Eduard Shantsila, Andreas Wolff, Gregory Y H Lip and Deirdre A Lane

Optimising stroke prevention in patients with atrial fibrillation:

application of the GRASP-AF audit tool in a UK general practice cohort

Abstract

Background
Oral anticoagulation (OAC) is recommended for effective stroke prevention in the majority of atrial fibrillation patients but is often under-utilised.

Aim
To use the Guidance on Risk Assessment and Stroke Prevention in the Atrial Fibrillation (GRASP-AF) tool to risk stratify patients, identify antithrombotic therapy received, and determine predictors of stroke and death in a UK general practice cohort.

Design and setting
Retrospective-observational cohort study in 11 general practices in Darlington, England, with 105 000 patients.

Method
The study included patients with atrial fibrillation (AF) identified from GP databases using the GRASP-AF tool. Stroke risk was determined by $CHADS_2$ and CHA_2DS_2-VASc scores.

Results
A total of 2259 (2.15%) patients with AF (mean age 76 years [SD 12]; 46% female) were identified. Use of CHA_2DS_2-VASc rather than $CHADS_2$ increased the proportion eligible for OAC from 86.0% to 92.5%. Of those with CHA_2DS_2-VASc score of ≥2, 39.7% were not receiving appropriate OAC, and of those with $CHADS_2$ score of ≥1, 39.5% were not receiving appropriate OAC. Antiplatelet monotherapy was utilised in 33–40% of patients at high risk of stroke. During 12-month follow-up, 67 (3.0%) patients experienced a stroke and 214 (9.5%) died. Use of OAC significantly reduced stroke risk (odds ratio [OR] 0.60, 95% confidence intervals [CI] = 0.45 to 0.81) and death (OR = 0.54, 95% CI = 0.38 to 0.75, $P<0.001$) among patients at moderate–high risk of stroke. Use of antiplatelet agents also independently predicted death (OR = 0.69, 95% CI = 0.50 to 0.94; $P = 0.020$).

Conclusion
Most patients with AF in general practice are at high risk of stroke, but OAC is under-utilised in about 40%. Risk of stroke and death was significantly reduced by OAC, yet antiplatelet monotherapy was inappropriately used in approximately 25% of patients at risk of stroke. Optimal implementation of the CHA_2DS_2-VASc score in the GRASP-AF tool could help prevent more strokes annually.

Keywords
antithrombotic therapy; atrial fibrillation; general practice; mortality; risk stratification; stroke.

INTRODUCTION

Oral anticoagulation (OAC) significantly reduces the risk of stroke among patients with atrial fibrillation (AF) and, consequently, current clinical guidelines recommend the use of OAC therapy, either a vitamin K antagonist (VKA) or a non-VKA oral anticoagulant (NOAC), for all patients, except those at truly low risk (essentially patients aged <65 years with no stroke risk factors).[1–3]

Until recently, the only OAC available was an 'inconvenient' drug, warfarin; thus, older guidelines had focused on identifying 'high risk' patients for warfarin, using risk scores such as the $CHADS_2$ score.[4] Given the limitations and difficulties associated with warfarin, there was substantial under-treatment with OAC,[5–10] and many patients were treated with aspirin, despite this drug being minimally effective and conferring a risk of bleeding similar to warfarin.[11,12] In the UK, a survey of 1857 UK general practices using the Guidance on Risk Assessment and Stroke Prevention in Atrial Fibrillation (GRASP-AF) audit tool reported that 34% of patients with a $CHADS_2$ score ≥2 did not receive OAC therapy.[5]

Currently the first step in making treatment decisions regarding OAC requires individual stroke risk assessment[1–3] using a validated risk stratification tool, and new guidelines recommend using the CHA_2DS_2-VASc score.[13] CHA_2DS_2-VASc permits further risk stratification of those patients with a $CHADS_2$ score of 0, as not all these patients are low risk.[14,15] The present study examined the use of the GRASP-AF tool, utilising the $CHADS_2$ and CHA_2DS_2-VASc scores to risk stratify patients and identify the choice of antithrombotic therapy received and to determine the predictors of stroke and death in a general practice cohort in the UK.

METHOD

Study population

The study population was derived from all 105 000 patients who were registered at one of 11 general practices serving the town of Darlington, County Durham. A set of Read Codes (Appendix 1) was developed to identify patients with a history of AF or atrial flutter occurring at any time in the patient's life. Patients were also included in the study even if they had an 'atrial fibrillation resolved' code. All patients whose vital status in March 2013 was known were eligible for inclusion.

Data collection

Data were collected primarily using the GRASP-AF audit tool which was developed by the West Yorkshire Cardiovascular Network and PRIMIS (Primary Care Information Services) at The University of Nottingham (http://www.nottingham.ac.uk/primis/tools/audits/grasp-af/grasp-af.aspx). This software interrogates primary care databases with a pre-defined set of search criteria based on Morbidity Information QUery and Export SynTax

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How this fits in

Oral anticoagulation (OAC) is recommended for patients with atrial fibrillation (AF) and at least one risk factor for stroke, yet implementation of clinical guidelines in practice varies considerably. Implementation of the CHA_2DS_2-VASc score in the GRASP-AF tool could help to optimise OAC utilisation and prevent more strokes annually. Most patients with AF in general practice are at high risk of stroke, but OAC is under-utilised in about 40%. Despite overwhelming evidence of the benefit of OAC to reduce risk of stroke and death in patients with AF, antiplatelet monotherapy is still inappropriately used in about one-quarter of patients at risk of stroke.

(MIQUEST), a common query process supported by all primary care databases in England. It collects demographic information, details about AF diagnosis, stroke risk factors, and antithrombotic treatment. All practices in Darlington used the latest version of GRASP-AF in March 2013, which assimilates information to allow calculation of the $CHADS_2$ (C = recent congestive heart failure, H = hypertension, A = age ≥75 years, or D = diabetes mellitus, 1 point for presence of each and 2 points for presence of S = stroke/transient ischaemic attack [TIA]. Scores range from 0 to 6),[4] and CHA_2DS_2-VASc (C = congestive heart failure, H = hypertension, A = age ≥75 years, D = diabetes mellitus, S = stroke/TIA, V = vascular disease [peripheral arterial, myocardial infarction, or aortic plaque], A = age 65–74 years, and Sc = sex category [female]; 2 points each for age ≥75 or previous stroke/TIA and 1 point for presence of each other risk factor. Scores range from 0 to 9)[13] scores. Low risk defined by CHA_2DS_2-VASc score is 0 for males and 1 for females. As the GRASP-AF tool only searches the databases for active patients, a further manual search was carried out to identify patients with a diagnosis of AF or atrial flutter who had died within the previous 12 months. The same type of information used in GRASP-AF tool was collected for deceased patients.

In addition, Read Codes were identified to search for any type of stroke event (Appendix 1) that occurred within the 12 months prior to data collection, for all study patients. All events were manually reviewed and only included in the analysis if there was a hospital letter available confirming the new onset of symptoms compatible with stroke which was supported by cranial imaging. Transient ischaemic events and diagnoses of stroke made only on clinical grounds were excluded. The database was also searched to identify whether or not patients were receiving antithrombotic therapy. Patients were classified as anticoagulated if a prescription was issued within the last 6 months of the data collection, stroke event, or death. Patients with a recorded contraindication for antithrombotic therapy or refusal of such therapy were also noted.

Furthermore information on the cause of death was collected for those patients who were deceased by March 2013, and this process was repeated 6 months later because of delays with autopsy and coroner reports. In addition to these documents, information from death certificates and general practice records were used to establish the cause of death. Data were collected by a data analyst from the North of England Cardiovascular Network and a senior clinician. All events were reviewed by the clinician.

Statistical analysis

Normal data are expressed as mean (standard deviation, SD), and categorical data are presented as numbers and percentages of patients. Univariable logistic regression analyses were used to assess predictors of stroke and death. Multivariable analyses were conducted using hierarchical regression modelling entering risk factors for stroke at step 1 and use of antithrombotic therapy at step 2. For all analyses a $P<0.05$ was considered statistically significant. IBM SPSS Statistics (version 21) software was used for statistical analyses.

RESULTS

From a population of 105 000 patients representing 11 general practices, a total of 2259 (2.15%) patients with AF were identified using the GRASP-AF tool and included in the present analysis. The demographic and clinical characteristics and risk factors for stroke are presented in Table 1. The mean age was 76 years (SD 12), and almost half were female.

Stroke risk and prescription of antithrombotic therapy

Most patients had a moderate–high predicted risk of stroke evidenced by a CHA_2DS_2-VASc score of ≥1 or a $CHADS_2$ score of ≥1 (Table 2), and the median (interquartile range) CHA_2DS_2-VASc and $CHADS_2$ scores were 4 (2 to 5) and 2 (1 to 3), respectively. When the CHA_2DS_2-VASc score was used to inform decision

Table 1. Demographic and clinical characteristics and stroke risk factors

	n (%)
Mean age, years (SD)	76 (12)
Female	1041 (46)
Hypertension	1404 (62)
Diabetes	490 (22)
Heart failure	514 (23)
Aged 65–74 years	554 (25)
Aged ≥75 years	1338 (59)
History of stroke	428 (19)
History of haemorrhagic stroke	17 (0.8)
Vascular disease	389 (17)

Table 2. Predicted risk of stroke and systemic thromboembolism by $CHADS_2$ and CHA_2DS_2-VASc score at baseline and observed stroke risk over 12-month follow-up

	CHA_2DS_2-VASc score		$CHADS_2$ score	
Score	*n* (%)	Observed stroke rate *n* (%)	*n* (%)	Observed stroke rate *n* (%)
0	119 (5.3)	1 (0.8)	325 (14)	1 (0.3)
1	205 (9.1)	0	535 (24)	6 (1.1)
2	321 (14)	2 (0.6)	678 (30)	15 (2.2)
3	483 (21)	5 (1.0)	367 (16)	12 (3.3)
4	492 (22)	17 (3.5)	240 (11)	23 (9.6)
5	321 (14)	17 (5.3)	98 (4.4)	9 (9.2)
6	205 (9.1)	14 (6.8)	16 (0.7)	1 (6.3)
7	96 (4.3)	10 (10.4)	NA	NA
8	16 (0.7)	0	NA	NA
9	1 (<0.1)	1 (100)	NA	NA
Low risk[a]	170 (7.5)	1 (0.6)	325 (14)	1 (0.3)
Moderate or high risk[b]	2089 (92.5)	66 (3.2)	1934 (86)	66 (3.4)

NA, not applicable. $CHADS_2$ score, C = recent congestive heart failure, H = hypertension, A = age ≥75 years, D = diabetes mellitus, S = stroke/transient ischaemic attack (TIA); 2 points for presence of stroke/TIA and 1 point for presence of each other risk factor.[4] CHA_2DS_2-VASc score, C = congestive heart failure, H = hypertension, A = age ≥75 years, D = diabetes mellitus, S = stroke/TIA, V = vascular disease (peripheral arterial, myocardial infarction, or aortic plaque), A = age 65–74 years, and Sc = sex category (female); 2 points each for age ≥75 or previous stroke/TIA and 1 point for presence of each other risk factor.[13] [a]Low risk by CHA_2DS_2-VASc score = 0 for males and 1 for females. [b]Moderate or high risk denotes a $CHADS_2$ score ≥1 or a CHA_2DS_2-VASc score ≥1 (males) and ≥2 (females).

Table 3. Antithrombotic therapy depending on stroke risk

CHA_2DS score	None	OAC	Antiplatelet agents	OAC + Antiplatelet agents
0	126 (39)	80 (25)	108 (33)	11 (3)
1	91 (17)	214 (40)	216 (40)	14 (3)
2	89 (13)	311 (46)	245 (36)	33 (5)
3	37 (10)	182 (50)	126 (34)	22 (6)
4	17 (7)	131 (55)	72 (30)	20 (8)
5	5 (5)	46 (47)	39 (40)	8 (8)
6	2 (13)	7 (44)	6 (38)	1 (6)
Low risk[a]	126 (39)	80 (25)	108 (33)	11 (3)
Moderate or high risk[b]	241 (12)	891 (46)	704 (36)	98 (5)
CHA_2DS_2-VASc score				
0	58 (49)	28 (24)	29 (24)	4 (3)
1	72 (35)	58 (28)	70 (34)	5 (2)
2	49 (15)	124 (39)	139 (43)	9 (3)
3	72 (15)	236 (49)	155 (32)	20 (4)
4	61 (12)	221 (45)	184 (37)	26 (5)
5	33 (10)	149 (46)	122 (38)	17 (5)
6	15 (7)	99 (48)	72 (35)	19 (9)
7	5 (5)	49 (51)	34 (35)	8 (8)
8	1 (6)	7 (44)	7 (44)	1 (6)
9	1 (100)	0	0	0
Low [a]	86 (51)	40 (24)	38 (22)	6 (4)
Moderate or high risk[b]	281 (13)	931 (45)	774 (37)	103 (5)

Data given as n (%). OAC = oral anticoagulants. [a]Low risk by CHA_2DS_2-VASc score = 0 for males and 1 for females. [b]Moderate or high risk denotes a $CHADS_2$ score≥1 or a CHA_2DS_2-VASc score ≥1 (males) and ≥2 (females).

making for the initiation of OAC compared with the $CHADS_2$ score, an additional 6.5% (147/2259) of patients were eligible for OAC (Table 2).

Overall, 43% (971/2259) patients received OAC alone and 4.8% (109/2259) received OAC and concomitant antiplatelet agent(s); a VKA (predominantly warfarin) was used in most patients, while the NOACs dabigatran and rivaroxaban were used in only a few patients (26 and 4 patients, respectively) (Table 3). Treatment with OAC was declined by 5.0% (113/2259) of patients and was contraindicated in 8.3% (187/2259) of patients. An antiplatelet agent (mainly aspirin) was used as monotherapy in 35.9% (812/2259) of patients, declined by 1.7% (38/2259), and contraindicated in 18.6% (420/2259) of patients.

Among patients with a CHA_2DS_2-VASc score of ≥2, 50.9% (985/1935) were prescribed OAC, in 9.4% (182/1935) OAC was recorded as contraindicated, and 5.6% (108/1935) declined OAC. Consequently, 39.7% (768/1935) of the patients with AF with a CHA_2DS_2-VASc score of ≥2 were not receiving appropriate OAC. The analogous figures for a $CHADS_2$ score of ≥1 demonstrated that 51.1% (989/1934) were prescribed OAC, in 9.3% (180/1934) OAC was recorded as contraindicated, and 5.6% (108/1934) declined OAC; suggesting that 39.5% (764/1934) of the patients with AF with a $CHADS_2$ score of ≥1 were not receiving appropriate OAC. Applying the GRASP-AF audit tool based on CHA_2DS_2-VASc rather than $CHADS_2$ would increase the proportion eligible for OAC from 86.0% to 92.5%.

Table 3 and Figure 1 show that the proportions of patients receiving OAC were similar among those with a CHA_2DS_2-VASc score of ≥2 or $CHADS_2$ score of ≥1, and that antiplatelets were employed in between one-third to two-fifths of patients at moderate–high risk of stroke. In addition, OAC was prescribed to one-quarter of patients without any risk factors for stroke.

During the 12-month period of observation, 3.0% (67/2259) developed a stroke, including 0.2% (5/2259) haemorrhagic strokes, and 9.5% (214/2259) of patients died. Causes of death were: cancer (*n* = 42); heart failure-related (*n* = 24); other cardiac causes (*n* = 14); thromboembolic events (*n* = 12); intracranial (*n* = 5) and extracranial (*n* = 3) bleeding; other (*n* = 69); and unknown (*n* = 45) causes. Univariable regression analyses for the predictors of stroke and death are shown in Table 4. In a multivariable hierarchical regression analysis including components of the CHA_2DS_2-VASc score

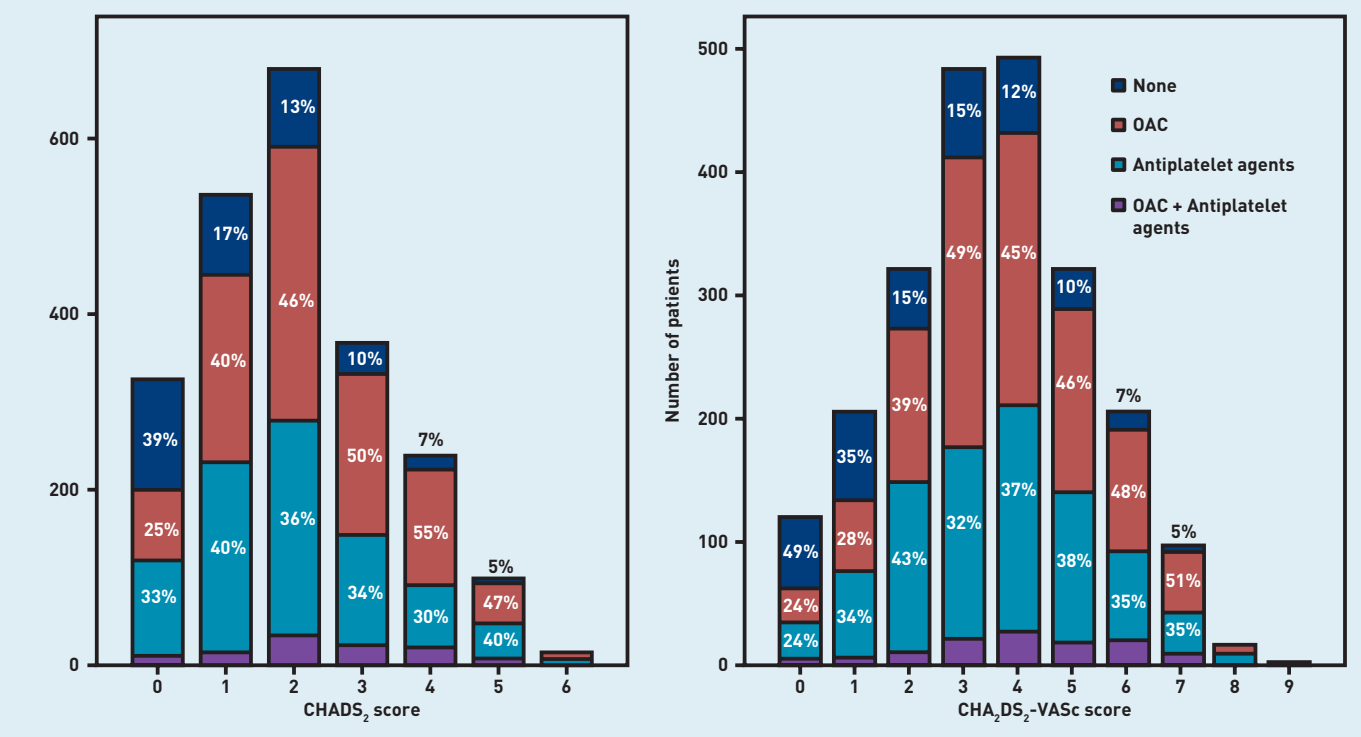

Figure 1. Antithrombotic therapy in patients stratified by predicted risk of stroke. OAC = oral anticoagulation.

(age assessed as a continuous variable) and use of antithrombotic agents, the use of OAC was an independent predictor of future stroke (OR 0.60, 95% CI = 0.45 to 0.81) and death (OR 0.54, 95% CI = 0.38 to 0.75, *P*<0.001) among patients at moderate–high risk of stroke. Use of antiplatelet agents was also an independent predictor of death (OR = 0.69, 95% CI = 0.50 to 0.94; *P* = 0.020).

Table 4. Unadjusted and adjusted regression analysis of factors associated with stroke and death in patients at moderate-high risk of stroke at baseline

	Stroke		Death	
	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Unadjusted analysis				
Age	1.10 (1.08 to 1.12)	<0.001	1.11 (1.09 to 1.13)	<0.001
Female	1.65 (1.27 to 2.15)	<0.001	1.70 (1.28 to 2.27)	<0.001
Heart failure	1.86 (1.41 to 2.46)	<0.001	2.09 (1.56 to 2.81)	<0.001
Hypertension	1.09 (0.82 to 1.45)	0.541	1.10 (0.81 to 1.49)	0.554
Diabetes	1.47 (1.10 to 1.96)	0.010	1.43 (1.04 to 1.95)	0.027
Previous stroke	1.68 (1.25 to 2.26)	0.001	0.95 (0.66 to 1.35)	0.769
Vascular disease	2.88 (2.17 to 3.83)	<0.001	3.20 (2.37 to 4.33)	<0.001
$CHADS_2$ score	1.48 (1.34 to 1.63)	<0.001	1.36 (1.23 to 1.51)	<0.001
CHA_2DS_2-VASc score	1.51 (1.38 to 1.64)	<0.001	1.44 (1.31 to 1.57)	<0.001
Use of oral anticoagulation	0.53 (0.40 to 0.69)	<0.001	0.43 (0.32 to 0.58)	<0.001
Use of antiplatelet agents	1.14 (0.88 to 1.49)	0.318	0.99 (0.74 to 1.32)	0.951
Adjusted analysis [a]				
Use of oral anticoagulation	0.60 (0.45 to 0.81)	0.001	0.54 (0.38 to 0.75)	<0.001
Use of antiplatelet agents	0.86 (0.64 to 1.14)	0.286	0.69 (0.50 to 0.94)	0.020

OR = odds ratio. [a]Predictive value of antithrombotic agents after adjustment for stroke risk factors.

DISCUSSION

Summary

This study shows that most patients with AF in this general practice cohort were at high predicted risk of stroke, and almost 40% were not receiving an effective stroke prevention strategy, namely OAC. Second, the risk of stroke and death was significantly reduced by OAC, yet antiplatelet monotherapy was still inappropriately used in about one-quarter of patients at risk of stroke. Third, the optimal use of the CHA_2DS_2-VASc score in the GRASP-AF audit tool could have prevented strokes annually.

The GRASP-AF tool is a functional means of capturing and summarising individual patient and practice-level data for patients with AF, allowing GPs to review individual stroke risk and antithrombotic treatment, and has demonstrated clinical relevance and usefulness. Incorporation of clinical guidelines into tools such as GRASP-AF should promote greater translation of evidence-based medicine into clinical practice and could help to guide treatment decisions. In addition, the visual way in which the GRASP-AF tool displays the patient's individual stroke risk factors and their risk of stroke, may also be a useful

way of demonstrating the need for OAC and discussing the treatment options with the patient.

Strengths and limitations

The data were retrospectively collected using the GRASP-AF tool rather than prospectively, but this is the only AF dataset derived entirely from a primary care population without pre-selection, for which outcome data are available. The vital status of all patients in March 2013 was known, although cause of death was not available in 21% of patients. The endpoint of stroke was defined using robust criteria employed in clinical trials, with stroke confirmed by a hospital letter confirming the new onset of symptoms compatible with stroke, supported by cranial imaging, and all events were manually reviewed by a senior clinician. Given that the GRASP-AF tool captures data from GP records, the accuracy of the data is dependent on the quality of the data recording and coding. Therefore, it is possible that some comorbidities were not recorded, but as most patients had CHA_2DS_2-VASc score ≥1 or $CHADS_2$ score ≥1, this is unlikely to impact the findings greatly. It is also possible that contraindications to antithrombotic therapy were not recorded for some patients, but as these may be subjective (for example, risk of falls), it is also possible that the proportion of patients with contraindications may be over-represented.

The 11 general practices were from one geographical location, which may limit the generalisability of the findings. However, the study population is representative of the age distribution of England, and is also comparable with the Swedish[16] and Danish[14] AF cohorts. In addition, the risk factor profile is comparable with a recent analysis using the GRASP-AF tool in UK general practice[5] ($CHADS_2$ score ≥1, 86% in the present analysis versus 83.7%).

Comparison with existing literature

The present finding of the under-utilisation of OAC in patients with AF at moderate–high risk of stroke is corroborated by other recent prospective observational cohorts[5,6,10,17] and a systematic review.[9] The GARFIELD registry, which also assessed stroke risk using the CHA_2DS_2-VASc score, found that two out of five patients with a CHA_2DS_2-VASc score ≥2 did not receive OAC.[6]

Analyses of UK general practice suggest that there appears to have been a slight improvement in the number of high-risk patients with AF receiving OAC over the past few years. For example, an analysis of antithrombotic therapy initiation after 1 January 2000 from the UK General Practice Research Database (GPRD) by Gallagher *et al*[18] demonstrated that approximately 60% of patients with a high risk of stroke ($CHADS_2$ score ≥2) were not receiving OAC. A more recent analysis by Holt *et al*[10] reported that 53% of high-risk patients with AF received OAC, although this study did not use the GRASP-AF tool or report observed stroke risk, while the most recent analysis by Cowan *et al* using the GRASP-AF tool, suggests that only 34.0% of patients at high risk of stroke without contraindications to OAC are not prescribed it.[5] This was also evident among European cardiologists, with an increase in OAC use from 56.6% in the Euro Heart survey of AF [7] to 80% in the more recent EORP-AF survey.[19]

The present analysis demonstrated that the proportion of patients receiving OAC varied by stroke risk from 25% with a $CHADS_2$ score of 0, to 55% with a $CHADS_2$ score of 4 which then plateaued; a similar pattern was evident with increasing CHA_2DS_2-VASc scores of 0 to 3. These findings are similar to the results from two recent analyses of UK general practice [5,10] and a global survey of OAC,[6] but contrast with previous analyses of antithrombotic therapy by stroke risk.[17,18] This could suggest that the greater emphasis on risk stratifying patients advocated by guidelines is beginning to affect contemporary clinical practice, and that using the GRASP-AF tool, incorporating the CHA_2DS_2-VASc score, could help to identify those at risk of stroke and increase the use of appropriate OAC therapy.

Perhaps a more worrying finding from the present analysis was that roughly a quarter of patients at high risk of stroke were receiving antiplatelet monotherapy; a finding mirrored in other research.[6,7,18] Cowan *et al* report that 36.2% received antiplatelets alone;[5] suggesting that the prescription of antiplatelet therapy for stroke prevention in AF may vary markedly in the UK. The discrepancy in the proportions of patients receiving antiplatelet therapy between the present study and Cowan *et al*[5] may reflect differences in the interpretation and implementation of clinical guidelines between different areas of the UK, as the present study was conducted in one geographical location only. There were also significant changes in practice over time as the current analysis looked at treatment in March 2013, whereas Cowan *et al*[5] looked at data uploaded between July 2009 and

Funding

None.

Ethical approval

Ethical approval was not required under NHS research governance arrangements for the project.

Provenance

Freely submitted; externally peer reviewed.

Competing interests

Gregory YH Lip has served as a consultant for Bayer, Astellas, Merck, Sanofi, BMS/Pfizer, Daiichi-Sankyo, Biotronik, Portola, and Boehringer Ingelheim and has served as a speaker for Bayer, BMS/Pfizer, Boehringer Ingelheim, Daiichi-Sankyo and Sanofi Aventis. Deirdre A Lane has received investigator-initiated educational grants from Bayer Healthcare and Boehringer Ingelheim and served as a speaker for Boehringer Ingelheim, Bayer Healthcare, BMS/Pfizer. Deirdre A Lane is on the Steering Committee of a Phase IV apixaban study (AEGEAN). Both Gregory YH Lip and Deirdre A Lane have participated in various clinical trials of stroke prevention in atrial fibrillation. Andreas Wolff has served as clinical advisor to Boehringer Ingelheim, Pfizer, BMS, Sanofi-Aventis, and Daiichi-Sankyo and also received educational grants and investigator payments. In addition he served as speaker for Boehringer Ingelheim, Sanofi and Pfizer. Eduard Shantsila has declared no competing interests.

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March 2012. Greater implementation of the European Society of Cardiology focused guidelines of not using antiplatelet monotherapy for stroke prevention in AF may have influenced prescribing patterns in the present analyses. Although the present analysis did not capture the reasons for withholding antithrombotic therapy, the GARFIELD registry[6] found that more than half of reasons reported were based on physician choice (that is, fears over the risk of bleeding and/or falls, or worries over patient adherence). A recent analysis of older patients from the UK GPRD[8] suggests that the under-utilisation of OAC among this group was not a result of bleeding risk or comorbidities. This highlights the importance of determining individual stroke and bleeding risk and discussing treatment options with patients to determine their preferences for treatment, as patients are often more willing to accept a higher risk of bleeding to prevent a stroke compared with physicians.[20–22]

Implications for practice

Most patients with AF in general practice are at high risk of stroke but OAC is currently under-utilised in about 40% of these patients. Risk of stroke and death was significantly reduced by OAC, yet antiplatelet monotherapy is still inappropriately used in about one-quarter of patients at risk of stroke. Optimal use of the CHA_2DS_2-VASc score in the GRASP-AF audit tool could help prevent strokes.

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Appendix 1. Read codes for stroke-related outcome searches[a]

Code	Outcome
Eu01y	[X]Other vascular dementia
Eu01z	[X]Vascular dementia, unspecified
G613.	Cerebellar haemorrhage
G614.	Pontine haemorrhage
X003T	Subcortical vascular dementia
X003V	Mixed cortical and subcortical vascular dementia
X00D1	Cerebrovascular accident
X00D3	CVA — cerebral artery occlusion
X00D6	Total anterior cerebral circulation infarction
X00D7	Partial anterior cerebral circulation infarction
X00D8	Posterior cerebral circulation infarction
X00DA	Lacunar infarction
X00DT	Posterior circulation stroke of uncertain pathology
XE0VJ	Cerebral infarction NOS
XE1Xs	Vascular dementia
XE2aB	Stroke and cerebrovascular accident unspecified
Xa00J	Cerebellar infarction
Xa0kZ	Cerebral infarction
XaB4Z	Multiple lacunar infarcts
XaBEC	Left sided cerebral infarction
XaEGq	Stroke NOS
XaJgQ	Infarction of basal ganglia
S63	Other cerebral haemorrhage
s63z	Other cerebral haemorrhage
XE1m2	Traumatic intracranial haemorrhage
XM0rV	Cerebral haemorrhage

[a]All identified patients' notes were reviewed by a clinician and only counted as stroke if a specialist letter was available documenting the new onset of symptoms compatible with stroke and supported by cranial imaging findings.