CONTROVERSIAL ISSUES ON MANAGEMENT OF ARRHYTHMIAS IN ACUTE CORONARY SYNDROMES

Catheter ablation of sustained ventricular arrhythmias

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EHRA/ACCA/EAPCI POSITION PAPER

Cardiac arrhythmias in acute coronary syndromes: position paper from the joint EHRA, ACCA, and EAPCI task force

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Introduction

It is known that myocardial ischaemia and infarction leads to severe metabolic and electrophysiological changes that induce silent or symptomatic life-threatening arrhythmias. Sudden cardiac death is most often attributed to this pathophysiology, but many patients survive the early stage of an acute coronary syndrome (ACS) reaching a medical facility where the management of ischaemia and infarction must include continuous electrocardiographic (ECG) and hemodynamic monitoring, because life-threatening arrhythmias may occur. Prophylactic antiarrhythmic management strategies have largely been discouraged.

Although the mainstay of antiarrhythmic therapy used to rely on antiarrhythmic drugs (AADs), particularly sodium channel blockers and amiodarone, their use has now declined, since clinical evidence to support such treatment has never been convincing. Therapy for acute coronary syndromes and arrhythmic management are now

- Sustained ventricular arrhythmias
  - Ventricular tachycardia
  - Ventricular fibrillation

- Sustained ventricular arrhythmias incidence in STEMI patients:
  - Primary PCI: 4.4%
  - Thrombolytic therapy: 10.2%

- The incidence of sustained VT and VF occurring within 48 h of the onset of an ACS seems to have decreased over the past decades.

Al-Khatib SM, et al. Am Heart J 2003; 145: 515-21.
Mehta RH, et al, JAMA 2009; 301: 1779-89
Mehta RH, et al. Am J Cardiol 2012; 109: 805-12

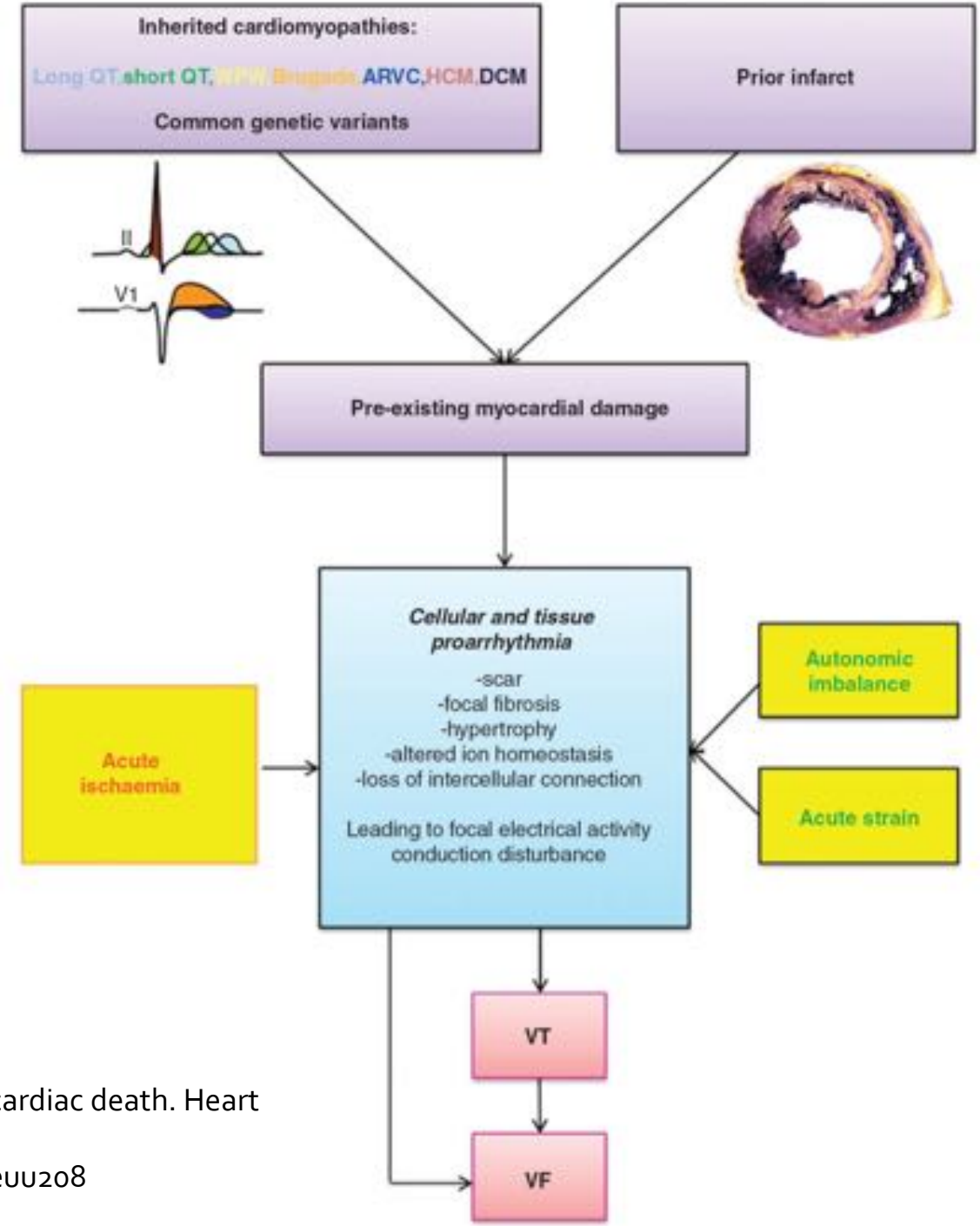
Patients with acute coronary syndrome at risk for ventricular tachyarrhythmia

- Patients with ACS who present with either of the following conditions
  - Late presenters (late from the onset of the symptoms)
  - Incomplete revascularization
  - Presence of substrate prior to the event
  - Patients with complications

  should be considered at increased risk for arrhythmia development during initial evaluation.

The mechanisms responsible for the initiation of the VA

- Intramural re-entry in ischaemia
- Triggered activity in reperfusion



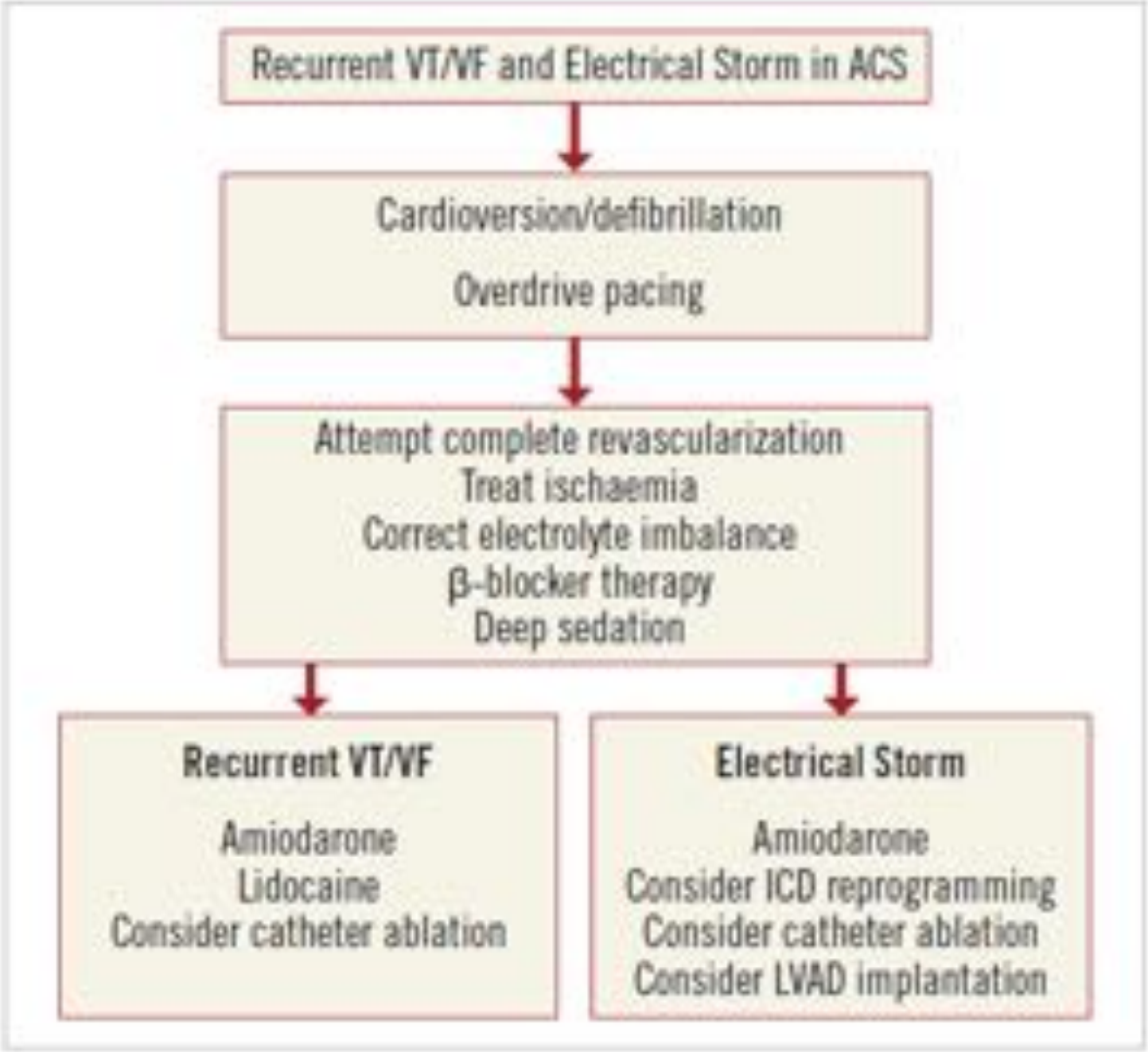
Kirchhof P, et al. Primary prevention of sudden cardiac death. Heart 2006;92:1873–8.
Bulent Gorenek et al. Europace 2014;europace.euu208

Initial therapy in patients with sustained VA and ACS

- Only limited data exist from clinical trials concerning the use of AADs in ACS.
- The nature of VT/VF in the setting of ACS is complex, dynamic, and different from the chronic phase of MI
- Prophylactic antiarrhythmic drug treatment should not be administered.

Initial therapy in patients with sustained VA and ACS

- Revascularization: PCI, CABG
- If life-threatening VA related to ACS occur despite optimal revascularization
  - Early treatment with beta-blockers
  - Balancing electrolytes
  - Sedation to reduce sympathetic drive
  - Overdrive stimulation
  - Electrical cardioversion/defibrillation
- If antiarrhythmic drug therapy is necessary
  - IV amiodarone is reasonable
  - IV lidocaine, if necessary



Bulent Gorenek et al. Europace 2014;europace.euu208

Catheter ablation of sustained ventricular arrhythmias in acute coronary syndrome

Catheter ablation of sustained VA in ACS

- Incessant sustained VA that occurs in ACS is a life-threatening condition, carrying a high morbidity and mortality rate.
- Catheter ablation of VA during the acute phase of an ACS is rarely performed, and most ablations for incessant VA occur post - MI.
- In patients with intractable, drug-refractory VA
  - Catheter ablation after treating the underlying ischemia
  - These patients should be referred to a specialized ablation center.
- Acute success rates are
  - 70% - 80%

Carbucicchio C, et al. Circulation 2008;117:462–9.
Bulent Gorenek et al. Europace 2014;europace.euu208

Catheter ablation of sustained VA in ACS

- Ablation targets
  - Macro re-entry from heterogeneous substrate, and after-depolarizations
  - Triggered activity from impaired but ischemia resistant Purkinje fibers within areas of myocardial ischemia leading to PVC

Catheter ablation of sustained VA in ACS

- Radiofrequency ablation
  - Irrigated-tip ablation catheter
  - 3D-electroanatomical mapping
- Ablation approach
  - Antegrade transseptal
  - Retrograde aortic
  - Combined approach.
- In the majority of cases endocardial mapping, and ablation suffices.

Mapping Techniques for Catheter Ablation of Ventricular Tachycardia

- Hemodynamically stable VT
  - Activation mapping
    - Idiopathic (triggered or automatic): earliest site of origin
    - Scar-mediated (reentry): diastolic activity, LAVA
  - Entrainment mapping
    - Presystolic (<30% TCL) = exit
    - Middiastolic (30%–70% TCL) = isthmus
    - Early diastolic (>70% TCL) = entrance
  - Entrainment mapping of isthmus
    - Concealed fusion
    - PPI = TCL
    - S-QRS = EGM-QRS

Roderick Tung, et al. Circulation. 2011;123:2284-2288

Mapping Techniques for Catheter Ablation of Ventricular Tachycardia

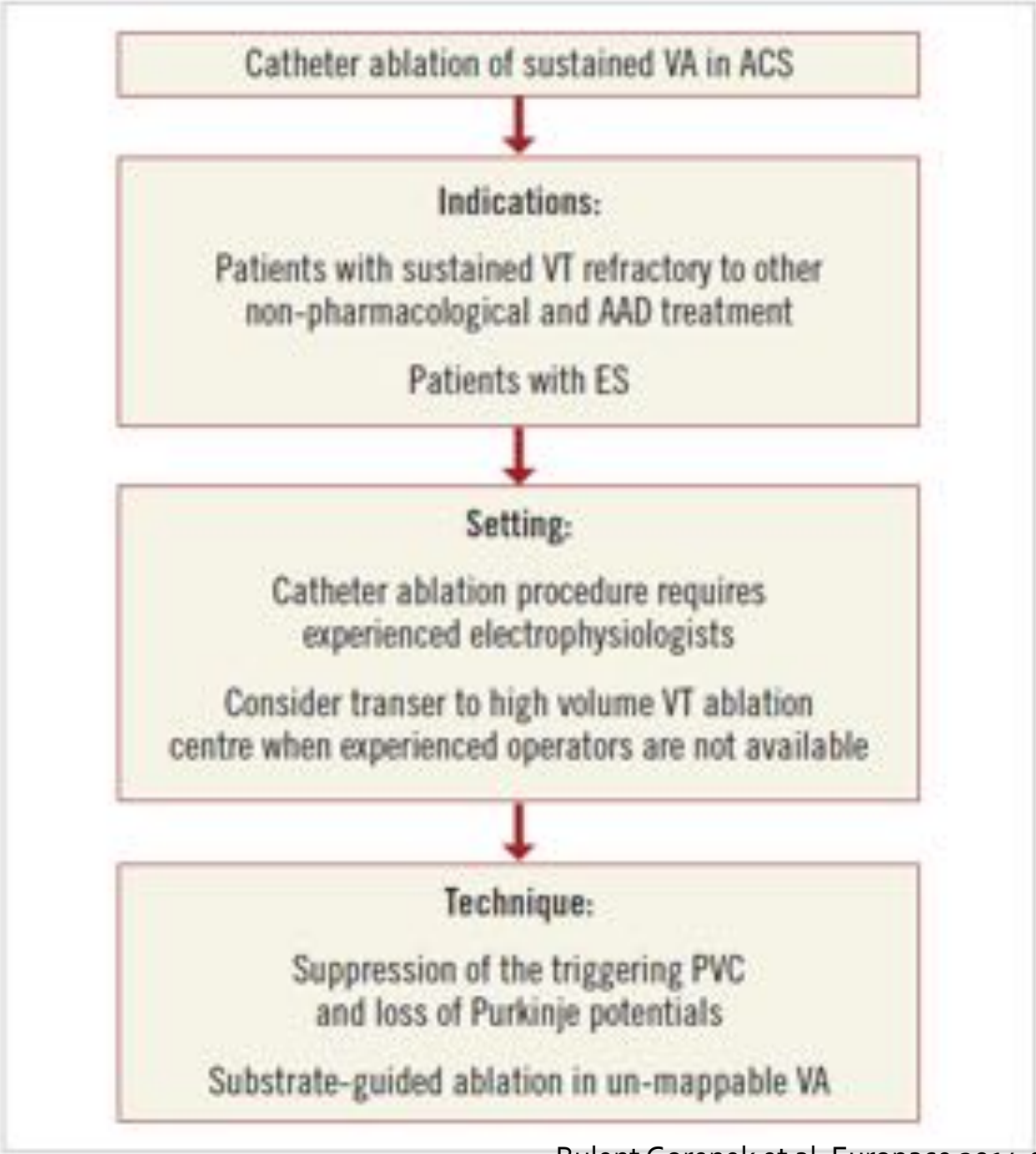
- Hemodynamically unstable VT
  - Electroanatomic substrate mapping/scar delineation
  - Pace mapping
  - Targeting of LAVA
  - Linear ablation lesions sets
    - Scar border zones
    - Scar transection
    - Connecting scars and anatomic boundaries, ie, annulus
  - Mechanical hemodynamic support, ie, IABP, LVAD, ECMO

Roderick Tung, et al. Circulation. 2011;123:2284-2288

Catheter ablation of sustained VA in ACS

- Complications associated with catheter ablation of VA
  - Cardiac tamponade
  - Ischemic stroke
  - Atrioventricular (AV) block
  - Valvular injury
  - Cardiac decompensation
  - Death
- Peri-procedural mortality
  - 3% in this sub-group of unstable patients
  - Mostly associated with uncontrolled, intractable arrhythmia

Stevenson WG, et al. Circulation 2008;118:2773–82.



Bulent Gorenek et al. Europace 2014;europace.euu208

Case presentation

Case 1

- 64 years old, male
- Type 2 DM, HT
- 1 week ago in another hospital, Acute coronary syndrome, hospitalization, mild troponin-I elevation
  - Coronary angiography:
    - Apical akynesia
    - LAD 60-70%
    - Cx-OM 60%
    - RCA Normal
    - Decision: CABG suggested
- 1 week later the patient came to our outpatient clinic

- While he was waiting at the waiting lounge, he experienced sudden cardiac death
  - CPR
  - EKG: No ST elevation or ST, T change
  - We performed coronary angiography for PCI
    - We found same findings as the previous CAG
    - LAD - 2 stent implanted
    - CX OM - 1 stent implanted
- The patient was admitted to CCU

Next day morning

- 06:20 **VF** – 360 J – NSR
- 06:25 **VF** – 360 J – NSR
- Amiodaron 300 mg IV
- 06:40 **VF** – 360 J – NSR
- 06:42 **VF** – 360 J – NSR
- Lidokain 75 IV
- 06:55 **VF** – 360 J – NSR
- Transient atrial pacemaker implanted and overdrive pacing performed

- 1., 2., 3., 4., 5., 6 day later,
  - Amiodaron infusion continued
  - When transient atrial pacemaker turned off –
    - VF ---- 360J ---- NSR, pacemaker turned on

Atrial pacemaker turn on

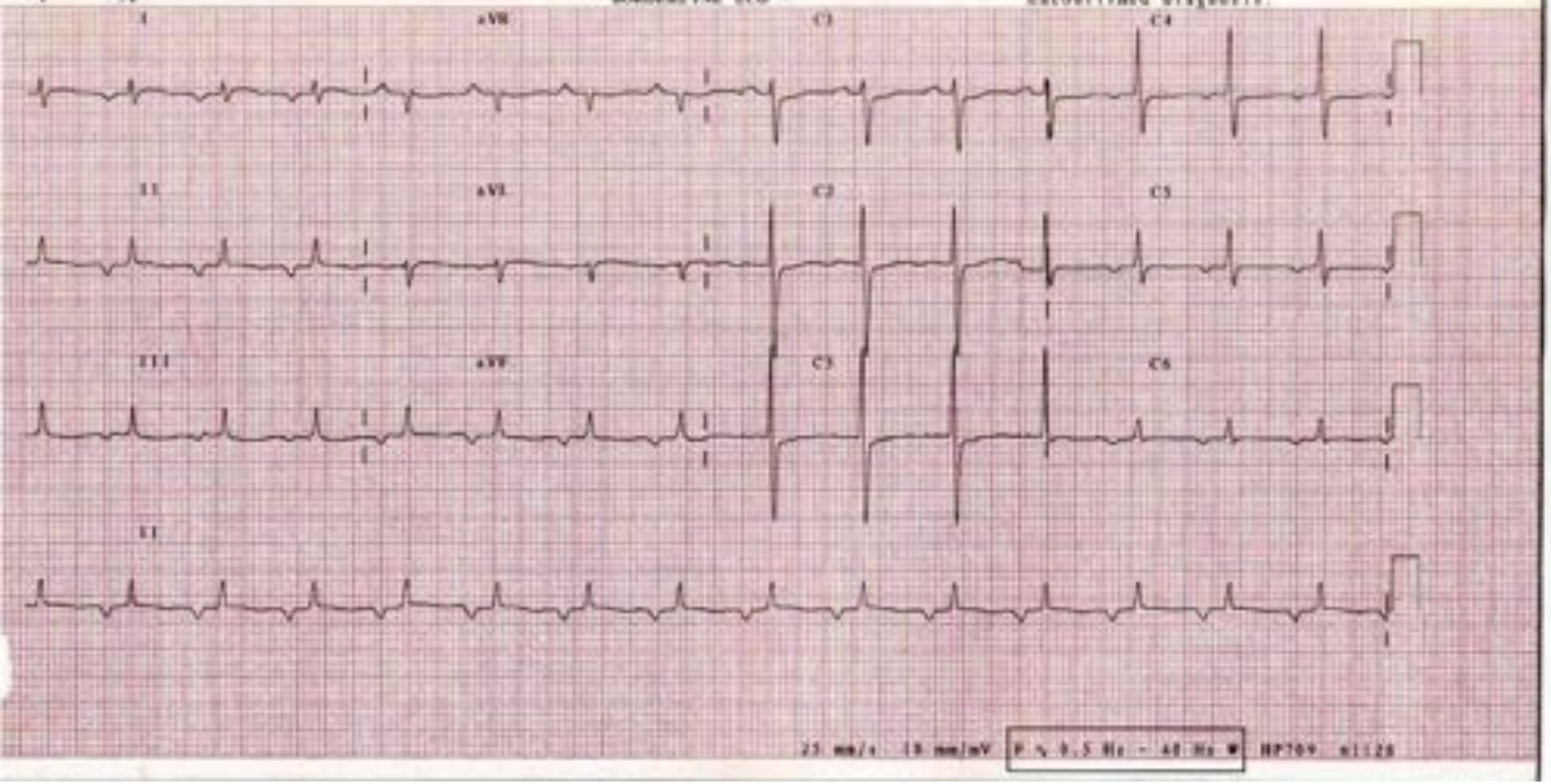
26-Jan-2009 12:06:51 PageWriter 300pi

Rate	88	. AGE NOT ENTERED, ASSUMED TO BE 50 YEARS FOR PURPOSE OF ECG INTERPRETATION
PR	204	. SINUS OR ECTOPIC ATRIAL RHYTHM, RATE 88.....P axis (133,-45) or indeterminate
QRSD	90	. BORDERLINE AV CONDUCTION DELAY.....PR>200 age 16-60 rate 51- 90
QT	381	. BORDERLINE RIGHT AXIS DEVIATION.....age-specific ranges
QTc	461	

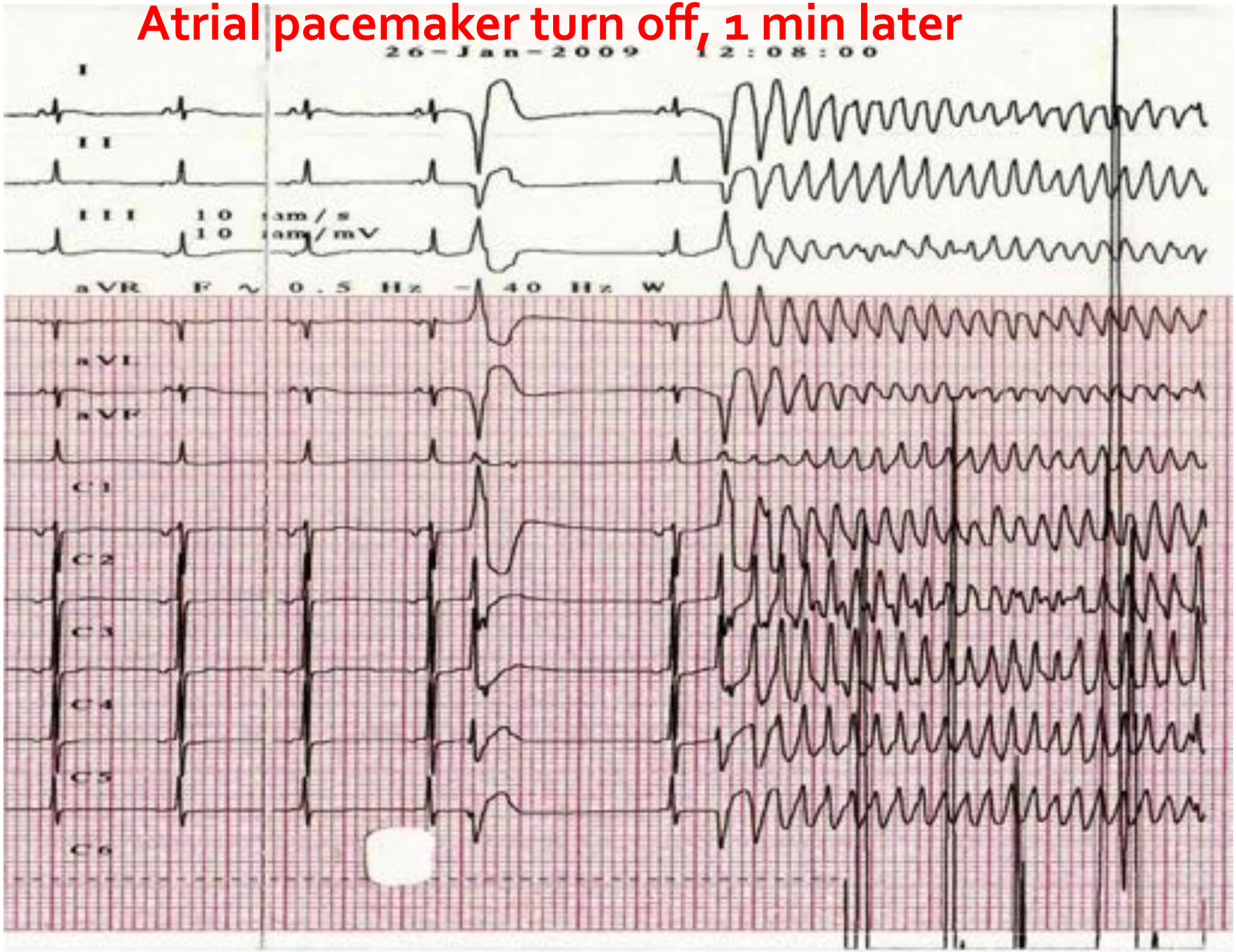
--Axis--

P	226
QRS	81
T	-70

- BORDERLINE ECG - Unconfirmed diagnosis.

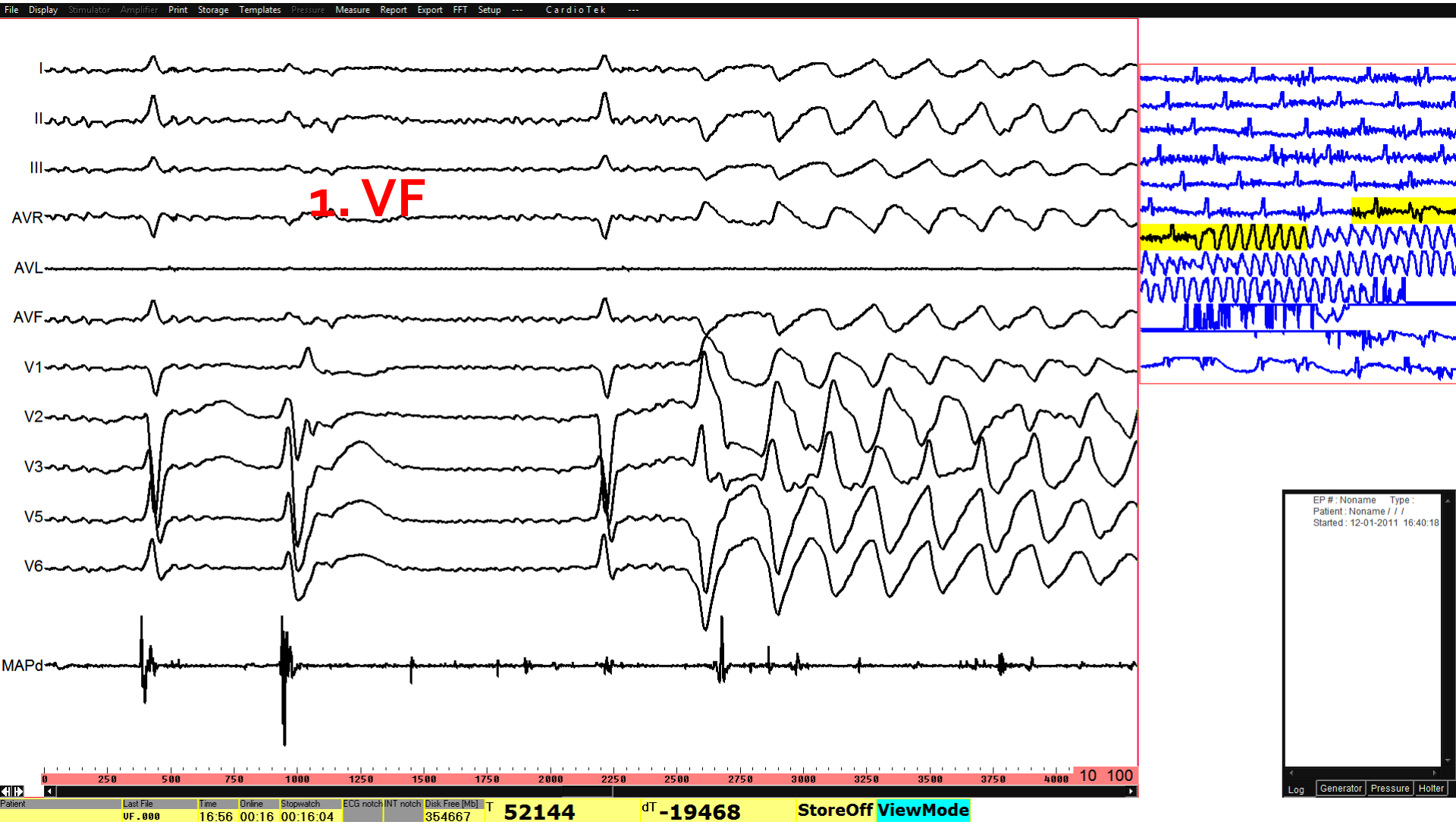


Atrial pacemaker turn off, 1 min later



Time: 14:41

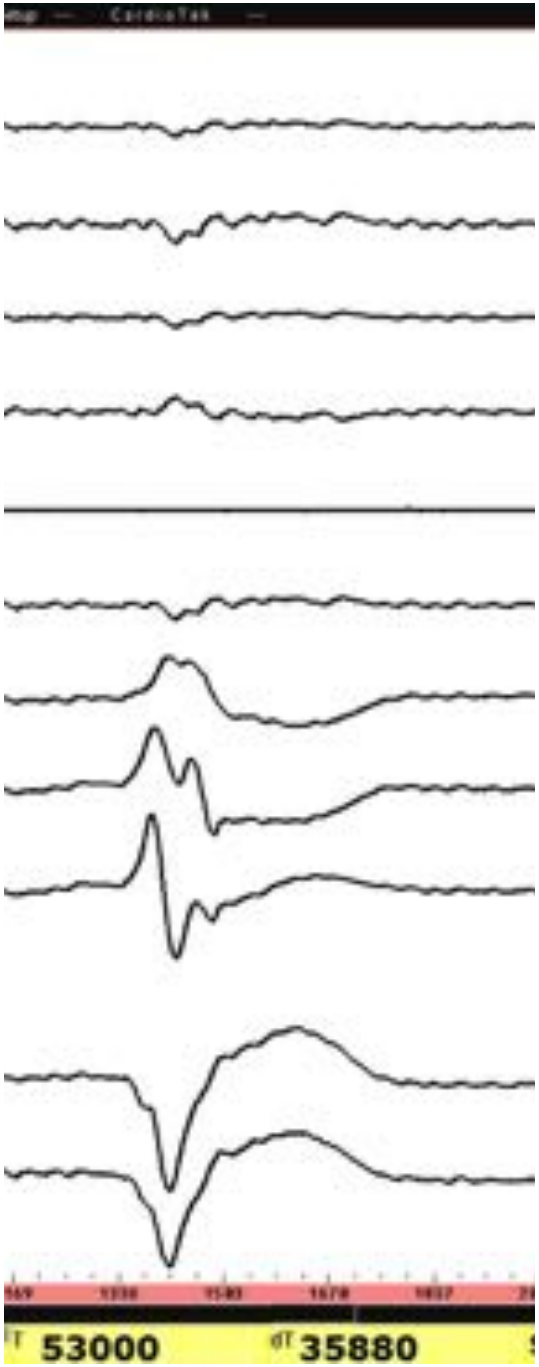
Electrophysiology lab
First map: Atrial pacemaker turn off = VF



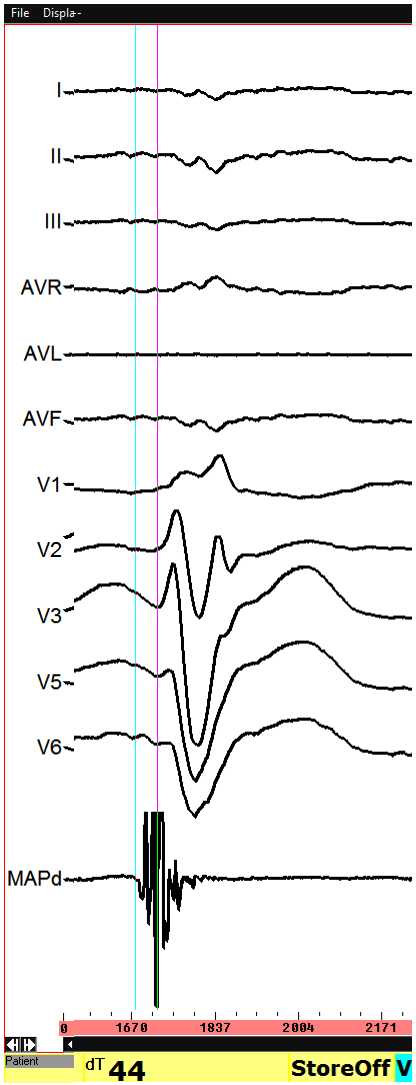
Pace mapping of target PVC

Left ventricul inf-lat part wide area

12 – 12 pace map

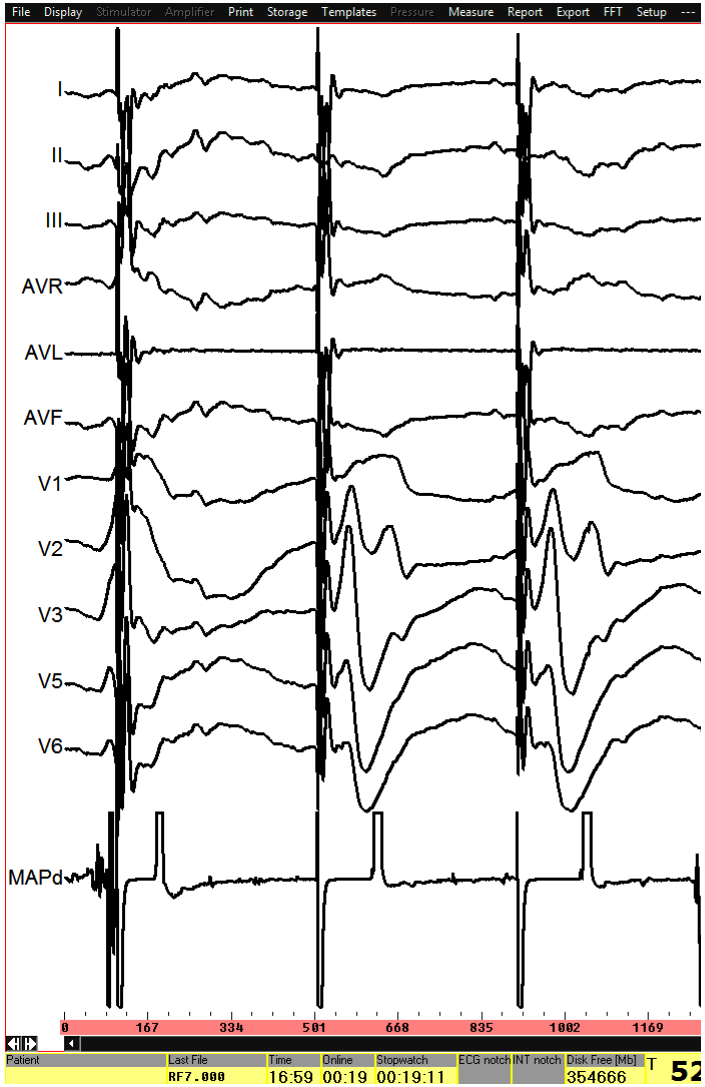


First ablation area Activation mapping

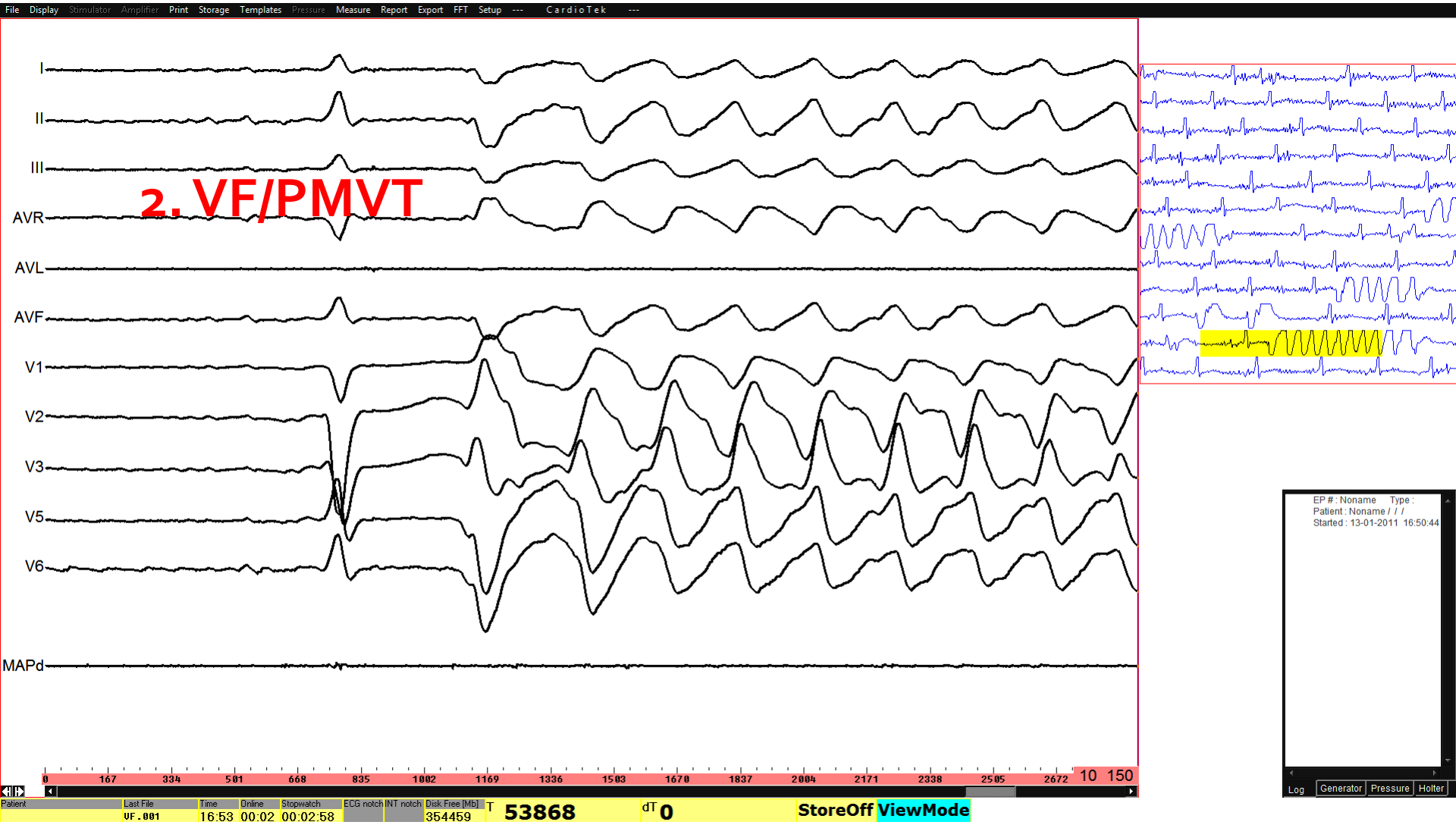


8 RF performed

First ablation area pace mapping



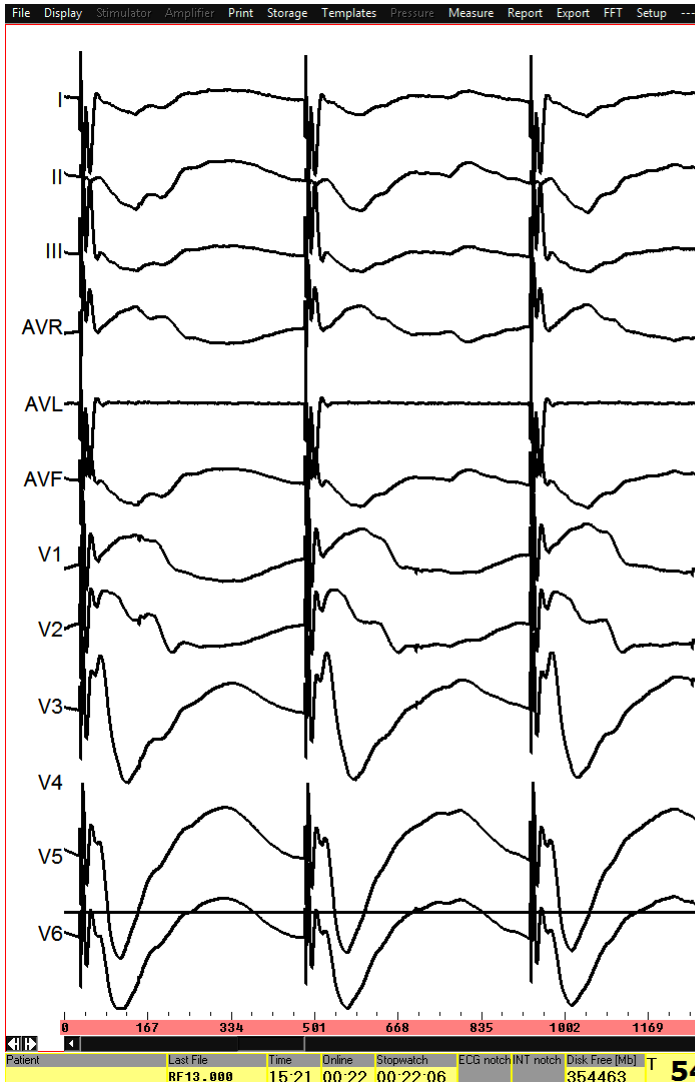
2nd map: Atrial pacemaker turn off = VF



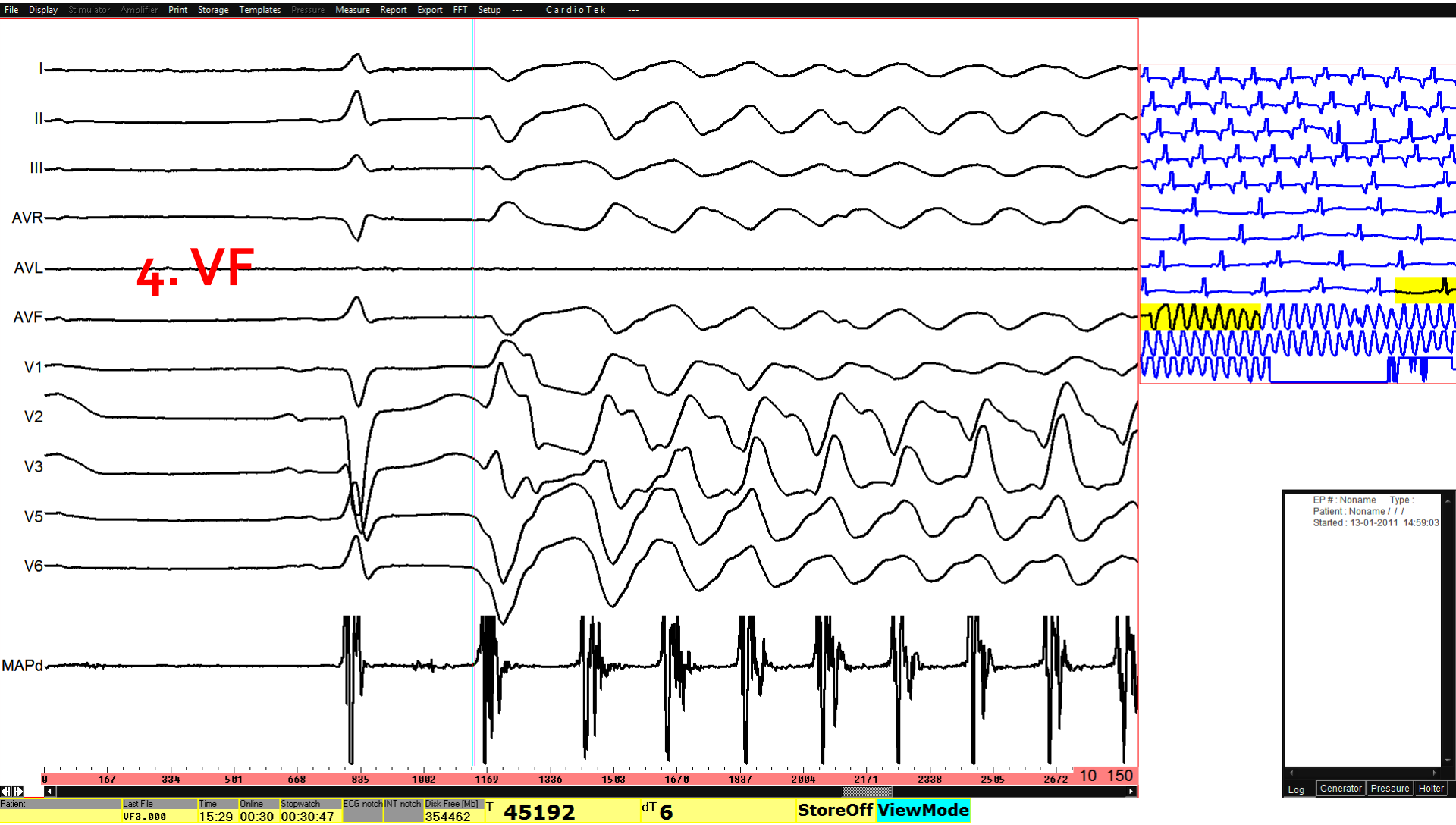
2nd ablation area
Activation mapping

5 RF

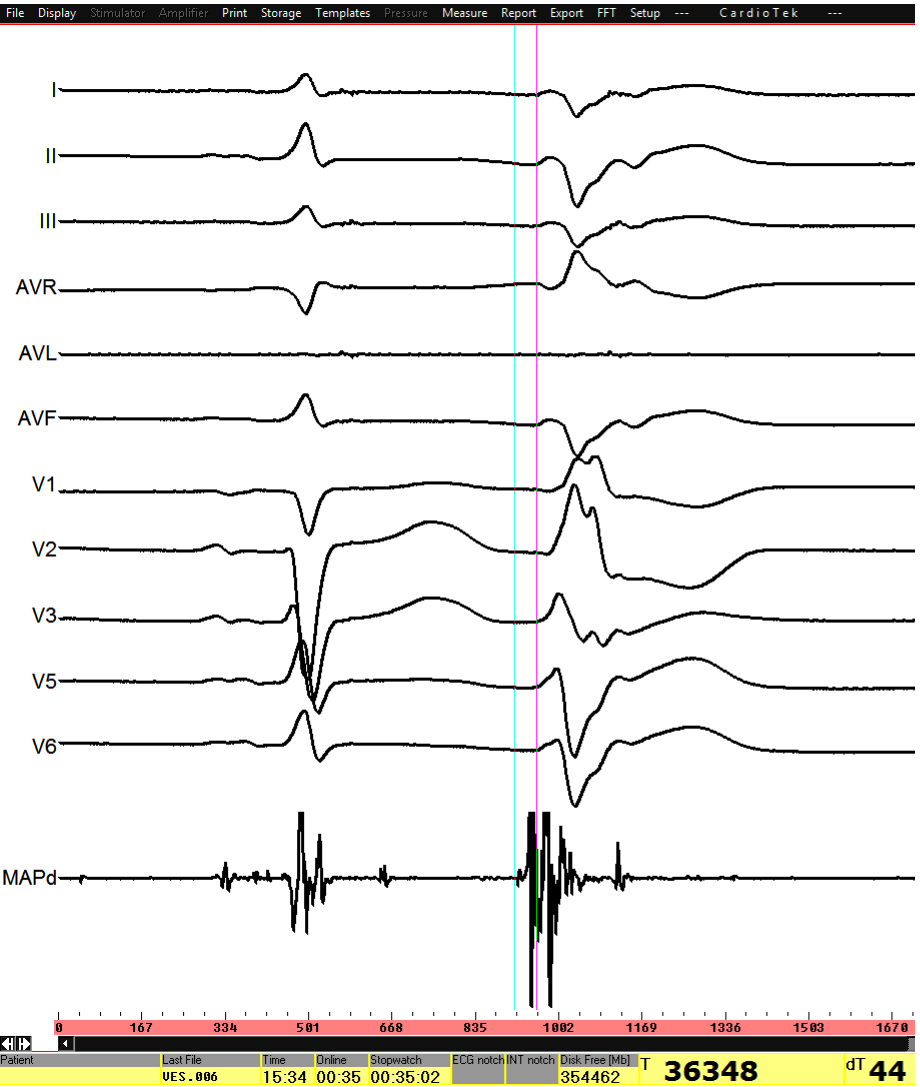
2nd ablation area
pace mapping



4th map: Atrial pacemaker turn off = VF

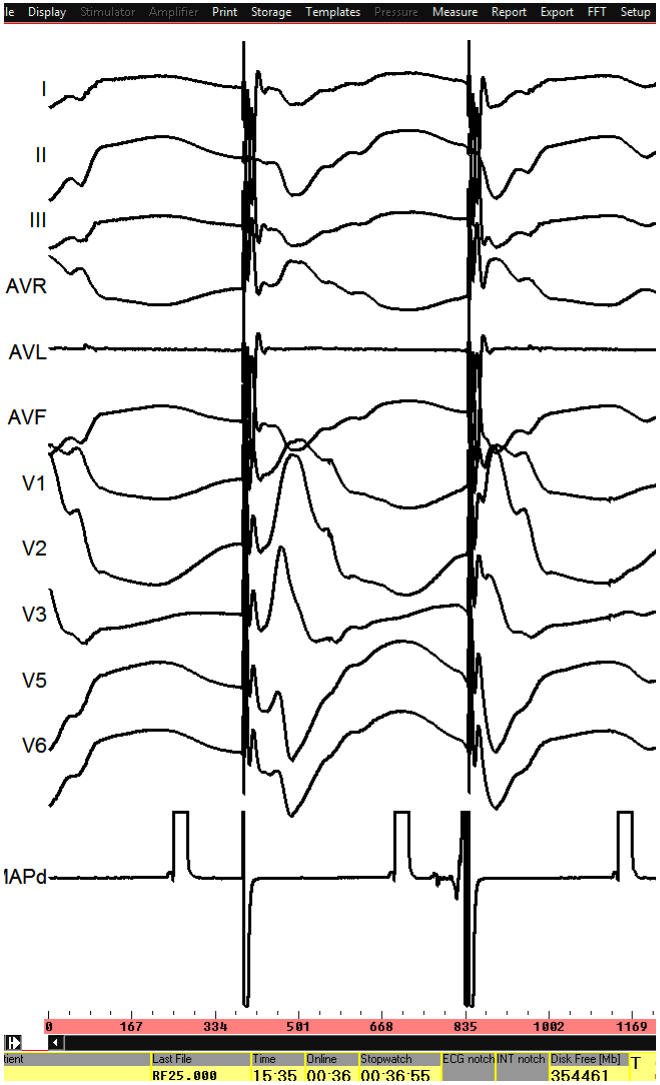


4th ablation area
Activation mapping



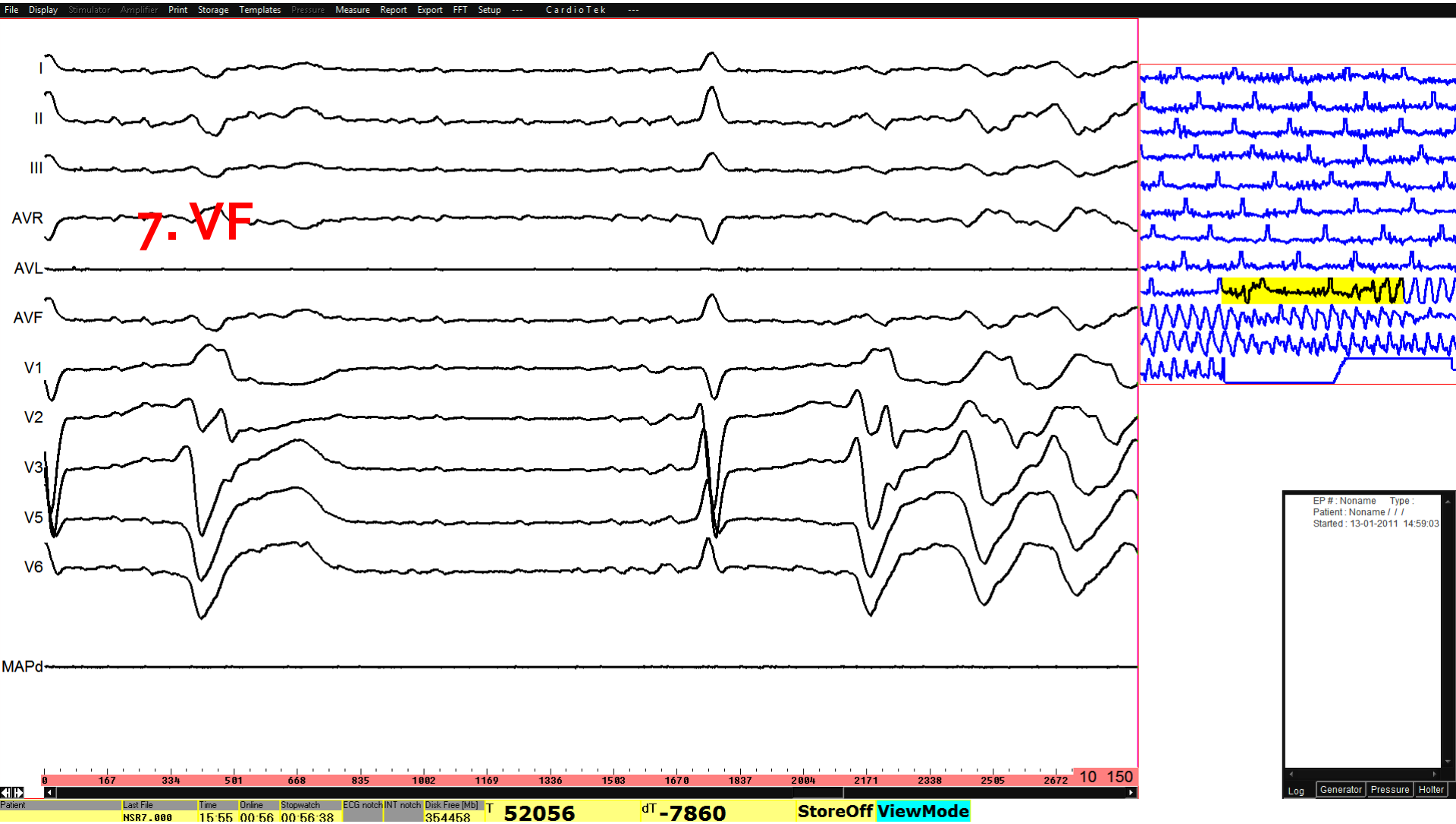
10 RF

4th ablation area
pace mapping

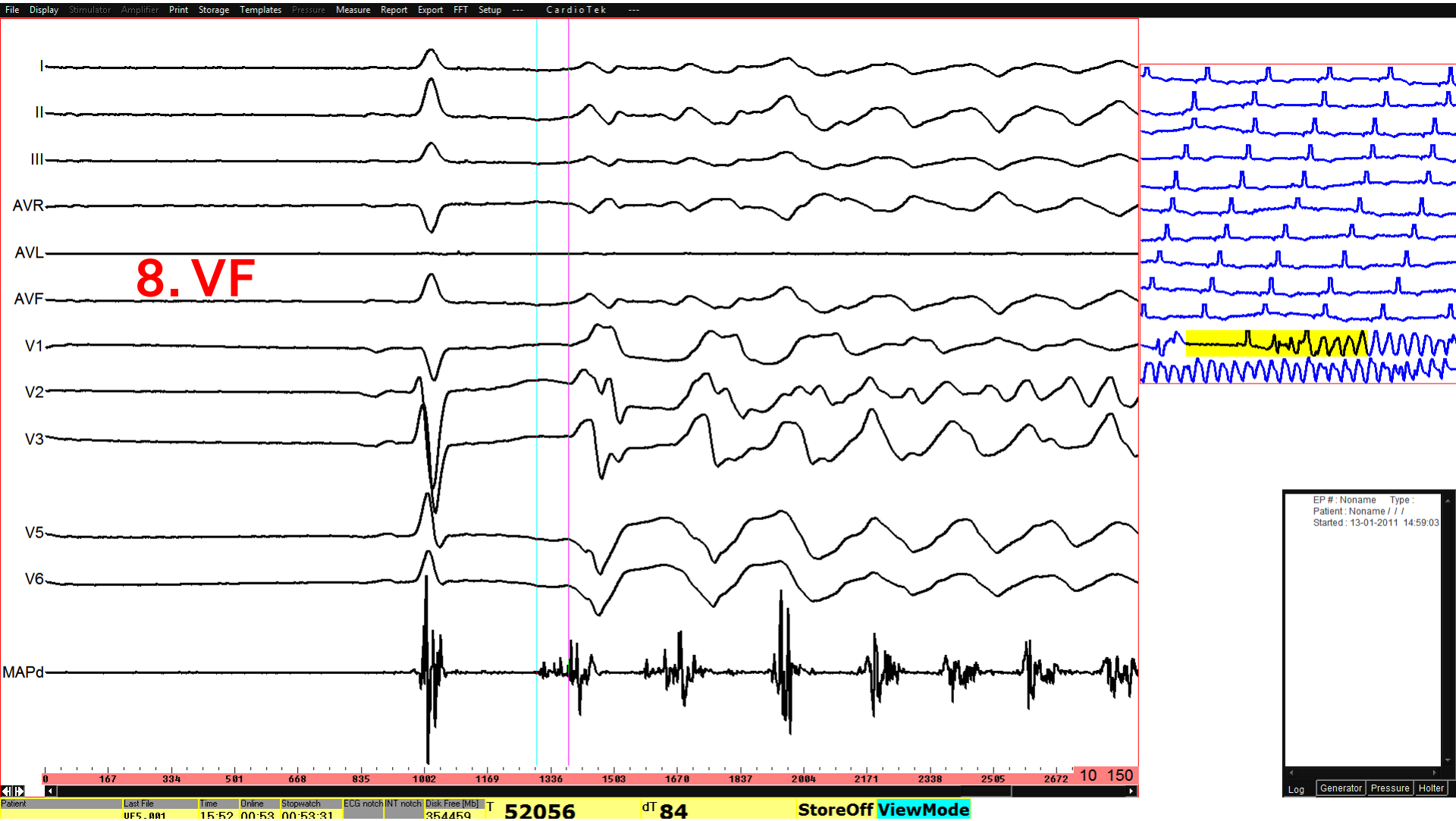


6th map: Atrial pacemaker turn off = VF

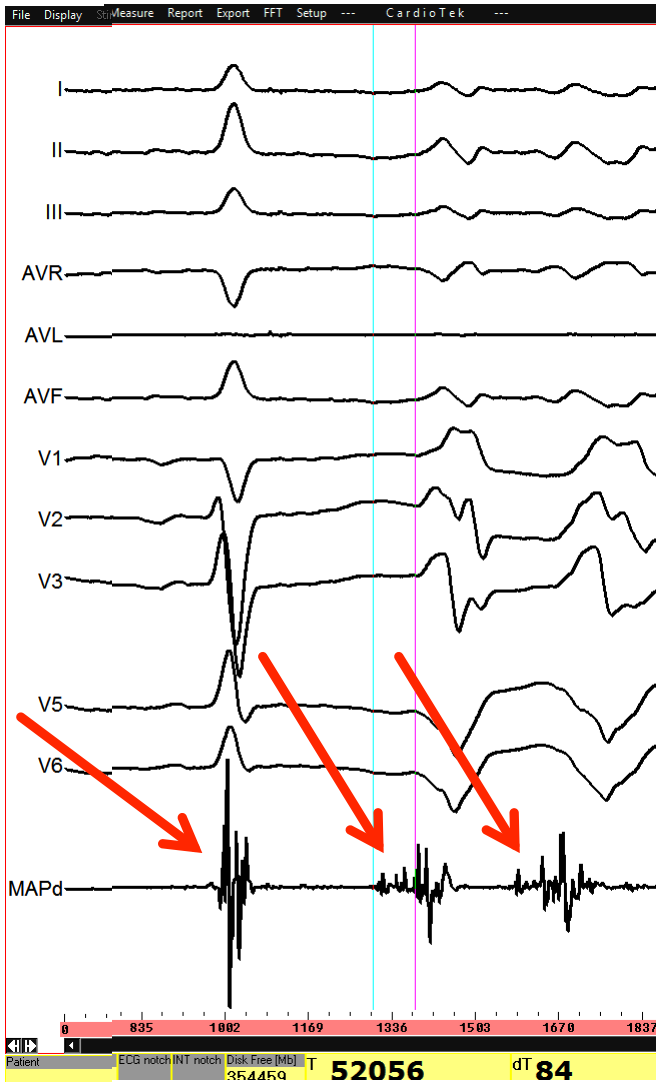
7th map: Atrial pacemeker turn off = VF



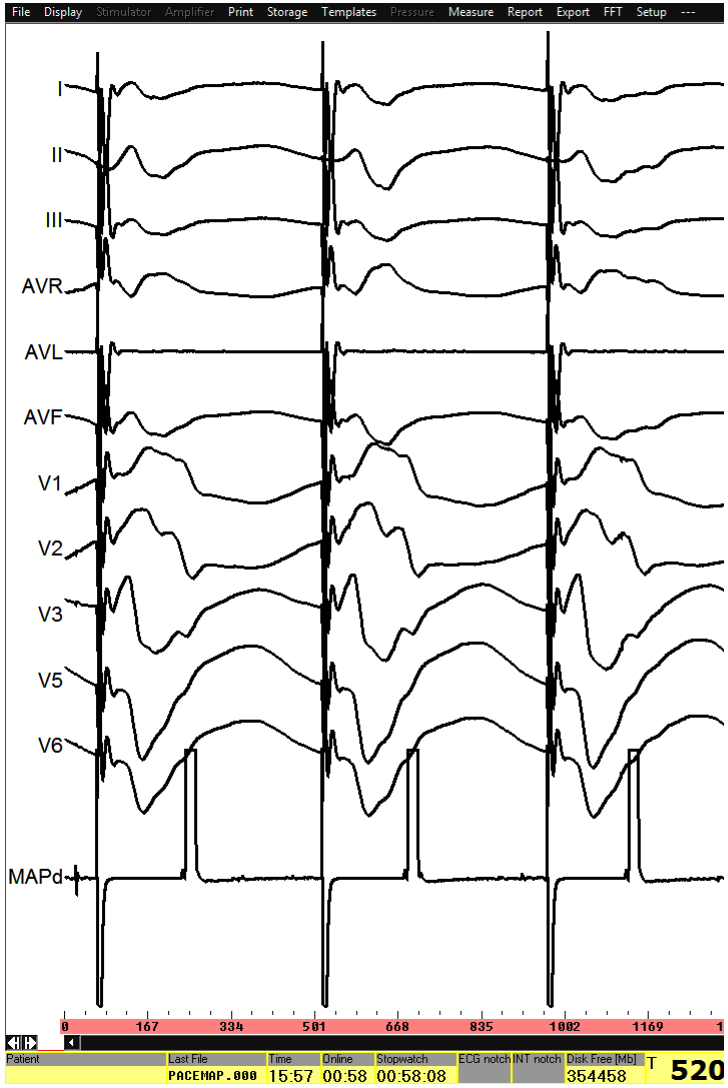
Last map: Atrial pacemeker turn off = VF



Successful - 8th ablation area Activation mapping



Successful 8th ablation area pace mapping

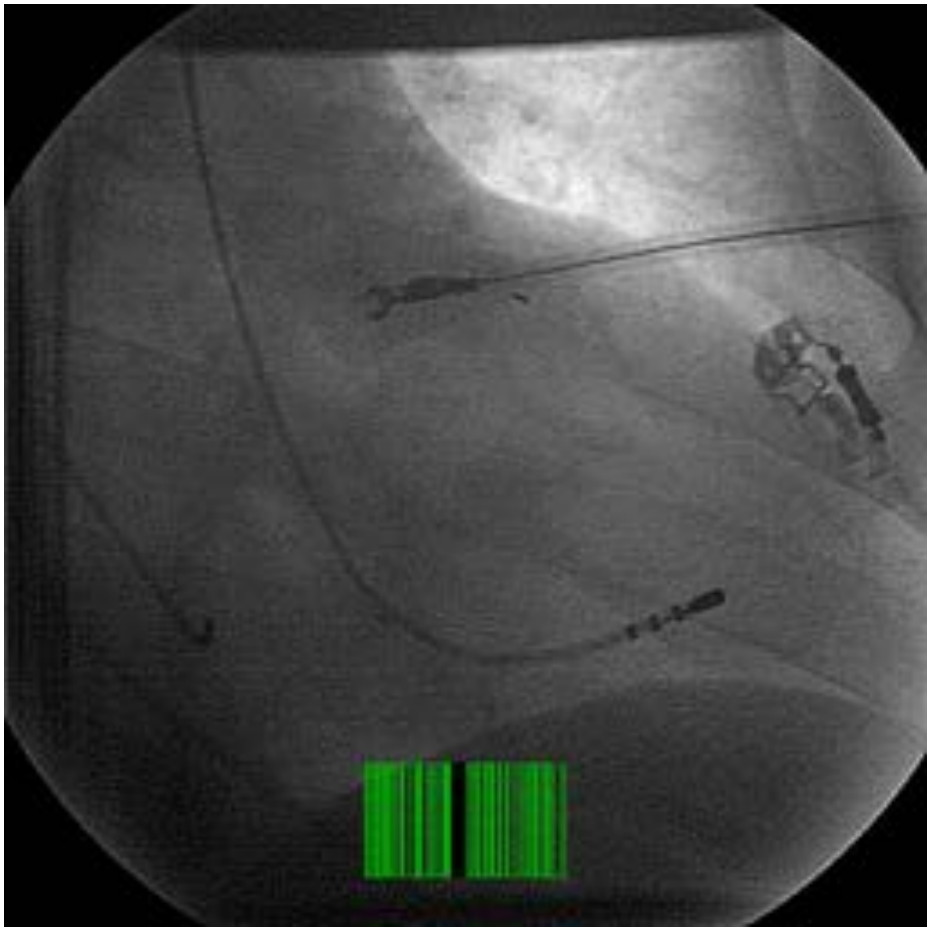


Post procedure ECG

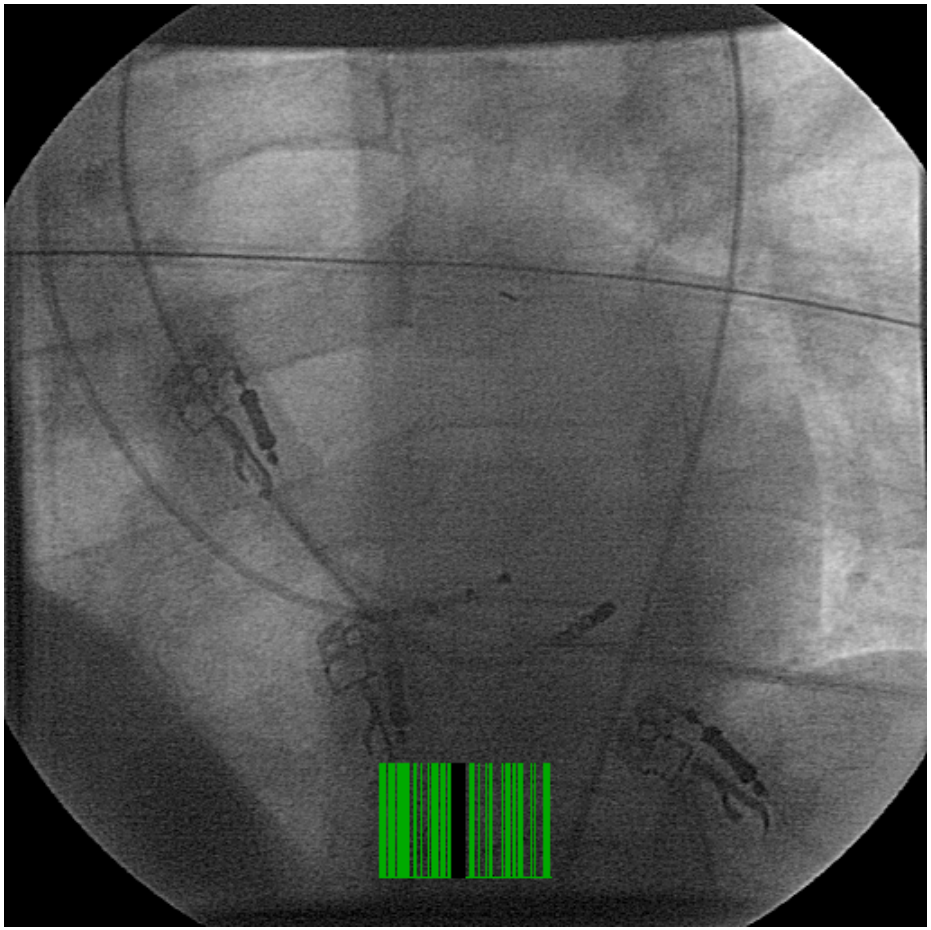
Time: 17:09

Successful ablation site

RAO 30°



LAO 45°



Follow up

28.01.2009

- DDDR ICD implantation

19.01.2010

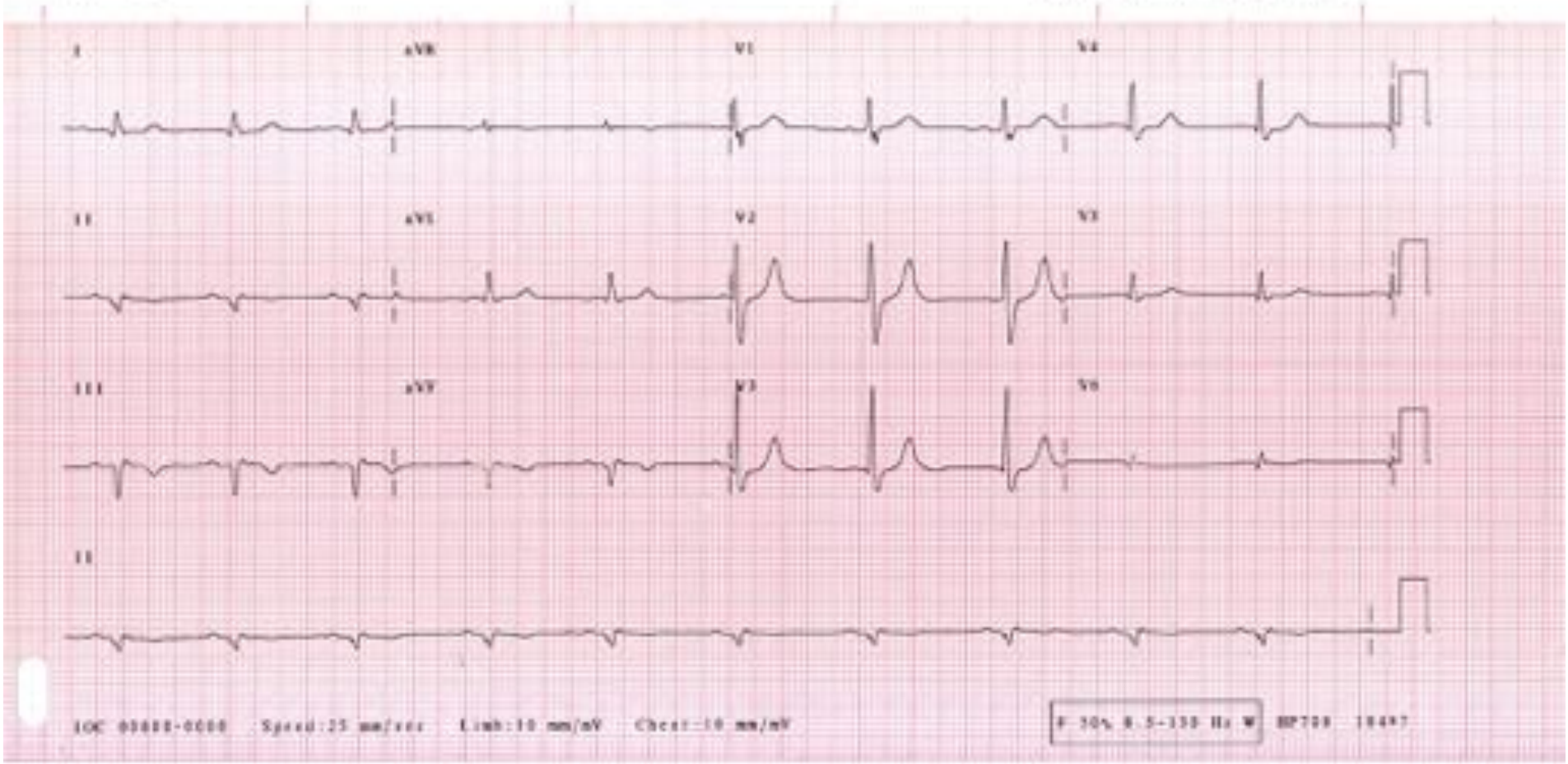
- Stent restenosis – ACS - CABG

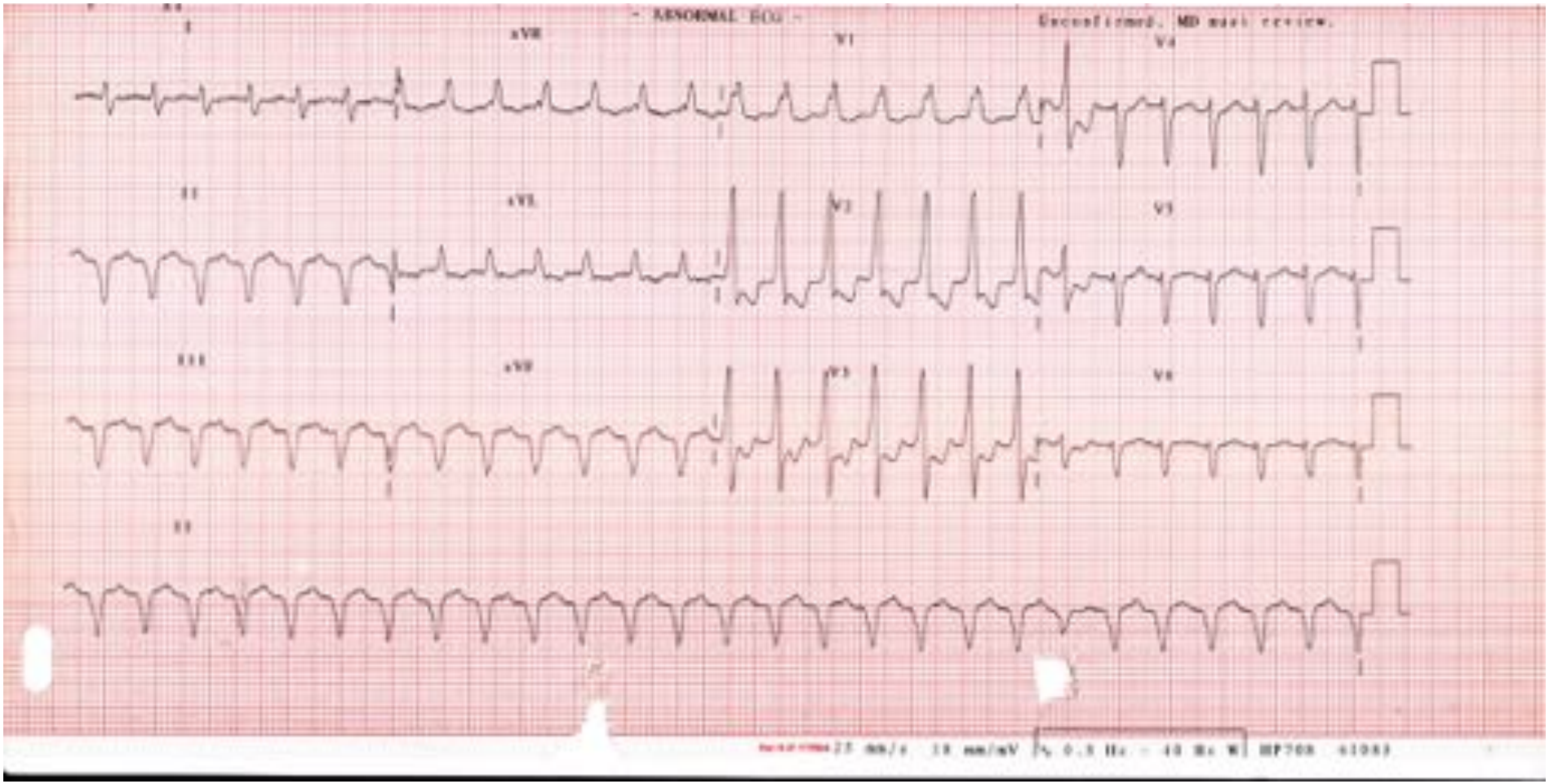
09/2015

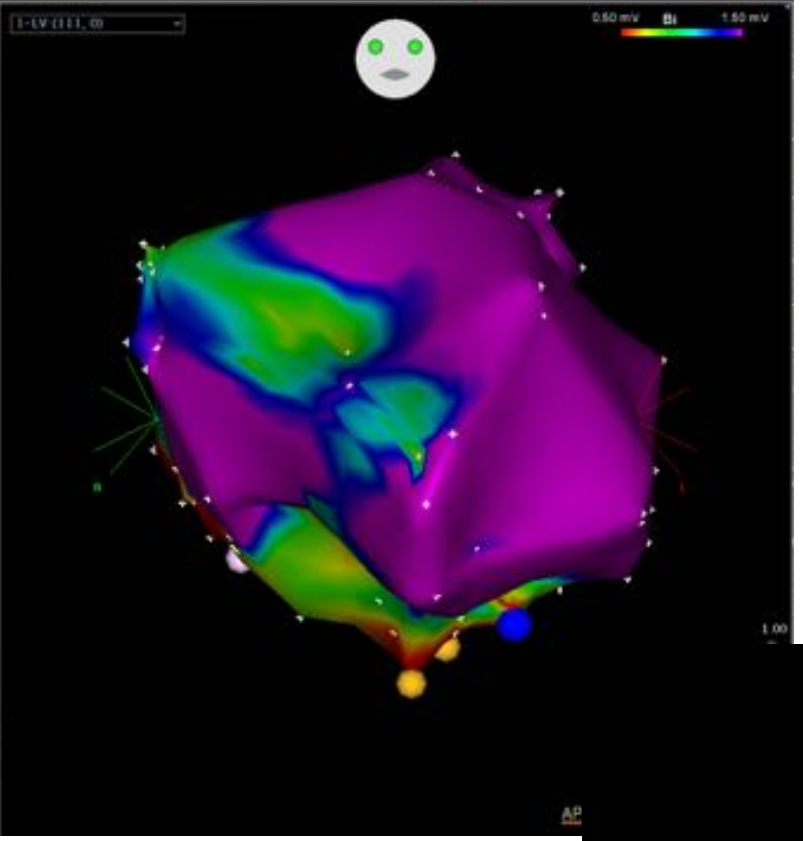
- Last ICD check: No arrhythmia, no shock or ATP

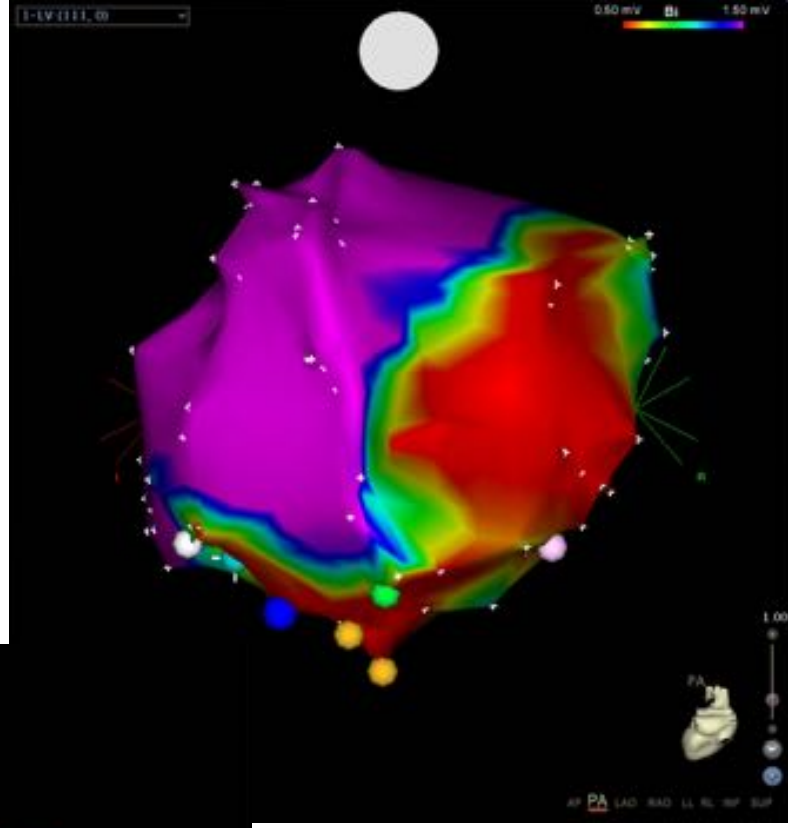
Case 2

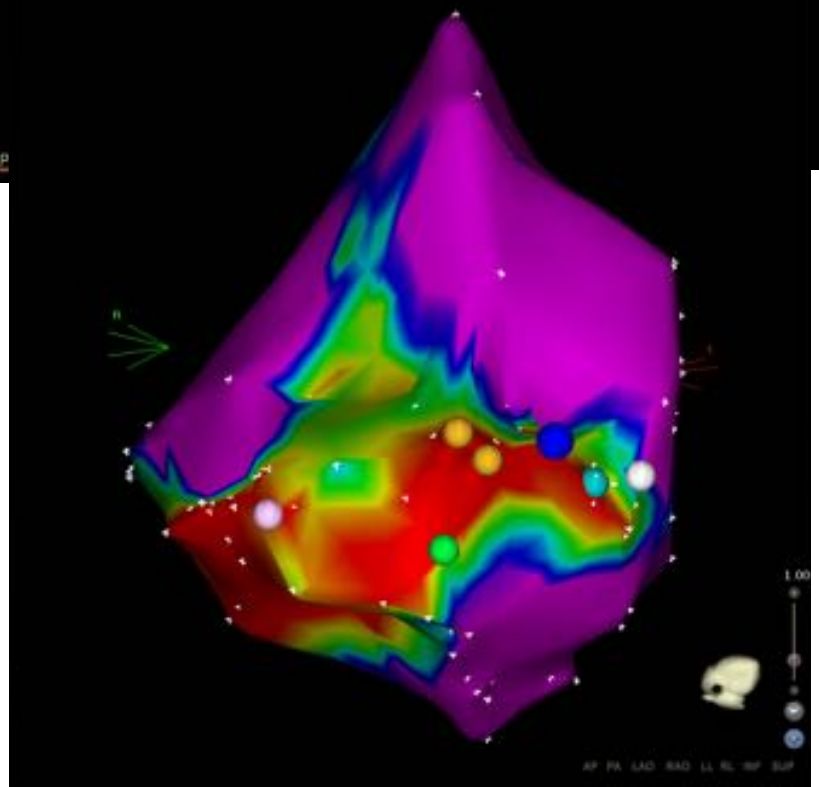
- 77 age, male
- 2011 …. CABG
- 3/2013 … syncope + sustained VT ….. ICD
- 11/2013 ….1 week ago, after chest pain incessant VT – 6 times 35 J shock
  - Hospitalization CCU
  - IV amiodarone + sedation
  - Coronary angiography: All grafts patent, no PCI
- Echocardiography: **EF 41%,** inf akinesia

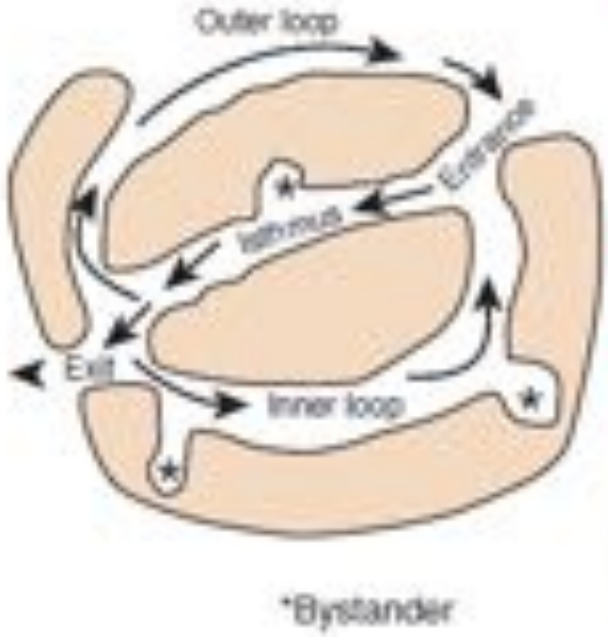

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
IOC 00000-0000 Speed:25 mm/sec Limb:10 mm/mV Chest:10 mm/mV
F 30% 0.5-150 Hz W
BP700 18497

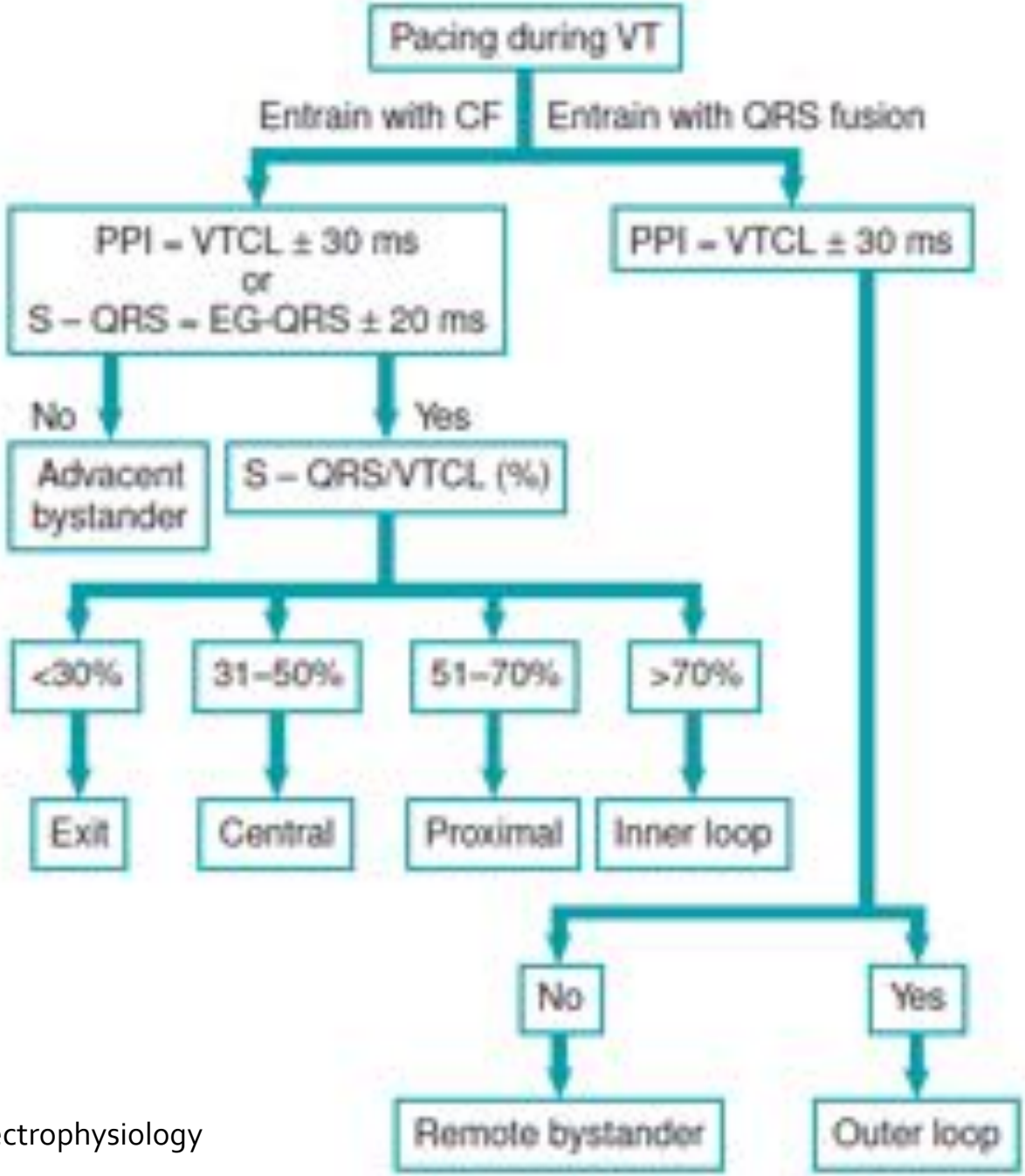

- ABNORMAL ECG -
Unconfirmed, MD must review.
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II


1-LV (111, 0)
0.50 mV
Bi
1.50 mV
1.00
AP


1-LV (111, 0)
0.50 mV
Bi
1.50 mV
1.00
PA
AP PA LAO RAO LL RL INF SUP

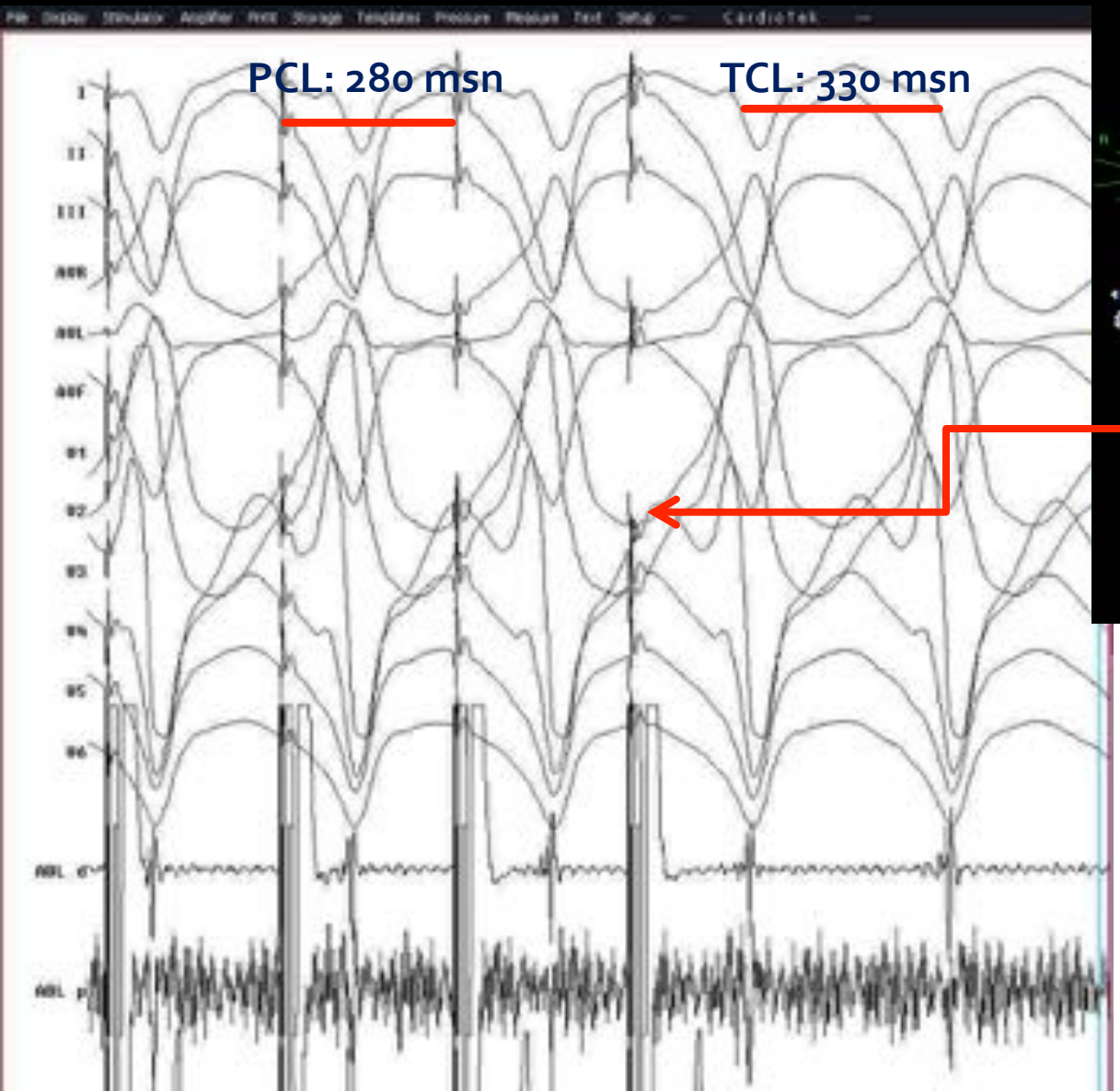

1.00
AP PA LAO RAO LL RL INF SUP

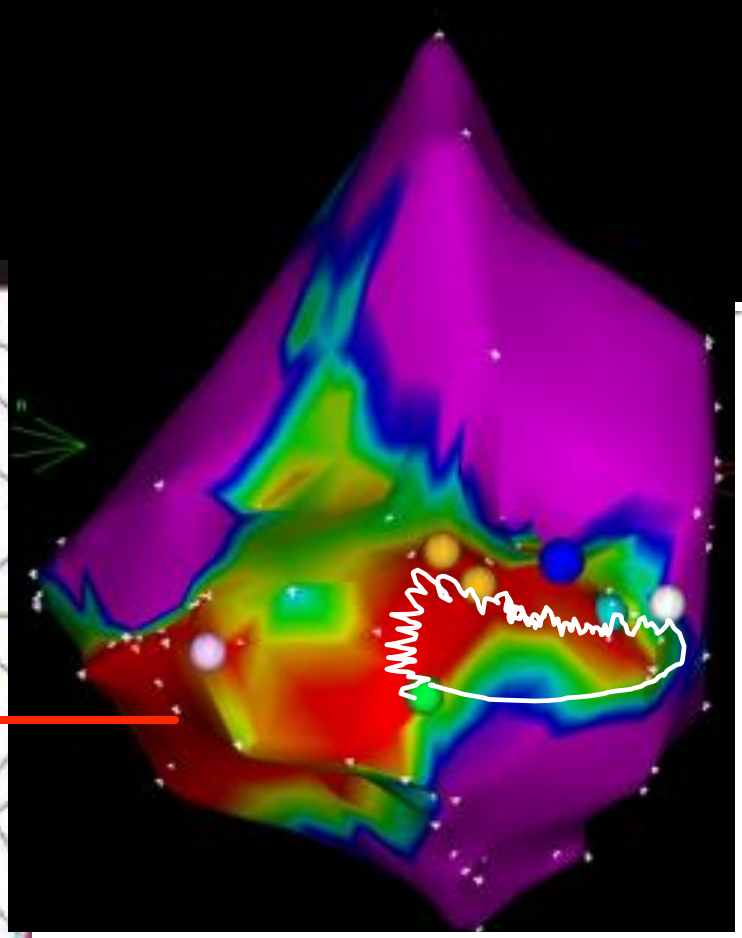




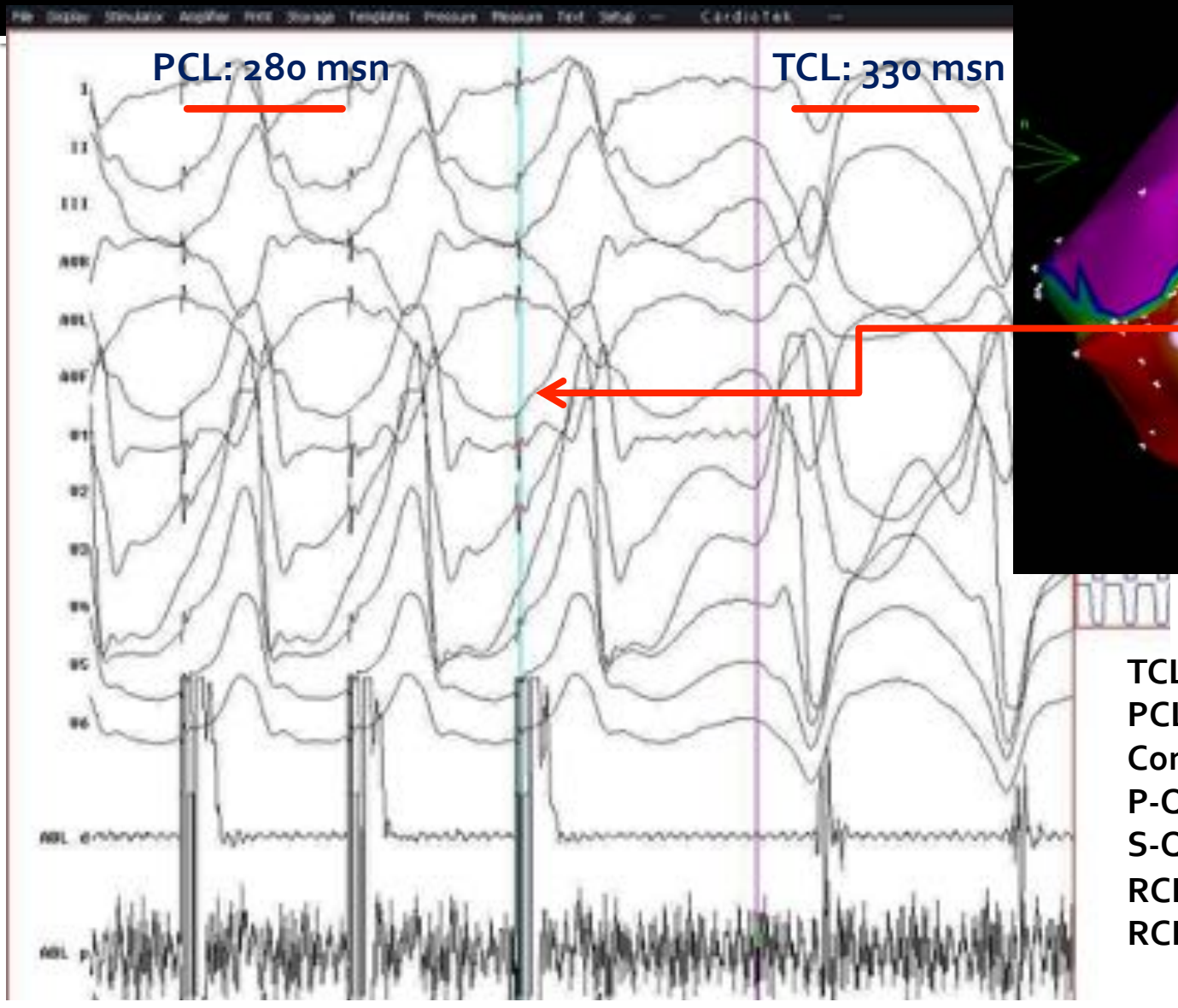
Sanjay Dixit and David J. Callans Cardiac Electrophysiology Review 2002;6:436–441

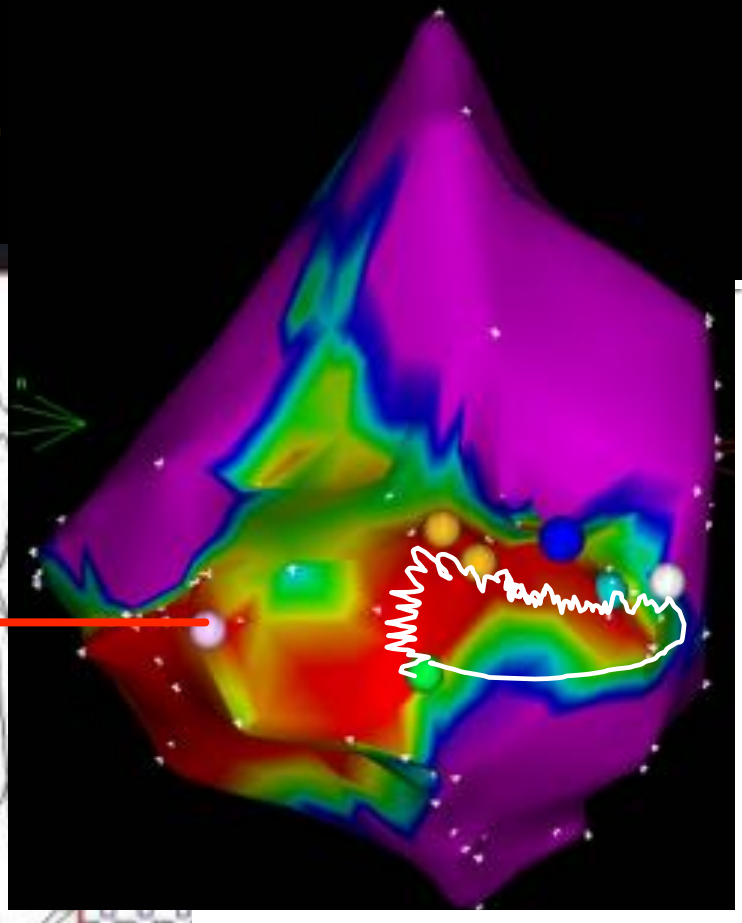
Entrainment 1: No capture





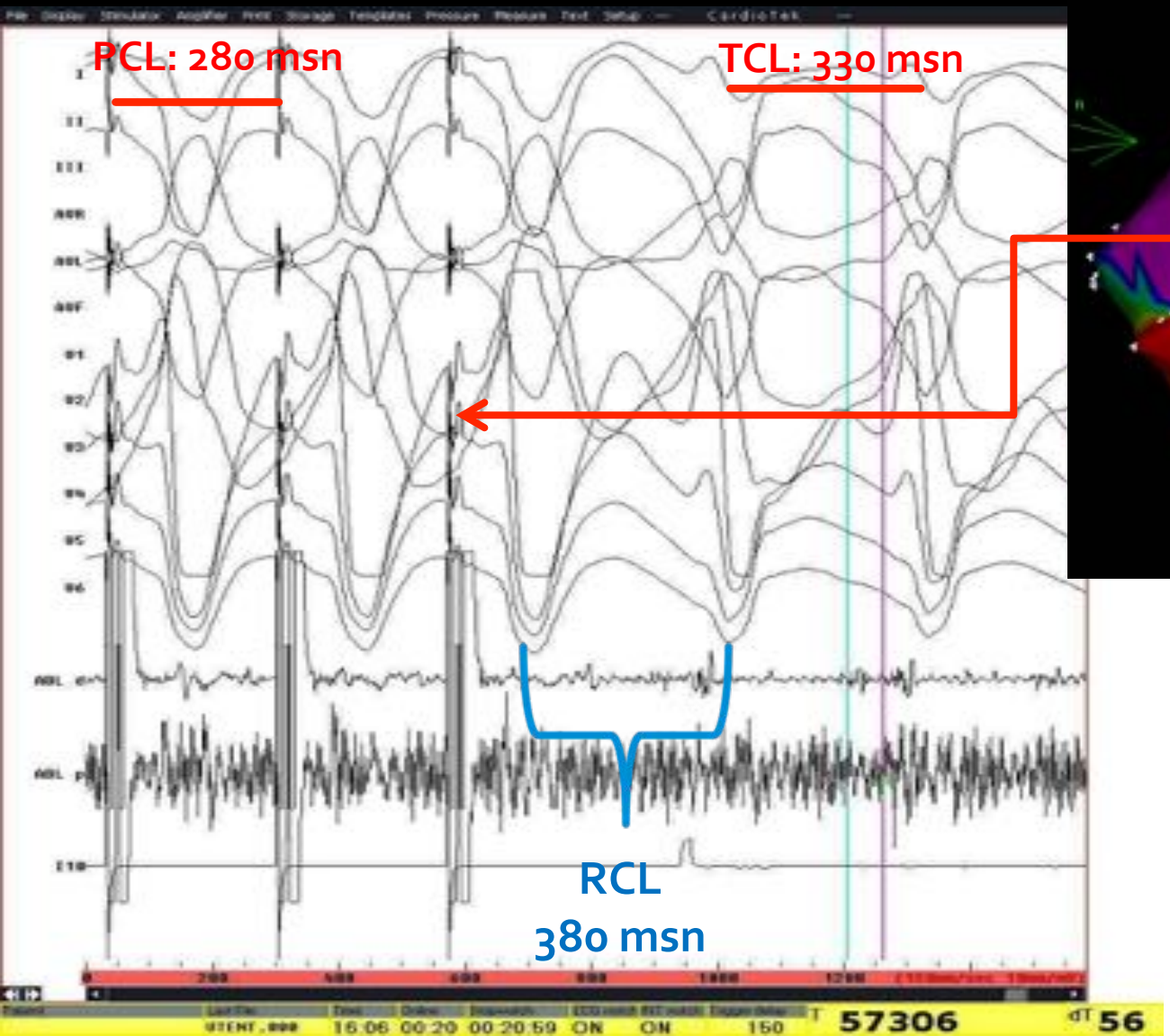
Entrainment 2: out of circuit

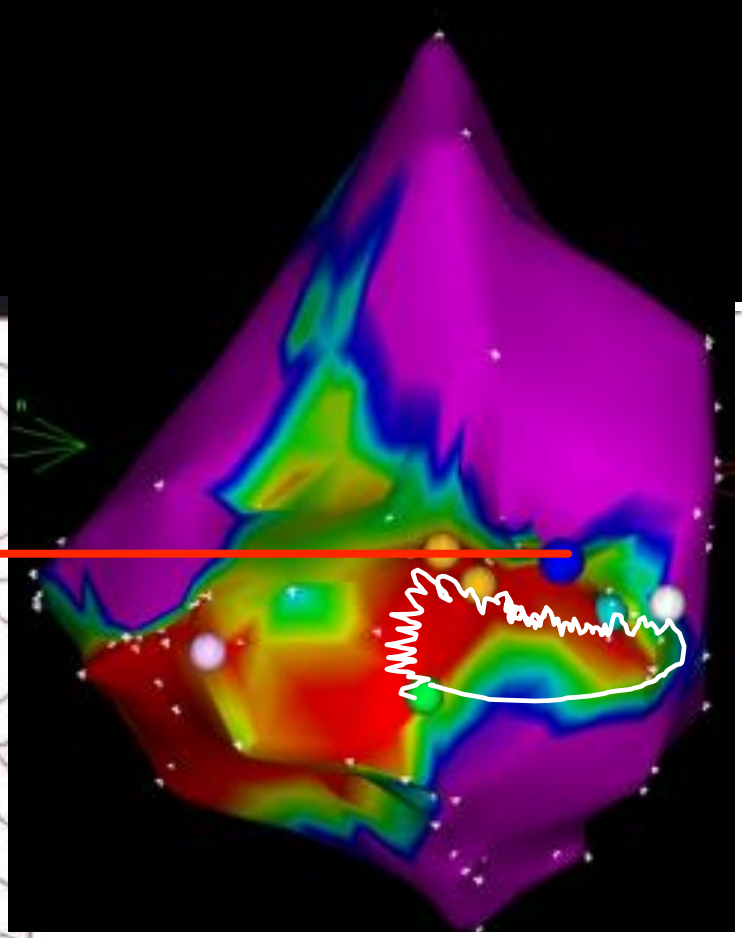




TCL: 330 msn
PCL: 280 msn
Concealed entrainment: No
P-QRS: 0 msn
S-QRS: .....
RCL: 380 msn
RCL – TCL = 50 msn

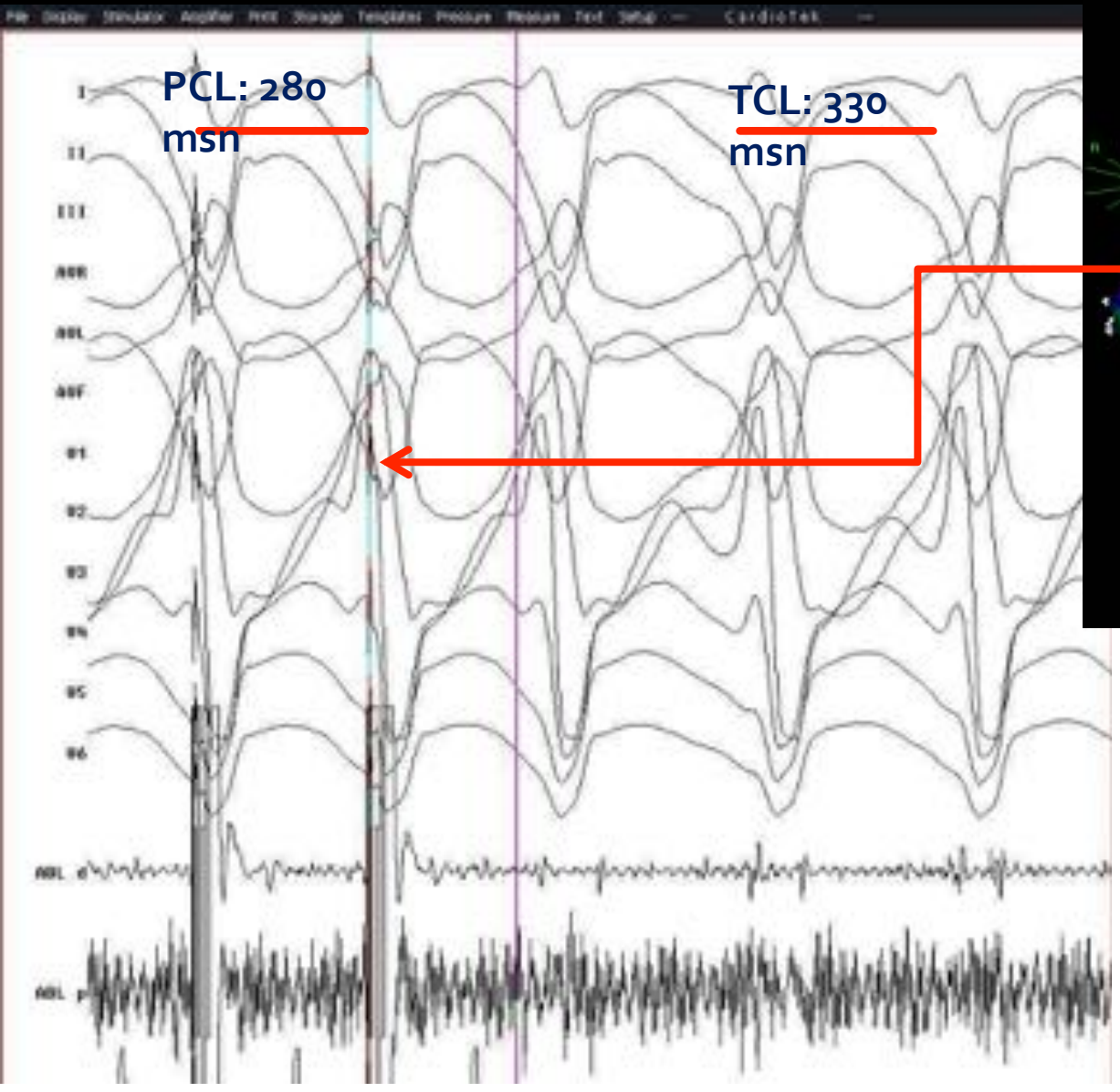
Entrainment 3: Remote by-stander

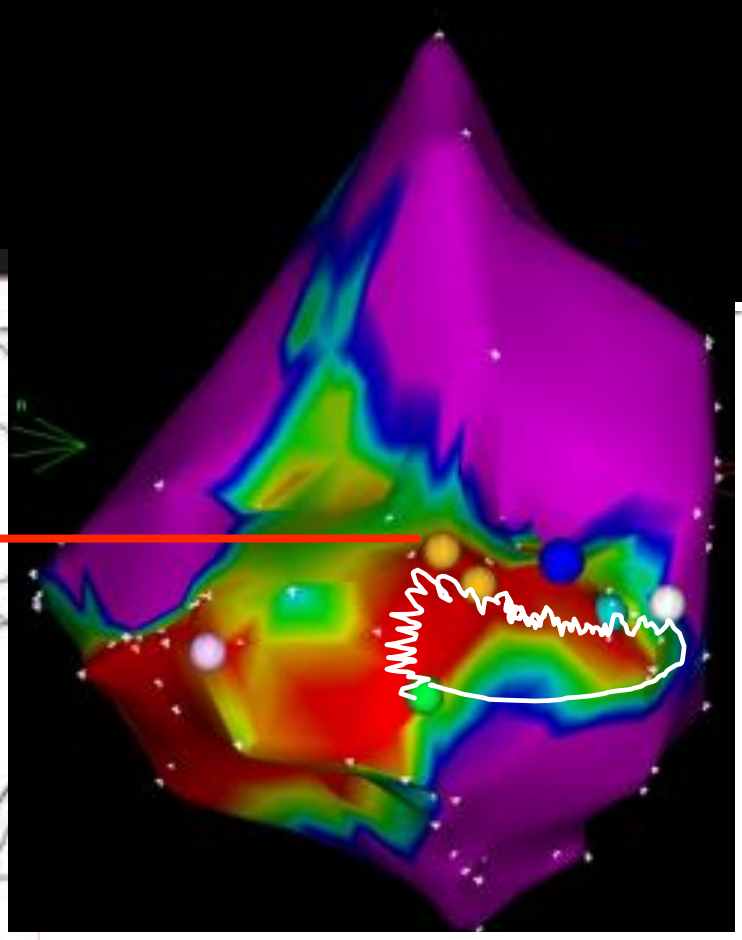




TCL: 330 msn
PCL: 280 msn
Concealed entrainment: No
P-QRS: 56 msn
S-QRS: 70 msn
RCL: 380 msn
RCL – TCL = 50 msn

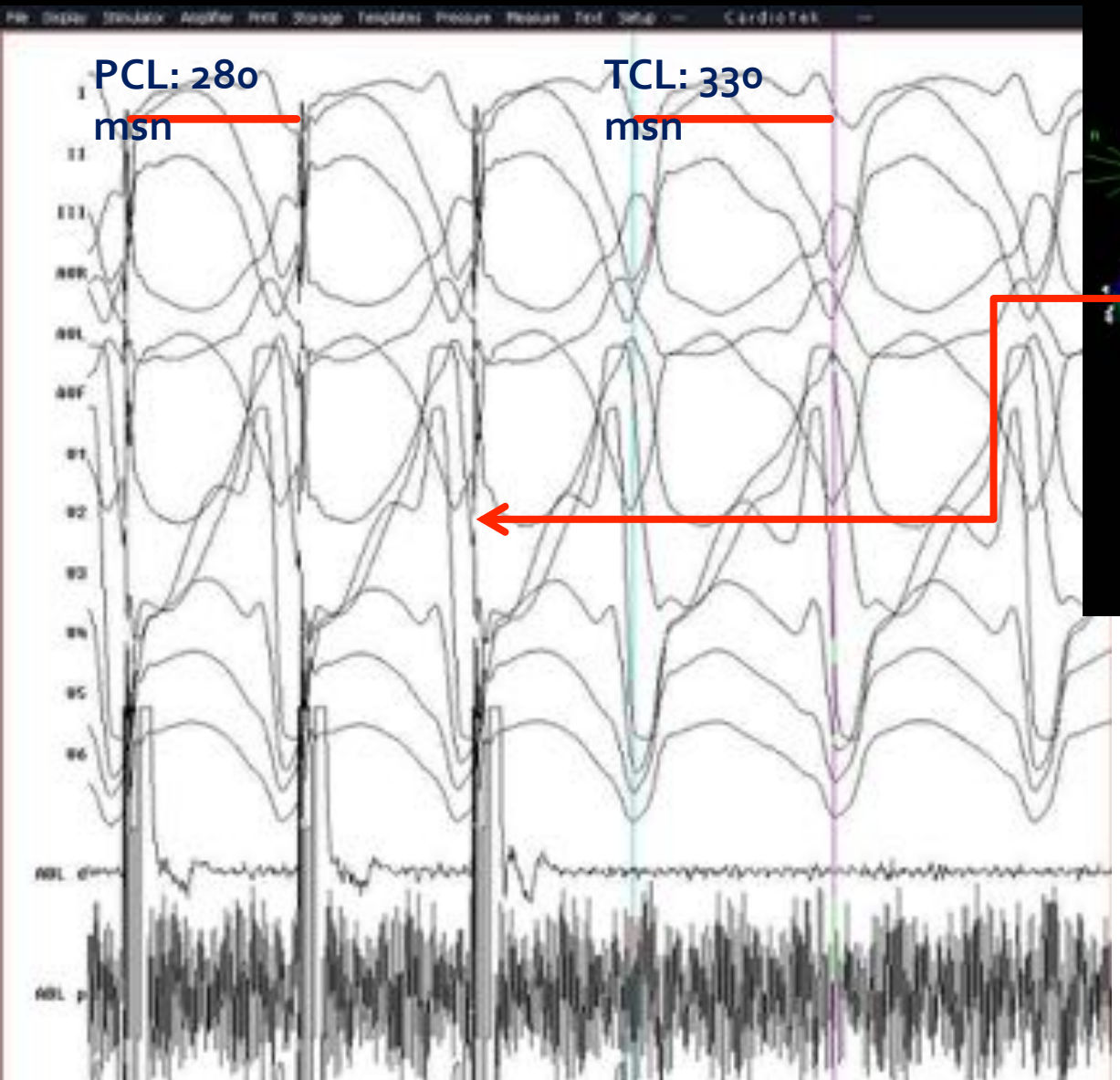
Entrainment 4: Proximal

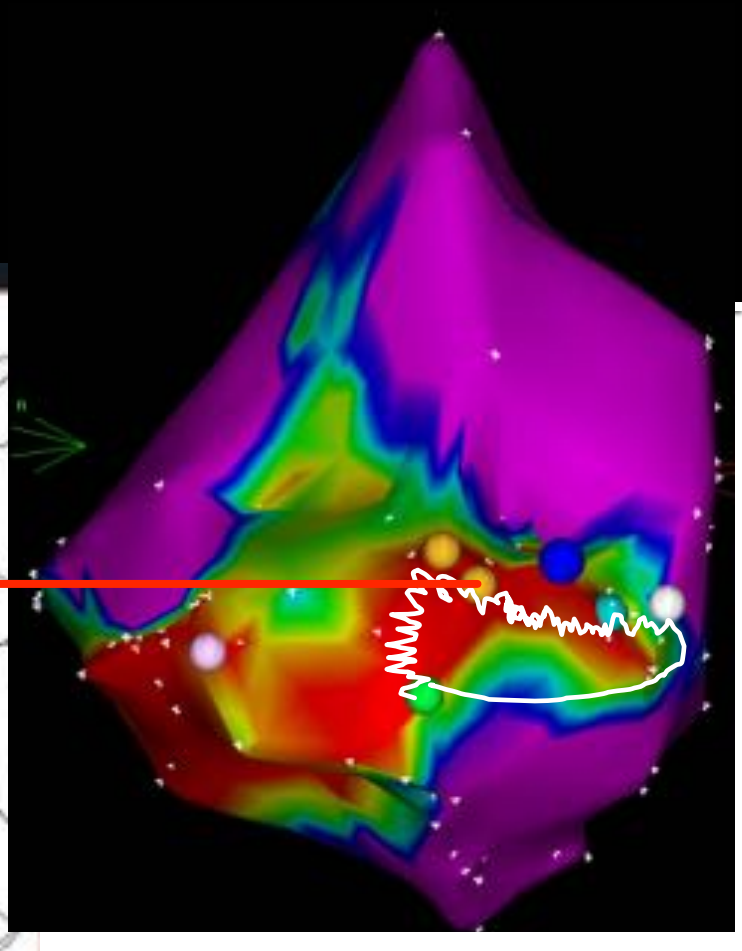




TCL: 330 msn
PCL: 280 msn
Concealed entrainment: yes
P-QRS: 220 msn
S-QRS: 220 msn
RCL: 338 msn
RCL – TCL = 8 msn
S-QRS/TCL = 66%

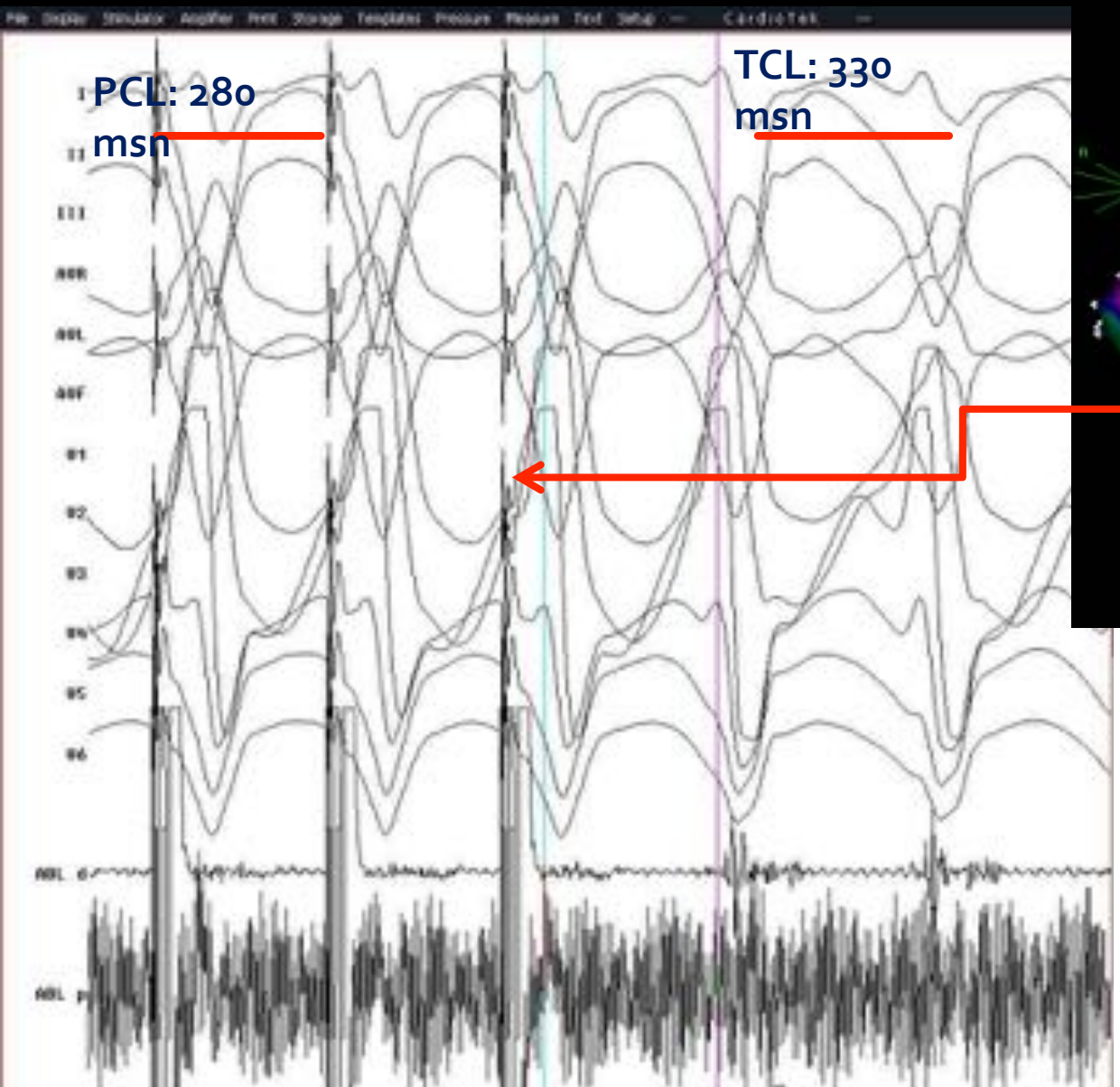
Entrainment 5: Proximal

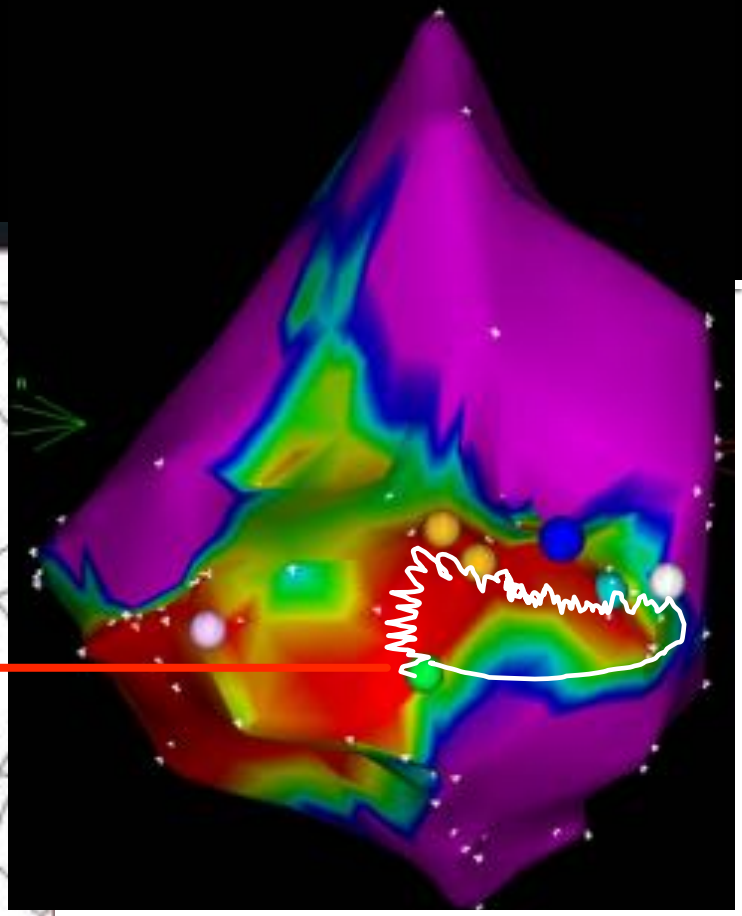




TCL: 330 msn
PCL: 280 msn
Concealed entrainment: yes
P-QRS: 188 msn
S-QRS: 188 msn
RCL: 330 msn
RCL – TCL = 0 msn
S-QRS/TCL = 57%

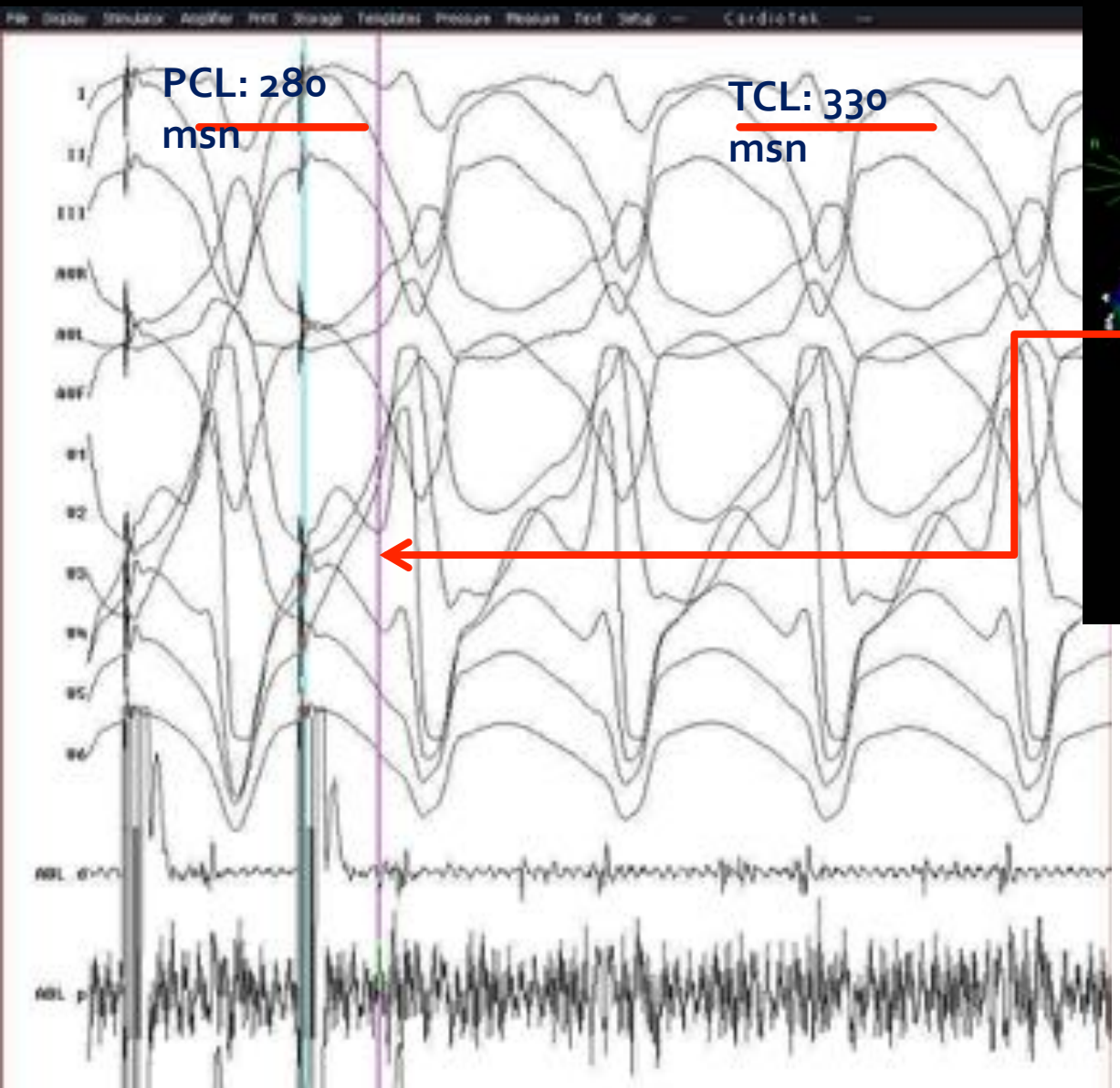
Entrainment 6: Inner loop

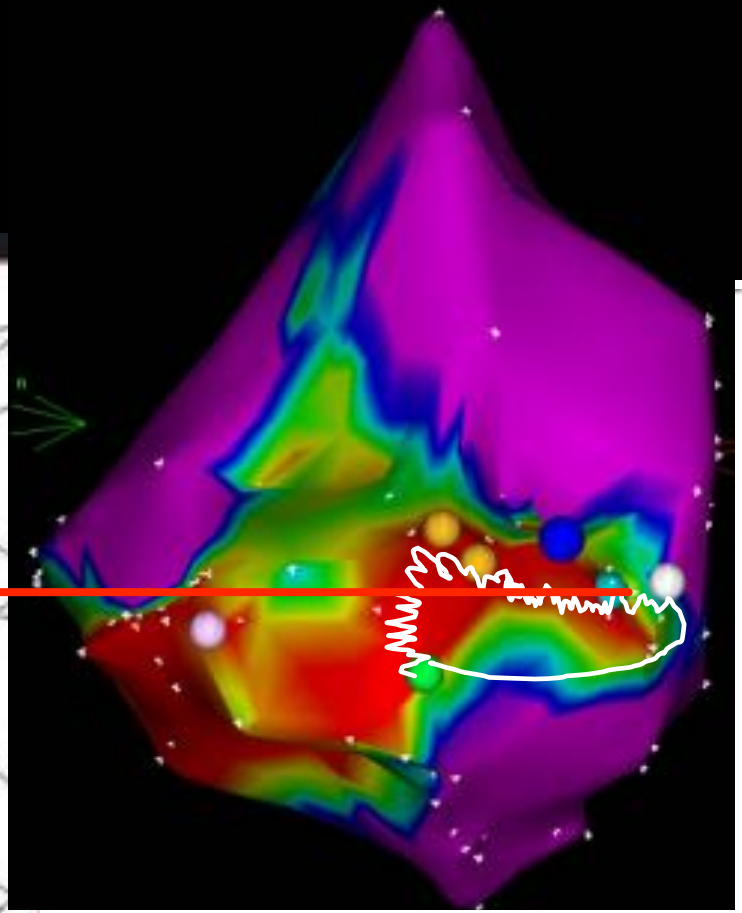




TCL: 330 msn
PCL: 280 msn
Concealed entrainment: yes
P-QRS: 302 msn
S-QRS: 302 msn
RCL: 330 msn
RCL – TCL = 0 msn
S-QRS/TCL = 79%

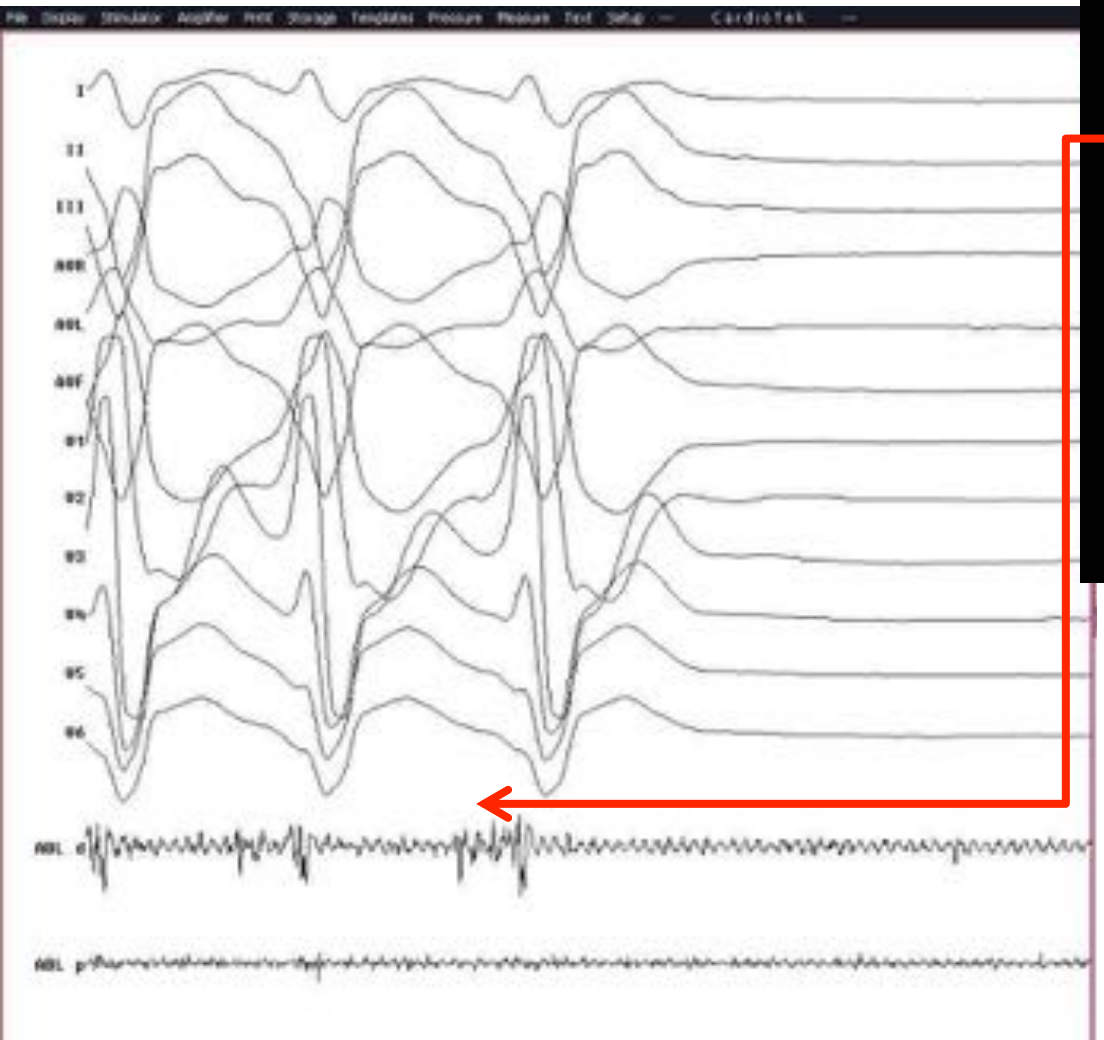
Entrainment 7: Exit

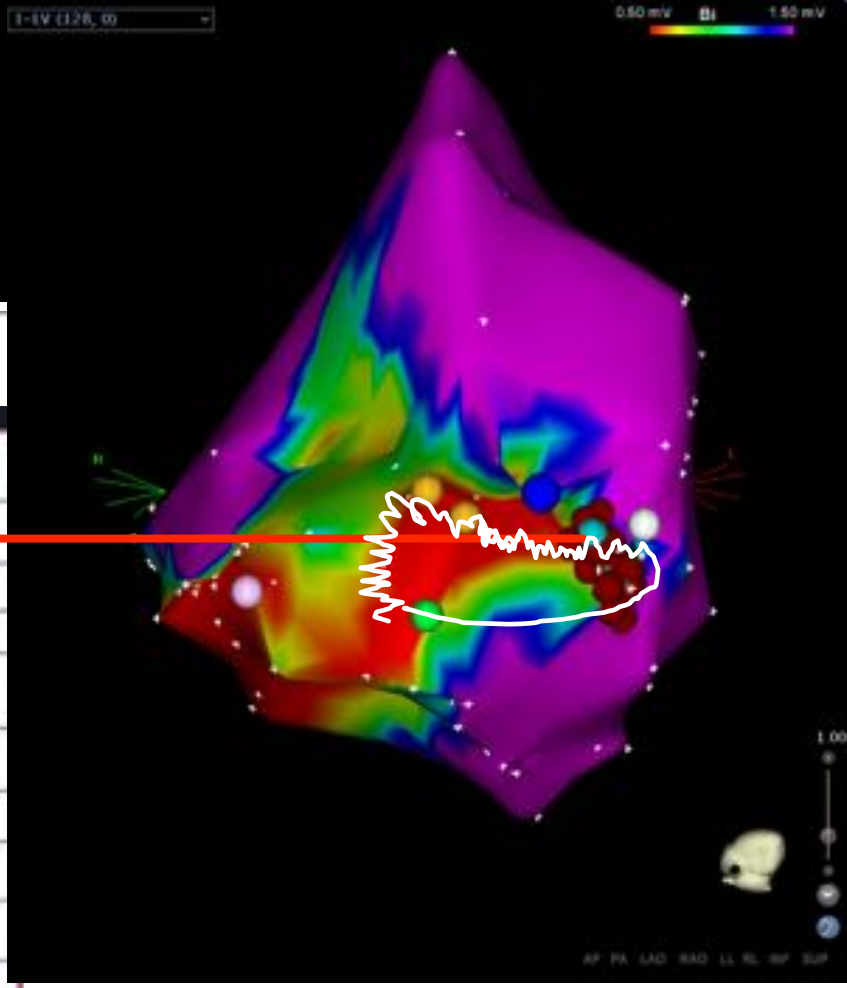




TCL: 330 msn
PCL: 280 msn
Concealed entrainment: yes
P-QRS: 92 msn
S-QRS: 94 msn
RCL: 330 msn
RCL – TCL = 0 msn
S-QRS/TCL = 28%

Ablation start





Ablation completed