Ventricular Arrhythmia in ARVC: Mechanisms and Management

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Declaration of Conflict of Interest or Relationship

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I have no conflicts of interest to disclose with regard to the subject matter of this presentation.

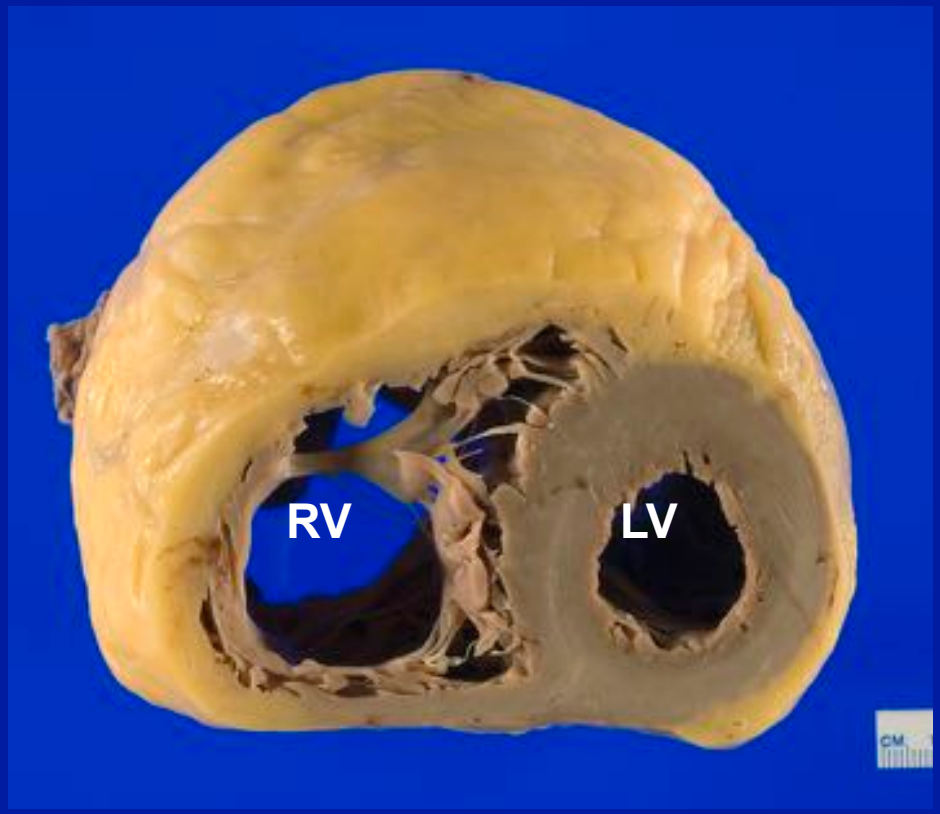
Objectives

- To define the substrate in ARVD/C
- Access considerations
- The optimal mapping strategy
- Interpreting electrograms
- To plan a strategy for ablation

Arrhythmogenic Right Ventricular Dysplasia

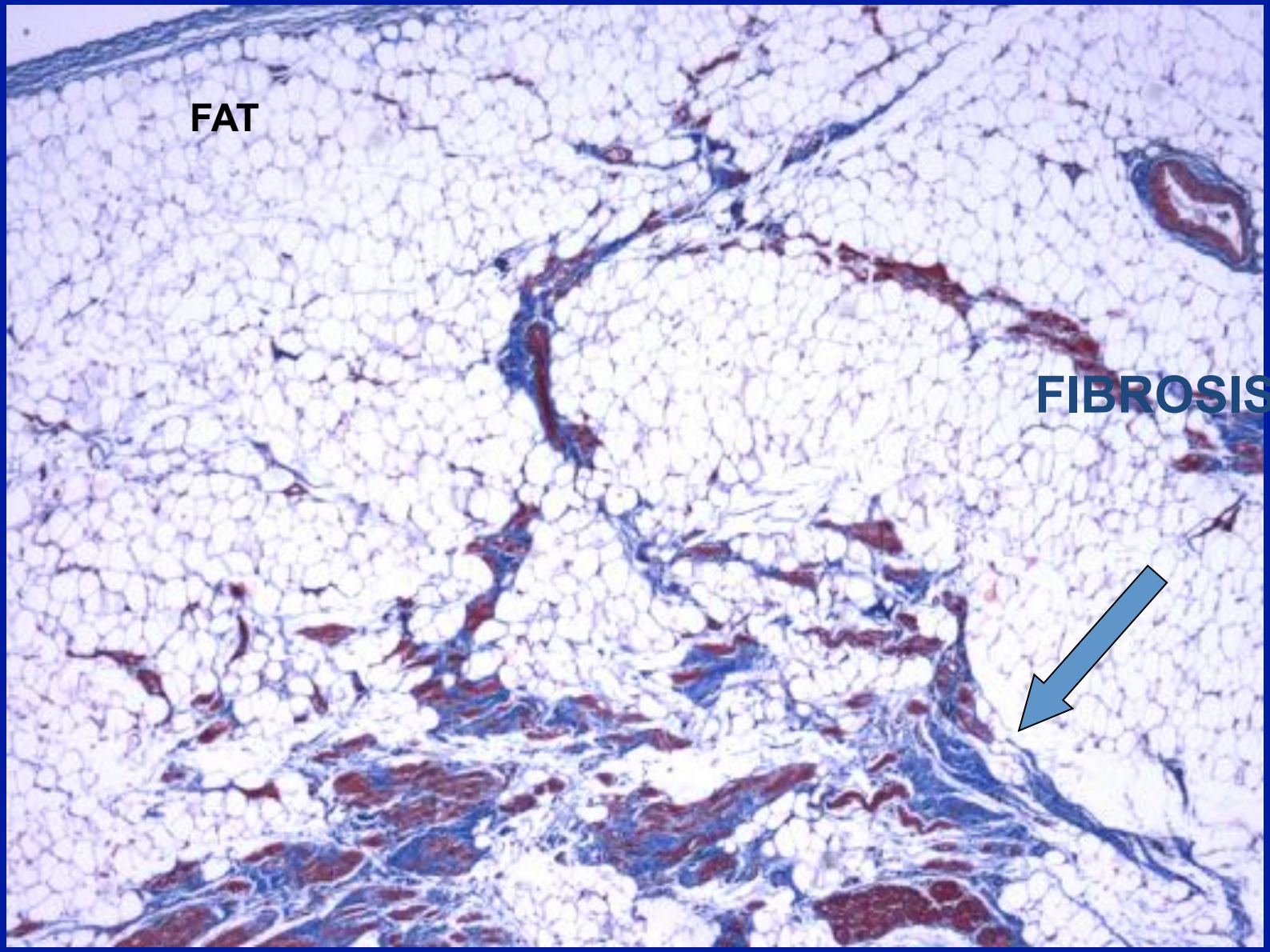
- Inherited predominantly RV myopathy
- High prevalence of arrhythmias originating from the RV
- Fibrosis and fatty replacement of RV
- Substrate for arrhythmias is poorly defined by imaging

What is the substrate in ARVD/C?



- Epicardial substrate
- Endocardial hypertrophy
- Anterior and inferior wall involvement
- Peri tricuspid disease
- LV posterolateral fat replacement

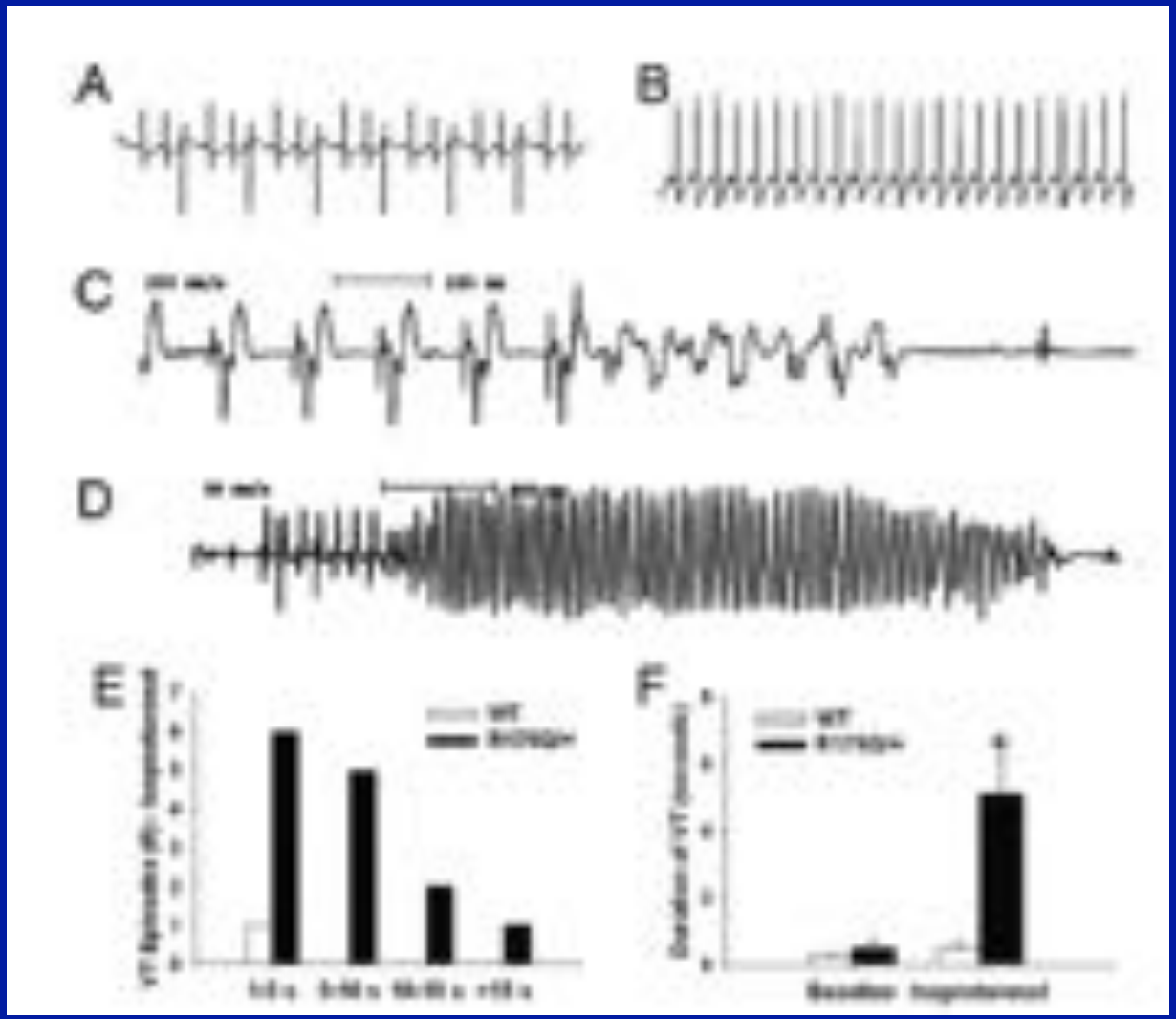
What is the substrate in ARVD/C?



Mechanisms of VT in ARVD/C

- Enhanced automaticity
  - High prevalence in concealed and early ARVD/C
  - Rapid self terminating VT
  - Onset during exercise
  - Beta-blockade is highly effective
- Scar mediated re-entry
  - Established disease
  - Recurrent sustained VT
  - AAD or catheter ablation

Isoproterenol provokes VT in RYR2 mutation in mice



Kannankeril et al Proc Natl Acad Sci. 8;103:12179-12184

Diagnostic Value of Isoproterenol Testing in Arrhythmogenic Right Ventricular Cardiomyopathy

- Continuous infusion of isoproterenol (45 µg/min) for 3 minutes
- Polymorphic PVCs or NSVT in 32 of 35 (91.4%) patients with ARVC vs. 42 of 377 (11.1%) of non ARVC
- Sensitivity and specificity for ARVC were 91.4%, 88.9% respectively

Denis A et al Circ Arrhythm Electrophysiol. 2014;7:590-597.

EP study: High dose Isoproterenol infusion

Complex Ventricular Ectopy

Sustained VT

Approach to VT ablation

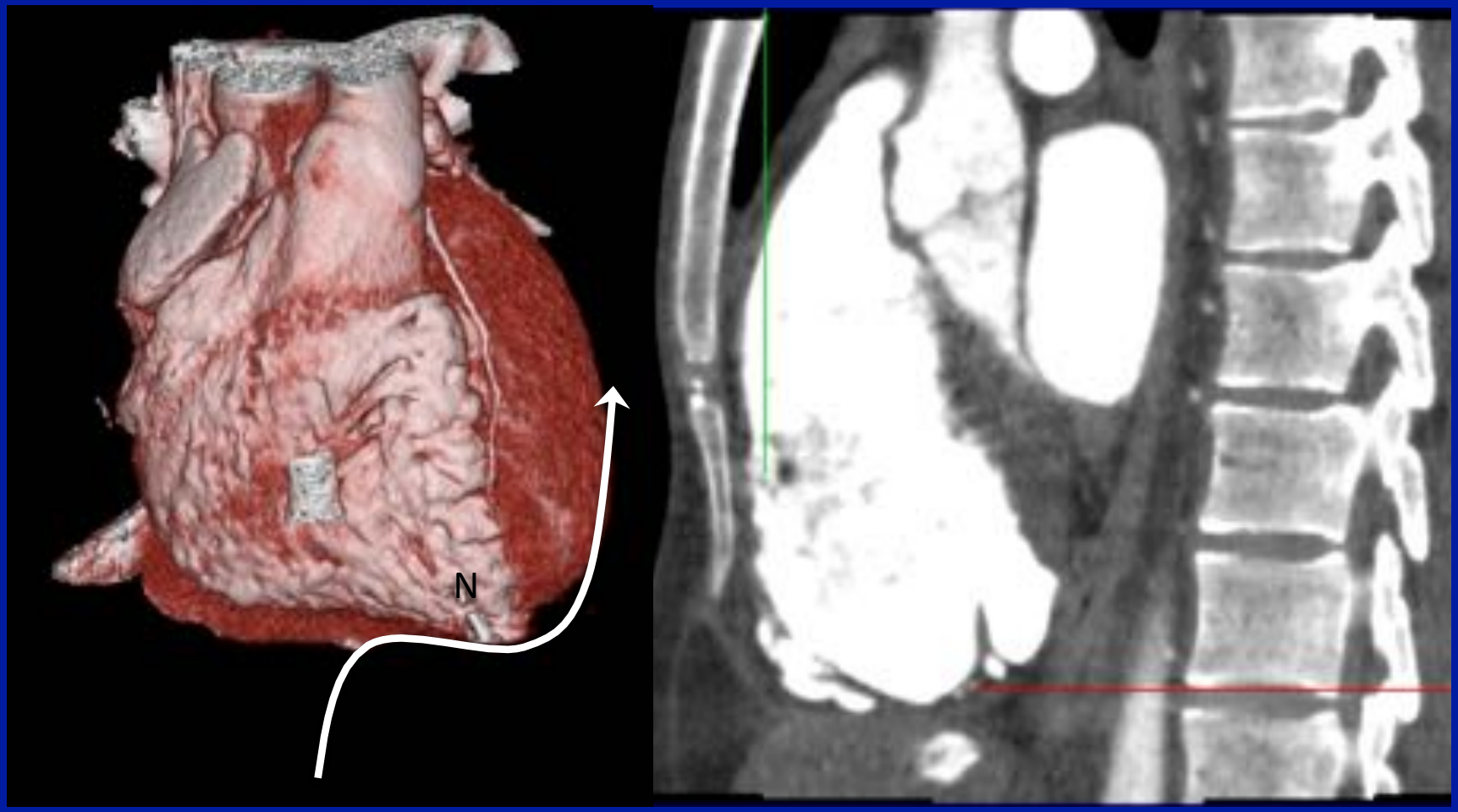
- Pre procedure planning
- Endo and epicardial access
- Creating a voltage map
- Induction of arrhythmias
  - High dose Isoproterenolol
  - Programmed stimulation
- Mapping during VT
- Power requirements

Pre Procedure Planning

- Imaging
  - Review CT / MRI /Echo
  - Assess for access problems
    - Hiatal hernia
    - Enlarged liver
    - Prior thoracotomy
- Assess cardiac anatomy
  - Wall motion abnormalities
  - Wall thinning/calcification
  - RV/LVEF / Chamber size

Accessing the pericardial space

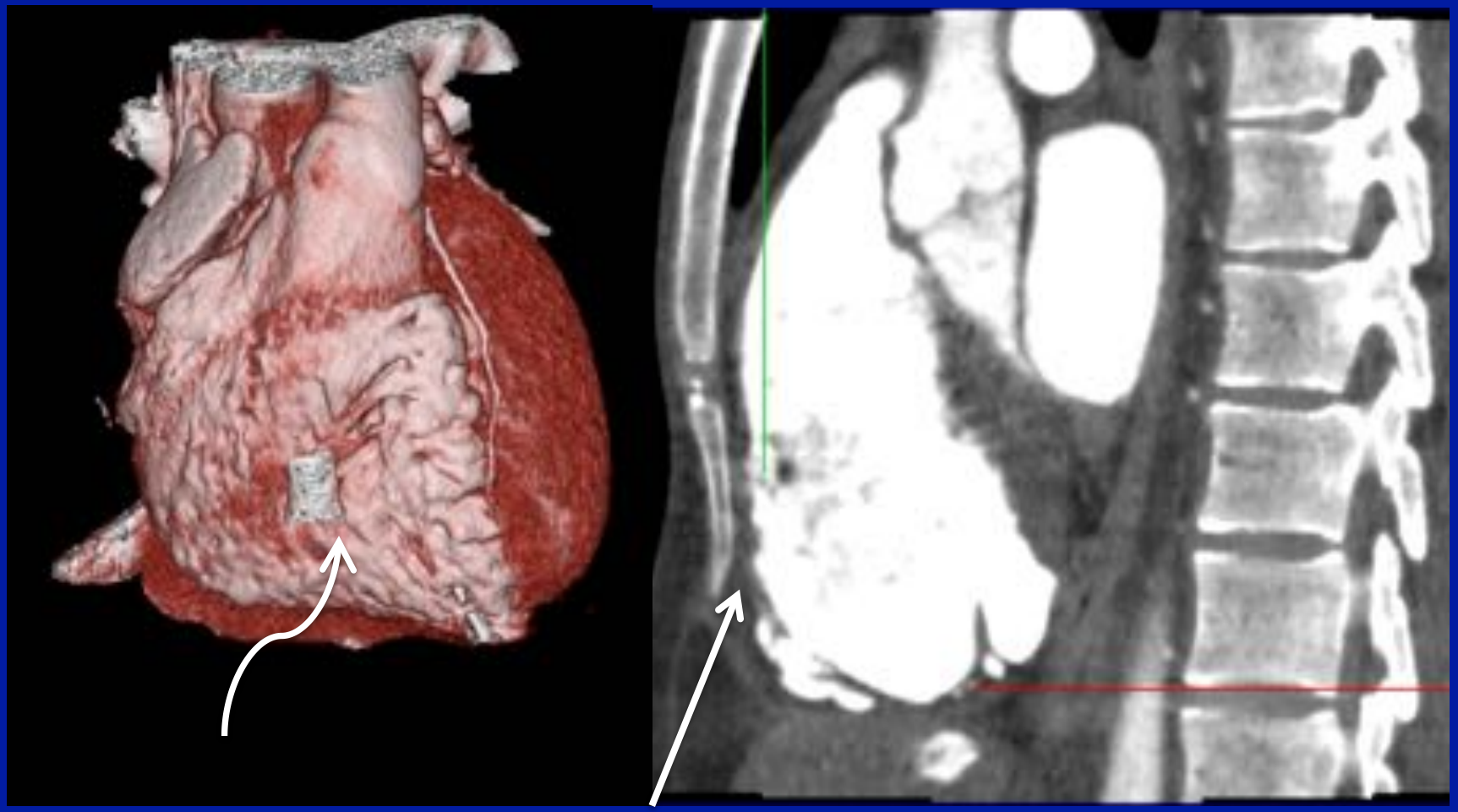
Posterior Approach: Sosa technique



Posterior Approach: Sosa technique

- Deeper trajectory
- Crosses interventricular groove
- Not optimal for RV ablation
- 6% complication rate

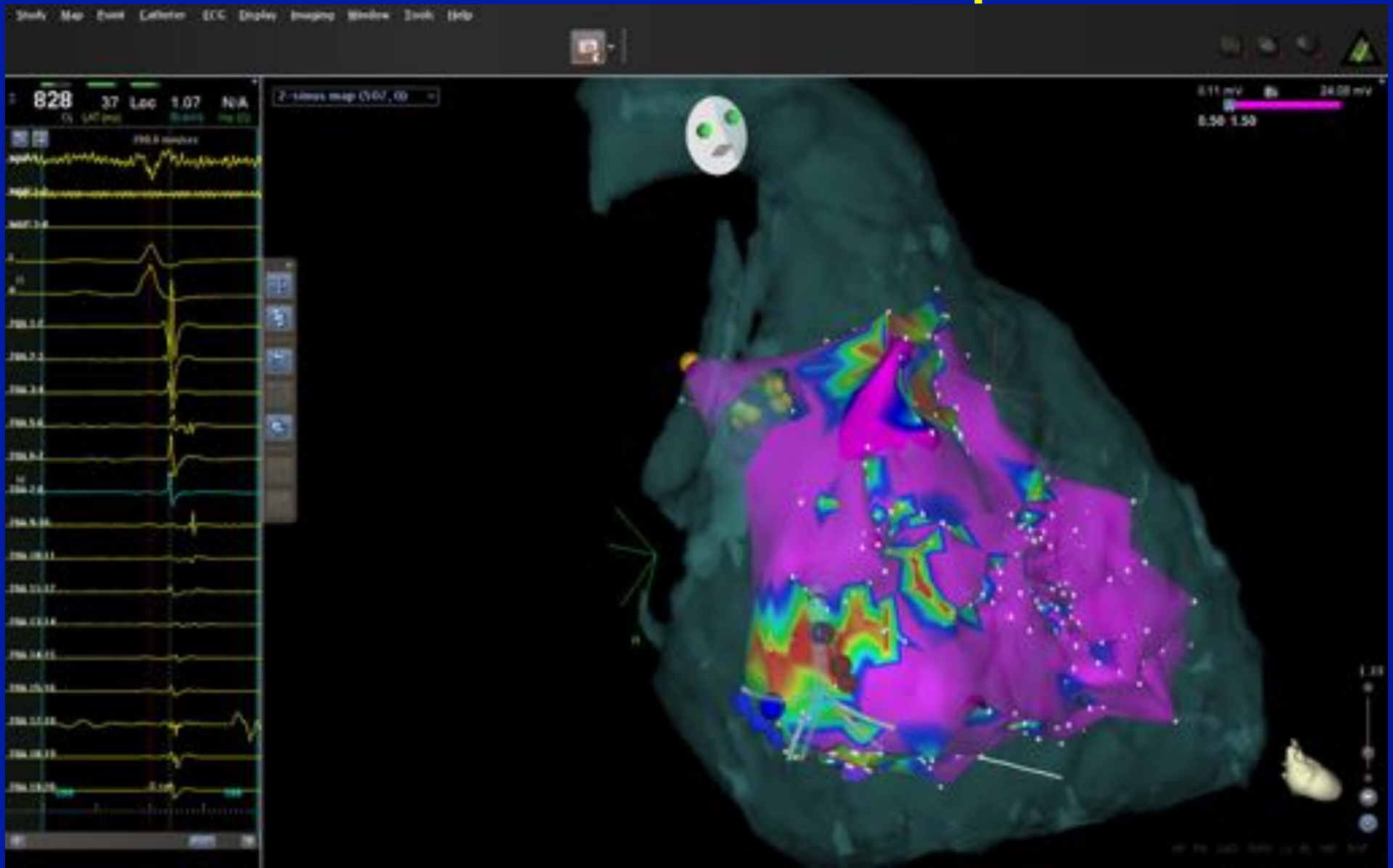
Anterior Approach



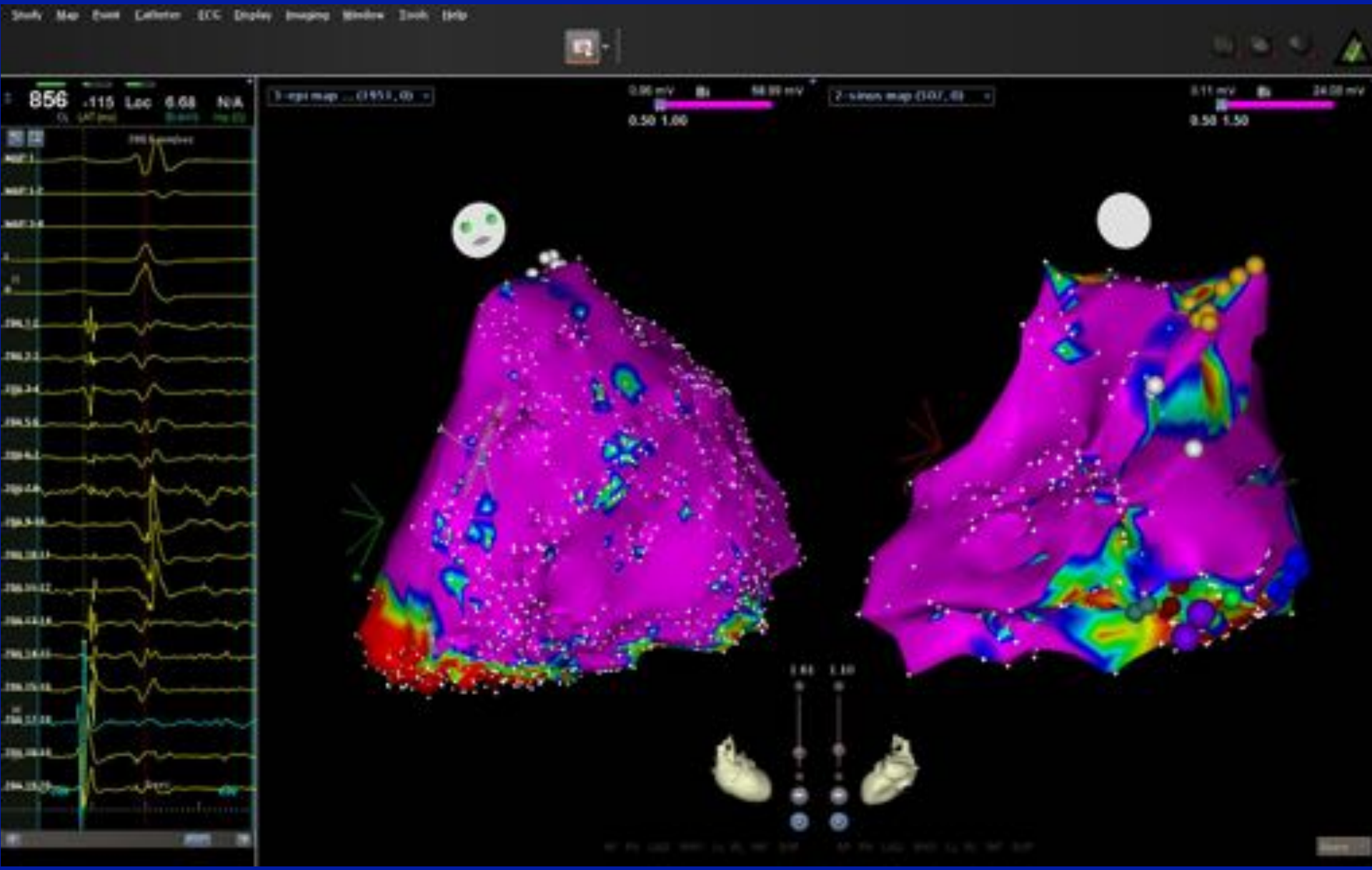
Mapping Strategy

- High density voltage map
- Defining boundaries of RV
- Annotating and book keeping
- Pace mapping interesting regions

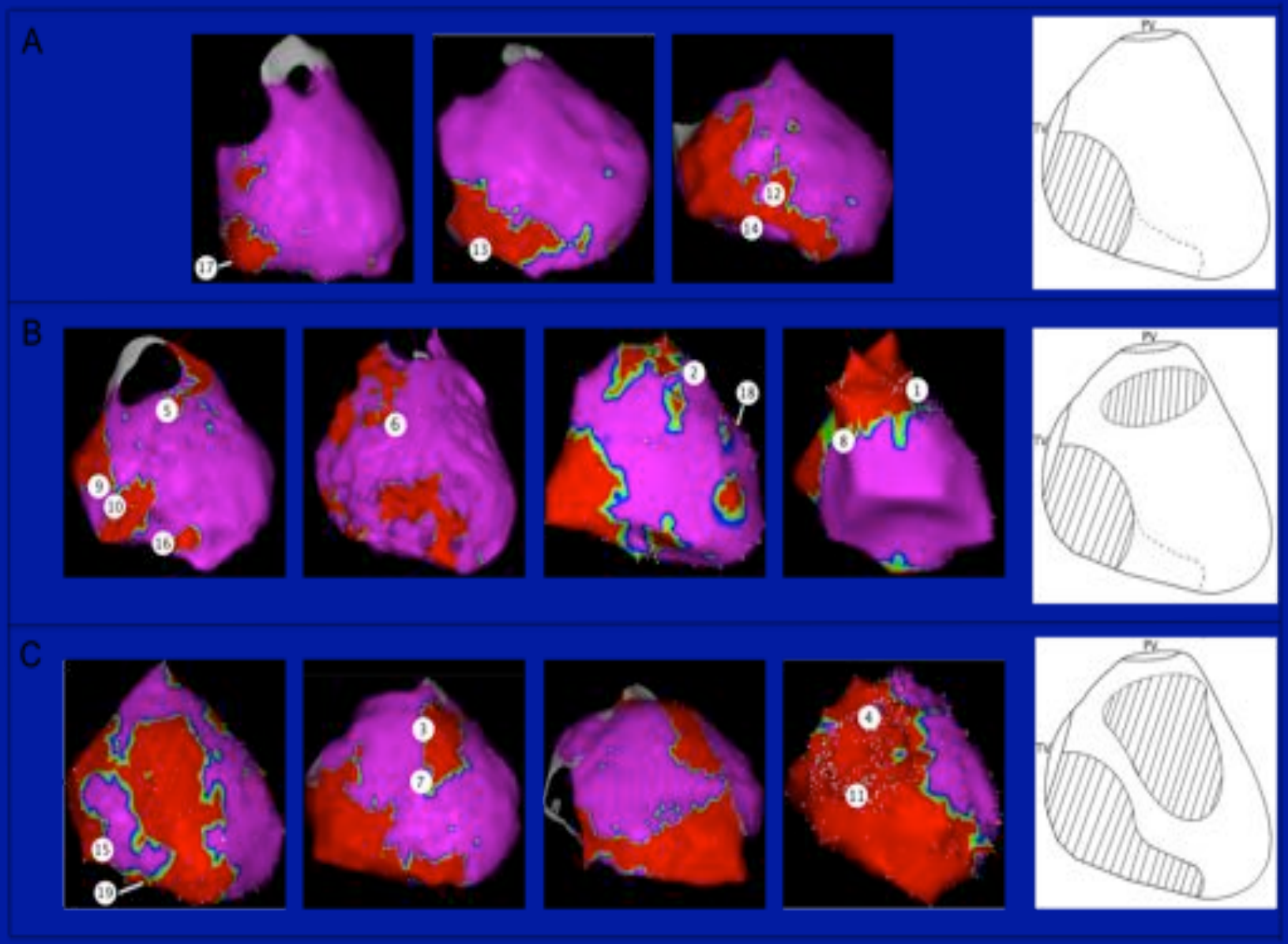
Endocardial Map



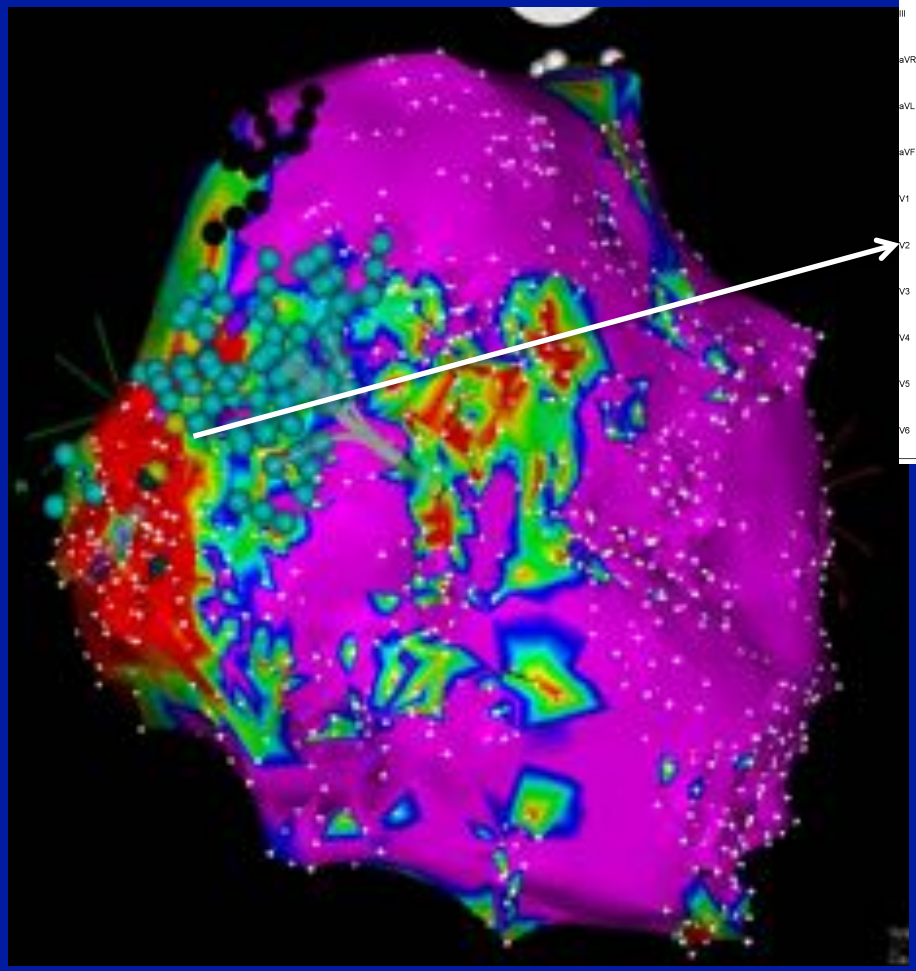
High Density Voltage Map

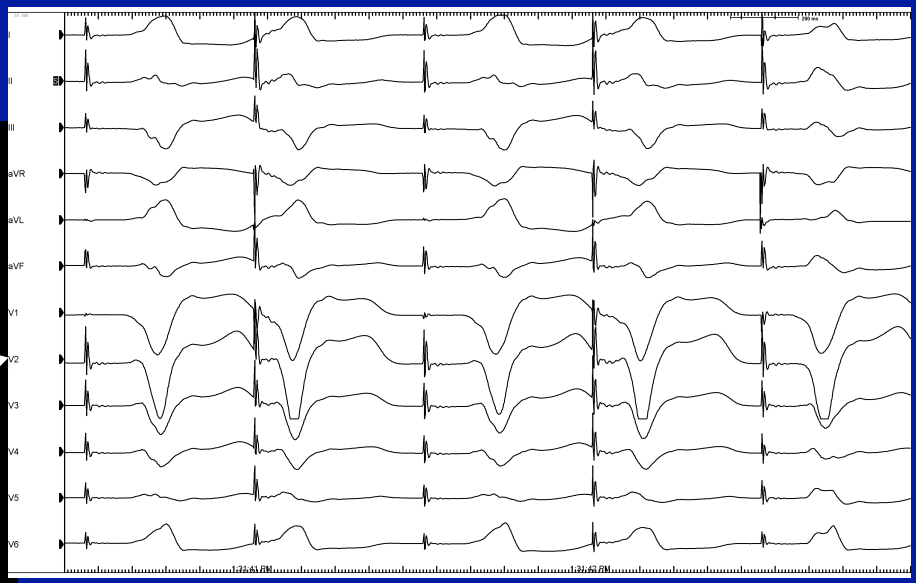


Patterns of Epicardial Scar in ARVD/C

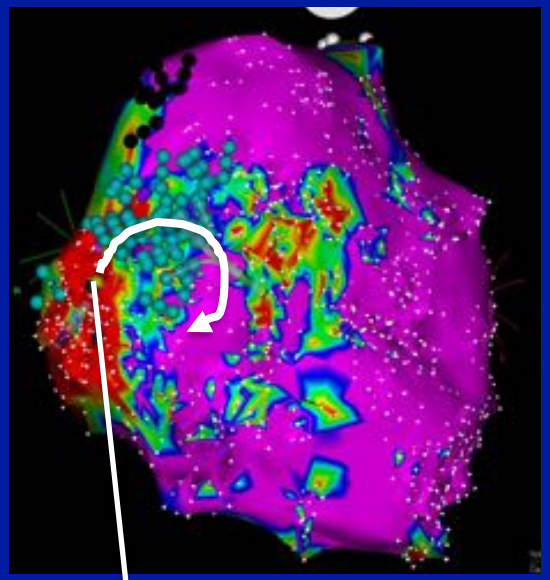


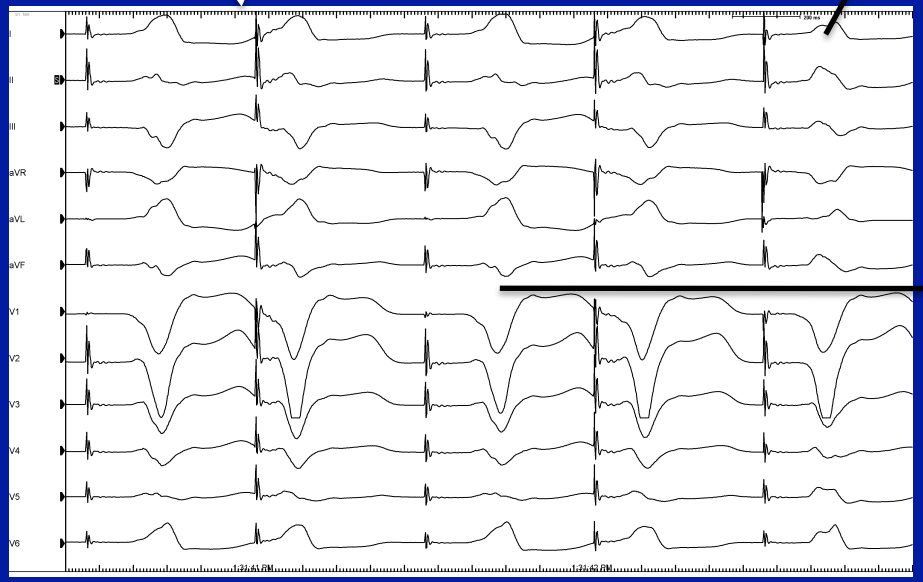
Pace mapping late activated regions

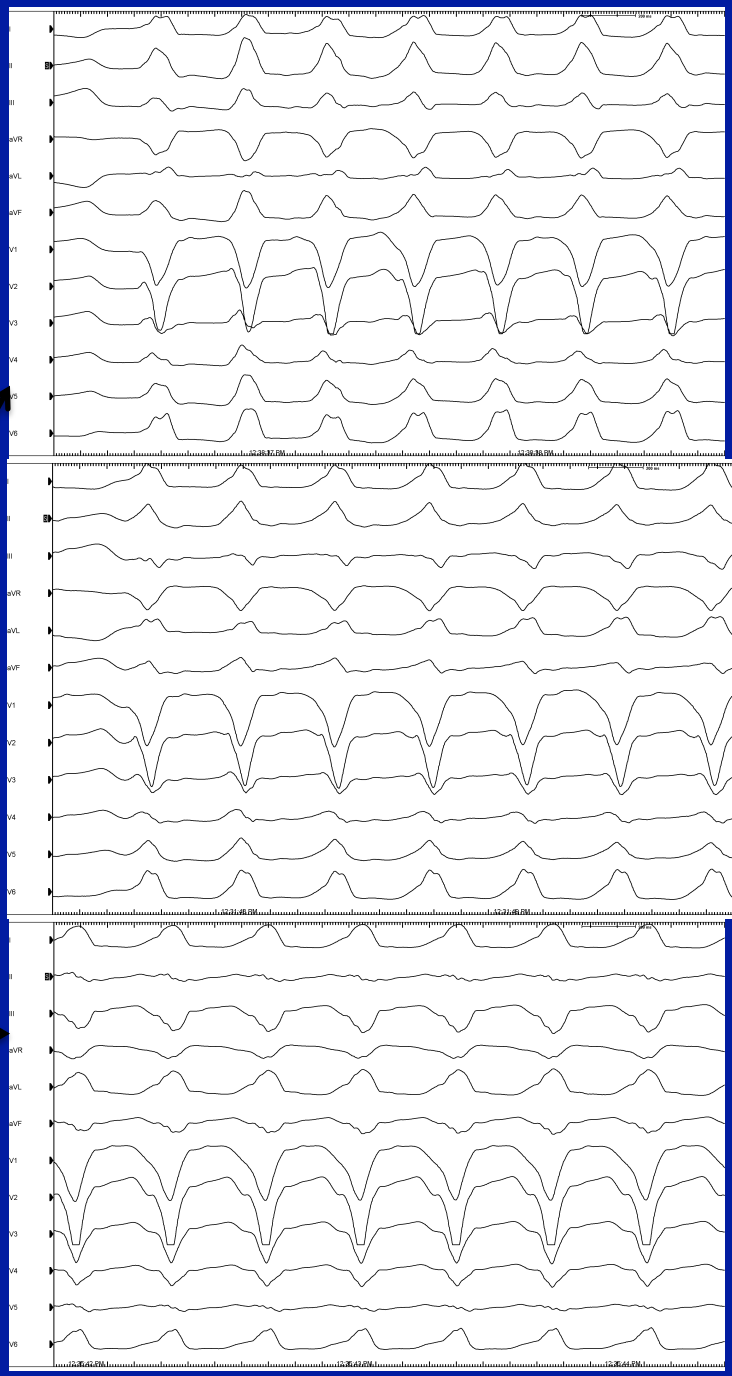




Multiple exit sites
from the scar
Varying stim to QRS




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


I
II
III
aVR
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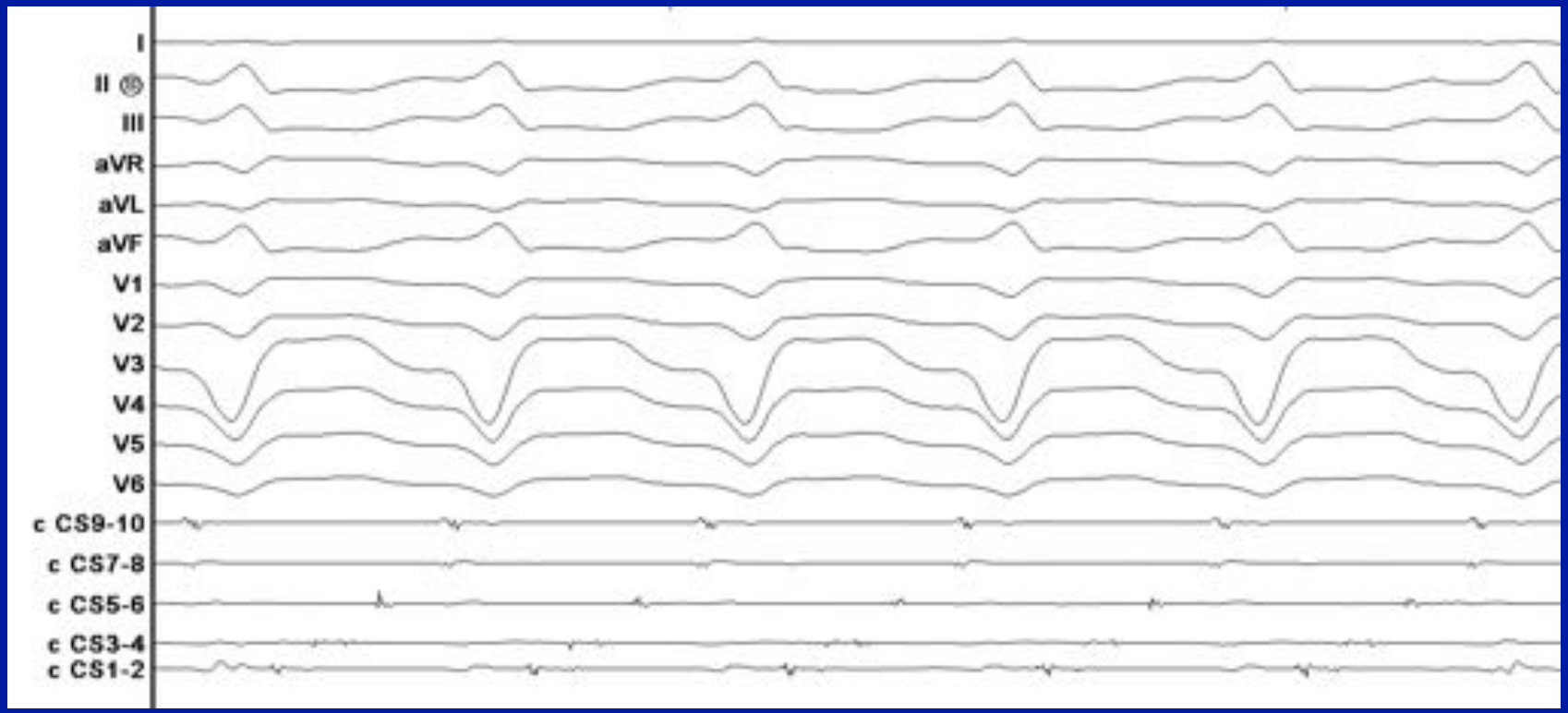
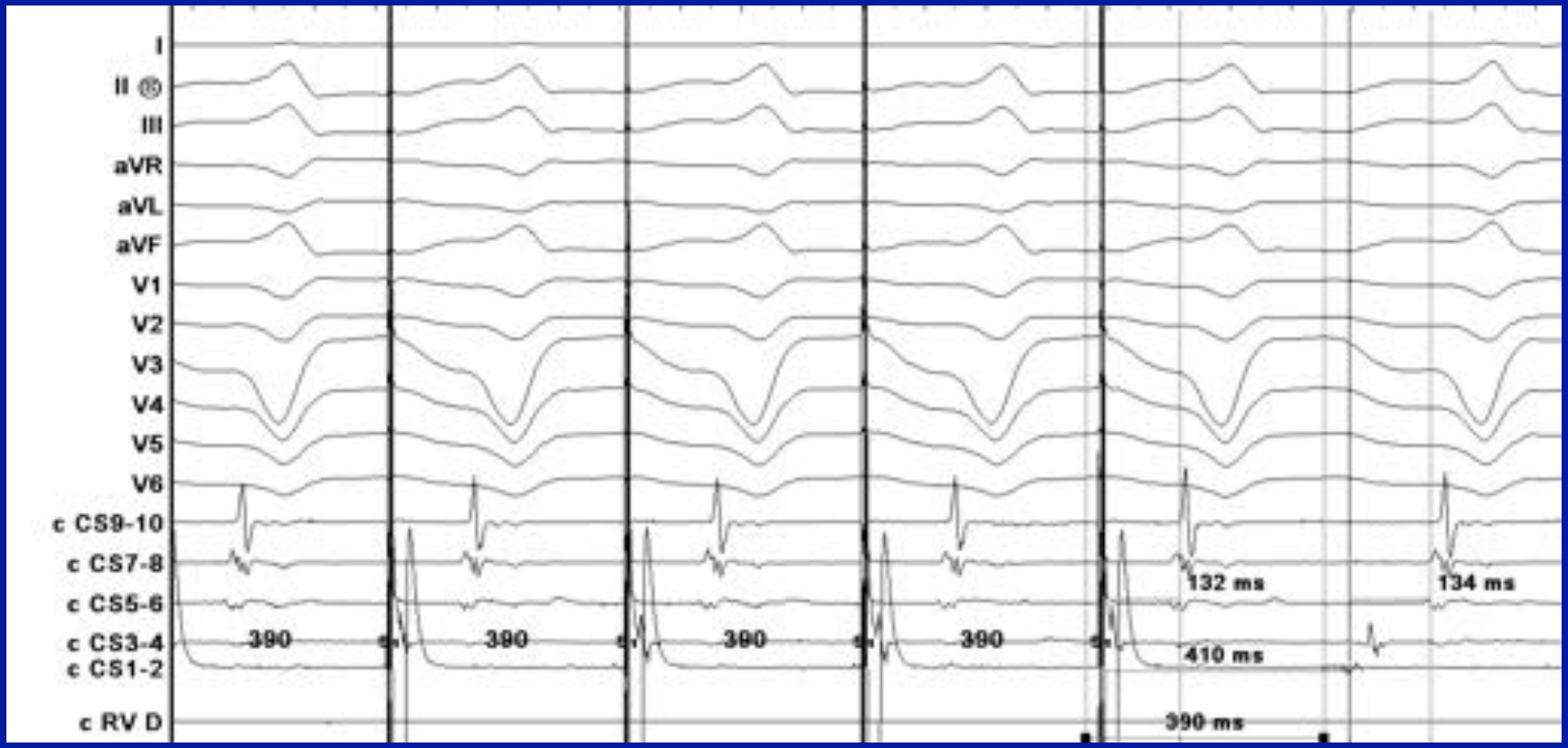
aVF
V1
V2
V3
V4
V5
V6

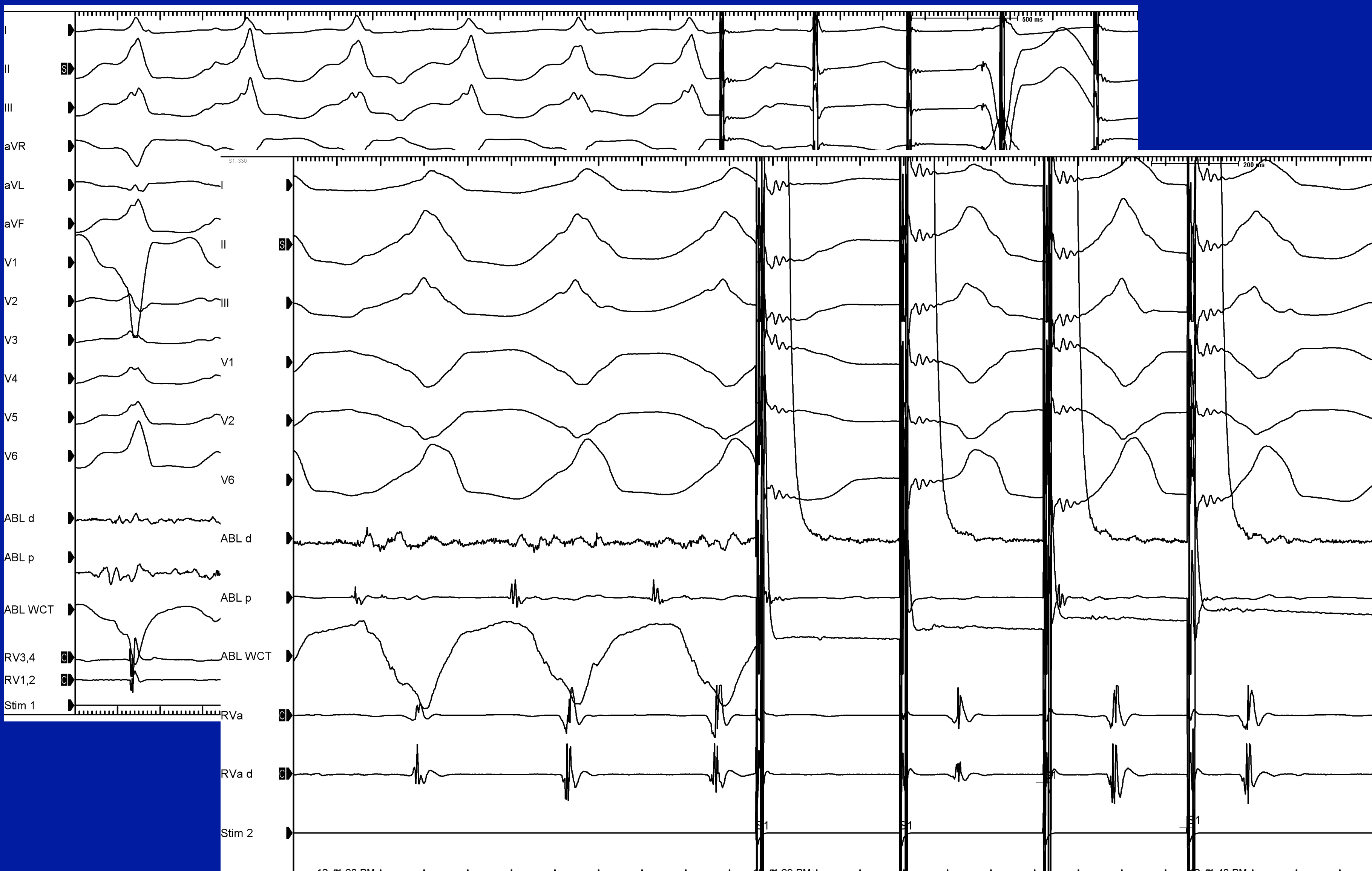
Entire Diastolic Interval During VT



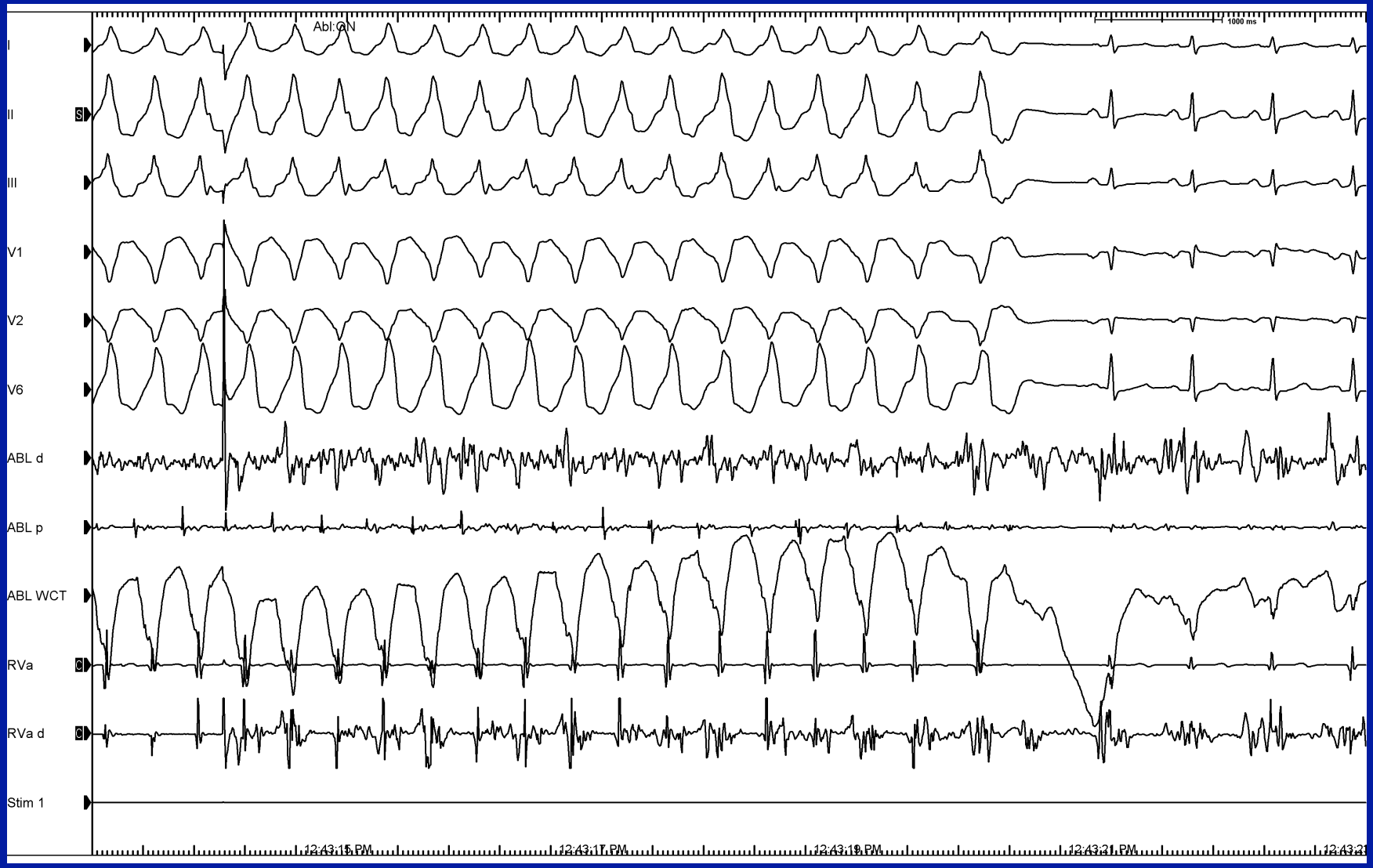
Entrainment



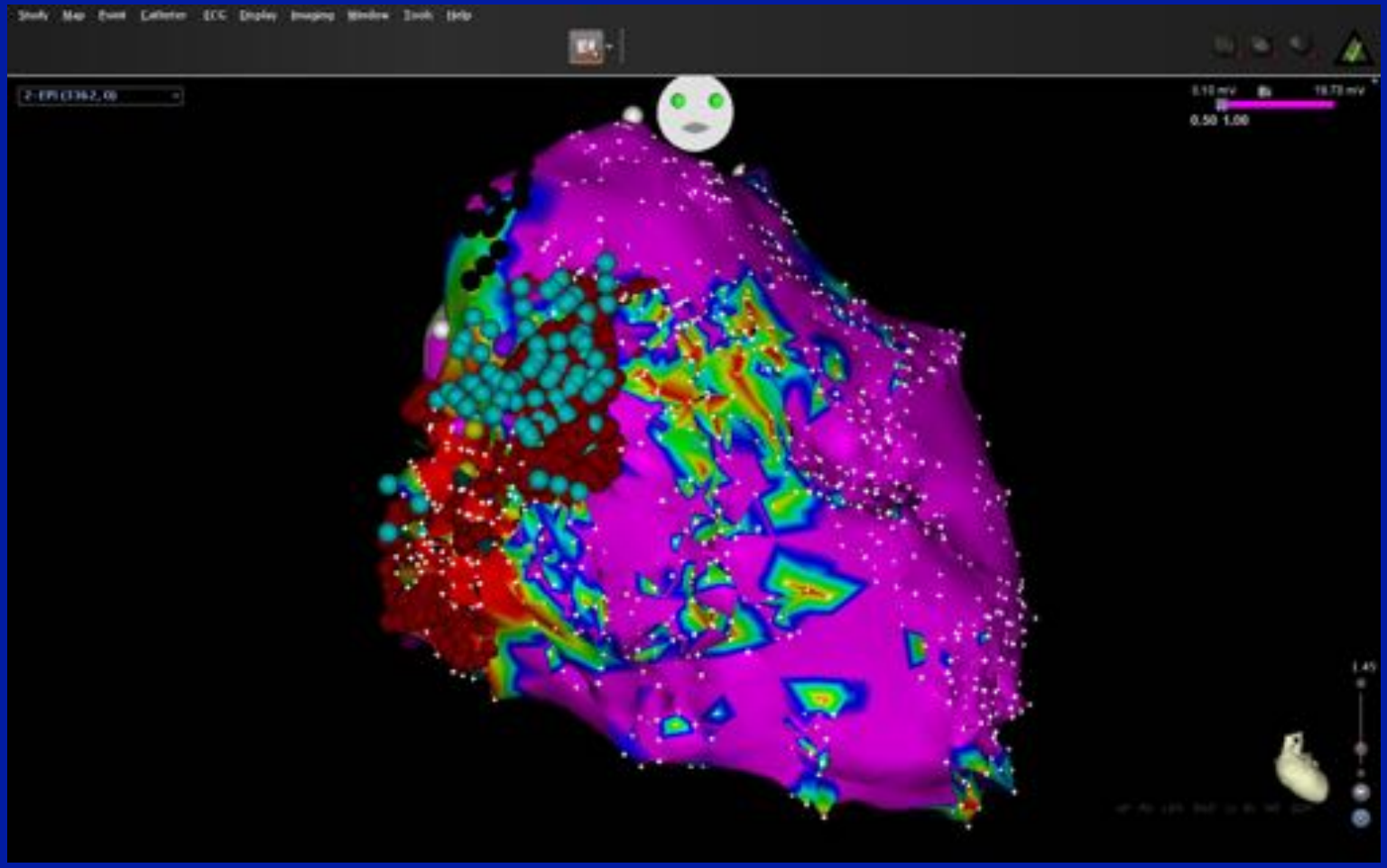
Termination without capture



Ablation at the critical site



Ablation strategy



Ablate all marked late potentials in addition to critical sites for induced VT

Power Requirements

- Irrigated RF
- Start with 20 W and increase to 30 W
- No flow so larger lesion size
- Watch for AV and interventricular groove
- Watch for impedance drop
- Impedance rise due to fat close to the groove

Advanced Therapies

- Open cryo-ablation of the RV
- Bilateral sympathectomy
- Renal Denervation
- Cardiac Transplantation

Success Rates of Catheter Ablation

- Endocardial only ablation has a high failure rate (30% success at 1 year)
- Endo/Epicardial ablation
  - 76% free from VT recurrence at 1 year
  - 70% free from VT recurrence at 2 yrs
  - Significant reduction in arrhythmia burden in ~80% of patients

Binu et al Heart Rhythm. 2015 Apr;12(4):716-25.

Conclusions

- Epicardial ablation is needed in most patients
- Anterior epicardial approach appears to be safe
- Extensive ablation may be needed
- VT free survival is ~ 70% at 2 years

Conclusions

- Substrate for ARVD/C is perivalvular
- Epicardial circuit
- Anterior epicardial approach preferable
- Map and ablate late potentials
- Avoid the grooves
- Extensive ablation may be needed
- VT free survival is ~ 80% at 3 years

Thank You