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Seasonal trends in atrial fibrillation episodes and physical activity collected daily with a remote monitoring system for cardiac implantable electronic devices

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ABSTRACT

Background: Remote monitoring (RM) of cardiac implantable electronic devices is an ideal experimental model to evaluate long-term trends of physiological and clinical data automatically collected from large patient cohorts.
Objectives: We studied data of atrial fibrillation (AF) and physical activity (PA) transmitted daily during 3.5 years from a subgroup of patients enrolled in the HomeGuide trial, a previously conducted study on patients routinely followed with a RM system transmitting clinical and diagnostic data daily.
Methods: We selected 988 patients (80% male, mean age 68 ± 11) implanted with a pacemaker (16%) or an implantable defibrillator and provided with atrial sensing and movement sensors. Remotely transmitted data were processed in order to obtain AF incidence and time of PA in the form of collective time series daily sampled.
Results: We found that both PA and AF incidence clearly showed seasonal trends with an annual period and inverse correlation. In a first-order autoregressive model the regression coefficient of daily activity to AF incidence was −0.64 (standard error, 0.18, $p < 0.0001$), while the cross-correlation coefficient reached its maximum values at ± 180 day lags. AF incidence was 14.4% higher and PA was 14.7% lower in winters than in summers ($p < 0.0001$ for both comparisons). Power spectral analysis revealed weekly periodicity in the PA series (corresponding to festivity rest) but not in the AF incidence.
Conclusions: RM data collected daily from a relatively large patient cohort revealed marked seasonal trends in AF incidence and PA with opposite behavior in winters and summers.

1. Introduction

Atrial fibrillation (AF) is the most common cardiac rhythm disorder, and is associated with a substantial risk of mortality and morbidity from thromboembolism and especially thromboembolic stroke.

Besides the well-known risk factors for atrial fibrillation, seasons of the year seem to be a compellingly emerging one [1]. Since the first of the relatively few number of papers about seasonality of AF published in 1990 [2], AF peaks in winters have been always observed, although using different methodologies and different sample sizes [1,3–13]. Most of these studies were based on the analysis of AF hospital admissions [1,3–13]. One study documented the seasonal variation in paroxysmal AF by a 24-h Holter electrocardiogram [9].

Many studies significantly correlated AF incidence to air temperature, in cold [9,10] as well as in tempered and continental climates [13]. Although low temperature exposure induces behavior changes and enhances the susceptibility to infections, the need to better understand the etiology underlying this correlation cannot be underestimated.

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Table 1
Characteristics of patient population.

	All 988	PM 156 (15.6%)	ICD 571 (57.8%)	CRT-D 261 (26.4%)	P
Gender (male)	787 (80%)	103 (66%)	472 (83%)	212 (81%)	<0.0001
Age (years)	68 ± 11	73 ± 11	66 ± 11	69 ± 9	0.0001
Cardiomyopathies					
None	72 (7%)	60 (38%)	12 (2%)	0 (0%)	
Hypertensive	93 (9%)	52 (33%)	30 (5%)	11 (4%)	<0.0001
Dilatative	537 (54%)	11 (7%)	320 (56%)	206 (79%)	<0.0001
Ischemic	448 (45%)	30 (19%)	298 (52%)	120 (46%)	<0.0001
Congenital	4 (0%)	0 (0%)	3 (1%)	1 (0%)	0.66
Valvular disease	64 (6%)	9 (6%)	37 (6%)	18 (7%)	0.90
Channelopathies	19 (2%)	0 (0%)	19 (3%)	0 (0%)	0.001
Other	3 (0%)	2 (1%)	1 (0%)	0 (0%)	
NYHA class					
I	157 (16%)	61 (39%)	90 (16%)	6 (2%)	
II	482 (49%)	66 (42%)	335 (59%)	81 (31%)	
III	333 (34%)	28 (18%)	141 (25%)	164 (63%)	<0.0001
IV	16 (2%)	1 (1%)	5 (1%)	10 (4%)	0.004
LVEF (%)	34 ± 11	50 ± 12	35 ± 11	28 ± 6	0.0001
Prior SVT	234 (24%)	42 (27%)	132 (23%)	60 23(%)	0.58
Bradyarrhythmias	246 (25%)	124 (80%)	60 (10%)	261 (24%)	<0.0001
Therapy at implant					
ACE-inhibitors	594 (60%)	62 (40%)	327 (57%)	205 (78%)	<0.0001
Sartans	131 (13%)	12 (13%)	55 (10%)	55 (21%)	<0.0001
Betablockers	686 (69%)	45 (29%)	407 (71%)	234 (90%)	<0.0001
Diuretics	656 (66%)	58 (37%)	367 (64%)	231 (88%)	<0.0001
Spironolactone	137 (14%)	4 (3%)	58 (10%)	75 (29%)	<0.0001
Ca-channel blockers	84 (8%)	27 (13%)	43 (7%)	14 (5%)	<0.0001
Vasodilators	42 (4%)	8 (5%)	23 (4%)	11 (4%)	0.83
Nitrates	09 (10%)	9 (6%)	56 (10%)	33 (13%)	0.07
Digitals	76 (8%)	3 (2%)	34 (6%)	39 (15%)	<0.0001
Antiplatelets	452 (46%)	60 (38%)	272 (48%)	120 (46%)	0.12
Anticoagulants	286 (29%)	32 (20%)	174 (30%)	80 (31%)	0.04
Antiarrhythmics	235 (24%)	30 (19%)	138 (24%)	67 (26%)	0.31

ACE: angiotensin-converting-enzyme; Ca: calcium; LVEF: left ventricle ejection fraction; NYHA: New York Heart Association; SVT: supraventricular tachyarrhythmias including atrial tachycardias, flutter, fibrillation.

Understanding the mechanism underlying such seasonal variations and its appropriate control will definitely help reduce AF-related hospitalizations [12].

While it is relatively easy to get data related to AF-hospitalizations, collecting continuous longitudinal trends of AF burden from a large population is technically challenging. Accounting for the parallel level of physical activity in a population over time may appear almost impossible.

The aim of the present analysis was to investigate the longitudinal correlation between trends of AF incidence and physical activity, over a period of 3 years and a half, obtained in a relatively large cohort, implanted with pacemakers or defibrillators remotely monitored.

2. Methods

2.1. Patient selection

The present analysis was performed on a subgroup of patients from the HomeGuide Registry (Clinical Trials identifier NCT01459874). The HomeGuide registry was an observational multicentre study with the primary objective of estimating sensitivity and positive predictive value of remote detection of all major cardiovascular events by using the Home Monitoring (HM) system (Biotronik SE & Co. KG, Berlin, German) [14]. The HM system allows retrieving data on a daily basis from an implanted device through a wireless receiver for long-distance telemetry. The receiver forwards the data to a unique Service Center, by connecting to the GSM (Global System for Mobile Communication) network. The Service Center anonymously decodes, analyzes and uploads the data on a secure website. The HomeGuide registry was approved by the competent ethics committees; it

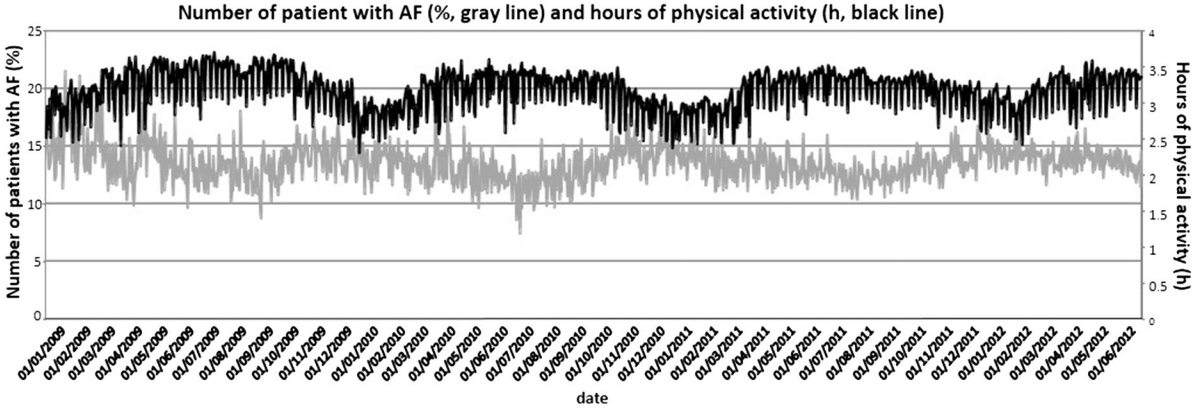

Fig. 1. 3.5-year-trends of AF incidence and physical activity. Time series of the hours of physical activity (h, black line) and of the percentage of patients with AF (%, gray line).

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