CJC Open 4 (2022) 424–427

Case Report

Polymorphic Ventricular Tachycardia Detected With a Smartwatch

Kaien Gu, MD,[a] Kirsten Marshall, MD,[b] Quinn Robertson-Stovel, BSc,[c] and Shelley Zieroth, MD[b,d]

[a] Department of Medicine, University of Manitoba, Winnipeg, Manitoba, Canada
[b] Section of Cardiology, Department of Medicine, University of Manitoba, Winnipeg, Manitoba, Canada
[c] Max Rady College of Medicine, University of Manitoba, Winnipeg, Manitoba, Canada
[d] St Boniface Hospital, Winnipeg, Manitoba, Canada

ABSTRACT

"Wearable" devices are a rapidly evolving technology that often can record and store personal healthcare data. We report the case of a 64-year-old woman who presented with a syncopal episode and subsequent cardiac arrest, ultimately requiring a dual-chamber implantable cardioverter defibrillator. Prior to hospitalization, she obtained electrocardiogram recordings using her Apple Watch, due to feeling unwell, and one showed nonsustained polymorphic ventricular tachycardia. Direct-to-consumer electrocardiogram monitors in "wearables" are increasing in popularity and may play a role in the work-up and diagnosis of patients' symptoms. However, they are not a replacement for healthcare expertise, and their misuse may result in undue anxiety and inappropriate healthcare utilization.

RÉSUMÉ

Les appareils « prêt-à-porter » disposent d'une technologie qui évolue rapidement. Ils peuvent souvent enregistrer et stocker les données de santé personnelles. Nous présentons le cas d'une femme de 64 ans qui après avoir subi un épisode de syncope et un arrêt cardiaque subséquent a finalement eu besoin d'un défibrillateur cardioverteur implantable double chambre. Avant l'hospitalisation, elle a obtenu les enregistrements de l'électrocardiogramme grâce à sa montre Apple, puisqu'elle se sentait mal, et l'un des enregistrements montrait une tachycardie ventriculaire polymorphique non soutenue. Les moniteurs électrocardiogrammes vendus directement aux consommateurs dans les « prêts-à-porter » augmentent en popularité et peuvent jouer un rôle dans le bilan de santé et le diagnostic des patients. Toutefois, ils ne remplacent pas les experts de la santé, et leur mésusage peut entraîner une anxiété excessive et une utilisation inappropriée des soins de santé.

In September 2020, a 64-year-old woman presented to the emergency room (ER) of a tertiary care hospital for an episode of syncope. She provided written consent for publication of this case report. Her past medical history included recovered heart failure with reduced ejection fraction, now with a left ventricular ejection fraction of 50%-60% and moderate mitral regurgitation. The cause of her heart failure was unclear and was being worked-up by her community cardiologist. She was diagnosed with atrial flutter with rapid ventricular response 2 months prior and had a successful outpatient cardioversion as a result. Other medical conditions included hypertension, gastroesophageal reflux, and diverticulosis. Prescribed medications at the time of admission were sacubitril/valsartan, rivaroxaban, triamterene/hydrochlorothiazide, and rabeprazole. The patient stated that her outpatient cardiologist had recently stopped her bisoprolol and amiodarone, originally initiated for rate control of her atrial flutter, on account of symptomatic bradycardia.

On this presentation, she was started on an amiodarone infusion in the ER for high burden of ventricular ectopy, predominantly ventricular bigeminy. Her initial QTc in the electrocardiogram (EKG) obtained at triage was automatically calculated to be prolonged; however, the recording demonstrates late-coupled premature ventricular contractions, and the precise QT cannot be calculated (Fig. 1). Her heart rate dropped to 35-50 beats per minute on the amiodarone infusion, with continued runs of nonsustained polymorphic ventricular tachycardia (PMVT). The electrophysiology service recommended stopping amiodarone and starting isoproterenol for overdrive suppression of the ventricular ectopy. Within the first hour of this change in management,

Received for publication August 1, 2021. Accepted December 8, 2021.

Ethics Statement: The subject of this case report provided written consent for its publication.

Corresponding author: Dr Kaien Gu, GH415-820 Sherbrook Street, Winnipeg, Manitoba R3A 1R9, Canada. Tel.: +1-431-275-6102.
E-mail: kgu@manitoba-physicians.ca

See page 426 for disclosure information.

https://doi.org/10.1016/j.cjco.2021.12.003

Novel Teaching Points

- "Wearable" technology, including smartwatches, is a rapidly advancing field of technology that is becoming increasingly popular with the public.
- Such direct-to-consumer devices often contain sensors that allow for collection of healthcare data, such as EKG recordings, that may be beneficial to healthcare professionals in making diagnoses.
- "Wearable" devices are not a replacement for physician expertise, and incorrect interpretation of data may result in undue anxiety and inappropriate healthcare resource utilization.
- Given the expected ubiquity of "wearable" technologies, and advancements in their technological capabilities, professional organizations need to develop guidelines and consensus statements regarding their capabilities, role in diagnoses, and use and potential misuse.

she experienced a witnessed cardiac arrest secondary to PMVT, likely due in part to amiodarone-induced QT prolongation and abnormal repolarization (Supplemental Fig. S1). Resuscitative efforts were initiated, and she regained consciousness after less than 2 minutes of cardiopulmonary resuscitation. A transvenous pacemaker was placed for overdrive pacing, the patient was admitted to the coronary care unit, and arrangements for implantable cardioverter-defibrillator (ICD) insertion were made. A dual-chamber ICD was selected, in keeping with previous guidelines, given this occurrence of PMVT, our patient's history of structural heart disease, and her previously documented episodes of atrial flutter and symptomatic bradycardia; our patient independently met indications for both a pacemaker and an ICD at our institution.[1,2]

During this hospitalization, the discovery was made that she had captured a variety of EKG recordings in the days leading up to her presentation, using her recently acquired smartwatch (Apple Watch Series 5, watchOS 6.2.8; Cupertino, CA). On one captured EKG, which documented nonsustained PMVT and occurred only a few hours before the patient's presentation, the patient endorsed presyncopal symptoms (Fig. 2). This EKG recording was consistent with documented events on telemetry witnessed in the ER.

The patient had an uneventful ICD placement, and her final rhythm was atrial-paced, ventricular-sensed. She was discharged home with outpatient follow-up and provided with a prescription for nadolol in addition to her previous medications.

Discussion

"Wearable" technology is a rapidly advancing area, and the market size is expected to exceed $34 billion in 2020.[3] Within this category of technology, certain direct-to-consumer devices, such as our patient's Apple Watch, have the ability to act as an EKG recorders and record personal health data, making such data more accessible to the general population. A large-scale trial recently demonstrated the ability of a smartwatch to detect atrial fibrillation (AF), and such devices have even been approved for use by Health Canada and the US Food and Drug Administration to provide information to aid

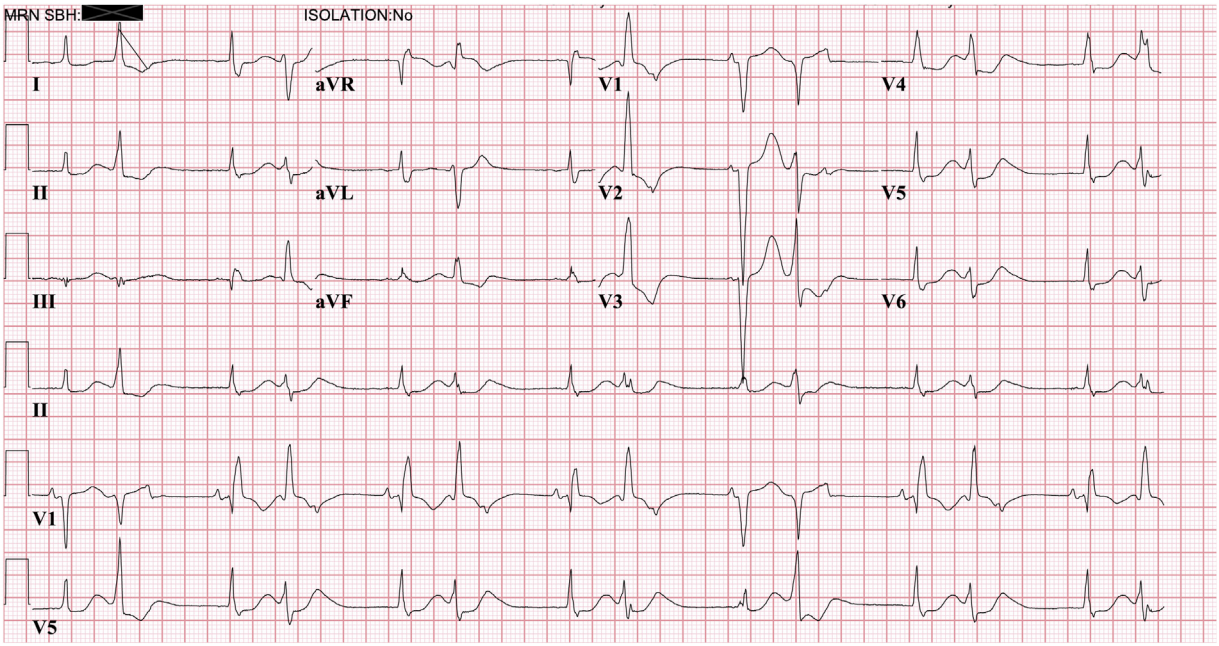

Figure 1. Initial electrocardiogram recordings (25 mm/s, 10 mm/mV, 100 Hz) of our patient on presentation to the emergency department triage, prior to receiving any medications. Her baseline conduction was a right-bundle branch block. The QTc interval was automatically calculated to be 509 milliseconds, though it cannot be precisely calculated.

Figure 2. Lead I electrocardiogram recording from an Apple Watch Series 5 (Apple Inc., Cupertino, CA) (25 mm/s, 10 mm/mV, 513 Hz) prior to presentation to the hospital was notable for a run of polymorphic ventricular tachycardia. Our patient endorsed presyncopal symptoms at the time of this recording.

in the identification of cardiac arrythmias.[4] Advanced capabilities to collect and record personal health data likely will be increasingly common in future-generation "wearables."

Given the transient nature of many cardiac arrhythmias, diagnosis can be a challenge. Although accessibility to traditional diagnostic tests may be inconvenient for patients, advances in "wearable" technology may present a less-invasive alternative for diagnosis of arrhythmia and allow for symptom-rhythm correlation. However, as in the case of the Apple Watch, an individual must initiate an EKG recording of their own volition by following the watch's instructions; such patient initiation would not be possible, for example, during a syncopal episode. Currently, data on the ability of "wearables" to detect arrythmias outside of AF are sparse, and AF is the only irregular rhythm that the Apple Watch can detect. A previous case report did demonstrate the ability of Apple Watch to detect ventricular tachycardia; however, the device cannot recognize it as such and advises the individual to talk to a doctor.[5] In our patient's case, her EKG was marked as "inconclusive," with an average heart rate of 86. Her Apple Watch advised her to contact a doctor if she repeatedly received the result or if she was feeling unwell; neither the irregular rhythm nor the high/low heart rate notifications were triggered. Although no technology "failure" occurred in our case, such technologies present an opportunity for early intervention. Had our patient presented these recordings to her cardiologist (or had even been explicitly prompted to do so), her management plan likely would have been different, and she might have avoided this hospitalization. Future hardware and software enhancements likely will address these shortcomings and allow for better recognition and management of potentially life-threatening arrhythmias.

Despite their benefits and the potential of "wearables" to aid in diagnosis, increased use of EKG recordings via such technology conceivably could result in additional, and potentially unnecessary, healthcare resource utilization and will benefit predominantly those able to afford such technology, further exacerbating already existing inequities in healthcare. However, these devices are not a replacement for healthcare expertise, and ultimately, the individual physician is responsible for interpreting the utility and meaningfulness of such data and how they relate to the patient's clinical presentation and overall diagnosis. Considering this, and given the rapid advances in technology and the variation among different devices, professional organizations, such as the Canadian Cardiovascular Society and Canadian Heart Rhythm Society, should aim to develop guidelines and consensus statements regarding their use, capabilities and limitations, and role in diagnoses.

Funding Sources

The authors have no sources of funding to declare.

Disclosures

The authors have no conflicts of interest to disclose.

References

1. Kusumoto FM, Calkins H, Boehmer J, et al. HRS/ACC/AHA expert consensus statement on the use of implantable cardioverter-defibrillator therapy in patients who are not included or not well represented in clinical trials. Circulation 2014;130:94-125.

2. Epstein AE, Dimarco JP, Ellenbogen KA, et al. ACC/AHA/HRS 2008 guidelines for device-based therapy of cardiac rhythm abnormalities. Heart Rhythm 2008;5:e1-62.

3. Pevnick JM, Birkeland K, Zimmer R, Elad Y, Kedan I. Wearable technology for cardiology: an update and framework for the future. Trends Cardiovasc Med 2018;28:144-50.

4. Perez MV, Mahaffey KW, Hedlin H, et al. Large-scale assessment of a smartwatch to identify atrial fibrillation. N Engl J Med 2019;381:1909-17.

5. Burke J, Haigney MCP, Borne R, Krantz MJ. Smartwatch detection of ventricular tachycardia: case series. HeartRhythm Case Rep 2020;6:800-4.

Supplementary Material

To access the supplementary material accompanying this article, visit *CJC Open* at https://www.cjcopen.ca/ and at https://doi.org/10.1016/j.cjco.2021.12.003.