

1 **Title:** ECG Artifact by a Spinal Cord Neurostimulator: A Case Report

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19
20 **Highlights:**

- 21 • This case report brings to light important information regarding ECG artifact to prevent misdiagnosis of
- 22 atrial fibrillation or other heart rhythms.
- 23 • The information will help physicians and technicians identify sources of electromagnetic interference
- 24 when patients are getting ECGs.
- 25 • The case report will draw to light the importance of obtaining sufficient ECG recordings to make valid
- 26 medical decisions.

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36 **Discussion Points:**

- 37 1. This case report brings to light important information regarding ECG artifact to prevent misdiagnosis of
- 38 atrial fibrillation or other heart rhythms.
- 39 2. The information will help physicians and technicians identify sources of electromagnetic interference
- 40 when patients are getting ECGs.

- 1 3. The case report will draw to light the importance of obtaining sufficient ECG recordings to make valid
- 2 medical decisions.
- 3 4. Where does electromagnetic interference come from?
- 4 5. Why are potential misdiagnoses probable if an ECG is obtained inadequately?
- 5

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1 **ABSTRACT.**

2

3 **Background:** Neurostimulator devices produce electrical oscillations that may prevent accurate diagnosis of
4 an ECG.

5 **The Case:** We present the case of a 68-year-old man who came to the emergency department with chest pain
6 and a spinal cord neuromodulator device in situ to treat his polymyalgia rheumatic. A 12-lead ECG was obtained
7 to determine the cause of the chest pain, and atrial fibrillation was wrongly diagnosed.

8 **Conclusion:** This case reiterates the value of recognizing this uncommonly encountered ECG artifact to avoid
9 unnecessary mistakes in interpretation of heart rhythms.

10

11 **Key Words:** Neurostimulator devices, ECG artifact, Atrial fibrillation

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1 INTRODUCTION.

2
3 Acquisition of high-quality surface 12-lead ECGs in the Emergency Department (ED) is paramount to facilitate
4 interpretation of different clinical presentations.¹ Inability to obtain adequate recordings significantly diminish the
5 capacity of the interpreter, leading to potentially serious medical errors.

7 THE CASE.

8
9 We present the case of a 68-year-old male with a history of polymyalgia rheumatic with pain refractory to usual
10 care and implanted with a neuromodulation device (MyStim Neuromodulator Device, Medtronic) (**Figure 1A**).
11 The patient reported a history of metastatic lung cancer, for which he underwent surgical removal of a lung
12 mass via thoracotomy. On this occasion, he presented to the ED with complaints of chest pain. A 12-lead ECG
13 was obtained; however, the automatic analysis of the ECG machine was unable to determine whether the
14 patient had a pacemaker. From this ECG, there was an erroneous diagnosis of atrial fibrillation (**Figure 2A**).
15 The patient had an external programmer (MyStim Programmer Model 97740, Medtronic) with the ability to
16 inactivate the neurostimulator and adjust the stimulation level (**Figure 1B**). After the neuromodulation device
17 was switched off, a repeat ECG showing normal sinus rhythm was obtained (**Figure 2B**).
18

19 DISCUSSION.

20
21 Neuromodulation stimulators are inserted in a wide variety of patients in the context of a range of conditions.
22 Devices like these target different anatomical sites, such as the deep brain and spinal cord. Neurostimulator
23 devices produce electrical oscillations that may hinder the procurement of an ECG and can generate artifacts
24 that may interfere with the accurate diagnosis of the data attained.² The neurostimulator controller is a miniature
25 hand-held, wireless device, similar to a remote controller. It delivers electrical signals to the epidural space near
26 the spine through lead-wires.³ It is used for the treatment of polymyalgia rheumatica chronic pain. Spinal cord
27 stimulation reduces chronic pain and improves the ability to go about daily activities by modifying and masking
28 the pain signal before it reaches the brain.⁴
29

30 The device works by adjusting amplitude, pulse width, and rate of pulses delivered per second, according to the
31 therapy prescribed by the physician.
32

33 The stimulation induces artifact in the ECG tracing, posing different difficulties to a precise analysis of the
34 surface ECG. In this case, momentarily impairing the device provided an accurate ECG recording, showing a
35 normal ECG instead of wrongly diagnosing atrial fibrillation (or any perceived arrhythmia). Other common
36 sources of interference, such as Parkinson disease and tremors, hearing aid devices or sacral neuromodulators,
37 may also act as a barrier to accurate electrocardiographic diagnosis.⁵
38

39 Similarly, deep brain stimulation is another form of electrical interference that has been shown to cause
40 electrocardiogram artifact. Because the ECG can pick up electrical activity created by these stimulators, this
41 brings to light other potential sources of interference, artifacts are only visible when neurostimulators are in

1 monopolar mode.⁶ This is likely because in bipolar mode, the electrode contact in the brain does not possess
2 enough magnitude to create a notable interference.

3
4 Another example of interference comes from transcutaneous electrical nerve stimulators. TENS produce electric
5 currents that interfere with ECG machines.⁷ Artifact can occur depending on the frequency and amplitude
6 through which skin electrodes are placed. Additionally, artifact can occur if ECG leads are placed incorrectly,
7 and mimic pathology like in this case.⁸ Proper ECG interpretation depends on several aspects of clinical care.

8
9 Recognizing different sources of artifact, learning how to facilitate a situation where ECG artifact is minimized,
10 and being able to collect a proper ECG is quite essential to maintaining high level care.⁹ Being aware of the
11 effects of different neuromodulator devices is important for both ECG technicians and physicians.¹⁰ Rapid
12 recognition of sources of electromagnetic interference improves surface ECG recordings quality facilitating the
13 accurate diagnosis or exclusion of different medical conditions relating to cardiac electrophysiology.¹¹
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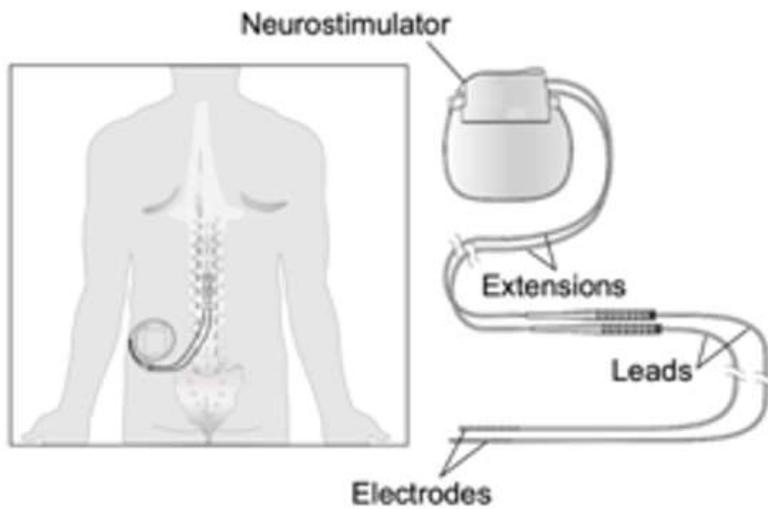
1 **FIGURES AND TABLES.**

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3 **Figure 1. A:** Implanted Parts of an Internal Neurostimulator System. **B:** External Programming Unit of the
4 MyStim Spinal Cord Neurostimulator Model 97740.

5

A



B

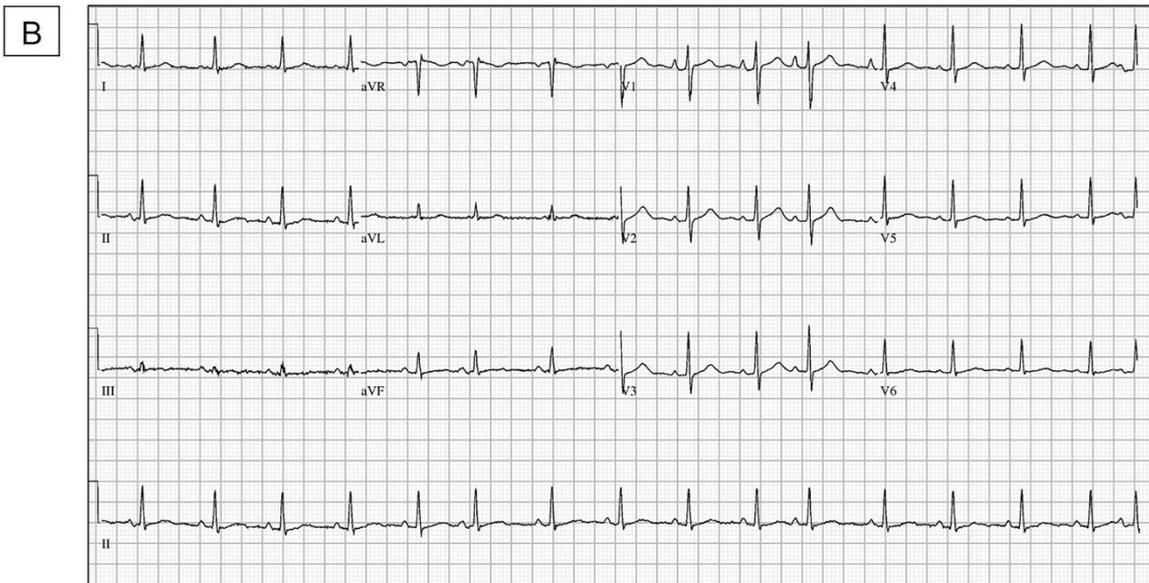
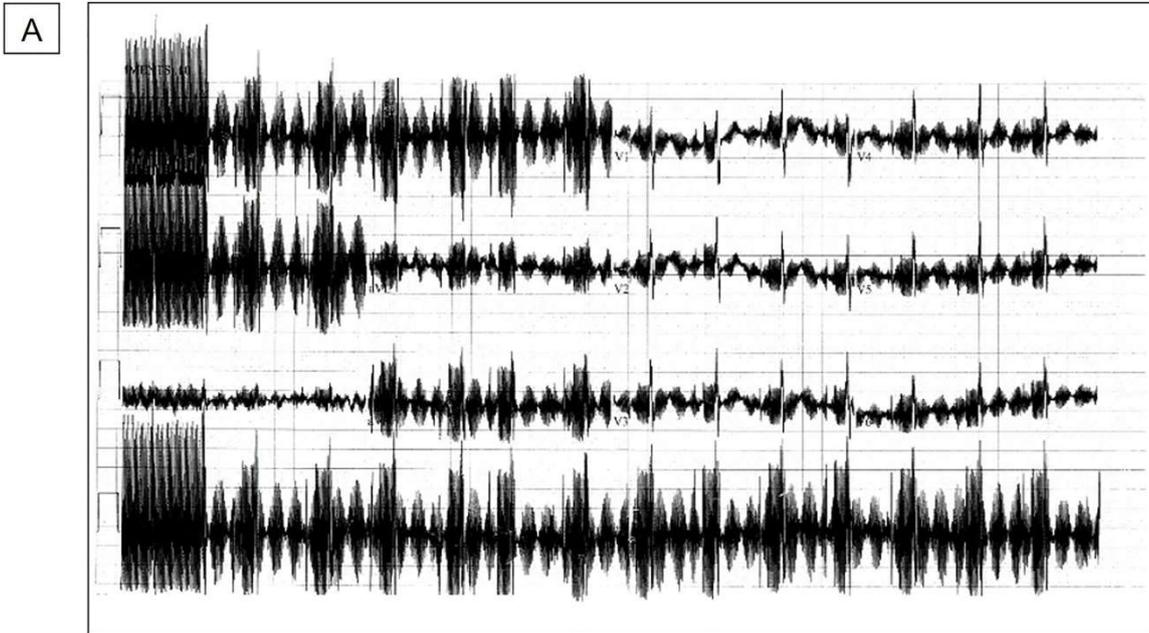


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- 1 **Figure 2. A:** ECG with atrial fibrillation obtained with neuromodulator active. **B:** ECG without artifact, obtained
- 2 after turning off the neuromodulator device.



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