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Prevalence Of Validated Risk Factors For Developing Atrial Fibrillation - Can We Identify High Risk ED Patients?

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Abstract

Objective—Investigate whether emergency department (ED) patients who were newly diagnosed with atrial fibrillation (AF) displayed risk factors for incident AF on prior ED visits.

Methods—This was a secondary analysis of a retrospective cohort study of ED patients with symptomatic AF at a tertiary referral center. We selected patients who were newly diagnosed with AF between 7/1/05 and 8/31/08 and had at least one ED visit prior to their diagnosis. We calculated the Framingham Heart Study AF risk score for each visit by documenting the presence of the risk factors (age, sex, body-mass index, systolic blood pressure, hypertension treatment, PR interval, and ages of clinically significant cardiac murmur and heart failure diagnosis).

Results—Of the 296 patients newly diagnosed with AF, 115 (39%) had at least one prior ED visit resulting in 454 ED visits for analysis. The median time from first to last visit was 4 years (IQR 2.1, 5.9). The median age was 66 (IQR: 49 to 79). Home medications included antihypertensives in 81% of visits and 60% of visits with available electrocardiograms had a PR interval 160 msec. Heart failure history was reported in 23% of visits. The median AF risk score was 8 (IQR 4, 10) corresponding to a 16% 10-year predicted risk.

Conclusions—Nearly 40% of patients diagnosed with new AF had previous ED visits and displayed validated risk factors for incident AF. The ED provides an opportunity to identify and educate these patients, as well as refer them for primary prevention interventions.

Keywords

atrial fibrillation; primary prevention; forecasting

INTRODUCTION

Atrial fibrillation (AF), the most common sustained cardiac arrhythmia, affects over 2.3 million individuals in the United States and accounts for nearly 1% of all emergency department (ED) visits. [1,2] The prevalence of AF is expected to more than double by 2050. [1] AF is often first diagnosed in the ED when patients present with relevant

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complaints, and receive an electrocardiogram (ECG) or pulse measurements. [2] AF increases the risk for heart failure and stroke, complications that are commonly treated in the ED. [3] Previous investigations have reported that one of every 6 strokes occurs in a patient with AF. [4] AF increases annual health care costs to about 5 times that of patients without AF, with total healthcare expenditures estimated to cost between \$6 and 26 billion. [5]

The National Heart, Lung, and Blood Institute, in response to the increasing burden of AF, convened an expert panel that recommended further studies to improve the understanding of the epidemiology, detection, and prevention of AF. [3] The Framingham Heart Study cohort, based on these recommendations, developed and validated a risk score for predicting AF incidence. [6,7] Essential hypertension, heart failure, heart valve dysfunction, diabetes, obesity and PR-interval prolongation are risk factors associated with developing AF. [6,7]. We evaluated this score in ED patients with newly diagnosed AF and found that these risk factors are commonly present at the time of diagnosis. [8] Many of these factors are regularly assessed in the ED and could be evaluated quickly without interfering with physicians' time.

This study's objective was to investigate whether a cohort of patients who were initially diagnosed with AF in our ED displayed validated AF risk factors on ED visits prior to their diagnosis. We hypothesized that patients with multiple risk factors for AF might frequent the ED providing a unique opportunity for identifying and educating high-risk individuals. Modifying these factors and initiating appropriate medical therapy might potentially delay or prevent the onset of AF. [3]

MATERIALS AND METHODS

Study Design

This was a secondary analysis of a retrospective, observational cohort study. We performed a systematic chart review of the electronic medical records (EMR) of patients newly diagnosed with AF in the ED. Our medical center's institutional review board approved the study.

Study setting and population

This study took place at an urban, university-affiliated, adult ED with an annual volume of 55,000 patients. Detailed methodology of the original study has been previously reported. [8] Briefly, adult patients with a primary or supporting International Classification of Disease, Ninth Edition ED diagnosis of AF between August 1, 2005 and July 31, 2008 were eligible for inclusion in the original cohort. Inclusion criteria required documented evidence of AF or atrial flutter on an electrocardiographic (ECG) or rhythm strip. We excluded patients whose ED visits were for complaints unrelated to their AF diagnosis and those with a prior history of AF. Only patients who were newly diagnosed with AF at their ED visit were considered for this investigation. To be eligible for inclusion, patients also had to have EMR evidence of at least one ED visit to our institution prior to their AF diagnosis. Our EMR system includes ED visit documentation beginning in August 2003 providing a 2–5 year time interval for recorded ED visits prior to the patient's AF diagnosis.

Study protocol

We identified eligible patients and systematically reviewed their EMR for corresponding data. Two abstractors trained on a set of 10 records prior to data collection. One investigator extensively reviewed all patients' EMR adhering to strict chart review methodology guidelines. [9] A second investigator randomly selected and reviewed 15% of records to ensure interrater reliability. For each ED visit, we recorded information on patient past and

current medical history, home medications, physical exam findings, and diagnostic test results. We abstracted data from both ED and inpatient records. We specifically documented the presence or absence of each of the Framingham risk score's variables for each visit. The Framingham Heart Study risk score includes the following variables: age, sex, BMI, SBP, treatment for hypertension, PR interval, age of clinically significant cardiac murmur diagnosis, and age of heart failure diagnosis. [6] Due to the retrospective nature of the study, some changes from the original Framingham Heart Study were necessary. Rather than age at enrollment as in the Framingham Heart Study, we used the patient's age at the time of each visit. The information for body mass index (BMI), systolic blood pressure (SBP), and current treatment for hypertension were also obtained from the time of each visit. [Should you mention something here about how PR interval is modified from Framingham?] We entered data into an electronic spreadsheet (Microsoft Excel 2008, Redmond, WA).

Data Analysis

All analyses were done using the statistical programming language R (R Development Core Team. 2009, version 2.8.1. Vienna, Austria) As subjects have multiple visits, the visit profiles were characterized by the number of visits per person, the length of time between the first and the last (when AF diagnosis made) visit, and the length of time between visits. Continuous measures were summarized using medians and interquartile ranges (IQR); categorical variables were summarized with frequencies and percents. We calculated the AF risk score for each subject at each individual ED visit, and the distribution of risk scores in the sample were reported as median (IQR). Missing values for risk factors that comprised the risk score were assigned a value of 0.

RESULTS

In the original cohort, there were 834 patients treated for AF-related complaints during the 5-year study period. Of the 834, AF was newly diagnosed in 296 patients (35.4%) with 117 (40%) having documented prior ED visits in our EMR. We excluded 2 additional patients after detailed EMR review revealed a prior diagnosis of AF. The 115 patients who comprised this investigation's cohort accounted for 569 ED visits between August 1, 2003 and July 31, 2008. This includes the 115 ED visits at which the patients were newly diagnosed with AF and 454 visits prior to their diagnosis. Women accounted for nearly half of the ED visits. The median number of ED visits per patient was 3 (IQR: 2, 5) with the minimum and maximum number of ED visits per patient of 2 and 23, respectively. The median time interval was 4 years (IQR: 2.1, 5.9) from a patient's first reported ED visit to the visit when AF was diagnosed. The median time interval between ED visits within each subject was 221 days (IQR: 95.6, 484.8). Table 1 reports the baseline characteristics for the 454 ED visits prior to AF diagnosis.

Table 2 presents the frequency of the Framingham Heart Study AF risk factors present at ED visits prior to diagnosis. Home medication regimens included antihypertensives in 81% of ED visits. Electrocardiograms were performed at 268 of the 454 (59%) ED visits prior to the patients' AF diagnosis. Of these 268 visits, 160 (60%) electrocardiograms had PR intervals 160 msec including 37 (14%) with evidence of a first-degree atrioventricular block (PR>200 msec). When summarized within an individual, the median risk score was 6.2 (IQR 2, 9.1), corresponding to an 8% 10-year predicted risk. Table 3 reports the AF risk scores for each subject at each individual ED visit prior to their AF diagnosis.

LIMITATIONS

We performed a retrospective chart review and, therefore, this study is subject to the limitations that affect all retrospective cohort analyses. Our cohort consisted only of ED

patients with newly diagnosed AF and previous visits to our ED. The inclusion criteria introduced a significant selection bias; however, our objective was only to estimate the frequency of validated risk factors in patients who later developed AF. The retrospective analysis also required that we adjust the definitions for some of the risk factors and assign a zero value for missing data. This very likely might have impacted our estimated Framingham Heart Study risk scores for each visit. Our hospital's EMR only contains ED visit documentation dating back to 2003 thus limiting the number of prior ED visits available for review.

DISCUSSION

The Framingham Heart Study risk score is a validated prediction rule for identifying individuals at risk for developing AF with greatest risk score weighting assigned to the development of heart failure or significant cardiac murmur prior to 54 years of age. [6,7] We have previously reported that these risk factors are present in many ED patients with newly diagnosed AF. [8] Nearly all of the Framingham risk factors are routinely identified during an ED visit including patient age, sex, SBP, home antihypertensive treatment and PR interval (if an ECG is performed). BMI and ages of significant cardiac murmur and heart failure diagnosis might be less reliably documented in the ED record. BMI was only documented in 10% of this study's ED records. In this study, we found that nearly 40% of patients diagnosed with AF in the ED had documented prior visits to the same ED. Furthermore, we identified that these risk factors were evident on prior ED visits and may therefore provide opportunity to identify and educate high-risk patients about their risk for AF, as well as the associated 4–5 fold increase risk of stroke, 3-fold increase in developing heart failure, and the potential need to be on lifelong blood thinners. [3–5] Given the significant complications and healthcare costs, our goal should be to prevent, or at least delay, the onset of AF. In order to prevent AF development, it is necessary to identify patients at risk before diagnosis. Our results show that nearly half of the patients who were subsequently diagnosed with AF in the ED presented at high risk (predicted absolute risks of 12% to >30%) for developing AF. Patients reported home antihypertensive therapy in more than 80% of the ED visits prior to AF diagnosis. ED electrocardiograms showed PR-intervals ≥ 160 msec in 60% of ED visits prior to AF diagnosis. Of these, 14% had a first-degree atrioventricular block, a conduction disturbance that has been shown to double one's risk for developing AF. [10] Our EMR review found that both of these risk factors were often ascertained in the ED and therefore could be used to identify patients at risk for developing AF. ED physicians should consider educating these patients about their increased risk for AF and recommending that they follow-up with their internist or cardiologist to discuss potential prevention strategies.

We acknowledge that it is unlikely that identifying these high risk individuals would have prevented their development of AF given the relatively short time interval from initial ED visit to AF diagnosis. However, aggressive behavior modification and medical treatments potentially might delay the onset of AF in similar high-risk patients. Research into AF primary prevention has shown benefit of renin-angiotensin-aldosterone system inhibitors, statin drugs, dietary supplements and beta-blockers at delaying or preventing incident AF. [11–15] Recent meta-analyses question these treatments' preventive efficacy thus further demonstrating the need for additional high quality clinical trials in at risk populations. [16–17] The effect of Losartan, an angiotensin receptor blocking drug, on atrial conduction was studied using P wave duration, and the drug was found to inhibit atrial remodeling, improve atrial conduction disturbance, and suppress AF recurrence. [14]

ED physicians are already asked to perform numerous public health screenings (eg, smoking cessation, immunization status, domestic violence) and education (eg, use of seatbelts and

helmets) during our routine patient care. We are not proposing an additional burdensome screening or educational intervention. Instead, we recommend that ED physicians consider a patient's risk for AF during their standard treatment of patients with hypertension and PR prolongation. A brief discussion with the patient or their physician might encourage closer surveillance and potentially prevent a devastating complication such as an ischemic stroke in a patient with undiagnosed AF.

Our study suggests that patients often present to the ED and display multiple risk factors for developing AF several years before being diagnosed with AF. Antihypertensive treatment and PR prolongation are easily measurable risk factors that, if present, might warrant a brief discussion about AF and referral to a primary care physician or cardiologist for aggressive primary prevention measures to delay or prevent the onset of AF.

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Table 1

Baseline characteristics per emergency department visit in a cohort of patients with newly diagnosed atrial fibrillation and emergency department visits prior to their diagnosis.

	Number of non- missing data per ED visit	Male N = 234	Female N = 220	Combined N=454
Age (median and IQR)	454	56 (41.3, 66.8)	75 (65.0, 83.0)	66 (49.0, 79.0)
Framingham Age category	454			
<=49		101 (43%)	14 (6%)	115 (25%)
50–54		11 (5%)	17 (8%)	28 (6%)
55–59		25 (11%)	18 (8%)	43 (9%)
60–64		25 (11%)	5 (2%)	30 (7%)
65–69		26 (11%)	9 (4%)	35 (8%)
70–74		12 (5%)	44 (20%)	56 (12%)
75–79		16 (7%)	27 (12%)	43 (9%)
80–84		8 (3%)	48 (22%)	56 (12%)
85		10 (4%)	38 (17%)	48 (11%)
Age risk score (median and IQR)	454	3 (1, 5)	6 (3, 7)	4 (1, 7)
Body Mass Index	48			26 (24, 30)
Systolic Blood Pressure (mm Hg)	402			145 (128, 164)
PR interval (msec)	268			166 (149, 187)
Age of cardiac murmur first diagnosis (years)	140			76 (66, 82)
Age of heart failure diagnosis (years)	176			66 (58, 79)

Table 2

Descriptive Statistics for Framingham Risk Factors and Risk Score on ED visits prior to the visit when atrial fibrillation was newly diagnosed

Framingham Risk Factor Category	Number of non- missing data per ED visit	N (%)
Body Mass Index	48	
< 30		37 (77%)
30		11 (23%)
Systolic Blood Pressure (mm Hg)	402	
<160		290 (72%)
160		112 (28%)
Treatment for Hypertension	442	
No		84 (19%)
Yes		358 (81%)
PR interval (msec)	268	
<160		108 (40%)
160–199		123 (46%)
200		37 (14%)
Age of cardiac murmur first diagnosis (years)	140	
<=54		33(24%)
55–64		
65–74		35 (25%)
75–84		51 (36%)
85		21 (15%)
Age of heart failure first diagnosis (years)	176	
45–54		43 (24%)
55–64		35 (20%)
65–74		30 (17%)
75		68 (39%)
Framingham Risk Score (median and IQR)		8 (4, 10)

Table 3

Calculated AF risk scores for each subject at each individual ED visit prior to their AF diagnosis

Case	Visit																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	4	7	8																			
2	4																					
3	11																					
5	8	8	7	7	7	7	7	7	8	7	8	7	8	7	8							
6	11	12	9	9																		
7	9	9	9	9	9	10	10															
8	10	8	11	10	10	11	11	9	8	10	10											
9	5	8	8																			
10	9	9	10	10	10	11																
11	-3																					
12	-2	-1	-1	-1	-1	1	1															
13	2	2																				
14	7																					
15	10																					
16	5	5	5	5	5	5	6	6	8	8	8	8										
17	14	15	15																			
18	5	5	6	5	6	5	6	6	8	7	8	8	8	8								
19	8	8	7	8	8	9	10	9	10	11	10	9	11	10	10	10						
20	7	8																				
21	5	7	6	6	6																	
22	-2	-1	0	1																		
23	13	12	13	13																		
24	4	3	5																			
25	7																					
26	1	1	1	1																		
27	7	8																				
28	4																					
29	10	9	9	10	9	9																

Case	Visit																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
30	-3	-3																				
31	9	11																				
32	1	2																				
33	1	1	1	1	1	1	1	1	1	1	1	1										
34	4																					
35	9	9	9	9	10	7	11	8	11	8	8	9	11	8	10	8	11	9	8	8	11	8
36	11	12	11																			
37	4	4																				
38	4	6																				
40	17	18	18	18	17	17																
41	1																					
42	10	9	10	10	10	10	10	10														
43	3	3	3	3	3	3	4	4	2	2	2	5	3	3								
44	12	13	13																			
45	9	9	11	11																		
46	-2	-2																				
47	2	2																				
48	10	9																				
49	1	2	2	3																		
50	4																					
51	9	8																				
52	1	1																				
53	4	5																				
54	17	17	17	17	18	18	18	17	17	17	17	17	17	17	18	18						
55	7																					
57	10	11	11	11	10	11	12	10	12	13	13	13	13	11	13	13	12	13	12			
58	-1																					
59	8	8	8	8																		
60	7																					
61	1	1	1	1	3	2	3	3														

Case	Visit																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
62	4	4	4																			
63	8	7	7																			
64	10	10																				
65	2																					
66	6	5	5	6	5	7	6	7	7	8	6											
67	5																					
68	4	4																				
69	8	9																				
70	9	9																				
71	9	9	10	8	11	10																
72	4	5																				
73	1	1	1	1	1																	
74	9	9																				
75	3	3																				
76	1	2																				
77	3	3																				
78	1	1																				
79	18	17	17	20																		
80	9	10	9	9	9	9	10	9	9	10	11	11	11	10								
81	10	12	10																			
82	6																					
83	17	17	18	19																		
85	4	7	6																			
86	7																					
87	6	5	6	8	7	8	8	8	7	8												
88	1																					
89	1	1	1	1	1	1	1	1														
90	8	10	9	9	9	9	10															
91	8	8	9	8	10	9	9	9	8	9												
92	6																					

Case	Visit																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
93	8																					
94	1	1																				
95	2	2																				
96	9	9	8																			
97	-2	-1																				
98	8	8	8																			
99	1																					
100	4																					
101	9																					
102	10	11	11																			
103	-2																					
104	-2	-1																				
105	8																					
106	-3	-3	-3																			
107	6																					
108	6																					
111	2																					
112	2	2																				
114	5	5																				
115	8																					
116	3																					
117	5	5																				
118	7	9																				
121	3																					
122	10	9																				
123	10	10	10																			
126	8																					