

Atrial Fibrillation: Update for 2026

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- Stanford University School of Medicine (MD/PhD)
- Medicine Internship/Residency @ BWH
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- Director - Atrial Fibrillation Program @BWH
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- Associate Professor of Medicine @ BWH/HMS
 - Clinical focus – Electrophysiology, Atrial Fibrillation
 - Research focus – Atrial fibrillation, innovations in catheter ablation, non-invasive ablation

- Biosense Webster, Inc.
 - Research support
 - Scientific Advisory Board
- Boston Scientific
 - Consulting
- Varian
 - Research support
 - Scientific Advisory Board
- Volta Medical
 - Consulting
- HRCRS
 - Medical Consultant
- APT
 - Consulting

Learning Objectives

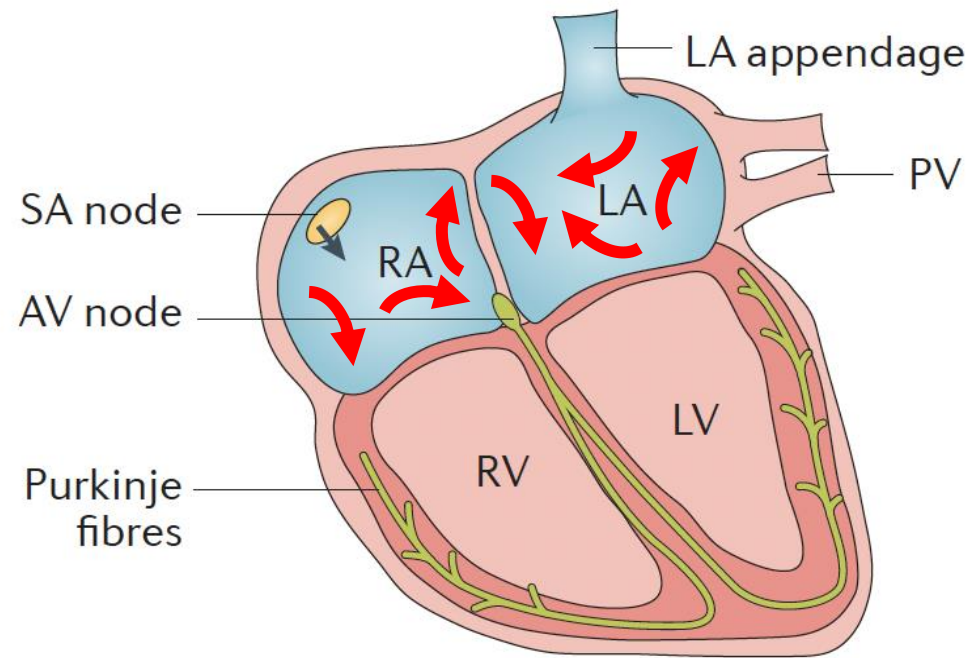
- Understand the current indications, options, risks, and benefits of stroke prevention for atrial fibrillation
- Understand the current indications for medical therapy vs. catheter ablation for the control of rhythm in atrial fibrillation
- Understand the impact of risk factors and risk factor modification on atrial fibrillation clinical outcomes
- Understand the most updated, emerging data impacting AF management

CLINICAL PRACTICE GUIDELINES

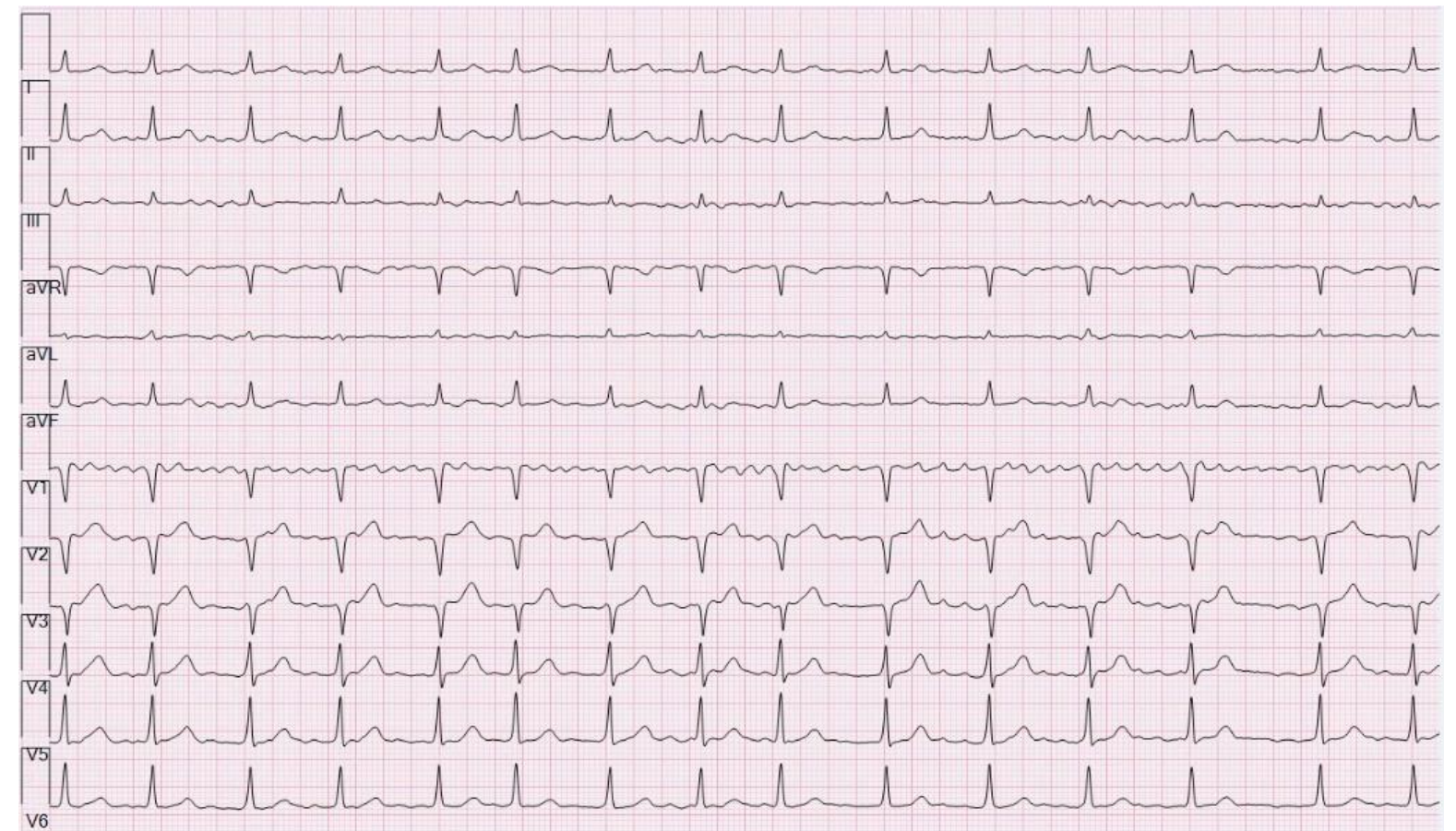
2023 ACC/AHA/ACCP/HRS Guideline for the Diagnosis and Management of Atrial Fibrillation: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines

Developed in Collaboration With and Endorsed by the American College of Clinical Pharmacy and the Heart Rhythm Society

- Rapid irregular electrical activation in the atria
- Irregular rapid (usually) ventricular response



Atrial Fibrillation



Adapted from Lip et al Nature, 2016

AF: Now the Most Prevalent Arrhythmia Worldwide

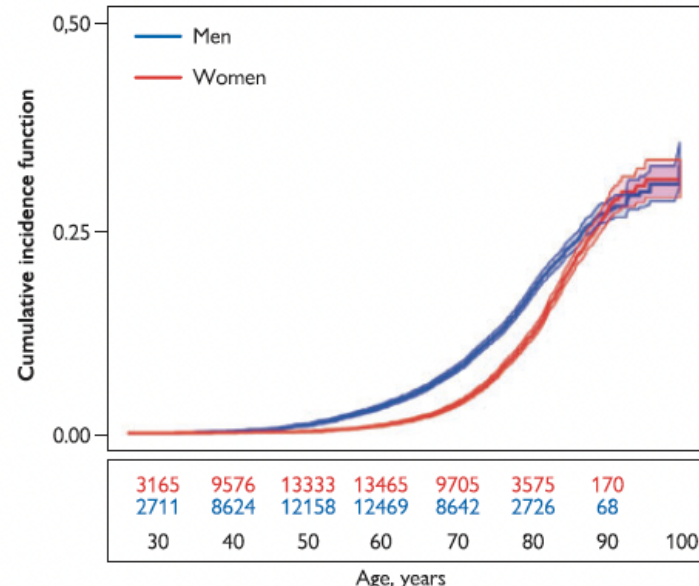
LIFETIME RISK for AF 1 in 3 individuals



of European ancestry
at index age of 55 years
37.0% (34.3% to 39.6%)

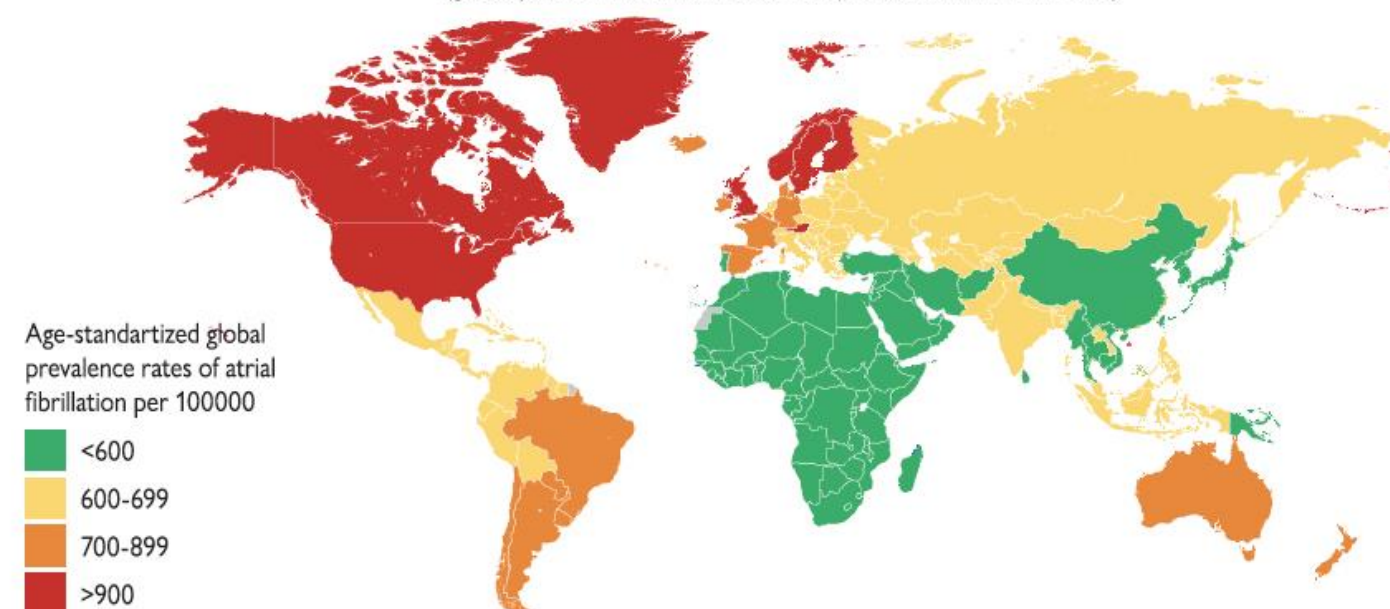
AF is more common in males

Cumulative incidence curves and 95% CIs
for AF in women and men with death as a competing risk

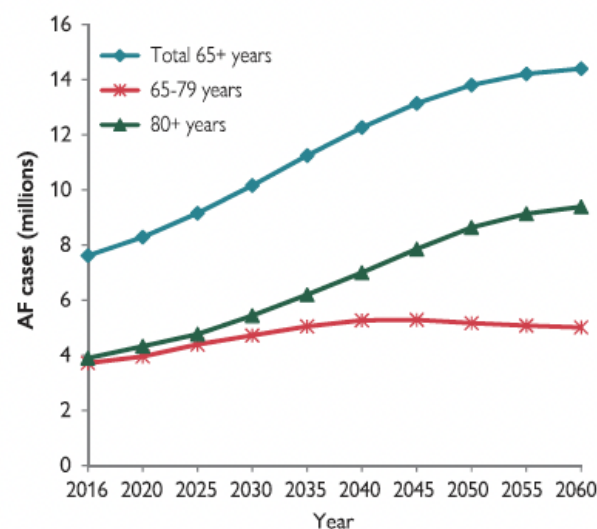


GLOBAL PREVALENCE OF AF

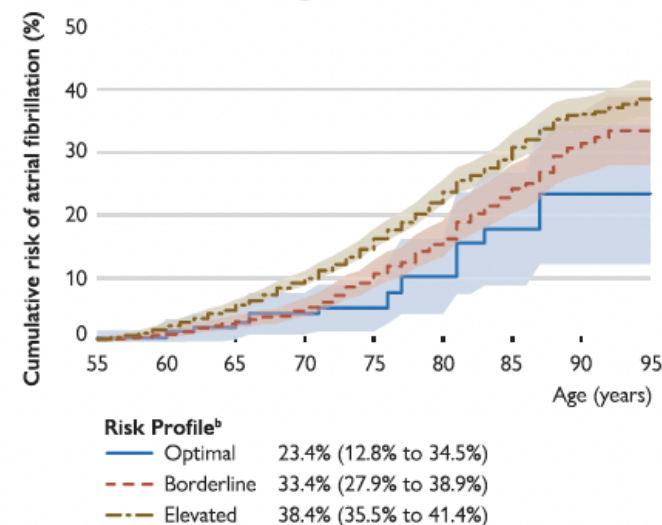
(globally, 43.6 million individuals had prevalent AF/AFL in 2016)



Projected increase in AF prevalence among elderly in EU 2016-2060



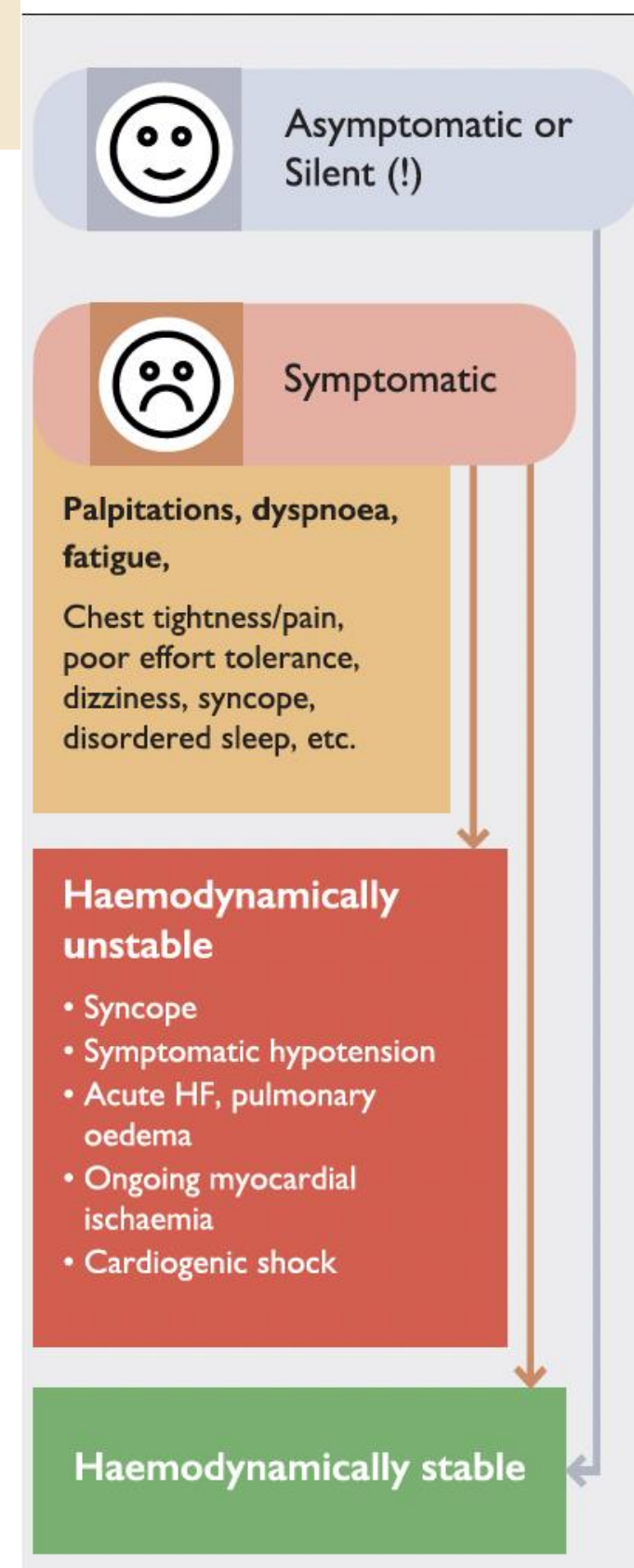
Lifetime risk of AF increases with increasing risk factor burden^a






- Higher prevalence in developed countries
- More common with aging, male gender
- Unclear if this is due to diagnosis bias vs. biological underpinnings

Clinical Manifestations and Presentation Vary Significantly

- Reasons for patient-to-patient variation unclear
- Severity of symptoms and impact on quality of life are important factors in decision on rhythm control management
- Conundrum: the asymptomatic patient
 - When is rhythm control indicated?
 - Who should be screened?
 - Concerns for initial presentation as stroke (without other warning signs)







Major CV Outcomes

AF-Related Outcome	Frequency in AF	Mechanism(s)
Death 	1.5 - 3.5 fold increase	Excess mortality related to: <ul style="list-style-type: none"> • HF, comorbidities • Stroke
Stroke 	20-30% of all ischaemic strokes, 10% of cryptogenic strokes	<ul style="list-style-type: none"> • Cardioembolic, or • Related to comorbid vascular atheroma
LV dysfunction / Heart failure 	In 20-30% of AF patients	<ul style="list-style-type: none"> • Excessive ventricular rate • Irregular ventricular contractions • A primary underlying cause of AF

ESC Guidelines 2020

Additional Manifestations

AF-Related Outcome	Frequency in AF	Mechanism(s)
Cognitive decline / Vascular dementia 	HR 1.4 / 1.6 (irrespective of stroke history)	<ul style="list-style-type: none"> • Brain white matter lesions, inflammation, • Hypoperfusion, • Micro-embolism
Depression 	Depression in 16-20% (even suicidal ideation)	<ul style="list-style-type: none"> • Severe symptoms and decreased QoL • Drug side effects
Impaired quality of life 	>60% of patients	<ul style="list-style-type: none"> • Related to AF burden, comorbidities, psychological functioning and medication • Distressed personality type
Hospitalizations 	10-40% annual hospitalization rate	<ul style="list-style-type: none"> • AF management, related to HF, MI or AF related symptoms • Treatment-associated complications

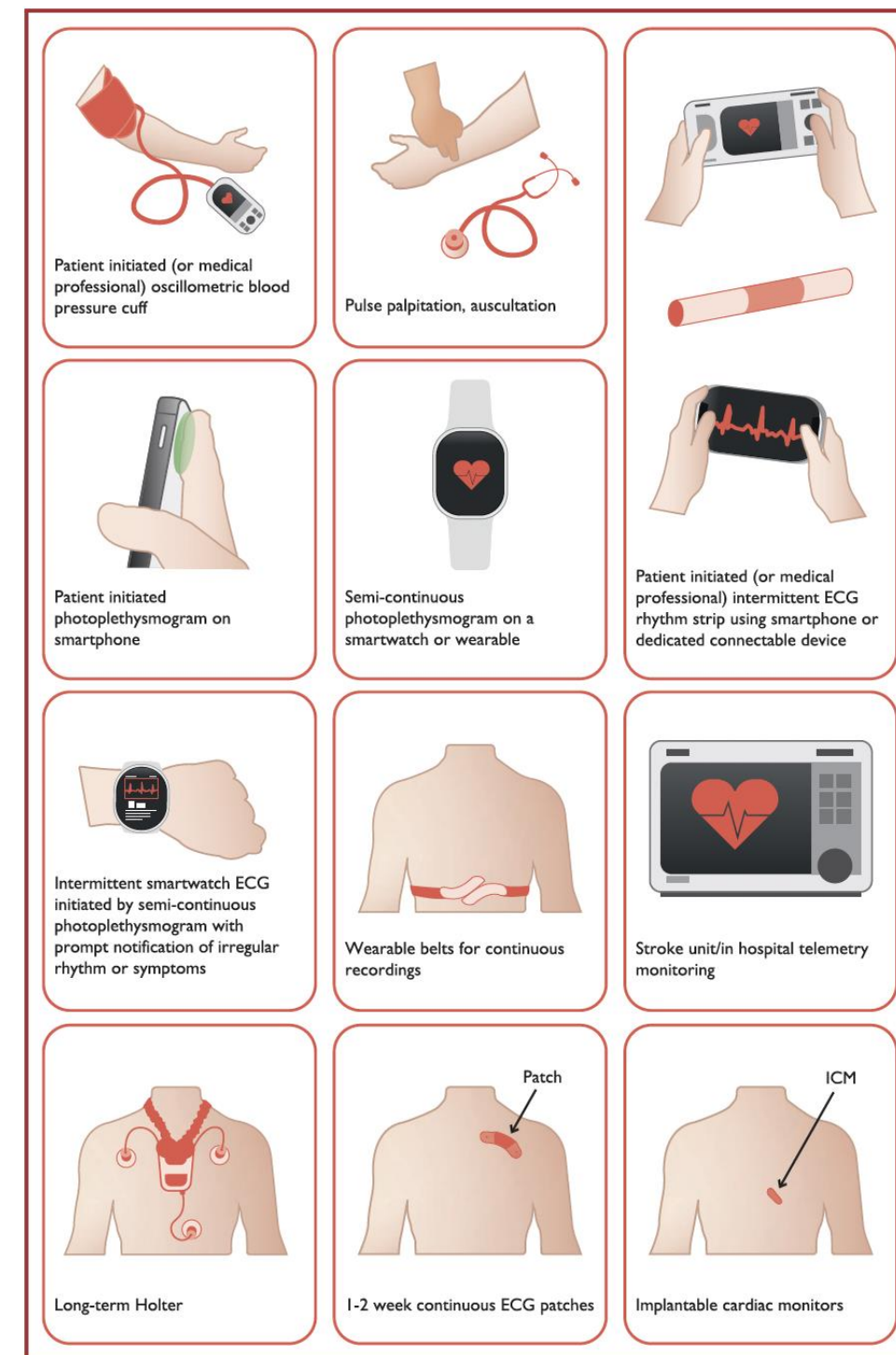
Atrial Fibrillation: Detection and Confirmation

- Pulse measurements – irregular pulse
- ECG detection – in office vs. mobile

Table 5 Sensitivity and specificity of various AF screening tools considering the 12-lead ECG as the gold standard¹⁷³

	Sensitivity	Specificity
Pulse taking ²⁰³	87 - 97%	70 - 81%
Automated BP monitors ^{204–207}	93 - 100%	86 - 92%
Single lead ECG ^{208–211}	94 - 98%	76 - 95%
Smartphone apps ^{188,189,191,195,212,213}	91.5 - 98.5%	91.4 - 100%
Watches ^{196,198,213,214}	97 - 99%	83 - 94%

AF = atrial fibrillation; BP = blood pressure; ECG = electrocardiogram.



Simple Risk Model Predicts Incidence of Atrial Fibrillation in a Racially and Geographically Diverse Population: the CHARGE-AF Consortium

Alvaro Alonso, MD, PhD;* Bouwe P. Krijthe, MSc;* Thor Aspelund, PhD;* Katherine A. Stepas, MPH;* Michael J. Pencina, PhD; Carlee B. Moser, MA; Moritz F. Sinner, MD, MPH; Nona Sotoodehnia, MD, MPH; João D. Fontes, MD; A. Cecile J. W. Janssens, PhD; Richard A. Kronmal, PhD; Jared W. Magnani, MD; Jacqueline C. Witteman, PhD; Alanna M. Chamberlain, PhD; Steven A. Lubitz, MD, MPH; Renate B. Schnabel, MD, MSc; Sunil K. Agarwal, MD, PhD; David D. McManus, MD; Patrick T. Ellinor, MD, PhD; Martin G. Larson, ScD; Gregory L. Burke, MD, MSc; Lenore J. Launer, PhD; Albert Hofman, MD, PhD; Daniel Levy, MD; John S. Gottdiener, MD; Stefan Käåb, MD, PhD; David Couper, PhD; Tamara B. Harris, MD, MS; Elsayed Z. Soliman, MD, MS, MSc; Bruno H. C. Stricker, MB, PhD; Vilmundur Gudnason, MD, PhD; Susan R. Heckbert, MD, PhD; Emelia J. Benjamin, MD, ScM

Table 6. CHARGE-AF Risk Score for Detecting Incident AF*

Variable (X)	Estimated β Coefficient (SE)	HR (95% CI)
Age (per 5-y increment)	0.508 (0.022)	1.66 (1.59-1.74)
White race	0.465 (0.093)	1.59 (1.33-1.91)
Height (per 10-cm increment)	0.248 (0.036)	1.28 (1.19-1.38)
Weight (per 15-kg increment)	0.115 (0.033)	1.12 (1.05-1.20)
Systolic BP (per 20-mm Hg increment)	0.197 (0.033)	1.22 (1.14-1.30)
Diastolic BP (per 10-mm Hg increment)	−0.101 (0.032)	0.90 (0.85-0.96)
Smoking (current versus former/never)	0.359 (0.063)	1.42 (1.25-1.60)
Diabetes (yes)	0.237 (0.073)	1.27 (1.64-2.48)
Myocardial infarction (yes)	0.496 (0.089)	1.64 (1.38-1.96)

Alonso et al, J Am Heart Assoc. 2013

A Simple Clinical Risk Score (C₂HEST) for Predicting Incident Atrial Fibrillation in Asian Subjects

Derivation in 471,446 Chinese Subjects, With Internal Validation and External Application in 451,199 Korean Subjects

Yan-Guang Li, MD, PhD; Daniele Pastori, MD, PhD; Alessio Farcomeni, PhD; Pil-Sung Yang, MD; Eunsun Jang, MD; Boyoung Joung, MD, PhD; Yu-Tang Wang, MD, PhD; Yu-Tao Guo, MD, PhD; and Gregory Y. H. Lip, MD

TABLE 3] C₂HEST Score for Incident Atrial Fibrillation

Acronym	Risk Factor	Points
C ₂	CAD/COPD	1-2
H	Hypertension	1
E	Elderly (age ≥ 75 y)	2
S	Systolic HF	2
T	Thyroid disease (hyperthyroidism)	1
	Total points	0-8
	AUC (C index)	95% CI
C ₂ HEST score	0.749	0.729-0.769

AUC = area under the curve. See Table 1 legend for expansion of other abbreviations.

Li et al, CHEST 2019



ORIGINAL ARTICLE

Large-Scale Assessment of a Smartwatch to Identify Atrial Fibrillation

Marco V. Perez, M.D., Kenneth W. Mahaffey, M.D., Haley Hedlin, Ph.D., John S. Rumsfeld, M.D., Ph.D., Ariadna Garcia, M.S., Todd Ferris, M.D., Vidhya Balasubramanian, M.S., Andrea M. Russo, M.D., Amol Rajmane, M.D., Lauren Cheung, M.D., Grace Hung, M.S., Justin Lee, M.P.H., Peter Kowey, M.D., Nisha Talati, M.B.A., Divya Nag, Santosh E. Gummidipundi, M.S., Alexis Beatty, M.D., M.A.S., Mellanie True Hills, B.S., Sumbul Desai, M.D., Christopher B. Granger, M.D., Manisha Desai, Ph.D., and Mintu P. Turakhia, M.D., M.A.S., for the Apple Heart Study Investigators*

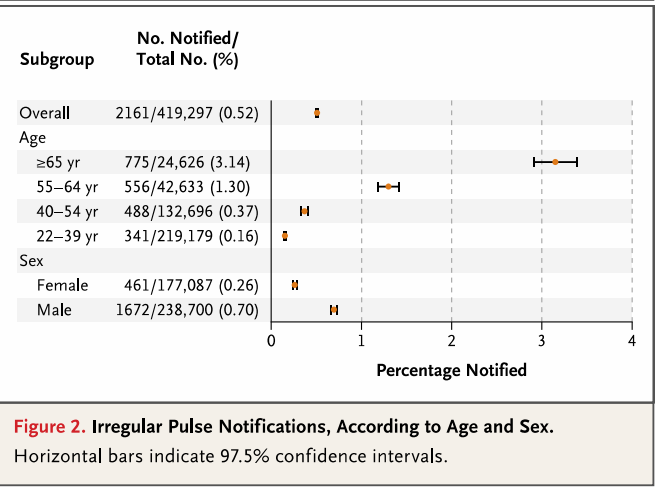


Figure 2. Irregular Pulse Notifications, According to Age and Sex. Horizontal bars indicate 97.5% confidence intervals.

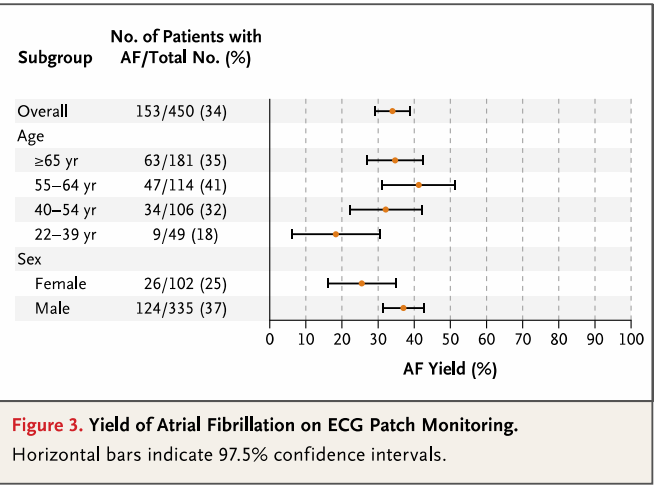


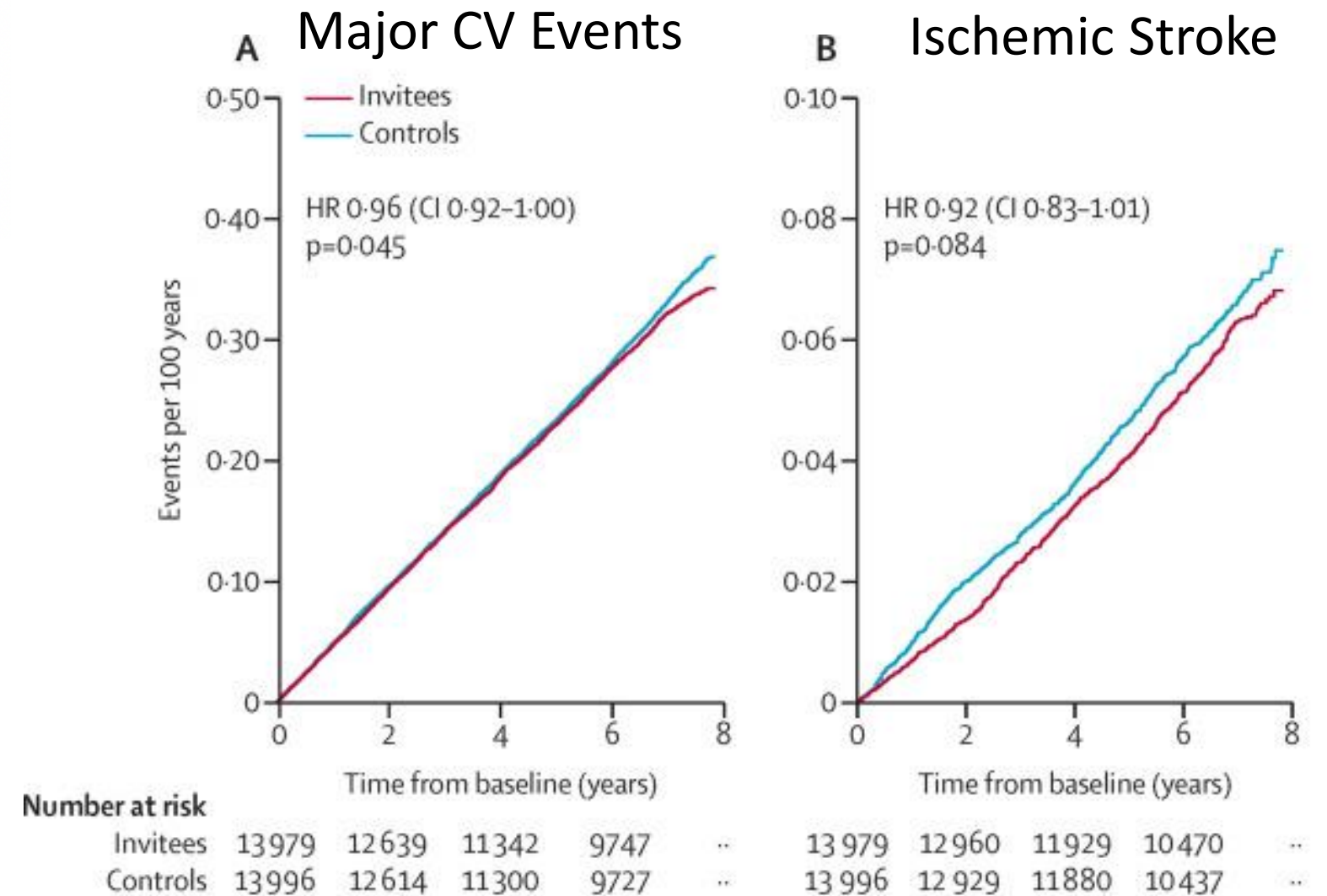
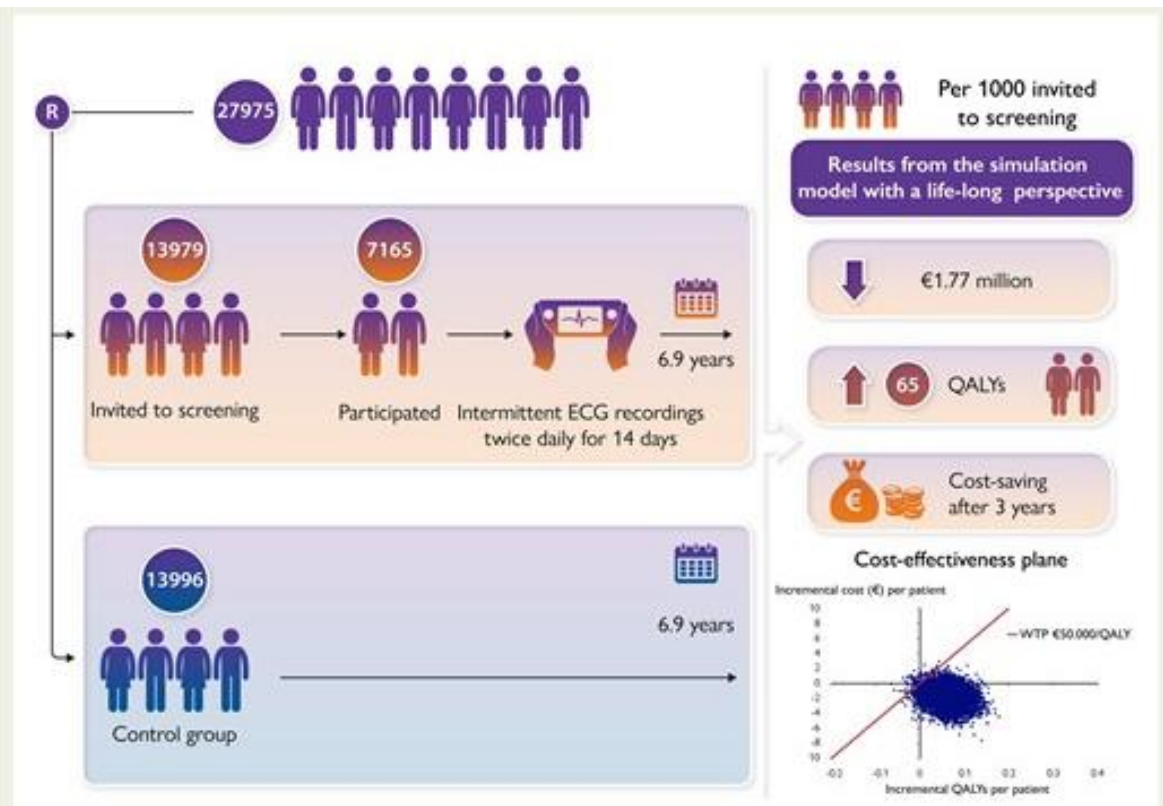
Figure 3. Yield of Atrial Fibrillation on ECG Patch Monitoring. Horizontal bars indicate 97.5% confidence intervals.

Perez et al, NEJM 2019

Does General Population Screening Impact Long-term Outcomes?

Clinical outcomes in systematic screening for atrial fibrillation (STROKESTOP): a multicentre, parallel group, unmasked, randomised controlled trial

Emma Svennberg, Leif Friberg, Viveka Frykman, Faris Al-Khalili, Johan Engdahl*, Mårten Rosenqvist*



Svennberg et al, Lancet 2021

Guideline Recommendations for General Population Screening

- AF screening is cost-effective
- No specific guidance is provided on the specific device to use
- If the screening tool does not provide an interpretable ECG (eg pulse oximetry etc), then a confirmatory ECG showing AF should be obtained if possible
- As with all screening processes, a plan for those ultimately diagnosed with AF is needed

* *ESC and US AF Guidelines 2020, 2024*

- *Specific opportunity and age*

Recommendations for screening to detect AF

Recommendation	Class ^a	Level ^b
Opportunistic screening for AF by pulse taking or ECG rhythm strip is recommended in	I	B
		B
		B
≥30 s of 12-lead ECG or 1-min ECG rhythm strip shows AF.		
Systematic ECG screening should be considered to detect AF in individuals aged ≥75 years, or those at high risk of stroke. ^{212,224,227}	IIa	B

ESC 2020

Initial evaluation:

- Exclude common treatable etiologies
- Evaluate for underlying cardiac structural pathology
- Evaluate medical comorbidities that will impact stroke risk and decisions for anticoagulation

Specific recommendations regarding coronary artery disease evaluation:

- Ischemic evaluation is appropriate if signs or symptoms suggesting CAD are present
- Routine ischemic evaluation is otherwise not indicated

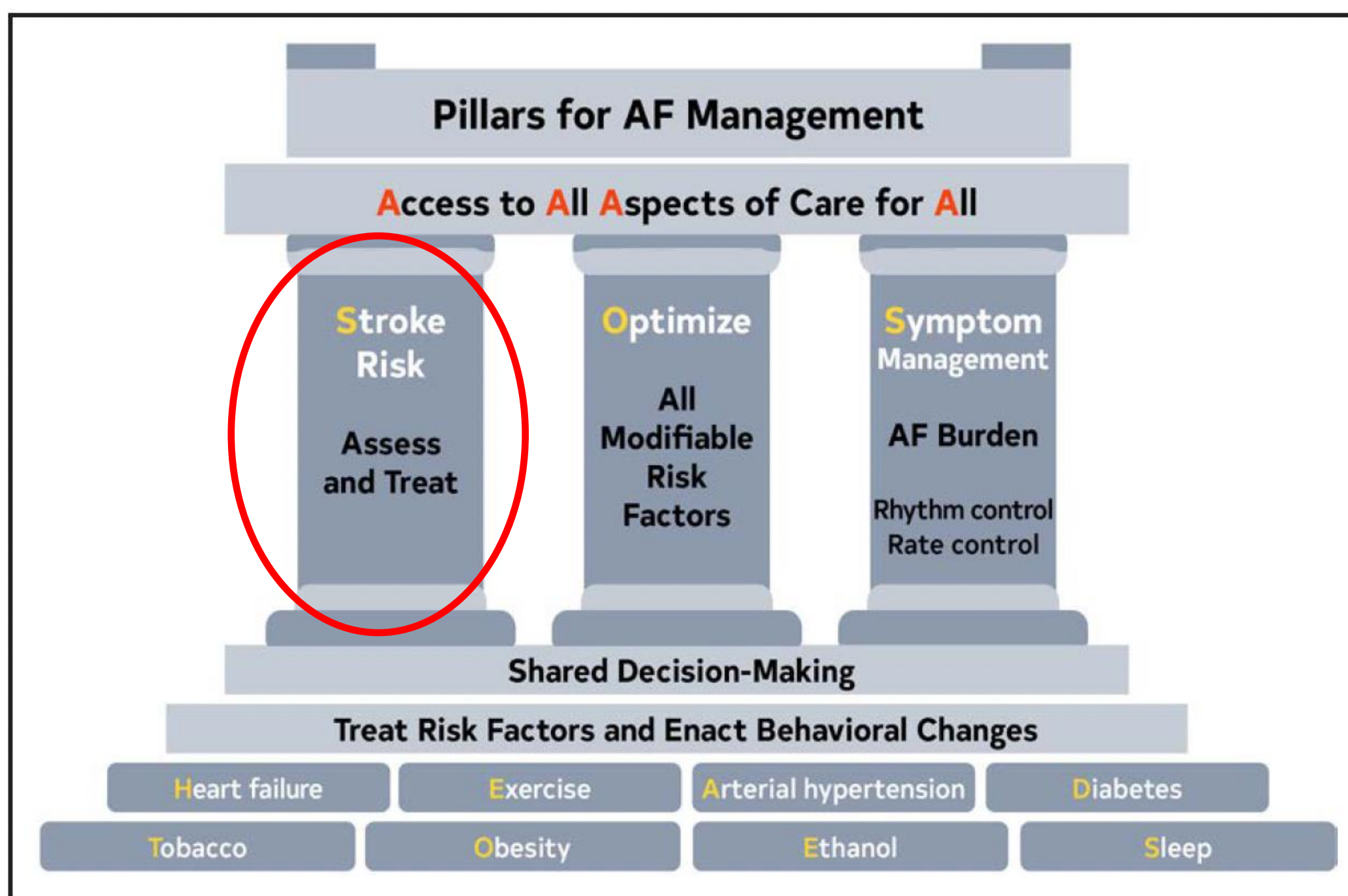
4.2.1. Basic Clinical Evaluation

Recommendations for Basic Clinical Evaluation

Referenced studies that support the recommendations are summarized in the [Online Data Supplement](#).




COR	LOE	Recommendations
1	B-NR	1. In patients with newly diagnosed AF, a transthoracic echocardiogram ¹⁻⁴ to assess cardiac structure, laboratory testing to include a complete blood count, metabolic panel, and thyroid function, ⁵⁻⁷ and when clinical suspicion exists, targeted testing to assess for other medical conditions associated with AF are recommended to determine stroke and bleeding risk factors, as well as underlying conditions that will guide further management.
3: No benefit	B-NR	2. In patients with newly diagnosed AF, protocolized testing for ischemia, acute coronary syndrome (ACS), and pulmonary embolism (PE) should not routinely be performed to assess the etiology of AF unless there are additional signs or symptoms to indicate those disorders. ⁸⁻¹⁰

Next steps? AHA/ACC Guidelines







Joglar J, et al. *AHA/ACC/HRS 2024 guideline for the management of patients with atrial fibrillation*. Circulation, 2024.

Major CV Outcomes

AF-Related Outcome	Frequency in AF	Mechanism(s)
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LV dysfunction / Heart failure 	In 20-30% of AF patients	<ul style="list-style-type: none"> • Excessive ventricular rate • Irregular ventricular contractions • A primary underlying cause of AF

Additional Manifestations

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Impaired quality of life 	>60% of patients	<ul style="list-style-type: none"> • Related to AF burden, comorbidities, psychological functioning and medication • Distressed personality type
Hospitalizations 	10-40% annual hospitalization rate	<ul style="list-style-type: none"> • AF management, related to HF, MI or AF related symptoms • Treatment-associated complications

Virchow's Triad and Atrial Fibrillation

Loss of mechanical atrial contraction of the LAA leads to blood flow stasis



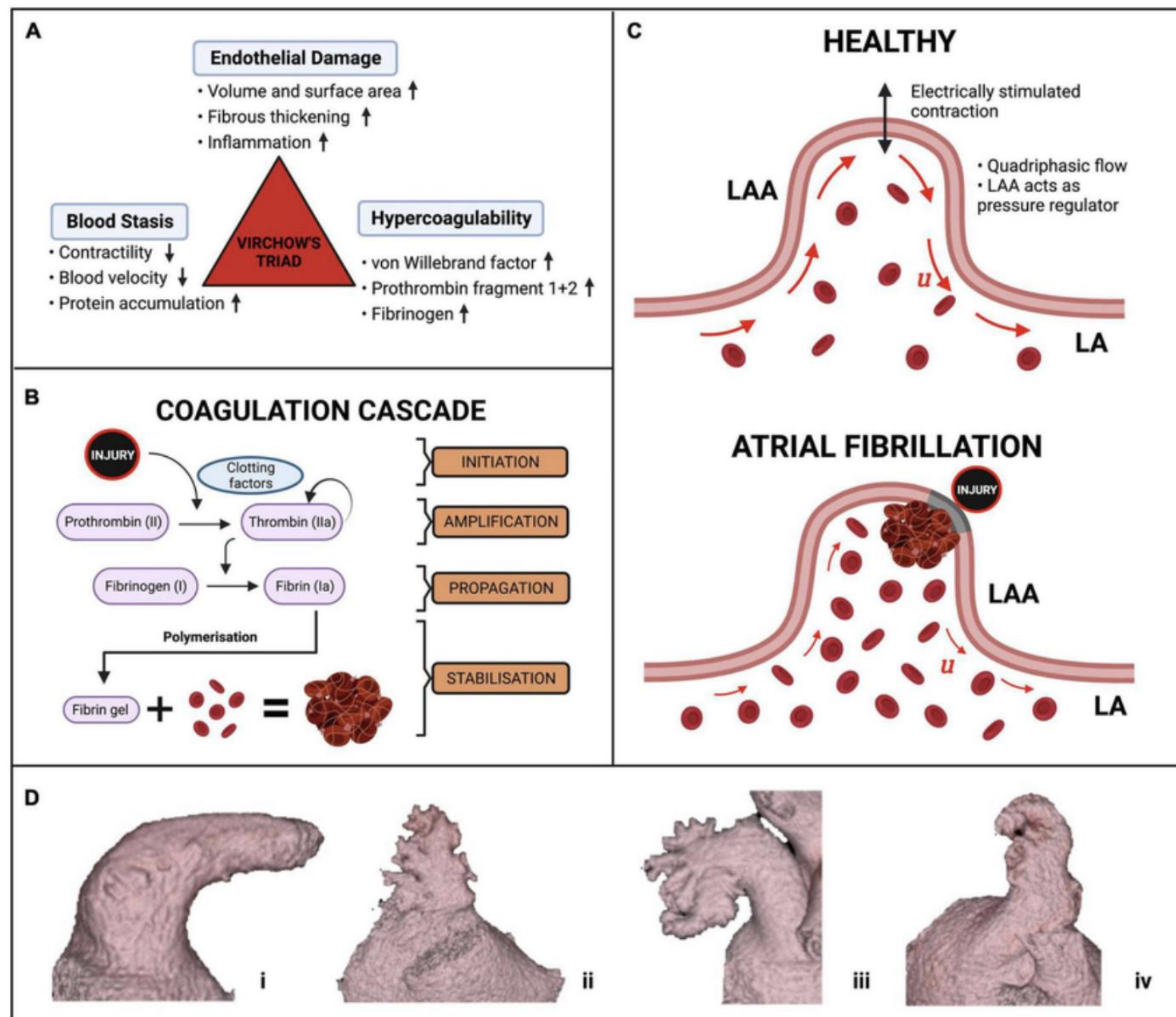
The stagnant blood may coagulate and form thrombus



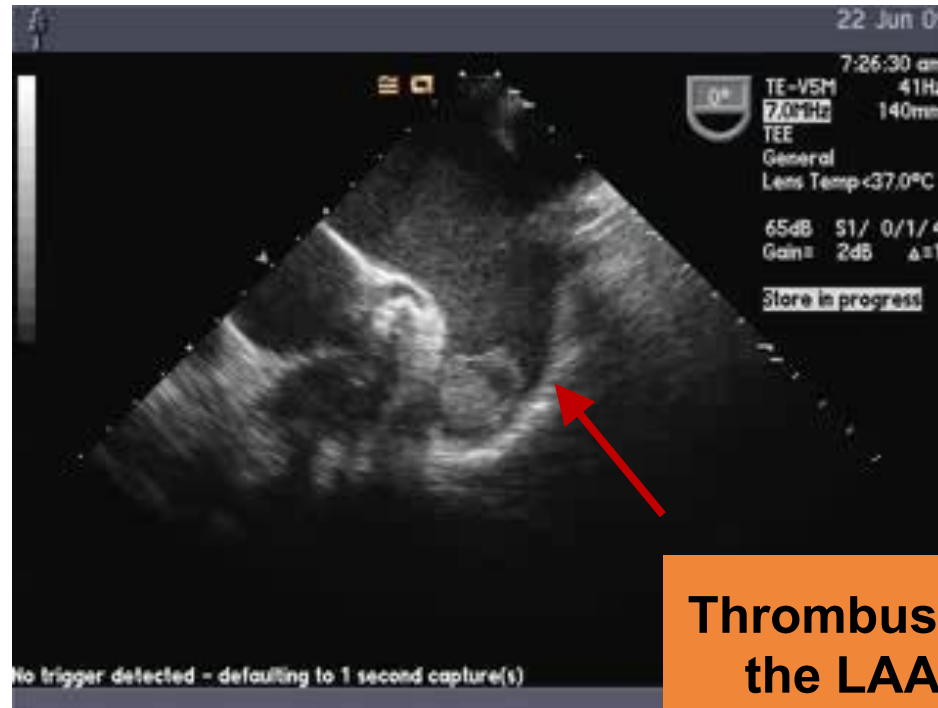
Dislodgement of the thrombus, with distal embolization in the cerebral circulation



Occlusion of the cerebral circulation leads to stroke



Stroke Risk: ~90% of stroke in AF is caused by blood clots that form in the left atrial appendage (LAA)¹



Thrombus in the LAA

Thrombus Revealed by Transesophageal Echocardiography

A total of 76 patients (13.8 percent) with right or left heart thrombi were identified among the 549 patients who underwent a transesophageal echocardiographic examination. Of these 76 patients with thrombi, 67 (88.2 percent) had a thrombus in the left atrial appendage. None of the patients with thrombi had an embolic event during the eight-week study, although four of these patients died from various

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USE OF TRANSESOPHAGEAL ECHOCARDIOGRAPHY TO GUIDE CARDIOVERSION IN PATIENTS WITH ATRIAL FIBRILLATION

ALLAN L. KLEIN, M.D., RICHARD A. GRIMM, D.O., R. DANIEL MURRAY, PH.D., CAROLYN APPERSON-HANSEN, M.STAT.,
RICHARD W. ASINGER, M.D., IAN W. BLACK, M.D., RAVIN DAVIDOFF, M.B., B.CH., RAIMUND ERBEL, M.D.,
JONATHAN L. HALPERIN, M.D., DAVID A. ORSINELLI, M.D., THOMAS R. PORTER, M.D., AND MARCUS F. STODDARD, M.D.,
FOR THE ASSESSMENT OF CARDIOVERSION USING TRANSESOPHAGEAL ECHOCARDIOGRAPHY INVESTIGATORS*

¹ *Blackshear JL. Odell JA., Annals of Thoracic Surgery. 1996*

² *Klein et al., NEJM 2001*

Stroke Risk and AF: CHA₂DS₂-VASc

CHA2DS2-VASc Risk Criteria	Points
C ongestive Heart Failure/LV Dysfunction	1
H ypertension	1
A ge ≥ 75 Years	2
D iabetes Mellitus	1
Prior S troke, TIA, thromboembolism	2
Peripheral V ascular Disease or Coronary Artery Disease	1
A ge 65-74 Years	1
S ex Category (i.e., Female Sex)	1

Score	Adjusted stroke rate (%/year) based on CHA ₂ DS ₂ -VASc score
0	0
1	1.3
2	2.2
3	3.2
4	4.0
5	6.7
6	9.8
7	9.6
8	6.7
9	15.2

- Complicated
- Too non-granular
- Limited external validation
- Limited data on reclassification improvement

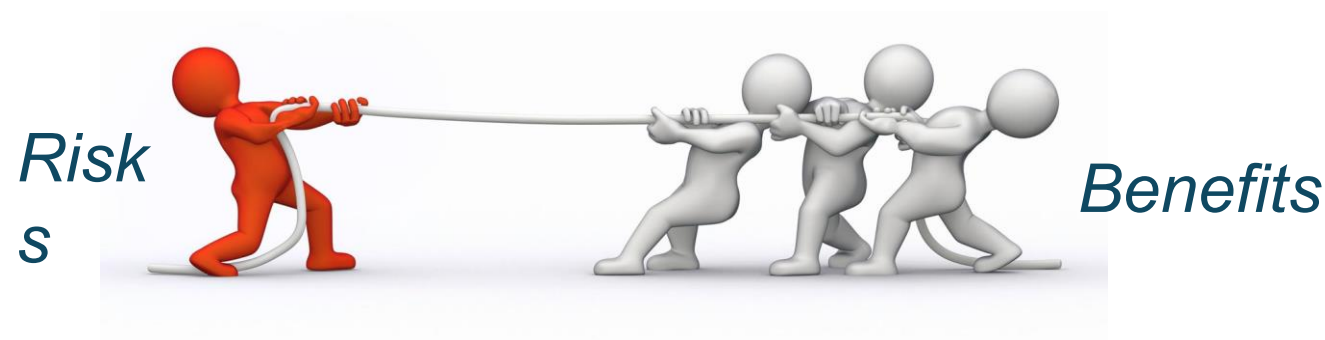
Bleeding Risk on Anticoagulation

Table 10 Clinical risk factors in the HAS-BLED score³⁹⁵

Risk factors and definitions		Points awarded
H	Uncontrolled hypertension SBP >160 mmHg	1
A	Abnormal renal and/or hepatic function Dialysis, transplant, serum creatinine >200 µmol/L, cirrhosis, bilirubin > × 2 upper limit of normal, AST/ALT/ALP >3 × upper limit of normal	1 point for each
S	Stroke Previous ischaemic or haemorrhagic ^a stroke	1
B	Bleeding history or predisposition Previous major haemorrhage or anaemia or severe thrombocytopenia	1
L	Labile INR^b TTR <60% in patient receiving VKA	1
E	Elderly Aged >65 years or extreme frailty	1
D	Drugs or excessive alcohol drinking Concomitant use of antiplatelet or NSAID; and/or excessive ^c alcohol per week	1 point for each
Maximum score		9

© ESC 2020

**These
factors also
affect risk
of stroke**



CHA ₂ DS ₂ -Vasc Score	
0 men, 1 women	“reasonable to omit anticoagulation”
1 men, 2 women	“anticoagulation may be considered”
≥ 2	“anticoagulation is recommended”

Current Guidelines: AHA/ACC/HRS + ESC:

- Anticoagulation decisions based on CHA₂DS₂-Vasc Score irrespective of AF burden
- **After catheter ablation**, anticoagulation should be continued based on CHA₂DS₂-Vasc Score, irrespective of AF burden

8.4.4. Anticoagulation Therapy Before and After Catheter Ablation

Recommendations for Anticoagulation Therapy Before and After Catheter Ablation

Referenced studies that support the recommendations are summarized in the [Online Data Supplement](#).

COR	LOE	Recommendations
1	B-NR	1. In patients on warfarin who are undergoing catheter ablation of AF, catheter ablation should be performed on uninterrupted therapeutic anticoagulation with a goal INR of 2.0 to 3.0. ¹
1	A	2. In patients on a DOAC who are undergoing catheter ablation of AF, catheter ablation should be performed with either continuous or minimally interrupted oral anticoagulation. ²⁻¹⁰
1	B-NR	3. In patients who have undergone catheter ablation of AF, oral anticoagulation should be continued for at least 3 months after the procedure with a longer duration determined by underlying risk. ¹¹
1	B-NR	4. In patients who have undergone catheter ablation of AF, continuation of longer-term oral anticoagulation should be dictated according to the patients' stroke risk (eg, CHA ₂ DS ₂ -VASc score ≥ 2). ¹¹⁻¹⁷

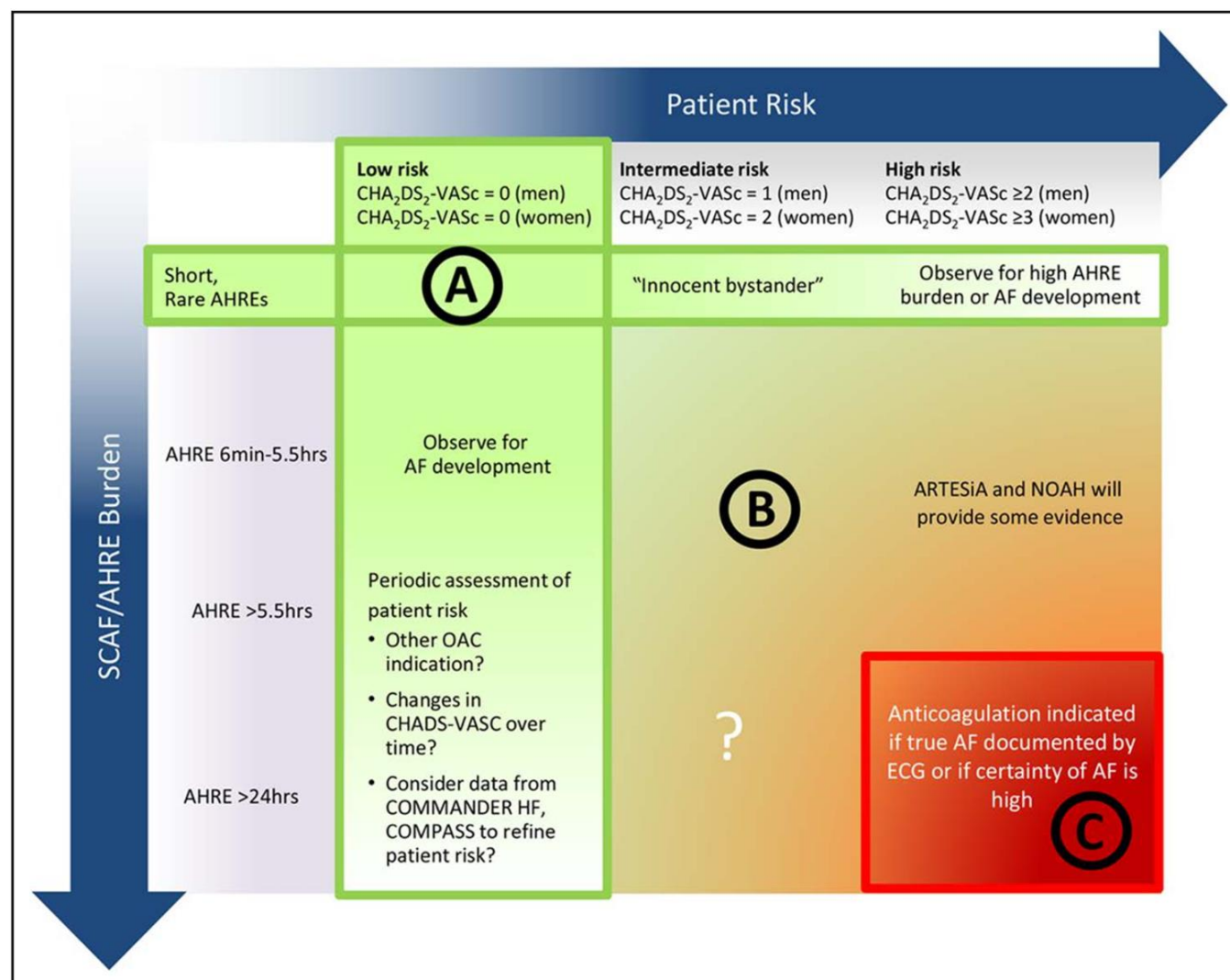
11. Packer DL, Mark DB, Robb RA, et al. Effect of catheter ablation vs antiarrhythmic drug therapy on mortality, stroke, bleeding, and cardiac arrest among patients with atrial fibrillation: the CABANA randomized clinical trial. *JAMA*. 2019;321:1261–1274.
12. Steinberg BA, Hellkamp AS, Lokhnygina Y, et al. Higher risk of death and stroke in patients with persistent vs paroxysmal atrial fibrillation: results from the ROCKET-AF Trial. *Eur Heart J*. 2015;36:288–296.
13. Al-Khatib SM, Thomas L, Wallentin L, et al. Outcomes of apixaban vs warfarin by type and duration of atrial fibrillation: results from the ARISTOTLE trial. *Eur Heart J*. 2013;34:2464–2471.
14. Uittenbogaart SB, Lucassen WAM, van Etten-Jamaludin FS, et al. Burden of atrial high-rate episodes and risk of stroke: a systematic review. *Europace*. 2018;20:1420–1427.
15. Reynolds MR, Gunnarsson CL, Hunter TD, et al. Health outcomes with catheter ablation or antiarrhythmic drug therapy in atrial fibrillation: results of a propensity-matched analysis. *Circ Cardiovasc Qual Outcomes*. 2012;5:171–181.
16. Friberg L, Tabrizi F, Englund A. Catheter ablation for atrial fibrillation is associated with lower incidence of stroke and death: data from Swedish health registries. *Eur Heart J*. 2016;37:2478–2487.
17. Marrouche NF, Brachmann J, Andresen D, et al. Catheter ablation for atrial fibrillation with heart failure. *N Engl J Med*. 2018;378:417–427.

- Impact of AF Burden
- New data on Left Atrial Appendage Closure (LAAO)
- New data on Impact of Catheter Ablation on stroke risk and need for anticoagulation long-term

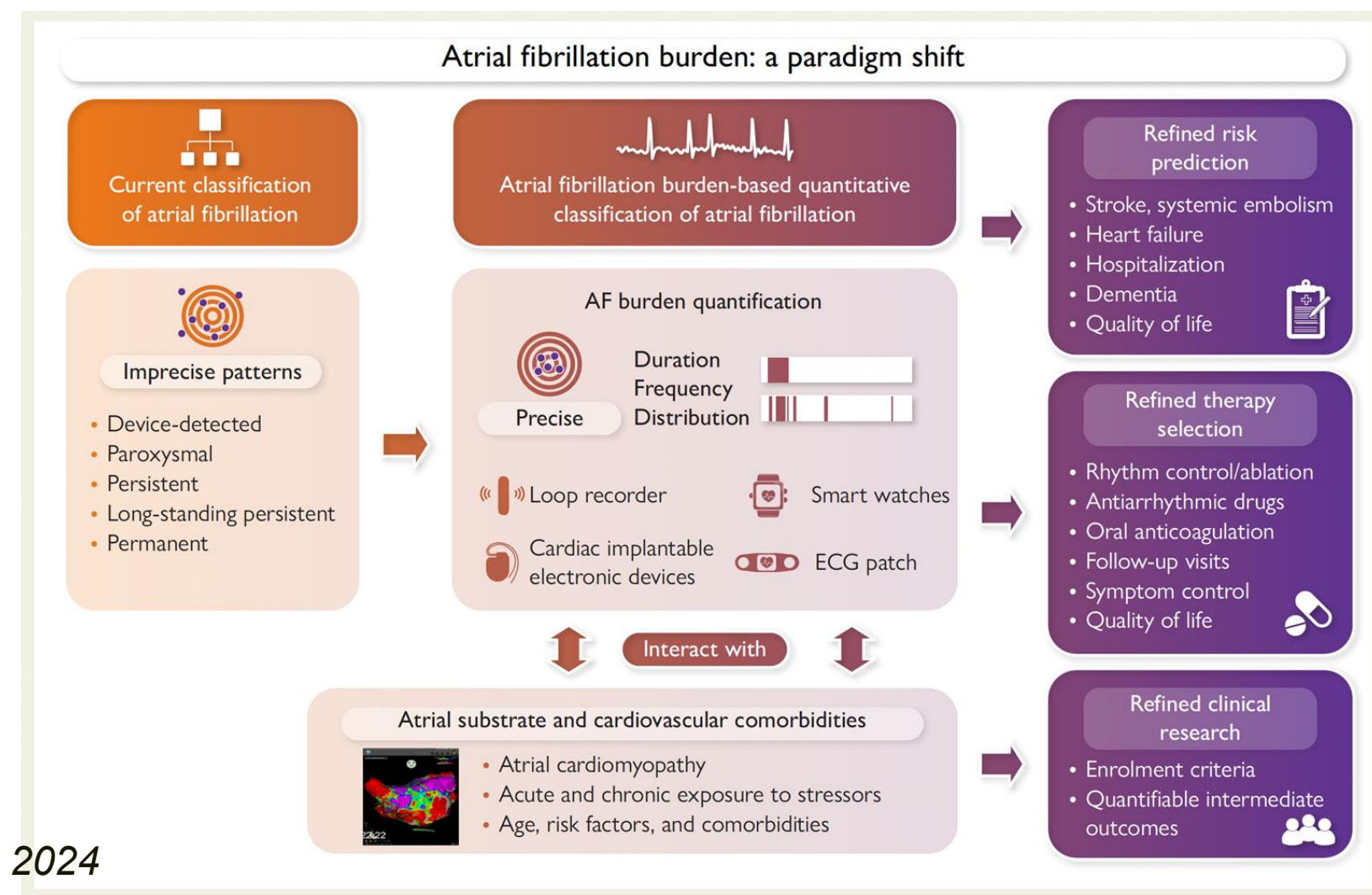
AF Burden – Impact on Stroke Risk

Emerging questions

- AF Burden is emerging as an important determinant of stroke risk
- Does reduction of AF burden (ie, rhythm control) reduce stroke risk?



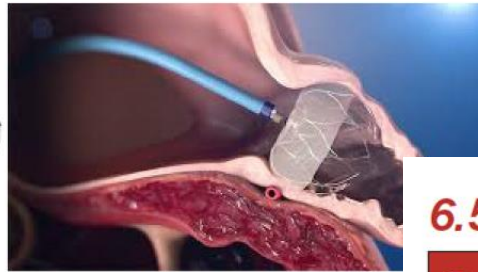
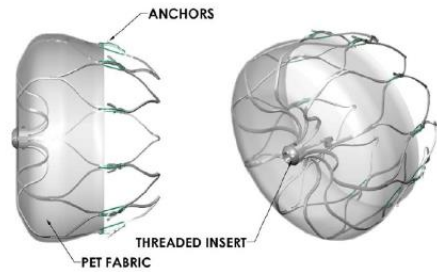
Joglar et al, AHA/ACC Guidelines 2023/2024



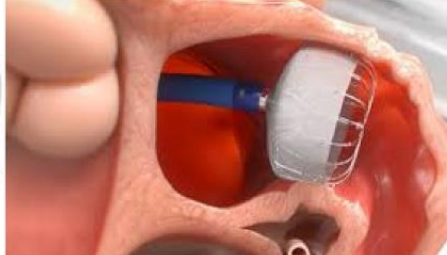
Becher et al, EHJ 2024

LA Appendage Exclusion

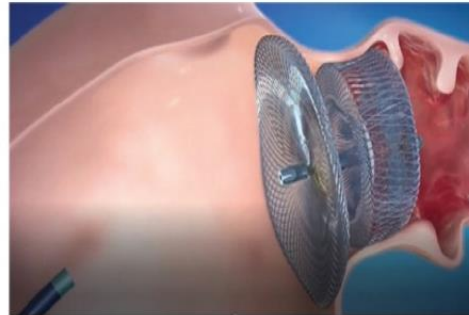
A. Watchman Device



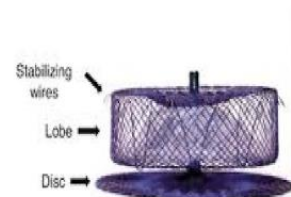
B. Watchman FLX Device



C. Amplatzer Cardiac Plug



D. Amplatzer Amulet



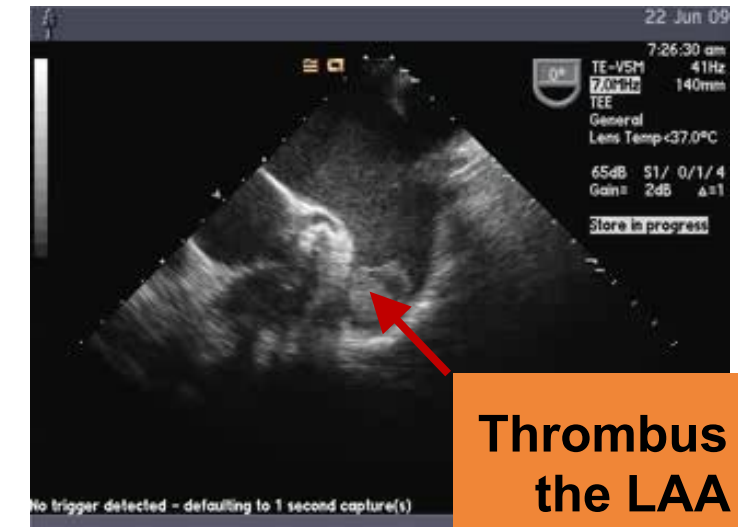
- ~88% of thrombi causing AF related thromboembolic strokes originate in the LAA
- Exclusion of the LAA prevents blood entry into the LAA, and

6.5.1. Percutaneous Approaches to Occlude the LAA

Recommendations for Percutaneous Approaches to Occlude the LAA
Referenced studies that support the recommendations are summarized in the [Online Data Supplement](#).

COR	LOE	Recommendations
2a	B-NR	1. In patients with AF, a moderate to high risk of stroke (CHA ₂ DS ₂ -VASc score ≥2), and a contraindication (Table 14) to long-term oral anticoagulation due to a nonreversible cause, percutaneous LAAO (pLAAO) is reasonable. ¹⁻⁴
2b	B-R	2. In patients with AF and a moderate to high risk of stroke and a high risk of major bleeding on oral anti-coagulation, pLAAO may be a reasonable alternative to oral anticoagulation based on patient preference, with careful consideration of procedural risk and with the understanding that the evidence for oral anticoagulation is more extensive. ^{1-3,5,6}

in US and Europe: Watchman
Amplatzer/Amulet
Warfarin, NOAC results emerging



Thrombus in the LAA



Lariat Device

¹ Blackshear JL, Odell JA., *Annals of Thoracic Surgery*. 1996

² Klein et al., *NEJM* 2001

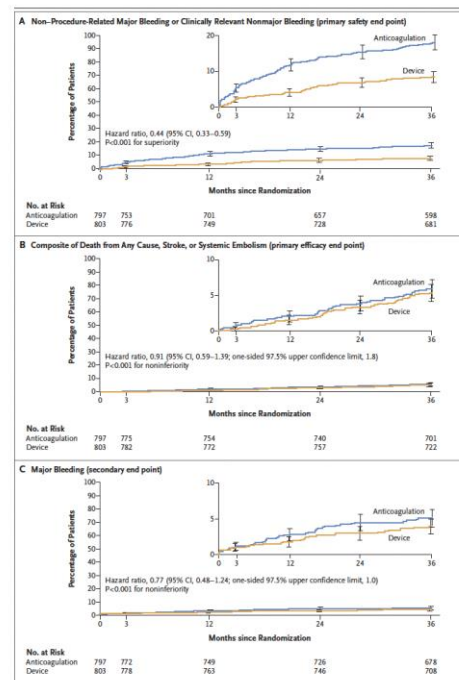
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Left Atrial Appendage Closure after Ablation for Atrial Fibrillation

O.M. Wazni, W.I. Saliba, D.G. Nair, E. Marijon, B. Schmidt, T. Hounshell, H. Ebel, C. Skurk, S. Oza, C. Patel, A. Kanagasundram, A. Sadhu, S. Sundaram, J. Osorio, G. Mark, M. Gupta, D.B. DeLurgio, J. Olson, J.E. Nielsen-Kudsk, L.V.A. Boersma, J.S. Healey, K.P. Phillips, F.M. Asch, K. Wolski, K. Roy, T. Christen, B.S. Sutton, K.M. Stein, and V.Y. Reddy, for the OPTION Trial Investigators*

- RCT – AF ablation +/- LAAO
- LAAO reduces major and minor bleeding
- No significant difference in CVA
- Both arms had notably lower CVA rates



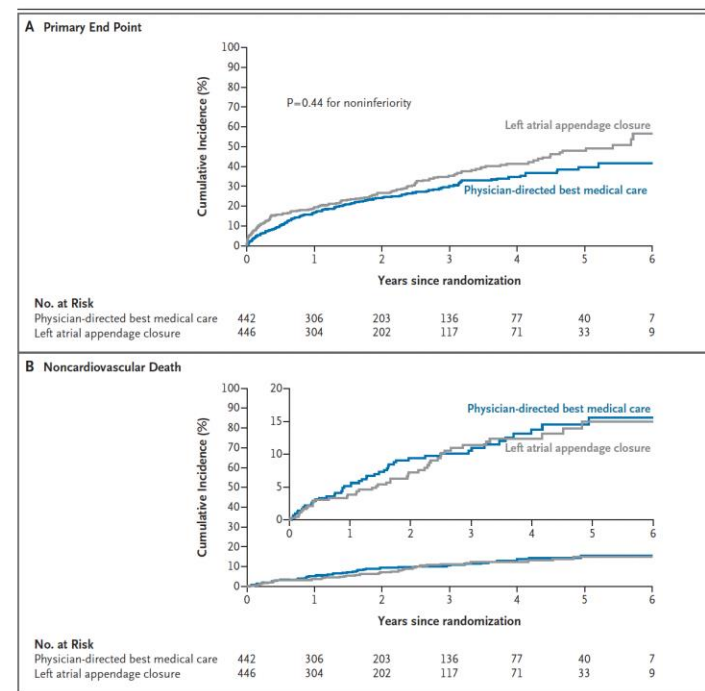
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Left Atrial Appendage Closure or Medical Therapy in Atrial Fibrillation

U. Landmesser,^{1,3} C. Skurk,^{1,2} P. Kirchhof,⁴⁻⁶ T. Lewalter,⁷ J. Hartung,^{1,2} A. Rroku,¹ B. Pieske,⁸ J. Brachmann,⁹ I. Akin,¹⁰ C. Jacobshagen,¹¹ B. Meder,^{12,13} A. Zeiher,^{14,15} S.D. Anker,^{2,16} H. Thiele,¹⁷ S. Blankenberg,^{4,5} S. Massberg,^{18,19} H. Schunkert,^{19,20} N. Frey,^{12,13} A. Joost,^{5,21} M. Bergmann,²² R.S. von Bardeleben,²³ T. Friede,^{24,25} M. Placzek,^{24,25} A. Suling,²⁶ K.G. Haeusler,²⁷ M. Endres,^{2,28} K. Wegscheider,^{5,26} L.-H. Boldt,^{2,29} and I. Eitel,^{5,21} for the CLOSURE-AF Trial Investigators*

- European RCT – LAAO vs. AC in AF
- LAAO arm worse composite endpoint, driven by procedural bleeding (complications)



The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Left Atrial Appendage Closure or Anticoagulation for Atrial Fibrillation

S.K. Doshi,^{1,2} S. Kar,³ D.G. Nair,⁴ T. Waggoner,⁵ H. Agarwal,⁶ M. Moussavian,⁷ A. Kashani,⁸ S. Oza,⁹ L. Feldman,¹⁰ A. Sadhu,¹¹ D. DeLurgio,¹² O. Alli,¹³ J.E. Nielsen-Kudsk,¹⁴ M. Yamamoto,¹⁵ M. Alkhouli,¹⁶ A.J. Camm,¹⁷ M. Coylewright,¹⁸ C.M. Gibson,¹⁹ C.B. Granger,²⁰ M.E. Guroi,²¹ K.C. Huber,²² M. Mansour,²¹ A. Natale,^{23,24} S.J. Pocock,²⁵ V.Y. Reddy,²⁶ W.I. Saliba,²⁷ F.M. Asch,²⁸ S. Wehrenberg,²⁹ K. Frost,²⁹ T. Christen,²⁹ B.S. Sutton,²⁹ K.M. Stein,²⁹ M.B. Leon,³⁰ and K.A. Ellenbogen,³¹ for the CHAMPION-AF Investigators*

- RCT – LAA vs. AC in AF
- Noninferiority design
- LAAO reduces minor bleeding
- Numerically higher non-significant CVA rates in LAAO arm

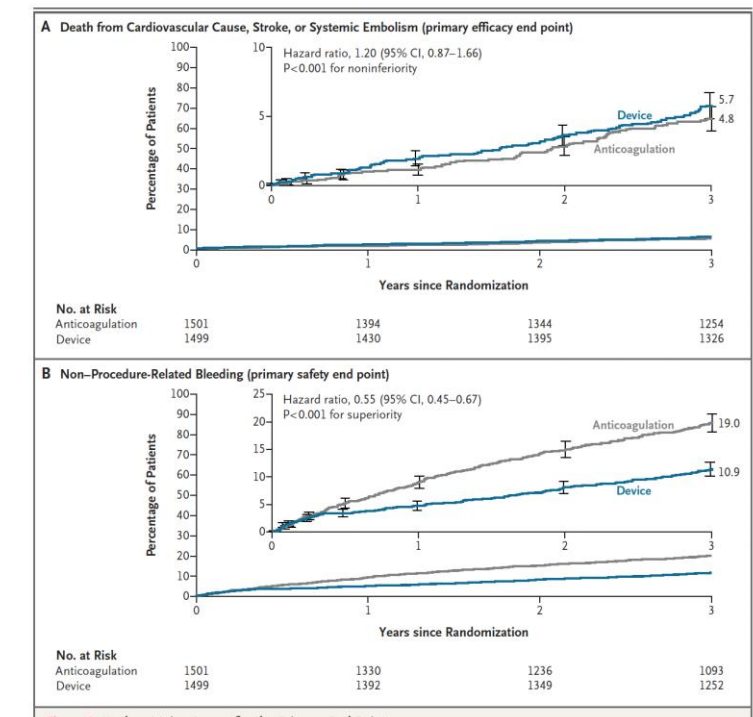


Figure 2. Kaplan-Meier Curves for the Primary End Points.

But is Anticoagulation or LAAO Needed at All After Ablation?

- Some non-randomized observational data suggests AF burden correlates with stroke risk ¹
- Some non-randomized observation data suggests lower stroke risk after catheter ablation²
- **Hypothesis: reduction or elimination of AF burden significantly reduces stroke risk**
- **Hypothesis: the reduction in stroke risk renders it safe to stop anticoagulation**

¹Joglar et al, AHA/ACC Guidelines 2023/2024

²Kanaoka K, et al. Eur Heart J. 2024

JAMA | Original Investigation

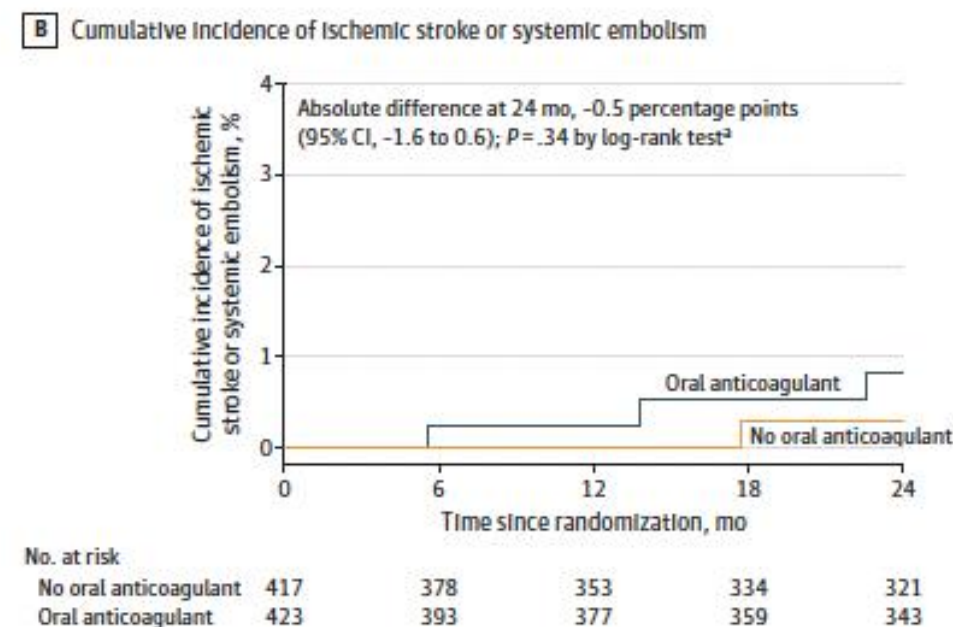
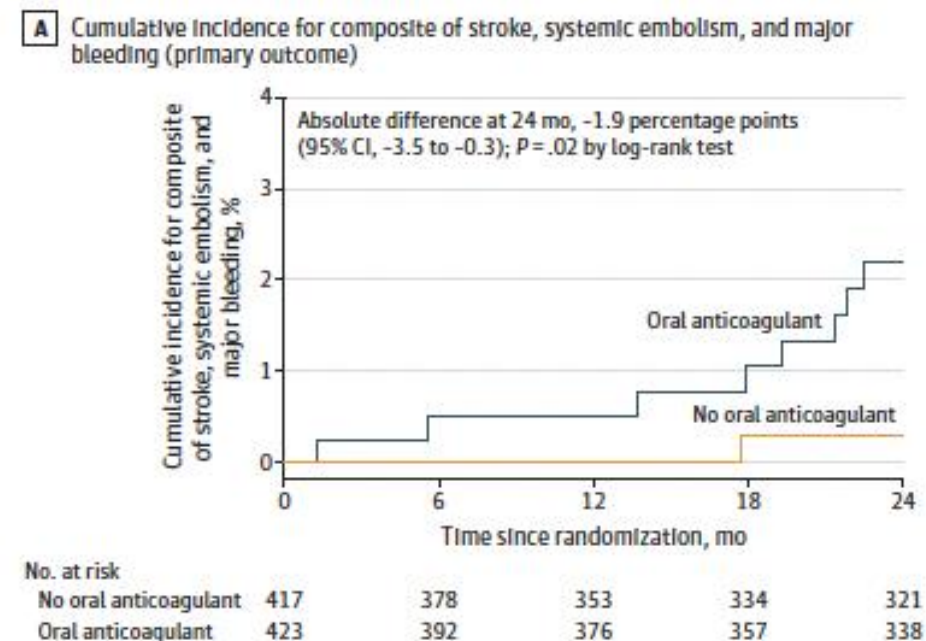
Long-Term Anticoagulation Discontinuation After Catheter Ablation for Atrial Fibrillation

The ALONE-AF Randomized Clinical Trial

Daehoon Kim, MD; Jaemin Shim, MD; Eue-Keun Choi, MD; Il-Young Oh, MD; Jun Kim, MD; Young Soo Lee, MD; Junbeom Park, MD; Jum-Suk Ko, MD; Kyoung-Min Park, MD; Jung-Hoon Sung, MD; Hyung Wook Park, MD; Hyung-Seob Park, MD; Jong-Youn Kim, MD; Ki-Woon Kang, MD; Dongmin Kim, MD; Jin-Kyu Park, MD; Dae-Hyeok Kim, MD; Jin-Bae Kim, MD; Hee Tae Yu, MD; Tae-Hoon Kim, MD; Jae-Sun Uhm, MD; Hui-Nam Pak, MD; Boyoung Joung, MD; for the ALONE-AF Investigators

- 840 patients >1y after AF ablation without documented AF randomized 1:1 discontinuation or continuation of DOAC
- Mean CHA2DS2-VASc = 2
- Composite end point (stroke, systemic embolism, major bleed) 0.3% vs. 2.2% discontinue vs. continue
- **Nonsignificant difference in stroke**
- **Significant reduction in bleeds**

Figure 2. Primary and Secondary Outcomes





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
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ORIGINAL ARTICLE



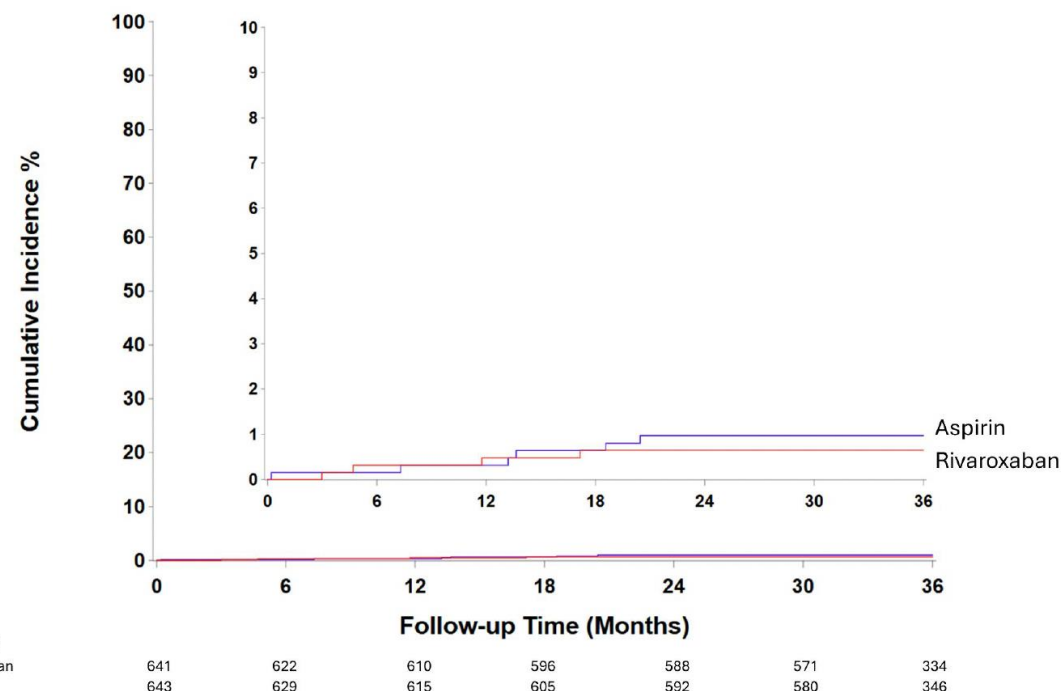
Antithrombotic Therapy after Successful Catheter Ablation for Atrial Fibrillation

Authors: Atul Verma, M.D. , David H. Birnie, M.D., Chenyang Jiang, M.D., Ph.D., Hein Heidbüchel, M.D., Gerhard Hindricks, M.D., Paulus Kirchhof, M.D., D.Sc., Jeff S. Healey, M.D. ,  +22, for the OCEAN Investigators* [Author](#)
[Info & Affiliations](#)

Published November 8, 2025 | DOI: 10.1056/NEJMoa2509688 | [Copyright © 2025](#)

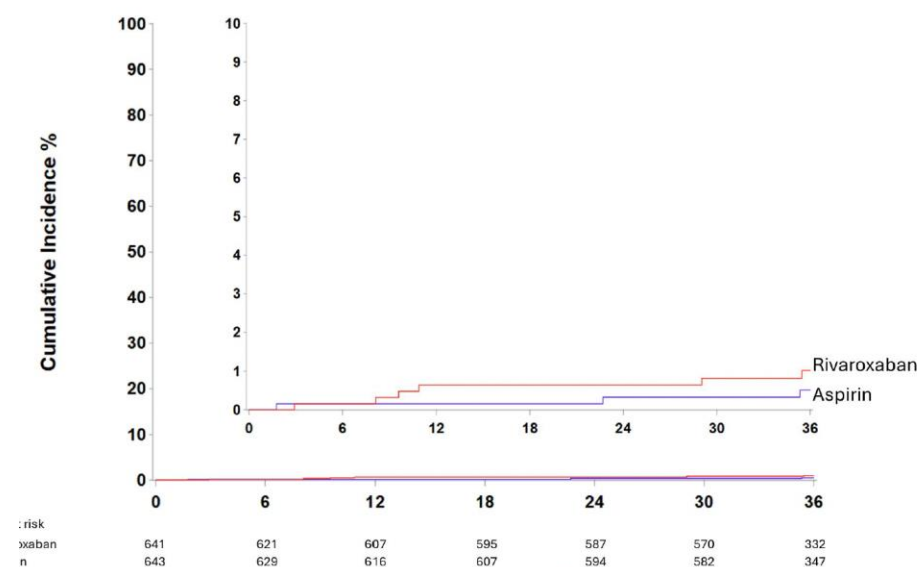


Figure 3 – Cumulative Incidence Curves of Stroke and Systemic Embolism



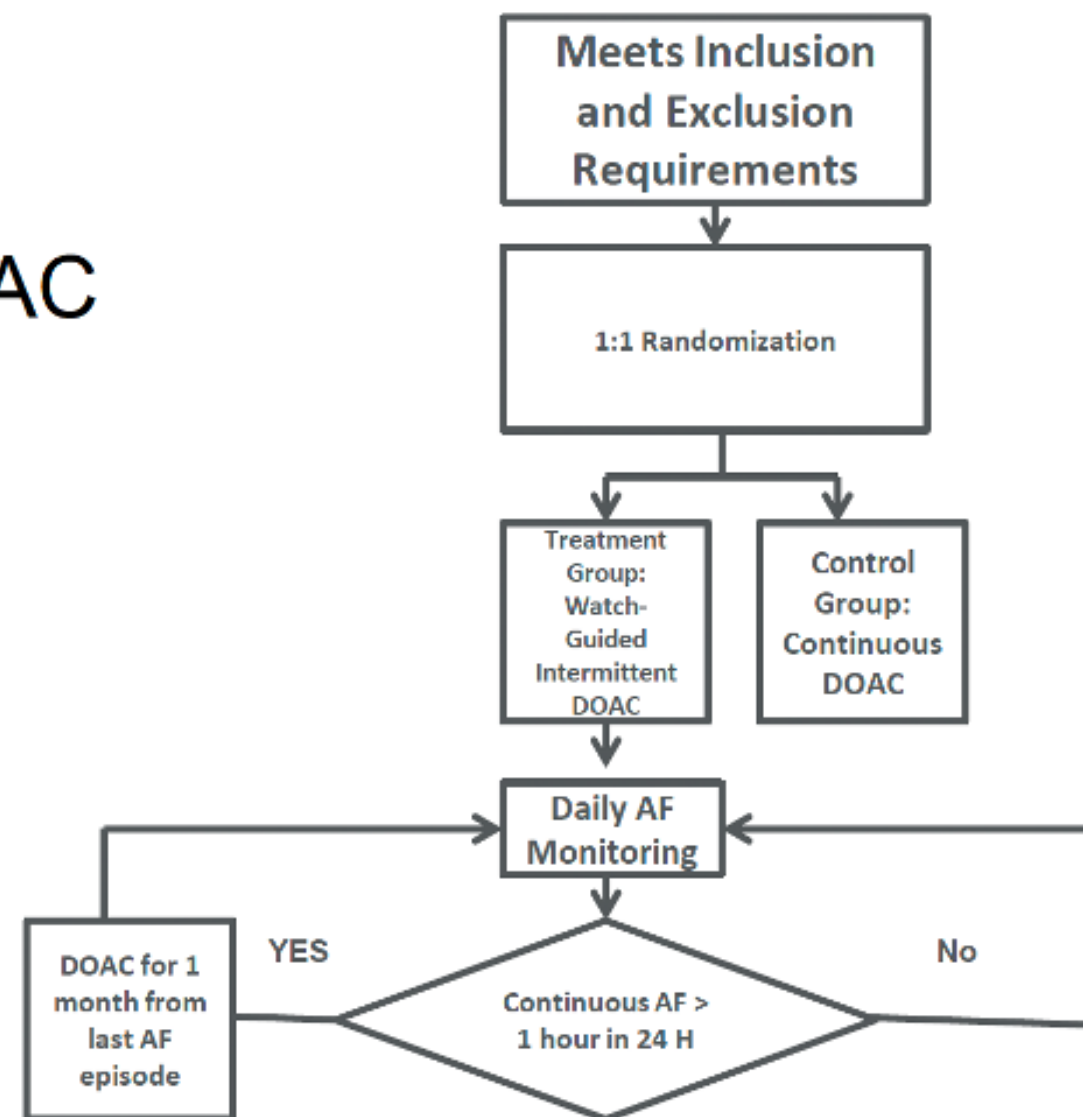
- 1241 patients >1y after AF ablation without documented AF randomized 1:1 continue rivaroxaban 15mg vs. 81mg ASA
- Mean CHA2DS2-VASc = 2.2
- 3 year f/u
- Composite end point (stroke, systemic embolism, silent MRI infarct) NS difference
- Major and non-major bleeding higher in AC arm

Figure 2 – Cumulative Incidence Curves of Fatal and Major Bleeding



REACT-AF: STUDY OVERVIEW

- **1:1 randomized trial**
 - Chronic DOAC
 - Smartwatch-guided/targeted DOAC
- **Primary endpoint (non-inferiority)**
 - Ischemic stroke
 - Systemic embolism
 - All-cause mortality
- **Secondary endpoint (superiority)**
 - Major bleeds
- **5350 pts / 80-100 US sites**
- **Follow-up for 3-5 years**

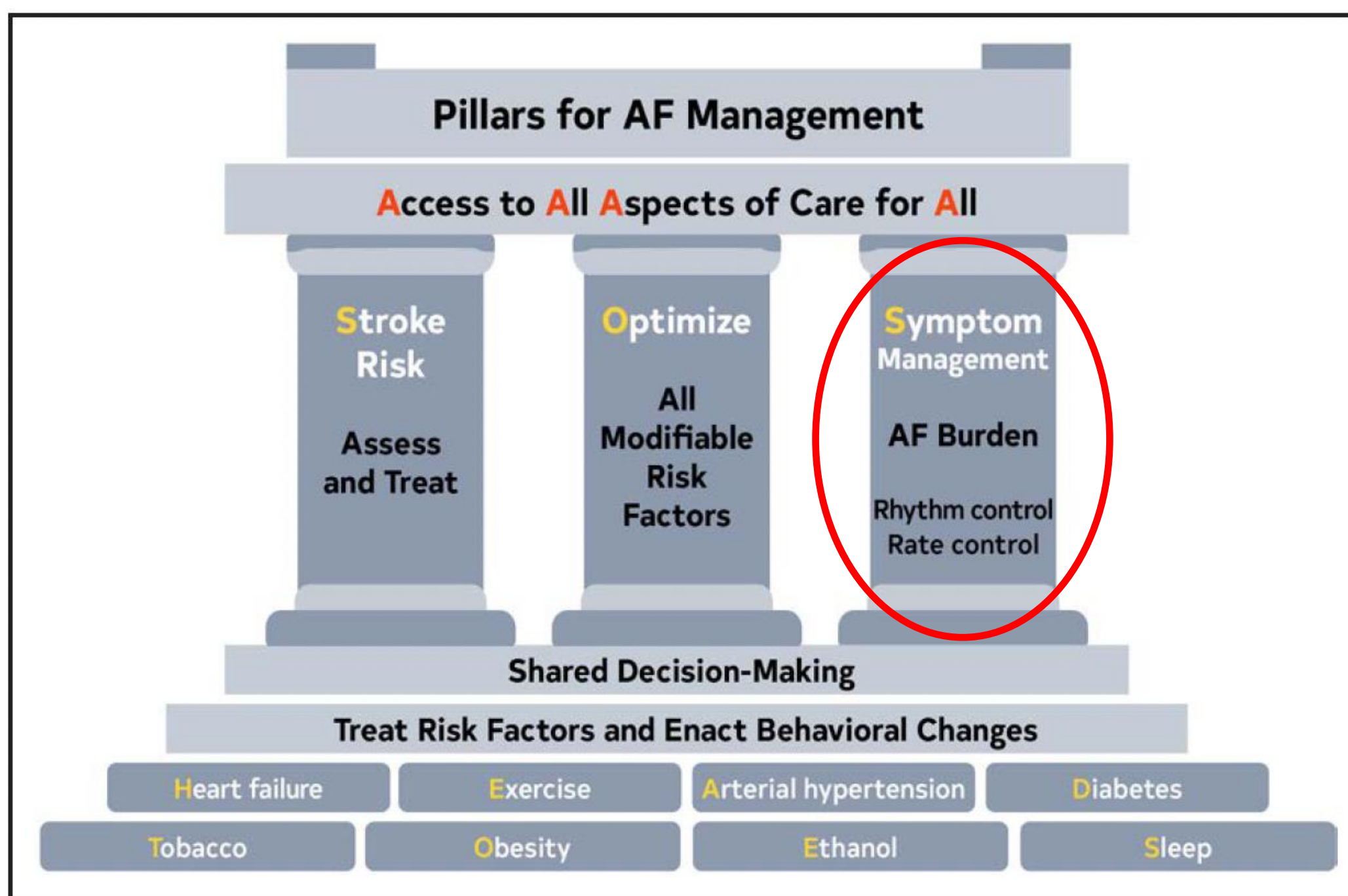


Questions Raised by Recent Data:

Updated Stroke Risk Management Strategies?

- Should stroke reduction be an indication for catheter ablation?
- What are the updated appropriate criteria for LAAO, whether standalone or concomitant with AF ablation?
- What is the best strategy?
 - 1) If ablation effective/successful, discontinue anticoagulation
 - 2) Continue to consider LAAO an alternative to AC (not a first line therapy)
 - 3) What is the “warranty” on AF ablation enabling discontinuation of AC?

Next steps? AHA/ACC Guidelines



Joglar J, et al. AHA/ACC/HRS 2024 guideline for the management of patients with atrial fibrillation. Circulation, 2024.

- **That Was Then:**

- The AFFIRM, RACE, and AF-CHF trials showed no mortality benefit to a rhythm control strategy compared to a rate control strategy.
- But these studies are >20-30 years old, before current ablation strategies, anticoagulation recommendations (AC was typically stopped in patients in the rhythm control arm)

- **This is Now:**

- Newest studies demonstrate across the board benefit to *early* rhythm control/ablation strategy
- Benefit includes not only ability to maintain sinus rhythm, but reduced hospitalizations, improved morbidity, improved *mortality*

The Atrial Fibrillation Follow-Up Investigation of Rhythm Management (AFFIRM) Investigators. *A comparison of rate control and rhythm control in patients with atrial fibrillation.* N Engl J Med. 2002;347: 1825-1833.

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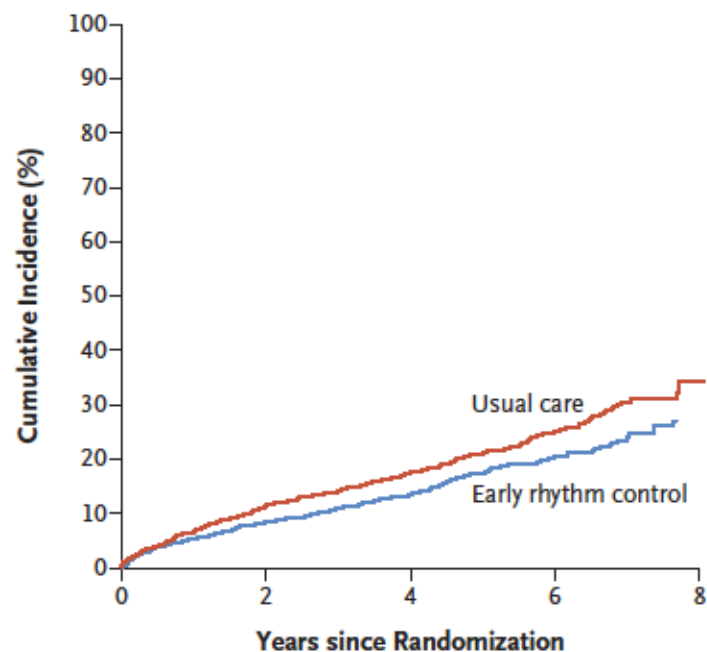
ESTABLISHED IN 1812

OCTOBER 1, 2020

VOL. 383 NO. 14

Early Rhythm-Control Therapy in Patients with Atrial Fibrillation

P. Kirchhof, A.J. Camm, A. Goette, A. Brandes, L. Eckardt, A. Elvan, T. Fetsch, I.C. van Gelder, D. Haase, L.M. Haegeli, F. Hamann, H. Heidbüchel, G. Hindricks, J. Kautzner, K.-H. Kuck, L. Mont, G.A. Ng, J. Rekosz, N. Schoen, U. Schotten, A. Suling, J. Taggeselle, S. Themistoclakis, E. Vettorazzi, P. Vardas, K. Wegscheider, S. Willems, H.J.G.M. Crijns, and G. Breithardt, for the EAST-AFNET 4 Trial Investigators*



No. at Risk					
Usual care	1394	1169	888	405	34
Early rhythm control	1395	1193	913	404	26

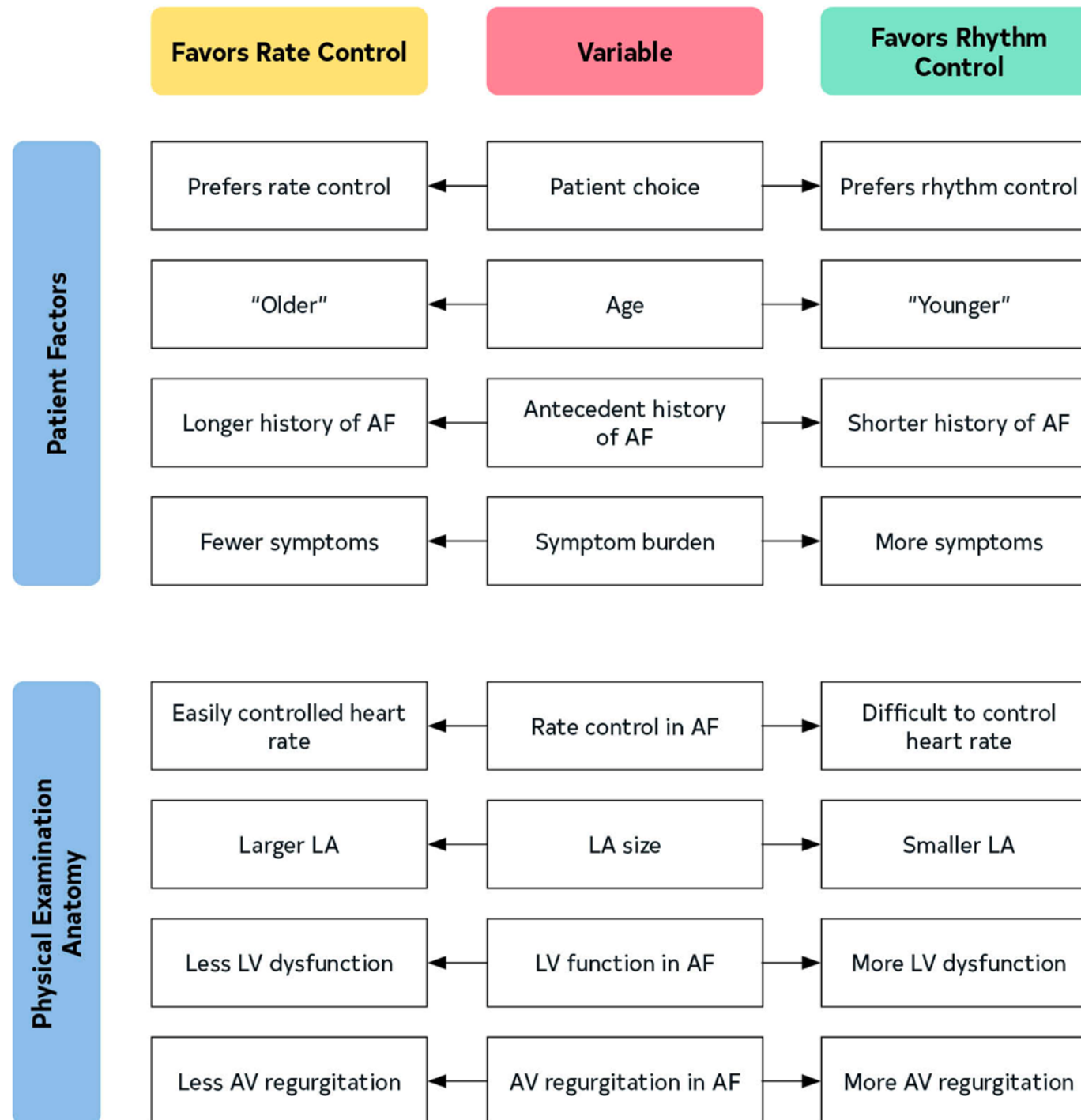
Figure 2. Aalen-Johansen Cumulative-Incidence Curves for the First Primary Outcome.

The first primary outcome was a composite of death from cardiovascular causes, stroke, or hospitalization with worsening of heart failure or acute coronary syndrome.

Table 2. Efficacy Outcomes.*

Outcome	Early Rhythm Control	Usual Care	Treatment Effect
First primary outcome — events/person-yr (incidence/100 person-yr)	249/6399 (3.9)	316/6332 (5.0)	0.79 (0.66 to 0.94)†
Components of first primary outcome — events/person-yr (incidence/100 person-yr)			
Death from cardiovascular causes	67/6915 (1.0)	94/6988 (1.3)	0.72 (0.52 to 0.98)‡
Stroke	40/6813 (0.6)	62/6856 (0.9)	0.65 (0.44 to 0.97)‡
Hospitalization with worsening of heart failure	139/6620 (2.1)	169/6558 (2.6)	0.81 (0.65 to 1.02)‡
Hospitalization with acute coronary syndrome	53/6762 (0.8)	65/6816 (1.0)	0.83 (0.58 to 1.19)‡
Second primary outcome — nights spent in hospital/yr	5.8±21.9	5.1±15.5	1.08 (0.92 to 1.28)§
Key secondary outcomes at 2 yr			
Change in left ventricular ejection fraction — %	1.5±9.8	0.8±9.8	0.23 (−0.46 to 0.91)¶
Change in EQ-5D score	−1.0±21.4	−2.7±22.3	1.07 (−0.68 to 2.82)¶
Change in SF-12 Mental Score**	0.7±10.6	1.6±10.1	−1.20 (−2.04 to −0.37)¶
Change in SF-12 Physical Score**	0.3±8.5	0.1±8.2	0.33 (−0.39 to 1.06)¶
Change in MoCA score	0.1±3.3	0.1±3.2	−0.14 (−0.39 to 0.12)¶
Sinus rhythm — no. of patients with feature/total no. (%)	921/1122 (82.1)	687/1135 (60.5)	3.13 (2.55 to 3.84)††
Asymptomatic — no. of patients with feature/total no. (%)‡‡	861/1159 (74.3)	850/1171 (72.6)	1.14 (0.93 to 1.40)††

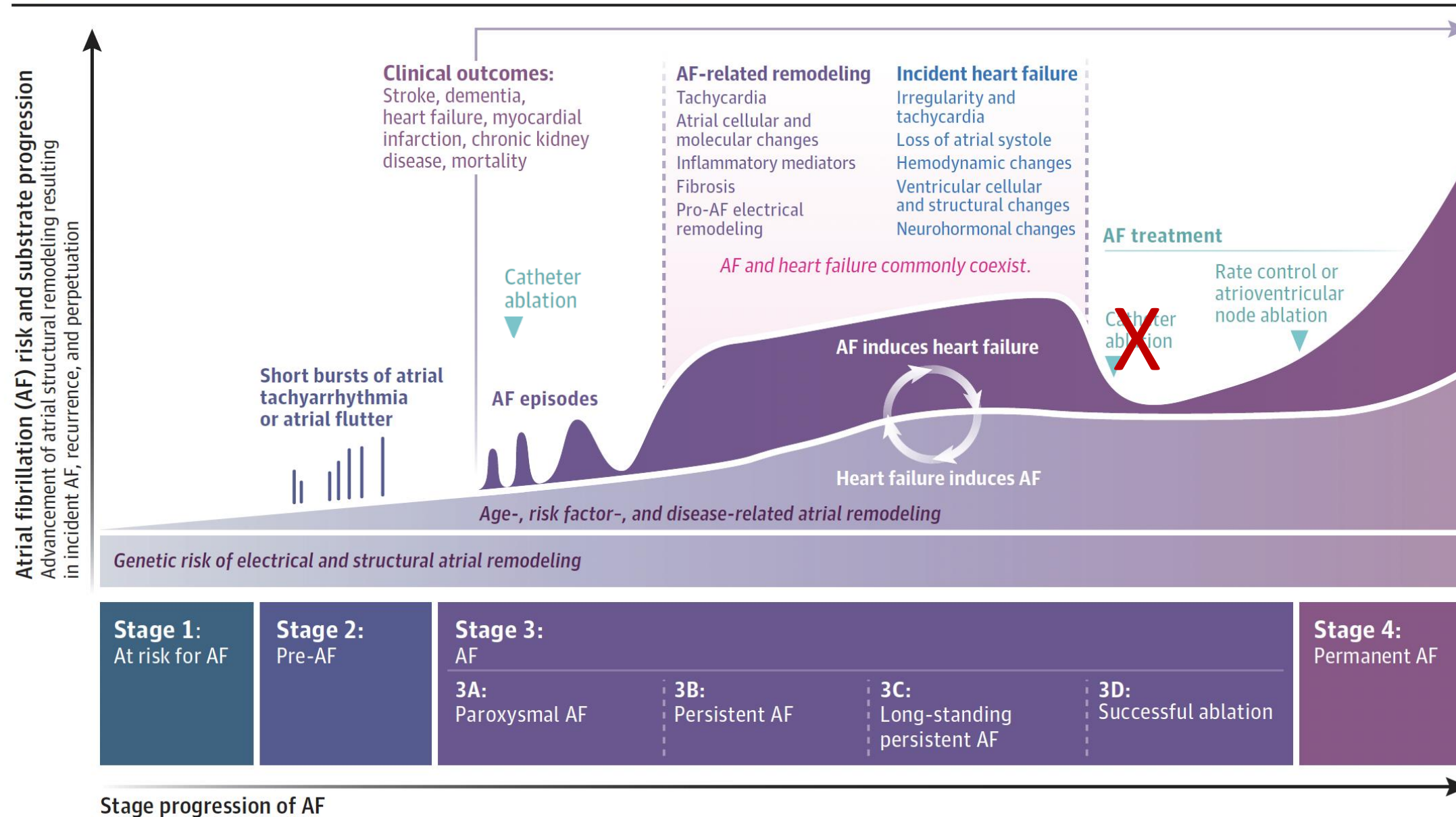
Rhythm Control Indications



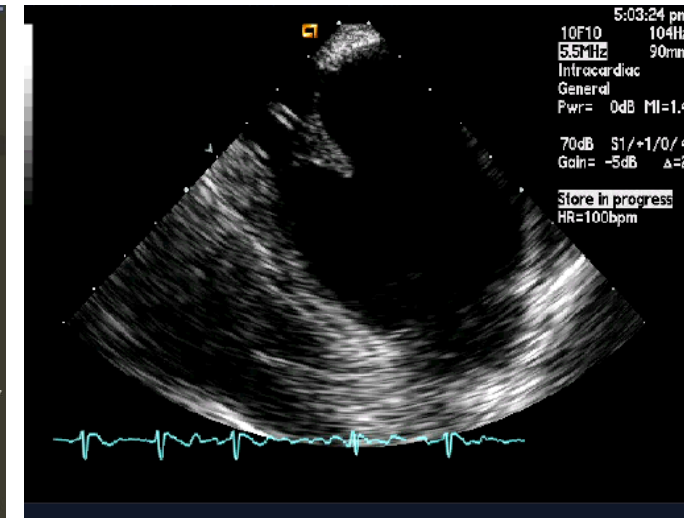
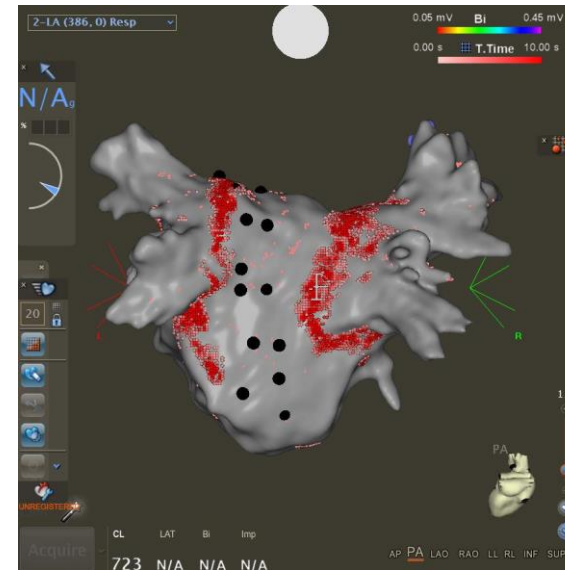
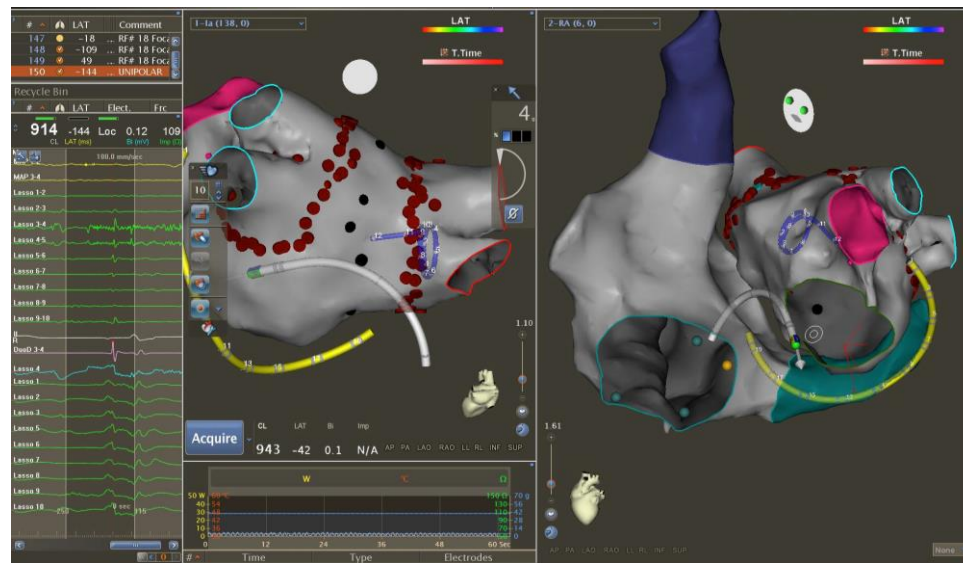
Joglar J, et al. *AHA/ACC/HRS 2024 guideline for the management of patients with atrial fibrillation*. Circulation, 2024.

That Was Then This is Now

Figure 1. Atrial Fibrillation Stages and the Evolution of Atrial Pathology

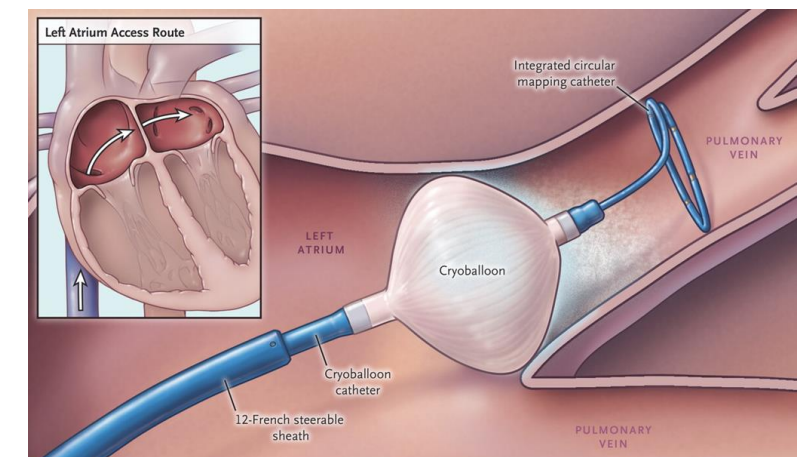
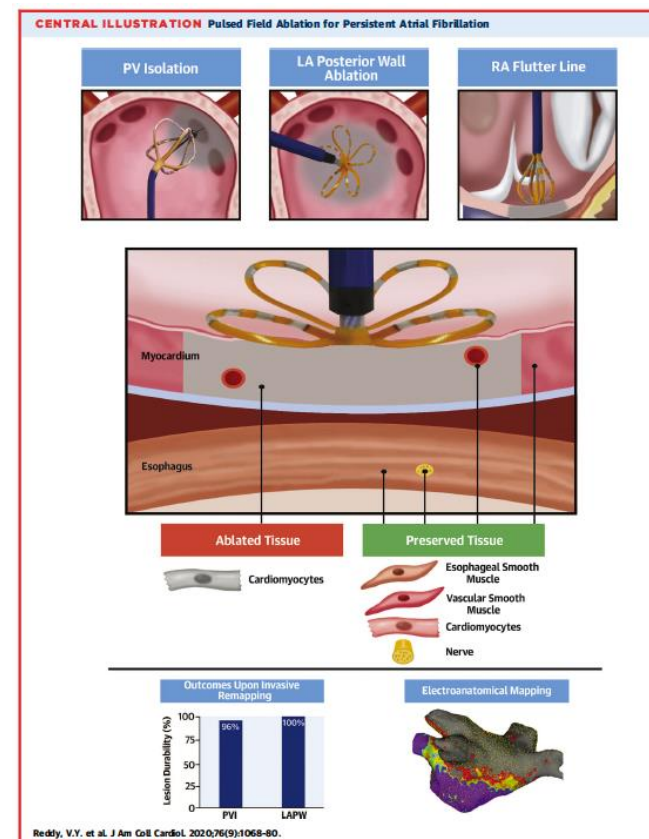


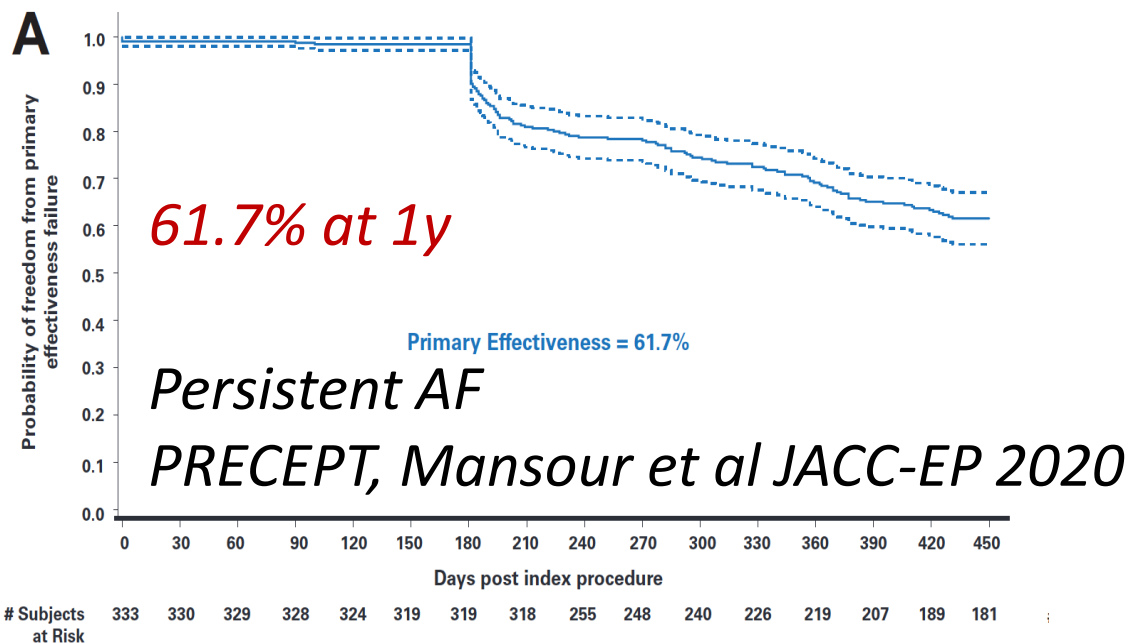
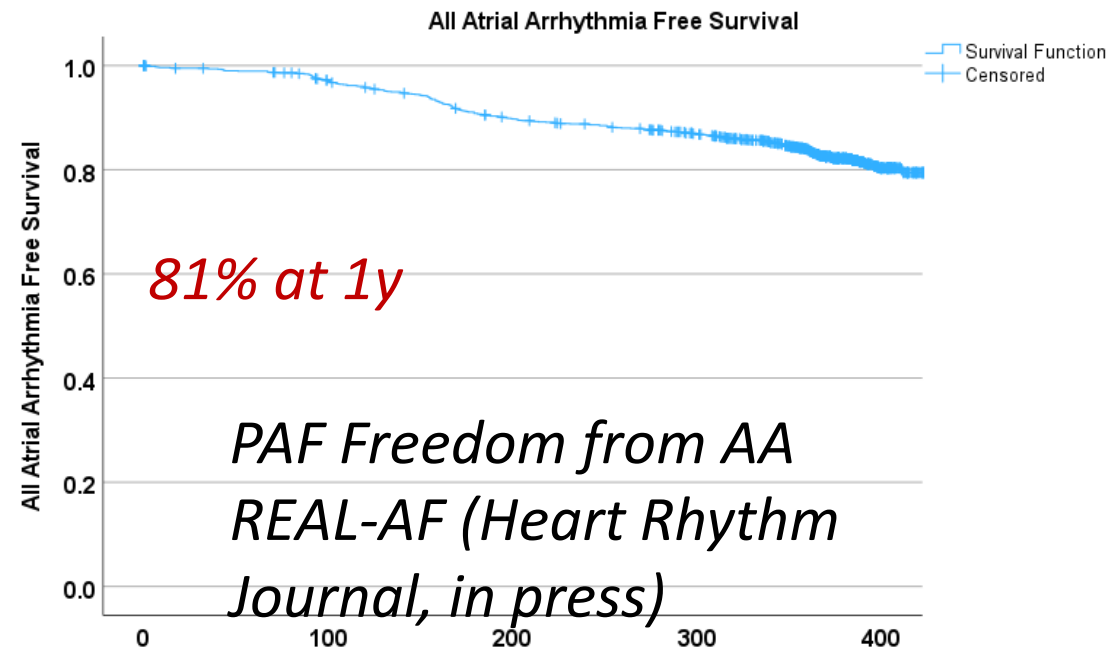
What happens during catheter ablation for AF?



Commonly used tools:

- Electroanatomic mapping
- RF energy: irrigated tip, contact force
- Cryoablation: balloon catheter
- **Pulsed Field Ablation (PFA) – now nearly 100% of new ablations since start of 2025**
- ICE (intracardiac ultrasound)





Benefits of Rhythm Control (specifically ablation)

- Symptom improvement
- Reduction in hospitalization, heart failure
- Improved mortality in select patients
- Possible decreased long-term risks of dementia, cognitive decline
- Efficacy: Paroxysmal > Persistent

Risks of Rhythm Control (specifically ablation)

- Mechanical complications (perforation, MI, stroke, vascular)
- AE fistula, PV stenosis, phrenic injury – **nearly eliminated with PFA**

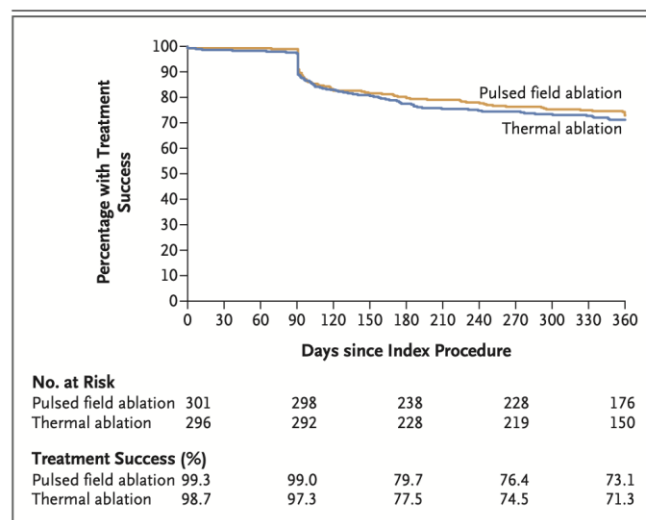
73% freedom from AA

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Pulsed Field or Conventional Thermal Ablation for Paroxysmal Atrial Fibrillation

Vivek Y. Reddy, M.D., Edward P. Gerstenfeld, M.D., Andrea Natale, M.D., William Whang, M.D., Frank A. Cuoco, M.D., Chinmay Patel, M.D., Stavros E. Mountantonakis, M.D., Douglas N. Gibson, M.D., John D. Harding, M.D., Christopher R. Ellis, M.D., Kenneth A. Ellenbogen, M.D., David B. DeLurgio, M.D., Jose Osorio, M.D., Anitha B. Achyutha, M.Tech., M.S.E., Christopher W. Schneider, M.Eng., Andrew S. Mugglin, Ph.D., Elizabeth M. Albrecht, Ph.D., Kenneth M. Stein, M.D., John W. Lehmann, M.D., M.P.H., and Moussa Mansour, M.D., for the ADVENT Investigators*



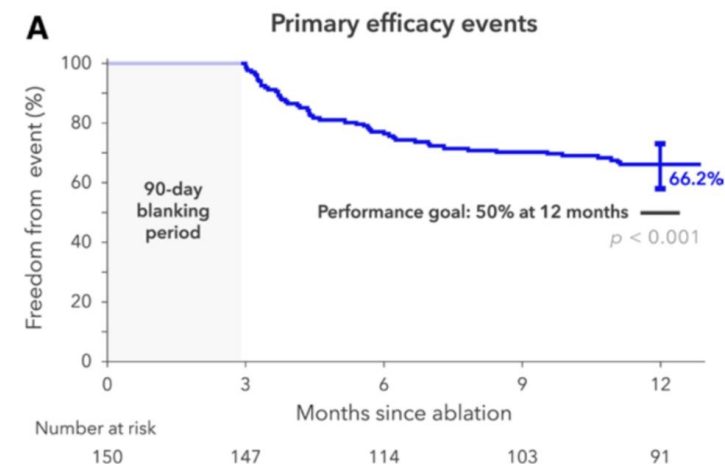
66.2% freedom from AA

Circulation

ORIGINAL RESEARCH ARTICLE

Pulsed Field Ablation for the Treatment of Atrial Fibrillation: PULSED AF Pivotal Trial

Atul Verma, MD; David E. Haines, MD; Lucas V. Boersma, MD; Nitesh Sood, MD; Andrea Natale, MD; Francis E. Marchlinski, MD; Hugh Calkins, MD; Prashanthan Sanders, MBBS; Douglas L. Packer, MD; Karl-Heinz Kuck, MD; Gerhard Hindricks, MD; Birce Onal, PhD; Jeffrey Cerkvenik, MS; Hiroshi Tada, MD; David B. DeLurgio, MD; on behalf of the PULSED AF Investigators



81.6% freedom from AA

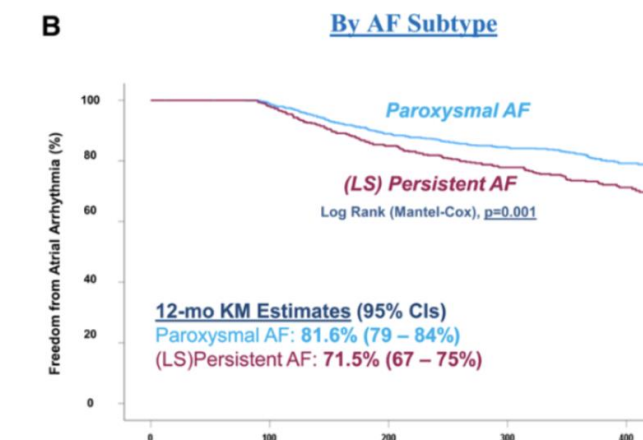
- But only 66% pts >1 24h Holters

Circulation

ORIGINAL RESEARCH ARTICLE

Safety and Effectiveness of Pulsed Field Ablation to Treat Atrial Fibrillation: One-Year Outcomes From the MANIFEST-PF Registry








Mohit K. Turagam, MD; Petr Neuzil, MD PhD; Boris Schmidt, MD; Tobias Reichlin, MD; Kars Neven, MD; Andreas Metzner, MD; Jim Hansen, MD; Yuri Blaauw, MD; Philippe Maury, MD; Thomas Arentz, MD; Philipp Sommer, MD; Ante Anic, MD; Frédéric Anselme, MD; Serge Boveda, MD, PhD; Tom Deneke, MD; Stephan Willems, MD; Pepijn van der Voort, MD; Roland Tilz, MD; Moritoshi Funasako, MD; Daniel Scherr, MD; Reza Wakili, MD; Daniel Steven, MD; Josef Kautzner, MD; Johan Vijgen, MD; Pierre Jais, MD; Jan Petru, MD; Julian Chun, MD; Laurent Roten, MD; Anna Fiting, MD; Marc D. Lemoine, MD; Martin Ruwald, MD; Bart A Mulder, MD; Anne Rollin, MD; Heiko Lehmann, MD; Thomas Fink, MD; Zrinka Jurisic, MD; Corentin Chaumont, MD; Raquel Adelfo, MD; Karin Nentwich, MD; Melanie Gunawardene, MD; Alexandre Ouss, MD; Christian-Hendrik Heeger, MD; Martin Manninger, MD; Jan-Eric Bohnen, MD; Arian Sultan, MD; Petr Peichl, MD; Pieter Koopman, MD; Nicolas Derva, MD; Thomas Kueffer, MD; Gilbert Rahe, MD; Vivek Y. Reddy, MD



PFA Data

- Short/intermediate term efficacy comparable to RF/Cryo
- Complication risks similar as well
- Theoretical risk of collateral injury, esp esophageal injury leading to AEF is reduced
- Procedure times significantly shorter

- Equivalent efficacy
 - Improved safety
 - Improved efficiency (procedures now 60-90m)
- *Jayazeri, Zei et al Heart Rhythm 2026*
 - *Mansour et al JACC-EP 2026*

System	Company	Key Features		Dedicated Mapping System? *
Farapulse	Boston Scientific	OTW Flower/Basket		Yes (new) *
Pulse Select	Medtronic	OTW fixed circular loop		No
Varipulse	Biosense	Variable loop		Yes
Omnypulse	Biosense	Small spheroid		Yes
STSF Dual Energy	Biosense	Point catheter (STSF)		Yes
Affera	Medtronic	Large spheroid		Yes
Others are under development/evaluation	Various	Various		Various

Principles

- Recommended (Class I) in symptomatic, drug refractory PAF or persistent AF
- Younger, symptomatic patients, esp with LV dysfunction may have more benefit
- PVI remains the primary strategy




Recommendations Based on Pre-PFA Era Data

AF catheter ablation after failure of drug therapy		
AF catheter ablation for PVI is recommended for rhythm control after one failed or intolerant class I or III AAD, to improve symptoms of AF recurrences in patients with ^{235–238,247,605–609,612,613,615–617,654,677,678,680,682,685,758,779,780,815} .	I	A
• Paroxysmal AF, or		A
• Persistent AF without major risk factors for AF recurrence, or		B
• Persistent AF with major risk factors for AF recurrence.		
AF catheter ablation for PVI should be considered for rhythm control after one failed or intolerant to beta-blocker treatment to improve symptoms of AF recurrences in patients with paroxysmal and persistent AF. ²⁴⁶	IIa	B
First-line therapy		
AF catheter ablation for PVI should/may be considered as first-line rhythm control therapy to improve symptoms in selected patients with symptomatic:		
• Paroxysmal AF episodes, ^{240–242,614,615} or	IIa	B
• Persistent AF without major risk factors for AF recurrence. ^{253–255,264,598–601,609,610,633,636,641,724,745,746,832}	IIb	C
as an alternative to AAD class I or III, considering patient choice, benefit, and risk.		
AF catheter ablation:		
• Is recommended to reverse LV dysfunction in AF patients when tachycardia-induced cardiomyopathy is highly probable, independent of their symptom status. ^{666,675,676}	I	B
• Should be considered in selected AF patients with HF with reduced LVEF to improve survival and reduce HF hospitalization. ^{612,659,662–666,668–671,817–826}	IIa	B
AF catheter ablation for PVI should be considered as a strategy to avoid pacemaker implantation in patients with AF-related bradycardia or symptomatic pre-automaticity pause after AF conversion considering the clinical situation. ^{816–818}	IIa	C

COR	LOE	Recommendations
1	A	1. In patients with symptomatic AF in whom anti-arrhythmic drugs have been ineffective, contraindicated, not tolerated or not preferred, and continued rhythm control is desired, catheter ablation is useful to improve symptoms. ^{1–10}
1	A	2. In selected patients (generally younger with few comorbidities) with symptomatic paroxysmal AF in whom rhythm control is desired, catheter ablation is useful as first-line therapy to improve symptoms and reduce progression to persistent AF. ^{11–16}
1	A	3. In patients with symptomatic or clinically significant AFL, catheter ablation is useful for improving symptoms. ^{17–19}

- **Paroxysmal AF**
 - Ablation after failing medication is a Class IA indication
 - Ablation first line is a Class IA indication in younger, healthier patients, or with HFrEF
- **Persistent AF**
 - Ablation after failing medication is a Class IA indication
 - Ablation first line is a Class IIA indication in younger, healthier patients
- Overall AF: early rhythm control is superior to a “wait and see” approach (not incorporated in guidelines *yet*)
- As we are improving outcomes with ablation for rhythm control, a signal for **mortality benefit** is emerging

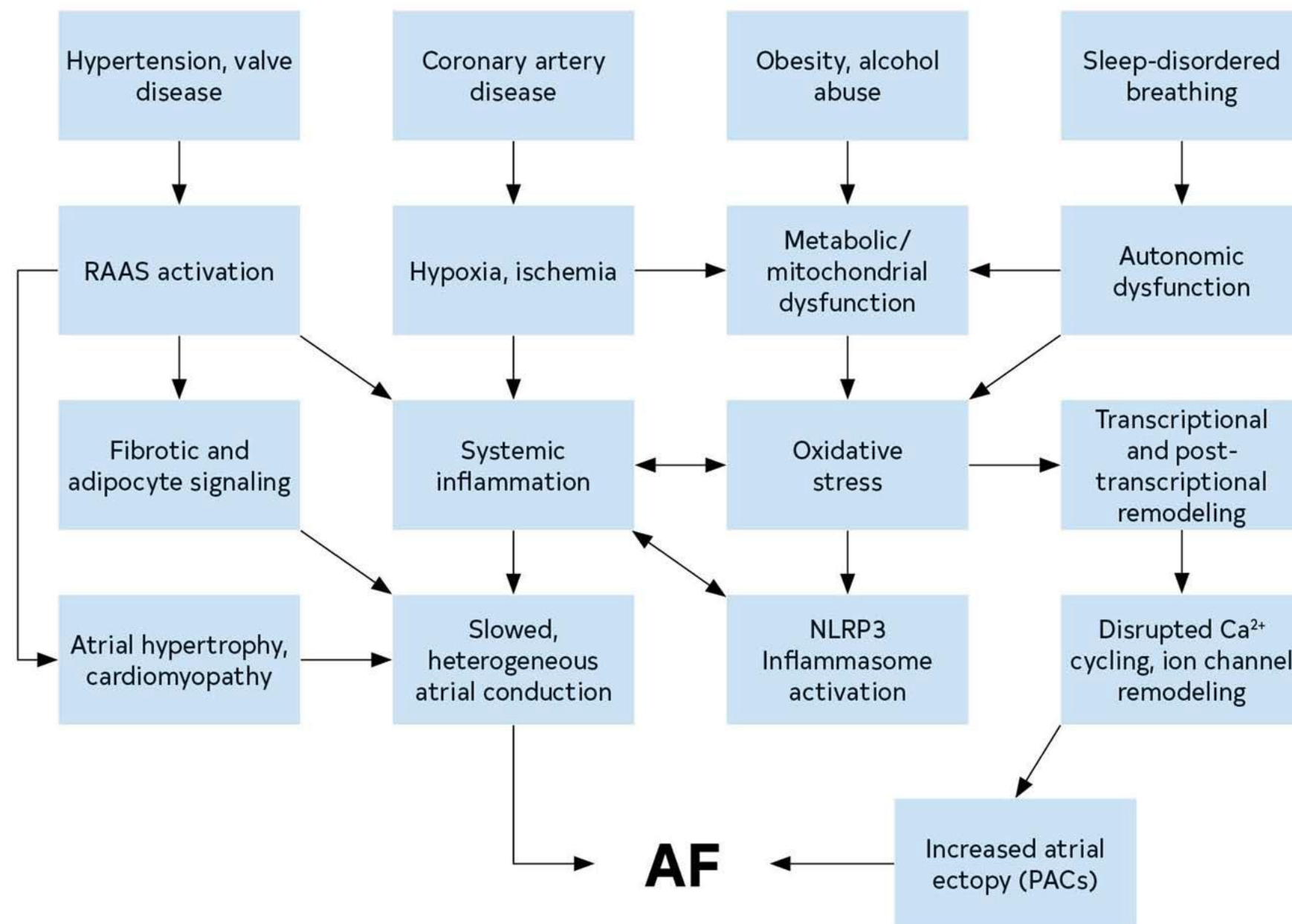
Reduction in Major CV Outcomes

AF-Related Outcome	Frequency in AF	Mechanism(s)
Death 	1.5 - 3.5 fold increase	Excess mortality related to: <ul style="list-style-type: none"> • HF, comorbidities • Stroke
Stroke 	20-30% of all ischaemic strokes, 10% of cryptogenic strokes	<ul style="list-style-type: none"> • Cardioembolic, or • Related to comorbid vascular atheroma
LV dysfunction / Heart failure 	In 20-30% of AF patients	<ul style="list-style-type: none"> • Excessive ventricular rate • Irregular ventricular contractions • A primary underlying cause of AF

ESC Guidelines 2020

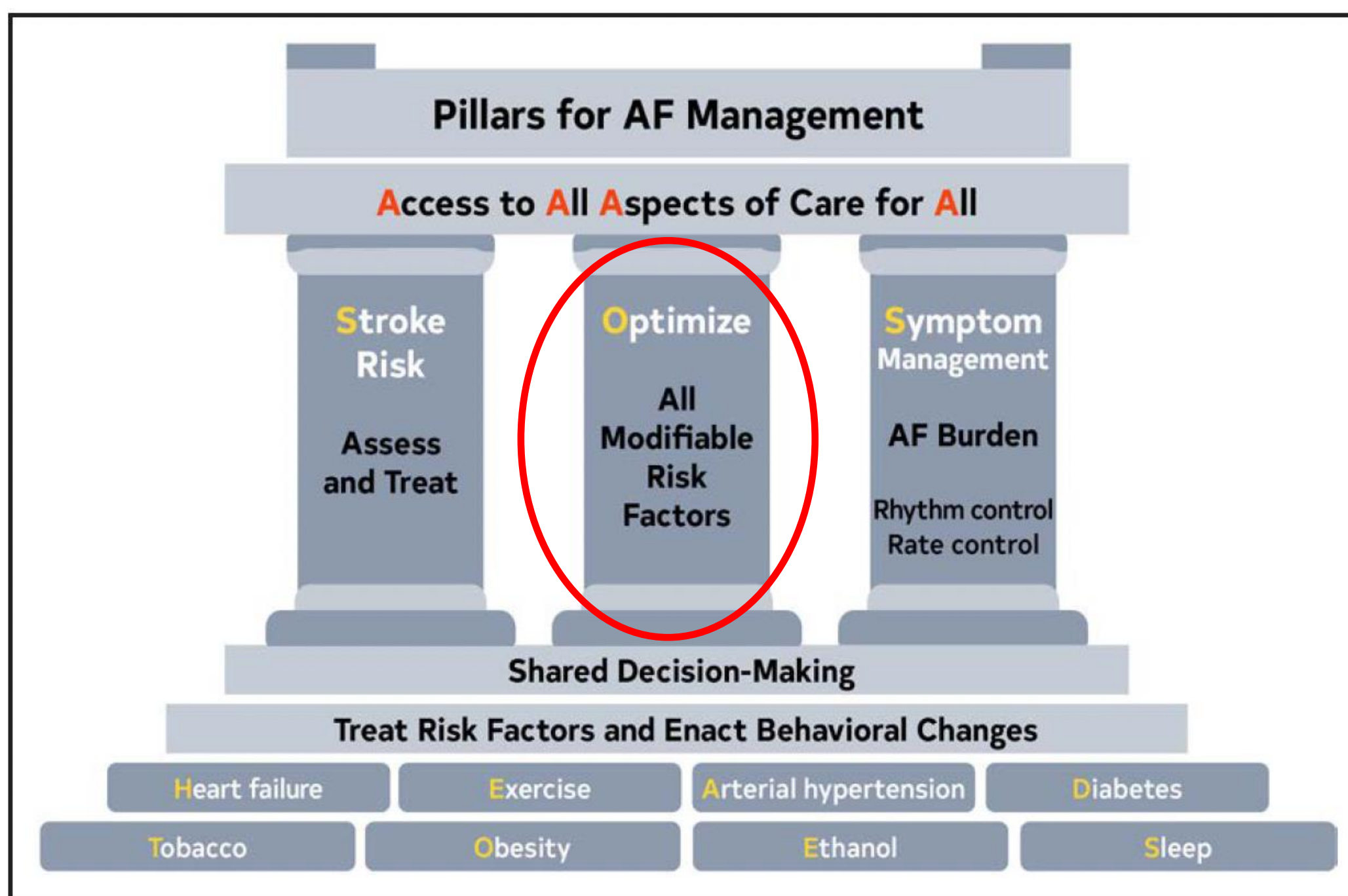
The known modifiable MEDICAL risk factors in AF:

- Hypertension
- Obesity
- Diabetes
- Sleep apnea
- CAD

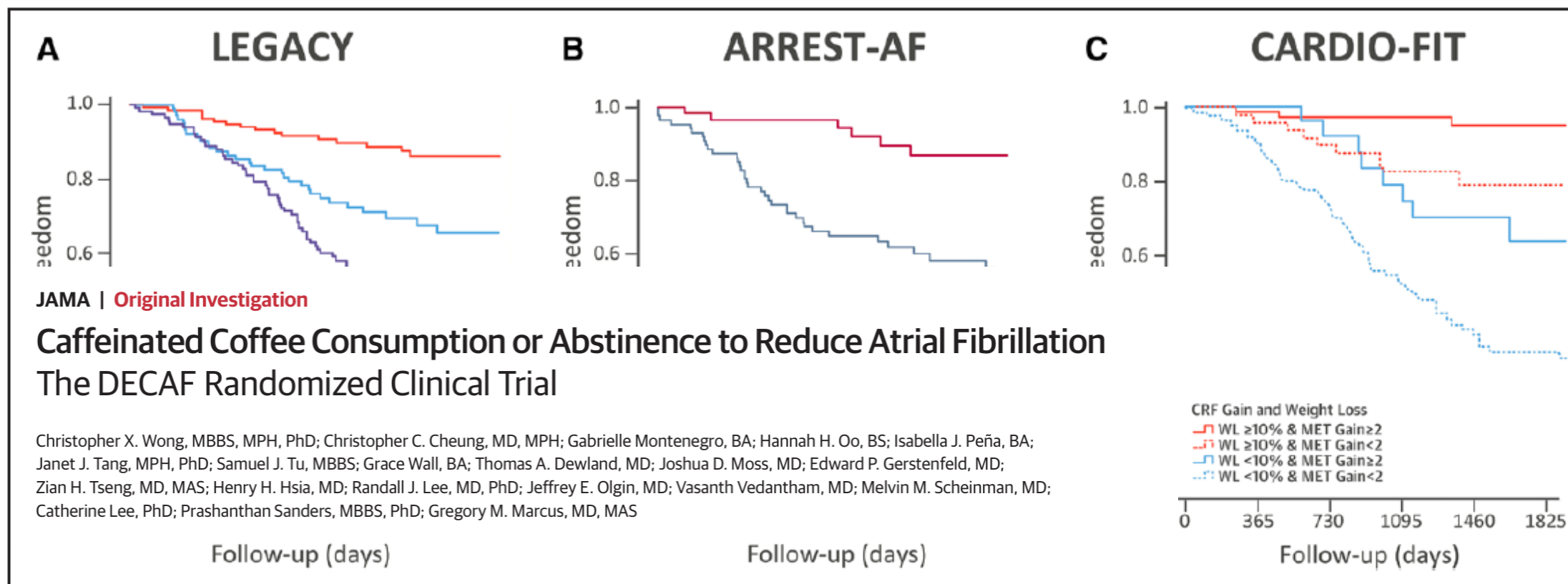


Treating the upstream inputs: Can we reduce AF incidence with reduction of these risk factors?

Next steps? AHA/ACC Guidelines

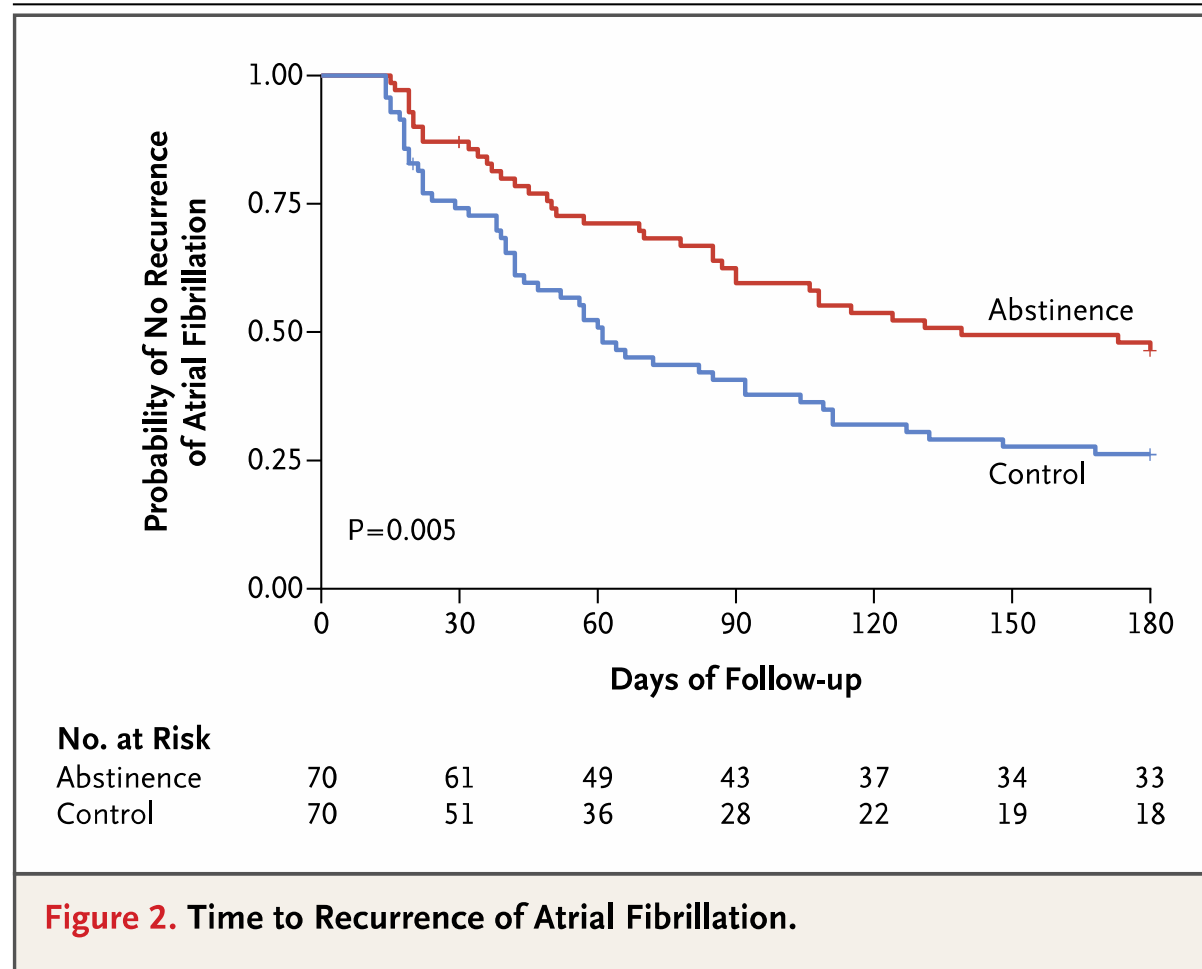


Joglar J, et al. AHA/ACC/HRS 2024 guideline for the management of patients with atrial fibrillation. Circulation, 2024.



- LEGACY – **weight loss** leads to reduced AF burden w/o ablation
- ARREST-AF – improved control of **multiple risk factors** reduces AF burden after AF ablation (HTN, DM, weight)
- CARDIO-FIT – improved **CV fitness** leads to decreased AF burden after AF ablation

Sanders et al, Circ 2017



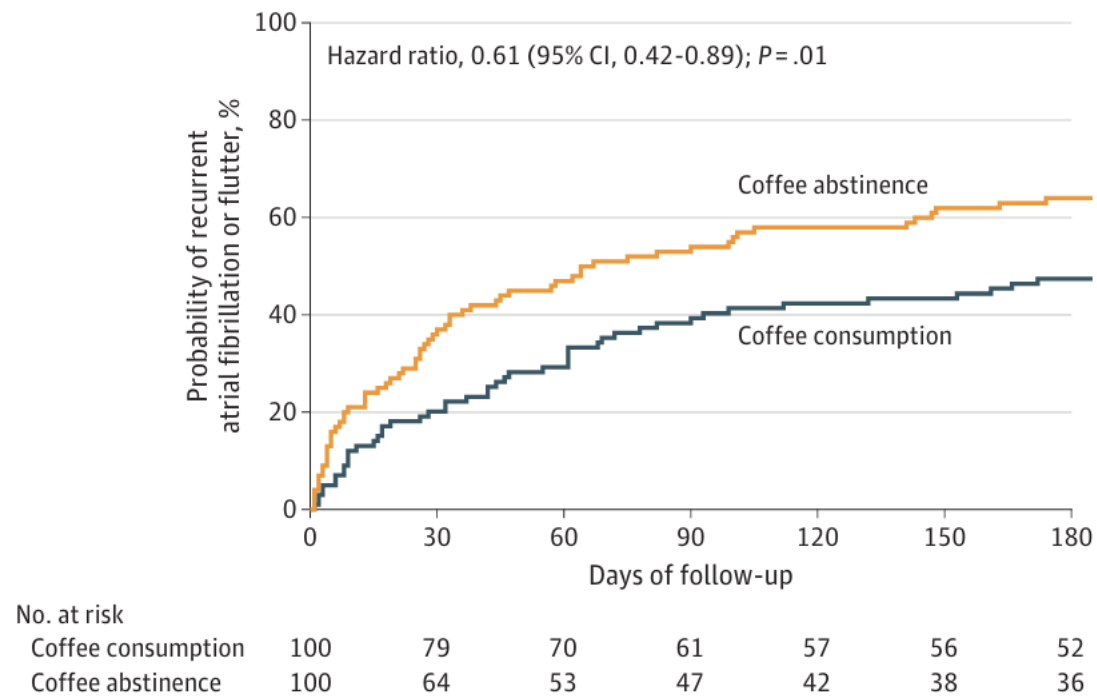
- **Moderate to heavy alcohol drinkers** with AF: abstinence significantly reduces AF recurrence
- On the other hand, no studies to date have demonstrated an association between caffeine intake and AF risk or burden
- We are often asked about stress level and AF burden/risk, but this has been very challenging to study

JAMA | Original Investigation

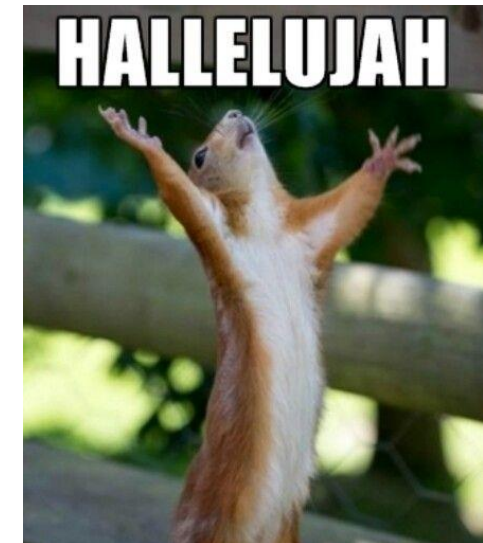
Caffeinated Coffee Consumption or Abstinence to Reduce Atrial Fibrillation The DECAF Randomized Clinical Trial

Christopher X. Wong, MBBS, MPH, PhD; Christopher C. Cheung, MD, MPH; Gabrielle Montenegro, BA; Hannah H. Oo, BS; Isabella J. Peña, BA; Janet J. Tang, MPH, PhD; Samuel J. Tu, MBBS; Grace Wall, BA; Thomas A. Dewland, MD; Joshua D. Moss, MD; Edward P. Gerstenfeld, MD; Zian H. Tseng, MD, MAS; Henry H. Hsia, MD; Randall J. Lee, MD, PhD; Jeffrey E. Olgin, MD; Vasanth Vedantham, MD; Melvin M. Scheinman, MD; Catherine Lee, PhD; Prashanthan Sanders, MBBS, PhD; Gregory M. Marcus, MD, MAS

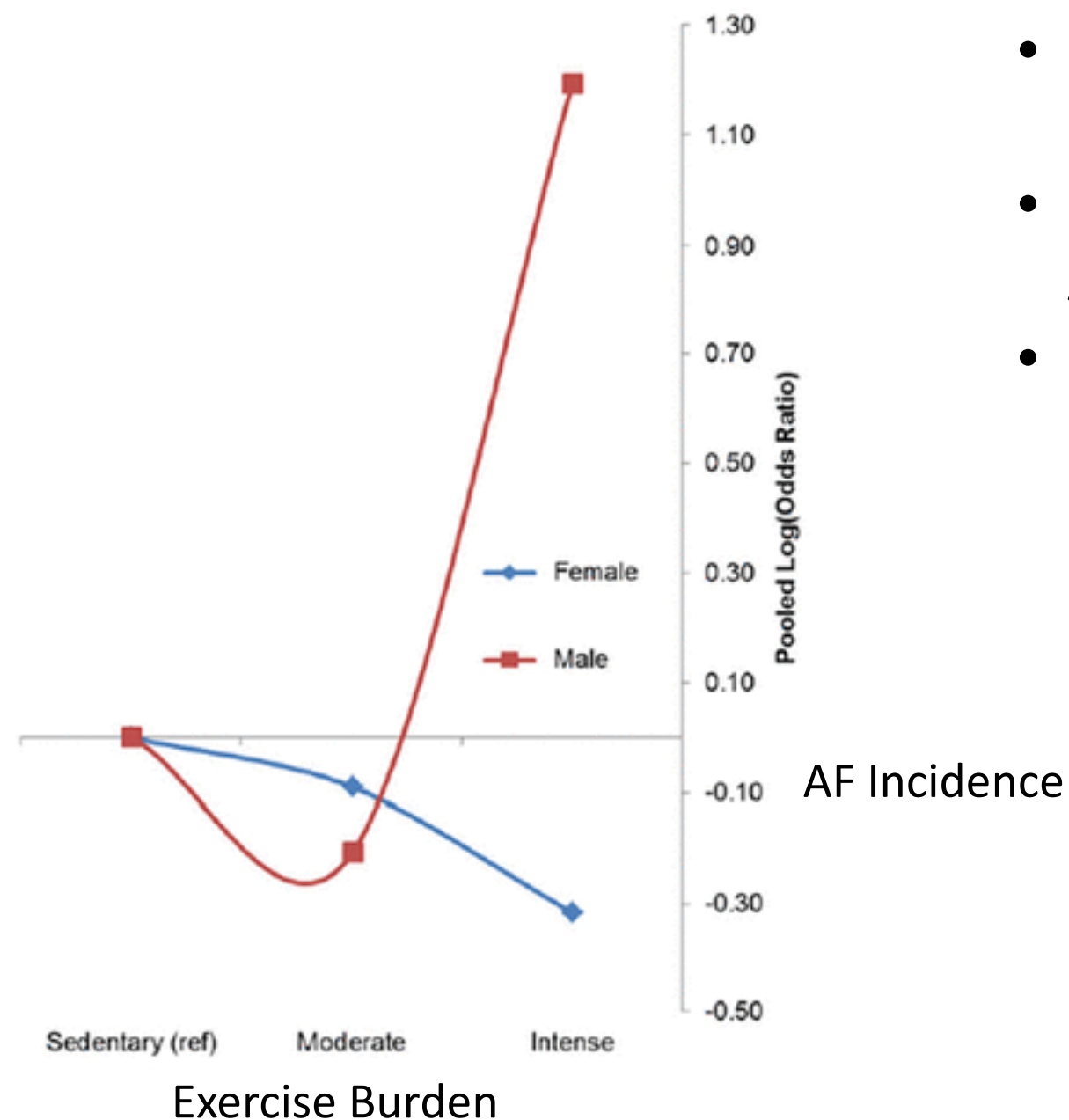
Figure 3. Time to Recurrence of Atrial Fibrillation or Flutter



- **Open Label RCT – patients with AF coffee abstinence vs. consumption**
- Consumption associated with LESS AF recurrence

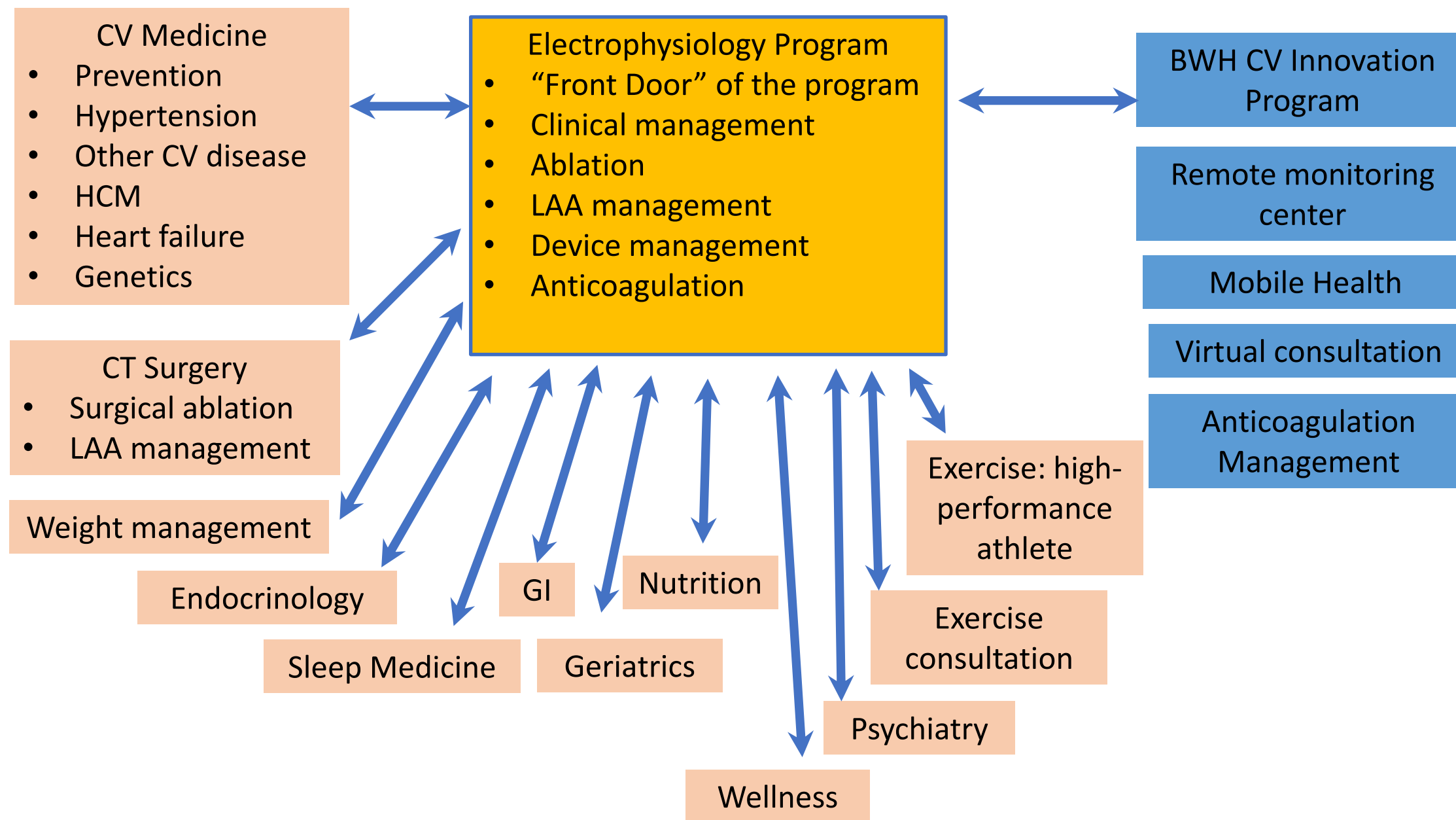


Wong, et al JAMA 2026



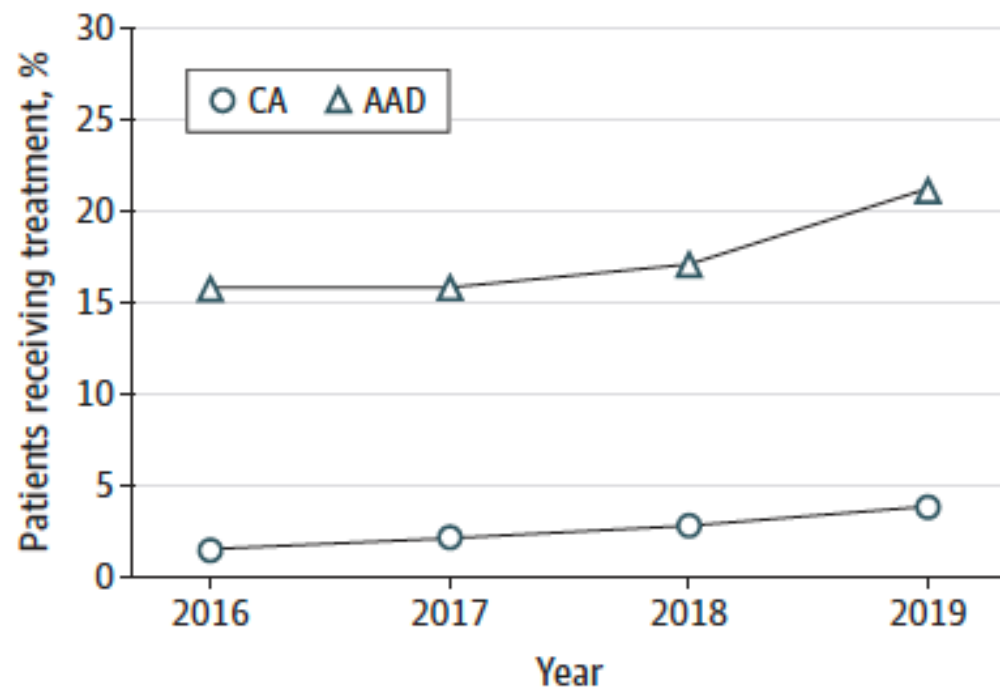
- Exercise quantity/burden demonstrates a “U-shaped” relationship with AF incidence in males
- In females, data suggests decreasing incidence of AF with increasing AF burden
- In males, data suggest that there is such a thing as “too much exercise” as far as AF risk goes

The New AF Treatment Paradigm: BWH Comprehensive AF Program

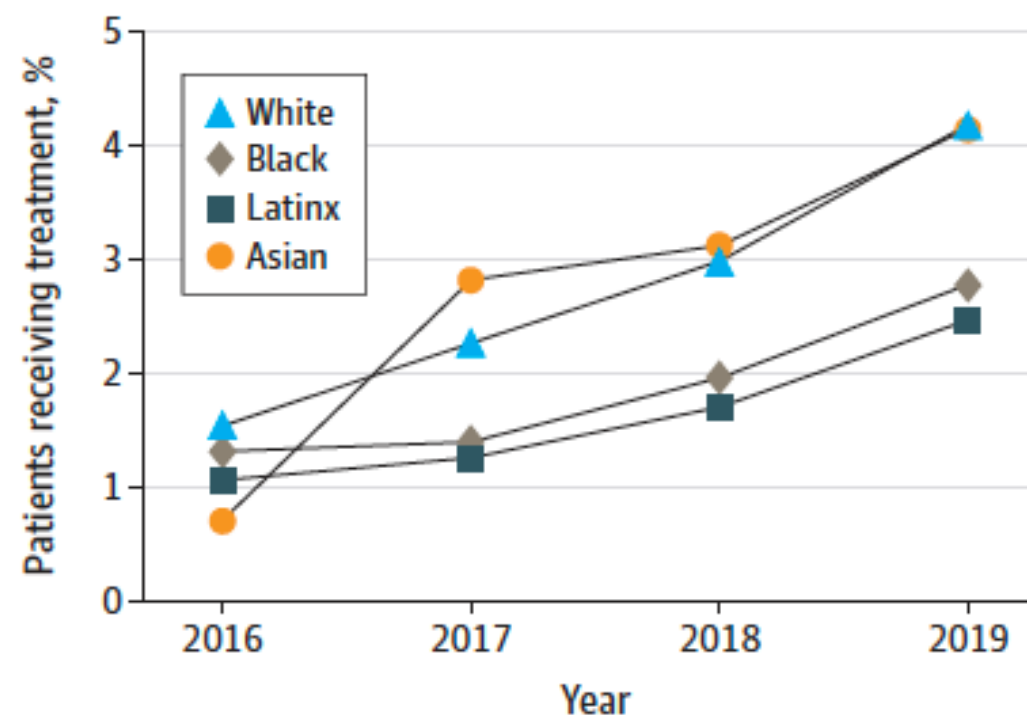


RACE: Disparities persist in treatment for AF
- AAD and catheter ablation are relatively under-utilized among Blacks, Latinx

A Cumulative rates of treatment with AADs and CA for paroxysmal AF



B Cumulative rates of treatment with CA for paroxysmal AF by race/ethnicity



Eberly et al. *JAMA Network Open*. 2021

Sex Differences in AF

AF in Women:

- Lower incidence/prevalence compared to White men
- More likely to be symptomatic than men with AF
- More likely to receive rate control than rhythm control
- Less likely to receive stroke reduction therapies including:
 - Oral Anticoagulation
 - Left Atrial Appendage Occlusion
- Higher risk of stroke and heart failure
- Higher mortality compared to men

Nat Rev Cardiol. 2017 Feb; 14 (2):113-124
Curr Cardiol Rev. 2019 May; 15(2): 136-144
JCE. 2020 Dec; 32(10): 2793-2807

Basic take home messages

- Understand the current indications, options, risks, and benefits of stroke prevention for atrial fibrillation
- Understand the current indications for medical therapy vs. catheter ablation for the control of rhythm in atrial fibrillation
- Understand the impact of risk factors and risk factor modification on atrial fibrillation clinical outcomes

Key updates

- Who should be screened for AF?
- PFA has taken over with overall lowered risks, but some new risks – will likely move AF even further towards first line therapy
- ALONE-AF and OCEAN - AC may be safe to discontinue in certain patients

- Writing Committee Members; Joglar JA, Chung MK, Armbruster AL, Benjamin EJ, Chyou JY, Cronin EM, Deswal A, Eckhardt LL, Goldberger ZD, Gopinathannair R, Gorenek B, Hess PL, Hlatky M, Hogan G, Ibeh C, Indik JH, Kido K, Kusumoto F, Link MS, Linta KT, Marcus GM, McCarthy PM, Patel N, Patton KK, Perez MV, Piccini JP, Russo AM, Sanders P, Streur MM, Thomas KL, Times S, Tisdale JE, Valente AM, Van Wagoner DR. 2023 ACC/AHA/ACCP/HRS Guideline for the Diagnosis and Management of Atrial Fibrillation: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *J Am Coll Cardiol*. 2024 Jan 2;83(1):109-279. doi: 10.1016/j.jacc.2023.08.017. Epub 2023 Nov 30. Erratum in: *J Am Coll Cardiol*. 2024 Mar 5;83(9):959. doi: 10.1016/j.jacc.2024.01.020. Erratum in: *J Am Coll Cardiol*. 2024 Jun 25;83(25):2714. doi: 10.1016/j.jacc.2024.05.033. PMID: 38043043; PMCID: PMC11104284.
- Hindricks G, Potpara T, Dagres N, Arbelo E, Bax JJ, Blomström-Lundqvist C, Boriani G, Castella M, Dan GA, Dilaveris PE, Fauchier L, Filippatos G, Kalman JM, La Meir M, Lane DA, Lebeau JP, Lettino M, Lip GYH, Pinto FJ, Thomas GN, Valgimigli M, Van Gelder IC, Van Putte BP, Watkins CL; ESC Scientific Document Group. 2020 ESC Guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS): The Task Force for the diagnosis and management of atrial fibrillation of the European Society of Cardiology (ESC) Developed with the special contribution of the European Heart Rhythm Association (EHRA) of the ESC. *Eur Heart J*. 2021 Feb 1;42(5):373-498. doi: 10.1093/eurheartj/ehaa612. Erratum in: *Eur Heart J*. 2021 Feb 1;42(5):507. doi: 10.1093/eurheartj/ehaa798. Erratum in: *Eur Heart J*. 2021 Feb 1;42(5):546-547. doi: 10.1093/eurheartj/ehaa945. Erratum in: *Eur Heart J*. 2021 Oct 21;42(40):4194. doi: 10.1093/eurheartj/ehab648. PMID: 32860505.

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Diagnosing AF, Clinical Manifestations

- AF clinical presentation is variable
- Clinicians will be seeing more and more patients with personal ECG devices
- What to do about personal data remains unclear – for now it is reasonable to take data into account in the course of standard medical diagnosis and management

Cornerstones of therapy for AF:

- **Stroke prevention**
 - CHA2DS2-Vasc should guide anticoagulation (with patient individualization)
 - DOAC agents are recommended (except pts with mitral stenosis or mechanical heart valves)
- **Rhythm Control** – catheter ablation is superior to medication for maintaining sinus rhythm
 - Early rhythm control strategy results in mortality benefit and improved ability to maintain sinus rhythm
 - Current guidelines are moving gradually towards ablation as initial rhythm control in select patients
- **Risk factor modification**
 - Evaluation and treatment of known modifiable risk factors is indicated
 - Reduction of alcohol intake may improve AF outcomes
 - Exercise vs. AF burden has a complex relationship

Thank you!



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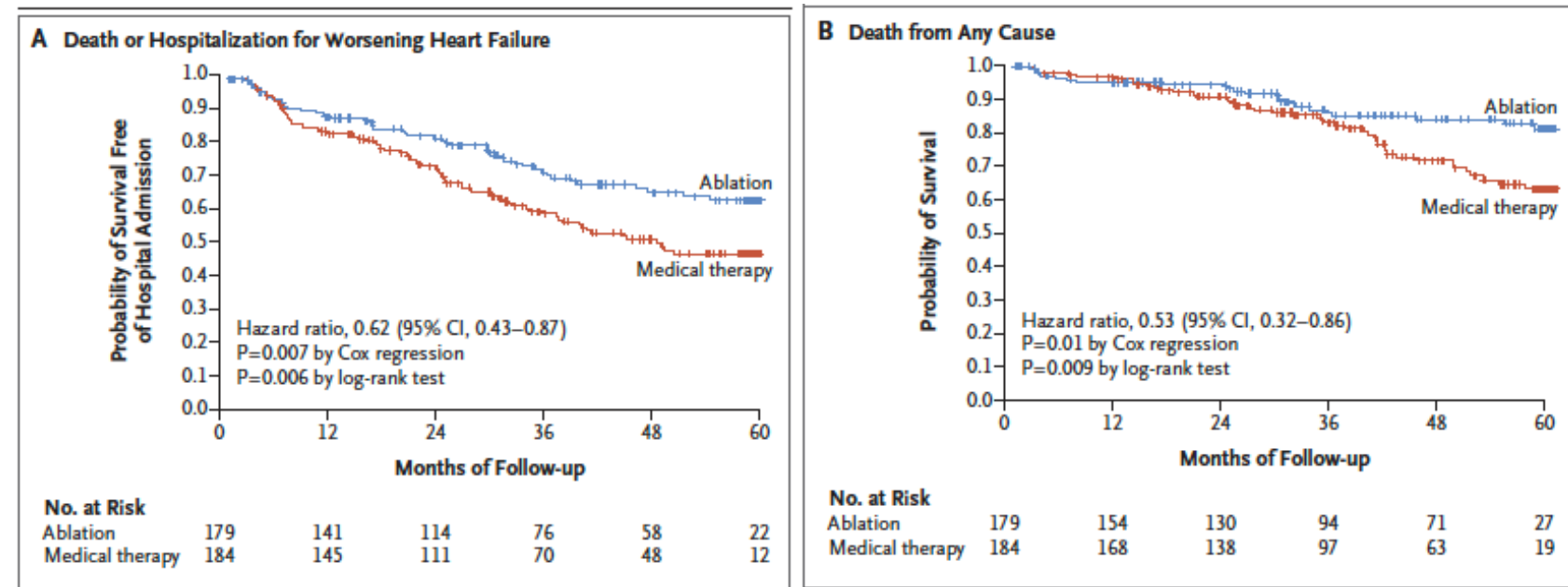
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- **CASTLE-AF study (NEJM 2018)**
- 179 patients with HFpEF randomized to AAD vs. catheter ablation
- All outcomes favor ablation: composite death, HF hospitalization, all-cause mortality
- F/U Study **CASTLE-HTX (NEJM 2023)** demonstrates mortality benefit in advanced HFrEF patients

1	B-NR	1. In patients who present with a new diagnosis of HFrEF and AF, arrhythmia-induced cardiomyopathy should be suspected, and an early and aggressive approach to AF rhythm control is recommended. ^{1,2}
1	A	2. In appropriate patients with AF and HFrEF who are on GDMT, and with reasonable expectation of procedural benefit (Figure 24), catheter ablation is beneficial to improve symptoms, QOL, ventricular function, and cardiovascular outcomes. ^{3–13}

Joglar J, et al. *AHA/ACC/HRS 2024 guideline for the management of patients with atrial fibrillation*. Circulation, 2024.



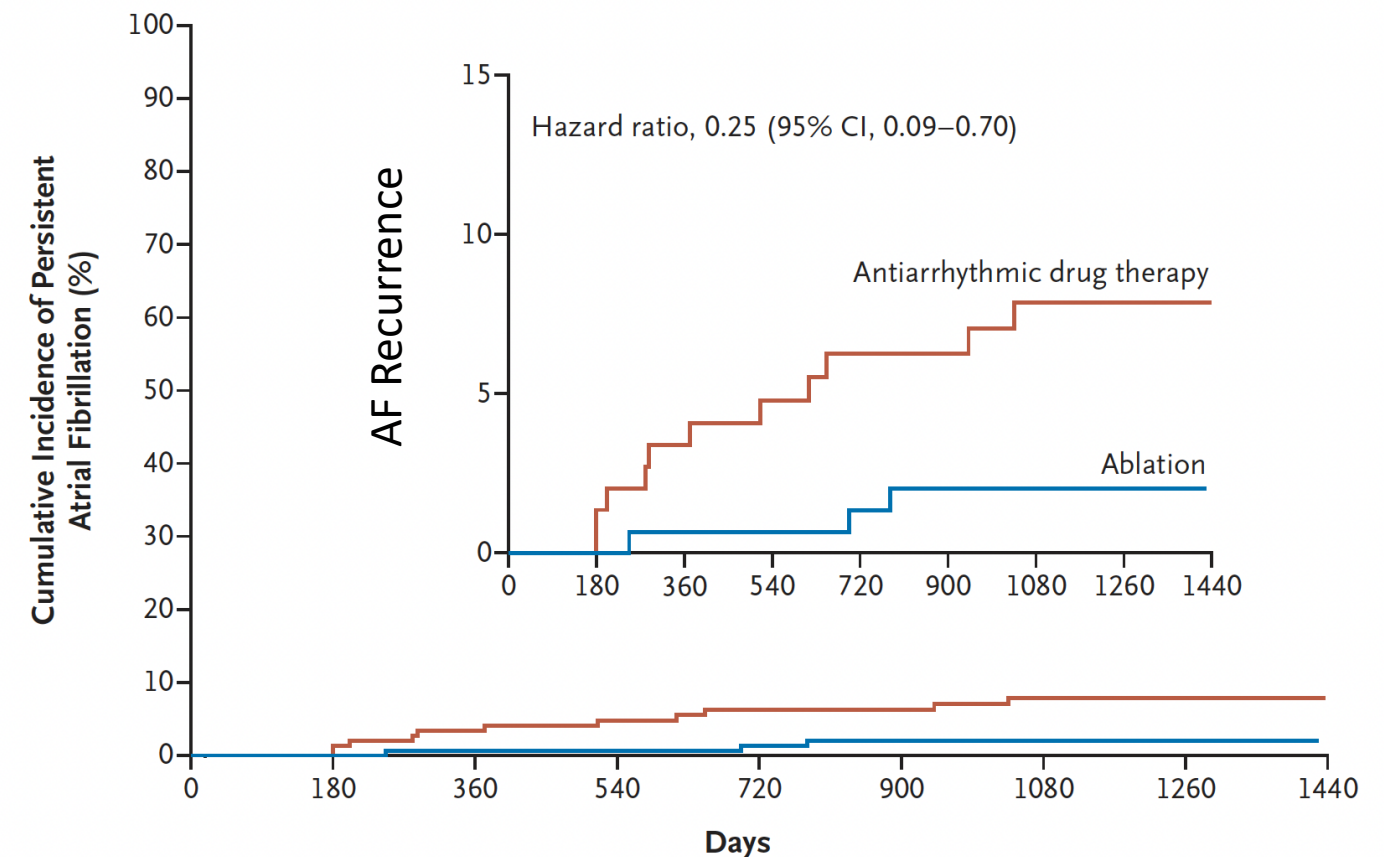
First Line Catheter Ablation: Ready for Prime Time?

- Accumulating data in the modern era of ablation supports early ablation
- Early ablation improves freedom from AF long-term
- Consensus supports outcomes regardless of ablation modality (cryo, RF, other)
- Newer data incorporated into the newest guidelines (2020, 2024)

ORIGINAL ARTICLE

Progression of Atrial Fibrillation after Cryoablation or Drug Therapy

J.G. Andrade, M.W. Deyell, L. Macle, G.A. Wells, M. Bennett, V. Essebag, J. Champagne, J.-F. Roux, D. Yung, A. Skanes, Y. Khaykin, C. Morillo, U. Jolly, P. Novak, E. Lockwood, G. Amit, P. Angaran, J. Sapp, S. Wardell, S. Lauck, J. Cadrin-Tourigny, S. Kochhäuser, and A. Verma, for the EARLY-AF Investigators*



NEJM Nov 2022

What happens during catheter ablation for AF?

- Typically performed under general anesthesia
- Vascular access (venous)
- Catheter advancement into the heart (RA)
- Transseptal puncture to access the left atrium (LA)
- Tools utilized – almost all cases performed using either radiofrequency energy (RF) or cryotherapy (freezing), with a goal of creating permanent scar and resultant electrical conduction block
- Ablation delivered to circumferentially electrically isolate all pulmonary veins
- Additional ablation beyond PV isolation may be performed, particularly in patients with persistent or long-standing persistent AF

Vaughan Williams Class I - Na channel blockade

- Flecainide PO: 50-150mg every 12 hrs
- Propafenone PO: 150-300mg every 8 hrs, or sustained release 225-425mg every 12 hrs

Vaughan Williams Class III – K channel blockade

- Amiodarone PO: 200mg TID x 2 weeks, 200mg BID x 2wks, then 200mg daily. Take with meals.
 - Monitor for hepatic, thyroid, pulmonary, ophthalmologic, skin toxicity
- Dofetilide PO: 125-500mcg every 12 hrs, based on renal function and QTc;
 - must be initiated in the hospital
- Dronedarone PO: 400mg twice daily with meals
 - Monitor for hepatotoxicity; contraindicated in permanent AF, low EF
- Sotalol PO: 80mg BID, to a maximum of 240-320mg/day, based on renal function and QTc
 - In-hospital initiation favored
- Less commonly prescribed: disopyramide, quinidine

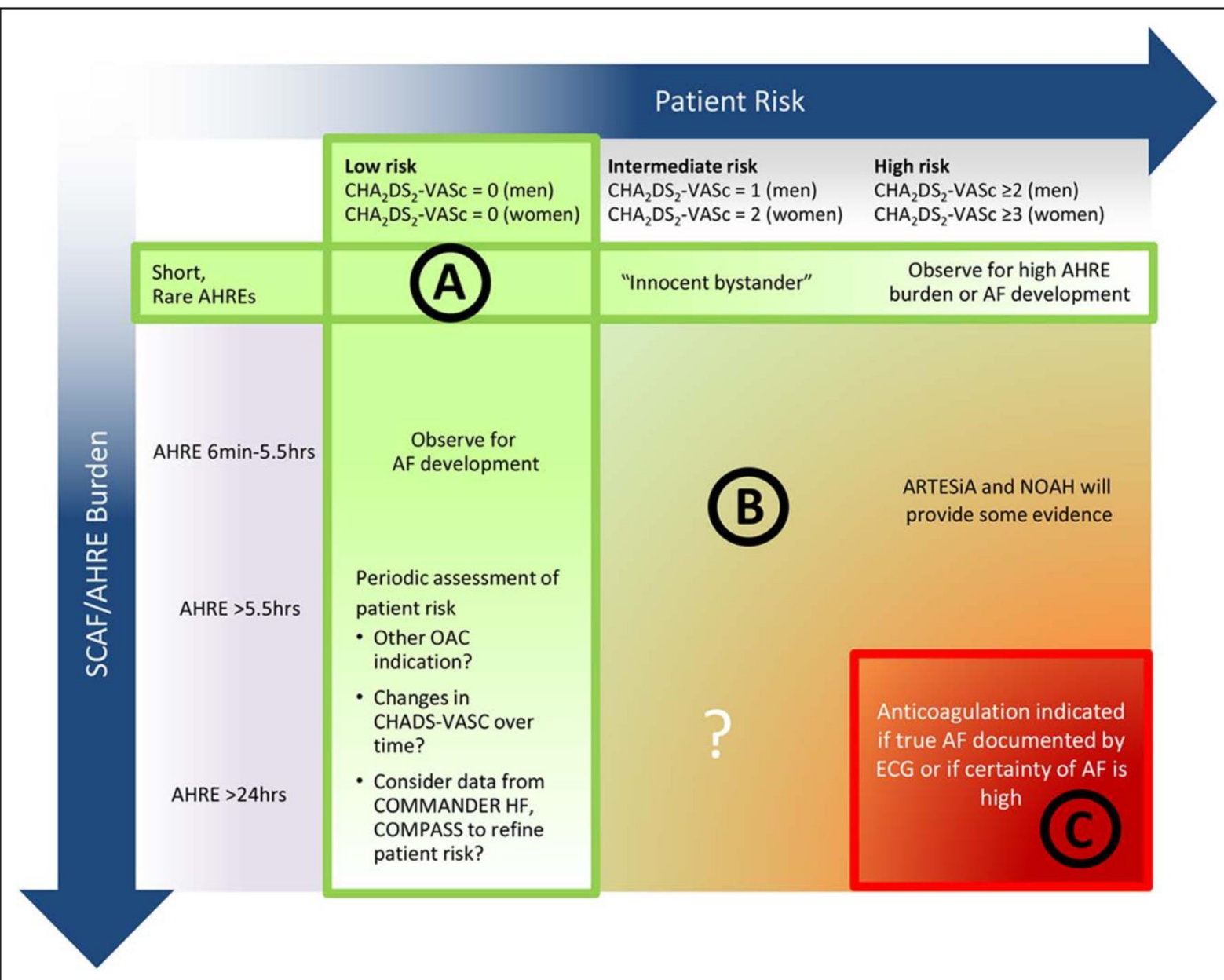
Emerging findings

- AF Burden is emerging as an important determinant of stroke risk
- Burden is yet to be incorporated into guideline recommendations

Potential Implications for management:
AF seen on pre-existing device
(pacemaker, ICD, monitor)

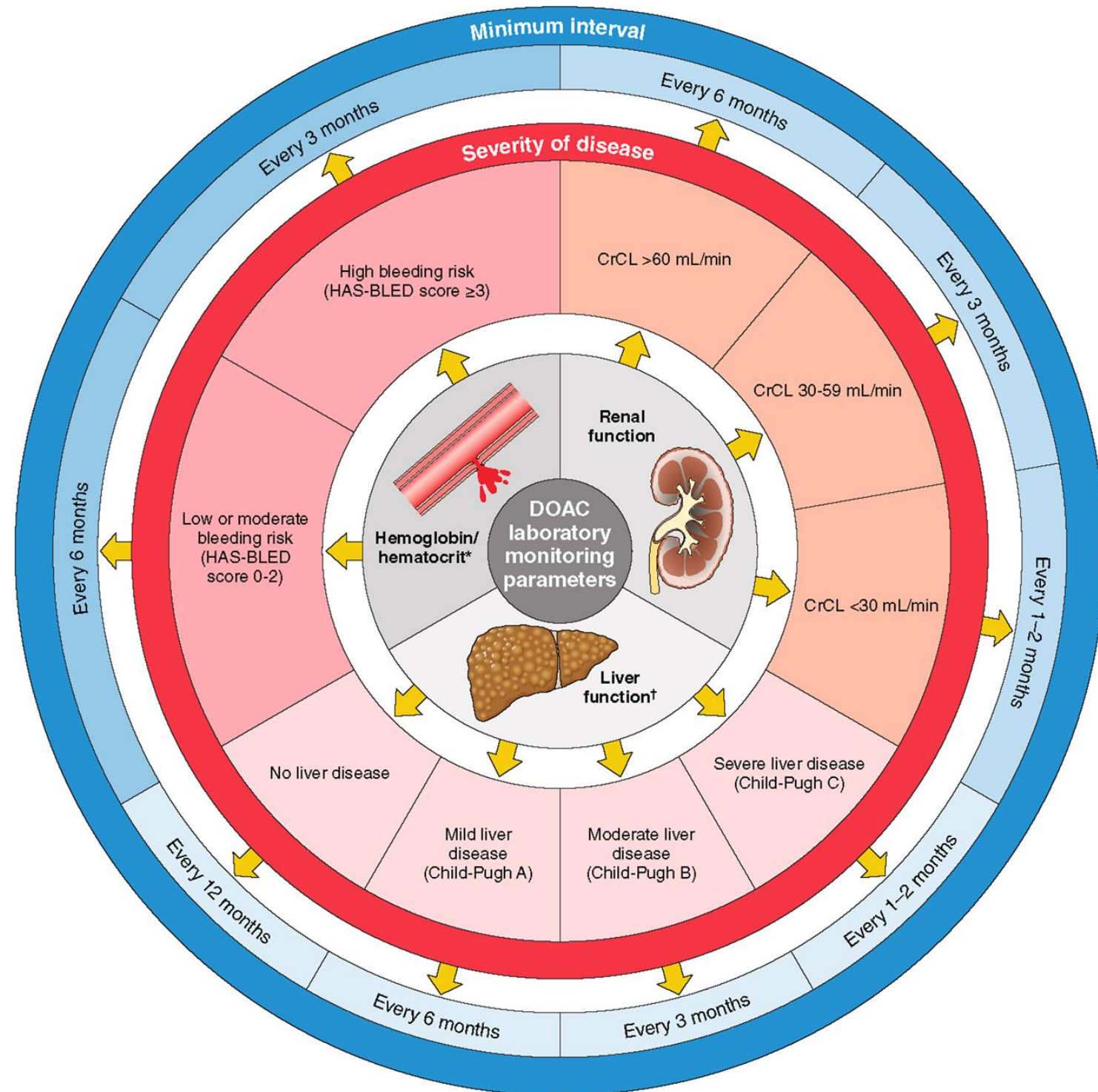
CHADS-Vasc ≥ 2

- $>24h$ episodes: anticoagulate
- 5m-24h: may anticoagulate
- $<5m$: no benefit

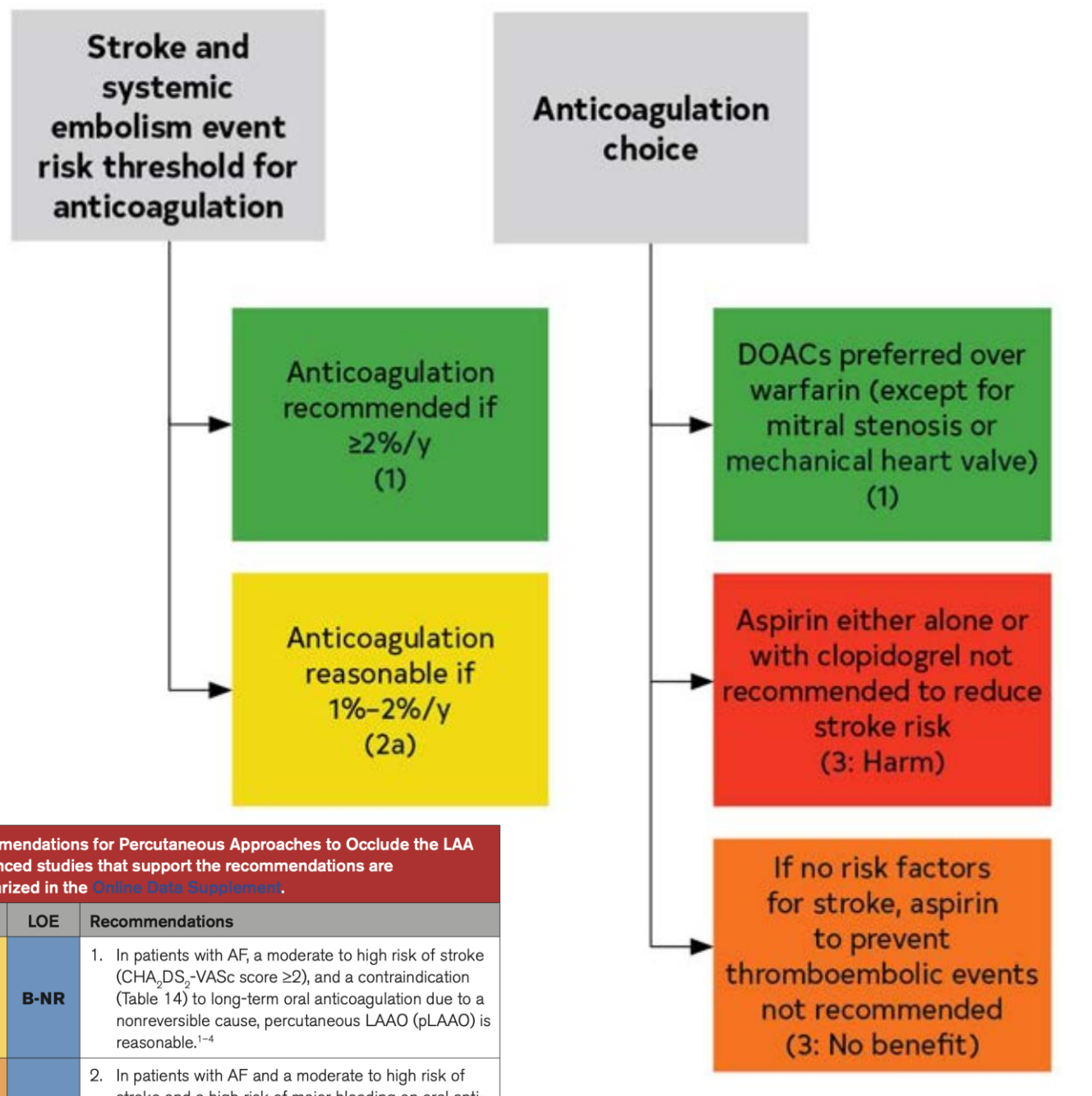


Monitoring Anticoagulation

- Basic monitoring interval: q 6 months
- With increased hepatic or renal disease, increase monitoring frequency
- With higher bleed risk, monitor more frequently



Options for stroke prevention in AF



Recommendations for Percutaneous Approaches to Occlude the LAA		
Referenced studies that support the recommendations are summarized in the Online Data Supplement .		
COR	LOE	Recommendations
2a	B-NR	1. In patients with AF, a moderate to high risk of stroke (CHA ₂ DS ₂ -VAsc score ≥2), and a contraindication (Table 14) to long-term oral anticoagulation due to a nonreversible cause, percutaneous LAAO (pLAAO) is reasonable. ¹⁻⁴
2b	B-R	2. In patients with AF and a moderate to high risk of stroke and a high risk of major bleeding on oral anticoagulation, pLAAO may be a reasonable alternative to oral anticoagulation based on patient preference, with careful consideration of procedural risk and with the understanding that the evidence for oral anticoagulation is more extensive. ^{1-3,5,6}

- Anticoagulation considered for all regardless of whether a rhythm or rate control strategy is chosen
- AF pts with mitral stenosis or a mechanical valve should be treated with **warfarin**
- CHA₂DS₂-Vasc Score
 - 0(M)/1(F) – no anticoagulation
 - 1(M)/2(F) – anticoagulation may be considered
 - ≥2(M)/3(F) – anticoagulation is recommended
- Mechanical left atrial appendage exclusion in select patients

JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY

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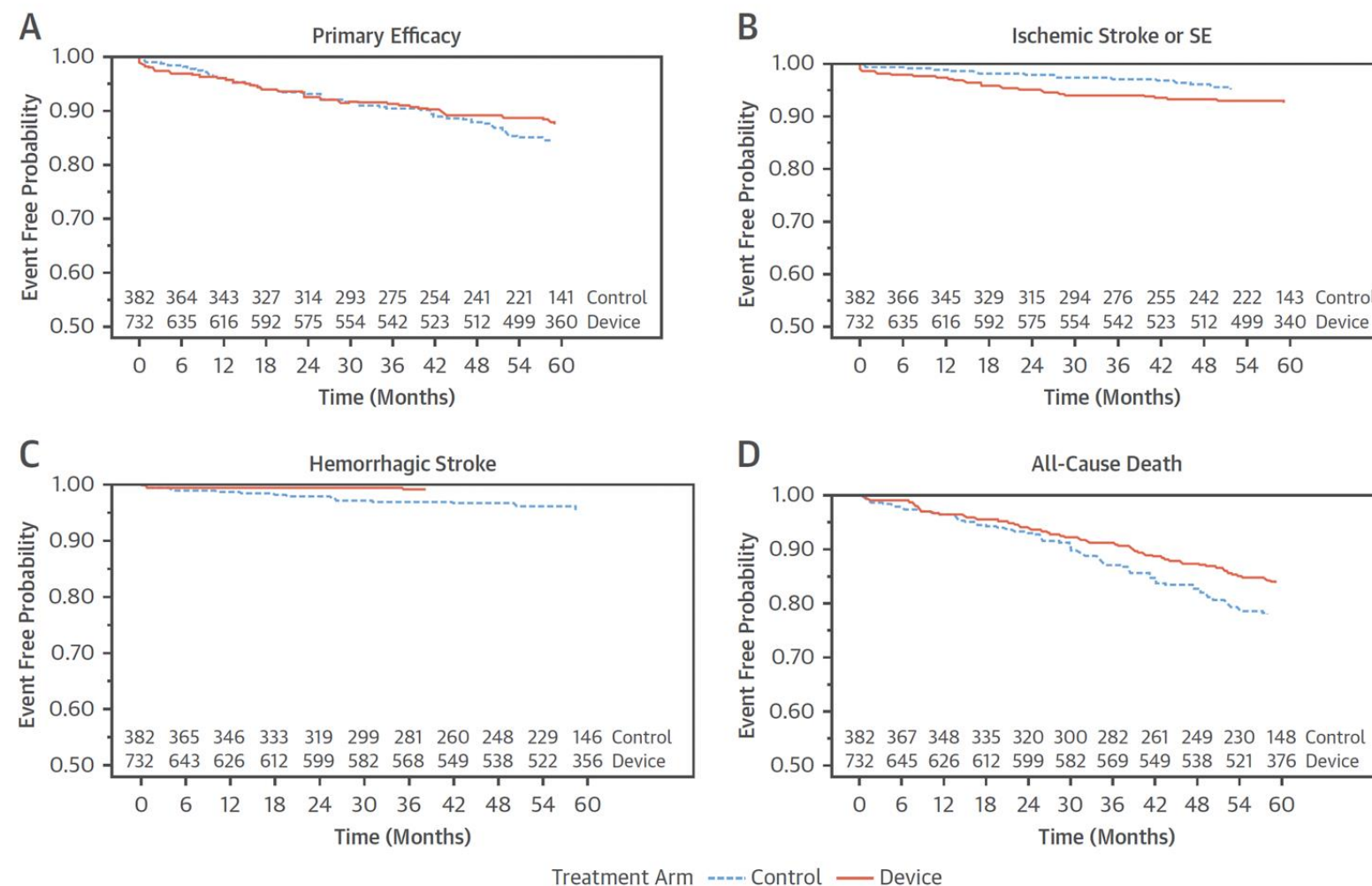
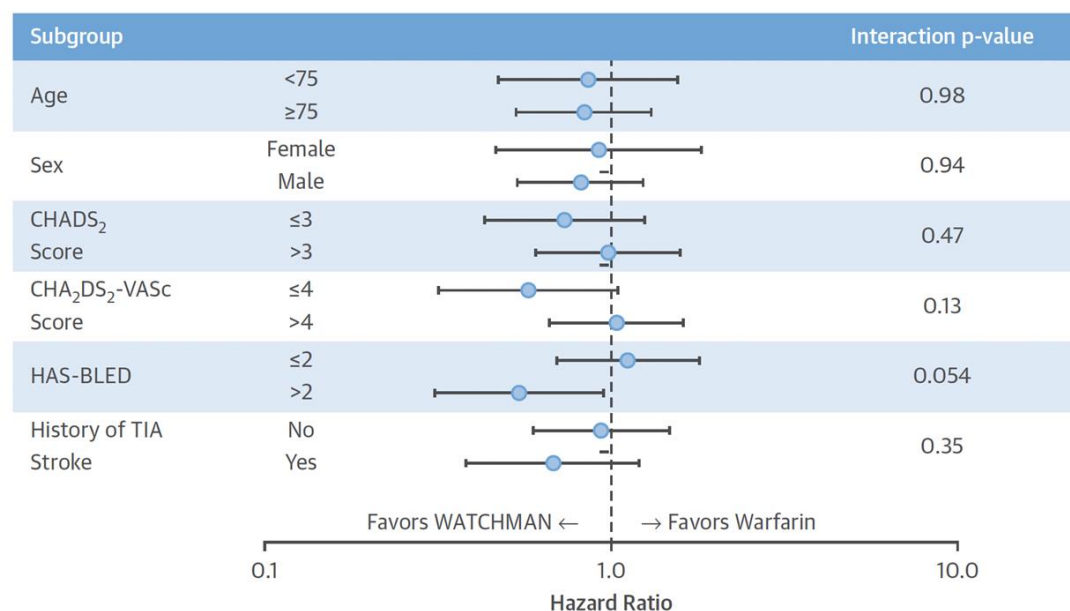
<https://doi.org/10.1016/j.jacc.2017.05.038>

5-Year Outcomes After Left Atrial Appendage Closure

From the PREVAIL and PROTECT AF Trials

Vivek Y. Reddy, MD,^{a,b} Shephal K. Doshi, MD,^c Saibal Kar, MD,^d Douglas N. Gibson, MD,^e Matt Kenneth Huber, MD,^f Rodney P. Horton, MD,^g Maurice Buchbinder, MD,^h Petr Neuzil, MD, PhD,ⁱ Nicole T. Gordon, BSEE,^j David R. Holmes, Jr, MD,^j on behalf of the PREVAIL and PROTECT AF

FIGURE 2 PROTECT AF/PREVAIL Combined: Primary Efficacy by Subgroup



- 5 year follow up data combining PROTECT AF and PREVAIL demonstrates long-term significant superiority for LAAO for ischemic stroke, hemorrhagic stroke, A-C mortality c/t **WARFARIN**
- BUT, what about LAAO compared to DOAC?**

Which Anticoagulant(s) Are Best For Stroke Prevention in AF?

- **Dabigatran:** (direct thrombin inhibitor) superior to warfarin
- **Rivaroxaban:** (factor Xa inhibitor) noninferior to warfarin
- **Apixaban:** (factor Xa inhibitor) superior to warfarin
- **Edoxaban:** (factor Xa inhibitor) noninferior to warfarin
- **Safety:**
 - All DOACs have lower risk of serious intracranial bleed, equivalent or superior safety with GI bleed
 - Increased thromboembolism in patients with mechanical heart valves or severe mitral stenosis
 - IV in-hospital reversal agents available for all agents

TOP 10

Meds Linked to Hospitalizations
for Adverse Drug Events in
Older Americans

10.	Renin-angiotensin inhibitors	(2.9%)
9.	Antiadrenergic agents	(2.9%)
8.	Antineoplastics	(3.3%)
7.	Digoxin	(3.5%)
6.	Antibiotics	(4.2%)
5.	Opioid analgesics	(4.8%)
4.	Oral hypoglycemic agents	(10.7%)
3.	Oral antiplatelet agents	(13.3%)
2.	Insulins	(13.9%)
1.	Warfarin	(33.3%)



Source: Budnitz D et al. N Engl J Med. 2011;365:2002-12.

- Connolly, S., et al. *Dabigatran versus warfarin in patients with atrial fibrillation*. N Engl J Med 2009 Sep 17; 361(12):1139-1151.
- Patel, MR, et al. *Rivaroxaban versus warfarin in nonvalvular atrial fibrillation*. N Engl J Med. 2011 Sep 8;365(10):883-91.
- Granger, CB, et al. *Apixaban versus warfarin in patients with atrial fibrillation*. N Engl J Med. 2011 Sep 15;365(11):981-92.

Why do we differentiate between paroxysmal vs. persistent AF when it comes to ablation?

	Paroxysmal AF	Persistent AF	Long-standing persistent AF
Definition	Episodes self terminate or via CV <7d	Episodes do not self terminate < 7d	Persistent AF >1 year
LA size	Normal to mildly enlarged	Mild to severely enlarged	Severely enlarged
LA scar burden	Low	Moderate	high
Efficacy of AAD	Often effective	Not as effective	Usually refractory
When to offer ablation?	First-line therapy	First-line OK, but after AAD failure best	After AAD failure
Ablation technique	PV isolation alone	PV isolation only probably still best	PV isolation; additional ablation likely needed
Catheter ablation efficacy	Excellent	Not quite excellent, but still good	?, but likely low with current approaches

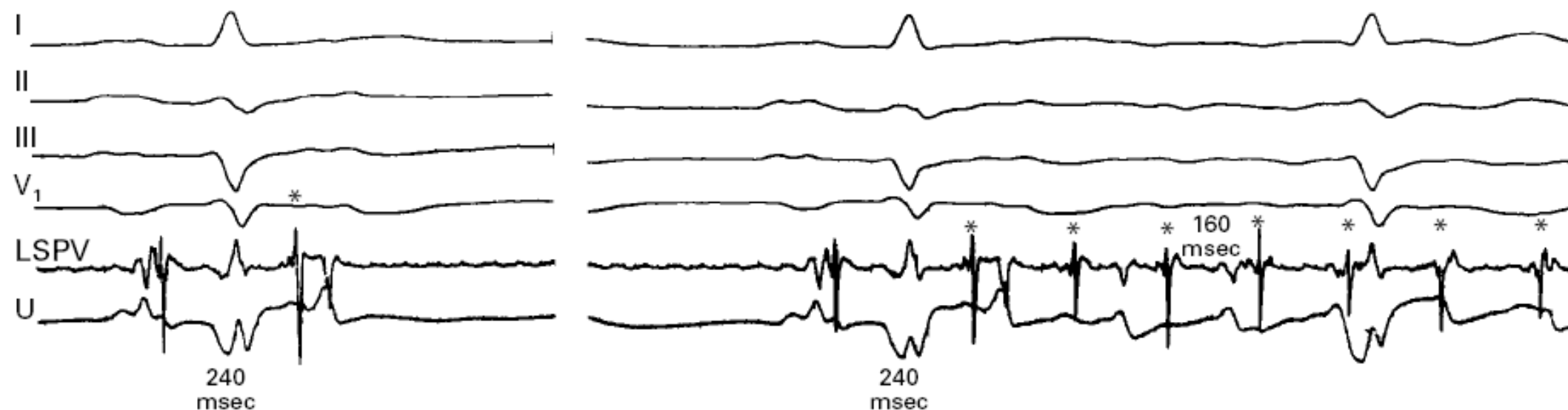
- Class IC agents
 - Contraindicated in patients with “structural heart disease”
 - May be used as maintenance or “pill in the pocket”
 - Should be given with concomitant rate control agent to prevent rapidly conducting atrial flutter
- Class III agents
 - All agents can prolong QT interval (amiodarone less so)
 - Dofetilide and sotalol should be initiated in the hospital
 - Patients taking amiodarone should have periodic monitoring for organ toxicity

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

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.

- Arrhythmogenic triggers for AF in the pulmonary vein musculature demonstrated in 45 patients with PAF



- Ablation of these PV triggers resulted in reduction/elimination of AF

ORIGINAL ARTICLE

Left Atrial Appendage Closure after Ablation for Atrial Fibrillation

O.M. Wazni, W.I. Saliba, D.G. Nair, E. Marijon, B. Schmidt, T. Hounshell, H. Ebel, C. Skurk, S. Oza, C. Patel, A. Kanagasundram, A. Sadhu, S. Sundaram, J. Osorio, G. Mark, M. Gupta, D.B. DeLurgio, J. Olson, J.E. Nielsen-Kudsk, L.V.A. Boersma, J.S. Healey, K.P. Phillips, F.M. Asch, K. Wolski, K. Roy, T. Christen, B.S. Sutton, K.M. Stein, and V.Y. Reddy, for the OPTION Trial Investigators*

- 1600 patients undergoing catheter ablation for AF randomized 1:1 to LAAO vs. continued anticoagulation
- LAAO procedure performed either at the time of AF ablation or at a separate procedure
- “Non-procedural” major bleeding events significantly lower in LAAO arm
- **Stroke rates very low in both arms (1.2%/1.3%)**

