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Smartwatch detection of new-onset monomorphic ventricular tachycardia in pregnancy

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SUMMARY

Smartwatches provide health tracking in various ways and there has been a recent rise in reporting cardiac arrhythmias. While original studies focused on atrial fibrillation, fewer reports have been made on other arrhythmias especially in pregnancy. We report a pregnant patient who presented at 34 weeks' gestation with palpitations. An ECG recorded through her Apple Watch showed ventricular tachycardia. Hospital ECG confirmed monomorphic ventricular tachycardia likely caused by increased sympathetic tone from the gravid state. She was admitted to the cardiac intensive care unit for close monitoring with intravenous anti-arrhythmic agents; however, the rhythm persisted. She underwent a caesarean delivery and the arrhythmia resolved post partum. She later underwent a catheter ablation, after which she discontinued all anti-arrhythmic medications with no recurrence. This case highlights the importance of requesting relevant digital health information, if available, from patients in our modern era. Controlled clinical studies are needed to validate such practices.

BACKGROUND

The use of smartwatches for health monitoring has greatly increased in recent years with over 1 billion smartwatch users as of 2022.¹ There has been a notable rise in community-based heart rate monitoring devices with the integration of photoplethysmographic sensors in smartwatches.² Recent versions of smartwatches have combined the photoplethysmographic sensor with an actual one-lead ECG that allows the recording of lead I.²

While the original Apple Heart Study focused on detection of occult atrial fibrillation in an asymptomatic population,³ fewer reports have been made on other types of arrhythmias especially in pregnancy. A handful of case reports and case series have described smartwatch detection of ventricular tachycardia (VT) in non-pregnant individuals over recent years.^{2,4,5}

VT presenting for the first time in pregnancy is a serious event with potential for associated morbidity and mortality.⁶ We present a case of VT in a pregnant patient initially detected on her Apple Watch, which aided in expedited management and treatment. Our case highlights the importance of comprehensive healthcare providers' education on the importance of smartwatch health monitoring and its implications in clinical care.

CASE PRESENTATION

A previously healthy female patient in her mid-30s, with a G3P0020 obstetric history, presented at 34 weeks and 6 days of gestation to our emergency department (ED) with palpitations. Her pregnancy was otherwise uncomplicated, and she had had routine prenatal care. She reported worsening palpitations over the past week, which corresponded with wide complex tachycardia with heart rate in the 150s on her Apple Watch (figure 1). The rhythm appeared to be VT. After consultation with a cardiologist outpatient, she started oral metoprolol; however, her symptoms worsened up to 10 episodes per day, lasting up to 30 min. She subsequently presented to our ED, where her symptoms recurred and confirmed monomorphic VT on ECG during the episodes (figure 2). She was admitted to the cardiac intensive care unit (ICU) for further monitoring.

Investigations

Maternal-fetal medicine physicians were consulted, and bedside fetal ultrasound newly diagnosed fetal growth restriction based on abdominal circumference less than 10th percentile. Umbilical artery Doppler had a normal systolic-to-diastolic ratio for gestational age with forward flow. Continuous fetal heart monitoring was notable for rare late decelerations, however with moderate variability and accelerations in between.

The cardiac electrophysiology physician team was consulted. The patient was started on intravenous lidocaine drip and oral sotalol; however, her runs of VT persisted. In the setting of concerning maternal status and high likelihood of imminent delivery in the late preterm period, a course of betamethasone was initiated for fetal lung maturity. The patient had not received a prior course of betamethasone.

Differential diagnosis

Over the course of hospital day 2, the patient had multiple prolonged episodes of repetitive VT longer than 10 min requiring intravenous lidocaine boluses. She remained haemodynamically stable during the episodes; however, she became more symptomatic with palpitations. The fetal heart tracing was stable from the previous day. The patient underwent a transthoracic echocardiogram which was unremarkable with normal ejection fraction of 64%. According to the cardiac electrophysiology physicians, the patient likely experienced new-onset idiopathic VT due



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Case report

Heart Rate Over 150 — ❤️ 156 BPM

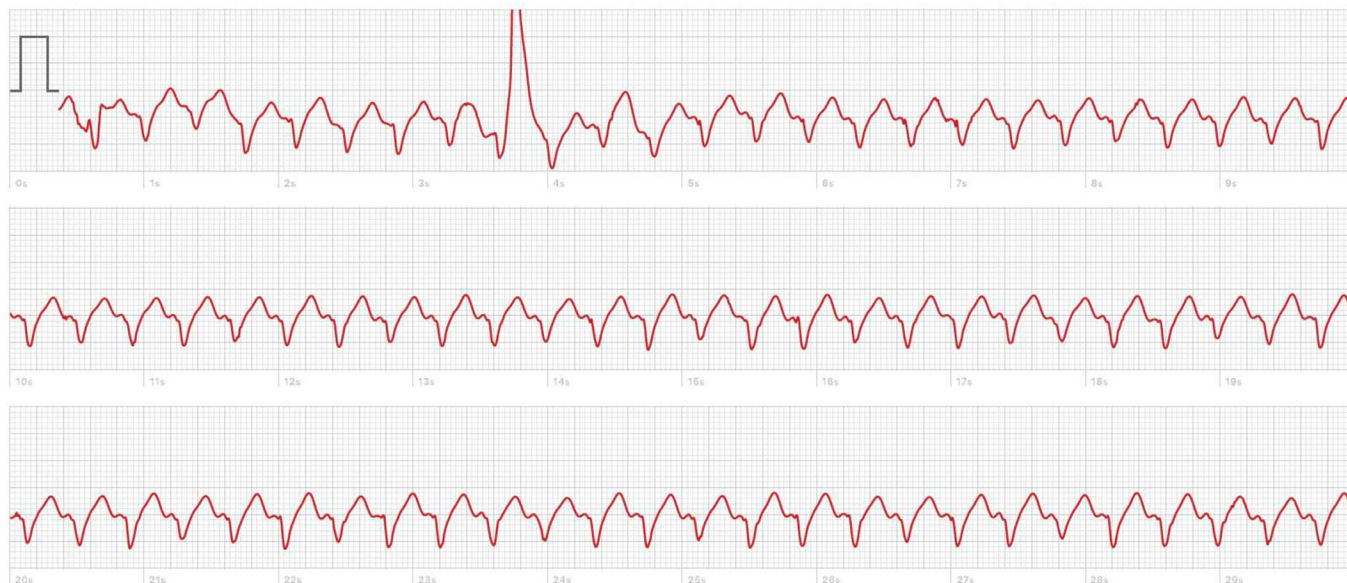
Average

This ECG was not checked for atrial fibrillation because your heart rate was over 150 BPM.

If you repeatedly get this result, or you're not feeling well, you should talk to your doctor.

Reported Symptoms

- Rapid, pounding, or fluttering heartbeat



25 mm/s, 10 mm/mV, Lead I, 513Hz, iOS 15.6.1, watchOS 7.6.2, Watch4,2, Algorithm Version 2 — The waveform is similar to a Lead I ECG. For more information, see Instructions for Use.

Figure 1 The patient's Apple Watch recording demonstrating wide complex tachycardia suggestive of ventricular tachycardia. BPM, beats per minute.

to heightened sympathetic activity associated with gravid uterus in pregnancy. This was exacerbated by activities stimulating catecholamine release, such as ambulation, pain or stress, which were confirmed triggers for the patient. It was hypothesised that the arrhythmias would likely improve after delivery with the decrease in sympathetic tone.

Over the course of the day, with the increased frequency and length of episodes of VT despite multiple agents, there was concern for worsening maternal cardiac status. A multidisciplinary team decision among the maternal-fetal medicine, cardiac electrophysiology and cardiac ICU physicians was made to proceed with delivery to avoid maternal cardiac decompensation. At this time, the patient had a 20-minute episode triggered by attempting to use the bedpan to void. Given the current clinical status and aforementioned triggers, there was concern that labour and an attempted vaginal delivery would further worsen symptoms and potentially trigger haemodynamic instability. Recommendation was made for delivery via caesarean section and the patient agreed to proceed.

Treatment

The caesarean section was uncomplicated with a quantitative blood loss of 385 cc. A live female neonate was delivered with Apgar scores 8 and 9, weighing 2067 g. She had an uncomplicated neonatal ICU course and was eventually discharged on hospital day 9 in stable condition.

The patient's intraoperative course was unremarkable with only rare beats of bigeminy. Postoperatively, the patient had

no further episodes of VT in-house. She was quickly weaned off the intravenous lidocaine and remained asymptomatic. She was discharged on postoperative day 3 on oral metoprolol with plan for outpatient cardiac MRI and evaluation for cardiac catheter ablation.

OUTCOME AND FOLLOW-UP

After discharge, the patient was switched back to sotalol by her outpatient cardiologist. However, she had persistent runs of palpitations. Cardiac MRI showed periods of VT and premature ventricular contractions, otherwise normal study. She underwent a successful catheter ablation of targeted premature ventricular contractions at 2 months post partum, after which she was able to discontinue all cardiac medications with no recurrence of symptoms or arrhythmias.

DISCUSSION

We present the first reported case of new-onset monomorphic VT in pregnancy in a structurally normal heart detected with the help of a smartwatch. Review of the smartwatch heart monitoring tracings expedited work-up and treatment, resulting in an overall optimal outcome. Our case raises the question of the utility of smartwatch devices in evaluating cardiac symptoms, even in otherwise healthy individuals.

Initial studies focused on detection of atrial fibrillation in asymptomatic patients; however, case reports, case series and a handful of cohort studies have shown other arrhythmias

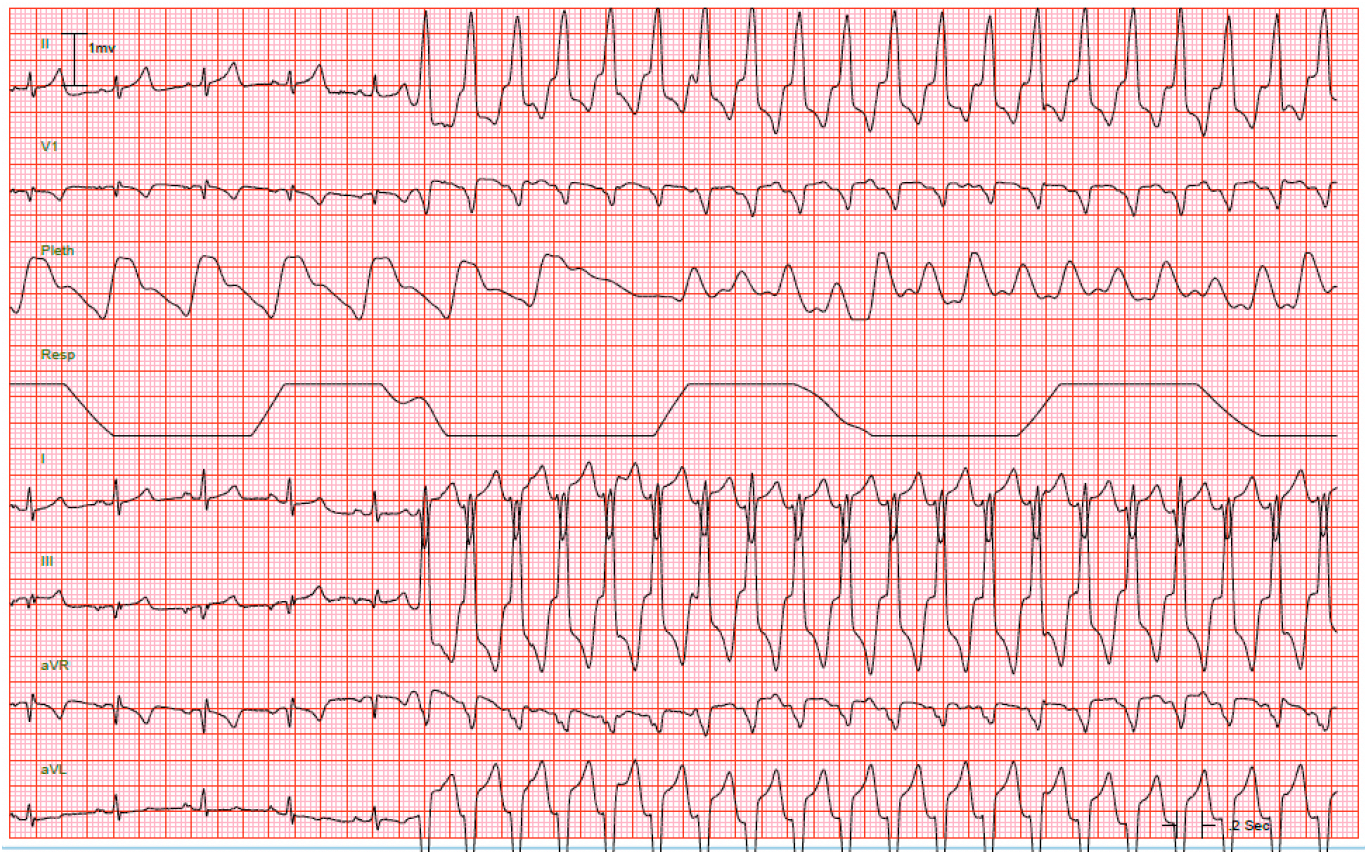


Figure 2 The patient's initial ECG upon presenting to the emergency department demonstrating ventricular tachycardia.

are being picked up as well.²⁻⁵ A recent systematic review of detection of cardiac arrhythmias other than atrial fibrillation found that a multitude of arrhythmias were commonly detected, including VT.⁷ Having smartwatch self-recordings of ECGs and evaluation by clinicians have facilitated the detection and subsequent management of patients. Given they can also serve as event monitors, they have been even suggested as a non-invasive alternative to implantable loop recorder.⁷

The utility of the smartwatch as an event monitor is depicted in previously published case reports. One case series presented patients who had reported palpitations and lightheadedness and had normal sinus rhythm on formal ECG or Holter monitor; however, their smartwatches showed periods of VT that was temporally associated with their symptoms. Subsequent work-up confirmed the arrhythmia on formal monitoring.² Another case presented a patient who had reported syncope but normal work-up in the ED; however, his Apple Watch had recorded a 30-second monomorphic VT timed with him losing consciousness. He was subsequently hospitalised and diagnosed with monomorphic VT and fitted with an implantable cardioverter defibrillator.⁴ Similarly, our patient had attributed her symptoms corresponding to the periods of VT seen on her smartwatch, which aided in expediting work-up, diagnosis and management of her condition.

Larger cohort studies are needed to fully evaluate the utility of smartwatch arrhythmia monitoring outside of atrial fibrillation.³ The positive predictive value may not be very high, and the negative predictive value is to be determined. However, it can be a helpful tool for symptomatic patients

especially with temporal symptom–rhythm correlation. Of note, a full arrhythmia assessment cannot be conducted on smartwatches, and they cannot replace comprehensive evaluation with a 12-lead ECG or a formal Holter monitor. The main advantage is the accessibility for patients and contributing to expedited work-up with a higher degree of suspicion.

It is important to bring up that increased monitoring in the general population can increase anxiety and contribute to excessive primary care and ED visits. However, given most arrhythmias are transient in nature, smartwatches provide a snapshot in time for a condition that can be difficult to diagnose.^{8,9} Patients with arrhythmias can be asymptomatic with a normal ECG in the ED, and Holter monitors can take time for insurance authorisation and approval. The use of smartwatches is being explored in the neonatal and paediatric space as well for patients with limited subjective reporting ability, and they have shown potential to detect clinically relevant conditions.¹⁰

Catecholaminergic polymorphic VT is very rare in the general population, with studies on pregnancy management limited to largely case reports and studies in these patients.¹¹⁻¹⁶ Its appearance in otherwise low-risk patients has been associated with a pathogenic cardiac ryanodine receptor mutation.^{11,17} Medical therapy entails beta-blockers as first line, generally nadolol or propranolol, with the addition of verapamil or flecainide if beta-blockers are not effective at arrhythmia suppression.¹⁸ If diagnosed early in gestation, an implantable cardioverter defibrillator can be considered.¹⁷ A multidisciplinary team approach is essential especially in the perinatal period, including being

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prepared for maternal cardiac decompensation.^{6 11} Long-term management is essential for patients with catecholaminergic polymorphic VT as the incidence of sudden cardiac death is reportedly 30% by age 40 years without adequate treatment.¹⁹

It is overall uncommon for monomorphic VT to manifest for the first time during pregnancy. The cases described in the literature have presented in any trimester and presented in women with no structural cardiac disease. However, most patients had short runs of VT under 4 min and were able to obtain control with medication^{11–13 16} unlike our patient who became unresponsive to medication with persistent VT necessitating delivery. It was clear in our case that the physiological changes of pregnancy were contributing to the episodes of VT, as the patient's symptomatic episodes resolved immediately after delivery. Multidisciplinary collaboration and shared decision-making with the patient are key to ensuring an optimal outcome in these high-risk cases.⁶

There is a rapidly growing role for digital health applications in healthcare that clinicians should know about and that needs more research. Data from smartwatches can provide helpful information to guide investigation and work-up in the clinical space. Our case shows it is worth asking patients about personal electronic devices that may help inform diagnosis and pursuit of further work-up. Final assessment and treatment plans should be based on formal diagnostic modalities and decided by physicians.

Patient's perspective

I worked full time during my pregnancy in a busy clinic and was on call for the local hospitals at night. I usually felt the palpitations during my lunch or at night when I was at home. I used my Apple Watch to record my heart rhythm and heart rate when I felt the palpitations and it gave me an instant reading compared to a pulse oximeter which took about 1 min to measure my heart rate. The palpitations became more frequent as the pregnancy progressed and the stress I felt from my work made the palpitations worse and I started to feel dizzy while sitting down and talking to my patients and I had shortness of breath when walking down the hallway. I took a maternity leave earlier than I had planned due to my symptoms and I found that staying home and resting helped me feel better. I remember when I used my Apple Watch at 34 weeks of pregnancy and the rhythm consistently showed ventricular tachycardia. I was very scared and I contacted my cardiologist who advised me to start driving to a hospital with a VT [ventricular tachycardia] center 2 hours away from my home since we do not have any local centers. I felt very fortunate to have the whole team at the hospital watching over me and my baby very closely. Proceeding with the C-section was a great relief when the VT stopped and I was able to recover quickly and get discharged home. I had a premature baby who stayed in the NICU [neonatal intensive care unit] for 1 week due to feeding issues. The VT returned 4 days after delivery and I had several short runs of VT during the day and I was unable to breast feed my baby because of the sotalol. The EP [electrophysiology] study and ablation went well and the VT has now resolved. The entire experience has changed my perspective on prioritizing my health. I learned to take more breaks and slow down at work in order to take care of my physical health.

Learning points

- ▶ Smartwatches are a rapidly developing technology and are becoming increasingly used by patients.
- ▶ A wide range of cardiac arrhythmias, including ventricular tachycardia, can be detected on smartwatches and can provide a helpful temporal symptom–rhythm correlation.
- ▶ Smartwatch data are not a replacement for formal diagnostic modalities or physician expertise, and increased patient anxiety and healthcare resource utilisation should be considered.

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Case reports provide a valuable learning resource for the scientific community and can indicate areas of interest for future research. They should not be used in isolation to guide treatment choices or public health policy.

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