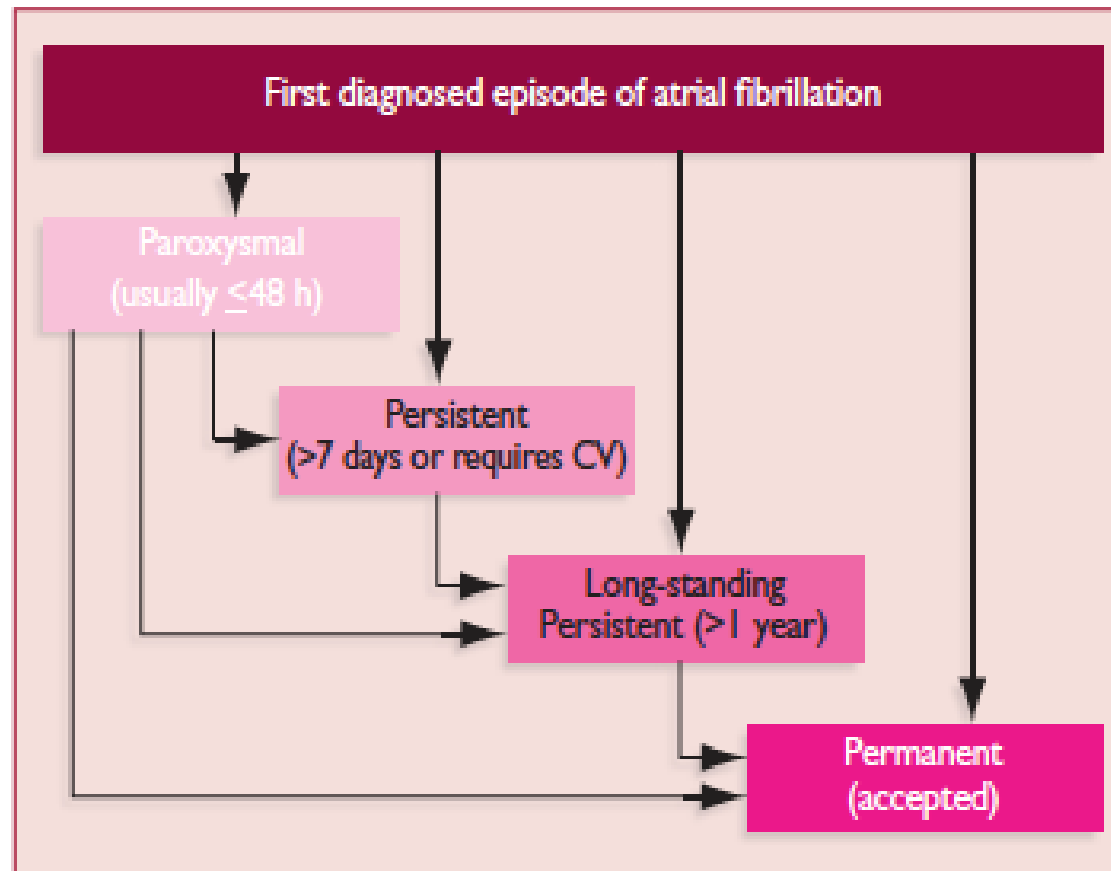


Κατάλυση κολπικής μαρμαρυγής

Βασίλειος Π. Βασιλικός M.D., F.A.C.C., F.E.S.C.
Αναπληρωτής Καθηγητής Καρδιολογίας Α.Π.Θ.



AF mechanisms

Paroxysmal AF

Persistent AF

Trigger

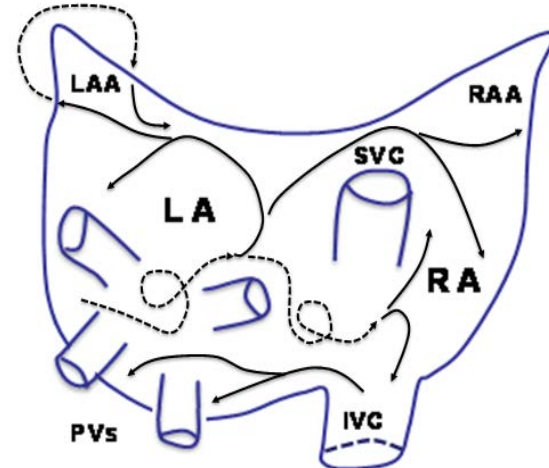
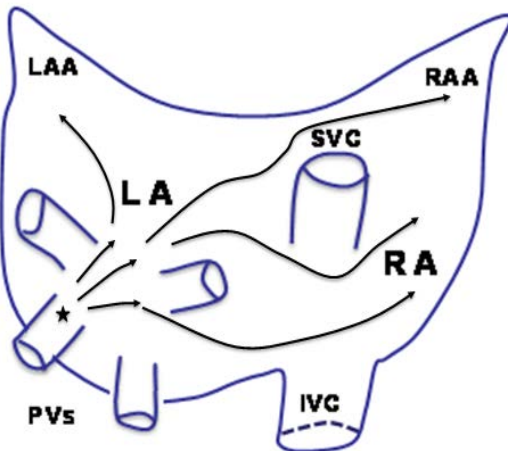
Substrate

No Structural Heart Disease

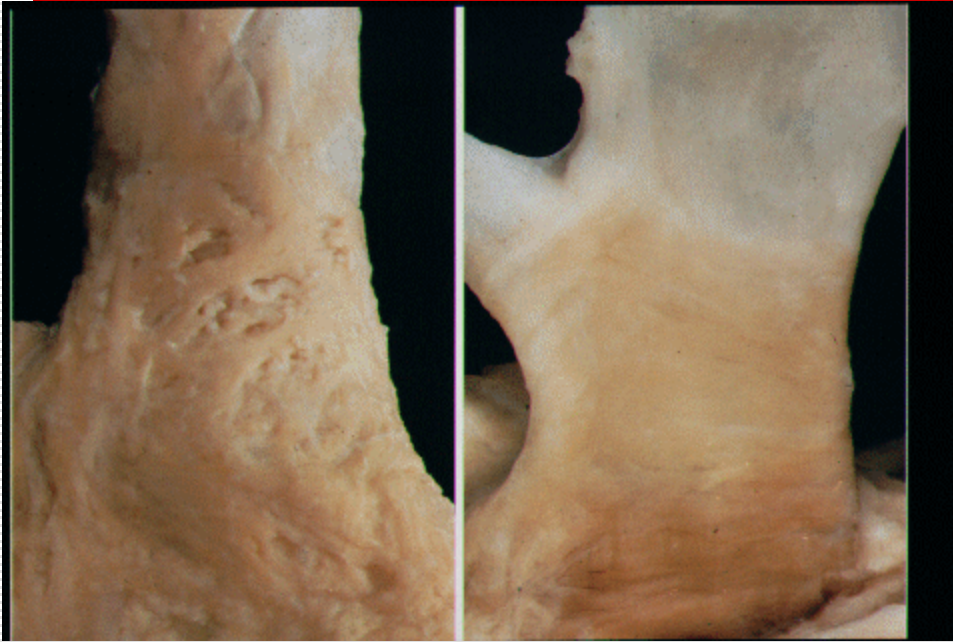
Structural Heart Disease

PV triggers

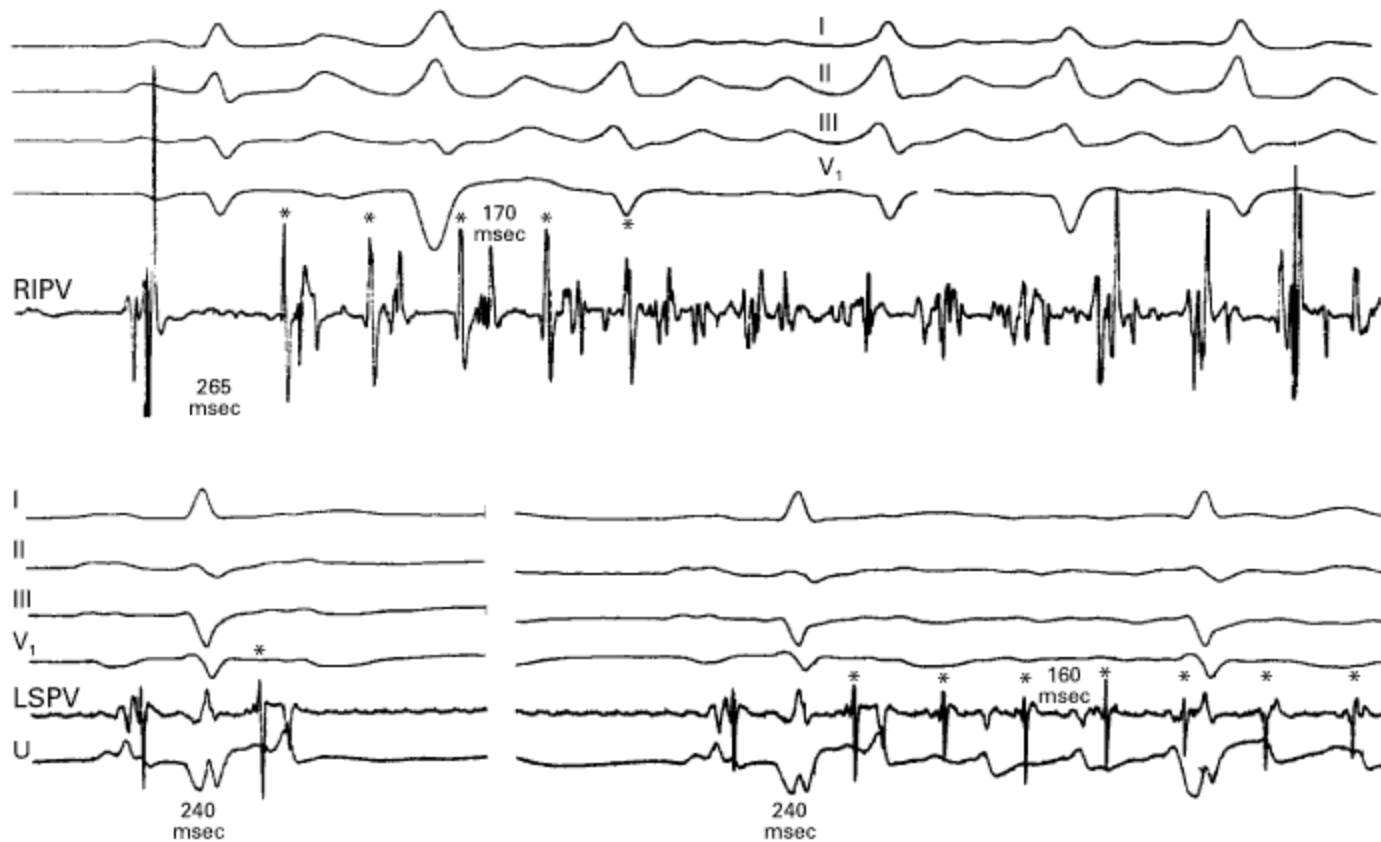
Multiple Wavelets, Nests, Rotors



Πνευμονικές φλέβες

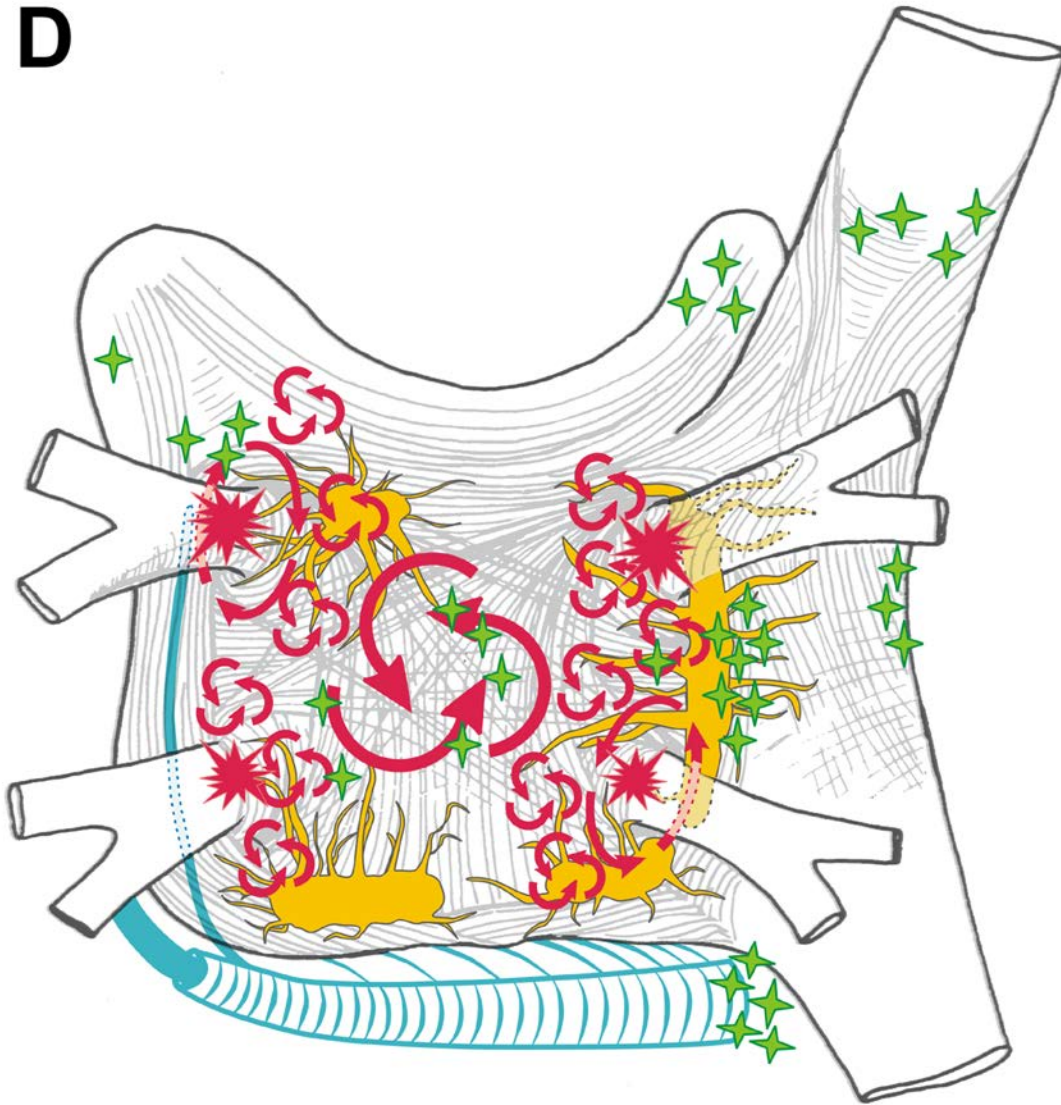


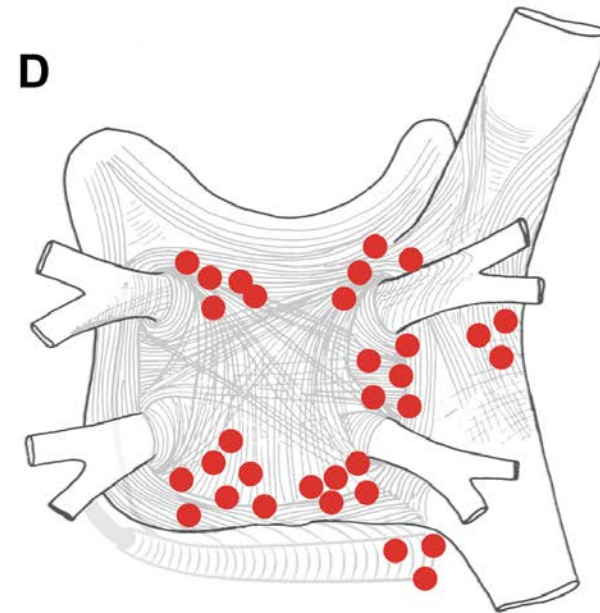
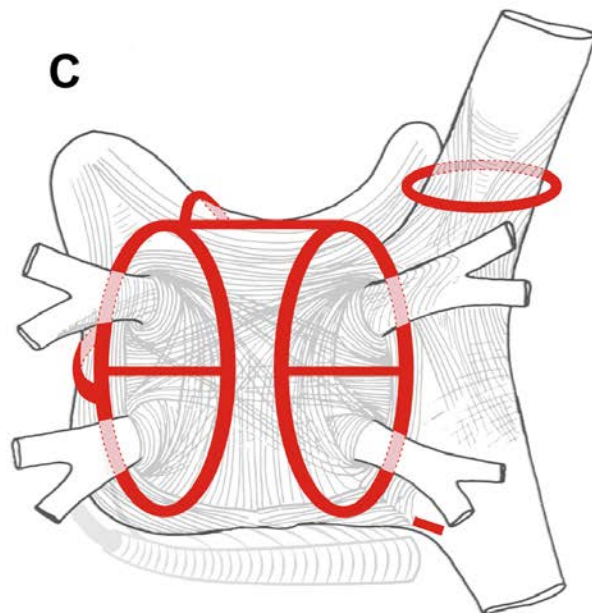
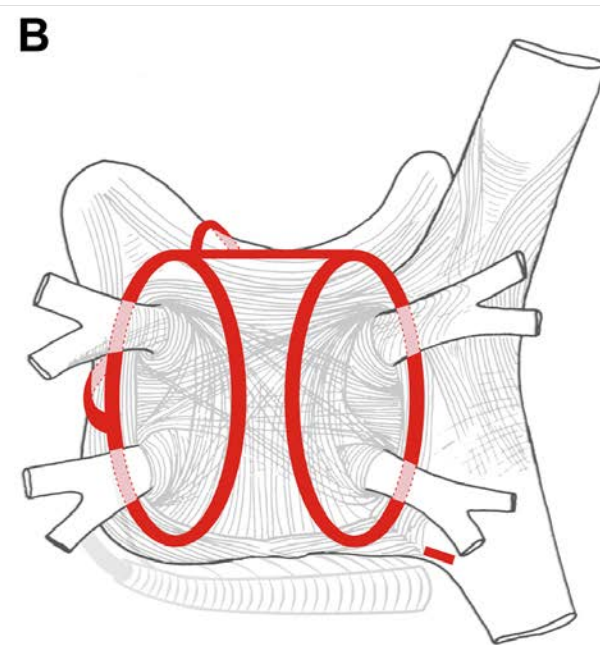
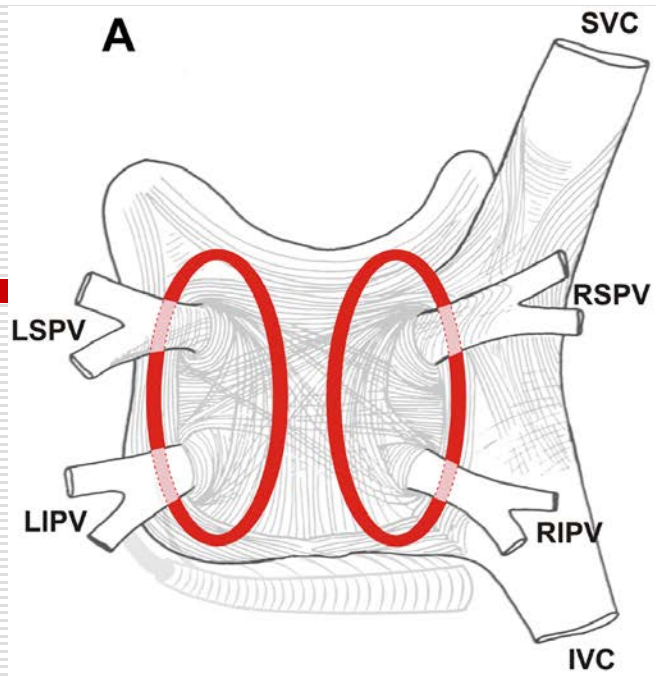
Εναρξη εστιακής ΚΜ

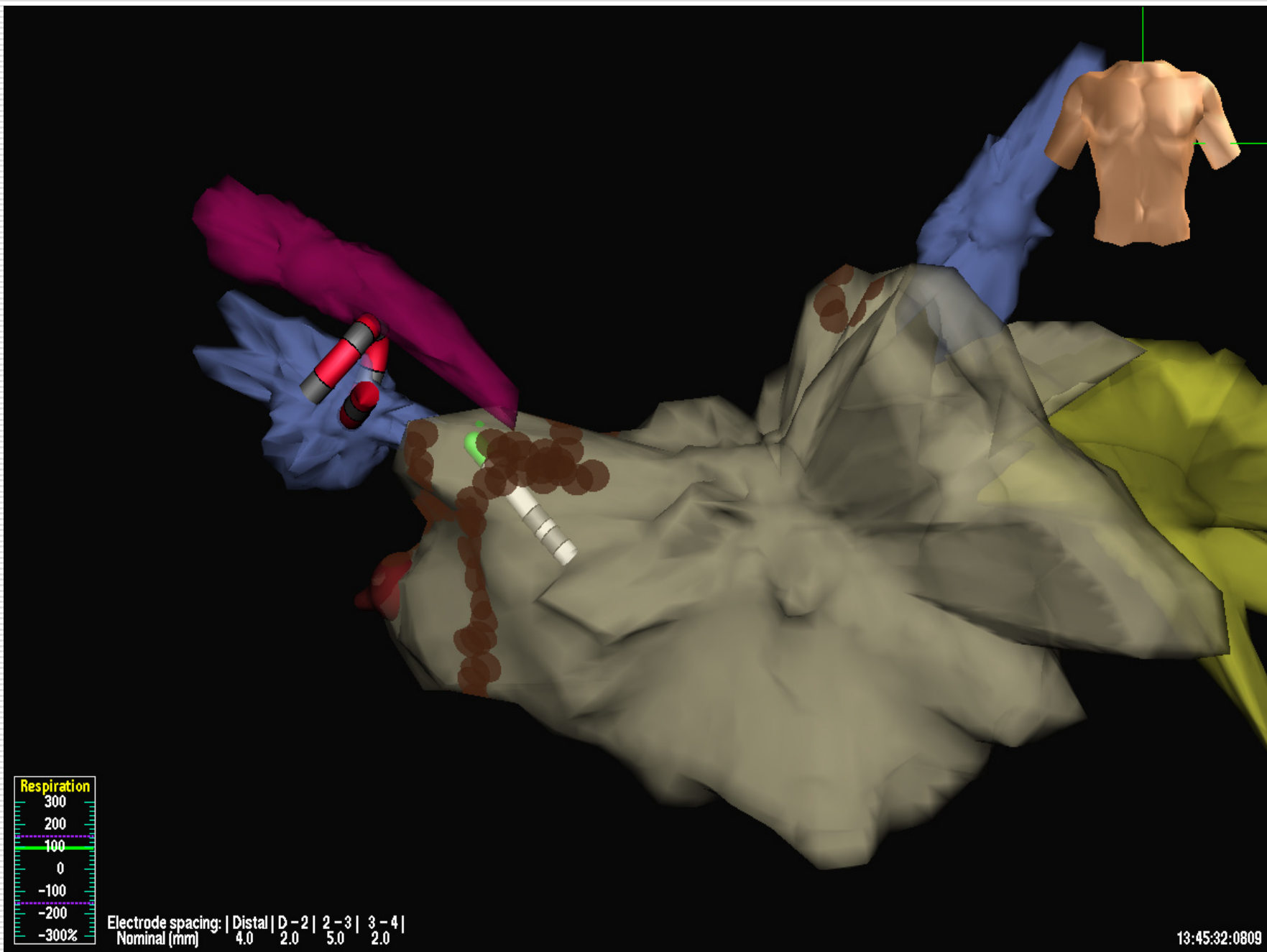




D







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;
Douglas Packer, MD; Allan Skanes, MD

Background—The purpose of this study was to conduct a worldwide survey investigating the methods, efficacy, and safety of catheter ablation (CA) of atrial fibrillation (AF).

Methods and Results—A detailed questionnaire was sent to 777 centers worldwide. Data relevant to the study purpose were collected from 181 centers, of which 100 had ongoing programs on CA of AF between 1995 and 2002. The number of patients undergoing this procedure increased from 18 in 1995 to 5050 in 2002. The median number of procedures per center was 37.5 (range, 1 to 600). Paroxysmal AF, persistent AF, and permanent AF were the indicated arrhythmias in 100.0%, 53.0%, and 20.0% of responding centers, respectively. The most commonly used techniques were right atrial compartmentalization between 1995 and 1997, ablation of the triggering focus in 1998 and 1999, and electrical disconnection of multiple pulmonary veins between 2000 and 2002. Of 8745 patients completing the CA protocol in 90 centers, of whom 2389 (27.3%) required >1 procedure, 4550 (52.0%; range among centers, 14.5% to 76.5%) became asymptomatic without drugs and another 2094 (23.9%; range among centers, 8.8% to 50.3%) became asymptomatic in the presence of formerly ineffective antiarrhythmic drugs over an 11.6 ± 7.7 -month follow-up period. At least 1 major complication was reported in 524 patients (6.0%).

Conclusions—The findings of this survey provide a picture of the variable and evolving methods, efficacy, and safety of CA for AF as practiced in a large number of centers worldwide and may serve as a guide to clinicians considering therapeutic options in patients suffering from this arrhythmia. (*Circulation*. 2005;111:1100-1105.)

Key Words: fibrillation ■ catheter ablation ■ antiarrhythmia agents ■ follow-up studies

Worldwide survey

Cappato et al, Circulation 2005

TABLE 2. Success Rates Relative to Number of Procedures Performed per Center

No. of Procedures per Center	No. of Centers	No. of Patients	Success Without AADs			Success With AADs			Overall Success	
			n	Rate, %	(Range), %	n	Rate, %	(Range), %	n	Rate, %
1–30	35	547	163	29.8	(14.5–43.6)	165	30.1	(18.7–46.5)	328	59.9
31–60	15	639	214	33.5	(20.8–46.6)	217	34.0	(20.4–48.1)	431	67.5
61–90	12	923	341	36.9	(18.3–51.2)	311	33.7	(16.7–50.3)	652	70.6
91–120	7	728	258	35.4	(24.1–48.7)	221	30.4	(22.8–39.0)	594	81.6
121–150	4	556	187	33.6	(22.6–46.5)	160	28.8	(20.9–37.1)	347	62.4
151–180	4	671	297	44.3	(32.8–51.9)	199	29.7	(23.1–37.8)	496	74.0
181–230	3	607	320	52.7	(42.1–63.0)	138	22.7	(18.3–25.9)	458	75.4
231–300	3	830	519	62.5	(55.7–70.4)	236	28.4	(22.3–35.6)	755	91.0
>300	7	3244	2069	63.8	(50.3–76.5)	514	15.8	(8.8–24.5)	2583	87.9
Total	90	8745	4550	52.0	(14.5–76.5)	2094	23.9	(8.8–50.3)	6644	75.9

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. Complete interviews were collected from 182 centers, of which 85 reported to have performed 20 825 catheter ablation procedures on 16 309 patients with AF between 2003 and 2006. The median number of procedures per center was 245 (range, 2 to 2715). All centers included paroxysmal AF, 85.9% also included persistent and 47.1% also included long-lasting AF. Carto-guided left atrial circumferential ablation (48.2% of patients) and Lasso-guided ostial electric disconnection (27.4%) were the most commonly used techniques. Efficacy data were analyzed with centers representing 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 $\sim 80\%$ of patients after 1.3 procedures per patient, with $\sim 70\%$ of them not requiring further antiarrhythmic drugs during intermediate follow-up. (*Circ Arrhythm Electrophysiol.* 2010;3:32-38.)

Table 1. Entry Criteria, Outcome, and Complications in the 2 Surveys

	Previous Survey	Current Survey
Period Investigated	1995–2002	2003–2006
No. of centers enrolled	90	85
No. of patients	8745	16 309
No. of patients per center	97	192
No. procedures	12 830	20 825
No. procedures per patient	1.5	1.3
Male, %	63.8	60.8
Lower and upper age limit for entry	18–82	15–90
Proportion of centers (%) performing ablation of		
Paroxysmal AF	100	100
Persistent AF	53.4	85.9
Long-lasting AF	20	47.1
Success rate, %, median		
Free of AADs	52.0	70.0
With AADs	23.5	10.0
Overall	75.5	80.0
Proportion of centers (%) using as exclusion		
Left atrial size upper limit	46.3	31.8
Prior heart surgery	65.1	23.5
Lower cut-off limit of LVEF	64.3	22.4
Overall complication rate, %	4.0	4.5
iatrogenic flutter	3.9	8.6

Worldwide survey II

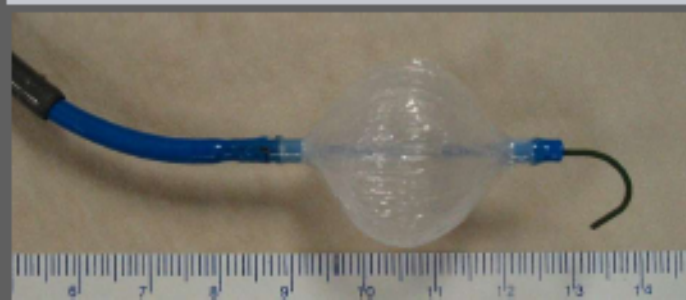
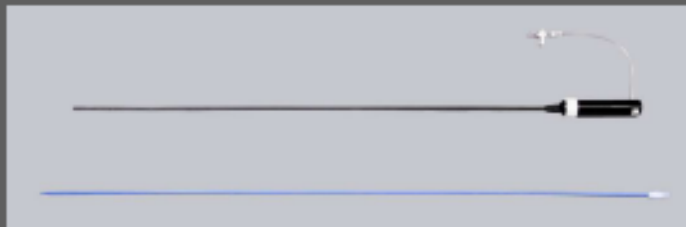
Cappato et al, Circ Arrhythm Electr 2010

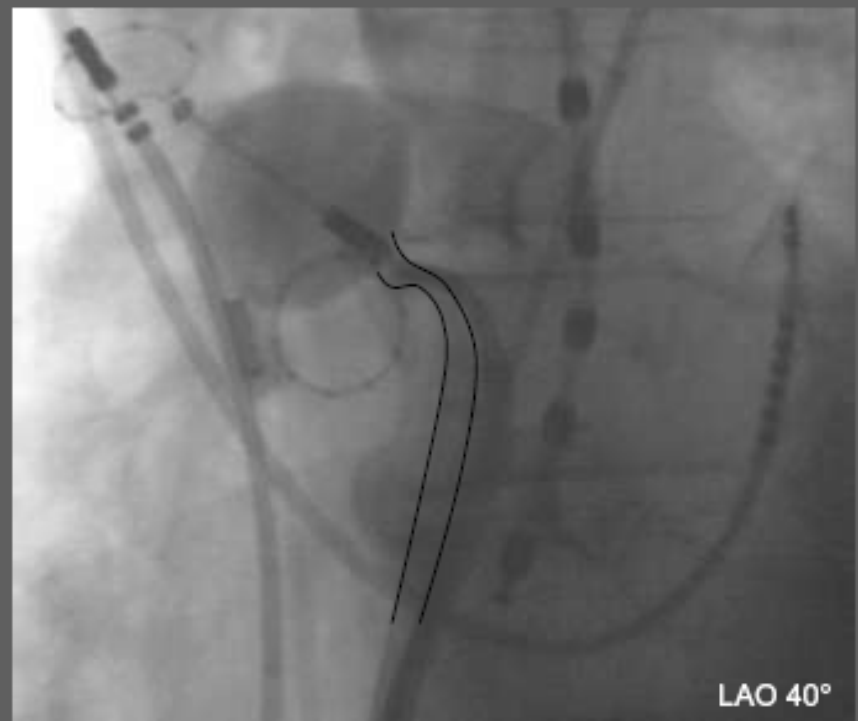
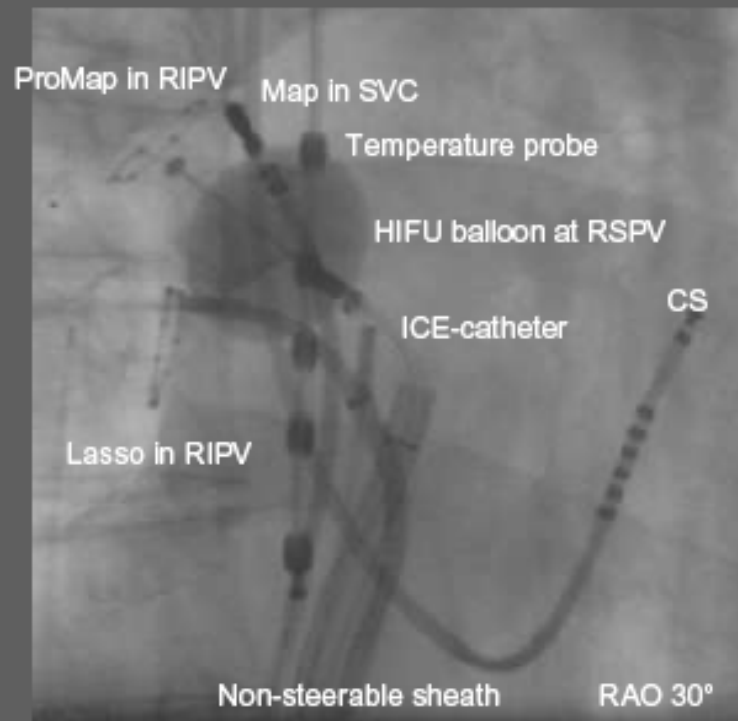
Table 7. Major Complications in the Overall Population

Type of Complication	No. of Patients	Rate, %
Death	25	0.15
Tamponade	213	1.31
Pneumothorax	15	0.09
Hemothorax	4	0.02
Sepsis, abscesses, or endocarditis	2	0.01
Permanent diaphragmatic paralysis	28	0.17
Total femoral pseudoaneurysm	152	0.93
Total artero-venous fistulae	88	0.54
Valve damage/requiring surgery	11/7	0.07
Atrium-esophageal fistulae	6	0.04
Stroke	37	0.23
Transient ischemic attack	115	0.71
PV stenoses requiring intervention	48	0.29
Total	741	4.54

PV Isolation using the Cryo-Balloon

Methods

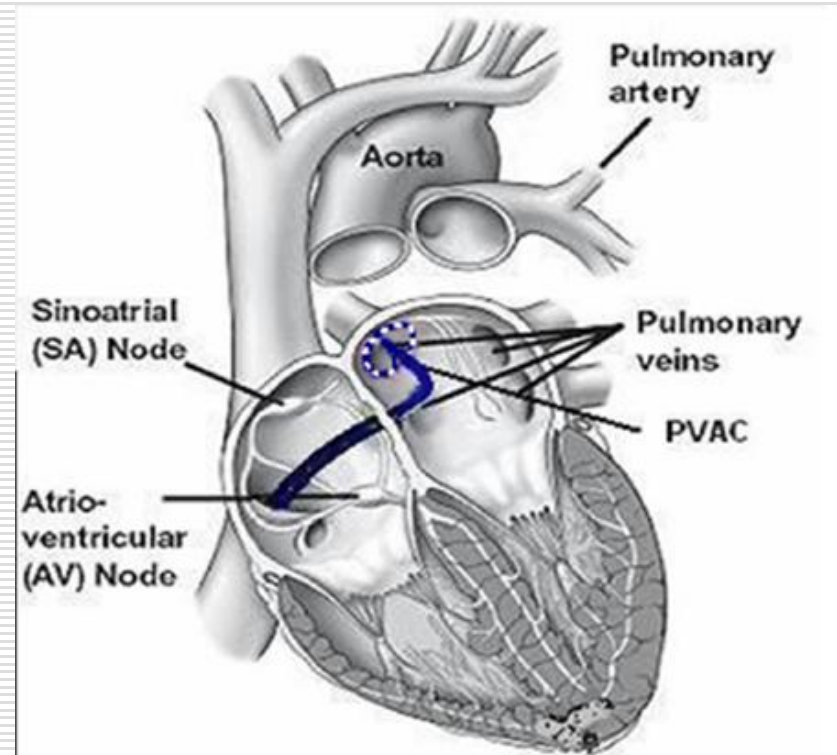


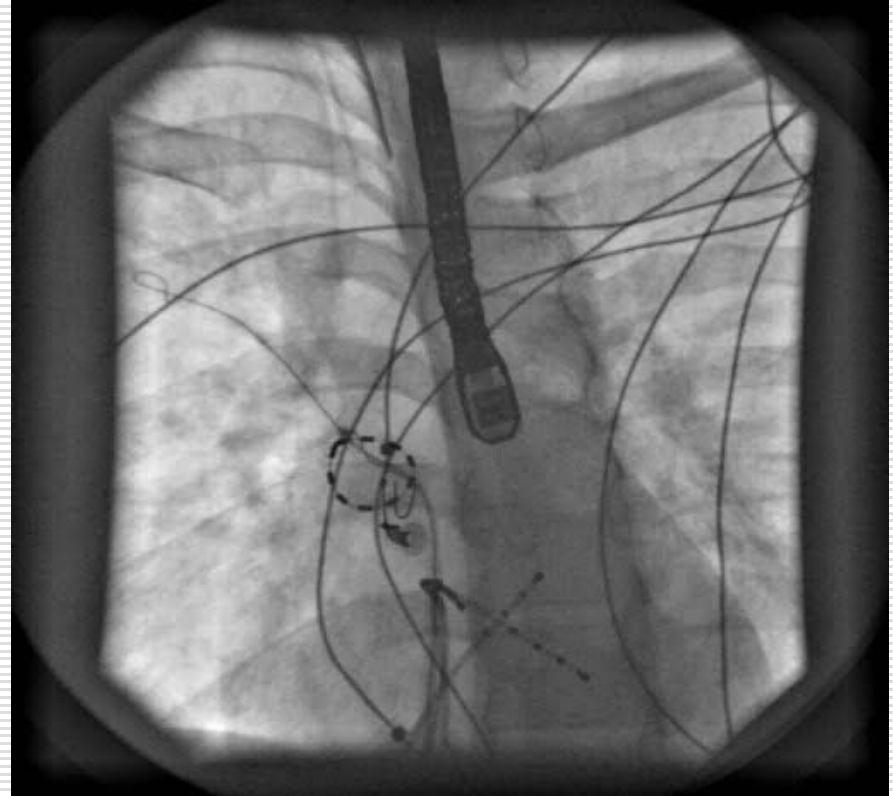


Cryo ablation results

	Patients, n	Left atrial size (mm)	Ablation catheter	PVI using the balloon alone	Follow-up (months)	Success rate
Van Belle et al. [10]	57	43 ± 7	23- and 28 mm and FMax	84%	6	60%
Neumann et al. [11]	346	~41	23- and 28 mm and FMax	78%	12	74%*
Chun et al. [12]	27	42	28 mm	98%	9	70%
Van Belle et al. [13]	141	42 ± 7	23- and 28 mm and FMax	n/a	15 ± 8	59%
Klein et al. [14]	21	38 ± 3	23- and 28 mm and FMax	95%	6	86%

Fmax = Freezor Max (conventional cryocatheter)
* The success rate was 42% in patients with persistent atrial fibrillation who were enrolled in the study (n = 53)





Philips Medical

2009/12/03

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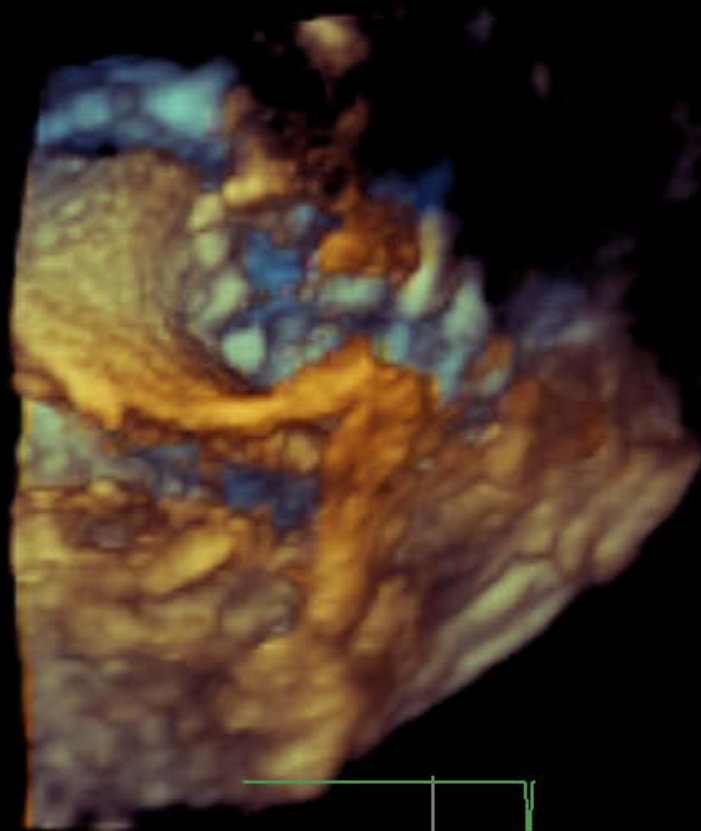
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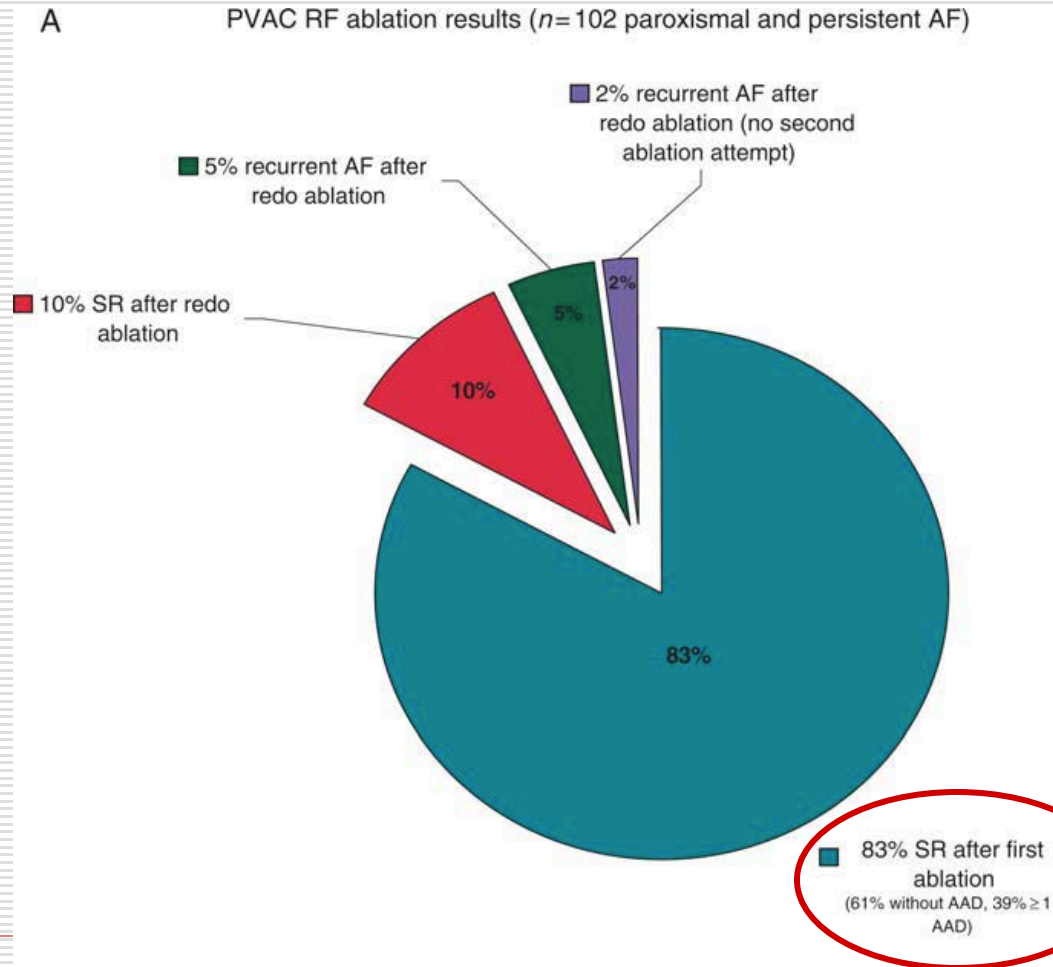
1%

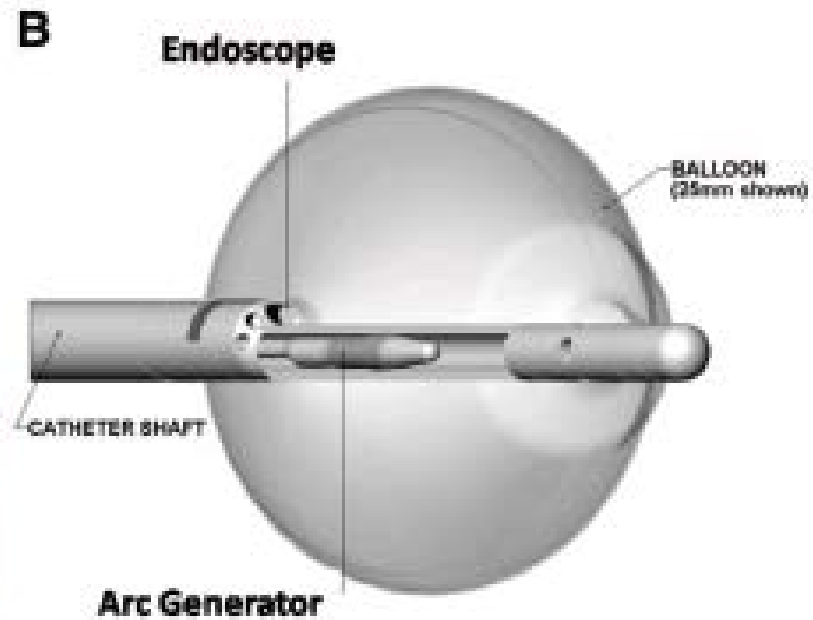
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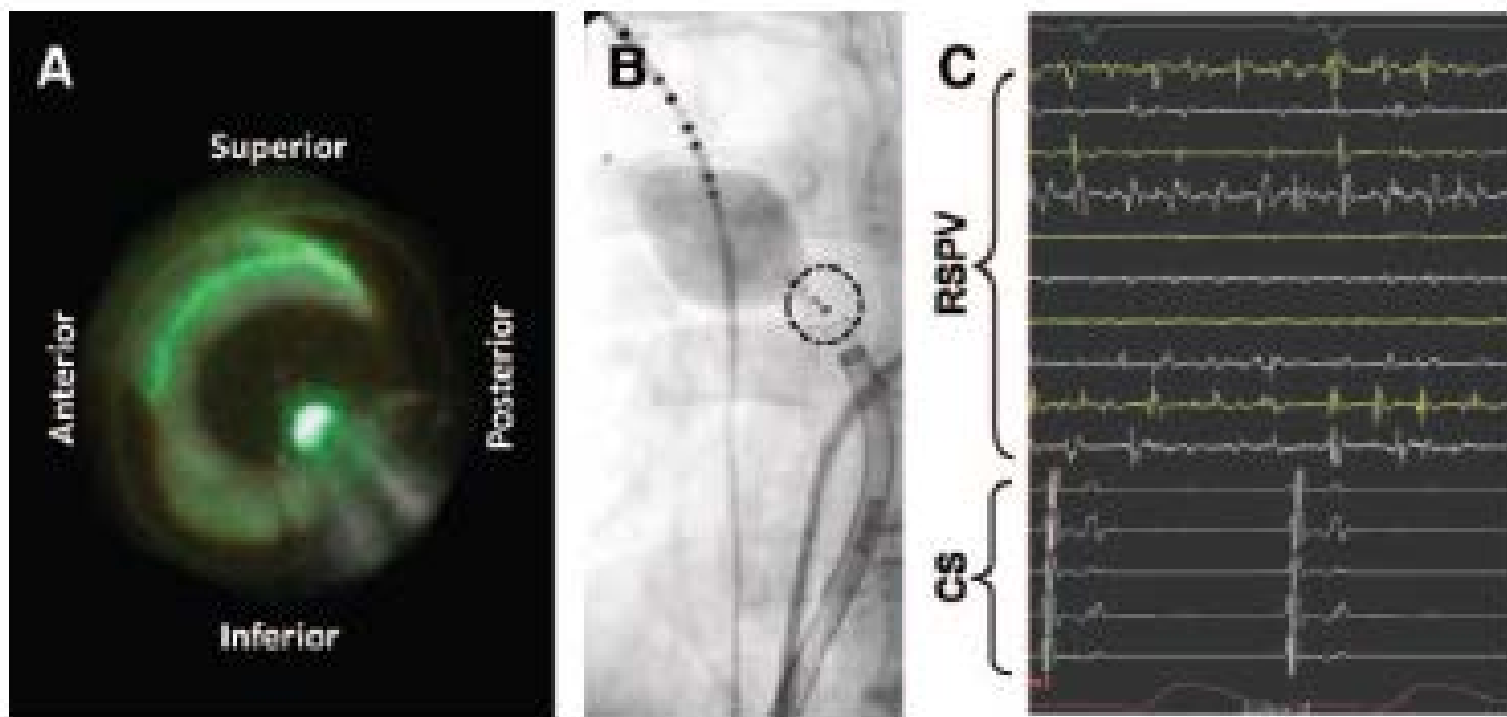


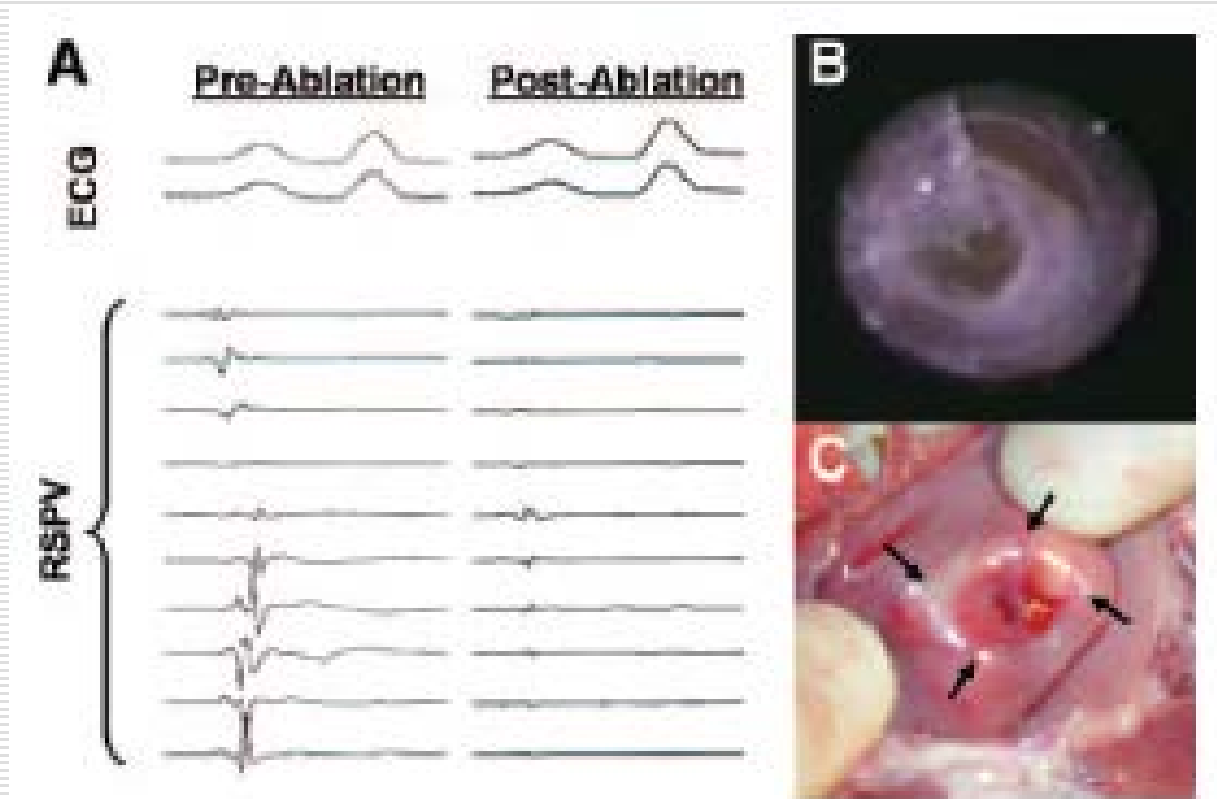
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PVAC ablation results





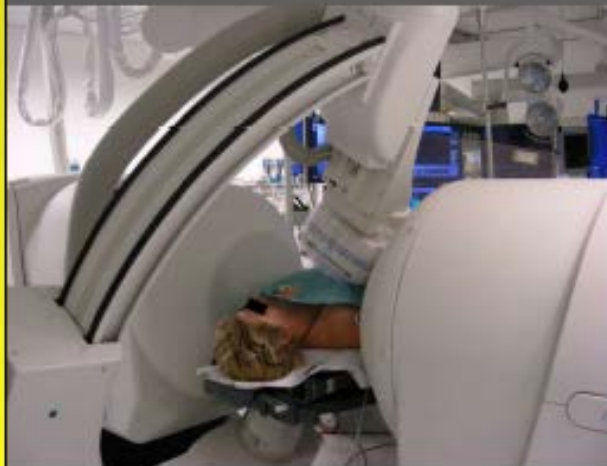




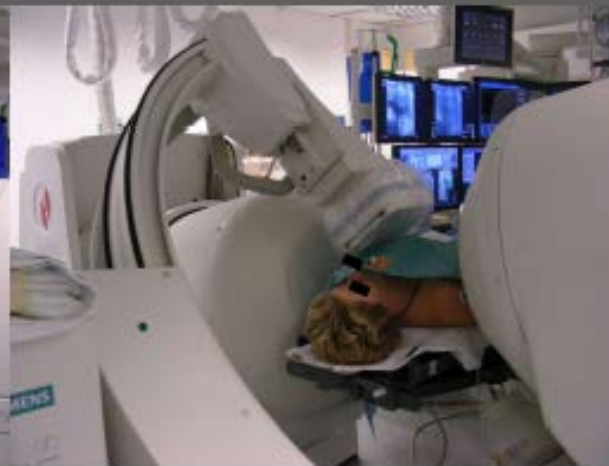
Reddy et al, Circulation 2009

Niobe II, C Arm Angulation

METHODS



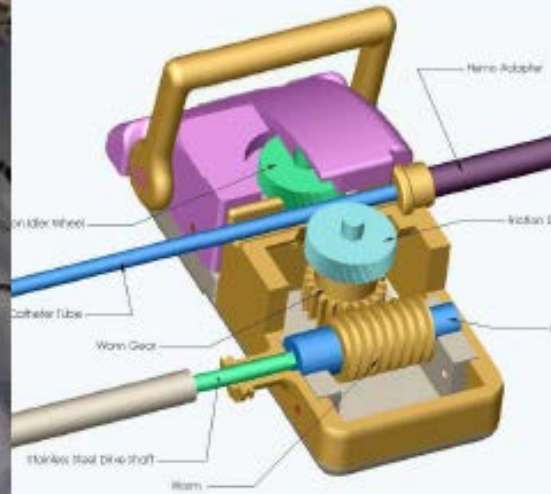
RAO 30°



LAO 40°

Basic Principle of Magnetic Navigation

METHODS - Cardiodrive



Remote controlled PV Isolation



Fellow physician controlling
ICE catheter and Lasso

The RCM
See next image



Physician controlling
catheter and Lasso



Instinctive Motion
Controller (IMC)

The remote catheter manipulator (RCM) is mounted to the tableside.

B



Validation of success following atrial fibrillation ablation: a European survey

Franck Halimi^{1*} and Lieselot Van Erven², on behalf of the EHRA Scientific Initiatives Committee (SIC)

¹Centre Médico-Chirurgical Parly 2, 21, rue Moxouris, 78150 Le Chesnay, France; and ²Leiden University Medical Center, Leiden, The Netherlands

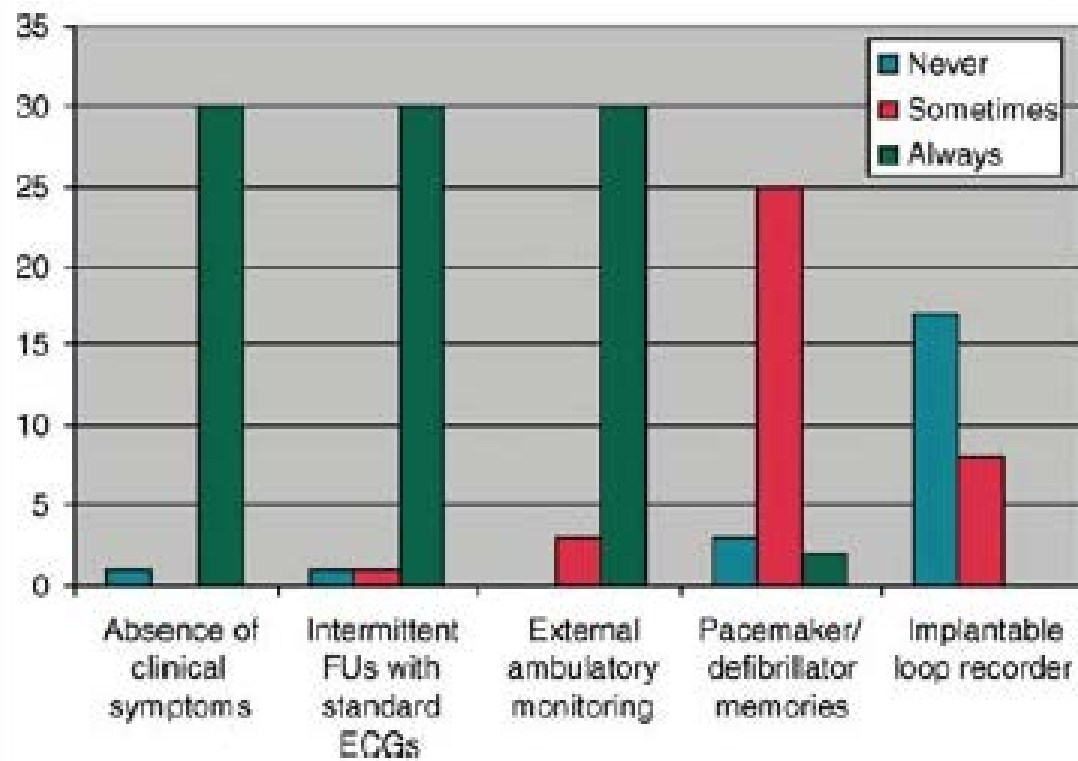
Online publish-ahead-of-print 3 June 2009

This survey sampled the follow-up (FU) strategies for atrial fibrillation ablation used by electrophysiology/ablation centres in Europe. Currently, FU relies on symptoms and short-term ECG recordings rather than monitoring by implantable devices. The responding centres show a lack of confidence in the long-term success after ablation, and confusion about definition of success which needs to be informed by updated European guidelines.

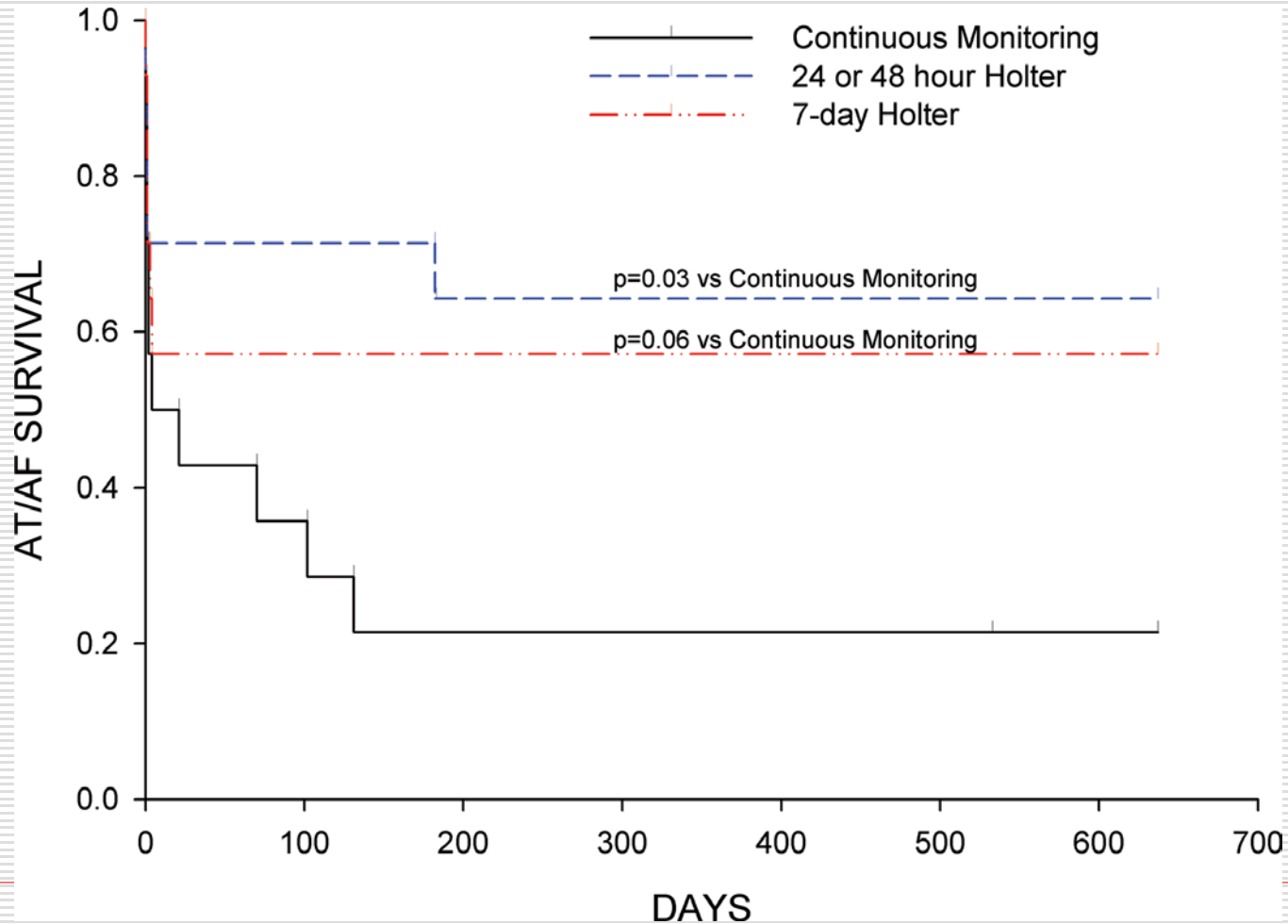
Keywords

Atrial fibrillation • Catheter ablation • Monitoring • Holter

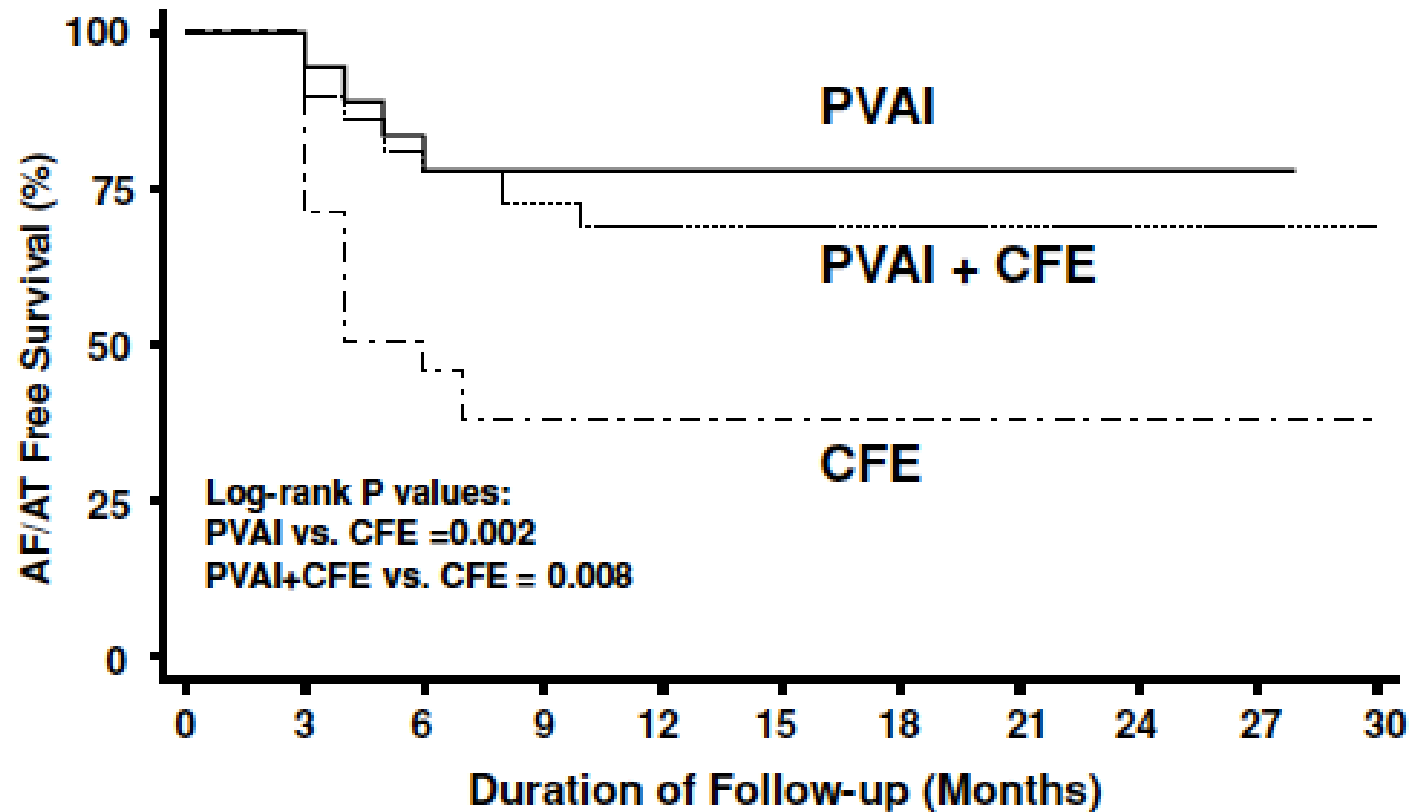
Confirmation of success (33 centers)



Continuous monitoring vs snapshots



PVAI vs CFE RFA in PAF



Independent predictors of late recurrences (multivariate)

- ☐ Non paroxysmal AF
- ☐ Hx of hypertension
- ☐ Prior failure of AAD

Radiofrequency Catheter Ablation of Atrial Fibrillation: A Cause of Silent Thromboembolism?

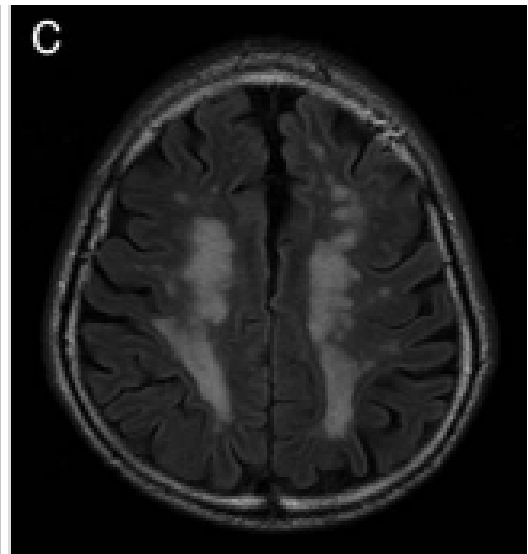
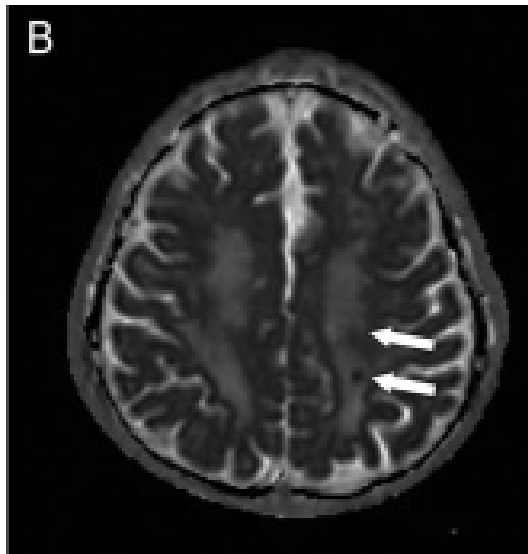
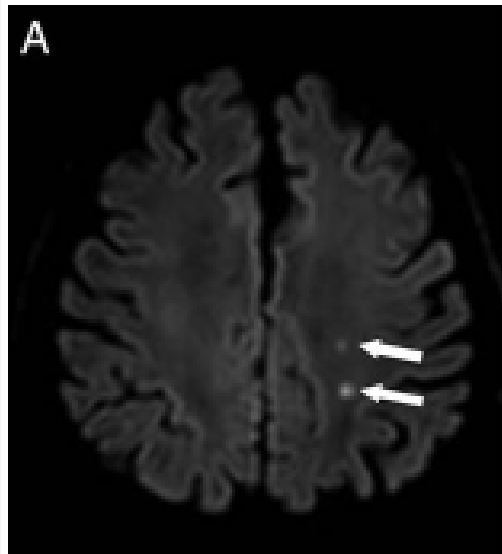
Magnetic Resonance Imaging Assessment of Cerebral Thromboembolism in Patients Undergoing Ablation of Atrial Fibrillation

Fiorenzo Gaita, MD; Domenico Caponi, MD; Martina Pianelli, MD; Marco Scaglione, MD; Elisabetta Toso, MD; Federico Cesarani, MD; Carlo Boffano, MD; Giovanni Gandini, MD; Maria Consuelo Valentini, MD; Roberto De Ponti, MD; Franck Halimi, MD; Jean François Leclercq, MD

Background—Radiofrequency left atrial catheter ablation has become a routine procedure for treatment of atrial fibrillation. The aim of this study was to assess with preprocedural and postprocedural cerebral magnetic resonance imaging the thromboembolic risk, either silent or clinically manifest, in the context of atrial fibrillation ablation. The secondary end point was the identification of clinical or procedural parameters that correlate with cerebral embolism.

Methods and Results—A total of 232 consecutive patients with paroxysmal or persistent atrial fibrillation who were candidates for radiofrequency left atrial catheter ablation were included in the study. Pulmonary vein isolation or pulmonary vein isolation plus linear lesions plus atrial defragmentation with the use of irrigated-tip ablation catheters was performed. All of the patients underwent preprocedural and postablation cerebral magnetic resonance imaging. A periprocedural symptomatic cerebrovascular accident occurred in 1 patient (0.4%). Postprocedural cerebral magnetic resonance imaging was positive for new embolic lesions in 33 patients (14%). No clinical parameters such as age, hypertension, diabetes mellitus, previous history of stroke, type of atrial fibrillation, and preablation antithrombotic treatment showed significant correlation with ischemic cerebral embolism. Procedural parameters such as activated clotting time value and, in particular, electric or pharmacological cardioversion to sinus rhythm correlated with an increased incidence of cerebral embolism. Cardioversion was also associated with an increased risk of 2.75 (95% confidence interval, 1.29 to 5.89; $P=0.009$).

Conclusions—Radiofrequency left atrial catheter ablation carries a low risk of symptomatic cerebral ischemia but is associated with a substantial risk of silent cerebral ischemia detected on magnetic resonance imaging. Independent risk factors for cerebral thromboembolism are the level of activated clotting time and, in particular, the electric or pharmacological cardioversion to sinus rhythm during the procedure. (*Circulation*. 2010;122:1667-1673.)



IMAGE

Microbubbles during pulmonary vein radiofrequency ablation

Vasileios P. Vassilikos, MD, PhD,* Vlasios Ninios, MD, MRCP,[†] Efstratios K. Theofilogiannakos, MD, PhD*

From the *First Department of Cardiology, AHEPA Hospital, Aristotle University of Thessaloniki, Thessaloniki, Greece;

[†]Department of Cardiology, St Luke's Hospital, Thessaloniki, Greece.

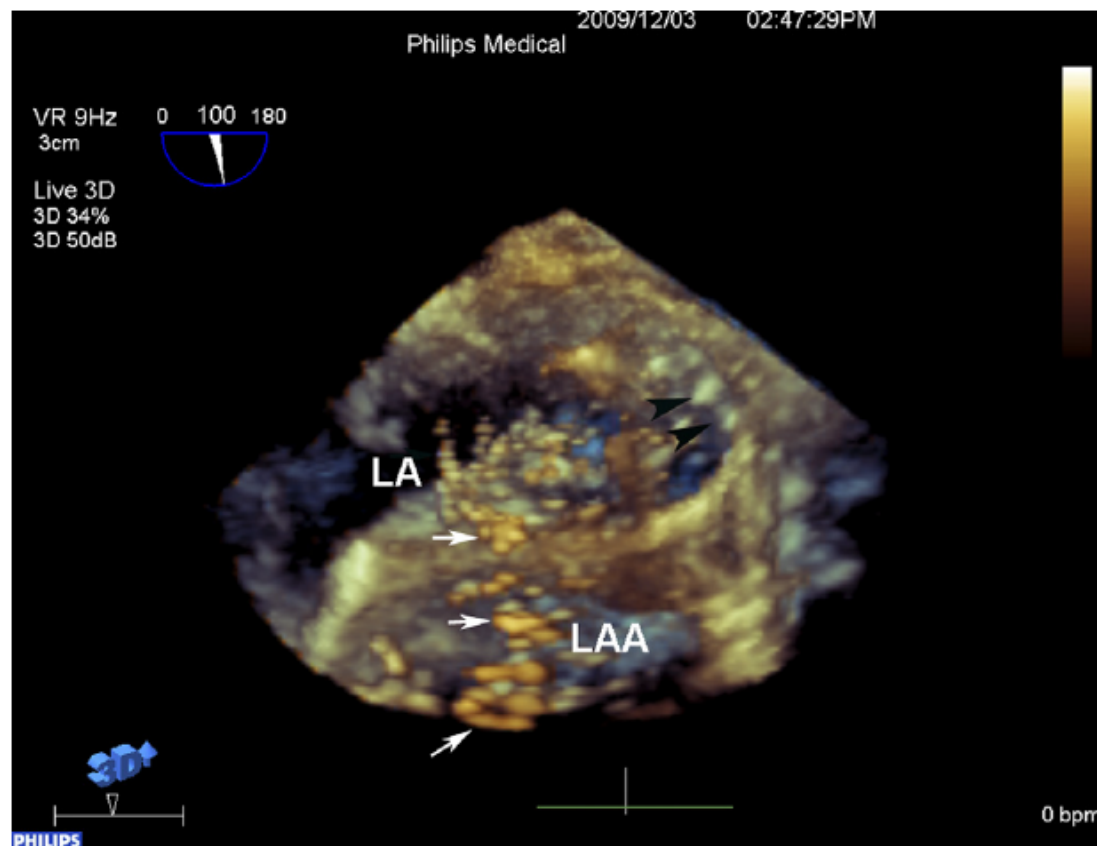


Figure 1

Catheter Ablation for Atrial Fibrillation

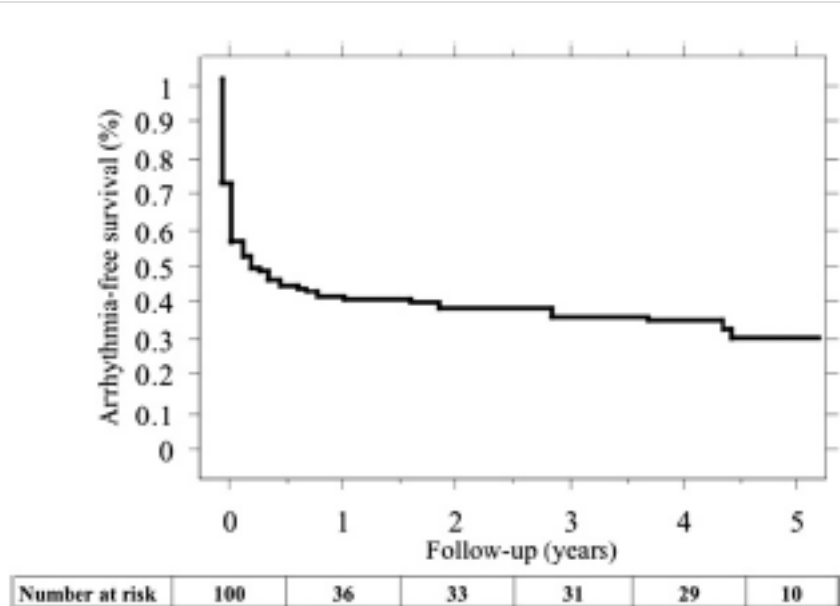
Are Results Maintained at 5 Years of Follow-Up?

Rukshen Weerasooriya, BMEDSc(HONS), MBBS,*† Paul Khairy, MD, PhD,‡ Jean Litalien, MD,* Laurent Macle, MD,‡ Meleze Hocini, MD,* Frederic Sacher, MD,* Nicolas Lellouche, MD,* Sebastien Knecht, MD,* Matthew Wright, PhD, MD,* Isabelle Nault, MD,* Shinsuke Miyazaki, MD,* Christophe Scavee, MD,* Jacques Clementy, MD,* Michel Haissaguerre, MD,* Pierre Jais, MD*
Bordeaux-Pessac, France; Crawley, Western Australia; and Montreal, Quebec, Canada

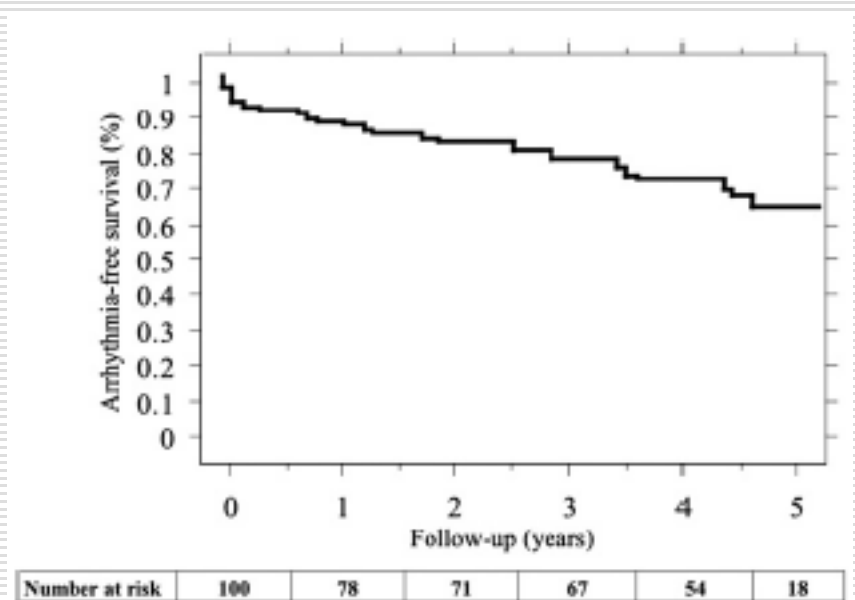
Objectives	This study describes 5-year follow-up results of catheter ablation for atrial fibrillation (AF).
Background	Long-term efficacy following catheter ablation of AF remains unknown.
Methods	A total of 100 patients (86 men, 14 women), age 55.7 ± 9.6 years, referred to our center for a first AF ablation (63% paroxysmal; 3.5 ± 1.4 prior ineffective antiarrhythmic agents) were followed for 5 years. Complete success was defined as absence of any AF or atrial tachycardia recurrence (clinical or by 24-h Holter monitoring) lasting ≥ 30 s.
Results	Arrhythmia-free survival rates after a single catheter ablation procedure were 40%, 37%, and 29% at 1, 2, and 5 years, respectively, with most recurrences over the first 6 months. Patients with long-standing persistent AF experienced a higher recurrence rate than those with paroxysmal or persistent forms (hazard ratio [HR]: 1.9, 95% confidence interval [CI]: 1.0 to 3.5; $p = 0.0462$). In all, 175 procedures were performed, with a median of 2 per patient. Arrhythmia-free survival following the last catheter ablation procedure was 87%, 81%, and 63% at 1, 2, and 5 years, respectively. Valvular heart disease (HR: 6.0, 95% CI: 2.0 to 17.6; $p = 0.0012$) and nons ischemic dilated cardiomyopathy (HR: 34.0, 95% CI: 6.3 to 182.1; $p < 0.0001$) independently predicted recurrences. Major complications (cardiac tamponade requiring drainage) occurred in 3 patients (3%).
Conclusions	In selected patients with AF, a catheter ablation strategy with repeat intervention as necessary provides acceptable long-term relief. Although most recurrences transpire over the first 6 to 12 months, a slow but steady decline in arrhythmia-free survival is noted thereafter. (J Am Coll Cardiol 2011;57:160–6) © 2011 by the American College of Cardiology Foundation

AFIB RFA Long term follow up

Single procedure



Multiple procedures



Randomized Trials

Ablation vs AADs

Study	PAF/PsAF	Procedures (n)	Patients (n)	AF freedom Ablation	AF freedom AADs
Krittayaphong et al. ¹	100% PsAF		30	79%	40%
Wazni et al. ²	96%PAF/4%PsAF	1	70	85%	21%
Pappone et al. ³	100%PAF	1	198	85% without AAD	35%
Oral et al. ⁴	100%PAF	32% Redo	146	74% without AAD	58% (77% cross-over to ablation)
Stabile et al. ⁵	67%PAF/33%PsAF	1	137	66%	8,7%
Jais et al. ⁶	100%PAF	1,8	112	89% without AAD	23%
Forleo et al. ⁷	41%PAF/59%PsAF	1	70	80% without AAD	43%
Wilber et al. ⁸	100% PAF	12.6% Redo within 80 d	167	66%	16%

¹ Krittayaphong et al. J Med Assoc Thai 2003;86(S1):S8-16

² Wazni et al. JAMA 2005;293:2634-40

³ Pappone et al. JACC 2006;48:2340-7

⁴ Oral et al. NEJM 2006;354:934-41

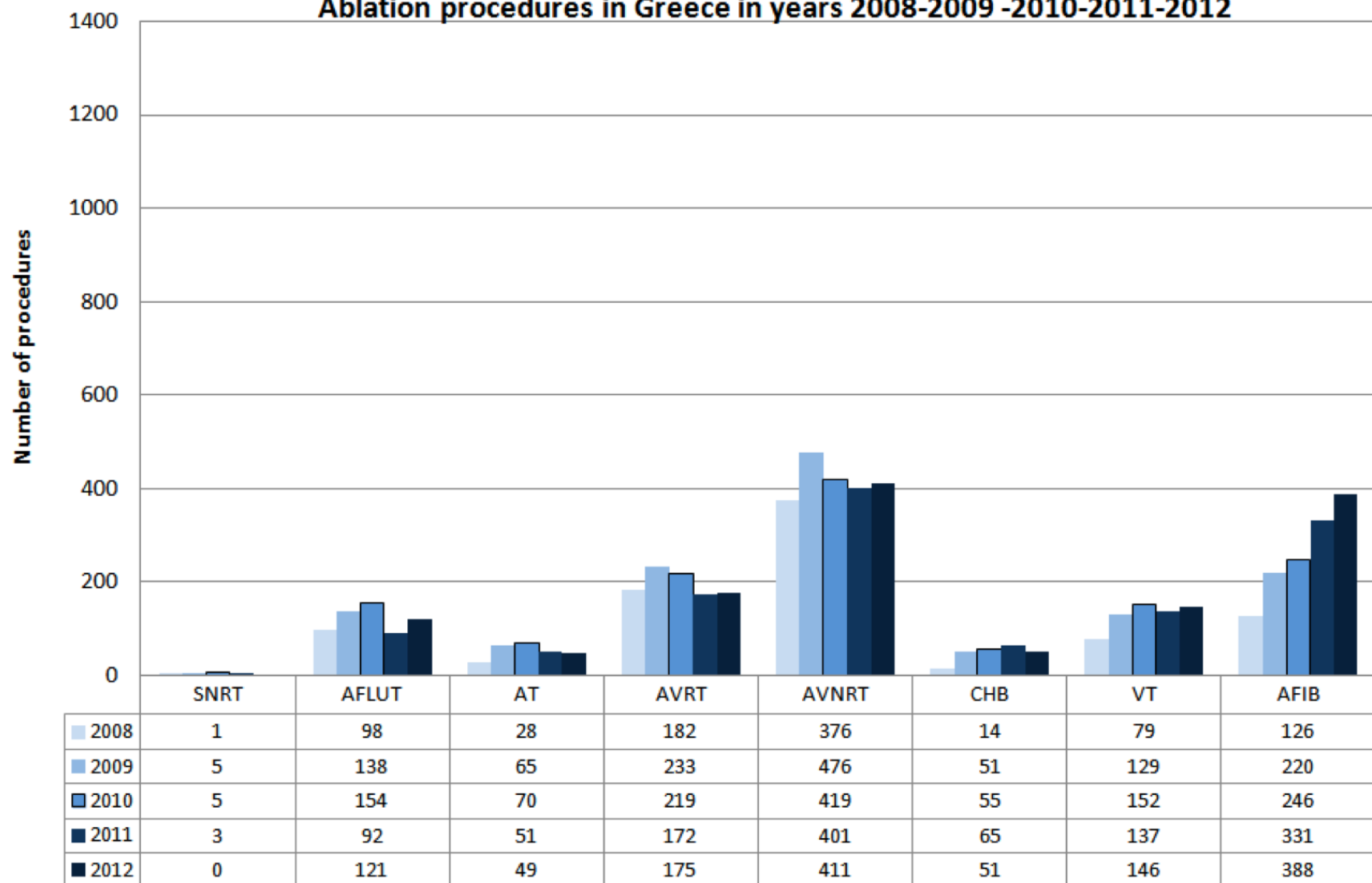
⁵ Stabile et al. Eur Heart J 2006;27:216-21

⁶ Jais et al. Circulation 2008;118:2498-2505

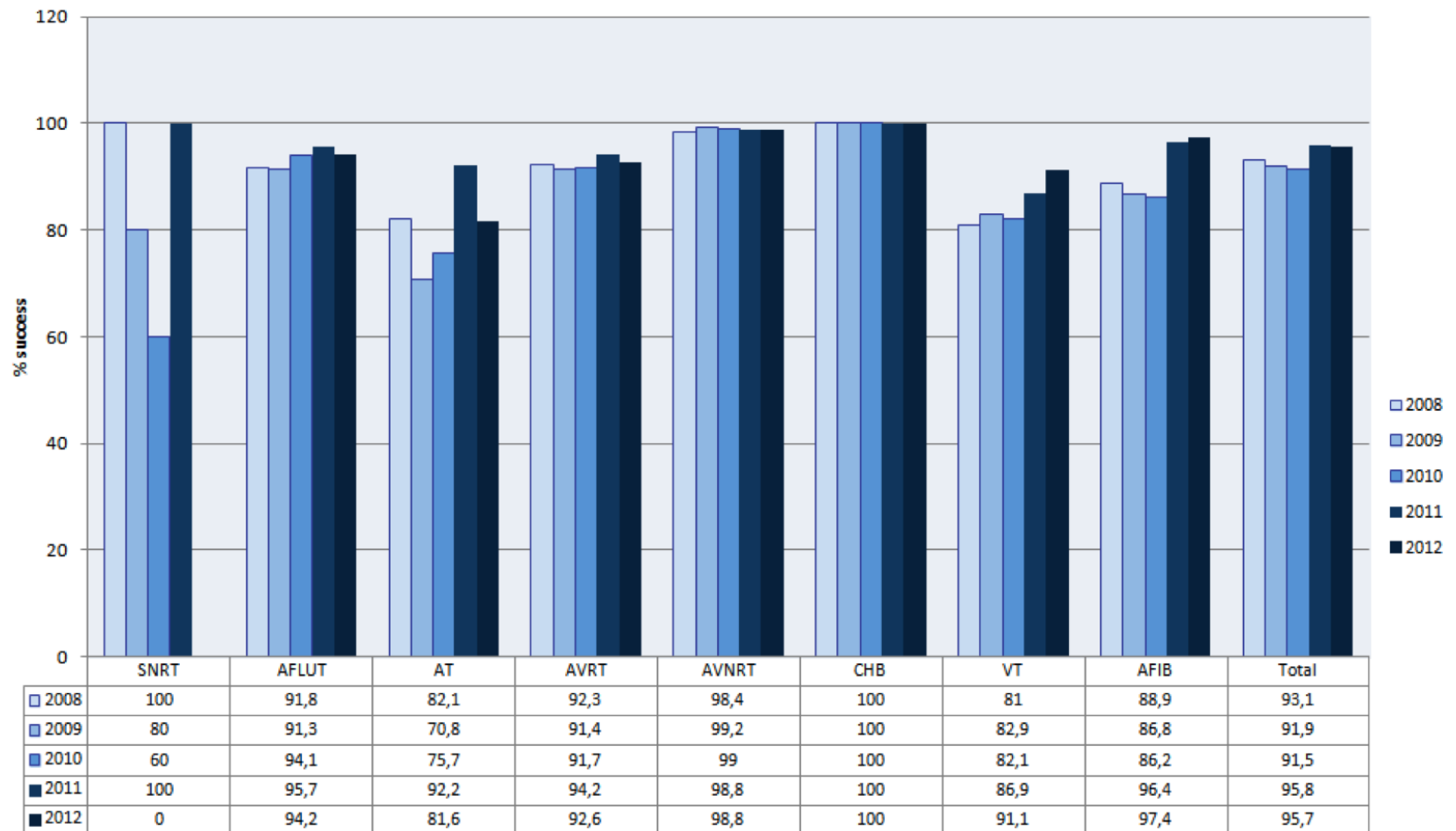
⁷ Forleo et al. J Cardiovasc Electrophysiol 2009;20:22-28

⁸ Wilber et al. JAMA. 2010;303:333-340

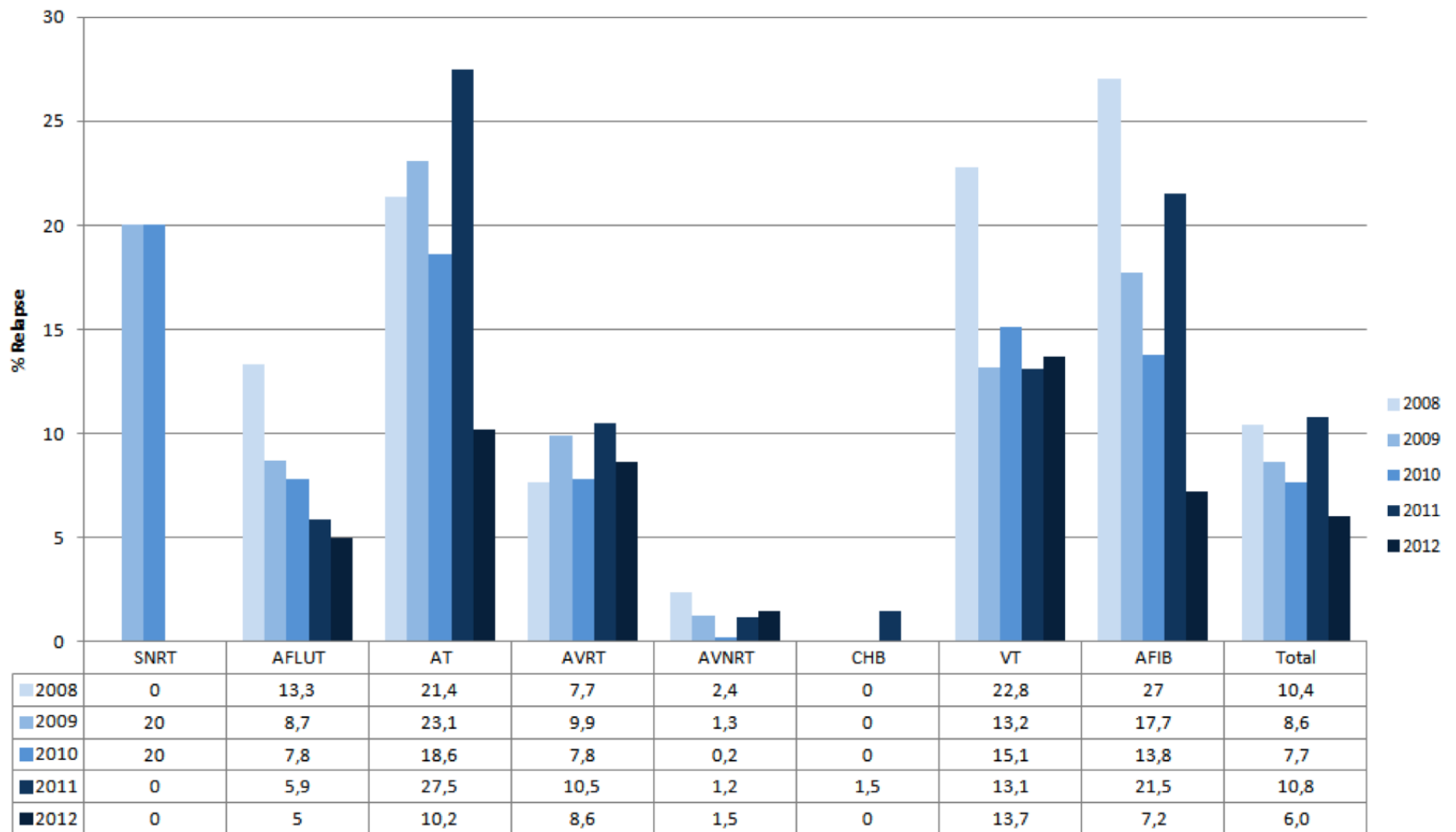
Ablation procedures in Greece in years 2008-2009 -2010-2011-2012



% Success rates per procedure



Relapse rates (%) per procedure

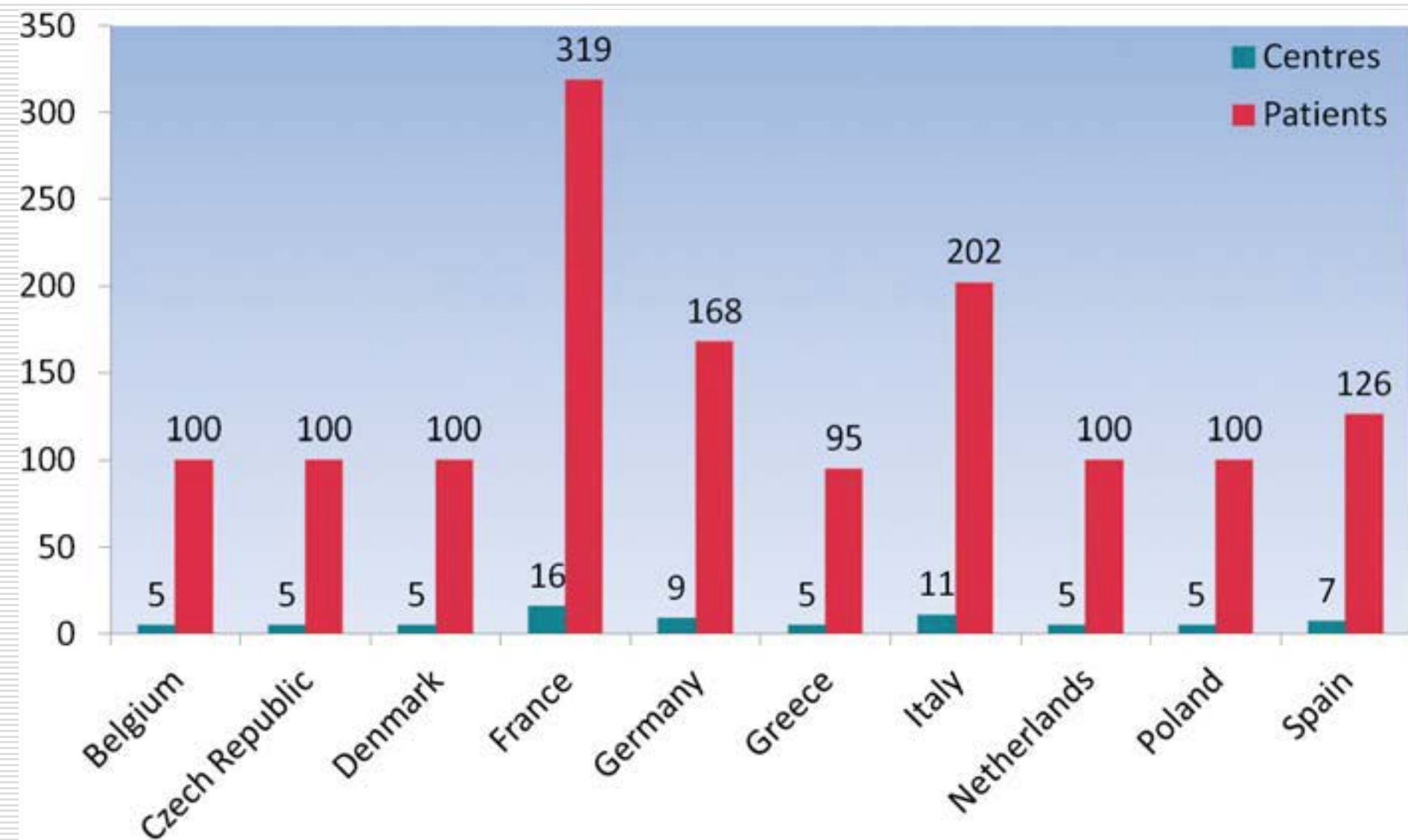


EURObservational Research Programme

Atrial Fibrillation Ablation Pilot Registry

1-year follow-up results

Elena Arbelo¹, Josep Brugada¹, Gerhard Hindricks², Aldo Maggioni³, Luigi Tavazzi⁴, Panos Vardas⁵, Frédéric Anselme⁶, Giuseppe Inama⁷, Pierre Jais⁸, Zbigniew Kalarus⁹, Josef Kautzner¹⁰, Thorsten Lewalter¹¹, Georges Mairesse¹², Julian Perez-Villacastin¹³, Sam Riahi¹⁴, Milos Taborsky¹⁵, George Theodorakis¹⁶, Serge Trines¹⁷, on the behalf of the *Atrial Fibrillation Ablation Pilot Study Investigators**



Characteristics of atrial fibrillation

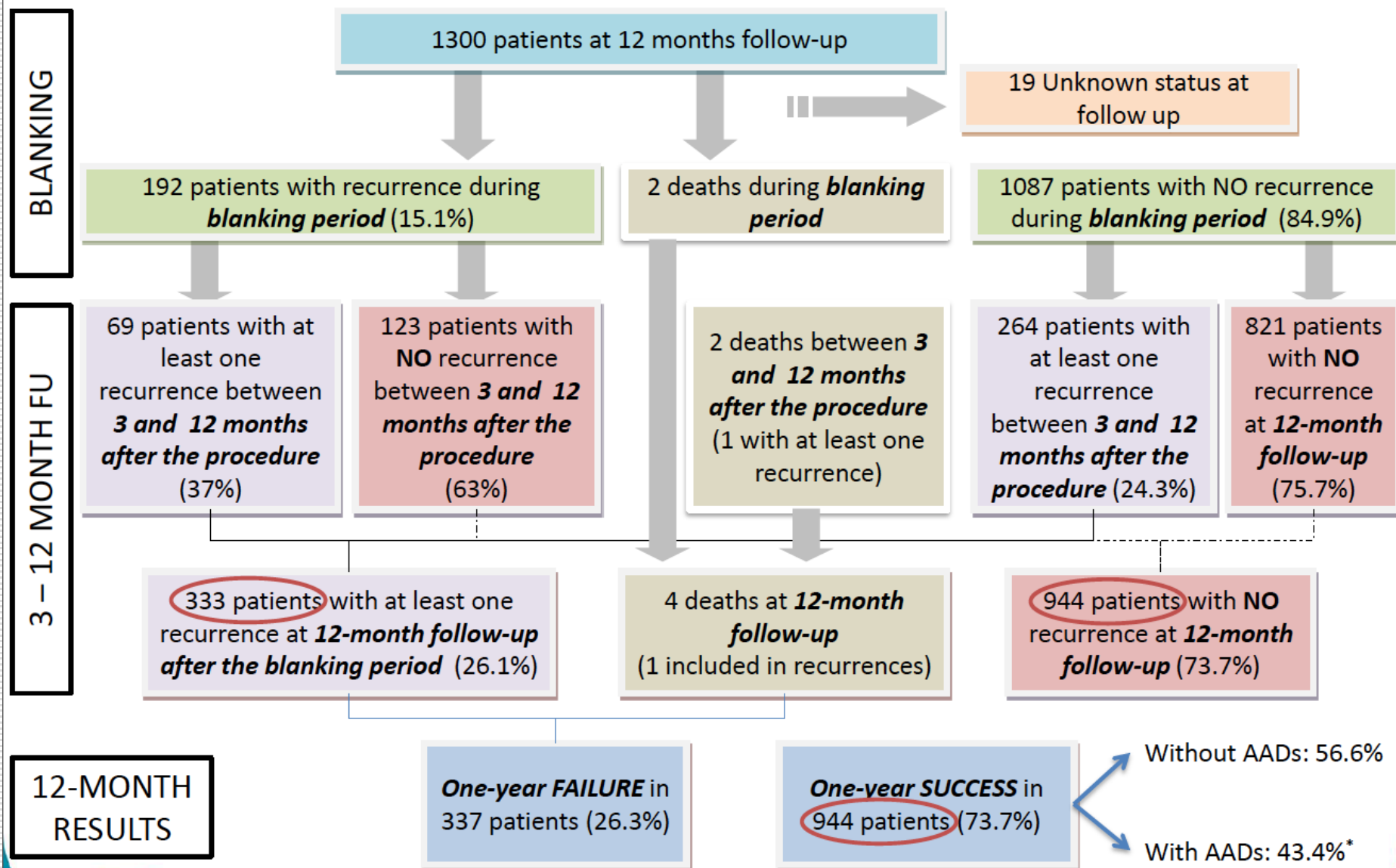
- n: 1391
- Paroxysmal 66.8%
- Persistent 27.6%
- Permanent 4.5%

Underlying disorder

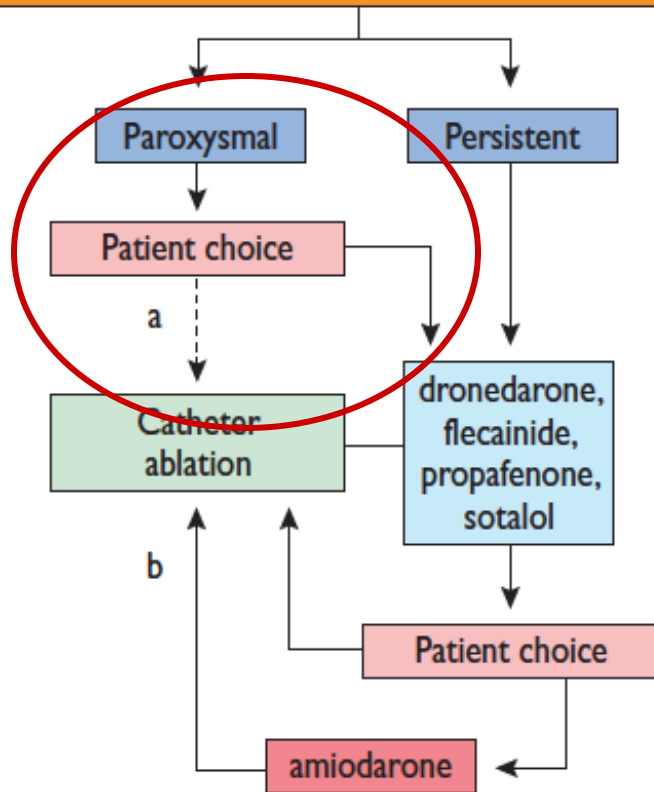
<input type="checkbox"/> Lone atrial fibrillation	38.2
<input type="checkbox"/> Hypertension	27.9
<input type="checkbox"/> Valvular heart disease	12.3
<input type="checkbox"/> Coronary artery disease	3.6
<input type="checkbox"/> Dilated cardiomyopathy	3.2
<input type="checkbox"/> Hypertrophic cardiomyopathy	2.9
<input type="checkbox"/> Chronic heart failure	2.6
<input type="checkbox"/> Other cardiac disease	2.7
<input type="checkbox"/> Hyperthyroidism	2.4
<input type="checkbox"/> Chron. obstr. pulm. disease	0.7
<input type="checkbox"/> Not defined	3.5

Indications for ablation (%)

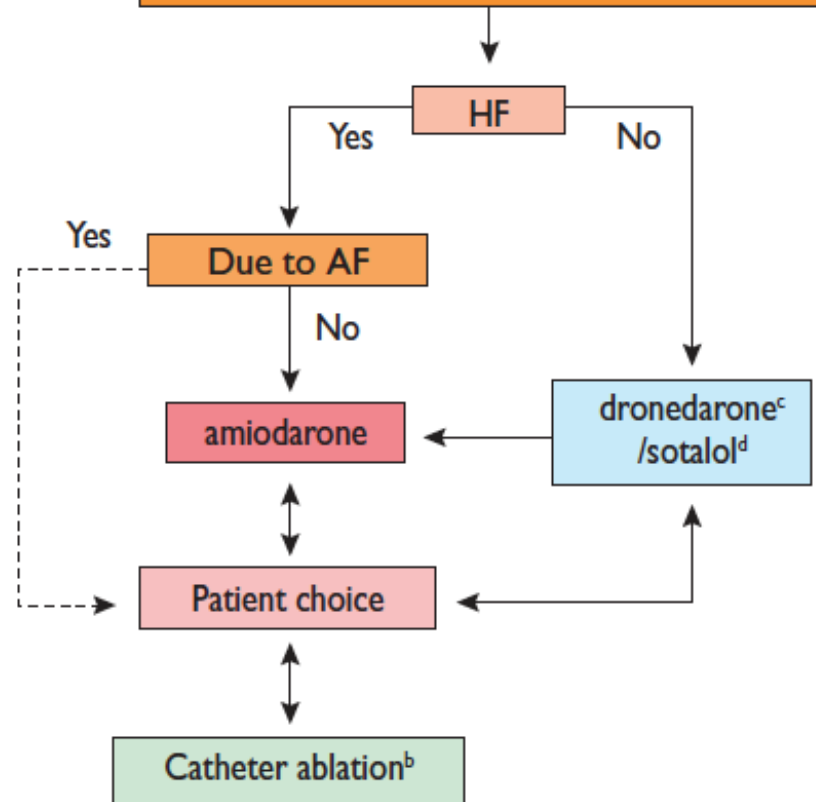
<input type="checkbox"/> Symptoms	89.7
<input type="checkbox"/> Quality of life	73.4
<input type="checkbox"/> Desire for drug-free lifestyle	34.9
<input type="checkbox"/> Desire for sinus rhythm	39.6



No or minimal structural heart disease



Relevant structural heart disease



These recommendations are restricted to: (i) highly experienced centres/investigators; (ii) appropriate patient selection; (iii) careful evaluation of treatment alternatives and (iv) patient preference.

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- ❑ Operator experience
 - ❑ Catheter ablation is usually undertaken in patients with symptomatic paroxysmal AF
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- ❑ The stage of atrial disease (i.e. AF type, LA size, AF history).
 - ❑ The presence and severity of underlying cardiovascular disease.
 - ❑ Patient preference.
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