Atrial fibrillation ablation: less is more?

31 GIORNATE CARDIOLOGICHE TORINESI

TURIN
October
24th-26th
2019

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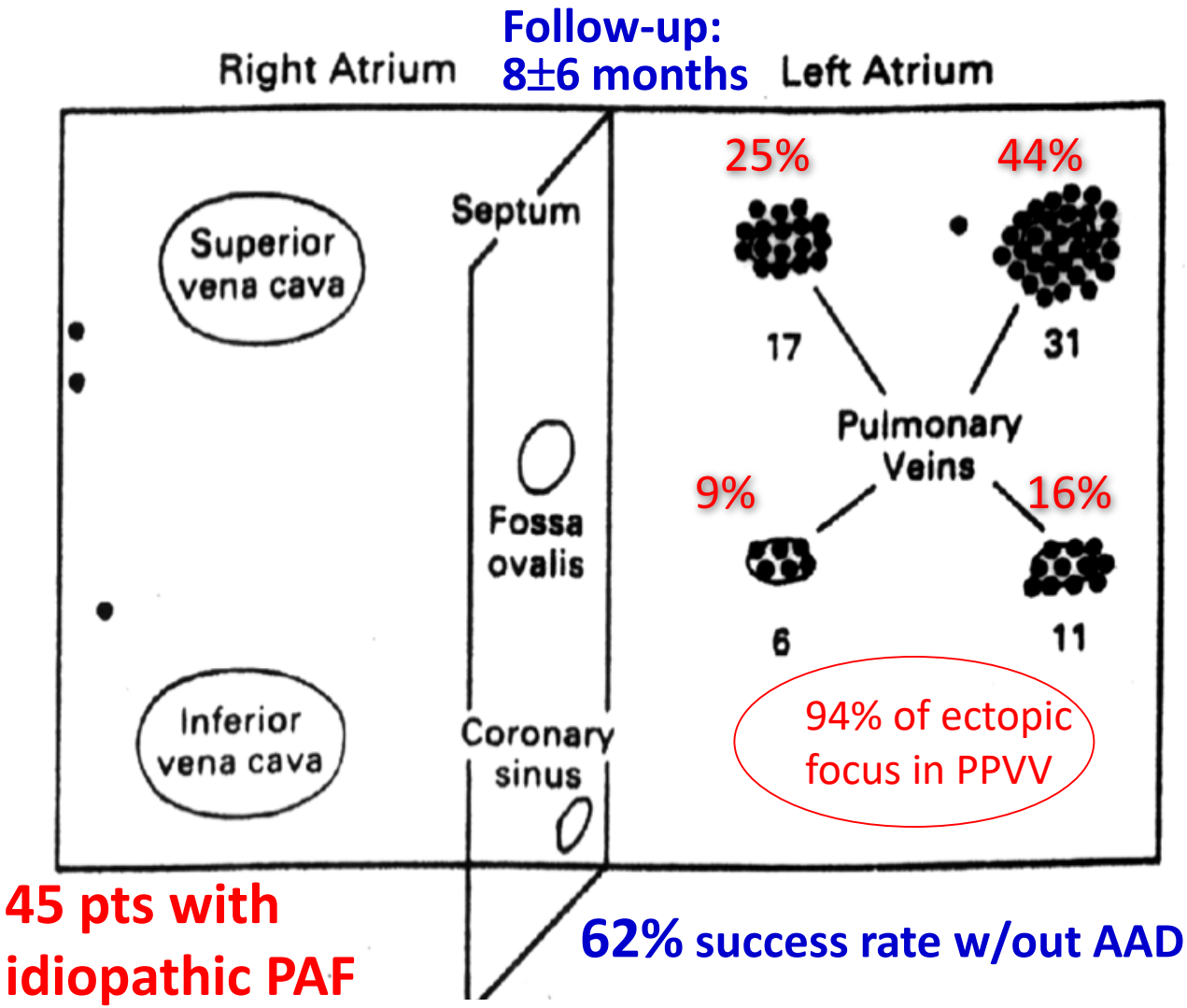
Director of
Division of Cardiology
Cardinal Massaia Hospital – Asti –Italy

1998
The role of pulmonary veins as AF trigger

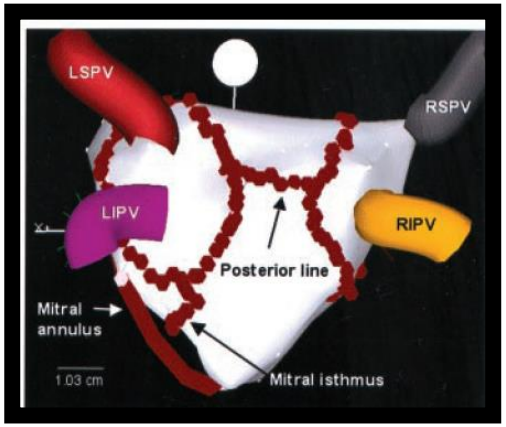


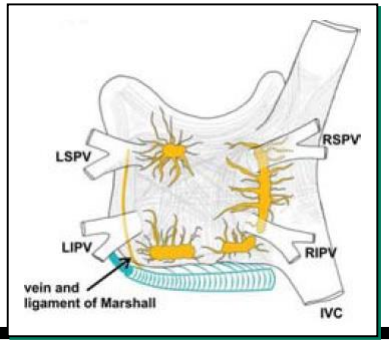
45 pts with idiopathic PAF

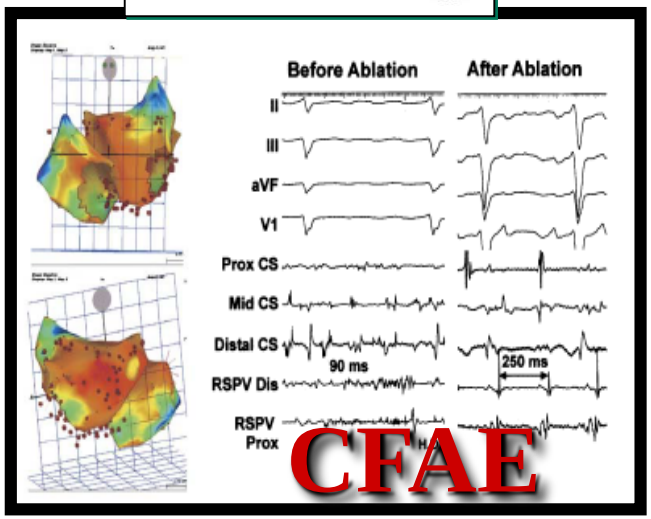
62% success rate w/out AAD

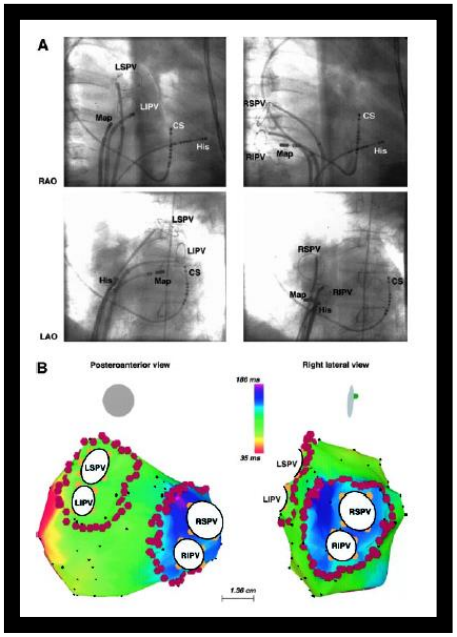
Haissaguerre et al. N Engl J Med 1998:339;659-66

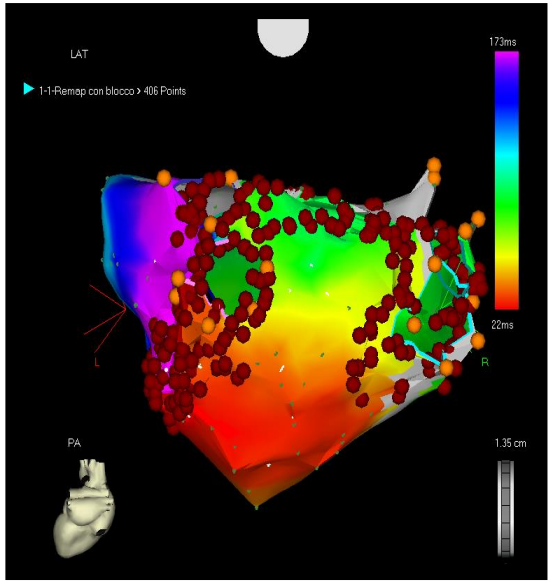
WE WANT …TO TREAT PERSISTENT AF

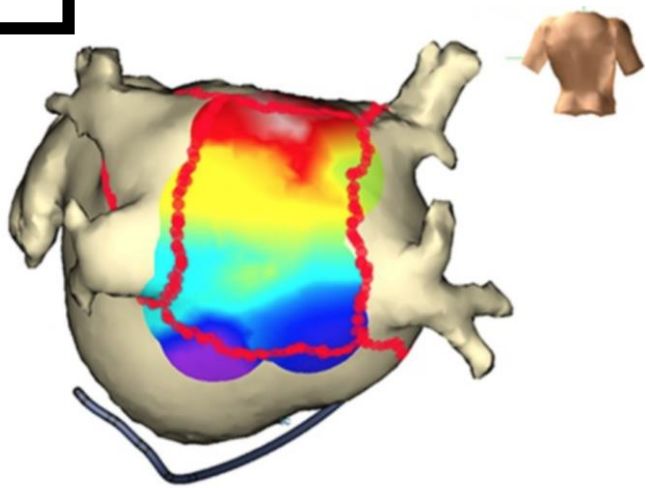

LSPV
RSPV
LIPV
RIPV
Posterior line
Mitral annulus
Mitral isthmus
1.03 cm


LSPV
RSPV
LIPV
RIPV
vein and ligament of Marshall
IVC


Before Ablation
After Ablation
II
III
aVF
V1
Prox CS
Mid CS
Distal CS
RSPV Dis
RSPV Prox
90 ms
250 ms
CFAE


A
RAO
LAO
LSPV
LIPV
CS
His
Map
RIPV
B
Posteroanterior view
Right lateral view
RSPV


LAT
173ms
22ms
1-1-Remap con blocco > 406 Points
PA
1.35 cm



After a second procedure

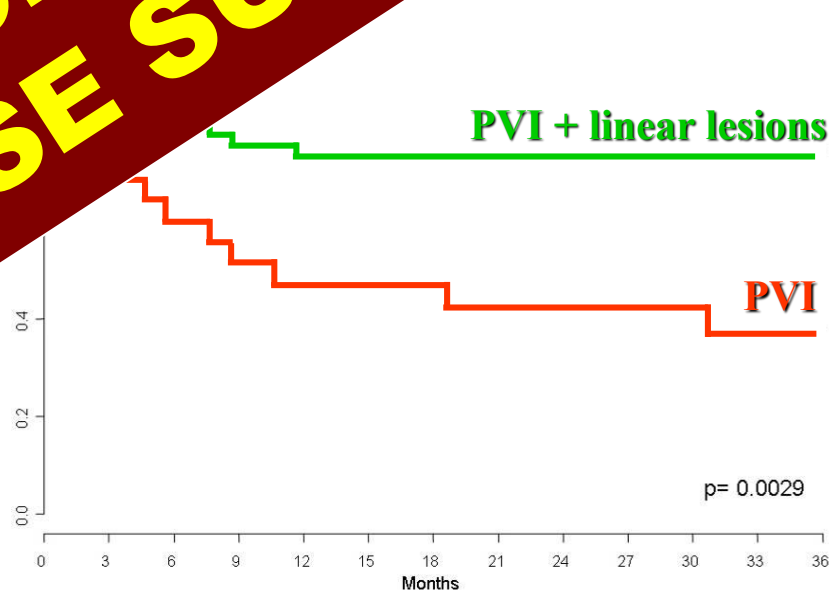
PVI vs PVI + linear lesi

Maintenance of SR during 36

TWO PROCEDURES TO INCREASE SUCCESS

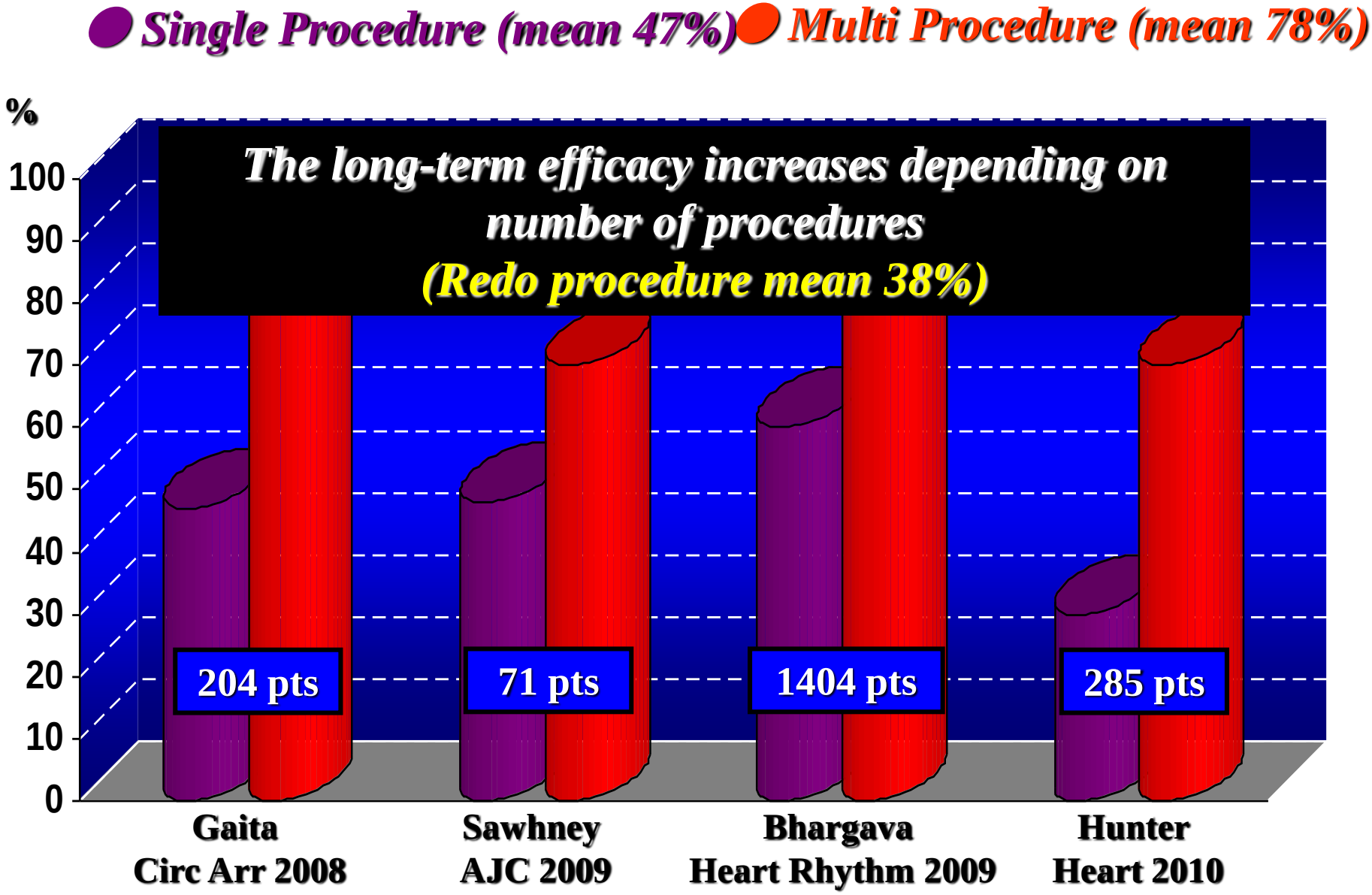
Paroxysmal AF

ermanent AF



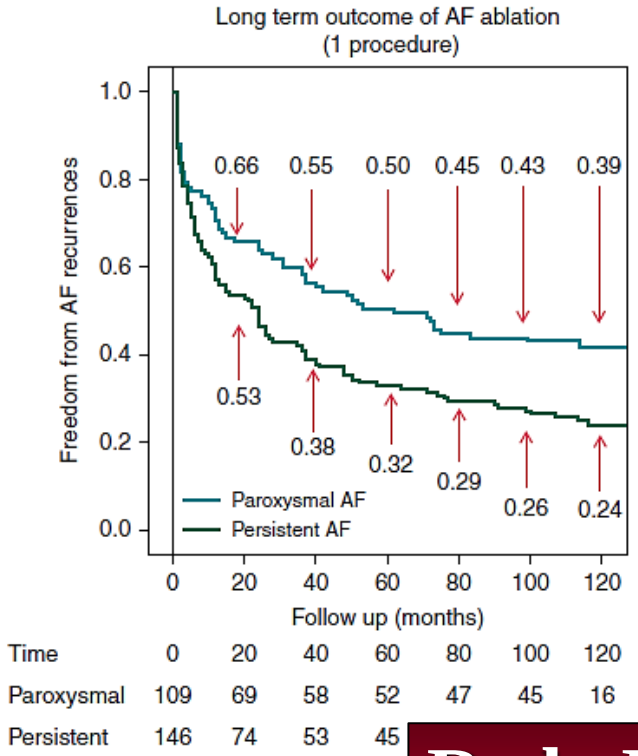
Gaita et al. CIRCULATION Arrhythmia Electrophysiol. 2008;1:269-275

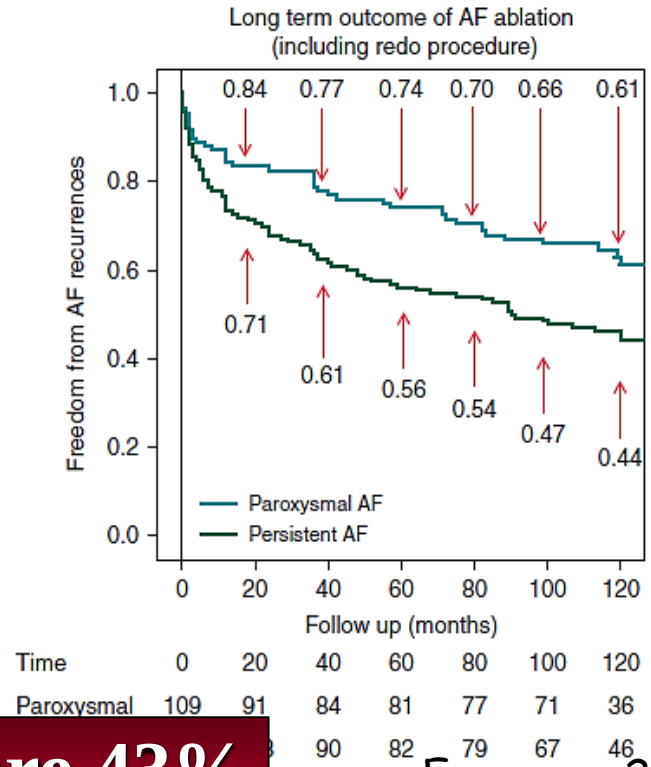
Long-term efficacy of AF Ablation (mean FU 3 y)



Very long-term outcome following transcath-eter ablation of atrial fibrillation. Are results maintained after 10 years of follow up?

Fiorenzo Gaita[1]*, Marco Scaglione[2], Alberto Battaglia[1], Mario Matta[1], Cristina Gallo[1], Michela Galatà[1], Domenico Caponi[2], Paolo Di Donna[2], and Matteo Anselmino[1]





Redo Procedure 43%

Europace 2017

Complications related to AF ablation

Complications	16309 pts Worldwide Survey		83236 pts Systematic Review		93801 pts In-Hospital USA	
	Pts	3.6%	Pts	3.9%	Pts	4.6%
Deaths	25	0.2	50	0.06	236	0.4
AE fistula	6	0.04	67	0.08	NA	NA
Stroke	37	0.2	333	0.4	177	0.3
TIA	115	0.7	333	0.4	414	0.7
Severe PV stenosis	48	0.3	416	0.5	118	0.2
Tamponade	213	1.3	832	1.0	886	1.5
Vascular events	152	0.9	1165	1.4	886	1.5
	Cappato 2010		Gupta 2013		Deshmukh 2013	

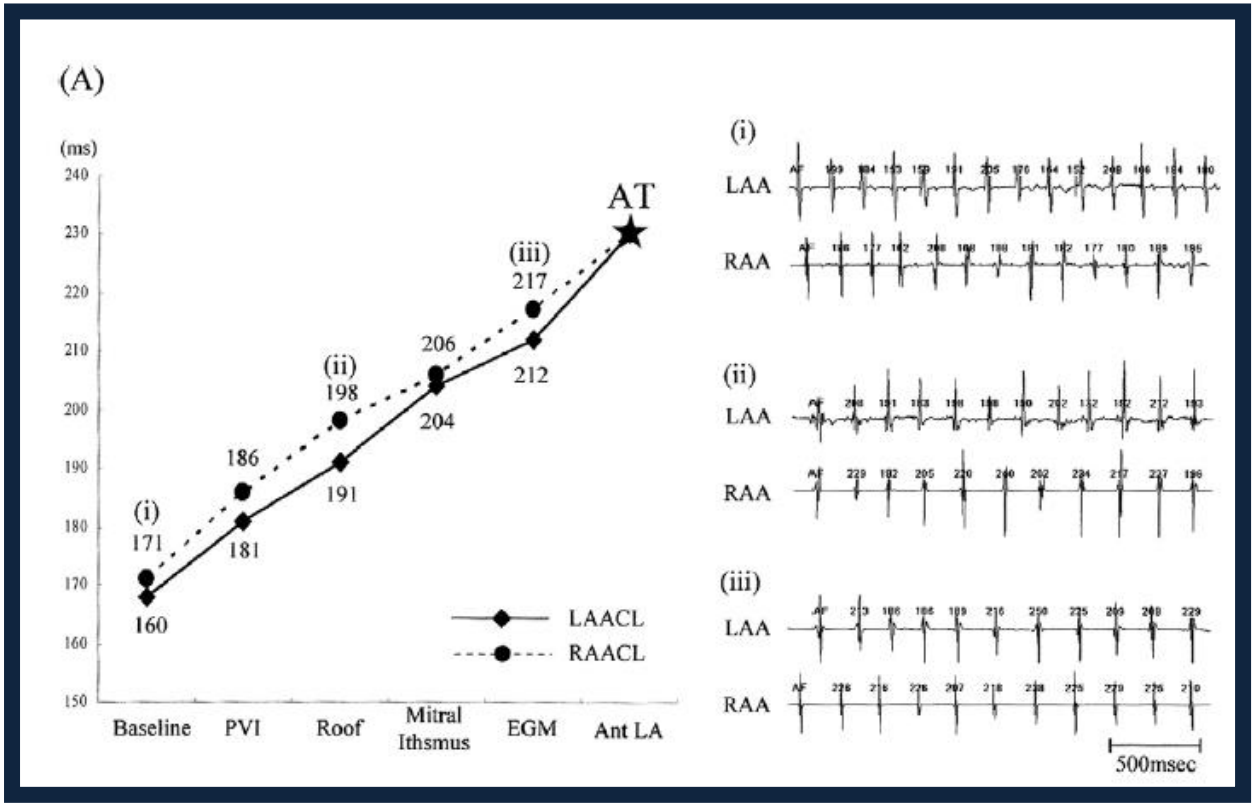
2 PROCEDURES = RISK X 2

THE MORE YOU BURN …

POST AF ABLATION AT (Iatrogenic circuits)

Onset time differences - Acutely

Atrial tachycardias may occur acutely during an atrial fibrillation ablation procedure and are often the arrhythmia to which persistent atrial fibrillation converts during the course of radiofrequency ablation.



Matsuo S et al. Heart Rhythm 2007;4:1461–1463

Gerstenfeld Circ 2004
PAF+ Pers AF (PVI)
LATach 10 pts 8/10 foci: (6 PV-2 extra PV)
1/10 macroreentry

Lemola Heart Rhythm 2004
AF (PVI seg.)
Recurrence AF pts >/=1 PV rec. (98%)
PV Tachycardias*

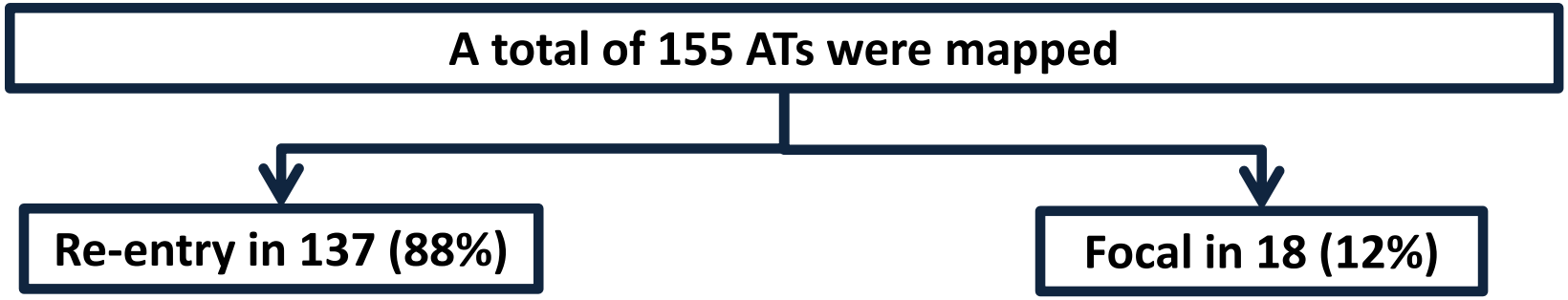
Pappone Circ 2004
AF (CPVA-CPVA lines)
macroreentry

Gerstenfeld Heart Rhythm 2005
AF (PVI seg.)
Recurrence AT: focal reentry at PV ostium

Cummings JCE 2005
AF (PVAI)
Recurrence LAFL: 100% PV rec. – LA scar

Onset time differences - Late

The possible mechanisms of AT include macro–re-entry related to gaps in ablation lines and organization of AF because of elimination of fibrillatory conduction



The most common left atrial (LA) ablation targets were the mitral isthmus, roof, and septum.

The critical isthmus in 115 of the 120 LA re-entrant ATs (96%) traversed a prior ablation line, consistent with a gap-related mechanism

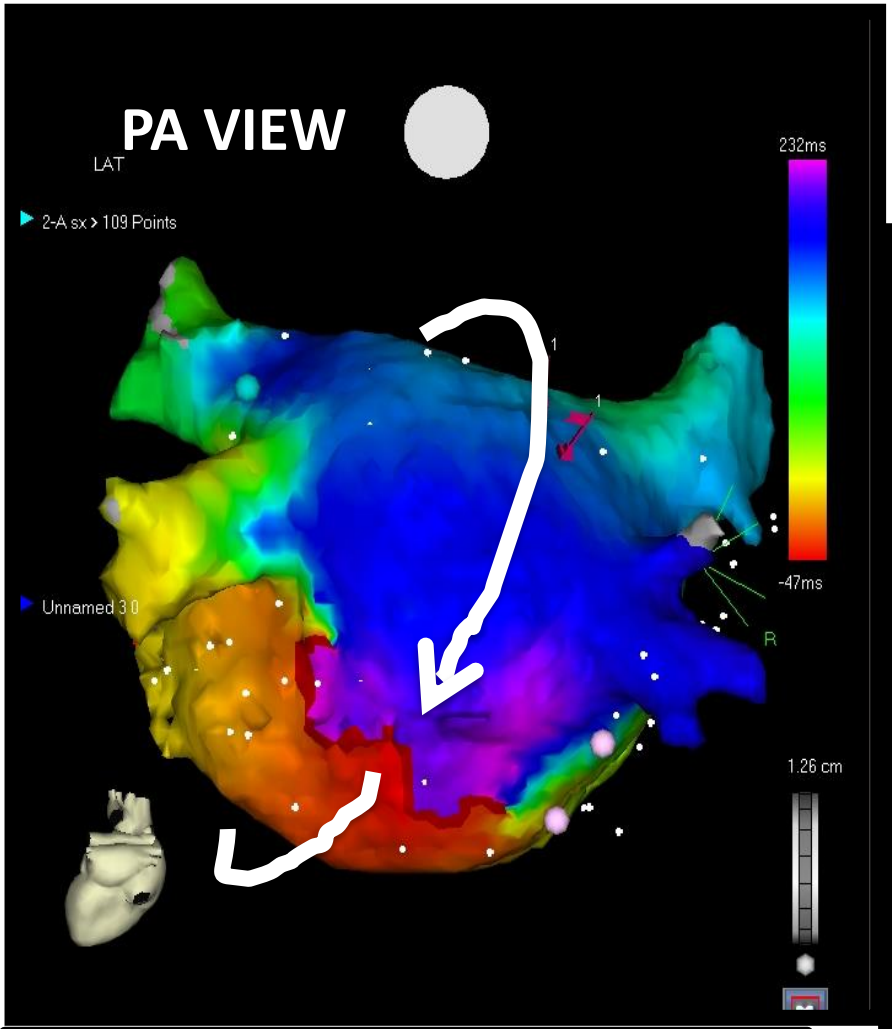
Chae S. et al J Am Coll Cardiol 2007;50:1781–7

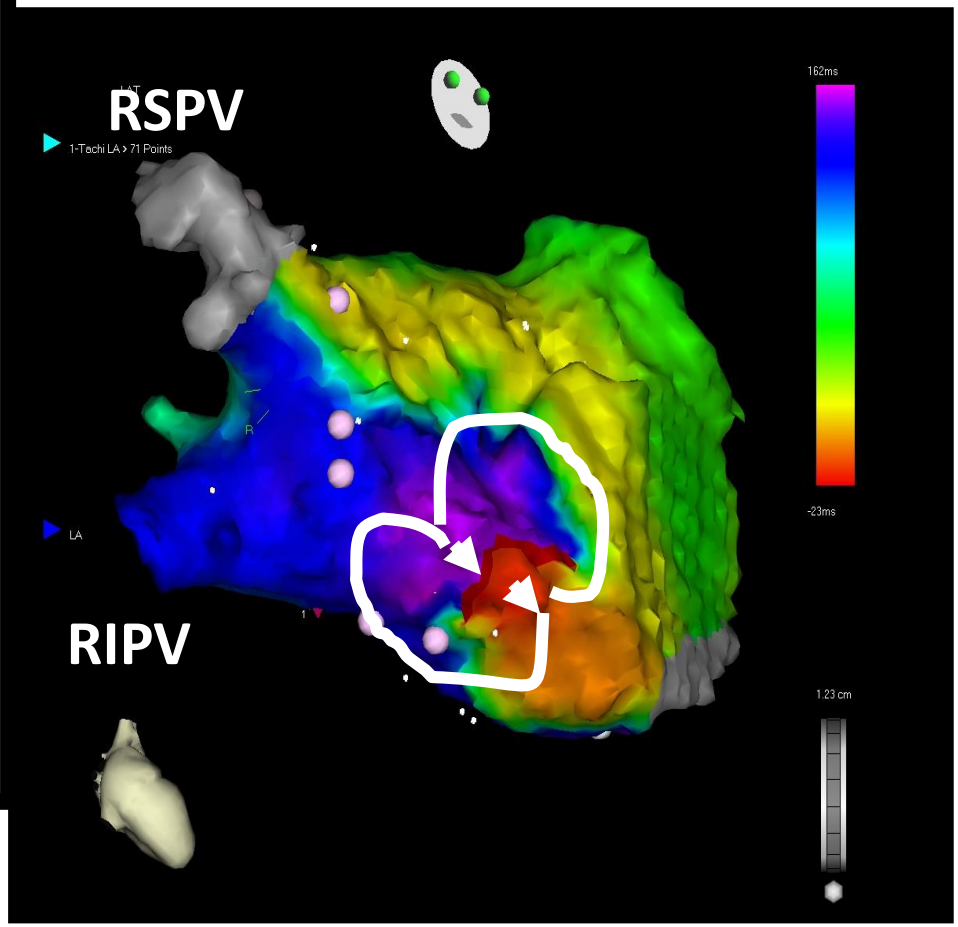
Iatrogenic atrial Flutter post AF ablation

Author	N pts	TA/FL (%)	Time (mo)	Cycle length	Chronic success	Follow up (mo)
Gerstenfeld	341	10 (3.4)	5.7±2.8	253±33	100	6.7±2.3
Mesas	276	13 (4.7)	2.6±1.6	275±25	87	2.5±1.2
Pappone	560	39 (7.0)	2.4/2.9	NR	100	6.3/8.2
Chugh	349	85 (24)	1.5±2.0	238±35	82	7.5±4
Shah	207	16 (8)	2.3±2.0	271±45	87	21±11
Chae	800	78 (10)	NR	256±49	77	13±10
Rostock	320	128 (40)	NR	270±40	82	21±4

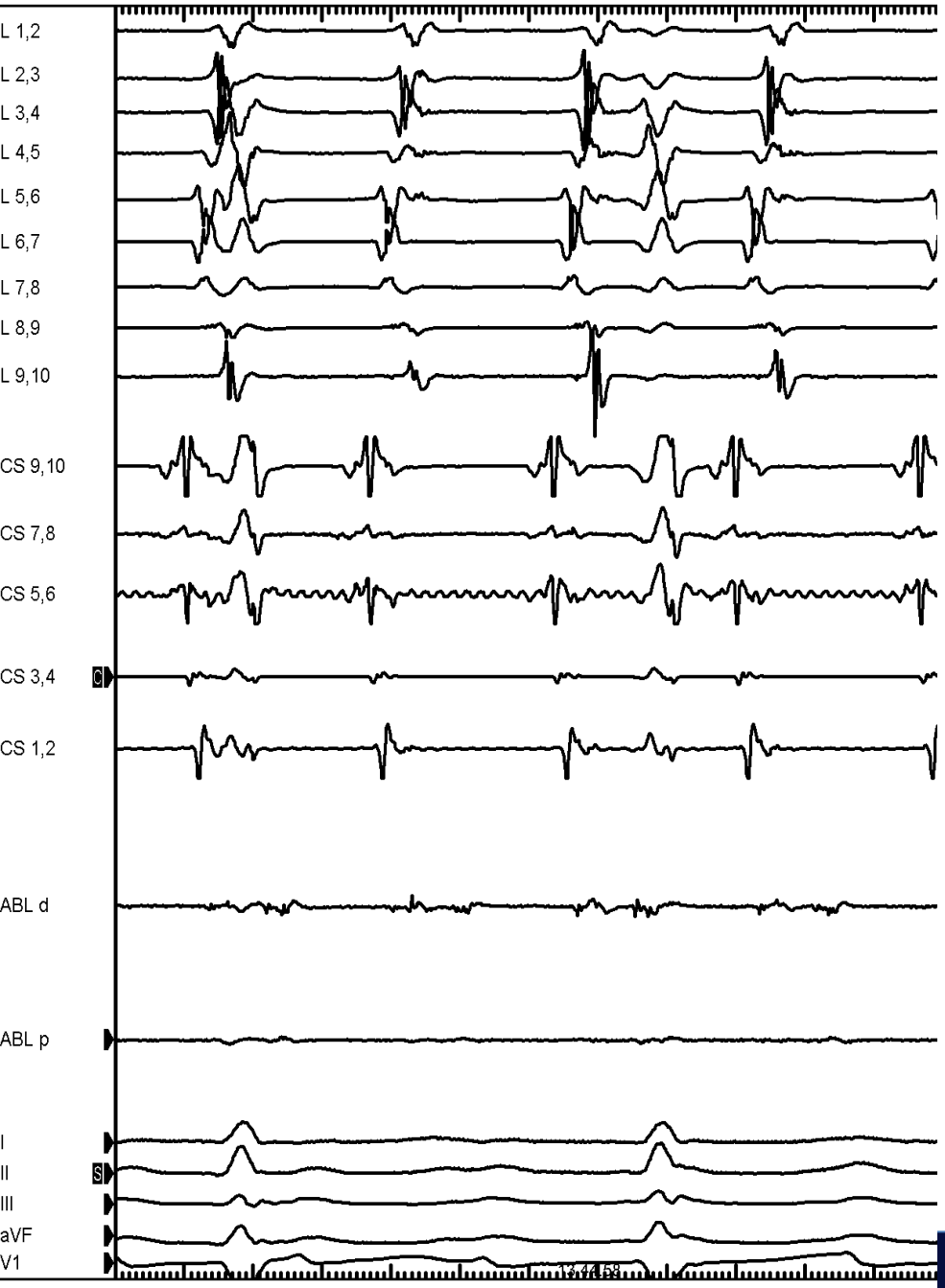
Venice Chart International Consensus Document JCE 2012;23: 890-923

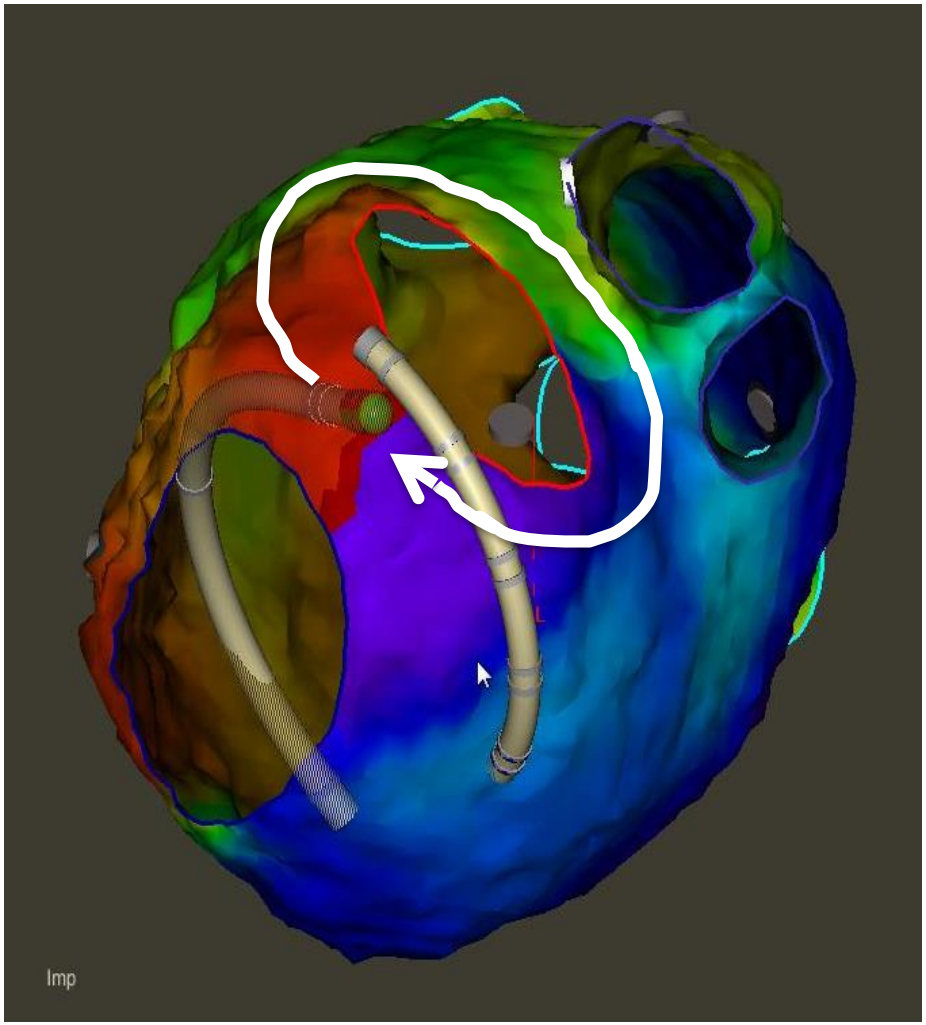
Focal circuit





Macro Reentrant circuit


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
CS 9,10
CS 7,8
CS 5,6
CS 3,4
C
CS 1,2
ABL d
ABL p
I
II
S
III
aVF
V1


Imp

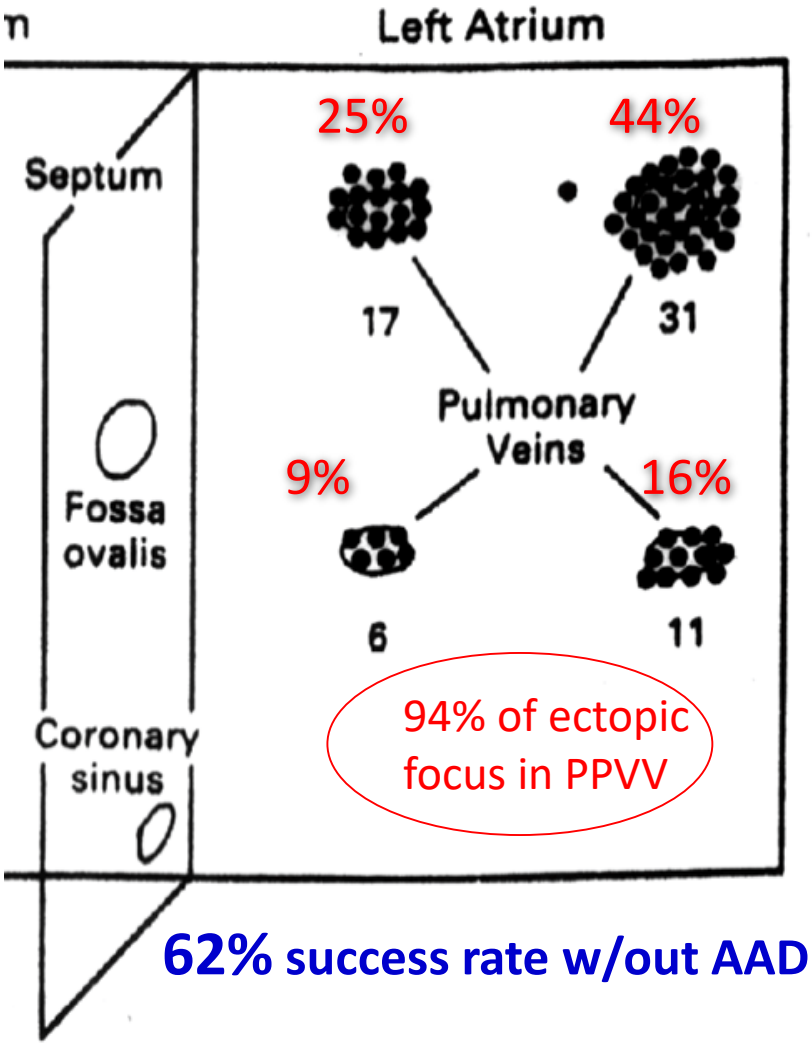
Left Atrial Flutter

Left atrial flutter is occasionally encountered, particularly in patients with prior AF ablation

- **multiple circuits are quite common**
- **s/times difficult to define critical isthmus**
- **difficult to achieve block across an isthmus**
- **mapping is facilitated by an advanced mapping system**
- **efficacy is less predictable and less satisfactory**

45 pts with idiopathic PAF

Follow-up: 8±6 months



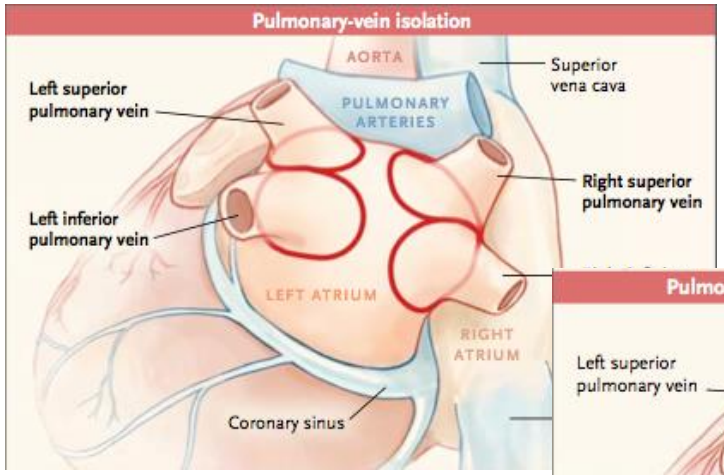
62% success rate w/out AAD

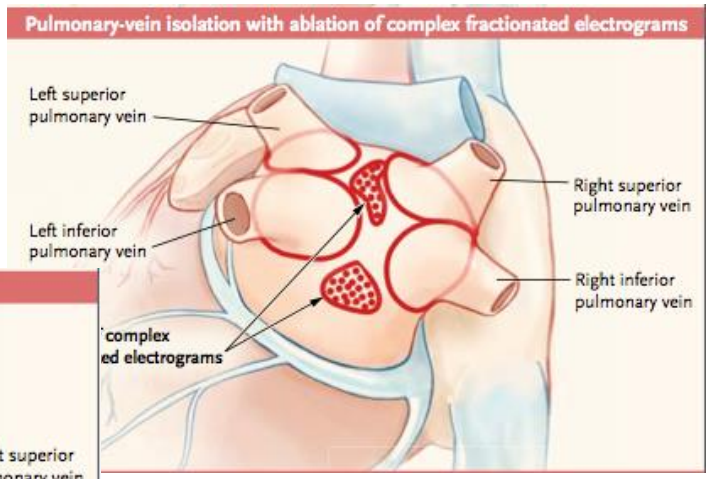
The NEW ENGLAND JOURNAL of MEDICINE

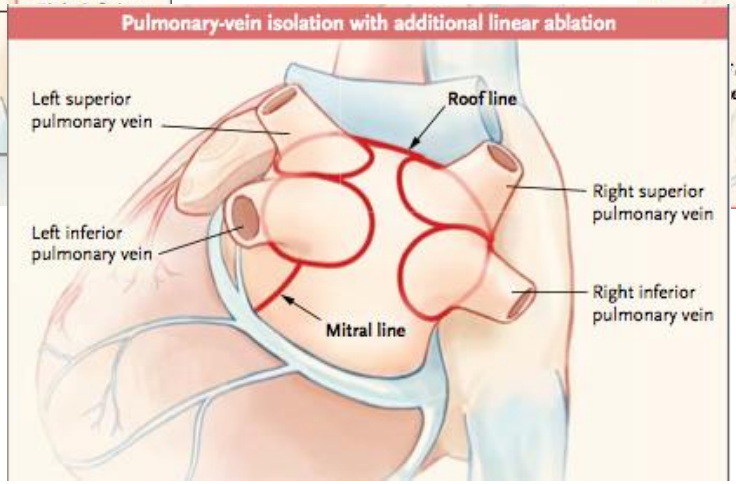
ORIGINAL ARTICLE

Approaches to Catheter Ablation for Persistent Atrial Fibrillation

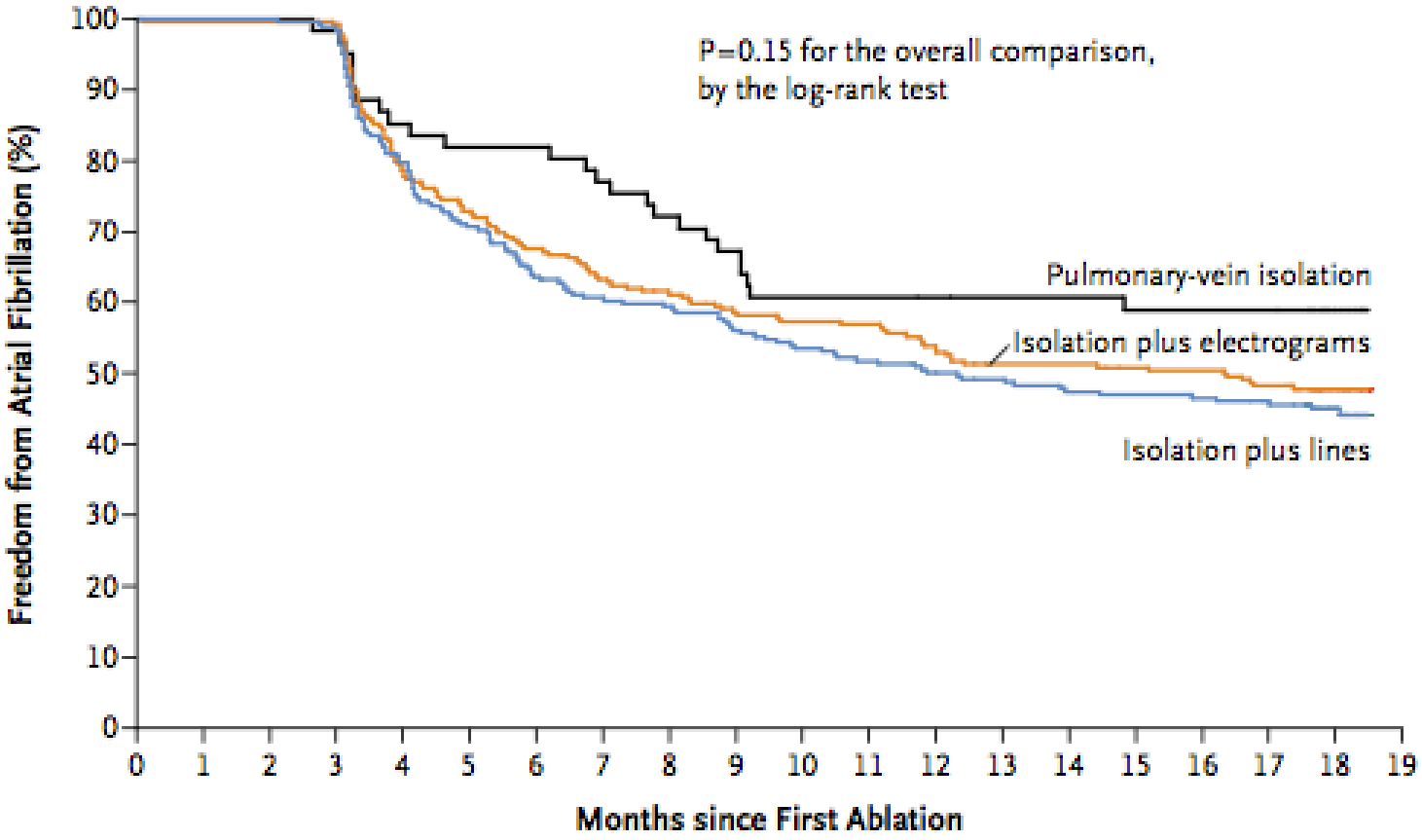
Atul Verma, M.D., Chen-yang Jiang, M.D., Timothy R. Betts, M.D., M.B., Ch.B., Jian Chen, M.D., Isabel Deisenhofer, M.D., Roberto Mantovan, M.D., Ph.D., Laurent Macle, M.D., Carlos A. Morillo, M.D., Wilhelm Haverkamp, M.D., Ph.D., Rukshen Weerasooriya, M.D., Jean-Paul Albenque, M.D., Stefano Nardi, M.D.,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







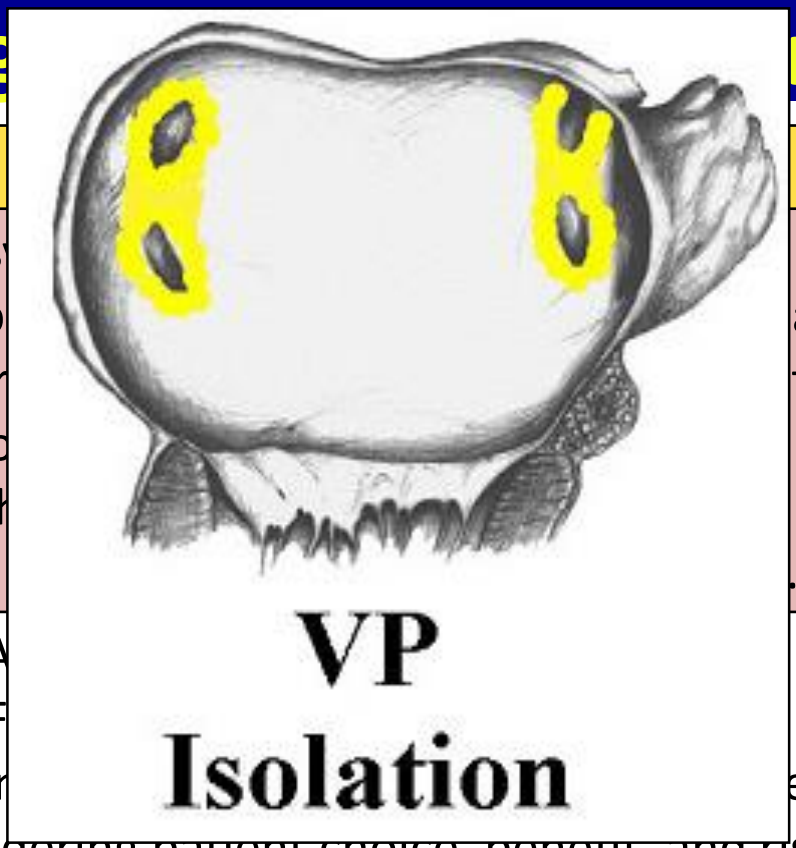
N Engl J Med 2015;372:1812-22.



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

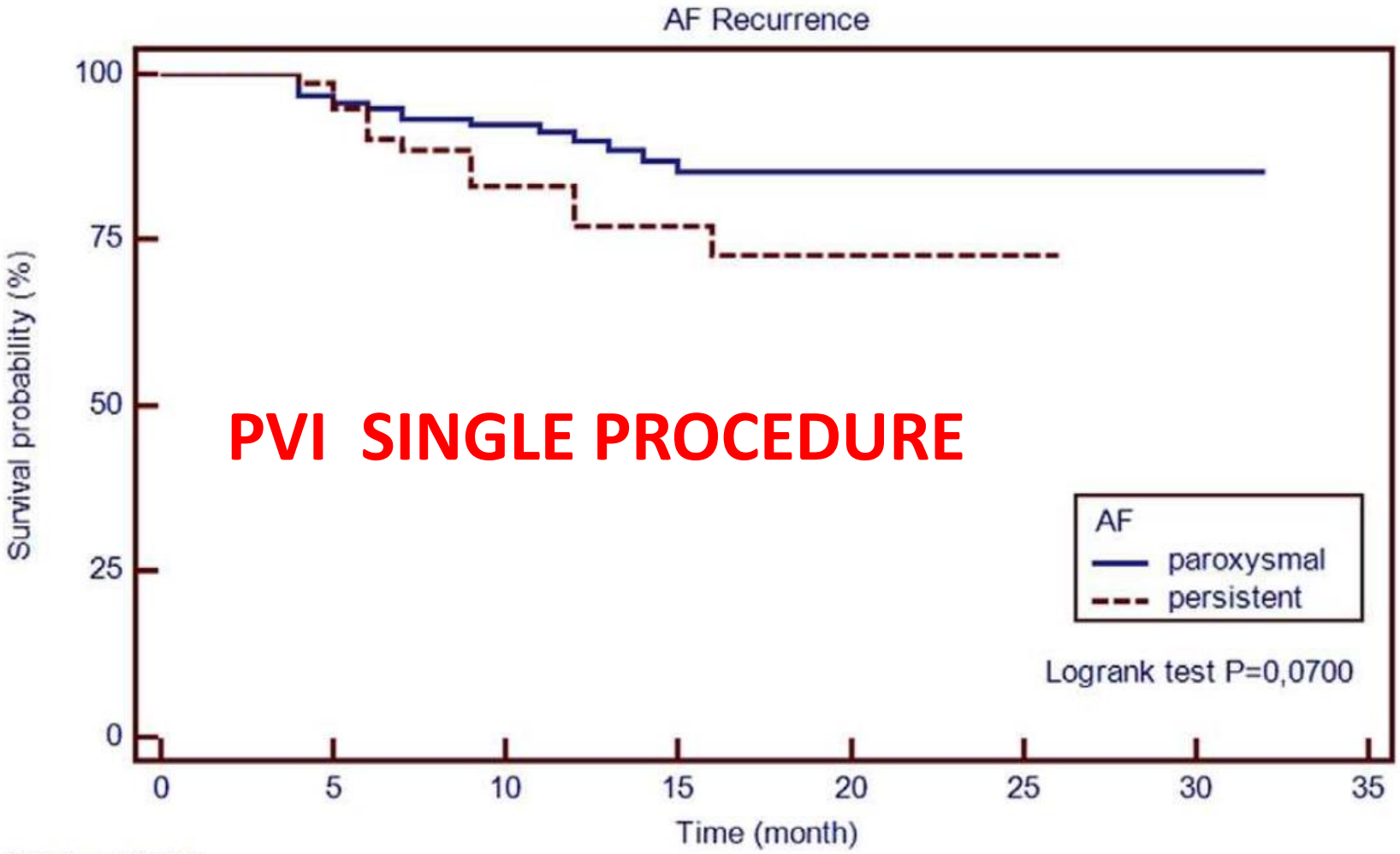
2016 ESC guidelines for the manag rillation



Recommendations	Class	Level
Catheter ablation of s recommended to imp ave symptomatic AF recur fer further rhythm contro electrophysiologist wh and is performing the .	I	A
Catheter ablation of A therapy to prevent AF patients with symptor e to AAD therapy, considering patient choice, benefit, and risk.	IIa	B
Catheter ablation should target isolation of the pulmonary veins using radiofrequency ablation or cryothermy balloon catheters.	IIb	B

2016 ESC Guidelines on AF management. Eur Heart J 2016;37:2893


adidas

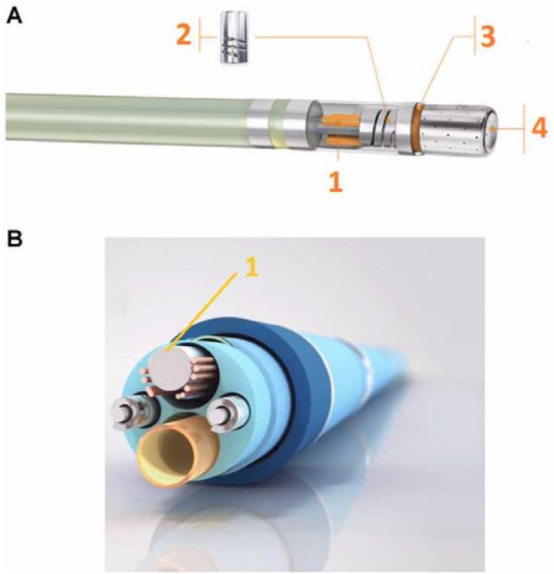

AF Recurrence
Survival probability (%)
100
75
50
25
0
PVI SINGLE PROCEDURE
AF
paroxysmal
persistent
Logrank test P=0,0700
0
5
10
15
20
25
30
35
Time (month)
Number at risk
Group: paroxysmal
157 125 81 43 14 4 2 0
Group: persistent
76 62 39 18 7 3 0 0

Safety and efficacy of pulmonary vein isolation using a surround flow catheter with contact force measurement capabilities: A multicenter registry

Giuseppe Stabile MD[1] | Paolo Di Donna MD[2] | Vincenzo Schillaci MD[3] | Antonio Di Monaco MD[4] | Assunta Iuliano MD[1] | Domenico Caponi MD[2] | Francesco Urraro MD[3] | Francesco Solimene MD[3] | Massimo Grimaldi MD[4] | Marco Scaglione MD[2]

JCardiovascElectrophysiol.2017

233 pts: 157 PAF, 76 PersAF F-Up 12 ± 6 months



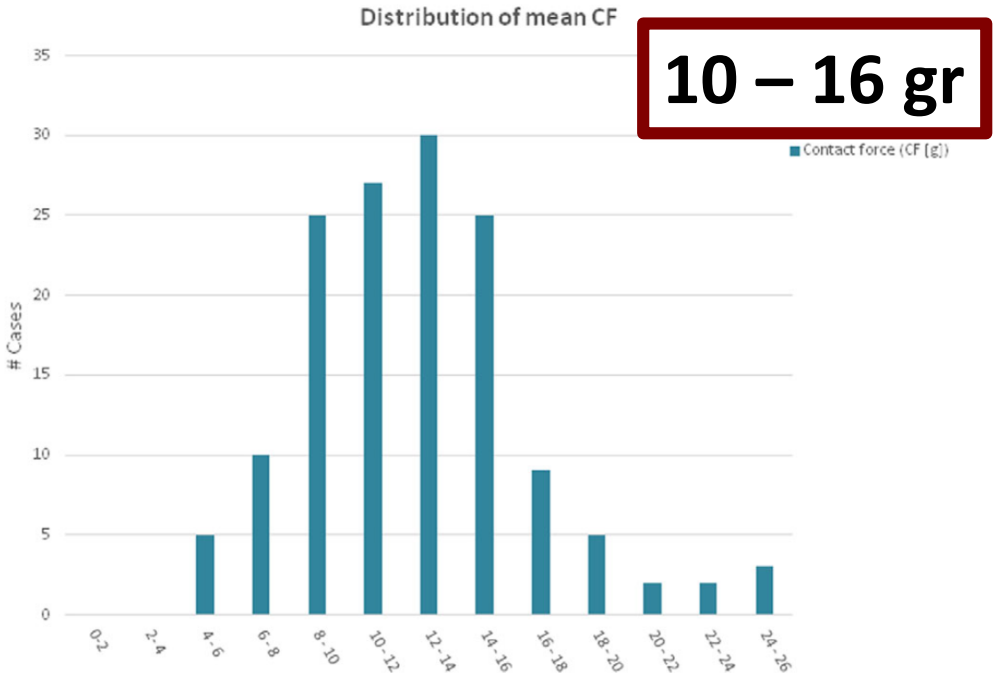
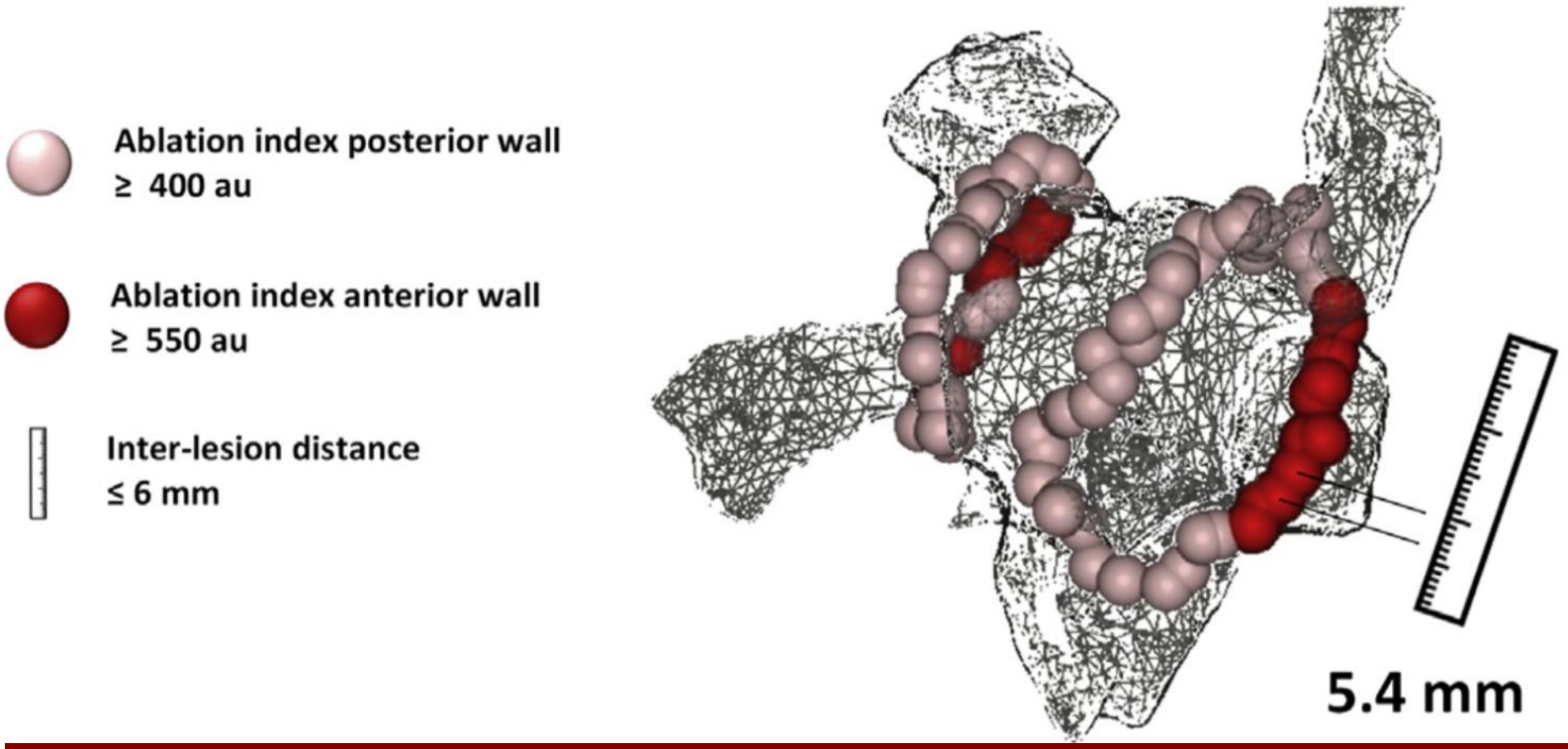
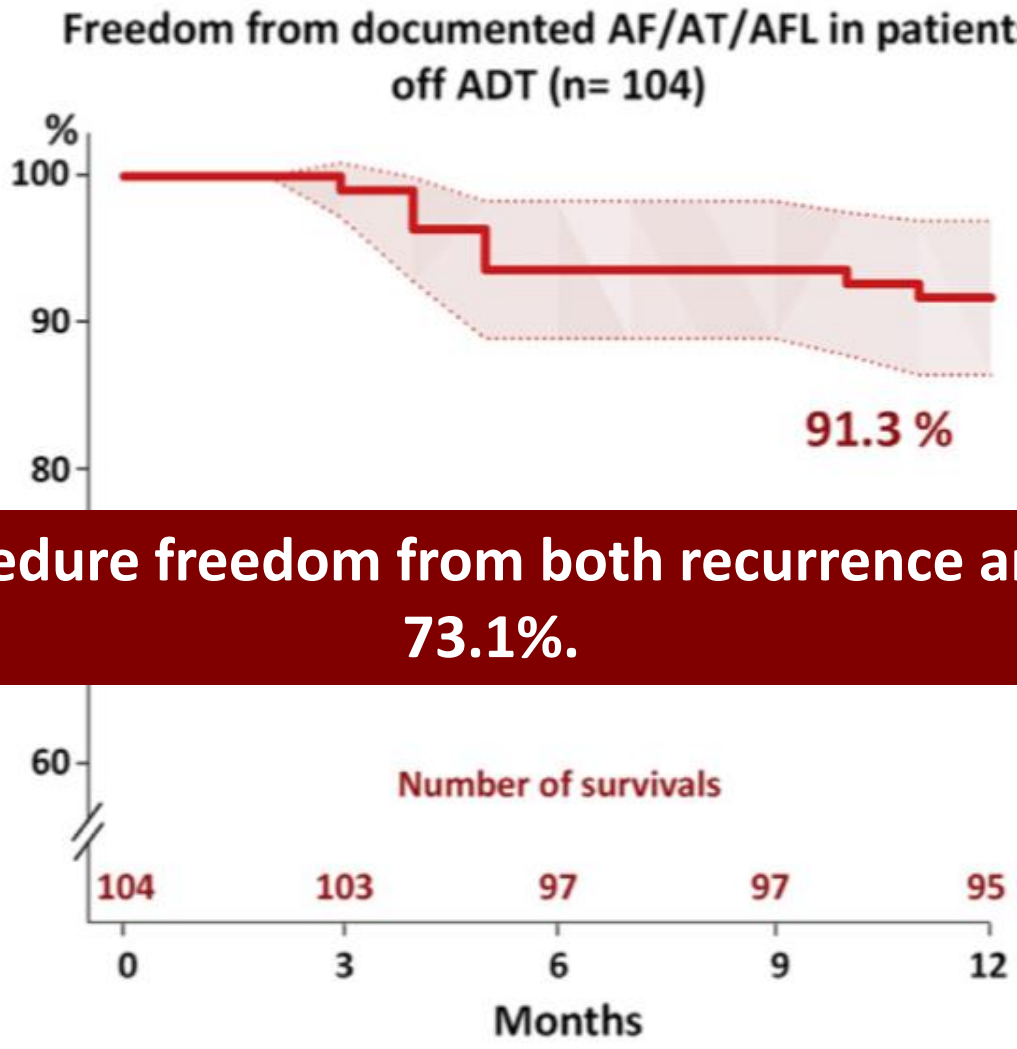


FIGURE 1 Illustration of CLOSE-Guided PVI **Philippe Taghji et al JACC EP 2017**



STABILITY + TIME + CONTACT + POWER = ABLATION INDEX

See text for explanation. AU = arbitrary unit; CLOSE = enclosing the PV with contiguous and optimized RF lesions; ILD = interlesion distance; PVI = pulmonary vein isolation.



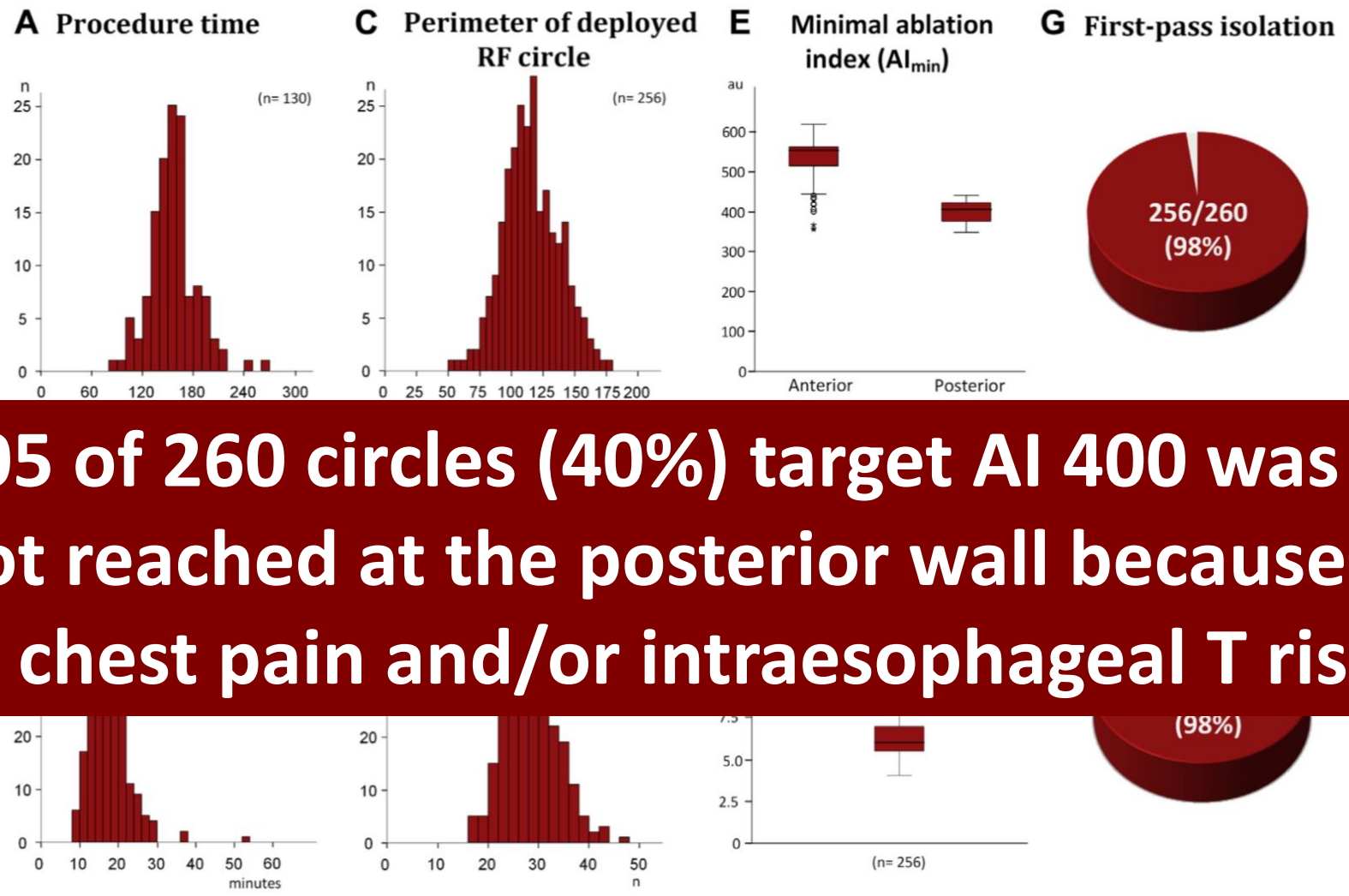
Single- procedure freedom from both recurrence and ADT was 73.1%.

Freedom from documented AF/AT/AFL in patients on ADT (n= 26)

Philippe Taghji et al JACC EP 2017

FIGURE 2 RF Characteristics and Incidence of Acute Durable PVI

Philippe Taghji et al JACC EP 2017



105 of 260 circles (40%) target AI 400 was not reached at the posterior wall because of chest pain and/or intraesophageal T rise.

(A) Procedure time. **(B)** Radiofrequency (RF) time per circle. **(C)** Perimeter of the deployed circle. **(D)** Number of RF tags within the circle. **(E)** Obtained minimal ablation index (AI$_{min}$) per circle. **(F)** Obtained maximal ILD. **(G)** Incidence of first-pass isolation. **(H)** Incidence of waiting time/adenosine-proof isolation. See text for further explanation. Abbreviations as in Figure 1.

DOI: 10.1111/pace.13710

PACE WILEY

ELECTROPHYSIOLOGY

Reproducibility of acute pulmonary vein isolation guided by the ablation index

Francesco Solimene MD[1] | Antoine Lepillier MD[2] | Ermenegildo De Ruvo MD[3] | Marco Scaglione MD[4] | Matteo Anselmino MD[5] | Frederic A. Sebag MD[6] | Domenico Pecora MD[7] | Mark M. Gallagher MD[8] | Mariano Rillo MD[9] | Graziana Viola MD[10] | Luca Rossi MD[11] | Valerio De Santis MD[12] | Maurizio Landolina MD[13] | Antonello Castro MD[14] | Massimo Grimaldi MD[15] | Nicolas Badenco MD[16] | Maurizio Del Greco MD[17] | Antonio De Simone MD[18] | Emanuele Bertaglia MD[19] | Giuseppe Stabile MD[1,18]

Group ST 330-450 (n = 96)	Group ST 380-500 (n = 81)	Group STSF 330-450 (n = 162)	Group STSF 380-500 (n = 151)

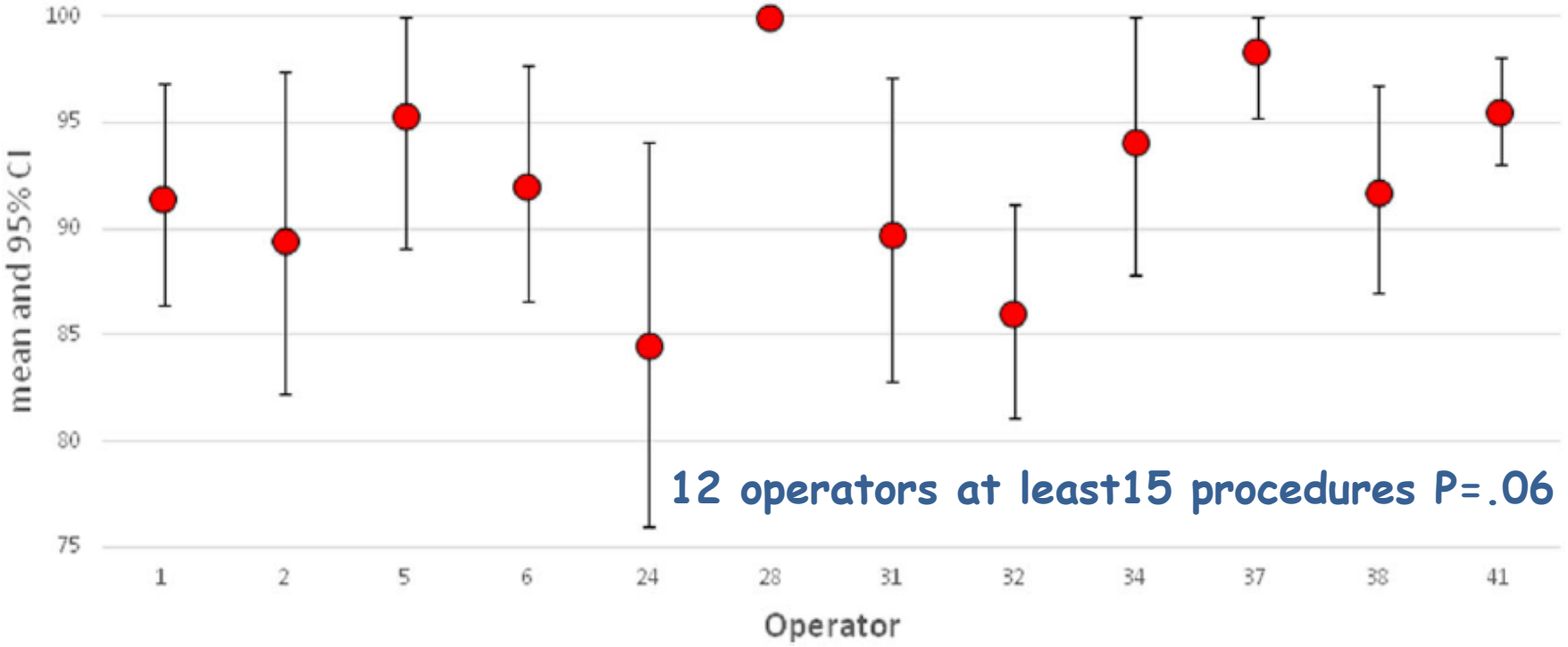
EP Lab, Cardiovascular Division, Cardinal G. Massaia Hospital, Asti, Italy

ABLATION INDEX (AI)

Reproducibility of acute pulmonary vein isolation guided by the AI

490 pts, 80,4% PAF, four study group contact force ST or contact force ST surround flow (STSF)

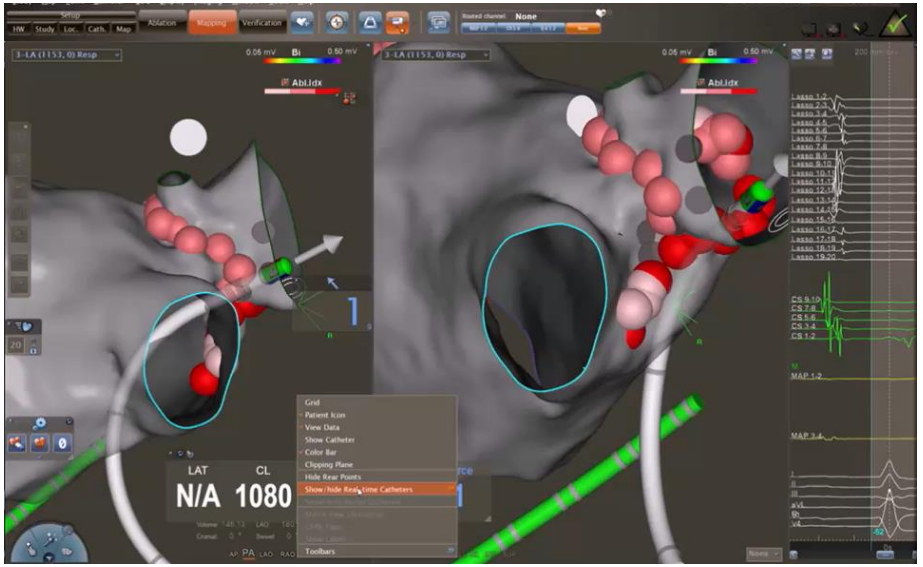
Rate of first pass isolation PV P=.585



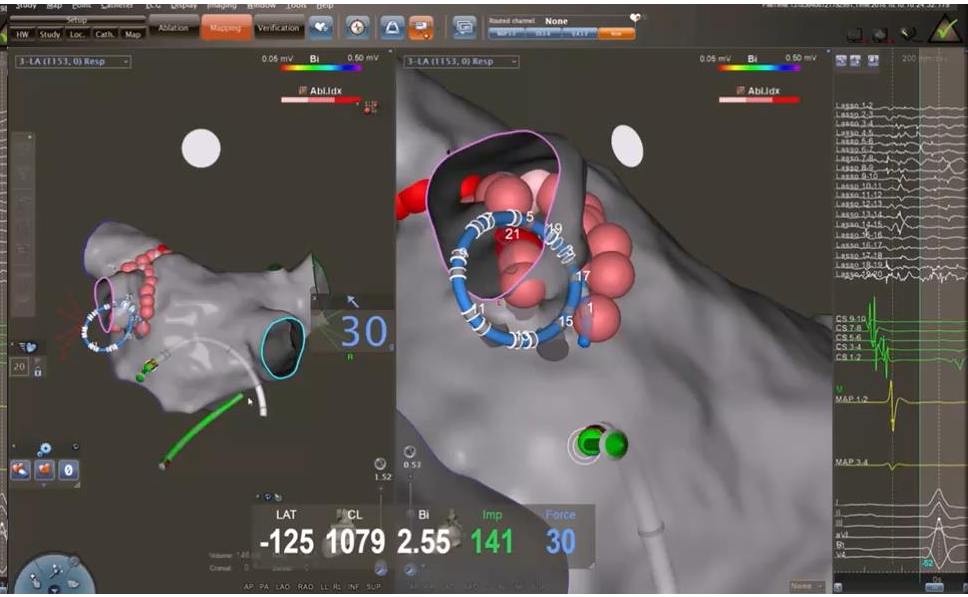
Solimene et al. PACE 2019

ABLATION


Sec
Power
Force
Imp
Temp
Stability
011
40
364
11
140
26
11


LAT
CL
N/A
1080


LAT
CL
Bi
Imp
Force
N/A
1054
0.15
145
32


LAT
CL
Bi
Imp
Force
-125
1079
2.55
141
30

ASTI SMART-TOUCH SF + ABLATION INDEX EXPERIENCE F-UP 18 months

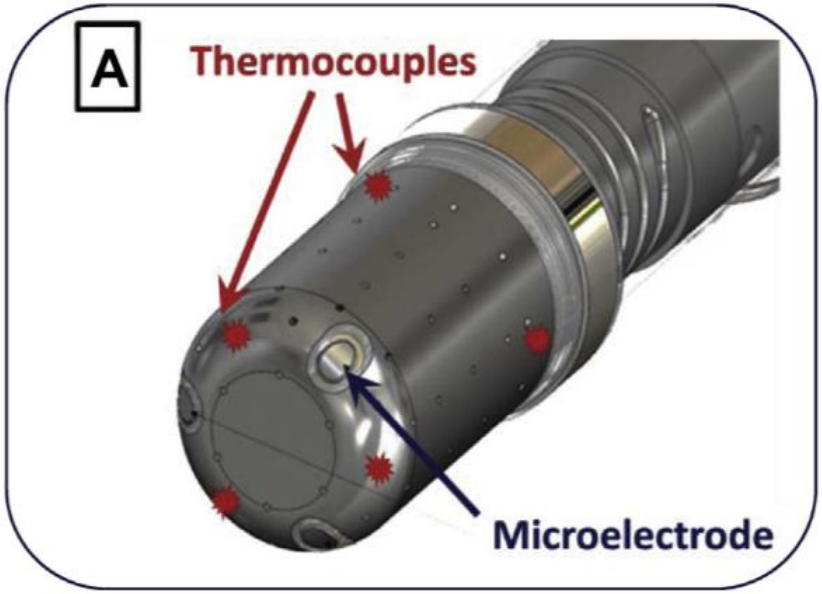
EFFICACY (acute)	→	100%
EFFICACY (follow-up)	→	85%
ATYPICAL FLUTTER	→	0
MAJOR COMPLIC.	→	0

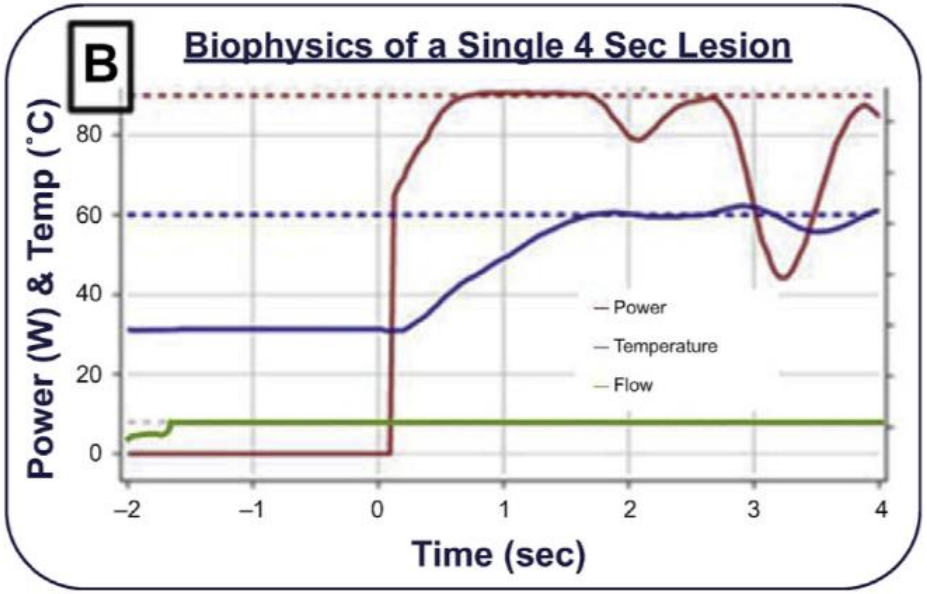
Pulmonary Vein Isolation With Very High Power, Short Duration, Temperature-Controlled Lesions

The QDOT-FAST Trial

JACC CEP 2019

Vivek Y. Reddy, MD,[a,b] Massimo Grimaldi, MD,[c] Tom De Potter, MD,[d] Johan M. Vijgen, MD,[e] Alan Bulava, MD, PhD,[f] Mattias Francis Duytschaever, MD,[g] Martin Martinek, MD,[h] Andrea Natale, MD,[i] Sebastien Knecht, MD, PhD,[g] Petr Neuzil, MD, PhD,[b] Helmut Pürerfellner, MD[h]





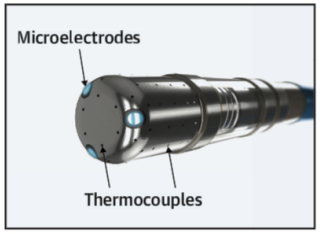
(A) The very high power-short duration (vHPSD) catheter tip is shown highlighting the microelectrodes and 6 thermocouples. **(B)** The biophysical parameters of an example ablation lesion is shown. This includes a 2-s pre-cooling phase, followed by a 4-s vHPSD ablation lesion. Note the power modulation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

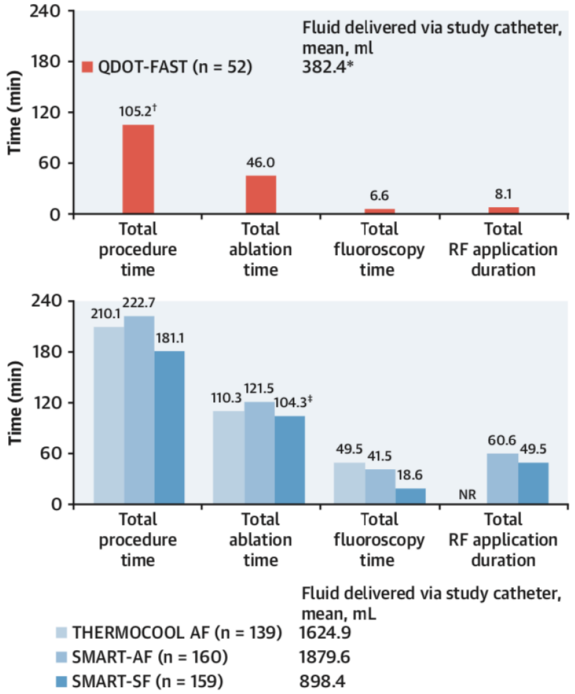
TABLE 3 PAE in the Safety Population (n = 52)

	PAE	Relationship With Device or Procedure
Total PAE	2 (3.8)	
Death	0	–
Atrioesophageal fistula*	0	–
Cardiac tamponade/perforation	0	–
Myocardial infarction	0	–
Stroke	0	–
Cerebrovascular accident	0	–
Thromboembolism	1 (1.9)	Possibly related to device; probably related to procedure
Transient ischemic attack	0	–
Phrenic nerve paralysis	0	–
PV stenosis*	0	–
Major vascular access complication or bleeding	1 (1.9)	Not related to device; possibly related to procedure

Values are n (%). *Device- or procedure-related death, PV stenosis, and atrioesophageal fistula that occur >1 week (7 days) post-procedure are considered and analyzed as PAE.

PAE = primary adverse event; PV = pulmonary vein.





*n = 50.
†Includes 20-minute waiting period.
‡Includes 30-minute waiting period.

Reddy, V.Y. et al. J Am Coll Cardiol EP. 2019;5(7):778–86.

Electroporation and its Relevance for Cardiac Catheter Ablation

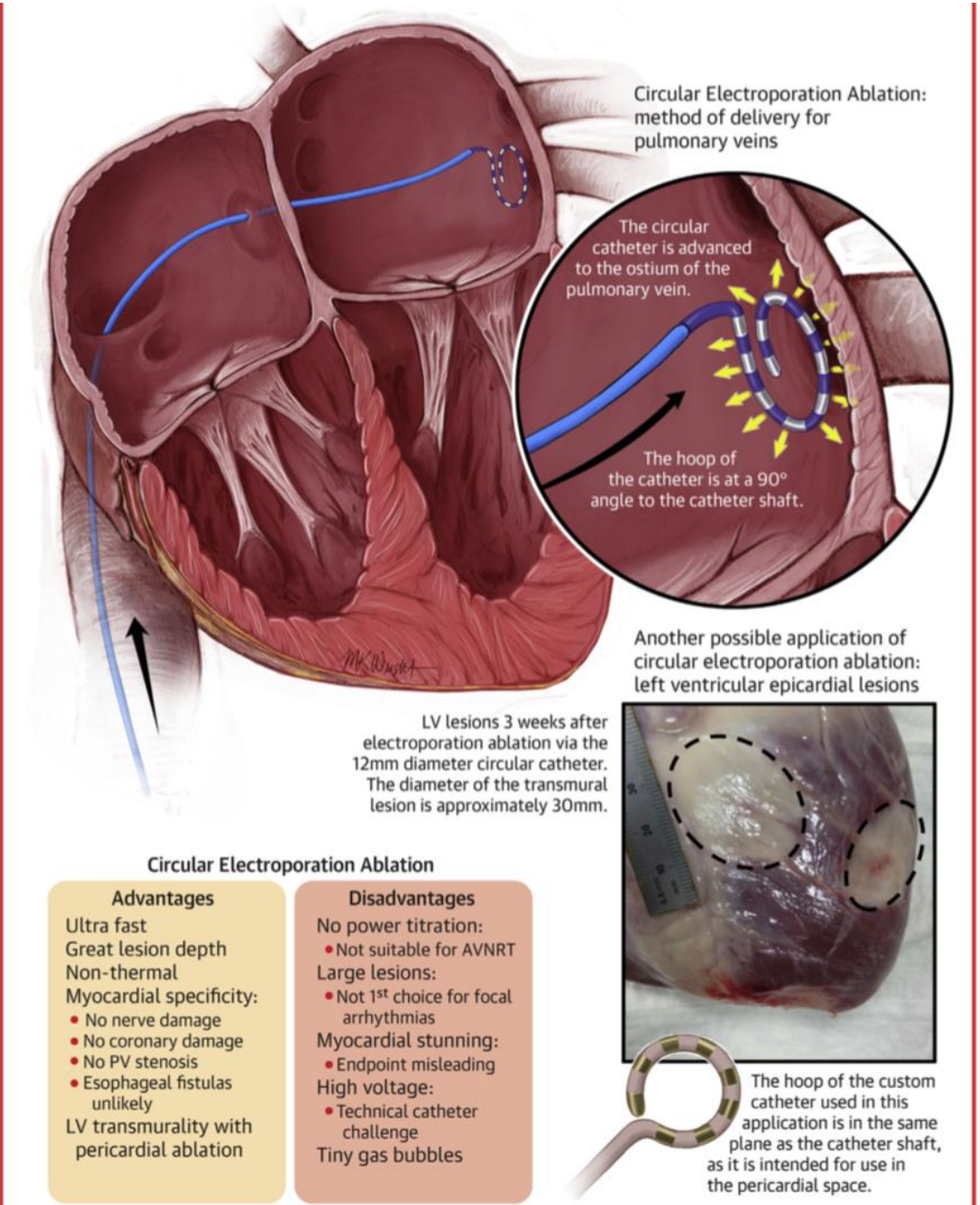
Fred H.M. Wittkampf, PhD,[a] René van Es, PhD,[a] Kars Neven, MD, PhD[a,b,c]

ABSTRACT

Irreversible electroporation can be used as a nonthermal energy source to ablate tissue.

parameter that most directly relates to the local voltage gradient that causes electroporation. Electroporation can be achieved with various modalities: direct current, alternating current, pulsed direct current, or any combination of these. Experimental cardiac and noncardiac studies have demonstrated tissue specificity with survival of arteries and nerves in large lesions. In addition, porcine data suggest that application inside a pulmonary vein does not lead to pulmonary vein stenosis and that the esophagus is remarkably insensitive to electroporation. Therefore, irreversible electroporation is a very promising technique for cardiac catheter ablation and especially for electrical pulmonary vein isolation. (J Am Coll Cardiol EP 2018;4:977–86) © 2018 by the American College of Cardiology Foundation.

JACC CEP 2018


Circular Electroporation Ablation: method of delivery for pulmonary veins
The circular catheter is advanced to the ostium of the pulmonary vein.
The hoop of the catheter is at a 90° angle to the catheter shaft.
Another possible application of circular electroporation ablation: left ventricular epicardial lesions
LV lesions 3 weeks after electroporation ablation via the 12mm diameter circular catheter. The diameter of the transmural lesion is approximately 30mm.
Circular Electroporation Ablation
Advantages
Ultra fast
Great lesion depth
Non-thermal
Myocardial specificity:
• No nerve damage
• No coronary damage
• No PV stenosis
• Esophageal fistulas unlikely
LV transmurality with pericardial ablation
Disadvantages
No power titration:
• Not suitable for AVNRT
Large lesions:
• Not 1st choice for focal arrhythmias
Myocardial stunning:
• Endpoint misleading
High voltage:
• Technical catheter challenge
Tiny gas bubbles
The hoop of the custom catheter used in this application is in the same plane as the catheter shaft, as it is intended for use in the pericardial space.
Wittkampf, F.H.M. et al. J Am Coll Cardiol EP. 2018;4(8):977-86.

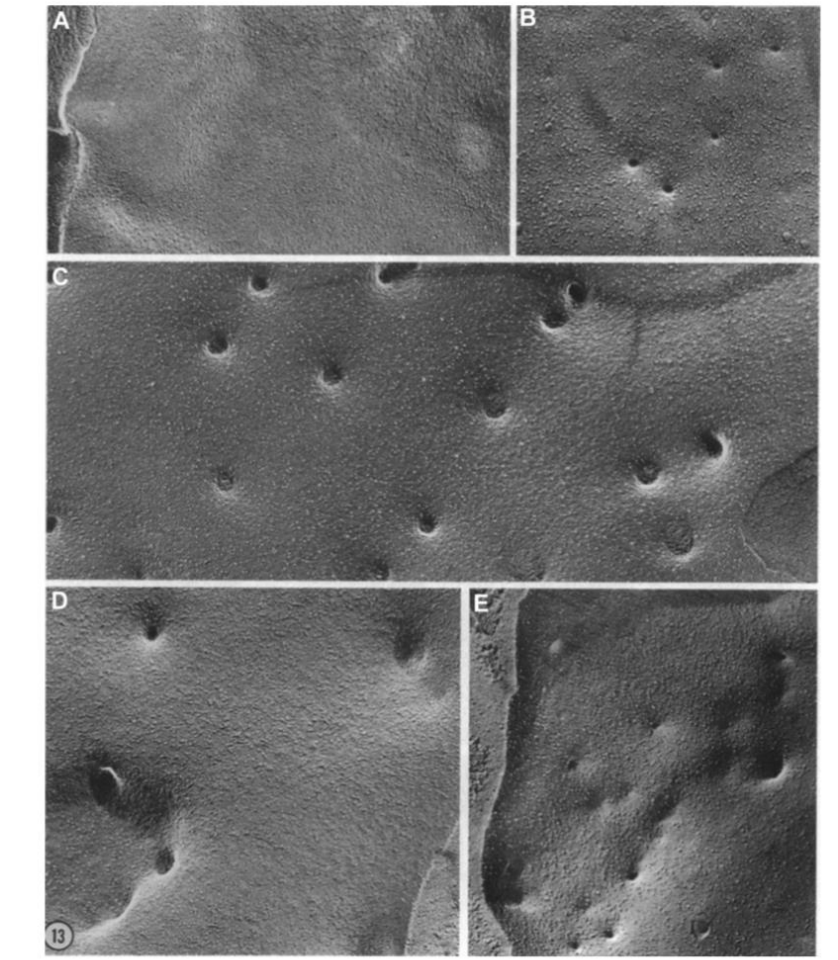


FIGURE 1 Electroporated Red Blood Cell Membrane
A
B
C
D
E
13
Micrographs showing the structure of the membranes of red blood cells, frozen at different times (t) after the application of the porating electrical pulse. (A) t = 0.5 ms; (B) t = 3 ms; (C) t = 40 ms; (D) t = 5 s; and (E) t = 10 s. Original magnification: 60,000×. Reprinted with permission from Chang and Reese (8).

CONCLUSIONS

Atrial fibrillation ablation: less is more?

YES, IT IS

CONCLUSIONS

AF ABLATION TARGET EBM → PVI

(THUS REDUCING IATROGENIC ATRIAL FLUTTERS)

YOU CAN DO LESS BUT YOU HAVE TO DO IT BETTER

(CONTACT FORCE, LESION ASSESSMENT)

TECHNOLOGICAL ADVANCEMENT

(Q-DOT & ELECTRPORATION)