11th ANNUAL CONFERENCE OF INDIAN HEART RHYTHM SOCIETY

INTERGRATING ADVANCED MULTI-MODALITY IMAGING IN VT ABLATION

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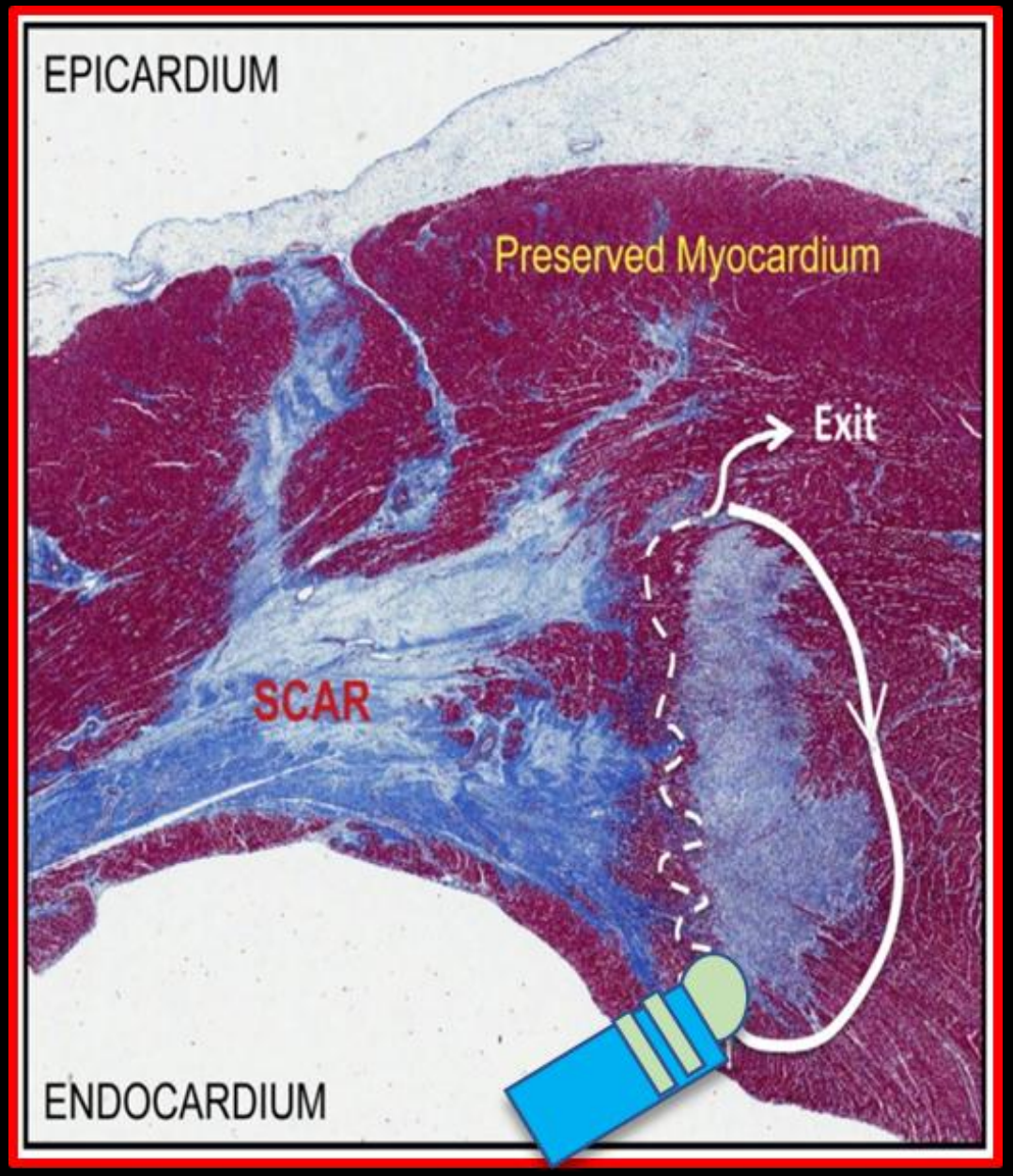
Arrhythmia Heart Failure Academy

The Madras Medical Mission

Founder President: Tamilnadu Electrophysiology Council

President Elect: Indian Society of Electrocardiology

IMAGING TOOLS FOR VT ABLATION



IMAGING TOOLS FOR VT ABLATION

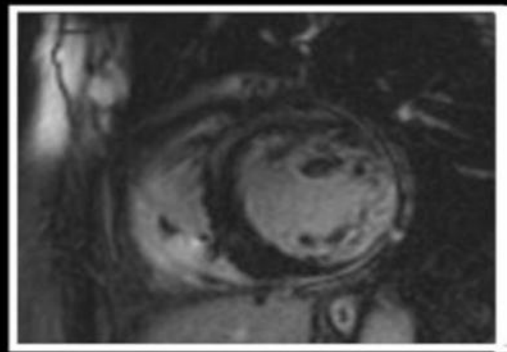
Identification of substrate

- **Structural details**
  - TEE
  - ICE
  - 3-D EAM
  - LGE-MRI
  - MDCT
- **Functional details**
  - LGE MRI
  - PET-CT
  - 123 MIBG
- **Precise or limited ablation target**
  - High density mapping
- **Safety and Efficacy**
  - Contact force

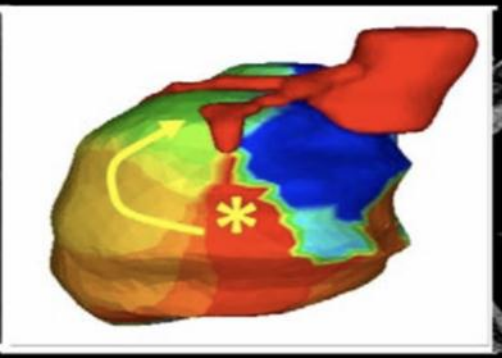
ADVANCED IMAGING TOOLS

ADVANCED IMAGING TOOLS
NON-INVASIVE ABLATION

Cardiac MRI



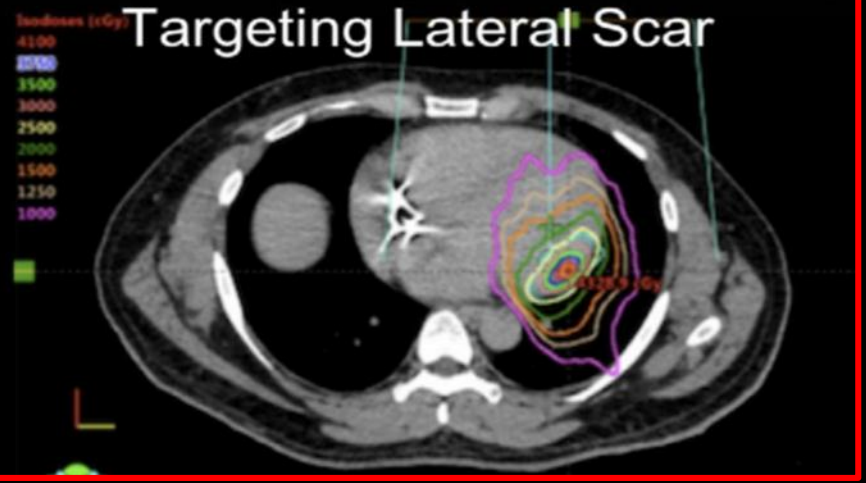
ECGI



Cardiac CT

FDG-PET-CT

Noninvasive Treatment Plan,
Targeting Lateral Scar



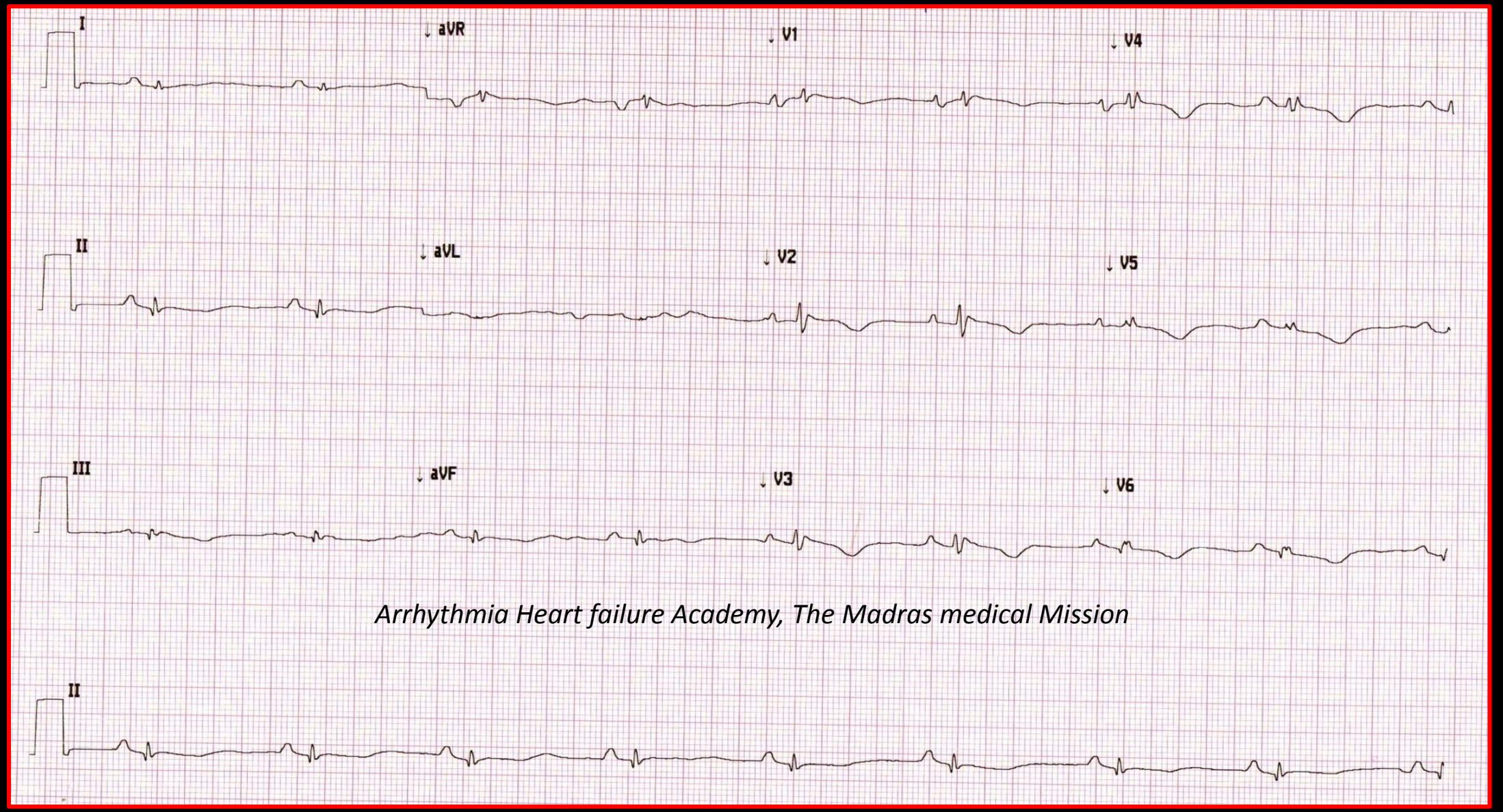
CASE 1

45Y, M, Syncopal episodes

Documented VT

Echo – RA, RV dilated, RV dyskinesia+, ?ARVD

ECG


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
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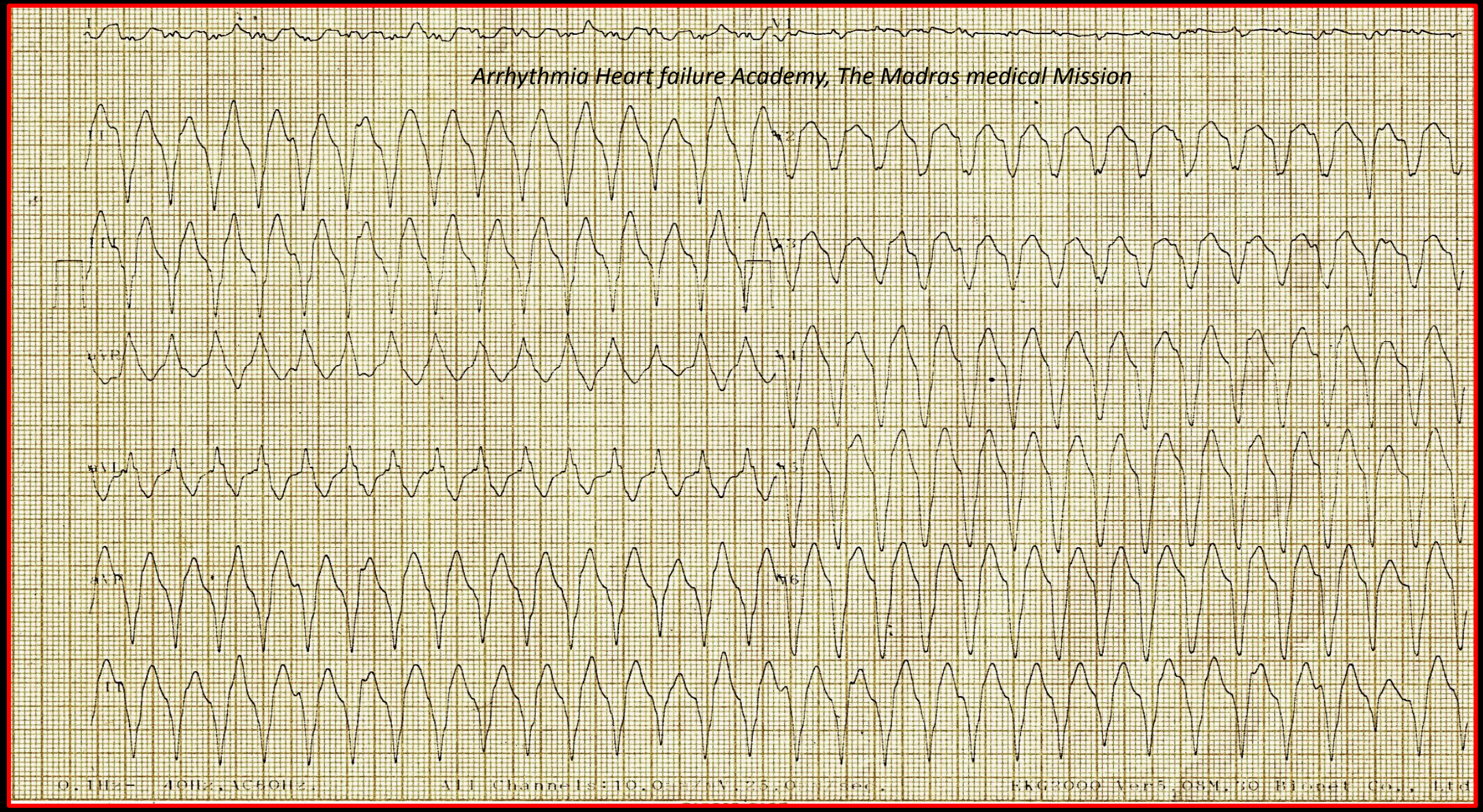
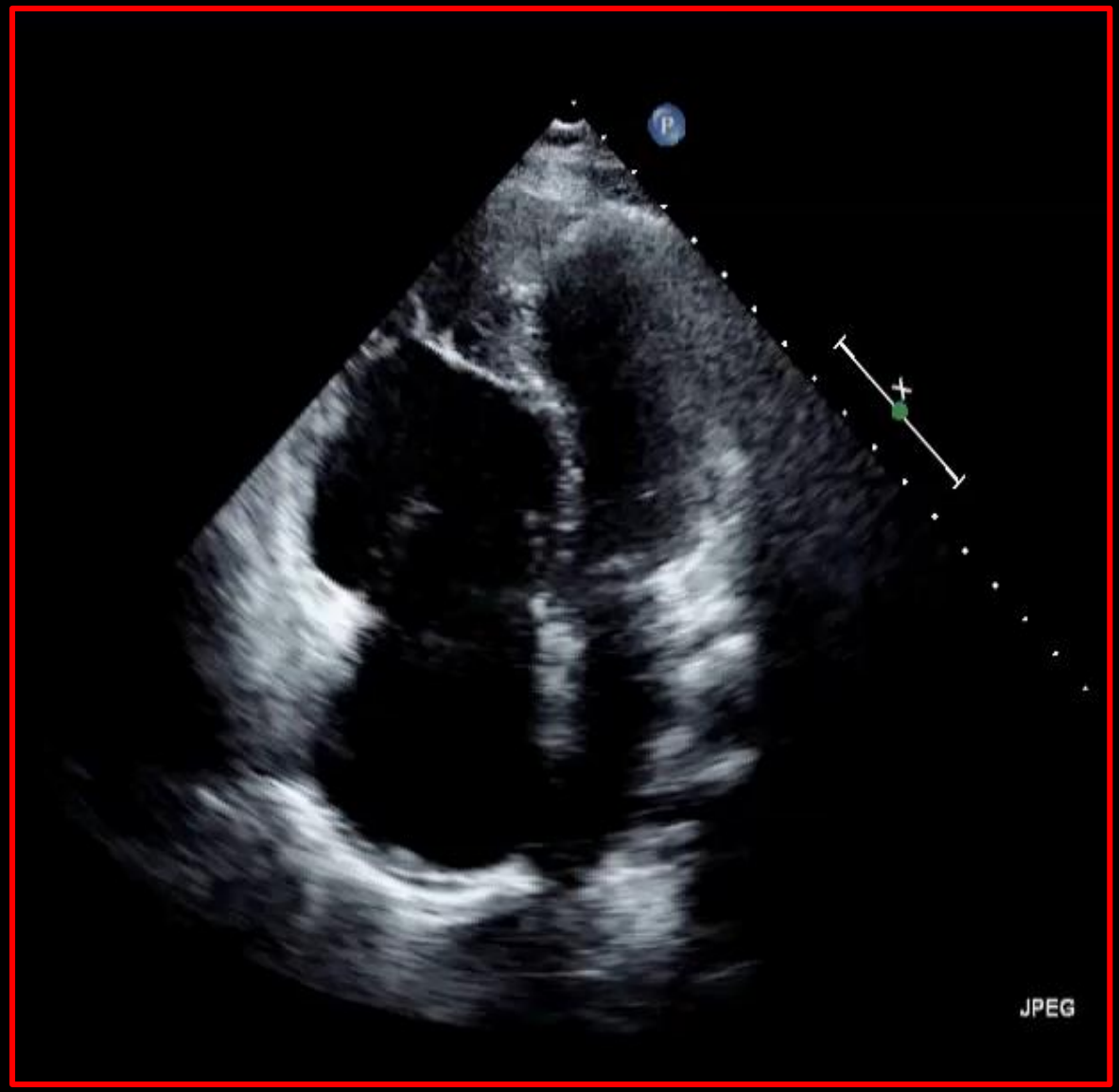
II

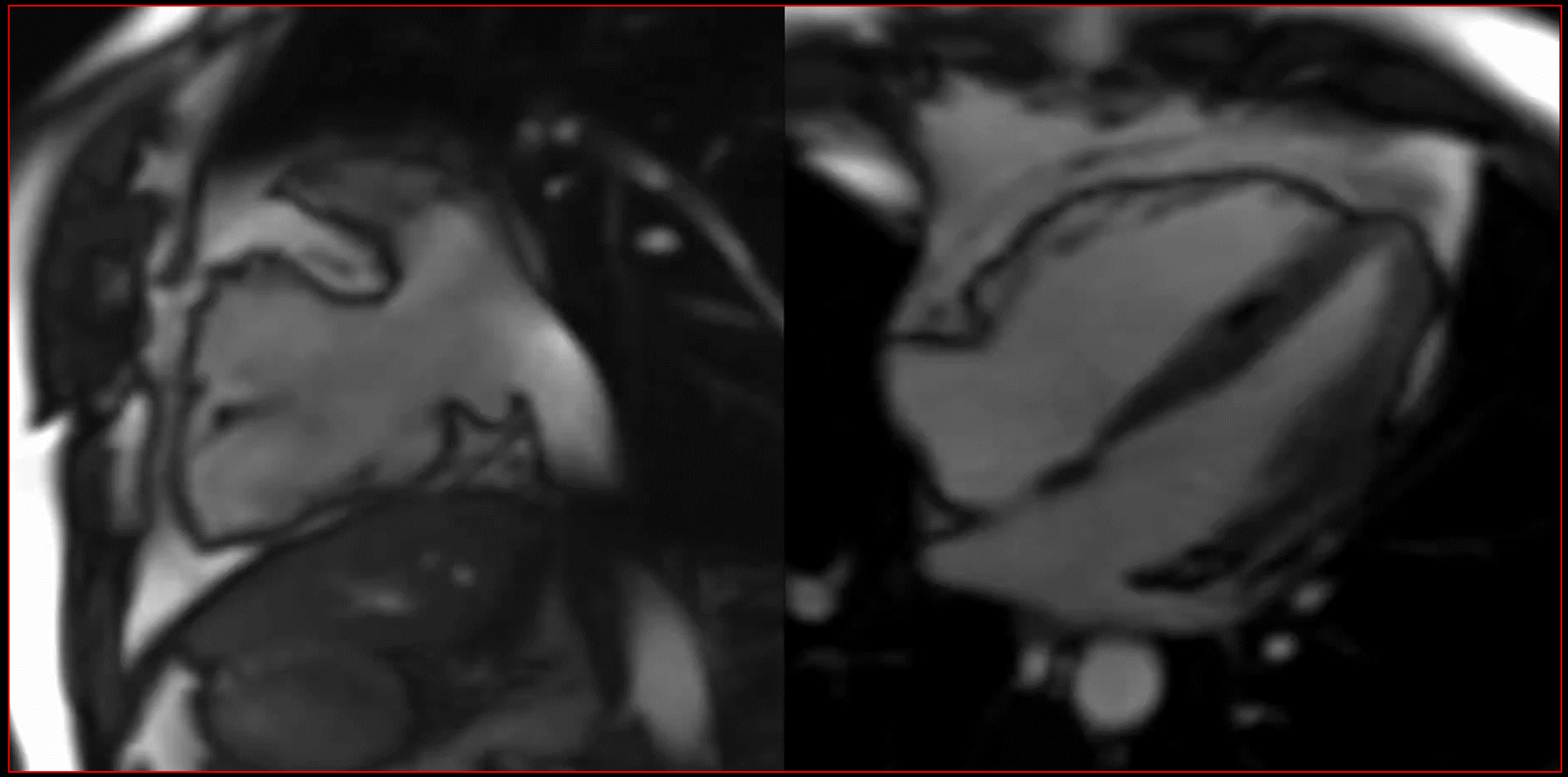
ECG during tachycardia



ECHO



MRI



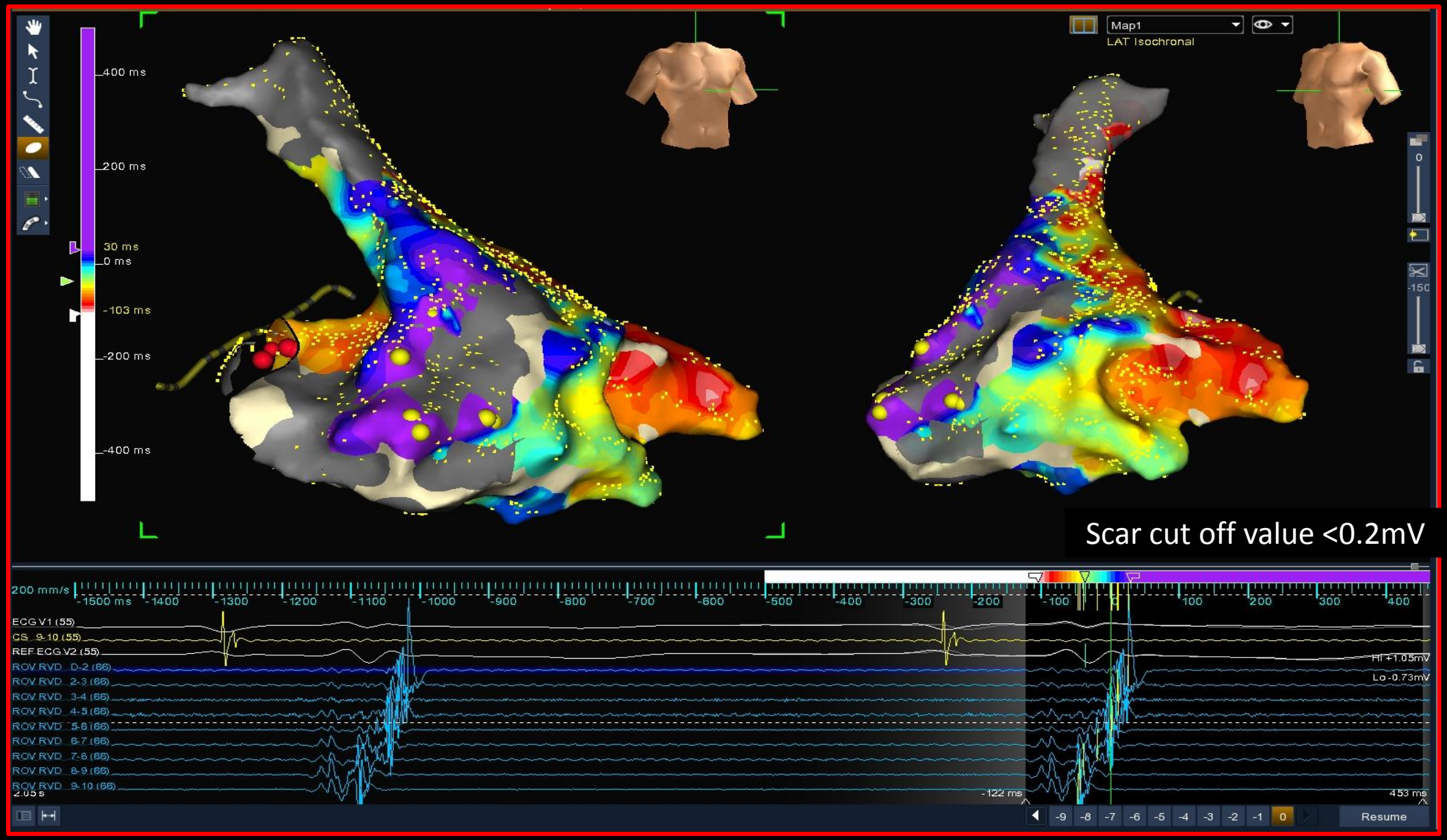
Conclusions: 1. Marked thinning of the right ventricular anterior wall

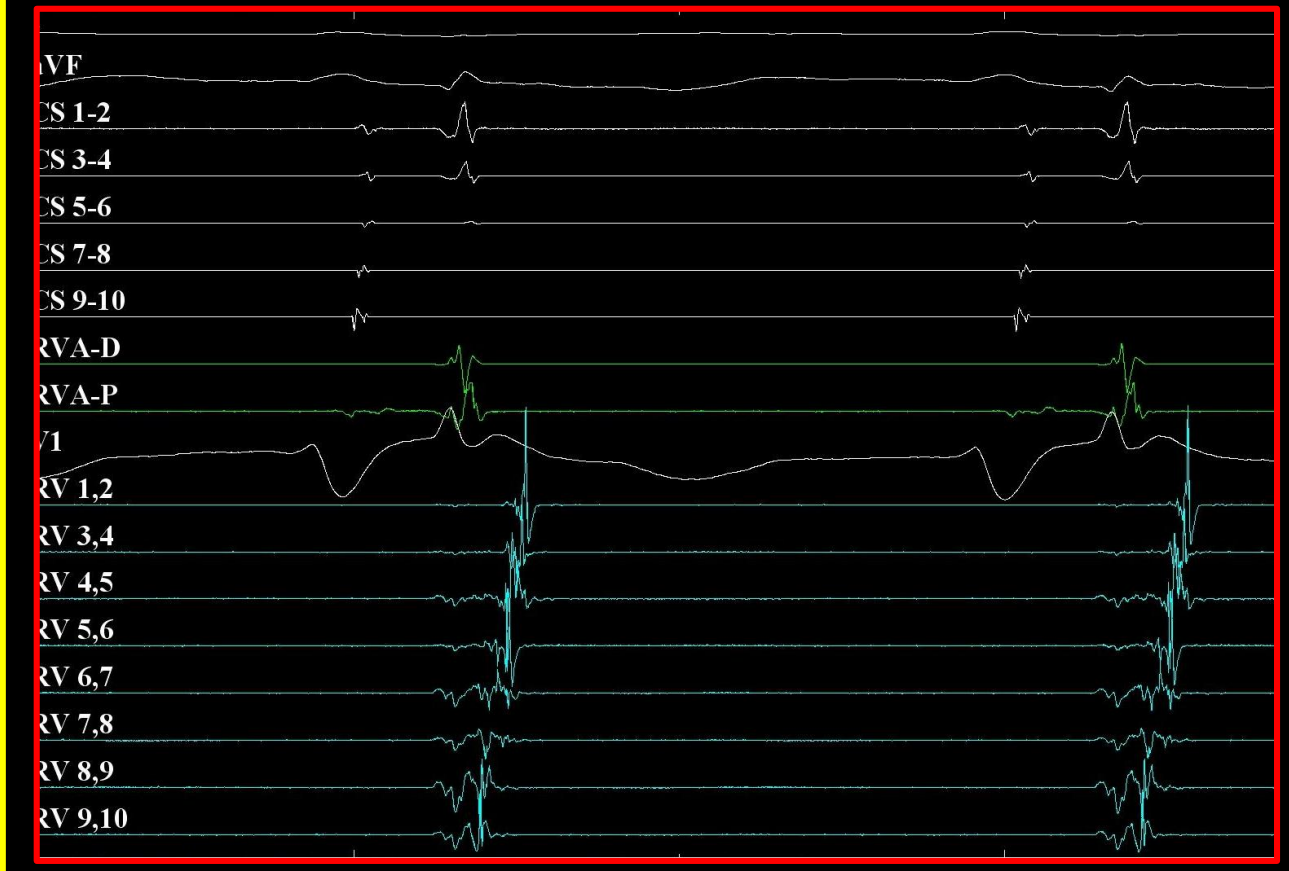
2. There are areas of hypo and dyskinesia over the anterior RV wall from the inlet till the RVOT with patchy fibrotic regions

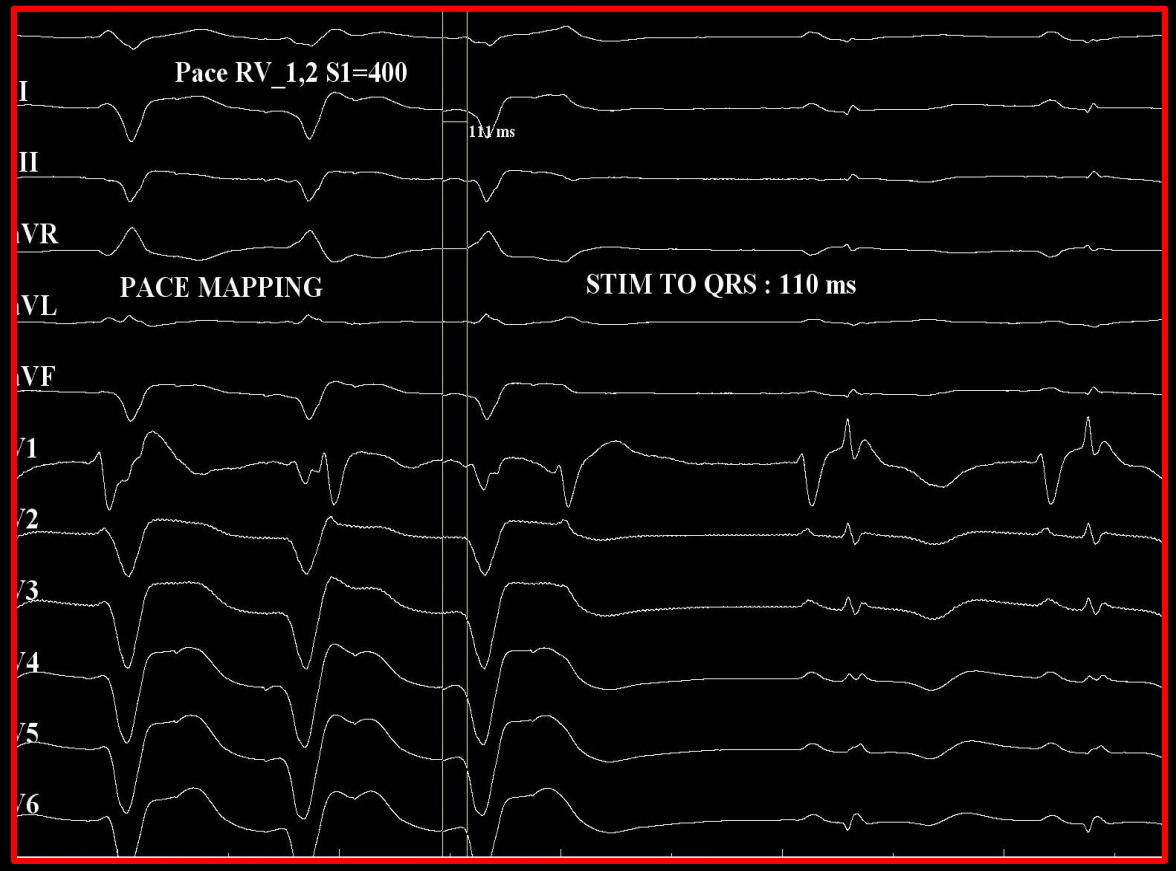
3. Dilated RV with indexed volume of 124ml/M^2.

The features could fill the major MRI criteria for a diagnosis of ARVD/C .

3D-EAM


Map1
LAT Isochronal
400 ms
200 ms
30 ms
0 ms
-103 ms
-200 ms
-400 ms
Scar cut off value <0.2mV
200 mm/s
ECG V1 (55)
CS 9-10 (55)
REF ECG V2 (55)
ROV RVD D-2 (66)
ROV RVD 2-3 (66)
ROV RVD 3-4 (66)
ROV RVD 4-5 (66)
ROV RVD 5-6 (66)
ROV RVD 6-7 (66)
ROV RVD 7-8 (66)
ROV RVD 8-9 (66)
ROV RVD 9-10 (66)
Hi +1.05mV
Lo -0.73mV
-122 ms
453 ms
Resume





Endocardial ablation “alone” was considered enough

MRI + Late potential map + Contact force ablation

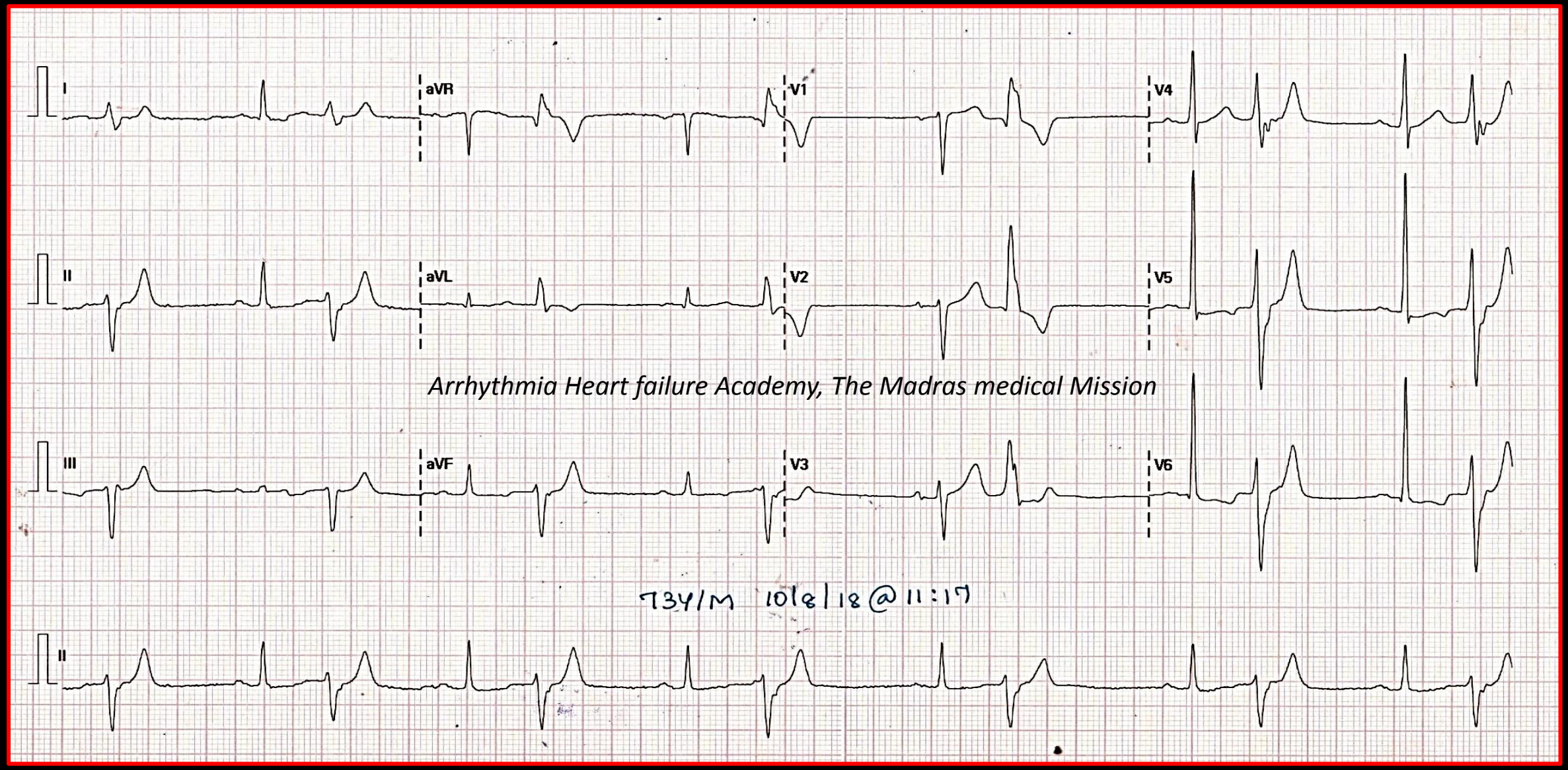
CASE 2

73Y, M, SYNCOPAL EPISODES

GOOD BIVENTRICULAR FUNCTION

NORMAL EPICARDIAL CORONARIES

ECG


I
aVR
V1
V4
II
aVL
V2
V5
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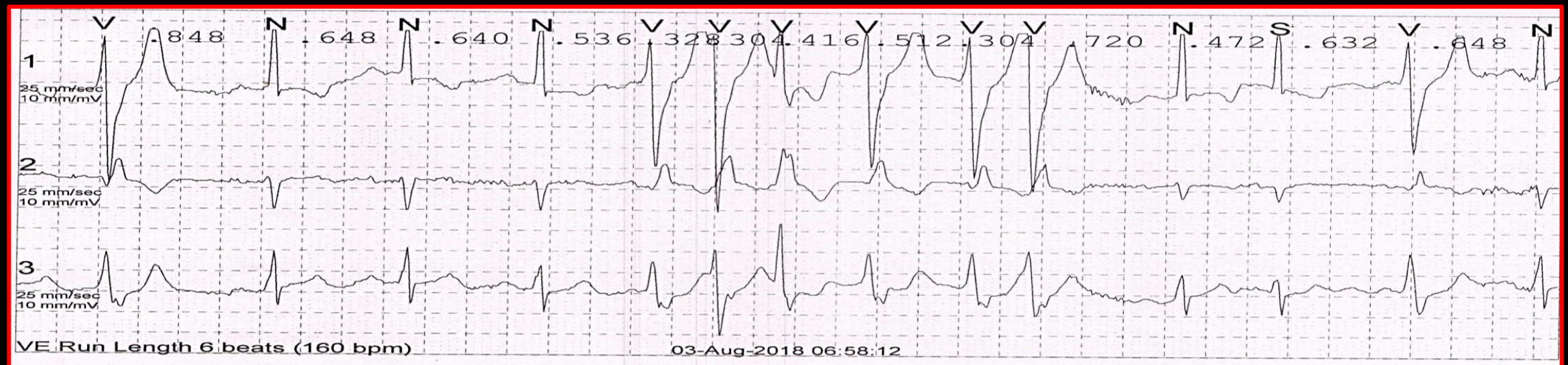
III
aVF
V3
V6
73Y/M 10/8/18 @ 11:17
II

HOLTER



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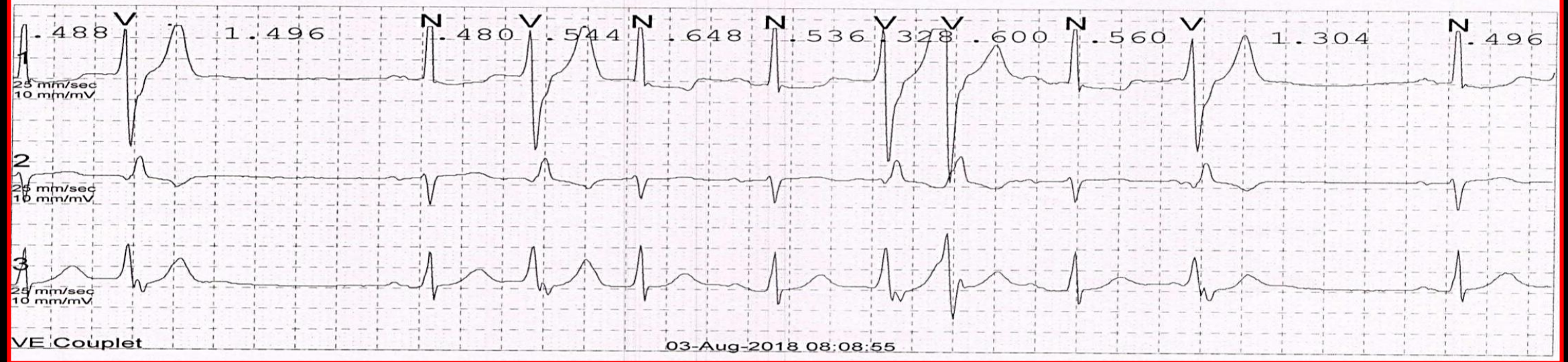
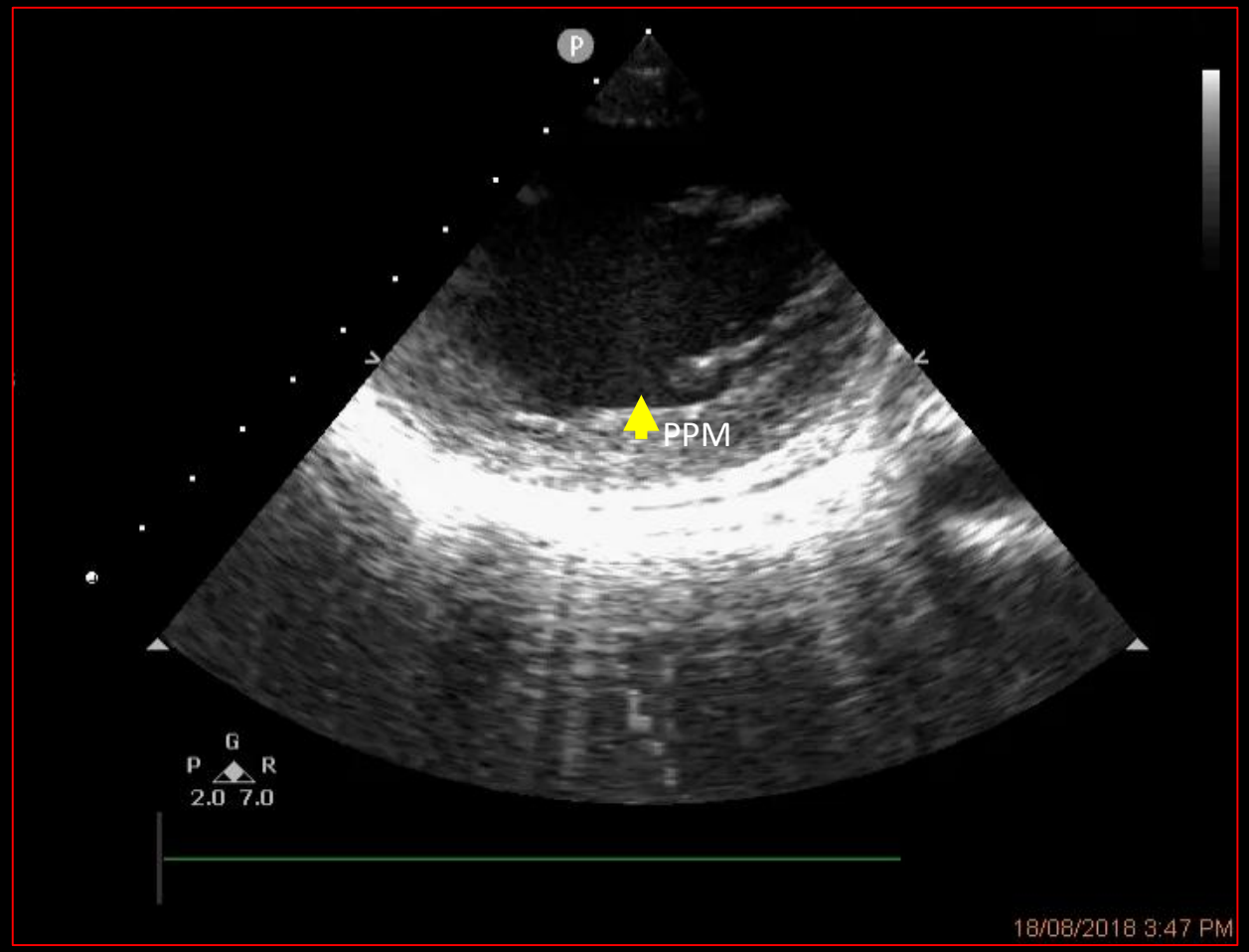
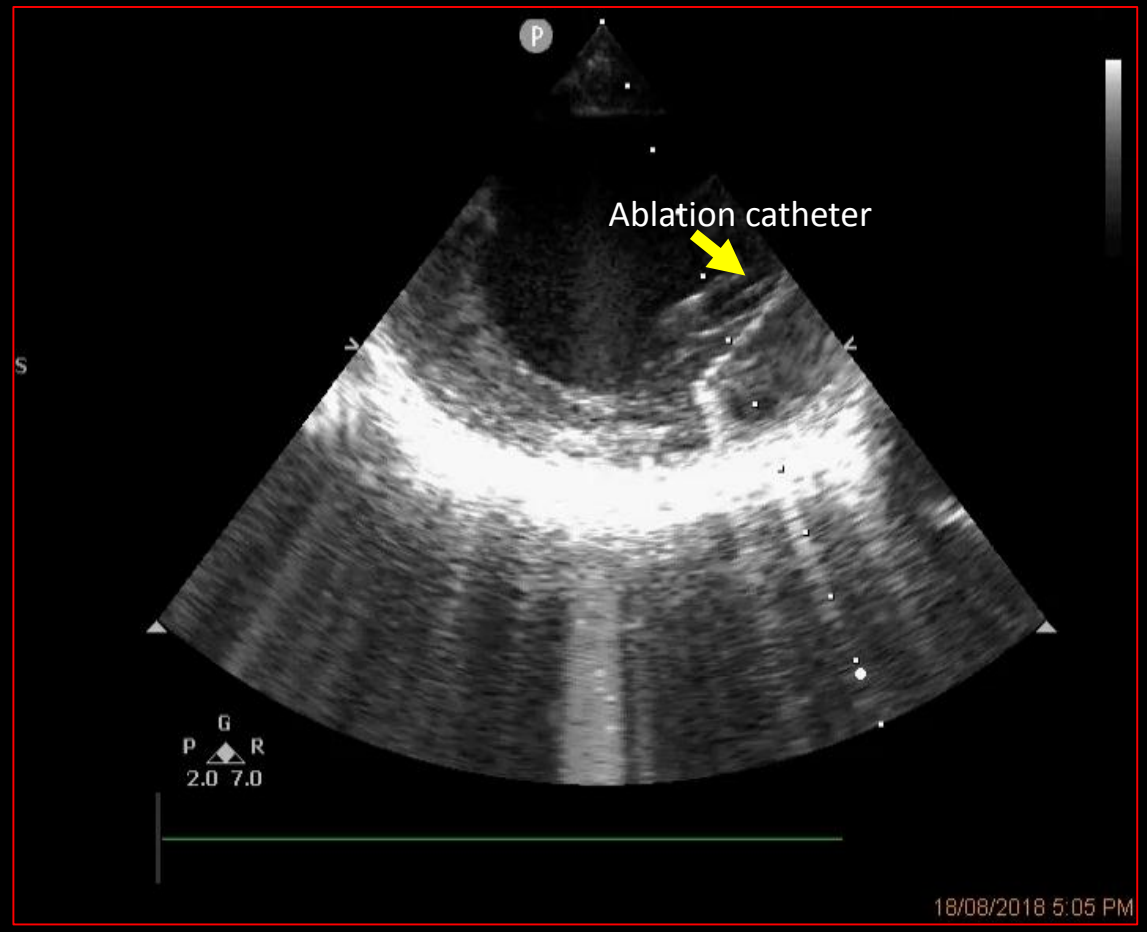
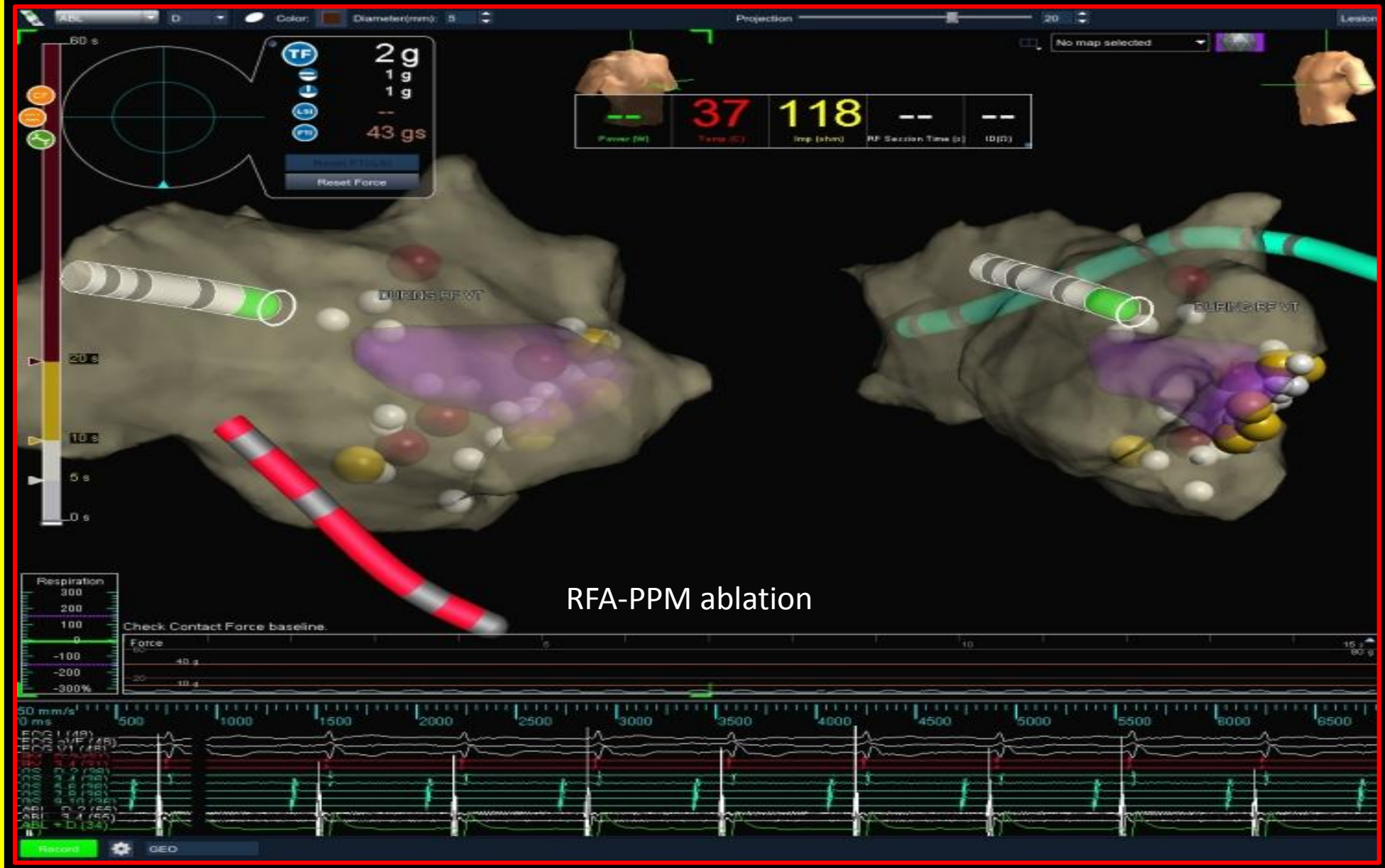


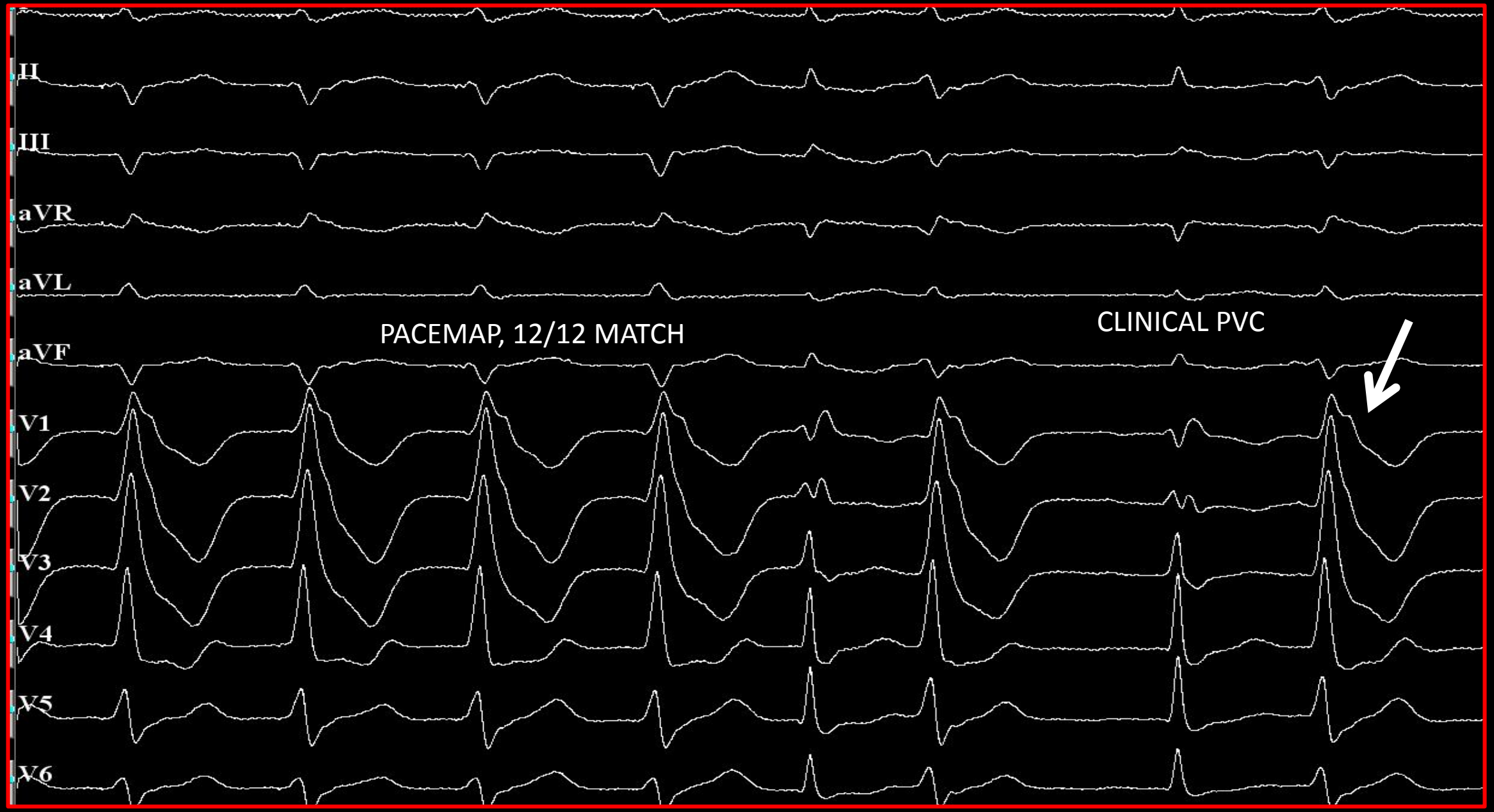
ICE

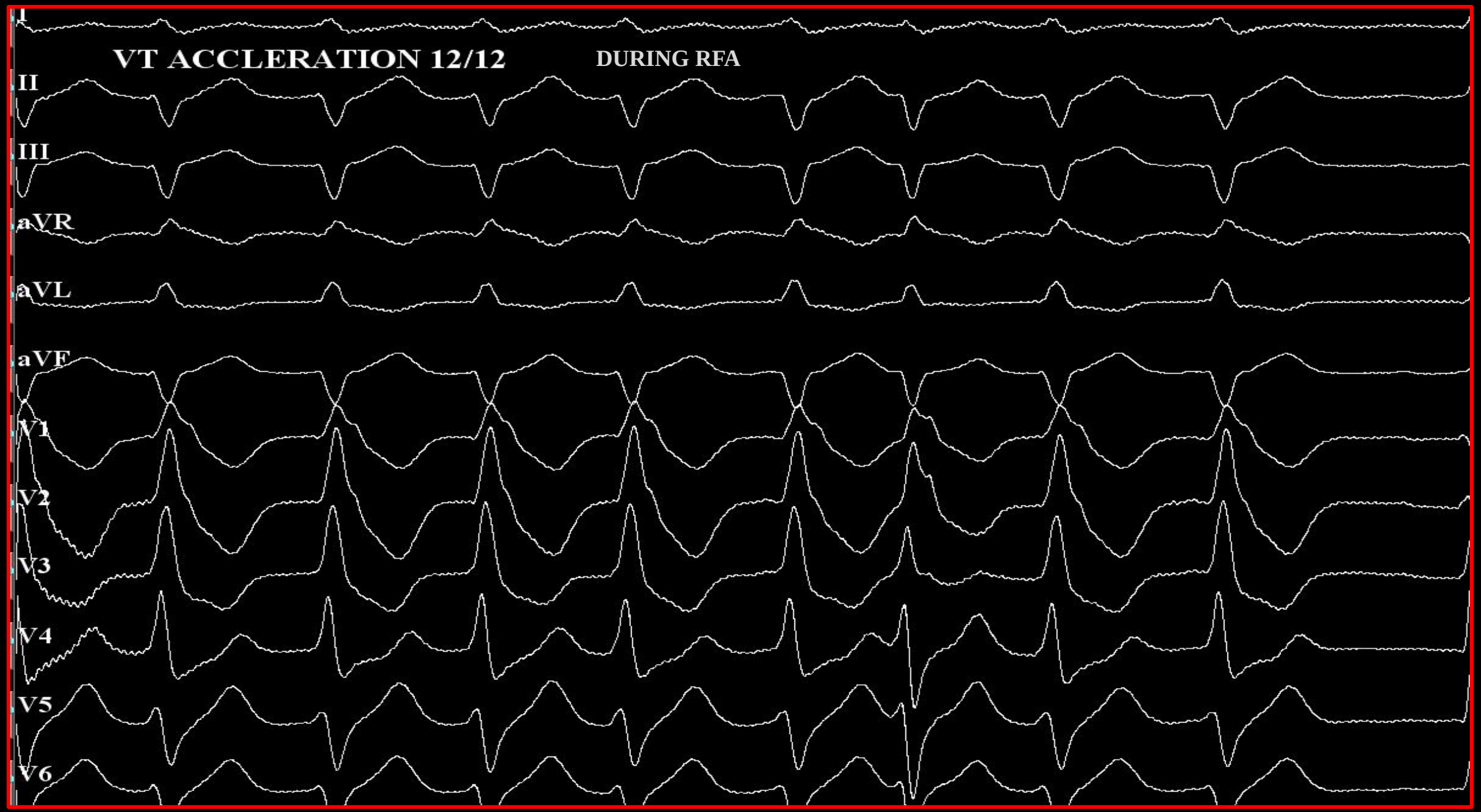

PPM
G
P R
2.0 7.0
18/08/2018 3:47 PM


Ablation catheter
G
P R
2.0 7.0
18/08/2018 5:05 PM



RFA-PPM ablation


II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
PACEMAP, 12/12 MATCH
CLINICAL PVC


I
VT ACCLERATION 12/12
DURING RFA
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

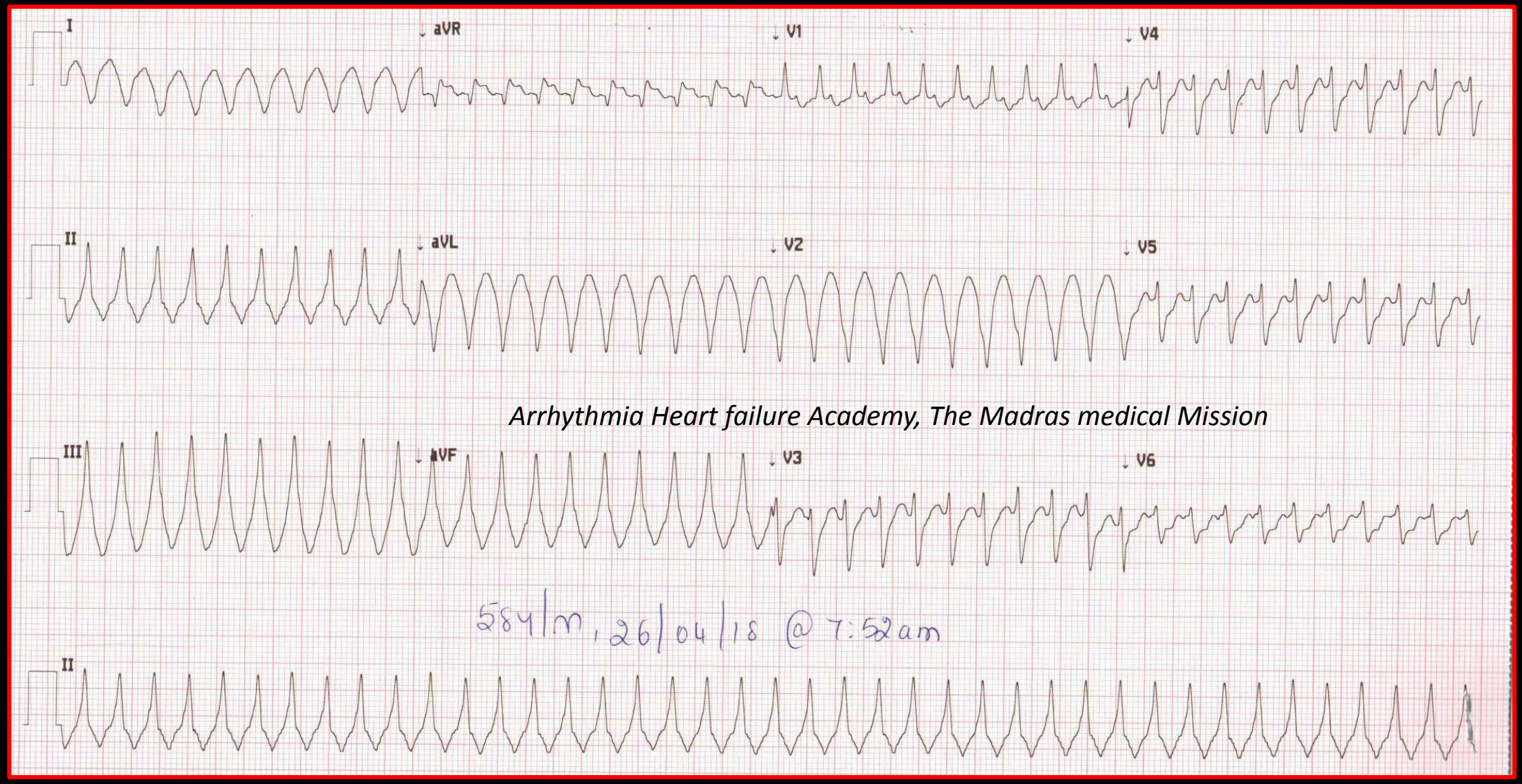
PAPILLARY MUSCLE VT

ICE + Intracavitary 3D map +
Contact force ablation catheter

CASE 3

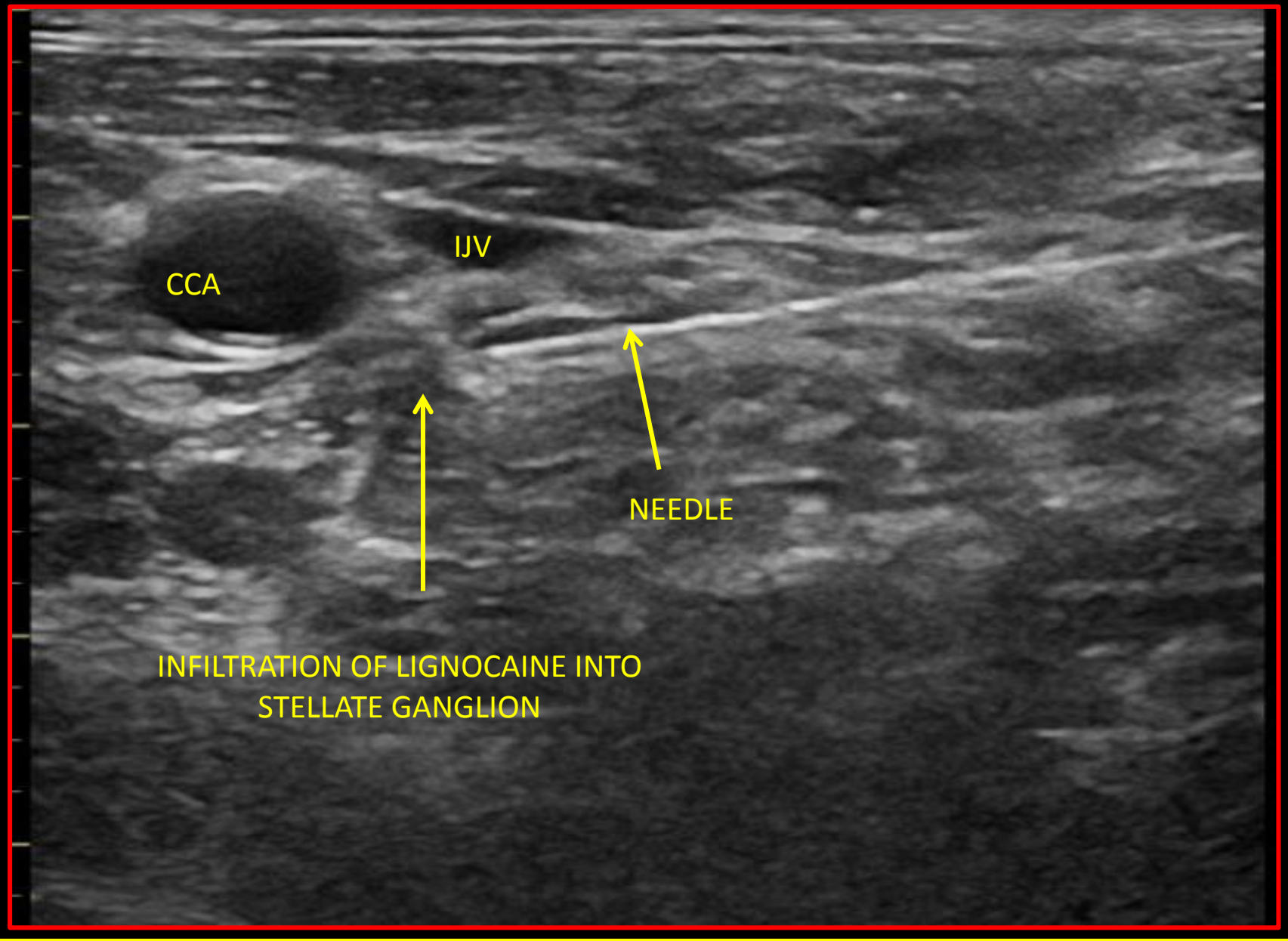
58Y, M, Presents to the ER: Unconscious

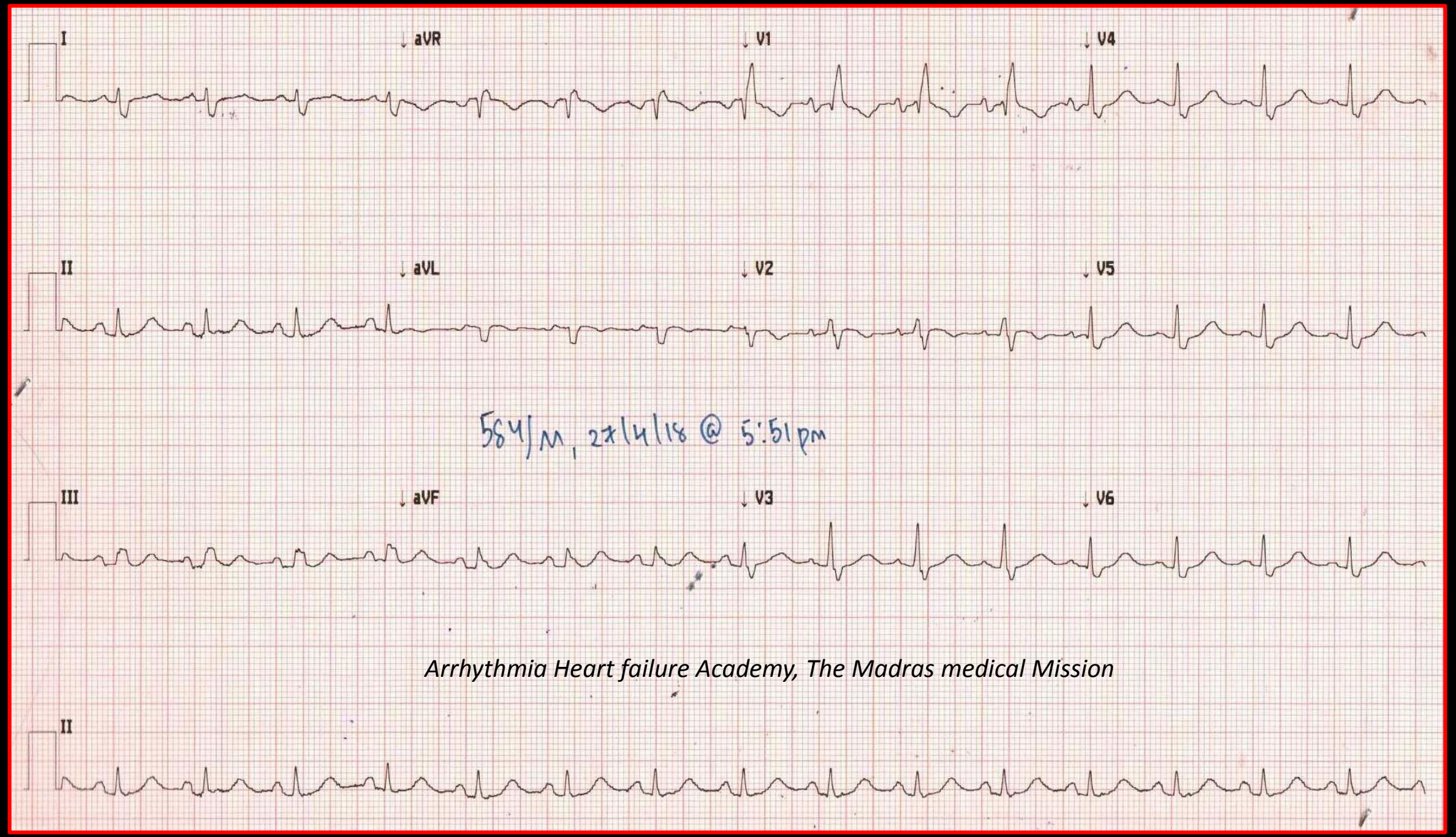
Refractory to Cordarone, Lignocaine, Beta Blocker - Multiple shocks



Echo : Structurally Normal Heart, No LV/RV Dysfunction

Stellate Ganglion Block





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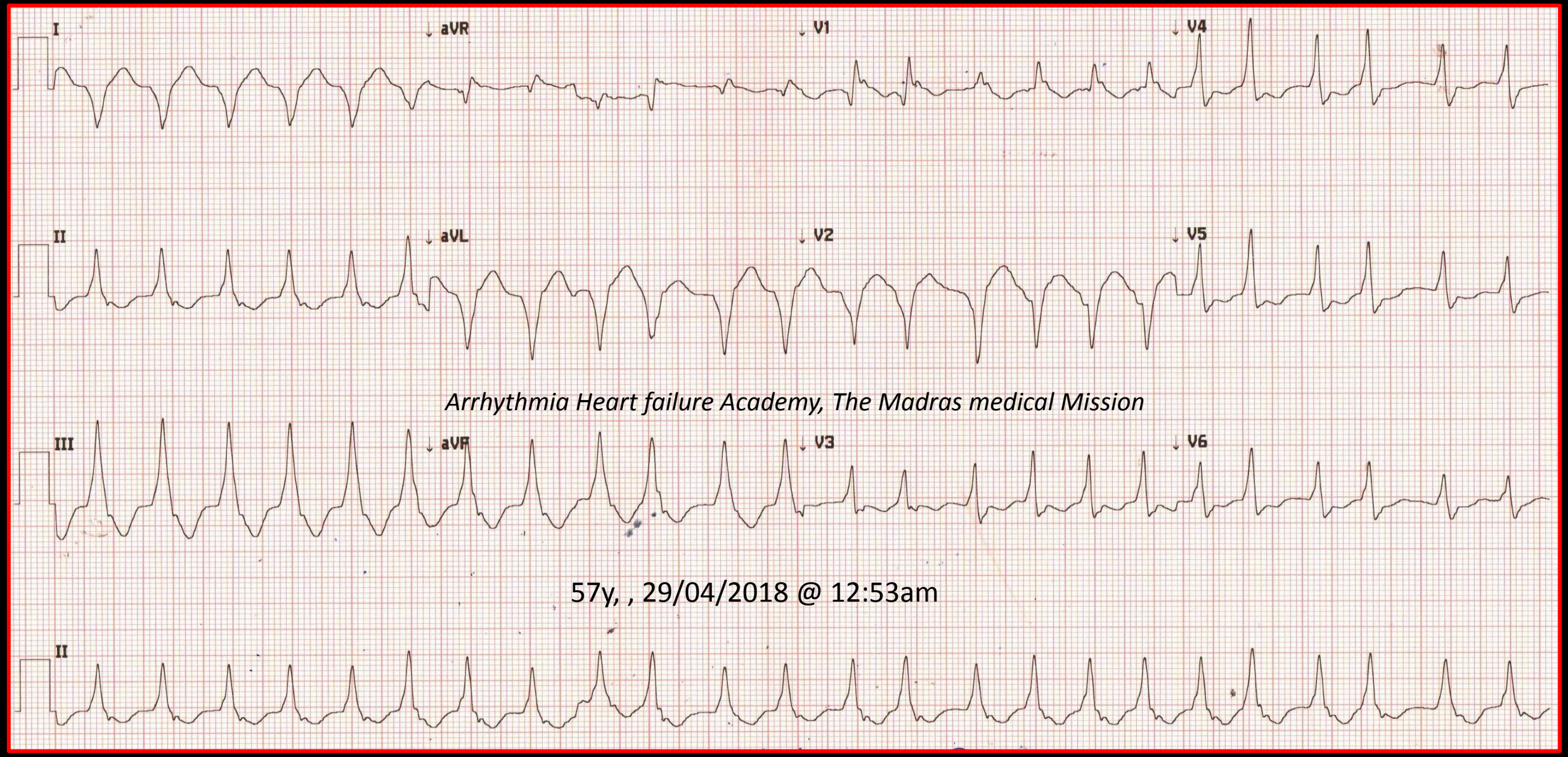
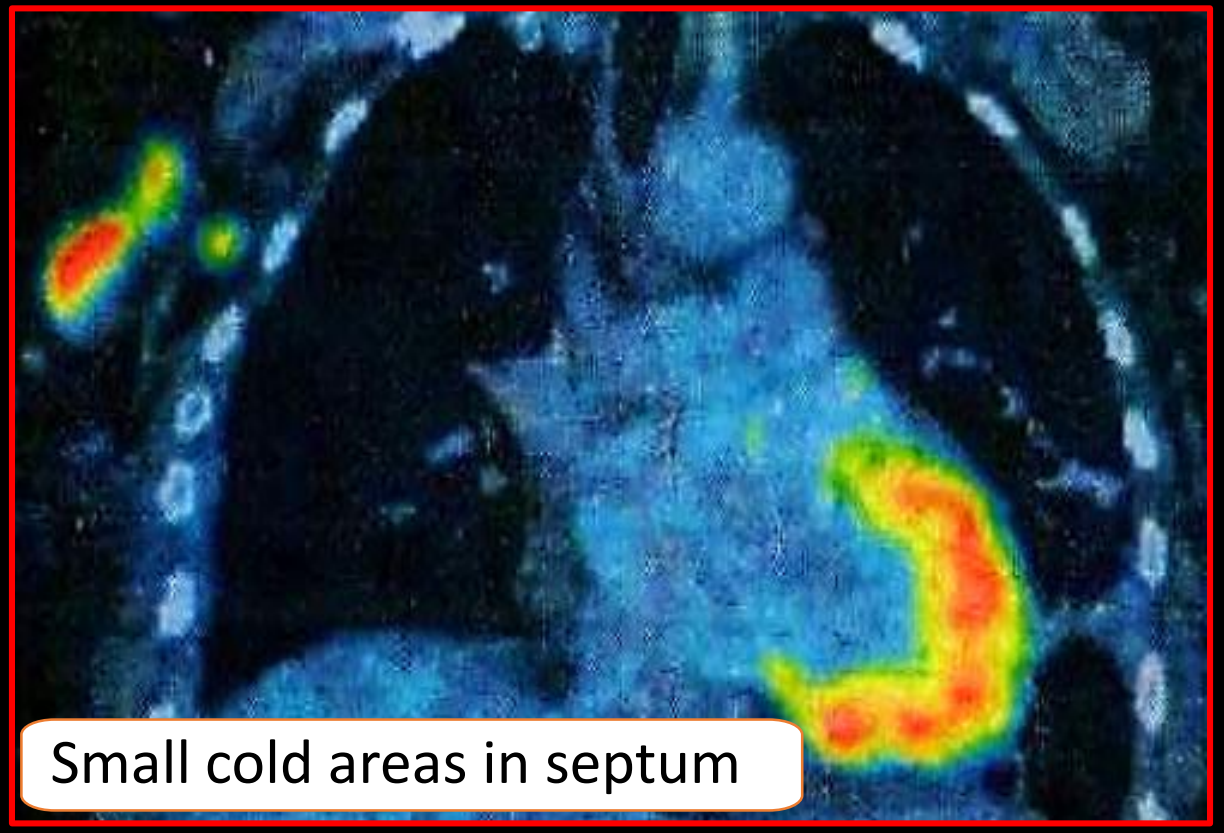
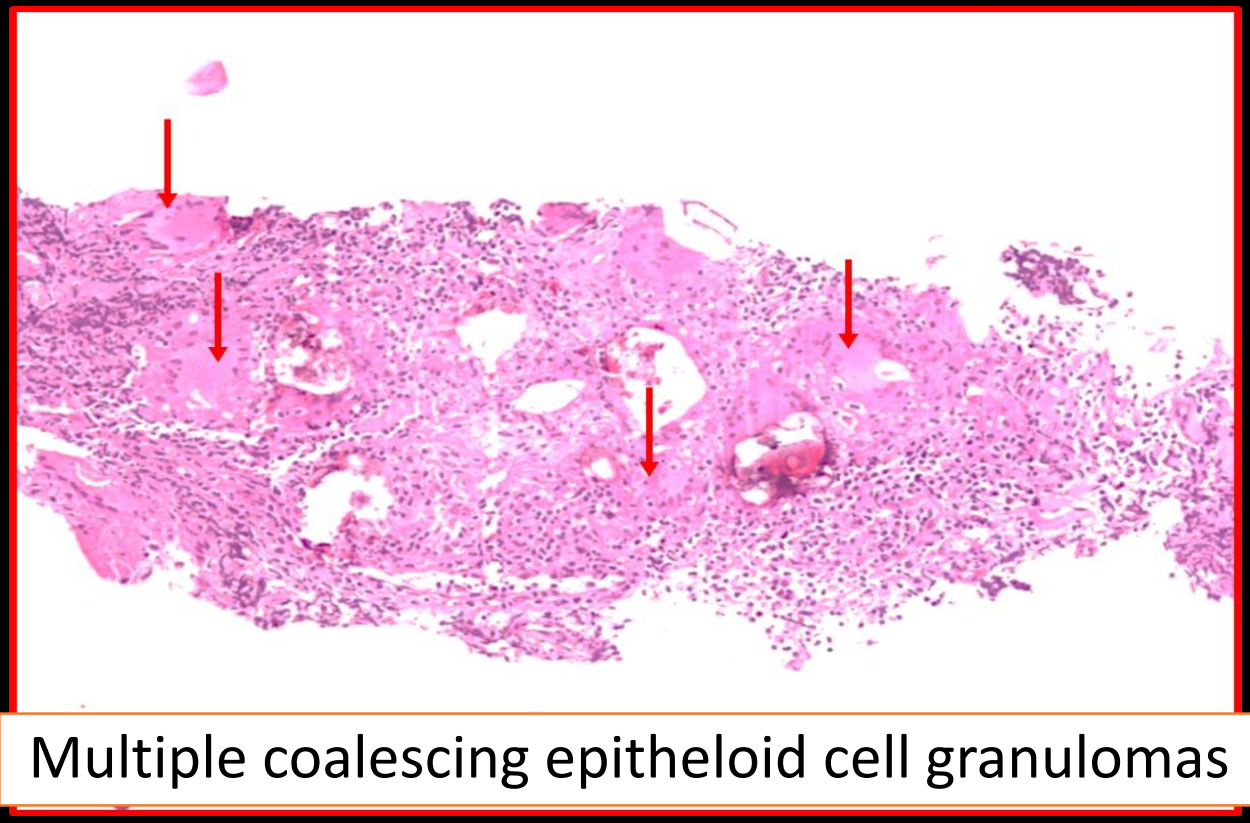
VT Recurs 30 hours post Stellate Ganglion Block



Patient undergoes PET CT & CT guided Lymph node biopsy



Small cold areas in septum



Multiple coalescing epitheloid cell granulomas

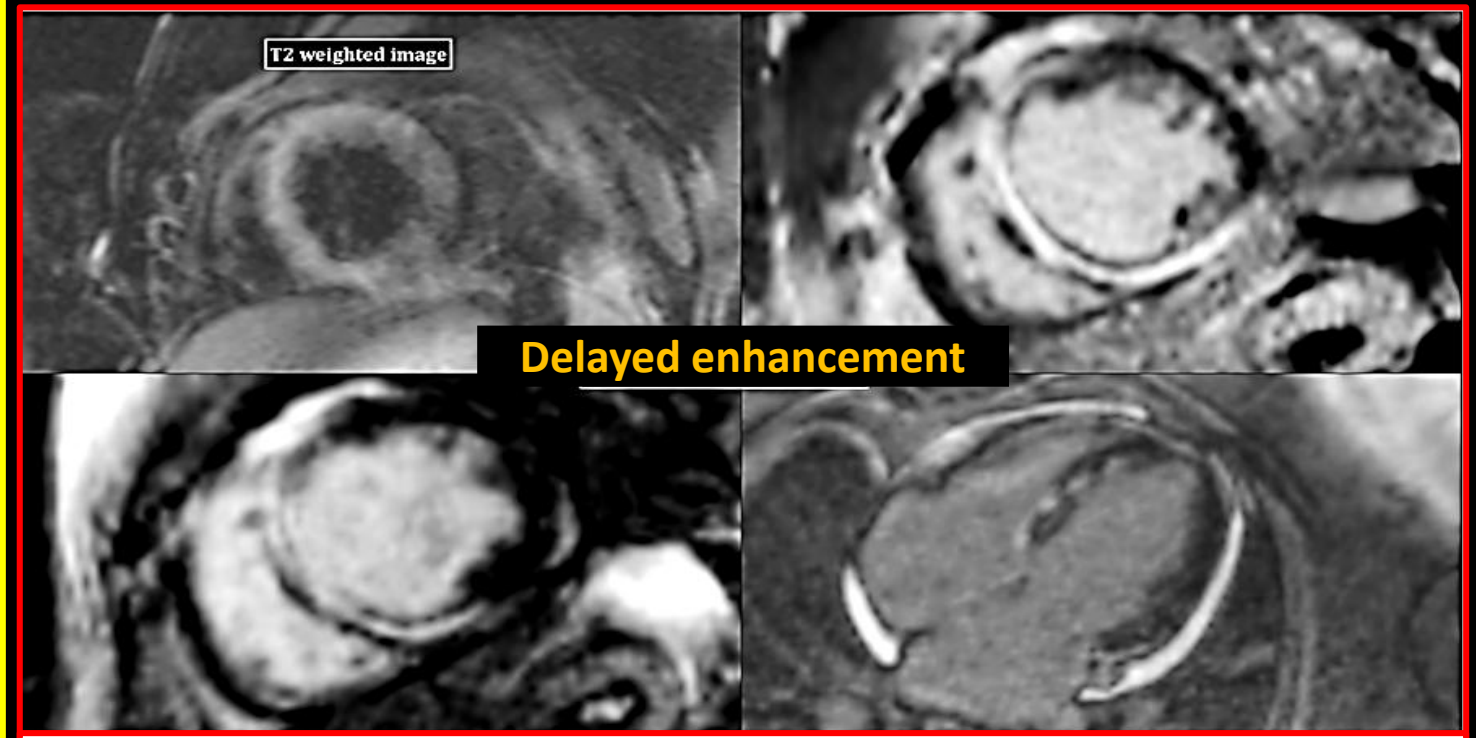
SPECIMEN: Right axillary node

ZIEHL NEELSEN STAIN (DIRECT & CONCENTRATED) : NO ACID FAST BACILLI SEEN.

AURAMINE O STAIN (DIRECT & CONCENTRATED) : NO ACID FAST BACILLI SEEN.

Real time PCR : Negative

Cardiac MRI



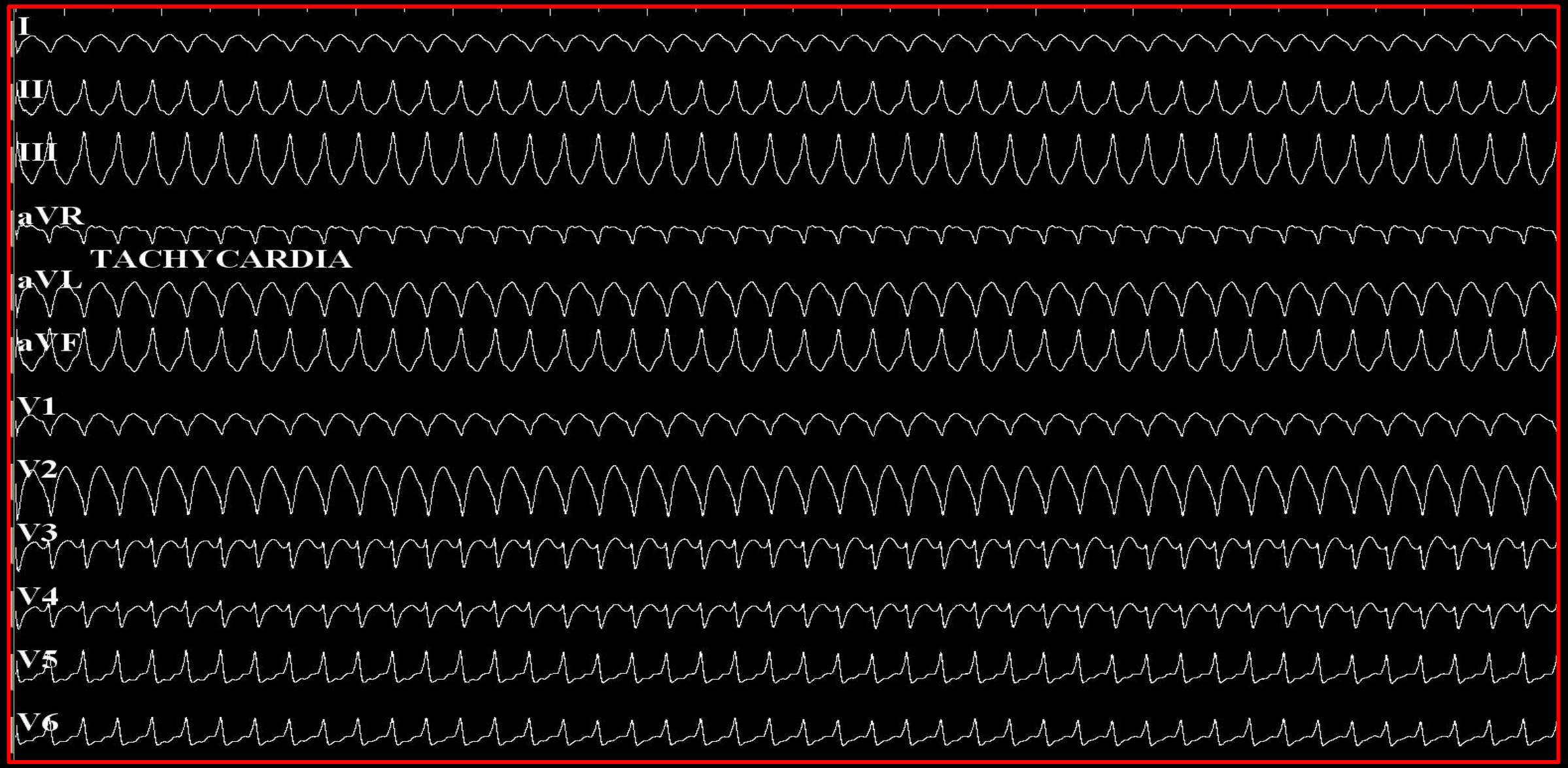
Conclusions:

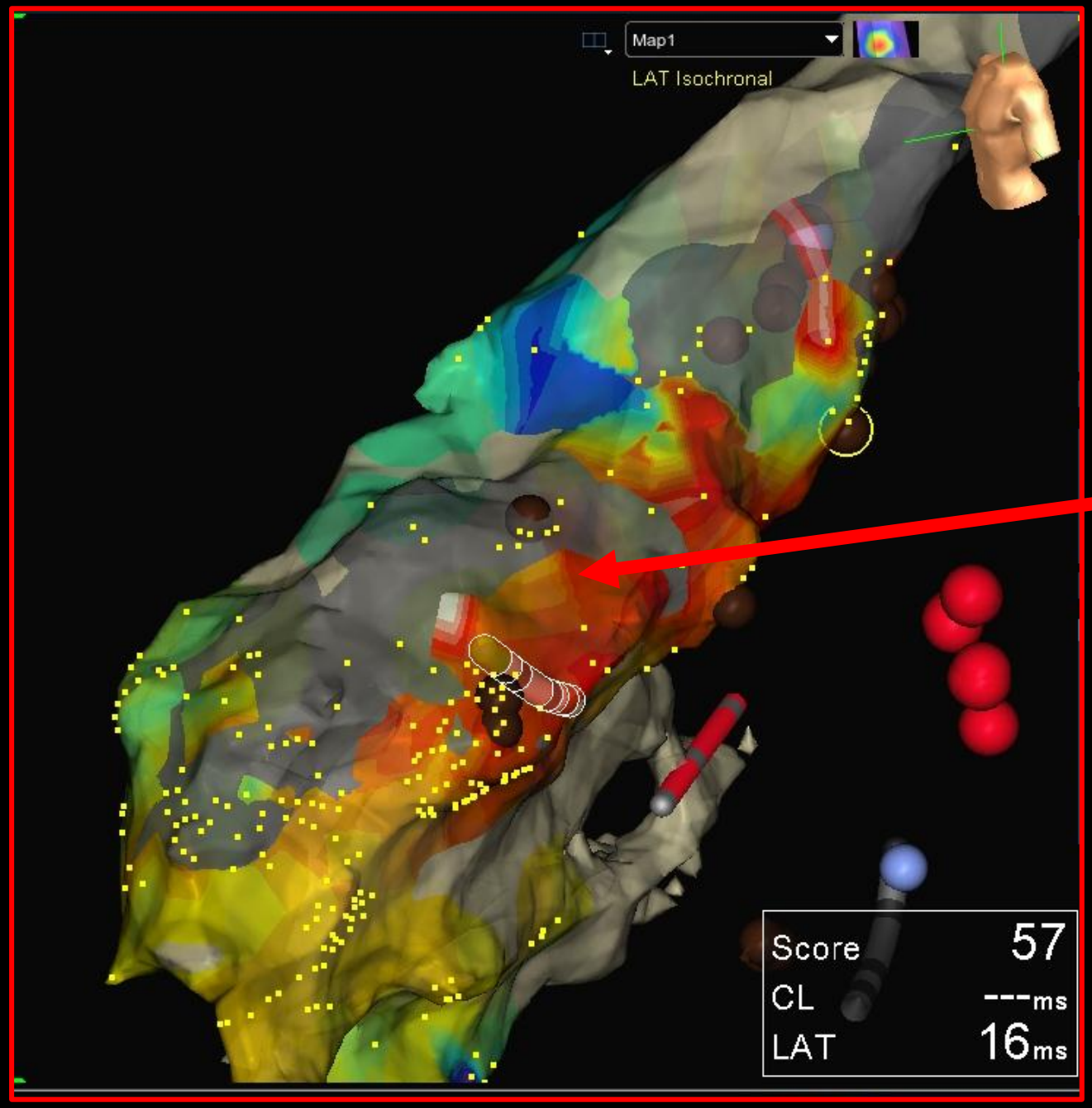
1. Structurally normal heart.
2. Significant LV dilatation with systolic dysfunction.
3. Interventricular septal hypokinesia with myocardial edema.
4. Delayed enhancement of the IVS of the mid wall to nearly transmural in extent
5. The features are consistent with inflammatory process like sarcoidosis etc.

Diagnosis: Sarcoidosis

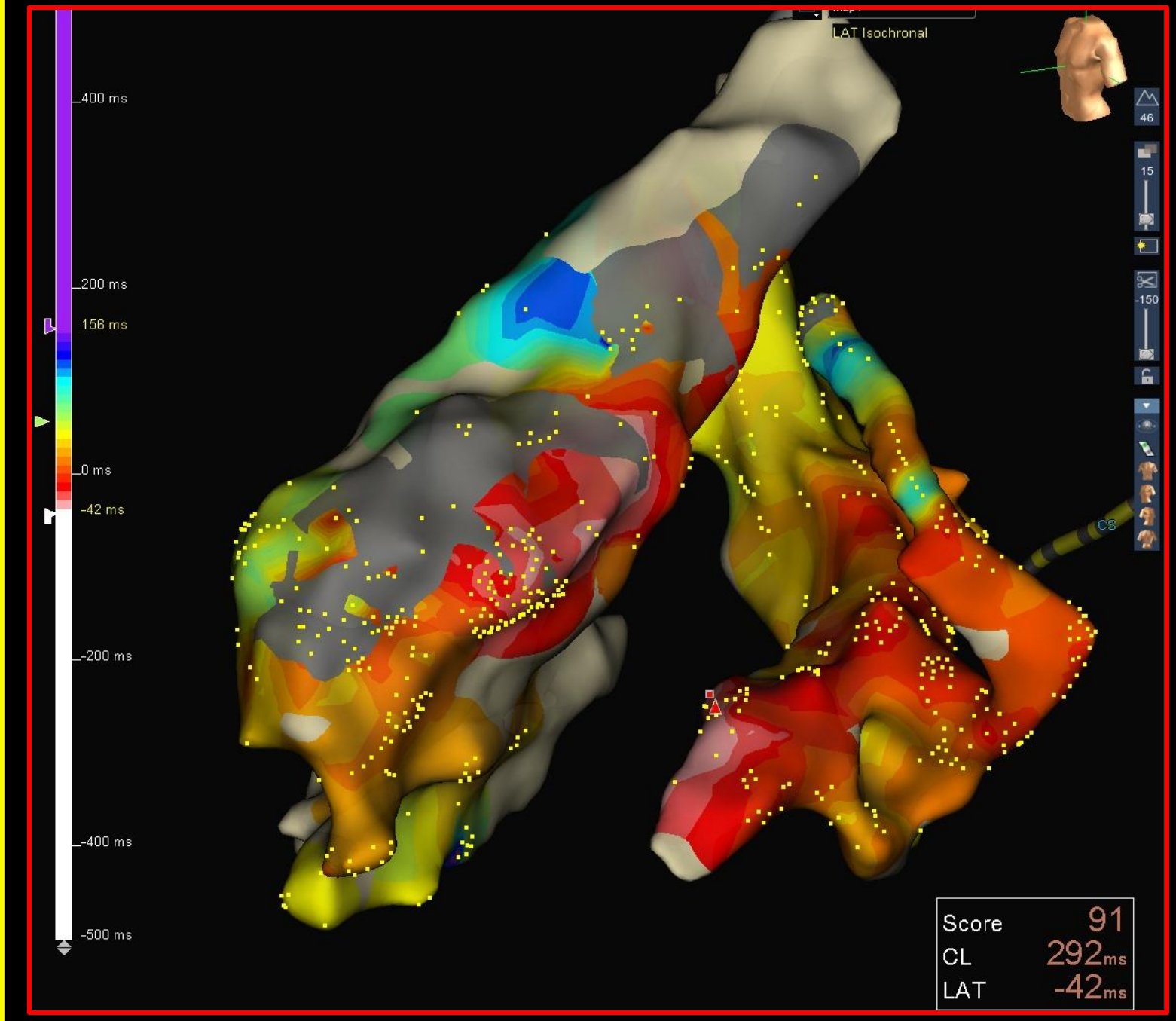
Plan: Steroids +/- RFA

Easily Inducible, Different Morphology



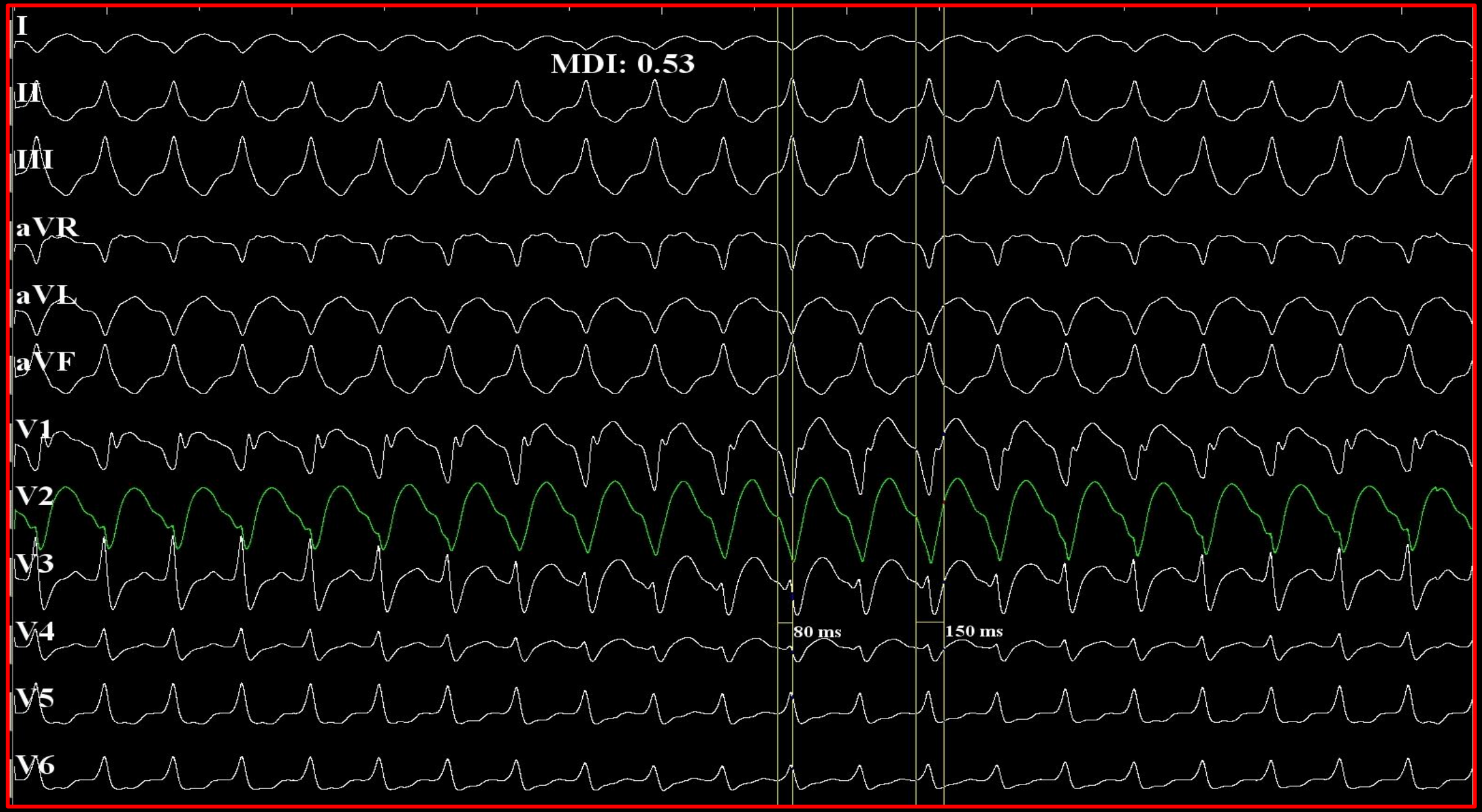


Scar noted in RVOT basal septum

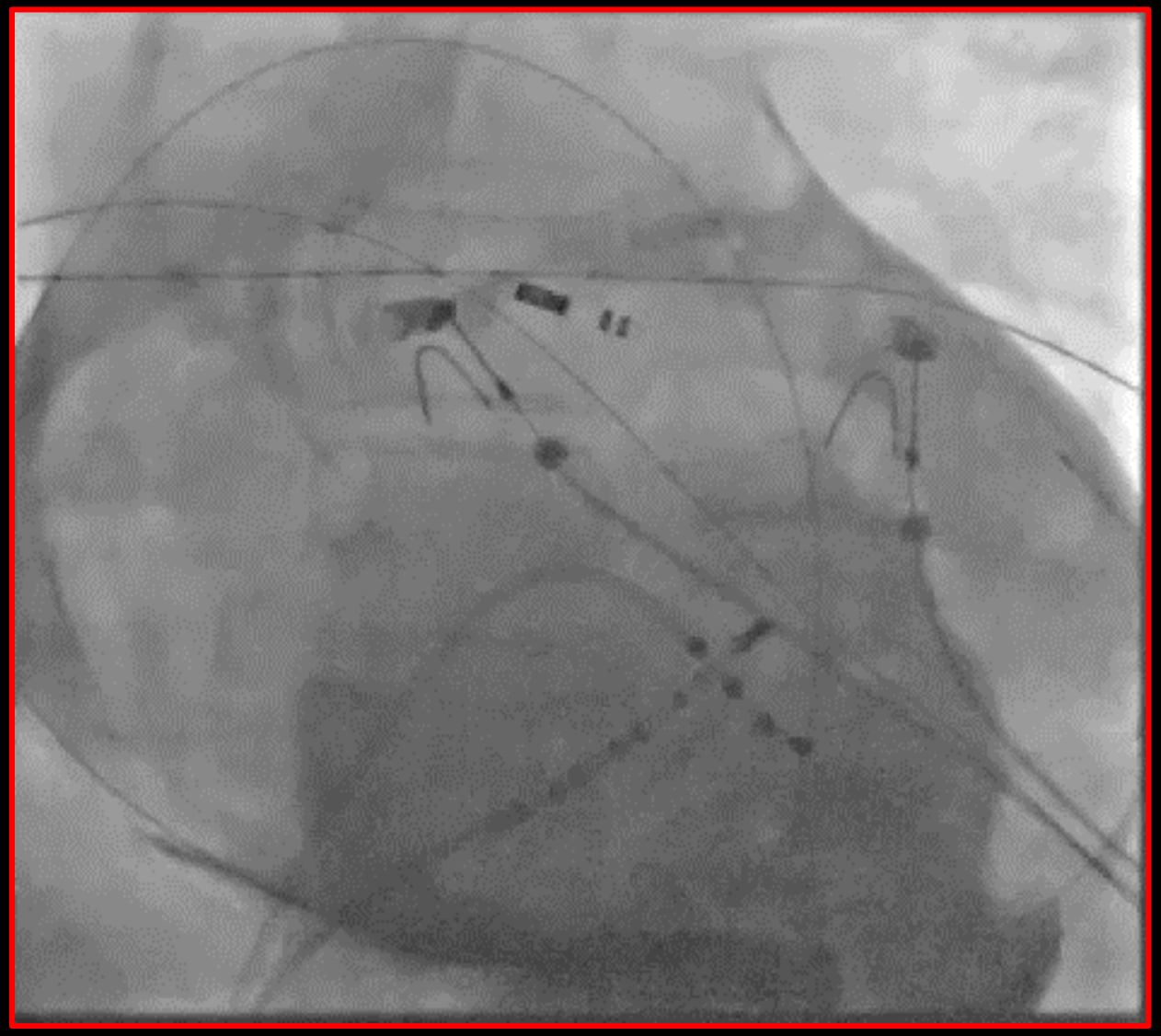


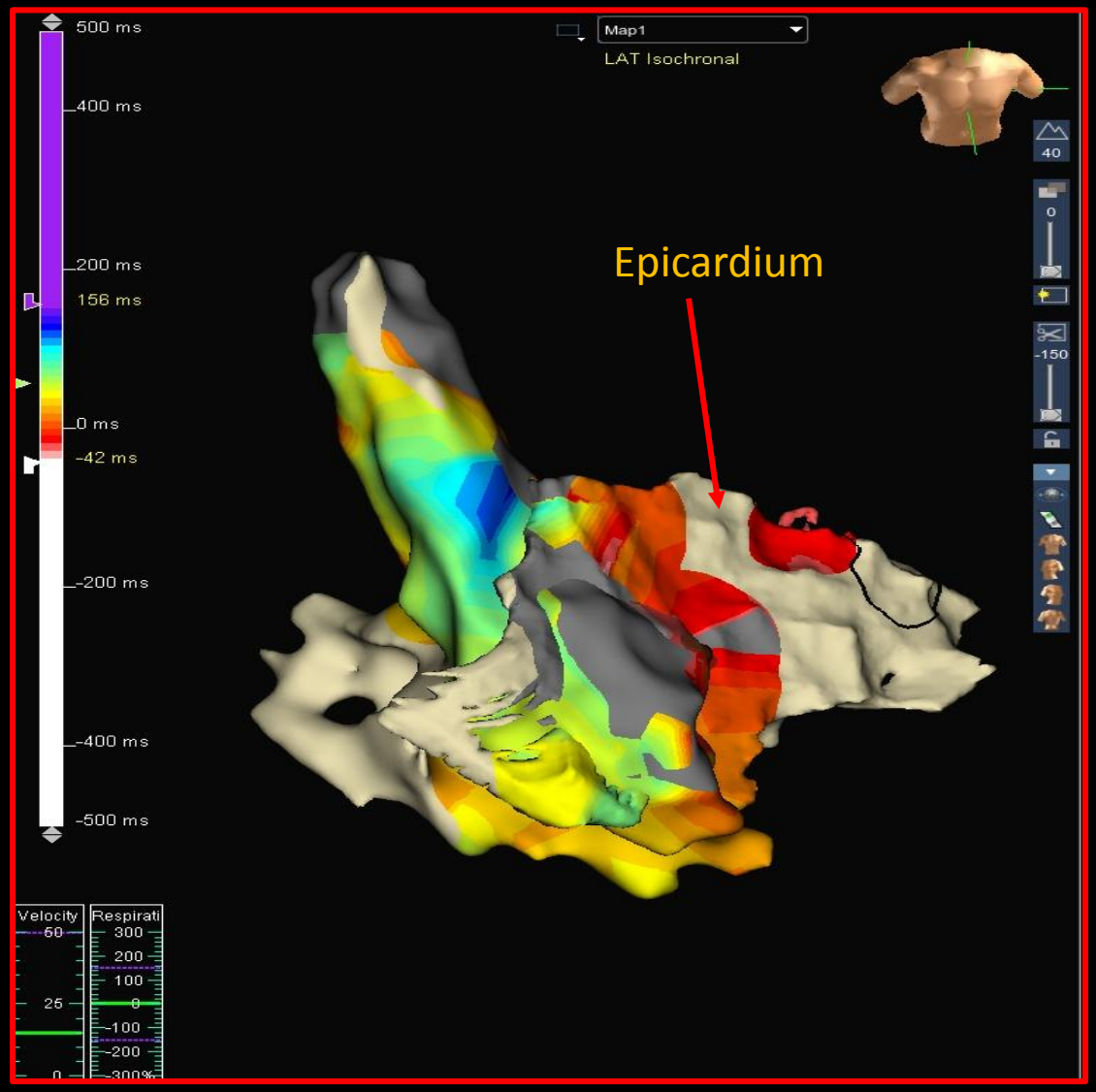
LV WAS MAPPED

- NO SCAR POTENTIALS
- ENTRAINMENT MAPPING NOT SATISFACTORY

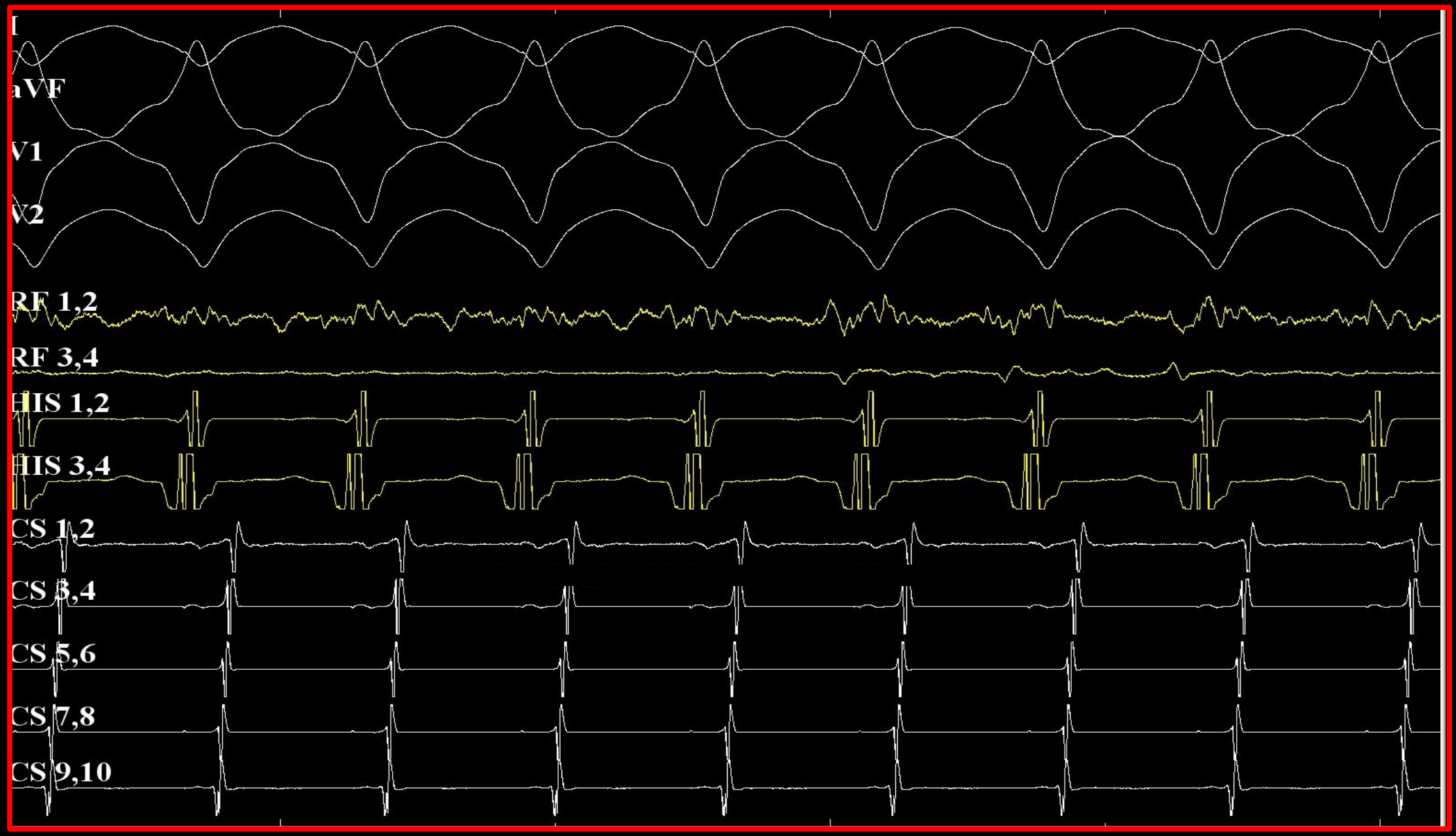

I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
MDI: 0.53
80 ms
150 ms

Epicardial mapping





Epicardial continuous potential



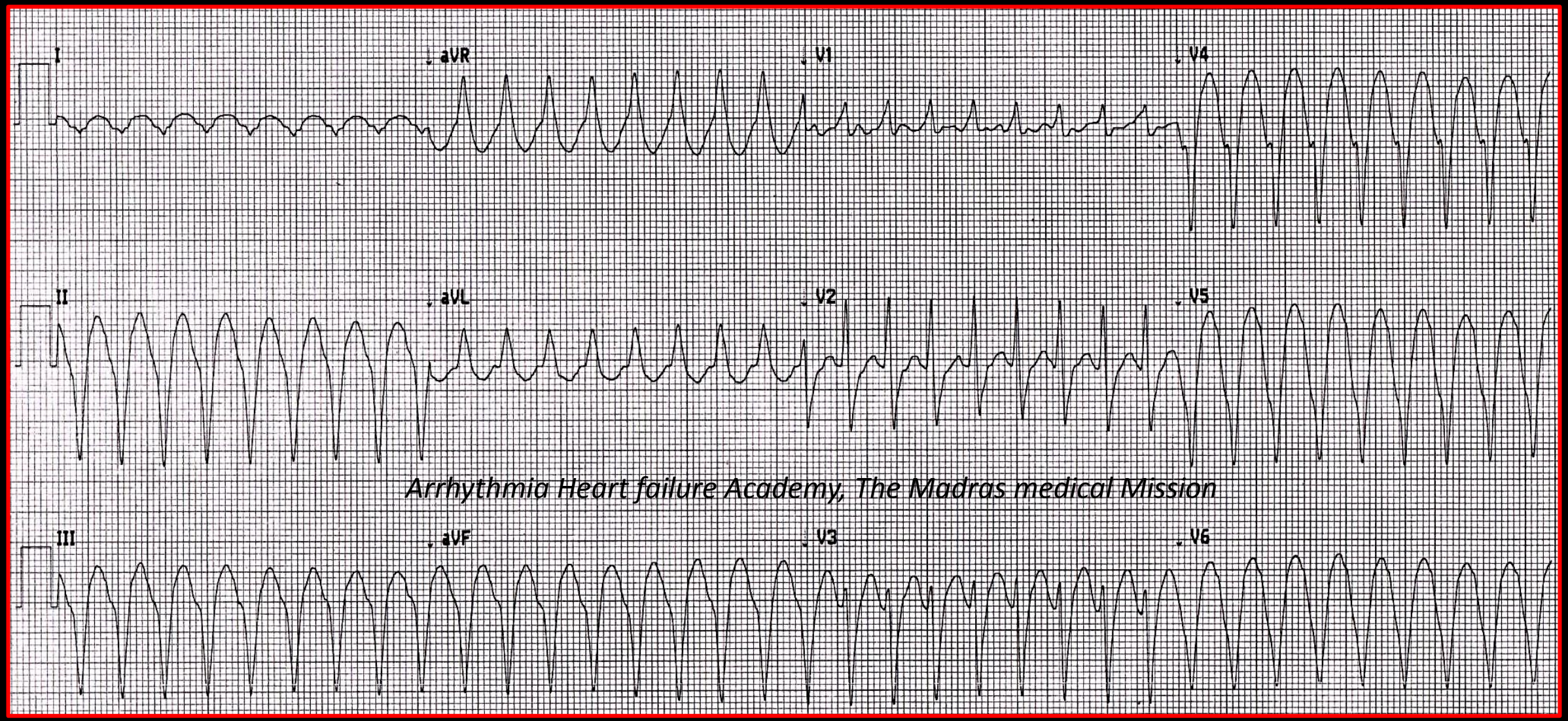
SARCOIDOSIS

PET CT + MRI + Biopsy +

Advance 3D Electroanatomical mapping

CASE 4

52Y, F, DCM, Severe LV dysfunction, Monomorphic VT,

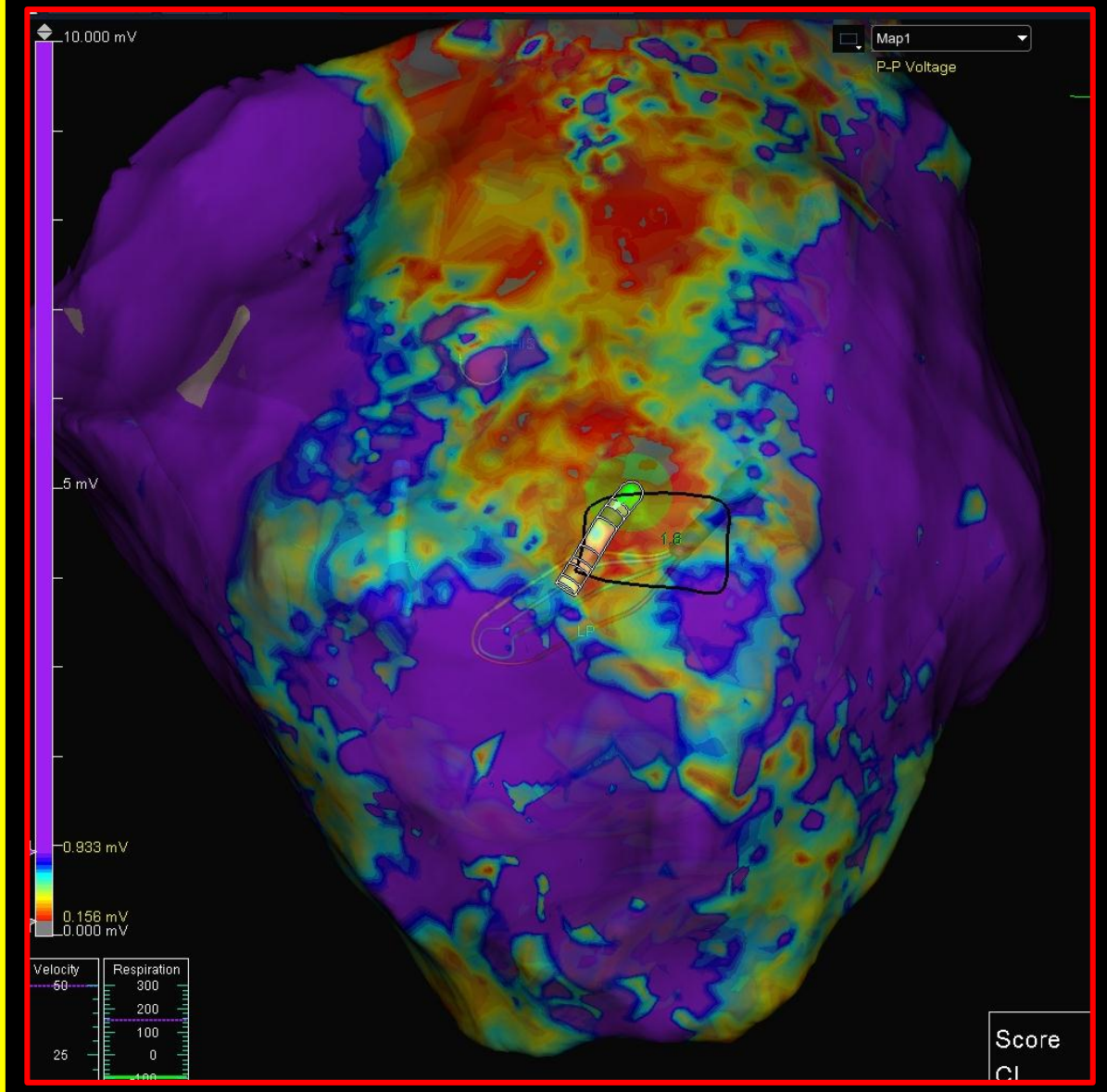


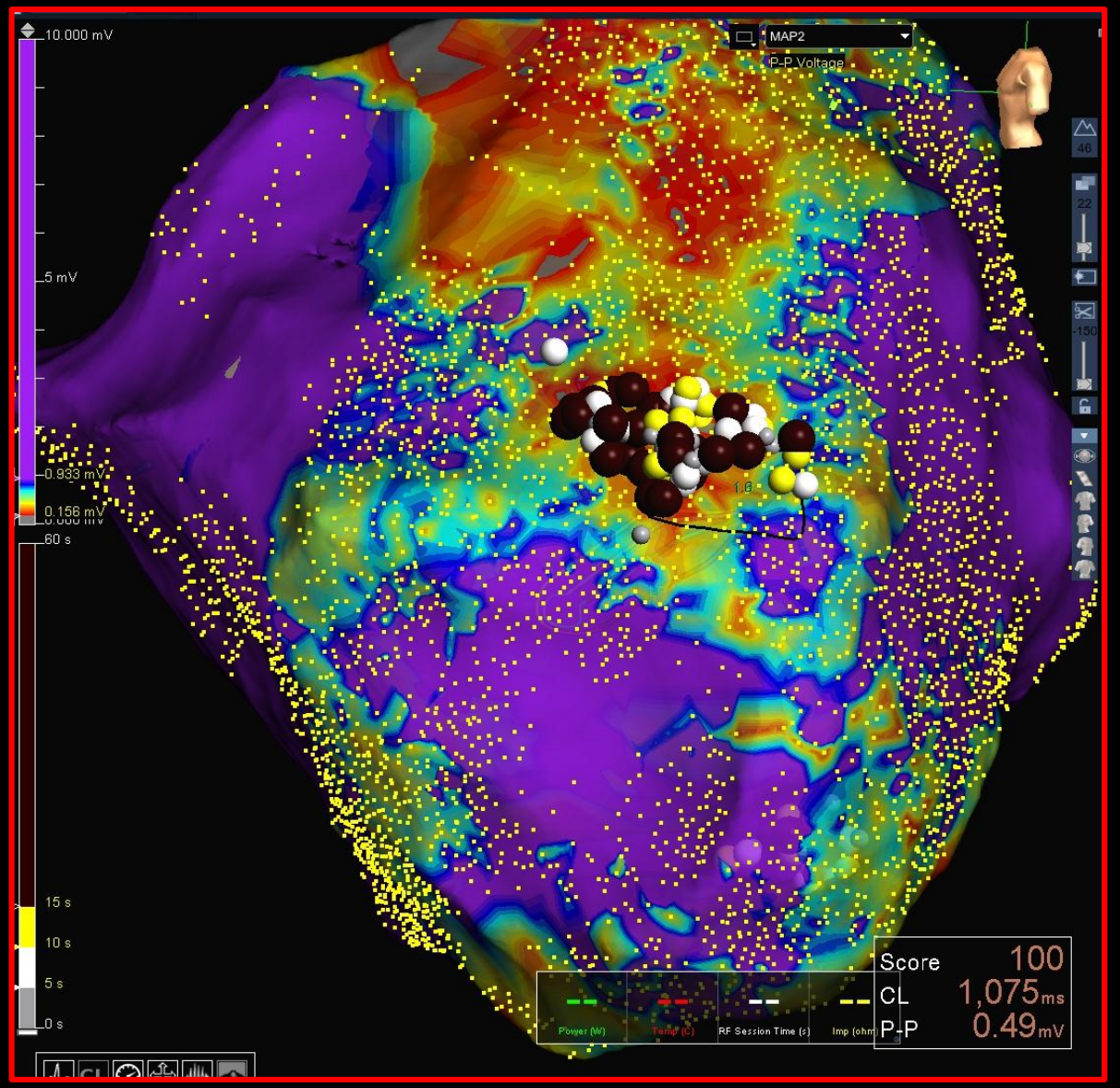
Cardiac MRI

Conclusions:

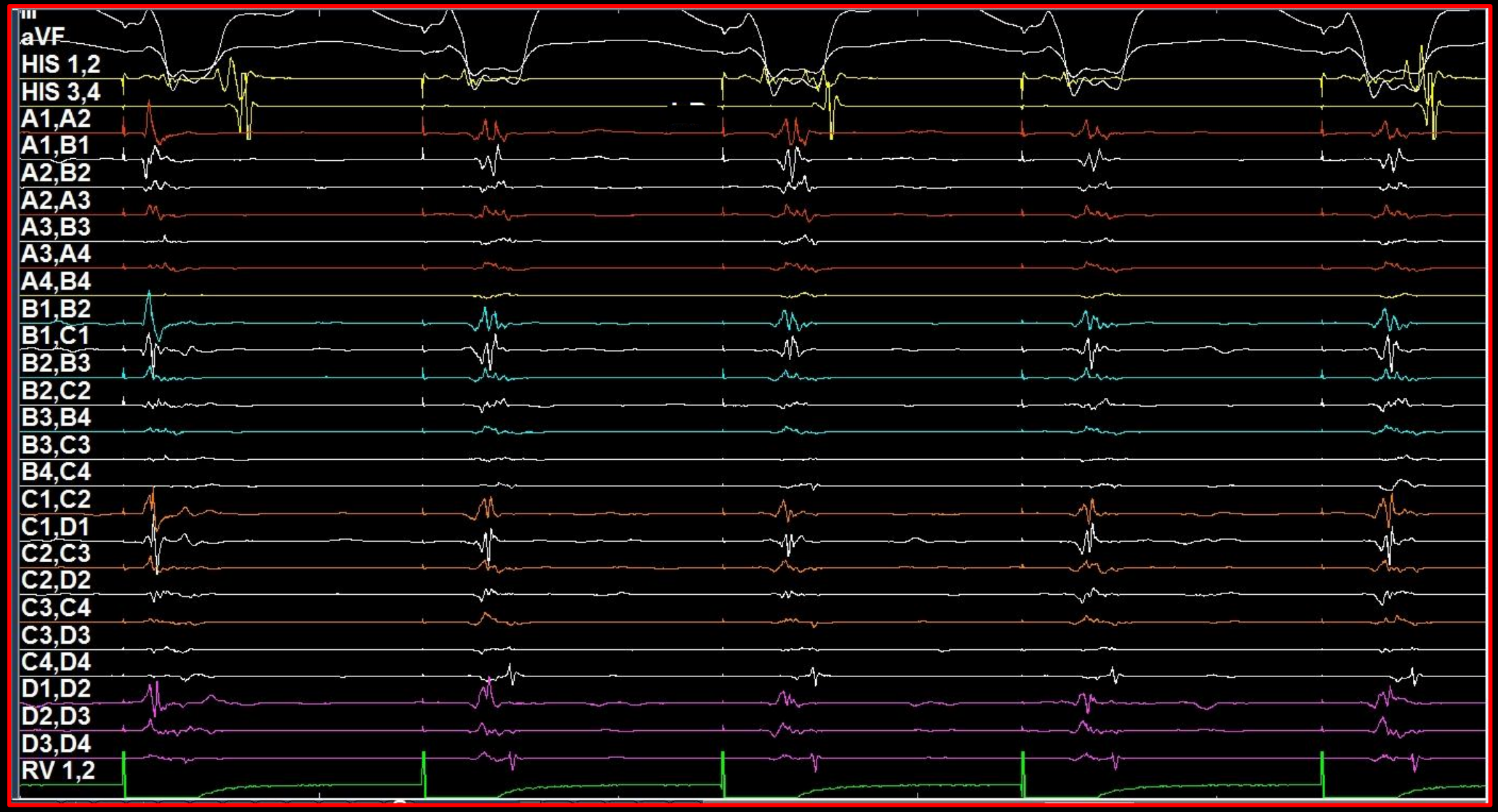
1. Structurally normal heart.
2. Biventricular systolic dysfunction LV> RV(LVEF=30%, RVEF=45%).
3. Mid myocardial and sub-epicardial delayed enhancement of the IVS and apex. Significant LA wall fibrosis.
4. Significant LA/RA dilatation with atrial fibrillation.
5. These features suggest an inflammatory process probably a myocarditis and its sequale.
6. Chronic myocardial inflammatory process like sarcoidosis should also be considered.
7. LA appendage thrombus.

Voltage map


10.000 mV
Map1
P-P Voltage
5 mV
0.933 mV
0.156 mV
0.000 mV
Velocity
Respiration
Score
CL

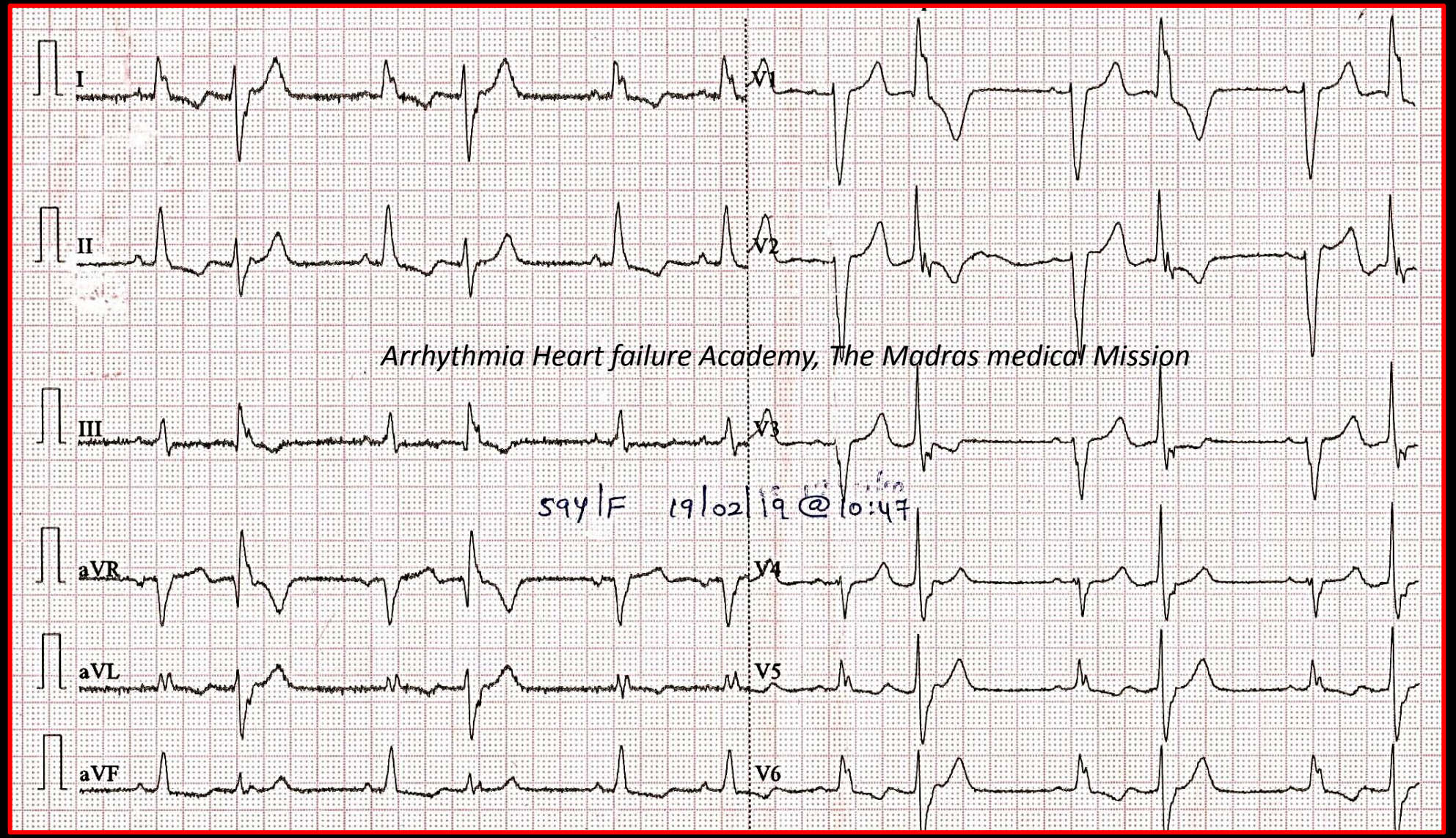

10.000 mV
MAP2
P-P Voltage
5 mV
0.933 mV
0.156 mV
60 s
15 s
10 s
5 s
0 s
Score 100
CL 1,075ms
P-P 0.49mV

Fractionated potenial during RV pacing

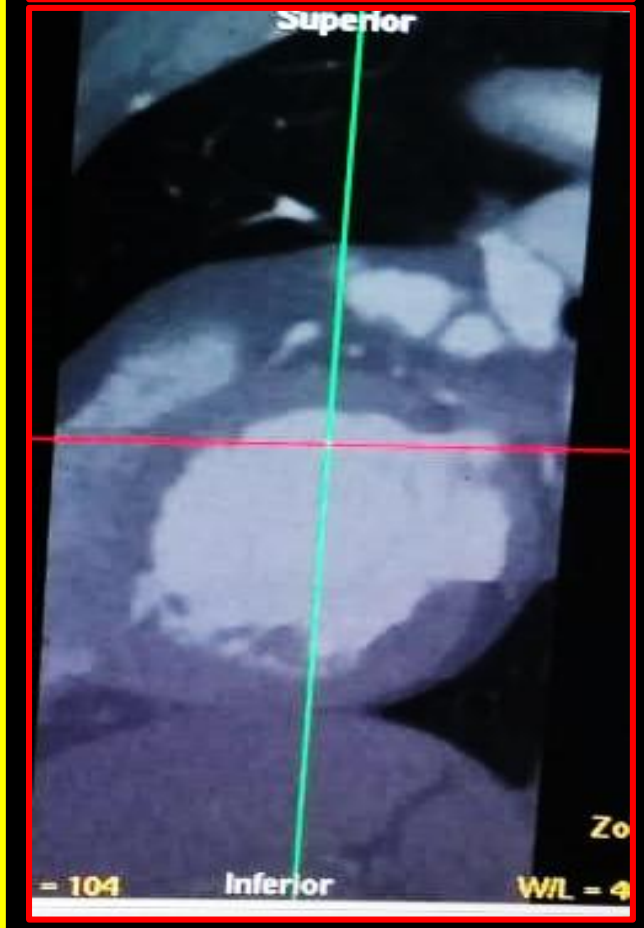


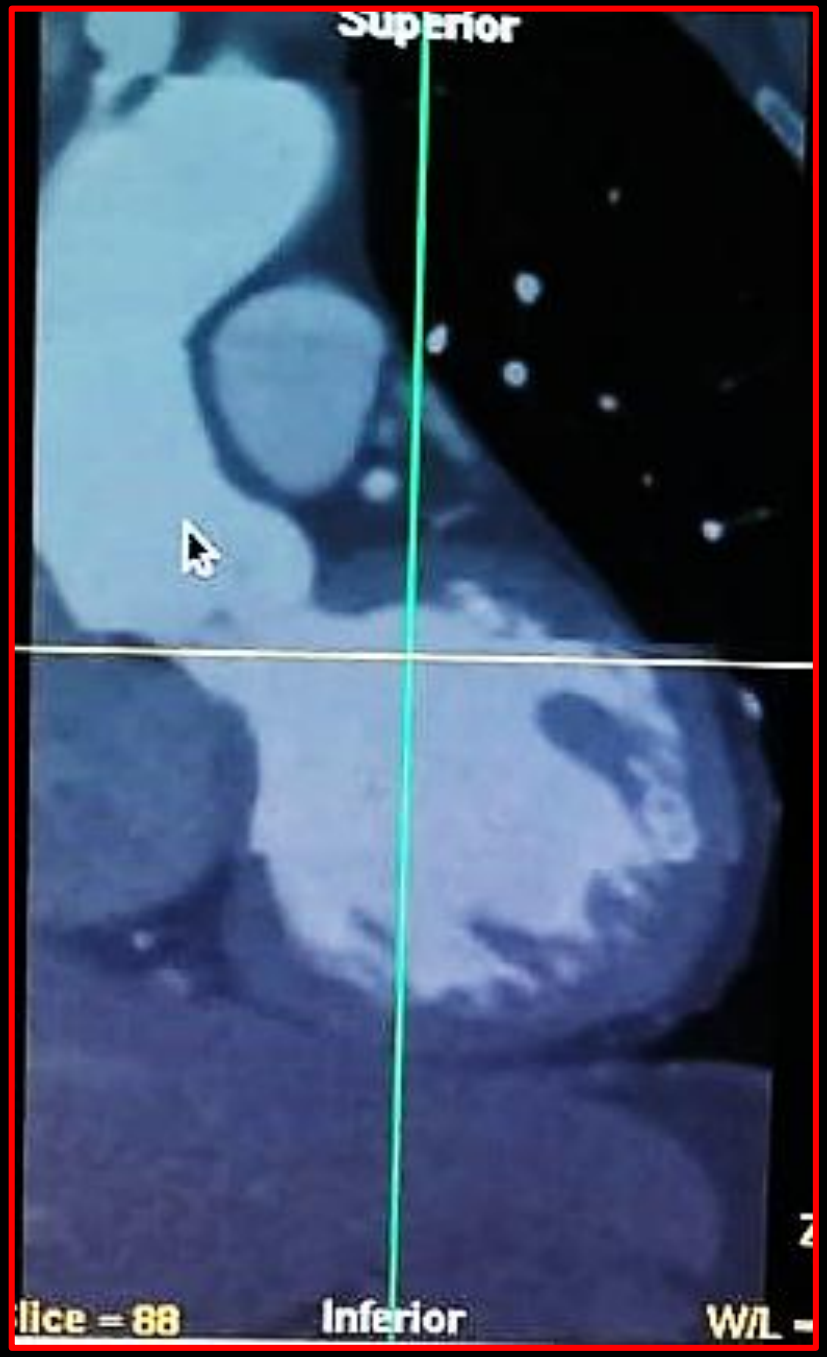
CASE 5

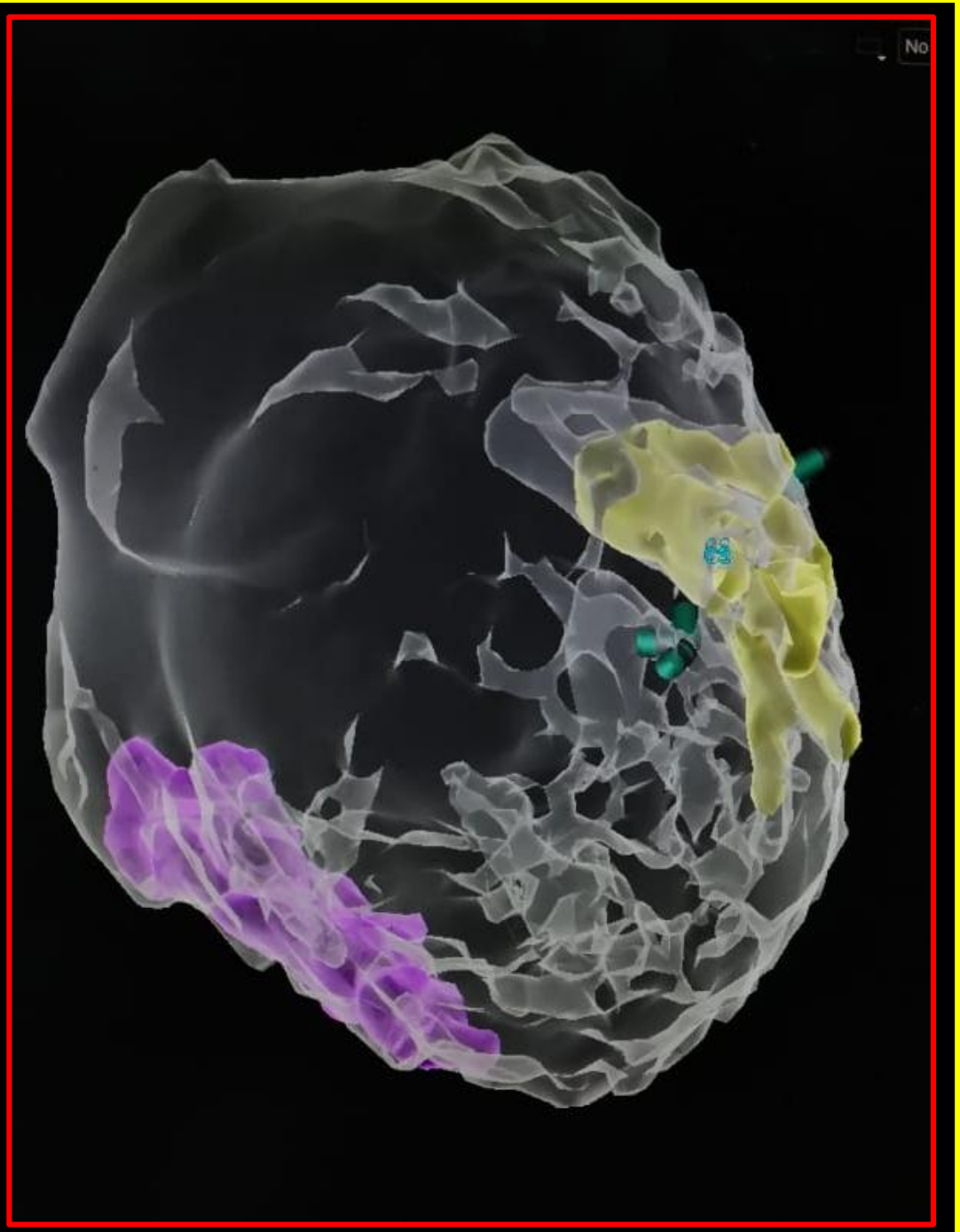
59Y, F, C/O Palpitation, Moderate LV dysfunction



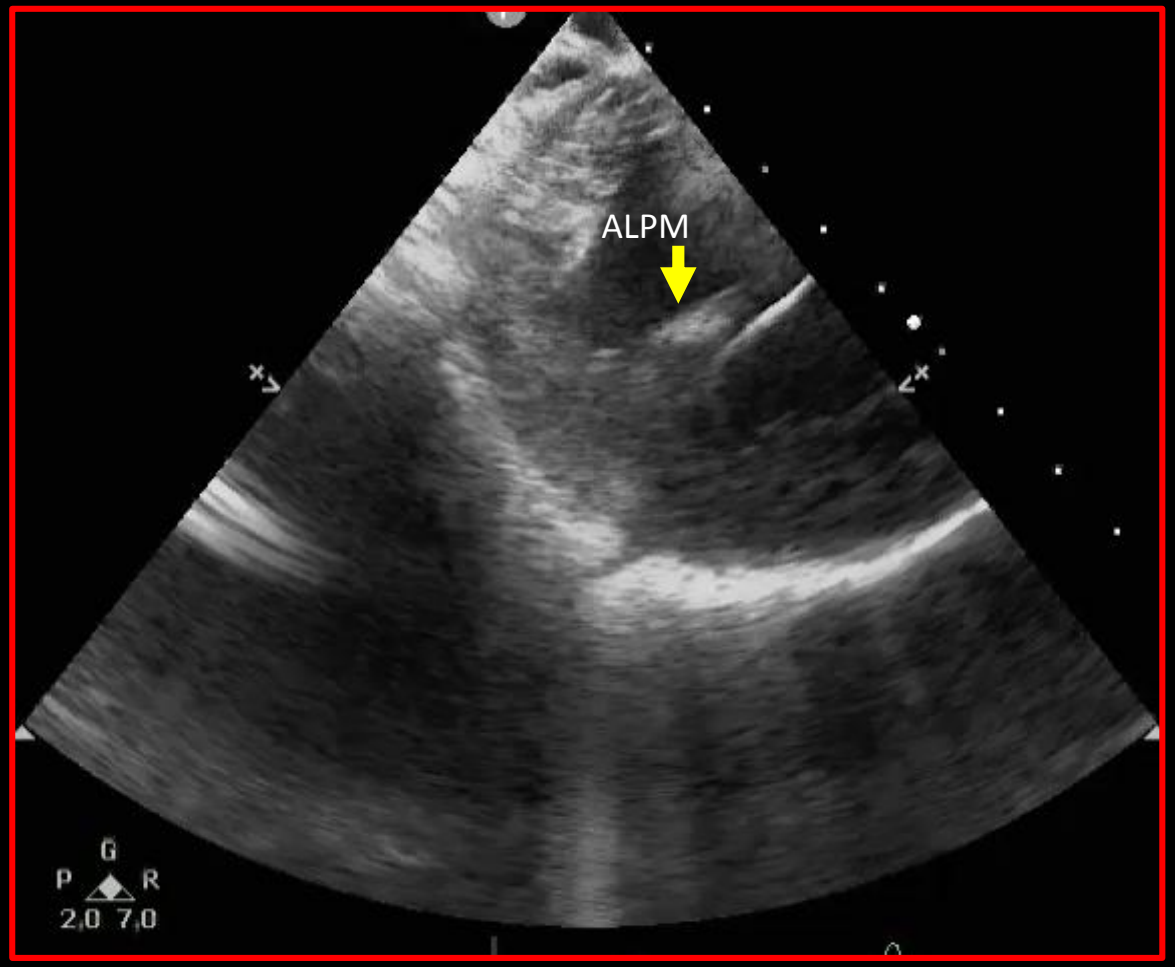

Right
Zoom = 2.30x

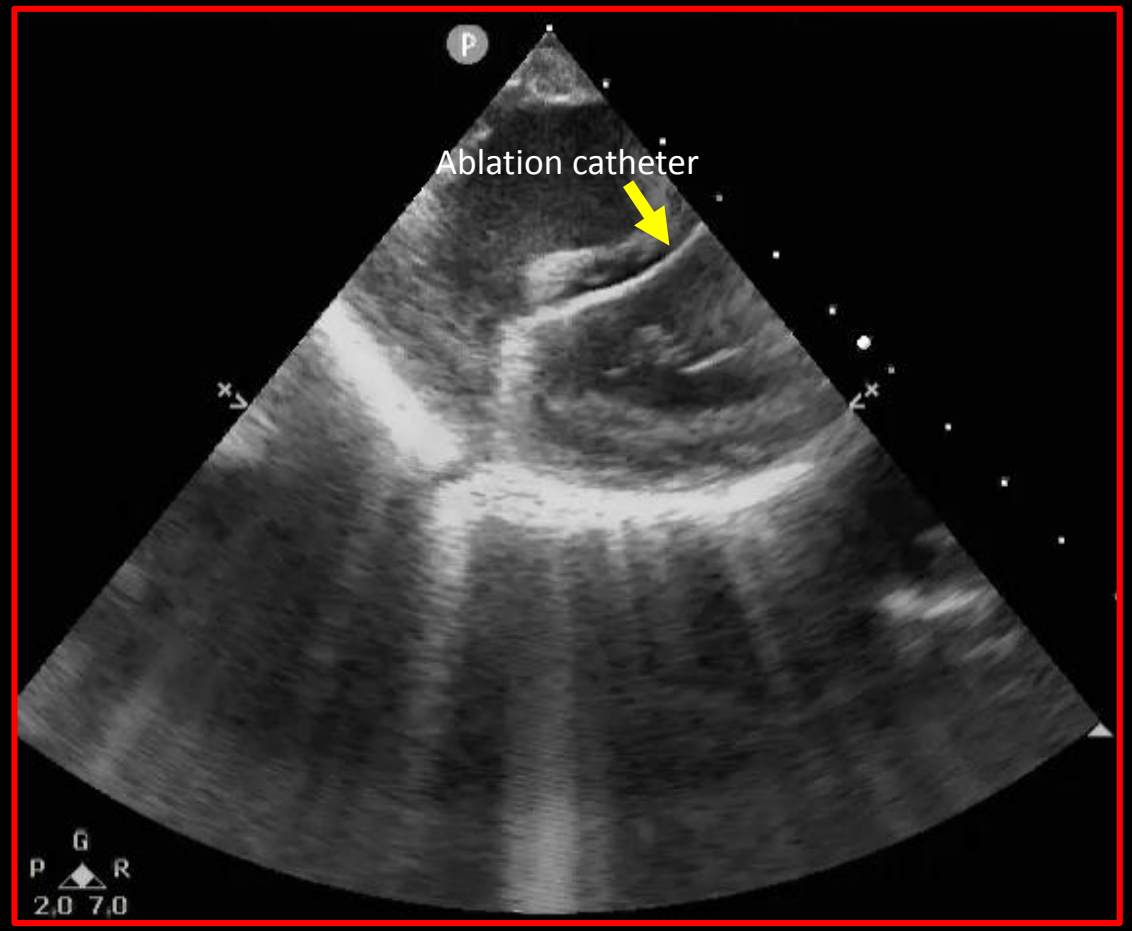

Superior
Zo
= 104
Inferior
W/L = 4

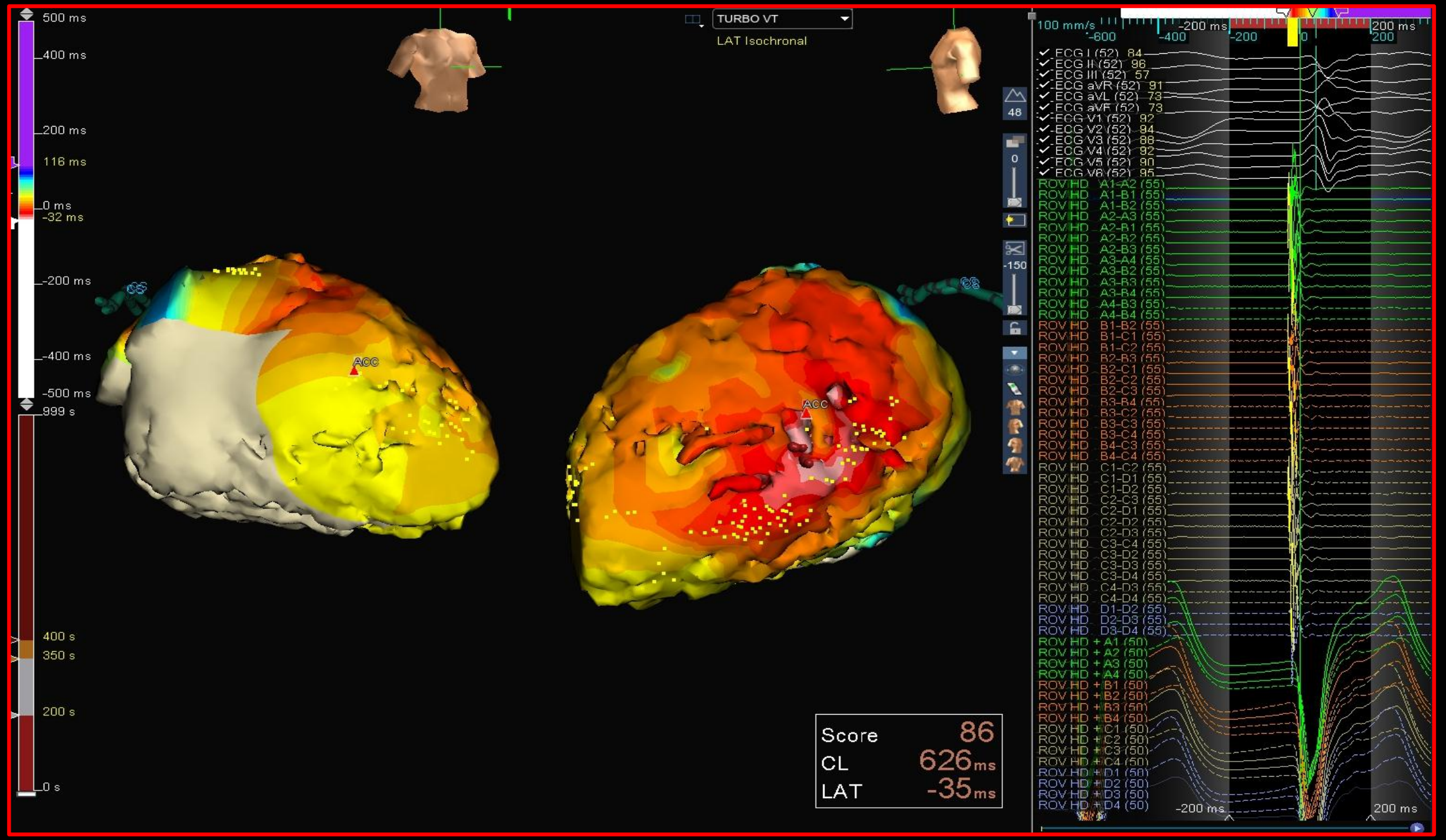

Superior
lice = 88
Inferior
W/L

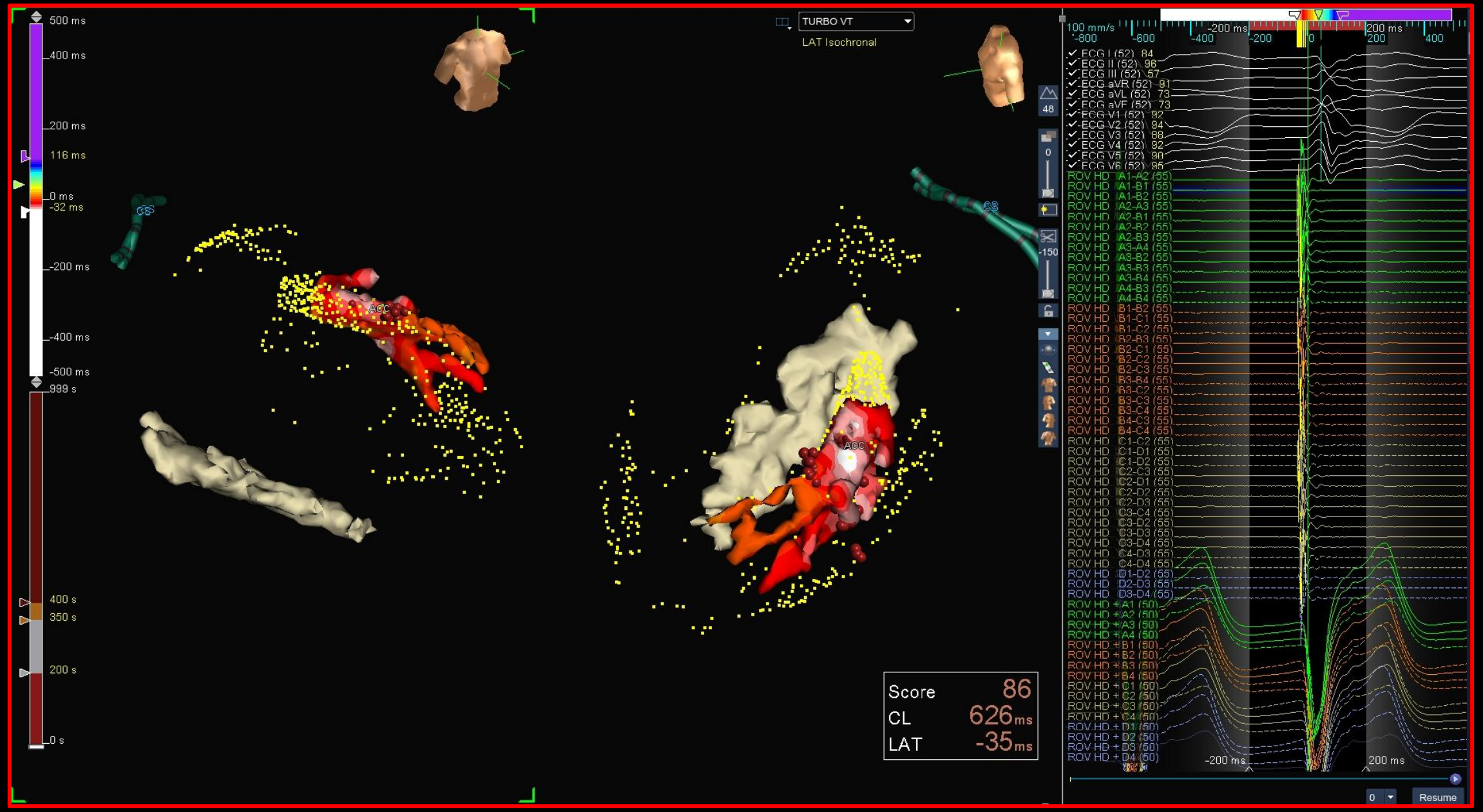

No

ICE

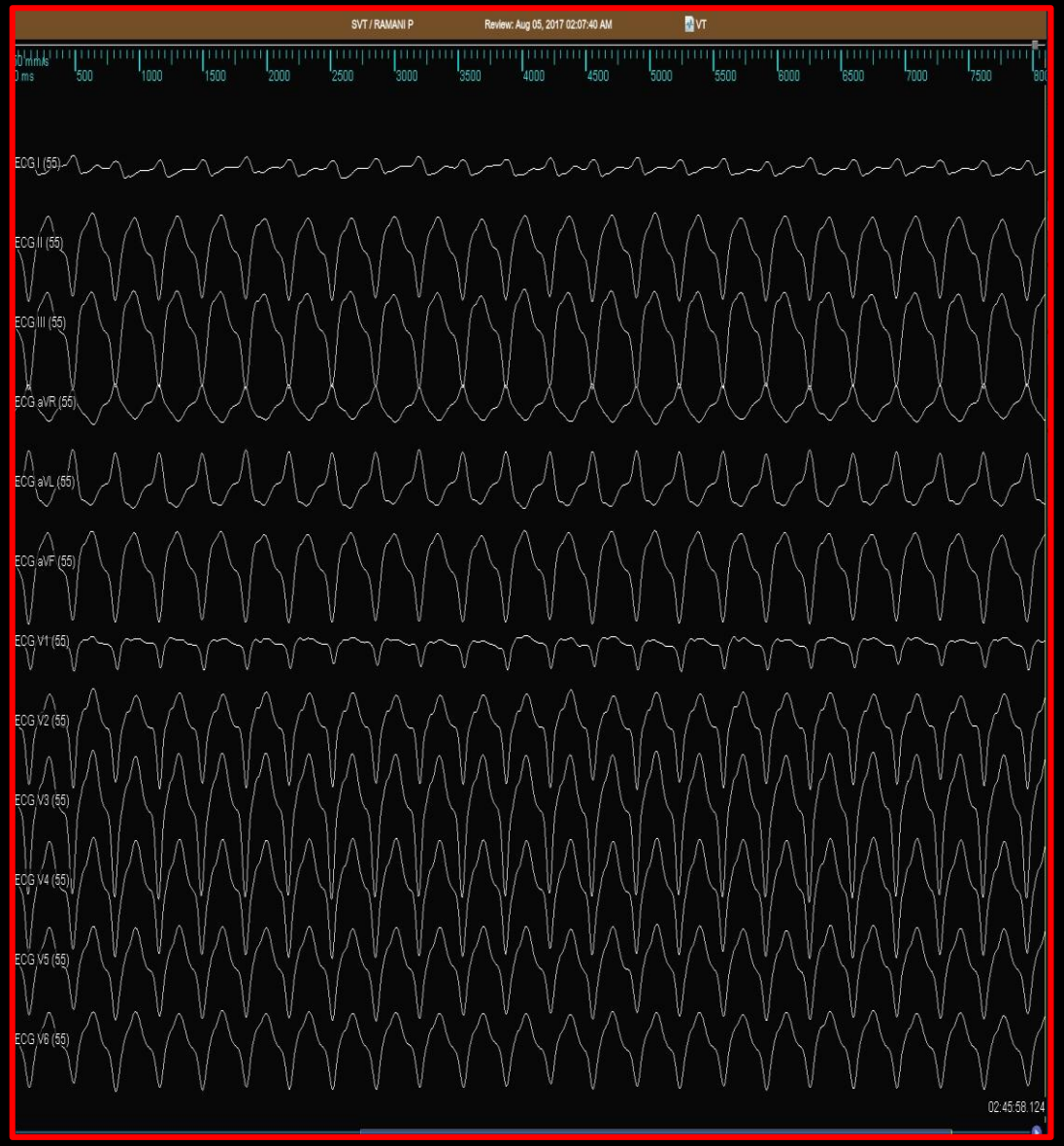


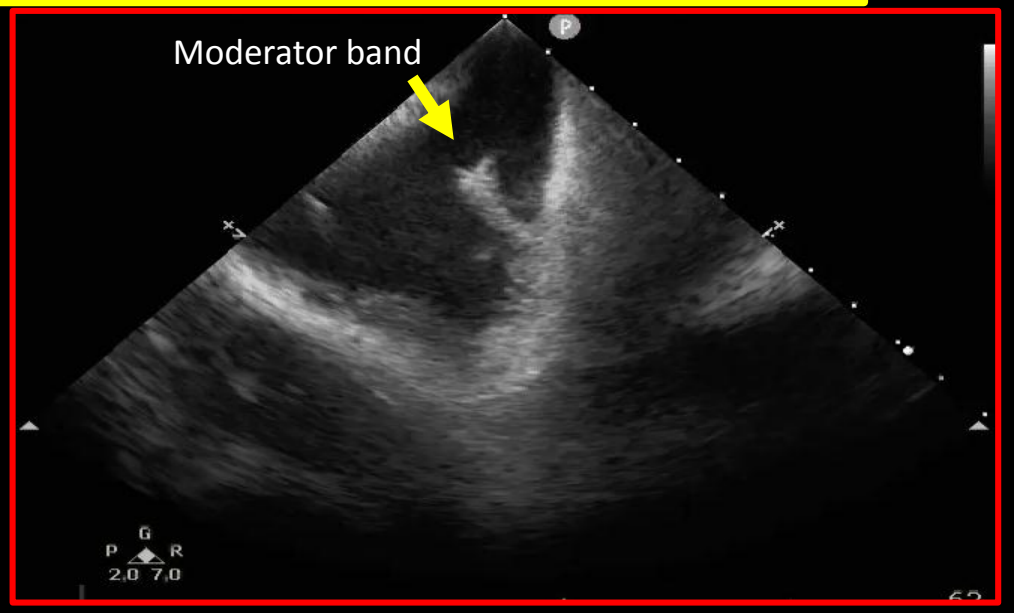


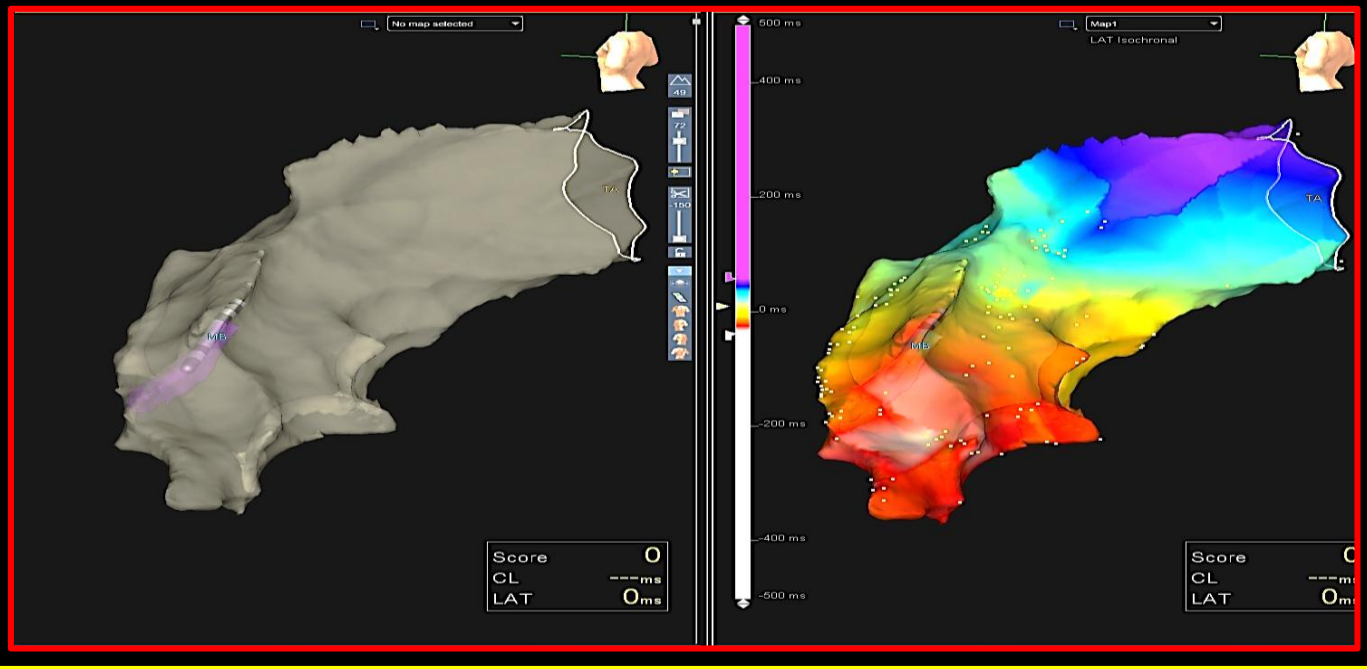

500 ms
400 ms
200 ms
116 ms
0 ms
-32 ms
-200 ms
-400 ms
-500 ms
999 s
400 s
350 s
200 s
0 s
TURBO VT
LAT Isochronal
ACC
ACC
Score 86
CL 626ms
LAT -35ms
100 mm/s
-600
-400
-200
0
200
-200 ms
200 ms
ECG I (52) 84
ECG II (52) 96
ECG III (52) 57
ECG aVR (52) 91
ECG aVL (52) 73
ECG aVF (52) 73
ECG V1 (52) 92
ECG V2 (52) 94
ECG V3 (52) 88
ECG V4 (52) 92
ECG V5 (52) 90
ECG V6 (52) 95
48
0
-150


500 ms
400 ms
200 ms
116 ms
0 ms
-32 ms
-200 ms
-400 ms
-500 ms
999 s
400 s
350 s
200 s
0 s
TURBO VT
LAT Isochronal
CS
ACC
Score 86
CL 626ms
LAT -35ms
100 mm/s
-200 ms
200 ms
ECG I (52) 84
ECG II (52) 98
ECG III (52) 57
ECG aVR (52) 91
ECG aVL (52) 73
ECG aVF (52) 73
ECG V1 (52) 92
ECG V2 (52) 94
ECG V3 (52) 88
ECG V4 (52) 92
ECG V5 (52) 90
ECG V6 (52) 95
Resume

50Y, F, C/O Palpitation, Good biventricular function







Imaging protocols at MMM:

LGE-CMRI

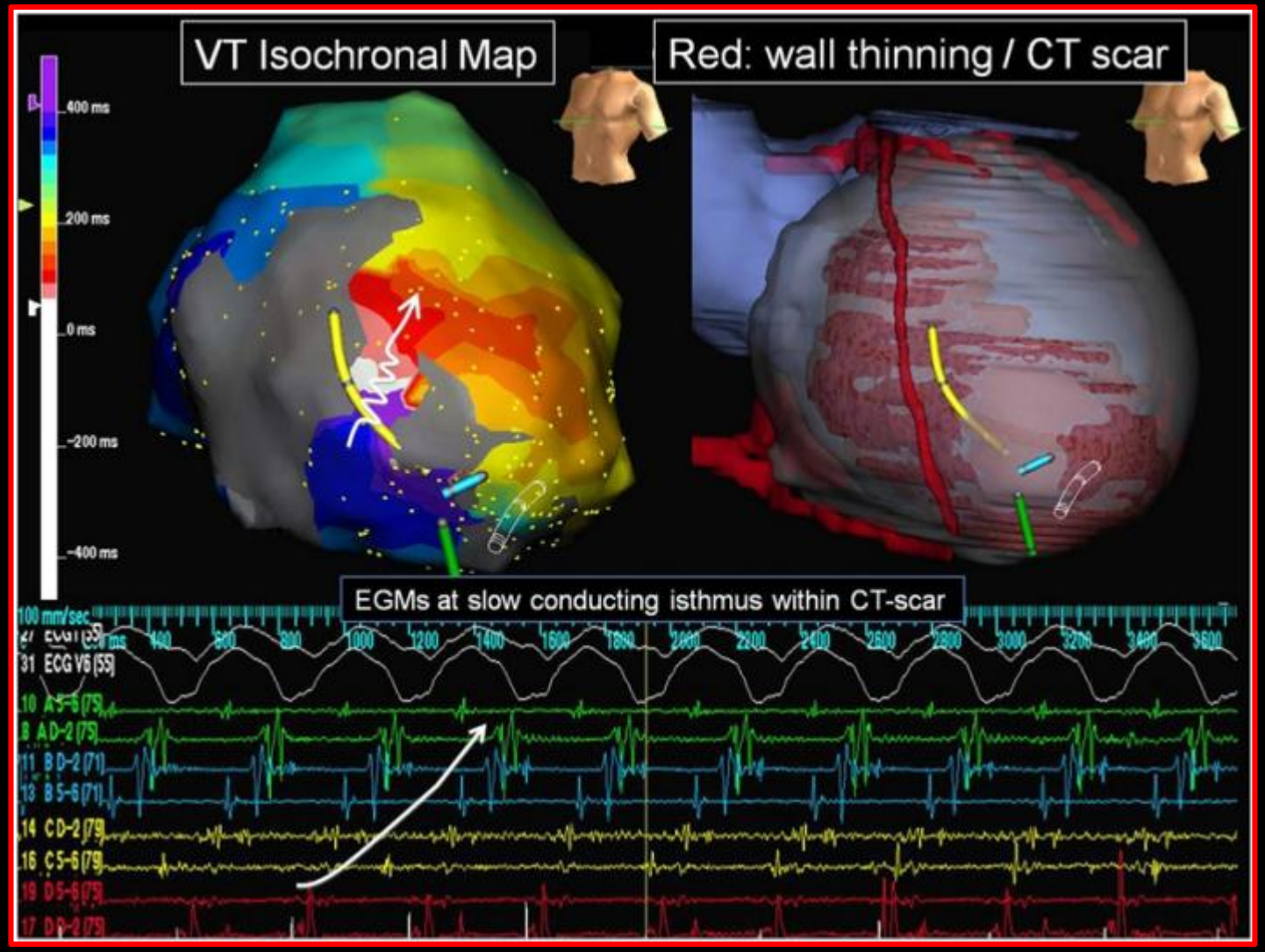
PET-CT Scan

ICE

Integration : CT and 3-D EAM

Recently:

Integration of MRI and 3-D EAM


VT Isochronal Map
Red: wall thinning / CT scar
400 ms
200 ms
0 ms
-200 ms
-400 ms
EGMs at slow conducting isthmus within CT-scar
100 mm/sec
ECG V6 [55]
A 5-6 [75]
A D-2 [75]
B D-2 [71]
B 5-6 [71]
C D-2 [75]
C 5-6 [75]
D 5-6 [75]
D D-2 [75]

11th ANNUAL CONFERENCE OF INDIAN HEART RHYTHM SOCIETY

Thank you

Dr. Ulhas M. Pandurangi MD., DM

Chief – Cardiac Electrophysiology & Pacing

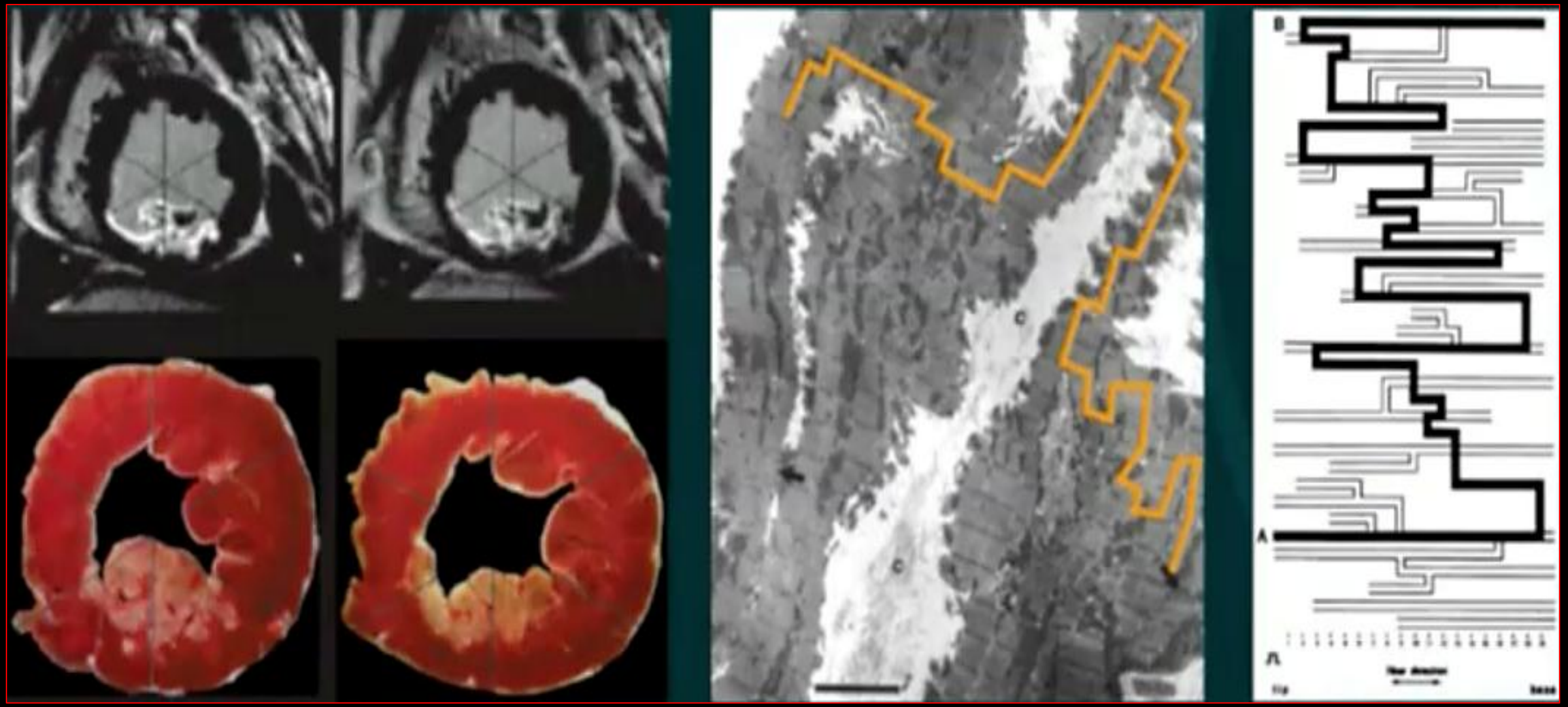
Arrhythmia Heart Failure Academy

The Madras Medical Mission

Founder President: Tamilnadu Electrophysiology Council

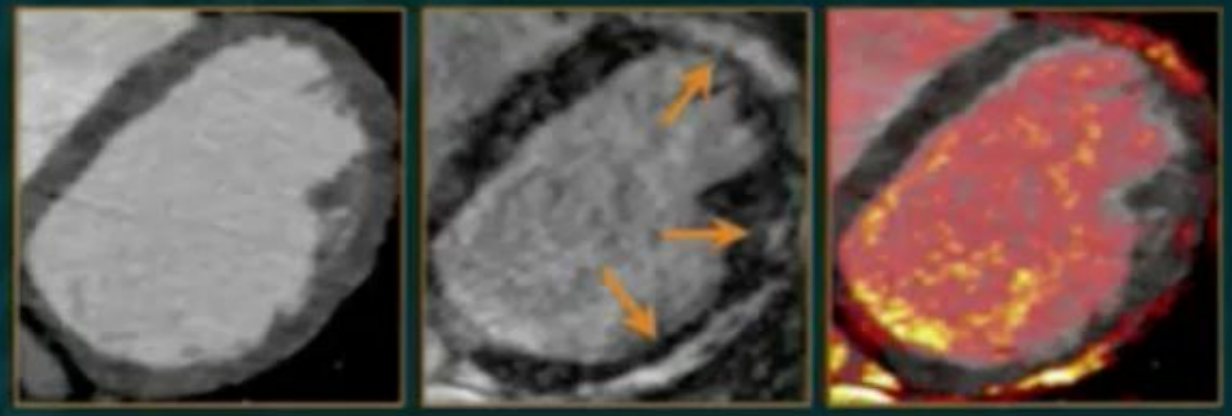
President Elect: Indian Society of Electrocardiology

IMAGING GENERAL

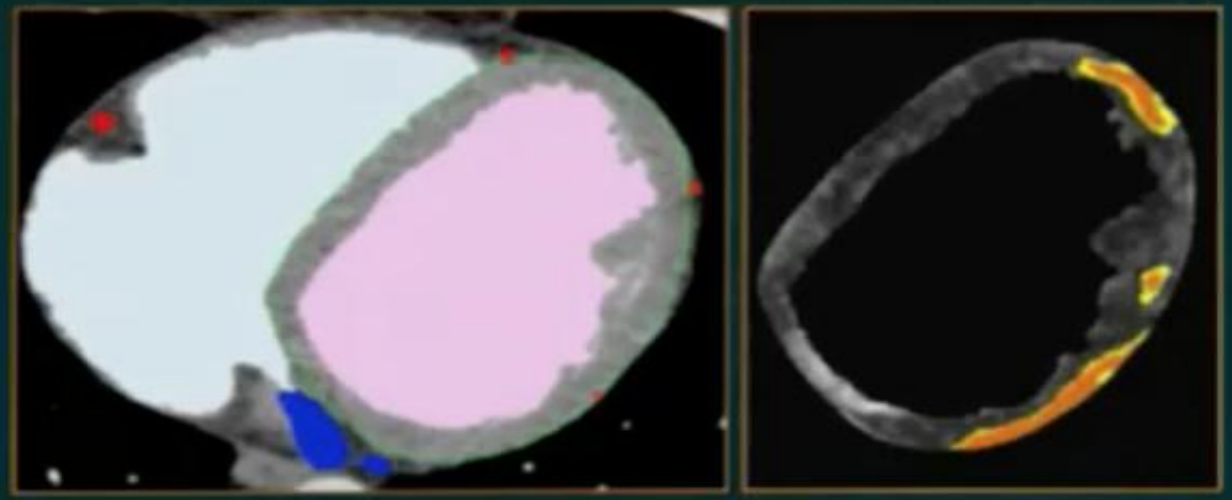


INTEGRATION

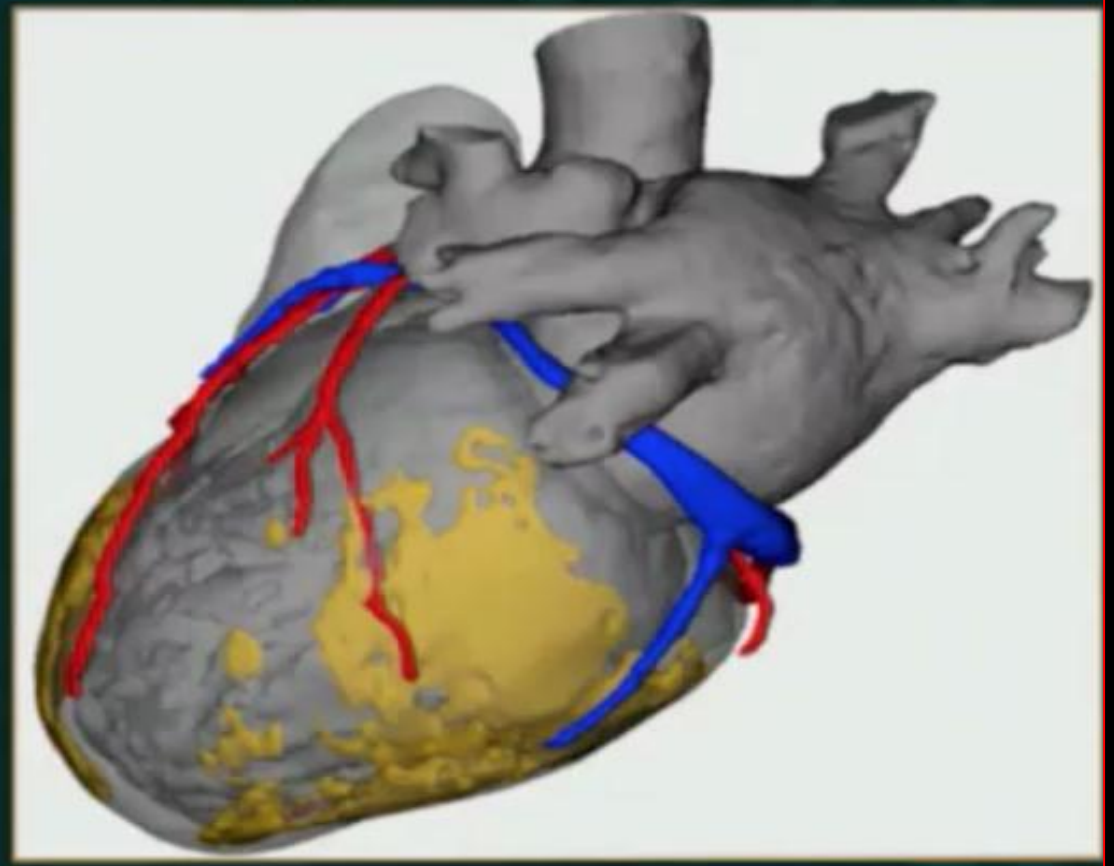
MDCT/MRI FUSION



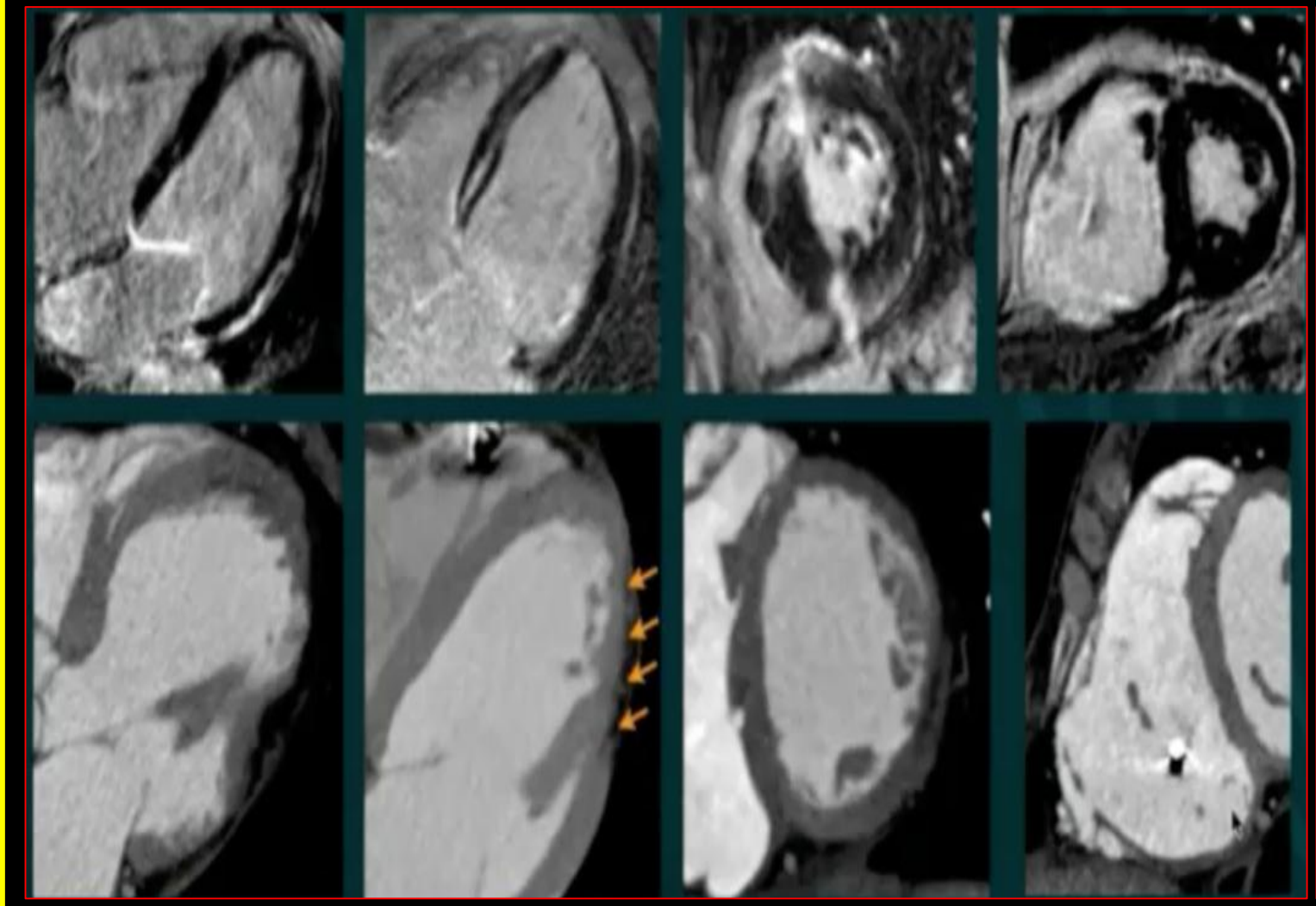
SEGMENTATION

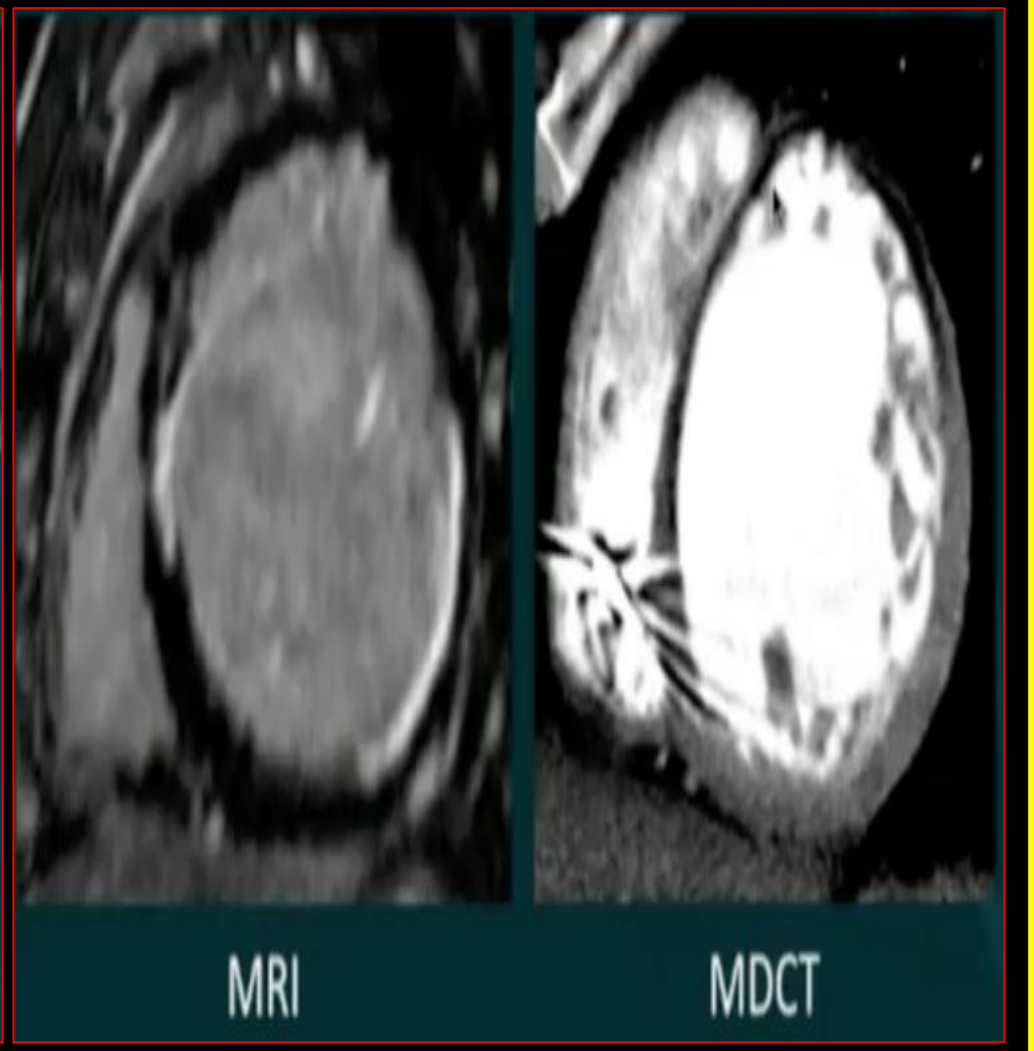


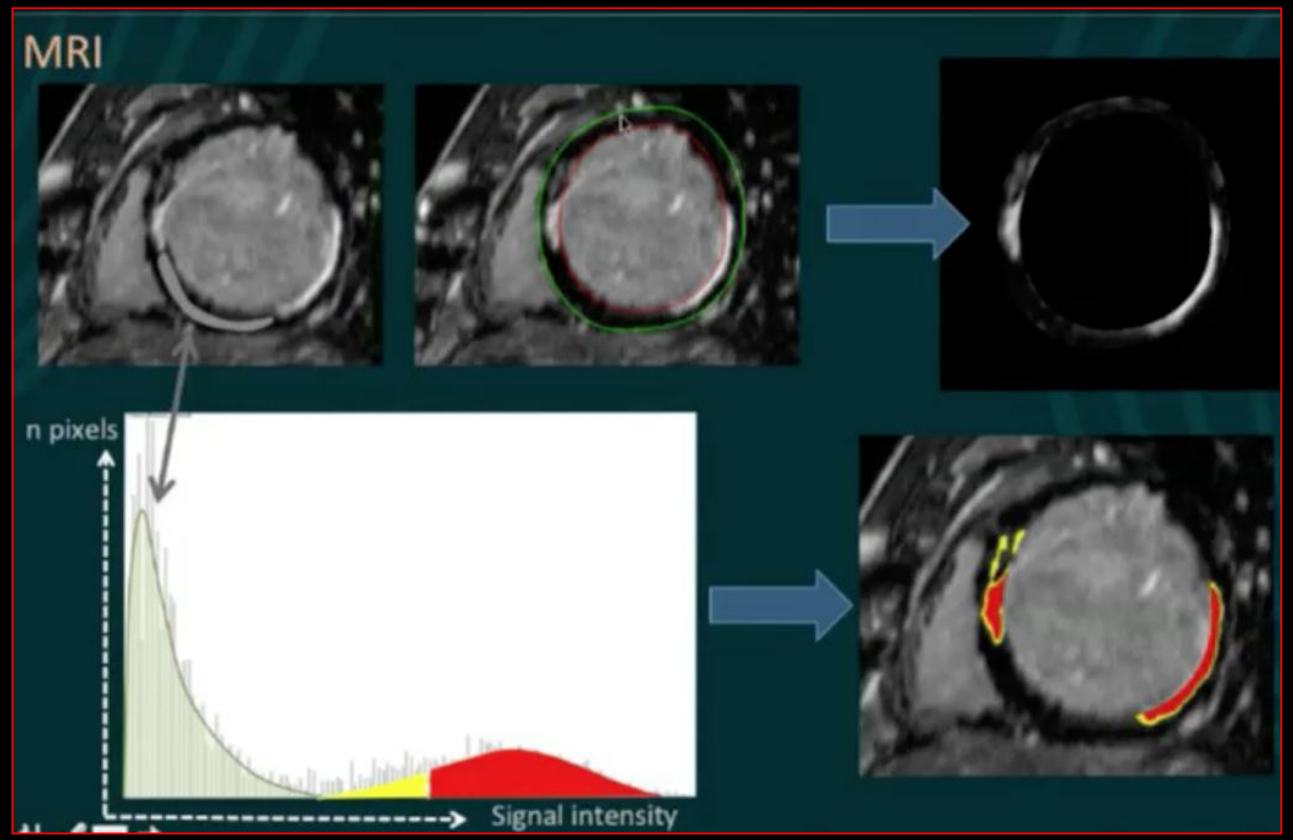
MODELING

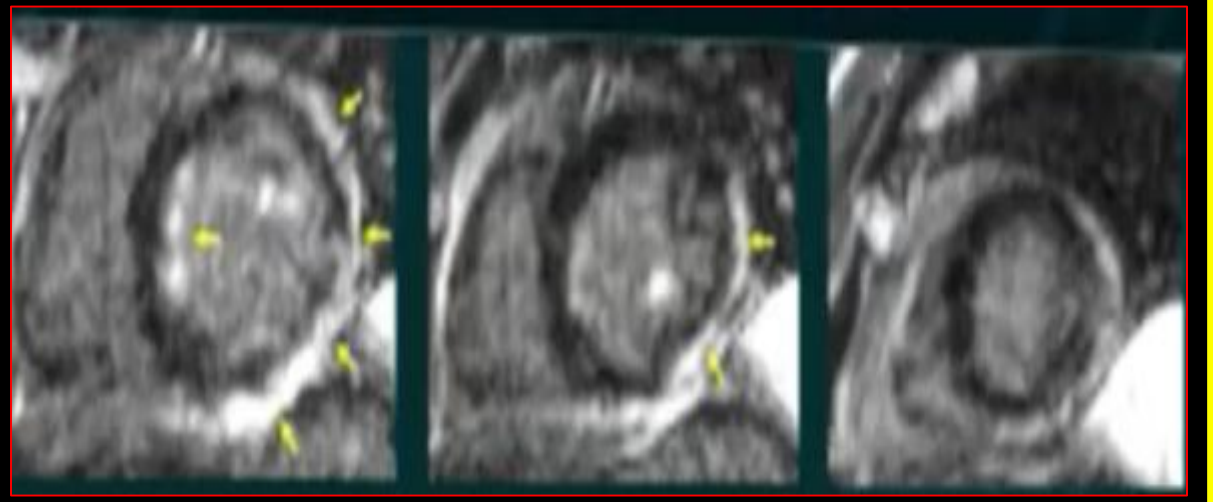


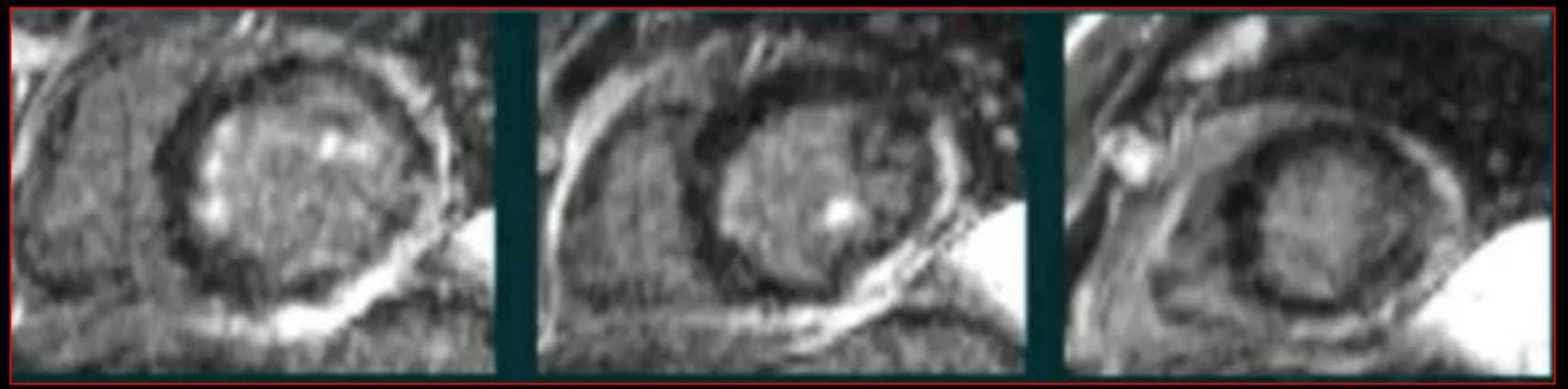
MRI



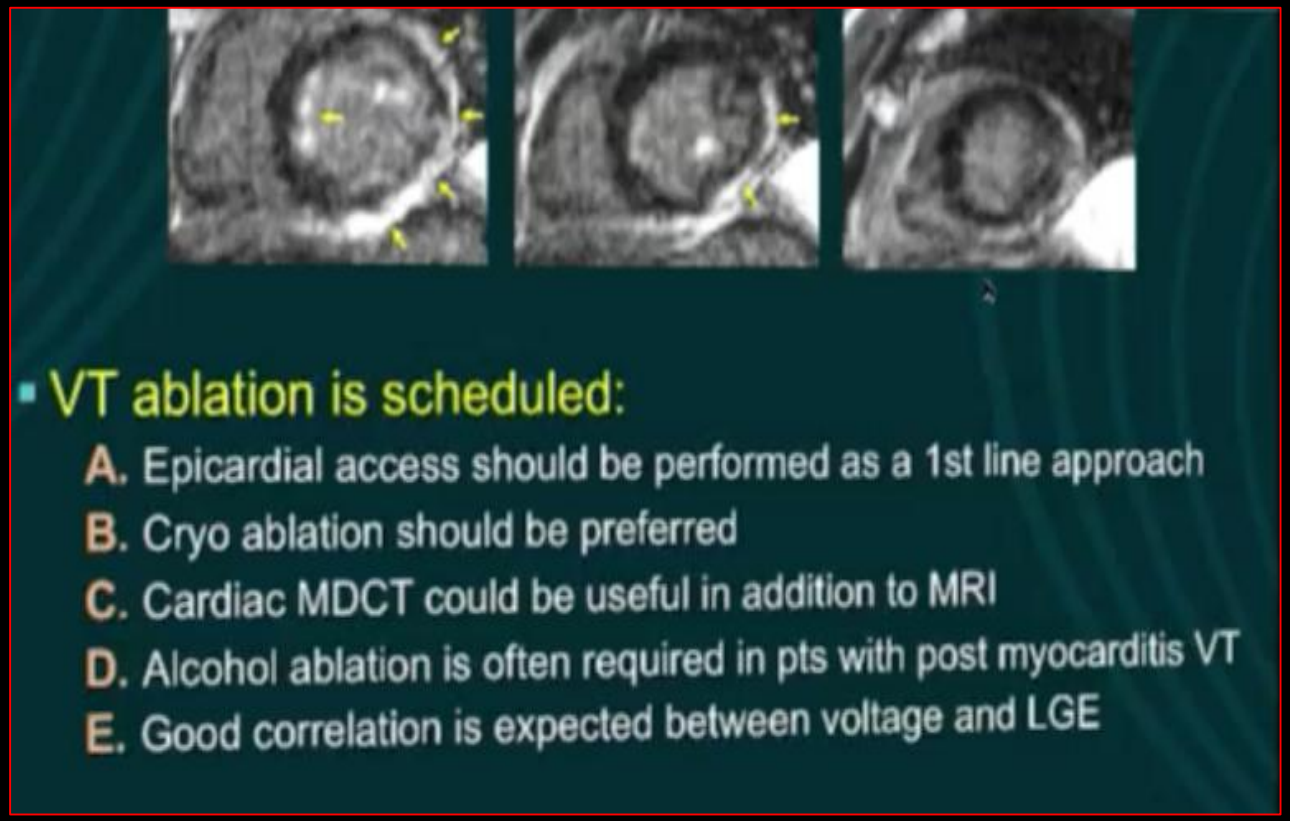



MRI
n pixels
Signal intensity

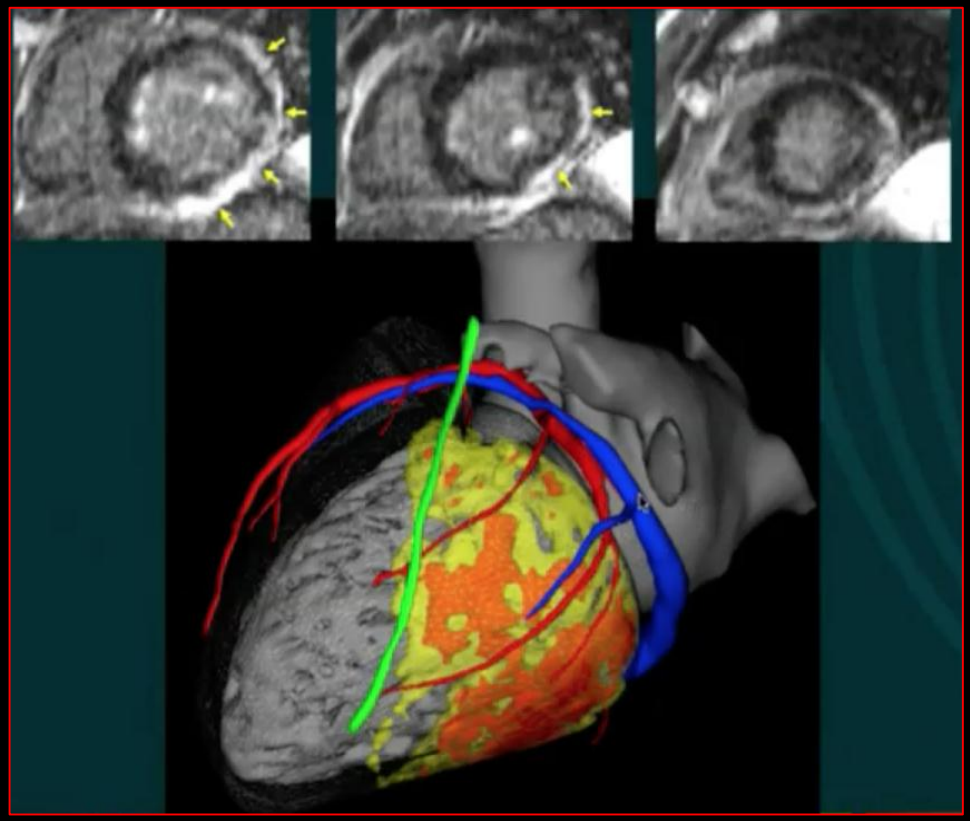


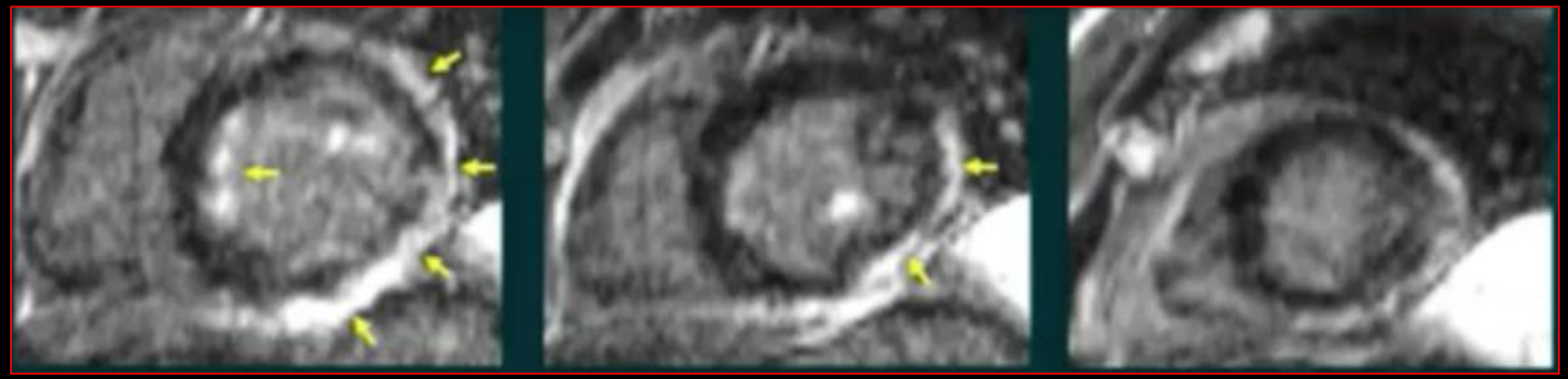



I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

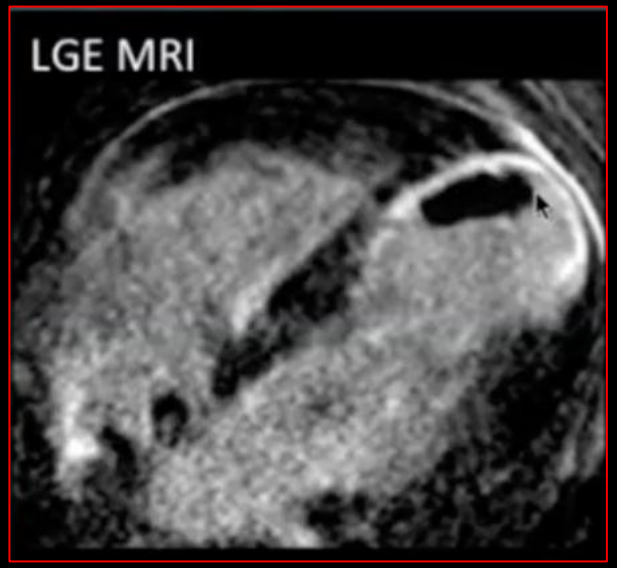


- VT ablation is scheduled:
  - A. Epicardial access should be performed as a 1st line approach
  - B. Cryo ablation should be preferred
  - C. Cardiac MDCT could be useful in addition to MRI
  - D. Alcohol ablation is often required in pts with post myocarditis VT
  - E. Good correlation is expected between voltage and LGE



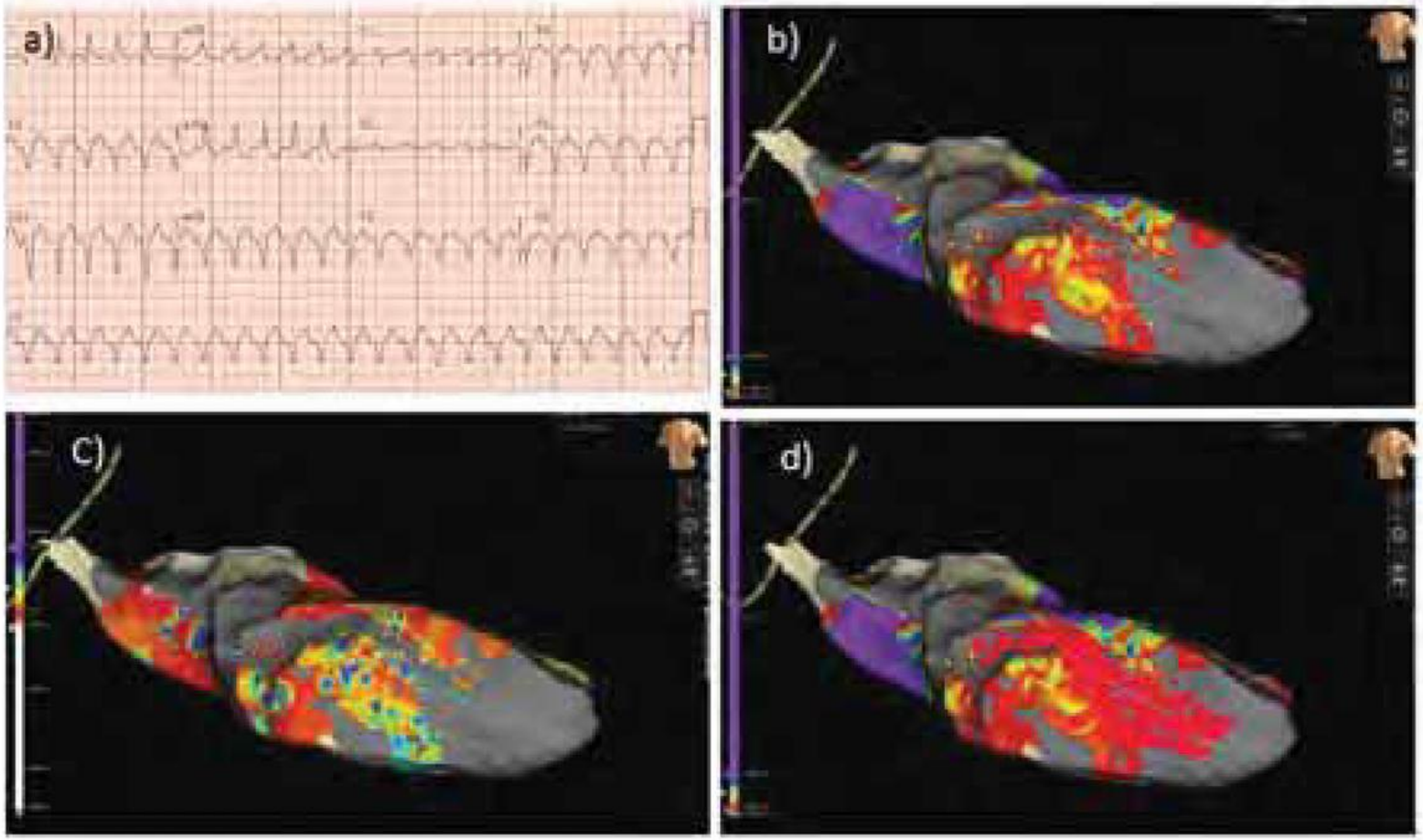



Delayed Enhancement on MRI
276
-162
Loc
0.20
N/A
10
NICHT FÜR PRIMÄRE DIAGNOSTIK


LGE MRI

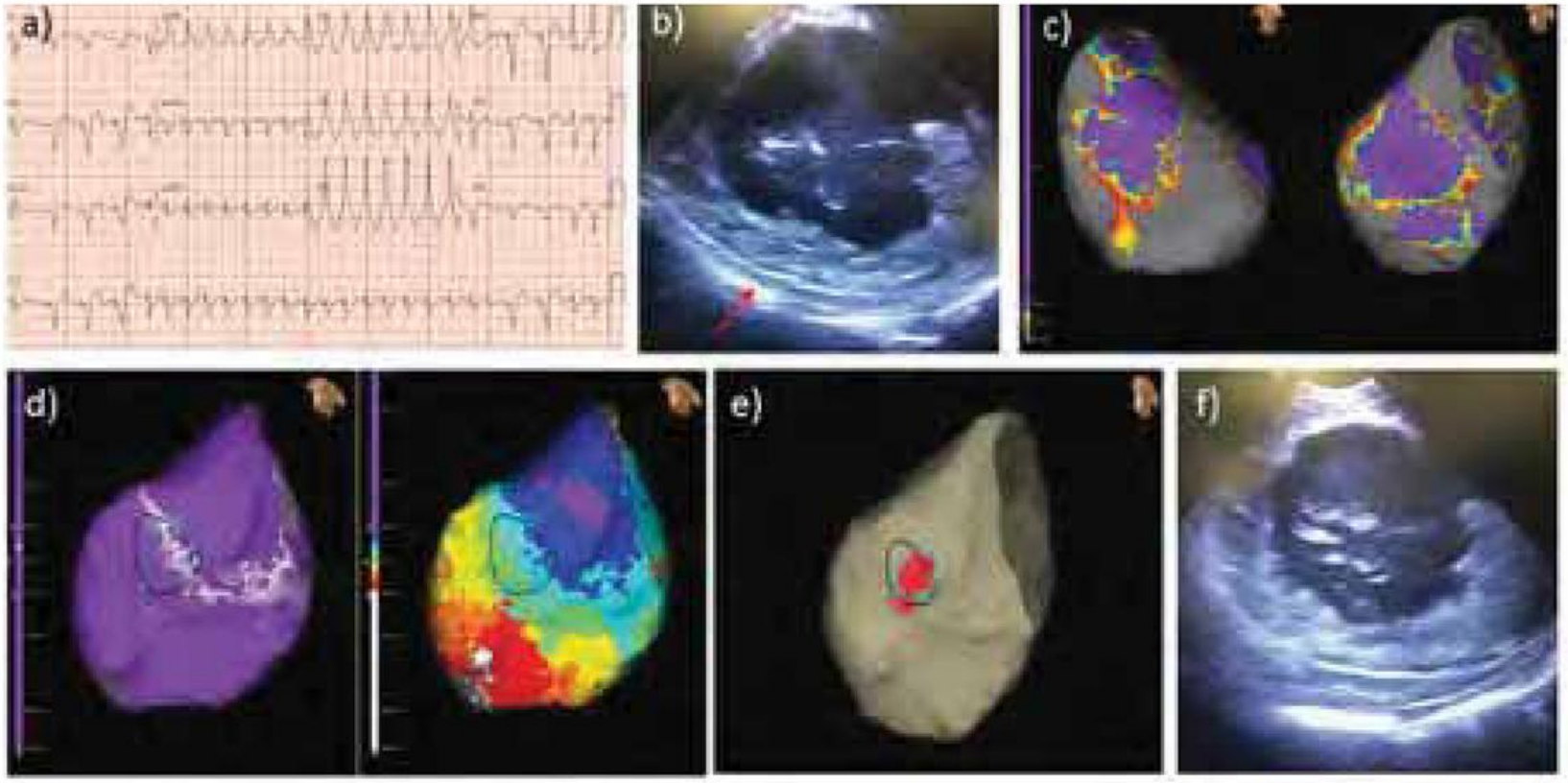
	Ischemic Cardiomyopathy	Nonischemic Cardiomyopathy	ARVC/D	Cardiac Sarcoidosis	HOCM	Chagas
Substrate	Subendocardial	Mid-myocardial/ epicardial	Subepicardial	Nodular, circumferential; subepicardial, subendocardial	Mid wall	Epicardial > endocardial
Scar distribution	Focal	Patchy	Patchy	Patchy	Patchy - Anterior and posterior RV insertion points[6]	Patchy
Scar location (most common)	Coronary distribution	Basal anteroseptal and inferolateral LV regions[7]	RV > LV, Perivalvular Triangle of dysplasia* [8]	Vary widely, Basal and mid inter-ventricular septum[9]	Interventricular septum, Aneurysmal areas	Basal lateral LV[7,10]
Ablation Approach	Endocardial[7]	Endo/epicardial	Endo/ epicardial	Endo > epicardial	Endo/ epicardial	Epicardial and endocardial

Figure 1



Example of a case with ischemic cardiomyopathy and VT. Patient with history of left anterior descending territory infarct. **a)** Presenting VT with right bundle branch block morphology, superior axis and septal exit site. **b)** Voltage map showing a dense anterior wall scar corresponding to previous MI with a potential channel. **c)** Activation map with isochronal crowding around the area of low voltage. **d)** Ablation strategy: dechanneling along the isthmus site with good results and non-inducibility.

Figure 2



Example of case with nonischemic cardiomyopathy and VT. Patient with long history of nonischemic cardiomyopathy, likely viral in origin, presenting with VT. **a)** Clinical VT with RBBB and superior axis. **b)** Intra-cardiac echocardiogram showing a mid-myocardial scar (arrow). **c)** Voltage map showing extensive epicardial scar in a patchy distribution. **d)** Propagation and activation map, showing isochronal crowding in the highlighted area. **e)** Ablation lesions of the critical isthmus. **f)** Post-ICE images showing post-ablation edema around the mid-myocardial scar.