EP CASE REPORT

Inappropriate inhibition of biventricular pacing due to diaphragmatic myopotentials amplified by the selectable sensing filter

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A 66-year-old man with a cardiac resynchronization therapy defibrillator (CRT-D: Quadra Assura 3367-40QC, St. Jude Medical Inc.) experienced asymptomatic intermittent inhibition of biventricular pacing, mainly after meals. All measured parameters of the true bipolar ventricular lead (Durata 7122Q, St. Jude Medical Inc.) were in the normal range and general provocative maneuvers could not reproduce any noise. Only Valsalva maneuvers succeeded in reproducing the noise, showing the typical signal morphology of extracardiac myopotentials (*Panel A*); thus, oversensing of diaphragmatic myopotentials was diagnosed. After turning off the low-frequency attenuation filter (LFA) of the CRT-D, neither inhibition of pacing for bradycardia nor inappropriate detection of tachyarrhythmias was observed, even at the highest sensitivity (*Panel A*).

In this patient, turning off the LFA was effective in preventing oversensing of diaphragmatic myopotentials. The LFA is designed to enhance sensing performance and may reduce the possibility of oversensing T waves. Although the precise mechanism of the LFA is proprietary information, it seems to attenuate signals with low frequency components such as T waves and to amplify high-frequency signals such as R waves. Because extracardiac diaphragmatic myopotentials consist of high-frequency components, the LFA may increase the risk of oversensing of extracardiac myopotentials.

Introduction

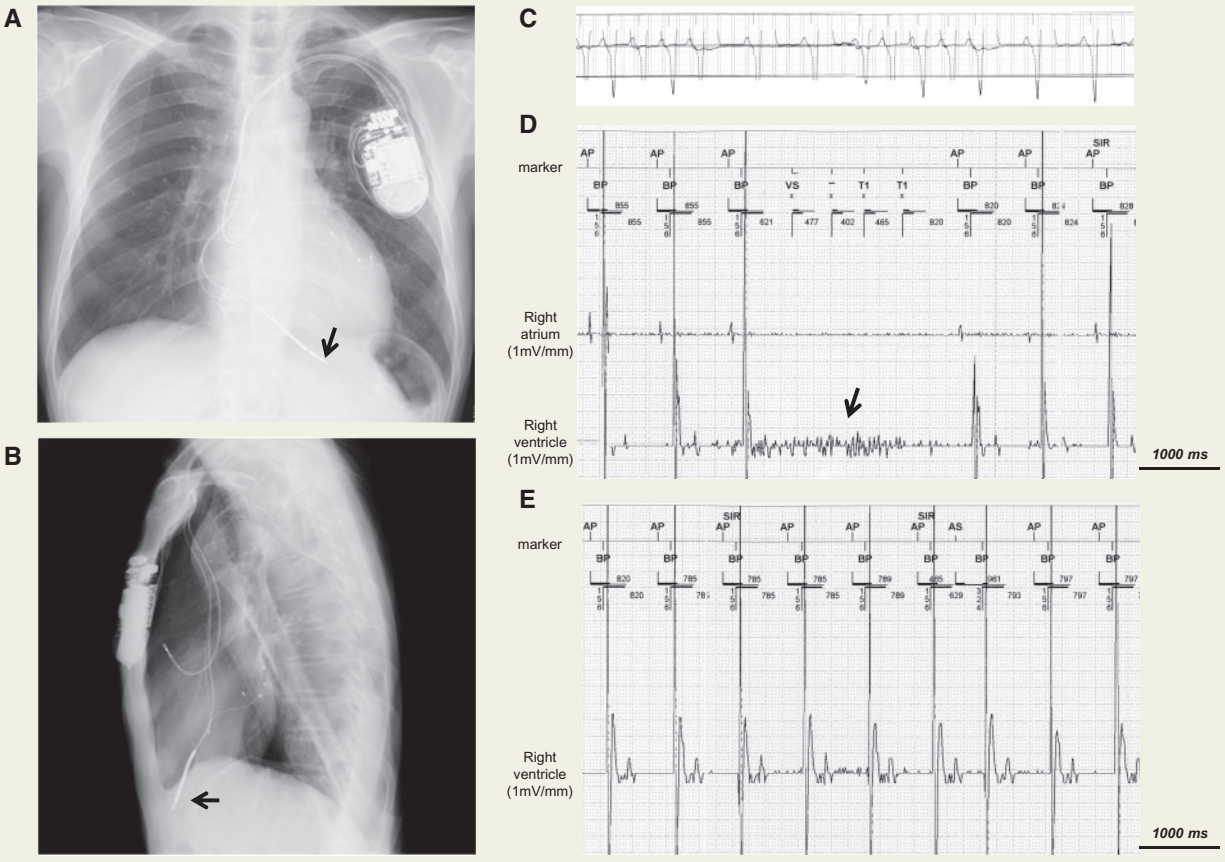
Oversensing of extracardiac myopotentials is a well-recognized problem in arrhythmia management with cardiac implantable electronic devices (CIEDs). The potentials can cause two types of CIED malfunctions: intermittent inhibition of pacing for bradycardia and/or inappropriate delivery of therapy for ventricular tachyarrhythmia.[1,2] Bandpass filters designed to attenuate the extracardiac myopotentials have been used to avoid these malfunctions (sensing filters), and some state-of-the-art CIED models are equipped with selectable bandpass filters in accordance with the frequency characteristics of the signal from the sensing electrodes. We present a case in which the oversensing of diaphragmatic myopotentials was successfully avoided by adjusting the setting of the sensing filter.

Case presentation

A 66-year-old man with mitochondrial myopathy and a cardiac resynchronization therapy defibrillator (CRT-D) (Quadra Assura 3367-40QC, St. Jude Medical Inc., MN, USA) was hospitalized owing to exacerbation of heart failure. Intermittent inhibition of biventricular pacing (*Panel C*) was observed, mainly after meals. The patient experienced neither symptom nor inappropriate antitachycardia pacing/shock delivery rerated to the inhibition. We presumed the inhibition was due to oversensing of noise from the ventricular defibrillation lead; however, all measured parameters of the true bipolar ventricular lead (Durata 7122Q, St. Jude Medical Inc. MN, USA) were in the normal range and general provocative maneuvers for noise provocation such as rotating the arms and shaking the generator could not reproduce any noise. Only Valsalva maneuvers succeeded in reproducing noise showing the typical morphology of extracardiac myopotential signals (*Panel D*). The chest radiograph showed that the sensing electrodes of the ventricular lead were in close proximity to the diaphragm (*Panels A* and *B*). Thus, we diagnosed the noise as oversensing of diaphragmatic myopotentials. The noise appeared to consist of high-frequency components; therefore, we turned off the low-frequency attenuation filter (LFA) of the CRT-D device after the defibrillation testing to ensure the appropriate sensing of ventricular fibrillation without the LFA, and the amplitude of the noise was attenuated (*Panel E*). After turning off the LFA, neither inhibition of pacing for bradycardia nor inappropriate detection of tachyarrhythmias due to oversensing was observed, even at the highest sensitivity of the device (*Panels D* and *E*). F1

Discussion

Integrated bipolar leads and right ventricular leads at the apex are risk factors of oversensing of extracardiac myopotentials.[1] In this patient, the ventricular lead was a dedicated true bipolar, and turning off the LFA was effective in preventing oversensing of diaphragmatic myopotentials. The LFA is designed to enhance sensing performance and may reduce the possibility of T wave oversensing. Although the precise mechanism of the LFA is proprietary information, it seems to attenuate signals with low-frequency components such as T waves and to amplify high-frequency signals such as R waves. Because extracardiac diaphragmatic myopotentials consist of high-frequency components, the LFA may increase the risk of oversensing of extracardiac myopotentials.[3] CIEDs by Biotronik are also equipped with the selectable sensing filter. Thus, it is important to select the proper filter setting in accordance with the frequency characteristics of noise when we use CIEDs with selectable sensing filter.



Panels A and *B*. A chest radiograph showing the sensing electrodes of the ventricular lead in close proximity to the diaphragm (marked by arrows). *Panel C*. Intermittent inhibition of biventricular pacing was observed mainly after meals on electrocardiograph monitoring. *Panel D*. Valsalva maneuvers succeeded in reproducing noise, showing the typical morphology of extracardiac myopotential signals (marked by arrows). The noise caused inappropriate inhibition of biventricular pacing and was inappropriately sensed as ventricular tachycardia in the VT-1 zone of the device. *Panel E*. After turning off the low amplitude attenuation filter, neither inhibition of pacing for bradycardia nor inappropriate detection of tachyarrhythmias was observed.

Conflict of interest: none declared.

References

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