Predictors for atrial fibrillation detection after cryptogenic stroke
Results from CRYSTAL AF

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ABSTRACT

Objective: We assessed predictors of atrial fibrillation (AF) in cryptogenic stroke (CS) or transient ischemic attack (TIA) patients who received an insertable cardiac monitor (ICM).

Methods: We studied patients with CS/TIA who were randomized to ICM within the CRYSTAL AF study. We assessed whether age, sex, race, body mass index, type and severity of index ischemic event, $CHADS_2$ score, PR interval, and presence of diabetes, hypertension, congestive heart failure, or patent foramen ovale and premature atrial contractions predicted AF development within the initial 12 and 36 months of follow-up using Cox proportional hazards models.

Results: Among 221 patients randomized to ICM (age 61.6 ± 11.4 years, 64% male), AF episodes were detected in 29 patients within 12 months and 42 patients at 36 months. Significant univariate predictors of AF at 12 months included age (hazard ratio [HR] per decade 2.0 [95% confidence interval 1.4–2.8], $p = 0.002$), $CHADS_2$ score (HR 1.9 per one point [1.3–2.8], $p = 0.008$), PR interval (HR 1.3 per 10 milliseconds [1.2–1.4], $p < 0.0001$), premature atrial contractions (HR 3.9 for >123 vs 0 [1.3–12.0], $p = 0.009$ across quartiles), and diabetes (HR 2.3 [1.0–5.2], $p < 0.05$). In multivariate analysis, age (HR per decade 1.9 [1.3–2.8], $p = 0.0009$) and PR interval (HR 1.3 [1.2–1.4], $p < 0.0001$) remained significant and together yielded an area under the receiver operating characteristic curve of 0.78 (0.70–0.85). The same predictors were found at 36 months.

Conclusion: Increasing age and a prolonged PR interval at enrollment were independently associated with an increased AF incidence in CS patients. However, they offered only moderate predictive ability in determining which CS patients had AF detected by the ICM. **Neurology® 2016;86:261–269**

GLOSSARY

AF = atrial fibrillation; **CI** = confidence interval; **CS** = cryptogenic stroke; **EMBRACE** = Event Monitor Belt for Recording Atrial Fibrillation After a Cerebral Ischemic Event; **ICM** = insertable cardiac monitor; **PFO** = patent foramen ovale; **TEE** = transesophageal echocardiography; **TIA** = transient ischemic attack.

The CRYSTAL AF trial showed that the rate of atrial fibrillation (AF) detection among patients with cryptogenic stroke (CS) or transient ischemic attack (TIA) was 30% within 3 years after insertion of an insertable cardiac monitor (ICM).[1]

Numerous genetic, clinical, electrocardiographic, and echocardiographic features have been proposed as risk markers for developing AF.[2–12] Within the Framingham Heart Study, a risk score for development of AF within 10 years was created, which included age, sex, body mass index, systolic blood pressure, treatment for hypertension, PR interval, clinically significant cardiac murmur, and heart failure.[13] Echocardiographic measures did not improve risk prediction substantially.

AF episodes are frequently asymptomatic and intermittent. Most CS/TIA patients monitored by ICM for AF detection have already undergone short-term Holter monitoring or telemetry in addition to cardiac and vascular imaging before device insertion.

Supplemental data at Neurology.org

Identification of predictors of AF may help stratify CS/TIA patients at high and low risk of AF, and may aid in deciding in whom ICM utilization would be most useful. Increasing spending pressure on health care systems mandates careful patient evaluation before applying new technologies to particular patient groups.

We assessed clinical, ECG, and echocardiographic predictors of AF in a cohort of CS/TIA patients randomized to receive an ICM. We also investigated whether risk factors for AF detection were similar within the first 12 months and over a significantly longer follow-up period of 36 months. Our hypothesis was that predictors of AF detected by ICMs in CS/TIA patients may differ from more general populations undergoing traditional arrhythmia monitoring.

METHODS **Standard protocol approvals, registrations, and patient consents.** The trial was conducted in compliance with the Declaration of Helsinki and in accordance with Good Clinical Practice and ISO-14155. The study protocol was approved by all relevant institutional review boards or ethics committees and all patients provided written informed consent before randomization. The trial is registered under CRYSTAL AF (ClinicalTrials.gov NCT00924638).

Study design. CRYSTAL AF was a prospective, parallel, 1:1 randomized trial comparing time to AF detection through continuous monitoring with an ICM vs conventional follow-up monitoring in CS or TIA patients. Patients were enrolled at 55 centers in Europe, Canada, and the United States between June 2009 and April 2012. The study design and main results have been published previously.[1,14] The study included patients 40 years of age or older, with a CS/TIA (index event) within 90 days of study enrollment. The index event was considered cryptogenic after 12-lead ECG, 24-hour ECG monitoring (Holter or telemetry), transesophageal echocardiography (TEE), screening for thrombophilic states (in patients younger than 55 years), and detailed vascular imaging were performed and no other etiology was found. Patients were considered ineligible in the presence of a documented history of AF or atrial flutter, a permanent indication or contraindication for anticoagulation at enrollment, and an indication for implantation of a pacemaker, implantable cardioverter defibrillator, or cardiac resynchronization therapy device. The presence of patent foramen ovale (PFO) with or without atrial septum aneurysm was not an exclusion criterion per se, unless considered an indication for permanent anticoagulation at enrollment by the treating physician.

Patients randomized to the intervention arm were scheduled to receive an ICM suitable for the detection of AF (Reveal XT; Medtronic, Minneapolis, MN) within 10 days after randomization. The ICM automatically detects and records episodes of AF using an analysis window of 2 minutes with a high diagnostic accuracy, irrespective of heart rate or symptoms.[15]

Patients received scheduled follow-up visits at 1 month, 6 months, 12 months, and every 6 months thereafter until study closure, when the last randomized patient had been followed for 12 months. For each patient, the first detected AF episode (defined as ≥30 seconds) was adjudicated by an independent committee to confirm its diagnosis. The reporting of this study conforms to the STROBE statement.[16]

Statistical analysis. Baseline characteristics, stroke/TIA parameters, medication use including antiarrhythmic medication, and ECG and echocardiogram indices were collected during the initial evaluation of the patients by the local investigator. From the patient characteristics and stroke parameters collected, age, sex, race, body mass index, type and severity of index event (TIA or ischemic stroke), $CHADS_2$ score, and presence of diabetes, hypertension, and congestive heart failure were selected for evaluation as potential risk factors. PR interval measured on the baseline ECG, PFO presence, left atrial diameter (with and without indexing by body surface area calculated with the Mosteller formula)[17] based on the TEE, and NIH Stroke Scale score were also selected for evaluation.

All patients underwent either Holter monitoring or telemetry at the time of enrollment in the study. The duration of Holter/telemetry monitoring and the number of premature atrial contractions observed during monitoring were also evaluated.

Cox regression models were used to assess potential predictors of the rate of AF detection by the ICM during follow-up. To be considered for inclusion in a multivariable risk model, baseline variables were required to be recorded in ≥90% of patients and found to be significant ($p < 0.05$) in a univariate Cox regression model. Model discrimination was estimated by Uno c-statistic, which for time-to-event data is analogous to the area under the receiver operator characteristic curve.[18] Calibration was assessed by graphing the predicted and observed AF detection rates within 6 subgroups partitioned by ranking patients' Cox model AF detection rate predictions. The mean, minimum, and maximum Cox model linear predictor and Kaplan-Meier estimate at the end of the detection period are displayed for each subgroup. The agreement between the observed and expected number of events based on the multivariable Cox model was further assessed using the Parzen and Lipsitz test.[19] Six groups were used according to Parzen and Lipsitz's recommendation to use one fifth as many groups as there are events. All analyses were done with SAS software (version 9.2).

RESULTS During the study, 447 patients were enrolled and 441 randomized to the ICM arm (n = 221) or to the control arm (n = 220). Predictors for AF were assessed in the ICM arm only (figure e-1 on the *Neurology*® Web site at Neurology.org). Table 1 presents a summary of baseline characteristics indicating those assessed as potential predictors. The mean age was 61 years and 36% were female. AF was detected in 42 ICM patients during a total follow-up of 407.4 patient-years (mean follow-up 20.3 ± 9.4 months). Episodes of AF were detected in 29 patients within the initial 12 months following randomization, and an additional 13 patients developed AF between 12 and 36 months.

Table 2 shows the relative rate (hazard ratio) of AF detection at 12 and 36 months for each potential predictor. The rate of AF detection was higher in patients who were older, had diabetes, had longer PR intervals, and had a greater number of

Table 1	Baseline characteristics (ICM arm)
Patient characteristics	ICM (n = 221)
Age, y	61.6 ± 11.4
Sex	
Male	142 (64.3)
Female	79 (35.7)
BMI, kg/m²ᵃ	28.1 ± 5.4
Race	
Not available	15 (6.8)
Asian	3 (1.4)
Black or African American	7 (3.2)
Hispanic or Latino	2 (0.9)
White or Caucasian	194 (87.8)
Region	
North America	83 (37.6)
Europe	138 (62.4)
Patent foramen ovale	52 (23.5)
Index event	
Stroke	200 (90.5)
TIA	21 (9.5)
Prior stroke/TIA	
Prior stroke	37 (16.7)
Prior TIA	22 (10.0)
Modified Rankin Scaleᵇ	
0-2	184 (83.3)
>2	36 (16.3)
NIH Stroke Score	1.6 ± 2.7
Congestive heart failure	7 (3.2)
Hypertension	144 (65.2)
Diabetes	34 (15.4)
CHADS₂ Score	
2	69 (31.2)
3	92 (41.6)
4	50 (22.6)
5	9 (4.1)
6	1 (0.5)
Hypercholesterolemia	125 (56.6)
Smoking (current)	43 (19.5)
Coronary artery disease	16 (7.2)
Antiplatelet use	212 (95.9)
PR intervalᶜ	170.7 ± 36.6
PR interval prolonging medication	90 (40.7)
Holter/telemetry monitoring, h	41.3 ± 58.3
PAC count (max in 24 h)	219.7 ± 767.6
Left atrial diameter, mm	39.0 ± 7.0
Left atrial diameter index, mm/m²	19.7 ± 3.8

Abbreviations: BMI = body mass index; ICM = insertable cardiac monitor; TIA = transient ischemic attack.
Data are mean ± SD or n (%).
ᵃ BMI not reported for 1 patient.
ᵇ Modified Rankin Scale not reported for 1 patient.
ᶜ PR interval not reported for 3 patients.

premature atrial contractions on the screening Holter or telemetry test. Higher CHADS₂ scores were also associated with an increased incidence of AF detection.

In the multivariable model, older age and a longer PR interval at enrollment were associated with an increased likelihood of detecting AF within 12 months. Diabetes, CHADS₂ scores (excluding age), and premature atrial contractions were no longer significant in the model that included age and PR interval. An interaction test found a significant interaction ($p = 0.009$) between baseline use of PR interval prolonging medications (digoxin, β-blockers, calcium antagonists, Class I–III antiarrhythmic drugs) and PR interval on the likelihood of AF detection. The interaction accounts for prolonged PR intervals raising the likelihood of AF detection more in patients who are not taking these medications than in patients on at least one of these medications at baseline. The same characteristics that were significant at 12 months were also found in the multivariate model at 36 months.

These multivariable Cox regression models (table 3) were used to predict the probability of detecting AF (figure 1). The Uno c-statistic for the multivariate model was 0.778 at 12 months (95% confidence interval [CI] 0.701–0.854) and 0.656 at 36 months (95% CI 0.524–0.788). The models display moderate ability to discriminate between patients more and less likely to have AF detected by an ICM.

The calibration of the AF detection rate predictions is shown across 6 equal-sized patient subgroups with an increasing predicted AF detection probability (figure 2). The calibration was found to be adequate based on the Parzen and Lipsitz test, with no statistically significant difference found between the observed and predicted rates of AF detection across the 6 subgroups at 12 months ($p = 0.28$) or at 36 months ($p = 0.15$). To aid interpretation, the agreement between predicted and observed AF detection rates is also shown for several age and PR interval ranges (table e-1). This agreement is marginally better at 12 months than at 36 months.

DISCUSSION In this study of CS/TIA patients who underwent continuous monitoring using an ICM after a rigorous diagnostic evaluation, only age and a prolonged PR interval at enrollment were associated

	12 mo		36 mo	
Variable	**HR (95% CI)**	**p Value**	**HR (95% CI)**	**p Value**
Age				
Per 10 y	1.96 (1.38–2.77)	0.0002	1.79 (1.34–2.39)	<0.0001
First quartile (<54 y)	1.00 (reference)	0.0072	1.00 (reference)	0.0012
Second quartile (54–61 y)	1.85 (0.31–11.09)		1.18 (0.29–4.71)	
Third quartile (62–70 y)	6.31 (1.40–28.46)		4.90 (1.65–14.58)	
Fourth quartile (>70 y)	8.52 (1.92–37.77)		5.40 (1.82–16.07)	
Sex (male vs female)	1.19 (0.54–2.61)	0.67	1.04 (0.55–1.98)	0.90
Race				
White	0.65 (0.15–2.77)	0.27	0.95 (0.23–3.97)	0.37
All other races	1.00 (reference)		1.00 (reference)	
Not provided	1.52 (0.28–8.29)		1.88 (0.36–9.72)	
BMI (per kg/m²)	0.99 (0.92–1.06)	0.77	1.02 (0.96–1.07)	0.58
PFO status (PFO vs no PFO)	1.42 (0.65–3.13)	0.38	1.20 (0.61–2.34)	0.60
Index event (stroke vs TIA)	0.63 (0.22–1.80)	0.39	0.77 (0.30–1.97)	0.59
Rankin (>2 vs 0–2)	0.38 (0.09–1.59)	0.18	0.77 (0.30–1.98)	0.59
Congestive heart failure (yes vs no)	1.05 (0.14–7.74)	0.96	0.70 (0.10–5.06)	0.72
Hypertension (yes vs no)	2.22 (0.90–5.44)	0.08	1.61 (0.81–3.20)	0.18
Diabetes mellitus (yes vs no)	2.28 (1.01–5.16)	0.05	2.53 (1.29–4.94)	0.0068
CHADS$_2$				
2	1.00 (reference)	0.02	1.00 (reference)	0.0077
3	1.93 (0.61–6.16)		1.45 (0.61–3.41)	
4	4.79 (1.55–14.87)		3.00 (1.26–7.18)	
5	7.93 (1.77–35.48)		6.10 (1.99–18.69)	
6	No estimate		No estimate	
PR interval (per 10 milliseconds) (n = 218)	1.29 (1.17–1.41)	<0.0001	1.23 (1.13–1.33)	<0.0001
Duration of Holter/telemetry monitoring, h				
First quartile (≤22)	1.00 (reference)	0.83	1.00 (reference)	0.92
Second quartile (>22–24)	1.54 (0.60–3.97)		1.05 (0.51–2.14)	
Third quartile (>24–39)	1.03 (0.12–8.56)		0.53 (0.07–4.04)	
Fourth quartile (>39)	1.36 (0.46–4.06)		0.94 (0.39–2.23)	
PAC (max in 24 h) (n = 192)				
First quartile (0)	1.00 (reference)	0.0094	1.00 (reference)	0.0029
Second quartile (>0–15.5)	0.57 (0.10–3.09)		0.39 (0.08–1.95)	
Third quartile (>15.5–123.0)	1.61 (0.45–5.71)		1.76 (0.64–4.86)	
Fourth quartile (>123.0)	3.94 (1.30–11.97)		3.47 (1.38–8.70)	
Left atrial diameter (n = 115)				
First quartile (≤3.45 cm)	1.00 (reference)	0.75	1.00 (reference)	0.44
Second quartile (>3.45–3.90 cm)	0.94 (0.19–4.66)		2.10 (0.54–8.13)	
Third quartile (>3.90–4.40 cm)	1.65 (0.41–6.61)		2.89 (0.81–10.39)	
Fourth quartile (>4.40 cm)	1.79 (0.40–7.99)		2.41 (0.58–10.10)	
Left atrial index (n = 115)				
First quartile (≤1.73 cm/m²)	1.00 (reference)	0.52	1.00 (reference)	0.53
Second quartile (>1.73–1.96 cm/m²)	1.06 (0.21–5.24)		0.65 (0.18–2.32)	

Table 2   Univariate Cox model results for atrial fibrillation detected by 12 or 36 months

Continued

Table 2 Continued

Variable	12 mo		36 mo	
	HR (95% CI)	p Value	HR (95% CI)	p Value
Third quartile (>1.96–2.18 cm/m²)	2.18 (0.56–8.43)		1.53 (0.55–4.21)	
Fourth quartile (>2.18 cm/m²)	1.02 (0.21–5.06)		1.05 (0.34–3.25)	
NIH Stroke Scale score (per point)	0.90 (0.73–1.10)	0.29	0.98 (0.86–1.11)	0.71

Abbreviations: BMI = body mass index; CI = confidence interval; HR = hazard ratio; PFO = patent foramen ovale.

with a higher likelihood of AF detection during follow-up.

The age dependence in our study is in accordance with previous studies demonstrating the close correlation between AF incidence and increasing age.[20,21] In the Event Monitor Belt for Recording Atrial Fibrillation After a Cerebral Ischemic Event (EMBRACE) study, also analyzing CS/TIA patients, age and the number of atrial extrasystoles on Holter were significant predictors of AF as well.[20,22] Patients in EMBRACE were significantly older (73 vs 61 years), and this potentially explains the higher AF detection rate in that study. Prolonged PR interval has been found in several epidemiologic studies to be an early marker of AF.[21,23,24] In the Framingham Heart Study, each 20-millisecond increase in PR interval was associated with a 20% increase in the risk of developing subsequent AF. In CRYSTAL AF, every 10-millisecond increase led to a relative PR interval increase of approximately 30%, averaging across patients on and off PR interval prolonging medications. The Framingham Heart Study investigated a primary prevention population and did not use an ICM to detect AF.[23] In the Atherosclerosis Risk in Communities study, the risk of developing AF was 5-fold with prolonged PR intervals in the upper 95th percentile compared to the lowest fifth percentile, after adjusting for other risk factors.

Intrinsic PR prolongation has been consistently demonstrated to be associated with AF as it represents intrinsic atrial conduction disease; the same is not true for medication-induced PR interval prolongation and in fact drugs that have some activity in preventing AF such as β-blockers also prolong the PR interval.

Additional predictors of paroxysmal AF in patients with cryptogenic stroke may include the NIH Stroke Scale score,[25] radiologic evidence of new cortical or cerebellar infarcts,[26] and cardiac biomarkers such as B-type natriuretic peptide,[27,28] highly sensitive cardiac troponin T,[29] and others.[30] However, in the CRYSTAL AF trial, we did not observe any correlation between infarction pattern and AF detection[31] and biomarker data were not collected.

Despite the strong associations we observed, a multivariate model based on age and PR interval had only moderate predictive capacity in our study. Other studies have attempted to predict the development of AF in primary care or after CS. A predictive model (Framingham AF risk score) proposed for use in primary care that incorporated age, PR interval, sex, heart failure, body mass index, and heart murmur also had a moderate discriminatory capacity.[13] A risk score that was initially introduced to identify AF in stroke patients based on clinical, radiologic, and echocardiographic features had low sensitivity and specificity when applied to patients with stroke of undetermined etiology.[32,33]

From these studies, it is apparent that individual prediction of AF development, despite the high prevalence of AF, remains elusive. These results demonstrate that large population trends are often difficult to apply on a patient level. Therefore, although it may be desirable to identify subgroups of CS patients in whom use of an ICM is most cost-effective, further research will

Table 3 Multivariable Cox model results for atrial fibrillation detected by 12 or 36 months

Variable	12 mo		36 mo	
	HR (95% CI)	p Value	HR (95% CI)	p Value
Age (per 10 y)	1.91 (1.31–2.80)	0.0009	1.84 (1.33–2.52)	0.0002
PR interval (per 10 milliseconds)				
On PR interval prolonging medication	1.17 (1.02–1.35)	0.02	1.15 (1.01–1.30)	0.03
Off PR interval prolonging medication	1.58 (1.32–1.90)	<0.0001	1.41 (1.21–1.64)	<0.0001
PR interval prolonging medication at PR interval of 170 milliseconds	1.95 (0.72–5.30)	0.19	1.03 (0.48–2.19)	0.94

Abbreviations: CI = confidence interval; HR = hazard ratio.

Figure 1   Model predictions of atrial fibrillation (AF) detection rate
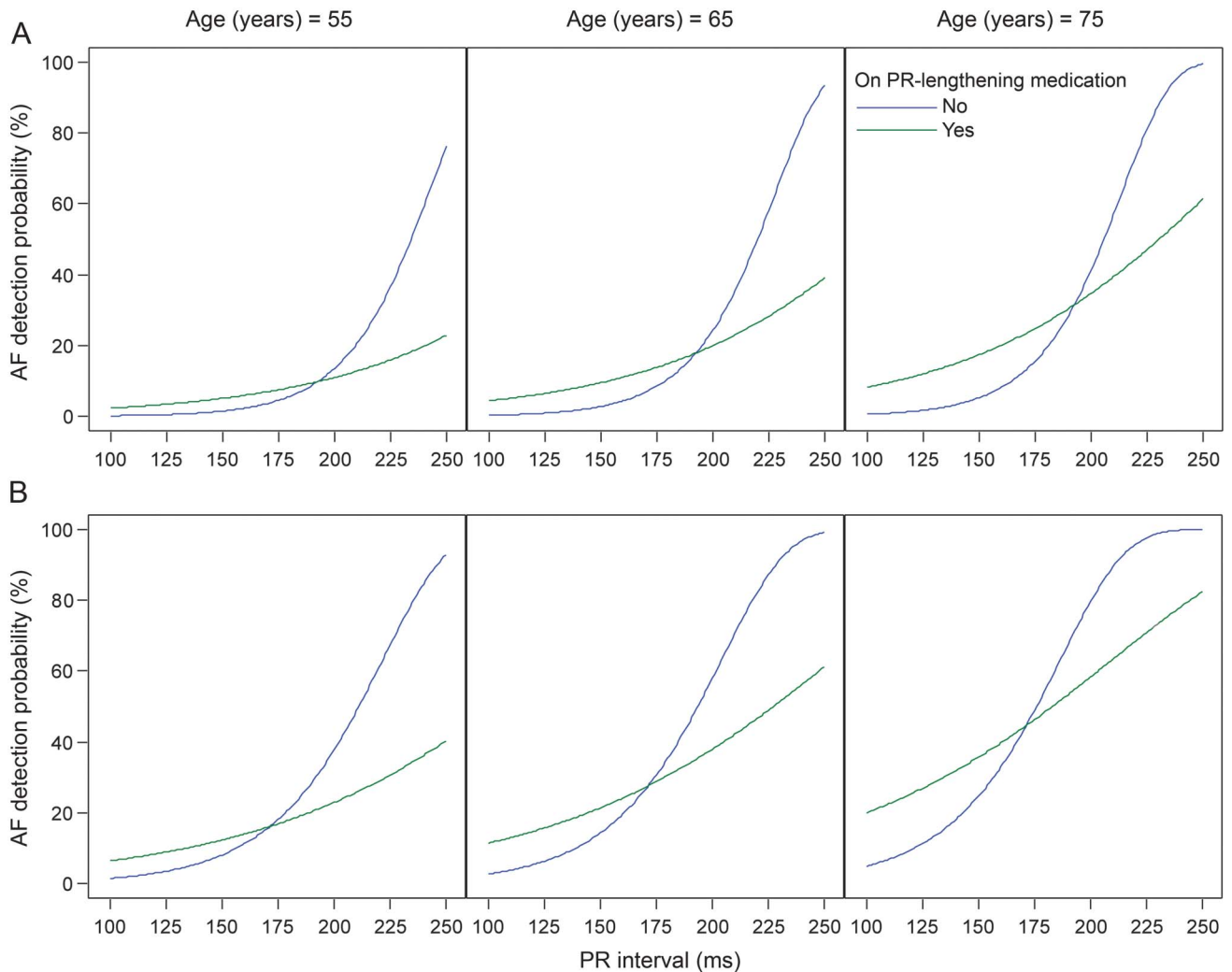
Model predictions of AF detection within 12 months (A) and 36 months (B) of insertable cardiac monitor monitoring by age, PR interval, and use of medications that can prolong the PR interval.

be required. A forthcoming article based on the CRYSTAL AF data will analyze the cost-effectiveness of this diagnostic from a QALY perspective.

An association exists between CS and the presence of a PFO, especially in younger patients.[34,35] Paradoxical embolization or embolization from an associated interatrial septal aneurysm have been proposed as the main etiologic mechanisms. One electrophysiologic study found increased atrial vulnerability in young stroke patients with atrial septal abnormalities.[36] In our study, AF developed as frequently in patients with a PFO as without. Attribution of a CS to a PFO, without prolonged monitoring with an ICM to rule out intermittent AF, especially in patients older than 55 years, may be unreliable.

This study has a number of limitations. Our sample size was moderate and despite the high frequency of AF development, only 42 patients had AF detected over the course of the study. The ICM reliably detects episodes lasting 2 minutes in duration or longer. Because the primary endpoint of CRYSTAL AF was the detection of AF episodes ≥30 seconds in duration, it is possible that some AF episodes between 30 seconds and 2 minutes in duration may have been missed in the ICM arm. Not all risk factors for AF could be analyzed because they were not collected systematically or in a standardized fashion in CRYSTAL AF. These include echocardiographic features such as left atrial volume or the presence of spontaneous echo contrast on TEE. It is controversial whether these factors have additional predictive value beyond traditional clinical risk factors.[13] Electrocardiographic features such as P-wave characteristics (force, duration, and amplitude) that have been associated with AF were not analyzed systematically.[4,8,37,38] We also did not collect information on clinical factors including heavy alcohol use, exercise, sleep apnea, or other biological

Figure 2   Observed vs predicted atrial fibrillation (AF) detection rate
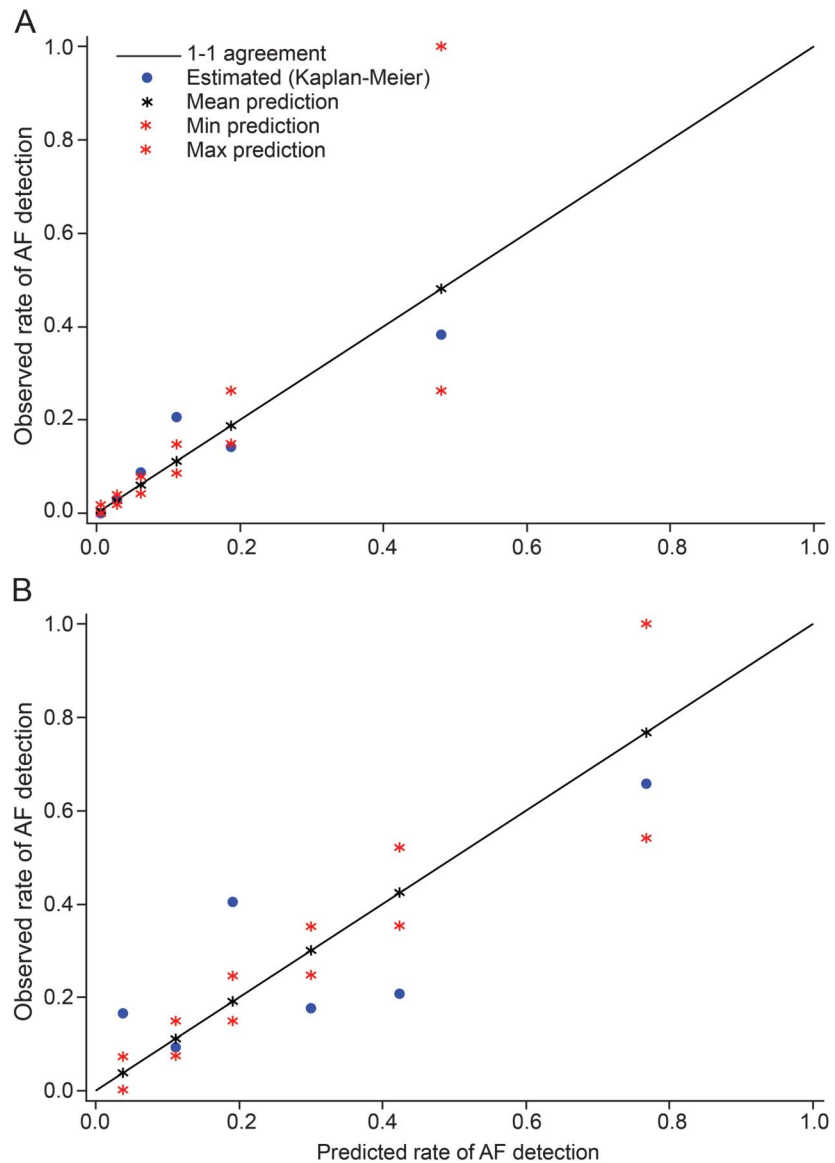
Predicted vs observed AF detection rates are shown for 6 subgroups (sextiles) of insertable cardiac monitor arm patients based on Cox model prediction of AF detection rates. The predicted AF detection rate at the end of the follow-up period based on the mean Cox linear predictor for each subgroup is plotted (x-axis) against the observed rate determined by the Kaplan-Meier estimate (y-axis). The predicted rate for the minimum and maximum Cox linear predictor among patients in the subgroup are also plotted to describe the range of predictions within the subgroup. The predicted vs observed calibration curves are shown for AF detection with 12 months (A) and within 36 months (B).

markers such as thyroid function that associate with AF.[11] The presence of vascular disease at baseline was not collected, and hence we were not able to use the CHA_2DS_2-VASc scoring system. In addition, we did not collect N-terminal of the prohormone brain natriuretic peptide values, despite being a robust predictor of AF. Finally, given that 88% of the patients in our cohort were Caucasian, the generalizability of this study's findings may be limited. Further studies will determine whether addition of these clinical, laboratory, echocardiographic, and electrocardiographic features can enhance prognostication for individual patients.

Older age and a longer PR interval at enrollment were independently associated with an increased risk of detecting AF in CS or TIA patients. However, these variables offered only moderate predictive ability in determining which CS or TIA patients had AF detected by ICM in the CRYSTAL AF study. Further research will be required to identify subgroups of CS or TIA patients who would benefit most from ICM insertion.

AUTHOR CONTRIBUTIONS

Vincent Thjis (principal and corresponding author): drafting/revising the manuscript for content, including medical writing for content, study concept and design, analysis and interpretation of data. Johannes Brachmann: study concept and design, revising the manuscript for

content. Carlos A. Morillo: study concept and design, revising the manuscript for content. Rod S. Passman: study concept and design, revising the manuscript for content. Tommaso Sanna: study concept and design, revising the manuscript for content. Richard A. Bernstein: study concept and design, revising the manuscript for content. Hans-Christoph Diener: study concept and design, revising the manuscript for content. Vincenzo Di Lazzaro: study concept and design, revising the manuscript for content. Marilyn M. Rymer: study concept and design, revising the manuscript for content. Laurence Hogge: study coordination, revising the manuscript for content. Tyson Rogers: drafting/revising the manuscript for content, statistical analysis, and interpretation of data. Paul D. Ziegler: data interpretation and drafting/revising the manuscript for content. Manish D. Assar: study concept and design, revising the manuscript for content.

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This Week's *Neurology*® Podcast

Predictors for atrial fibrillation detection after cryptogenic stroke: Results from CRYSTAL AF (see p. 261)

This podcast begins and closes with Dr. Robert Gross, Editor-in-Chief, briefly discussing highlighted articles from the January 19, 2016, issue of *Neurology*. In the second segment, Dr. Bryan Eckerle talks with Dr. Vincent Thijs about his paper on predictors for atrial fibrillation detection after cryptogenic stroke. Dr. Adam Numis reads the e-Pearl of the week about the treatment of pediatric-onset neuromyelitis optica. In the next part of the podcast, Dr. Prachi Mehndiratta focuses her interview with Dr. Lee H. Schwamm on implications for stroke systems of care in endovascular stroke therapy.

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