

The Role of Ablation in Brugada Syndrome

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*Pacific Rim Research Institute at White Memorial
Medical Center in Los Angeles & Bangkok*

Medical Center in Thailand

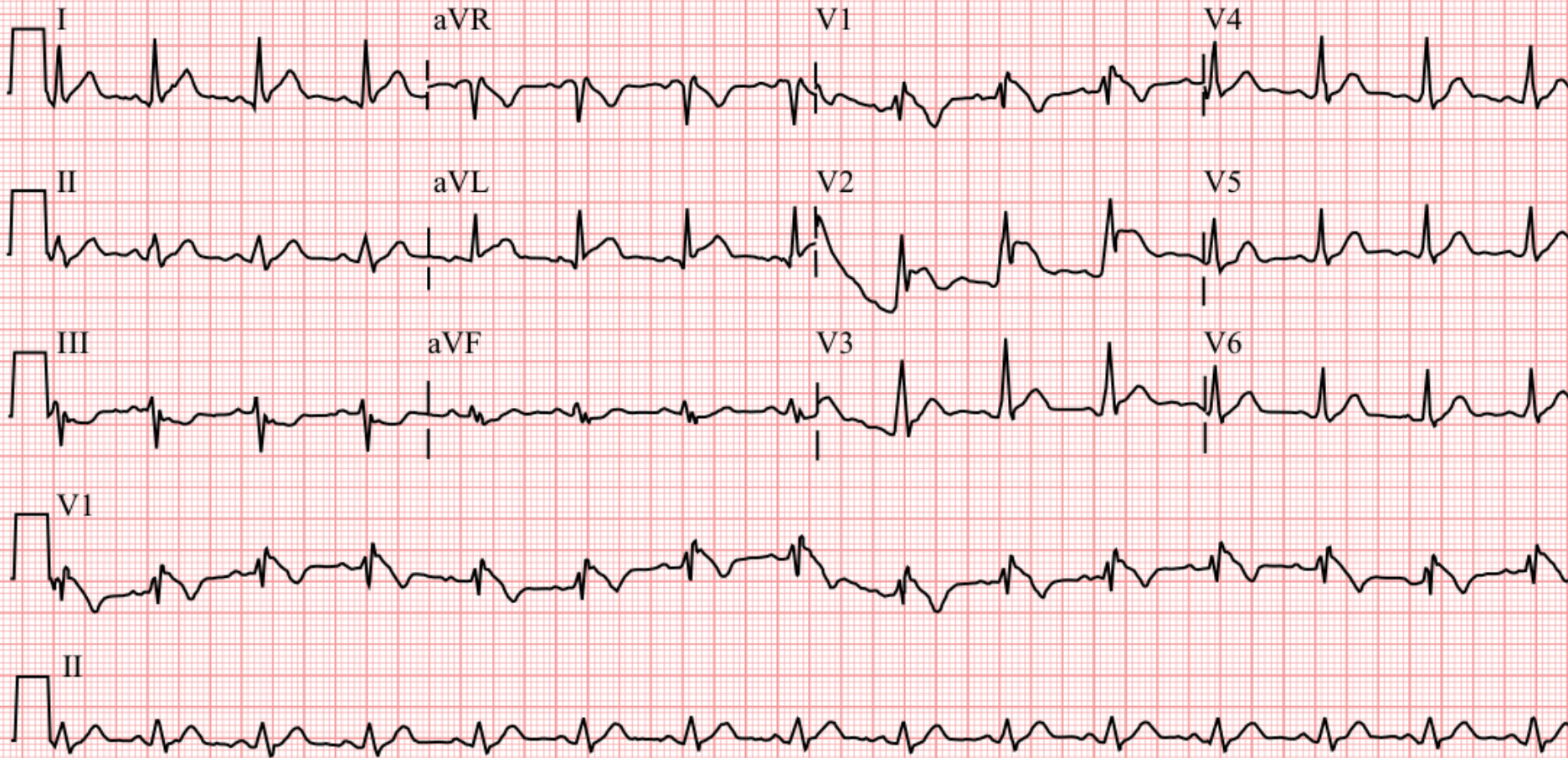
Acknowledgment

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- Pacific Rim Electrophysiology Research and Arrhythmia Center at Bangkok Heart Hospital, Thailand.
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Brugada Syndrome: Treatment options



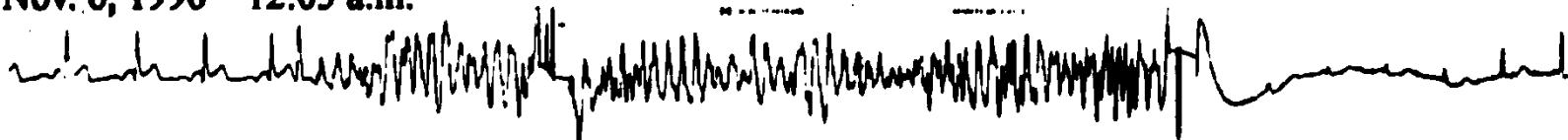
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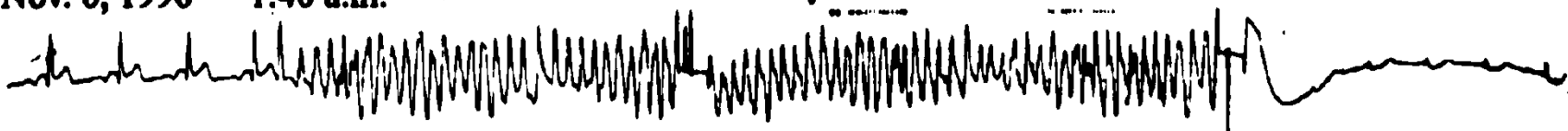
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Nov. 6, 1996 1:40 a.m.



P.A.

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Mapping and Ablation of Ventricular Fibrillation Associated With Long-QT and Brugada Syndromes

Michel Haïssaguerre, Fabrice Extramiana, Mélèze Hocini, Bruno Cauchemez, Pierre Jaïs, Jose Angel Cabrera, Geronimo Farre, Antoine Leenhardt, Prashanthan Sanders, Christophe Scavée, Li-Fern Hsu, Rukshen Weerasooriya, Dipen C. Shah, Robert Frank, Philippe Maury, Marc Delay, Stéphane Garrigue and Jacques Clémenty
Circulation 2003;108:925-928; originally published online Aug 18, 2003;

DOI: 10.1161/01.CIR.0000099791.00042.05

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HRS-2010-Suds-abl...

SUDS-ablation

Nademanee-NEJM (...)

suds-ablation

Haissaguerre Mappi...

Circulation

JOURNAL OF THE AMERICAN HEART ASSOCIATION



**Prevention of Ventricular Fibrillation Episodes in Brugada Syndrome by
Catheter Ablation Over the Anterior Right Ventricular Outflow Tract
Epicardium**

Koonlawee Nademanee, Gumpanart Veerakul, Pakorn Chandanamattha, Lertlak
Chaothawee, Aekarach Ariyachaipanich, Kriengkrai Jirasirojanakorn, Khanchit
Likittanasombat, Kiertijai Bhuripanyo and Tachapong Ngarmukos

Circulation 2011;123:1270-1279; originally published online Mar 14, 2011;

DOI: 10.1161/CIRCULATIONAHA.110.972612

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Key Questions

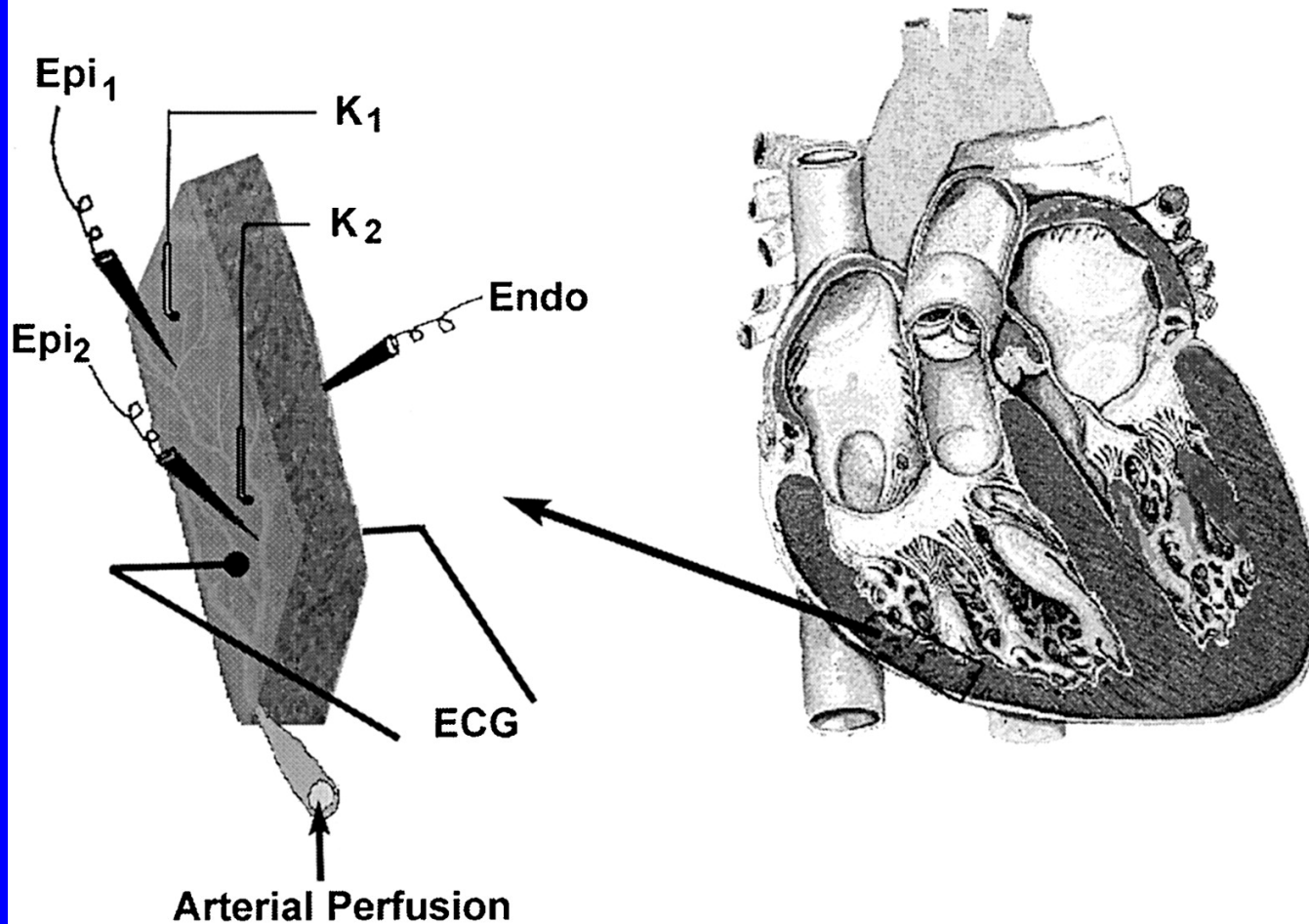
- What is the electrophysiologic mechanism underlying Brugada syndrome?
- Where is the arrhythmogenic substrate?

Brugada Syndrome: Underlying Electrophysiologic Mechanisms

- Repolarization disorder.
- Depolarization Disorder,

Repolarization hypothesis

Arterially Perfused Canine Right Ventricular Wedge

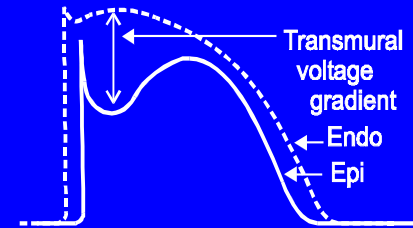
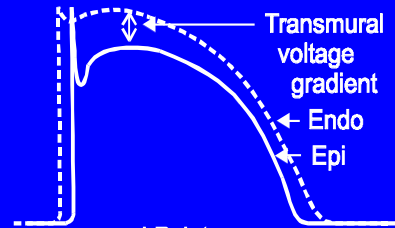
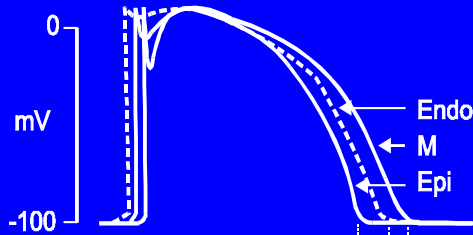


A. Normal

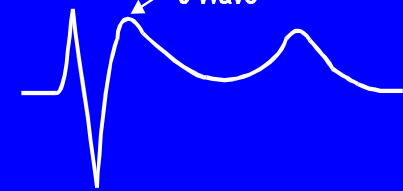
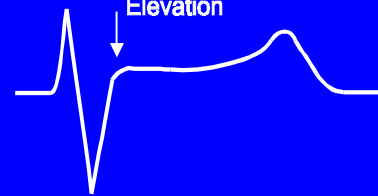
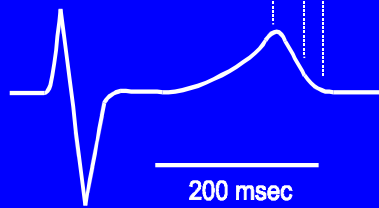
B. Early Repolarization Syndrome

C. Brugada Syndrome (Saddleback)

Transmembrane Action Potentials



ECG (V2)

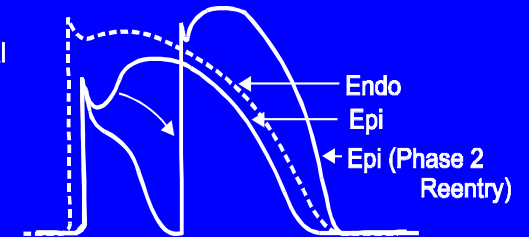
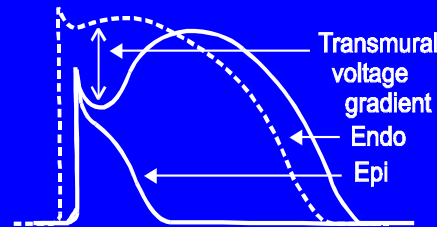
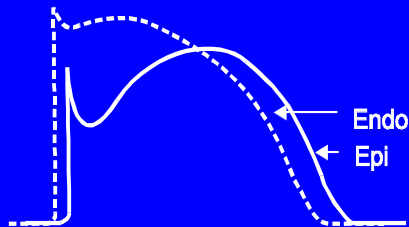


D. Brugada Syndrome (coved)

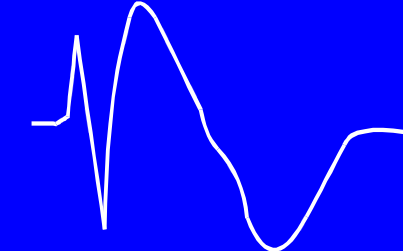
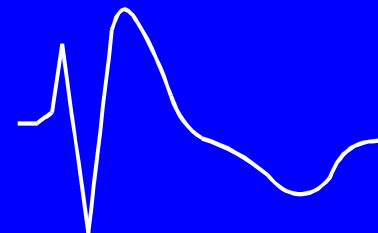
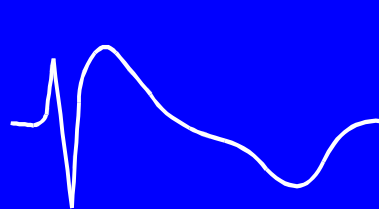
E. Brugada Syndrome (Heterogeneous loss of AP dome)

F. Brugada Syndrome (Phase 2 Reentry)

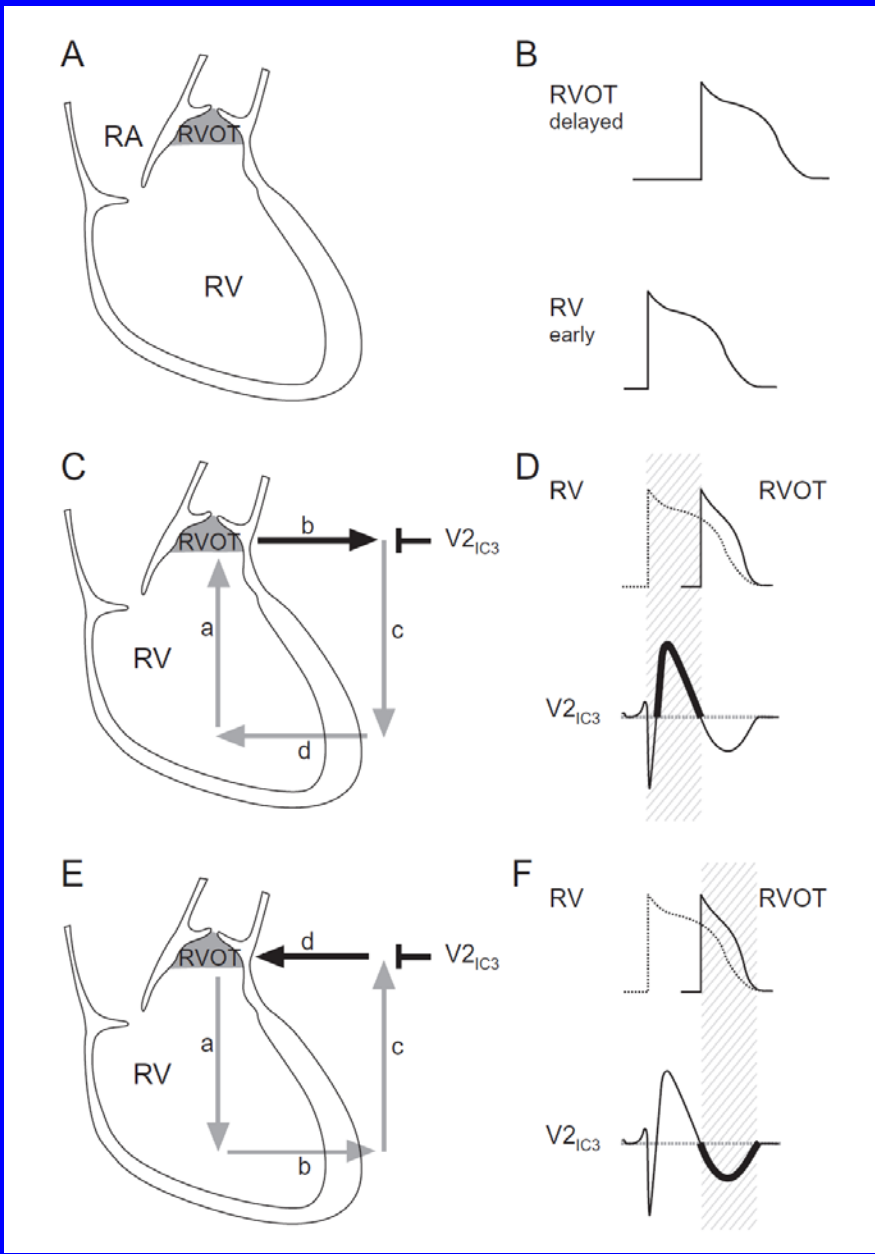
Transmembrane Action Potentials



ECG (V2)

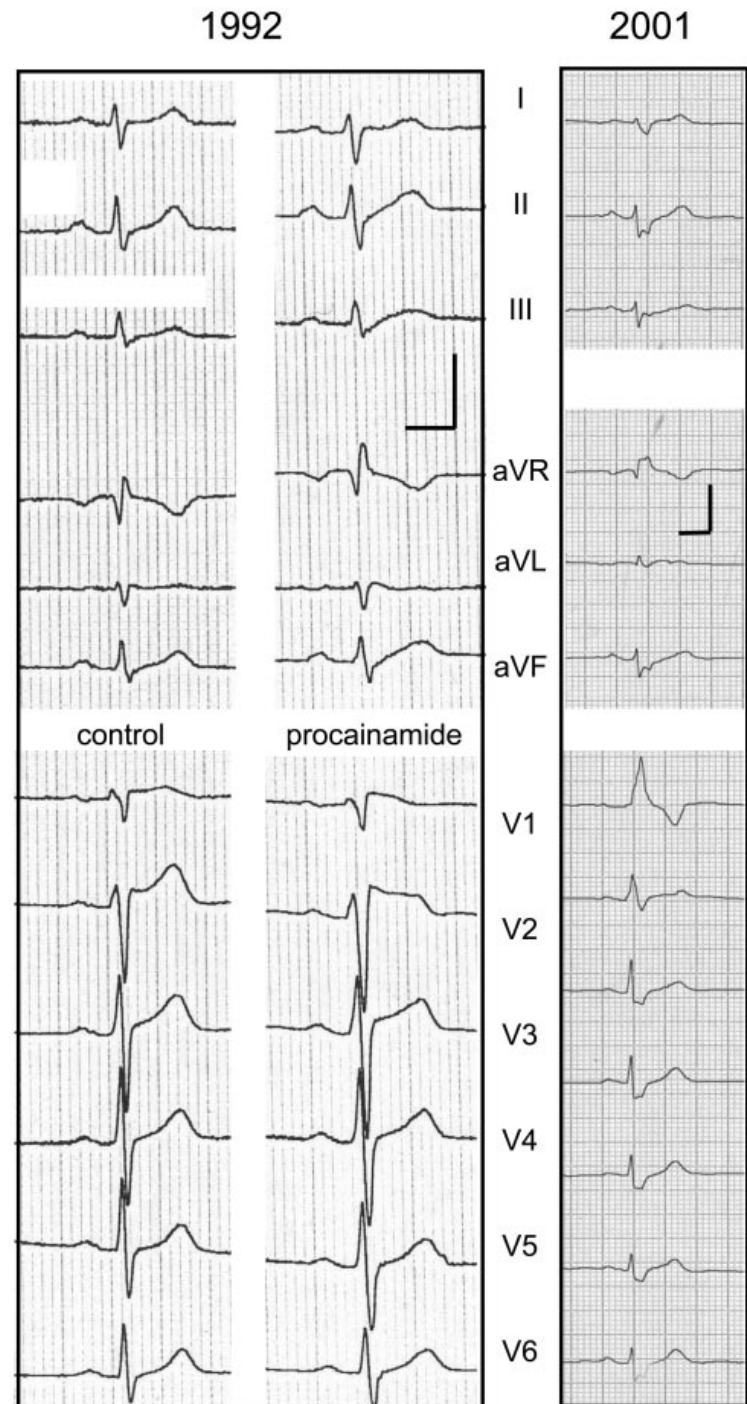


Depolarization Disorder Model



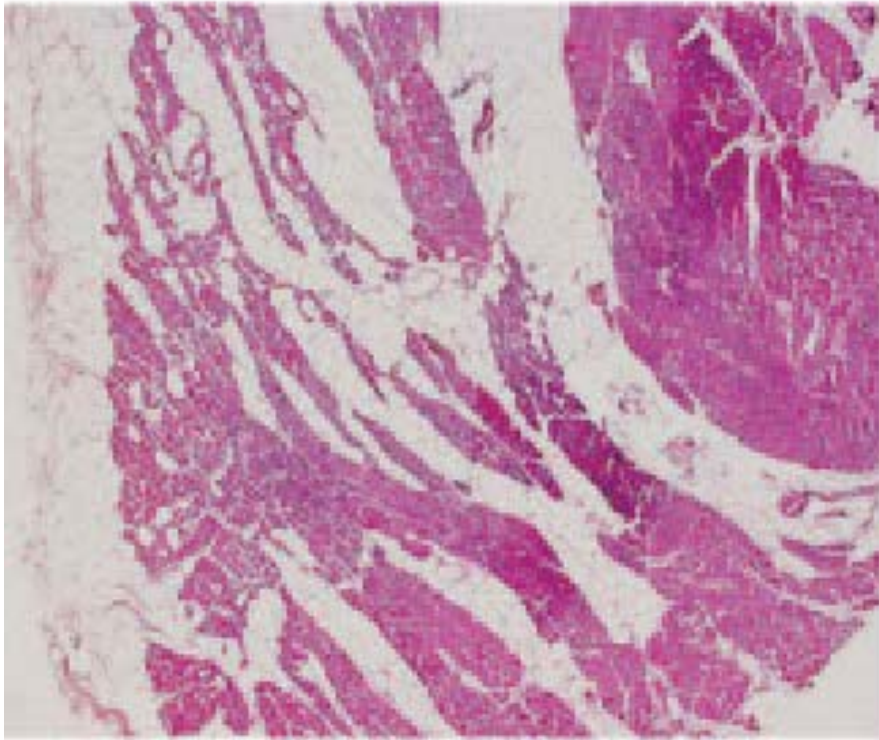
Left, ECG before and after provocation with procainamide, Right, ECG in 2001. Bars = 200 ms, 1 mV

Ruben et al. Circulation 2005;112;2769-2777



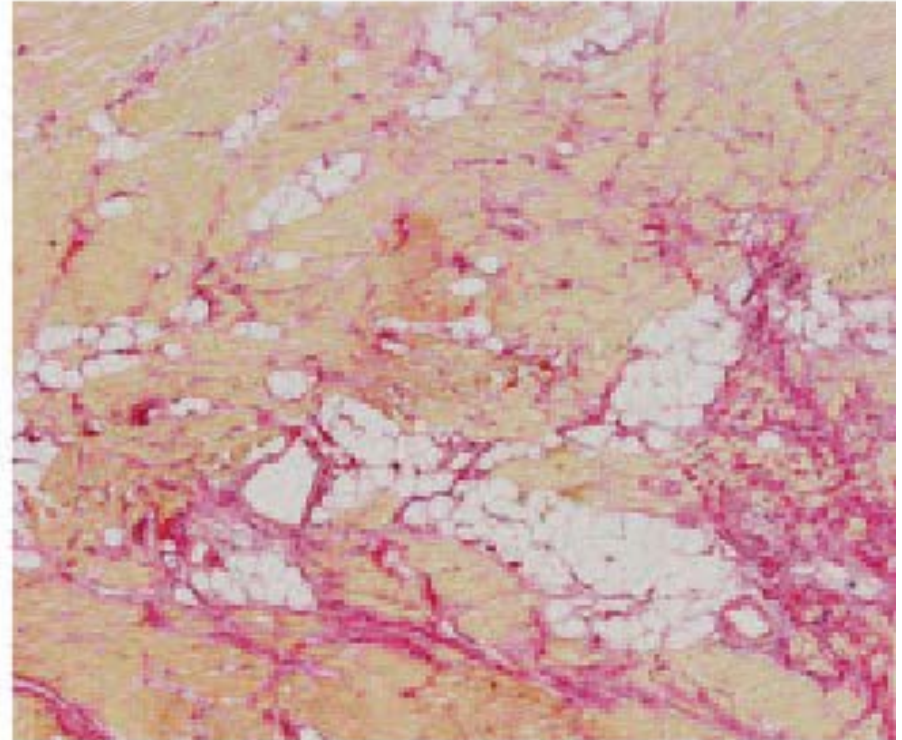
Section of RVOT myocardium, showing prominent fatty infiltration

A



Area of RVOT myocardium, showing interstitial fibrosis (red) in addition to slight fatty infiltration

B



Hypothesis

1. Identification of the arrhythmogenic substrate in BrS patients would enable ablation as a potential treatment option in patients with recurrent ventricular arrhythmias.
2. RVOT is the most likely arrhythmogenic site underlying BrS.

NO.
I

NAME

June/09/2008 08:39 HF, DF, MF1

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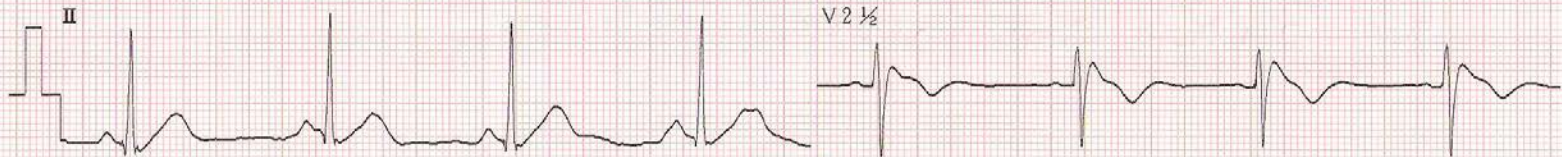
V1

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II

V2 1/2



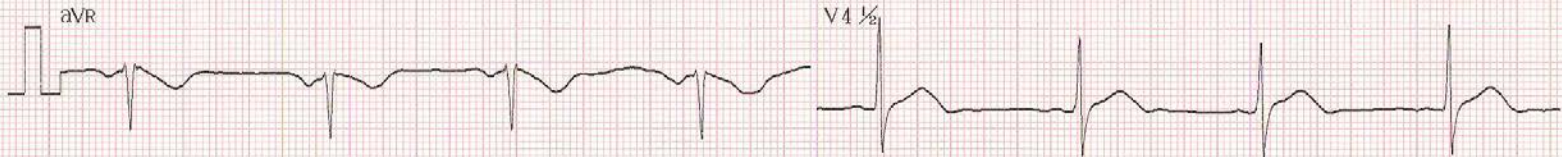
III

V3 1/2



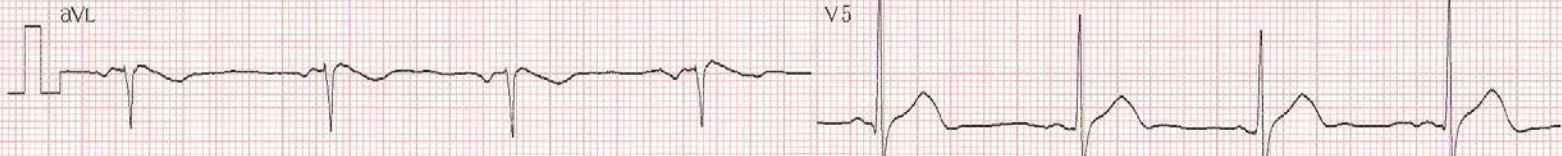
aVR

V4 1/2



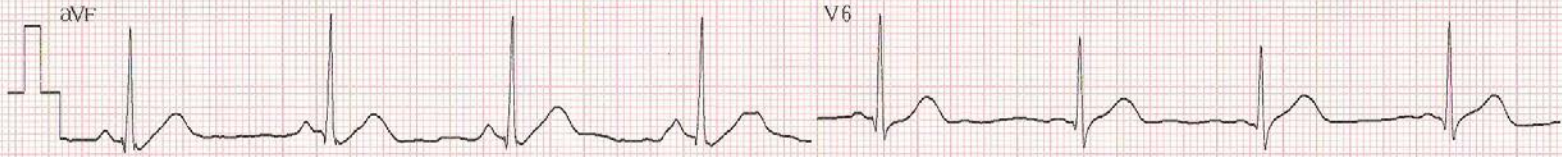
aVL

V5



aVF

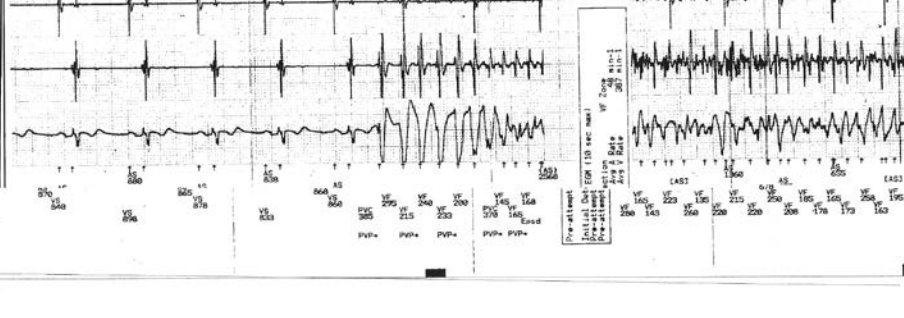
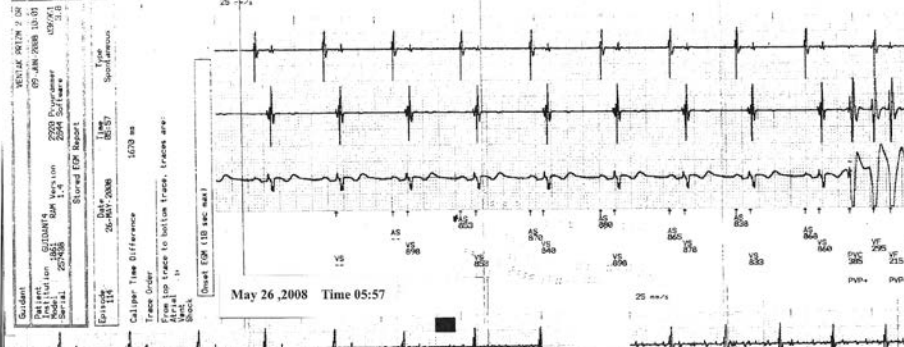
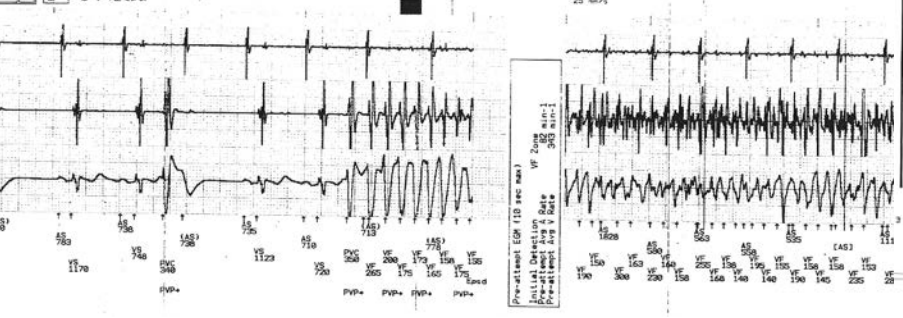
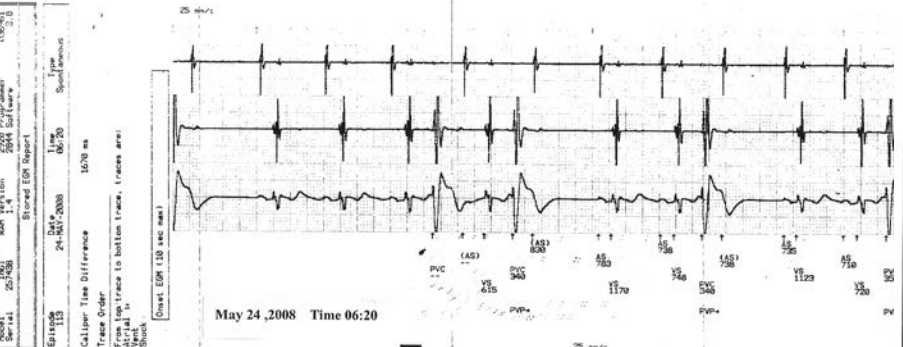
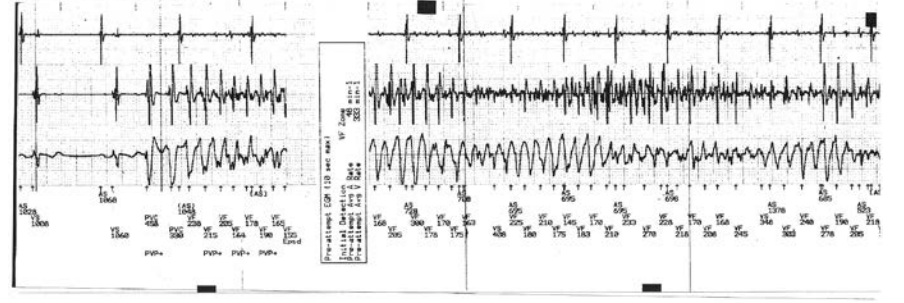
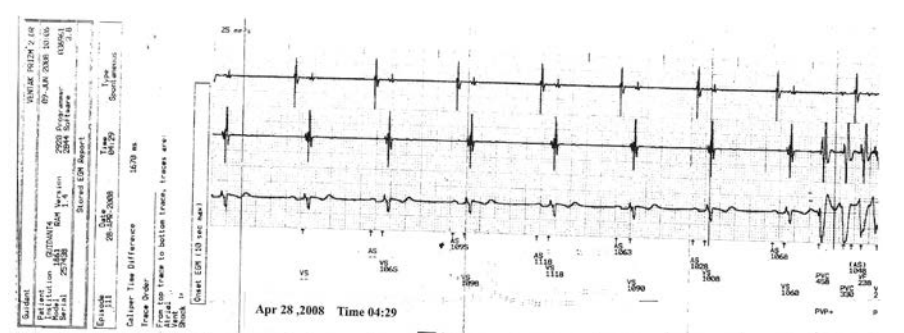
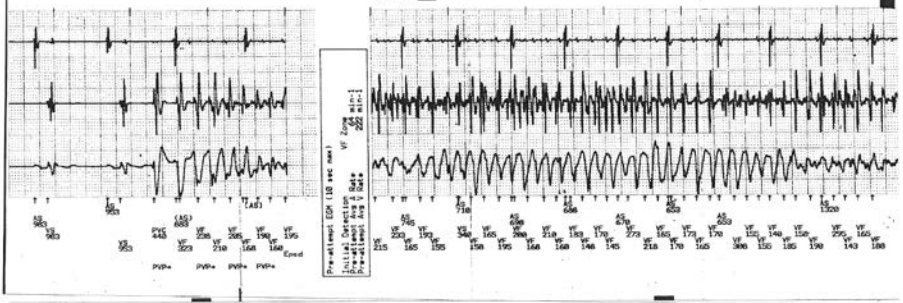
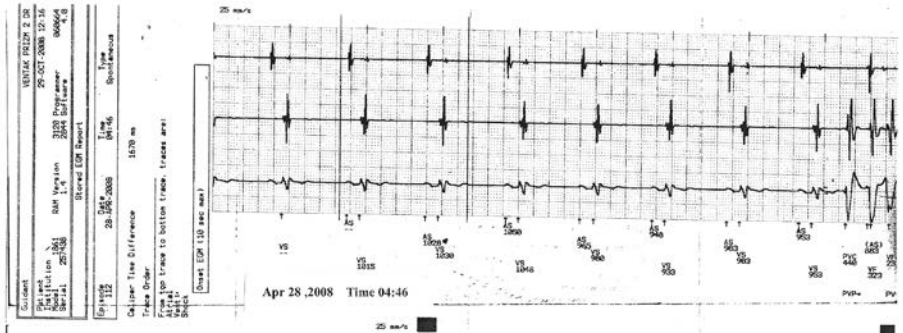
V6

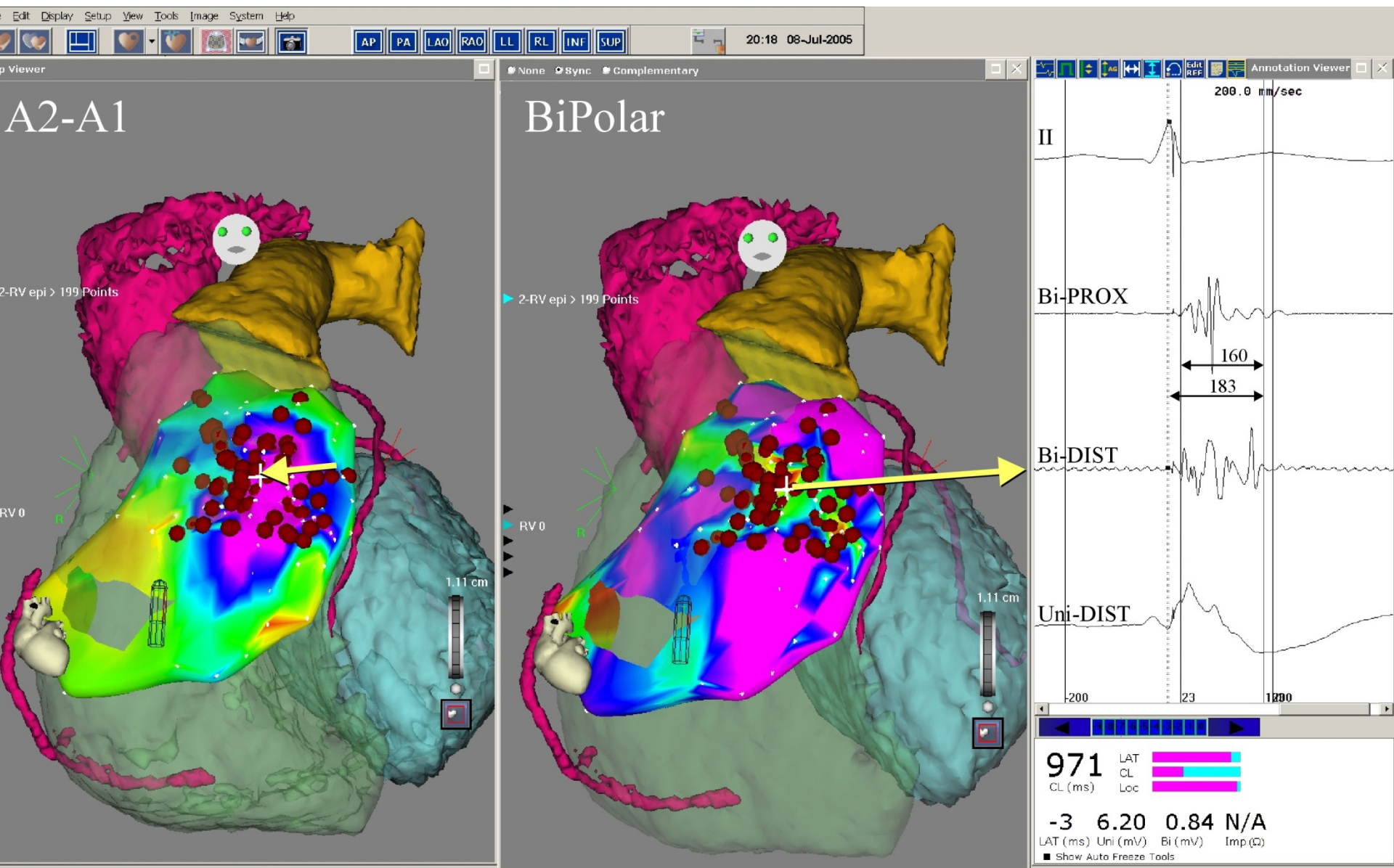


Kenz

R183X52Z-D

LOT NO. BK





Abnormal Electrograms: Definition

- Low Voltage ($< 1\text{mV}$)
- Fractionated or split electrogram
- Prolonged duration ($>80\text{ msec}$)
- Late potential

Ablation End Points

- Non-inducible VT/VF
- Normalization of the Brugada ECG pattern

Clinical End Points

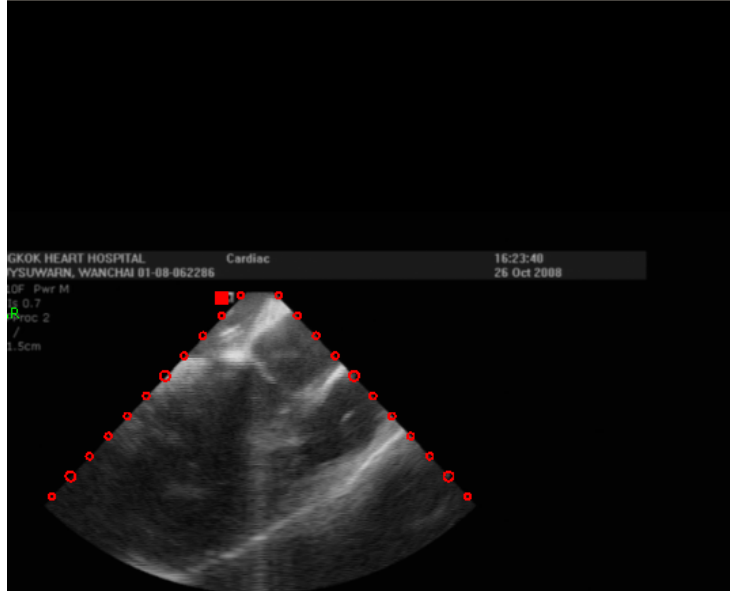
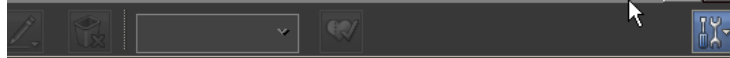
- VT/VF episodes interrogated from ICD.
- Death

Study Patients

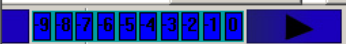
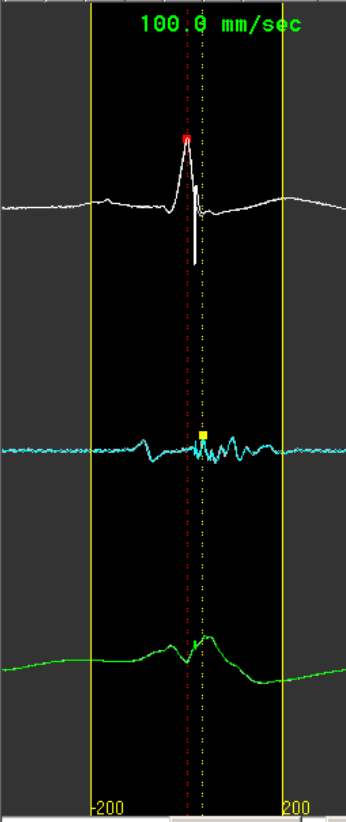
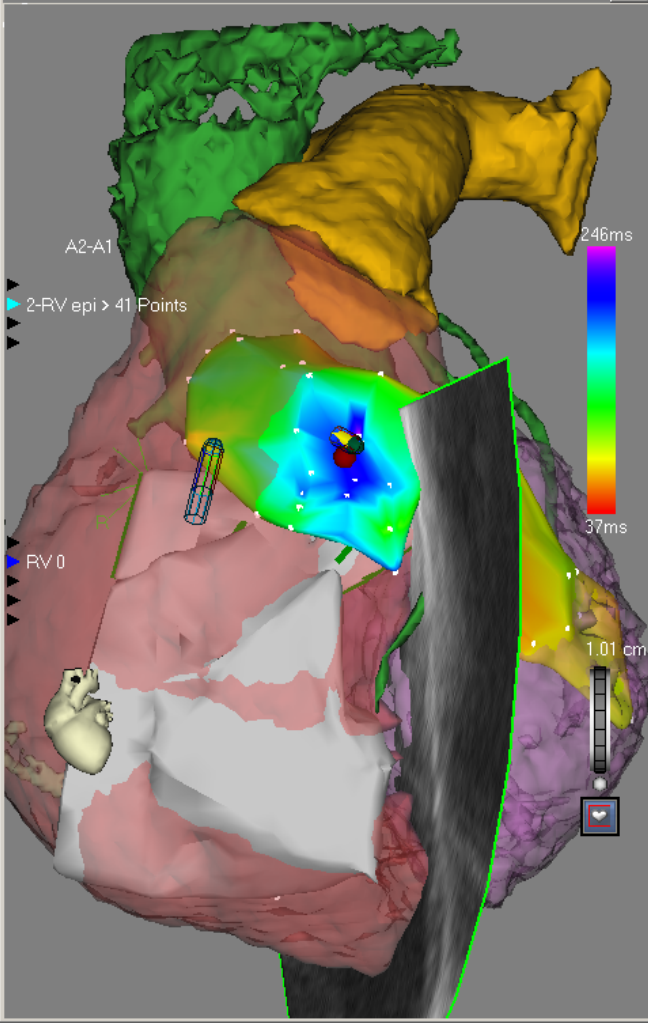
- 14 Brugada Syndrome patients (mean age 41 yrs, all men) with normal structural heart
- All patients had Type-I Brugada ECG pattern (2 with ajmaline).
- All had inducible VF / polymorphic VT.
- All had multiple VF episodes with frequent ICD discharges.



Sound Viewer



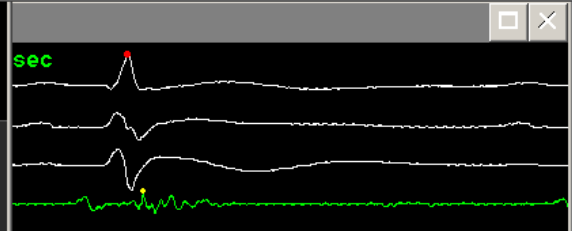
Map Viewer

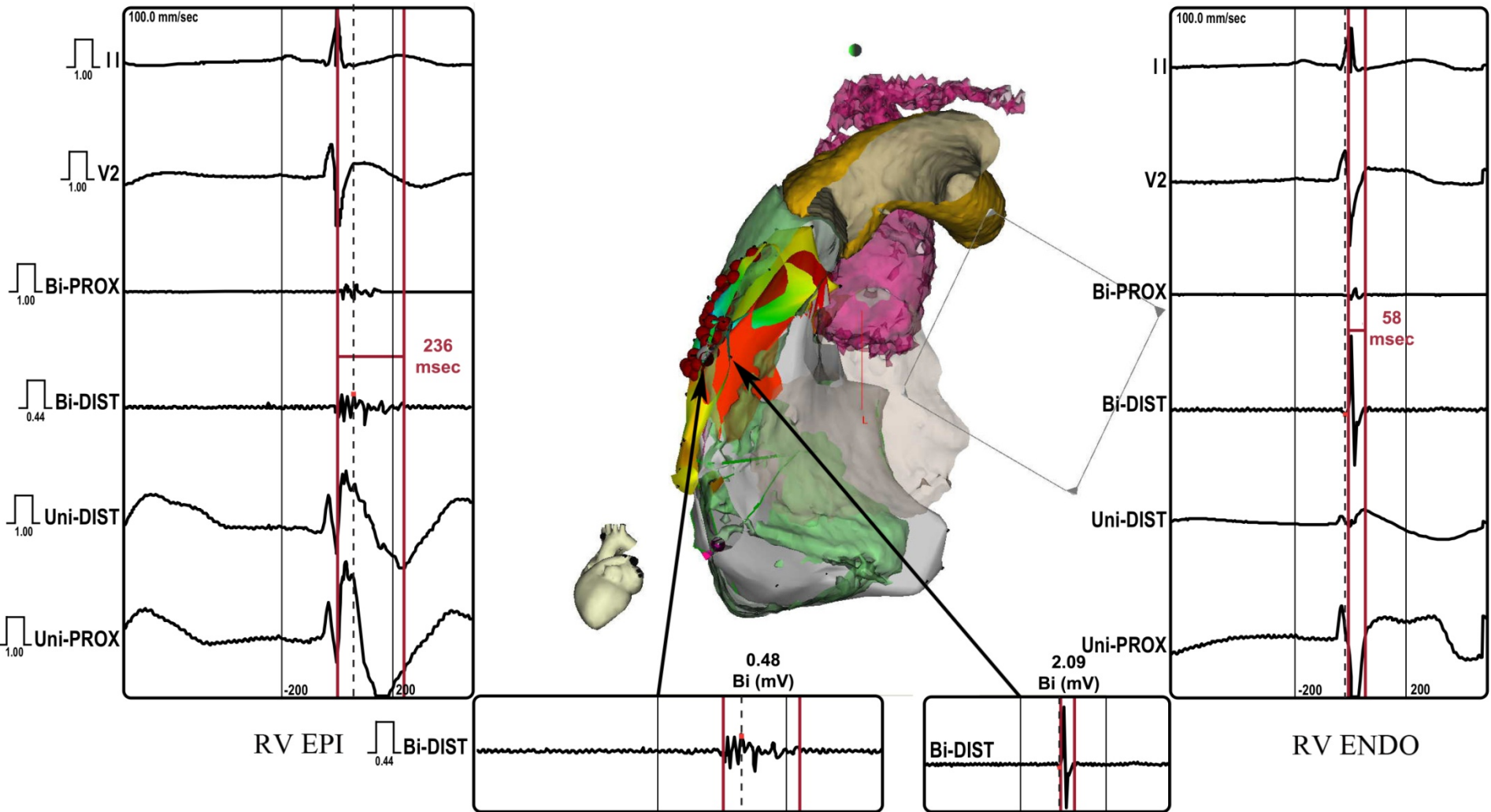


74 LAT
 CL
 (ms) Loc

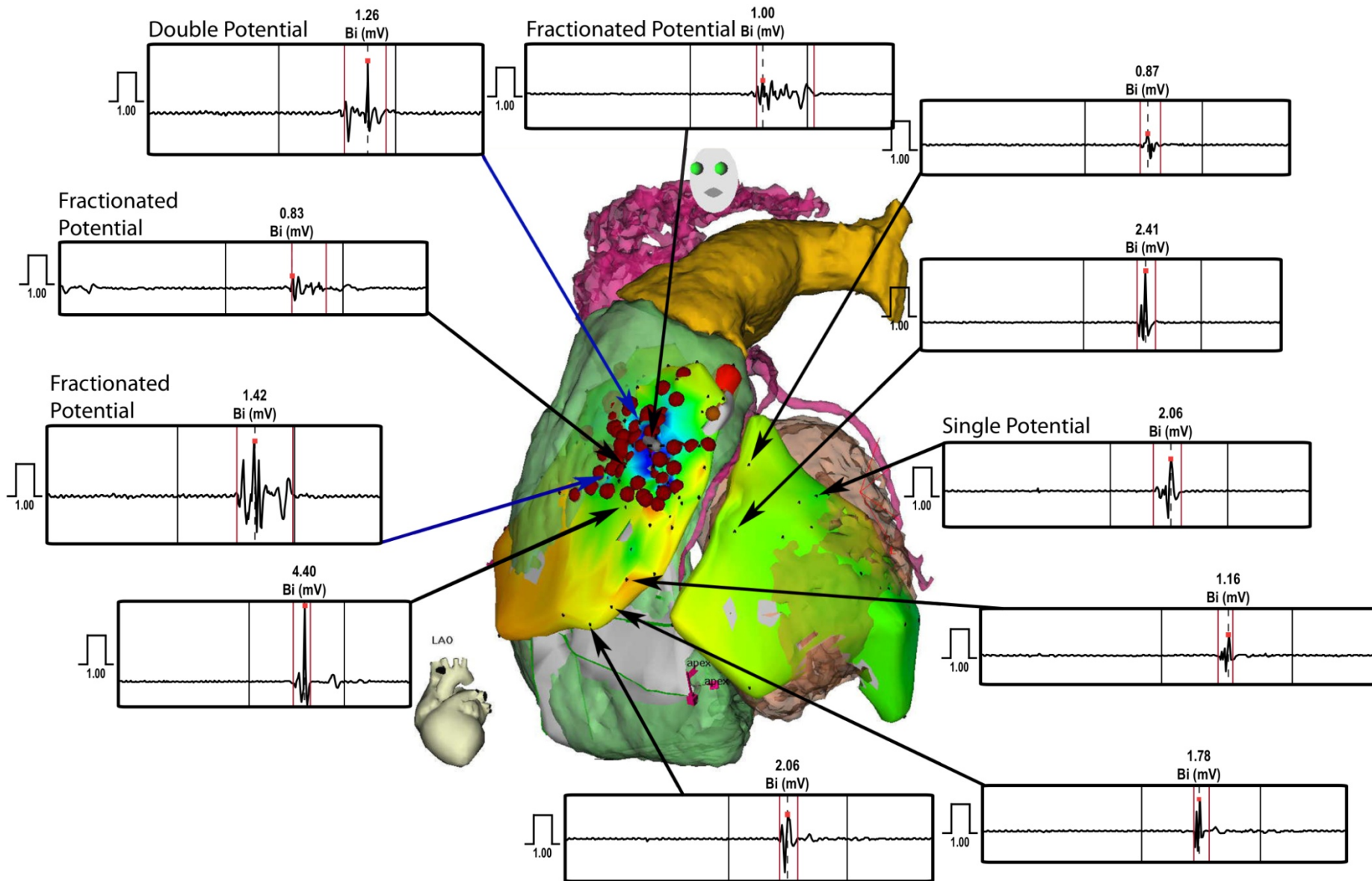
33 5.23 0.40 N/A
 LAT (ms) Uni (mV) Bi (mV) Imp (Ω)
 Show Auto Freeze Tools

Left-Right Invert
 Apex Invert



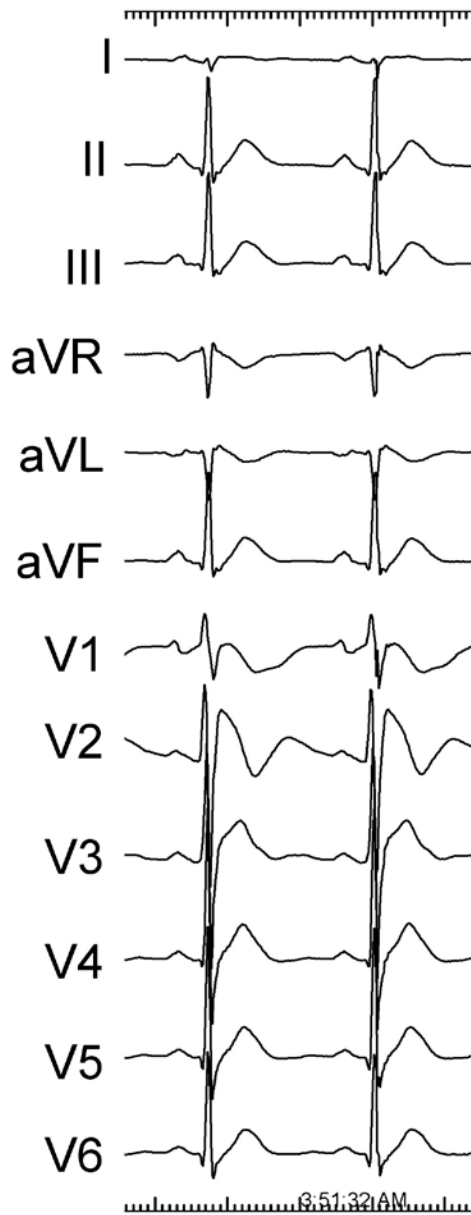


Nademanee et al. Circulation; 2011; 123; 1270-1279

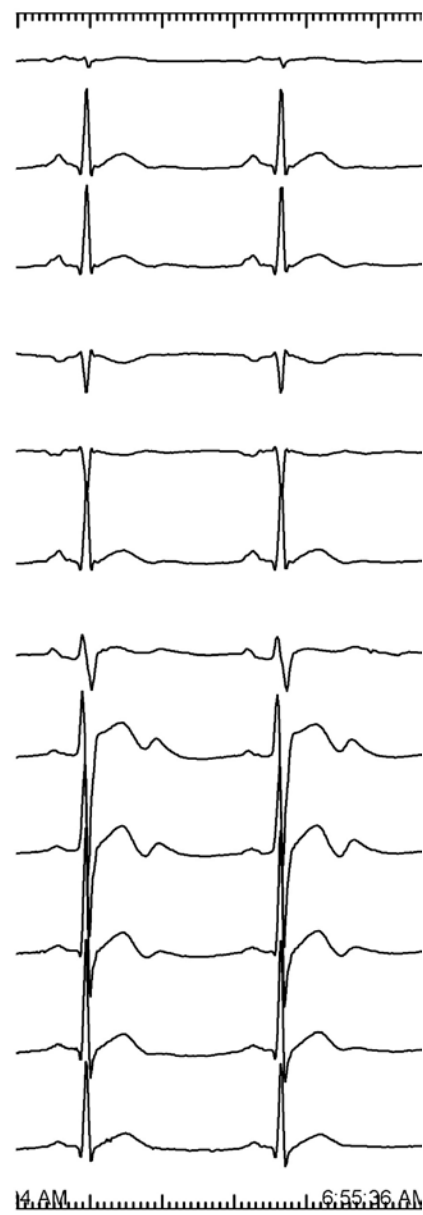


Nademanee et al. Circulation; 2011; 123; 1270-1279

Before Ablation



After Ablation

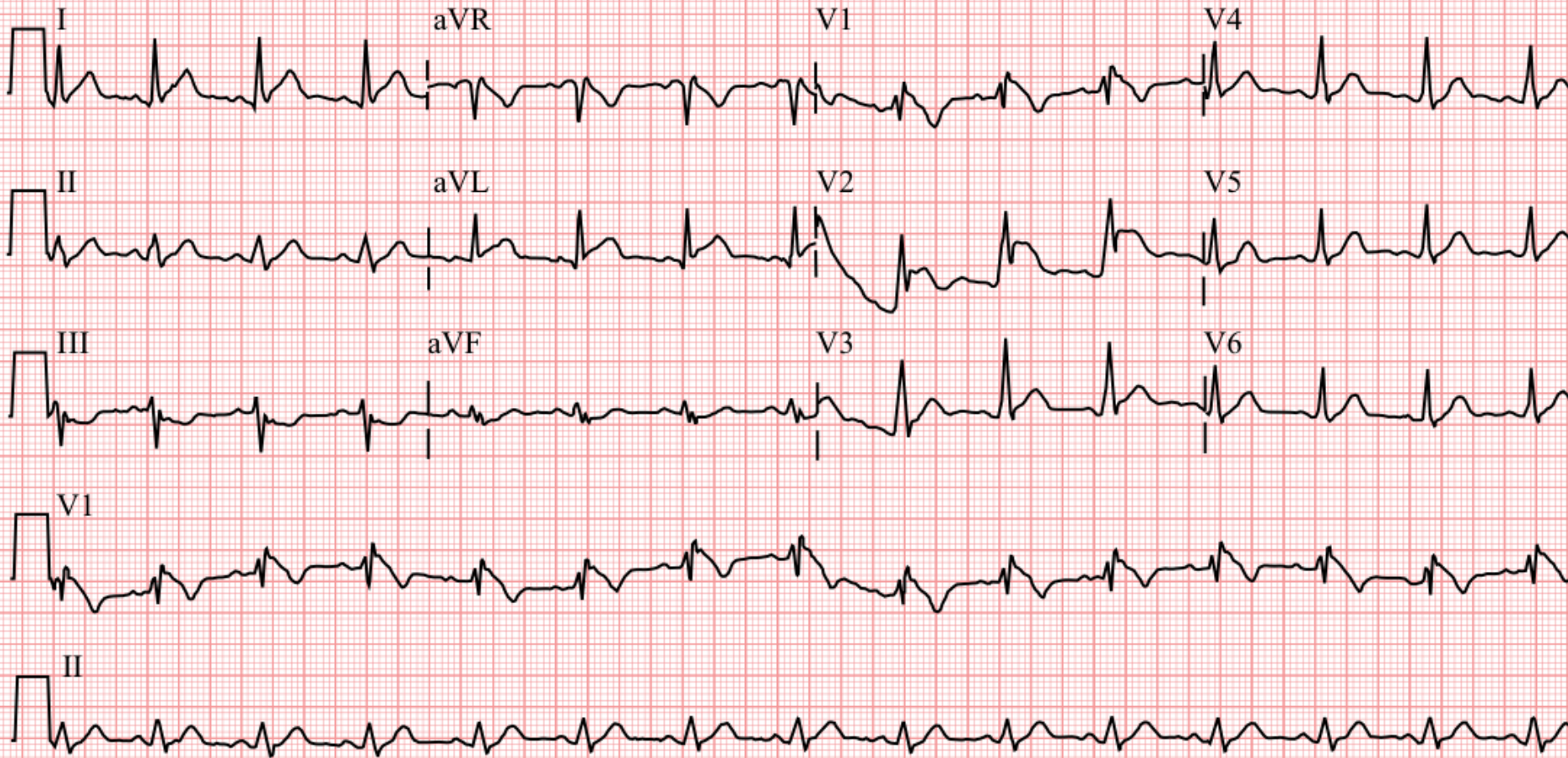


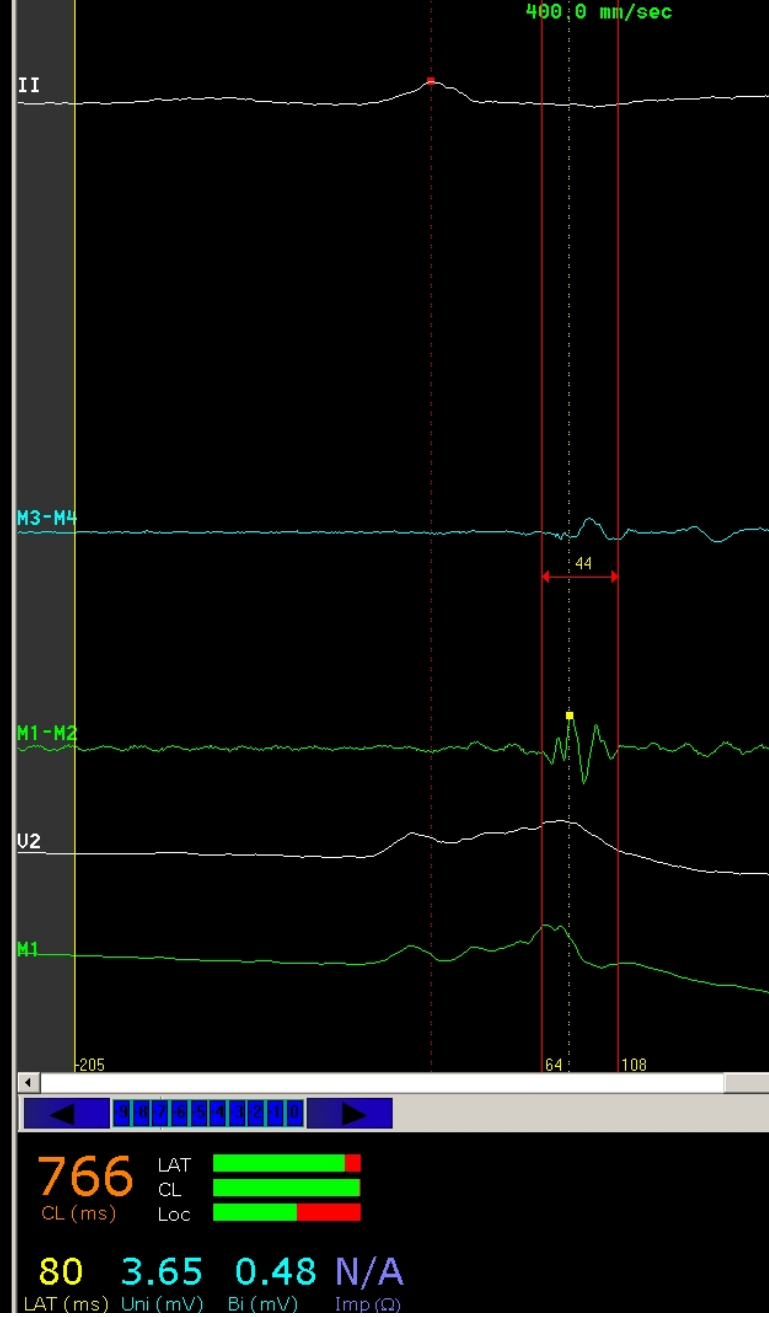
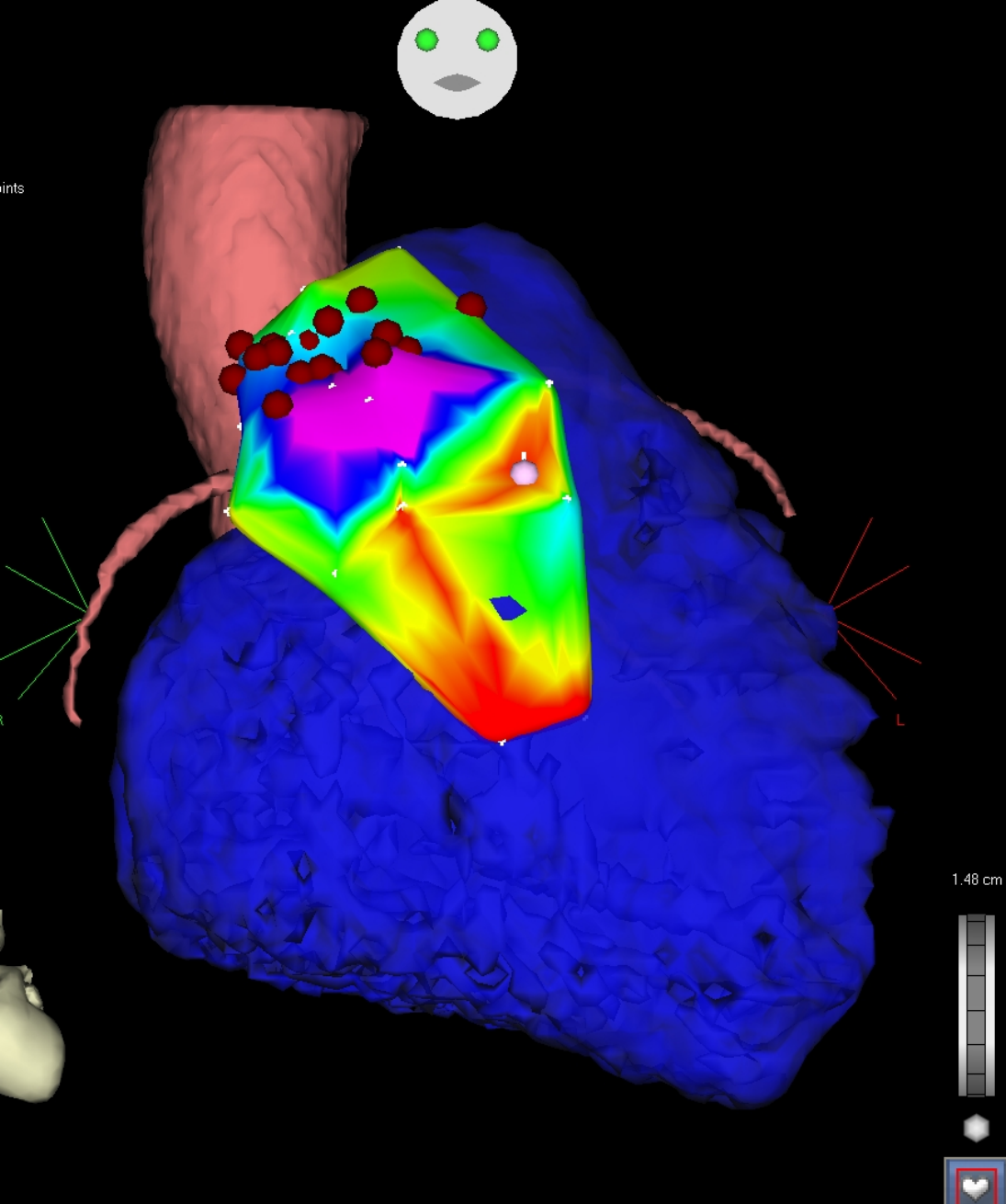
Characteristics of Electrogram among 4 Mapping Areas

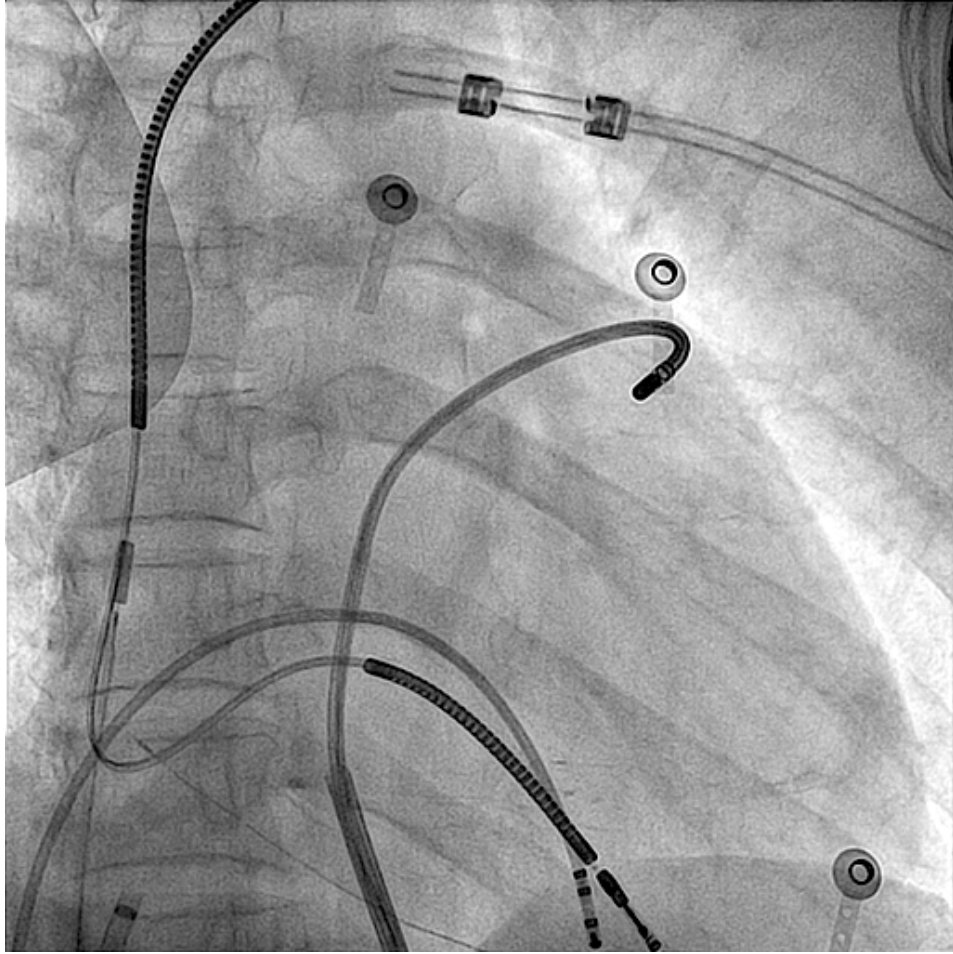
	RV- Epicardium (n =261)	Ant. RVOT Epicardium (n= 189)	LV- Epicardium (n= 164)	RV- Endocardium (n = 213)
Bipolar (mV)	1.35 ± 1.2	0.94 ± 0.79 *	2.81 ± 2	3 ± 2.7
LP (msec)	32 ± 31	96 ± 47 *	6 ± 19	13 ± 23
Electrogram Duration	76 ± 28	132 ± 48*	60 ± 17	66 ± 21

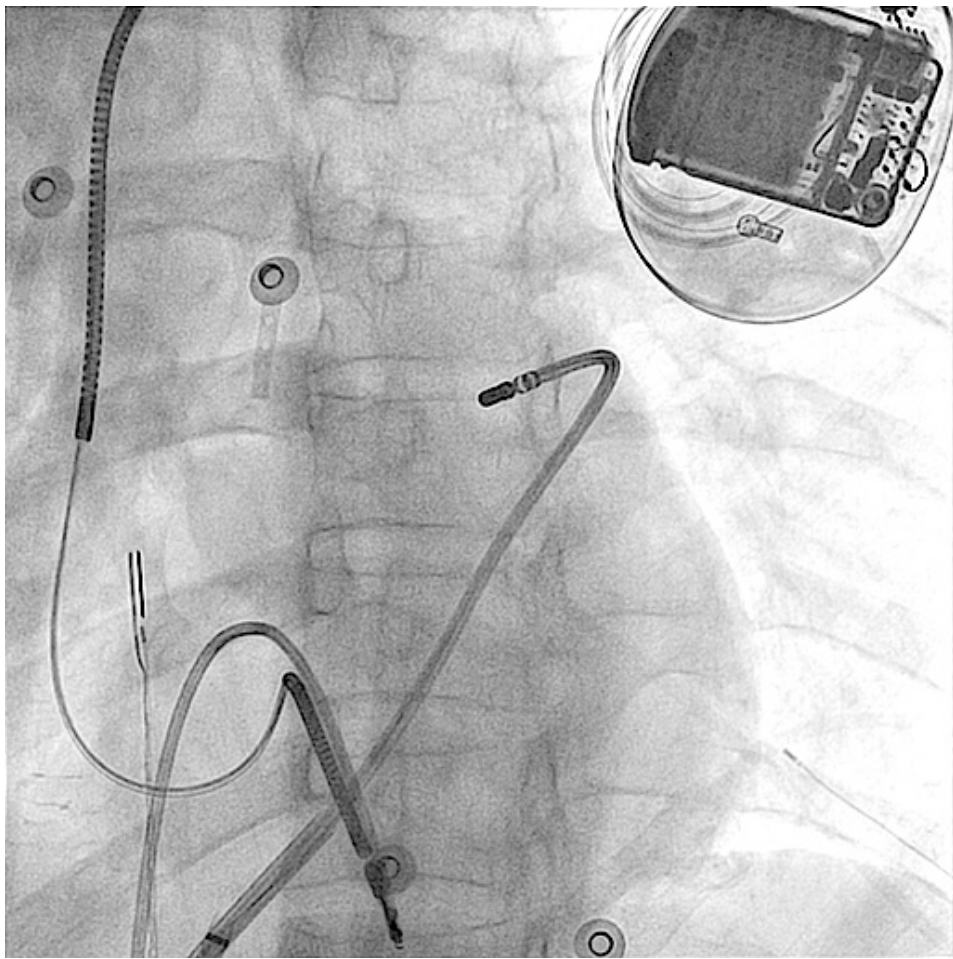
ANOVA, * P < 0.001

Brugada Syndrome: Epicardial Ablation

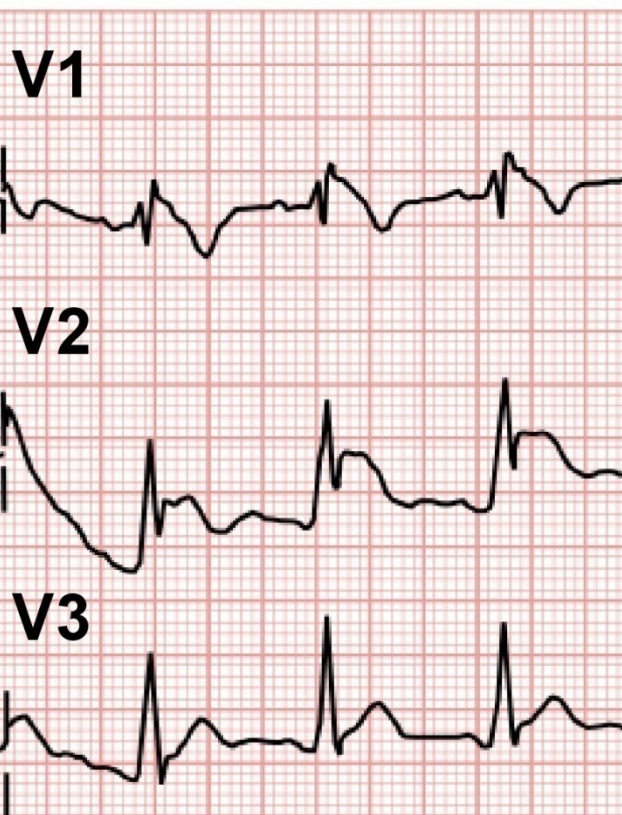




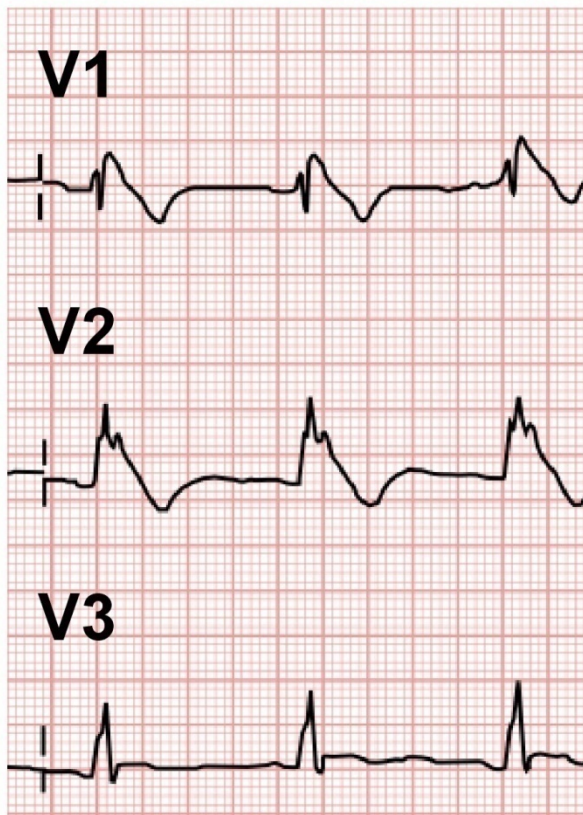




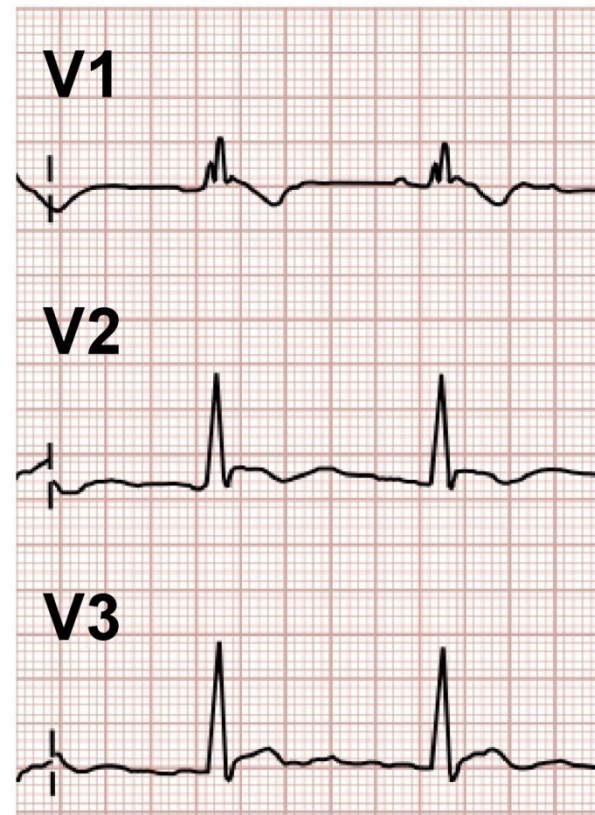
Before Ablation



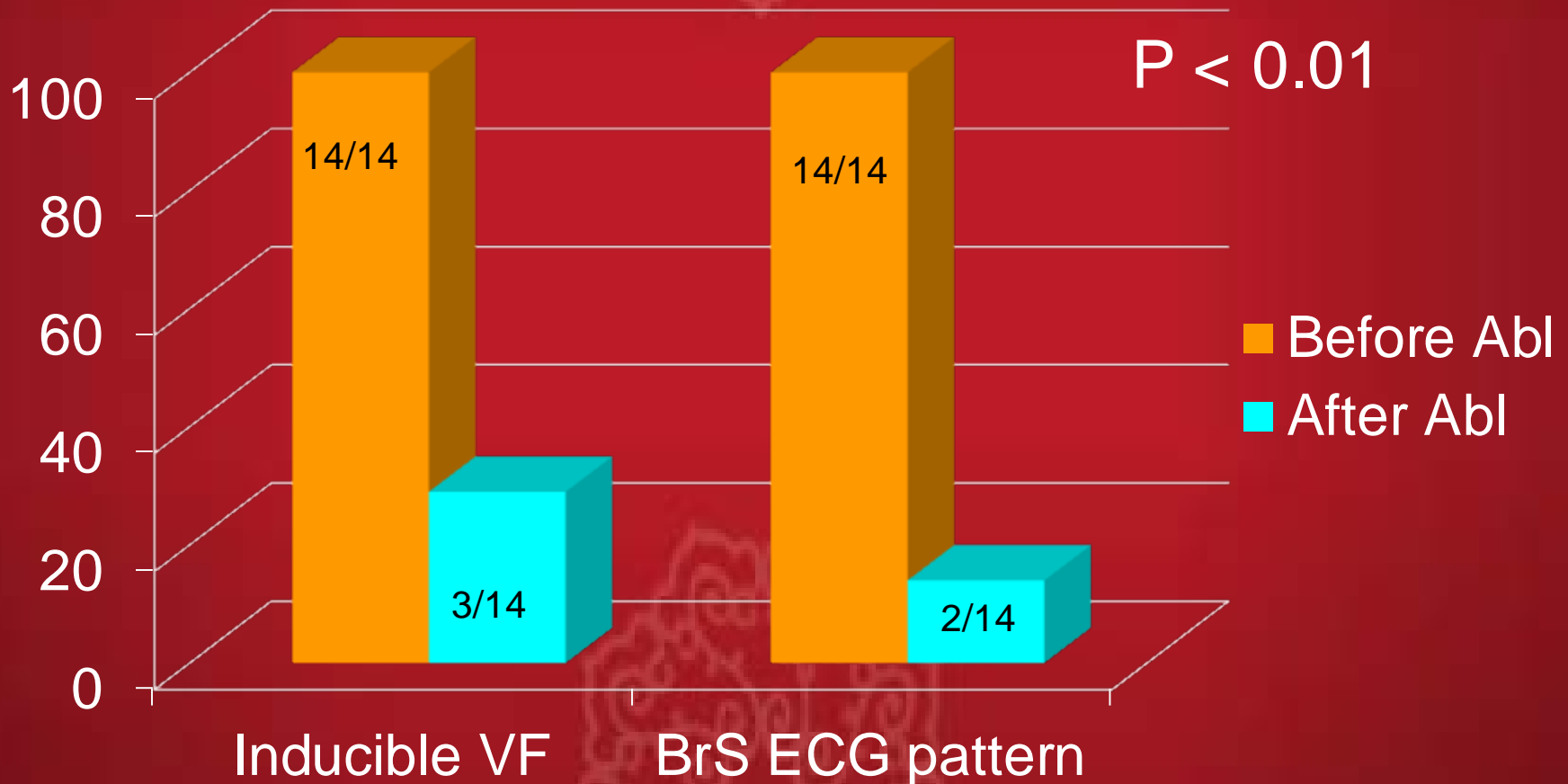
1 Mo. Post Ablation



3 Mo. Post Ablation



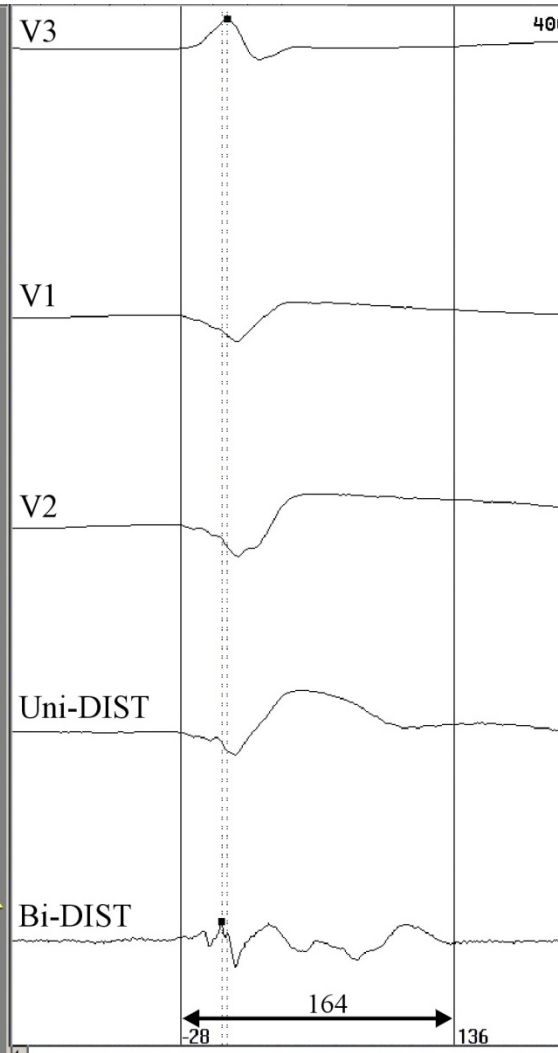
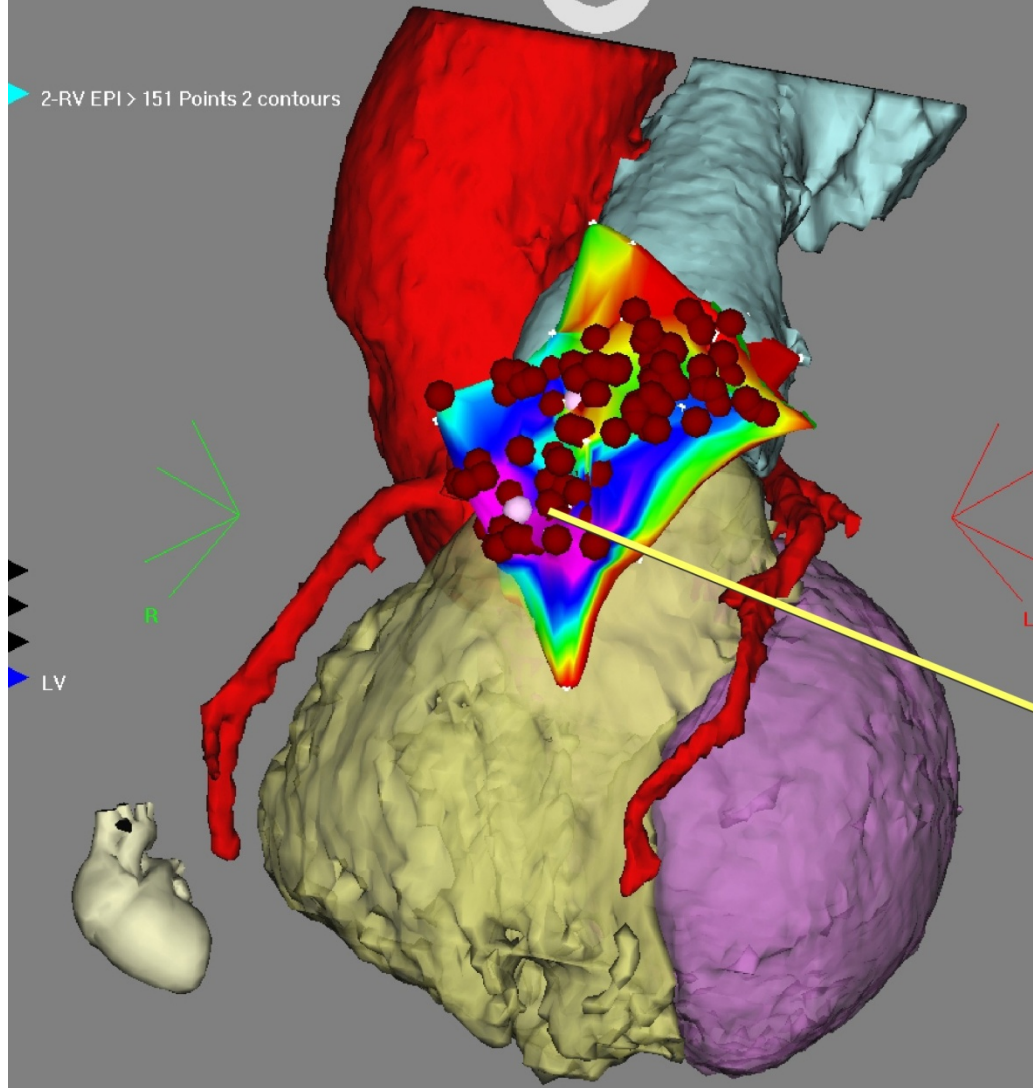
Effect of Ablation on VF induction and BrS Pattern



A2-A1

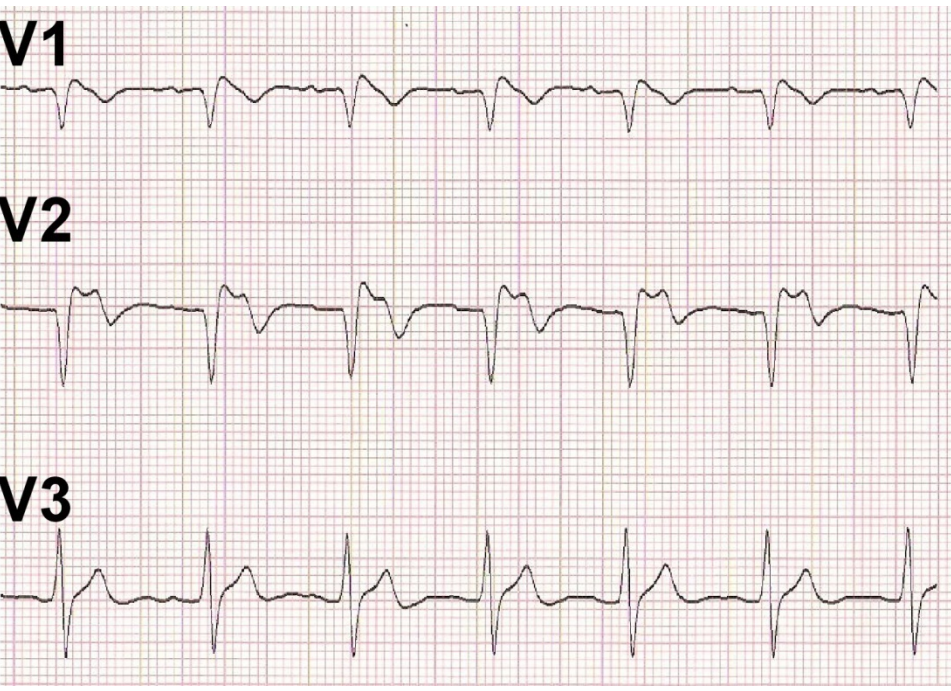


2-RV EPI > 151 Points 2 contours

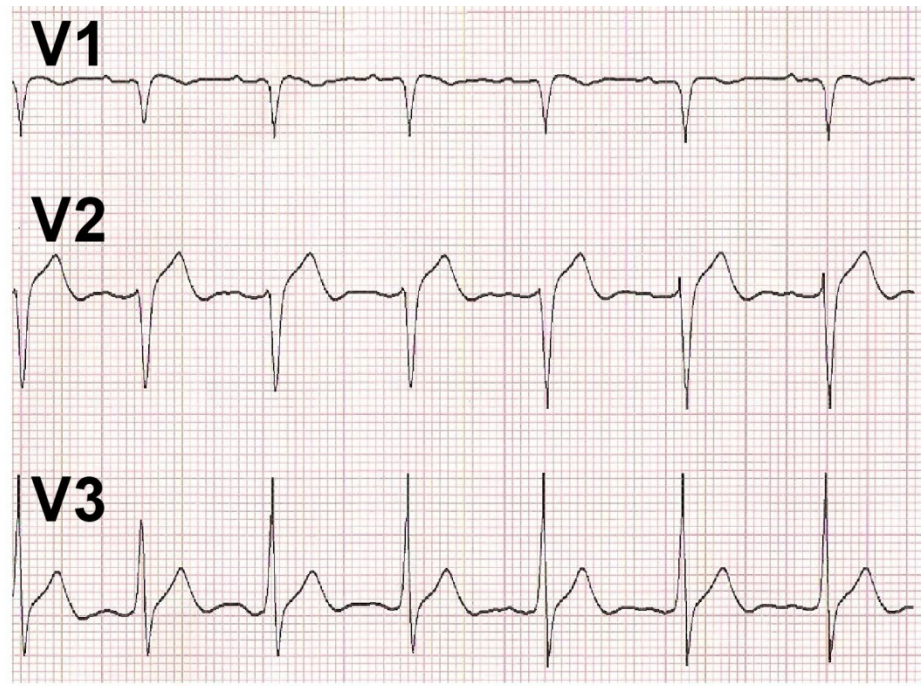


775 LAT
CL CL (ms)
Loc

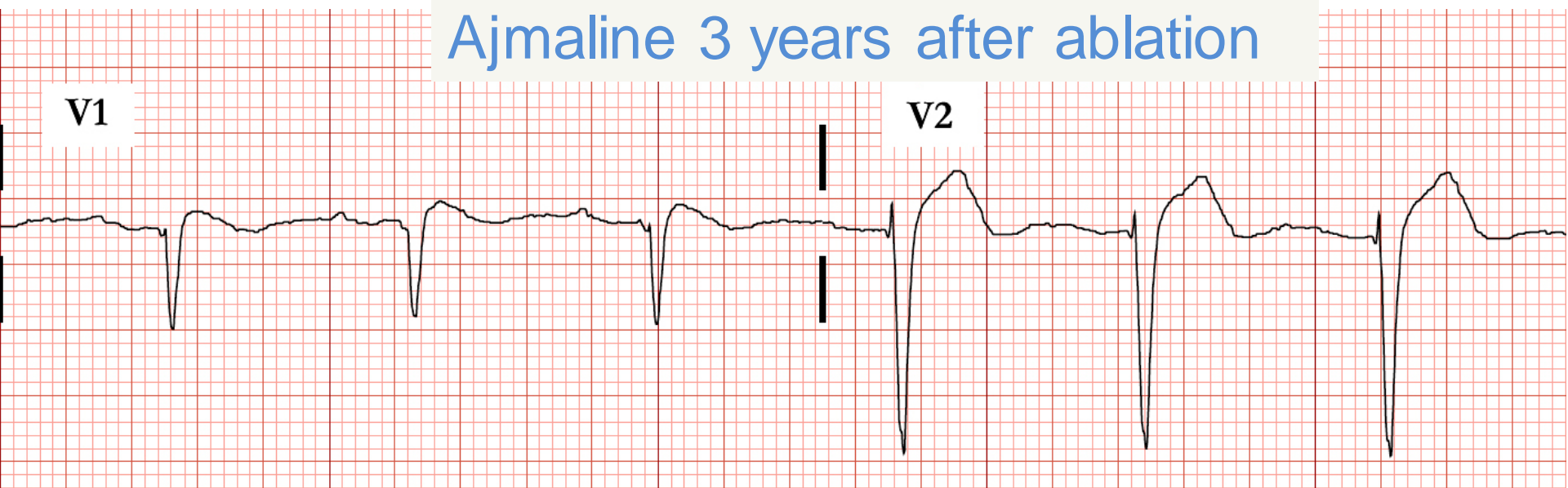
Before ablation



1 month post ablation



Ajmaline 3 years after ablation



ATITHEP YAPAKAI MR.

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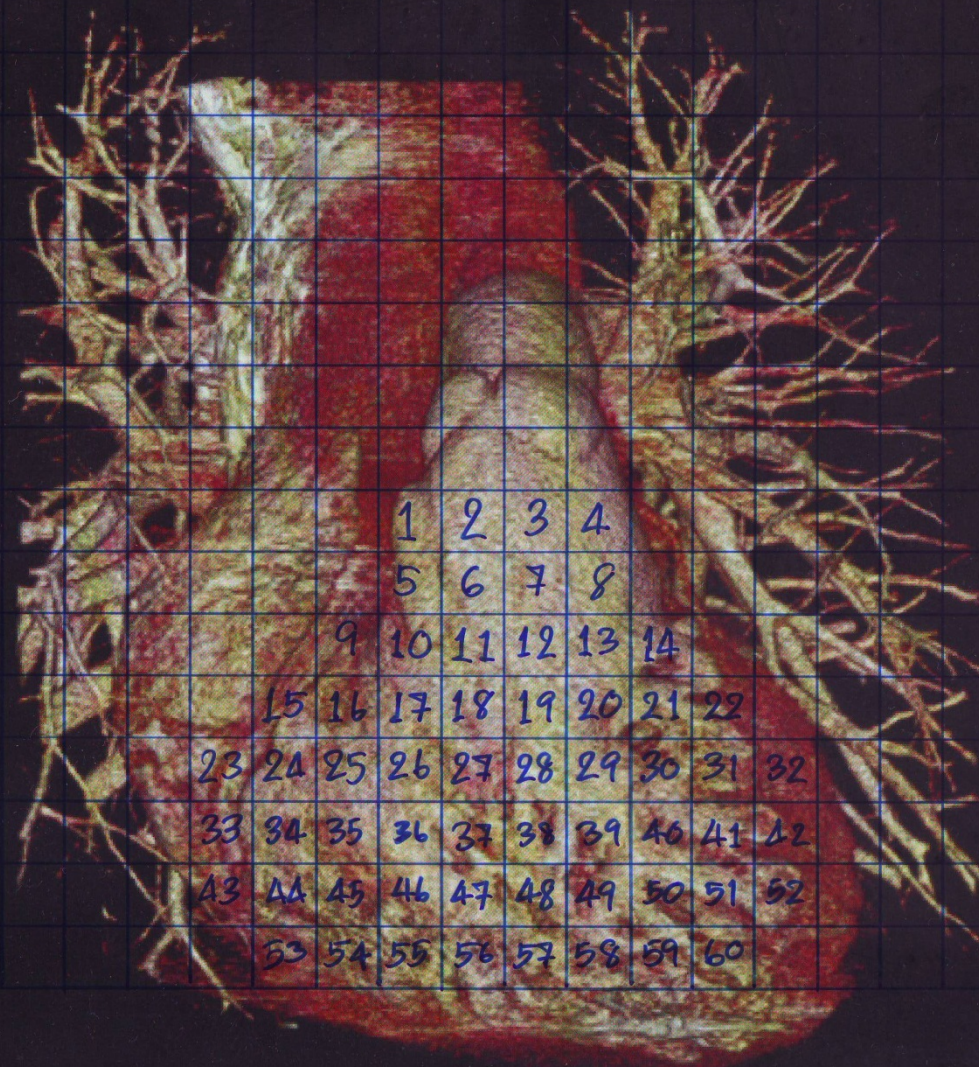
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BangkokHeartHospital

Philips, Brilliance iCT

2 Jan, 2012 10:20:33.00

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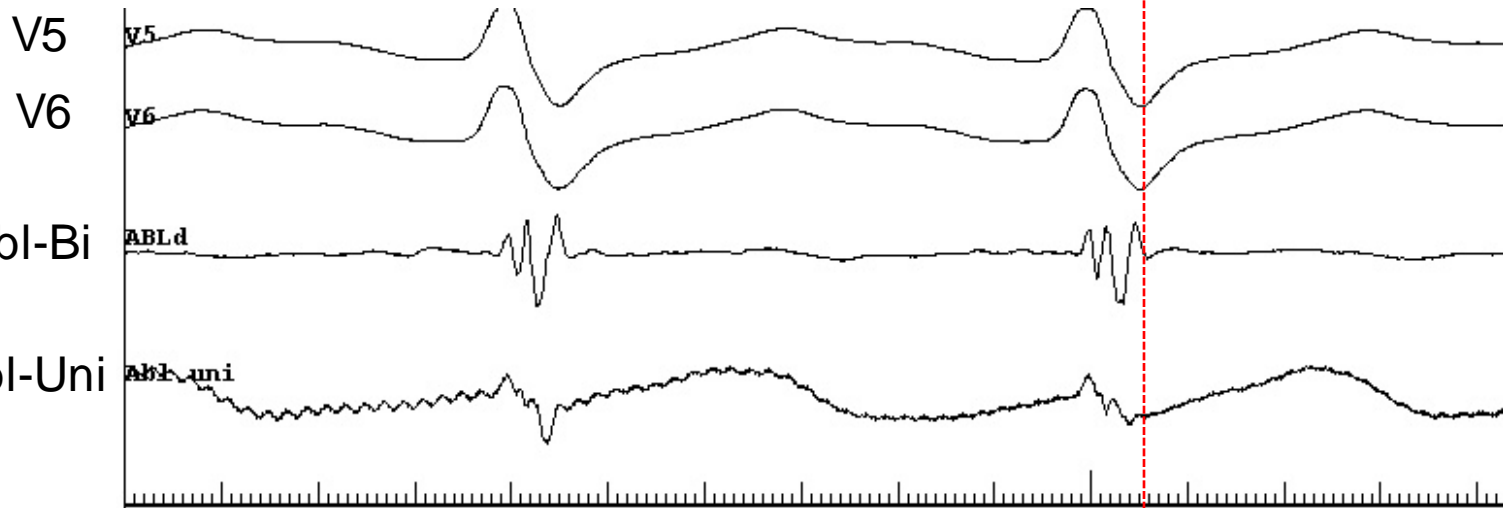
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43 44 45 46 47 48 49 50 51 52

53 54 55 56 57 58 59 60

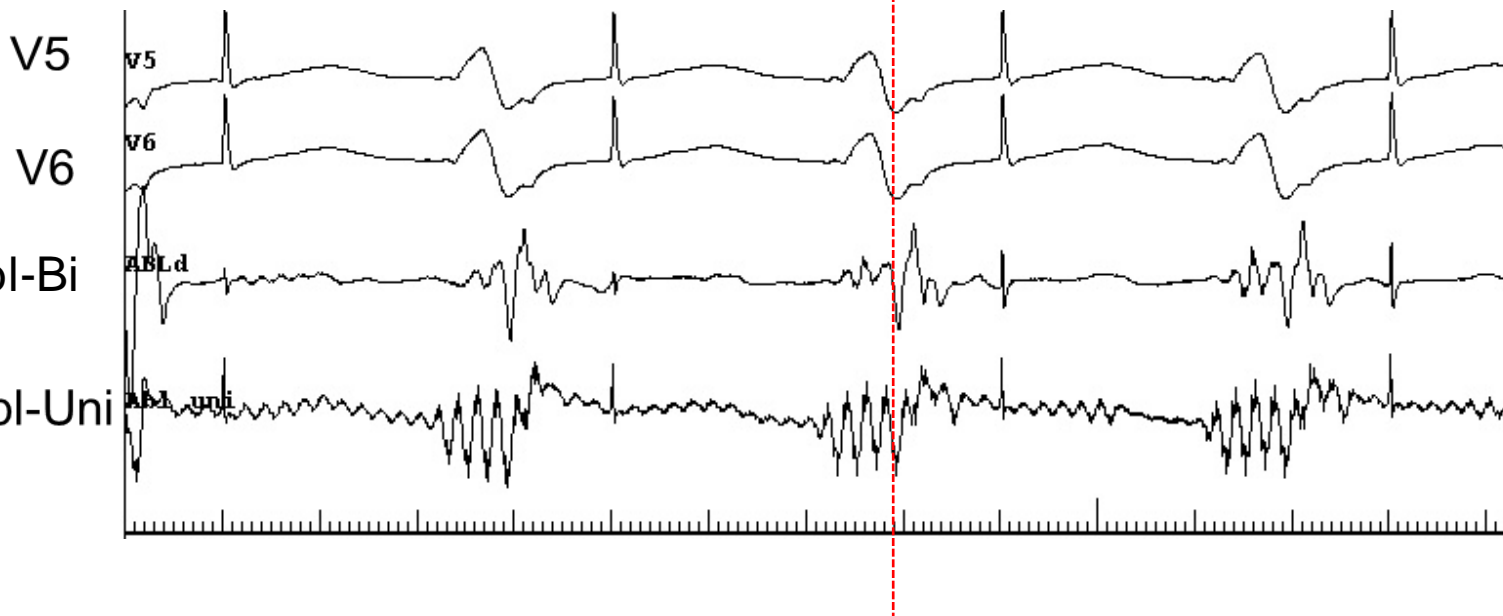
HN: 01-12-000130 Age: 28Y2M7D
 DOB : 26/10/1983(2526) Admit: 02/01/2012

Sinus rhythm 600 msec

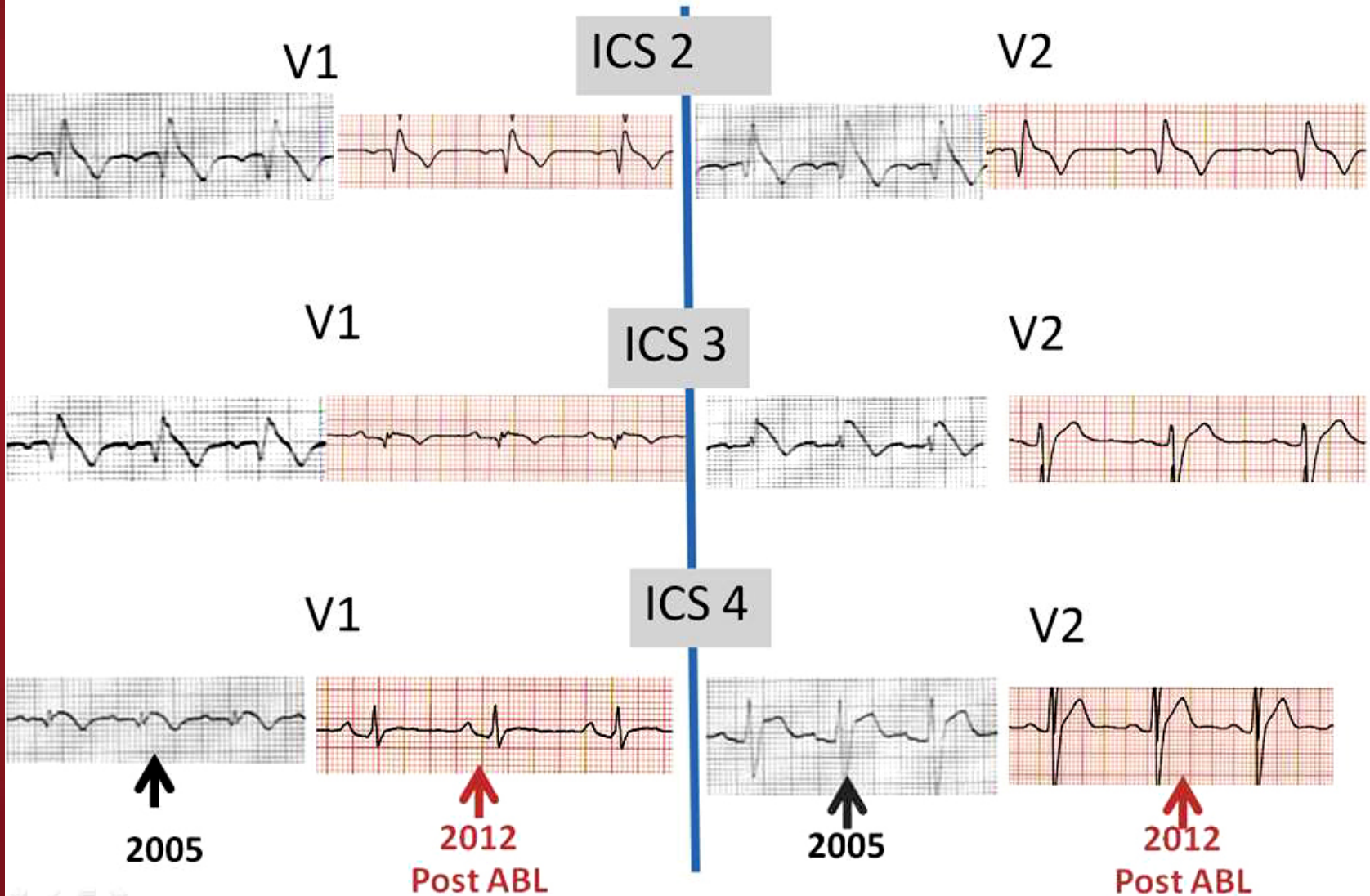


100

Atrial pacing 400 msec



Ajmaline Test before and after Ablation



Longterm Clinical Outcomes after Epicardial Ablation of Anterior RVOT in BrS Patients

After the mean follow-up of 30 ± 15 months (median =32 months).

- 12 of 14 patients (86%) are free of VF recurrences and had normal ECG.
- The remaining 2 patients had recurrent VF associated with presence of BrS ECG necessitating a second ablation. Both had no more VF recurrence and normal ECG.

VF Recurrent Episodes After Successful RF Ablation

	Debut Study	Success Ablation Brs ECG pattern eliminated
Recurrent VF Episodes	25%	0%
Annual VF recurrent rate	20%	0%
Major Complications	6%	0%

Summary

Nademanee et al Cir; 2011;123; 1270-1279

- **Abnormal delayed depolarization**
 - Identified exclusively over anterior RVOT epicardium.
 - Characterized by abnormal prolonged fractionated late potentials.
- Catheter ablation over this area of abnormal potentials.
 - Normalization of the Brugada ECG pattern
 - Preventing VT/VF episodes, both spontaneously occurring or induced via PES.

Conclusions

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

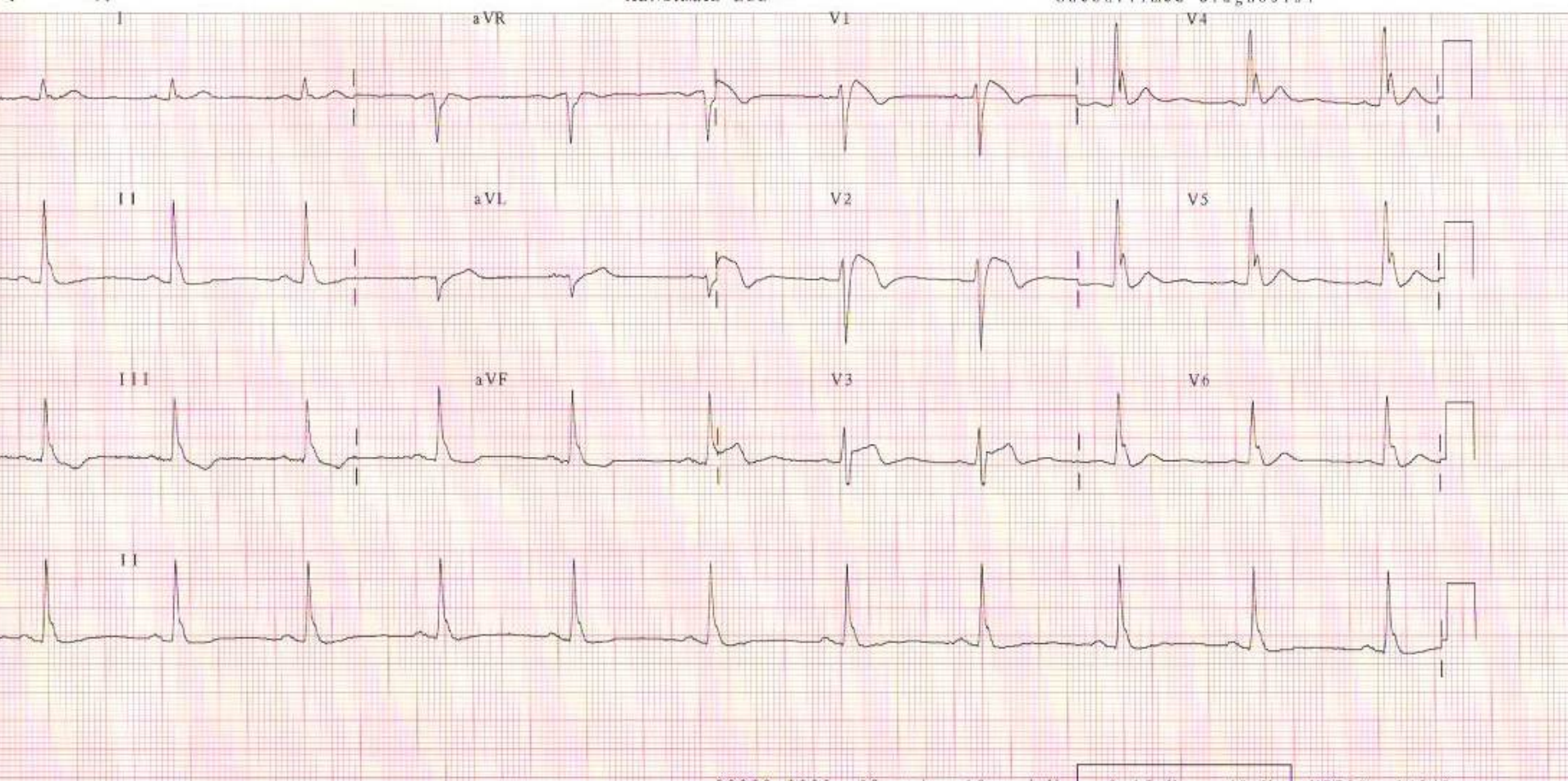
1. Delayed depolarization over anterior RVOT epicardium is the underlying electrophysiologic mechanisms of the Brugada syndrome.
1. Ablation over this arrhythmogenic substrate site is effective in preventing life-threatening arrhythmias in the BrS patients.

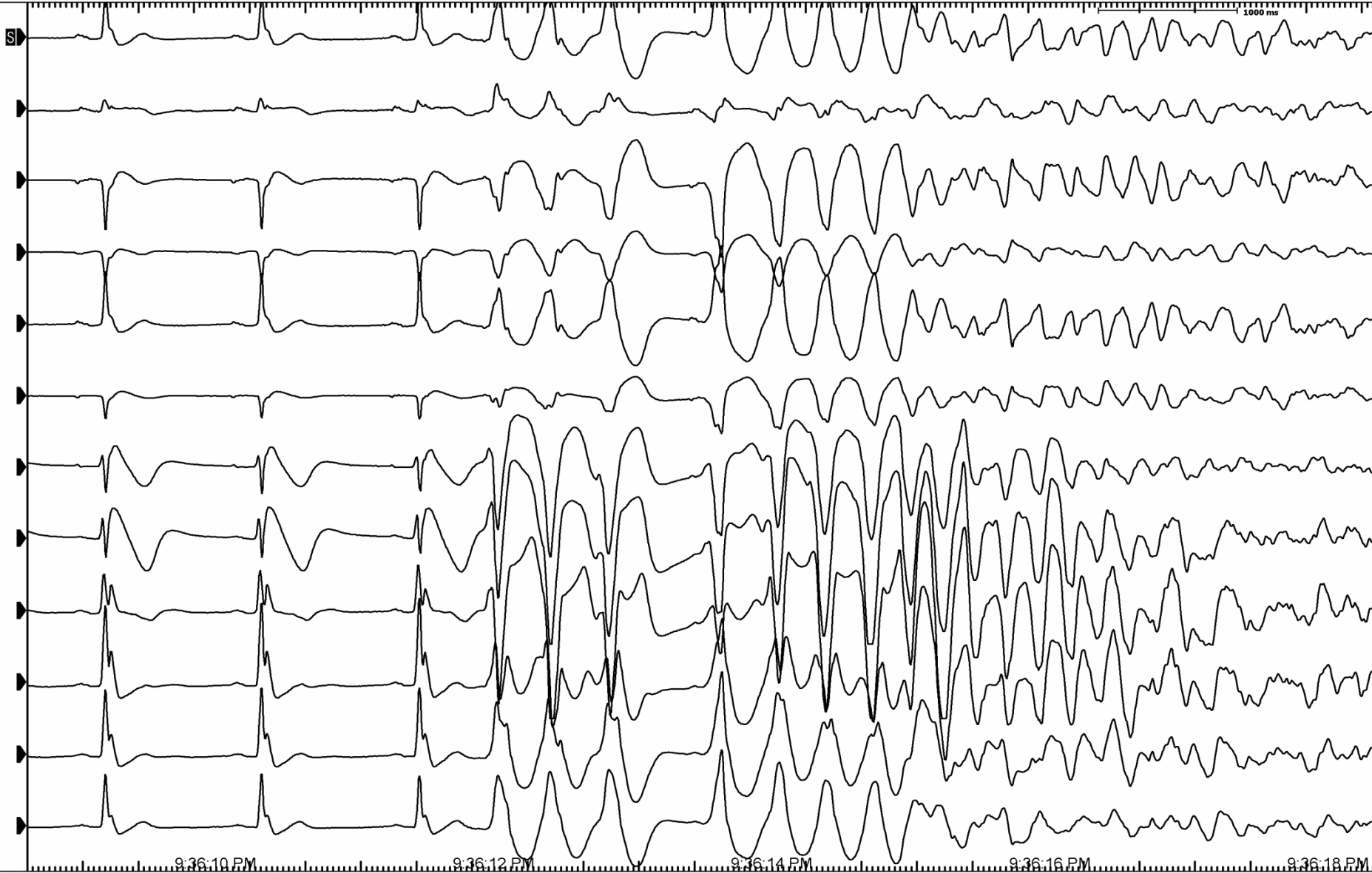
Rate 64 .. NORMAL SINUS RHYTHM, RATE 64.....normal P axis, PR, rate & rhythm
PR 154 .. ANTERIOR INJURY (PROBABLE ACUTE INFARCT).....ST>.35mV V1-V5
ORS 115
QT 371
QTc 383

--Axis--
P 38
ORS 75
T -41

- ABNORMAL ECG -

Unconfirmed diagnosis.





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9:36:12 PM

9:36:14 PM

9:36:16 PM

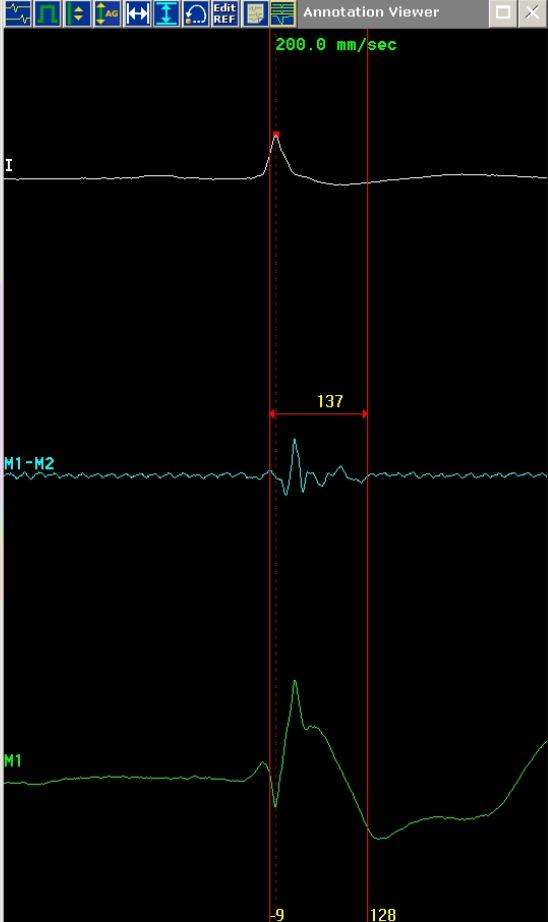
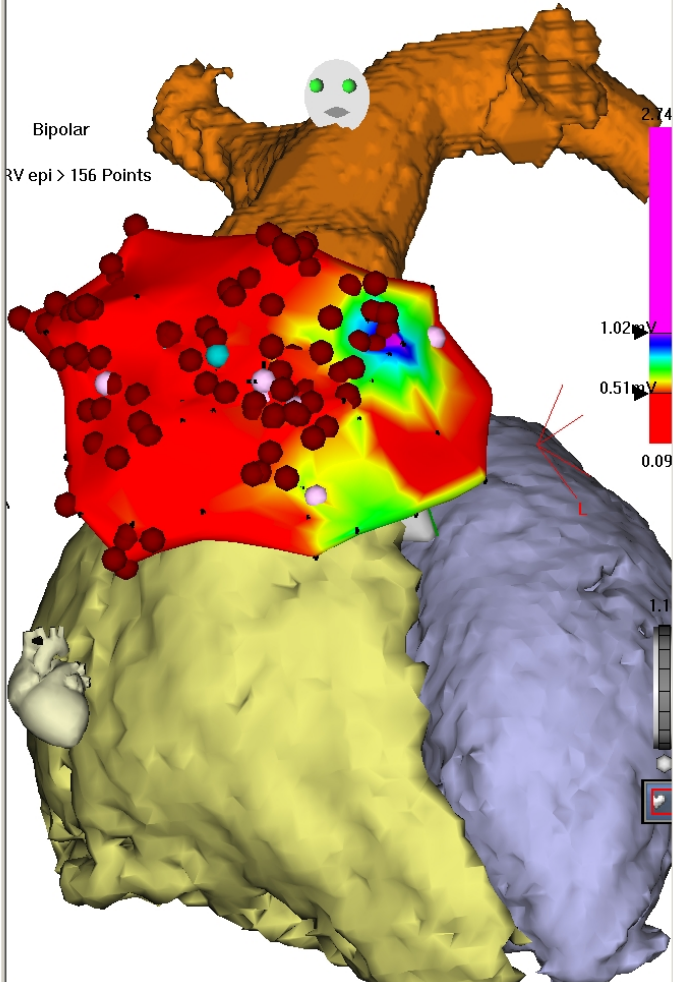
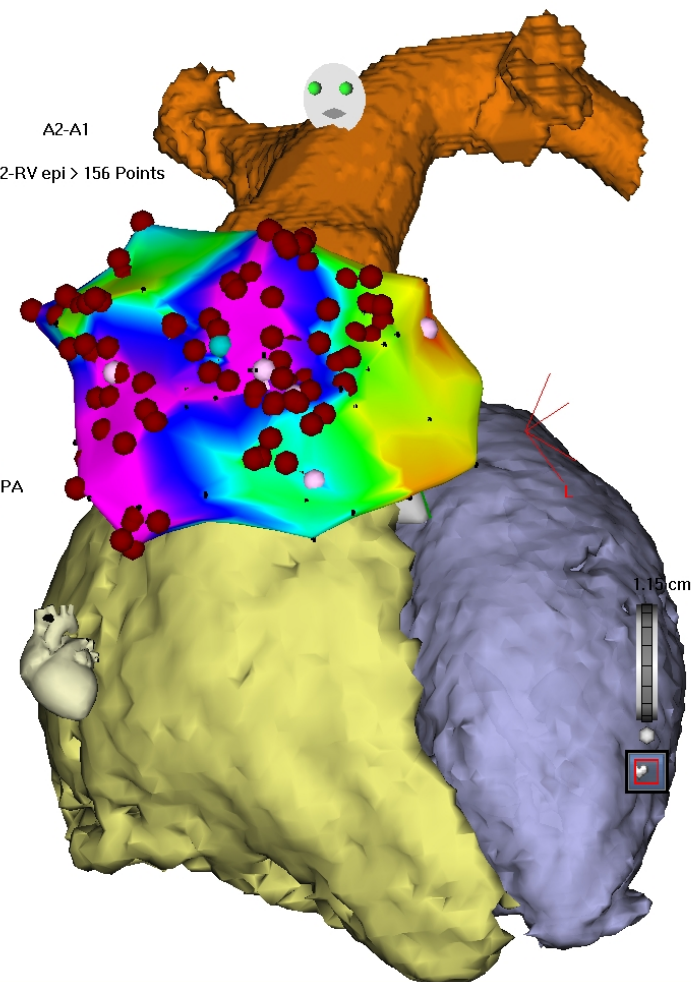
9:36:18 PM



Viewer

Sync Complementary

Annotation Viewer



1106 LAT CL
CL (ms) Loc

26 4.51 0.48 N/A
LAT (ms) Uni (mV) Bi (mV) Imp (Ω)

Show Auto Freeze Tools

Before Ablation

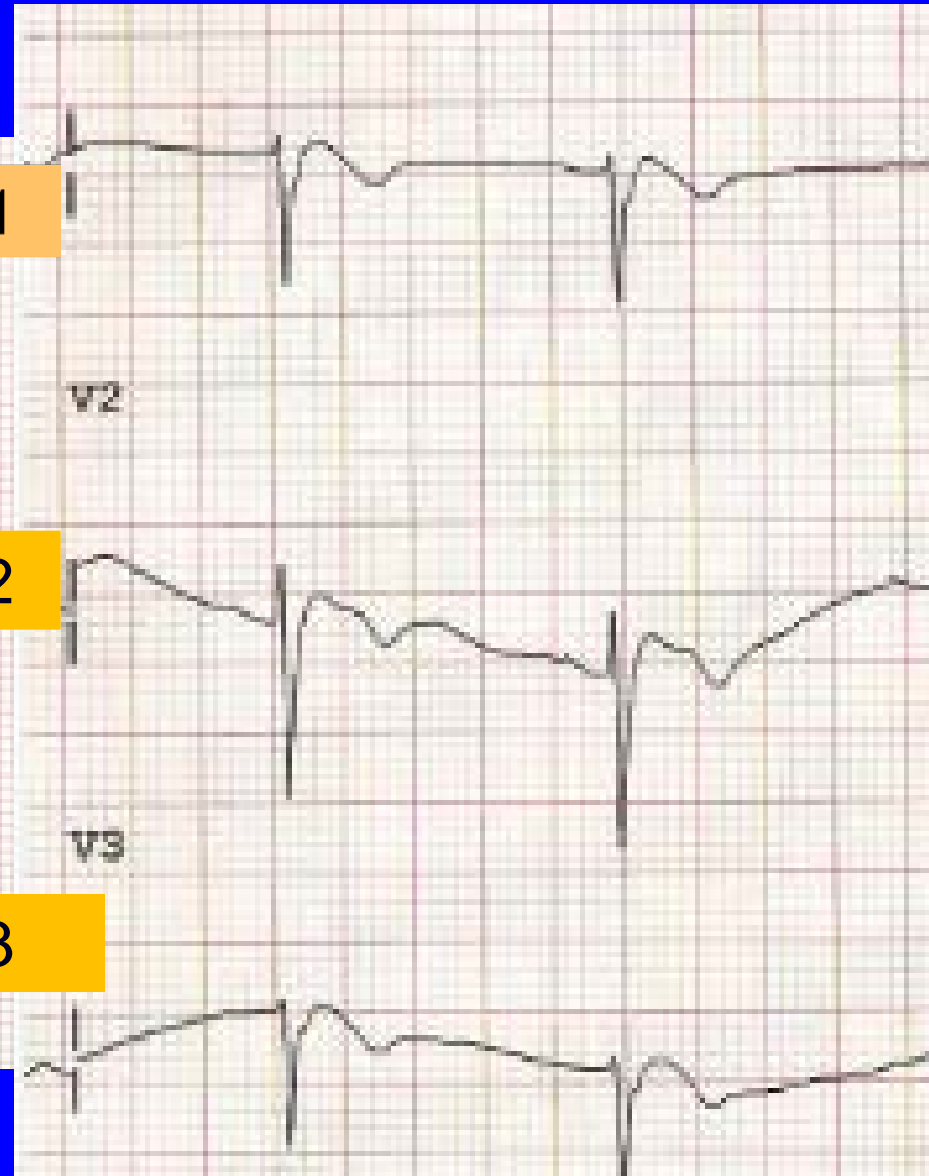


V1

V2

V3

After Ablation



V2

V3

Beware of Combined Brs & ER Syndromes

- In BrS patients with frequent VF episodes, abnormal early repolarization pattern is present in 10-20%.
- If combined ER and BrS syndromes are present, elimination of the BrS pattern alone may not completely eliminate the risk of VF recurrence.