Electromagnetic interference with electrocardiogram recording of exercise test equipment

Egzersiz testi cihazındaki elektrokardiyografi kaydına elektromanyetik etkileşim

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Herein, we report a case of pseudosinus tachycardia resulting from an electromagnetic interference between a mobile phone and treadmill device. Electromagnetic interference from a charging mobile phone connected to the same socket with the exercise device turned the recording of a patient to that of pseudosinus tachycardia at approximately twice the rate of actual basal heart rate. Removal of the mobile phone from the socket resulted in normalization of the electrocardiogram.

Key words: Cellular phone/adverse effects; electrocardiography; electromagnetic fields/adverse effects; equipment failure; tachycardia, sinus.

Bu yazıda, mobil telefon ile efor testi cihazı arasındaki elektromanyetik etkileşimin yol açtığı yalancı sinüs taşikardisi olgusu sunuldu. Şarz edilmekte olan mobil telefon ile efor testi cihazının aynı prize takılı olması, monitörde hastanın bazal kalp hızının yaklaşık iki katına ulaşan yalancı sinüs taşikardisi kaydedilmesine yol açtı. Mobil telefonun prizden çıkarılması ile söz konusu yalancı taşikardi görüntüsü kayboldu ve elektrokardiyogram normale döndü.

Anahtar sözcükler: Cep telefonu/yan etki; elektrokardiyografi; elektromanyetik alan/yan etki; ekipman arızası; taşikardi, sinüs.

Electromagnetic interference (EMI) is one of the most frequently neglected causes of inappropriately functioning medical equipment. This type of interference may result in serious and sometimes life-threatening complications. Herein, we present an example of EMI occurring due to the interaction between a mobile phone and exercise stress device.

CASE REPORT

A 46-year-old male was referred for evaluation of atypical anginal chest pain. Exercise stress test was scheduled. Immediately after initiation of monitoring, we observed sinus tachycardia at a rate of 188 beats per minute (Fig. 1a). However, the actual heart rate obtained from radial artery pulsation was in a range of 95 to 100 beats per minute. Then, we simultaneously monitored the patient on another electrocardiography device (both devices were from the same manufacturer and both were used during exercise stress tests), which showed the patient's real rhythm (Fig. 1b). Electromagnetic interference by a charging mobile phone connected to the same socket with the exercise device was thought, and removal of the mobile phone resulted in normalization of the electrocardiogram (ECG).

DISCUSSION

This was a very interesting observation because, as it is generally appreciated, EMI is expected to cause various forms of artifacts, but this kind of confusing ECG is not an expected one. It disrupted not only the filtered ECG, but also the unfiltered ECG (*see* bottom strip of Fig. 1 showing unfiltered recording).

Nonphysiological sources most commonly exert 60-Hz interference from alternating current sources in the area, which is usually filtered out by the electrocardiographic machine. It can lead to a wide, indistinct baseline. Flow of electricity through appliances in the vicinity of the electrocardiographic machine, cables, electrodes, and other components of the system may disrupt the signal.[1] The degree for EMI depends on several factors such as the power emitted by the phone, distance, and carrier frequency. One

Received: April 27, 2009 *Accepted:* September 1, 2009

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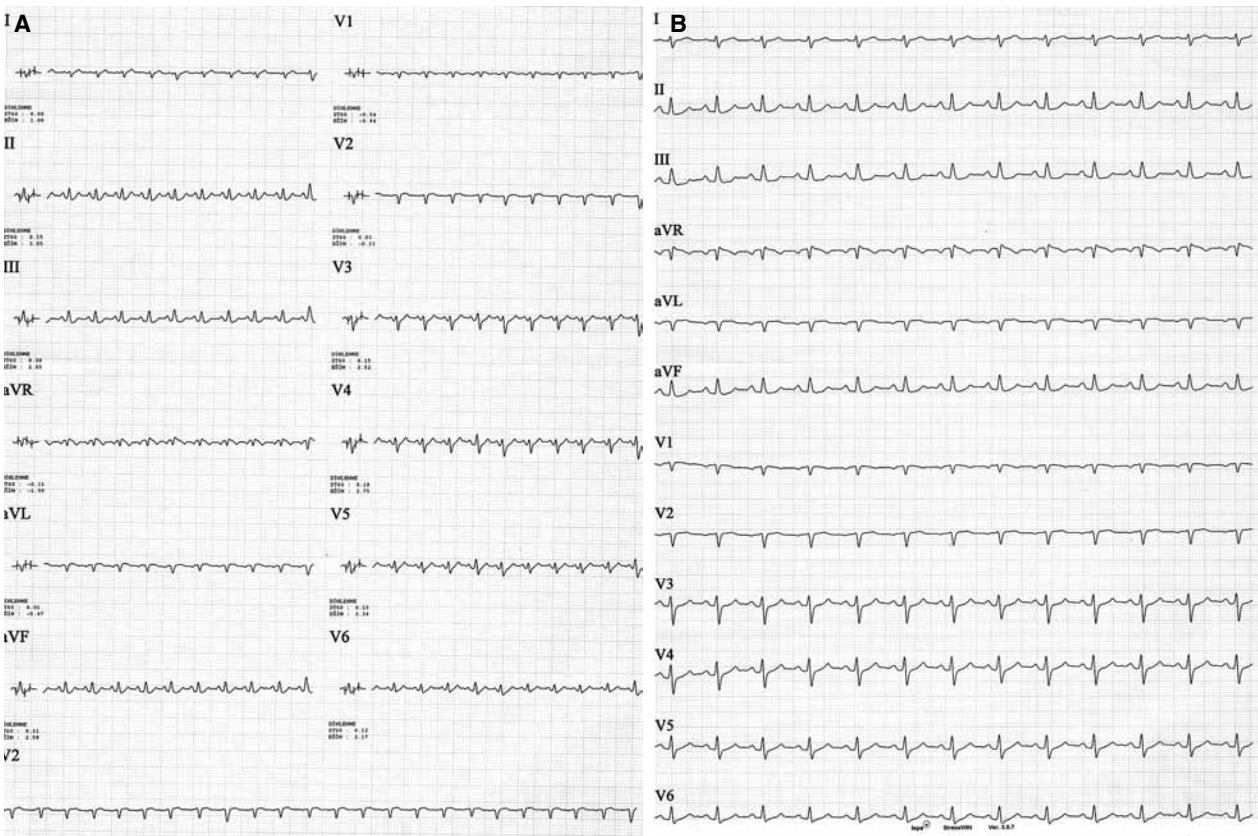

Figure 1. (A) The electrocardiogram (ECG) obtained before exercise displays sinus tachycardia at a rate of 188 beats/min. Note that the ECG strip at the bottom, which represents unfiltered ECG recording, also shows the presence of tachycardia. **(B)** The ECG obtained on a different device shows that the heart rate is in a range of 95 to 100 beats/min. During this ECG recording, the first device still continued to display tachycardia.

study investigated the EMI with infusion and syringe pumps from mobile phones at various distances and emitted powers. Malfunctions occurred in four of the seven infusion pumps and in one of the four syringe pumps exposed to mobile phones working with maximum output and at a distance up to 30 cm.[2] Cell phones in close proximity have also been shown to induce "vent inop" modes.[3] One of the important risk factors for EMI by mobile phones is the strength of the signal. Cell phones and wireless PDAs, in general, have an average power output of 0.6 watts, but this can be increased up to 2 watts in the presence of a relatively low signal strength.[4] Transmit power of mobile phones depends on the strength of their communication with the closest base station. Hence, upon receiving a strong signal from the environment, the phone will decrease its power to a level that is sufficient to maintain the link. Conversely, with a poor signal, the phone will increase its power. This feature is especially important in intensive care units and operation rooms, because they are generally located in isolated and so called ''underground'' areas of hospitals. Most cellular wireless devices do not generate much EMI at distances greater than 50 cm. However, their mobility increases the chance of a close encounter with a medical device. Coupled with increased output power due to low signal strength, the risk for EMI increases. Additionally, older models of mobile phones use two different frequency bands, 900 MHz or 1800 MHz, but newer models incorporate both of these frequency bands (dual band technology) and this factor increases the chance for EMI (900 MHz band frequency more frequently causes EMI compared to 1800 MHz). Although reports of the ECRI (Emergency Care Research Institute) state that a distance of one meter is quite enough to avoid EMI,[5] it is generally recommended to keep mobile phones at a safe distance (at least two meters) away from medical equipment.

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