8-17-2022

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Recommended Citation

Plawecki A, Tripathi N, Tovar Torres M, and Yaremchuk K. Interference With Implanted Upper Airway Stimulation Device by Phones With Magnet Technology. Laryngoscope 2022.

The Laryngoscope

Case Report

Interference With Implanted Upper Airway Stimulation Device by Phones With Magnet Technology

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Newer iPhone models with MagSafe magnetic technology can cause electromagnetic interference with the Inspire upper airway stimulator device (a surgical implant for the treatment of obstructive sleep apnea).

Key Words: electromagnetic interference, hypoglossal nerve stimulator, implant, OSA.

***Laryngoscope*, 00:1–3, 2022**

INTRODUCTION

Over the last decade, the implanted hypoglossal nerve stimulator device has emerged as a novel and increasingly prevalent surgical therapy for the treatment of obstructive sleep apnea (OSA). By stimulating branches of the hypoglossal nerve responsible for tongue protrusion, it effectively targets upper airway collapse during sleep. Thus far, the literature has demonstrated a favorable safety profile for this device.[1] As a relatively new therapy, subtle adverse effects and device interactions may continue to be uncovered during more widespread use in the population and should be monitored closely. Specifically, interactions involving medical implants must be thoroughly investigated to inform patients of possible interference, given the non-temporary nature of implants.

One of the largest technology companies to date and producers of the iPhone, Apple Inc., recently began incorporating a novel magnetic technology (MagSafe) in the iPhones 12 and 13 (see Fig. 1). This technology has been built into the internal structure of the newer phone models and produces a strong magnetic array to facilitate attachment to accessories and augment wireless charging, a novel development from previous iPhone versions. Recent studies have raised concern regarding magnetic interference from these new phones with other electronic and implanted medical devices. Specifically, one study explored the effects of the iPhone 12 on a Medtronic implantable cardioverter-defibrillator (ICD) and found that the ICD device was deactivated when the iPhone was brought close to the left chest,[2] leading the authors to caution patients of this interference, which could potentially inhibit lifesaving therapy. Another study similarly demonstrated clinically identifiable magnetic interference, measured by device interrogation, on cardiac implantable electronic devices from the Apple iPhone 12 ProMax.[3]

Much of the current literature on magnetic interference generated from cellular devices has revolved around implantable cardiac devices. To our knowledge, there has been no study looking at the effect of cellular devices with magnetic technology on the implanted hypoglossal nerve stimulator.

CASE SERIES

This study was approved by the Henry Ford Health System Institutional Review Board. Three patients with hypoglossal nerve stimulator device implants were invited to participate in a test, in which the implant was activated and observed in clinic under the following conditions: baseline function, with an iPhone 12 placed on the patient's right chest directly over the implantable pulse generator (IPG), and an iPhone 13 placed over the right chest. The patient was awake in a supine position during testing.

Patient 1 was a 62-year-old female with Inspire Model 3028. Patient 2 was a 60-year-old female with Inspire Model 3028. Patient 3 was a 71-year-old male with Inspire model 3024. When the iPhone was placed directly over the IPG, interference was observed with implant function in all three patients. The pulse stimulation appeared to be prolonged, impeding full relaxation of the tongue between pulse stimulations (see Fig. 2).

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Editor's Note: This Manuscript was accepted for publication on August 01, 2022.

The authors have no funding, financial relationships, or conflicts of interest to disclose.

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DOI: 10.1002/lary.30348

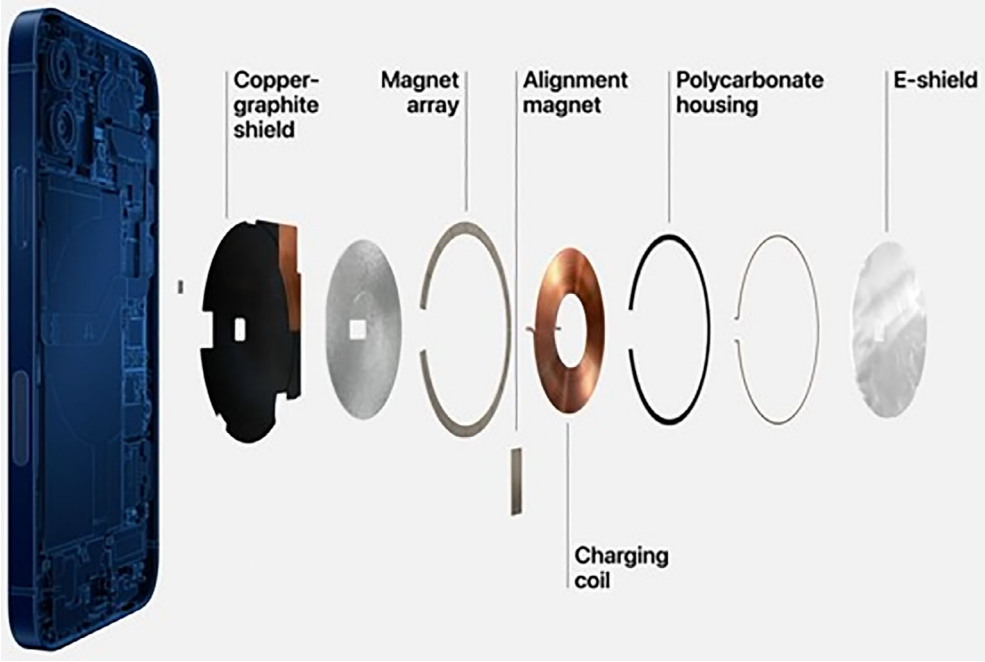

Fig. 1. Diagram of iPhone MagSafe internal components. Image reproduced with permission from Andrew O'Hara, Editor, AppleInsider. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

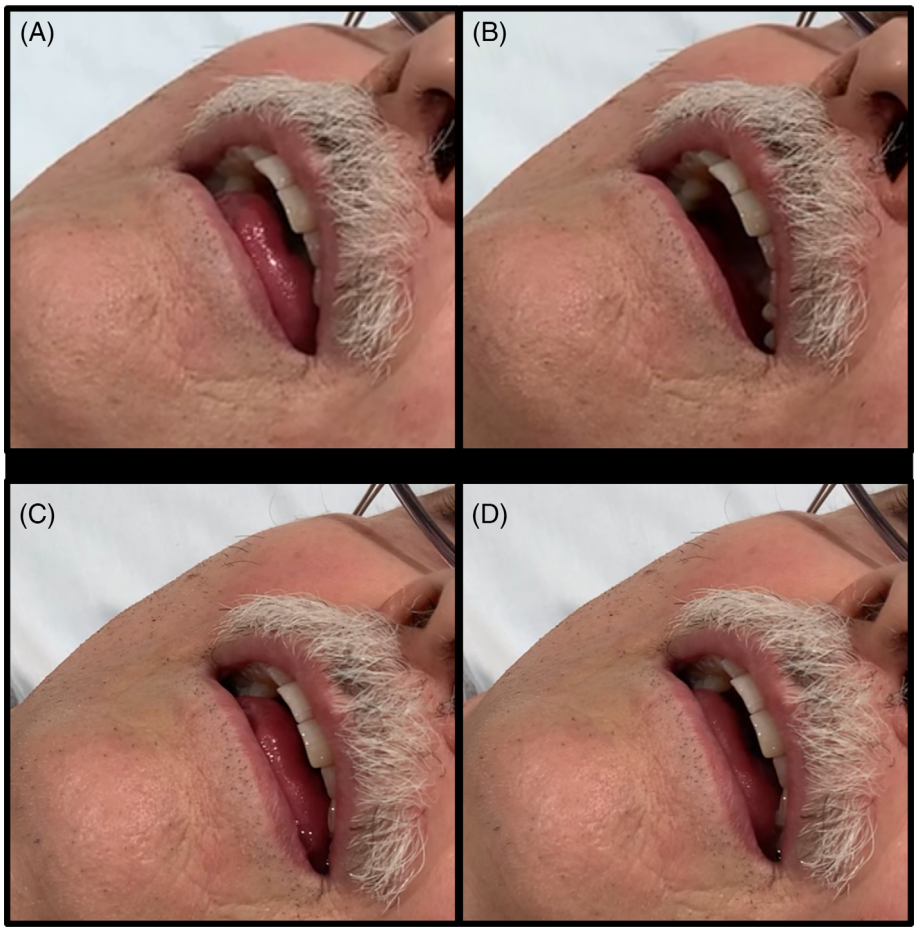

Fig. 2. Baseline function of hypoglossal nerve stimulator showing normal tongue protrusion (A) and relaxation (B). Function of the same hypoglossal nerve stimulator in the presence of iPhone showing normal tongue protrusion (C) but impaired relaxation (D). [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

The magnitude of this effect varied among the three patients but was present in all. The effect was seen with both iPhones 12 and 13. Upon removal of the phone from the chest, all implants returned to normal function, with no lasting negative effects. The patients denied any pain or discomfort during testing, although they did report that the change in function was mildly noticeable.

DISCUSSION

Many people sleep with cell phones in the bedroom, often within arm's reach. One patient, in this case series, described how he would often use his device although napping seated, such as on an airplane, and noted that his cellular phone would sometimes be in his shirt pocket. As of 2019, Apple reported 900 million iPhone users globally with over 113 million active in the United States, and in 2021, that number rose to over 1 billion.[4] Although the Inspire upper airway stimulator patient instruction manual warns of the possibility of electromagnetic device interference, it does not specifically include cellular phones on the list of potential sources, and patients may not realize that the magnetic technology in a cellular phone can be strong enough to interfere with an implanted medical device.

In late 2021, Apple included an announcement in their support forum to highlight the potential interference that may be caused by their technology when brought close to certain medical devices, specifically citing defibrillators and implanted pacemakers. It is important to also bring attention to potential interactions with other devices, as they can have health implications. As technology continues to rapidly evolve, especially that associated with devices as widespread as cellular phones, physicians and device developers must be aware of new potential interactions that can interfere with medical device functions.

The results of this case series may lead providers to caution patients with implanted upper airway stimulators that close contact with cellular phones may impact device functions. This information can also be helpful for providers troubleshooting suboptimal performance of the hypoglossal nerve stimulator implant in the treatment of OSA in their patients. This is important because untreated or undertreated OSA is associated with poor sleep, lower quality of life, increased morbidity, and all-cause mortality.[5] Future studies are needed to characterize the objective and clinical effects of reported electromagnetic interference, such as by obtaining a sleep study of patients with the hypoglossal nerve stimulator device sleeping in close proximity to an iPhone with magnetic technology.

CONCLUSION

This study describes an electromagnetic interaction observed between the hypoglossal nerve stimulator device implants and newer iPhones with magnetic technology. Patients with these implants should be informed about the potential for cellular phones with magnetic technology impacting device performance.

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