CASE REPORT

Undetected supraventricular tachycardia causing congestive heart failure: a pitfall of remote monitoring system

Keisuke Nakabayashi, Ryo Sugiura, Toshiaki Oka

Department of Cardiology,
Seirei Hamamatsu General
Hospital, Hamamatsu,
Shizuoka, Japan

Correspondence to
Dr Keisuke Nakabayashi,
keisuke2018@gmail.com

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SUMMARY

Remote monitoring systems with automated clinician alerts are a milestone development for implantable cardiovascular devices, and improve the quality of life for patients and physicians by reducing the number of conventional clinic visits. In addition, remote monitoring systems can detect many bradyarrhythmias and tachyarrhythmias earlier than traditional methods, although these devices are not perfect. We report the case of an 80-year-old woman with an implanted pacemaker and a remote monitoring system that failed to report acute heart failure at 10 months after implantation. ECG and telemetry revealed relatively slow supraventricular tachycardia, which did not trigger the alert, and catheter ablation successfully controlled the heart failure. Subsequent analysis revealed that the monitoring function had detected the arrhythmia as frequent premature ventricular contraction, although the arrhythmia did not trigger the automated clinician alert. Therefore, remote monitoring systems with accurate settings are essential, although conventional monitoring methods are still important for some patients.

BACKGROUND

Remote monitoring systems (RMS) utilise technology to improve the quality of life for patients and physicians, by reducing the number of conventional clinic visits.¹ In addition, RMS can detect many bradyarrhythmias and tachyarrhythmias earlier than traditional methods, thereby reducing the time to a clinical decision;² RMS with automatic clinician alerts can facilitate even earlier clinical decision-making.³ Furthermore, RMS also generally provide significant economic benefits without affecting patient safety.⁴ However, these systems are not perfect, and a few cases of missed arrhythmia causing heart failure have been reported. We report a case of heart failure that was triggered by supraventricular tachycardia, which was not detected by an RMS with an automatic clinician alert.

CASE PRESENTATION

An 80-year-old woman without any specific medical history had received a permanent implanted pacemaker (Evia DR-T, BIOTRONIK, Berlin, Germany), due to sick sinus syndrome with syncope, and began using an RMS (Home Monitoring, BIOTRONIK) without conventional clinic visits. This system evaluates various parameters, including the device's condition, the

patient's condition and arrhythmic events, once per day (figure 1). Seven months after activating the RMS, the patient became aware of palpitations (which did not trigger the automatic clinician alert), and subsequently developed acute heart failure with orthopnoea and worsening exertional dyspnoea at 10 months after implantation, which was also not detected by the RMS. She was fully conscious when she was admitted to our hospital, and had a blood pressure of 188/104 mm Hg, a heart rate of 110 bpm, a respiratory rate of 22 breaths/min and 98% percutaneous oxygen saturation under oxygen inhalation (nasal cannula at 2 L/min). No murmur was detected, but we observed jugular vein dilation, coarse crackles in all lung fields and severe bilateral pitting oedema in the legs. Chest radiography revealed an enlarged cardiothoracic ratio and butterfly pulmonary oedema, and ECG and telemetry revealed supraventricular tachycardia with a heart rate of 106 bpm (figure 2). Transthoracic echocardiography subsequently revealed normal contraction of the left ventricle, tricuspid regurgitation at 40 mm Hg, and an inferior vena cava diameter of 18 mm. In addition, the patient's brain-type natriuretic peptide level was 548 pg/mL.

TREATMENT

We initially treated the patient with volume reduction and vasodilation (intravenous furosemide (40 mg/day), human atrial natriuretic polypeptide (0.025 γ) that was converted to olmesartan (20 mg), eplerenone (50 mg) and oral furosemide (20 mg)), however, the clinical response was not adequate. Therefore, we performed an electrophysiological evaluation, which confirmed the presence of atrioventricular nodal re-entry tachycardia; this was successfully treated via catheter ablation. The heart failure was quickly controlled after the procedure, the patient's brain natriuretic protein levels decreased from 548 to 58 pg/mL, and her body weight decreased from 50.4 to 42.8 kg (figure 3).

OUTCOME AND FOLLOW-UP

The patient was free from any episodes of arrhythmia or heart failure 18 months after the procedure.

DISCUSSION

The development of RMS with automatic clinician alerts is a milestone in implantable cardiovascular device technology.¹⁻³ In Japan, which has a large

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Monitoring details		Urgency	Correspondence
Generator	ERI	Emergency	Mail or Fax
Programmer usage		Urgent	Mail or Fax
Leads	Atrium pacing impedance of <200 or >1,500 ohms	Urgent	Mail or Fax
	Atrium sensing of <0.5 mV	Urgent	None
	Atrium pacing threshold of >3.0 V	Urgent	Mail or Fax
	Ventricular pacing impedance of <200 or >1,500 ohms	Emergency	Mail or Fax
	Ventricular sensing of <2.0 mV	Urgent	Mail or Fax
Arrhythmia	Ventricular pacing threshold of >3.0 V	Urgent	Mail or Fax
	AT/AF burden of >25%	Urgent	Mail or Fax
	Mean ventricular rate in mode switching of >130 bpm	Urgent	Mail or Fax
	>1 high ventricular rate episode per day	Urgent	Mail or Fax
Heart monitoring	Mean heart rate of >80 bpm	Urgent	None
	PVC of >50/h	Urgent	None
IEGM	Receipt of regular IEGM	Urgent	None
Home monitoring	Receipt of first data	Urgent	Mail or Fax
	No received data for 21 days	Urgent	Mail or Fax

Figure 1 Default setting for the BIOTRONIK Home Monitoring system. ERI, elective replacement indicator; AT, atrial tachycardia; AF, atrial fibrillation; PVC, premature ventricular contraction; IEGM, intracardiac ECG.

ageing population, RMS devices are common and help to reduce the burden on physicians.⁵ Furthermore, RMS has potential applications in monitoring for heart failure.⁶ However, this technology was unable to report the tachyarrhythmia in this

case, which raises the issues of how the event was missed and what should be done to avoid these missed events.

Owing to the failed detection, the patient's tachyarrhythmia had continued, unnoticed, for approximately 3 months.

Figure 2 Admission findings from 12-lead ECG, intracardiac ECG and chest radiography. The 12-lead ECG revealed a retrograde P wave immediately after the QRS complex (black arrows), and the intracardiac ECG revealed nearly co-instantaneous atrial and ventricular waves, which suggested atrioventricular nodal re-entry tachycardia. The chest radiograph revealing severe pulmonary oedema and bilateral pleural effusion.

Figure 3 The patient's clinical course. BNP, brain natriuretic peptide; BW, body weight; hANP, human atrial natriuretic polypeptides; UO, urinary output.

Therefore, the monitoring and alert setting functions should be considered separately. Interestingly, evaluation of the monitoring function revealed that it had detected a ventricular rate of >80 bpm and premature ventricular contractions of >50/h during the tachyarrhythmia period (figure 4). Unfortunately, the default settings for the patient's RMS were not set to trigger an alert for these events (figure 1). In addition, she did not make conventional clinic visits, given the absence of basic heart disease and her responsibilities in caring for her family. Therefore, the combination of the RMS' inadequate default settings and the lack of clinical follow-up resulted in the missed tachyarrhythmia.

In the future, similar events could be avoided by scheduling routine clinic visits, as this tachyarrhythmia was easily detected via 12-lead ECG and telemetry. In addition, our active evaluation of the RMS data confirmed the presence of the tachyarrhythmia over a 3-month period (figure 4). Therefore, we suggest several corrective steps that could be taken to avoid similar events: (1) programming accurate default alert settings, (2) frequent

active evaluation of the RMS data and (3) adding conventional clinic visits for patients with an RMS. The first step should be performed for all patients who have an RMS and a history of arrhythmia. Unfortunately, the second step is slightly impractical for most patients, given that the physician does not exclusively manage the RMS, especially in Japan. Finally, the third step is the most practical, although it reduces the benefits that are associated with using an RMS. Although reprogramming the alert setting of ventricular rate might detect this arrhythmia after the first event, we did not alter the monitoring and alert settings in this case, as the catheter ablation was successful. We proposed monthly active evaluations of the RMS data, and clinical visits to the patient's family physician every 2 months, with ECG and chest radiography. This strategy, including both active RMS evaluations and clinical follow-up with the family physician, can potentially diagnose >99.5% of arrhythmia-related or device-related problems.⁷

This report is the first to focus on RMS failure to detect tachyarrhythmia that caused heart failure. Although RMS with an automatic clinician alert is useful technology, it can miss relatively slow tachyarrhythmias. Therefore, accurate and personalised monitoring and alert settings are essential for easier and more effective management of patients who are monitored remotely.⁸ Furthermore, traditional physical examinations, active evaluation of the RMS data and conventional clinic visits remain important for some patients. In addition, we have to know the limitation of RMS and educate patients to visit us when they feel different from their normal daily condition.

Learning points

- ▶ Remote monitoring systems with automated clinician alerts improve the quality of life for patients and physicians by reducing the number of conventional clinic visits.
- ▶ This technology cannot detect some arrhythmias, such as relatively slow supraventricular tachycardia.
- ▶ Remote monitoring systems with accurate settings are essential, although conventional monitoring methods are still important for some patients.
- ▶ Physicians have to know the limitations of remote monitoring systems and must educate their patients to visit them when they feel different from their normal daily condition.

Figure 4 Active evaluation of the remote monitoring system data. The upper panel showing sudden acceleration of the ventricular rate at 20XX/11. The lower panel showing that the remote monitoring misidentified this event as premature ventricular contractions. HR, heart rate; PVC, premature ventricular contraction; A, atrium; V, ventricle.

Contributors KN mainly treated the patient and wrote the manuscript. KN and RS performed the catheter ablation. TO supervised the study.

Competing interests None declared.

Patient consent Obtained.

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