

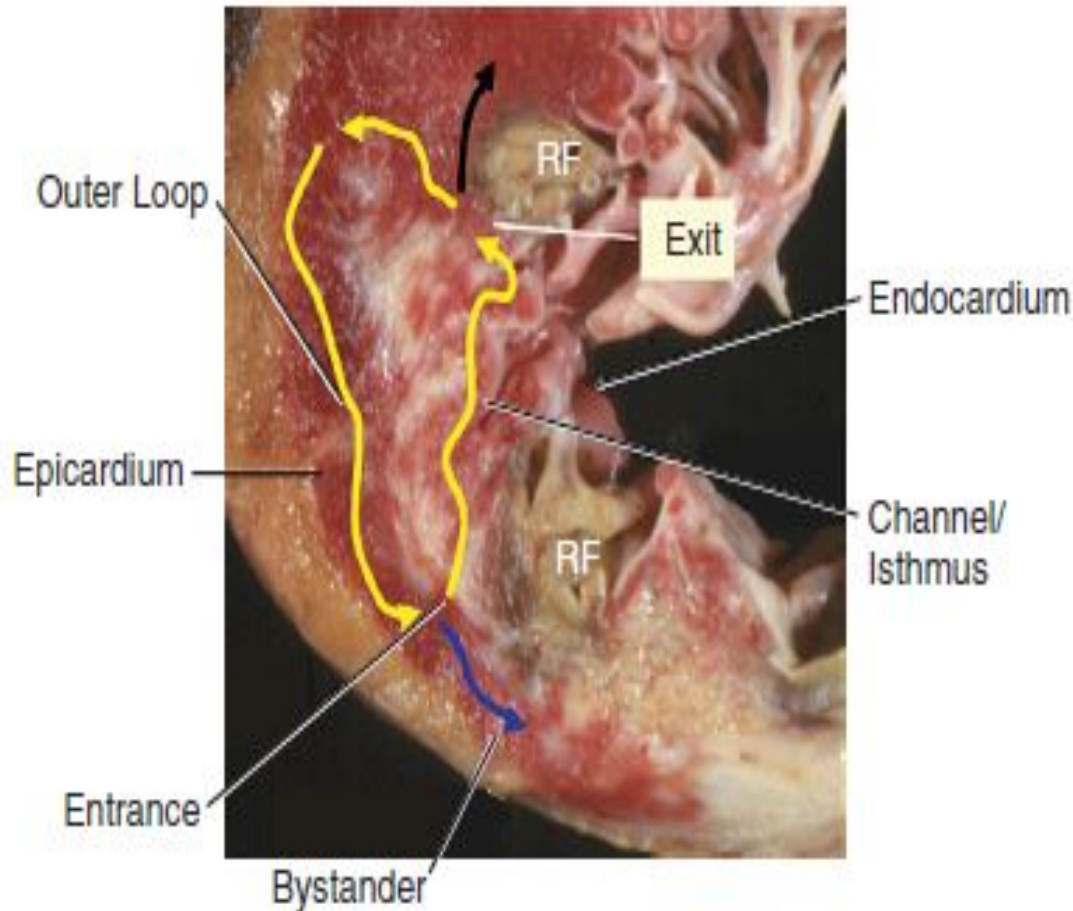


Ventriküler Taşikardide Geç Potansiyel Ablasyonu

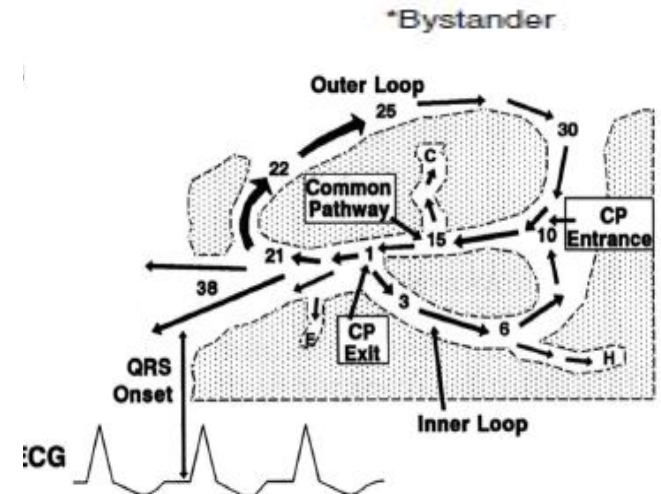
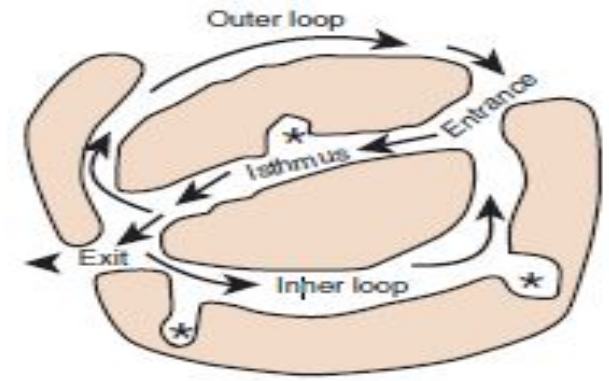
Dr.Bernas ALTINTAŞ

Gazi Yaşargil Eğitim ve Araştırma Hastanesi

- **Skar ilişkili reentri;** tekrarlayan sustained VT atakları olan hastalarda en yaygın aritmi substratını temsil eder ve en sık nedeni geçirilmiş MI' dır



FUNCTIONAL LINES OF BLOCK



Aktivasyon ve Eintrainment mapping

Re-entry devresinin tespit edilebilmesi için VT'nin

- Sürekli olmalı
- Monomorfik olmalı
- Siklus uzunluğu düzenli olmalı (≤ 20 msn)
- Hemodinamiyi bozmamalı
- Farklı morfolojilere dönüşmemeli
- Over-drive pace ile sonlanmamalı veya morfolojisi değişmemeli

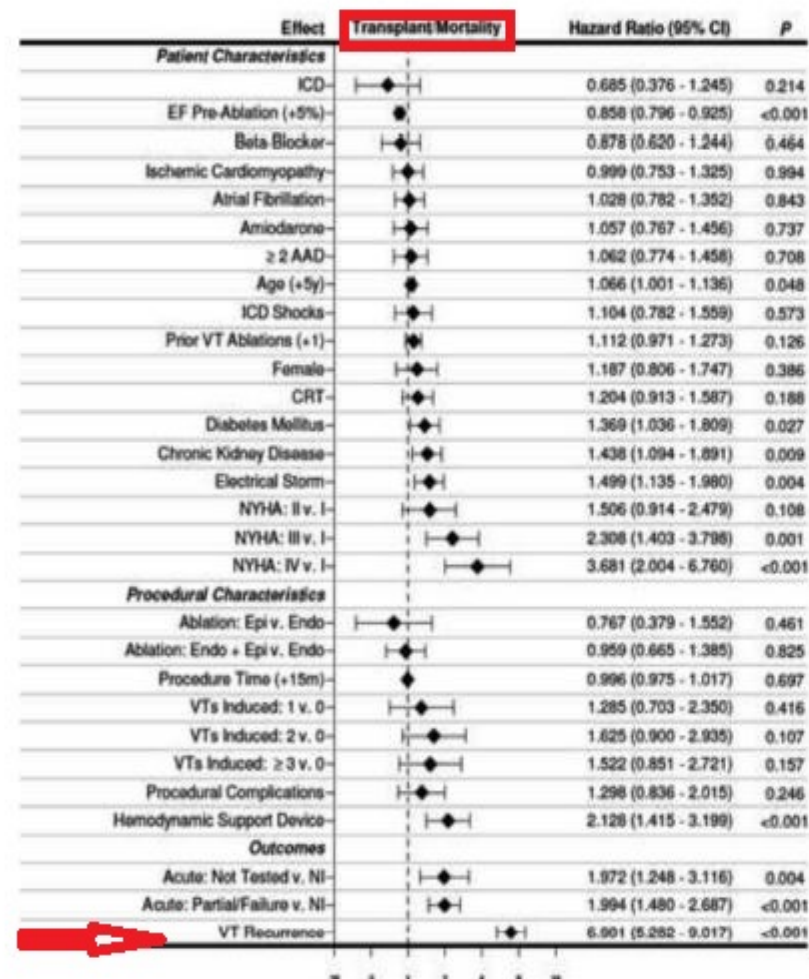
FREEDOM FROM RECURRENT VENTRICULAR TACHYCARDIA AFTER CATHETER ABLATION IS ASSOCIATED WITH IMPROVED SURVIVAL IN PATIENTS WITH STRUCTURAL HEART DISEASE:

AN INTERNATIONAL VT ABLATION CENTER COLLABORATIVE GROUP STUDY

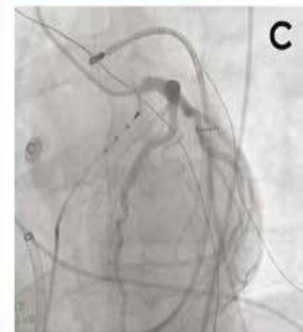
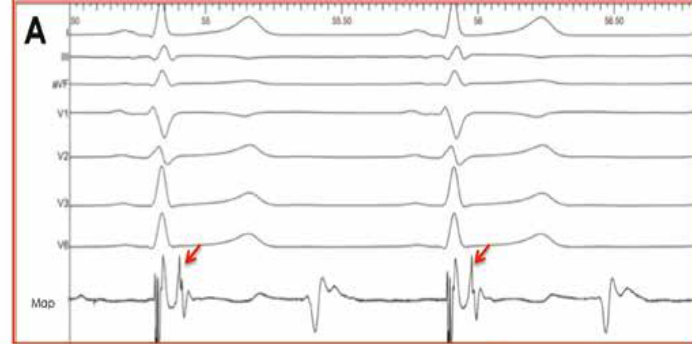
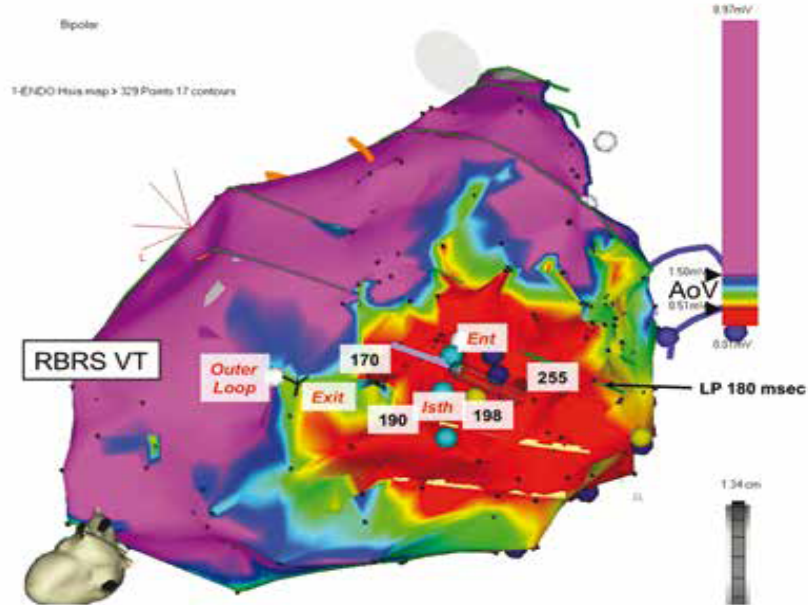
Roderick Tung, MD^{1,*}, Marmar Vaseghi, MD MS^{1,*}, David S. Frankel, MD^{2,#}, Pasquale Vergara, MD^{3,#}, Luigi DiBiase, MD PhD^{4,#}, Koichi Nagashima, MD⁵, Ricky Yu, MD¹, Sitaram

Procedural characteristics by VT recurrence and mortality

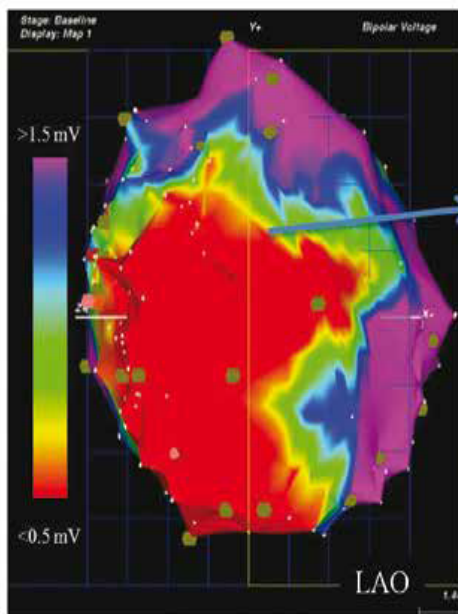
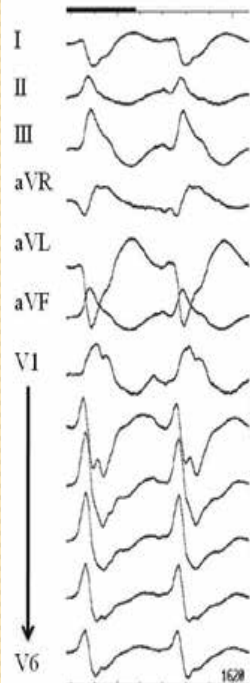
N (%) or median (Q1-Q3)	VT Recurrence within 12 Months		p value	Transplant/Death within 12 Months		p value
	Yes (N=536)	No (N=1525)		Yes (N=273)	No (N=1788)	
Hemodynamic Support Device	32 (7.9)	63 (5.3)	0.068	39 (19.9)	56 (4.0)	<0.001
Epicardial Access	178 (37.5)	404 (29.3)	0.001	83 (33.7)	499 (31.1)	0.440
Ablation			0.040			0.131
Endo	350 (72.2)	1049 (75.6)		186 (74.1)	1213 (74.8)	
Epi	24 (4.9)	94 (6.8)		9 (3.6)	109 (6.7)	
Endo+Epi	106 (21.9)	236 (17.0)		54 (21.5)	288 (17.8)	
Number of VTs Induced			<0.001			<0.001
0	40 (8.4)	176 (12.7)		15 (6.0)	201 (12.5)	
1	116 (24.4)	503 (36.2)		52 (20.8)	567 (35.2)	
2	131 (27.6)	318 (22.9)		72 (28.8)	377 (23.4)	
≥3	188 (39.6)	391 (28.2)		111 (44.4)	468 (29.0)	
VT Mappability			0.193			<0.001
All Unmappable	149 (40.4)	394 (38.8)		93 (46.3)	450 (38.0)	
All Mappable	150 (40.7)	462 (45.5)		63 (31.3)	549 (46.4)	
Both Unmappable and Mappable	70 (19.0)	160 (15.7)		45 (22.4)	185 (15.6)	
Fastest TCL	340 (290-394)	330 (280-392)	0.563	362 (310-428)	330 (280-390)	<0.001
Slowest TCL	410 (344-500)	390 (323-470)	0.012	450 (380-540)	384 (320-460)	<0.001
Acute Outcome			<0.001			<0.001
Noninducible	286 (57.5)	991 (70.5)		105 (42.5)	1172 (70.8)	
Partial/Failure	176 (35.4)	365 (26.0)		116 (47.0)	425 (25.7)	
Not Tested	35 (7.0)	50 (3.6)		26 (10.5)	59 (3.6)	
Total Lesion Time (m)	35.5 (20.2-54.0)	32.1 (17.0-53.8)	0.392	38.1 (24.1-60.5)	32.0 (17.0-53.2)	0.012
Procedure Time (m)	294.0 (222.0-390.0)	247.4 (187.1-339.9)	<0.001	300 (230-418)	251 (193-344)	<0.001
Procedural Complications	30 (6.3)	97 (7.0)	0.671	30 (12.3)	97 (6.0)	<0.001



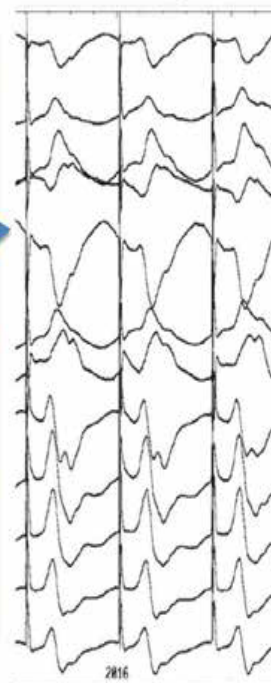
Inferolateral Scar



Clinical VT



Pacemap

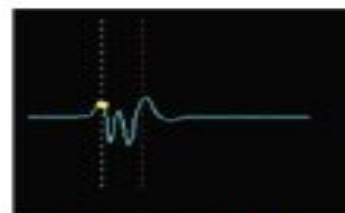


- Elektroanatomik Haritala
- Voltaj mapping
- Pace mapping
- Geç potansiyeller

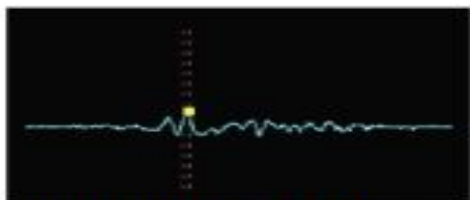
LPs; Tanım



Normal EGM:
 <4 deflections
 voltage >1.5 mV
 duration <70 ms
 amplitude:duration >0.046



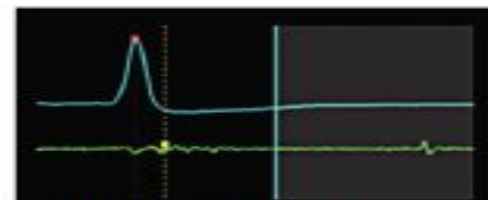
Abnormal EGM:
 not fitting into one
 of the other
 categories



Fractionated EGM:
 BiV <0.5 mV,
 duration >133 ms,
 amplitude:duration <0.005



Isolated potentials:
 >20 ms isoelectric
 segment



Very late potentials:
 >100 ms isoelectric
 segment

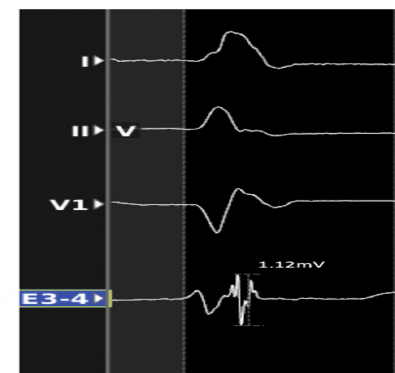
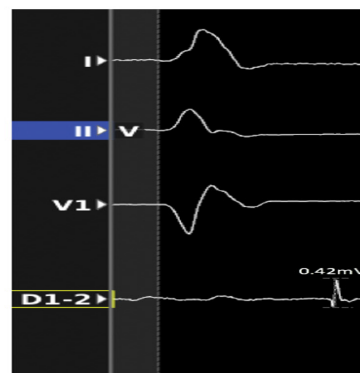
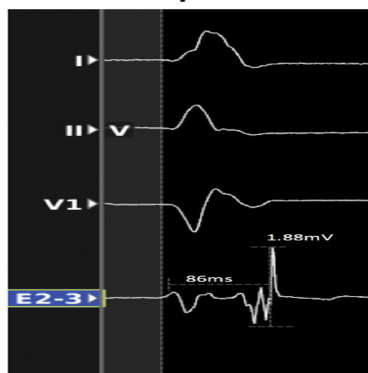
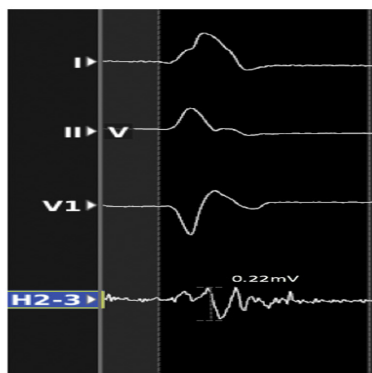
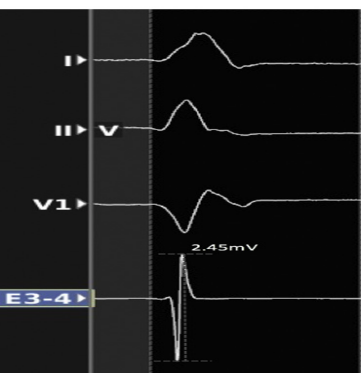
Normal

Fractionated

Split

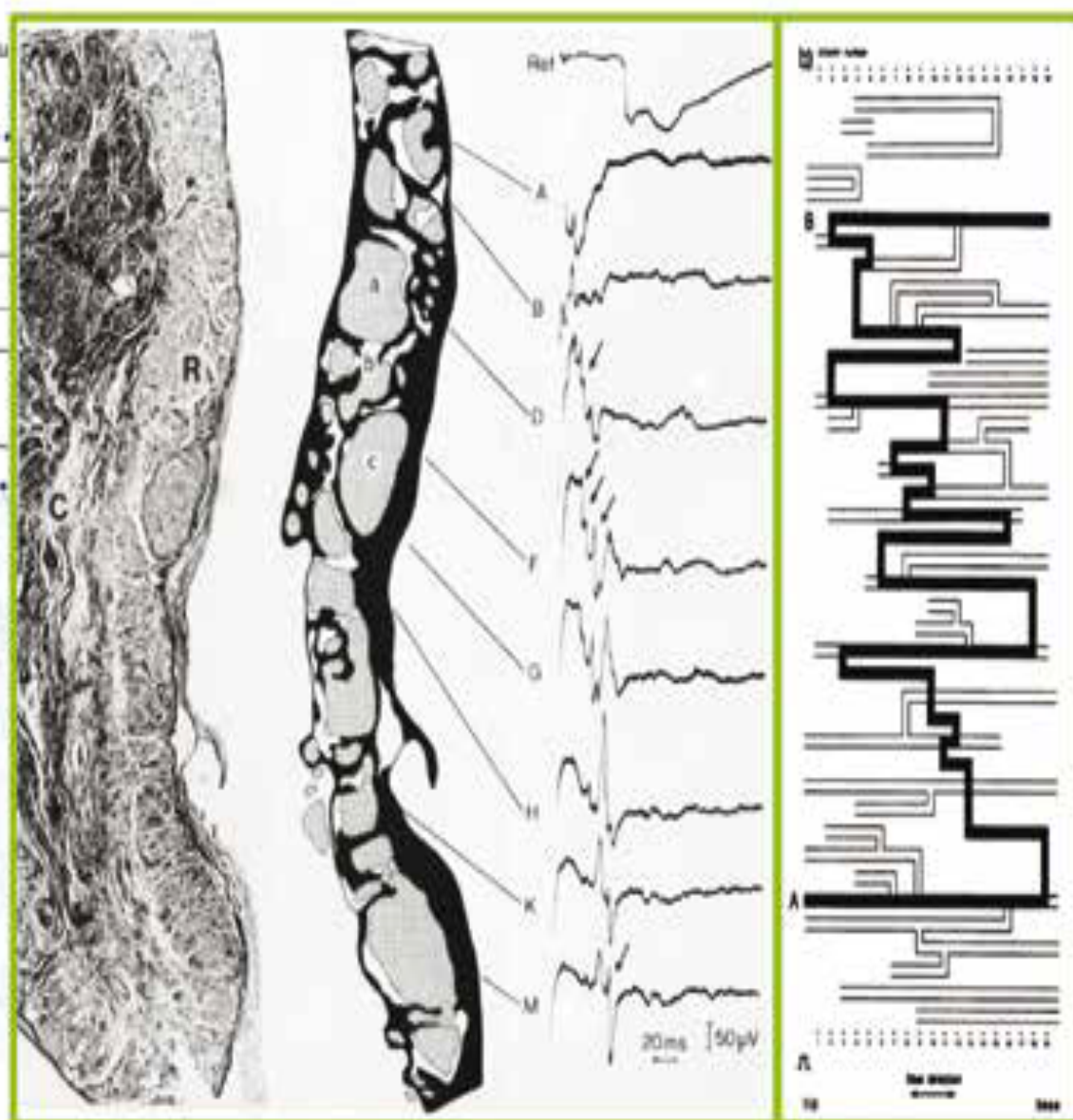
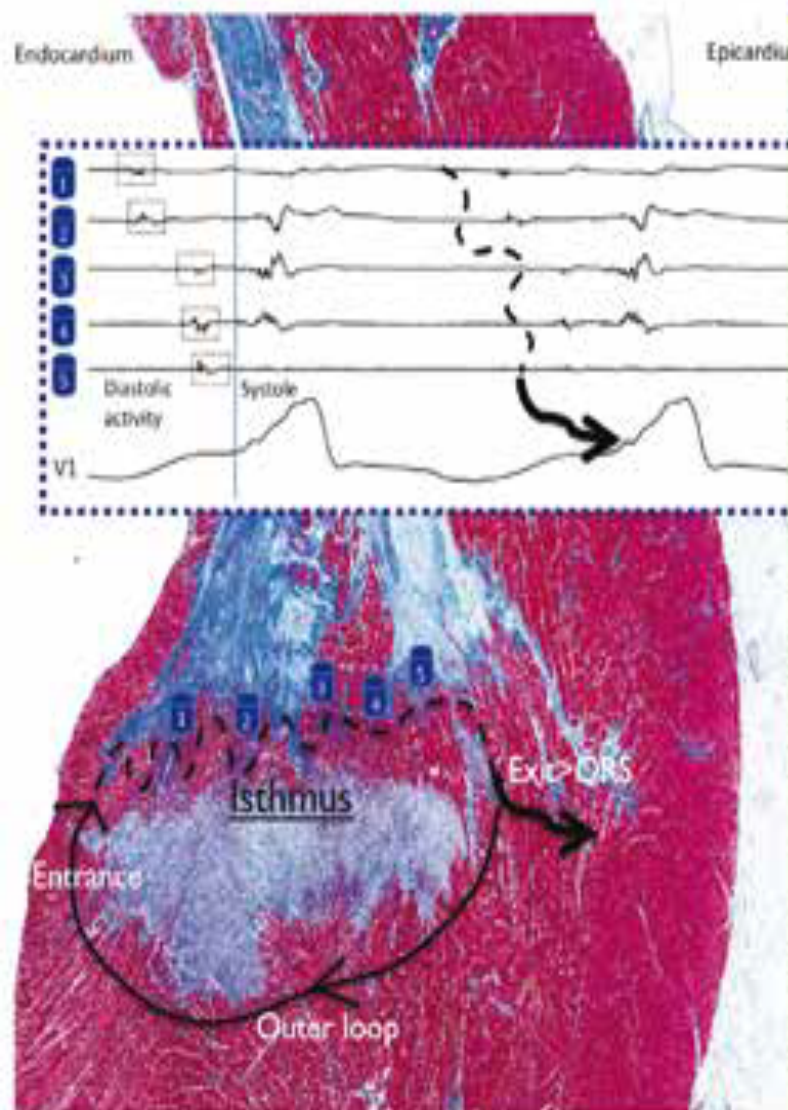
Isolated late

LAVA



200ms

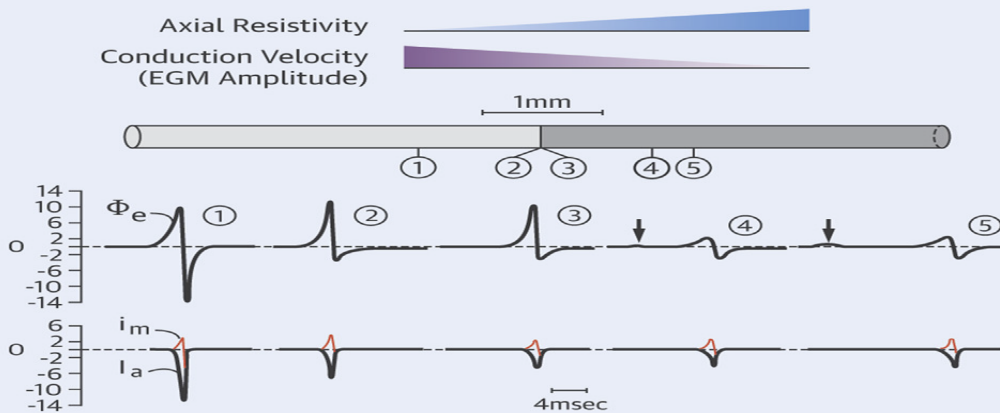
Slow conduction in the infarcted tissue,
with 'zigzag' course of activation



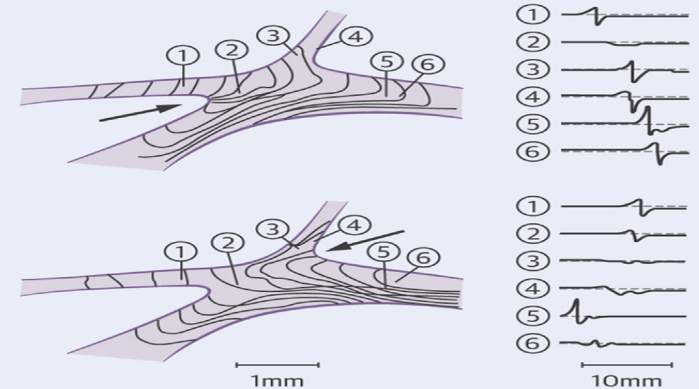
FACTORS AFFECTING SIZE AND SHAPE OF EGM

- Electrode size and interelectrode spacing
- Angle and force of contact
- Wavefront of activation
- Conduction velocity influenced by:
 - reduced sodium channel activity
 - axial resistivity
 - impedance mismatch
 - curvature
- Gap Junction (Connexin-43) disarray
- Insulating tissue: scar, fat, inflammation and edema

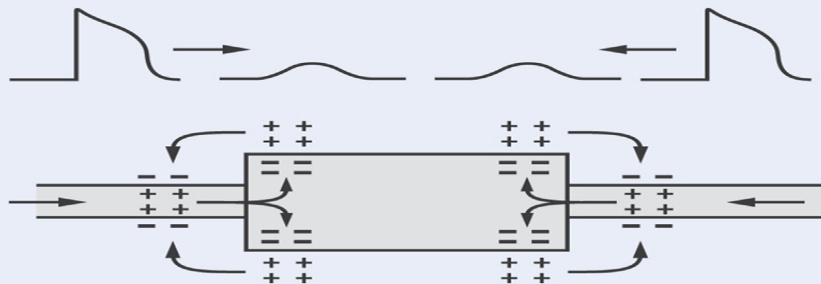
High Axial Resistivity Causes Low Amplitude Electrograms



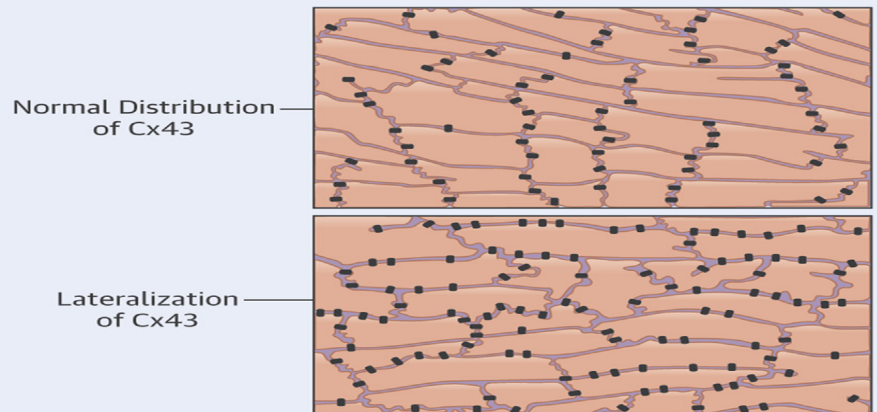
Fibrosis Induced Fiber Orientation Affects: Curvature, Axial Resistivity and Impedance Mismatch



Impedance Mismatch

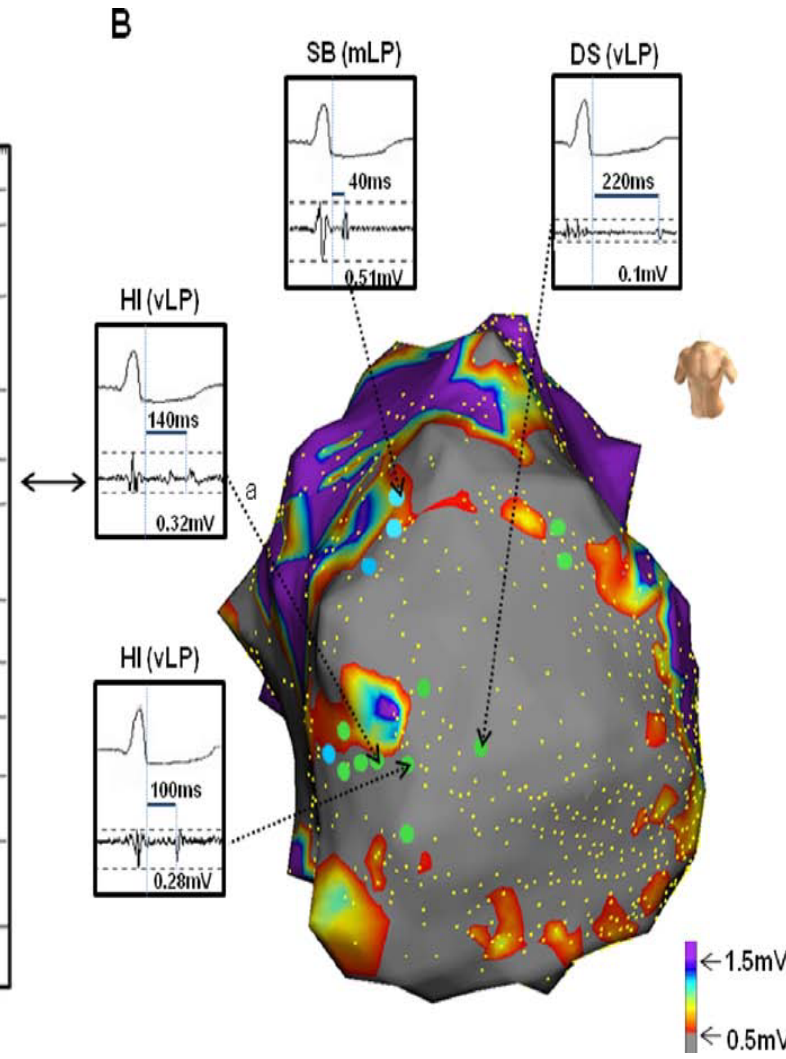
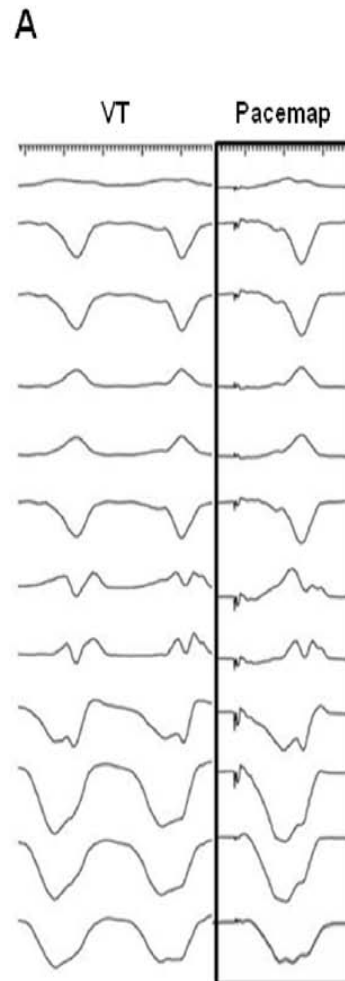
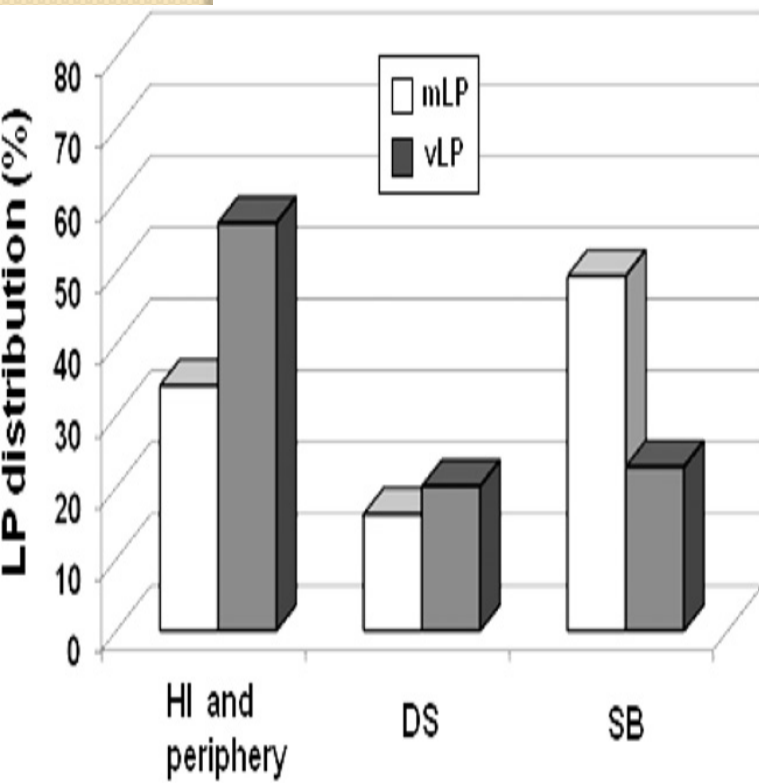
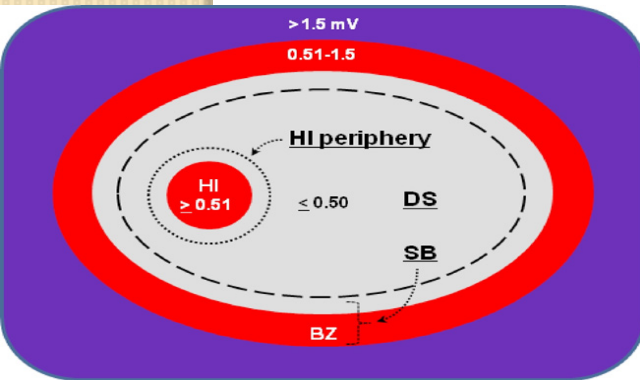


Gap Junction Disarray Slows Conduction-Fractionated EGMs



Distribution of late potentials within infarct scars assessed by ultra high-density mapping

Shiro Nakahara, MD, PhD, Roderick Tung, MD, Rafael J. Ramirez, PhD, Jean Gima, RN, MN, NP, Isaac Wiener, MD, FHRS, Aman Mahajan, MD, PhD, Noel G. Boyle, MD, PhD, FHRS, Kalyanam Shivkumar, MD, PhD, FHRS



Relationship of late potentials to the ventricular tachycardia circuit defined by entrainment

Henry H. Hsia · David Lin · William H. Sauer ·
David J. Callans · Francis E. Marchlinski

Table 2 Local electrogram amplitude for sites within the reentrant circuit

	Entrance	Mid-isthmus	Exit	Outer loop
Dense scar (<0.5 mV)	3	13	4	0
Border zone (0.5 – 1.5 mV)	0	0	11	1
Normal (>1.5 mV)	0	0	2	0
Total (sites)	3	13	17	1

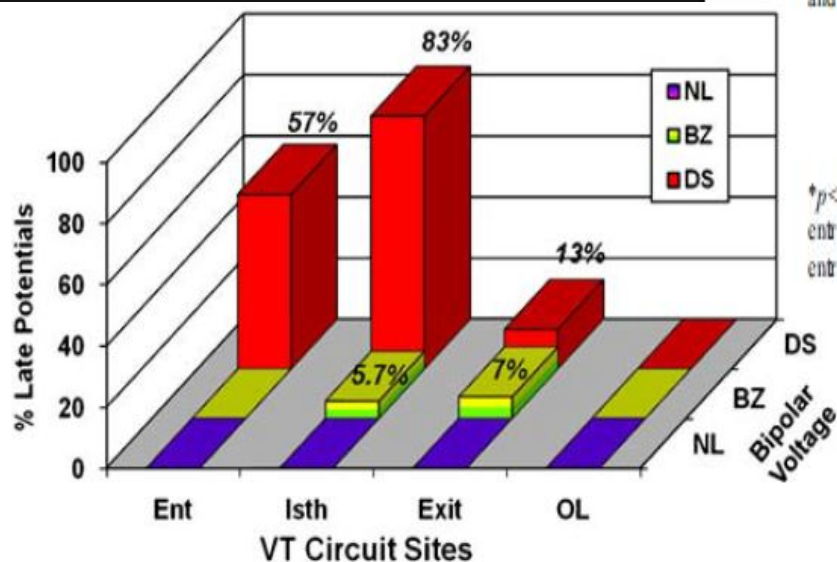


Table 3 Relationships of LPs and the tachycardia circuit

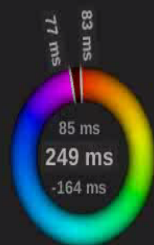
* $p < 0.05$ exit vs isthmus and entrance; ** $p < 0.05$ isthmus vs entrance and exit

	Entrance ($n=3$)	Isthmus ($n=13$)	Exit ($n=17$)	Outer loop ($n=1$)
Number of sampled sites	7	52	70	4
Endocardial sites in VT circuits with LP+	2/3	12/13**	5/17	0/1
Percent sampled sites with LP+	57.1%	88.5%**	20.0%	0%
QRS-LP (ms)	$218 \pm 27^*$	$194 \pm 40^*$	131 ± 29	N/A

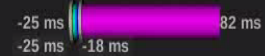
3 LV VT #...

B.Time ▾

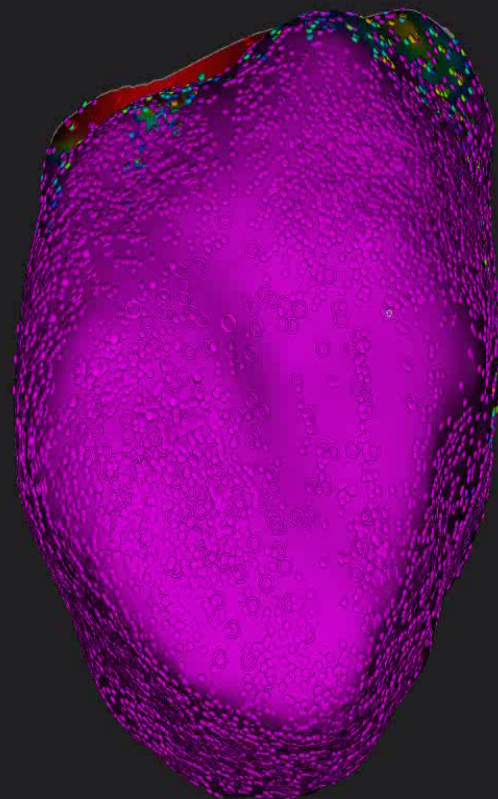
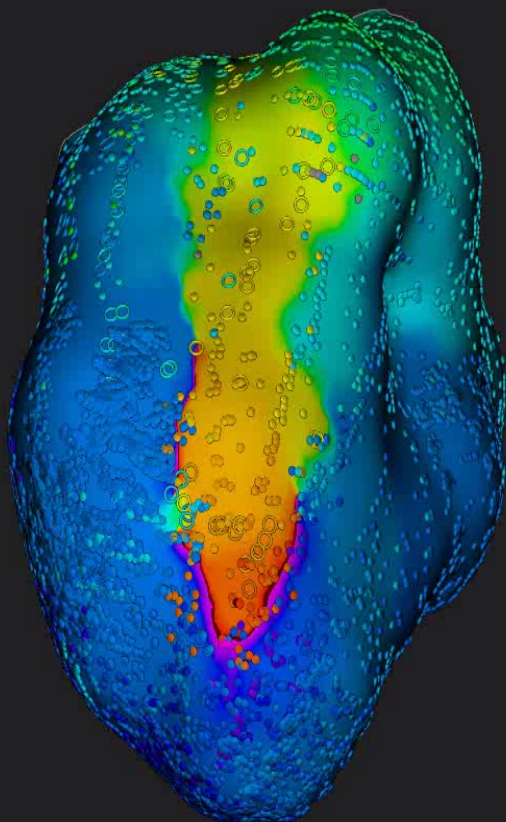
Study Log



2 LV Sinus ...



B.Time ▾



Auto

*

INF

SUP

RL

LL

RAO

LAO

PA

AP



Time: 08:57 Beats: 1137

Volume: 53.65 cc

EGMs: 15915



Auto

*

INF

SUP

RL

LL

RAO

LAO

PA

AP



Time: 33:29 Beats: 1150

Volume: 73.25 cc

EGMs: 20419

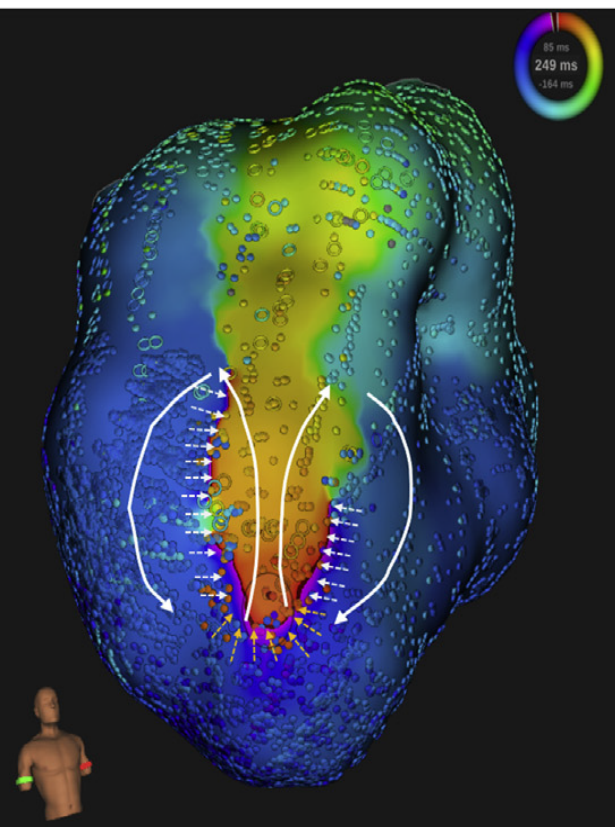
Continuous Review Graph

Infarct-Related Ventricular Tachycardia: Redefining the Electrophysiological Substrate of the Isthmus During Sinus Rhythm

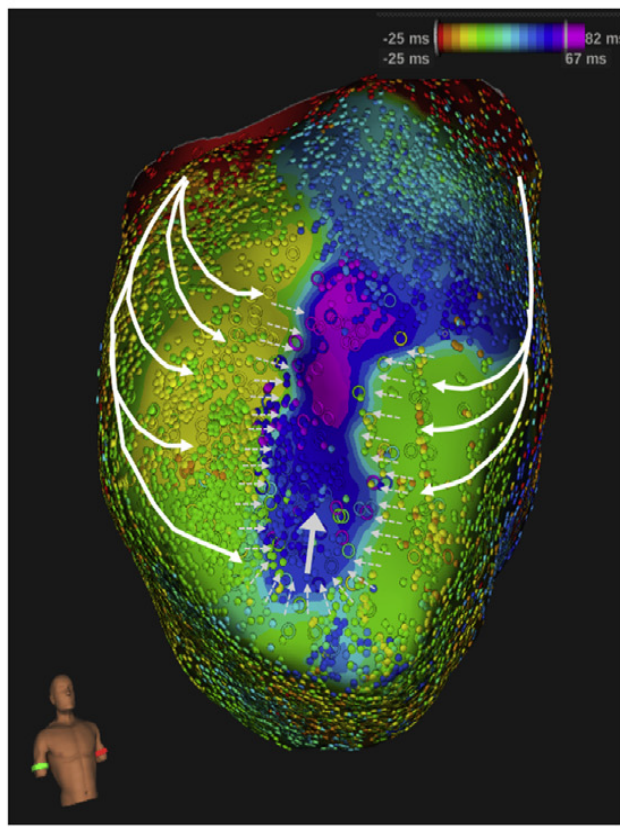


Elad Anter, MD, Andre G. Kleber, MD, Markus Rottmann, PhD, Eran Leshem, MD, MHA, Michael Barkagan, MD, Cory M. Tschabrunn, PhD, Fernando M. Contreras-Valdes, MD, Alfred E. Buxton, MD

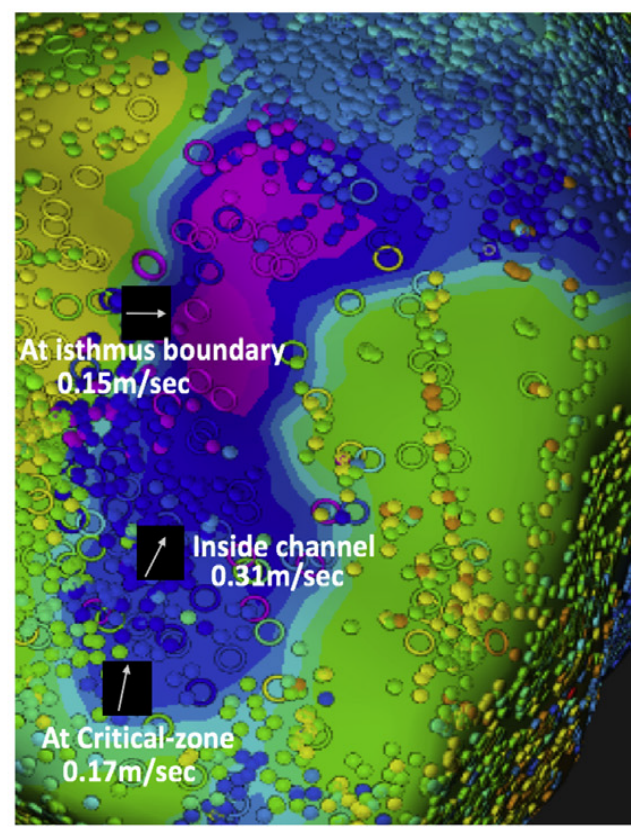
Activation Map during VT



Activation Map during Sinus



Conduction Velocity during Sinus

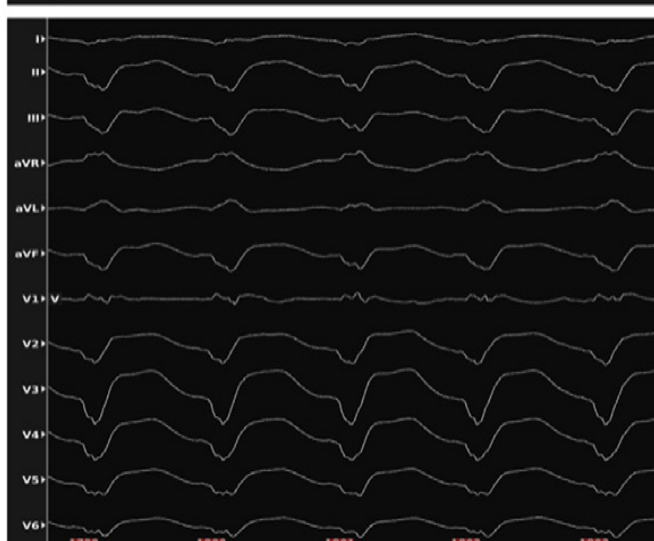
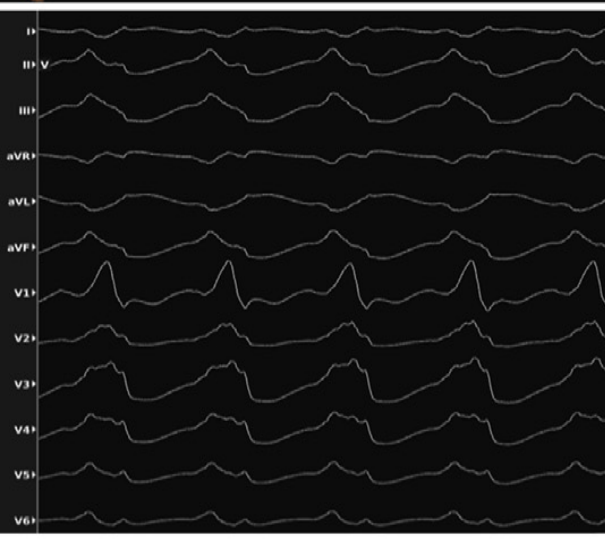
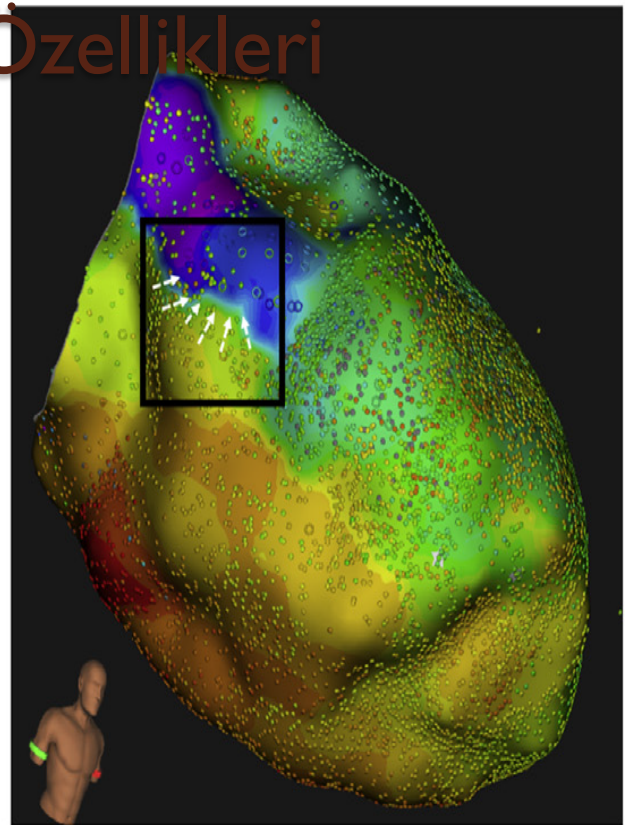
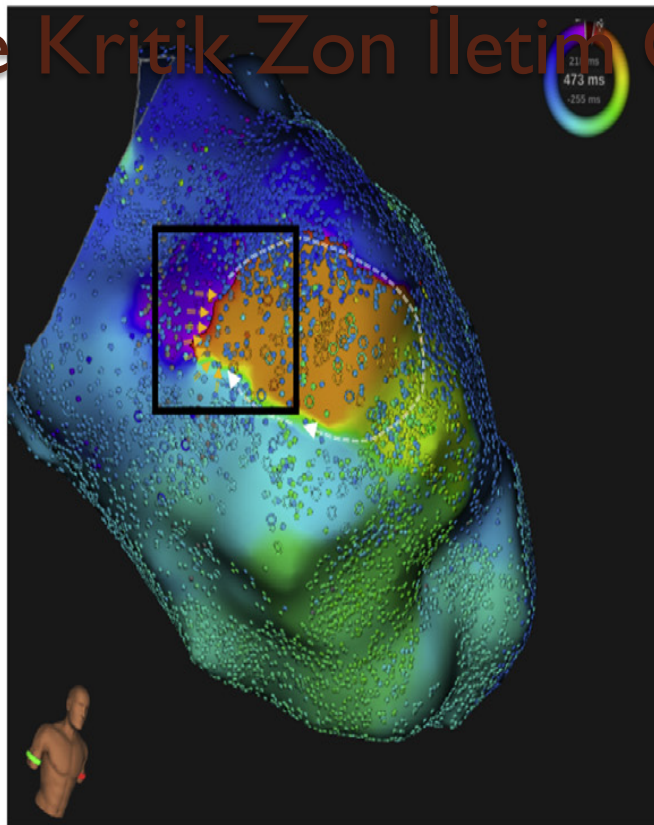
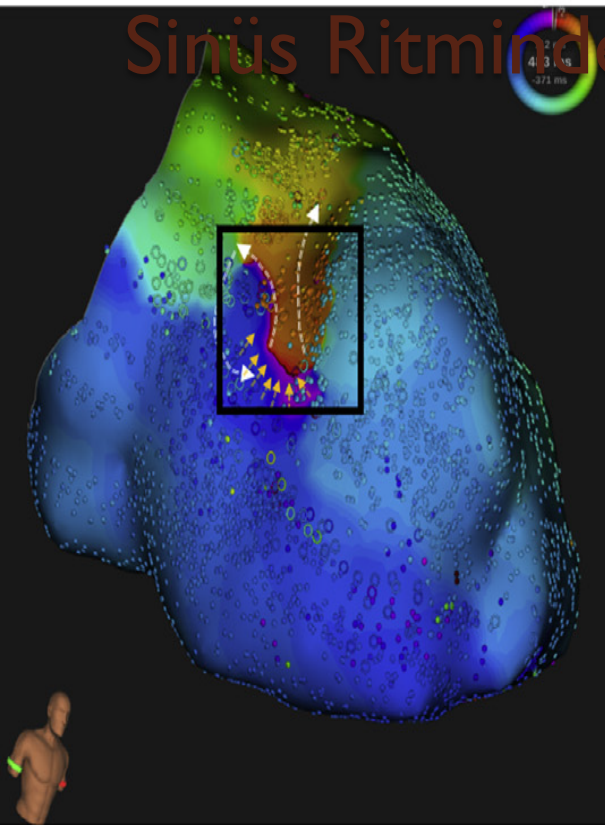


Activation Map VT-1

Activation Map VT-2

Activation Map during Sinus

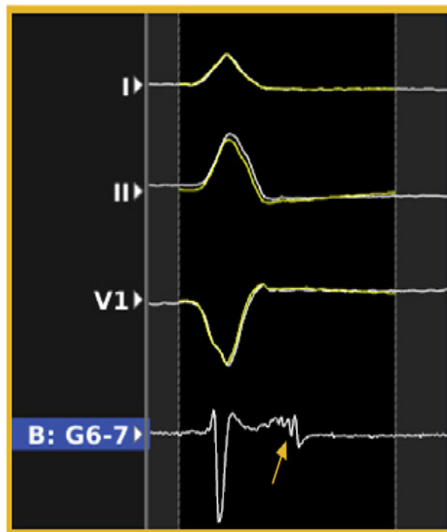
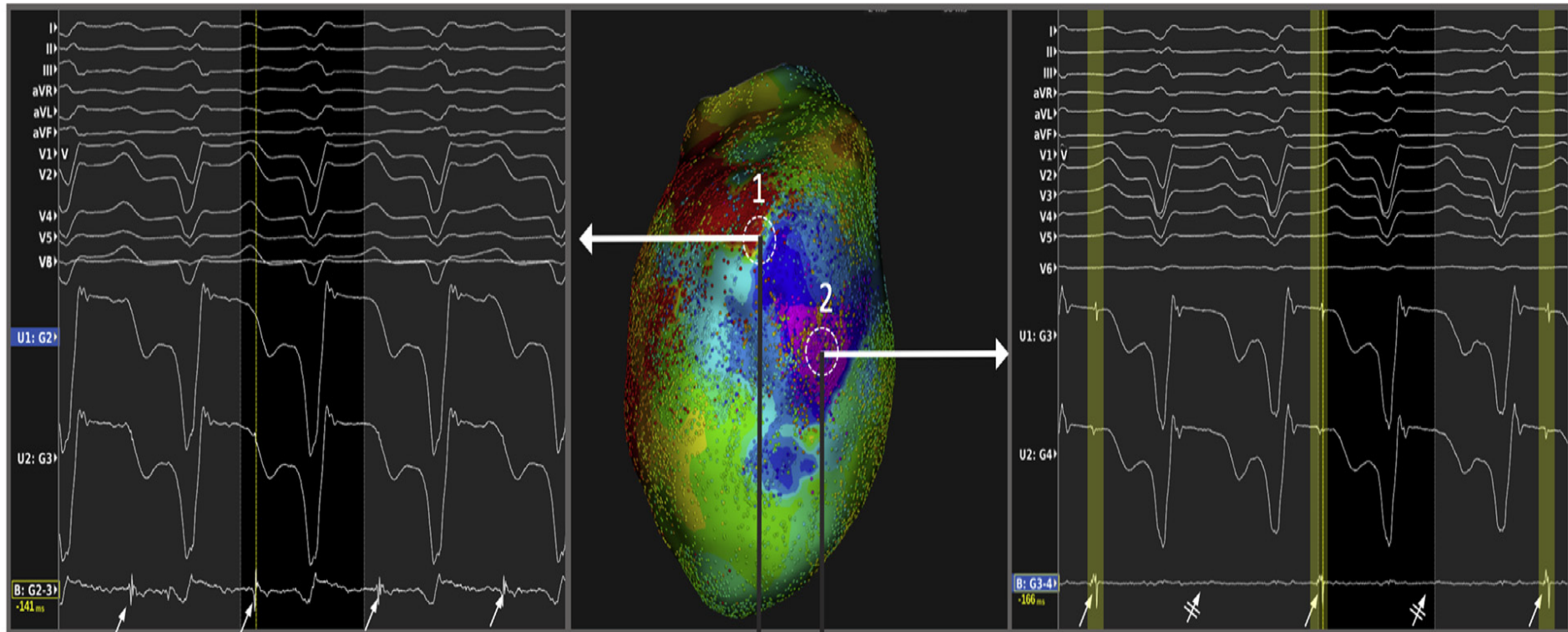
Sinüs Ritminde Kritik Zon İletim Özellikleri



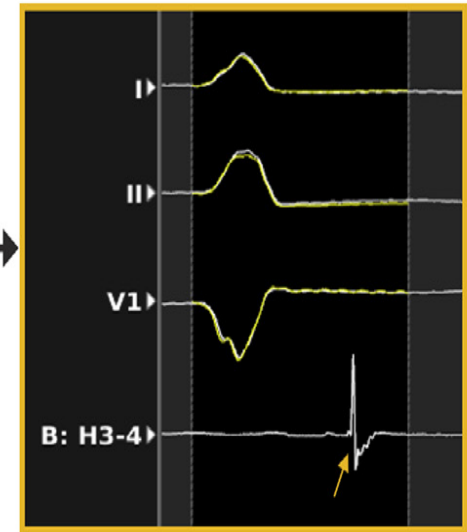
EGMs at zone of slowest sinus activation during VT

LV activation during sinus rhythm

EGMs at zone of latest sinus activation during VT



Sinus EGM



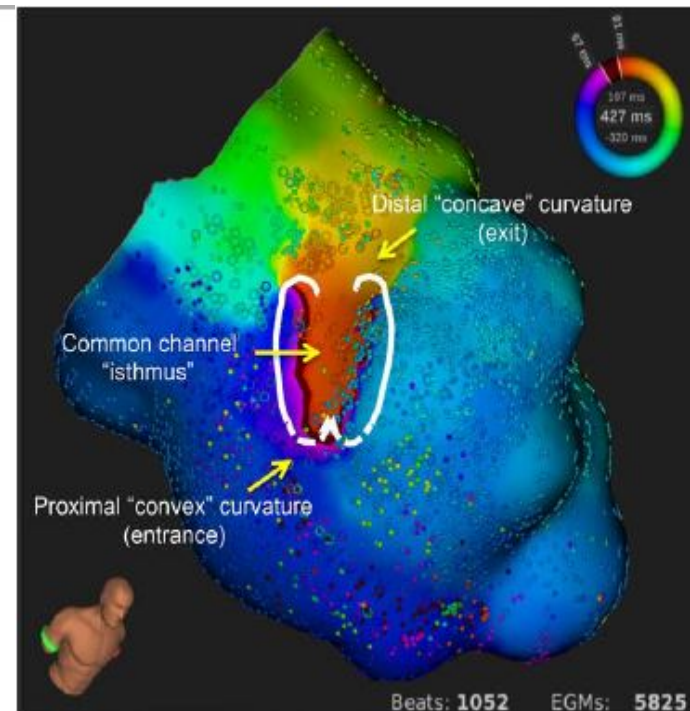
High-Resolution Mapping of Postinfarction Reentrant Ventricular Tachycardia

Electrophysiological Characterization of the Circuit

Table. Response to Overdrive Pacing at Various Zones of the Reentrant Circuit

Site	EGM	QRS Morphology	PPI-TCL, ms	EGM-QRS, % of TCL
Proximal curvature (entrance)	Fractionated (85%)	Concealed (5/7)	16±12	50–85
	Split (24%)	Fused (2/7)		
Common channel (midisthmus)	Split (90%)	Concealed (7/7)	5±2	25–50
	Fractionated (41%)			
Distal curvature (exit)	Fractionated (87%)	Concealed (17/17)	5±5	10–25
	Split (39%)			
Pseudoexit *	Fractionated (82%)	Concealed (6/6)	22±8	0–10
	Split (27%)			
Outer loop	Split (78%)	Fused (11/11)	9±6	Negative (within the QRS)
	Fractionated (44%)			

EGM indicates electrogram; PPI, postpacing interval; and TCL, tachycardia cycle length.



Ablation of Electrograms With an Isolated, Delayed Component as Treatment of Unmappable Monomorphic Ventricular Tachycardias in Patients With Structural Heart Disease

Angel Arenal, MD, Esteban Glez-Torrecilla, MD, Mercedes Ortiz, PhD, Julian Villacastín, MD, Javier Fdez-Portales, MD, Elena Sousa, MD, Silvia del Castillo, MD, Leopoldo Perez de Isla, MD, Javier Jimenez, MD, Jesus Almendral, MD

Madrid, Spain

-
- | | |
|--------------------|--|
| OBJECTIVES | We sought to evaluate the feasibility of identifying and ablating the substrate of unmappable ventricular tachycardia (VT). |
| BACKGROUND | Noninducible and nonstable VT cannot be ablated by the conventional approach. |
| METHODS | We studied 24 patients with documented monomorphic VT. Twenty-one patients had ischemic cardiomyopathy, two had nonischemic cardiomyopathy, and one had tetralogy of Fallot. Twelve patients had an implantable cardioverter-defibrillator. Conventional activation mapping was not possible in 18 patients: at least 1 of the clinical VTs or the clinical VT was not inducible in 12 patients, and VT was not tolerated in 6 patients. This group had experienced between 1 and 106 VT episodes in the month before the ablation procedure. Endocardial electroanatomic activation maps (Carto System) during sinus rhythm (SR) and right ventricular apex (RVA) pacing were obtained to define areas for which an electrogram displayed isolated, delayed components (E-IDC). These electrograms were characterized by double or multiple components separated by ≥ 50 ms. |
| RESULTS | One area of E-IDC was recorded in 20 patients, and 2 or more were recorded in 4 patients. In 23 patients, these areas were detected during RVA pacing; in only 14 during SR. An E-IDC area related to the clinical VT was identified in each patient. Ablation guided by E-IDC suppressed all but one clinical VT whose inducibility suppression was tested. During a follow-up period of 9 ± 4 months, three patients had recurrences of the ablated VT and two of a different VT. |
| CONCLUSIONS | Electrograms with IDCs related to clinical VT can be identified in the majority of patients during RVA pacing. Radiofrequency ablation of E-IDC seems effective in controlling unmappable VT. (J Am Coll Cardiol 2003;41:81-92) © 2003 by the American College of Cardiology Foundation |

Isolated Potentials During Sinus Rhythm and Pace-Mapping Within Scars as Guides for Ablation of Post-Infarction Ventricular Tachycardia

Frank Bogun, MD, FACC, Eric Good, DO, Stephen Reich, MD, Darryl Elmouchi, MD, Petar Igic, MD, Kristina Lemola, MD, David Tschopp, MD, Krit Jongnarangsin, MD, Hakan Oral, MD, FACC, Aman Chugh, MD, Frank Pelosi, MD, FACC, Fred Morady, MD, FACC

Ann Arbor, Michigan

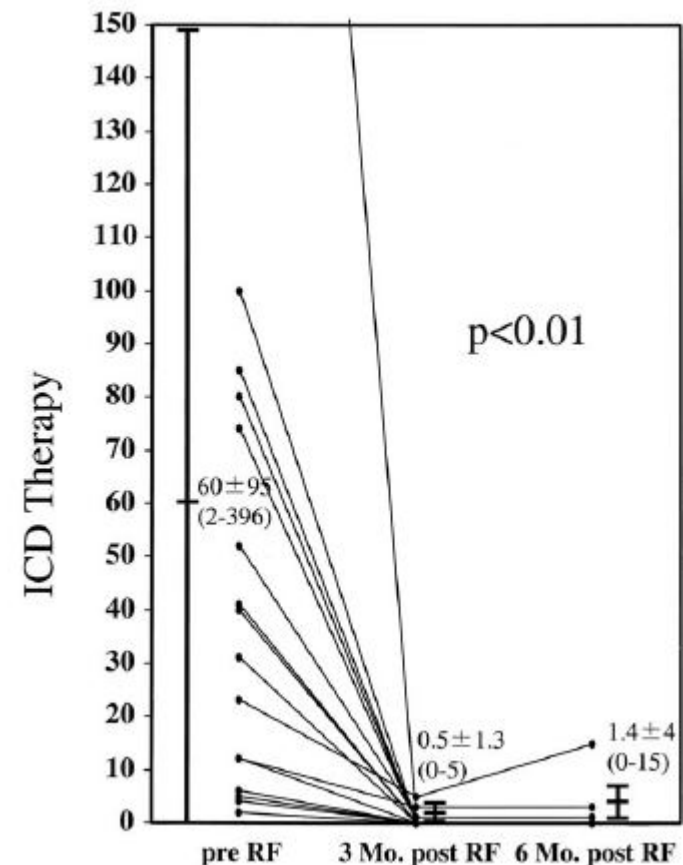
Table 1. Criteria Used to Identify 41 Critical Isthmus Sites

Criterion	Identified Isthmus	IPs Present During SR
Concealed entrainment	6 (15%)	6
Perfect pace-map	17 (41%)	17
Good pace-map	14 (34%)	14
Mechanical VT termination	4 (10%)	3

IP = isolated potential; SR = sinus rhythm; VT = ventricular tachycardia.

Table 3. Comparison of Sites With Perfect, Good, and Poor Pace-Maps

Characteristics	Perfect	Good	Poor
Evaluated sites	70	124	487
Amplitude	$0.07 \pm 0.04^*$	$0.19 \pm 0.3^*$	$0.63 \pm 0.7^*$
EGM width	$241 \pm 83^*$	$177 \pm 65^*$	$140 \pm 38^*$
S-QRS	$120 \pm 52^*$	$99 \pm 41^*$	$86 \pm 53^*$
Isolated potentials	69/70 (99%)†	102/124 (82%)†	96/487 (20%)†



Late Potentials Abolition as an Additional Technique for Reduction of Arrhythmia Recurrence in Scar Related Ventricular Tachycardia Ablation

PASQUALE VERGARA, M.D., Ph.D., NICOLA TREVISI, M.D., ANNALISA RICCO, M.D.,
FRANCESCO PETRACCA, M.D., FRANCESCA BARATTO, M.D., MANUELA CIREDU, M.D.,
CATERINA BISCEGLIA, M.D., Ph.D., GIUSEPPE MACCABELLI, M.D.,
and PAOLO DELLA BELLA, M.D.

From the Arrhythmia Unit and Electrophysiology Laboratories, San Raffaele Hospital, Milan, Italy

- Endocardial and/or Epicardial substrate Mapping
- Programmed ventricular stimulation

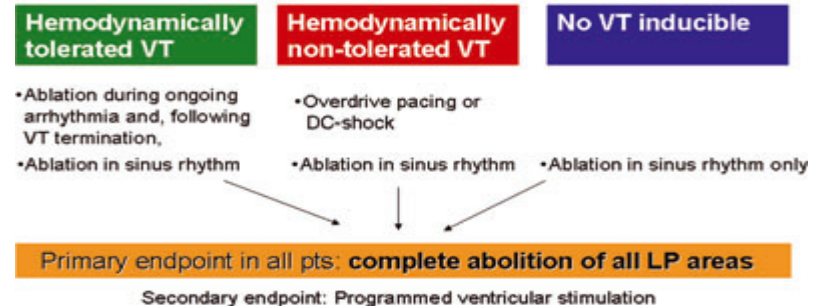
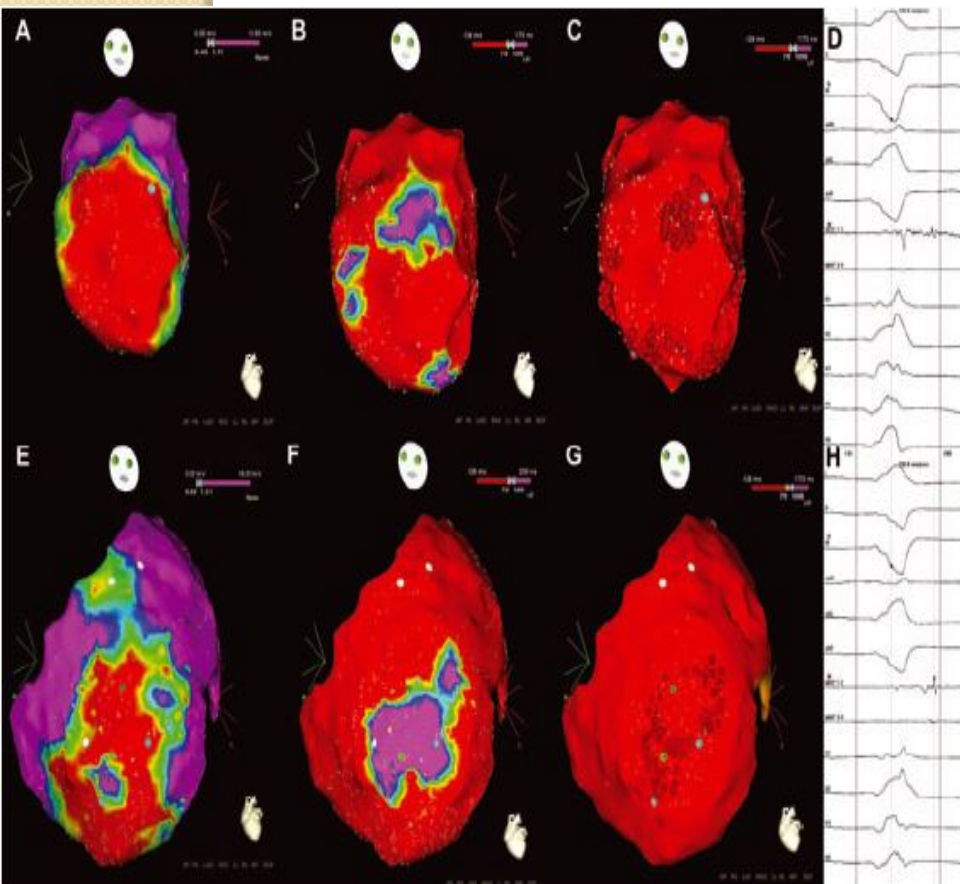


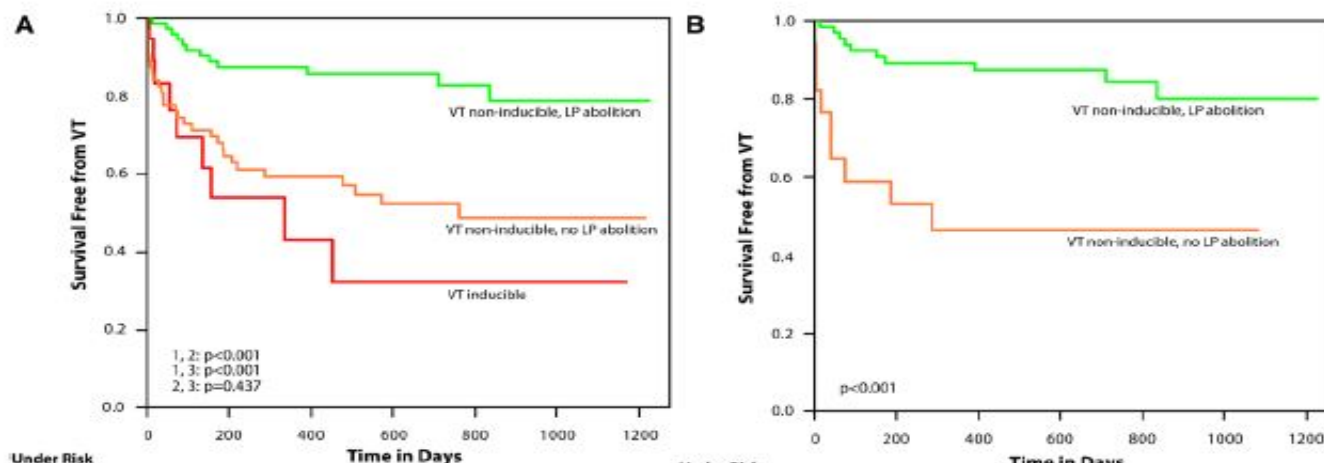
TABLE 4
Arrhythmia Recurrence During the Follow-up in Relation with Complete LPs Abolition and VT Inducibility at Programmed Stimulation Immediately After the Ablation

		VT Recurrence During Follow-up					
		Yes		No		Total Pts	P value
		Pts	%	Pts	%		
Complete LP abolition	Yes (-)	4	9.5%	38	90.5%	42	P = 0.00002
	No	6	75%	2	25%	8	
VT inducibility after RFCA	No (-)	5	12.5%	35	87.5%	40	P = 0.008
	Yes	5	50.0%	5	50.0%	10	
Total		10	20.0%	40	80.0%	50	

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



Under Risk

VT non-inducible, LP abolition 61
VT non-inducible, no LP abolition 37
VT inducible 6

Time in Days

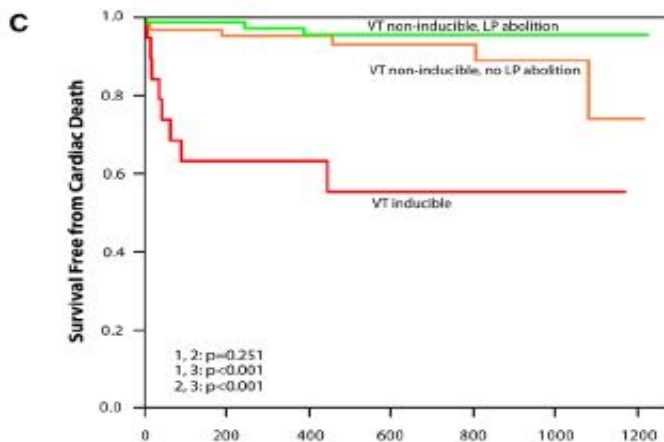
51 32 21 10 2
30 20 13 7 4
4 3 3 1 0

Under Risk

VT non-inducible, LP abolition 56
VT non-inducible, no LP abolition 9

Time in Days

47 31 20 10 2
7 4 3 1 0



Under Risk

VT non-inducible, LP abolition 69
VT non-inducible, no LP abolition 58
VT inducible 11

Time in Days

56 35 22 10 2
48 33 22 9 4
8 4 4 1 0

Table 4. Multivariate Cox Regression Analysis of VT Recurrence and Cardiac Mortality

	HR (95% CIs)	P Value
VT recurrence		
Combined end point vs VT inducibility		<0.01
VT noninducible and LP abolition	0.21 (0.09–0.49)	<0.01
VT noninducible without LP abolition	0.70 (0.33–1.49)	0.35
Cardiac death		
Combined end point vs VT inducibility		<0.01
VT noninducible and LP abolition	0.11 (0.03–0.42)	<0.01
VT noninducible without LP abolition	0.21 (0.07–0.62)	<0.01
NYHA class	2.03 (1.11–3.70)	0.02

CI indicates confidence interval; HR, hazard ratio; LP, late potential; NYHA, New York Heart Association; and VT, ventricular tachycardia.

	Noninducible With LP Abolition (n=73)	Noninducible Without LP Abolition (n=63)	1 vs 2 P Value	VT Inducible (n=19)	1 vs 3 P Value
Hospital stay					
Inpatient stay, d	8 (7–13)	9 (7–14)	0.25	14 (9–17)	<0.01
Procedural parameters					
Procedure time, min	220 (180–255)	210 (180–240)	0.52	270 (180–330)	0.05
Endo-epicardial access, %	15 (21%)	11 (18%)	0.65	6 (32%)	0.38
Endocardial RF time, min	25.5 (18–38.5)	23.5 (16.2–32)	0.31	25.5 (17.7–32.2)	0.66
Epicardial RF time, min	6 (2–20)	8 (2–22.5)	0.94	5 (0–8.7)	0.35
Baseline VT Inducibility					
Monomorphic VT inducibility	56 (77%)	46 (73%)	0.62	14 (74%)	0.77
VF inducible	0 (0%)	1 (2%)	0.46	0 (0%)	0.46
Incessant VT	6 (8%)	7 (11%)	0.57	4 (21%)	0.21
VT noninducible	11 (15%)	9 (14%)	0.90	0 (0%)	0.11
VT characteristics					
VT in procedure (±)	1 (1–2)	2 (1–2)	0.34	2 (1–3)	0.01
VT ablated in procedure (±)	1 (0–1)	1 (0–2)	0.07	1 (0–1)	0.25
Nontolerated VT	30 (41%)	27 (43%)	1.00	7 (37%)	0.95
Clinical VT ablated/documented	24/44 (55%)	31/49 (63%)	0.39	7/14 (50%)	0.77
Final VT inducibility					
VT noninducibility (broad)	66 (90%)	55 (87%)	0.56	0 (0%)	<0.01
VT noninducibility (narrow)	73 (100%)	63 (100%)	0.56	0 (0%)	<0.01
Electrogram-based parameters					
Endocardial LP presence	72/73 (99%)	18/63 (29%)	<0.01	10/16 (62.5%)	<0.01
Epicardial LP presence	10/15 (67%)	6/11 (55%)	0.74	3/6 (50%)	0.43
Endo- or Epicardial LP presence	73 (100%)	19/63 (30%)	<0.01	10/16 (62.5%)	<0.01
Endocardial LP abolition	72/72 (100%)	2/18 (11%)	<0.01	5/10 (50%)	<0.01
Epicardial LP abolition	10/10 (100%)	2/6 (33%)	<0.01	0/3 (0%)	<0.01
LP abolition	73 (100%)	0 (0%)	<0.01	4/16 (25%)	<0.01
EP ablation	9/73 (12%)	18/63 (29%)	0.02	4/19 (21%)	0.46
Outcome					
Follow-up time, d	590 (422–885)	556 (364–858.5)	0.91	255 (44–500)	0.02
Time to VT recurrence, d	112 (64.7–336.5)	70 (6–197.5)	0.17	72 (17–246.5)	0.38
VT recurrence	12 (16%)	29 (47%)	<0.01	9 (47%)	<0.01
Cardiac death	3 (4%)	6 (10%)	0.25	8 (42%)	<0.01
Noncardiac death	3 (4%)	5 (8%)	0.47	1 (5%)	1.00

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

Pragmatic Approach Favoring Late Potentials Abolition

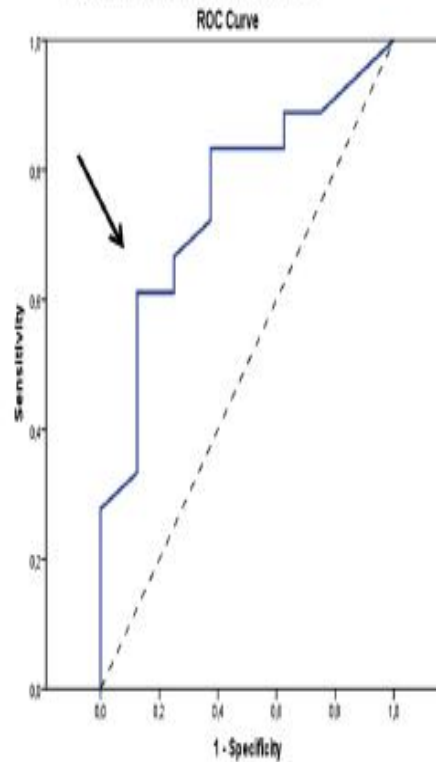
Dimitris Tsiachris, MD; John Silberbauer, MD; Giuseppe Maccabelli, MD; Teresa Oloriz, MD; Francesca Baratto, MD; Hiroya Mizuno, MD; Caterina Bisceglia, MD; Pasquale Vergara, MD; Alessandra Marzi, MD; Nicoleta Sora, MD; Fabrizio Guarracini, MD; Andrea Radinovic, MD; Manuela Cireddu, MD; Simone Sala, MD;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

	Endo-Epicardial Procedures		P Value
	Epicardial Presence of LPs (n=17)	Epicardial Absence of LPs (n=9)	
Background			
Age	70.7±5.1	68.4±5.3	0.28
Anterior myocardial infarction, %	35.3	44.4	0.64
LV ejection fraction, %	29.2±10	35.0±8.3	0.154
Procedural data			
Procedure time, min	306.7±41	287.5±90	0.46
VTs in procedure (±)	2 (0.5–3)	3 (1–3)	0.87
Nontolerated VT	29.4	66.7	0.067
Electroanatomical data			
ENDO surface area, cm ²	252.1±70	211.0±47	0.130
ENDO points	356.6±186	337.7±131	0.79
ENDO LV volume, cm ³	280.8±102	225.4±78	0.170
ENDO BIP dense scar area, cm ²	33 (11–52)	5 (0–21.5)	0.009*
ENDO BIP low voltage area, cm ²	55 (31.5–84.5)	19 (3–67)	0.085
ENDO absence of BIP dense scar	11.8	44.4	0.060
ENDO BIP scar density	0.36 (0.23–0.40)	0.11 (0.00–0.29)	0.006*
ENDO unipolar scar area, cm ²	127 (71.5–147.5)	85 (26.5–136.5)	0.22
ENDO penumbra area, cm ²	45 (31.2–77.5)	52 (14.5–100)	0.71
ENDO LP area, cm ²	17.5 (12.5–27.7)	8 (4–20.2)	0.122
ENDO LPs, %	94.1	44.4	0.004*
EPI BIP dense scar area, cm ²	18 (5–53)	1 (0–12.5)	0.008*
EPI BIP low voltage area, cm ²	45 (23–94.5)	14 (0–27.5)	0.011*
EPI BIP scar density	0.19 (0.11–0.34)	0.07 (0.00–0.22)	0.034*
EPI unipolar scar area, cm ²	99 (53.5–141.5)	20 (6–67.5)	0.001*
EPI penumbra area, cm ²	32 (27–54.5)	7 (0–40)	0.085
ENDO ablation area, cm ²	25 (14–35)	22.6±16.3	0.63
ENDO ablation time, min	26.4±20	31.6±9	0.47
EPI ablation area, cm ²	10 (5.5–21)	0 (0–4.5)	<0.001*
EPI ablation time, min	11 (6–22.5)	0 (0–5)	0.001*

BIP indicates bipolar; ENDO, endocardial; EPI, epicardial; LPs, late potentials; LV, left ventricular; and VT, ventricular tachycardia.

*P<0.05 (statistical significance).

Endocardial bipolar DS area as predictor of epicardial DS



Endocardial bipolar DS area as predictor of epicardial LPs

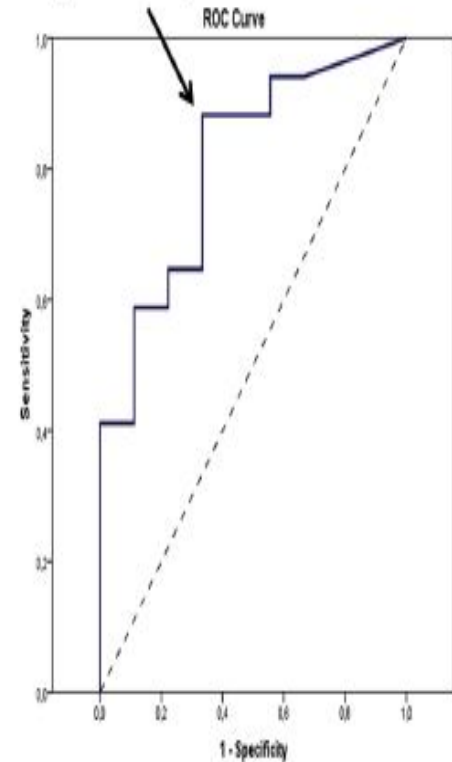


Table 1 Summary of studies evaluating different substrate ablation approaches for unstable VT

Study	Year	No. of patients	Type of substrate	LVEF (%)	End-point assessed (% achieved)	EPI mapping/ablation	RF duration (lesions or min)	Follow-up (months)	VT recurrence	Complications
Ablation of late potentials										
Arenal et al ⁹	2003	24	21 ICM, 2 NICM, 1 ToF	30 ± 9	Elimination of LPs related to the VT and noninducibility (88%)	No	11 ± 8 lesions	9 ± 4	21%	None
Volkmer et al ³⁹	2006	25	ICM	30 ± 8	Elimination of LPs and noninducibility (81%)	No	14 ± 6 lesions	26 ± 14	29%	NR
Nogami et al ¹⁴	2008	18	ARVC	NR	Change of LPs* (67%)	No	17 ± 10 lesions	61 ± 38	33%	NR
Garcia et al ³⁴	2009	13	ARVC	NR	Elimination of LPs and noninducibility (85%)	Yes	35 ± 26 lesions ENDO 37 ± 21 lesions EPI	18 ± 13	33%	None
Bai et al ¹¹	2011	26	ARVC	53 ± 10	Elimination of LPs and noninducibility (100%)	Yes	26 ± 14 min	39 ± 4	15%	1 groin hematoma
Vergara et al ¹⁸	2012	50	36 ICM, 14 NICM	32 ± 9 ICM; 36 ± 10 NICM	Elimination of LPs (84%)	Yes	NR	13 ± 4	20%	NR
Arenal et al ²⁰	2013	59	ICM	30 ± 11	Elimination of LPs (78%)	No	11 ± 5 min	39 ± 21	42%	No major

LPs Haritalama ve Ablasyon Limitasyonları

1. Klinik Çalışmalar;

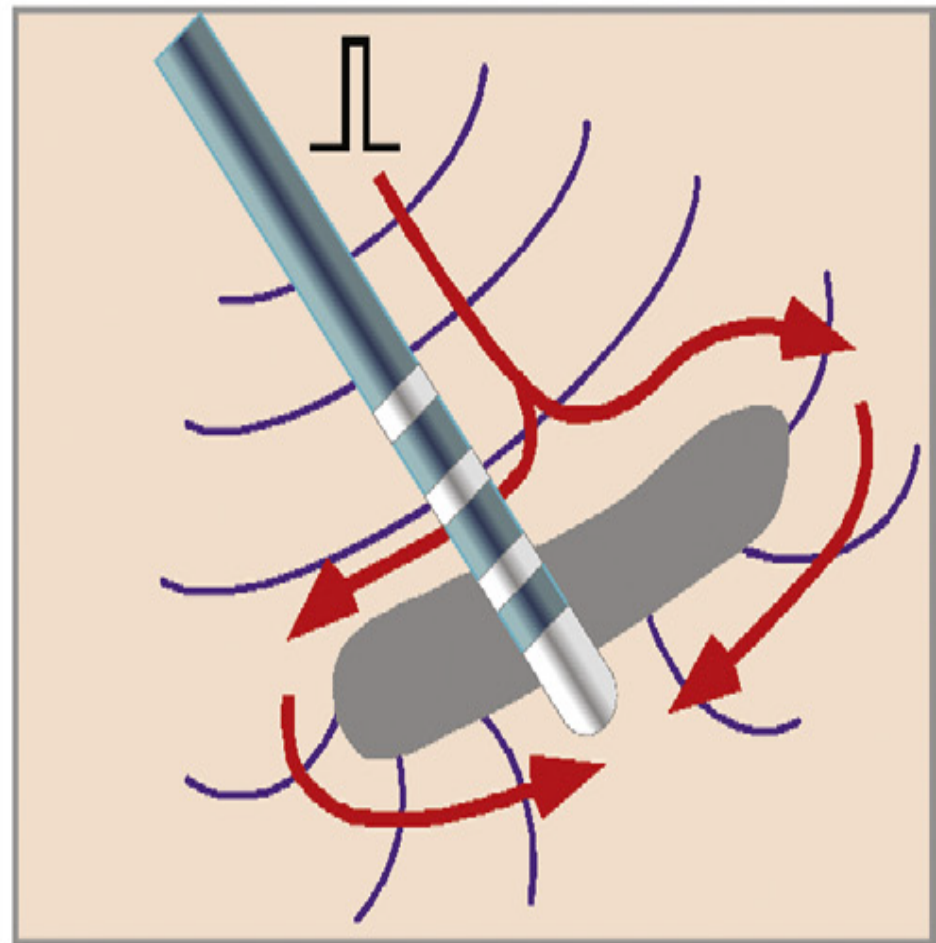
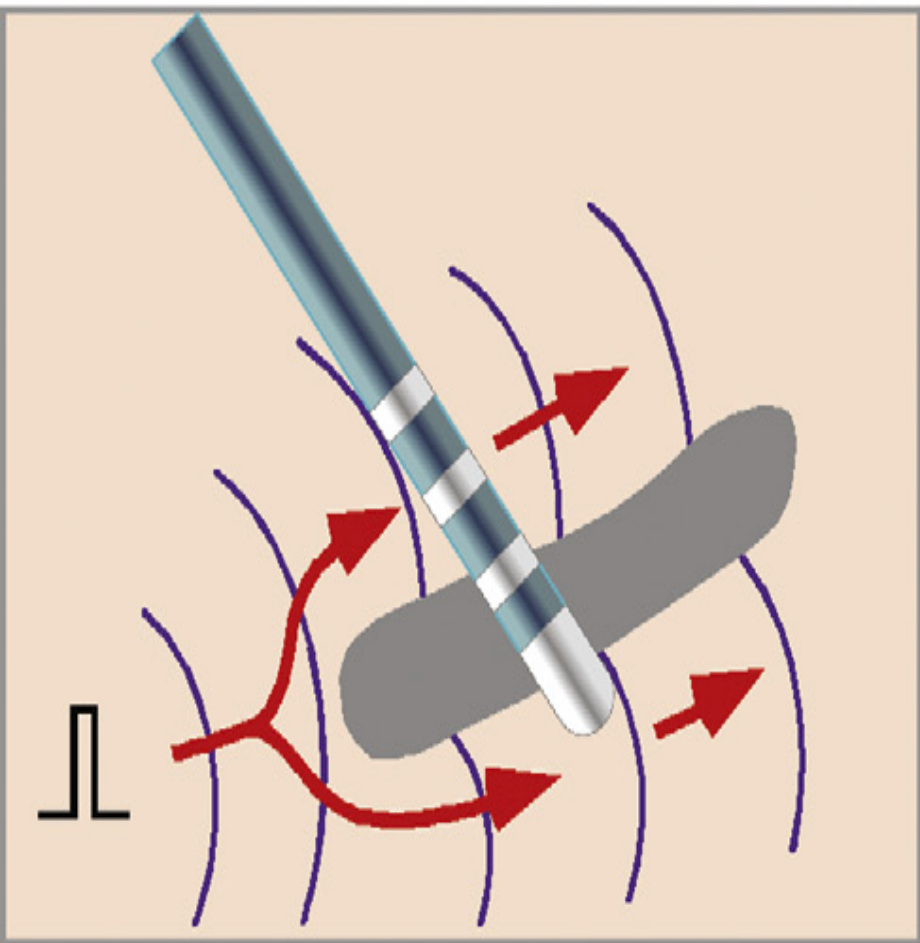
- Klinik tanım tutarsızlığı
- Örneklem küçüklüğü
- Hasta seçim yanlılığı
- Klasik istatistiksel eksiklikler

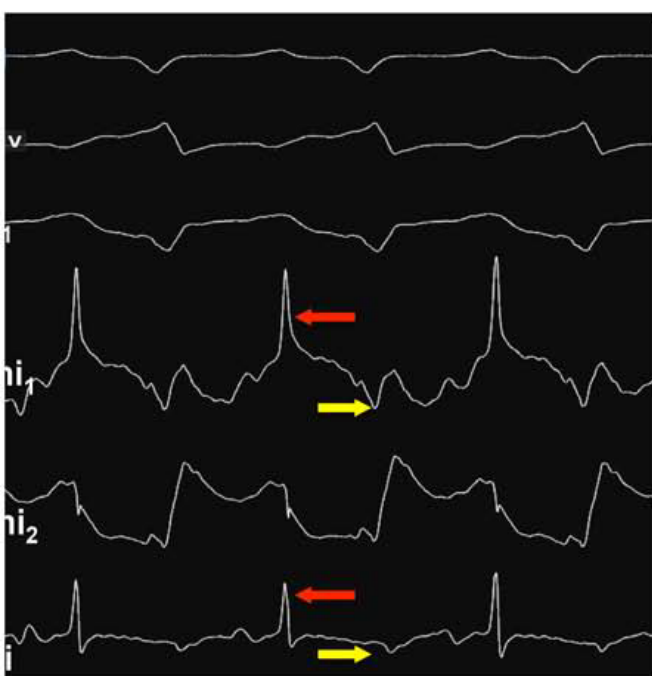
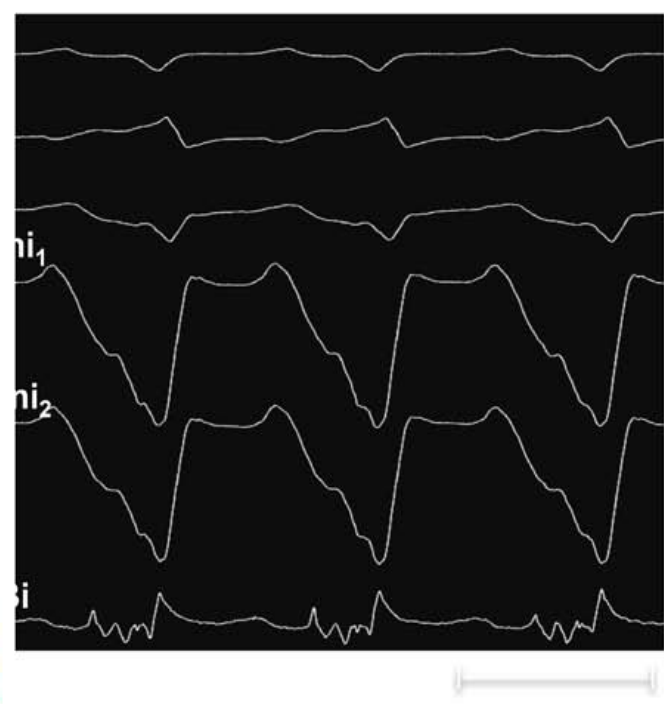
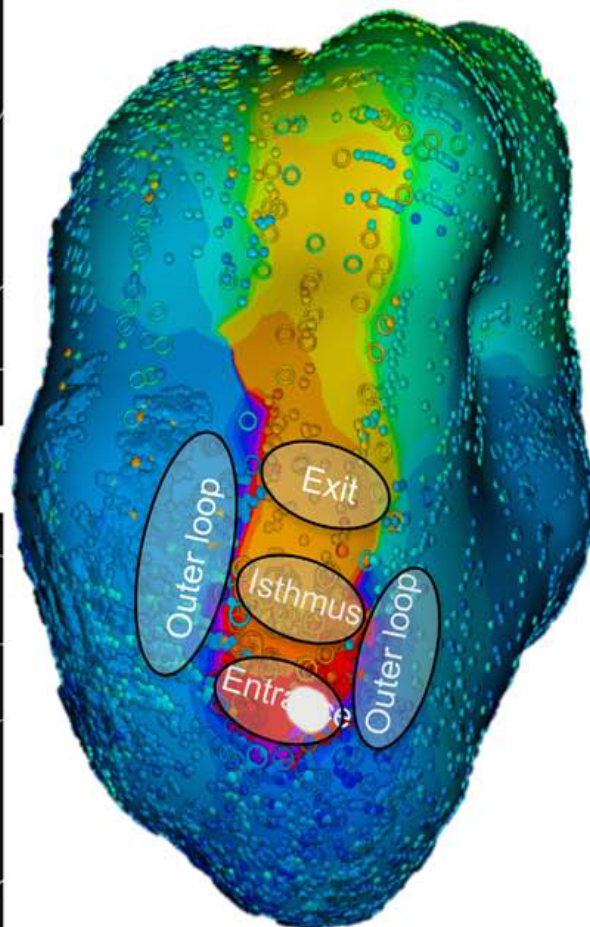
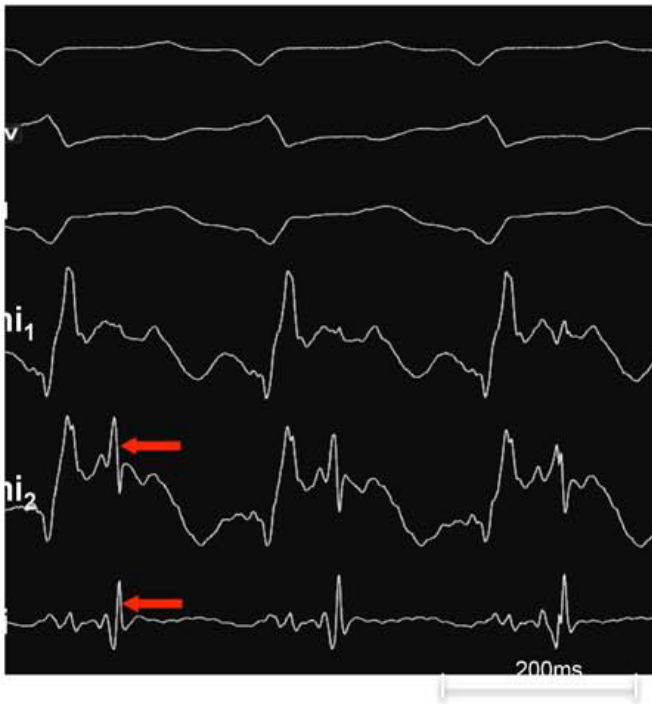
2. Haritalama;

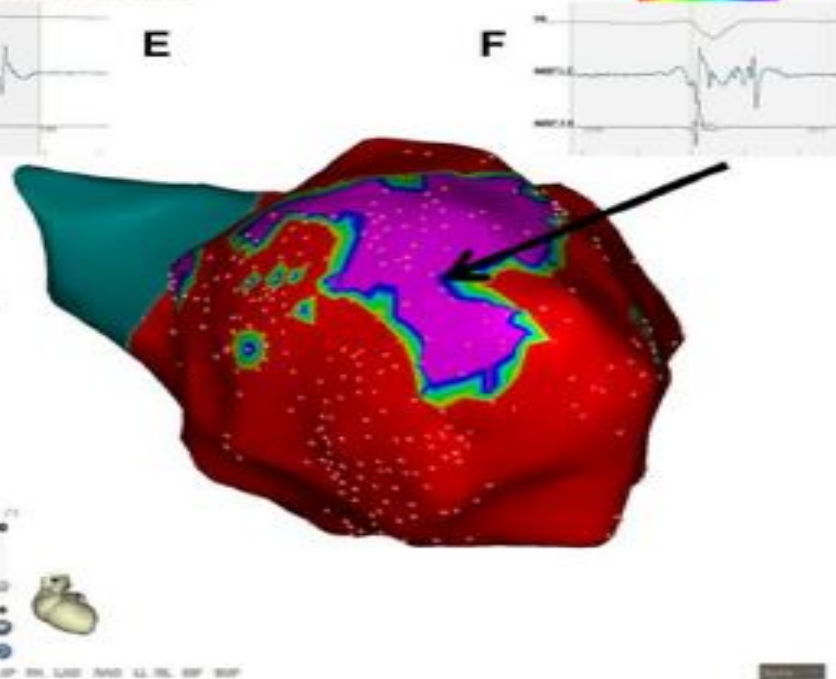
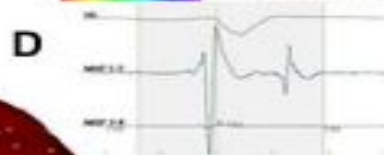
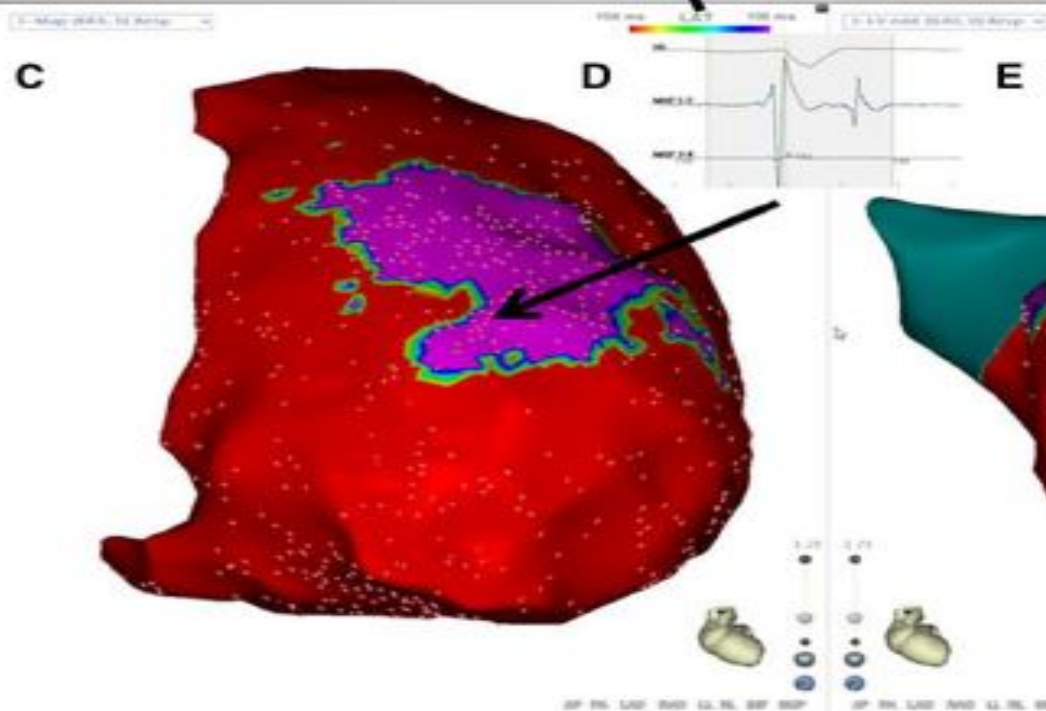
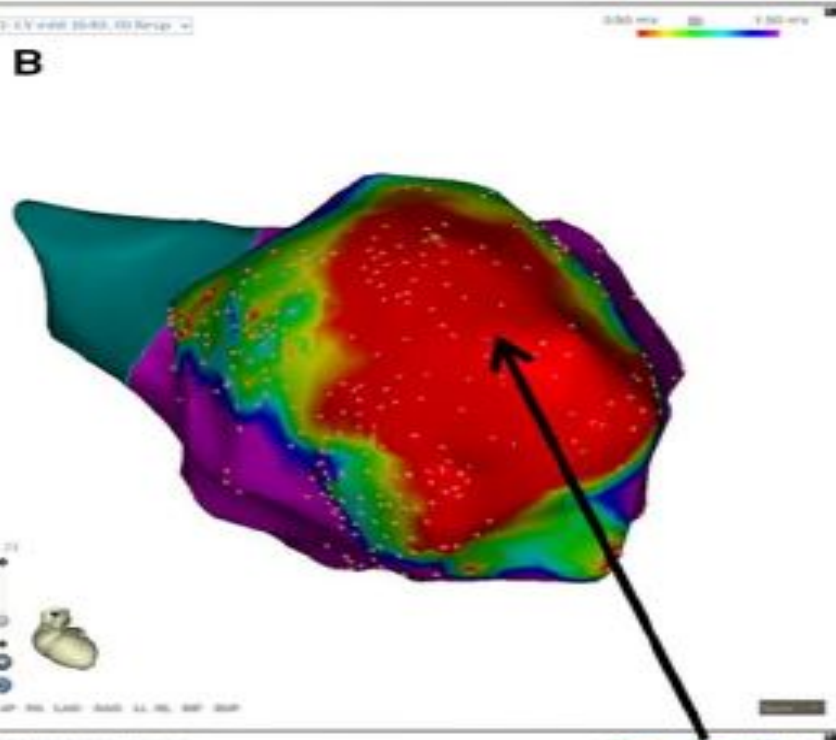
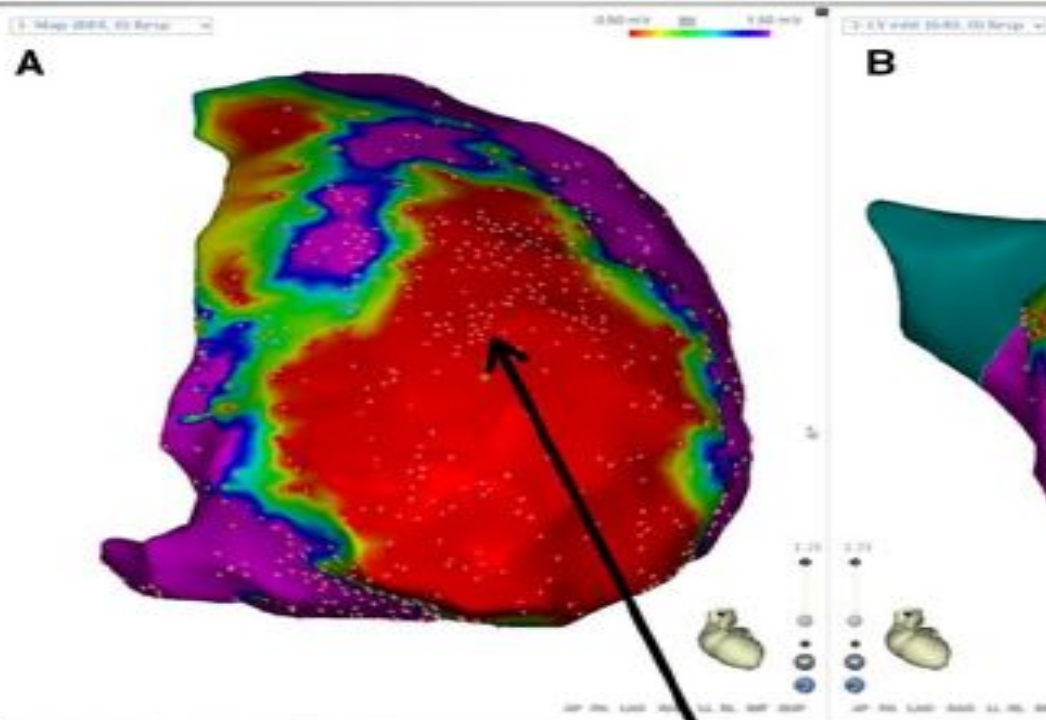
- Gürültü
- Kateter çapı ve elektrodlar arası mesafe
- Kateter oryantasyonu ve açısı
- Aktivasyonun yönü
- Haritalamanın eksik yapılması
- Pace-mapping

3. Ablasyon;

- Skar içindeki anormal EGM ablasyonu (Klinik VT karakterize edilememesi, bystander bölgeler, intramural veya epikardiyal isthmus)
- Farfield ve near-field EGM lerin yanlış yorumlanması
- Anormal substrat komşuluğuna bağlı yeterince ablasyon yapılamaması (papiller kas, koroner arterler)
- Ablasyon sonrası Re-mapping

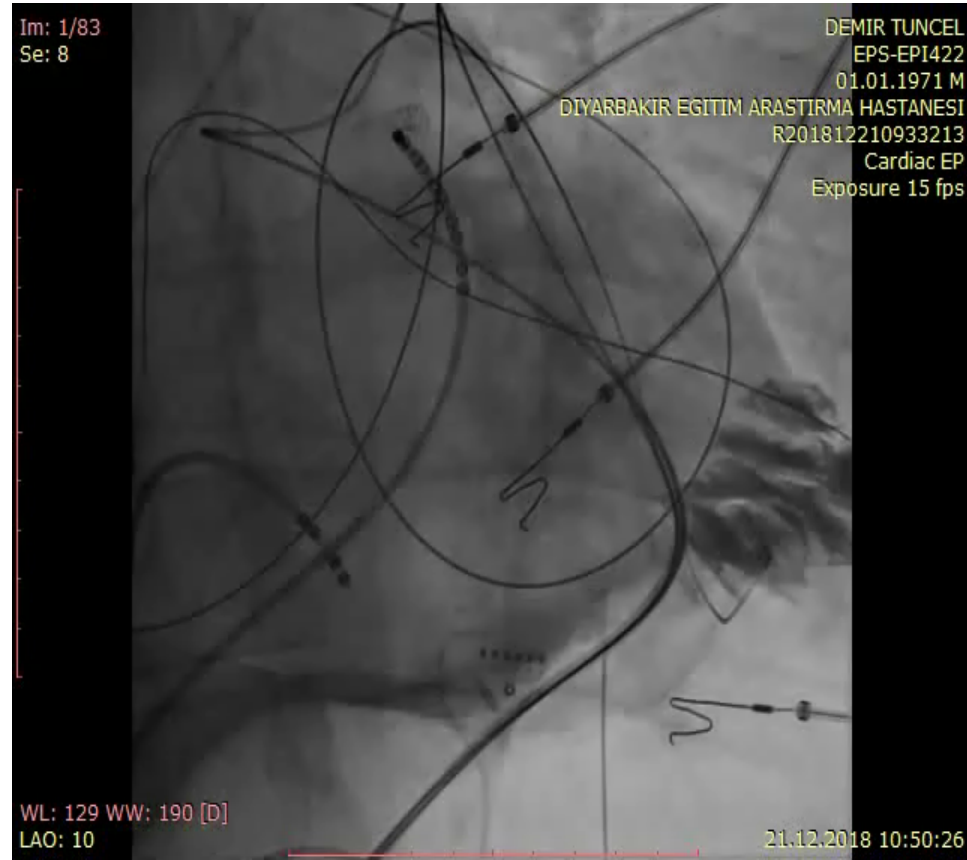
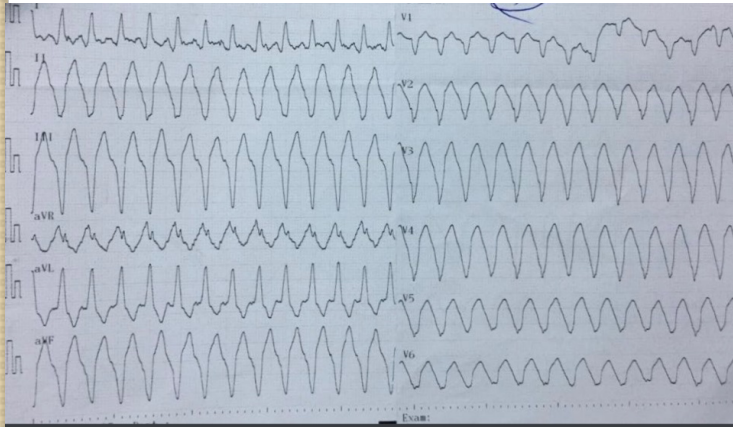


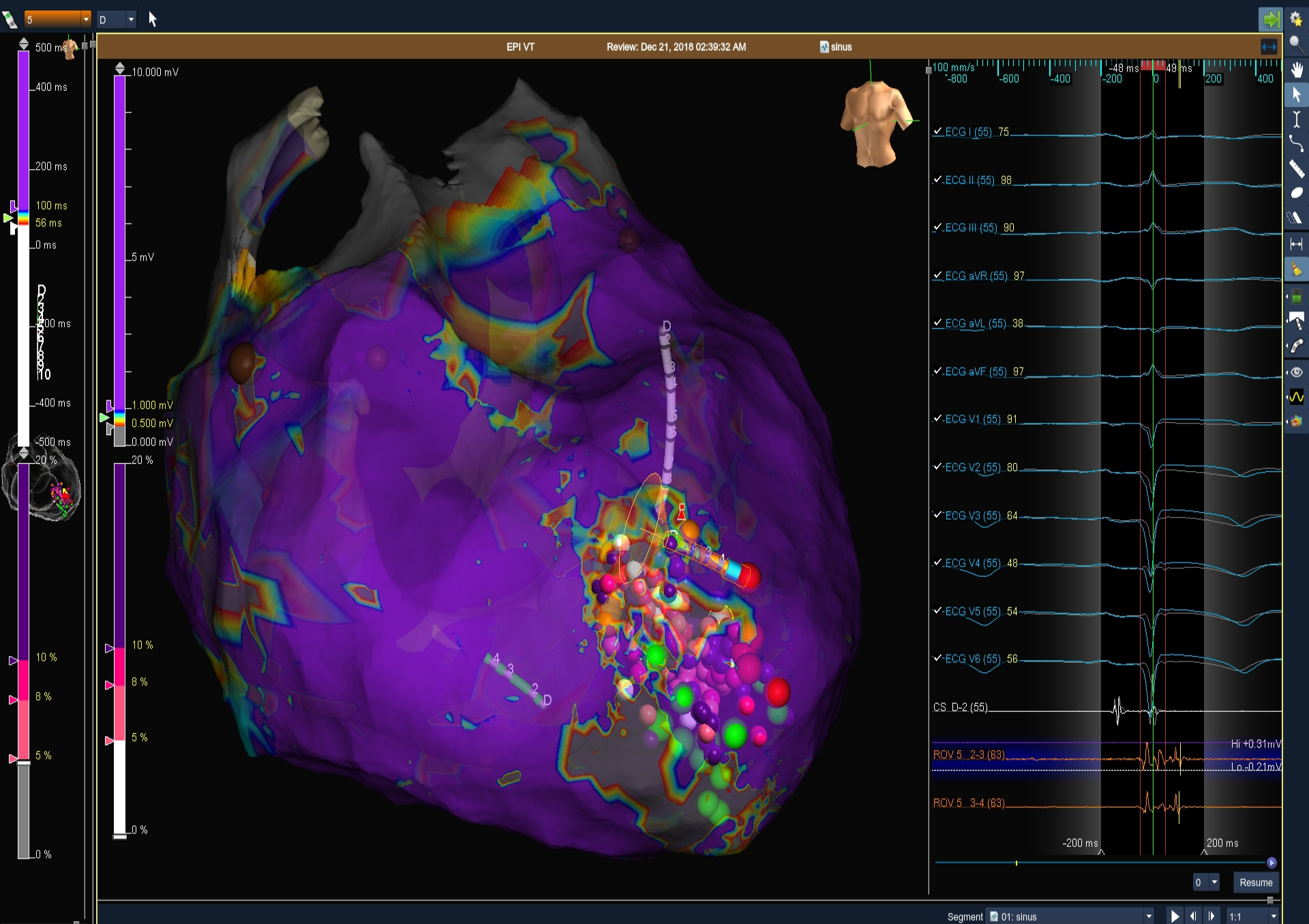




OLGU

- 48y iKMP, DM erkek hasta
- Sustained Monomorfik VT, ICD (-)
- Epi-Endo ablasyon stratejisi





1, Protocol: Baseline 01:23:32.047



150 mm/sec

01:23:32

Seq

S1

S2

Imped

S3

S4

STIM

EP-4 is ON

Save P-Key

Auto

Set Cycle

Menu

SetUp

F1

F2

F3

F4

F5

F6

F7

F8

F9

Burst

P1

P2

P3

P4

P5

P6

P7

P8

F8 - Arrhythmia Induction

Protocol Parameters

Site	S1	S2	S3	S4
1	400 ms	300 ms	270 ms	200 ms
Extra Beats	3	# in Train	Rest Time	Train Type
		8	3 sec	Paced

S2-S7 Limit

Repeat

180 ms

1

Channel Output

Amp 1

5.0 mA

PW 1

1.0 ms

Auto

Seq.Output

Protocol Initialization Parameters

Synchronization

Pre-Int I/D

-10 ms

Sync

OFF

Auto

ON

☒ Off

☐ External

☐ 1

☐ 2

☐ 3

☐ 4

Search

1

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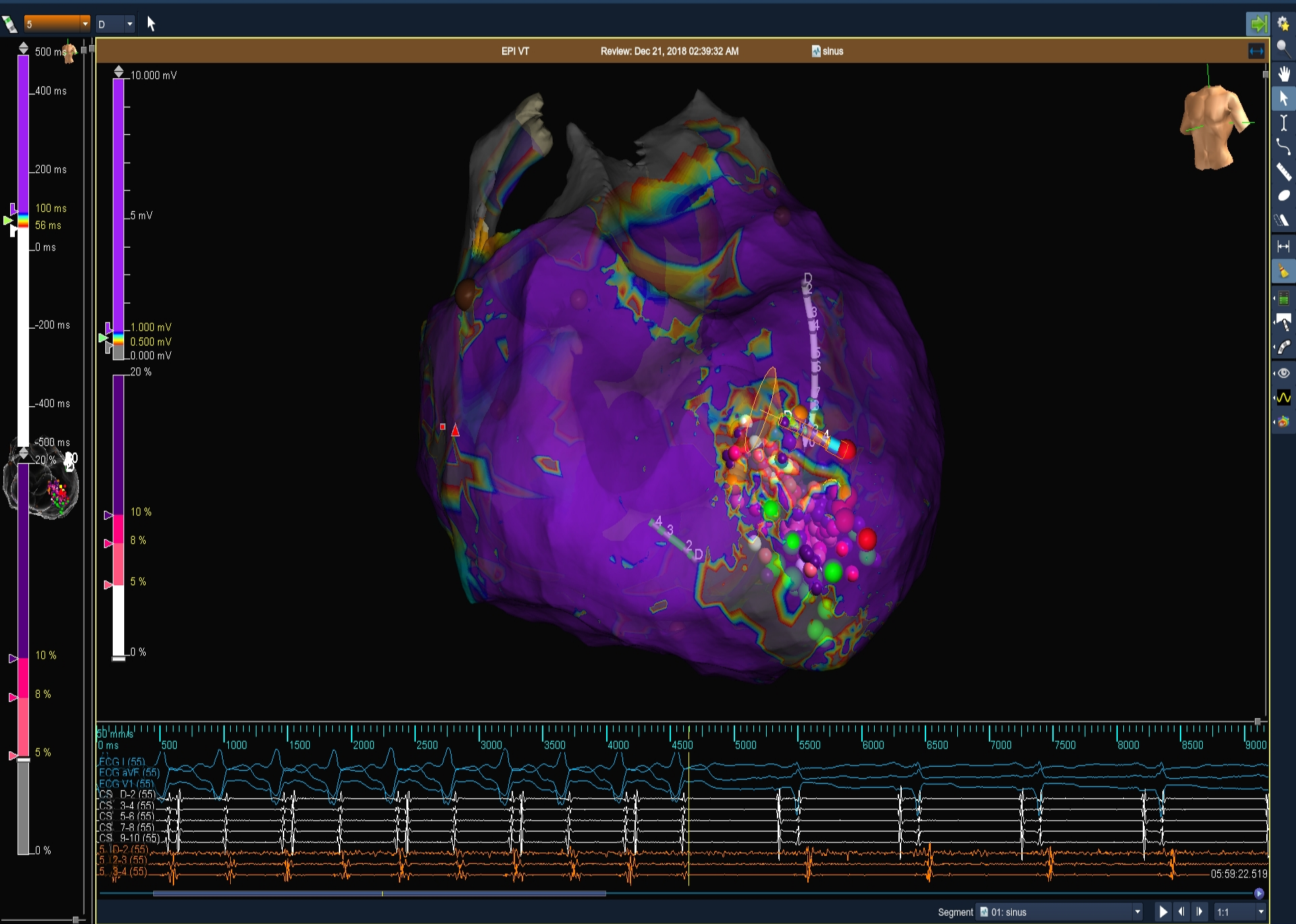
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- **Assess location of scars (echo, ventriculogram)**
- **Predict exit point of each VT**

VT induction; Predict exit point of each VT

- **Substrate mapping; identify the extent of scar**
- **Tag all late potentials within the scar**

- **Pace mapping from the late potentials in the area predicted to be exit point of VT**

**Ablate here if
12/12
match with any VT**

**Entrainment mapping if
VT is induced by pacing
Ablate if:**

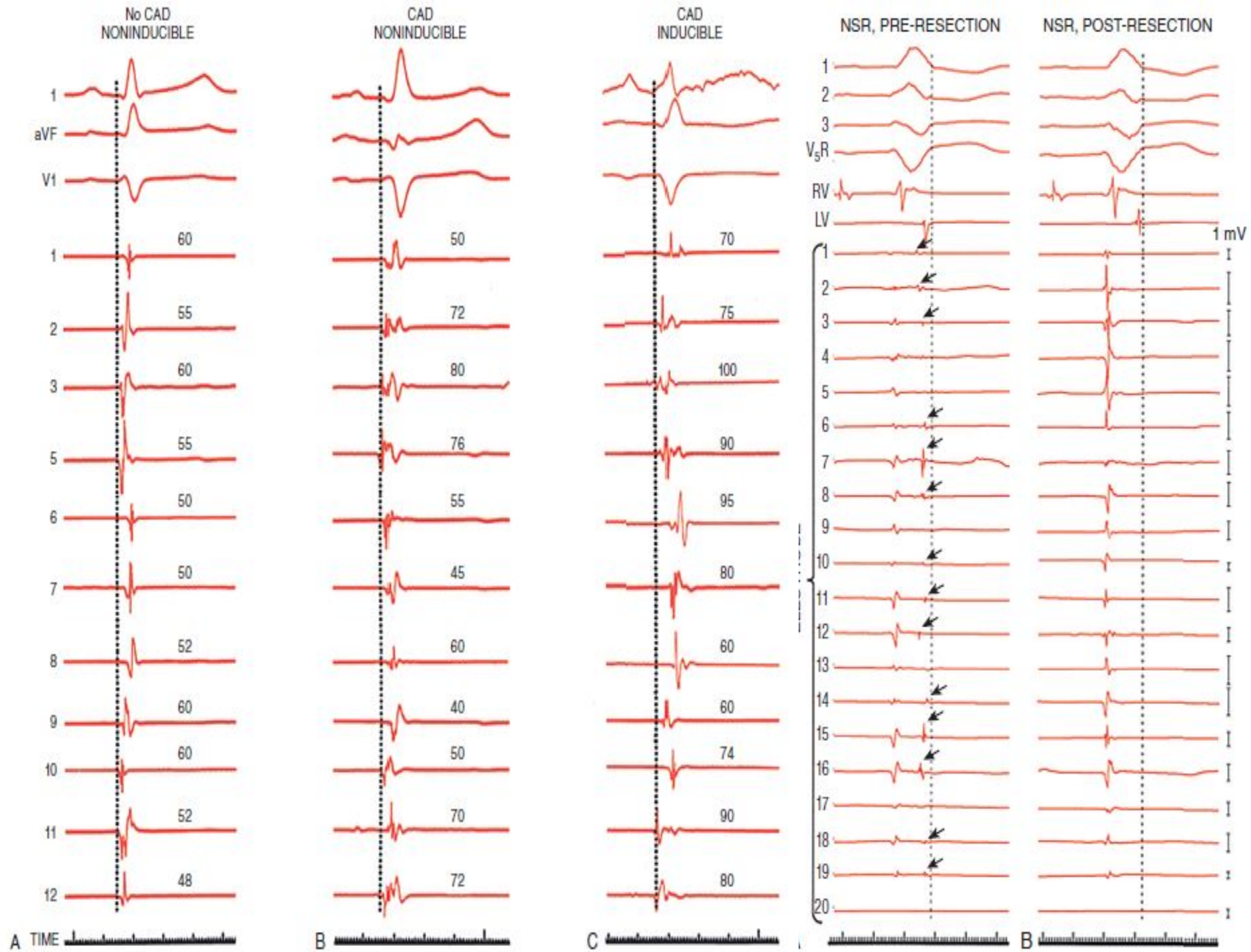
- **12/12 match with VT**
- **S-QRS = EGM-QRS**

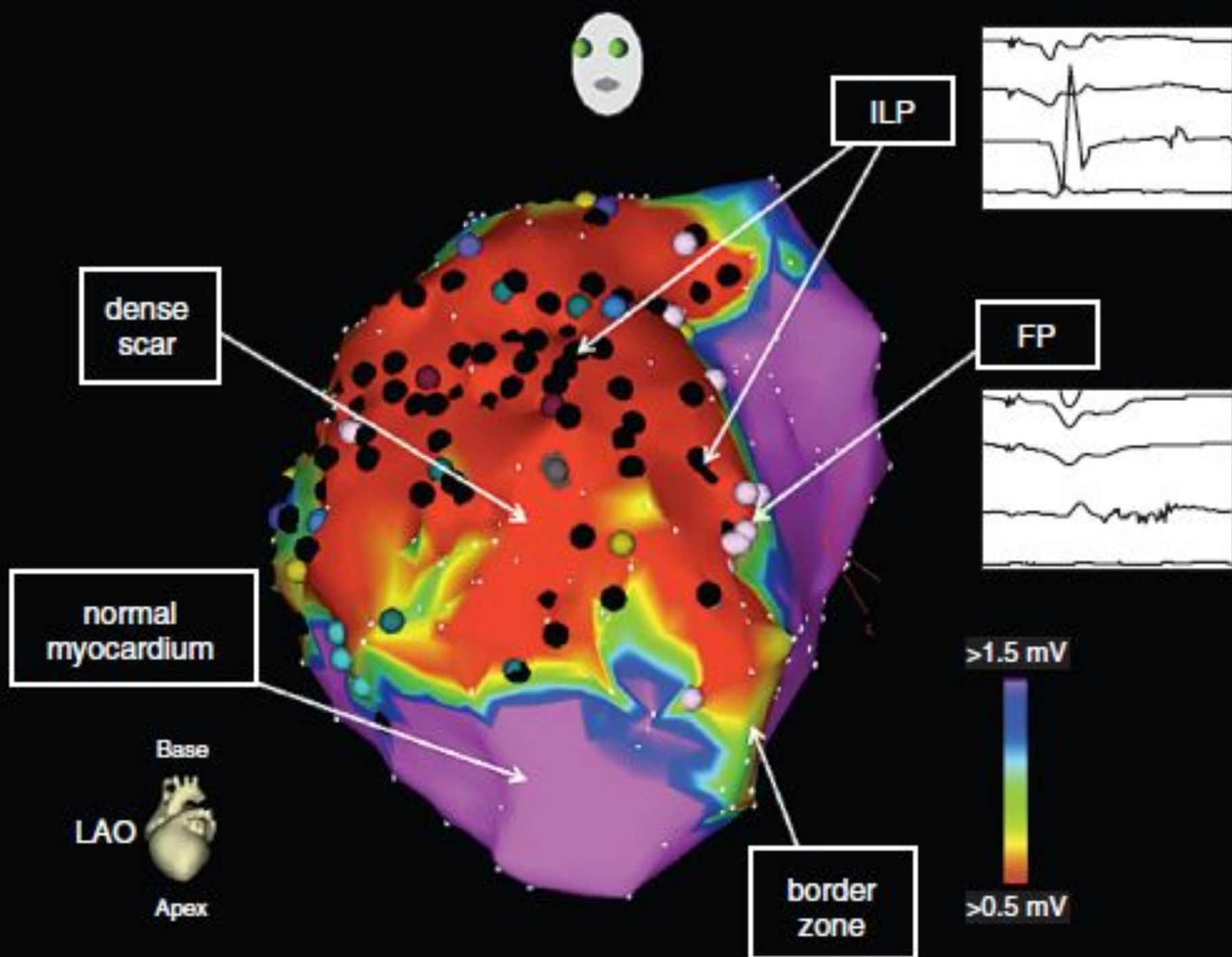
- **Ablate as many late potentials as possible**

- **Attempt to induce VT**
- **If VT remains inducible:**
 - **Repeat pacing mapping or entrainment mapping**
 - **More substrate ablation**

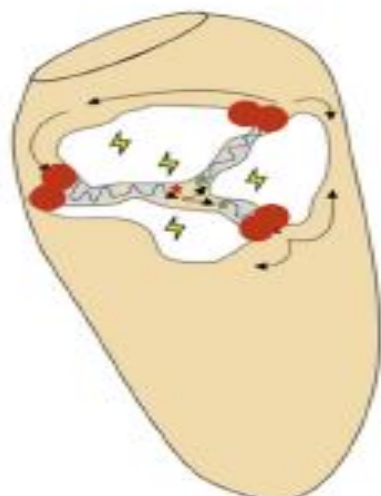


TEŞEKKÜRLER





A Scar Dechanneling



Identification of a corridor of consecutive EGMs with delayed components (conducting channels), and subsequent ablation of the entrance regions.

B Late Potentials and Local Abnormal Ventricular Activities



LPS: Ablation of any low-voltage EGM (<1.3 mV) with a single component or multiple continuous delayed components, recorded after the surface QRS.

LVA: Ablation of sharp high-frequency ventricular potentials occurring anytime from the ventricular EGM (before-TT; during/after-S300).

C Core Isolation

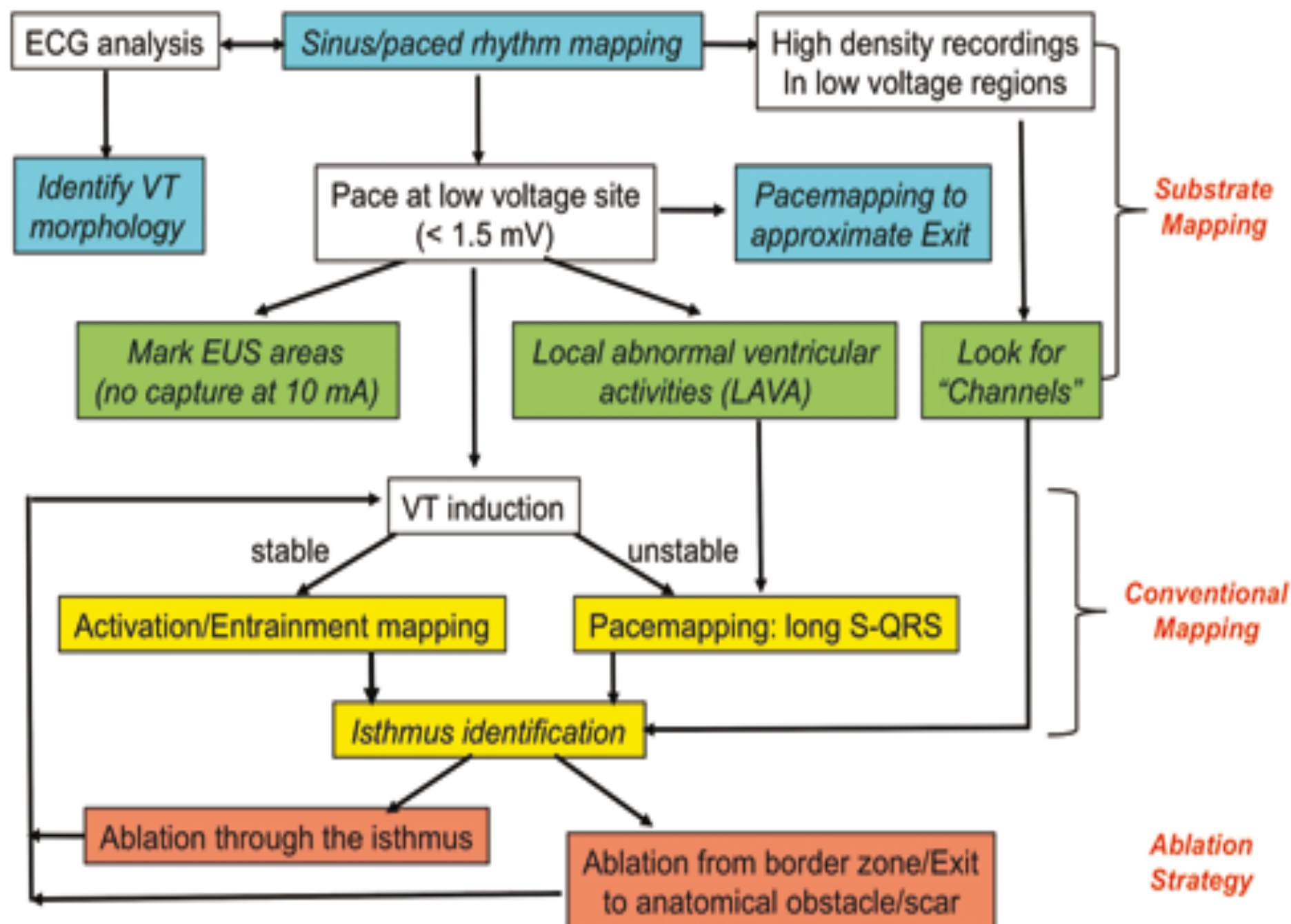


Isolation of the area that incorporates critical VT circuit elements.

D Homogenization



Ablation lesions aimed to cover the entire scar (homogenization of the scar) targeting all abnormal electrograms.

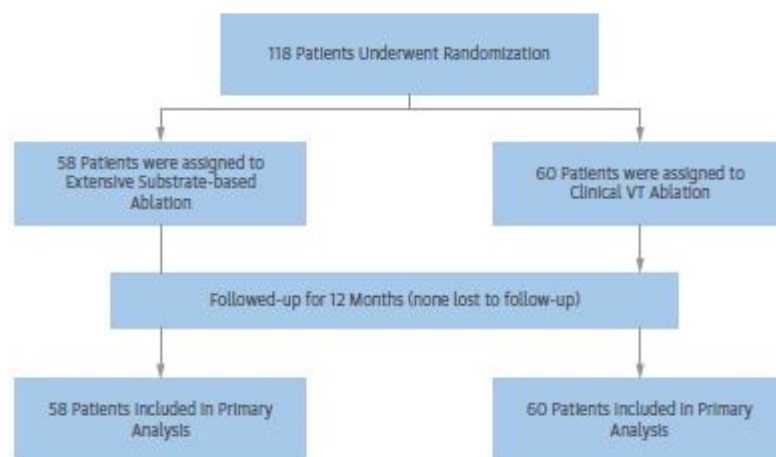


Ablation of Stable VTs Versus Substrate Ablation in Ischemic Cardiomyopathy

The VISTA Randomized Multicenter Trial

Luigi Di Biase, MD, PhD, J. David Burkhardt, MD, Dhanujaya Lakkireddy, MD, Corrado Carbuicchio, MD, Paschamitra Mohanty, MD, Prasant Mohanty, MBBS, MPH, Chintan Trivedi, MD, MBBS, Pasquale Santangeli, MD, Rong Bai, MD, Giovanni Forleo, MD, Rodney Horton, MD, Shane Bailey, MD, Javier Sanchez, MD, Amin Al-Ahmad, MD, Patrick Hranitzky, MD, G. Joseph Gallinghouse, MD, Gemma Pelargonio, MD, Richard H. Hongo, MD, Salwa Beheiry, RN, Steven C. Hao, MD, Madhu Reddy, MD, Antonio Rossillo, MD, Sakis Themistodakis, MD, Antonio Dello Russo, MD, Michela Casella, MD, Claudio Tondo, MD, Andrea Natale, MD

FIGURE 1 Trial Enrollment and Follow-Up



Patients were followed up for 12 months post-ablation. No patient was lost at follow-up during the study period. VT = ventricular tachycardia.

TABLE 3 Univariate and Multivariate Cox Regression Analyses of Potential Risk Factors for VT Recurrence

Factors	Univariate Model		Multivariate Model	
Predictors of VT Recurrence	HR (95% CI)	p Value	HR (95% CI)	p Value
Age, per 5 yrs	1.11 (1.07-1.53)	0.016	1.09 (0.87-1.63)	0.271
Male	3.23 (1.13-6.28)	0.029	2.53 (0.59-10.75)	0.210
LVEF	0.77 (0.48-0.92)	0.035	1.05 (0.80-1.39)	0.716
Diabetes	3.11 (1.19-8.12)	0.020	2.75 (1.01-7.46)	0.042
Hypertension	1.34 (0.61-2.93)	0.460	1.14 (0.89-1.45)	0.303
No. of VT morphologies	1.01 (0.75-1.37)	0.952	1.04 (0.76-1.42)	0.817
Electrical storm	1.86 (1.06-2.81)	0.043	1.29 (0.95-1.83)	0.102
ICD shocks	2.53 (0.59-7.80)	0.209	2.24 (0.47-10.77)	0.314
Substrate-based ablation	0.26 (0.11-0.61)	0.001	0.33 (0.13-0.18)	0.014

TABLE 1 Baseline and Procedural Characteristics of Study Population

	Extensive Substrate-Based Ablation (n = 58)	Clinically Stable VT Ablation (n = 60)	p Value
Age, yrs	67 ± 9	65 ± 12	0.13
Male	54 (93.1)	56 (93.3)	0.96
Hypertension	44 (75.9)	43 (71.7)	0.60
Diabetes	24 (41.7)	19 (31.7)	0.27
BMI	26.4 ± 6.1	24.9 ± 7.2	0.22
NYHA III/IV	31 (53.4)	37 (61.7)	0.37
LVEF	32.0 ± 9.9	32.6 ± 14	0.80
Hypertlipidemia	44 (75.9)	43 (71.7)	0.60
Prior CABG	19 (32.8)	21 (35.0)	0.79
Failed AADs	1.4 ± 0.7	1.5 ± 0.7	0.86
Medications			
Sotalol	4 (6.9)	5 (8.3)	1.00
Beta-blocker	46 (79.3)	50 (83.3)	0.57
Mexiletine	5 (8.6)	6 (10.0)	0.68
Nonsustained VT cycle length	352 ± 86	376 ± 100	0.20
Sustained VT cycle length	399 ± 86	410 ± 90	0.49
Procedure time, h	4.2 ± 1.3	4.6 ± 1.6	0.14
Fluoroscopy time, min	35 ± 32	28 ± 16	0.13
RF time, min	68 ± 21	35 ± 27	<0.001

Values are mean $\pm$ SD or n (%)

AAD = antiarrhythmic drug; AF = atrial fibrillation; BMI = body mass index; CABG = coronary artery bypass graft; LVEF = left ventricular ejection fraction; NYHA = New York Heart Association; RF = radiofrequency; VT = ventricular tachycardia.

TABLE 2 Summary of Outcomes by Study Groups

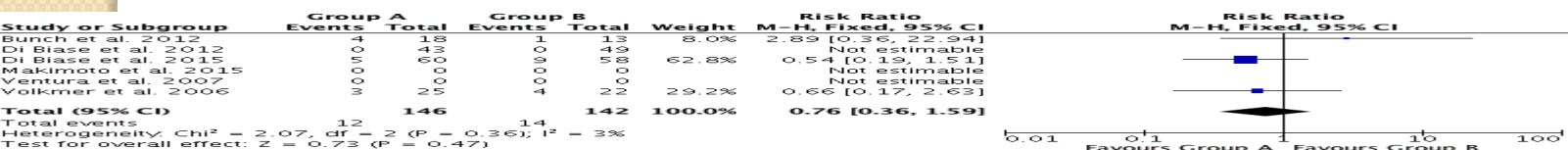
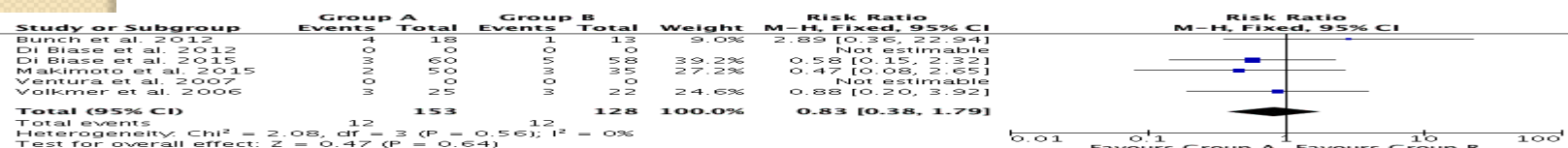
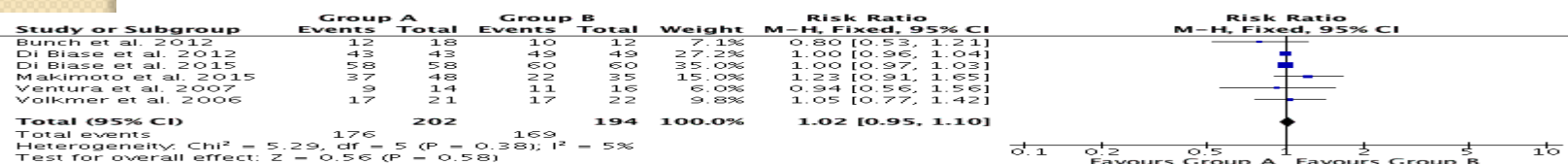
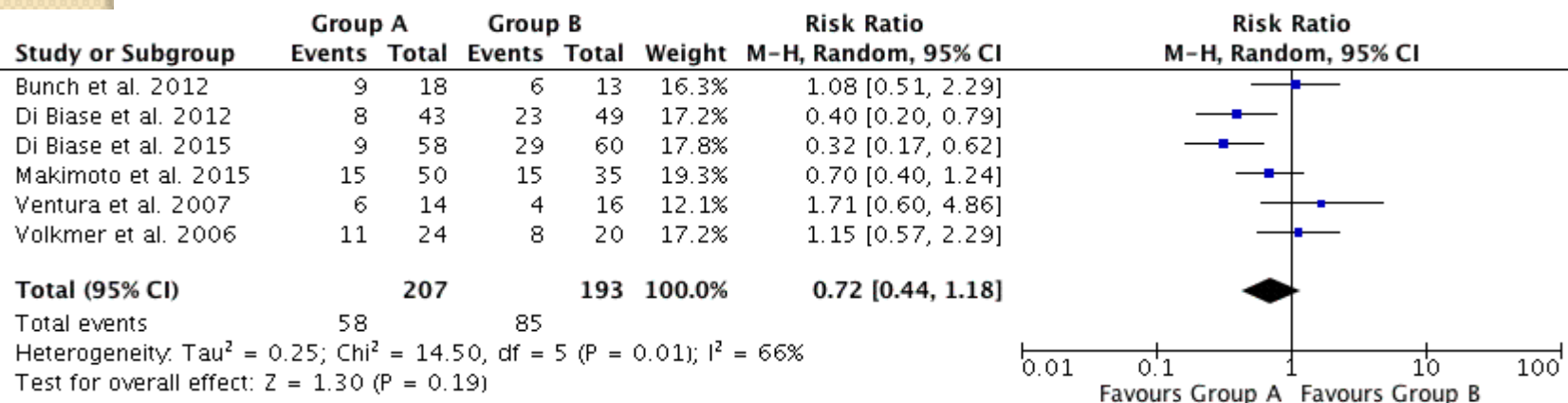
	Substrate-Based Ablation (%)	Clinical Ablation (%)	p Value	HR (95% CI)
VT recurrence rate	15.5 (8.4–27.7)	48.3 (36.6–61.2)	<0.001	0.26 (0.11–0.61)
All-cause mortality rate	8.6 (1.4–14.2)	15.0 (5.9–24.2)	0.21	0.54 (0.17–1.82)
Arrhythmia-related rehospitalization	12.1 (3.8–19.7)	31.7 (22.1–41.6)	0.014	0.31 (0.13–0.78)
Composite: rehospitalization and mortality	20.7 (10.3–30.1)	46.7 (34.0–59.3)	0.003	0.32 (0.17–0.61)
Composite: VT recurrence and mortality	24.1 (13.2–35.1)	63.3 (51.1–75.5)	<0.001	0.20 (0.09–0.43)

The summary table presents the event rates (95% confidence interval), p values from log-rank test, and unadjusted hazard ratio for the outcome measures.

CI = confidence interval; HR = hazard ratio; VT = ventricular tachycardia.

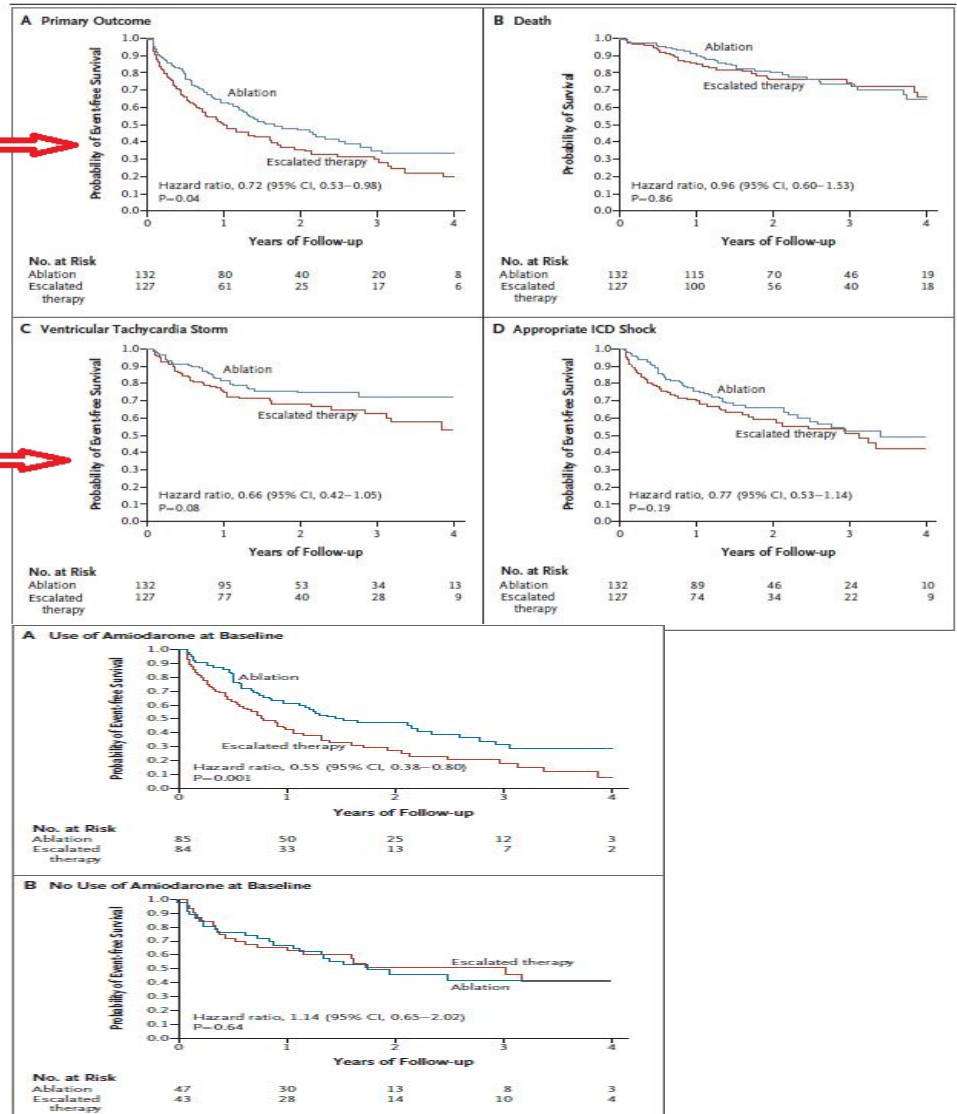
Substrate-Based Ablation Versus Ablation Guided by Activation and Entrainment Mapping for Ventricular Tachycardia: A Systematic Review and Meta-Analysis

SAURABH KUMAR B.Sc.(MED)/M.B.B.S., Ph.D., SAMUEL H. BALDINGER M.D., JORGE ROMERO M.D., AKIRA FUJII M.D., SAAGAR N. MAHIDA M.D., USHA B. TEDROW M.D., M.Sc., WILLIAM G. STEVENSON M.D.



Ventricular Tachycardia Ablation versus Escalation of Antiarrhythmic Drugs

Outcome	Escalated Therapy (N=127)	Catheter Ablation (N=132)	Hazard Ratio (95% CI)	P Value
	no. (%)			
Primary outcome†	87 (68.5)	78 (59.1)	0.72 (0.53–0.98)	0.04
Death	35 (27.6)	36 (27.3)	0.96 (0.60–1.53)	0.86
From cardiovascular causes‡	26	24		
From noncardiovascular causes	8	12		
From unknown cause	1	0		
Appropriate ICD shock after 30 days	54 (42.5)	50 (37.9)	0.77 (0.53–1.14)	0.19
Ventricular tachycardia storm after 30 days	42 (33.1)	32 (24.2)	0.66 (0.42–1.05)	0.08
Other outcomes				
Appropriate ICD shock at any time	54 (42.5)	56 (42.4)	0.97 (0.66–1.40)	0.85
Ventricular tachycardia storm at any time	46 (36.2)	38 (28.8)	0.74 (0.48–1.14)	0.17
Sustained ventricular tachycardia below ICD detection limit				
At any time	13 (10.2)	4 (3.0)	0.27 (0.09–0.84)	0.02
After 30 days	8 (6.3)	3 (2.3)	0.33 (0.09–1.25)	0.09
Cardioversion for ventricular tachycardia§	14 (11.0)	8 (6.1)	0.52 (0.22–1.23)	0.13
Appropriate ATP				
At any time	79 (62.2)	84 (63.6)	0.97 (0.71–1.32)	0.83
After 30 days	78 (61.4)	77 (58.3)	0.87 (0.63–1.19)	0.37
Inappropriate ICD shock				
At any time	11 (8.7)	13 (9.8)	1.08 (0.48–2.41)	0.86
After 30 days	11 (8.7)	13 (9.8)	1.08 (0.48–2.42)	0.85
Hospital admission for cardiac causes	39 (30.7)	33 (25.0)	0.76 (0.48–1.21)	0.25
	no. (mean no./person-yr)			
Total shocks or arrhythmia events¶				
ICD shock				
Appropriate	266 (2.09)	169 (1.28)	NA	0.28
Inappropriate	85 (0.67)	66 (0.50)	NA	0.46
Appropriate ATP	2453 (19.2)	1711 (13.0)	NA	0.27
Sustained ventricular tachycardia below ICD detection	18 (0.14)	4 (0.03)	NA	0.02



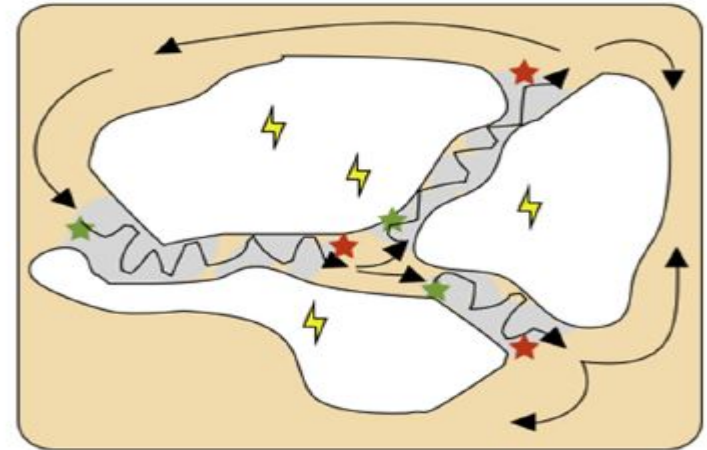
LPs; Tanım

B Late Potentials and Local Abnormal Ventricular Activities

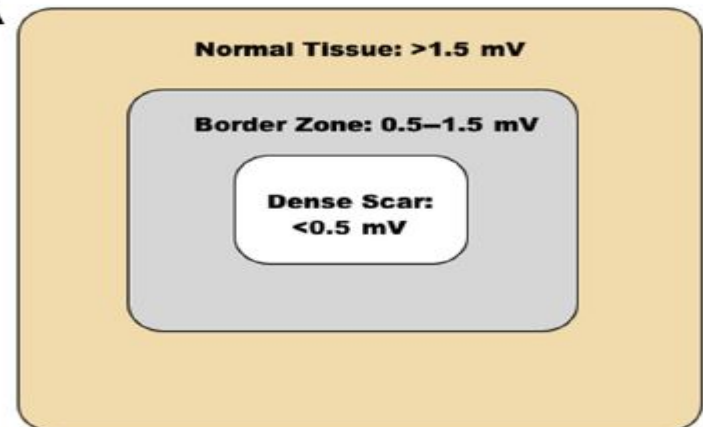


LPs: Ablation of any low voltage EGM (<1.5 mV) with a single component or multiple continuous delayed components, recorded after the surface QRS.

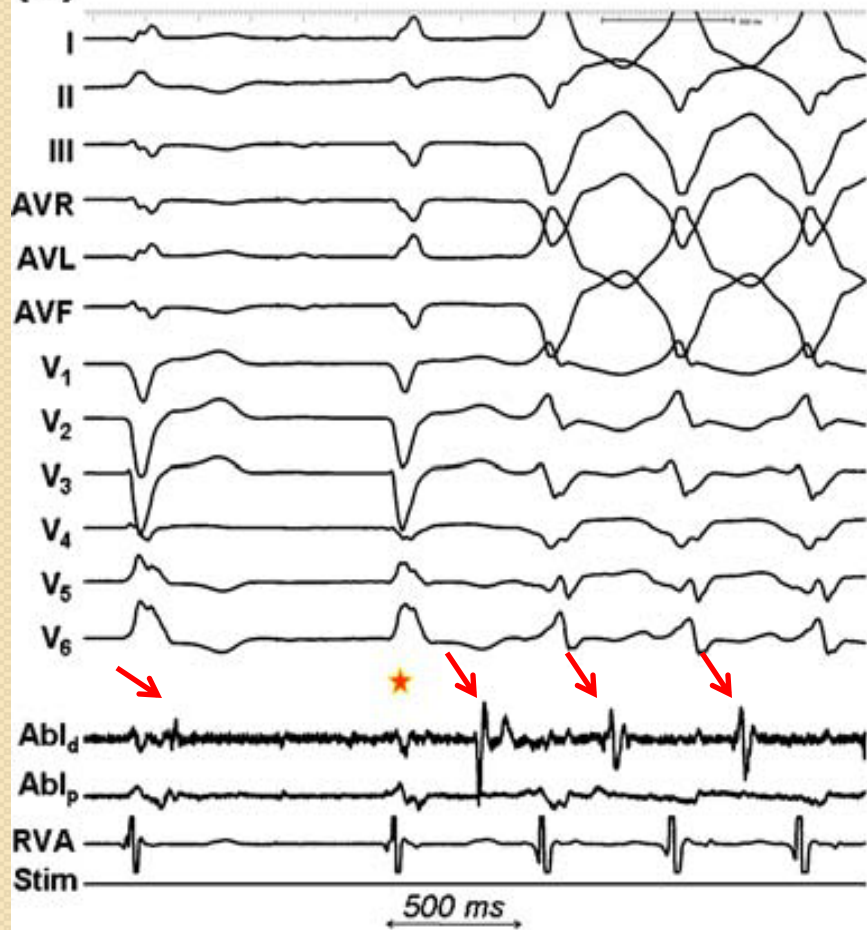
LAVA: Ablation of sharp high-frequency ventricular potentials occurring anytime from the ventricular EGM (before-VT; during/after-NSR)



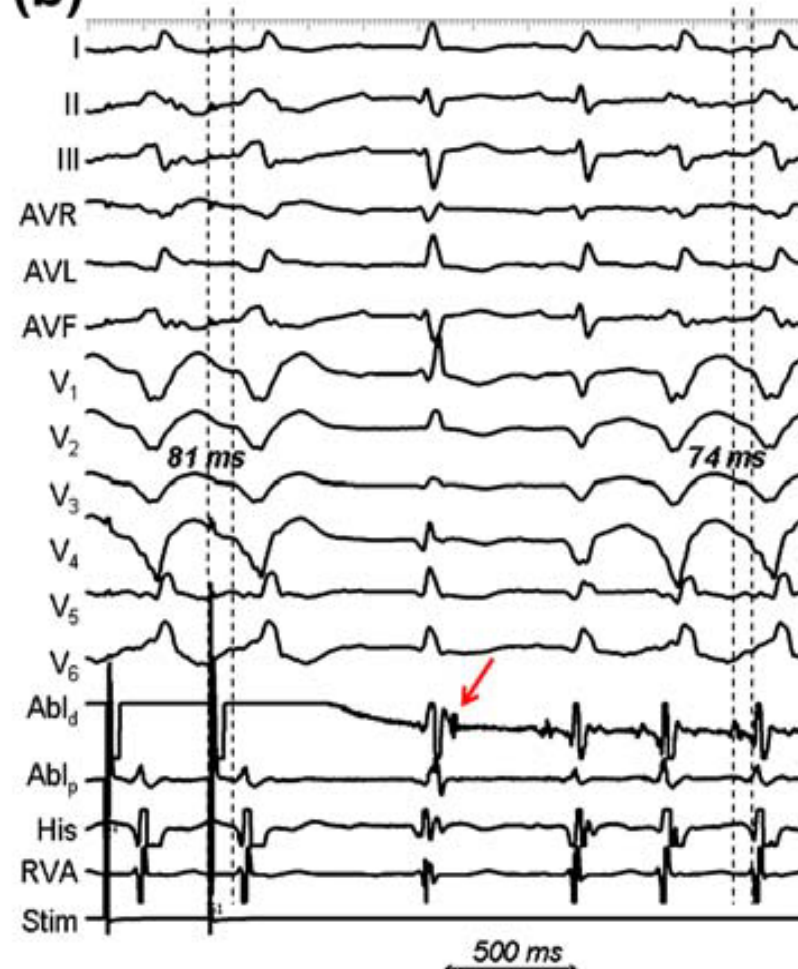
A



(a)



(b)



Entrainment Mapping

Overdrive Pacing during VT:

pacing at 20-30 msec faster than the VT CL

Concealed Fusion

QRS Fusion

*PPI~VT (< 30 msec)
S-QRS ~ Egm-QRS (< 20 msec)*

PPI~VTCL (< 30 msec)

No

Yes

Adjacent
Bystander

No

Yes

Remote
Site

Outer
Loop

S-QRS/VTCL (%)

< 30%

30-50%

50-70%

> 70%

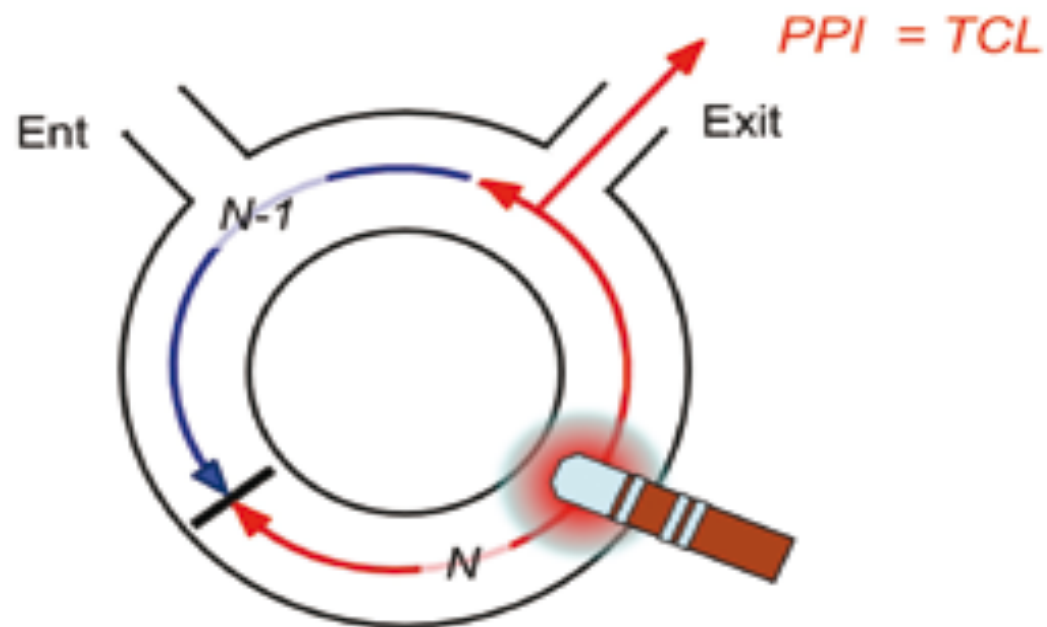
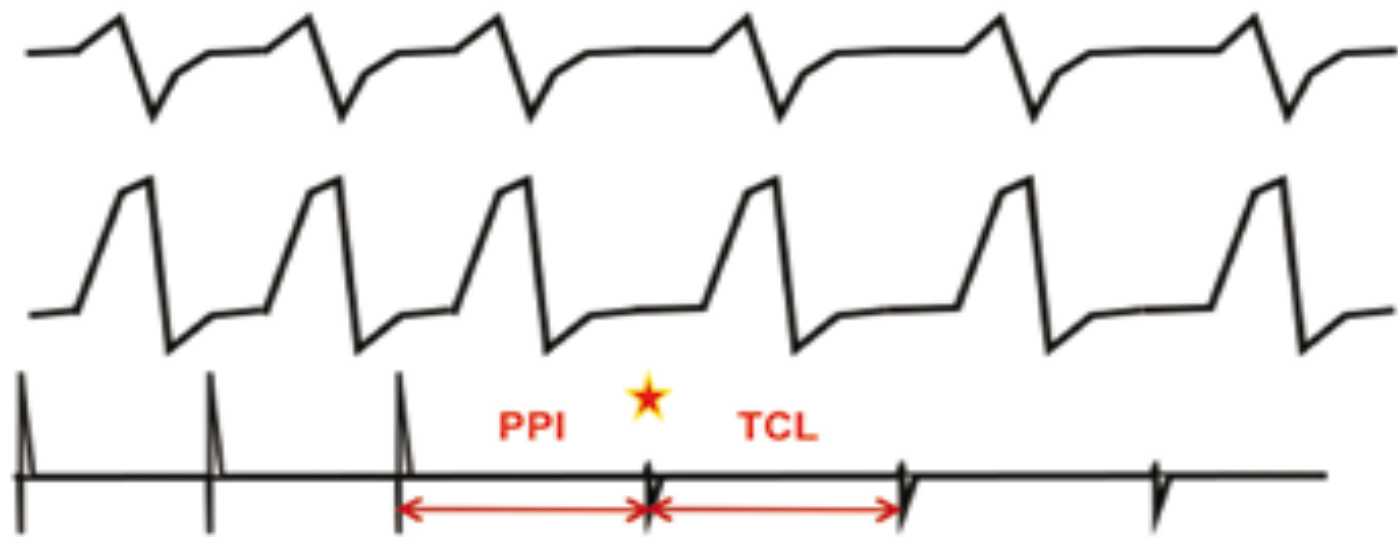
Exit

Central isthmus

Entrance

Inner Loop

Concealed Entrainment/Entrainment with Concealed Fusion



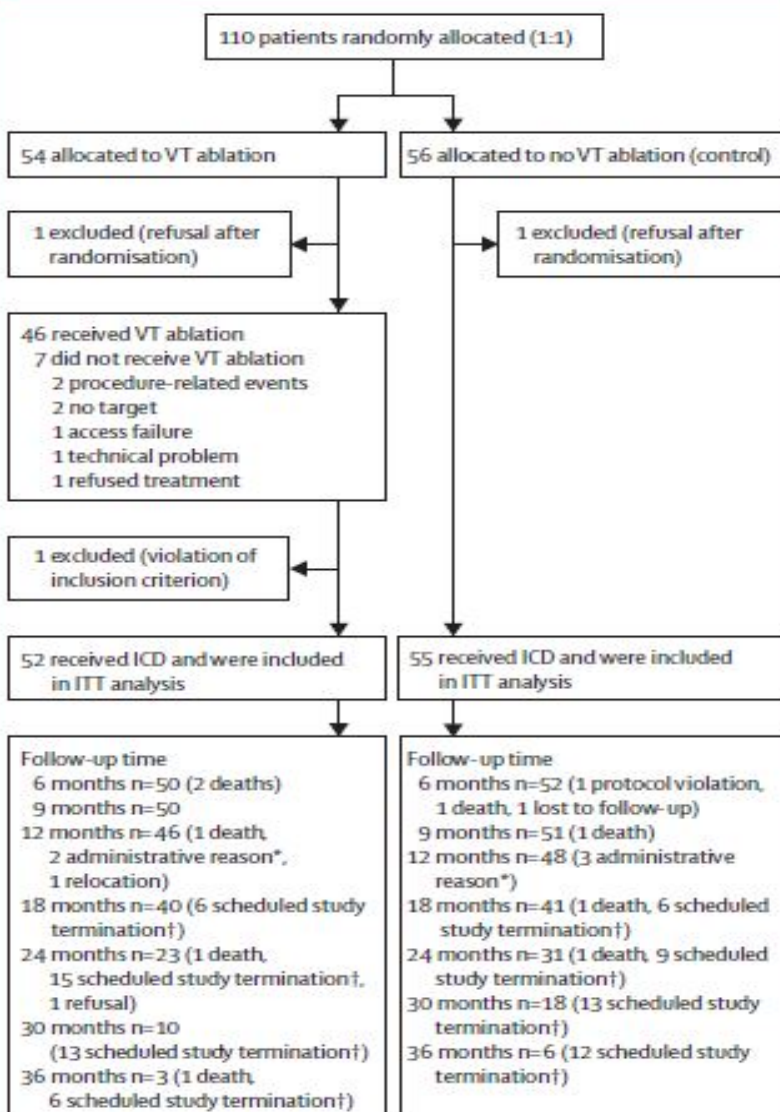


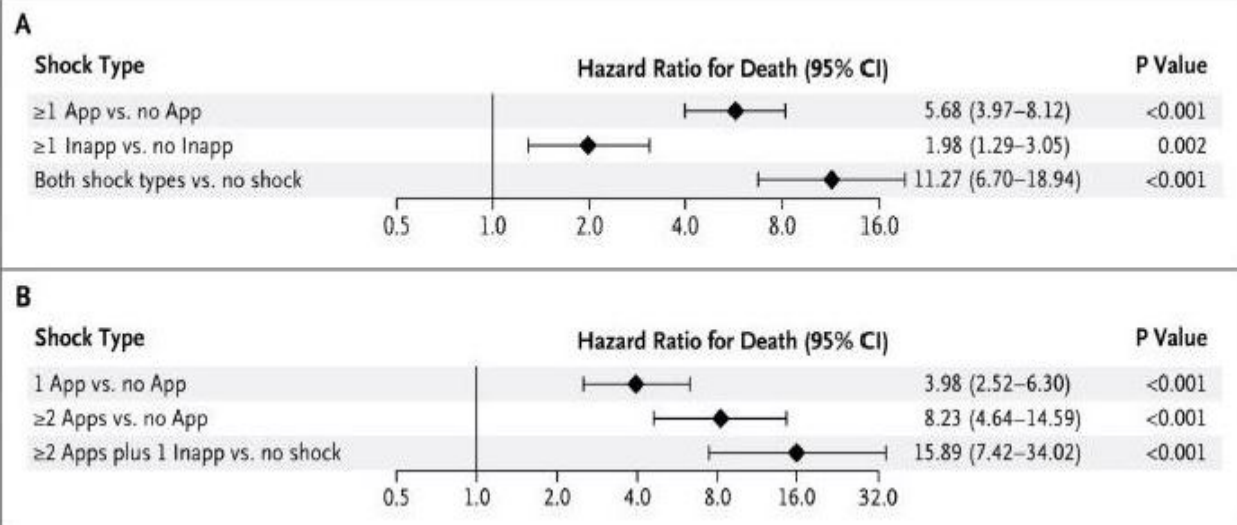
Table 2. Procedural Data

	Noninducible With LP Ablation (n=73)	Noninducible Without LP Ablation (n=63)	1 vs 2 P Value	VT Inducible (n=19)	1 vs 3 P Value
Hospital stay					
Inpatient stay, d	8 (7–13)	9 (7–14)	0.25	14 (9–17)	<0.01
Procedural parameters					
Procedure time, min	220 (180–255)	210 (180–240)	0.52	270 (180–330)	0.05
Endo-epicardial access, %	15 (21%)	11 (18%)	0.65	6 (32%)	0.38
Endocardial RF time, min	25.5 (18–38.5)	23.5 (16.2–32)	0.31	25.5 (17.7–32.2)	0.66
Epicardial RF time, min	6 (2–20)	8 (2–22.5)	0.94	5 (0–8.7)	0.35
Baseline VT inducibility					
Monomorphic VT inducibility	56 (77%)	46 (73%)	0.62	14 (74%)	0.77
VF inducible	0 (0%)	1 (2%)	0.46	0 (0%)	0.46
Incessant VT	6 (8%)	7 (11%)	0.57	4 (21%)	0.21
VT noninducible	11 (15%)	9 (14%)	0.90	0 (0%)	0.11
VT characteristics					
VT in procedure (+)	1 (1–2)	2 (1–2)	0.34	2 (1–3)	0.01
VT ablated in procedure (+)	1 (0–1)	1 (0–2)	0.07	1 (0–1)	0.25
Nontolerated VT	30 (41%)	27 (43%)	1.00	7 (37%)	0.95
Clinical VT ablated/documentated	24/44 (55%)	31/49 (63%)	0.39	7/14 (50%)	0.77
Final VT inducibility					
VT noninducibility (broad)	66 (90%)	55 (87%)	0.56	0 (0%)	<0.01
VT noninducibility (narrow)	73 (100%)	63 (100%)	0.56	0 (0%)	<0.01
Electrogram-based parameters					
Endocardial LP presence	72/73 (99%)	18/63 (29%)	<0.01	10/16 (62.5%)	<0.01
Epicardial LP presence	10/15 (67%)	6/11 (55%)	0.74	3/6 (50%)	0.43
Endo- or Epicardial LP presence	73 (100%)	19/63 (30%)	<0.01	10/16 (62.5%)	<0.01
Endocardial LP ablation	72/72 (100%)	2/18 (11%)	<0.01	5/10 (50%)	<0.01
Epicardial LP ablation	10/10 (100%)	2/6 (33%)	<0.01	0/3 (0%)	<0.01
LP ablation	73 (100%)	0 (0%)	<0.01	4/16 (25%)	<0.01
EP ablation	9/73 (12%)	18/63 (29%)	0.02	4/19 (21%)	0.46
Outcome					
Follow-up time, d	590 (422–885)	556 (364–858.5)	0.91	255 (44–500)	0.02
Time to VT recurrence, d	112 (64.7–336.5)	70 (6–197.5)	0.17	72 (17–246.5)	0.38
VT recurrence	12 (16%)	29 (47%)	<0.01	9 (47%)	<0.01
Cardiac death	3 (4%)	6 (10%)	0.25	8 (42%)	<0.01
Noncardiac death	3 (4%)	5 (8%)	0.47	1 (5%)	1.00

ORIGINAL ARTICLE

Prognostic Importance of Defibrillator Shocks in Patients with Heart Failure

Jeanne E. Poole, M.D., George W. Johnson, B.S.E.E., Anne S. Hellkamp, M.S.,
 Jill Anderson, R.N., David J. Callans, M.D., Merritt H. Raitt, M.D.,
 Ramakota K. Reddy, M.D., Francis E. Marchlinski, M.D., Raymond Yee, M.D.,
 Thomas Guarnieri, M.D., Mario Talajic, M.D., David J. Wilber, M.D.,
 Daniel P. Fishbein, M.D., Douglas L. Packer, M.D., Daniel B. Mark, M.D., M.P.H.,
 Kerry L. Lee, Ph.D., and Gust H. Bardy, M.D.



Catheter ablation of stable ventricular tachycardia before defibrillator implantation in patients with coronary heart disease (VTACH): a multicentre randomised controlled trial

Karl-Heinz Kuck, Anselm Schumann, Lars Eckardt, Stephan Willems, Rodolfo Ventura, Etienne Delacretaz, Heinz-Friedrich Pitschner, Josef Kautzner, Burghard Schumacher, Peter S Hansen, for the VTACH study group*

	Ablation (n=52)	Control (n=55)	Hazard ratio (95% CI)	p value
Time to first VT or VF (months, mean [SD]; median [IQR])	15.9 (1.7); 18.6 (2.4*)	11.3 (1.5); 5.9 (0.8-26.7)	0.61 (0.37-0.99)	0.045†
24-month event-free survival estimates (%)‡				
VT recurrence (category 1)	46.6%	28.8%	0.61 (0.37-0.99)	0.045†
VT recurrence (all categories)	46.4%	28.8%	0.61 (0.38-1.01)	0.051†
Hospital admission for cardiac reasons	67.4%	45.4%	0.55 (0.30-0.99)	0.044†
VT storm	75.0%	69.7%	0.73 (0.36-1.50)	0.395†
Syncope	96.2%	85.4%	0.36 (0.07-1.81)	0.197†
Death	91.5%	91.4%	1.32 (0.35-4.94)	0.677†
Appropriate ICD intervention (n (%))	26 (50.0%)	38 (69.1%)	..	0.051§
ICD shock (n (%))	17 (32.7%)	29 (52.7%)	..	0.051§
Appropriate ICD shock (n (%))	14 (26.9%)	26 (47.3%)	..	0.045§
Inappropriate ICD shock (n (%))	4 (7.7%)	6 (10.9%)	..	0.743§
≥2 shocks per year (n (%))	6 (11.5%)	15 (27.3%)	..	0.021§
≥2 appropriate shocks per year (n (%))	4 (7.7%)	12 (21.8%)	..	0.018§
Number of appropriate ICD interventions per patient per year¶ (mean [SD]; median [range])	7.1 (16.3); 0.2 (0-91)	58.3 (263.5); 3.0 (0-1940)	..	0.013
Number of appropriate ICD shocks per patient per year§ (mean [SD]; median [range])	0.6 (2.1); 0 (0-14.2)	3.4 (9.2); 0 (0-48.4)	..	0.018

VT=ventricular tachycardia. VF=ventricular fibrillation. ICD=implantable cardioverter defibrillator. *Lower quartile shown (upper quartile not determinable because, at the end of the observation period, 37% of the patients were still event-free). †Calculated by log-rank test. ‡Kaplan-Meier survival estimates. §Calculated by Fisher's exact test.

¶Analysis done on all event categories. ||Calculated by Wilcoxon test.

Table 3: Endpoints in ablation and control groups

Ventricular Tachycardia Ablation versus Escalation of Antiarrhythmic Drugs

Outcome	Escalated Therapy (N=127)	Catheter Ablation (N=132)	Hazard Ratio (95% CI)	P Value
no. (%)				
Primary outcome†	87 (68.5)	78 (59.1)	0.72 (0.53-0.98)	0.04
Death	35 (27.6)	36 (27.3)	0.96 (0.60-1.53)	0.86
From cardiovascular causes‡	26	24		
From noncardiovascular causes	8	12		
From unknown cause	1	0		
Appropriate ICD shock after 30 days	54 (42.5)	50 (37.9)	0.77 (0.53-1.14)	0.19
Ventricular tachycardia storm after 30 days	42 (33.1)	32 (24.2)	0.66 (0.42-1.05)	0.08
Other outcomes				
Appropriate ICD shock at any time	54 (42.5)	56 (42.4)	0.97 (0.66-1.40)	0.85
Ventricular tachycardia storm at any time	46 (36.2)	38 (28.8)	0.74 (0.48-1.14)	0.17
Sustained ventricular tachycardia below ICD detection limit				
At any time	13 (10.2)	4 (3.0)	0.27 (0.09-0.84)	0.02
After 30 days	8 (6.3)	3 (2.3)	0.33 (0.09-1.25)	0.09
Cardioversion for ventricular tachycardia§	14 (11.0)	8 (6.1)	0.52 (0.22-1.23)	0.13
Appropriate ATP				
At any time	79 (62.2)	84 (63.6)	0.97 (0.71-1.32)	0.83
After 30 days	78 (61.4)	77 (58.3)	0.87 (0.63-1.19)	0.37
Inappropriate ICD shock				
At any time	11 (8.7)	13 (9.8)	1.08 (0.48-2.41)	0.86
After 30 days	11 (8.7)	13 (9.8)	1.08 (0.48-2.42)	0.85
Hospital admission for cardiac causes	39 (30.7)	33 (25.0)	0.76 (0.48-1.21)	0.25
no. (mean no./person-yr)				
Total shocks or arrhythmia events¶				
ICD shock				
Appropriate	266 (2.09)	169 (1.28)	NA	0.28
Inappropriate	85 (0.67)	66 (0.50)	NA	0.46
Appropriate ATP	2453 (19.2)	1711 (13.0)	NA	0.27
Sustained ventricular tachycardia below ICD detection	18 (0.14)	4 (0.03)	NA	0.02

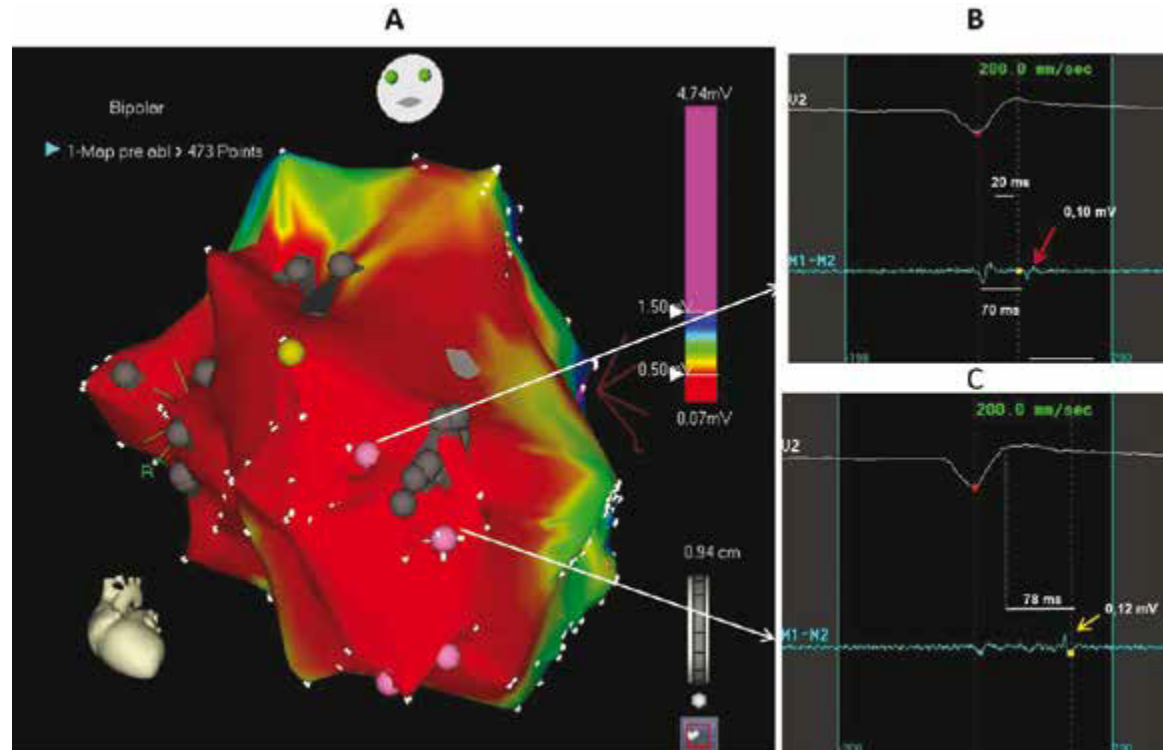
LPs; Tanim

B Late Potentials and Local Abnormal Ventricular Activities



LPs: Ablation of any low voltage EGM (<1.5 mV) with a single component or multiple continuous delayed components, recorded after the surface QRS.

LAVA: Ablation of sharp high-frequency ventricular potentials occurring anytime from the ventricular EGM (before-VT, during/after-NSR)





Mapping and Ablation of Post MI VT
Scared-Substrate Modification Approach
Bipolar Voltage Mapping In Sinus Rhythm
Dense Scar < 0.5mV Scar Border > 0.5 < 1.8 mV

Tag Areas Exhibiting

- Late Potentials
- Double potentials
- High Voltage Channels within the Scar

12- Lead ECG
Spontaneous VT
Regionalize VT Exit Site
at The Scar Border

Ventricular Stimulation
Induce VT

VT
Sustained / Stable
Hemodynamically Tolerated

Focal Ablation
Guided by Activation
Mapping and Entrainment

Ablation Targeting

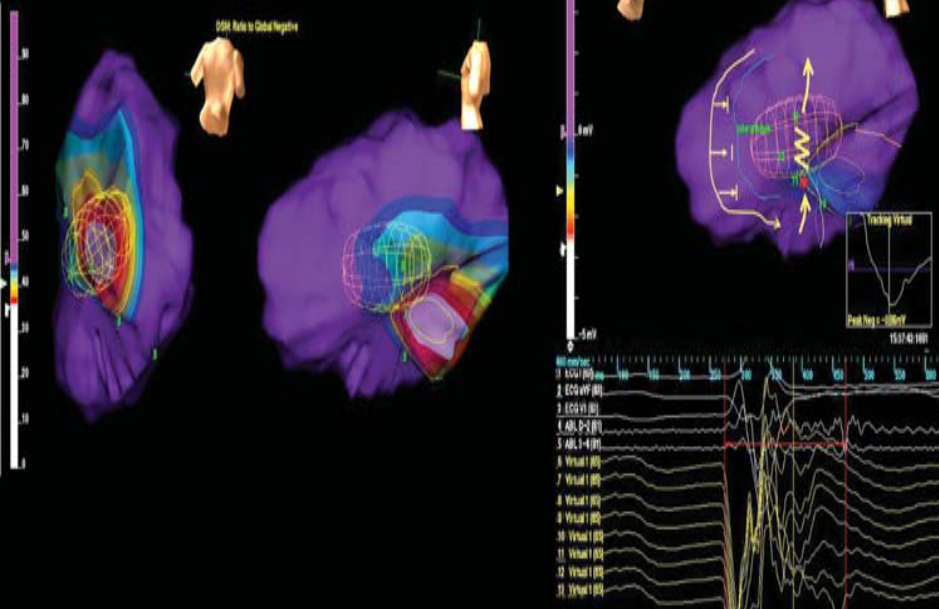
- Good Pace Map at Scar Borders
- Late Potentials
- Across Isthmus or Channels
- Ablation Line from Dense Scar to Mitral Annulus

Pace Map
At Exit Sites on Scar Borders
Based on 12-Leads ECG of
Spontaneous or Induced VTs

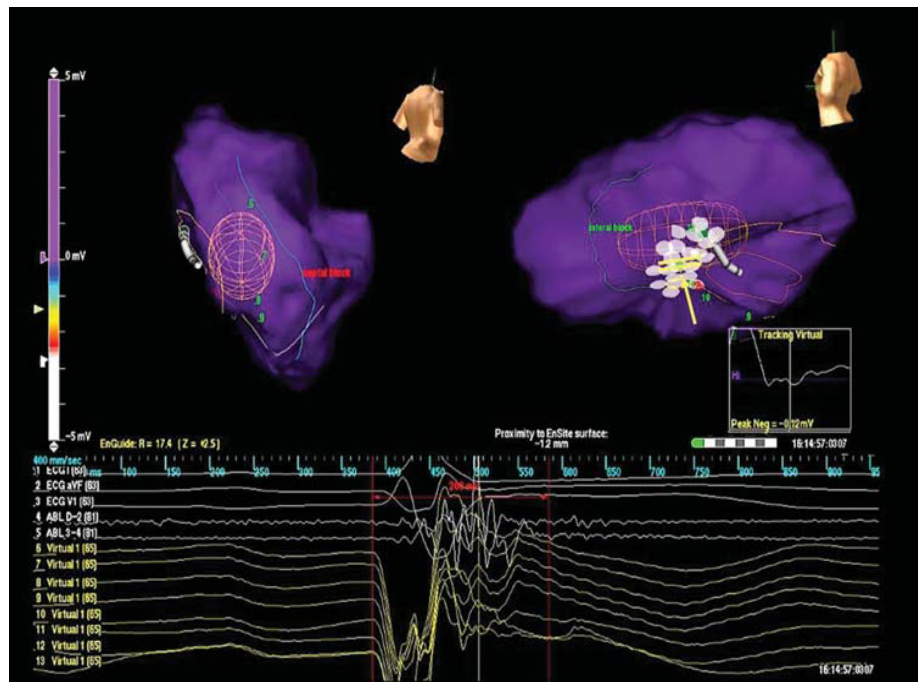
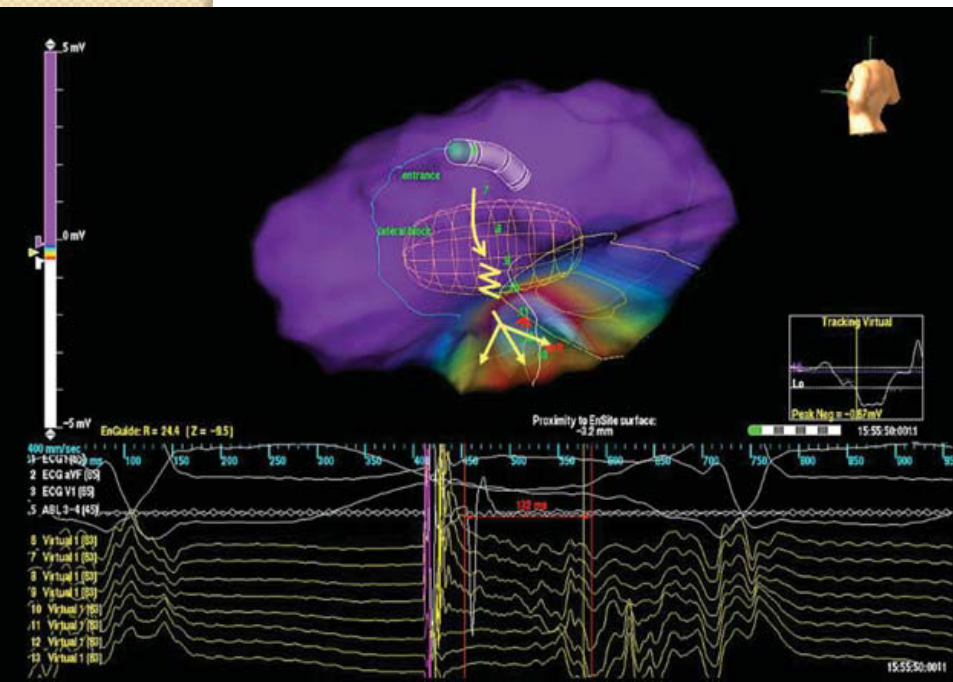
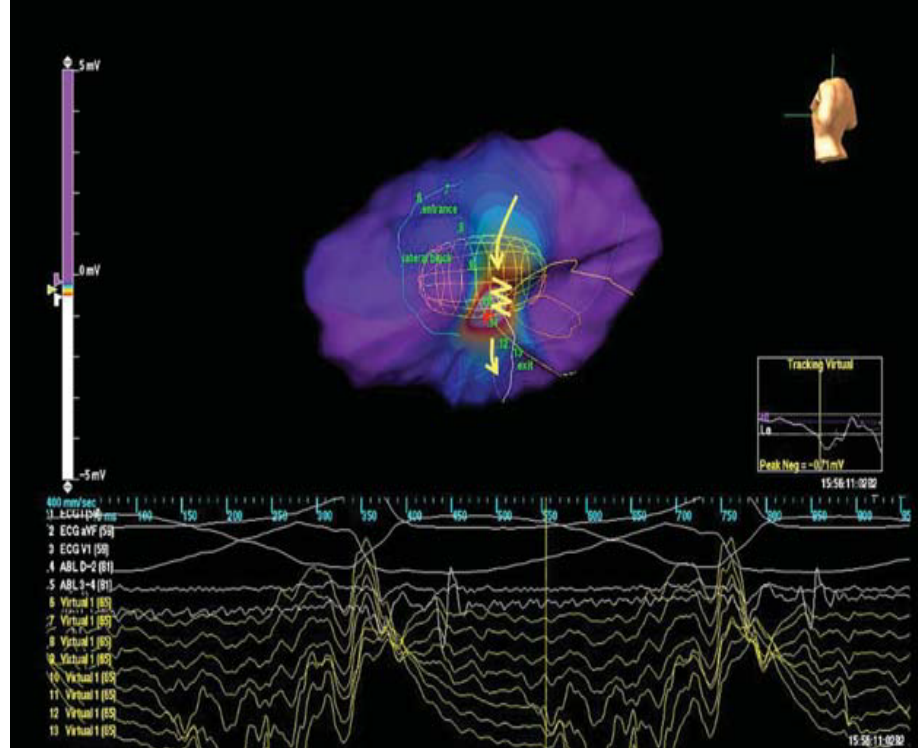
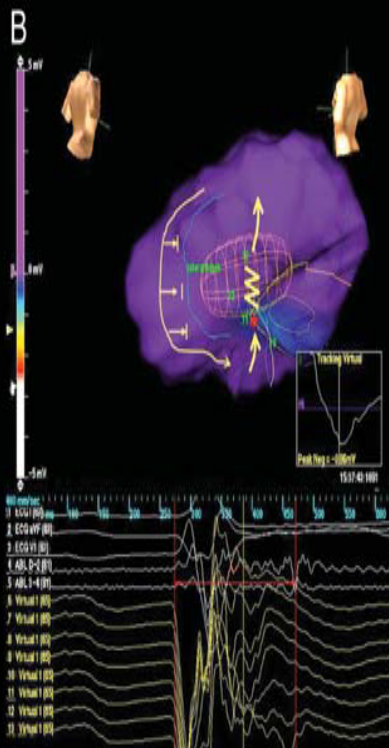
- VT**
- Non-inducible
 - Non-sustained
 - Not tolerated
 - Unable to Capture or Change to a different VT



A



B



6 LV VT4

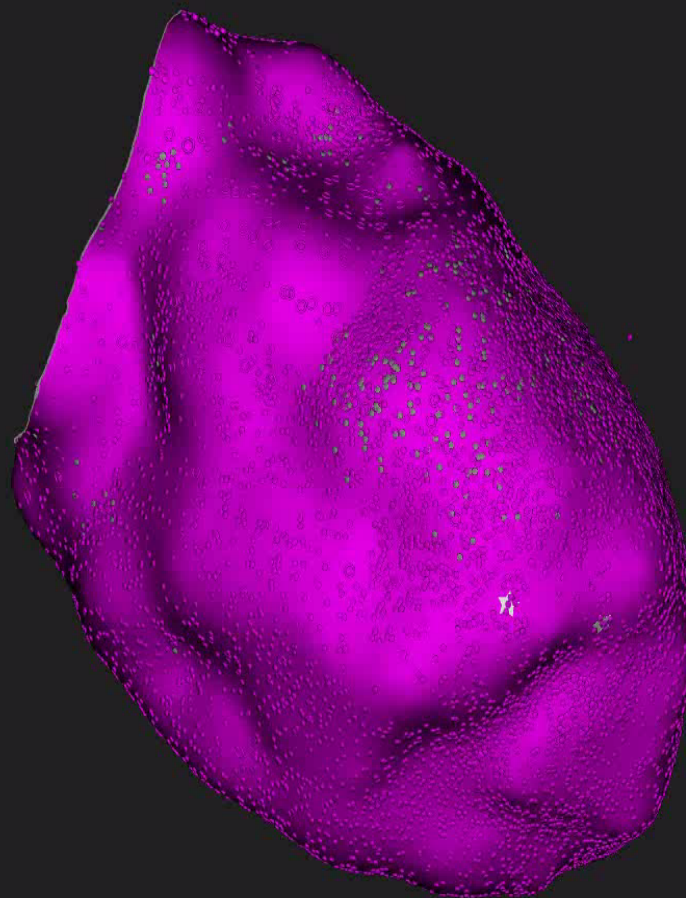
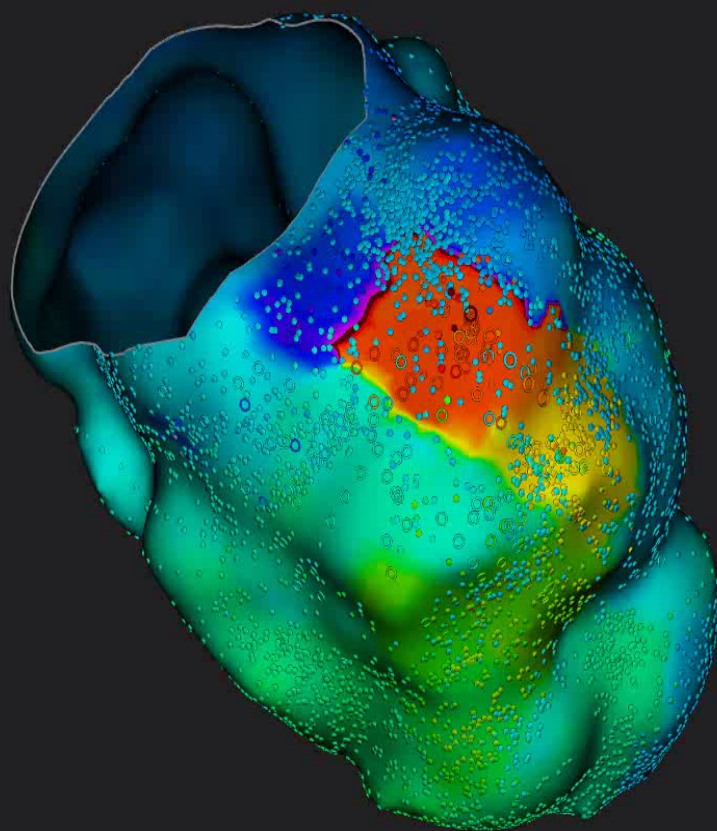
Study Log

U.Time



1 LV sinus

-51 ms -50 ms -40 ms 244 ms B.Time



Auto

INF

SUP

RL

LL

RAO

LAO

PA

AP



Time: 22:29 Beats: 911

Volume: 127.39 cc

EGMs: 9718



Auto

INF

SUP

RL

LL

RAO

LAO

PA

AP



Time: 55:24 Beats: 1112

Volume: 167.54 cc

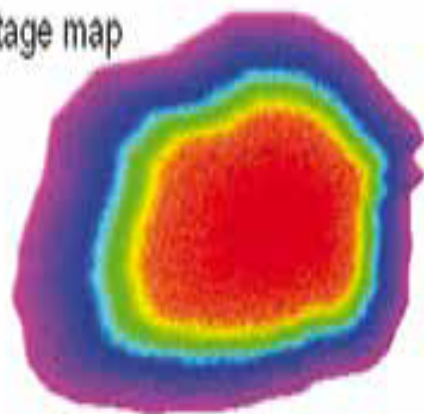
EGMs: 20085

Continuous Review Graph

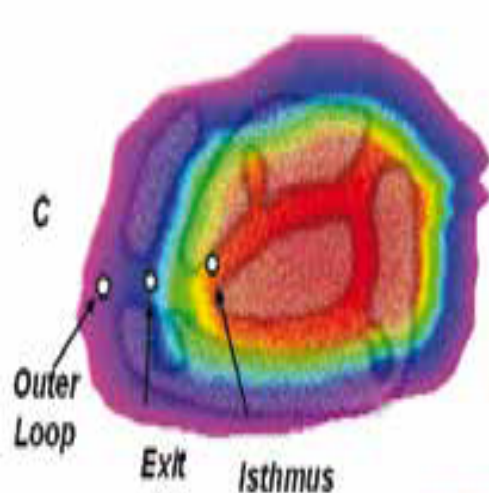
VT Circuit

Voltage map

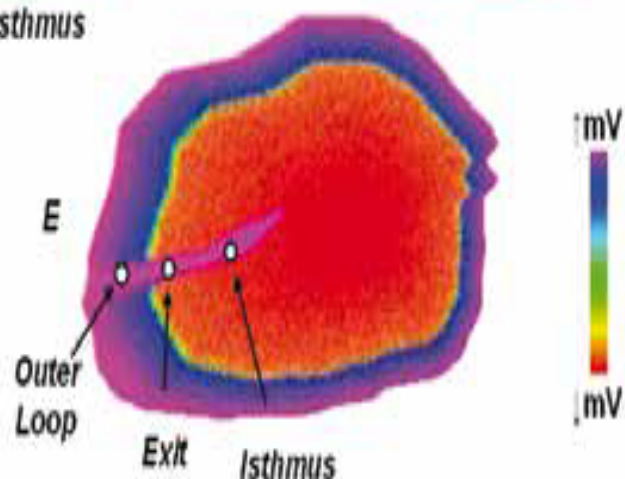
A



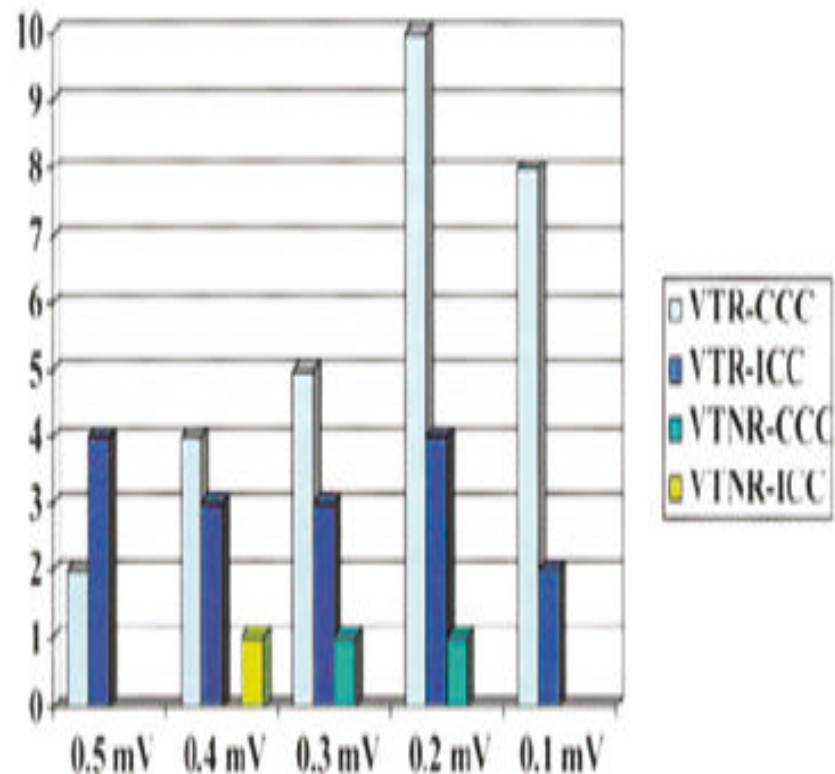
C



E



Relationship Between Scar Voltage Definitions and Identification of Conducting Channels



VTR-CCC: VT-related complete CCs

VTR-ICC: VT-related incomplete CCs

VTNR-CCC: VT-nonrelated complete CCs

VTNR-ICC: VT-nonrelated incomplete CCs.