

Prevalence and clinical implications of atrial fibrillation episodes detected by pacemaker in patients with sick sinus syndrome

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Recent prospective clinical trials have demonstrated that physiologic pacing mode reduces the risk of atrial fibrillation (AF) compared to single chamber ventricular pacing in patients with sick sinus syndrome (SSS).^{1–3} Previous studies have shown that patients with a prior history of AF before pacemaker implant are associated with an increase risk of persistent AF.³ Recent advances in the ability to store diagnostic information in implanted devices have provided an opportunity for detection and documentation of AF. The aim of this study was to define the prevalence and clinical significance of device detected AF episodes in patients implanted with pacemakers for SSS.

METHODS

We studied the clinical characteristics and long term clinical outcome in patients with SSS who had received a dual chamber rate responsive pacemaker (DDDR) for symptomatic bradycardia in our institutions from 1992 to 1998. Patients were eligible if they received a DDDR pacemaker which was capable of providing diagnostic counters for supraventricular tachyarrhythmias and was programmed “ON”. P wave analysis was manually measured by a single investigator. A surface echocardiogram was performed in all patients before implant to assess left atrial size, left ventricular ejection fraction, and left ventricular mass.

Data were retrospectively collected regarding demographic characteristics, device diagnostics, clinical status, and outcome during the follow up period. Clinical data were retrieved from the medical records and subsequently during the most recent clinic visit. The following clinical events of each patient were retrieved from their clinical records: the time to the first occurrence of AF; the development of persistent AF; and major cardiovascular events: non-fatal stroke, hospitalisation for congestive heart failure, or cardiovascular death. The AF episode was categorised as either paroxysmal if sinus rhythm was recorded at the subsequent follow up after an episode of AF, or persistent if it was recorded at two consecutive follow up visits.

Continuous variables are expressed as mean (1 SD). Statistical comparisons were performed with Student's *t* test or Fisher's exact test, as appropriate. Cox regression analysis was used to examine the clinical predictors of major cardiovascular events and persistent AF. Actuarial curves for the incidence of persistent AF and major cardiovascular events in patients with and without device detected AF episodes were calculated by the Kaplan-Meier method. A probability value of $p < 0.05$ was considered significant.

RESULTS

The clinical characteristics of 226 patients included in this analysis are shown in table 1. After a mean follow up of 84 (16) months, 99 patients (44%) had at least one AF episode documented by the pacemaker. In 30/139 (22%) patients

without a prior history of AF, their pacemaker diagnostic counters detected AF after implant. In 18/87 (21%) patients with a prior history of AF, their pacemaker diagnostic counters did not detect any AF after implant. Patients with device detected AF episodes were more likely to have a history of AF before pacemaker implant, underlying structural heart diseases, antiarrhythmic drug treatment and anticoagulation use, larger left atria, lower left ventricular ejection fraction and higher prevalence of left ventricular hypertrophy on echocardiography, and longer P wave duration than patients without AF (table 1).

Persistent AF developed in 49/226 (22%) patients. Cox regression analysis demonstrated that a prior history of AF before pacemaker implantation (hazard ratio (HR) 4.2, 95% confidence interval (CI) 2.1 to 10.8; $p < 0.001$) and the presence of device detected AF episodes (HR 3.1, 95% CI 1.9 to 12.8; $p = 0.02$) were independent predictors of the development of persistent AF. Kaplan-Meier analysis revealed a significantly higher proportion of persistent AF in patients with a prior history of AF, any device detected AF episodes, or newly device detected AF episodes compared to patients without any AF episodes ($p < 0.001$) (fig 1).

Patients with device detected AF episodes had significantly higher prevalence of major cardiovascular events and nonfatal strokes than those without AF episodes ($p < 0.001$) (table 1). Cox regression analysis showed that a prior history of AF before pacemaker implantation (HR 2.4, 95% CI 1.2 to 13.8; $p = 0.013$) and the presence of device detected AF episodes (HR 2.0, 95% CI 1.1 to 15.8; $p = 0.020$) were independent predictors of major cardiovascular events. Kaplan-Meier analysis revealed a significantly higher prevalence of major cardiovascular events in patients with a prior history of AF, any device detected AF episodes, or new device detected AF episodes compared to patients without any AF episodes ($p < 0.05$) (fig 1).

DISCUSSION

Previous clinical studies have reported that up to two thirds of patients with a pacemaker have atrial arrhythmias detected by the devices.⁴ However, the clinical significance of this unexpectedly high incidence of non-sustained device detected atrial arrhythmias remains unclear. In this study, we detected AF episodes in 44% of our patients during long term follow up, and it was associated with a 10 fold increase in the incidence of persistent AF, and a 2.5-fold increase in major cardiovascular events, especially stroke. Our results confirm the finding of a recent study,⁵ and reveal that the presence of device detected AF episodes, irrespective of symptoms, was an independent predictor for persistent AF and major cardiovascular events. Most importantly, our data

Abbreviations: AF, atrial fibrillation; CI, confidence interval; HR, hazard ratio; SSS, sick sinus syndrome

Table 1 Clinical characteristics and outcome of patients with or without device detected atrial fibrillation (AF) episodes by pacemaker diagnostic counters after implantation

	AF (n = 99)	No AF (n = 127)	P values*
Age (years)	72 (10)	70 (10)	0.21
Female (%)	56	66	0.17
Duration of follow up (months)	88 (32)	82(27)	0.19
Prior history of AF (%)	55	25	<0.001
Antiarrhythmic			
Baseline (%)	32	5	<0.001
Follow up (%)	56	6	<0.001
Anticoagulation			
Baseline (%)	28	3	<0.001
Follow up (%)	49	6	<0.001
Underlying heart disease (%)	76	54	<0.001
Hypertension	37	36	0.22
Ischaemic heart disease	36	28	0.02
Hypertrophic cardiomyopathy	9	13	0.42
Thyroid heart disease	5	5	0.66
Dilated cardiomyopathy	2	1	0.33
Left atrial diameter (cm)	4.0 (0.7)	3.6 (0.7)	0.02
Left ventricular ejection fraction	0.50 (0.13)	0.56 (0.15)	0.04
Left ventricular mass (g)	274 (105)	240 (120)	0.21
Left ventricular hypertrophy (%)	39	18	<0.001
P wave duration (ms)	130 (21)	122 (17)	0.049
Combined cardiovascular events (%)	42	15	<0.001
Non-fatal stroke (%)	32	8	<0.001
Hospitalisation for congestive heart failure (%)	15	10	0.31
Cardiovascular death (%)	9	4	0.16

*Comparison between the presence and the absence of atrial fibrillation documented by the pacemaker after implantation.

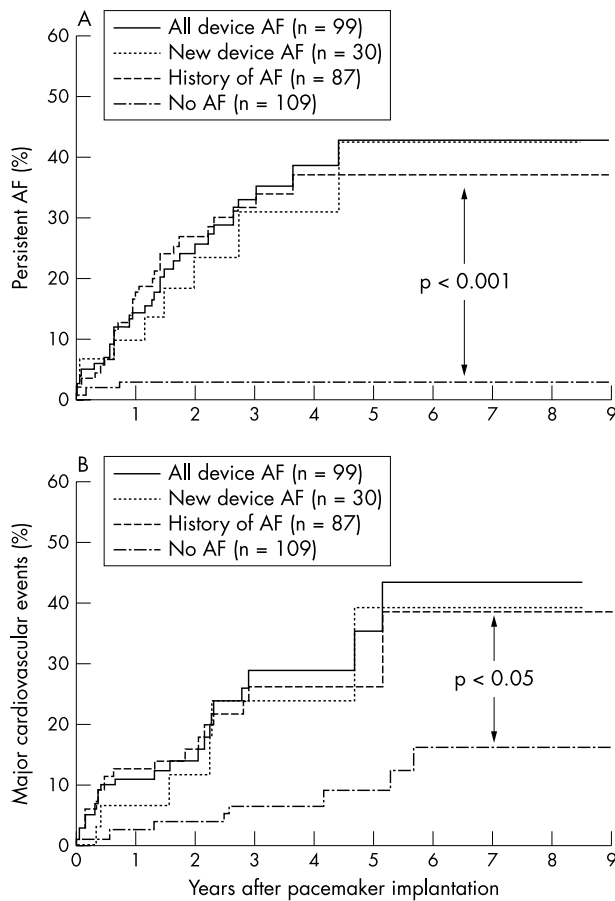


Figure 1 Kaplan-Meier plots depicting the percentage of patients with (A) persistent AF and (B) major cardiovascular events during long term follow up in patients with a prior history of AF (History of AF), any device detected AF episodes (All device AF), newly device detected AF episodes without a prior history of AF (New device AF), and patients without any history or device detected AF episodes (No AF).

demonstrated the presence of new device detected AF episodes in 22% patients without a prior history of AF. The occurrence of AF in those patients was also associated with a higher incidence of developing persistent AF and major cardiovascular events during long term follow up. The use of device detected AF episodes defines a subgroup of patients who did not have a prior history of AF at higher risk of developing persistent AF and major cardiovascular events. Therefore, it is clinically valuable to detect AF episodes in those patients so that anticoagulation treatment can be initiated to prevent stroke.

In conclusion, in patients with SSS, AF frequently develops after DDDR pacemaker implantation, and progresses to persistent AF over long term follow up. These data suggest the use of a pacemaker diagnostic counter to detect AF episodes in pacemaker patients, especially in those without a prior history of AF, can assist in identifying patients at risk of developing persistent AF and major cardiovascular events, especially stroke. Anticoagulation treatment for stroke prevention should be considered in those patients who have a prior history of AF or device detected AF episodes.

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IMAGES IN CARDIOLOGY

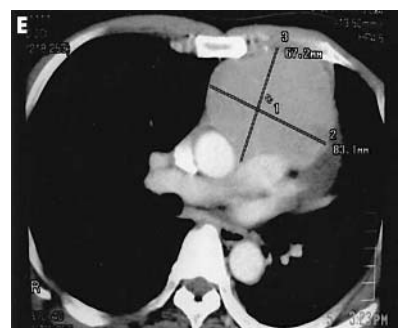
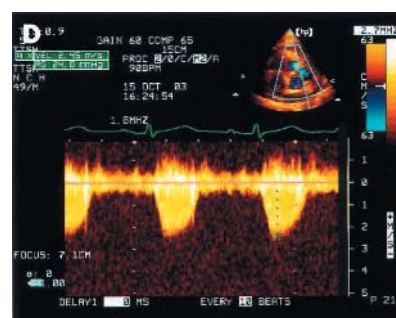
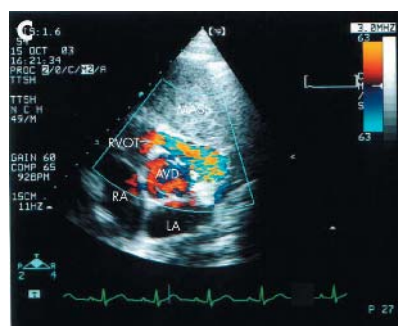
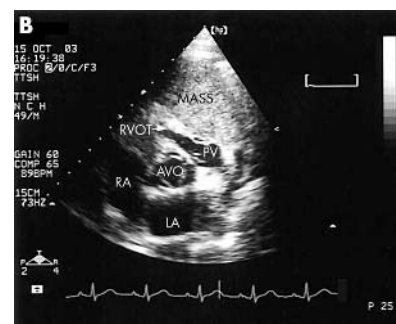
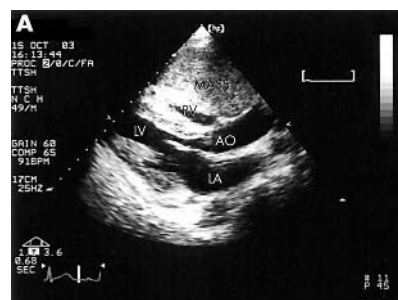
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Extracardiac cause of right ventricular outflow tract obstruction

A 49 year old man was referred to the cardiology clinic for a loud systolic murmur. He was an ex-smoker and had a past history of thyrotoxicosis for which he had radioactive iodine treatment followed by current oral thyroxine replacement. His co-morbid problems included hypertension and hyperlipidaemia. He complained of having retrosternal chest discomfort for two years with a recent onset of exertional dyspnoea over two months. In addition, he also had loss of appetite as well as weight loss over the past one year. On examination, he was clinically euthyroid. There was a loud and harsh ejection systolic murmur loudest over the left lower sternal edge with no radiation of the murmur.

A two dimensional echocardiogram was performed. This revealed a large mass lesion adjacent to the right ventricle (panel A: Ao, aorta; LA, left atrium; LV, left ventricle; RV, right ventricle). Colour flow imaging demonstrated a mosaic pattern consistent with that of a turbulent flow across the right ventricular outflow tract (panels B and C: AVO, aortic valve orifice; PV, pulmonary valve; RVOT, right ventricular outflow tract). The peak Doppler gradient across the right ventricular outflow tract was 24 mm Hg (panel D).

A computed tomogram (CT) of the thorax was performed on the same day. This showed a heterogenous anterior mediastinal mass measuring approximately 8 × 6 cm which was invading the pericardium inferiorly (panels E and F). The mass was distorting the superior portion of the right ventricle. It was also displacing the pulmonary trunk posteriorly. Several lobulated hypodensities were seen in the right hepatic lobe and the caudate lobe which were suggestive of hepatic metastases. The patient then underwent a CT guided biopsy of this anterior mediastinal mass.



The histopathology of this mass was consistent with that of a thymic carcinoma. He was referred to the oncologist

and chemotherapy was planned as the modality of treatment for his condition.

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