

Interrogation of Patient Smartphone Activity Tracker to Assist Arrhythmia Management

Joshua Rudner, DO; Carol McDougall, MSN, APN-C; Vivek Sailam, MD; Monika Smith, DO; Alfred Sacchetti, MD*

*Corresponding Author. E-mail: sacchetti1011@gmail.com, Twitter: @SacchettiAlfred.

A 42-year-old man presented to the emergency department (ED) with newly diagnosed atrial fibrillation of unknown duration. Interrogation of the patient's wrist-worn activity tracker and smartphone application identified the onset of the arrhythmia as within the previous 3 hours, permitting electrocardioversion and discharge of the patient from the ED. [Ann Emerg Med. 2016;■:1-3.]

0196-0644/\$-see front matter

Copyright © 2016 by the American College of Emergency Physicians.

<http://dx.doi.org/10.1016/j.annemergmed.2016.02.039>

INTRODUCTION

Activity trackers are becoming more commonplace as personal monitoring devices to record steps taken, distances covered, and pulse rates.^{1,2} We report here the use of an activity tracker to determine the onset time of a patient's arrhythmia to guide his emergency department (ED) management.

CASE REPORT

A 42-year-old man presented to the ED after a self-limited grand mal seizure. The seizure occurred 20 minutes before arrival and was witnessed by coworkers and described as lasting approximately 1 minute, followed by a postictal period. The patient had a history of seizures managed with oxcarbazepine 900 mg twice daily, although he later admitted he had missed his morning dose that day. The patient had no other relevant medical history.

Emergency medical services providers reported that on their arrival the patient was postictal, with significant findings of a rapid irregularly irregular pulse rate of up to 190 beats/min and atrial fibrillation on their cardiac monitor. The patient was treated with a single bolus injection of diltiazem on scene, which slowed his pulse rate to a range of 100 to 120 bpm.

Initial assessment at arrival to the ED revealed an awake aware man in no acute distress. Vital signs included a blood pressure of 135/64 mm Hg, an irregularly irregular pulse rate of approximately 163 beats/min with variations between 130 and 190 beats/min, respiration rate of 20 breaths/min, an oral temperature of 37.2°C (98.9°F), and a room air pulse oximetry of 94%.

The patient's physical examination result was essentially normal, with the exception of his cardiac and neurologic

examination results. Auscultation of the heart demonstrated a rapid irregularly irregular rhythm with no abnormal heart sounds. Neurologically, the patient's examination result demonstrated no focal deficits, with his only significant finding being a slightly depressed mental status thought to be a result of his resolving postictal state.

An ECG obtained at the time confirmed atrial fibrillation with a rapid ventricular response of 150 beats/min. There were no other acute findings on the tracing.

During the next 30 minutes, the patient's mental status cleared and he returned to his baseline state.

Management in the ED included administration of oxcarbazepine 900 mg orally and a repeated diltiazem bolus. After the diltiazem administration, the patient remained in atrial fibrillation, but the pulse rate decreased to 80 to 100 beats/min.

Both the patient and his wife confirmed that he had no history of cardiac disease and no previous episodes of atrial fibrillation. The patient could not sense any abnormality in his pulse rate either when he had a rapid ventricular response or when his rate was controlled.

The treatment of recent-onset atrial fibrillation in the ED of Our Lady of Lourdes Medical Center is electrocardioversion in any patient who can reliably relate an arrhythmia onset time of less than 48 hours or who receives long-term anticoagulation. Because the patient was asymptomatic during his current atrial fibrillation event, it was not possible to assign an onset time for his arrhythmia.

During the patient's examination, it was noted that he was wearing a wrist activity tracker (Fitbit Charge HR, Fitbit, San Francisco, CA), which was synchronized with an application on the patient's smartphone, recording his pulse rate as part of a fitness program. The application was accessed

on the patient's smartphone and revealed a baseline pulse rate between 70 and 80 beats/min, with an immediate persistent increase to a range of 140 to 160 bpm at the approximate time of the patient's seizure. The pulse rate remained elevated until administration of the diltiazem in the field.

Once the patient's onset time for his atrial fibrillation was established as 3 hours before ED presentation, he was considered a candidate for rhythm conversion. The patient was sedated with propofol and underwent a single successful synchronized 200-J cardioversion to normal sinus rhythm in the ED. The patient's smartphone application was again interrogated after the cardioversion and accurately recorded the change in pulse rate consistent with a rhythm change from atrial fibrillation to normal sinus rhythm. The activity tracker was left in place during the procedure, with no adverse effects noted to either the patient's wrist or the device. After recovery from his procedural sedation, the patient was discharged home with arrangements for outpatient cardiology follow-up.

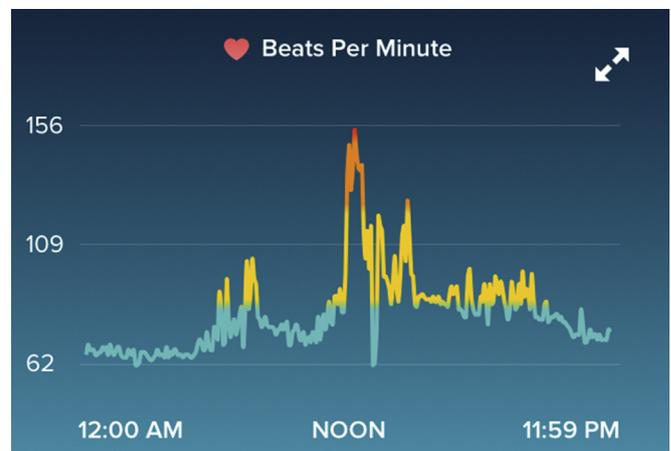
At his follow-up appointment, the patient was in normal sinus rhythm, with no cardiovascular complaints.

The [Figure](#) presents the screen capture from the smartphone application tracking the patient's pulse rate. The changes at the onset and termination of the atrial fibrillation can be noted, as well as the decreases in pulse rate after the diltiazem boluses.

DISCUSSION

Activity trackers are best described as wearable electronic devices capable of monitoring physical activity and limited physiologic parameters. Elite athletes may use very sophisticated activity trackers as part of their training or competitive regimens, although most activity trackers in use are worn by individuals to record daily activities such as steps taken or distances covered. Wearable electronic devices may be self-contained but many synchronize with an enabled device such as a smartphone or computer to permit trending and analysis of the activity being tracked.

Not all activity trackers measure pulse rates, but this is the function of most value to medical providers. The FitBit Charge HR is worn on the wrist and determines pulse rate through a pulsed light-emitting diode and a light-sensing photodiode to measure light reflected from blood in capillary beds. This allows the unit to detect alterations in capillary blood volume, and a computer algorithm is then used to filter out noise and calculate a pulse rate. Pulse rate monitoring with activity trackers has been shown to compare favorably with measurements from a professional pulse oximeter.^{3,4} At present, activity trackers are not considered approved medical devices, and use of their



RESTING HEART RATE

76 bpm

TIME IN HEART RATE ZONES

Figure. Screen capture from smartphone application synchronized with activity tracker demonstrating pulse rate change with onset and termination of atrial fibrillation. Decreases in pulse rate after administration of diltiazem can also be seen. The maximum pulse rate noted on the activity tracker dashboard is approximately 150 beats/min, which is lower than the 190 beats/min reported by the paramedics. This difference is a result of the averaging interval for the activity tracker being longer than the averaging interval on the paramedics' cardiac monitor. This particular device can display pulse rates averaged at either 5- or 1-minute intervals.

information to make medical decisions is at the clinician's own discretion.

Any number of symptomatic conditions can resolve before an encounter with a medical provider. Syncope, palpitations, dizziness, and even chest pain are all frequently self-limited complaints, leaving the clinician with only the history of the present illness on which to formulate a diagnosis. In many instances, knowledge of the patient's pulse rate at the event could help in establishing a firmer diagnosis. Dizziness associated with a pulse rate of 180 beats/min would be approached much differently than the same complaint with a pulse rate of 30 beats/min.

Interrogation of an activity tracker can not only correlate symptoms with pulse rates but also document the onset or duration of abnormally high or low rates. As in the case report described here, the identification that the patient's atrial fibrillation was present for only a few hours permitted him to undergo cardioversion as opposed to simply receive rate control and then an anticoagulant. Information from

the activity tracker could also be used to determine the frequency of tachycardic events in a patient with intermittent atrial fibrillation and aid in determining whether long-term anticoagulation or ablative therapy were required.

Another use of activity trackers is in reconstruction of the heart's activity surrounding a major adverse event. Using the pulse rate record in a patient presenting in cardiac arrest may help direct resuscitative efforts or postresuscitation care. A patient with a sudden loss of any pulse rate is more likely to have experienced a primary ventricular fibrillation event compared with a patient who develops rapid tachycardia followed by bradycardia progressing to asystole and who has a suspected pulmonary embolism or aortic catastrophe. These devices could also be used to establish the time when detection of pulse activity was lost, which might help to identify patients for whom resuscitative efforts might be futile.

Unlike formal professional medical monitors, activity trackers cannot identify the type of arrhythmia present, only the pulse rate. There are other smartphone applications that can determine rhythm, as well as pulse rate. These devices are similar to event recorders and require patients to actively initiate monitoring when they become symptomatic. However, even without the ability to record a rhythm, tracking rate abnormalities can guide the clinician in designing further evaluation strategies using more sophisticated instrumentation.

To date, activity trackers have been used medically only to encourage or monitor patient activity, particularly in conjunction with weight loss programs.^{5,6} To our knowledge, this is the first report to use the information in an activity tracker–smartphone system to assist in specific

medical decisionmaking. The increased use of these devices has the potential to provide clinicians with objective clinical information before the actual patient encounter.

Supervising editor: Tyler W. Barrett, MD, MSCI

Author affiliations: From the Department of Emergency Medicine, Thomas Jefferson University, Philadelphia, PA (Rudner); and the Department of Cardiology (McDougall, Sailam) and Department of Emergency Medicine (Smith, Sacchetti), Our Lady of Lourdes Medical Center, Camden, NJ.

Funding and support: By *Annals* policy, all authors are required to disclose any and all commercial, financial, and other relationships in any way related to the subject of this article as per ICMJE conflict of interest guidelines (see www.icmje.org). The authors have stated that no such relationships exist.

REFERENCES

1. O'Brien T, Troutman-Jordan M, Hathaway D, et al. Acceptability of wristband activity trackers among community dwelling older adults. *Geriatr Nurs*. 2015;36:S21-S25.
2. Shin DW, Joh HK, Yun JM, et al. Design and baseline characteristics of participants in the Enhancing Physical Activity and Reducing Obesity Through Smartcare and Financial Incentives (EPAROSFI): a pilot randomized controlled trial. *Contemp Clin Trials*. 2015;47:115-122.
3. Evenson KR, Goto MM, Furberg RD. Systematic review of the validity and reliability of consumer-wearable activity trackers. *Int J Behav Nutr Phys Act*. 2015;12:159.
4. El-Amrawy F, Nounou MI. Are currently available wearable devices for activity tracking and heart rate monitoring accurate, precise, and medically beneficial? *Healthc Inform Res*. 2015;21:315-320.
5. Wang JB, Cadmus-Bertram LA, Natarajan L, et al. Wearable sensor/device (Fitbit One) and SMS text-messaging prompts to increase physical activity in overweight and obese adults: a randomized controlled trial. *Telemed J E Health*. 2015;21:782-792.
6. Rowe-Roberts D, Cercos R, Mueller F. Preliminary results from a study of the impact of digital activity trackers on health risk status. *Stud Health Technol Inform*. 2014;204:143-148.