



Narrow QRS tachycardia



김도영

한림의대

Korean Heart Rhythm Society

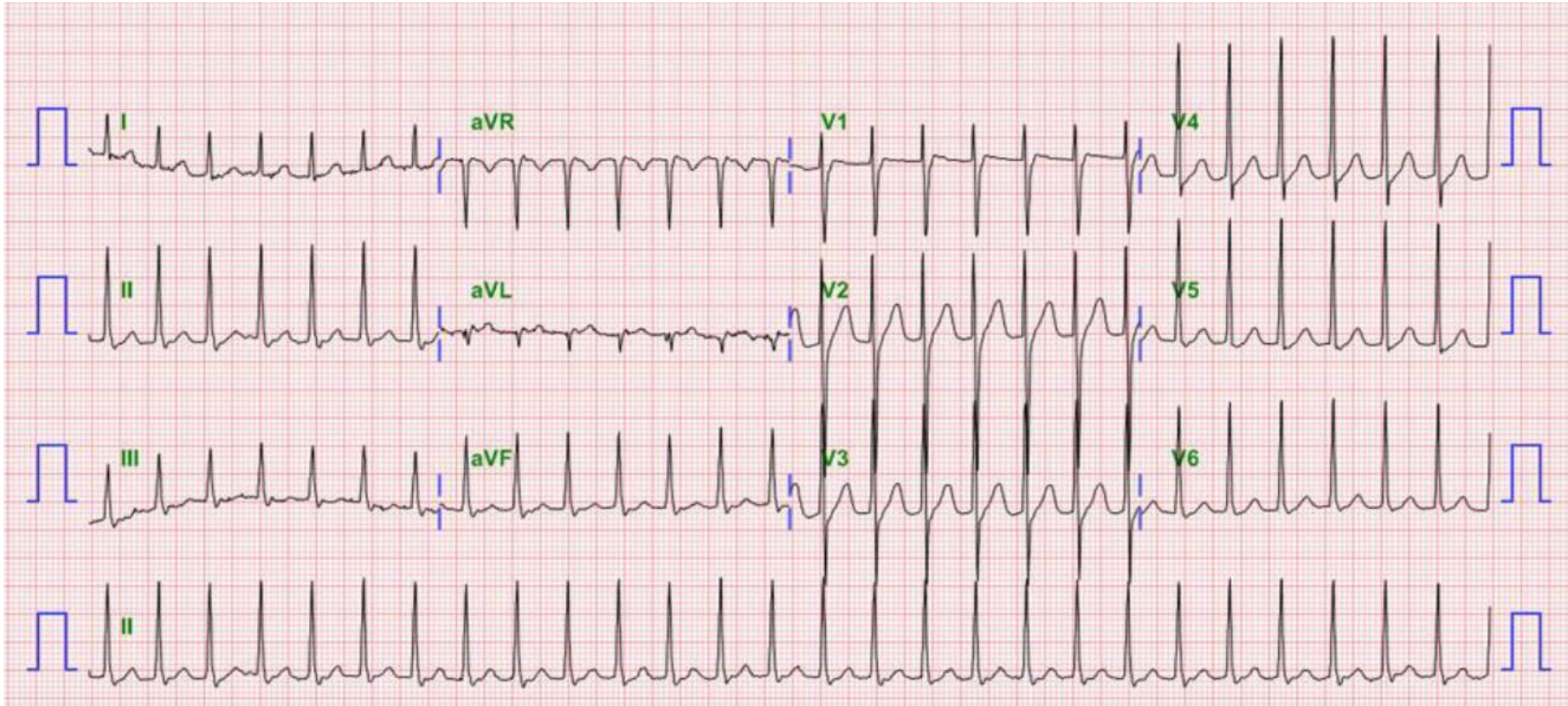
COI Disclosure

Name of First Author:

The authors have no financial conflicts of interest to disclose concerning the presentation



Case 49/M, palpitations



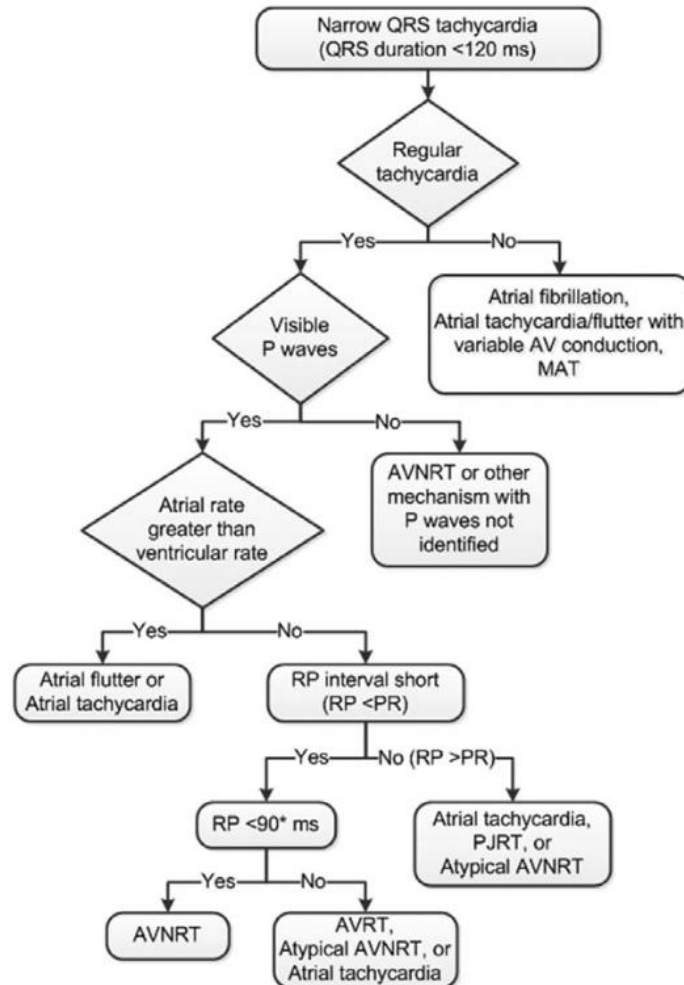
가장 가능성이 높은 진단은?

- 1) AT
- 2) Atrial flutter
- 3) AVNRT
- 4) AVRT



Differential diagnosis for adult narrow QRS tachycardia

-It begins with electrocardiogram-



- ✓ Regularity of Rhythm
 - Irregularly irregular – AF
 - Regularly irregular – AT

- ✓ A-V relationship
 - A>V – AT, AVNRT

- ✓ Determined P waves and Analyze RP interval
 - Long RP tachycardia (RP>PR)
→ AT, PJRT, Atypical AVNRT

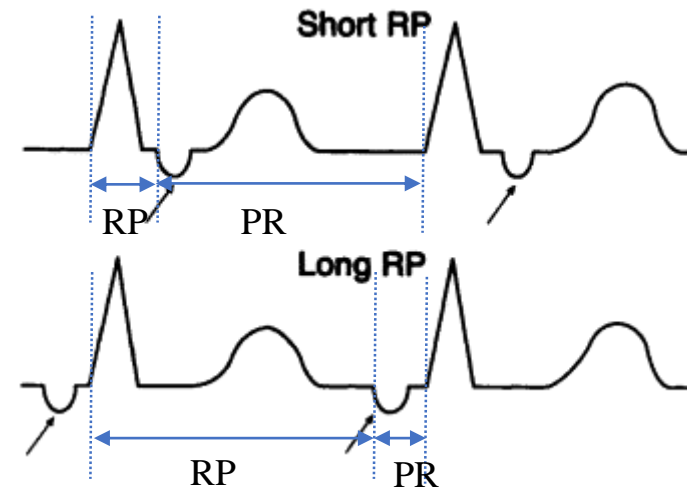
Short RP tachycardia (RP<PR)
→ AVNRT, AVRT, AT



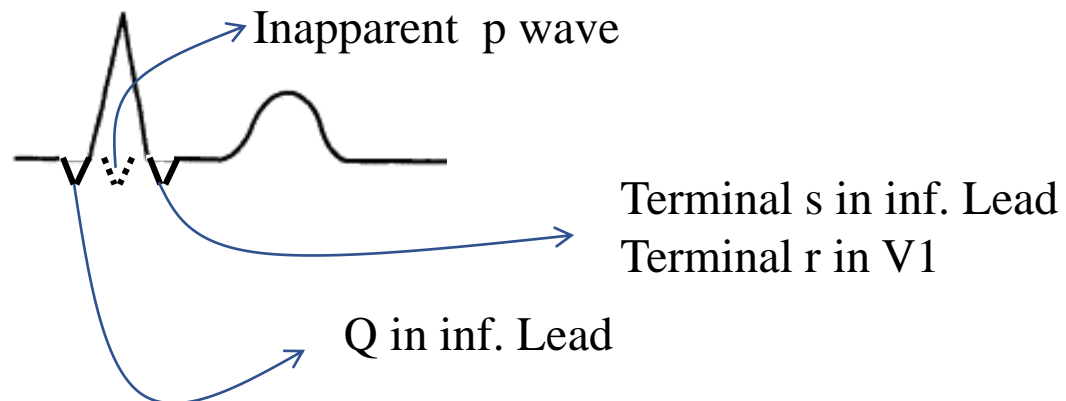
Looking at RP, and PR intervals

Short RP tachycardia (RP < PR)

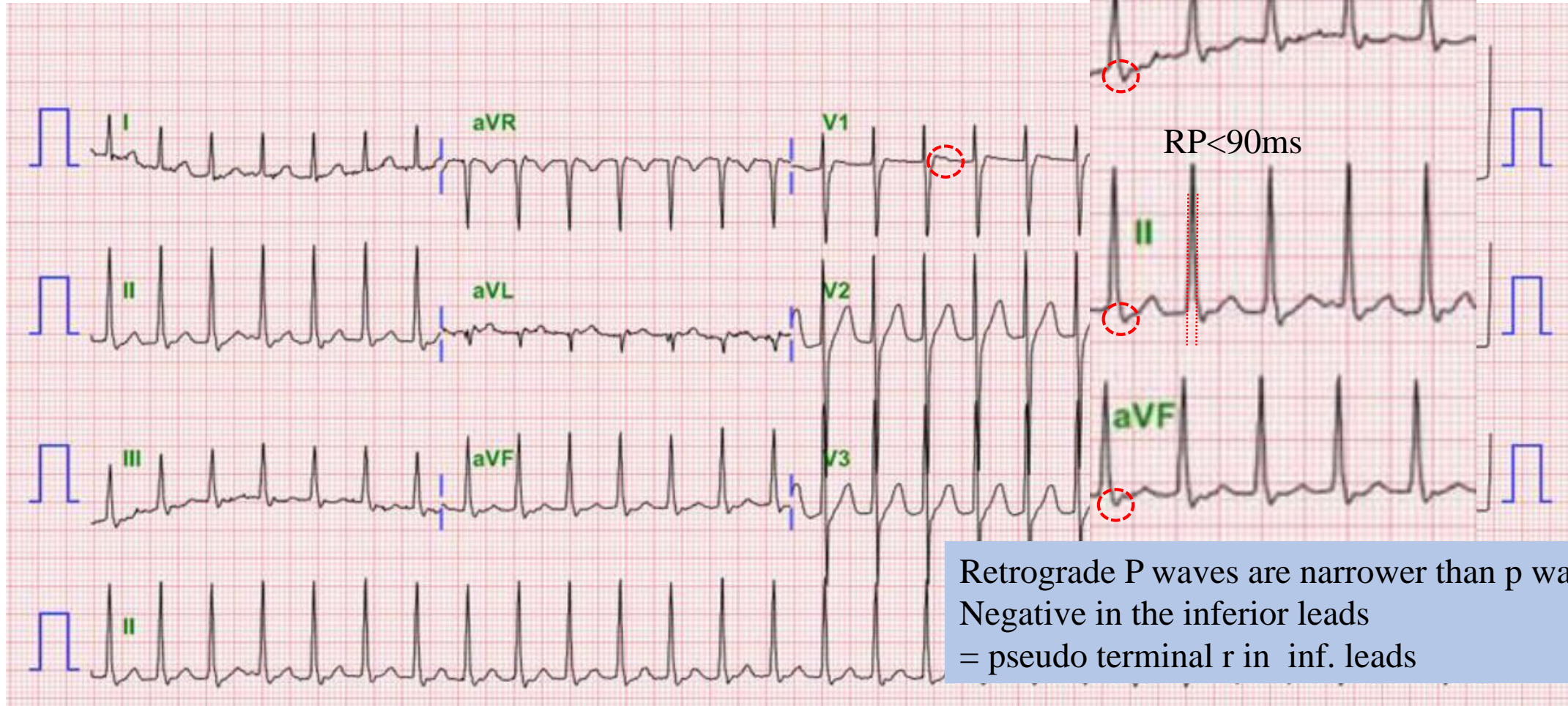
- $RP < 90ms \rightarrow AVNRT, AT$
- $RP \geq 90ms \rightarrow AVRT, Atypical AVNRT, AT$



P-QRS relationship in AVNRT



Case 49/M, palpitations



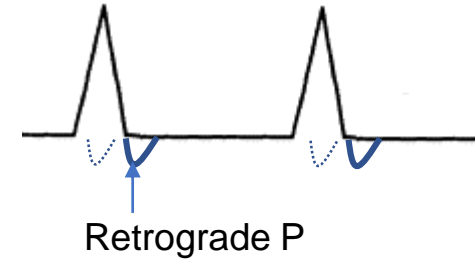
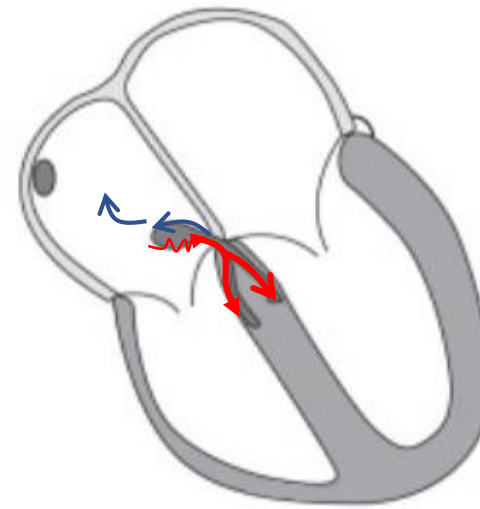
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- 1) AT 2) Atrial flutter **3) AVNRT** 4) AVRT

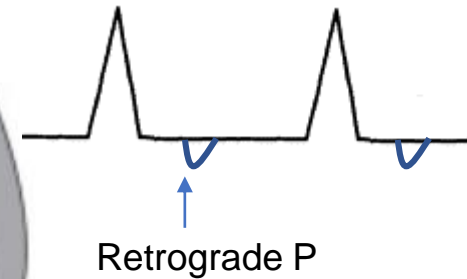
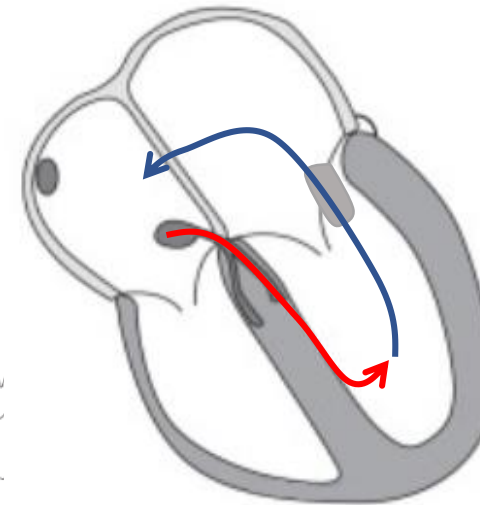


P-QRS relationship in AVNRT and AVRT

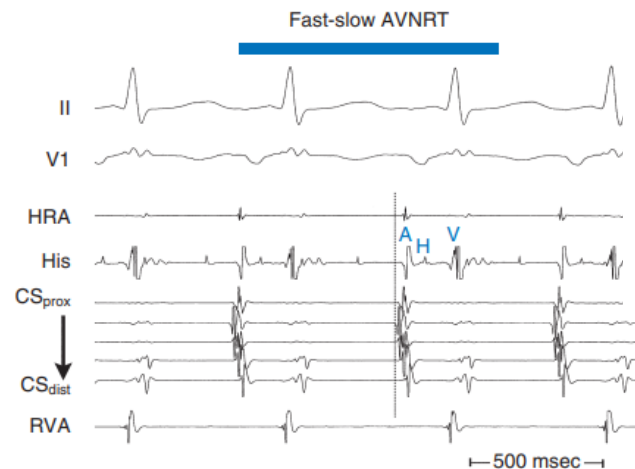
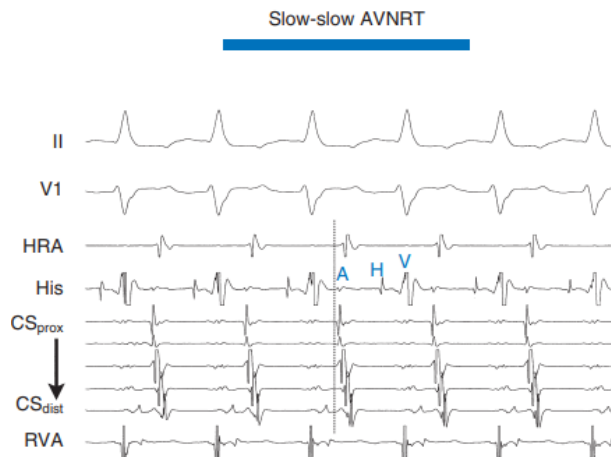
- AVNRT
 - Simultaneous A and V stimulation
- AVRT
 - Sequential A and V stimulation
- Variants in P-QRS relationship in AVNRT
 - Atypical AVNRT – slow-slow, fast-slow



AVNRT

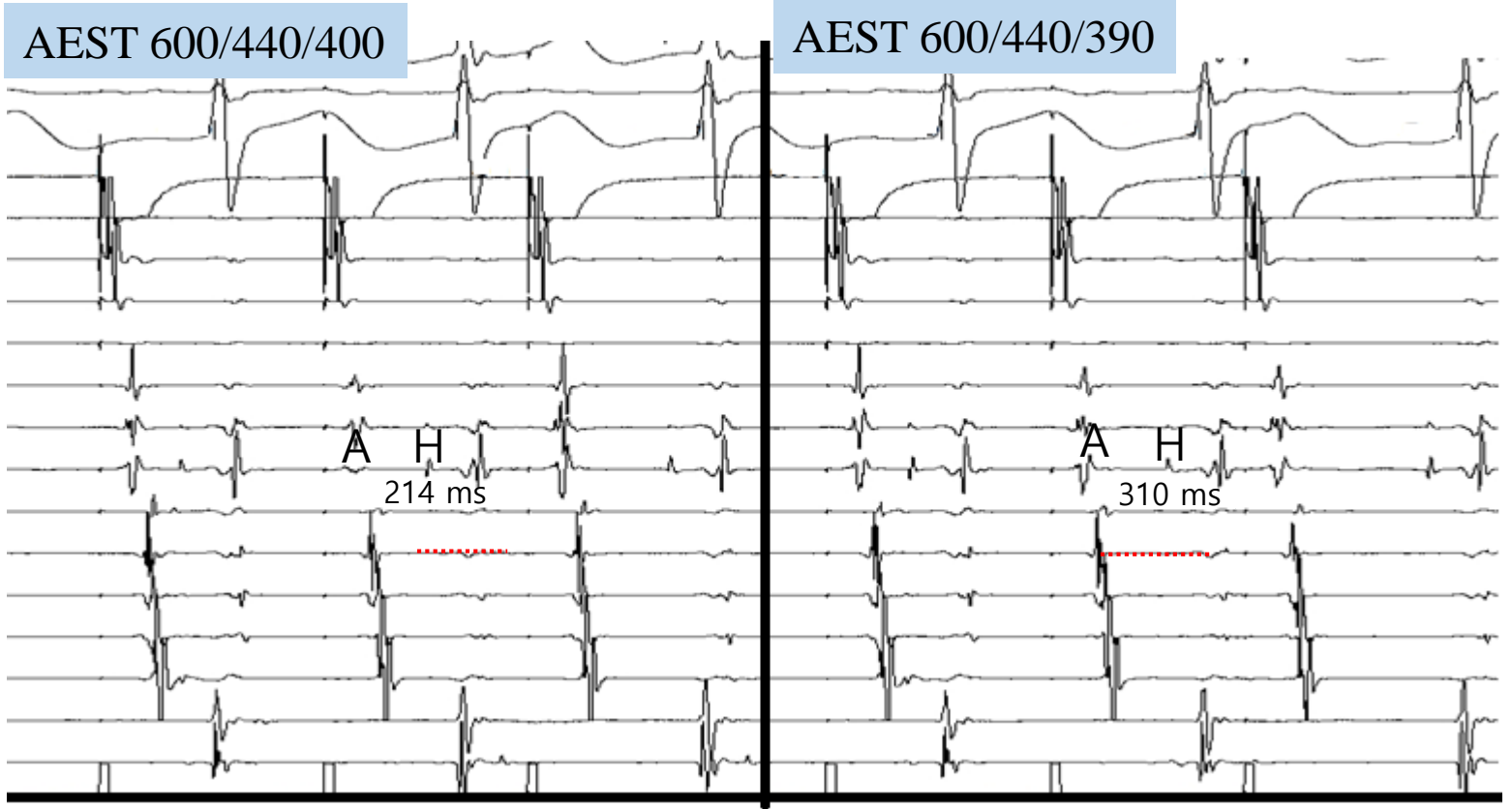


AVRT

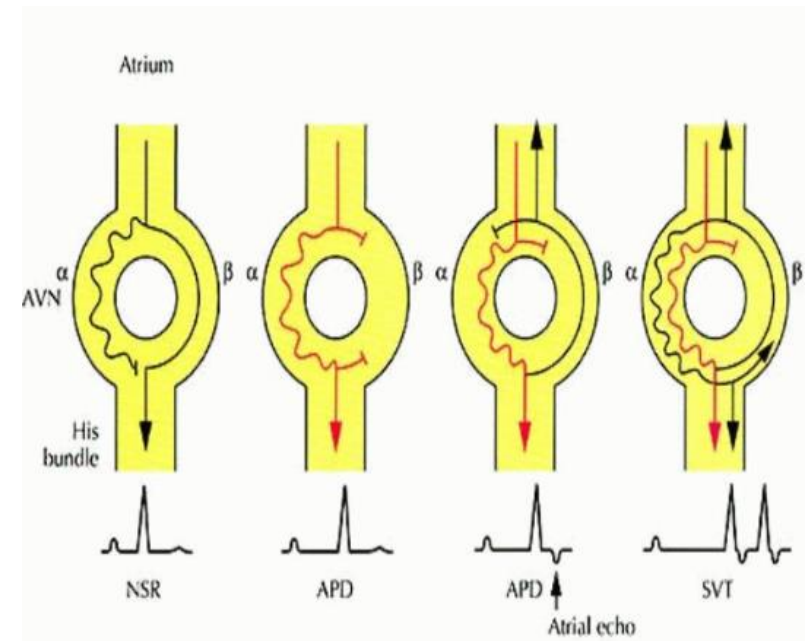


Manifest anterograde dual AV node physiology

-AH jump



- AH jump
AH interval of ≥ 50 ms in response to 10-ms decrement of the AES coupling interval



SVT induction, septal VA < 70ms, concentric A sequence



Six Features of SVT to Consider before Considering a Diagnostic Pacing Maneuver

Feature	Details	SVT Mechanism(s)
1. VA relationship	$V = A$ $V > A \pm AV$ dissociation $V < A$	AVNRT, AVRT, AT ONVRT, ONFRT, AVNRT AVNRT, AT
2. <u>VA interval</u>	$VA > 70$ ms $VA \leq 70$ ms $VA > AV$	aAVNRT, AVRT, AT tAVNRT, AT aAVNRT, AT, AVRT using slowly conducting AP
3. <u>Atrial activation sequence</u>	High to low Concentric Eccentric	AT AVNRT, AVRT, AT AVRT, AT*
4. Spontaneous termination	Ends with an "A" Ends with a "V"	AVNRT, AVRT AVNRT, AVRT, AT
5. HH changes precede and predict AA changes	Yes No	AVNRT, AVRT AVNRT, AVRT, AT
6. VA increase > 30 ms with functional BBB	Yes No	AVRT with free wall AP ipsilateral to BBB AVNRT, AVRT, AT

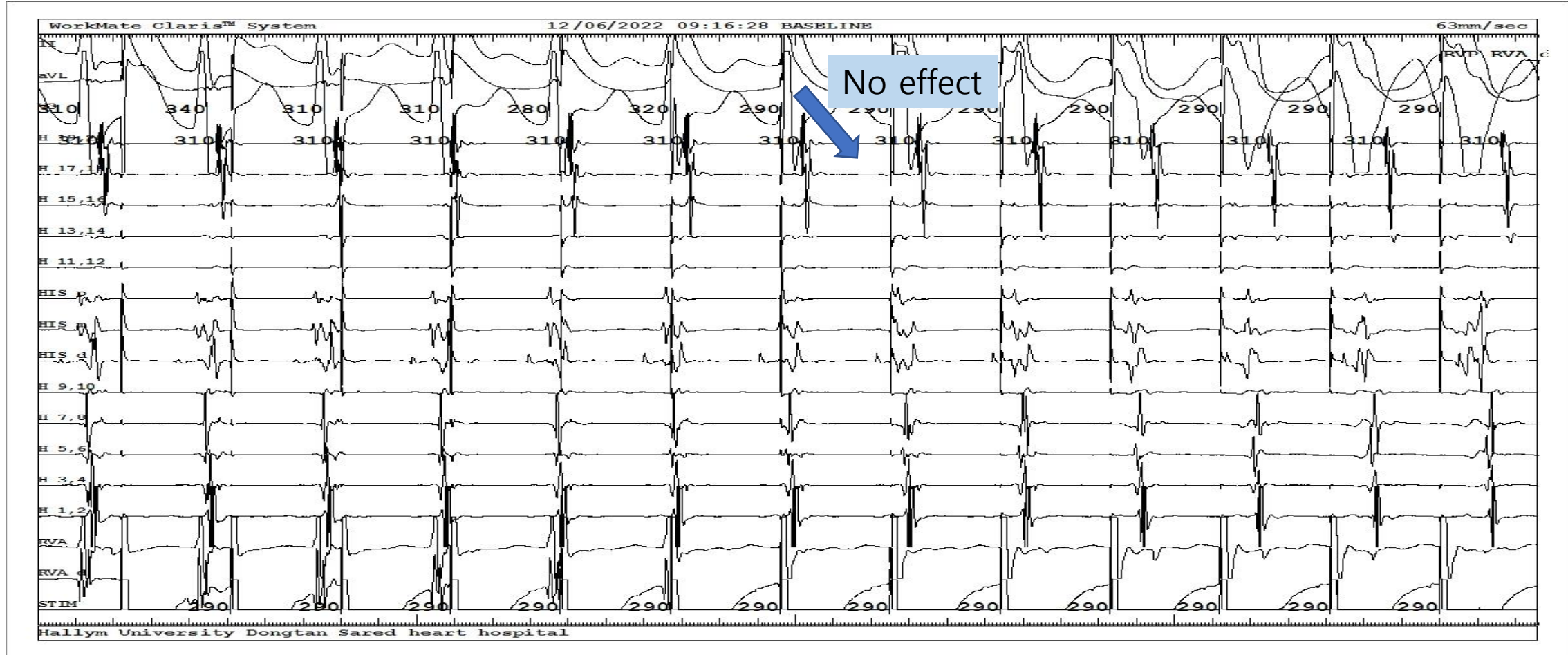


Entrainment

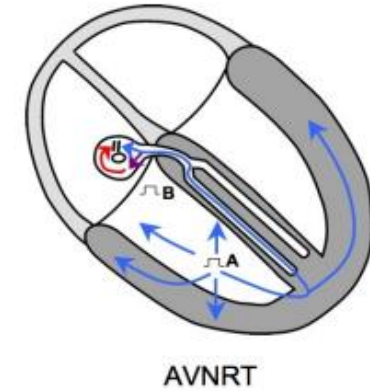
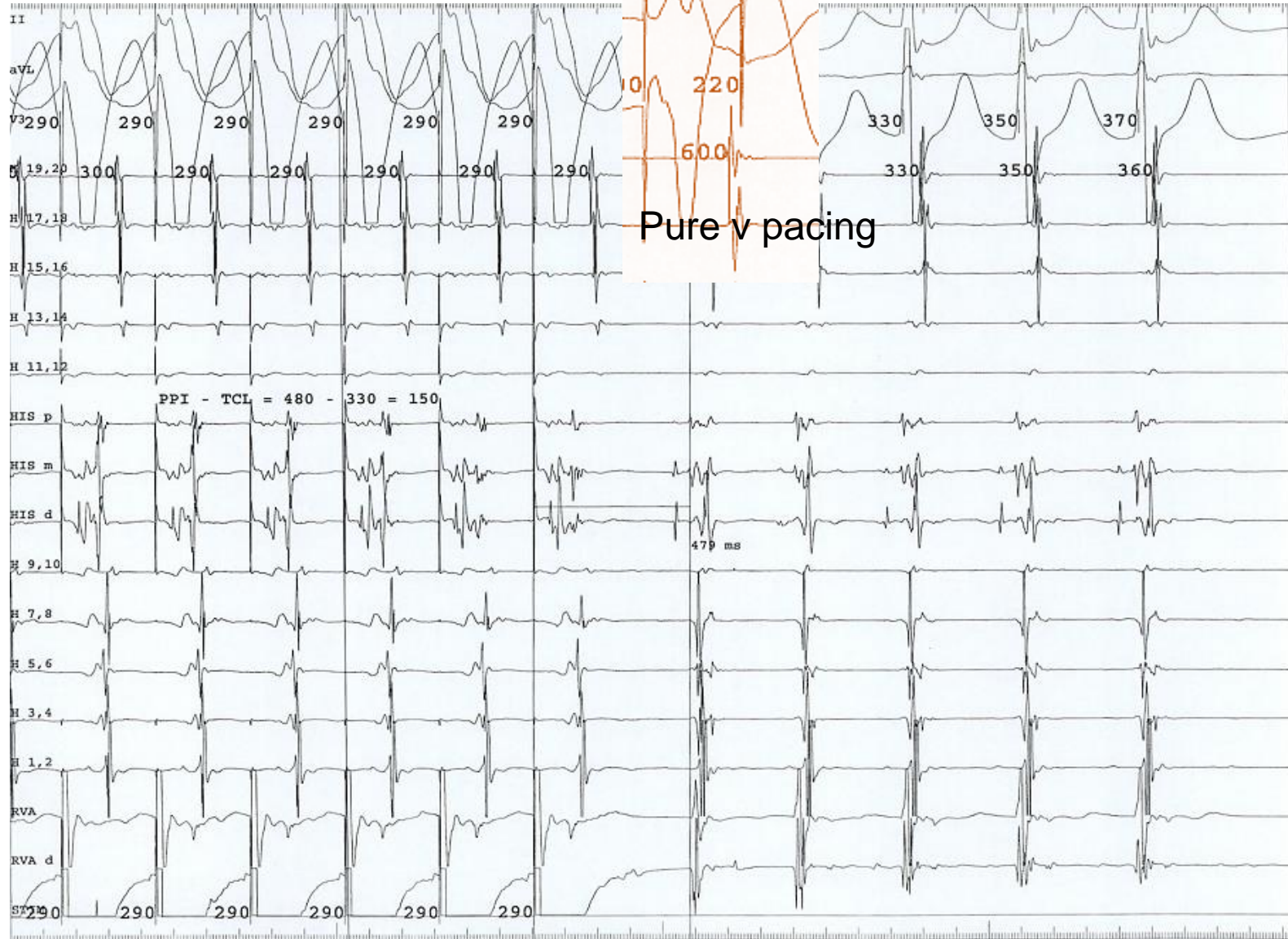
- Transient entrainment of tachycardia as continuous resetting of a reentrant tachycardia to a pacing rate that is faster than the rate of the tachycardia, but fails to interrupt it.
 - ✓ A sequence should be repeatedly accelerated to pacing cycle length (PCL)
 - ✓ Manifest fusion
 - ✓ V pacing rate 10-40ms faster than SVT cycle length
 - ✓ SVT persists following VOP



Ventricular overdrive pacing (VOP) from the right ventricular apex (RVA) during SVT



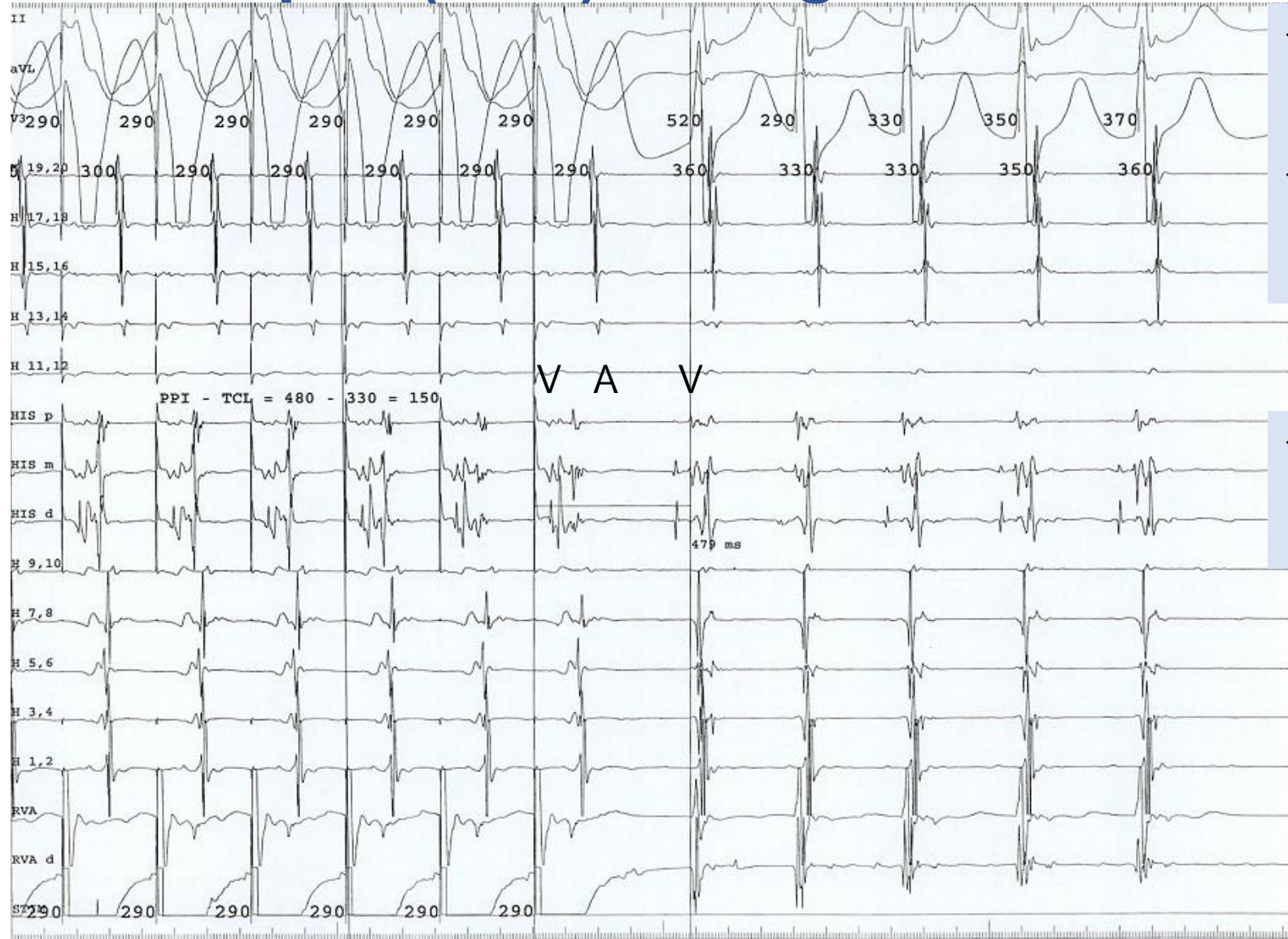
Ventricular overdrive pacing (VOP) from the right ventricular apex (RVA) during SVT



- ✓ Collision of wave fronts happens in the AV node. So, no manifest fusion on ECG
- ✓ Suggests V is not a component of reentrant circuit
- ✓ AVNRT or AT



Ventricular overdrive pacing (VOP) from the right ventricular apex (RVA) during SVT



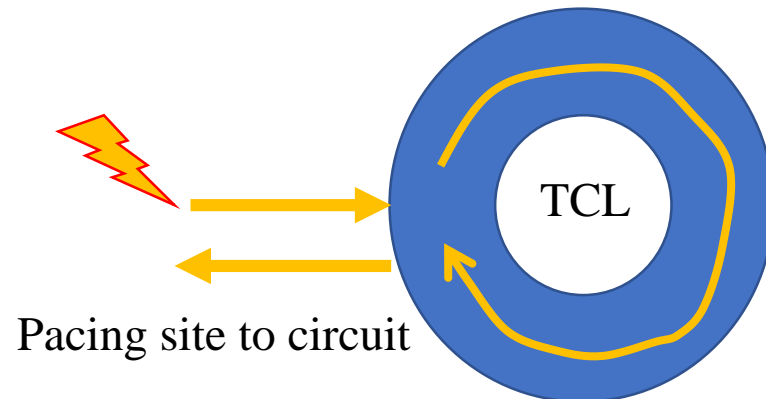
- ✓ SVT should be continued following VOP
- ✓ A sequence should be accelerated to Pacing cycle length

- ✓ Post-VOP response
 - ✓ V-A-A-V rules in AT
 - ✓ V-A-V rules out AT



Post pacing interval(PPI)-Tachycardia cycle length difference

- PPI
 - Time required for the last stimulated orthodromic wavefront to reach the excitable gap of a circuit, travel around the circuit, and return to the pacing site.
- PPI - TCL
 - The farther a pacing site is from a circuit, the greater the PPI-TCL difference will be.



$$\text{PPI} = \text{pacing site to circuit} \times 2 + \text{TCL}$$



Cut-off values of PPI-TCL

AVRT



SVT circuit

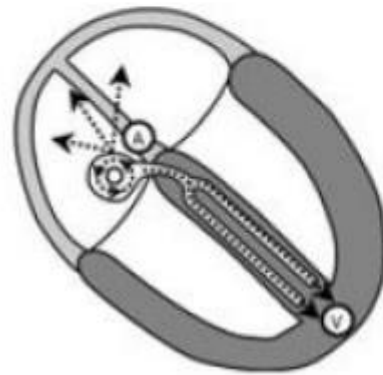


Post-VOP circuit

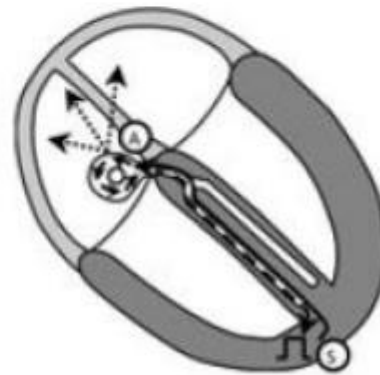
✓ AVRT PPI-TCL < 115ms

✓ AVNRT PPT-TCL > 115ms

AVNRT



SVT circuit

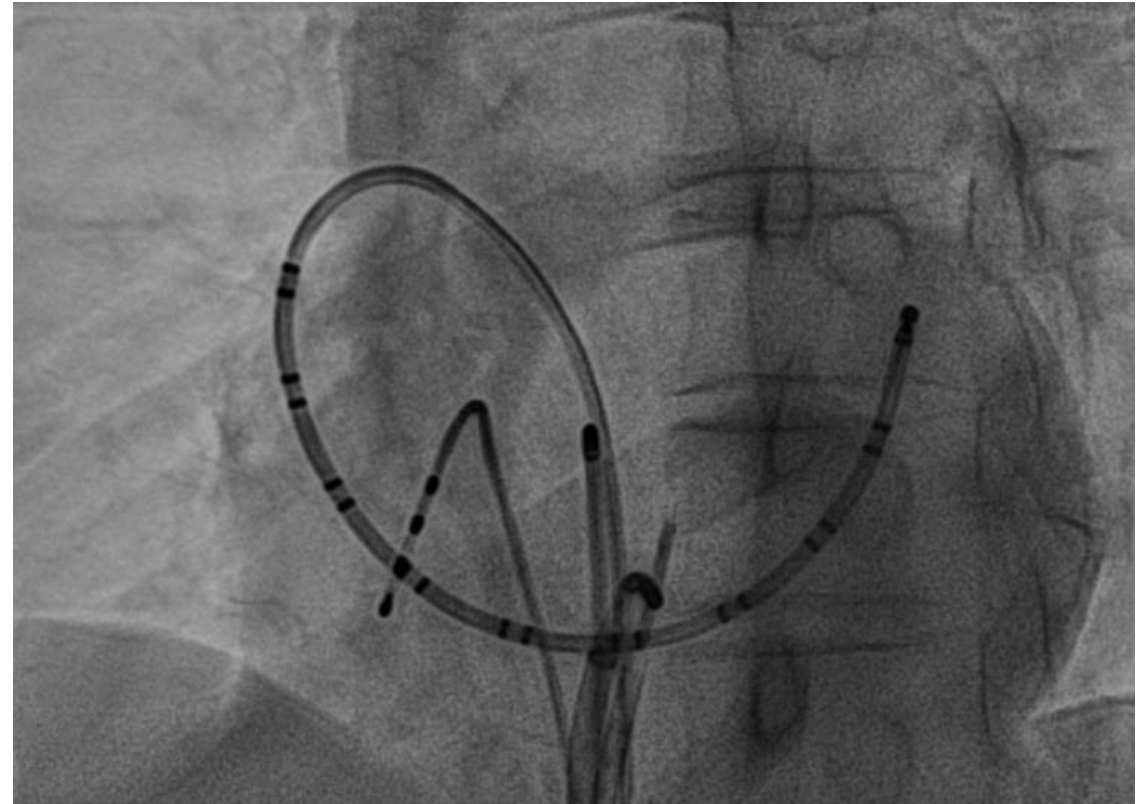
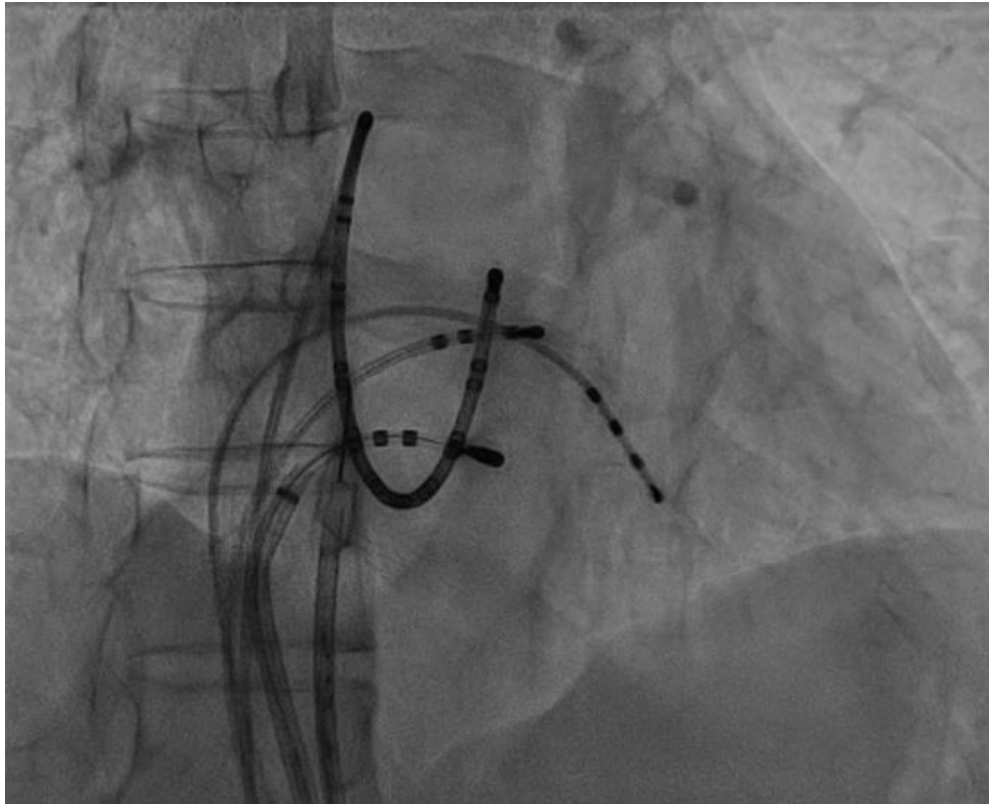


Post-VOP circuit

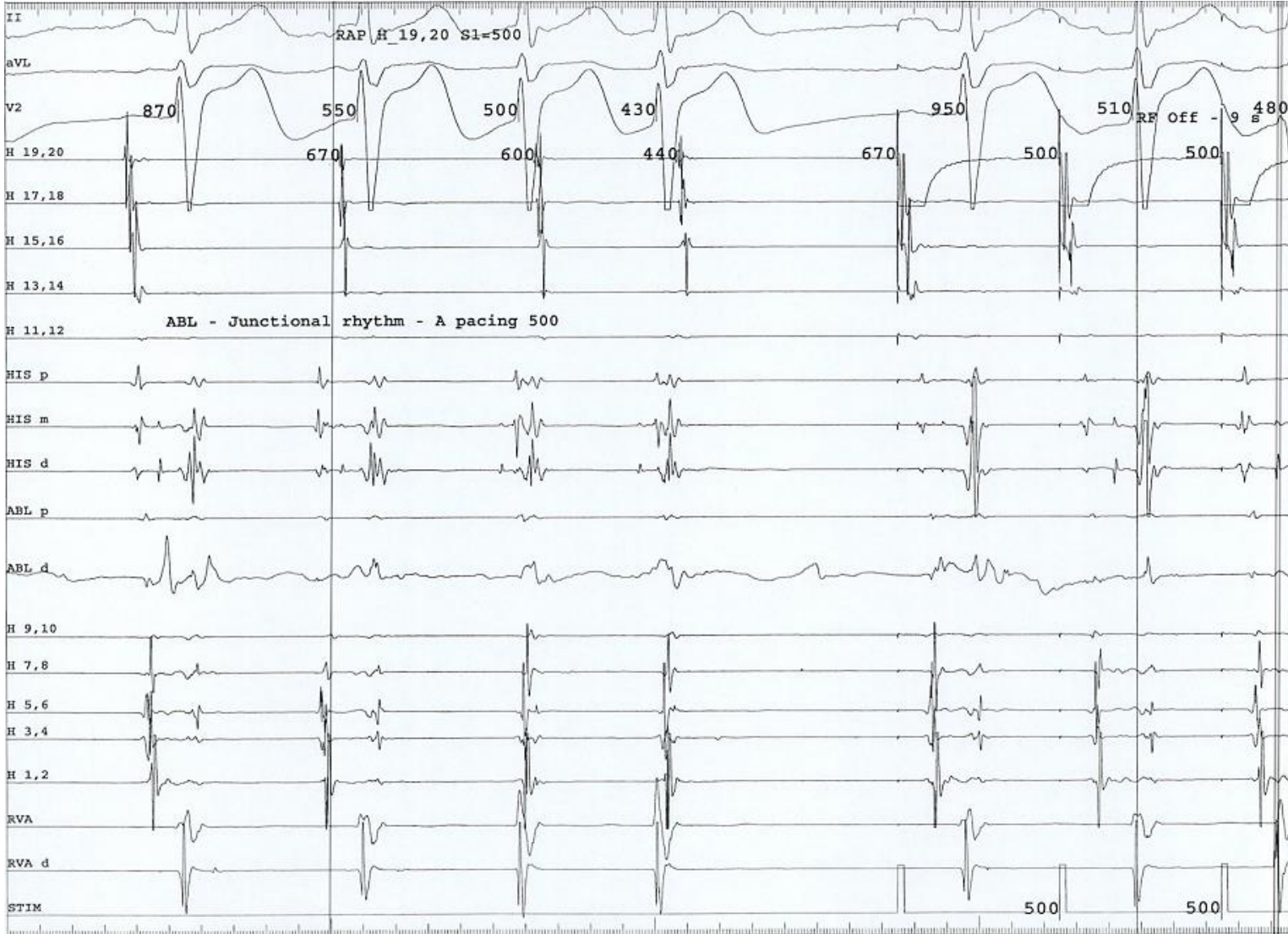


Diagnosis : Typical AVNRT

Slow pathway modification



Junctional rhythm during slow pathway modification



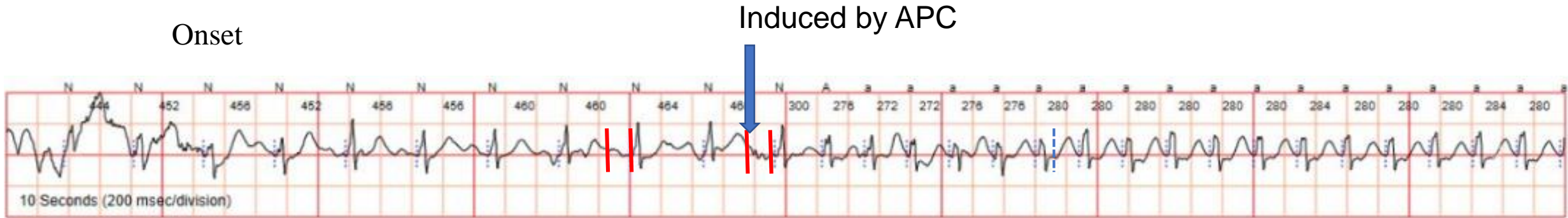
Case 51/M, palpitations

- Life-long history of sudden onset palpitation
- Presented with on-going palpitation to another hospital and tachycardia was terminated by IV adenosine



Case 51/M, palpitations

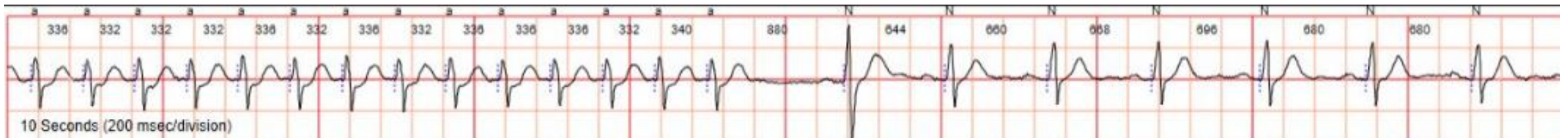
Onset



No significant PR prolongation

Short RP tachycardia
RP interval > 90ms

Offset

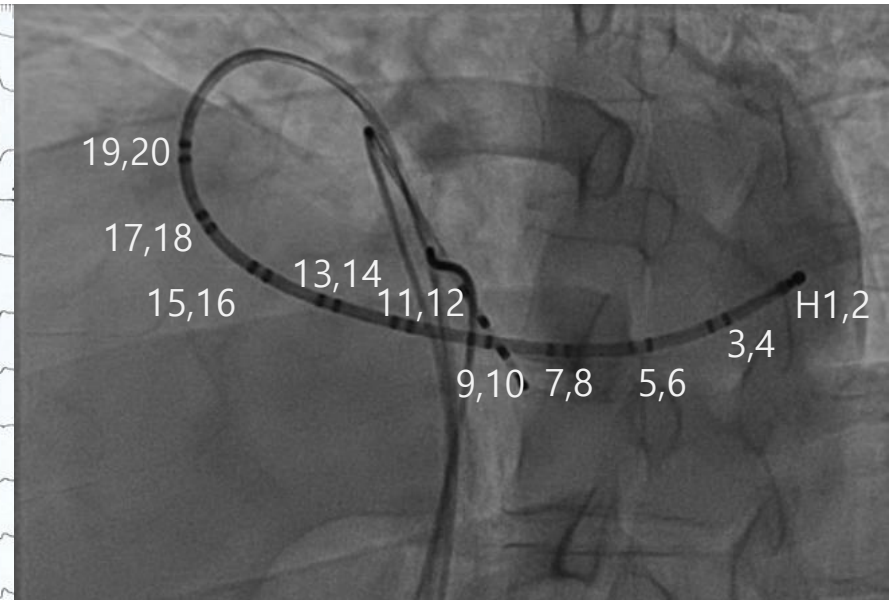


가장 가능성이 높은 진단은?

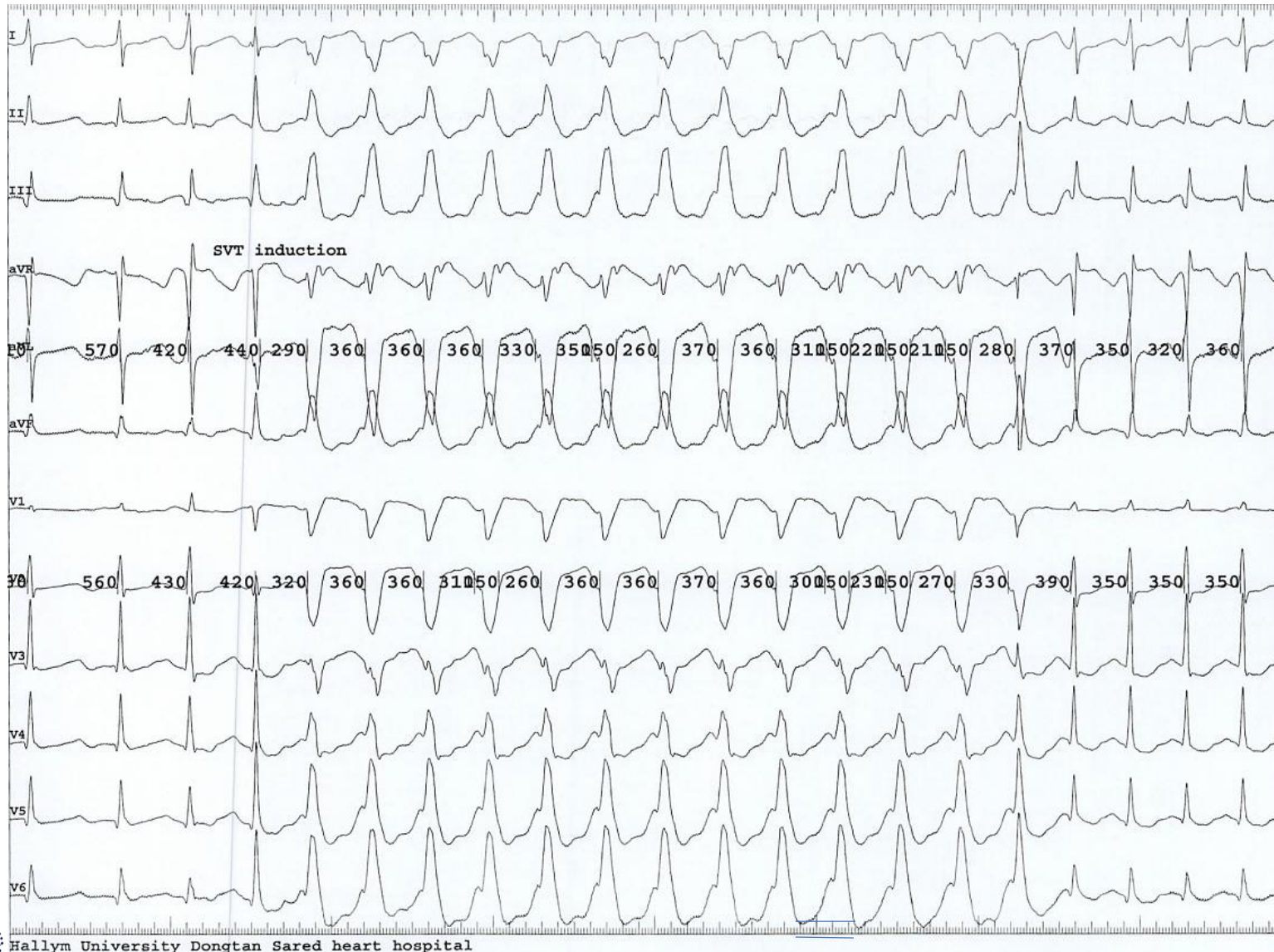
1) AT 2) Atrial flutter 3) typical AVNRT 4) AVRT



SVT induction, septal VA >70ms, Eccentric A sequence



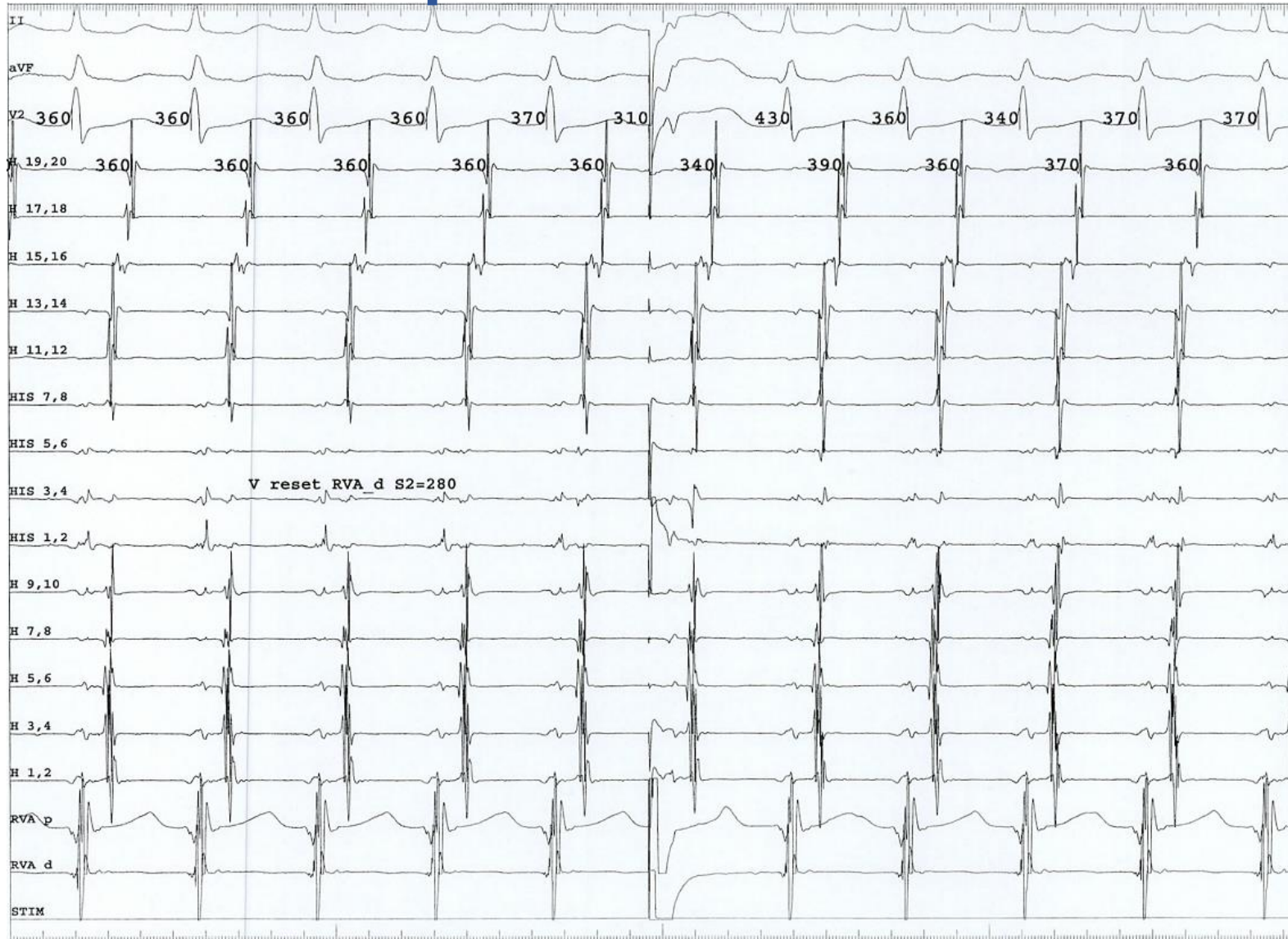
SVT induction with LBBB



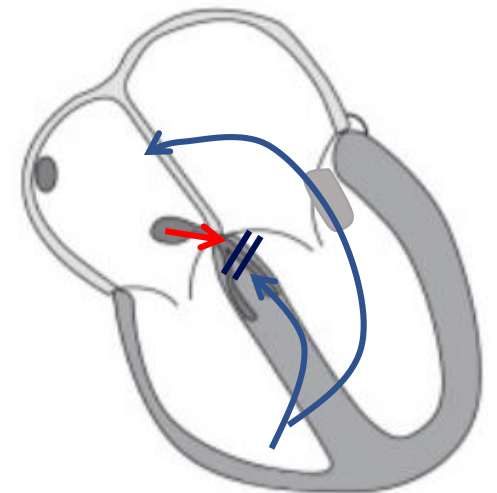
- LBBB during SVT favors AVRT especially in young age adults.
- ✓ AVNRT - Significant AVN delay prevent aberrant conduction
- ✓ AVRT -LBBB provide AV delays for sustaining reentrant



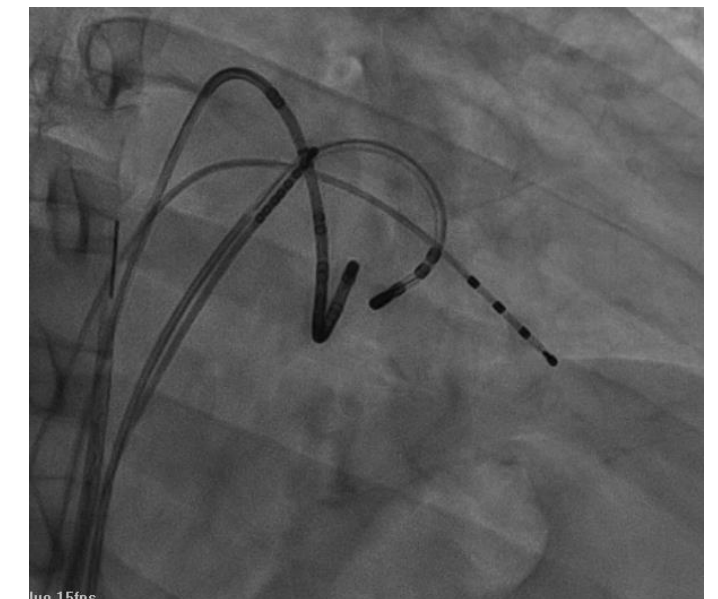
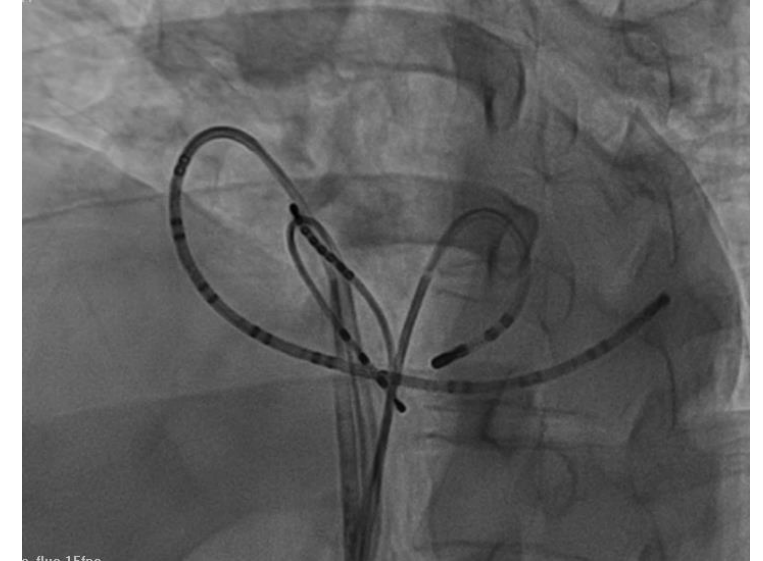
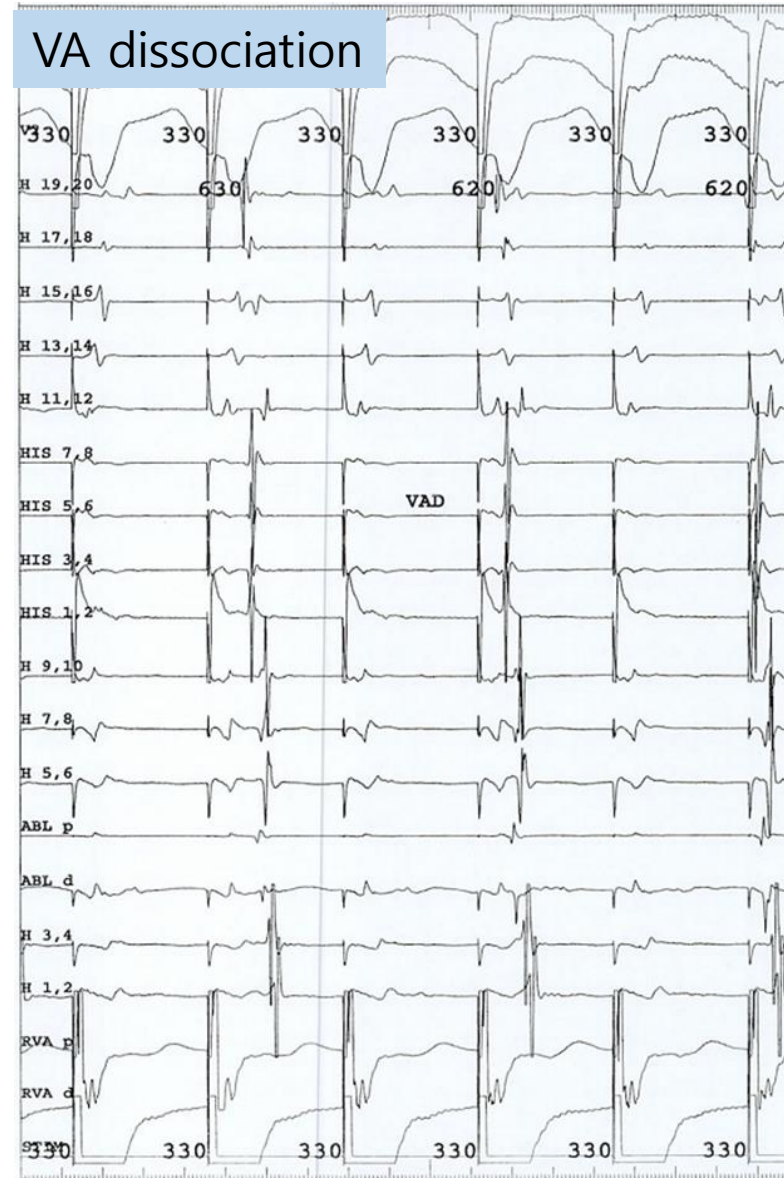
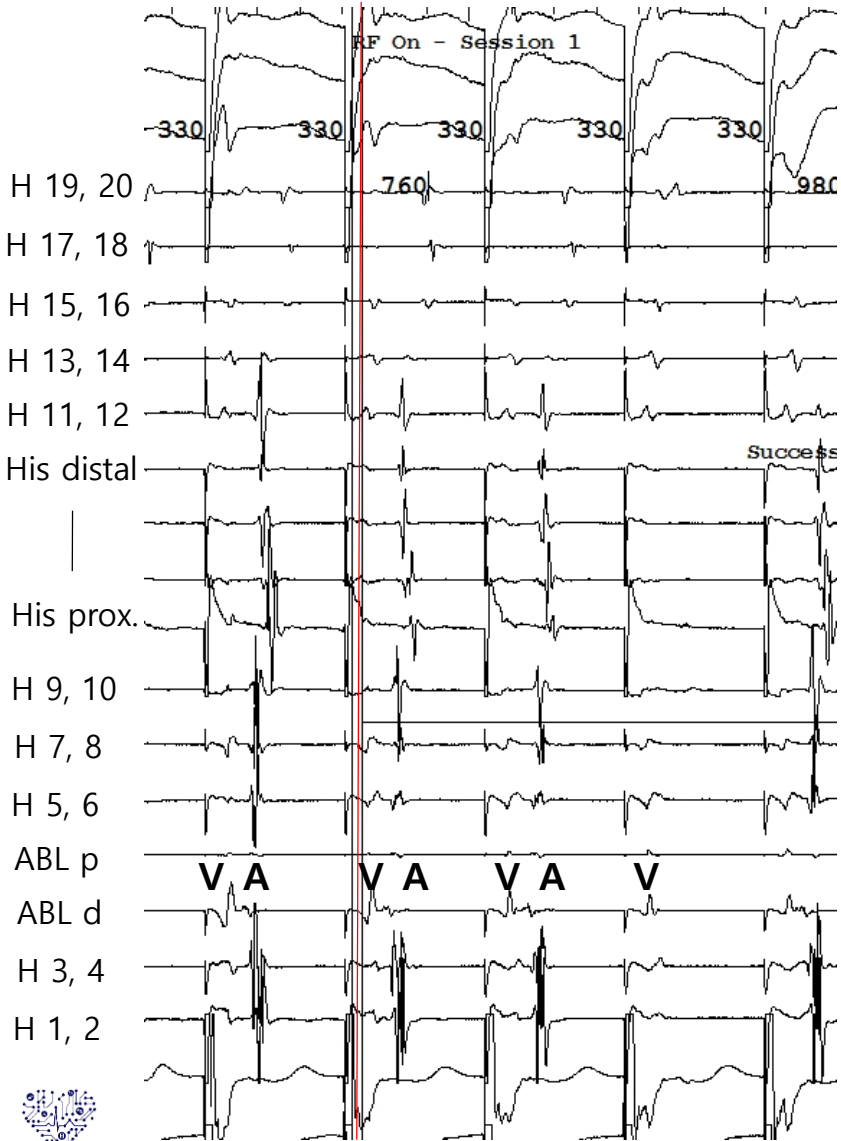
His-Refractory VPC advanced Atrial activation with identical A sequence



- orthodromic AVRT
- BT participate in tachycardia circuit



Diagnosis : orthodromic AVRT c concealed Left posterior BT





Narrow QRS tachycardia



권창희

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Korean Heart Rhythm Society

COI Disclosure

Name of First Author: Chang Hee Kwon

The authors have no financial conflicts of interest to disclose concerning the presentation

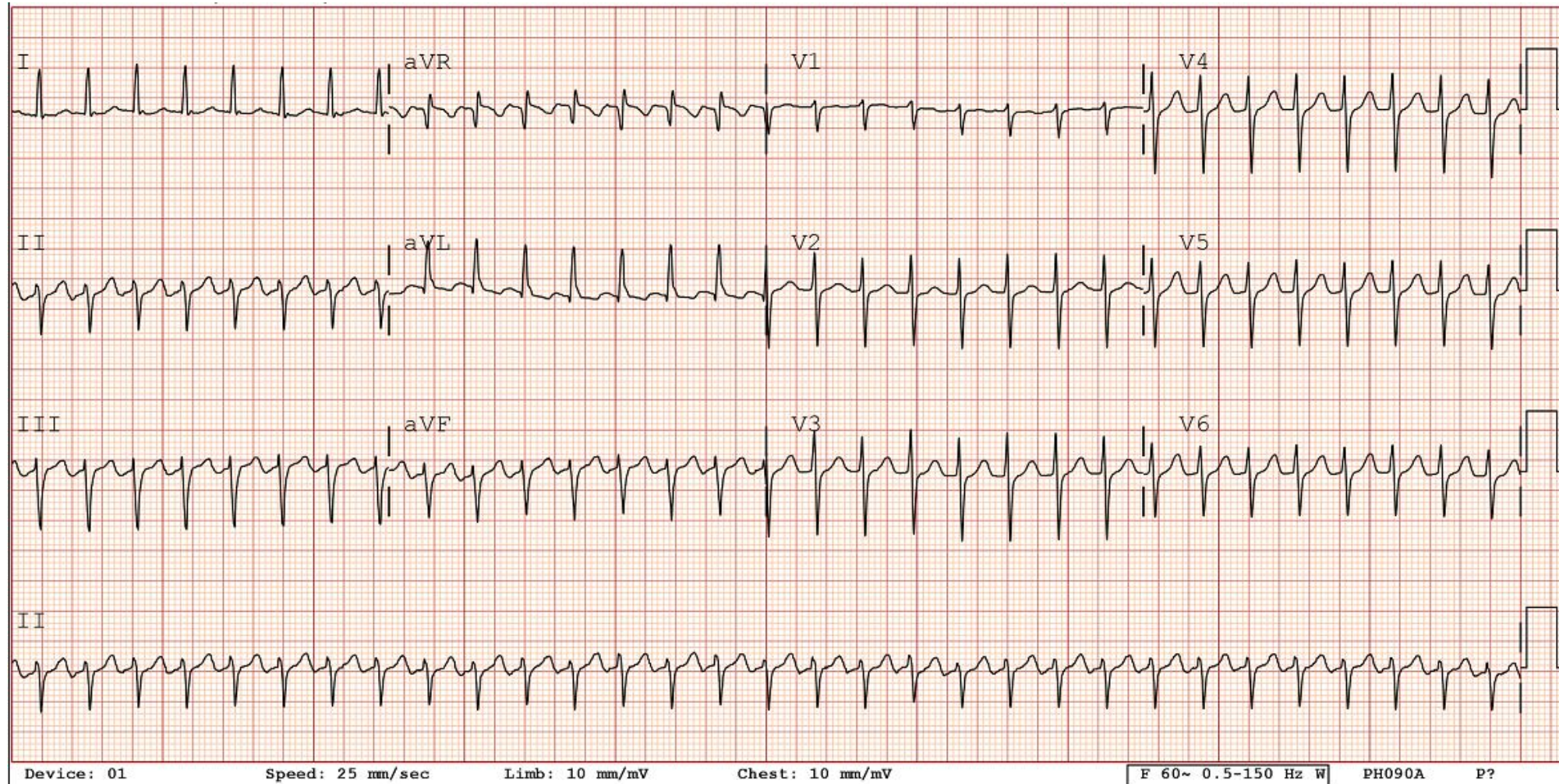


Case 1. F/62

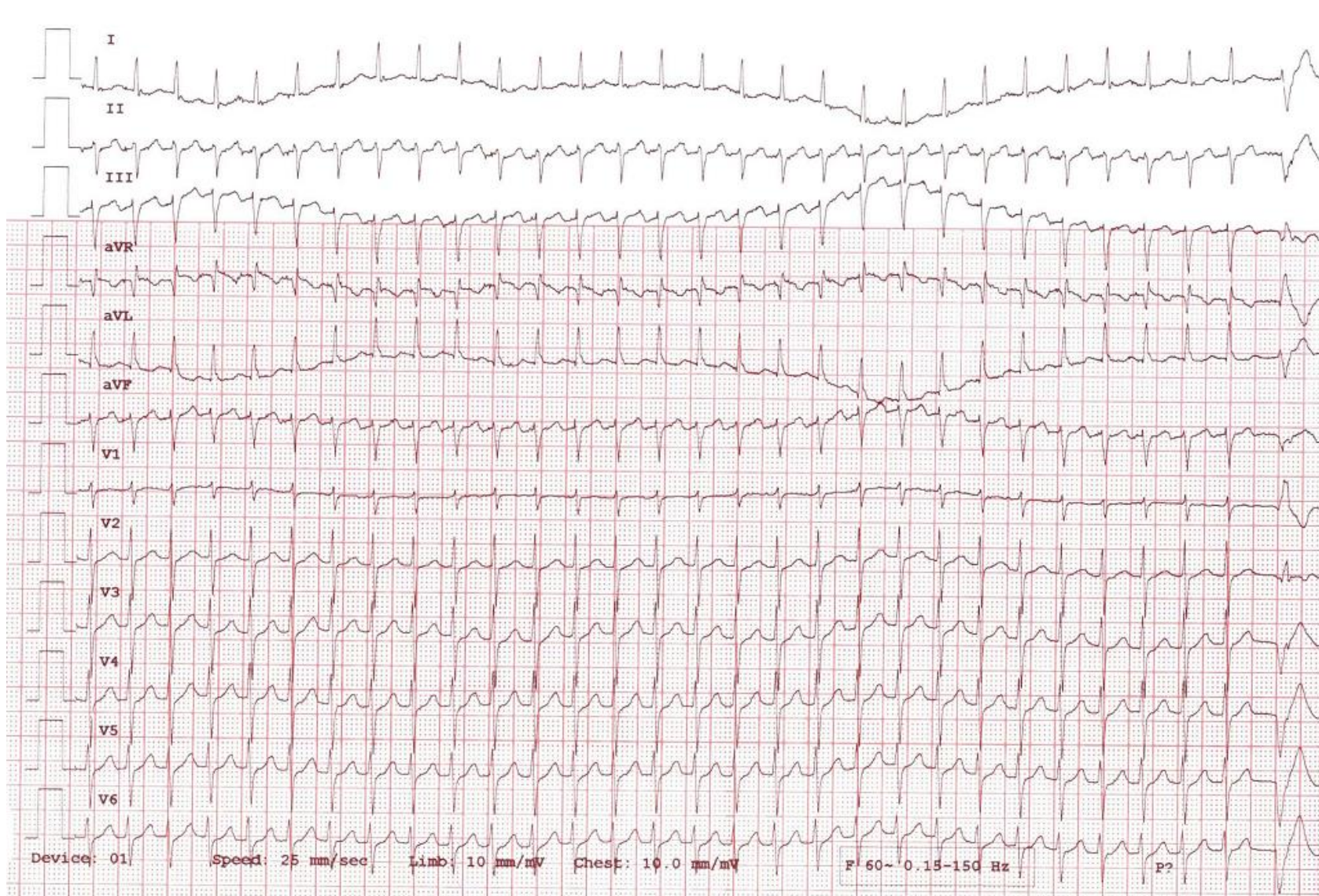
- Chief complaint: palpitation
 - Sudden onset 4 hours ago
- P/Hx: Dyslipidemia
- V/S: BP 113/89, PR 189, RR 20, BT 36.0, SPO2 100



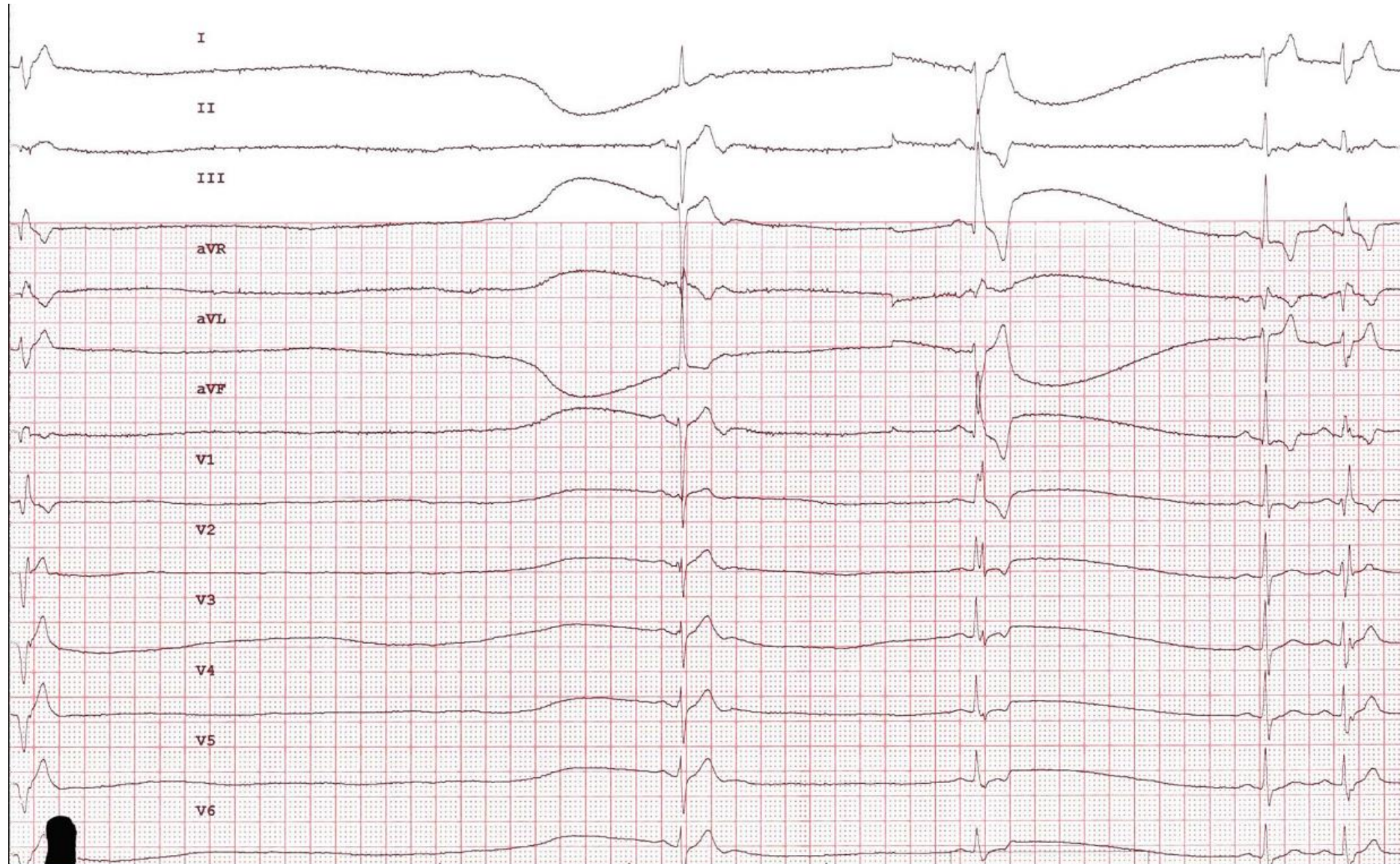
Initial ECG



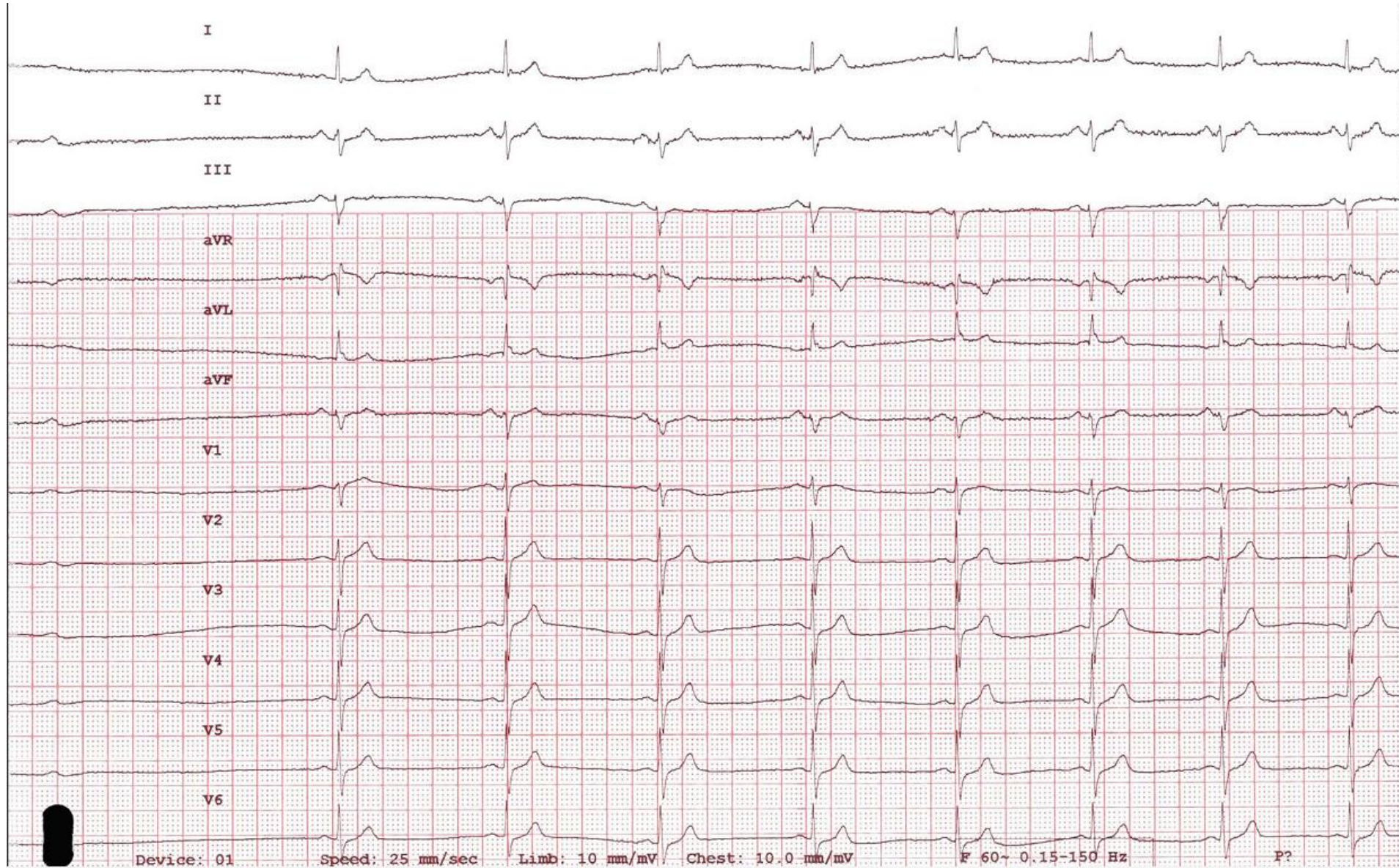
Response to adenosine



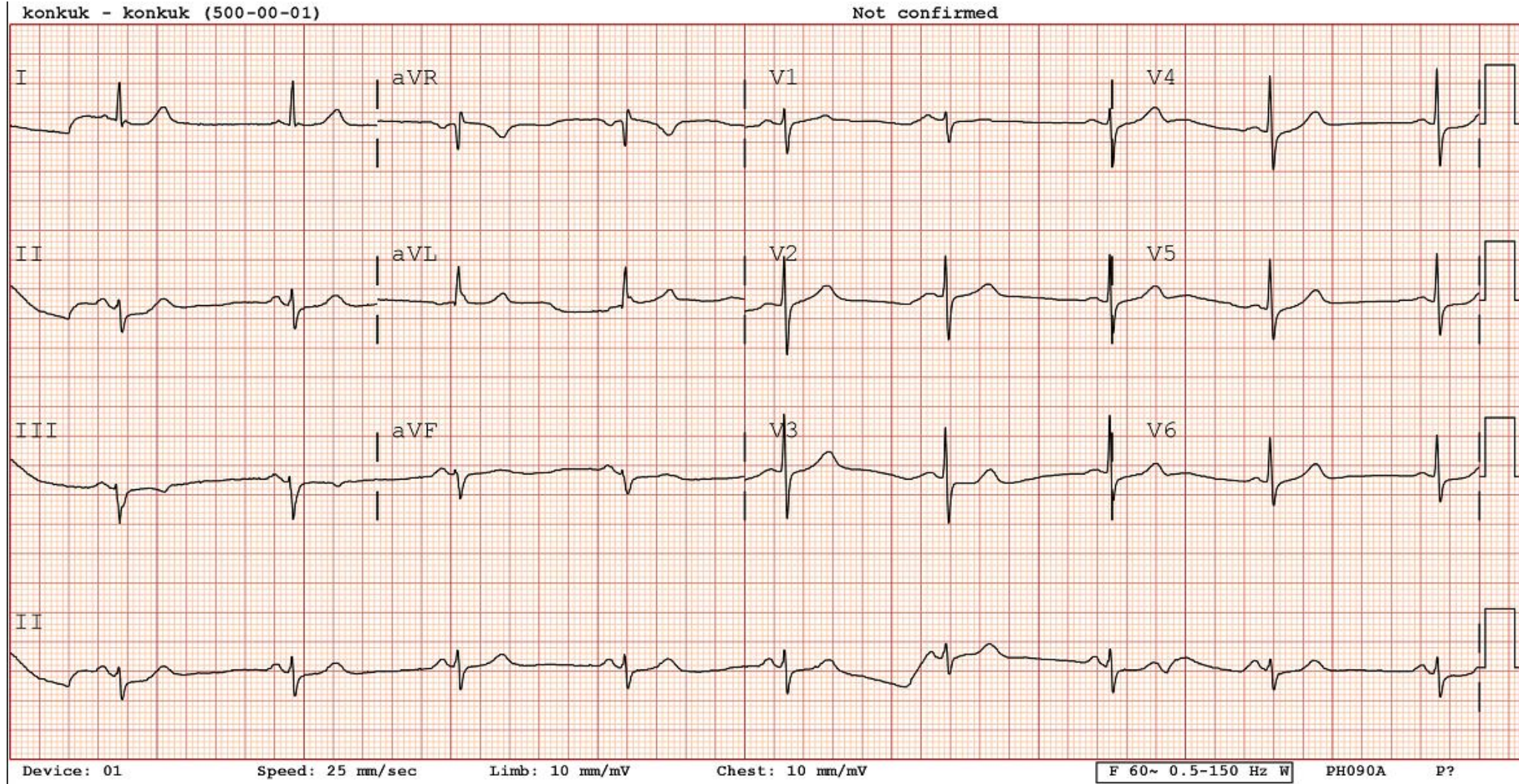
Response to adenosine



Response to adenosine



ECG of sinus rhythm



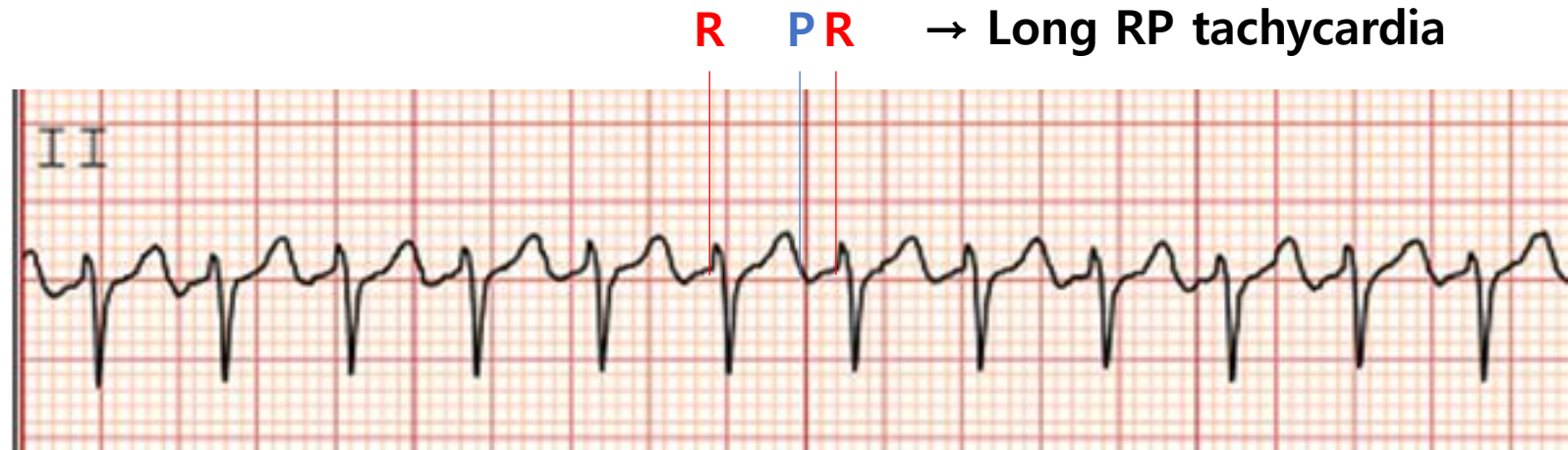
Tachycardia 의 원인으로 가장 가능성은 높은 것은?

1. Focal AT
2. Atrial flutter with 1:1 AV conduction
3. AVRT using a normally conducting AP
4. Typical AVNRT
5. Atypical AVNRT



Review of tachycardia

- Narrow QRS tachycardia, Long RP tachycardia

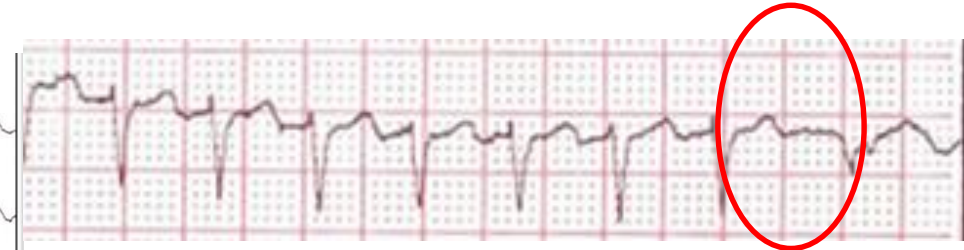
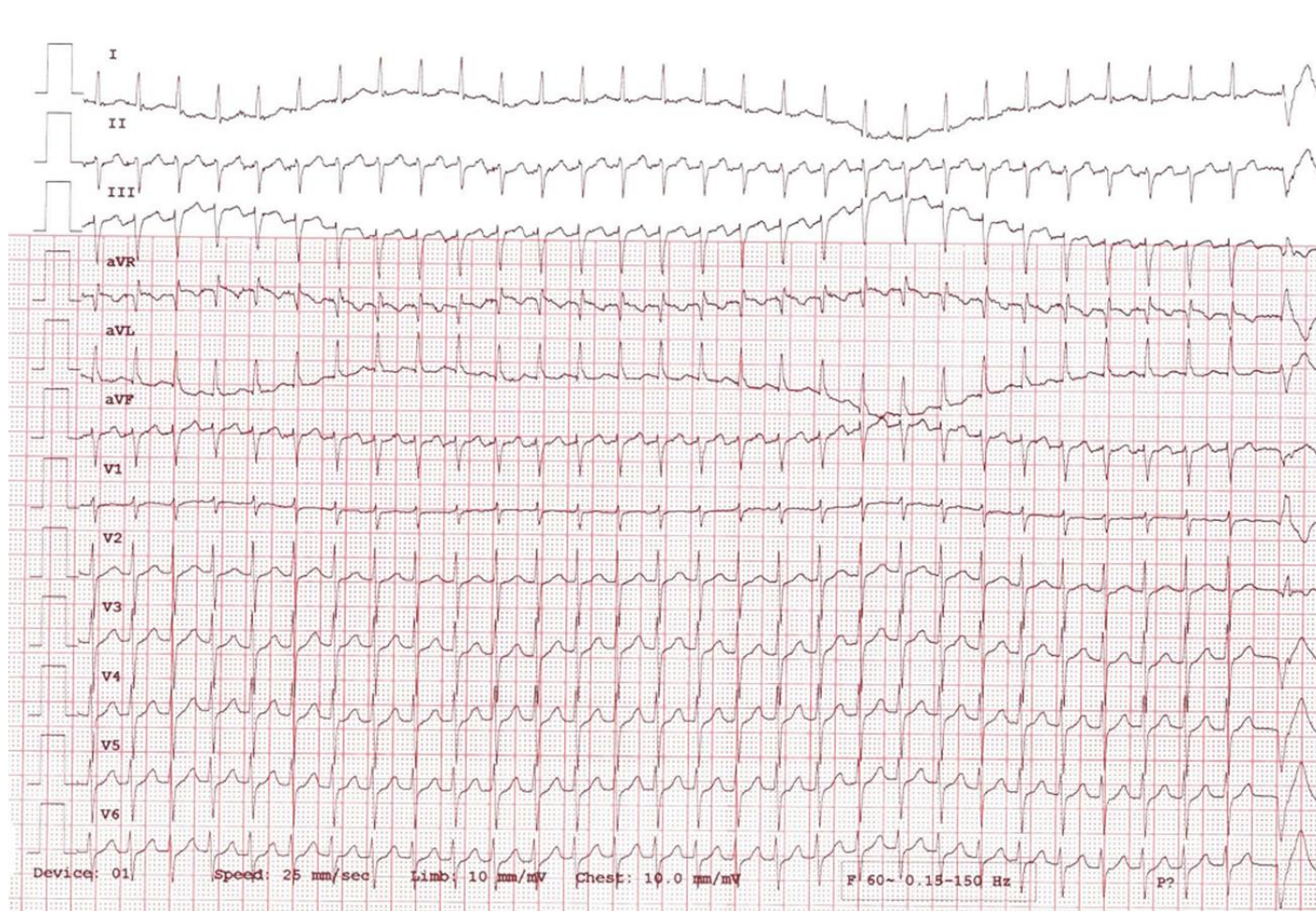


- Possible mechanism
 - Focal AT (m/c)
 - AVRT (using a slowly conducting AV BT)
 - Atypical AVNRT (F/S, S/S)



Review of tachycardia

- Response to adenosine



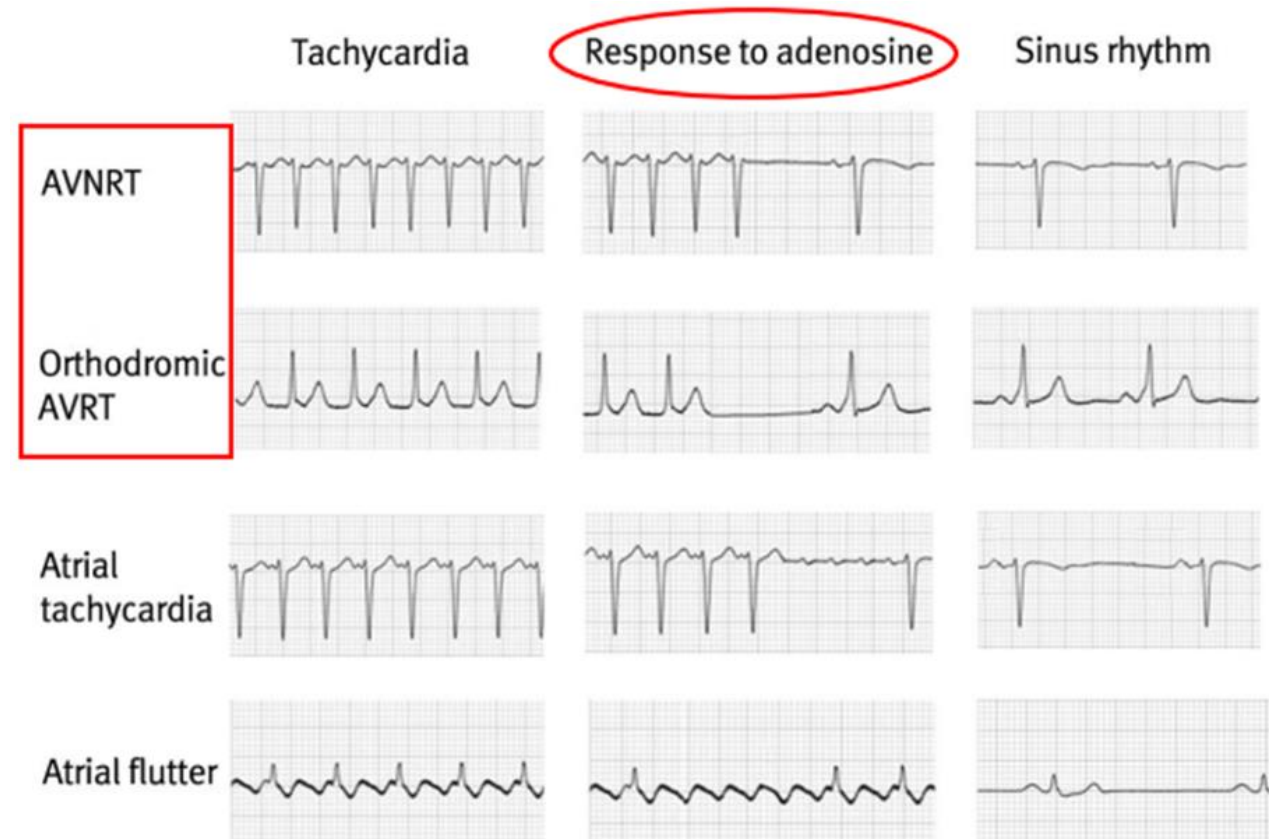
- Tachycardia termination with AV block



Response to Adenosine

- **Adenosine**

- a very short-acting endogenous nucleotide
- blocks AVN conduction
- **terminates nearly all AVNRT and AVRT**, and up to 80% of AT



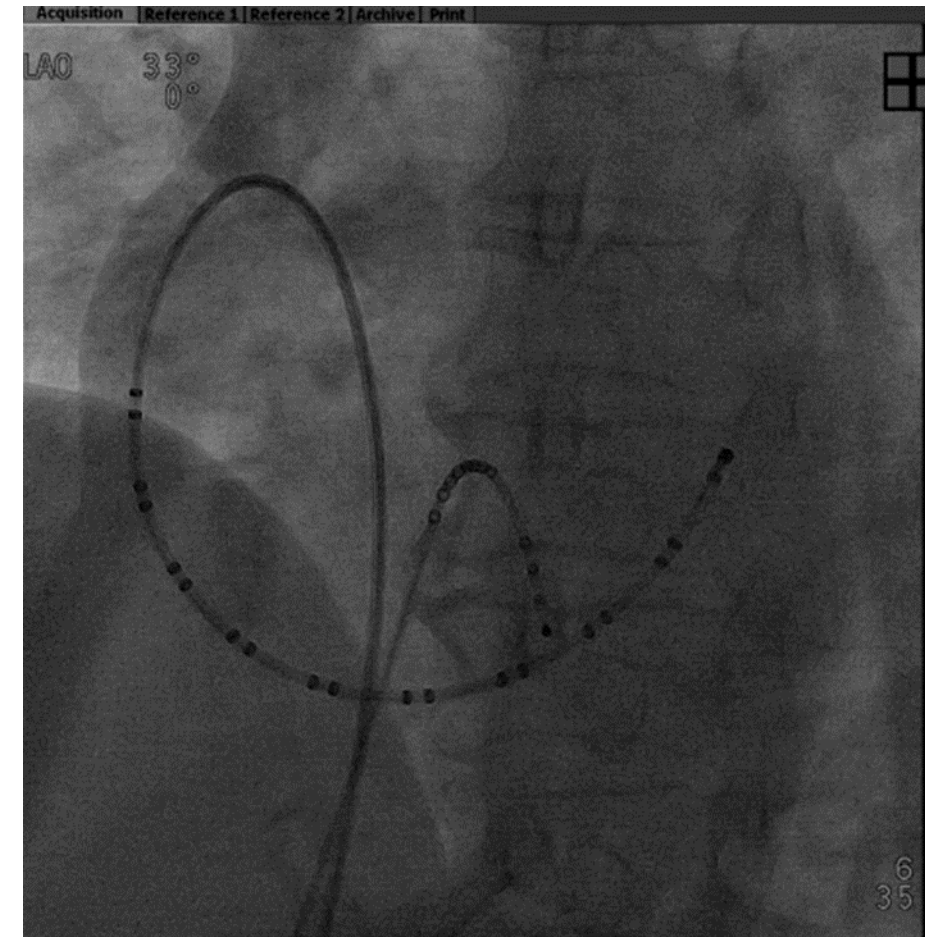
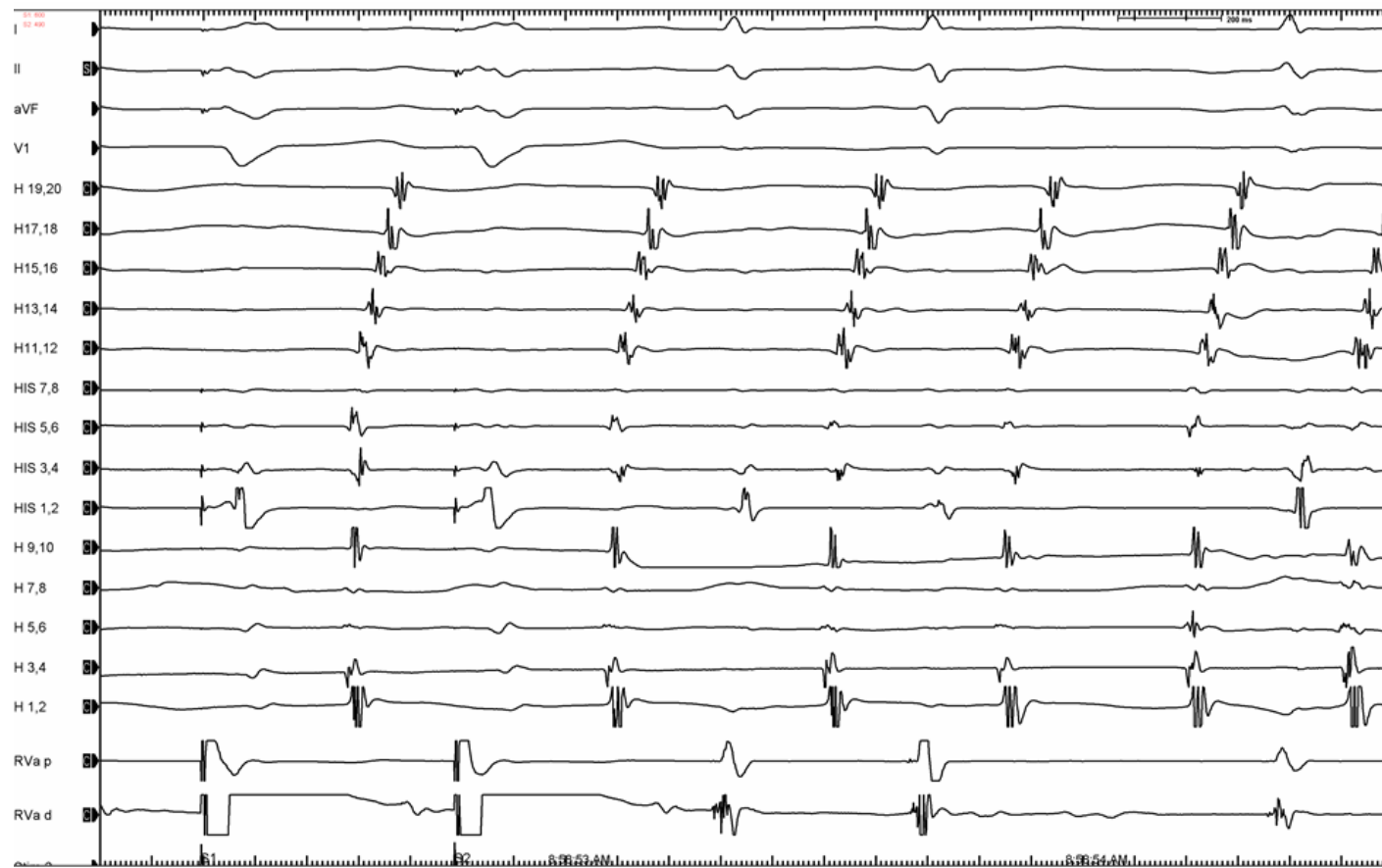
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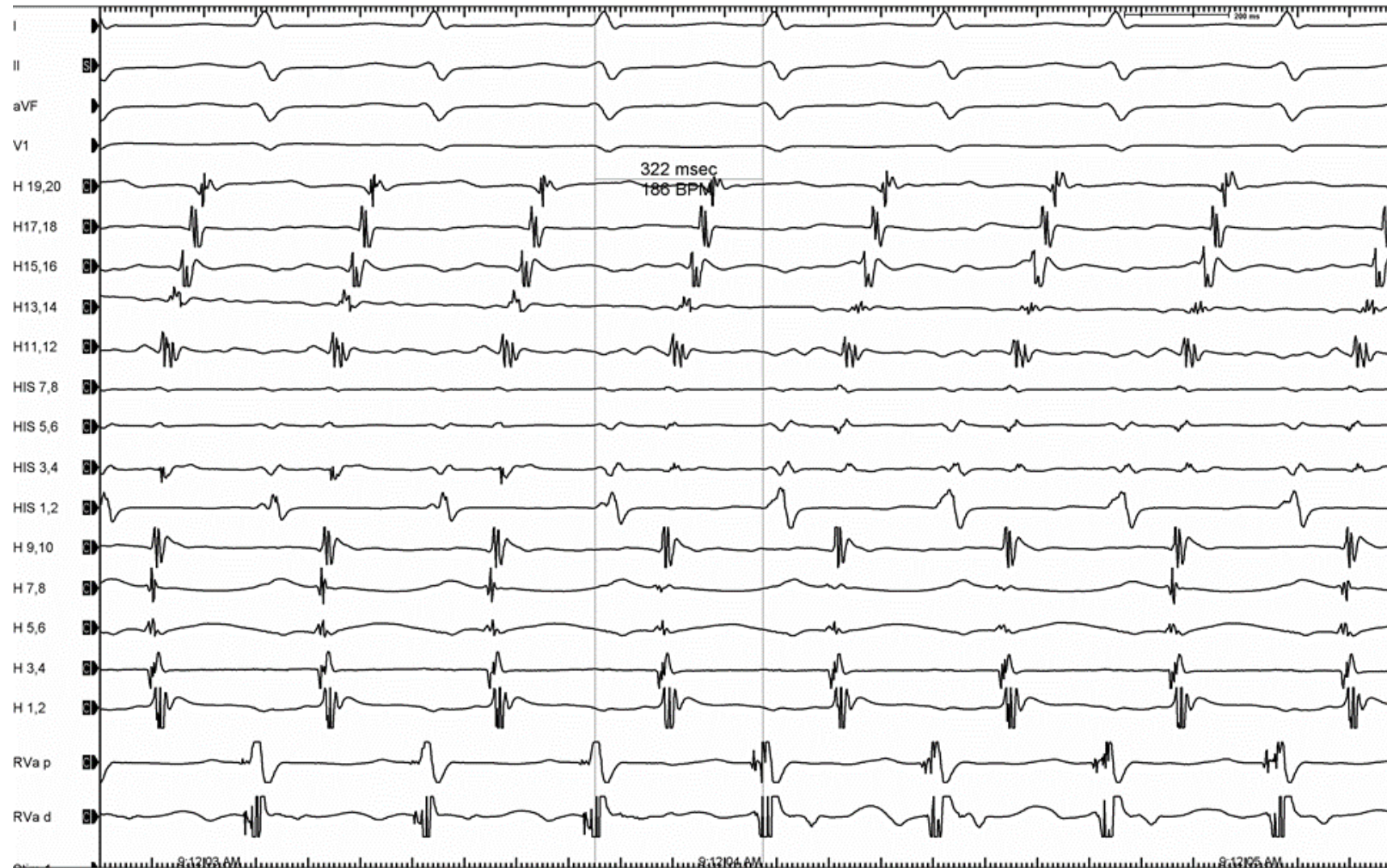
EPS and RFCA

VEST 600/490 -NS SVT



EPS and RFCA

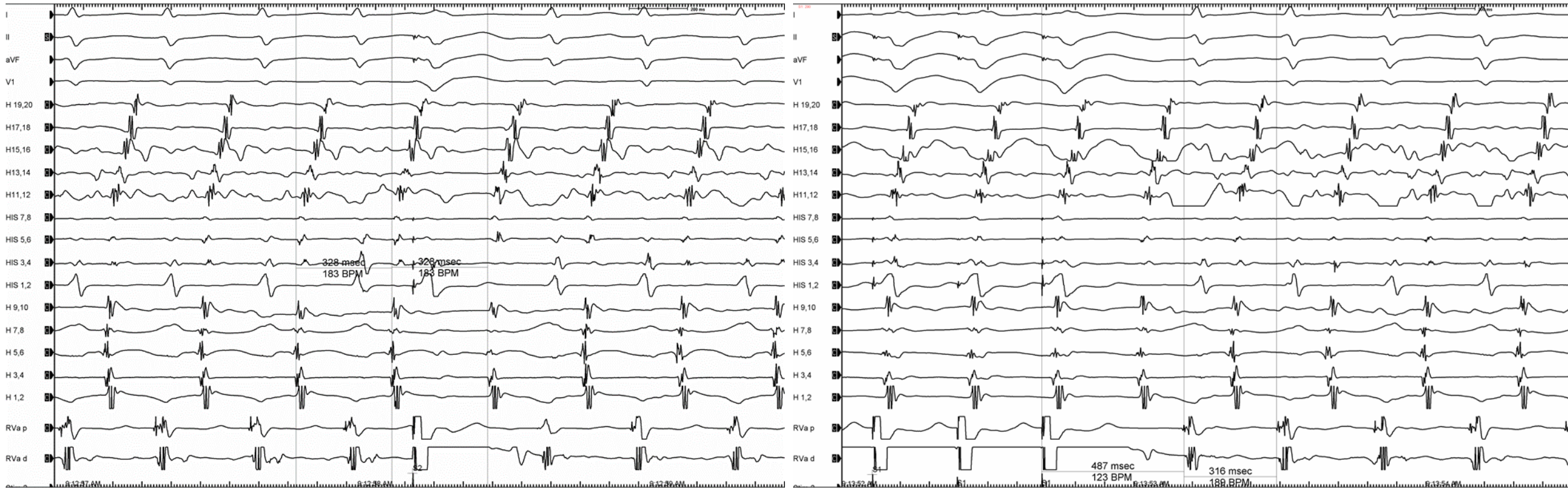
SVT induction (TCL 320 msec) by RAP 400 msec



EPS and RFCA

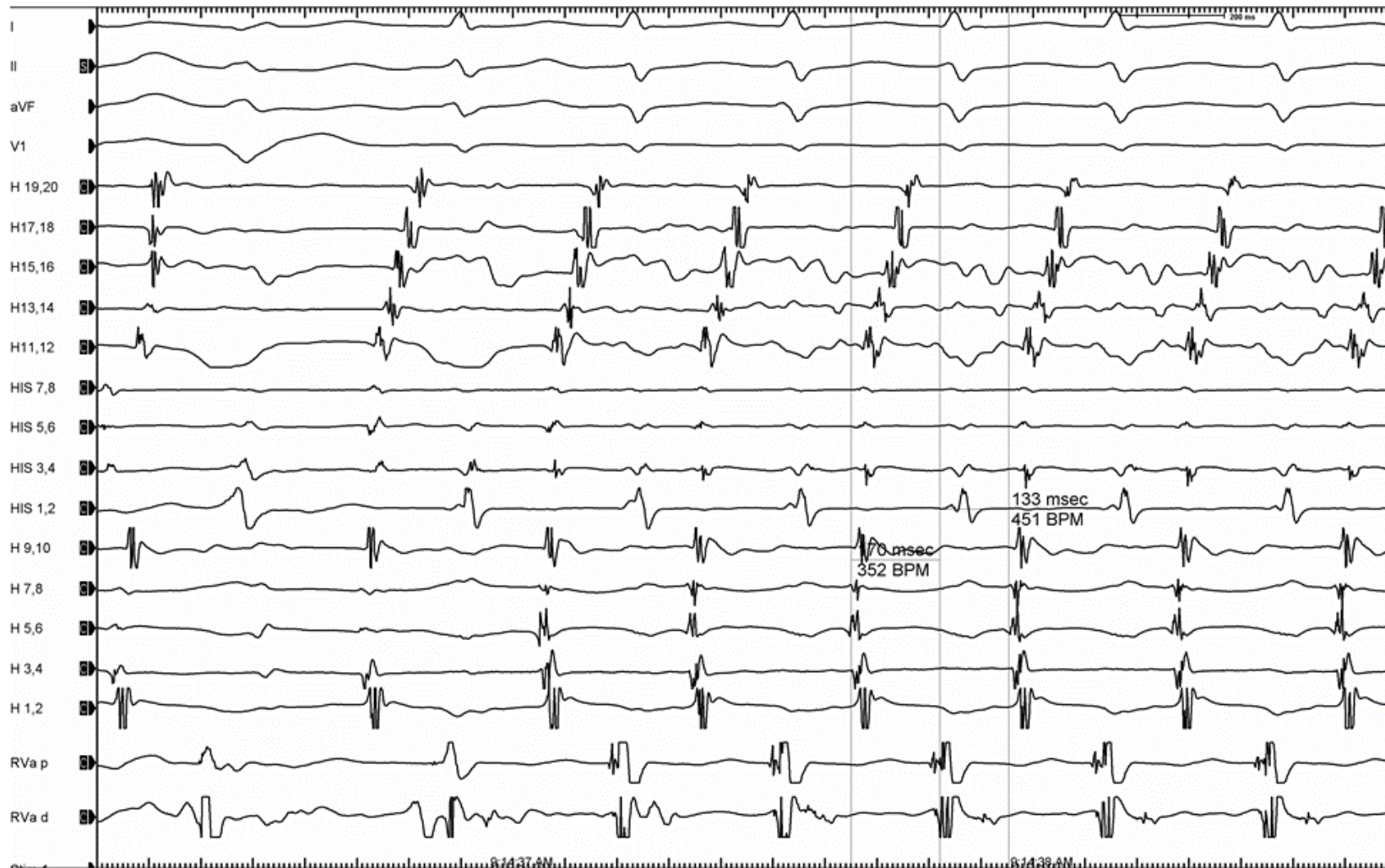
VPC no A adv.

VENT 290 487 -316ms = 171ms



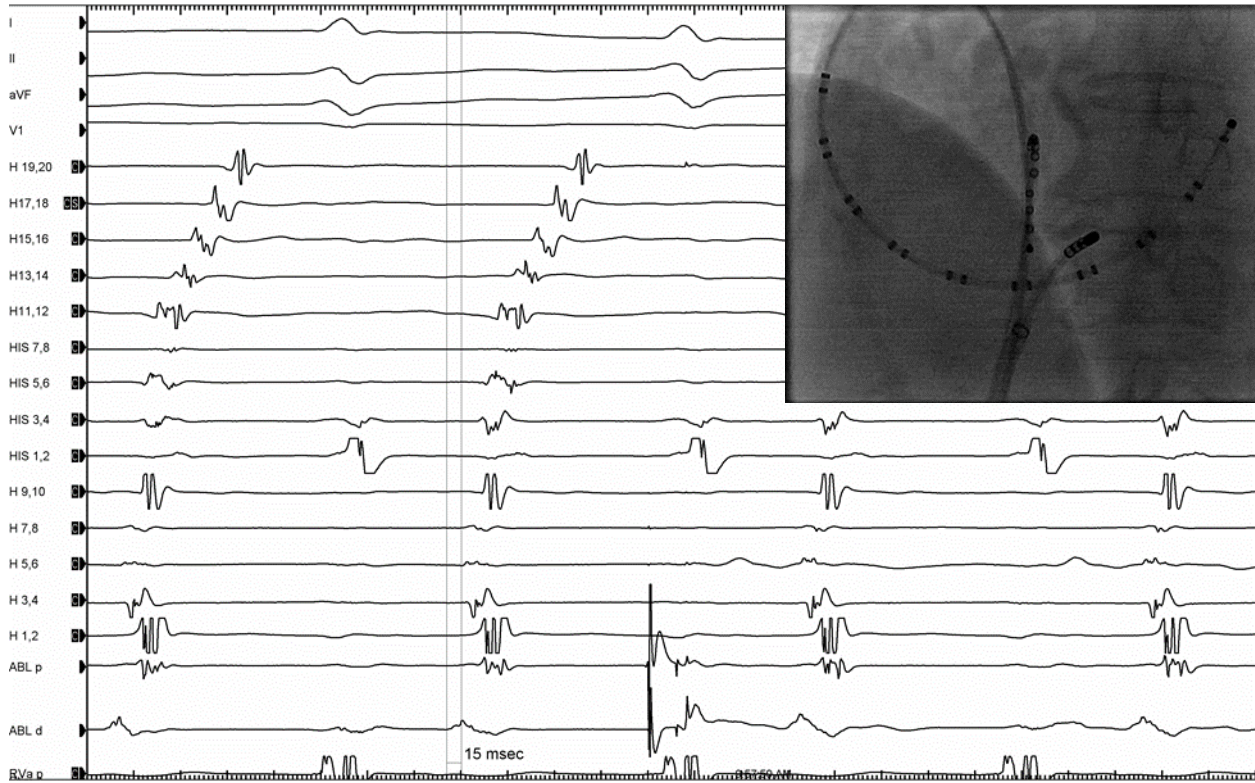
EPS and RFCA

Atypical AVNRT (fast-slow)

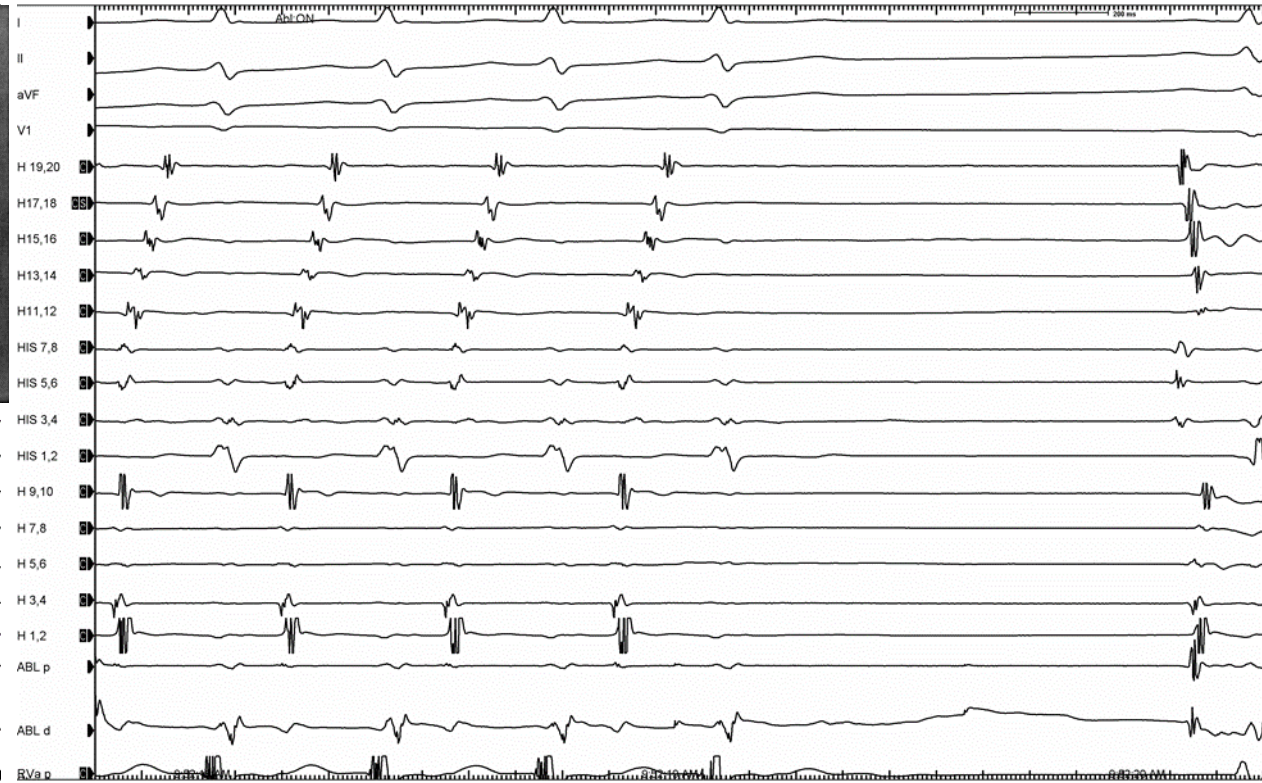


EPS and RFCA

-15ms @ CS OS INSIDE ROOF

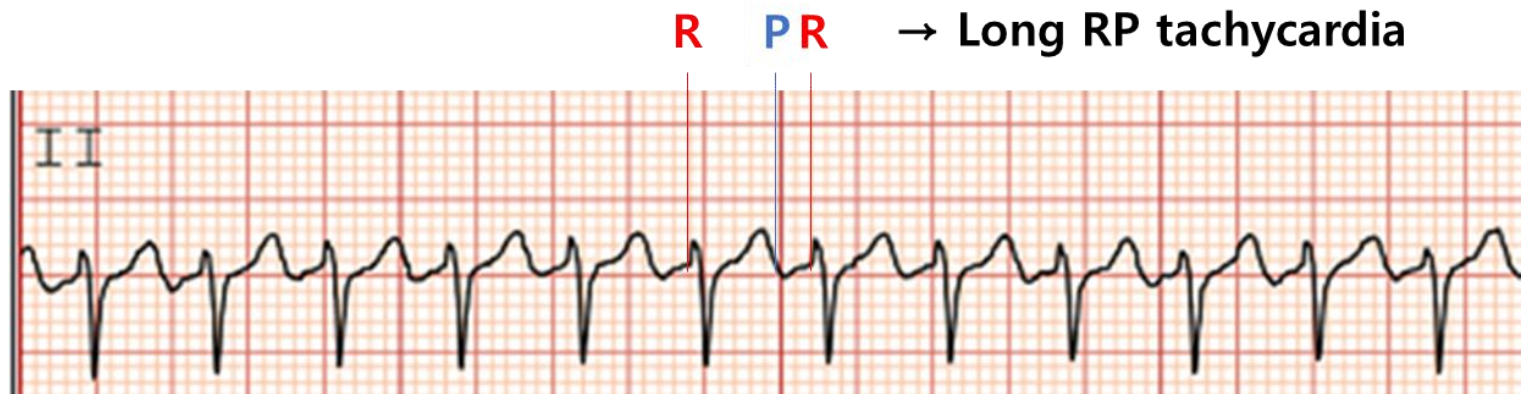


ABL @ CS OS INSIDE SVT TER



What is long RP tachycardia?

- One phenotype of narrow QRS tachycardia
- $RP > PR$ during tachycardia



- Possible mechanism
 - Focal AT (m/c)
 - AVRT (using a slowly conducting AV BT)
 - Atypical AVNRT



Differentiation of Long RP Tachycardia

- Characteristic of each SVTs

	AT	AVRT	AVNRT (atypical)
Mechanism	Automaticity	Reentry	Reentry
Using AV node (fast pathway)	No	Yes	Yes
Using AV node (slow pathway)	No	No	Yes
Using Bypass tract	No	Yes	No



Differential pacing maneuver for Long RP tachycardia

	AT	AVRT	AVNRT (atypical)
1. VOP	V-A-A-V	V-A-V	V-A-V
	Difference atrial activation between VOP and SVT	Same atrial activation between VOP and SVT	Same atrial activation between VOP and SVT
		S-A – VA <85ms	S-A – VA >85ms
		PPI – TCL <115ms	PPI – TCL >115ms
2. AOP	ΔVA >14ms after differential AOP	Δ VA <14ms after differential AOP	Δ VA <14ms after differential AOP
	Δ AH <20ms between AOP and SVT	ΔAH <20ms between AOP and SVT	Δ AH >40ms between AOP and SVT
3. V extrastimulus		ΔS-A – VA_{base} <85ms	Δ S-A – VA _{base} >85ms
		Longer CI for reset	Shorter CI for reset
		Atrial advance or delay by HRPVB	No advance or delay by HRPVB
4. Para-His pacing		AP response	Nodal response

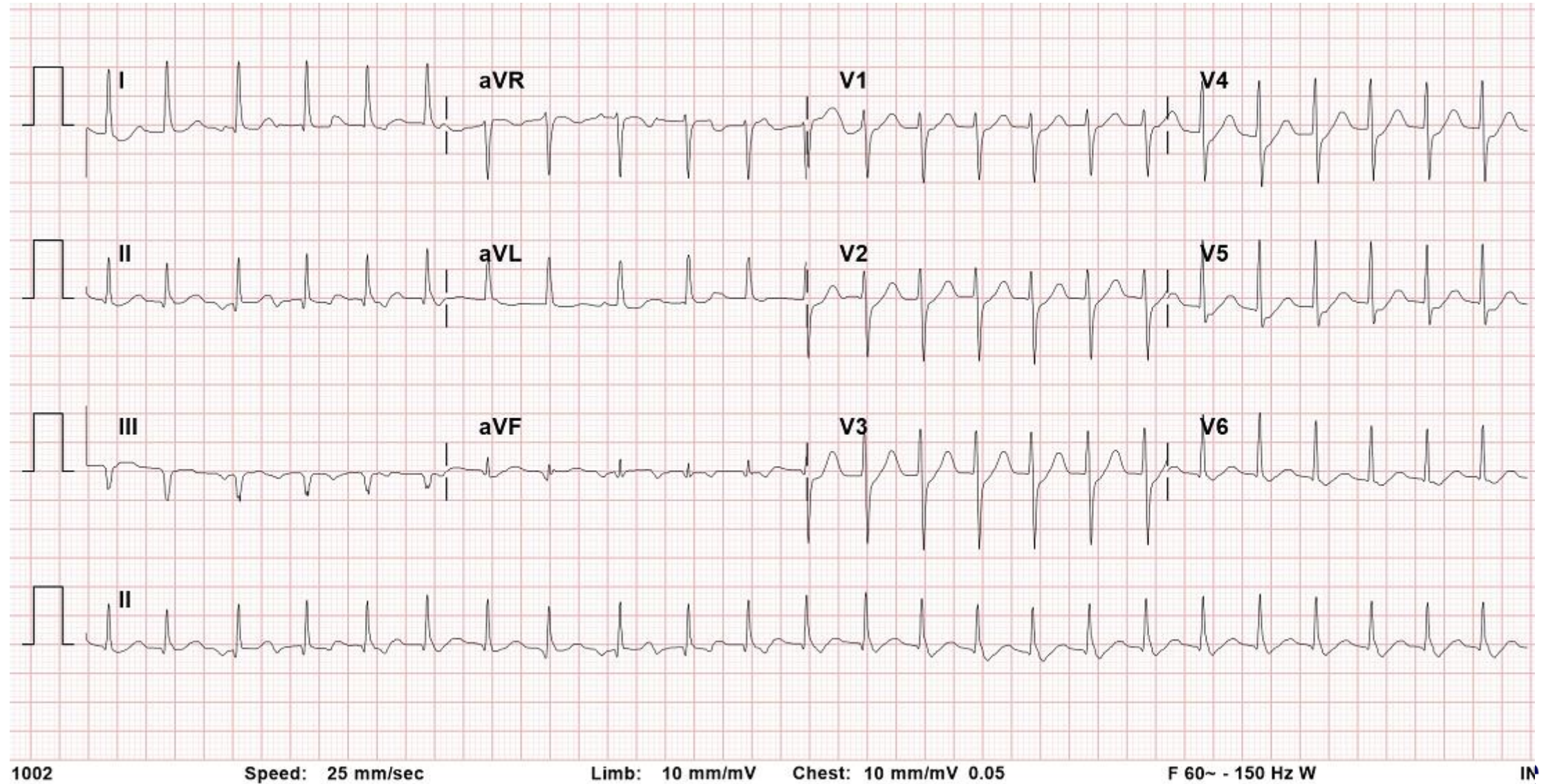


Case 2. F/63

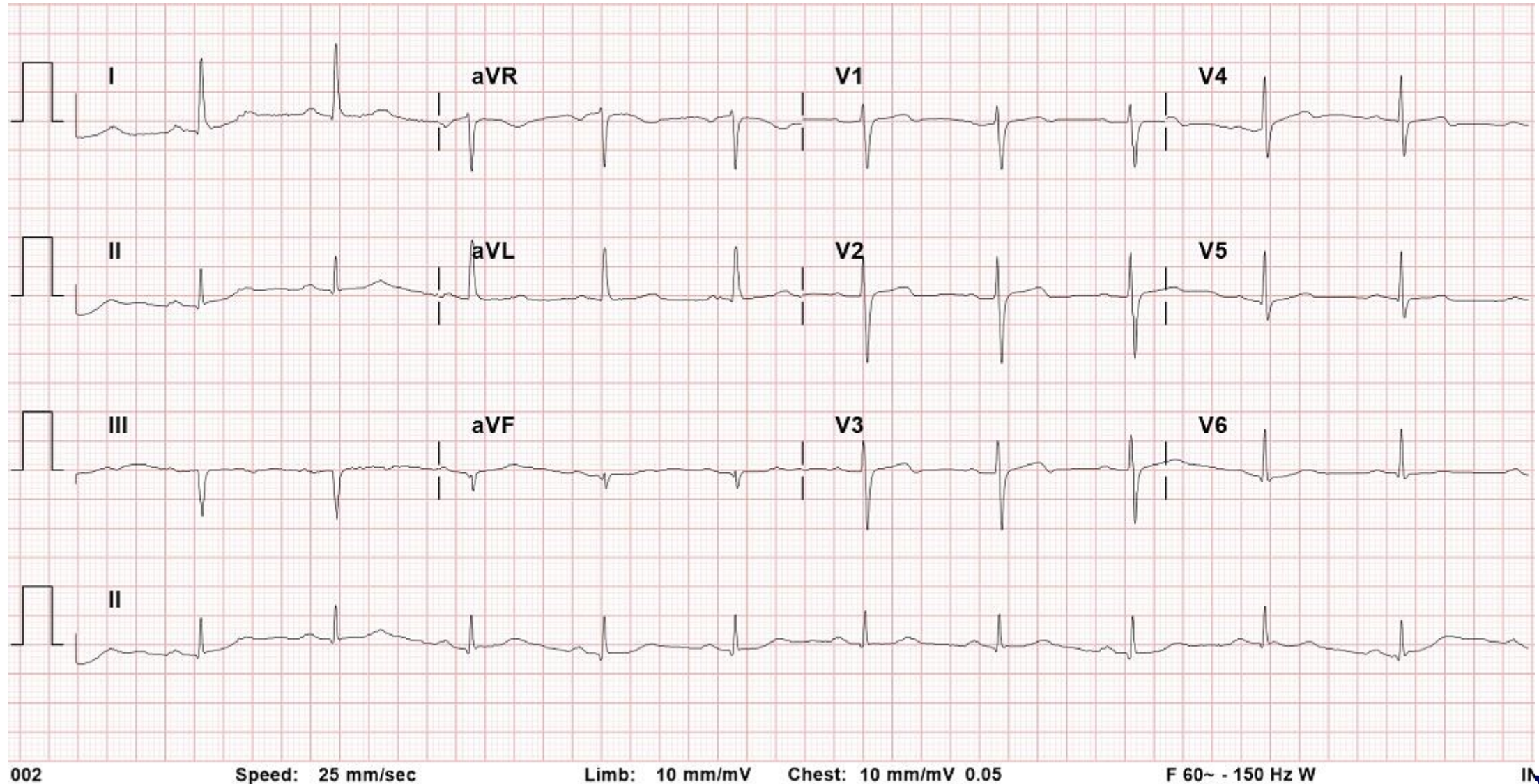
- Chief complaint: palpitation
 - Onset: 2 days ago
 - Repetitive development
- P/Hx: HTN
- V/S: BP 102/65, PR 148, RR 20, BT 36, SPO2 100



Initial ECG



Sinus rhythm ECG

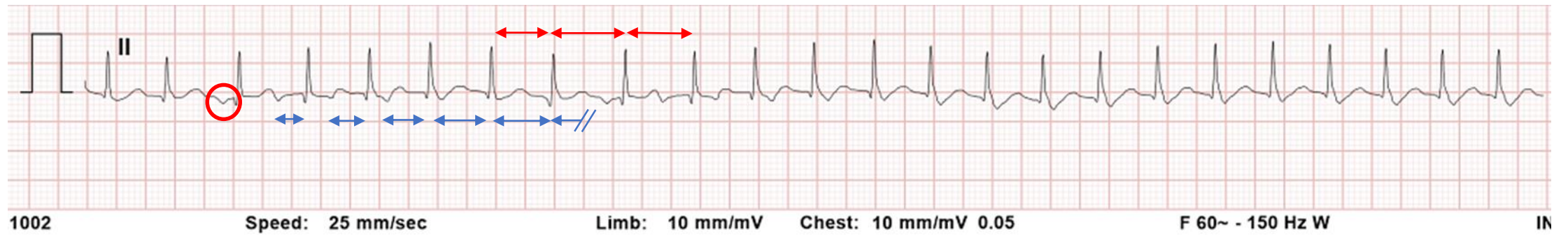


Tachycardia 심전도에서 관찰되는 소견은?

1. VA linking
2. Regular QRS tachycardia
3. Not visible P wave
4. Wenckebach block
5. None of above



Review of tachycardia



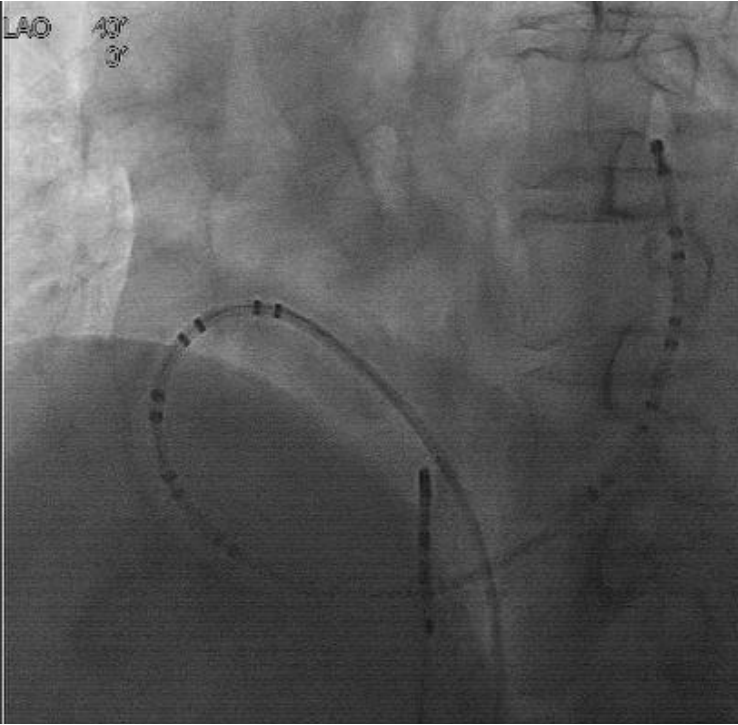
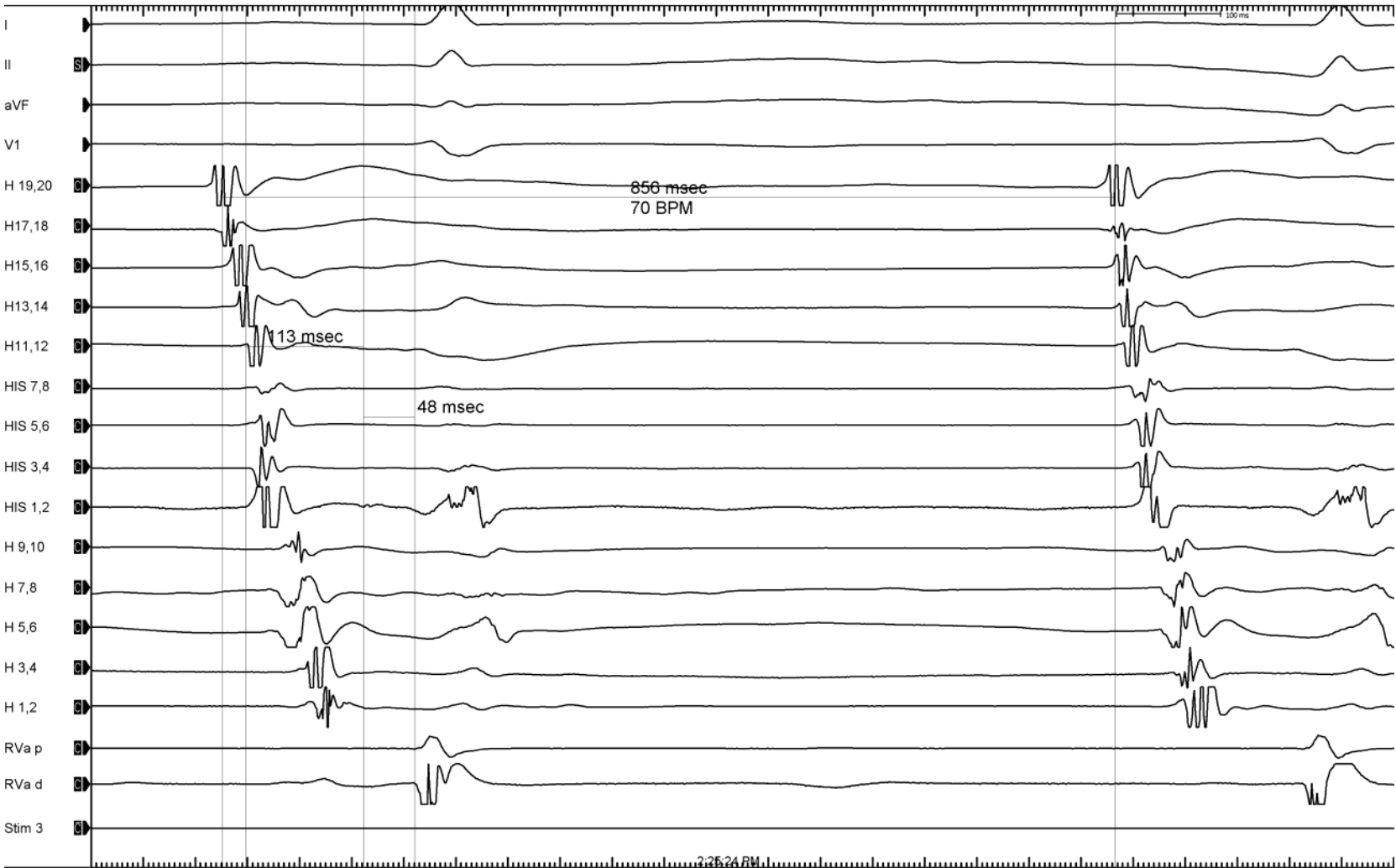
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5. None of above



EPS

BASELINE SR, SCL 856MS, AH 113MS, HV 48MS

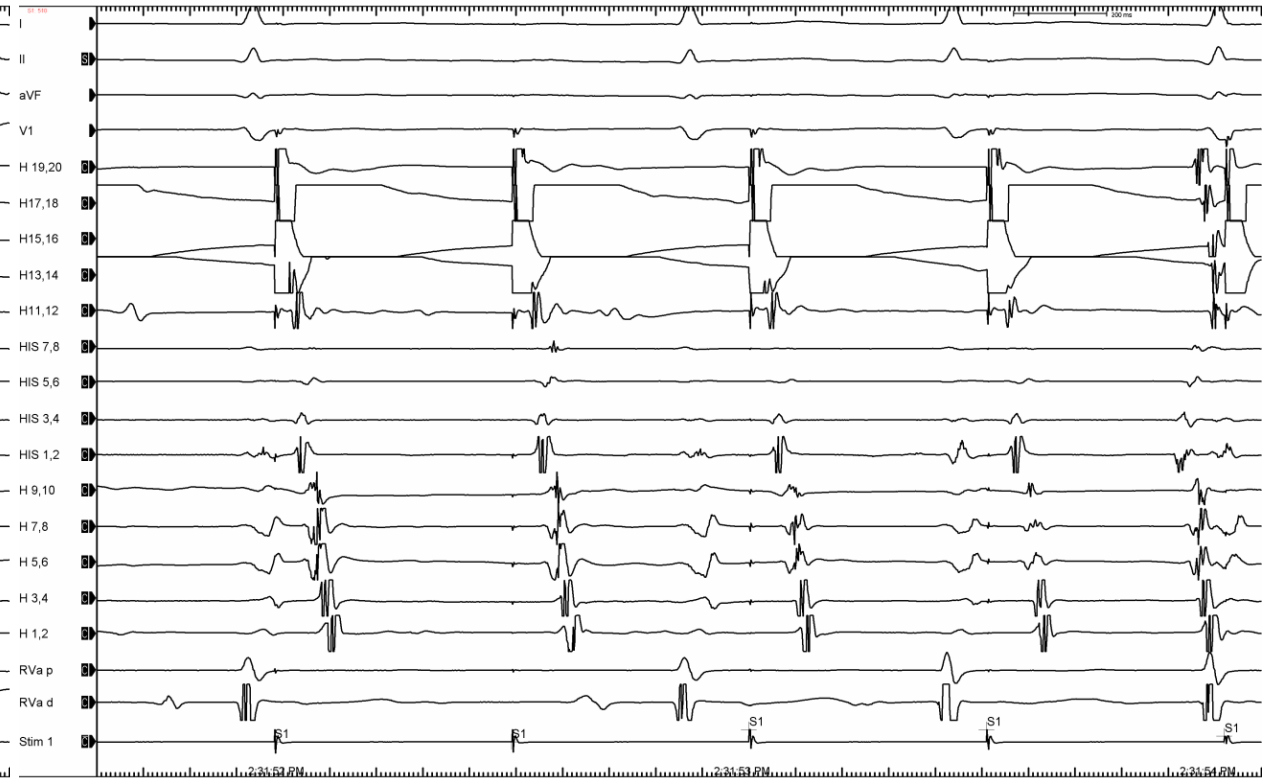


EPS

RVP 670 - VABCL

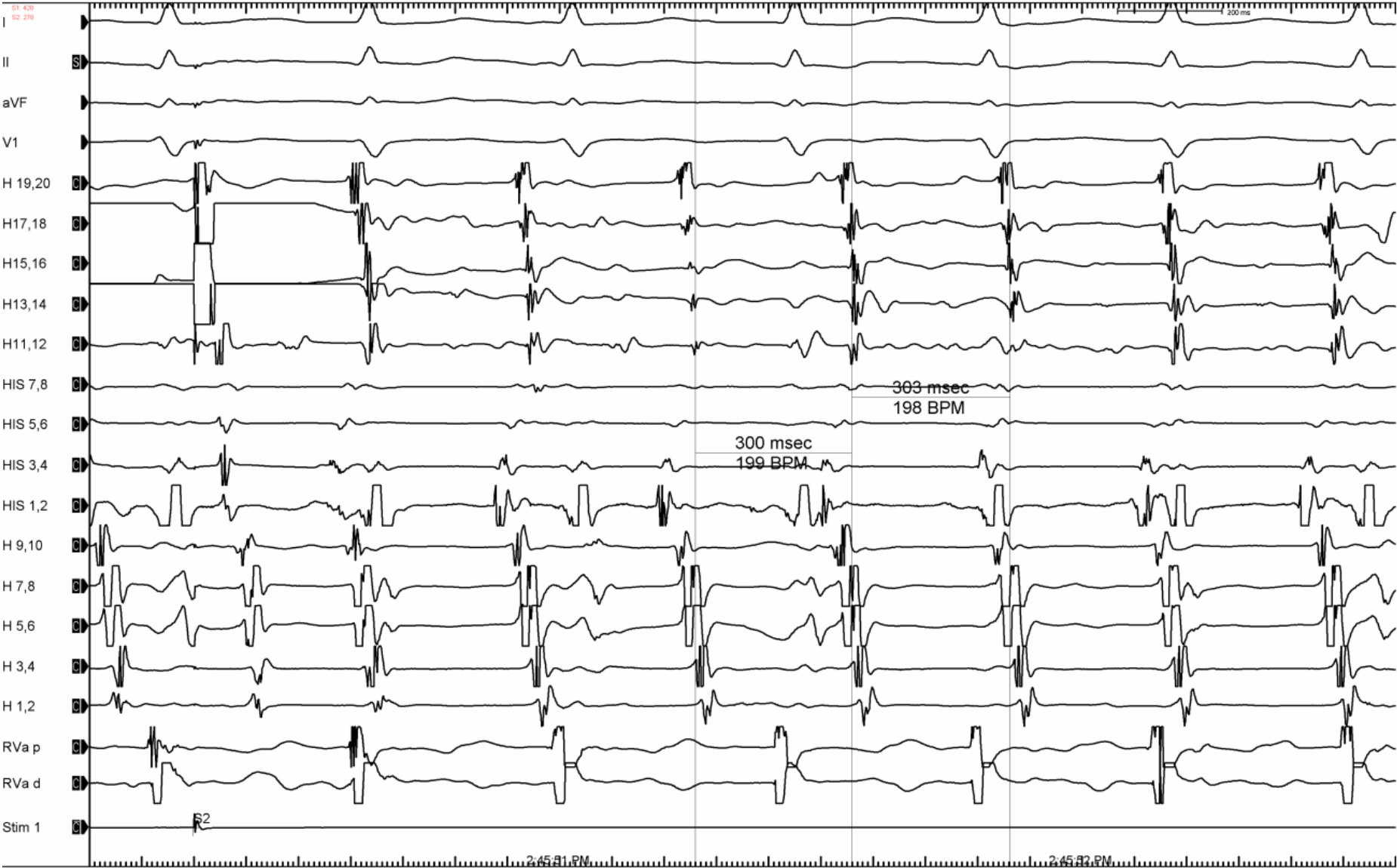


RAP 510 - AVBCL



EPS

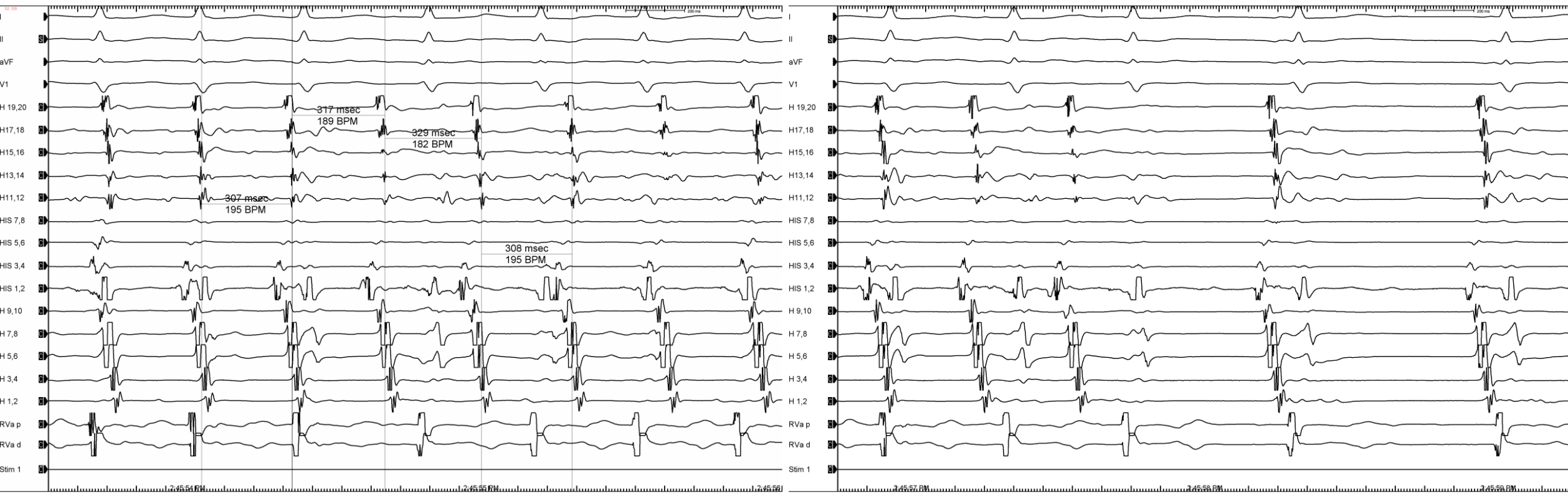
ISO 2MCG, AEST 430/270 - NS SVT INDICATION TCL 300MS 6" EA@HIS1,2



EPS

SVT, TACHY CL VARIATION >15msec

SPON TER, VAB -> AT FAVOR



Baseline observation and tachycardia features of AT

Table 4. Prevalence and Diagnostic Value of Baseline Observations and Tachycardia Features

Baseline Observations and Tachycardia Features	Prevalence (%)	Sensitivity (%)			Specificity (%)			PPV (%)			NPV (%)		
		AVNRT	ORT	AT	AVNRT	ORT	AT	AVNRT	ORT	AT	AVNRT	ORT	AT
Baseline Observations													
● Preexcitation present during sinus rhythm	15	3	41	4	69	97	83	10	86	3	46	78	86
● Dual AV nodal physiology	55	86	10	36	83	24	42	86	6	8	82	36	82
● <u>VA block cycle length >600 ms at baseline</u>	11	8	2	50	84	84	84	41	5	55	41	66	93
● Extranodal response to para-Hisian pacing	18	5	47	0	67	96	80	17	83	0	36	80	85
Tachycardia Features													
● Induction dependent on a critical AH interval	55	90	16	4	88	26	36	91	8	1	87	42	71
● Isoproterenol required to sustain tachycardia	39	47	23	57	68	51	62	65	18	17	56	58	91
● Tachycardia cycle length \geq 500 ms	3	4	2	0	99	96	97	83	17	0	44	69	87
● <u>Septal VA interval >70 ms</u>	53	16	100	100	0	69	54	17	59	24	0	100	100
● Eccentric atrial activation	31	0	74	61	30	89	74	0	76	24	19	88	93
● <u>Spontaneous AV block during tachycardia</u>	10	11	0	33	91	85	93	60	0	40	44	65	91
● <u>Spontaneous termination with AV block</u>	28	33	31	0	78	73	67	66	34	0	48	70	82
● Development of RBBB	32	31	36	30	66	69	67	54	35	11	42	71	82
● Development of LBBB	12	1	36	4	73	99	87	4	92	4	36	81	87
● Increase in VA interval >20 ms with BBB	7	0	35	0	69	100	80	0	100	0	51	57	92

AH = atrial His bundle; AT = atrial tachycardia; AVNRT = atrioventricular nodal reentry; BBB = bundle branch block; CL = cycle length; LBBB = left bundle branch block; NPV = negative predictive value; PPV = positive predictive value; ORT = orthodromic reciprocating tachycardia; RBBB = right bundle branch block; SVT = supraventricular tachycardia; VA = ventriculoatrial.

- **Tachycardia cycle length variability of 15 ms or more** associated with a change in atrial cycle length that predicts a change in ventricular cycle length **favours either AT or atypical AVNRT.**





Arrhythmia Review Course 3



강기운

중앙의대 순환기 내과

Korean Heart Rhythm Society

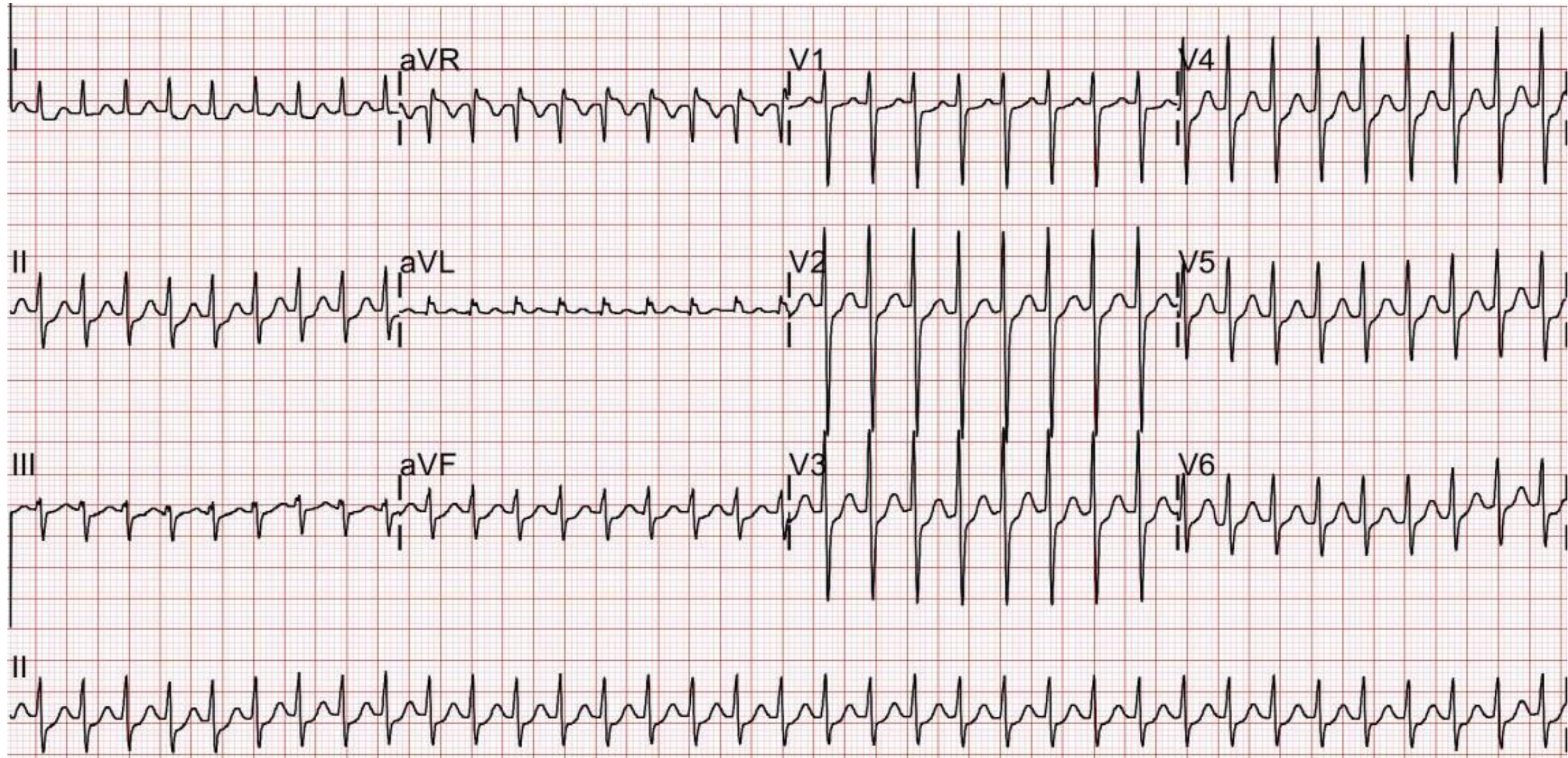
COI Disclosure

Name of First Author: Ki-Woon Kang

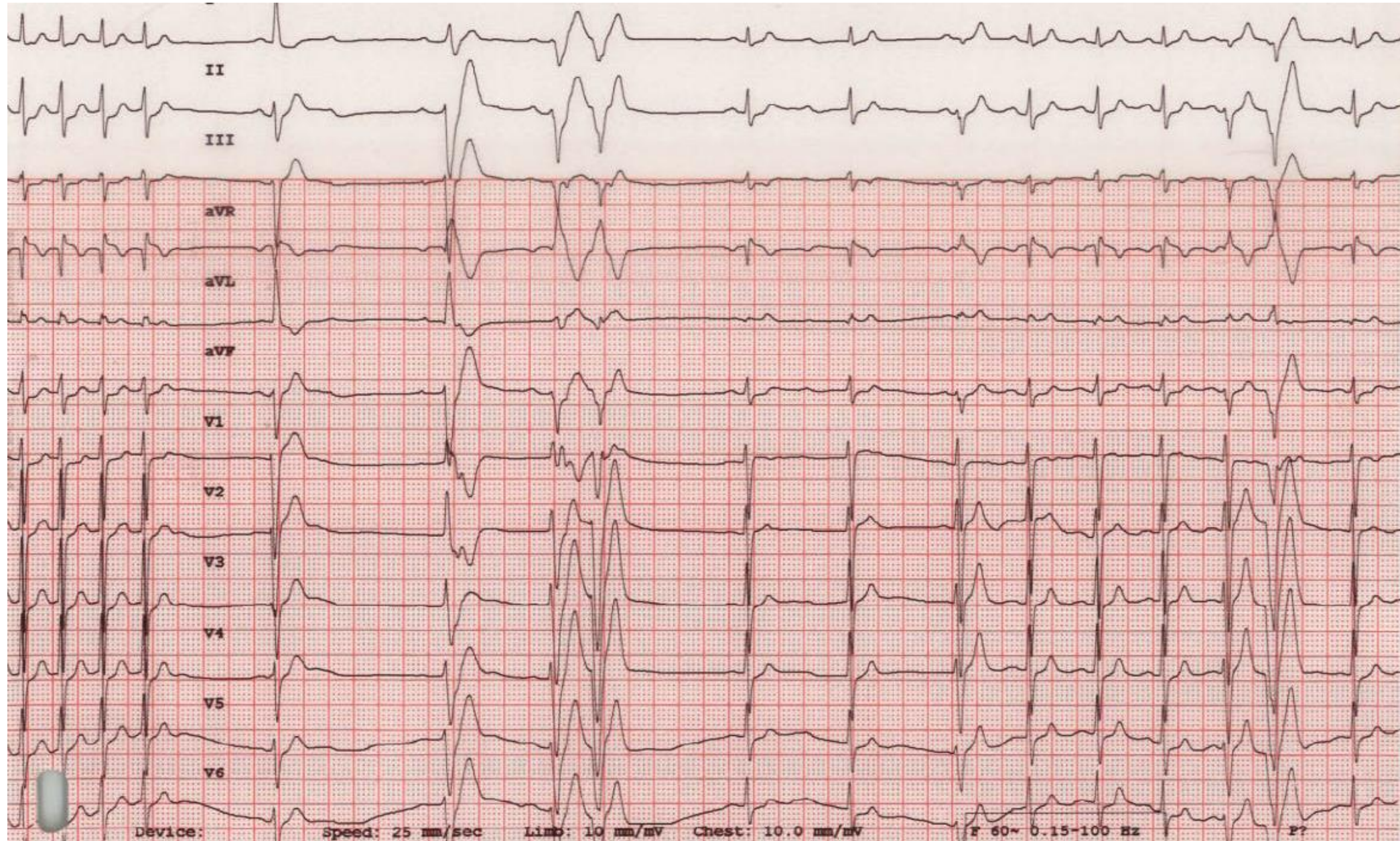
The authors have no financial conflicts of interest to disclose concerning the presentation



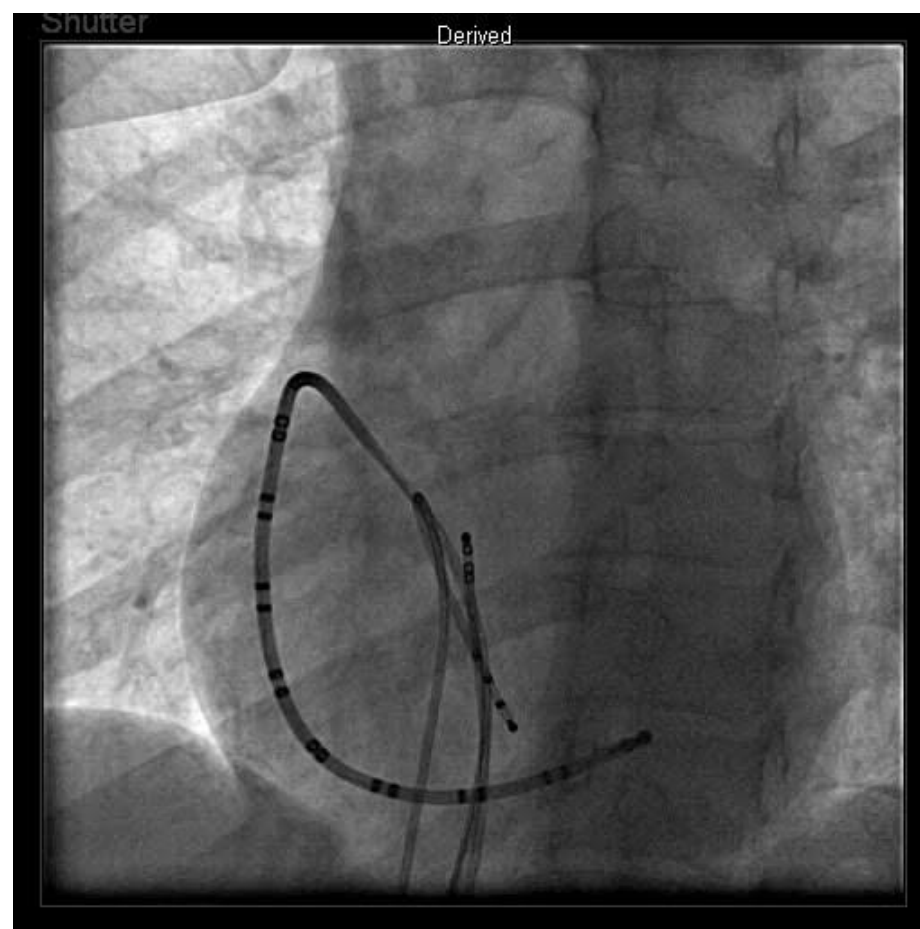
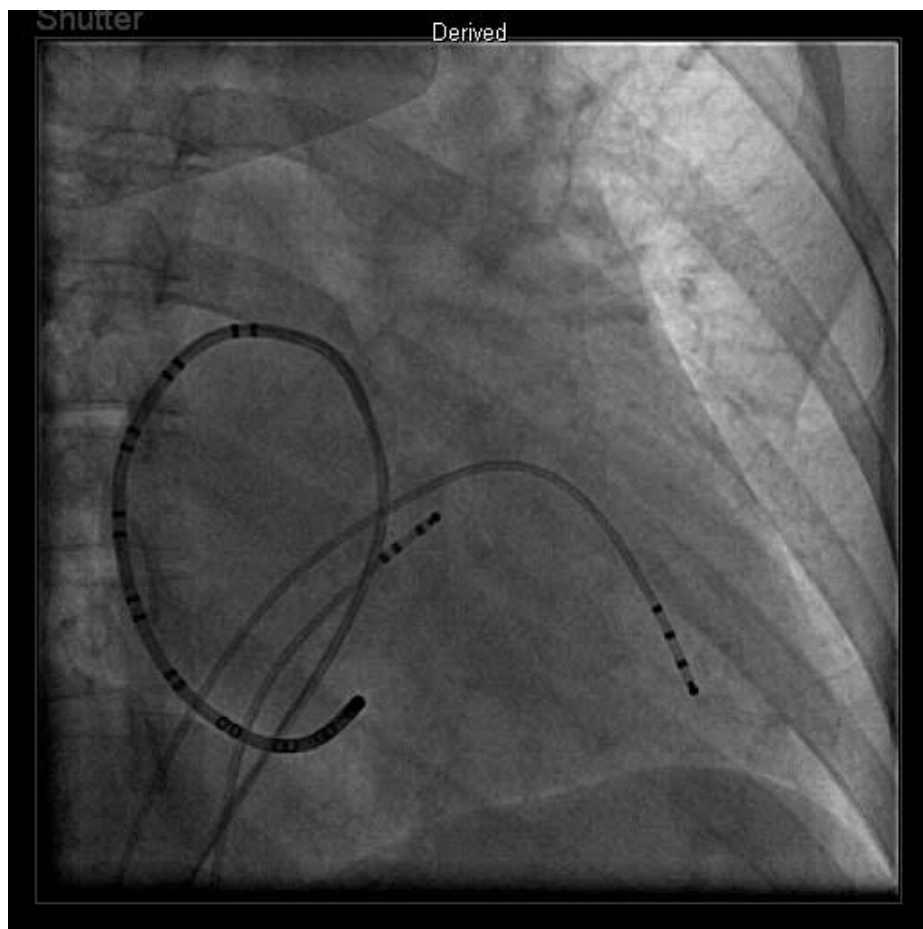
Case 5. (F/28) 재발성 두근거림으로 응급실 내원 BP 120/80 (TCL 296)



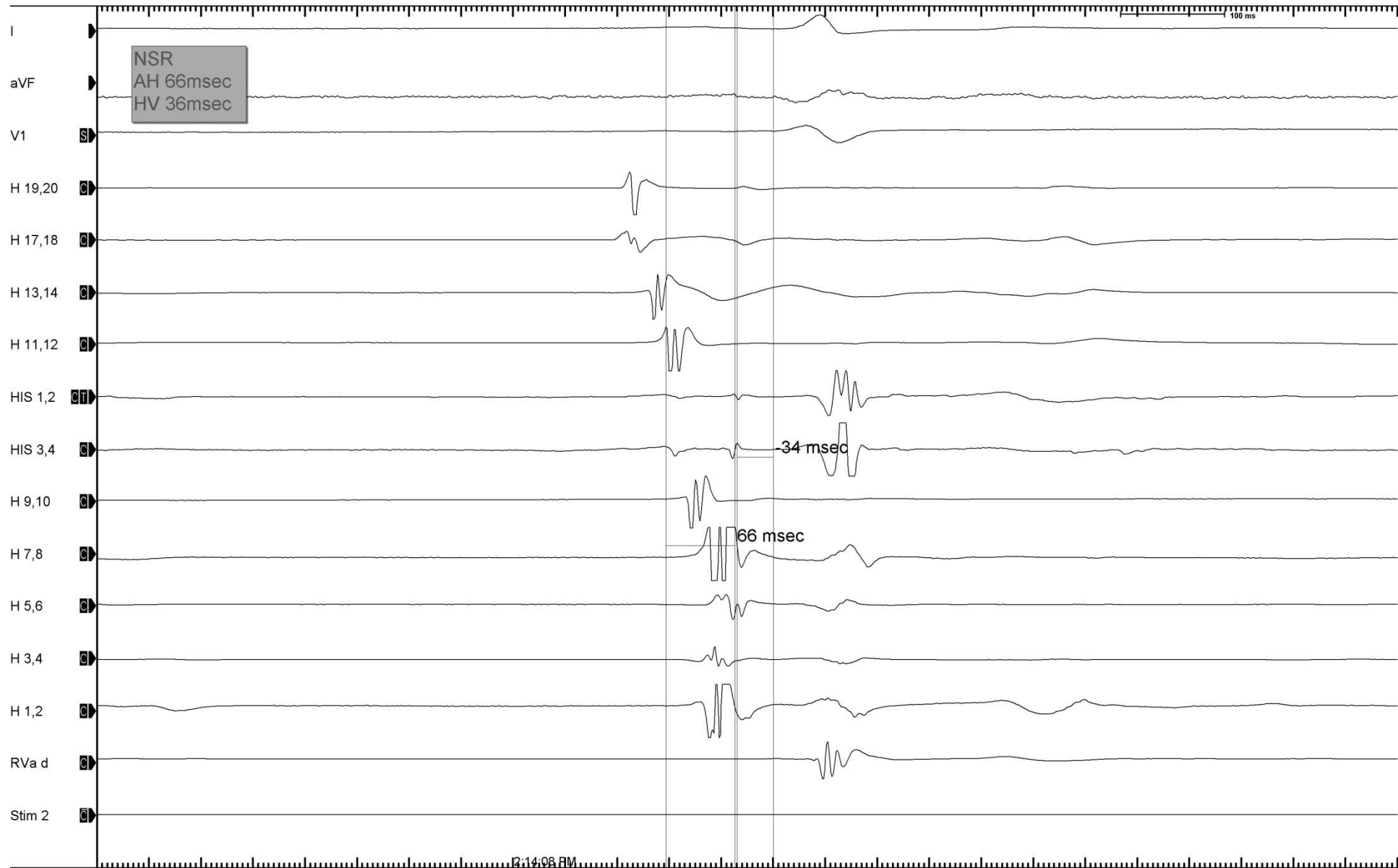
Adenosine 6mg iv → Termination



CATHETER POSITON



Sinus Rhythm



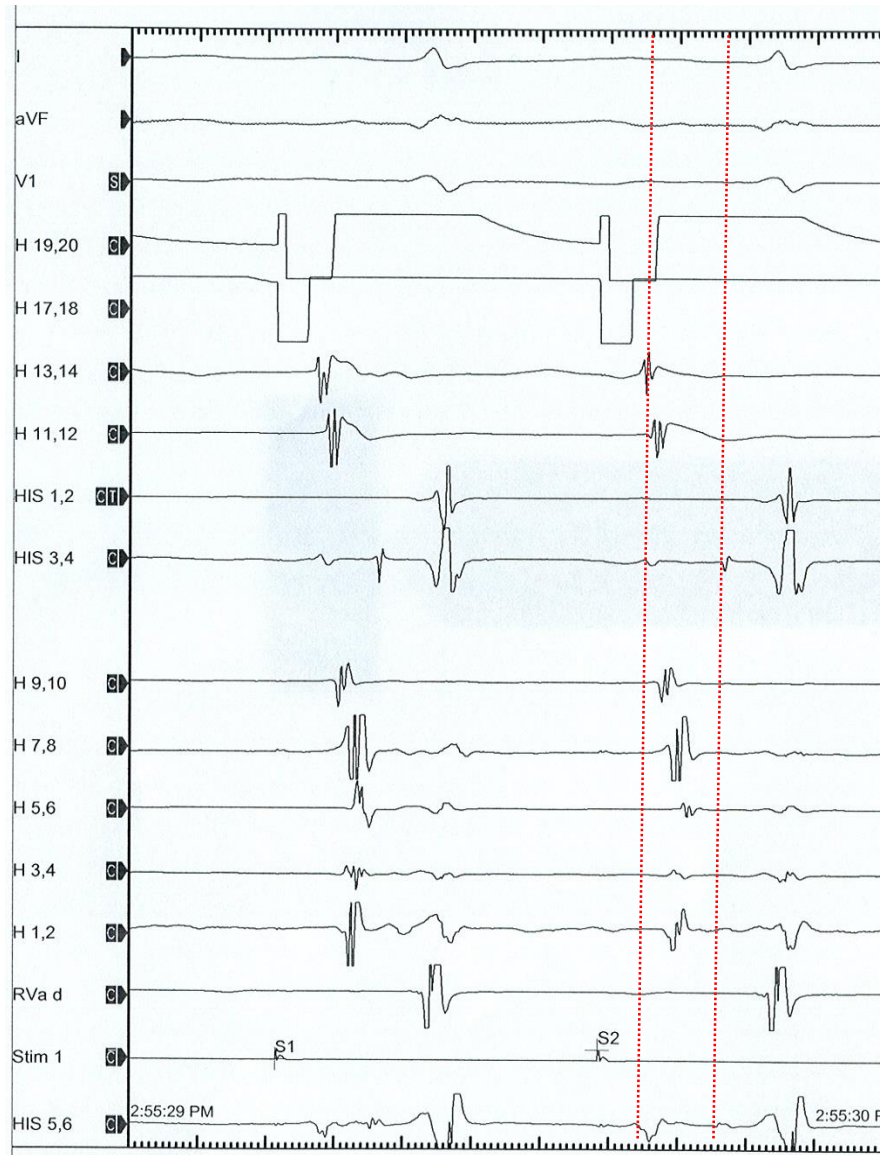
Spontaneous Induction



NO RESET



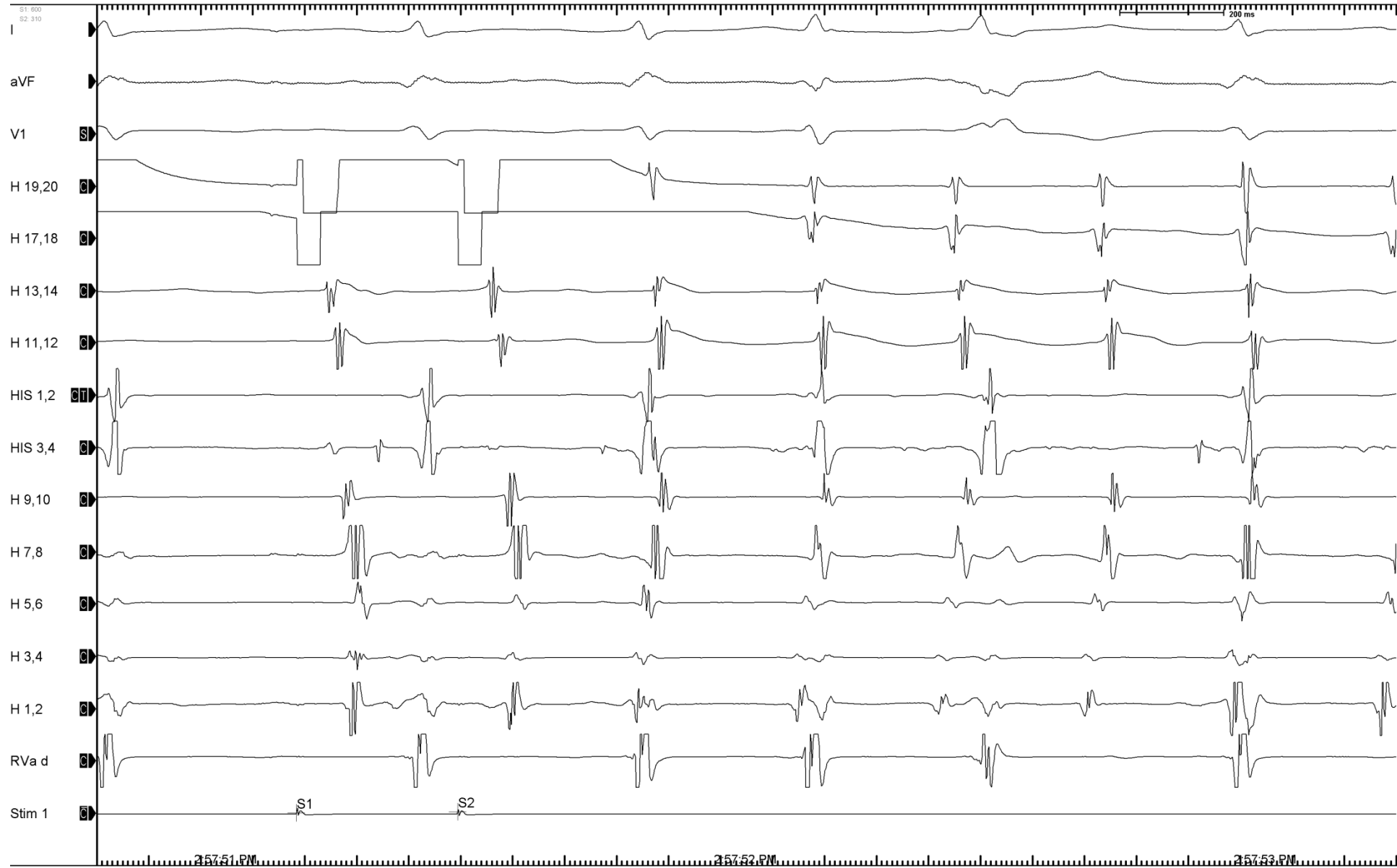
SAEST 600/480



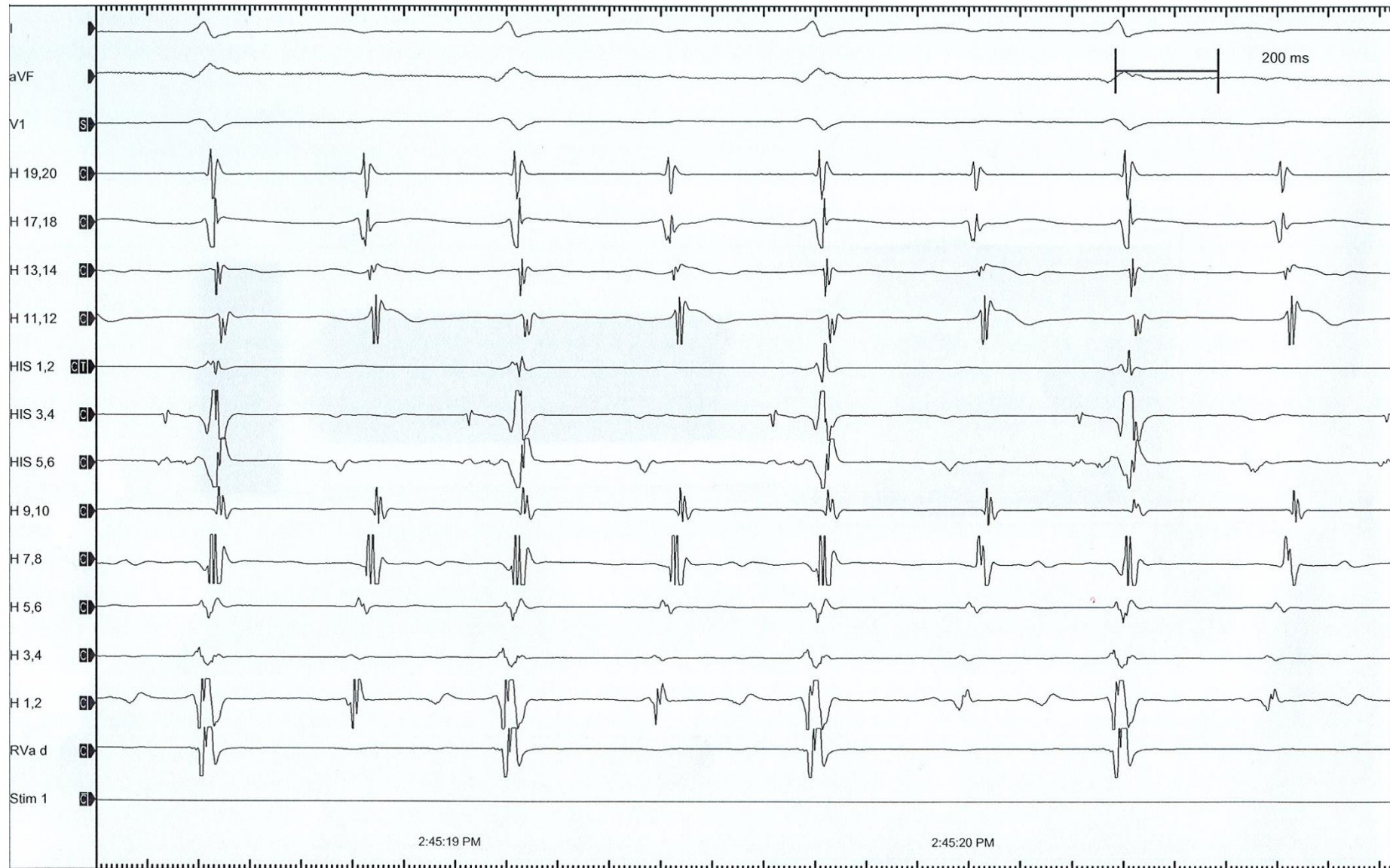
SAEST 600/470



SAEST 600/320 IND



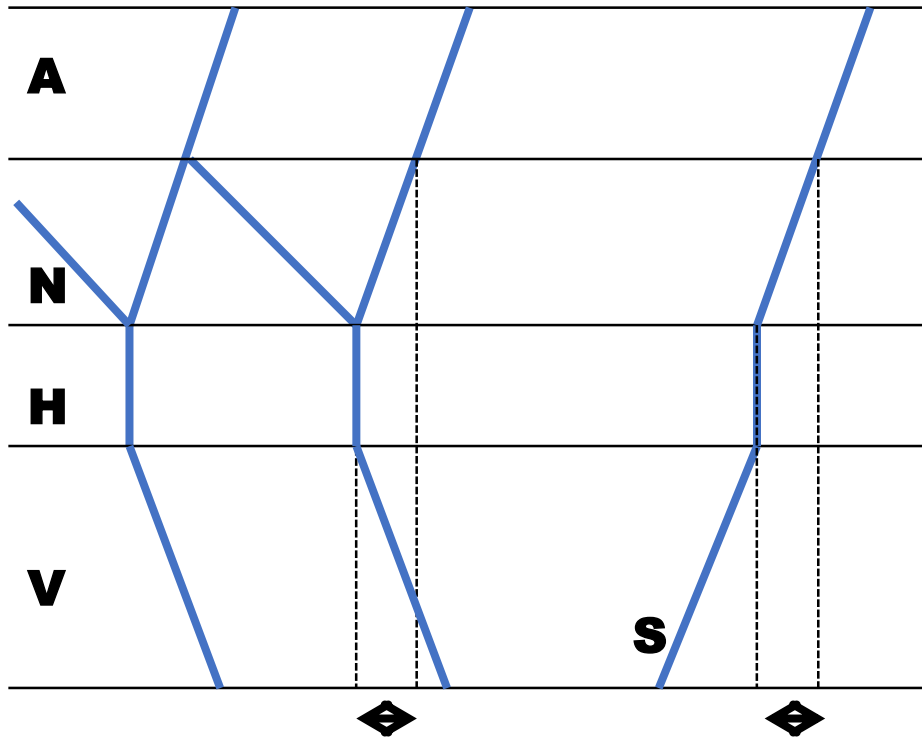
Induction 2:1 AV block



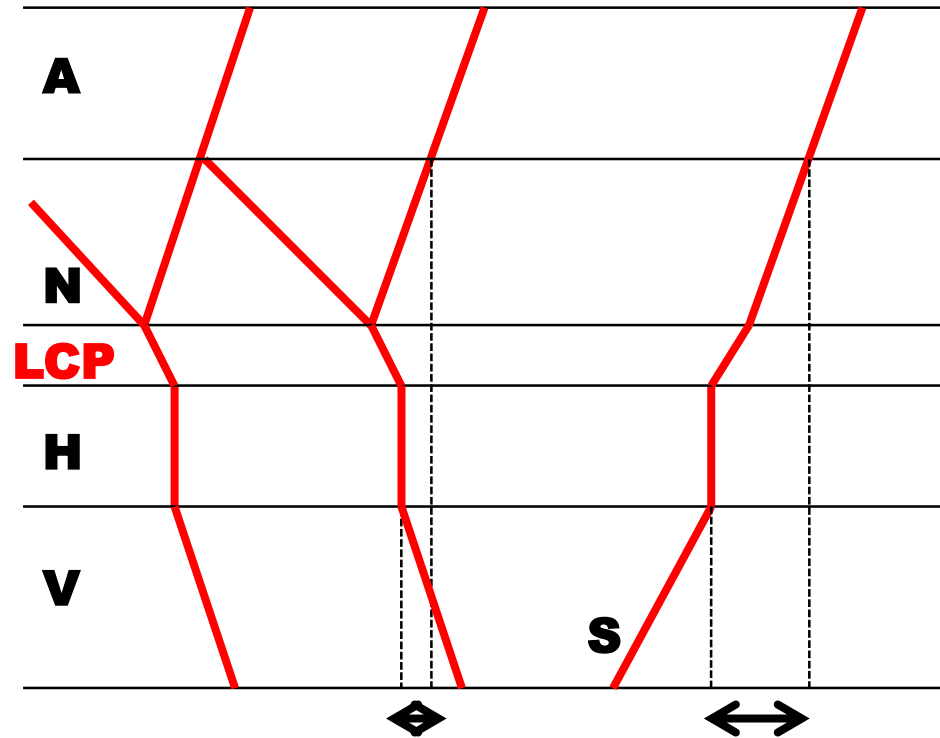
가능성이 높은 기전은?

- 1. Lower common final pathway**
- 2. Functional AV block**

SVT (ΔHA) : RVP (ΔHA)



NO LCP



LCP

LCP → nodal inferior extension → Atypical ANVRT

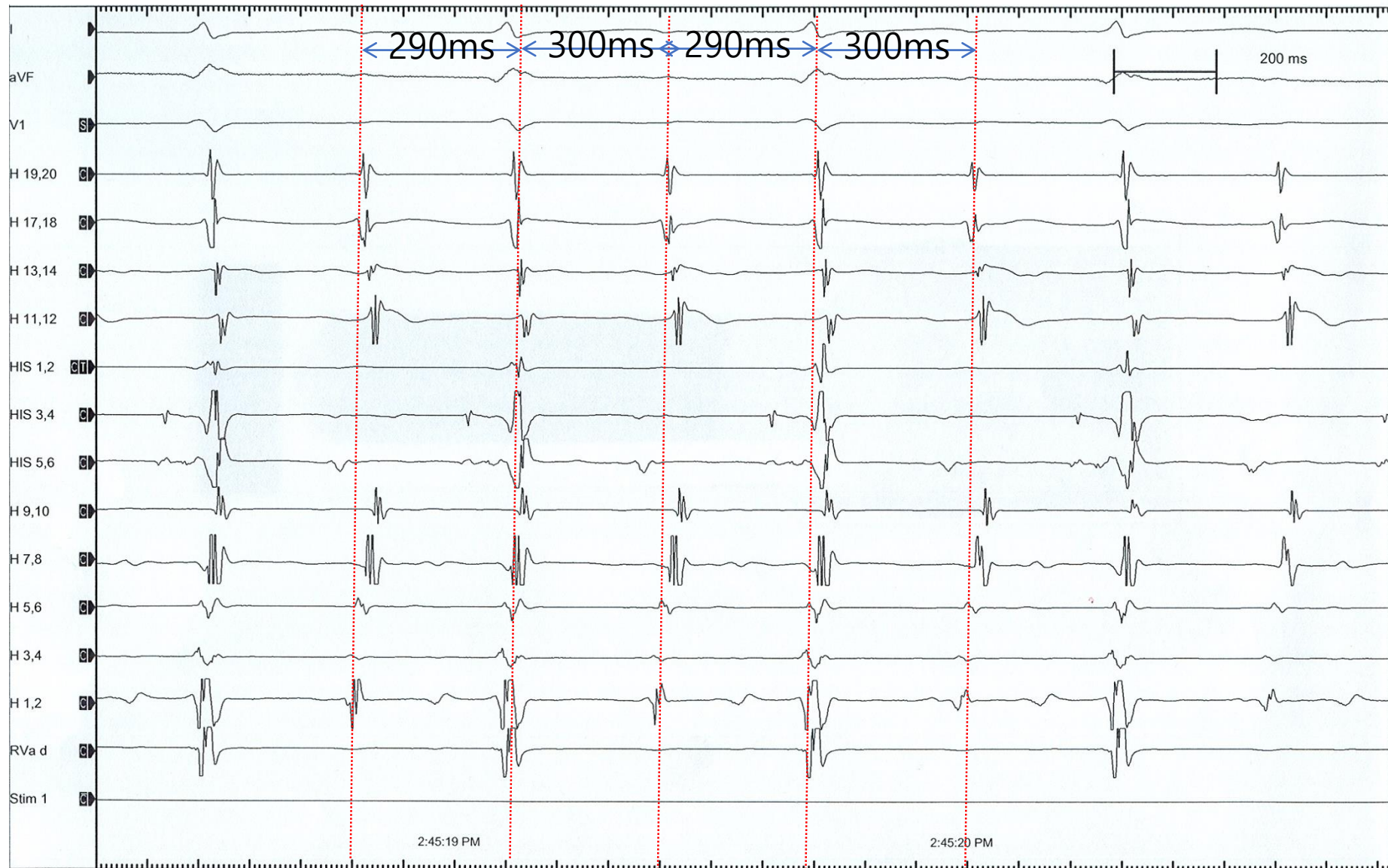
Subform	n (%)	Women (%)	Age (years)	Earliest retrograde atrial activation ^a	Shortest cycle length with 1:1 antegrade FP conduction (baseline)	Demonstrable 1:1 antegrade SP conduction (baseline)	Shortest cycle length with 1:1 antegrade SP conduction (baseline)	Demonstrable 1:1 retrograde FP conduction (baseline)	1:1 retrograde SP conduction during ventricular pacing at tachycardia cycle length (immediately after tachycardia)	Evidence of lower common pathway
Slow/Fast	280 (81.4%)	78%	43 ± 16	Superior Septum	543 ± 139 (300–1300)	73%	442 ± 101 (270–1250)	94%	–	10%
Slow/Slow	47 (13.7%)	60%	44 ± 12	Inferior Septum	551 ± 157 (350–1200)	81%	448 ± 102 (290–800)	13%	72%	84%
Fast/Slow	17 (4.9%)	65%	35 ± 14	Inferior Septum	531 ± 210 (270–950)	65%	457 ± 165 (250–750)	29%	6%	100%
Total	344	75%	43 ± 15							
	Slow/Fast vs. Slow/Slow	0.03	NS		NS	NS	NS	<0.0001	–	<0.0001
	Slow/Fast vs. Fast/Slow	NS	0.04		NS	NS	NS	NS	<0.0001	NS
	Slow/Slow vs. Fast/Slow	NS	0.01		NS	NS	NS	<0.0001	–	<0.0001

^a Two Slow/Fast patients had earliest retrograde atrial activation at the mid-septum. Three Slow/Slow and 1 Fast/Slow patients had simultaneous retrograde breakthroughs in the superior and inferior septum.

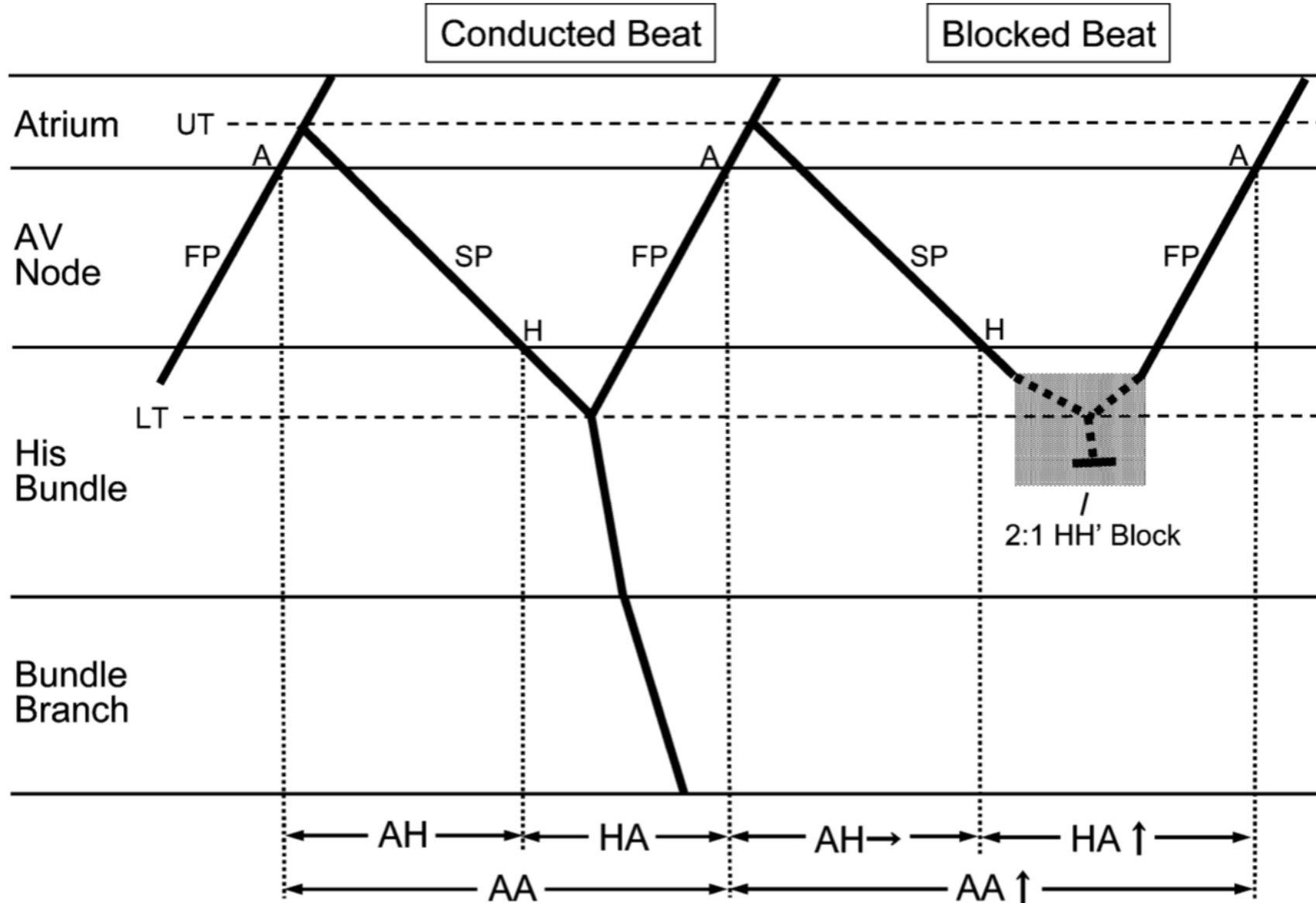
RV or Parahian pacing (ΔHA) and SVT (ΔHA)



Induction 2:1 AV block



Involvement of the proximal HB in the Re-entrant Circuit



2:1 Atrioventricular Block During Atrioventricular Node Reentrant Tachycardia

K. CHING MAN, DO, KARIN BRINKMAN, BS, FRANK BOGUN, MD, BRADLEY KNIGHT, MD, MARWAN BAHU, MD, RAUL WEISS, MD, RAJIVA GOYAL, MD, MARK HARVEY, MD, EMILE G. DAOUD, MD, S. ADAM STRICKBERGER, MD, FRED MORADY, MD, FACC

Ann Arbor, Michigan

Objectives. The purpose of this study was to determine the incidence and to clarify the mechanism of 2:1 atrioventricular (AV) block during AV node reentrant tachycardia induced in the electrophysiology laboratory.

Background. In patients with 2:1 AV block during AV node reentrant tachycardia, the absence of a His bundle potential in the blocked beats has been considered evidence of intranodal, lower common pathway block.

Methods. In consecutive patients with AV node reentrant tachycardia, the incidence of 2:1 AV block and the response to atropine and a single ventricular extrastimulus was observed.

Results. Persistent 2:1 AV block occurred in 13 of 139 patients with AV node reentrant tachycardia. A His bundle deflection was present in the blocked beats in eight patients and absent in five. Patients with 2:1 AV block had a shorter tachycardia cycle length

than did patients without such block (mean \pm SD 312 ± 32 vs. 353 ± 55 ms, $p < 0.01$). Atropine did not alter the 2:1 block in any patient. In every patient, a single ventricular extrastimulus introduced during the tachycardia converted the 2:1 block to 1:1 conduction.

Conclusions. The incidence of induced 2:1 AV block during AV node reentrant tachycardia is $\sim 10\%$. The lack of a response to atropine and the consistent conversion of 2:1 block to 1:1 conduction by a ventricular extrastimulus indicate that, regardless of the presence or absence of a His bundle potential in blocked beats, 2:1 block during AV node reentrant tachycardia is due to functional infranodal block.

(J Am Coll Cardiol 1996;28:1770-4)

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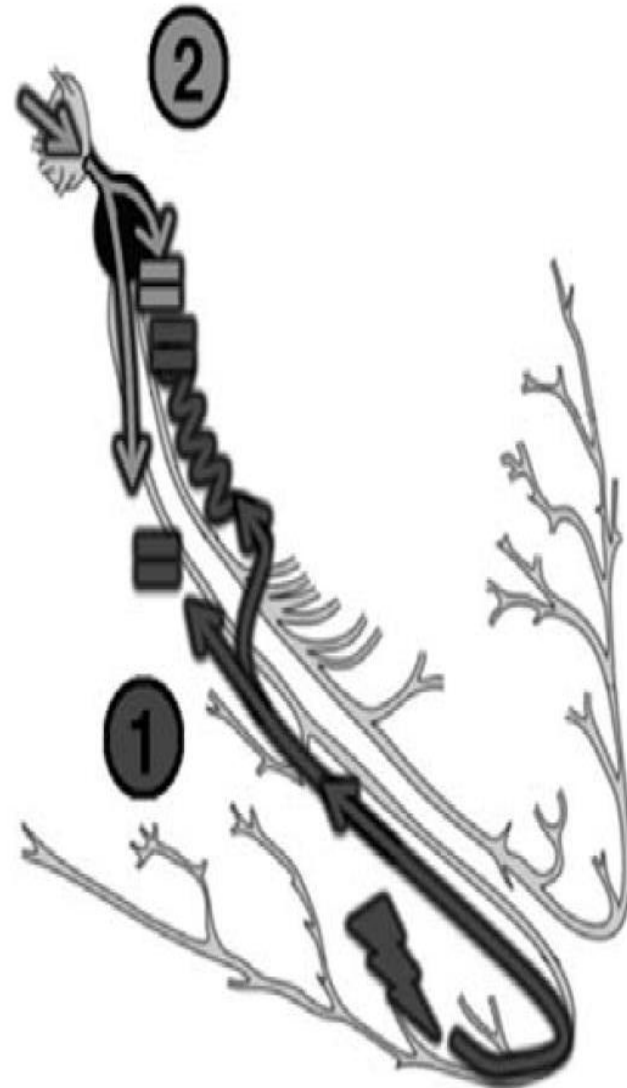
Table 1. Baseline Electrophysiologic Characteristics in Patients With 1:1 and 2:1 Atrioventricular Conduction During Atrioventricular Node Reentrant Tachycardia

	Conduction		p Value
	1:1 (n = 126)	2:1 (n = 13)	
Age (yr)	45 ± 15	42 ± 20	0.43
Male/female ratio	39:81	4:8	0.11
Sinus CL (ms)	803 ± 153	793 ± 151	0.71
AH interval (ms)	85 ± 23	77 ± 18	0.39
HV interval (ms)	46 ± 8	41 ± 4	0.09
AV block CL (ms)	362 ± 94	327 ± 65	0.16
VA block CL (ms)	352 ± 82	283 ± 53	0.004
Fast pathway ERP	335 ± 97	287 ± 57	0.11
Slow pathway ERP	276 ± 60	292 ± 52	0.97
<u>AVNRT cycle length</u>	<u>353 ± 55</u>	<u>312 ± 32</u>	<u>0.04</u>

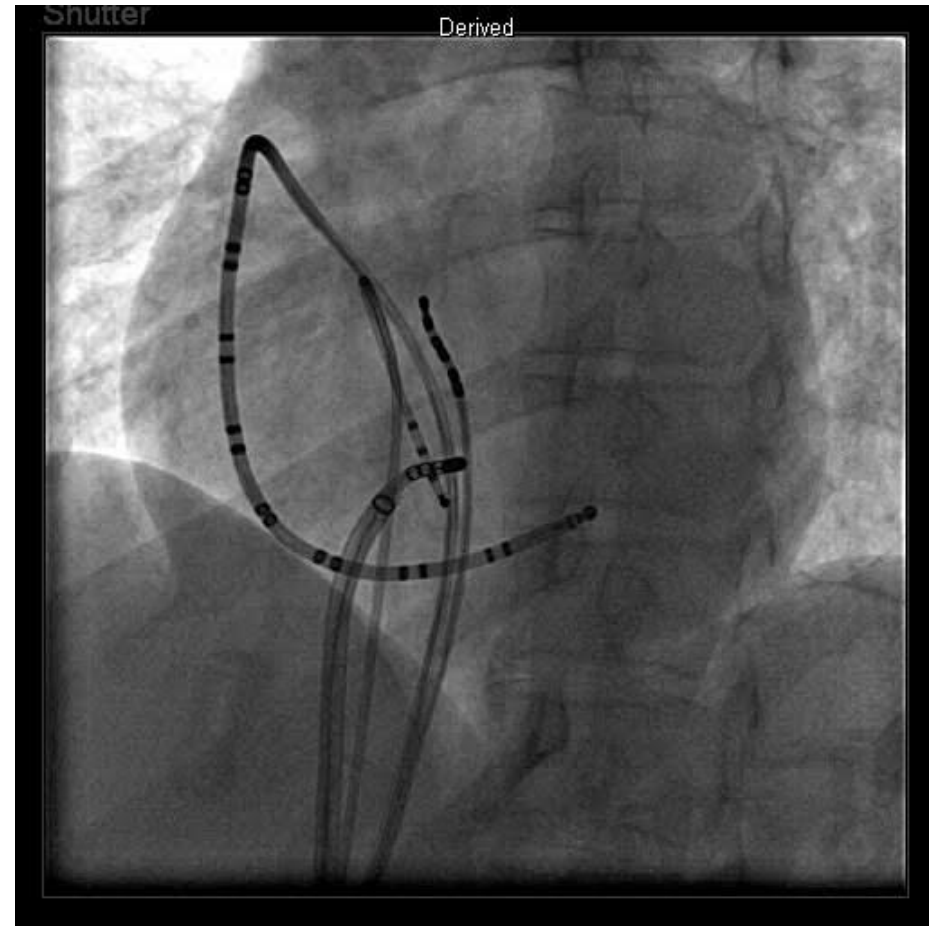
PVC induced 1:1 AV consistent conversion



PEELING BACK



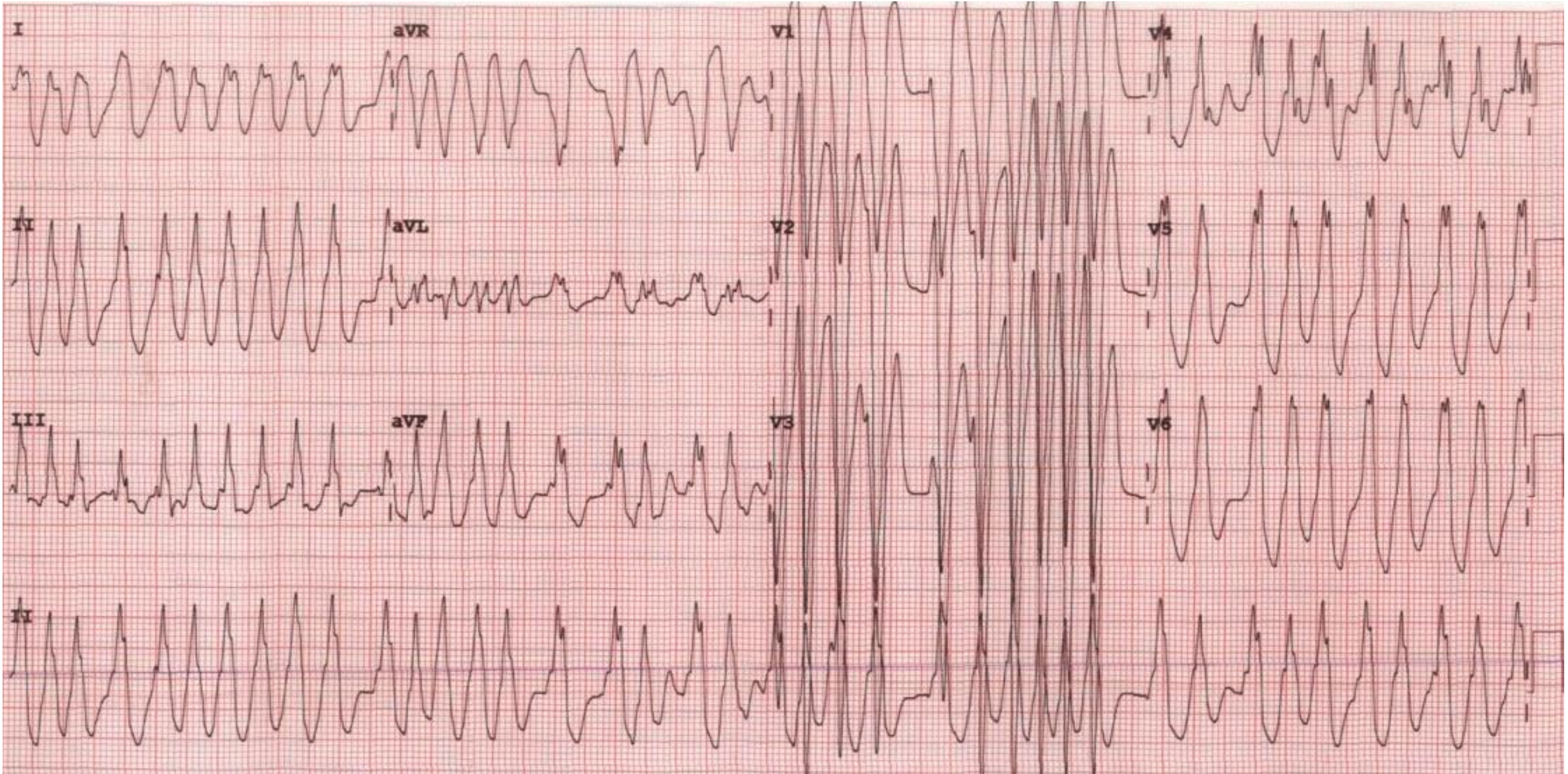
Ablation Mapping without LCP



RF induced sustained JR

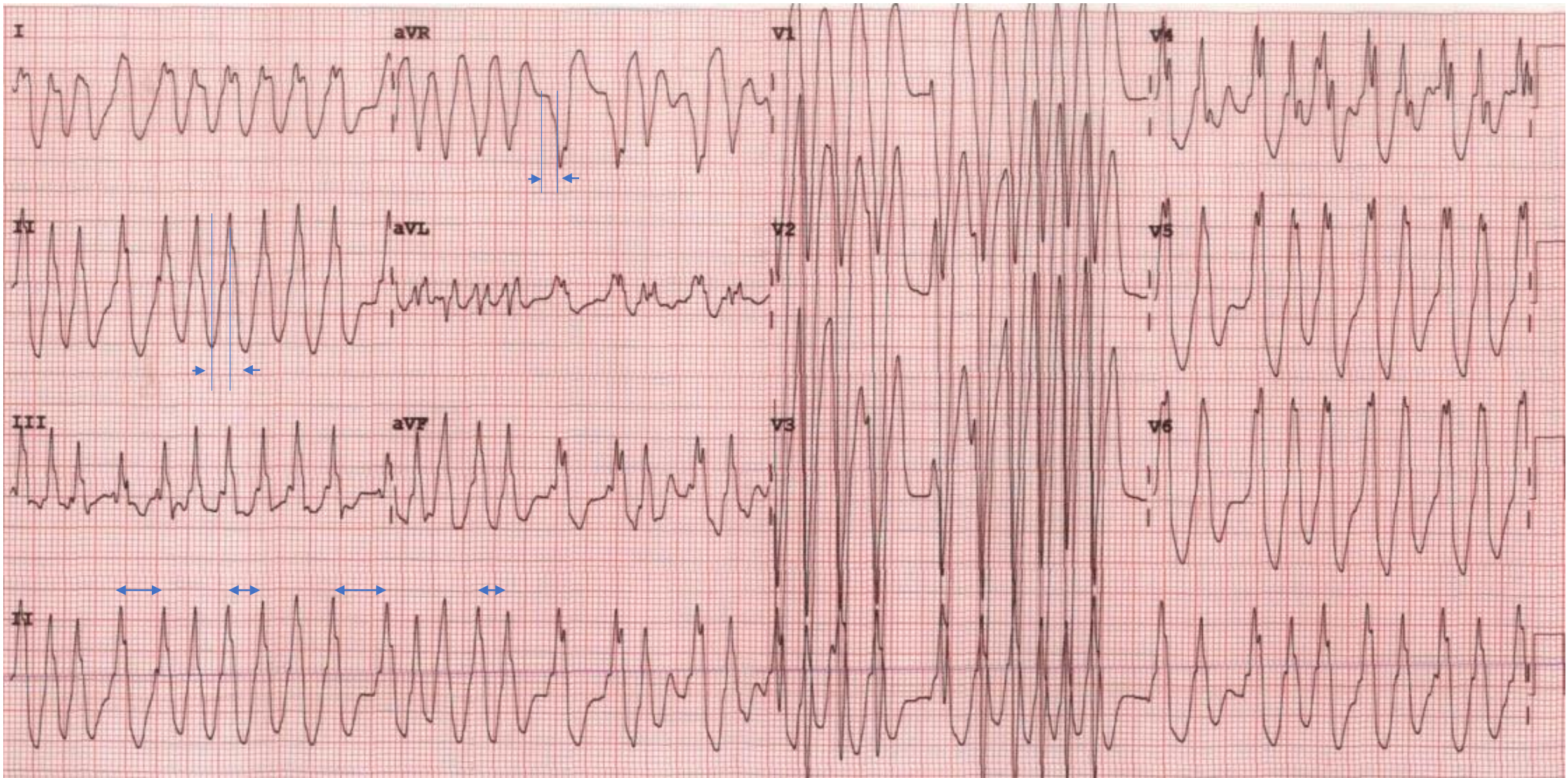


CASE 6 (M/20) 두근거림 및 어지럼증으로 ER 내원 BP 80/40



응급실 심전도에 적합한 진단은 ?

- 1. Atrial tachycardia**
- 2. Atrial fibrillation with aberrant conduction**
- 3. Ventricular tachycardia**
- 4. Atrial fibrillation with pre-excitation**



1) Irregular ventricular rhythm

2) LBBB pattern, RS Interval, slur S

3) Shorten PR interval (delta like)

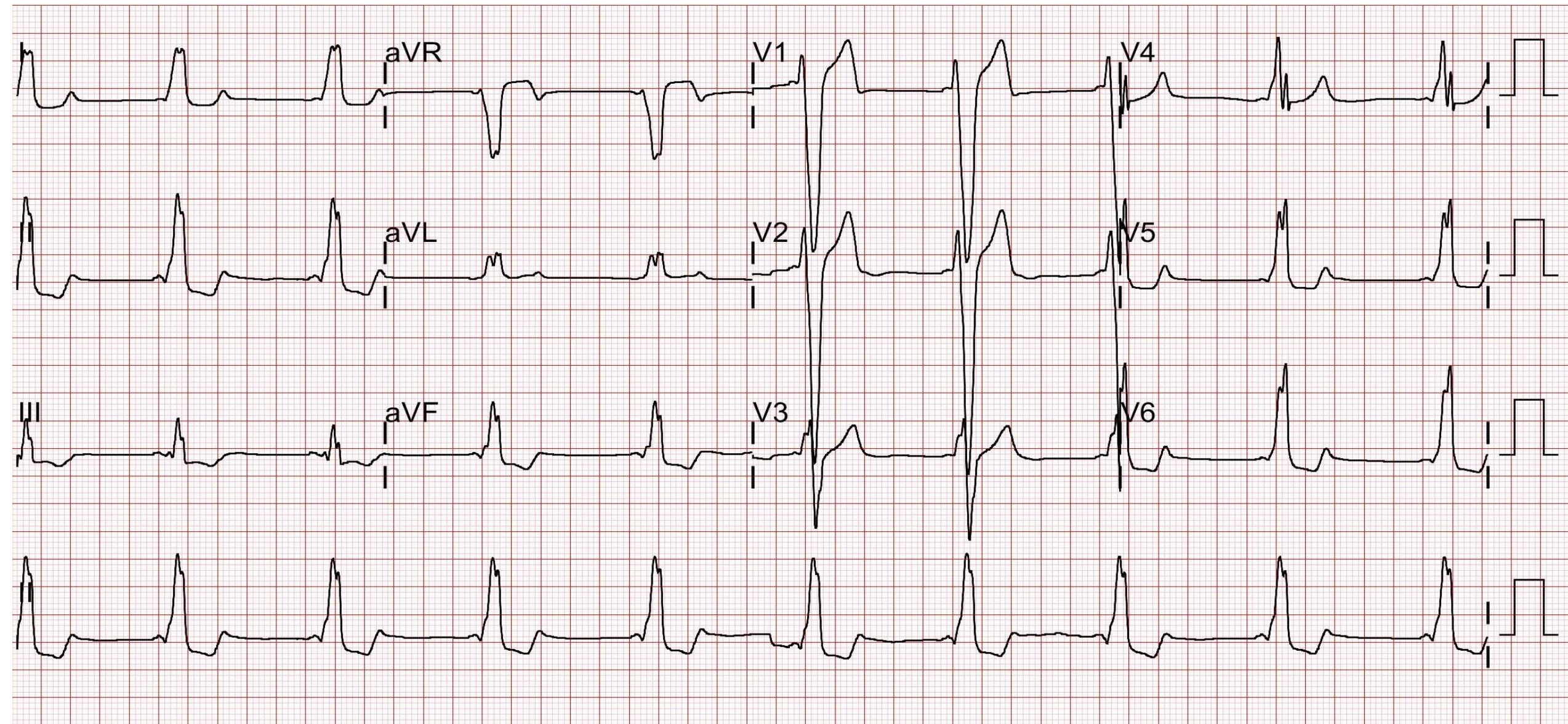
응급실 심전도에 적합한 진단은 ?

1. Atrial tachycardia
2. Atrial fibrillation with aberrant conduction
3. Ventricular tachycardia
4. Atrial fibrillation with pre-excitation

가장 먼저 해야 될 처치는 ?

- 1. Adenosine iv injection**
- 2. Diltiazem iv infusion**
- 3. DC cardioversion**
- 4. Digoxin iv injection**

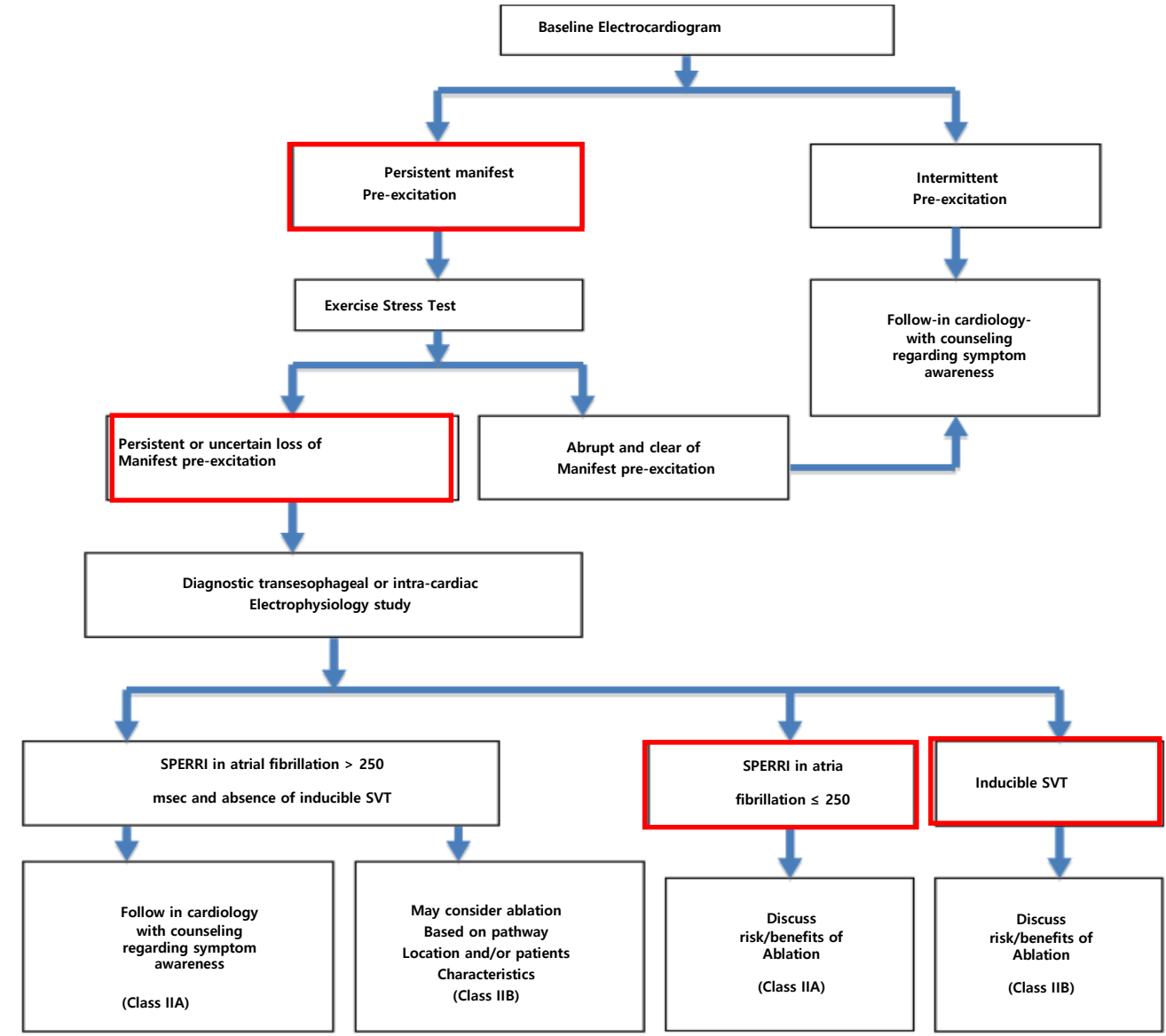
DC cardioversion 후 증상 호전 BP 120/80



향후 치료 계획은 ?

1. 경과 관찰
2. Beta blocker
3. Verapamil po
4. 전기생리학검사

2012 PACES/HRS Expert Consensus Statement on the Management of the Asymptomatic Young Patient with a WPW ECG Pattern



* patients unable to perform an exercise stress test should undergo risk-stratification with an EP study

Clinical Risk Factor

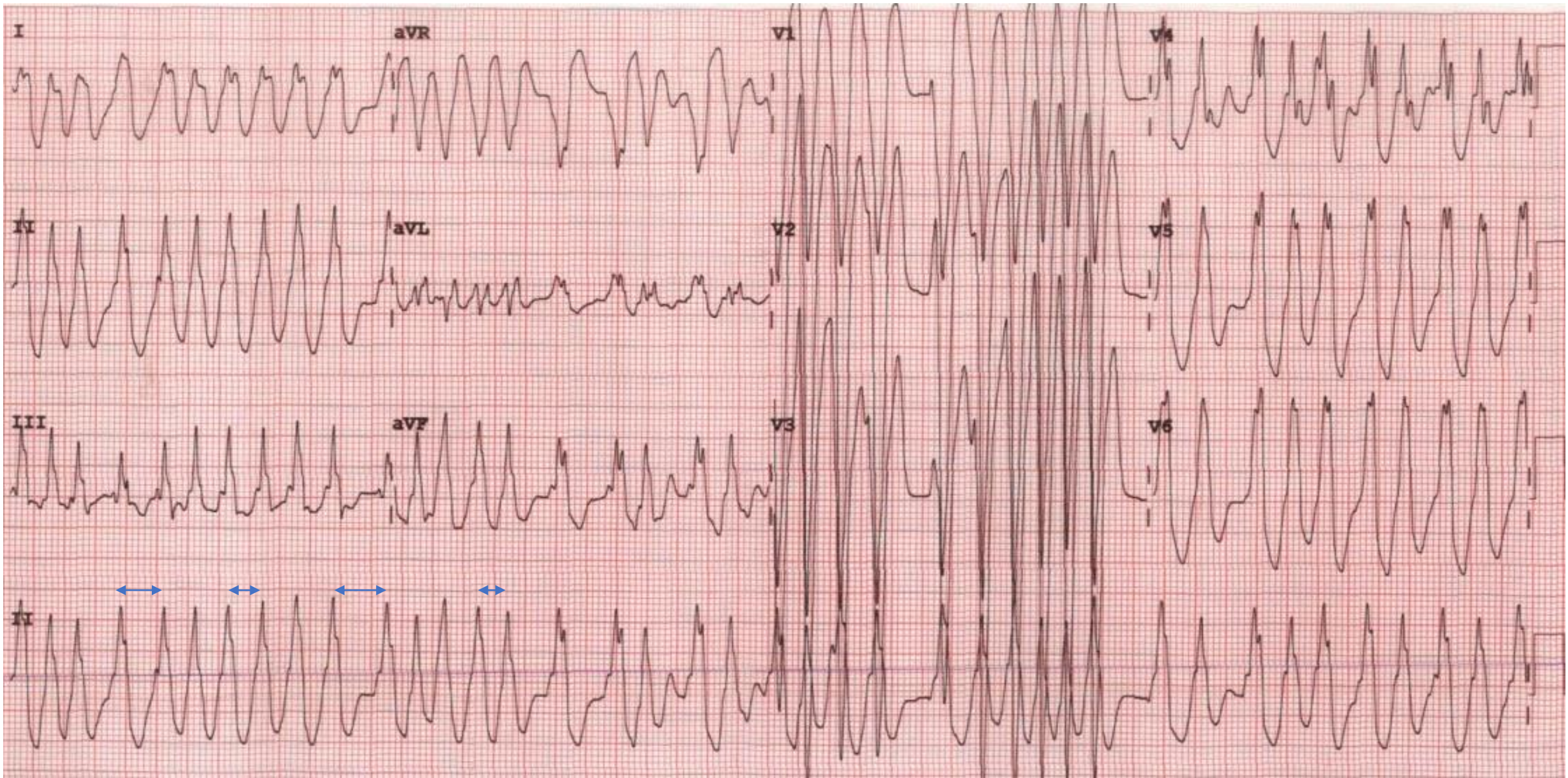
- Male^{38,51,52}
- Age <30 years⁵³
- Structural heart disease^{33,51}
- Septal localisation^{38,55}

Electrophysiological Properties of Accessory Pathways

- Anterograde accessory pathway conduction:
- Loss of pre-excitation^{57,59}
 - Anterograde effective refractory periods ≤ 250 ms^{22,51}
 - Shortest pre-excited RR interval ≤ 250 ms^{33,63}
- Inducibility
- Atrioventricular reciprocant tachycardia or atrial fibrillation lasting ≥ 1 min^{20,22}
- Multiple accessory pathways^{33,37,66,67}

Risk Factors for Sudden Cardiac Death in the WPW syndrome

Brugada et al. Arrhythmia & Electrophysiology Review 2018;7(1):32–8



Shortest Pre-excited RR Interval < 250ms, Septal Location

Radiofrequency Ablation (RFCA) for accessory pathway in the antero-septum

