SCIENTIFIC LETTER

"Flip" Syndrome, a new Mechanism of Lead Macrodislodgement of Cardiac Stimulation Devices

Síndrome de flip, un nuevo mecanismo de macrodesalojo de electrodos de dispositivos de estimulación cardíaca

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Lead dislodgement and subsequent dysfunction are among the rarest complications after implantation of a permanent cardiac device, such as a pacemaker, with an incidence of 1.7%. (1) Its advent may be related to external manipulation of the device, inadequate fixation in the muscular plane, and a large pocket area/generator area ratio, among others. (1) Multiple macrodisplacement and rotation syndromes of the device and leads, including reel, twiddler and ratchet syndromes, have been described.

We present the case of a 64-year-old woman who was admitted to the emergency department with 10 hours of chest pain, palpitations, and "vibrations" in the chest, and without other symptoms. The patient had a history of coronary and ischemic heart disease, which triggered heart failure with reduced left ventricular ejection fraction (26%).

Five months before the current admission, she had been fitted with a dual-chamber implantable cardioverter-defibrillator (ICD) for primary prevention of sudden cardiac death, through access by cephalic vein dissection. The leads were fixed to the muscle plane with separate nonabsorbable sutures over the fixation drums, and the device was fixed to the muscle plane with a nonabsorbable suture, without complications. However, the patient mentioned a burning sensation in the pocket of the device every night and, consequently, she performed a "massage" with counterclockwise and clockwise rotating movements on the generator casing. Additionally, she did not attend device review appointments after the implantation. Her physical examination presented no significant findings.

The initial electrocardiogram showed a pacemaker rhythm in DDD mode with adequate atrial stimulation, ventricular sensing failure, and frequent pseudofusions. A transthoracic echocardiogram exposed the right ventricle without a lead inside it. The chest X-ray showed lead displacement; the atrial lead was located in the right atrium under traction and the ventricular lead was in the superior vena cava (Figure 1a). Additionally, the leads were observed coiled around the casing. Interestingly, a 180-degree rotation of the device in its sagittal axis was evident; the rotation was later on confirmed by comparing the connector location with the X-ray taken in the immediate postoperative period of the implant (Figure 1b). Therefore, it was suspected that lead dislodgement corresponded to a mixed mechanism, including ratchet. and reel syndromes. The device was examined, revealing a normal battery and dysfunction due to defects in sensing and capture of the atrial and ventricular leads. No arrhythmias or shocks were recorded as active vibratory alerts, so the symptoms were not related to device shock.

The patient was subsequently transferred to the coronary care unit.

Explantation and implantation of the ICD and repositioning of the leads under fluoroscopic guidance was scheduled for the next day.

During the procedure, the previously described findings on the chest X-ray were confirmed. These included a 180º ICD displacement in the sagittal axis with the device brand directed towards the posterior region (at the time of implantation this area had been positioned towards the anterior region), the casing fixation point was loose, there was lead retraction with clockwise rotation in the ICD short axis (reel) and a cogwheel mechanism on the fixing cap (ratchet).

An obvious deterioration of the leads and their endocardial fixation mechanisms was also documented, making their complete removal necessary. Given the extensive vascular stenosis, it was decided to insert a single ventricular lead, so the resulting device had a

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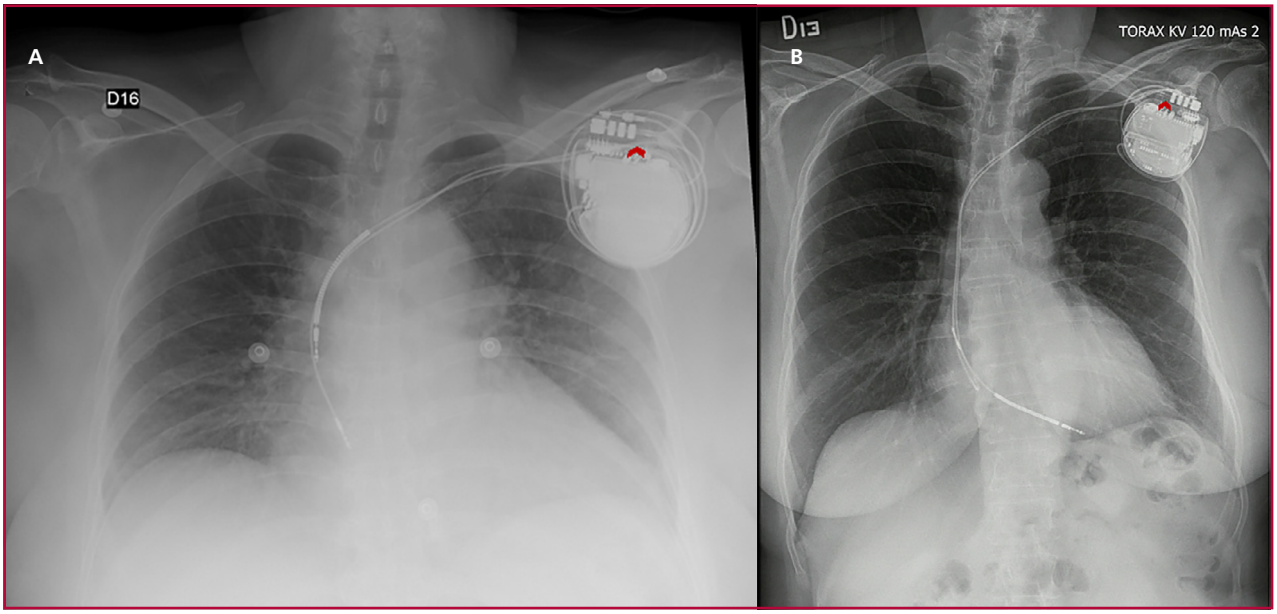

Fig. 1. A. Initial chest X-ray upon arrival to the emergency room. Lead displacement is evident; the atrial lead is in traction in the right atrium and the ventricular lead is observed in the superior vena cava. Reel and ratchet syndromes are confirmed. The lead connectors are seen laterally directed (arrowhead), so a 180° rotation of the device in its sagittal axis is suspected. **B.** Chest x-ray in the immediate postoperative period after ICD implantation, five months before arrival at the emergency room. The lead connectors are seen medially directed (arrowhead).

unicameral configuration. The procedure ended without complications. The post-procedure chest X-ray showed adequate lead and generator positioning, so the patient was discharged within the next 24 hours.

Three different syndromes have been described in the literature (Figure 2):

• Twiddler syndrome produced by the rotation of the generator on its long (axial) axis, which would correspond to the X axis in the Cartesian coordinate system, with lead coiling or twisting (characteristically in the form of a braid). This results in lead dislodgement or fracture, and, consequently, device dysfunction. (2)

• Reel syndrome occurs due to rotation of the pacemaker generator on its transverse axis (short axis), which would correspond to the Z axis in the Cartesian coordinate system, with subsequent coiling (reel) of the pacemaker leads around the generator.

• The ratchet mechanism is produced by an initial lead retraction, followed by a ratchet (cogwheel) mechanism. It is caused by the progressive retraction of the leads from their fixing protections, without twisting or wrapping around the device. Furthermore, it is associated with a lateral displacement of the generator in the frontal plane. (1)

In our patient, it was considered that performing repetitive massage in the area of the device to relieve

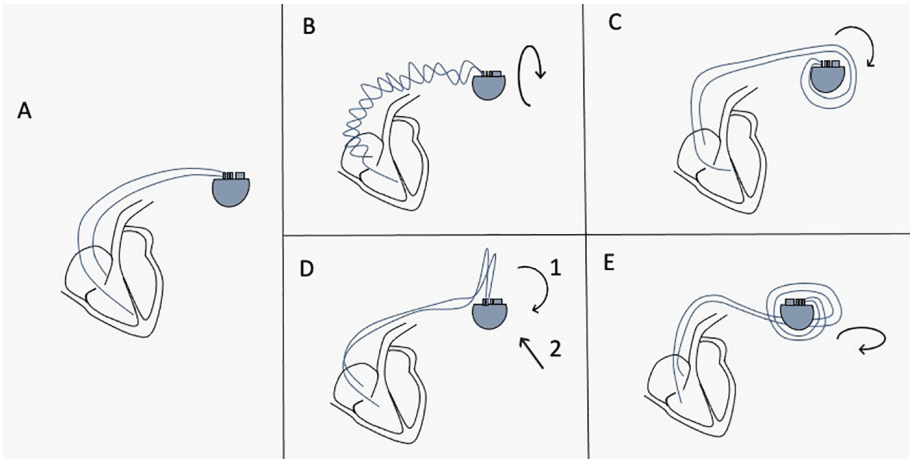

Fig. 2. A. Normal arrangement of leads and generator. **B.** Twiddler mechanism. **C.** Reel mechanism. **D.** Ratchet mechanism. **E.** New mechanism described with rotation in the sagittal axis of 180°: flip mechanism.

the "burning" sensation caused the progressive rotation of the generator. Although coiling of the leads around it, known as reel syndrome, and the lateral displacement of the generator along the frontal plane, known as ratchet syndrome, can explain lead dislodgement and device dysfunction, in this particular case a different mechanism was observed. This was a macrorotation not previously reported in the literature, where the generator is flipped 180 degrees on its sagittal axis, which would correspond to the Y axis in the Cartesian coordinate system. As a result, the brand letters were oriented towards the posterior region, favoring lead retraction and dislodgement (Figure 2). Therefore, it is proposed to call this phenomenon "flip" syndrome or mechanism.

Diagnosis is made by chest X-ray and treatment depends on the underlying mechanism. In the case of the reel syndrome, lead repositioning is the most common strategy. On the other hand, in the twiddler syndrome, leads are replaced in most cases due to the higher frequency of fracture/damage. Additionally, in some specific cases the device pocket can be remodeled. Several strategies have been proposed to prevent device rotation, such as creating a small pocket, subpectoral implantation of the device, use of nonabsorbable or polyester fixation sutures, and the use of active fixation leads and even immobilization of the upper limb in the first week after implantation. (4)

In conclusion, this case emphasizes the importance of device care recommendations and timely and close follow-up of patients in the first 2 to 3 months after device implantation, or remote monitoring that allows early detection of device dysfunction, in order to identify risk behaviors and thus avoid complications such as those described in our patient. In addition, we described a macrorotation mechanism of the device in its sagittal axis, not previously reported in the literature, which we propose to call "flip" syndrome or mechanism.

Ethical considerations

Informed consent was obtained from the patient.

Conflicts of interest

None declared.

(See conflicts of interest forms on the website).

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