Title: Ablation Strategies in Atrial Fibrillation

Name: Amr Alfakhouri
Department of Cardiology
Lausitzer Seenland Klinikum
Hoyerswerda, Germany



Biography

After qualifying as an Internist in Syria in 2011, he continued with his residencies in Germany and then became a specialist in Internal Medicine and Cardiology in 2017. He has gained experience in the field of Cardiac Electrophysiology and Device Therapy at the Heart and Vascular Day Hospital Dresden (Praxisklinik Herz und Gefäße Dresden), the Heart Centre Dresden and Heart Centre Cottbus. Currently he is employed as an Consultant Interventional Cardiologist and Electrophysiologist at Lausitzer Seenland Klinikum in Hoyerswerda, Germany. He also participated in the global research “CABANA and RDN-AF Enlight” at the Heart Centre Dresden.

Presenting author details

Full name: Amr Alfakhouri
Contact number: 0049 1737376109
Twitter account:
Linked In account: https://www.linkedin.com/in/amr-alfakhouri-10154b146/

Session name/ number:
Category: Oral presentation

The final presentation will be in .pptx format

ABLATION STRATEGIES IN ATRIAL FIBRILLATION





Amr Alfakhouri

Department of Cardiology
Lausitzer Seenland Klinikum
Hoyerswerda, Germany

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doi:10.1093/eurheartj/ehw210

ESC GUIDELINES

2016 ESC Guidelines for the management of atrial fibrillation developed in collaboration with EACTS

The Task Force for the management of atrial fibrillation of the European Society of Cardiology (ESC)

Developed with the special contribution of the European Heart Rhythm Association (EHRA) of the ESC

Endorsed by the European Stroke Organisation (ESO)

Authors/Task Force Members: Paulus Kirchhof* (Chairperson) (UK/Germany), Stefano Benussi*[1] (Co-Chairperson) (Switzerland), Dipak Kotecha (UK), Anders Ahlsson[1] (Sweden), Dan Atar (Norway), Barbara Casadei (UK), Manuel Castella[1] (Spain), Hans-Christoph Diener[2] (Germany), Hein Heidbuchel (Belgium), Jeroen Hendriks (The Netherlands), Gerhard Hindricks (Germany), Antonis S. Manolis (Greece), Jonas Oldgren (Sweden), Bogdan Alexandru Popescu (Romania), Ulrich Schotten (The Netherlands), Bart Van Putte[1] (The Netherlands), and Panagiotis Vardas (Greece)

Document Reviewers: Stefan Agewall (CPG Review Co-ordinator) (Norway), John Camm (CPG Review Co-ordinator) (UK), Gonzalo Baron Esquivias (Spain), Werner Budts (Belgium), Scipione Carerj (Italy), Filip Casselman (Belgium), Antonio Coca (Spain), Raffaele De Caterina (Italy), Spiridon Deftereos (Greece), Dobromir Dobrev (Germany), José M. Ferro (Portugal), Gerasimos Filippatos (Greece), Donna Fitzsimons (UK),

Recommendations for catheter ablation of atrial fibrillation and atrial fibrillation surgery

Recommendations	Class[a]	Level[b]	Ref[c]
Catheter ablation of symptomatic paroxysmal AF is recommended to improve AF symptoms in patients who have symptomatic recurrences of AF on antiarrhythmic drug therapy (amiodarone, dronedarone, flecainide, propafenone, sotalol) and who prefer further rhythm control therapy, when performed by an electrophysiologist who has received appropriate training and is performing the procedure in an experienced centre.	I	A	585–587, 713, 727
Ablation of common atrial flutter should be considered to prevent recurrent flutter as part of an AF ablation procedure if documented or occurring during the AF ablation.	IIa	B	827
Catheter ablation of AF should be considered as first-line therapy to prevent recurrent AF and to improve symptoms in selected patients with symptomatic paroxysmal AF as an alternative to antiarrhythmic drug therapy, considering patient choice, benefit, and risk.	IIa	B	585
All patients should receive oral anticoagulation for at least 8 weeks after catheter (IIaB) or surgical (IIaC) ablation.	IIa	B C	727
Anticoagulation for stroke prevention should be continued indefinitely after apparently successful catheter or surgical ablation of AF in patients at high-risk of stroke.	IIa	C	
When catheter ablation of AF is planned, continuation of oral anticoagulation with a VKA (IIaB) or NOAC (IIaC) should be considered during the procedure, maintaining effective anticoagulation.	IIa	B C	760, 768
Catheter ablation should target isolation of the pulmonary veins using radiofrequency ablation or cryothermy balloon catheters.	IIa	B	585, 715, 716, 734, 735
AF ablation should be considered in symptomatic patients with AF and heart failure with reduced ejection fraction to improve symptoms and cardiac function when tachycardiomyopathy is suspected.	IIa	C	185, 226–228, 720, 777–779, 828
AF ablation should be considered as a strategy to avoid pacemaker implantation in patients with AF-related bradycardia.	IIa	C	829, 830
Catheter or surgical ablation should be considered in patients with symptomatic persistent or long-standing persistent AF refractory to AAD therapy to improve symptoms, considering patient choice, benefit and risk, supported by an AF Heart Team.	IIa	C	468, 735, 777, 831, 832, 1040
Minimally invasive surgery with epicardial pulmonary vein isolation should be considered in patients with symptomatic AF when catheter ablation has failed. Decisions on such patients should be supported by an AF Heart Team.	IIa	B	468 812, 819, 823
Maze surgery, possibly via a minimally invasive approach, performed by an adequately trained operator in an experienced centre, should be considered by an AF Heart Team as a treatment option for patients with symptomatic refractory persistent AF or post-ablation AF to improve symptoms.	IIa	C	808, 832
Maze surgery, preferably biatrial, should be considered in patients undergoing cardiac surgery to improve symptoms attributable to AF, balancing the added risk of the procedure and the benefit of rhythm control therapy.	IIa	A	461, 466, 790, 791, 796, 797
Concomitant biatrial maze or pulmonary vein isolation may be considered in asymptomatic AF patients undergoing cardiac surgery.	IIb	C	796, 797, 833

11.3 Catheter ablation

Since the initial description of triggers in the pulmonary veins that initiate paroxysmal AF,[108] catheter ablation of AF has developed from a specialized, experimental procedure into a common treatment to prevent recurrent AF.[587,715] This is primarily achieved through isolation of the pulmonary veins, probably requiring complete isolation for full effectiveness,[716] and additional ablation in the posterior left atrial wall. AF ablation, when performed in experienced centres by adequately trained teams, is more effective than antiarrhythmic drug therapy in maintaining sinus rhythm, and the complication rate, though not negligible, is similar to the complication rate for antiarrhythmic drugs.[585,717]

11.3.1 Indications

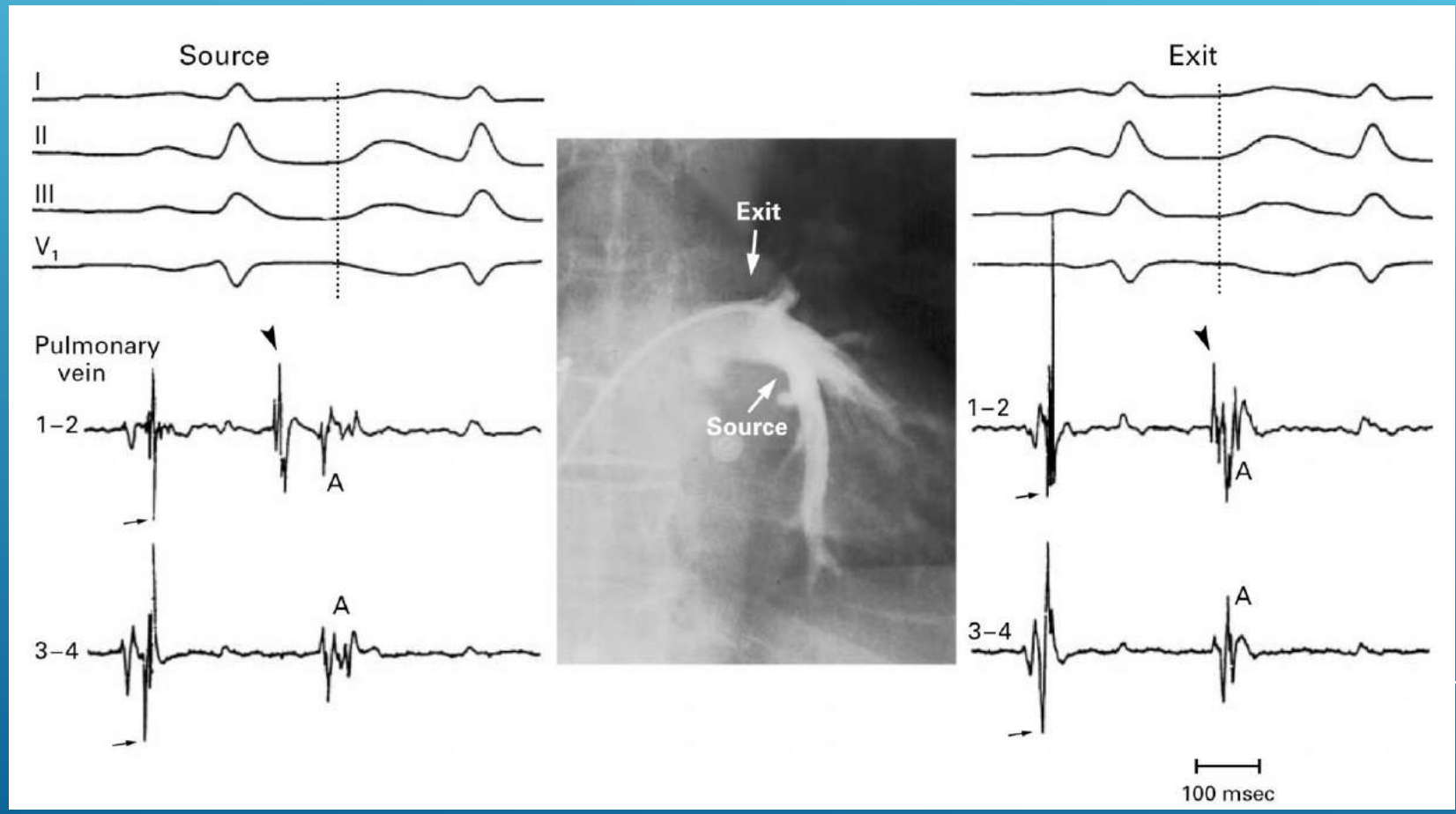
Catheter ablation of AF is effective in restoring and maintaining sinus rhythm in patients with symptomatic paroxysmal, persistent, and probably long-standing persistent AF, in general as second-line treatment after failure of or intolerance to antiarrhythmic drug therapy. In such patients, catheter ablation is more effective than antiarrhythmic drug therapy.[185,586,713,717–720] As first-line treatment for paroxysmal AF, randomized trials showed only modestly improved rhythm outcome with catheter ablation compared to antiarrhythmic drug therapy.[585,721–723] Complication rates were similar, when ablation was performed in expert centres, justifying catheter ablation as first-line therapy in selected patients with paroxysmal AF who ask for interventional therapy. Fewer data are available reporting the effectiveness and safety of catheter ablation in patients with persistent or long-standing persistent AF, but all point to lower recurrence rates after catheter ablation compared to antiarrhythmic drug therapy with or without cardioversion (*Web Figure 2*).[185,717,723–726,1039] In patients who experience symptomatic recurrences of AF despite antiarrhythmic drug therapy, all RCTs showed better sinus rhythm maintenance with catheter ablation than on antiarrhythmic drugs.[586,713,727,728] There is no current indication for catheter ablation to prevent cardiovascular outcomes (or desired withdrawal of anticoagulation), or to reduce hospitalization.[40,594]

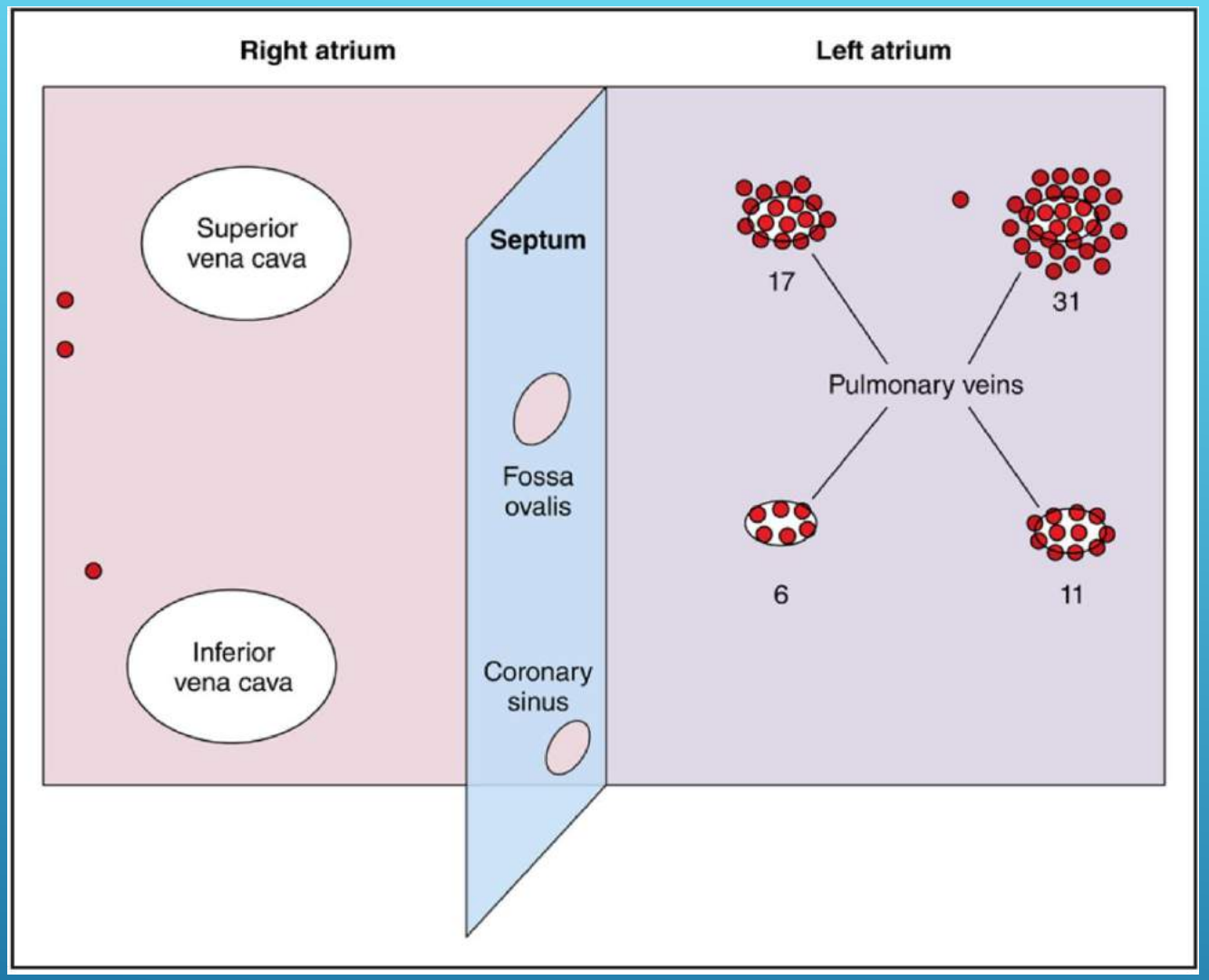
11.3.2 Techniques and technologies

Complete pulmonary vein isolation (PVI) on an atrial level is the best documented target for catheter ablation,[716,729–731] achievable by point-by-point radiofrequency ablation, linear lesions encircling the pulmonary veins, or cryoballoon ablation, with similar outcomes.[732–734] Complete isolation of the pulmonary veins has better rhythm outcomes than incomplete isolation.[716] PVI was initially tested in patients with paroxysmal AF, but appears to be non-inferior to more extensive ablation in persistent AF as well.[729,735] More extensive ablations have been used in patients with persistent

SPONTANEOUS INITIATION OF ATRIAL FIBRILLATION BY ECTOPIC BEATS ORIGINATING IN THE PULMONARY VEINS

MICHEL HAÏSSAGUERRE, M.D., PIERRE JAÏS, M.D., DIPEN C. SHAH, M.D., ATSUSHI TAKAHASHI, M.D., MÉLÈZE HOCINI, M.D., GILLES QUINIOU, M.D., STÉPHANE GARRIGUE, M.D., ALAIN LE MOUROUX, M.D., PHILIPPE LE MÉTAYER, M.D., AND JACQUES CLÉMENTY, M.D.

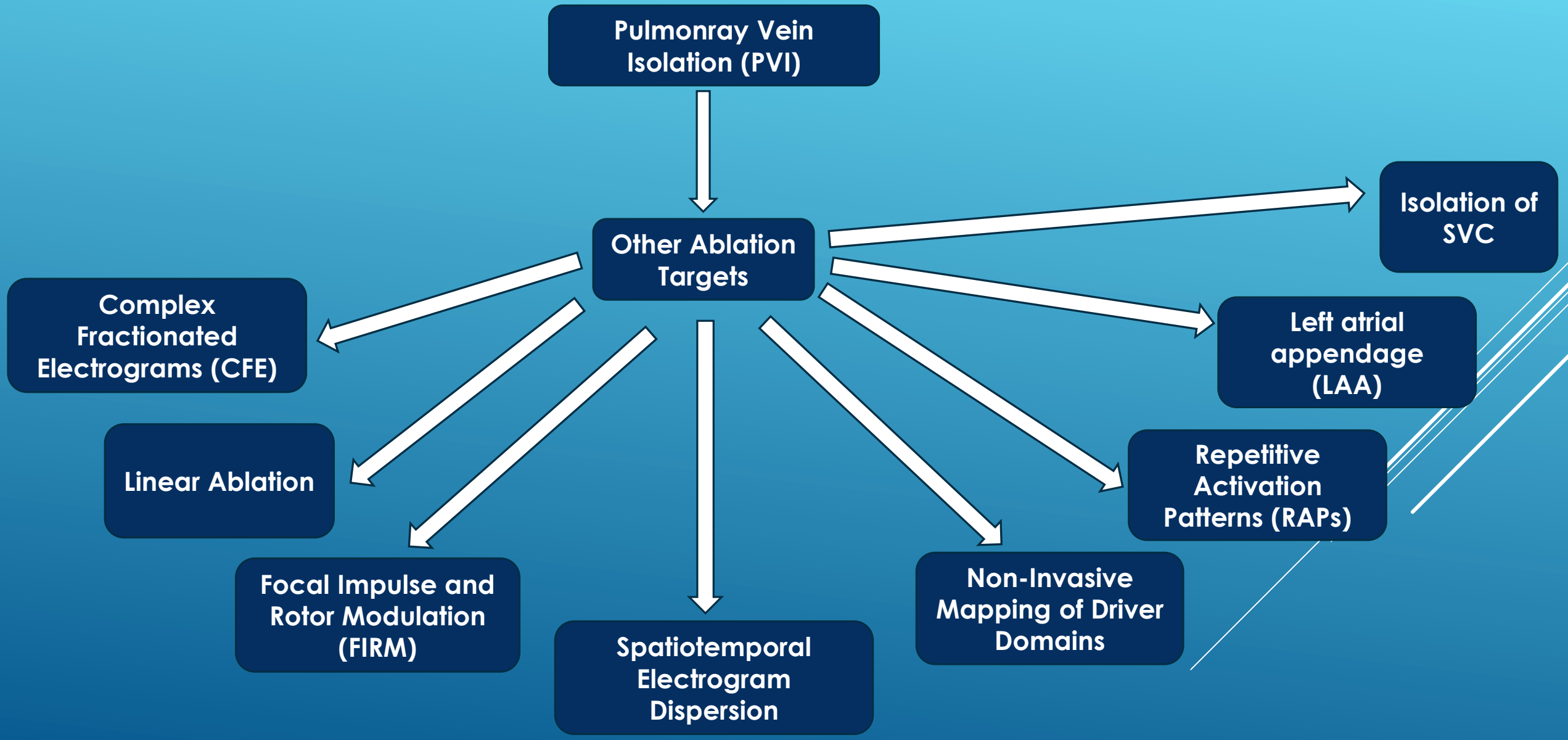




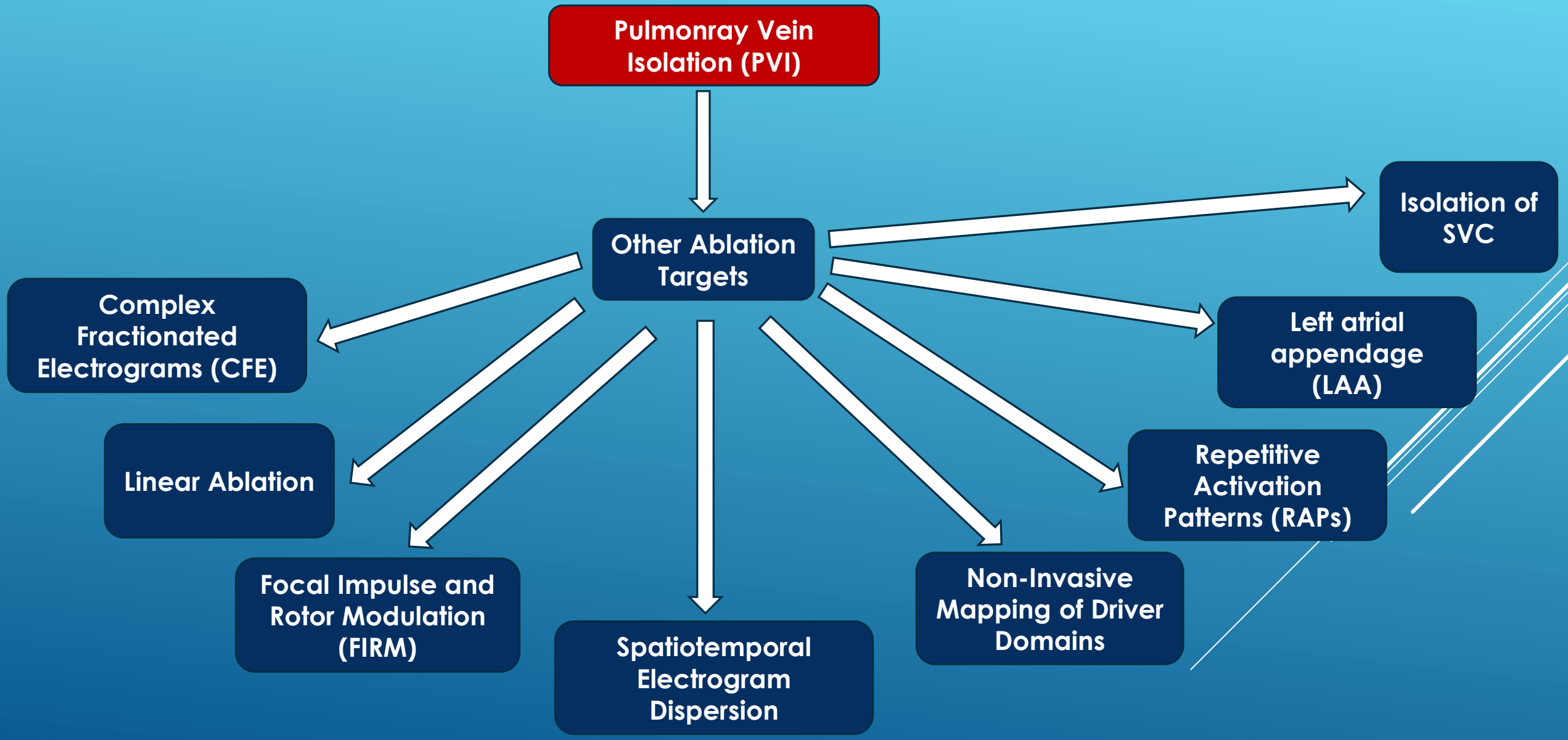
Ablation of Atrial Fibrillation; Circulation. 2016;134:339–352. DOI: 10.1161/CIRCULATIONAHA.116.021727; Adapted from

Haïssaguerre M, Jaïs P, Shah DC, Takahashi A, Hocini M, Quiniou G, Garrigue S, Le Mouroux A, Le Métayer P, Clémenty J. Spontaneous initiation of atrial fibrillation by ectopic beats originating in the pulmonary veins. N Engl J Med. 1998;339:659–666. doi: 10.1056/NEJM199809033391003.

Ablation Strategies in Atrial Fibrillation



Ablation Strategies in Atrial Fibrillation



European Heart Journal (2017) **38**, 20–26
doi:10.1093/eurheartj/ehw260

REVIEW

Clinical update

Catheter ablation in patients with persistent atrial fibrillation

Paulus Kirchhof[1,2,3,4]* and Hugh Calkins[5]

[1]Institute of Cardiovascular Sciences, University of Birmingham, IBR, Room # 136, Birmingham B15 2TT, UK; [2]SWBH and UHB NHS Trusts, Birmingham, UK; [3]Atrial Fibrillation NETwork (AFNET), Münster, Germany; [4]Department of Cardiovascular Medicine, Hospital of the University of Münster, Münster, Germany; and [5]Johns Hopkins University, Baltimore, MD, USA

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REVIEW

Clinical update

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Table 2 Controlled trials and selected observational data sets reporting sinus rhythm rates after catheter ablation of persistent atrial fibrillation

	Patients	Intervention	Control	Sinus rhythm outcome	
				Ablation	Control
Controlled trials					
Wazni[47]	70 (paroxysmal and persistent)	CA	AAD + CV	*87%*[a]	*46%*[a]
Oral[48]	146	PVI + Amiodarone	Amiodarone + CV	*74%*[a]	*58%*[a]
Stabile[49]	137 (paroxysmal or persistent)	CA: PVI + mitral line + CTI	AAD	56%	10%
Forleo[50]	70 (41 persistent)	CA	AAD + CV	*80%*[a]	*43%*[a]
Jones[51]	*52*	*CA*	*Rate control*	*88%*[a]	*n.a.*
Mont[10]	146	CA	AAD + CV	70%	44%
Verma[43]	589	PVI	PVI + lines, PVI + CFAE	59%	46%; 49%
Dong[52]	146	CA + lines (fix)	CA (stepwise)	67%	60%
Observational data sets					
Hunter (multi centre)[53]	586 (persistent)	CA (1.8 mean procedures, mainly PVI)	n.a.	*60%*[a]	n.a.
Scherr (single centre)[54]	150	CA (AF termination outcome)	n.a.	65%	n.a.
Schreiber (single centre)[55]	549	CA (stepwise approach)	n.a.	56%	n.a.
Haissaguerre[56]	103	CA (driver domains)	*65%*[a]	n.a.	

AAD, antiarrhythmic drugs; CA, catheter ablation; CV, cardioversion; PVI, pulmonary vein isolation.
[a]Numbers in italic indicate success rates without intensive ECG monitoring.

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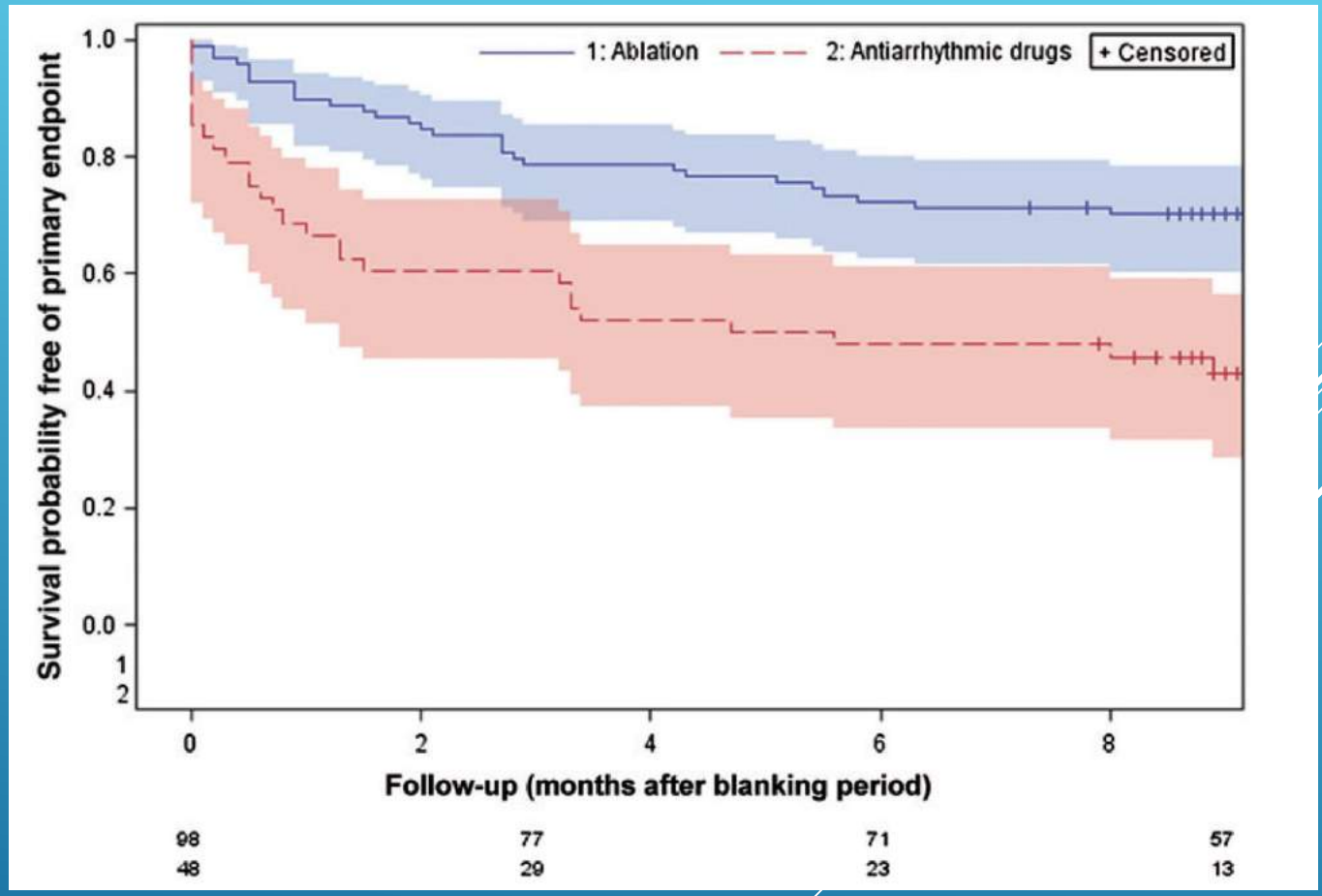
FASTTRACK CLINICAL RESEARCH

Catheter ablation vs. antiarrhythmic drug treatment of persistent atrial fibrillation: a multicentre, randomized, controlled trial (SARA study)

Lluís Mont[1]*, Felipe Bisbal[1], Antonio Hernández-Madrid[2], Nicasio Pérez-Castellano[3], Xavier Viñolas[4], Angel Arenal[5], Fernando Arribas[6], Ignacio Fernández-Lozano[7], Andrés Bodegas[8], Albert Cobos[9], Roberto Matía[2], Julián Pérez-Villacastín[3], José M. Guerra[4], Pablo Ávila[5], María López-Gil[6], Victor Castro[7], José Ignacio Arana[8], and Josep Brugada[1], on behalf of SARA investigators

[1]Unitat de Fibril·lació Auricular (UFA), Arrhythmia Section – Hospital Clínic, Universitat de Barcelona and Institut d'Investigacions Biomèdiques August Pi i Sunyer (IDIBAPS), C/ Villarroel, 170, Barcelona, Catalonia 08036, Spain; [2]Hospital Ramón y Cajal, Madrid, Spain; [3]Hospital Clínico San Carlos, Madrid, Spain; [4]Hospital de la Santa Creu i Sant Pau, Barcelona, Spain; [5]Hospital Gregorio Marañón, Madrid, Spain; [6]Hospital 12 de Octubre, Madrid, Spain; [7]Hospital Puerta de Hierro, Madrid, Spain; [8]Hospital de Cruces, Barakaldo, Spain; and [9]Dpto. Salud Pública, Universidad de Barcelona, Barcelona, Spain

- 146 patients were included (aged 55+9 years, 77% male)
- randomly assigned to CA or ADT
- The proportion of patients free of any recurrence (> 30 s) was higher in the CA group than in the ADT group (60.2 vs. 29.2%; P < 0.001) and cardioversion was less frequent (34.7 vs. 50%, respectively; P = 0.018)



Original Article

Efficacy of Catheter Ablation for Persistent Atrial Fibrillation

A Systematic Review and Meta-Analysis of Evidence From Randomized and Nonrandomized Controlled Trials

Gareth J. Wynn, MBChB; Moloy Das, MBBS; Laura J. Bonnett, PhD; Sandeep Panikker, MBBS; Tom Wong, MD; Dhiraj Gupta, MD

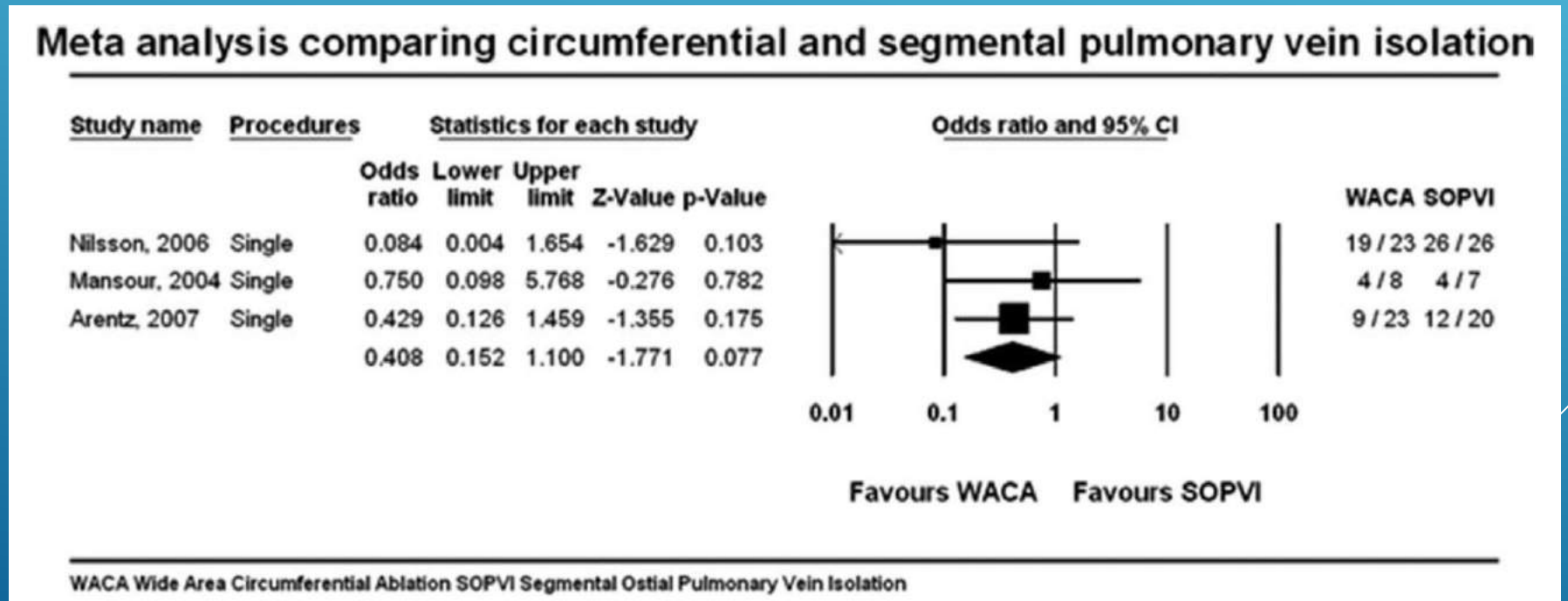
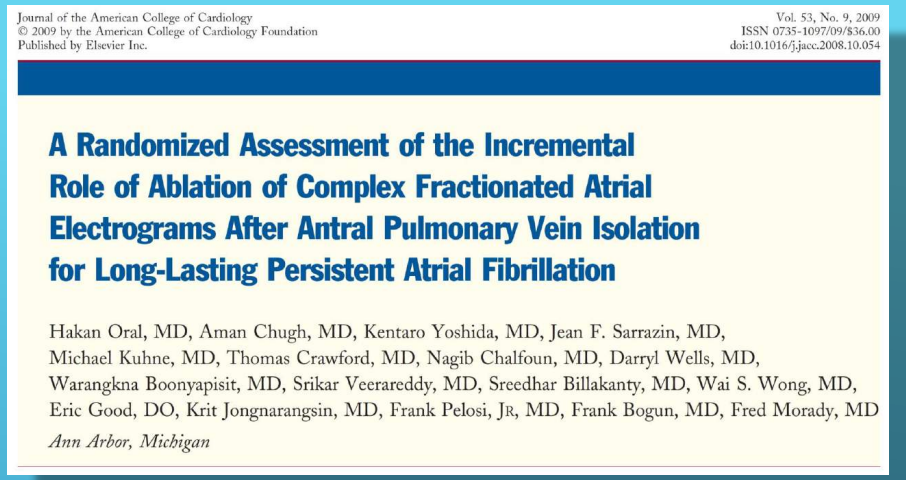


Figure 5. Forest plot showing odds ratios and 95% confidence intervals for AF recurrence for studies comparing circumferential pulmonary vein isolation with a segmental technique.

THE MECHANISMS OF ANTRAL PULMONARY VEIN ISOLATION



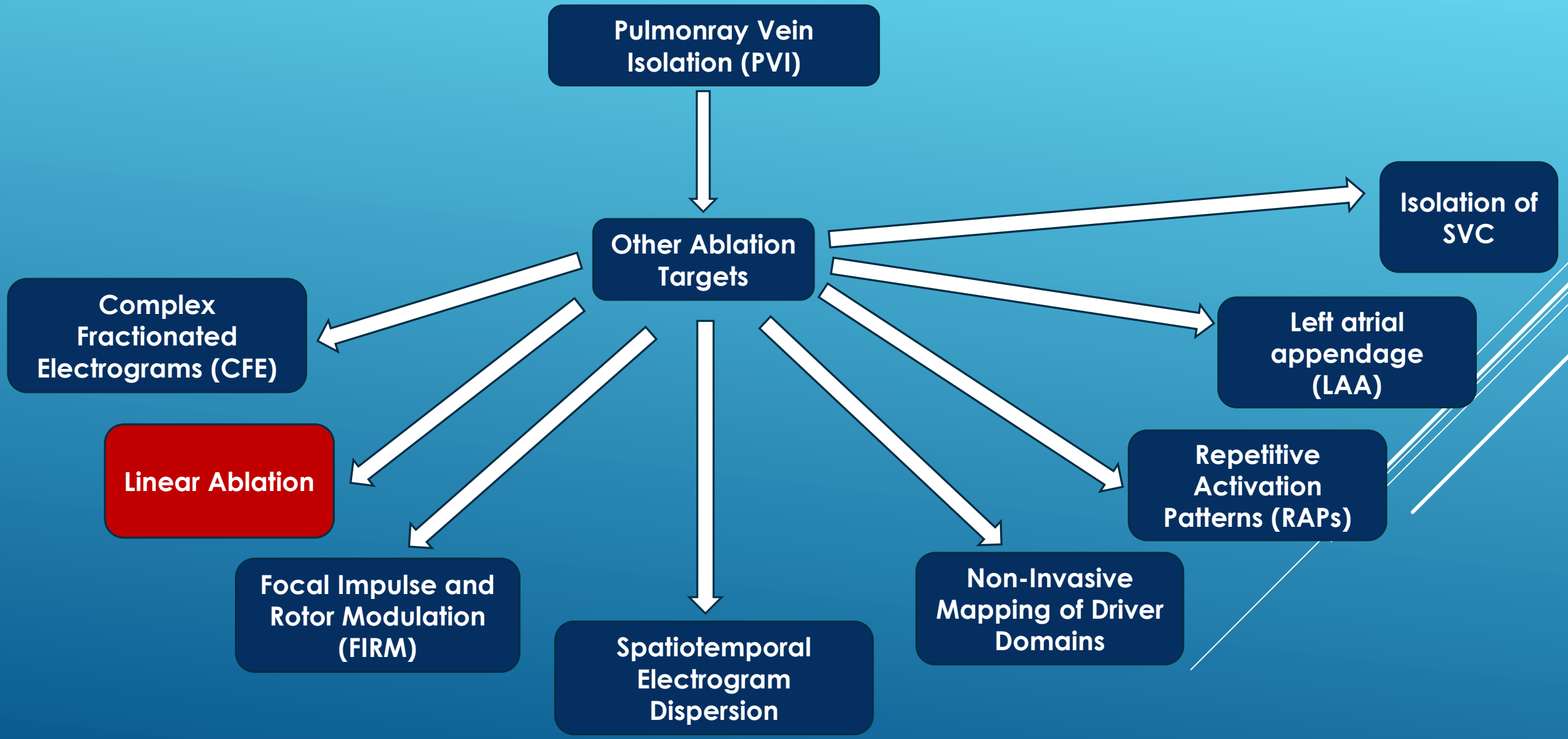
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A Randomized Assessment of the Incremental Role of Ablation of Complex Fractionated Atrial Electrograms After Antral Pulmonary Vein Isolation for Long-Lasting Persistent Atrial Fibrillation

Hakan Oral, MD, Aman Chugh, MD, Kentaro Yoshida, MD, Jean F. Sarrazin, MD, Michael Kuhne, MD, Thomas Crawford, MD, Nagib Chalfoun, MD, Darryl Wells, MD, Warangkna Boonyapisit, MD, Srikar Veerareddy, MD, Sreedhar Billakanty, MD, Wai S. Wong, MD, Eric Good, DO, Krit Jongnarangsin, MD, Frank Pelosi, JR, MD, Frank Bogun, MD, Fred Morady, MD
Ann Arbor, Michigan

- elimination of PV tachycardias that initiate and perpetuate AF
- exclusion of PV antrum, which has similar histoembryologic properties and arrhythmogenic activity to that of the PVs
- elimination of anchor points of high-frequency sources such as rotors
- ablation of ganglionated plexi and/or "AF nests" in the proximity of the PV antra
- debulking of the left atrium by 25% to 30% so that a circuit can no longer accommodate a wavelength within the effective refractory period and conduction velocity of the left atrium

Ablation Strategies in Atrial Fibrillation



Original Article

Efficacy of Catheter Ablation for Persistent Atrial Fibrillation

A Systematic Review and Meta-Analysis of Evidence From Randomized and Nonrandomized Controlled Trials

Gareth J. Wynn, MBChB; Moloy Das, MBBS; Laura J. Bonnett, PhD; Sandeep Panikker, MBBS; Tom Wong, MD; Dhiraj Gupta, MD

Meta analysis of the impact of linear ablation lesions

Study name	Outcome	Odds ratio	Lower limit	Upper limit	Z-Value	p-Value	Linear lesions	Control
Willems, 2006	Single	0.112	0.035	0.361	-3.673	0.000	10 / 32	24 / 30
Fassini, 2005	Single	0.198	0.066	0.591	-2.902	0.004	8 / 32	19 / 29
Gaita, 2008	Single	0.445	0.160	1.236	-1.553	0.120	29 / 53	19 / 26
		0.223	0.101	0.491	-3.728	0.000		



LL: Linear lesions

Biatrial linear ablation in sustained nonpermanent AF: Results of the substrate modification with ablation and antiarrhythmic drugs in nonpermanent atrial fibrillation (SMAN-PAF) trial

Gareth J. Wynn, MB ChB, MRCP, MD(Res),[*†‡] Sandeep Panikker, MBBS, MRCP,[*‡§¶] Maureen Morgan, RN,[*†] Mark Hall, MD, FRCP,[*†] Johan Waktare, MD, FRCP,[*†] Vias Markides, MD, FRCP,[*‡§¶] Wajid Hussain, MB ChB, MRCP,[*‡¶] Tushar Salukhe, MD(Res), MRCP,[*‡§] Simon Modi, MBBS, MRCP,[*†] Julian Jarman, MA, MBBS, MRCP, MD(Res),[*‡§] David G. Jones, MBBS, MD,[*‡¶] Richard Snowdon, MD, MRCP,[*†] Derick Todd, MD, FRCP,[*†‡] Tom Wong, MD, FRCP,[*‡§¶] Dhiraj Gupta, MD, FRCP[*†‡]

From the [*]Institute of Cardiovascular Medicine and Science, Liverpool & London, United Kingdom, [†]Liverpool Heart and Chest Hospital, Liverpool, United Kingdom, [‡]Imperial College London, London, United Kingdom, [§]Royal Brompton Hospital, London, United Kingdom, and [¶]Harefield Hospital, London, United Kingdom.

- multicenter randomized controlled trial
- 122 patients with persistent AF or sustained (>12 hours) paroxysmal AF with risk factors for atrial substrate were included and followed up for 12 months.
- Patients were randomized to:
  - PVI-only
  - PVI + lines (left atrial roof line, mitral isthmus line, and tricuspid isthmus line) group

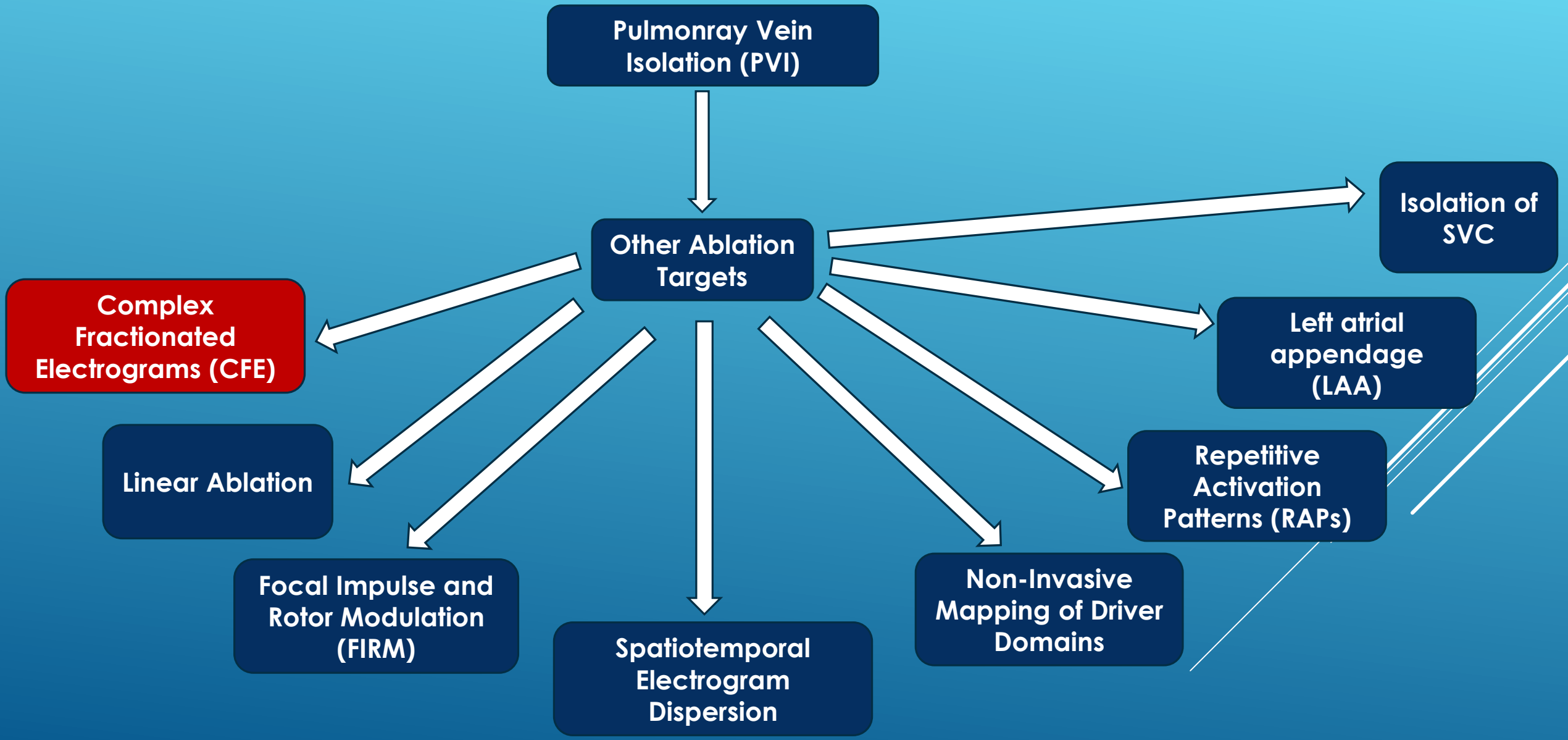
RESULTS

- Recurrence of AF/AT occurred in 32% in the PVI-only group and 38% in the PVI + lines group (P = .50)
- Adding lines to wide antral PVI in substrate-based AF requires significantly more ablation, increases procedure duration and radiation dose, but provides no additional clinical benefit

DISCUSSION

- Unklik other studies, this specified PVI bei WACA technique
- Use of contact force sensing ablation catheter, which shown to improve the durability of PVI
- Mor extensive ablation have the potential for subacute recovery, leading to zones of slow conduction that may be proarrhythmic

Ablation Strategies in Atrial Fibrillation



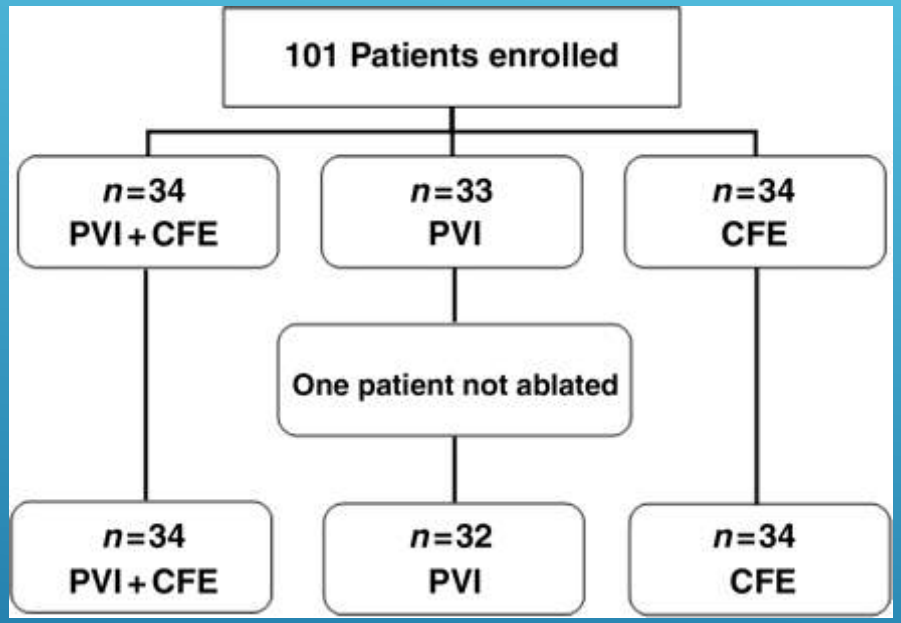
European Heart Journal (2010) **31**, 1344–1356
doi:10.1093/eurheartj/ehq041

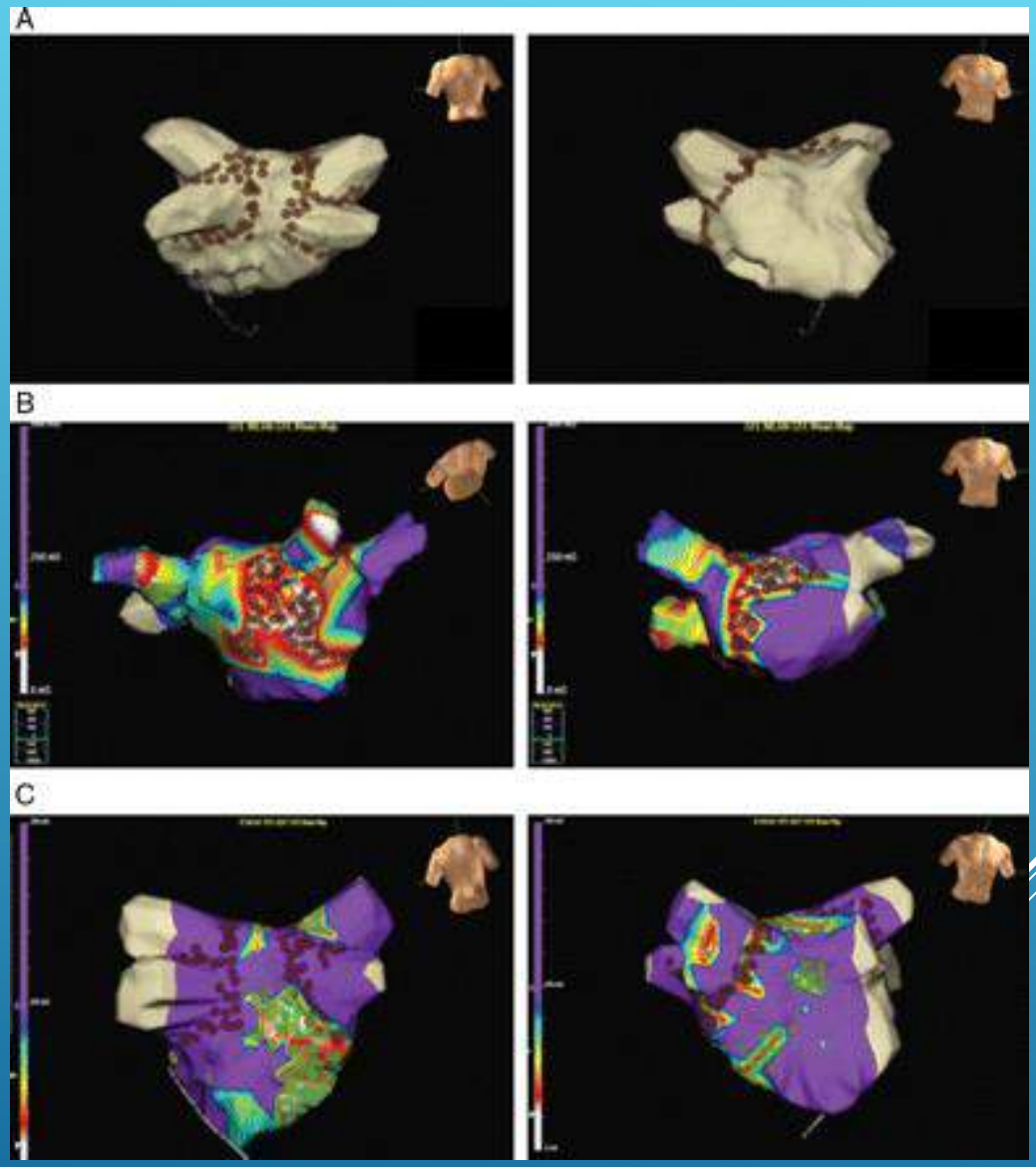
CLINICAL RESEARCH
Arrhythmia/electrophysiology

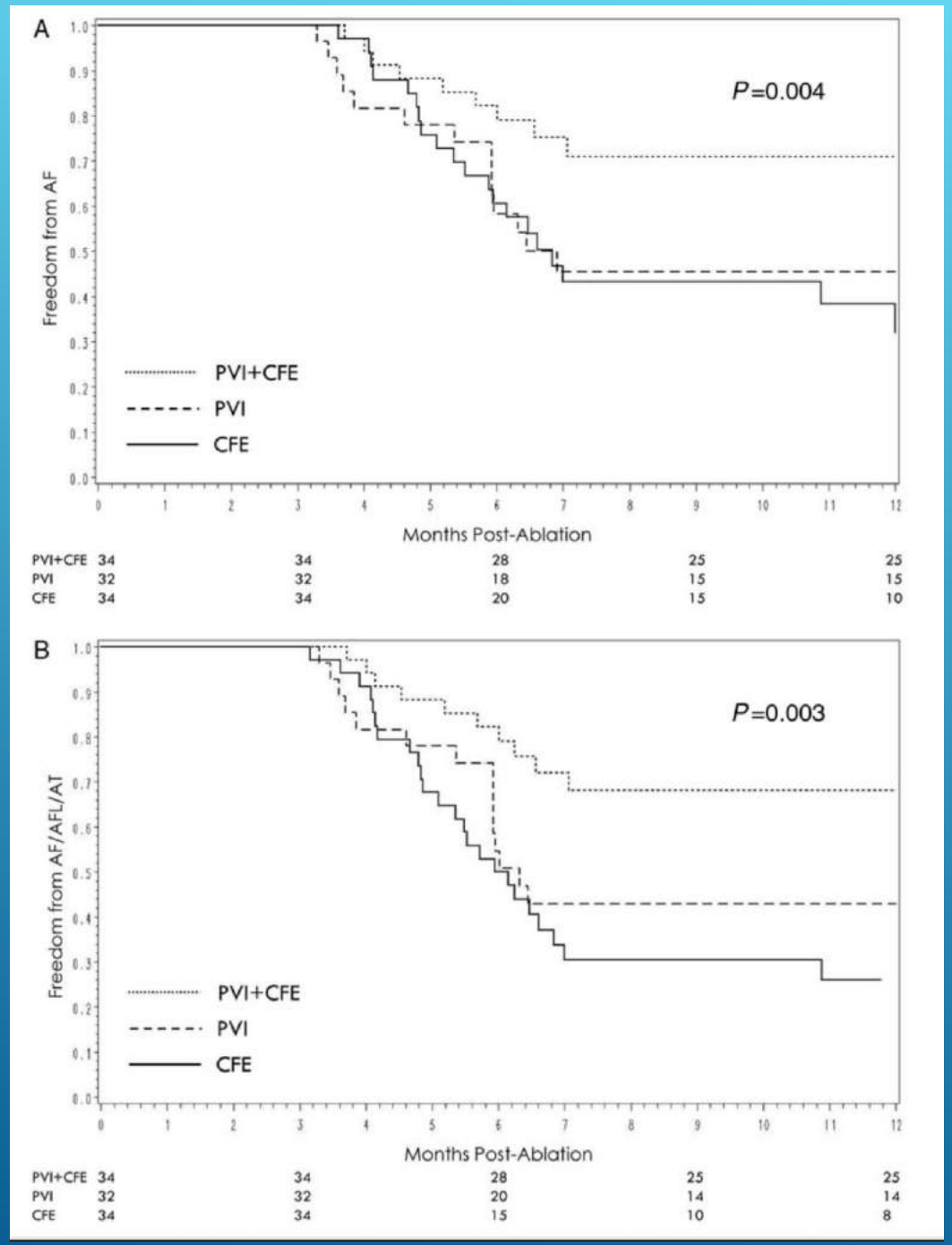
Substrate and Trigger Ablation for Reduction of Atrial Fibrillation (STAR AF): a randomized, multicentre, international trial†

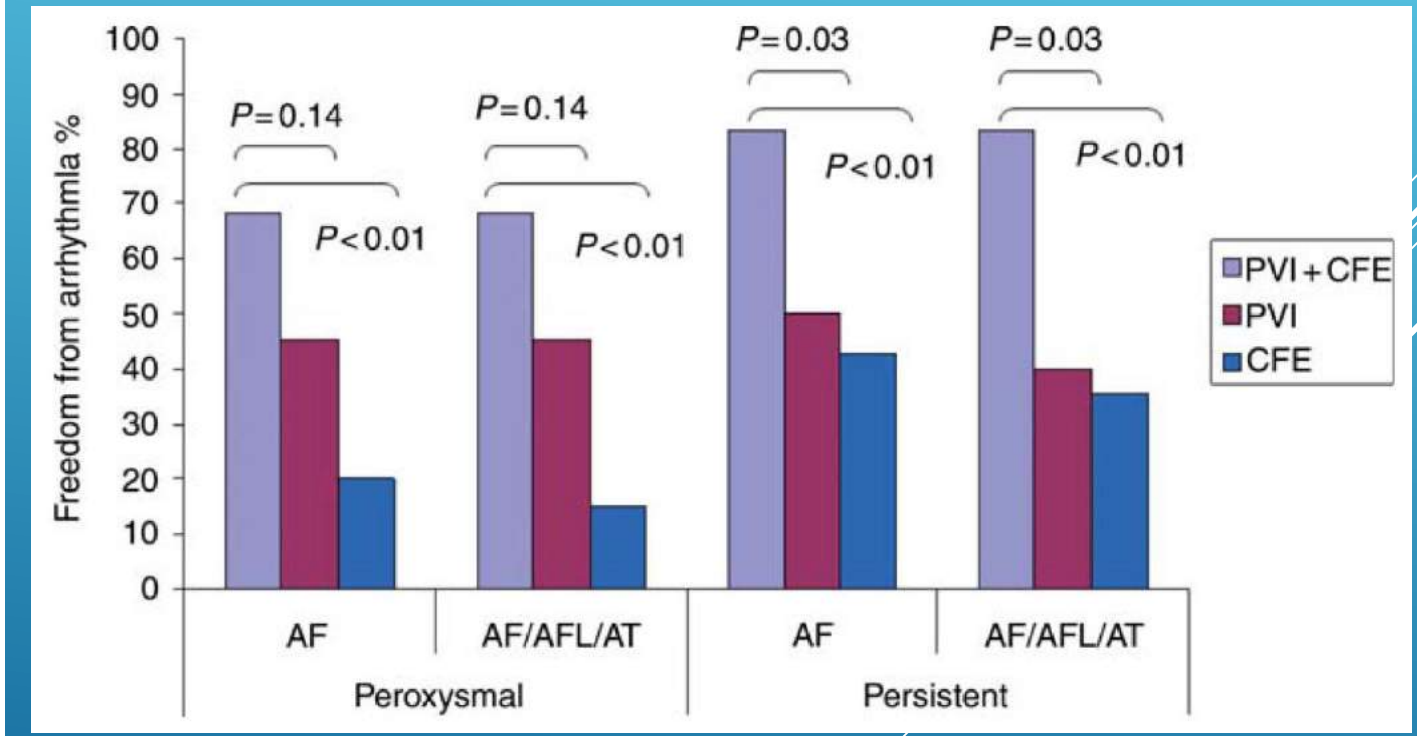
Atul Verma[1]*, Roberto Mantovan[2], Laurent Macle[3], Guiseppe De Martino[4], Jian Chen[5], Carlos A. Morillo[6], Paul Novak[7], Vittorio Calzolari[2], Peter G. Guerra[3], Girish Nair[6], Esteban G. Torrecilla[8], and Yaariv Khaykin[1]

[1]Southlake Heart Rhythm Program, Southlake Regional Health Centre, 105-712 Davis Drive, Newmarket, Ontario, Canada L3Y 8C3; [2]Ospedale Regionale di Treviso, Piazzale Ospedale, Treviso, Italy; [3]Montreal Heart Institute, Montreal, Quebec, Canada; [4]Casa di Cura Santa Maria, Bari, Italy; [5]Haukeland University Hospital, Bergen, Norway; [6]Hamilton Health Sciences Centre, Hamilton, Ontario, Canada; [7]Royal Jubilee Hospital, Victoria, British Columbia, Canada; and [8]Hospital General Universitario Gregorio Marañón, Madrid, Spain


101 Patients enrolled
n=34
PVI + CFE
n=33
PVI
n=34
CFE
One patient not ablated
n=34
PVI + CFE
n=32
PVI
n=34
CFE


A
B
C


A
P=0.004
Freedom from AF
PVI+CFE
PVI
CFE
Months Post-Ablation
PVI+CFE 34 34 28 25 25
PVI 32 32 18 15 15
CFE 34 34 20 15 10
B
P=0.003
Freedom from AF/AFL/AT
PVI+CFE
PVI
CFE
Months Post-Ablation
PVI+CFE 34 34 28 25 25
PVI 32 32 20 14 14
CFE 34 34 15 10 8


Freedom from arrhythmla %
P=0.14
P<0.01
P=0.14
P<0.01
P=0.03
P<0.01
P=0.03
P<0.01
AF
AF/AFL/AT
AF
AF/AFL/AT
Peroxysmal
Persistent
PVI+CFE
PVI
CFE

- CFE are both spatially and temporally stable
- studies suggested that CFAEs may indicate sites of slow conduction, collision, anchor points for reentrant circuits *(Konings KT, Smeets JL, Penn OC, Wellens HJ, Allessie MA. Configuration of unipolar atrial electrograms during electrically induced atrial fibrillation in humans. Circulation 1997;95:1231– 41.)*

- CFE ablation may eliminate the substrate required for chronic AF maintenance, it does not eliminate the triggers that can initiate paroxysms of AF and AT/AFL
- It is interesting that the low success rate occurred even though the rate of acute procedural AF termination was high (more than 65%)

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A Randomized Assessment of the Incremental Role of Ablation of Complex Fractionated Atrial Electrograms After Antral Pulmonary Vein Isolation for Long-Lasting Persistent Atrial Fibrillation

Hakan Oral, MD, Aman Chugh, MD, Kentaro Yoshida, MD, Jean F. Sarrazin, MD, Michael Kuhne, MD, Thomas Crawford, MD, Nagib Chalfoun, MD, Darryl Wells, MD, Warangkna Boonyapisit, MD, Srikar Veerareddy, MD, Sreedhar Billakanty, MD, Wai S. Wong, MD, Eric Good, DO, Krit Jongnarangsin, MD, Frank Pelosi, JR, MD, Frank Bogun, MD, Fred Morady, MD

Ann Arbor, Michigan

Table 1 Clinical Characteristics

	Group A: AF Terminated During APVI (n = 19)	Group B: Randomized to APVI Only (n = 50)	Group C: Randomized to APVI + CFAE RFA (n = 50)	p Value
Age, yrs	60 ± 7	58 ± 10	62 ± 8	0.16
Sex, male/female	14/5	41/9	41/9	0.70
Duration of AF, yrs	4 ± 4	6 ± 5	5 ± 4	0.48
Left atrial diameter, mm	42 ± 5	47 ± 6*	46 ± 6*	0.03
Left ventricular EF	0.54 ± 0.10	0.53 ± 0.12	0.54 ± 0.09	0.72
Structural heart disease	14 (74)	36 (72)	37 (74)	0.97
Coronary artery disease	3 (16)	8 (16)	9 (18)	0.96
Nonischemic cardiomyopathy	4 (21)	11 (22)	9 (18)	0.89
Valvular heart disease	2 (11)	3 (6)	2 (4)	0.59
Hypertensive heart disease	11 (58)	32 (64)	29 (58)	0.80
Amiodarone before RFA	1 (5)	6 (12)	2 (4)	0.34

- patients with termination of AF during APVI did not undergo additional ablation of CFAEs (Group A)

Patients who still had AF after APVI were randomly assigned to undergo

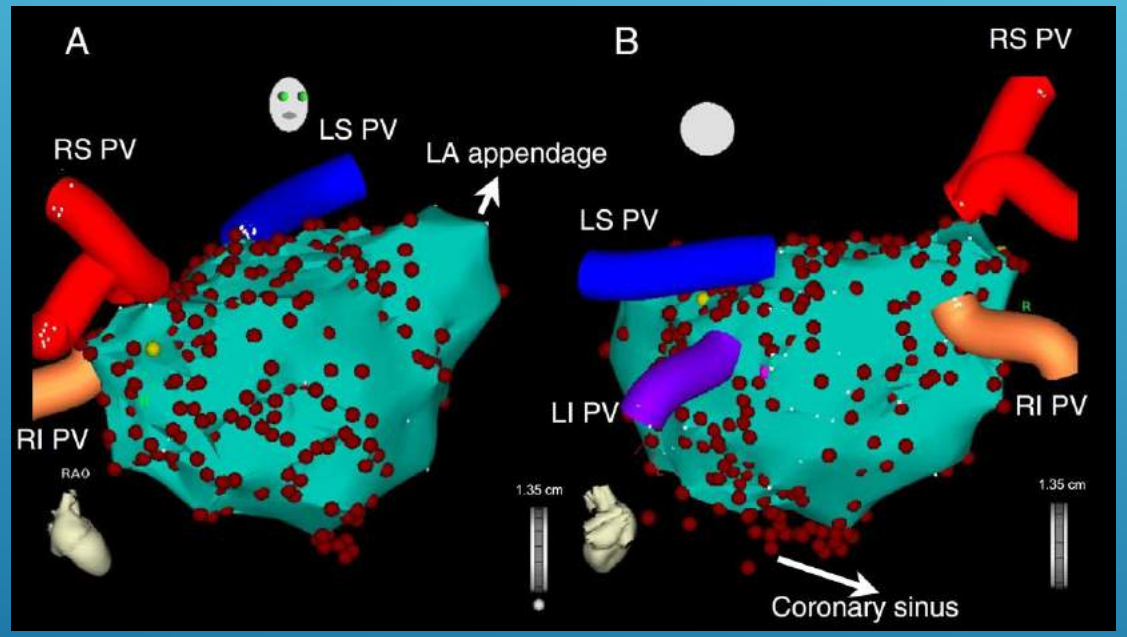
- no further ablation (Group B)
- or to undergo additional ablation of CFAEs in the left atrium and coronary sinus up to 2 additional hours of procedure duration or until AF terminated (Group C)

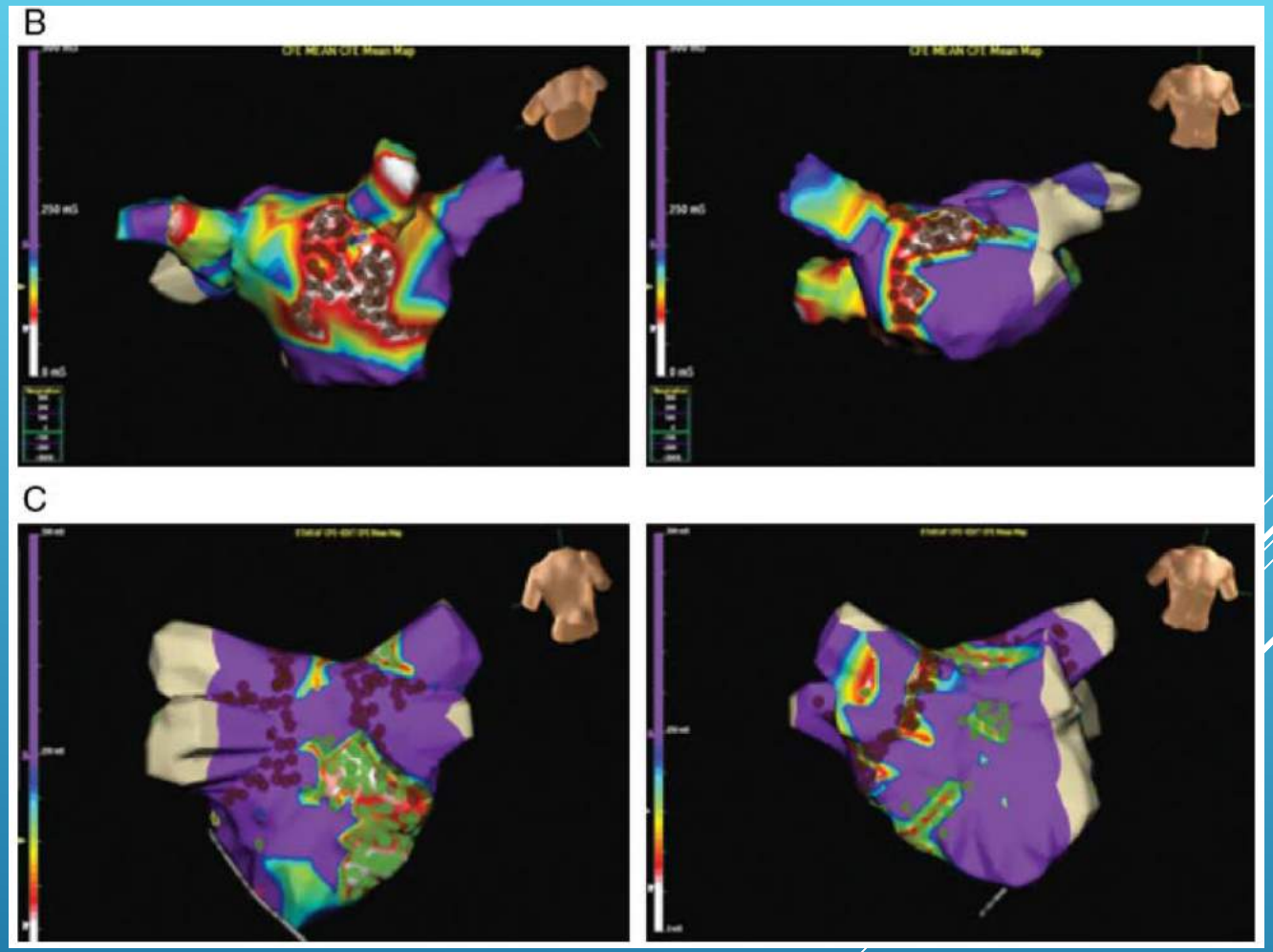
RESULTS

- mean follow-up of 10 3 months
- After a single ablation procedure, 19 of 50 patients (38%) in Group B and 18 of 50 patients (36%) in Group C were in sinus rhythm in the absence of antiarrhythmic drug therapy (p = 0.84)

DISCUSSION

- CFAEs were identified in the time domain by visual inspection
- CFAEs were targeted at the discretion of the operator
- CFAEs in the right atrium were not targeted in this study


A
RS PV
LS PV
LA appendage
RI PV
RAO
B
RS PV
LS PV
LI PV
RI PV
1.35 cm
1.35 cm
Coronary sinus

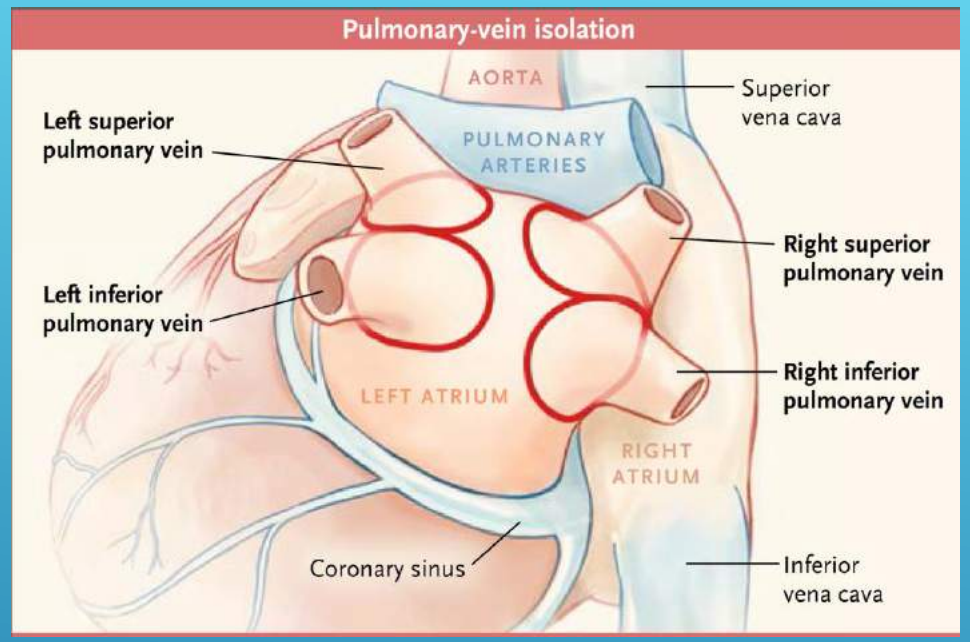

B
C

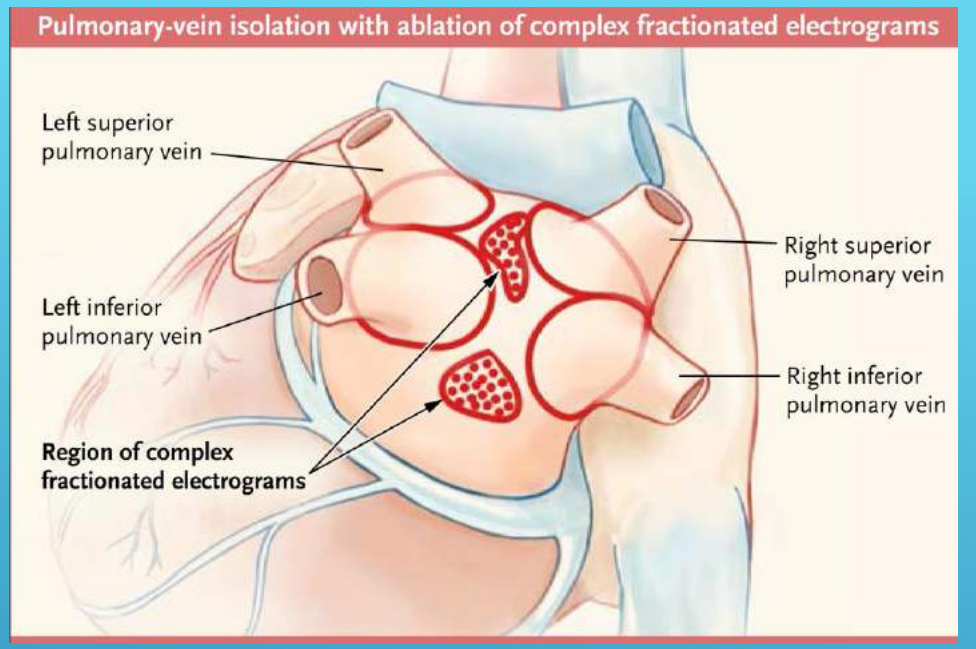
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Approaches to Catheter Ablation for Persistent Atrial Fibrillation

Atul Verma, M.D., Chen-yang Jiang, M.D., Timothy R. Betts, M.D., M.B., Ch.B., Jian Chen, M.D., Isabel Deisenhofer, M.D., Roberto Mantovan, M.D., Ph.D., Laurent Macle, M.D., Carlos A. Morillo, M.D., Wilhelm Haverkamp, M.D., Ph.D., Rukshen Weerasooriya, M.D., Jean-Paul Albenque, M.D., Stefano Nardi, M.D., Endrj Menardi, M.D., Paul Novak, M.D., and Prashanthan Sanders, M.B., B.S., Ph.D., for the STAR AF II Investigators*


Pulmonary-vein isolation
AORTA
Superior vena cava
Left superior pulmonary vein
PULMONARY ARTERIES
Right superior pulmonary vein
Left inferior pulmonary vein
Right inferior pulmonary vein
LEFT ATRIUM
RIGHT ATRIUM
Coronary sinus
Inferior vena cava


Pulmonary-vein isolation with ablation of complex fractionated electrograms
Left superior pulmonary vein
Right superior pulmonary vein
Left inferior pulmonary vein
Right inferior pulmonary vein
Region of complex fractionated electrograms

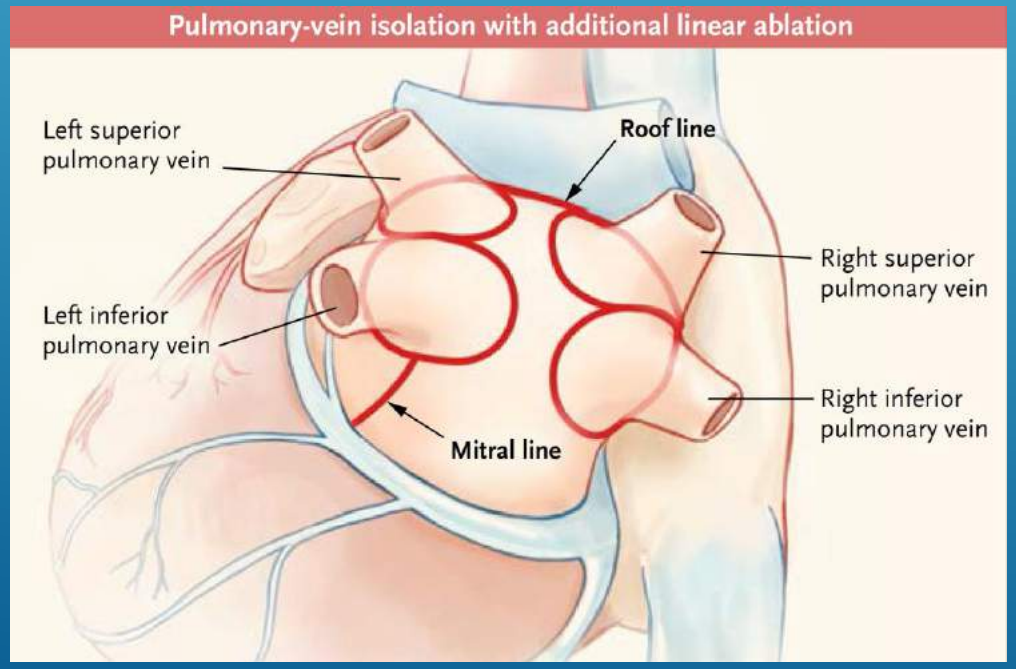
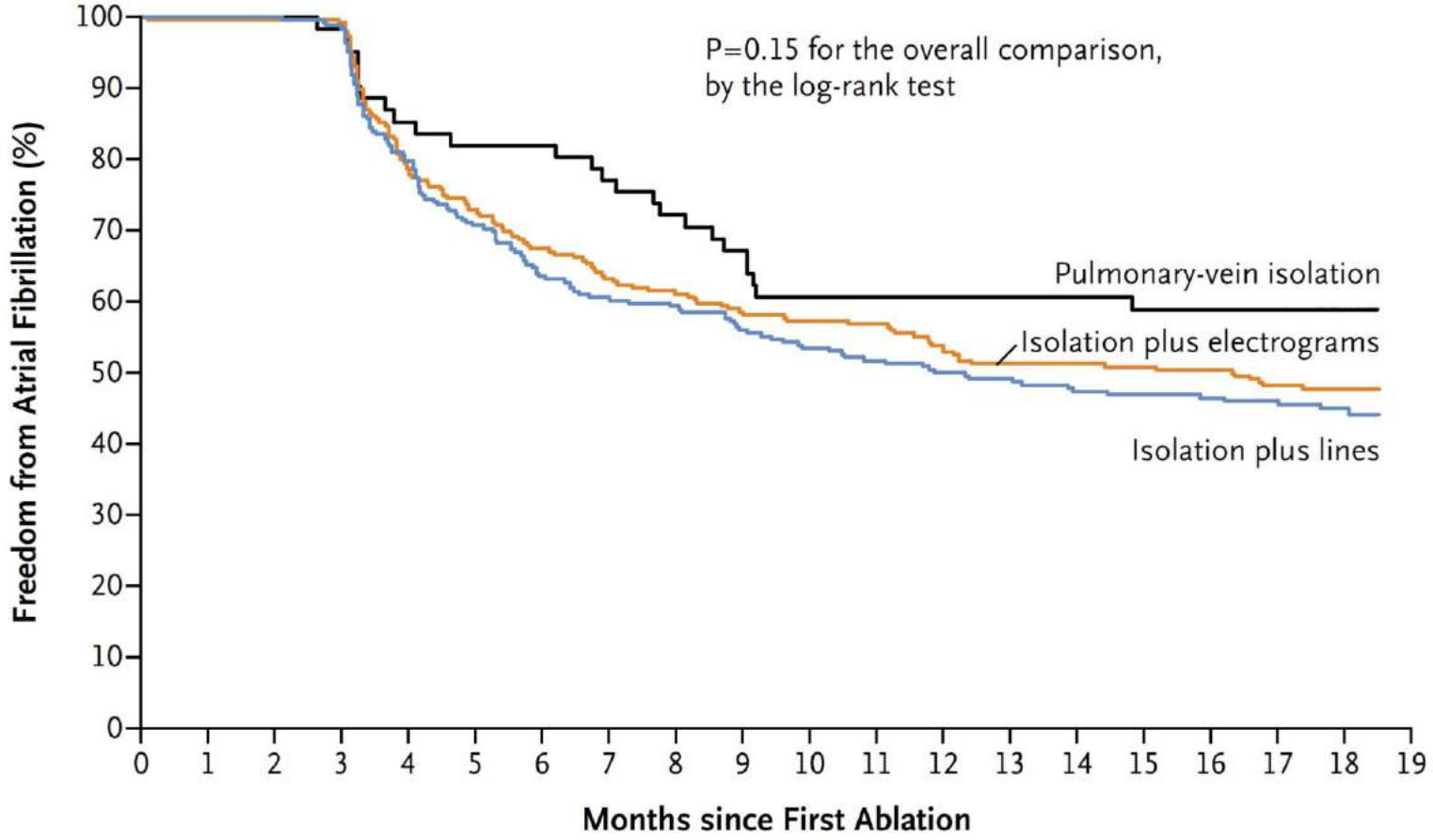

Pulmonary-vein isolation with additional linear ablation
Left superior pulmonary vein
Roof line
Right superior pulmonary vein
Left inferior pulmonary vein
Right inferior pulmonary vein
Mitral line

Table 2. Major Efficacy Outcomes.

Variable	Isolation Alone (N=61)	Isolation plus Electrograms (N=244)	Isolation plus Lines (N=244)	P Value
		number (percent)		
Freedom from documented atrial fibrillation after one procedure, with or without antiarrhythmic drugs	36 (59)	119 (49)	112 (46)	0.15
Freedom from documented atrial fibrillation after one procedure, without antiarrhythmic drugs*	29 (48)	90 (37)	81 (33)	0.11
Freedom from documented atrial arrhythmia after one procedure, with or without antiarrhythmic drugs	30 (49)	100 (41)	90 (37)	0.15
Freedom from documented atrial arrhythmia after one procedure, without antiarrhythmic drugs*	25 (41)	81 (33)	71 (29)	0.08
Freedom from documented atrial fibrillation after two procedures, with or without antiarrhythmic drugs	44 (72)	146 (60)	142 (58)	0.18
Freedom from documented atrial arrhythmia after two procedures, with or without antiarrhythmic drugs	37 (61)	122 (50)	117 (48)	0.24
Documented atrial flutter or tachycardia after one procedure, with or without antiarrhythmic drugs	7 (11)	27 (11)	34 (14)	0.57
Documented atrial flutter or tachycardia after two procedures, with or without antiarrhythmic drugs	7 (11)	32 (13)	29 (12)	0.98
Patients undergoing a second ablation procedure	13 (21)	63 (26)	81 (33)	0.10



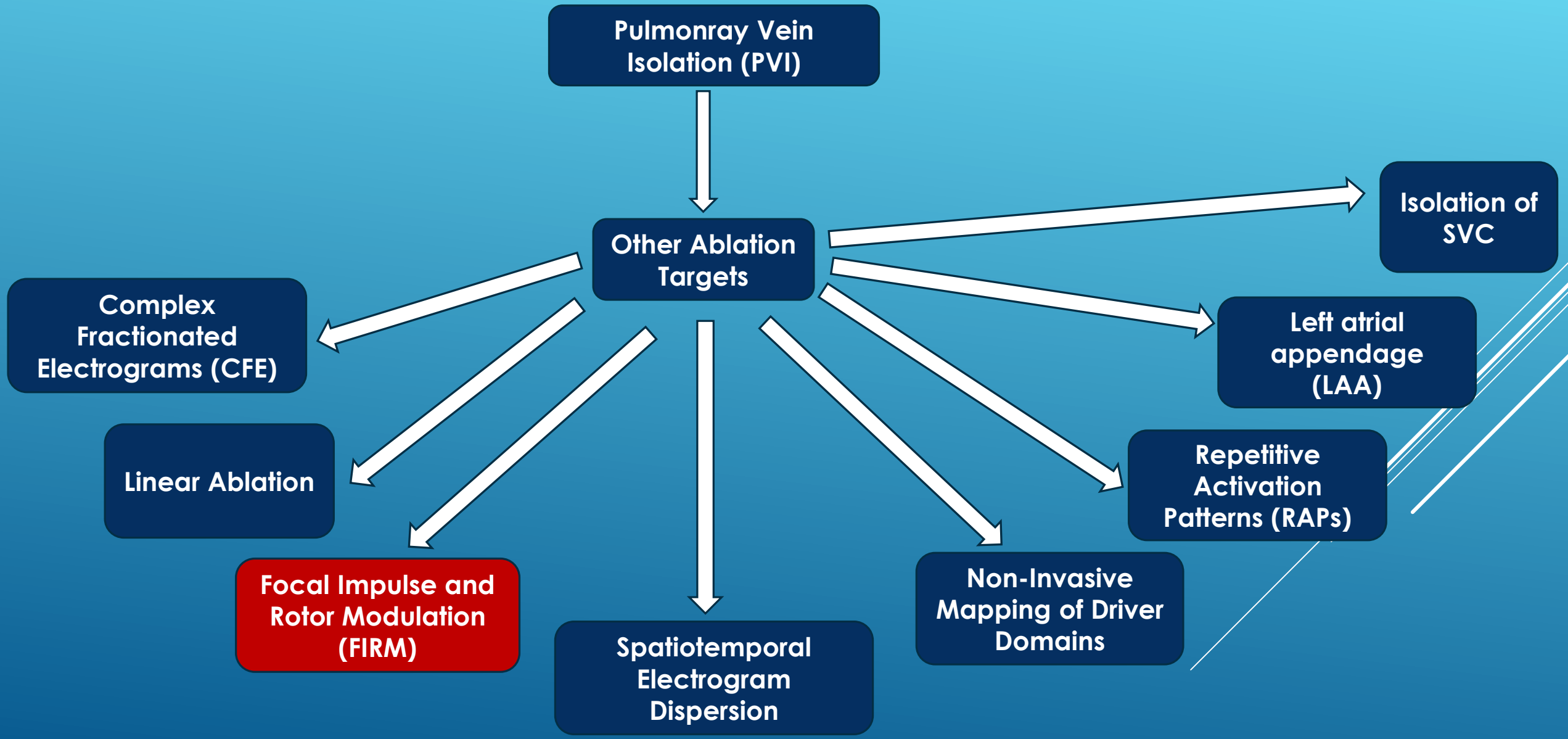
No. at Risk

Pulmonary-vein isolation	61	60	50	41	36	23
Isolation plus electrograms	244	242	161	137	124	72
Isolation plus lines	244	240	152	133	115	57

DISCUSSION

- The reason for the lack of benefit associated with additional ablation in our trial is unclear
- evaluated three approaches to radiofrequency ablation for patients with persistent atrial fibrillation
- More extensive ablation may cause new, iatrogenic areas of arrhythmogenesis
- More selective targets may be needed to better characterize an individual patient's specific arrhythmic substrate
- group assigned to the combination of pulmonary-vein isolation, ablation of complex electrograms, and linear ablation

Ablation Strategies in Atrial Fibrillation



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EXPEDITED PUBLICATIONS

Treatment of Atrial Fibrillation by the Ablation of Localized Sources

CONFIRM (Conventional Ablation for Atrial Fibrillation With or Without Focal Impulse and Rotor Modulation) Trial

Sanjiv M. Narayan, MD, PHD,*† David E. Krummen, MD,*† Kalyanam Shivkumar, MD, PHD,‡ Paul Clopton, MS,† Wouter-Jan Rappel, PHD,§ John M. Miller, MD‖

San Diego and Los Angeles, California; and Indianapolis, Indiana

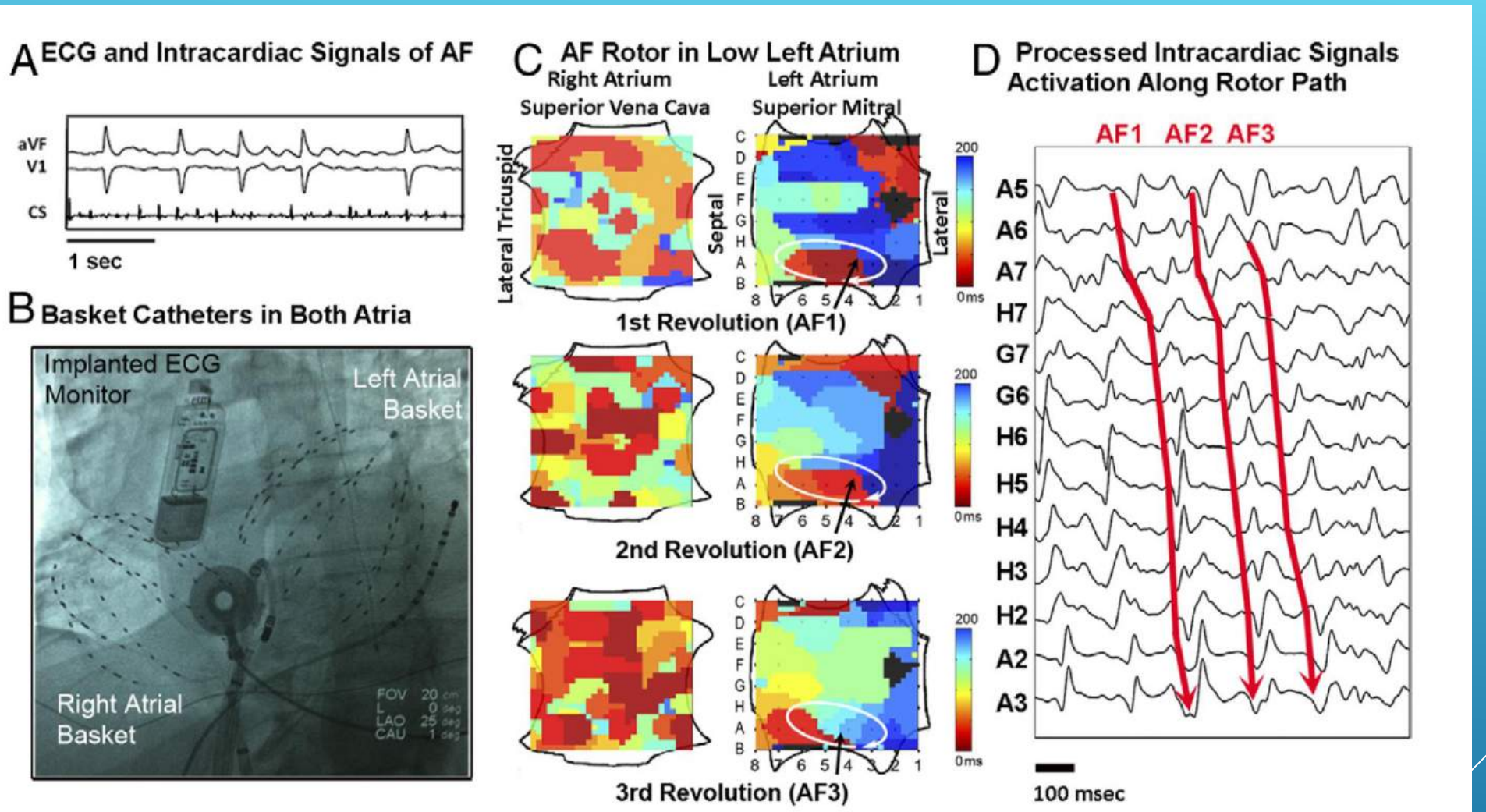


Figure 1 Computational Mapping of "Electrical Rotor" During Atrial Fibrillation

Table 2 Acute Results in All Cases or Those With Sustained AF During Their Procedure

Characteristic	Conventional Ablation	FIRM-Guided Ablation	p Value
Cases with intraprocedural sustained AF	65/71 (92%)	36/36 (100%)	0.10
Subjects with AF sources	63/65 (97%)	35/36 (97%)	1.00
Acute endpoint achieved	13/65 (20%)	31/36 (86%)	<0.001
AF termination endpoint	6/65 (9%)	20/36 (56%)	<0.001
Ablation time, min, at primary source	—	2.5 (1.0–3.1)	
To sinus rhythm/atrial tachycardia	3/3	16/4	0.29
AF slowing (CL prolongation) endpoint	7/65 (11%)	11/36 (31%)	0.01
Extent of AF CL prolongation, ms	28 ± 8 (18 ± 6%)	33 ± 12 (19 ± 8%)	0.38
Ablation time for acute endpoint, min	31.8 (22.1–71.5)	18.5 (7.9–24.5)	<0.001
Total procedural ablation (all cases), min	52.1 ± 17.8	57.8 ± 22.8	0.16
Complications, all cases	6 (8%)	2 (6%)	0.72
Cardiac tamponade	2	1	
Groin bleed requiring transfusion	3	1	
Vascular injury requiring surgical repair	0	0	
Permanent diaphragmatic paralysis	0	0	
Symptomatic pulmonary vein stenosis	1*	0	
Stroke/TIA	0	0	
Atrioesophageal fistula	0	0	
Death	0	0	

- AF was observed intraprocedurally in 88 of 92 patients
- in whom FIRM mapping revealed stable AF rotors or focal sources in 86 (97.7%)
- 1.9 ± 1.1 concurrent stable sources per patient
- 67% lay in the left atrium and 33% lay in the right atrium

THEREFORE PULMONARY VEIN ISOLATION ALONE OFTEN IS INSUFFICIENT TO ELIMINATE PERSISTENT AF

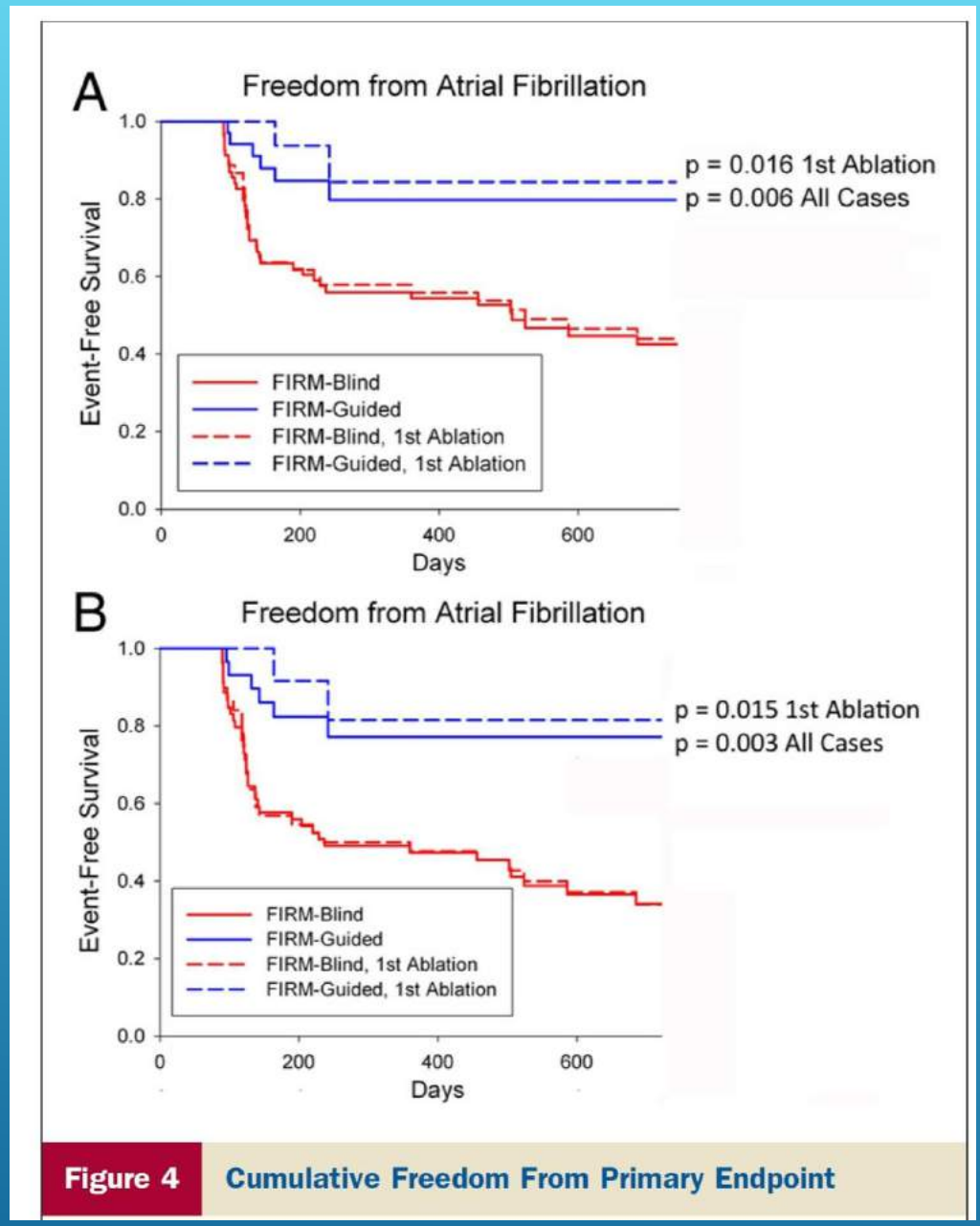


Figure 4 **Cumulative Freedom From Primary Endpoint**

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Heart Rhythm Disorders

Ablation of Rotor and Focal Sources Reduces Late Recurrence of Atrial Fibrillation Compared With Trigger Ablation Alone

Extended Follow-Up of the CONFIRM Trial (Conventional Ablation for Atrial Fibrillation With or Without Focal Impulse and Rotor Modulation)

Sanjiv M. Narayan, MD, PHD,*† Tina Baykaner, MD,*† Paul Clopton, MS,† Amir Schricker, MD,*† Gautam G. Lalani, MD,*† David E. Krummen, MD,*† Kalyanam Shivkumar, MD, PHD,‡ John M. Miller, MD§

San Diego and Los Angeles, California; and Indianapolis, Indiana

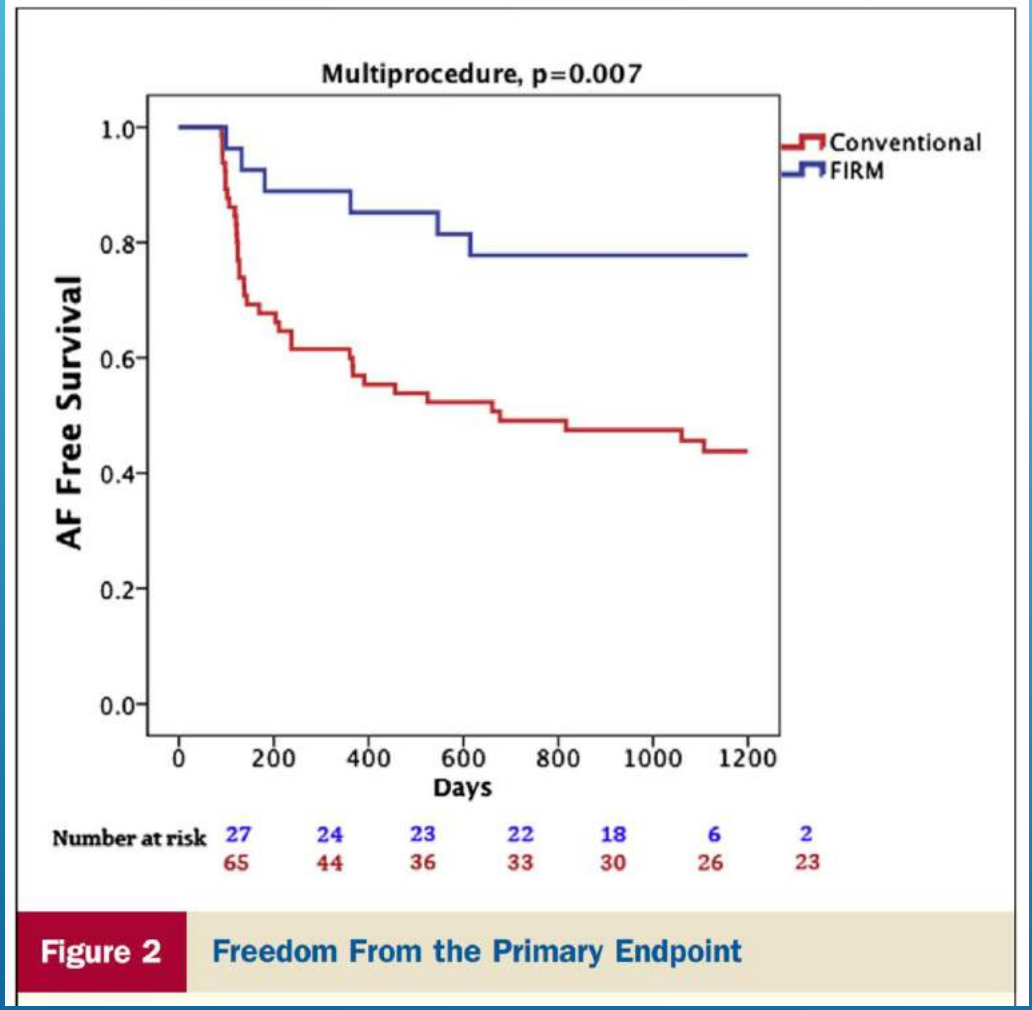


Figure 2 Freedom From the Primary Endpoint

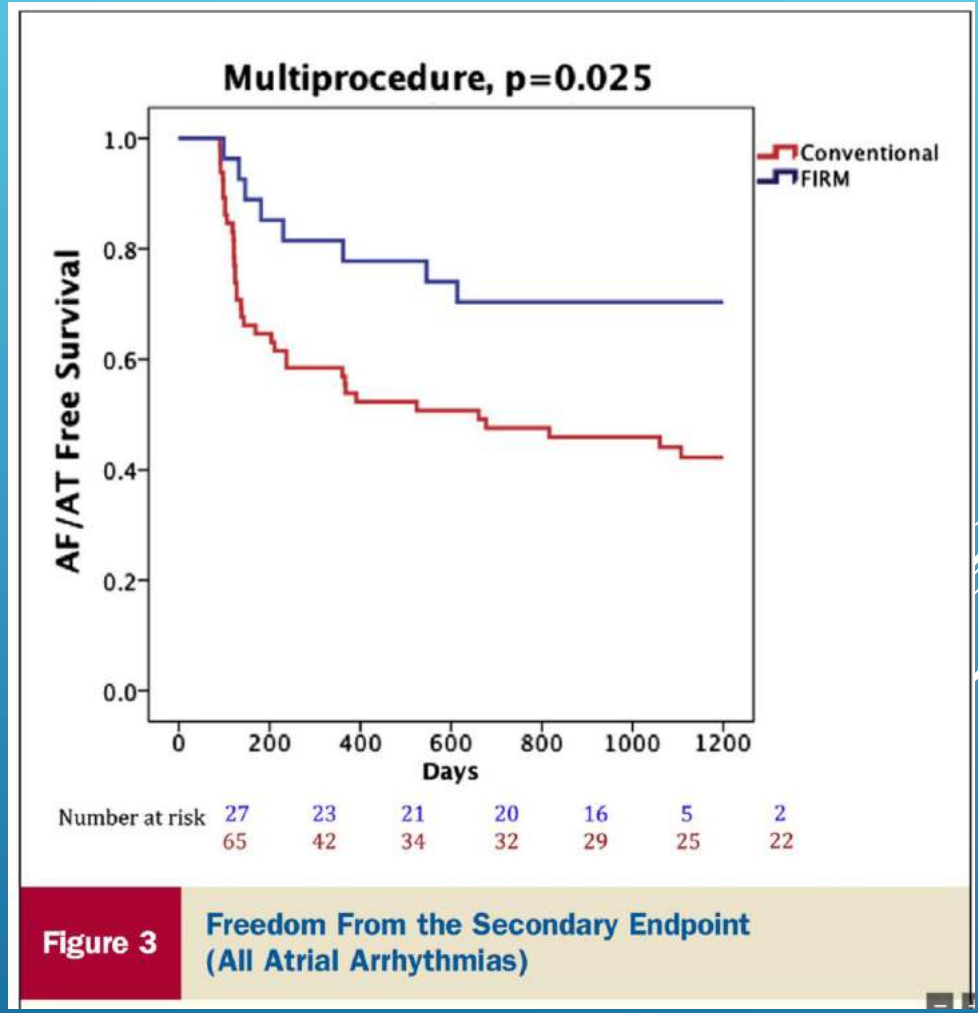


Figure 3 Freedom From the Secondary Endpoint (All Atrial Arrhythmias)

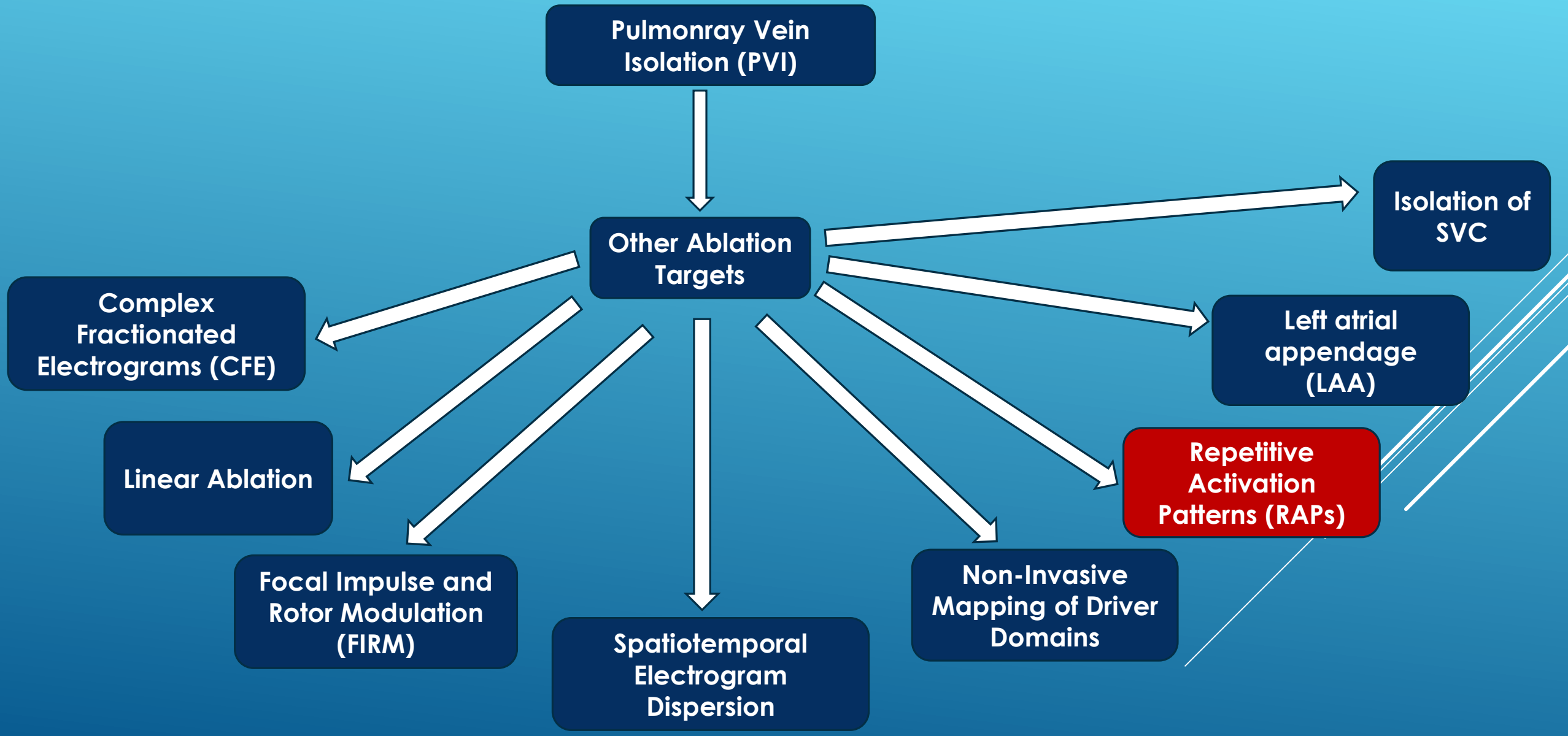
LIMITATIONS

- The major limitation of CONFIRM is that it was nonrandomized

The interim results of the REAFFIRM (Randomised Evaluation of Atrial Fibrillation treatment with Focal Impulse and Rotor Modulation guided procedures) trial showed there was no statistically significant difference in outcomes between the treatment and control arms. These results were presented by principal investigator Johannes Brachmann, (Klinikum Coburg GmbH, Germany) at the AF Symposium (11–13 January 2018, Orlando, USA).

RANDOMIZED CLINICAL TRIALS UNDERWAY

Ablation Strategies in Atrial Fibrillation



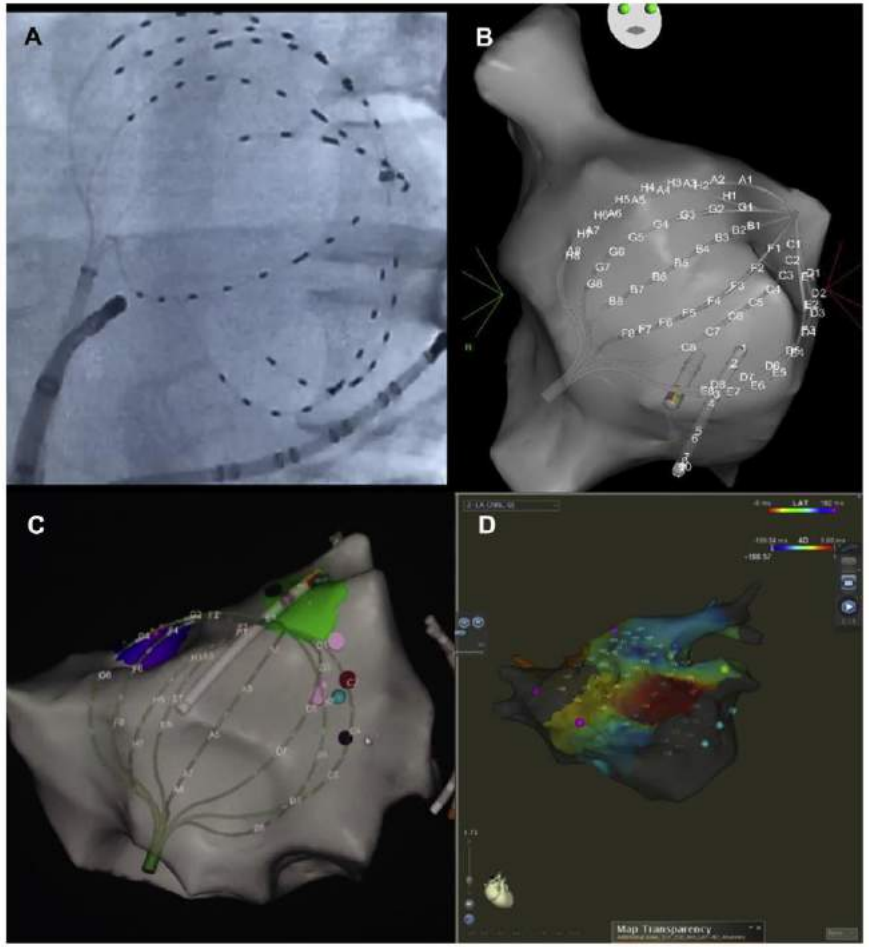
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FOCUS ON NEW MAPPING APPROACHES FOR COMPLEX ARRHYTHMIAS

Identification of Repetitive Activation Patterns Using Novel Computational Analysis of Multielectrode Recordings During Atrial Fibrillation and Flutter in Humans

Emile G. Daoud, MD,[a] Ziad Zeidan, MD,[b] John D. Hummel, MD,[a] Raul Weiss, MD,[a] Mahmoud Houmsse, MD,[a] Ralph Augostini, MD,[a] Steven J. Kalbfleisch, MD[a]

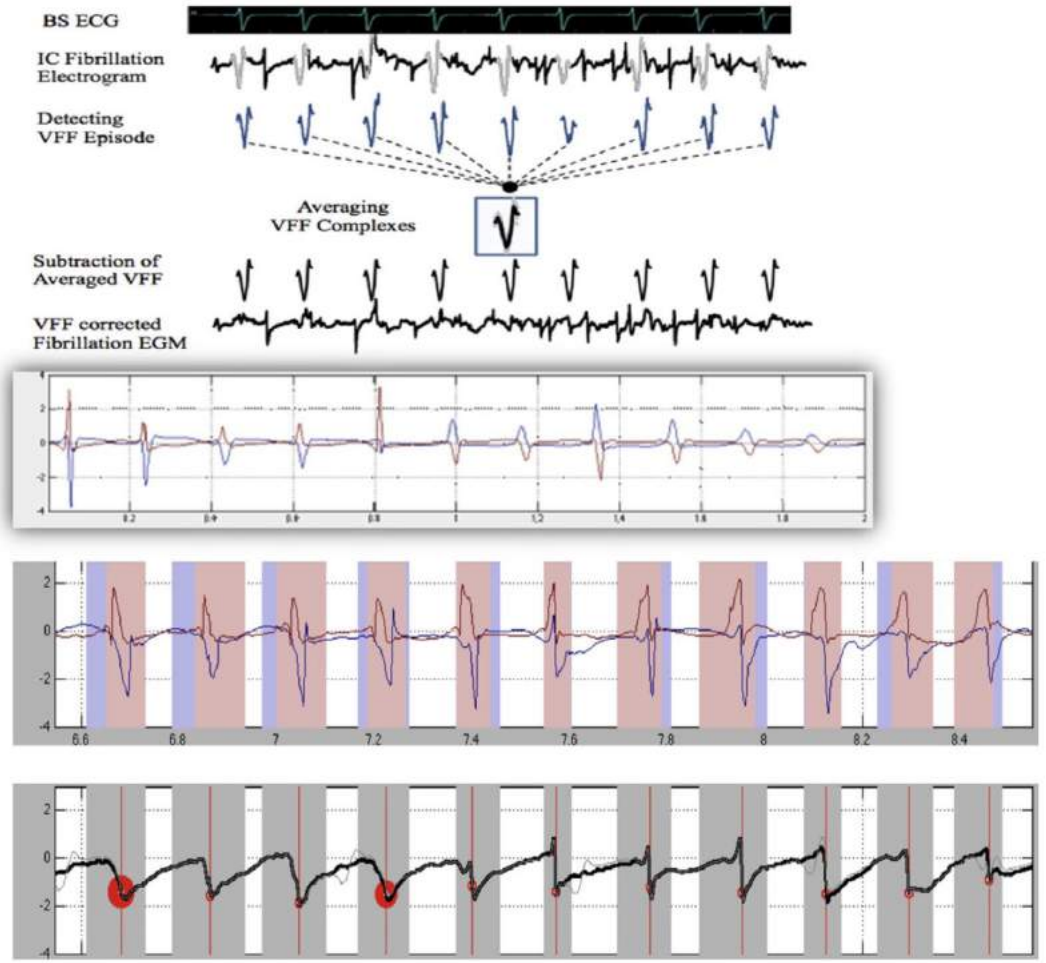
FIGURE 1 Image of BC in RA and LA



(A,B) Fluoroscopic images of the basket catheter (BC) in the right atrium (RA) and the corresponding display of the BC on the 3-dimensional (3D) CARTO RA anatomic map. **(C)** The BC on the 3D CARTO left atrium (LA) anatomic map. **(D)** The repetitive activation pattern (RAP) recording from the LA superimposed upon the BC and the CARTO map.

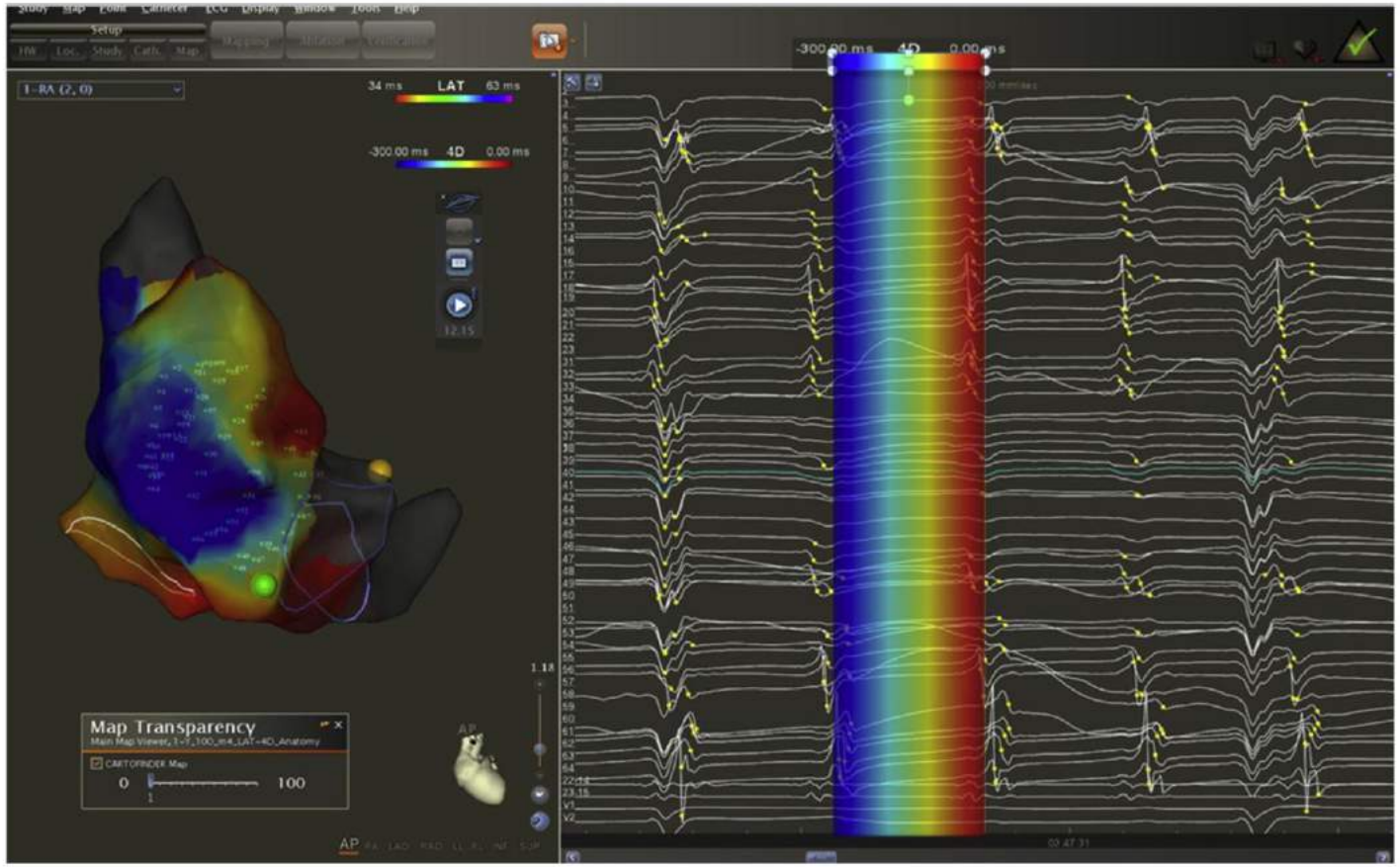
FIGURE 2 Filtering Ventricular Far-Field Signal and Annotation of Local Activation Times

- Subtraction of far-field ventricular signal
- Calculate bipolar electrogram for each BC electrode
- Determine bipolar electrogram windows
- Apply bipolar windowing on unipolar signals
- Performing a wavelet analysis to identify annotations



(Top to bottom) The first step of CF algorithm is subtraction of the averaged ventricular far-field signal (VFF); then, calculation of 2 bipolar signals for each unipolar BC electrode; followed by calculation of the bipolar electrogram window, which is the earliest onset to the latest offset of the 2 bipole electrograms. **(Bottom)** Using the bipolar electrogram window, the unipolar atrial signal is recorded from the specific BC electrode. (Images courtesy of Richard Houben, PhD.) BS = baseline; ECG = electrocardiogram; IC = intra-cardiac; other abbreviations as in Figure 1.

FIGURE 3 Generating Dynamic 3-Dimensional CARTOFINDER Map on Chamber Anatomical Map



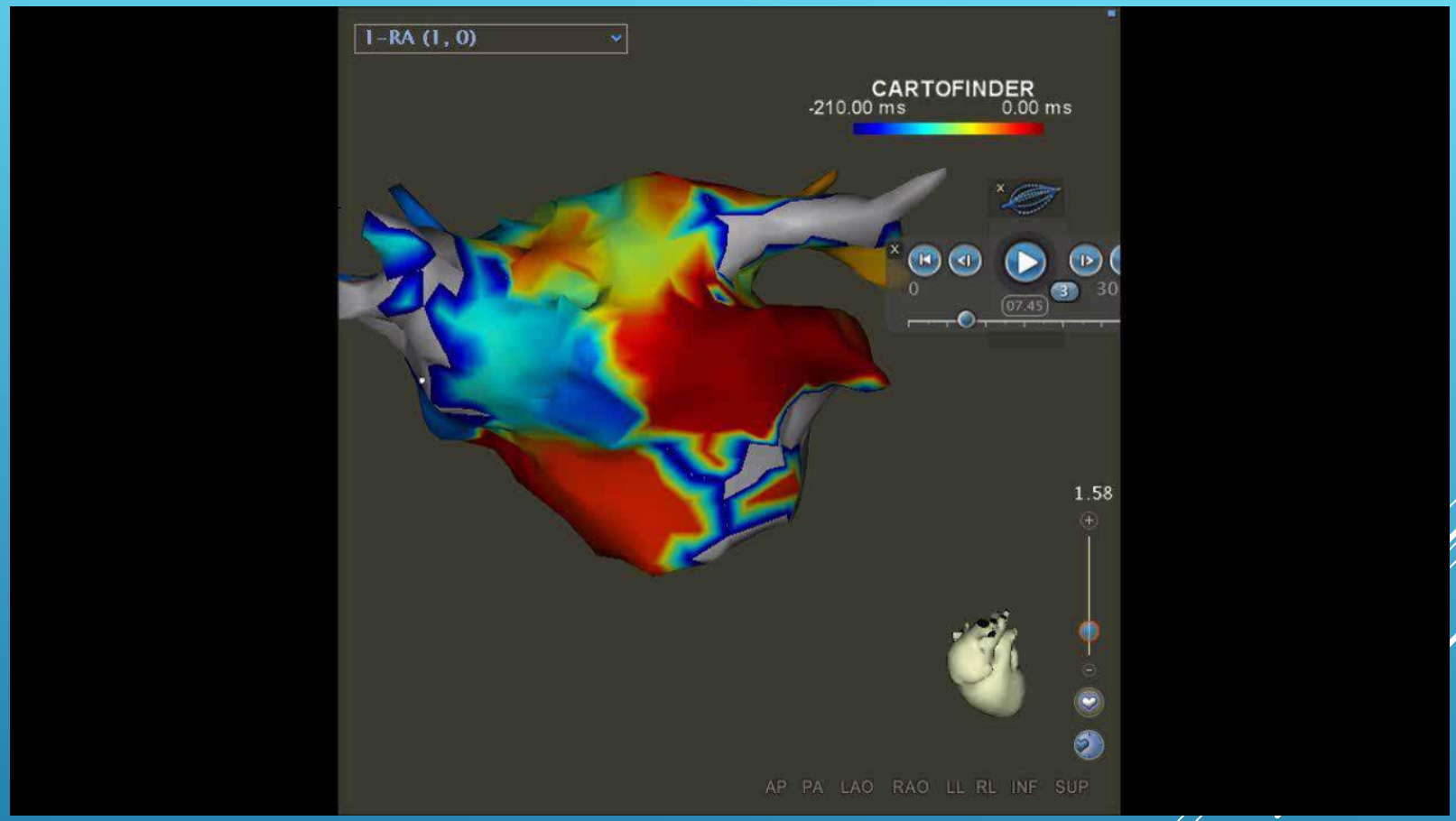
Yellow dots annotate the local activation times on the atrial unipolar signals. The colored window of interest moves through the atrial unipolar electrograms **(left to right)** and as the unipolar signal enters and moves through the window of interest, that region of the CARTO map (on left of image) is annotated by the particular color (color range **red to blue**; note this varies from the conventional CARTO color range "**red meets purple**").

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FOCUS ON NEW MAPPING APPROACHES FOR COMPLEX ARRHYTHMIAS

Identification of Repetitive Activation Patterns Using Novel Computational Analysis of Multielectrode Recordings During Atrial Fibrillation and Flutter in Humans

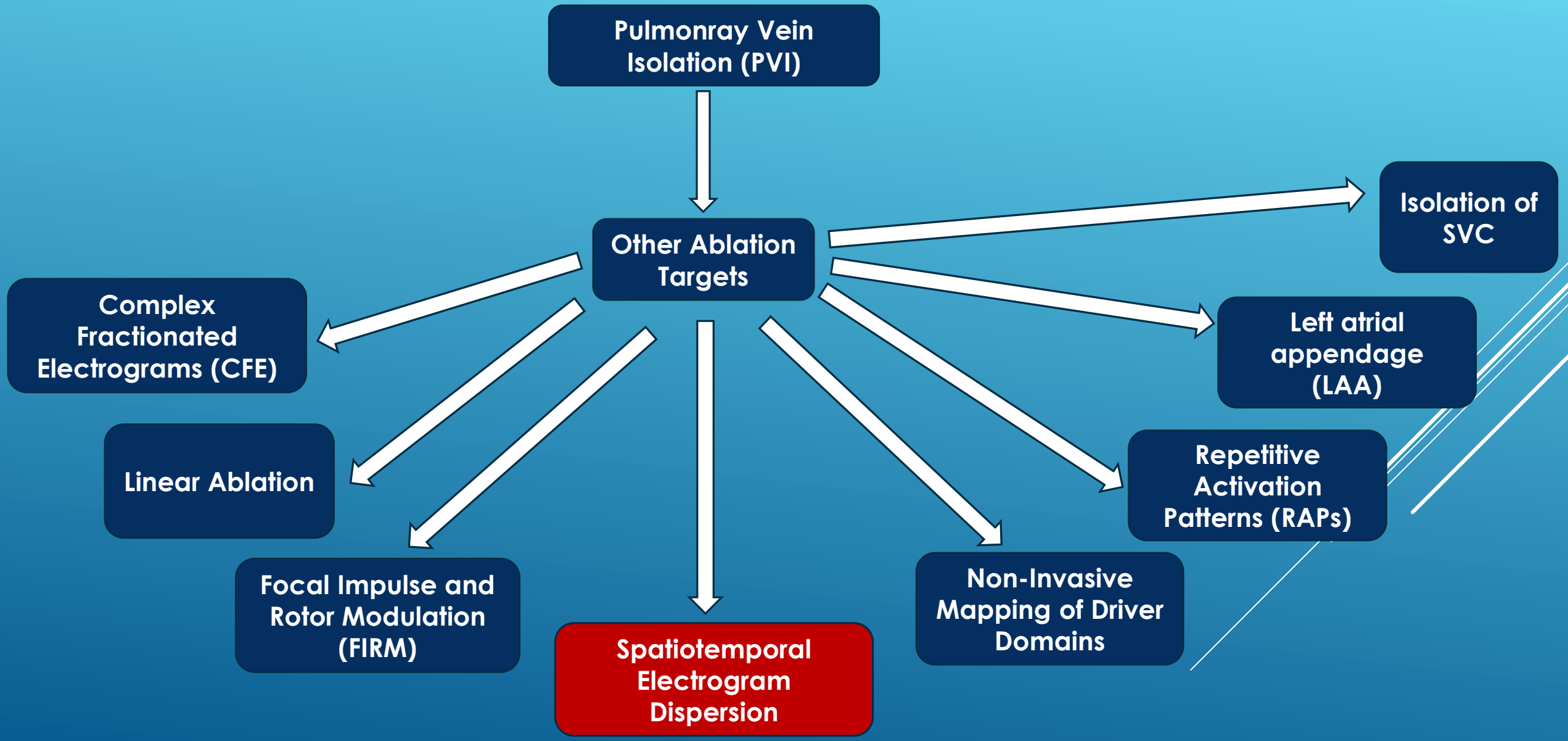
Emile G. Daoud, MD,[a] Ziad Zeidan, MD,[b] John D. Hummel, MD,[a] Raul Weiss, MD,[a] Mahmoud Houmsse, MD,[a] Ralph Augostini, MD,[a] Steven J. Kalbfleisch, MD[a]



RESULTS

- Twenty consecutive patients undergoing RFA of AF using the CARTO electroanatomic mapping system
- There were 2.9 rotational RAPs per patient (1.3 RA; 1.6 LA). No RAPs were noted in 2 patients.
- RFA was delivered on top of (n = 10), within 5 mm (n = 5), or distant (n = 10) from any RAP.
- Reproducibility of the BC to identify the same RAP was 82%.
- Post-pulmonary vein (PV) isolation, there was a 45% reduction in RAP versus pre-RFA.

Ablation Strategies in Atrial Fibrillation



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AF Ablation Guided by Spatiotemporal Electrogram Dispersion Without Pulmonary Vein Isolation

A Wholly Patient-Tailored Approach

Julien Seitz, MD,[a] Clément Bars, MD,[a,b] Guillaume Théodore, MD,[c] Sylvain Beurtheret, MD,[a] Nicolas Lellouche, MD, PhD,[d] Michel Bremondy, MD,[a] Ange Ferracci, MD,[a] Jacques Faure, MD,[a] Guillaume Penaranda,[e] Masatoshi Yamazaki, MD, PhD,[f] Uma Mahesh R. Avula, MD,[f] Laurence Curel, MS,[a] Sabrina Siame,[a] Omer Berenfeld, PhD,[f] André Pisapia, MD,[a] Jérôme Kalifa, MD, PhD[f]

FIGURE 1 Spatiotemporal Dispersion of Multipolar Electrograms

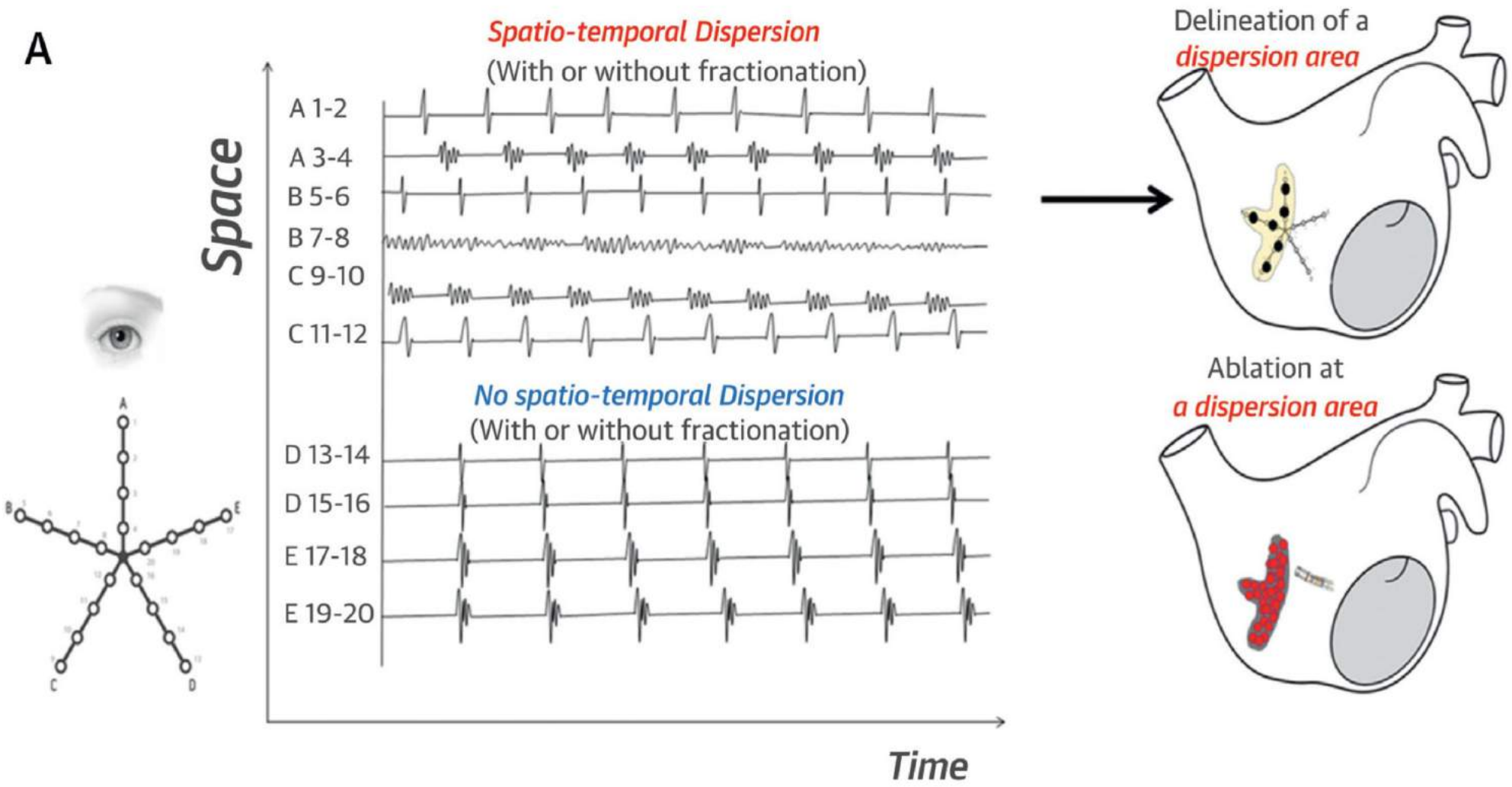
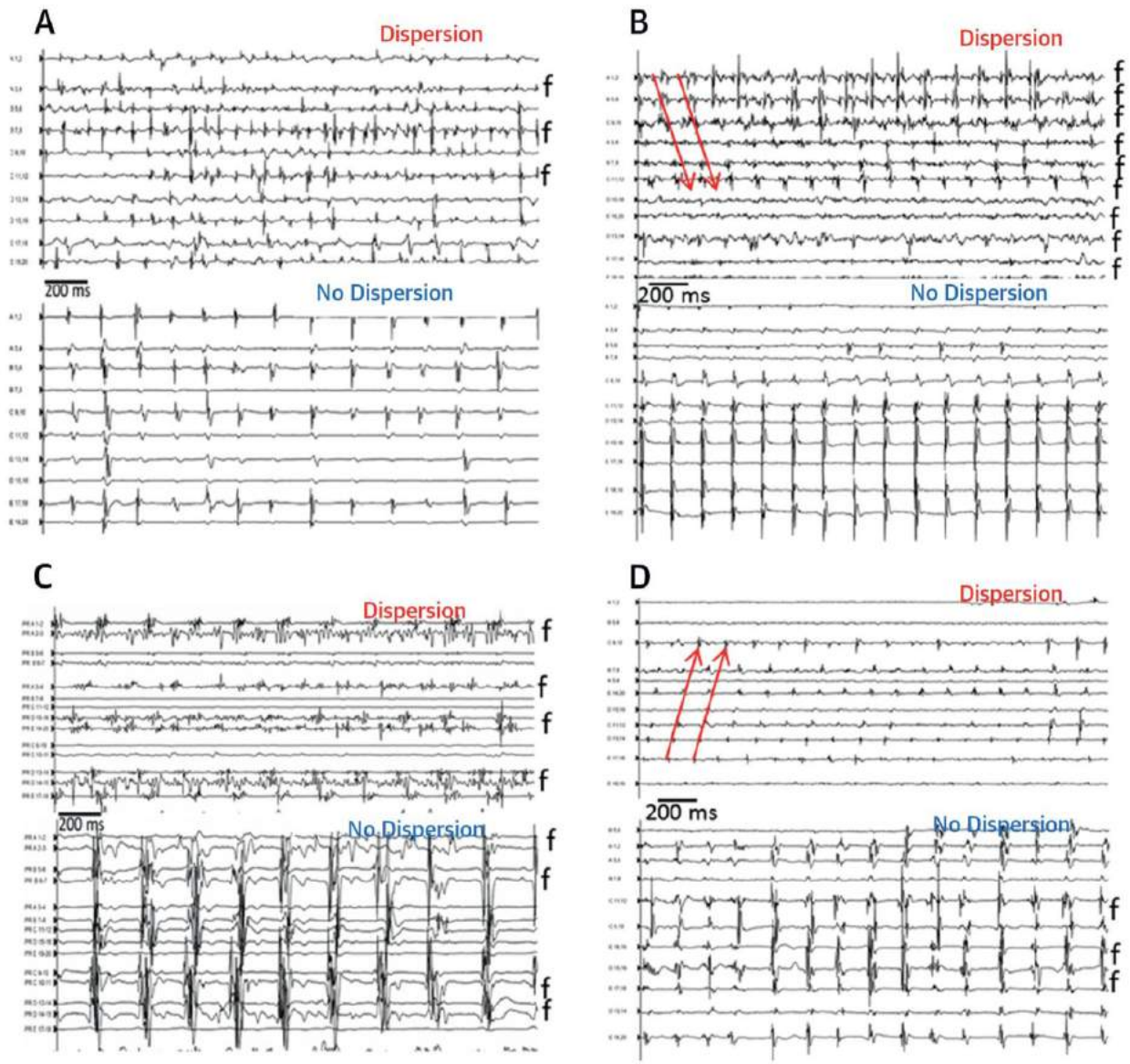


FIGURE 2 Examples of Spatiotemporal Dispersion



(A to D) These representative examples of multipolar electrograms were recorded in dispersion and nondispersion regions in 4 patients. In the dispersion regions, bipoles exhibiting continuously fractionated signal were common **(B and C)**. **f** indicates fractionated electrograms; **red arrows** indicate sequential activation of consecutive bipoles of multielectrode catheter spanning 100% of the atrial fibrillation cycle length.

- Ablation at dispersion areas terminated AF in 95% of the 105 patients

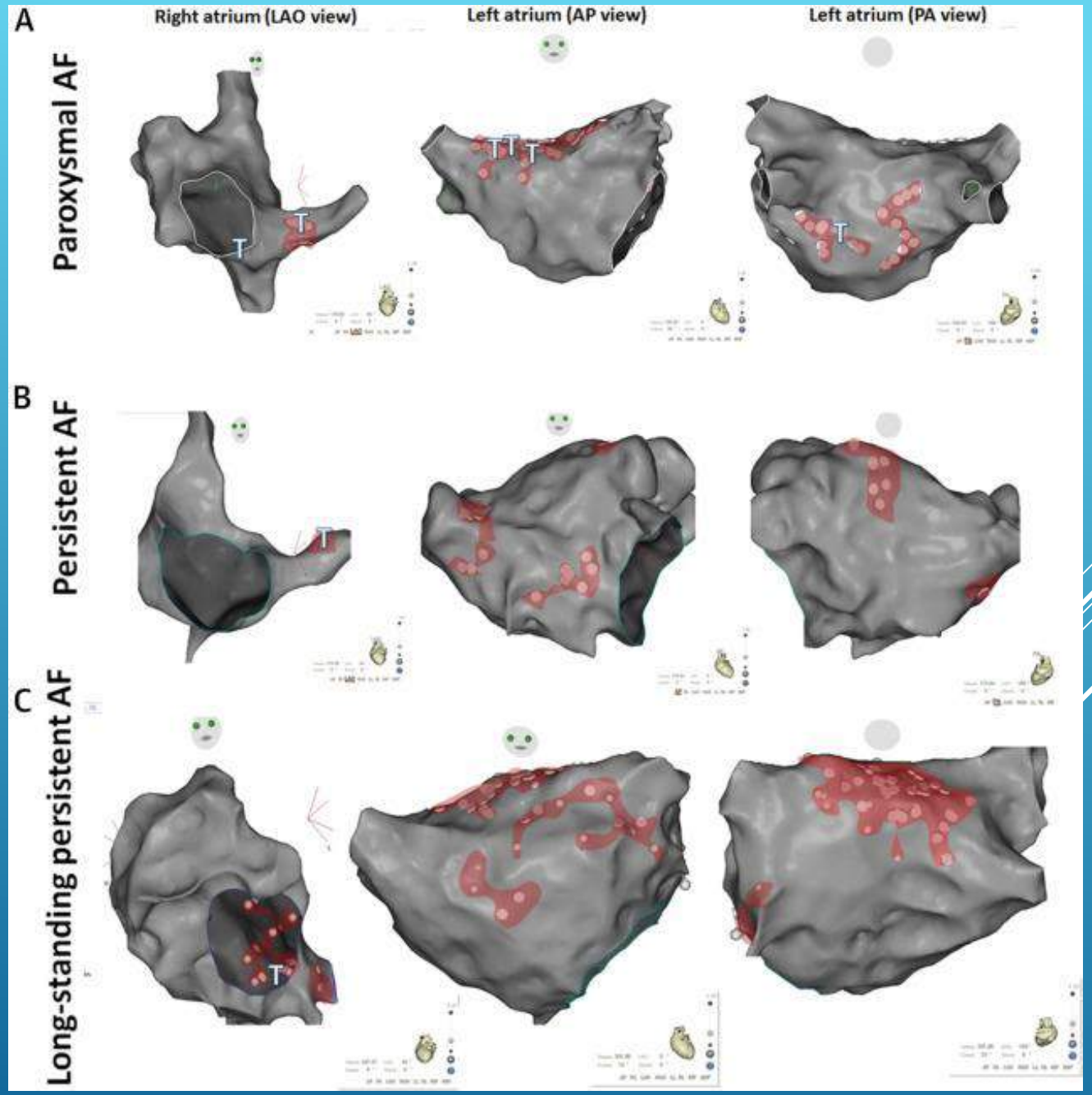
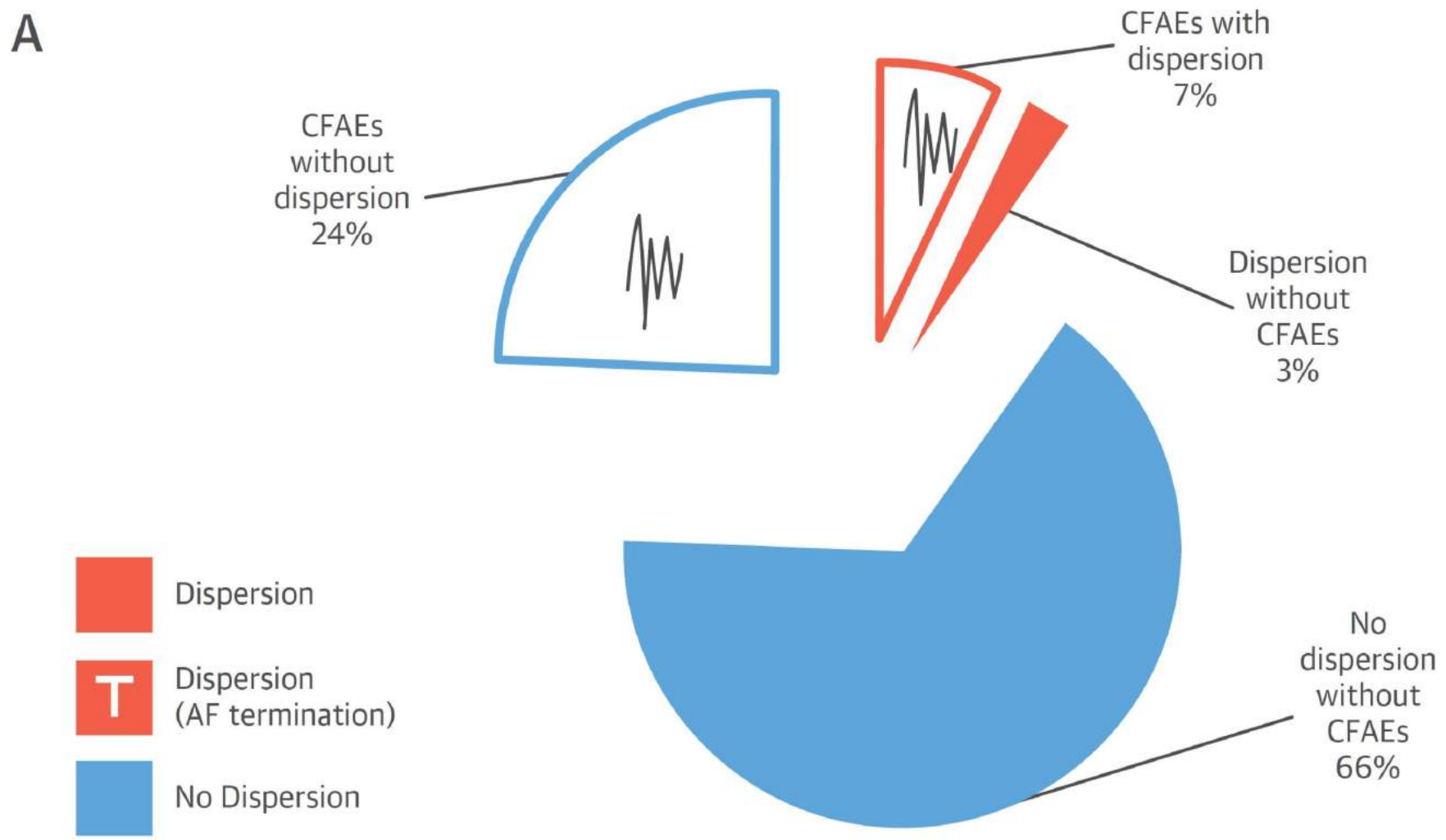


FIGURE 6 Signal Analysis



CENTRAL ILLUSTRATION **Wholly Patient-Tailored Ablation Approach Guided by Spatiotemporal Dispersion of Electrograms**

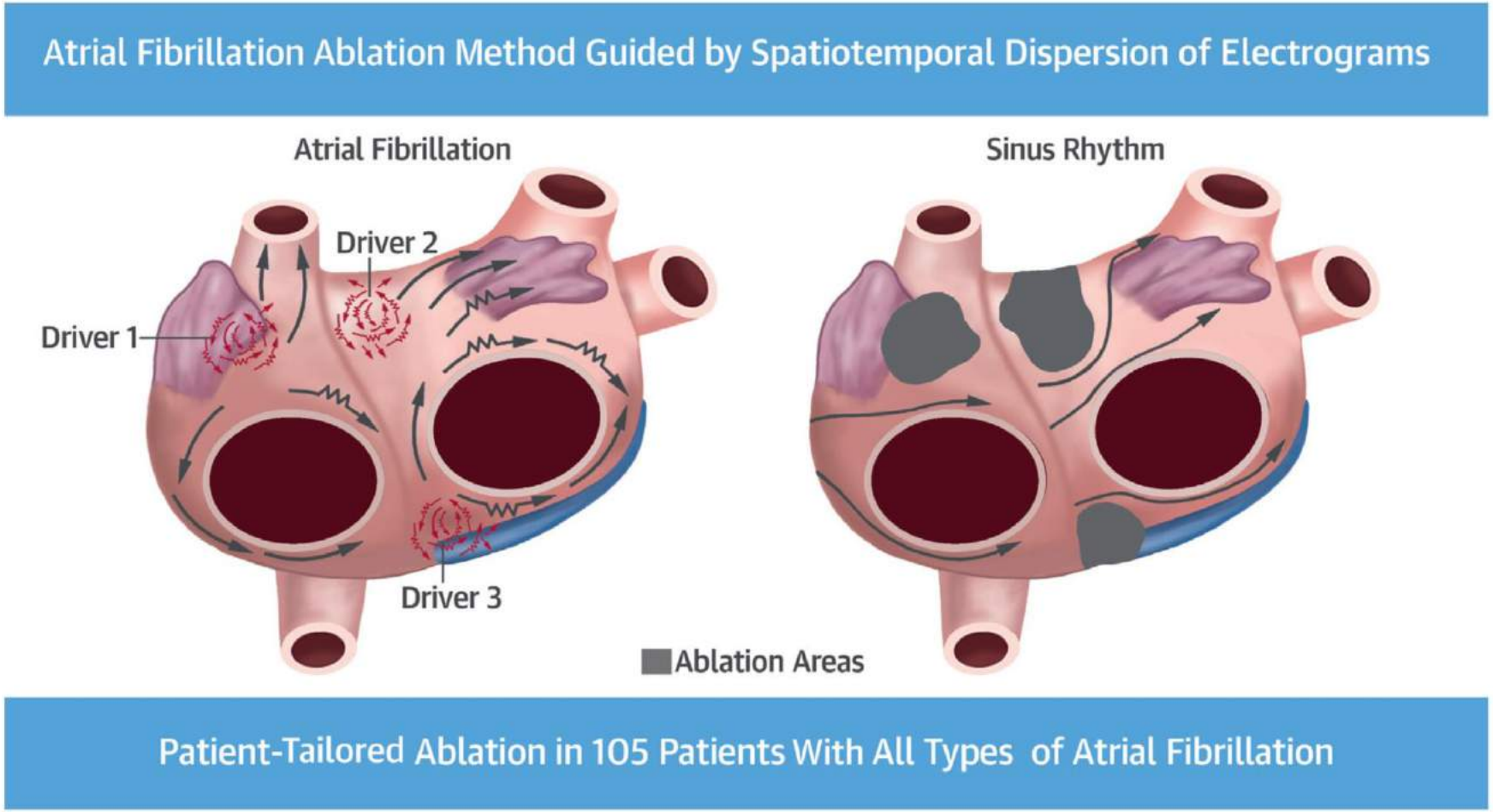
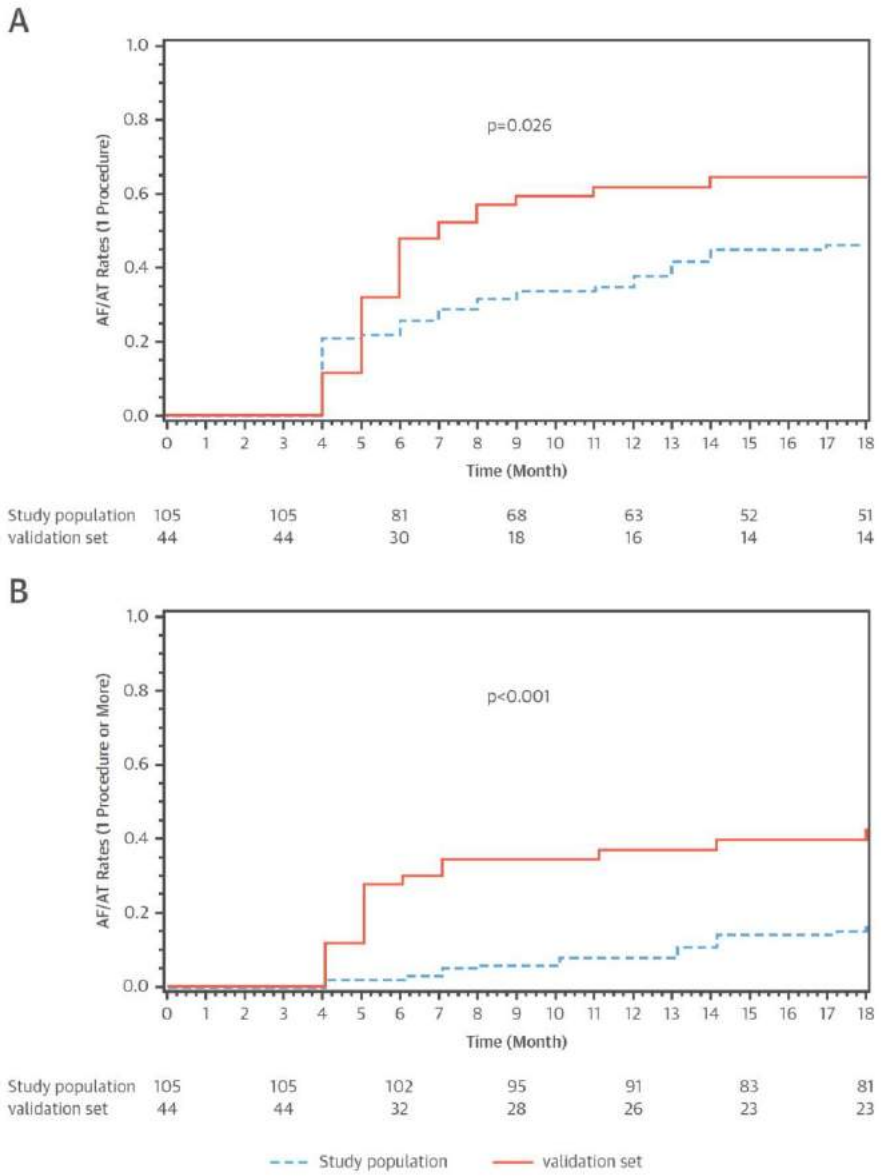
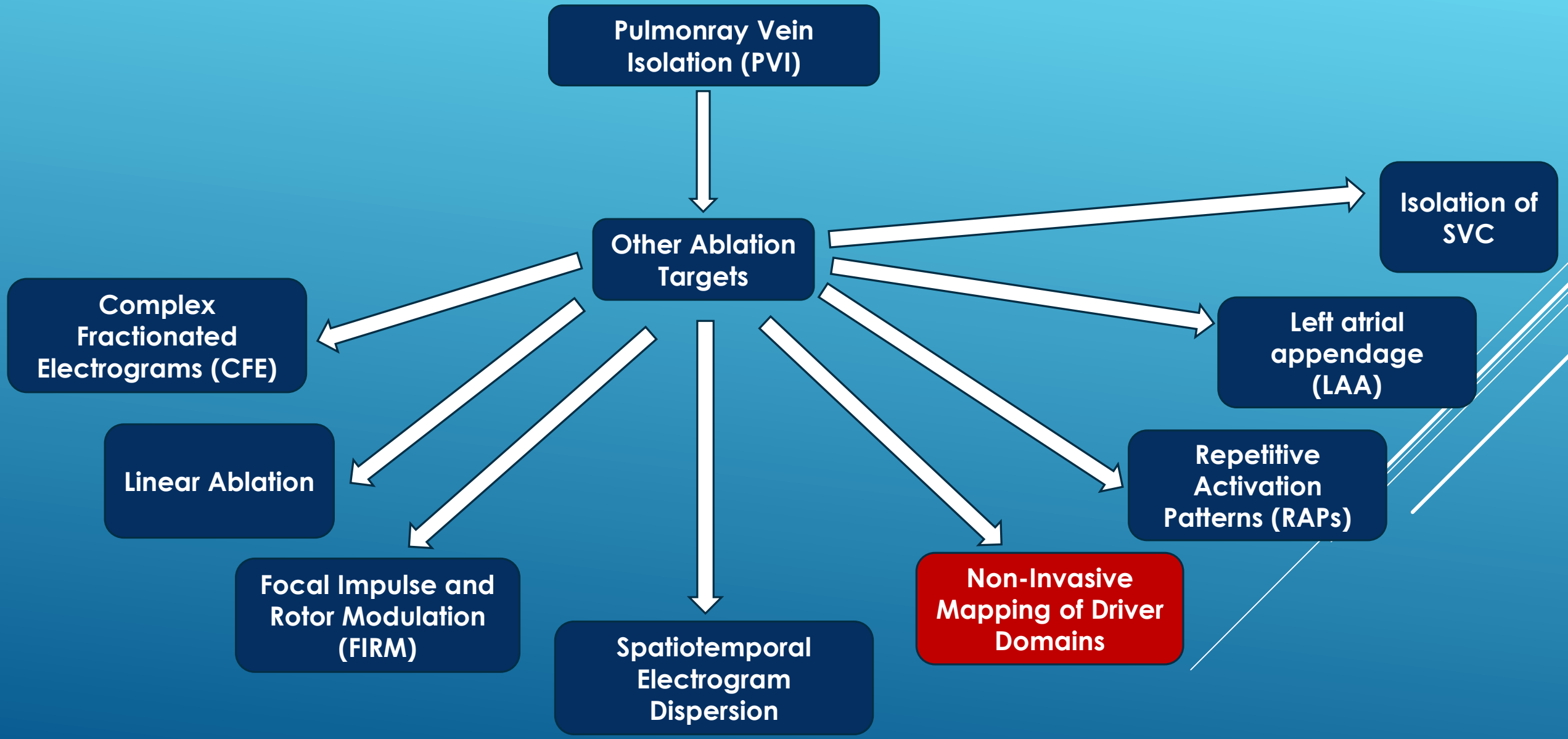


FIGURE 5 18-Month Outcome



Kaplan-Meier curves show atrial fibrillation (AF)/atrial tachycardia (AT) recurrence rates after **(A)** a single procedure and after **(B)** multiple procedures in the study population and the validation set.

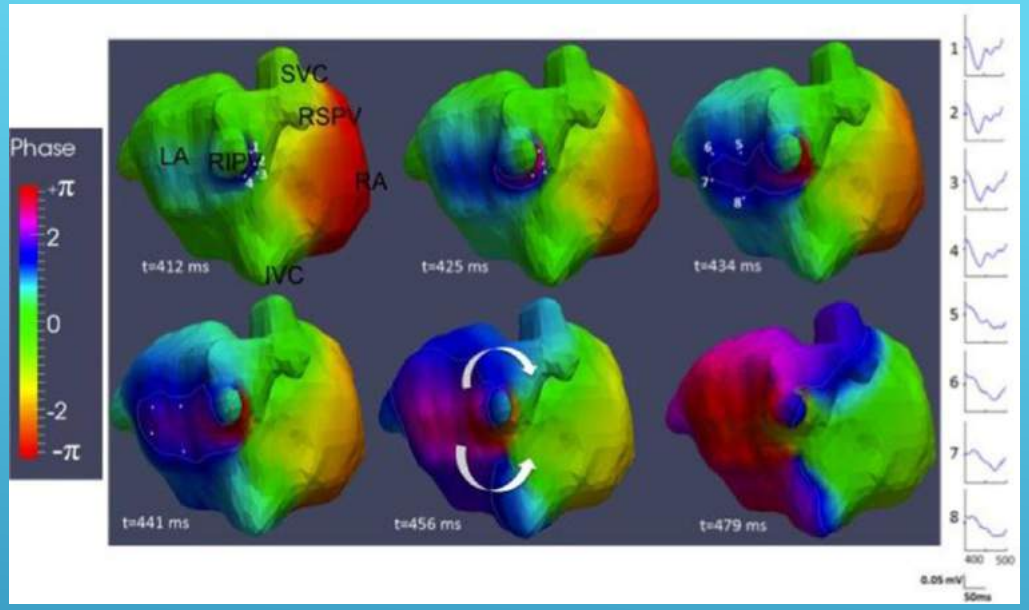
Ablation Strategies in Atrial Fibrillation

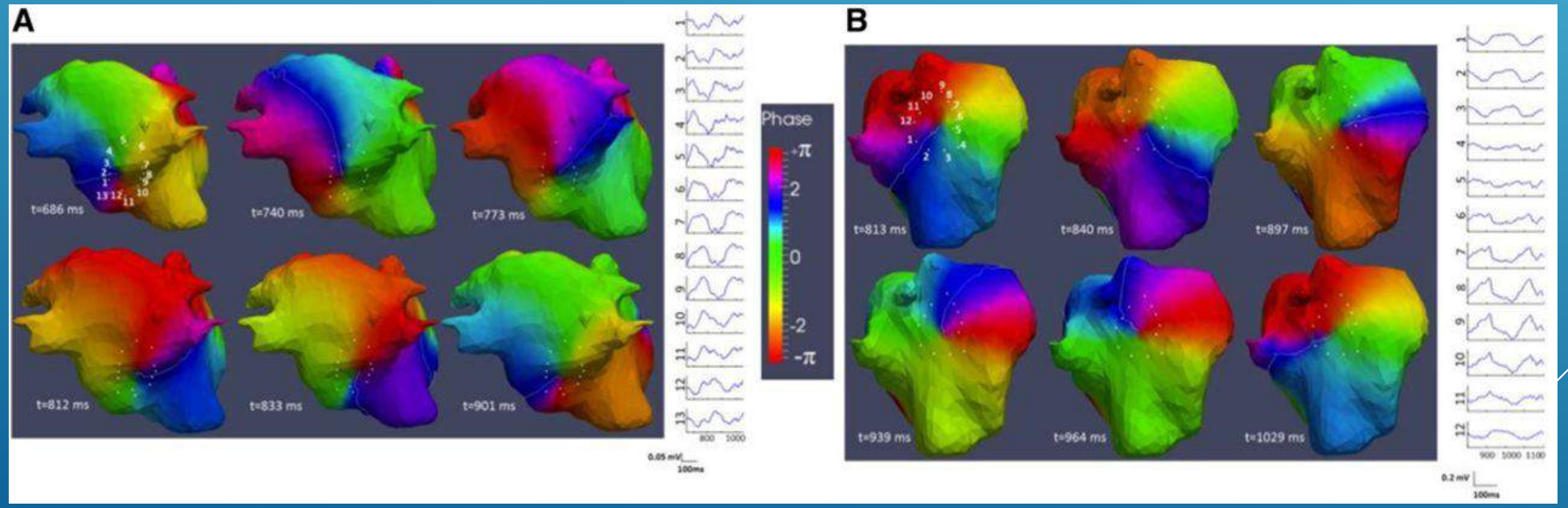


Arrhythmia/Electrophysiology

Driver Domains in Persistent Atrial Fibrillation

Michel Haissaguerre, MD; Meleze Hocini, MD; Arnaud Denis, MD; Ashok J. Shah, MD; Yuki Komatsu, MD; Seigo Yamashita, MD; Matthew Daly, MD; Sana Amraoui, MD; Stephan Zellerhoff, MD; Marie-Quitterie Picat, MD; Adam Quotb, PhD; Laurence Jesel, MD; Han Lim, MD; Sylvain Ploux, MD; Pierre Bordachar, MD; Guillaume Attuel, PhD; Valentin Meillet, MSc; Philippe Ritter, MD; Nicolas Derval, MD; Frederic Sacher, MD; Olivier Bernus, PhD; Hubert Cochet, MD; Pierre Jais, MD; Remi Dubois, PhD





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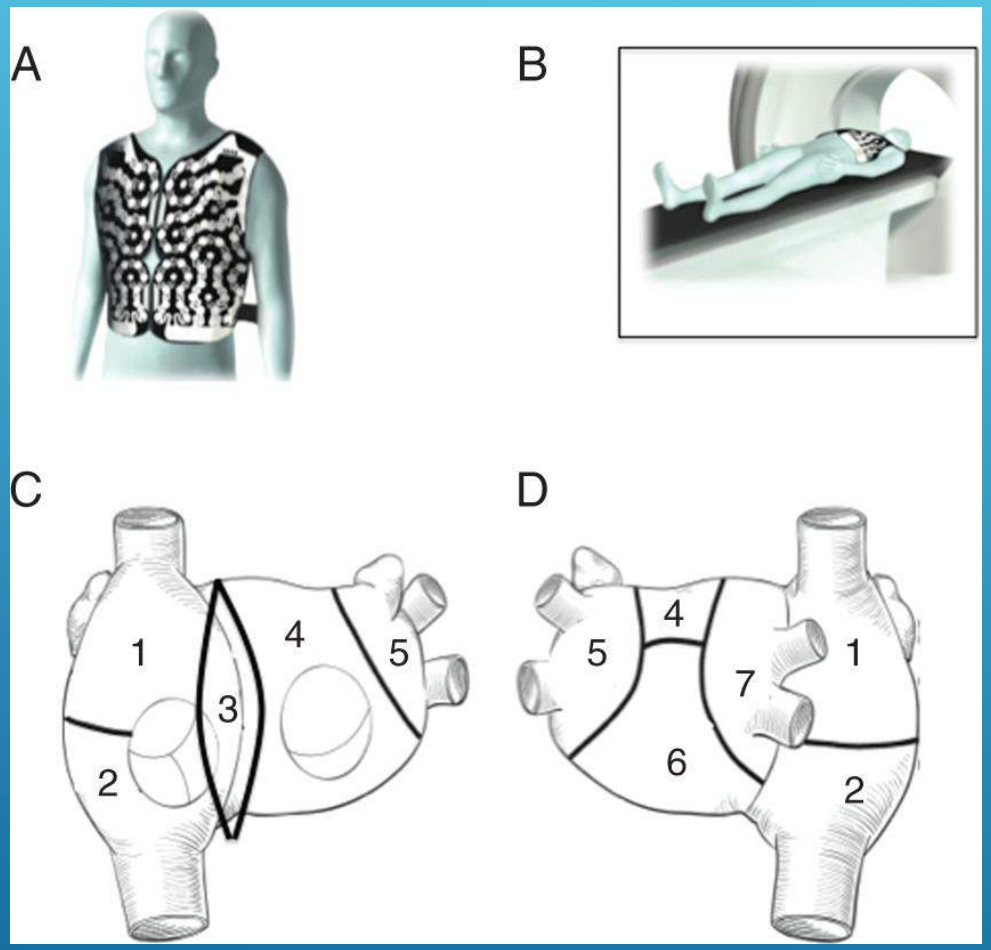
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CLINICAL RESEARCH
Ablation for atrial fibrillation

Multicentre evaluation of non-invasive biatrial mapping for persistent atrial fibrillation ablation: the AFACART study

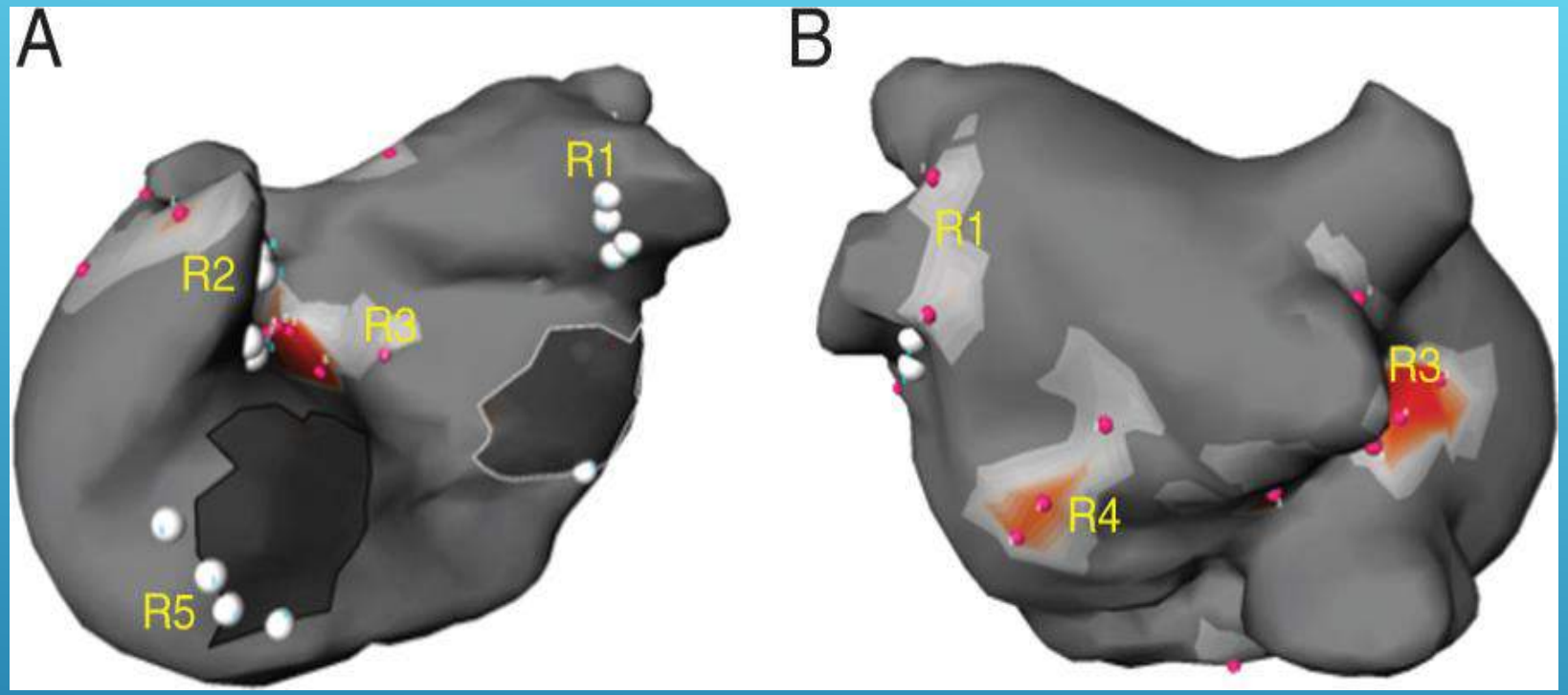
Sébastien Knecht[1,2], Manav Sohal[1,2]*, Isabelle Deisenhofer[3], Jean-Paul Albenque[4], Thomas Arentz[5], Thomas Neumann[6], Bruno Cauchemez[7], Mattias Duytschaever[2], Khaled Ramoul[1], Thierry Verbeet[1], Sonia Thorsten[3], Amir Jadidi[5], Stephane Combes[4], René Tavernier[2], Yves Vandekerckhove[2], Sabine Ernst[8], Douglas Packer[9], and Thomas Rostock[10]

[1]CHU-Brugmann, Brussels, Belgium; [2]Department of Cardiology, AZ Sint-Jan, Ruddershove 10, 8000 Brugge, Belgium; [3]Deutsches Herzzentrum München, Munich, Germany; [4]Clinique Pasteur, Toulouse, France; [5]Universitäts Herzzentrum Freiburg, Bad Krozingen, Germany; [6]Kerkhoff Klinik, Bad Nauheim, Germany; [7]Clinique Ambroise Paré, Paris, France; [8]Biomedical Research Unit, Royal Brompton and Harefield NHS Foundation Trust, Imperial College, London, UK; [9]Mayo Clinic, Rochester, NY, USA; and [10]II. Medizinische Klinik und Poliklinik, Universitätsmedizin Mainz, Mainz, Germany

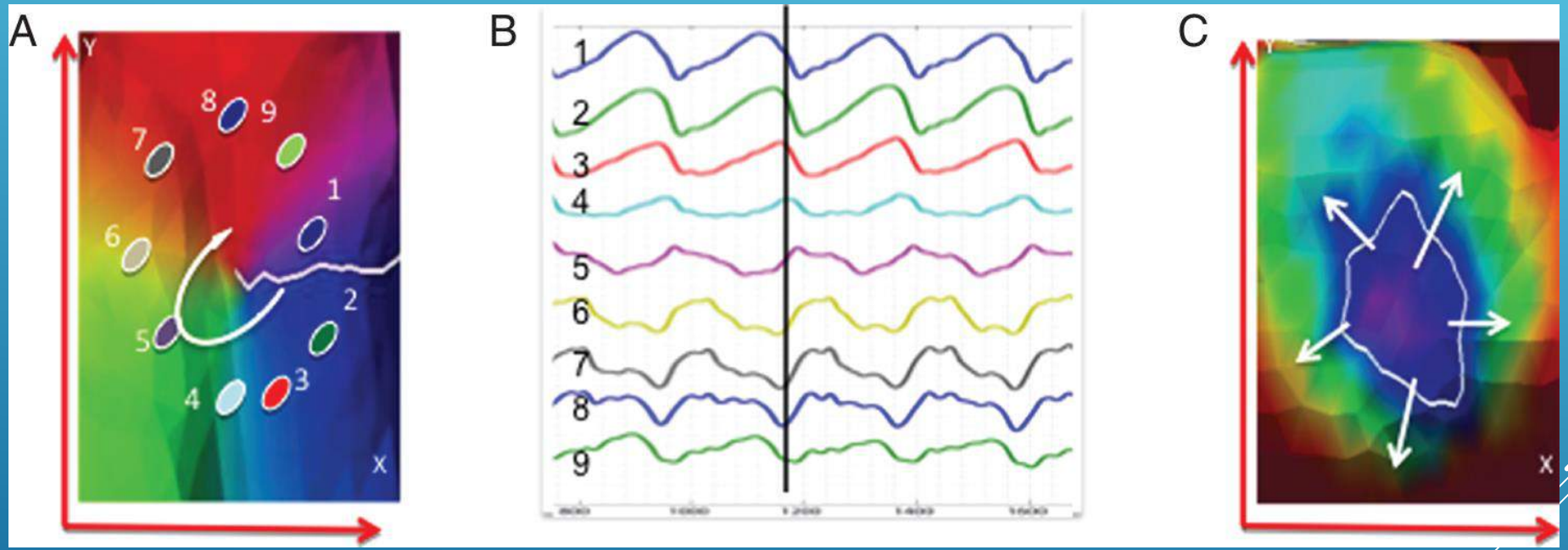


- patient-specific cumulative biatrial spatiotemporal density map generated by the ECVUE system.
- A model patient wearing the 252-electrode vest before undergoing a non-contrast CT scan.
- Biatrial anatomy was then segmented and the multiple AF windows mapped. Biatrial anatomy was divided into 7 regions

NON-INVASIVE MAPPING SYSTEM



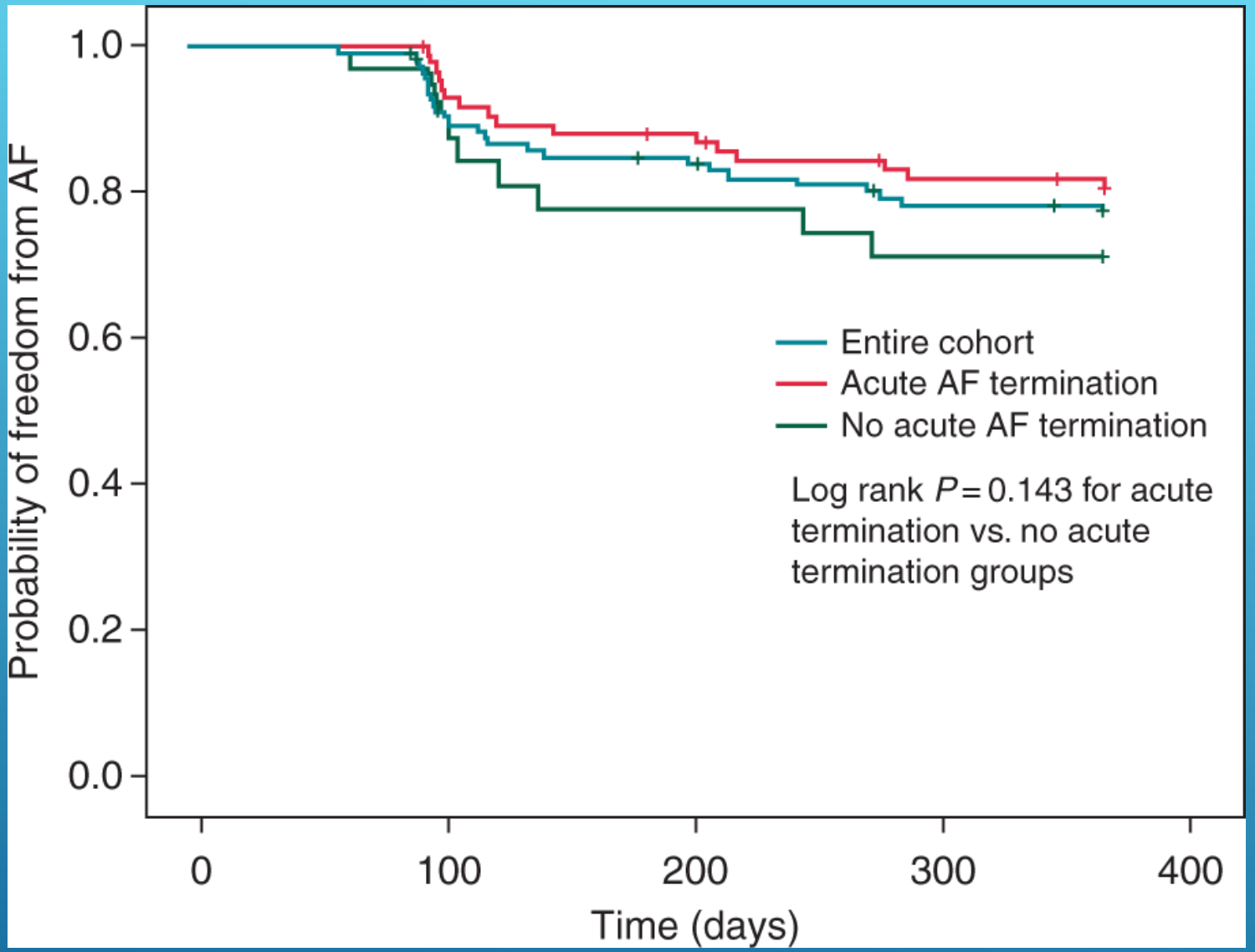
- Regions in light grey and red represent areas with the highest density of re-entrant core trajectories during the entire recording period
- Focal breakthroughs are depicted by the white dots


A
Y
X
1
2
3
4
5
6
7
8
9
B
1
2
3
4
5
6
7
8
9
C
X

ELECTROPHYSIOLOGICAL PROCEDURE AND RADIOFREQUENCY ABLATION

non-randomized multicentre study 118 Patients

- Step 1: ablation of patient-specific AF drivers mapped by the ECVUE system (including the PVs if implicated)
- Step 2: isolation of the 4 PVs
- Step 3: linear lesion at the roof and the mitral isthmus



The Kaplan–Meier curves of the probability of AF freedom at 1 year.

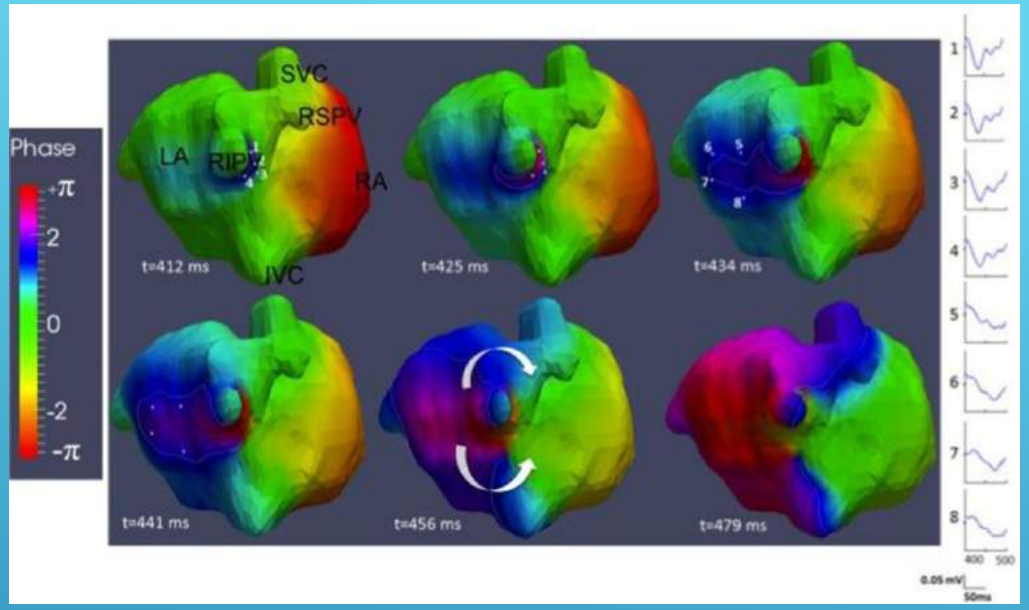
At 1 year, 77% of the patients were free from recurrent AF.

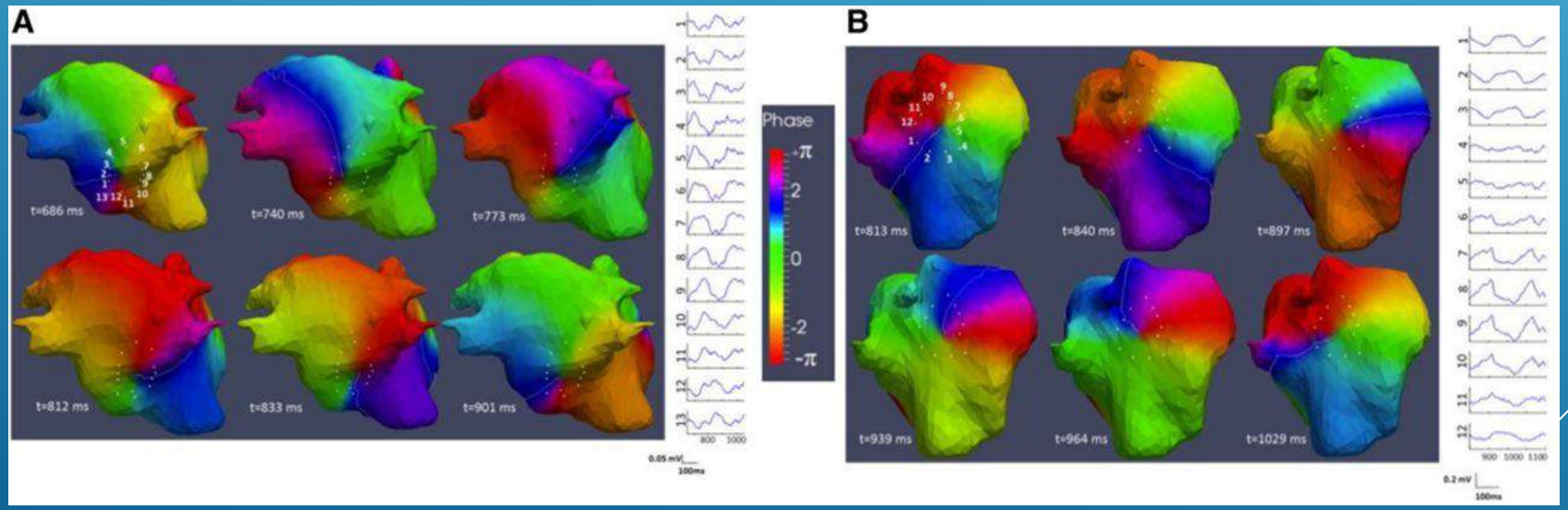
The rates for patients with and without acute AF termination at the index procedure were 80 and 67%, respectively.

Arrhythmia/Electrophysiology

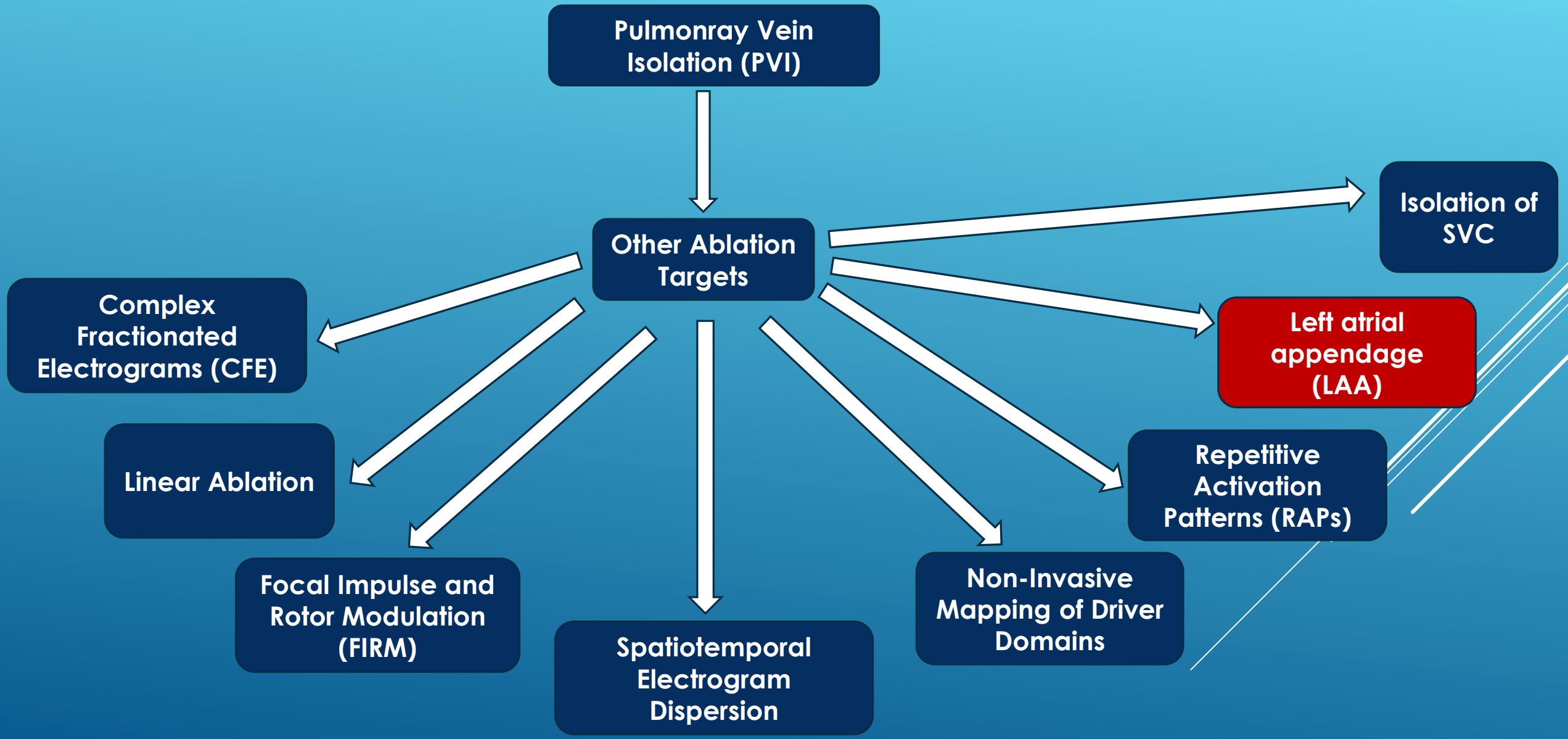
Driver Domains in Persistent Atrial Fibrillation

Michel Haissaguerre, MD; Meleze Hocini, MD; Arnaud Denis, MD; Ashok J. Shah, MD; Yuki Komatsu, MD; Seigo Yamashita, MD; Matthew Daly, MD; Sana Amraoui, MD; Stephan Zellerhoff, MD; Marie-Quitterie Picat, MD; Adam Quotb, PhD; Laurence Jesel, MD; Han Lim, MD; Sylvain Ploux, MD; Pierre Bordachar, MD; Guillaume Attuel, PhD; Valentin Meillet, MSc; Philippe Ritter, MD; Nicolas Derval, MD; Frederic Sacher, MD; Olivier Bernus, PhD; Hubert Cochet, MD; Pierre Jais, MD; Remi Dubois, PhD





Ablation Strategies in Atrial Fibrillation

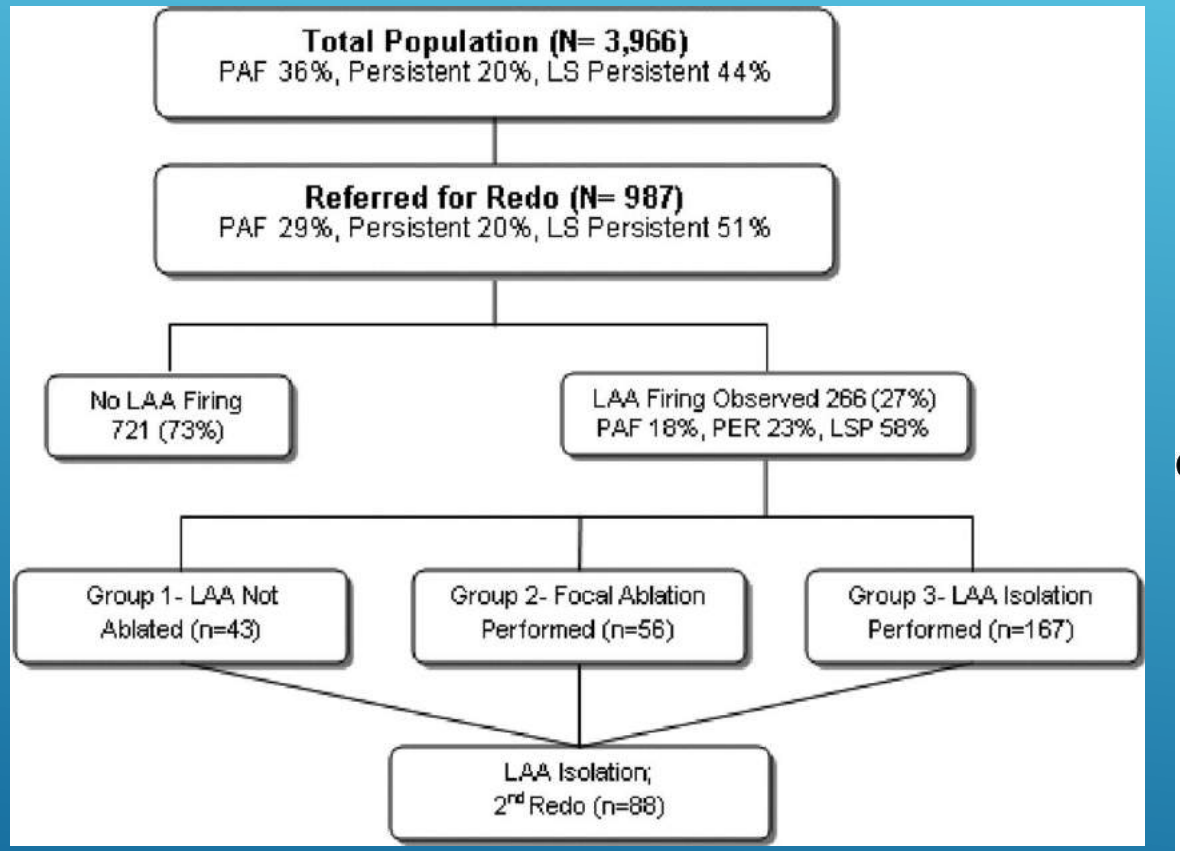


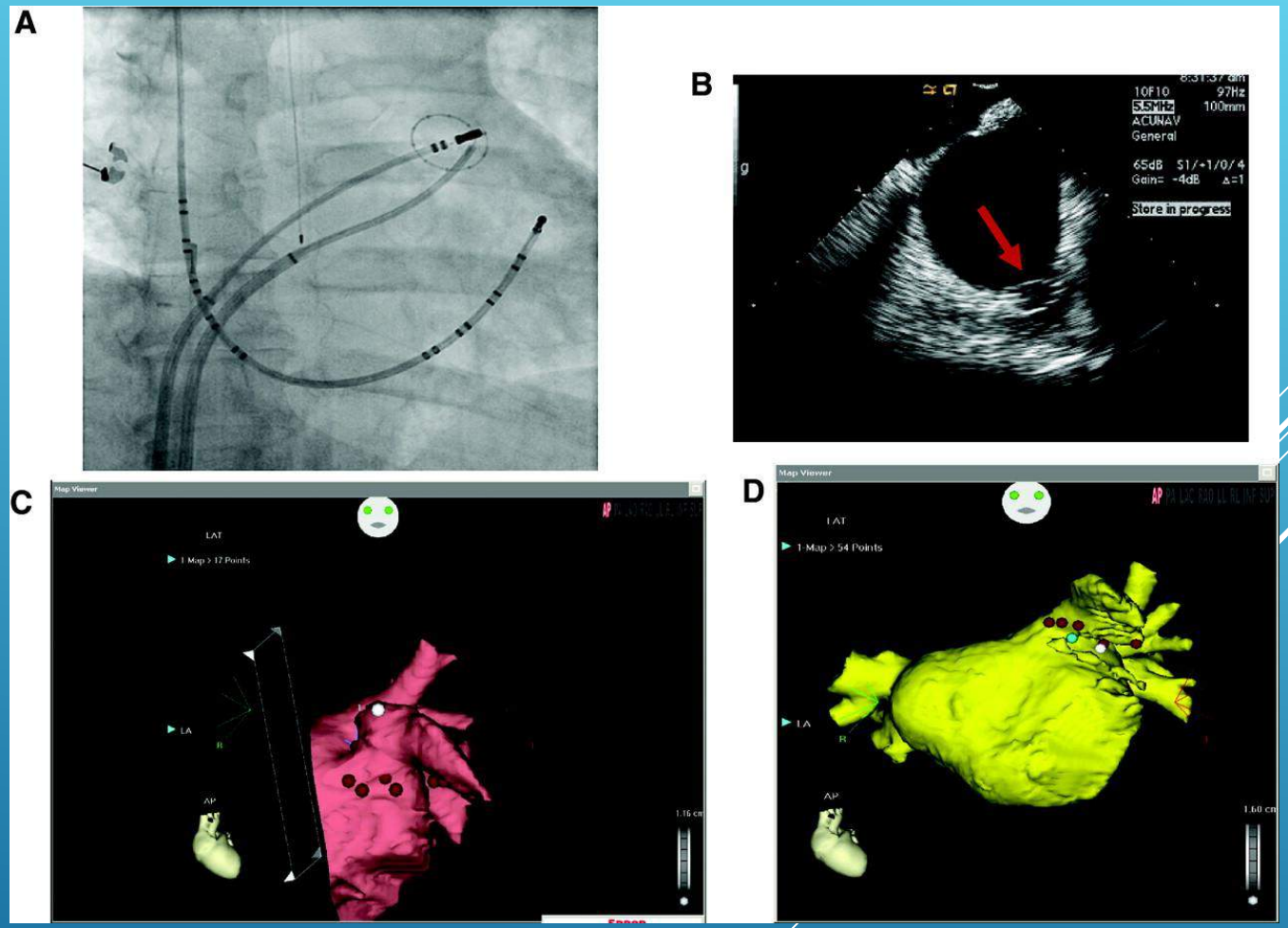
Arrhythmia/Electrophysiology

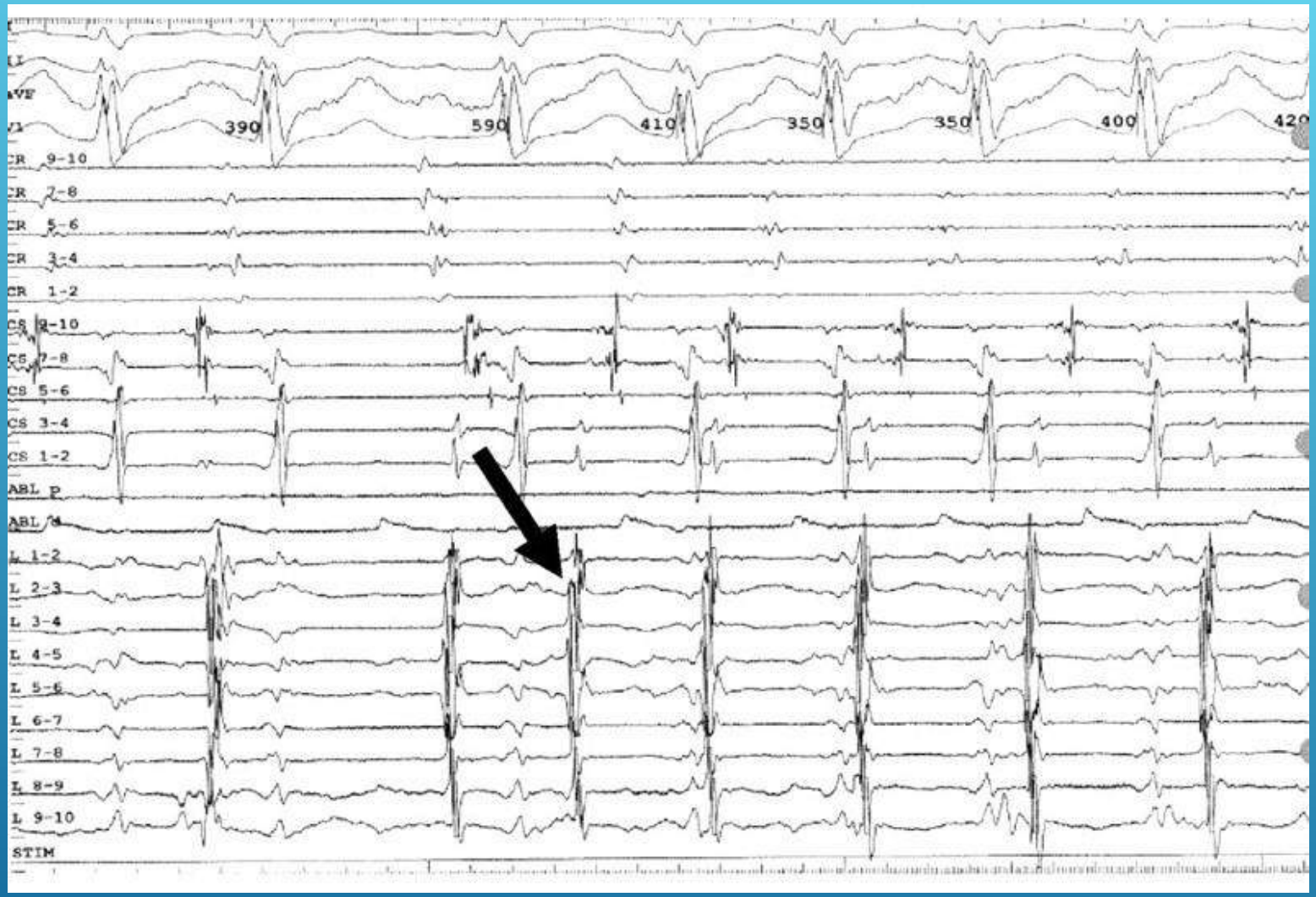
Left Atrial Appendage

An Underrecognized Trigger Site of Atrial Fibrillation

Luigi Di Biase, MD; J. David Burkhardt, MD; Prasant Mohanty, MBBS, MPH; Javier Sanchez, MD; Sanghamitra Mohanty, MD; Rodney Horton, MD; G. Joseph Gallinghouse, MD; Shane M. Bailey, MD; Jason D. Zagrodzky, MD; Pasquale Santangeli, MD; Steven Hao, MD; Richard Hongo, MD; Salwa Beheiry, MD; Sakis Themistoclakis, MD; Aldo Bonso, MD; Antonio Rossillo, MD; Andrea Corrado, MD; Antonio Raviele, MD; Amin Al-Ahmad, MD; Paul Wang, MD; Jennifer E. Cummings, MD; Robert A. Schweikert, MD; Gemma Pelargonio, MD; Antonio Dello Russo, MD; Michela Casella, MD; Pietro Santarelli, MD; William R. Lewis, MD; Andrea Natale, MD, FHRS


Total Population (N= 3,966)
PAF 36%, Persistent 20%, LS Persistent 44%
Referred for Redo (N= 987)
PAF 29%, Persistent 20%, LS Persistent 51%
No LAA Firing
721 (73%)
LAA Firing Observed 266 (27%)
PAF 18%, PER 23%, LSP 58%
Group 1- LAA Not Ablated (n=43)
Group 2- Focal Ablation Performed (n=56)
Group 3- LAA Isolation Performed (n=167)
LAA Isolation; 2nd Redo (n=88)


A
B
C
D
Store in progress
1 Map > 12 Points
1 Map > 54 Points


390
590
410
350
350
400
420
CR 9-10
CR 7-8
CR 5-6
CR 3-4
CR 1-2
CS 9-10
CS 7-8
CS 5-6
CS 3-4
CS 1-2
ABL p
ABL d
L 1-2
L 2-3
L 3-4
L 4-5
L 5-6
L 6-7
L 7-8
L 8-9
L 9-10
STIM

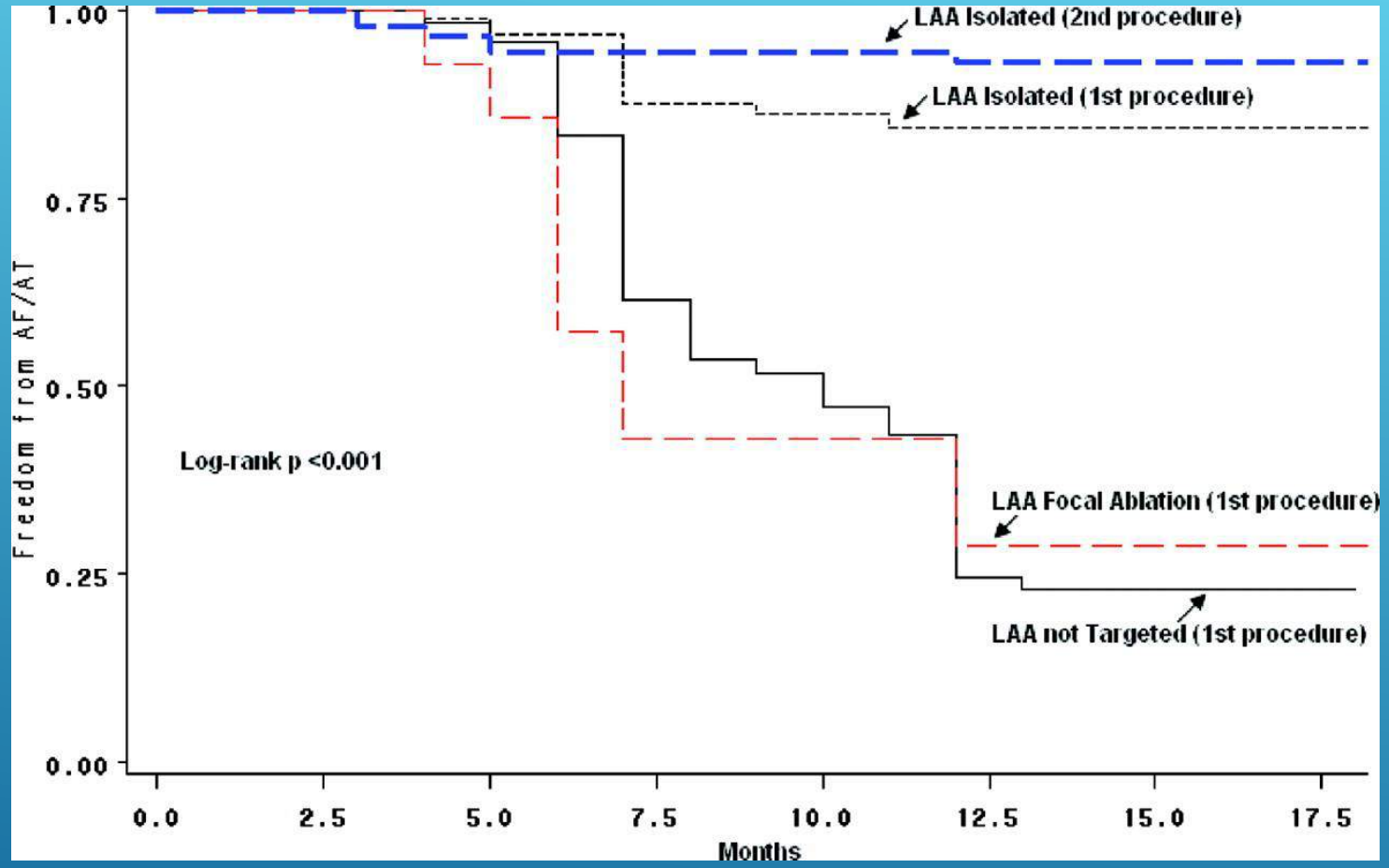
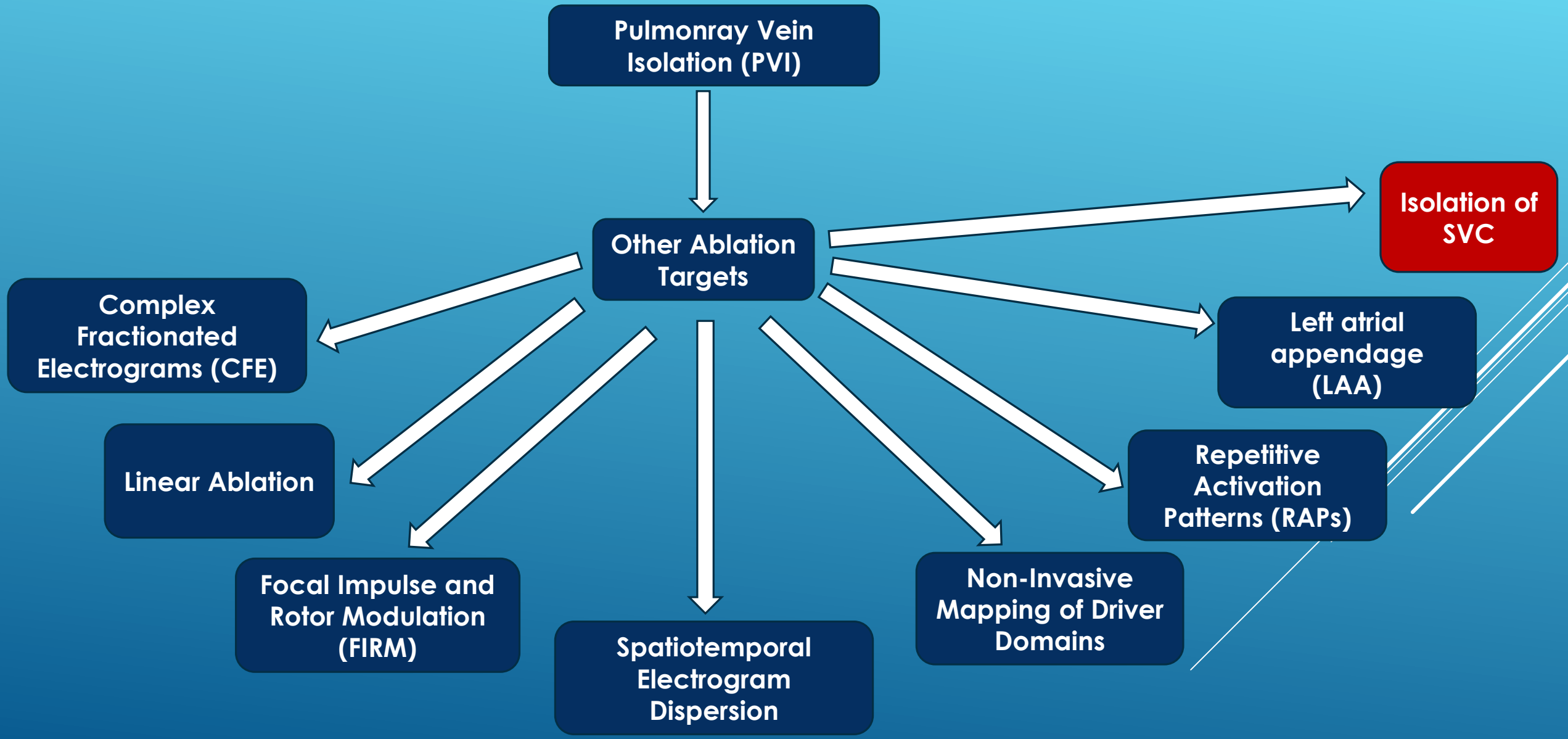


Table 2. Recurrences by AF Type

AF Type	Group 1 (n=43), n (%)	Group 2 (n=56), n (%)	Group 3 (n=167)	Log-Rank *P* (Comparing Groups 1 Through 3)
Paroxysmal	3 (9)	3 (8)	1 (4)	
Persistent	9 (28)	12 (32)	7 (28)	
Long-standing persistent	20 (63)	23 (60)	17 (68)	
Total recurrences	32 (74)	38 (68)	25 (15)	<0.001

Ablation Strategies in Atrial Fibrillation



IMPACT OF SYSTEMATIC ISOLATION OF SUPERIOR VENA CAVA IN ADDITION TO PULMONARY VEIN ANTRUM ISOLATION ON THE OUTCOME OF PAROXYSMAL, PERSISTENT, AND PERMANENT ATRIAL FIBRILLATION ABLATION: RESULTS FROM A RANDOMIZED STUDY

ANDREA CORRADO M.D. ALDO BONSO M.D. MICHELA MADALOSSO M.D. ANTONIO ROSSILLO M.D. SAKIS THEMISTOCLAKIS M.D. LUIGI DI BIASE M.D. ANDREA NATALE M.D. ANTONIO RAVIELE M.D.

- A total of 320 consecutive patients who had been referred to our center in order to undergo a first attempt of AF ablation were randomized into 2 groups. Group I (160 patients) underwent PVAI only; Group II (160 patients) underwent PVAI and SVCI.

- Comparison of the outcome data between the 2 groups, after a follow-up of 12 months, revealed a significant difference in total procedural success solely with patients manifesting paroxysmal atrial fibrillation (56/73 [77%] Group I vs. 55/61 [90%] Group II; P = 0.04; OR 2.78).