American Journal of Physical Medicine & Rehabilitation Articles Ahead of Print
DOI: 10.1097/PHM.0000000000002285

A case study of intrathecal baclofen pump motor shutdown secondary to the effect of the magnetic field created by a personal digital tablet and magnetic cover.

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Authors contribution statement: M.Fostier writing, Th.Deltombe and Th.Gustin: revision

Informed consent: the patient gave verbal consent to be included in this case study

Funding: no funding or grant support

Conflict of interest: none

Acknowledgements: none

Data Access Statement: available

ABSTRACT

We present the case of a post-traumatic C6 AIS A tetraplegic patient with spasticity treated with an intrathecal baclofen pump (ITB), who noticed a transient increase in his spasticity each time he used a digital tablet (Ipad®) protected by a magnetic shell placed on his abdomen. Telemetry confirmed transient motor shutdown responsible for withdrawal symptoms each time the tablet was used. Symptoms resolved after the removal of the protective shell. Effects of magnetic fields like magnetic resonance imaging (MRI) are known to stall the pump rotor, which recover at the end of MRI. Other sources of magnetic fields like laptops or new smartphones with magnet charging technology may also interfere with implanted devices. We therefore recommend patients to avoid close contact of magnetic devices with the intrathecal baclofen pump. More robust studies are warranted to assess the effect of the new magnetic technologies on the function of intrathecal pumps.

KEY WORDS: Intrathecal Baclofen Pump, Spasticity, Withdrawal Syndrome, Magnetic field

INTRODUCTION

Spasticity caused by central nervous system (CNS) lesions is commonly treated with baclofen, a gamma-aminobutyric- acid (GABA) analog. This drug is the treatment of choice for decreasing muscle spasms and pain and increasing functional motor activity .[1,2]

Intrathecal baclofen administration allows a better reduction of spasticity with doses a thousand times lower than the oral administration of baclofen, thus causing fewer adverse effects.[3] Medtronic, Inc., Minneapolis, MN, USA, Synchromed is the only approved pump and catheter system for intrathecal baclofen (ITB). The pump is placed surgically in the abdominal wall and connected to the catheter in the intrathecal space between T8 and T10.[4]

Pump dysfunction may accidentally occur causing baclofen withdrawal syndrome responsible for mild symptoms, including hyperthermia, pruritus, and hypertonicity, but may also be life-threatening, causing multiple organ failure, cardiac arrhythmias, disseminated intravascular coagulation, seizures, and even death.[3,4,5] The most frequent causes of baclofen withdrawals are an empty reservoir, leak or displacement of the catheter, pump malfunction, programming error, or drug concentration error.

We present a case of pump dysfunction due to exposure to a low magnetic field which, to our knowledge, has not been described.

This case conforms to all CARE guidelines and reports the required information accordingly (see CARE Checklist, Supplemental Digital Content 1, http://links.lww.com/PHM/C63).

CASE REPORT

We describe the case of a 39 years-old man with C6 AIS A tetraplegia from a C5-C6 fracture sustained as a result of a motor vehicle accident in January 2006. In December 2006, an ITB pump (Medtronic Synchromed II model 8637-40 ml) was implanted to treat diffuse spasticity (Modified Ashworth scale 2) with bilateral triceps surae clonus and quadriceps spasms destabilizing the sitting position in a wheelchair. The pump, replaced in 2021 and containing baclofen 2000 µg per milliliter, was programmed as follows:33 µg per hour and a bolus of 100 micrograms at 5.00 PM totaling 892 µg per day, resulting in the disappearance of spasticity and clonus (Modified Ashworth Scale 0). At the refill consultation, the patient reported hearing the pump ring alarm several times, mainly in the evening when he watched movies on his digital tablet (Apple's Ipad®). The tablet was placed on his abdomen, close to the pump, while he was in bed and he noticed an increase in upper limb spasticity just after watching movies. The symptoms resolved within a few hours. The patient reported the onset of symptoms since he had used a new magnetic protective shell (Zugu®) on his tablet. Checking pump logs confirmed multiple motor stalls corresponding to the time of tablet use with a recovery occurring at the end of tablet use. As magnetic fields such as MRI can cause interference with intrathecal pumps, we hypothesized that the magnetic field created by the shell of the tablet temporarily stalled the rotor of the pump motor and suspended drug delivery. We therefore asked the patient to note each use of the tablet placed on his abdomen with or without the protective cover. When using the tablet alone, no motor stall was noted on the pump logs. When using the tablet with the magnetic protective cover, the telemetry revealed each time a motor stall confirming our hypothesis.

DISCUSSION

To the best of our knowledge, this is the first case of ITB withdrawal linked to an external magnetic field generated by a tablet protective shell. As the use of personal digital tablets is increasing, it is important to be aware that magnetic covers and potentially other devices generating magnetic fields may directly interfere with baclofen pump function and potentially lead to ITB withdrawal syndrome. ITB withdrawal syndrome, caused by an abrupt functional cessation of the pump is a rare complication. Among the causes of this potentially life-threatening syndrome, magnetic fields, such as MRI, are known to stall the pump rotor, suspending drug delivery, which recovers at the end of MRI. [6,7,8,9] There is a potential risk of permanent motor stall if the pump is oriented 90° to the axis of the magnetic field, which can occur in patients whose pump is mobile.[7] Therefore, it is recommended to verify the pump function after MRI examination.

Factory tests indicate that the pump motor stops when exposed to magnetic fields of 20 gauss or higher. Less powerful magnets at closer distances can also stop the pump. Generally, magnetic fields of 10 gauss or less do not affect the pump.[6] In the described case we were not able to obtain information about the level of the magnetic field generated by the protective shell. However, as the protective shell stands alone on a fridge door, we extrapolate values between 20 and 100 Gauss which are the values described for fridge magnets. According to Medtronic engineers, there are no known interactions between the tablets and infusion pumps. However, because the pump is sensitive to magnets, it is plausible that the magnet in the tablet cover causes temporary motor stalls when it is in close proximity to the pump. Theoretically, if the tablet and magnet are maintained at least 25 cm away from the system, the risk of affecting the baclofen pump is low. However, therapy may be interrupted depending on the duration of exposure to the magnetic field. It is difficult to predict how long

it takes for a pump to recover from a motor stall which can take a few minutes to several hours to recover according to flow rate. When a motor stall occurs, the critical alarm goes off.[6] If patients suspect that their therapy has been affected by exposure to a magnetic field, they should contact their physician to check the pump logs to determine if the motor is being stopped by the magnetic field.[9]

Literature described only one case of withdrawal syndrome due to a magnetic field in a patient with a morphine intrathecal pump using a laptop near his abdomen. The authors concluded that the loudspeakers of the laptop created a magnetic field that blocked the pump.[10]

A recent study showed that Apple's IPhone 12 MagSafe® technology can cause magnet interference on cardiac implantable devices, inhibiting lifesaving therapy.[11] Apple's MagSafe® is a new technology that uses wireless charging with an added magnet giving the IPhone 12 a magnetic field strength that can exceed 50 Gauss, causing interference to implantable cardiac device when the phone is placed directly on the skin over the patient device. As the baclofen pump motor can stop when exposed to magnetic fields of 20 gauss [6], caution should be exercised when using new smartphones with magnetic wireless charging technology.

Studies are therefore needed to evaluate the effect of new magnetic smartphones charging technologies on intrathecal pumps.

CONCLUSION

This case study highlights the risk of an ITB pump failure due to close contact with a digital tablet fitted with a magnetic protective shell. Proper education of patients and caregivers is essential to reduce the risk of ITB withdrawal syndrome. We recommend patients with ITB pump to be cautious when using laptops, smartphones, or tablets, keeping these devices away from the pump. Magnet covers should be avoided. The pump logs must be checked each time the patients are exposed to a magnetic field.

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