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Ventricular arrhythmia detected by an Apple Watch – a case report

Arytmia komorowa udokumentowana przez Apple Watch – opis przypadku

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Abstract

The impact of digital health innovations on healthcare is rapidly accelerating. In particular, wearable devices for ambulatory cardiac monitoring are gaining increasing popularity among the general population. A 45-year-old physically active male presented to a cardiology clinic following an episode of palpitations and dizziness, which occurred after a 24-hour work shift. Shortly after symptom onset, he used his Apple Watch to perform an electrocardiogram, which detected monomorphic ventricular tachycardia, followed by sinus rhythm and a premature atrial extrasystole. Despite further extensive testing, no clear cause of ventricular tachycardia was identified. This case highlights the growing role of wearable devices, such as smartwatches, in cardiac monitoring and their ability to detect significant arrhythmias in asymptomatic individuals. However, it also raises questions regarding the extent of diagnostic testing required for such findings, particularly in cases of self-limiting arrhythmias.

Keywords: monitoring, case report, wearable technology, ventricular arrythmia, Apple Watch, m-health

Streszczenie

Wpływ innowacji w zakresie cyfrowego zdrowia na opiekę zdrowotną wciąż się zwiększa. W szczególności coraz większą popularność zyskują urządzenia służące do ambulatoryjnego monitorowania czynności serca. Różne typy przenośnych urządzeń do elektrokardiografii są dostępne zarówno dla osób zdrowych, jak i dla pacjentów cierpiących na choroby układu sercowo-naczyniowego. Czterdziestopięcioletni, aktywny fizycznie mężczyzna zgłosił się do poradni kardiologicznej z powodu epizodów kołatania serca z towarzyszącymi zawrotami głowy, które wystąpiły rano po 24-godzinnym dyżurze. Kilka sekund po wystąpieniu objawów pacjent wykonał elektrokardiogram za pomocą zegarka Apple Watch, który wykazał monomorficzną tachykardię komorową. Mimo przeprowadzenia szerokiej diagnostyki nie zidentyfikowano przyczyny złożonej arytmii komorowej. Przypadek ten podkreśla rosnącą rolę urządzeń, takich jak smartwatche, w monitorowaniu pracy serca oraz ich zdolność do wykrywania istotnych arytmii u osób bezobjawowych. Zwraca także uwagę na dylematy dotyczące zakresu diagnostyki w takich przypadkach oraz podkreśla znaczenie indywidualnego podejścia do pacjenta i potrzebę opracowania wytycznych dotyczących klinicznej oceny arytmii wykrywanych przez urządzenia noszone.

Słowa kluczowe: monitorowanie, opis przypadku, urządzenia/technologia noszalna, arytmia komorowa, Apple Watch, m-zdrowie

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INTRODUCTION

The impact of digital health innovations on healthcare is rapidly accelerating. In particular, wearable devices for ambulatory cardiac monitoring are gaining increasing popularity among the general population. Different types of portable devices for electrocardiography (ECG) are available, both for healthy individuals and patients afflicted with cardiovascular diseases[1,2]. The use of mobile devices in health services is referred to as mobile health (m-health)[3,4]. M-health technologies provide health services anytime and anywhere, overcoming temporal and geographic barriers[3]. Highlighting m-health technologies, the demand for wearable devices continues to grow[3]. The wearables market is expected to see an annual growth rate of 20% in the coming years, reaching approximately 150 billion euros by 2028[5].

Smartwatches are especially popular for their 24-hour monitoring of heart rate and ECG, including during periods of exercise or intense physical activity. These devices enable the detection of serious ECG abnormalities in otherwise asymptomatic individuals[6]. Some smartwatches, such as the Apple Watch (AW), have been approved by the Food and Drug Administration for the diagnosis of atrial fibrillation (AF)[7–9]. Moreover, the usefulness of smartwatches in diagnosing other ECG abnormalities, such as ventricular tachycardia (VT), recurrent nocturnal ST-T deviation, sinus bradycardia, second- and third-degree atrioventricular block, and atrioventricular reentry tachycardia, has also been previously reported[10–18]. What is worth underlining is that these medical situations fall outside the designed detection parameters of the AW and other smartwatches.

The widespread availability of wearable devices and the increasing health awareness, especially among young and physically active individuals, may pose challenges for cardiologists. Many people may seek professional advice after receiving a supposed "diagnosis" from their smartwatch. Here, we present one example of such a patient.

A 45-year-old healthy, physically active man presented to the cardiology clinic because of palpitation episodes with accompanying dizziness, which occurred in the morning after a 24-hour work shift. A few seconds after the onset of symptoms, he decided to perform an ECG using an AW (Fig. 1). In the past, he had experienced palpitations, but of a different type. He denied loss of consciousness, chest pain, or exercise intolerance. A single-lead AW ECG recorded monomorphic VT (Fig. 1), followed by sinus rhythm and a single premature atrial extrasystole. This finding prompted further diagnostic tests. The resting 12-lead ECG revealed sinus bradycardia (53 bpm), incomplete right bundle branch block, and heart axis deviation to the left (Fig. 2). An extended 7-day Holter ECG recorded 607 instances of single premature ventricular extrasystole without any complex ventricular arrhythmia. Transthoracic echocardiography showed a normal left ventricle size and left ventricular ejection fraction. To exclude coronary artery disease, computed tomography was performed, revealing only early-stage atherosclerosis – non-calcified, high-risk atherosclerotic plaques resulting in 15–20% stenosis in the left anterior descending artery; there were no other stenoses. Gadolinium-enhanced cardiac magnetic resonance imaging showed normal sizes of both ventricles, normal regional contractility, and normal global left ventricular systolic function (70%). In late post-contrast enhancement sequences, a discrete intramuscular area of enhancement within the basal segments of the anteroseptal and inferoseptal walls was noted, but without any areas of myocardial fibrosis or necrosis. Laboratory tests (conducted a few days after arrhythmia) revealed normal complete blood count, electrolytes, and renal parameters. Because of hyperlipidaemia (a low-density lipoprotein cholesterol concentration of 169 mg/dL) and early-stage coronary atherosclerosis, rosuvastatin was recommended at a daily dose of 40 mg. As the cause of VT remained unidentified, an electrophysiology study was conducted, during which no ventricular arrhythmia was detected. At the follow-up, the patient did not report any further palpitations or dizziness.

DISCUSSION

It is a significant advancement in self-care to be able to monitor health status, including ECG, heart rate, blood pressure, and oxygen saturation, using a simple and comfortable wearable device like a smartwatch. The widespread use of smartwatches enables the detection of previously undiagnosed heart rhythm disturbances and can reassure

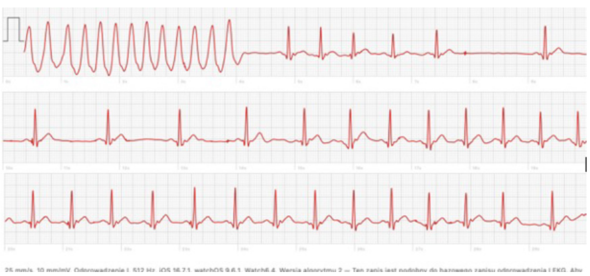

Fig. 1. Apple Watch single-lead ECG showing monomorphic ventricular tachycardia and sinus rhythm (25 mm/s, 10 mm/mV)

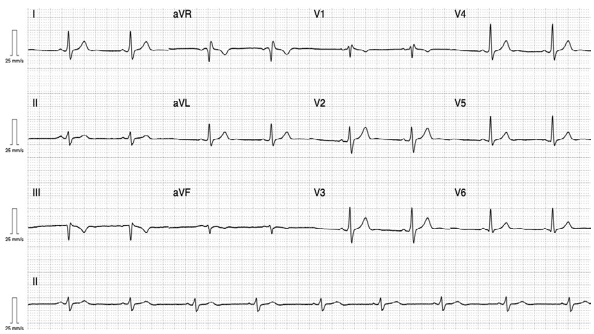

Fig. 2. Rest ECG

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patients who experience palpitations but have a normal ECG. Smartwatches can passively measure pulse rate from the wrist using photoplethysmography with an optical sensor[19] and hence detect pulse irregularity and variability in real time, which may indicate irregular heart rhythms, such as AF. However, for other types of arrhythmias, ECG recording must generally be initiated by the patient themselves by touching the electrode on the device with the opposite hand. This is why the detection of most abnormalities remains symptom-driven. Some case reports describe clinically relevant diagnoses, such as ischaemia and ventricular arrhythmia treated by percutaneous coronary intervention (PCI)[15] or arrhythmia managed with catheter ablation and insertion of an implantable defibrillator[11–18]. The recognition of these abnormalities by wearable devices has significantly influenced the course of diagnostics and therapy. However, a major limitation is that such devices only record a single-lead ECG[19]. Additionally, in cases of symptom-driven initiation, it is not possible to record the preceding ECG (as shown in Fig. 1).

AF is the most common sustained arrythmia worldwide, with its incidence doubling every few decades[20]. According to the European Society of Cardiology guidelines for AF management, AF can be recognised by a standard ECG (6 or more leads) or by a 1- or 2-lead ECG (for example recorded by a smartwatch, wearable patches, or biotextiles); however, photoplethysmography (PPG) may be indicative for AF, though diagnostic[20].

The deployment smart devices, including smart watches, may differ between cases of primary and secondary prevention in patients after a thromboembolic event. In the latter group, prolonged monitoring has a class I recommendation, whereas in patients with risk factors, it carries a class IIa recommendation[20]. Future research should focus on monitoring with the AW in patients after thromboembolic events or those with more than one point on the CHA2DS2-VA scale.

Interventions utilising smartphones have been considered effective tools for the self-management of chronic diseases, such as diabetes and hypertension[21]. Mobile health interventions also hold potential for reaching a substantial proportion of the global population, given their popularity. Users of m-health benefit from having information, self-monitoring, and continuous ongoing support. The World Health Organization (WHO) has also emphasised critical recommendations for using m-health to maximise its benefits, including the importance of perceived utility, ease of use, and addressing technical concerns such as privacy, security, and cost. Additionally, WHO highlights the need for familiarity with technology, careful evaluation of risk-benefit profiles, and seamless integration with existing health systems. By addressing these factors, m-health interventions can be effectively optimised to improve healthcare delivery, especially in resource-limited settings[22].

The question remains whether each detected abnormality should lead to extended diagnostics, especially given that worldwide sales of smartwatches have exceeded 1 billion in 2022[23]. This case report highlights the future of cardiology with smartwatch diagnoses which, in some cases, will result in further clinical evaluations. This underscores the need for studies and guidelines to address this issue. Even in cases of AF detection through various screening methods, the balance between benefit and harm is debatable[24]. Data from the STROKESTOP study[25] showed that to prevent one stroke among individuals aged 75 to 76 years, 10,000 people would need to be screened. This is associated not only with high costs, but also with the potentially harmful consequences of anticoagulation treatment. Therefore, it is crucial to learn how to react to different types of abnormalities detected by smartwatches and to search for markers that can improve risk evaluation. The plan of action is obvious in cases of second- and third-degree atrioventricular block or atrioventricular reentry tachycardia, but how far should testing go in cases of oligosymptomatic and self-limiting VT?

In this presented case, after a detailed discussion with the patient, the decision was made to extend diagnostic testing to include an invasive electrophysiology study. However, this report shows that such cases require an individualised approach.

CONCLUSIONS

The integration of wearable technology into healthcare, particularly for the monitoring of cardiac conditions, marks a significant advancement in patient self-care and health management. This case report underscores the importance of utilising data from wearable devices, such as smartwatches. As the popularity of these devices continues to rise, it is essential that healthcare professionals make informed decisions regarding the expansion of diagnostic procedures based on the data provided by wearables. While these devices offer the potential for enhanced detection of heart rhythm disturbances, the reliance on patient-driven symptom reporting calls for a cautious and judicious approach to further diagnostic testing. Individualised assessment and clear guidelines are crucial to balance the benefits of wearable technology with the potential risks and costs associated with excessive diagnostic procedures. Ultimately, as the capabilities of wearable devices in cardiac care continue to be explored, it will be essential to refine strategies for managing abnormal findings and optimising patient outcomes within this evolving landscape of digital health innovation.

Conflict of interest

The authors do not report any financial or personal connections with other persons or organisations which might negatively affect the content of this publication and/or claim authorship rights to this publication.

Author contribution

Original concept of study; collection, recording and/or compilation of data; analysis and interpretation of data: AG. Writing of manuscript: AG, PK. Critical review of manuscript: PK. Final approval of manuscript: AG, PK.

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