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ORIGINAL RESEARCH

Stroke Risk Stratification in Patients With Postoperative Atrial Fibrillation After Coronary Artery Bypass Grafting

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BACKGROUND: The CHA_2DS_2-VASc (congestive heart failure, hypertension, age ≥75 years, diabetes, previous stroke or TIA [transient ischemic attack], vascular disease, age 65 to 74 years, sex category female; 2 indicates 2 points, otherwise 1 point) scoring system is recommended to guide decisions on oral anticoagulation therapy for stroke prevention in patients with nonsurgery atrial fibrillation. A score ≥1 in men and ≥2 in women, corresponding to an annual stroke risk exceeding 1%, warrants long-term oral anticoagulation provided the bleeding risk is acceptable. However, in patients with new-onset postoperative atrial fibrillation, the optimal risk stratification method is unknown. The aim of this study was therefore to evaluate the CHA_2DS_2-VASc scoring system for estimating the 1-year ischemic stroke risk in patients with new-onset postoperative atrial fibrillation after coronary artery bypass grafting.

METHODS AND RESULTS: All patients with new-onset postoperative atrial fibrillation and without oral anticoagulation after first-time isolated coronary artery bypass grafting performed in Sweden during 2007 to 2017 were eligible for this registry-based observational cohort study. The 1-year ischemic stroke rate at each step of the CHA_2DS_2-VASc score was estimated using a Kaplan-Meier estimator. Of the 6368 patients included (mean age, 69.9 years; 81% men), >97% were treated with antiplatelet drugs. There were 147 ischemic strokes during the first year of follow-up. The ischemic stroke rate at 1 year was 0.3%, 0.7%, and 1.5% in patients with CHA_2DS_2-VASc scores of 1, 2, and 3, respectively, and ≥2.3% in patients with a score ≥4. A sensitivity analysis, with the inclusion of patients on anticoagulants, was performed and supported the primary results.

CONCLUSIONS: Patients with new-onset atrial fibrillation after coronary artery bypass grafting and a CHA_2DS_2-VASc score <3 have such a low 1-year risk for ischemic stroke that oral anticoagulation therapy should probably be avoided.

Key Words: CHA_2DS_2-VASc ■ coronary artery bypass grafting ■ new-onset postoperative atrial fibrillation

Atrial fibrillation (AF) is the most common clinically significant arrhythmia in the general population.[1,2] It also occurs in 20% to 40% of cardiac surgery patients without history of AF.[3] Prevention of ischemic stroke is a primary objective in the management of patients with AF.[4–6] International guidelines provide explicit recommendations on how to estimate and manage the risk of ischemic stroke and other thromboembolic events in patients with nonsurgery AF. However, the optimum management of new-onset postoperative AF (POAF) is not clear.[4,5]

The CHA_2DS_2-VASc (congestive heart failure, hypertension, age ≥75 years, diabetes, previous stroke or TIA [transient ischemic attack], vascular disease, age 65 to 74 years, sex category female; 2 indicates 2 points, otherwise 1 point) scoring system was introduced in 2010 to refine risk stratification in patients with low thromboembolic risk.[7] It has since gained wide

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CLINICAL PERSPECTIVE

What Is New?

- In a cohort exceeding 6000 patients with new-onset postoperative atrial fibrillation after coronary artery surgery, the CHA$_2$DS$_2$-VASc (congestive heart failure, hypertension, age ≥75 years, diabetes, previous stroke or TIA [transient ischemic attack], vascular disease, age 65 to 74 years, sex category female) score was applicable for identifying those with a low risk for ischemic stroke during 1 year following hospital discharge.
- In patients with new-onset postoperative atrial fibrillation after coronary artery surgery, a CHA$_2$DS$_2$-VASc score of <3 was associated with a low 1-year stroke risk (ie, <1% risk).

What Are the Clinical Implications?

- The CHA$_2$DS$_2$-VASc scoring system is suitable in patients with new-onset postoperative atrial fibrillation after coronary artery bypass for identification of those with a low stroke risk during the first year following hospital discharge.
- Oral anticoagulation therapy should probably be avoided in patients with new-onset atrial fibrillation after coronary bypass surgery and a CHA$_2$DS$_2$-VASc score of <3, at least in the 1-year perspective.

Nonstandard Abbreviations and Acronyms

CHA$_2$DS$_2$-VASc	congestive heart failure, hypertension, age ≥75 years, diabetes, previous stroke or TIA [transient ischemic attack], vascular disease, age 65 to 74 years, sex category female; 2 indicates 2 points, otherwise 1 point
OAC	oral anticoagulation
POAF	postoperative atrial fibrillation

acceptance and become the most commonly used tool for stroke risk stratification and treatment recommendations in patients with nonsurgery AF.[4–6] The system classifies patients with nonsurgery AF into those at low risk (<1%), intermediate risk (1–2%), and high risk (>2%) for ischemic stroke in a 1-year perspective.[5,7–9] Low risk corresponds to 0 points in men and 1 point in women, intermediate risk to 1 point in men and 2 points in women, and high risk to ≥2 points in men and ≥3 points in women. Current guidelines recommend oral anticoagulation (OAC) for patients at intermediate and high risk for ischemic stroke, provided the bleeding risk is acceptable, but not for those at low risk.[4–6]

Several studies have shown that POAF is associated with an increased long-term risk of stroke,[10,11] but current guidelines only offer weak recommendations for OAC in patients with POAF.[1,2] There is therefore an ongoing debate both about how best to estimate the stroke risk and the risk/benefit ratio of OAC therapy in patients with POAF.[4,5] Whether the CHA$_2$DS$_2$-VASc scoring system is useful for stroke risk assessment in patients with POAF after cardiac surgery thus remains unclear. The main purpose of this study was therefore to explore whether the CHA$_2$DS$_2$-VASc score could be used to estimate the 1-year risk for ischemic stroke in patients with POAF after coronary artery bypass grafting (CABG).

METHODS

Study Design and Patient Cohort

This was an observational, nationwide, registry-based cohort study. Patients with a first-time isolated CABG (without any concomitant procedure) between January 1, 2007, and December 31, 2017, were eligible for inclusion. The patients were identified in the Swedish Cardiac Surgery Registry,[12] which is a part of the SWEDEHEART (Swedish Web System for Enhancement and Development of Evidence-Based Care in Heart Disease Evaluated According to Recommended Therapies) registry.[13] POAF was defined as any new-onset AF during the index hospitalization for CABG using data obtained from the Swedish Cardiac Surgery Registry and the National Patient Registry, as previously described.[10] Patients who died during the index hospitalization and those who had a history of AF recorded in the National Patient Registry from 1997 to the admission date for the index CABG were excluded.

We focused on the question of whether CHA$_2$DS$_2$-VASc could be used to differentiate low-risk from intermediate- and high-risk patients with POAF at hospital discharge, and this date was the baseline for follow-up. Patients who had a filled prescription for OAC within 6 months before and up to 7 days after baseline were excluded from the main analysis. However, patients with POAF with a filled prescription for OAC beyond day 7 but within the first year after hospital discharge were included but censored when OAC was dispensed (n=653). In addition, one sensitivity analysis comprising patients with at least 1 year's follow-up and another including patients with oral anticoagulation at discharge were performed.

Data Sources

Preoperative AF status, baseline characteristics, and data on POAF were obtained from the Swedish Cardiac

Surgery Registry and the National Patient Registry. Data on postoperative morbidity, including end points, were taken from the National Patient Registry; data on medications dispensed preoperatively and postoperatively were taken from the Swedish Prescribed Drug Registry; and mortality data were taken from the National Cause of Death Registry. Data linkage was performed using the unique personal identification number given to all Swedish citizens at birth or shortly after immigration. The Swedish Cardiac Surgery Registry contains detailed information on all cardiac surgical procedures since 1992.[12,13] The National Patient Registry records all diagnoses in conjunction with hospital admissions and hospital outpatient visits since 1987. This registry has full coverage and a validity of 85% to 95%, depending on diagnosis.[14] Preoperative data, including AF status and CHA_2DS_2-VASc score as well as end points, were identified using the *International Classification of Diseases, Tenth Revision* (*ICD-10*). A list of *ICD-10* codes used to identify diagnoses is provided in Table S1.

All information on medication both preoperatively and following discharge was obtained from the Swedish Prescribed Drug Registry, which holds detailed information about all dispensed prescription drugs since July 2005.[15] Anatomical Therapeutic Chemical Classification codes were used to identify medications, as listed in Table S2. Finally, all deaths in Sweden are reported to the National Cause of Death Registry, from which information on deaths was obtained. The authors declare that all supporting data are available within the article and the supplementary file.

Study End Points

The primary end point was the ischemic stroke rate during a 1-year follow-up, in accordance with previous studies on the CHA_2DS_2-VASc scoring system.[7–9] Secondary end points were the rates of any thromboembolic event (ischemic stroke, TIA, and/or systemic embolism) and major bleeding during the 1-year follow-up. Finally, the event rates for ischemic stroke and any thromboembolic event during the entire follow-up period were calculated. End points were only counted if they occurred after discharge and were associated with hospital admission or death. All patients were followed up until the occurrence of end points, initiation of OAC, death, emigration, or the end of the study period (December 31, 2017).

Statistical Analysis

Descriptive statistics are presented as means and SDs for continuous variables and as counts and percentages for categorical variables. Associations between CHA_2DS_2-VASc score and the risk of stroke within 1 year of follow-up in patients with POAF without oral anticoagulation (the primary end point) are presented as percentages of patients with events (with 95% exact Poisson CIs) estimated using a Kaplan-Meier estimator.[16] Associations between CHA_2DS_2-VASc score and risks during the complete follow-up are presented as events per 100 patient-years with 95% exact Poisson CIs, and cumulative incidence curves are estimated as one minus the Kaplan-Meier curve using the complete follow-up time.

The sensitivity and specificity of the CHA_2DS_2-VASc score in estimating the risk of events during the 1-year follow-up was assessed using a logistic regression model with CHA_2DS_2-VASc score as an independent categorical variable and presented as a receiver operating characteristic curve. The receiver operating characteristic curve was summarized using the area under the curve with a 95% CI[17] using the algorithm developed by Sun and Xu.[18]

All statistical analyses were performed in version 4.0.2 of R (R Foundation for Statistical Computing, Vienna, Austria; https://www.R-project.org/), using the pROC package for the calculations of area under the receiver operating characteristic curves.

Ethical Approval

The study complies with the Declaration of Helsinki and was approved by the regional Human Research Ethics Committee in Gothenburg, Sweden (approval number 139-16). The need for individual consent from the patients was waived by the Ethics Committee.

RESULTS

Study Cohort

During the study period, 32 109 patients underwent first-time isolated CABG in Sweden. After excluding patients who died before discharge (n=546; 1.7%) and those with a history of AF (n=2854; 8.9%), a total of 28 709 patients remained. POAF was diagnosed in 8348 of them (29.1%). Patients with POAF and preoperative use of OAC (n=116; 1.4%) and those prescribed OAC at discharge (n=1864; 22.6%) were excluded as per protocol (Figure 1). The final primary study population comprised 6368 patients with POAF and without OAC.

Baseline characteristics and medications at discharge for all included patients are presented in Table 1 for the total group and in Tables S3 and S4 divided per step in CHA_2DS_2-VASc score. The mean (SD) age was 69.9 (7.9) years, and 81.2% were men. At discharge, 97.1% were prescribed at least one antiplatelet drug, and 20.5% had dual antiplatelet therapy. Because all were patients undergoing CABG, the lowest possible CHA_2DS_2-VASc score was 1 (for vascular disease). Furthermore, a stroke before or during the

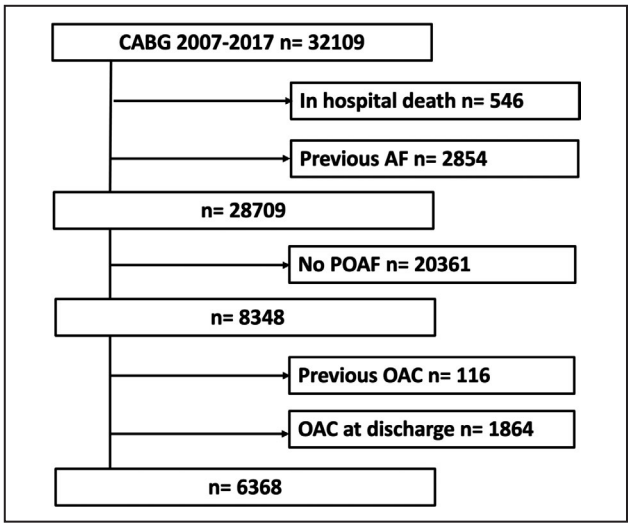

Figure 1. Selection of study cohort.
Selection process for the study cohort of 6368 patients with new-onset postoperative atrial fibrillation (POAF) after first-time isolated coronary artery bypass grafting (CABG) not treated with oral anticoagulation (OAC) at hospital discharge. AF indicates atrial fibrillation.

index hospitalization would add 2 more points and put the patient in the categories of ≥3 points for men and ≥4 points for women. Mean (SD) CHA_2DS_2-VASc score was 3.7 (1.5). All patients with CHA_2DS_2-VASc score of 1 were men, and only 2.3% of patients with CHA_2DS_2-VASc score of 2 were women.

CHA_2DS_2-VASc and 1-Year Rates for Ischemic Stroke and Any Thromboembolism

In the primary analysis, 5875 (92.3%) of 6368 included patients with POAF had a follow-up of at least 1 year. A total of 147 ischemic strokes occurred within the first year following discharge, 42 (28.6%) of them within the first month. The ischemic stroke rates at 1 year were 0.3%, 0.7%, and 1.5% in patients with a CHA_2DS_2-VASc score of 1, 2, and 3, respectively, and ≥2.3% for patients with a score ≥4 (Table 2 and Figure 2). No woman with a CHA_2DS_2-VASc score <3 had a diagnosis of ischemic stroke at 1-year follow-up (Table S5). A sensitivity analysis restricted to patients with POAF and at least 1-year follow-up (n=5875) did not alter the results of the primary analysis (Table S6).

Overall, 200 thromboembolic events were diagnosed within 1-year follow-up (147 ischemic strokes, 47 TIAs, and 6 systemic embolisms). The rates of any thromboembolic event at 1 year are presented in Table 2.

The area under the receiver operating characteristic curve was 0.67 (95% CI, 0.64–0.69) for ischemic stroke and 0.64 (95% CI, 0.61–0.66) for any thromboembolic event (Figure S1). The sensitivity and specificity of the CHA_2DS_2-VASc score are given in Table S7. The specificity at 1 year was ≥98% at scores of ≤2.

Another sensitivity analysis included 1864 patients who had OAC at hospital discharge (total n=8232) and were consequently not among those censored at the initiation of OAC therapy during follow-up. This analysis showed similar results as the main analysis (Table S8). The proportions of patients who received OAC at discharge for each step in the score are presented in Figure S2. An additional analysis focusing only on the 1864 patients with POAF who were

Table 1. Baseline Characteristics and Medications at Discharge for 6368 Patients With New-Onset POAF After Isolated First-Time Coronary Bypass Surgery and Without OAC

Variable	Value
Male sex	5170 (81.2)
Age, y	69.9 (7.9)
Body mass index, kg/m^2	27.6 (5.0)
Acute coronary syndrome	3196 (50.2)
Heart failure	825 (13.0)
Hypertension	4727 (74.2)
Diabetes	1915 (30.1)
Peripheral vascular disease	658 (10.3)
Previous stroke	438 (6.9)
Previous transitory ischemic attack	388 (6.1)
Arterial embolism	28 (0.4)
Pulmonary embolism	39 (0.6)
Deep vein thrombosis	129 (2.0)
Respiratory disease	678 (10.6)
Renal failure	233 (3.7)
Renal replacement therapy	26 (0.4)
Liver disease	56 (0.9)
History of cancer	969 (15.2)
Antiplatelet therapy	6181 (97.1)
DAPT	1304 (20.5)
Lipid-lowering agents	6107 (95.9)
β blockers	5909 (92.8)
ACE-i/ARB	4888 (76.8)
MRA	750 (11.8)
CCB	1774 (27.9)
Diuretics	3091 (48.5)
Digoxin	135 (2.1)
Sotalol	712 (11.2)
Amiodarone	763 (12.0)
Antidiabetics	1222 (19.2)

Data are given as number (percentage) or mean (SD). ACE-i indicates angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; CCB, calcium channel blocker; DAPT, dual-antiplatelet therapy; MRA, mineralocorticoid receptor antagonist; OAC, oral anticoagulation; and POAF, postoperative atrial fibrillation.

Table 2. Number of Events and Event Rates Within 1 Year per 100 Patient-Years With Exact 95% Poisson CIs by CHA_2DS_2-VASc Score at Discharge Among 6368 Patients With New-Onset POAF After Isolated First-Time Coronary Bypass Surgery and Without OAC

CHA_2DS_2-VASc score	No. (%) of patients	Ischemic stroke		Any thromboembolism		Major bleeding	
		No. of events (n=147)	Event rate/100 patient-years (95% CI)	No. of events (n=200)	Event rate/100 patient-years (95% CI)	No. of events (n=174)	Event rate/100 patient-years (95% CI)
1	328 (5.2)	1	0.3 (0.0–1.8)	2	0.7 (0.8–2.4)	5	1.7 (0.5–3.9)
		0	…	1	…	3	…
2	1066 (16.7)	7	0.7 (0.3–1.5)	13	1.4 (0.7–2.3)	16	1.7 (1.0–2.7)
		2	…	4	…	9	…
3	1662 (26.1)	22	1.5 (0.9–2.3)	33	2.2 (1.5–3.1)	39	2.7 (1.9–3.6)
		5	…	7	…	14	…
4	1621 (25.5)	33	2.3 (1.6–3.3)	43	3.0 (2.2–4.1)	57	4.1 (3.1–5.3)
		12	…	6	…	28	…
5	1038 (16.3)	39	4.4 (3.1–6.0)	50	5.6 (4.2–7.4)	31	3.5 (2.4–4.9)
		10	…	6	…	16	…
6	423 (6.6)	24	6.7 (4.3–9.9)	31	8.7 (5.9–12.4)	12	3.3 (1.7–5.8)
		5	…	2	…	7	
7	179 (2.8)	16	11.4 (6.5–18.5)	21	15.2 (9.4–23.3)	9	6.1 (2.8–11.6)
		7	…	3	…	2	…
8–9	51 (0.8)	5	11.3 (3.7–26.3)	7	15.8 (6.4–32.6)	5	11.6 (3.7–27.0)
		1	…	1	…	1	…

Gray cells indicate the number of events within the first 30 days after discharge. CHA_2DS_2-VASc indicates congestive heart failure, hypertension, age ≥75 years, diabetes, previous stroke or TIA [transient ischemic attack], vascular disease, age 65 to 74 years, sex category female; OAC, oral anticoagulation; and POAF, postoperative atrial fibrillation.

discharged on OAC therapy yielded fairly similar results (Table S9).[19]

Major Bleedings Within 1 Year

During the first year following hospital discharge, 174 major bleeding events were diagnosed: 81 (46.6%) of them during the first month. The 1-year rate was 1.7% in patients with POAF with CHA_2DS_2-VASc scores 1 and 2 and increased with higher scores (Table 2).

CHA_2DS_2-VASc and Ischemic Stroke and Thromboembolism Rates During the Entire Follow-Up Period

During the entire follow-up period (median, 5.2 years; range, 0–10 years), 1044 patients died (16.4%), 473 were diagnosed with ischemic stroke (7.4%), and 639 were diagnosed with any thromboembolic event (10.0%). The event rate per 100 patient-years for ischemic stroke was 0.2, 0.7, 1.2, and 1.7 in patients with POAF with a CHA_2DS_2-VASc score of 1, 2, 3, and 4, respectively, and ≥2.9 in patients with a score of ≥5 (Table 3). The rates of ischemic stroke in each step of the score were largely linear during follow-up for CHA_2DS_2-VASc scores <7 (Figure 3). The rates of any thromboembolism during the entire follow-up period are presented in Table 3.

DISCUSSION

The ischemic stroke rate was ≤0.7% for patients with CHA_2DS_2-VASc scores <3 in a cohort of 6358 patients with POAF after first-time isolated CABG who were not receiving OAC. The CHA_2DS_2-VASc scores thus identified patients with POAF and low risk for ischemic stroke during follow-up, in whom OAC probably should be avoided, at least in the 1-year perspective.

International AF guidelines state that patients with nonsurgery AF and low risk for stroke, defined as a 1-year risk of <1% (corresponding to a CHA_2DS_2-VASc score of 0 in men and 1 in women), should not be recommended OAC for stroke prevention.[4–6] In our study, the 1-year rate for ischemic stroke in patients with POAF was >1% for CHA_2DS_2-VASc score ≥3. These results suggest that if the CHA_2DS_2-VASc score is used in patients with POAF to identify those with <1% 1-year risk for ischemic stroke, a higher cutoff level should be applied than in patients with nonsurgery AF. The rates of ischemic stroke and any thromboembolism in this cohort with POAF were apparently lower for any given CHA_2DS_2-VASc score than the rates observed in studies conducted on patients with nonsurgery AF.[7,8,20,21] Our results therefore partly corroborate those of a recently published study where the

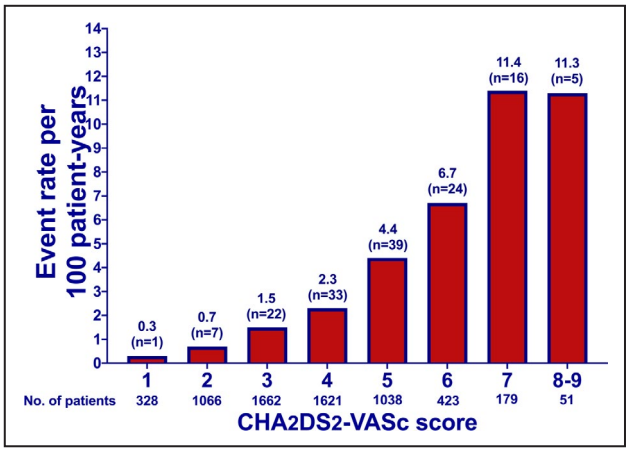

Figure 2. Ischemic stroke rates within 1 year, divided by CHA_2DS_2-VASc score.
Ischemic stroke rates per 100 patient-years within 1 year, divided by CHA_2DS_2-VASc score, among 6368 patients with new-onset atrial fibrillation following coronary artery bypass grafting. Numbers above the bars denote ischemic strokes. CHA_2DS_2-VASc indicates congestive heart failure, hypertension, age ≥75 years, diabetes, previous stroke or TIA [transient ischemic attack], vascular disease, age 65 to 74 years, sex category female.

risk for a stroke in patients with POAF was comparable to that in patients with sinus rhythm for CHA_2DS_2-VASc score <4, and significantly higher in patients with POAF and CHA_2DS_2-VASc score ≥4.[22] Likewise, our study is in line with the findings of Gialdini et al, who reported low stroke risk in relation to CHA_2DS_2-VASc score in a mixed population of patients with POAF.[23] However, the latter study excluded patients with POAF and previous stroke, which might explain their low stroke rates. Our findings are also in accordance with the observations of a recent study in patients undergoing CABG, showing that the risk for thromboembolism is lower in patients with POAF than in matched patients with nonsurgery AF.[24]

One possible explanation for the lower event rates for ischemic stroke and any thromboembolism observed in our study, compared with studies on patients with nonsurgery AF, might be a beneficial effect of antiplatelet therapy, which in a previous study was associated with a 22% reduction in stroke risk compared with no antithrombotic treatment.[19] Antiplatelet therapy was present in 97.1% of the patients in our cohort versus 31% to 74% in previous studies evaluating the CHA_2DS_2-VASc score in nonsurgery AF.[7,8,21] In addition, patients undergoing CABG are most likely subjected to more rigorous medical examinations and closer follow-up, which might result in improved cardiovascular risk factor modification also reducing the ischemic stroke risk. Although the exact mechanism cannot be decided in individual cases, POAF presumably occurs because of various perioperative and postoperative triggers and might have a different pathophysiology to that in nonsurgery AF. The thromboembolic risk might therefore be different in patients with POAF despite the fact that patients undergoing CABG share many risk factors with patients with nonsurgery AF.

Nonsurgical AF is generally associated with a 5-fold increase in the risk for ischemic stroke,[25] which is reduced by ≈65% with OAC.[19] The decision to recommend OAC is, however, based not solely on the thromboembolic risk, but also on balancing this risk reduction with the risk for bleeding on OAC therapy. Patients with POAF following CABG are at increased risk for bleeding complications, because at the time of the POAF diagnosis they have recently undergone major cardiac surgery and are being treated with antiplatelet drugs.[26] Studies conducted on patients with AF who have undergone percutaneous coronary intervention showed that the combination of OAC and antiplatelet therapy is associated with a higher risk for major bleeding (2.9%) compared with antiplatelet therapy alone (0.8%).[27]

Table 3. Number of Events, Patient-Years, and Event Rate per 100 Patient-Years With Exact 95% Poisson CIs by CHA_2DS_2-VASc Score at Discharge Among 6368 Patients With New-Onset POAF Followed Up on Average 5 Years

CHA_2DS_2-VASc score	Ischemic stroke			Any thromboembolism		
	No. of events (n=473)	Patient-years (n=27 472)	Event rate/100 patient-years (95% CI)	No. of events (n=639)	Patient-years (n=26 990)	Event rate/100 patient-years (95% CI)
1	3	1823	0.2 (0.0–0.5)	13	1806	0.7 (0.4–1.2)
2	36	5325	0.7 (0.5–0.9)	60	5241	1.1 (0.9–1.5)
3	87	7422	1.2 (0.9–1.5)	128	7314	1.8 (1.5–2.0)
4	116	6792	1.7 (1.4–2.0)	148	6700	2.2 (1.9–2.6)
5	114	3968	2.9 (2.4–3.5)	143	3874	3.7 (3.1–4.4)
6	70	1448	4.8 (3.8–6.1)	87	1402	6.2 (5.0–7.7)
7	34	550	6.2 (4.3–8.6)	41	515	8.0 (5.7–10.8)
8–9	13	144	9.0 (4.8–15.4)	19	138	13.7 (8.3–21.5)

CHA_2DS_2-VASc indicates congestive heart failure, hypertension, age ≥75 years, diabetes, previous stroke or TIA [transient ischemic attack], vascular disease, age 65 to 74 years, sex category female; and POAF, postoperative atrial fibrillation.

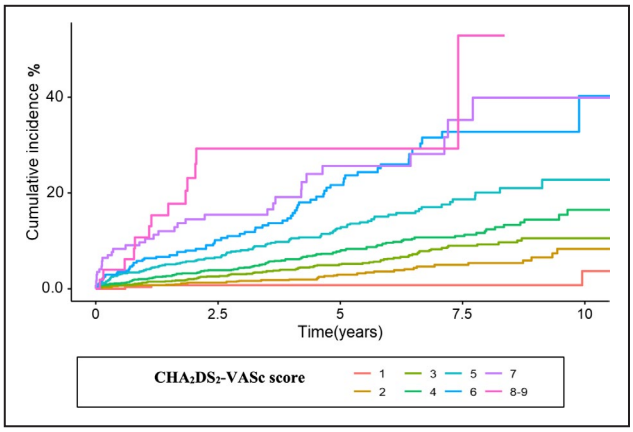

Figure 3. Cumulative incidence of ischemic stroke, divided by CHA_2DS_2-VASc score.
Cumulative incidence of ischemic stroke, divided by CHA_2DS_2-VASc score, in 6368 patients with new-onset postoperative atrial fibrillation after first-time isolated coronary artery bypass grafting during the entire follow-up period (median, 5.2 years; range, 0–10 years). CHA_2DS_2-VASc indicates congestive heart failure, hypertension, age ≥75 years, diabetes, previous stroke or TIA [transient ischemic attack], vascular disease, age 65 to 74 years, sex category female.

Retrospective studies investigating the consequences of early-initiated OAC therapy in patients with POAF have shown conflicting results. Two studies showed an association between OAC and reduced stroke risk,[24,28] whereas another 2 showed no reduction in the stroke risk but reported an increased risk of bleeding both within 30 days of hospital discharge and during long-term follow-up.[10,29] We acknowledge that an increased bleeding risk for any particular reason should not automatically lead to withholding OAC in patients with intermediate or high stroke risk.[5,9] However, initiation of OAC therapy in patients with POAF after CABG would presumably increase the bleeding risk further in patients with low stroke risk. This elevated risk for bleeding might not be balanced by the potential benefit, and therefore OAC should probably be avoided in patients with low stroke risk, at least in the 1-year perspective.

In patients with nonsurgery AF, there is a consensus that OAC should be recommended when the CHA_2DS_2-VASc score is ≥2 in men and ≥3 in women because of a proven benefit of OAC therapy with risk reduction for stroke exceeding the risk for severe bleedings with such therapy.[4,5] Unfortunately, data are not yet available at which risk level defined by CHA_2DS_2-VASc benefit of OAC therapy exceeds risk in patients with POAF. Consequently, our results only allow us to express an opinion on at which score the risk for stroke and any thromboembolism is so low that OAC therapy is unlikely to offer a benefit. We cannot state that OAC therapy should be recommended in all patients with POAF with a score exceeding that level.

The CHA_2DS_2-VASc score in this cohort showed a limited overall ability to estimate the risk of ischemic stroke and thromboembolism, with an area under the curve of 0.67.[30] This result is similar to that for the CHA_2DS_2-VASc score in patients with nonsurgery AF.[31] On the other hand, the specificity in patients with a CHA_2DS_2-VASc score of <3 was high (≥98%), emphasizing the ability of this scoring system to identify patients with low stroke and thromboembolic risk.

Our study suggests that if CHA_2DS_2-VASc is used to identify patients with low ischemic stroke risk, a higher cutoff score for identification of low-risk patients should be used for patients with POAF after CABG than for patients with nonsurgical AF. However, only randomized controlled studies can provide information about the net clinical benefit of OAC therapy in patients with POAF after CABG.

Methodological Aspects and Limitations

This study carries the inherent weaknesses of any observational study, including selection bias and the potential effect of unaccounted confounding. However, previous stroke risk stratification schemes, including the CHA_2DS_2-VASc score, were also developed and validated using retrospective studies.[1,7,8,32]

Ischemic stroke, rather than any thromboembolism, was chosen as the primary end point. The reason was that ischemic stroke is a specific outcome measure with consequences most likely leading to hospitalization and therefore registered in available databases. Furthermore, of 200 thromboembolic events that were diagnosed within 1-year follow-up, 47 (23.5%) were attributable to TIA. The accuracy in diagnosing TIA is often questioned because of the short symptom duration, retrospective evaluation, and interobserver variability,[33,34] making TIA a less reliable end point to study. Because our focus was on the association between the CHA_2DS_2-VASc score and the risk of stroke within a 1-year time period, we calculated the cause-specific survival function estimated by a Kaplan-Meier estimator, rather than estimating the cumulative incidence function (adjusted for competing risks).

Our study population was composed of patients with POAF and without OAC, which constitutes a potential selection bias. Censoring of patients who received OAC during follow-up was performed to obtain the true ischemic stroke rates in patients with POAF after CABG without such therapy. However, inclusion of patients with OAC therapy at discharge in a sensitivity analysis yielded similar results.

The rates of major bleedings were explored in the different levels of the CHA_2DS_2-VASc scoring system merely to illustrate the true bleeding rates in patients with POAF after CABG and without OAC.

Because of the retrospective nature of this study, an underestimation of the presence of risk factors composing the CHA$_2$DS$_2$-VASc score, such as hypertension, is possible. However, this would have driven our results toward an even lower risk at a higher score, rather than the opposite. We cannot exclude the possibility that some patients had undiagnosed AF before surgery or that an AF episode went unrecognized during the index hospitalization after the initial period of continuous electrocardiography telemetry. In addition, we were not able to evaluate the clinical course of AF during the hospitalization period and the heart rhythm at discharge, information that potentially influenced the decision to prescribe OAC or not. Finally, we focused on events occurring during the first postoperative year, similar to the original CHA$_2$DS$_2$-VASc study.[7] Longer follow-up periods would presumably lead to changes in patient characteristics and risk profiles, altering the CHA$_2$DS$_2$-VASc score and hence attenuating the relative risk estimates. However, the 5-year results emphasize the relatively lower risks in patients with POAF compared with observations in patients with nonsurgery AF.

CONCLUSIONS

Among patients with new-onset atrial fibrillation after coronary bypass surgery, the CHA$_2$DS$_2$-VASc score was suitable for identifying those with a 1-year risk for ischemic stroke so low that oral anticoagulation therapy should probably be avoided.

ARTICLE INFORMATION

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Supplemental Material

Tables S1–S9
Figures S1–S2

REFERENCES

1. Björck S, Palaszewski B, Friberg L, Bergfeldt L. Atrial fibrillation, stroke risk, and warfarin therapy revisited: a population-based study. *Stroke*. 2013;44:3103–3108. doi: 10.1161/STROKEAHA.113.002329
2. Virani SS, Alonso A, Benjamin EJ, Bittencourt MS, Callaway CW, Carson AP, Chamberlain AM, Chang AR, Cheng S, Delling FN, et al. Heart disease and stroke statistics-2020 update: a report from the American Heart Association. *Circulation*. 2020;141:e139–e596. doi: 10.1161/CIR.0000000000000757
3. Filardo G, Damiano RJ Jr, Ailawadi G, Thourani VH, Pollock BD, Sass DM, Phan TK, Nguyen H, da Graca B. Epidemiology of new-onset atrial fibrillation following coronary artery bypass graft surgery. *Heart*. 2018;104:985–992. doi: 10.1136/heartjnl-2017-312150
4. Hindricks G, Potpara T, Dagres N, Arbelo E, Bax JJ, Blomström-Lundqvist C, Boriani G, Castella M, Dan GA, Dilaveris PE, et al. 2020 ESC guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European Association of Cardio-Thoracic Surgery (EACTS). *Eur Heart J*. 2020:42:373–498. doi: 10.1093/eurheartj/ehaa612
5. January CT, Wann LS, Alpert JS, Calkins H, Cigarroa JE, Cleveland JC, Conti JB, Ellinor PT, Ezekowitz MD, Field ME, et al. 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association task force on practice guidelines and the Heart Rhythm Society. *Circulation*. 2014;130:e199–e267. doi: 10.1161/CIR.0000000000000041
6. January CT, Wann LS, Calkins H, Chen LY, Cigarroa JE, Cleveland JC, Ellinor PT, Ezekowitz MD, Field ME, Furie KL, et al. 2019 AHA/ACC/HRS focused update of the 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society in Collaboration with the Society of Thoracic Surgeons. *Circulation*. 2019;140:e125–e151. doi: 10.1161/CIR.0000000000000665
7. Lip GY, Nieuwlaat R, Pisters R, Lane DA, Crijns HJ. Refining clinical risk stratification for predicting stroke and thromboembolism in atrial fibrillation using a novel risk factor-based approach: the Euro Heart Survey on Atrial Fibrillation. *Chest*. 2010;137:263–272. doi: 10.1378/chest.09-1584
8. Olesen JB, Lip GYH, Hansen ML, Hansen PR, Tolstrup JS, Lindhardsen J, Selmer C, Ahlehoff O, Olsen AM, Gislason GH, et al. Validation of risk stratification schemes for predicting stroke and thromboembolism in patients with atrial fibrillation: nationwide cohort study. *BMJ*. 2011;342:d124. doi: 10.1136/bmj.d124
9. Lip GY, Tse HF, Lane DA. Atrial fibrillation. *Lancet*. 2012;379:648–661. doi: 10.1016/S0140-6736(11)61514-6
10. Taha A, Nielsen SJ, Bergfeldt L, Ahlsson A, Friberg L, Björck S, Franzén S, Jeppsson A. New-onset atrial fibrillation after coronary artery bypass grafting and long-term outcome: a population-based nationwide study from the SWEDEHEART registry. *J Am Heart Assoc*. 2021;10:e017966. doi: 10.1161/JAHA.120.017966
11. Lin MH, Kamel H, Singer DE, Wu YL, Lee M, Ovbiagele B. Perioperative/postoperative atrial fibrillation and risk of subsequent stroke and/or mortality. *Stroke*. 2019;50:1364–1371. doi: 10.1161/STROKEAHA.118.023921
12. Vikholm P, Ivert T, Nilsson J, Holmgren A, Freter W, Ternström L, Ghaidan H, Sartipy U, Olsson C, Granfeldt H, et al. Validity of the Swedish Cardiac Surgery Registry. *Interact Cardiovasc Thorac Surg*. 2018;27:67–74. doi: 10.1093/icvts/ivy030
13. Jernberg T, Attebring MF, Hambraeus K, Ivert T, James S, Jeppsson A, Lagerqvist B, Lindahl B, Stenestrand U, Wallentin L. The Swedish web-system for enhancement and development of evidence-based care in heart disease evaluated according to recommended therapies (SWEDEHEART). *Heart*. 2010;96:1617–1621. doi: 10.1136/hrt.2010.198804
14. Ludvigsson JF, Andersson E, Ekbom A, Feychting M, Kim JL, Reuterwall C, Heurgren M, Olausson PO. External review and validation of the

Swedish National Inpatient Register. *BMC Public Health*. 2011;11:450. doi: 10.1186/1471-2458-11-450
15. The Swedish National Board of Health and Welfare. The Swedish Prescribed Drug Registry: reporting procedures and quality of data. Available at: https://www.socialstyrelsen.se/en/statistics-and-data/registers/register-information/the-swedish-prescribed-drug-register/. Accessed February 14, 2021.
16. Kaplan EL, Meier P. Nonparametric estimation from incomplete observations. *J Am Stat Assoc*. 1958;53:457–481. doi: 10.1080/01621459.1958.10501452
17. DeLong ER, DeLong DM, Clarke-Pearson DL. Comparing the areas under two or more correlated receiver operating characteristic curves: a nonparametric approach. *Biometrics*. 1988;44:837–845. doi: 10.2307/2531595
18. Sun X, Xu W. Fast implementation of Delong's algorithm for comparing the areas under correlated receiver operating characteristic curves. *IEEE Signal Process Lett*. 2014;21:1389–1393. doi: 10.1109/LSP.2014.2337313
19. Hart RG, Pearce LA, Aguilar MI. Meta-analysis: antithrombotic therapy to prevent stroke in patients who have nonvalvular atrial fibrillation. *Ann Intern Med*. 2007;146:857–867. doi: 10.7326/0003-4819-146-12-200706190-00007
20. Friberg L, Skeppholm M, Terént A. Benefit of anticoagulation unlikely in patients with atrial fibrillation and a CHA$_2$DS$_2$-VASc score of 1. *J Am Coll Cardiol*. 2015;65:225–232. doi: 10.1016/j.jacc.2014.10.052
21. Fauchier L, Clementy N, Bisson A, Ivanes F, Angoulvant D, Babuty D, Lip GY. Should atrial fibrillation patients with only 1 nongender-related CHA$_2$DS$_2$-VASc risk factor be anticoagulated? *Stroke*. 2016;47:1831–1836. doi: 10.1161/STROKEAHA.116.013253
22. Benedetto U, Gaudino MF, Dimagli A, Gerry S, Gray A, Lees B, Flather M, Taggart DP, Westaby S, Cook J, et al. Postoperative atrial fibrillation and long-term risk of stroke after isolated coronary artery bypass graft surgery. *Circulation*. 2020;142:1320–1329. doi: 10.1161/CIRCULATIONAHA.120.046940
23. Gialdini G, Nearing K, Bhave PD, Bonuccelli U, Iadecola C, Healey JS, Kamel H. Perioperative atrial fibrillation and the long-term risk of ischemic stroke. *JAMA*. 2014;312:616–622. doi: 10.1001/jama.2014.9143
24. Butt JH, Xian Y, Peterson ED, Olsen PS, Rørth R, Gundlund A, Olesen JB, Gislason GH, Torp-Pedersen C, Køber L, et al. Long-term thromboembolic risk in patients with postoperative atrial fibrillation after coronary artery bypass graft surgery and patients with nonvalvular atrial fibrillation. *JAMA Cardiol*. 2018;3:417–424. doi: 10.1001/jamacardio.2018.0405
25. Wolf PA, Abbott RD, Kannel WB. Atrial fibrillation as an independent risk factor for stroke: the Framingham Study. *Stroke*. 1991;22:983–988. doi: 10.1161/01.STR.22.8.983
26. Sato H, Ishikawa K, Kitabatake A, Ogawa S, Maruyama Y, Yokota Y, Fukuyama T, Doi Y, Mochizuki S, Izumi T, et al. Low-dose aspirin for prevention of stroke in low-risk patients with atrial fibrillation: Japan Atrial Fibrillation Stroke Trial. *Stroke*. 2006;37:447–451. doi: 10.1161/01.STR.0000198839.61112.ee
27. Sra S, Tan MK, Mehta SR, Fisher HN, Déry J-P, Welsh RC, Eisenberg MJ, Overgaard CB, Rose BF, Siega AJD, et al. Ischemic and bleeding events in patients with myocardial infarction undergoing percutaneous coronary intervention who require oral anticoagulation: insights from the Canadian Observational Antiplatelet Study. *Am Heart J*. 2016;180:82–89. doi: 10.1016/j.ahj.2016.07.015
28. El-Chami MF, Kilgo P, Thourani V, Lattouf OM, Delurgio DB, Guyton RA, Leon AR, Puskas JD. New-onset atrial fibrillation predicts long-term mortality after coronary artery bypass graft. *J Am Coll Cardiol*. 2010;55:1370–1376. doi: 10.1016/j.jacc.2009.10.058
29. Matos JD, McIlvaine S, Grau-Sepulveda M, Jawitz OK, Brennan JM, Khabbaz KR, Sellke FW, Yeh R, Zimetbaum P. Anticoagulation and amiodarone for new atrial fibrillation after coronary artery bypass grafting: prescription patterns and 30-day outcomes in the United States and Canada. *J Thorac Cardiovasc Surg*. 2021;162:616–624.e3. doi: 10.1016/j.jtcvs.2020.01.077
30. Mandrekar JN. Receiver operating characteristic curve in diagnostic test assessment. *J Thorac Oncol*. 2010;5:1315–1316. doi: 10.1097/JTO.0b013e3181ec173d
31. Borre E, Goode A, Raitz G, Shah B, Lowenstern A, Chatterjee R, Sharan L, Allen LaPointe N, Yapa R, Davis J, et al. Predicting thromboembolic and bleeding event risk in patients with non-valvular atrial fibrillation: a systematic review. *Thromb Haemost*. 2018;118:2171–2187. doi: 10.1055/s-0038-1675400
32. O'Donnell MJ, Chin SL, Rangarajan S, Xavier D, Liu L, Zhang H, Rao-Melacini P, Zhang X, Pais P, Agapay S, et al. Global and regional effects of potentially modifiable risk factors associated with acute stroke in 32 countries (INTERSTROKE): a case-control study. *Lancet*. 2016;388:761–775. doi: 10.1016/S0140-6736(16)30506-2
33. Castle J, Mlynash M, Lee K, Caulfield AF, Wolford C, Kemp S, Hamilton S, Albers GW, Olivot JM. Agreement regarding diagnosis of transient ischemic attack fairly low among stroke-trained neurologists. *Stroke*. 2010;41:1367–1370. doi: 10.1161/STROKEAHA.109.577650
34. Lee W, Frayne J. Transient ischaemic attack clinic: an evaluation of diagnoses and clinical decision making. *J Clin Neurosci*. 2015;22:645–648. doi: 10.1016/j.jocn.2014.09.020

SUPPLEMENTAL MATERIAL

Table S1. List of diagnoses according to ICD-10: International classification of diseases 10th version.

Variable	ICD-codes
Intracranial bleeding	I60, I61, I62, I690, I691, I692
Gastrointestinal bleeding	I850, I983, K226, K250, K252, K254, K256, K260, K262, K264, K266, K270, K272, K274, K276, K280, K284, K290, K625, K661, K920, K921, K922, K25, K26, K27, K28, I850, I983, K221,K226
Hemopericardium	I230, I312
Hemothorax	J942
Urogenital bleeding	N02, R319, N95, N939, N501A
Other bleeding	H431, R04, R58, D629, T810, DR029, D50
Anemia	D50-64
Atrial fibrillation	I48
Ischemic stroke	I63, I69.3, I69.4
Stroke unspecified	I64
Transitory ischemic attack	G45, I66, I65
Peripheral arterial embolism	I74
Heart failure	I50, I110, I130, I132, I255, I42-43
Hypertension	I10-15
Diabetes mellitus	E10-14
Ischemic heart disease	I20, I24, I25
Myocardial infarction	I21, I22
Percutaneous coronary intervention	FNG
Peripheral vascular disease	I70, I71, I72, I73, I74, I77
Vascular disease	I21, I22, I252, I70-73
Renal disease and RRT	N17-19, DR016, DR024, KAS10, KAS20
Liver disease	K70-77, JJB, JJC
Alcohol related conditions	E244, F10, G312, G621, G721, I426, K292, K70, K860, O354, P043, Q860, T51, Y90-91, Z502, Z714
Chronic obstructive pulmonary disease	J44
Pulmonary embolism	I26
Deep vein thrombosis	I80
Major bleeding	D62, N03, R31, D683, H356, H922, I230, I312, J942, M250, N421, N939, N950, R040, R041, R042, R048, R049, N501A + Intracranial bleeding + Gastrointestinal bleeding

RRT: Renal replacement therapy

Table S2. List of medications according to ATC: T**he Anatomical Therapeutic Classification.**

Medication	ATC-codes
Renin-angiotensin inhibitors	C09
Betablockers	C07 (excluding C07AA07)
Mineralocorticoid receptor antagonists	C03DA
Calcium antagonists	C08
Oral anticoagulants	B01AA, B01AE, B01AF
Antiplatelets	B01AC
Lipid lowering agents	C10
Antidiabetics	A10
Systemic corticosteroids	H02
Antiinflammatory and antirheumatic agents	M01
Diuretics	C03 (excluding C03DA)
Antiarrhythmic drugs	C01B, C07AA07
Digoxin	C01AA05

Table S3. Baseline characteristics according to CHA_2DS_2-VASc category presented as number and proportions (%) or mean (SD).

		1	2	3	4	5	6	7	8	9
	All patients (n= 6368)	**n= 328 (5.2%)**	**n= 1066 (16.7%)**	**n= 1662 (26.1%)**	**n= 1621 (25.5%)**	**n= 1038 (16.3%)**	**n= 423 (6.6%)**	**n= 179 (2.8%)**	**n= 47 (0.7%)**	**n= 4 (0.1%)**
Male sex	5170 (81.2)	392 (100.0)	1041 (97.7)	1534 (92.3)	1310 (80.8)	616 (59.3)	240 (56.7)	89 (49.7)	12 (25.5)	0 (0.0)
Age [yrs]	69.9 (7.9)	58.6 (4.9)	63.6 (6.6)	68.8 (6.7)	72.6 (6.6)	74.3 (6.1)	75.4 (5.9)	75.1 (5.4)	77.4 (3.9)	76.8 (1.7)
Body mass index I [kg*m-2]	27.6 (5.0)	26.9 (3.6)	27.6 (3.9)	27.7 (5.2)	27.7 (6.3)	27.6 (4.3)	28.0 (4.5)	27.6 (4.5)	27.2 (4.4)	27.6 (2.3)
Acute coronary syndrome	3196 (50.2)	158 (48.2)	474 (44.5)	782 (47.1)	810 (50.0)	573 (55.2)	260 (61.5)	106 (59.2)	30 (63.8)	3 (75.0)
Heart failure	825 (13.0)	0 (0.0)	33 (3.1)	120 (7.2)	194 (12.0)	227 (21.9)	150 (35.5)	73 (40.8)	24 (51.1)	4 (100.0)
Hypertension	4727 (74.2)	0 (0.0)	483 (45.3)	1190 (71.6)	1453 (89.6)	971 (93.5)	402 (95.0)	177 (98.9)	47(100.0)	4 (100.0)
Diabetes mellitus	1915 (30.1)	0 (0.0)	63 (5.9)	320 (19.3)	624 (38.5)	496 (47.8)	248 (58.6)	117 (65.4)	43 (91.5)	4 (100.0)
Peripheral vascular disease	658 (10.3)	7 (2.1)	66 (6.2)	148 (8.9)	174 (10.7)	139 (13.4)	62 (14.7)	48 (26.8)	12 (25.5)	2 (50.0)
Previous stroke	438 (6.9)	0 (0.0)	0 (0.0)	2 (0.1)	39 (2.4)	131 (12.6)	145 (34.3)	89 (49.7)	32 (68.1)	0 (0.0)
Transitory ischemic attack	388 (6.1)	0 (0.0)	0 (0.0)	6 (0.4)	24 (1.5)	127 (12.2)	108 (25.5)	97 (54.2)	23 (48.9)	3 (75.0)
Arterial embolism	28 (0.4)	0 (0.0)	0 (0.0)	1 (0.1)	0 (0.0)	11 (1.1)	6 (1.4)	7 (3.9)	2 (4.3)	1 (25.0)
Pulmonary embolism	39 (0.6)	1 (0.3)	2 (0.2)	11 (0.7)	9 (0.6)	9 (0.9)	4 (0.9)	2 (1.1)	1 (2.1)	0 (0.0)
Deep vein thrombosis	129 (2.0)	4 (1.2)	13 (1.2)	32 (1.9)	44 (2.7)	22 (2.1)	10 (2.4)	3 (1.7)	1 (2.1)	0 (0.0)
Respiratory disease	678 (10.6)	24 (7.3)	91 (8.5)	177 (10.6)	160 (9.9)	120 (11.6)	66 (15.6)	34 (19.0)	5 (10.6)	1 (25.0)
Renal failure	233 (3.7)	3 (0.9)	9 (0.8)	42 (2.5)	71 (4.4)	53 (5.1)	33 (7.8)	14 (7.8)	7 (14.9)	1 (25.0)
Renal replacement therapy	26 (0.4)	0 (0.0)	1 (0.1)	7 (0.4)	8 (0.5)	5 (0.5)	4 (0.9)	1 (0.6)	0 (0.0)	0 (0.0)
Liver disease	56 (0.9)	1 (0.3)	4 (0.4)	10 (0.6)	20 (1.2)	13 (1.3)	3 (0.7)	4 (2.2)	1 (2.1)	0 (0.0)
Cancer	969 (15.2)	18 (5.5)	100 (9.4)	255 (15.3)	285 (17.6)	197 (19.0)	80 (18.9)	28 (15.6)	6 (12.8)	0 (0.0)

Table S4. Medications at discharge according to CHA_2DS_2-VASc category presented as number and proportions (%).

		1	2	3	4	5	6	7	8	9
	All patients (n= 6368)	n= 328 (5.2%)	n= 1066 (16.7%)	n= 1662 (26.1%)	n= 1621 (25.5%)	n= 1038 (16.3%)	n= 423 (6.6%)	n= 179 (2.8%)	n= 47 (0.7%)	n= 4 (0.1%)
Antiplatelets	6181 (97.1)	325 (99.1)	1050 (98.5)	1616 (97.2)	1575 (97.2)	995 (95.9)	403 (95.3)	168 (93.9)	45 (95.7)	4 (100.0)
DAPT	1304 (20.5)	75 (22.9)	236 (22.1)	322 (19.4)	312 (19.2)	194 (18.7)	101 (23.9)	50 (27.9)	12 (25.5)	2 (50.0)
Lipid lowering agents	6107 (95.9)	323 (98.5)	1040 (97.6)	1604 (96.5)	1539 (94.9)	995 (95.9)	406 (96.0)	159 (88.8)	37 (78.7)	4 (100.0)
Beta blockers	5909 (92.8)	305 (93.0)	998 (92.7)	1542 (92.8)	1494 (92.2)	980 (94.4)	394 (93.1)	162 (90.5)	40 (85.1)	4 (100.0)
ACE-i /ARB	4888 (76.8)	182 (55.5)	728 (68.3)	1247 (75.0)	1319 (81.4)	864 (83.2)	365 (86.3)	141 (78.8)	38 (80.9)	4 (100.0)
MRA	750 (11.8)	22 (6.7)	76 (7.1)	157 (9.4)	201 (12.4)	160 (15.4)	77 (18.2)	40 (22.3)	14 (29.8)	3 (75.0)
CCB	1774 (27.9)	17 (5.2)	185 (17.4)	446 (26.8)	546 (33.7)	354 (34.1)	140 (33.1)	68 (38.0)	18 (38.3)	0 (0.0)
Diuretics	3091 (48.5)	72 (22.0)	364 (34.1)	721 (43.4)	847 (52.3)	640 (61.7)	287 (67.8)	119 (66.5)	38 (80.9)	3 (75.0)
Digoxin	135 (2.1)	3 (0.9)	13 (1.2)	39 (2.3)	37 (2.3)	26 (2.5)	9 (2.1)	7 (3.9)	1 (2.1)	0 (0.0)
Sotalol	712 (11.2)	51 (15.5)	150 (14.1)	179 (10.8)	185 (11.4)	94 (9.1)	32 (7.6)	18 (10.1)	3 (6.4)	0 (0.0)
Amiodarone	763 (12.0)	42 (12.8)	137 (12.9)	197 (11.9)	193 (11.9)	119 (11.5)	47 (11.1)	24 (13.4)	3 (6.4)	1 (25.0)
Antidiabetics	1222 (19.2)	4 (1.2)	56 (5.3)	220 (13.2)	419 (25.8)	307 (29.6)	130 (30.7)	70 (39.1)	15 (31.9)	1 (25.5)

ACE-i: Angiotensin converting-enzyme inhibitor; ARB: Angiotensin receptor blocker; CCB: Calcium channel blocker; DAPT: Dual antiplatelete therapy; MRA: Mineralocorticoid receptorantagonist

Table S5. The number of ischemic strokes at one-year according to sex and CHA_2DS_2-VASc score.

CHA2DS2-VASc score	Total no. of ischemic strokes	Male		Female	
		No. of patients (%)	No. of ischemic strokes	No. of patients (%)	No. of ischemic strokes
1 (n=328)	1	328 (100.0)	1	0 (0.0)	0
2 (n=1066)	7	1041 (97.7)	7	25 (2.3)	0
3 (n=1662)	22	1534 (92.3)	18	128 (7.7)	4
4 (n=1621)	33	1310 (80.8)	27	311 (19.2)	6
5 (n=1038)	39	616 (59.3)	29	422 (40.7)	10
6 (n=423)	24	240 (56.7)	14	183 (43.3)	10
7 (n=179)	16	89 (49.7)	9	90 (50.3)	7
8-9 (n=51)	5	12 (23.5)	1	39 (76.5)	4

Table S6. Number of events and event rates within one year per 100 patient-years with exact 95% Poisson confidence intervals (CI) by CHA_2DS_2-VASc score at discharge among 5875 patients with new-onset post-operative atrial fibrillation after isolated first-time coronary bypass surgery with at least one year follow-up and without oral anticoagulation

		Ischemic stroke	
CHA_2DS_2-VASc	**n (%)**	**No. of Events (n=124)**	**Event rate/100 patient-years (95% CI)**
1	314 (5.3)	1	0.3 (0.0-2.3)
2	1007 (17.1)	7	0.7 (0.3-1.5)
3	1531 (26.1)	18	1.2 (0.7-1.9)
4	1492 (25.4)	30	2.0 (1.4-2.9)
5	953 (16.2)	33	3.5 (2.5-4.9)
6	380 (6.5)	20	5.3 (3.4-8.2)
7	152 (2.6)	12	7.9 (4.5-13.9)
8-9	46 (0.8)	3	6.5 (2.1-20.2)

Table S7. Logistic regression sensitivity and specificity for the prediction of the one-year risk for ischemic stroke and any thromboembolism by CHA_2DS_2-VASc score.

	Ischemic stroke		Any thromboembolism	
CHA_2DS_2-VASc	**Sensitivity**	**Specificity**	**Sensitivity**	**Specificity**
1	0	1	0	1
2	0.07	0.98	0.06	0.98
3	0.09	0.97	0.09	0.97
4	0.24	0.91	0.22	0.92
5	0.48	0.76	0.44	0.76
6	0.73	0.50	0.68	0.51
7	0.91	0.24	0.88	0.24
8-9	0.99	0.06	0.98	0.06

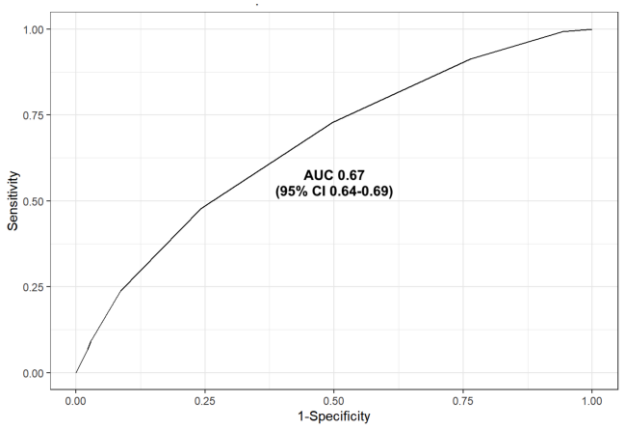
Table S8. Number of events and event rates for ischemic stroke within one year per 100 patient-years with exact 95% Poisson confidence intervals (CI) by CHA_2DS_2-VASc score at discharge among all patients (n= 8232) with new-onset post-operative atrial fibrillation (POAF).

CHA_2DS_2-VASc	n (%)	Events (n= 209)	Event rate/100 patient-years (95% CI)
1	392 (4.8)	2	0.5 (0.1-2.0)
2	1310 (15.9)	9	0.7 (0.4-1.3)
3	2165 (26.3)	27	1.2 (0.9-1.8)
4	2132 (25.9)	44	2.1 (1.5-2.8)
5	1331 (16.2)	55	4.1 (3.2-5.4)
6	588 (7.1)	43	7.3 (5.4-9.9)
7	244 (3.0)	22	9.0 (5.9-13.7)
8-9	70 (0.9)	7	10.0 (4.8-21.0)

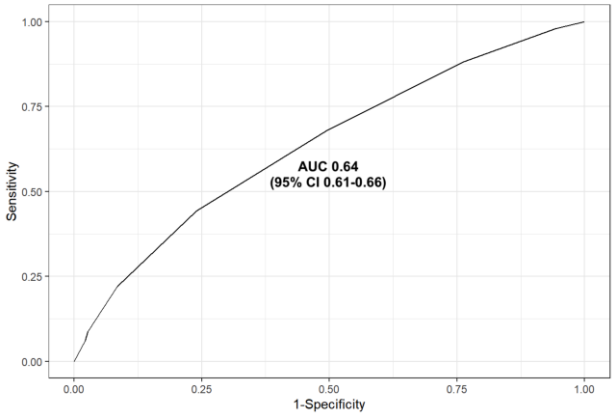
Table S9. Number of events and event rates for ischemic stroke within one year per 100 patient-years with exact 95% Poisson confidence intervals (CI) by CHA_2DS_2-VASc score at discharge among 1864 patients with new-onset post-operative atrial fibrillation (POAF) discharged on oral anticoagulants (OAC).

CHA_2DS_2-VASc	n (%)	Events (n= 51)	Event rate/100 patient-years (95% CI)
1	64 (3.4)	0	0 (0.0-5.6)
2	244 (13.1)	1	0.4 (0.1-2.9)
3	503 (27.0)	3	0.6 (0.2-1.8)
4	511 (27.4)	10	2.0 (1.1-3.6)
5	293 (15.7)	13	4.4 (2.6-7.6)
6	165 (8.9)	17	10.3 (6.4-16.6)
7	65 (3.5)	5	7.7 (3.2-18.5)
8-9	19 (1.0)	2	10.5 (2.6-42.1)

Figure S1. ROC for CHA_2DS_2-VASc score as a predictor of ischemic stroke and any thromboembolism.

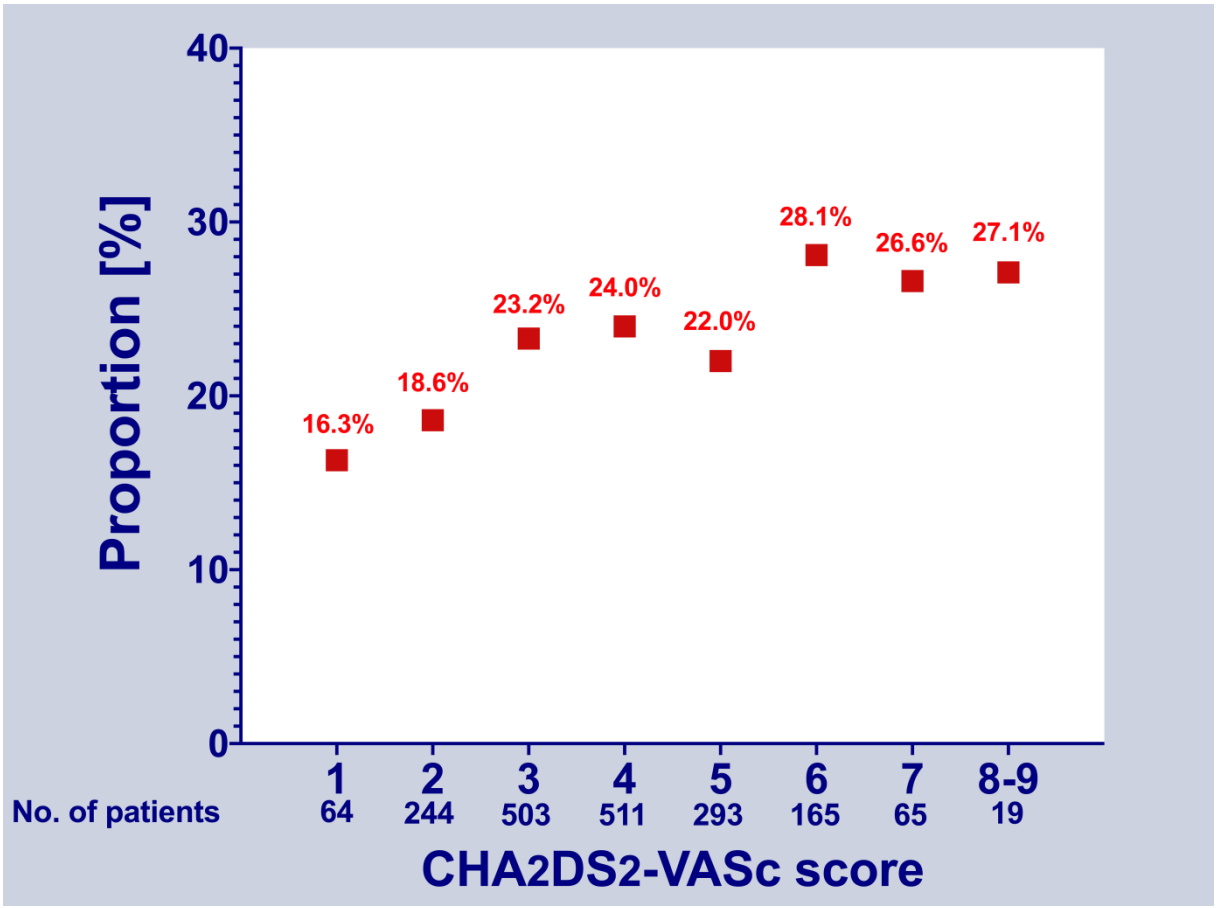


Ischemic stroke



Any thromboembolism

Figure S2. Oral anticoagulants at discharge.



]Proportions of patients with oral anticoagulant prescription at discharge among 8348 patients with new-onset post-operative atrial fibrillation divided by CHA_2DS_2-VASc score.