



## High-Power Short-Duration RF Application

*Hope, Hype, or Harmful?*



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# Korean Heart Rhythm Society

## COI Disclosure

*Jose L. Merino:*

The authors have financial conflicts of interest  
to disclose concerning the presentation:

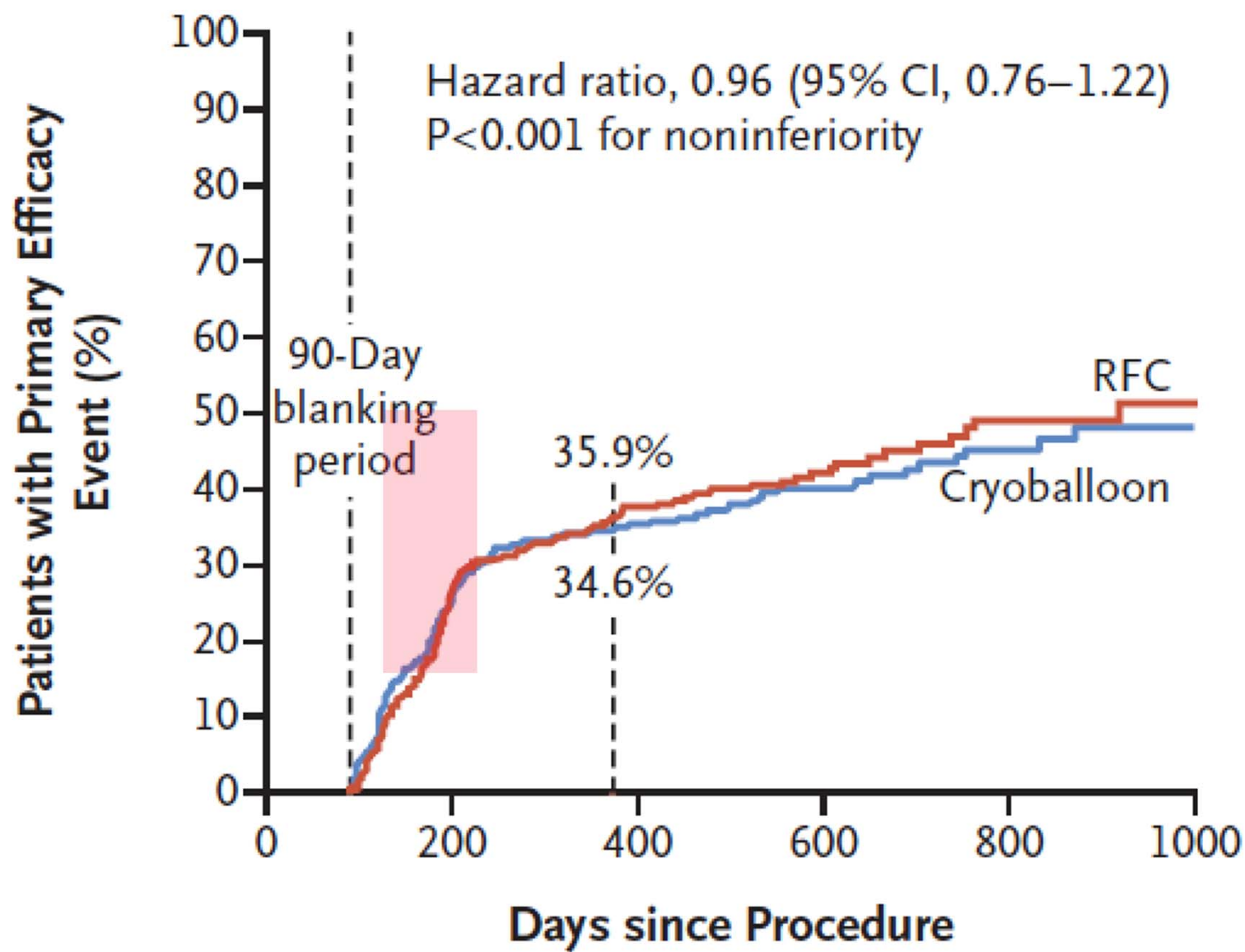
Advisory board: Sanofi, Medtronic

Research grants: Abbott, Boston Scientific, Medtronic

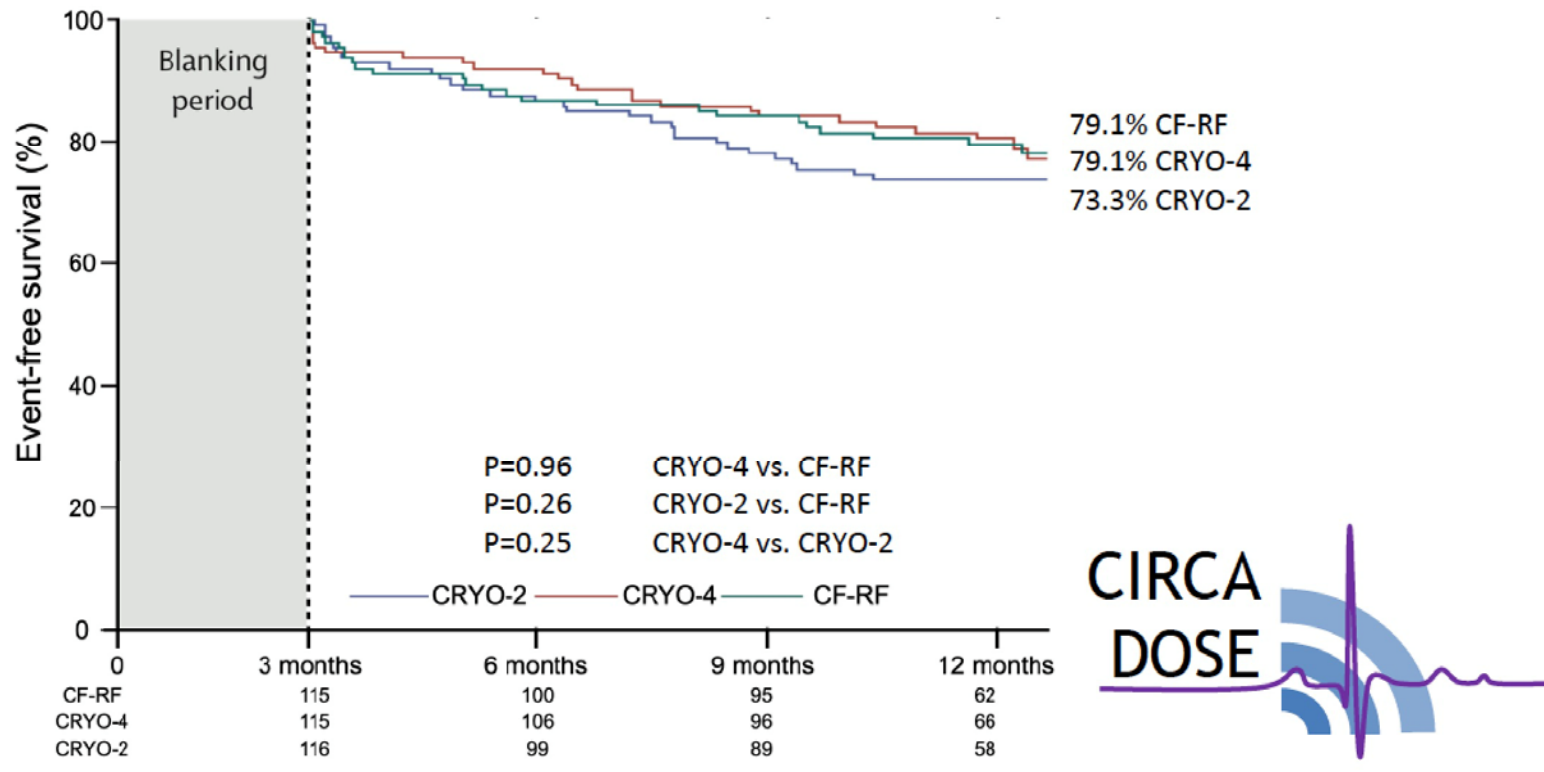
Educational fees/contracts: Abbott, Microport



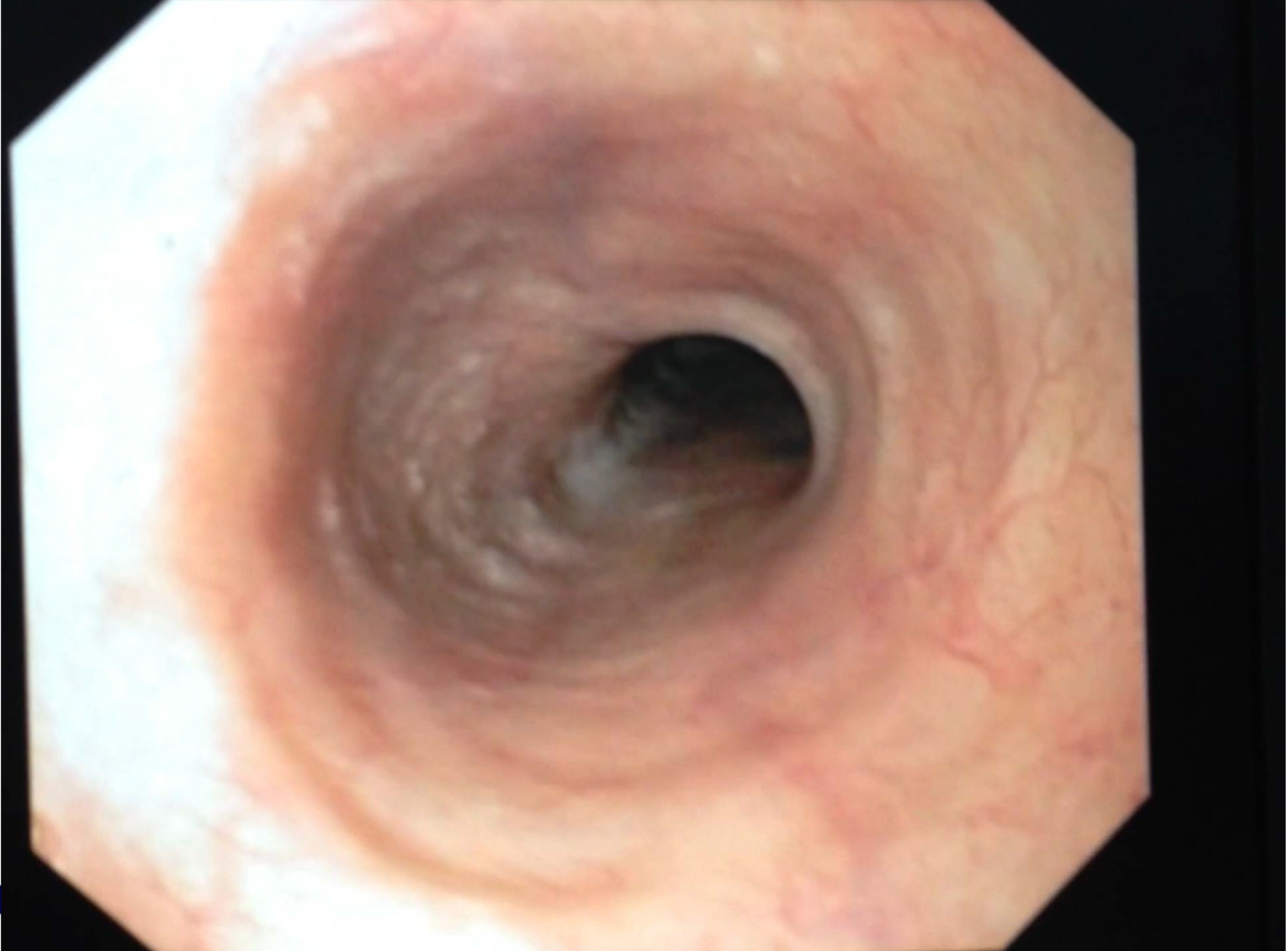
# Efficacy



## Secondary Outcome – freedom from **symptomatic** tachyarrhythmia (AF/AFL/AT) after a single ablation procedure



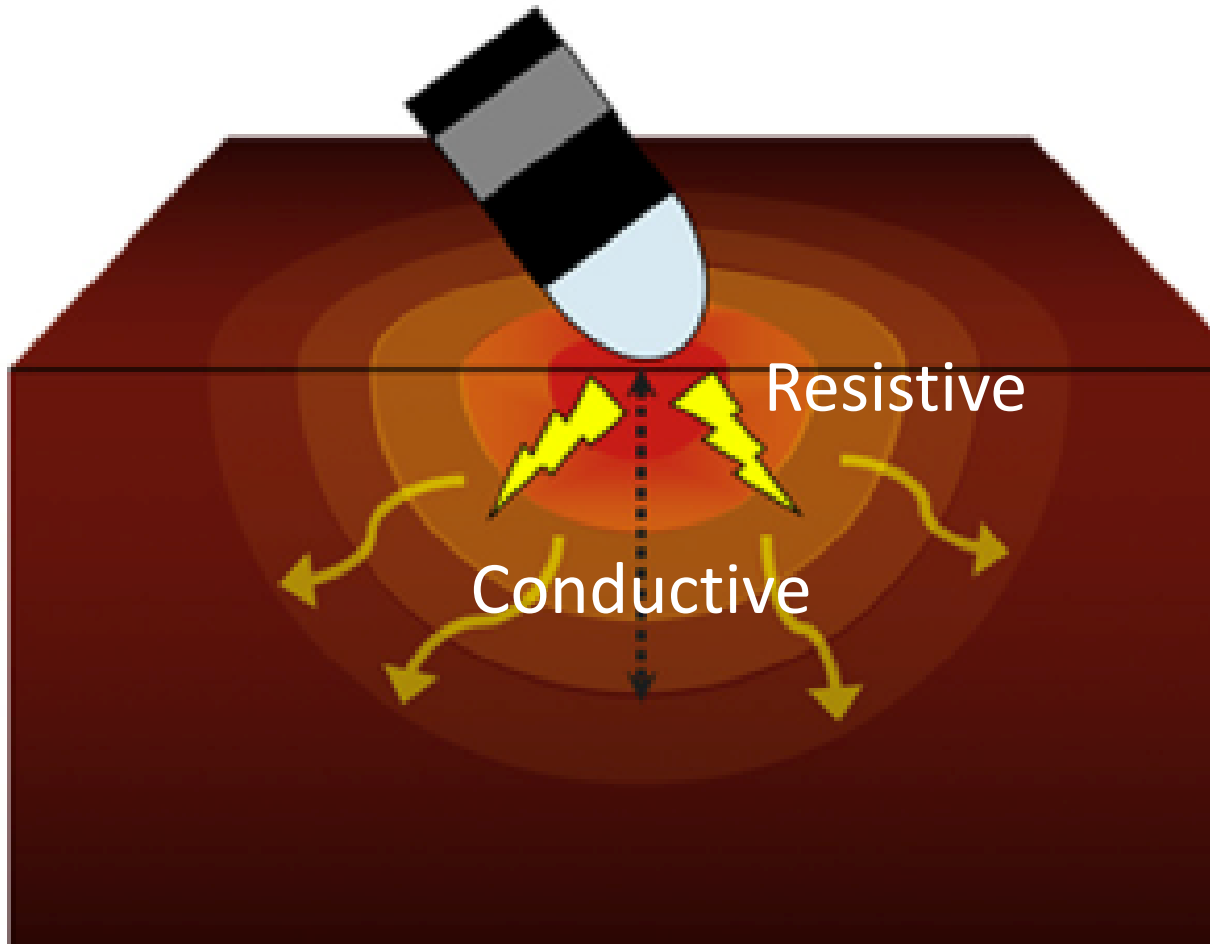
# Safety



# RF basis



# A Standard



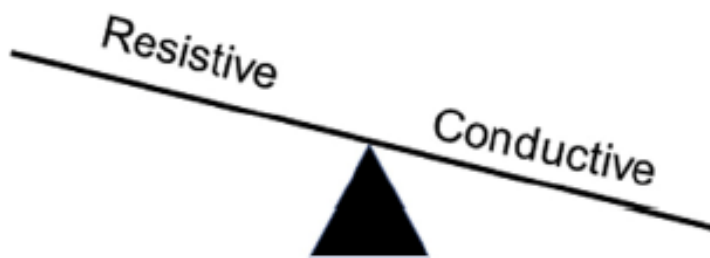
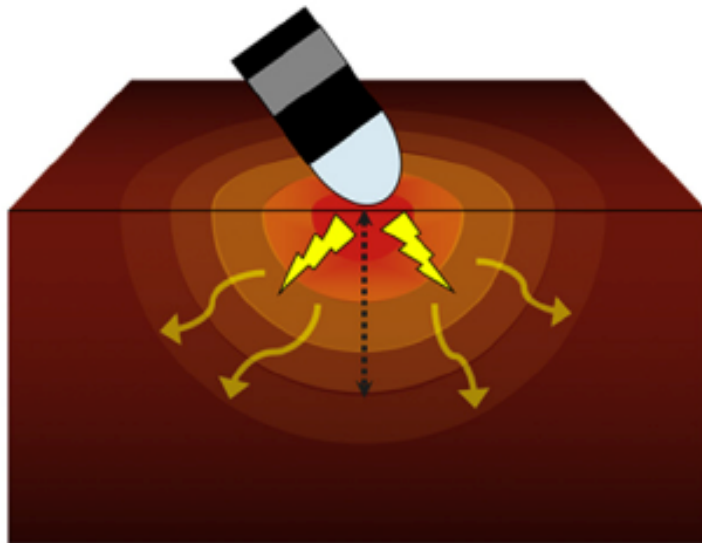
# What is “conventional” RF application?

Experience with contact force (CF) sensing catheters	n	W
Casella et al. 2014	20	35
Kimura et al. 2014	19	25-30
Pedrote et al. 2016	25	25-35
Nakamura et al. 2015	60	30-40
Ullah et al. 2016	59	30
Reddy et al. 2015	152	?
Sigmund et al. 2015	99	25-35
Jarman et al. 2015	<b>200</b>	<b>25-35</b>
Deubner et al. 2016	96	20-30
Martinek et al. 2012	25	25-35
Makimoto et al. 2015	35	30-40
Ullah et al. 2014	50	?
Wutzler et al. 2014	31	35
Wakili et al. 2014	32	30
Andrade et al. 2014	25	25-35
Fichtner et al. 2015	30	25-30
Rosso et al. 2016	50	25-30
Marijon et al. 2014	30	25-30
Itoh et al. 2016	50	20-30
Wolf et al. 2016	24	30-40
Lee et al. 2016	<b>510</b>	<b>30</b>
Sciara et al. 2014	21	20-30
Taghi et al. 2018	130	25-35
Phlips et al. 2018	50	35
<b>“Conventional” RF power: 25 – 30 W</b>		

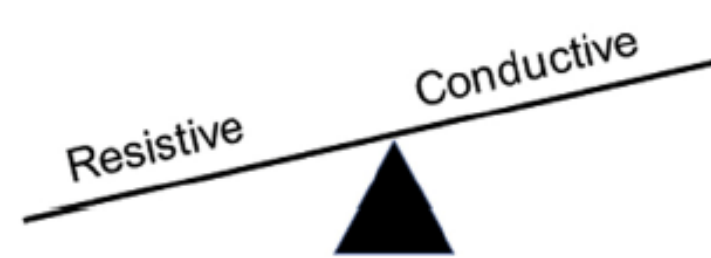
**25-30W**



**A** Standard

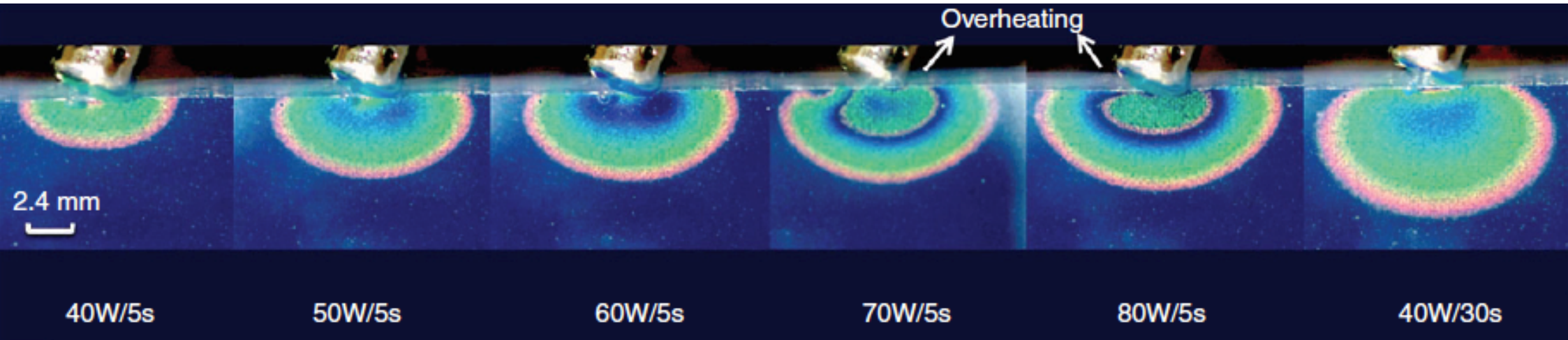


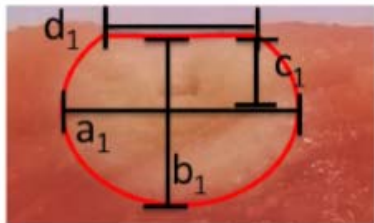
**B** High-Power Short-Duration



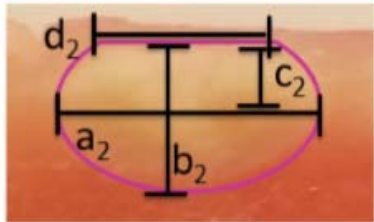
# Five seconds of 50–60 W radio frequency atrial ablations were transmural and safe: an *in vitro* mechanistic assessment and force-controlled *in vivo* validation

Conventional

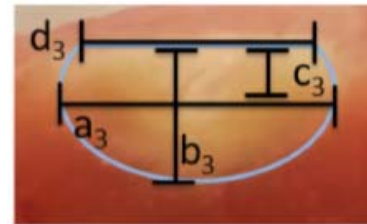




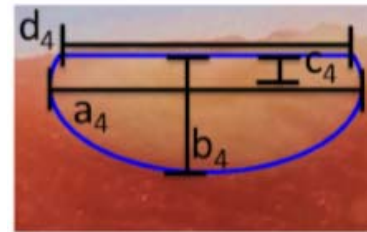
**Standard 30W, 30s, 15-20g**  
 $a_1 = 8.9 \pm 0.6 \text{ mm}$   $c_1 = 2.2 \pm 0.5 \text{ mm}$   
 $b_1 = 5.7 \pm 0.6 \text{ mm}$   $d_1 = 7.5 \pm 0.6 \text{ mm}$   
 $\text{Volume}_1 = 271 \pm 46 \text{ mm}^3$



**HPSD 50W, 13s, 15-20g**  
 $a_2 = 10.2 \pm 0.5 \text{ mm}$   $c_2 = 1.0 \pm 0.4 \text{ mm}$   
 $b_2 = 4.7 \pm 0.6 \text{ mm}$   $d_2 = 8.9 \pm 0.4 \text{ mm}$   
 $\text{Volume}_2 = 274 \pm 34 \text{ mm}^3$



**HPSD 60W, 10s, 15-20g**  
 $a_3 = 10.4 \pm 0.6 \text{ mm}$   $c_3 = 0.6 \pm 0.3 \text{ mm}$   
 $b_3 = 4.3 \pm 0.5 \text{ mm}$   $d_3 = 9.4 \pm 0.5 \text{ mm}$   
 $\text{Volume}_3 = 259 \pm 36 \text{ mm}^3$



**HPSD 70W, 7s, 15-20g**  
 $a_4 = 11.2 \pm 0.5 \text{ mm}$   $c_4 = 0.6 \pm 0.2 \text{ mm}$   
 $b_4 = 3.9 \pm 0.5 \text{ mm}$   $d_4 = 10.3 \pm 0.6 \text{ mm}$   
 $\text{Volume}_4 = 272 \pm 40 \text{ mm}^3$




**Overlay view of schematic lesion geometries**

(30W 30s red, 50W 13s purple, 60W 10s light blue, 70W 7s blue)



# Feasibility and safety of pulmonary vein isolation by high-power short-duration radiofrequency application: short-term results of the POWER-FAST PILOT study

Sergio Castrejón-Castrejón<sup>1</sup> · Marcel Martínez Cossiani<sup>1</sup> · Marta Ortega Molina<sup>1</sup> · Carlos Escobar<sup>1</sup> · Consuelo Froilán Torres<sup>2</sup> · Nerea Gonzalo Bada<sup>2</sup> · Marta Díaz de la Torre<sup>2</sup> · José Manuel Suárez Parga<sup>2</sup> · José Luis López Sendón<sup>1</sup> · José Luis Merino<sup>1</sup> 

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**Consecutive patients**  
Paroxysmal/persistent AF  
Informed consent

**LPLD**  
(control group)

**HPSD**

30 (20) W  
30 s

50 W  
LSI  $\geq 5$  or Abl-I  $\geq 350/400$

60 W  
9-10 s

**Esophag. Endoscopy (<72 h)**

**1-year follow-up (complete)**

## Acute Efficacy

	LPLD	HPSD		p
	30 W	50 W	60 W	
Patients with PVI of all targeted PV	96%	100%	100%	0.59
PV first-pass isolation	39%	57%		0.01
		56%	58%	0.05

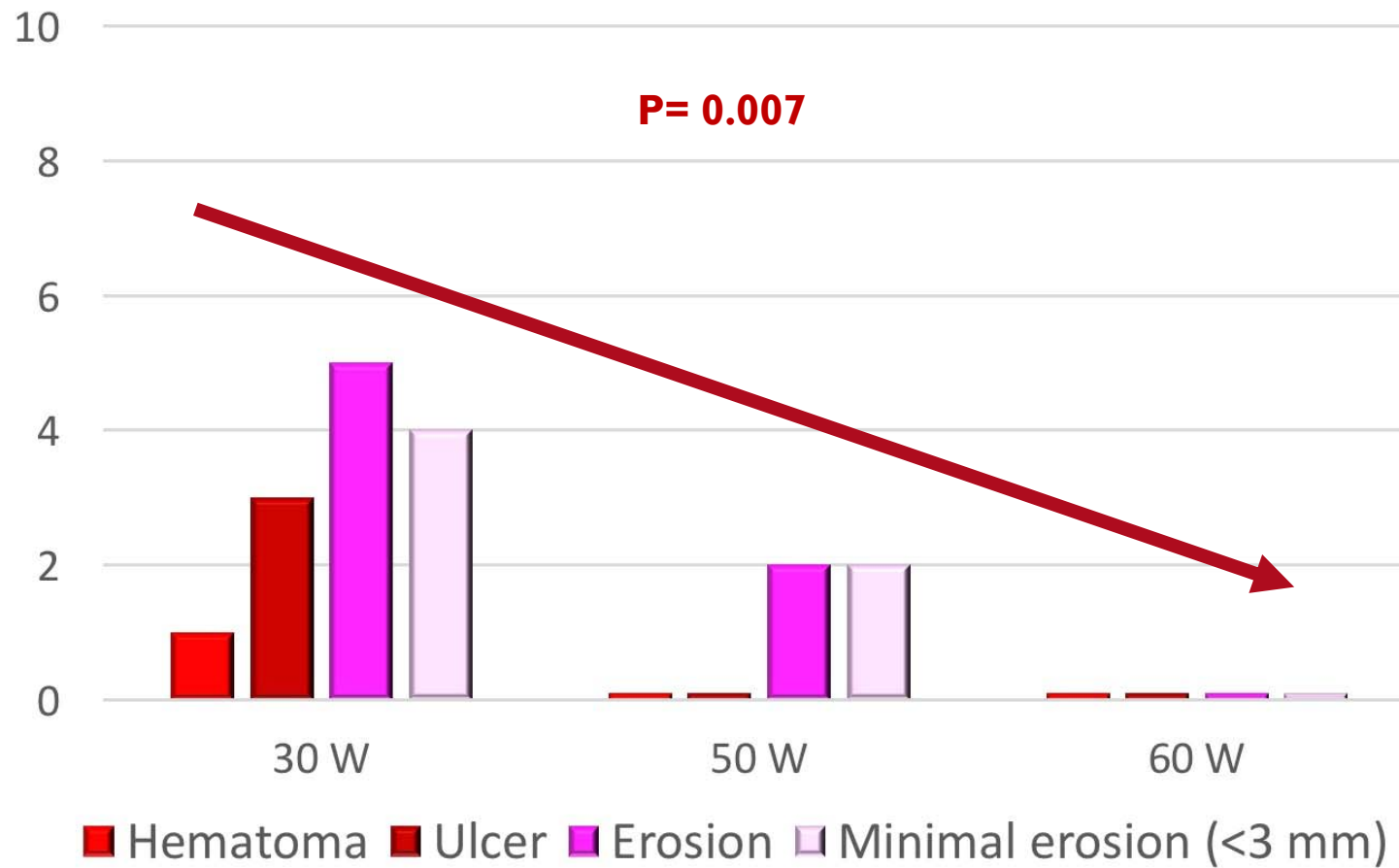




# Complications

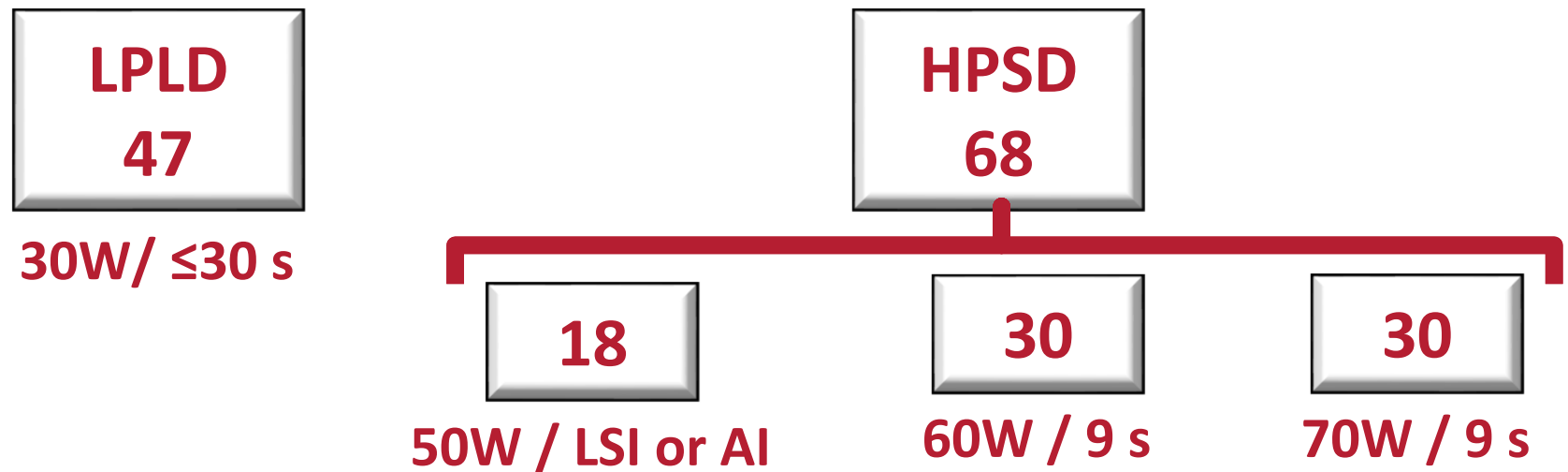
	<b>LPLD (47)</b>	<b>50 W (18)</b>	<b>HPSD (48)</b>	<b>60 W (30)</b>
<b>Peric. Effusion</b>	<b>3</b>	<b>0</b>		<b>0</b>
<b>Vascular</b>	<b>3</b>	<b>0</b>		<b>0</b>
<b>PV stenosis</b>	<b>1</b>	<b>0</b>		<b>0</b>
<b>TIA (48 h)</b>	<b>0</b>	<b>0</b>		<b>1</b>

# Esophageal lesions



# POWER-FAST II

- 125 consecutive AF pts



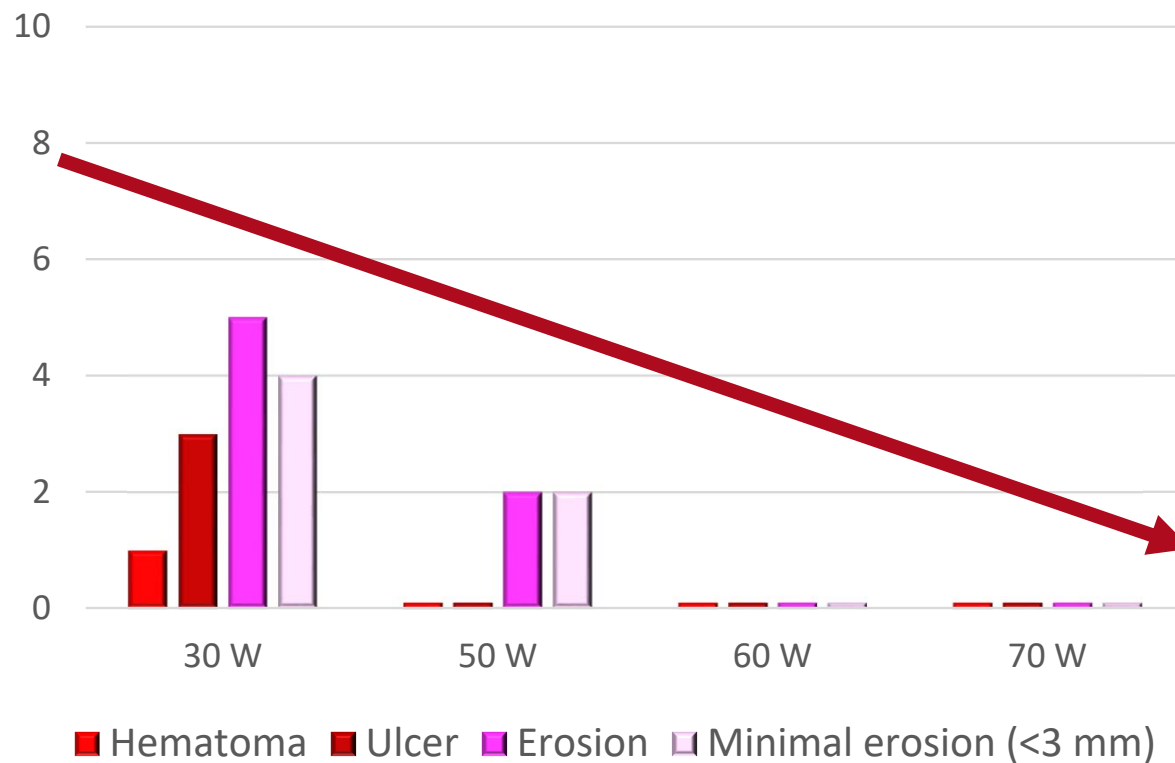
- Esophageal endoscopy after ablation in all.

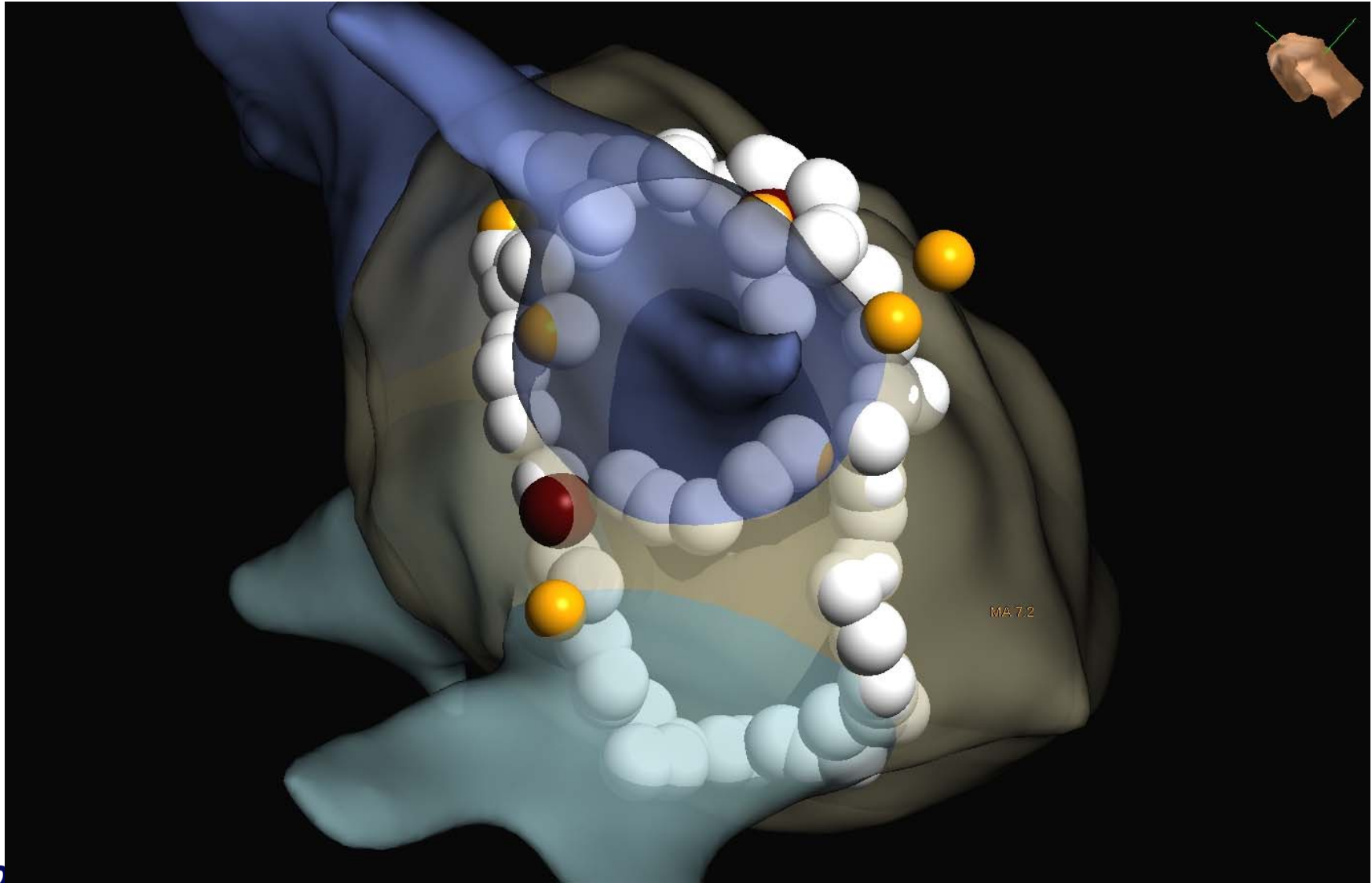
# Efficacy

• First-pass PVI:	Left PVs	Right PVs
✓ HPSD 50W:	56%	56%
✓ HPSD 60W:	57%	60%
✓ HPSD 70W:	85%	82%
	p=0.038	p=0.13

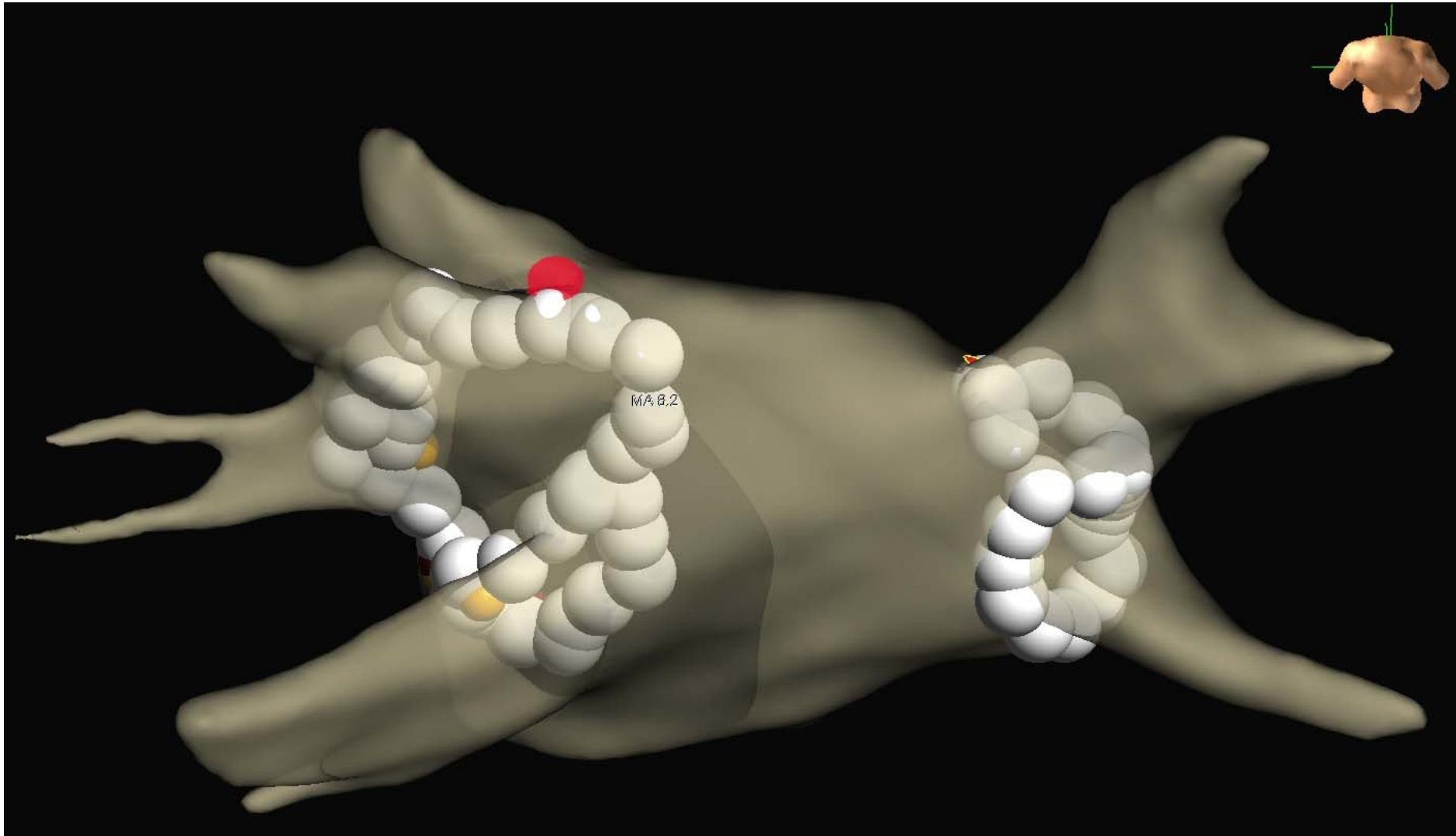
# Esophageal thermal injury

## *The POWER FAST I & II pilot studies*





MA 7.2



MA B.2





**ESC**

European Society  
of Cardiology

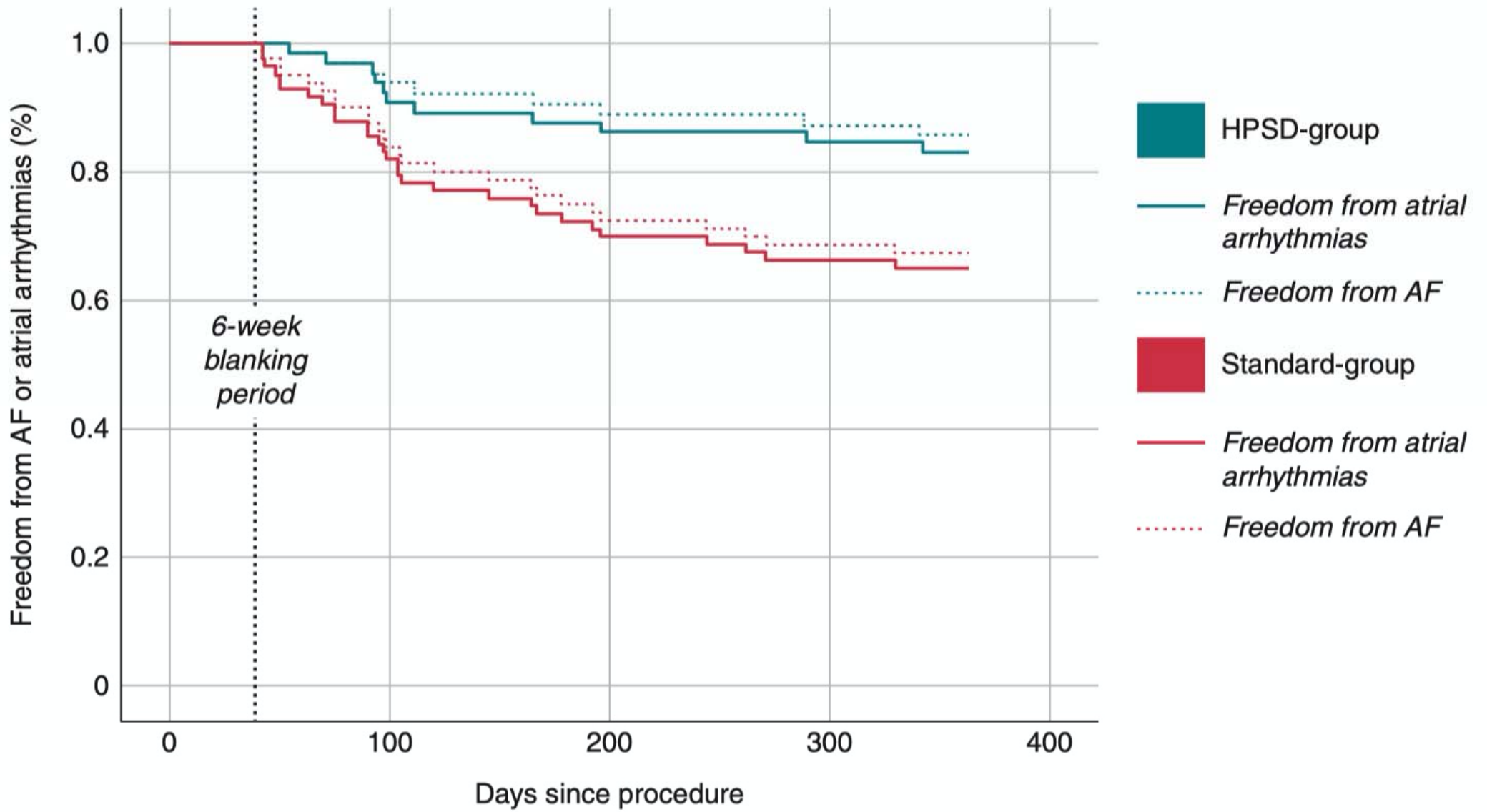
Europace (2019) **0**, 1–6  
doi:10.1093/europace/euz342

**CLINICAL RESEARCH**

# **Safety and outcome of very high-power short-duration ablation using 70 W for pulmonary vein isolation in patients with paroxysmal atrial fibrillation**

**Marc Kottmaier\***, Miruna Popa, Felix Bourier, Tilko Reents, Jairo Cifuentes, Verena Semmler, Martha Telishevskva, Ulanemekh Otgonbayar, Katharina Koch-Büttner, Carsten Lennerz, Marcin Bartkowiak, Marielouise Kornmayer, Elena Rousseva, Amir Brkic, Christian Grebmer, Christoph Kolb, Gabriele Hessling, and Isabel Deisenhofer





## ORIGINAL RESEARCH

### CATHETER ABLATION

# Very High-Power Short-Duration, Temperature-Controlled Radiofrequency Ablation in Paroxysmal Atrial Fibrillation

## The Prospective Multicenter Q-FFICIENCY Trial

Jose Osorio, MD,<sup>a</sup> Ayman A. Hussein, MD,<sup>b</sup> M. Craig Delaughter, MD, PhD,<sup>c</sup> George Monir, MD,<sup>d</sup> Andrea Natale, MD,<sup>e</sup> Srinivas Dukkipati, MD,<sup>f</sup> Saumil Oza, MD,<sup>g</sup> Emile Daoud, MD,<sup>h</sup> Luigi Di Biase, MD, PhD,<sup>i</sup> Moussa Mansour, MD,<sup>j</sup> Robert Fishel, MD,<sup>k</sup> Miguel Valderrabano, MD,<sup>l</sup> Kenneth Ellenbogen, MD,<sup>m</sup> on behalf of the Q-FFICIENCY Trial Investigators



# QDOT

## Prospective Multicenter Study (Q-EFFICIENCY)



**22** U.S. CENTERS

**166**

**PATIENTS WITH DRUG-REFRACTORY SYMPTOMATIC PAROXYSMAL AF**



63 years, 61% male  
2.4 CHA<sub>2</sub>DS<sub>2</sub>-VASc score  
60% LVEF  
38-mm LA diameter

Catheter courtesy of ©Biosense Webster, Inc. All rights reserved.  
QDOT MICRO™ is a trademark of Biosense Webster, Inc

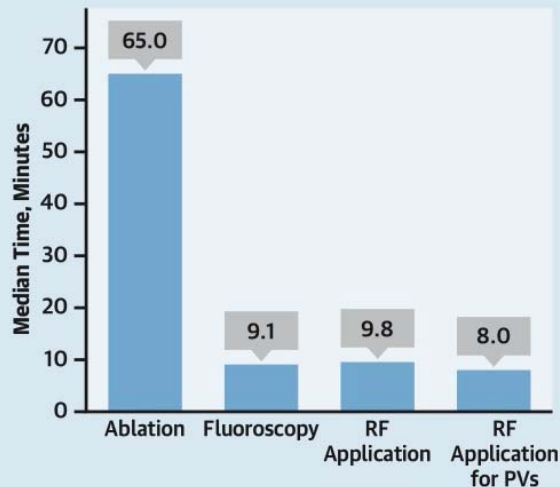
## Ablation Procedure QDOT MICRO Catheter

**PVI with very high-power short-duration (vHPSD)**  
(90 W, up to 4 seconds)

**Conventional-power temperature-controlled (CPTC) ablation allowed for touch-up**  
(25-50 W, target temperature 50°C, contact force 5-30 g)

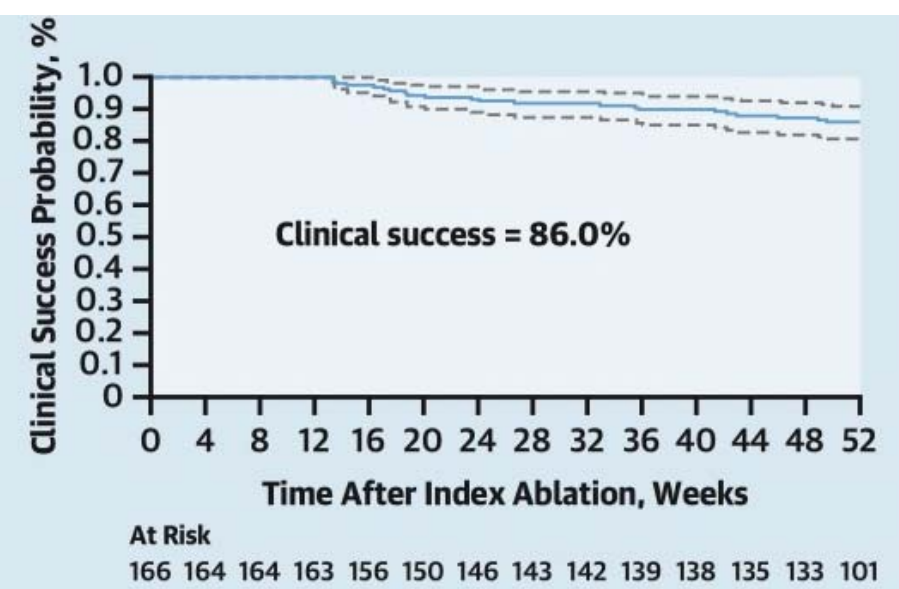
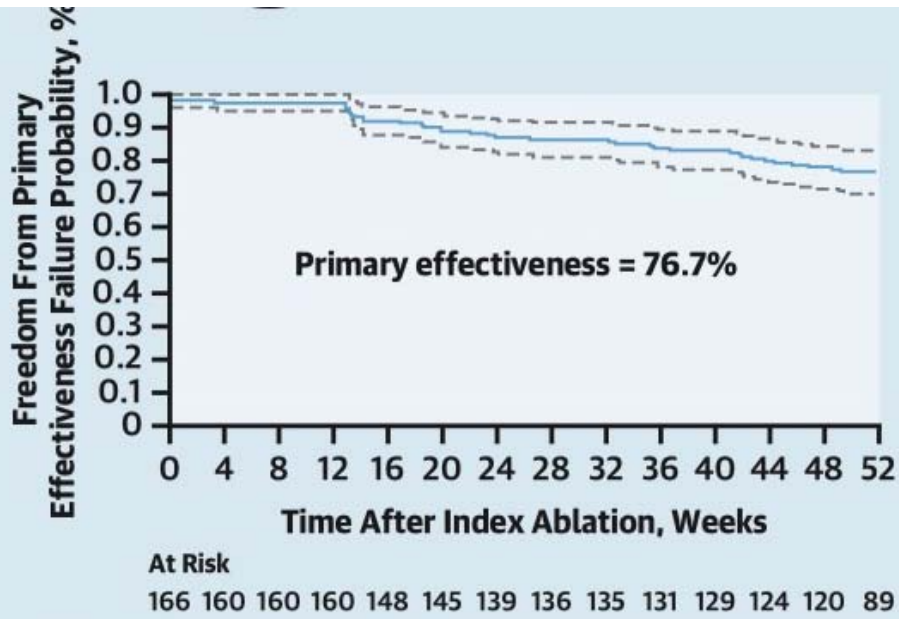


vHPSD or CPTC mode for non-PV ablation



**KHRS 2023**

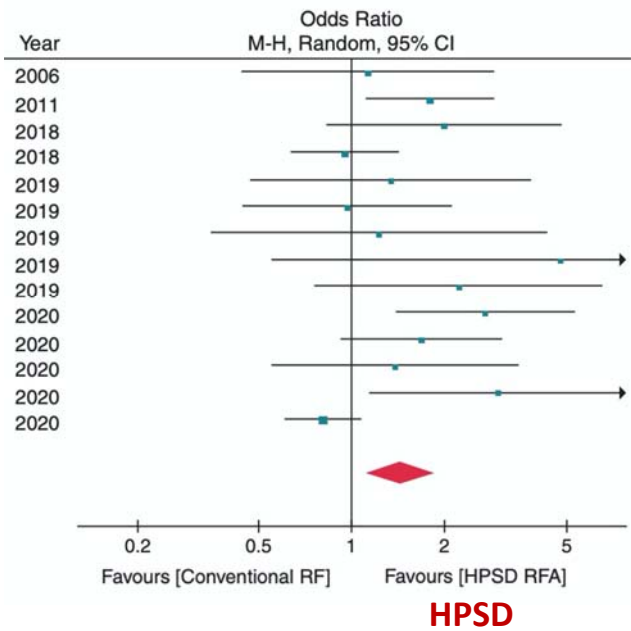
Osorio J, et al. J Am Coll Cardiol EP. 2023;9(4):468-480.



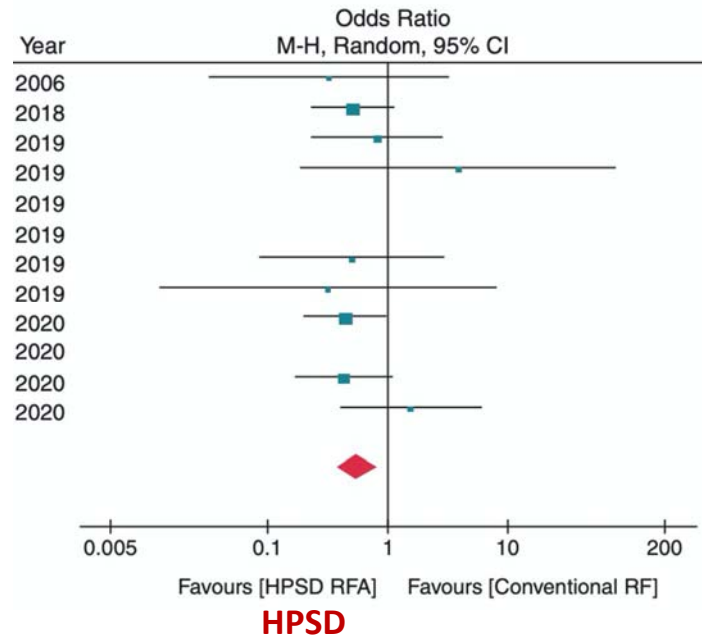
# HPSD vs Conventional PVI

## Metanalysis

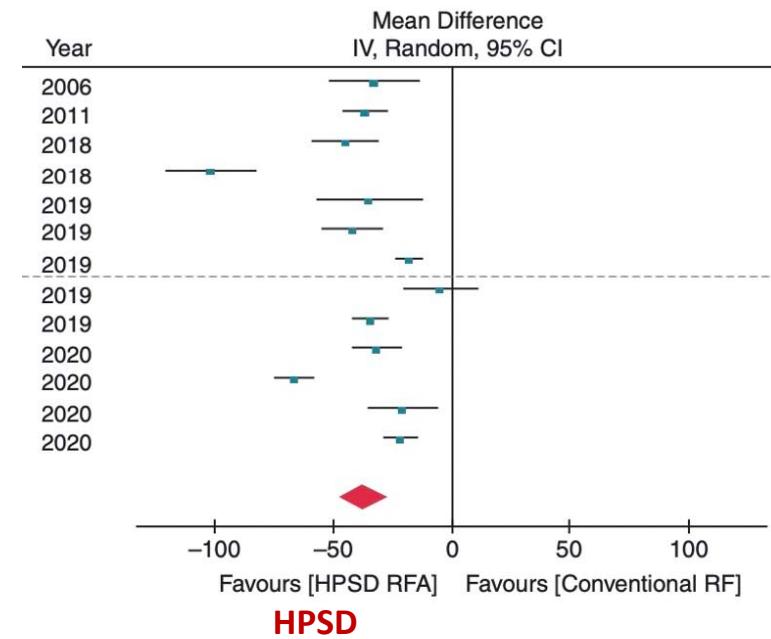
### Freedom from AF



### Acute PV reconnections



### Procedure duration



## Risk of esophageal injury?

Ravi V et al. Europace 2021

# *High RF POWER for FASTER and Safer PV Ablation*

## **The POWER FAST III Trial**

*(Preliminary results)*



S. Castrejón<sup>1</sup>, M. Martínez-Cossiani<sup>1</sup>, N. Basterra<sup>2</sup>, J. Romero<sup>2</sup>, JL. Ibáñez<sup>3</sup>, J. Osca<sup>4</sup>, I. Roca<sup>5</sup>, A. Moya<sup>6</sup>, A. Quesada<sup>7</sup>, VM. Hidalgo<sup>8</sup>, N. Pérez<sup>9</sup>, JM. Fernández<sup>10</sup>, B. Bochard<sup>11</sup>, R. Macías, M. Jáuregui<sup>1</sup>, C. Escobar<sup>1</sup>, JL. Merino<sup>1</sup>

**on behalf of the POWER FAST III investigators**

*(1) La Paz U. Hospital, Madrid, (2) Navarra U. Hospital, Pamplona, (3) Alicante U. Hospital, Alicante, (4) La Fe U. Hospital, Valencia, (5) Clinic Hospital, Barcelona, (6) Dexeus U. Hospital, Barcelona, (7) General U. Hospital, Valencia, (8) Albacete U. Hospital, Albacete, (9) San Carlos U. Hospital, Madrid, (10) Juan Ramon Jimenez U. Hospital, Huelva, (11) Ribera U. Hospital, Alzira, (12) Virgen de las Nieves U. Hospital, Granada. **SPAIN.***

# Objectives

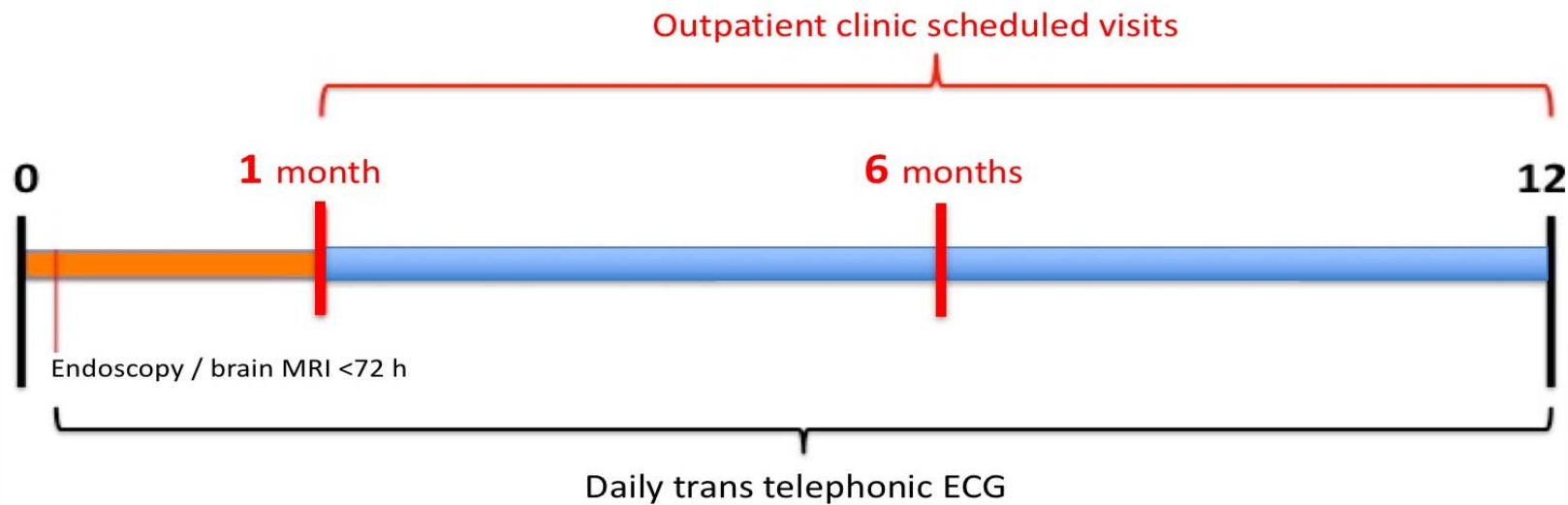
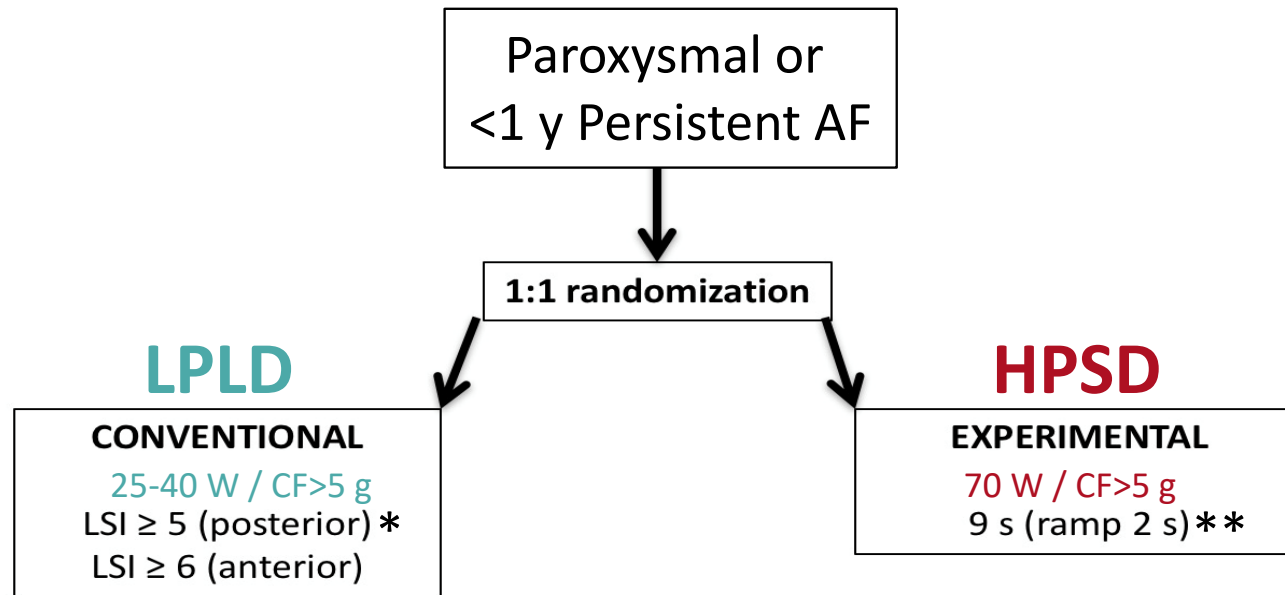
- **To compare the safety (esophageal) and efficacy of 2 modes of RF application for PVI in patients with paroxysmal or persistent AF:**
  - ✓ High-power short duration (HPSD): 70 W for 9-10 s vs
  - ✓ Conventional lower-power long duration (LPLD): 25-40 W guided by ablation lesion indexes (LSI or AI)
- **Irrigated tip catheters equipped with contact force sensors**

# Multicentre randomised trial



1. *La Paz U. Hospital, Madrid*
2. *Navarra U. Hospital, Pamplona*
3. *Alicante U. Hospital, Alicante*
4. *La Fe U. Hospital, Valencia*
5. *Clinic Hospital, Barcelona*
6. *Dexeus U. Hospital, Barcelona*
7. *General U. Hospital, Valencia,*
8. *Albacete U. Hospital, Albacete*
9. *San Carlos U. Hospital, Madrid*
10. *Juan Ramon Jimenez U. Hospital, Huelva*
11. *Ribera U. Hospital, Alzira*
12. *Virgen de las Nieves U. Hospital, Granada*



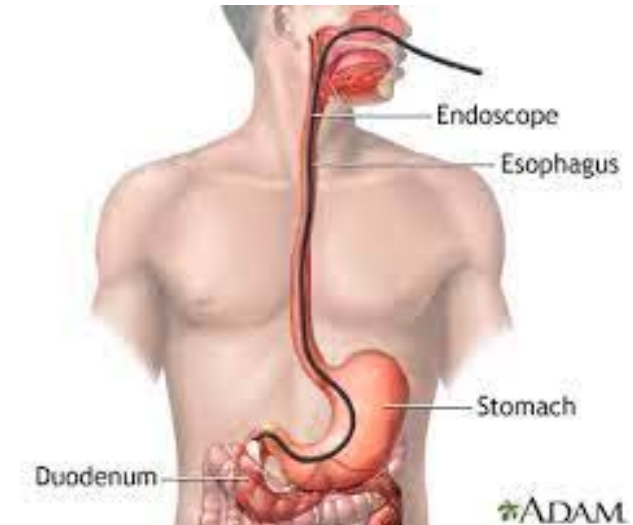


\*Ablation Index I ≥400 (posterior) & ≥500 (anterior) and \*\*10 s (ramp 3 s) if Biosense RF generator

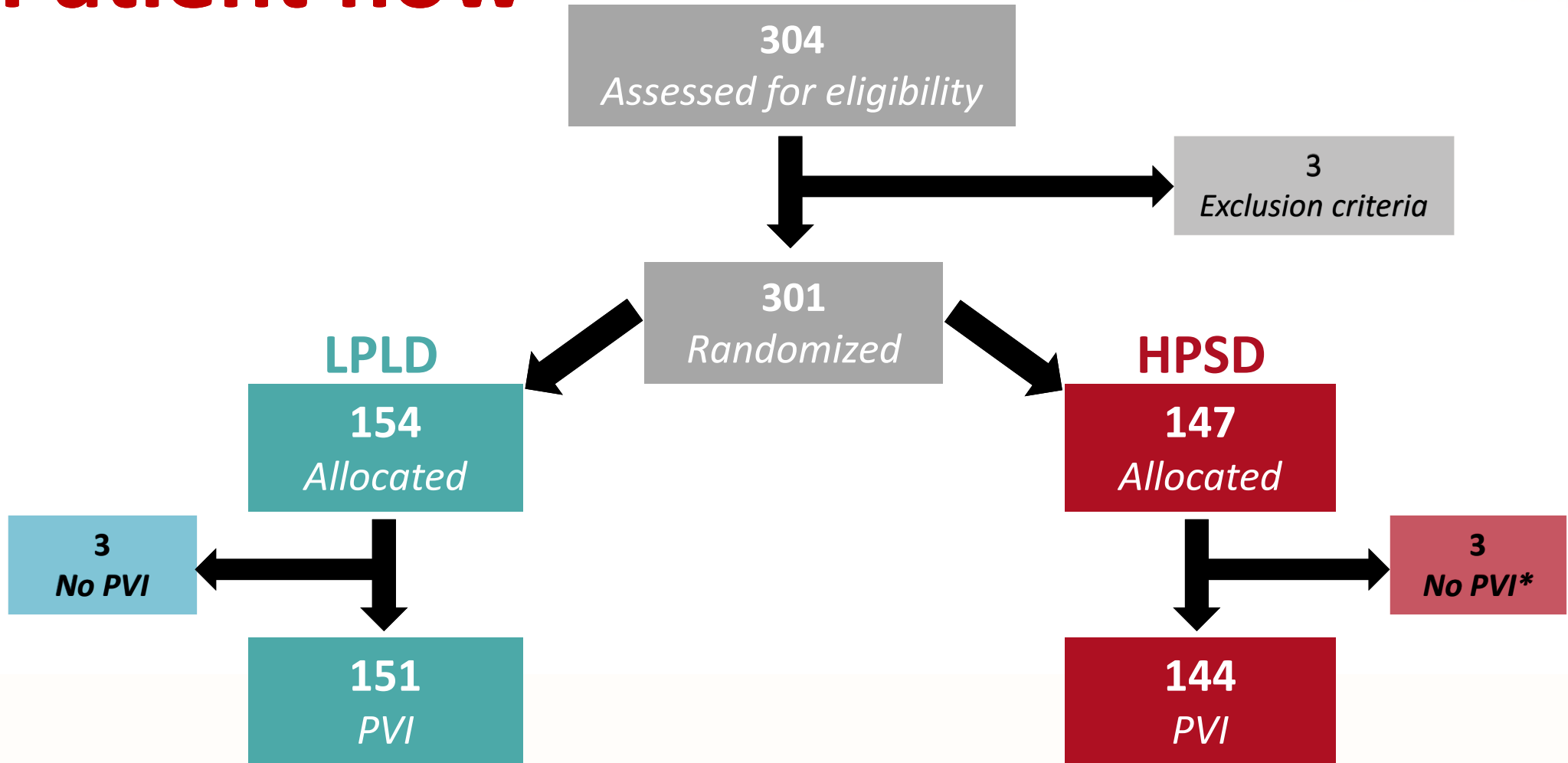
# Follow-up

- 1. Esophageal lesions were detected by upper digestive tract endoscopy systematically performed in the postablation 24 hs (<72 hs).**
- 2. Patients were closely followed for 1 year:**
  1. Scheduled clinical visits
  2. On-demand clinical visits
  3. Daily transtelephonic ECG monitoring and in case of symptoms

PWFA<sub>III</sub>

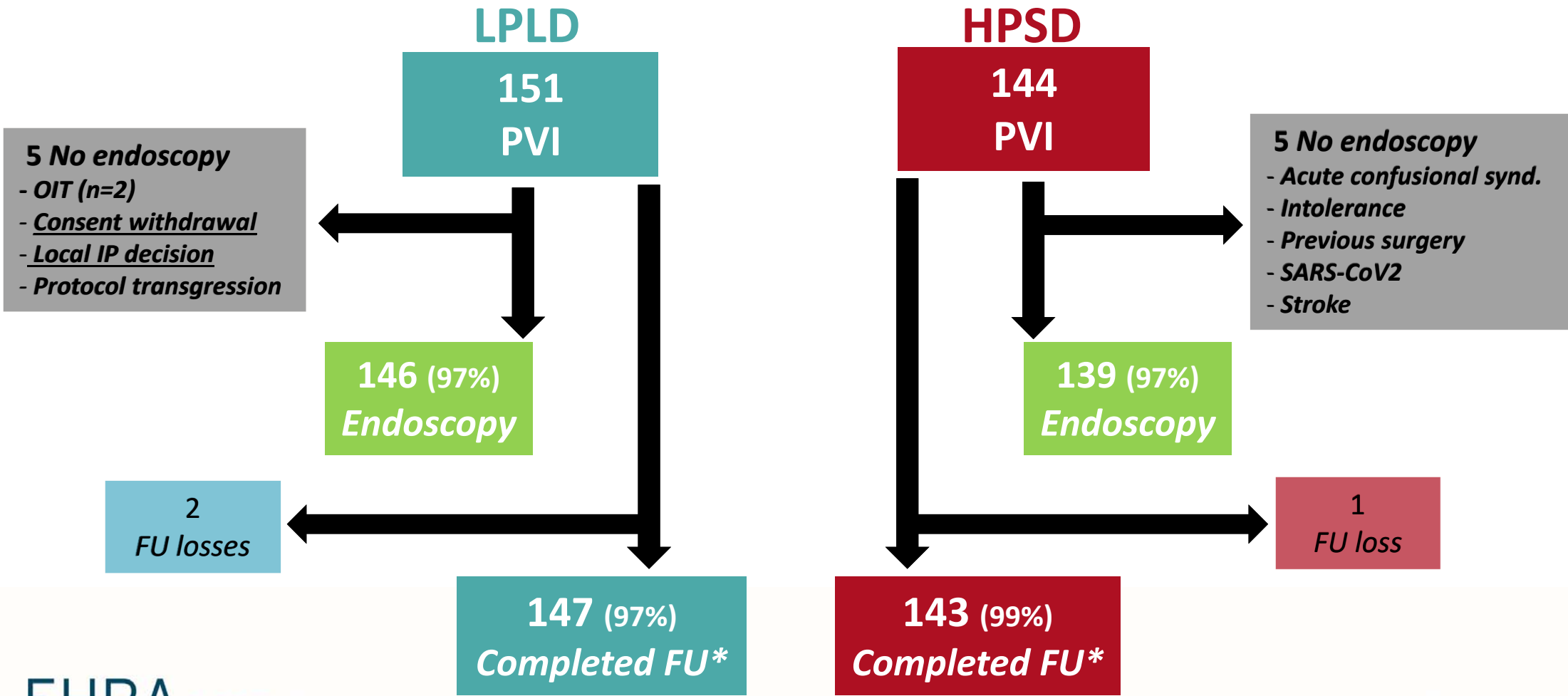


# Patient flow



\* 1 transgression of the protocol

# Patient flow



# Baseline characteristics (I)

Variable (median [IQR])	LPLD n = 151	HPSD n = 144	p
Age (years)	60 [53-68]	61 [54-69]	0.39
Sex (male)	116 (76.8%)	97 (67.4%)	0.09
Weight (Kg)	83 [74-90]	83 [72-93]	0.92
Height (cm)	173 [166-180]	172 [163-177]	0.12
BMI	27.5 [24.8-30.6]	27.8 [25.5-31.2]	0.26
Hypertension	72 ( 67.9%)	73 ( 71.6%)	0.67
Diabetes	17 ( 16%)	14 ( 13.7%)	0.79
Heart Failure	23 ( 21.7%)	15 ( 14.7%)	0.26
Coronary Artery Disease	9 ( 9.7%)	7 ( 8.0%)	0.88
Myocardial Infarction	7 ( 6.6%)	5 ( 4.9%)	0.82
Mitral Valve Disease (≥ moderate)	4 ( 3.8%)	3 ( 2.9%)	1.00
Aortic Valve Disease (≥ moderate)	2 ( 1.9%)	3 ( 2.9%)	0.97
Cardiomyopathy	9 ( 8.5%)	8 ( 7.8%)	1.00
Chronic Obstructive Pulmonary Disease	4 ( 3.8%)	4 ( 3.9%)	1.00
Sleep apnea (severe)	16 ( 15.1%)	15 ( 14.7%)	1.00
Renal failure	6 ( 5.7%)	5 ( 4.9%)	1.00
Stroke	8 ( 7.5%)	10 ( 9.8%)	0.74

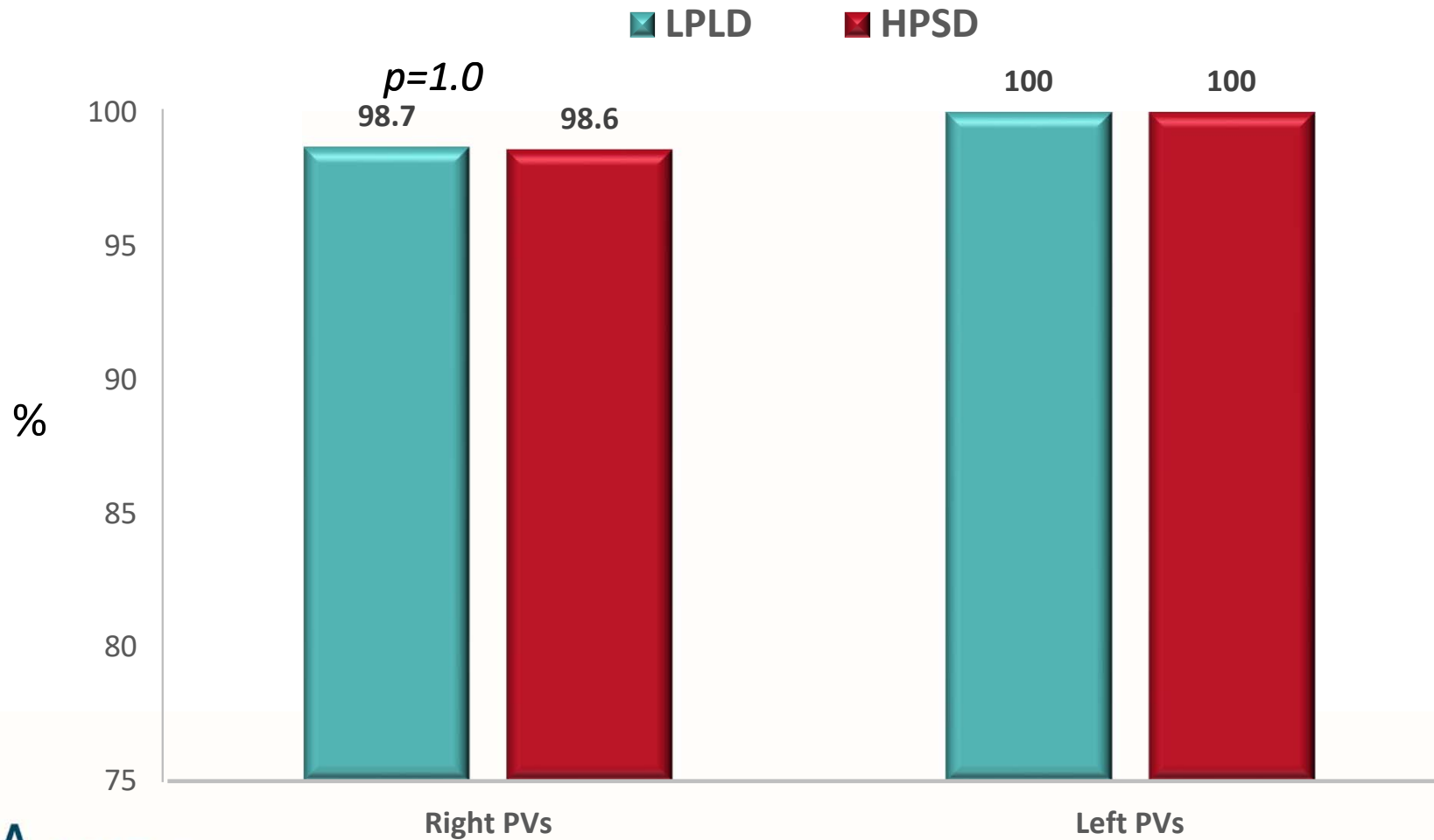
E

# Baseline characteristics (II)

Variable (median [IQR])	LPLD n= 151	HPSD n = 144	p
Paroxysmal AF	98 (64.9%)	91 (63.2%)	0.85
Persistent AF	53 (35.1%)	53 (36.8%)	
Prior AAD therapy	137 (90.7%)	126 (87.5%)	0.48
Tachycardiomyopathy	24 (15.9%)	26 (18.1%)	0.73
LVEF	60% [57-65]	60% [55-65]	0.45

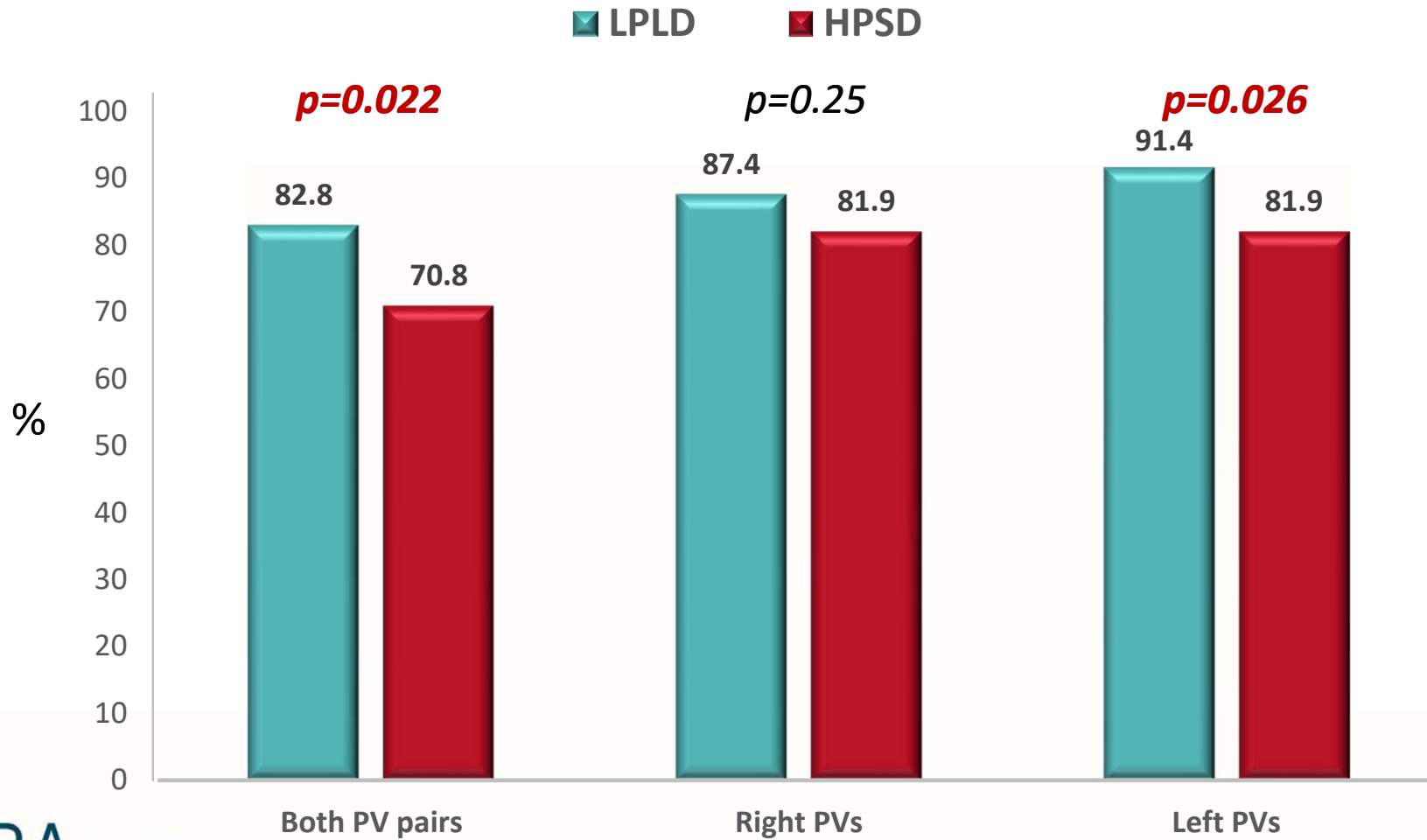
# Results

# Successful PVI

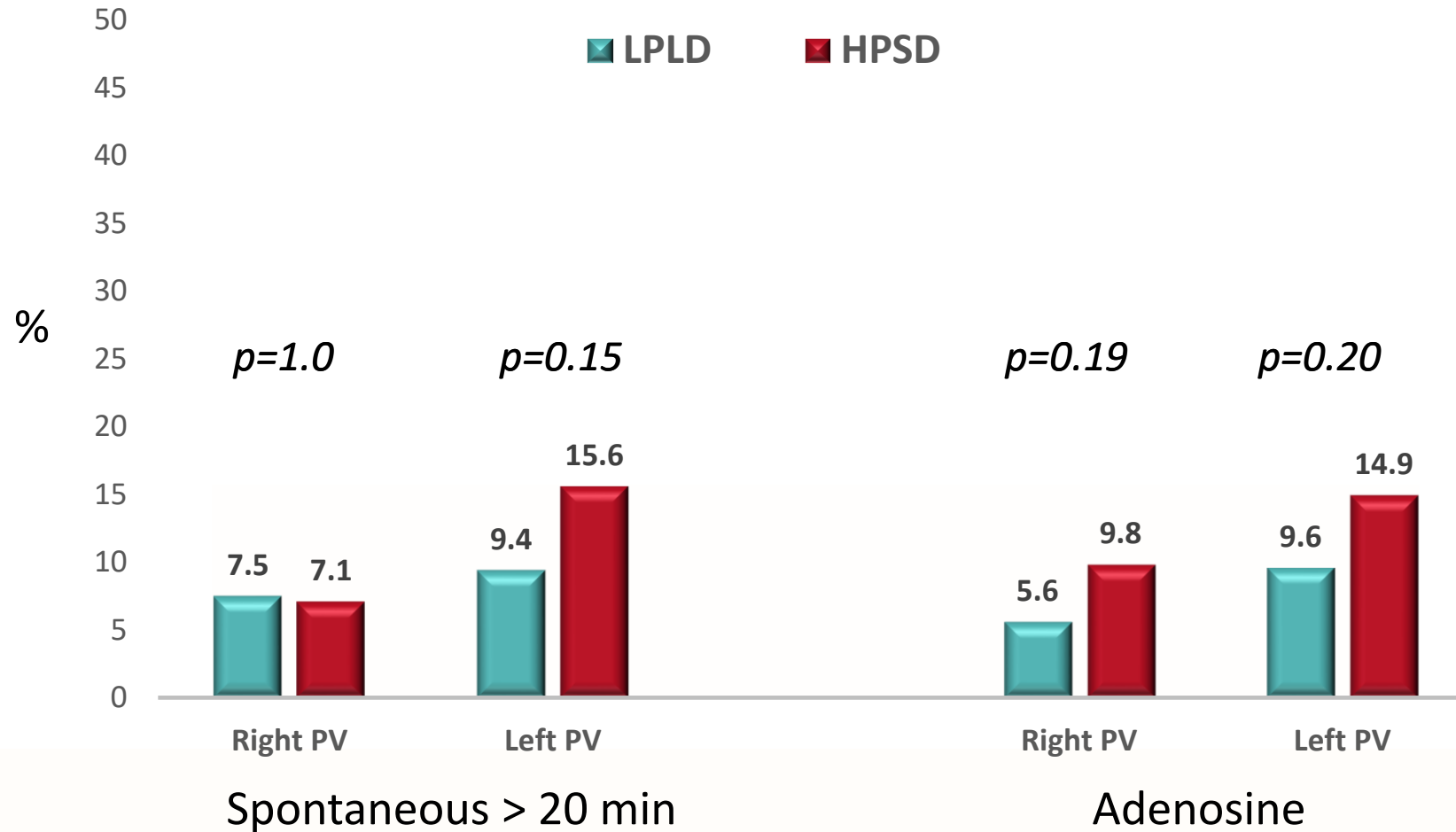




# First pass PVI



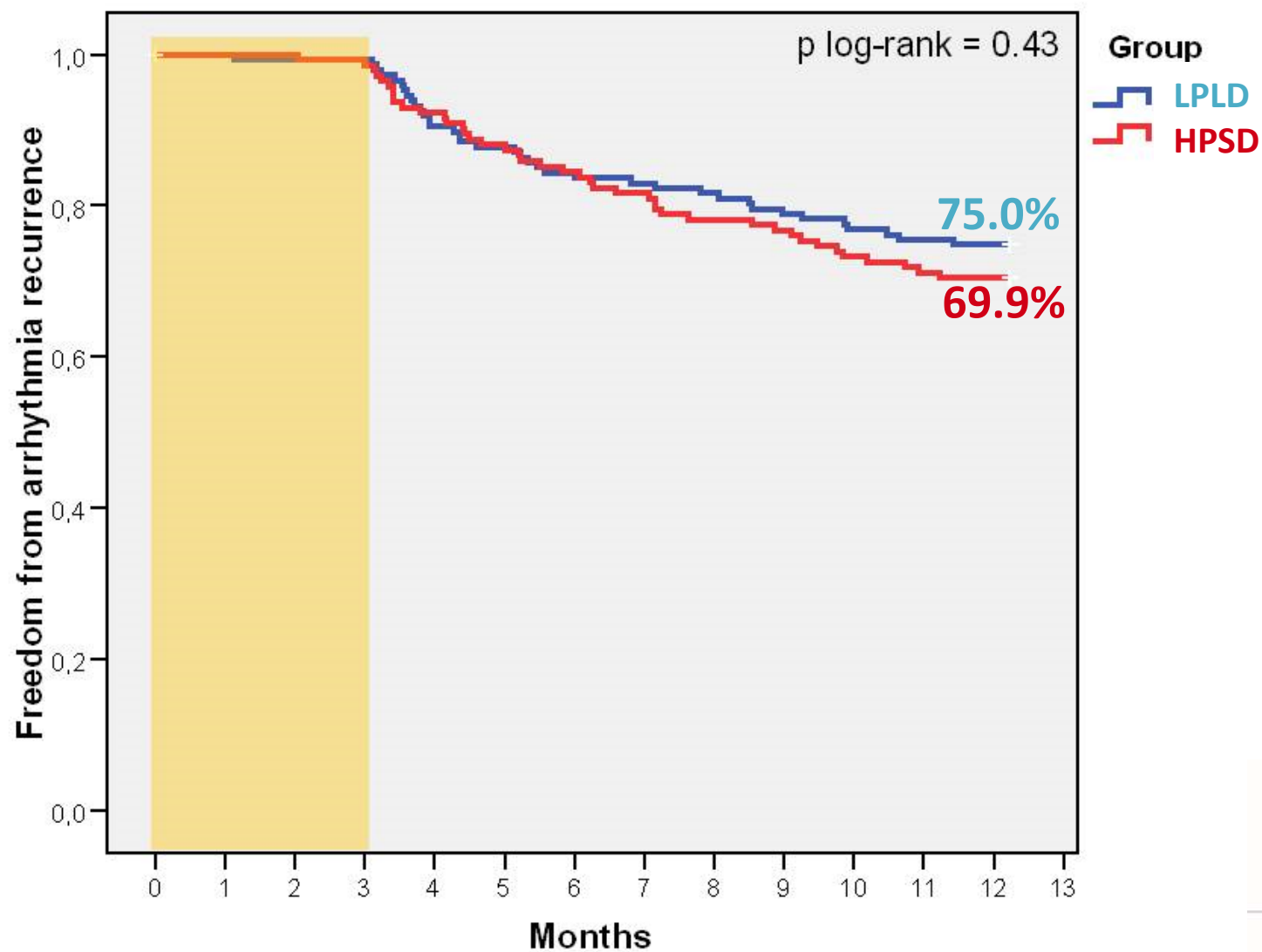
# Acute PV reconnections



# Procedure times

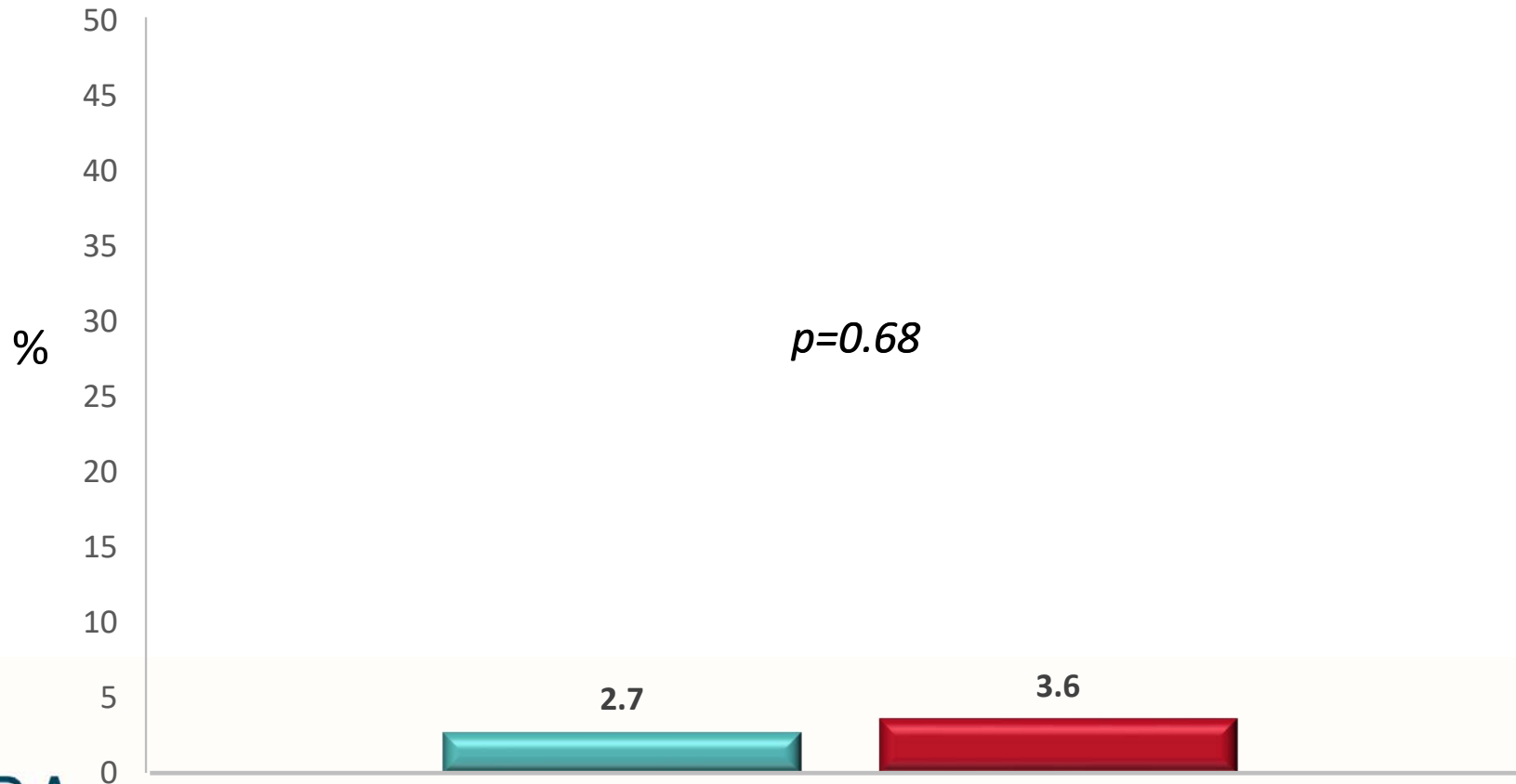
Time (min, median [IQR])	LPLD n= 151	HPSD n = 144	P
Total procedural	193 [147-248]	185 [135 -252]	0.37
LA dwell	151 [111- 194]	142 [98-189]	0.18
Fluoroscopy	9.3 [3-25]	6.9 [3.1-22.7]	0.59
RF to final PVI	31.9 [25.5- 44.3]	11.8 [9.13-14.2]	<0.001

# Freedom from arrhythmia recurrences at FU



# Esophageal thermal lesions

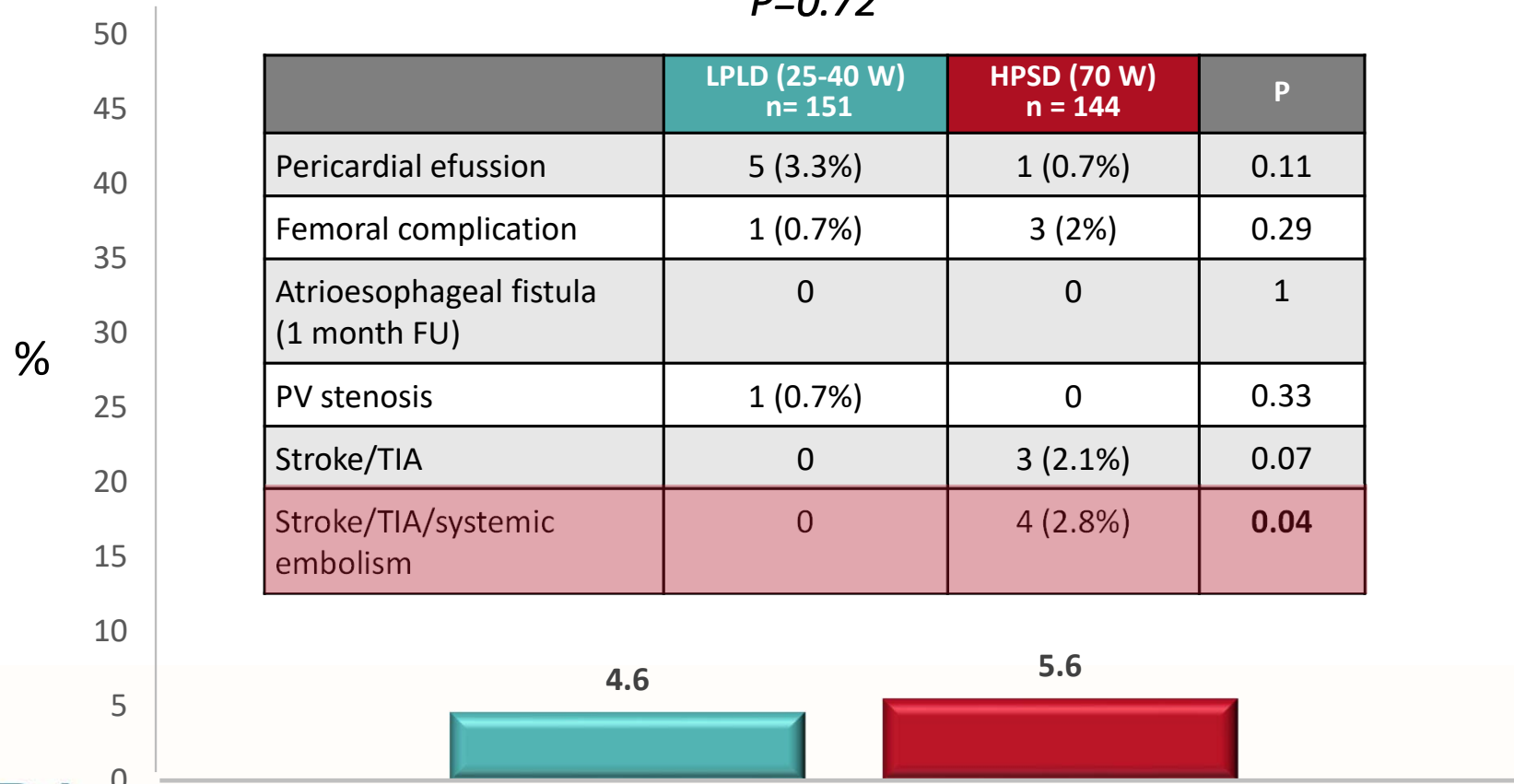
■ LPLD ■ HPSD



# Complications

▣ LPLD      ▣ HPSD

*P=0.72*



*Subclinical stroke and cerebral bleeds  
following HPSD RF application for AF ablation*

**PWFA<sub>III</sub>**  
**SUBSTROKE**

# **An MRI substudy of the POWERFAST III Trial**

## ***SUBSTROKE***

JL. Merino, S. Castrejon, M. Martinez-Cossiani, C. Utrilla, B. Marin Aguilera, A.F. Prieto, P. Garcia-Raya, M. Jauregui, C. Escobar, L. Guido, A. Carton, ME. Martinez-Maldonado, D. Merino.

La Paz U. Hospital, Madrid, SPAIN **on behalf of the POWER FAST III investigators**

# Background

- Diffusion-weighted MRI (DWI) → new ischaemic lesions in some patients undergoing catheter ablations.
- A high incidence in some new techniques & catheters.
- Thus, DWI can be used as a surrogate for systemic embolism.



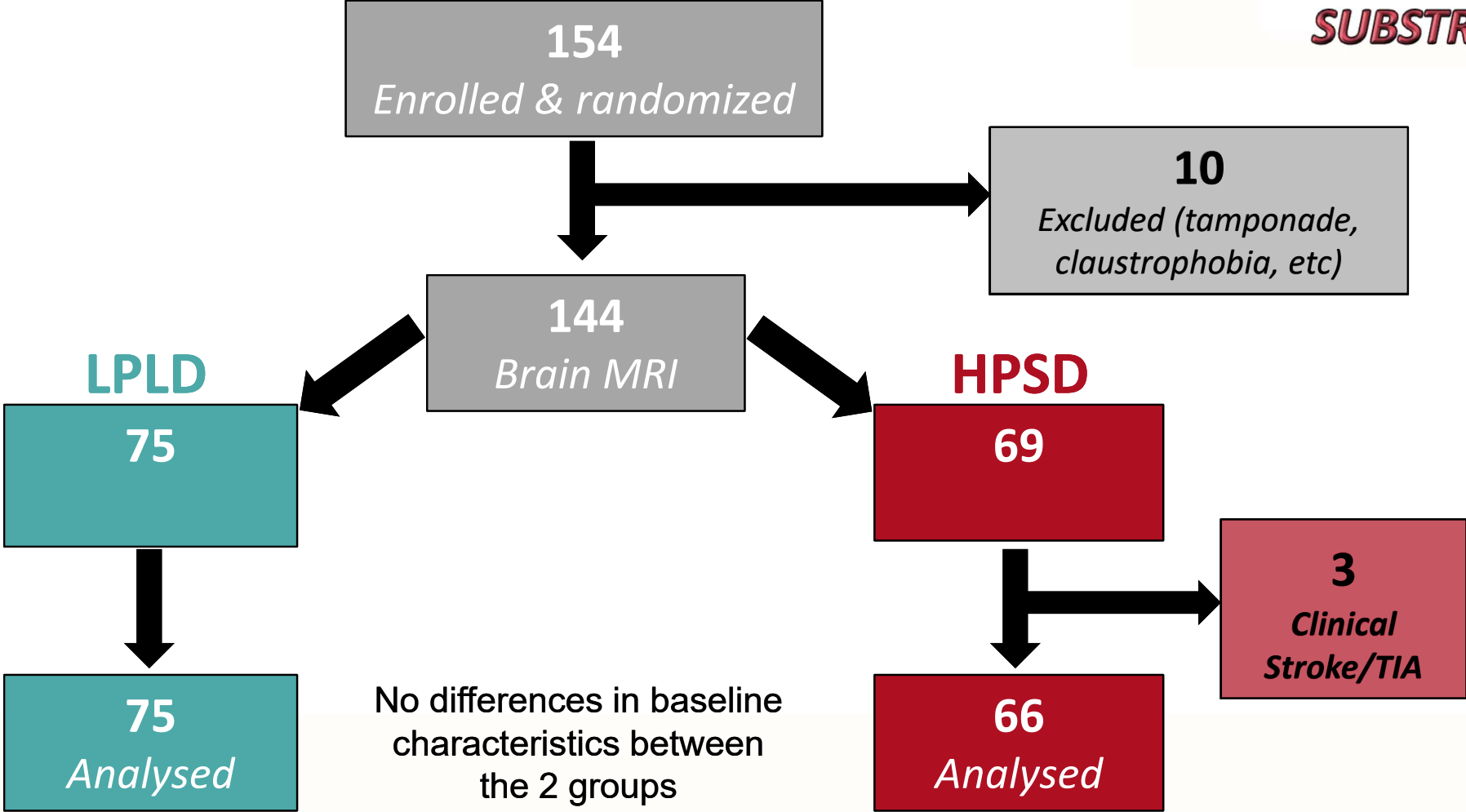
# Purpose

- To compare the rate of procedural subclinical cerebral complications (strokes and bleeds)
- Patients randomized to HPSD vs conventional RF application for PVI in the POWERFAST III trial.

# Methods

- **Cerebral MRI substudy:**
  - ✓ DWI
  - ✓ Flair
  - ✓ <24 hours after the procedure
- **Left at the discretion of each centre (randomization stratified per centre)**
- **All procedures were done under:**
  - ✓ Uninterrupted oral anticoagulation
  - ✓ Heparin infusion for a 350 s ACT target

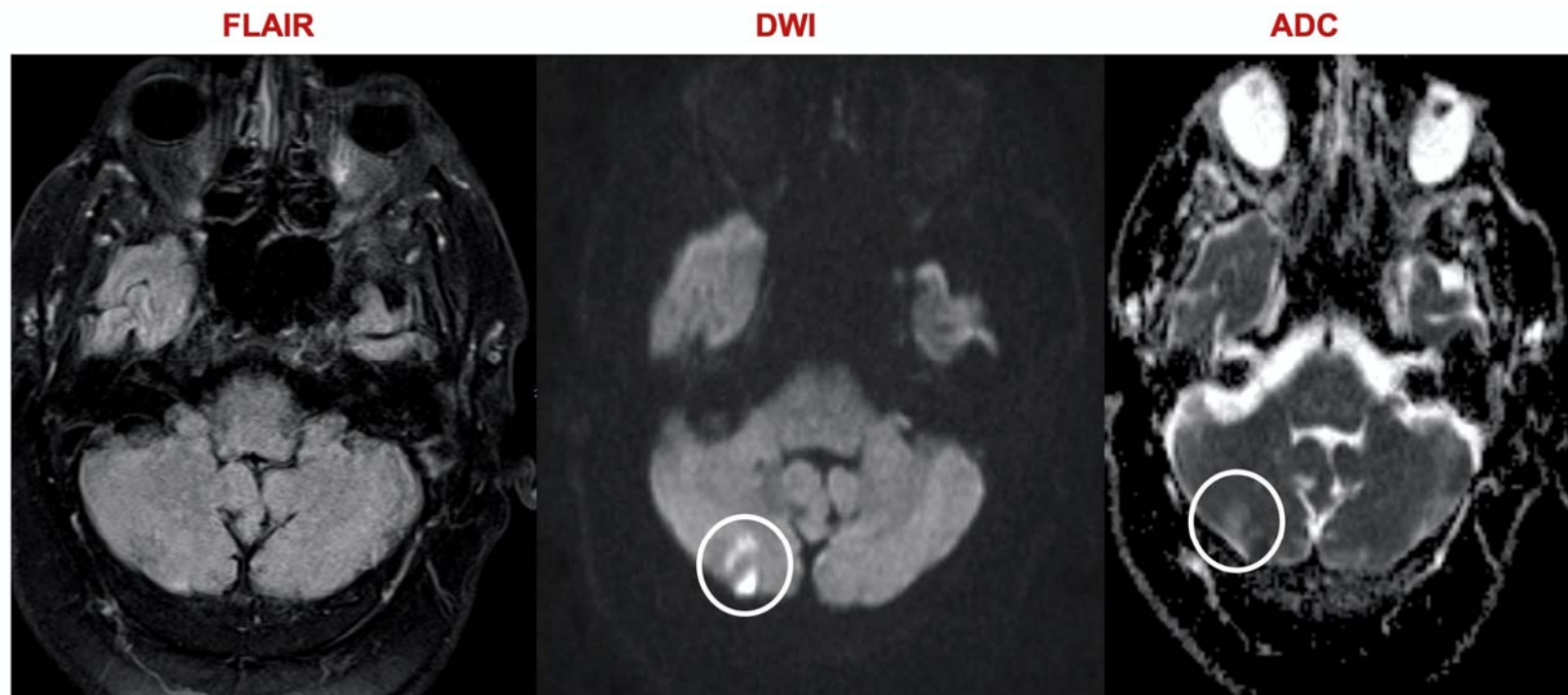
# Patient flow



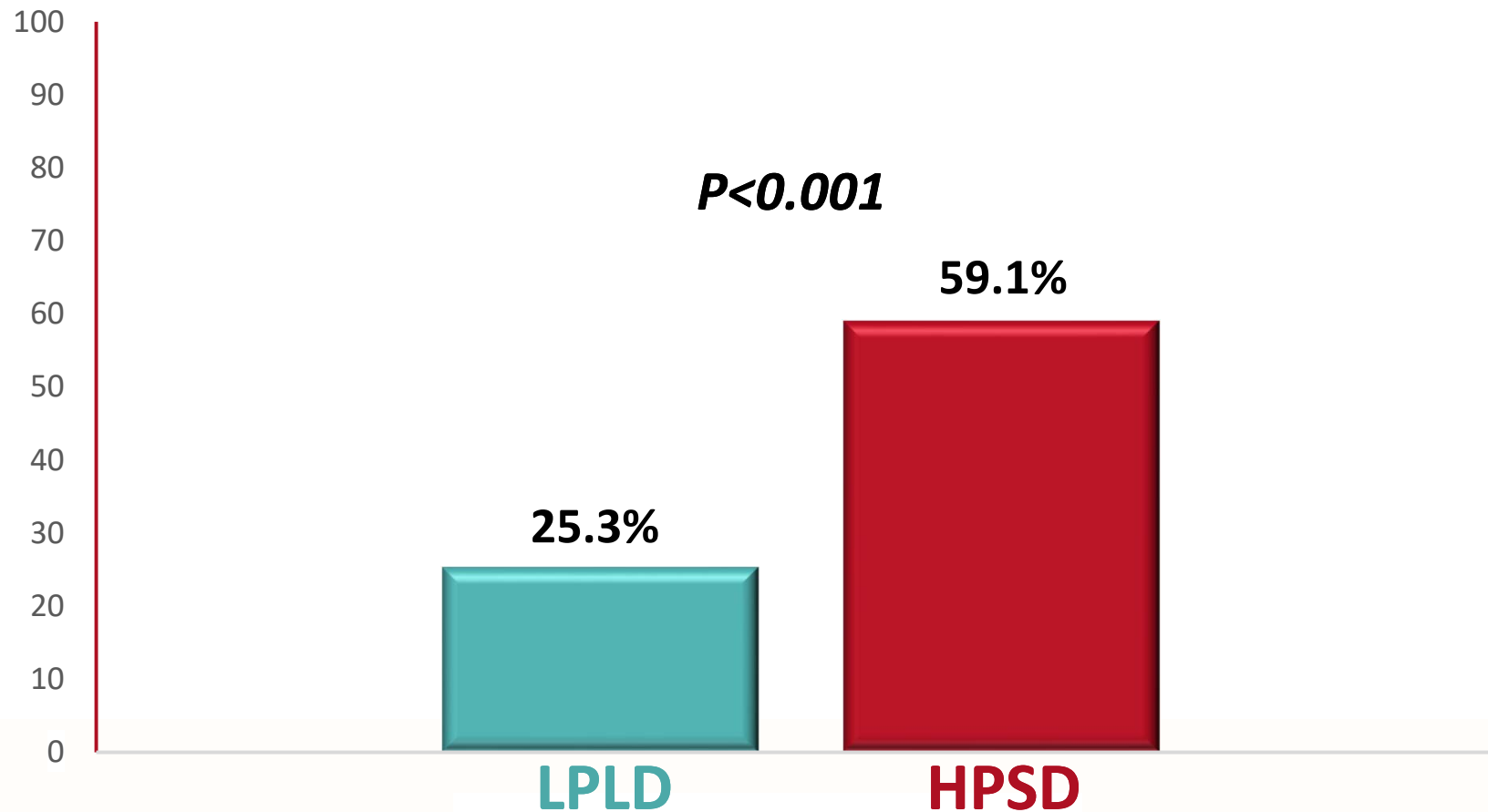
# Results

Subclinical ischemic brain lesions (DWI+, low ADC value, no haemorrhagic):

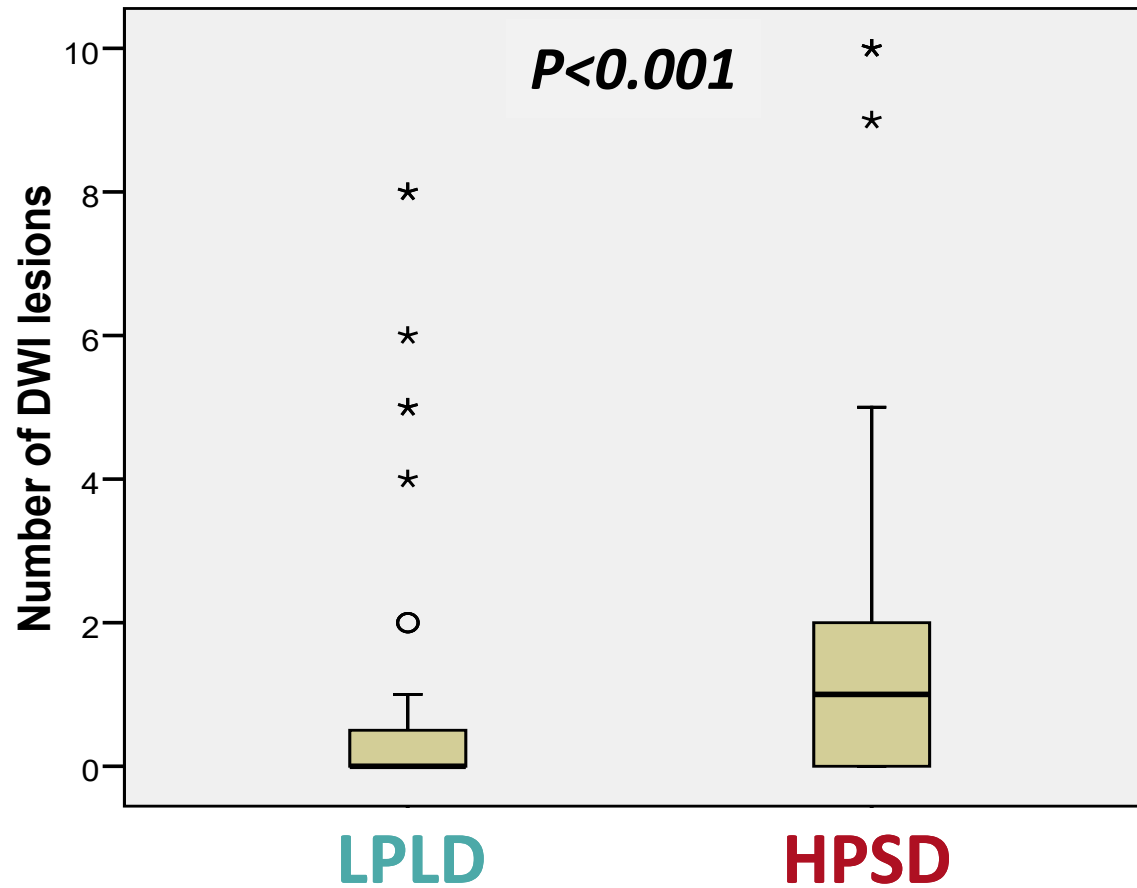
**58 patients (41.1%)**



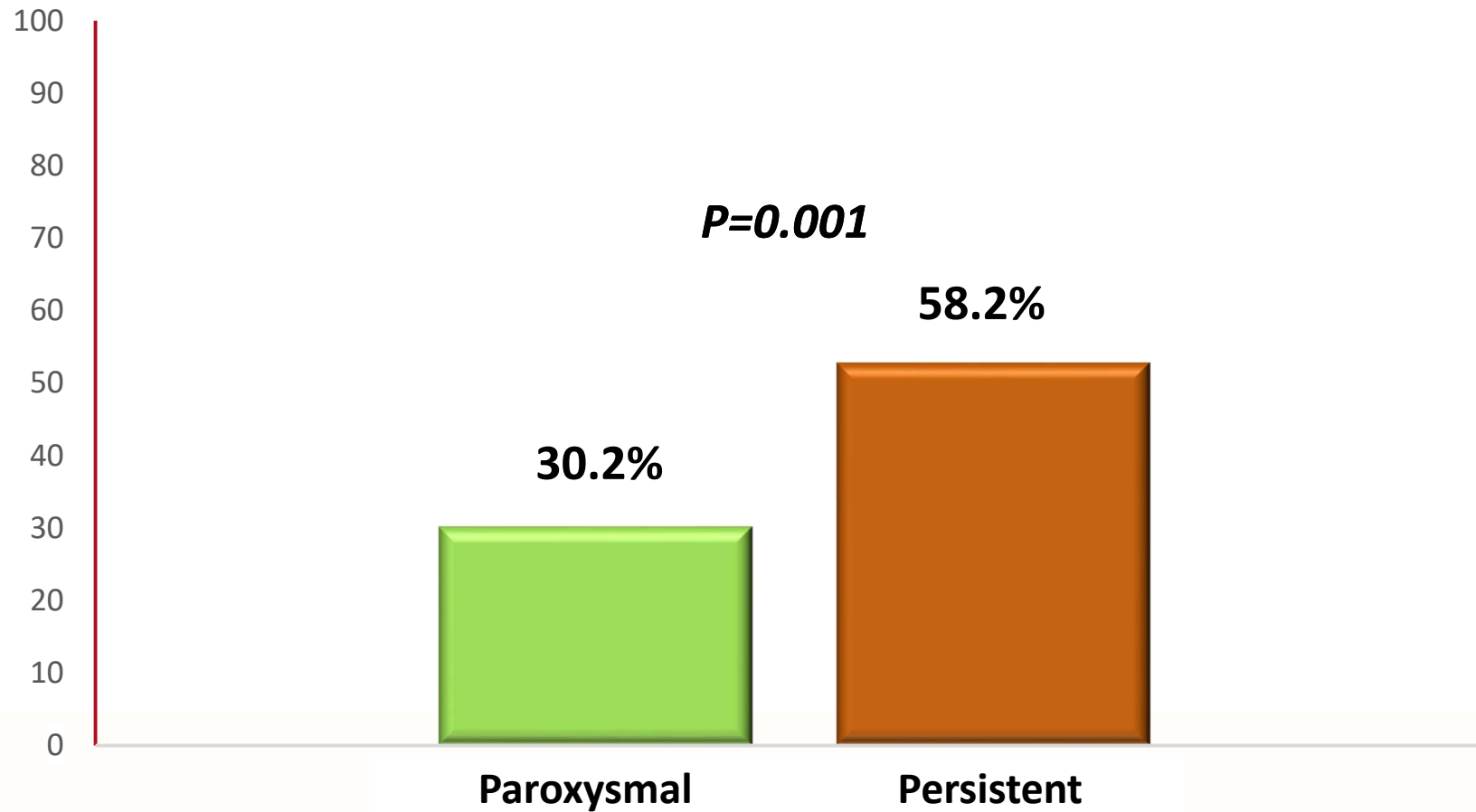
# Brain ischemic lesions (DWI)



# Number of lesions (DWI)



# Brain Ischemic Lesions by type of AF



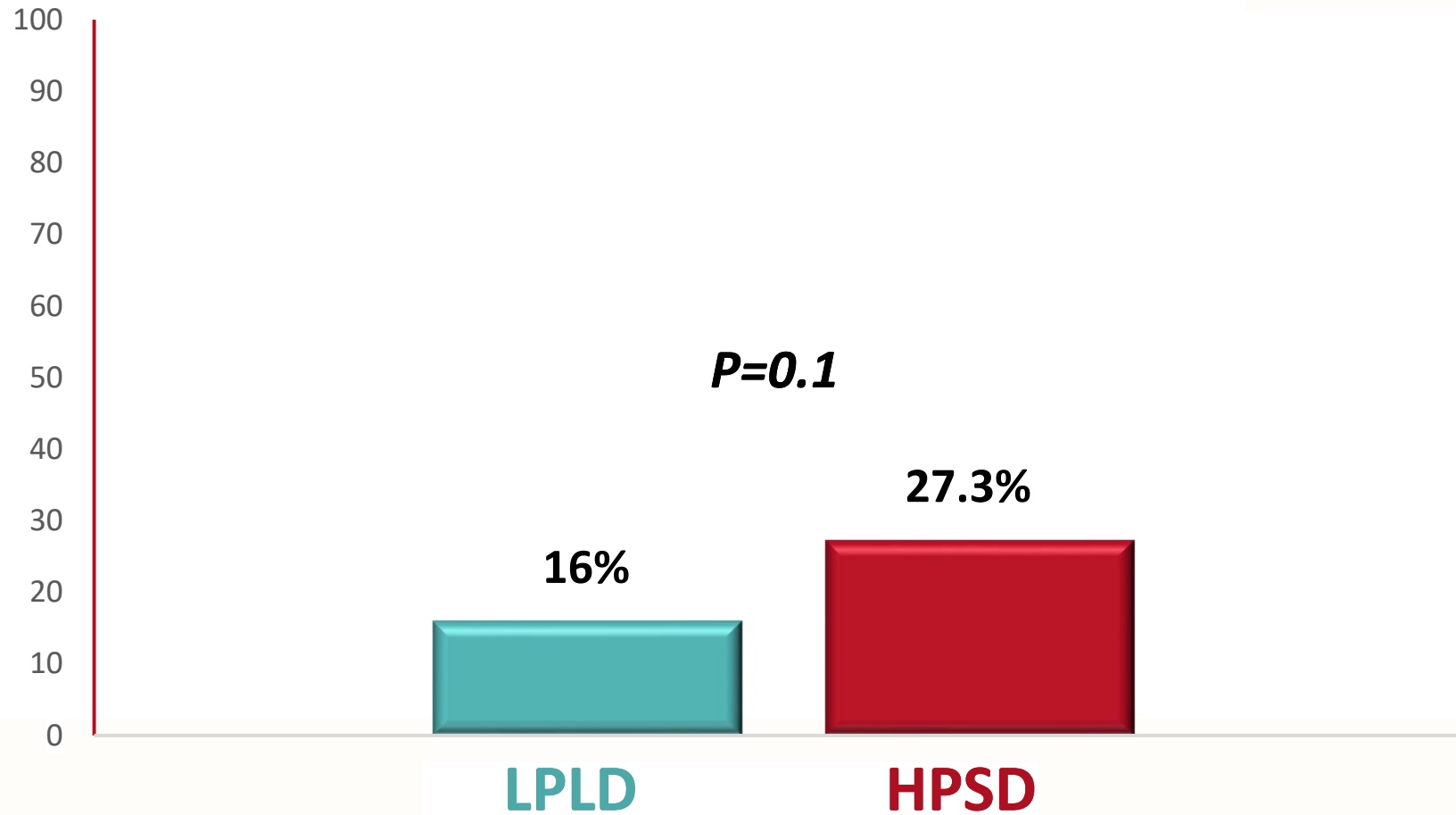
# Predictors of DWI lesions

	<b>OR</b>	<b>95% CI</b>	<b>P</b>
<b>HPSD</b>	4.9	2.3 – 10.6	<b>&lt;0.001</b>
<b>Persistent AF</b>	3.8	1.8 - 8.3	<b>0.001</b>

Logistic regression



# Microbleeds



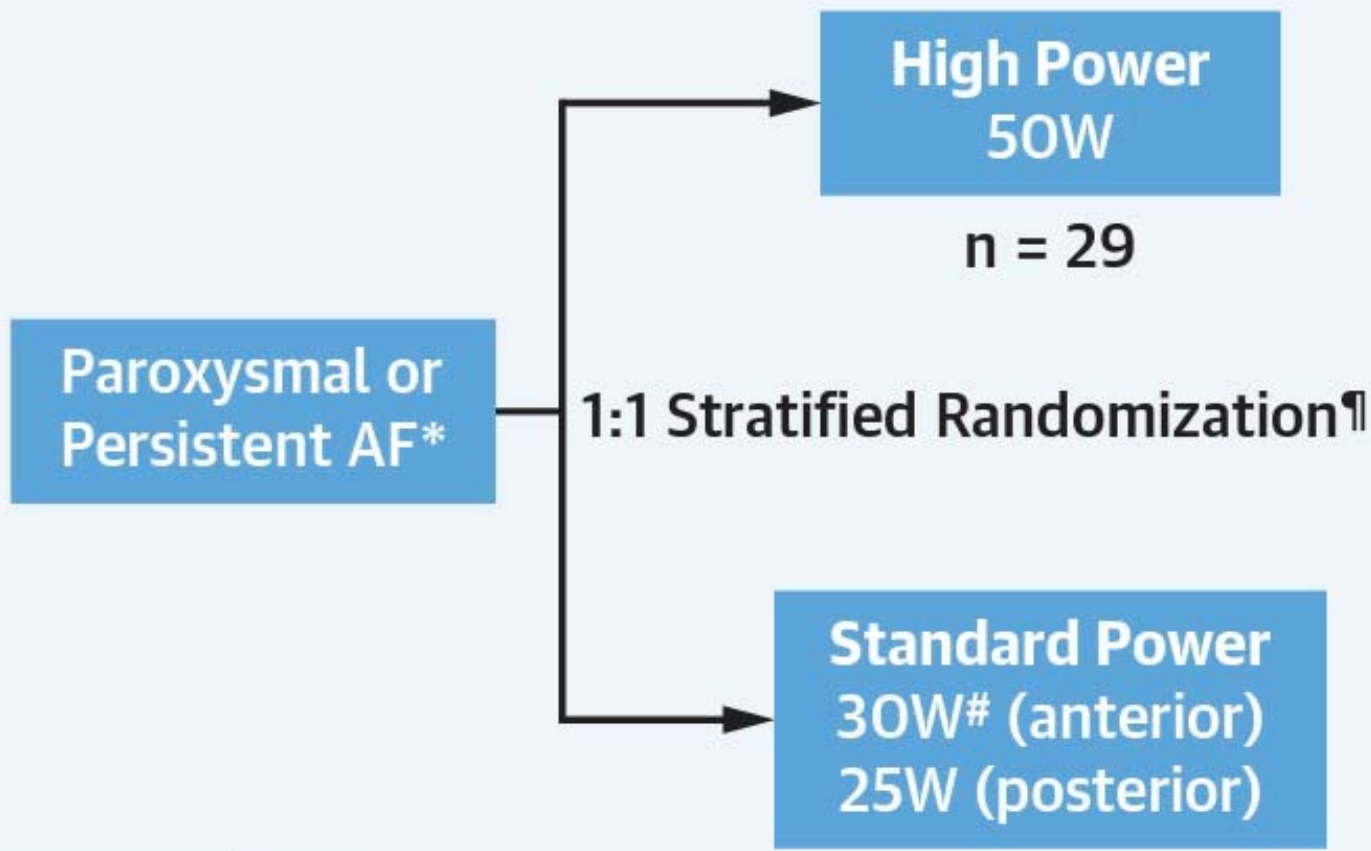
**ORIGINAL RESEARCH PAPER**

# A Randomized Trial of High vs Standard Power Radiofrequency Ablation for Pulmonary Vein Isolation

## SHORT-AF

Adam C. Lee, MBBS, MMED (CLIN EPI),<sup>a,\*</sup> Alex Voskoboinik, MBBS, PhD,<sup>a,b,\*</sup> Christopher C. Cheung, MD, MPH,<sup>a</sup> Sarah Yogi, BS,<sup>a</sup> Zian H. Tseng, MD, MAS,<sup>a</sup> Joshua D. Moss, MD,<sup>a</sup> Thomas A. Dewland, MD,<sup>a</sup> Byron K. Lee, MD,<sup>a</sup> Randall J. Lee, MD, PhD,<sup>a</sup> Henry H. Hsia, MD,<sup>a</sup> Gregory M. Marcus, MD, MAS,<sup>a</sup> Vasanth Vedantham, MD, PhD,<sup>a</sup> David Chieng, MBBS,<sup>b</sup> Peter M. Kistler, MBBS, PhD,<sup>b</sup> William Dillon, MD,<sup>c</sup> Eric Vittinghoff, PhD,<sup>d</sup> Edward P. Gerstenfeld, MD<sup>a</sup>





\* <1 year persistent

¶ Randomization stratified by attending

# Uptitrating to 35W was permitted at operator discretion

## Greater Freedom from Recurrent Atrial Arrhythmias (at 12 months)

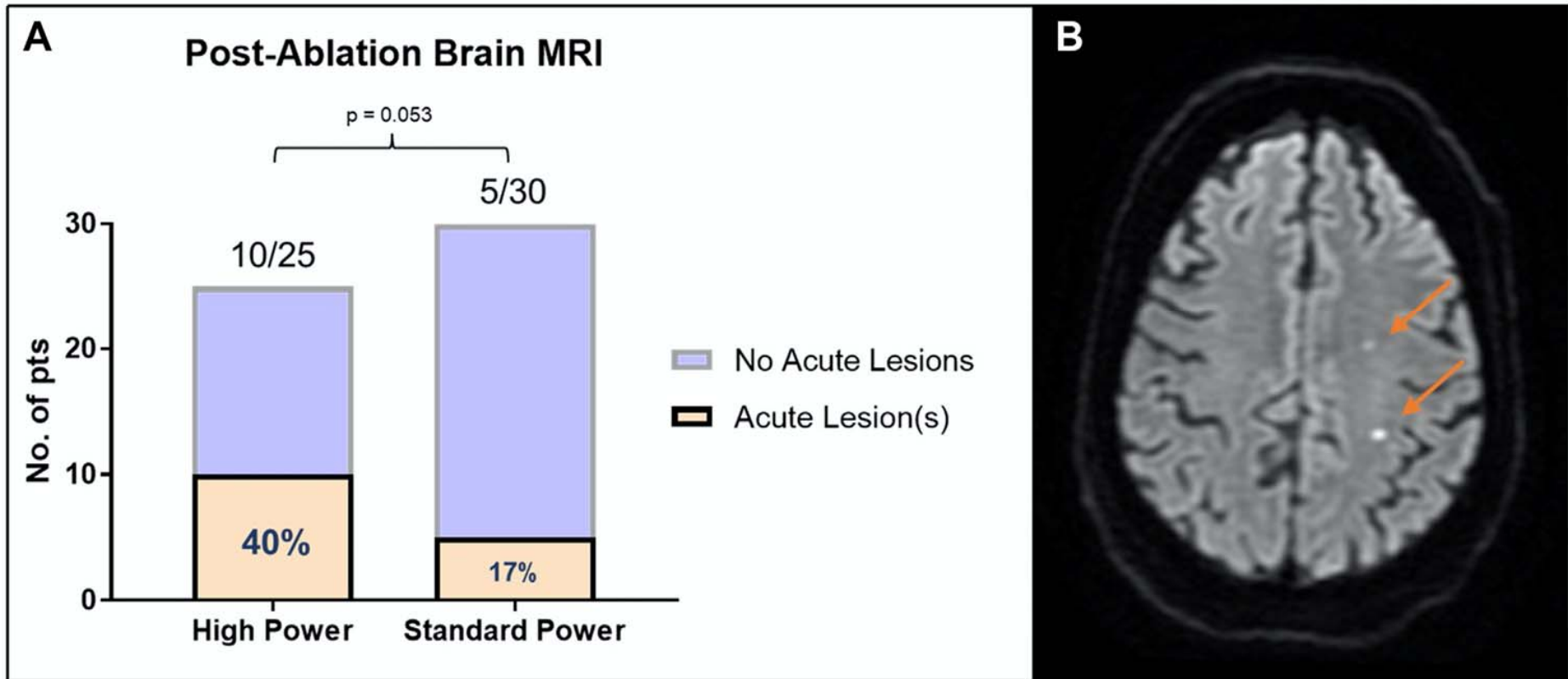
**HR 0.26**

**$P = 0.027$**

**HR - Hazard Ratio**



**FIGURE 5** Asymptomatic Cerebral Emboli





**ESC**

European Society  
of Cardiology

Europace (2022) **24**, 400–405

doi:10.1093/europace/euab261

**CLINICAL RESEARCH**

*Ablation for atrial fibrillation*

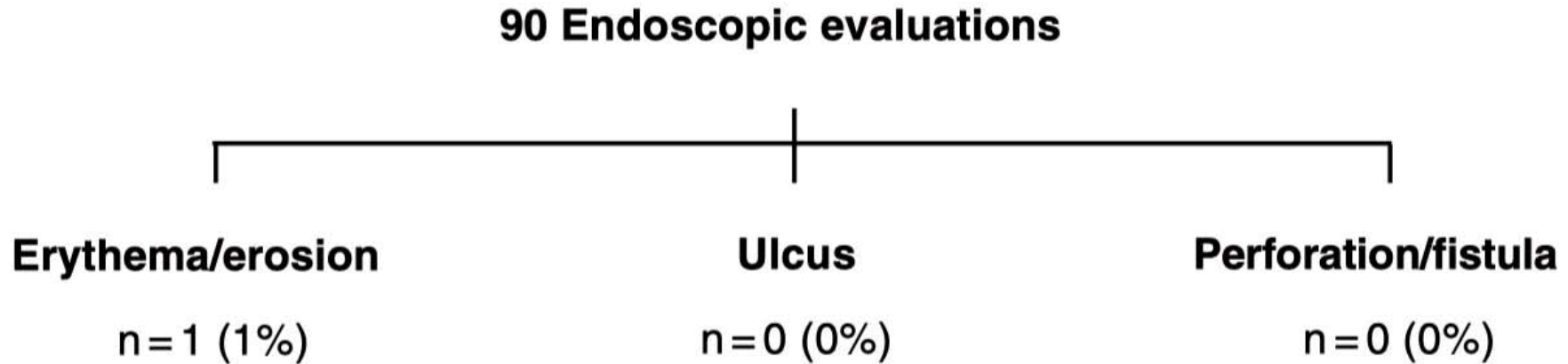
# Safety of very high-power short-duration radiofrequency ablation for pulmonary vein isolation: a two-centre report with emphasis on silent oesophageal injury

Philipp Halbfass <sup>1\*</sup>†, Jean-Yves Wielandts <sup>2†</sup>, Sébastien Knecht<sup>2</sup>,  
Jean-Benoît Le Polain de Waroux <sup>2</sup>, René Tavernier <sup>2</sup>, Vincent De Wilde<sup>3</sup>,  
Kai Sonne <sup>1</sup>, Karin Nentwich <sup>1</sup>, Elena Ene <sup>1</sup>, Artur Berkovitz <sup>1</sup>,  
Julian Mueller<sup>1</sup>, Lukas Lehmkuhl <sup>4</sup>, Amelie Reichart<sup>5</sup>, Ulrich Lüsebrink <sup>5</sup>,  
Mattias Duytschaever<sup>2</sup>, and Thomas Deneke <sup>1</sup>

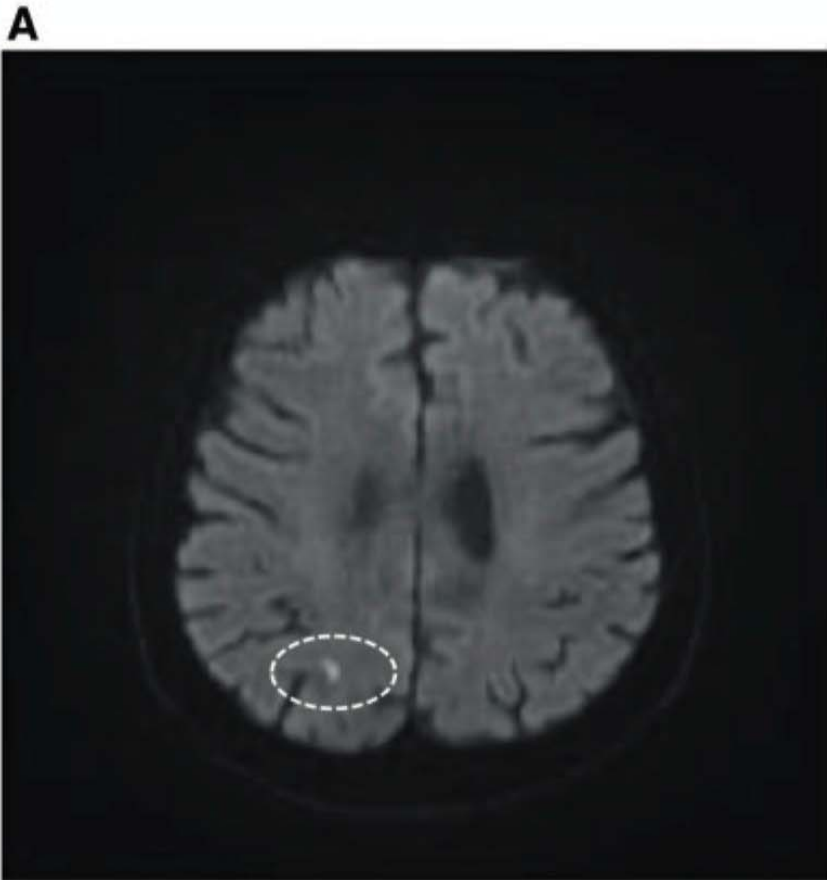


**KHRS 2023**

# Esophageal safety



# Stroke safety



Subclinical stroke in 2 out of 4 (50%)



# Conclusions (1)

## **1. HPSD RF application results in efficacy:**

1. Lower first-pass isolation than conventional LPLD RF application.
2. Atrial arrhythmias recurrence rates are lower (non-randomized or small trials) or similar between the two.

## **2. Safety:**

1. Similar for esophageal thermal lesions and pericardial effusions
2. Significantly more thromboembolic complications

## **3. This latter finding is a concern and needs to be supported by further investigation.**

# Conclusions (2)

1. HPSD RF application is associated with a **substantial and of subclinical stroke lesions** (*2 randomized studies*)
2. **Higher risk than conventional RF** application in AF patients (*2 randomized studies*).
3. The risk of **subclinical cerebral bleeds appears similar** between the 2 modes of RF appl.

# Thank you!!



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