

Epicardial Ablation Around the World:

What have we learned after 20 years performing epicardial mapping and ablation of cardiac arrhythmias?

Young-Hoon Kim, MD

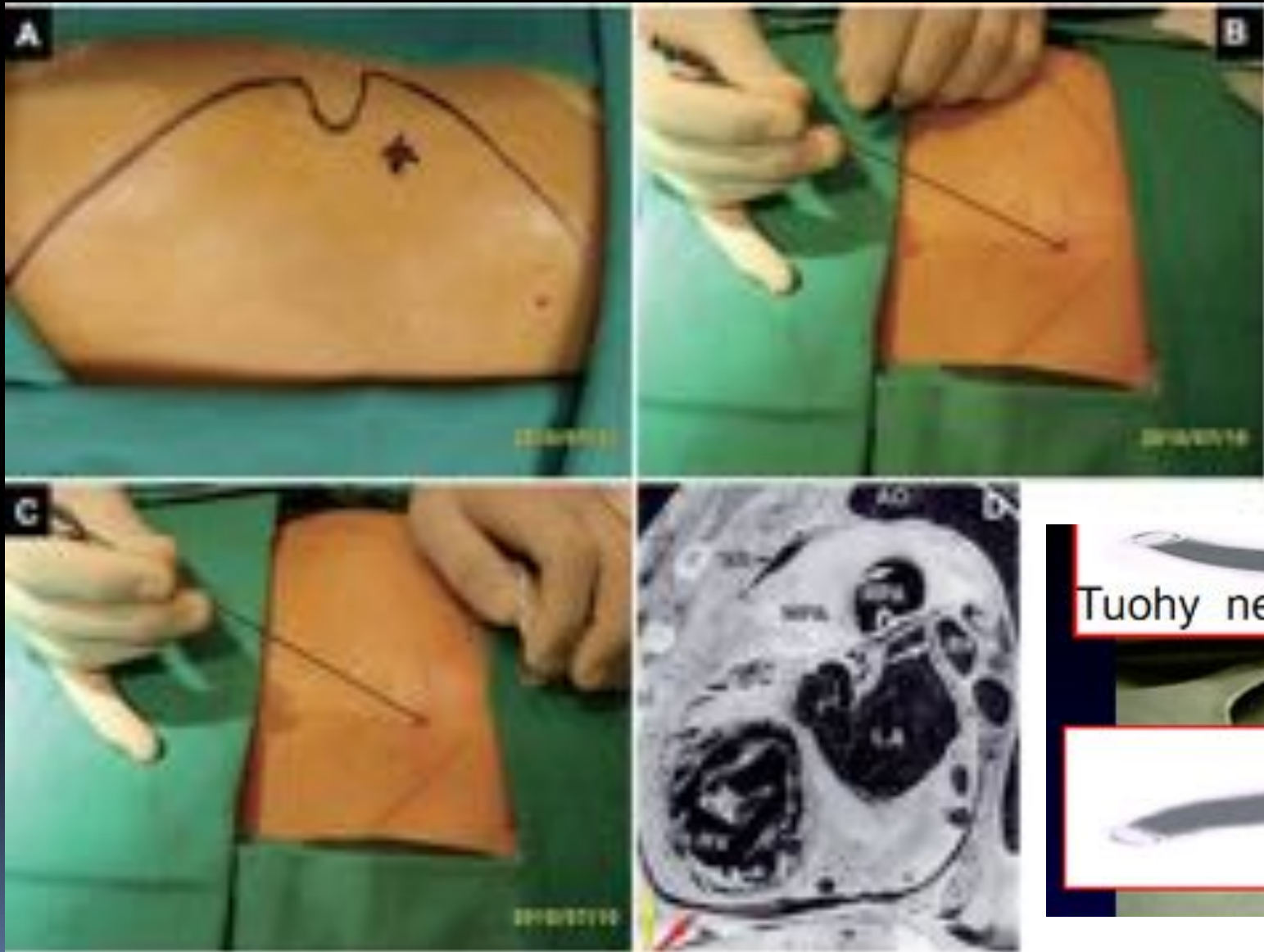


Arrhythmia Center, KUMC

www.korea-heartrhythm.com

**Korea University Medical Center
Seoul, Korea**

Subxiphoid Epicardial Puncture



Seongwook Han, et al. Korean Circ J 2010;40:479-488

Epicardial Approach



Epicardial ablation eliminates ventricular arrhythmias in an experimental model of Brugada syndrome

Hiroshi Morita, MD,^{*†} Douglas P. Zipes, MD, FHRF,^{*} Shiho T. Morita, MD,^{*†} John C. Lopshire, MD,^{*} Jiashin Wu, PhD^{*‡}

From the ^{}Krannert Institute of Cardiology, Indiana University School of Medicine, Indianapolis, Indiana, [†]Department of Cardiovascular Medicine, Okayama University Graduate School of Medicine, Dentistry, and Pharmaceutical Sciences, Okayama, Japan, [‡]Department of Molecular Pharmacology and Physiology, University of South Florida, Tampa, Florida.*

Heart Rhythm 2009;6:665–671



A.

One tissue from a canine heart



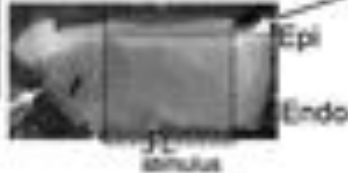
Epicardial tissue

Transmural tissue

Tissue preparations



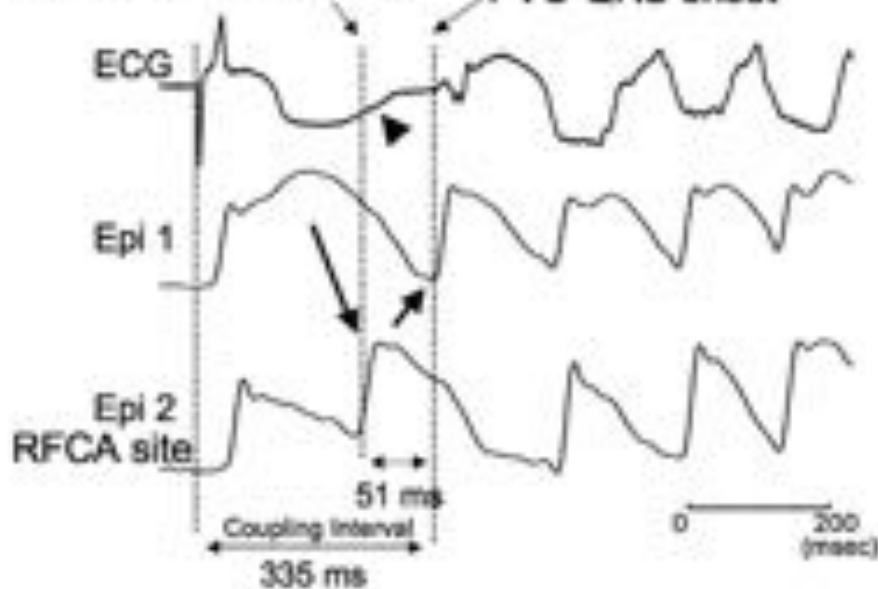
Mapping area



B.

The earliest activation

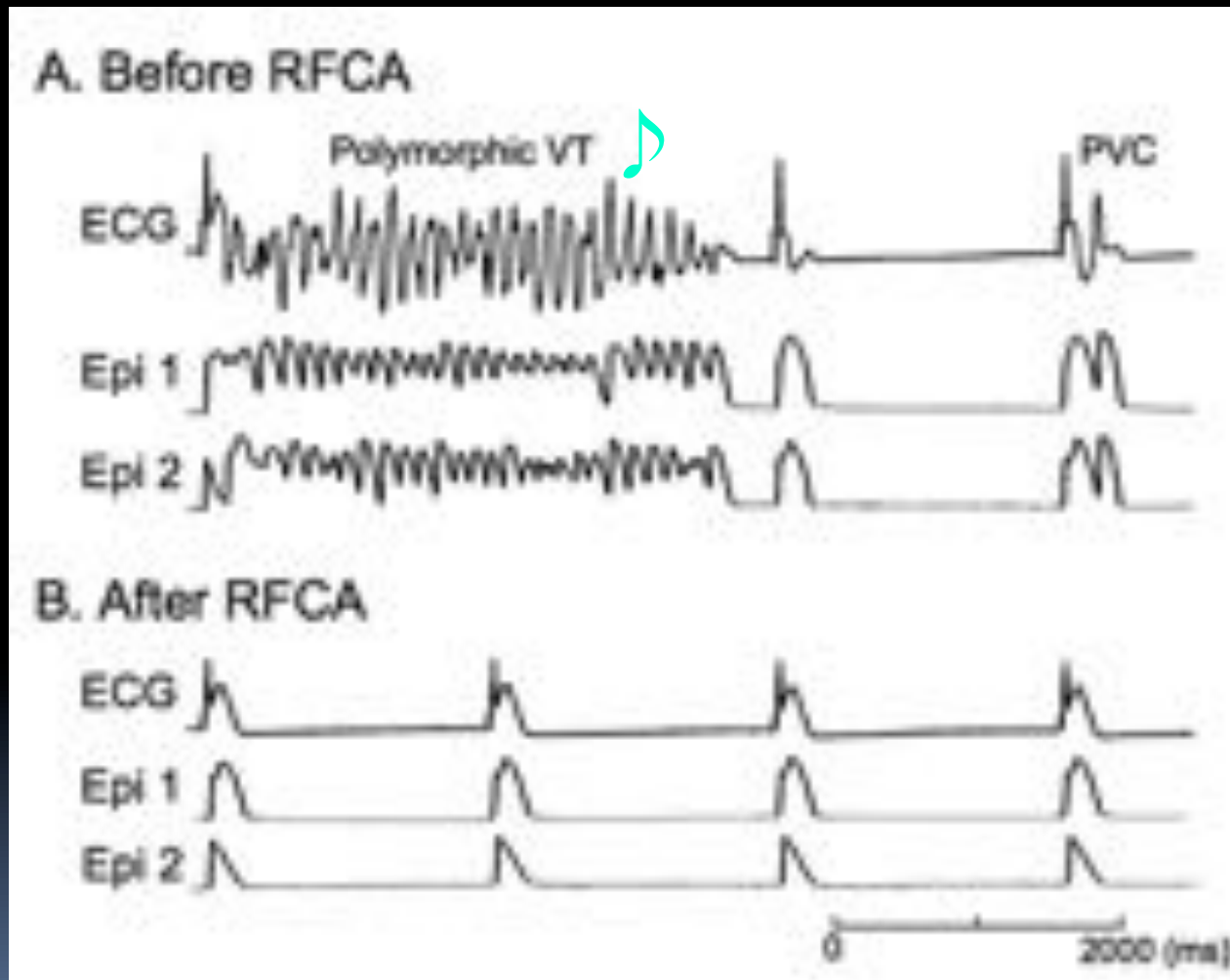
PVC-QRS onset

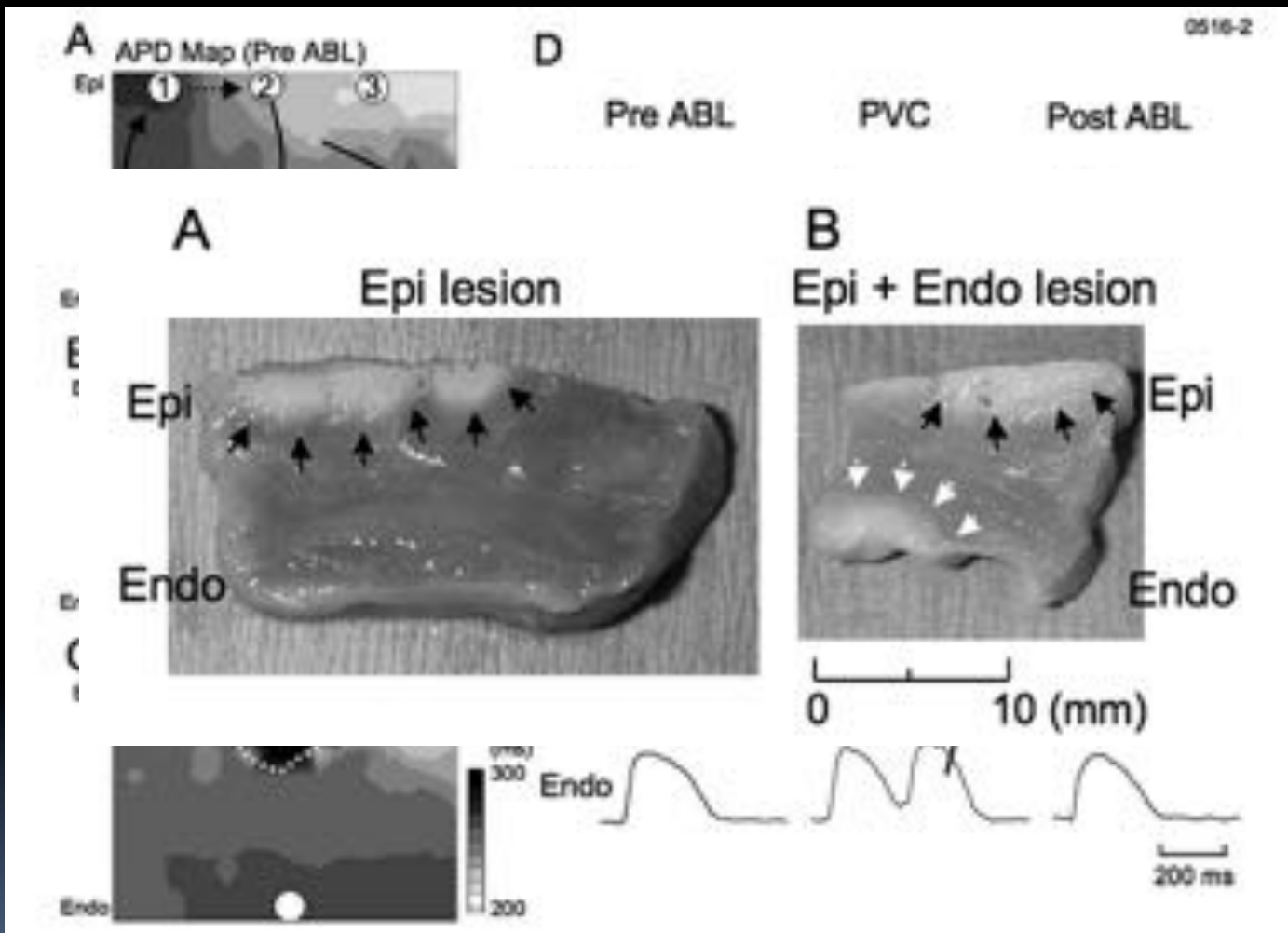


Using pinacidil ($5 \mu\text{M}$) and pilsicainide ($5 \mu\text{M}$), a model of BS was induced and showed spontaneous VT.



Arrhythmias before (A) and after (B) RFCA in the epicardial tissues





Heart Rhythm 2009;6:665–671



The Role of Ablation in Brugada Syndrome



*Nademanee et al. Circulation;
2011; 123; 1270-1279*♪



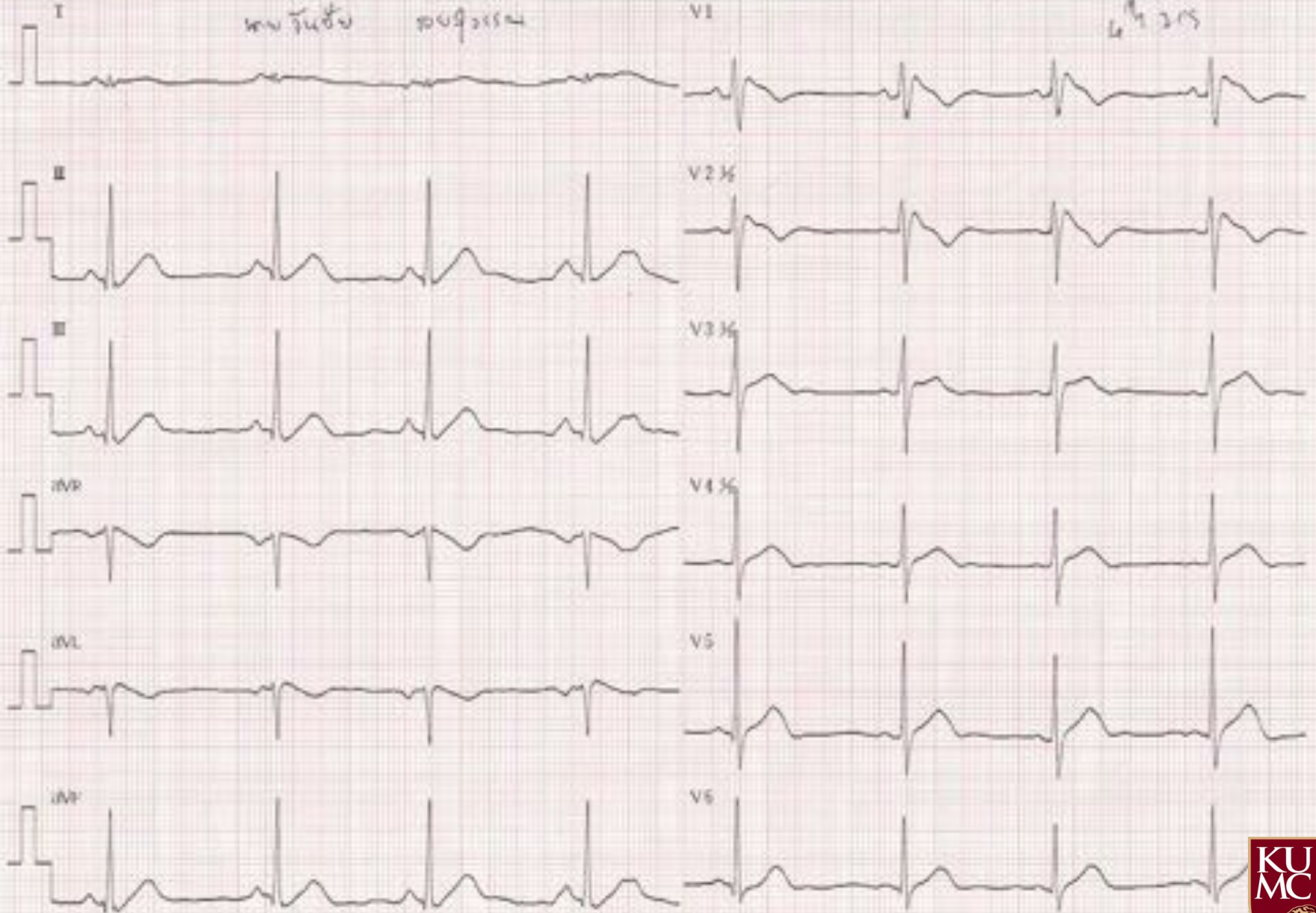
NO.

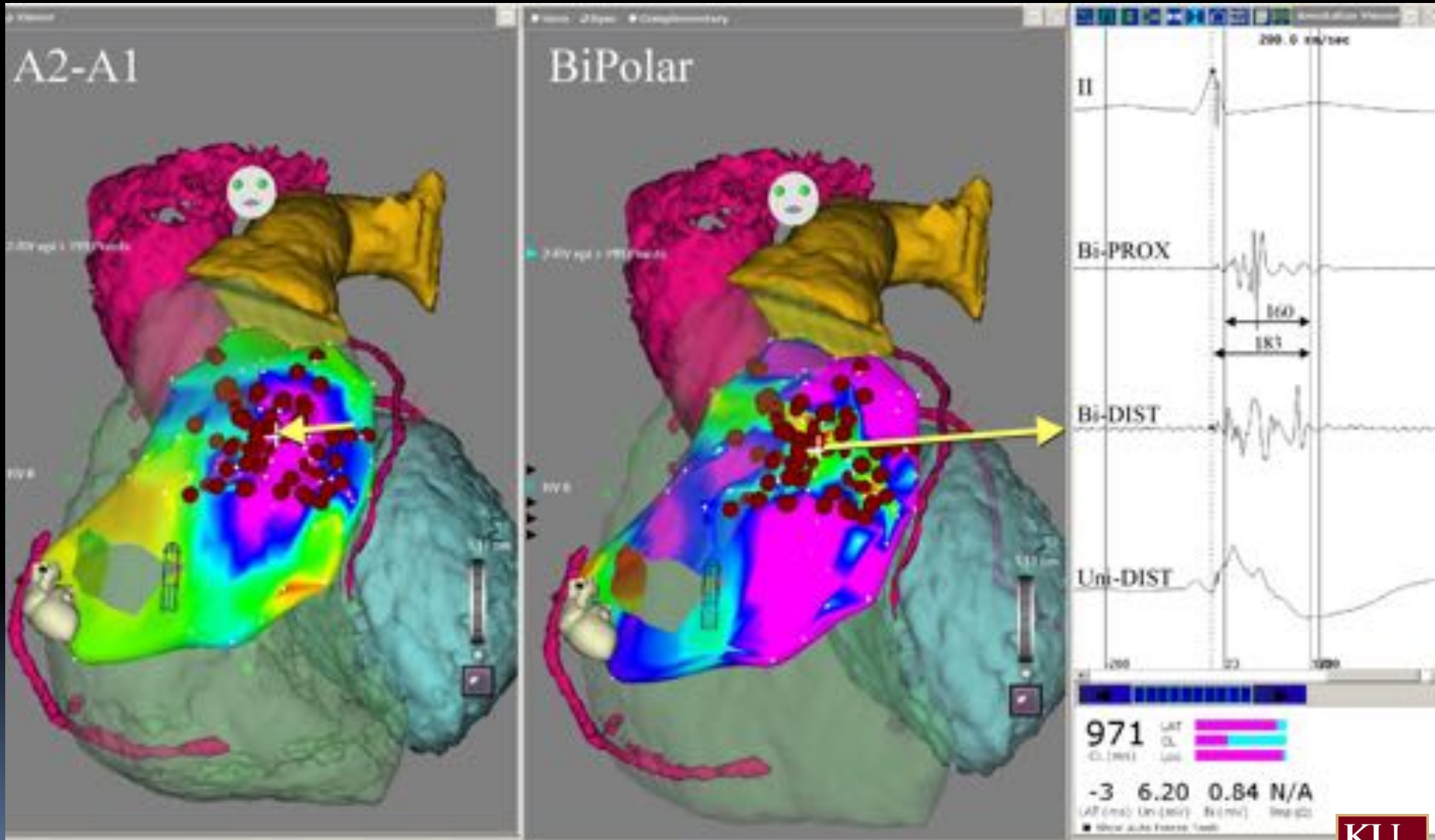
NAME

June/09/2008 08:35 HF. DF. MF1

Mr. 74000 2092154

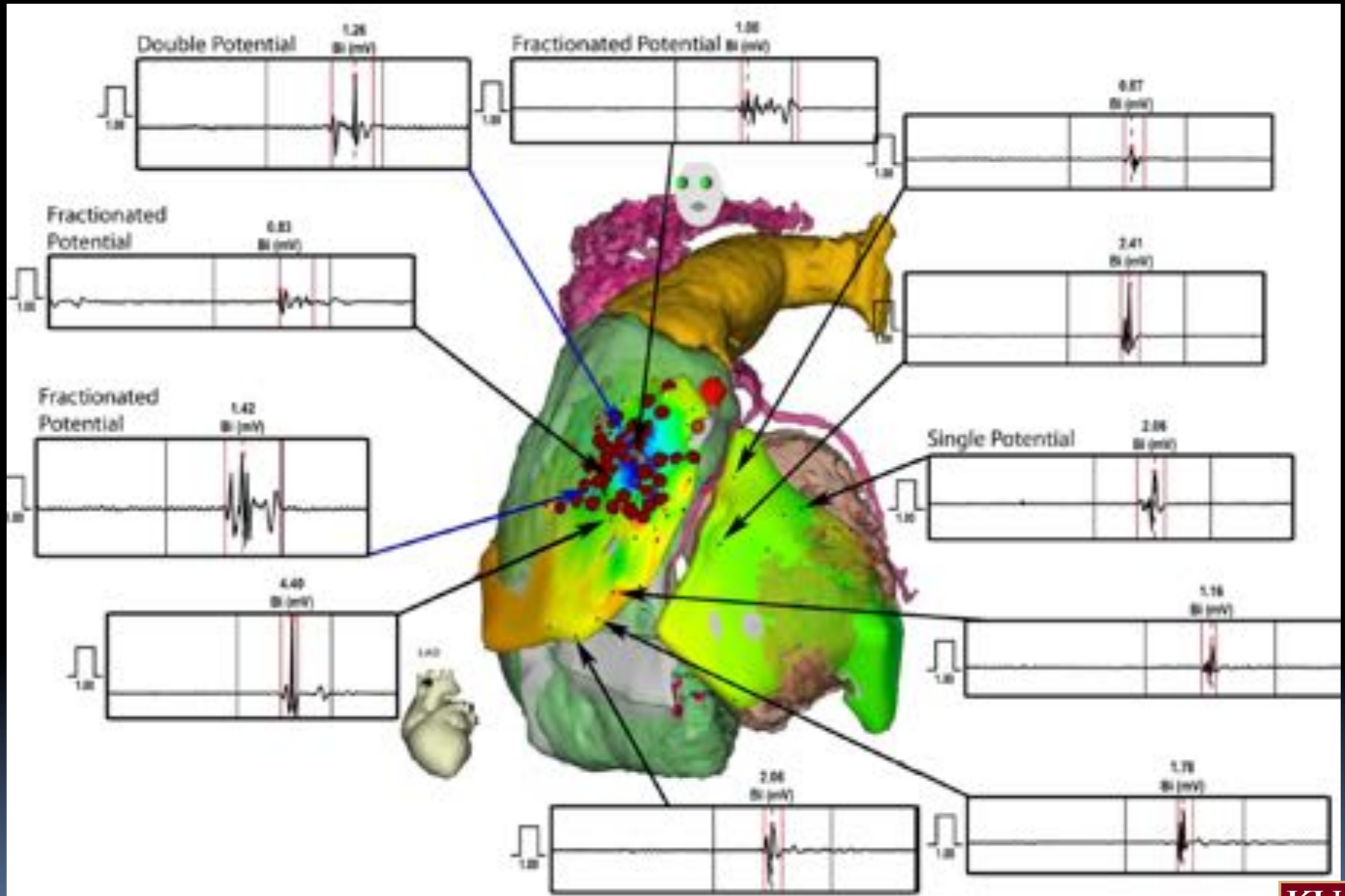
6/9/08





Nademanee et al. *Circulation*; 2011; 123; 1270-1279

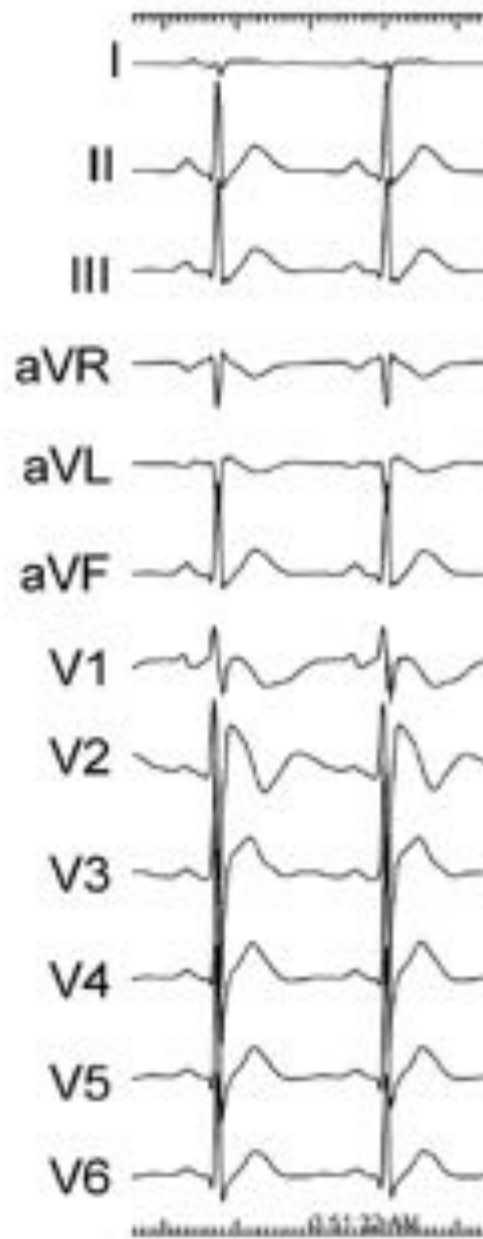




Nademanee et al. *Circulation*; 2011; 123; 1270-1279



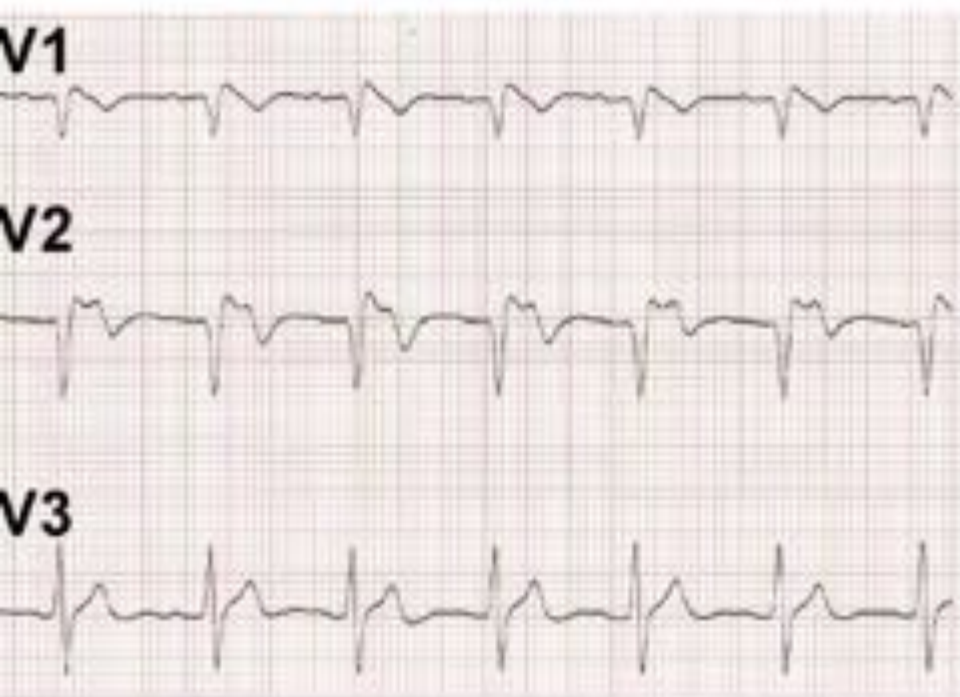
Before Ablation



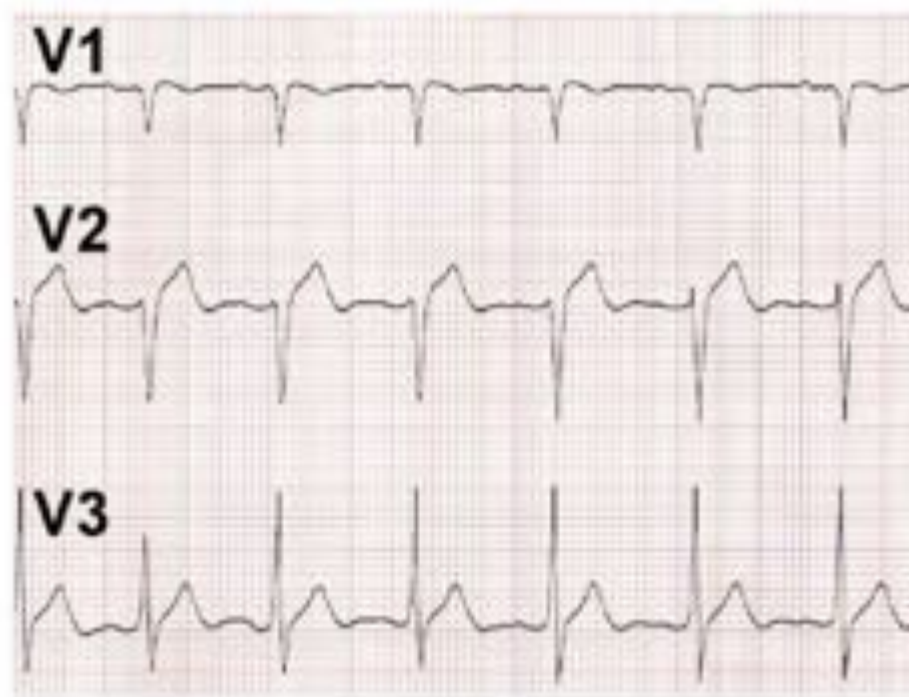
After Ablation



Before ablation



1 month post ablation



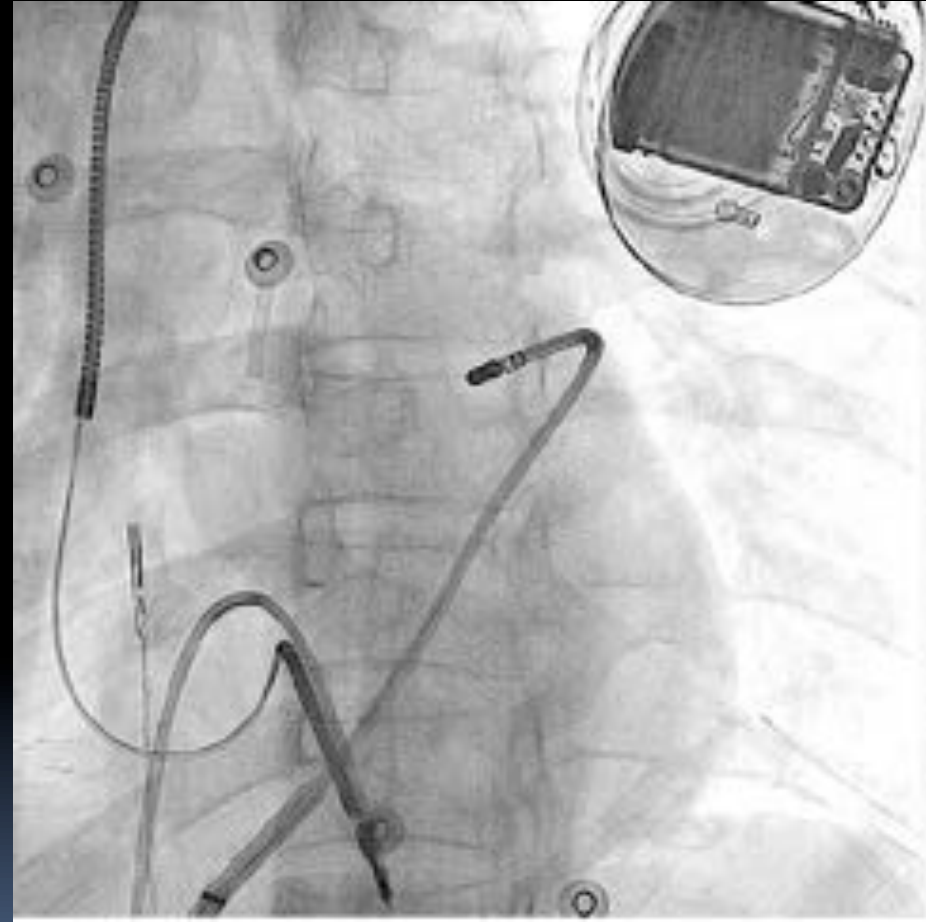
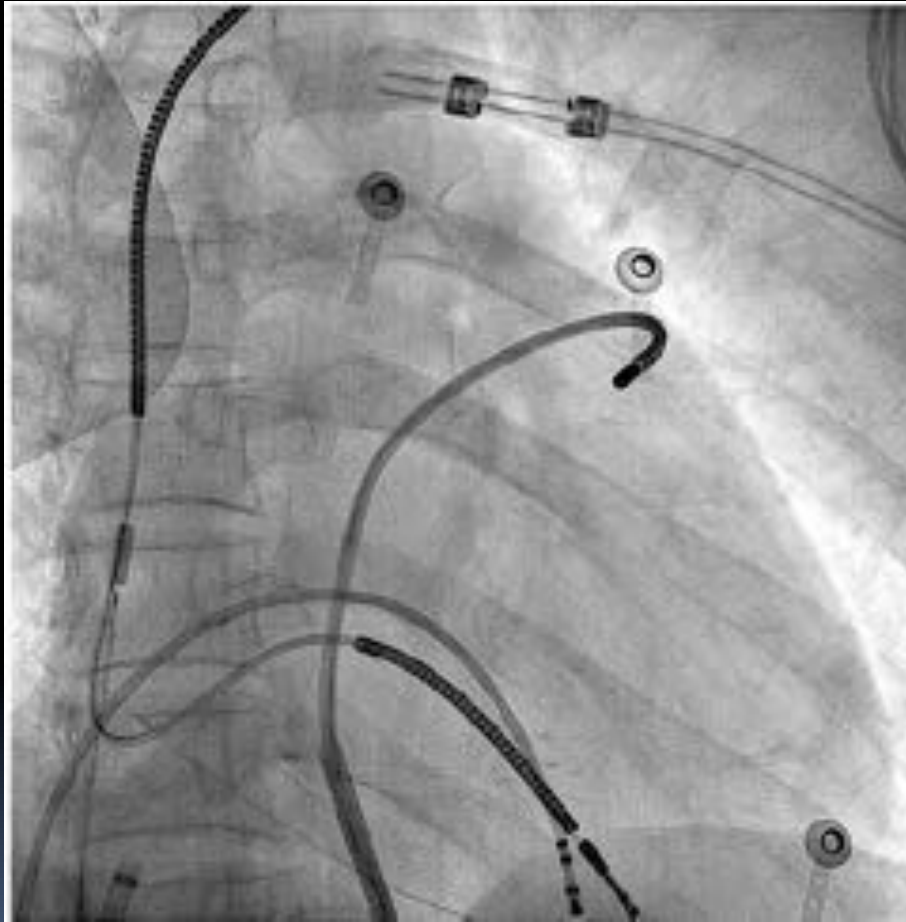
Ajmaline 3 years after ablation



Characteristics of Electrogram among 4 Mapping Areas

	RV- Epicardium (n = 261)	Ant. RVOT Epicardium (n= 189)	LV- Epicardium (n= 164)	RV- Endocardium (n = 213)
Bipolar (mV)	1.35 \pm 1.2	0.94 \pm 0.79 *	2.81 \pm 2	3 \pm 2.7
LP (msec)	32 \pm 31	96 \pm 47 *	6 \pm 19	13 \pm 23
Electrogram Duration	76 \pm 28	132 \pm 48*	60 \pm 17	66 \pm 21

ANOVA, * P < 0.001



Nademanee et al. Circulation; 2011; 123; 1270-1279



Effect of Ablation on VF induction and BrS Pattern

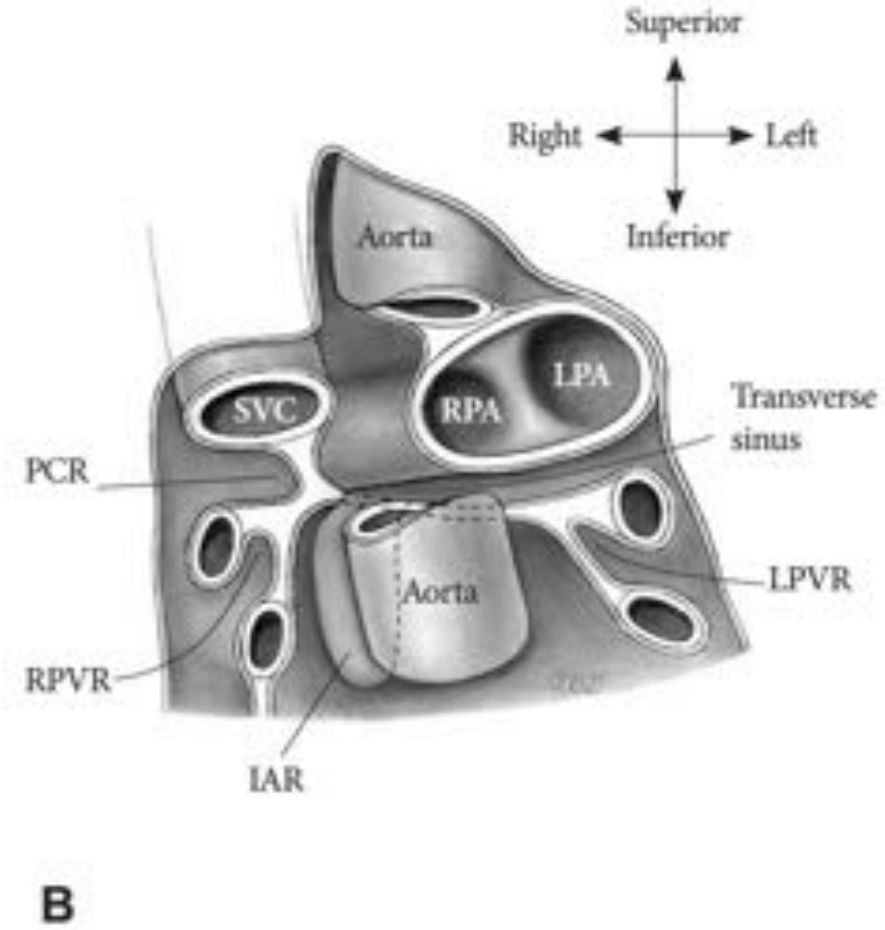
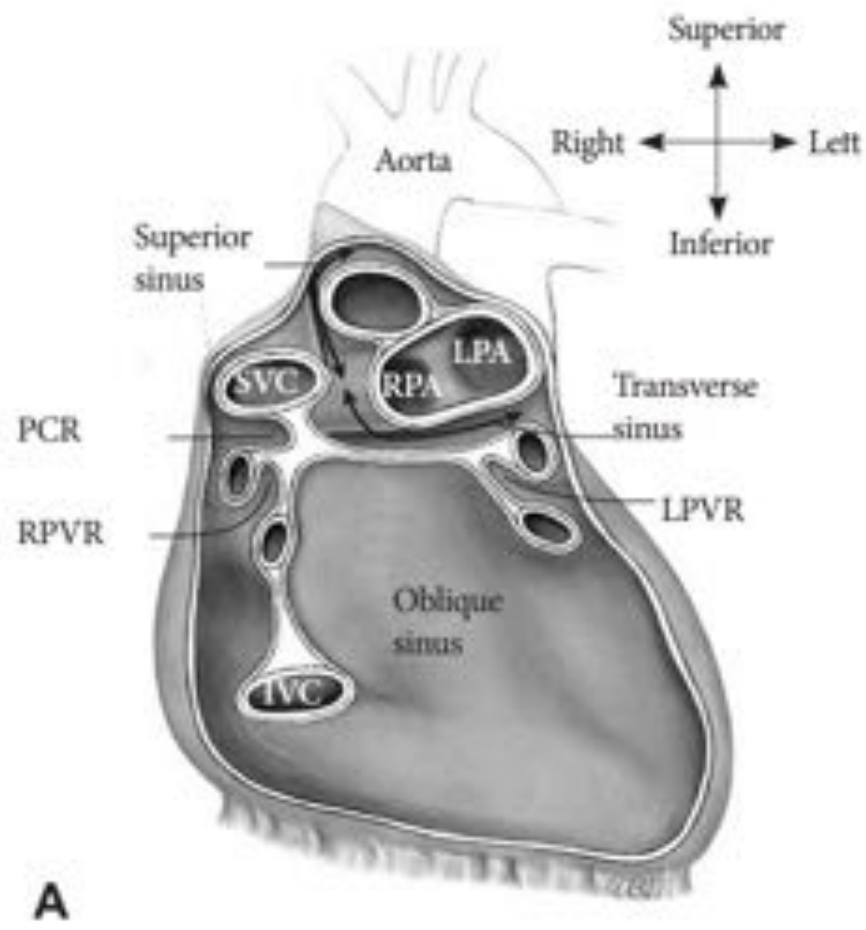


Conclusions

Nademanee et al. Circulation; 2011; 123; 1270-1279

1. Delayed depolarization over anterior RVOT epicardium is the underlying electrophysiologic mechanisms of the Brugada syndrome.
1. Ablation over this arrhythmogenic substrate site is effective in preventing life-threatening arrhythmias in the BrS patients.

The anatomy of the Pericardium and its Reflections



Role of Epicardial Mapping and Ablation in Repeated Procedures for Persistent AF



Hybrid Percutaneous Epicardial Catheter Ablation with Endocardial Ablation of AF

Hybrid endo- and epicardial catheter ablation via subxiphoid puncture is relevant and feasible in patients with high risk for left side pulmonary vein stenosis and those with suspicious intra-cardiac mural thrombus.

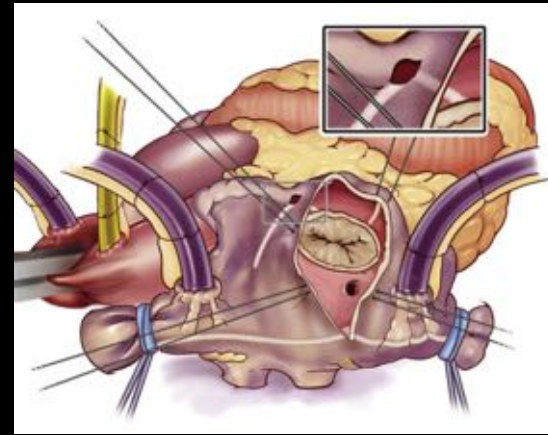
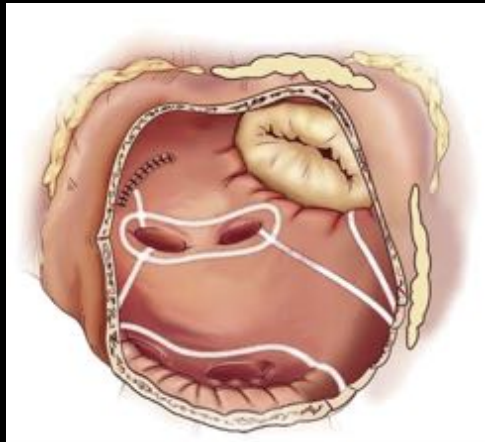
H-N Pak & Y-H Kim et al. JCE 2007;18:917-23

J-I Choi, H-N Pak & Y-H Kim et al. Circ J. 2009;73(2):384-7



Surgical Treatment of AF

- Cox maze IV



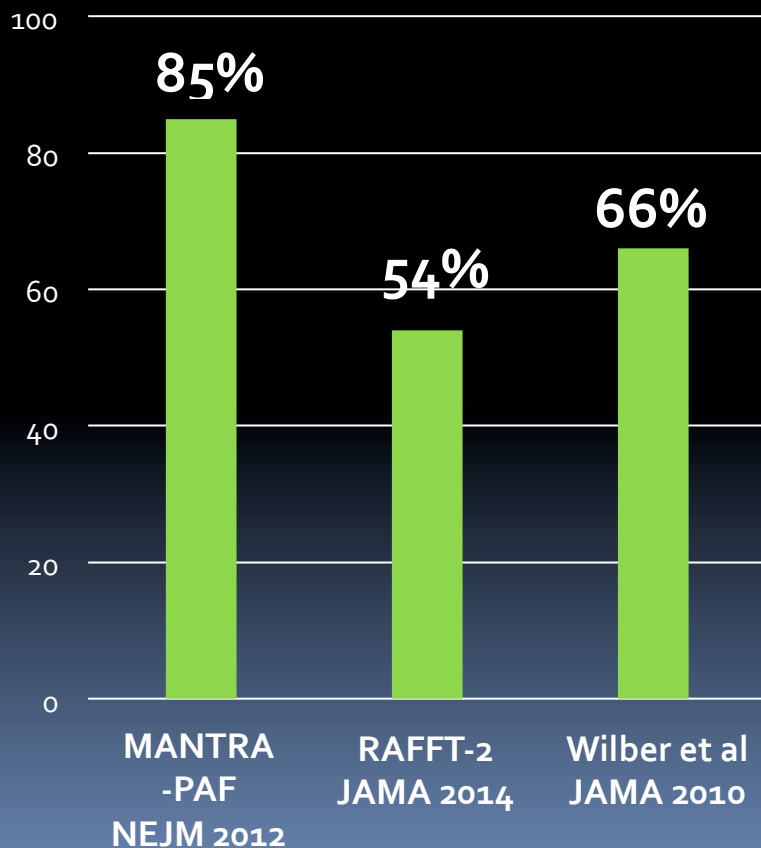
- High freedom rate of surgical treatment

Cox maze III → 97% (follow-up of 5.4±2.9 years)

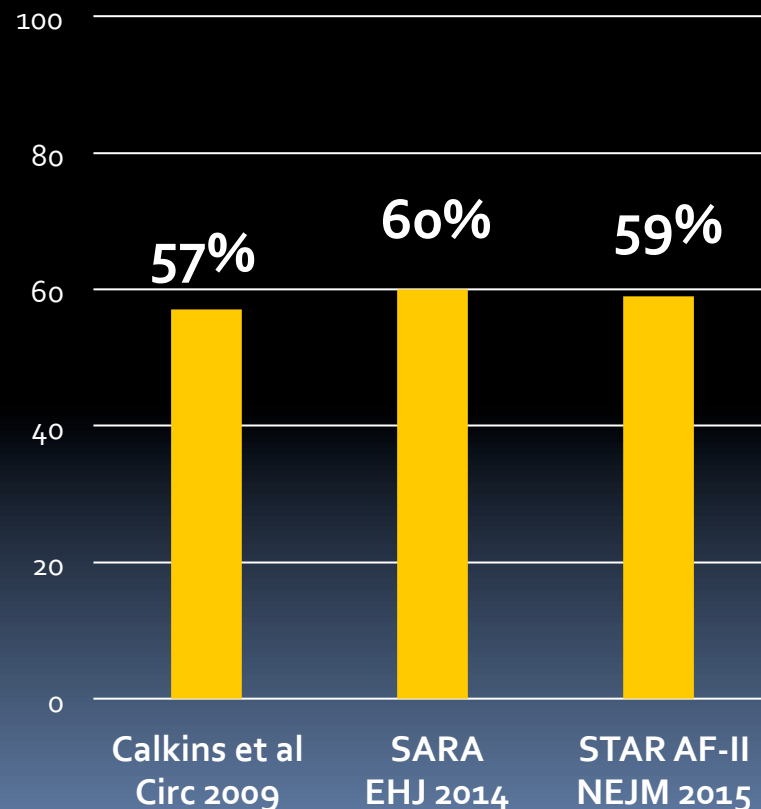
Cox maze IV → 89% (follow-up of 1 year)

Freedom from AF after Catheter Ablation in Recent Study

Paroxysmal AF



Persistent AF



The Success rate of Catheter Ablation is Lower than that of Surgical Treatment

1. Difficulty of transmural ablation
2. Disparity between epicardial and endocardial potential
3. Gap and conduction recovery of linear ablation

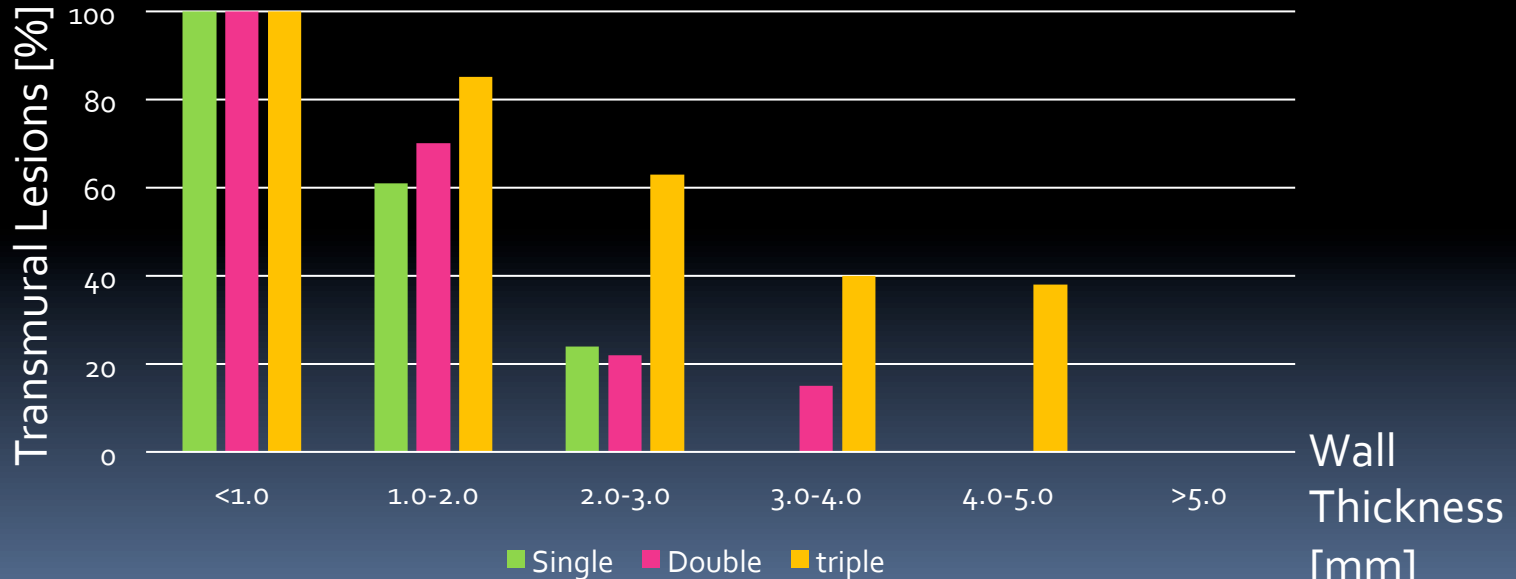


Achievement of Transmurality

ORIGINAL ARTICLE

Histological assessment of transmuralty after repeated radiofrequency ablation of the left atrial wall

Transmurality



Endo-Epicardial Electrical Dissociation

Electropathological Substrate of Longstanding Persistent Atrial Fibrillation in Patients With Structural Heart Disease

Epicardial Breakthrough

Natasja M.S. de Groot, MD, PhD; Richard P.M. Houben, BSc; Joep L. Smeets, MD, PhD;
Eric Boersma, PhD; Ulrich Schotten, MD, PhD; Martin J. Schalij, MD, PhD;
Harry Crijns, MD, PhD; Maurits A. Allessie, MD, PhD

Circ. 2010;122: 1674-1682.

Epicardial Foci of Atrial Arrhythmias Apparently Originating in the Left Pulmonary Veins

DEMOSTHENES KATRITSIS, M.D., Ph.D., ELEFThERIOS GIAZITZOGLOU, M.D.,
SOCRATES KOROVESIS, M.D., GEORGE PAXINOS, M.D.,
CONSTANTINE E. ANAGNOSTOPOULOS, M.D.,* and A. JOHN CAMM, M.D.†

JCE. Vol. 13, pp. 319-323, April 2002

Time course and mechanisms of endo-epicardial electrical dissociation during atrial fibrillation in the goat

Jens Eckstein^{1,2*}, Bart Maesen¹, Dominik Linz¹, Stef Zeemering¹, Arne van Hunnik¹, Sander Verheule¹, Maurits Allessie¹, and Ulrich Schotten¹

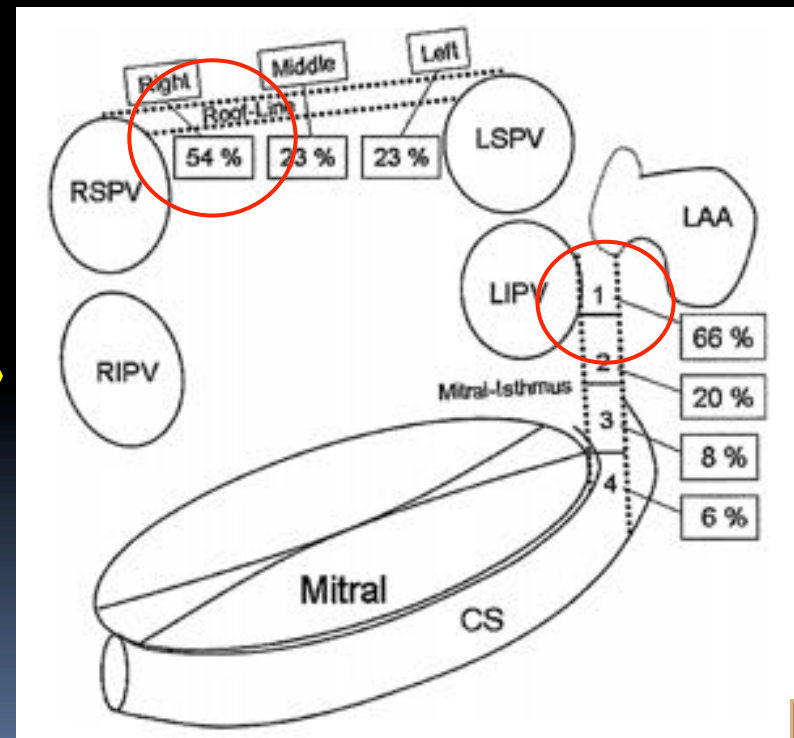
Cardiovascular Res 2011 Mar 1;89(4):816-24.



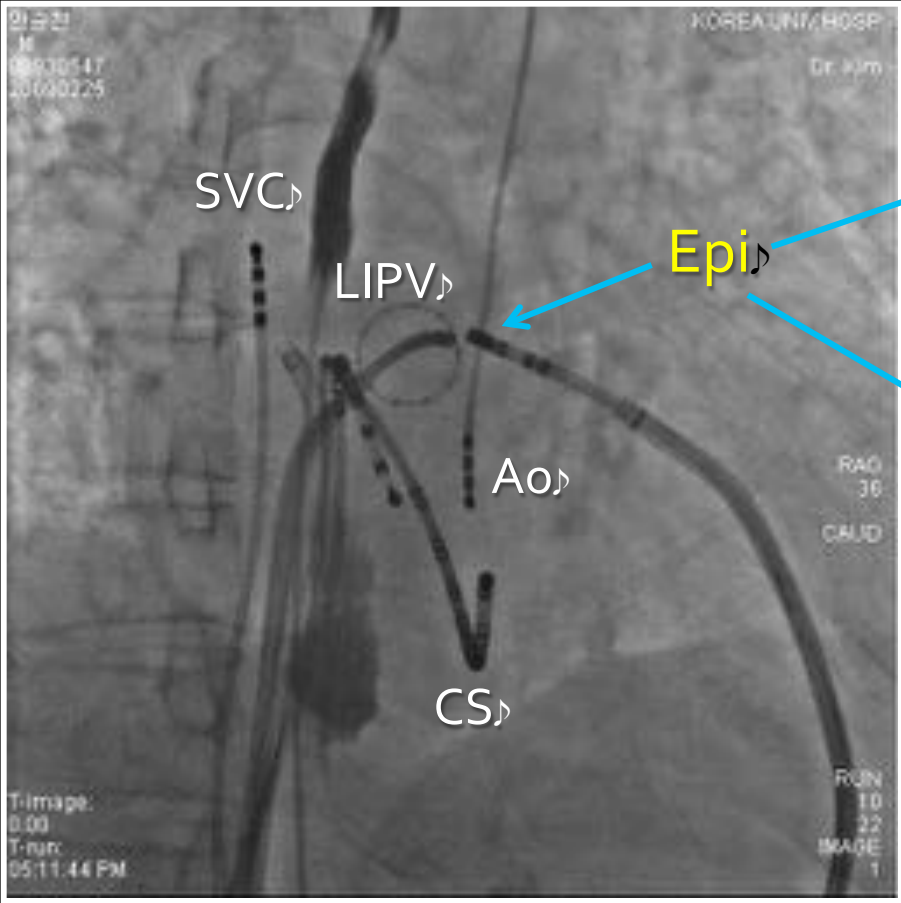
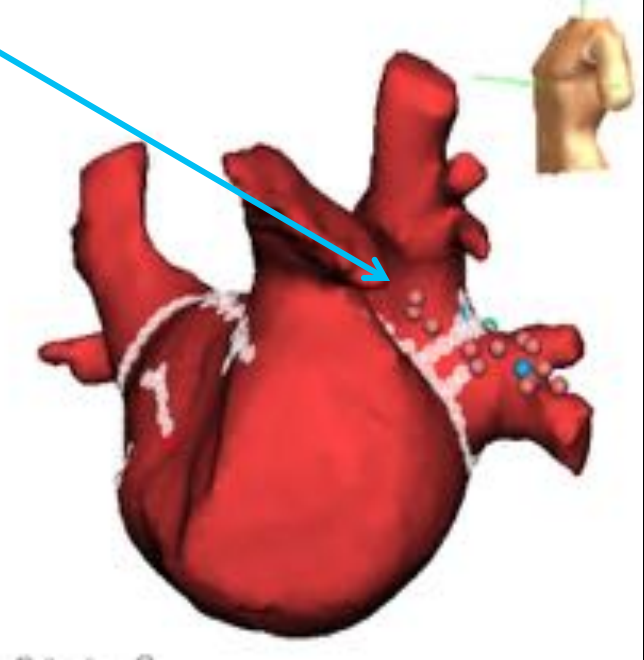
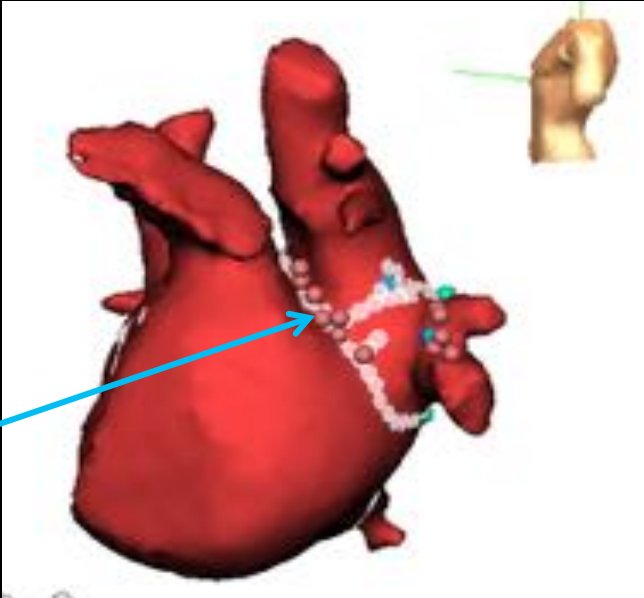
The Limitation of Linear Ablation

- Achievement of complete conduction block remains challenging and conduction recovery is common.

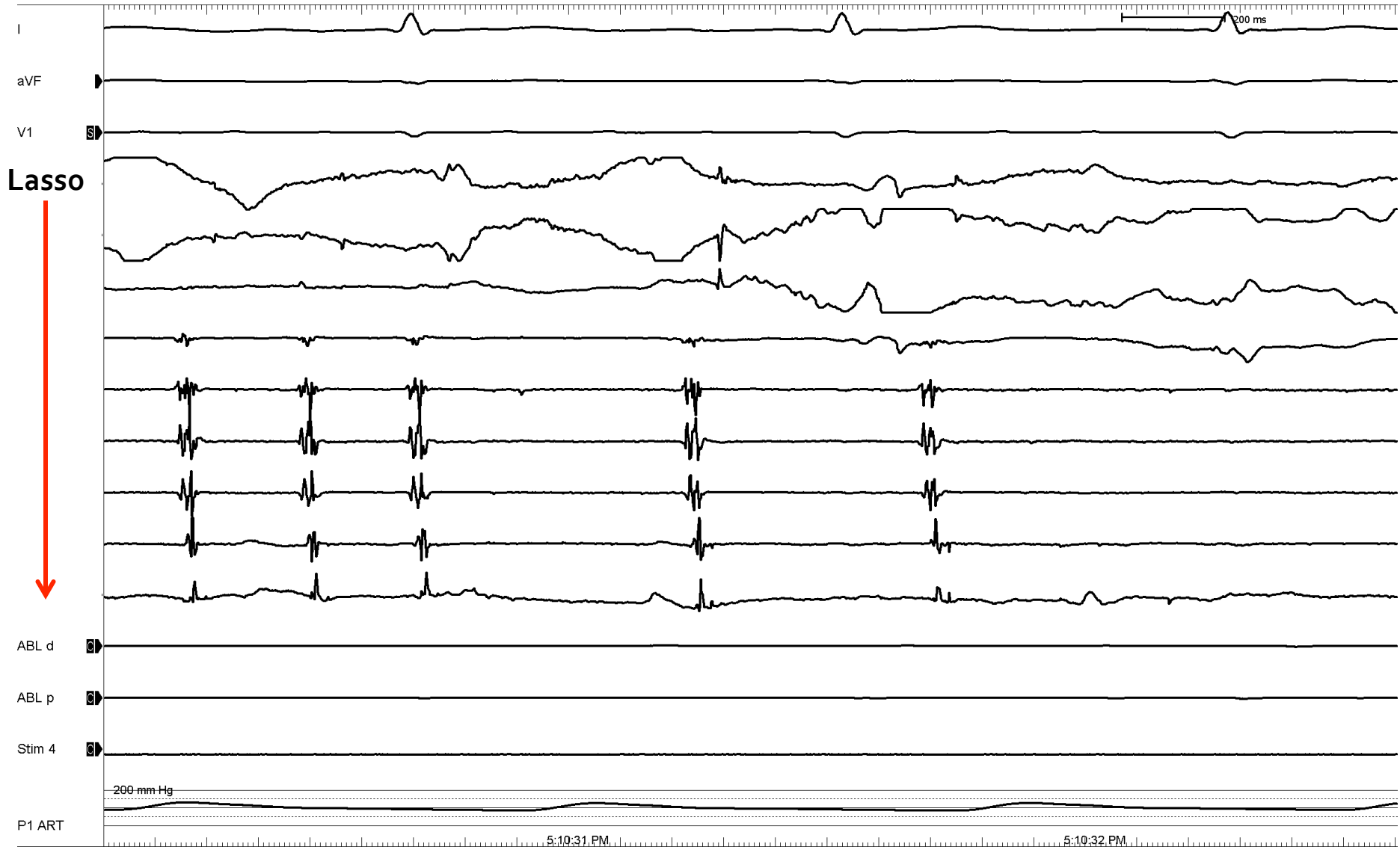
- Conduction recovery in previous LA linear ablation



Epicardial Abl for LIPV

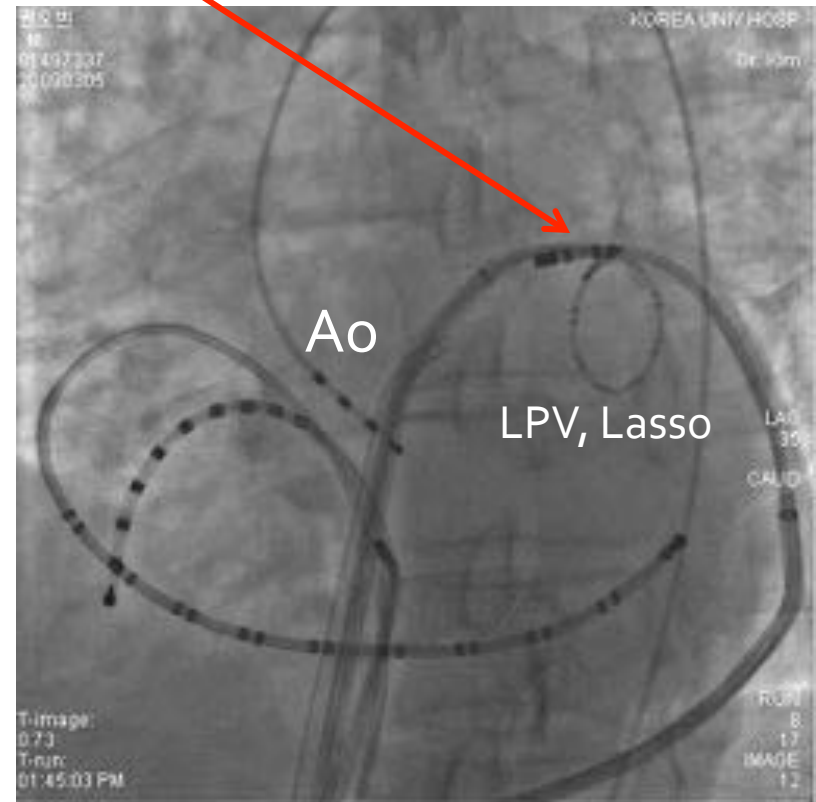
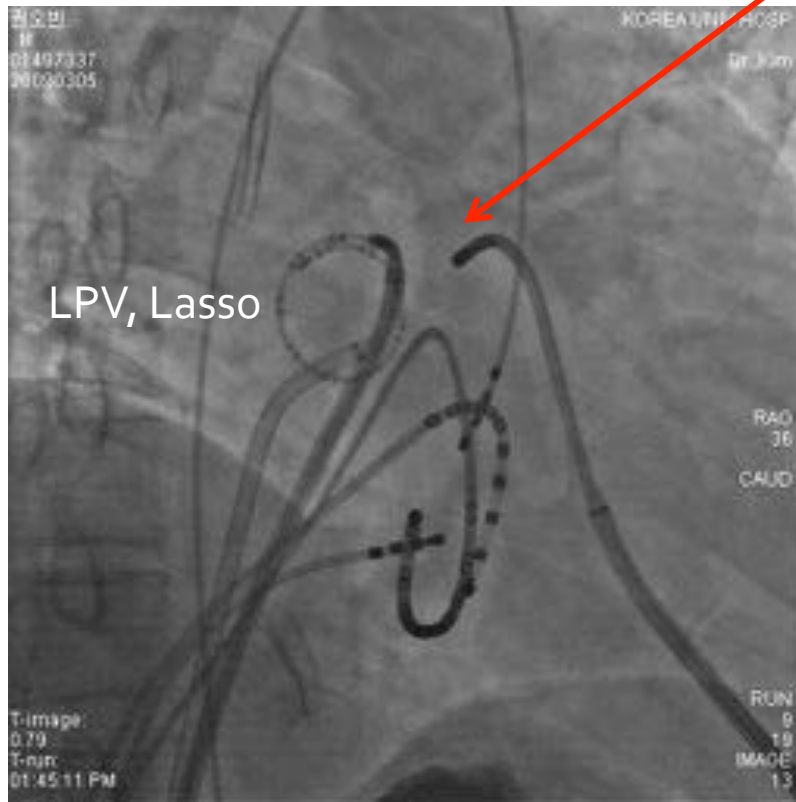


Epicardial Abl for LIPV (#2)



Epicardial Ablation at Common Left PV

Epicardial Ablation



Epicardial ablation

was effective for LPV isolation.

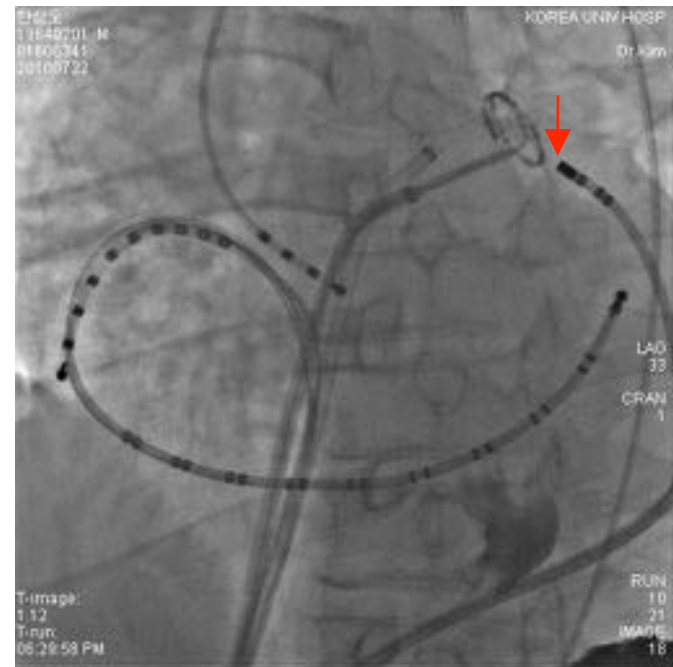
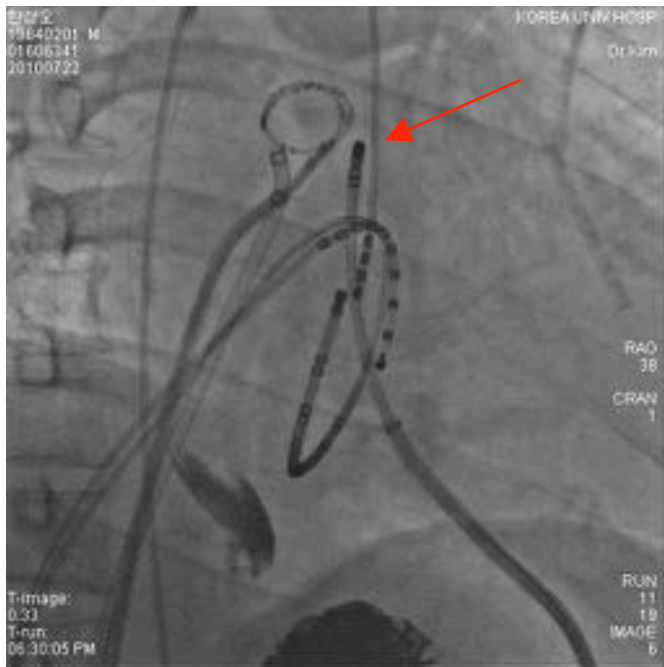
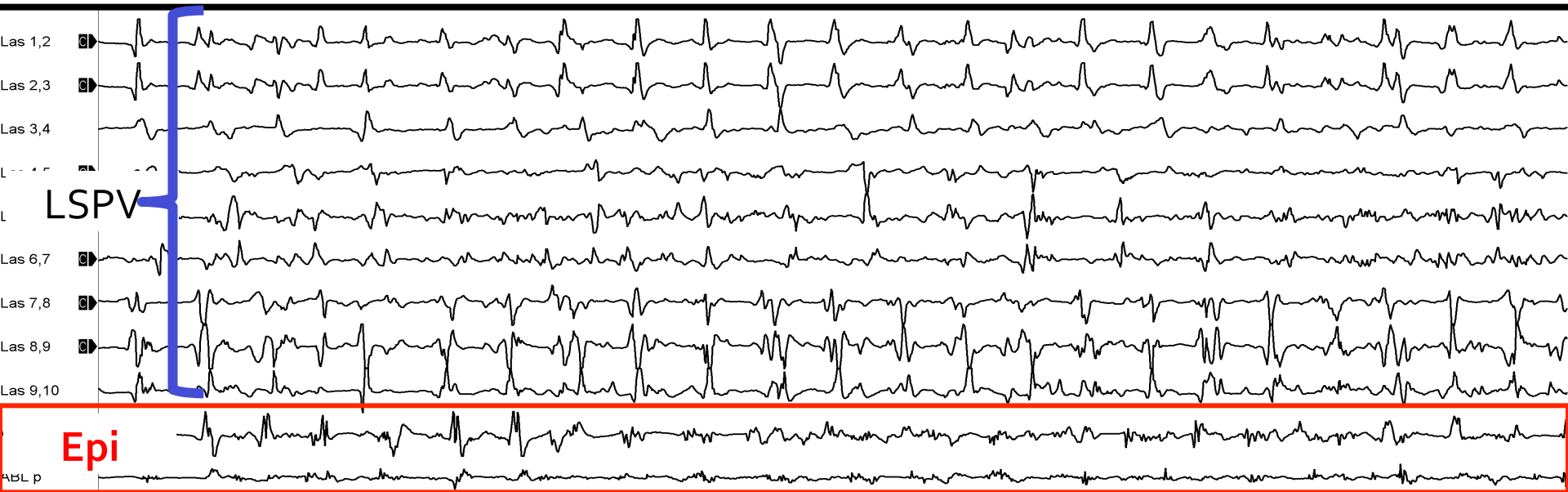


M/60, longstanding persistent AF

- ◆ AF > 4 years
- ◆ Recurrent AF after 2 times of DC cardioversion
- ◆ Refractory to PO amiodarone
- ◆ Gout
- ◆ LA: 49.7 mm, EF: 60%

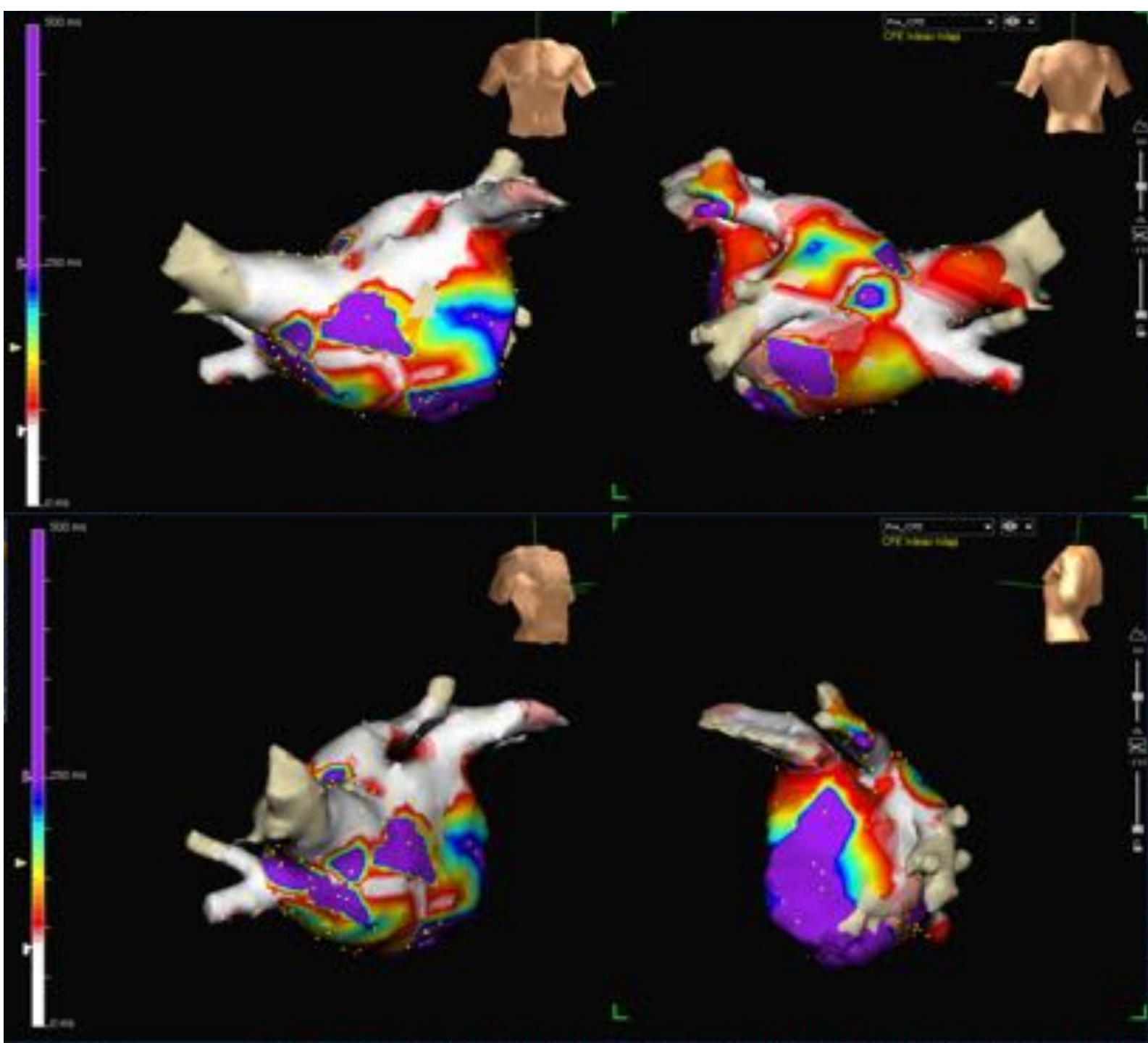


Epicardial vs. Endocardial Mapping of PV during AF



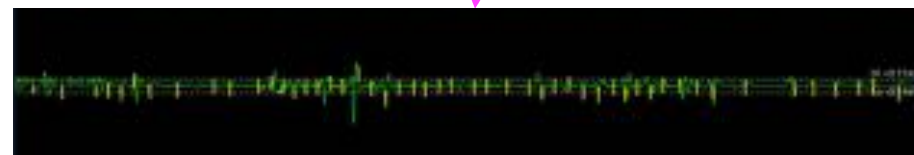
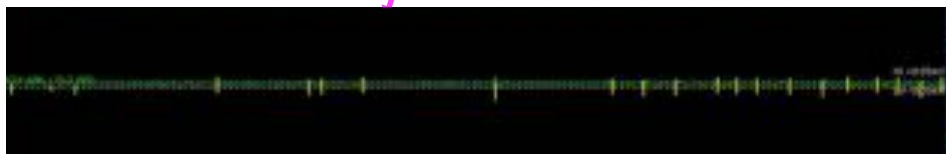
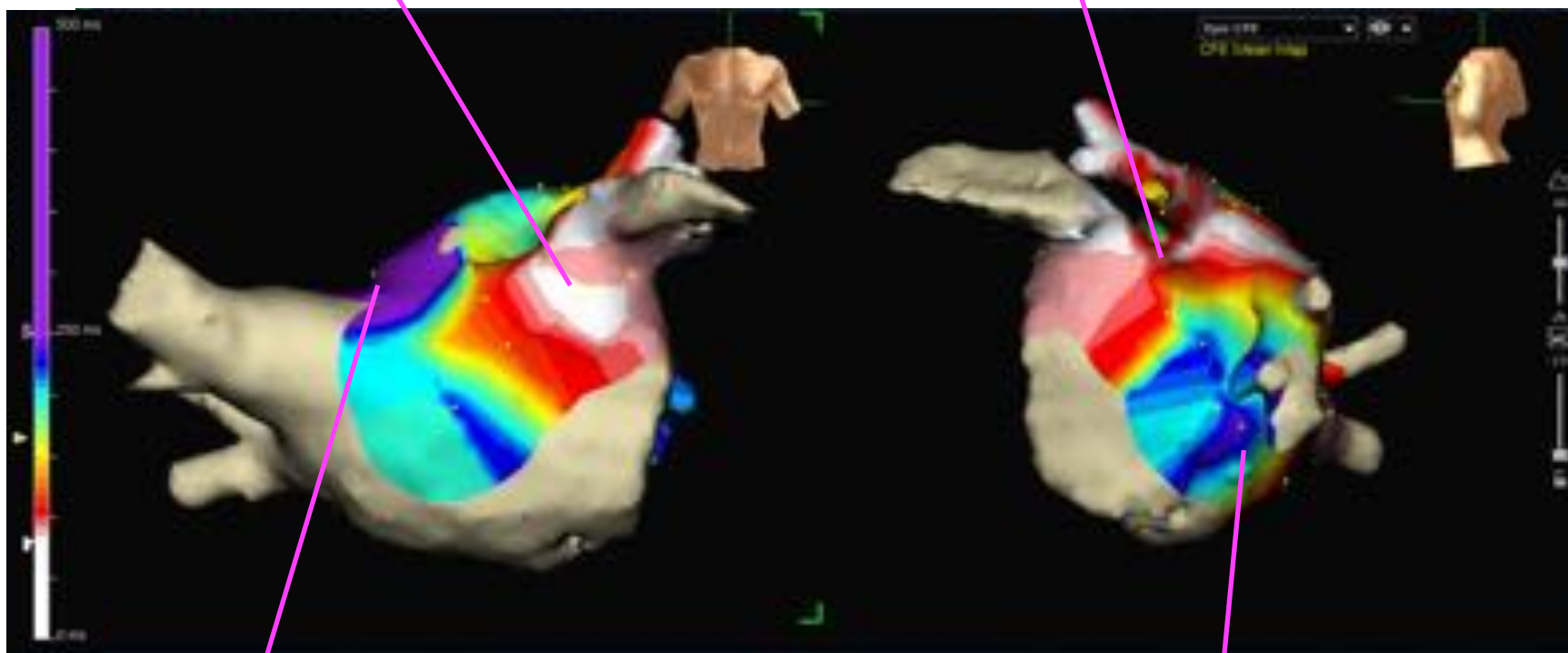
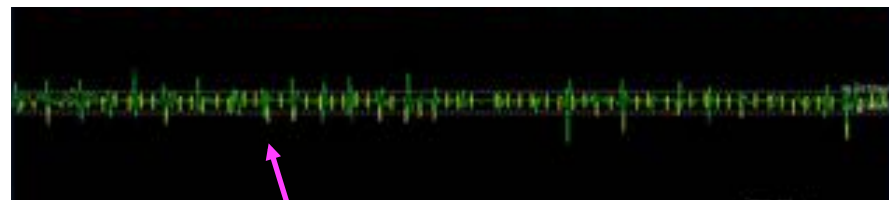
Endo-C
FE ma
p

CL color
setting:
80 to 250 ms

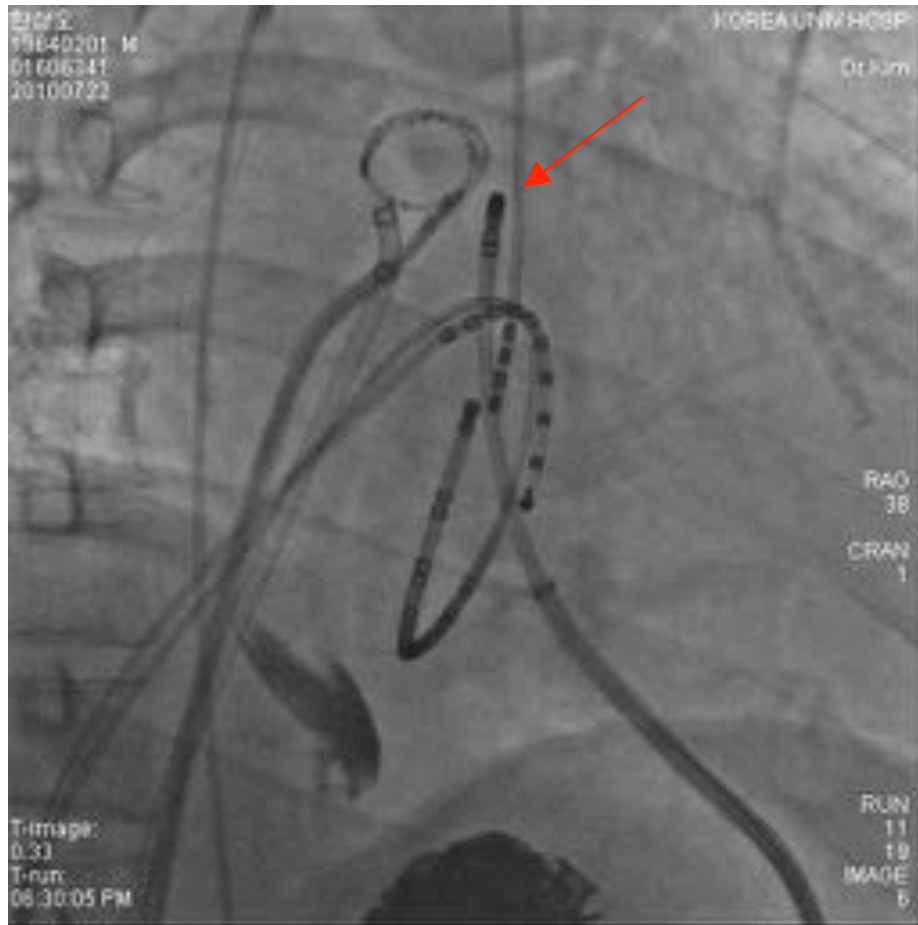


Epicardial CFE map

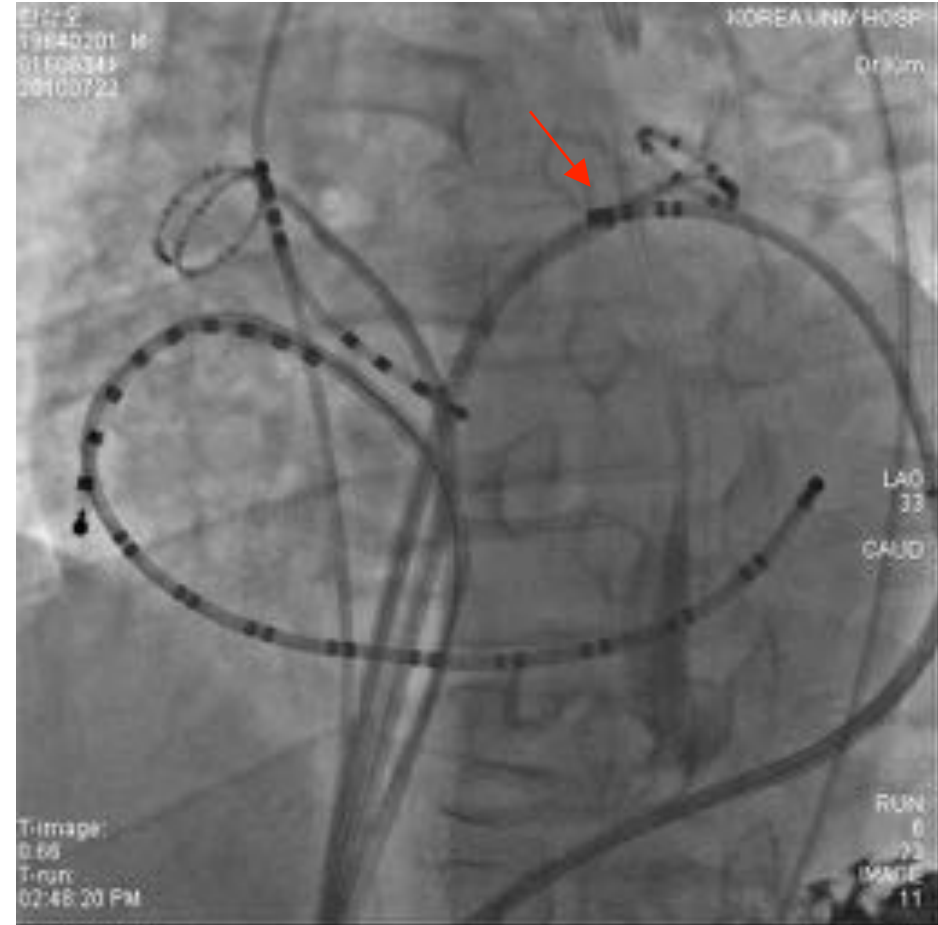
CL color setting: 50 to 250 ms



Epicardial Ablation



RAO



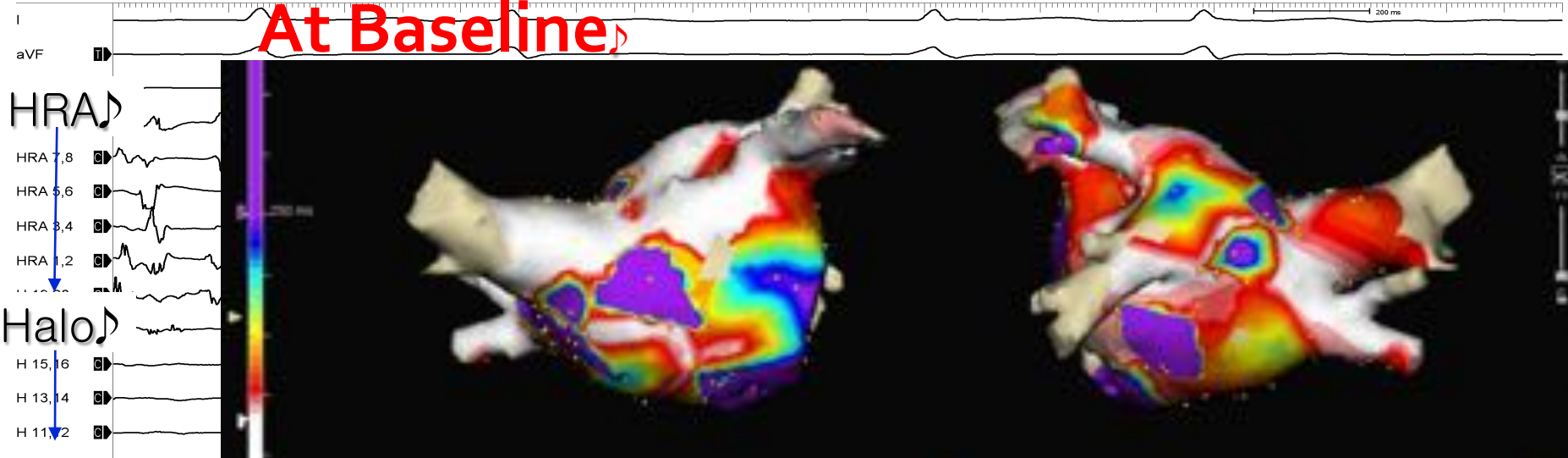
LAO

Post PVI+Epicardial Ablation at the Roof and Lateral Ridge

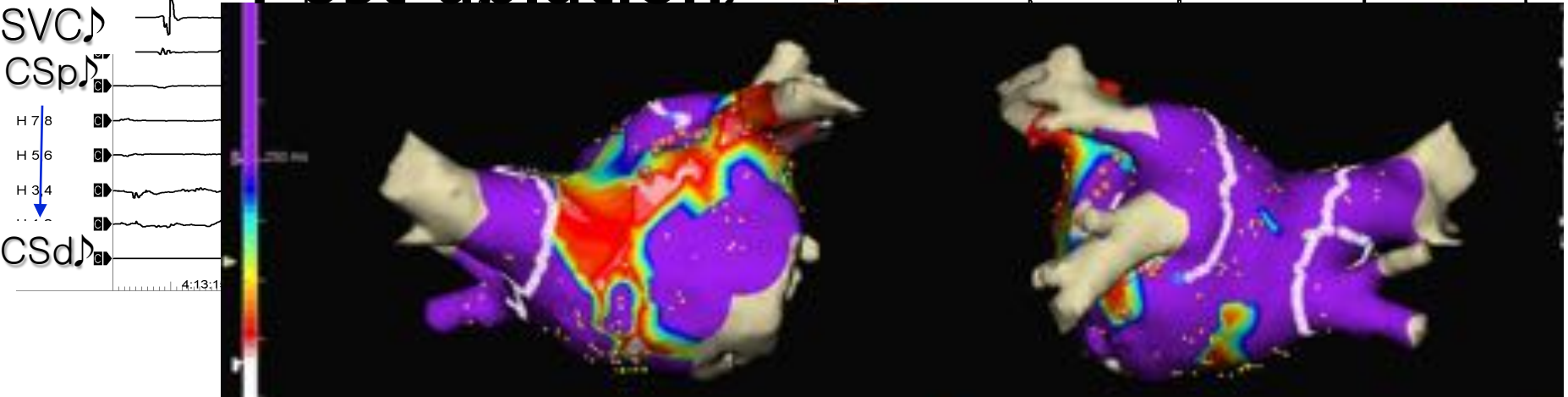


Post PVI+Epicardial Ablation at the Roof and Lateral Ridge

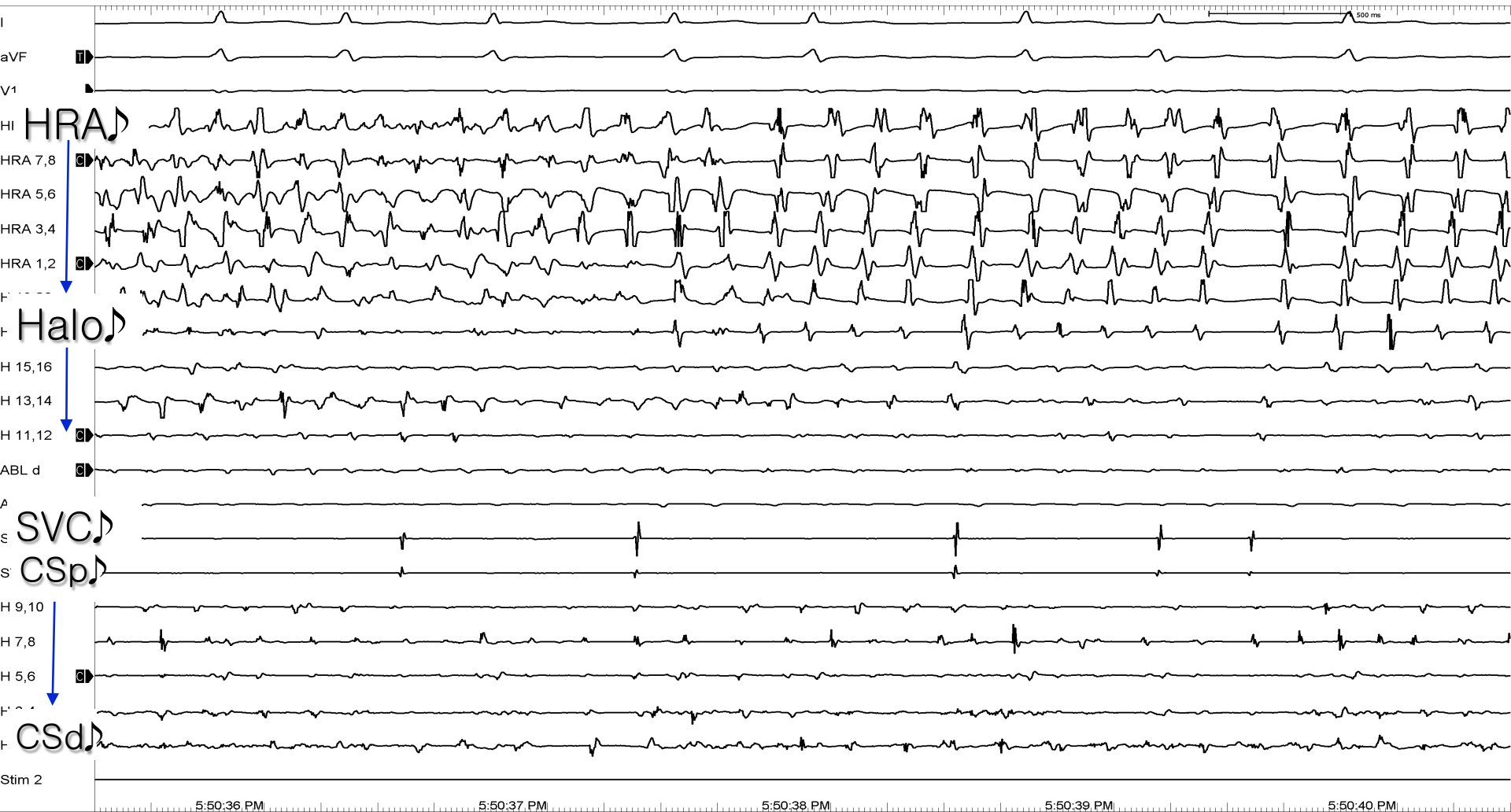
At Baseline



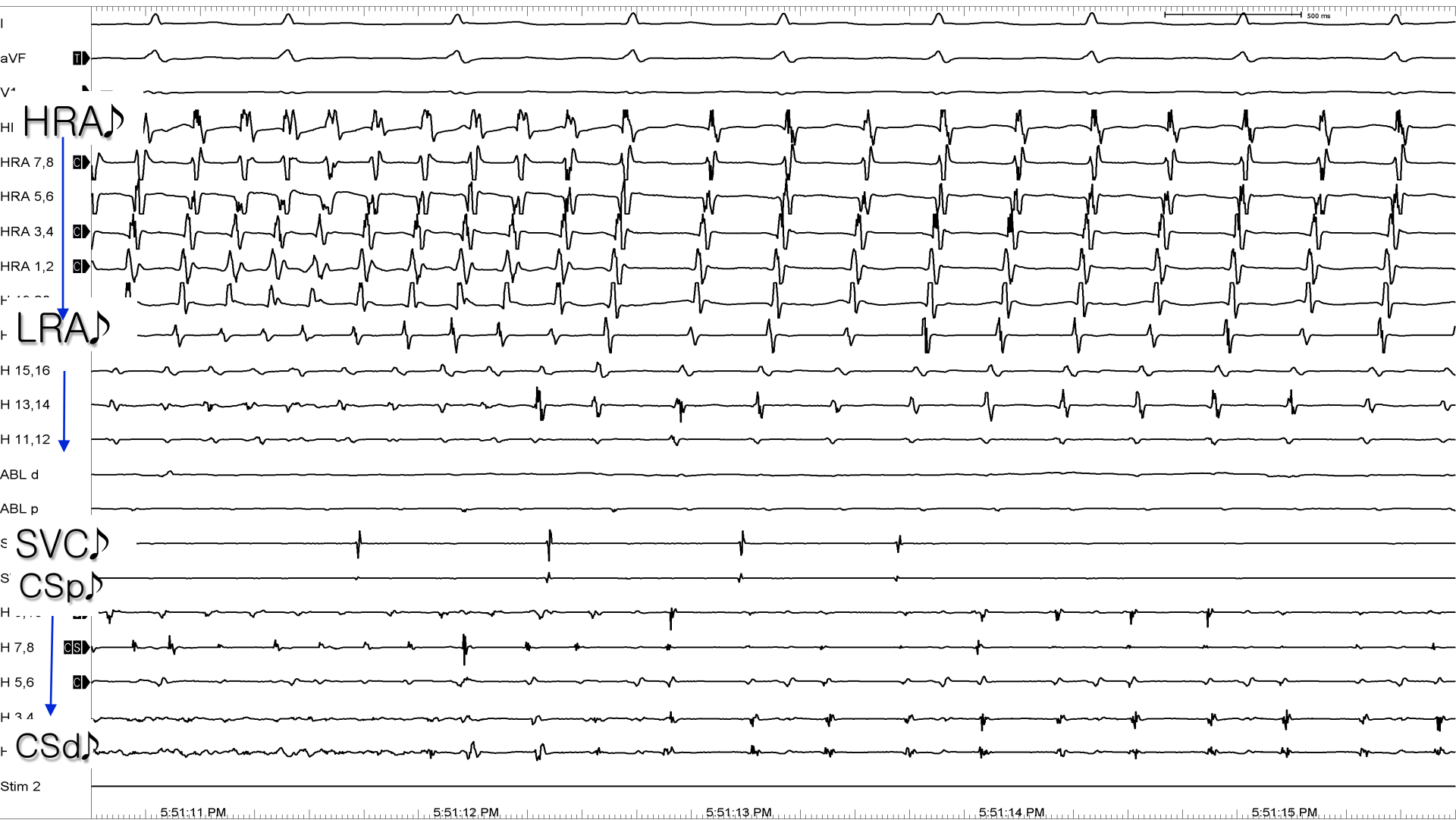
Post-ablation



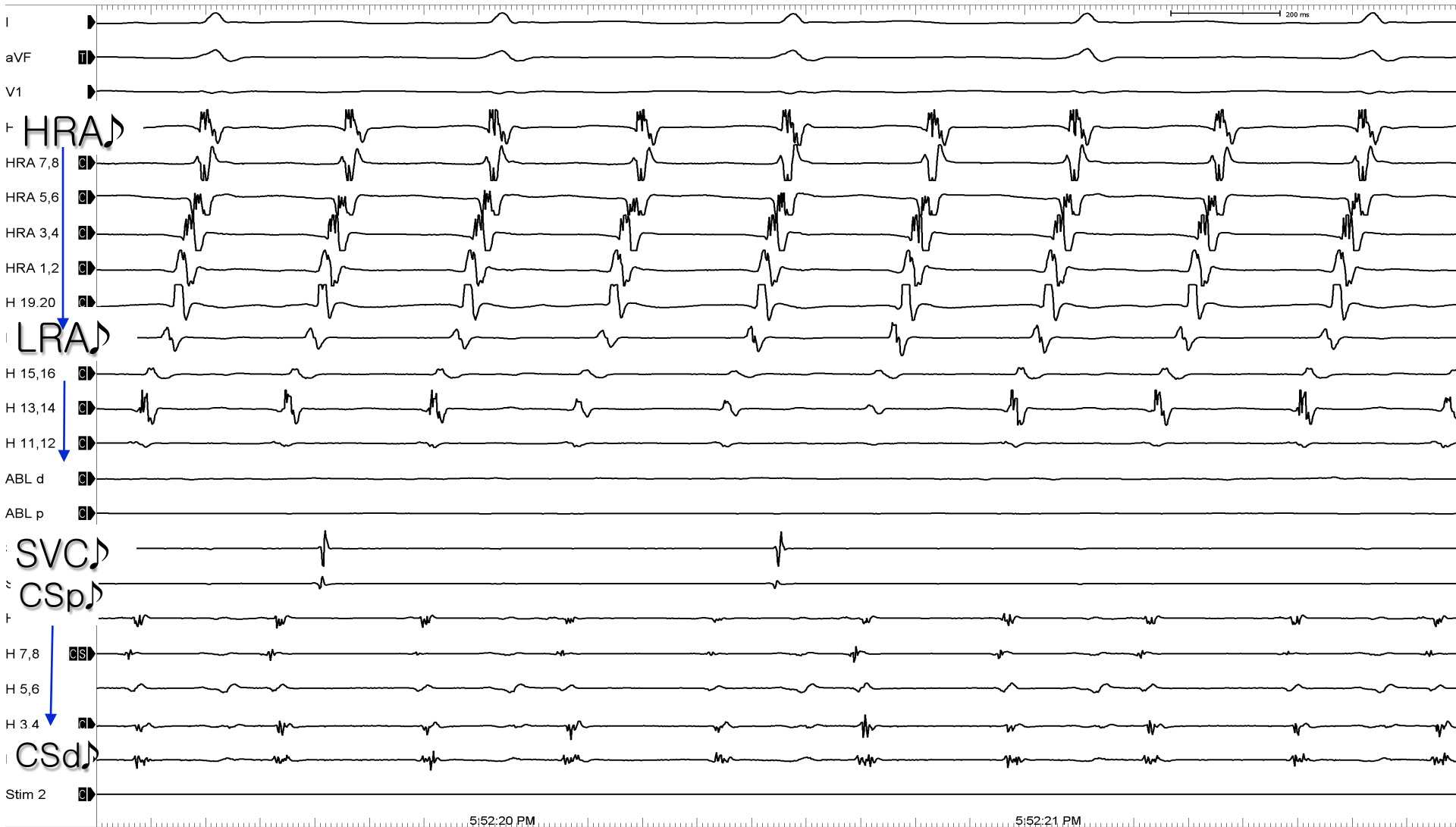
During Epicardial CFAE ABL AF Organized



AF Converted to AFL



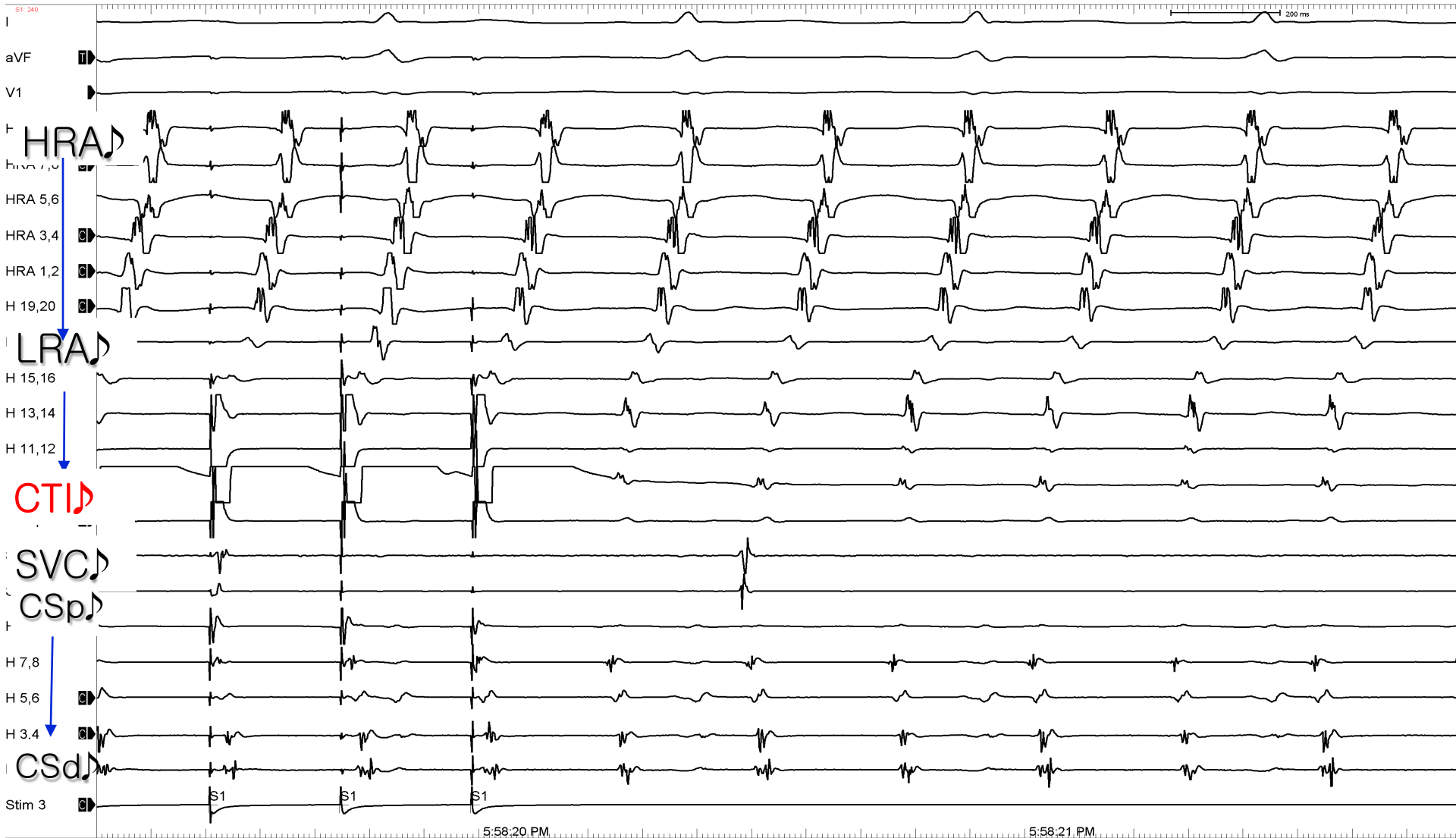
Atrial Flutter, TCL: 275 ms



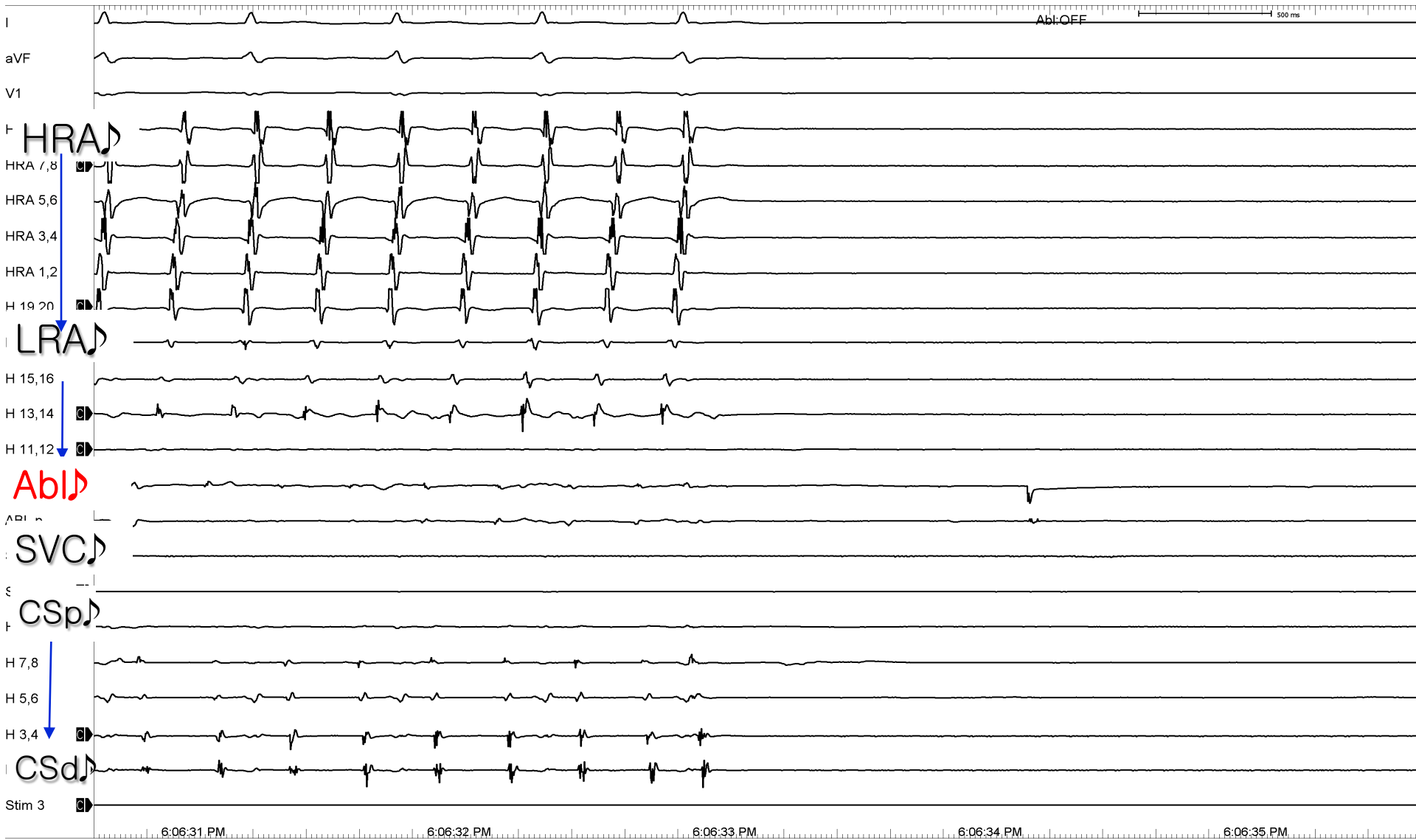
5:52:20 PM

5:52:21 PM

Concealed Entrainment at the CTI

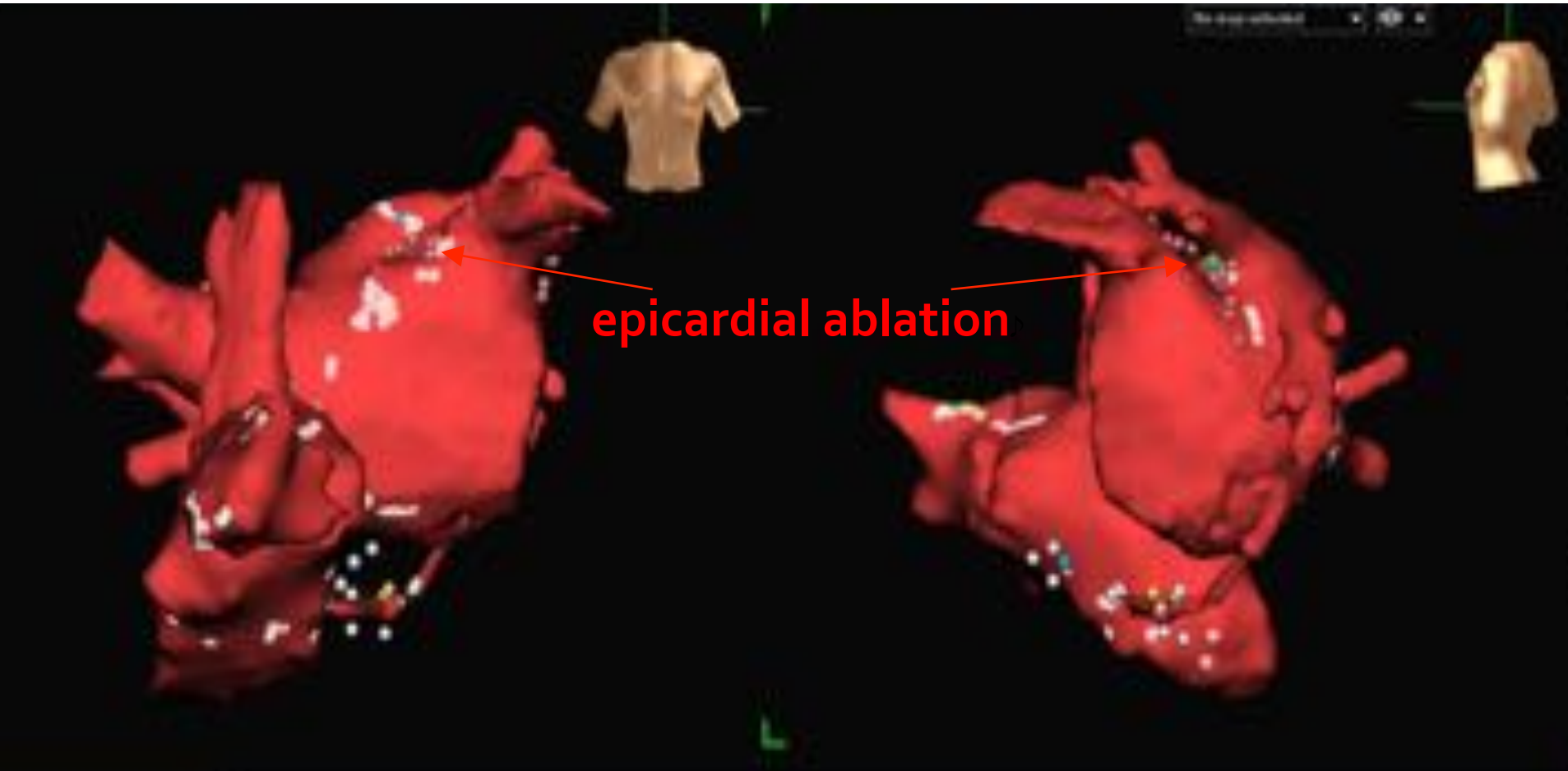


During CTI ABL, End Point: Non-inducible AF/AFL



Ablation Summary

Epicardial (LA) + Endocardial (LA+RA) Ablation



Epicardial ablation

1. was effective for LPV isolation.
2. was beneficial to ablate CFAEs at the anterior, roof, and lateral ridge of the LA.

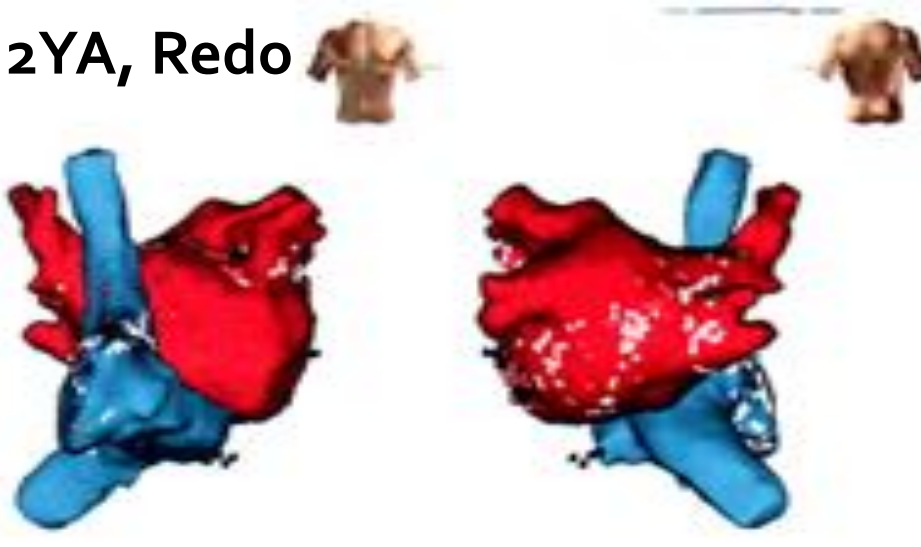


M/59, prior RFCA for PeAF

3YA, 1st ABL

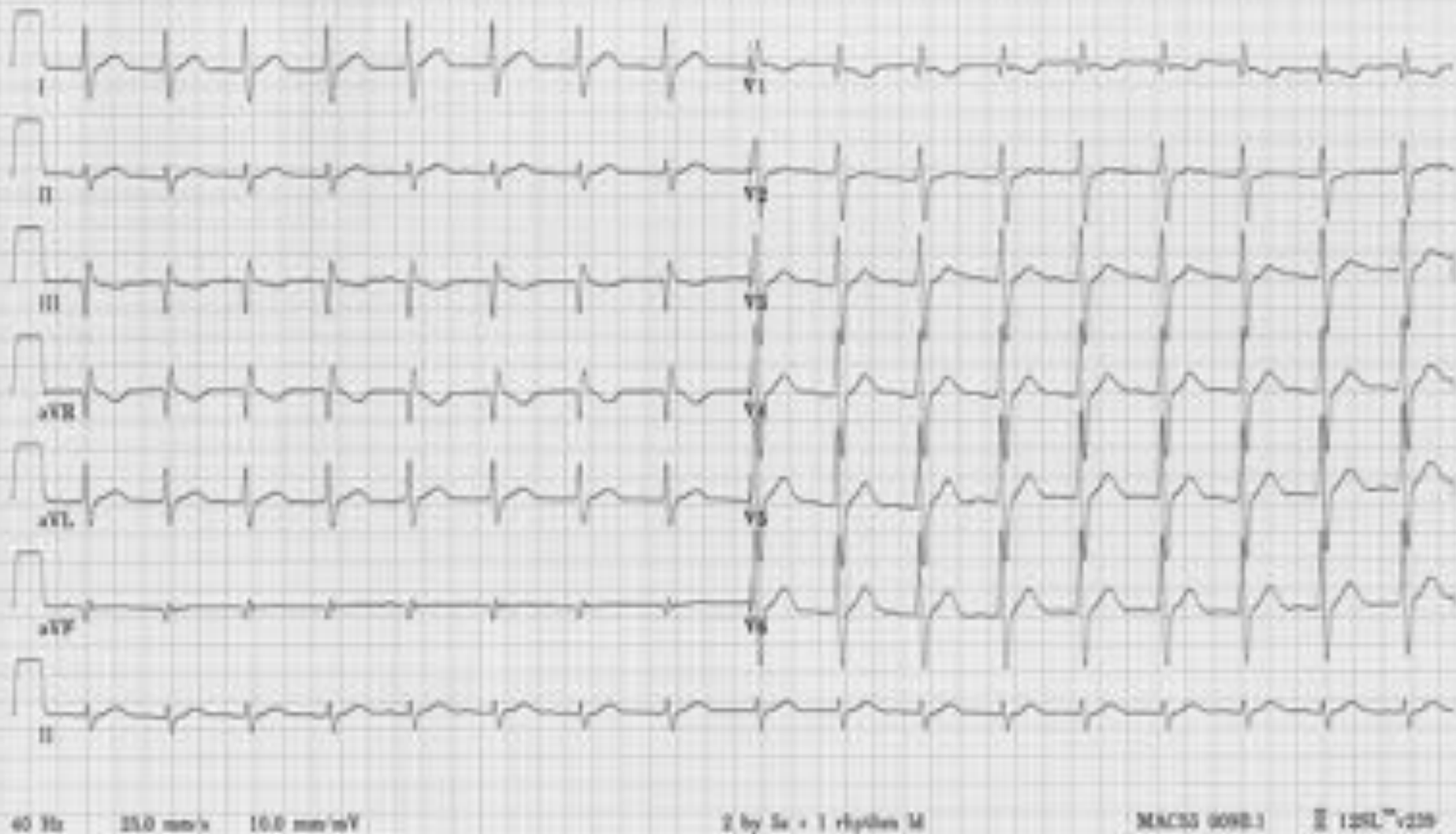
- PV isolation
- CFAE guided biatrial ablation
- Cardioversion terminated AF
- CTI block

2YA, Redo



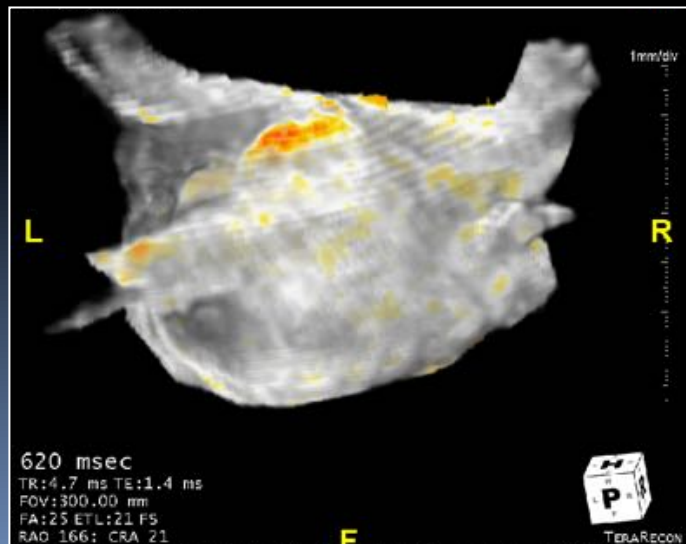
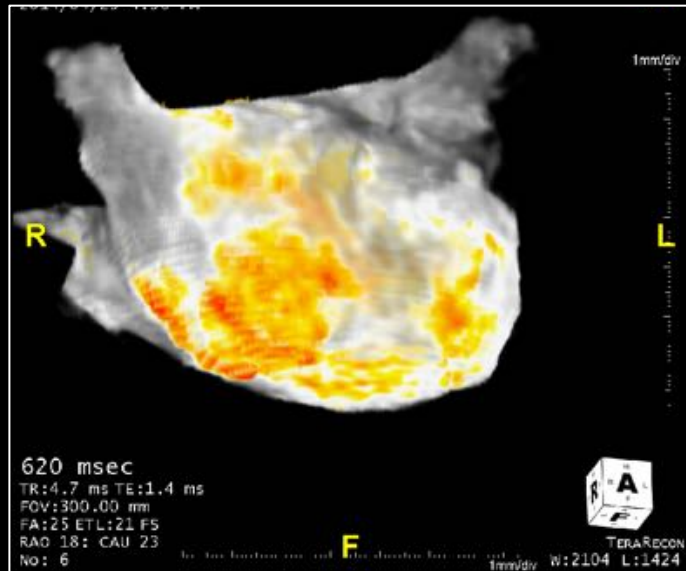
- Recurred AF
- Focal Ablation to reconnected PV
- CFAE guided biatrial ablation
- LA posterior wall: AF → AT
- LA anterior wall: CL prolongation
- RAA: AT → SR

Recurred AT, 6 Months post-2nd ABL

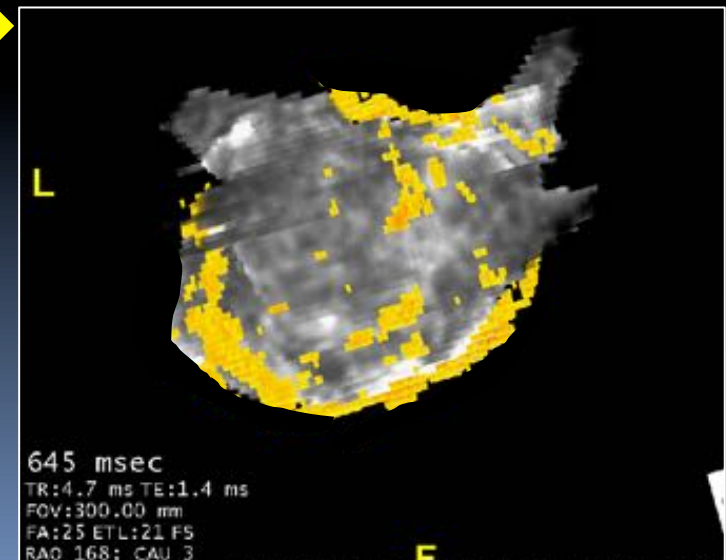
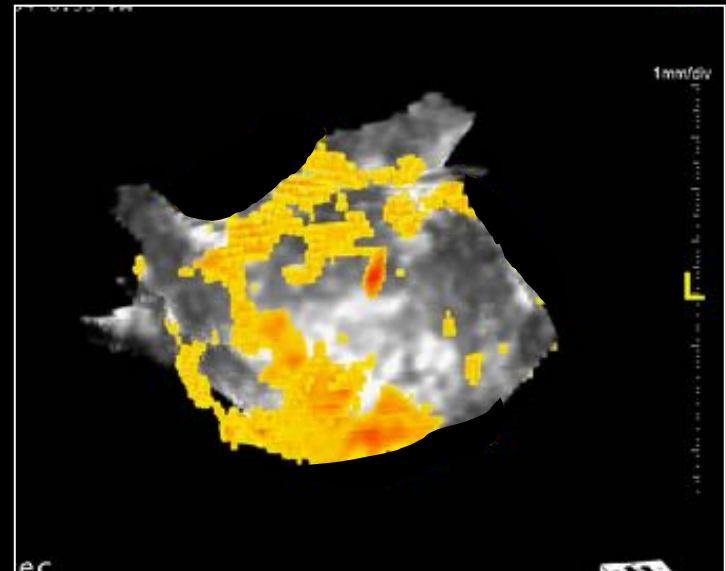


Delayed Enhancement in CMR

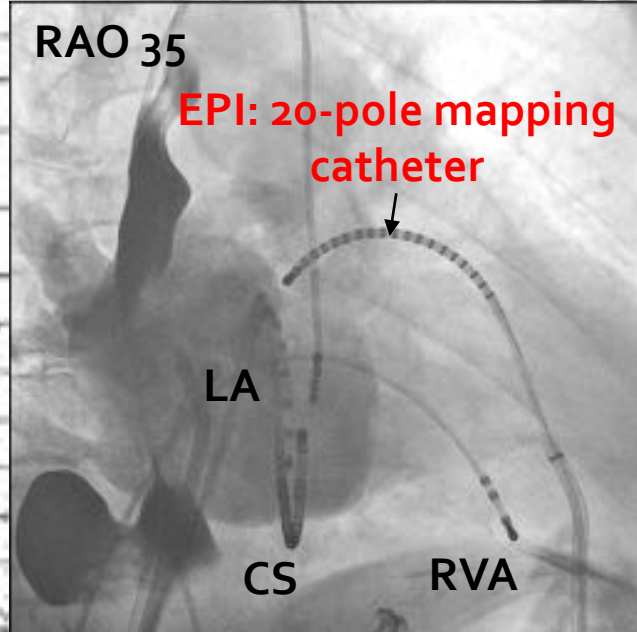
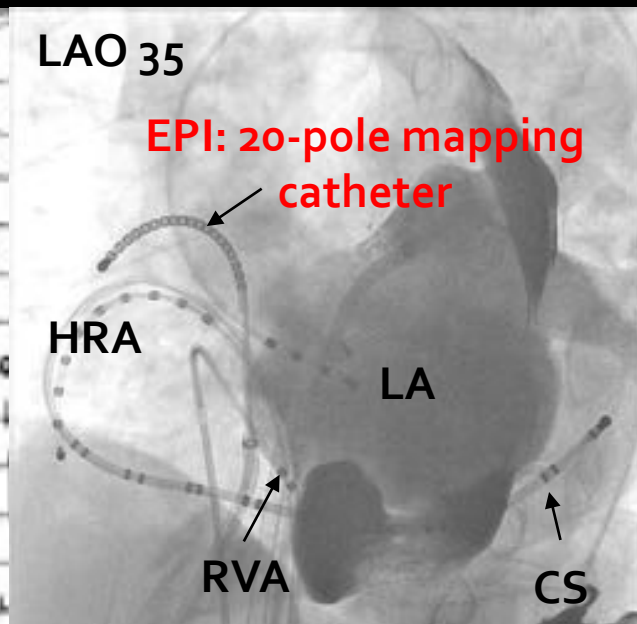
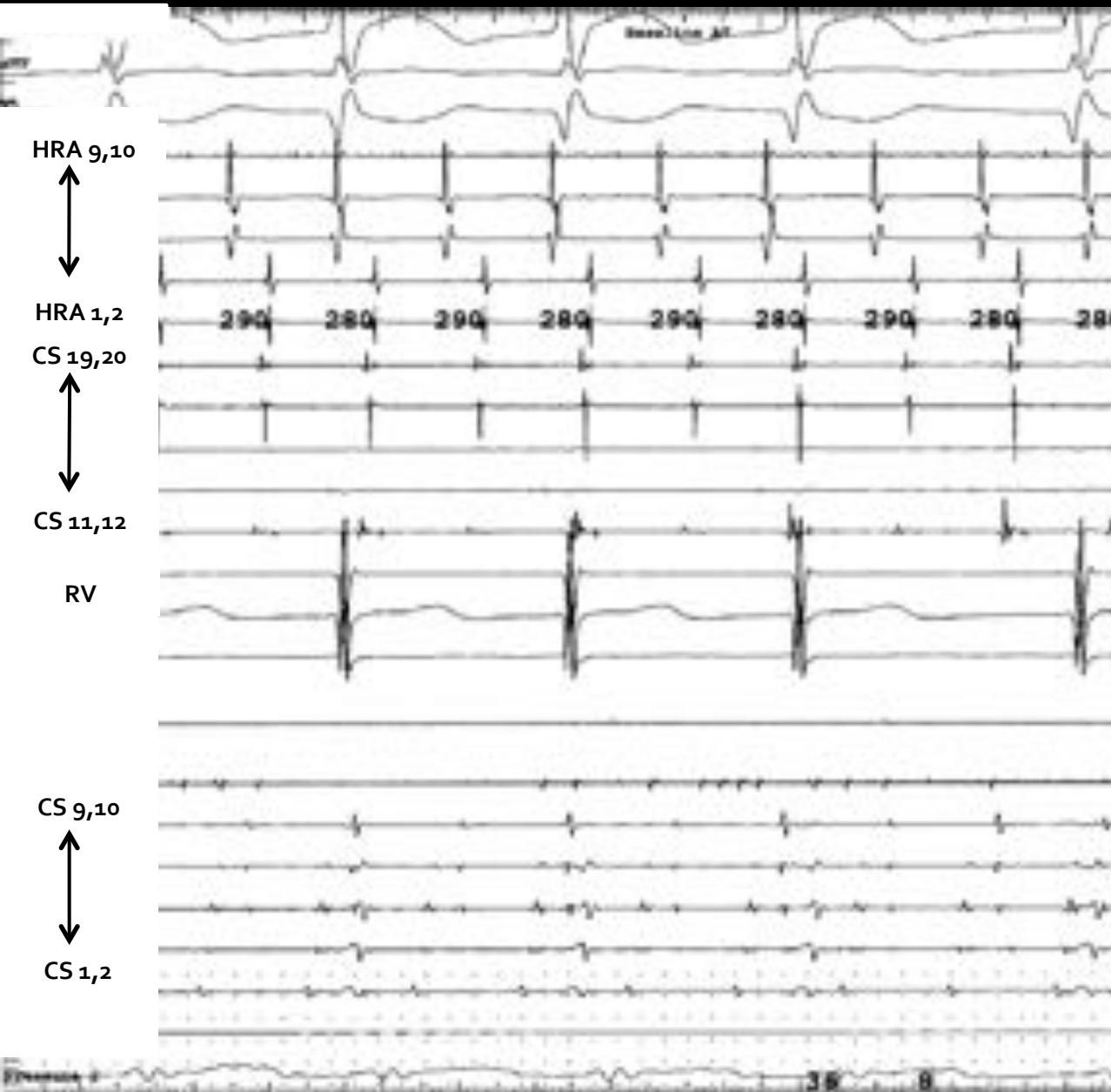
Pre-redo



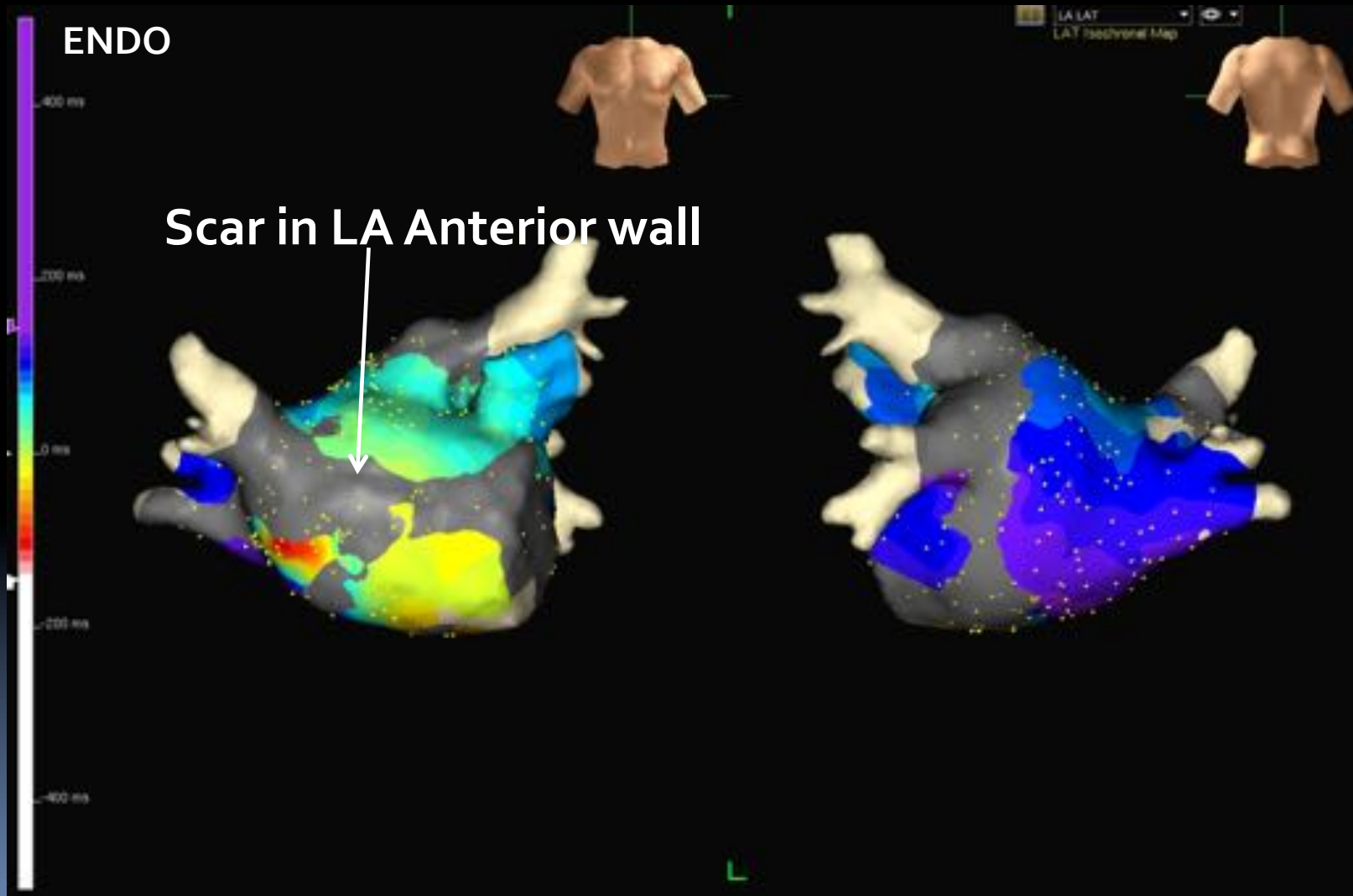
Pre-trido



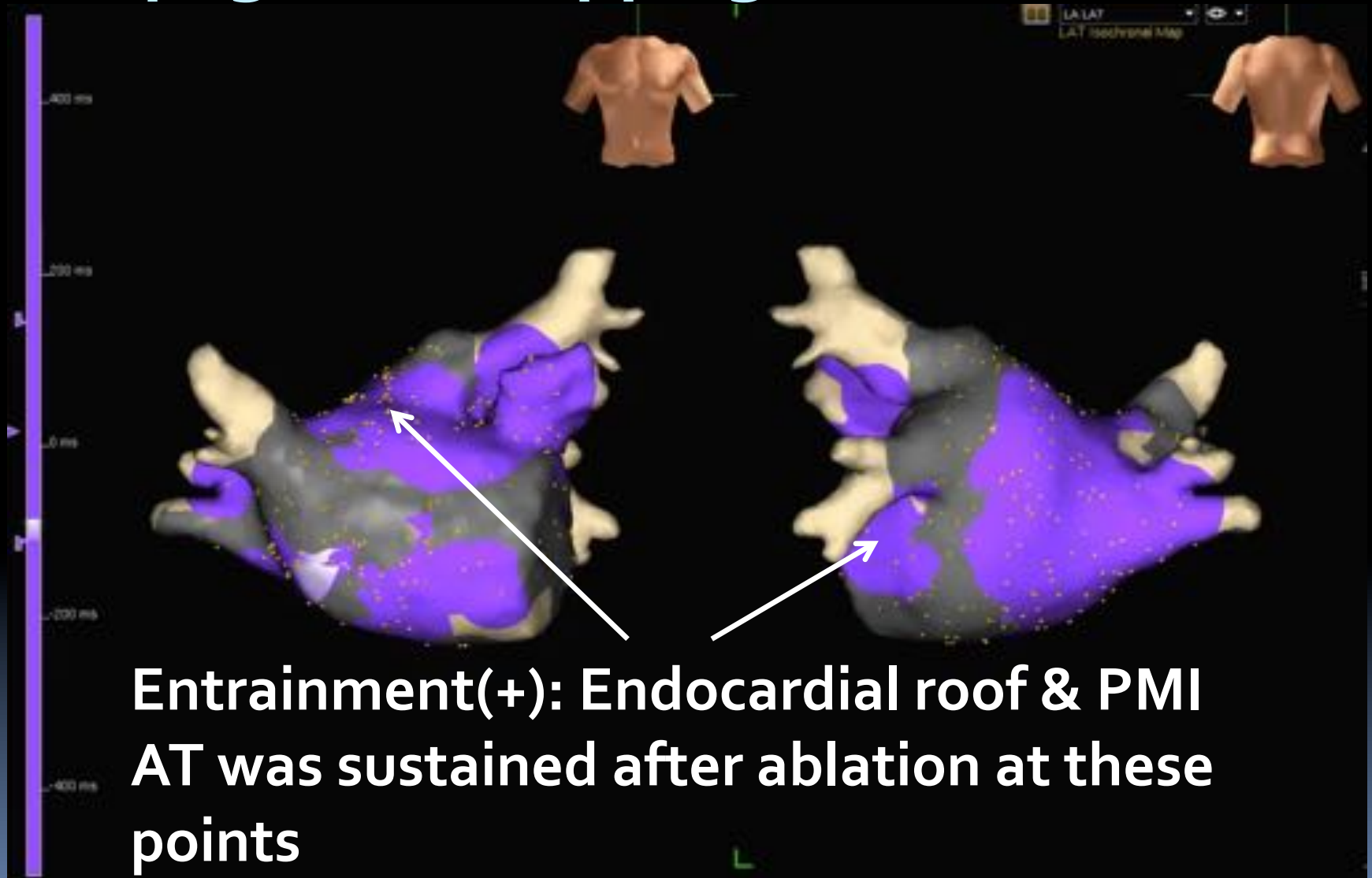
Baseline AT (CL 320ms)



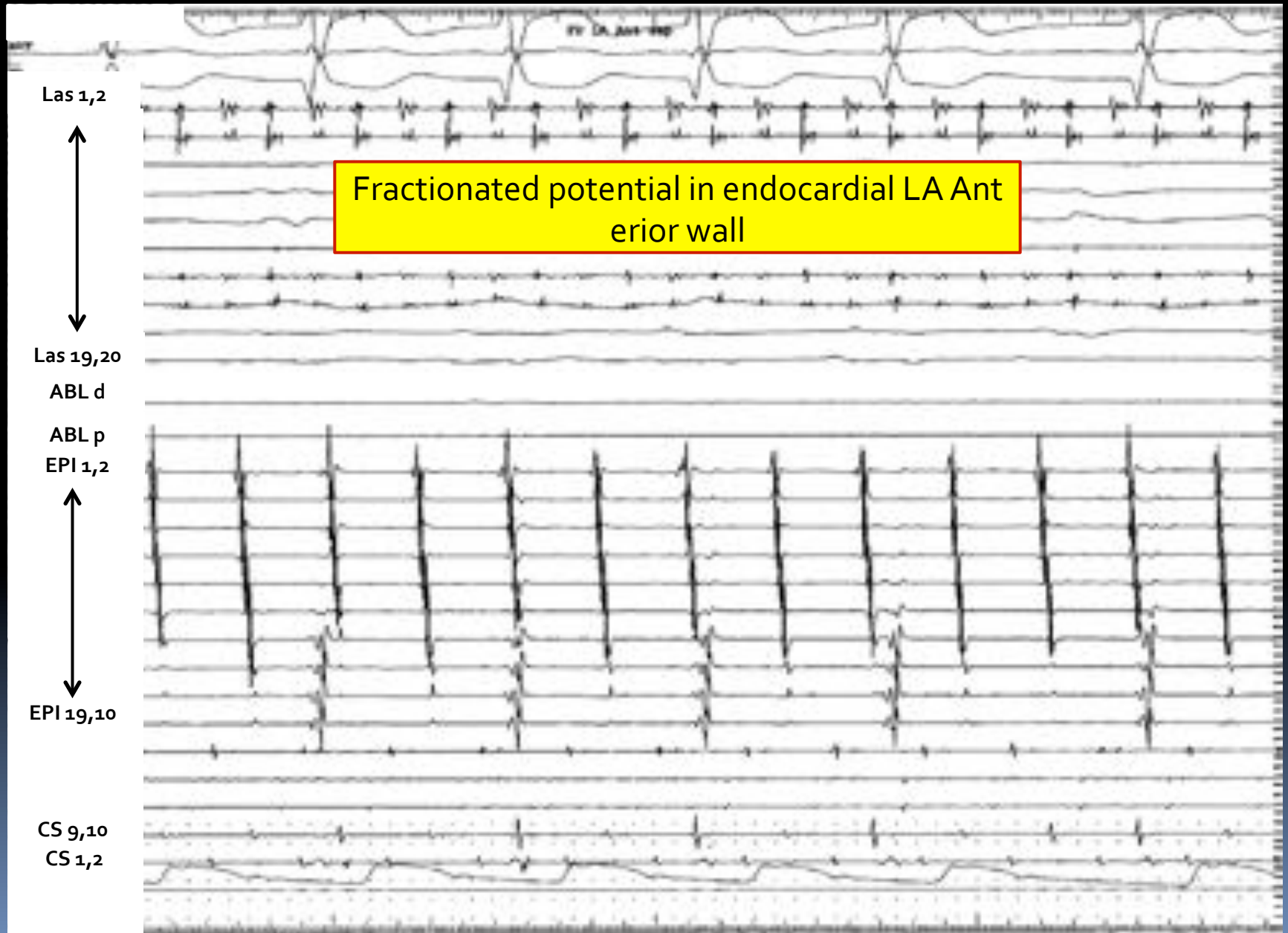
Activation Mapping



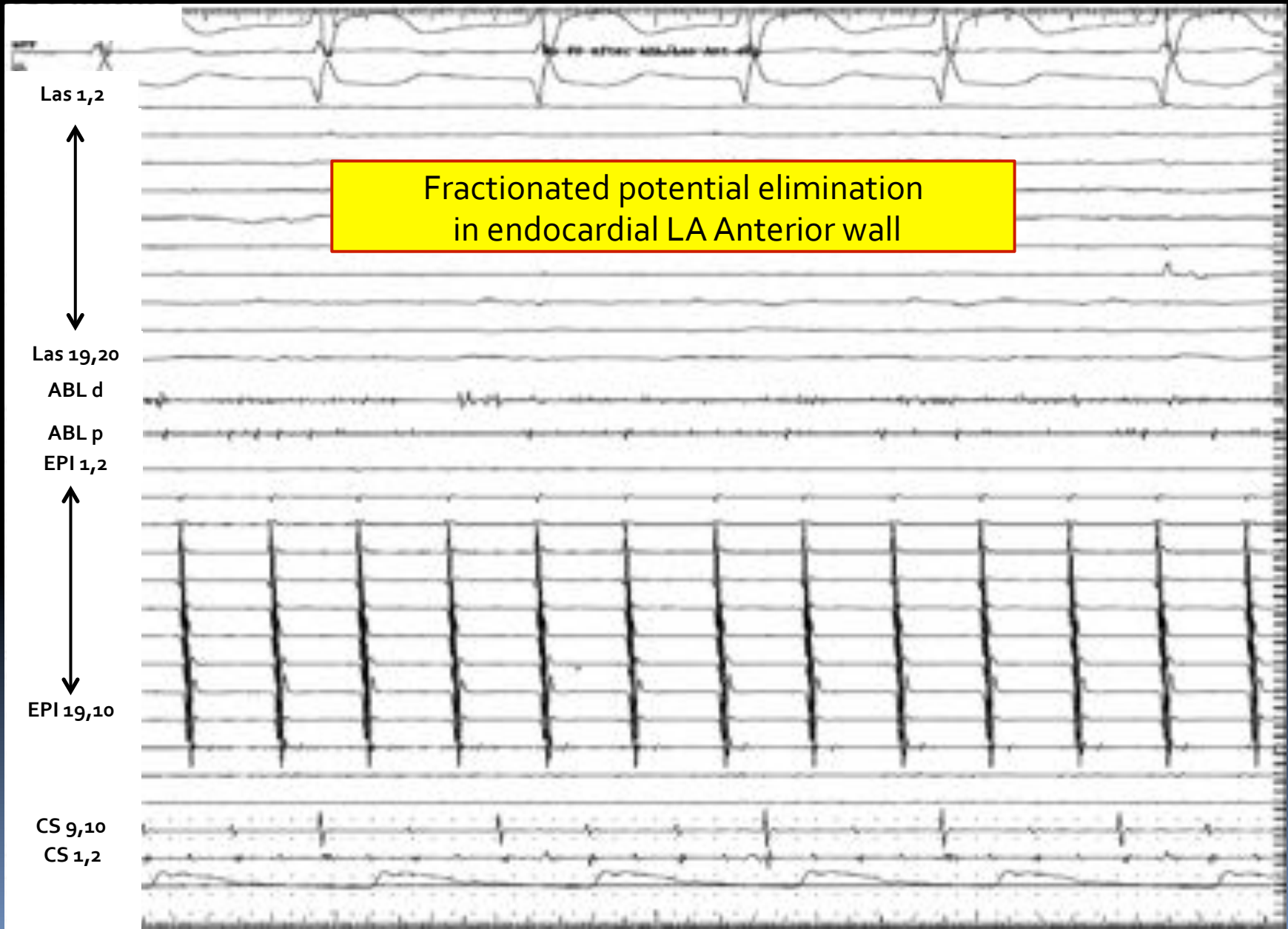
Propagation Mapping



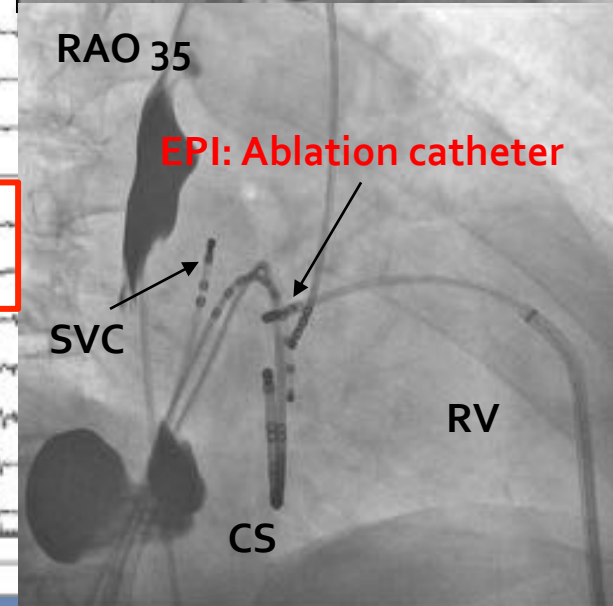
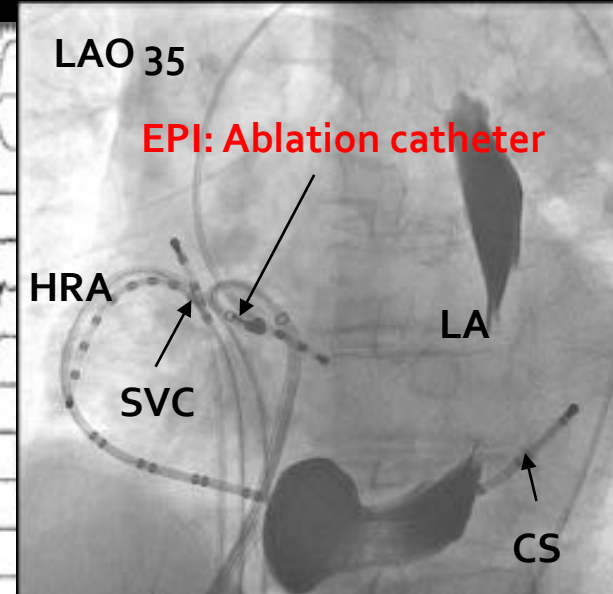
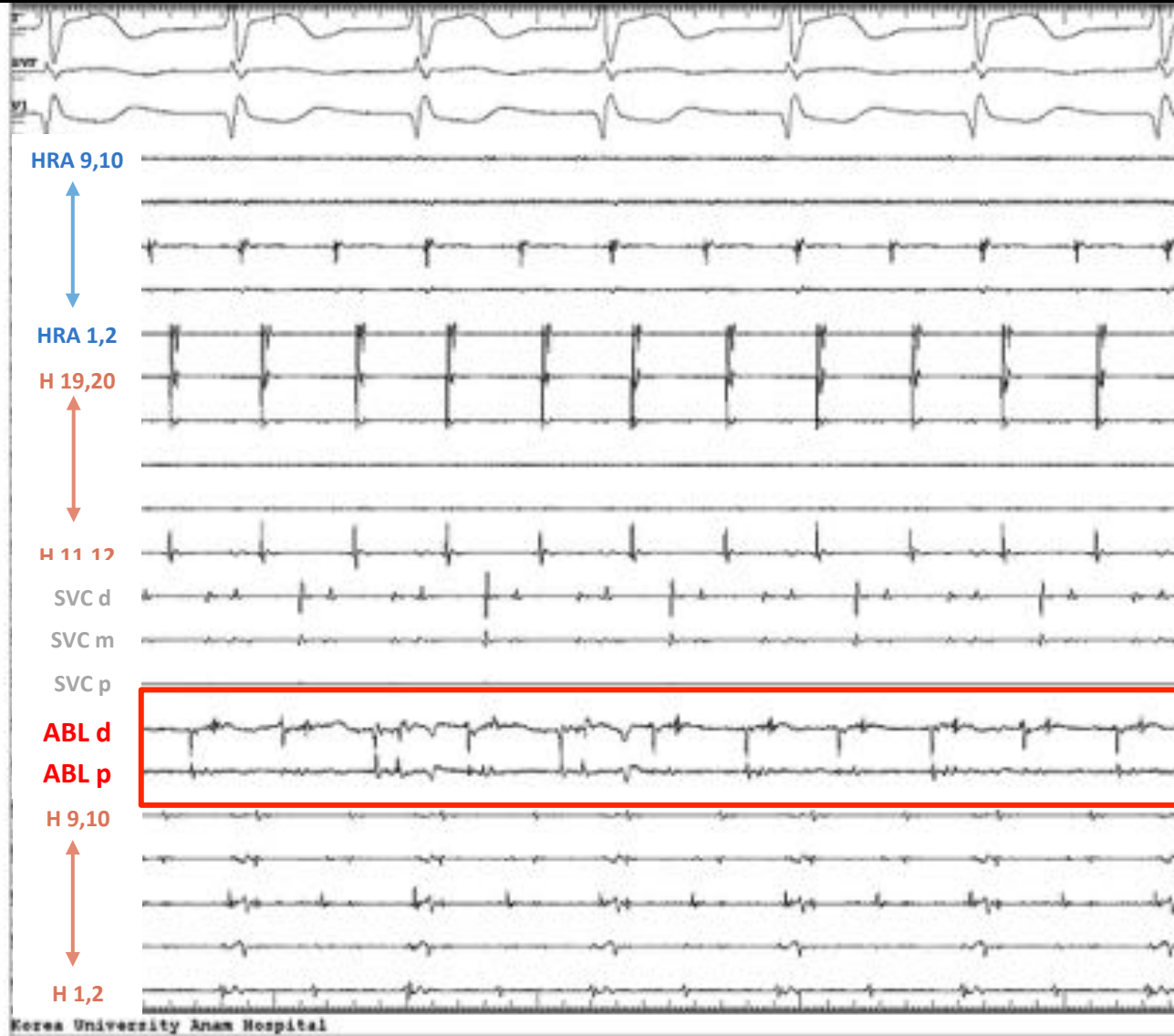
Potential in LA Anteroseptum



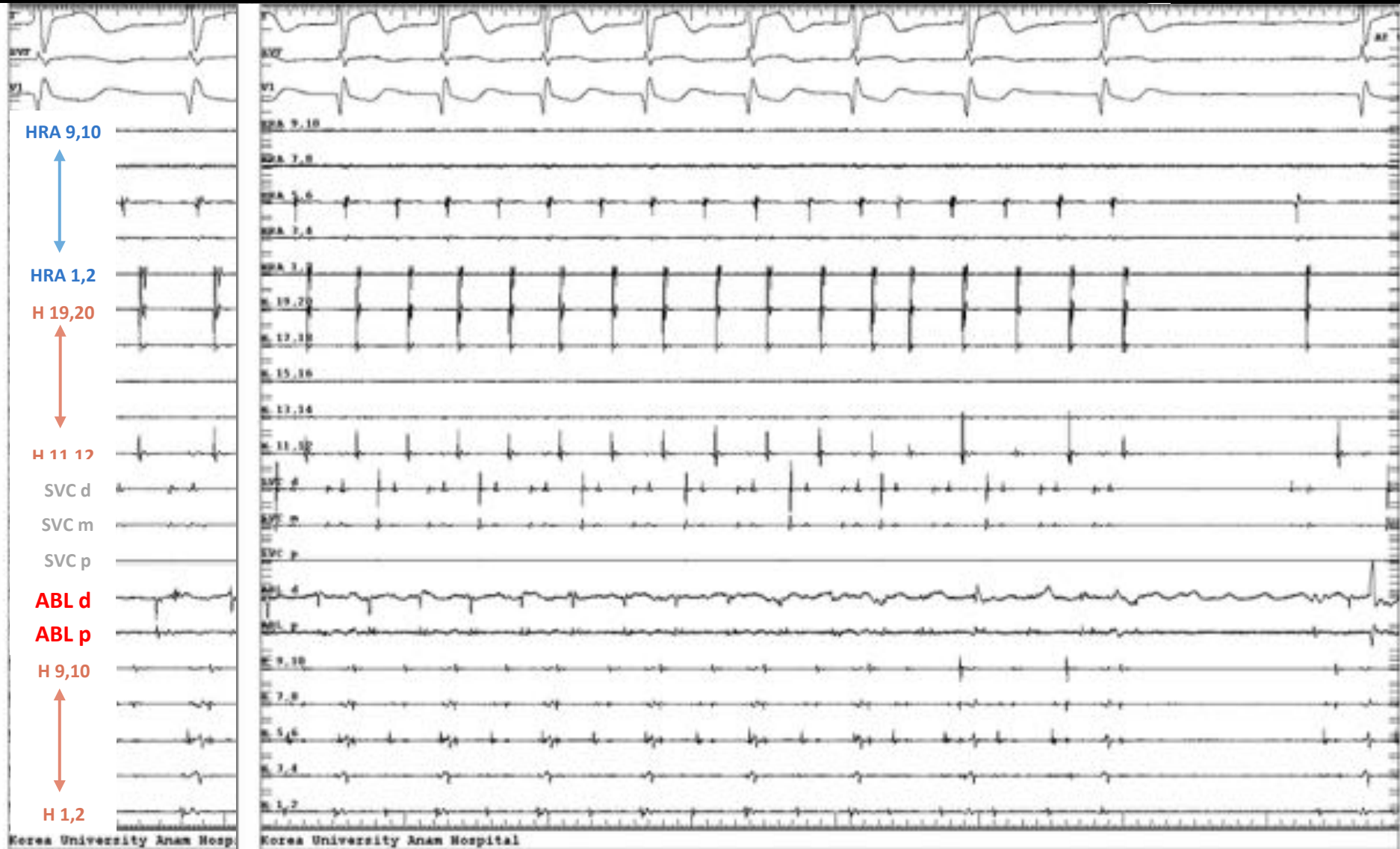
AT was sustained



Epicardial Ablation



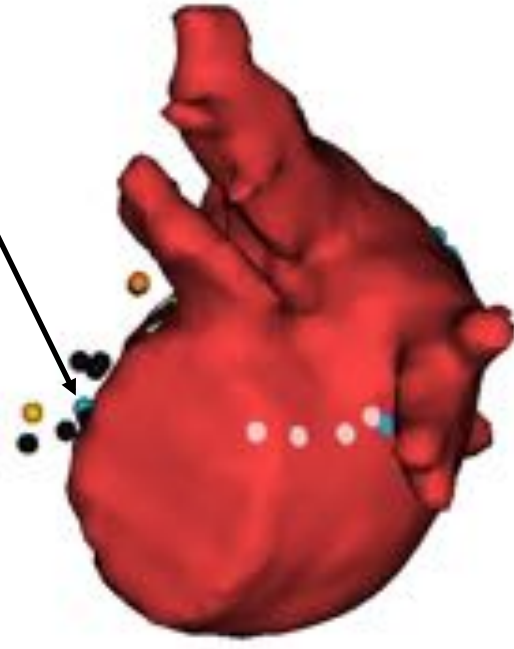
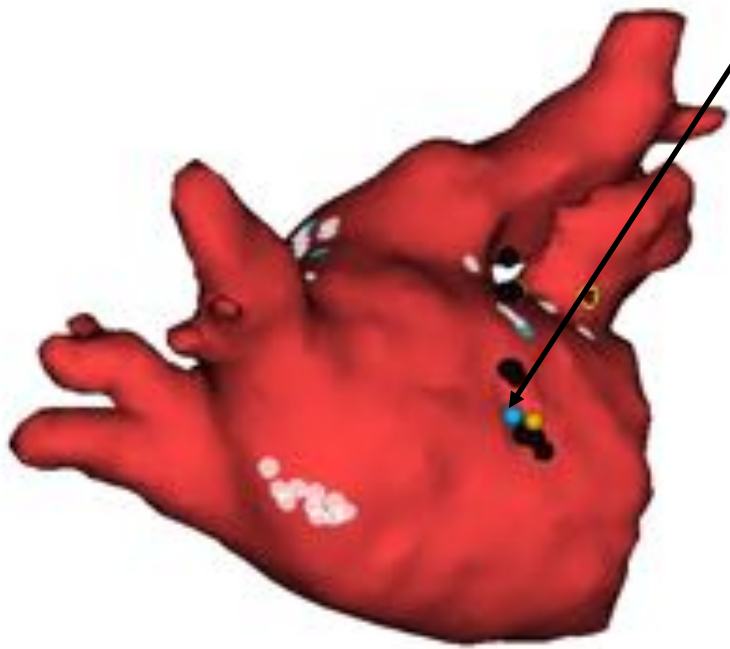
Epicardial Ablation terminated AT



Successful Ablation Site



Termination site



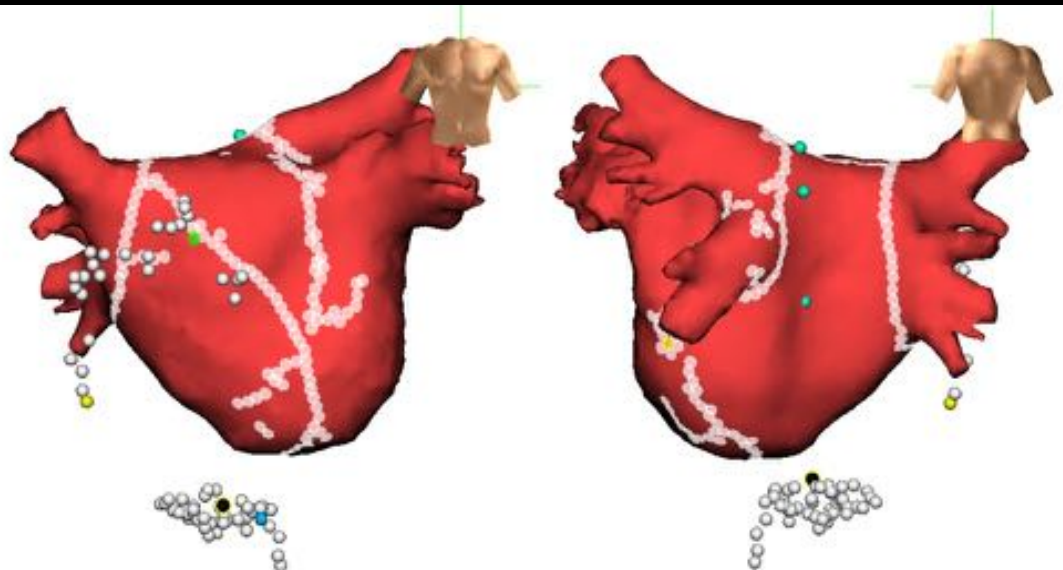
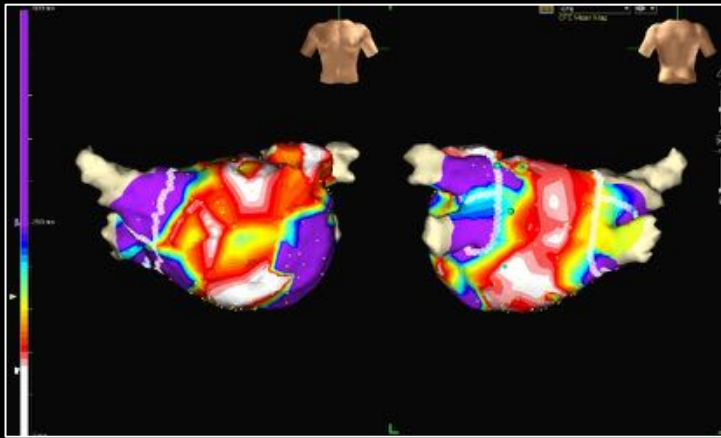
Epicardial ablation

1. was effective for LPV isolation.
2. was beneficial to ablate CFAEs at the anterior, roof, and lateral ridge of the LA.
3. was effective for elimination of roof-AT refractory to endocardial ablation.



M/49, AF was diagnosed since 2005. CHA₂DS₂-VASc: 0

LA diameter: 39.9mm



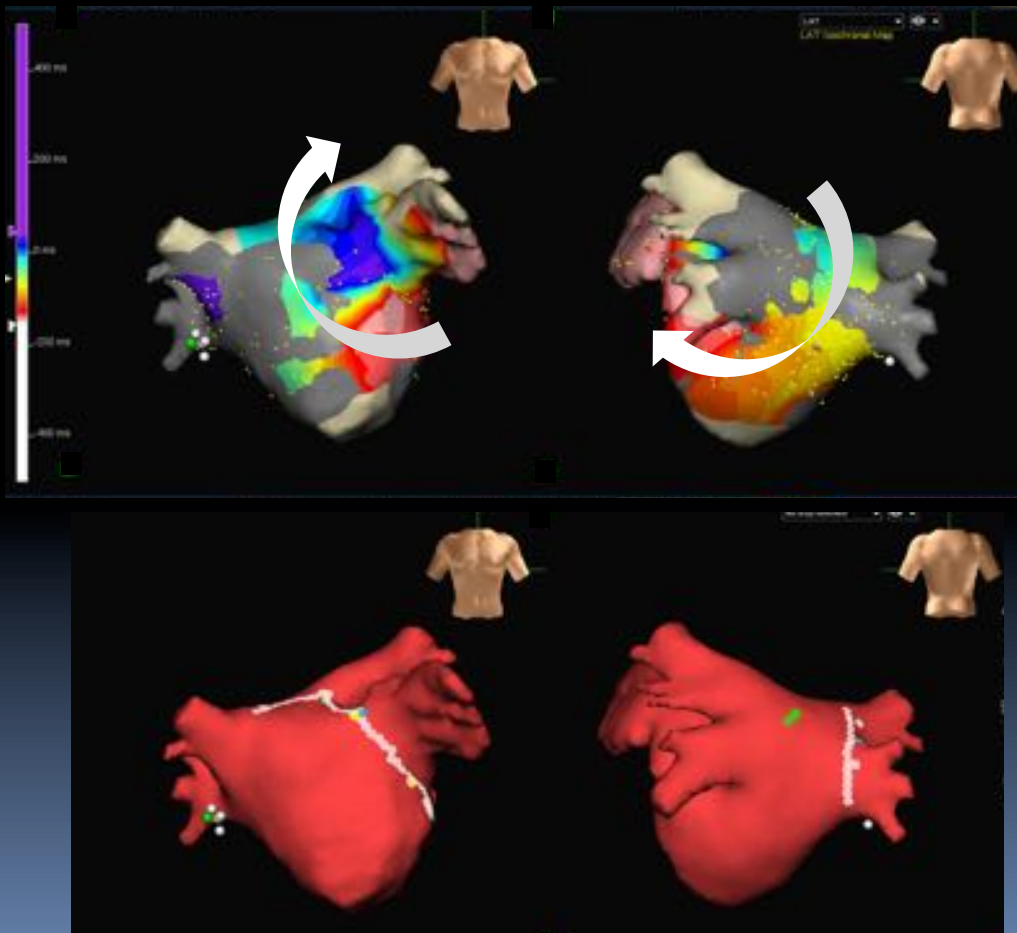
Index Procedure

- AF was changed into AT during anterior line Ablation.
- Entrainment maneuver demonstrated perimitral flutter.
- PMF was terminated by MII line ablation.
- Induced AT was terminated by CT line.

AT recurred 4 months after index ablation.

AT was refractory to antiarrhythmic drug and external CV.

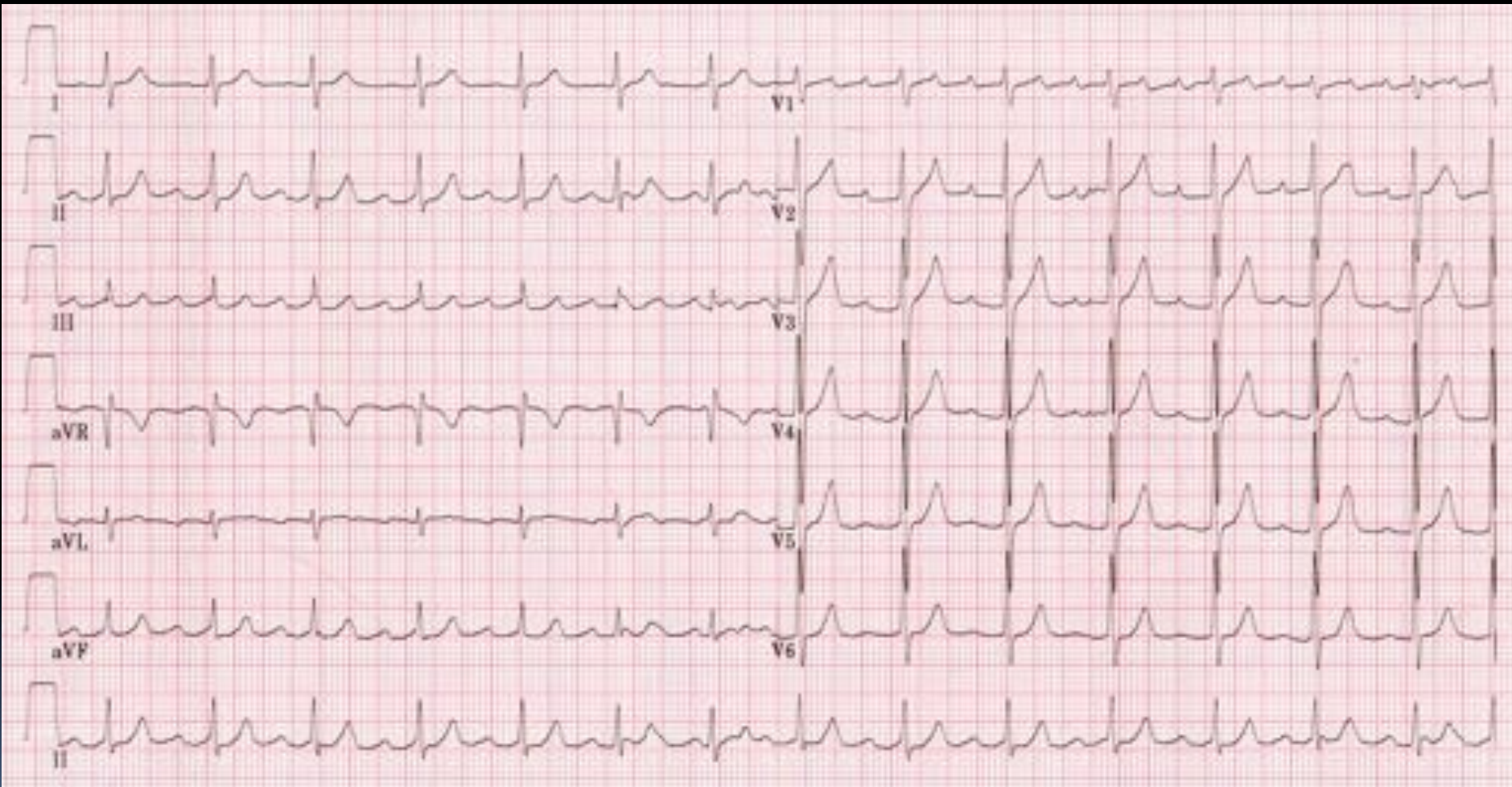
2nd Ablation



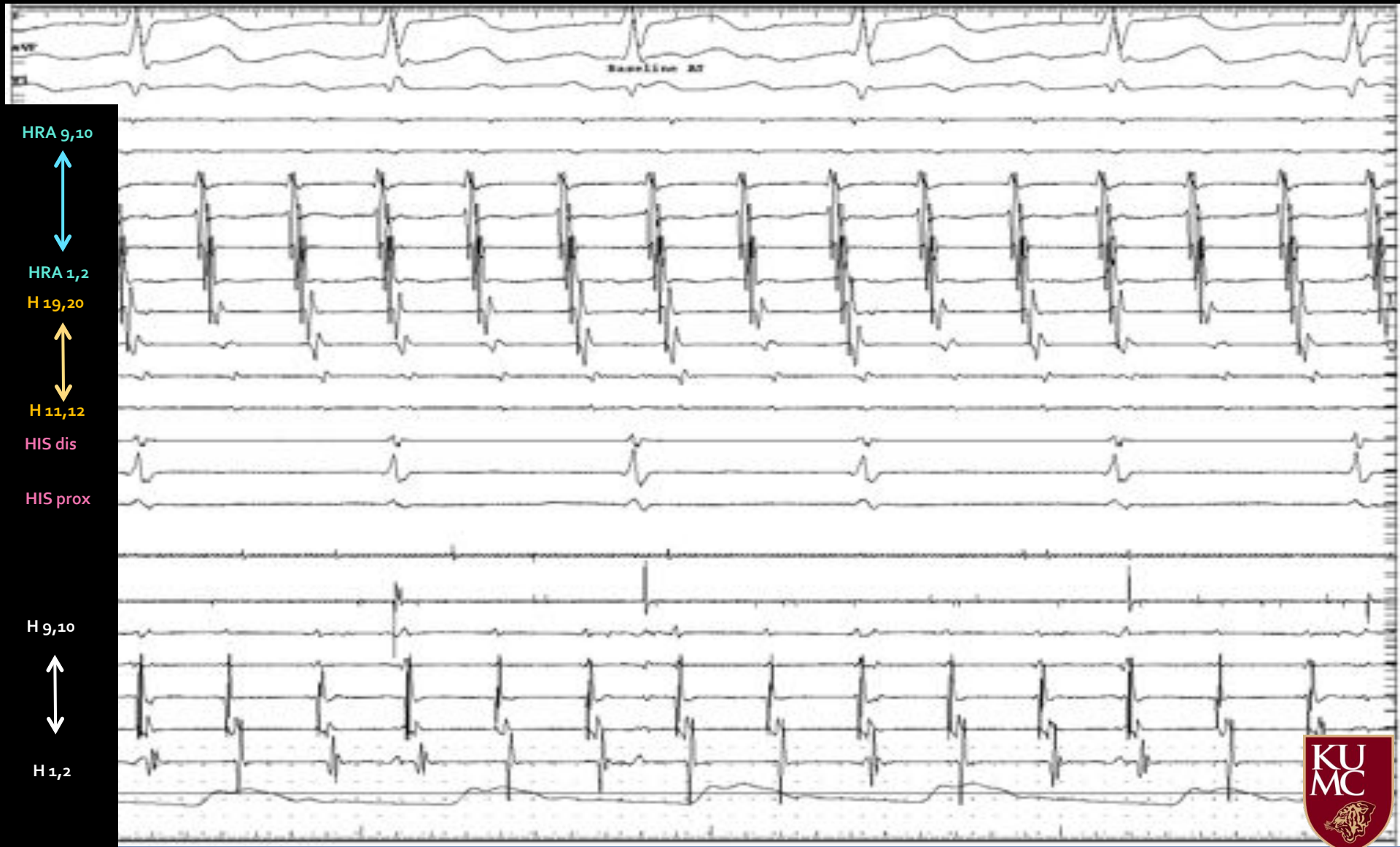
Repeat Procedure

- AT cycle length was 220ms.
- Concealed entrainment was documented at LAA neck.
- Propagation mapping revealed PMF.
- Ablation at LAA neck terminated PMF.
- Induced AT was terminated at LAA base.

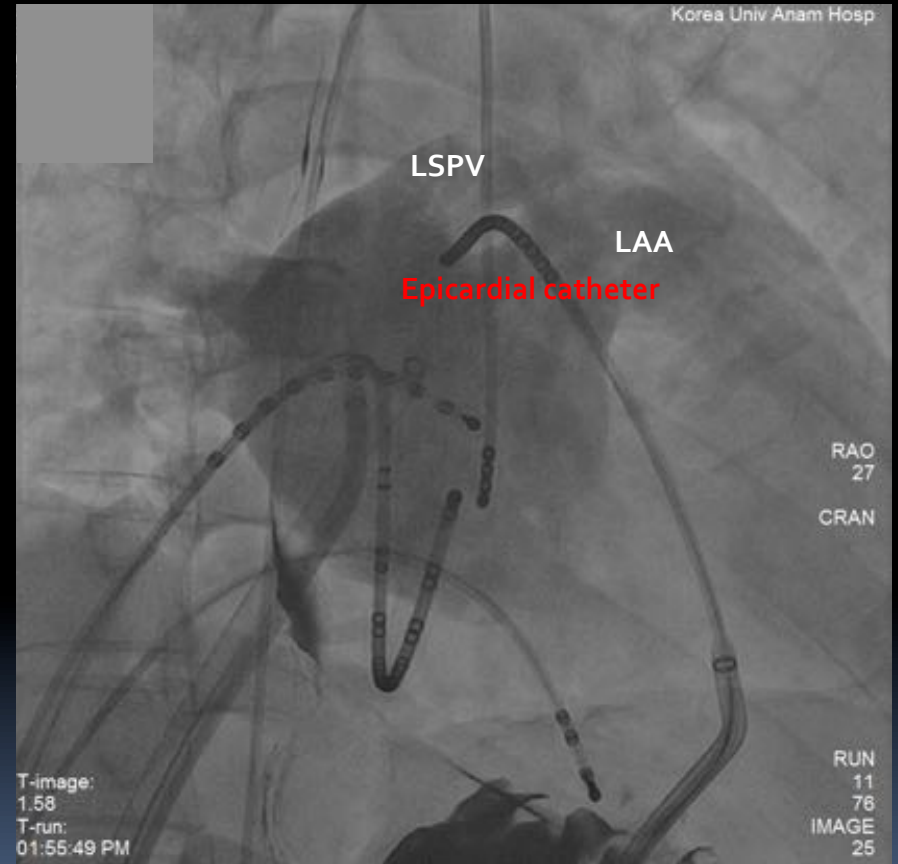
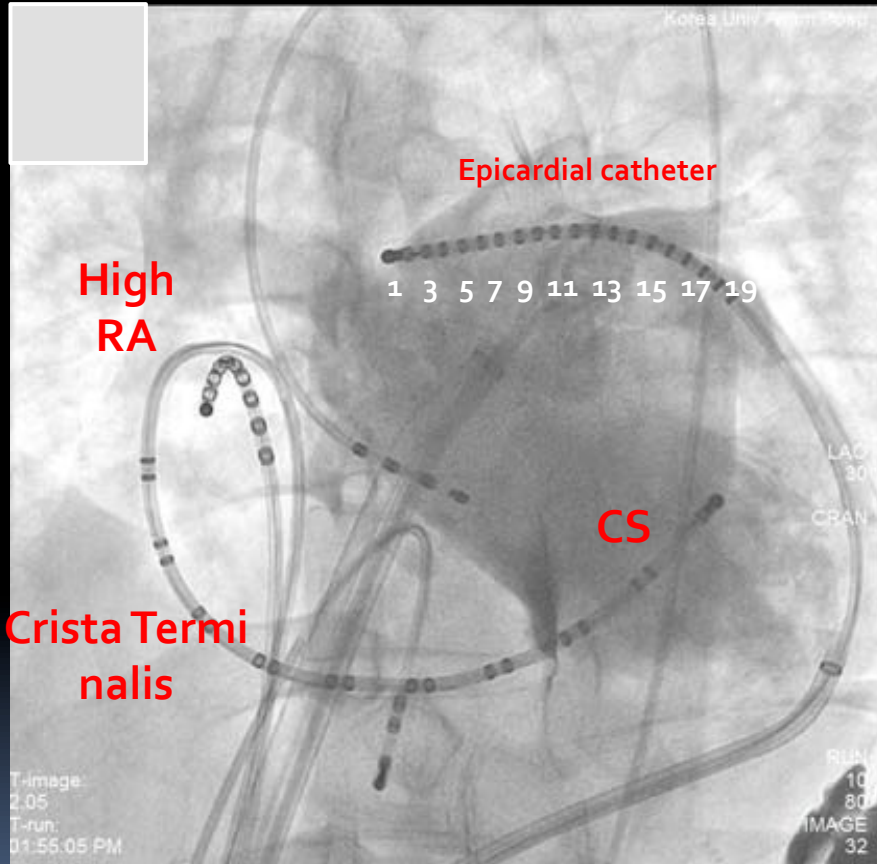
Recurred AT, 6 months after 2nd ABL



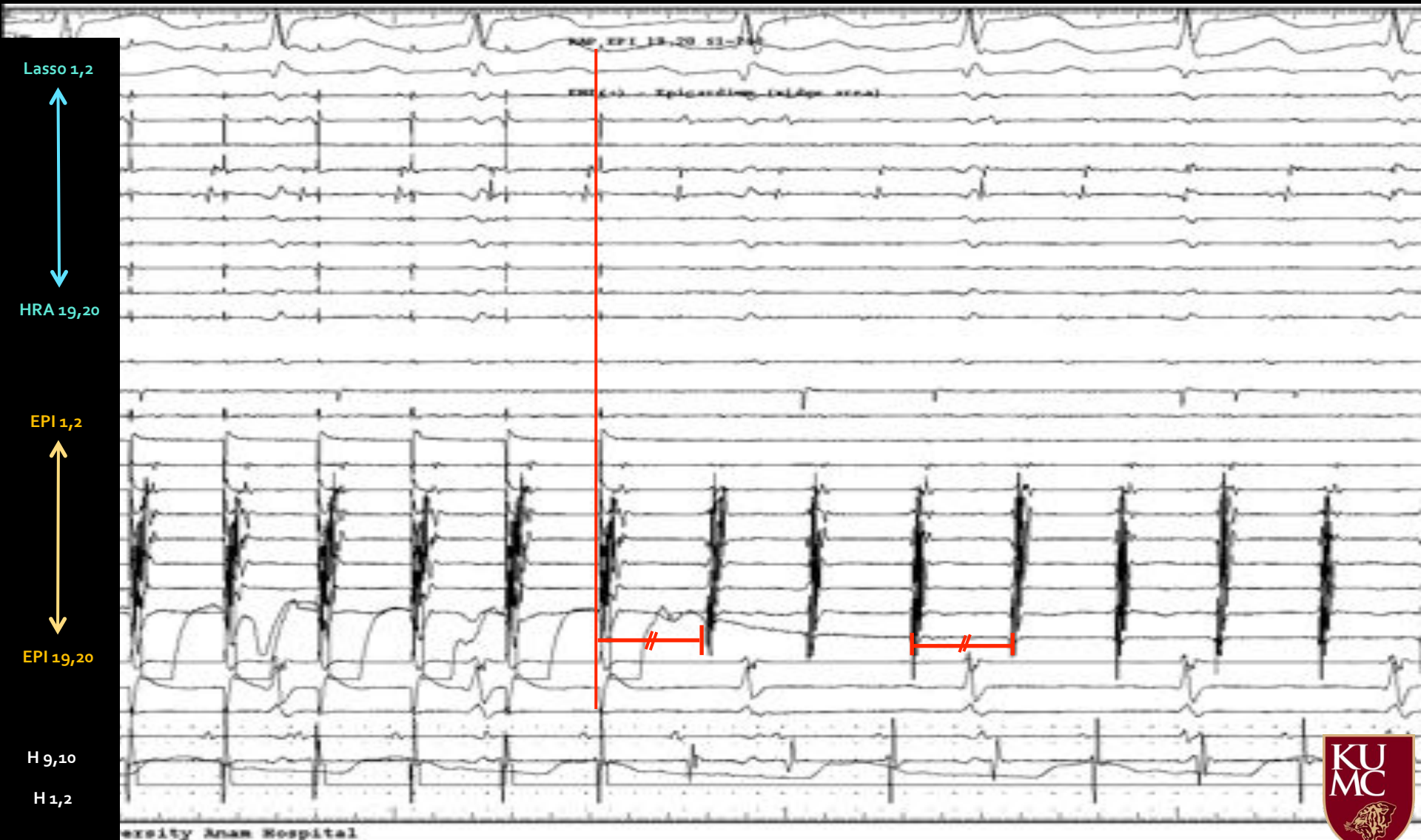
Baseline AT (CL = 230ms)



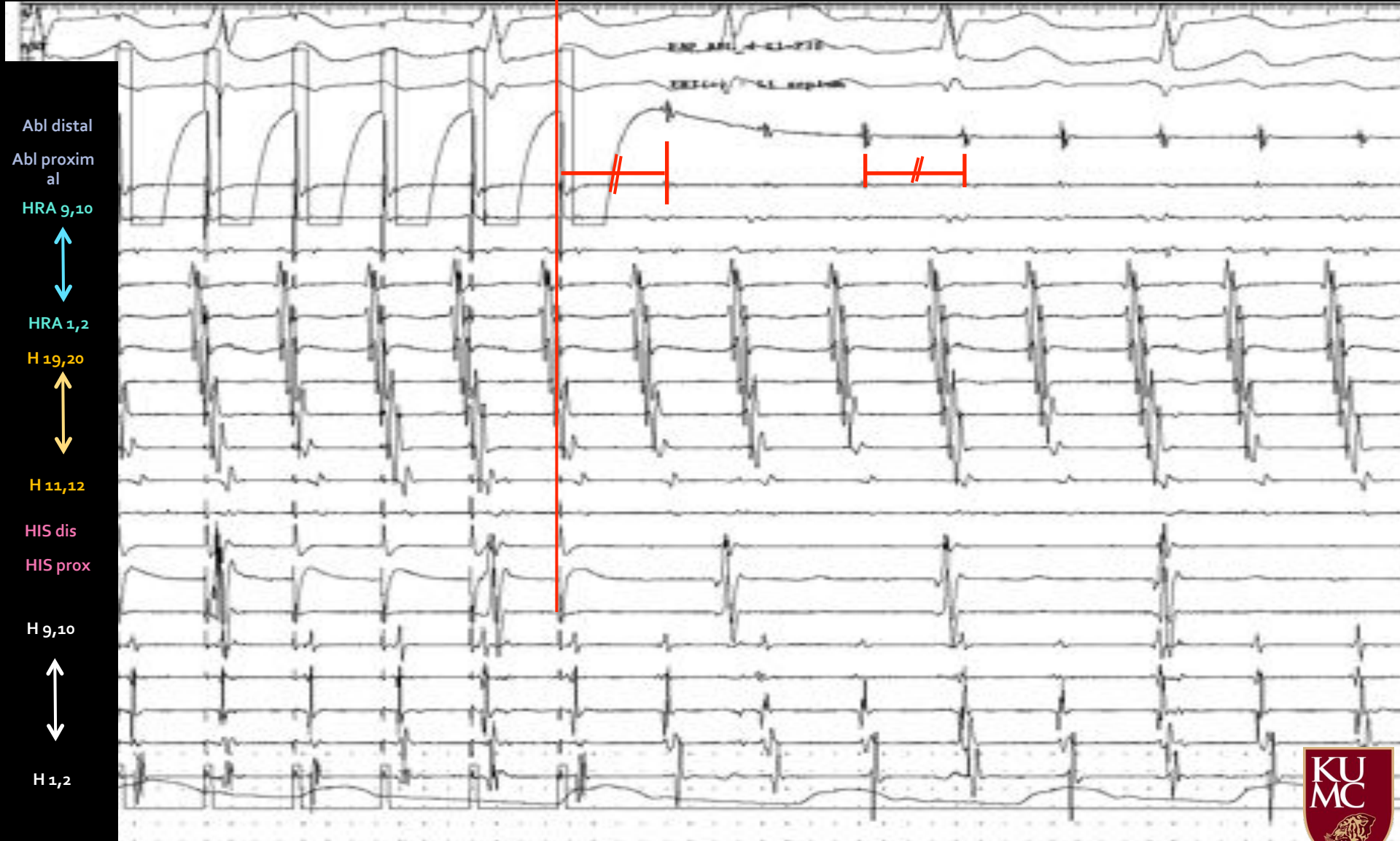
Catheter Position



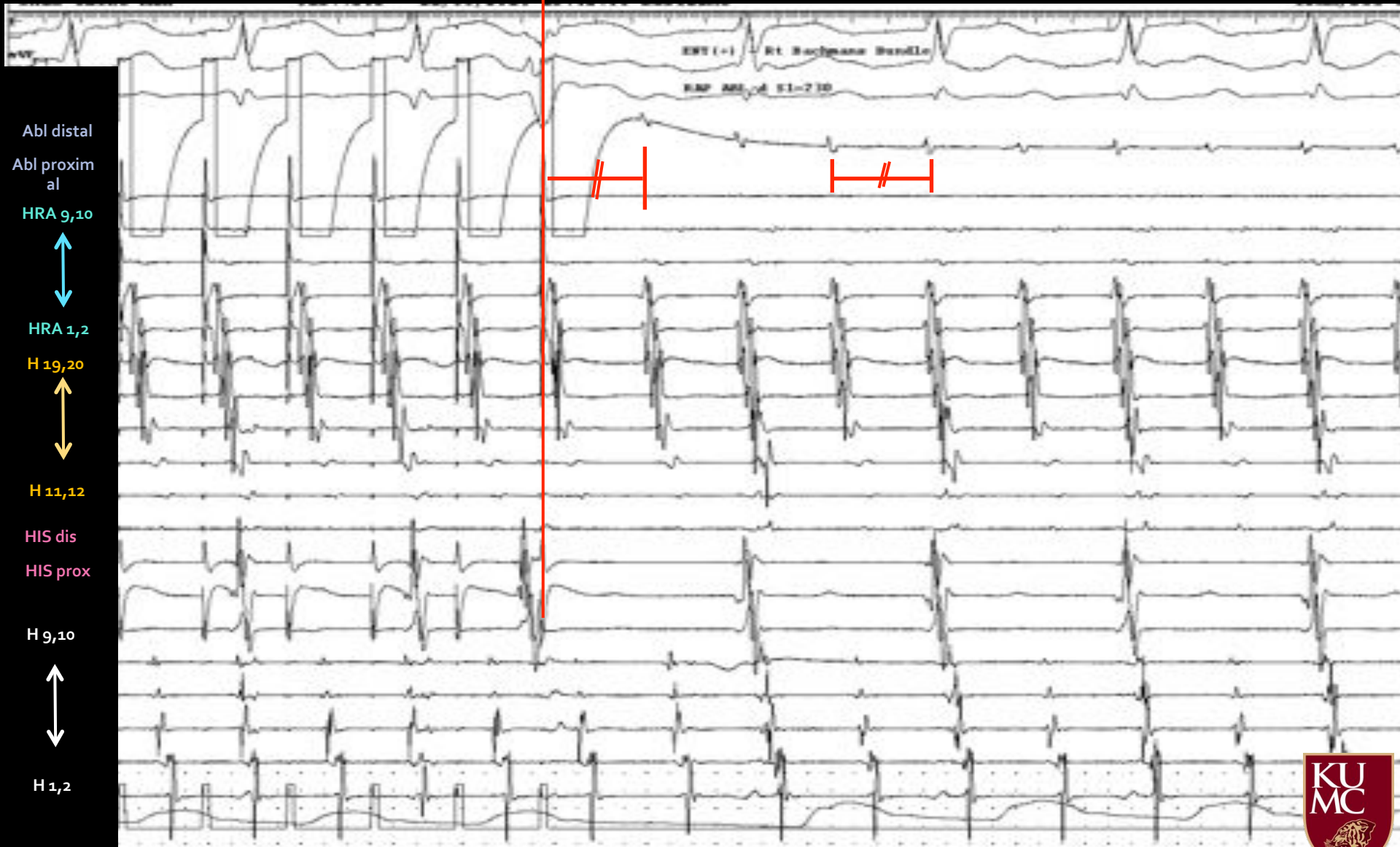
Concealed entrainment at LA lateral ridge



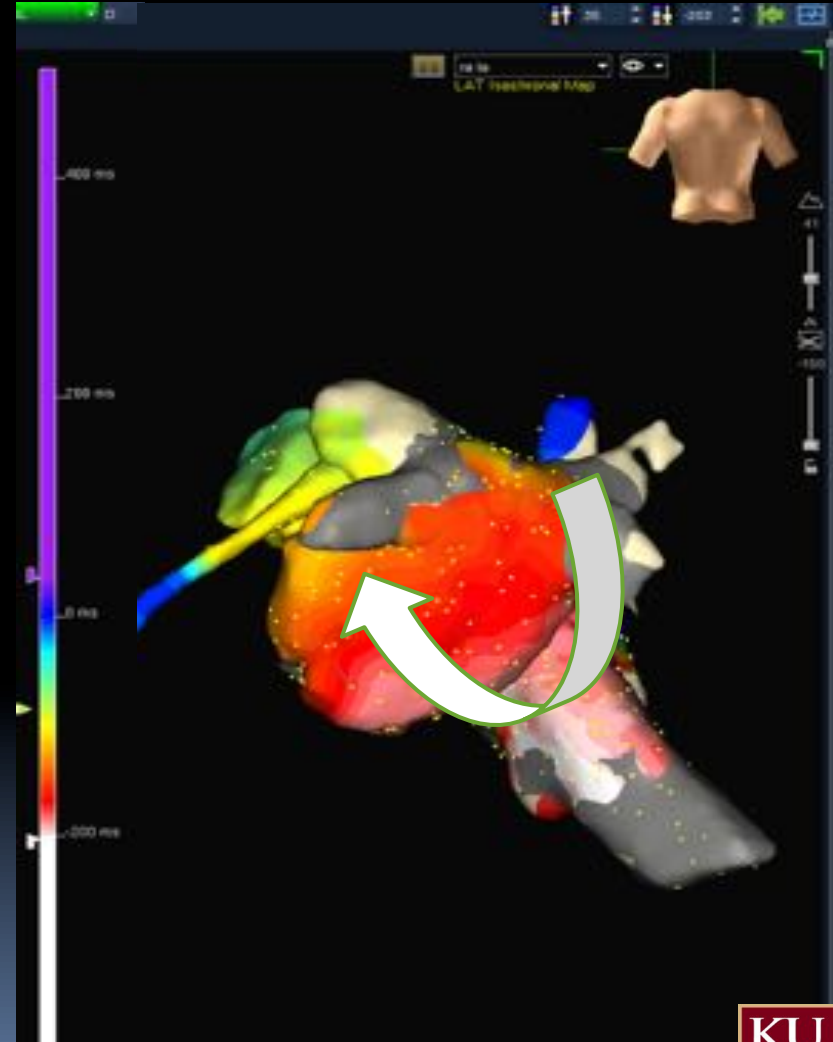
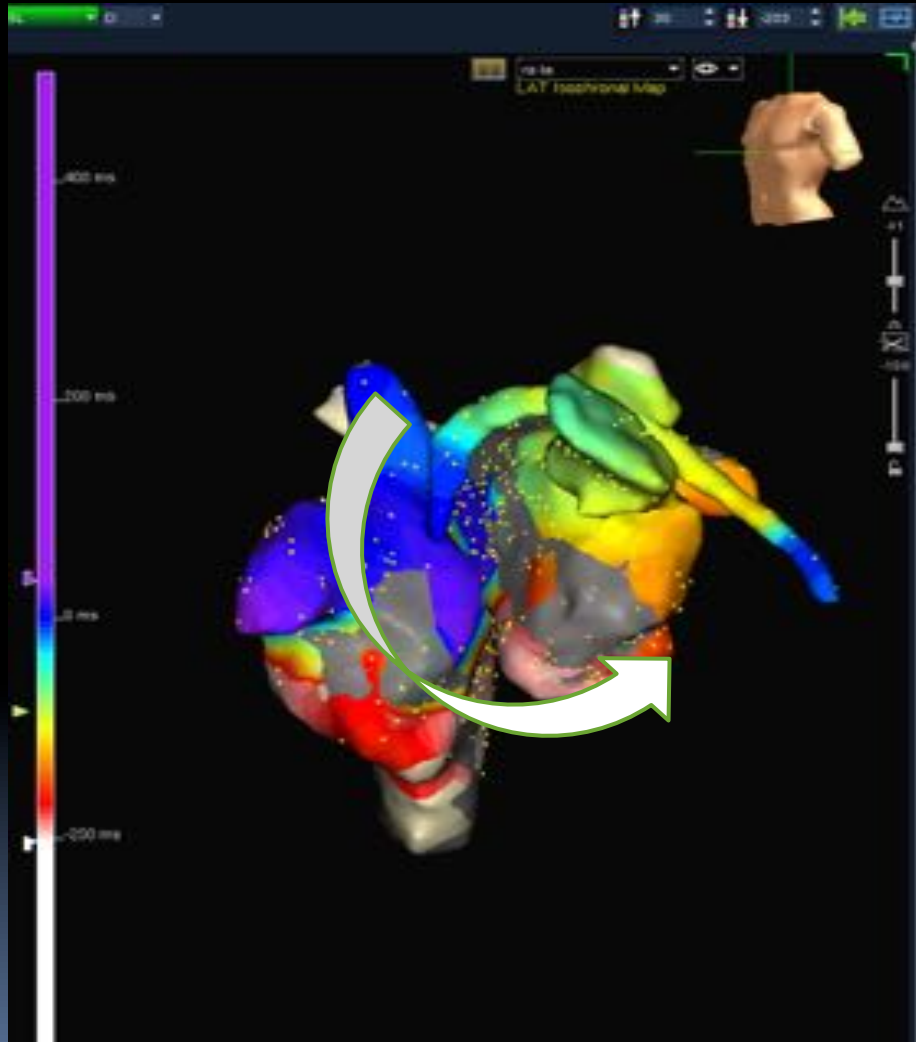
Concealed entrainment with left upper septum



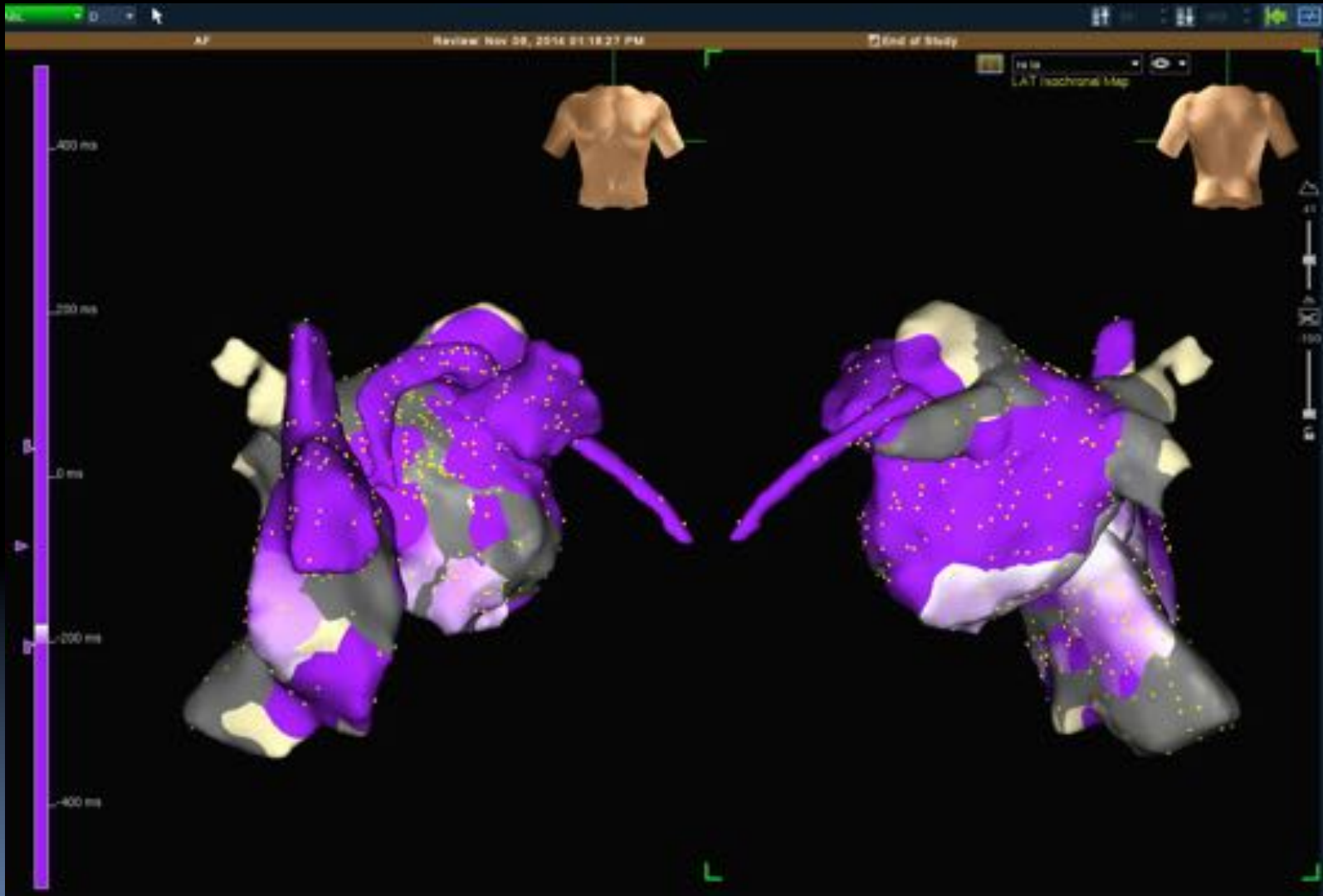
Concealed entrainment with right upper septum



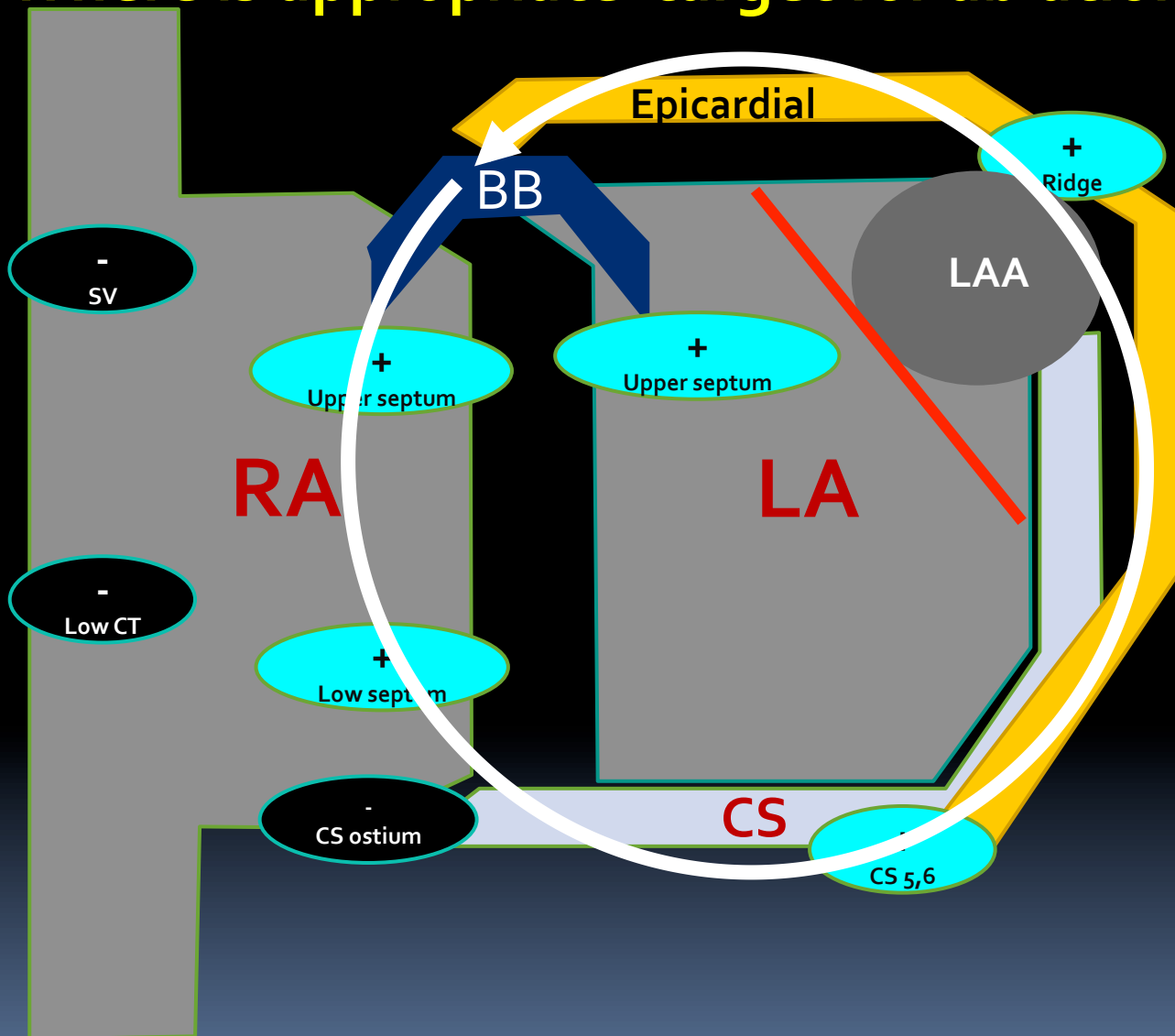
Activation mapping in both atria



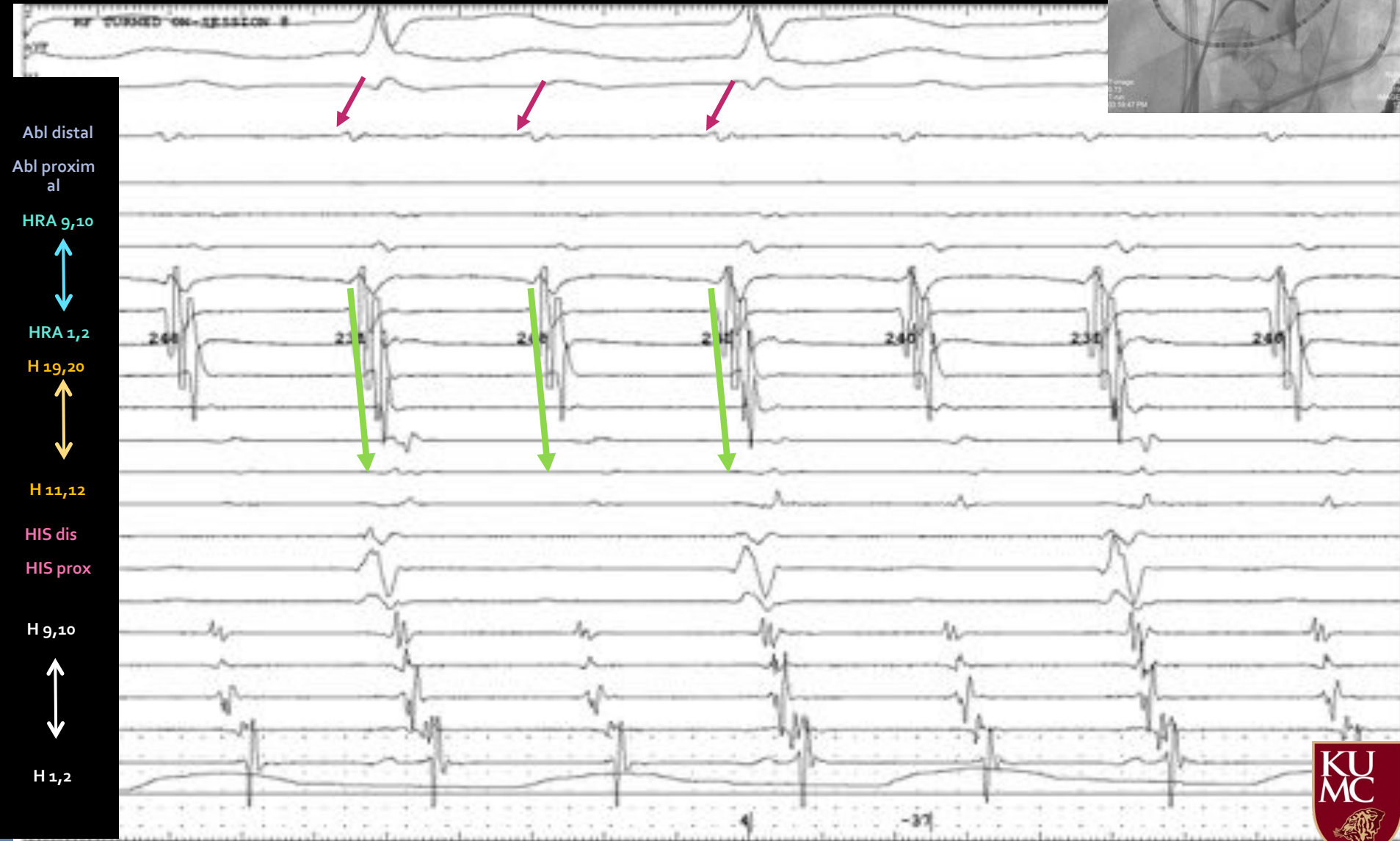
Propagation map in both atria



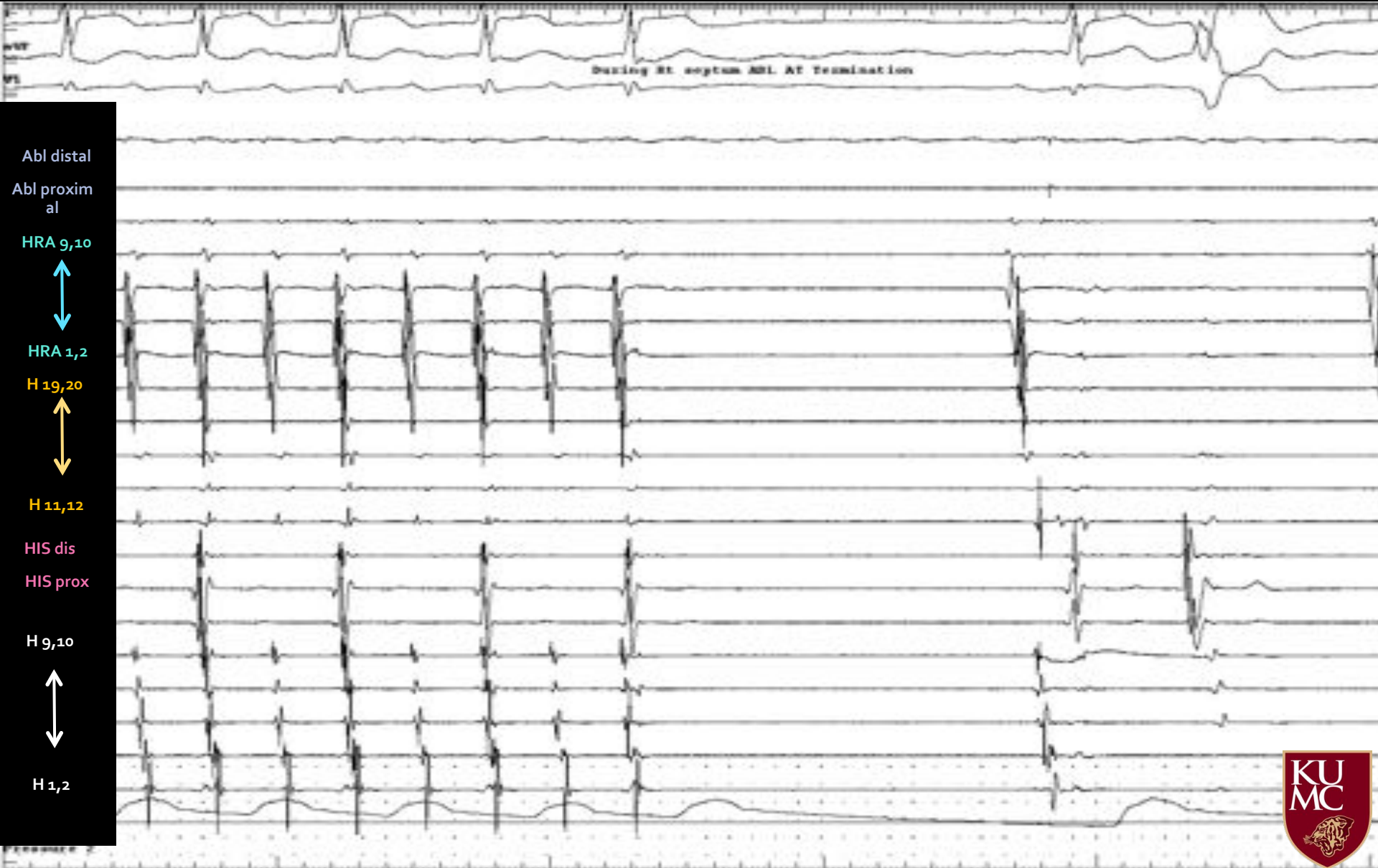
Where is appropriate target for ablation?



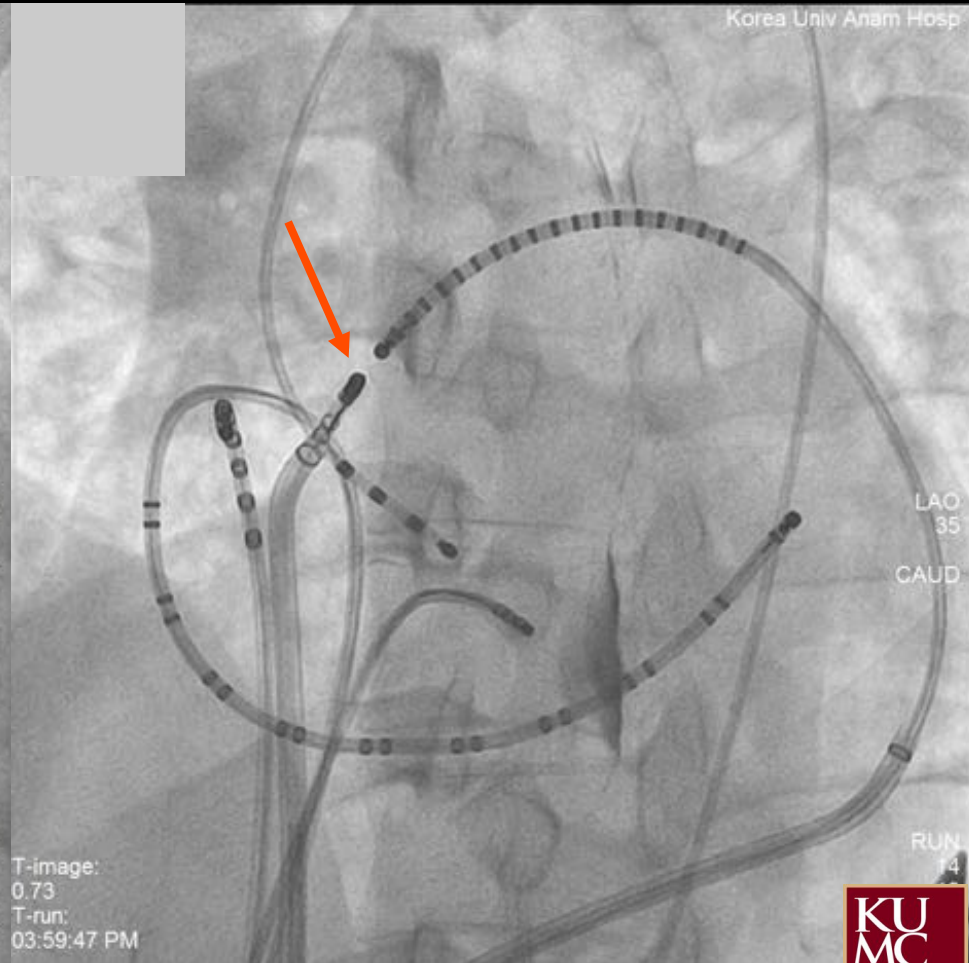
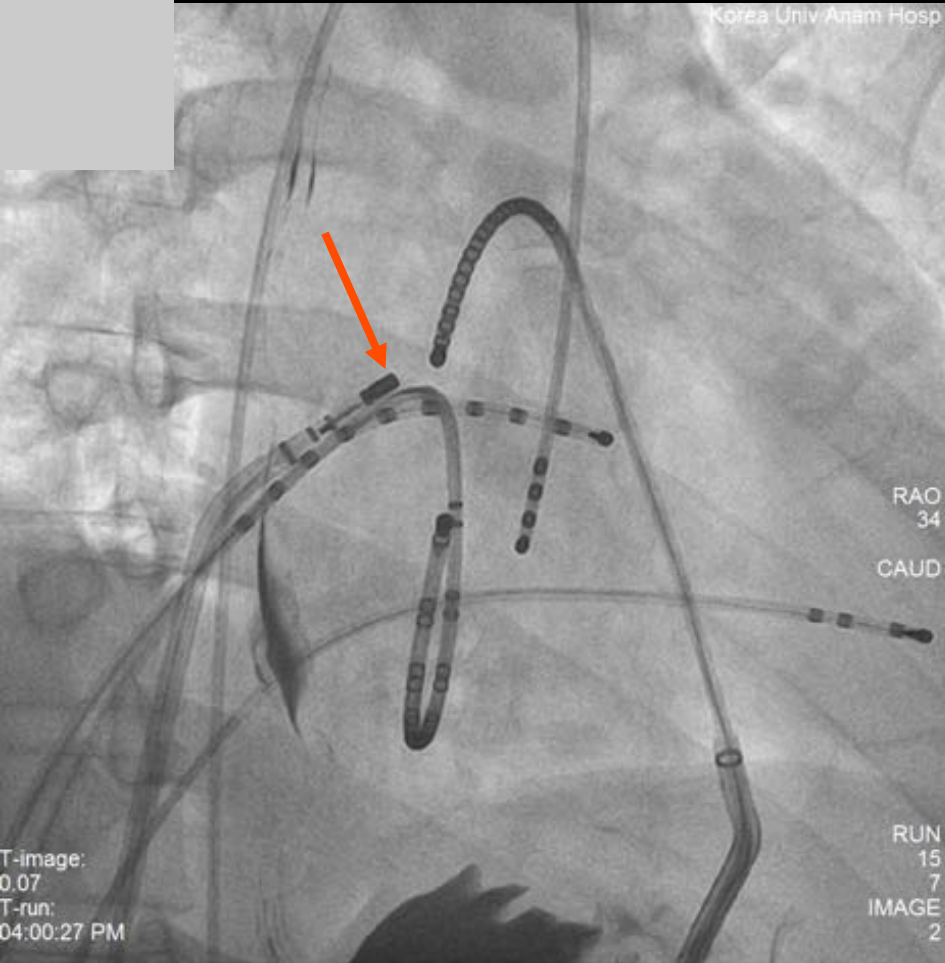
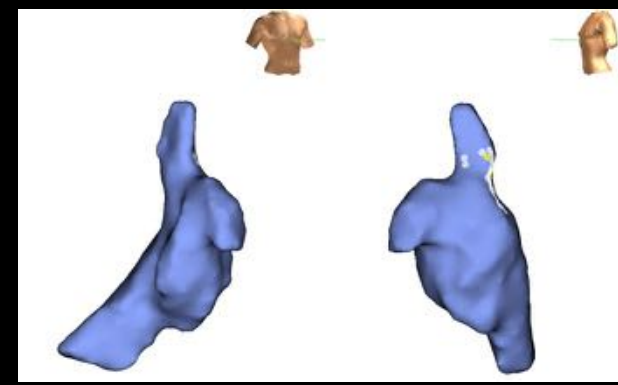
Ablation at the RA Bachmann's Bundle



AT termination



Final ablation site

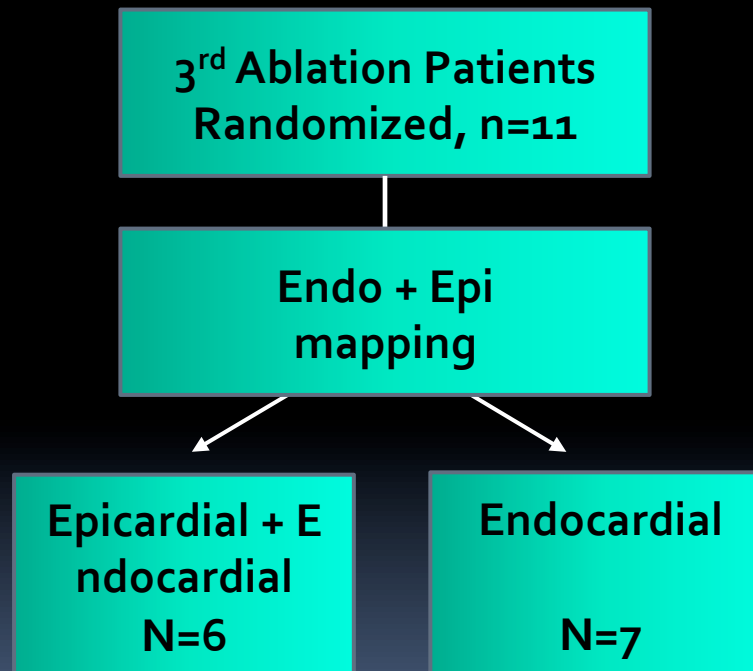


Case Summary

- Biatrial AT can be developed after multiple ablations, especially post-LA anterior ablation.
- Bachmann's bundle is an important part of biatrial reentrant AT, which can be mapped by epicardial catheter.
- Bachmann's bundle insertion at either RA or LA can be targeted for biatrial AT.

Epicardial Catheter Ablation First on Trido Procedure for PeAF in KUMC

Prospective Randomized Controlled trial



Primary endpoint: Freedom from AF/AT recurrence
Secondary endpoint: To achieve transmural lesion

Epicardial Ablation in Repeated procedure

Effectiveness

- Ablation of gap & epicardial structure

Safety

- Hemopericardium – 1/13 of enrolled patient
: controlled with medical management

Epicardial ablation

- was effective for LPV isolation, beneficial to ablate CFAEs at the anterior, roof, and lateral ridge of the LA. And was effective for elimination of roof-AT refractory to endocardial ablation.
- Bachmann's bundle is an important part of biatrial reentrant AT, which can be mapped by an epicardial catheter.



Conclusion

- Disparity between endocardial and epicardial side was often reported in patient with endocardial ablation-refractory PeAF.
- Long-term prospective comparison study (epi+endo vs. endo) is warranted.
- EPI approach for mapping and ablation is effective and safe strategy in patients who had selective epicardial substrate, such as BS.

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