

Ablation Methods for Atrial Fibrillation

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

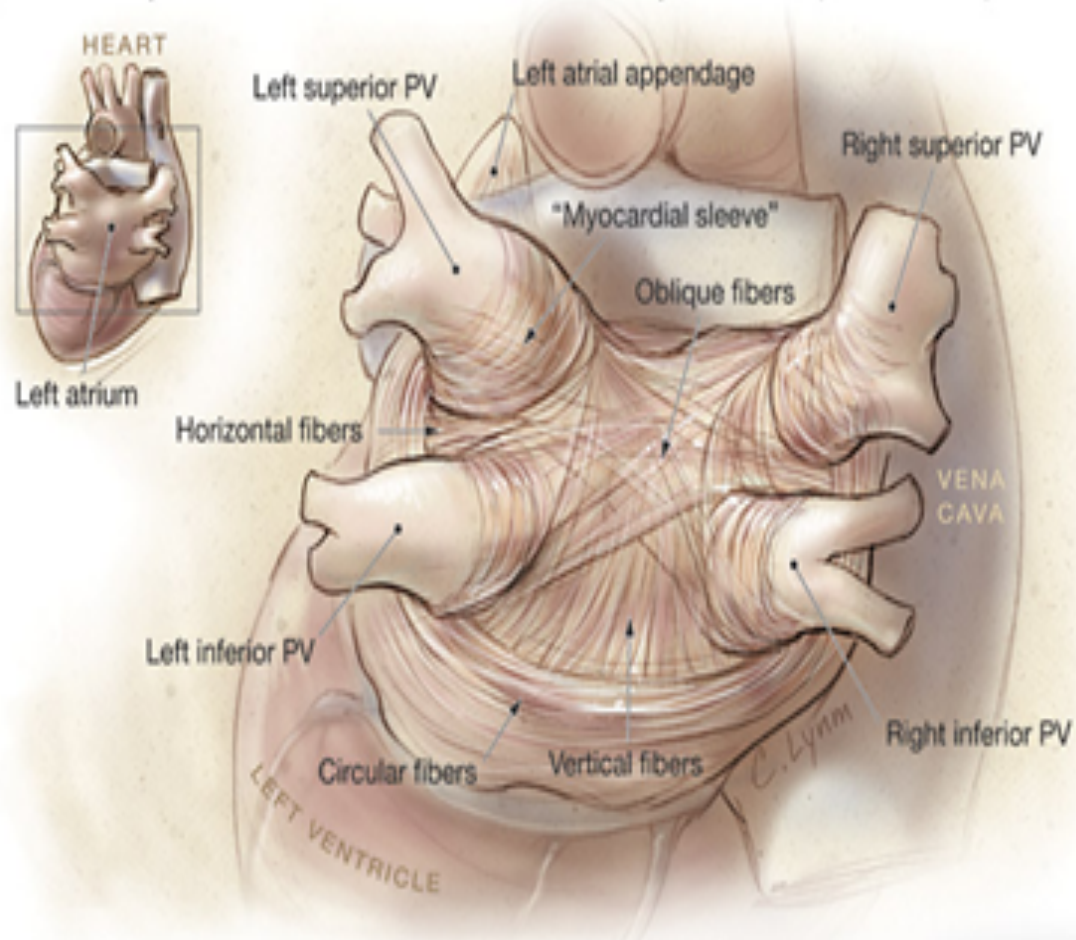
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ABSTRACT

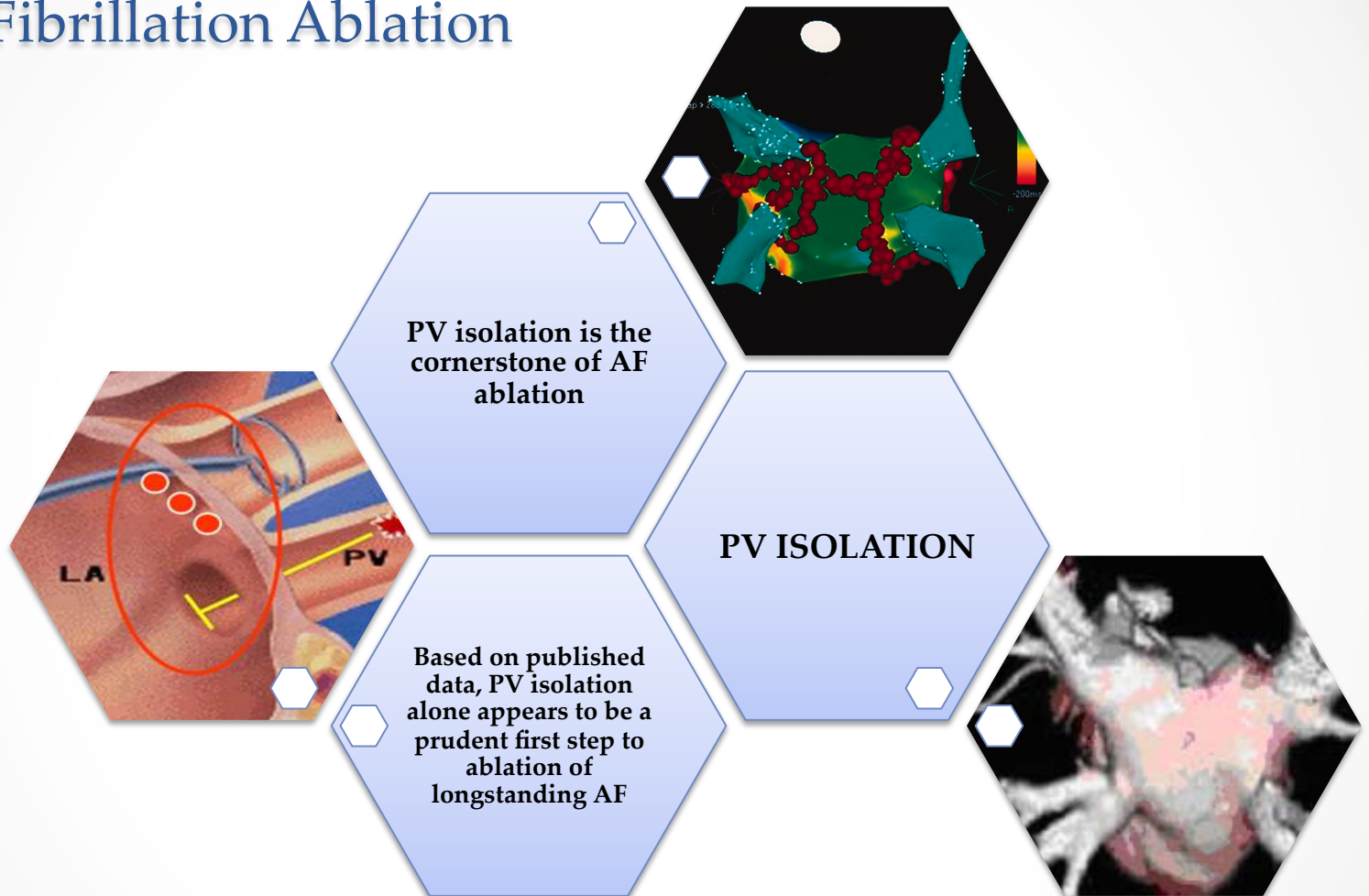
Background Atrial fibrillation, the most common sustained cardiac arrhythmia and a major cause of stroke, results from simultaneous reentrant wavelets. Its spontaneous initiation has not been studied.

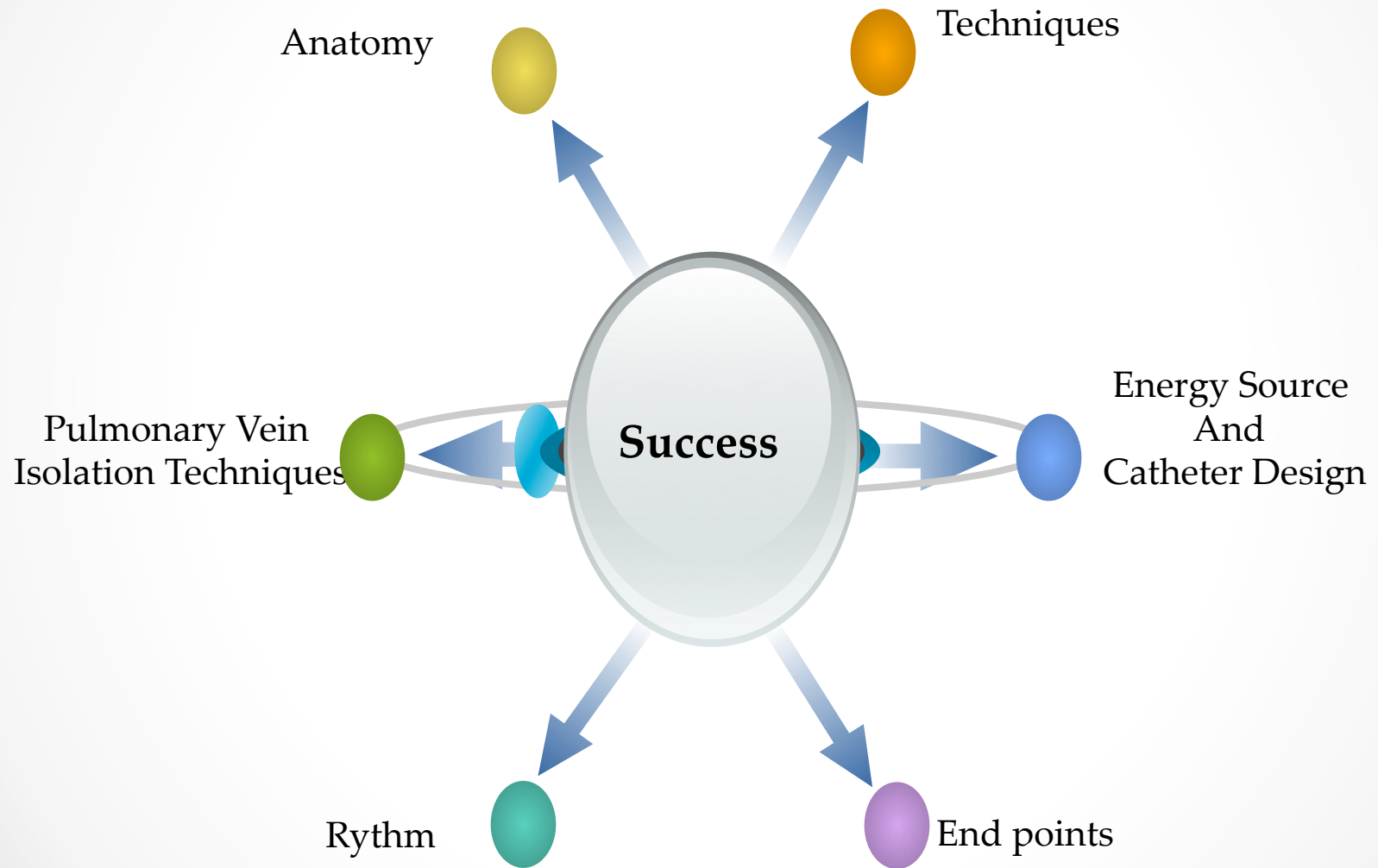
Methods We studied 45 patients with frequent episodes of atrial fibrillation (mean [\pm SD] duration, 344 ± 326 minutes per 24 hours) refractory to drug therapy. The spontaneous initiation of atrial fibrillation was mapped with the use of multielectrode catheters designed to record the earliest electrical activity preceding the onset of atrial fibrillation and associated atrial ectopic beats. The accuracy of the mapping was confirmed by the abrupt disappearance of triggering atrial ectopic beats after ablation with local radio-frequency energy.

Pattern of Myocardial Fibers of Left Atrium and Pulmonary Vein Trunks (Posterior View)

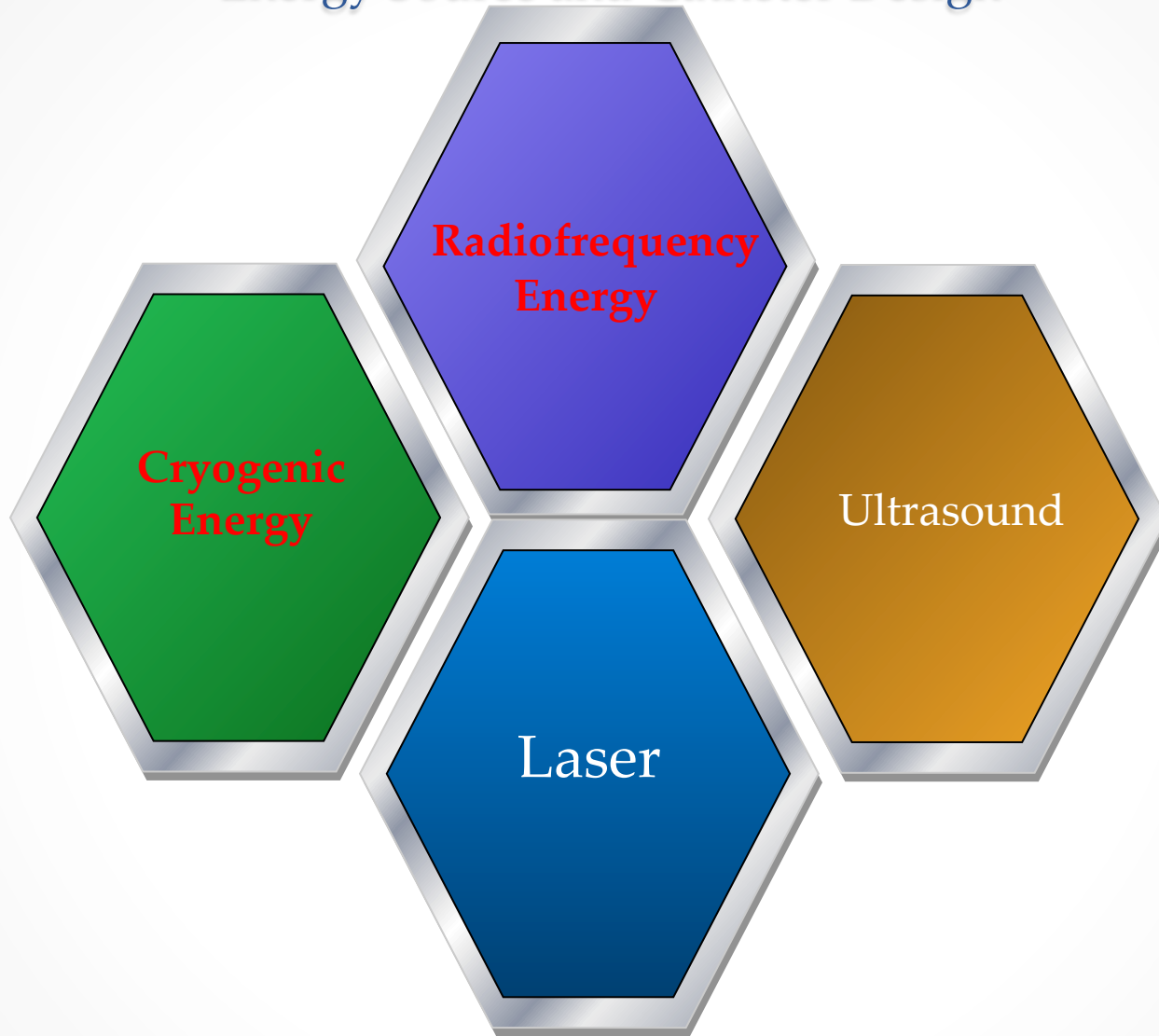


Atrial Fibrillation Ablation

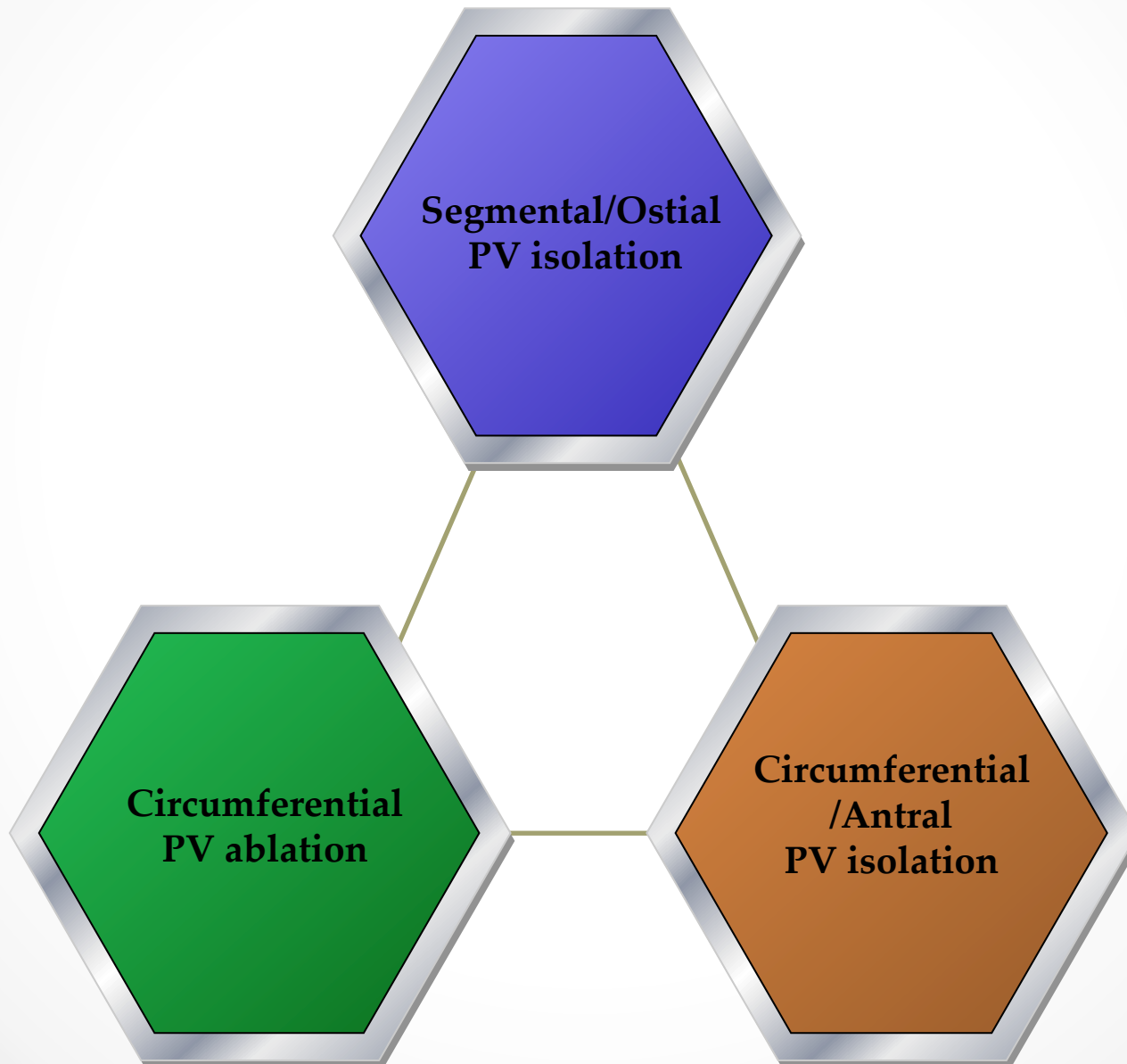


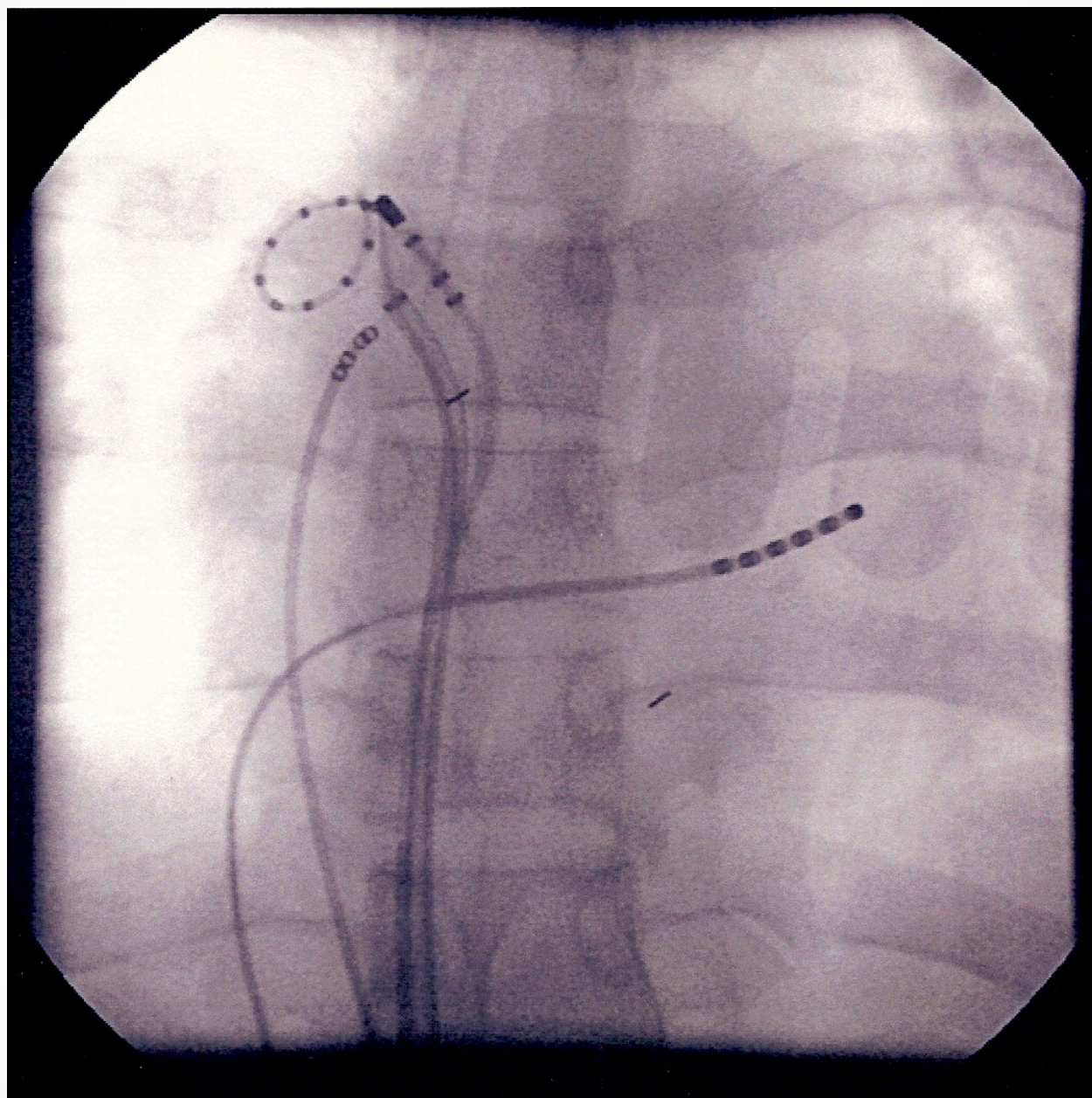


Energy Source and Catheter Design



Pulmonary Vein Isolation Techniques





Tools Used During Pulmonary Vein Isolation for Atrial Fibrillation

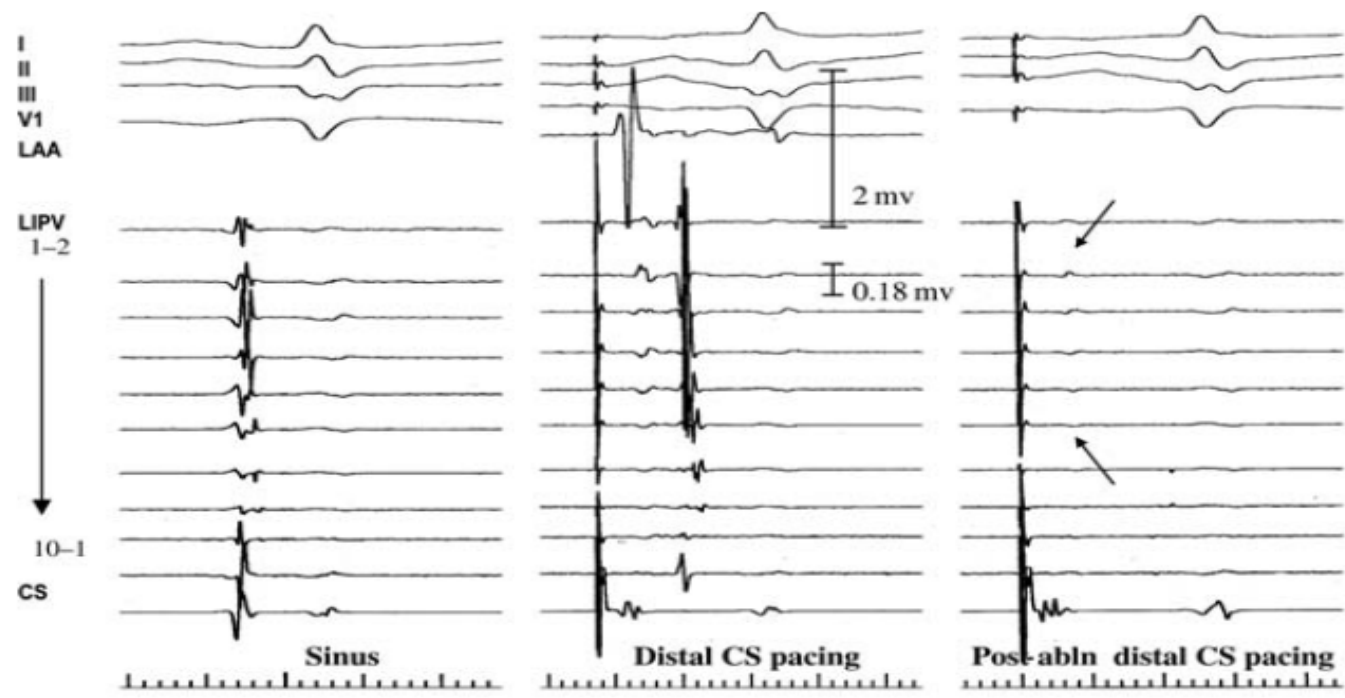
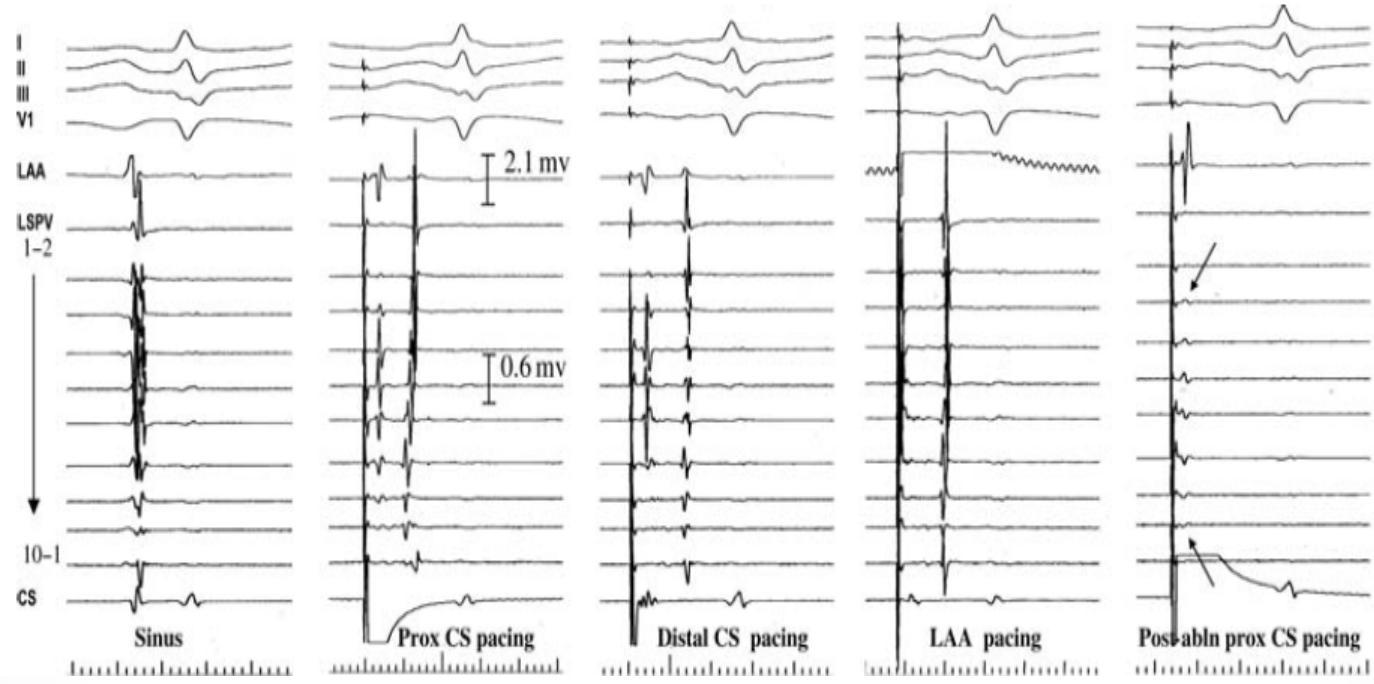
Cooled ablation by internal or external irrigation (preferred)

Ablation with 8-mm-tip

Cryoballoon ablation

Duty-cycled radiofrequency ablation using a circular mapping and ablation catheter

Radiofrequency ablation using a high-density mesh ablator catheter



Non Pulmonary Vein Triggers

- Superior vena cava
- Coronary sinus
- Left atrial appendage
- Crista terminalis
- Inter atrial septum
- Left atrial posterior wall



European Heart Journal
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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)

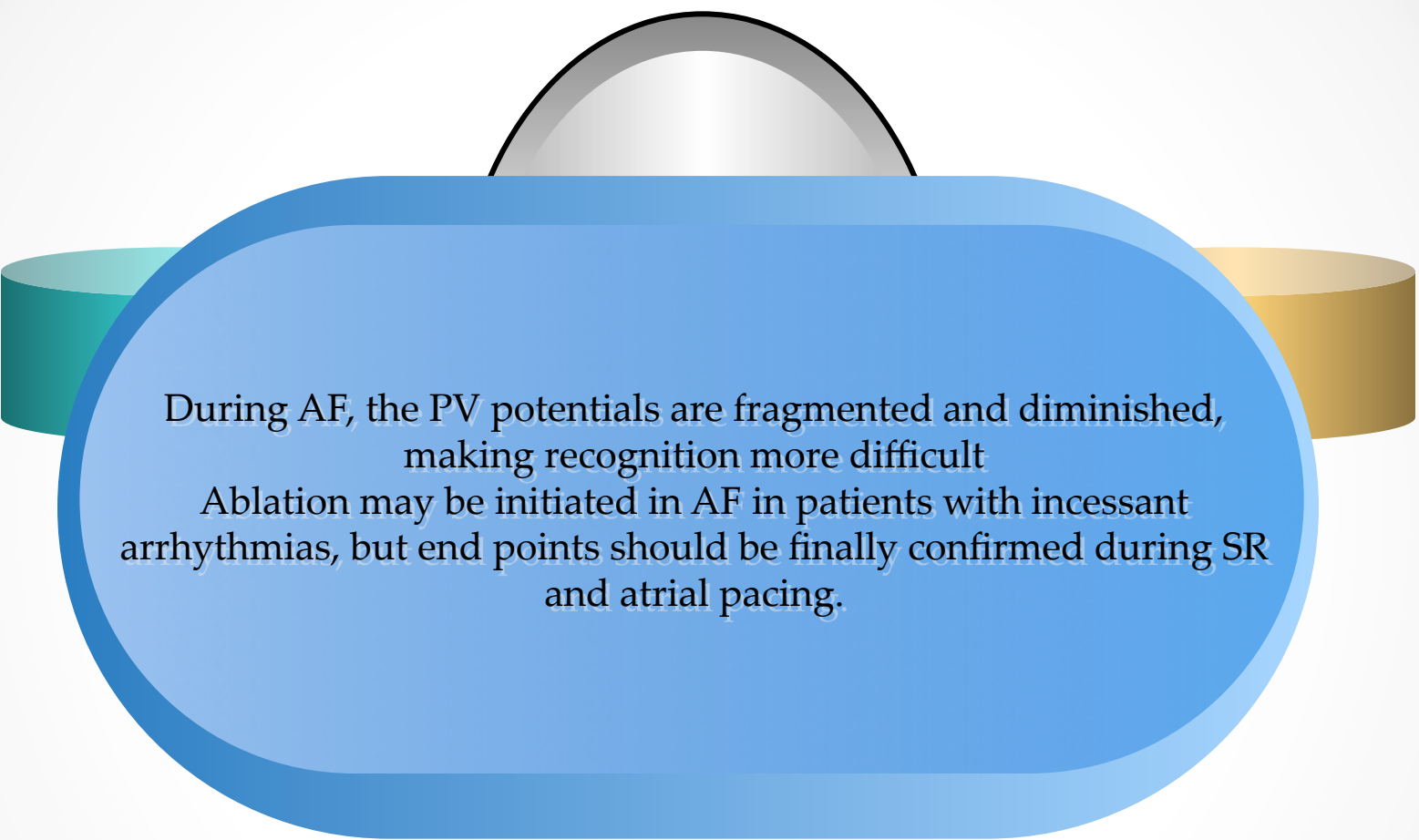
Developed with the special contribution of the European Heart Rhythm Association (EHRA) of the ESC

Catheter ablation of atrial fibrillation and atrial fibrillation surgery (1)

Recommendations	Class	Level
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
Ablation of common atrial flutter should be considered to prevent recurrent flutter as part of an AF ablation procedure if flutter has been documented or occurs during the AF ablation.	IIa	B
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
All patients should receive oral anticoagulation for at least 8 weeks after catheter (IIaB) or surgical (IIaC) ablation.	IIa	B C
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.	IIb	B C
Catheter ablation should target isolation of the pulmonary veins using radiofrequency ablation or cryotherapy balloon catheters.	IIa	B

Catheter ablation of atrial fibrillation and atrial fibrillation surgery (2)

Recommendations	Class	Level
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
AF ablation should be considered as a strategy to avoid pacemaker implantation in patients with AF-related bradycardia.	IIa	C
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
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
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
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
Concomitant biatrial maze or pulmonary vein isolation may be considered in asymptomatic AF patients undergoing cardiac surgery.	IIb	C



During AF, the PV potentials are fragmented and diminished,
making recognition more difficult

Ablation may be initiated in AF in patients with incessant
arrhythmias, but end points should be finally confirmed during SR
and atrial pacing.

Fluoroscopy (biplane, for rapid 3-D estimates)

A

Techniques

3-D Electroanatomic Mapping Systems

B

Intracardiac Echocardiography

C

Magnetic and Robotic Navigation Systems

D

Cryoballoon ablation



Cryoballoon ablation

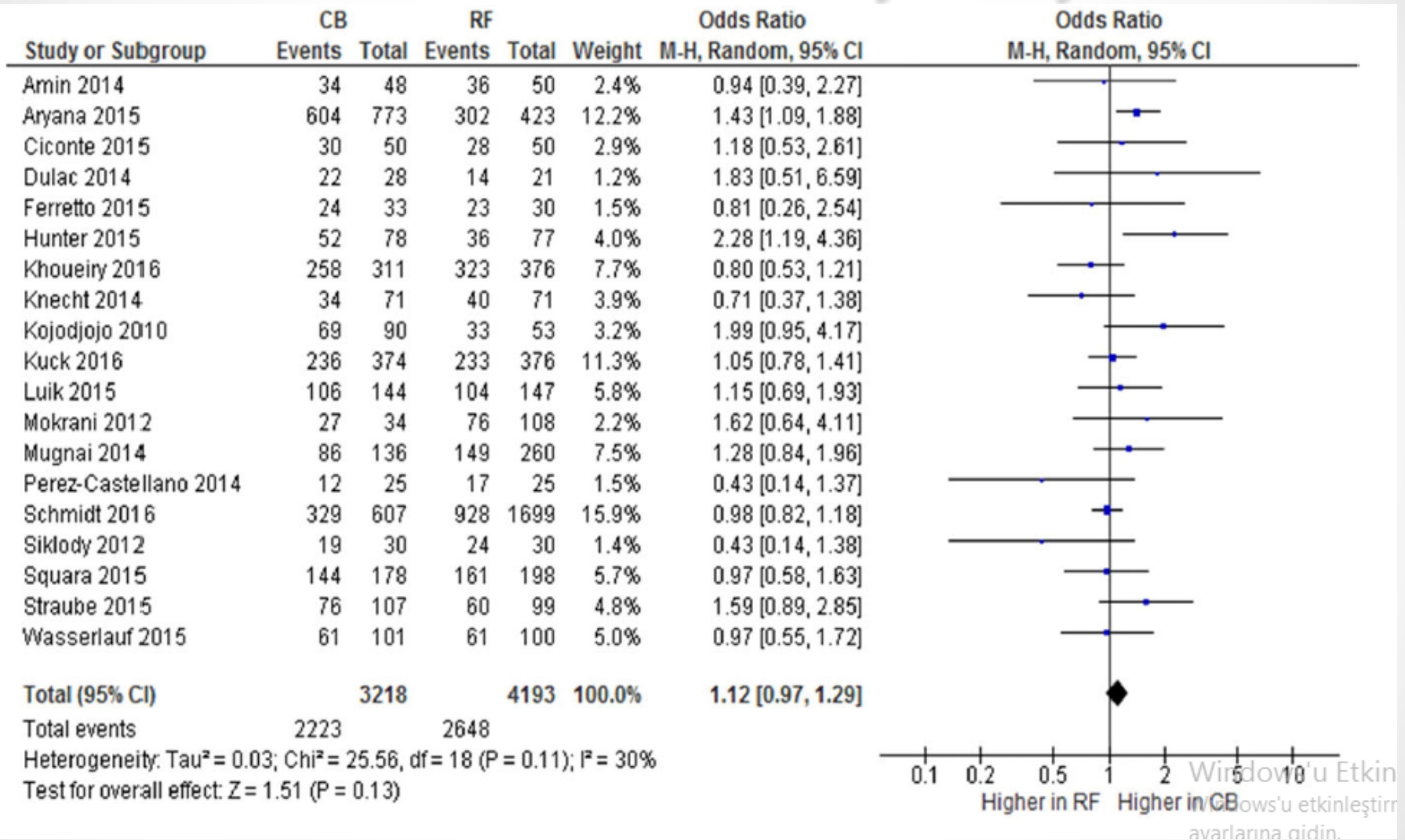


Cryoballoon versus Radiofrequency Catheter Ablation in Atrial Fibrillation: A Meta-Analysis

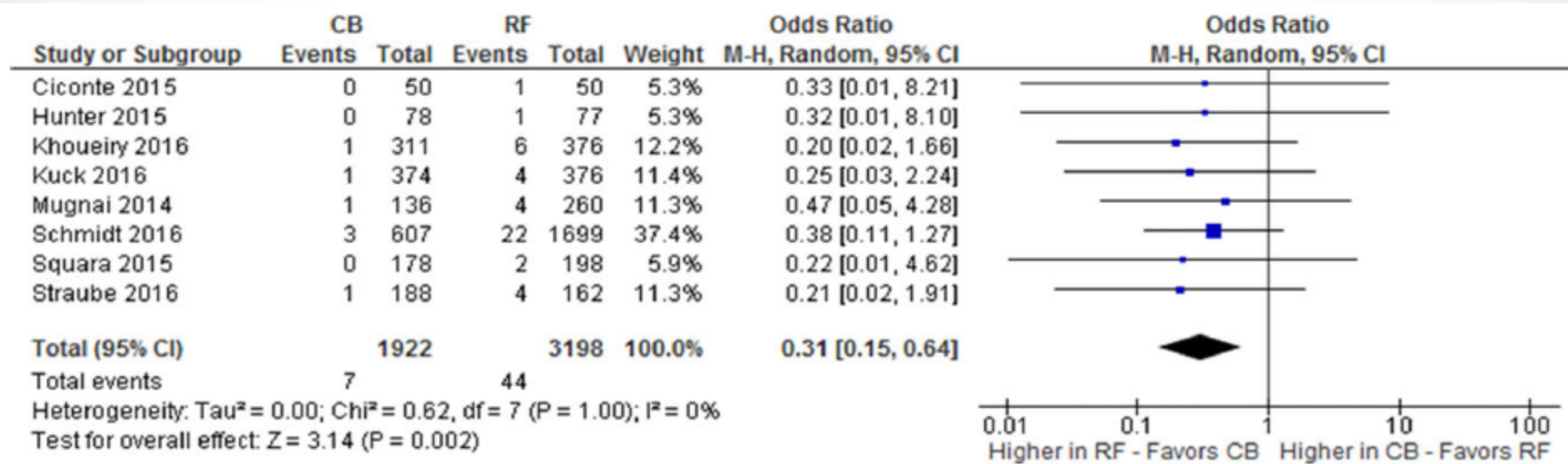
RHANDERSON CARDOSO, M.D., RODRIGO MENDIRICHAGA, M.D., GILSON FERNANDES, M.D., CHRIS HEALY, M.D., LITSA K. LAMBRAKOS, M.D., JUAN F. VILES-GONZALEZ, M.D., JEFFREY J. GOLDBERGER, M.D., and RAUL D. MITRANI, M.D.

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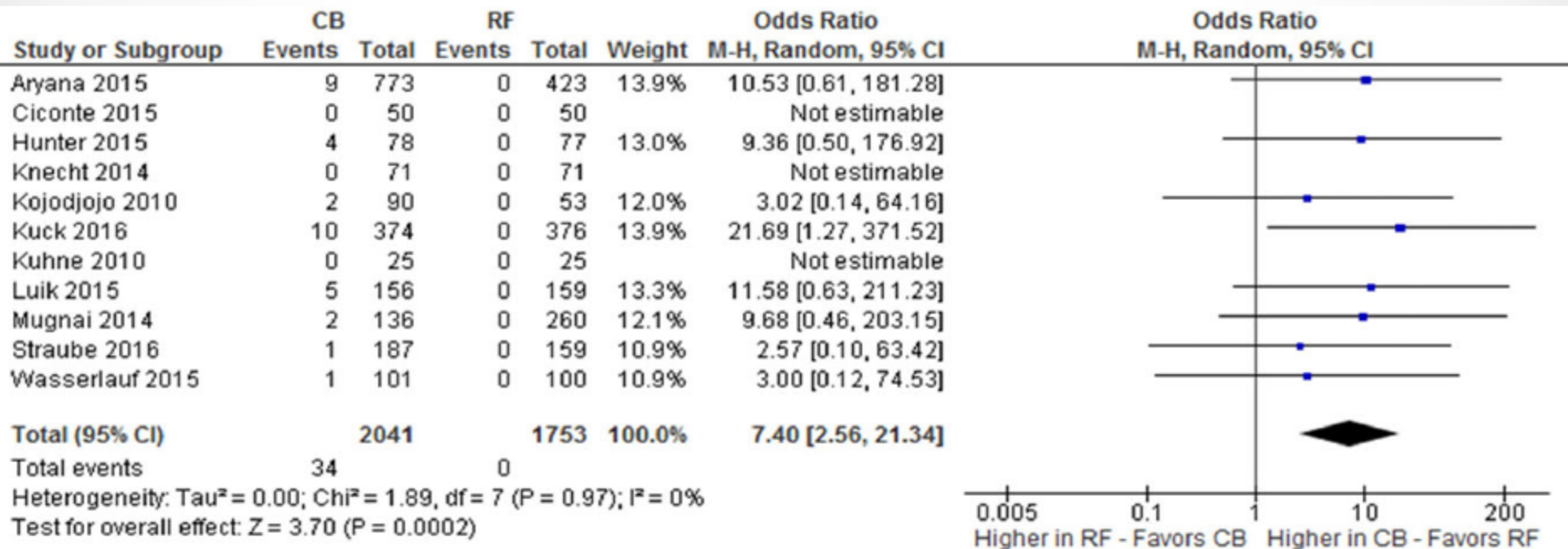
Freedom from atrial tachyarrhythmias



The incidence of pericardial tamponade



Phrenic nerve palsy



Substrate Modification

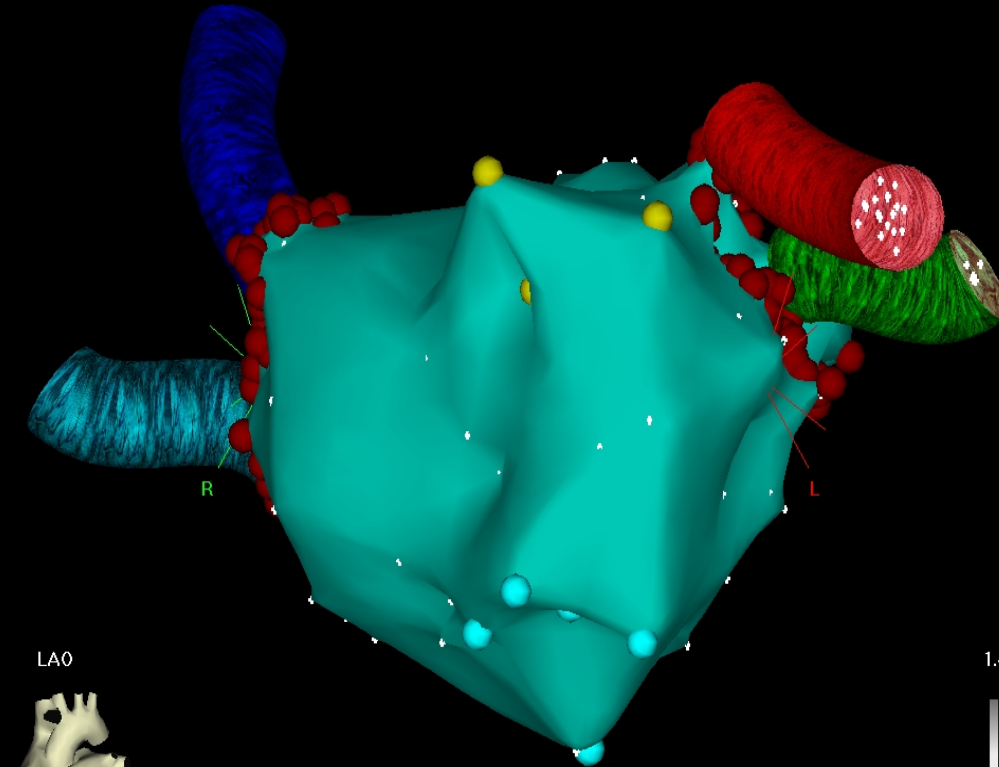
PVI alone insufficient in persistent AF

- Complex-fractionated atrial electrograms
- Rotor-driver ablation
- Linear ablation
- GP ablation
- Homogenization of the low-voltage zones

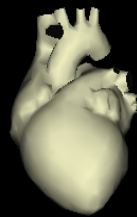


LAT

▶ 1-Map > 346 Points

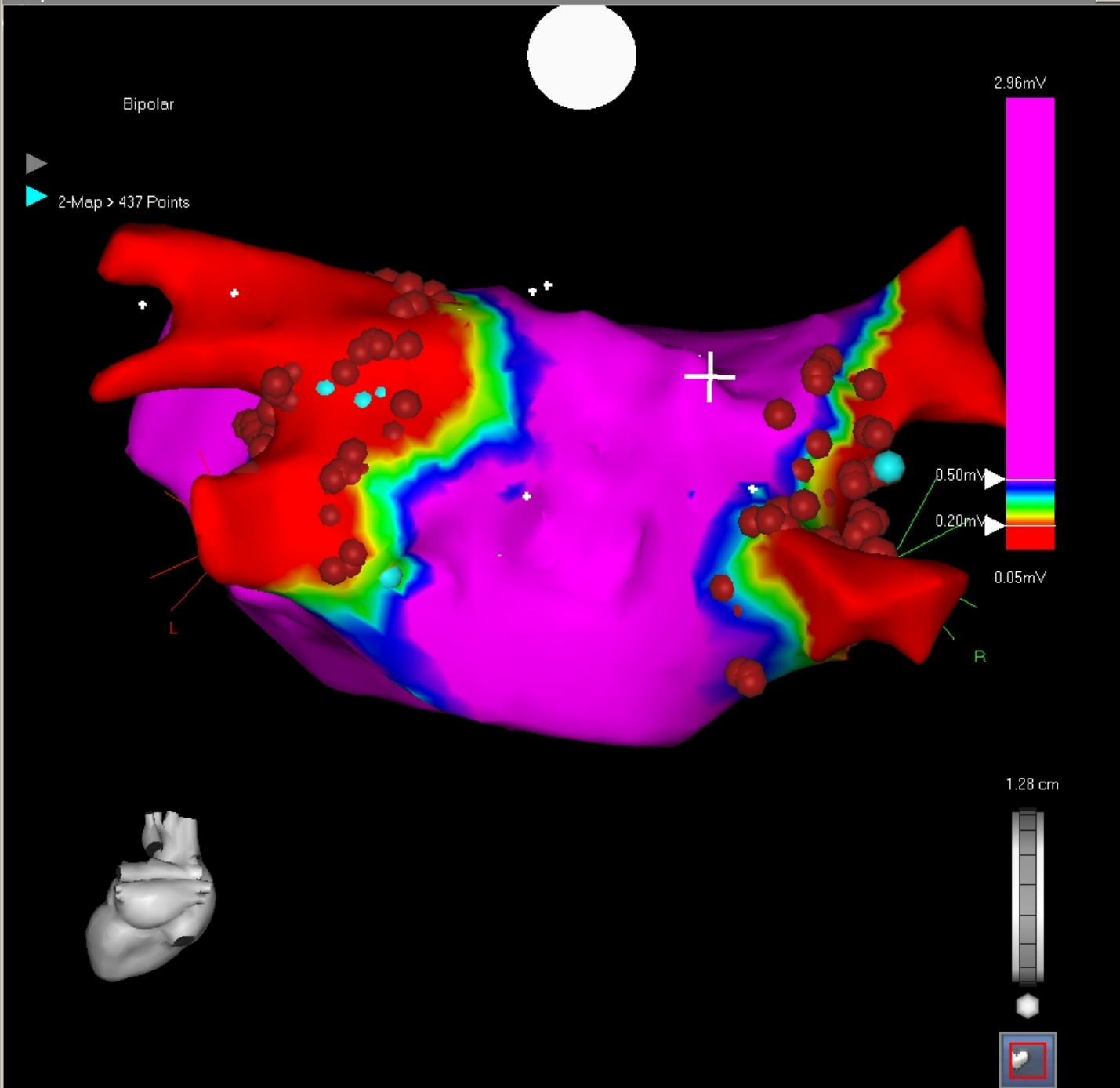


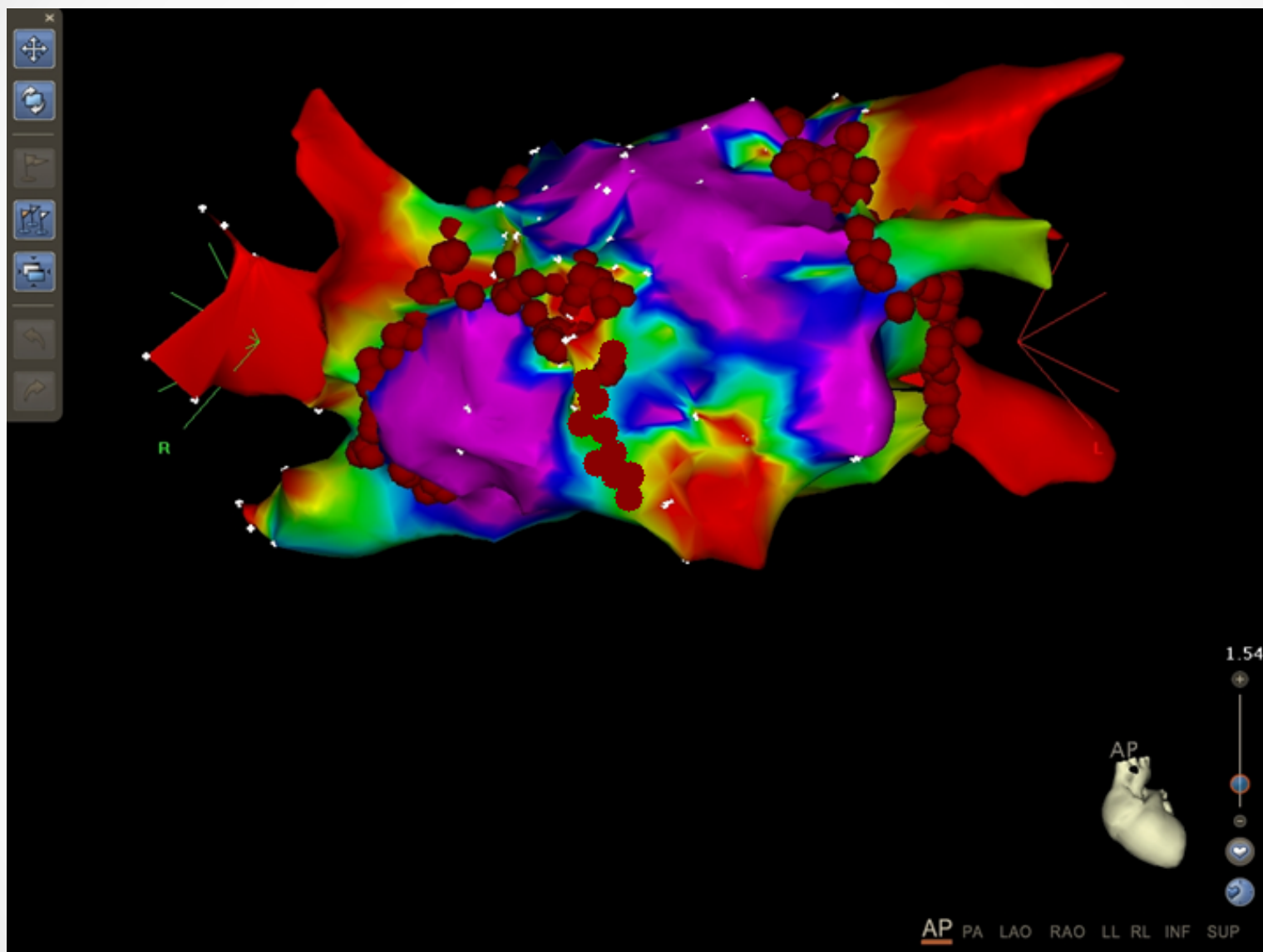
LAO

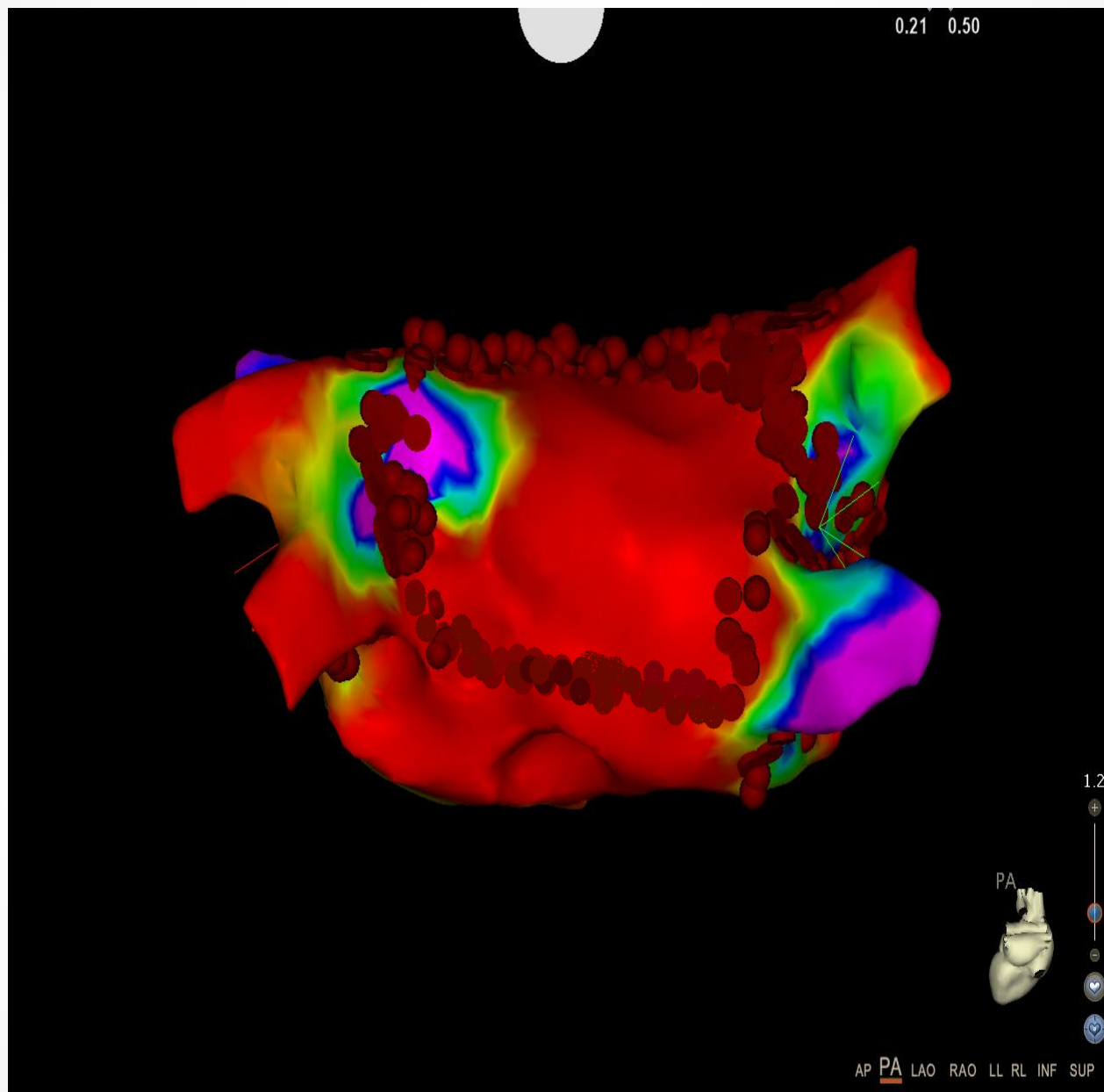


1.46 cm









ORIGINAL ARTICLE

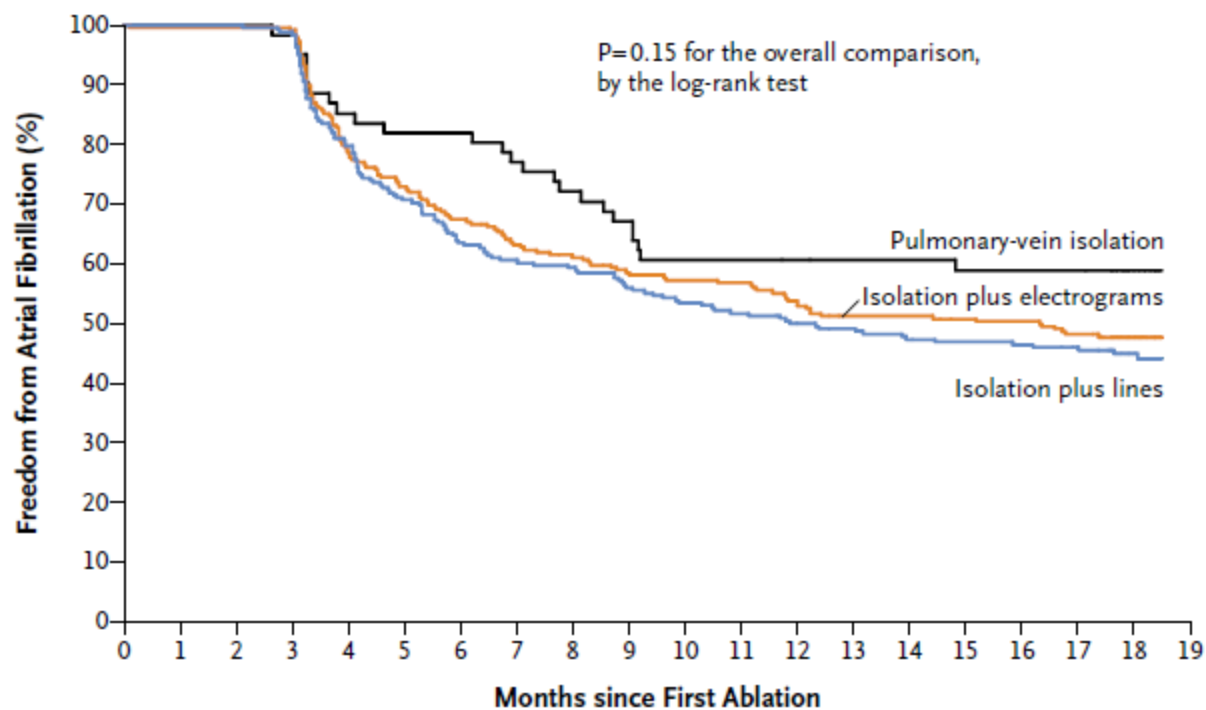
Approaches to Catheter Ablation for Persistent Atrial Fibrillation

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*

N ENGL J MED 372;19 NEJM.ORG MAY 7, 2015

- 589 persistent AF patients
- 67 PVI, 263 PVI+CFAE ablation, 259 PVI+linear ablation (roof+mitral isthmus)
- 18 m follow-up
- Primary end point: Freedom from atrial fibrillation lasting >30 seconds

NO REDUCTION in the rate of recurrent atrial fibrillation when either linear ablation or ablation of complex fractionated electrograms was performed in addition to pulmonary-vein isolation.



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

Figure 2. Freedom from Atrial Fibrillation.

Updated Worldwide Survey on the Methods, Efficacy, and Safety of Catheter Ablation for Human Atrial Fibrillation

Riccardo Cappato, MD; Hugh Calkins, MD; Shih-Ann Chen, MD; Wyn Davies, MD;
Yoshito Iesaka, MD; Jonathan Kalman, MD; You-Ho Kim, MD; George Klein, MD;
Andrea Natale, MD; Douglas Packer, MD; Allan Skanes, MD;
Federico Ambrogi, PhD; Elia Biganzoli, PhD

Background—The purpose of this study was to provide an updated worldwide report on the methods, efficacy, and safety of catheter ablation of atrial fibrillation (AF).

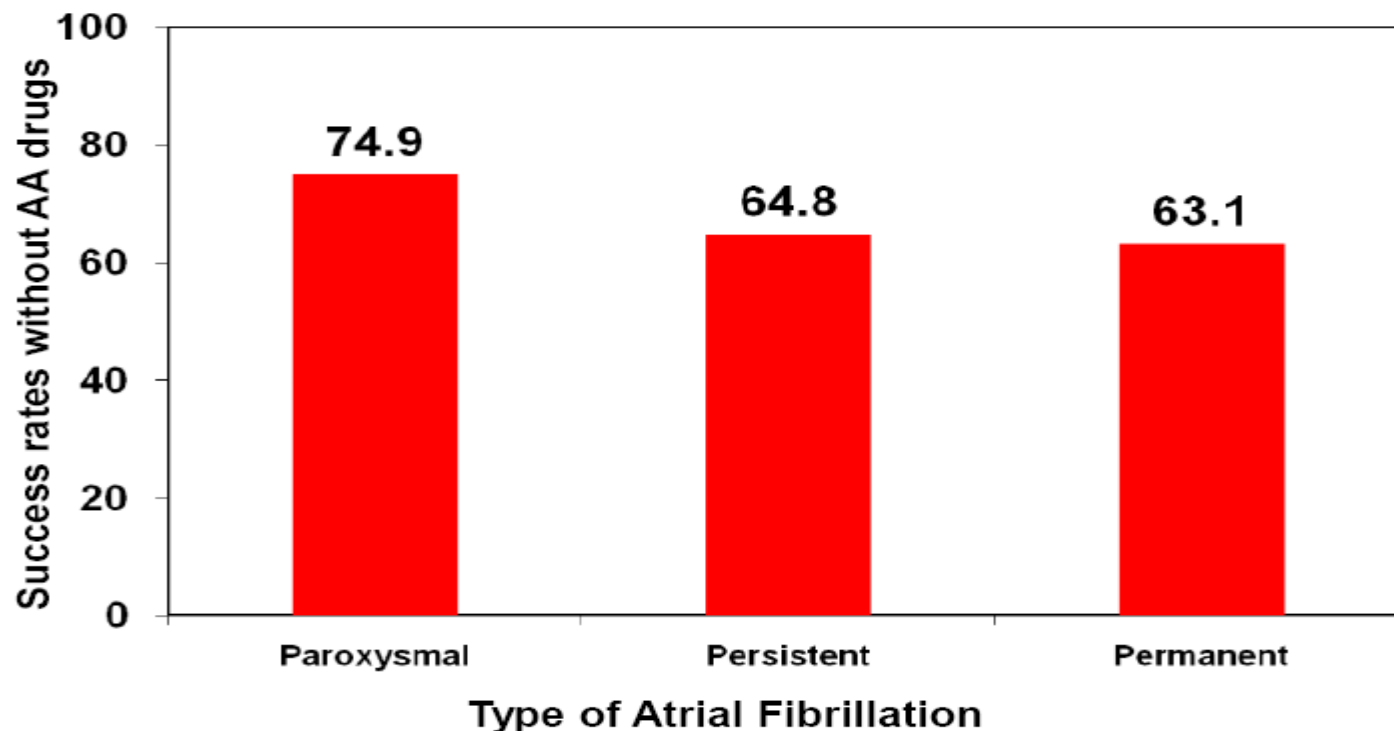
Methods and Results—A questionnaire with 46 questions was sent to 521 centers from 24 countries in 4 continents.

Total 16309 patients and 20825 AF ablation procedures between 2003-2006 at 521 centers

the unit of analysis. Of 16 309 patients with full disclosure of outcome data, 10 488 (median, 70.0%; interquartile range, 57.7% to 75.4%) became asymptomatic without antiarrhythmic drugs and another 2047 (10.0%; 0.5% to 17.1%) became asymptomatic in the presence of previously ineffective antiarrhythmic drugs over 18 (range, 3 to 24) months of follow-up. Success rates free of antiarrhythmic drugs and overall success rates were significantly larger in 9590 patients with paroxysmal AF (74.9% and 83.2%) than in 2800 patients with persistent AF (64.8% and 75.0%) and 1108 patients with long-lasting AF (63.1% and 72.3%) ($P<0.0001$). Major complications were reported in 741 patients (4.5%).

Conclusions—When analyzed in a large number of electrophysiology laboratories worldwide, catheter ablation of AF shows to be effective in $\approx 80\%$ of patients after 1.3 procedures per patient, with $\approx 70\%$ of them not requiring further antiarrhythmic drugs during intermediate follow-up. (*Circ Arrhythm Electrophysiol.* 2010;3:32-38.)

Second Worldwide Survey on the Efficacy and Safety of Catheter Ablation for AF



Complications related to catheter ablation of atrial fibrillation

Complication severity	Complication type	Rate
Life-threatening complications	Periprocedural death	<0.2%
	Oesophageal injury (perforation/fistula)	<0.5%
	Periprocedural stroke (including TIA/air embolism)	<1%
	Cardiac tamponade	1–2%
Severe complications	Pulmonary vein stenosis	<1%
	Persistent phrenic nerve palsy	1–2%
	Vascular complications	2–4%
	Other severe complications	≈1%
Other moderate or minor complications		1–2%
Unknown significance	Asymptomatic cerebral embolism (silent stroke)	5–20%
	Radiation exposure	

Conclusion

- Pulmonary vein isolation is still the cornerstone of all AF ablation procedures.
- Results are satisfactory, especially in paroxysmal AF patients
- Early intervention before advanced and complex stage of illness is associated with better results