Surgical Neurology International

OPEN ACCESS

For entire Editorial Board visit : http://www.surgicalneurologyint.com

Editor-in-Chief: **James I. Ausman**, MD, PhD University of California, Los Angeles, CA, USA

Case Report

Infected internal pulse generator: Treatment without removal

Marios S. Themistocleous[1,2], Efstathios J. Boviatsis[1,2], Pantelis Stathis[2,3], Lampis C. Stavrinou[1,2], Damianos E. Sakas[1,2]

[1]Department of Neurosurgery, University of Athens Medical School, "Evangelismos" Hospital, [2]Hellenic Center for Neurosurgical Research, "P.Kokkalis", [3]Department of Neurology, 1st Hospital of Social Security Services, Athens, Greece

E-mail: *Marios S. Themistocleous - mthemistocleous@gmail.com; Efstathios J. Boviatsis - eboviatsis@gmail.com; Pantelis Stathis - stathis.pantelis@gmail.com; Lampis C. Stavrinou - mplam@hotmail.com; Damianos E. Sakas - sakasde@med.uoa.gr
*Corresponding author

Received: 16 October 10 Accepted: 17 December 10 Published: 23 March 11

Surg Neurol Int 2011, 2:33

This article is available from: http://www.surgicalneurologyint.com/content/1/2/33

This article may be cited as:
Themistocleous MS, Boviatsis EJ, Stathis P, Stavrinou LC, Sakas DE. Infected internal pulse generator: Treatment without removal. Surg Neurol Int 2011;2:33.
Available FREE in open access from: http://www.surgicalneurologyint.com/text.asp? 2011/1/2/78240

Abstract

Background: One of the rare but devastating complications of deep brain stimulation (DBS) is internal pulse generator (IPG) infection. In the majority of the cases, removal of the device is required, despite appropriate antibiotic therapy. We demonstrate that eradication of an IPG infection is feasible without removal of the IPG device.

Case Description: This article reports the authors' experience on two patients who underwent DBS for advanced Parkinson's disease (PD) and, subsequently, suffered from infection and skin breakdown over the IPG. The patients were treated with antibiotic therapy, surgical revision of the wound, intraoperative disinfection of the IPG and relocation of the subcutaneous pocket. In both cases, the infection was eradicated and DBS therapy was continued uninterrupted.

Conclusion: Although not generally recommended, DBS IPG may be salvaged in selected cases of superficial device infection. Our experience suggests that it is possible to treat the infection without removing the device. Such an approach decreases the morbidity, duration of hospital stay and health care costs.

Key Words: Deep brain stimulation, infection, internal pulse generator, Parkinson's disease

Access this article online

Website: www.surgicalneurologyint.com

DOI: 10.4103/2152-7806.78240

Quick Response Code:

INTRODUCTION

Deep brain stimulation (DBS) is an effective form of treatment for an increasing number of patients with movement disorders and pain. It is a reversible procedure and its effect is based on an electrical modulation of the nervous system. Even though technological advances have improved the efficacy and safety of this procedure, there may be different hardware-related complications.[1,4]

The most frequent complications are lead fracture in the extracranial part, system infection, battery or connector problems and lead migration.[1,4,5]

The hardware-related infection rates may be as high as 12.2%,[5,6,8] and may result in considerable morbidity. Infection usually occurs either from direct microbial inoculation during surgery or as a result of hematogenous contamination of the device or due to skin breakdown over the device. In such cases, the infection is difficult to

be treated without removal of the internal pulse generator (IPG). At least two additional operations are required, one for IPG and/or electrode removal and a second for the replacement of the IPG after the infection has been eradicated. This procedure leads to increased morbidity, hospitalization and cost. Most importantly, the patient has to discontinue DBS therapy for a considerable period of time.

We describe our experience with two patients who developed wound infection and explantation of the IPG. They were successfully treated with IPG disinfection, systemic antibiotic treatment, revision of the surgical wound and relocation of the device. To the best of our knowledge, the treatment of the externalization of the IPG through skin breakdown, without replacing the device, has not been reported previously.

CASE DESCRIPTION

The first patient was a 54-year-old male with a 12-year history of Parkinson's disease (PD). The patient underwent bilateral subthalamic nucleus (STN) DBS surgery according to our standard protocol in 2003.[9] Two quadripolar DBS macroelectrodes (Medtronic electrode 3387 , Minneapolis, MN, USA) were implanted. The patient had undergone IPG (Kinetra, Medtronic, Minneapolis, MN, USA) replacement 6 months before due to battery depletion. The postoperative course was uneventful and he was discharged the next day. The patient returned to our department with the IPG explanted through the surgical scar. He was afebrile and clinical examination failed to reveal any symptoms or signs of central nervous system (CNS) or systemic infection. There was no subcutaneous collection, but the skin surrounding the extruded IPG showed signs of local inflammation and serous discharge [Figure 1]. Blood count results were normal. Wound discharge cultures revealed *Staphylococcus epidermidis*. Vancomycin intravenously (IV) (500 mg/8 h) and rifampicin orally (150 mg/8 h) were added to the antibiotic regimen based on the sensitivity tests.

The second patient was a 67-year-old female with a 20-year history of PD. She underwent bilateral DBS electrode (Medtronic electrode 3389 , Minneapolis, MN, USA) implantation in the STN. The IPG (Kinetra, Medtronic) was implanted in a subclavicular subcutaneous pocket. Four weeks later, she presented with explantation of the IPG [Figure 2]. She was afebrile and had no symptoms or signs of CNS infection. The blood count was normal. Cultures from the wound exudates revealed *Staphylococcus aureus*. The patient was started on Vancomycin IV (500 mg/8 h) and rifampicin orally (150 mg/8 h).

We concluded that it was worthwhile to try to preserve the IPG. Hence, both patients underwent surgical exploration of the subclavicular wound under general anesthesia. The IPG was removed from the subcutaneous pocket and disconnected from the lead extender. The scar behind the ear was explored and the lead extender was disconnected from the DBS electrode and removed. The IPG was meticulously cleaned and disinfected with the use of aqueous povidone–iodine and a vancomycin solution (1 g in 500 ml of NaCl 0.9%). The IPG was initially scrubbed for 10 min using the aqueous povidone–iodine solution and subsequently soaked in the vancomycin solution for another 20 min. Cultures taken from the IPG at this point were negative. The device was then repositioned in a new subcutaneous pocket fashioned superficial to the rectus sheath, under the right hypochondrial arc, opposite to the site of the original placement. A new lead extender was then tunneled under the scalp and attached to the DBS leads proximally and to the IPG distally. The wounds were sutured and the stitches were removed on

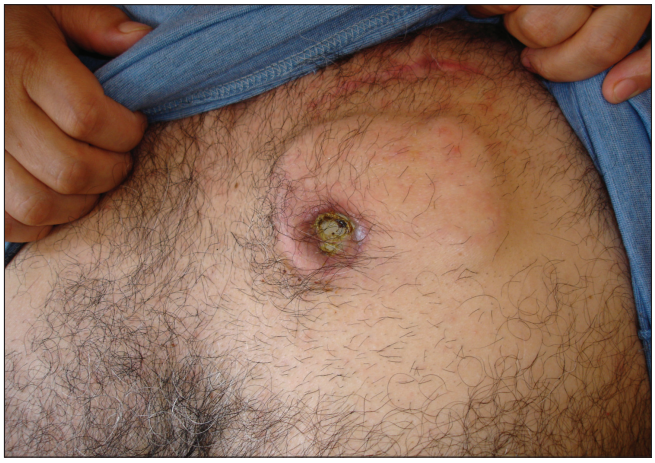

Figure 1: The internal pulse generator of the patient explanted 6 months after replacement

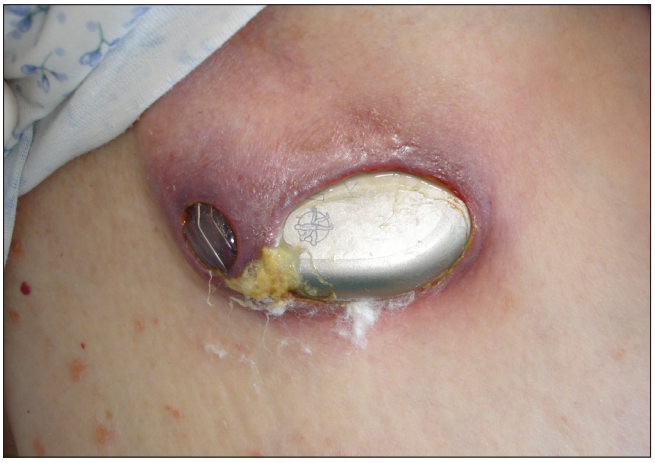

Figure 2: The internal pulse generator explanted 4 weeks after the implantation

the 10th postoperative day. Intraoperative vancomycin was administered and the antibiotic treatment was continued for a period of 2 weeks. At the 6-month and 1-year follow-up examinations, both patients showed no signs of local infection.

DISCUSSION

DBS involves implantation of electrodes and pulse generators, thereby introducing potential hardware-related adverse effects, with infection rates requiring removal of the IPG varying from 0.7 to 3.7%.[7,10] Infection remains among the most devastating complications due to the fact that medical treatment alone without device removal is generally considered unsuccessful and, frequently, leads to infection relapse. Moreover, if a decision for device removal is taken, the patient will not have the benefits of DBS for a period of 3–6 months.

Factors probably related to the infection rate include surgical technique, length of the procedure, antibiotic prophylaxis[7,10] and skin breakdown over the device. Several authors believe that the infection rate might not be related to the duration of surgery because the highest incidence of infections occurs during the second part of the DBS procedure, namely the implantation of the IPG, which usually lasts <1 h.[10] The skin tolerance to breakdown has an inverse relationship to the intensity and duration of the pressure. Insertion of the IPG leads to stretching and continuous compression of the skin, impairment of blood supply and, ultimately, necrosis and ulceration. Furthermore, the surgical incision itself compromises the vascularization of the skin.

IPG infections are usually caused by organisms of low virulence. Much like the cardiac pacemaker – a device very similar to the IPG – the microorganisms most frequently implicated are the coagulase-negative Staphylococci.[3,6] Early infections after implantation tend to be caused by *Staphylococcus aureus*, whereas late ones are usually due to *Staphylococcus epidermidis*.[3,11] It has been shown that Staphylococci are able to adhere to plastic surfaces, grow on plastic material and produce an extracellular amorphous material (slime) that acts as a scaffold for the development of antibiotic-resistant colonies thus making the implantable devices susceptible to treatment-resistant infections.[11]

Usually, Staphylococcal infections of the implantable material require replacement of the device. Some nonadherent bacteria that are unable to produce this slime are more likely to respond to treatment by antibiotics alone without the removal of the colonized device.[2]

To the best of our knowledge, there are no previous reports in the literature of IPG infection, skin breakdown and exposure to the air that have been treated successfully without replacing the device. In all previously reported cases, the treatment of this problem required the removal of the IPG and its replacement after a considerable period of time.[1,3-11] Our decision to neither discontinue the DBS therapy nor replace the IPG was the crucial rationale for our efforts to eradicate the local infection.

CONCLUSION

Although not generally recommended, DBS IPG may be salvaged in selected cases of superficial device infection. Our experience suggests that it is possible to treat infection without removing the device.

Our experience indicates that if the treatment is offered promptly, according to our protocol, it is possible to treat infection without removing the device. With this approach, the patients may be spared of DBS therapy interruptions and additional procedures for IPG replacement. In addition, health care insurers will not be asked to cover the increased costs for this type of therapy.

REFERENCES

1. Blomstedt P, Hariz MI. Hardware-related complications of deep brain stimulation: A ten year experience. Acta Neurochir 2005;147:1061-4.
2. Diaz-Mitoma F, Harding GK, Hoban DJ, Robert RS, Low DE. Clinical significance of a test for slime production in ventriculo-peritoneal shunt infections caused by coagulase-negative staphylococci. J Infect Dis 1987;156:555-60.
3. Hariz M. Complications of deep brain stimulation surgery. Mov Disord 2002;17:162-6.
4. Hariz MI, Shamsgovara P, Johansson F, Johansson F, Hariz G, Fodstad H. Tolerance and tremor-rebound following long-term chronic thalamic stimulation for Parkinsonian and essential tremor. Stereotact Funct Neurosurg 1999;72:208-18.
5. Joint C, Nandi D, Parkin S, Gregory R, Aziz T. Hardware related problems of deep brain stimulation. Mov Disord 2002;17:175-80.
6. Kondziolka D, Whiting D, Germanwala A, Oh M. Hardware related complications after placement of thalamic deep brain stimulator systems. Stereotact Funct Neurosurg 2002;79:228-33.
7. Lyons KE, Wilkinson SB, Overman J, Pahwa R. Surgical and hardware complications of subthalamic stimulation: A series of 160 procedures. Neurology 2004;63:612-6.
8. Oh MY, Abosch A, Kim SH, Lang AE, Lozano AM. Long-term hardware-related complications of deep brain stimulation. Neurosurgery 2002;50:1268-74.
9. Sakas DE, Kouyialis AT, Boviatsis EJ, Panourias IG, Stathis P, Tagaris G. Technical aspects and considerations of deep brain stimulation surgery for movement disorders. Acta Neurochir Suppl 2007;97:163-70.
10. Seijo FJ, Alvarez-Vega MA, Gutierrez JC, Gutierrez JC, Fdez-Glez F, Lozano B. Complications in subthalamic nucleus stimulation surgery for treatment of Parkinson's disease. Review of 272 procedures. Acta Neurochir 2007;149:867-75.
11. Sterio D, Zonenshayn M, Mogilner A, Rezai AR, Kiprovski K, Kelly PJ, *et al*. Neurophysiological refinement of subthalamic nucleus targeting. Neurosurgery 2002;50:58-67.