New Advances in mapping and ablation of Atrial Fibrillation

Arash Arya, M.D.

HERZZENTRUM LEIPZIG

Helios

Disclosures: NONE

Presentation available for download at:
www.arasharya.com

Overview:

(1) Introduction

(2) New Studies

(3) New Mapping Techniques

(4) New Energy Sources

Deep Learning and Artificial Intelligence

Moving From Big Data to Deep Learning

Cardiologist-level arrhythmia detection and classification in ambulatory electrocardiograms using a deep neural network

Awni Y. Hannun[1,6*], Pranav Rajpurkar[1,6], Masoumeh Haghpanahi[2,6], Geoffrey H. Tison[3,6], Codie Bourn[2], Mintu P. Turakhia[4,5] and Andrew Y. Ng[1]

Nature Medicine | VOL 25 | JANUARY 2019 | 65–69 | www.nature.com/naturemedicine

91,232 single-lead ECGs from 53,549 patients who used a **single-lead ambulatory ECG monitoring** device.

ECG data were recorded by the Zio monitor, which is a Food and Drug Administration (FDA)-cleared, single-lead, patch-based ambulatory ECG monitor that continuously records data from a single vector (modified Lead II) at 200 Hz.

The mean and median wear time of the Zio monitor in our dataset was 10.6 and 13.0 days, respectively.

Table 2 | DNN algorithm and cardiologist sensitivity compared to the cardiologist committee consensus, with specificity fixed at the average specificity level achieved by cardiologists

	Specificity	Average cardiologist sensitivity	DNN algorithm sensitivity
Atrial fibrillation and flutter	0.941	0.710	0.861
AVB	0.981	0.731	0.858
Bigeminy	0.996	0.829	0.921
EAR	0.993	0.380	0.445
IVR	0.991	0.611	0.867
Junctional rhythm	0.984	0.634	0.729
Noise	0.983	0.749	0.803
Sinus rhythm	0.859	0.901	0.950
SVT	0.983	0.408	0.487
Ventricular tachycardia	0.996	0.652	0.702
Wenckebach	0.986	0.541	0.651

JAMA Cardiology | Original Investigation

Passive Detection of Atrial Fibrillation Using a Commercially Available Smartwatch

JAMA Cardiol. doi:10.1001/jamacardio.2018.0136

To develop and validate a deep neural network to detect AF using smartwatch data.

Table 3. Performance Characteristics of Deep Neural Network in Validation Cohorts[a]

Cohort	%				
	Sensitivity	Specificity	PPV	NPV	AUC
Cardioversion cohort (sedentary)	98.0	90.2	90.9	97.8	0.97
Subset of remote cohort (ambulatory)	67.7	67.6	7.9	98.1	0.72

Abbreviations: AUC, area under the receiver operating characteristic curve; NPV, negative predictive value; PPV, positive predictive value.

[a] In the cardioversion cohort, the atrial fibrillation reference standard was 12-lead electrocardiography diagnosis; in the remote cohort, the atrial fibrillation reference standard was limited to self-reported history of persistent atrial fibrillation.

Moving From Big Data to Deep Learning

Screening for cardiac contractile dysfunction using an artificial intelligence–enabled electrocardiogram

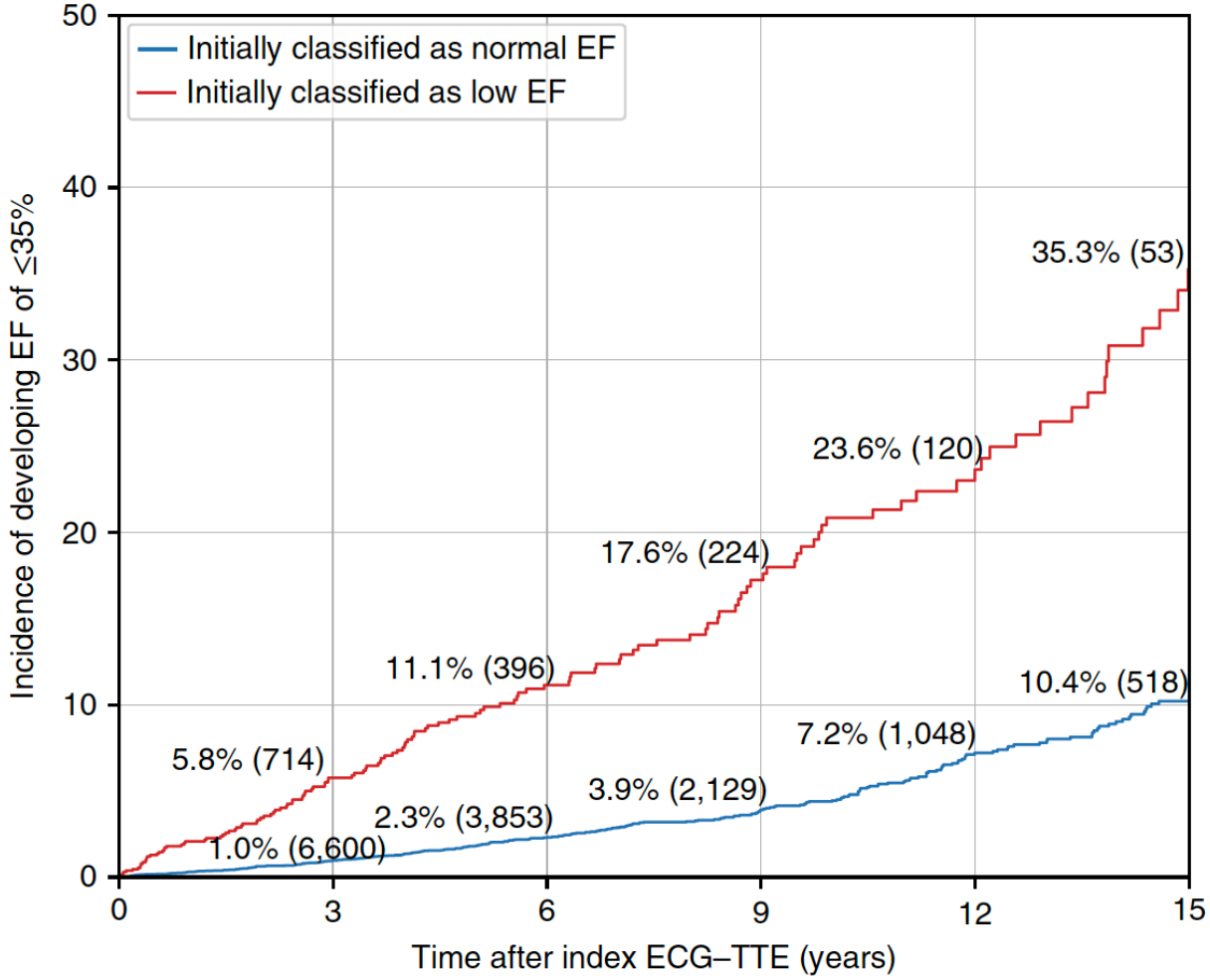
Zachi I. Attia[1], Suraj Kapa[1], Francisco Lopez-Jimenez[1], Paul M. McKie[1], Dorothy J. Ladewig[2], Gaurav Satam[2], Patricia A. Pellikka[1], Maurice Enriquez-Sarano[1], Peter A. Noseworthy[1], Thomas M. Munger[1], Samuel J. Asirvatham[1], Christopher G. Scott[3], Rickey E. Carter[4] and Paul A. Friedman[1]*

Nature Medicine | VOL 25 | 70 JANUARY 2019 | 70–74 | www.nature.com/naturemedicine

Using paired 12-lead ECG and echocardiogram data, including the LVEF, from 44,959 patients at the Mayo Clinic, we trained a convolutional neural network to identify patients with ventricular dysfunction, defined as ejection fraction ≤ 35%, using the ECG data alone.

When tested on an independent set of 52,870 patients, the network model yielded values for the area under the curve, sensitivity, specificity, and accuracy of 0.93, 86.3%, 85.7%, and 85.7%, respectively.

In patients without ventricular dysfunction, those with a positive AI screen *were at 4 times the risk (hazard ratio, 4.1; 95% confidence interval, 3.3 to 5.0) of developing future ventricular dysfunction compared with those with a negative screen.*



New Studies

Updated systematic review and meta-analysis of the impact of contact force sensing on the safety and efficacy of atrial fibrillation ablation: discrepancy between observational studies and randomized control trial data

Sohaib A. Virk[1], Jonathan Ariyaratnam[2], Richard G. Bennett[3], and Saurabh Kumar[1,4]*

When restricted to RCTs, CF guidance **neither improved freedom from AF** (RR 1.03; 95% CI 0.95-1.11), independent of AF type, nor did it reduce procedural, fluoroscopy, or ablation duration. Contact force guidance did not reduce the incidence of major peri-procedural complications (RR 0.89; 95% CI 0.64–1.24).

Europace. 2019 Feb 1;21(2):239-249.

Value Based Healthcare

Value-based healthcare is a healthcare delivery model in which providers, including hospitals and physicians, are paid based on patient health outcomes. Under value-based care agreements, providers are rewarded for helping patients improve their health, reduce the effects and incidence of chronic disease, and live healthier lives in an evidence-based way. The “value” in value-based healthcare is derived from measuring health outcomes against the cost of delivering the outcomes.

Value-Based Health Care Benefits

NEJM Catalyst eBook: Unlocking the Opportunities for Health Care Delivery Transformation

Comparison of a high throughput day case atrial fibrillation ablation service in a local hospital with standard regional tertiary cardiac centre care

Aaisha Opel[1,*], Josephine Mansell[1], Alison Butler[1], Rhona Schwartz[2], Michael Fannon[2], Malcolm Finlay[1], Ross J. Hunter[1], and Richard J. Schilling[1]

Europace. **2019** Mar 1;21(3):440-444.

Equipment involved is portable CRYO console and basic EP system.

What's new?

- Cryoablation for atrial fibrillation (AF) can be delivered safely and effectively in a local non-cardiac centre by experienced electrophysiologists as day cases.
- A highly defined procedure protocol and repetition allows the non-cardiac centre to perform the procedures faster with similar outcomes to the large regional cardiac centres.
- The service provides a model to meet increasing demands of catheter ablation for AF.

Table 2 Complications at the local hospital vs. regional cardiac centre

	Local hospital, *n* (% total no. of patients)	Regional cardiac centre, *n* (% total no. of patients)	*P*-value
Phrenic nerve palsy	5 (1.8)	7 (2.5)	0.80
Cardiac tamponade	2 (0.7)	1 (0.4)	1.00
Pericardial effusion	3 (1.1)	1 (0.4)	0.60
Vascular complications	4 (1.4)	3 (1.1)	1.00
Bradycardia	1 (0.4)	3 (1.1)	0.60
Pericarditis	0	1 (0.4)	1.00
Air embolus	0	1 (0.4)	1.00

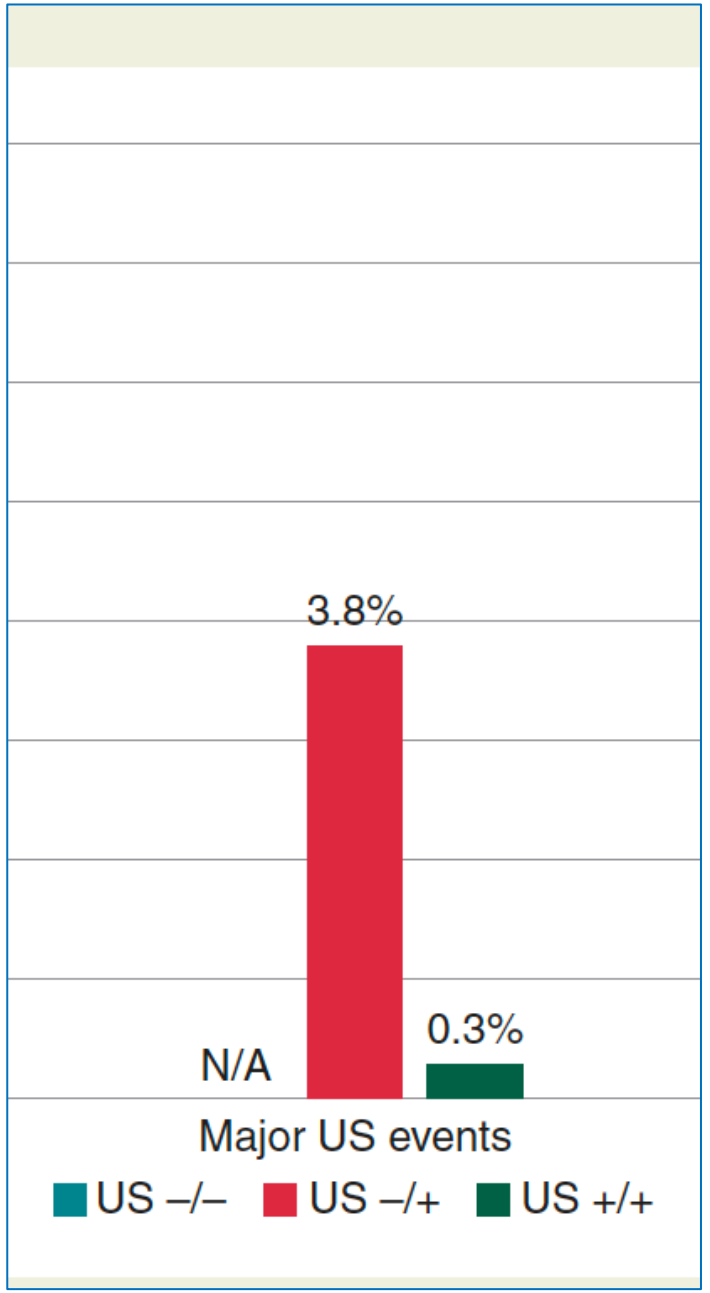
Table 3 Local hospital vs. regional cardiac centre procedural outcomes

	Local hospital, *n* (%)	Regional cardiac centre, *n* (%)	*P*-value
Complete resolution of symptoms at 3 months	150 (54.3)	149 (54.1)	1.00
Improvement of symptoms at 3 months	72 (26.1)	77 (27.9)	0.90
Redo procedures requested	46 (16.6)	48 (17.4)	1.00

Value of ultrasound for access guidance and detection of subclinical vascular complications in the setting of atrial fibrillation cryoballoon ablation

A total cohort of 1435 consecutive patients were studied. Major US events during the US protocol post-procedure were seen in **3.8%** (10/265) vs. **0.3%** (1/300) of patients in US-/+ vs. US+/+ group, respectively, P=0.004.

Europace. **2019** Mar 1;21(3):434-439



Life-Threatening Complications of Atrial Fibrillation Ablation

16-Year Experience in a Large Prospective Tertiary Care Cohort

JACC Clin Electrophysiol. 2019 Mar;5(3):284-291.

Between 2000 and 2015, 10,378 patients underwent AF ablation and were enrolled in a prospectively maintained data registry. No procedural death or atrioesophageal fistulae occurred.

TRANSLATIONAL OUTLOOK: The findings highlight the effect of novel technology and changing practices in decreasing the annual incidence of such complications.

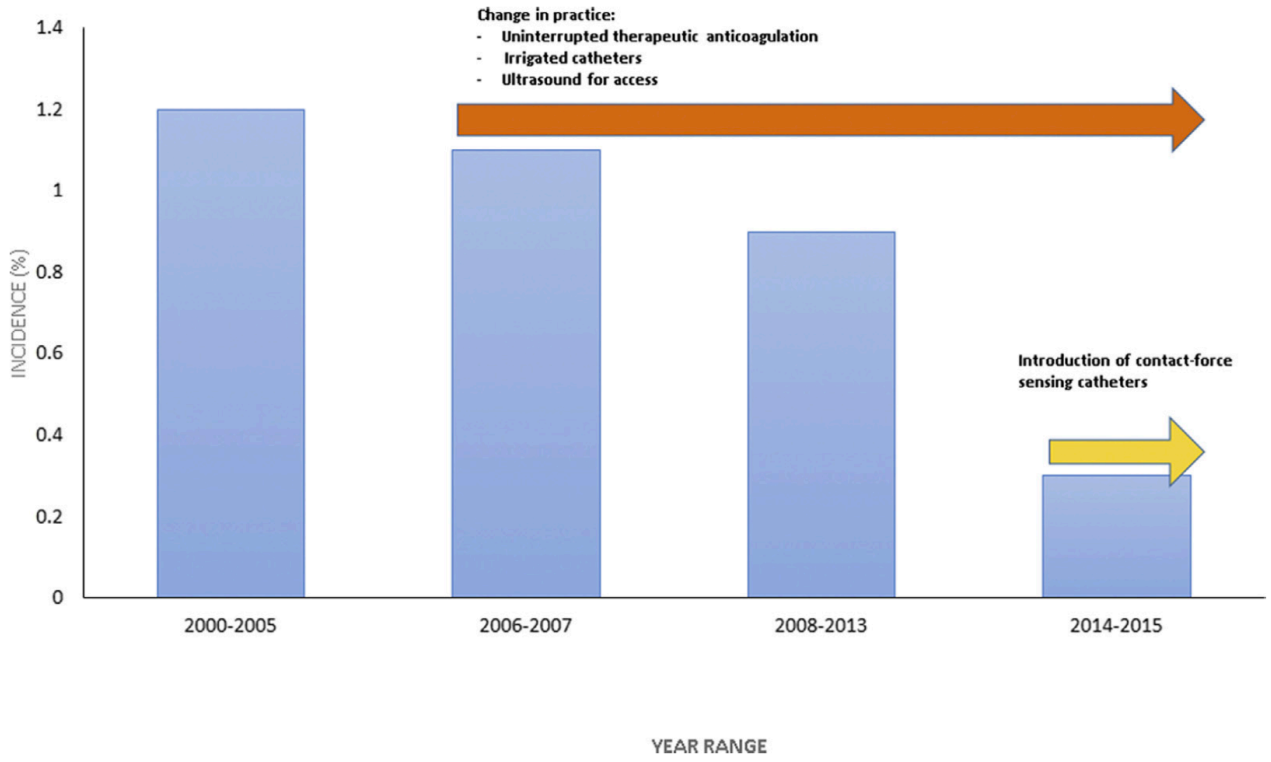
TABLE 2 Breakdown of Major Complications From AF Ablations at the Cleveland Clinic Between 2000 and 2015 (N = 100)

Complications during study period	
Pericardial effusion requiring pericardiocentesis	57 (57)
Cardiac perforation requiring surgical intervention	7 (7)
Cerebrovascular event	27 (27)
Vascular event	7 (7)
Required surgical intervention	5 (5)
Pressor support	2 (2)
Respiratory failure	6 (6)
Hemothorax	1 (1)
Neck hematoma	1 (1)
Pulmonary edema	2 (2)
Aspiration	1 (1)
Pneumonia	1 (1)
Myocardial infarction	3(3)
RCA STEMI	1 (1)
LAD dissection	1 (1)
Air embolism in RCA	1 (1)

Values are n (%).

AF = atrial fibrillation; LAD = left anterior descending artery; RCA = right coronary artery; STEMI = ST-segment elevation myocardial infarction.

FIGURE 1 Incidence of Major AF Ablation Complications at the Cleveland Clinic From 2000 to 2015



"One of the best healthcare systems in the world."
—PRESIDENT BARACK OBAMA

8 Trends That Will Define the Future of Medicine

The Cleveland Clinic Way

LESSONS IN EXCELLENCE FROM ONE OF THE WORLD'S LEADING HEALTHCARE ORGANIZATIONS

Toby Cosgrove, MD

President and CEO of Cleveland Clinic

Catheter Ablation of AF with and without On-Site Cardiothoracic Surgery

AF ablations *"should only be performed in hospitals equipped or prepared to manage these types of emergencies with access to emergency surgical support when required".*

TABLE 1 Unadjusted and Adjusted Rates of 30-Day Patient Outcomes After AF Ablation Performed at Hospitals With Versus Without On-Site CTS

	Unadjusted			Adjusted		
	Hospitals With CTS (n = 67,433)	Hospitals Without CTS (n = 1,348)	p Value	Hospitals With CTS (n = 4,029)	Hospitals Without CTS (n = 1,345)	p Value
Cardiac perforation*	458 (0.68)	…†	>0.20	22 (0.55)	…†	>0.20
Pericardiocentesis	394 (0.58)	…†	>0.20	18 (0.45)	…†	>0.20
Death (any cause)	289 (0.43)	12 (0.89)	0.011	22 (0.55)	12 (0.89)	0.1656
CTS	75 (0.11)	…†	>0.20	…†	…†	>0.20
30-day all-cause rehospitalization	5,456 (8.09)	115 (8.53)	0.5575	316 (7.84)	114 (8.48)	0.459

Values are n (%). *Defined as diagnosis of cardiac tamponade, hemopericardium, or pericardiocentesis. †No cell size <11 may be displayed according to the data use agreement with the Centers for Medicare & Medicaid Services. Nonsignificant p values were listed as ">0.20" to prevent back-calculation of cell size.

AF = atrial fibrillation; CTS = cardiothoracic surgery.

Of the 464 patients with perforation, 399 underwent pericardiocentesis, 4 underwent CTS alone, and 1 patient underwent both pericardiocentesis and CTS.

Impact of periprocedural anticoagulation therapy on the incidence of silent stroke after atrial fibrillation ablation in patients receiving direct oral anticoagulants: uninterrupted vs. interrupted by one dose strategy

Nagao et al. Europace 2019. doi:10.1093/europace/euy224

	Day-2		Day-1		Operation day		Day +1		Day +2	
	MD	ND	MD	ND	MD	ND	MD	ND	MD	ND
UG										
Once a day DOAC	●		●		●		●		●	
Twice a day DOAC	●	●	●	●	●	●	●	●	●	●
IG										
Once a day DOAC	●		●				●		●	
Twice a day DOAC	●	●	●	●		●	●	●	●	●

Our study demonstrated that the incidence of SS in the IG was significantly higher than that in the UG. In addition, the incidences of symptomatic ischemic stroke/TIA or SS were similar between patients taking once daily DOACs and twice daily DOACs in the IG.

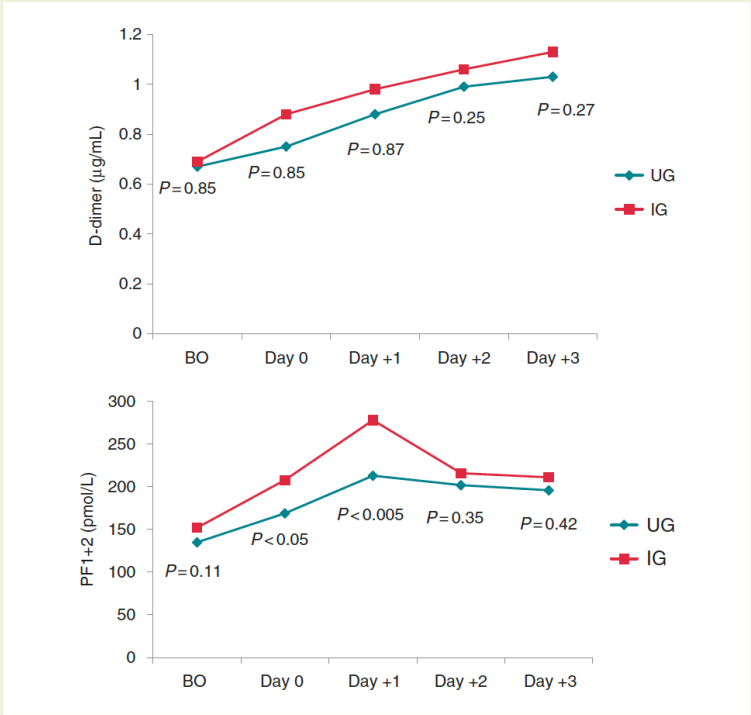


Figure 3 The trends for coagulation markers including mean D-dimer and PF1 + 2 values in the UG and the IG. BO, before operation; IG, interrupted group, PF1 + 2, prothrombin fragment 1 + 2; UG, uninterrupted group.

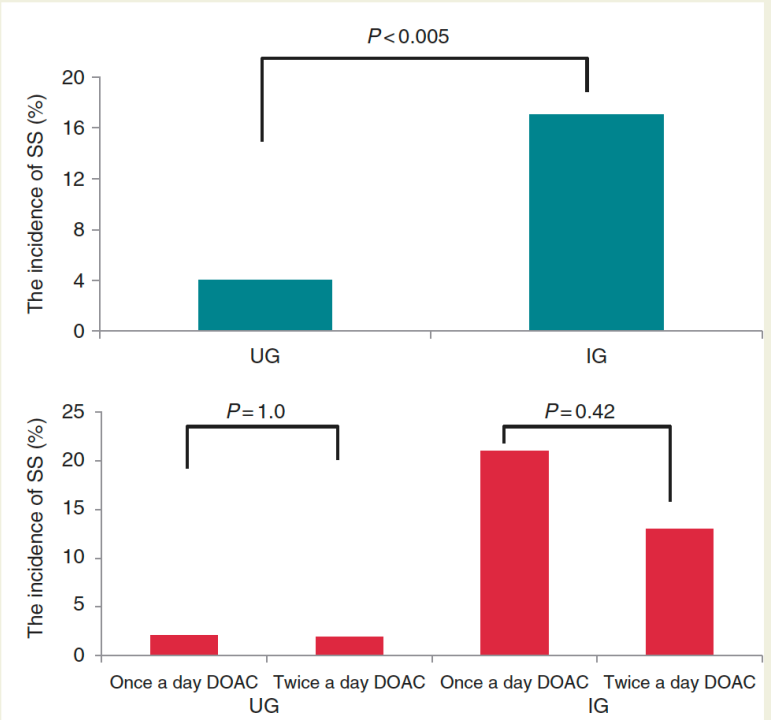
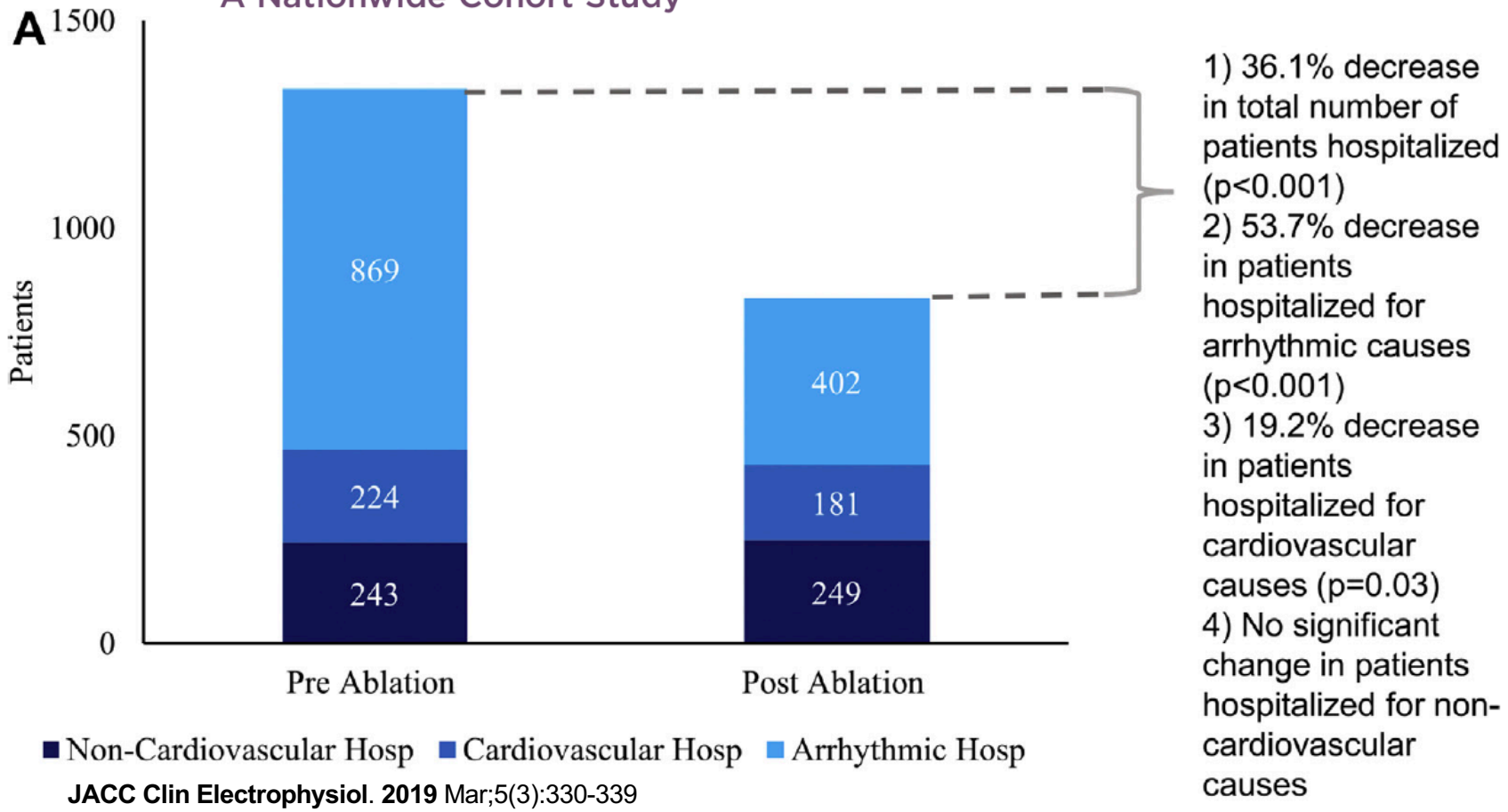


Figure 2 The comparison of the incidence of periprocedural SS in both the anticoagulant groups. DOAC, direct oral anticoagulant; IG, interrupted group; SS, silent stroke; UG, uninterrupted group.

Impact of Atrial Fibrillation Ablation on Recurrent Hospitalization

A Nationwide Cohort Study



1) 36.1% decrease in total number of patients hospitalized (p<0.001)
2) 53.7% decrease in patients hospitalized for arrhythmic causes (p<0.001)
3) 19.2% decrease in patients hospitalized for cardiovascular causes (p=0.03)
4) No significant change in patients hospitalized for non-cardiovascular causes

JACC Clin Electrophysiol. 2019 Mar;5(3):330-339

In this nationwide cohort, AF ablation was associated with significant decreases in arrhythmic and non-arrhythmic CV hospitalizations, which was driven by reductions in hospitalization for AF and HF.

The CABANA Randomized Clinical Trial

Figure 1. Randomization and Patient Flow in the CABANA Trial

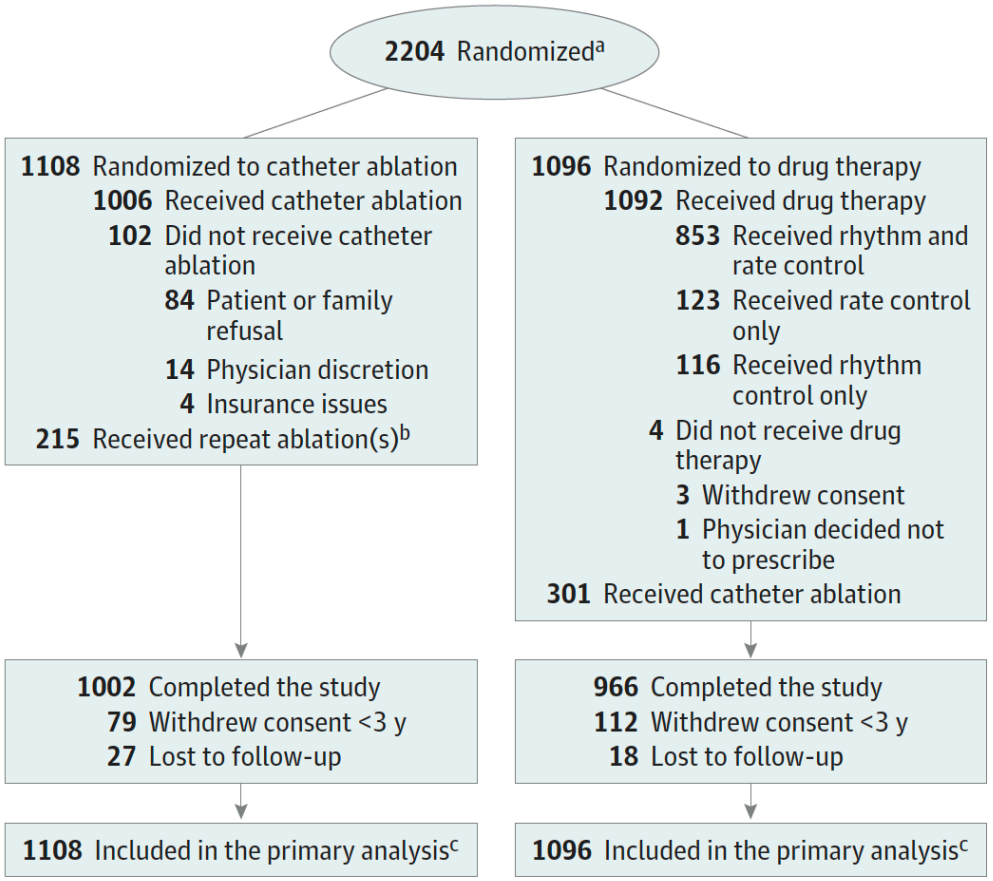
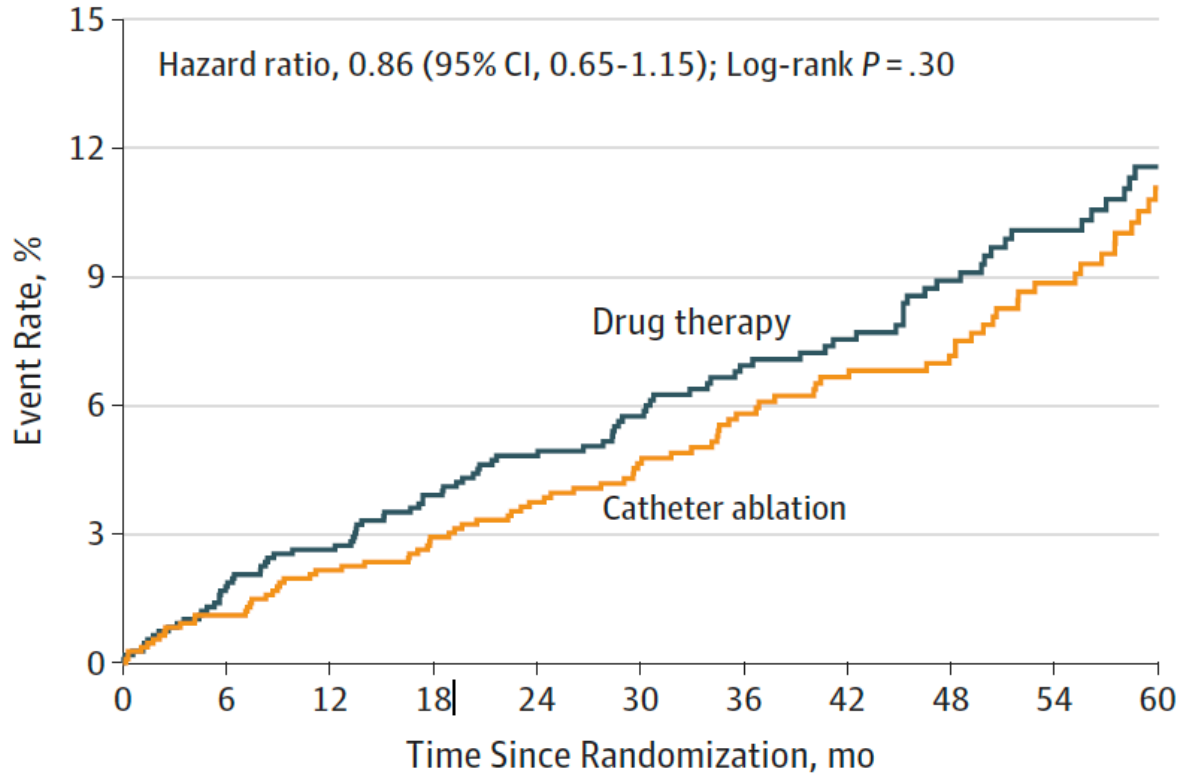


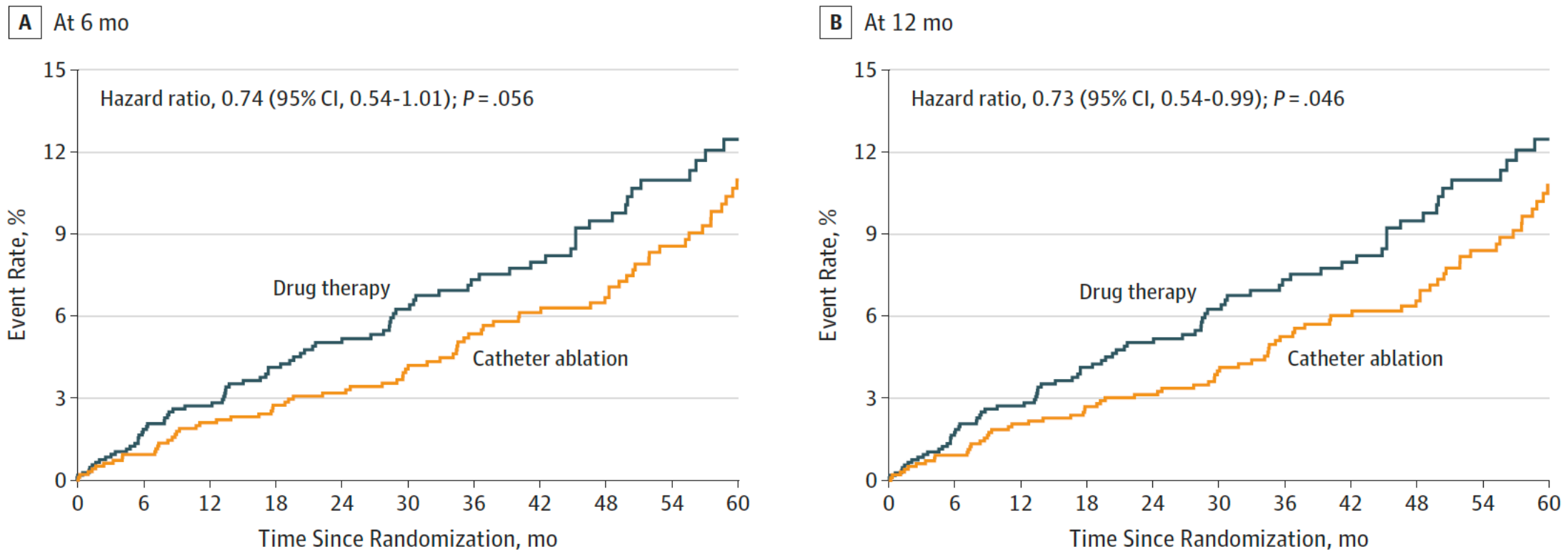
Figure 2. Kaplan-Meier Estimates of the Incidence of the Primary End Point



JAMA. **2019** Mar 15. doi: 10.1001/**jama**.**2019**.0693.

The CABANA Randomized Clinical Trial

Figure 5. Kaplan-Meier Estimates of the Primary End Point by Per-Protocol Analysis



No. at risk

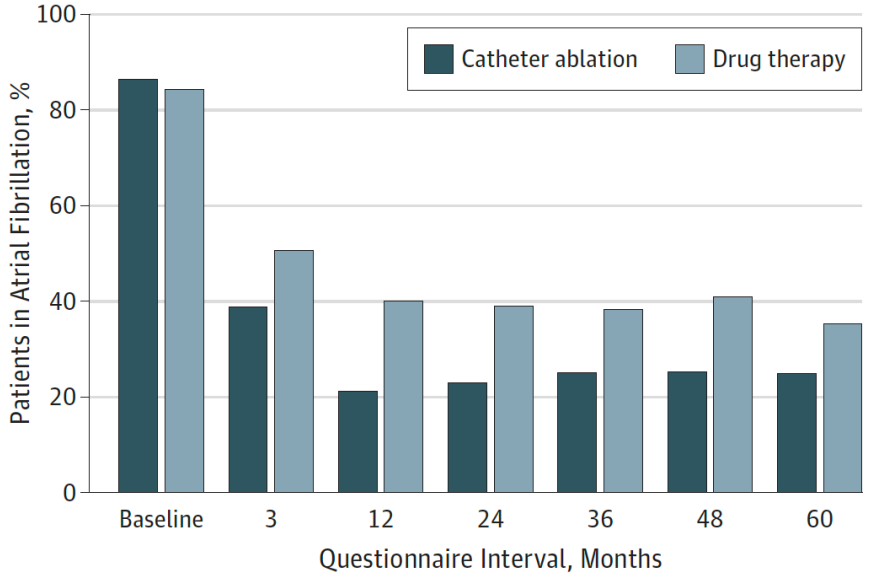
Drug therapy	1096	954	860	778	680	566	464	396	330	275	204
Catheter ablation	970	941	920	901	835	721	636	555	483	397	287

Drug therapy	1096	954	860	778	680	566	464	396	330	275	204
Catheter ablation	987	958	937	918	849	735	648	566	494	404	291

JAMA | Original Investigation

Effect of Catheter Ablation vs Medical Therapy on Quality of Life Among Patients With Atrial Fibrillation
The CABANA Randomized Clinical Trial

Figure 1. Patients Who Reported Being in Atrial Fibrillation Currently or Within the Past Month



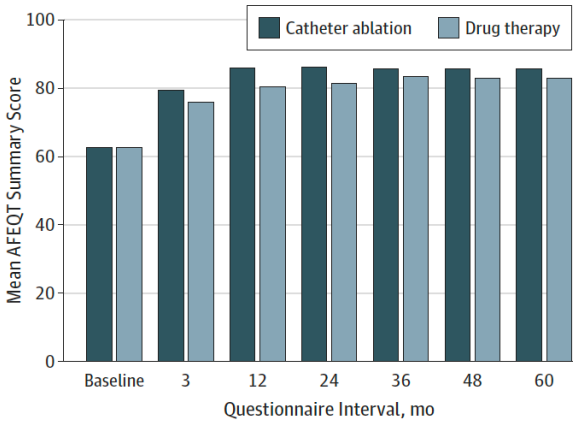
No. of patients							
Catheter ablation	915	374	195	198	164	127	85
Drug therapy	885	493	362	314	239	199	117

Responses to the first item in the Atrial Fibrillation Effect on Quality of Life instrument.

JAMA. **2019** Mar 15. doi: 10.1001/**jama.2019**.0692.

Figure 2. Atrial Fibrillation Effect on Quality of Life (AFEQT) Summary Scores

A Mean AFEQT summary score



B Between-group AFEQT summary score difference

Interval, mo	No. of Patients Ablation (n = 1108)	No. of Patients Drug Rx (n = 1096)	Adjusted Mean Difference (95% CI)
Baseline	1084	1078	-0.2 (-1.9 to 1.5)
3	971	983	3.0 (1.3 to 4.7)
12	915	903	5.3 (3.7 to 6.9
24	856	798	4.3 (2.7 to 6.0)
36	645	605	2.5 (0.8 to 4.1)
48	476	473	3.0 (1.1 to 4.9)
60	329	320	2.6 (0.3 to 4.8)
All	4192	4082	3.4 (2.1 to 4.8)

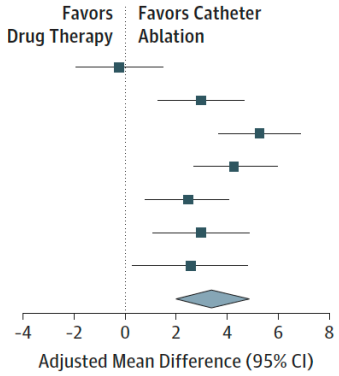
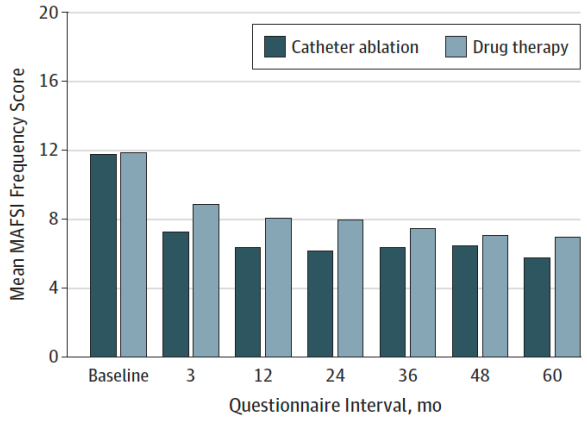


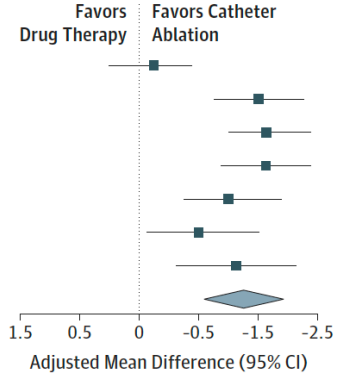
Figure 3. Mayo Atrial Fibrillation–Specific Symptom Inventory (MAFSI) Frequency Scores

A Mean MAFSI frequency score



B Between-group MAFSI frequency score difference

Interval, mo	No. of Patients Ablation (n = 1108)	No. of Patients Drug Rx (n = 1096)	Adjusted Mean Difference (95% CI)
Baseline	1069	1061	-0.2 (-0.7 to 0.4)
3	897	894	-1.6 (-2.2 to -1.0)
12	828	831	-1.7 (-2.3 to -1.2)
24	759	724	-1.7 (-2.3 to -1.1)
36	571	559	-1.2 (-1.9 to -0.6)
48	424	419	-0.8 (-1.6 to -0.1)
60	279	295	-1.3 (-2.1 to -0.5)
All	3758	3722	-1.4 (-1.9 to -0.9)



JAMA Network™

QUESTION Is pulmonary vein isolation more effective than optimized antiarrhythmic drug therapy for improving general health in patients with symptomatic atrial fibrillation (AF)?

CONCLUSION This randomized clinical trial of patients with symptomatic AF found that quality of life improved statistically and clinically significantly greater with catheter ablation than with medication.

POPULATION

120 Men
35 Women

Adults with AF >6 months and previous drug treatment

Mean age: 56 years

LOCATIONS

5
University hospitals in Sweden and Finland

INTERVENTION

155 Patients randomized

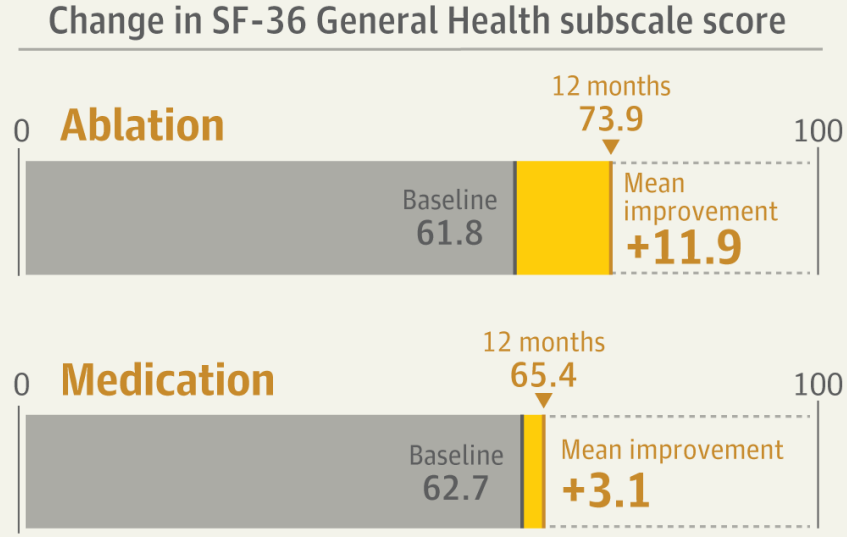
79
Ablation
Pulmonary vein isolation ablation

76
Medication
Antiarrhythmic drug (not previously used)

PRIMARY OUTCOME

Quality of life based on SF-36 General Health subscale score (range, 0 [worst] to 100 [best])

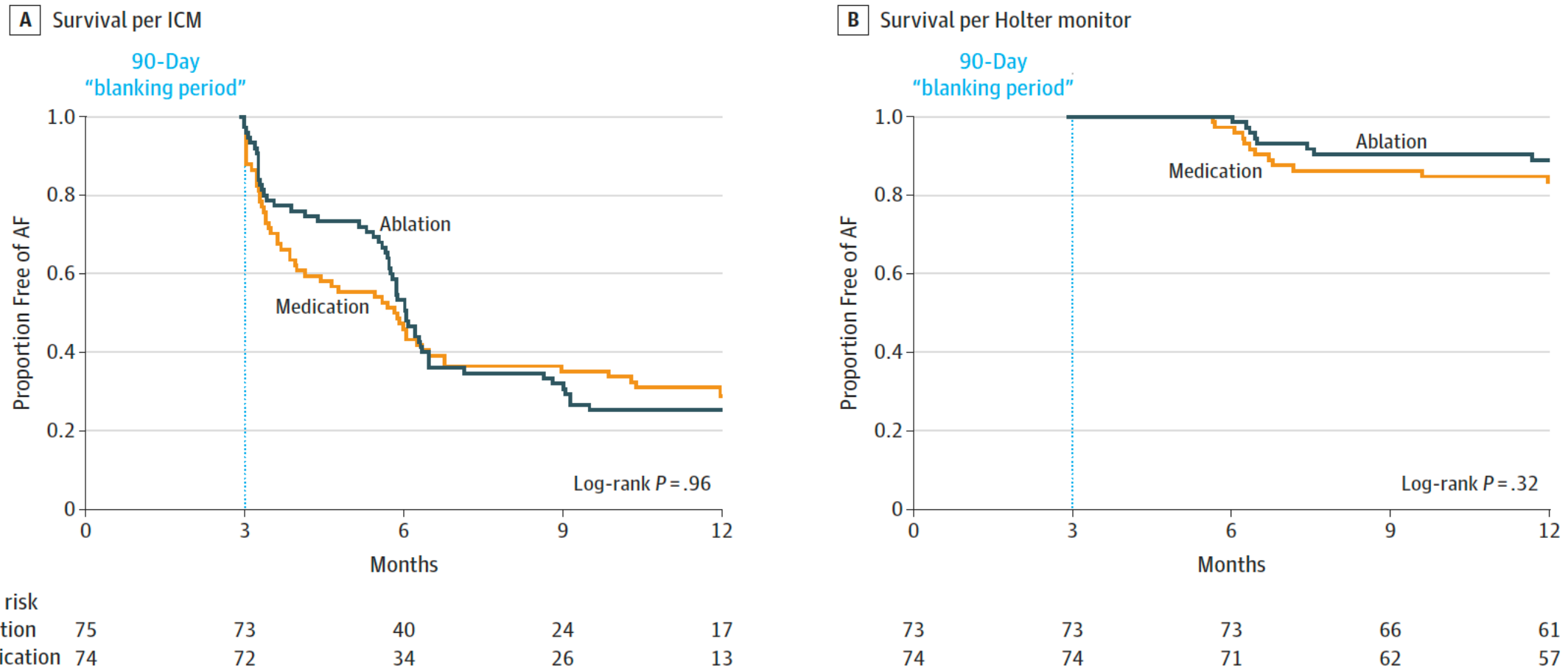
FINDINGS



Between-group difference: **8.9** points
(95% CI, 3.1-14.7; *P* = .003)

Blomström-Lundqvist C, Gizurarson S, Schwieler J, et al. Effect of catheter ablation vs antiarrhythmic medication on quality of life in patients with atrial fibrillation: the CAPTAF randomized clinical trial [published March 15, 2019]. *JAMA*. doi:10.1001/jama.2019.0335

Figure 4. Secondary End Point Event-Free Survival From Atrial Fibrillation



No. at risk										
Ablation	75	73	40	24	17	73	73	73	66	61
Medication	74	72	34	26	13	74	74	71	62	57

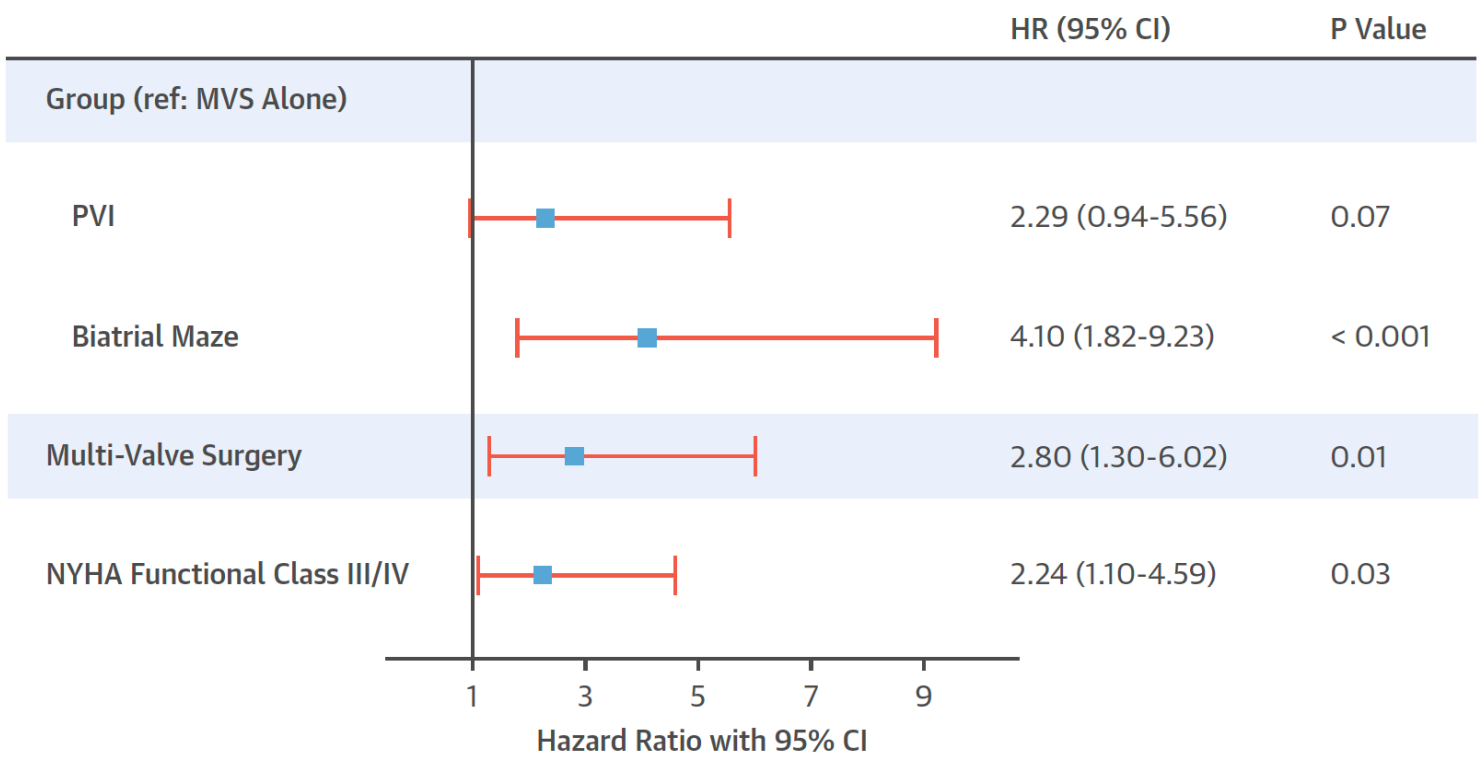
Kaplan-Meier curves comparing survival free from atrial fibrillation episodes according to implantable cardiac monitor (A) and cumulative 24-hour Holter recordings in the 2 treatment groups (B). There were no significant differences between treatment groups. Events were not counted during the first 90-day blanking period (a period of therapeutic stabilization after ablation during which any occurrence of atrial fibrillation is not considered treatment failure or atrial fibrillation recurrence). For the implantable cardiac monitor, the median (quartile 1-3) observation time was 12.2 months (12.0-12.5 months) for the ablation group and 12.1 months (11.9-12.6 months) for the drug group. The 24-hour Holter recordings were obtained for 12.0 months (12.0-12.0 months) in the ablation group and 12.0 months (12.0-12.0) in the antiarrhythmic medication group.

Pacemaker Implantation After Mitral Valve Surgery With Atrial Fibrillation Ablation

J Am Coll Cardiol 2019;73:2427–35

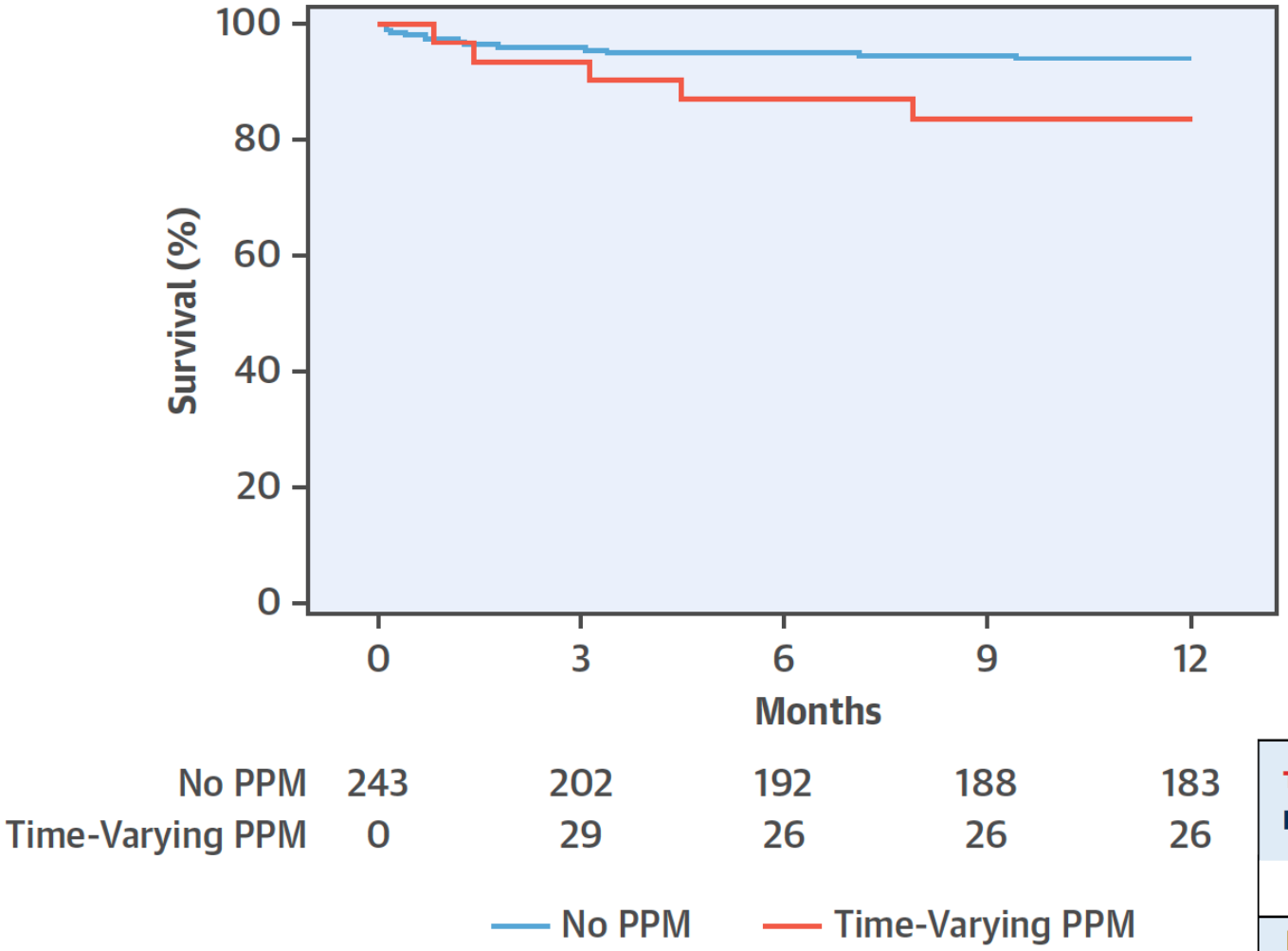
A total of 243 patients with AF and without previous PPM placement were randomly assigned to MVS alone (n=117) or MVS + ablation (n=126).

FIGURE 2 Patient and Procedure Characteristics Associated With PPM Placement



Patient and operative risk factors associated with PPM placement. The **blue squares** represent the estimated hazard ratio (HR) and the **red lines** extend from the lower limit to the upper limit of the estimated 95% CI. NYHA = New York Heart Association; other abbreviations as in Figure 1.

CENTRAL ILLUSTRATION Permanent Pacemaker Placement and Survival



DeRose, Jr., J.J. et al. J Am Coll Cardiol. 2019;73(19):2427-35.

Extended Kaplan-Meier curve assessing the effect of a permanent pacemaker (PPM) on survival probability using method (12). Median observation time was 1.3 months (interquartile range: 0.4 to 3.4 months) for patients who died.

TABLE 2 Impact of PPM Placement, Age, NYHA Functional Class III/IV and Ablation on 1-Year Mortality

	HR (95% CI)	p Value
PPM placement	3.21 (1.01-10.17)	0.05
Age, yrs	1.10 (1.03-1.17)	0.01
NYHA functional class III/IV	3.40 (1.09-10.56)	0.03
Ablation (yes/no)	0.66 (0.25-1.77)	0.41

CI = confidence interval; HR = hazard ratio; other abbreviations as in Table 1.

Prevalence of left atrial appendage thrombus detected by transoesophageal echocardiography before catheter ablation of atrial fibrillation in patients anticoagulated with non-vitamin K antagonist oral anticoagulants

Europace (2019) 21, 48–53

668 patients and 943 AF ablation procedures were included. At the time of ablation, 496 (53%) were on NOACs and 447 (47%) were on Warfarin.

There were three cases with LAAT (3/943, **0.3%**), all of whom had persistent AF and were on Warfarin.

Table 2 Baseline demographics of patients with LAAT and LAAS

Patient	Age	Gender	Type of AF	Rhythm during TOE	$CHADS_2$-VASc	$CHADS_2$ score	OAC	LV function
LAAT ($n = 3$)								
1	48	M	Persistent	AF	0	0	Warfarin	HCM
2	58	M	Persistent	AF	2 (TIA)	2 (TIA)	Warfarin	Normal
3	69	M	Persistent	AFL	2 (HTN)	1 (HTN)	Warfarin	Normal
LAAS ($n = 5$)								
4	64	M	Paroxysmal	NSR	0	0	Rivaroxaban 20 mg daily	Normal
5	48	M	Persistent	AF	2 (CVA)	2 (CVA)	Dabigatran 150 mg BID	Normal
6	58	F	Persistent	NSR	1 (sex)	0	Warfarin	Normal
7	72	F	Paroxysmal	NSR	2 (age/sex)	0	Warfarin	Normal
8	70	M	Persistent	AF	1 (age)	0	Warfarin	Normal

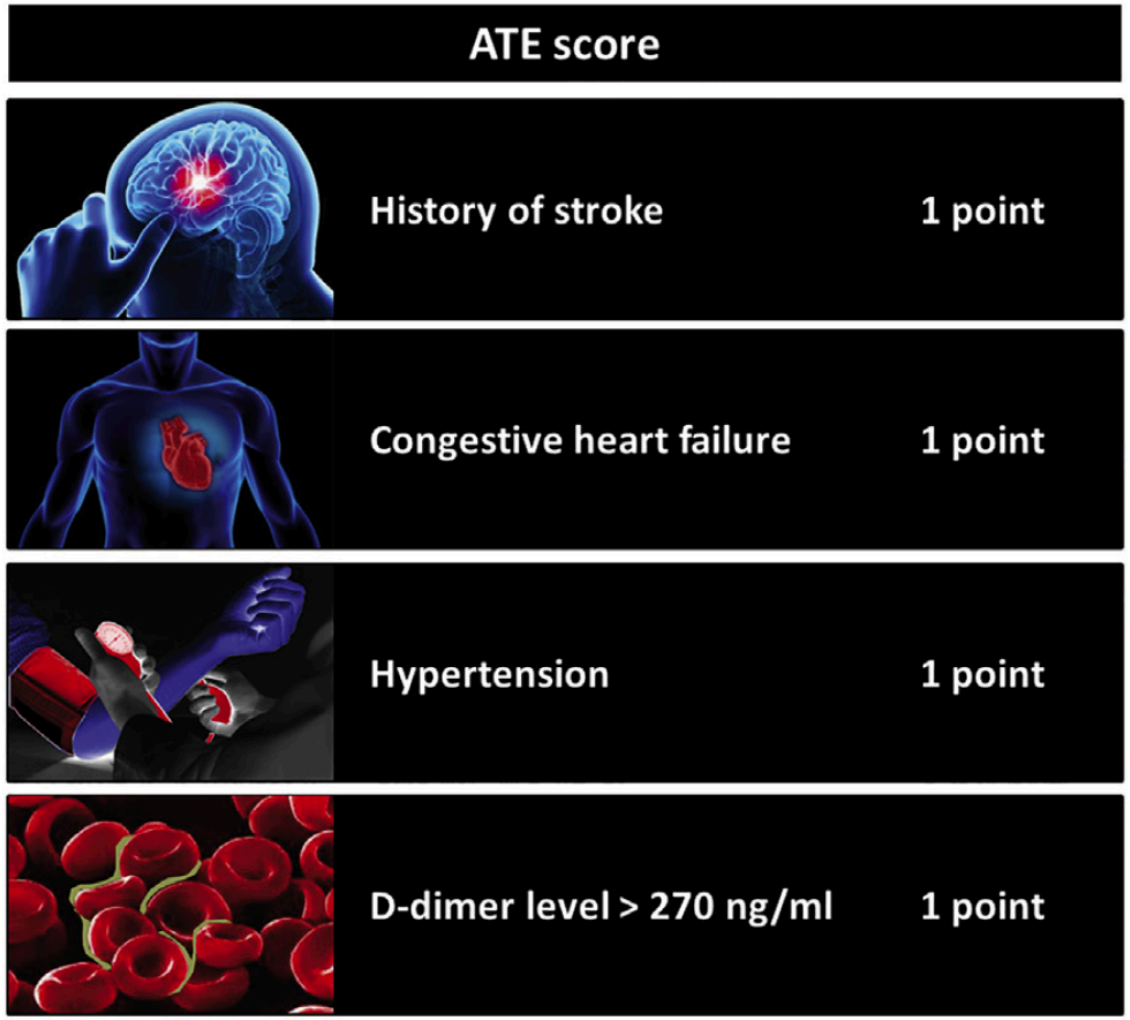
AF, atrial fibrillation; AFL, atrial flutter; BID, twice daily; CVA, cerebrovascular accident; F, female; HCM, hypertrophic cardiomyopathy; HTN, hypertension; LAAS, left atrial appendage sludge; LAAT, left atrial appendage thrombus; M, male; NSR, normal sinus rhythm; OAC, oral anticoagulation; TIA, transitory ischaemic attack; TOE, transoesophageal echocardiography.

Exclusion of Intra-Atrial Thrombus Diagnosis Using D-Dimer Assay Before Catheter Ablation of Atrial Fibrillation

Antoine Milhem, MD,[a] Pierre Ingrand, MD, PhD,[b] Frédéric Tréguer, MD,[c] Olivier Cesari, MD,[d] Antoine Da Costa, MD,[e] Dominique Pavin, MD,[f] Philippe Rivat, MD,[g] Nicolas Badenco, MD,[h] Sélim Abbey, MD,[i] Noura Zannad, MD,[j] Pierre François Winum, MD,[k] Jacques Mansourati, MD,[l] Philippe Maury, MD,[m] Hugues Bader, MD,[n] Arnaud Savouré, MD,[o] Frédéric Sacher, MD,[p] Marius Andronache, MD,[q] Caroline Allix-Béguec, PhD,[a] Christian De Chillou, MD, PhD,[q,r] Frédéric Anselme, MD, PhD,[o] the ATE Study Group

JACC Clin Electrophysiol. **2019** Feb;5(2):223-230.

FIGURE 1 ATE Score



Study population (n=2,494)

ATE score	Patients	Thrombus	
	n	n	%
0	911	0	0
1	988	23	2.3
2	481	14	2.9
3	111	10	9.0
4	3	1	33.3

The atrial thrombus exclusion (ATE) score is based on bioclinical parameters. A zero score matched up with the absence of intra-atrial thrombus.

Sn: 100%, Sp: 37%

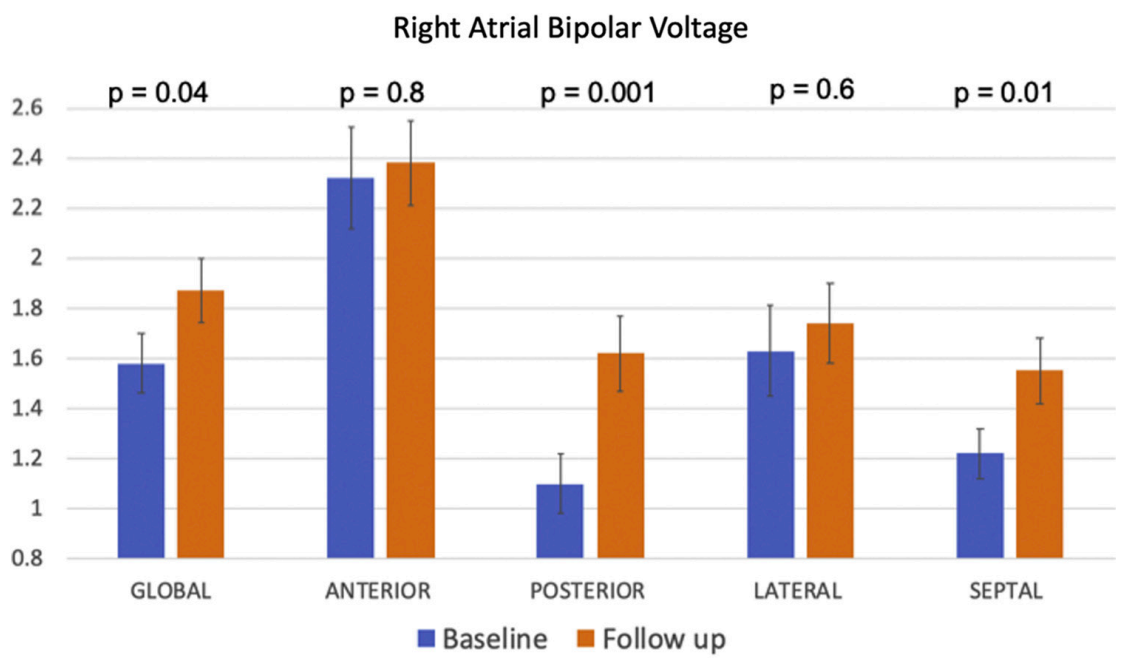
Studies on Imaging and Remodeling

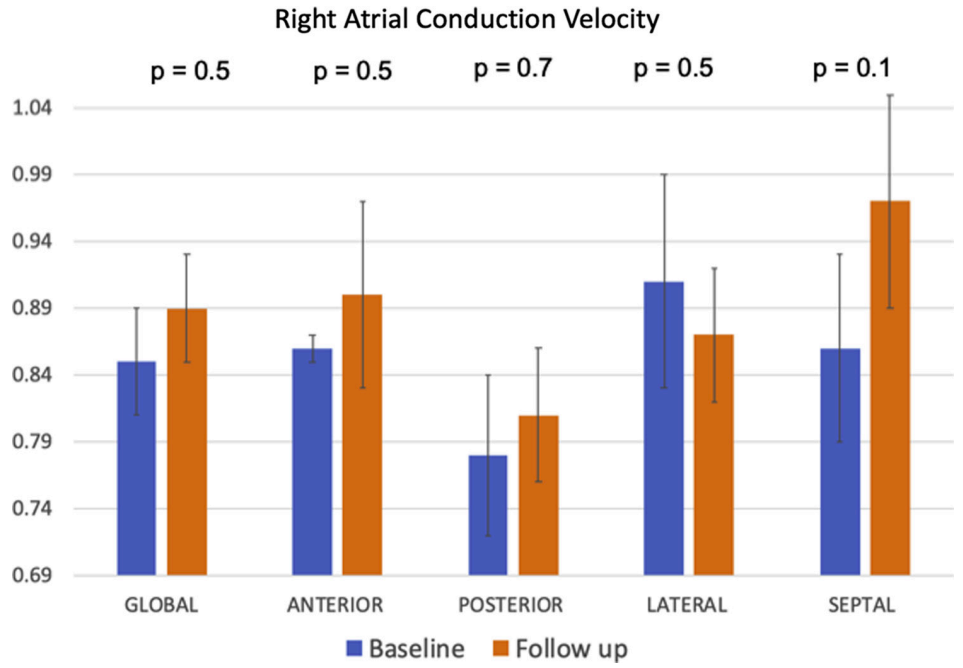
Atrial Remodeling Following Catheter Ablation for Atrial Fibrillation-Mediated Cardiomyopathy

Long-Term Follow-Up of CAMERA-MRI Study

Detailed EA mapping of the RA using CARTO3 and a force sensing catheter was performed at initial CA and electively at least 12 months after CA in patients with >90% reduction in AF burden following ablation. Bipolar voltage, fractionation, and conduction velocity were collected in 4 segments together with echo and cardiac magnetic resonance imaging.
LVEF improved from 33.6±3.2% to 54.1±3.2% (p<0.001).

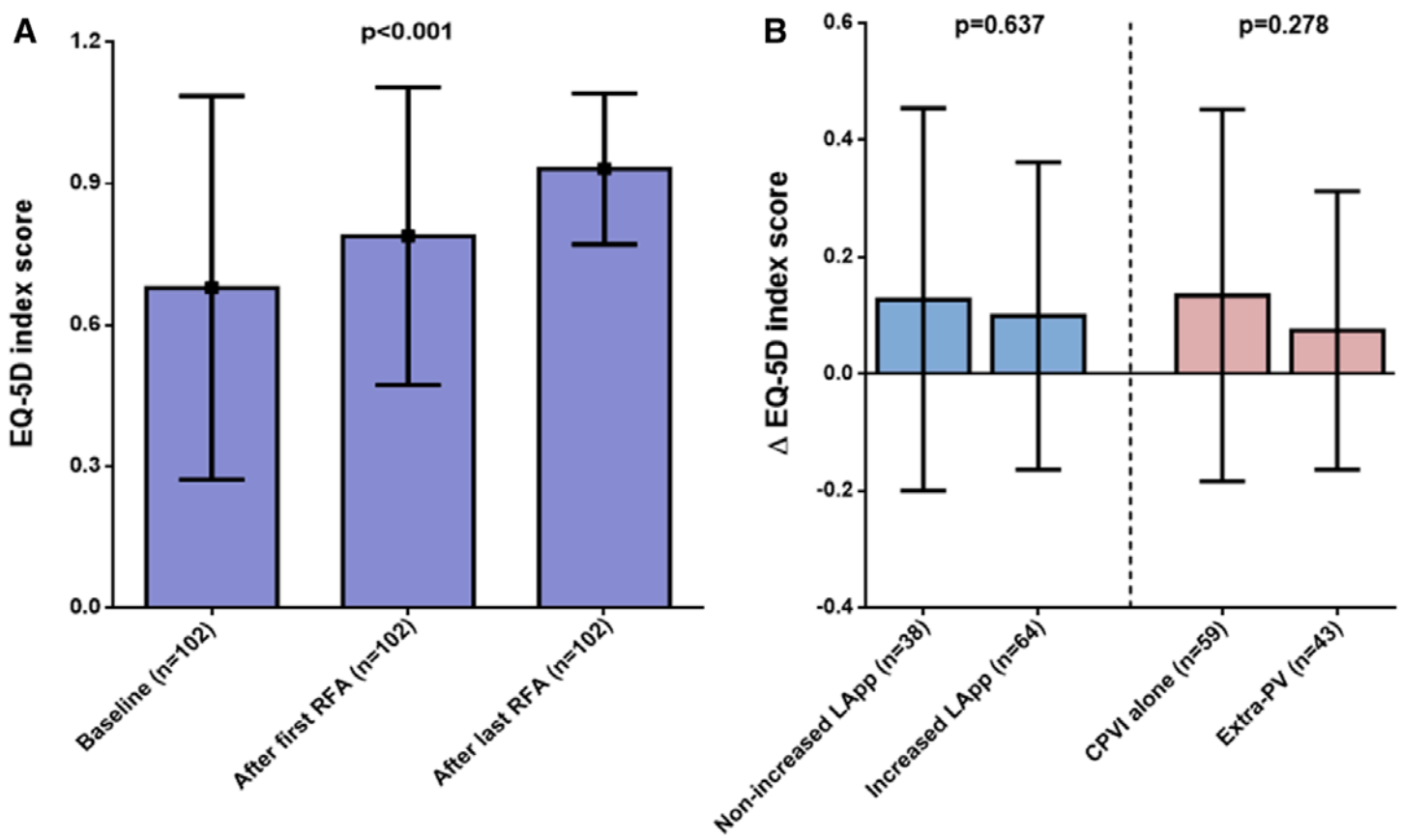
JACC Clin Electrophysiol. **2019** Jun;5(6):681-688

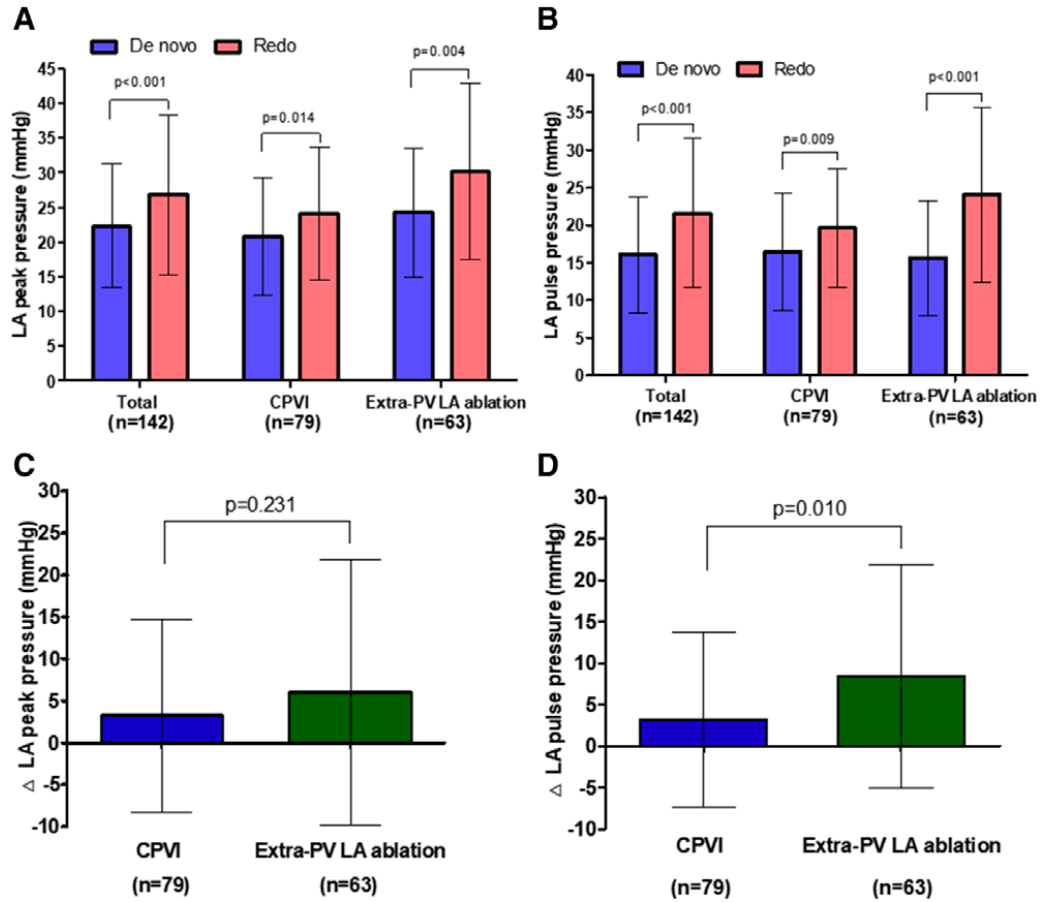




ORIGINAL ARTICLE

Atrial Fibrillation Catheter Ablation Increases the Left Atrial Pressure





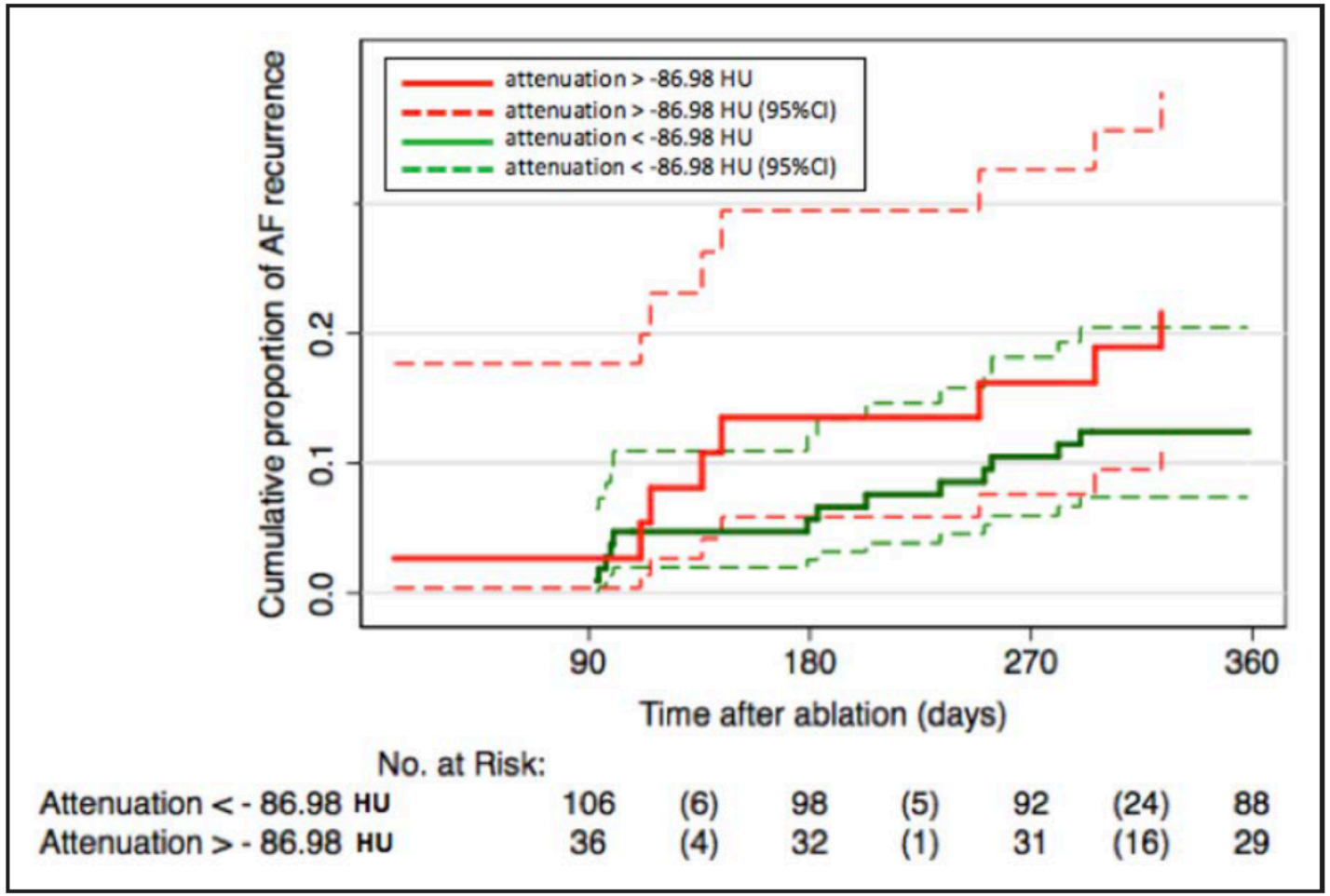
Circ Arrhythm Electrophysiol. **2019** Apr;12(4):e007073.

ORIGINAL ARTICLE

Periatrial Fat Quality Predicts Atrial Fibrillation Ablation Outcome

Circ Cardiovasc Imaging. **2019** Jun;12(6):e008764

We included 143 consecutive patients with drug-refractory AF referred for the first catheter ablation of AF (40% PAF). All participants had a pre-ablation cardiac CT. The authors measured the **quantity** of the LA peri atrial fat tissue by the area (millimeter square) and the **quality** by the mean computed tomography attenuation (Hounsfield units) in a standard 4-chamber view.



LA fat attenuation was **correlated** with LA fat **volume** and **LA bipolar voltage** by invasive mapping and was **associated with AF recurrence** after adjusting for clinical risk factors, including BMI, AF type, LA dimension, and fat area **(hazard ratio, 2.65; P=0.001).**

Reverse left ventricular structural remodeling after catheter ablation of atrial fibrillation in patients with preserved left ventricular function: Insights from cardiovascular magnetic resonance native T1 mapping

Heart Rhythm 2019;16:424–432

Screened n = 112

- → 8 eGFR < 30 ml/min/1.73 m^2
- → 41 Declined

Recruited n = 63 (56%)

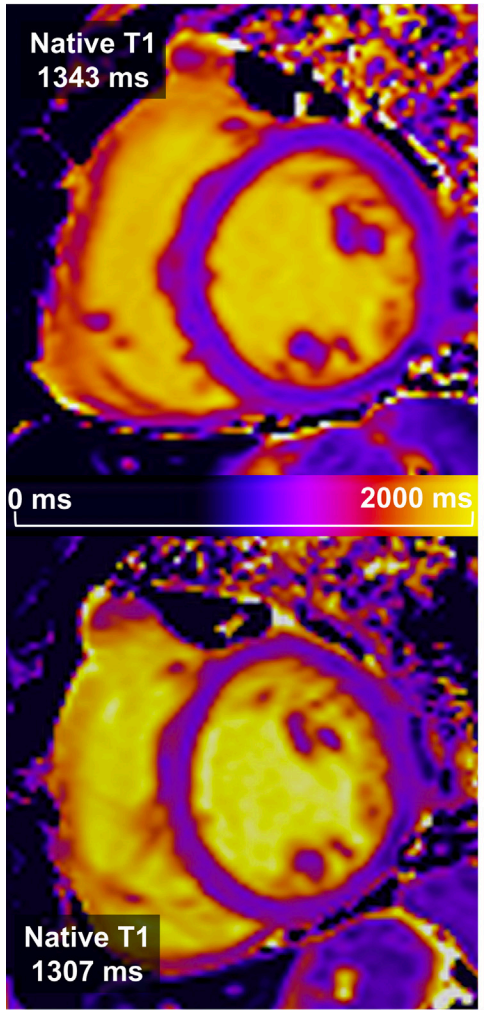
- → 12 AF at the time of CMR
- → 6 No CMR capacity
- → 2 Claustrophobia

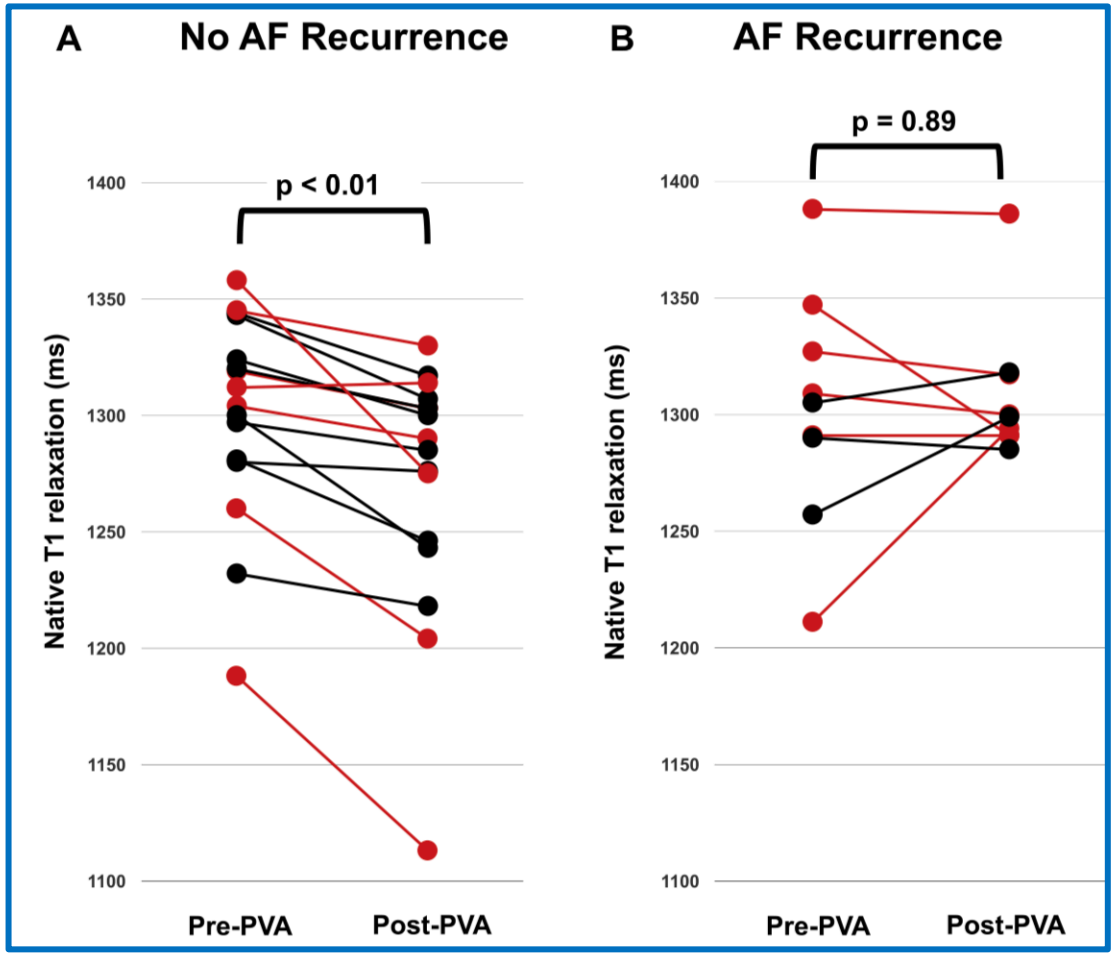
Pre CMR n = 43

PVA n = 43

- → 1 Pacemaker
- → 8 Declined to attend follow-up CMR
- → 6 AF at the time of follow-up CMR
- → 3 No CMR capacity

Follow-up CMR n = 25





New Mapping and Ablation Techniques

ORIGINAL ARTICLE

Wavefront Field Mapping Reveals a Physiologic Network Between Drivers Where Ablation Terminates Atrial Fibrillation

We recruited 54 patients from an international registry in whom persistent AF terminated by targeted ablation. Unipolar AF electrograms were analyzed from 64-pole baskets to reconstruct activation times, map propagation vectors each 20 ms, and create nonproprietary phase maps.

Circ Arrhythm Electrophysiol. 2019;12:e006835. DOI: 10.1161/CIRCEP.118.006835

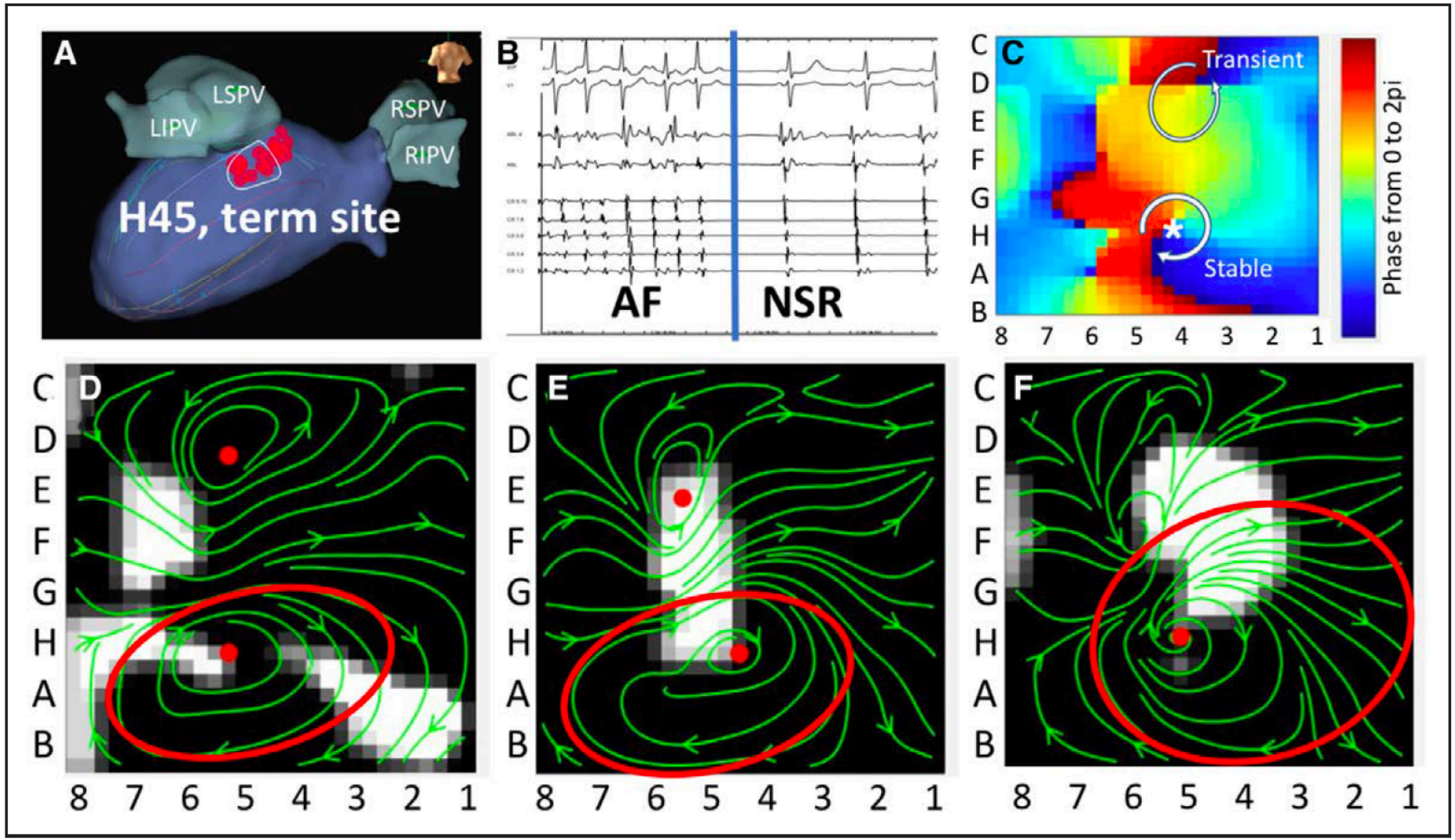


Figure 1. Persistent AF in a 49-y-old man sustained by one dominant atrial fibrillation (AF driver; type I).
A, Anatomic shell of left atrium (left posterior oblique view) showing solitary site where localized ablation terminated AF to sinus rhythm. **B**, Electrograms of AF termination to sinus rhythm. **C**, AF phase map identifies stable clockwise rotation at site H45, the site of termination marked by * and transient counter clockwise rotations at D45. **D**–**F**, Wavefront flow field defines rotational activation at termination site for multiple cycles (**D** and **E**). Red dots denote the centers of areas of rotational activity and are determined automatically by the wavefront flow field software. Red circles are manually annotated to show estimated atrial areas controlled by localized sources based on blinded visual estimates. LIPV indicates left inferior pulmonary vein; LSPV, left superior pulmonary vein; NSR, normal sinus rhythm; RIPV, right inferior pulmonary vein; and RSPV, right superior pulmonary vein.

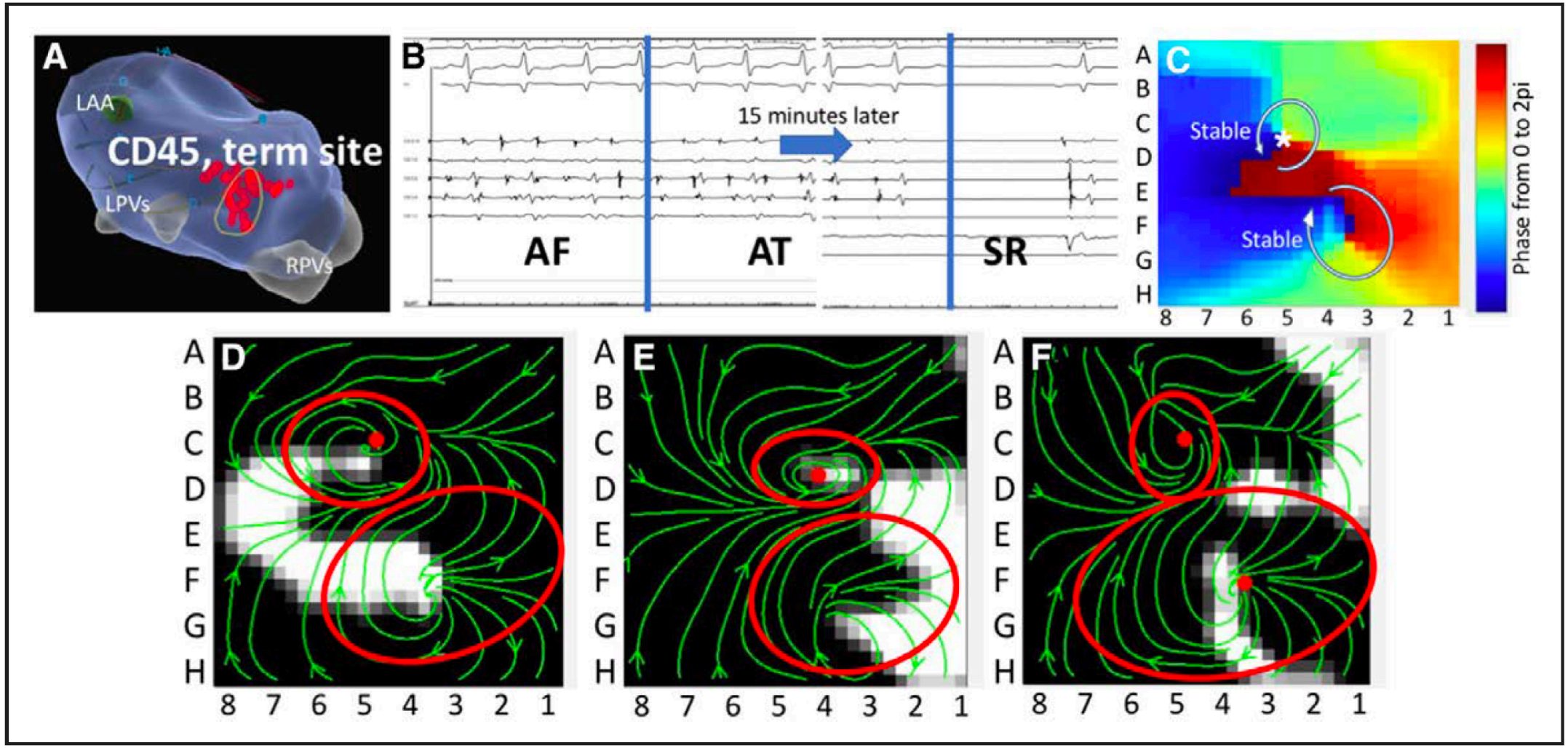


Figure 2. Persistent atrial fibrillation (AF) in a 67-y-old woman sustained by a dominant driver pair (type II).
A, Anatomic shell showing 2 left atrial sites where ablation organized, then terminated AF. **B**, Electrograms of termination to atrial tachycardia (AT) and sinus rhythm. **C**, AF phase map showing counterclockwise rotation at CD45 and clockwise (antichiral) rotation at F34. Site of termination is marked by *. **D**–**F**, Wavefront flow field defines a consistent pair of rotational sites over multiple cycles, fluctuating in the areas of mapped atrium emanating from each. LAA indicates left atrial appendage; LPVS, left pulmonary veins; RPVS, right pulmonary veins; and SR, sinus rhythm.

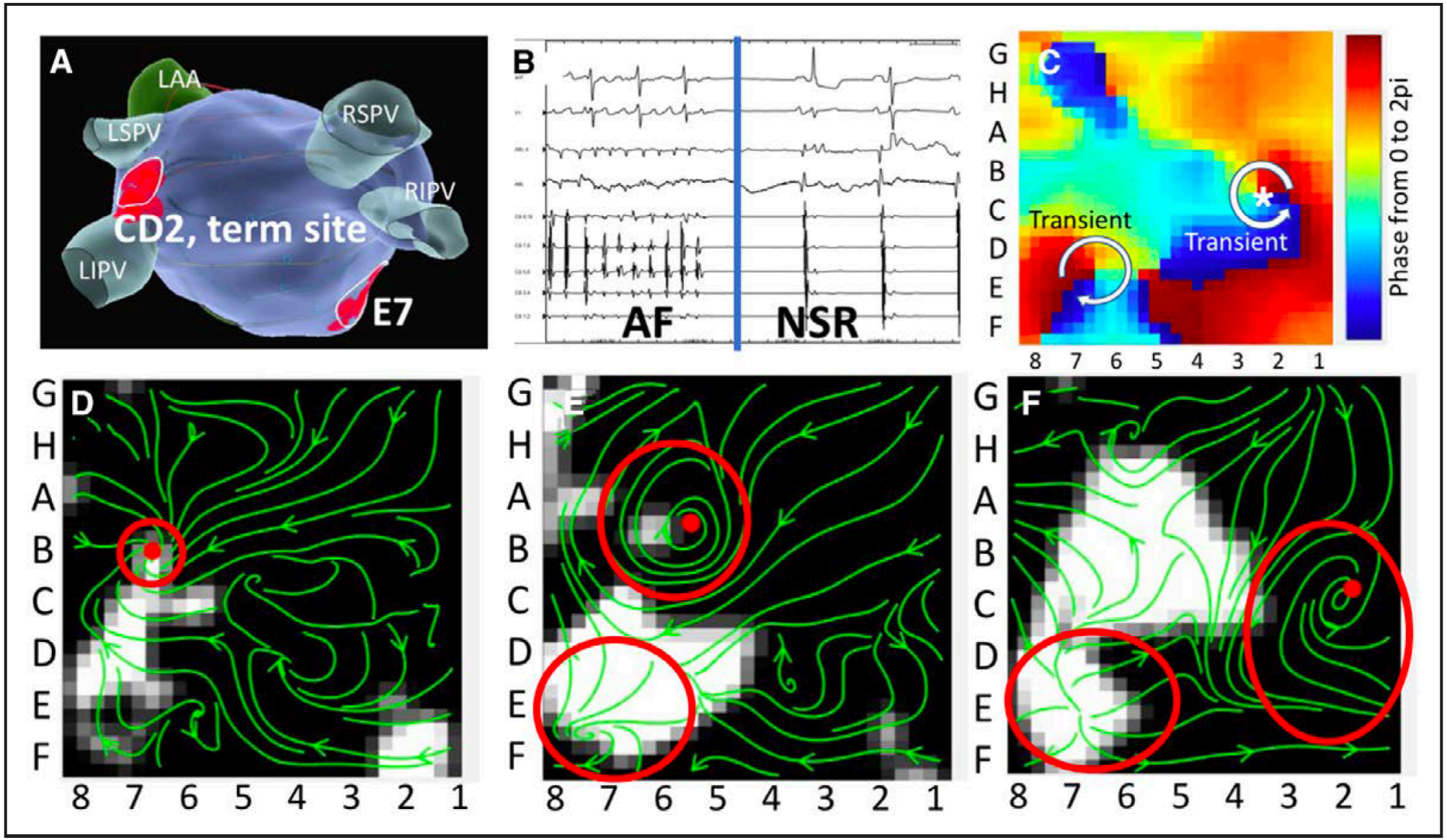


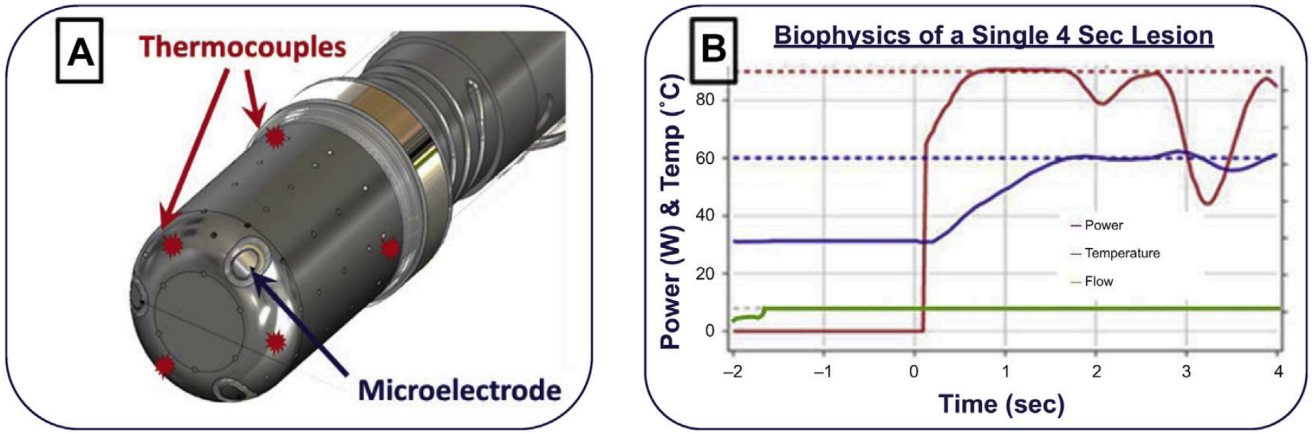
Figure 3. Persistent atrial fibrillation (AF) in a 72-y-old man with dynamically interacting AF drivers (type III).
A, Anatomic site of AF termination (C2) showing basket in position; (**B**) electrograms of AF termination by ablation; (**C**) Phase maps show singularity corresponding to counter clockwise phase progression at C2, as well as rotations at E7. **D**–**F**, Sequential WFF maps show dynamic back-and-forth interaction between the termination site and other sites at AB67 and E7 with changing spatial domains. LAA indicates left atrial appendage; LIPV, left inferior pulmonary vein; LSPV, left superior pulmonary vein; NSR, normal sinus rhythm; RIPV, right inferior pulmonary vein; and RSPV, right superior pulmonary vein.

Pulmonary Vein Isolation With Very High Power, Short Duration, Temperature-Controlled Lesions

The QDOT-FAST Trial

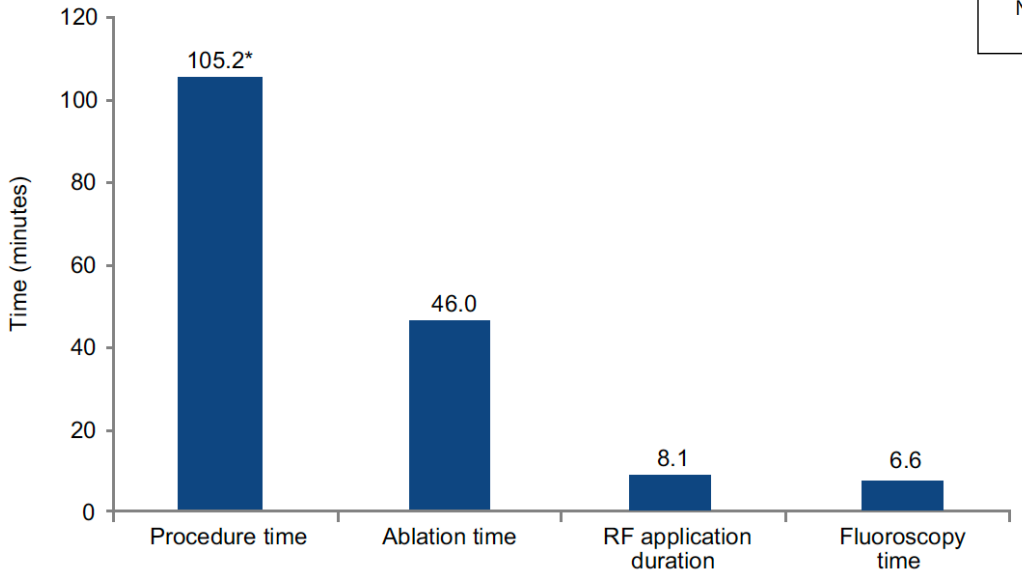
A total of 52 patients underwent ablation and completed follow-up.

FIGURE 1 The vHPSD Catheter



(A) The very high power–short duration (vHPSD) catheter tip is shown highlighting the microelectrodes and 6 thermocouples. **(B)** The biophysical parameters of an example ablation lesion is shown. This includes a 2-s pre-cooling phase, followed by a 4-s vHPSD ablation lesion. Note the power modulation that is particularly striking in the last 1.5 s of energy delivery to maintain the target temperature of 60°C.

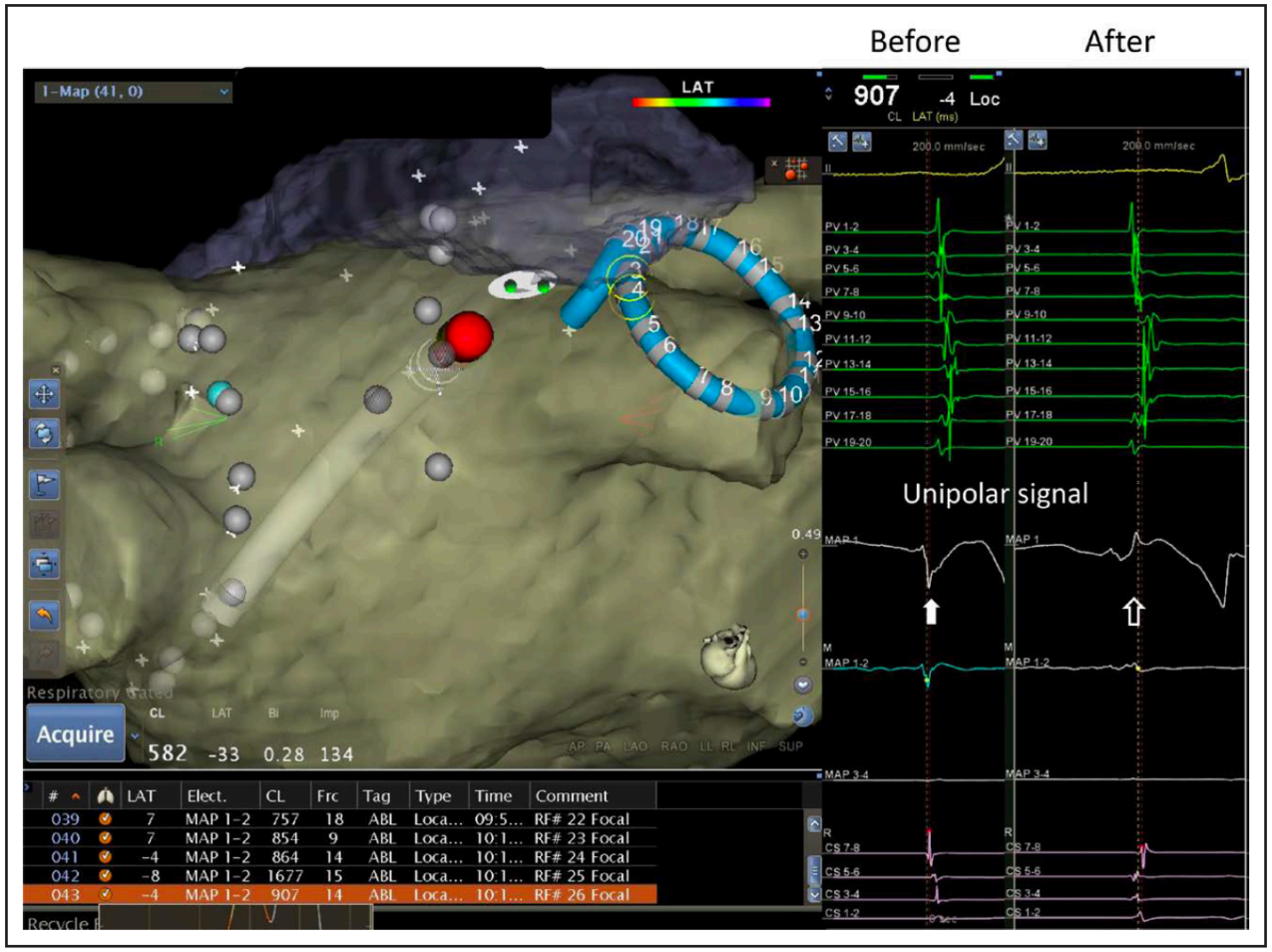
FIGURE 2 Procedural Parameters in the QDOT-FAST Study



Most patients (n=49; 94.2%) were in sinus rhythm at 3 months.

Comparison Between Contact Force Monitoring and Unipolar Signal Modification as a Guide for Catheter Ablation of Atrial Fibrillation

Prospective Multi-Center Randomized Study



Circ Arrhythm Electrophysiol. 2019;12:e007311. DOI: 10.1161/CIRCEP.119.007311

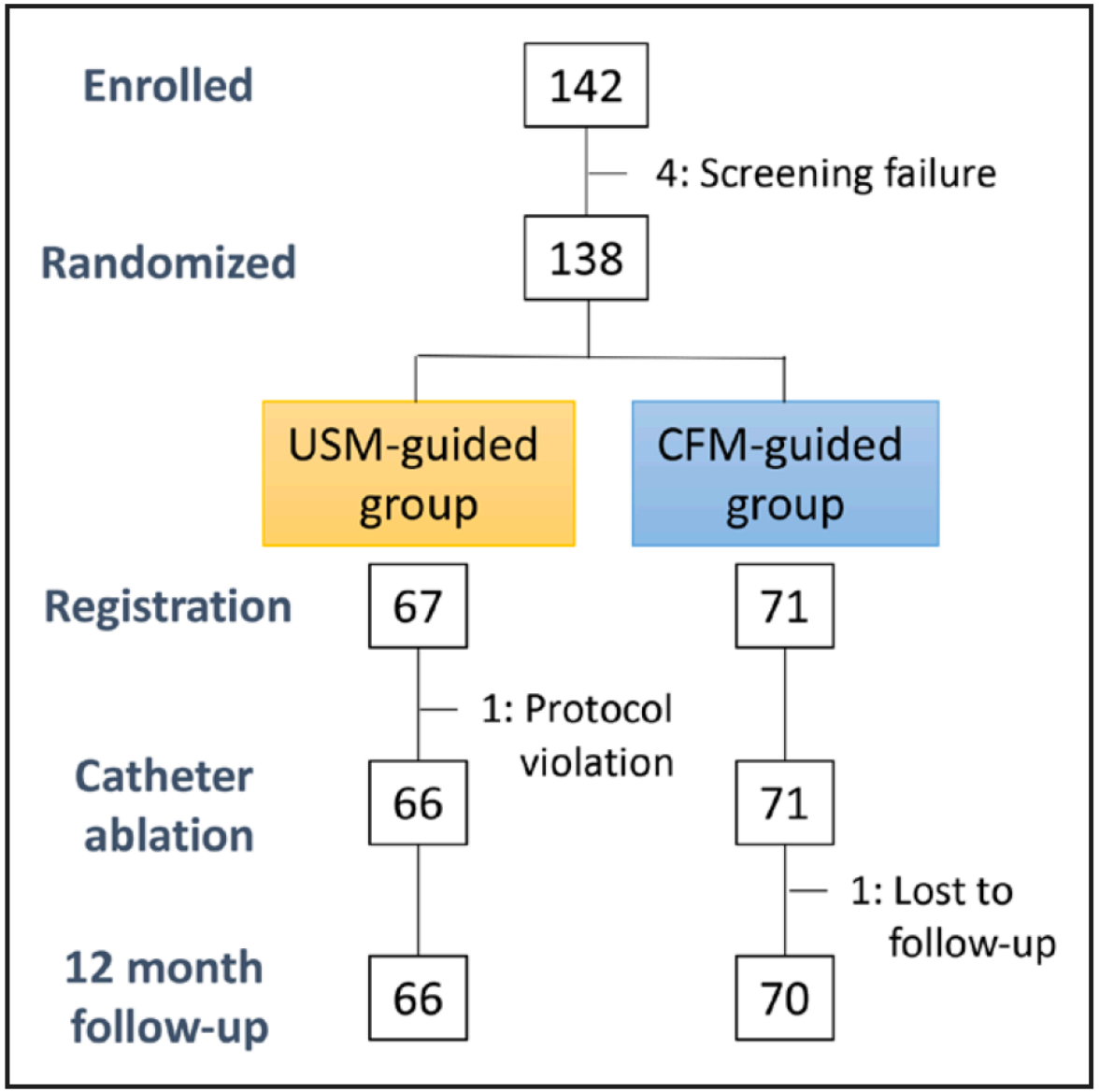


Figure 2. Study flow diagram.
CFM indicates contact force monitoring; and USM, unipolar signal modification.

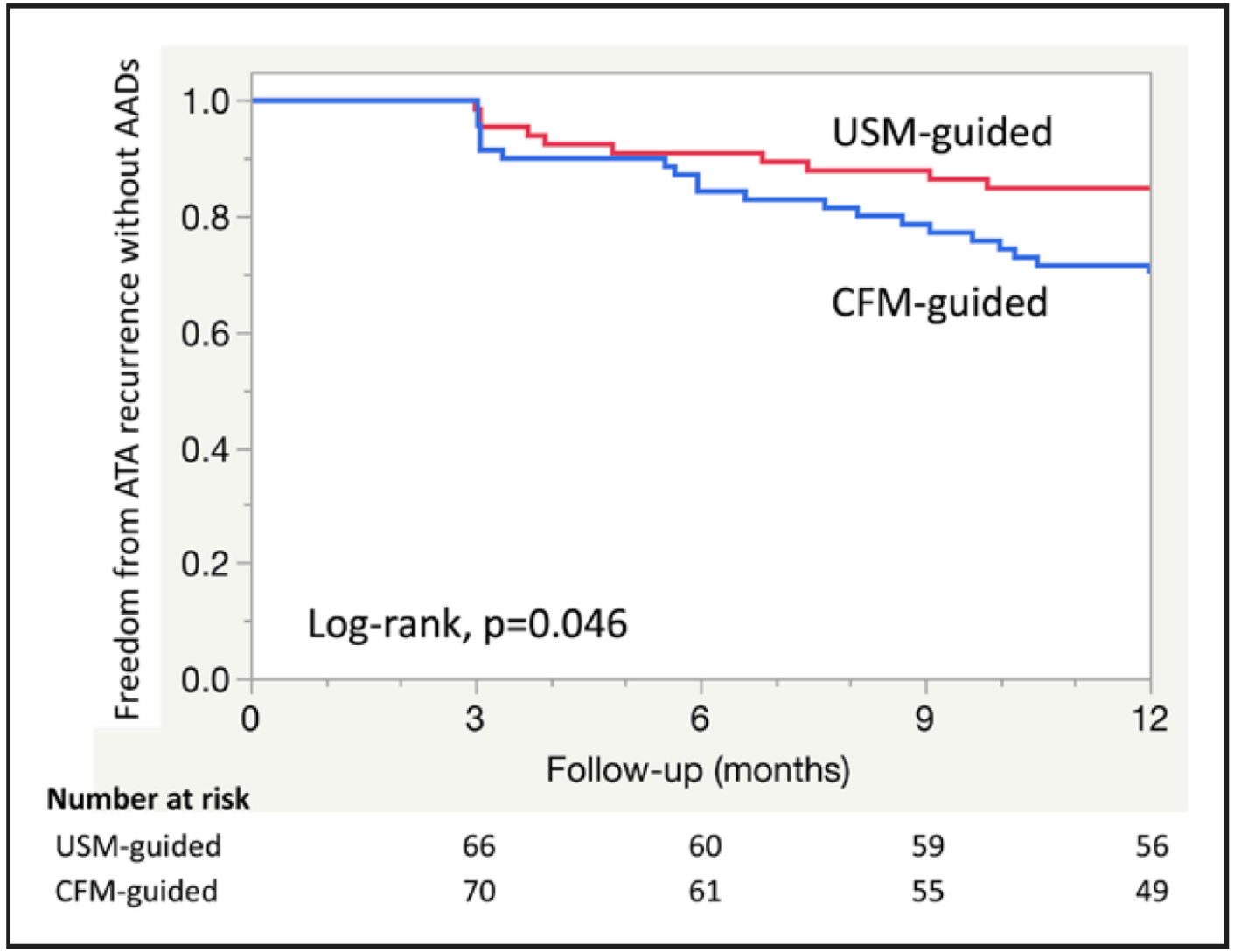


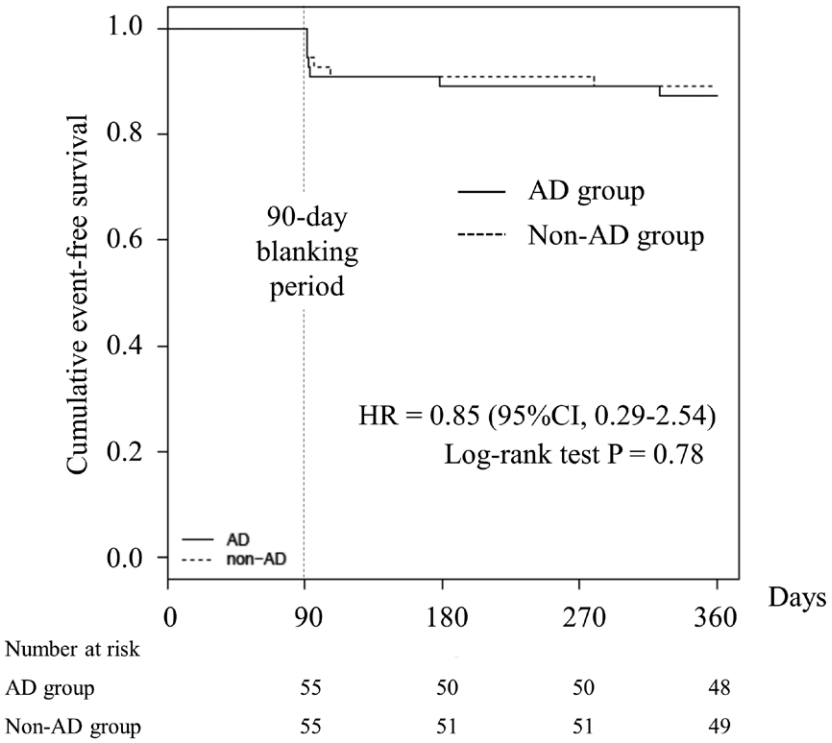
Figure 4. Kaplan-Meier survival curves showing the freedom from atrial tachyarrhythmias off antiarrhythmic drugs in both randomized groups.

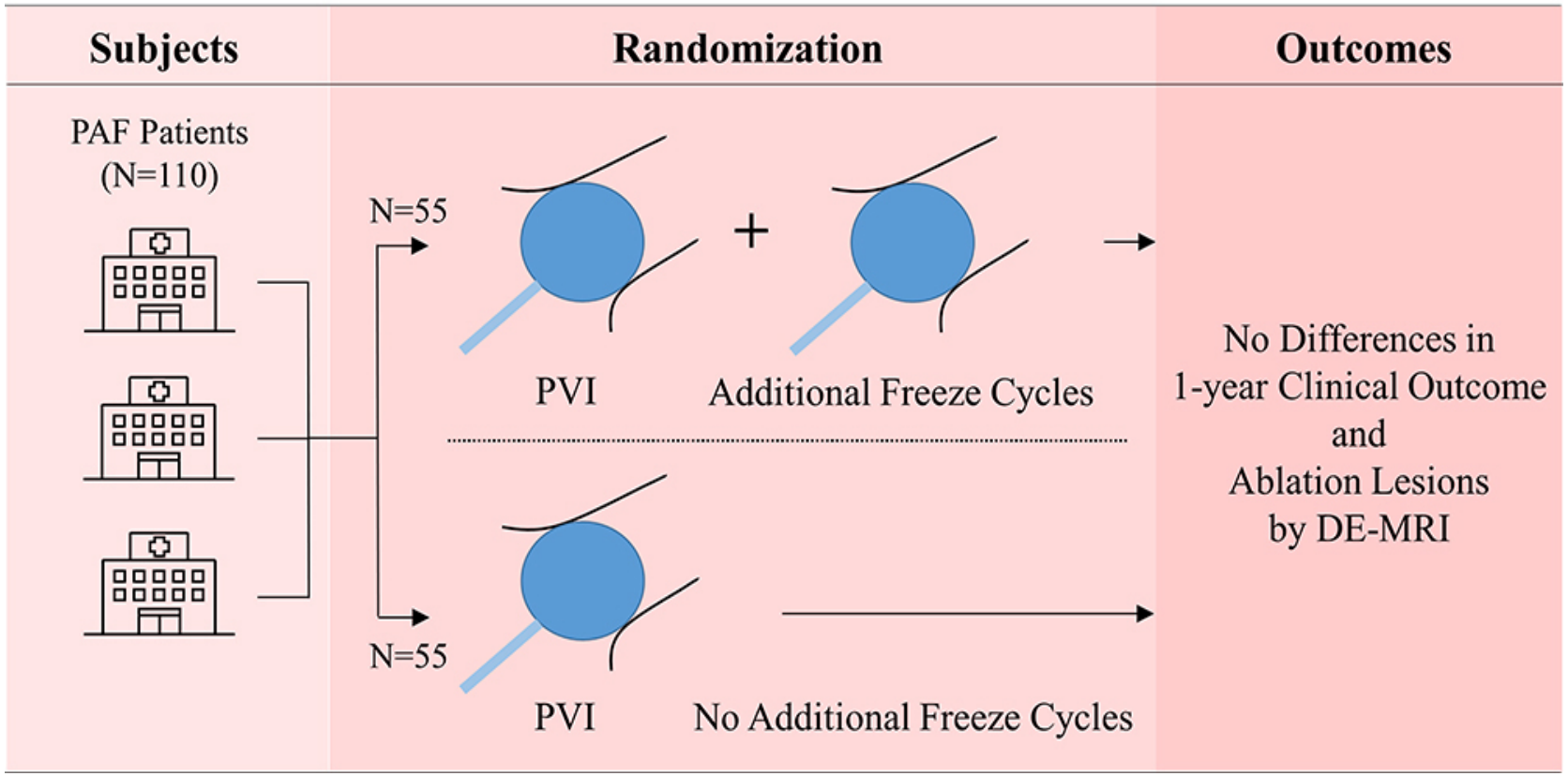
AAD indicates antiarrhythmic drug; ATA, atrial tachyarrhythmia; CFM, contact force monitoring; and USM, unipolar signal modification.

ORIGINAL ARTICLE

Multicenter Study of the Validity of Additional Freeze Cycles for Cryoballoon Ablation in Patients With Paroxysmal Atrial Fibrillation

The AD-Balloon Study





Circ Arrhythm Electrophysiol. 2019;12:e006989. DOI: 10.1161/CIRCEP.118.006989

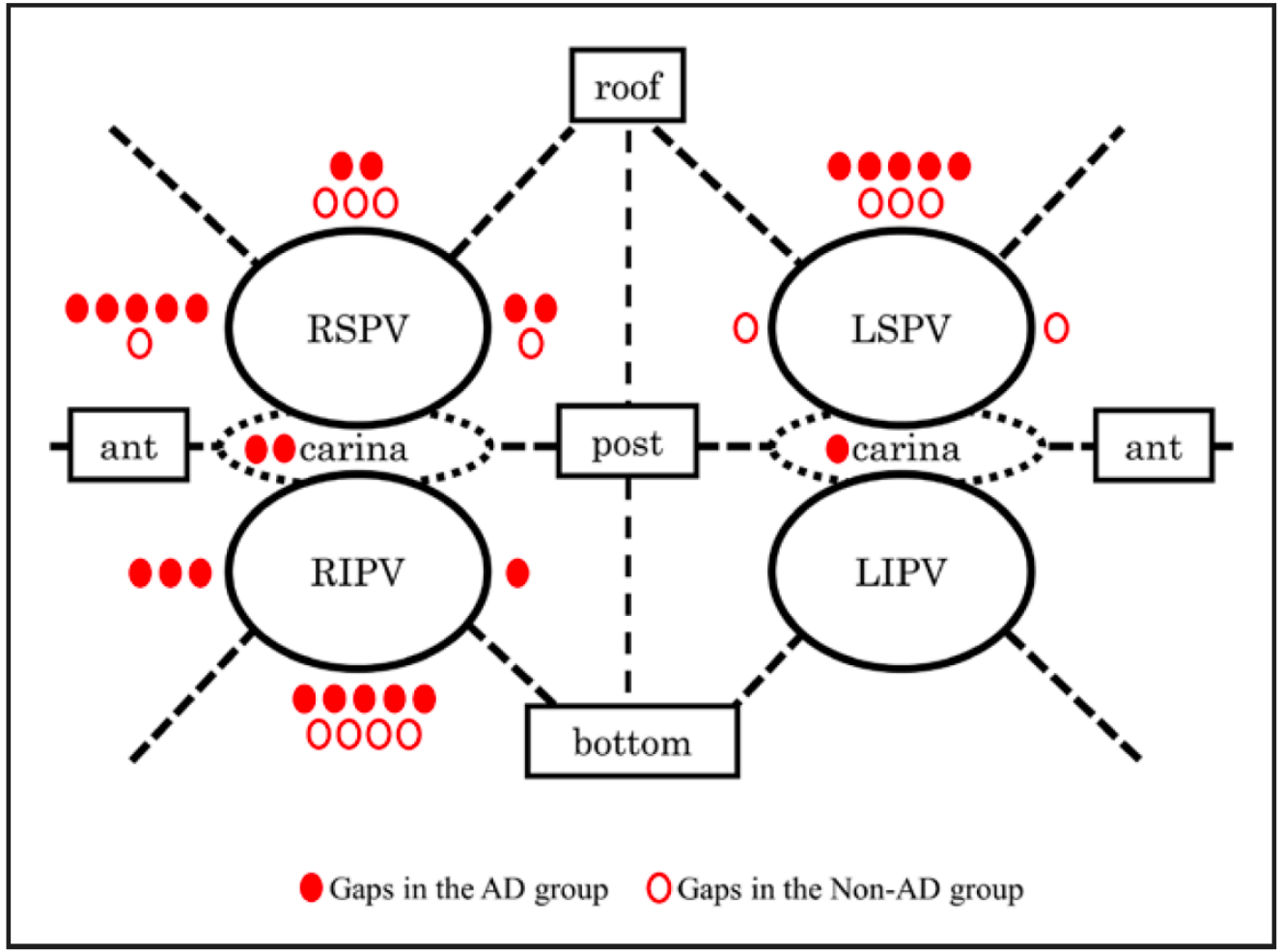


Figure 3. Distribution of gaps detected by delayed-enhancement magnetic resonance imaging.

There were 6 gaps at the left pulmonary veins (PVs) and 19 gaps at the right PVs in the AD group. In the non-AD group, there were 5 gaps at the left PVs and 9 gaps at the right PVs. LIPV indicates left inferior pulmonary vein; LSPV, left superior pulmonary vein; RIPV, right inferior pulmonary vein; and RSPV, right superior pulmonary vein.

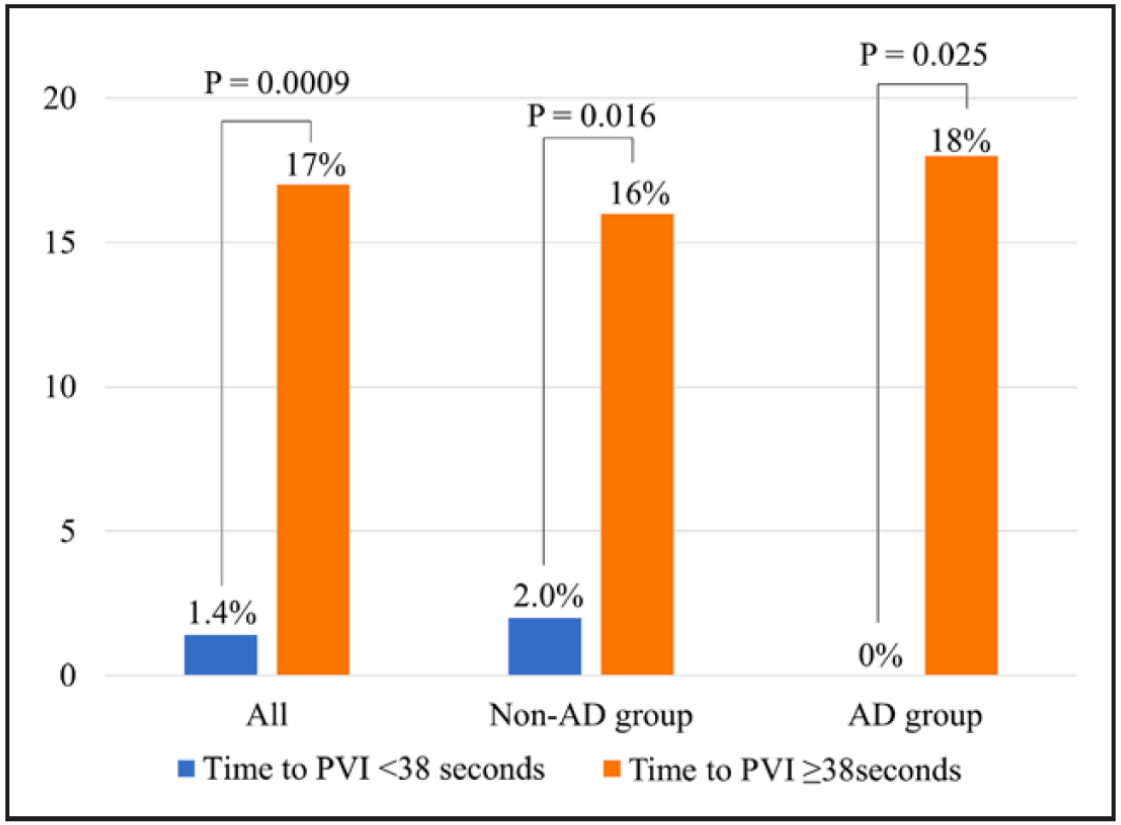


Figure 4. The frequency of gaps detected by delayed-enhancement magnetic resonance imaging.

The gaps were more frequently observed in pulmonary veins with a time to the pulmonary vein isolation (PVI) of ≥38 s than in those of <38 s (*P*=0.0015). The results were consistent when analyzed separately in the non-AD group (14% vs 2.0%; *P*=0.029) and AD group (18% vs 0%; *P*=0.025), respectively.

Pulsed Field Ablation for Pulmonary Vein Isolation in Atrial Fibrillation

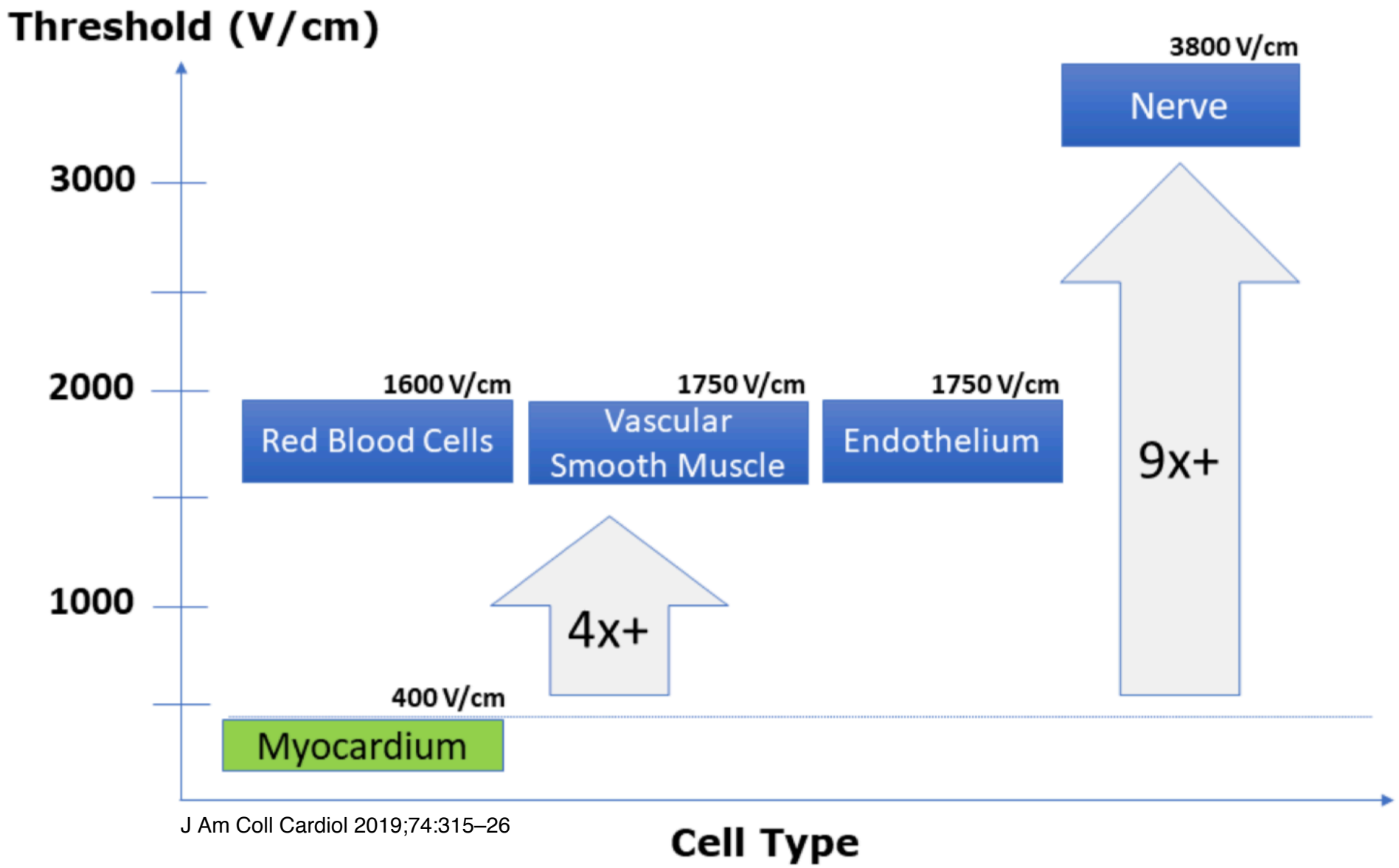
Vivek Y. Reddy, MD,[a,b] Petr Neuzil, MD, PhD,[a] Jacob S. Koruth, MD,[b] Jan Petru, MD,[a] Moritoshi Funosako, MD,[a] Hubert Cochet, MD,[c] Lucie Sediva, MD,[a] Milan Chovanec, MD,[a] Srinivas R. Dukkipati, MD,[b] Pierre Jais, MD[c]

J Am Coll Cardiol 2019;74:315–26

In 81 patients, all PVs were acutely isolated by monophasic (n=15) or biphasic (n=66) PFA with <3 min elapsed delivery/patient, skin-to-skin procedure time of 92.2±27.4 min, and fluoroscopy time of 13.1±7.6 min. With successive waveform refinement, durability at 3 months improved from 18% to 100% of patients with all PVs isolated.

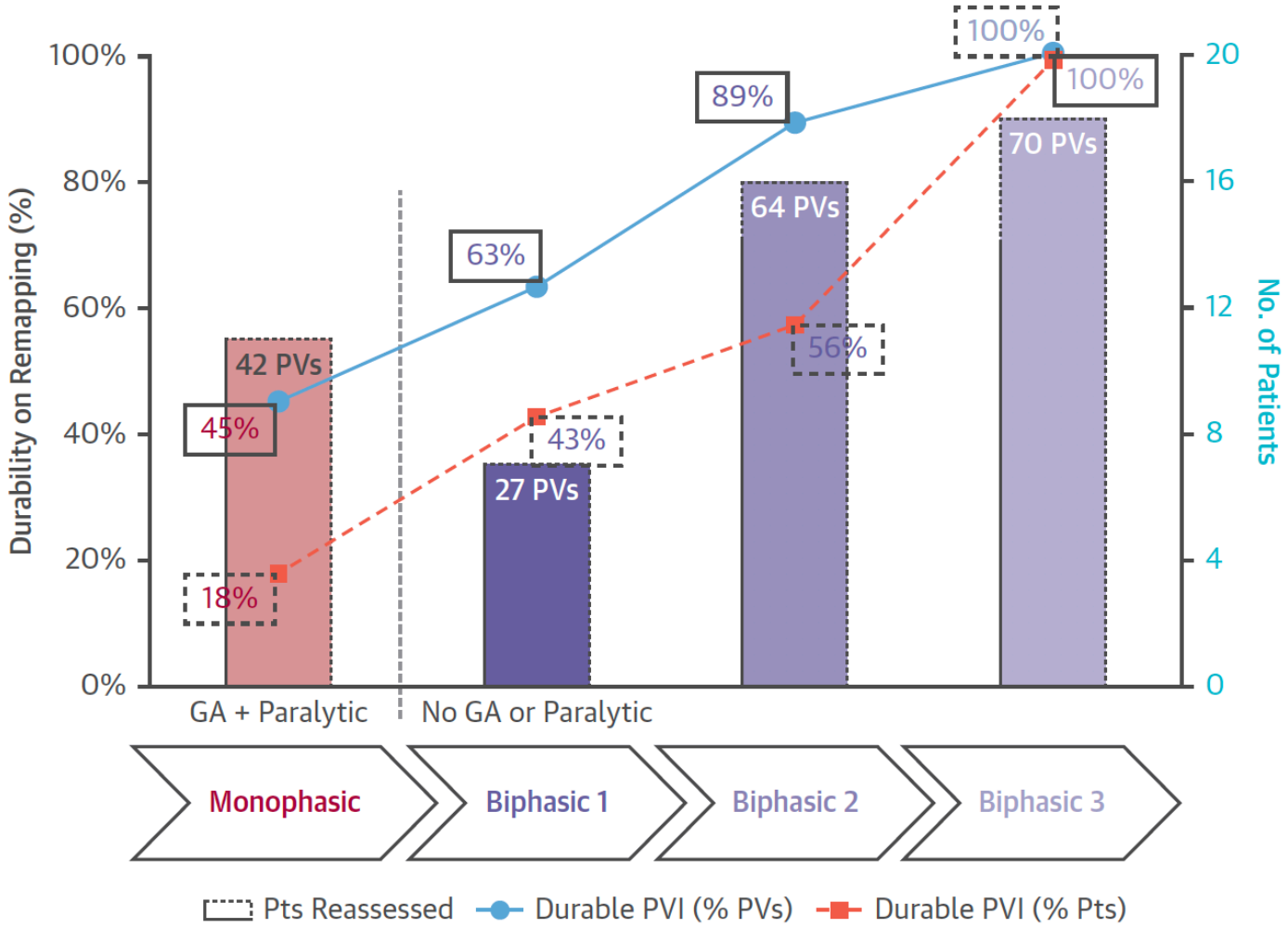
FFAF (Median Follow Up 120 days): 87±6%

Supplemental Figure S2: Thresholds of Various Cell Types to PFA



J Am Coll Cardiol 2019;74:315–26

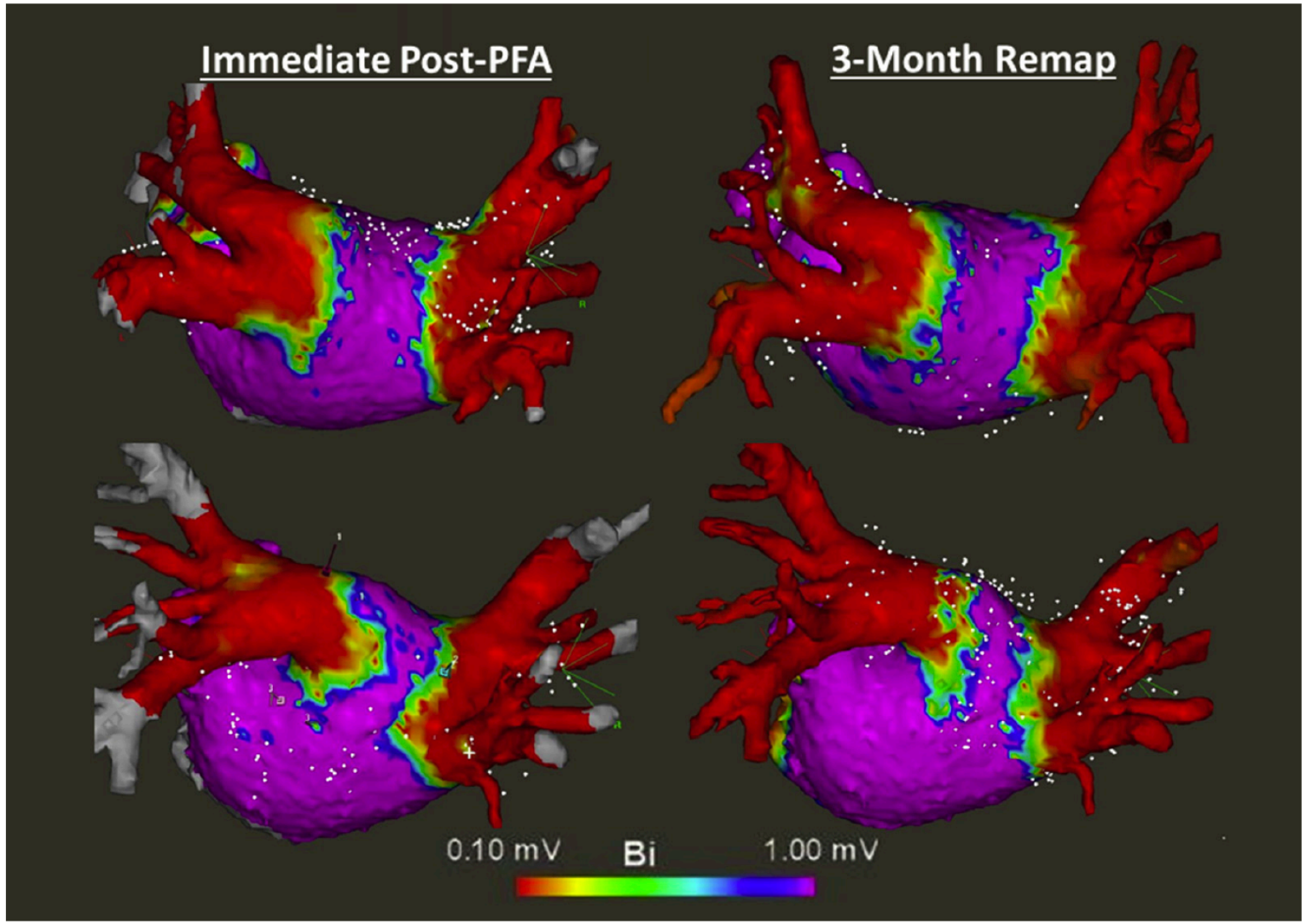
FIGURE 3 **Durability of PV Isolation With Successive Waveforms**



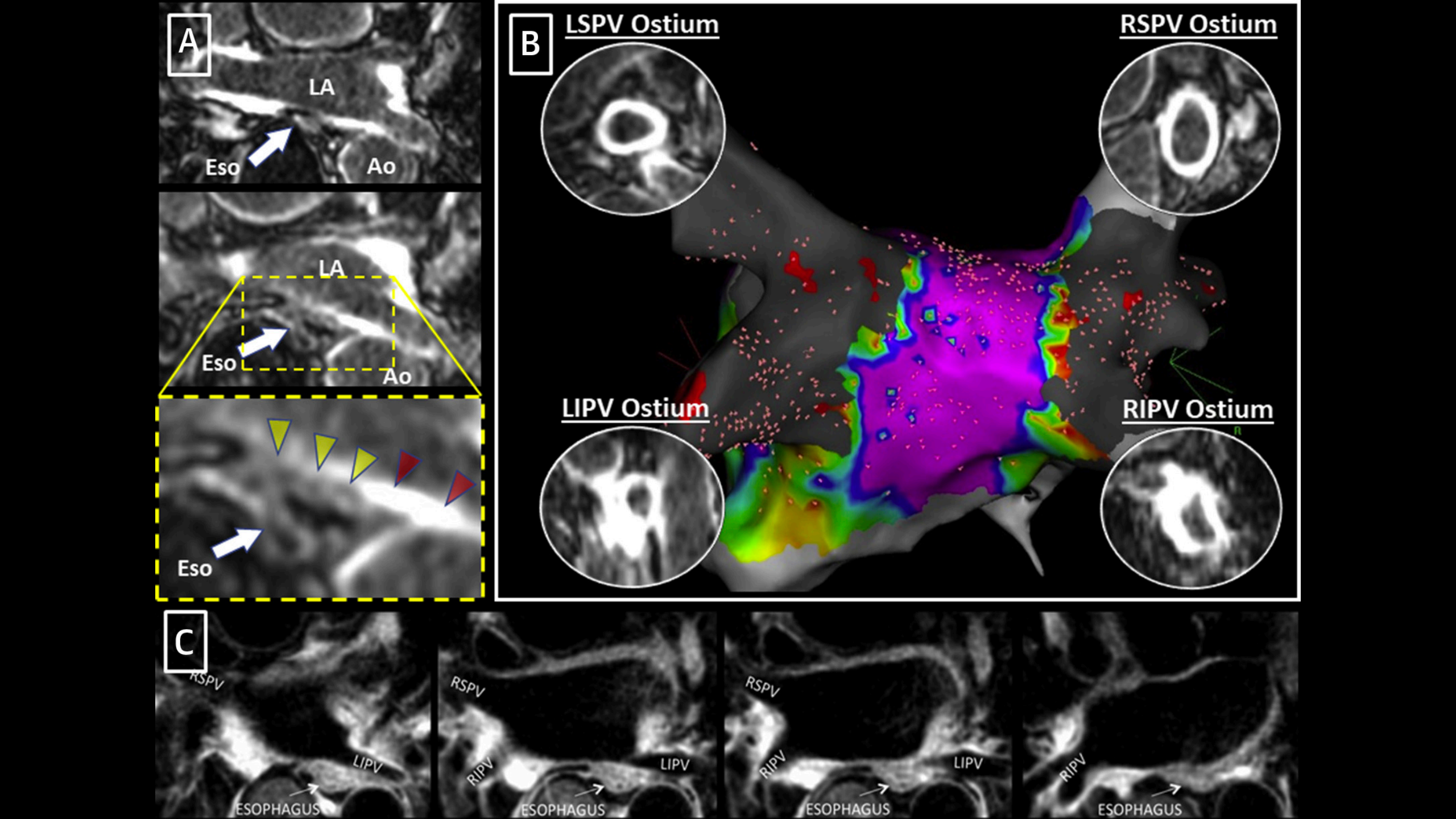
The bar graph demonstrates the durable pulmonary vein (PV) isolation rates during invasive electrophysiological remapping procedures. For each of the successive waveform protocols for which remapping data was obtained, shown are: 1) the number of patients (Pts) who presented for the remapping procedures **(bars)**; 2) the percentage of PVs that remained durably electrically isolated **(solid line)**; and 3) the percentage of patients with all PVs durably electrically isolated **(dashed line)**.

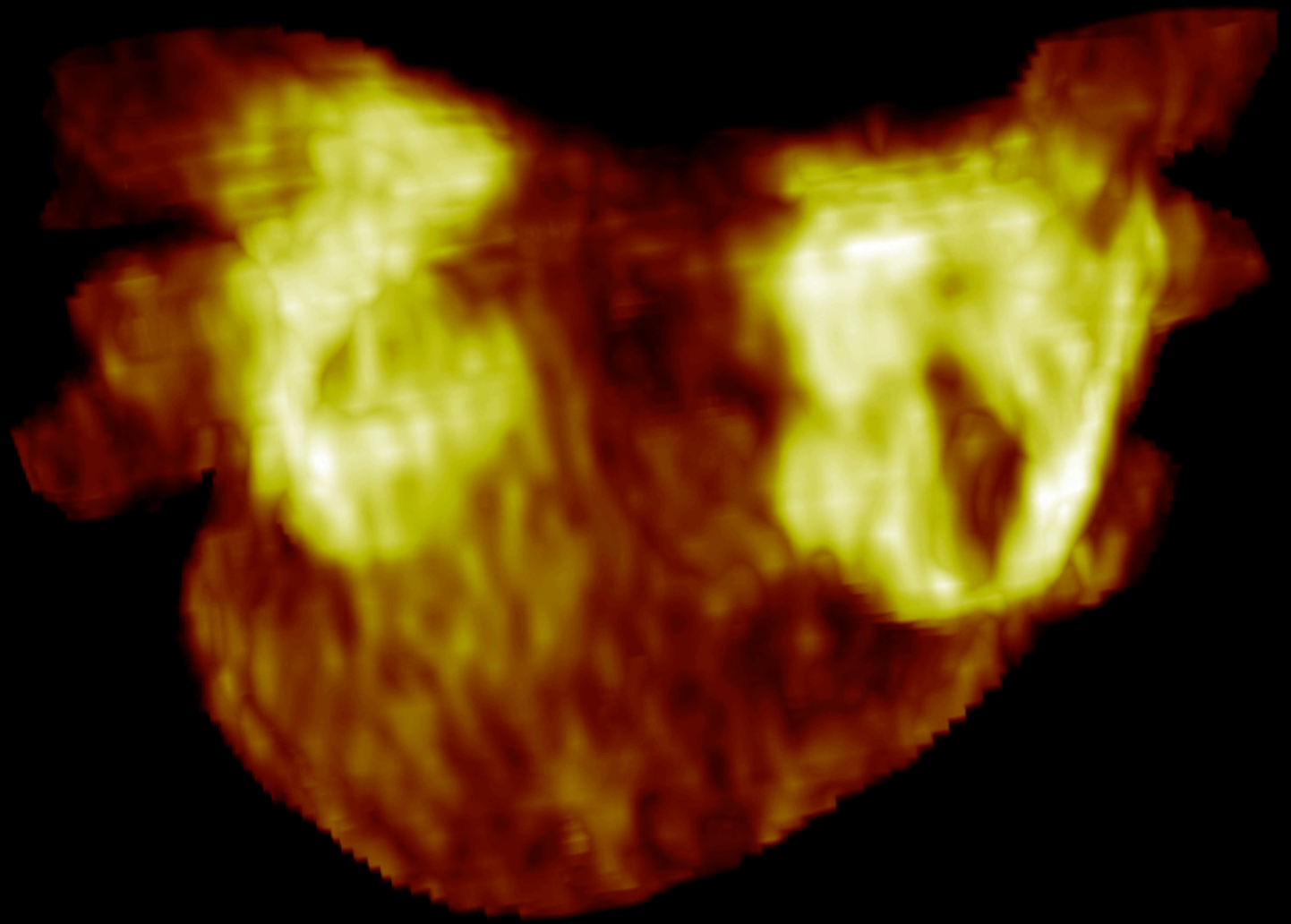
J Am Coll Cardiol 2019;74:315–26

FIGURE 2 Electroanatomic Voltage Mapping to Assess PV Isolation Level



Voltage mapping was performed both at the end of the index PFA procedure **(left)** and at the time of the 3-month remapping procedure **(right)**. The color scale of the bipolar voltage values is shown at the **bottom**: values above 1 mV are considered normal atrial tissue and depicted in **purple**. Abbreviations as in Figure 1.


A
LA
Eso
Ao
LA
Eso
Ao
Eso
B
LSPV Ostium
RSPV Ostium
LIPV Ostium
RIPV Ostium
C
RSPV
LIPV
ESOPHAGUS
RSPV
RIPV
LIPV
ESOPHAGUS
RSPV
RIPV
LIPV
ESOPHAGUS
RIPV
ESOPHAGUS



Important Questions:

Electroporation

The End of the Thermal Ablation Era?*

Sanjiv M. Narayan, MD, PhD, Tina Baykaner, MD, MPH

Long-term outcome is unclear

Role of PVI in long term success

Randomized controlled trials against RF (vHPSD/CF/USM) or cryoablation (Ultra-Low-T)

EPA in patients with persistent AF or with paroxysmal AF that recurs despite isolated PVs, who may have substrates outside the PV antra

Myocardial selectivity of electroporation could theoretically be a limitation

JACC VOL . 7 4 , NO . 3 , 2 0 1 9

Conclusion:

(1) Deep learning and the future of medicine

(2) Value based healthcare

(3) Role of RCTs in evaluation of new technologies

(4) Electroporation