CorSalud 2016 Oct-Dec;8(4):259-264

CorSalud

Cuban Society of Cardiology

Case Report

Cardiocentro ERNESTO CHE GUEVARA SANTA CLARA CUBA

Removal of abandoned wire leads from a cardiac device: untying or extracting the Gordian knot

Yoandy López de la Cruz[1]✉, MD, MSc; Yolepsis F. Quintero Fleites[1], MD, MSc; Mario E. Nápoles Lizano[2], MD; Rolando del Sol Berriel[1], MD; Lisset C. Machado Rodríguez[3], MD; and Laura B. Pérez Machado[4], Stu.

[1] Department of Cardiovascular Surgery. Cardiocentro Ernesto Che Guevara. Santa Clara, Villa Clara, Cuba.
[2] Department of Image Diagnosis. Cardiocentro Ernesto Che Guevara. Santa Clara, Villa Clara, Cuba.
[3] Policlínico Universitario Juan Bruno Zayas. Cifuentes, Villa Clara, Cuba.
[4] Faculty of Medicine. Universidad de Ciencias Médicas de Villa Clara. Santa Clara, Villa Clara, Cuba.

Este artículo también está disponible en español

ARTICLE INFORMATION

Received: November 24, 2016
Accepted: December 20, 2016

Competing interests
The authors declare no competing interests

Acronym
CAT: Computerized axial tomography

On-Line Versions:
Spanish - English

✉ *Y López de la Cruz*
Cardiocentro Ernesto Che Guevara
Calle Cuba 610,
e/ Barcelona y Capitán Velasco.
Santa Clara 50200. Villa Clara, Cuba.
E-mail address:
yoandylc@infomed.sld.cu

ABSTRACT

Wire leads are considered the weakest link of intracardiac devices. The removal of those which were chronically implanted is always a difficult procedure. Such procedure is performed with a near to 100% effectiveness in centers having devices for percutaneous extraction, but when there is no such technology, surgery –minor one or open heart with extracorporeal circulation– is often performed by the cardiovascular surgeon, who has to assume the leading role because of the risk of injury to cardiac structures. A patient with abandoned pacemaker leads is presented. The passage of the wire leads through the subaponeurotic space of the right hemithorax produced discomfort for years, and certain deformities of the chest wall, without the chance of being withdrawn in spite of multiple attempts. The particularities of this case outline the importance of not underestimating these kinds of surgeries, and performing adequate preoperative studies that allow the properly planning of surgical procedure.

Key words: Cardiac devices, Artificial pacemaker, Implanted electrodes, Device removal

Extracción de electrodos de dispositivos cardíacos abandonados: desatando el nudo Gordiano, o extrayéndolo

RESUMEN

Los electrodos son considerados el eslabón más débil de los dispositivos intracardíacos. La extracción de los crónicamente implantados constituye siempre un procedimiento dificultoso. En centros que cuentan con dispositivos para su extracción percutánea, el procedimiento se realiza con una efectividad cercana al 100 %, pero cuando no existe esa tecnología, la cirugía –menor o a corazón abierto con circulación extracorpórea– es muchas veces realizada por el cirujano cardiovascular, quien tiene que asumir el protagonismo por el riesgo de lesión de estructuras cardíacas. Se presenta un paciente con electrodos de marcapaso abandonados, cuyo trayecto por un espacio subaponeurótico del hemitórax derecho produjo, durante años, malestar y ciertas deformidades de la pared torácica, sin que se pudieran retirar después de múltiples intentos. Las particularidades de este caso

delinean la importancia de no subestimar estas cirugías y realizar adecuados estudios preoperatorios que permitan planificar convenientemente el procedimiento quirúrgico.

Palabras clave: Dispositivos cardíacos, Marcapaso artificial, Electrodos implantados, Remoción de dispositivos

INTRODUCTION

Based on the studies by von Ziemssen of the late nineteenth century, in 1928, two Australian scientists, an anesthetist and a physicist, developed the first device designed to stimulate a human heart (in this case, through a needle inserted into the ventricle), with an alternating current discharge[1]. Thirty years later, on October 8, 1958, at the Hospital of the Karolinska Institute in Solna, near Stockholm, Sweden[2], a system developed by the cardiac surgeon Ake Senning and the physicist inventor Rune Elmqvist was implanted for the first time to a patient, an engineer of 45 years old, with a complete heart block, suffering Stokes-Adams crisis up to 30 times a day[1]. Thus, there began a story that seems endless, the implant of the electronic cardiac devices, whose number increases substantially each year.

Almost six decades later, advances in medicine have resulted in increased life expectancy of a population –therefore– more aged, with more comorbidities and greater need for these devices[3], and also due to the expansion of their indications[4].

In this scenario, electrodes are considered the weakest link of the intracardiac devices, due to defects in design or construction, to the hostile biochemist environment *in vivo*, as well as the physical stress imposed by implantation, anatomy and cardiac activity. Moreover, unlike the generator, the extraction of the electrodes is a more difficult procedure, as the increase in the duration of implants causes their fibrous adhesions to veins and the heart chambers –starting almost immediately after implantation– and their evolution with time to cause the cable's anchor virtually to the surrounding cardiovascular structures; a process which complicates even more due to the mineralization and calcification of these adhesions[4].

The procedure of choice in centers where the technology exists is percutaneous removal of chronically implanted not useful electrodes, and it is performed with a higher effectiveness than 95%[3,5-7]. In Villa Clara, Cuba, the experience dictates that the majority of electrodes, that are no longer useful, are abandoned *in situ* by the electrophysiology's specialists; in the best case, anchored by suturing to any perivascular structure with more or less resistance.

On some occasions, an endocarditis associated to these electrodes is developed, which can even be fatal[8-10]. Other patients, as the one presented herein, fortunately, reach the operating room before developing infectious complications, but suffering from symptoms dependents of the abandoned electrodes that often require a multidisciplinary approach and preoperative study to plan the most suitable extraction procedure and free of complications.

CASE REPORT

White male, 55 years old, with a history of having been implanted a permanent pacemaker six years ago because of severe bradycardia. Ulterior procedures of generator changes left, as a consequence, the existence of endocavity electrodes abandoned with the end connector, in a situation not well specified in the right hemithorax, which for years has caused discomfort and chest pain to the patient, reason why there was decided to extract, at least, the electrode segments causing him discomfort.

The patient attended the cardiovascular surgery consulting room after being subjected to several unsuccessful minor surgical procedures intended to remove the electrode in question. At that moment, the patient referred pain of varied characteristics and intensity in the pectoral and right inframammary region. The physical examination confirmed the presence of six surgical wounds in different places along the supposed thoracic course of the electrode, some with important skin retraction, and apparent increase in the volume of the ipsilateral breast (**Figure 1A**).

The simple thoracic radiography in anteroposterior view (**Figura 1B**) showed the presence of two abandoned electrodes in the projection of the right hemithorax, virtually at the level of the diaphragmatic dome at that side (6º-7º intercostal space) in an unusual and unexpected position, being the end

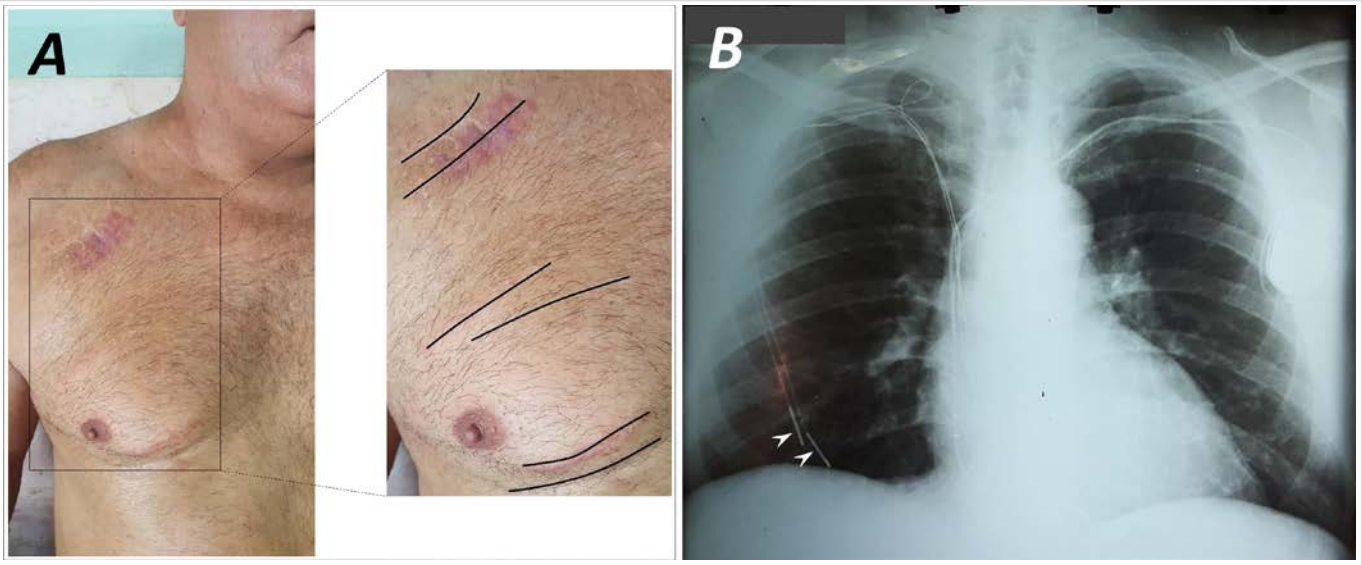

Figure 1. A. Surgical wounds of previous attempts of removing abandoned electrodes. The site chosen for the most recent incision, through which the electrode leads were extracted (second from top to bottom) coincided with a previous wound at the same location. The lines mark the surgical scars. **B.** Simple chest radiography, where are observed the abandoned electrodes in the right hemithorax projection, with end connectors (arrowheads) presumably at the level of the hemidiaphragm of that side.

connectors distant of the venous vessels, normally used to access the heart chambers in the placement procedures of such devices. In the lateral view, it was achieved, with difficulty, to specify a thin radiopaque line in the projection of the anterior chest wall, which confirmed the superficial trajectory –apparently subaponeurotic– of the electrodes. Without understanding the reasons why these electrodes have not been previously extracted, the suspected cause was the impossibility of finding them in the subcutaneous planes and there was carried out a soft tissue ultrasound to pinpoint exactly their trajectory, which did not provide the expected results, not being able to visualize the wire.

A simple computerized axial tomography (CAT) of the thorax was carried out, with which finally the reason that prevented the extraction of these electrodes was identified. The tomographic reconstruction of the images (**Figure 2**) showed the proximal end of the electrodes in the anterior chest wall, at the level of the anterior arch of the fourth rib and there was confirmed the presence of a cluster of wires and tissues forming a knot in its trajectory, in an anterior projection and slightly below the right clavicle (not entirely coincident details with the actual anatomical positions, being the patient with raised arms). This knot was undoubtedly the cause of the failed previous attempts at removal. Antero-posterior and lateral reconstructions also showed the right pectoral muscle hypertrophy, evidenced in the physical examination (**Figure 3**).

With this knowledge, the surgery was properly planned where, through a small incision with local anesthesia, the knot was located and, from it –by pulling manually–, it was possible to extract the distal and proximal portions of both electrodes (**Figure 4**) located on the anterior chest wall. A month after the surgery, the patient maintained a favorable evolution and the chest pain symptoms had gone.

COMMENT

Most patients requiring cardiovascular surgery, due to elementary matters of their underlying disease, need a multidisciplinary care at some point before passing through the operating room. Before surgery, a number of studies are performed, which in some way facilitate the work of surgeons. At other times, not involving specifically an open heart surgery, cardiovascular surgeons are summoned by other specialists for minor surgical procedures which, of

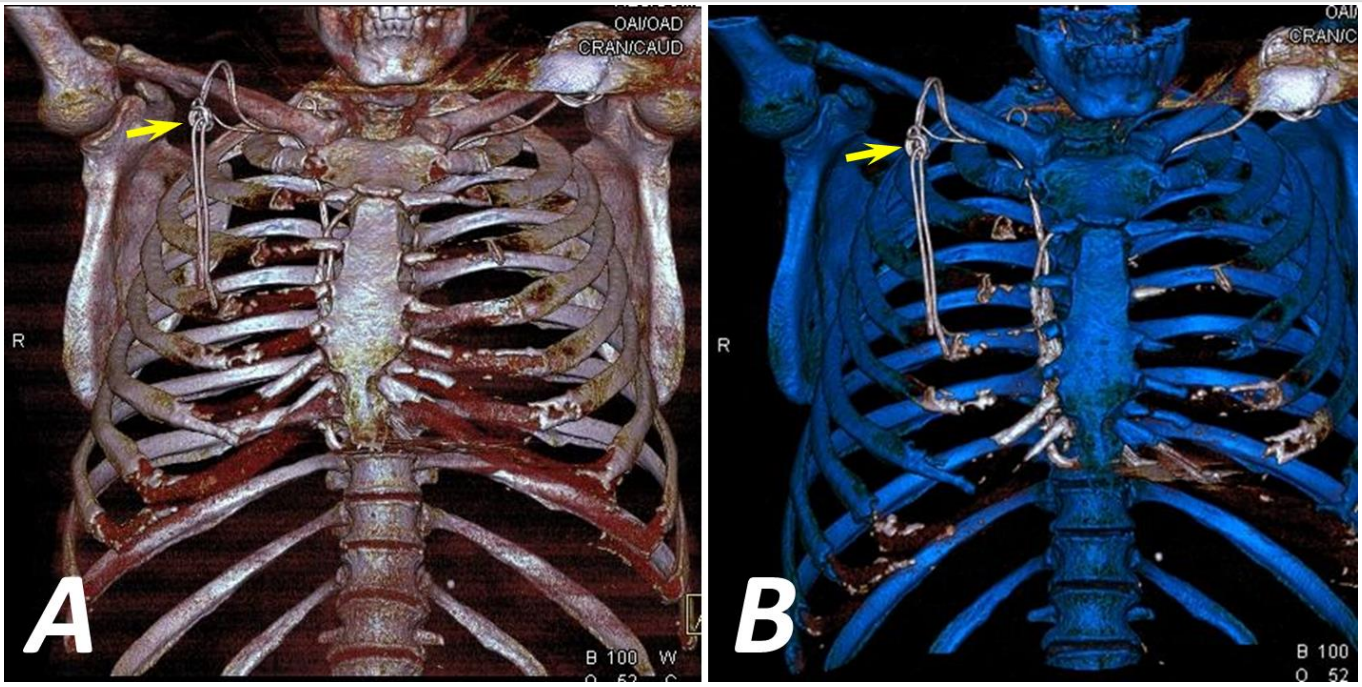

Figure 2. A y B. Tomographic details of the thoracic cavity and the trajectory of the abandoned electrodes. The arrows indicate the knot at the proximal cable trajectory.

course, are somehow a little away from the usual practice of their specialty. In these cases, some –adapted to the complexities of major surgeries– tend to minimize the procedure to be performed and underestimate the preoperative evaluation of the patient, which can sometimes interfere with obtaining good results[11].

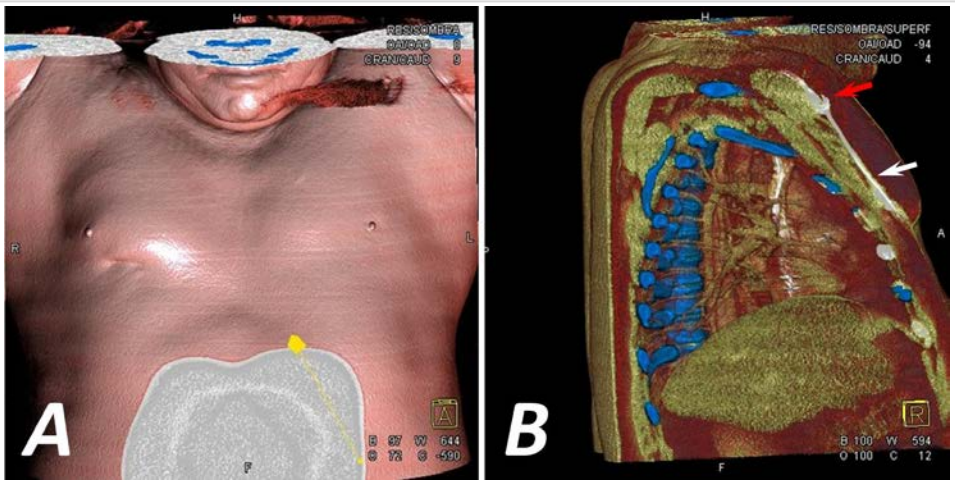

Figure 3. Tomographic details that show tissue retractions (**A**) and hypertrophy of the right pectoral muscle (**B**); in addition, the trajectory of the electrodes by the chest wall. The red arrow indicates the knot, and the white one the distal part of the electrodes, which shows the absence of a relation to the diaphragm that could be suspected on the radiography.

When there are no adequate technical conditions for percutaneous extraction of electrodes chronically implanted in the heart, this situation, like a Gordian knot, can become a problem of difficult solution. The lack of these specialized devices[12,13] has made this intervention a specific procedure in the field of cardiovascular surgery, and each passing day the number of patients who need this operation increases, either open heart with the use of extracorporeal circulation, or the cooperation of cardiovascular surgeons in minor surgeries with a specific complexity. The case presented herein is an example showing that, sometimes, all studies that are available must be employed for planning and pro-

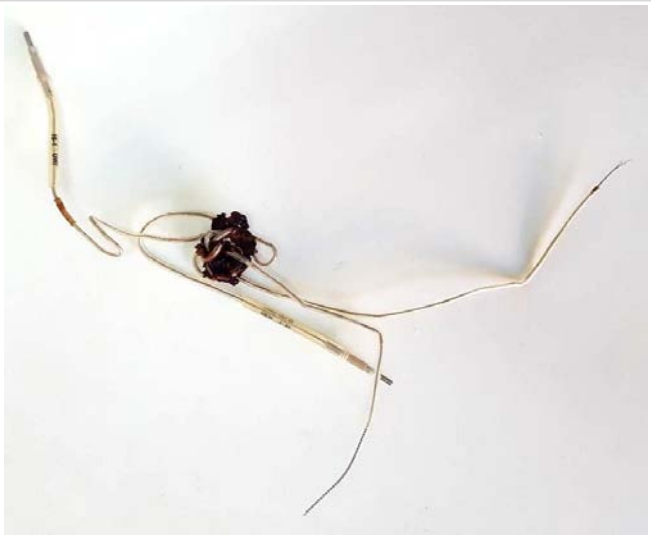

Figure 4. Electrodes extracted.

perly performing a surgical procedure, which seems to be simple in appearance.

A tomographic study of short duration allowed, by a surgery of only 20 minutes, with an incision of only 5 cm and the use of a small amount of local anesthetic, to end the patient's years of suffering; that same afternoon he was happily back in his house. Not having received these images, the electrodes would have been extracted anyway, but certainly by a longer and more traumatic surgery, an extensive and disfiguring incision, certainly, with the use of general anesthesia, and probably more hospital stay and the possibility of postoperative complications[14,15].

Nearly all these minor surgeries are performed on an outpatient basis, where often a simple chest radiography illustrates quite clearly the position of the electrodes and allows the surgeon to plan the surgery and to carry it on successfully. However, in this case, an unknown knot, perfectly visible on the CAT, was not found in conventional radiography, because it was masked by the radiopacity of the chest wall and rib arches (**Figure 1B**).

Few situations are more frustrating in medical practice that an invasive procedure that does not provide the expected results, and in the case of this patient, unfortunately, it included more surgeries before an accurate diagnosis was achieved, with the use of studies not always appropriately and efficiently used in our daily practice.

It is true that the CAT can be expensive and not available in some scenarios, but if the technology is already installed and there is an adequate staff to handle it, there only remains to make an effective use of it. This is a typical example resulting in the health and well-being of our patients.

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