



# 12. Atriyal Fibrilasyon Zirvesi 2023

8-9 Aralık 2023  
Nirvana Cosmopolitan Kongre Merkezi, Antalya



## AF Ablasyonu Sonrası Sol Atrial Taşikardiler

Dr. Selçuk Kanat

# İnsidans

- AF ablasyonu sonrası AT insidansı %5'ten %40'a kadar değişmektedir
- ABD'de yürütülen bir kohort çalışması, PVI sonrası AT'lerin tek AT veya birden fazla AT olabileceğini ve yaklaşık %90'ının reentran olduğunu ve önceki ablasyon hattındaki boşluklarla ilişkili olduğunu gösterdi.
- Chugh ve ark. PVI sonrası AT'lerin yaklaşık %60'ında mitral istmusa lokalize olan kritik isthmus bulunduğunu bildirmiştir.
- AF ablasyonundan sonra ortaya çıkan AT sıklıkla semptomatiktir, karmaşıktır ve antiaritmik ajanlar tarafından yeterince kontrol edilememektedir.

# Incidence, characteristics, and outcome of left atrial tachycardias after circumferential antral ablation of atrial fibrillation

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**BACKGROUND** Antral pulmonary vein isolation (PVI) for treatment of atrial fibrillation may induce left atrial tachycardias (ATs).

**OBJECTIVE** To determine the prevalence, time course of occurrence, mechanisms, and correlation with the electrocardiogram as well as the outcome of ablation of these tachycardias.

**METHODS AND RESULTS** Out of the 839 patients who underwent circumferential antral radiofrequency PVI guided by a circumferential pulmonary vein catheter at our institution between February 2005 and April 2011, 35 patients (4%) developed AT during follow-up. Six patients with left AT and a previous PVI at other institutions were also included. Of these 41 patients (26 men, 63%; age  $59 \pm 10$  years), 26 (63%) had underlying paroxysmal atrial fibrillation and 15 (37%) had persistent atrial fibrillation. AT ablation was performed  $47 \pm 60$  weeks after initial PVI, within the first 3 months in 16 patients (39%). The tachycardia mechanism was focal in 15 patients (37%), macroreentry in 25 patients (61%), and undetermined in 1 (2%). Focal tachycardias had an isoelectric line between distinct P waves in 13 of the 15 patients (87%), while only 4 (16%) with a macroreentrant mechanism had an isoelectric line ( $P < .001$ ). Although difficult to measure, a P-wave width of  $>140$  ms had the highest sensitivity and specificity to identify macroreentrant mechanism. Ablation was acutely successful in 32 patients (78%) and not successful in 4 (10%). In 5 patients, success could not be determined as the tachycardia

terminated or degenerated during mapping. During a mean follow-up of  $31 \pm 17$  months, 11 patients (27%;  $n = 9$  [82%] with macroreentry) underwent repeat ablation procedure for AT. Eight patients had true recurrence, for example, the same AT, and 3 patients had a second mechanism of AT.

**CONCLUSIONS** With the use of an identical ablation protocol, it was found that approximately 4% of the patients developed AT after mere circumferential antral PVI. The majority of ATs developed within a few months after ablation but occurred as late as several years after the initial PVI. Macroreentry was more frequent than a focal mechanism. Broad P waves and isoelectric lines between P waves help to distinguish a focal mechanism from a macroreentrant mechanism. Ablation has a high acute success rate, and AT recurrence occurs predominantly in macroreentrant AT.

**KEYWORDS** Left atrial tachycardia; Post-PVI; Ablation; Outcome

**ABBREVIATIONS** AF = atrial fibrillation; AT = atrial tachycardia; CL = cycle length; ECG = electrocardiogram; LA = left atrial; MA = mitral annulus; PV = pulmonary vein; PVI = PV isolation; RF = radiofrequency

(Heart Rhythm 2012;9:1660–1666) © 2012 Heart Rhythm Society. All rights reserved.

**Table 2** Atrial tachycardias

	Overall (n = 41)	Focal (n = 15)	Macroreentry (n = 25)	<i>P</i>
Interval after PVI (wk)	37 ± 52	46 ± 59	32 ± 49	.39
CL (ms)	275 ± 51	269 ± 56	276 ± 50	.64
LA volume (mL)	69 ± 23	68 ± 23	69 ± 25	.72
Paroxysmal vs persistent	15 vs 26	10 vs 5	15 vs 10	.68
P-wave width (ms)	175 ± 78	110 ± 38	203 ± 59	<.001
Isoelectric line between P waves	17/40 (37%)	13/15 (87%)	4/25 (16%)	<.001
Recurrence	11/41 (27%)	2/15 (13%)	9/25 (36%)	0.1
Antiarrhythmic medicines (class I/III)	I: 21 (51%) III: 11 (27%)	Same: 0 I: 9 (60%) III: 4 (27%)	Same: 8 I: 12 (48%) III: 7 (28%)	NS

CL = cycle length; LA = left atrial; NS = not significant; PVI = pulmonary vein isolation.

# Left atrial tachycardia after circumferential pulmonary vein ablation for atrial fibrillation: incidence, electrophysiological characteristics, and results of radiofrequency ablation

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Received 24 December 2005; accepted after revision 5 May 2006

## KEYWORDS

Circumferential pulmonary vein ablation;  
Atrial fibrillation;  
Left atrial tachycardia;  
Proarrhythmia;  
Re-entry;  
Small-loop

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**Aims** To investigate the incidence, electrophysiological properties, and ablation results for left atrial (LA) tachycardia as a sequel to the circumferential pulmonary vein ablation (CPVA) for atrial fibrillation (AF).

**Methods and results** Sixty-seven patients with AF underwent CPVA. Sustained LA tachycardia developed in 21/67 (31%) patients and in 16/21 symptomatic patients 55 LA tachycardias ( $3.4 \pm 2.4$  per patient) were mapped: 18 (33%) tachycardias were related to macro-re-entry around the mitral valve (7) or pulmonary vein(s) (11). In 20 tachycardias (36%), a 'small-loop' LA re-entrant tachycardia (LART) was identified; gaps in prior ablation lines (7 LART) or an area of extremely slow conduction adjacent to the CPVA lesions (13 LART) were crucial for these re-entries. Seventeen tachycardias (31%) were too unstable for complete mapping. Ablation was a primary success in 34 of 38 (89%) mapped LART, but in eight of 21 procedures, cardioversion was necessary to achieve sinus rhythm.

**Conclusion** LART develops in a high percentage of patients after CPVA. Small-loop re-entry, which is difficult to map, may arise and patients suffer from several and/or unstable variants of LART. Thus, mapping and ablation of these LART is challenging and the overall success is yet not satisfactory.

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# Circumferential Pulmonary Vein Ablation With Additional Linear Ablation Results in an Increased Incidence of Left Atrial Flutter Compared With Segmental Pulmonary Vein Isolation as an Initial Approach to Ablation of Paroxysmal Atrial Fibrillation

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**Background**—There has been growing concern that linear ablation is associated with an increased risk of iatrogenic arrhythmias in patients undergoing ablation for atrial fibrillation (AF). Therefore, we compared circumferential pulmonary vein ablation plus left atrial linear ablation (CPVA+LALA) with segmental pulmonary vein isolation (PVI) in patients with paroxysmal AF.

**Methods and Results**—Sixty-six consecutive patients with paroxysmal AF were prospectively randomly assigned to receive PVI versus CPVA+LALA (consisting of encircling lesions around the pulmonary veins), a roof line, and a mitral isthmus line with documentation of bidirectional mitral isthmus block. All patients were seen at 1, 3, 6, and every 12 months after ablation, with 14-day continuous ECG monitoring every 6 months. At  $16.4 \pm 6.3$  months after 1 ablation procedure, 19 patients (58%) remained free of atrial arrhythmias after PVI versus 17 patients (51%) after CPVA+LALA ( $P=0.62$ ). After PVI, 14 patients had recurrent paroxysmal AF, whereas after CPVA+LALA, 8 patients had recurrent AF, 6 had atypical left atrial flutter (LAFL), and 2 had both AF and LAFL ( $P=0.32$  between PVI versus CPVA+LALA for AF but  $P=0.002$  for LAFL). Twenty-eight patients (85%) remained arrhythmia-free after  $1.3 \pm 0.5$  PVI procedures versus 28 patients (85%) after  $1.4 \pm 0.6$  CPVA+LALA procedures ( $P=NS$ ). Fluoroscopy time was longer after CPVA+LALA versus PVI (91 versus 73 minutes,  $P=0.04$ ).

**Conclusions**—As an initial ablation approach in patients with paroxysmal AF, more LAFL occurred after CPVA+LALA and fluoroscopy times were longer compared with segmental PVI. (*Circ Arrhythm Electrophysiol.* 2010;3:243-248.)

**Key Words:** atrial fibrillation ■ pulmonary vein isolation ■ circumferential pulmonary vein ablation  
■ linear ablation ■ left atrial flutter

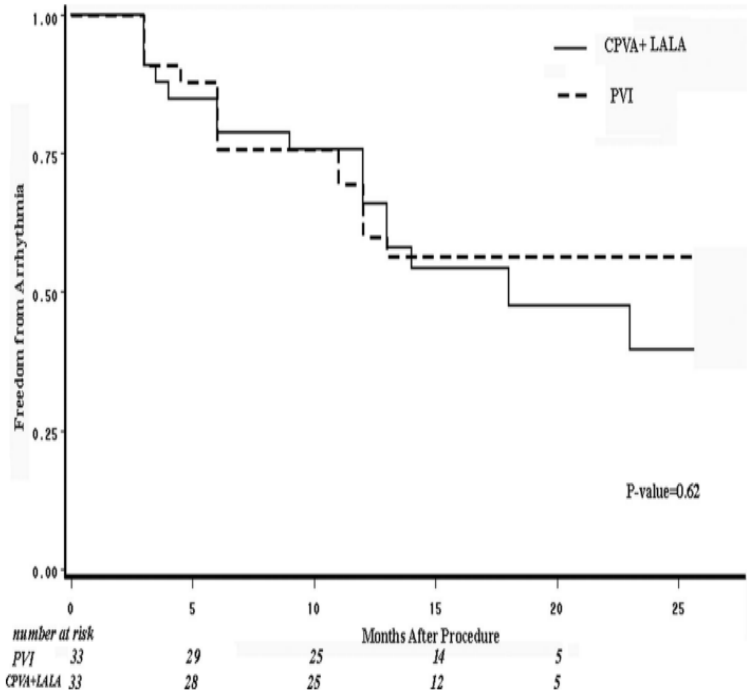


Figure 3. Kaplan–Meier curve showing the probability of recurrence of any atrial arrhythmia after 1 ablation procedure between the 2 groups.

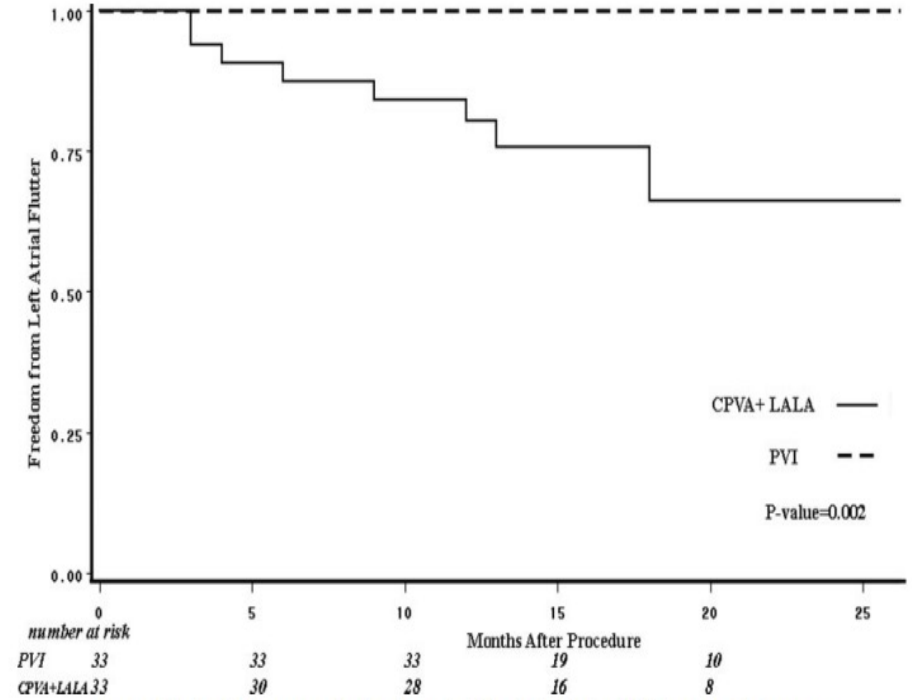


Figure 4. Kaplan–Meier curve showing the probability of developing LAFL between the 2 groups.

(Circ Arrhythm Electrophysiol. 2010;3:243-248.)



Original article

## Mechanism, underlying substrate and predictors of atrial tachycardia following atrial fibrillation ablation using the second-generation cryoballoon

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### ARTICLE INFO

*Article history:*

Received 9 November 2018

Accepted 18 November 2018

Available online xxx

*Keywords:*

Second generation cryoballoon

Pulmonary vein isolation

Atrial fibrillation

Atrial tachycardia

Catheter ablation

### ABSTRACT

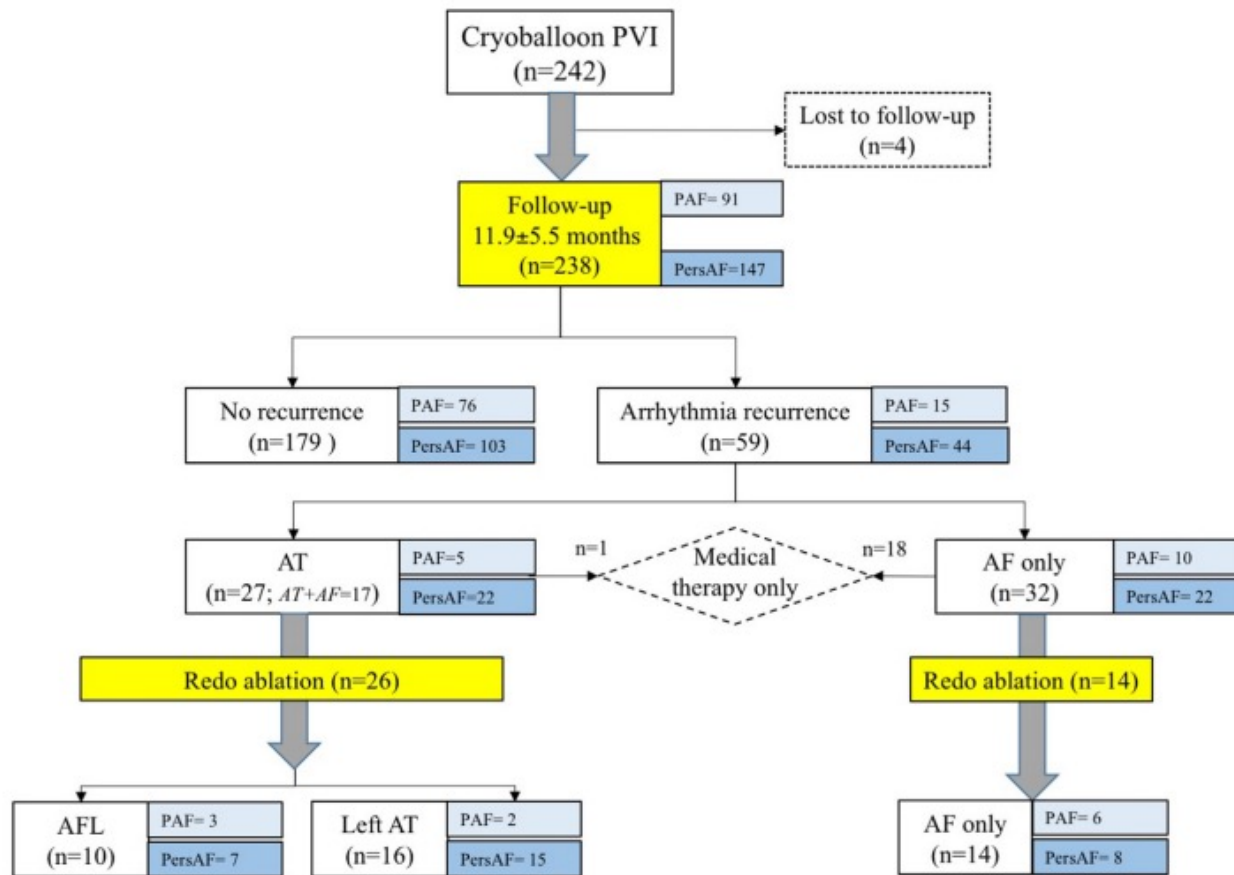
**Background:** Data regarding atrial tachycardia (AT) following second-generation cryoballoon ablation (CBA) of atrial fibrillation (AF) are limited.

**Aim:** To describe the incidence, mechanisms, and clinical predictors of ATs following CBA.

**Methods and results:** In this retrospective single-center study 238 patients undergoing CBA for treatment of paroxysmal (91/238; 38.2%) or persistent AF were analyzed. During a mean follow-up of  $11.9 \pm 5.5$  months recurrence of AF occurred in 49/238 patients (20.6%) and AT in 27/238 (11.3%). Twenty-six patients with AT and 14 with AF only underwent a redo ablation. The prevailing mechanism of AT was macroreentry [typical atrial flutter (AFL) (n = 10), left atrial macroreentry (n = 14), focal left-AT (n = 2)]. Non-cavotricuspid-isthmus-dependent macroreentry right-AT was mapped and ablated in 3 patients after initial AFL ablation. In a multivariate regression model, persistent type of AF (HR = 3.3; CI = 1.2–9.4), cardiomyopathy (HR = 3.5; CI = 1.5–8.4), treatment with beta-blockers (HR = 0.3; CI = 0.1–0.6), and pulmonary vein-abnormality (HR = 4.6; CI = 2.1–10.4) were independent predictors of AT. Substrate analysis revealed a significantly higher number of low voltage areas in the left atrium in patients with left-AT in comparison to patients with AF recurrence only (2.0; IQR = 2.0–4.0 vs. 0.5; IQR = 0.0–2.25;  $p = 0.005$ ).

**Conclusion:** In this study, AT after CBA occurred in 11.3% of patients with macroreentry being the prevalent mechanism. All patients with left-AT presented with low voltage areas in the left atrium, suggesting a more progressive underlying fibrotic disease in these patients.





**Fig. 1.** Study flowchart with numbers of patients.

AT, atrial tachycardia; AF, atrial fibrillation; AFL, typical atrial flutter; PAF, paroxysmal atrial fibrillation; PersAF, persistent atrial fibrillation; PVI, pulmonary vein isolation.

# The importance of extrapulmonary vein triggers and atypical atrial flutter in atrial fibrillation recurrence after cryoablation: Insights from repeat ablation procedures

## Abstract

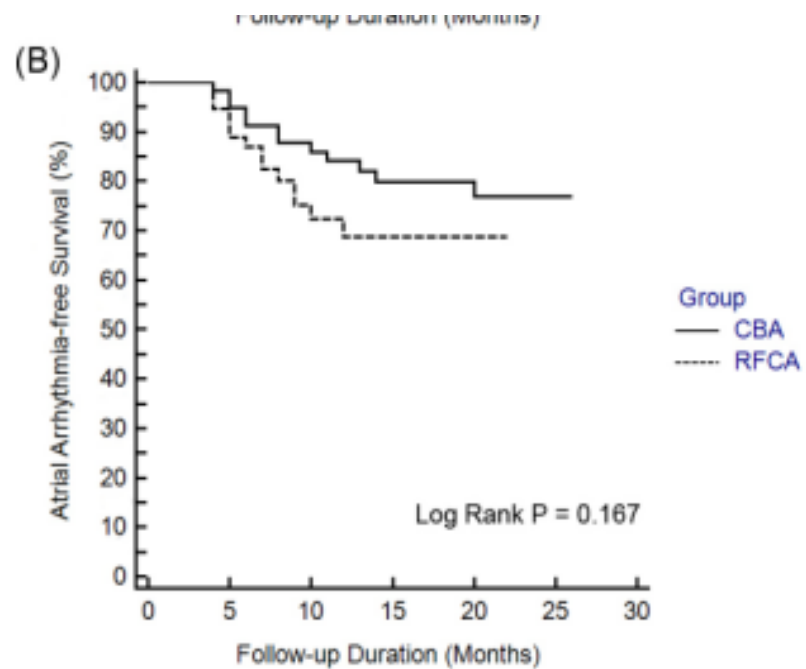
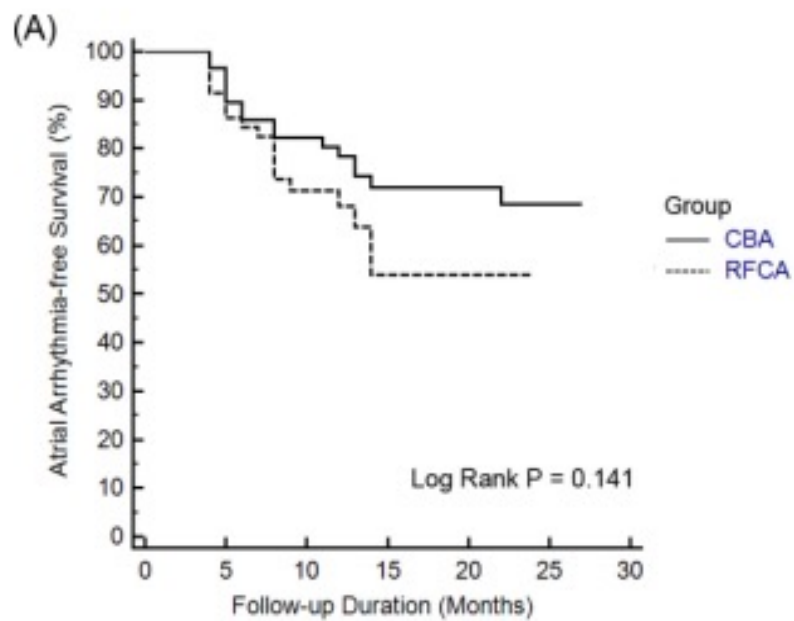
**Introduction:** It has not been previously investigated whether the recurrence mechanism after cryoballoon ablation (CBA) of paroxysmal atrial fibrillation (AF) is similar to that of radiofrequency catheter ablation (RFCA). We aimed to evaluate the differences of recurrence characteristics between RFCA and CBA after the index procedure.

**Methods:** A total of 210 patients were enrolled in the study, and 69 patients underwent pulmonary vein (PV) isolation using a 28-mm second-generation CBA. The control group comprising 140 patients underwent PV isolation using an open-irrigated radiofrequency ablation catheter. A total of 69 patients in the CBA group and 69 patients in the RFCA group were investigated after propensity score matching. Recurrence patterns of AF were studied in the repeated procedure.

**Results:** During the index procedure, there was no difference in PV or non-PV triggers between the two groups. Nineteen (27.5%) patients in the CBA group and 19 (27.5%) patients in the RFCA group had recurrence after a follow-up of  $11.3 \pm 7$  months. The Kaplan-Meier curve did not reveal significant difference in recurrence (log-rank,  $P = 0.364$ ) between the two groups. In the second procedure, the CBA group had more non-PV triggers (63.6%,  $P = 0.009$ ) and left atrial (LA) flutters (54.5%,  $P = 0.027$ ) compared with the RFCA group (12.5% and 12.5%, respectively). The PV reconnection rates were similar between both groups.

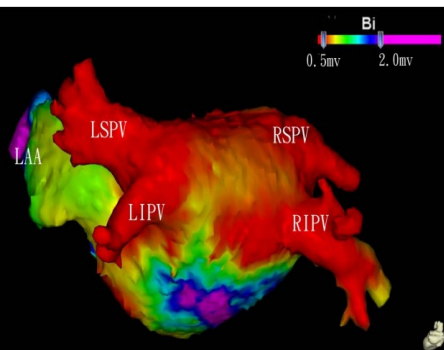
**Conclusions:** There was no difference in AF recurrence after catheter ablation between CBA and RFCA, but significant increases of non-PV triggers and LA flutter during the second procedure suggest the importance of the atrial substrate in maintaining AF during the second procedure after previous CBA.

**Keywords:** atrial fibrillation; atypical flutter; cryoballoon; extrapulmonary vein.



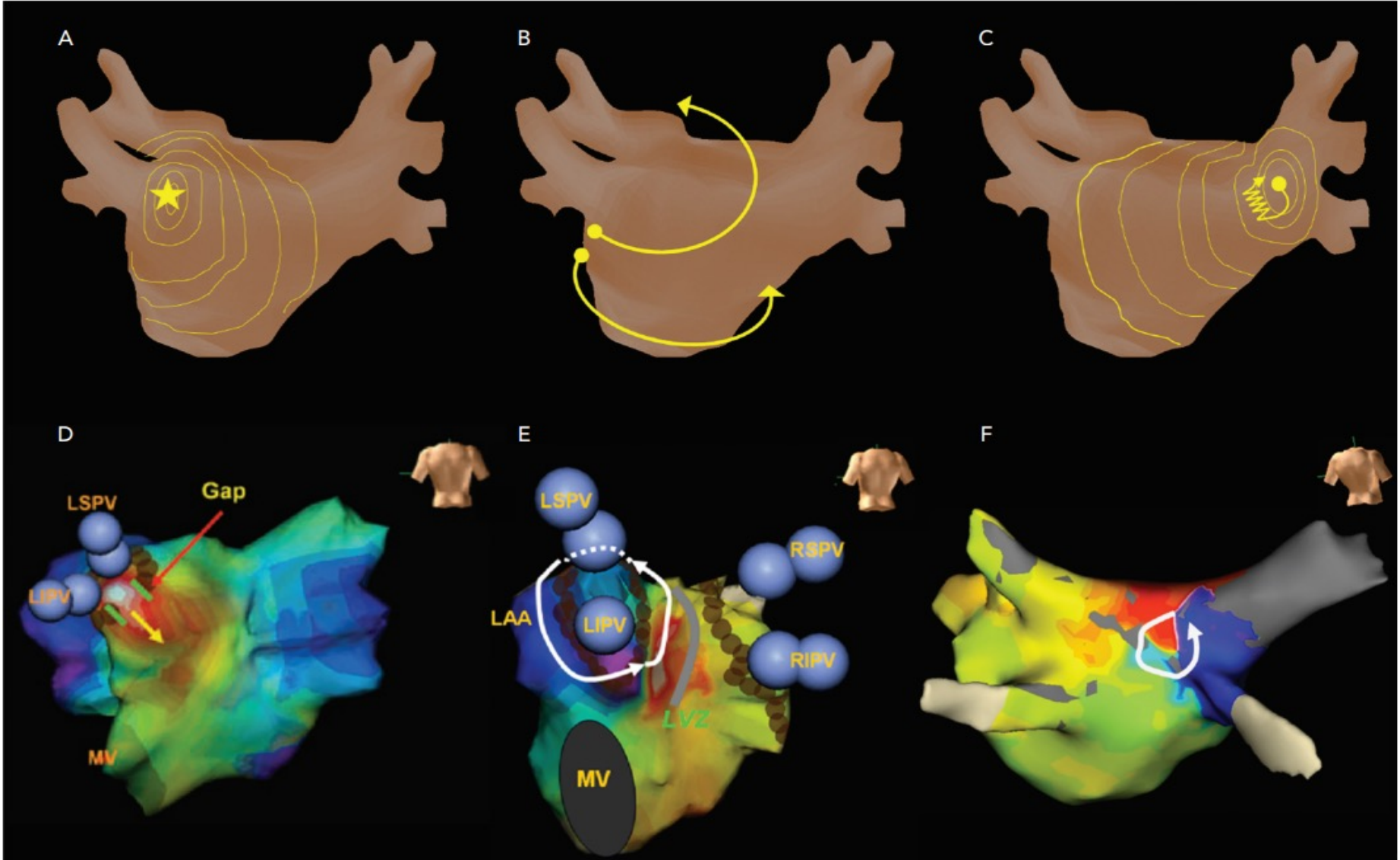
**Table 3. Characteristics of LA substrate and recurrent patterns of atrial arrhythmia in patients receiving repeat ablation procedure**

	CBA group (n=11)	RFCA group (n=16)	P value
LA scar area (2 <sup>nd</sup> procedure, cm <sup>2</sup> )	19.4 ± 9	7.3 ± 7	0.01
PV reconnection (2 <sup>nd</sup> procedure, n,%)	9 (81.8%)	15 (93.8%)	N.S.
LA Flutter (n,%)	6 (54.5%)	2 (12.5%)	0.027
Distributions of LA Flutter			N.S.
Roof Flutter (n,%)	3 (27.3%)	0 (0%)	
Peri-mitral Flutter (n,%)	5 (45.5%)	2 (12.5%)	
Septal Flutter (n,%)	1 (9%)	0 (0%)	





# AF Ablasyonu Sonrası Sol Atrial Taşikardilerin Mekanizması

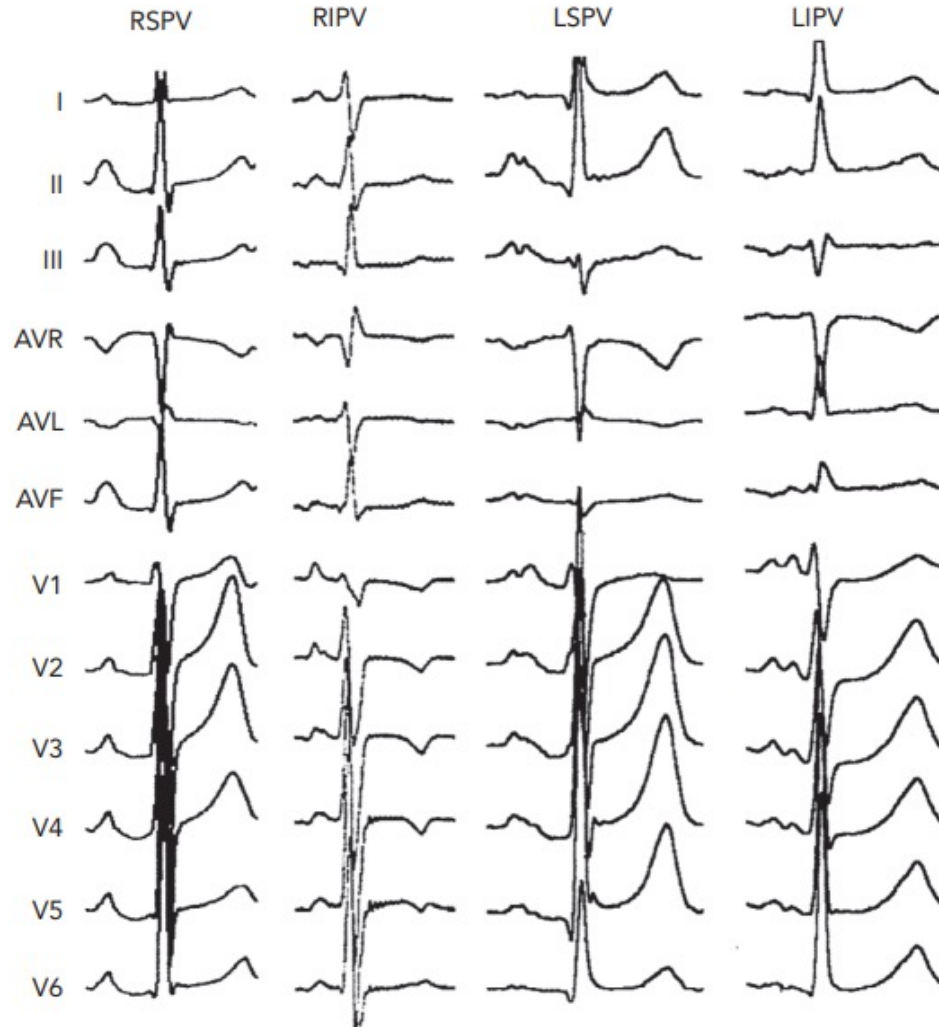


# Atrial Taşikardinin Elektrofizyolojik Özellikleri

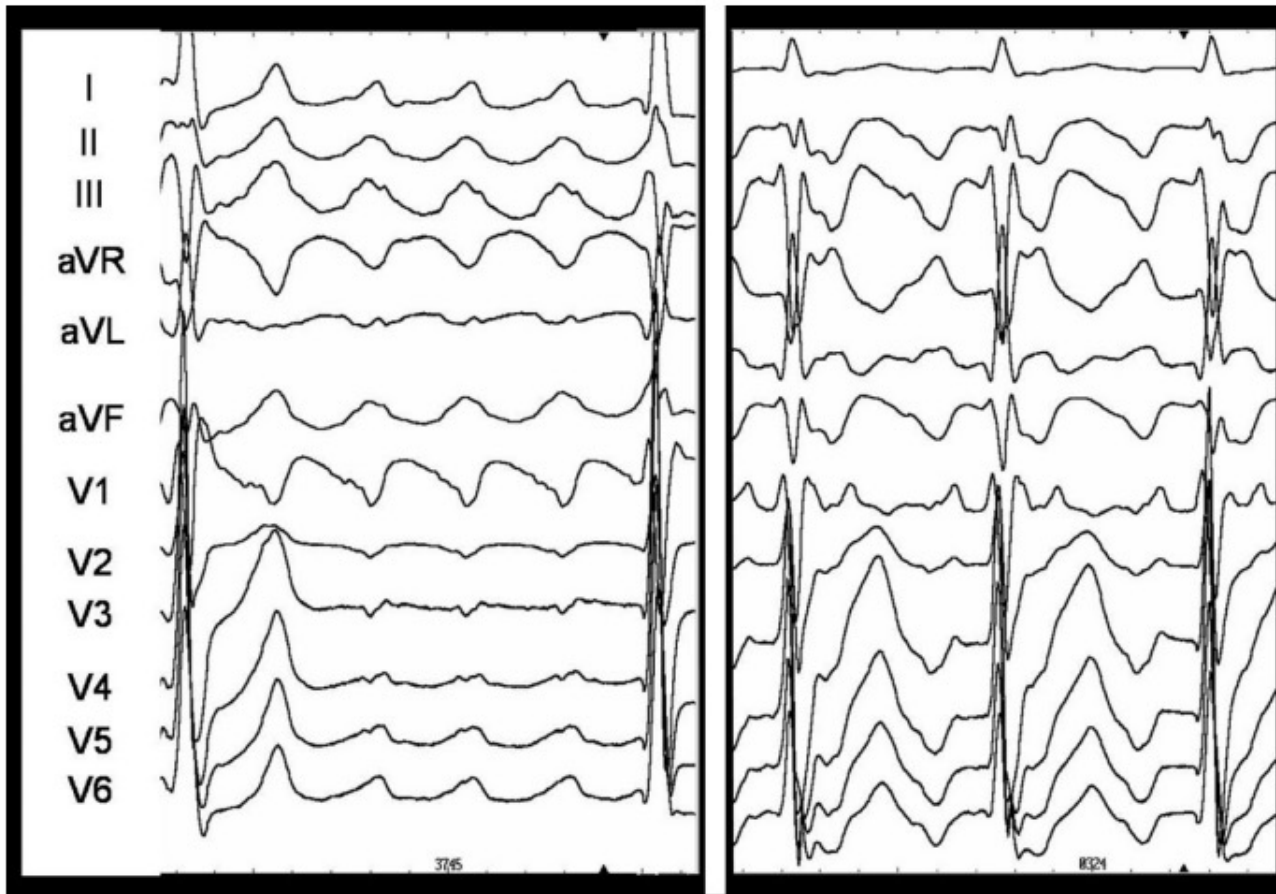
Classification	Focal AT		Macroreentrant AT	
	Abnormal automaticity		Microreentrant AT	
Mechanism	Triggered activity	Enhanced automaticity	Localised reentry	Macroreentry
Induced and terminated by PES	+	-	+	+
Catecholamine facilitation	+	+	±	±
Response to adenosine	Termination	Transient suppression	Insensitive	Insensitive
Ablation target	Earliest activation site	Earliest activation site	Conduction isthmus (often fractionated EGM)	Conduction isthmus

*AT = atrial tachycardia; EGM = electrogram; PES = programmed electrical stimulation.*

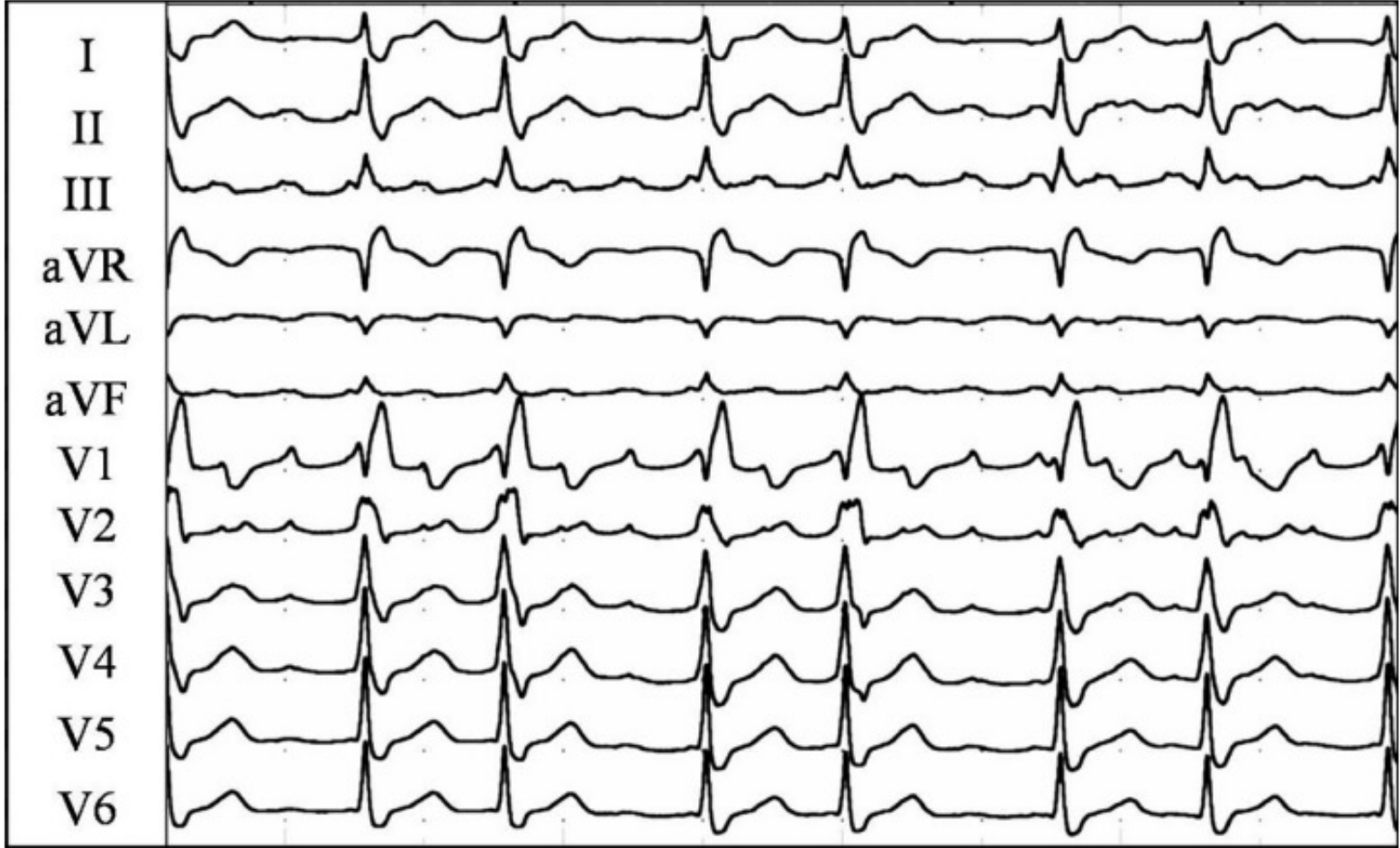
# Fokal Atrial Taşikardi



# Tipik Atrial Flutter







# Haritalama ve Ablasyon

- **Preprosedural Hazırlık**

Hasta ile detaylı görüşme (semptom, beklenti)-  
PPM,AAİ,potansiyel işlem başarısızlığı

EKG/EKO değerlendirmesi

İşlem öncesi ;mitral kapak cerrahisi ,insizyon  
,skar, ablasyon sırasında yapılan işlem( PVI-roof line,  
CTI), Sinüs p dalgası

- **Intraprosedural Hazırlık**

Koroner sinüs multipolar katater ( stabil referans, MA blok, aktivasyon sekansı)

Transseptal geçiş (LA basınç)

Pulmoner venlerin değerlendirilmesi (izolasyon?)

Tüm atriumun voltaj haritalaması ( skar ve fraksiyone alanların işaretlenmesi, voltaj değerlerini değiştirerek skar içi istmust değerlendirmesi, aktivasyon haritalama)

WACA

Aktivasyon haritalama

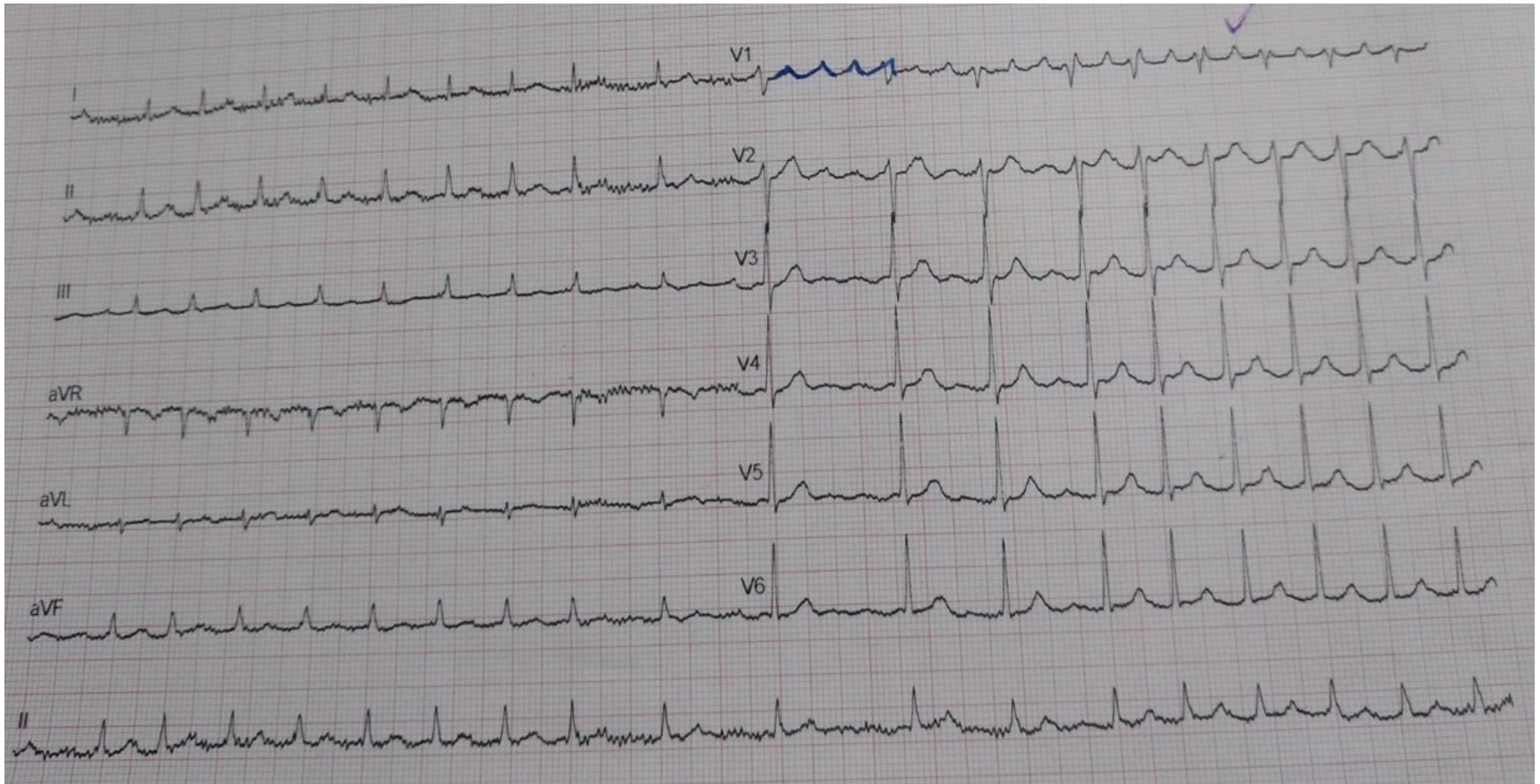
ENTRAINMENT (Roof, LAA, CTI, MA)

Terminasyon / CL ve aktivasyon patern değişikliği

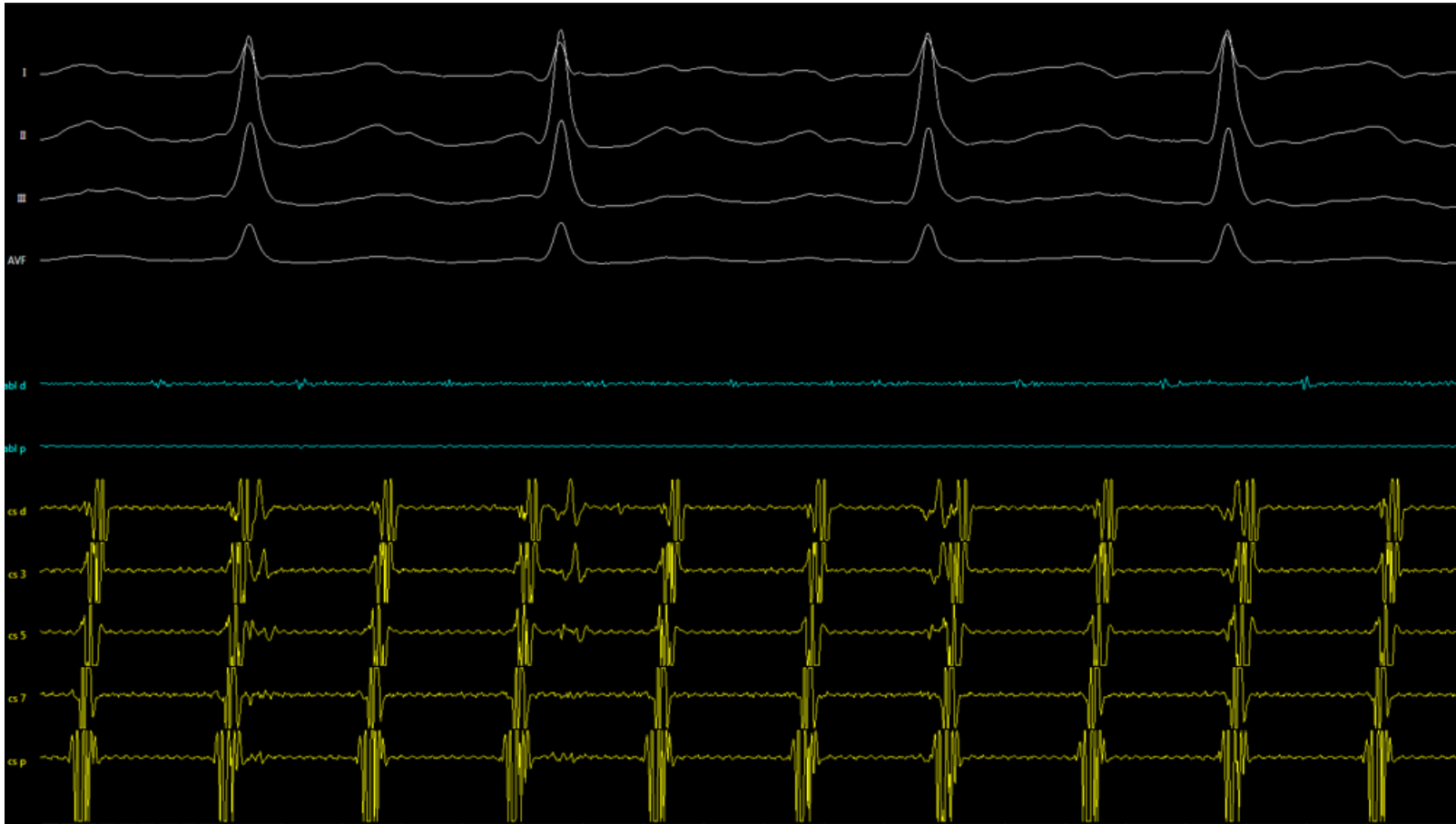
CTI yapılmalı

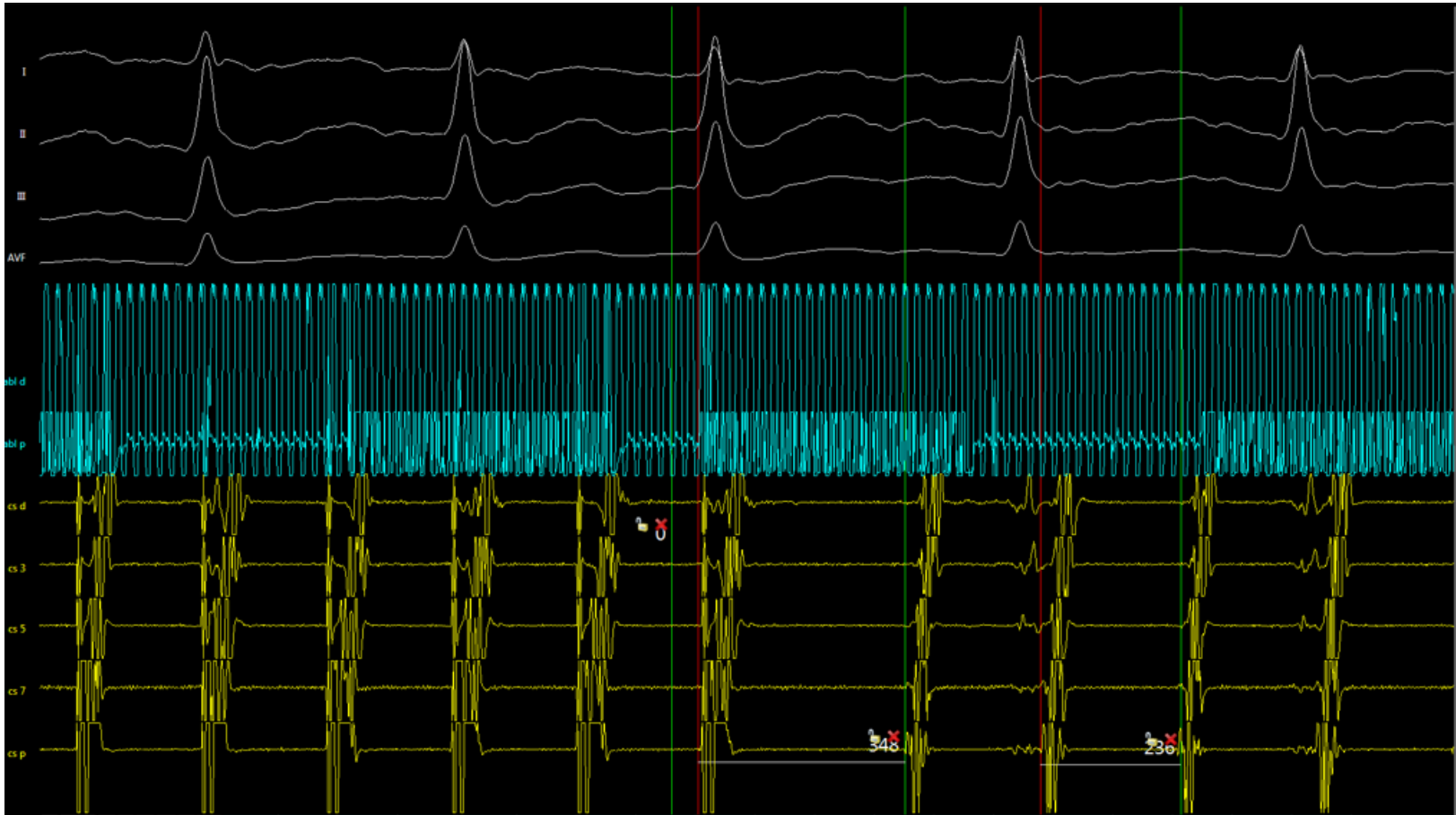
Ablasyon sonrası agresif EPS

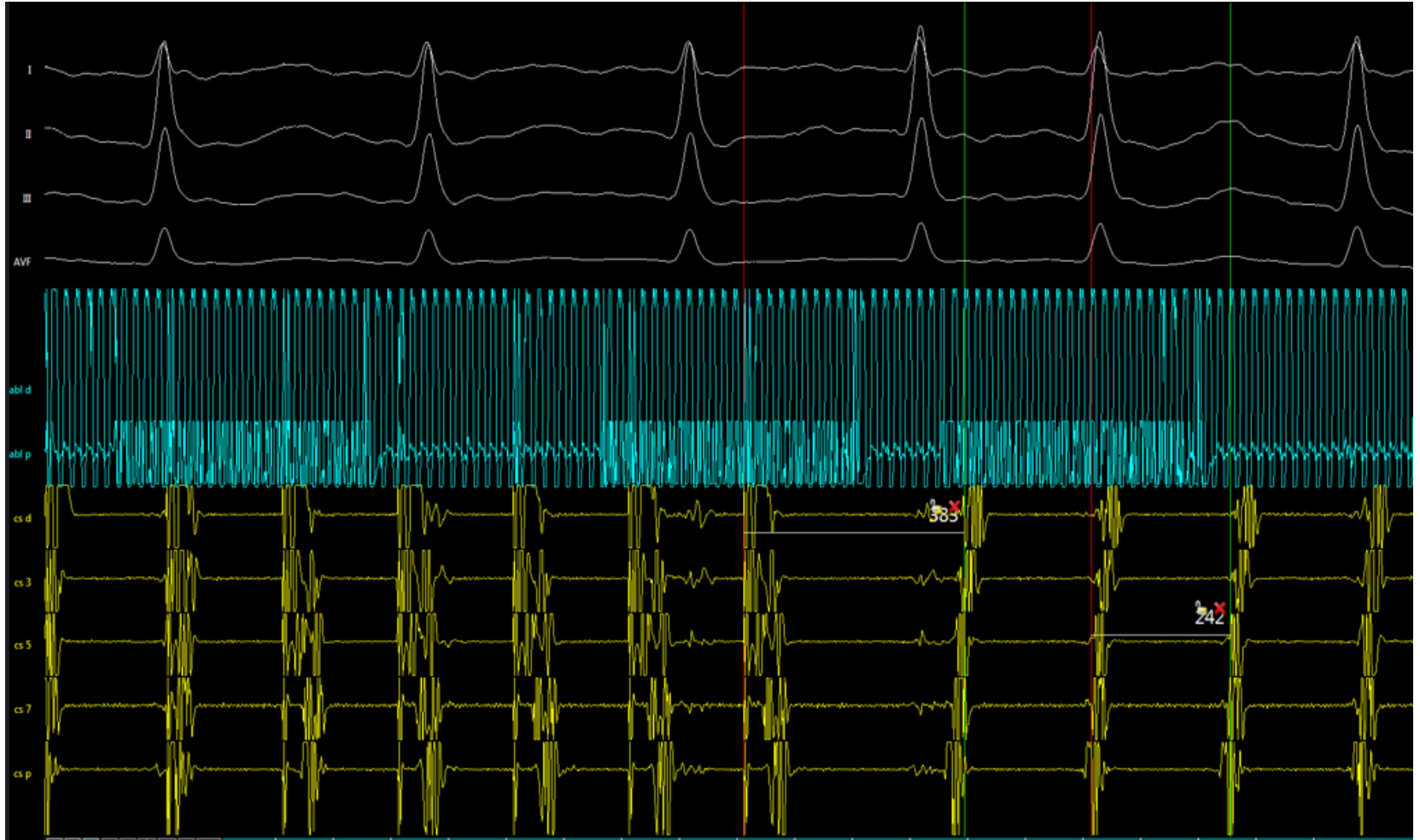
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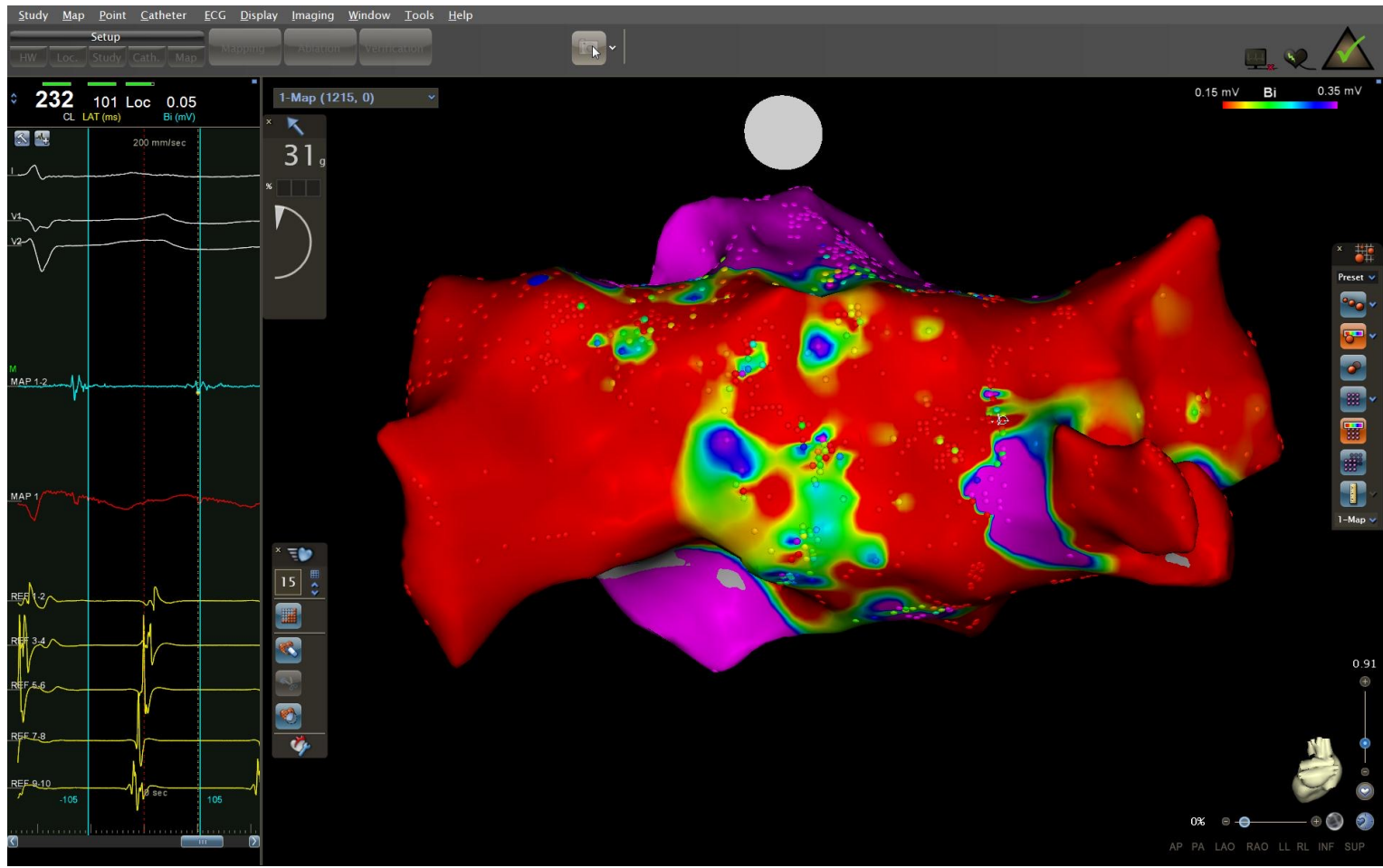






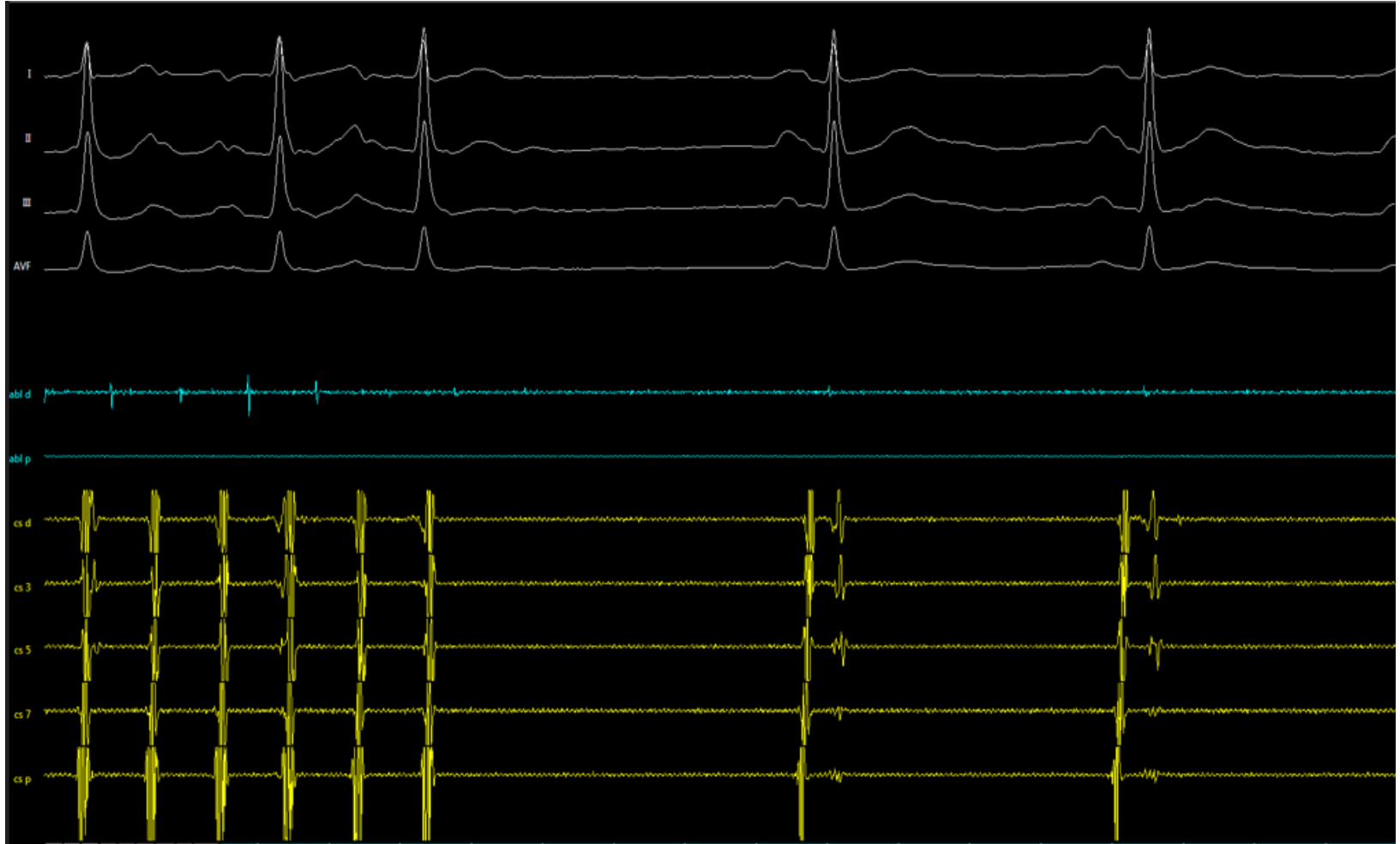


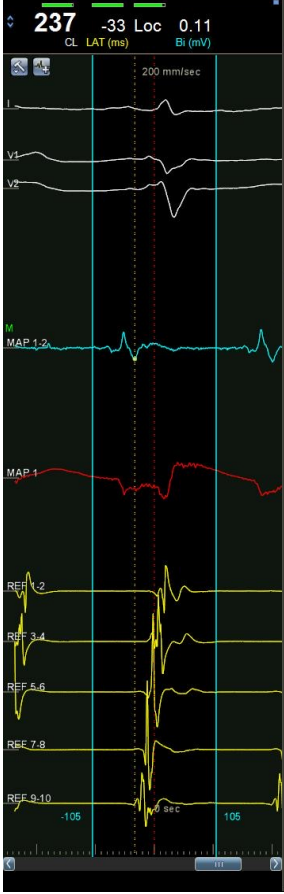










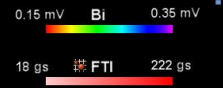
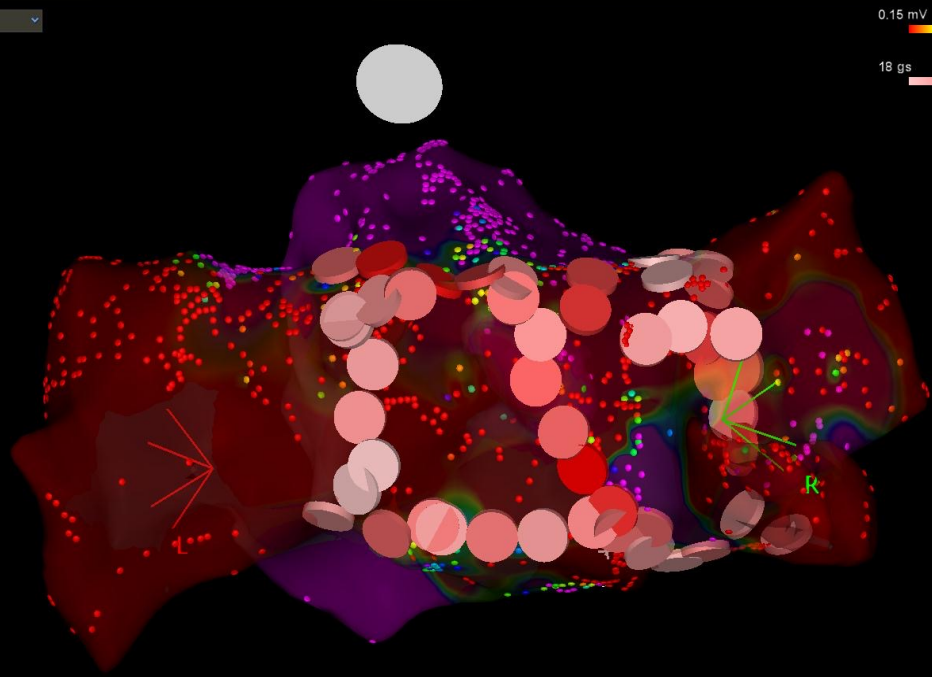


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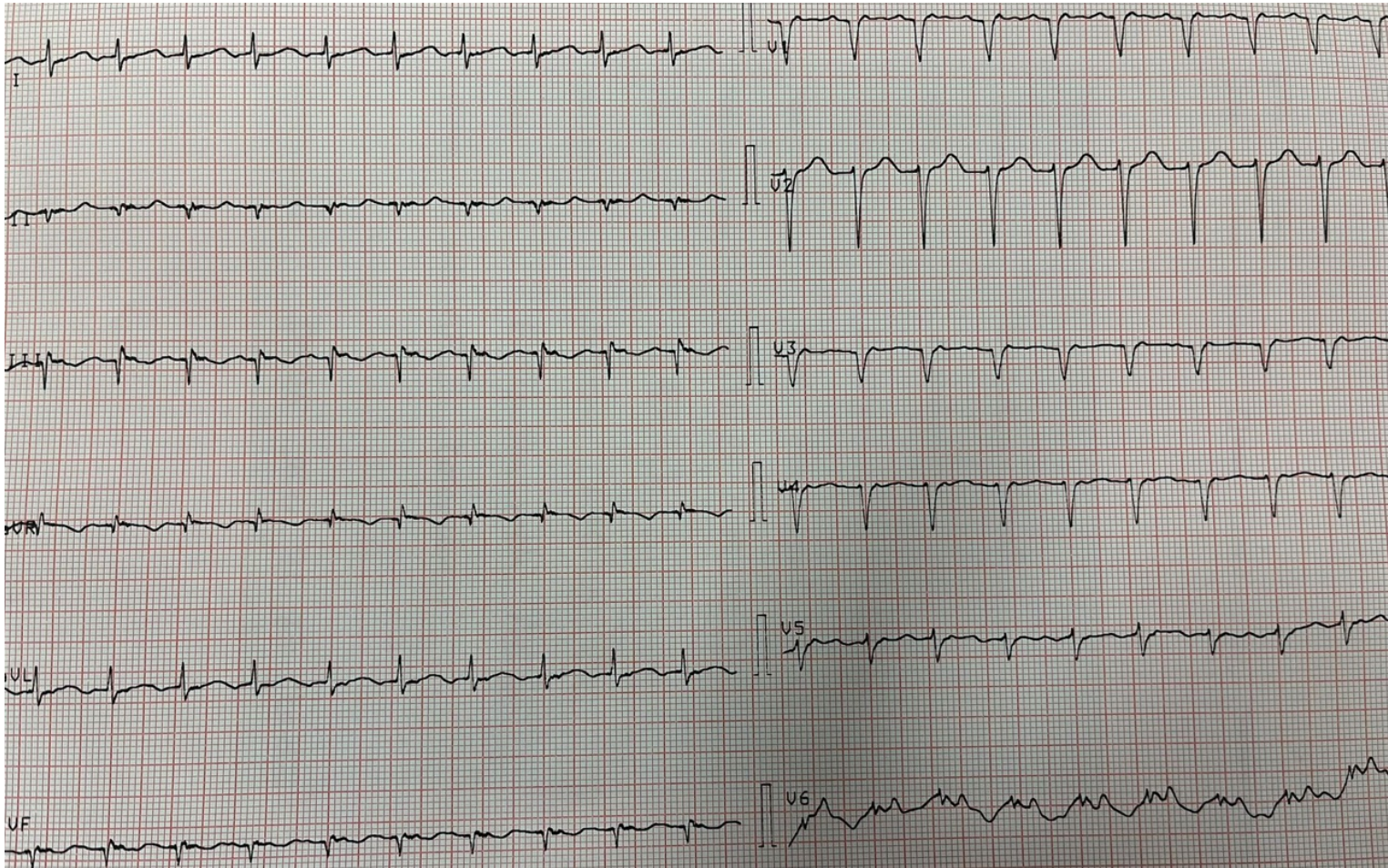
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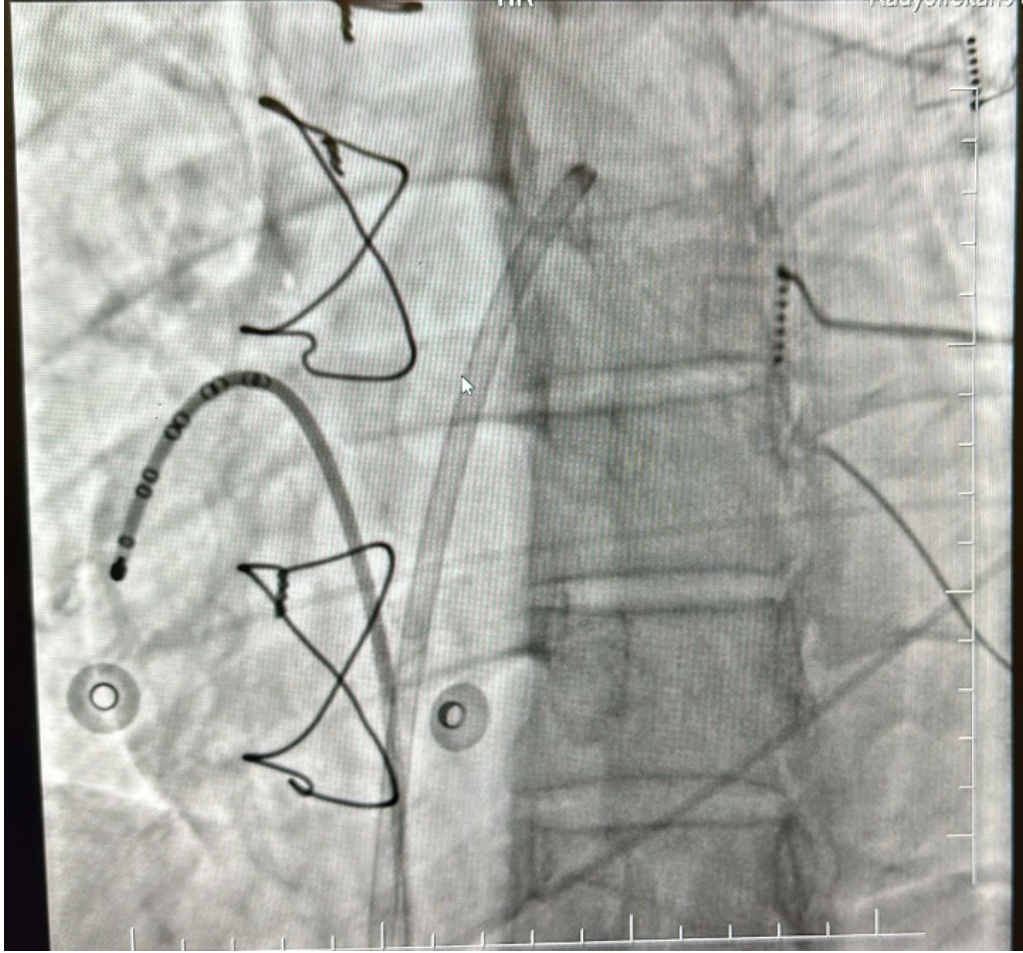
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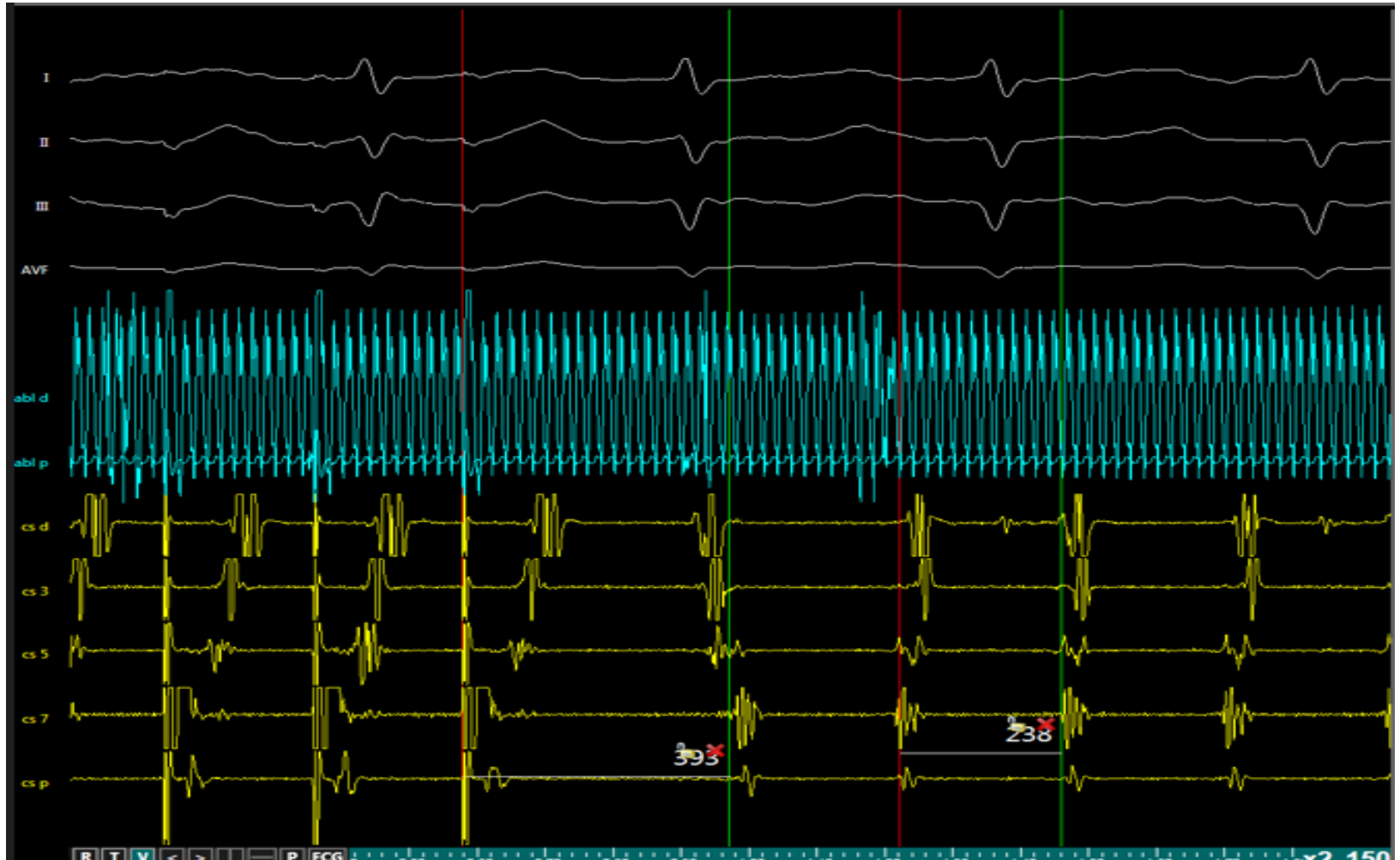
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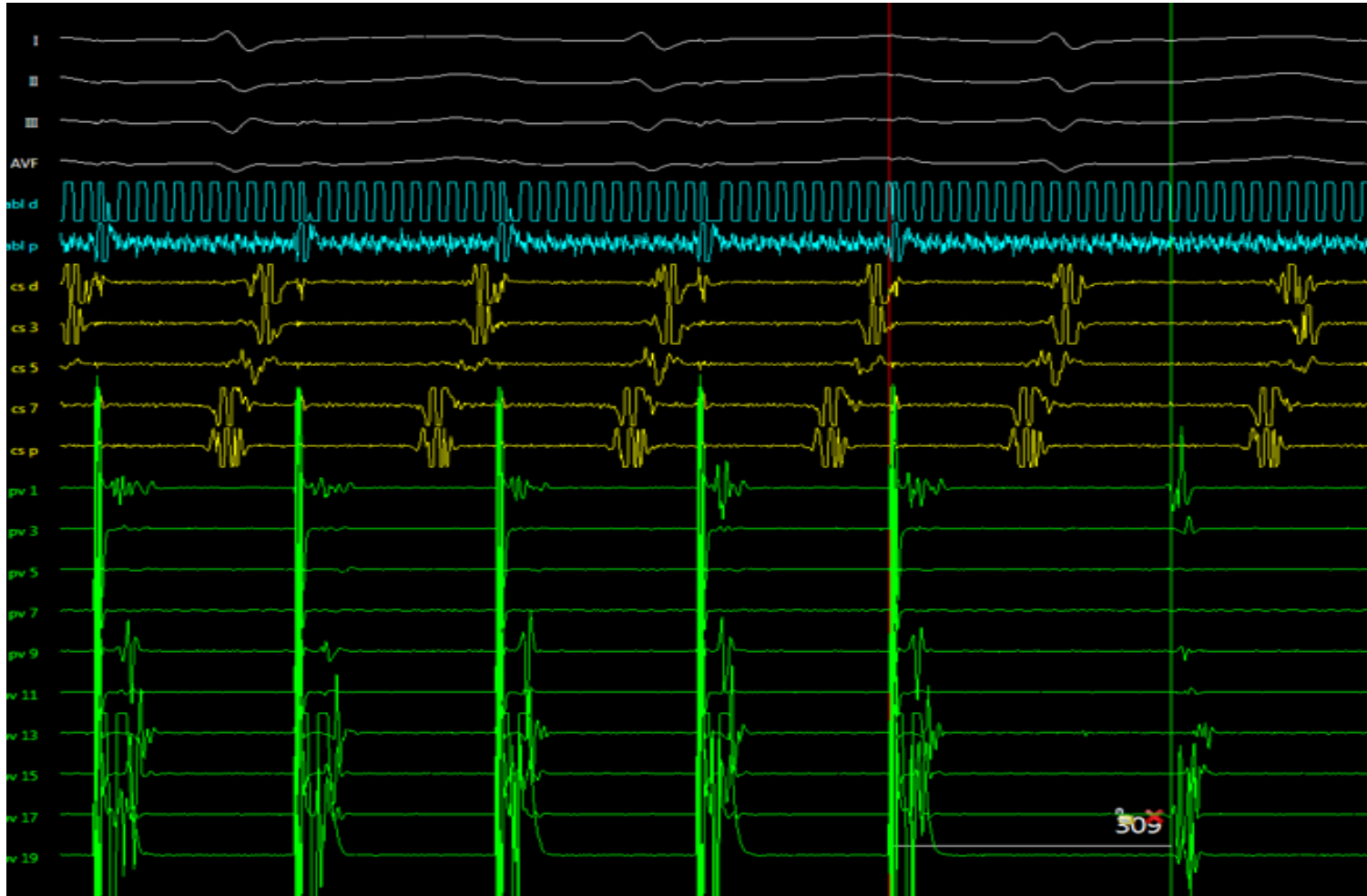


# RA Lateral Entrainment

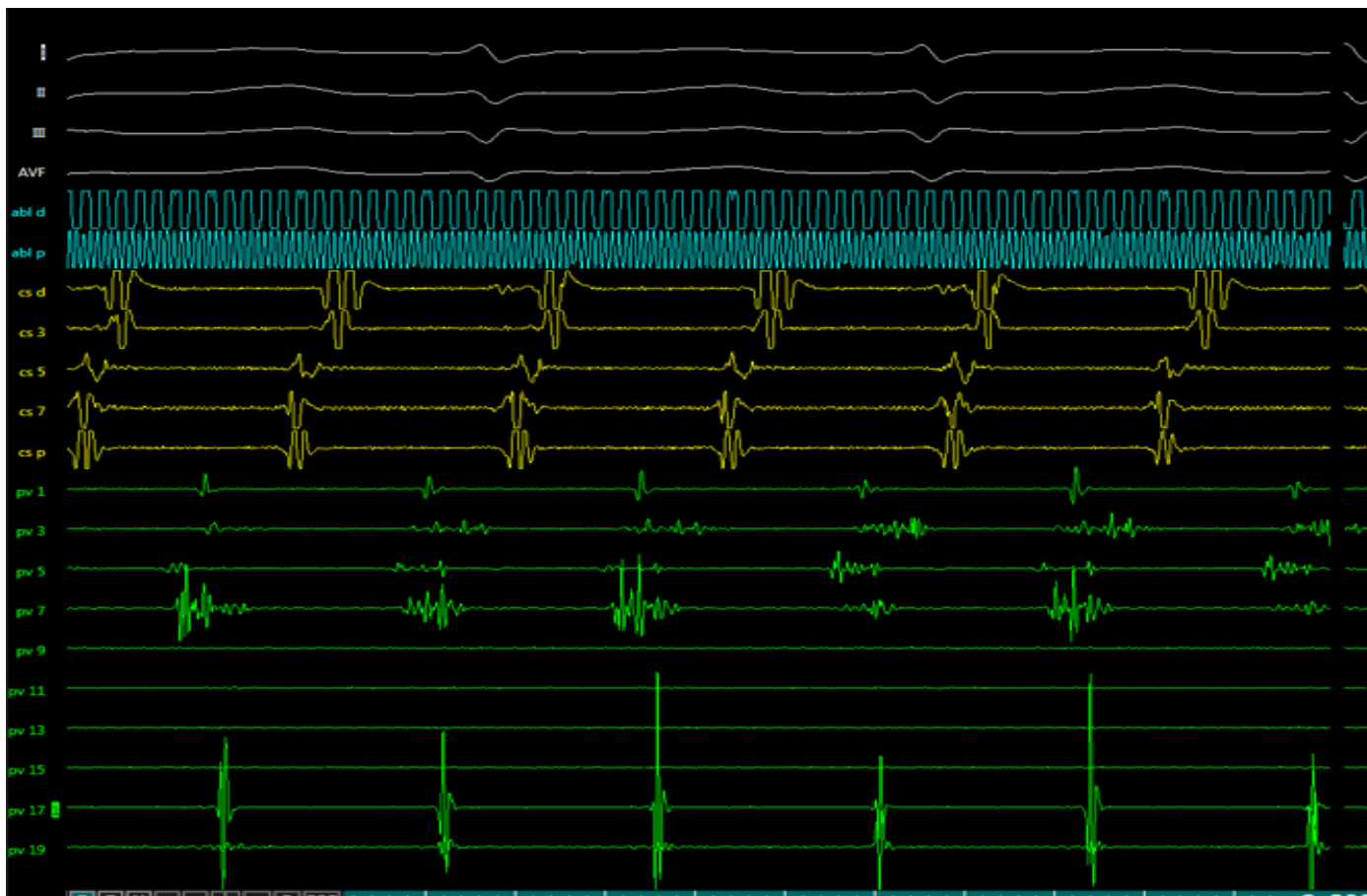




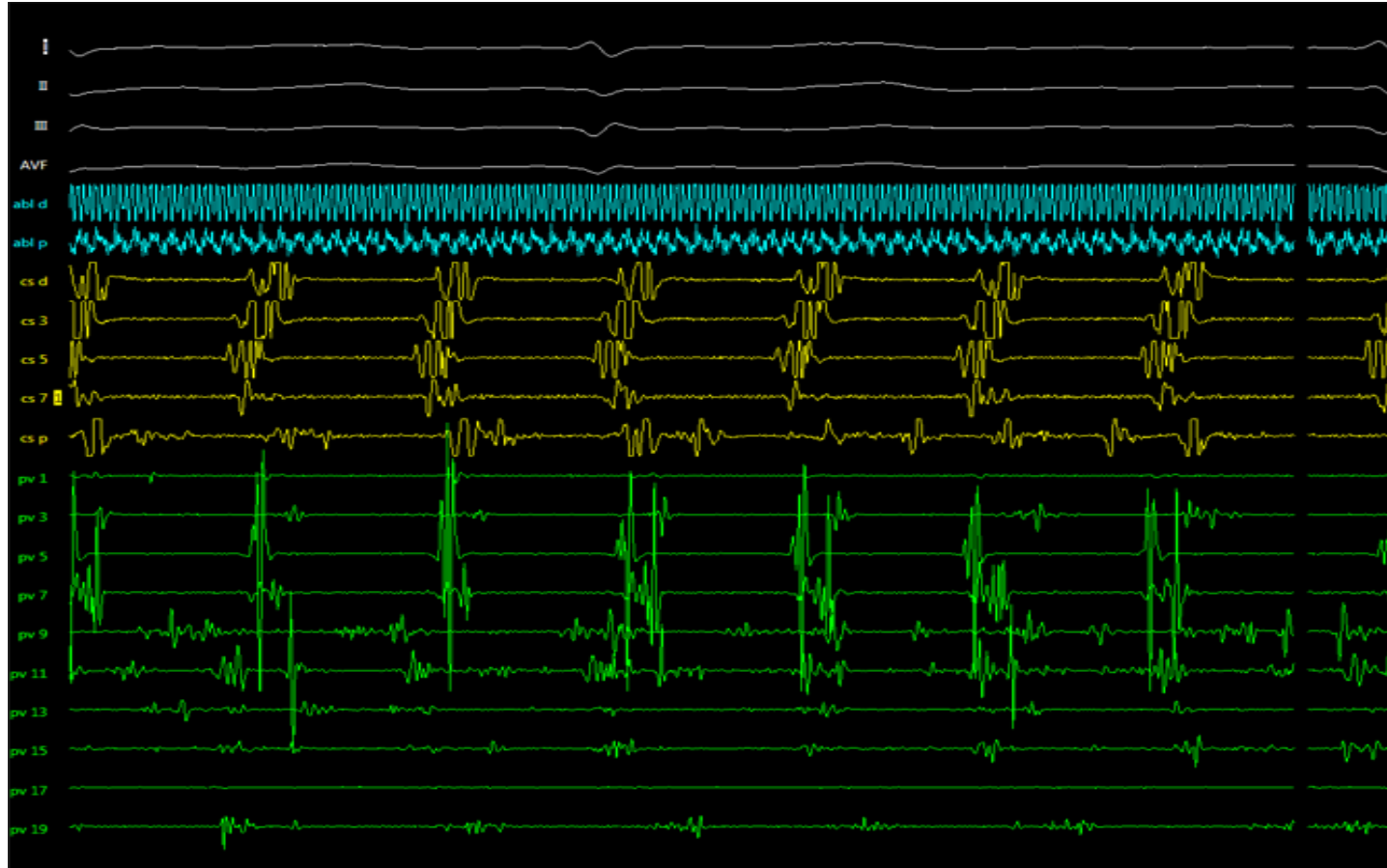
# Roof Entrainment

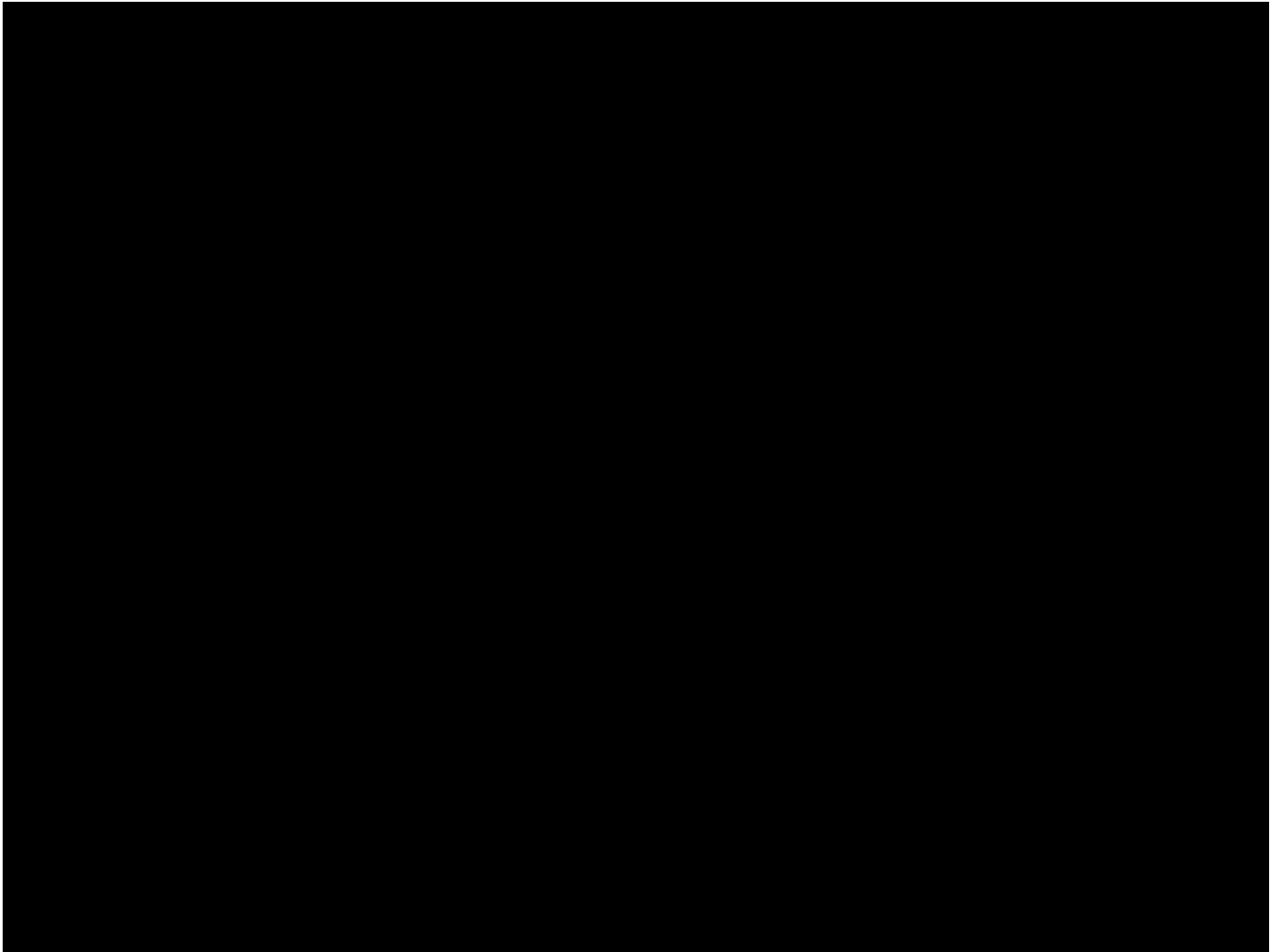


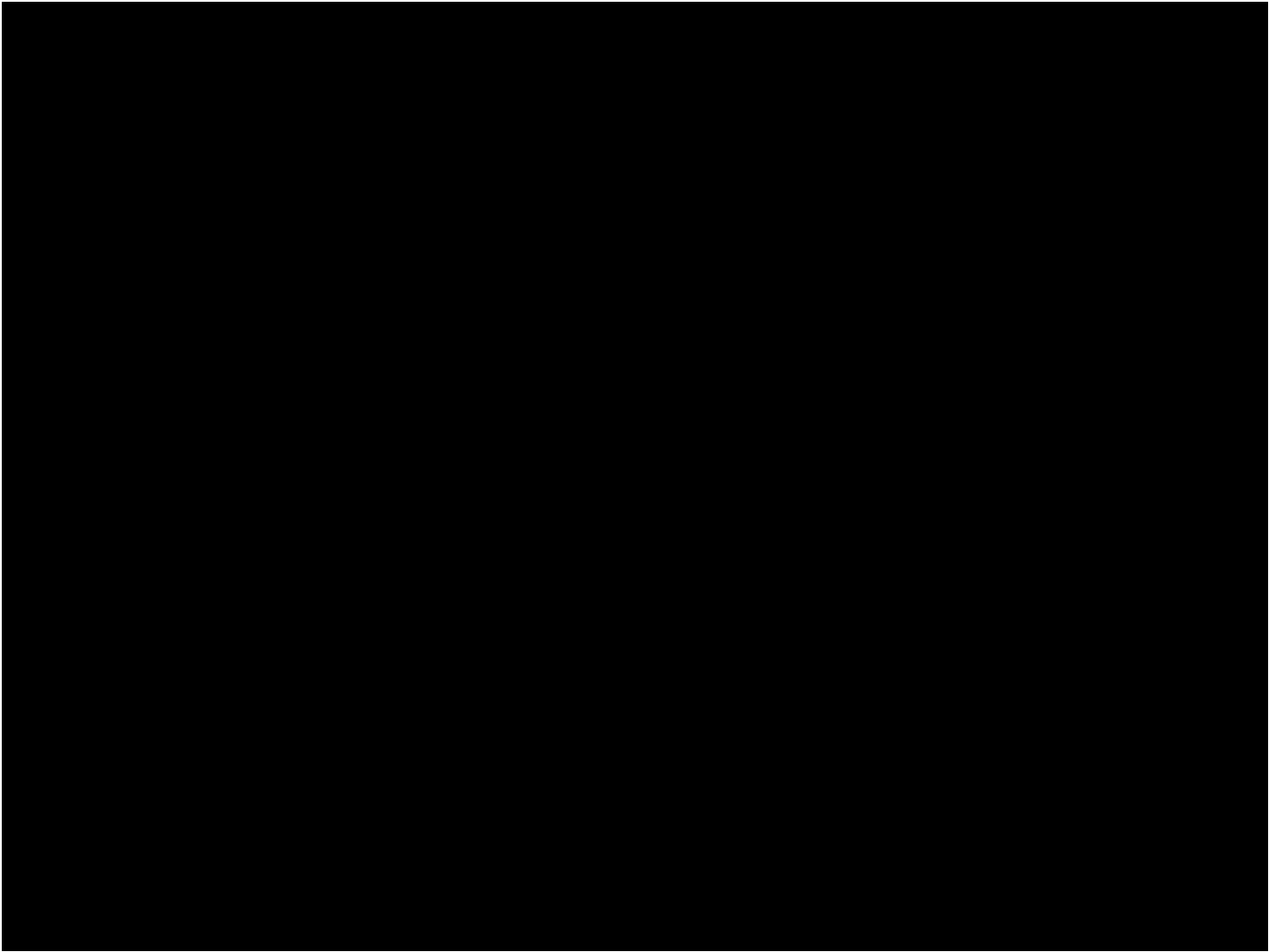
# Sol PV Karina



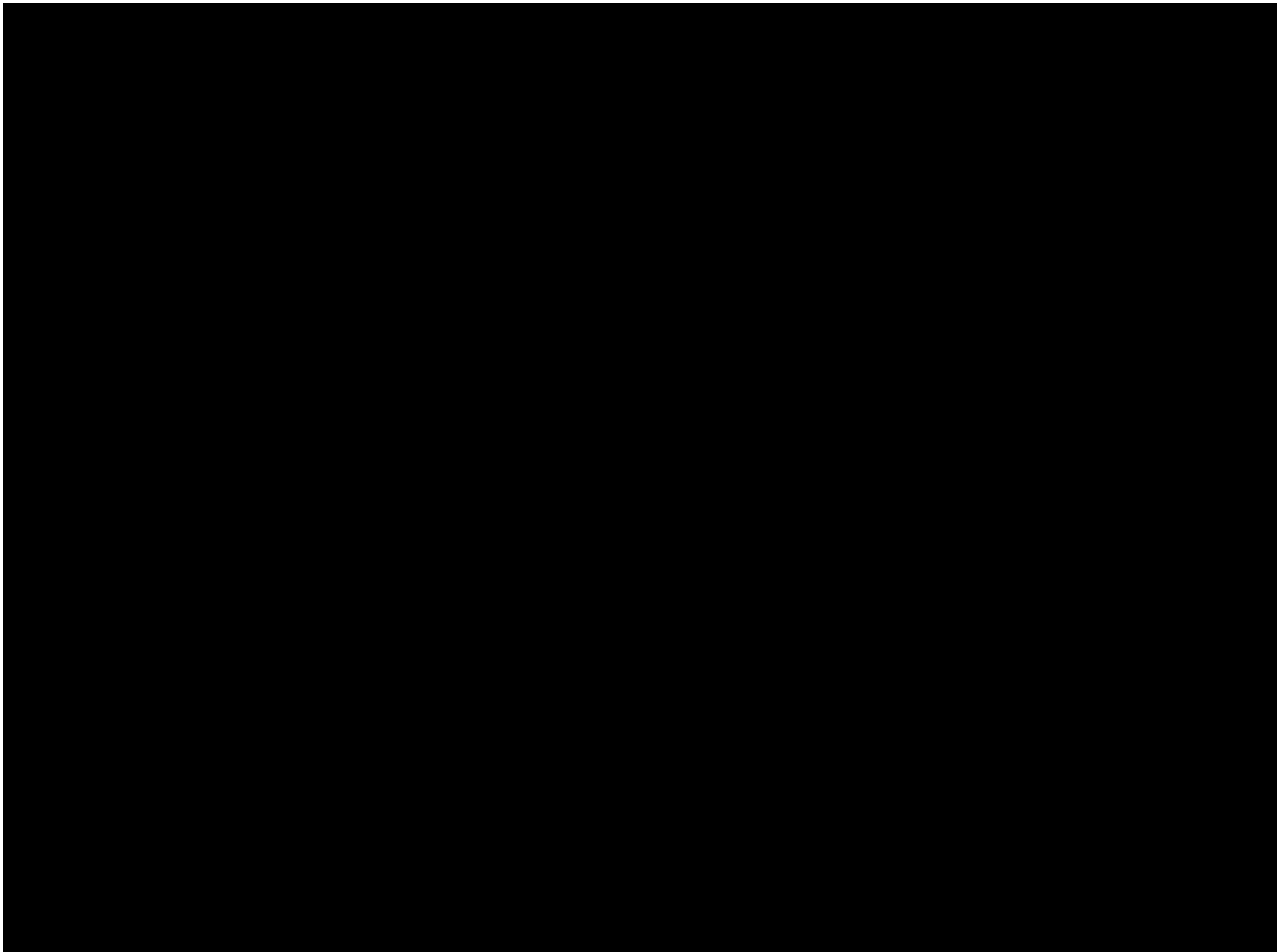
# Sol PV Ridge



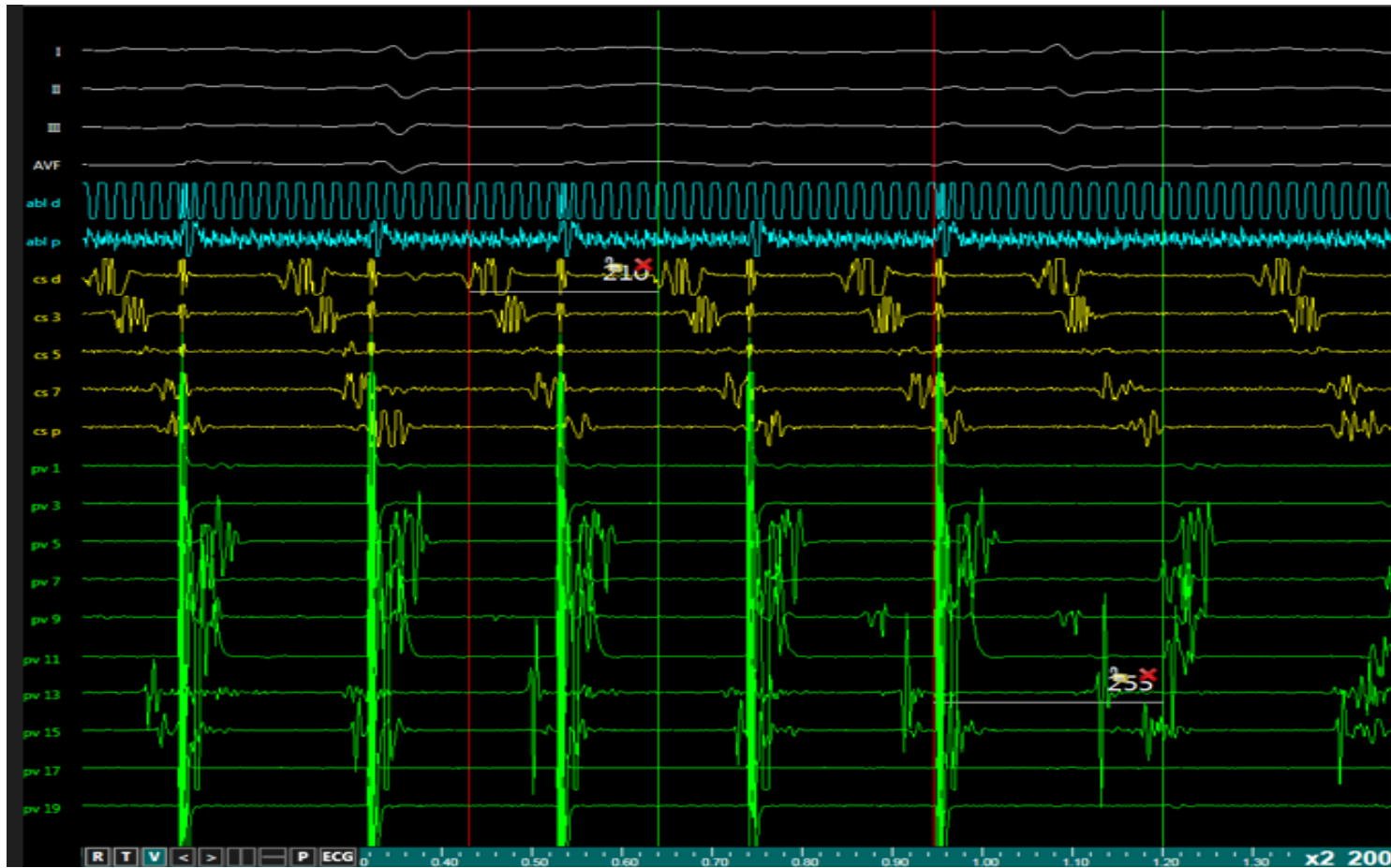


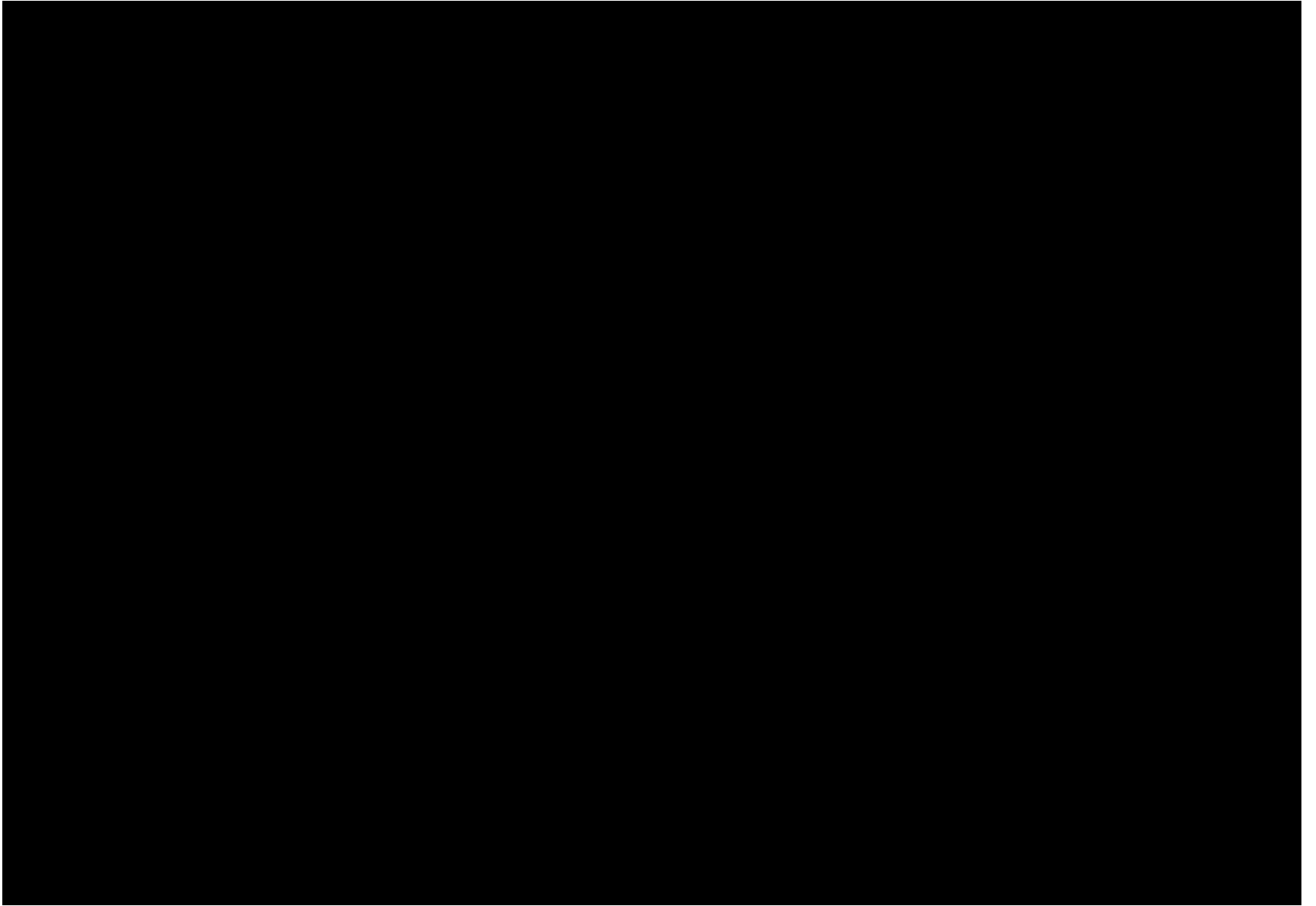


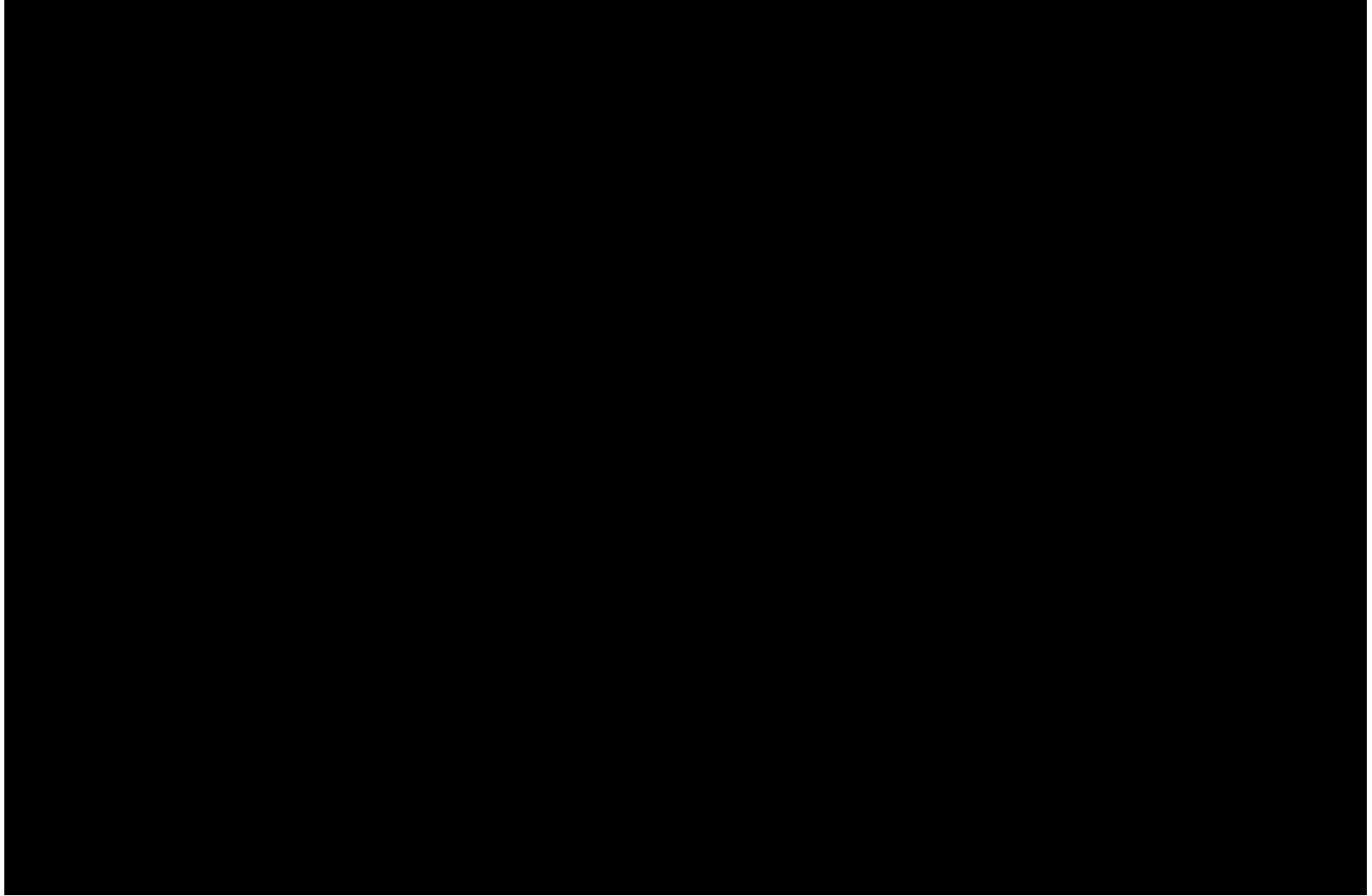


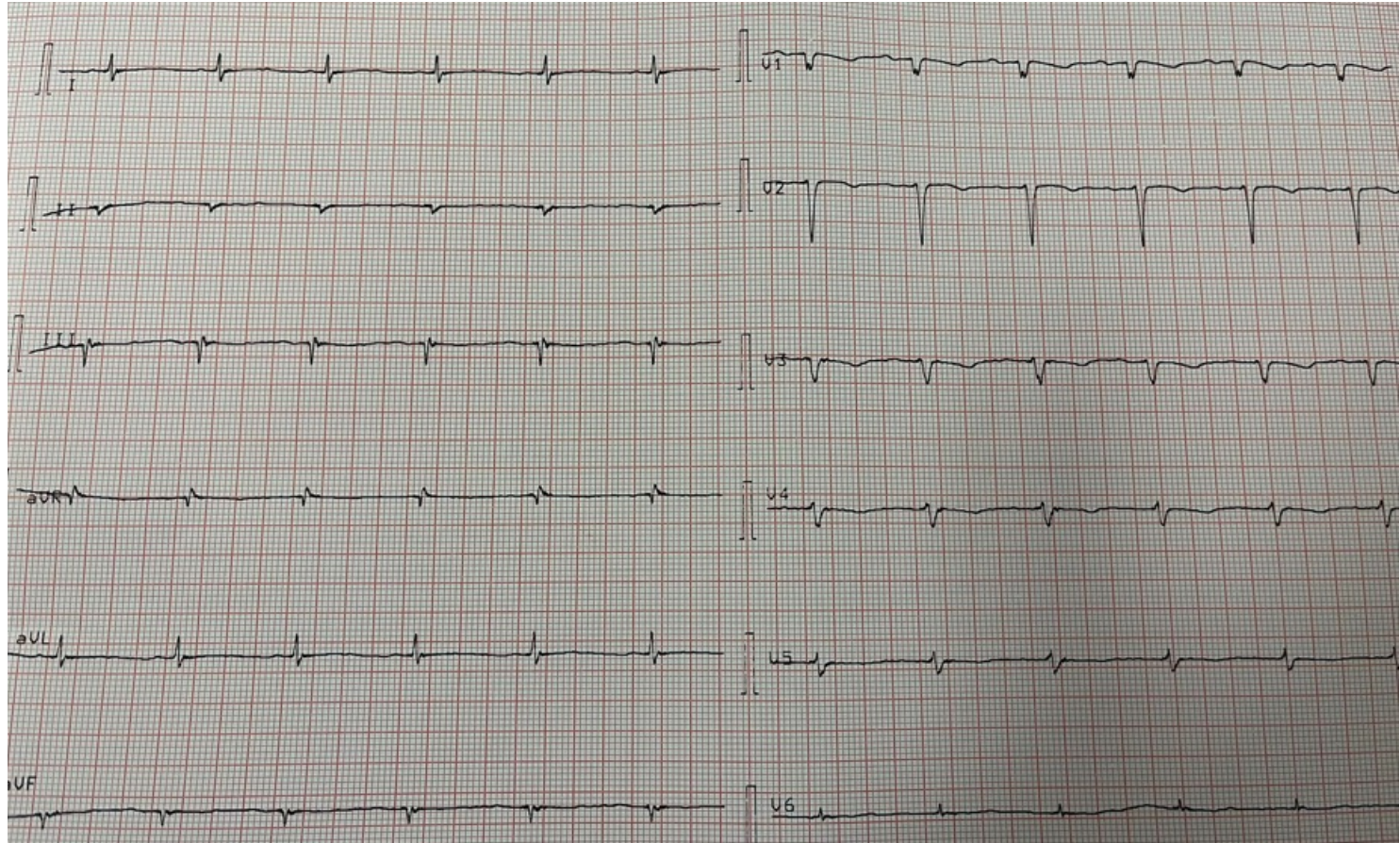


# Sağ atrium











# Sonuç

- Kalıcı pulmoner ven izolasyonu sağlanmalı
- Tüm ablasyon hatlarında blok gösterilmeli
- Entrainmen mapping önemli-uygulanmalı
- Bazen en iyi yöntem ablasyon olmayabilir

# Teşekkürler