Remote Monitoring for Chronic Disease Management

Atrial Fibrillation and Heart Failure

Maki Ono, MD, PhD[a,b], Niraj Varma, MD, PhD[b,*]

KEYWORDS

• Remote monitoring • Heart failure • Atrial fibrillation • Cardiac implantable electronic devices • Pacemaker • Implantable cardioverter defibrillator • Cardiac resynchronization therapy

KEY POINTS

- Remote monitoring for cardiac implantable electronic devices is a class I recommendation.
- Device-detected atrial fibrillation increases the risk of stroke and remote monitoring is useful for early detection and intervention for atrial fibrillation.
- Definitive data for merits of early anticoagulation to reduce the risk of stroke are awaited, but current evidence does not support discontinuation of anticoagulation based on remote monitoring.
- Multiparameter monitoring with automatic transmission is useful for heart failure management including mortality benefit.
- Thoracic impedance alone lacks the evidence to support its usefulness for clinical outcome for heart failure.

INTRODUCTION

More than 10 years have passed since the introduction of automatic remote monitoring (RM) of cardiac implantable electronic devices (CIEDs) and strong evidence has been built for its usefulness for the early detection of ventricular arrhythmias and the evaluation of system performance, such as lead failure and battery depletion.[1–5] Now we enter a new growth era to effectively use RM for chronic heart disease management, specifically for atrial fibrillation and heart failure.

In developed countries, atrial fibrillation and heart failure pose a significant medical burden. Atrial fibrillation, apart from triggering inappropriate shocks in implantable cardioverter-defibrillators (ICDs), affects patients in 2 major ways: (1) increased thromboembolic risk such as stroke and (2) precipitation of heart failure owing to the loss of atrial contraction and biventricular pacing, variation in ventricular cycle duration, or higher ventricular response rate. For the former, prompt anticoagulation decisions based on RM alerts and patient's profile such as embolic risk score (eg, CHADS2 or CHA2DS2-VASc2) and bleeding risk score (eg, HAS-BLED score) is ideal. For the latter, RM may prevent heart failure deterioration, with or without atrial fibrillation. Central to these aims is the early detection ability provided by RM.

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[a] Department of Cardiology, Kameda General Hospital, 929 Higashi-cho, Kamogawa City, Chiba 296-8602, Japan; [b] Cardiac Pacing and Electrophysiology, Heart and Vascular Institute, Cleveland Clinic, J2-2, 9500 Euclid Avenue, Cleveland, OH 44195, USA

* Corresponding author.

E-mail address: varman@ccf.org

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In this article, we provide an overview on the latest evidence of RM in terms of atrial fibrillation and heart failure management, update the current technology relating to the method, and discuss the future of RM.

REMOTE MONITORING AND ATRIAL FIBRILLATION

Current Evidence About Device-Detected Atrial Fibrillation

Prior studies have shown that the detection of device-based rapid atrial rate correlated well with electrocardiographic documentation of atrial fibrillation[6–8] and that either a high burden of atrial fibrillation or arrhythmia episodes are independent predictors for stroke and mortality.[9–13] Implanted devices provide a more sensitive and accurate measure of atrial fibrillation than symptoms.[14–16] The ASymptomatic atrial fibrillation and stroke Evaluation in pacemaker patients and the atrial fibrillation reduction atrial pacing trial (ASSERT) Investigators documented that device-detected atrial tachyarrhythmias, even asymptomatic subclinical atrial fibrillation, were associated with a significant increase of ischemic stroke or systemic embolism.[17–19]

The relationship between atrial fibrillation and stroke was, however, not as simple and direct as anticipated. This link was shown by the time lag between atrial fibrillation and thromboembolic event.[20] A subanalysis of the ASSERT trial clarified that, although subclinical atrial fibrillation was associated with an increased risk of stroke and embolism, very few patients had subclinical atrial fibrillation in the month before their event.[21] In another observational study, Shanmugam and colleagues[22] demonstrated that the majority of patients (73%) did not show a temporal association with the detected atrial episode and their adverse event, with a mean lag period of 46.7 $\pm$ 71.9 days before the thromboembolic complication. Thus, the link between atrial fibrillation and stroke seems to be more complex than previously appreciated, and subclinical atrial fibrillation may simply be a risk marker for stroke or may cause stroke via an indirect mechanism. Atrial fibrillation burden may play a role. Shanmugam and colleagues[22] demonstrated that patients with device-detected atrial high rate of greater than 3.8 hours over a day were 9 times more likely to develop thromboembolic events compared with patients without atrial high rate episodes (P<.006). A recent subanalysis of the ASSERT trial demonstrated a relationship of duration of subclinical atrial fibrillation and embolism. Patients with a duration of atrial fibrillation of greater than 24 hours had a significantly increased risk of subsequent stroke or systemic embolism (adjusted hazard ratio, 3.24; 95% confidence interval [CI], 1.51–6.95; P = .003).[23] The other end of the spectrum, short (<30-s) atrial fibrillation duration was not associated with increased risk.[24] Thus, although the causal relationship between atrial fibrillation and stroke remains unclear, current data indicate that a longer duration of atrial fibrillation (ie, >24 hours) is associated with a higher risk of stroke.

Current Evidence About Remote Monitoring and Atrial Fibrillation

The automatic intervention algorithm to suppress atrial fibrillation (eg, AF Suppression, continuous atrial overdrive pacing) was not only ineffective but also poorly tolerated for the management of new-onset atrial fibrillation, and it accelerated battery depletion.[25] Therefore, medical intervention by medical professionals, such as optimization of medication including anticoagulation with or without invasive methods such as cardioversion or ablation, should be considered. The next clinical question is whether we can reduce embolism and heart failure precipitated by atrial fibrillation by RM or not,[26] and if we can, what is the most efficient way of intervening.

The reliability of RM for atrial arrhythmia detection, quantification, and early notification has been well-established.[27] The percentage of inappropriate atrial fibrillation detection (owing to far-field R wave oversensing, T wave oversensing, repetitive nonreentrant V-A synchrony, or noise) is reduced using RM that permits visualization of intracardiac electrograms.[7,28] The HomeGuide Registry clarified that automatic RM had a high sensitivity and positive predictive value for major cardiovascular events, including atrial fibrillation.[29] Among the true positive events, 36% were atrial tachyarrhythmias and 93% of the atrial events were detected by RM. This technology allowed early detection of atrial fibrillation in CIED patients and appropriate reaction to optimize medical treatment on average 148 days earlier.[30] Computer modeling suggested that automatic daily monitoring of patients potentially reduced the stroke risk by 9% to 18% with an absolute reduction of 0.2% to 0.6% compared with standard follow-up with intervals of 6 to 12 months.[31] These observational studies and registry promised a potential paradigm shift for the care of patients with atrial fibrillation. However, data from randomized, controlled trials have not been so definitive.

In the Cardiovascular Outcomes for People Using Anticoagulation Strategies (COMPAS) trial[32] hospitalizations for atrial arrhythmias (6 vs 18) and strokes (2 vs 8) were fewer (P<.05) in RM group than in the control group. However, the IMPACT