Does Atrial Fibrillation Detected by Cardiac Implantable Electronic Devices Have Clinical Relevance?

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KEYWORDS

• Atrial fibrillation • Stroke • Implantable device • Continuous monitoring

KEY POINTS

- The precise role atrial fibrillation (AF) plays in increasing the risk of stroke is not well understood, and this is especially true for the implanted device population.
- Current cardiac implanted electronic devices have a very high sensitivity and specificity for true AF detection.
- It does not seem to matter if the AF episode is proximal to the stroke event, and risk seems to be increased by relatively brief AF episodes.
- The appearance of new atrial high-rate episodes increases thromboembolic event rates.
- Until larger trials or registries are conducted, it is important to follow established guidelines regarding anticoagulation.

The current evidence suggests the prevalence of atrial fibrillation (AF) detected by cardiac implanted electronic devices (CIEDs) is considerable, and the presence of this device-detected AF increases the risk of thromboembolism. The AF burden threshold which confers this increased thromboembolism risk is not precisely defined, but may be as brief as several minutes or as long as several hours. The advent of novel oral anticoagulation (NOAC) medications, which offer the promise of improved efficacy along with superior safety profiles, may warrant more aggressive identification of patients who may benefit from these therapies.

Over the last 10 years it has been learned that symptoms are an unreliable indicator of the presence of atrial arrhythmias. Page and colleagues[1] were among the first to demonstrate this lack of correlation by reporting that for each episode of symptomatic paroxysmal AF, patients were likely to experience 12 episodes of asymptomatic AF. Subsequent studies with implanted devices confirmed more than 90% of stored atrial arrhythmia episodes were asymptomatic.[2,3] Furthermore, it was demonstrated that symptoms thought to be caused by AF, actually correlated with AF in only about 20% of cases.[2–4] This lack of correlation of AF with symptoms led to the repurposing of the term "silent AF," which is now commonly used to describe device-detected AF.

PART 1: SENSITIVITY AND SPECIFICITY OF AF DETECTION BY IMPLANTED DEVICES

To assess the stroke risk of device-detected AF accurately, one must first evaluate the sensitivity and specificity of the detected AF, to be certain the implanted devices are accurately classifying and quantifying AF. AF detection algorithms are

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designed based on their intended application. To avoid rapid pacing in the ventricle, antibradycardia devices must detect atrial arrhythmias quickly to permit mode-switching to a nontracking pacing mode. Devices that deliver atrial tachyarrhythmia therapies, such as implantable cardioverter defibrillators (ICDs), must be highly specific to ensure only true atrial arrhythmias are being treated. If these therapies are delivered erroneously, there can be negative consequences such as proarrhythmia. These devices rely on both rate and pattern information to make accurate detection decisions. Pacemakers and ICDs have sensing leads in the atrium that deliver real-time bipolar intracardiac electrogram information to the implanted device, which make their sensitivity and specificity quite high.

Insertable cardiac monitors (ICMs) have recently been developed to provide continuous arrhythmia monitoring capabilities to patients who do not have an indication for a cardiac rhythm management device. These devices do not have an atrial lead and must detect AF from subcutaneously sensed patterns of ventricular irregularity and incoherence.

AF Detection Based on Mode-Switching

Dual-chamber pacemakers and ICDs that do not deliver atrial therapies have historically used mode-switch detection algorithms to detect AF and prevent ventricular tracking of the rapidly activating atrium. AF detection via mode-switching occurs very quickly and is very sensitive. Details regarding the operation of various mode-switching algorithms have been previously described,[5] but, in general, involve switching from an atrial tracking mode during sinus rhythm to a nontracking mode during atrial arrhythmias. A representative sample of the atrial intracardiac electrogram is typically stored in the device memory for clinicians to examine and adjudicate.

Passman and colleagues[6] reported a sensitivity and specificity for atrial tachyarrhythmia episode detection of 98.1% and 100%, respectively. In this evaluation, they also showed 98.9% of the overall duration of AF was detected accurately. Similarly, De Voogt and colleagues[7] found 99.9% of atrial tachycardia (AT)/AF duration was detected accurately. In contrast, other studies have reported instances of repetitive non-reentrant VA synchrony, which are frequently caused by long programmed AV delays[8] or interactions with AF suppression algorithms,[9] resulting in higher rates of false atrial tachyarrhythmia detection. This repetitive non-reentrant VA synchrony phenomenon contributed to positive predictive values (PPV) of 59.7% across all episodes, 82.7% for episodes greater than 6 minutes in duration, and 96.7% for episodes greater than 6 hours in duration in the ASSERT (ASymptomatic atrial fibrillation and Stroke Evaluation in pacemaker patients and the atrial fibrillation Reduction atrial pacing Trial) trial.[9] These results are consistent with the finding of Pollak and colleagues,[10] who found episodes greater than 5 minutes in duration had a high correlation with true AF and atrial flutter.

AF Detection Based on Rate and Pattern

High specificity for AF detection in devices that deliver atrial therapies (including most ICDs and some pacemakers) has been achieved by the use of more sophisticated detection algorithms. These algorithms often combine atrial rate information with pattern-based algorithms to recognize an atrial tachyarrhythmia when there is greater than 1:1 Atrial:Ventricular conduction, while rejecting far-field R-wave oversensing on the atrial sensing channel.

Purerfellner and colleagues[11] reported greater than 95% of AF episodes detected by both ICDs and pacemakers with atrial therapy capabilities were true episodes and 100% of sustained atrial arrhythmias observed on Holter recordings were detected appropriately by these devices. Similarly, Swerdlow and colleagues[12] reported a PPV of 98% for episodes of AF detected among ICD recipients. These investigators also observed an AF duration sensitivity and specificity of 100% and 99.99%, respectively. In contrast to previous reports,[9] the RESPECT (Reducing Episodes by Septal Pacing Efficacy Confirmation Trial) investigators did not observe an interaction between the AF detection algorithm and AF prevention algorithms in the devices they analyzed.[13] Furthermore, this study demonstrated a high PPV (95%) for even very brief episodes of less than 6 minutes in duration, which underscores that there can be significant differences between manufacturers and specific devices in terms of AF detection accuracy.

AF Detection Based on Ventricular Irregularity and Incoherence

For patients who do not require brady pacing or protection against sudden cardiac death, subcutaneous devices have been developed to provide continuous arrhythmia detection and monitoring capabilities. Early versions of these ICMs were capable of detecting tachyarrhythmias based solely on ventricular rate and were not designed to be highly sensitive and specific for AF. Recently, ICMs that have dedicated and validated AF