

Nice 2019, oct 17<sup>th</sup>

# A F ablation: back to the future talk

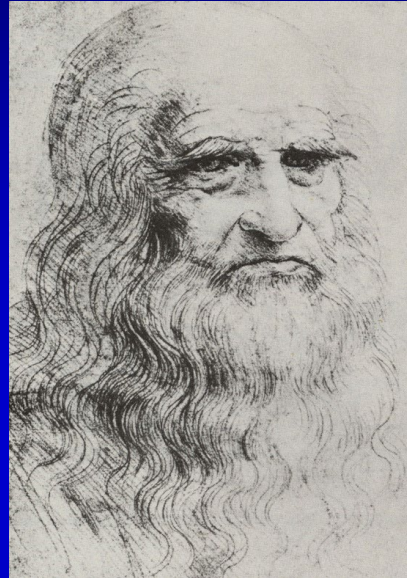
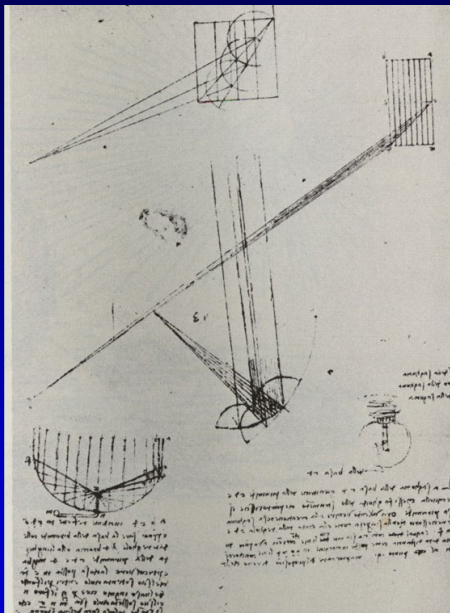
## History of A F ablation

Prof. Fiorenzo Gaita

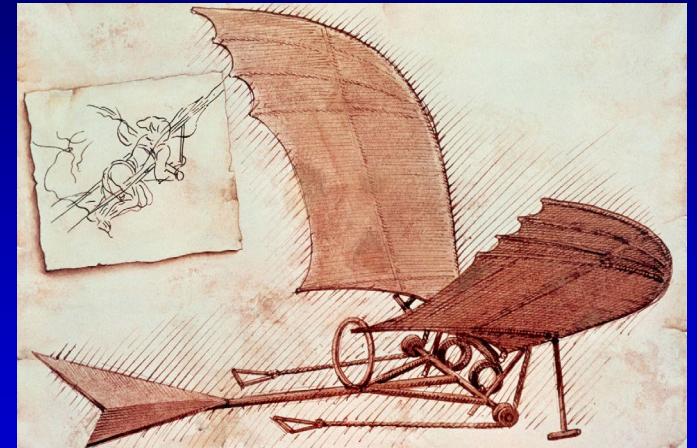
University of Turin, Italy



# Knowledge



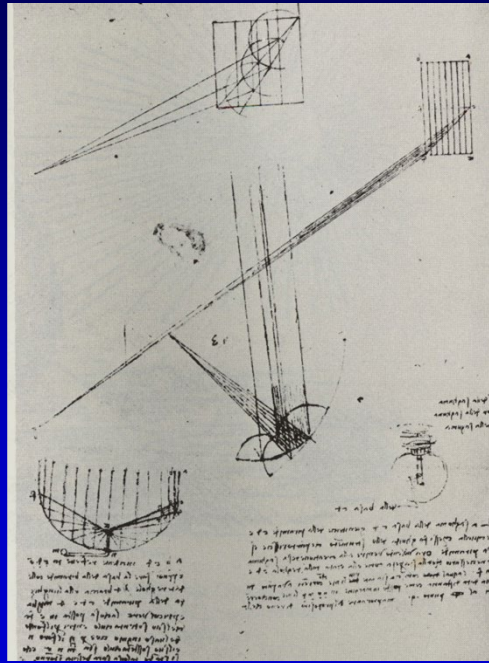
# Idea



# Technology

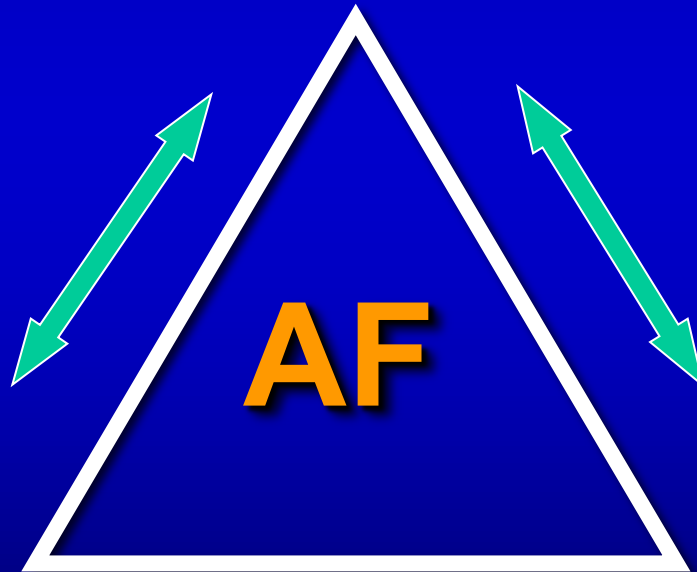
(right tools)





**KNOWLEDGE**

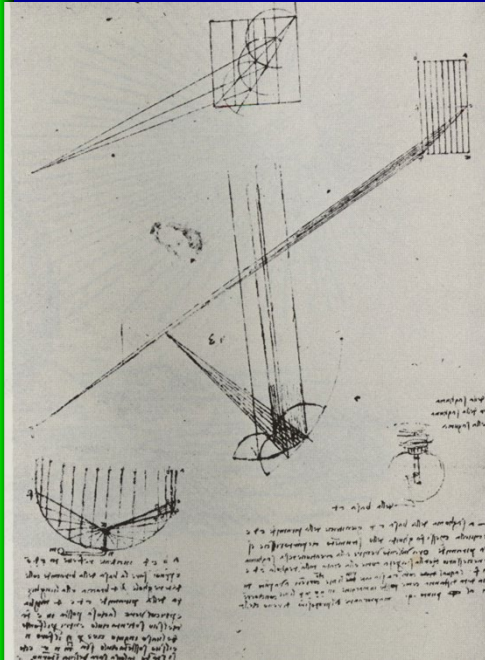
**Substrate  
(Critical mass)**



**Trigger  
(extrasystoles)**

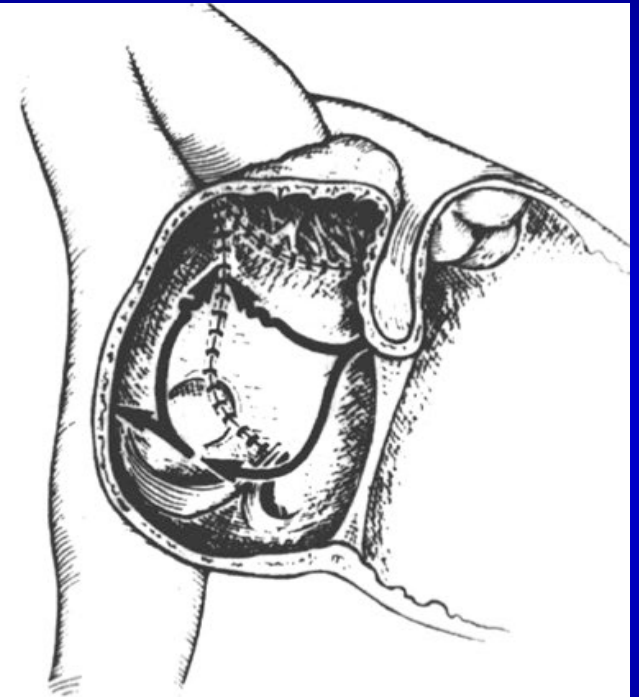
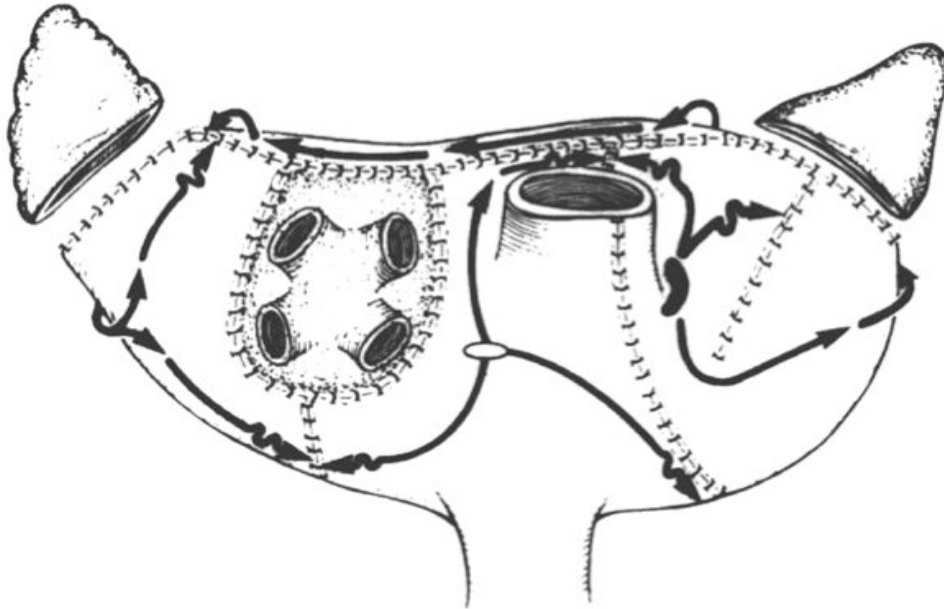
**Autonomic  
Nervous  
System**

# HISTORY of A F ABLATION started in the 90s with



**IDEA**  
**Surgical**  
**ablation of**  
**substrate**

# Substrate modification: **linear lesions**



178 pts ( 103 paroxysmal, 75 chronic )

Follow-up : 3 - 102 months

Success rate: **93%**

Complications: PM implant 30 pts, 1 stroke, 2 MI  
4 deaths

# Substrate modification: linear lesions with catheter ? 1996

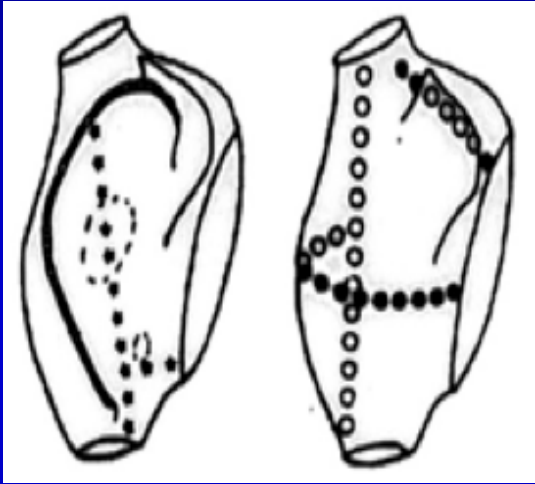


**Inappropriate tools and technologies:  
char formation with 1-mm tip catheter  
and absence of temperature control**

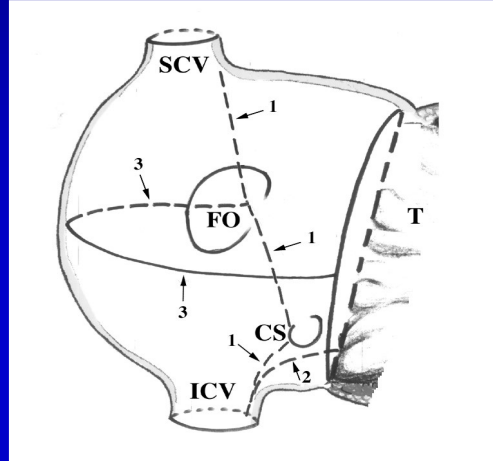


Courtesy of Prof. Breithard and Prof. Borgreffe 1986

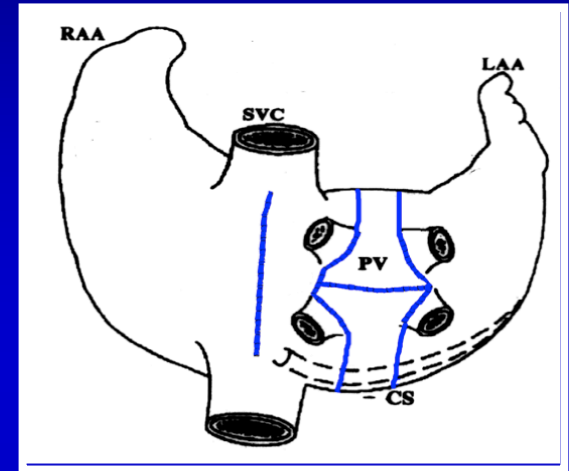
# Beginning of the era of AF TC ablation



Haissaguerre '96-98



Gaita '96-98



Swartz '96



# Right and left ablation for atrial fibrillation

29 Pts with **Chronic AF**

**Success**

79%

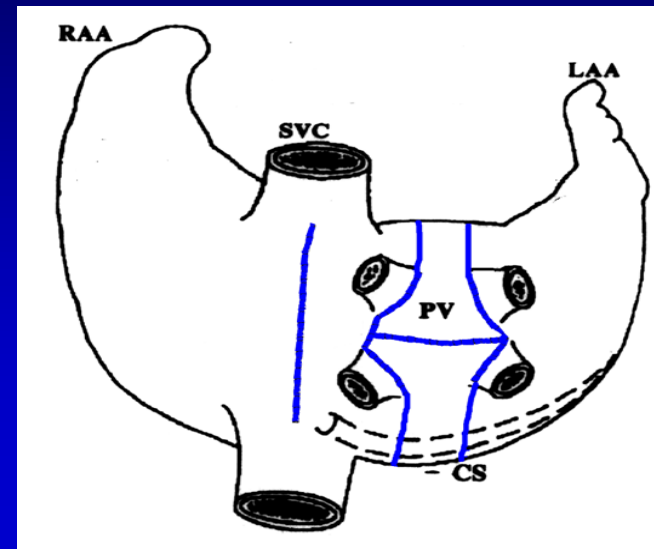
**Complication**

31%

(2 cerebral vascular accidents,  
1 pericardial effusion,  
1 pericarditis, 1 ARDS)

**Procedure duration** 10.50 h

**X-ray exposure** 118 min

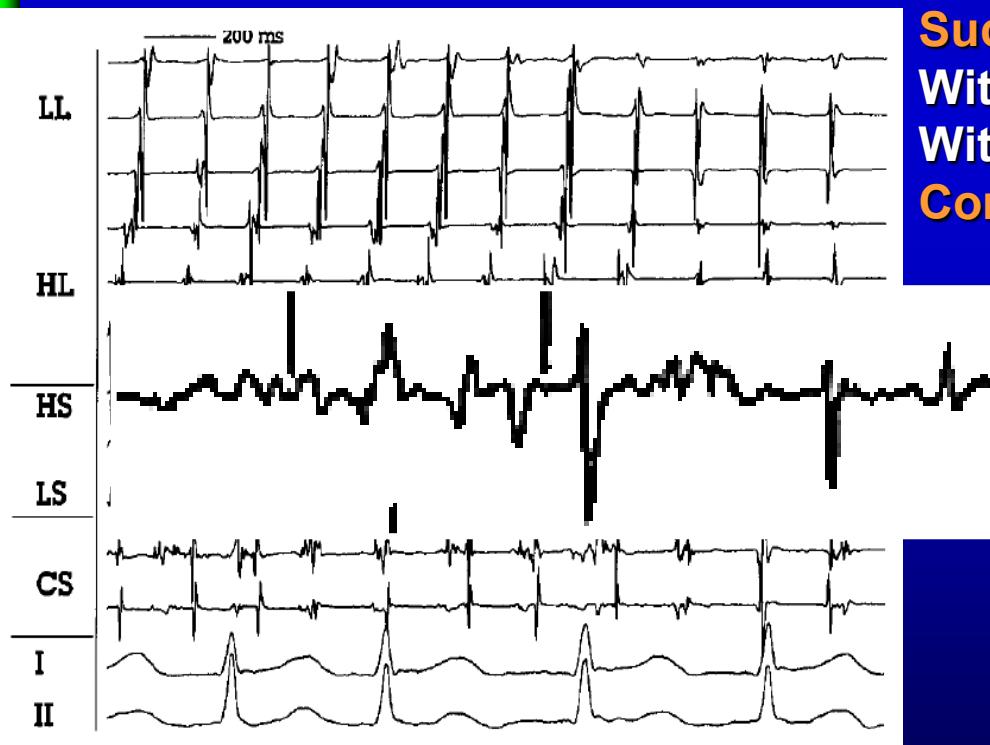
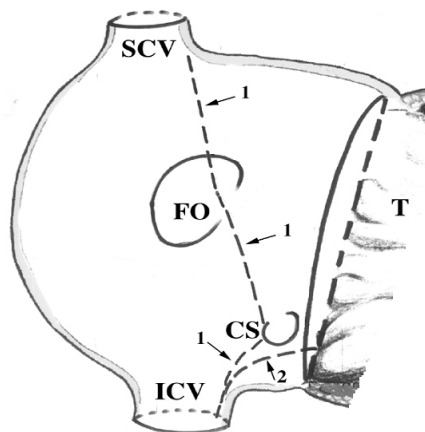


# Atrial Mapping and Radiofrequency Catheter Ablation in Patients With Idiopathic Atrial Fibrillation

## Electrophysiological Findings and Ablation Results

Fiorenzo Gaita, MD; Riccardo Riccardi, MD; Leonardo Calò, MD; Marco Scaglione, MD;  
 Lucia Garberoglio, MD; Renzo Antolini, PhD; Michele Kirchner, PhD;  
 Filippo Lamberti, MD; Elena Richiardi, MD

(*Circulation*. 1998;97:2136-2145.)

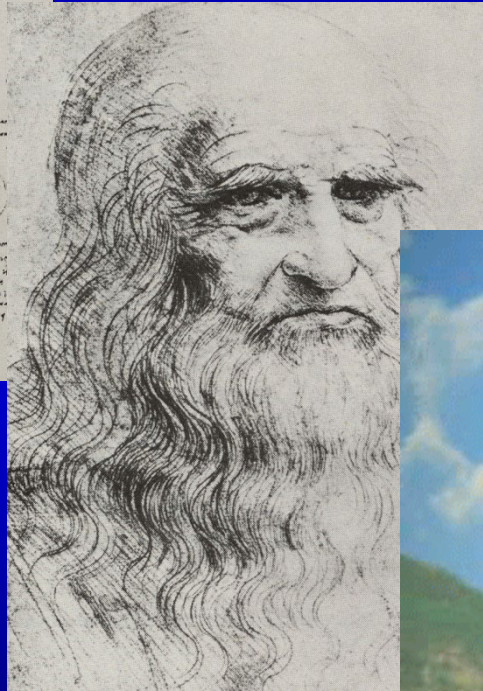
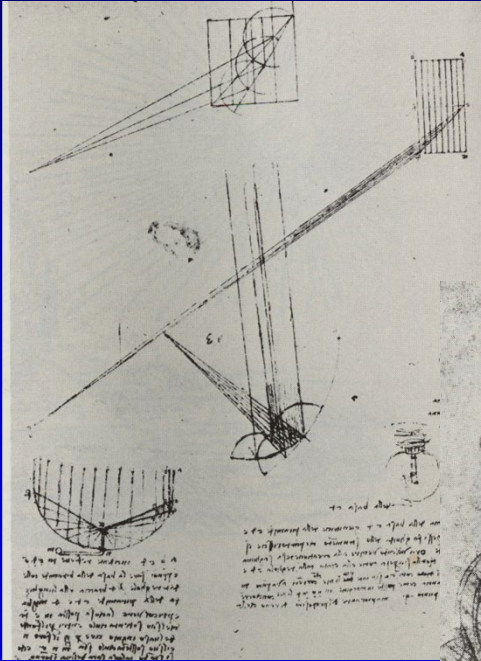


Follow-up (months)	11 ± 4	36 ± 6
<b>Success</b>	56%	39%
Without drugs	25%	11%
With drugs	31%	28%
<b>Complications</b>	none	none

**Predictors of success:**  
 ablation in areas with  
**shortest FF interval,**  
**low vagal tone**  
 demonstrated by heart rate  
 variability

...very often the realization of an idea may take some time....

**Knowledge**



**Idea**

**Technology**  
(right tools)

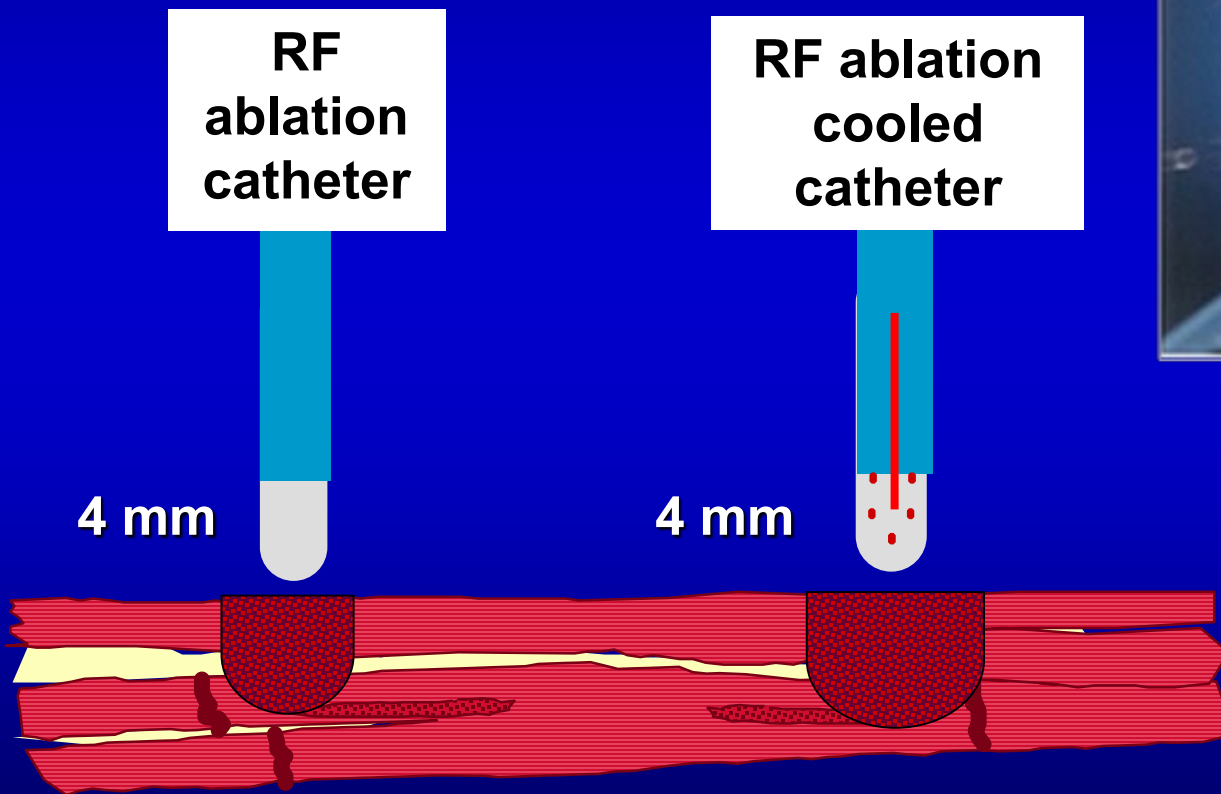


**1998**

**The right tools and a  
new idea**

# “The Right Tools” for left atrial ablation

**4 mm irrigated/cooled** catheter produces larger and safer lesions, decreasing the risk of cerebral vascular accidents



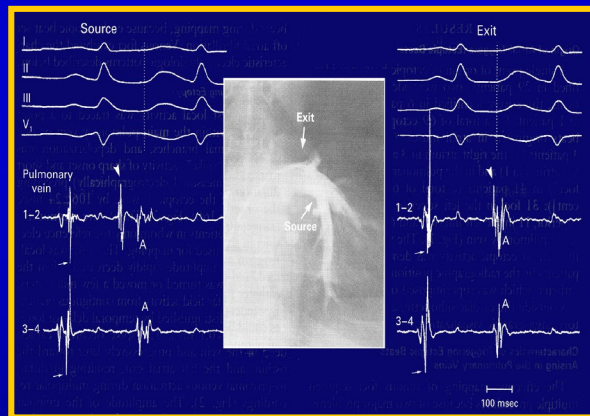
# The new idea: PV ablation

Interest moves from *substrate* to *triggers*

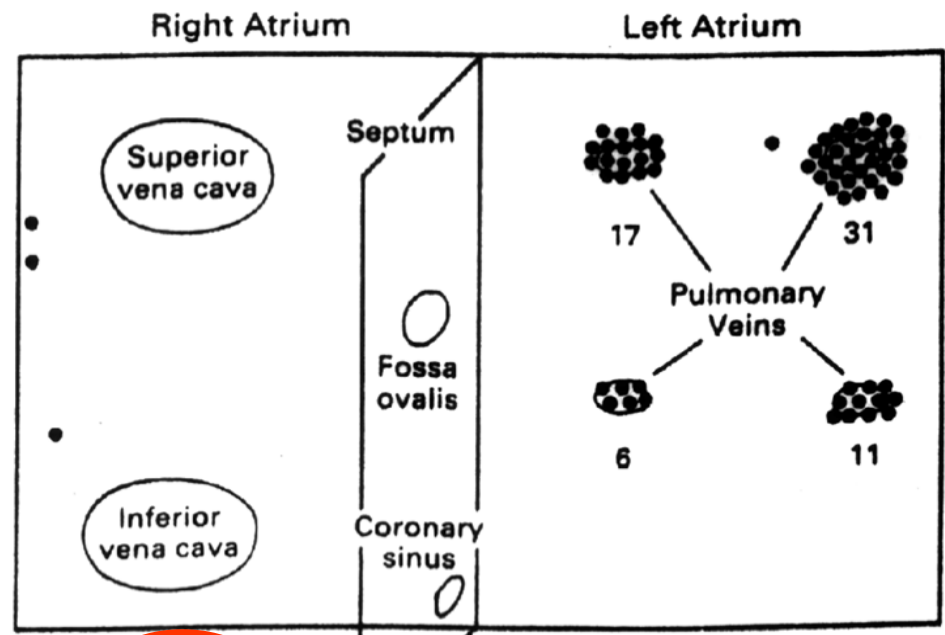
## SPONTANEOUS INITIATION OF ATRIAL FIBRILLATION BY ECTOPIC BEATS ORIGINATING IN THE PULMONARY VEINS

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.

NEJM 1998;339:659-666



45 pts with  
idiopathic PAF  
Follow-up:  
8±6 months

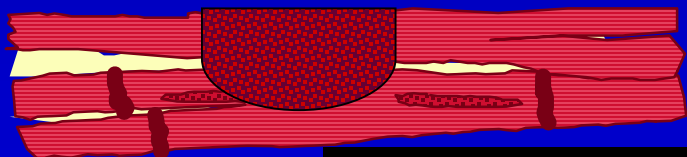


62% success rate w/oAAD

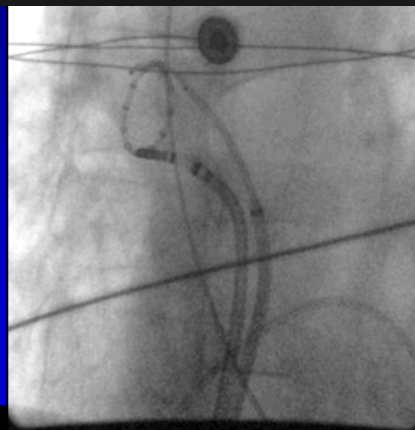
# The right tools for ablation:

RF ablation catheter

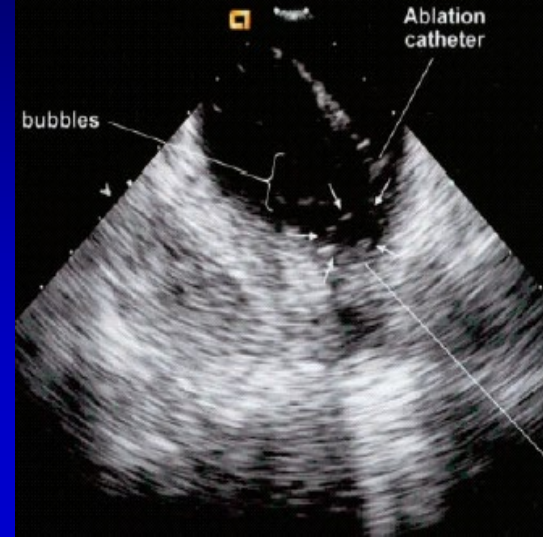
4 mm cooled



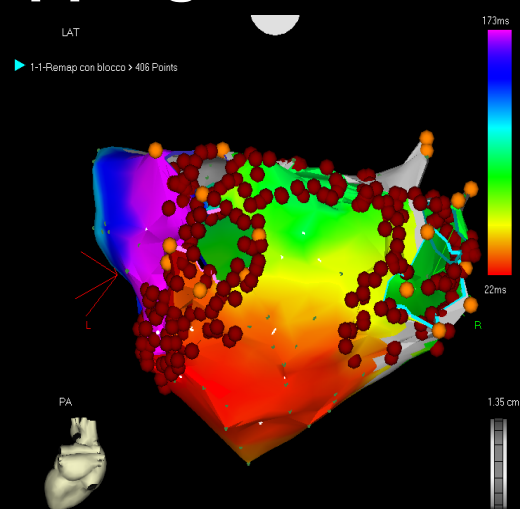
Rx Circular mapping catheter



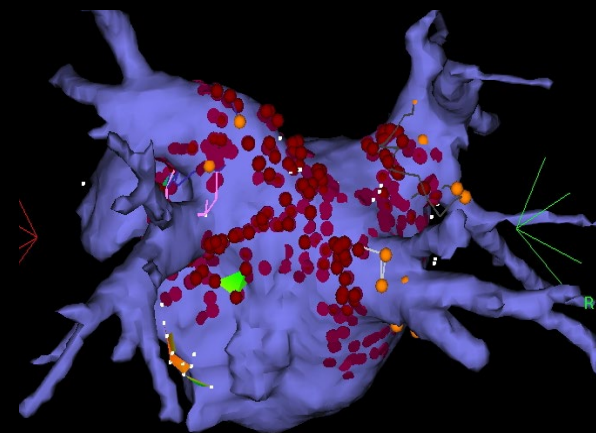
Intracardiac echo



3D electro-anatomical mapping



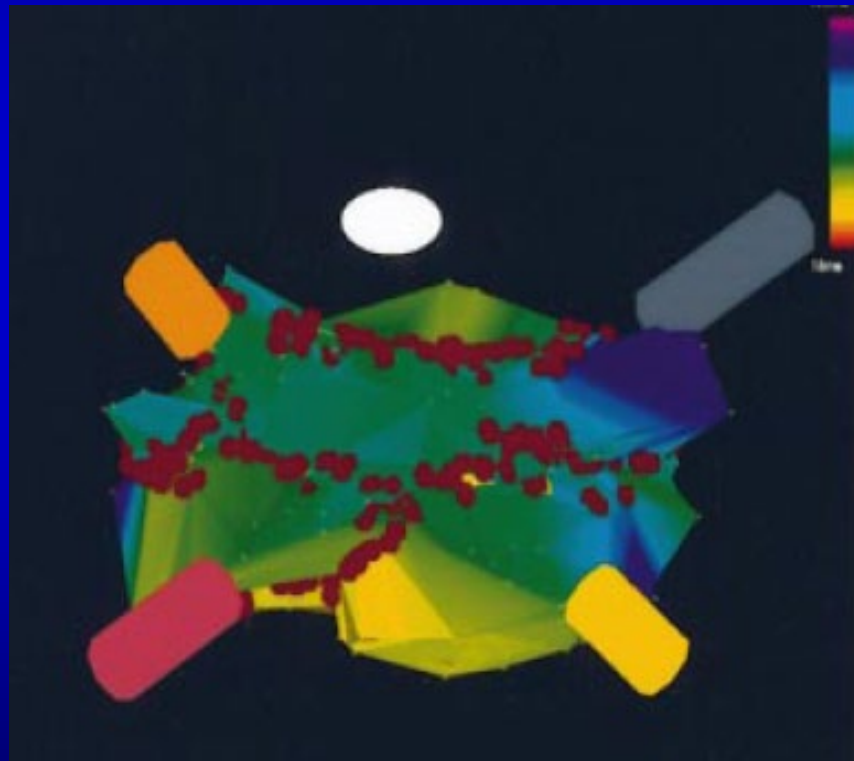
Integrated imaging with MRI-TC



# Electroanatomic mapping systems

## Catheter Ablation of Paroxysmal Atrial Fibrillation Using a 3D Mapping System

Carlo Papone, MD; Giuseppe Oreto, MD; Filippo Lamberti, MD; Gabriele Vicedomini, MD; Maria Luisa Loricchio, MD; Shlomo Shpun, DSc; Mariano Rillo, MD; Maria Pia Calabrò, MD; Andrea Conversano, MD; Shlomo A. Ben-Haim, MD, DSc; Riccardo Cappato, MD; Sergio Chierchia, MD  
(*Circulation*. 1999;100:1203-1208.)

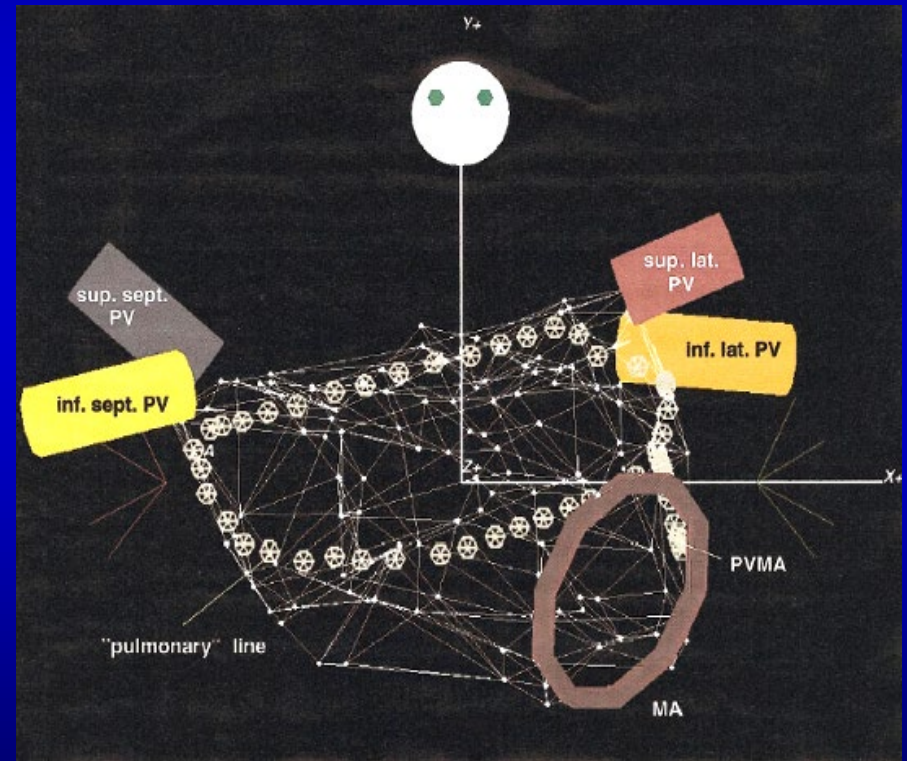


27 pts success 16 pts (59 %)

## Modification of the Substrate for Maintenance of Idiopathic Human Atrial Fibrillation

### Efficacy of Radiofrequency Ablation Using Nonfluoroscopic Catheter Guidance

Sabine Ernst, MD; Michael Schlüter, PhD; Feifan Ouyang, MD; Afsaneh Khanedani, MD; Riccardo Cappato, MD; Joachim Hebe, MD; Marius Volkmer, MD; Matthias Antz, MD; Karl-Heinz Kuck, MD  
(*Circulation*. 1999;100:2085-2092.)



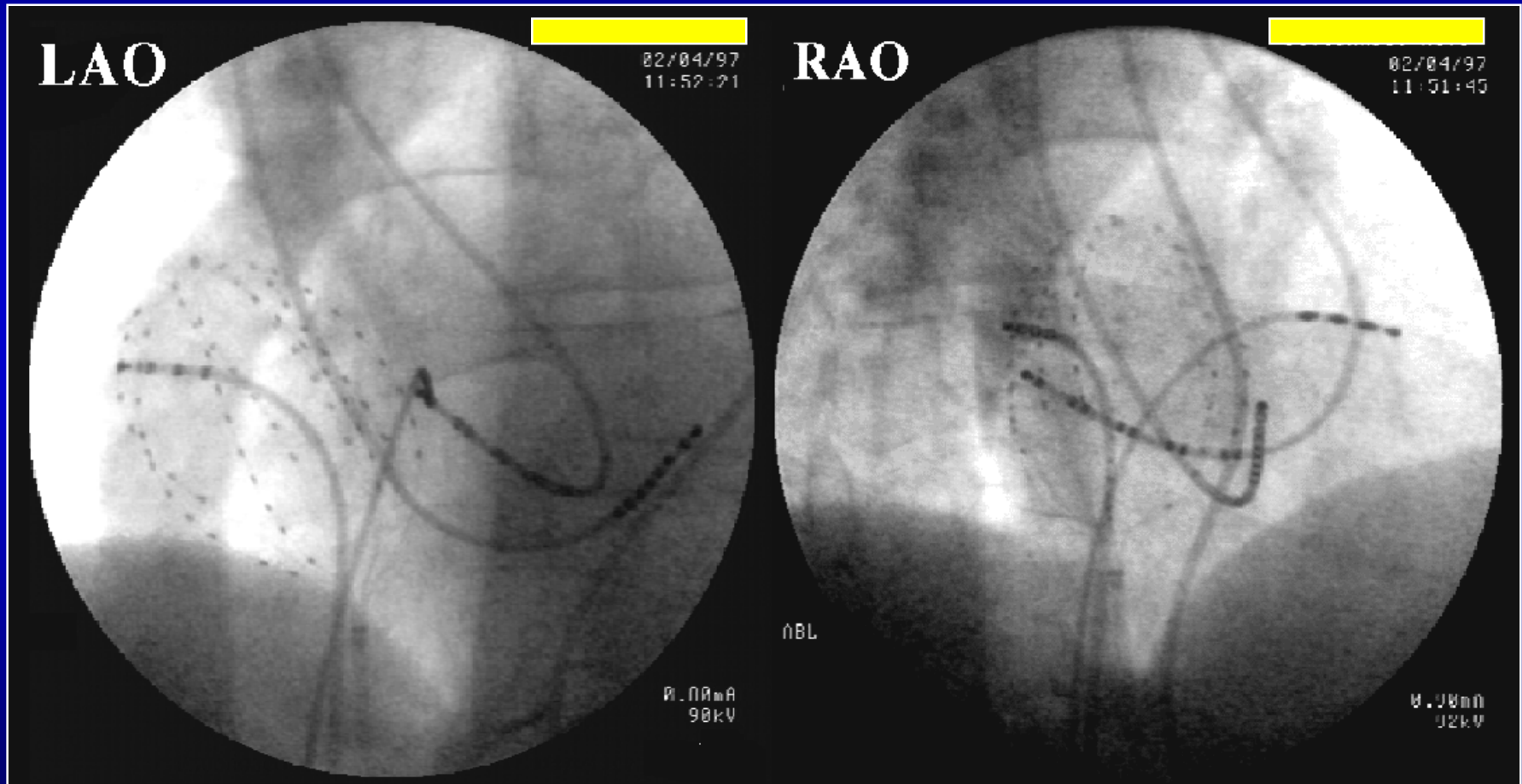
32 pts: success 2 pts (6%)



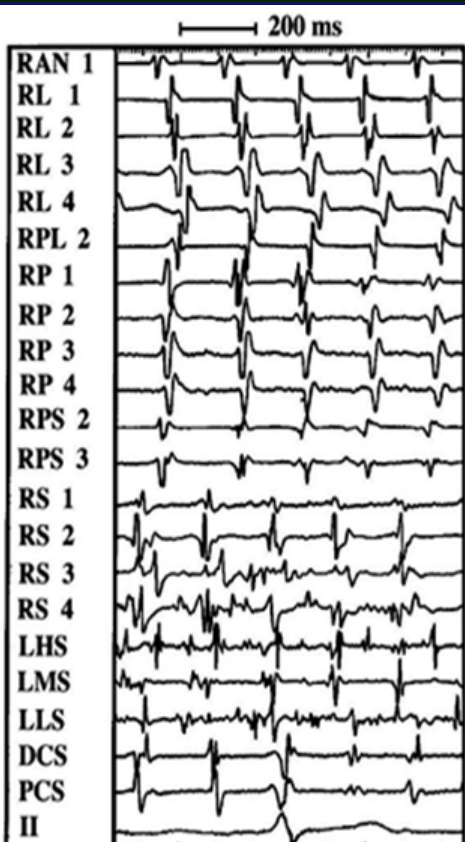
# The question in 2000

Can pulmonary vein isolation  
effectively treat also patients  
with **persistent AF** and  
**structural heart disease?**

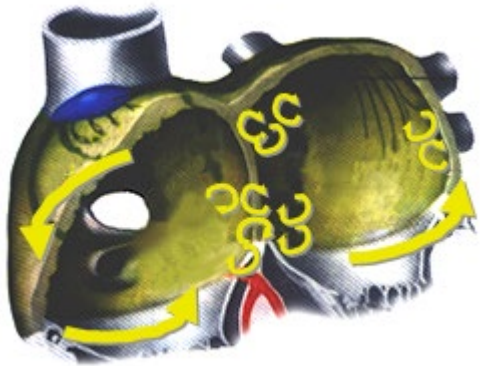
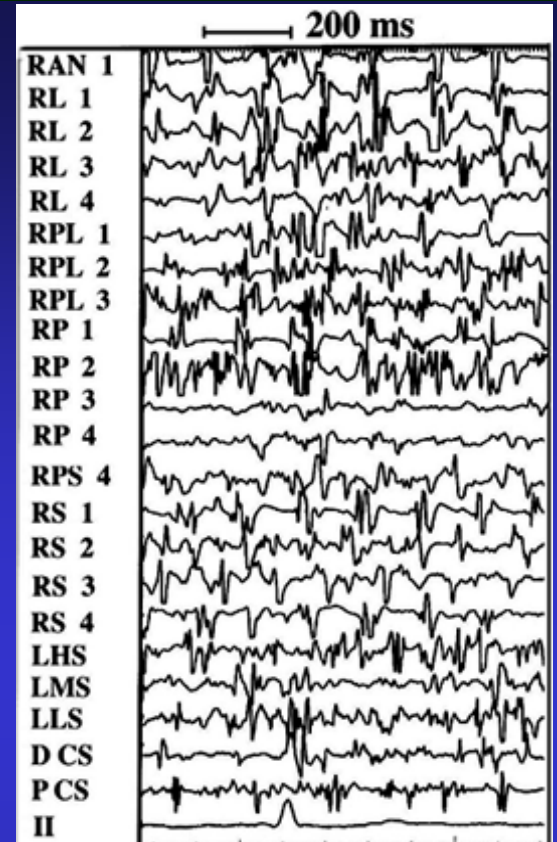
# Different Patterns of Atrial Activation in Idiopathic Atrial Fibrillation: Simultaneous Multisite Atrial Mapping in Patients With Paroxysmal and Chronic Atrial Fibrillation



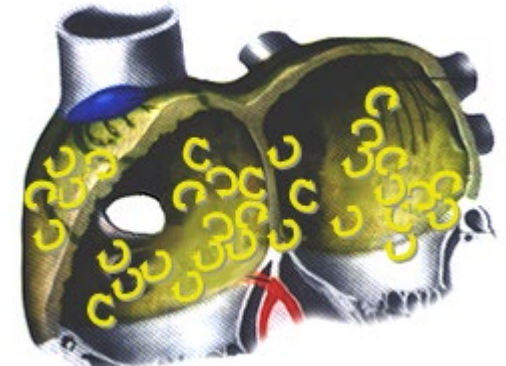
Gaita F. Scaglione M. Calo L. Riccardi R. JACC 2001



Areas with **complex fractionated electrograms** are smaller in paroxysmal AF, larger in persistent AF



**Paroxysmal AF**



**Persistent AF**

# Linear Cryoablation of the Left Atrium Versus Pulmonary Vein Cryoisolation in Patients With Permanent Atrial Fibrillation and Valvular Heart Disease

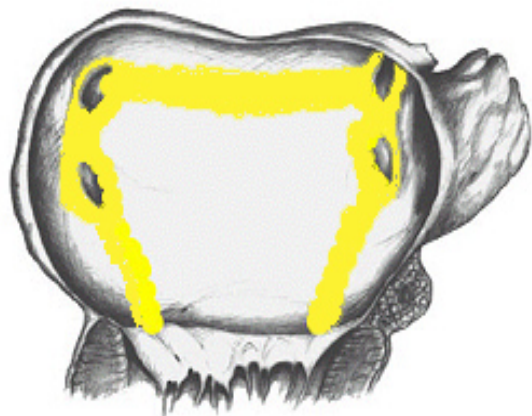
## Correlation of Electroanatomic Mapping and Long-Term Clinical Results

Fiorenzo Gaita, MD; Riccardo Ricciardi, MD; Domenico Caponi, MD; Dipen Shah, MD; Lucia Garberoglio, MD; Laura Vivalda, MD; Alessandro Dulio, BS; Andrea Chiecchio, PhD; Eric Manasse, MD; Roberto Gallotti, MD

**Circulation** 2005;111:136-42

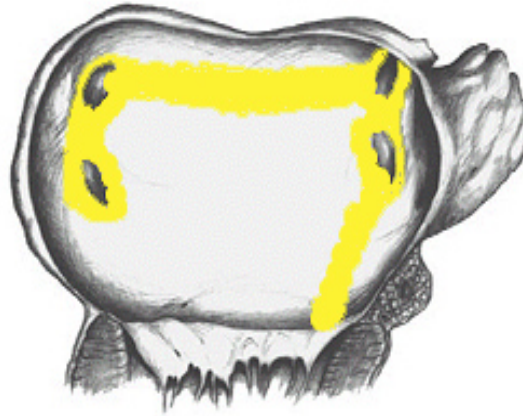
JOURNAL OF THE AMERICAN HEART ASSOCIATION

105 pts, Permanent AF and Valvular Heart Disease



reversed U

**Lesion**



7

**Lesion**



VP

**Isolation**

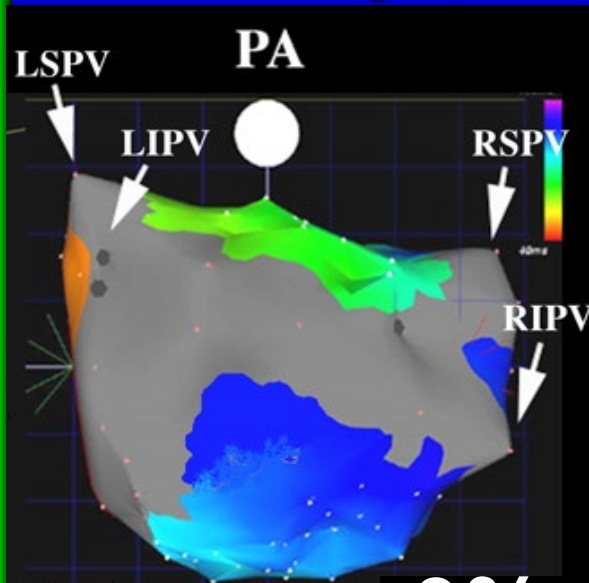
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## Correlation of Electroanatomic Mapping and Long-Term Clinical Results

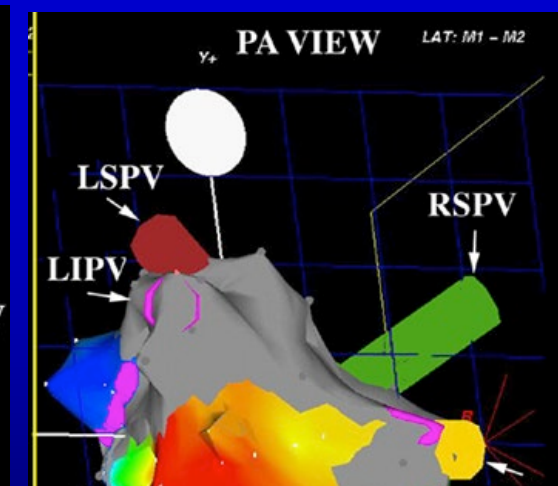
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### 3D left atrial mapping 3 months after procedure

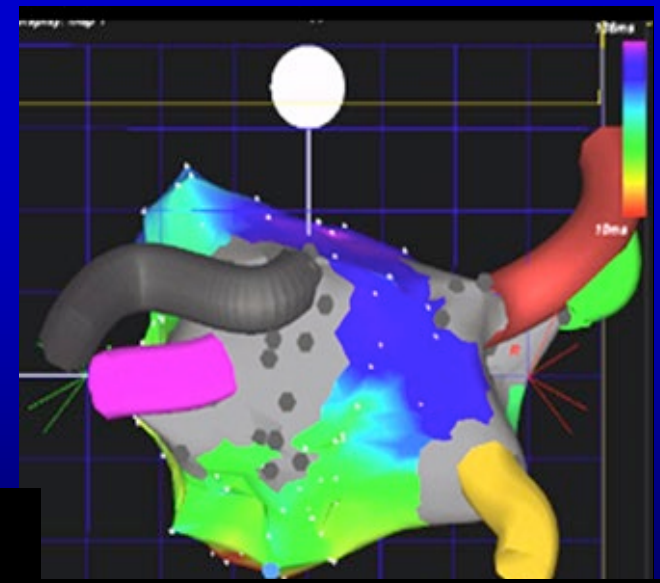
105 pts, Permanent AF and Valvular Heart Disease



"U" lesion 0%



Complete Lesions 7 scheme 65%



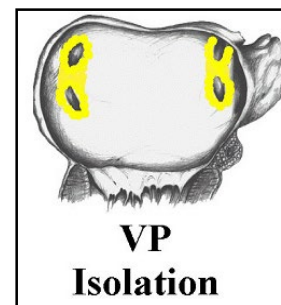
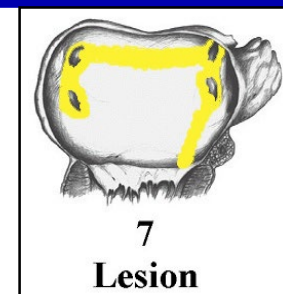
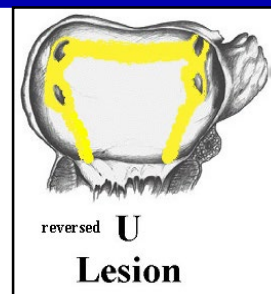
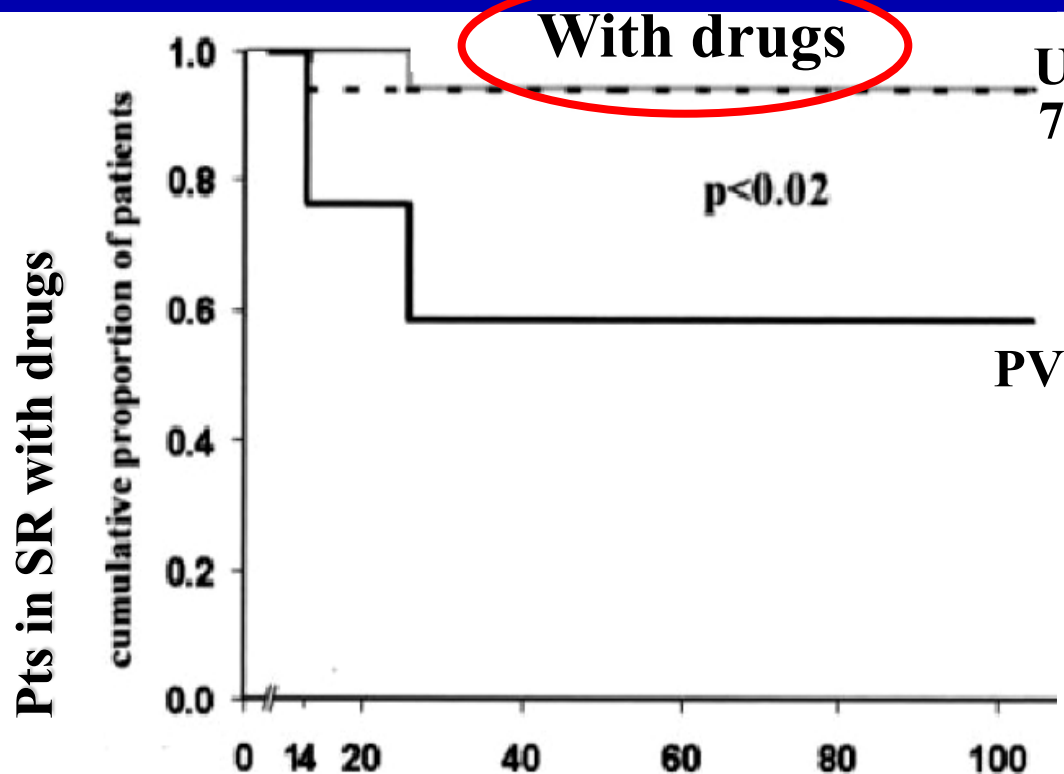
PVI isolation 81%

# Linear Cryoablation of the Left Atrium Versus Pulmonary Vein Cryoisolation in Patients With Permanent Atrial Fibrillation and Valvular Heart Disease

### Correlation of Electroanatomic Mapping and Long-Term Clinical Results

## Permanent AF and Valvular Heart Disease

Fiorenzo Gaita, MD; Riccardo Ricciardi, MD; Domenico Caponi, MD; Dipen Shah, MD; Lucia Garberoglio, MD; Laura Vivalda, MD; Alessandro Dulio, BS; Andrea Chiecchio, PhD; Eric Manasse, MD; Roberto Gallotti, MD



U pts	17	17	17	17	17	17
7 pts	17	17	17	17	17	17
PVI pts	17	17	17	17	17	17

# Linear Cryoablation of the Left Atrium Versus Pulmonary Vein Cryoisolation in Patients With Permanent Atrial Fibrillation and Valvular Heart Disease

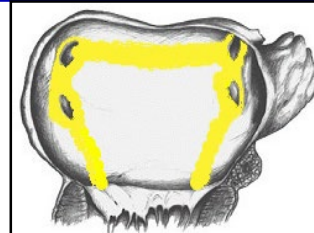
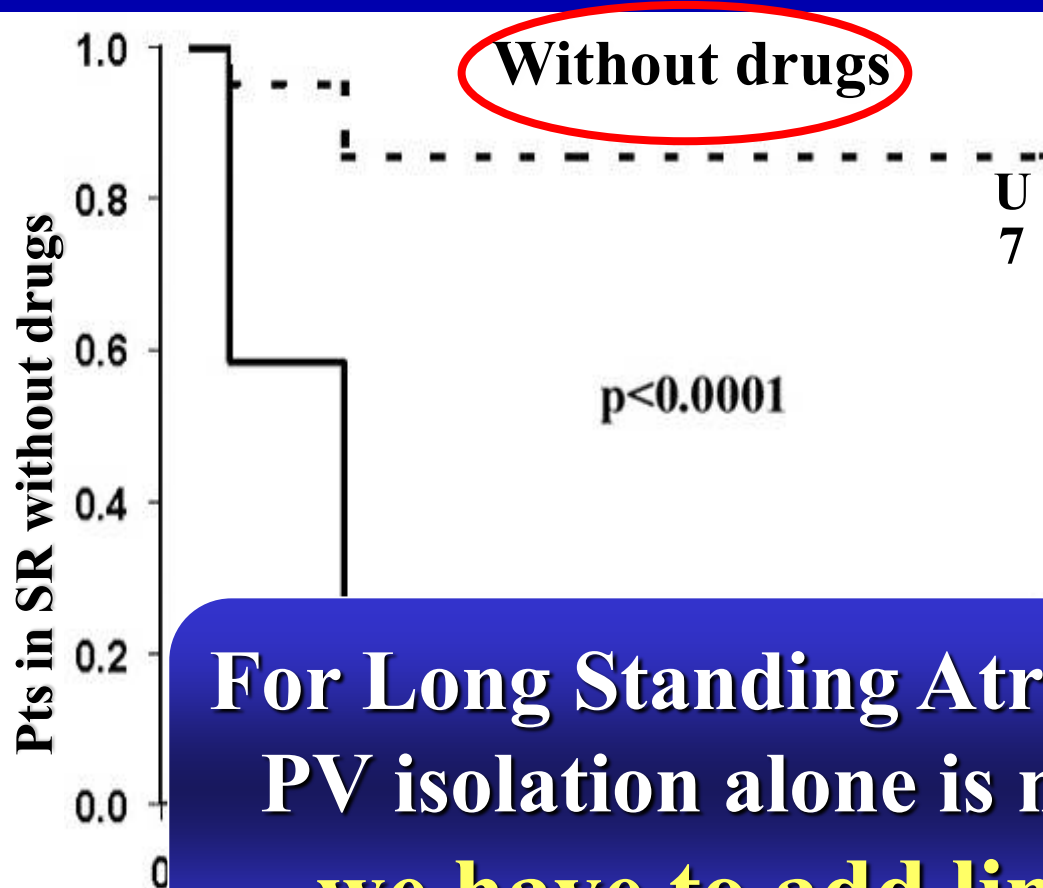
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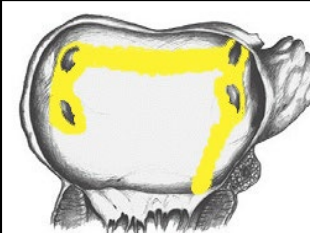
**Circulation**

2005;111:136-42

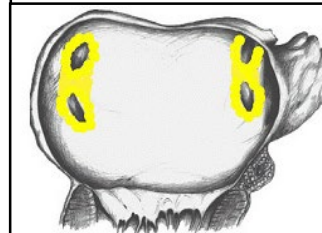
**Permanent AF  
and Valvular  
Heart Disease**



reversed U  
Lesion



7  
Lesion

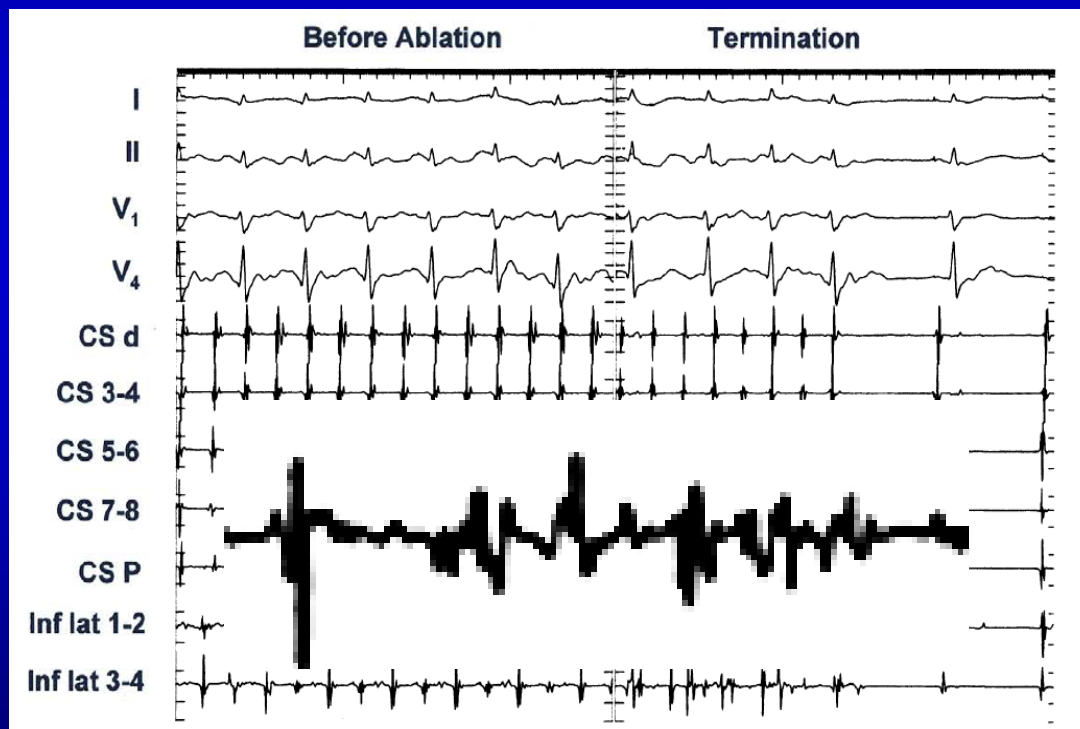
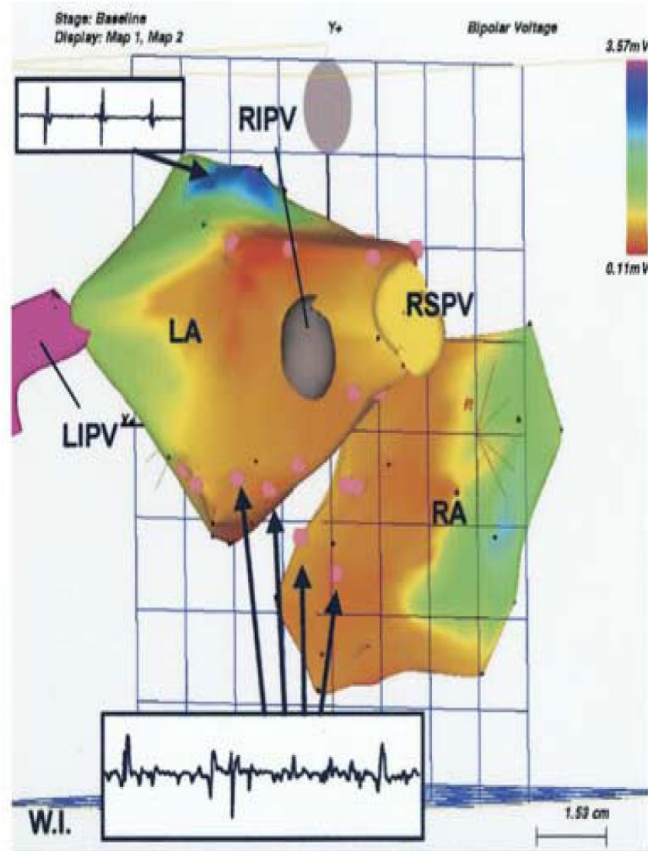


**For Long Standing Atrial Fibrillation  
PV isolation alone is not sufficient:  
we have to add linear lesions**

# A New Approach for Catheter Ablation of Atrial Fibrillation: Mapping of the Electrophysiologic Substrate

Koonlawee Nademanee, MD, FACC,\* John McKenzie, MD,\* Erol Kosar, MD,\* Mark Schwab, MD,\*  
Buncha Sunsaneewitayakul, MD,† Thaveekiat Vasavakul, MD,\* Chotikorn Khunnawat, MD,\*  
Tachapong Ngarmukos, MD‡ (J Am Coll Cardiol 2004;43:2044-53)

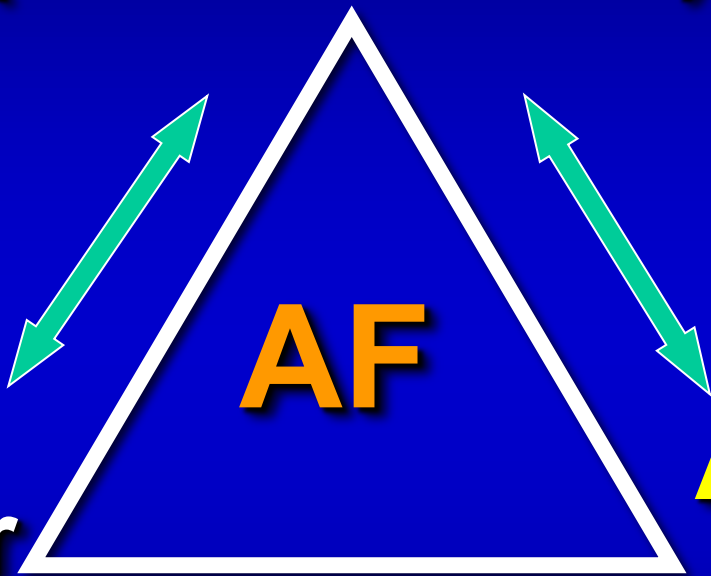
**121 pts with refractory AF (57 PAF, 64 chronic). FU: 1 y**



**84%** success rate w/out AAD (16% redo)



**Substrate  
(Critical mass)**



**AF**

**Trigger**

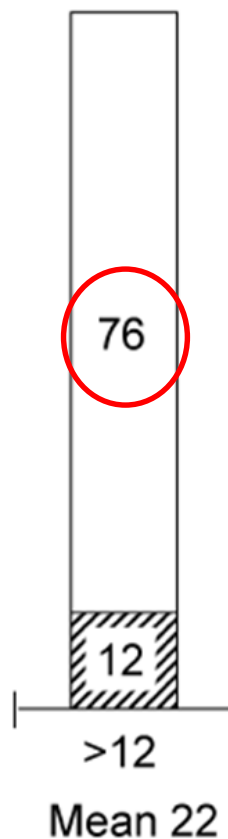
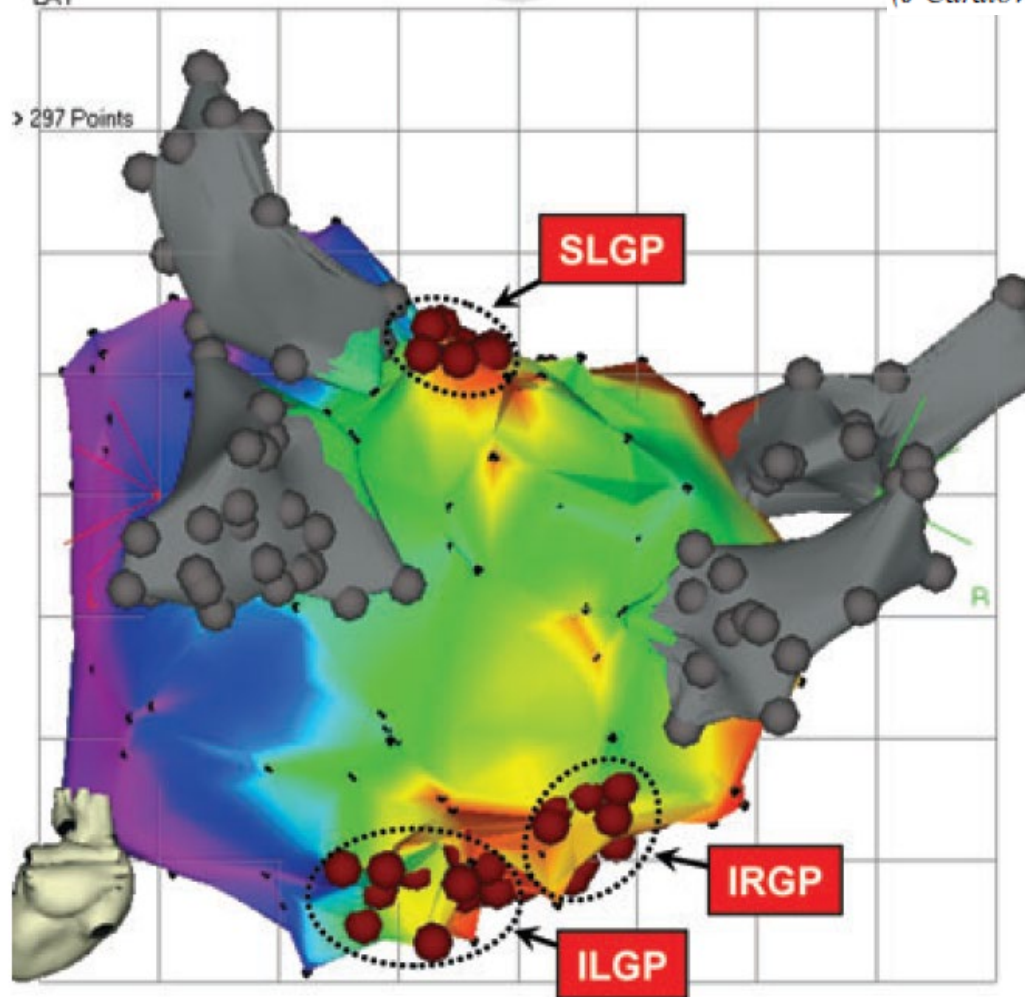
**(extrasystoles)**

**Autonomic  
Nervous  
System**

# Localization of Left Atrial Ganglionated Plexi in Patients with Atrial Fibrillation

SUNNY S. PO, M.D., PH.D., HIROSHI NAKAGAWA, M.D., PH.D.,  
and WARREN M. JACKMAN, M.D.

*(J Cardiovasc Electrophysiol, Vol. 20, pp. 1186-1189, October 2009)*



**83** paroxysmal  
AF patients

Mean follow-up  
of 22 months

**Single** procedure

# Stereotaxis

Year 2006



Integrating diagnostic data with the ability to maneuver dedicated catheters and guide wires, the Stereotaxis allows to perform interventional procedures either in the **EP Lab** (ablations, CRT) and in the **Cath Lab** (PTCA, stent).

# Sensei™ system with Artisan™ introducer (Hansen Medical)



# Sensei™ system with Artisan™ introducer (Hansen Medical)

Year 2006

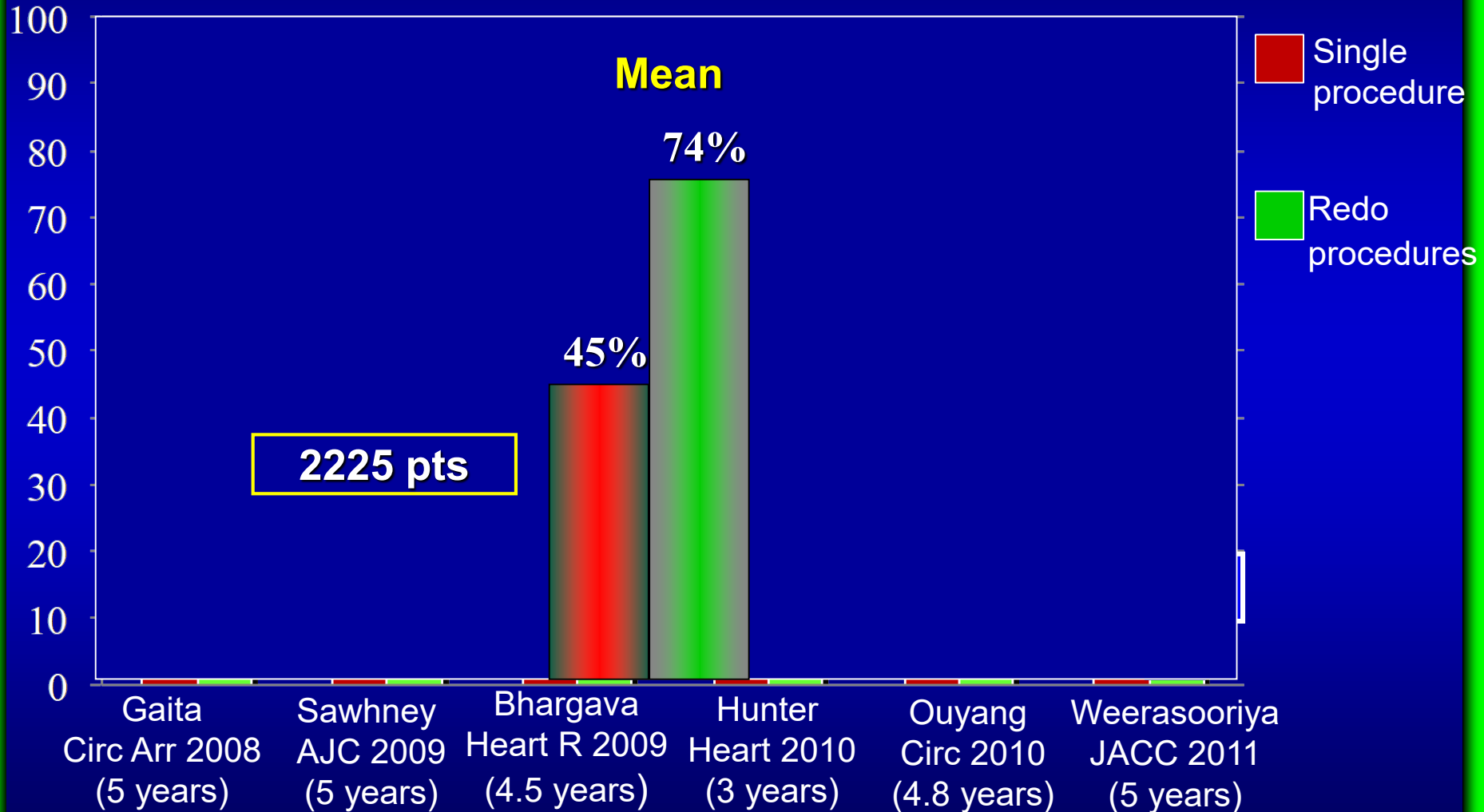


**LONG-TERM EFFICACY**

**5 years**

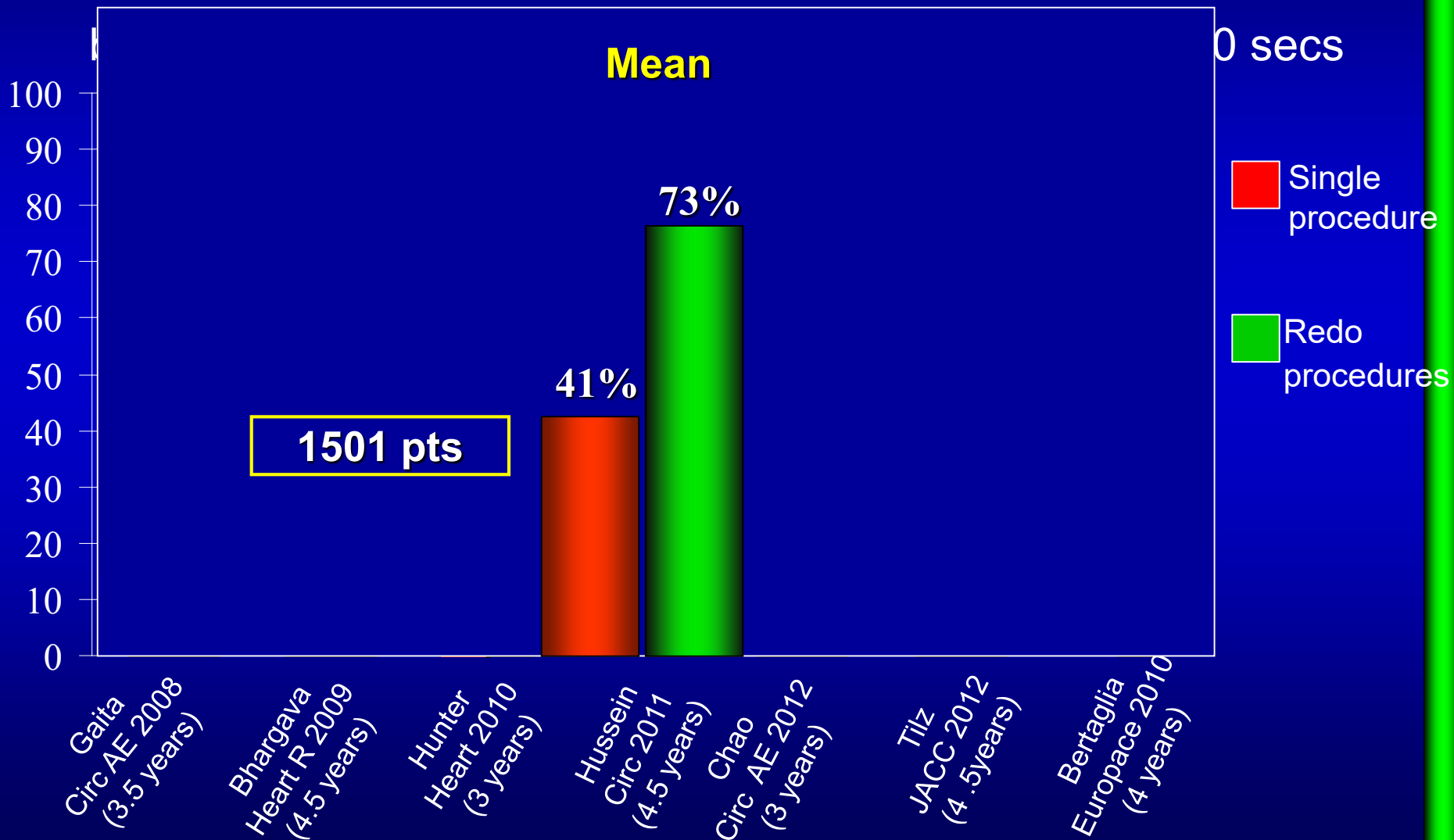
# Paroxysmal AF transcatheter ablation

Long term results (5 years) from studies involving more than 50 pts



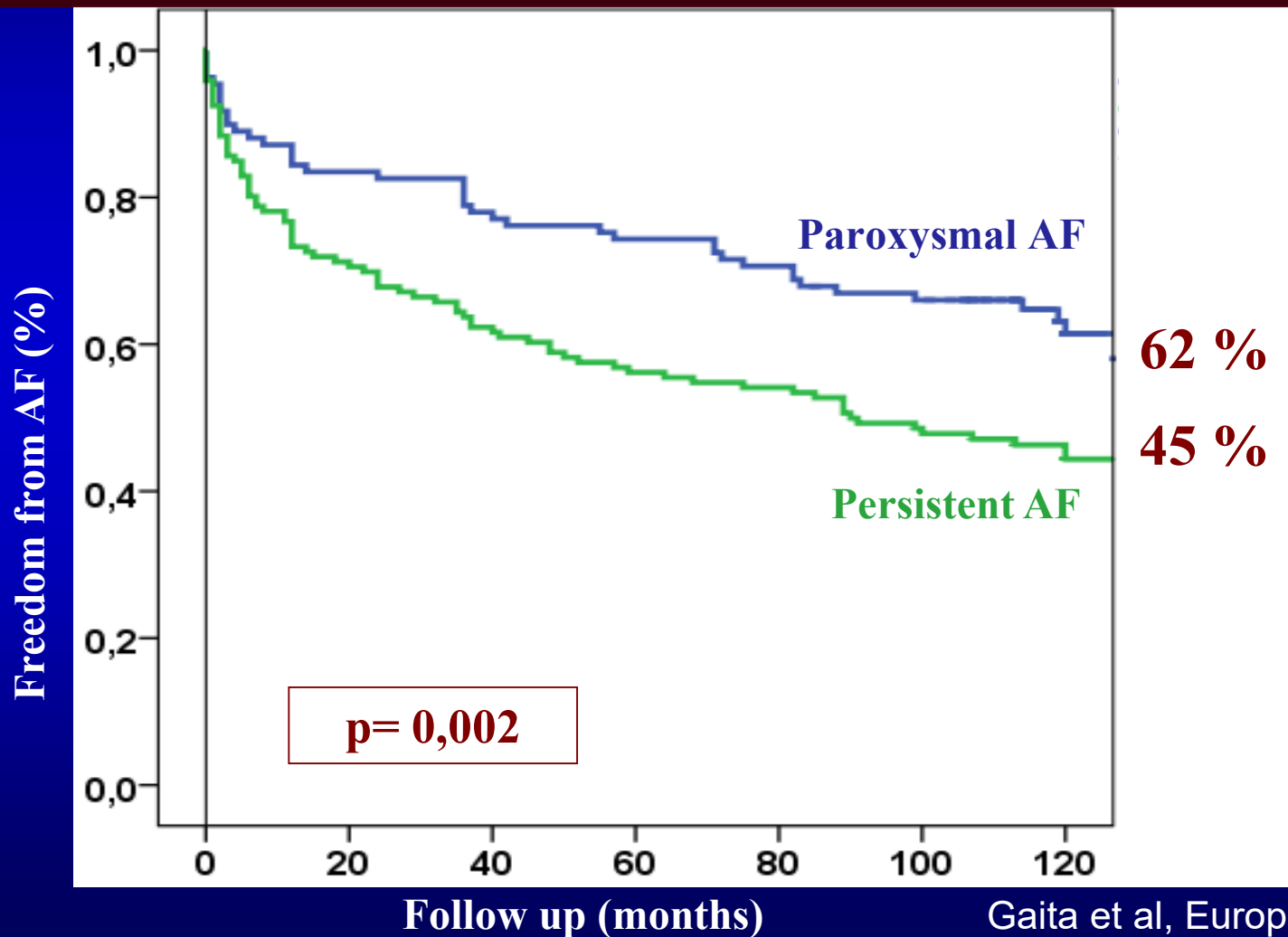
# Persistent AF transcatheter ablation

Long term results (3 years) from studies involving more than 50 pts





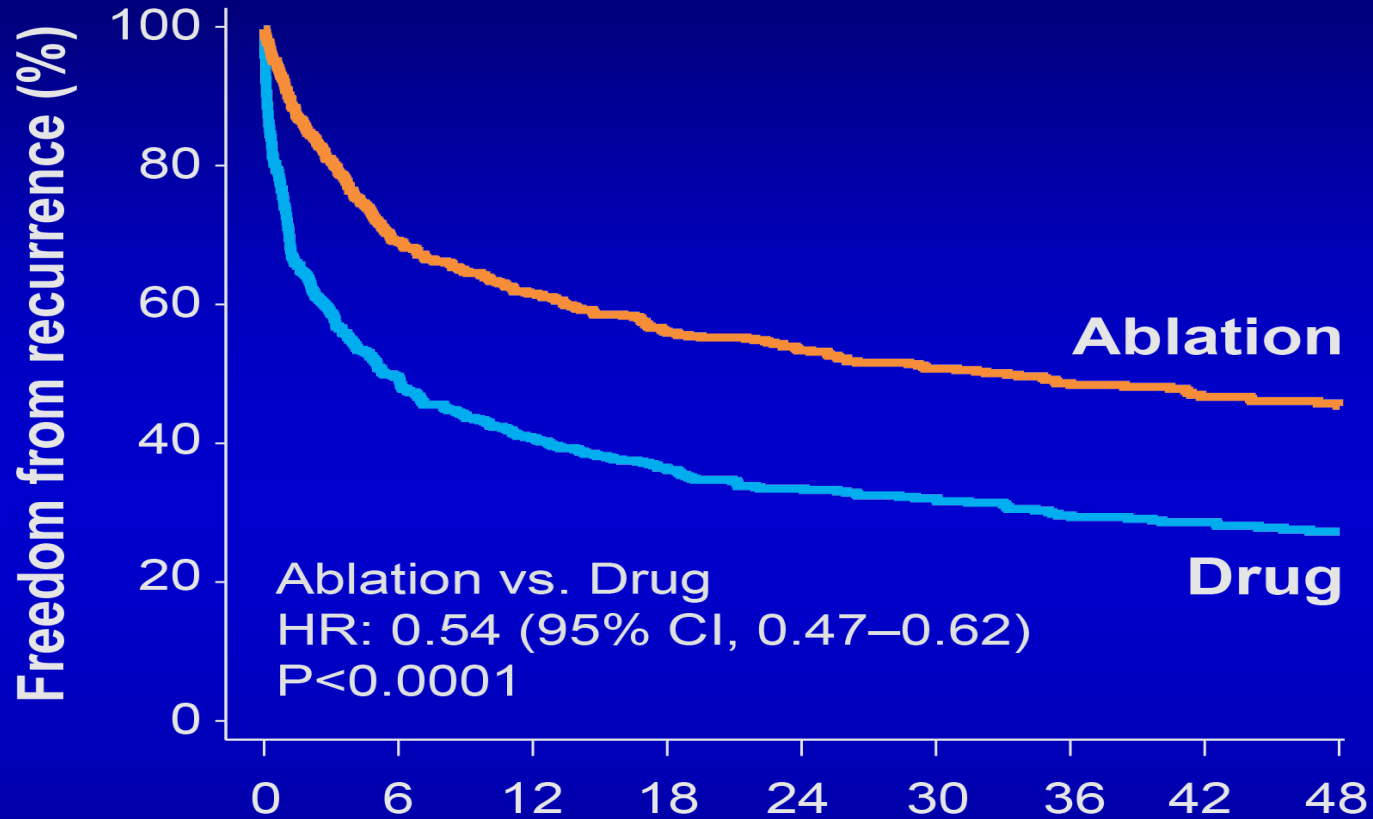
# Paroxysmal/Persistent AF ablation Results at 10 years follow-up



# Recurrence of Atrial Arrhythmias in the Catheter Ablation Versus Antiarrhythmic Drug Therapy for Atrial Fibrillation (CABANA) Trial

- CABANA randomized 2204 symptomatic patients with paroxysmal or persistent atrial fibrillation (AF) 1:1 to percutaneous left atrial catheter ablation versus medical therapy
  - Patients were  $\geq 65$  years or  $< 65$  years with  $\geq 1$  risk factor for stroke
- Primary endpoint - Composite of death, disabling stroke, serious bleeding, or cardiac arrest

# Atrial Fibrillation/Flutter



Number  
at risk:

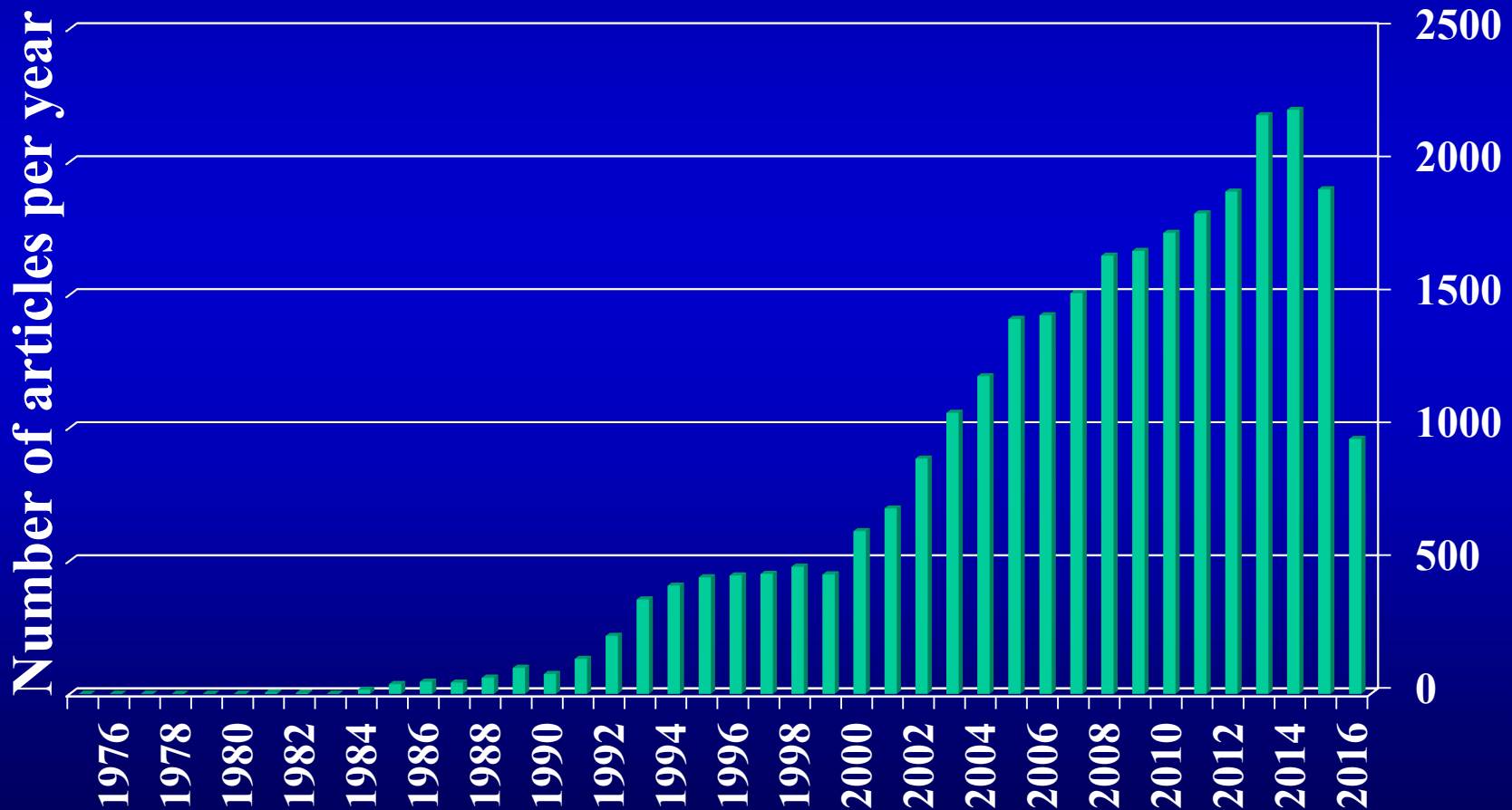
Months since end of blanking	0	6	12	18	24	30	36	42	48
Drug	629	311	255	210	178	155	127	112	92
Ablation	611	422	373	322	287	239	198	161	132

# CABANA : AF RECURRENCES

Catheter ablation was associated with a significant relative risk reduction in AF recurrence (~50%) and AF burden compared to drug-therapy across 5 years of follow-up

# In medicine when something works it spreads worldwide

## Publications over the years



# AF ablation per year today



213,000

85% RF

14% cryo

1% other



250,000

83% RF

16% cryo

1% other



800,000

84% RF

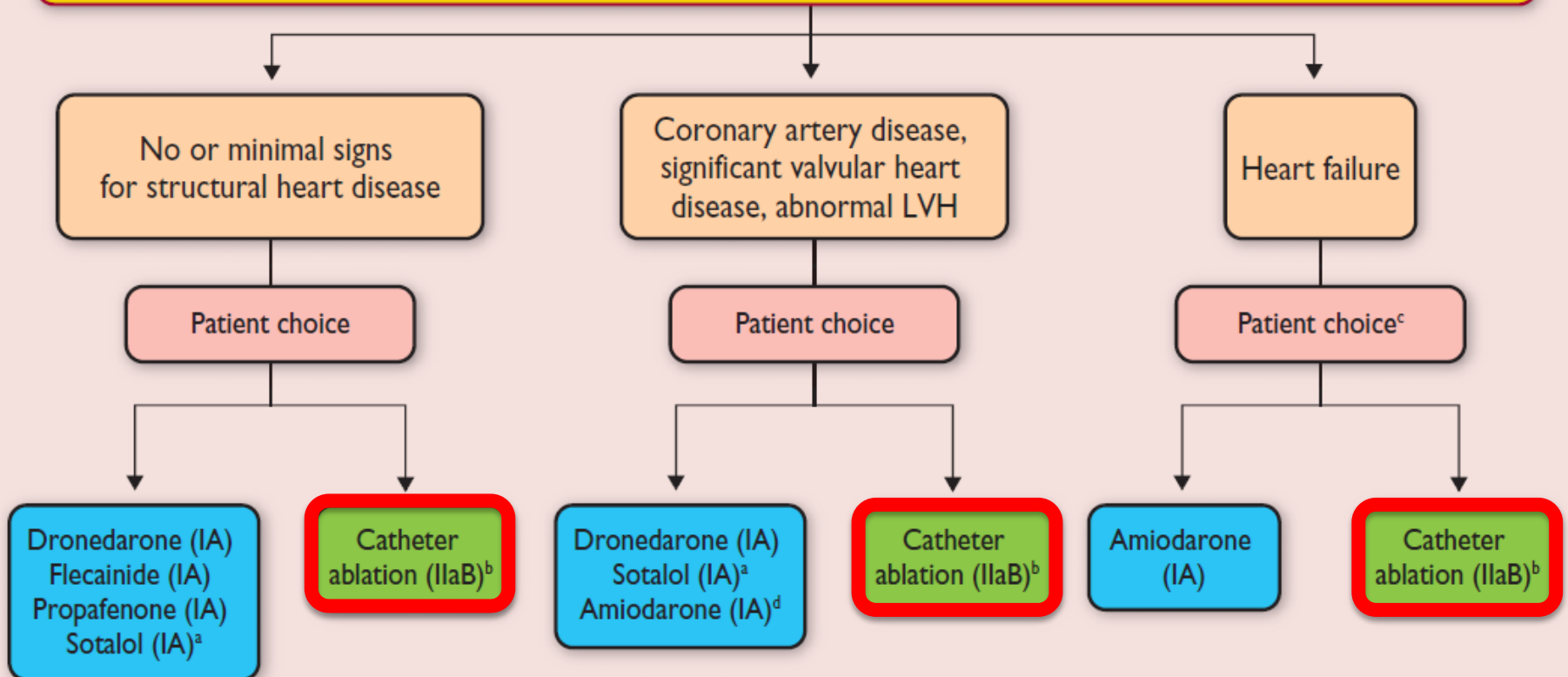
15% cryo

1% other

2016

# AF guidelines ESC

## Initiation of long term rhythm control therapy to improve symptoms in AF



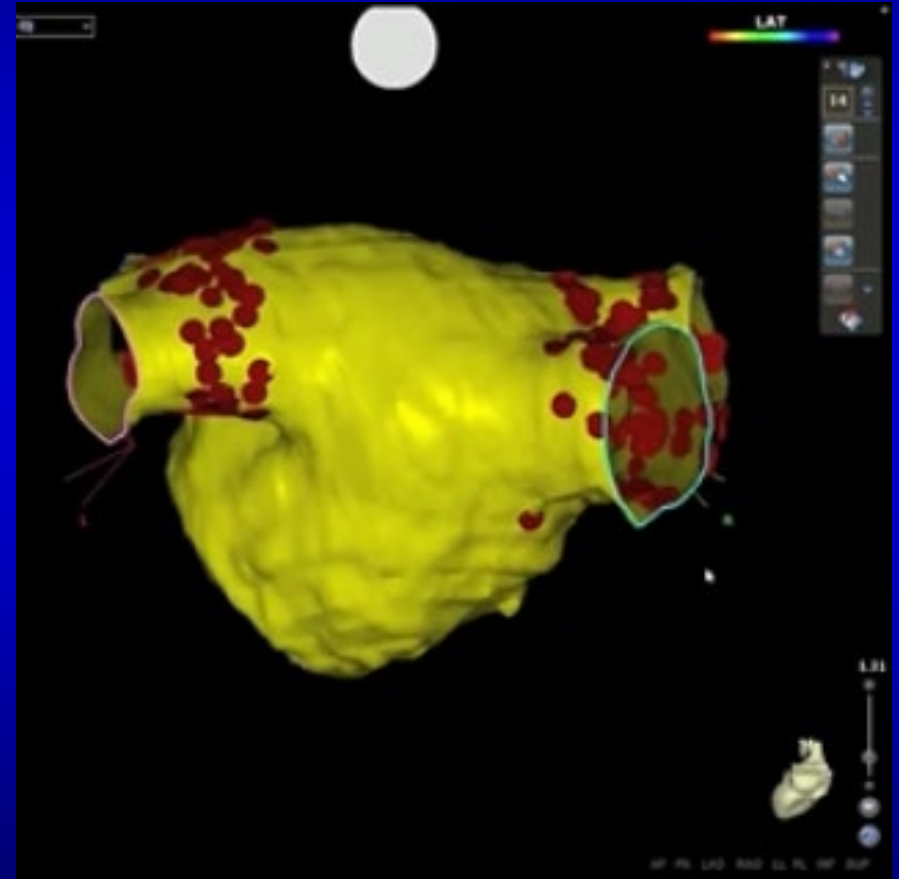
**So what is the  
state of the art of  
Atrial Fibrillation Ablation  
in 2019 ?**



# Target for Paroxysmal AF

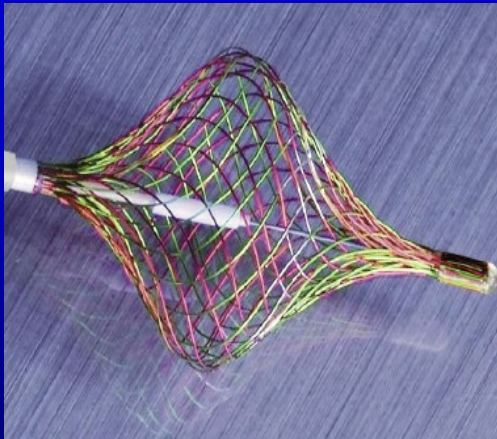
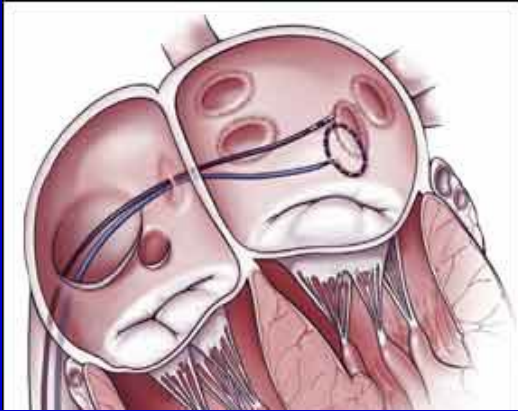


## Pulmonary vein isolation

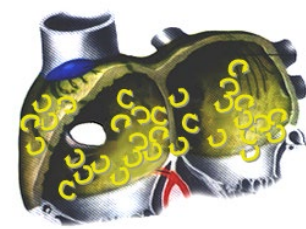


Courtesy of Dr. Damian Sanchez-Quintana

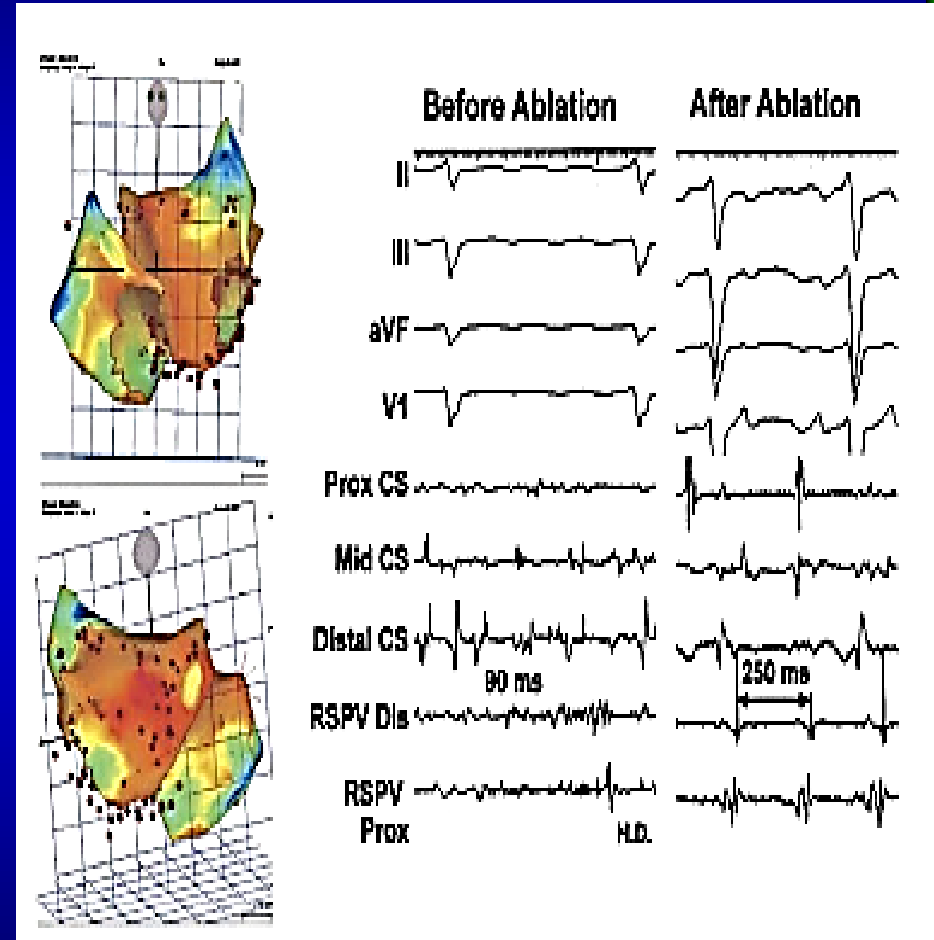
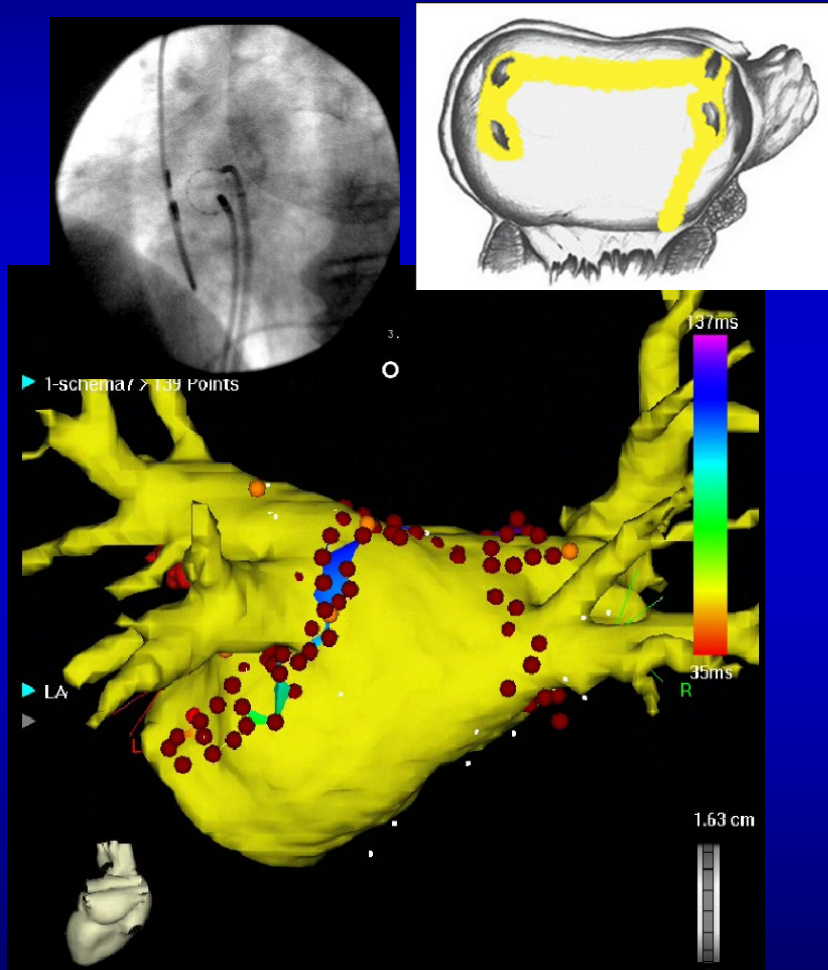
# Ablation of paroxysmal AF, : PVI...but which tool?



# Target for Persistent AF



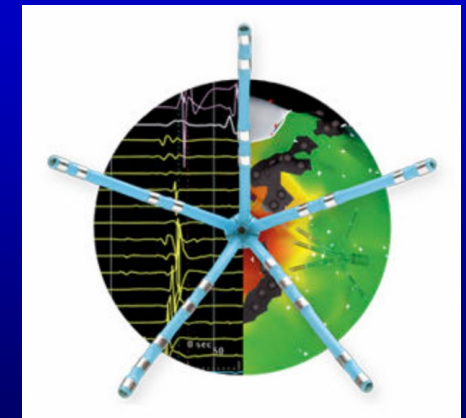
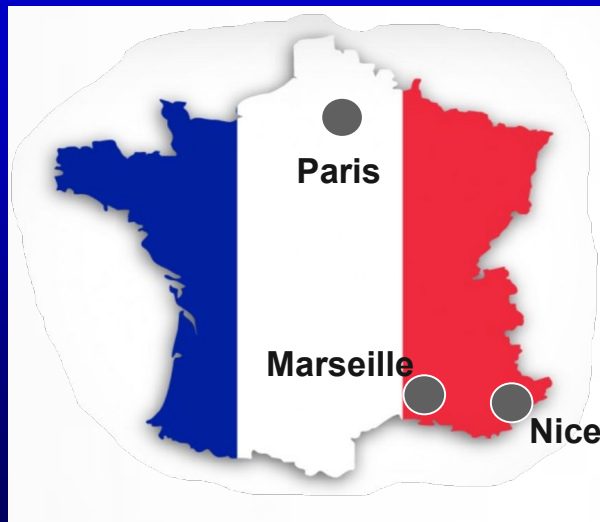
PVI + Linear Lesions (7 scheme) + Complex fractionated electrogram



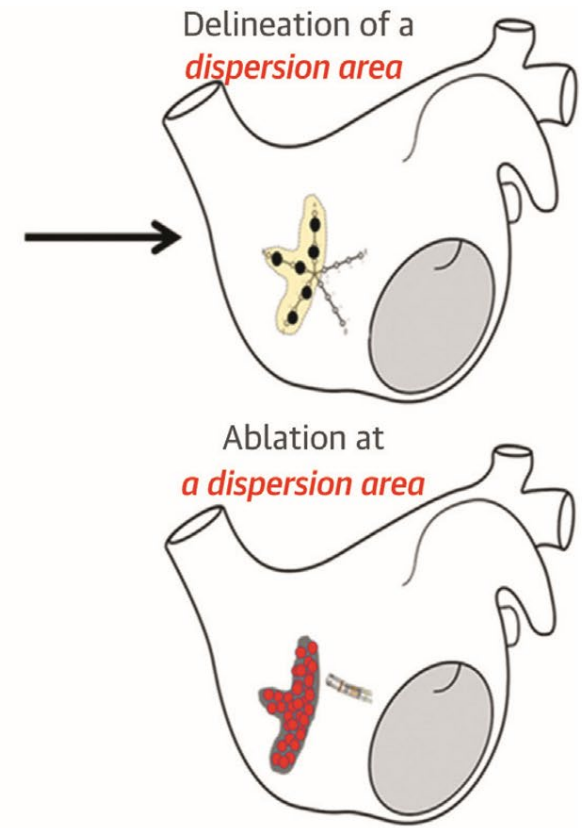
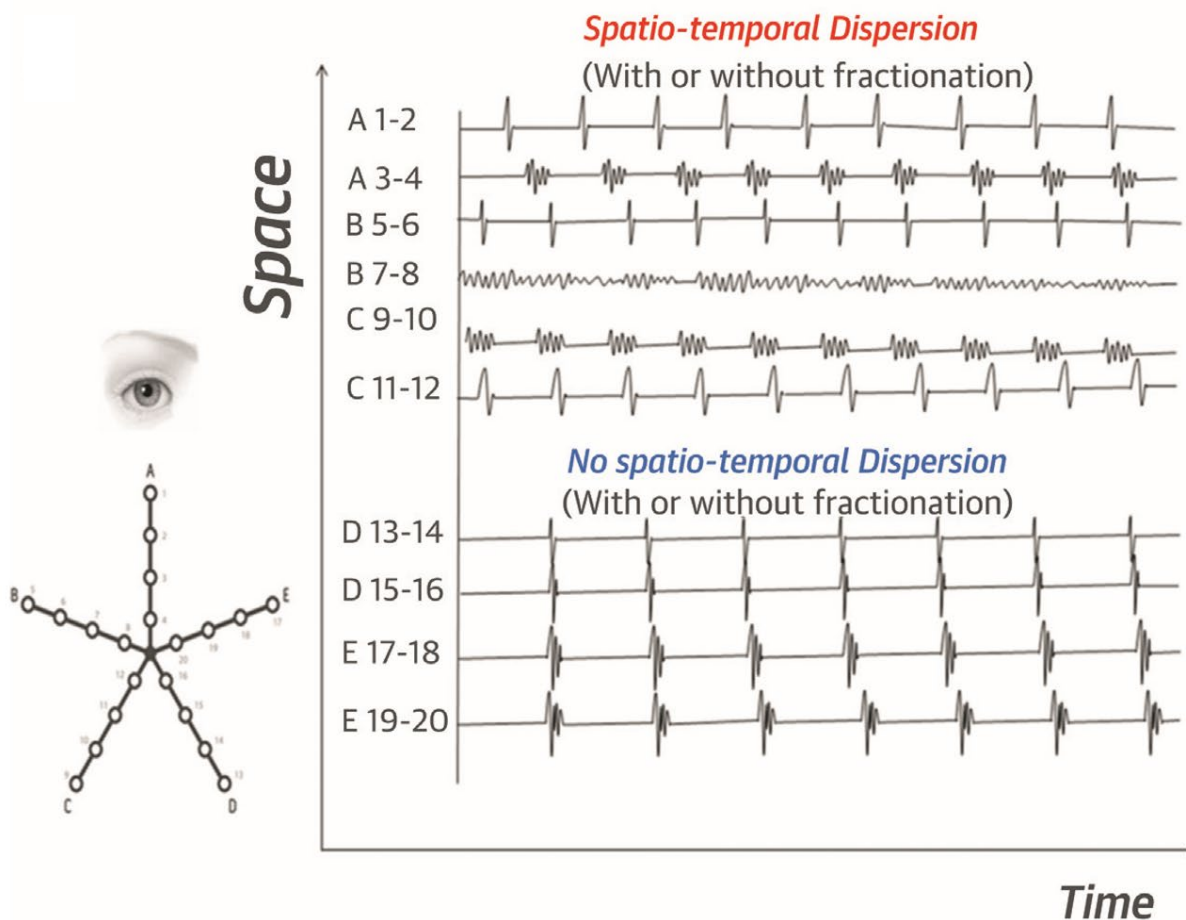
# AF Ablation Guided by Spatiotemporal Electrogram Dispersion Without Pulmonary Vein Isolation

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

**105 Patients with AF**  
**- Paroxysmal 23%**  
**- Non-paroxysmal 77%**



# AF Ablation Guided by Spatiotemporal Electrogram Dispersion Without Pulmonary Vein Isolation



**Where are we going  
in the future?**

# High resolution non invasive mapping

252 ELECTRODE VEST



HEART-TORSO  
GEOMETRY (CT)



ECM\* ALGORITHMS SOLVES  
"INVERSE PROBLEM"



ECM MAPS



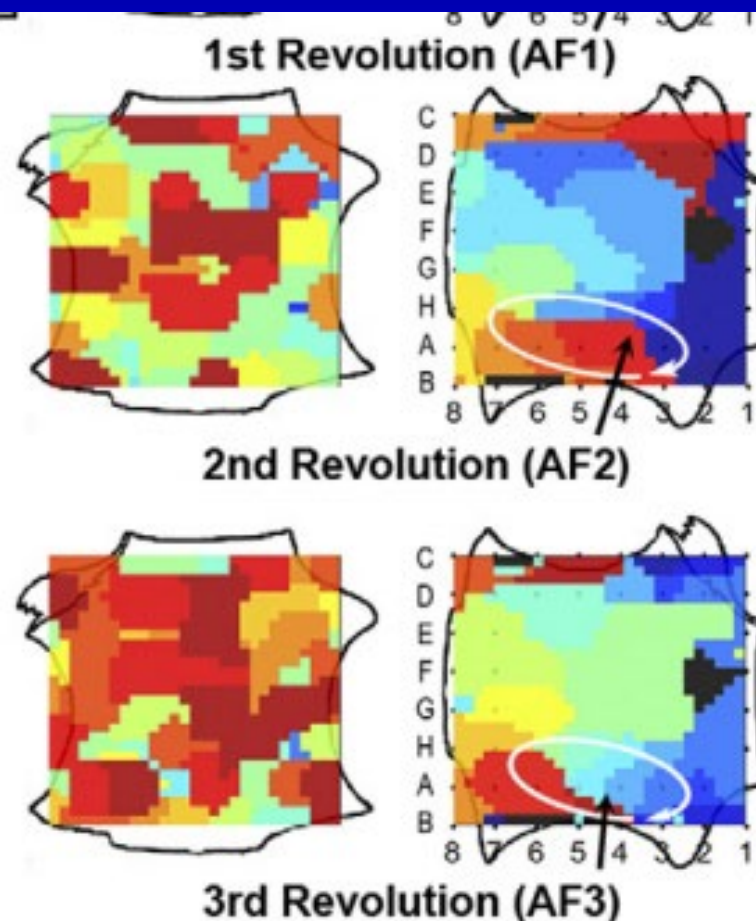
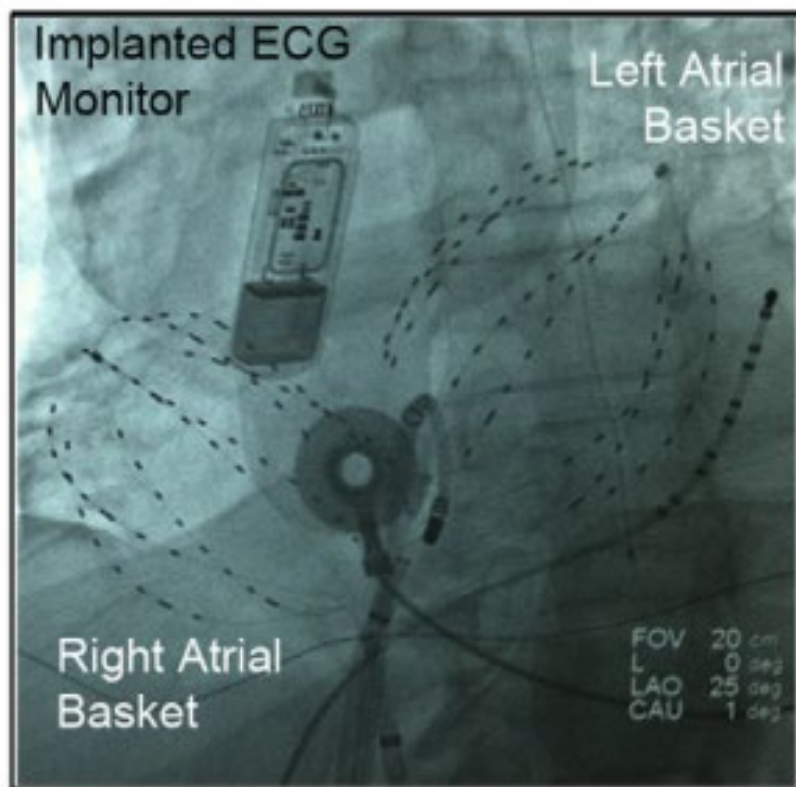
# Treatment of Atrial Fibrillation by the Ablation of Localized Sources

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||

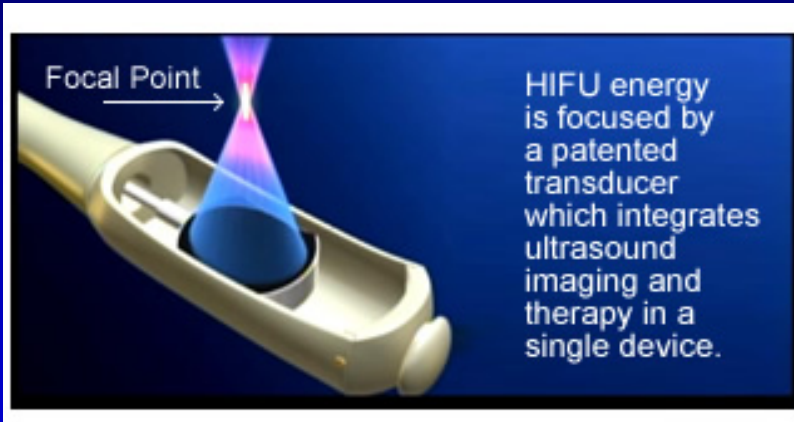
*San Diego and Los Angeles, California; and Indianapolis, Indiana*

## B Basket Catheters in Both Atria

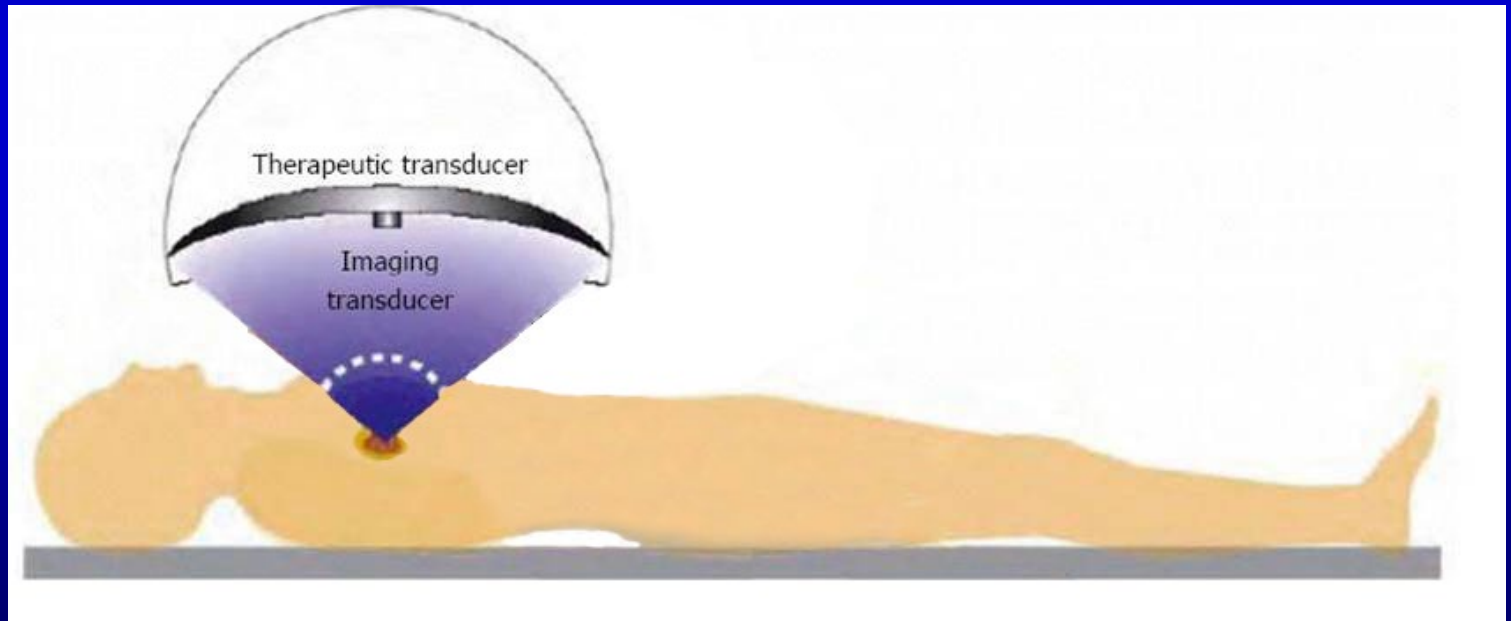




# External ablation for AF?



## Focused ultrasound therapy?



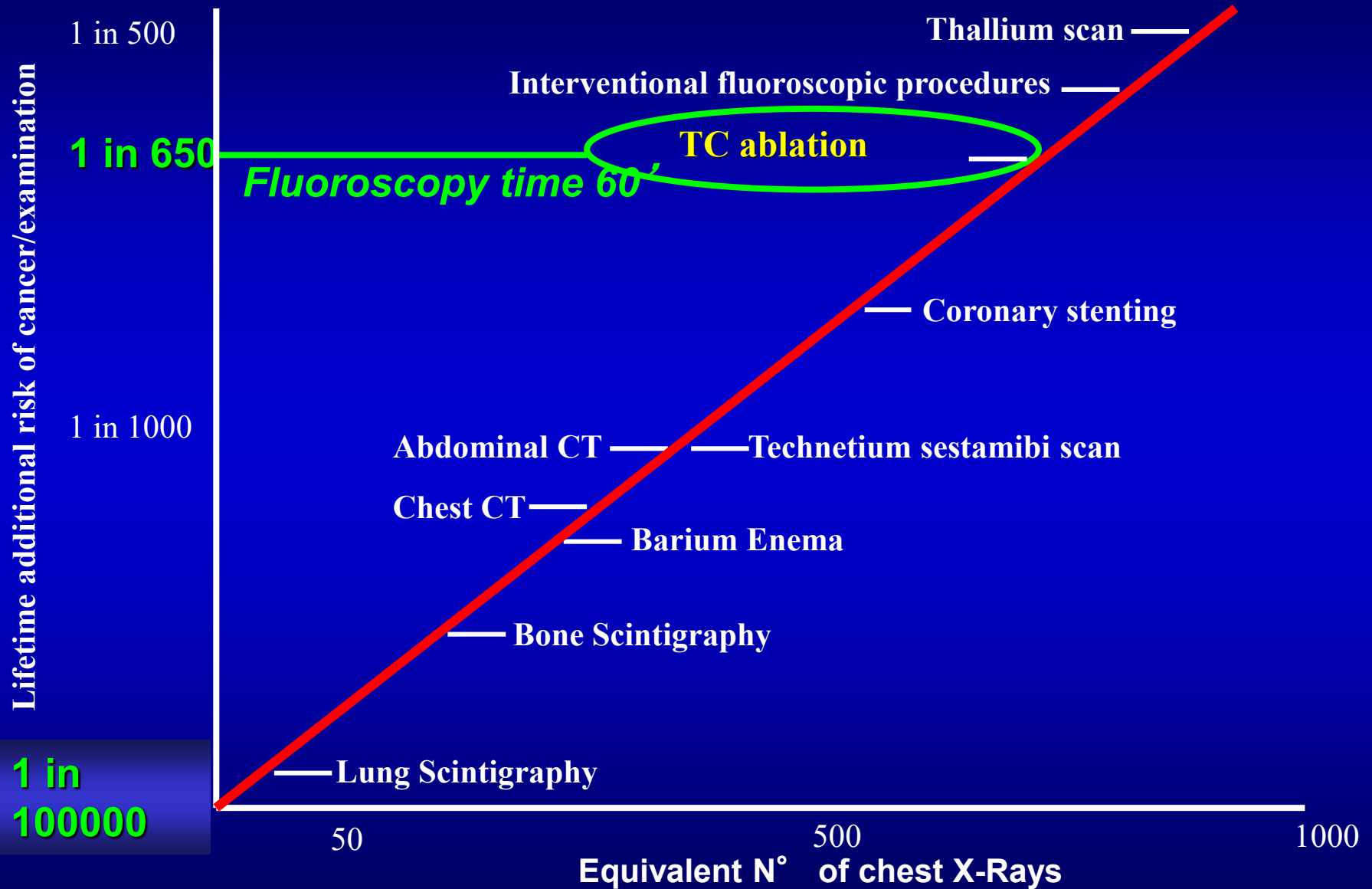
**In medicine when something works it spreads worldwide**

**But this not occurred  
with any of these three systems**

**Waiting for the future...**

**What can we do today to  
improve our results?**

# Radiation exposure: additional cancer risk for patients



**The New York Times** 30 Jan, 2014

# We Are Giving Ourselves Cancer

By RITA F. REDBERG M.D. 30, 2014



Ben Jones

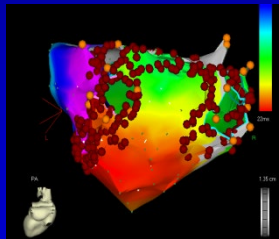
# AF Ablation, single center experience

(1999 - 2016) = 3592 pts

FU:  
1 year

1999-2001

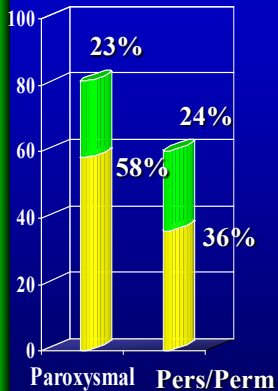
Pts 245



Proc. Durat.  
4 h.

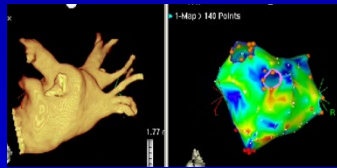
X-Ray:62'

Success w/o drugs  
Success with drugs



2002-2005

Pts 746

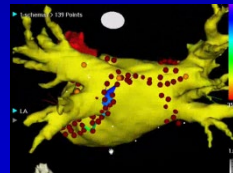


Proc. Durat  
2,30 h.

X-Ray:44'

2006-07

Pts = 500

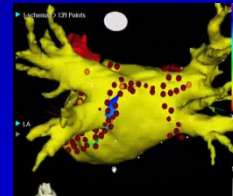


Proc. Durat.  
2 h.

X-Ray:22'

2008-10

Pts = 721

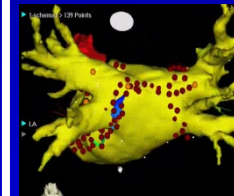


Dur. Proced.  
2 h.

X-Ray:9'

2011-13

Pts =660

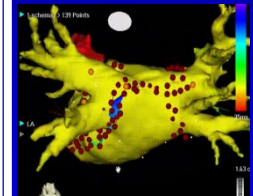


Dur. Proced  
1.30 h.

X-Ray:5'

2014-16

Pts = 780

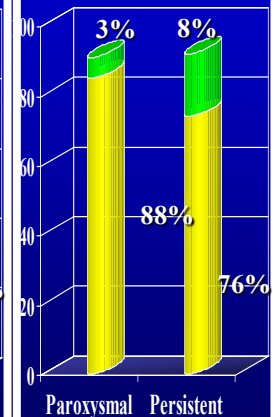


Dur. Proced.  
1.20 h

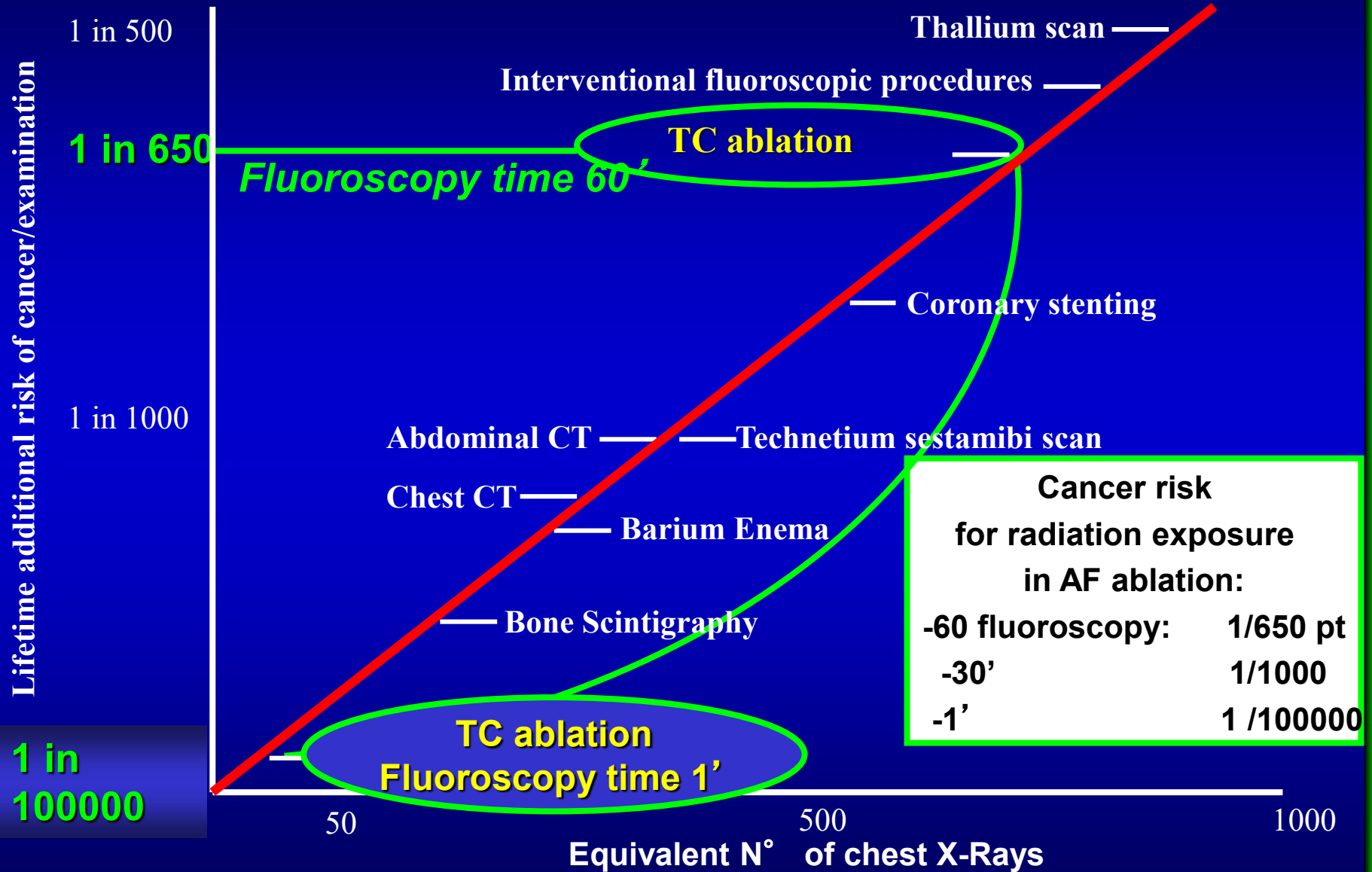
X-Ray:2,5'

2017

Mean X-ray time: <1 min



# Radiation exposure: additional cancer risk for patients



**Thank you for your attention**

