Lead dislodgement complicated with paroxysmal atrial fibrillation as a rare cause of inappropriate implantable cardioverter defibrillator shock: a case report

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Inappropriate shock of implantable cardioverter defibrillator (ICD) is a rare but catastrophic phenomenon. Inappropriate shock is usually caused by oversensing of noise or supraventricular tachycardias (SVTs). However, inappropriate shock can also be triggered by other uncommon mechanisms. Lead dislodgement is also rare in patients with cardiac implantable electronic devices, which can manifest as pacing failure and mis-sensing of other signals. Here, we report a rare case of inappropriate ICD shock triggered by lead dislodgement complicated with paroxysmal atrial fibrillation (PAF) in an elderly patient.

An 84-year-old woman presented to Beijing Hospital with a complaint of recurrent electrical shock in her left chest. One month before the admission, she was diagnosed with heart failure (HF) with reduced ejection fraction, sick sinus syndrome (sinus pause for 4.67 s) and had a dual chamber ICD implantation (Medtronic, Model EveraTM S DR). Two detection zones for ventricular tachycardia/ventricular fibrillation (VT/VF; VT at 176–207 beats/min, VF > 207 beats/min) were programmed (Table 1). Her past medical history was remarkable for coronary artery disease, PAF, hypertension, dyslipidemia and chronic kidney disease. About twenty days after the procedure, she suddenly heard alert from the device and felt a sense of electrical shock in her left chest when she was taking a rest at home. Within ten days, this condition happened almost every day. However, the patient did not complain of any palpitation, syncope, presyncope or spontaneous chest pain. Owing to solitary state and considering the coronavirus disease 2019 pandemic, the patient was unwilling to come to the hospital.

About eleven days later, she was admitted to the Emergency Center of Beijing Hospital, there were no any signs of worsening of HF or coronary artery disease. Her physical examination showed a heart rate of 60 beats/min, a blood pressure of 140/68 mmHg. No pulmonary rales, cardiac murmurs, lower-extremity edema and other remarkable cardiovascular signs were examined. The laboratory tests were as follows: troponin I of 0.03 ng/mL (0−0.04 ng/mL), creatine kinase muscle brain isoenzyme of 1.1 ng/mL (0−5.0 ng/mL), myoglobin of 1.1 ng/mL (0−70 ng/mL), B-type natriuretic peptide of 655.39 pg/mL (< 100 pg/mL); routine blood test, electrolytes and

| Table 1 The implantable cardioverter defibrillator parameters set before and after inappropriate shock. |
|---------------------------------------------------------------|
| Before inappropriate shock | Ventricular tachycardia zone, beats/min | Ventricular fibrillation zone, beats/min |
|------------------------------|-----------------------------------|-----------------------------------|
| Before inappropriate shock   | 176–207                           | > 207                             |
| After inappropriate shock    | 176–222                           | > 222                             |

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thyroid function test were within normal range. An initial electrocardiography showed normal sinus rhythm with intermittent pacing, no ST-T changes or QT interval prolongation were noted. Based on the above results, some diseases, like acute coronary syndrome, acute decompensated HF and electrolyte disturbance were excluded from further consideration. Then the patient was sent to the Electrophysiology Center of Beijing Hospital. Device interrogation of the ICD revealed that events including alerts and electrical shocks happened more than 40 times during this period. Intracardiac electrocardiogram found that it was PAF (around 220 beats/min) with 1:1 ventricular response but not wide QRS tachycardia that triggered the electrical shocks (Figure 1). Anti-tachycardia pacing (ATP) therapies were also recorded (Figure 1). However, most of the time, ATP could not terminate the tachycardia, an electrical shock was followed, and sinus rhythm was recovered (Figure 1). A bedside chest X-ray using the C-arm in the Electrophysiology Center of Beijing Hospital showed that the ventricular lead was dislodged in the right atrium (Figure 2).

At last, inappropriate ICD shock due to lead dislodgement complicated with PAF was diagnosed. ICD shock function was turned off temporarily for fear of more inappropriate shocks. Two days after admission, the patients received lead reimplantation procedure, the ventricular lead was reimplanted in right ventricular septum (Figure 3). The rate cutoff of VF zone was reprogrammed to 222 beats/min (Table 1). After the procedure, the patient recovered well. Up to now, during a follow-up time of six months, no further device alert or electrical shock were found.

In the case we reported, the right ventricular lead dislodged in the right atrium. When atrial fibrillation (AF) attacked, the dislodged ventricular lead recorded a fast electrical activity consisting with the atrial lead, which was recognized as VT or VF and a storm of ATPs or inappropriate shocks was delivered.

ICD has been widely used worldwide for primary and secondly prevention of sudden cardiac death. However, electrical shocks can be delivered inappropriately, which may cause anxiety, fear and has become a common concern for ICD recipients. According to SCD-HeFT and MADIT-II study, the rate of inappropriate shock can be as high as 11.5% to 17.4%.[1,2]
The causes of inappropriate shock consist of environmental causes, device-related causes and SVTs.[3] AF and other SVTs, including sinus tachycardia, atrial tachycardia, and paroxysmal supra-

![Figure 1 Recordings of intracardiac electrocardiogram and implantable cardioverter defibrillator therapy.](http://www.jgc301.com)
Ventricular tachycardia may cause oversensing and trigger inappropriate shock. AF is the most common arrhythmia among elderly people, and the prevalence increases with age.

Inappropriate ICD shock owing to lead dislodgement has seldom been reported. In a case reported by Ferretto, et al., inappropriate shock was due to atrial far-field on the tip-to-ring channel of the fast electrical activity during AF, caused by lead dislocation in the right ventricle outflow tract. Hashmani, et al. reported a case of inappropriate shock in a patient with single chamber ICD. However, the cause of lead dislodgement was some form of manipulation by the patient, which was called Twiddler’s syndrome. The right ventricular ICD lead displaced into the right atrium, P-wave oversensing during sinus tachycardia by the ICD lead resulted in inappropriate shock.

Lead dislodgement is an extremely rare complication after implantation of transvenous cardiac implantable electronic devices. The incidence of lead dislodgement ranged from 1% to 2.69% in various studies. Lead dislodgement can be divided into lead microdislodgement and lead macrodislodgement, which refers to leads that are grossly dislodged as seen on chest radiography or other cross-sectional imaging modalities. Lead dislodgement has also been classified as early dislodgement (within the first six weeks after implantation) and late dislodgement (more than six weeks). Early dislodgements are more frequent than late dislodgements. As shown in this case, this patient presented as macrodislodgement and early dislodgement.

The first sign of lead dislodgement is pacemaker malfunction, including sensing malfunction and pacing malfunction. Depending on patients’ state, types of device and sites of lead dislodgement, patients may experience such symptoms as palpitation, chest pain, dizziness or lightheadedness, presyncope or syncope, diaphragm contraction, and so on. In this patient, lead dislodgement of ICD ventricular lead to the atrium led to mis-sensing of atrial fast electrical activity during AF attacks and triggered electrical shock.

Published literature has suggested that various factors, such as older age, comorbidities (New York Heart Association functional class IV heart failure, AF/atrial flutter), having a cardiac resynchronization therapy-defibrillator device, and non-electrophysiology-trained operators are associated with increased risk of lead dislodgement. Potential risk factors for lead dislodgement in this case include older age, HF and AF.

Lead reposition is the most effective treatment for dislodgement, especially in early dislodgement. As for late dislodgement, implantation of a new lead may be more feasible. Nevertheless, prevention strategies and regular device interrogation are more important, especially for elderly patients. Remote monitoring has been proved to be effective in reducing inappropriate shocks and time to medical assessment, which has a high clinical application value for elderly patients and during the coronavirus disease outbreak.

To the best of our knowledge, this is the only one case of inappropriate ICD shock triggered by lead...
dislodgement in the right atrium complicated with PAF. Despite managing this type of inappropriate shock only requires lead reimplantation, understanding the mechanism is crucial to identify it as an uncommon cause of inappropriate shock and pay more attention to device management in elderly patients.

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