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SLEEP MEDICINE PEARLS

Polysomnography and Implantable Cardiac Devices: Identifying Normal and Abnormal Paced Beats

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Case Study

A 57-year-old gentleman never smoker was referred to our sleep center. He had a history of surgical repair for Tetralogy of Fallot in childhood with preservation of his pulmonary valve. A biventricular pacemaker-defibrillator (Medtronic 7299 In-Sync, Minneapolis, MN) was implanted 6 years prior for high-grade AV block. Prior interrogations of his device revealed underlying atrial fibrillation and pacemaker dependence but normal lead function. He was diagnosed with obstructive sleep apnea (OSA) by polysomnography (November 2010) with a respiratory disturbance index (RDI) of 22.2 and an apnea hypopnea index (AHI) of 20.5.

Physical examination revealed a body mass index of 32.1 kg/m^2, pulse 84 beats/min; other vital signs were unremarkable with SpO_2 96% on room air. He had left lateral thoracotomy, left clam shell, and midline sternotomy scars from his previous surgeries. His cardiac examination revealed regular rate and rhythm with systolic ejection murmur at base and a 2/6 diastolic decrescendo murmur. His left radial pulse was diminished.

Investigations

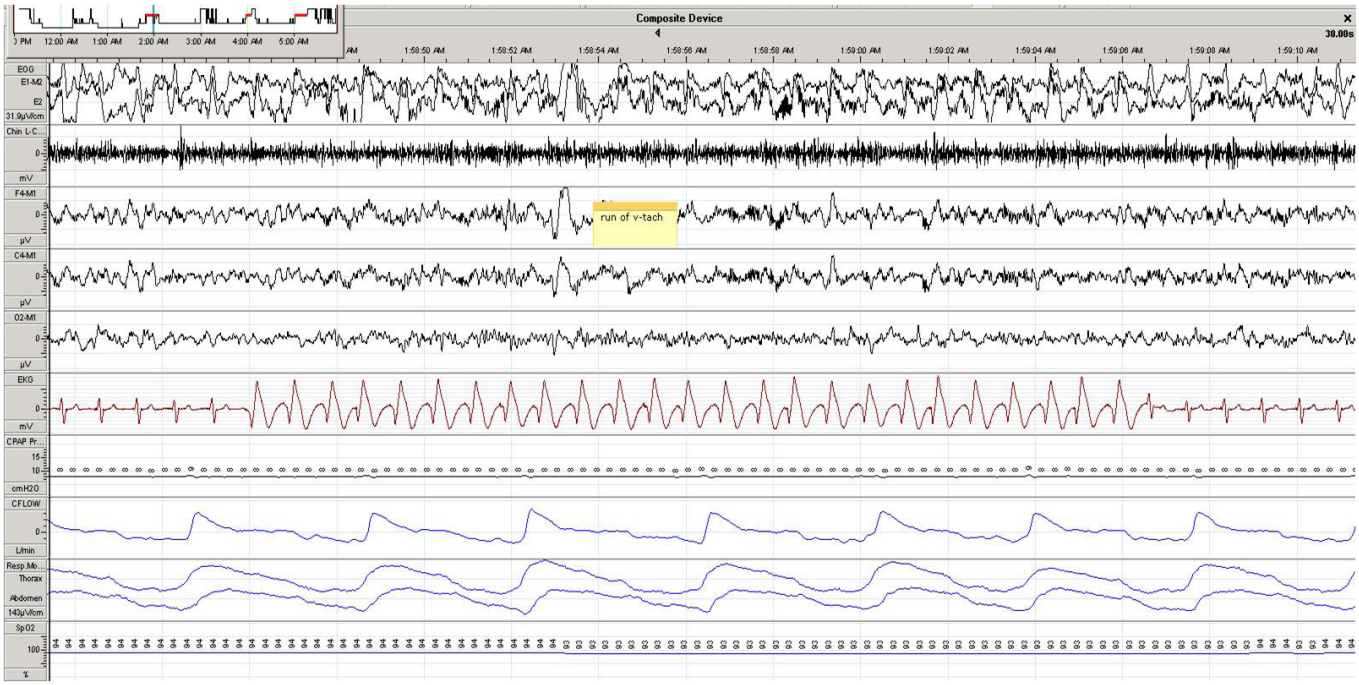
A recent electrocardiogram (EKG) showed underlying atrial fibrillation with a biventricular paced rhythm. Echocardiogram (September 2010) revealed a LVEF of 20%, enlarged right and left ventricular cavity, mitral regurgitation, reduced right ventricular systolic function, and pulmonic valve (PV) insufficiency with a diameter of 2.9 cm and peak gradient across the PV of 11 mm Hg (mean 5 mm Hg). The echo estimated a right ventricular systolic pressure of 45-50 mm Hg and a mean pulmonary artery pressure of 35-40 mm Hg. A recent interrogation of his biventricular pacer-defibrillator showed stable and normal function.

Sleep Study

He underwent a continuous positive airway pressure (CPAP) titration study. His sleep efficiency was 90% with a latency of 12.6 minutes. CPAP of 11 cm of water yielded improved control of his sleep disordered breathing, with residual RDI of 4.6 per hour. His overnight EKG analysis (modified lead II) demonstrated an abnormal wide complex rhythm at 01:58 (**Figure 1**). At that time patient was not having any respiratory event; his oxygen saturation was 93-94%.

Identify the abnormality in EKG on PSG in Figure 1.

Figure 1



ANSWER: Automated device self-diagnostic, probably related to a left ventricular capture management algorithm. The tracing shows a QRS vector compatible with a biventricular paced rhythm at baseline. The wide complex rhythm is a different morphology and implies only one of the two ventricular leads is being paced. Autocapture algorithms only check one lead at a time. There is a salvo of ventricular paced beats at a rate similar to the programmed base rate at the rest of the tracing. The morphology resembles LV paced morphology. This seemingly bizarre pacemaker behavior is frequently observed in the 1-2 AM time-frame and is one of many automated self-diagnostic or safety assurance algorithms used by implantable cardiac devices.

DISCUSSION

Recent literature has generated interest in epidemiological and clinical correlations between long-term pacing and sleep disordered breathing (SDB). It is well known that cardiac arrhythmias and conduction disturbances occur during SDB,[1] and it is likely that a high incidence of patients with SDB have pacemakers placed. Garrigue et al. reported a high prevalence of undiagnosed SDB (59%) in long-term paced patients and suggested that SDB should be actively searched in patients requiring a pacemaker or currently being treated by a pacemaker.[2] It is thus expected that a large number of patients with pacemakers and other cardiac rhythm devices are likely to be seen in sleep centers.

Gamaldo et al.[3] suggested that sleep technicians and sleep specialists should be well-versed in identification of cardiac arrhythmias and the proper procedure when a patient demonstrates an arrhythmia on PSG. Cardiac arrhythmias are among the most common serious adverse events encountered during a PSG.[4] With the increasing number of patients with implantable devices undergoing PSG, finding a transient abnormal rhythm or seemingly bizarre pacemaker behavior on EKG during PSG is very likely. Our case highlights the importance of recognizing an automated function of pacemaker which is a common feature of almost all current pacing devices.[5] This automated function of implantable devices is usually a "self-maintenance" feature which represents an important advancement in their safety and performance. These are discovered incidentally during continuous telemetric patient monitoring and often confused with arrhythmias or device malfunctioning. Nocturnal PSG with continuous monitoring is likely to detect these events because they are usually programmed to occur in the nighttime hours. Failure to recognize these features can cause unwanted alarm and confusion, which can lead to patient harm.[6] In our case, it is noteworthy that the wide complex rhythm seen due to the automated device self-diagnostic function was mislabeled by the technologist as a "run of v-tach" (**Figure 1**), even though rate of wide complex beats was around 60 to 70, which by definition is not tachycardia.

There are many automated functions performed by modern cardiac pacing devices, and medical staff at the sleep center should be aware of them while reporting on PSG. We would suggest consultation with the patient's electrophysiologist for assistance in reviewing these rhythms in such patients, so that these are not mistaken for arrhythmia or device malfunction. The PSG technologists should also be aware of the potential for these rhythms in any patient with an implantable device who is undergoing a PSG test, so that they are not alarmed or initiate any emergency measures.

CLINICAL PEARLS

1. Automated functions of cardiac implantable devices for "self-maintenance" or safety assurance are present in almost all modern pacing devices. These are frequently discovered during continuous telemetry patient monitoring and often confused with arrhythmias or device malfunctioning. These typically occur at 1 or 2 AM.
2. One should be aware of these automated pacemaker functions occurring during a PSG. Their recognition can avoid clinical dilemmas and improve patient care.

CITATION

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