Update of Clinical Trials and Future Direction for Left Atrial Appendage Occlusion in Neurologist Perspective

Asan Medical Center

Department of Neurology

Stroke center

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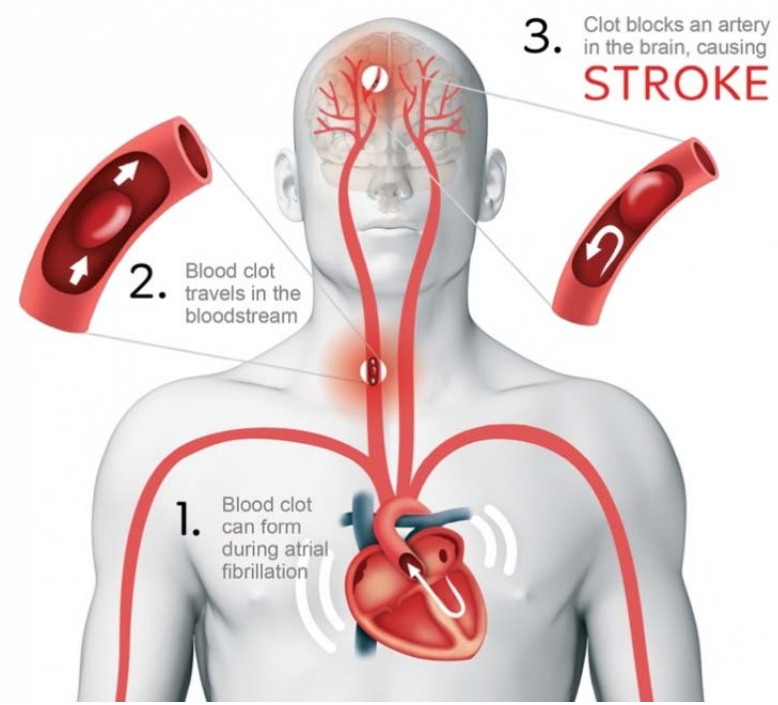
AF- stroke

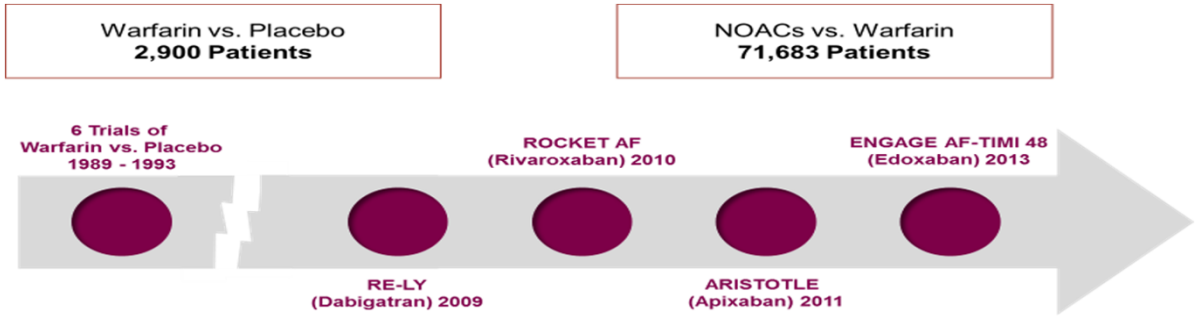
- **AF stroke**



15-20 % of all ischemic stroke

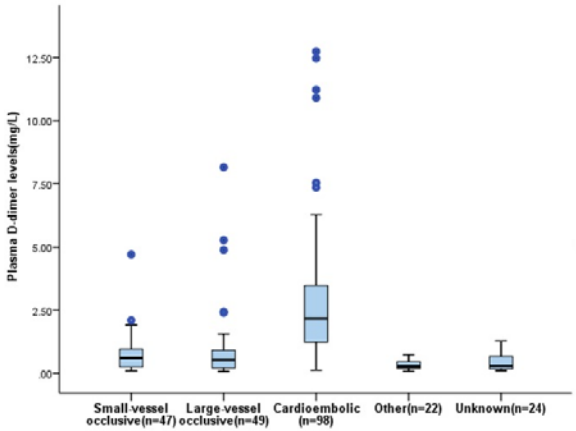
Higher severity
Large lesion

→
May need anticoagulation



Risk of cardioembolism in AF patients

- **Biochemical factors**
  - Hypercoagulable state matters CE



1. D-dimer higher in those with cardioembolic stroke than other mechanisms

2. D-dimer level well correlates with the risk of stroke stratified by CHADS2 or CHADSVASC score.

	$CHADS_2$ score		CHA_2DS_2-VASc score	
Point	Number	D-dimer	Number	D-dimer
0	27	0.40±0.18	10	0.35±0.22
1	77	0.47±0.26	25	0.39±0.17
2	148	0.70±0.46	54	0.52±0.27
3	57	0.79±0.32	117	0.64±0.49
4	11	0.78±0.38	78	0.79±0.35
5	4	0.95±0.21	28	0.78±0.28
6			9	0.81±0.49
7			2	0.55±0.35
8				

PLoS One. 2014; 9(1): e86

Medicine: October 2018 - Volume 97 - Issue 43 - p e12622

Obstacles of Long term anticoagulation

- **Bleeding**

- **Non-compliance**
- **Drug interaction**
- **Side effects**

- **Concerns of elderly**

- **Limited use in CKD**

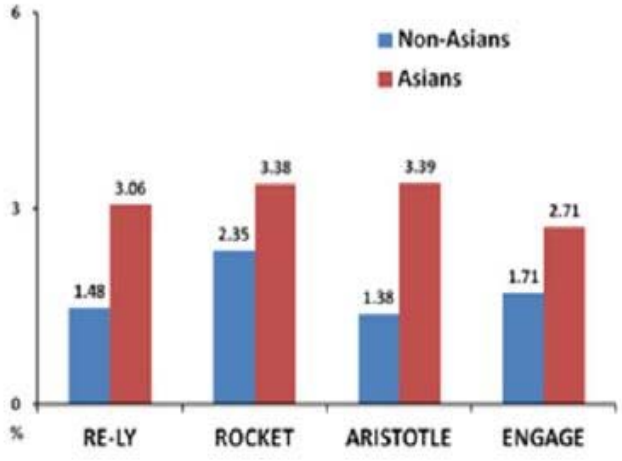
- **Residual stroke risk (2-5% annually)**

Table 2. Incidence Rate of Clinical Outcomes According to the Type of Anticoagulant

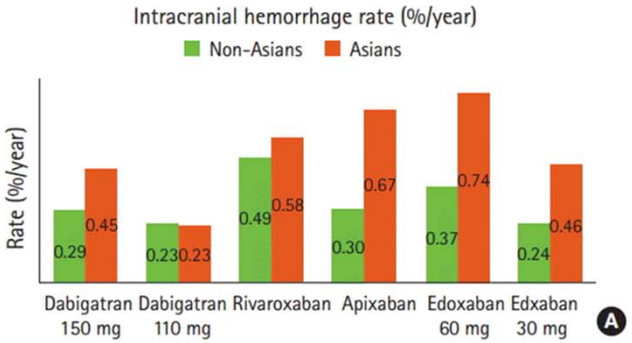
	Warfarin		Dabigatran		Rivaroxaban		Apixaban	
	Event	IR	Event	IR	Event	IR	Event	IR
Overall population, n	10409		12593		21000		12502	
Ischemic stroke or SE	459	3.73	458	2.89	703	2.83	388	2.82
All-cause death	602	4.74	553	3.41	978	3.85	583	4.14
Myocardial infarction	111	0.88	88	0.54	164	0.65	77	0.55
Major bleeding	324	2.60	328	2.05	632	2.53	257	1.85
Any bleeding	1717	15.17	1869	12.71	3458	15.22	1518	11.71
Intracranial bleeding	54	0.43	38	0.23	93	0.37	60	0.43
Gastrointestinal bleeding	475	3.86	633	4.02	995	4.05	474	3.45

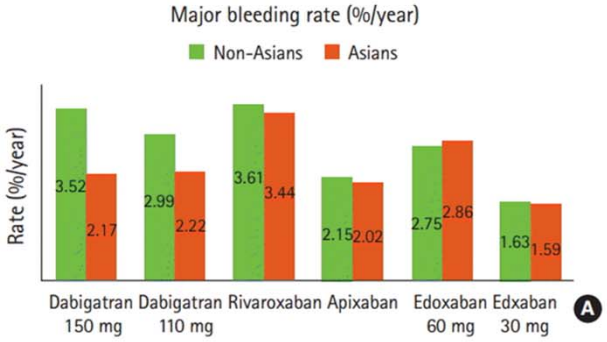
Bleeding issues in Asians

Stroke / SEE



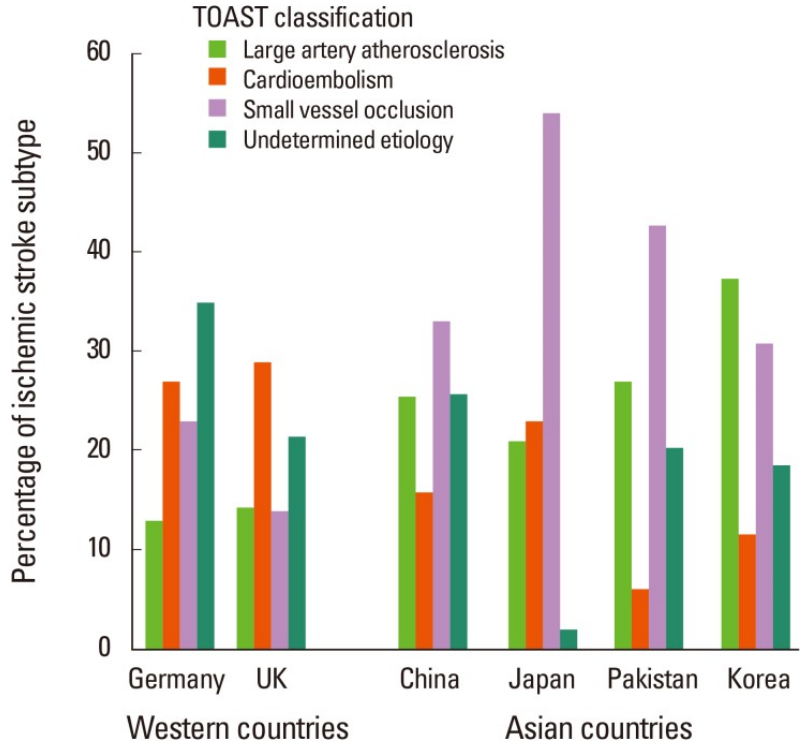
Higher risk of stroke/Systemic embolism in Asians

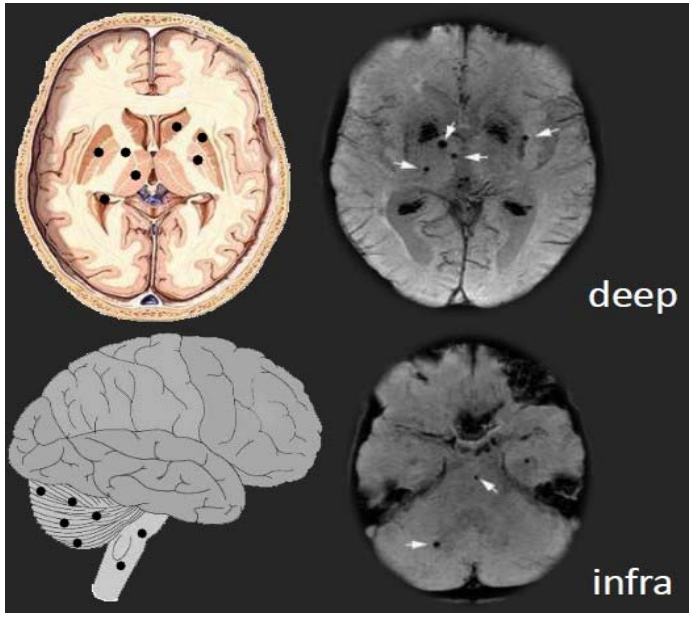




Higher risk of Bleeding in Asians → especially ICH

Why different ?





Presence of CMB
-disruption of BBB
-high risk of cerebral hemorrhage.

Higher incidence of small vessel disease
15-20% of AF-stroke is lacunar infarction

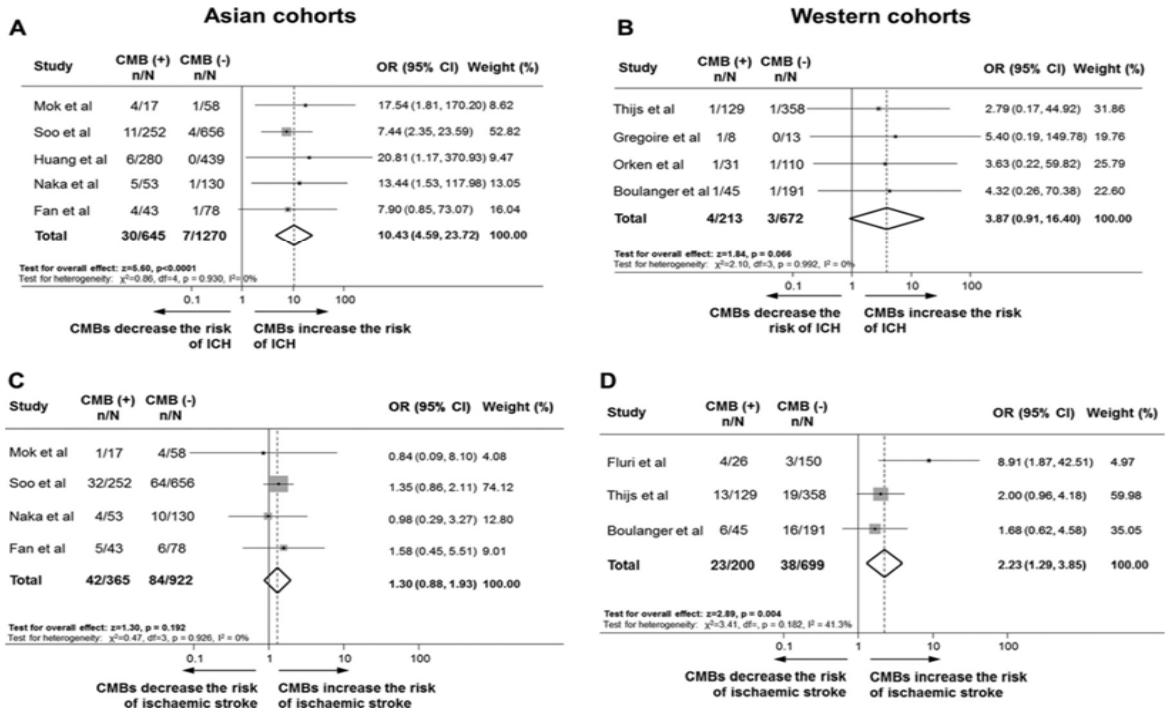
Another marker of small vessel disease → CMB

CMB and risk of ICH (Asians)

Cerebral Microbleeds and Recurrent Stroke Risk

Systematic Review and Meta-Analysis of Prospective Ischemic Stroke and Transient Ischemic Attack Cohorts

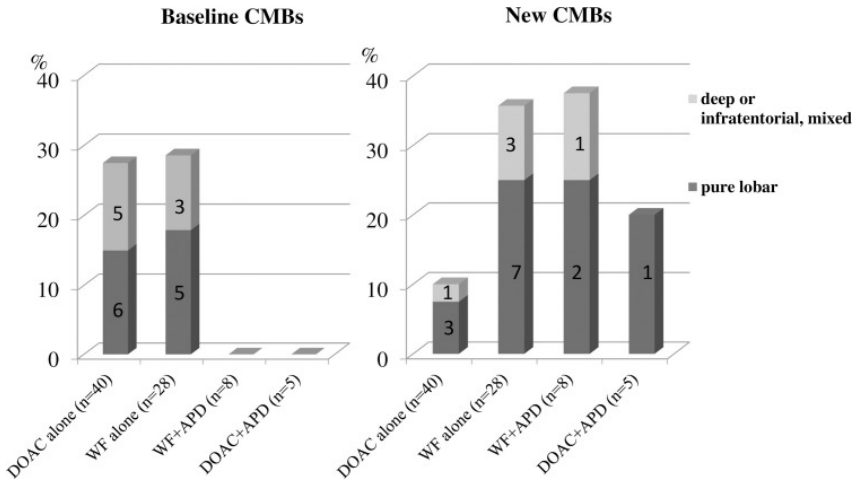
Andreas Charidimou, MSc; Puneet Kakar, MD; Zoe Fox, PhD; David J. Werring, PhD



- Higher risk of future cerebral hemorrhage when an Asian shows Cerebral microbleeds
- Also a slight increase in the risk of ischemic stroke

Factors associated with the presence of lobar or deep cerebral microbleeds (CMBs)

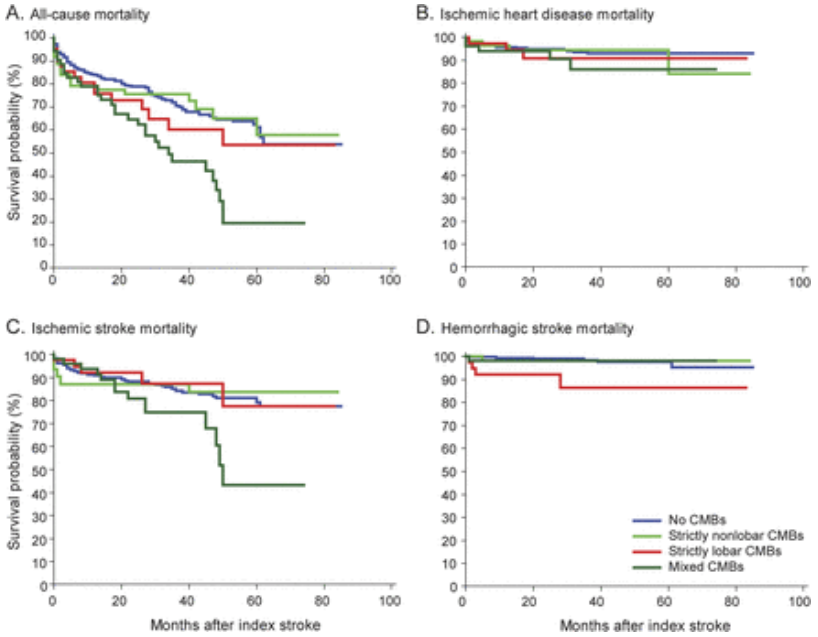
	Lobar CMB		Any Lobar CMB		Deep CMB		Any Deep CMB	
	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Male	1.03 (0.79-1.47)	0.762	1.21 (0.78-1.87)	0.401	0.82 (0.58-1.17)	0.275	0.50 (0.29-0.86)	0.013
Age	1.01 (0.99-1.04)	0.235	1.02 (1.00-1.04)	0.041	1.02 (1.00-1.04)	0.013	1.00 (0.96-1.01)	0.327
Hypertension	1.14 (0.68-1.91)	0.615	1.08 (0.59-1.96)	0.809	1.53 (1.03-2.28)	0.035	0.84 (0.42-1.68)	0.628
Diabetes mellitus	0.99 (0.59-1.65	0.955	1.20 (0.73-1.96)	0.468	0.65 (0.43-1.01)	0.053	1.13 (0.63-2.00)	0.690
Hyperlipidemia	1.26 (0.77-1.70)	0.312	0.76 (0.49-1.17)	0.213	1.10 (0.78-1.55)	0.607	1.18 (0.71-1.98)	0.526
Coronary artery disease	0.92 (0.45-1.89)	0.814	0.73 (0.33-1.63)	0.445	1.04 (0.62-1.73)	0.883	0.99 (0.38-2.56)	0.979
Smoking	1.15 (0.78-1.45)	0.672	1.00 (0.64-1.55)	0.993	1.02 (0.71-1.46)	0.909	1.12 (0.66-1.89)	0.671
Previous stroke history	1.08 (0.62-1.87)	0.789	1.16 (0.73-1.86)	0.538	1.64 (1.33-1.81)	0.021	1.11 (0.63-1.96)	0.707
Ischemic stroke subtypes								
Large artery atherosclerosis	1		1		1		1	
Small vessel occlusion	1.74 (0.97-3.14)	0.064	1.75 (1.33-2.16)	0.008	1.19 (0.80-1.77)	0.401	1.91 (1.36-2.68)	< 0.001
Cardioembolism	1.86 (1.04-3.34)	0.037	2.44 (1.60-3.71)	< 0.001	0.77 (0.49-1.19)	0.242	1.28 (0.90-1.83)	0.174
Use of Antithrombotic agents	1.81(1.13-2.90)	0.014	1.97 (1.26-3.07)	0.003	1.12 (0.76-1.64)	0.712	0.93 (0.56-1.57)	0.793



Use of antithrombotics more associated with Presence of Lobar CMBs

Use of warfarin more associated with increase in number of CMBs

PLoS One. 2020; 15(9): e0238456.



Higher mortality in those with mixed CMB or lobar CMB

Current Cardiology Reports (2018) 20: 106
https://doi.org/10.1007/s11886-018-1052-1

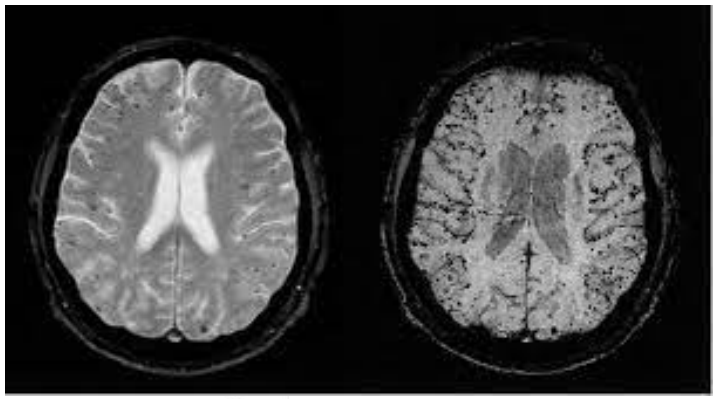
STROKE (JF MESCHIA, SECTION EDITOR)

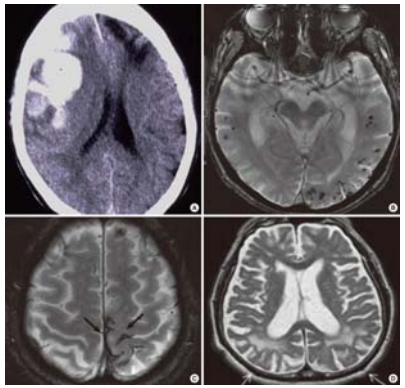
The Clinical Dilemma of Anticoagulation Use in Patients with Cerebral Amyloid Angiopathy and Atrial Fibrillation

Rocco J. Cannistraro[1] · James F. Meschia[1]

What About LAA Closure for AF?

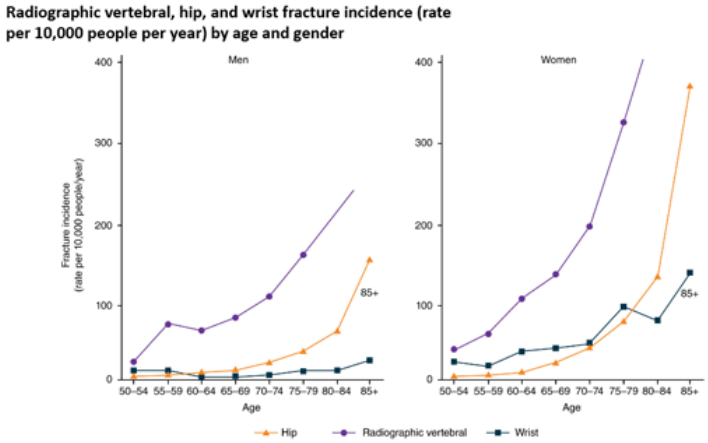
The 2014 AHA/ASA guidelines include LAA closure with the WATCHMAN device as therapy for AF patients at high risk of thromboembolism who are poor candidates for anticoagulation [10]. The PROTECT-AF trial found LAA closure non-inferior to warfarin for all vascular events. The stroke breakdown was as follows: LAA – 15 ischemic strokes / 694.6 patient-years versus warfarin – 6 ischemic strokes / 372.3 patient-years; LAA – 1 hemorrhagic stroke / 708.4 patient-years versus warfarin – 6 hemorrhagic strokes / 373.4 patient-years. Additionally, five of six of the ICHs on warfarin resulted in death. Of note, patients with LAA closure remain on warfarin for ≥ 45 days, the combination of aspirin and clopidogrel until 6 months post-procedure, and then aspirin indefinitely. Periprocedural complications (7-day procedure-related events) including procedure-related strokes, device embolization, and pericardial effusion occurred in 8.7% of the LAA closure group [41]. However, in 2014, the PREVAIL trial showed significantly lower adverse events (4.2%) [42]. This improvement was hypothesized to be from operators being more experienced post-PROTECT-AF with successful transfer of procedural knowledge to new sites and

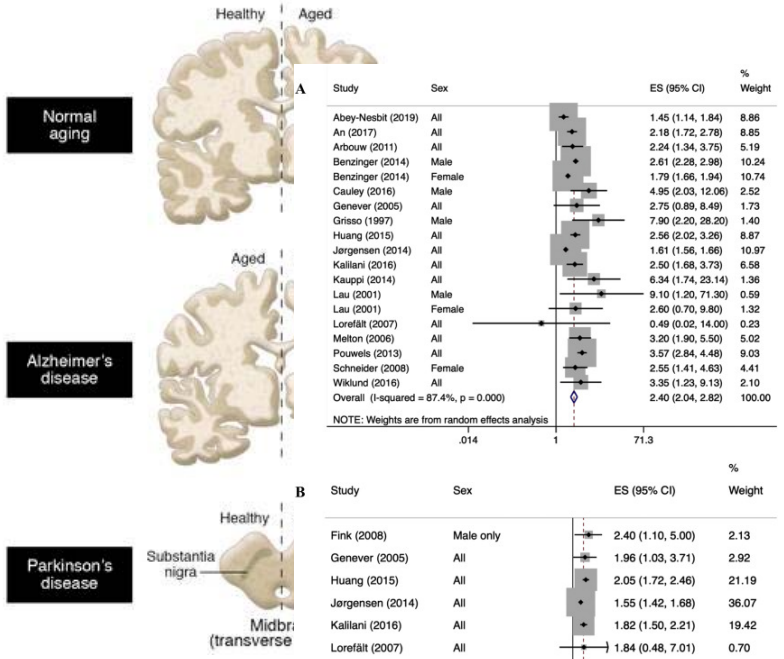




Concerns of elderly

- **Combined neuro-degenerative diseases**



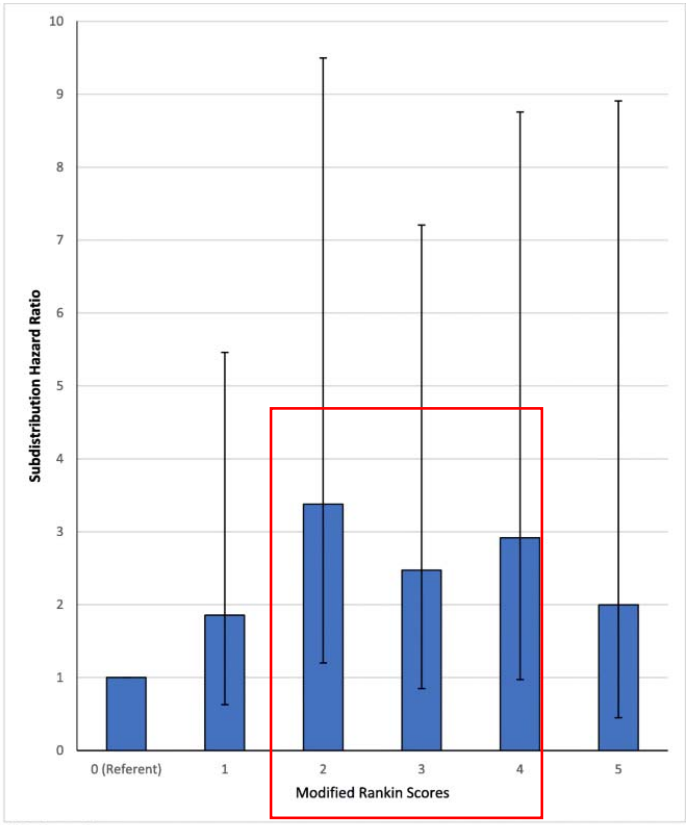


Higher risk of fracture in elderly patients

Higher risk of fracture in those with Parkinson's disease

Schini et al. Bone 2020

Falls after ischemic stroke



Modified Rankin Score

Post stroke falls associated with moderate neurological deficit

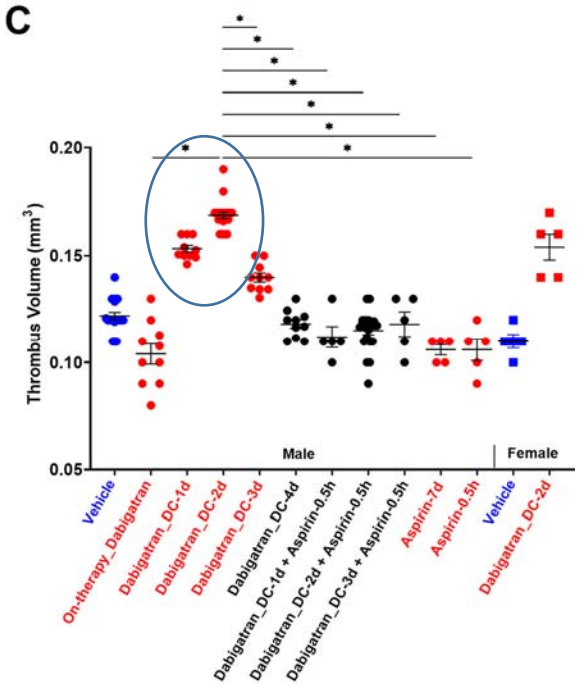
→May need caution for further traumatic ICH

→Especially those under anticoagulation

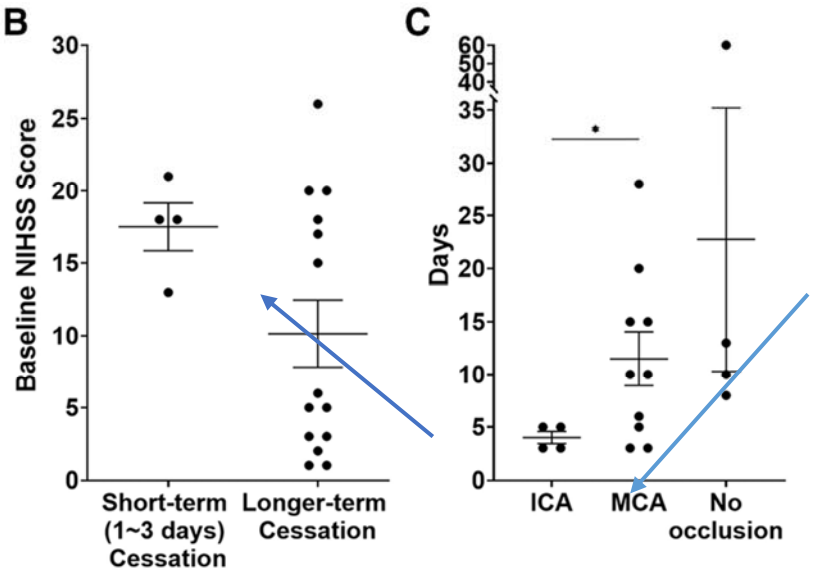
BMC Geriatrics volume 19, Article number: 373 (2019)

Short-term cessation of NOAC

- **Cessation of NOAC after fracture**
  - May cause paradoxical prothrombotic state



Thrombus formation larger after short term cessation



Short term after cessation is associated with more severe stroke and larger vessel occlusion

Ann Neurol 2021 Mar;89(3):444-458.

Cessation of anticoagulation

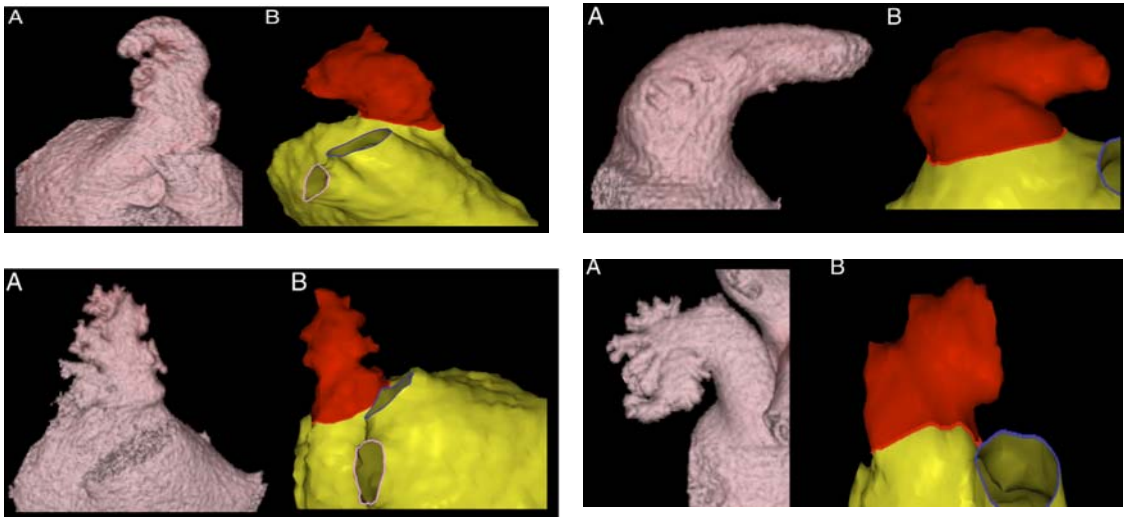
- **Other many procedures among elderly**

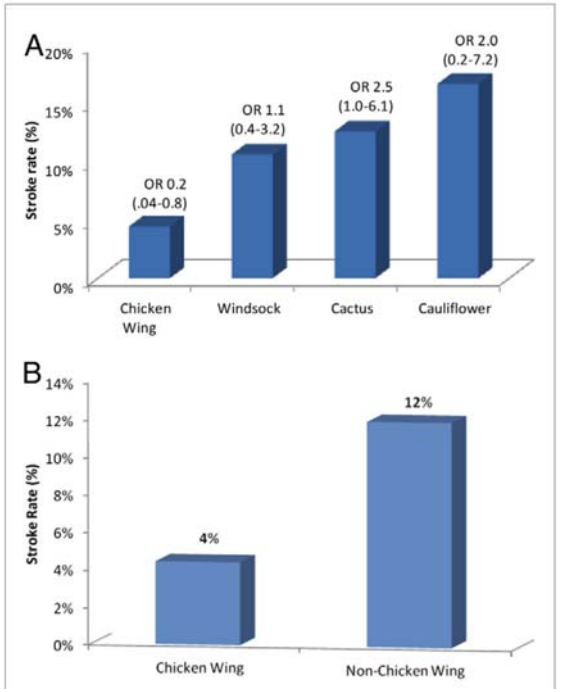
		D -4	D -3	D -2	D -1	Day of operation / procedure				D +1	D +2
Minor bleeding risk	Dabigatran	O O	O O	O O	O O	No Bridging	Operation / Procedure	Consider to restart ≥ 6h post operation / procedure	(O)	O O	O O
	Apixaban	O O	O O	O O	O O				(O)	O O	O O
	Edo/Riva (AM)	O	O	O	O				(O)	O	O
	Edo/Riva (PM)	O	O	O	O				(O)	O	O
Low bleeding risk	Dabigatran	O O	O O	O O	(O)				(O)	O O	O O
	Apixaban	O O	O O	O O	(O)				(O)	O O	O O
	Edo/Riva (AM)	O	O	O	(O)				(O)	O	O
	Edo/Riva (PM)	O	O	O					(O)	O	O
High bleeding risk	Dabigatran	O O	O O	No bridging				Non-pharmacological thrombo-prophylaxis			O O
	Apixaban	O O	O O								O O
	Edo/Riva (AM)	O	O								O
	Edo/Riva (PM)	O	O								O

→ Still a considerable portion of patients with NOAC do discontinue use of NOAC inappropriately and have stroke

physical factors associated with CE

- **Number of lobes**
  - Usually 2 lobes
  - Increased number of lobes associated with increased risk of thrombus
- **Morphology**





Risk of CE differs according to the shape of LAA

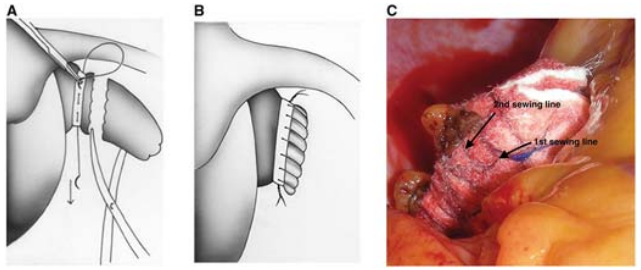
LAA morphology

- **Mean LAA contraction velocity**
  - lower in patients with LAA thrombus versus those without (10 +/− 4 vs. 22 ± 7 cm/s, p < 0.001),
  - lower in those with AF and a history of stroke or transient ischemic attack than in those without (11 +/− 3 vs. 15 +/− 6 cm/s, P = 0.008).

- **LAA flow velocity**
  - Lower in patients with stroke (36 ± 19 vs 55 ± 20 cm/s, p <0.001).

- **LAA orifice area**
  - Patients with stroke were found to have a larger LAA orifice area

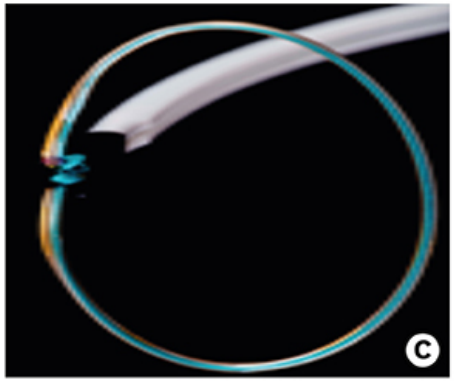
Devices occluding the LAA



Features	Watchman	ACP	Lariat
Approach	Endocardial	Endocardial	Endo and epicardial
Type	Deployable	Deployable	Suture ligation
Hardware left in heart	Yes	Yes	No
Retrievable	Yes	Yes	No
Used in prior open heart surgery	Yes	Yes	Yes
Approval	CE and FDA	CE	CE

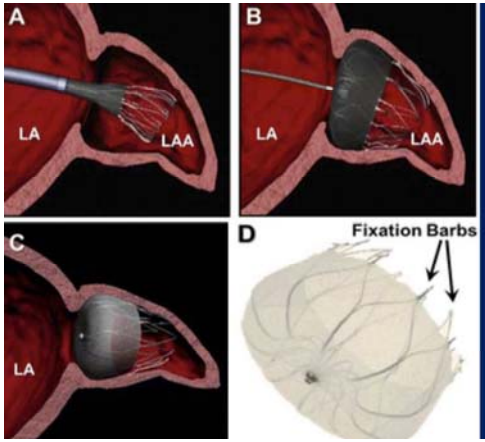
Watchman device
Image courtesy of Boston Scientific

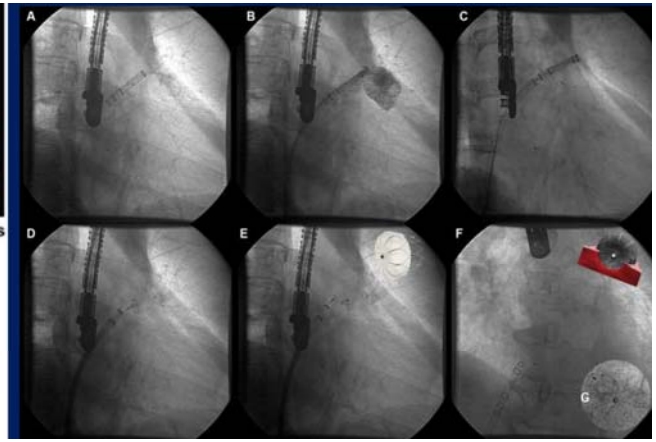
ACP device
Image courtesy of St. Jude Medical

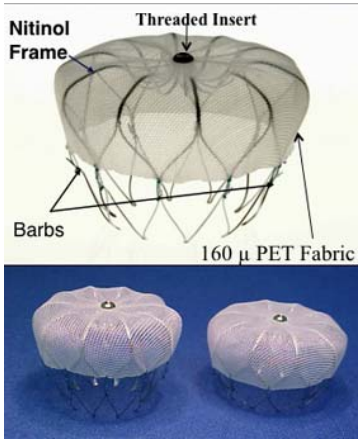


Lariat device
Image courtesy of SentreHEART

Watchman







- **A catheter-delivered heart implant designed to close the left atrial appendage (LAA)**
- **Permanently implanted at or slightly distal to the ostium of the LAA**

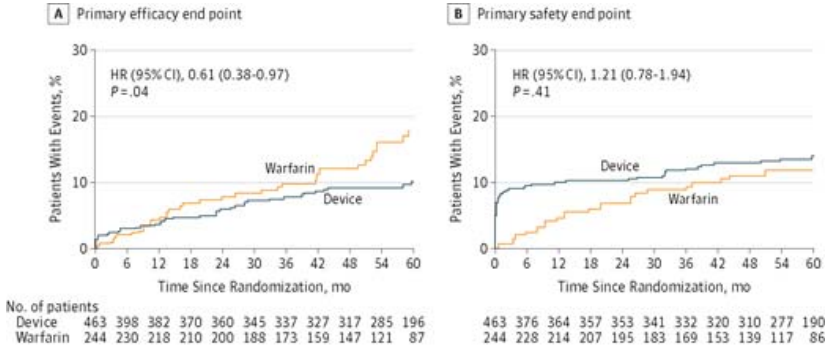
Study	Post-procedural medication	Study design	Mean follow-up	Success rate	MAE	Annual Stroke/SE risk vs. control	Annual bleed risk vs. control	Death (%)
PROTECT AF[17-19] *n* = 707, 2014	Aspirin indefinitely, Warfarin 45 days, Clopidogrel 4.5 months	RCT vs. warfarin	3.8 years	90.9%	3.6 vs. 3.1 per 100 patient-years	2.5% vs. 3.8%	4.8% vs. 7.4%	3.7% vs. 9.0%
PREVAIL[20] *n* = 407, 2014	Aspirin indefinitely, Warfarin 45 days, Clopidogrel 4.5 months	RCT vs. warfarin	18 months	95.1%	4.2% vs. 8.7% in PROTECT AF	2.3% vs. 0.7%	–	2.6% vs. 2.2%
CAP[21] *n* = 460, 2011	Aspirin indefinitely, Warfarin 45 days, Clopidogrel 4.5 months	Registry, multi-centre	12 months	95.0%	4.1% vs. 8.7% in PROTECT AF	–	–	–
ASAP[22] *n* = 150, 2013	Aspirin indefinitely Clopidogrel 6 mo	Registry, multi-centre	14 months	94.7%	8.7%	1.7% vs. 7.3%	–	5.0%
EWOLUTION[23] *n* = 1021, 2016	Warfarin 45 days (27%), aspirin and Clopidogrel for 6 months (59%), aspirin only (7%), none (6%)	Registry, multi-centre	30 days	98.5%	2.7% vs. 8.6% in PROTECT AF	–	–	0.7%

Coloured cells indicate studies that included subjects with contraindication to anticoagulation.
DAPT, dual antiplatelet therapy; MAE, major adverse events; SE, systemic embolism.[24]

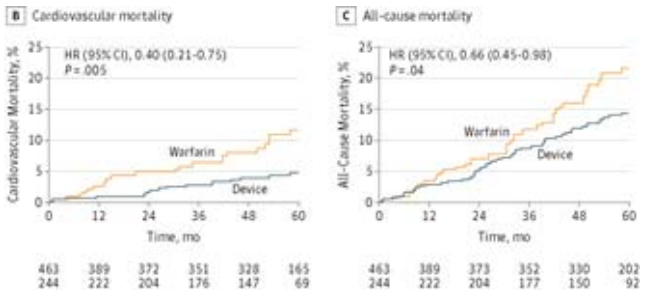
PROTECT AF trial

- **PROTECT AF trial**
  - 707 patients with NVAF (> 18 yrs old)
  - CHADS2 risk score >/= 1
  - LAAO by Watchman device vs warfarin (2:1)
  - Non inferiority trial design
    - Posterior probability > 95%
  - 4 yr follow-up
  - Primary outcome:
    - stroke, systemic embolism, cardiovascular and unexplained death

Device arm
-aspirin + warfarin -45d
-aspirin + clopidogrel -6m
-aspirin



Both non-inferiority and superiority



Superiority in mortality

JAMA. 2014;312(19):1988-1998

PRTECT AF trial

View from Neurologist

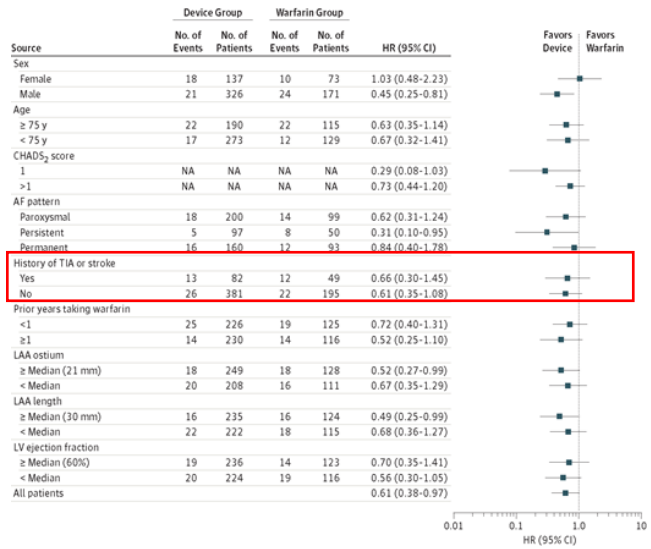
Table 1. Baseline Characteristics of the Study Participants by Treatment Group

	Device Group (n = 463)	Warfarin Group (n = 244)
Age, mean (SD) [range], y	71.7 (8.8) [46-95]	72.7 (9.2) [41-95]
Heart rate, mean (SD) [range], beats/min	73 (13) [37-120]	74 (13) [42-109]
Blood pressure, mean (SD) [range], mm Hg		
Systolic	135 (21) [90-229]	135 (19) [90-194]
Diastolic	77 (12) [32-117]	76 (12) [44-120]
Body mass index, mean (SD) [range][a]	31.6 (6.0) [14-54]	31.3 (6.2) [20-57]
Male sex, No. (%)	326 (70.4)	171 (70.1)
Race/ethnicity, No. (%)		
Asian	4 (0.9)	1 (0.4)
Black/African American	6 (1.3)	5 (2.0)
White	425 (91.8)	222 (91.0)
Hispanic/Latino	25 (5.4)	15 (6.1)
Hawaiian Pacific Islander	1 (0.2)	1 (0.4)
Other	2 (0.4)	0
$CHADS_2$ score[b]		
Mean (SD) [range]	2.2 (1.2) [1-6]	2.3 (1.2) [1-6]
Score, No. (%)		
1	156 (33.7)	66 (27.0)
2	158 (34.1)	88 (36.1)
≥3	149 (32.2)	90 (36.8)
Risk factors for stroke, No. (%)		
Congestive heart failure	124 (26.8)	66 (27.0)
History of hypertension	415 (89.6)	220 (90.2)
Age ≥75 y	190 (41.0)	115 (47.1)
Diabetes	113 (24.4)	72 (29.5)
Previous ischemic stroke or TIA	82 (17.7)	49 (20.1)
LV ejection fraction, mean (SD) [range], %	57.3 (9.7) [30-82]	56.7 (10.1) [30-86]
Classification of AF, No. (%)		
Paroxysmal	200 (43.2)	99 (40.6)
Persistent	97 (21.0)	50 (20.5)
Permanent	160 (34.6)	93 (38.1)
Unknown	6 (1.3)	2 (0.8)
Onset of AF, No. (%)		
<1 y	69 (14.9)	50 (20.5)
≥1 y	360 (77.8)	182 (74.6)
No estimate	34 (7.3)	12 (4.9)
Previous warfarin use, No. (%)		
<1 y	221 (47.7)	123 (50.4)
≥1 y	227 (49.0)	114 (46.7)
No estimate	15 (3.2)	7 (2.9)
Region of enrollment, No. (%)		
United States	382 (82.5)	201 (82.4)
Europe	81 (17.5)	43 (17.6)

Abbreviations: AF, atrial fibrillation; LV, left ventricular; TIA, transient ischemic attack.

[a] Calculated as weight in kilograms divided by height in meters squared.

[b] Validated risk score model to establish the risk of stroke in patients with nonrheumatic atrial fibrillation.



- LAAO decreased risk of cerebral hemorrhage
  - Unfortunately not much data with patients with stroke
  - Comparative was warfarin

Table 2. Intention-to-Treat Primary Efficacy and Safety Outcomes According to Treatment Group by Bayesian Model

Event	Device Group (n = 463) Events/Patient-Years	Device Group (n = 463) Observed Rate[a]	Warfarin Group (n = 244) Events/Patient-Years	Warfarin Group (n = 244) Observed Rate[a]	Device/Warfarin Rate Ratio (95% Credible Interval)	Posterior Probabilities, % Noninferiority	Posterior Probabilities, % Superiority
Primary efficacy end point[b]	39/1720.2	2.3 (1.7-3.2)	34/900.8	3.8 (2.5-4.9)	0.60 (0.41-1.05)	>99	96
Stroke	26/1720.7	1.5 (1.0-2.2)	20/900.9	2.2 (1.3-3.1)	0.68 (0.42-1.37)	>99	83
Ischemic	24/1720.8	1.4 (0.9-2.1)	10/904.2	1.1 (0.5-1.7)	1.26 (0.72-3.28)	78	15
Hemorrhagic	3/1774.2	0.2 (0.0-0.4)	10/916.2	1.1 (0.5-1.8)	0.15 (0.03-0.49)	>99	99
Disabling[c]	8/1771.3	0.5 (0.2-0.8)	11/912.7	1.2 (0.6-1.9)	0.37 (0.15-1.00)	>99	98
Nondisabling[c]	18/1723.7	1.0 (0.7-1.7)	9/907.7	1.0 (0.4-1.7)	1.05 (0.54-2.80)	89	34
Systemic embolization	3/1773.6	0.2 (0.0-0.4)	0/919.5	0	NA		
Cardiovascular or unexplained death	17/1774.3	1.0 (0.6-1.5)	22/919.4	2.4 (1.4-3.4)	0.40 (0.23-0.82)	>9	
Primary safety end point[d]	60/1666.2	3.6 (2.8-4.6)	27/878.2	3.1 (2.0-4.3)	1.17 (0.78-1.95)	9	

Abbreviation: NA, not applicable.

[a] Events per 100 patient-years (95% credible interval).

[b] Primary efficacy defined as composite of stroke, systemic embolization, or cardiovascular/unexplained death.

[c] Disabling or fatal strokes were those with a Modified Rankin Score of 3-6 after the stroke. Nondisabling strokes were those with M
O-2 after the stroke.

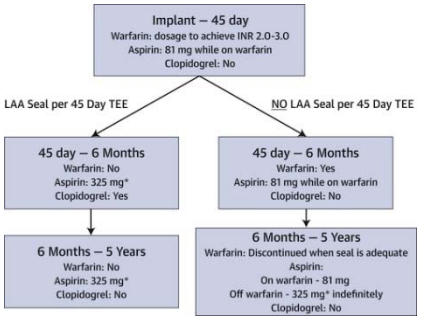
[d] Safety defined as procedure-related events (pericard
vention or prolonged hospitalization, procedure-relat
zation) and major bleeding (intracranial or bleeding re

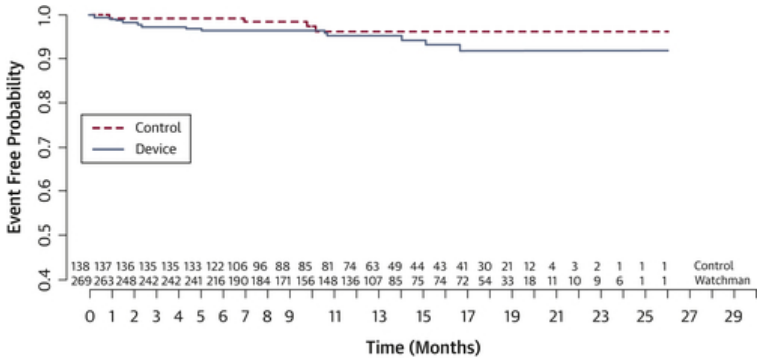
Table 3. Causes of Mortality by Treatment Group

	Device Group, No. (%) (n = 463)	Warfarin Group, No. (%) (n = 244)	*P* Value
Cardiovascular	17 (3.7)	22 (9.0)	.005
Heart failure	3 (0.6)	2 (0.8)	>.99
Hemorrhagic stroke	2 (0.4)	8 (3.3)	.004
Ischemic stroke	1 (0.2)	1 (0.4)	>.99
Myocardial infarction	2 (0.4)	2 (0.8)	.61
Sudden cardiac death	4 (0.9)	4 (1.6)	.46
Unexplained/other	5 (1.0)	5 (2.0)	.33
Cancer	10 (2.2)	3 (1.2)	.56
Pulmonary	9 (1.9)	9 (3.7)	.21
Neurologic	2 (0.4)	1 (0.4)	>.99
Multisystem organ failure	6 (1.3)	1 (0.4)	.43
Other	9 (1.9)	5 (2.0)	>.99
Renal failure	3 (0.6)	3 (1.2)	.42
Sepsis	2 (0.4)	1 (0.4)	>.99
Unexplained/other	4 (0.9)	1 (0.4)	.66

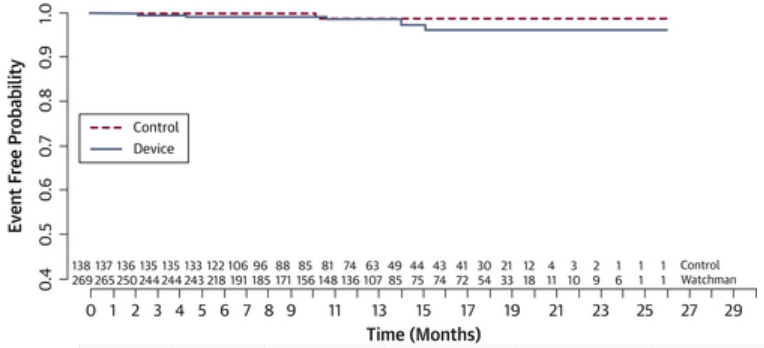
PREVAIL study

- **PREVAIL trial**
  - 407 patients
  - CHADS2 score >2
  - LAAO with WATCHMAN vs. warfarin (2:1)
  - Follow up: 18 months
  - Primary outcome:
    - hemorrhagic or ischemic stroke, SE, and cardiovascular/unexplained death.
    - Rate of stroke or SE 7 days after randomization (Late-ischemic primary efficacy endpoint)





Device 18-Month Rate	Control 18-Month Rate	18-Month Rate Ratio (95% CrI)	Rate Ratio Noninferiority Criterion
0.064	0.063	1.07 (0.57, 1.89)	95% CrI upper bound <1.75



Device 18-Month Rate	Control 18-Month Rate	18-Month Rate Ratio (95% CrI)	Rate Ratio Noninferiority Criterion	18-Month Rate Difference (95% CrI)	Rate Difference Noninferiority Criterion
0.0253	0.0200	1.6 (0.5 to 4.2)	95% CrI upper bound <2.0	0.0053 (−0.0190 to 0.0273)	95% CrI upper bound <0.0275

J Am Coll Cardiol. 2014 Jul, 64 (1) 1–12

- **View from neurologist**

Table 6.
Demographic Characteristics of Patients Receiving the Watchman Device in PROTECT AF, CAP, and PREVAIL

	PROTECT AF (n = 463)	CAP (n = 566)	PREVAIL (n = 269)	p Value
Age, yrs	71.7 ± 8.8 (46.0, 95.0)	74.0 ± 8.3 (44.0, 94.0)	74.0 ± 7.4 (50.0, 94.0)	<0.001
Male	326/463 (70.4%)	371/566 (65.5%)	182/269 (67.7%)	0.252
$CHADS_2$ score (continuous)	2.2 ± 1.2 (1.0, 6.0)	2.5 ± 1.2 (1.0, 6.0)	2.6 ± 1.0 (1.0, 6.0)	<0.001
$CHADS_2$ risk factors				
CHF	124/463 (26.8%)	108/566 (19.1%)	63/269 (23.4%)	
Hypertension	415/463 (89.6%)	503/566 (88.9%)	238/269 (88.5%)	
Age ≥75 yrs	190/463 (41.0%)	293/566 (51.8%)	140/269 (52.0%)	
Diabetes	113/463 (24.4%)	141/566 (24.9%)	91/269 (33.8%)	
Stroke/TIA	82/463 (17.7%)	172/566 (30.4%)	74/269 (27.5%)	

Table 3.
Coprimary Efficacy Endpoint Observed Events by Type: PREVAIL Subjects Only (Intention-to-Treat)+

	Device Group			Control Group		
	No. of Events	% of Subjects	% of Endpoints	No. of Events	% of Subjects	% of Endpoints
Ischemic stroke	5	1.9	35.7	1	0.7	25.0
Hemorrhagic stroke	1	0.4	7.1	0	0.0	0.0
Death (cardiovascular/unexplained)	7	2.6	50.0	3	2.2	75.0
Systemic embolism	1	0.4	7.1	0	0.0	0.0

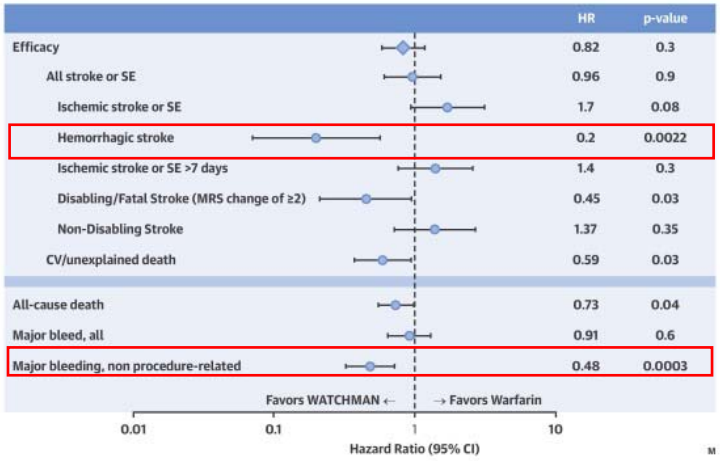
PREVAIL = Watchman LAA Closure Device in Patients With Atrial Fibrillation Versus Long Term Warfarin Therapy.

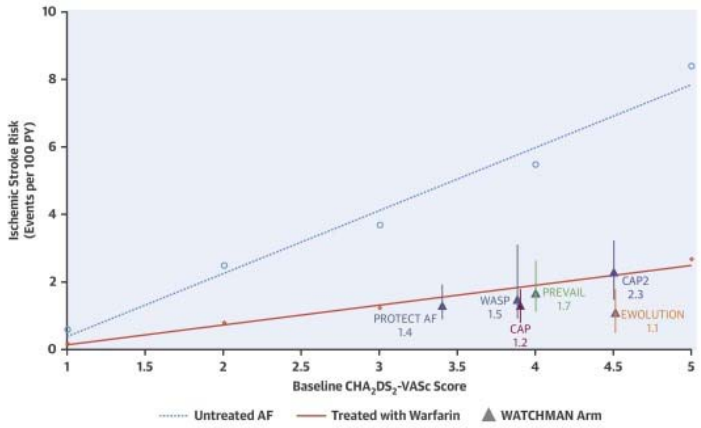
More elderly patients and with more stroke history
→But only had 1 case of Hemorrhagic stroke

→May be patients with low hemorrhagic risk or too short follow-up

Long term f/u data from PREVAIL and PROTECT AF

CENTRAL ILLUSTRATION: Stroke Prevention in Nonvalvular Atrial Fibrillation With LAA Closure





Reddy, V.Y. et al. J Am Coll Cardiol. 2017;70(24):2964-75.

Benefit of LAAO

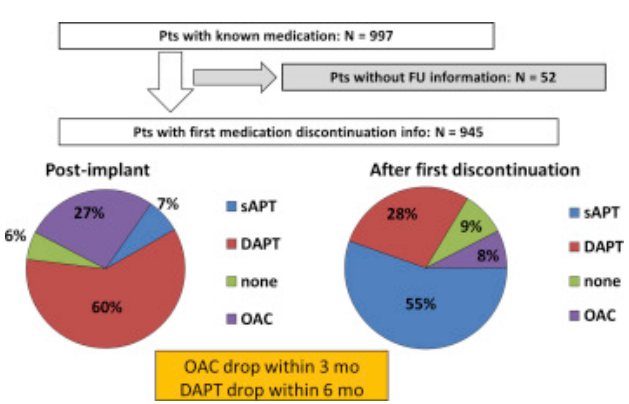
- Reduce the risk of hemorrhagic stroke

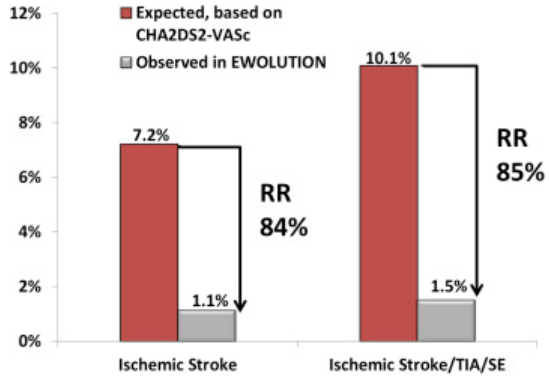
- Reduce CV and unexplained death

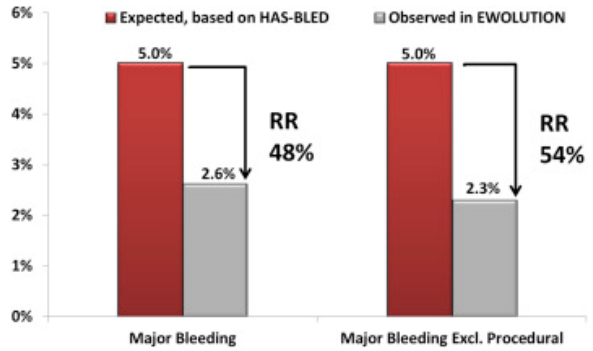
EWOLUTION trial

- **Prospective multicenter registry data (1025 patients from 47 centers)**
- **CHA2DS2-VASc score was 4.5 ± 1.6**

Previous ischemic stroke/TIA	312/1024 (30.5)
Previous hemorrhagic stroke	155/1024 (15.1)
History of major bleeding	320/1024 (31.3)
History of major bleeding or predisposition to bleeding	396/1024 (38.7)





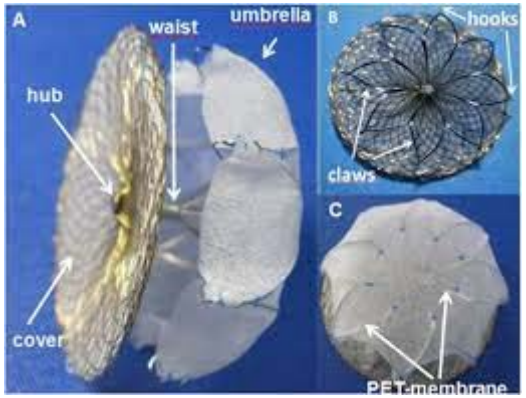


Who may more benefit from LAAO?

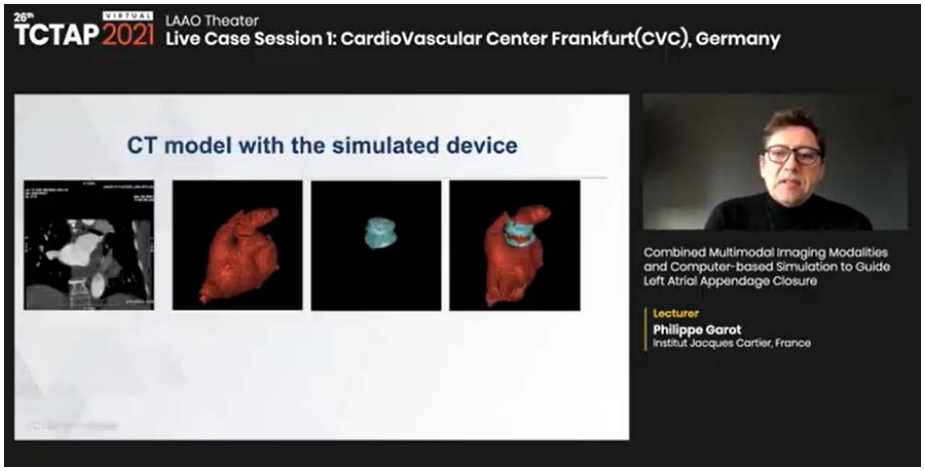
-those at both high risk of ischemic stroke and ICH (with prior stroke)

-those who should use warfarin instead of NOAC (with ESRD)

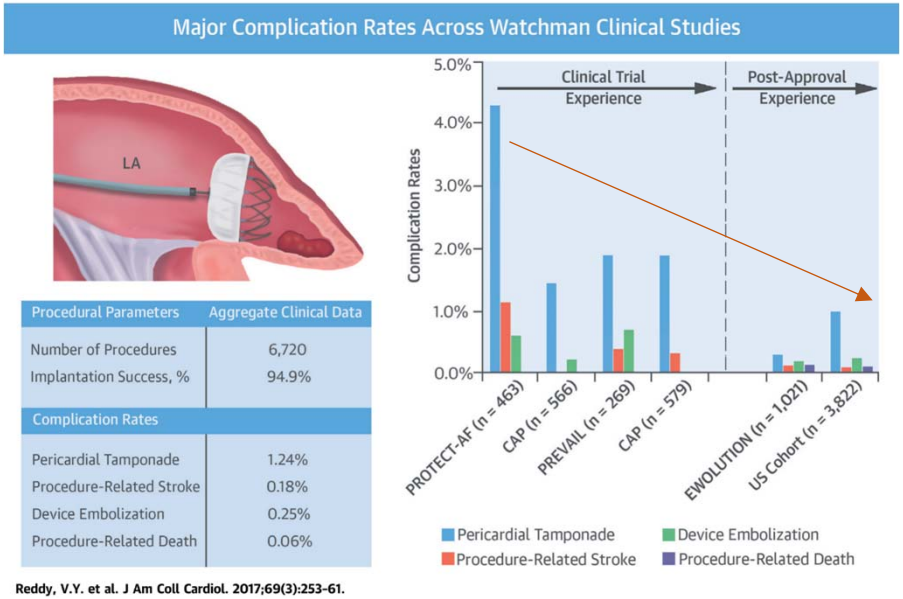
technique may reduce complications



Minimalist approach with lambre device



Using various imaging modalities



Reddy, V.Y. et al. J Am Coll Cardiol. 2017;69(3):253-61.

Still remaining question

- **Who may more benefit from LAAO?**
  - Those with at high risk of ICH (when anticoagulated)
    - With a previous ICH
    - With multiple microbleeds, especially cortical
    - Cerebral amyloid angiopathy
  - Those who should use warfarin
    - With CKD – ESRD
    - Patients with ESRD also has more CMBs
  - May be those with high risk of
    - Frequent falls - parkinsonism, moderate deficit after stroke
    - Discontinuation of NOAC

  ⇨ But may need more data in a specific high risk group