IMPLANTABLE DEFIBRILLATION THERAPY

FELLOWS CASE OF THE MONTH

Double-sensing and Inappropriate Shock: Case Presentation with Differential Diagnosis

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ABSTRACT. A patient with a history of cardiac arrest and ischemic cardiomyopathy was referred for a secondary prevention implantable cardiac defibrillator. Later, the patient was admitted because of multiple shocks. Device electrograms revealed inappropriate shocks as a result of double-sensing in the ventricular channel. Chest radiography also revealed lead dislodgement along with device rotation along its axis. Twiddler's syndrome occurs in obese women with loose, fatty subcutaneous tissue, and is characterized by the rotation of the pulse generator on its long axis with subsequent coiling of the pacemaker leads. Using active fixation leads, sub-pectoral implantation should be considered in obese patients to prevent progressive generator displacement inside the subcutaneous pouch and eventually progressive lead displacement. In this case report, we will discuss the differential diagnosis of double sensing and inappropriate therapies, as well as prevention and management of lead dislodgement.

KEYWORDS. Double-counting, implantable cardioverter-defibrillator, inappropriate treatment, lead dislodgement.

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Case presentation

A 75-year-old woman with a history of cardiac arrest (ventricular fibrillation [VF] arrest) and ischemic cardiomyopathy was referred for secondary prevention implantable cardioverter-defibrillator (ICD) implantation. She underwent a successful implantation of a dual-chamber secondary prevention ICD (Fortify Assura, St. Jude Med. Minnesota, USA). Three months later, the patient was admitted to the emergency room because of multiple shocks. Device interrogation revealed an interesting finding (**Figure 1a,b**). What could be a possible diagnosis in this case?

Discussion

This patient underwent dual-chamber ICD implantation for secondary prevention purposes. She was admitted,

3 months after implantation, with multiple shocks. Device interrogations revealed ventricular oversensing ensued inappropriate shocks at 36 joules. Intracardiac electrograms (EGMs) revealed double-sensing in the ventricular channel, triggering the VF algorithm and hence inappropriate shocks. The far-field EGM channel showed signals consistent with atrial and ventricular activities.

Anatomically, both atrial EGMs and ventricular far-field EGMs are seen when the lead is around the annulus of the tricuspid or mitral valves and/or in the coronary sinus. Also, double-sensing in the ventricular channel can be related to right ventricular lead integrity issues.¹ However, the third cause can be theoretically correlated to high atrial output in conjunction with very low-programmed sensitivity in the right ventricular lead. Professor Rosenbaum, a famous electrocardiologist, stated that “for each arrhythmia phenomenon, it should be at least 3 possible explanations.”² Based on this knowledge, our three differential diagnoses are as follows:

1. right ventricular lead dislodgement to the tricuspid annulus;
2. right ventricular lead dislodgement to the coronary sinus;
3. oversensing of the atrial signals (P-wave oversensing).

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Figure 1: (a) The intracardiac tracing obtained from the device showing double signals in the ventricular-sense channel. Also, leadless channel reveals two signals consistent with atrial and ventricular electrocardiograms. (b) The episode of inappropriate diagnosis of ventricular fibrillation and shock delivery. Please note the ventricular antitachycardia pacing does not capture the ventricle and double-sensing in the ventricular sense channel does not disappear after the shock delivery. All these signs strengthen the diagnosis of inappropriate shocks due to right ventricular lead dislodgement.

The first two differentials could be confirmed with chest radiography, which revealed that spontaneous device rotation led to lead retraction. The right atrial lead was within the right atrium near the cavoatrial junction, the

right ventricular lead displaced to the atrioventricular junction region (**Figure 2**).

With regards to the third differential, P-wave oversensing was ruled out with confirmation by a trial of adjusting

Figure 2: Anteroposterior chest radiography views of the patient. Device implantations after surgery (left), and lead dislodgements and retractions caused by rotation of the device (right). Arrows indicate rotation of the device header.

atrial sensitivity that failed to abolish double-sensing EGMs.

Displacement of pacemaker leads because of twisting of the box on the part of the patient is called twiddler's syndrome, first described in 1968.³ Classically, twiddler's syndrome occurs in obese women with loose, fatty subcutaneous tissue, and is characterized by the rotation of the pulse generator on its long axis with subsequent coiling of the pacemaker leads.⁴ Patients may rotate the device and this action may cause lead displacement. Interestingly, Goldenberg et al.⁵ reported a case of twiddler's syndrome as a consequence of device rotation without manipulation of the pocket. Several recommendations have to be taken into account in order to prevent lead dislodgements:

- avoid capacious device pockets, which may allow more device movement inside the pocket;
- use active fixation leads;
- consider subpectoral implantation in obese patients to prevent progressive generator displacement inside the subcutaneous pouch and eventually progressive lead displacement;
- firm fixation of the device to the fascia is essential to minimize the risk of device movements;

- instruct patients not to manipulate their device pockets.

Conclusion

In conclusion, careful interpretation of intracardiac EGMs with double-sensing is further elucidated by radiological investigations. Spontaneous device rotation and hence lead displacements as a cause needs to be considered.

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