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CASE REPORT Open Access

Watch for tachycardia

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Abstract

Background: Wearable devices capable of measuring health metrics are becoming increasingly prevalent. Most work has investigated the potential for these devices in the context of atrial fibrillation, our case highlights the potential of wearable devices across a wider range of arrhythmia.

Case presentation: A 51-year-old woman was referred to the cardiology clinic for an assessment of symptoms of intermittent exertional shortness of breath and palpitation. The patient was otherwise fit and well, took limited alcohol and no caffeine, and was a never smoker. There was no family history of heart disease. Physical examination in clinic was unremarkable, and a 12-lead electrocardiogram (ECG), seven-day ambulatory ECG, exercise stress ECG, and trans-thoracic echocardiogram were all normal. During a severe episode the patient recorded an ECG using an Apple Watch (Apple Inc, California, USA). This was forwarded to the patient's cardiologist, who suspected a broad complex tachycardia and organised an urgent follow-up appointment. A further 72-h Holter ECG monitor showed frequent sustained periods of monomorphic ventricular tachycardia, confirming the watch findings. The patient was started on beta blocker therapy with a rapid improvement in symptoms.

Conclusions: Current smartwatch technology can reliably identify irregular rhythms and can distinguish atrial fibrillation from sinus rhythm, with emerging evidence supporting detection of other cardiovascular diseases, including medical emergencies. There may also be a role for wearable devices in screening young populations for predictors of sudden cardiac death. At present device outputs require clinician interpretation, but in the future patients may present to primary or secondary care with a firm diagnosis of arrhythmia and may already be making wearable device guided behaviour changes.

Keywords: ECG, Wearables, Arrhythmia, Smartwatch, Case report, Ventricular tachycardia

Background

Wearable devices capable of measuring metrics related to cardiovascular health are becoming increasingly prevalent. Current work focusses on the management of atrial fibrillation (AF), with other indications being minimally investigated [1, 2]. We present a case of ventricular tachycardia detected via a wearable device in an otherwise fit and well person. We discuss the growing use of digital health devices, their implications for cardiovascular health, and how patient acquired data can transform the way that we manage patients with remote or infrequent symptoms.

Case presentation

A 51-year-old woman was referred to the cardiology clinic for an assessment of symptoms of intermittent exertional shortness of breath and palpitation. The patient was otherwise fit and well, took limited alcohol and no caffeine, and was a never smoker. There was no family history of heart disease. Physical examination in clinic was unremarkable, and a 12-lead electrocardiogram (ECG), seven-day ambulatory ECG, exercise stress ECG, and trans-thoracic echocardiogram were all normal.

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However, the patient started to get increasing episodes of palpitation associated with giddiness and during a particularly severe episode recorded an ECG using her husband's Apple Watch (Apple Inc, California, USA) (Fig. 1a). This was forwarded to the patient's cardiologist, who suspected a broad complex tachycardia and organised an urgent follow-up appointment. The patient reported their symptoms now occur on minimal exertion and their heart rate reaches 200 bpm. There was no history of syncope. A 72-h Holter ECG monitor on this occasion showed frequent sustained periods of monomorphic ventricular tachycardia (see Fig. 1b), confirming the watch findings. The patient was started on beta blocker therapy with a rapid improvement in symptoms.

Discussion

Wearable devices capable of recording digital health information are becoming more commonly available. A 2022 review of wearable devices identified 63 devices capable of recording data relevant to cardiovascular disease, of which 31 were commercial devices sold direct to consumers. Devices are most frequently watches or wristbands, and usually record heart rate, blood oxygen saturation, and/or a single lead ECG. These are marketed to consumers using claims of improving general health [1].

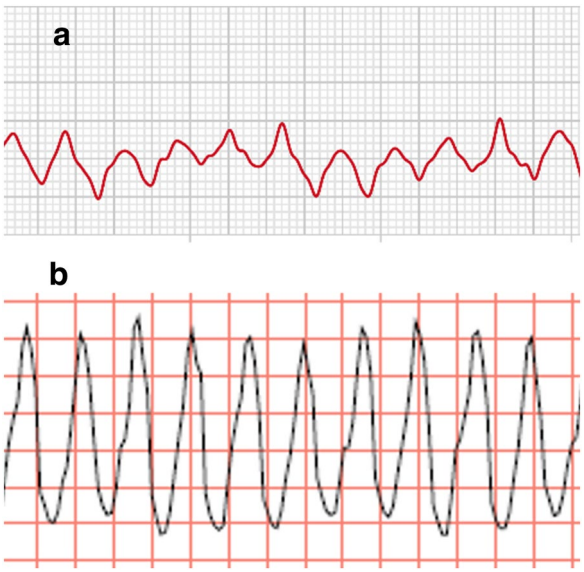

Fig. 1 ECGs captured by Apple iWatch (**a**) and 72 h ECG (**b**), both demonstrating a broad complex monomorphic tachycardia. Both strips are 25 mm/s, 10 mm/mV, and lead I

Atrial fibrillation

The AF has been targeted by wearable device manufacturers because it is the commonest clinical arrhythmia and causes significant mortality and morbidity [2], with diagnosis often delayed until after ischaemic stroke occurs [3]. Eleven commercial devices capable of recording heart rate are validated to distinguish AF from sinus rhythm (SR) [2], with nine devices FDA cleared or approved for this indication [1]. None have FDA approval for arrhythmia management [1]. The Apple Watch ECG can distinguish AF with 96% sensitivity and 97% specificity [4], the AliveCor (California, USA) Kardia with 93% sensitivity and 84% specificity, which increased with physician interpretation [4]. The sensitivity and specificity are lower when traces are of poor quality. Unsupervised use is often disturbed by motion artefact and real-world use may have lower sensitivity and specificity than in a trial setting [3, 5]. Nonetheless, intermittent ECG recordings over an extended period using wearable devices have been shown to be a cost-effective method of screening for AF, particularly in high-risk populations [2, 4]. Apple has received FDA clearance for an app that will store and present the owner's history of irregular rhythm detected via photoplethysmography [6], which may allow for similar population screening. They currently market it to consumers as a method of reducing AF frequency by correlating AF frequency with potential triggers (e.g. alcohol) and encouraging behaviour change aimed at eliminating triggers [7]. This patient empowerment has potential to improve outcomes and lower health care system costs [8]. In patients with known AF, continuous rhythm monitoring may support a "pill in the pocket" approach to AF management or help monitor patients post-intervention to identify those in need of escalation of therapy [4].

Unfortunately, populations with access to wearable devices are usually younger and more affluent, whereas those at risk from AF or its complications are typically older and of lower socio-economic status [4, 5]. Smartphone use in developed nations is high, even among older adults [9, 10], and physician prescription or provision of wearable devices (e.g. Kardia) that utilise smartphone technology may limit the effects of socio-economic status on uptake. Although evidence of increased access to health care services following smartwatch detection of arrhythmia is seen [11], there is limited research on whether these increased detection rates lead to improvement in outcomes (e.g. the reduction of stroke incidence) [2].

Beyond AF

The initial focus on wearable devices has been to identify AF but other indications have been explored. For

example, there are other case series illustrating smartwatch detection of supraventricular and ventricular tachycardias not seen on traditional investigations used to guide clinical management [12, 13]. Caution should be taken when interpreting wearable device interpretation as algorithms are currently only validated to distinguish AF from SR, and 'not AF' should not be taken to mean 'no life-threatening arrhythmia' [2, 14]. Additionally, smartwatch detected irregular rhythms may be ventricular or atrial ectopy, or atrial tachycardia [9]. Self-recording an ECG during symptomatic episodes or smartwatch-detected arrhythmia may enable early symptom-rhythm correlation when reviewed by a clinician, expediting further investigation and management [3, 4, 13, 15]. There is less evidence of the sensitivity and specificity of wearable devices detection of arrhythmia outside AF. ECG traces captured from smartwatches correlate strongly with traditional 12-lead ECG traces in healthy participants [16, 17] and may indicate that clinician interpreted traces may have similar sensitivity and specificity to traditional 12-lead ECG.

These studies assessed supervised use and, much like in studies of AF, smartwatch performance will likely drop due to motion artefact associated with unsupervised use [3, 5]; for example, some artefact shown in Fig. 1a

In addition to work identifying arrhythmia, there is interest in detecting abnormalities associated with sudden cardiac death; For example, by placing the Apple Watch on different locations Nasarre et al.[18] managed to record leads I, V1, V3, and V6. They compared cardiologist interpretation of these leads to traditional 12-lead ECG in participants with and without ECG morphologies associated with sudden cardiac death. They demonstrated that lead 1 alone was capable of detecting QTc prolongation, ventricular pre-excitation, and hypertrophic cardiomyopathy with sensitivities of 80%, 89%, and 92%, respectively. The addition of leads V1, V3, V6 was sensitive for ventricular pre-excitation, Brugada pattern, long-QT, hypertrophic cardiomyopathy, and arrhythmogenic right ventricular cardiomyopathy (sensitivities 100%, 92%, 90%, 85%, 100%, respectively). The combination of leads was highly specific (>99%) for all morphologies.

Conclusion

Current smartwatch technology can reliably identify irregular rhythms and, when supported by ECG recording, can distinguish AF from SR, with emerging evidence supporting detection of other cardiovascular diseases, including medical emergencies. There may also be a role for wearable devices in screening young populations for predictors of sudden cardiac death—of particular importance as the population at risk is comparable to the population using wearable devices. In industrialised nations with easy access to smartphones, health care services may provide wearable devices to use with a patient's smartphone to less affluent or older adults to improve equality of access. The Apple Watch AF history feature represents the next step in patient empowerment allowing owner identification of personal triggers and providing real-time feedback to behaviour changes. At present device outputs require clinician interpretation, but in the future patients may present to primary or secondary care with a firm diagnosis of arrhythmia and may already be making wearable device-guided behaviour changes.

Abbreviations

ECG: Electrocardiogram; AF: Atrial fibrillation; SR: Sinus rhythm.

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OG contributed to original draft and review and editing, PLP contributed to review and editing, ARM contributed to review and editing. All authors read and approved the final manuscript.

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Availability of data and materials

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Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

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Competing interests

The authors declare that they have no competing interests.

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