Are strokes related to atrial fibrillation under-estimated?

Gharib Fawi

Prof.of Neurology

Sohag faculty of medicne

(former Zagazig faculty of medicine)

Outline

- Background
- Prevalence of atrial fibrillation (AF)
- Burden of AF
- AF and stroke
- Conclusions

Background

- The most frequent potential source of emboli to the brain(Rhe-& non Rhe AF)
- Reported more than other cardiac causes as a risk of stroke(making a person 5-7 times more likely to have a stroke in non valvular AF, increased to 17 fold in valvular AF
- 3 out of 4 AF-related stroke can be prevented)
- Prevalence of AF is very closely related to age
- AF may be asymptomatic & paroxysmal →if undeteced→will be symptomatic & persistent or permanent
- Should be considered in all cryptogenic stroke

Background

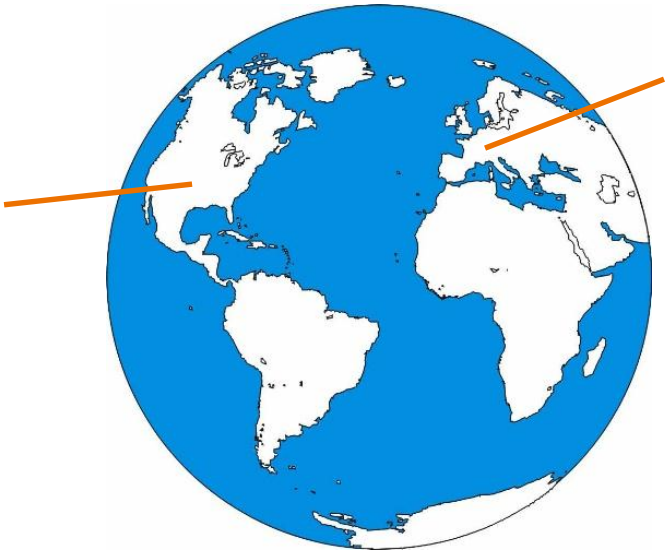
- **Stroke pts with untreated AF have more stroke severity,more hospital stay,& more stroke mortality&liable to develope HF**
- **AF is associated with more severe ischemic strokes and "longer" transient ischemic attacks (TIAs) than emboli from carotid disease**
- **Comparing ischemic brain events in patients with AF and those with carotid disease in two major trials: The ratio of hemispheric events to retinal events was 25:1 with AF compared to 2:1 with carotid disease**
- **AF ↑ risk of cognitive impairment & dementia in stroke and non stroke pts**
- **More than 70 percent of AF patients who have strokes will die.**
  (Stroke 2002; 33:1963, Stroke. 2009;40(6):2276)

PREVALENCE OF AF

AF is the most common, highly prevalent sustained cardiac arrhythmia

- Currently affects:[1,2,3]

US: 2.3 to 5.1 million people



Europe: 4.5 to > 6 million people

- Lifetime risk of developing AF is ¼ for men and women aged 40 years and older (Framingham Heart Study & Rotterdam study)[1,4]
- The prevalence of AF increases from ~4% at ≥ 60 years to 9% at ≥ 80 years[5]

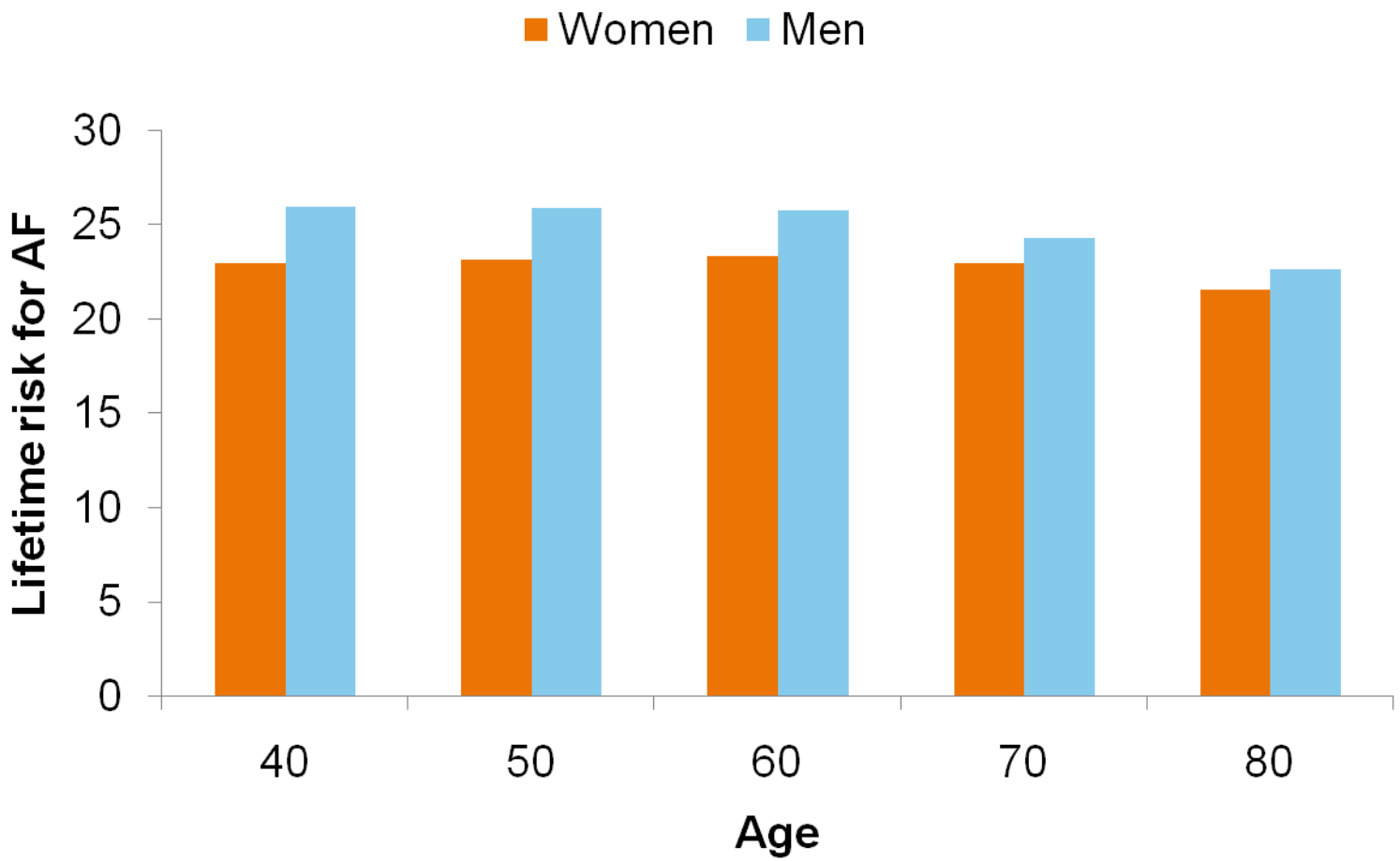
1. Lloyd-Jones DM, et al. Circulation 2004;110:1042-6; 2. Kannel WB, et al. Med Clin N Am 2008;92:17-40;
3. Miyasaka Y, et al. Circulation 2006;114:119-25; 4. Heeringa J, et al. Eur Heart J 2006;27:949-53;
5. Go AS, et al. JAMA 2001;285:2370-5

The lifetime risk of developing AF is high

Lifetime risk of developing condition when aged 40 years		
Breast cancer	1 in 8	
Heart failure	1 in 5	1 in 5
Atrial fibrillation	1 in 4	1 in 4

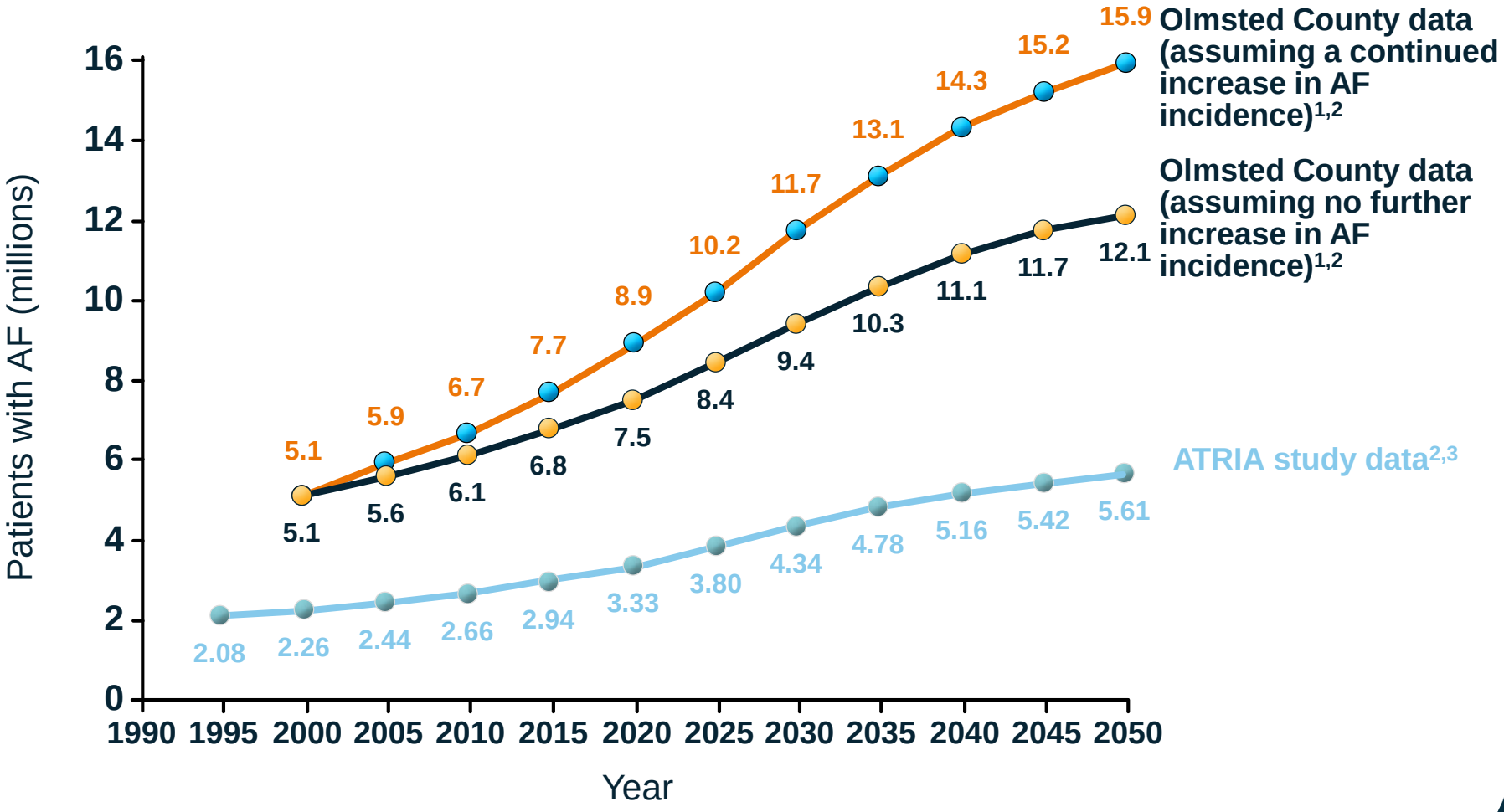
Lloyd-Jones DM, et al. Circulation 2004;110:1042-6

The lifetime risk of AF remains stable across ages



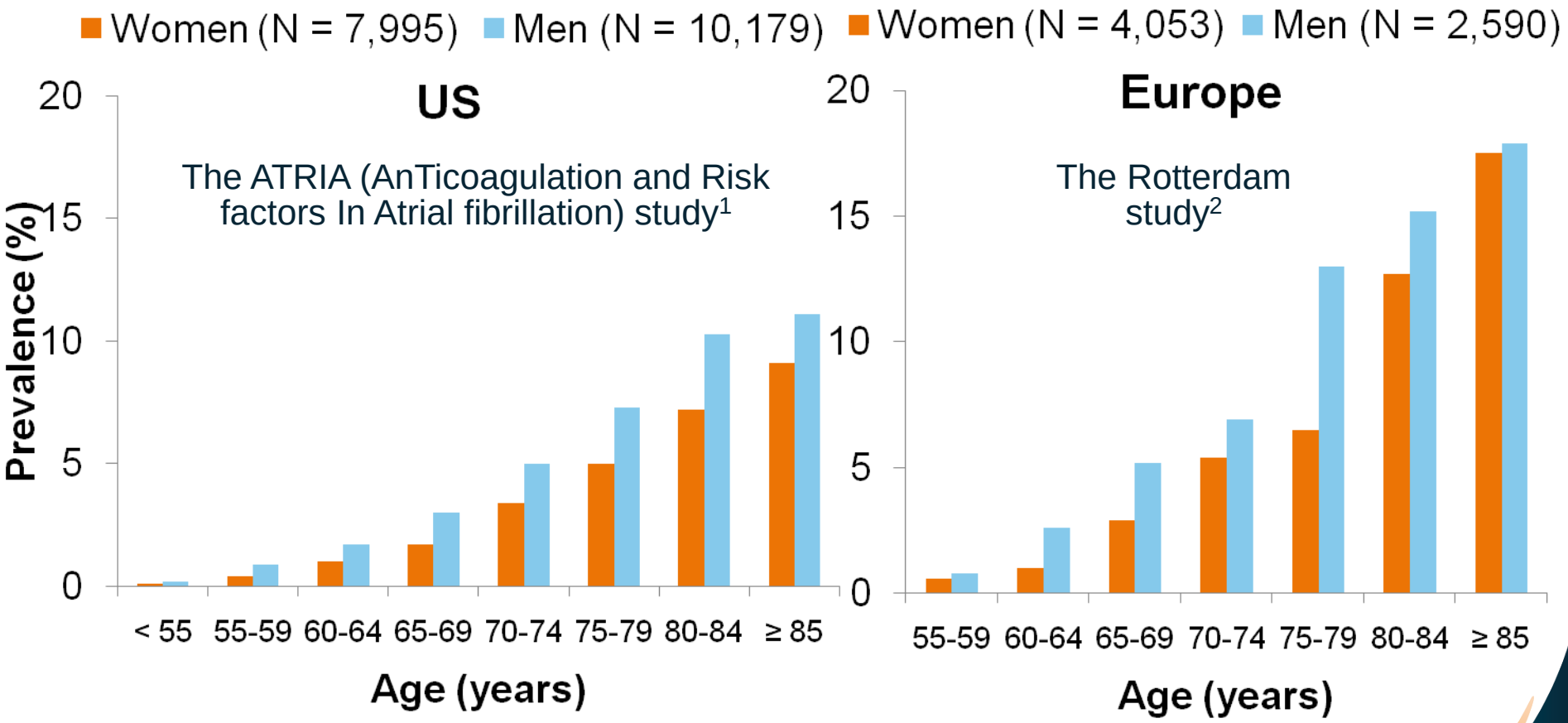
Lloyd-Jones DM, et al. Circulation 2004;110:1042-6

AF prevalence is expected to increase ≥ 2.5-fold by 2050 (in the US)



1. Miyasaka Y, et al. Circulation 2006;114:119-25 ; 2. Savelieva I, Camm J. Clin Cardiol 2008;31:55–62;
3. Go AS, et al. JAMA 2001;285:2370-5

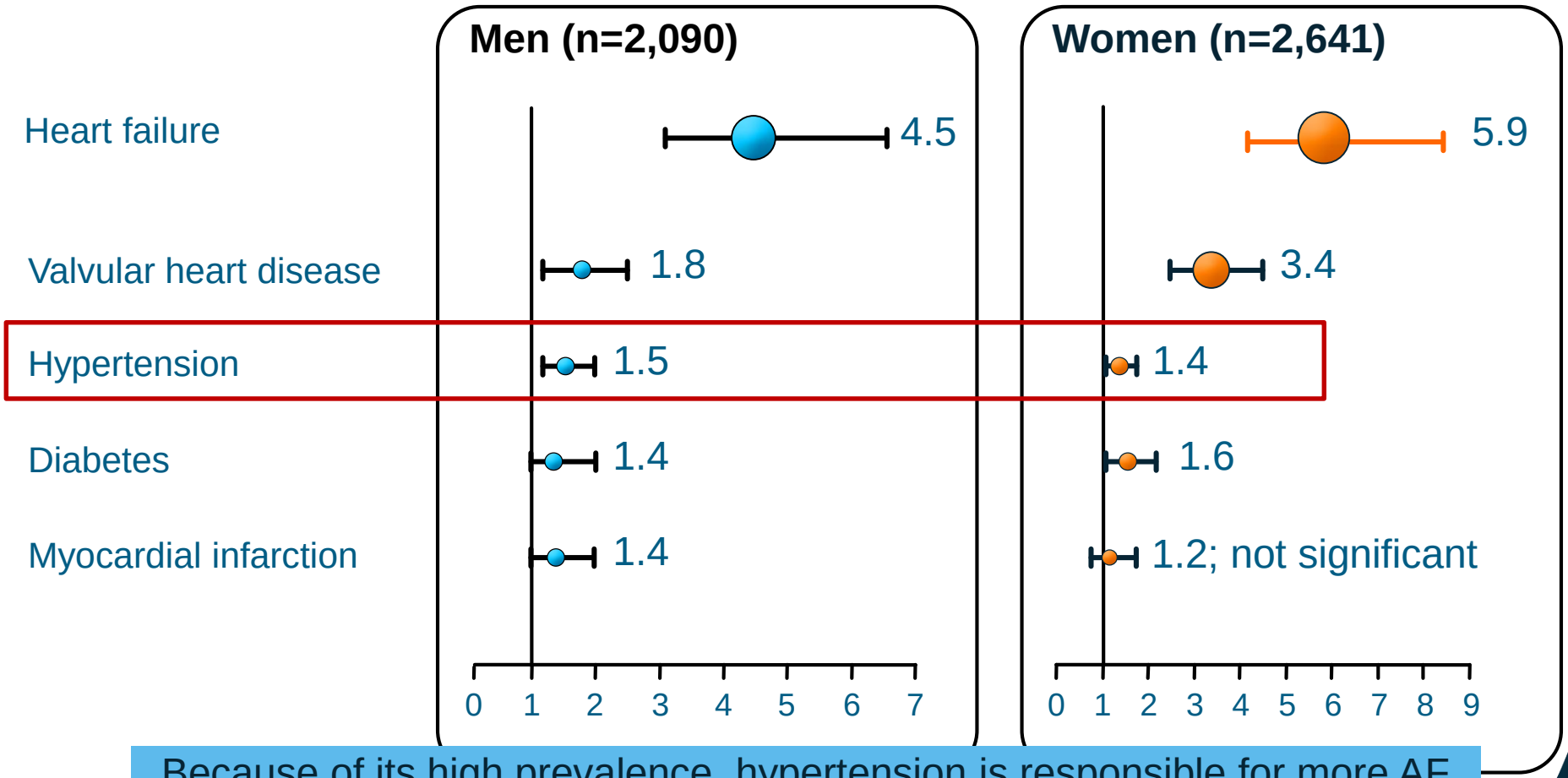
AF preferentially affects the elderly and men in the US and Europe(very closly related to age)



1. Go AS, et al. JAMA 2001;285:2370-5; 2. Heeringa J, et al. Eur Heart J 2006;27:949-53

Also cardiovascular (CV) risk factors / disease are important predictors of AF

The Framingham Heart Study



Because of its high prevalence, hypertension is responsible for more AF in the population (14%) than any other risk factor[1,2]

1. Benjamin EJ, et al. JAMA 1994;271:840-4; 2. Kannel WB, et al. Am J Cardiol 1998;82:2N-9N

BURDEN OF AF

AF can be a significant burden for the patient

- Typical symptoms of AF: palpitations, fatigue, chest pain, dizziness/light headedness, syncope, and dyspnea[1]

- AF symptoms have a significant impact on quality of life (QoL) independent of frequency or duration of symptoms[2,3]
  - 68% of patients report symptoms to be highly disruptive to life[3]
  - Impairment in QoL seen with AF is at least similar to that in heart failure, post myocardial infaction or angioplasty[4]
  - One-third of AF patients have elevated levels of anxiety or depression, with depression being an independent predictor of future QoL[5]

- AF accounts for 1/3 of hospitalisations for cardiac arrhythmia[1]; frequent hospitalisations may disrupt the patients' lifes[6]

1. ACC/AHA/ESC 2006 guidelines Eur Heart J 2006;27:1979–2030;
2. Van den Berg MP, et al. Neth J Med 2005;63:170-4; 3. Hamer ME, et al. Am J Cardiol 1994;74:826-9;
4. Dorian P, et al. J Am Coll Cardiol 2000;36:1303-9; 5. Thrall G, et al. Chest 2007;132:1259-64;
6. Le Heuzey JY, et al. Am Heart J 2004;147:121-6

AF can be a significant burden for society

- The public health burden of AF is huge and expected to continue to increase over the next decades
- 70% of the cost of AF management is driven by in-patient care and interventional procedures[1,3]
- AF accounts for more hospitalisations than any other arrhythmia[2]
  - 1.6 million consultations for AF and 59,000 hospitalisations of patients with a principal diagnosis of AF in the UK in 1995[3]
  - Number of hospitalisations for AF increased by 60% in last 20 years in the district of Copenhagen[4]

1. Ringborg A, et al. Europace 2008;10:403-11; 2. Bialy D, et al. J Am Coll Cardiol 1992;19:41A;
3. Stewart S, et al. Heart 2004;90:286-92; 4. Friberg J, et al. Epidemiology 2003;14:666-72

The different forms of AF:

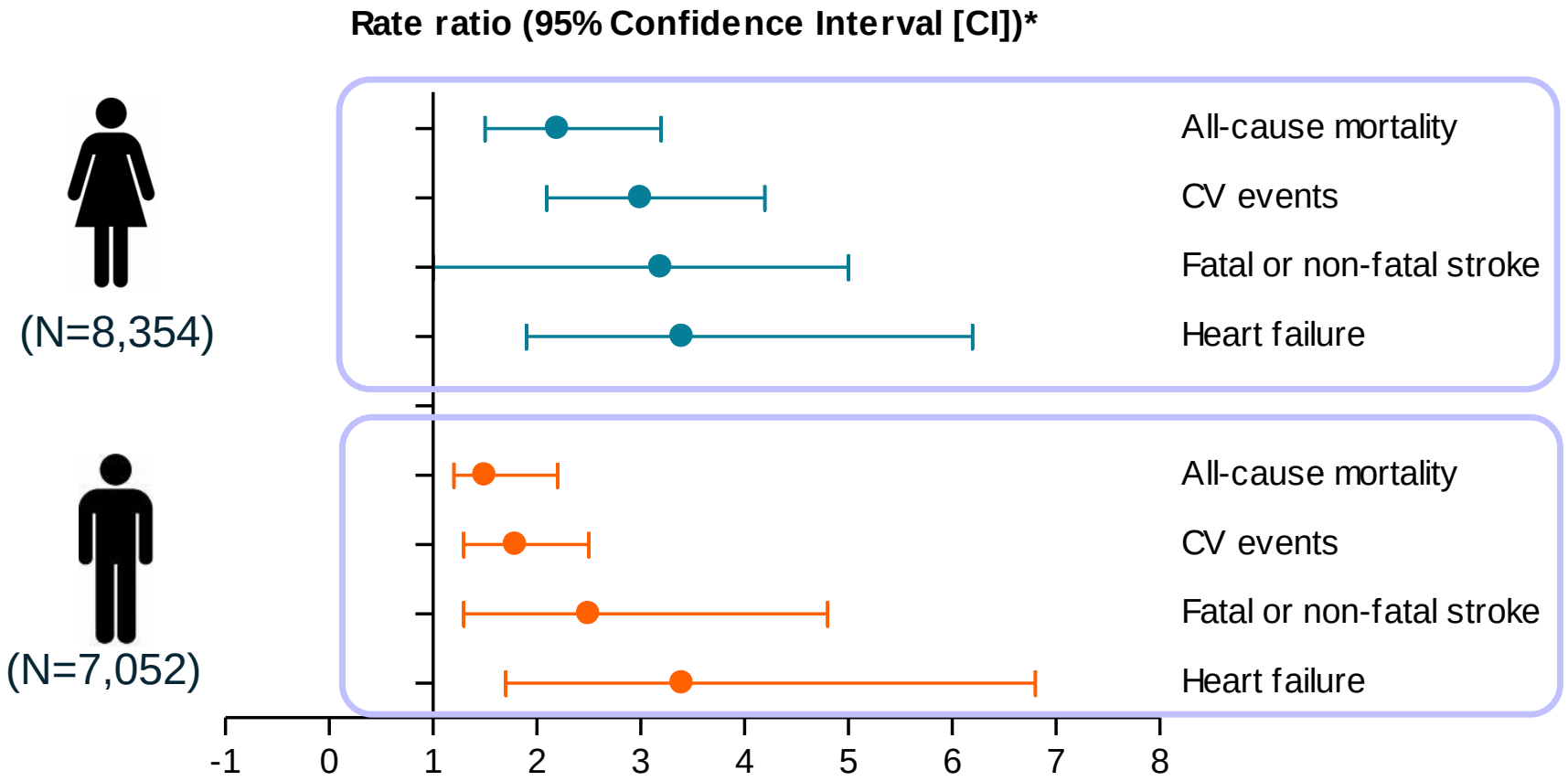
- **Paroxysmal AF** – These episodes can last anywhere from a few seconds to several days but usually returns to normal rhythm within 24 hours without medical assistance.
- **Persistent AF** – The AF does not stop by itself, episodes can last longer than a week. Medication or cardioversion treatment is used, If no treatment is given, the heart will permanently stay out of rhythm.
- Long standing AF – The AF persists for more than 12 month
- **Permanent AF** – The irregular heart beating lasts more than one year and cannot be returned to the normal rhythm by medications or controlled electrical shock.

Possible causes of AF

- High blood pressure
- Abnormal heart structure
- Inflammation or infection of the heart
- Diseases that damage the heart valves
- Overactive thyroid
- Blood clot in the lung
- Congenital heart disease
- Excessive use of alcoholor or caffeine,
- smoking can also trigger AF
- Taking illegal drugs, such as cocaine or amphetamines.

Patients with AF have an increased risk of CV disease and death

Data from Scotland

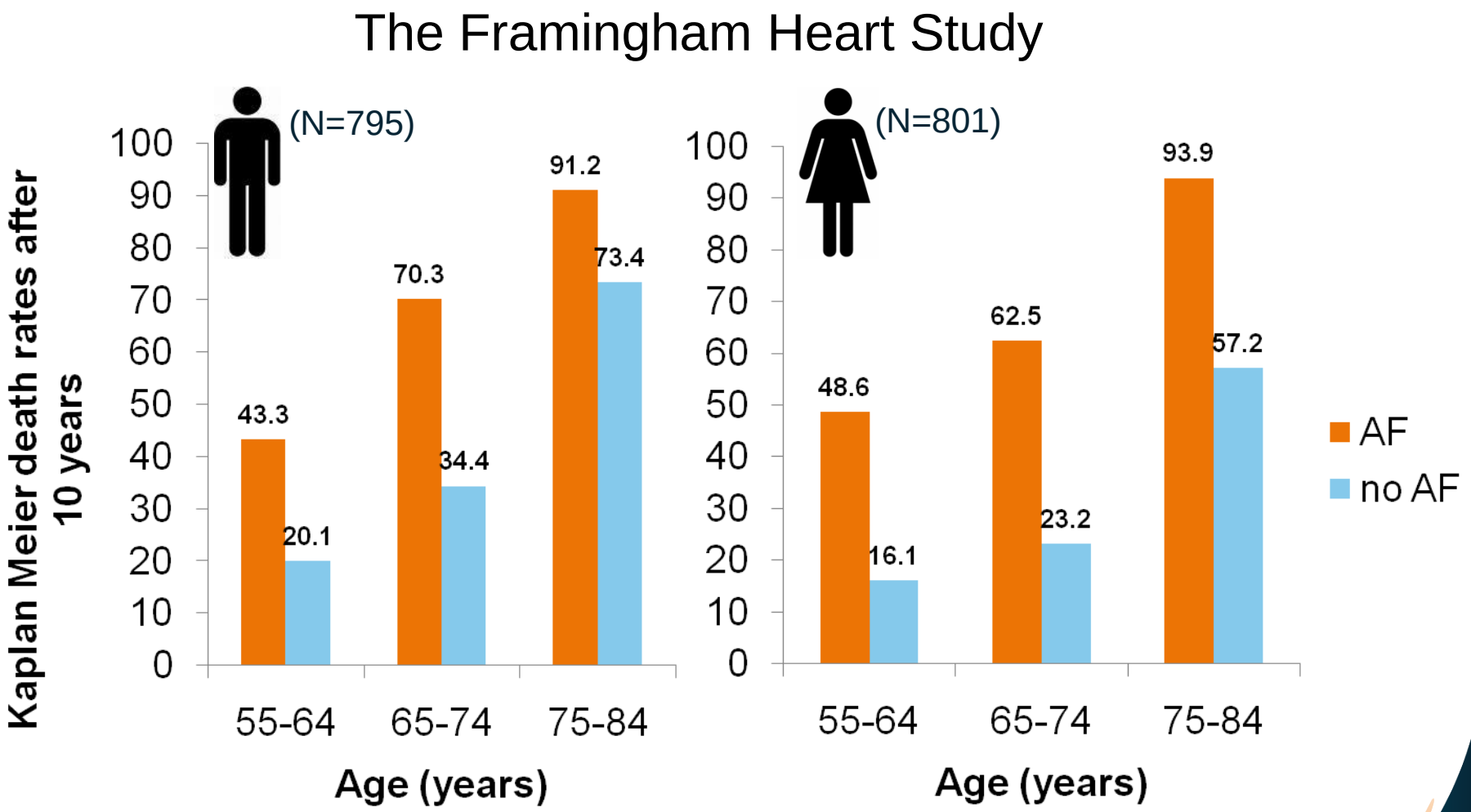


CV events: death or hospitalisation

*Adjusted for age; follow-up 20 years

Stewart S, et al. Am J Med 2002;113:359-64

AF almost doubles the risk of death in men and women across ages



Benjamin EJ, et al. Circulation 1998;98:946-52

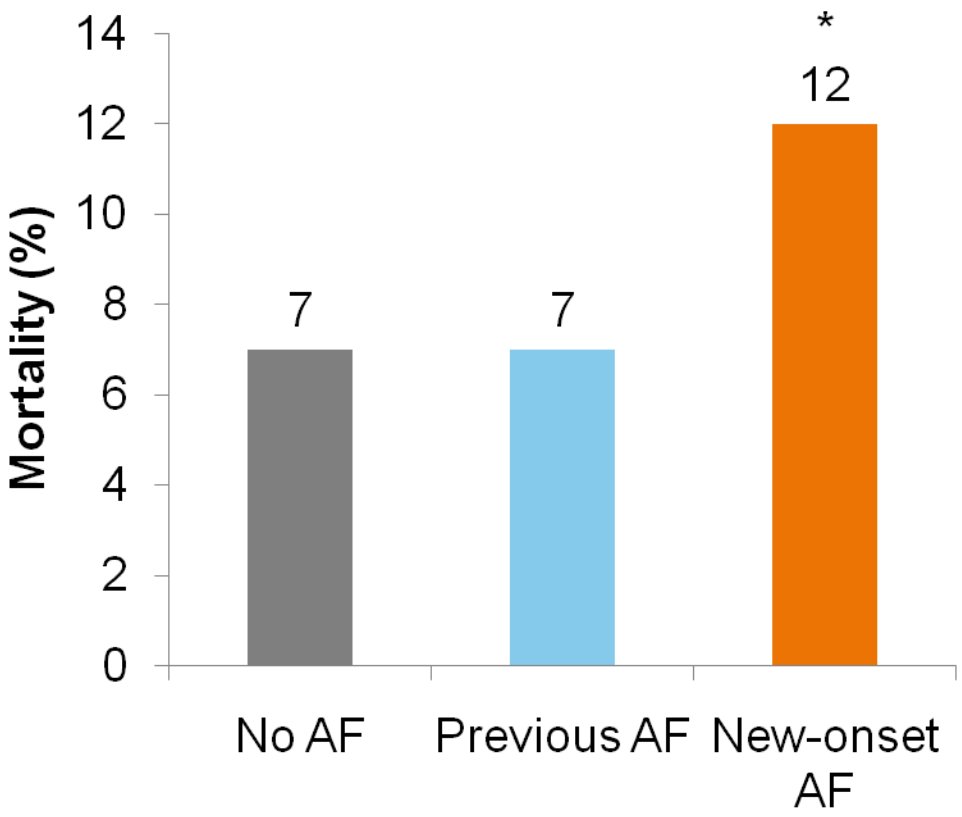
AF worsens the prognosis of patients with CV co-morbidities

Patients with new onset AF	Events	Risk/Hazard ratio (95% CI)
Hypertension (LIFE study)[1] • N = 8,851 • Mean follow-up: 4.8 years	CV events	1.88 (1.50-2.36)*
	Stroke	2.82 (2.14-3.72)*
	Hospitalisation for heart failure	4.96 (3.64-6.74)*
Myocardial infarction (GISSI-3 study)[2] • N = 17,944 • Follow-up: 4 years	In-hospital mortality	1.98 (1.67-2.34)
	Long-term mortality (4 years)	1.78 (1.60-1.99)
Congestive heart failure (Framingham Heart Study)[3] • N = 1,470 • Mean follow-up: 5.6 years	Mortality in men	1.6 (1.2-2.1)
	Mortality in women	2.7 (2.0-3.6)

* $p < 0.001$

1. Wachtell K, et al. J Am Coll Cardiol 2005;45:712-9; 2. Pizzetti F, et al. Heart 2001;86:527-32
3. Wang TJ, et al. Circulation 2003;107:2920-5

New-onset AF increases in-hospital mortality and hospital stay



New onset AF is an independent predictor of:

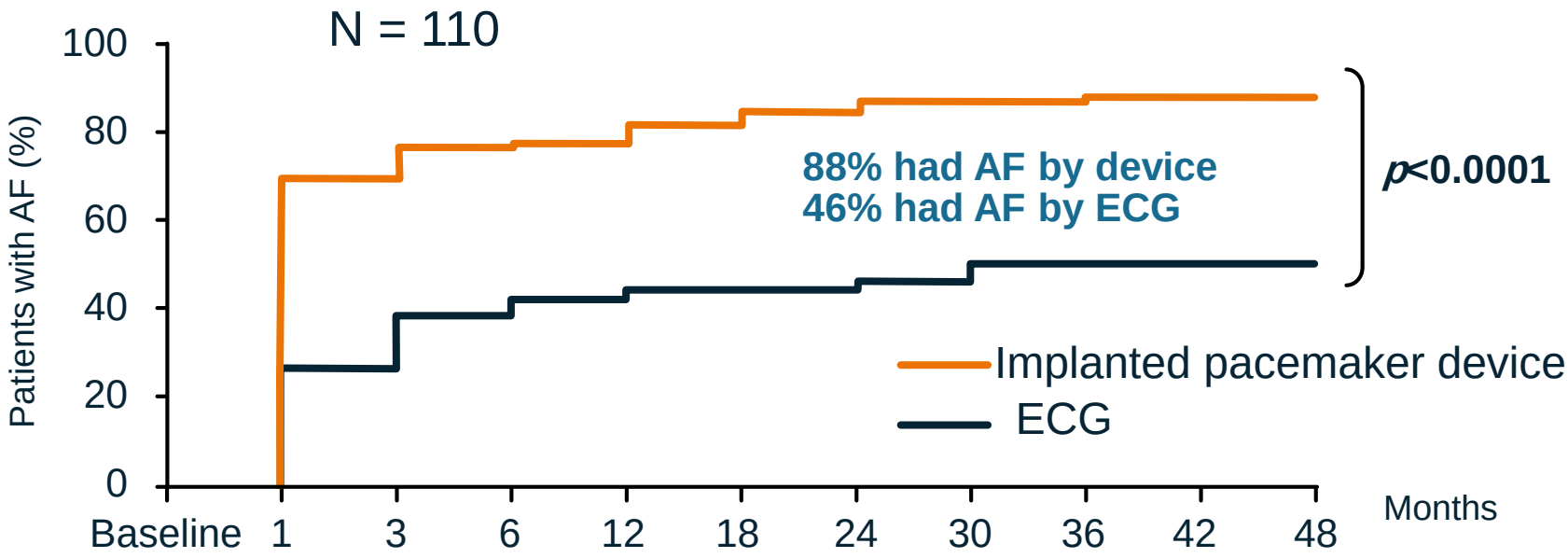
- in-hospital mortality
- longer intensive care unit (UCI) stay
- longer hospital stay

*$p < 0.001$ vs. patients with previous AF and without AF

Rivero-Ayerza M, et al. Eur Heart J 2008;29:1618-24

AF is often asymptomatic/silent but may still increase long-term risk

- Implanted device recording revealed the presence of asymptomatic AF in more than one-third of patients[1]
- 38% of AF recurrences lasting >48 h were completely asymptomatic and in sinus rhythm at follow-up by ECG

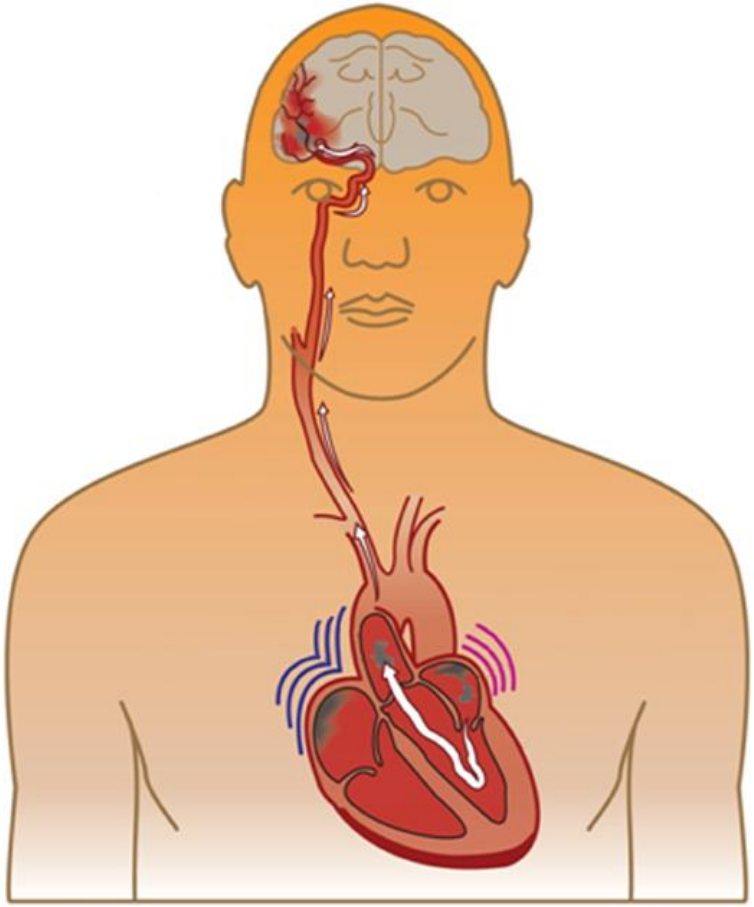


1. Israel CW, et al. J Am Coll Cardiol 2004;43:47-52

AF AND STROKE

Stroke is the most common and devastating complication of AF

- AF is responsible for 15-20% of all ischaemic strokes[1]
- AF increases the risk of stroke 4- to 5-fold[2]
- AF is an independent risk factor for ischaemic stroke severity and recurrence[3]
- Stroke risk persists even in asymptomatic AF[4]



1. Go AS. Am J Geriatr Cardiol 2005;14:56-61; 2. Wolf PA, et al. Stroke 1991;22:983-8;
3. Penado S, et al. Am J Med 2003;114:206-10; 4. Page RL, et al. Circulation. 2003;107:1141-5

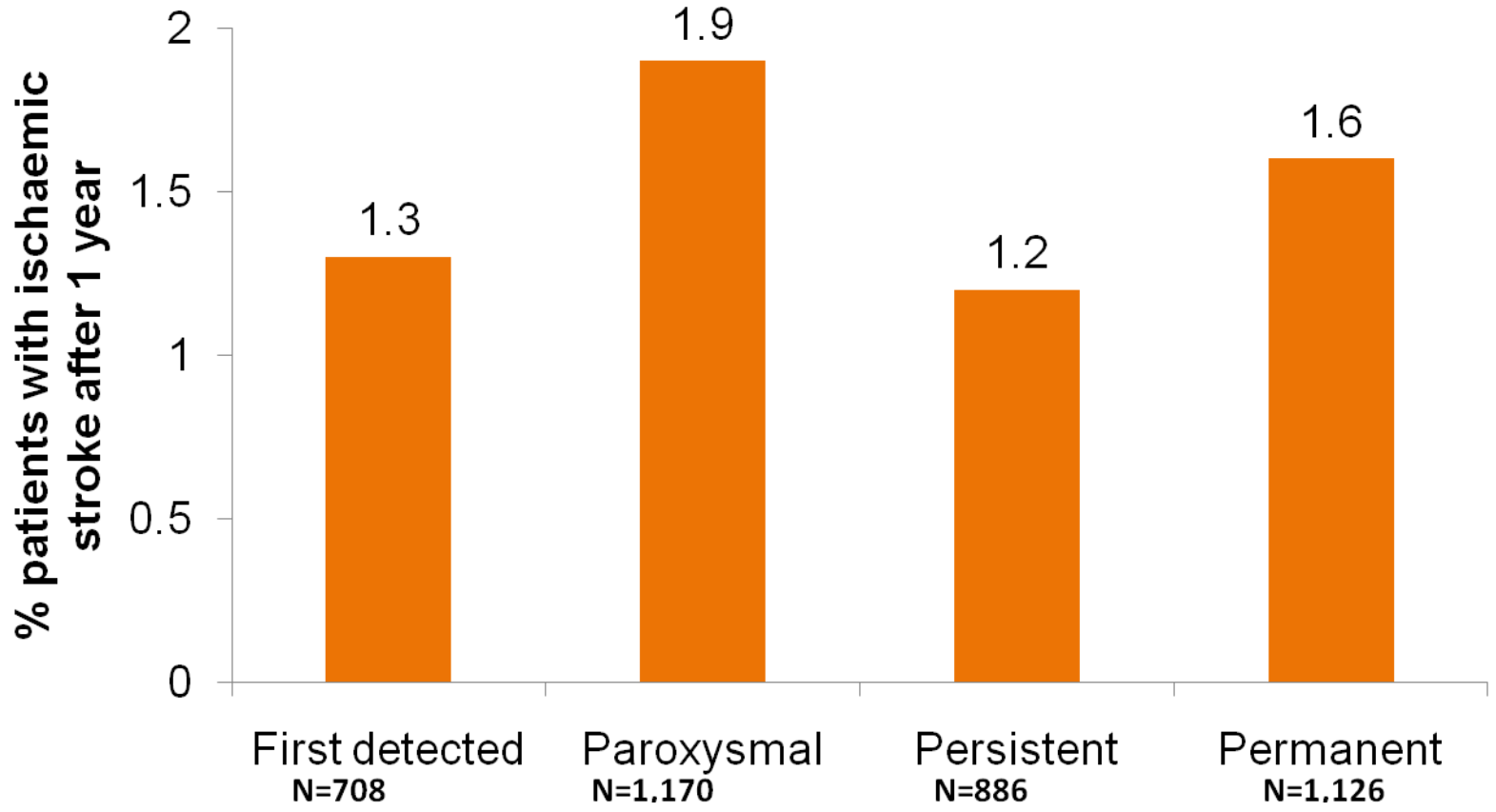
AF is an independent risk factor for stroke; the risk of stroke increases nearly 5-fold

The Framingham Heart Study

Condition	Risk ratio (vs. individuals without disease)
Atrial fibrillation	4.8
Heart failure	4.3
Hypertension	3.4
Coronary heart disease	2.4

Wolf PA, et al. Stroke 1991;22:983-8

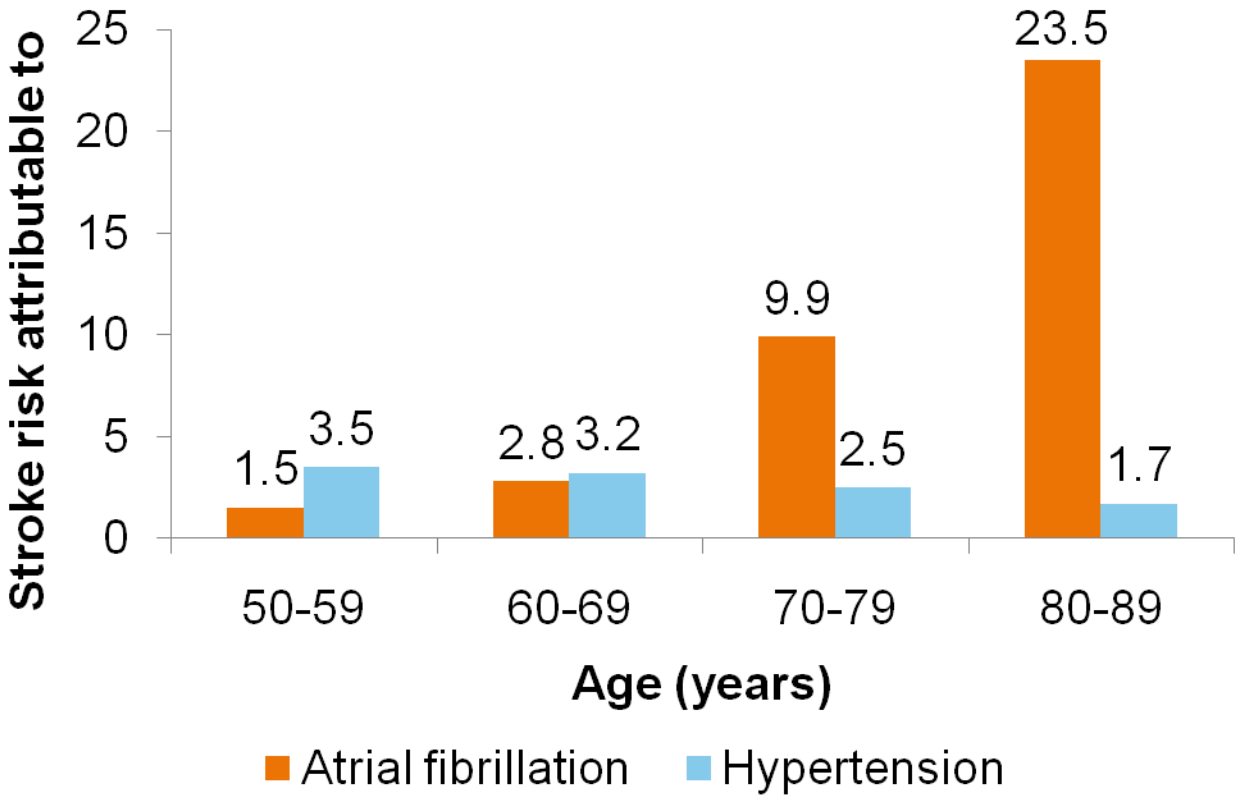
Stroke risk is independent of type of AF at baseline ($p = 0.582$)



Nieuwlaat R, et al. Eur Heart J 2008;29:1181-9

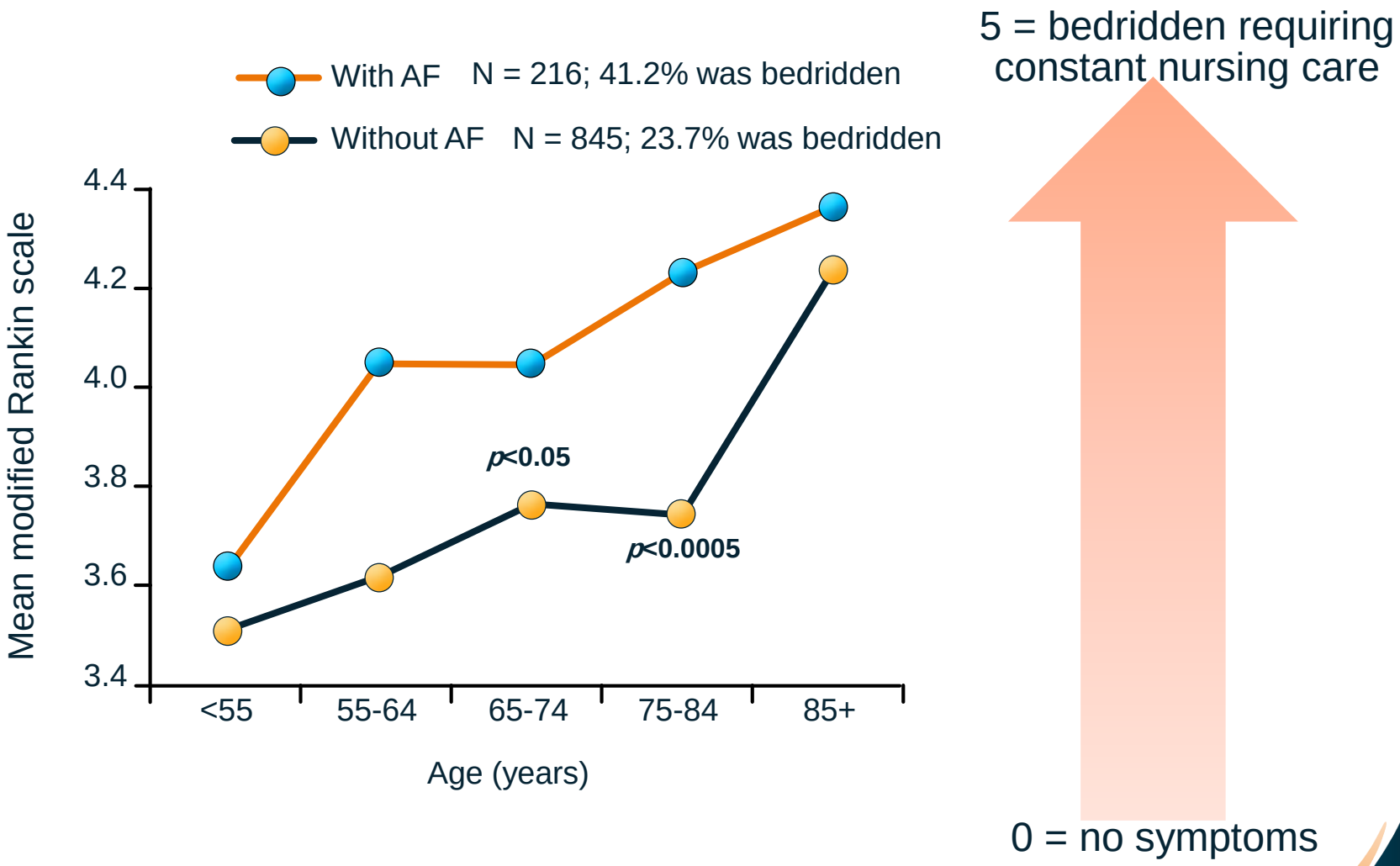
The risk of stroke due to AF increases with age

The Framingham Heart Study
In patients aged ≥ 70 years, stroke is mainly due to AF;
In patients aged ≥ 80 years, 1 in 4 strokes is due to AF



Wolf PA, et al. Stroke 1991;22:983-8

Stroke due to AF is typically more severe than stroke due to other aetiologies across age groups

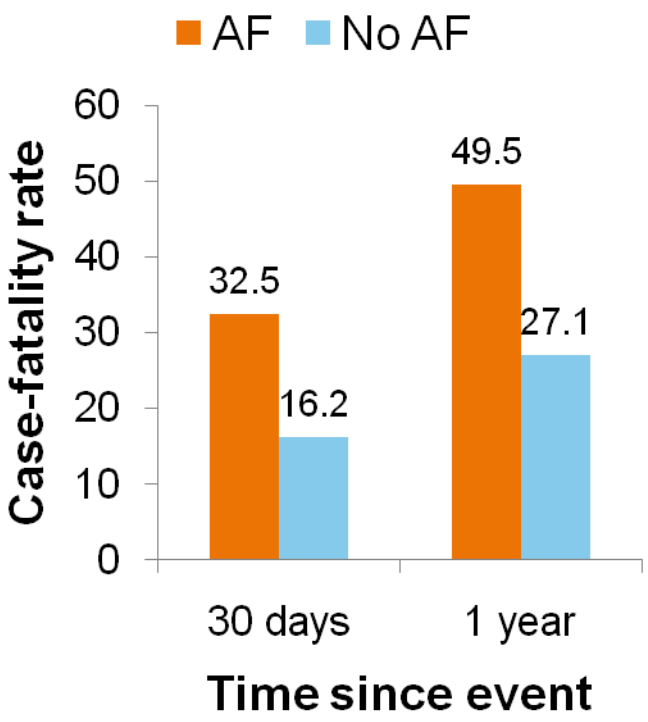


Dulli DA, et al. Neuroepidemiology 2003;22:118-23

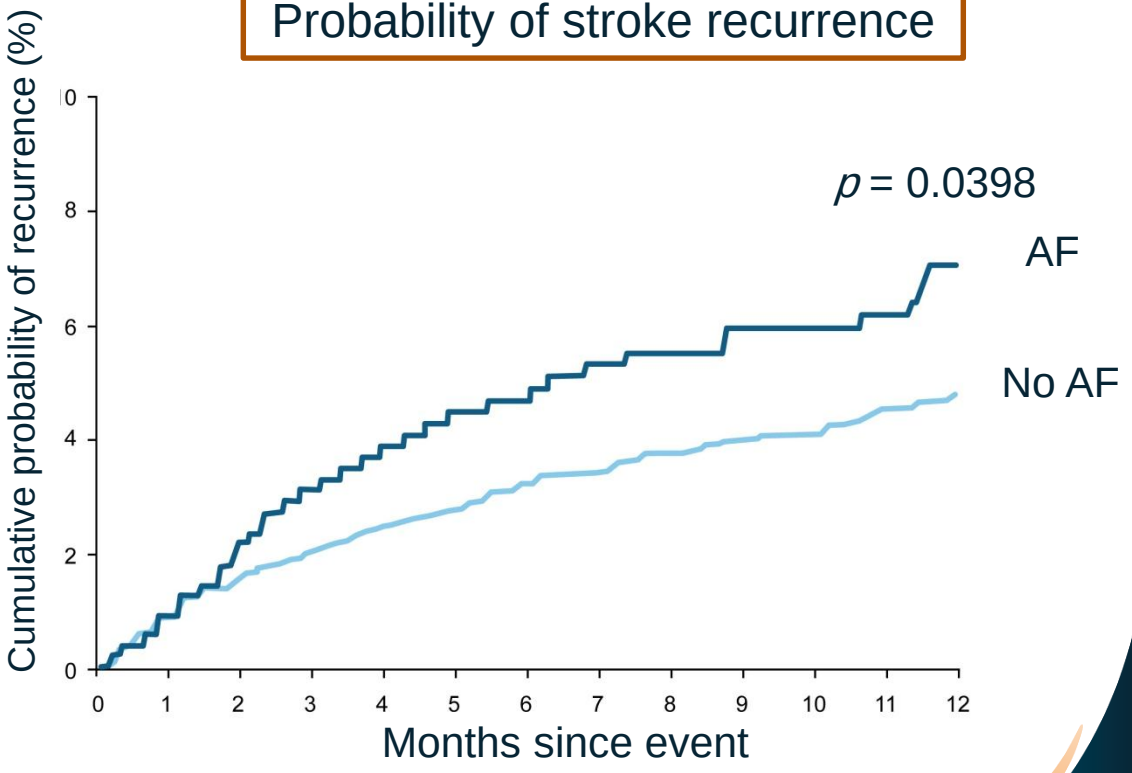
AF patients have increased post-stroke mortality and stroke recurrence

- 3,530 patients with first-ever ischaemic stroke
- AF was confirmed by ECG in 869 patients (25%)
- Mean age at stroke was 78.8 years

Mortality

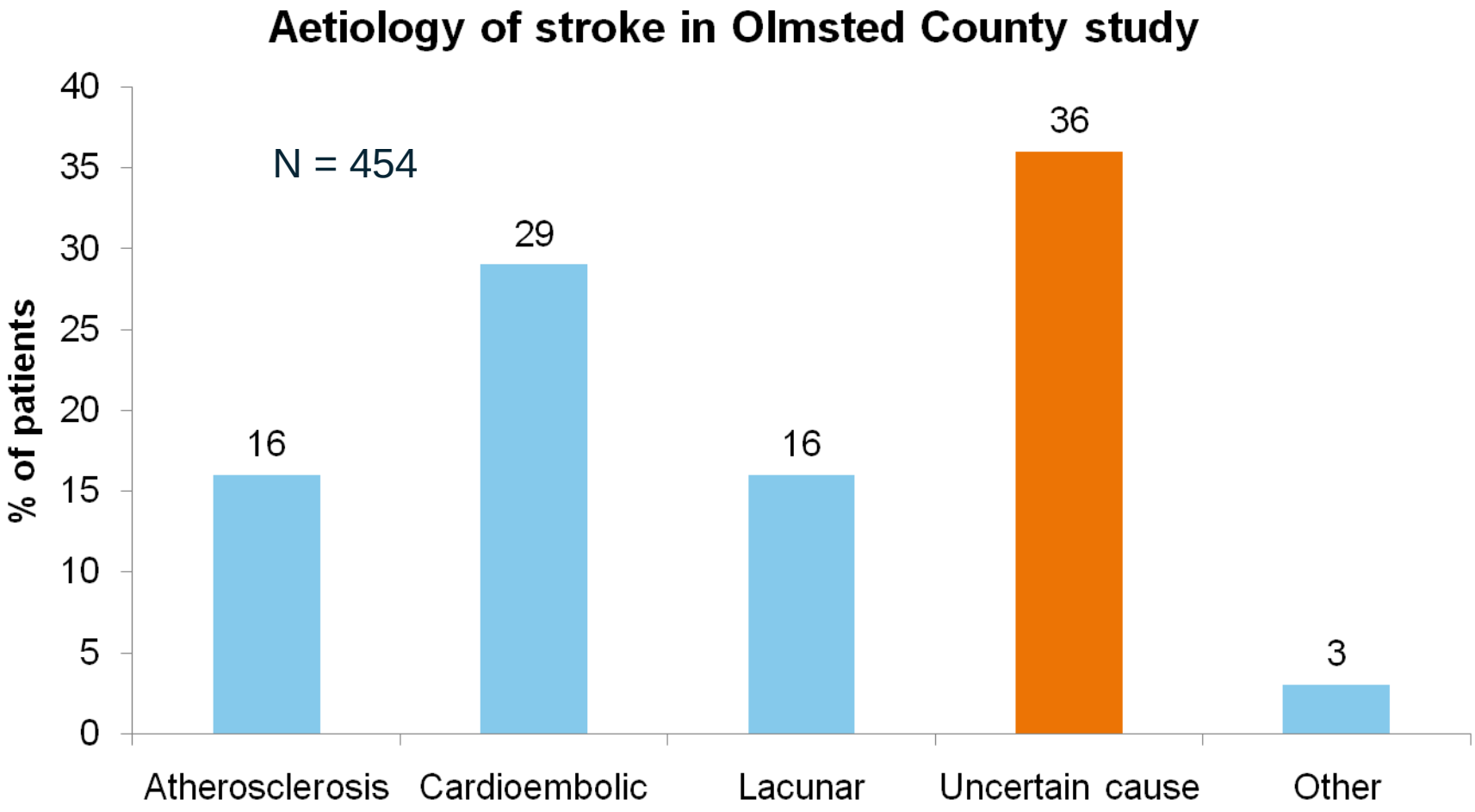


Probability of stroke recurrence



Marini C, et al. Stroke 2005;36;1115-9

~1/3 of first ischaemic strokes are classified as cryptogenic



Petty GW, et al. Stroke 1999;30:2513-6

Cryptogenic stroke may be attributed to AF

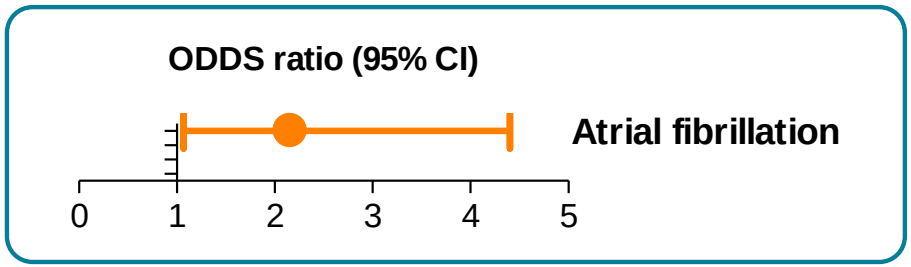
- Unrecognised AF may be present in patients with cryptogenic transient ischaemic attack (TIA) or stroke
- Asymptomatic AF is detected by (prolonged) mobile cardiac outpatient telemetry in 23% of patients with cryptogenic TIA/stroke
- Most AF episodes (85%) lasted < 30 seconds

Tayal AH, et al. Neurology 2008;71:1696-701

AF is a risk factor for silent stroke

The Framingham Offspring Study

- 2,040 asymptomatic subjects (free of clinical stroke) underwent MRI
- → At least 1 silent cerebral infarct was present in 10.7% of participants
- Prevalent silent cerebral infarct was associated with AF



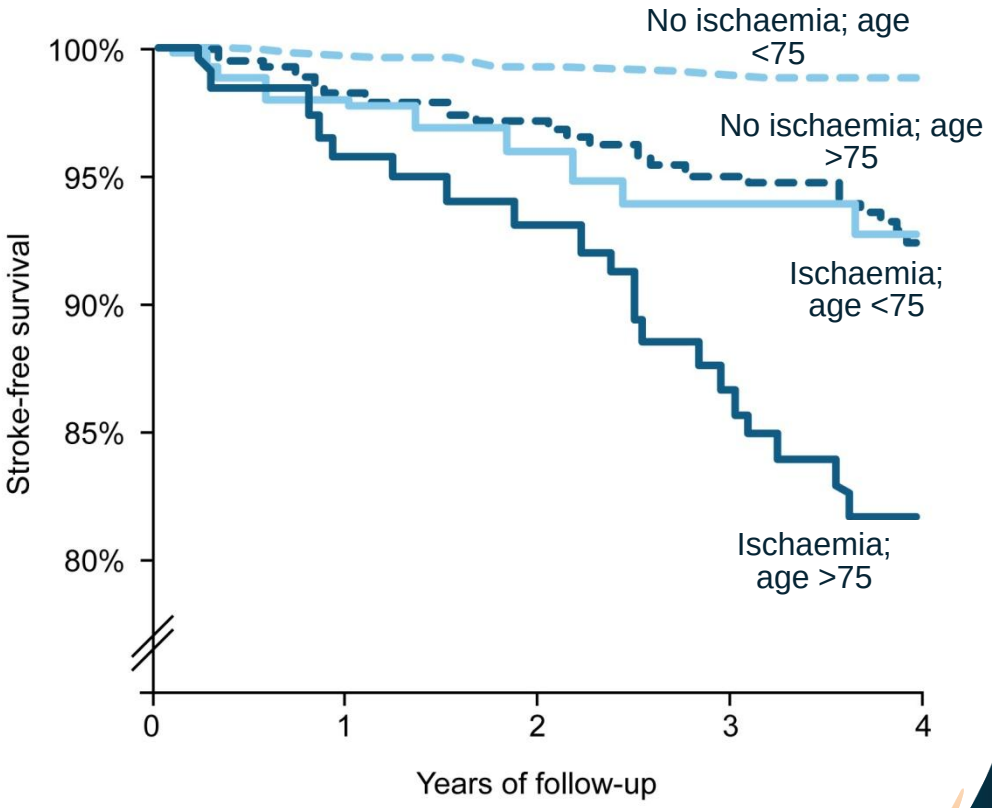
Das RR, et al. Stroke 2008;39:2929-35

Silent (asymptomatic) stroke increases the risk of stroke and dementia

Rotterdam Scan Study (1,077 elderly people)

The presence of silent ischaemia (infarcts / white matter lesions detected on MRI)

- increases the risk of stroke >3-fold independent of other risk factors[1]
- increases the risk of dementia 2.3-fold and is associated with a steeper decline in cognitive function[2]



1. Vermeer SE, et al. Stroke 2003;34:1126-9; 2. Vermeer SE, et al. N Engl J Med 2003;348:1215-22

►AF is associated with more severe ischemic strokes and "longer" transient ischemic attacks (TIAs) than emboli from carotid disease .

► This relationship was illustrated in a report comparing ischemic brain events in patients with AF and those with carotid disease in two major trials:

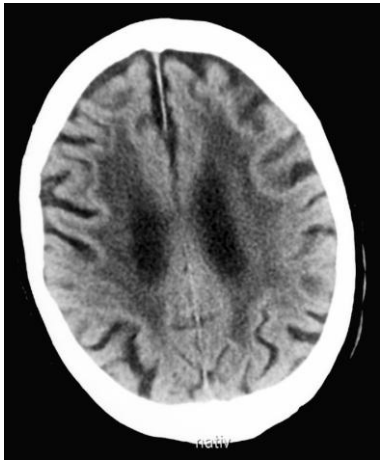
The ratio of hemispheric events to retinal events was 25:1 with AF compared to 2:1 with carotid disease

► As a result, patients with AF who suffer an ischemic stroke appear to have a worse outcome (more disability, greater mortality) than those who have an ischemic stroke in the absence of AF, even after adjustment for the advanced age of patients with AF-related stroke .

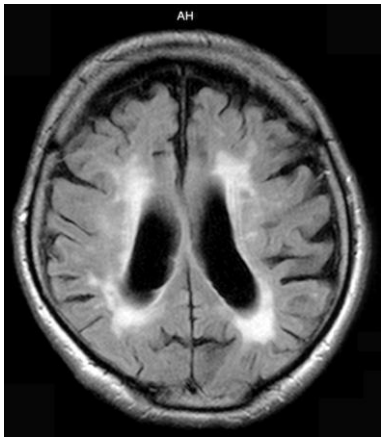
(Stroke 2002; 33:1963, Stroke. 2009;40(6):2276)

Imaging of silent ischaemia should be considered for high-risk AF patients

- Silent stroke causes new ischaemic lesions on CT or MRI (T2-imaging) without new clinical symptoms or symptoms unrelated to the new lesions



- Imaging of silent ischaemia should also be considered for high-risk patients
  → elderly AF patients
  with additional risk factors
  (CV co-morbidity, diabetes...)



STROKE RISK ASSESSMENT

$CHADS_2$ score for stroke prediction in AF

Risk factor	Score
C Congestive heart failure	1
H Hypertension	1
A Age ≥75	1
D Diabetes	1
S_2 Stroke,TIA (longer TIA)	2

CHA_2 DS_2 VASc score for stroke prediction in AF

Risk factor	Score
C Congestive heart failure	1
H Hypertension	1
A_2 Age ≥75	2
D Diabetes	1
S_2 Stroke,TIA (longer TIA)	2
V Vascular diseases	1
A Age 65-74	1
Sc Female sex	1

European guidelines on the management of AF

- **One major risk factor or two or more clinically relevant nonmajor risk factors(score** ≥2) → Oral anticoagulation
- **One clinically relevant nonmajor risk factor (score** 1) →Oral anticoagulation or aspirin 75–325 mg daily ------- Preferred: Oral anticoagulation rather than aspirin
- **No risk factors (**0)→ Aspirin 75–325 mg daily or no antithrombotic therapy------- Preferred: No antithrombotic therapy

SIGN 129 makes the following recommendations on treatment:

- All patients with AF who have a CHADS2 or CHA2DS2-VASc score of ≥1(one or more clinically relevant risk factors),should be considered for warfarin at a target INR of 2.5 (range 2.0-3.0),or a newer anticoagulant. The balance of risks and benefits of anticoagulant therapy should be assessed and discussed annually with the patient, with consideration given to patient preference.
- Antiplatelet therapy should only be considered where warfarin or one of the alternative new anticoagulants has been declined.
- In patients with AF the combination of aspirin and warfarin is not recommended.If warfarin is indicated for moderate- or high-risk AF it should be used alone even in the presence of concomitant stable cardiovascular disease.
- Dabigatran etexilate, Rivaroxaban, Apixaban, can be considered as alternatives to warfarin in the management of patients with atrial fibrillation with one or more risk factors for stroke.(sign.ac.uk scotand study,jan,2014)

Summary of Evidence-based AAN Guideline for PREVENTION OF STROKE IN NONVALVULAR ATRIAL FIBRILLATION

SCREENING AND DIAGNOSIS

Level C

- Clinicians might obtain outpatient cardiac rhythm studies in patients with cryptogenic stroke without known NVAF, to identify patients with occult NVAF.

- Clinicians might obtain cardiac rhythm studies for prolonged periods (e.g., for one or more weeks) instead of shorter periods (e.g.24 hours) in patients with cryptogenic stroke without known NVAF, to increase the yield of identification of patients with occult NVAF.

TREATMENT
which therapies will reduce stroke risk and severity with the least risk of hemorrhage?

- All patients with NVAF are at increased risk of ischemic
- The risk of ischemic stroke varies widely on the basis of the presence of other stroke risk factors.(a history

of previous stroke or (TIA), advanced age, hypertension, and diabetes, and, to a lesser extent, females sex and other symptomatic vascular disease .

- The absolute stroke risk is highest among patients with NVAF and a history of stroke and TIA (10%/year)
- Patients with NVAF who lack any additional risk factors—so-called lone AF patients—have a lower absolute stroke risk (< 2%/year)
- Patients with NVAF who lack a history of stroke or TIA but have other risk factors have an intermediate stroke risk.

TREATMENT

- The relative risk reduction (RRR) for ischemic stroke from aspirin use is about 20% and that from use of anticoagulation with warfarin is about 65%).
- The RRR provided by the newer anticoagulants is similar to or somewhat greater than that of the RRR from warfarin use .
- patients with NVAF and a history of stroke or TIA would realize an absolute reduction in stroke risk of about 6.5%/year from anticoagulation , and ARR of about 2%/year from aspirin.
- patients with NVAF without any risk factors would realize an ARR of ischemic stroke of about 1.3%/year from anticoagulation and an ARR of about 0.4%/year from aspirin .

TREATMENT

- The risk of major bleeding is increased in all patients with NVAF treated with antithrombotics. The absolute risk of major bleeding from anticoagulation with warfarin is about 3%/year and from anticoagulation with aspirin about 0.5%/year .
- Bleeding risk from the newer oral anticoagulants is similar to,or somewhat less than, that from warfarin .
- In patients with NVAF and a history of TIA and stroke, the benefit from stroke risk reduction from anticoagulation (ARR 6.5%/year) is larger than the harm from the increased risk of major bleeding from anticoagulation (3%/year).
- The benefit in stroke risk reduction from aspirin (2%/year) is also larger than the bleeding risk from aspirin (0.4%/year). The benefit in stroke risk reduction from anticoagulation is larger than that provided by aspirin in patients who are at high risk for stroke.
- In patients who have NVAF but no risk factors, the absolute risk of major bleeding (3%/year) is larger than the absolute reduction in stroke from

anticoagulation (1.3%/year). With aspirin, the magnitude of the risk of major bleeding (0.4%/year) is similar to the magnitude of the stroke risk decrease

TREATMENT

- **Level B** Clinicians should inform patients with NVAF that these patients have an increased stroke risk and that this risk can potentially be reduced by antithrombotic use. Patients should also be informed that antithrombotic use increases their risk of major bleeding.

Clinicians should routinely offer anticoagulation to patients with NVAF and a history of TIA or stroke, to reduce these patients'subsequent risk of ischemic stroke.

- .**Level C** Clinicians might not offer anticoagulation to patients with NVAF who lack additional risk factors ("lone" NVAF patients).

Clinicians might reasonably offer antithrombotic therapy with aspirin to such patients or might not offer antithrombotic therapy at all.

Selection of a Specific Oral Anticoagulant

- several anticoagulant medications decrease the risk of ischemic stroke or of recurrent ischemic stroke in patients with NVAF.
- In clinical trials the new oral anticoagulants are noninferior or superior to warfarin for reducing stroke, and in most patients the reduction in ischemic stroke risk outweighs the risk of bleeding complications .

Selection of a Specific Oral Anticoagulant

- **Level B** To reduce the risk of stroke in patients with NVAF judged to require oral anticoagulants, clinicians should choose one of the following options:

• Warfarin, target international normalized ratio (INR) 2.0–3.0

• Dabigatran 150 mg twice daily (if creatinine clearance [CrCl] > 30 mL/min)

• Rivaroxaban 15 mg/day (if CrCl 30–49 mL/min) or 20 mg/day

• Apixaban 5 mg twice daily (if serum creatinine < 1.5 mg/dL) or 2.5 mg twice daily if *any two* of the following criteria are present:

- serum creatinine > 1.5 mg/dL and < 2.5 mg/dL
- body weight ≤ 60 kg
- age ≥ 80 years

• Triflusal 600 mg plus acenocoumarol, target INR 1.25–2.0 (patients at moderate stroke risk, mostly in developing countries)

Selection of a Specific Oral Anticoagulant

- **Patients Already Taking Warfarin**

Level C Clinicians might recommend that patients taking warfarin whose condition is well controlled continue warfarin treatment rather than switch to treatment with a new oral anticoagulant

- **Intracranial Bleeding Risk**

The new oral anticoagulants have a more favorable intracranial-bleeding profile than warfarin

Level B Clinicians should administer dabigatran, rivaroxaban, or apixaban to patients who have NVAF requiring anticoagulant medication and are at higher risk of intracranial bleeding

.

Selection of a Specific Oral Anticoagulant

- **Gastrointestinal (GI) Bleeding Risk**

- In patients with NVAF, GI bleeding was greater with dabigatran 150 mg twice daily as compared with warfarin (1.51%/year vs warfarin 1.02%/year).

- Bleeding from GI sites, including upper, lower, and rectal sites, occurred more frequently in the rivaroxaban group than in the warfarin group, as did bleeding that led to a drop in the hemoglobin level or required transfusion (decrease in hemoglobin ≥ 2 g/dL, 2.8%/year in rivaroxaban group vs 2.3%/year in warfarin group).

- GI bleeding was nonsignificantly lesser with apixaban (0.76%/year) relative to that with warfarin (0.86%/year) (EVID).

- **Level C** Clinicians might offer apixaban to patients with NVAF and GI bleeding risk who require anticoagulant medication

Selection of a Specific Oral Anticoagulant

- **INR Monitoring** INR monitoring is not required for dabigatran, rivaroxaban, and apixaban.
- **Level B** Clinicians should offer dabigatran, rivaroxaban, or apixaban to patients unwilling or unable to submit to frequent periodic testing of INR levels.
- **Patients Unsuitable for Warfarin**

The combination of clopidogrel (75 mg) and aspirin (75–100 mg) as compared with aspirin (75–100 mg) alone reduces the risk of any stroke ,but increases the risk of major hemorrhage including intracranial bleeding

- **Level B** Clinicians should offer apixaban to patients unsuitable for being treated, or unwilling to be treated, with warfarin.
- **Level C** Where apixaban is unavailable, clinicians might offer dabigatran or rivaroxaban.
- Where oral anticoagulants are unavailable, clinicians might offer a combination of aspirin and clopidogrel.

Selection of a Specific Oral Anticoagulant

- **Patients with Moderate Stroke Risk and Higher Bleeding Risk**

Level B

- Where triflusal is available and patients are unable or unwilling to take new oral anticoagulants (mostly in developing countries),clinicians should offer acenocoumarol (target INR 1.25–2.0) and triflusal to patients with NVAF who are at moderate stroke risk and higher bleeding risk.

Selection of a Specific Oral Anticoagulant

- **Special Populations**
- Some clinicians are reluctant to treat elderly patients with anticoagulation because of perceived high risk of bleeding
- the Birmingham Atrial Fibrillation Treatment of the Aged trial demonstrated that anticoagulation with warfarin was superior to that with aspirin in community-based patients ≥ 75 years
- patients with renal failure. dabigatran, one of the newer anticoagulants, a lower dose of 75 mg bid is recommended by the US Food and Drug Administration when the CrCl reaches 15–30 mL/min. Apixaban is recommended at 5 mg twice daily, if serum creatinine < 1.5 mg/dL,or 2.5 mg twice daily, if serum creatinine > 1.5 and < 2.5 mg/dL. Rivaroxaban was tested in patients at 15 mg daily, if CrCl 30–49 mL/min, or 20 mg daily, if

  CrCl > 50 mL/min,

Selection of a Specific Oral Anticoagulant

Data have shown that warfarin treatment is associated with a decreased risk of stroke or systemic thromboembolism among patients with non–end-stage chronic kidney disease but that warfarin may be associated with increased bleeding risk.

- **Level B** Clinicians should routinely offer oral anticoagulants to elderly patients (aged > 75 years) with NVAF if there is no history of recent unprovoked bleeding or intracranial Hge
- Clinicians might offer oral anticoagulation to patients with NVAF who have dementia or occasional falls. However, clinicians should counsel patients or their families that the risk–benefit ratio of oral anticoagulants is uncertain in patients with NVAF who have moderate to severe dementia or very frequent falls.
- **Level U** Because the risk–benefit ratio of oral anticoagulants in patients with NVAF and end-stage renal disease is unknown, there is insufficient evidence for making practice recommendations

CONCLUSIONS

Conclusions (1)

- AF is the most common sustained cardiac arrhythmia
- Its prevalence is expected to increase considerably in the following decades
- AF can be a significant burden for the patient and society
- AF increases the risk of CV morbidity and mortality and worsens the prognosis of patients with CV co-morbidities

Conclusions (2)

- AF is a very important risk factor for stroke (particularly in the elderly) and should therefore be appropriately managed
- Unrecognised AF may be present in patients with cryptogenic stroke
- Stroke is often asymptomatic (silent); silent stroke increases the risk of recurrent stroke and dementia
- As AF is associated with an increased risk of silent cerebral infarctions, high risk AF patients (elderly patients with additional risk factors) should be screened for silent ischaemia
- Your risk of stroke changes with age and other medical problems. Therefore, you should be regularly reassessed to see if you need treatment to reduce your risk of stroke

Thank you