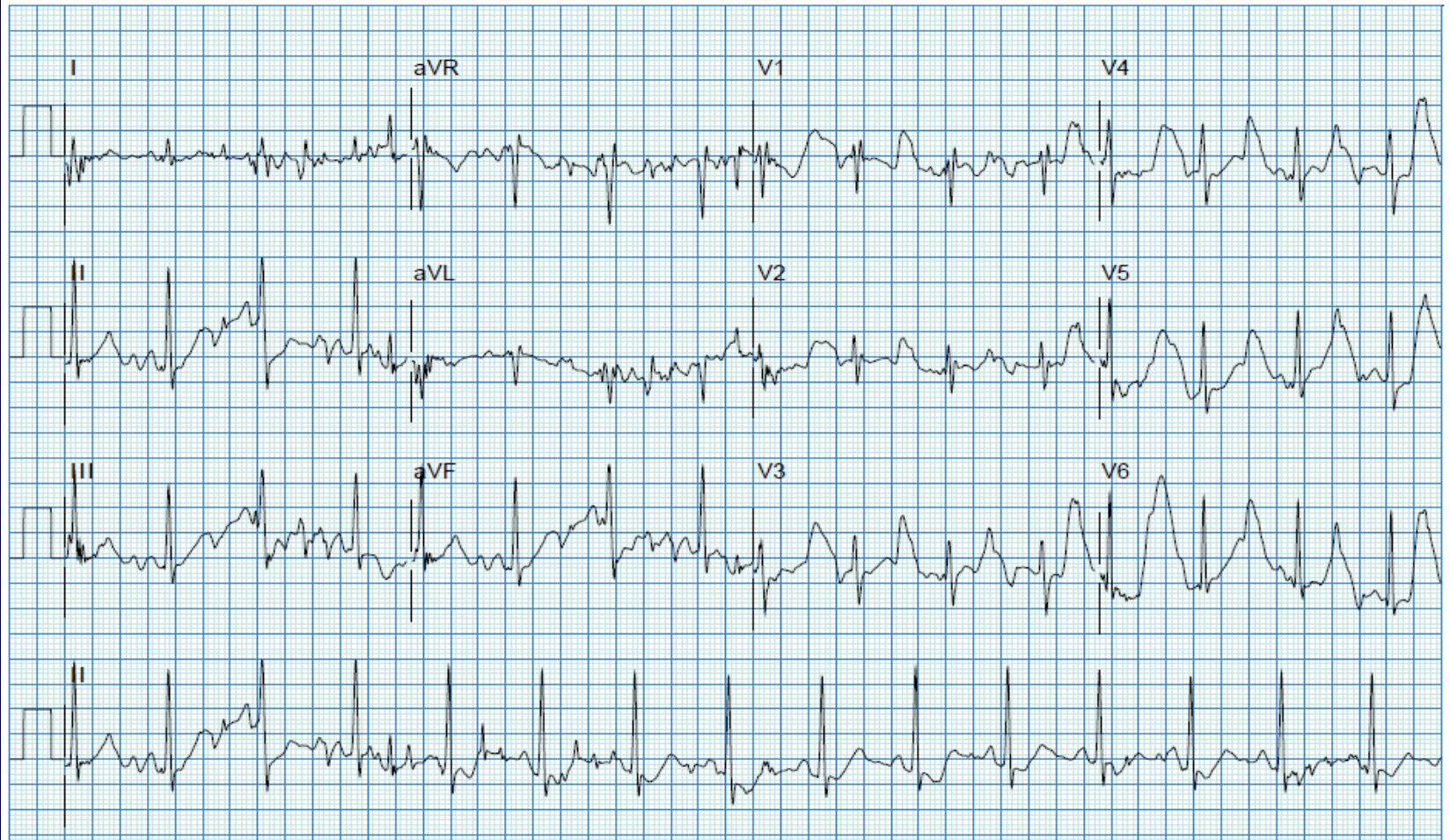
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

1 02:50 02:50
2.7 km/h 10.0%

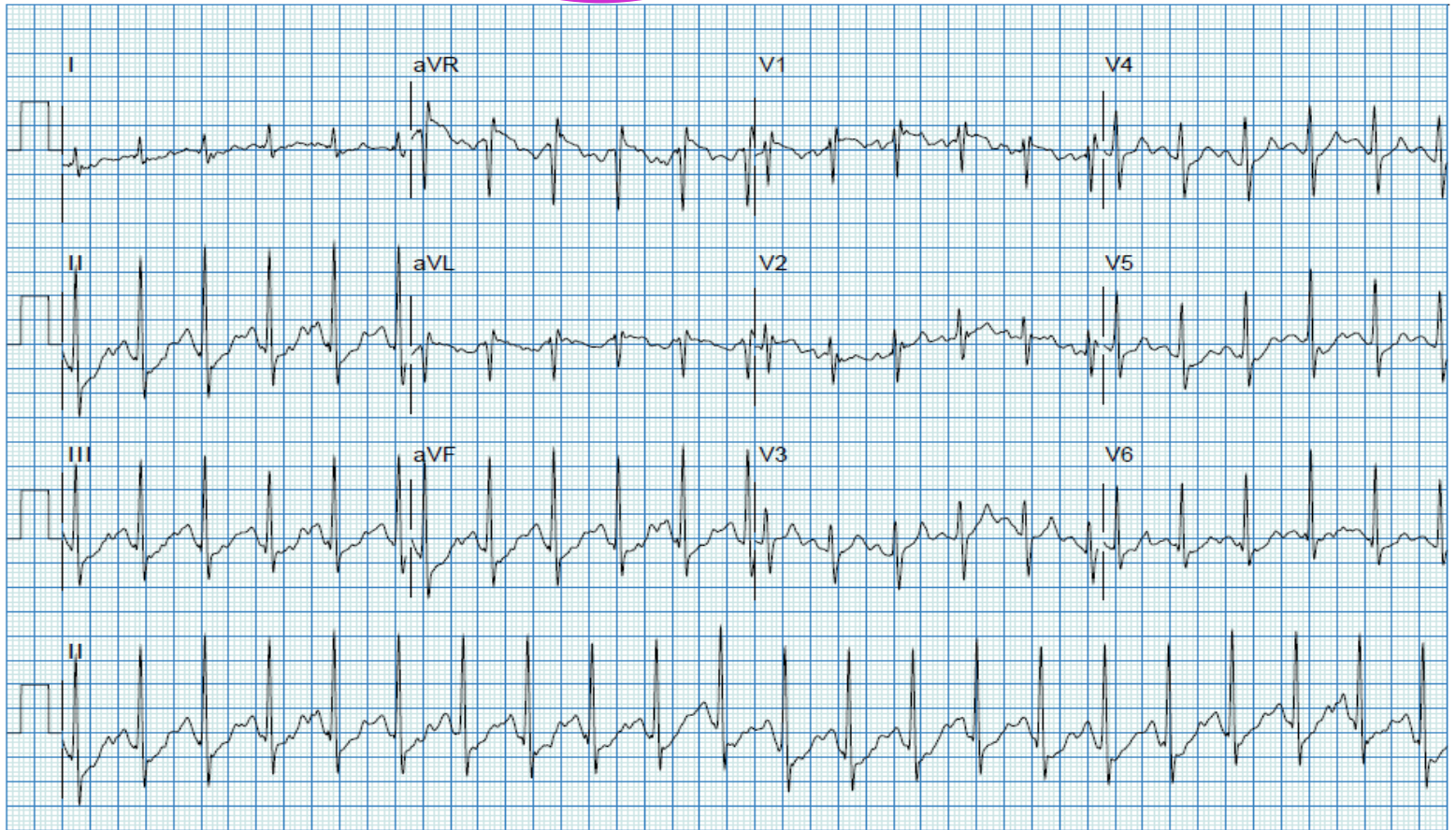
RPE	-	HR	86	II LVL	0.0	SLP	14
METs(a)	4.6	Target HR	133	V2 LVL	1.1	SLP	7
BP	121/58	Max HR	91	V5 LVL	0.6	SLP	22
Previous BP	111/62	HRxBP	10406				



12-Lead(simultaneous)

Protocol Bruce Stage 3 02:50 08:50 Spd/Grd 5.4 km/h 14.0%

RPE	-	HR	127	II	LVL	-1.3	SLP	24
METs(a)	10.1	Target HR	133	V2	LVL	0.6	SLP	6
BP	162/63	Max HR	128	V5	LVL	-0.4	SLP	20
Previous BP	132/58	HRxBP	20574					



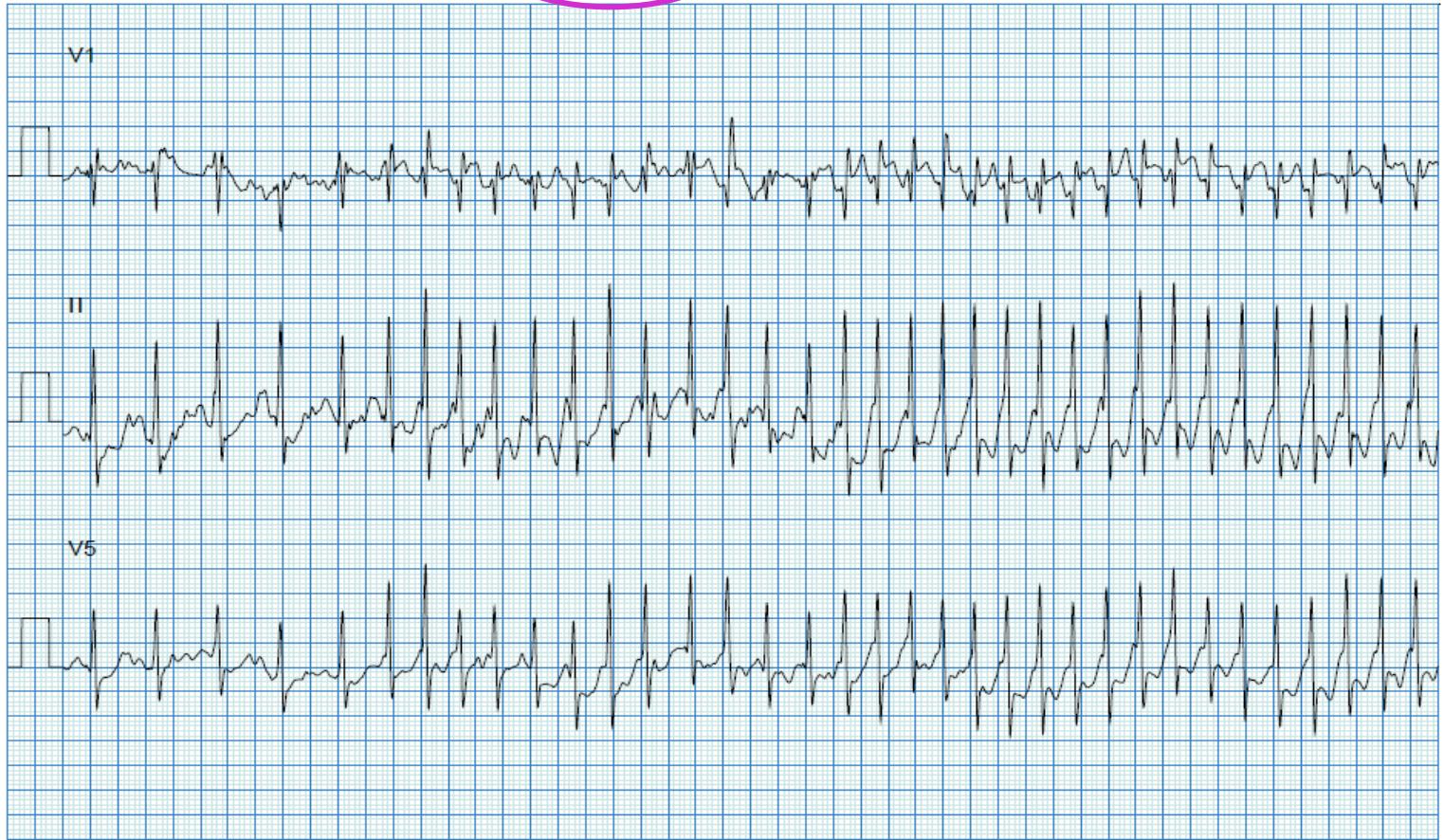
2014-03-20 10:30:19 25 mm/sec 10 mm/mV BWF On MAF On Line On 40Hz On Page 6

10-second Rhythm FF

Protocol Bruce
Stage
Spd/Grd

4 00: 16 09: 16
6.7 km/h 16.0%

RPE	--	HR	135	II LVL	-1.8 SLP	29
METs(a)	10.1	Target HR	133	V2 LVL	1.1 SLP	8
BP	---/---	Max HR	135	V5 LVL	-0.6 SLP	20
Previous BP	162/63	HRxBP	---			



2014-03-20

10:30:45

25 mm/sec 10 mm/mV BWF On MAF On Line On 40Hz On Page 7

Atrial fibrillation

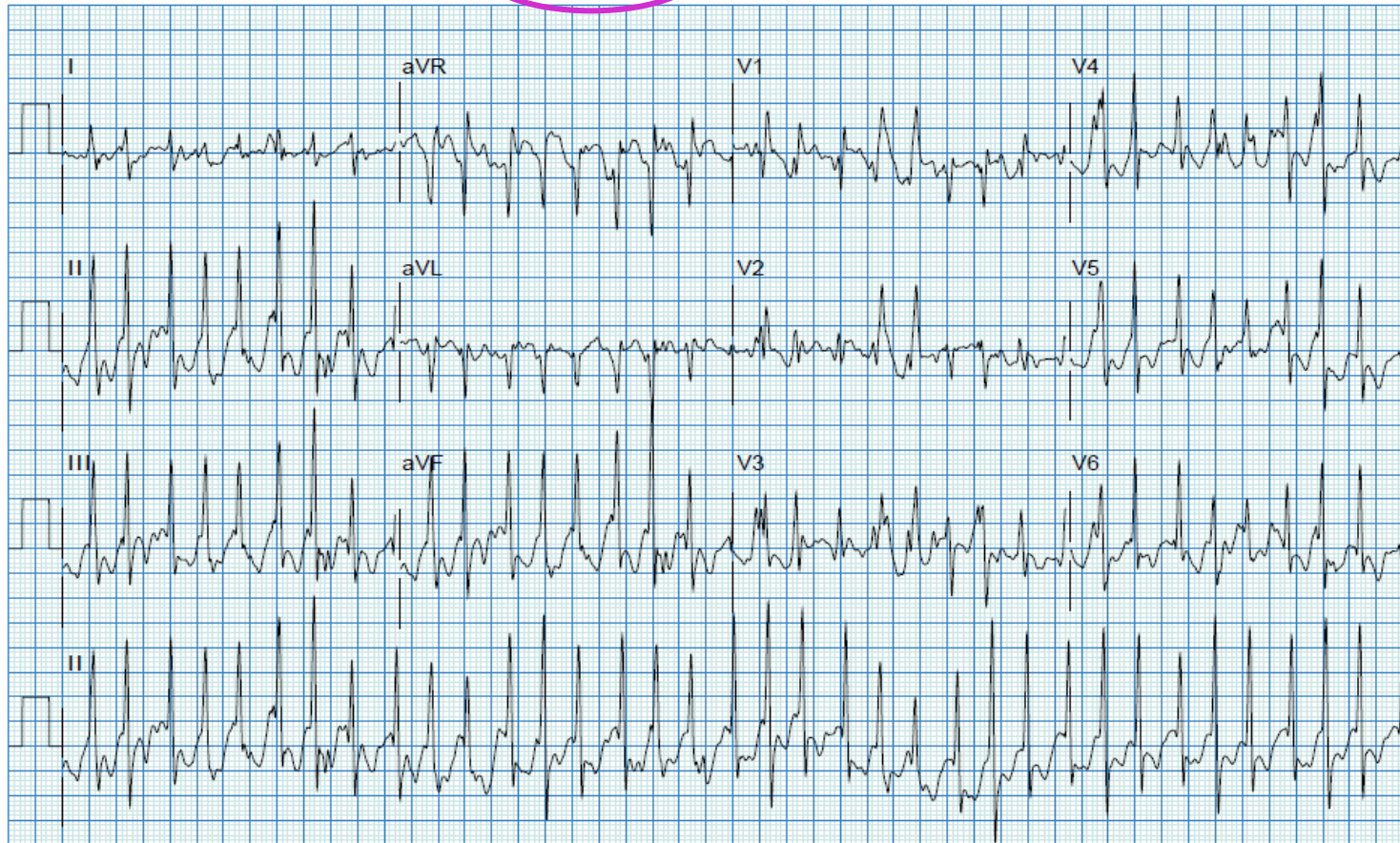
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

Recov 00:00
1.9 km/h 0.0%

RPE	-	HR	261	II LVL	-0.7 SLP	-23
METs(a)	10.1	Target HR	133	V2 LVL	-0.4 SLP	13
BP	---/---	Max HR	263	V5 LVL	-0.1 SLP	-19
Previous BP	162/63	HRxBP	----			



2014-03-20

10:31:05

25 mm/sec 10 mm/mV BWF On MAF On Line On 40Hz On Page 10

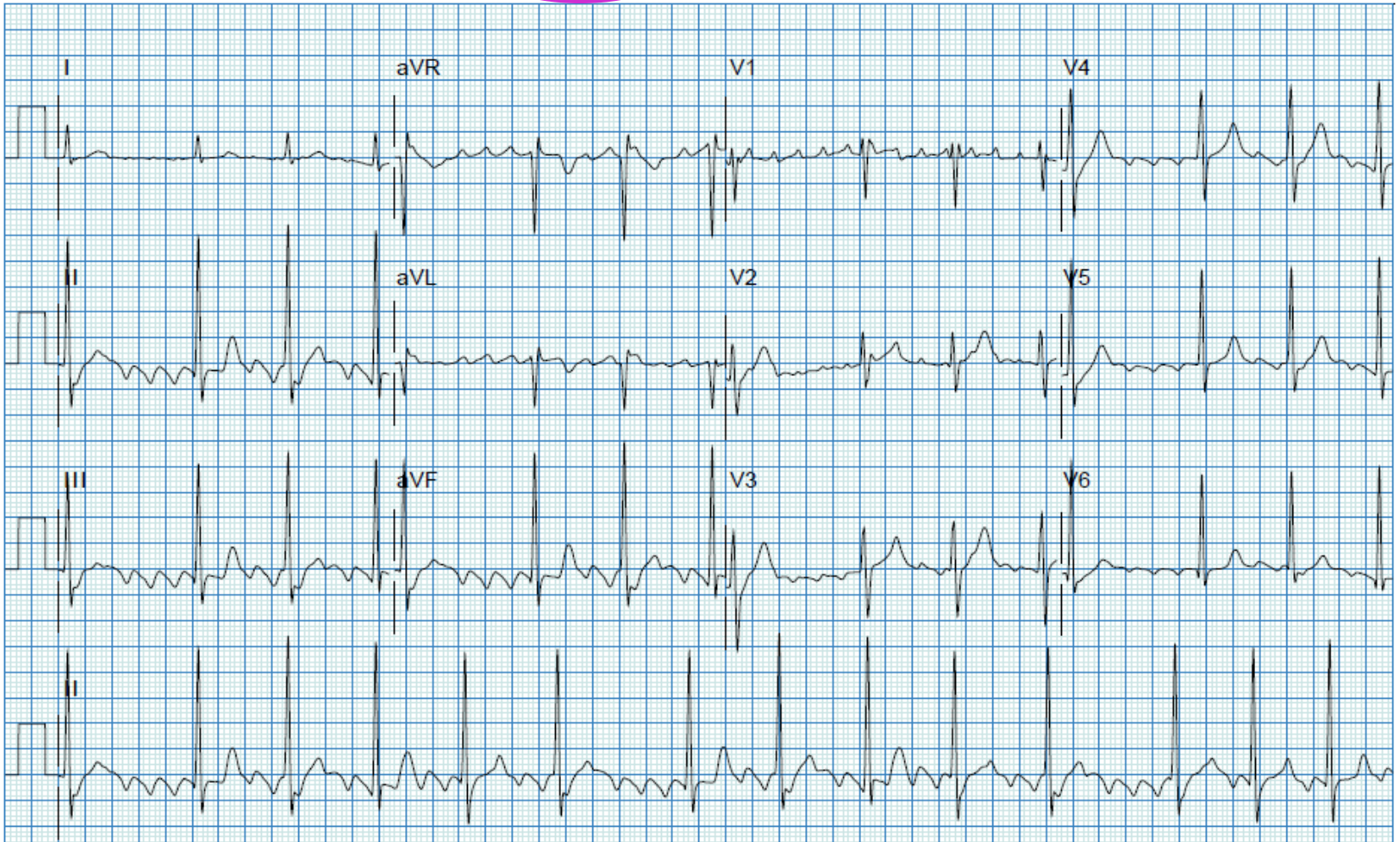
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

Recov 03:00
0.0 km/h 0.0%

RPE	-	HR	82	II LVL	-0.1 SLP	16
METs(a)	10.1	Target HR	133	V2 LVL	1.4 SLP	21
BP	---/---	Max HR	263	V5 LVL	0.3 SLP	17
Previous BP	121/64	HRxBP	---			



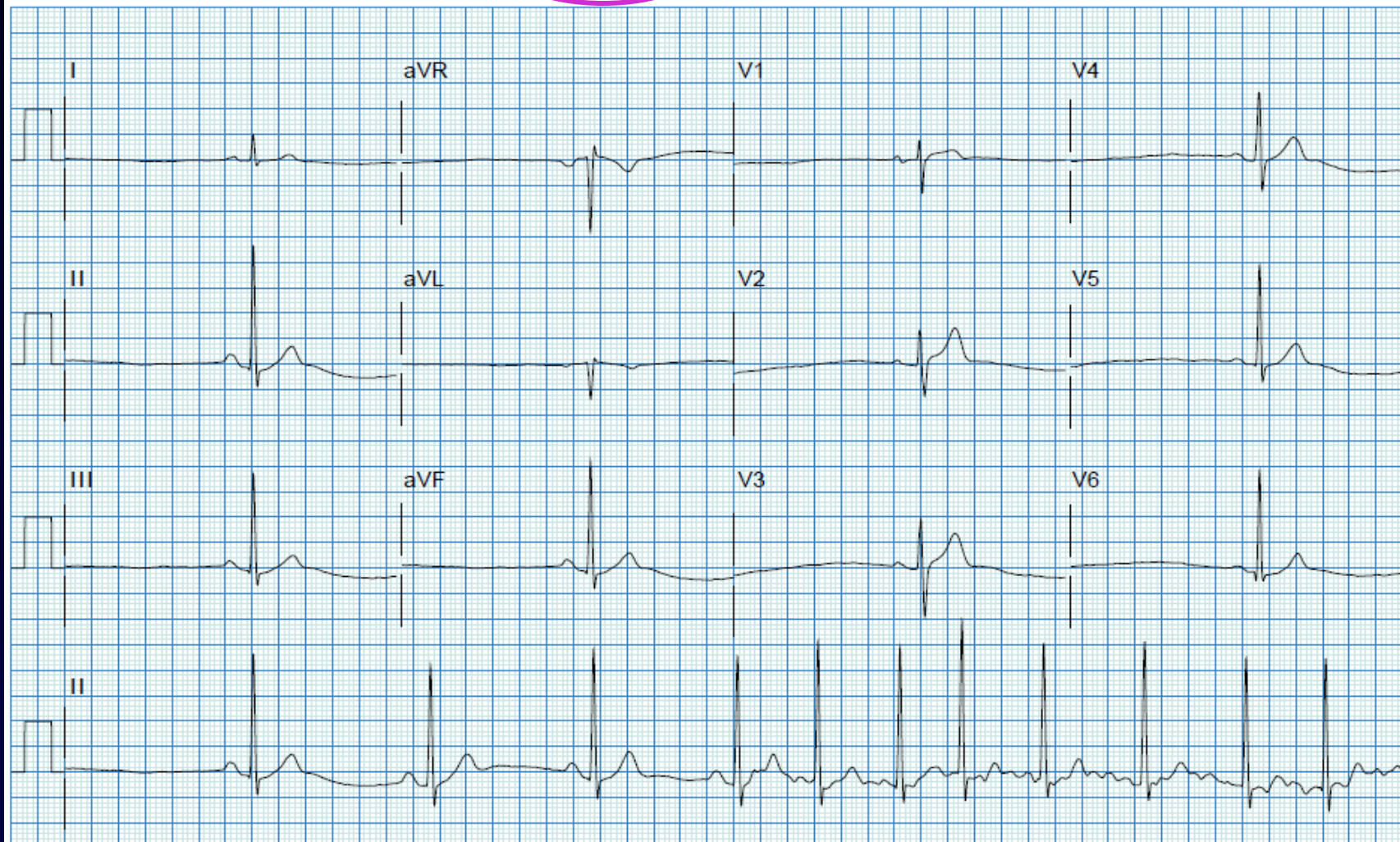
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

Recov 05:00
0.0 km/h 0.0%

RPE	--	HR	88	II	LVL	-0.1	SLP	3
METs(a)	10.1	Target HR	133	V2	LVL	1.6	SLP	13
BP	148/84	Max HR	263	V5	LVL	0.3	SLP	6
Previous BP	157/89	HRxBP	13024					



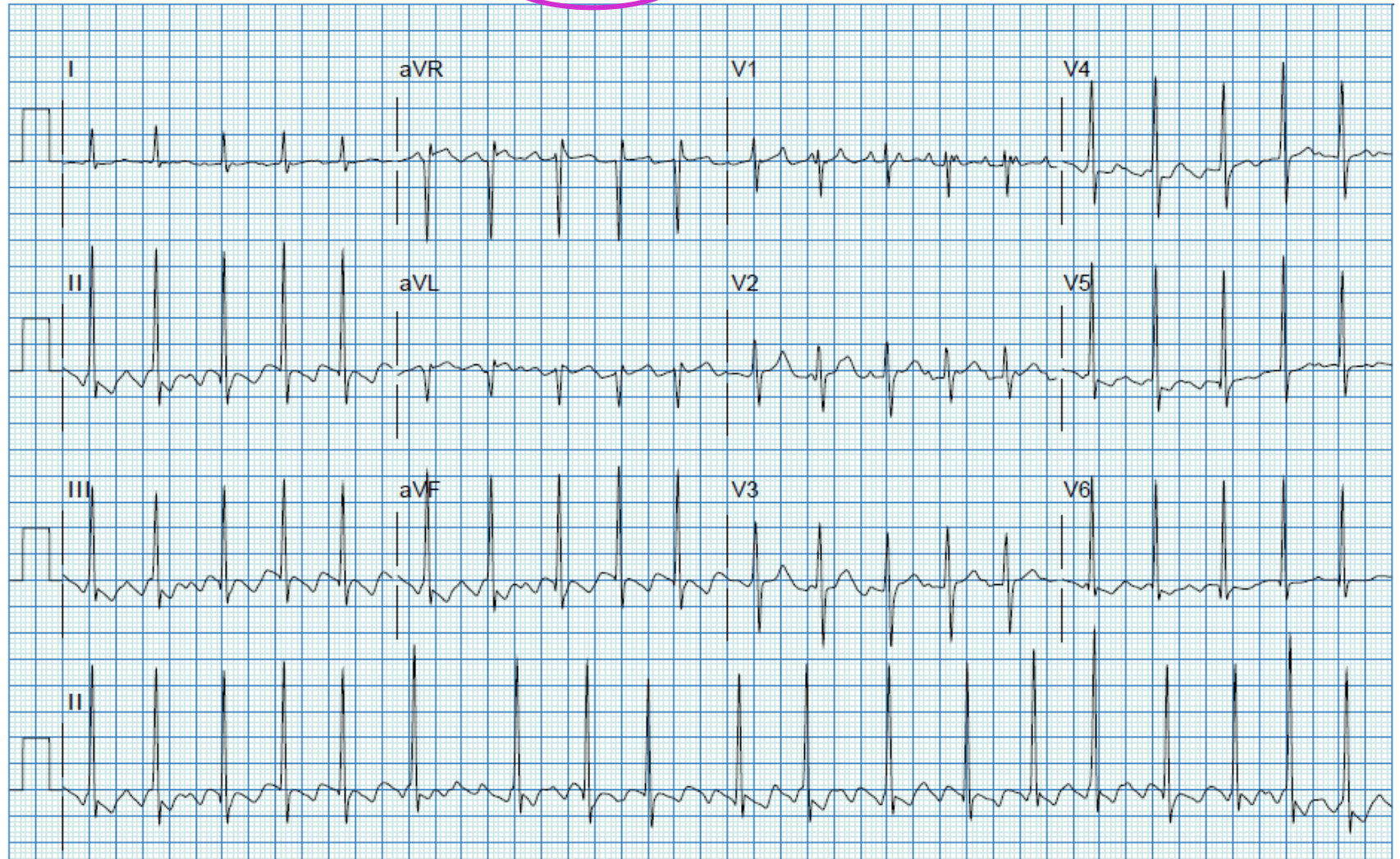
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

Recov 11:00
0.0 km/h 0.0%

RPE	--	HR	117						
METs(a)	10.1	Target HR	133	II	LVL	-0.9	SLP	-4	
BP	107/79	Max HR	263	V2	LVL	1.4	SLP	10	
Previous BP	106/78	HRxBP	12519	V5	LVL	-0.2	SLP	1	



Atrial fibrillation

운동시에 유발가능하고, 운동이 끝나는시점에 체내 카테콜아민은 감소하고 미주신경활성도가 상승하면서 발생할 수 있으며 1%에서 유발될 수 있다.

42/F 종합검진에서 정밀검사 의뢰

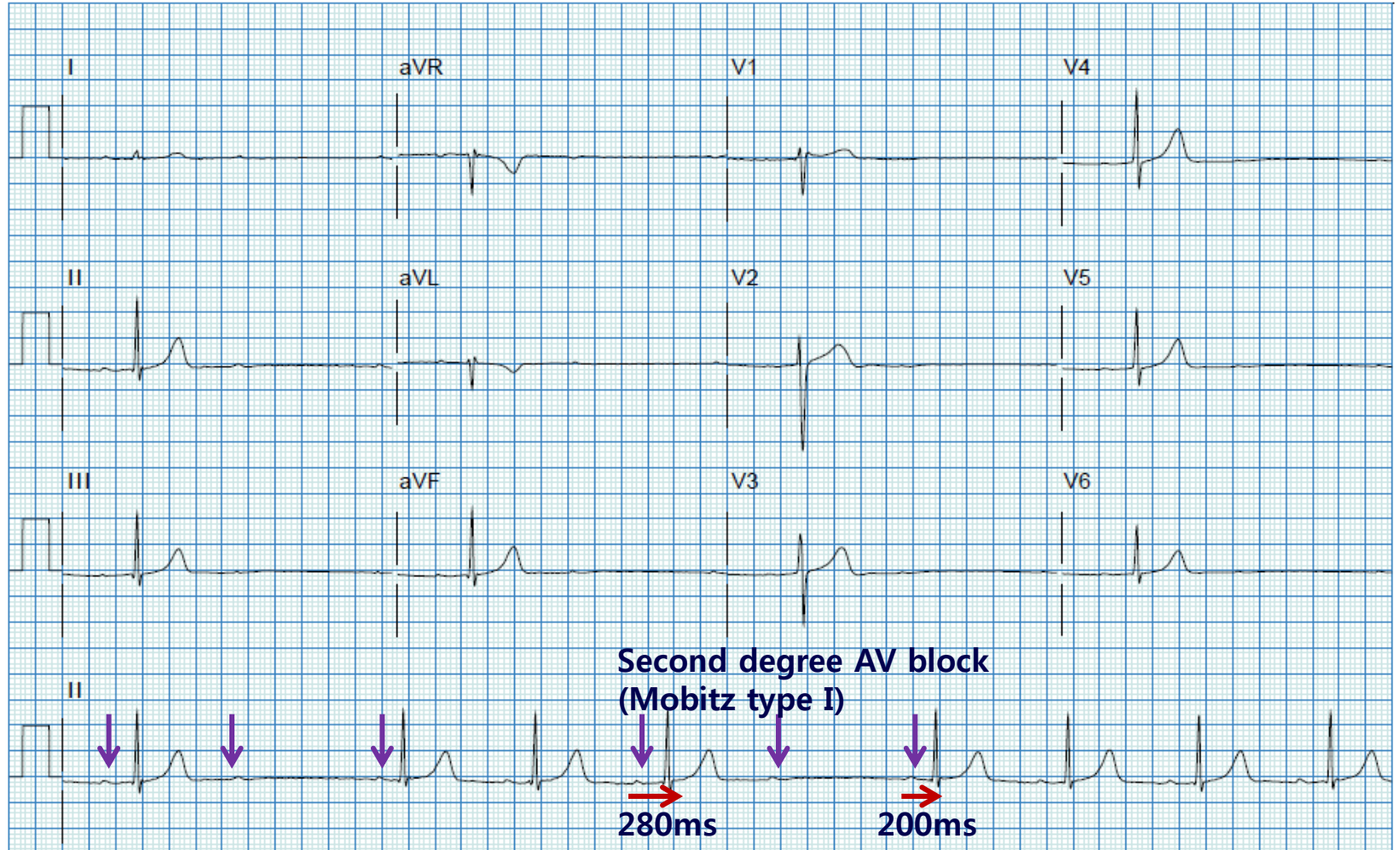
12-Lead Manual(simultaneous)
Supine

Protocol

Bruce
Stage
Spd/Grd

Rest 01:00
0.0 km/h 0.0%

RPE	--	HR	40	II	LVL	0.3	SLP	3
METs(a)	1.0	Target HR	152	V2	LVL	1.3	SLP	8
BP	100/67	Max HR	40	V5	LVL	0.3	SLP	4
Previous BP	--/--	HRxBP	4000					



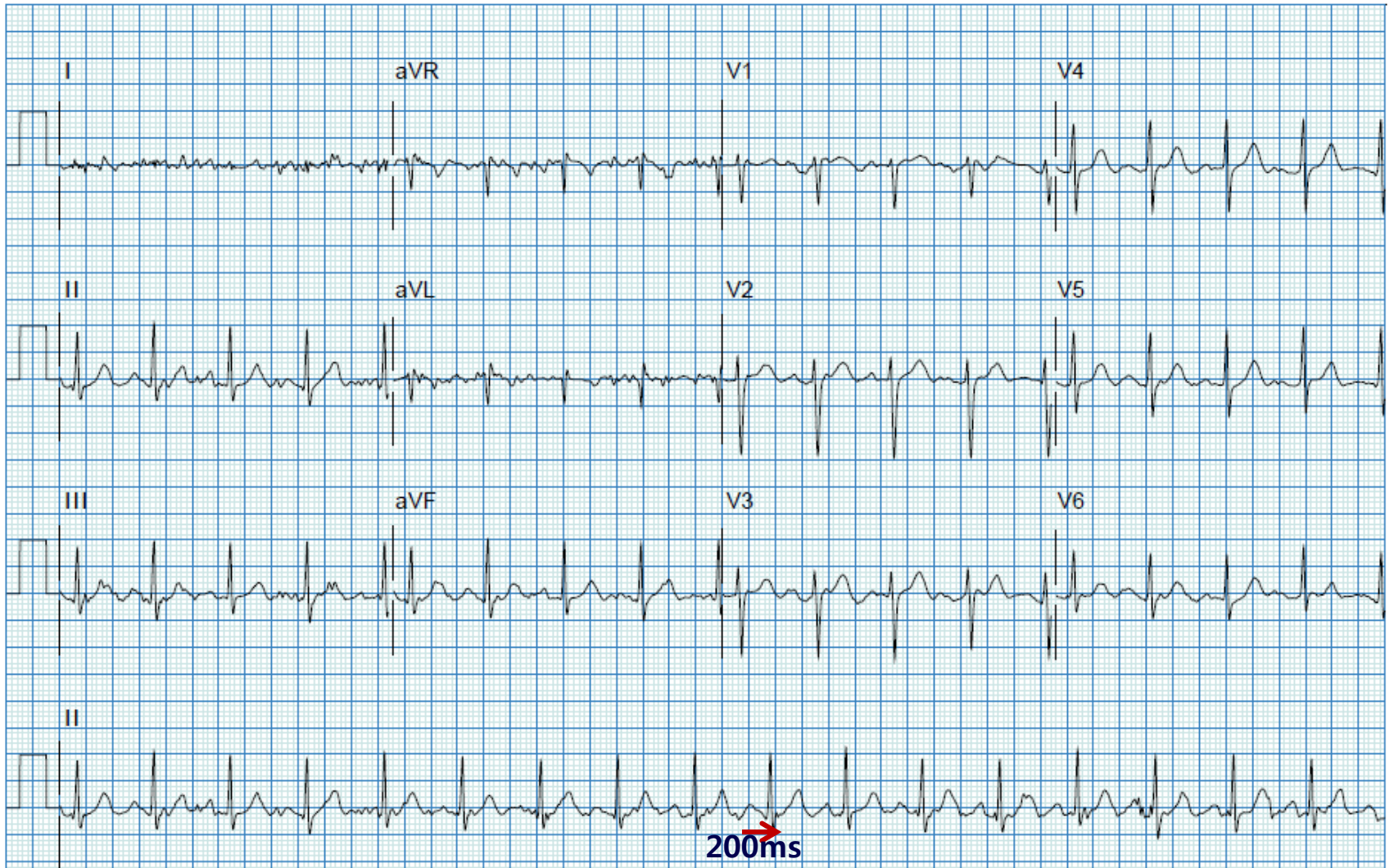
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

1 02:50 02:50
2.7 km/h 10.0%

RPE	--	HR	111						
METs(a)	4.6	Target HR	152	II	LVL	0.5	SLP	16	
BP	133/76	Max HR	115	V2	LVL	1.2	SLP	13	
Previous BP	100/67	HRxBP	14763	V5	LVL	0.9	SLP	14	



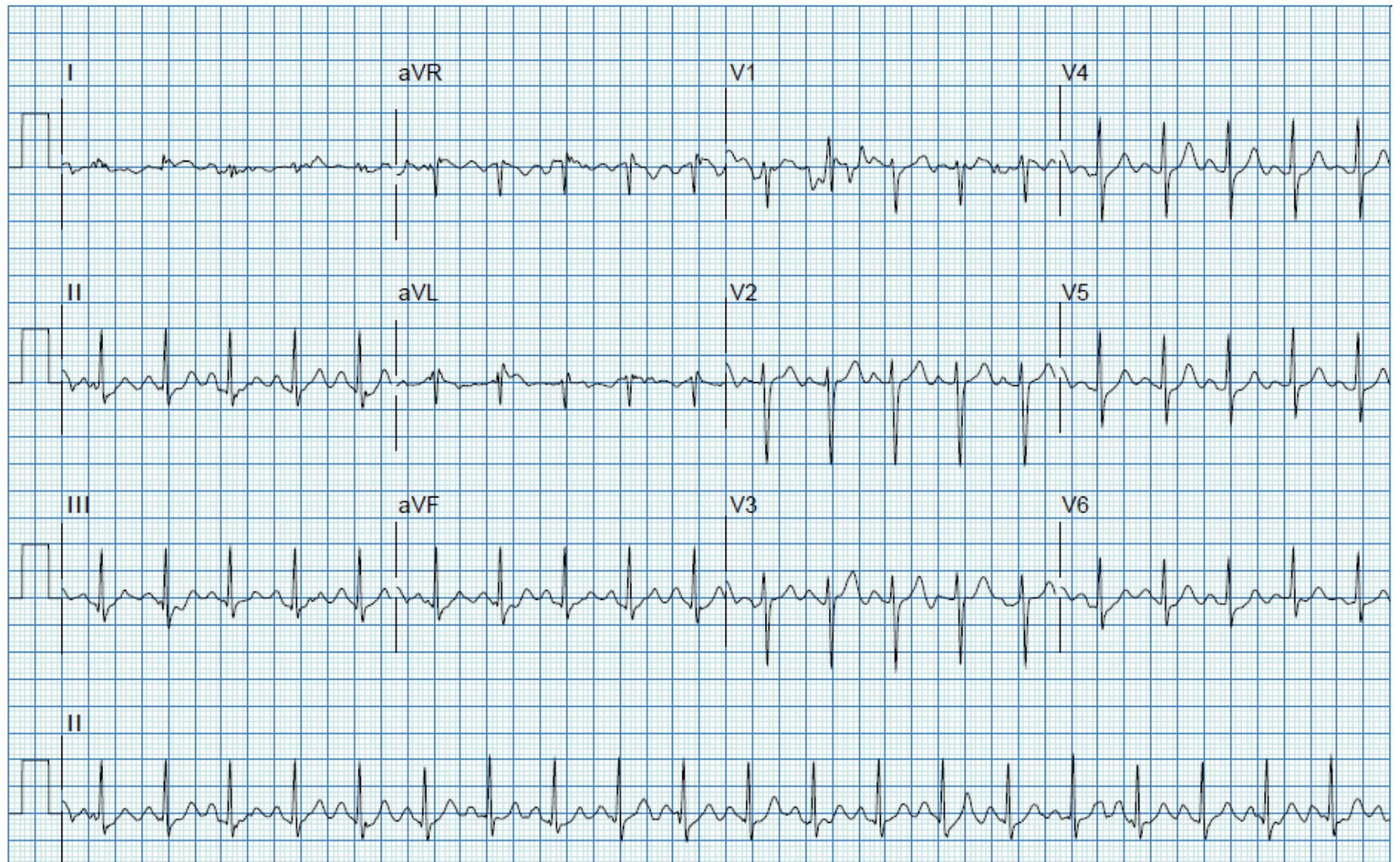
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

2 02:50 05:50
4.0 km/h 12.0%

RPE	--	HR	126						
METs(a)	7.0	Target HR	152	II	LVL	0.3	SLP	21	
BP	137/72	Max HR	127	V2	LVL	1.1	SLP	18	
Previous BP	133/76	HRxBP	17262	V5	LVL	0.6	SLP	20	



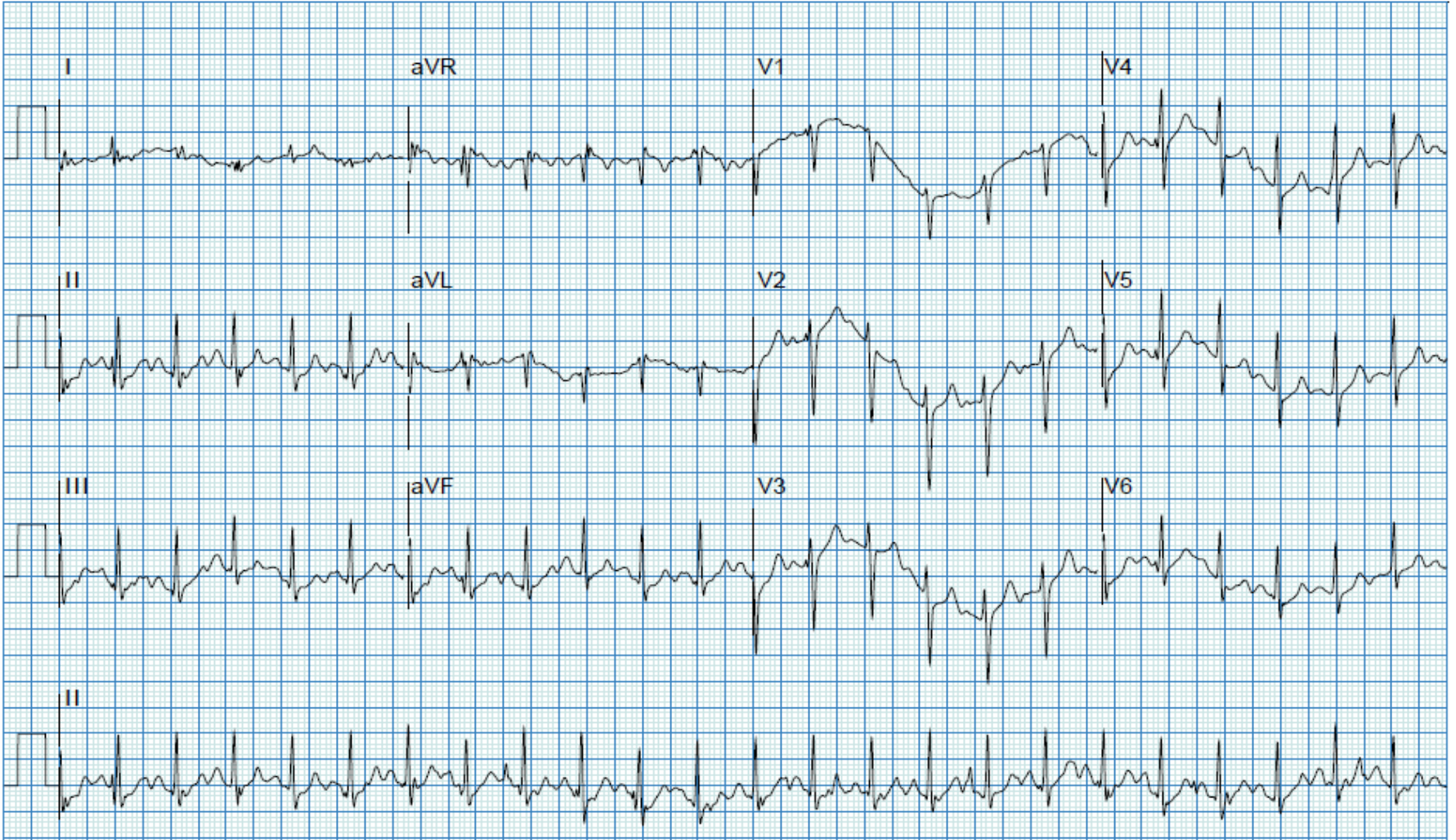
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

3 02:50 08:50
5.4 km/h 14.0%

RPE	-	HR	145	II	LVL	0.1	SLP	25
METs(a)	10.1	Target HR	152	V2	LVL	1.7	SLP	29
BP	141/66	Max HR	145	V5	LVL	0.6	SLP	31
Previous BP	137/72	HRxBP	20445					



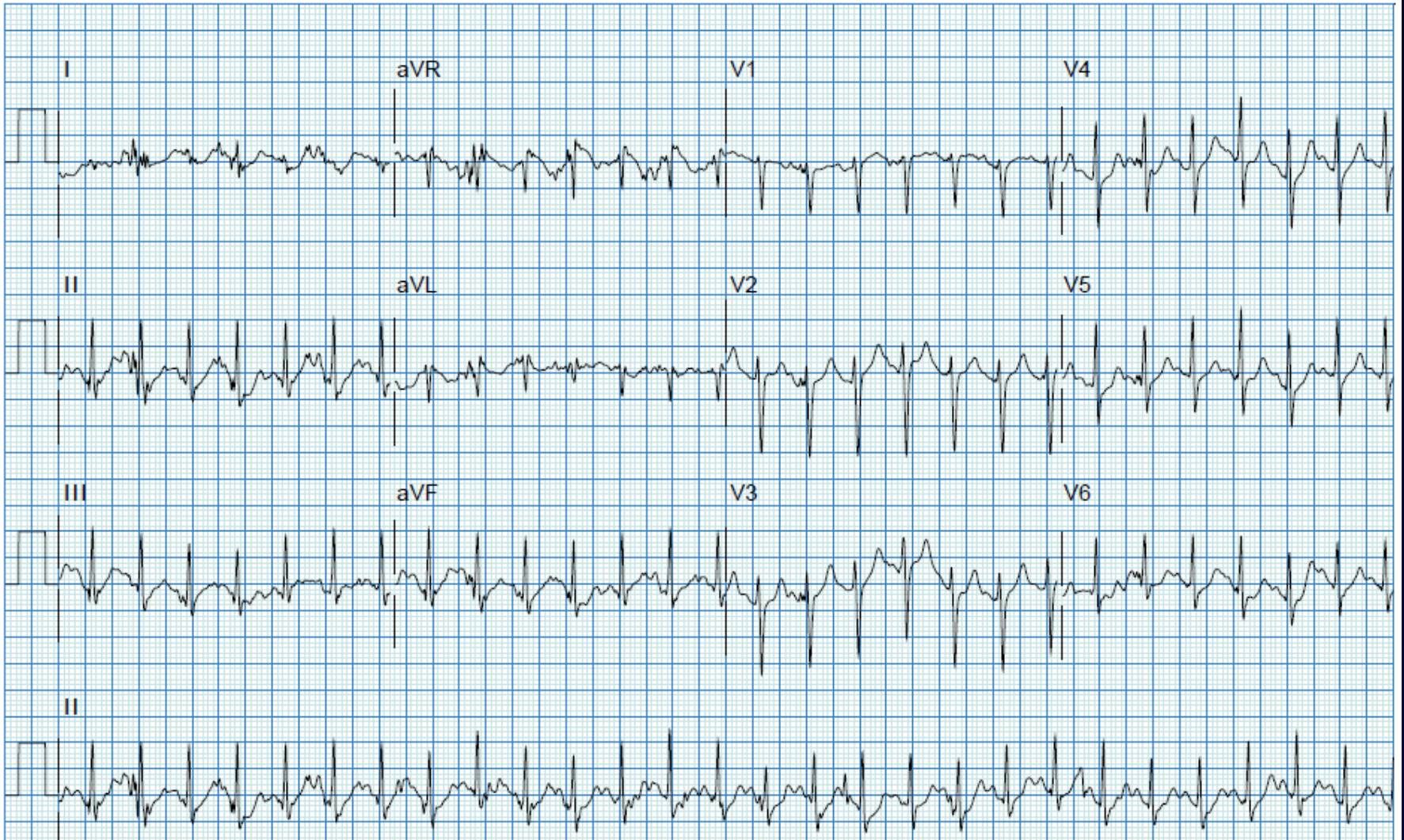
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

Recov 00:00
1.9 km/h 0.0%

RPE	--	HR	167	II LVL	0.5	SLP	31
METs(a)	12.8	Target HR	152	V2 LVL	2.1	SLP	39
BP	---/---	Max HR	167	V5 LVL	0.8	SLP	36
Previous BP	141/66	HRxBP	----				



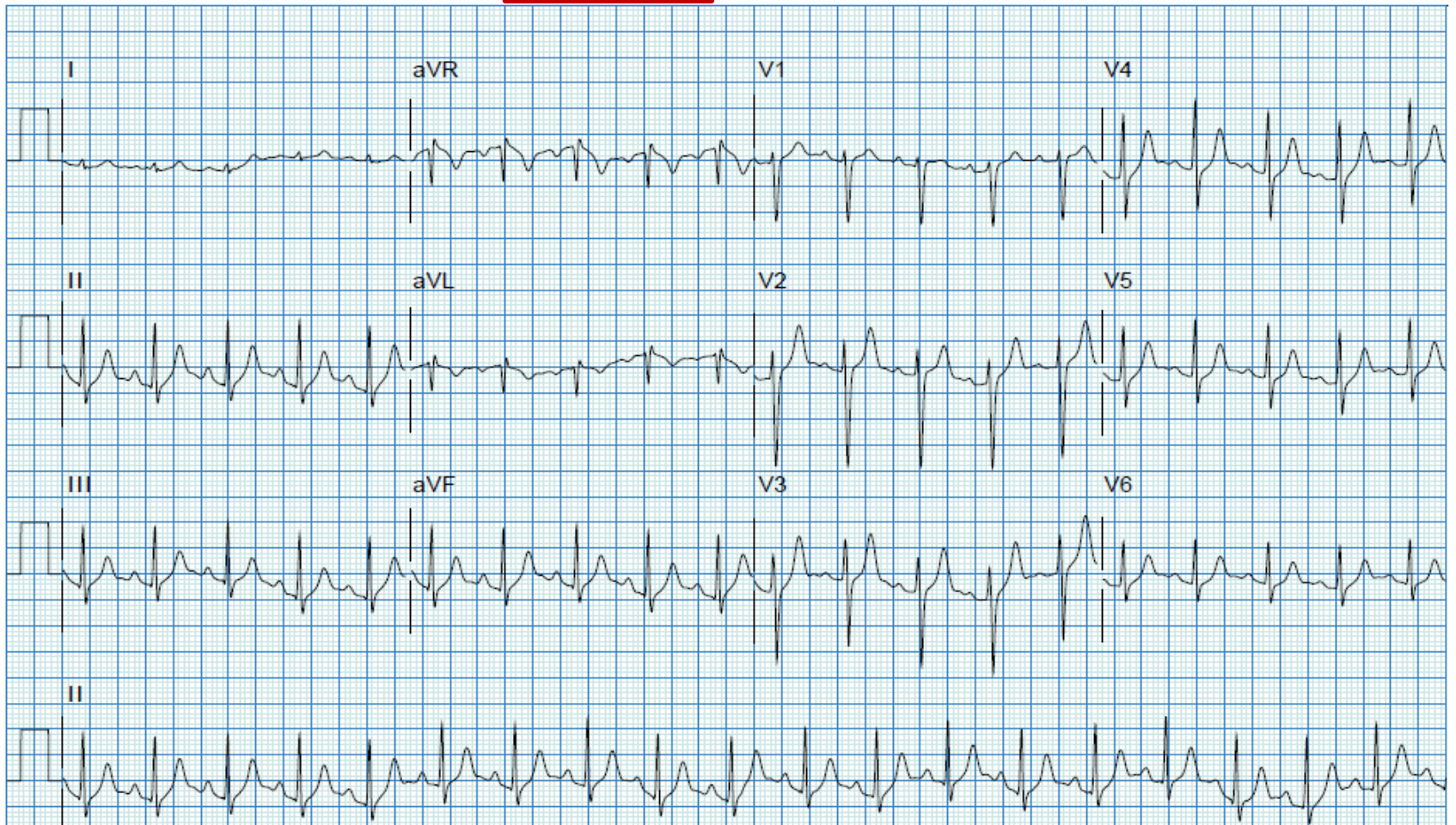
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

Recov 01:00
0.0 km/h 0.0%

RPE	-	HR	120
METs(a)	12.8	Target HR	152 II LVL 1.8 SLP 50
BP	137/63	Max HR	167 V2 LVL 2.6 SLP 50
Previous BP	141/66	HRxBP	16440 V5 LVL 1.6 SLP 50



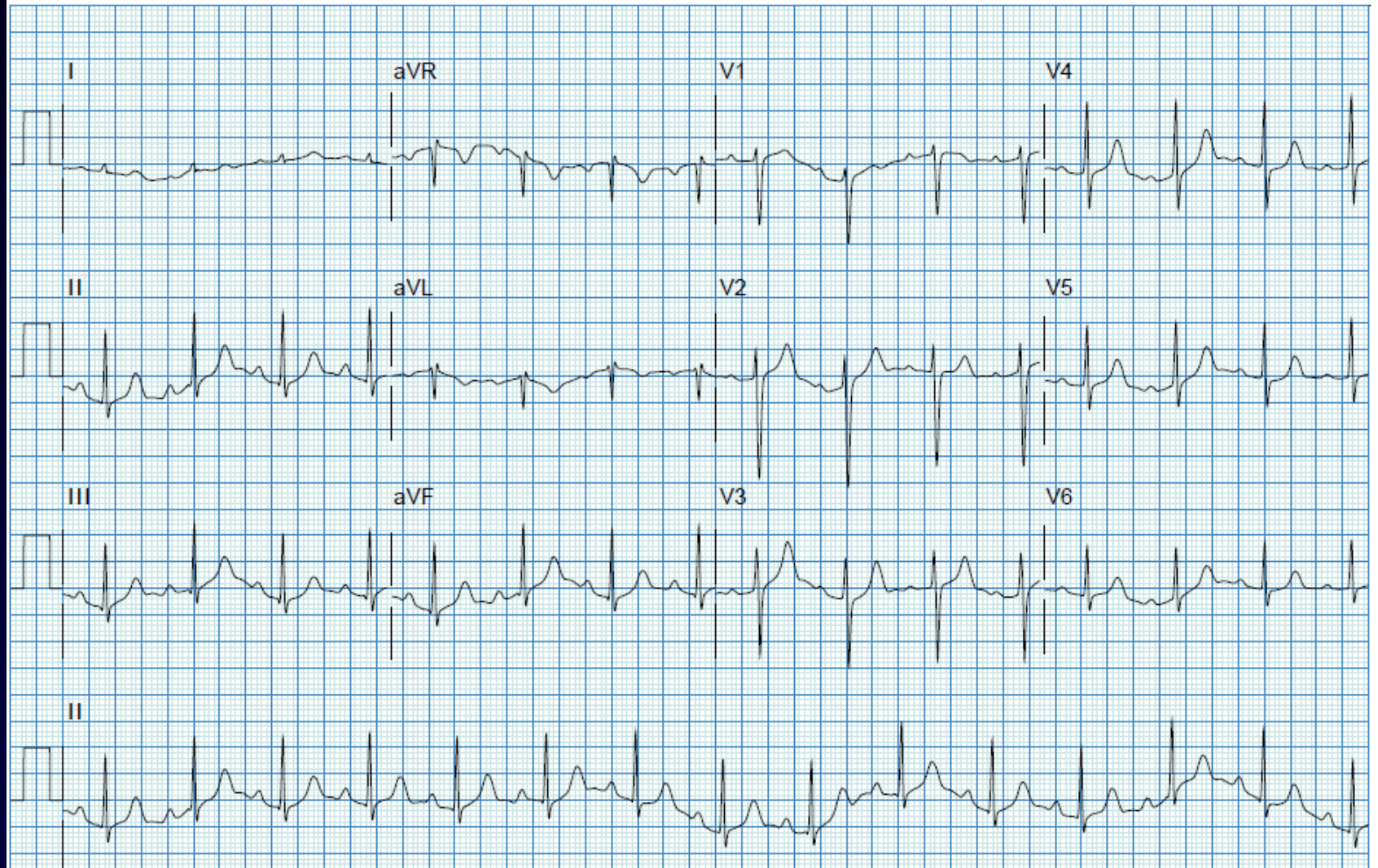
12-Lead(simultaneous)

Protocol

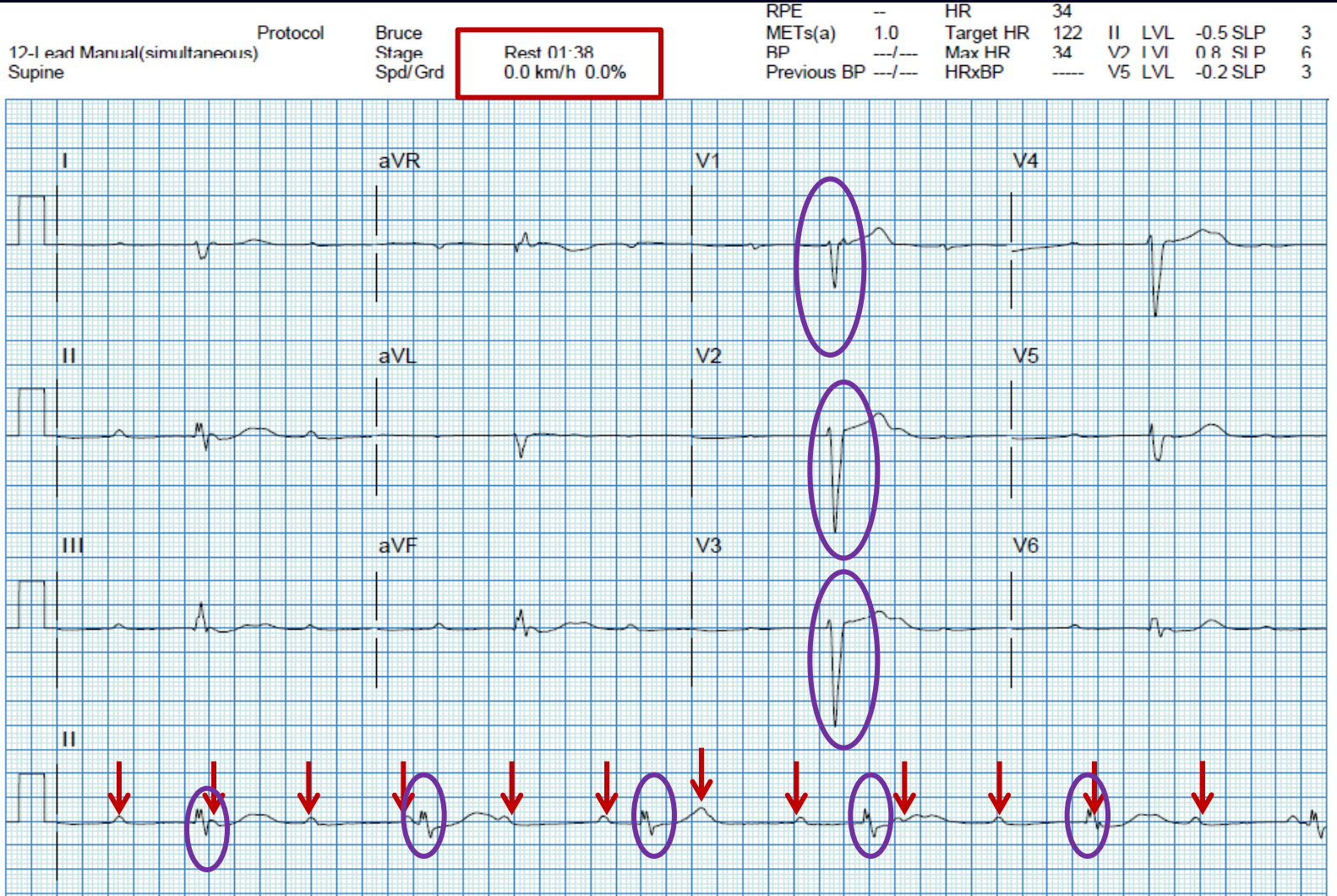
Bruce
Stage
Spd/Grd

Recov 03:00
0.0 km/h 0.0%

RPE	--	HR	93	II	LVL	1.0	SLP	15
METs(a)	12.8	Target HR	152	V2	LVL	1.6	SLP	15
BP	142/68	Max HR	167	V5	LVL	0.8	SLP	12
Previous BP	137/63	HRxBP	13206					



77/M 대화중 syncope



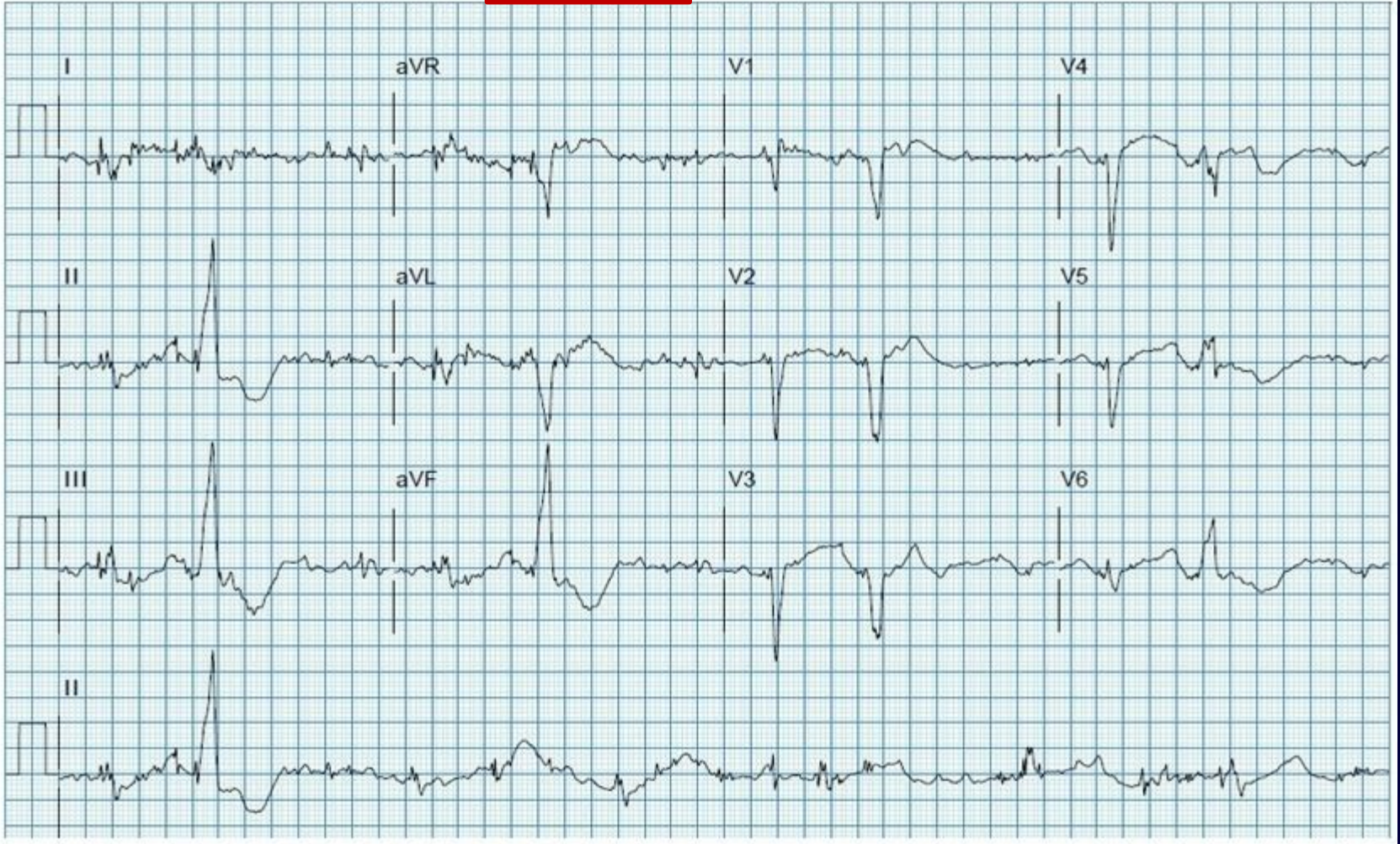
12-Lead FF(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

1 01:12 01:12
2.7 km/h 10.0%

RPE	--	HR	39	II LVL	-0.9 SLP	6
METs(a)	4.6	Target HR	122	V2 LVL	0.1 SLP	10
BP	---/---	Max HR	47	V5 LVL	-0.4 SLP	8
Previous BP	---/---	HRxBP	----			



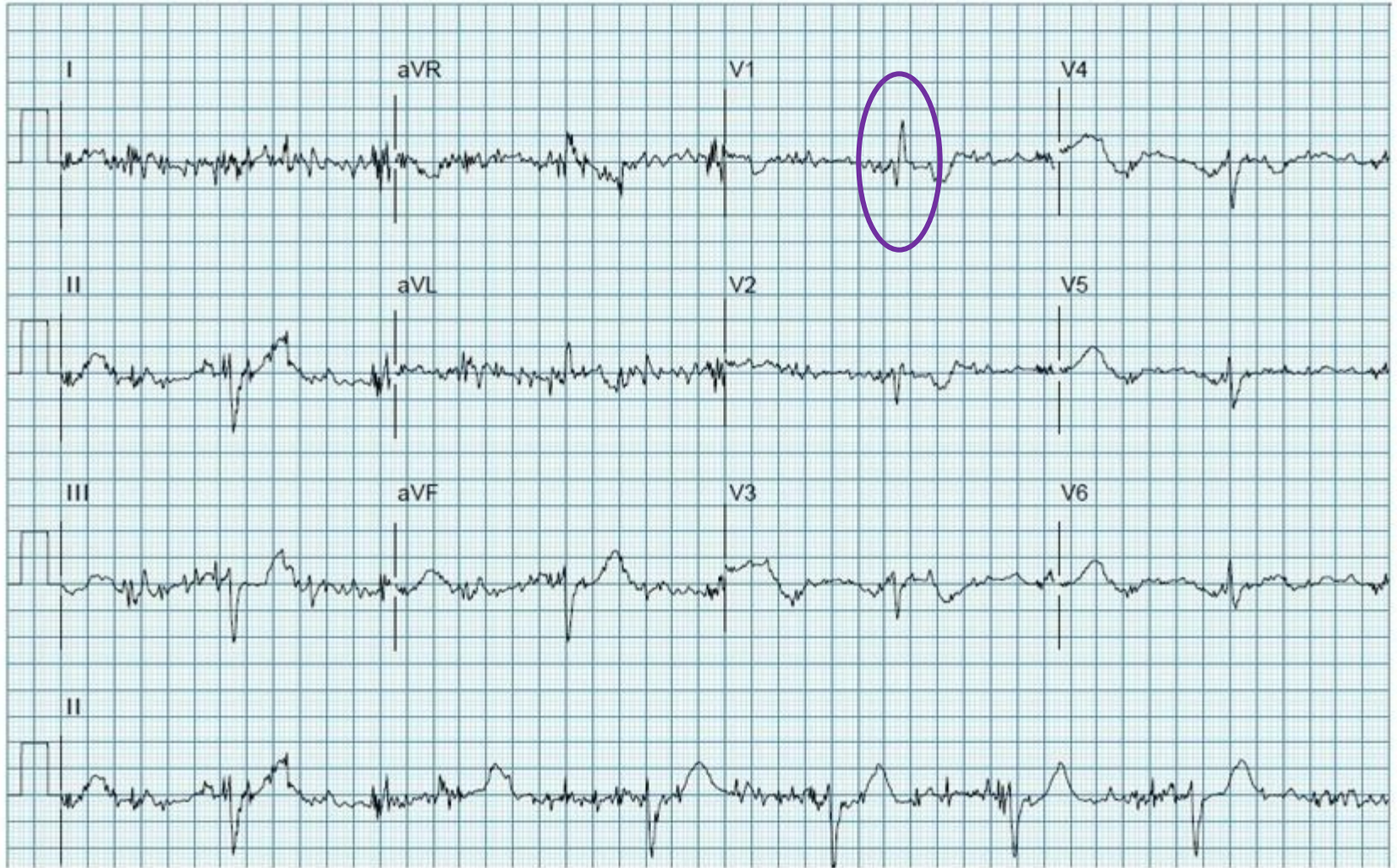
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

Recov 00:00
1.9 km/h 0.0%

RPE	--	HR	36	II LVL	-1.4	SLP	16
METs(a)	4.6	Target HR	122	V2 LVL	1.2	SLP	-6
BP	--/--	Max HR	73	V5 LVL	0.3	SLP	0
Previous BP	138/62	HRxBP	----				



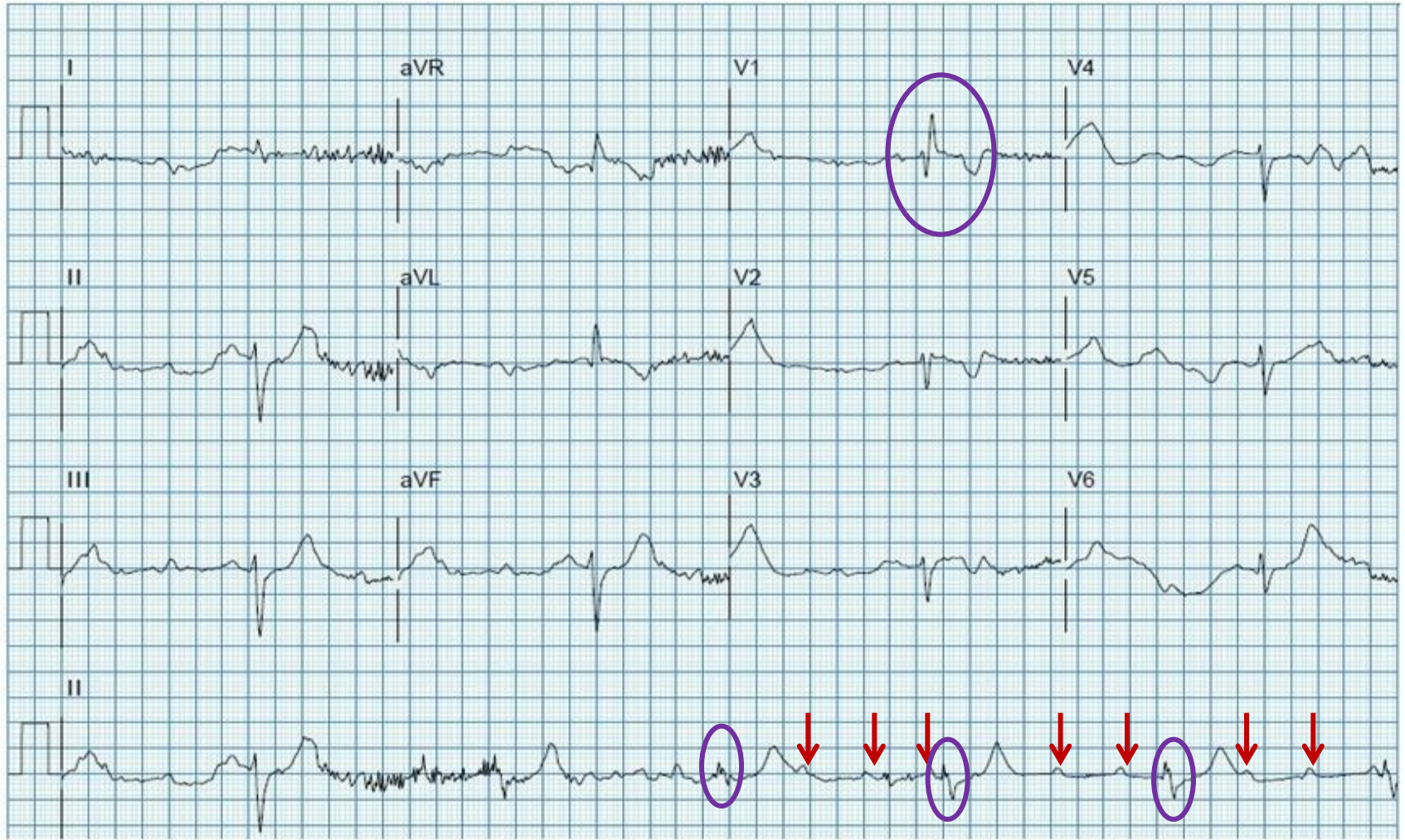
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

Recov 01:00
0.0 km/h 0.0%

RPE	--	HR	41	II	LVL	-1.7	SLP	50
METs(a)	4.6	Target HR	122	V2	LVL	1.9	SLP	50
BP	134/57	Max HR	73	V5	LVL	-1.6	SLP	50
Previous BP	138/62	HRxBP	5494					

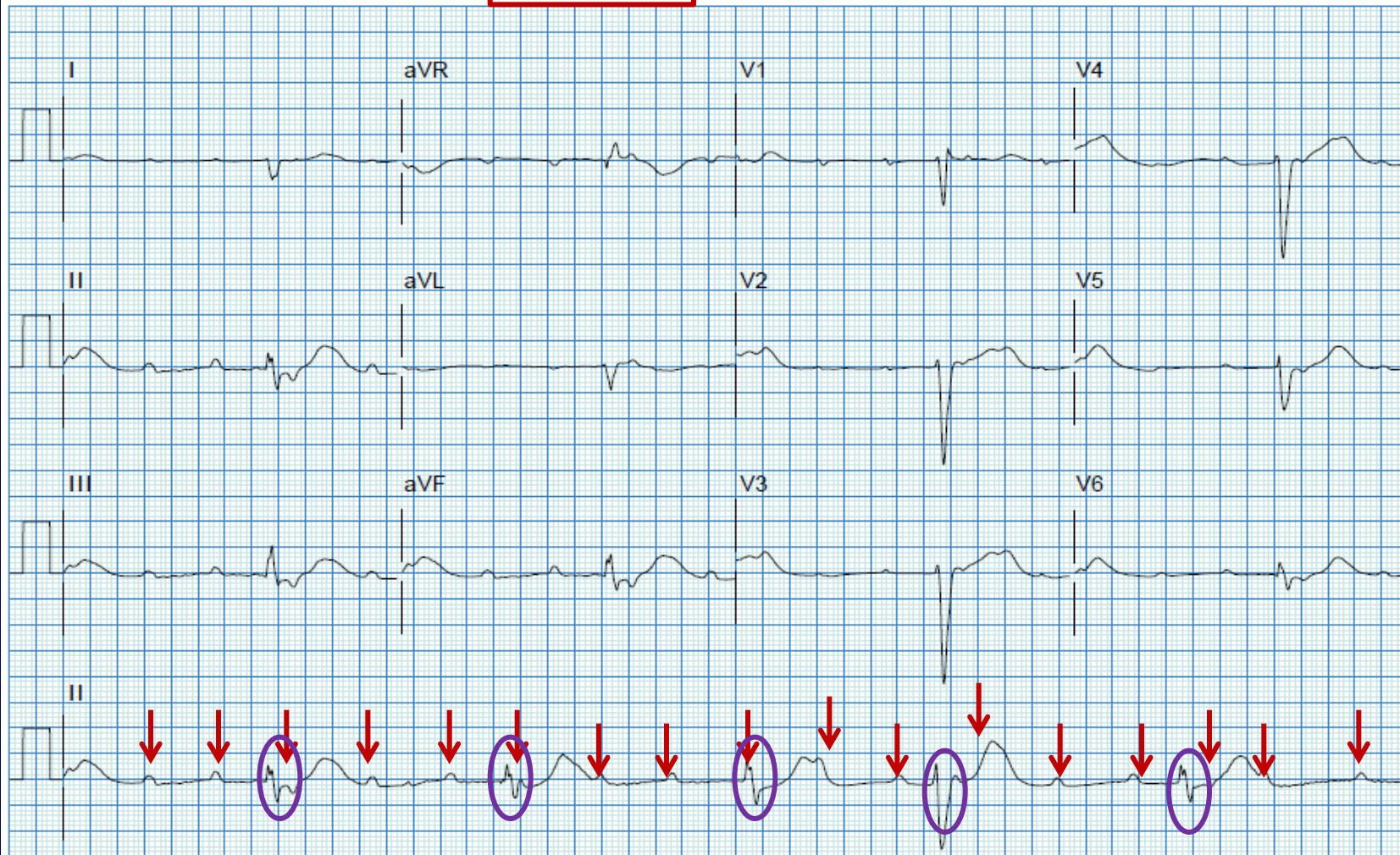


12-Lead(simultaneous)

Protocol
Bruce
Stage
Spd/Grd

Recov 05:00
0.0 km/h 0.0%

RPE	--	HR	34	II	LVL	-0.9	SLP	3
METs(a)	4.6	Target HR	122	V2	LVL	0.2	SLP	0
BP	--/--	Max HR	73	V5	LVL	-0.2	SLP	1
Previous BP	--/--	HRxBP	---					



Block site

-AV block이 호전되는 경우-

Supra His block

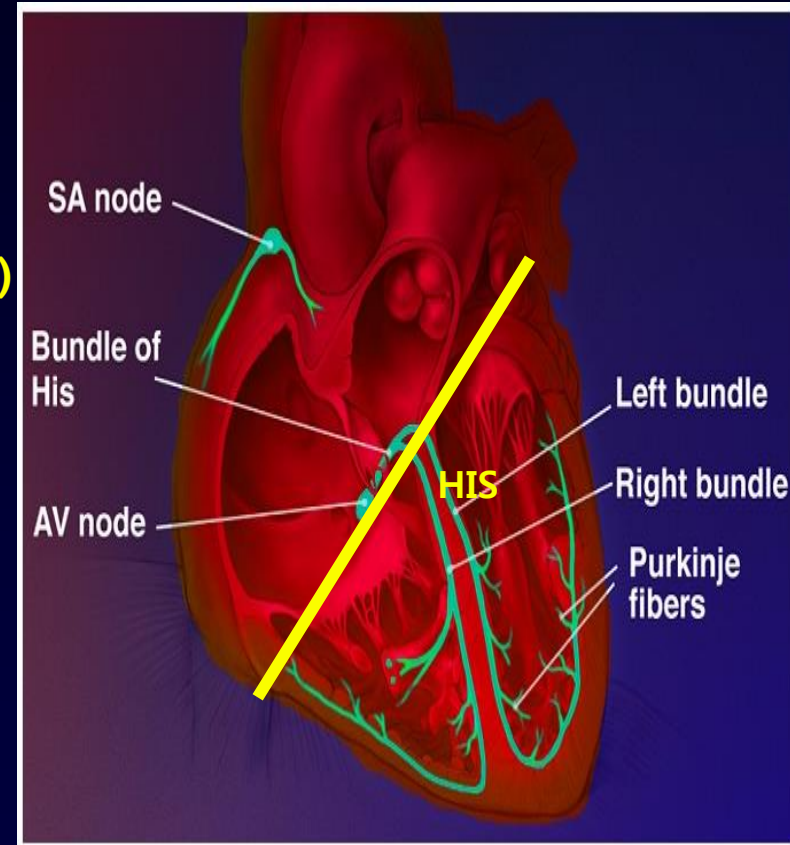
잠재적 pacemaker 는 AV node(40~60bpm/min)

-AV block이 변화가 없거나 악화되는 경우-

Infra His block

잠재적 pacemaker는 심실뿐(20~40bpm/min)

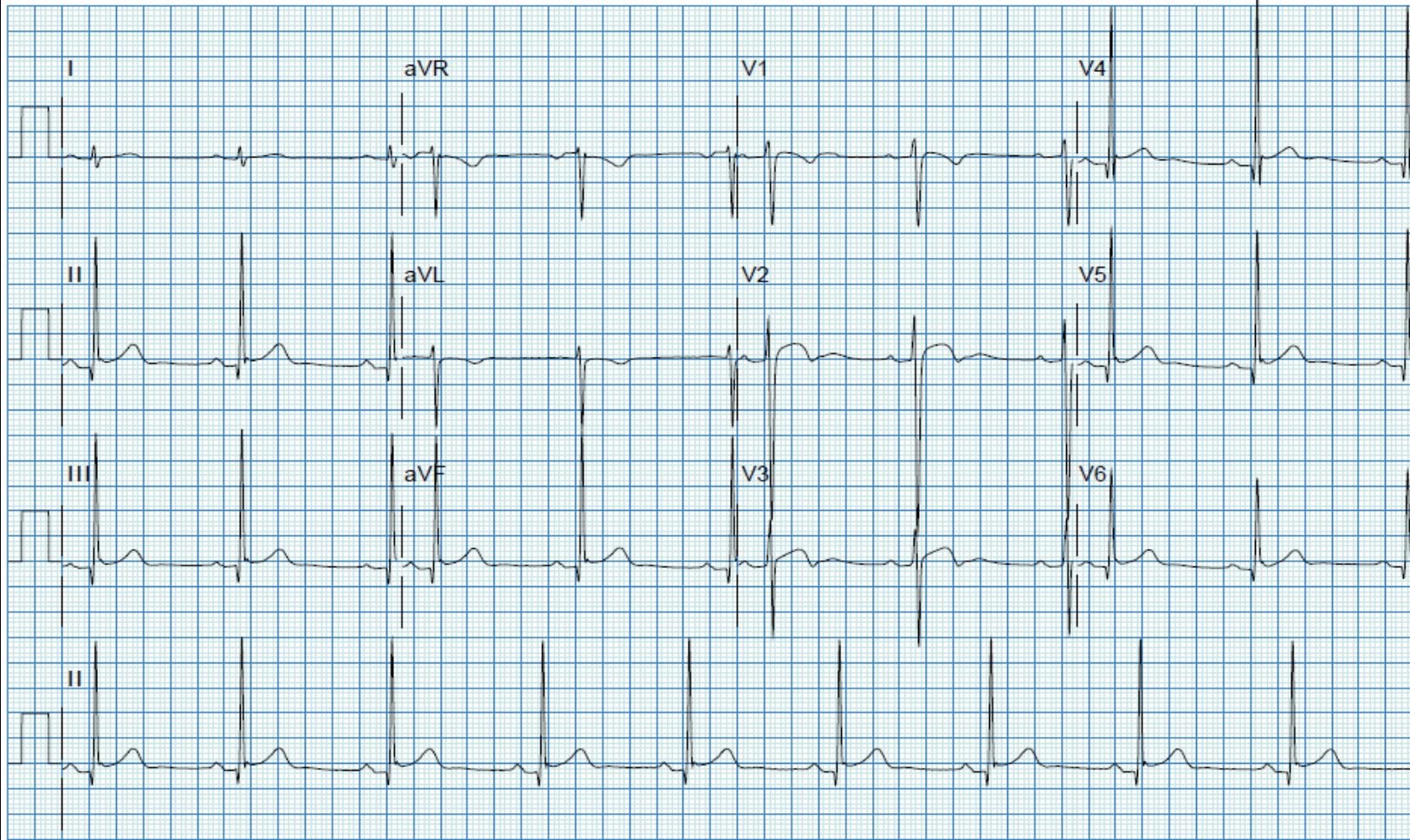
90% 이상에서 pacemaker 시술



62/M 수년전부터 1년에 한번꼴로 운동후 심한 dyspnea, dizziness, syncope(20분)

Protocol	Bruce	RPE	--	HR	55						
12-Lead Manual(simultaneous)	Stage	METs(a)	1.0	Target HR	135	II	LVL	1.3	SLP	6	
Supine	Spd/Grd	BP	108/60	Max HR	55	V2	LVL	2.6	SLP	13	
				Previous BP	--/--	HRxBP	V5	LVL	1.1	SLP	8

Rest 01:29
0.0 km/h 0.0%



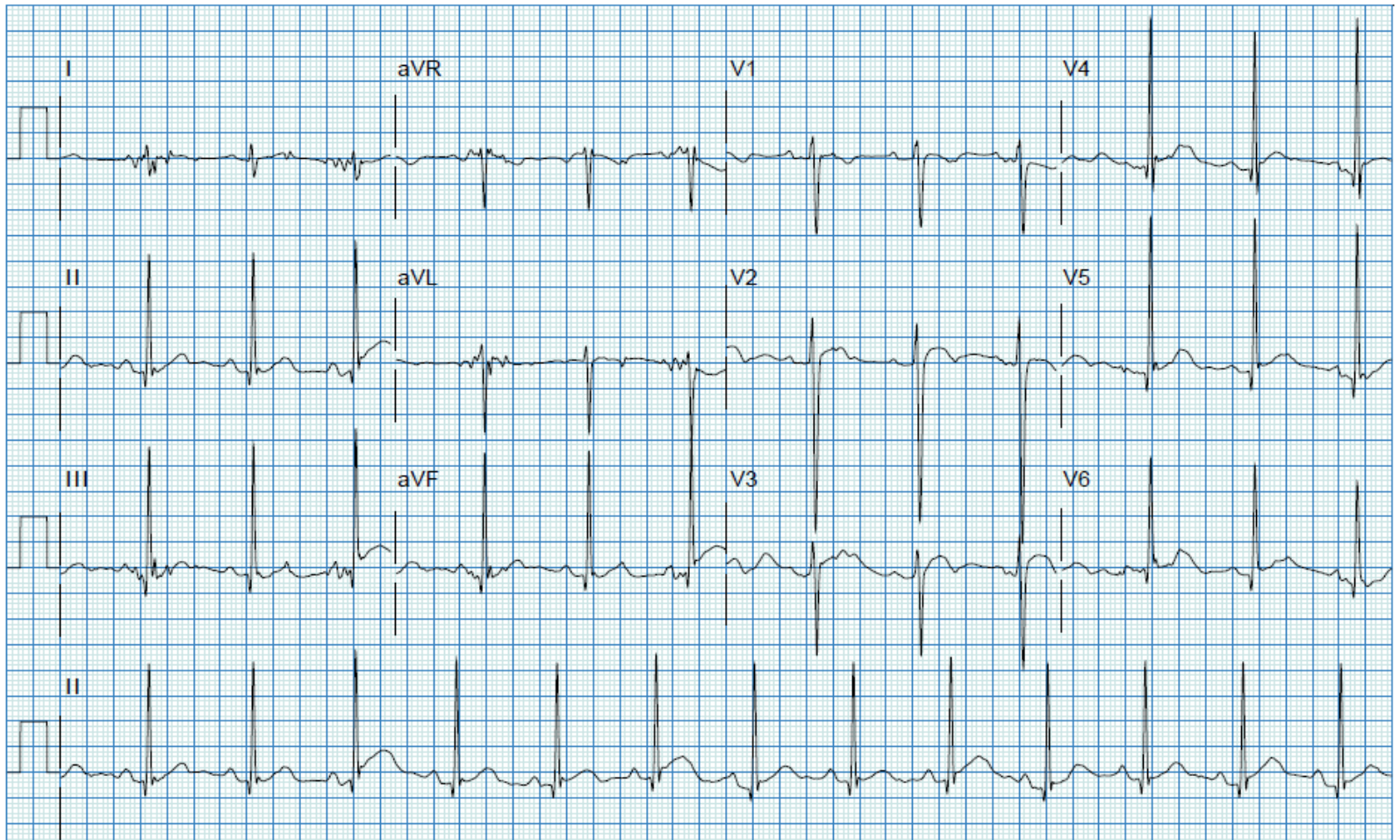
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

1 02:50 02:50
2.7 km/h 10.0%

RPE	--	HR	80	II	LVL	1.0	SLP	15
METs(a)	4.6	Target HR	135	V2	LVL	2.3	SLP	7
BP	--/--	Max HR	88	V5	LVL	0.9	SLP	13
Previous BP	108/60	HRxBP	----					



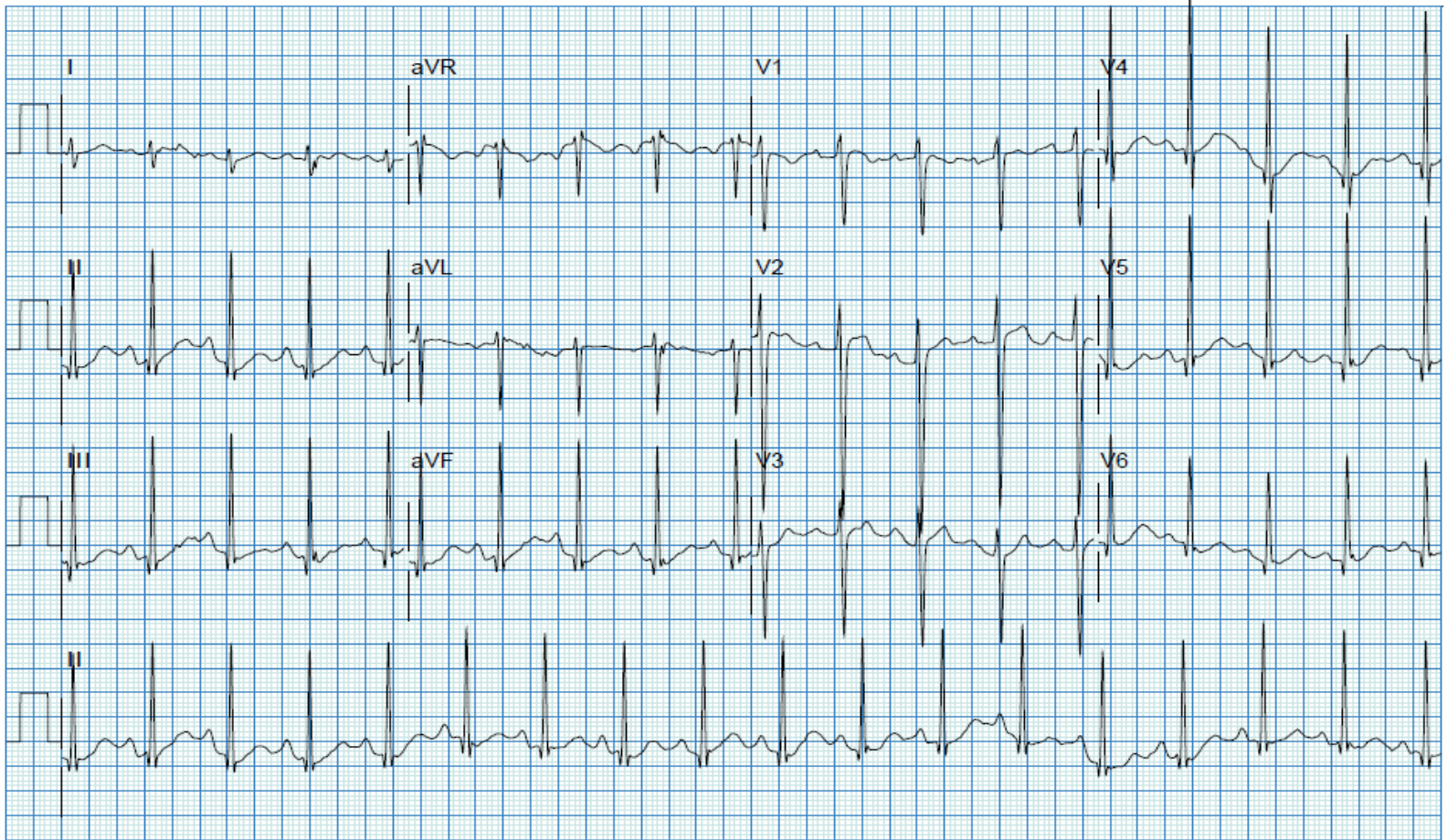
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

2 02:50 05:50
4.0 km/h 12.0%

RPE	--	HR	97						
METs(a)	7.0	Target HR	135	II	LVL	0.5	SLP	19	
BP	133/60	Max HR	100	V2	LVL	2.3	SLP	11	
Previous BP	141/61	HRxBP	12901	V5	LVL	0.0	SLP	18	



2013-05-02

10:59:45

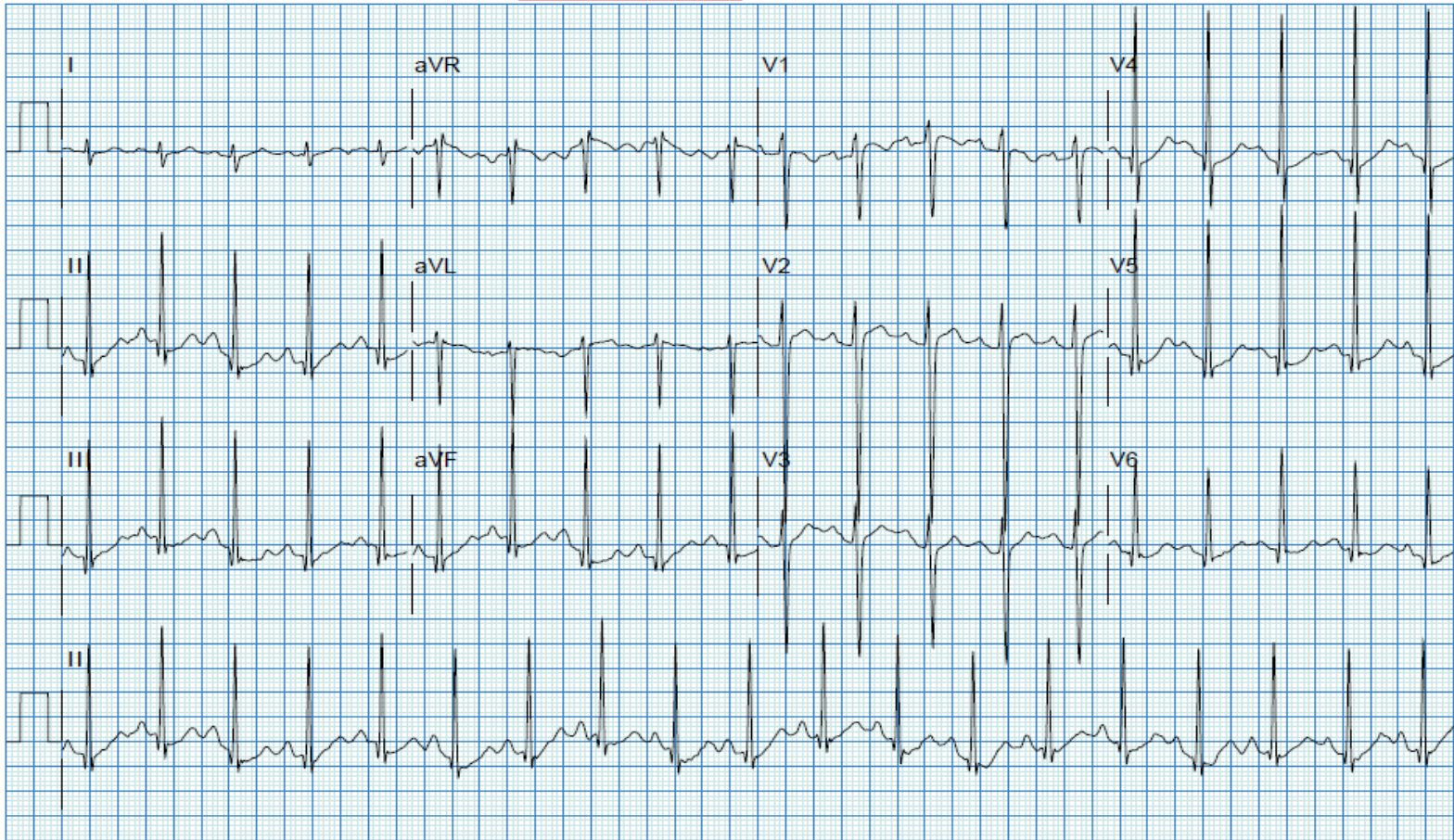
25 mm/sec 10 mm/mV BWF On MAF On Line On 40Hz On Page 5

12-Lead(simultaneous)

Protocol Bruce
Stage
Spd/Grd

3 02:50 08:50
5.4 km/h 14.0%

RPE	-	HR	114	II LVL	0.0	SLP	16
METs(a)	10.1	Target HR	135	V2 LVL	2.2	SLP	14
BP	154/65	Max HR	114	V5 LVL	-1.0	SLP	16
Previous BP	133/60	HRxBP	17556				



2013-05-02

11:02:45

25 mm/sec 10 mm/mV BWF On MAF On Line On 40Hz On Page 6

12-Lead FF(simultaneous)

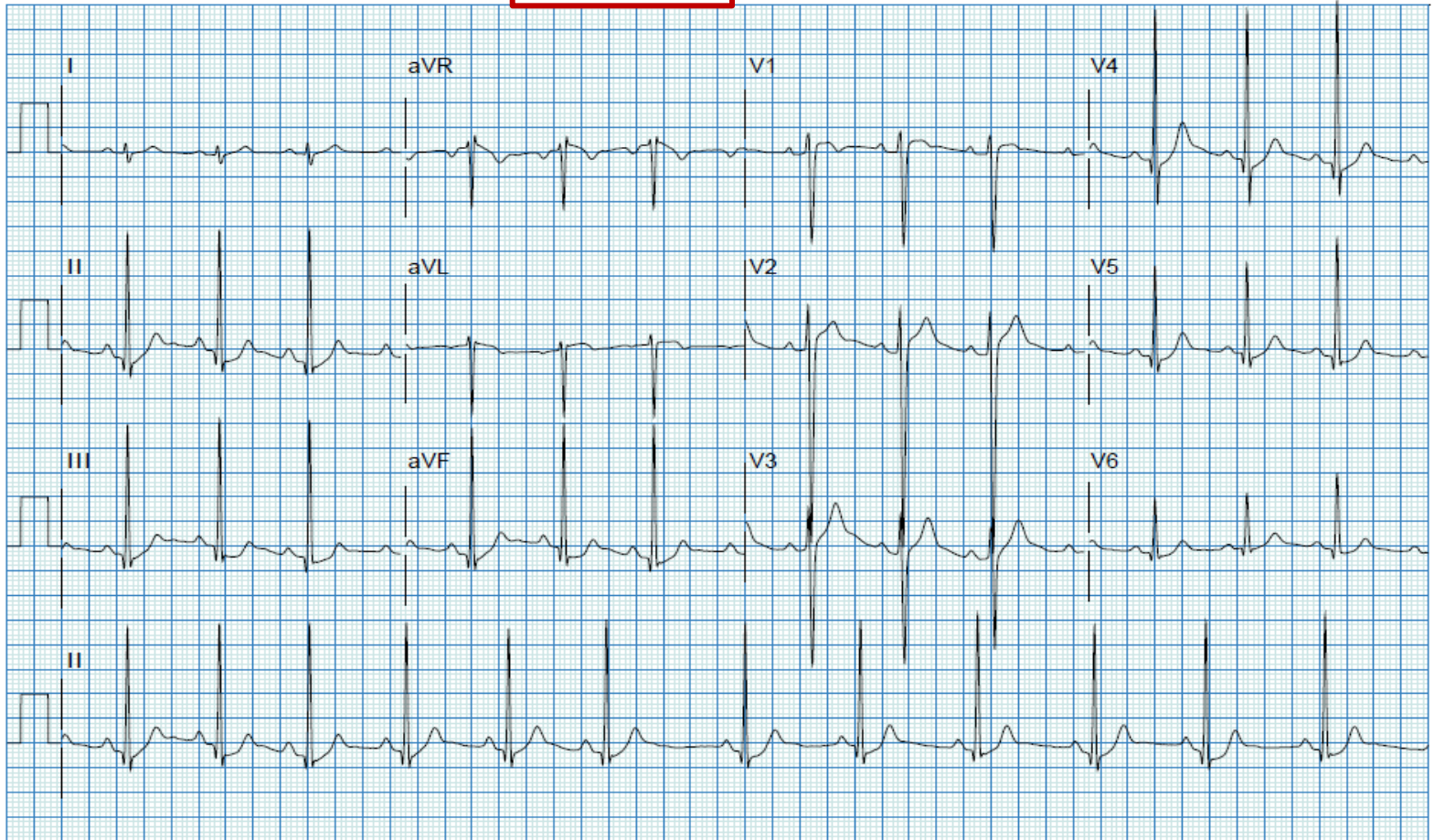
Protocol

Bruce
Stage
Spd/Grd

Recov 00:40
0.0 km/h 0.0%

RPE	-	HR	108
METs(a)	12.8	Target HR	135
BP	169/63	Max HR	140
Previous BP	154/65	HRxBP	18252

II LVL	-0.2	SLP	16
V2 LVL	4.0	SLP	30
V5 LVL	-0.5	SLP	21



2013-05-02

11:05:35

25 mm/sec 10 mm/mV BWF On MAF On Line On 40Hz On Page 8

운동후 pause

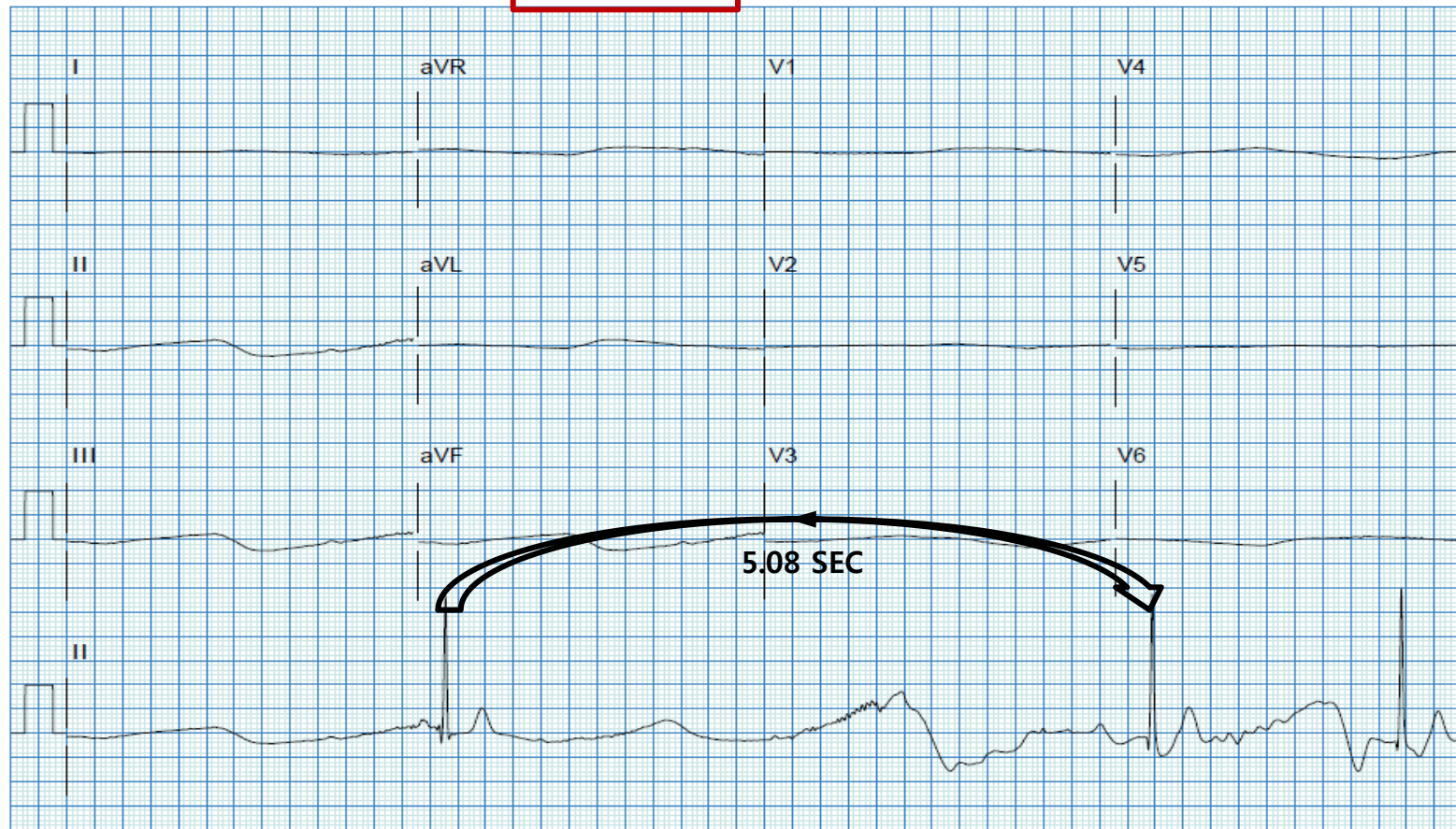
12-Lead FF(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

Recov 01:17
0.0 km/h 0.0%

RPE	--	HR	0	II LVL	-0.4 SLP	16
METs(a)	12.8	Target HR	135	V2 LVL	3.7 SLP	10
BP	169/63	Max HR	140	V5 LVL	-0.3 SLP	14
Previous BP	154/65	HRxBP	----			



2013-05-02

11:06:12

25 mm/sec 10 mm/mV BWF On MAF On Line On 40Hz On Page 12

12-Lead Manual(simultaneous)

Protocol Bruce
Stage
Spd/Grd

Recov 01:36
0.0 km/h 0.0%

RPE	--	HR	--	II LVL	-1.8	SLP	-2
METs(a)	12.8	Target HR	135	V2 LVL	4.1	SLP	-6
BP	169/63	Max HR	140	V5 LVL	-0.6	SLP	8
Previous BP	154/65	HRxBP	----				



2013-05-02

11:06:31

25 mm/sec 10 mm/mV BWF On MAF On Line On 40Hz On Page 13

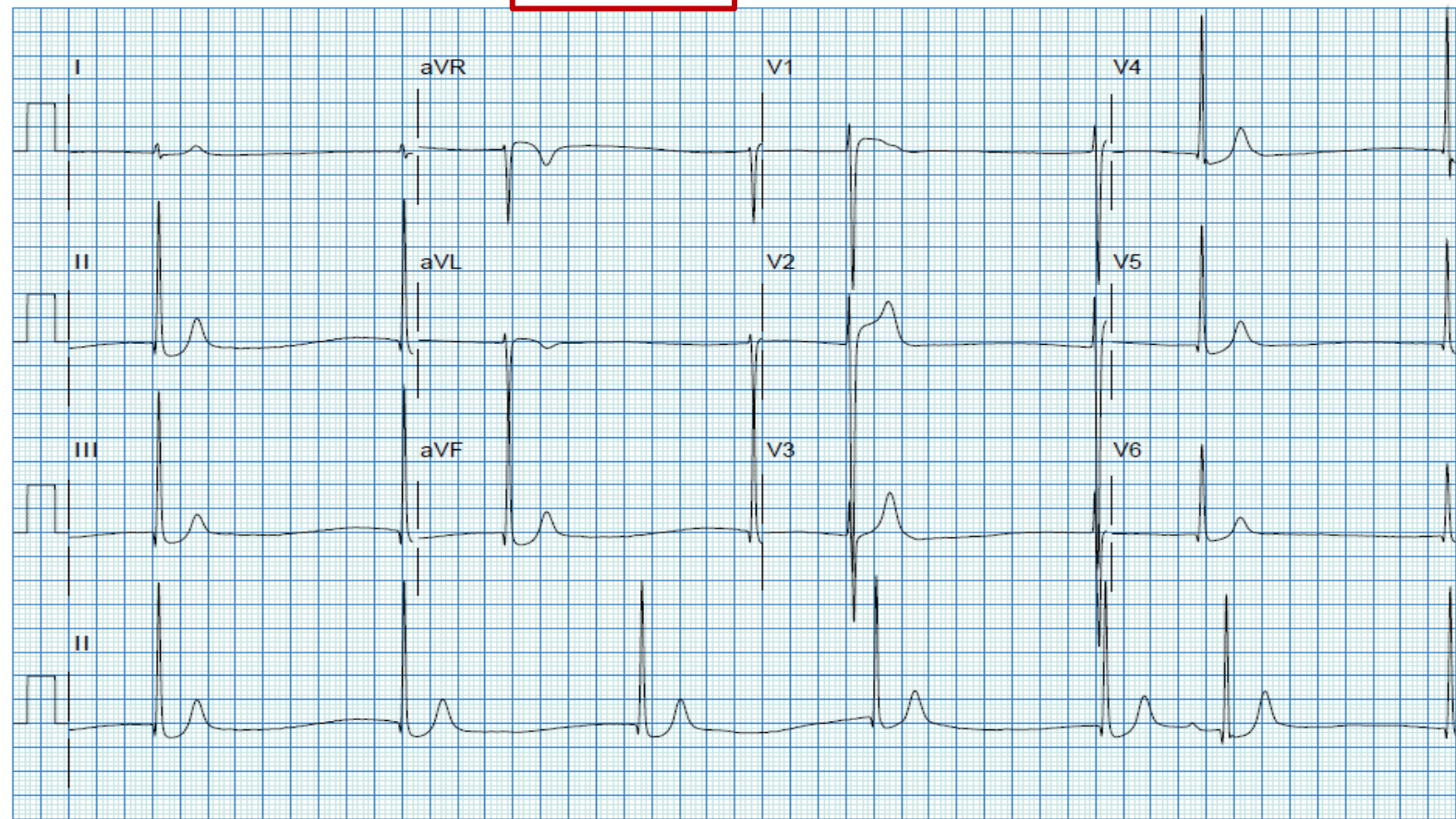
12-Lead Manual(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

Recov 01:49
0.0 km/h 0.0%

RPE	--	HR	44					
METs(a)	12.8	Target HR	135	II LVL	-2.7	SLP	2	
BP	169/63	Max HR	140	V2 LVL	4.4	SLP	11	
Previous BP	154/65	HRxBP	7436	V5 LVL	-1.5	SLP	12	



2013-05-02 11:06:44 25 mm/sec 10 mm/mV BWF On MAF On Line On 40Hz On Page 14

12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

Recov 03:00
0.0 km/h 0.0%

RPE	--	HR	49	II LVL	-2.0	SLP	2
METs(a)	12.8	Target HR	135	V2 LVL	3.0	SLP	7
BP	98/43	Max HR	140	V5 LVL	-2.1	SLP	0
Previous BP	169/63	HRxBP	4802				



2013-05-02

11:07:55

25 mm/sec 10 mm/mV BWF On MAF On Line On 40Hz On Page 15

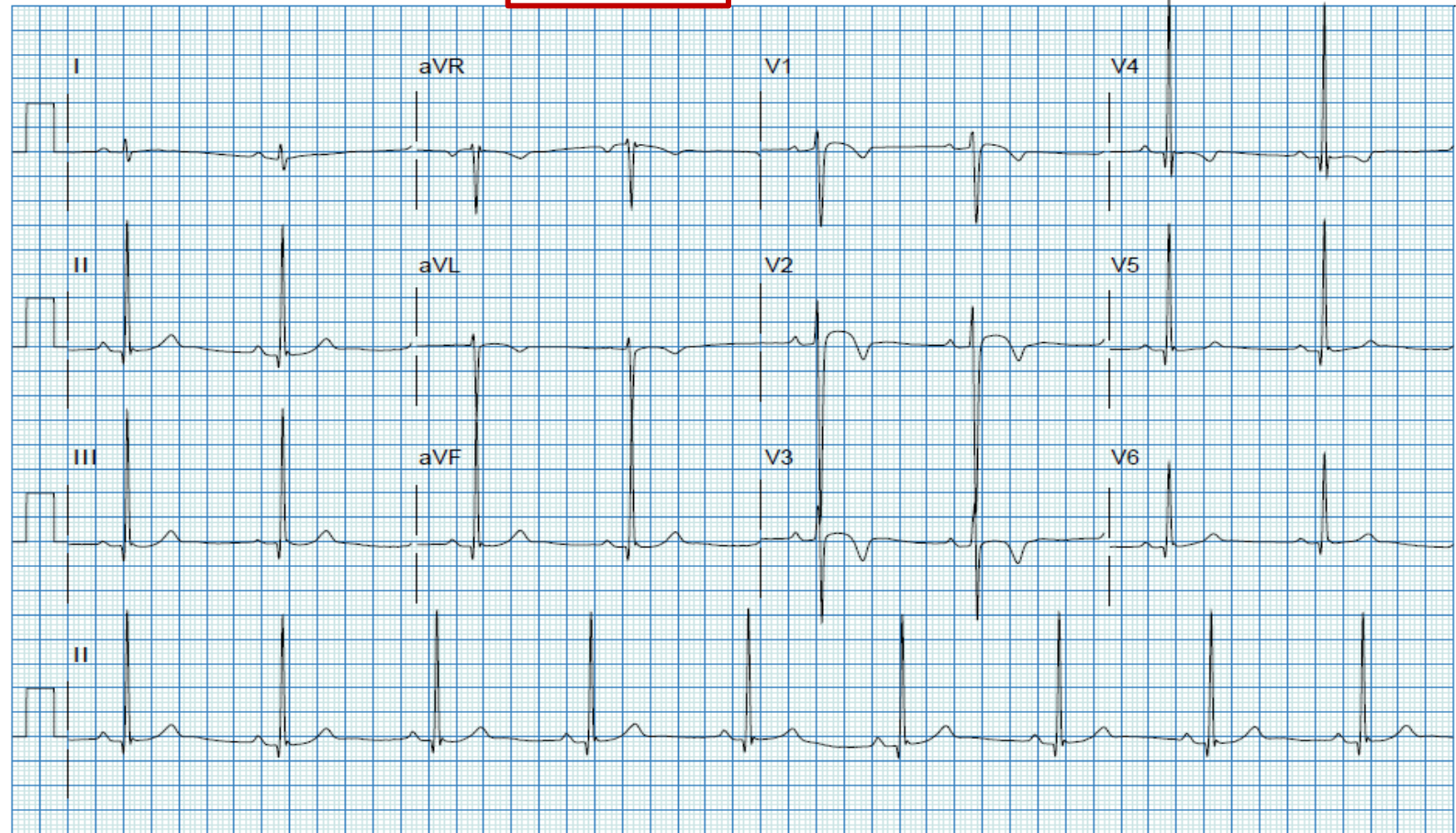
12-Lead(simultaneous)

Protocol

Bruce
Stage
Spd/Grd

Recov 05:00
0.0 km/h 0.0%

RPE	-	HR	54	II	LVL	0.1	SLP	1
METs(a)	12.8	Target HR	135	V2	LVL	2.4	SLP	7
BP	109/53	Max HR	140	V5	LVL	0.0	SLP	2
Previous BP	98/43	HRxBP	5886					



2013-05-02

11:09:55

25 mm/sec 10 mm/mV BWF On MAF On Line On 40Hz On Page 16

운동후 pause

기질적 심질환이 없는 경우 운동후 회복기에 발생하는
실신은 과도한 미주신경 반응 때문이다.

따라서, 유발상황을 피할수 있는 교육과 함께 관찰하여 볼
수 있다.

Take home message

부정맥을 진단하기 위한 검사는 일반적으로 안전하고
입원이 필요없는 Non -invasive study 부터 시작하여,
복잡하고 위험성이 있고, 입원이 필요한 Invasive study
순서로 진행되고 있습니다.

경청해주셔서 감사합니다

