Α΄ ΚΑΡΔΙΟΛΟΓΙΚΗ ΚΛΙΝΙΚΗ
ΚΑΙ ΟΜΩΝΥΜΟ (Α' ΚΑΡΔΙΟΛΟΓΙΚΟ – ΑΙΜΟΔΥΝΑΜΙΚΟ) ΕΡΓΑΣΤΗΡΙΟ

ΙΠΠΟΚΡΑΤΕΙΕΣ ΗΜΕΡΕΣ ΚΑΡΔΙΟΛΟΓΙΑΣ
ΛΗΨΗ ΚΛΙΝΙΚΩΝ ΑΠΟΦΑΣΕΩΝ ΜΕΣΑ ΑΠΟ ΤΗΝ ΠΑΡΟΥΣΙΑΣΗ ΠΕΡΙΣΤΑΤΙΚΩΝ
ΜΕ ΔΙΕΘΝΗ ΣΥΜΜΕΤΟΧΗ

ΕΘΝΙΚΟ ΚΑΙ ΚΑΠΟΔΙΣΤΡΙΑΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ
ΙΑΤΡΙΚΗ ΣΧΟΛΗ

Στρατηγικές κατάλυσης κοιλιακών αρρυθμιών

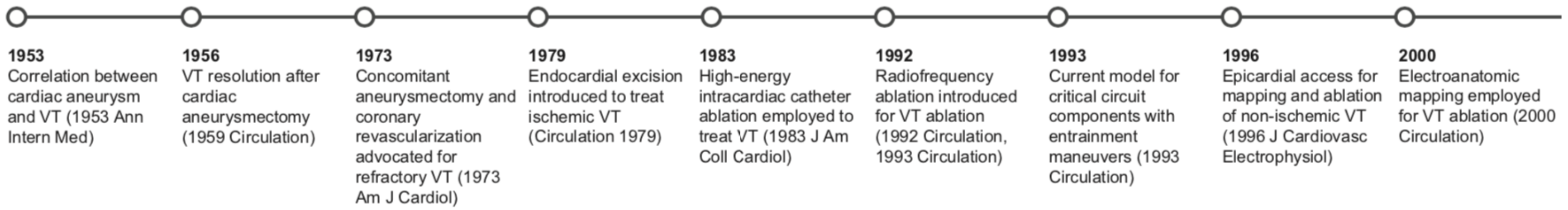
Dimitris Tsiachris

Ass. Professor Cardiology

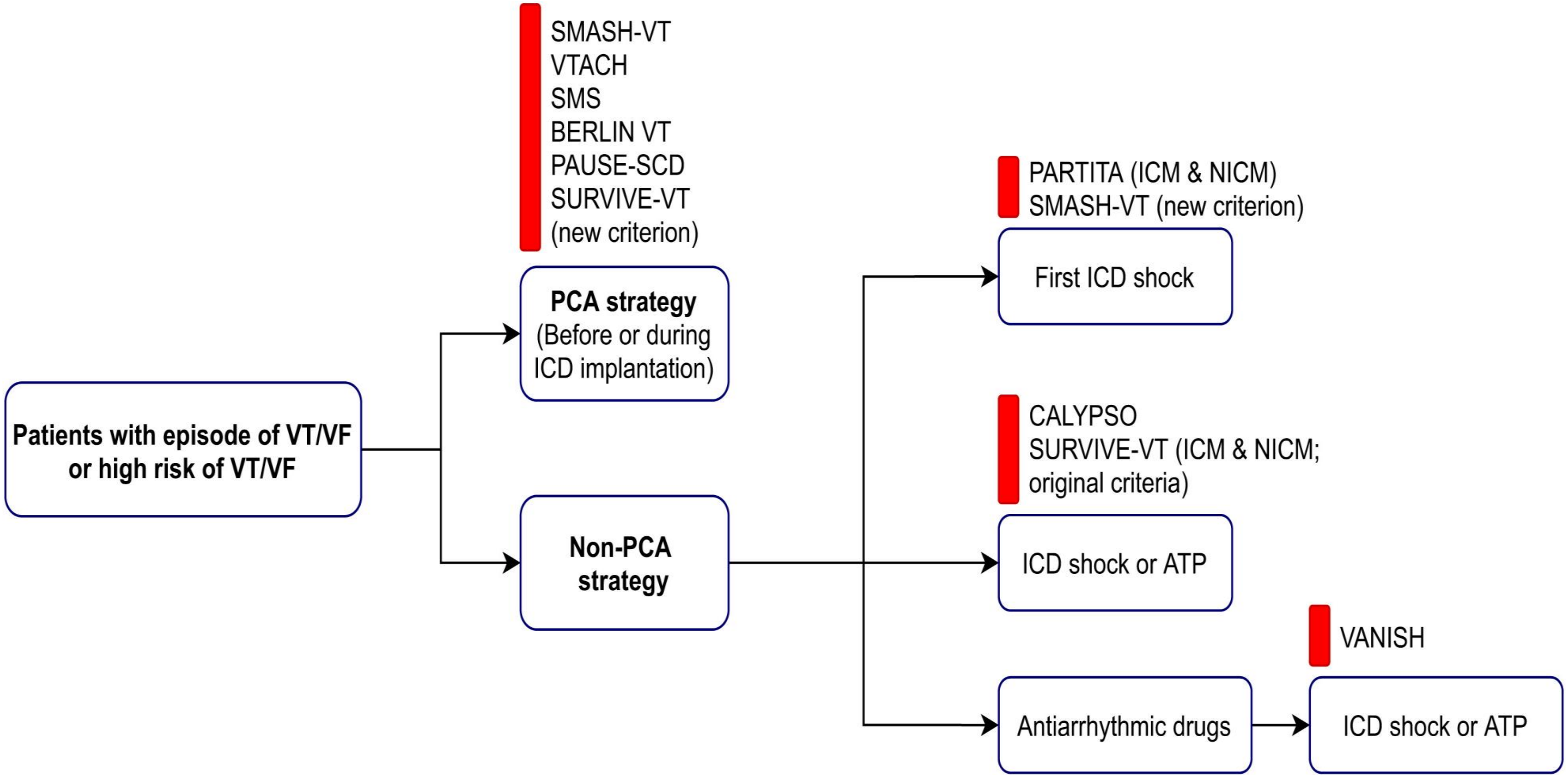
University of Athens Medical School

Athens Heart Center

FIGURE 1 Timeline Summarizing Historical Evolution of VT Ablation



The field evolved from surgical observations of ventricular aneurysm participation in ventricular tachycardia (VT) to surgical aneurysmectomy followed by surgical endocardial resection to treat ischemic VT. The introduction of high-energy direct current catheter ablation followed by radiofrequency ablation supplanted surgical procedures. Modern catheter-based techniques rely on stimulation techniques and mapping systems to describe circuits and define substrate that can be targeted for successful elimination of VT.



SMASH-VT
VTACH
SMS
BERLIN VT
PAUSE-SCD
SURVIVE-VT
(new criterion)
Patients with episode of VT/VF or high risk of VT/VF
PCA strategy (Before or during ICD implantation)
Non-PCA strategy
PARTITA (ICM & NICM)
SMASH-VT (new criterion)
First ICD shock
CALYPSO
SURVIVE-VT (ICM & NICM; original criteria)
ICD shock or ATP
VANISH
Antiarrhythmic drugs
ICD shock or ATP

VT ablation indications

- **First line at different clinical settings**

✓ **ES**

✓ **incessant VT**

✓ **multiple shocks**

✓ first shock

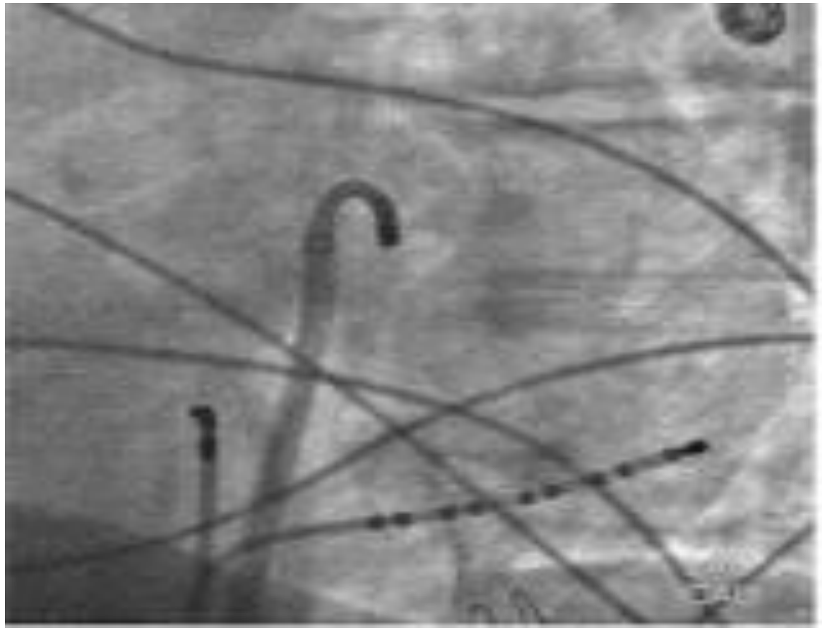
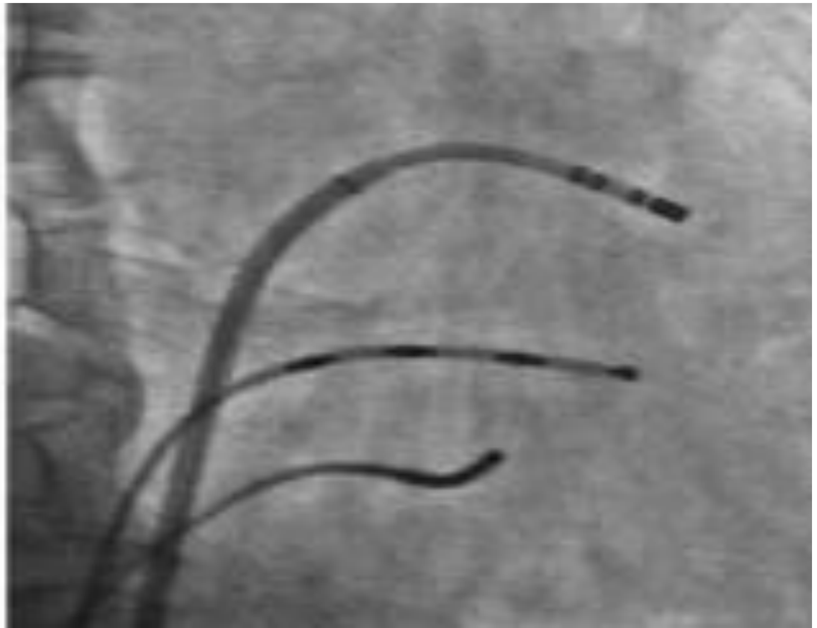
✓ at ICD implant

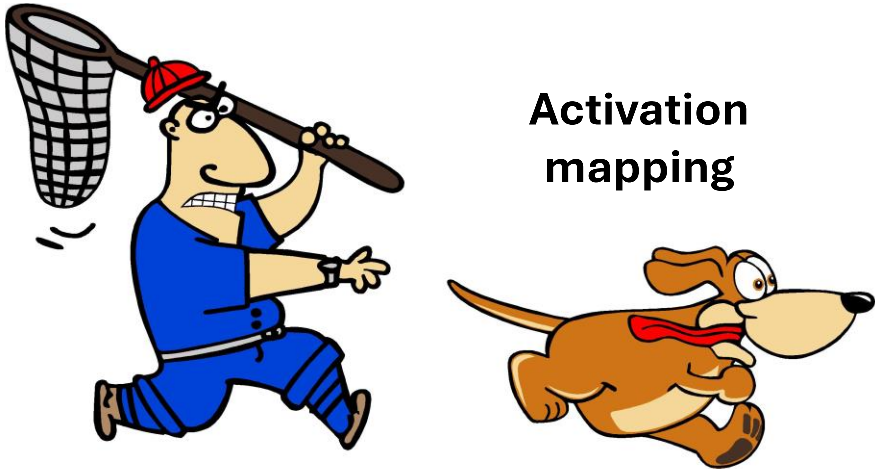
Procedural Steps

- Heart and renal failure management
- External defib patches (proper positioning, proper cleaning)
- Presence of anesthesiologist, iv antibiotics
- General anesthesia (safer but non inducible VT)
- Femoral access (US guided, long arterial sheaths)
- LV access (aortic calcification)
- LV thrombus (use of ICE)
- Transeptal puncture (deflectable sheath) (in case of basal inferior scar)
- Hemodynamic support (inotropes, LV assist devices)

Endo trans-septal approach

- Sole approach in aortic prosthetic valve and in severe vascular disease
- Necessary in basal perimitral scars – exit sites
- Use of large deflectable sheaths
- Avoid in large apical scars (aneurysms)

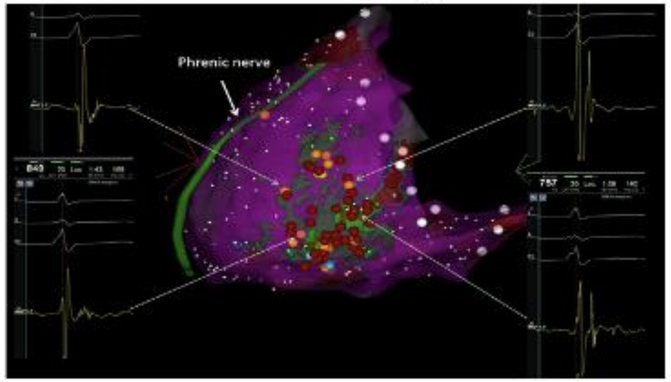


Activation mapping

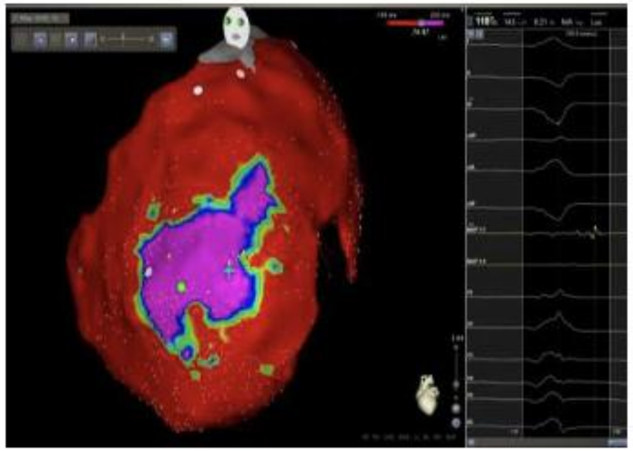
Substrate mapping

Not let the VT get out

Substrate Mapping and Ablation for Ventricular Tachycardia: The LAVA Approach

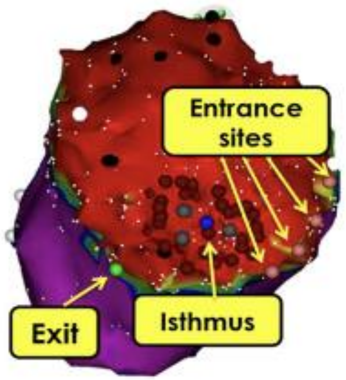


Noninducibility and Late Potential Abolition
A Novel Combined Prognostic Procedural End Point for Catheter Ablation of Postinfarction Ventricular Tachycardia

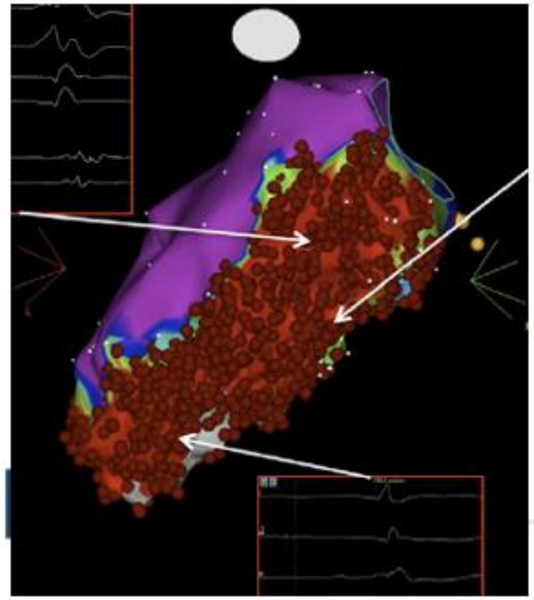


Core Isolation of Critical Arrhythmia Elements for Treatment of Multiple Scar-Based Ventricular Tachycardias

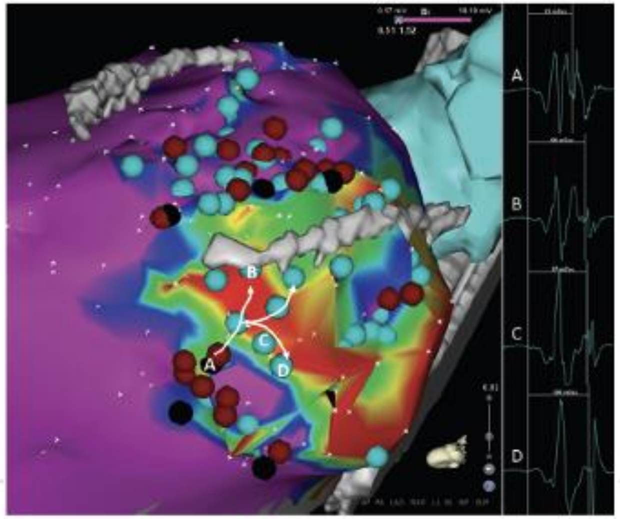
A



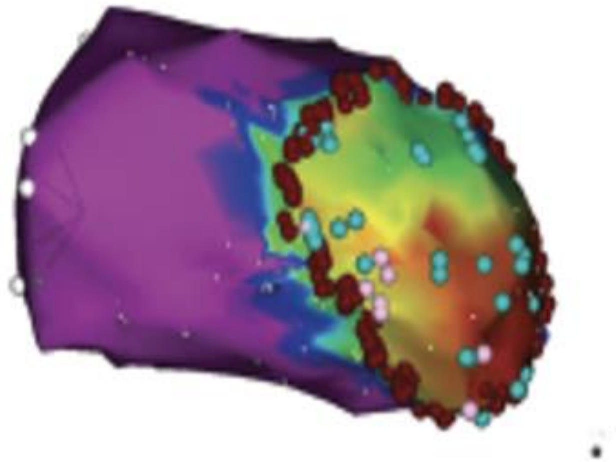
Endo-Epicardial Homogenization of the Scar Versus Limited Substrate Ablation for the Treatment of Electrical Storms in Patients With Ischemic Cardiomyopathy



Scar Dechanneling
New Method for Scar-Related Left Ventricular Tachycardia Substrate Ablation



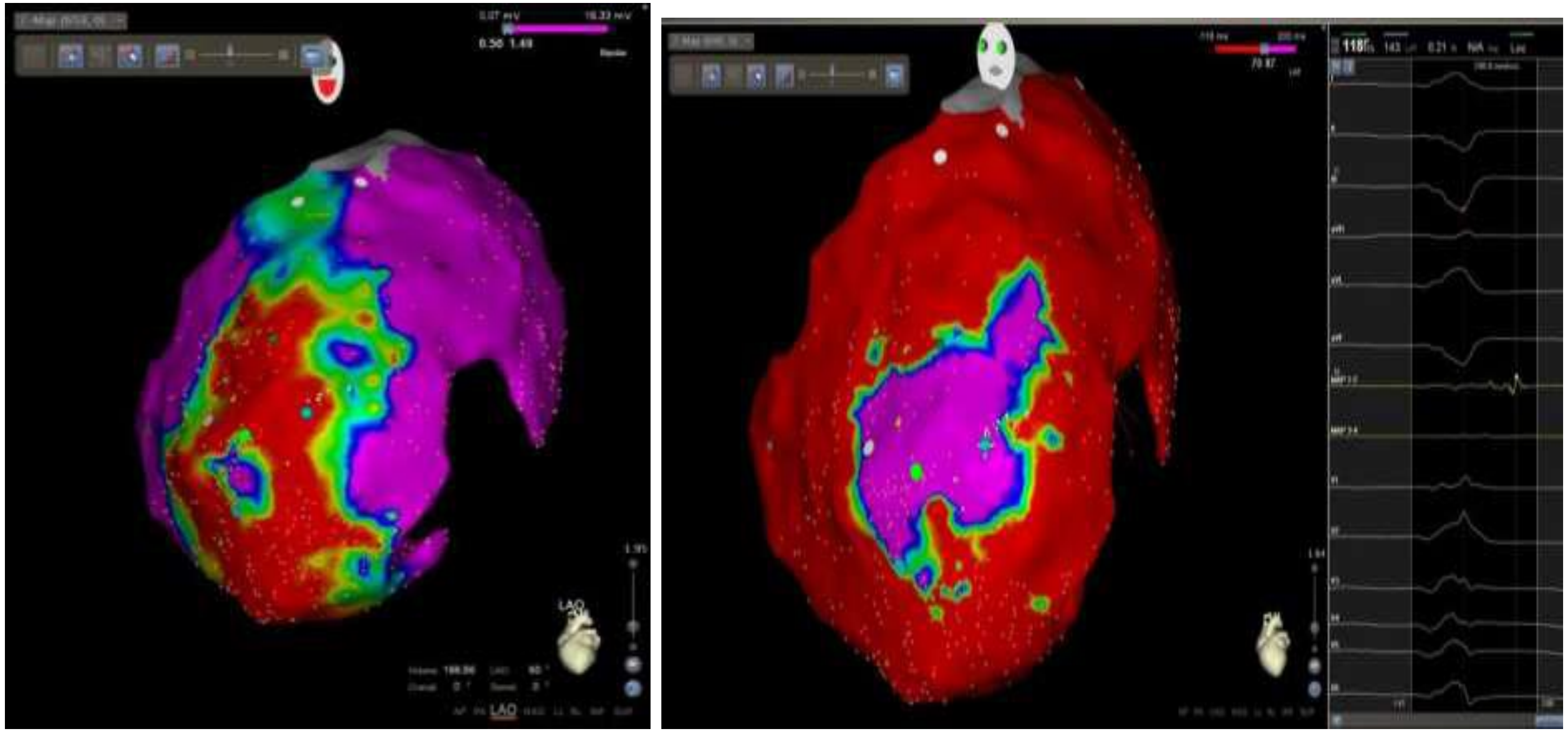
Electrical isolation of a substrate after myocardial infarction: a novel ablation strategy for unmappable ventricular tachycardias—feasibility and clinical outcome



Noninducibility and Late Potential Abolition

A Novel Combined Prognostic Procedural End Point for Catheter Ablation of Postinfarction Ventricular Tachycardia

John Silberbauer, MA, MD (Res), MRCP; Teresa Oloriz, MD; Giuseppe Maccabelli, MD; Dimitris Tsiachris, MD, PhD; Francesca Baratto, MD; Pasquale Vergara, MD, PhD; Hiroya Mizuno, MD, PhD; Caterina Bisceglia, MD, PhD; Alessandra Marzi, MD; Nicoleta Sora, MD; Fabrizio Guarracini, MD; Andrea Radinovic, MD; Manuela Cireddu, MD; Simone Sala, MD; Simone Gulletta, MD; Gabriele Paglino, MD; Patrizio Mazzone, MD; Nicola Trevisi, MD; Paolo Della Bella, MD



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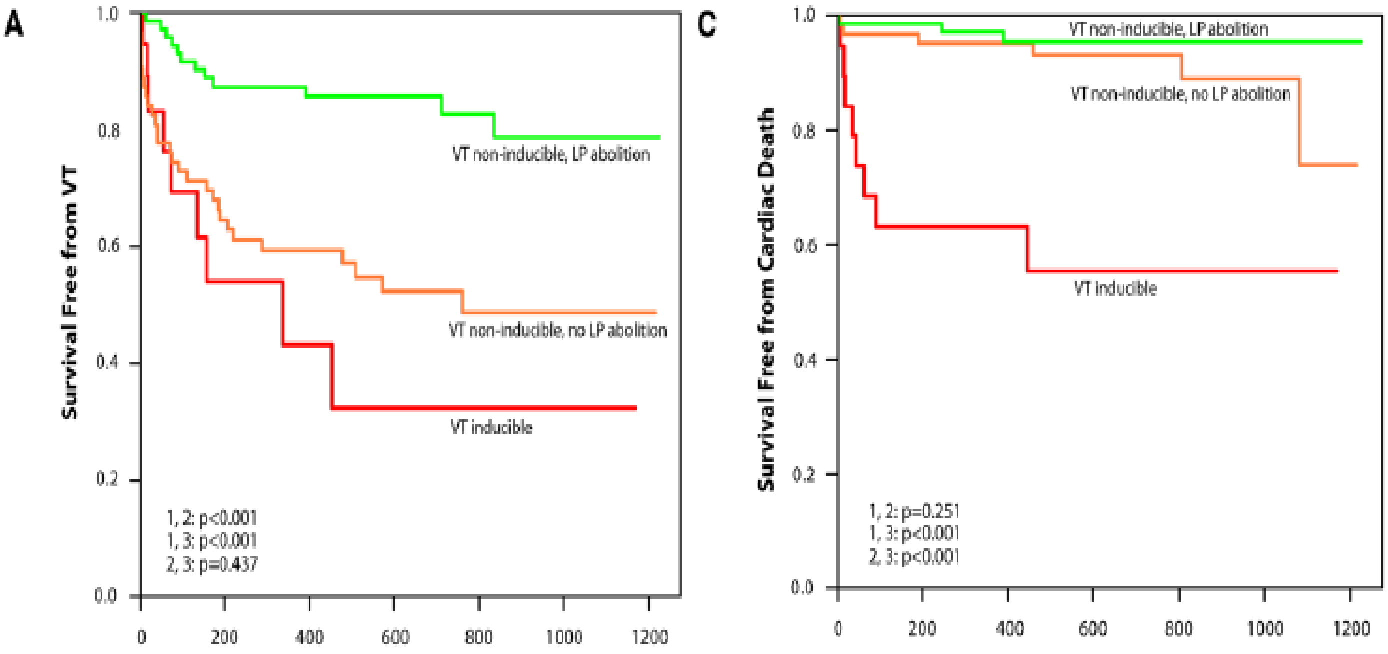
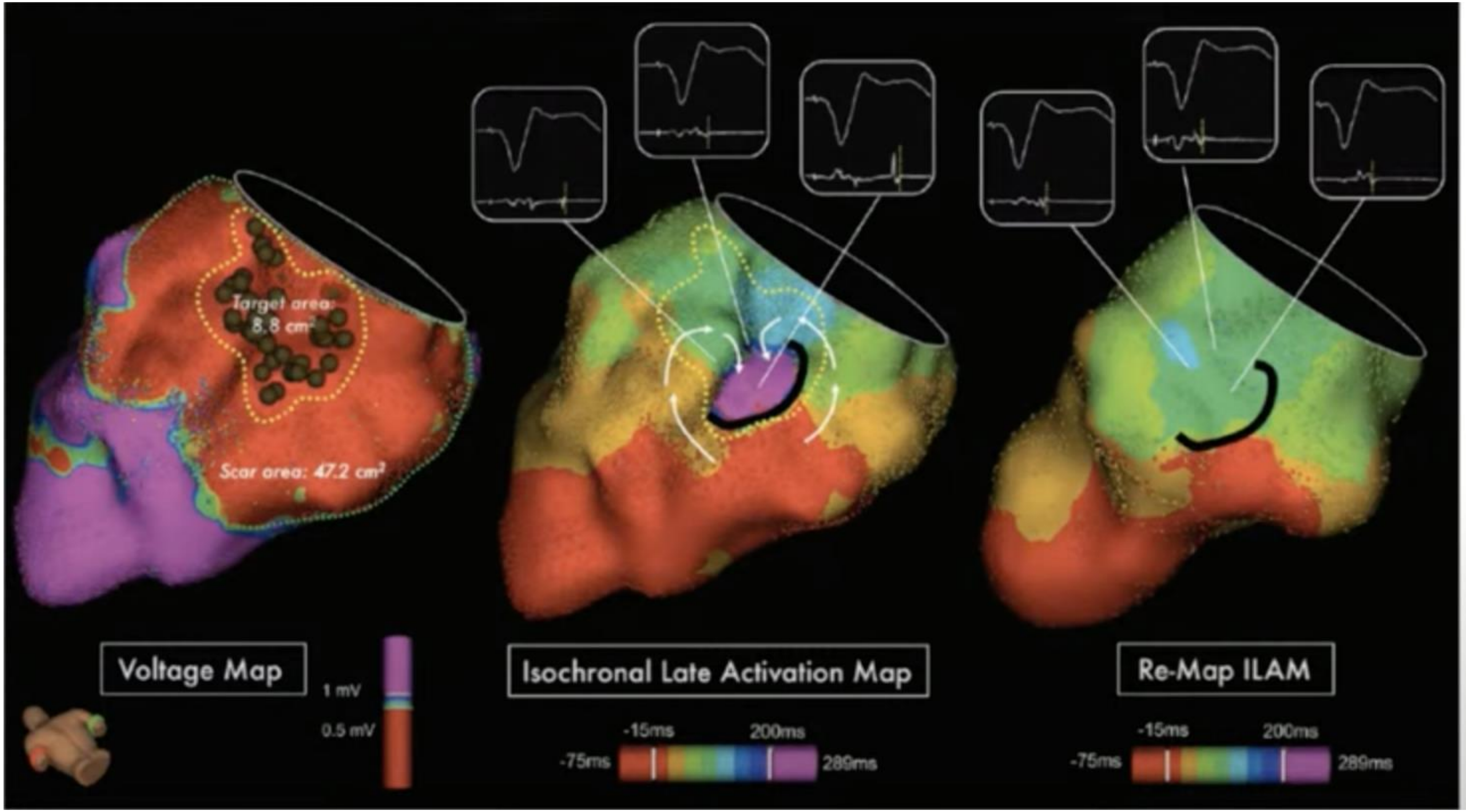
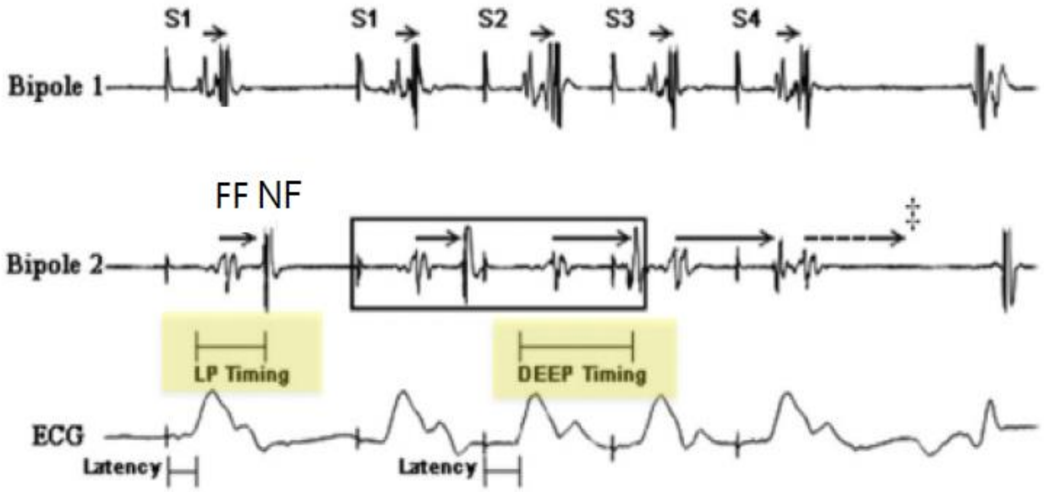


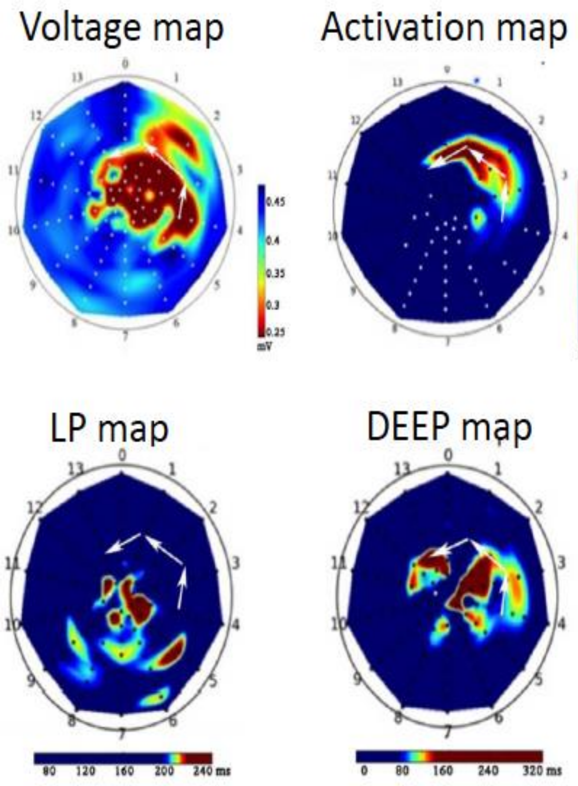
Identification of areas of multiple slow conduction (ILAM:isochromal late activation mapping)



Assess all LPs for further conduction delay upon RV stim

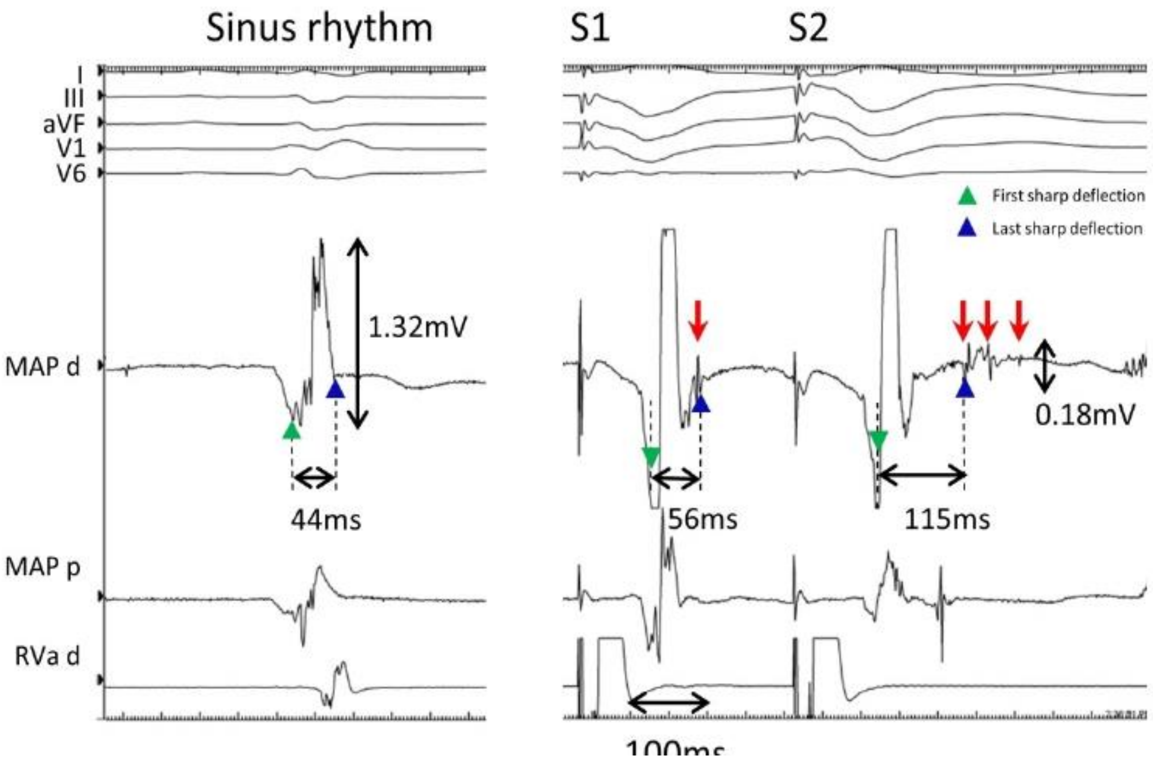
Mechanistic basis of DEEP (decremental evoked potential mapping)





In absence of LPs, signals are analyzed during SR, RV pace & stim

EDP (evoked delayed potential) mapping and ablation



- EDP = near-field prolongation >10ms during S2
- Endpoint: EDP elimination + non-induciblity (600/500/350 + 3-4 extra's RV & LV)

I. *Conventional and functional substrate mapping*

1. High-density mapping, using an omnipolar-potential capable grid catheter will be the first performed step. Standard bipolar voltage criteria will be used to define scar (<0.5mV) and low voltage areas LVAs (0.5–1.5mV). In unipolar mapping, borderline scar zone cutoff will be 8mV[29]. Unipolar penumbra area is defined as the unipolar scar beyond the bipolar LVA[30].
2. The electrogram duration and the extent of the fragmentation will be recorded at all sites (sampling density: 3mm). LPs are defined as distinct local ventricular potentials recorded after the QRS end, while local abnormal ventricular activations (LAVAs) are defined as abnormal potentials (low voltage, >3 fragmentations, >100ms in duration) recorded within the QRS complex[30,31].
3. Isochronal late activation mapping (ILAM), where SR propagation is displayed with 8 equally distributed isochrones of activation, will be performed to investigate the presence isochronal crowding (>2 isochrones within a 1cm radius) and conduction delay of propagation[32,33].
   In case of presence of multiple deceleration zones, the one constituting a primary ablation target will be determined by:
   - The greatest extent of crowding
   - Later activation within the chamber mapping window with regards to other deceleration zones (i.e., the crowding isochrones are also *late isochrones*)
   - Better pace mapping matching to the induced tachycardia
4. Decrement-evoked potentials (DeEP) approach will involve assessing all recorded LPs for further conduction delay (>10msec) *upon right ventricular pacing* (train @600msec plus an extrastimulus delivered at a coupling interval equal to VERP+20msec)[32,34,35].
5. Evoked delayed potential (EDP) mapping will be used if no LPs are detected. Signals are analyzed during sinus rhythm, RV pacing at 500ms, and during the application of a single RV extrastimulus delivered at 50ms above the ventricular effective refractory period. Low voltage (<1.5mV) local potentials that delay >10ms or block in response to RV extrastimuli are considered EDPs[36].

Παρουσίαση περιστατικού

- 56 ετών, άνδρας, εργαζόμενος
- Στεφανιαία νόσος 3 αγγείων με αγγειοπλαστική στη RCA και LCx.
- Σοβαρά επηρεασμένη συσπαστικότητα LV με ΚΕ ~30-35%.
- CRTD
- Χρόνια νεφρική νόσος.
- Παροξυσμική κολπική μαρμαρυγή.
- Περιφερική αγγειοπάθεια.

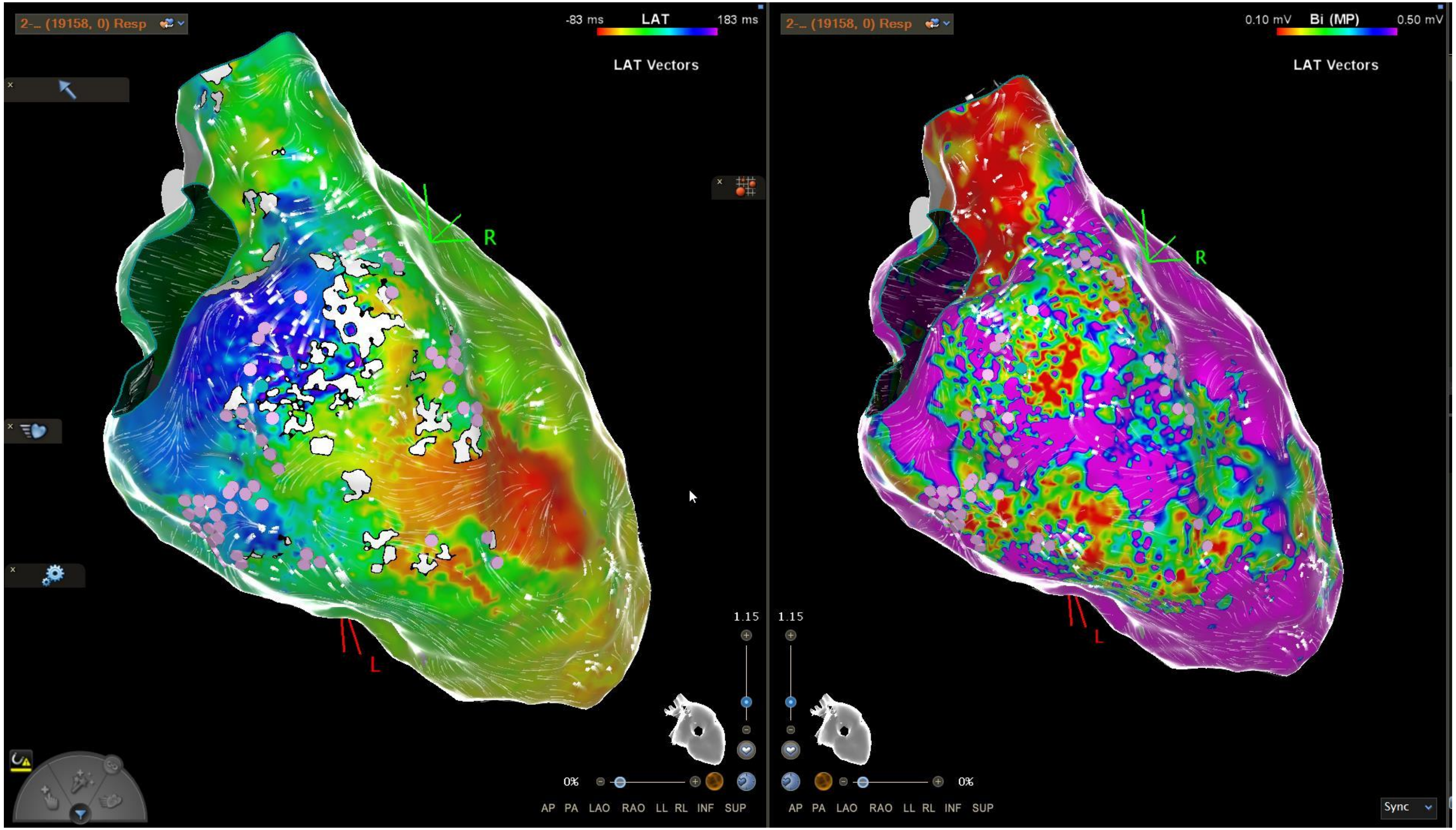
- **Προ μηνός** επεισόδια κοιλιακής ταχυκαρδίας με εκφορτίσεις της συσκευής για τα οποία νοσηλεύτηκε στο ΓΝ Ασκληπιείο Βούλας
- Φόρτιση με Angoron – αποκλεισμός ισχαιμίας
- **Προ 48 ωρών** νέα επεισόδια κοιλιακής ταχυκαρδίας κάτω από τη ζώνη ανίχνευσης του απινιδωτή και επανανοσηλεία στη Μονάδα στο ΓΝ Ασκληπιείο Βούλας

Μορφολογία -I, +aVL, RBBB με ζώνη μετάπτωσης V4-V5, - II, III, AVF.

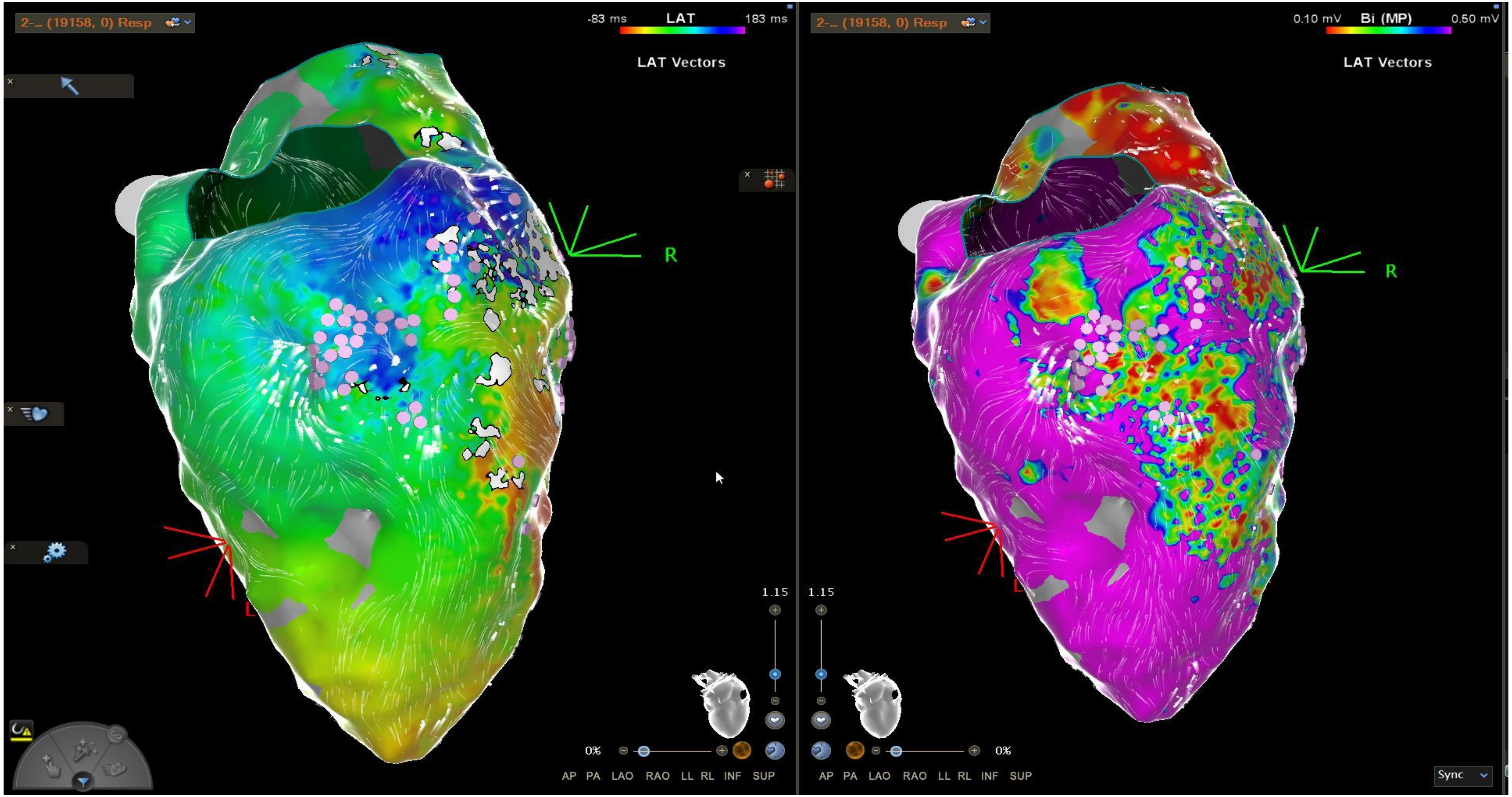
Procedural Steps

- Heart and renal failure management
- External defib patches (proper positioning, proper cleaning)
- Presence of anesthesiologist, iv antibiotics
- General anesthesia (safer but non inducible VT)
- Femoral access (US guided, long arterial sheaths)
- LV access (aortic calcification)
- LV thrombus (use of ICE)
- Transeptal puncture (deflectable sheath) (in case of basal inferior scar)
- Hemodynamic support (inotropes, LV assist devices)
- **CARTO, Optrell catheter, QDOT**

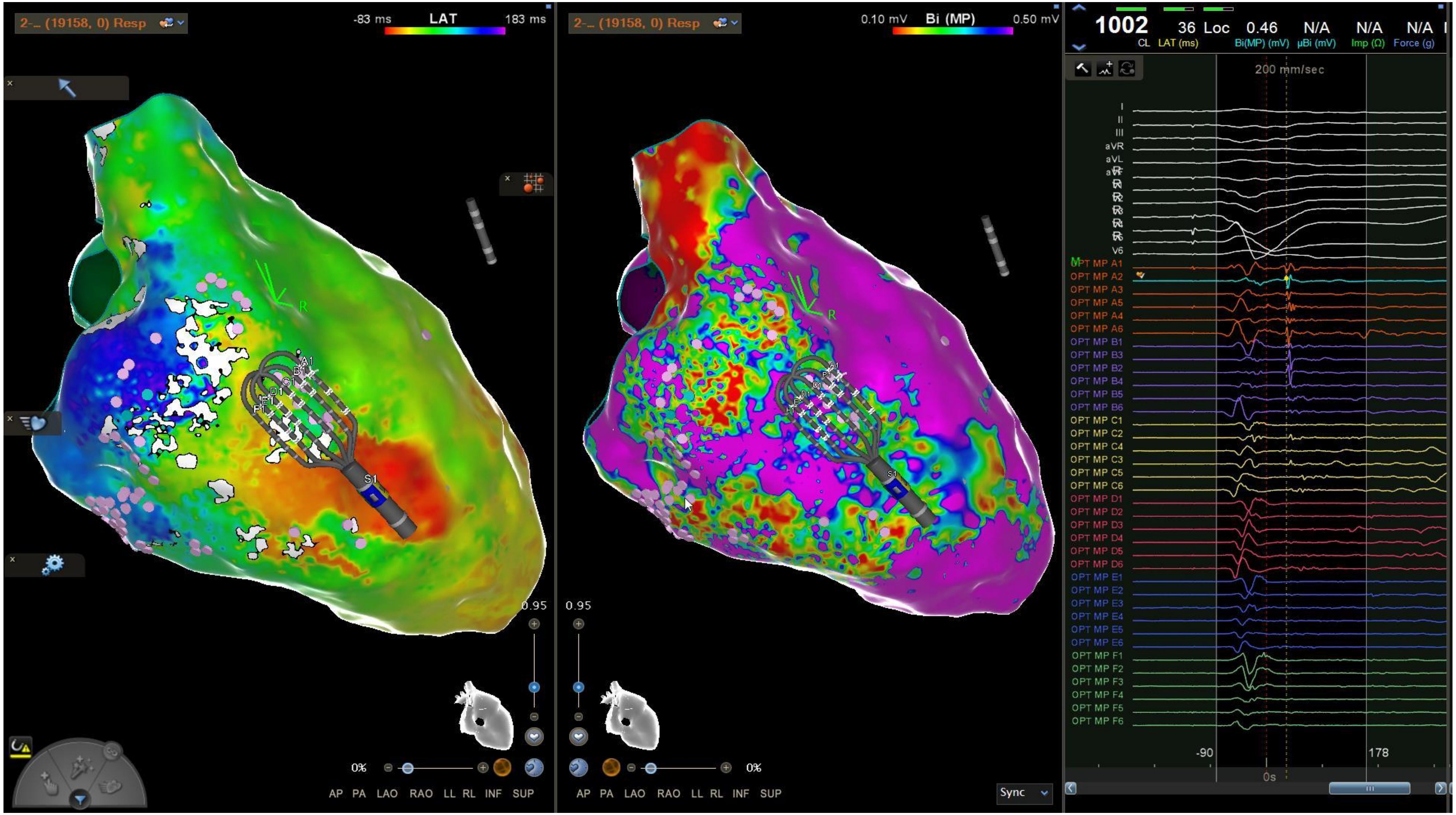
LAT and BIP map in SR



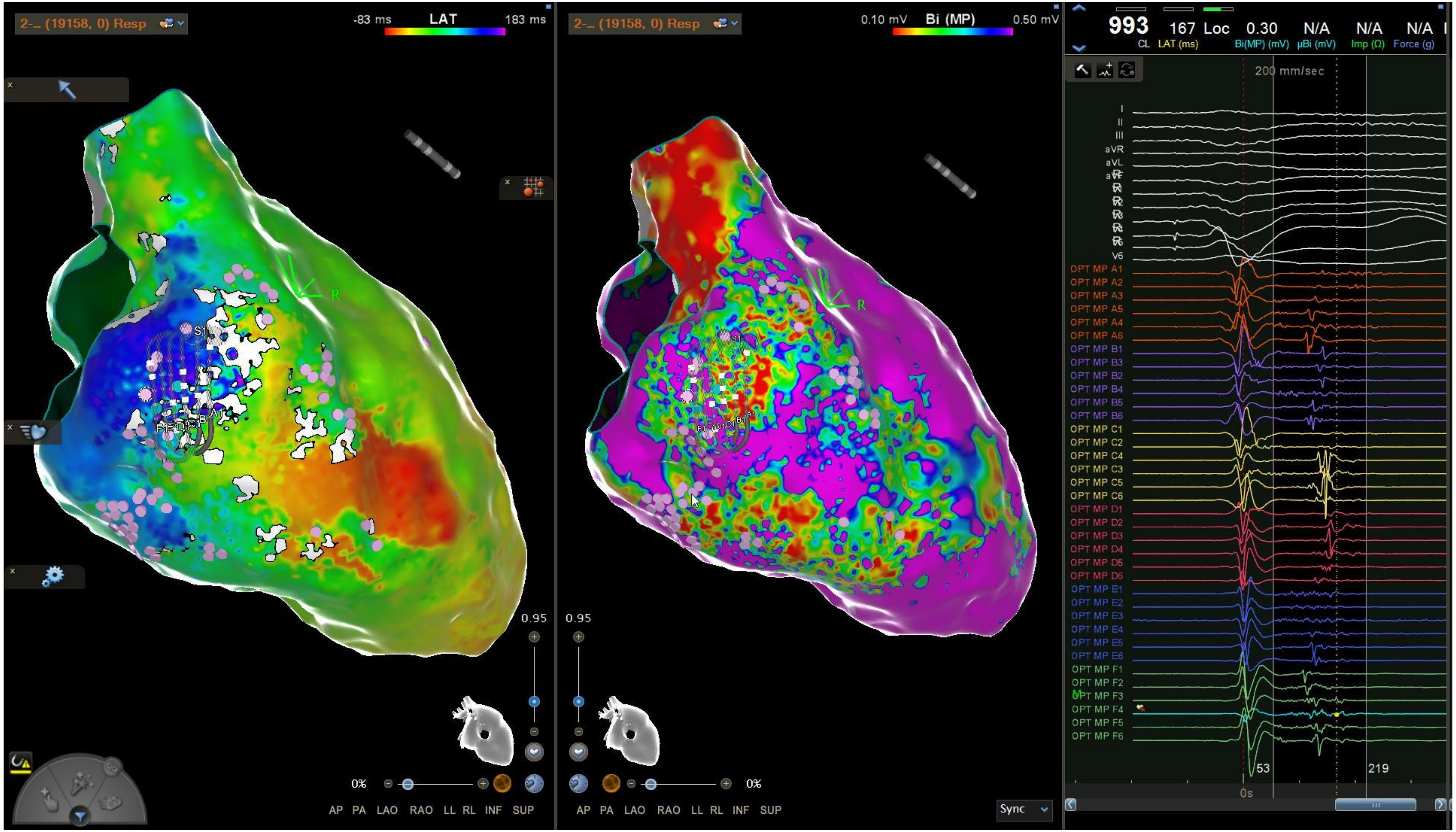
LAT and BIP map in SR



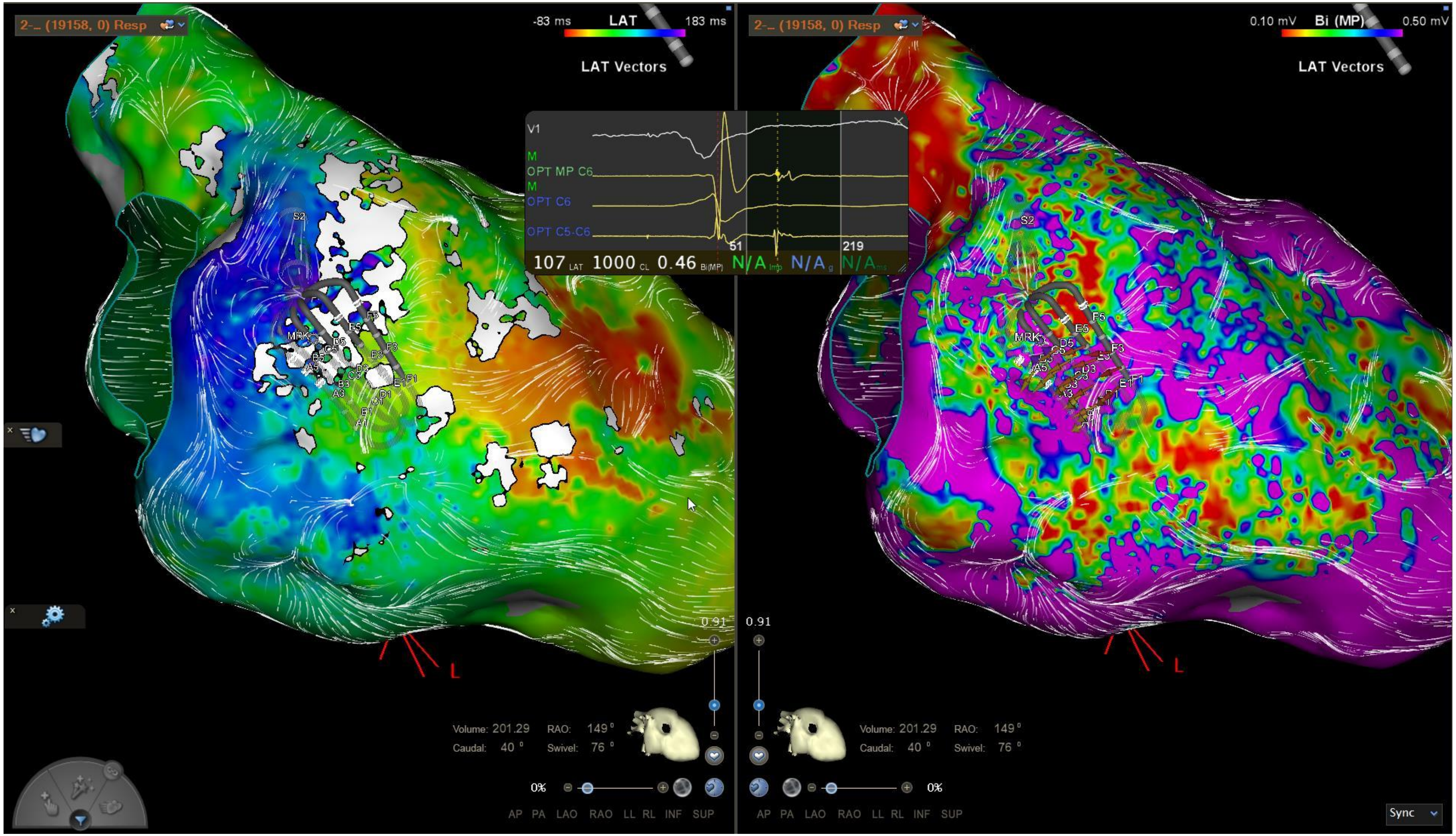
LAT and BIP map in SR



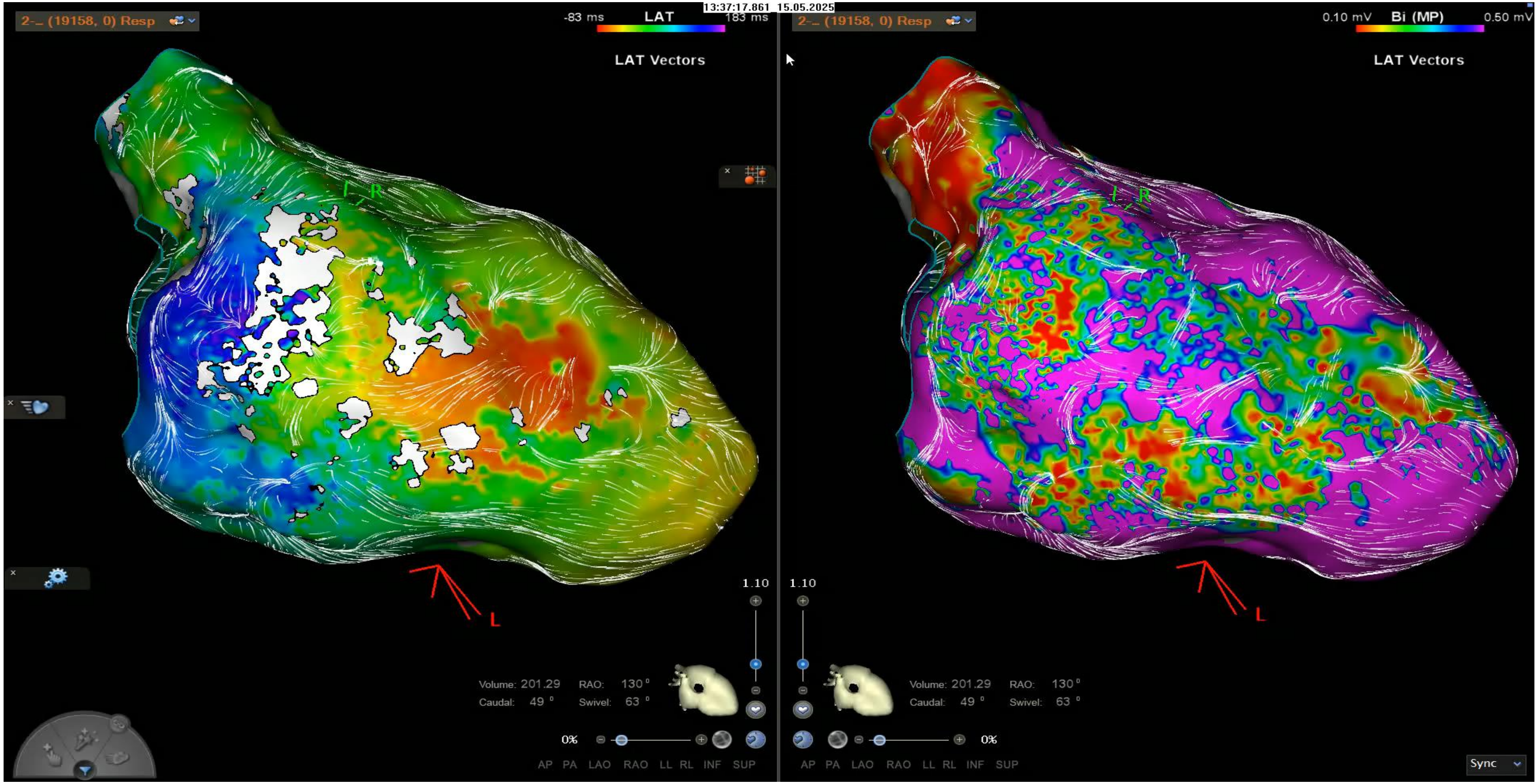
LAT and BIP map in SR



Isolated double potentials in SR



LAT vectors in SR



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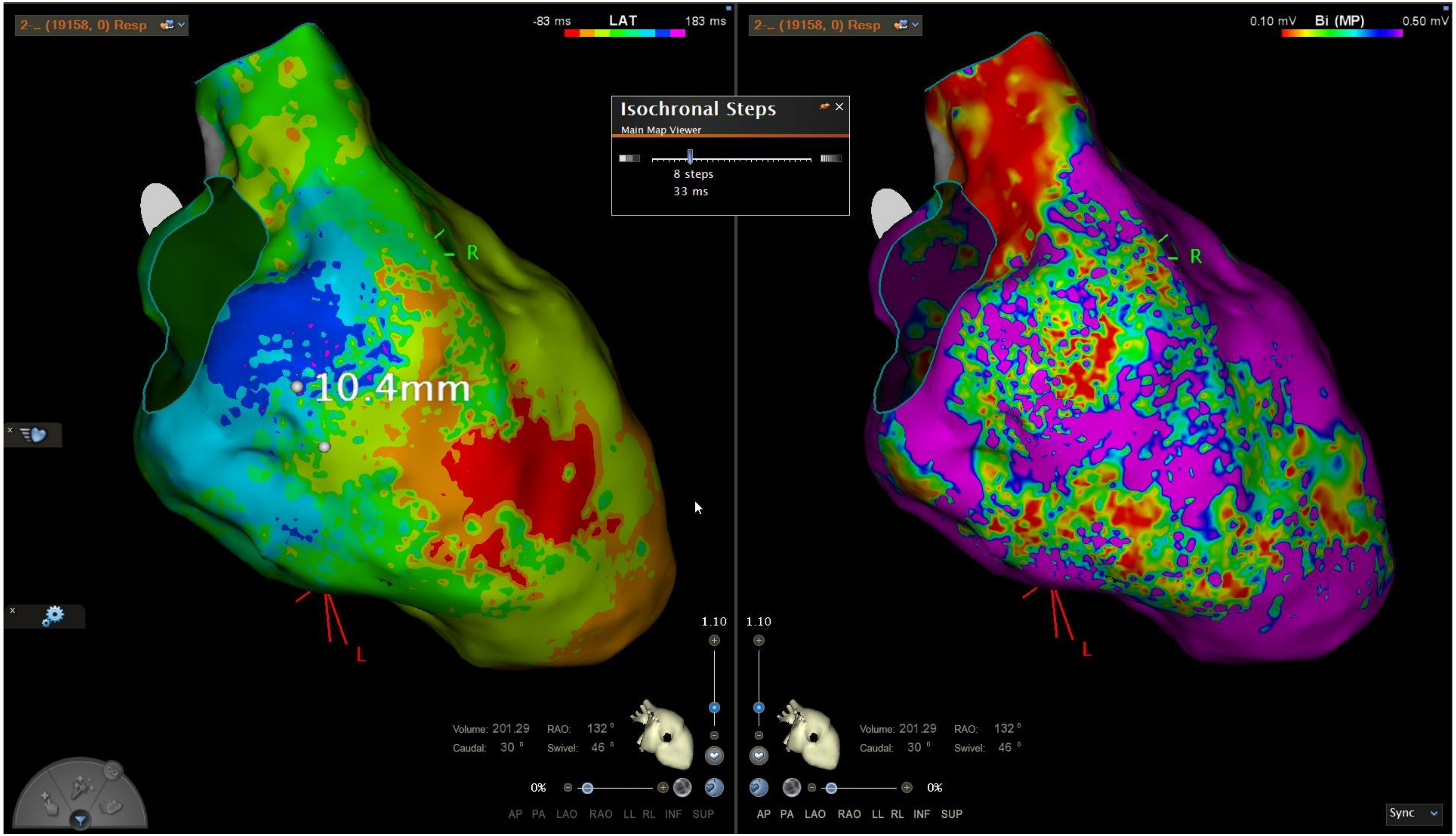
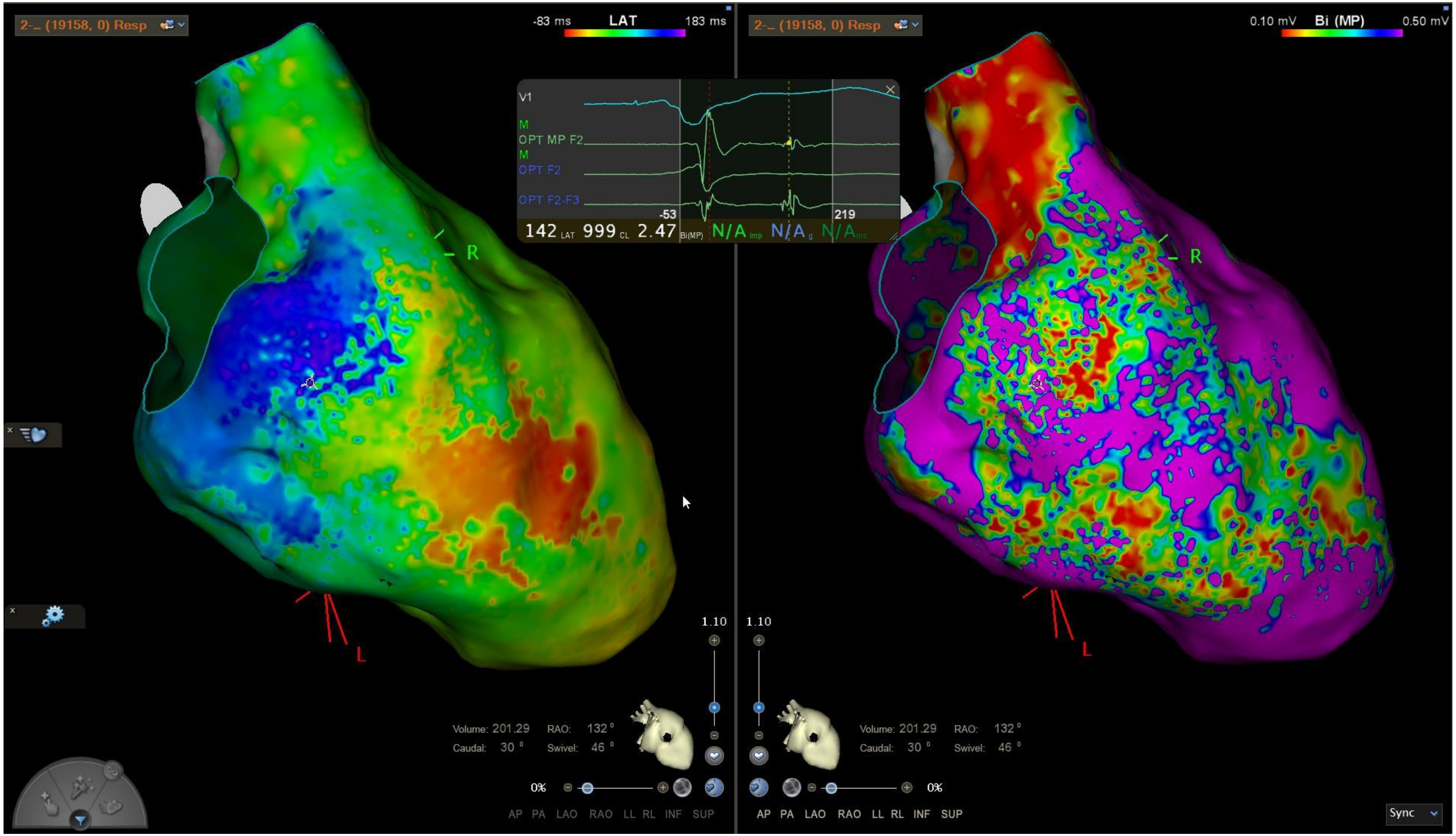
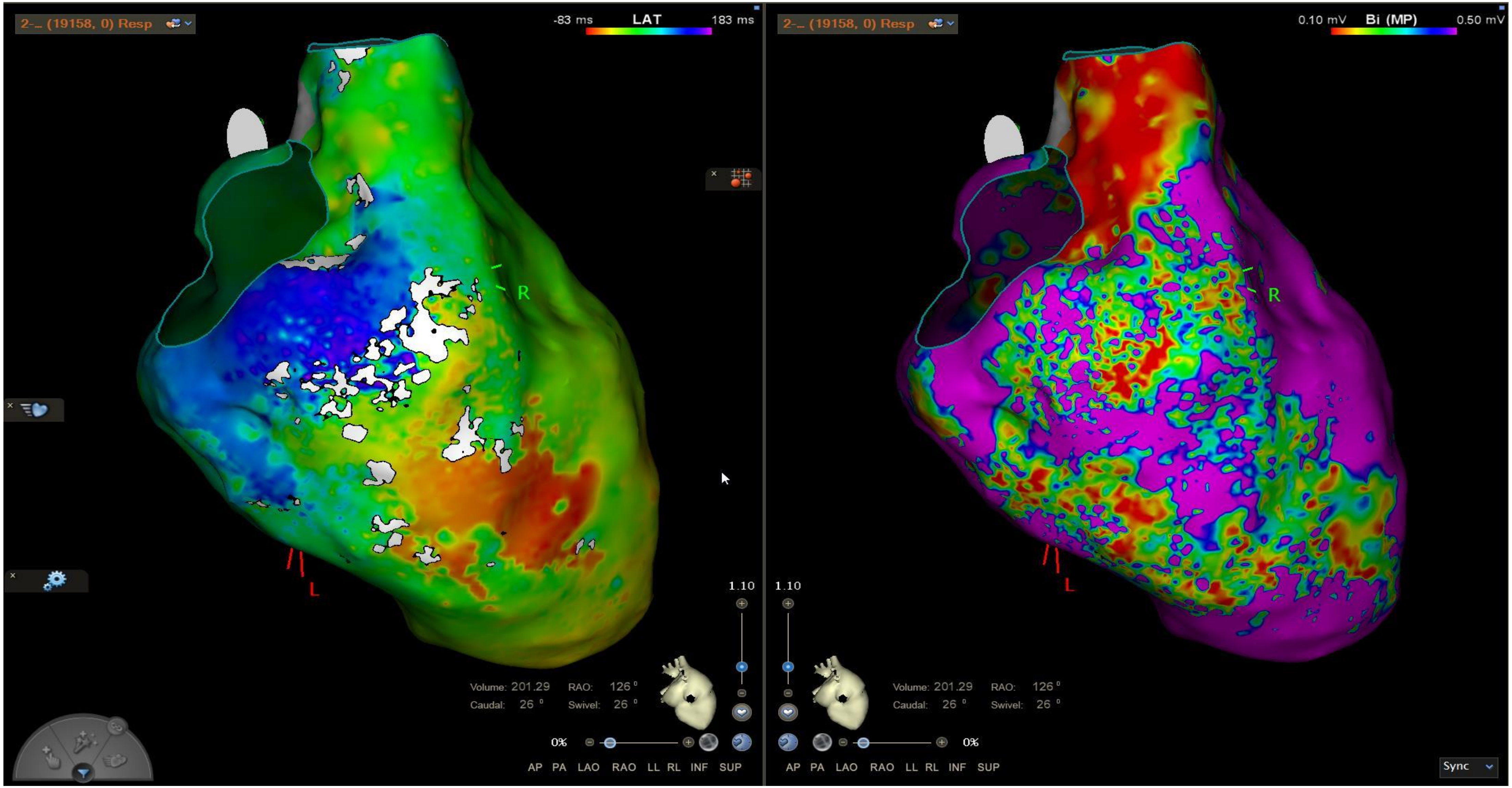


DEEP mapping SR



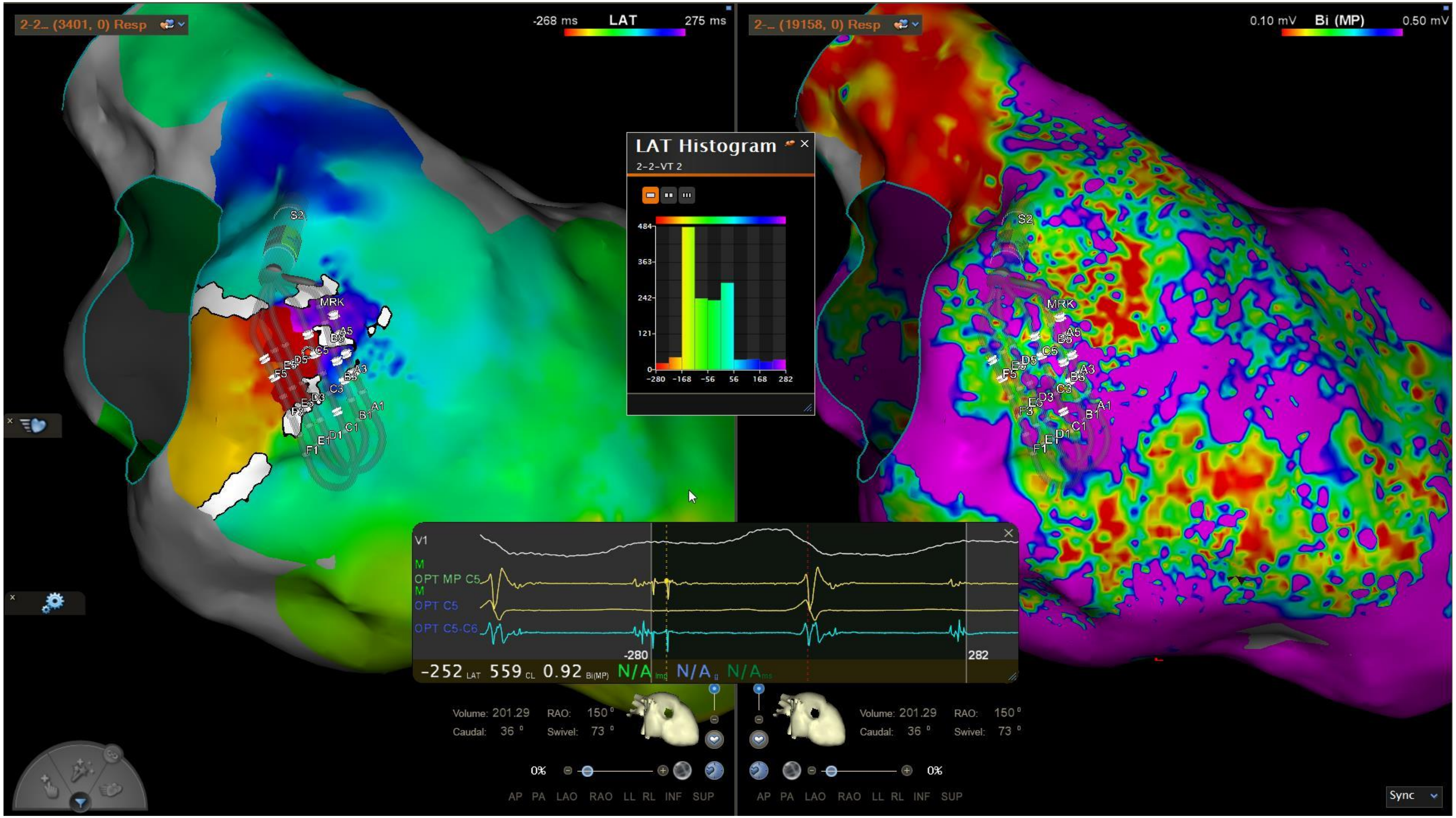
DEEP mapping SR



- Αυτόματη πρόκληση της κλινικής ταχυκαρδίας, αλλά και δεύτερης ταχυκαρδίας με μορφολογία +ΙΙ, ΙΙΙ, AVF, QR V1, QS V2 και Rs V4-6.
- Αιμοδυναμικά ανεκτές και οι δύο ταχυκαρδίες και επακόλουθη χαρτογράφηση ενεργοποίησης.
- Ανάδειξη μεσοδιαστολικών δυναμικών και ισθμού για την κλινική ταχυκαρδία στο οπίσθιο μέσο προς βασικό τοίχωμα της αριστερής κοιλίας και στο οπίσθιο ΜΚΔ για τη δεύτερη ταχυκαρδία.
- Προγραμματισμένη κοιλιακή διέγερση από την κορυφή της δεξιάς κοιλίας με πρόκληση εμμένουσας κοιλιακής ταχυκαρδίας, αιμοδυναμικά ανεκτής (ΣΑΠ: 100 mmHg), με μορφολογία ίδια με της κλινικής ταχυκαρδίας και CL: 390 ms.

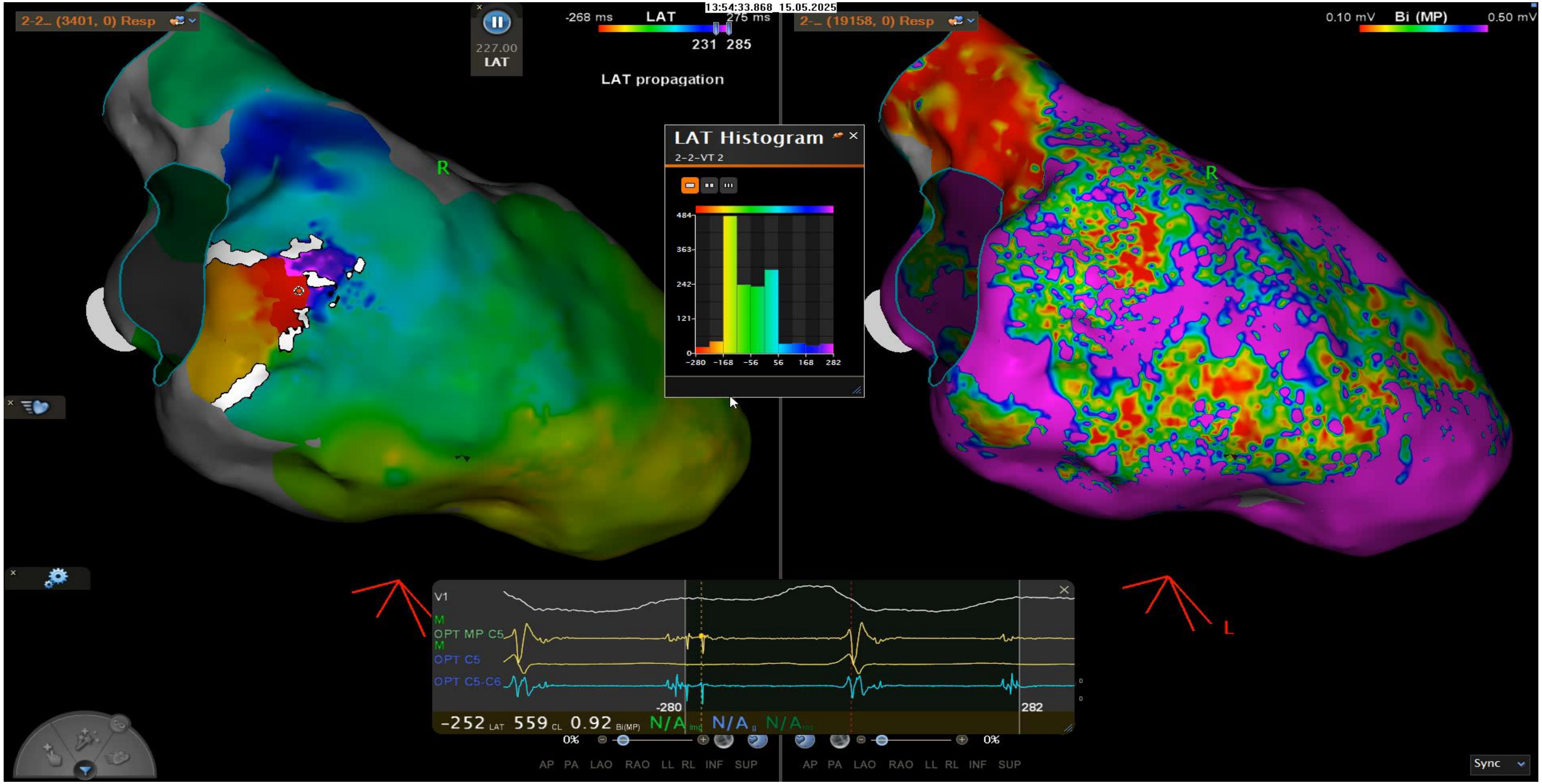
Κλινική VT

VT mapping

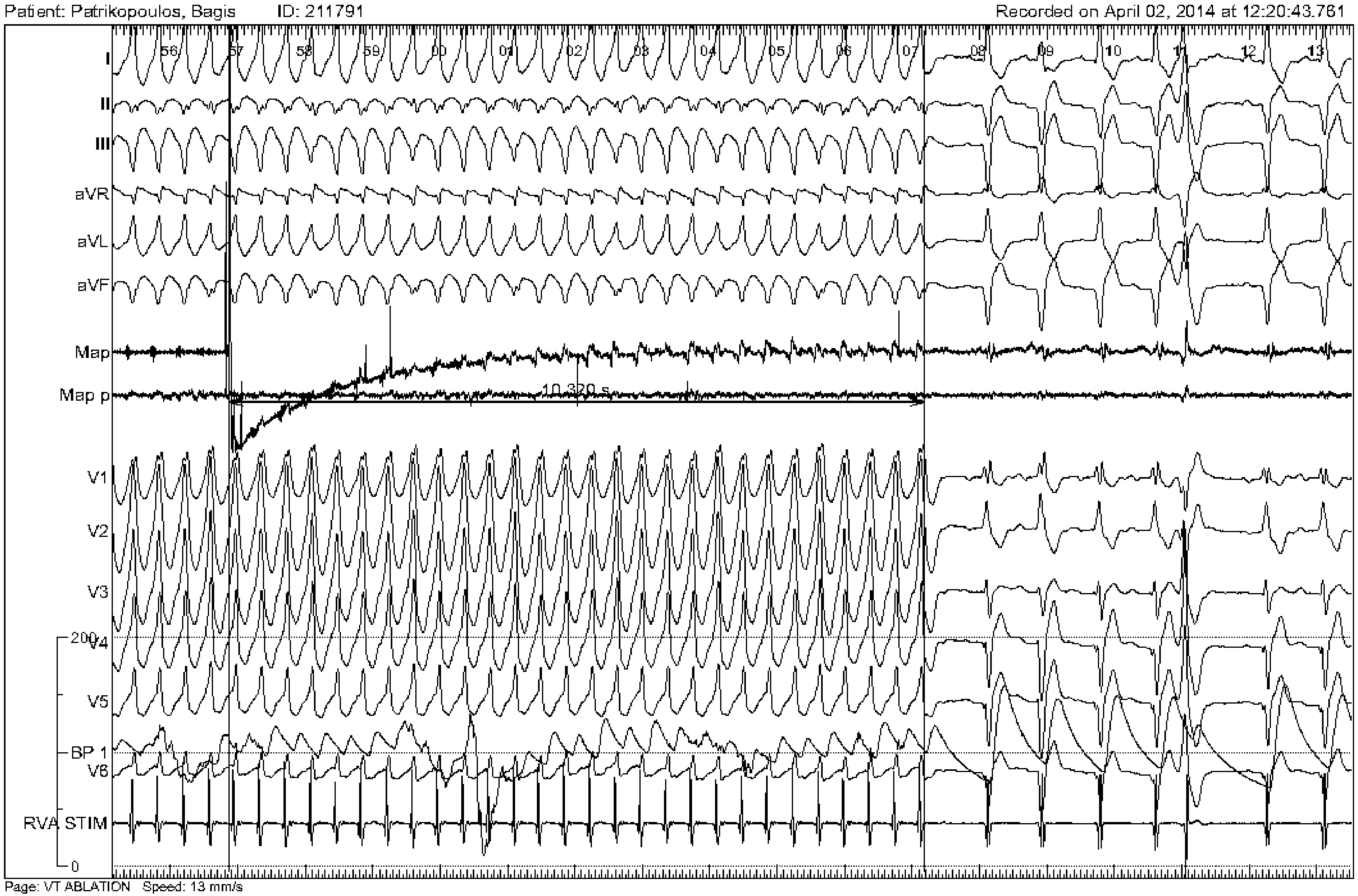


2-2... (3401, 0) Resp
-268 ms
LAT
275 ms
2-... (19158, 0) Resp
0.10 mV
Bi (MP)
0.50 mV
LAT Histogram
2-2-VT 2
484
363
242
121
0
-280
-168
-56
56
168
282
MRK
S2
V1
OPT MP C5
OPT C5
OPT C5-C6
-280
282
-252 LAT
559 CL
0.92 Bi(MP)
N/A
N/A
N/A
Volume: 201.29
RAO: 150°
Caudal: 36°
Swivel: 73°
0%
AP PA LAO RAO LL RL INF SUP
Sync

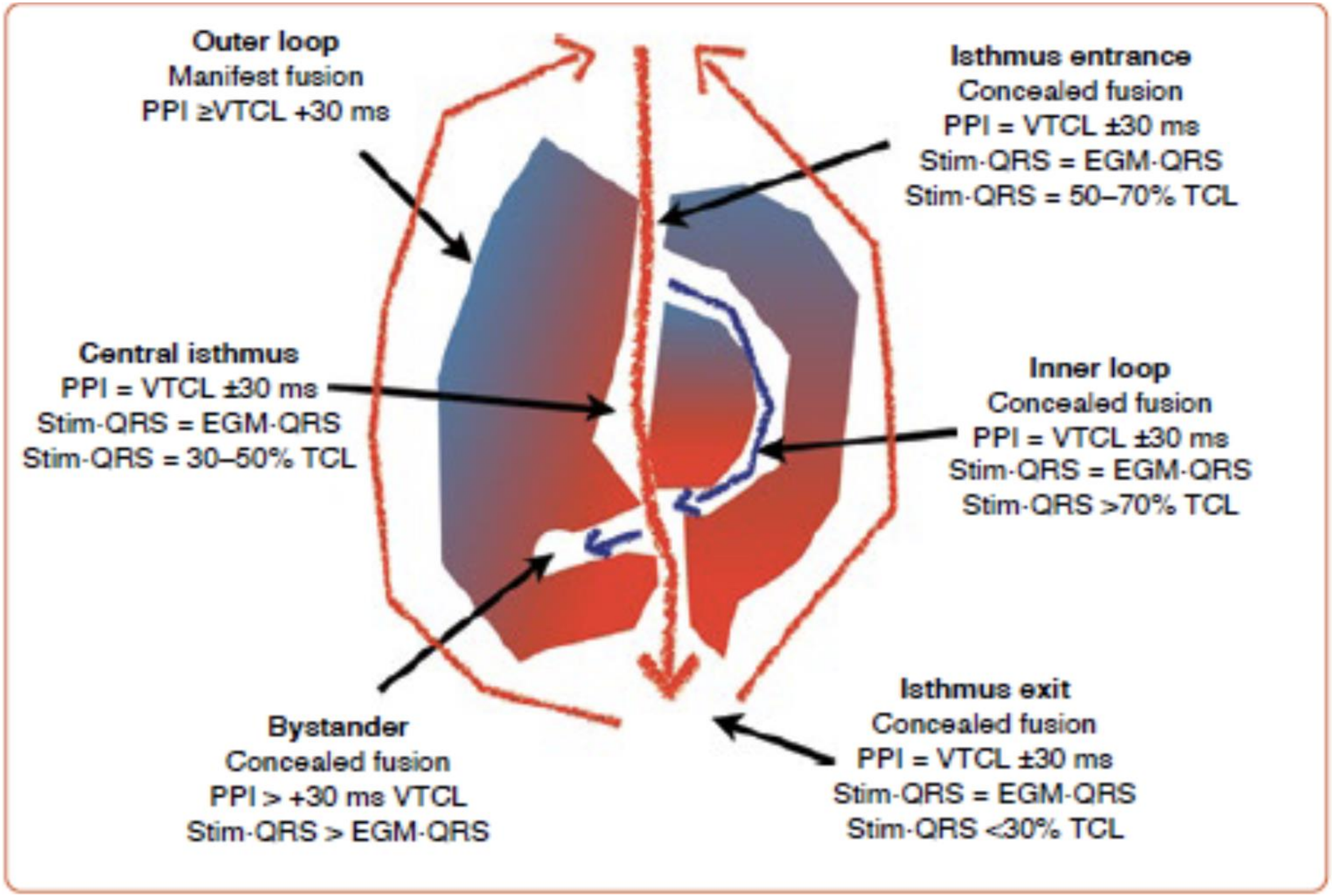
VT propagation mapping

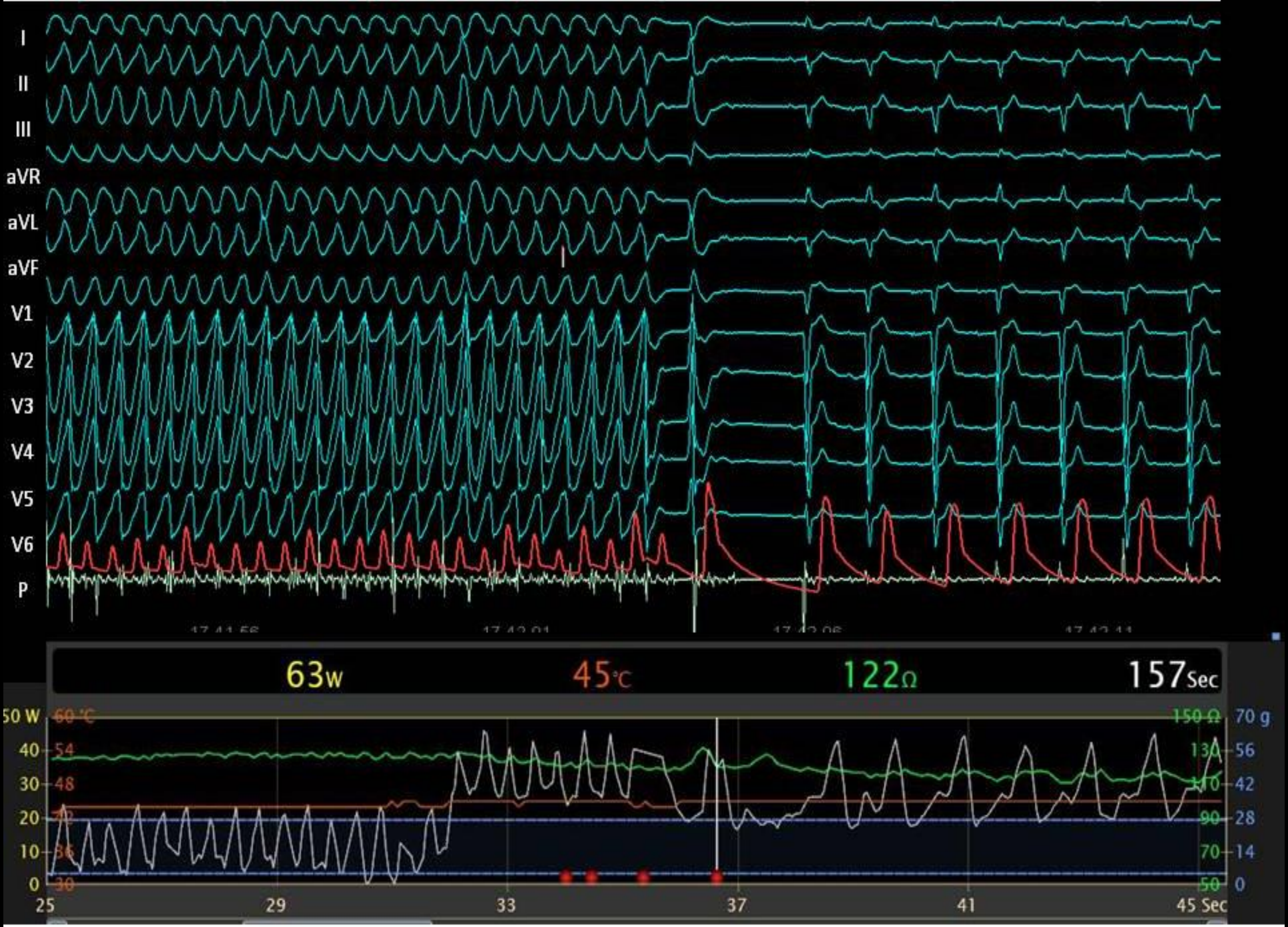


VT termination after 10 sec



Entrainment mapping

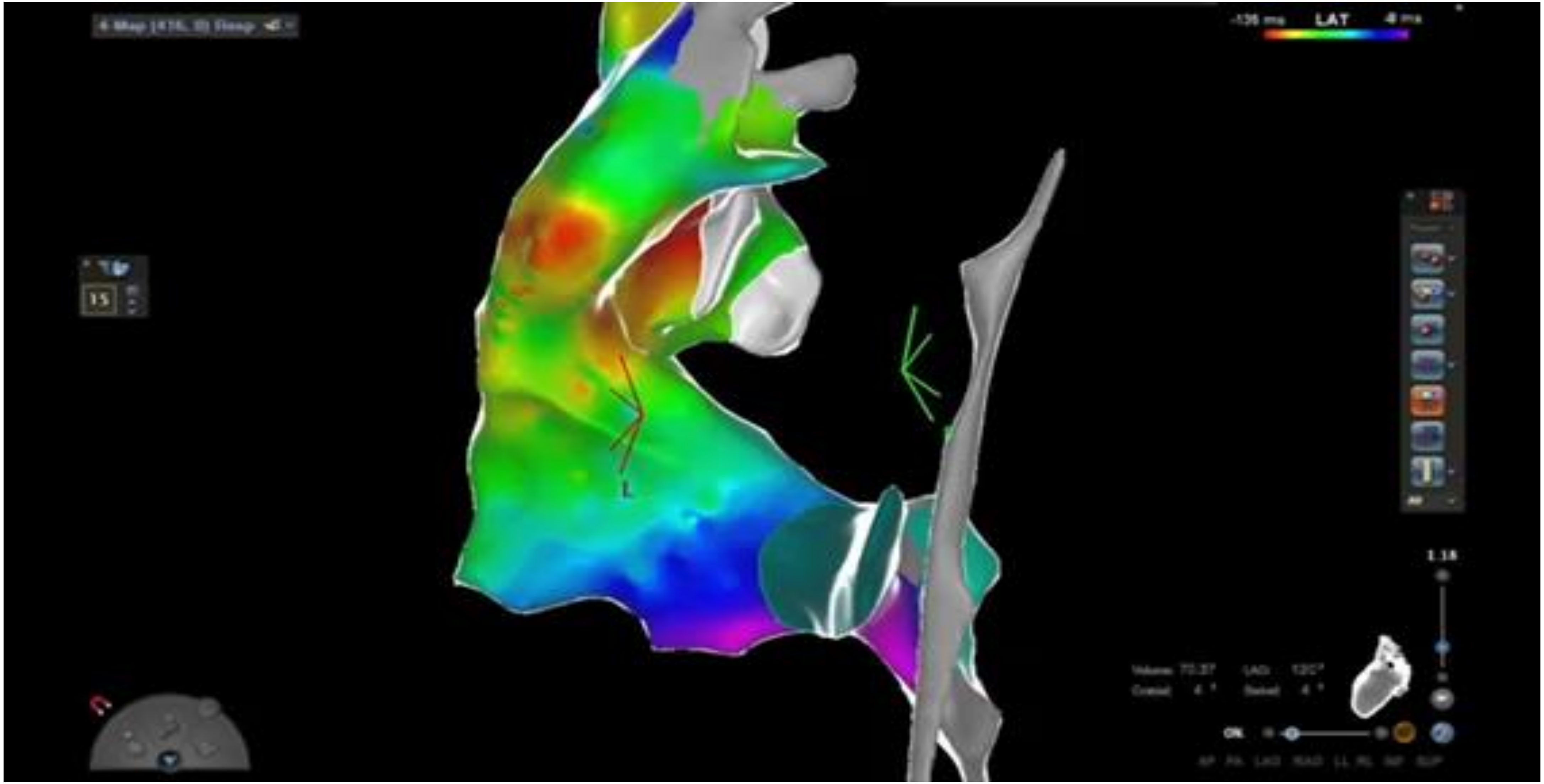



I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
P
63W
45°C
122Ω
157Sec
50 W
40
30
20
10
0
60 °C
54
48
150 Ω
130
110
90
70
50
70 g
56
42
28
14
0
25
29
33
37
41
45 Sec

Final PVS

- Εκ νέου προγραμματισμένη κοιλιακή διέγερση από την κορυφή της δεξιάς κοιλίας με χορήγηση έως και 4 εκτάκτων κοιλιακών ερεθισμάτων χωρίς πρόκληση εμμένουσας κοιλιακής ταχυκαρδίας
- (αρχική πρόκληση της κλινικής ταχυκαρδίας με ένα έκτακτο ερέθισμα).

Zero fluoro feasible even for complex anatomies



Electroanatomical Voltage and Morphology Characteristics in Postinfarction Patients Undergoing Ventricular Tachycardia Ablation

Pragmatic Approach Favoring Late Potentials Abolition

Dimitris Tsiachris, MD; John Silberbauer, MD; Giuseppe Maccabelli, MD; Teresa Oloriz, MD; Francesca Baratto, MD; Hiroya Mizuno, MD; Caterina Bisceglia, MD; Pasquale Vergara, MD; Alessandra Marzi, MD; Nicoleta Sora, MD; Fabrizio Guarracini, MD; Andrea Radinovic, MD; Manuela Cireddu, MD; Simone Sala, MD; Simone Gulletta, MD; Gabriele Paglino, MD; Patrizio Mazzone, MD; Nicola Trevisi, MD; Paolo Della Bella, MD

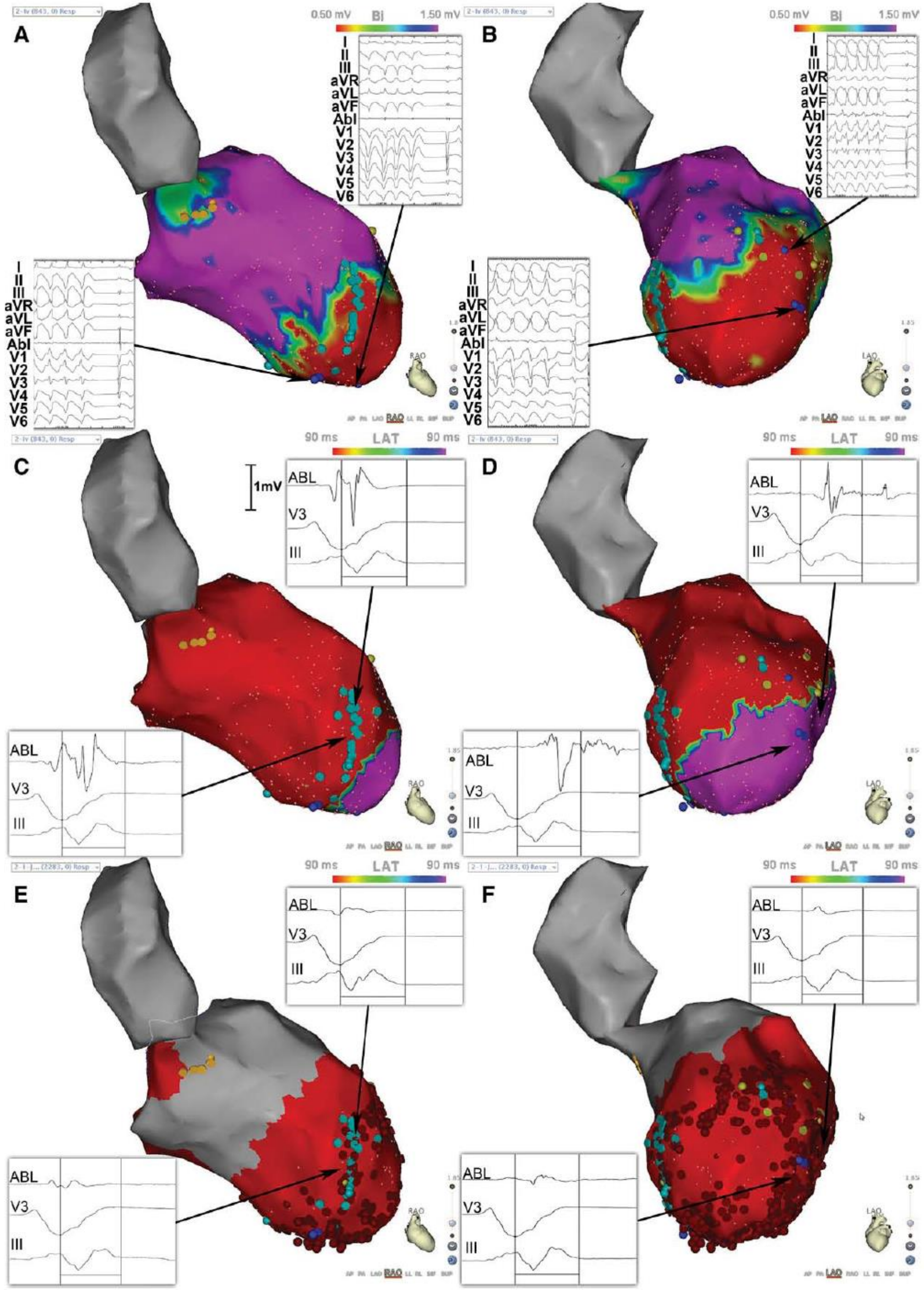
The purpose of this study was to analyze the endo–epicardial EAM voltage and morphology characteristics to describe the appropriateness of each substrate ablation strategy, the interrelationship of EAM characteristics, their association with clinical data, and their prognostic value in a large cohort of post-MI patients undergoing EAM-based catheter ablation for VT.

Endo and epicardial **unipolar scar** were areas with a unipolar voltage <8 mV.
We defined as unipolar **penumbra** area the unipolar scar beyond the bipolar LVA

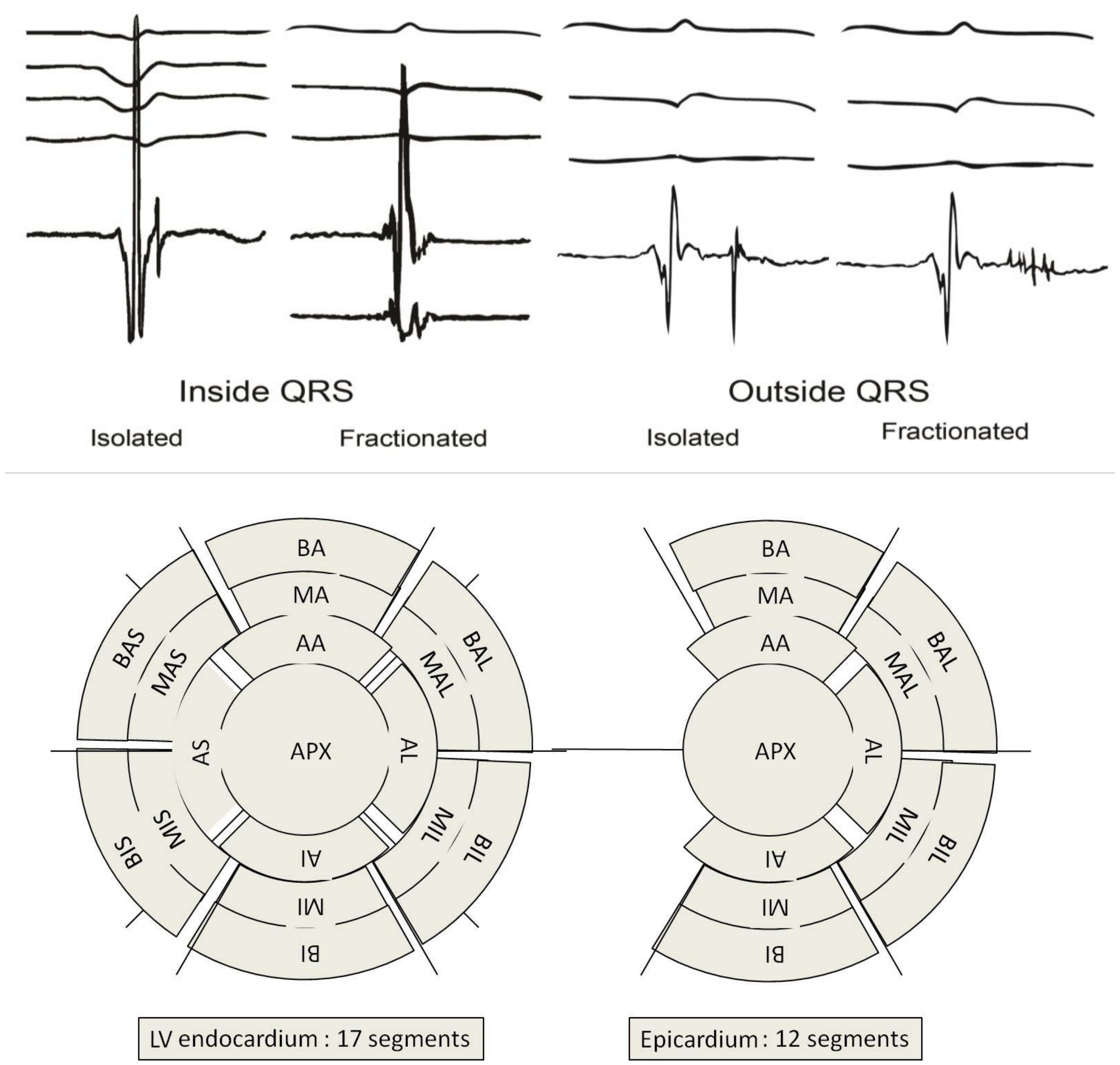
Electrogram Analysis

A color-coded map of sinus rhythm activation delay was drawn on the same anatomic shell by manual tagging the latest activity of all electrograms (LPs map). The definition of LPs included either continuous fragmented activity bridging from the main component within the QRS to the latest signal recorded outside the QRS, without a definite voltage cutoff (fractionated LPs), or isolated potentials recorded after the QRS offset (isolated LPs). Baseline LPs maps were used to define the localization and size of LP areas and were compared with remaps created post ablation (Figure 1).

Early potentials (EPs) were defined as fractionated (EGM containing >4 sharp deflections) or isolated (≥2 sharp EGMs separated by an isolelectric segment) within the QRS; pacing was systematically attempted at these sites looking for morphology match with any induced VT and for latency between the stimulus and the QRS (>40 ms). Pacing was undertaken at just above the capture threshold aiming for near-field capture only. The predominant electrogram (EGM) type was also noted for each segment. LP abolition was a primary target in all patients and ablation of selected EPs secondary or adjunctive.



Ventricular Potential Classification Scheme



Although DS is not always identified in post-MI patients, its endocardial extension and density predict not only scar transmurality but also the presence of LPs either in the endocardium or in the epicardium.

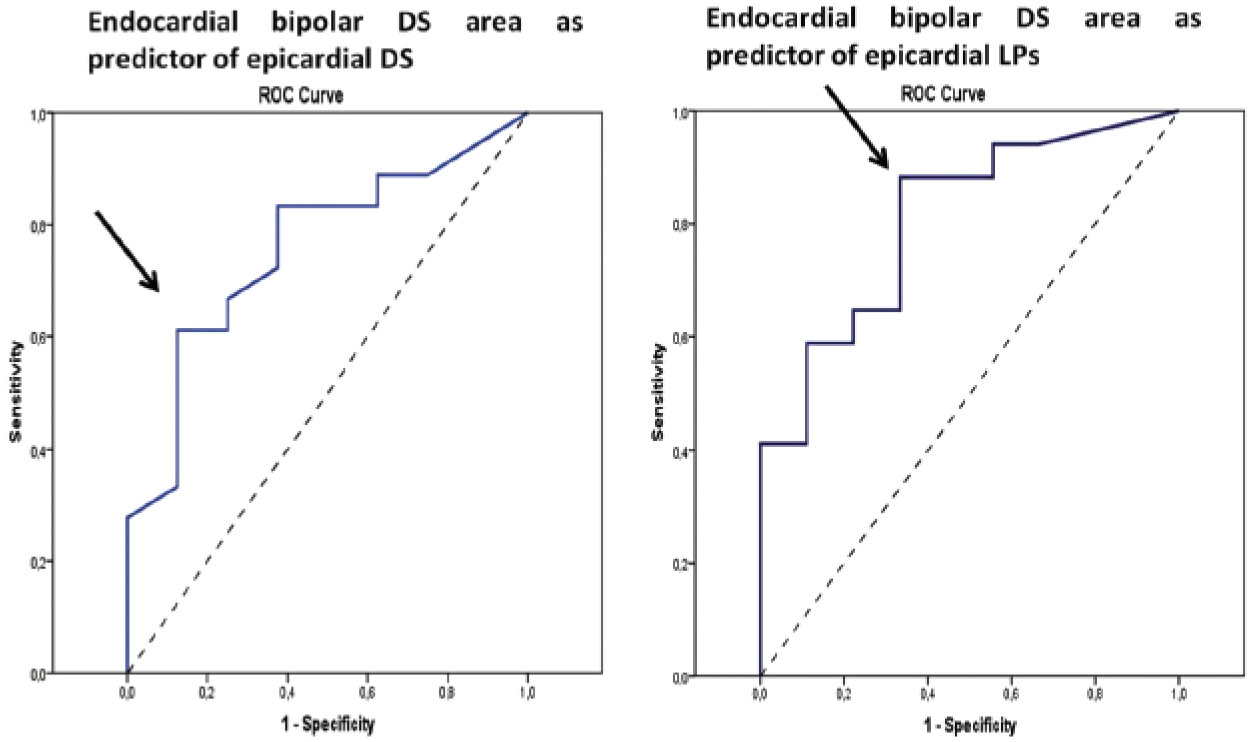
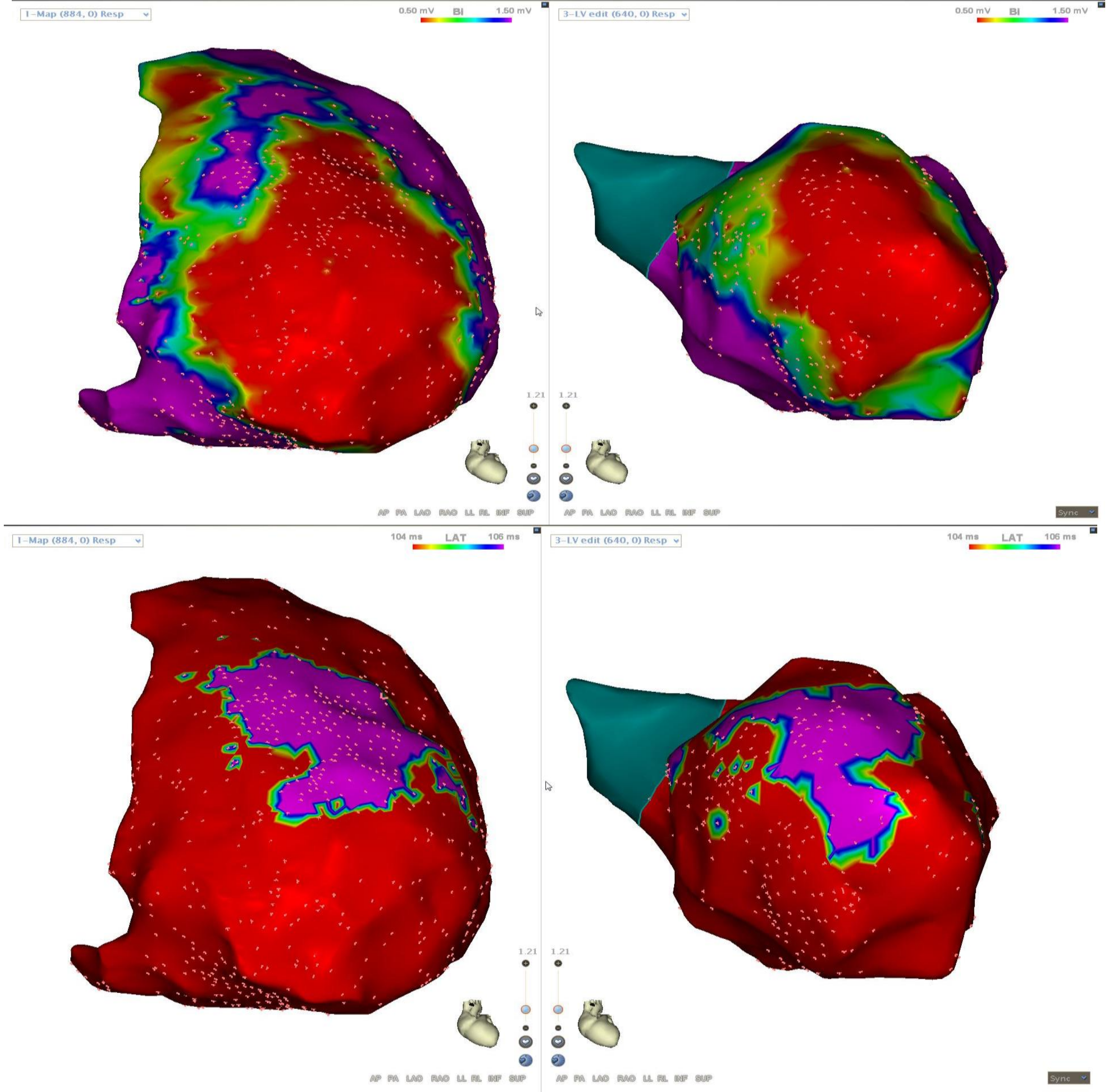


Figure 2. Based on receiver operating characteristic curve analyses, endocardial bipolar dense scar (DS) area predicted the epicardial presence of both DS and late potentials (LPs) with optimal values of 22.5 cm² (sensitivity, 61.1% and specificity, 87.5%) and 7 cm² (sensitivity, 88.2% and specificity, 66.7%), respectively.


1-Map (884, 0) Resp
0.50 mV
BI
1.50 mV
3-LV edit (640, 0) Resp
0.50 mV
BI
1.50 mV
1.21
1.21
AP PA LAO RAO LL RL INF SUP
AP PA LAO RAO LL RL INF SUP
Sync
1-Map (884, 0) Resp
104 ms
LAT
106 ms
3-LV edit (640, 0) Resp
104 ms
LAT
106 ms
1.21
1.21
AP PA LAO RAO LL RL INF SUP
AP PA LAO RAO LL RL INF SUP
Sync

Scar and EGM segmental analysis

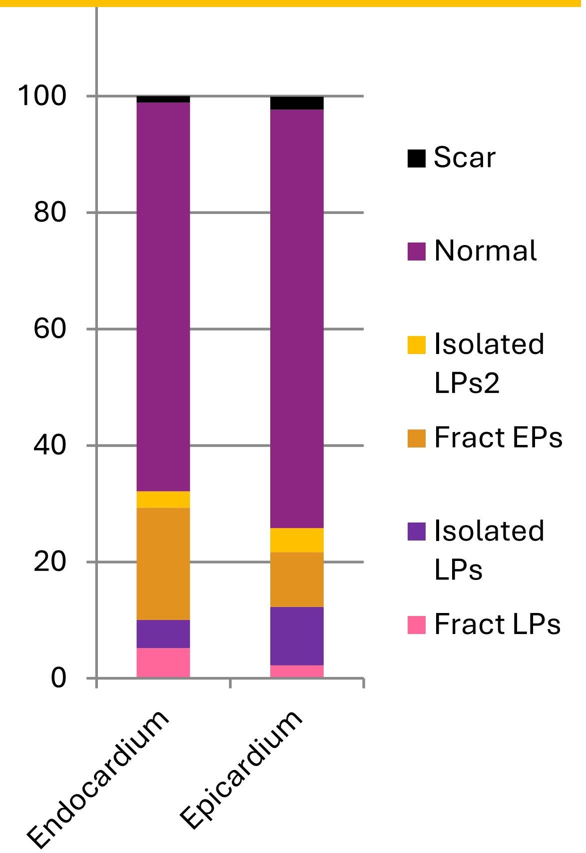
DS was the predominant bipolar voltage type in 14.3% of the segments and border zone in 20%.

Endocardium

- LPs were present in 10% of the 1597 endocardial segments (in 5.2% fractionated LPs and in 4.8% isolated LPs)
  - Underlying DS in 60% and border zone in 33.8%
- EPs in 22.1% (in 19.3% fractionated LPs and in 2.8% isolated LPs) and
  - Underlying border zone in 67.7% and DS in 32.3%
- Normal EGMs in 66.8% of the segments
- In 1.1% of the segments there was diffuse dense scar.

Epicardium

- LPs were present in 12.3% of the epicardial segments (in 2.2% fractionated LPs and in 10.1% isolated LPs)
- EPs in 13.5% (in 9.4% fractionated LPs and in 4.1% isolated LPs)
- Normal EGMs in 71.9%
- Diffuse dense scar in 2.2%.



Isolated LPs are found more commonly in the epicardium compared to endocardium (p=0.004) and any type of EPs in the endocardium as compared to the epicardium (p=0.003)

3. Epicardial approach

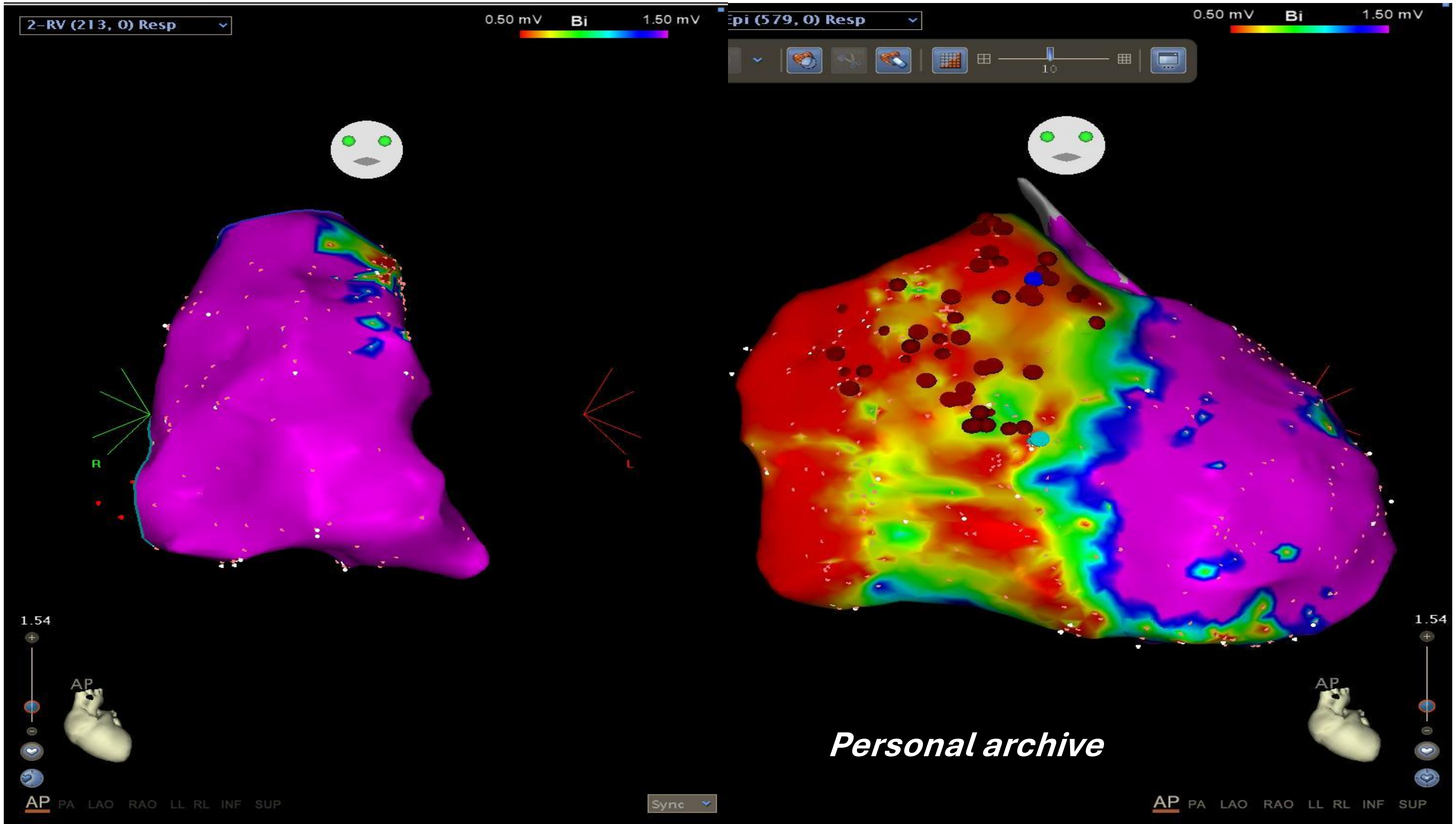
- **First line endo-epi approach**

1. ARVC
2. Prior myocarditis
3. DCM or
4. when pre-procedural imaging suggested the epicardial origin of the re-entrant circuit.

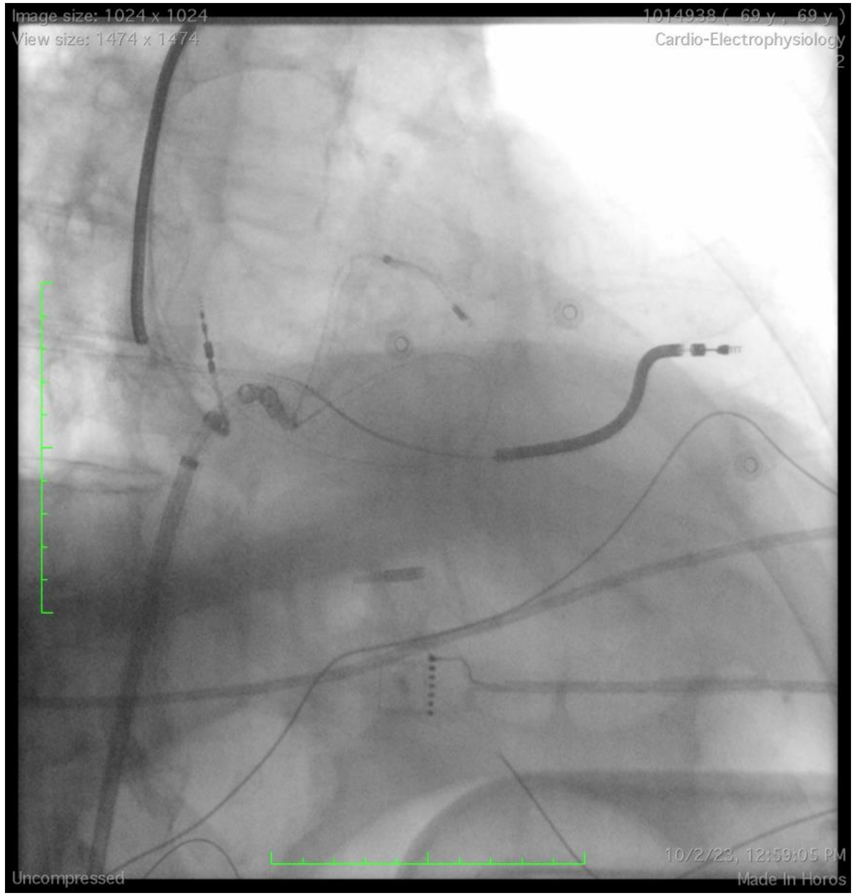
- **Second line endo-epi approach**

1. Clinical VT recurrence following a previous endocardial ablation.

- Garcia et al showed that the scar in ARVD/C is predominantly epicardial, and isolated late potentials were much more frequently encountered in the epicardium. *Circulation. 2009;120:366–375*
- Low recurrence rates of VT during long-term follow-up



Silberbauer technique



Pericardial access