Turk Kardiyol Dern Ars 2019;47(7):616-618 doi: 10.5543/tkda.2018.52386

CASE REPORT

An unusual pacing artifact

Olağan dışı bir kalp pili uyarı artefaktı

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Summary– Cardiac implantable electronic devices (CIEDs) are widely used in current practice. Analyzing the electrocardiographic patterns of these devices and having knowledge of artifacts is crucial to appropriate CIED management. A 32-year-old female patient presented at the device clinic for a routine follow-up visit. A dual-chamber pacemaker had been implanted 12 years previously for sinus node dysfunction. An initial 12-lead electrocardiogram (ECG) prompted concern due to a cyclical pattern of multiple, rapid pacing stimulus artifacts. Device interrogation revealed normal overall pacemaker function. Turning the pace gain function of the ECG machine off failed to eliminate the artifact. On review of the past medical history, the patient was found to have a prior diagnosis of congenital central hypoventilation syndrome and pulmonary hypertension, for which she underwent insertion of a diaphragmatic pacemaker. Interrogation of the diaphragmatic pacemaker revealed that the programmed parameters correlated with the frequency of the artifact noted on the ECG. In cardiac pacing, a single stimulus artifact of sufficient threshold can enable myocardial capture. Capturing diaphragmatic pacing, however, requires a train of multiple stimuli above the threshold. Thus, an understanding of the pacing configurations of various electrical devices that can potentially interfere with CIEDs is crucial to appropriate patient management.

Özet– İmplante edilebilir elektronik kardiyak cihazlar (İEEKC'ler) güncel uygulamada yaygın olarak kullanılmaktadır. Bu cihazların elektrokardiyografik paternlerini analiz etmek ve artefaktlar hakkında bilgi sahibi olmak, uygun CIED yönetimi için kritik önemdedir. Otuz iki yaşındaki kadın hasta rutin takip ziyareti için cihaz kliniğine başvurdu. Sinüs düğümü disfonksiyonu için 12 yıl önce kendisine çift odacıklı bir kalp pili takılmıştı. İlk çekilen 12 derivasyonlu elektrokardiyogramında (EKG), çoklu, hızlı kalp pili uyarı artefaktlarının döngüsel paterni kaygı nedeni olmuştu. Cihazın incelenmesi genelde kalp pili fonksiyonunun normal olduğunu gösterdi. EKG makinesini kalp pili uyarılarına kapatma artefaktı ortadan kaldıramadı. Hastanın tıbbi öyküsü incelendiğinde, önceden doğuştan santral hipoventilasyon sendromu ve pulmoner hipertansiyon tanısı aldığı ve bu nedenle diyafragma pili takıldığı tespit edildi. Diyafragma pilinin incelenmesi programlanan parametrelerin EKG'de belirtilen artefaktın sıklığı ile ilişkili olduğunu ortaya koydu. Kalp pili çalışırken yeterli eşikte tek bir uyarı artefaktı miyokardı etkileyebilir. Bununla birlikte, diyafram pilinin uyarı hızını yakalamak, eşiğin üstünde birden fazla uyarı dizisinin varlığını gerektirir. Bu nedenle, İEEKC'leri potansiyel olarak engelleyebilecek çeşitli elektrikli cihazların pacing konfigürasyonlarının anlaşılması uygun hasta yönetimi için kritik önem taşır.

Cardiac implantable electronic devices (CIEDs) are widely used in current practice. Thorough analysis of the electrocardiographic patterns of these devices and knowledge of artifacts is crucial to appropriate CIED management. Described is a case of a rare artifact detected during a routine electrocardiogram in a patient with a CIED.

Abbreviations:

CIED	*Cardiac implantable electronic device*
ECG	*Electrocardiogram*

CASE REPORT

A 32-year-old female patient presented at the device clinic for a routine follow-up examination. A dual-chamber pacemaker had been implanted 12 years prior for sinus node dysfunction. The results of an initial 12-lead electrocardiogram (ECG) recorded on arrival are shown in Fig. 1. The observation of a cyclical pattern of multiple, rapid pacing stimulus artifacts prompted concern. An ECG recorded a year earlier had revealed a normal sinus

Received: September 19, 2018 *Accepted:* November 23, 2018
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rhythm and biatrial enlargement. Device interrogation in the clinic revealed normal overall pacemaker function (normal sensing, thresholds, and lead impedance). Turning the pace gain function on the ECG machine off failed to eliminate the artifact. A review of past medical history revealed a diagnosis of congenital central hypoventilation syndrome and pulmonary hypertension, for which she underwent insertion of a diaphragmatic pacemaker (Avery Biomedical Devices, Inc., Commack, NY, USA). Interrogation of the diaphragmatic pacemaker revealed programmed parameters of a pulse interval of 50 milliseconds, inspiratory time of 1.2 seconds, respiratory rate of 27 per minute, and an output of 25 pulses per inspiration, which correlated with the frequency of the artifact noted on the ECG.

Figure 1. A 12-lead electrocardiogram recorded upon presentation revealing a cyclical artifact pattern.

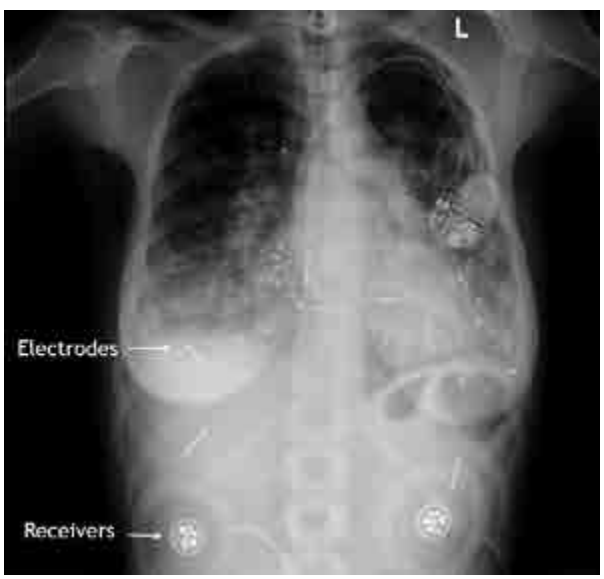

Figure 2. Chest X-ray of the patient revealing components of the diaphragmatic pacing system.

DISCUSSION

A diaphragm pacing system consists of surgically implanted receivers and electrodes and an external transmitter with antennas worn directly over the implanted receivers (Fig. 2). Each antenna is placed on the skin, centered over the receiver. The external transmitter control unit generates a stimulus pulse train, which is converted into radiofrequency energy at the antennas.[1] Radiofrequency pulses are sent through the skin to the implanted electrodes, which then transmit the impulse to the phrenic nerve. In contrast to cardiac pacing, where a single stimulus artifact of sufficient threshold can enable myocardial capture, capturing the diaphragm requires a train of multiple stimuli above the threshold.[2] Therefore, diaphragmatic pacemakers are programmed to deliver multiple electrical pulses with each stimulus, as evidenced on the 12-lead ECG recording of the patient. Routine interventions, such as activating the low pass filter, would not limit this artifact.[3]

Interaction between the 2 systems is possible, although fortunately, it was not observed in the present patient (Fig. 3). Measures to minimize such interference include using bipolar rather than unipolar sensing parameters and adjusting the sensitivity to minimize far-field oversensing while maintaining an adequate safety margin. In extreme situations, lead repositioning may be required if these measures do not help. In addition, pacing the diaphragm at maximum output during cardiac pacemaker implantation or lead repositioning may help to assess for potential interference and determine the choice of pacing sites.

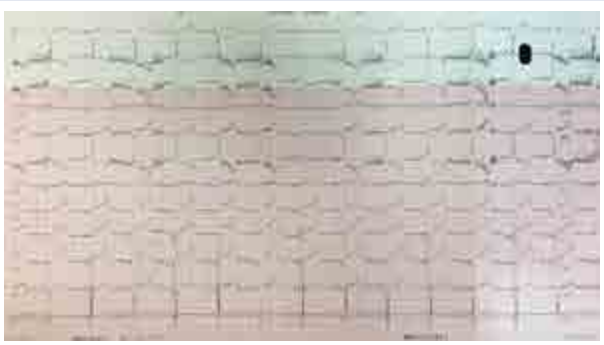

Figure 3. A 12-lead rhythm strip recorded during device interrogation demonstrating the cyclical pattern of diaphragmatic pacing as well as unaffected sequential atrioventricular (AV) pacing. The cardiac pacemaker was temporarily programmed to DDD 70 bpm, with a paced AV delay of 120 ms.

Conclusion

An understanding of the pacing configurations of various electrical devices that can potentially interfere with CIEDs is crucial to providing appropriate patient management.

Peer-review: Externally peer-reviewed.

Conflict-of-interest: None.

Informed Consent: Written informed consent was obtained from the patient for the publication of the case report and the accompanying images.

Authorship contributions: Concept: A.A., N.V.P., H.P.; Design: A.A., N.V.P.; Supervision: H.P., N.V.P.; Materials: H.P., A.A.; Data collection: A.A.; Literature search: A.A., N.V.P.; Writing: A.A., H.P., N.V.P.

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Keywords: Artifact; electrocardiogram; pacemaker.

Anahtar sözcükler: Artefakt; elektrokardiyogram; kalp pili.