# Stroke Risk in Patients with Implanted Cardiac Devices

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**KEYWORDS**

• Atrial fibrillation • Stroke • Atrial high rate events • Defibrillator • Pacemaker • Thromboembolism

**KEY POINTS**

- Current technology of cardiac implanted electronic devices (CIED) allows continuous monitoring of atrial tachyarrhythmias and digitally stores the electrograms associated with atrial high rate events (AHRE).
- AHRE of greater than 5 minutes' duration have a 97% accuracy of being atrial fibrillation (AF).
- Newly diagnosed AF, as detected by stored electrograms of CIEDs during routine device interrogation, is often unassociated with symptoms ("silent AF") and occurs with high frequency (≈25% of patients).
- Compared with patients without device-detected AHRE, patients with device-detected AHRE have a significantly greater risk for stroke.
- Data from CIEDs suggest that AF duration is a risk factor for thromboembolic events.
- Currently, there is no consensus on initiation or withdrawal of anticoagulation therapy in response to device-detected AF; however, AHREs detected by device interrogation should prompt the consideration to begin anticoagulation/antiplatelet therapy.

## INTRODUCTION

The presence of atrial fibrillation (AF) increases the risk of ischemic stroke by 5-fold.[1] In the Framingham study, it is estimated that AF causes 14% of all stroke, and the mechanism is thromboembolism (TE).[2–4] Primary prevention anticoagulation therapy using warfarin with a target international normalized ratio (2.0–3.0) or the newer oral anticoagulants (direct thrombin inhibitors and factor X antagonists) have demonstrated a significant reduction of stroke as well as all-cause mortality.[5–10] The initiation of anticoagulation for patients with AF and high risk for thromboemboli is thus of critical importance. However, many patients with AF are unaware of their AF episodes (ie, asymptomatic or "silent" AF), which has been reported to occur in 24% of AF patients.[11] For these patients, the first manifestation of AF may be a TE event.

The diagnosis of asymptomatic (silent) AF is increasingly encountered in clinical practice in patients with cardiac implantable electronic devices (CIED) in 2 different clinical presentations. The first is when a CIED is implanted in a patient who has no prior diagnosis of AF; then, during routine follow-up, device-stored electrograms confirm the diagnosis of AF that may have occurred several months earlier and could be of

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long duration. These episodes of newly diagnosed AF (NDAF) may not be associated with any symptoms. The second scenario is device detection of NDAF in patients who have had an embolic cryptogenic stroke before device implantation. The CIED then confirms the diagnosis of asymptomatic AF, which may be the cause of the stroke.

The purpose of this article is to review the data regarding these 2 scenarios and to address clinical management.

## ATRIAL HIGH RATE EVENTS DETECTED BY CIED

CIED routinely monitor for atrial high rate events (AHRE). With the current technology of CIEDs, when an AHRE duration exceeds 5 minutes, the accuracy of a diagnosis of AF is 97%. Unlike clinical AF, most device-detected AF is brief in duration, infrequent, and usually asymptomatic.

Clinical data of AHRE detected by CIEDs have been derived from observational studies with no consensus on the definition or management of AHRE. In pooled data from 9 observational studies including a total of 8853 patients who had CIED, NDAF developed in 2040 patients (23%) during an average follow-up of 17 months (Table 1).[12–20] The detection rate of NDAF increased during continued follow-up, reaching 35% to 40% at 30 to 40 months (Fig. 1).

These same studies also demonstrated that there is poor correlation between device-detected AHRE and symptoms. Orlov and colleagues[14] reported AHRE in 46% of 331 patients with a pacemaker. Nevertheless, when patients

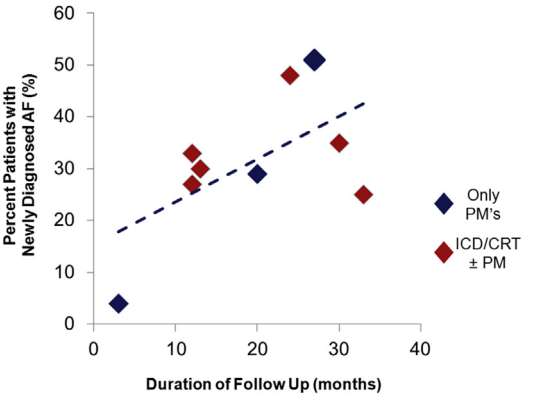


**Fig. 1.** Relationship between duration of CIED follow-up and NDAF. Data generated from studies presented in Table 1. CRT-D, defibrillator with cardiac resynchronization pacing; ICD, implantable cardiac defibrillator; PM, pacemaker.

complained of symptoms, there was no AHRE on 92% of symptomatic days. Another study by Quirino and colleagues[21] confirmed the same observation that 81% of symptomatic days had no AHRE. The correlation between symptoms and AHRE was higher when the duration of AHRE was greater than 24 hours.

Even though the patient is often asymptomatic, AHREs significantly increase the risk of developing clinical AF and has been illustrated in 2 important observational studies. In the Mode Selection Trial (MOST) pacemaker substudy, 312 patients, who did not have a prior diagnosis of AF, were followed for 27 months. AHREs were recorded in 51% of patients and clinical AF subsequently developed

**Table 1**
**Summary of clinical trials of NDAF from CIEDs**

| Study | Number of Patients | Device | AHRE (bpm) | Duration | Patients with NDAF | F/U (mo) |
|---|---|---|---|---|---|---|
| MOST[12] | 312 | PM | ≥220 | ≥10 beats | 160 (51%) | 27 |
| Cheung[13] | 262 | PM | ≥177 | ≥5 min | 77 (29%) | 20 |
| Orlov[14] | 331 | PM | >180 | ≥1 min | 159 (48%) | 24 |
| Bunch[15] | 1170 | ICD | — | ≥12 beats | 45 (4%) | 3 |
| Borleffs[16] | 223 | CRT-D | >180 | ≥10 min/d | 55 (25%) | 33 |
| Caldwell[17] | 101 | PM/ICD/ CRT-D | ≥200 | >30 s | 27 (27%) | 12 |
| TRENDS[18] | 1428 | PM/ICD | ≥175 | ≥5 min | 432 (30%) | 13 |
| Shanmugam[19] | 382 | CRT-D | >180 | ≥14 min/d | 127 (33%) | 12 |
| ASSERT[20] | 2580 | PM/ICD | ≥190 | ≥6 min | 633 (25%) | 30 |

TOTAL: 6789 patients; NDAF in 1715 (25%) patients during an average follow-up ≈17 months.

*Abbreviations:* CRT-D, defibrillator with cardiac resynchronization pacing; Dx, diagnosis; F/U, follow-up; ICD, implantable cardiac defibrillator; PM, pacemaker.