Literature Review on Pacemaker Lead Dislodgement Complexes: The experience of a Tertiary Center with Eight Cases

Kalp Pili Lead Dislokasyonları Kompleksleri Üzerine Literatür İncelemesi: Üçüncü Basamak Bir Merkezin Sekiz Vakalık Deneyimi

Emre ÖZDEMİR[1], Ersin Çağrı ŞİMŞEK[2], Mustafa KARACA[1]

[1]Sağlık Bakanlığı İzmir Atatürk Eğitim ve Araştırma Hastanesi Kardiyoloji Kliniği, İzmir
[2]Sağlık Bakanlığı Tepecik Eğitim ve Araştırma Hastanesi Kardiyoloji Kliniği, İzmir

Abstract

Cardiac pacemakers (CPM) and implantable cardioverter defibrillators (ICD) are indispensable treatment option for the cardiac arrhythmias. The most common complication of pacemaker implantation is lead dislodgement. We will present eight patients with lead dislodgement about Twiddler, Reel and Ratchet Syndromes. The patients who need lead repositioning for lead dislodgement were collected retrospectively at the Cardiology Clinic of İzmir Katip Celebi University Ataturk Training and Research Hospital from 2016 to 2017. Lead dislodgement is mostly detected at the device interrogation, with worsening insensing voltage or pacing thresholds. The dislodgement of a ventricular lead incidence in a CPM is known as 0.5 to 2.5%. Our center's experience is lower than these rates (<%0.03). Patient education, opening appropriate pocket for generator size, fixing the sleeves tight enough as required, hanging battery with a strong suture can be used to avoid lead dislodgement.

Keywords: Cardiac Pacemaker, Complication of Pacemaker Implantation, Implantable Cardioverter Defibrillator, Lead Dislodgement

Öz

Kardiyak aritmiler için kardiyak kalp pilleri (CPM) ve implante edilebilir kardiyoverter defibrilatörler (ICD) vazgeçilmez bir tedavi seçeneğidir. Kalp pilinin implantasyonunda en sık görülen komplikasyon lead dislokasyonudur. Twiddler, Reel ve Ratchet Sendromları dahilinde leadlerin dislokasyonu ile sekiz hastayı sunacağız. İzmir Katip Çelebi Üniversitesi Atatürk Eğitim ve Araştırma Hastanesi Kardiyoloji Kliniğinde 2016'dan 2017'ye kadar ki leadlerin dislokasyonu için lead revizyonuna ihtiyaç duyan hastalar geriye dönük olarak toplandı. Leadlerin dislokasyonu, çoğunlukla pil kontrolünde, daha düşük sens voltajı ya da yüksek pacing eşiği ile saptanır. KPM'deki bir ventriküler leadin dislokasyon insidansı % 0.5 ila % 2.5 olarak bilinir. Merkezimizde bu oranlardan daha düşük (<%0.03) olarak saptanmıştır. Jeneratör boyutu için uygun boyutta cep açmak, leadi uygun bir şekilde sabitlemek, jeneratörü sağlam bir dikişle pili cebe asmak, hasta eğitimi leadin dislokasyonunu önlemek için önemlidir.

Anahtar Kelimeler: İmplante Edilebilir Kardiyoverter Defibrilator, Kardiyak Pacemaker, Kardiyak Pacemaker İmplantasyon Komplikasyonları, Lead Dislokasyonları

Başvuru Tarihi / Received: 16.04.2018
Kabul Tarihi / Accepted : 04.06.2018

Introduction

Cardiac pacemakers (CPM) and implantable cardioverter defibrillators (ICD) are the indispensable treatment options for the cardiac arrhythmias. And most patients, up to two-thirds of patients need CPMs and ICDs, are older than 65. CPMs and ICDs complications are more frequent in advanced age. Complications can be related with implantation procedure, generator dysfunction and external forces. As in the PASE study(1), the most common complication is lead dislodgement. These malfunctions of CPMs and ICDs cause clinical worsening. We will present eight patients with lead dislodgement about Twiddler, Reel and Ratchet Syndromes.

Material and Method

With the approval of patients and institution retrospectively, the patients who need lead repositioning for lead dislodgement were collected at the Cardiology Clinic of İzmir Katip Celebi University Ataturk Training and Research Hospital from 2016 to 2017. Totally eight patients who had CPM or ICD detected within this period. On the other hand, totally 254 patients with CPM had ICD implantation in this period at our tertiary center hospital.

Adres / *Correspondence*: Emre ÖZDEMİR
Sağlık Bakanlığı İzmir Atatürk Eğitim ve Araştırma Hastanesi Kardiyoloji Kliniği, İzmir
e-posta / *e-mail* **:** emreozdemir27@yahoo.com.tr

Case reports:

Case 1: A 78-year-old female who has ischemic cardiomyopathy and documented VT was implanted a single chamber (VVI) ICD implantation via the right subclavian access because of a complete left subclavian venous occlusion. Increase in ventricular pacing threshold and the decrease in R wave were detected at the routine control of battery in the 6 months of follow-up. The teleradiography revealed that the electrode dislodged from the right ventricular apex, the SVC coil came back from SVC to the subclavian vein, although the battery was in the normal position. When battery pocket reopened to be repositioned, the fixing sleeve unwinded and the lead could be moved easily. The electrode was released reposition after making sure that its functions were normal (Figure 1).

Case 2: A 65-year-old woman who had a DDD-ICD came for routine device check.Her ICD was implanted after diagnosed ischemic cardiomyopathy after successful CPR on cardiac arrest 6 years ago. Although the atrial lead threshold and impedance values were normal, R wave decreased to 0.5 mV. On the telecardiogram, we detected that the

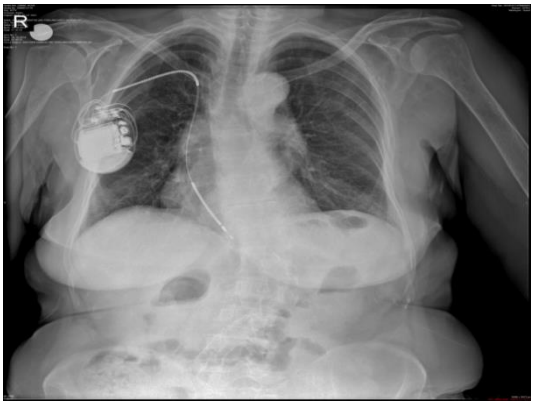

Figure 1. The electrode dislodged from right ventricul apex, the SVC coil came back from SVC to the subclavian vein, but the battery is in the normal position.

ventricular lead was circulated around the generator and lead came up to the superior vena cava while the atrial lead was in the normal place. On the chest x-ray of the patient, we detected active fixation leads were used in both atrium and ventricle. When the battery pocket was reopened, a new ventricular lead was placed after extraction of the old ventricular lead. We replaced the battery in the pectoral muscle deeper than before (Figure 2).

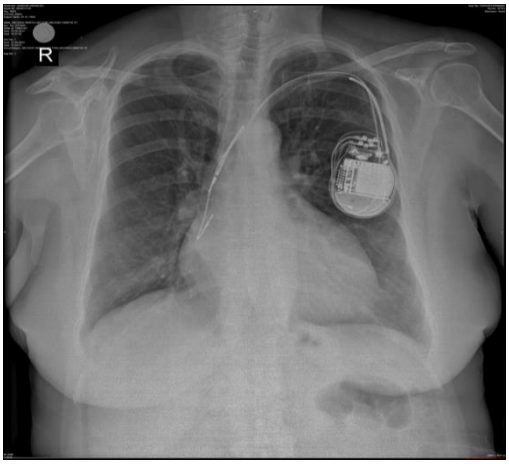

Figure 2. The ventricular lead was circulated around the generator and lead came up to the superior vena cava while the atrial lead is in normal place.

Case 3: A 71-year-old patient with DDD-CPM due to the sick sinus syndrome suffered from palpitation.There was no atrial sensation in the routine pacemaker control. On the telecardiogram, the atrial lead tip came back into the SVC and the lead was collected around the battery. After battery pocket was opened, we noticed that the battery did not turn in any direction but the sleeve was not fixed enough.Then atrial lead was repositioned (Figure 3).

Case 4: A 74-year-old woman who was implanted CRT-ICD 4 months ago due to non-ischemic dilated cardiomyopathy admitted to cardiology with an increase of cardiac failure symptoms. There is no right ventricular R wave sensation on pacemaker control. On the telecardiogram, we observed that the right

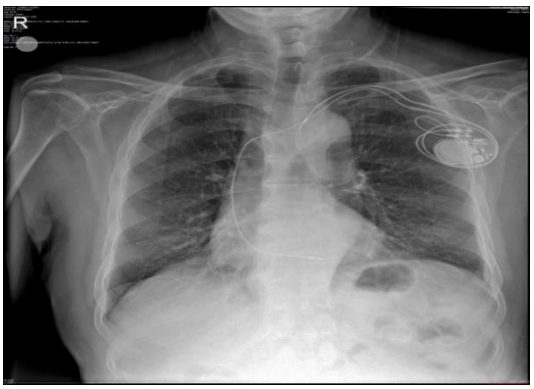

Figure 3. The atrial lead tip came back into the SVC and the lead was collected around the battery, ventriculer lead is at the normal position.

ventricular lead retracted and it came back nearly to the SVC, the atrial lead was also dislodged but coronary sinus lead was in the normal position. The battery pocket was opened again, the battery was stable with the suture inside the capsule, and the ventricular lead fixation sleeve was loose. The right ventricle and atrial electrodes were released and repositioned after ensuring that their function was normal (Figure 4).

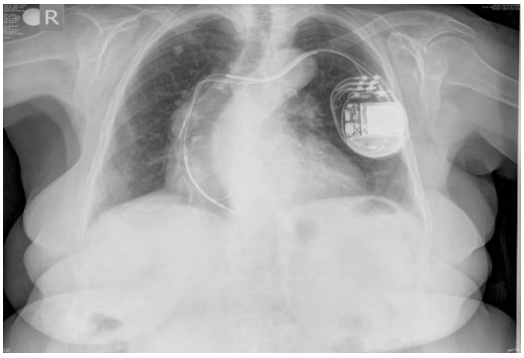

Figure 4. The right ventricular lead retracted and it came back nearly to the SVC, the atrial lead dislodged too but coronary sinus lead was on the normal position.

Case 5: An 86-year-old woman who had VVI-ICD for a seconder prophylaxis was admitted to the emergency department with ICD shock, An improper shock was detected in the control of the VVI-ICD. On the telecardiogram, it was observed that the battery migrated down than the normal location in the generator pocket and the ventricular lead came back to the right atrium due to downward movement of the battery. Considering advanced age and patient's comorbidities, all ICD system was removed and no new device was implanted (Figure 5).

Case 6: A 68-year-old patient with CRT-D was found to have a pace dysfunction in pacemaker control. On the telecardiogram, it was observed that the battery migrated down than the expected location in the generator pocket and accordingly, the atrial lead came back to out of the subclavian vein, ventricular lead and the coronary sinus lead also dislodged due to the retraction. The battery pocket

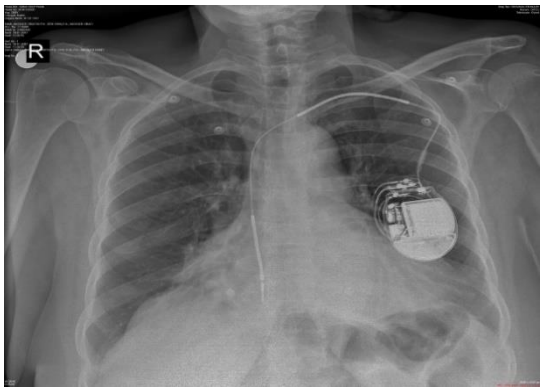

Figure 5. The battery migrated down than the normal location in the generator pocket and the ventricular lead came back to the right atrium due to down movement of the battery.

reopened, the electrodes released and after making sure that the leads' functions were normal, both the battery and the leads were repositioned (Figure 6).

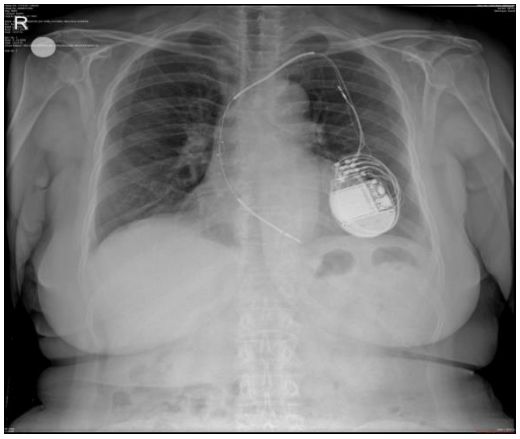

Figure 6. The battery migrated down than expected location in the generator pocket and accordingly, the atrial lead came back to out of the subclavian vein, ventricular lead and the coronary sinus lead also dislocated.

Case 7: A 61-year-old patient who was diagnosed ischemic cardiomyopathy, was implanted a VVI-ICD two months ago. No R wave sensation detected on the pacemaker control. We noticed that ventricular lead dislodged and migrated into the right atrium on the scopy. The battery pocket was opened, the active fixation electrode released but we could not draw back the active fixation lead screw-helix. A new electrode was replaced because the active fixation system could not work due to the myocardial tissue on the tip of old lead (Figure 7).

Case 8: An 80-year-old patient was implanted a VVI-ICD 5 years ago due to ischemic cardiomyopathy There is low R wave voltage on pacemaker control. We saw ventricular lead retracted and dislodged on the telecardiography. The battery pocket was reopened, but the lead's insulation was injured during manipulation So the lead was extracted by simple traction and a new lead was implanted. After being sure that the lead's functions were normal, battery pocket was closed (Figure 8).

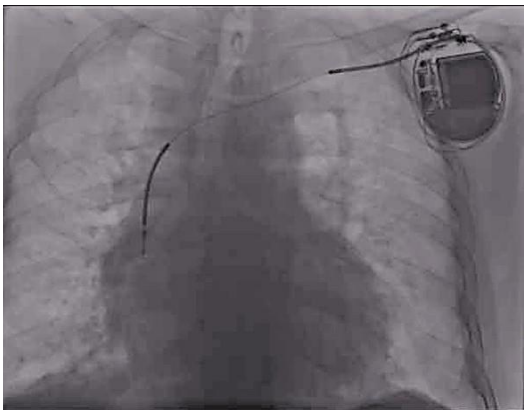

Figure 7. The ventriculer lead dislodged and migrated into the right atrium (A fluoroscopy image).

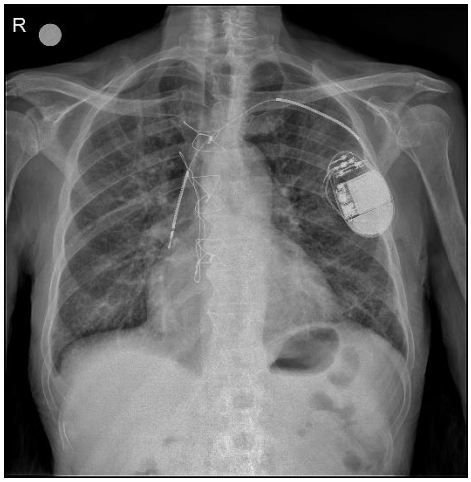

Figure 8. The ventriculer lead retracted and dislodged.

Discussion

Pacemaker lead dislodgement is a well-known complication of device implantation as in the PASE study (1). Lead dislodgement is mostly detected at the device interrogation, with worsening insensing voltage or pacing thresholds. Atrial lead dislodgment becomes more frequent than ventricular lead in the first 6 weeks as early period (2). The dislodgement of a ventricular lead incidence in a CPM is 0.5 to 2.5% (3). Our center's experience is lower than these rates (<%0.03, 8 dislodgements at 254 pacemaker implantations), this lower rate can be misleading since our center serves almost all of the Aegean region, some of the dislodgements may not have reached our center and these leads may have been revised by other hospitals.

Ventricular lead dislodgement becomes less common with advancements in ventricular lead placement and lead design. Lead migration can be detected with pacing defects and inadequate defibrillation. This complication's early recognition is needed for easy repositioning, by the time of late recognition, fibrosis of leads by the myocardium or venous endothelium can make the reposition of leads difficult or impossible. Some mechanisms of

pacemaker lead dislodgement involve retraction of the lead. Twiddler syndrome and Reel syndrome have been described as the displacement of lead due to the rotation of the battery around long axis and around the horizontal axis. Twiddler syndrome (4) is conscious (by the patient) or unconscious manipulation of the pulse generator causing it to rotate around its long axis. Reel syndrome (5) is about the rotation around battery's short axis. Ratchet syndrome has a different mechanism that occurs after the displacement of the pinhole-like movement through the lead fixation sleeve (6).

Reel and Twiddler syndromes have similar pathophysiology (5). The difference between these two syndromes is rotation axis of the battery. These two syndromes are always seen in old and fat women with loose subcutaneous tissue and large battery pocket for pacemaker generator. Demans is a risk factor for these two syndromes (7). Ratchet syndrome (6) has a different mechanism that is caused by not fixing the sleeves tight enough as required. So after generator pocket reopened lead was seen as curled on itself like the spiral-shaped in Twiddler syndrome but the lead was seen circled around the battery in Reel and Ratchet syndromes. So it can be difficult to distinguish between Reel and Ratchet syndromes.

In patients with cardiac devices, a large number of interventions rates are due to the dislodgement of the leads (8). Cardiac devices and leads are exposed to environmental frictional forces, including surrounding muscle tissues, subcutaneous tissue, and other device components. If the leads are not fixed with the sleeves as enough tight as required, the leads can be dislodged by the effect of environmental forces. While retracting forces pull the lead out of the vein, forward thrust forces may cause the lead to curl within the pocket due to the flexibility of the lead. As a result, the lead, which is exposed to multidirectional forces, probably moves one-way with a 'latch-like' mechanism (9).

In our cases, except the fifth one, patients did not have any symptoms and they were mentally normal. None of them had a story of manipulation with the battery pocket. At the first, fifth, seventh and eighth cases the VVI leads were dislodged; in the second and fourth cases, the two leads (except coronary sinus lead) of three leads were dislodged. The only atrial lead (in a DDD-CPM) was dislodged in the third case. Interestingly, in three of our all cases (case 2, 3 and 4), although there were multiple leads, not all leads of cases have been dislodged and in the three of all cases, dislodgements became though leads were actively fixed. In the second and eighth cases, dislodgements were seen at relatively late periods (after the sixth and fifth years of operation).

In all cases, except the sixth one, the leads came back by the help of loosened sleeves and arm movements (Reel or Ratchet syndrome), without a rotation of the battery around the long axis (Twiddler syndrome). It is not easy to distinguish Reel and Ratchet syndromes due to the fact that they have a similar view after reopening the generator pocket as the leads came back and looped around the battery.

In our sixth case, it was seen that the battery migrated downward. When this patient's battery pocket was opened again, we saw that the subcutaneous tissue was quite loose and the suture which was used to hang the battery was not strong enough. For this case, unlike the etiologies of the syndromes described above, technical reasons such as a relatively heavy devices like a CRT-ICD, positioning the battery in a loose subcutaneous area, the suture was not strong enough to hang the battery and this caused the migration of the battery downward due to gravitational force and it passively withdrew the leads back.

The telecardiography and scopy are the most important and simplest methods for diagnosis. The treatment consists of put the generator under the pectoral muscle, into a smaller battery pocket and fixing the battery to the fascia after lead revision.

To avoid these problems patient education, the opening of proper generator pocket and the placement of the battery under the pectoral muscle, well fixing the battery to the surrounding tissues and fasia (10); the placement of a printed bandage on the shoulder area and during the first 5-7 days after operation the limitation of arm movements may be useful (11) and can protect patients and operators from additional interventions.

As a conclusion, pacemaker lead dislodgement is a well-known complication of device implantation. Patient education, opening appropriate pocket for generator size, fixing the sleeves tight enough as required, hanging battery with a strong suture can be used to avoid lead dislodgement.

Informed Consent: Written informed consent were obtained from patients who participated in these cases:
Case 1: 03.06.2016
Case 2: 01.05.2016
Case 3: 06.03.2016
Case 4: 10.12.2016
Case 5: 14.02.2016
Case 6: 06.03.2017
Case 7: 22.06.2017
Case 8: 13.09.2017

References

1. Link MS, Estes NA 3rd, Griffin JJ, et al. Complications of dual chamber pacemaker implantation in the elderly. Pacemaker Selection in the Elderly (PASE) Investigators. J Interv Card Electrophysiol. 1998;2(2):175–9.
2. Chauhan A, Grace AA, Newell SA et al. Early complications after dual chamber versus single chamber pacemaker implantation. Pacing Clin Electrophysiol. 1994;17(2):2012–5.
3. Fortescue EB, Berul CI, Cecchin F, Walsh EP, Triedman JK, Alexander ME. Patient, procedural, and hardware factors

associated with pacemaker lead failures in pediatrics and congenital heart disease. Heart Rhythm. 2004;1(2):150–9.
4. Bayliss CE, Beanlands DS, Baird RJ. The pacemaker-Twiddler's syndrome: a new complication of implantable transvenous pacemakers. Can Med Assoc J. 1968;99(8):371–3.
5. Carnero-Varo A, Perez-Paredes M, Ruiz-Ros JA et al. "Reel Syndrome": a new form of Twiddler's syndrome? Circulation. 1999;100(8):e45– 6.
6. Von Bergen NH. "Ratchet" syndrome, another etiology for pacemaker lead dislodgement: a case report. Heart Rhythm. 2007;4(6):788-9.
7. Alvarez-Acosta L, Romero Garrido R, Farrais-Villalba M, Hernández Afonso J.Reel syndrome: a rare cause of pacemaker malfunction. BMJ case reports. 2014.
8. Ghani A, Delnoy PP, Ramdat Misier AR et al. Incidence of lead dislodgement, malfunction and perforation during the first year following device implantation. Neth Heart J. 2014;22(6):286-91.
9. Cooper JM, Mountantonakis S, Robinson MR. Removing the Twiddling stigma: spontaneous lead retraction without patient manipulation. Europace. 2010 Sep;12(9):1347-8.
10. Munawar M, Munawar DL, Basalamah F, Pambudi J. Reel syndrome: A variant form of Twiddler's syndrome. J Arrhythmia. 2011; 27(4): 338–342
11. Vural A, Agacdiken A, Ural D, Komsuoglu B. Reel syndrome and pulsatile liver in a patient with a two-chamber pacemaker. Jpn Heart J. 2004;45(6):1037-42.