October
17-18
NICE

RHYTHM

HOW TO LOCALIZE THE CRITICAL ISTHMUS IN VT ABLATION

Using Imaging

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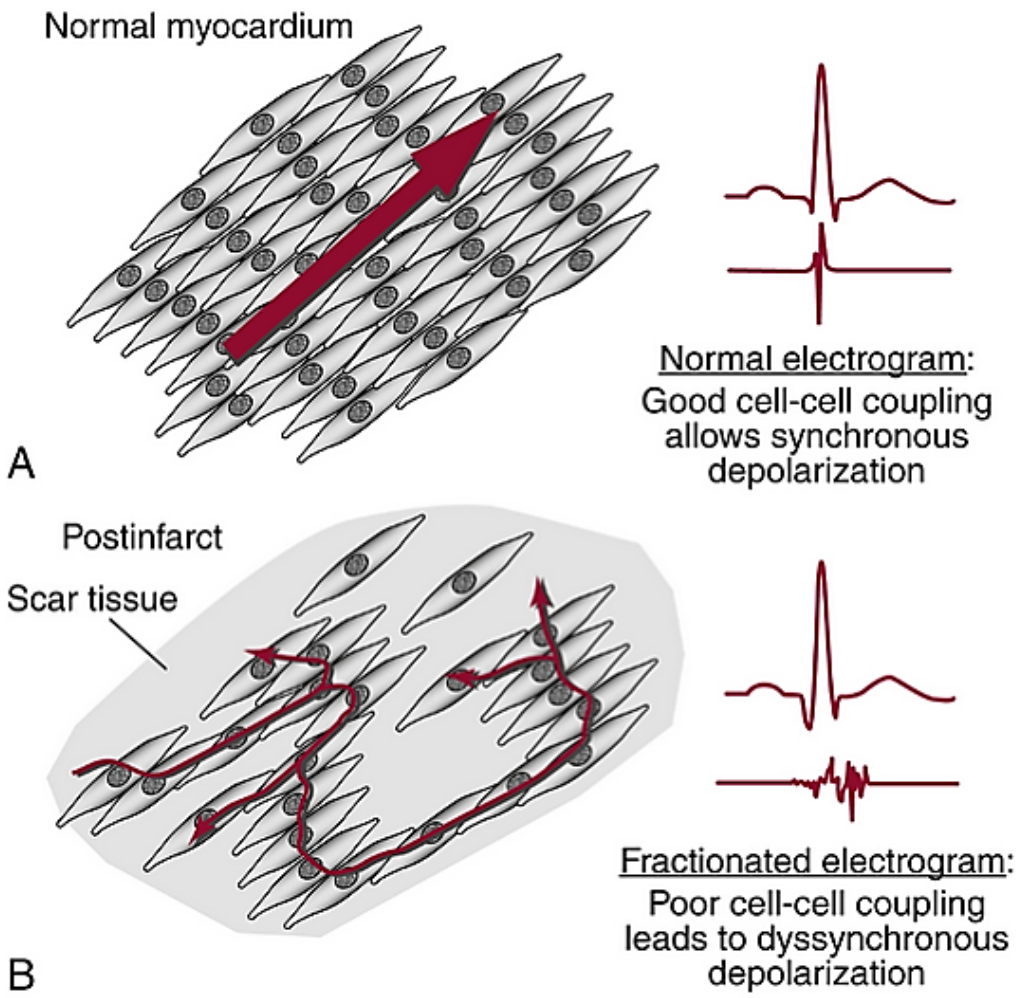
Disclosure

Speaker name:

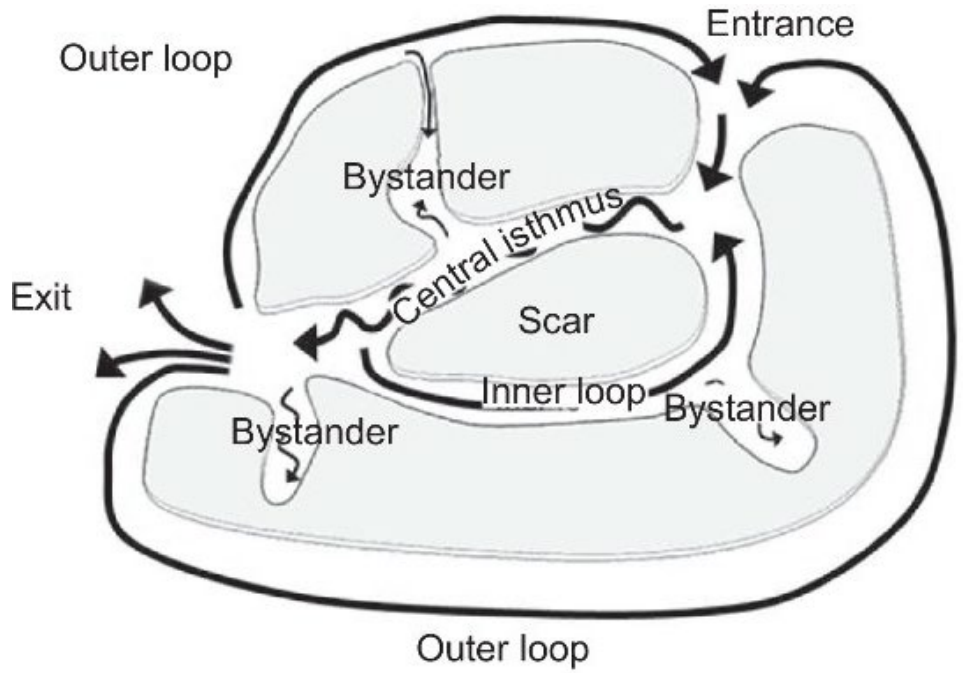
Alberto Battaglia

I do not have any potential conflict of interest

Substrate



Zipes et al Clinical Arrhythmology and Electrophysiology Elsevier 2012



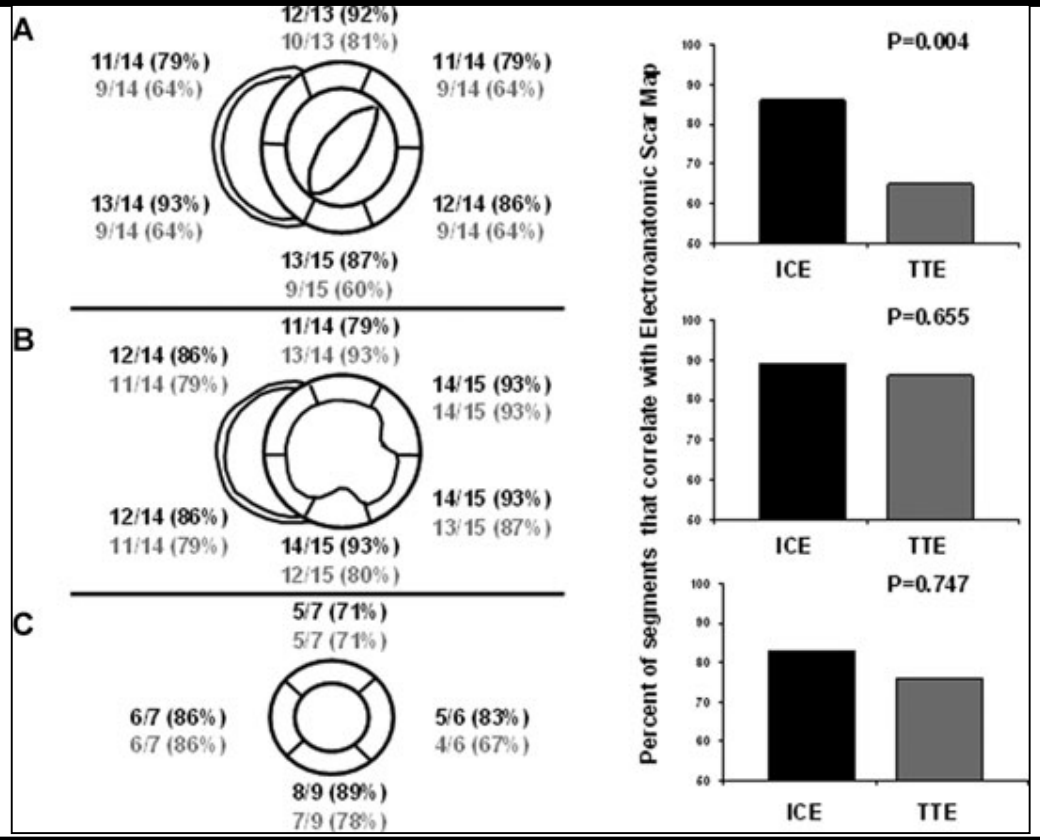
Identification of Reentry Circuit Sites During Catheter Mapping and Radiofrequency Ablation of Ventricular Tachycardia Late After Myocardial Infarction

William G. Stevenson, MD; Hafiza Khan, MD; Philip Sager, MD; Leslie A. Saxon, MD; Holly R. Middlekauff, MD; Paul D. Natterson, MD; Isaac Wiener, MD

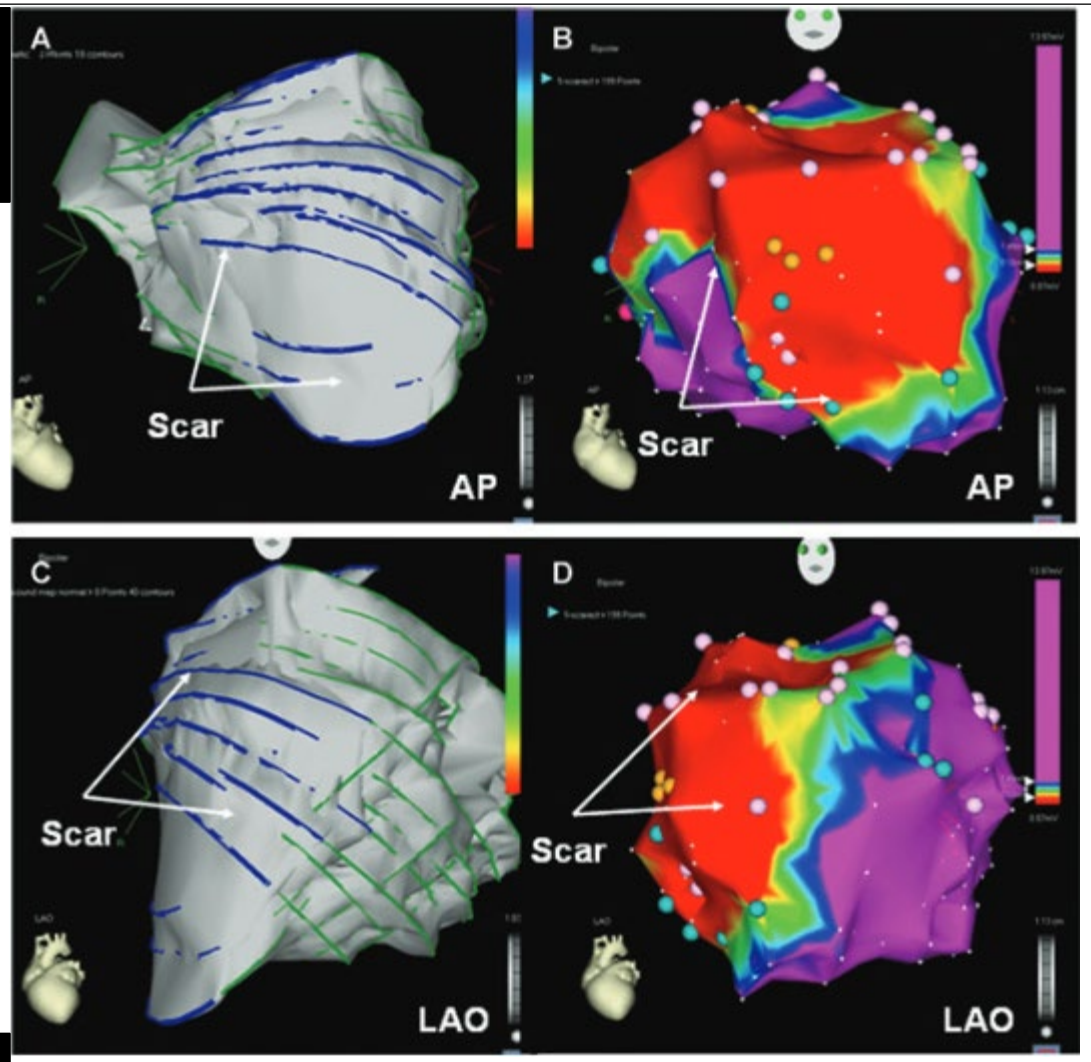
Circulation. 1993 Oct;88(4 Pt 1):1647-70

Image Integration Using Intracardiac Ultrasound and 3D Reconstruction for Scar Mapping and Ablation of Ventricular Tachycardia

Eighteen patients underwent VT ablation with real time ICE mapping from the right atrium and ventricle with online 3D-image reconstruction of scar segments



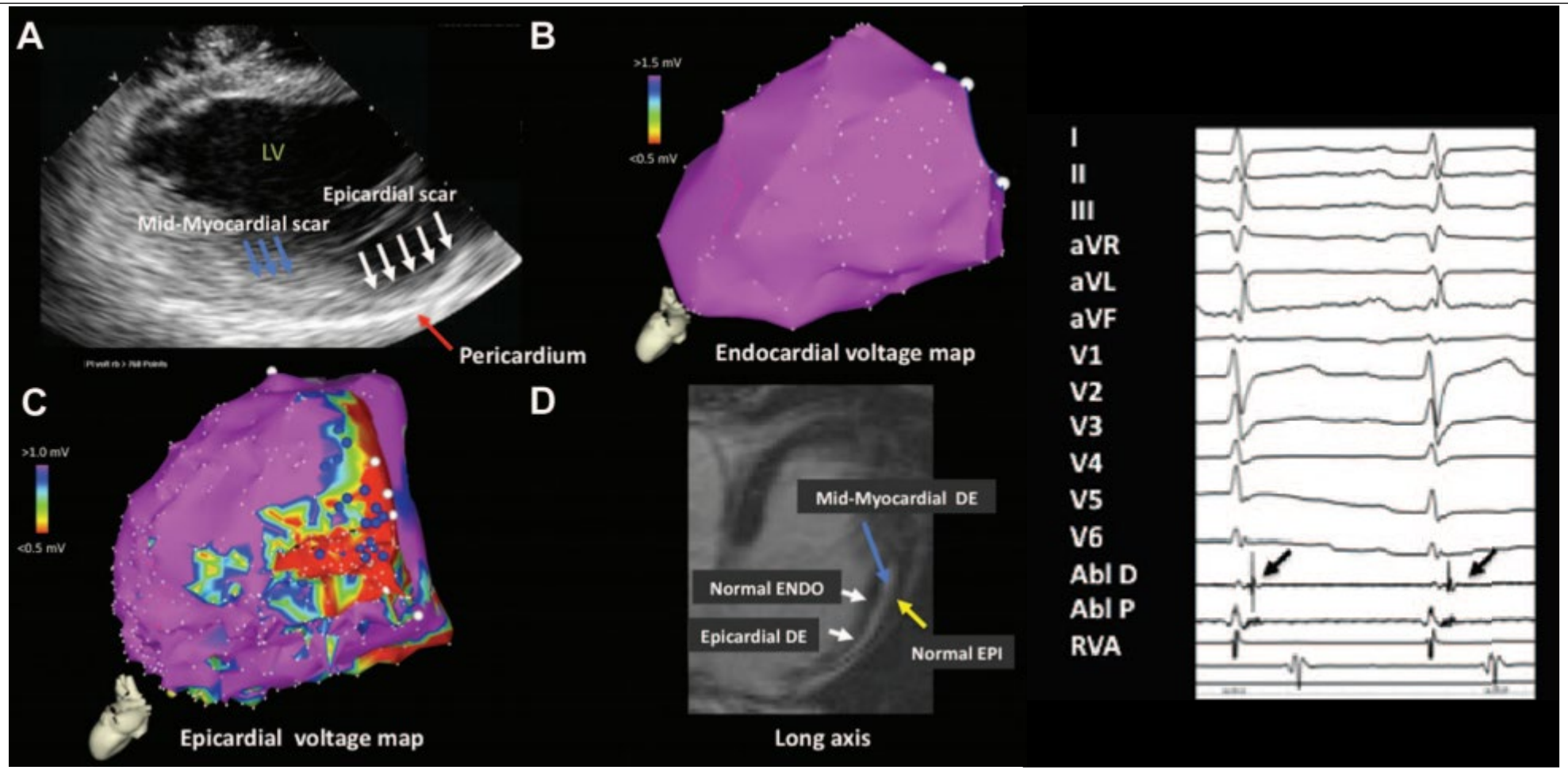
Real time ICE images provide accurate chamber geometries and scar boundaries of the left ventricle



Bunch J Cardiovasc Electrophysiol 2010;21:678–684

Assessing Epicardial Substrate Using Intracardiac Echocardiography During VT Ablation

18 patients with NICM and recurrent VT compared to a control group of 30 patients with structurally normal hearts who underwent ICE imaging for other ablation procedures



In all patients, the epicardial scar identified by electroanatomic mapping correlated with the echogenic area identified on ICE imaging. ICE imaging identified no areas of increased echogenicity in the control group

Rupa Bala et al Circ Arrhythm Electrophysiol. 2011;4:667-673

Electroanatomic Characterization of Post-Infarct Scars

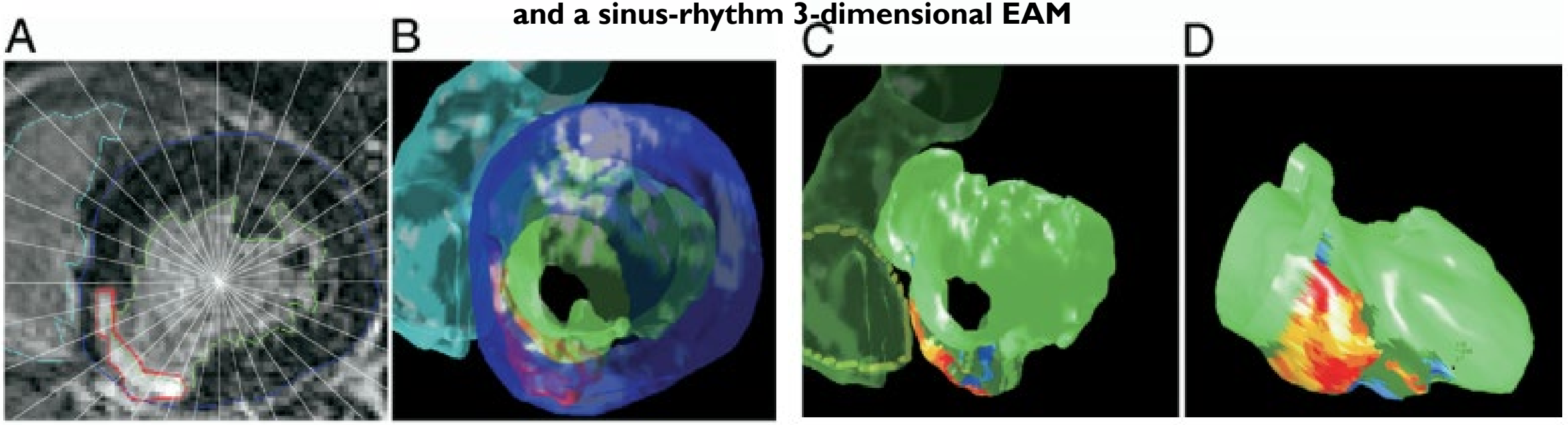
Comparison With 3-Dimensional Myocardial Scar Reconstruction Based on Magnetic Resonance Imaging

Andrei Codreanu, MD,*§ Freddy Odille, MS,§ Etienne Aliot, MD,* Pierre-Yves Marie, MD, PHD,†‖
Isabelle Magnin-Poull, MD,* Marius Andronache, MD,* Damien Mandry, MD,‡
Wassila Djaballah, MD,†§ Denis Régent, MD,‡§ Jacques Felblinger, PHD,§
Christian de Chillou, MD, PHD*§

Nancy, France

This study was designed to compare electroanatomic mapping (EAM) and magnetic resonance imaging (MRI) with delayed contrast enhancement (DCE) data for delineation of post-infarct scars

Ten patients admitted for post-infarct VT ablation underwent both a left ventricle DCE MRI and a sinus-rhythm 3-dimensional EAM



J Am Coll Cardiol 2008;52:839–42

Electroanatomic Characterization of Post-Infarct Scars

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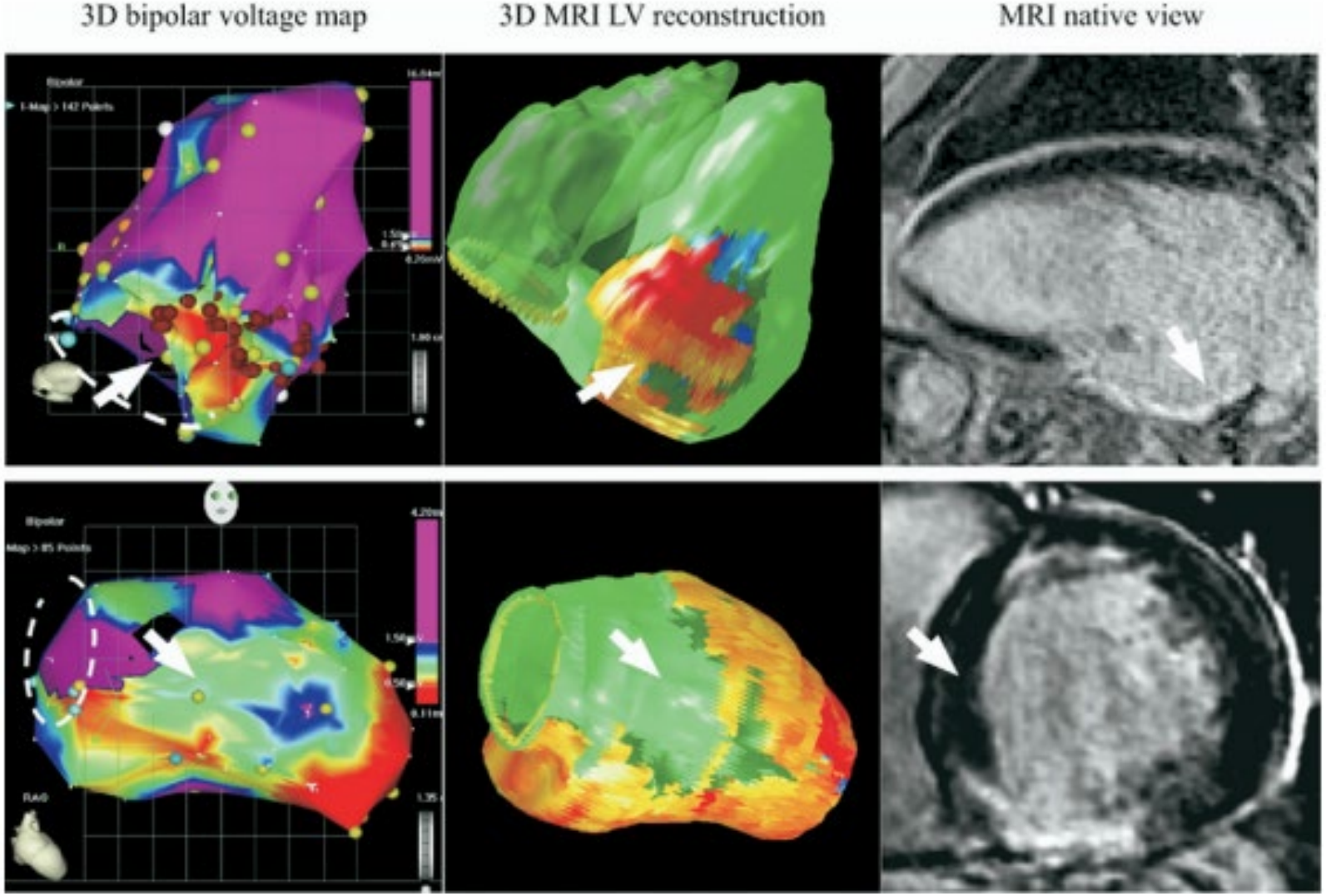
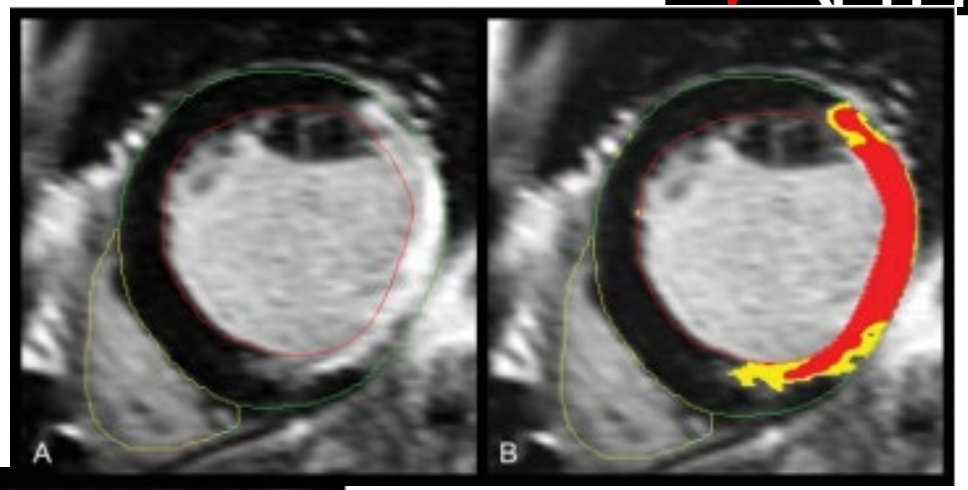


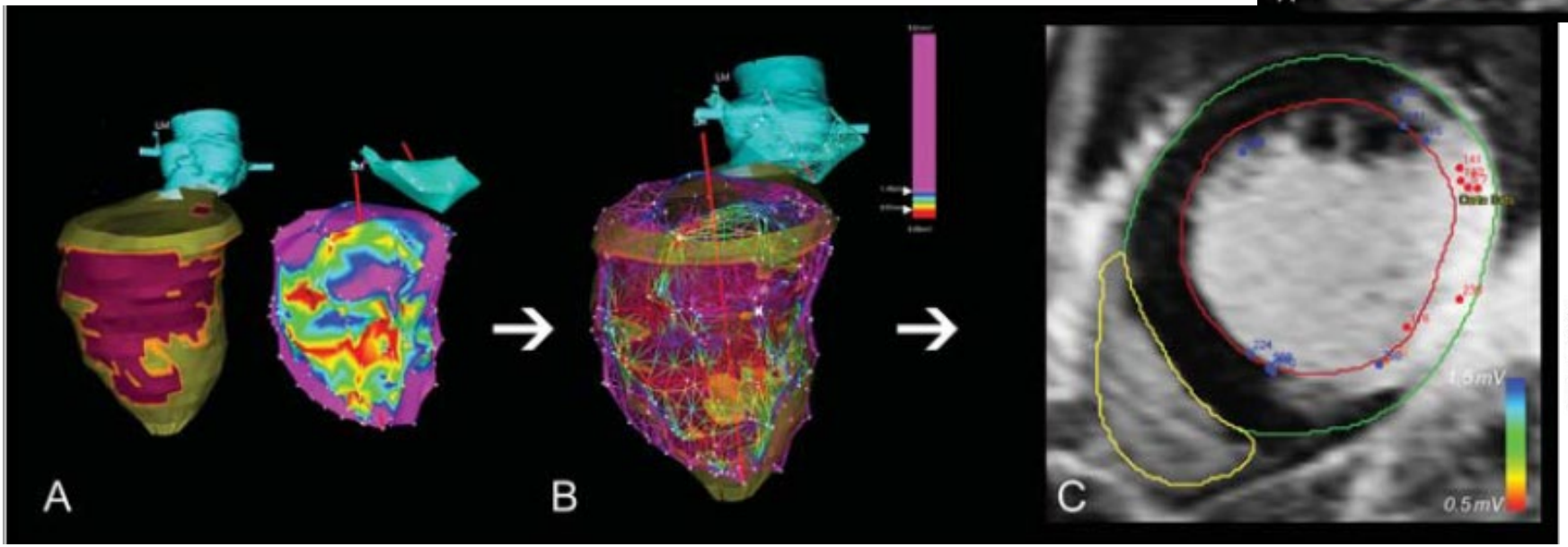
Sinus-rhythm EAM helps identify the limits of post-infarct scars. However, the accuracy of EAM for precise scar delineation is limited. This limit might be circumvented using anatomical information provided by 3D MRI data.

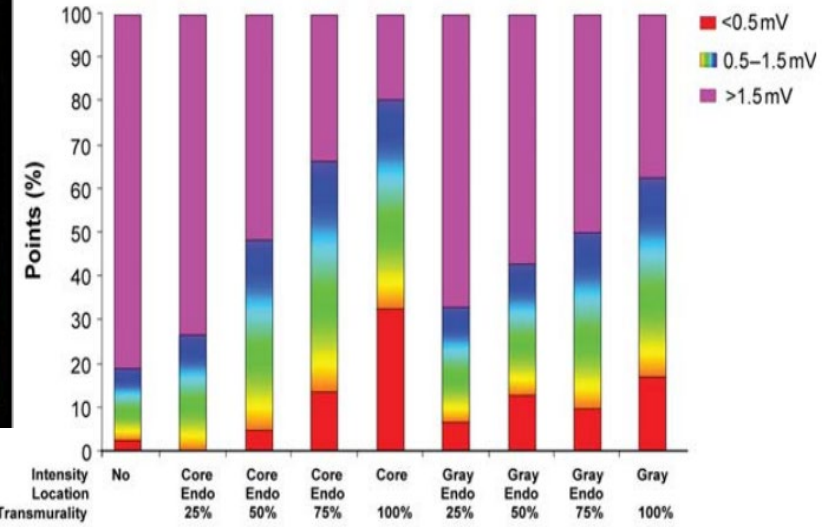
Codreanu et al J Am Coll Cardiol 2008;52:839–42

Head-to-head comparison of contrast-enhanced magnetic resonance imaging and electroanatomical voltage mapping to assess post-infarct scar characteristics in patients with ventricular tachycardias: real-time image integration and reversed registration

Fifteen patients without implantable cardiac defibrillator (14 males, 64+9 years) referred for VT ablation after myocardial infarction underwent CE-MRI.







Local bipolar and unipolar voltages decreased with increasing scar transmurality and were influenced by scar heterogeneity.

Wijnmaalen et al European Heart Journal (2011) 32, 104–114

Imaging Guided versus Non Imaging Guided Ventricular Tachycardia Ablation

a meta - analysis

MRI guided

Figure 1. VT-free survival

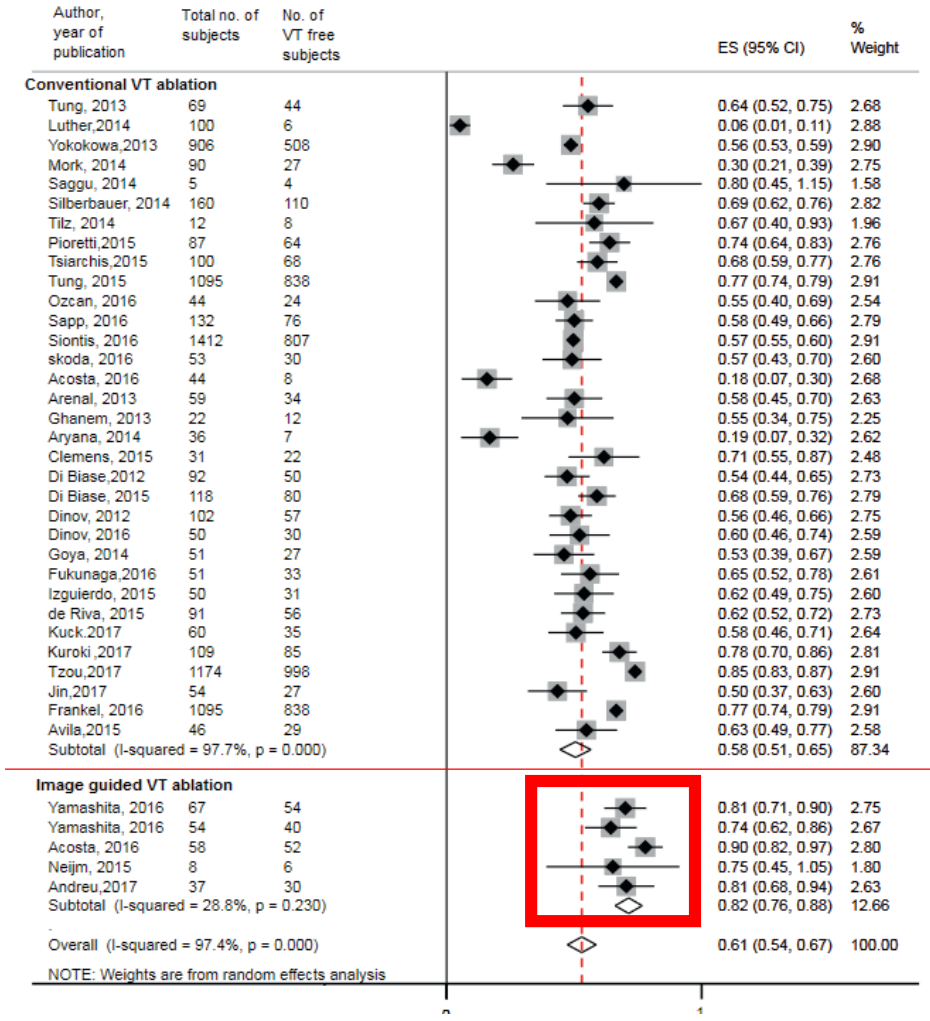
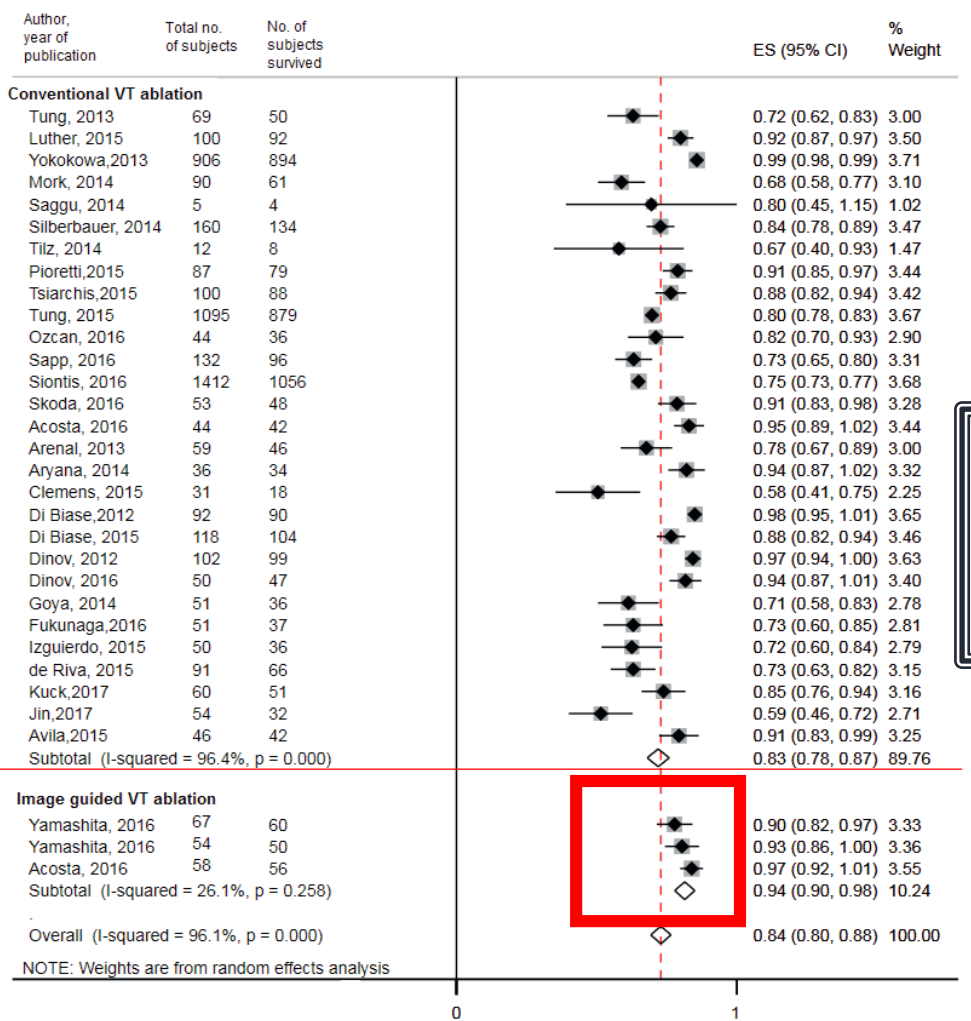


Figure 2. Overall survival



Total of 7824 patients

Mean follow-up duration of 35 months

Hendriks et al EHRA 2018

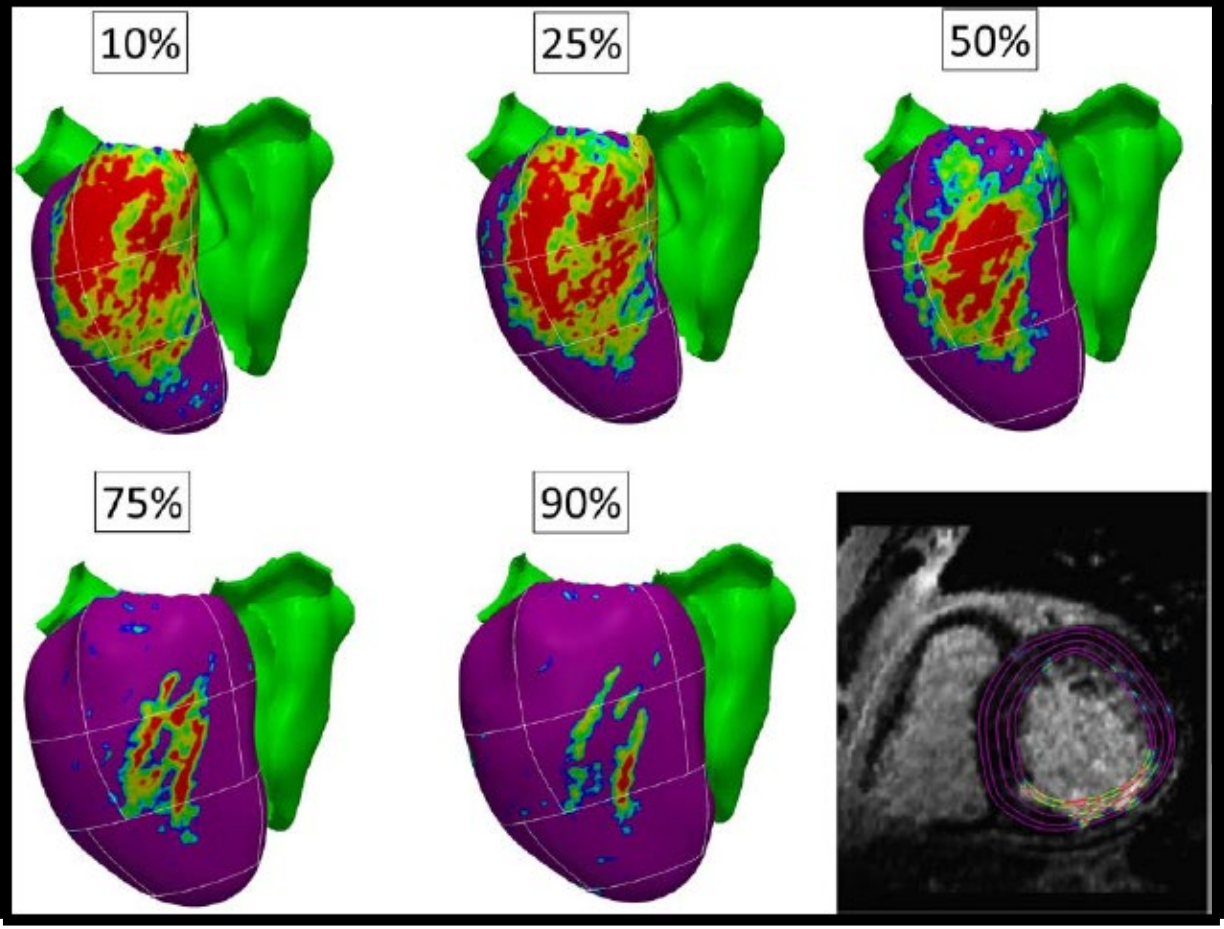
Poster Session

Three-Dimensional Architecture of Scar and Conducting Channels Based on High Resolution ce-CMR

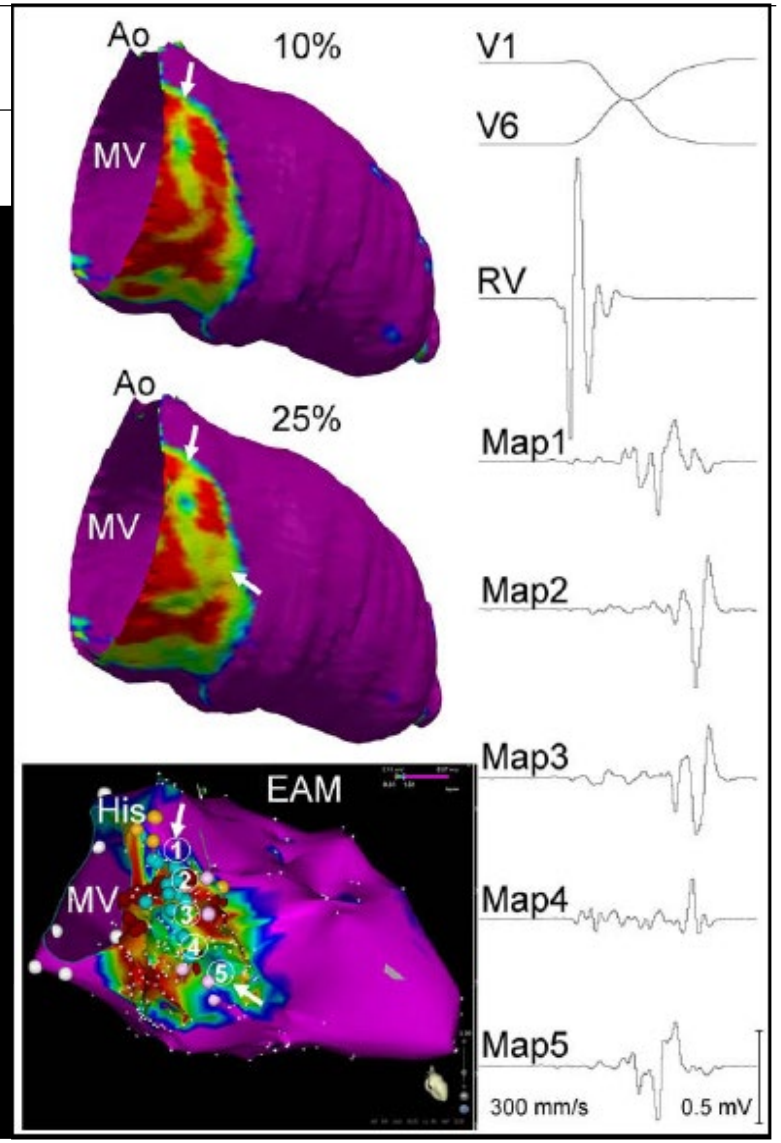
Insights for Ventricular Tachycardia Ablation

21 patients with healed myocardial infarction and VT

A 3D high-resolution 3T ce-CMR was performed



The ce-CMR–defined BZ channels identified 74% of the critical isthmus of clinical VTs and 50% of all the conducting channels identified in electroanatomic maps.

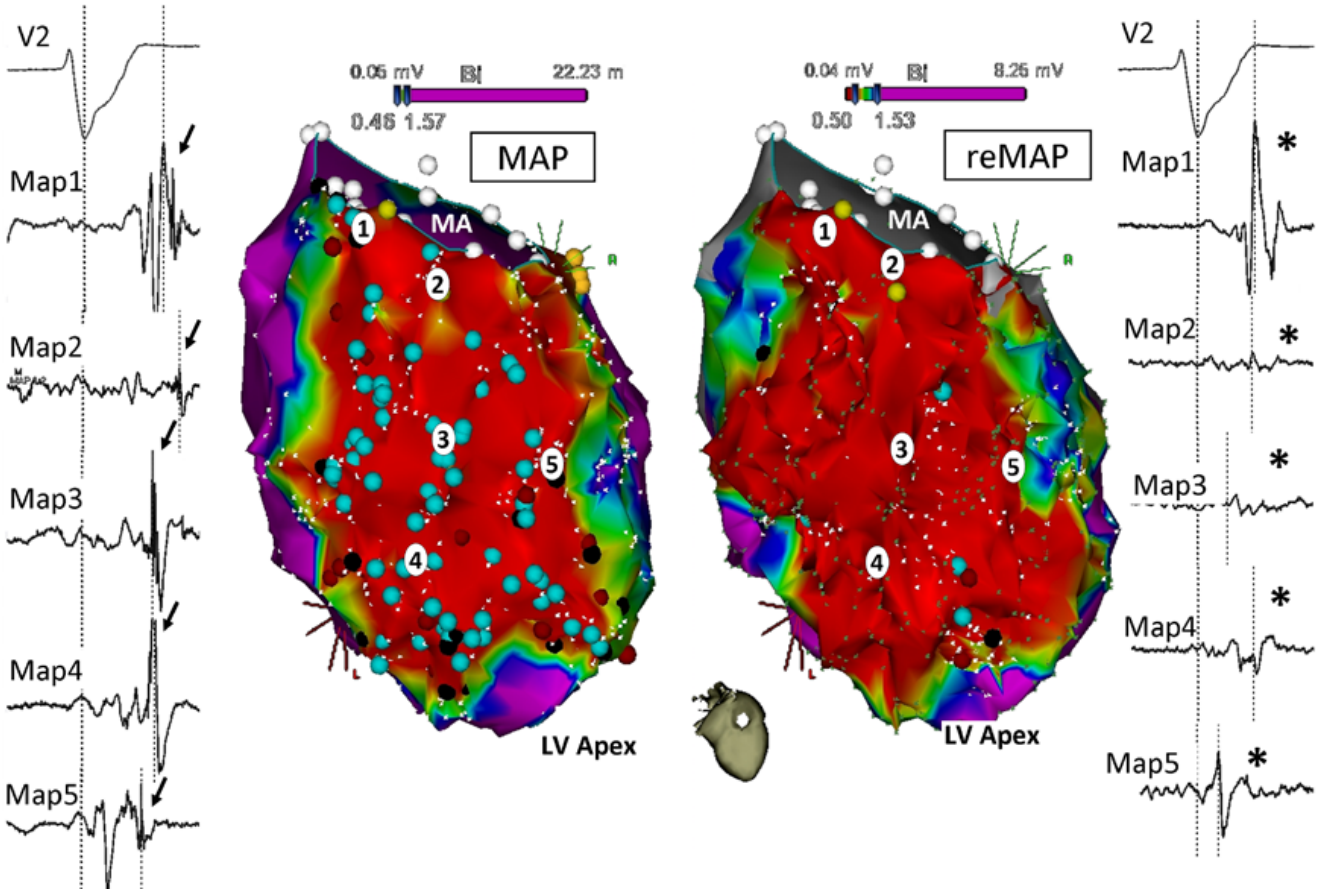


Fernández-Armenta et al Circ Arrhythm Electrophysiol. 2013;6:528-537

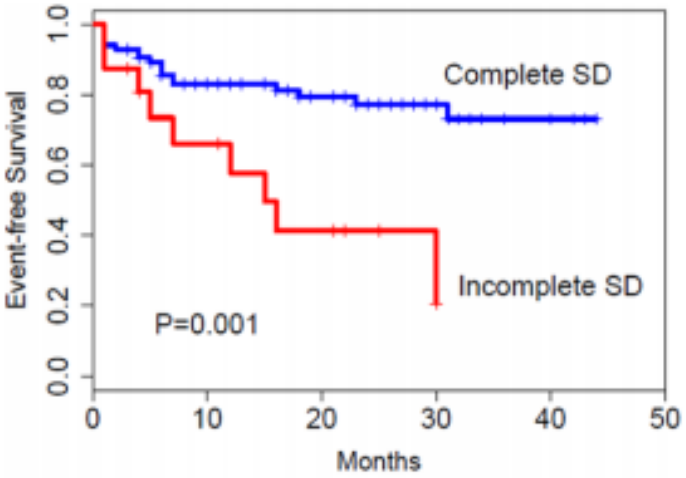
Scar Dechanneling

New Method for Scar-Related Left Ventricular Tachycardia Substrate Ablation

Antonio Berruezo, MD, PhD; Juan Fernández-Armenta, MD, PhD; David Andreu, MSc, PhD; Diego Penela, MD; Csaba Herczku, MD; Reinder Evertz, MD; Laura Cipolletta, MD; Juan Acosta, MD; Roger Borràs, MSc; Elena Arbelo, MD, PhD; Jose María Tolosana, MD, PhD; Josep Brugada, MD, PhD; Lluis Mont, MD, PhD

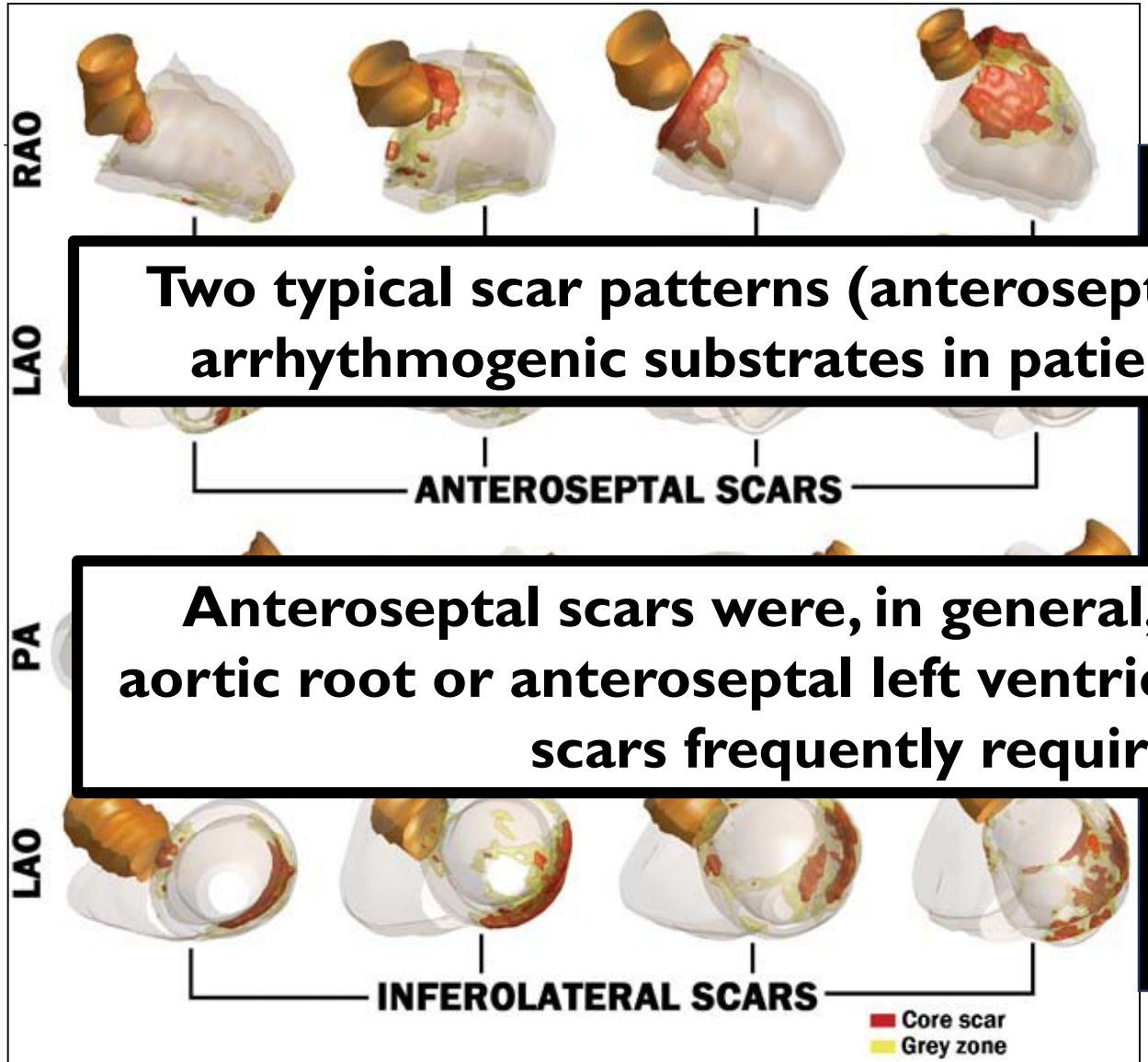


	Endocardial
Entrance CC-EG amplitude, mV	0.38 (0.16–0.44)
QRS onset to CC entrance EG delay, ms	87 (71–117)
Inner CC-EG amplitude, mV	0.23 (0.13–0.48)
QRS onset to latest inner CC-EG delay, ms	156 (113–183)



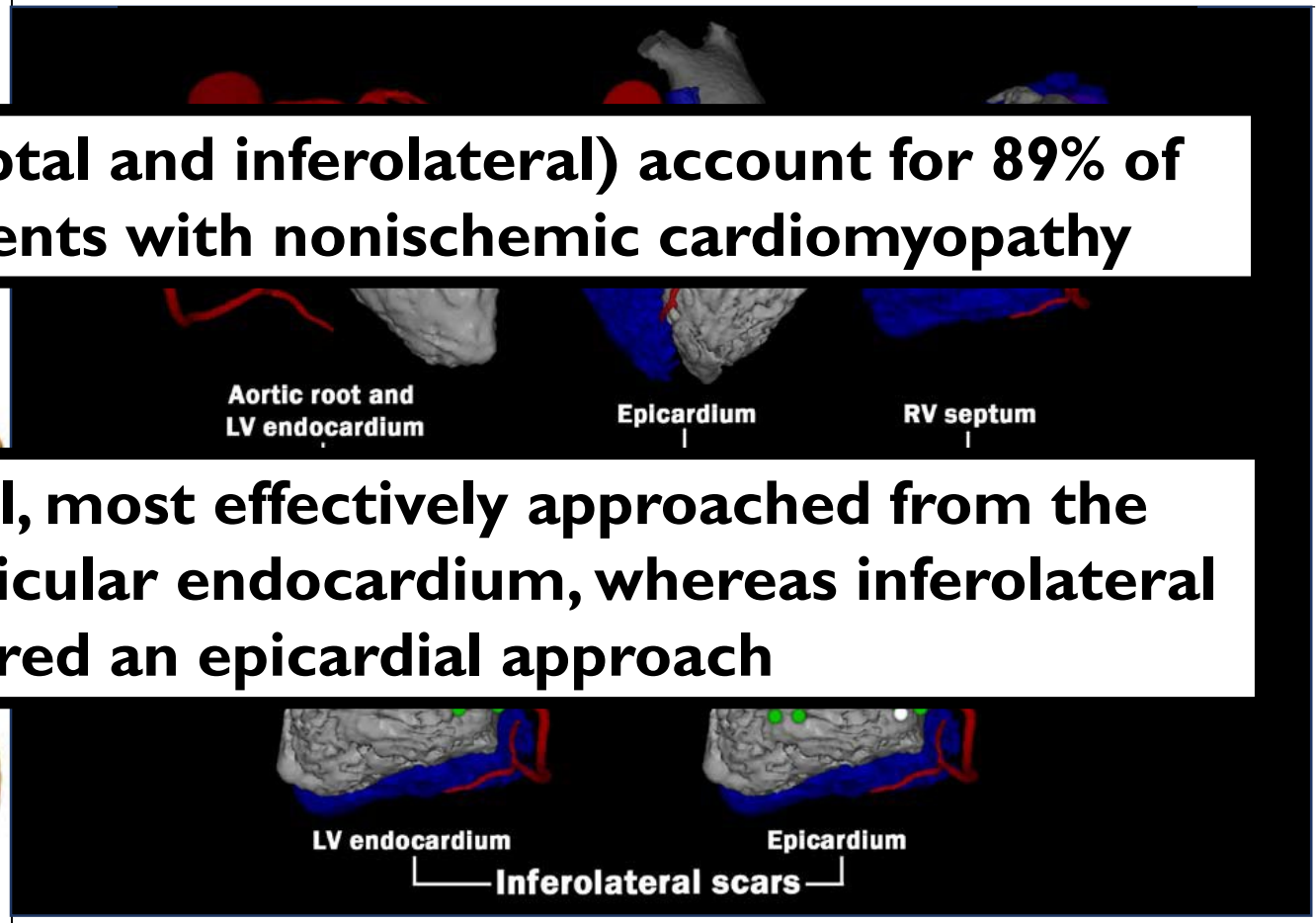
Circ Arrhythm Electrophysiol. 2015;8:326-336.

Contrast-Enhanced MRI–Derived Scar Patterns and Associated Ventricular Tachycardias in Nonischemic Cardiomyopathy



19 consecutive patients with NICM undergoing ceMRI and VT ablation were included

Two typical scar patterns (anteroseptal and inferolateral) account for 89% of arrhythmogenic substrates in patients with nonischemic cardiomyopathy

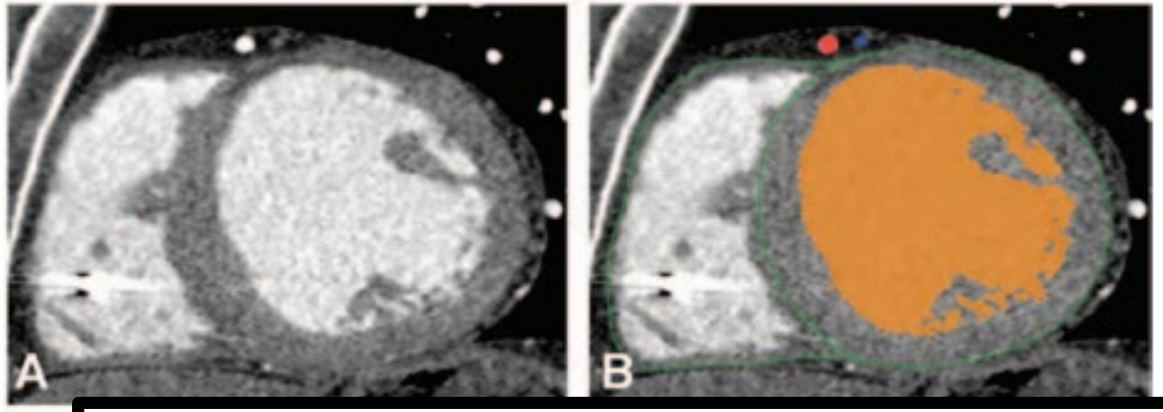


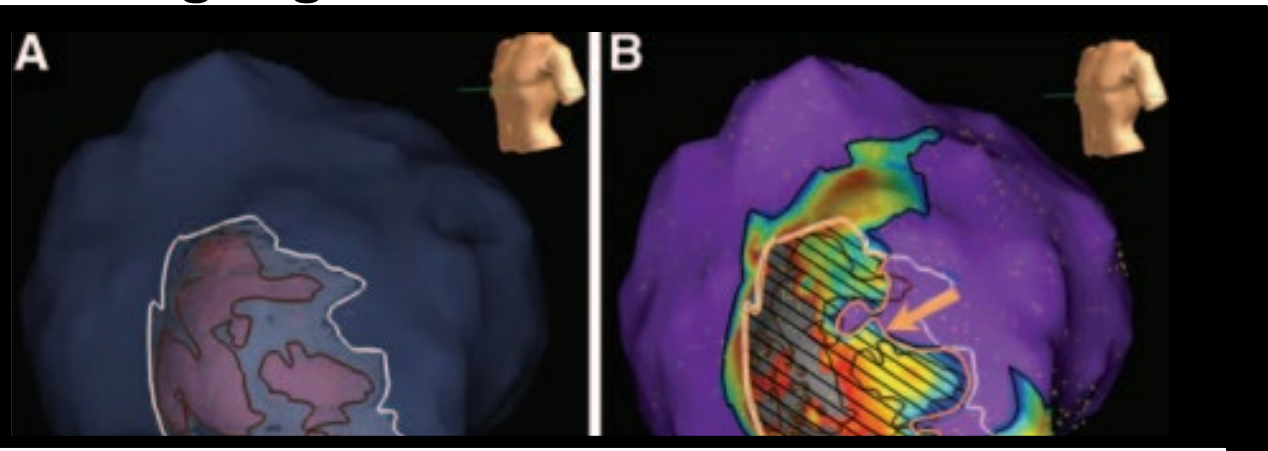
Anteroseptal scars were, in general, most effectively approached from the aortic root or anteroseptal left ventricular endocardium, whereas inferolateral scars frequently required an epicardial approach

Piers SRD et al Circ Arrhythm Electrophysiol. 2013;6:875-883

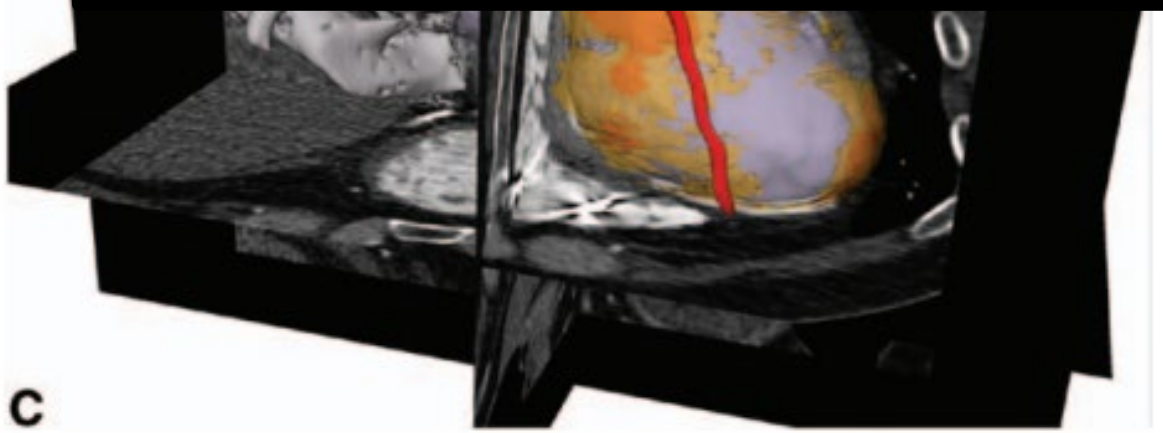
Regional Myocardial Wall Thinning at Multidetector Computed Tomography Correlates to Arrhythmogenic Substrate in Postinfarction Ventricular Tachycardia

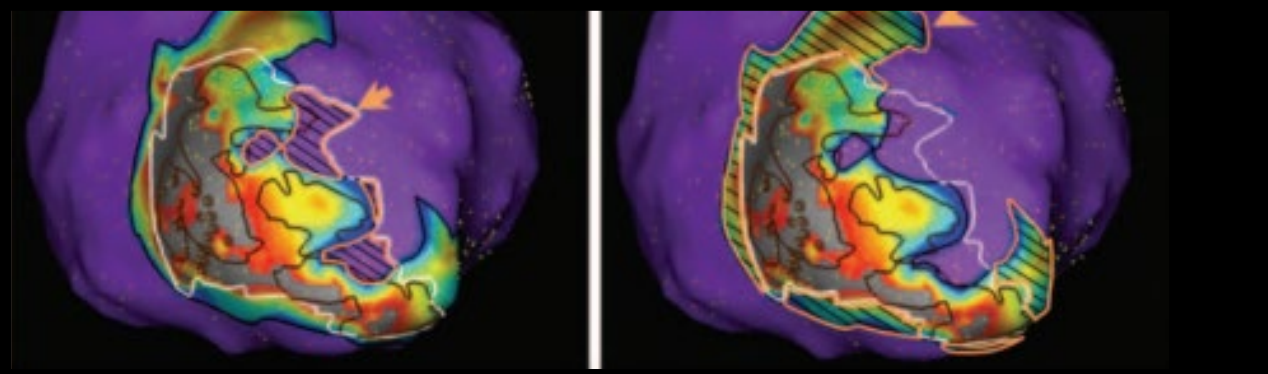
13 consecutive postinfarction patients undergoing MDCT before ablation





LAVA were located within the WT <5 mm (87%) or at its border (100% within 23 mm). Very late LAVA (>100 ms) were exclusively detected within the thinnest area (93% in the WT<3 mm).





Komatsu et al Circ Arrhythm Electrophysiol. 2013;6:342-350

Image Integration to Guide Catheter Ablation in Scar-Related Ventricular Tachycardia

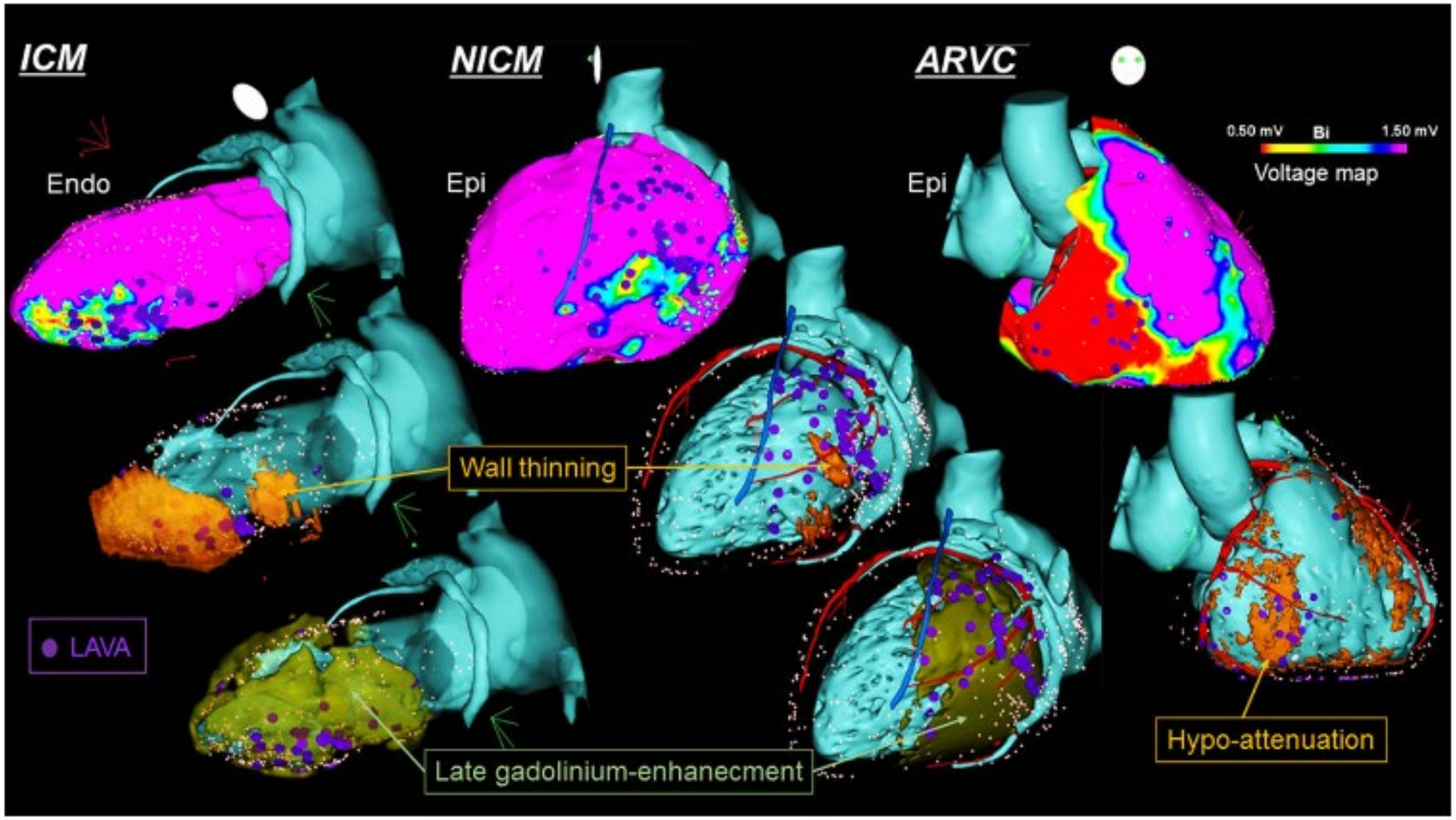


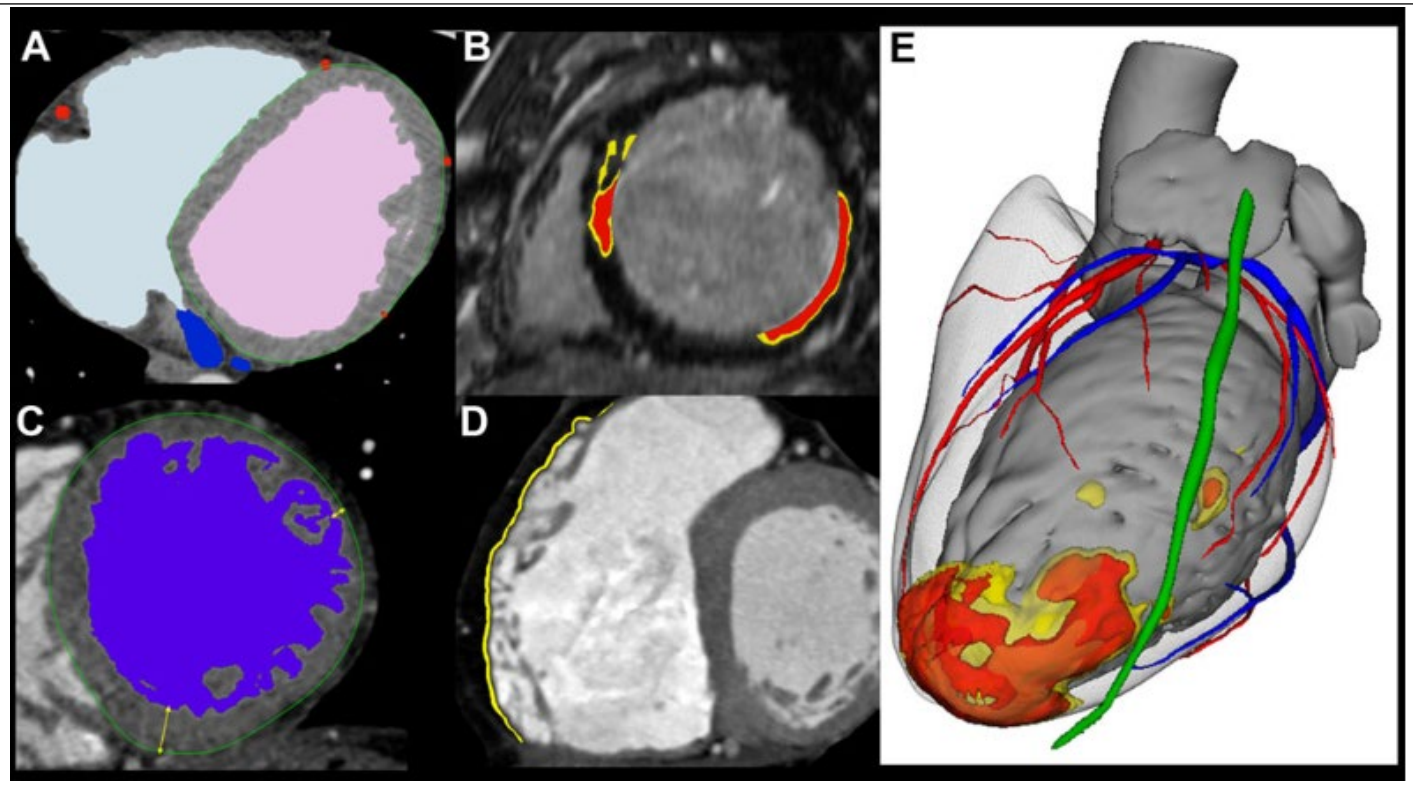
Image integration is feasible in large series of patients, provides information on VT substrate, and impacts procedural management, particularly in ARVC/NICM, and in case of epicardial approach.

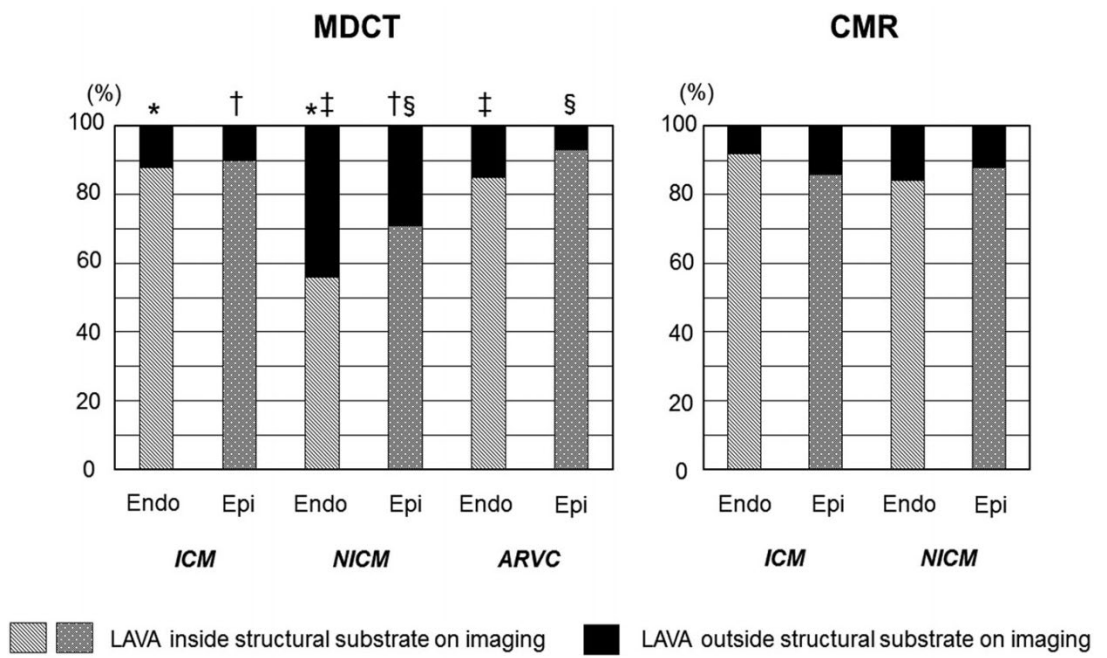
Yamashita et al J Cardiovasc Electrophysiol, Vol. 27, pp. 699-708, June 2016

Image Integration to Guide Catheter Ablation in Scar-Related Ventricular Tachycardia

A total of 116 consecutive patients (67 ICM; 30 NICM; 19 ARVC) underwentVT ablation with image integration (MDCT 91%; CMR 30%; both 22%)

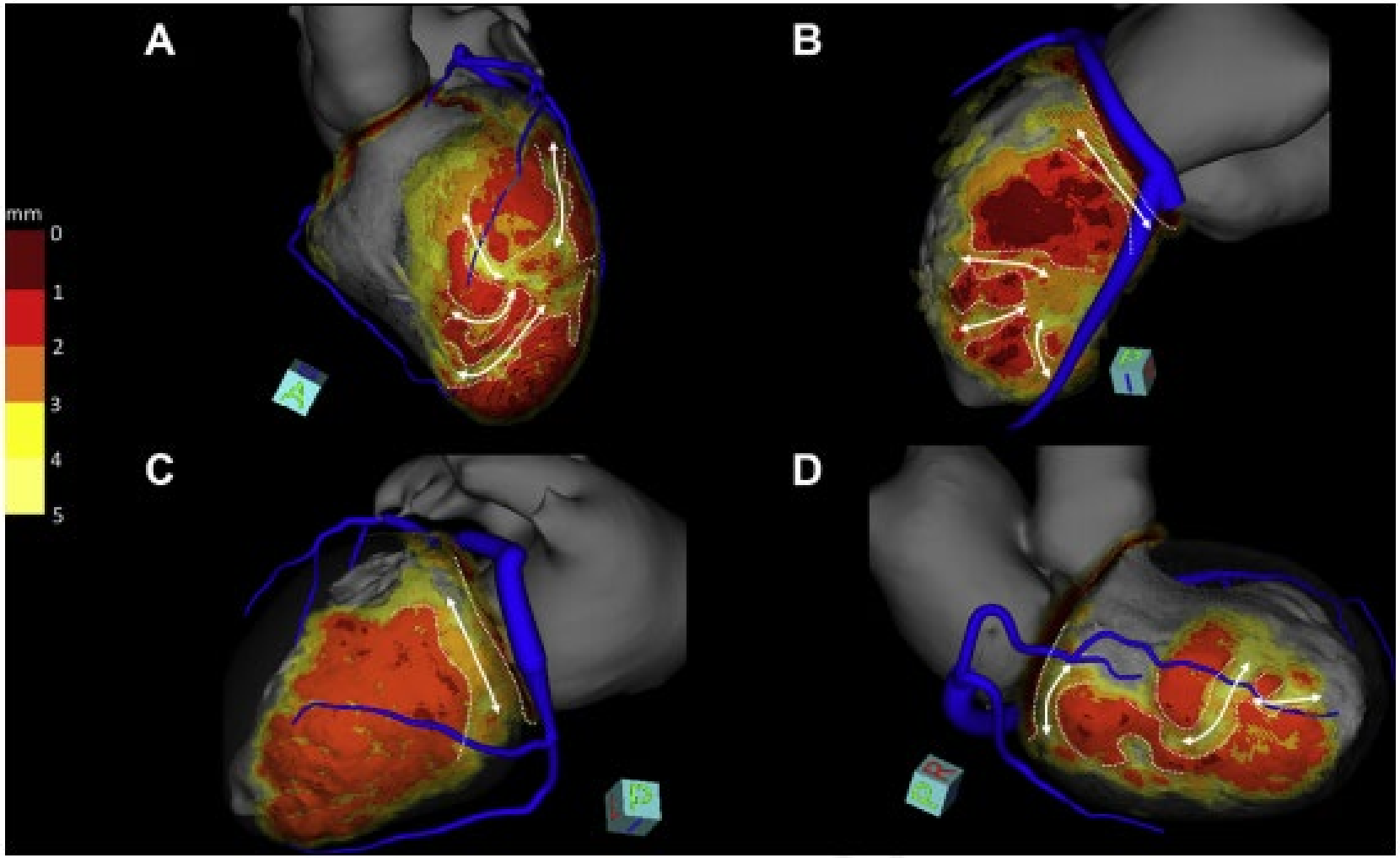
Substrate was defined as wall thinning on MDCT and late gadolinium-enhancement on CMR in ICM/NICM, and as myocardial hypoattenuation on MDCT in ARVC





Yamashita et al J Cardiovasc Electrophysiol, Vol. 27, pp. 699-708, June 2016

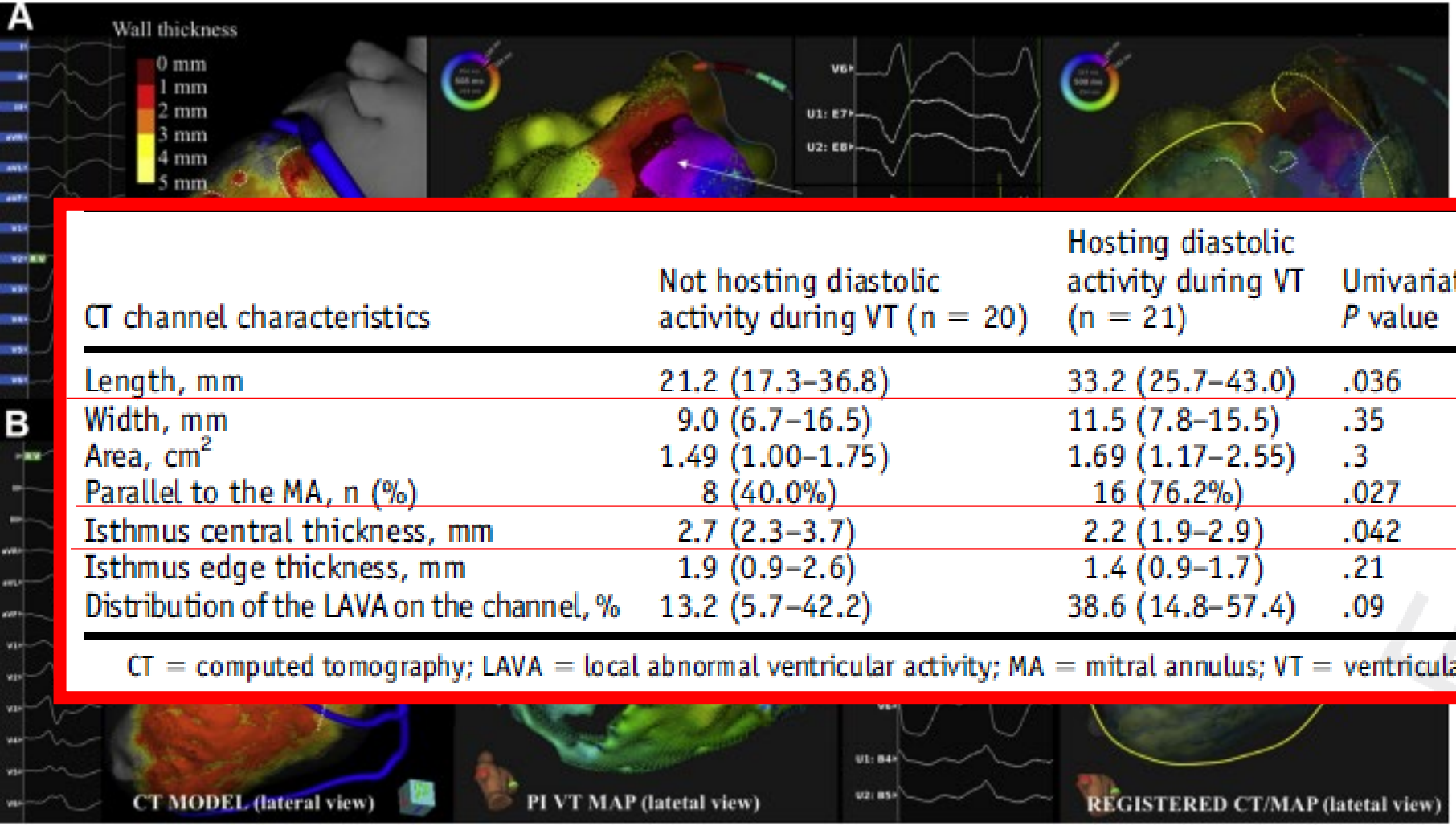
Are wall thickness channels defined by computed tomography predictive of isthmuses of postinfarction ventricular tachycardia?



9 post-infarction patients with 10 complete VT activation maps (cycle length 429 ± 77ms) created using high-resolution mapping. Three dimensionally-reconstructed WT maps from CT were merged with the activation map during sinus rhythm (SR) and VT.

Takigawa et al Heart Rhythm 2019 In press

Are wall thickness channels defined by computed tomography predictive of isthmuses of postinfarction ventricular tachycardia?



CT channel characteristics	Not hosting diastolic activity during VT (n = 20)	Hosting diastolic activity during VT (n = 21)	Univariate *P* value	Multivariate *P* value	OR (95% CI)
Length, mm	21.2 (17.3–36.8)	33.2 (25.7–43.0)	.036	.04	1.05 (1.00–1.10)
Width, mm	9.0 (6.7–16.5)	11.5 (7.8–15.5)	.35		
Area, cm^2	1.49 (1.00–1.75)	1.69 (1.17–2.55)	.3		
Parallel to the MA, n (%)	8 (40.0%)	16 (76.2%)	.027	.07	3.93 (0.89–17.42)
Isthmus central thickness, mm	2.7 (2.3–3.7)	2.2 (1.9–2.9)	.042	.03	0.36 (0.14–0.90)
Isthmus edge thickness, mm	1.9 (0.9–2.6)	1.4 (0.9–1.7)	.21		
Distribution of the LAVA on the channel, %	13.2 (5.7–42.2)	38.6 (14.8–57.4)	.09		

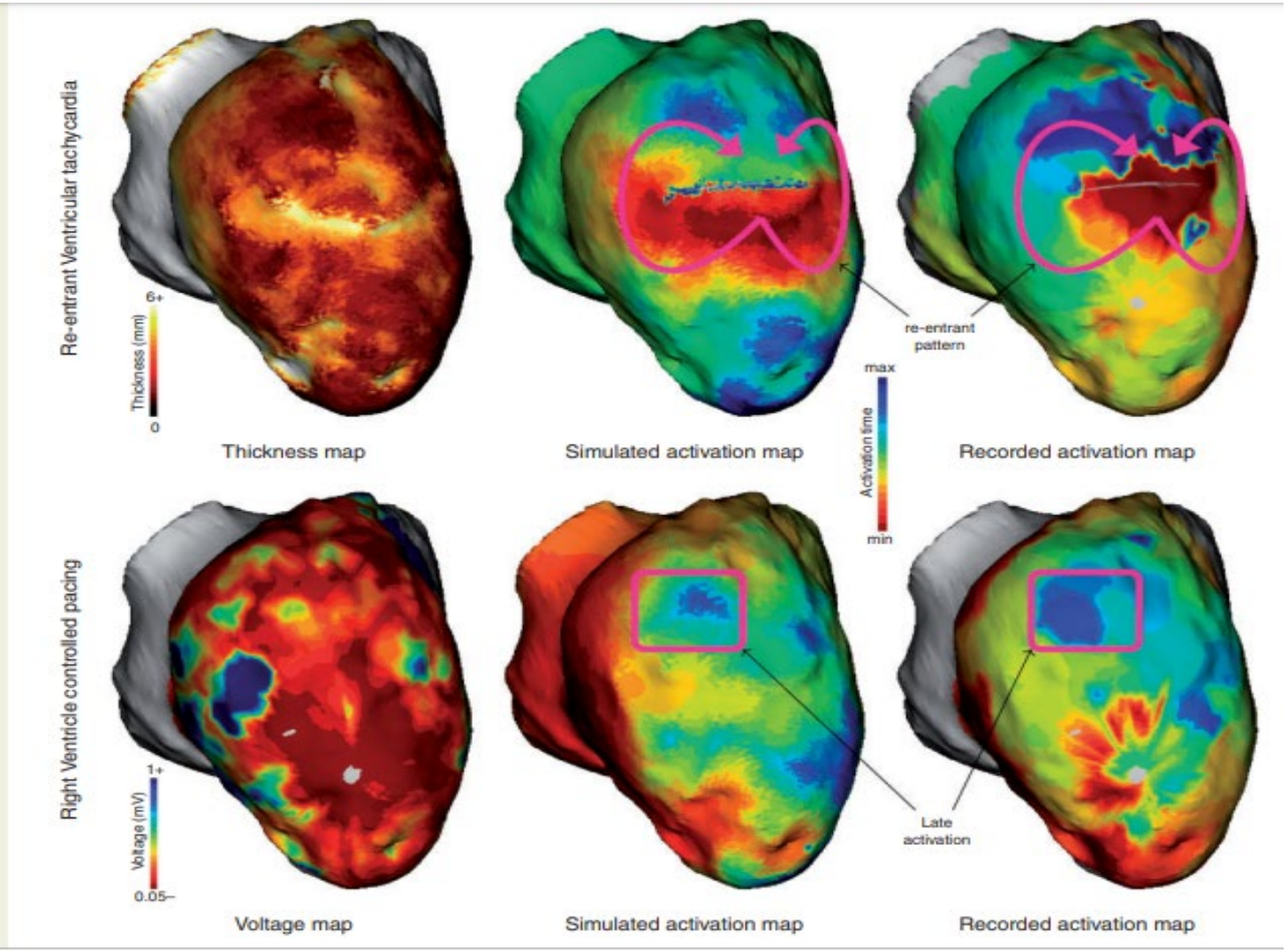
CT = computed tomography; LAVA = local abnormal ventricular activity; MA = mitral annulus; VT = ventricular tachycardia.

VT isthmuses were always found in CT

with VT isthmuses

Takigawa et al Heart Rhythm 2019 In press

Fast personalized electrophysiological models from computed tomography images for ventricular tachycardia ablation planning



Our simulation framework has an application in VT RFA intervention planning. It could be used to guide EP explorations and even predict ablation targets pre-operatively

Europace 2018 Nov 1;20(suppl_3):iii94-iii101

Take home messages

ICE correctly identifies myocardial scar but no information about VT isthmus location are available

Cardiac MRI in dedicated centres is able to detect VT channel in ICM

Cardiac MRI performs better for substrate identification in NICM

Cardiac CT is able to detect VT channel in ICM

Cardiac CT better performs in AVRC pts for substrate identification

Thanks for the attention

RHYTHM