

Outcomes of Patients Presenting with Primary or Secondary Atrial Fibrillation with Rapid Ventricular Rate to the Emergency Department

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Abstract

Introduction: Atrial fibrillation (AF) with rapid ventricular rate (RVR) is a common diagnosis in the Emergency Department (ED) requiring evaluation and treatment. We present the characteristics and outcomes of patients presenting with primary or secondary AF in a tertiary hospital ED. **Materials and Methods:** This retrospective cohort study included consecutive patients ≥ 21 years old, with a primary or secondary diagnosis of AF with RVR in the ED over a 1-year period from 1 January 2016 to 31 December 2016. Primary AF is defined as AF with no precipitating cause and secondary AF as AF secondary to a precipitating cause. **Results:** A total of 464 patients presented to the ED from 1 January to 31 December 2016 with primary and secondary diagnosis of AF with RVR; 44.8% had primary diagnosis of AF whereas 55.2 % had secondary AF. Overall admission rate from ED was high at 91.8% (primary 84.6% vs secondary 97.7%). Patients with primary AF were younger (68 vs 74 years, $P < 0.001$), had lower rates of cardiovascular risk factors, and shorter length of stay (median 4 vs 5 days). Within 30 days of discharge, they had lower ED reattendance (16.3% vs 25.8%, $P < 0.001$) and lower readmission (16.3% vs 25.8%, $P < 0.001$). There was no mortality in the primary AF group (0% vs 9.8%, $P < 0.001$). **Conclusion:** Currently, majority of patients with AF with RVR are admitted from the ED. Our study suggests patients with uncomplicated primary AF have lower adverse outcomes and some could potentially be treated as outpatients.

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Key words: Characteristics, Outpatients

Introduction

Atrial fibrillation (AF) is the most common arrhythmia managed by emergency medicine physicians.^{1,2} The prevalence of AF in developed countries is estimated to be between 0.5 to 1.0%,³ with AF accounting for 0.8% of Emergency Department (ED) visits in the United States from 1993 to 2004.⁴ In Singapore, AF is the most common arrhythmia with an increasing trend. In a study done in 2008 among Chinese residents, the estimated prevalence of AF in Singapore was an estimated 2.6% in men and 0.6% in women, with an increase to 5.8% in adults more than 80

years and above.⁵ However, this number has increased over recent years due to population ageing, increasing prevalence of comorbidities (diabetes, hypertension, ischaemic heart disease) and increased awareness and diagnosis of AF.⁶ AF affects the quality of life. It increases the risk of stroke and heart failure; and overall mortality rate is approximately double compared to patients in normal sinus rhythm.^{7,8} Patients with AF are also older and have a higher prevalence of comorbidities (diabetes, hypertension, cardiovascular disease).^{9,10} All these make AF a major global health problem, imposing a heavy burden on healthcare systems

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worldwide, with increasing hospital admissions^{11,12} and healthcare costs¹³ over the recent years.

AF with rapid ventricular rate (RVR) (i.e. ventricular rate ≥ 100 beats/minute) is a common ED diagnosis that requires prompt evaluation and treatment. However, RVR can possibly be managed in the ED, avoiding hospital admissions and thus reducing overcrowding and healthcare costs. The challenge will be identifying low-risk patients suitable for outpatient management.

Patients coming to the ED can present with primary or secondary AF. Primary AF is defined as AF without a precipitating cause and secondary AF as AF precipitated by a secondary or reversible condition (e.g. surgery, sepsis, acute myocardial infarction, thyrotoxicosis or acute pulmonary disease).¹⁴ Patients with a secondary diagnosis of AF may have different prognostic outcomes.¹⁵

This study outlines the characteristics of patients presenting with primary or secondary AF with RVR to a tertiary hospital ED and the burden of AF on the ED including the admission rate, length of stay, morbidity and mortality and ED reattendance.

Materials and Methods

Study Design

This study was a 1-year retrospective observational cohort study focusing on consecutive patients attending the ED with primary or secondary diagnosis of AF with RVR. The study was approved by the SingHealth Centralised Institutional Review Board.

Study Setting and Population

The study involved the ED of a single tertiary centre, Singapore General Hospital (SGH). It utilised Electronic Medical Record data of patients attending the ED with primary or secondary diagnosis of AF with RVR from 1 January to 31 December 2016. SGH is a tertiary centre in Singapore and the ED serves about 130,000 to 140,000 patients annually. The hospital has a national heart centre that provides both cardiology and cardiothoracic services.

Inclusion criteria included patients ≥ 21 years old, with a primary or secondary diagnosis of AF in the ED. We included only patients with AF with RVR, as this is the group of symptomatic patients who commonly require intervention and treatment in the ED. Patients' clinical data were extracted from the hospital's computerised medical records and all data were anonymised.

Data Collection

Data was collected from the Sunrise Clinical Manager (SCM) electronic database for patients attending the ED. The SCM database provides a unified patient record workflow

and captures clinical information from the moment the patient enters the hospital to the moment of discharge, through to continued care in an outpatient setting. The International Classification of Disease (ICD) version 10 was used to classify and code all diagnoses and symptoms. Patients with first and second diagnosis listed as AF were extracted.

Study data were extracted and managed using the REDCap (Research Electronic Data Capture) tools hosted at SGH.¹⁶ REDCap is a secure, web-based application designed to support data capture for research studies, providing: 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources.

Patients' data were anonymised and reviewed by a first reviewer (2nd author) using an electronic spreadsheet including demographics, comorbidities, treatment in ED, diagnosis of primary or secondary AF, ED disposition, length of stay, 30-day morbidity and mortality and ED reattendance and readmission. The data was subsequently reviewed and verified by a second reviewer (1st author). Any differences in conclusions were resolved with the last author. The CHA₂DS₂-VASc score was also calculated. We used the CHA₂DS₂-VASc score as this is the recommendation of the European Society of Cardiology (ESC)¹⁷ and the American Heart Association/American College of Cardiology/Heart Rhythm Society (AHA/ACC/HRS)¹⁸ to estimate stroke risk for AF patients. Consideration of oral anticoagulant (OAC) prophylaxis is recommended for patients with a score of 1. OAC use is a definite recommendation for patients with a score of 2 or greater and for those with a history of stroke or transient ischaemic attack.¹⁸

Statistical Analysis

All data analyses were performed using SPSS version 23 (SPSS, Chicago, IL). Categorical and continuous data were presented as frequencies with percentage and median with interquartile range (IQR), respectively. Association between categorical variables were assessed using chi-squared test. Statistical significance was generally set at a 2-tailed *P* value of less than 0.05.

Results

The study flowchart is shown in Figure 1. Between 1 January to 31 December 2016, there were 464 patients with primary or secondary diagnosis of AF with RVR in the ED. Two-hundred-and-eight patients (44.8%) had primary diagnosis of AF, whereas 259 patients (55.2%) had secondary AF with precipitating causes. Primary AF patients had a lower inpatient admission rate from ED; 84.6% of primary AF patients were admitted compared

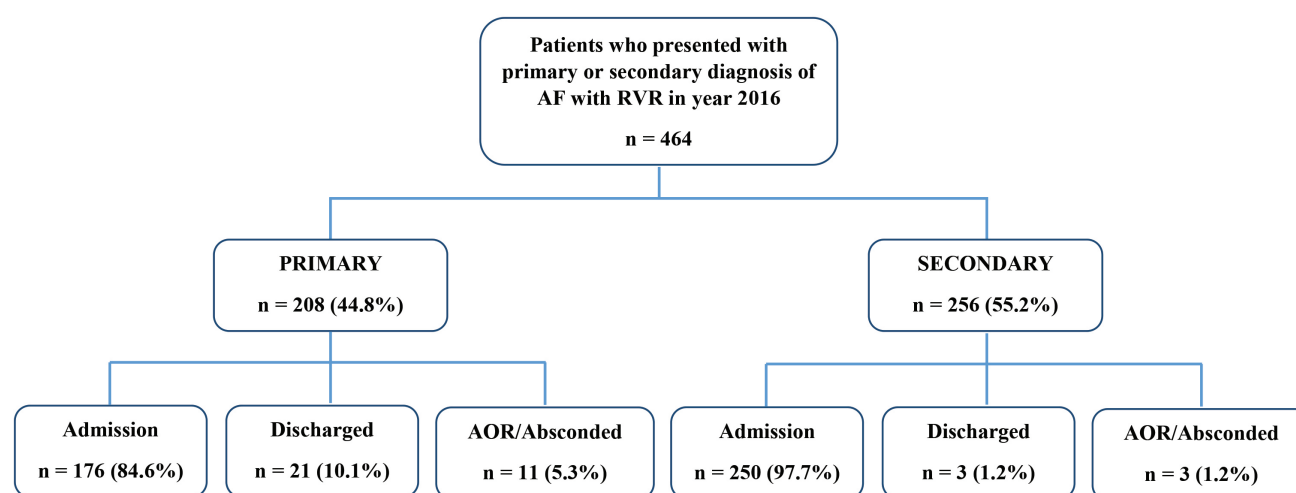


Fig. 1. Flowchart of patients presenting to the Emergency Department with atrial fibrillation and rapid ventricular rate. AF: Atrial fibrillation; AOR: Discharge at own risk; RVR: Rapid ventricular rate.

to 97.7% of secondary AF patients ($P < 0.001$). A total of 10.1% of primary AF patients were discharged versus only 1.2% of secondary AF patients.

Table 1 shows the demographics, comorbidities, presenting symptoms, CHA₂DS₂-VASc score, treatment in ED and inpatient anticoagulation between primary and secondary AF patients. Median age of patients was 70 years old (IQR ranges, 62–81) and 45.3 % were men.

Secondary AF patients were older (median age of 74 years vs 67 years, $P < 0.001$). A higher proportion of patients with secondary AF had cardiovascular risk factors compared to primary AF patients. Hypertension was the most prevalent cardiovascular risk factor (primary 65.9% vs secondary 71.9%). Secondary AF patients were more likely to have hypertension, diabetes, ischaemic heart disease, previous stroke and end-stage renal failure. They were also more likely

to have a history of AF compared to primary AF patients.

Patients with primary AF with RVR were more likely to present with palpitations (45.7% vs 20.3%, $P < 0.001$) and chest pain (22.1% vs 6.6%, $P < 0.001$). A total of 55.8% of patients who presented to the ED with AF were not on prior antiplatelet or anticoagulation (primary 61.5% vs secondary 51.2%). Majority of patients (80.8%) had CHA₂DS₂-VASc score of ≥ 2 (primary 74.5% vs secondary 85.9%). More patients with primary AF had CHA₂DS₂-VASc score of 0 compared to secondary AF (11.5% vs 2.3%, $P < 0.001$). Most of the patients were treated with rate control agents in the ED; 57.7% of patients with primary AF were treated with diltiazem compared to 35.2% of secondary AF patients ($P < 0.001$). One patient with secondary AF underwent synchronised cardioversion in the ED due to haemodynamic instability. A total of 40.9% of primary AF patients were

Table 1. Characteristics of Patients Presenting to the Emergency Department with Atrial Fibrillation and Rapid Ventricular Rate

Characteristics	All n = 464 (%)	Primary AF n = 208 (%)	Secondary AF n = 256 (%)	P Value
Median age (IQR)	70 (62–81)	67 (60–76)	74 (63–83)	<0.001*
Male	210 (45.3)	99 (47.6)	111 (43.4)	0.399
Race				0.260
Chinese	364 (78.4)	160 (76.9)	204 (79.7)	
Malay	49 (10.6)	25 (12.0)	24 (9.4)	
Indian	26 (5.6)	8 (4.1)	18 (7.0)	
Eurasian	5 (1.1)	3 (1.4)	2 (0.8)	
Others	20 (4.3)	12 (5.8)	8 (3.1)	

AF: Atrial fibrillation; COPD: Chronic obstructive pulmonary disease; ED: Emergency department; ESRF: End stage renal failure; IQR: Interquartile range; NIL: zero; NOACs: Novel oral anticoagulants

*Statistical significance ($P < 0.05$).

Table 1. Characteristics of Patients Presenting to the Emergency Department with Atrial Fibrillation and Rapid Ventricular Rate (Cont'd)

Characteristics	All n = 464 (%)	Primary AF n = 208 (%)	Secondary AF n = 256 (%)	P Value
Medical history				
Hypertension	321 (69.2)	137 (65.9)	184 (71.9)	0.189
Diabetes mellitus	155 (33.4)	53 (25.5)	102 (39.8)	<0.001*
Hyperlipidaemia	264 (56.9)	113 (54.3)	151 (59.0)	0.346
Ischaemic heart disease	125 (26.9)	49 (23.6)	76 (29.7)	0.143
Acute myocardial infarction	50 (10.8)	18 (8.7)	32 (12.5)	0.228
Haemorrhagic/ischaemic stroke	66 (14.2)	20 (9.6)	46 (18.0)	0.011*
COPD	8 (1.7)	2 (1.0)	6 (2.3)	0.306
ESRF	33 (7.1)	9 (4.3)	24 (9.4)	0.045*
AF	231 (49.8)	89 (42.8)	142 (55.5)	0.007*
Prior anticoagulation or antiplatelet therapy				
NIL	259 (55.8)	128 (61.5)	131 (51.2)	0.031*
Warfarin	78 (16.8)	23 (11.1)	55 (21.5)	0.003*
NOACs	42 (9.1)	25 (12.0)	17 (6.6)	0.051
Aspirin	63 (13.6)	21 (10.1)	42 (16.4)	0.056
Clopidogrel	36 (7.8)	15 (7.2)	21 (8.2)	0.730
Presenting symptom				
Palpitations	147 (31.7)	95 (45.7)	53 (20.3)	<0.001*
Chest pain	63 (13.6)	46 (22.1)	17 (6.6)	<0.001*
Others	333 (71.8)	103 (49.5)	230 (89.8)	<0.001*
CHA₂DS₂-VASc score				
0	30 (6.5)	24 (11.5)	6 (2.3)	0.001*
1	59 (12.7)	29 (13.9)	30 (11.7)	0.001*
≥2	375 (80.8)	155 (74.5)	220 (85.9)	0.001*
Treatment instituted in ED				
Rate/rhythm control				
None	79 (17.0)	36 (17.3)	43 (16.8)	0.902
Diltiazem	210 (45.3)	120 (57.7)	90 (35.2)	<0.001*
Bisoprolol	61 (13.1)	37 (17.8)	24 (9.4)	0.009*
Digoxin	68 (14.7)	19 (9.1)	49 (19.1)	0.002*
Amiodarone	103 (22.2)	18 (8.7)	85 (33.2)	<0.001*
Verapamil	4 (0.9)	3 (1.4)	1 (0.4)	0.330
Others	7 (1.5)	2 (1.0)	5 (2.0)	0.467
Synchronised cardioversion				
Yes	1 (0.2)	0 (0.0)	1 (0.4)	1.000
No	0 (0.0)	208 (100.0)	255 (99.6)	1.000
Inpatient treatment				
Anticoagulation				
None	51 (11.0)	21 (10.1)	30 (11.7)	0.655
Aspirin	146 (31.5)	58 (27.9)	88 (34.4)	0.159
Clopidogrel	97 (20.9)	44 (21.2)	53 (20.7)	0.909
Warfarin	104 (22.4)	31 (14.9)	73 (28.5)	<0.001*
Novel oral anticoagulant	145 (31.3)	85 (40.9)	60 (23.4)	<0.001*

AF: Atrial fibrillation; COPD: Chronic obstructive pulmonary disease; ED: Emergency department; ESRF: End stage renal failure; IQR: Interquartile range; NIL: zero; NOACs: Novel oral anticoagulants

*Statistical significance ($P < 0.05$).

started on novel oral anticoagulant (NOAC) as inpatients, compared to 23.4% of secondary AF patients.

Table 2 shows the outcomes of patients with primary and secondary AF. A total of 426 patients (91.8%) were admitted. Secondary AF patients had higher hospital admission rates (97.7% vs 84.6%, $P < 0.001$) and longer length of stay (median, 5 days vs 4 days). They had higher ED reattendance (23.8% vs 13.5%, $P < 0.001$) and readmission rate (25.8% vs 16.3%, $P < 0.001$) within 30 days of discharge compared to the primary AF group. Thirty-day mortality for secondary AF patients was also higher (9.8% vs 0%). Four patients each in the primary and secondary AF group had ischaemic stroke whereas 1 patient in the primary AF group had intracranial haemorrhage.

Discussion

In this study of 464 patients attending the ED of a single tertiary centre in Singapore with primary and secondary diagnosis of AF with RVR, the demographics were similar to other global cohorts for baseline characteristics and comorbidities.^{19–22} Overall admission rate from ED was high (91.8%). There was a high proportion of patients with primary AF (84.6%) who were admitted. This was different from other studies where a lower percentage of patients with primary AF without an acute medical cause were admitted.^{23,24} A population-based study done in Alberta²³ on ED presentations for AF and flutter showed ED admission of 26.9%, whereas a study done in 2 urban Canadian EDs on patients with AF with no acute underlying medical cause²⁴ had admission rate of 15.3% from ED.

There were various factors for the high admission rate

of patients with primary AF in our study's ED. Whereas centres in other countries do electrical cardioversion for acute onset of AF (<48 hours)^{25–27} in the ED, this is not usually carried out in our local EDs. In the ED of our study, we do not have access to trans-esophageal echocardiogram (TEE) prior to cardioversion. It is also difficult and time consuming to counsel patients with regard to cardioversion and subsequent anticoagulation, which makes it even more challenging in a busy ED environment. All these are the possible barriers to why patients are admitted.

There were more patients who presented with secondary AF with RVR. The secondary causes of AF included sepsis, congestive cardiac failure, thyrotoxicosis and other intercurrent illness (e.g. pulmonary disease, chronic obstructive pulmonary disease [COPD]). The most common precipitating cause for secondary AF is congestive cardiac failure (51.4%) followed by sepsis (34.7%) in this study. Patients with secondary AF had a longer length of stay, higher ED reattendance, readmission rate and 30-day mortality rate. This could be due to various factors. Firstly, patients in the secondary AF group were older and a higher proportion had cardiovascular risk factors. Secondly, the primary disease precipitating the AF could attribute to the higher mortality rate as compared to patients in the primary AF group with no precipitating cause. There have been studies^{15,28,29} which suggested that concomitant AF with congestive cardiac failure and sepsis may have a worse effect on prognosis. A recent study by Clare L Atzema et al showed that such group of patients with secondary AF have high short- and long-term mortality rates and mortality was higher than in patients with primary diagnosis of AF.¹⁵

In this study, patients with primary AF with RVR were

Table 2. Outcomes in Patients with Primary Atrial Fibrillation vs Secondary Atrial Fibrillation

Outcomes	All n = 464 (%)	Primary AF n = 208 (%)	Secondary AF n = 256 (%)	P Value
Disposition				
Hospital admission	426 (91.8)	176 (84.6)	250 (97.7)	<0.001*
Discharge from ED	24 (5.2)	21 (10.1)	3 (1.2)	<0.001*
AOR/absconded	14 (3.0)	11 (5.3)	3 (1.2)	<0.001*
Length of stay (days)				
Median (IQR)	4 (3 – 7)	4 (3 – 5)	5 (3 – 8)	<0.001*
30-day morbidity				
Ischaemic stroke	8 (1.7)	4 (1.9)	4 (1.6)	1.000
Intracranial and extracranial haemorrhage	1 (0.2)	1 (0.5)	0 (0.0)	0.449
30-day mortality	25 (5.4)	0 (0.0)	25 (9.8)	<0.001*
Reattendance to ED within 30 days discharge from ED/ward	89 (19.2)	28 (13.5)	61 (23.8)	<0.001*
Readmission to inpatient within 30 days of discharge	100 (21.6)	34 (16.3)	66 (25.8)	<0.001*

AF: Atrial fibrillation; AOR: Discharge at own risk; ED: Emergency department; IQR: Interquartile range

*Statistical significance ($P < 0.05$).

younger with lower rates of cardiovascular risk factors. A higher proportion of them had CHA₂DS₂-VASc score of 0 compared to the secondary AF group. They had shorter length of stay, lower ED reattendance and readmission. Risk of stroke for this group of patients was low and similar to the secondary AF group. There was no mortality in the primary AF group. In comparison to the secondary AF group, primary AF patients have lower adverse outcomes and can be an opportunity for outpatient management and discharge from ED. In our study, 40.9% of primary AF patients were started on NOAC as inpatients, compared to 14.9% on warfarin. It may be worth considering discharging AF patients with a NOAC from ED instead of admitting them as inpatients for anticoagulation which is the usual practice. This may help to reduce hospital overcrowding and healthcare costs.

With an increasing prevalence of AF in Singapore, there can be an opportunity for outpatient management in the ED. In Singapore, most EDs have an emergency observation ward or short stay unit. These observation wards are for stable patients with conditions that can likely be discharged after 8 to 24 hours. Patients can be monitored on telemetry while in the observation ward. In Singapore, there is at least 1 ED with an AF protocol in their observation unit. In the study's ED, there is no emergency observation ward protocol for patients with AF with RVR. With the data collected, future plans include implementation of an AF pathway and observation protocol, looking into more efficient processes to reduce length of stay and potentially discharging patients within 24 hours. There had been studies done on ED observation unit for AF. Most of them focused on acute onset of AF <48 hours with discharge from ED postcardioversion.^{25,27} There were more recent studies on the impact of ED observation unit management algorithm and pathway for AF.^{26,30} These pathways included selecting patients with primary AF in the ED who then underwent rate control, cardioversion for those with acute AF and initiation of anticoagulation based on CHA₂DS₂-VASc score.³¹ They showed that implementation of an ED observation unit AF algorithm was associated with significantly decreased hospital admissions without increasing the rates of return ED visits, hospitalisation, or adverse events within 30 days.²⁶

Limitations

This study was a retrospective study done in a single tertiary centre in Singapore. Therefore, the results may have limited applicability and generalisability to other centres. Patients with main (first) and second diagnosis of AF were extracted from our centre's computerised medical records. It could be possible that patients with AF listed other than the first and second diagnoses were also eligible but missed in the selection process. We included only patients with AF

with RVR as this was the group of patients most commonly encountered in our ED who required intervention and treatment. Therefore, there could be a large group of patients with AF who were excluded as they did not have RVR. All data were de-identified and processed by a first investigator and reviewed/checked by a second investigator. However, we did not check inter-rater reliability in this study, which is a major limitation. The data could be subjected to bias and subjectivity. There could be errors in data processing and missing out essential information in the process.

Conclusion

Currently, the majority of patients with primary or secondary AF with RVR are admitted from the ED. Our study suggests that patients with primary AF have lower adverse outcomes and can potentially be treated as outpatients. It may be worth looking into improving processes for an AF pathway within the ED for such patients.

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