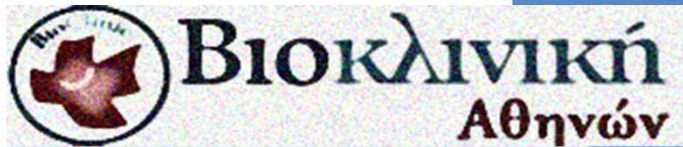




# “Κατάλυση για την κοιλιακή μαρμαρυγή: ΟΧΙ στους περισσότερους ασθενείς”



Παναγιώτης Ιωαννίδης  
Διευθυντής Τμ. Καρδιακής  
Ηλεκτροφυσιολογίας & Βηματοδότησης,  
Βιοκλινική Αθηνών, Όμιλος Βιοϊατρική



Σεμινάριο Βηματοδοτών Ηλεκτροφυσιολογίας, ΙΓΝΑ  
Αθήνα, 23-11-2019





## AF prevalence and AF ablations in western world

- Estimates suggest an AF prevalence of approximately 3% in adults  $\geq 20$  years

Bjorck S, et al. Stroke 2013;44:3103-3108

Haim M, et al. J Am Heart Assoc 2015;4:e001486.



- 8,700,000 adults  $\rightarrow$  260,000 AF cases
- National registry  $\rightarrow$  942 AF Ablations (2018)
  - Only 0.4% of total AF patients



- 506 AF Ablations/million p. (2016)
  - Only 2% of total AF patients

Βασιλικός Β. και συν. Πανελλήνιο Καρδιολογικό Συνέδριο 2019, Ιωάννινα

Hindricks G et al. The EHRA White Book 2017

Raatikainen et al. Europace 2017;19:ii1-ii90



# The incidence of AF



Study	Study population (n)	Place	Time period	Age (AF patients, years)	Prevalence (%)	Incidence (n/1000 person-years)
Johansson et al 2017 <sup>1</sup>	75,779	Sweden	2011-2012	73.5 (mean)	3.88	4
Wilke et al 2013 <sup>2</sup>	8,298,896	Germany	2007-2008	73.1 (mean)	2.13	4.1
Murphy et al 2007 <sup>3</sup>	362,155	Scotland	2001-2002	75-84 (median)	0.87	0.9
Heeringa et al 2006 <sup>4</sup>	6,808	The Netherlands	1993-2000	75-79 (median)	5.5 (≥55 years)	9.9 (≥55 years)

<sup>1</sup> Johansson et al. *Clinical Epidemiology* 2017;9:53-62

<sup>2</sup> Wilke et al. *Europace* 2013;15:486-493

<sup>3</sup> Murphy et al. *Heart* 2007;93:606-612

<sup>4</sup> Heeringa et al. *Eur Heart J.* 2006;27:949-53



# The incidence of AF



Open Access Full Text Article

ORIGINAL RESEARCH

## Incidence, type of atrial fibrillation and risk factors for stroke: a population-based cohort study

Cecilia Johansson  
Erik Dahlqvist  
Jonas Andersson  
Jan-Håkan Jansson  
Lars Johansson

Department of Public Health and  
Clinical Medicine, Skellefteå Research  
Unit, Umeå University, Umeå,  
Västerbotten, Sweden



The incidence of AF in the entire population was 4.0 per 1,000 person-years.

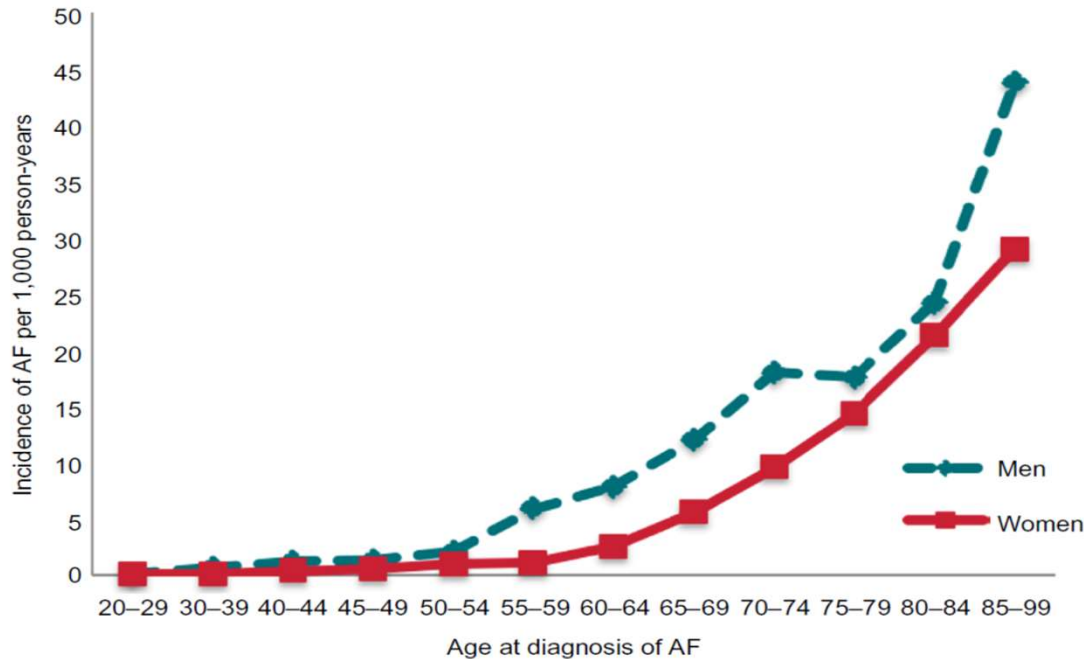


Figure 2 The incidence of first-diagnosed atrial fibrillation or atrial flutter (AF) according to age group and sex.



# The incidence of AF



Open Access Full Text Article

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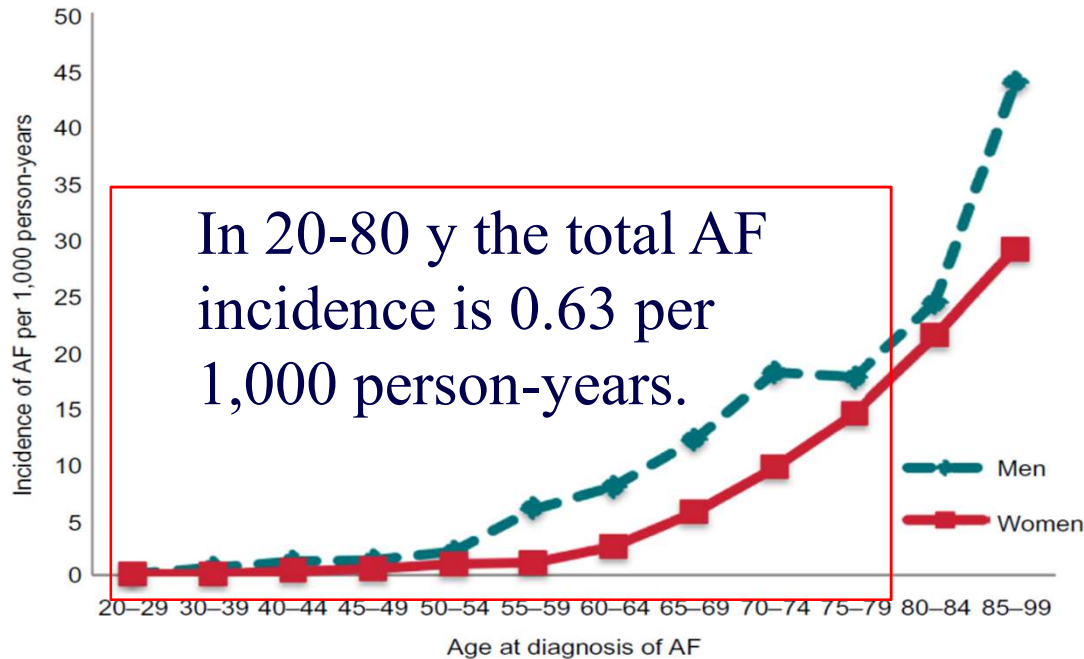


Figure 2 The incidence of first-diagnosed atrial fibrillation or atrial flutter (AF) according to age group and sex.



# The incidence of AF



Open Access Full Text Article

ORIGINAL RESEARCH

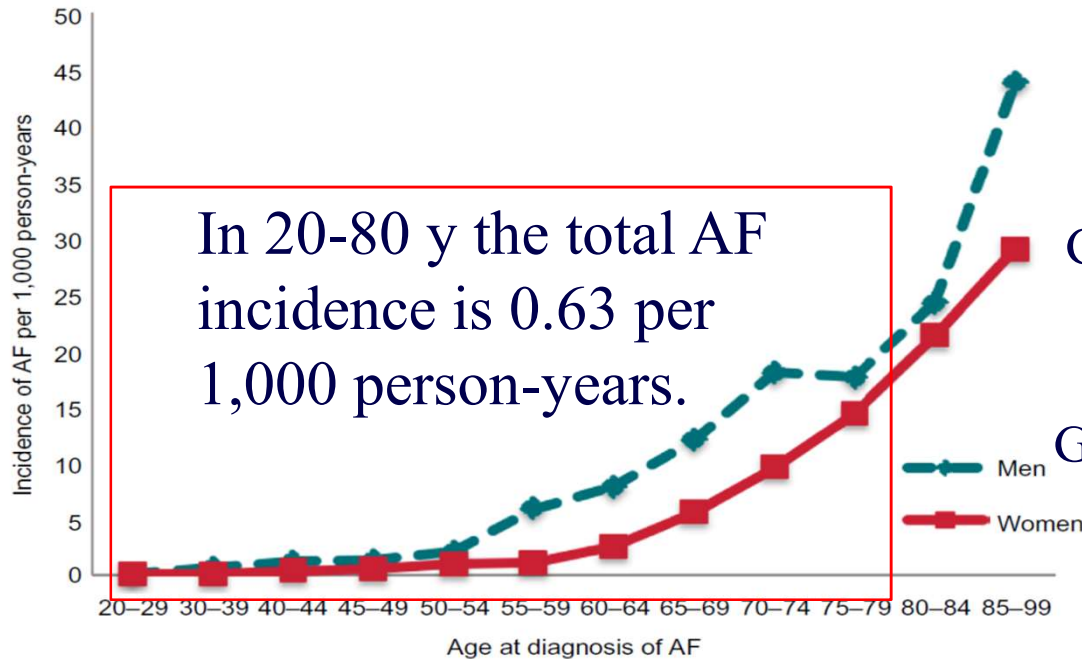
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Department of Public Health and Clinical Medicine, Skellefteå Research Unit, Umeå University, Umeå, Västerbotten, Sweden



The incidence of AF in the entire population was 4.0 per 1,000 person-years.



In 20-80 y the total AF incidence is 0.63 per 1,000 person-years.

AF incidence (per year):  
630 new patients / 1,000,000 people

Greece: 88 ablations/ 1,000,000 people  
**14% of the patients ablated**

Germany: 506 ablations/ 1,000,000 people  
**80% of the patients ablated**

Figure 2 The incidence of first-diagnosed atrial fibrillation or atrial flutter (AF) according to age group and sex.



# The incidence of AF



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ORIGINAL RESEARCH

## Incidence, type of atrial fibrillation and risk factors for stroke: a population-based cohort study

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The incidence of AF in the entire population was 4.0 per 1,000 person-years.

**Table 2** Characteristics of 607 patients with and without a provoking factor associated with first-diagnosed atrial fibrillation or atrial flutter (AF)

	Cardiac surgery n = 46	Non-cardiac surgery n = 21	Acute infection n = 24	Myocardial infarction n = 16	Other <sup>a</sup> n = 18 ~20%	No provoking factor n = 482 ~80%
Age, years, mean ± standard deviation	68.0±10.7	73.6±10.8	73.3±14.2	78.3±8.5	76.3±10.6	73.8±12.3
Female sex, n (%)	12 (26.1)	8 (38.1)	10 (41.7)	6 (37.5)	11 (61.1)	210 (43.6)
Deceased, n (%)	2 (4.3)	0 (0)	8 (33.3)	4 (25.0)	5 (27.8)	49 (10.2)

**Notes:** <sup>a</sup>Other types of provoking factors included anemia (six patients), thyrotoxicosis or overdosage of levothyroxine (four patients), dehydration (two patients), acute abdominal pain (two patients), high tumor burden (two patients), aortic aneurysm (one patient) and status epilepticus (one patient). Data are reported as n (%) or mean ± standard deviation.



# 2017 HRS/EHRA/ECAS/APHRS/SOLAECE expert consensus statement on catheter and surgical ablation of atrial fibrillation



Table 2 Indications for catheter (A and B) and surgical (C, D, and E) ablation of atrial fibrillation

Recommendation	Class	LOE	References	
<b>Indications for catheter ablation of atrial fibrillation</b>				
<b>A. Indications for catheter ablation of atrial fibrillation</b>				
Symptomatic AF refractory or intolerant to at least one Class I or III antiarrhythmic medication	Paroxysmal: Catheter ablation is recommended.	I	A	261,262,462,489,503,655, 673,684,709,1027-1029
	Persistent: Catheter ablation is reasonable.	IIa	B-NR	245,262,515,527,733, 1015,1025-1030
	Long-standing persistent: Catheter ablation may be considered.	IIb	C-LD	245,262,515,527,733, 1015,1025-1030
Symptomatic AF prior to initiation of antiarrhythmic therapy with a Class I or III antiarrhythmic medication	Paroxysmal: Catheter ablation is reasonable.	IIa	B-R	370,372,377-383
	Persistent: Catheter ablation is reasonable.	IIa	C-E0	
	Long-standing persistent: Catheter ablation may be considered.	IIb	C-E0	

**Calkins et al. 2017 HRS/EHRA/ECAS/APHRS/SOLAECE expert consensus statement on catheter and surgical ablation of AF**



# AF Ablation In Special Categories of Patients

## Catheter Ablation of AF

- as First-Line Therapy
- in Patients with Asymptomatic AF
- in Patients with Heart Failure
- in Older People
- In patients with persistent / long-standing AF

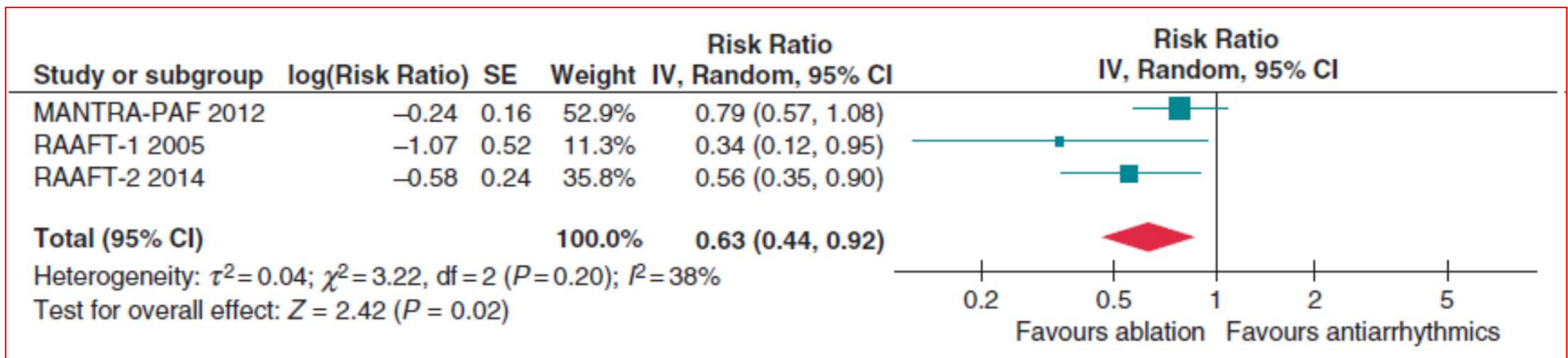


# Radiofrequency ablation vs. antiarrhythmic drug therapy as first line treatment of symptomatic atrial fibrillation: systematic review and meta-analysis



Antti Hakalahti<sup>1\*</sup>, Fausto Biancari<sup>2</sup>, Jens Cosedis Nielsen<sup>3</sup>, and M.J. Pekka Raatikainen<sup>4,5</sup>

## Risk of recurrence of AF



Hakalahti et al. *Europace* 2015;17:370-378

Catheter ablation of AF should be considered as first-line therapy to prevent recurrent AF and to improve symptoms in selected patients with symptomatic paroxysmal AF as an alternative to antiarrhythmic drug therapy, considering patient choice, benefit, and risk.

**Ila**

**B**

2016 ESC Guidelines for the management of AF. *European Heart Journal* 2016;37:2893-2962



# Clinical Course of Lone Atrial Fibrillation Since First Symptomatic Arrhythmic Episode



Carlo Rostagno, MD, PhD, Francesca Bacci, MD, Moira Martelli, MD, Alessandra Naldoni, MD, Giovanni Bertini, MD, and GianFranco Gensini, MD

- Prognosis of lone AF
- 106 patients after the 1<sup>st</sup> AF episode

**TABLE I** Clinical Characteristics of Patients

	Number of Patients	Men	Women	Mean Age (yr)	Follow-Up (mo)
Total	106	43	63	65 ± 14	67 ± 10
>70 years	43	12	31	77 ± 6	68 ± 33
<70 years	63	31	32	56 ± 11	77 ± 33
AF recurrences	59	21	38	63 ± 13	77 ± 31
No AF recurrences	47	21	26	68 ± 12	69 ± 35
Death	21	10	11	74 ± 8	37 ± 22

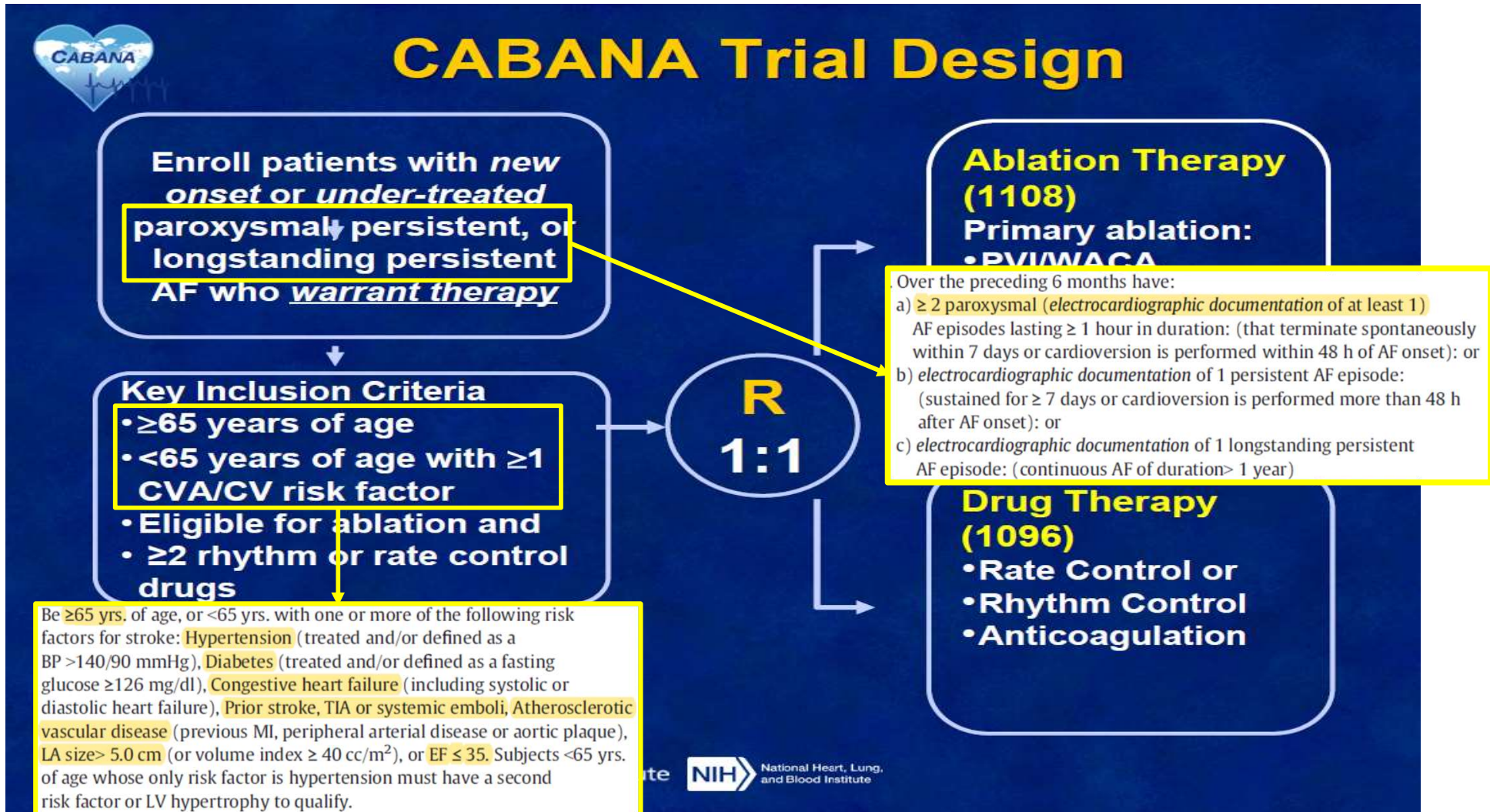
44%

5.8 years



# CABANA Trial

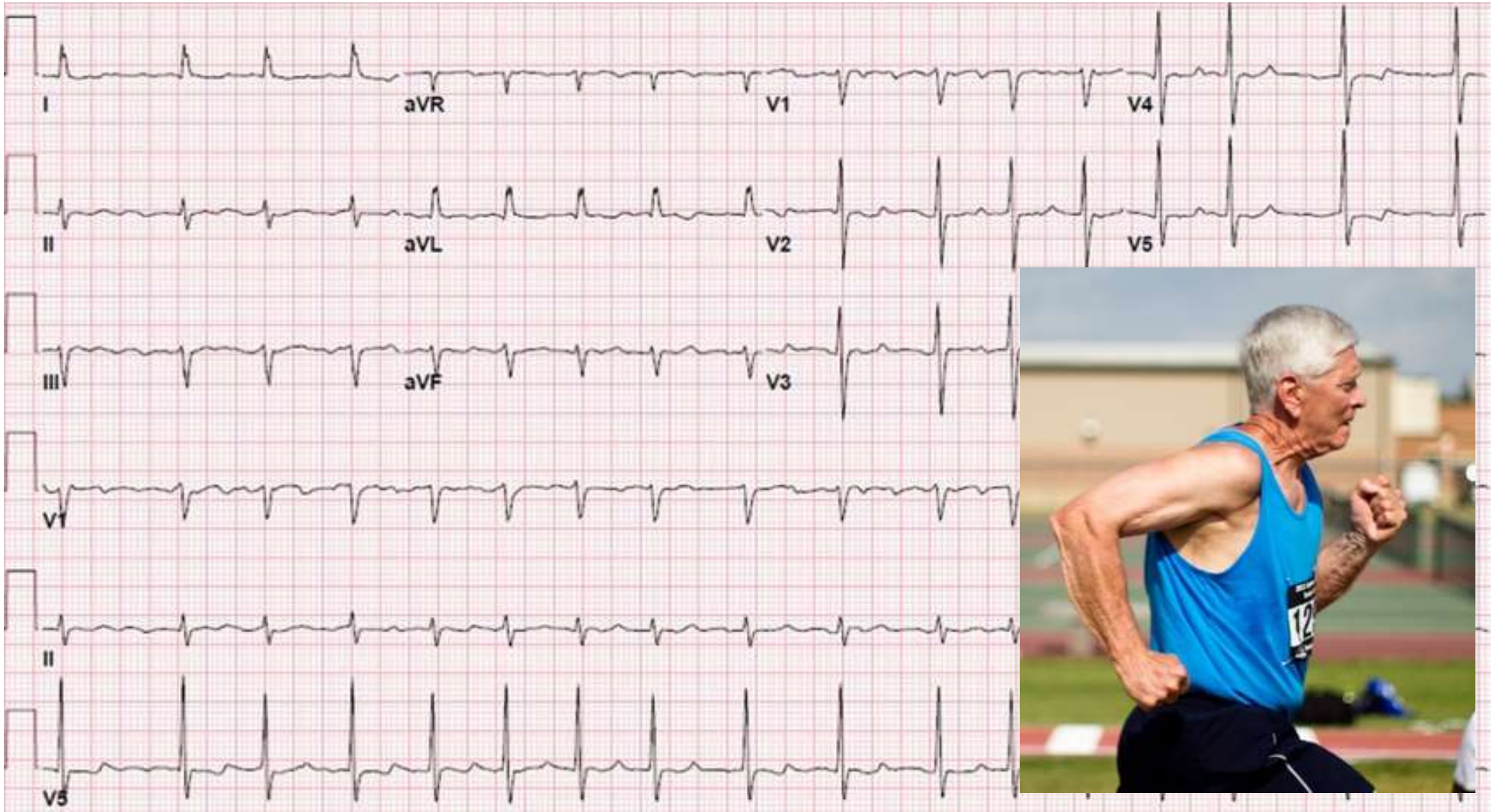
## Catheter Ablation vs ANtiarrhythmic Drug Therapy in Atrial Fibrillation



Packer D, et al. Heart Rhythm Society's 39th Annual Scientific Sessions. May 16, 2018  
 Packer D, et al. American Heart Journal 2018;199: 192-199  
 Packer D, et al. JAMA 2019;321:1261-1274



# Ablation in Patients with Asymptomatic AF





## 2017 HRS/EHRA/ECAS/APHRS/SOLAECE expert consensus statement on catheter and surgical ablation of atrial fibrillation



- The writing group believes that AF ablation may be considered in select asymptomatic patients with paroxysmal or persistent AF when performed by an experienced operator and following a detailed discussion of the risks and benefits of undergoing the procedure (Class IIb, LOE C-EO)



# 2017 HRS/EHRA/ECAS/APHRS/SOLAECE expert consensus statement on catheter and surgical ablation of atrial fibrillation



- The writing group *believes* that AF ablation may be considered in select asymptomatic patients with paroxysmal or persistent AF when performed by an experienced operator and following a detailed discussion of the risks and benefits of undergoing the procedure (Class IIb, LOE C-EO)



# “Trial of Sinus Rhythm”

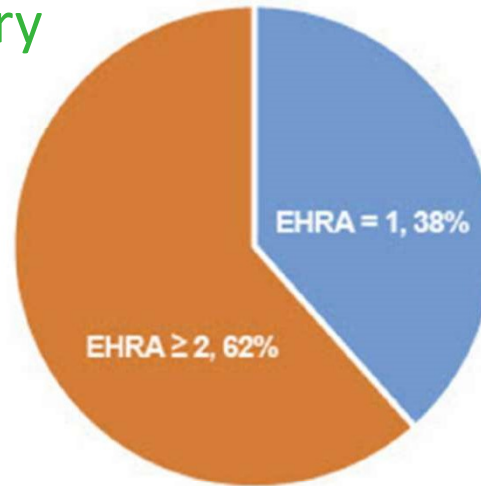




# Importance of Asymptomatic AF



from the ORBIT-AF Registry



- Men
- Older Age
- Persistent AF
- Comorbidities

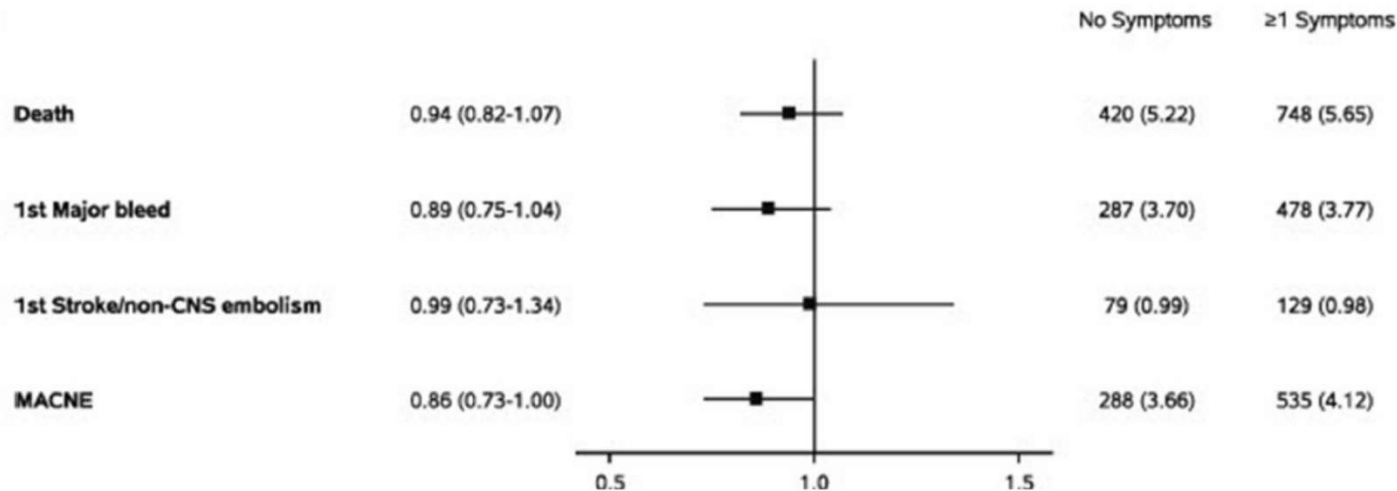


Figure 1. Association between outcomes and asymptomatic atrial fibrillation defined using EHRA score (*top*) and by symptom checklist (*bottom*). Pie chart (*middle*) illustrates proportion of asymptomatic patients (EHRA = 1). The incidence rate in parentheses represents the number of events per 100 subject-years. CI = confidence interval; CNS = central nervous system; EHRA = European Heart Rhythm Association; HR = hazard ratio; MACNE = major adverse cardiovascular and neurologic events.



# Asymptomatic persistent atrial fibrillation and outcome: Results of the RACE study <sup>e</sup>



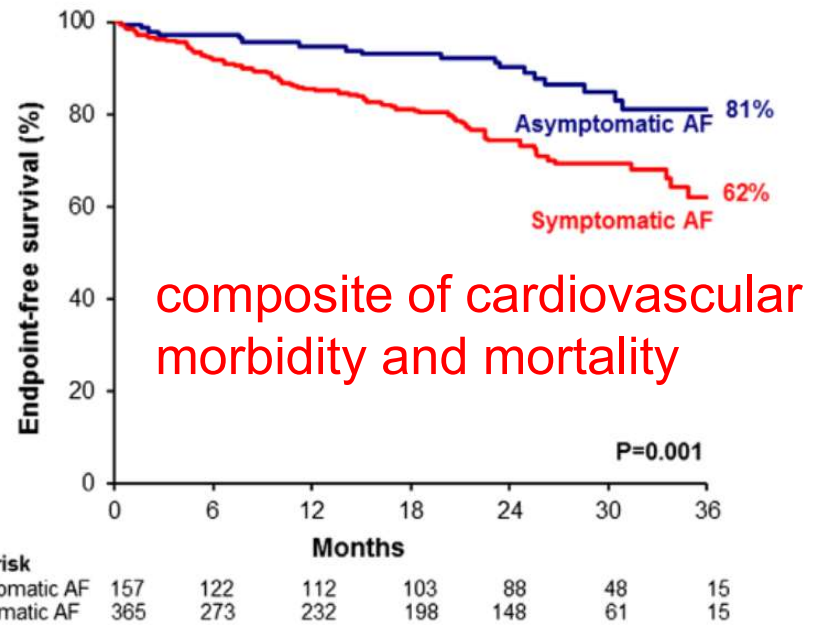
Michiel Rienstra, MD, PhD,<sup>\*</sup> Rob A. Vermond, MD,<sup>\*</sup> Harry J.G.M. Crijns, MD, PhD,<sup>†</sup>  
Jan G.P. Tijssen, PhD,<sup>‡</sup> Isabelle C. Van Gelder, MD, PhD,<sup>\*</sup> for the RACE Investigators

- **RACE trial: rhythm vs rate**

Patients with asymptomatic AF (n=157 [30%]) were compared with patients with symptomatic AF (n=365 [70%]).

Patients with asymptomatic AF:

- younger
- more often men
- Less HF



**Figure 3** Kaplan-Meier curve according to the presence of symptoms. AF = atrial fibrillation.

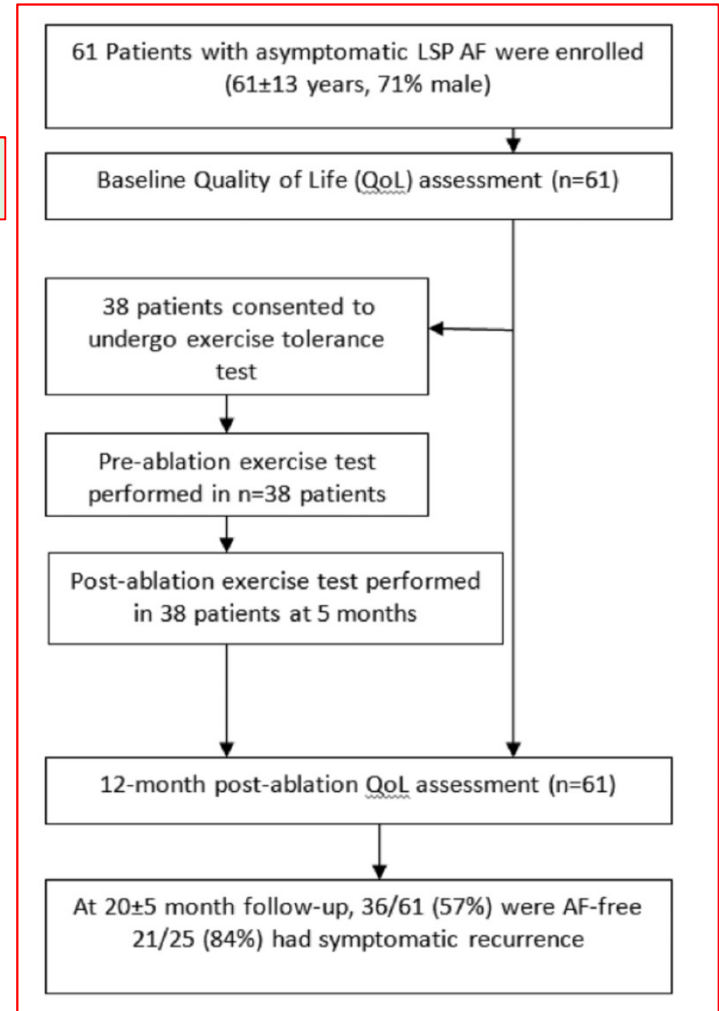
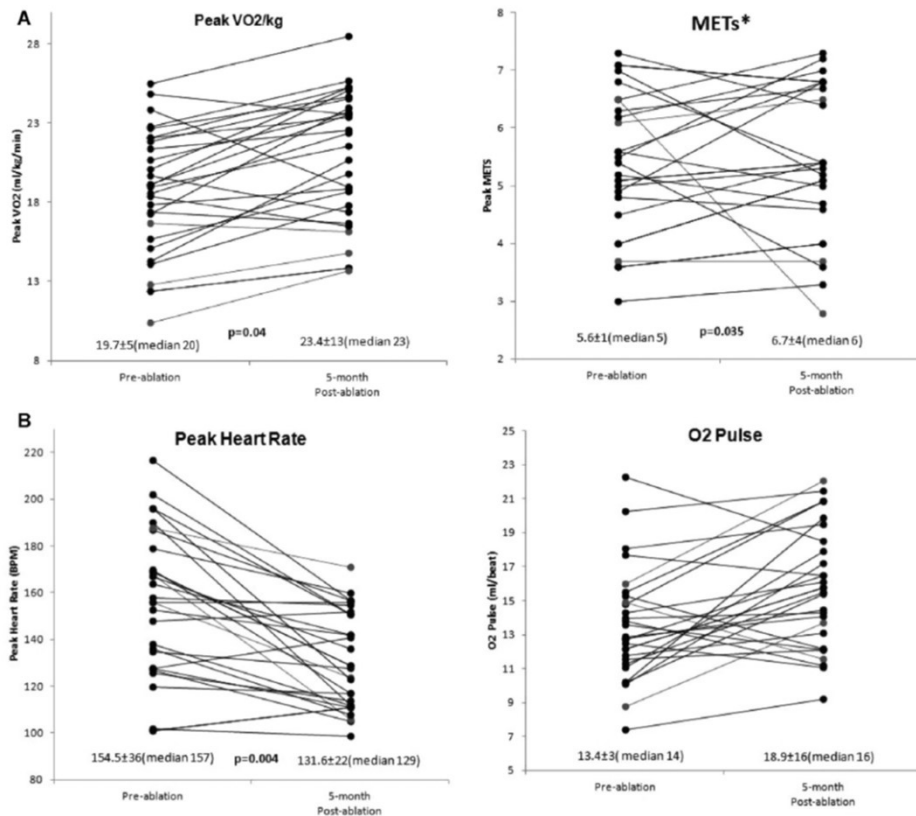


# Catheter Ablation of Asymptomatic Longstanding Persistent Atrial Fibrillation: Impact on Quality of Life, Exercise Performance, Arrhythmia Perception, and Arrhythmia-Free Survival

SANGHAMITRA MOHANTY, M.D., M.S.,\* † PASQUALE SANTANGELI, M.D.,\*

- 61 asymptomatic pts with Longstanding Persistent AF
- After 20±5 months follow-up, 36 (57%) patients were recurrence free

Successful ablation improved exercise performance



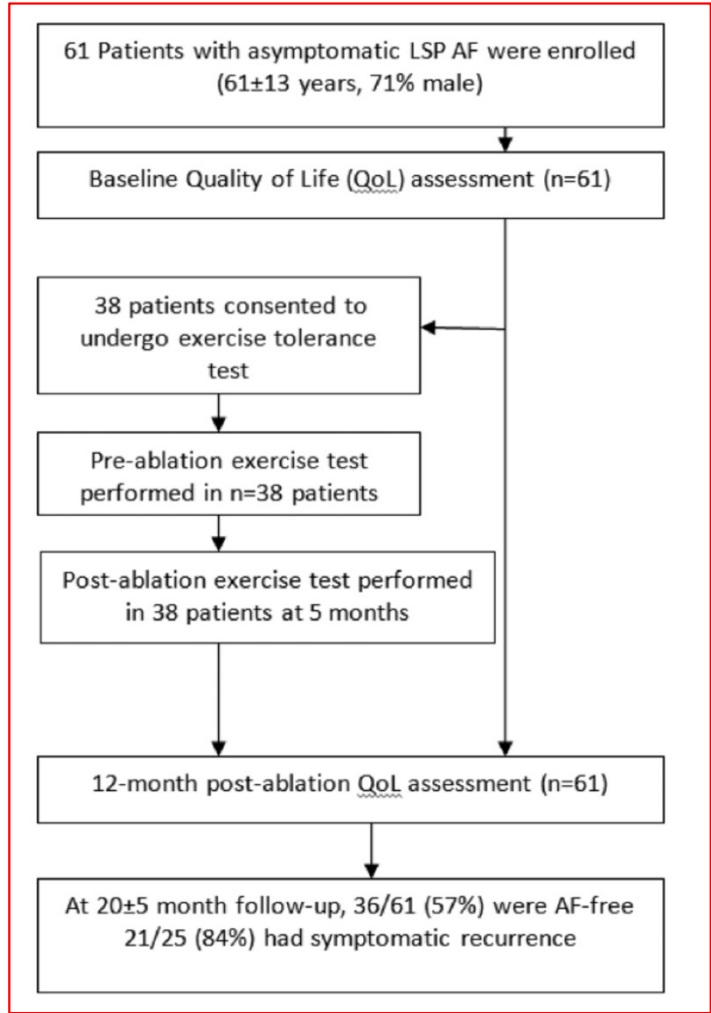


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- 61 asymptomatic pts with Longstanding Persistent AF
- After 20±5 months follow-up, 36 (59%) patients were recurrence free

- 25 pts (41%) had recurrence
- 21 of the 25 (84%) became symptomatic of recurrence
- 34% became symptomatic post ablation



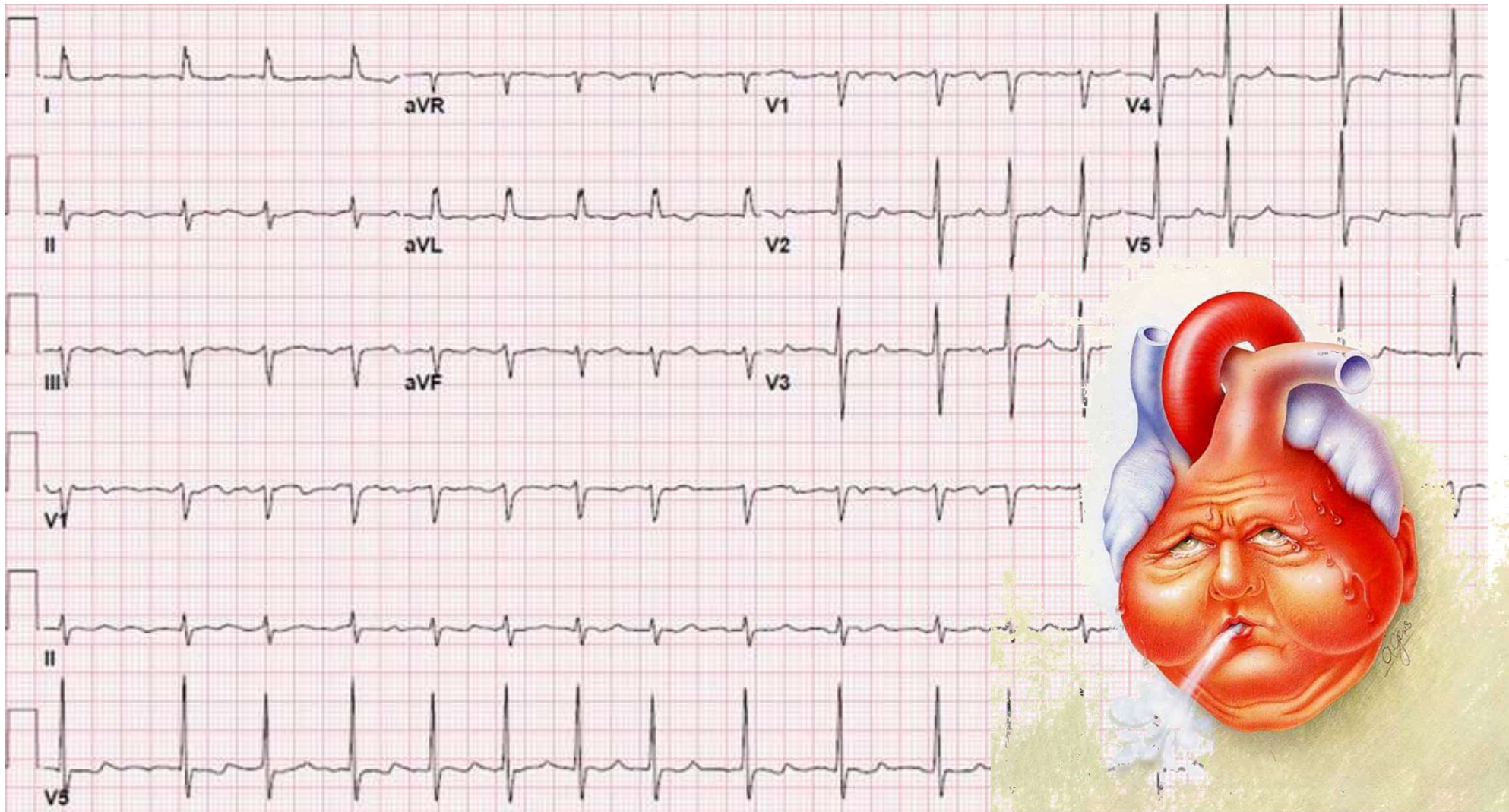
**TABLE 4**

Arrhythmia Status and Heart Rate According to Symptom Status Among Patients with Recurrence

	Symptomatic		Asymptomatic	
	n	Heart Rate Range (Holter)	n	Heart Rate range (Holter)
AF	4 (57%)	110–150	3 (43%)	90–130
Atrial flutter	16 (94%)	140–164	1 (6%)	120–150
Atrial tachycardia	1 (100%)	154	0 (0%)	



# AF Ablation in Patients with Heart Failure





# Catheter Ablation for Atrial Fibrillation with Heart Failure

Nassir F. Marrouche, M.D., Johannes Brachmann, M.D., Dietrich Andresen, M.D., Jürgen Siebels, M.D., Lucas Boersma, M.D., Luc Jordaens, M.D., Béla Merkely, M.D., Evgeny Pokushalov, M.D., Prashanthan Sanders, M.D., Jochen Proff, B.S., Heribert Schunkert, M.D., Hildegard Christ, M.D., Jürgen Vogt, M.D., and Dietmar Bänsch, M.D., for the CASTLE-AF Investigators\*



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## Patient Profile

- Patients with HF and a history of symptomatic (paroxysmal or persistent) AF
- LVEF  $\leq$  35%, ICD or CRT-D
- NYHA class II-IV
- Major exclusion criteria: candidacy for heart transplantation or planned cardiovascular intervention

## Randomization

- Ablation or Drug (rate or rhythm control) therapy

## Primary End Point

- Composite of death from any cause or hospitalization for worsening HF

**Marrouche et al. N Engl J Med 2018;378:417-27**

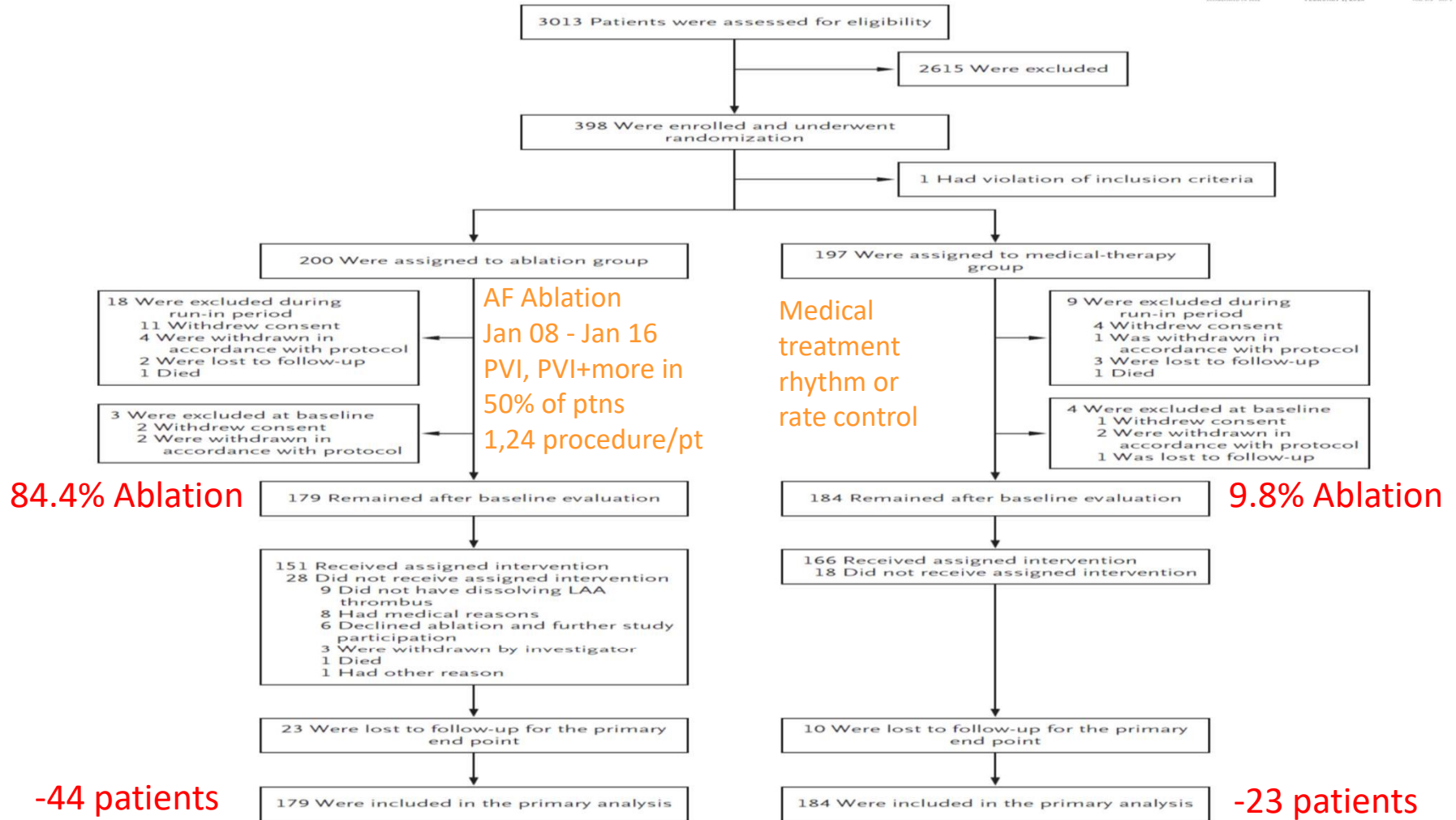


# Catheter Ablation for Atrial Fibrillation with Heart Failure

Nassir F. Marrouche, M.D., Johannes Brachmann, M.D., Dietrich Andresen, M.D., Jürgen Siebels, M.D., Lucas Boersma, M.D., Luc Jordaens, M.D., Béla Merkely, M.D., Evgeny Pokushalov, M.D., Prashanthan Sanders, M.D., Jochen Proff, B.S., Heribert Schunkert, M.D., Hildegard Christ, M.D., Jürgen Vogt, M.D., and Dietmar Bänsch, M.D., for the **CASTLE-AF** Investigators\*



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median follow-up: 37.8 m

Marrouche et al. N Engl J Med 2018;378:417-27



# Catheter Ablation for Atrial Fibrillation with Heart Failure

Nassir F. Marrouche, M.D., Johannes Brachmann, M.D., Dietrich Andresen, M.D., Jürgen Siebels, M.D., Lucas Boersma, M.D., Luc Jordaens, M.D., Béla Merkely, M.D., Evgeny Pokushalov, M.D., Prashanthan Sanders, M.D., Jochen Proff, B.S., Heribert Schunkert, M.D., Hildegard Christ, M.D., Jürgen Vogt, M.D., and Dietmar Bänsch, M.D., for the CASTLE-AF Investigators\*

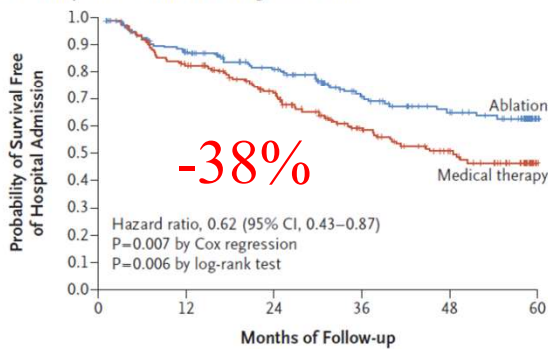


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**Table 2. Primary and Secondary Clinical End Points.\***

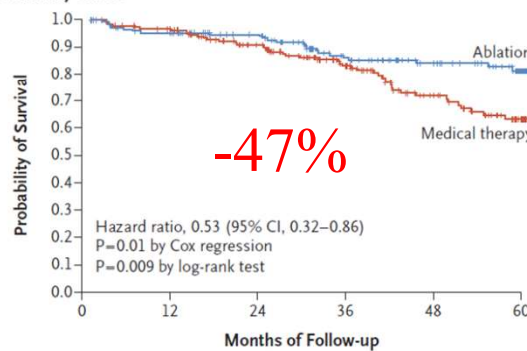
End Point	Ablation (N=179)	Medical Therapy (N=184)	Hazard Ratio (95% CI)	P Value	
				Cox Regression	Log-Rank Test
	<i>number (percent)</i>				
Primary†	51 (28.5)	82 (44.6)	0.62 (0.43–0.87)	0.007	0.006
Secondary					
Death from any cause	24 (13.4)	46 (25.0)	0.53 (0.32–0.86)	0.01	0.009
Heart-failure hospitalization	37 (20.7)	66 (35.9)	0.56 (0.37–0.83)	0.004	0.004
Cardiovascular death	20 (11.2)	41 (22.3)	0.49 (0.29–0.84)	0.009	0.008
Cardiovascular hospitalization	64 (35.8)	89 (48.4)	0.72 (0.52–0.99)	0.04	0.04
Hospitalization for any cause	114 (63.7)	122 (66.3)	0.99 (0.77–1.28)	0.96	0.96
Cerebrovascular accident	5 (2.8)	11 (6.0)	0.46 (0.16–1.33)	0.15	0.14

**A Death or Hospitalization for Worsening Heart Failure**



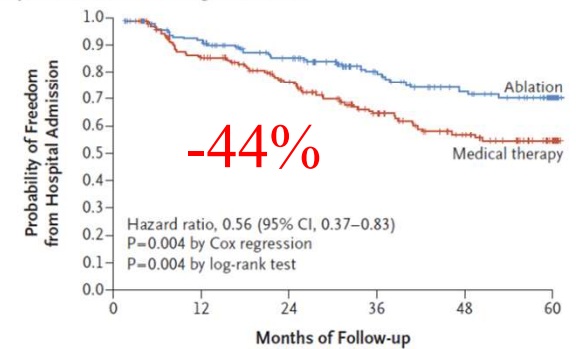
No. at Risk	0	12	24	36	48	60
Ablation	179	141	114	76	58	22
Medical therapy	184	145	111	70	48	12

**B Death from Any Cause**



No. at Risk	0	12	24	36	48	60
Ablation	179	154	130	94	71	27
Medical therapy	184	168	138	97	63	19

**C Hospitalization for Worsening Heart Failure**



No. at Risk	0	12	24	36	48	60
Ablation	179	141	114	76	58	22
Medical therapy	184	145	111	70	48	12

**Marrouche et al. N Engl J Med 2018;378:417-27**



# Catheter Ablation for Atrial Fibrillation with Heart Failure

Nassir F. Marrouche, M.D., Johannes Brachmann, M.D., Dietrich Andresen, M.D., Jürgen Siebels, M.D., Lucas Boersma, M.D., Luc Jordaens, M.D., Béla Merkely, M.D., Evgeny Pokushalov, M.D., Prashanthan Sanders, M.D., Jochen Proff, B.S., Heribert Schunkert, M.D., Hildegard Christ, M.D., Jürgen Vogt, M.D., and Dietmar Bänsch, M.D., for the CASTLE-AF Investigators\*



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## Concerns about CASTLE-AF results

- The total duration of AF is not reported
- Despite randomization there was a significant difference between the two groups in crucial baseline characteristics (Ischemic HF [Abl: 42% vs C:51%], diabetes [Abl: 24%vs C:36%], digoxin treatment [Abl: 20% vs C:30%])
- Number of randomized patient with missing or excluded data/events from primary analysis (44 in ablation group vs 23 in control group)



# Catheter Ablation for Atrial Fibrillation with Heart Failure

Nassir F. Marrouche, M.D., Johannes Brachmann, M.D., Dietrich Andresen, M.D., Jürgen Siebels, M.D., Lucas Boersma, M.D., Luc Jordaens, M.D., Béla Merkely, M.D., Evgeny Pokushalov, M.D., Prashanthan Sanders, M.D., Jochen Proff, B.S., Heribert Schunkert, M.D., Hildegard Christ, M.D., Jürgen Vogt, M.D., and Dietmar Bänsch, M.D., for the CASTLE-AF Investigators\*



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The profile of HF patients with AF who are likely to benefit from ablation

- Patients with symptoms attributed to AF
- Age <71y
- Mean LVEF 32%
- LA ≤ 59mm (mean 48mm)



# Atrial Fibrillation and Heart Failure: A bad combination



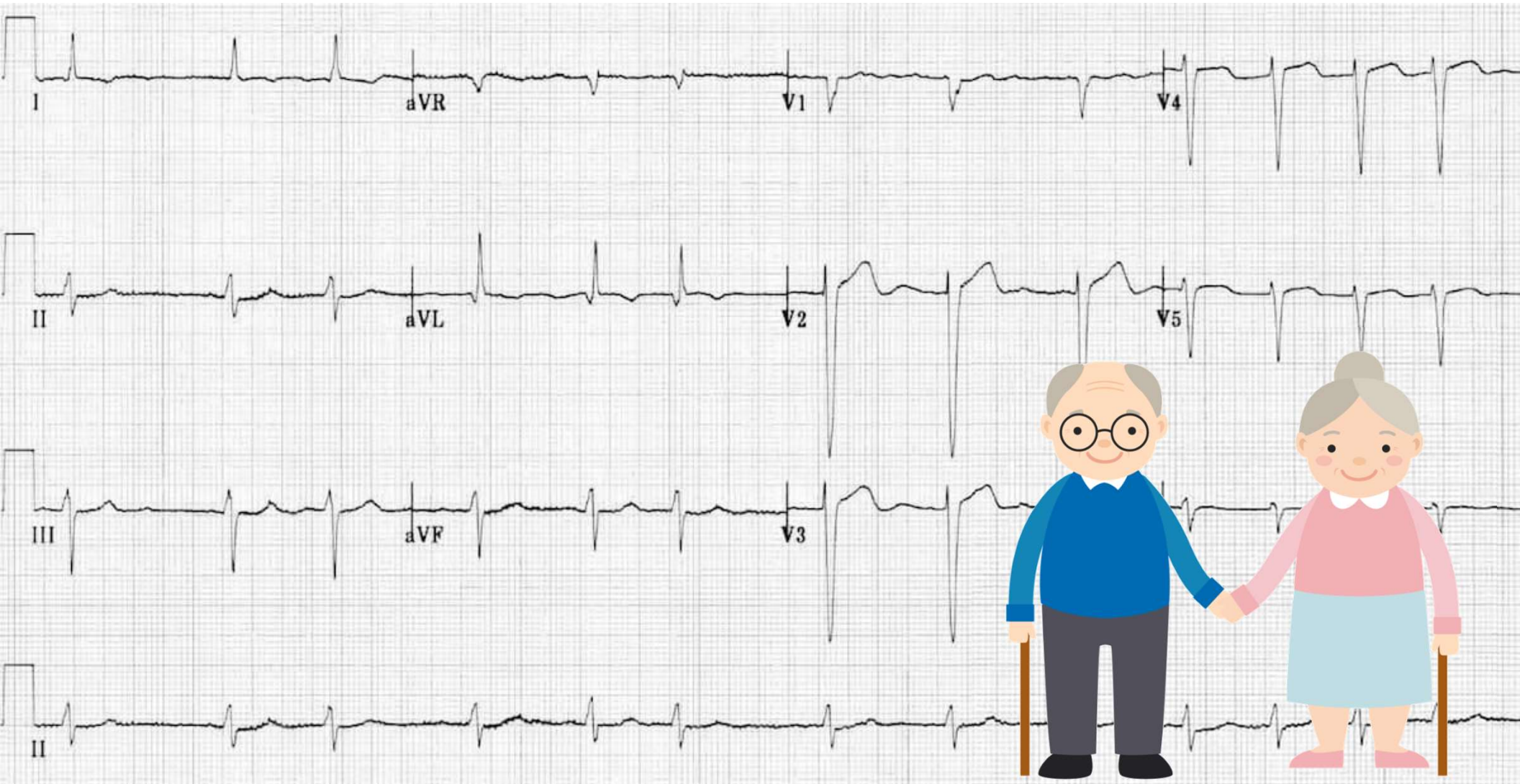
- HF is present in 34% of AF patients
- AF in 42% of HF patients

EuroHeart Failure survey

Cleland JG, et al. *Eur Heart J* 2003; 24:442-463.  
Nieuwlaat R, et al. *Eur Heart J* 2005; 26:2422-2434.



# AF ablation in Older People





## AF outcomes in elderly compared with nonelderly patients



Authors	No. of elderly <sup>a</sup>	No. of comparison	Follow-up duration	Success elderly <sup>a</sup>	Success nonelderly	P
Bunch et al. 2010 <sup>1</sup>	35	717	12 mo	78 %	75 %	P = NS
Corrado et al. 2008 <sup>2</sup>	174	N/A	12 mo	73 % -1st procedure 80 % - 2nd procedure	N/A	N/A
Zado et al. 2008 <sup>3</sup>	32	1130	18 mo	86 %	88 %	P = NS
Shah et al. 2012 <sup>4</sup>	609	3547	Median 1.58 y	Not observed	Not observed	N/A
Santangeli et al. 2012 <sup>5</sup>	103	2651	18 mo	69 %	71 %	P = NS
Lim et al. 2011 <sup>6</sup>	123	732	12 mo	WACA: 64% WACA-L: 82%	WACA: 84 % <sup>b</sup> WACA-L: 80 % <sup>b</sup>	N/A

WACA wide area circumferential ablation, WACA-L wide area circumferential ablation with additional linear lines in the left atrium

<sup>a</sup> No. of elderly includes those ≥75 years of age

<sup>b</sup> 55–75 year age group

<sup>1</sup> Bunch et al. *Pacing Clin Electrophysiol.* 2010;33:146–52

<sup>2</sup> Corrado et al. *J Cardiovasc Electrophysiol.* 2008;19:807–11

<sup>3</sup> Zado et al. *J Cardiovasc Electrophysiol.* 2008;19:621–6

<sup>4</sup> Shah et al. *J Am Coll Cardiol.* 2012;59:143–9

<sup>5</sup> Santangeli et al. *J Cardiovasc Electrophysiol.* 2012;23:687–93

<sup>6</sup> Lim et al. *J Card Rhythm Manage.* 2011;2:206–11



# Prevalence of major AF ablation complications in the elderly



Major Procedural Complications		Bunch et al. (%) <sup>1</sup>	Corrado et al. (%) <sup>2</sup>	Zado et al. (%) <sup>3</sup>	Shah et al. (%) <sup>4</sup>	Lim et al. (%) <sup>6</sup>	Santangeli et al. (%) <sup>5</sup>
Death	Elderly	0	0	0	NA	0.8	0
	Nonelderly	0.7		0 <sup>#</sup>		0.5 <sup>c</sup>	
Stroke/TIA <sup>b</sup>	Elderly	0	0.5	2.9	NA	0.8	0
	Nonelderly	0.9		0.3 <sup>c</sup>		0.4 <sup>c</sup>	
Pericardial effusion/Tamponade	Elderly	2.8	0	0	NA	NA	1
	Nonelderly	1.3		0.8 <sup>c</sup>			
LA-esophageal fistula	Elderly	0	0	0	NA	NA	0
	Nonelderly	0		0.07 <sup>c</sup>			
PV stenosis	Elderly	0	0	0	NA	NA	0
	Nonelderly	0.1		0.07 <sup>c</sup>			
Deep venous thrombosis	Elderly	2.8 <sup>a</sup>	0	0	NA	NA	0
	Nonelderly	0		0.07 <sup>c</sup>			
Total major and minor complications	Elderly	8.5 %	2 %	8.8 %	19.2 % <sup>d</sup>	NA	3.9 %
	Nonelderly	4.1 %		3.6 %			

<sup>a</sup> Significant P value

<sup>b</sup> Includes acute and within 30 days postprocedure

<sup>c</sup> Nonelderly age groups combined

<sup>d</sup> Ages 75–84 and ≥85 combined

<sup>1</sup> Bunch et al. *Pacing Clin Electrophysiol.* 2010;33:146–52

<sup>2</sup> Corrado et al. *J Cardiovasc Electrophysiol.* 2008;19:807–11

<sup>3</sup> Zado et al. *J Cardiovasc Electrophysiol.* 2008;19:621–6

<sup>4</sup> Shah et al. *J Am Coll Cardiol.* 2012;59:143–9

<sup>5</sup> Santangeli et al. *J Cardiovasc Electrophysiol.* 2012;23:687–93

<sup>6</sup> Lim et al. *J Card Rhythm Manage.* 2011;2:206–11



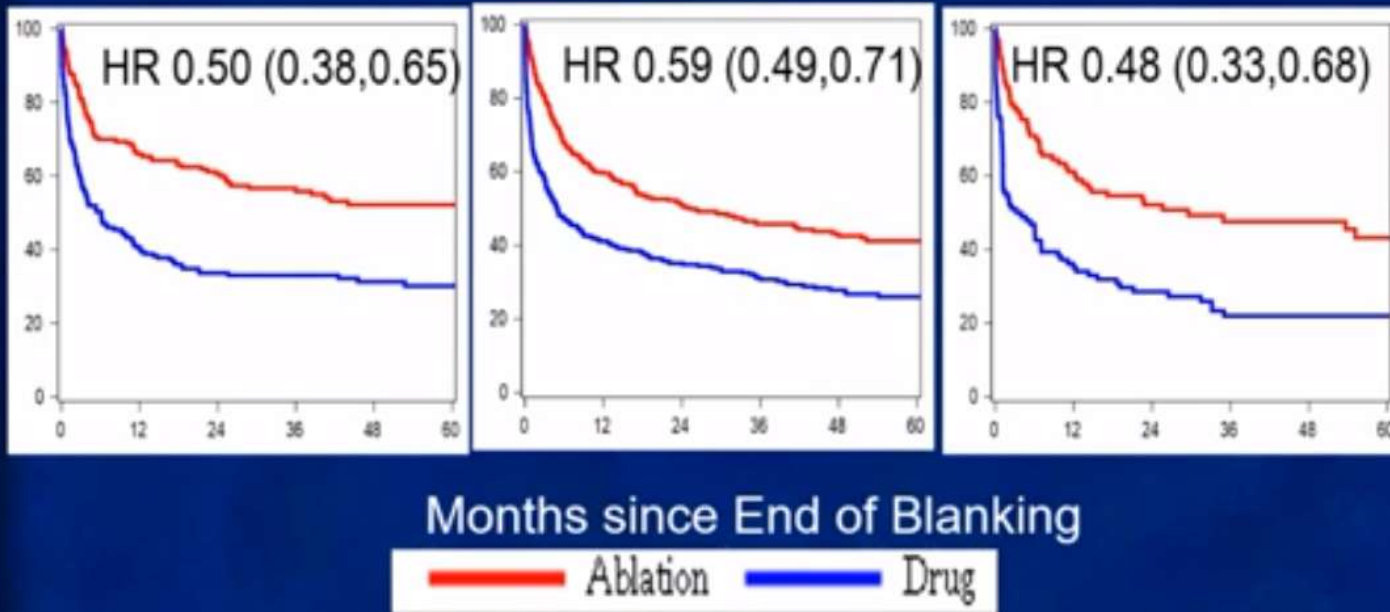
## Freedom From Recurrence of AF/AT/AFL in CABANA Age Subgroups (competing risk analysis)

<65 years old

≥65 to <75 years old

≥75 years old

Freedom From Recurrence (%)



\*Hazard Ratio (95% CI), Interaction P-Value for Ablation:Drug = \*0.452



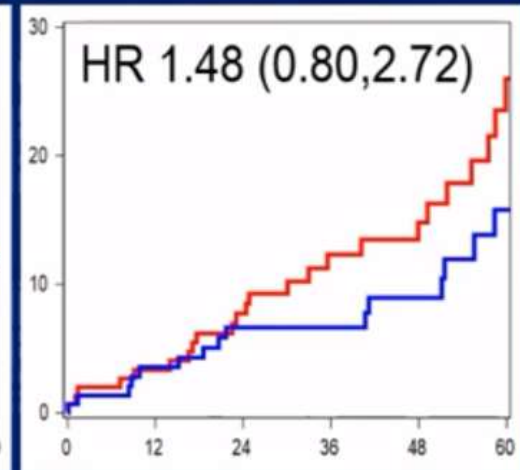
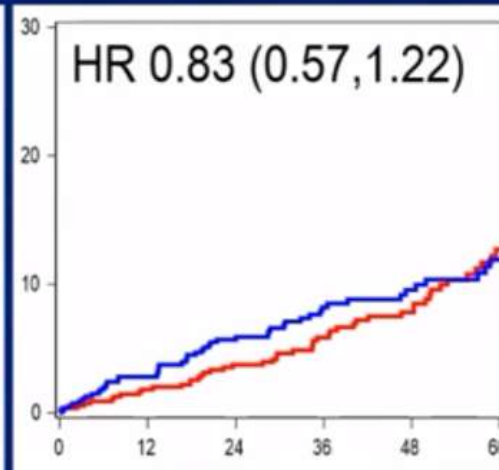
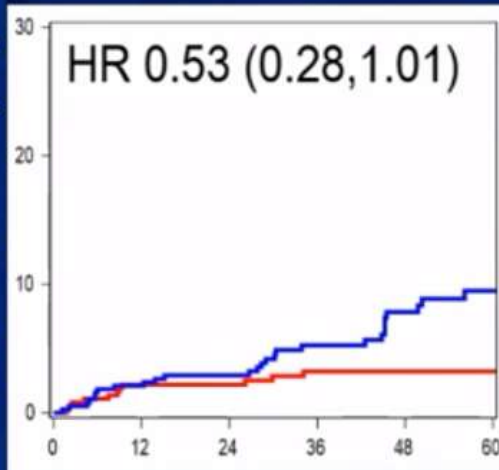
# Death, Disabling Stroke, Major Bleeding, Cardiac Arrest in CABANA Age Subgroups

<65 years old

≥65 to <75 years old

≥75 years old

Event Rate (%)



Months Since Randomization



\*Hazard Ratio (95% CI), Interaction P-Value for Ablation:Drug = 0.072



# Ablation in Patients with Long-Standing Persistent AF





# AF Ablation: Long-term results



[www.eponline.gr](http://www.eponline.gr)

Study	No. of pts	Mean Age	AF type	Ablation strategy	Mean Follow-up (years)	Results			
						Success Rate		No. of proced.	Pts on AAD
						after 1 <sup>st</sup> procedure	after last procedure		
Ouyang (2010) <sup>1</sup>	161	59,8	paroxysmal	PVI, occasional linear ablation	4.6	46,6%	79,5%	1,5	15%
Medi (2011) <sup>2</sup>	100	54	paroxysmal	PVI	3,25	49%	82%	1,22	27%
Weerasooriya (2011) <sup>3</sup>	100	55,7	64 paroxysmal, 22 persistent, 14 long-standingng persistent	PVI, CTI ablation ± linear ablation	4,5	29%	63%	1,75	NA
Sorgente (2012) <sup>4</sup>	103	53,5	40 paroxysmal, 63 non-paroxysmal	PVI, ±linear ablation ± extra PV triggers	6	23%	39%	1,5	NA
Tilz (2012) <sup>5</sup>	202	61	Long standing persistent	PVI, ±CFAE, ±targeted ablation	4.7	20%	45%	1,9	12%
De Bortoli (2013) <sup>6</sup>	66	58	non-paroxysmal	PVI+CFAE ablation	3,3	32%	57,6%	1.7	24% on β-blockers

AF: atrial fibrillation, CFAE: complex fractionated atrial electrograms, CTI: cavo-tricuspid isthmus, PV: pulmonary vein, PVI: pulmonary vein isolation, SR: sinus rhythm

<sup>1</sup> Ouyang et al. *Circulation* 2010;122:2368-2377

<sup>2</sup> Medi et al. *J Cardiovasc Electrophysiol* 2011;22:137-141

<sup>3</sup> Weerasooriya et al. *JACC* 2011;57:160-6

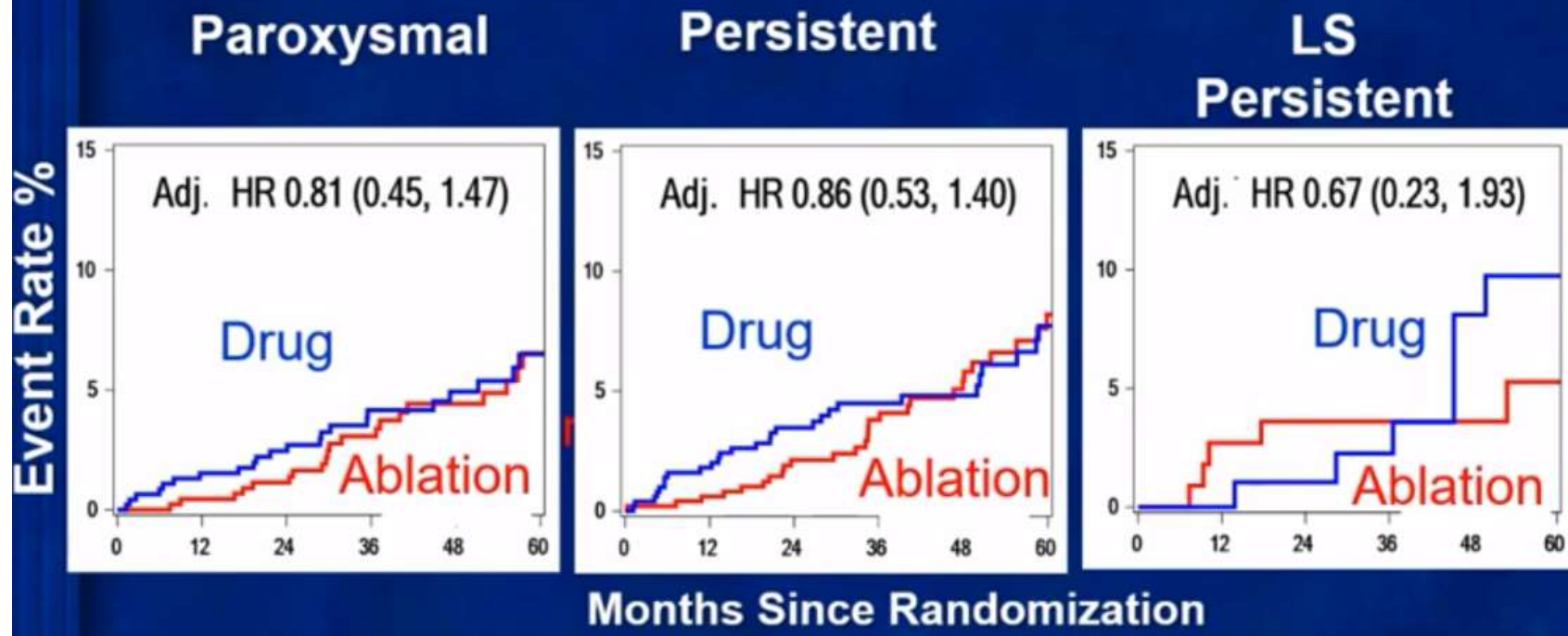
<sup>4</sup> Sorgente et al. *Am J Cardiol* 2012;109:1179-1186

<sup>5</sup> De Bortoli et al. *J Interv Card Electrophysiol.* 2013;38:19-26

<sup>6</sup> Tilz et al. *JACC* 2012;60:1921-1929



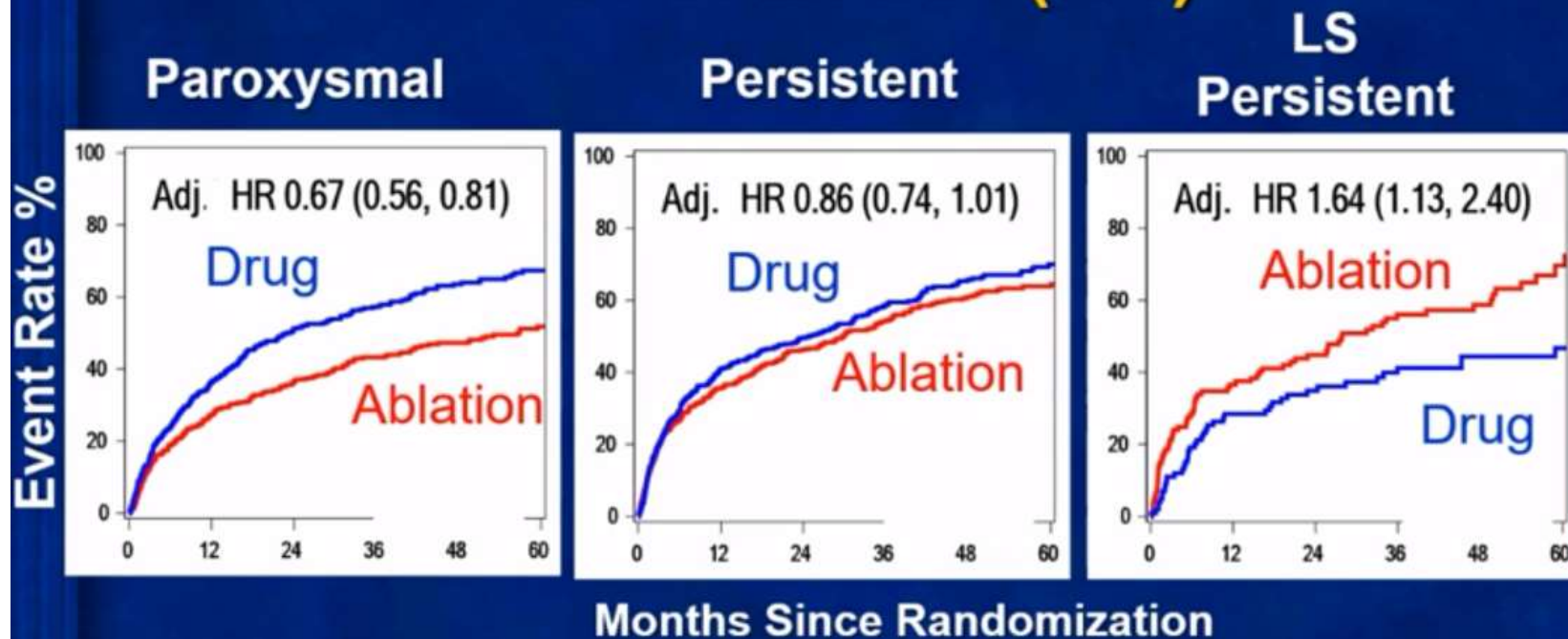
# Impact of AF Type on Risk of All-Cause Mortality in CABANA (ITT)



*Hazard Ratio (95% CI), Interaction P-Value for Ablation:Drug = 0.911*



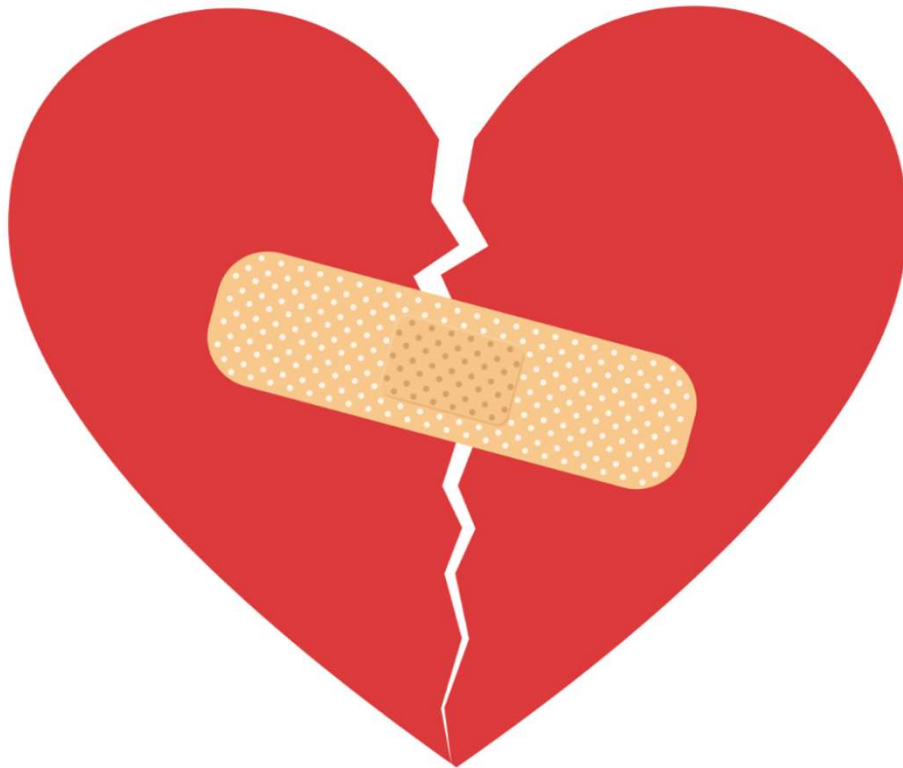
# Impact of AF Type on Risk of All-Cause Mortality or CV Hospitalization in CABANA (ITT)



*Hazard Ratio (95% CI), Interaction P-Value for Ablation:Drug = <.001*



# The risks of catheter ablation



## 2016 ESC Guidelines for the management of atrial fibrillation developed in collaboration with EACTS

Complication severity	Complication type	Rate <sup>727, 748, 750, 754-759</sup>
Life-threatening complications	Periprocedural death	<0.2%
	Oesophageal injury (perforation/fistula) <sup>a</sup>	<0.5%
	Periprocedural stroke (including TIA/air embolism)	<1%
	Cardiac tamponade	1–2%
Severe complications	Pulmonary vein stenosis	<1%
	Persistent phrenic nerve palsy	1–2%
	Vascular complications	2–4%
	Other severe complications	≈1%
Other moderate or minor complications		1–2%
Unknown significance	Asymptomatic cerebral embolism (silent stroke) <sup>b</sup>	5–20%
	Radiation exposure	

Kirchhof P et al. European Heart Journal 2016



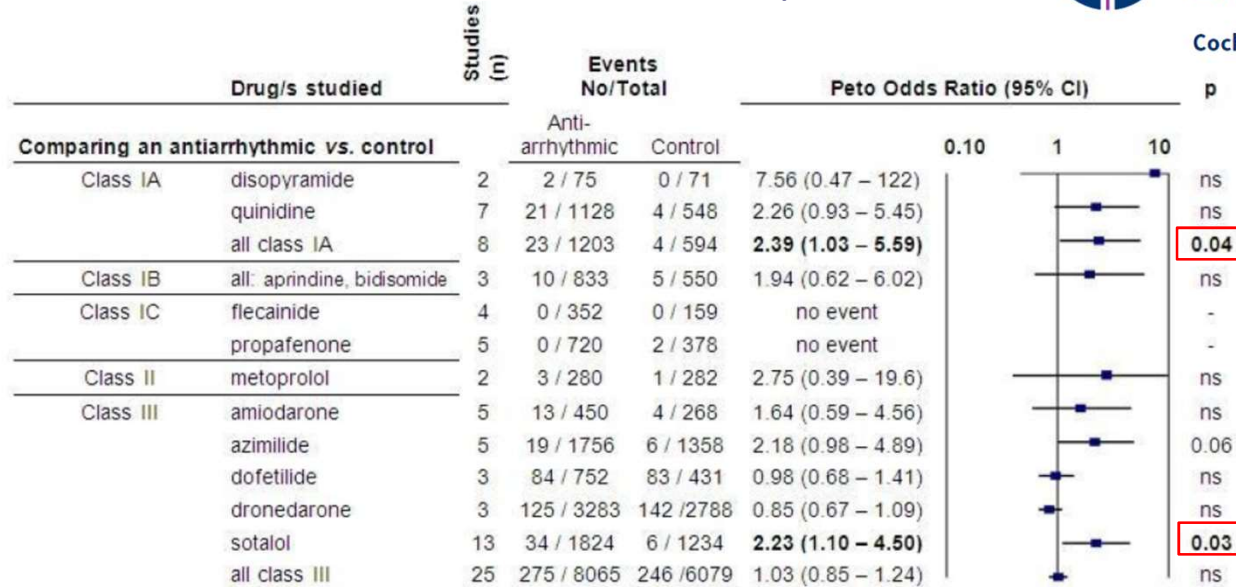
# Antiarrhythmics for maintaining sinus rhythm after cardioversion of atrial fibrillation (Review)



## Overall Mortality



Cochrane Database of Systematic Reviews



59 studies  
21,305 patients

- Compared with controls, class IA drugs quinidine and disopyramide (OR 2.39, 95% confidence interval (95% CI) 1.03 to 5.59, number needed to treat to harm (NNT<sub>H</sub>) 109, 95% CI 34 to 4985) and sotalol (OR 2.23, 95% CI 1.1 to 4.50, NNT<sub>H</sub> 169, 95% CI 60 to 2068) were associated with increased all-cause mortality.
- All analysed drugs increased withdrawals due to adverse affects and all but amiodarone, dronedarone and propafenone increased pro-arrhythmia.



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# Cardiac Rhythm News

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## Almost one in 200 patients die early after AF ablation in a real-world analysis from the US Nationwide Readmissions Database

29th October 2019 516



Senior author Jim W Cheung

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## Deaths After Ablation of Atrial Fibrillation 'Concerning' in Real-World Analysis

This should serve as a wake-up call that ablation is not a benign procedure and that operator experience matters, say experts.



By Michael O'Riordan | October 29, 2019

the heart.org Medscape Cardiology

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More Lives of CAD Patients than Aspirin Alone

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## 'Real-World' Take on AF Ablation Early Mortality Finds Slightly Higher Risk

### Cardiovascular Business

STRATEGIES IN ECONOMICS, PRACTICE & TECHNOLOGY

#### Early mortality 'a very real complication' after catheter ablation of AFib

Anicka Slachta | October 30, 2019 | Electrophysiology & Arrhythmia



19

ments



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A reappraisal of early mortality after ablation procedures for atrial fibrillation (AF) suggests the risk is higher than often appreciated, in part because the new analysis is based on "real world" numbers rather than outcomes only from



# Risk of Mortality Following Catheter Ablation of Atrial Fibrillation



Edward P. Cheng, MD, PhD,<sup>a</sup> Christopher F. Liu, MD,<sup>a</sup> Ilhwan Yeo, MD,<sup>b</sup> Steven M. Markowitz, MD,<sup>a</sup> George Thomas, MD,<sup>a</sup> James E. Ip, MD,<sup>a</sup> Luke K. Kim, MD,<sup>a</sup> Bruce B. Lerman, MD,<sup>a</sup> Jim W. Cheung, MD<sup>a</sup>

**BACKGROUND** Although procedure-related deaths during index admission following catheter ablation of AF have been reported to be low, adverse outcomes can occur after discharge. There are limited data on mortality early after AF ablation.

**OBJECTIVES** This study aimed to identify rates, trends, and predictors of early mortality post-atrial fibrillation (AF) ablation.

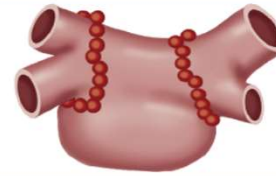
**METHODS** Using the all-payer, nationally representative Nationwide Readmissions Database, we evaluated 60,203 admissions of patients 18 years of age or older for AF ablation between 2010 and 2015. Early mortality was defined as death during initial admission or 30-day readmission. Based on International Classification of Diseases-9th Revision, Clinical Modification codes, we identified comorbidities, procedural complications, and causes of readmission following AF ablation. Multivariable logistic regression was performed to assess predictors of early mortality.

**RESULTS** Early mortality following AF ablation occurred in 0.46% cases, with 54.3% of deaths occurring during readmission. From 2010 to 2015, quarterly rates of early mortality post-ablation increased from 0.25% to 1.35% ( $p < 0.001$ ). Median time from ablation to death was 11.6 (interquartile range [IQR]: 4.2 to 22.7) days. After adjustment for age and comorbidities, procedural complications (adjusted odds ratio [aOR]: 4.06;  $p < 0.001$ ), congestive heart failure (CHF) (aOR: 2.20;  $p = 0.011$ ) and low AF ablation hospital volume (aOR: 2.35;  $p = 0.003$ ) were associated with early mortality. Complications due to cardiac perforation (aOR: 2.98;  $p = 0.007$ ), other cardiac (aOR: 12.8;  $p < 0.001$ ), and neurologic etiologies (aOR: 8.72;  $p < 0.001$ ) were also associated with early mortality.

**CONCLUSIONS** In a nationally representative cohort, early mortality following AF ablation affected nearly 1 in 200 patients, with the majority of deaths occurring during 30-day readmission. Procedural complications, congestive heart failure, and low hospital AF ablation volume were predictors of early mortality. Prompt management of post-procedure complications and CHF may be critical for reducing mortality rates following AF ablation.

Cheng et al. JACC 2019;74:2254-64

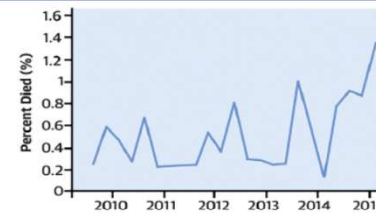
## Catheter Ablation of Atrial Fibrillation, 2010-2015



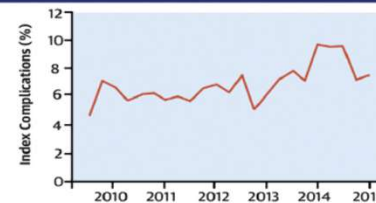
- 60,203 admissions
- 0.46% early mortality, with over half occurring during 30-day readmission

### Trends Associated With AF Ablation

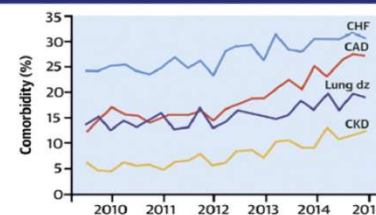
#### ↑ Trend in Early Mortality



#### ↑ Trend in Complications



#### ↑ Trend in Comorbidities



### Risk Factors for Early Mortality Post-AF Ablation

#### Procedural Complications



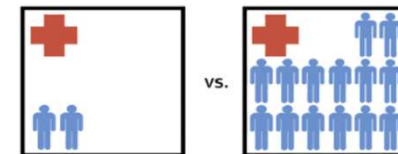
aOR 4.06;  $p < 0.001$

#### Congestive Heart Failure



aOR 2.20;  $p = 0.011$

#### Low AF Ablation Hospital Volume



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Supplemental Table 1. Inclusion and Exclusion Criteria for Selection of Study Discharge Records.

Inclusion Criteria	ICD-9 Codes
Atrial fibrillation*	427.31
Ablation of heart tissue via a peripherally inserted catheter	37.34
Exclusion Criteria†	ICD-9 Codes
Supraventricular tachycardia	427.0
Ventricular tachycardia	427.1
Atrial flutter	427.32
Other premature beats	427.69
Wolf-Parkinson-White	426.7
Lown-Ganong-Levine	426.81
Atrioventricular nodal tachycardia	426.89
Pacemaker implantation	00.50, 00.52, 00.53, 37.71 to 37.79, 37.80 to 37.89
ICD implantation	37.94, 37.95, 37.96, 37.97, 37.98, 00.51, 00.54
Open surgical ablation	37.33

\*Atrial fibrillation had to be primary diagnosis code for index admission in order to be included

†Any cases where any one of the following codes were listed as a secondary diagnosis were excluded

ICD = implantable cardioverter-defibrillator; ICD-9-CM = International Classification of Diseases, Ninth Edition, Clinical Modification; MI = myocardial infarction



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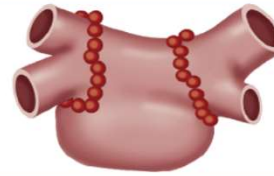
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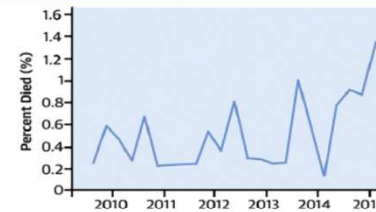
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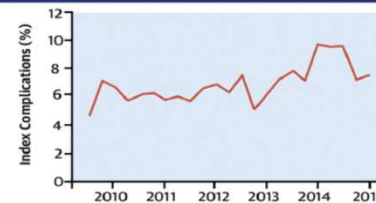
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### Trends Associated With AF Ablation

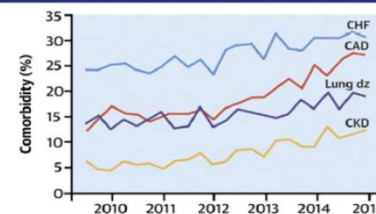
#### ↑ Trend in Early Mortality



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#### ↑ Trend in Comorbidities



### Risk Factors for Early Mortality Post-AF Ablation

#### Procedural Complications



aOR 4.06;  $p < 0.001$

#### Congestive Heart Failure



aOR 2.20;  $p = 0.011$

#### Low AF Ablation Hospital Volume

Hospital procedural volume		
Low-volume tertile	<21 AF ablations/year	21,642 (35.9)
Middle-volume tertile	21 - 52 AF ablations/year	19,915 (33.1)
High-volume tertile	>52 AF ablations/year	18,647 (31.0)

aOR 2.35;  $p = 0.003$



- When and How to Refer a Patient for AF Ablation



*Ευχαριστώ για την ιδροδοχή σας!*

