CASE REPORT

Delayed cerebritis after bilateral stereotactic implantation of globus pallidus interna electrodes for treatment of dystonia

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SUMMARY

Deep brain stimulation (DBS) is being used to treat an increasing number of movement and psychiatric disorders. However, the risk of infection remains as a problem that can hinder the usefulness of this technology. We report a case of a patient with dystonia who underwent bilateral globus pallidus interna electrode and impulse generator (IPG) placement, developed an infection of his IPG, and later cerebritis. The patient was initially treated with antibiotics and partial hardware removal. Follow-up cranial imaging showed an area concerning for cerebritis around one of the intracranial electrodes. The patient was then treated with complete hardware removal followed by a course of intravenous antibiotics. Four-month follow-up imaging showed resolution of the infection. This case demonstrates the importance of following cranial imaging in DBS patients with delayed infection, continued vigilance for infection in implanted patients and that partial hardware removal may not be successful in the setting of methicillin-sensitive *Staphylococcus aureus* infections.

BACKGROUND

Deep brain stimulation (DBS) is a procedure for reversible modulation of brain function with a growing application for treatment of different movement disorders and psychiatric pathologies. DBS surgery has been approved for 20+ years, with more promising applications under investigation. However, the risk of infection remains a problem that can hinder the usefulness of this technology. Articles describing infectious complications place a broad estimate anywhere from 0%–15% per individual or 0–9.7% per electrode.^{1–20} These figures may be misleading, however, due to varying definitions of infection; some authors include superficial skin infection at the incision site, whereas others restrict the definition to infection involving the hardware. Intracranial infection after DBS implantation is rare in neurosurgical literature.^{21–22} To the best of our knowledge, there are no reports of a case of cerebritis after implantation of bilateral globus pallidus interna (GPI) electrodes. We report a case of a patient with dystonia who underwent bilateral GPI electrode placement, developed a late infection of his impulse generator (IPG) and later cerebritis.

CASE PRESENTATION

This is the case of a 49-year-old man with severe, progressive dystonia including grade 3 retrocollis of the

neck and back, by the Toronto Western Spasmodic Torticollis Rating Scale (TWSTERS) scale,²³ rightward torticollis, speech difficulty, back pain and gait difficulties refractory to medical management. The patient underwent bilateral GPI electrode placement using stereotaxis and microelectrode monitoring. He received 1 g of cefazolin intravenously prior to skin incision. At the completion of the case, Stim-lock burr hole covers were used to secure the electrodes, which were left in a subgaleal pocket. The patient was monitored over night, received two more doses of intravenous cefazolin, was discharged the following day and returned to the operating room a month later for placement of his IPG and extension wires.

The patient had been following up regularly in the neurology and neurosurgery clinics in order to establish the most appropriate setting of his IPG pack. Three months after placement of the bilateral GPI electrodes, the patient had improvement in his speech, back pain, ability to walk, sit and was able to perform fine motor functions with his hands. Approximately 3.5 months after the placement of his IPG, swelling was noted along his right chest wall. A fine needle aspiration was performed in the clinic, which grew methicillin-sensitive *Staphylococcus aureus* (MSSA). This resulted in antibiotic treatment with subsequent removal of the IPG and eventually the distal extension wires.

TREATMENT

As a result, the patient was started on dicloxacillin. After 1 week of antibiotics, the swelling persisted and progressed upward towards the right side of his neck. The patient was subsequently admitted for removal of the IPG along with clipping of the distal extension wires connected to the IPG. Cultures obtained at the time of surgery were positive for MSSA. The C reactive protein (CRP) value was 5.1. On intraoperative inspection there was no evidence of infection around the two extension wires proximal to the clipped site. Therefore, the extension wires in the neck and both GPI electrodes were left in place. The patient was sent home on a 2-week course of intravenous cefazolin and, upon the 2-week follow-up in the infectious disease clinic, was prescribed a further 2-week course of oral amoxicillin/clavulanate. At the end of antibiotic treatment the patient's CRP was 0.2 and white blood cell count (WBC) was 7500 mm³. Three weeks later a follow-up head CT scan was ordered to confirm the location of his DBS electrodes for consideration of possible repositioning of

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Figure 1 (A and B) Axial T2-weighted and T1-weighted postcontrast MRI showing removal of the right electrode with surrounding vasogenic oedema resulting in 9 mm of right to left midline shift with compression of the right lateral ventricle. (C) Coronal T2-weighted MRI showing the oedema extending to the level of the subinsular cortex, basal ganglia, thalamus and temporal lobe with enhancement along the course of the right electrode tract.

the leads. The CT scan showed a large ill-defined area of hypoattenuation centred in the right basal ganglia surrounding the right electrode. The CRP value drawn at that time had climbed to 2.3 and the WBC to $11\,500\text{ mm}^3$. Owing to the concern about possible infection, the patient was taken urgently to surgery for bilateral removal of the GPI electrodes and extension wires; following which an MRI was ordered (figure 1) confirming evidence of cerebritis. However, besides headaches and the return of his dystonia symptoms, he was asymptomatic. The cultures taken during surgery from the electrode tips grew MSSA. Blood cultures were negative and cerebrospinal fluid cultures were not performed prior to or after removal of the GPI electrodes. After a short hospitalisation he was discharged on intravenous oxacillin for 6 weeks.

OUTCOME AND FOLLOW-UP

At the time of his 1-month follow-up visit the patient was without symptoms and his surgical incisions were well healed. A follow-up MRI (figure 2) performed at the time showed resolving infection around the right electrode with an improvement of the mass effect. On the 4-month follow-up MRI (figure 3) there was a near complete disappearance of hypoattenuation where the right electrode had been located. Fourteen months after his DBS electrodes were removed and upon completion of his antibiotic treatment he underwent reimplantation of bilateral GPI electrodes.

DISCUSSION

Infections related to hardware after DBS electrode implantations are one of the major complications associated with this procedure. The same is true for any procedure involving a permanent implantable device. The incidence of infection in the DBS

literature is quite variable depending on the interpretation of the authors, with higher rates reported for superficial infections not contiguous with any hardware.²⁴ Infection in DBS usually involves intraoperative contamination resulting in early infection; with late infection attributed to chronic skin erosion. This can lead to skin breakdown and ulceration, manifesting as either superficial or deep infection. Intracranial infections from DBS implantation are seldom reported.^{21 22}

The management of hardware-related infections has neither been standardised nor is there any class I level evidence to support a particular algorithm. Hardware salvage is surgeon dependent based on prior experience. In a report by Oh *et al*¹⁷ five of six patients failed hardware salvage. In another study involving 19 infected patients, hardware was completely removed in 4 patients with partial preservation of hardware in 9 of the remaining 15 patients.²⁴ A study by Bhadia showed that only 1 of 12 patients infected with *S aureus* had complete

Figure 2 (A and B) Axial T2-weighted and T1-weighted contrast MRI 1 month after removal of the right electrode and antibiotic therapy showing punctate 2 mm focus of enhancement within the right globus pallidus with the resolution of oedema and mass effect.

Figure 3 Axial T1-weighted contrast MRI 4 months after removal of the right electrode and antibiotic therapy showing nearly complete resolution of enhancement within the right basal ganglia/subthalamic nucleus suggestive of complete resolution of infection.

hardware preservation.²⁵ The authors of another study report that partial hardware removal is possible when the organism is not *S aureus*.²⁴ This has also been reported in other surgical specialties.²⁶ This may be attributed to the organism's ability to form biofilms on foreign objects.²⁵ The practice at our institution, as in other groups, has been to attempt lead-sparing partial hardware removal in selected patients where the infection is distal to the intracranial lead, localised to one component and has no purulent drainage.^{10 13 20}

The mechanism of delayed infection at the IPG site 3 months after the implantation is still unclear, as is the delayed cerebritis that developed around the site of the right electrode after the completion of antibiotic treatment. There neither was skin erosion over the IPG site nor purulent drainage. The only sign was swelling over the area with tenderness. Similarly, the skin around the cranial incision showed no erythema, swelling or drainage. Given the result of the cultured bacteria from the surgical site at the removal of the IPG, there may have been a contaminant during implantation of the IPG.

Learning points

- It is important to obtain cranial imaging in a patient presenting with a delayed infection in one of the deep brain stimulation (DBS) components.
- Continued vigilance for infection in patients with implanted devices.
- Cases characterised by methicillin-sensitive *Staphylococcus aureus* infections, a partial DBS hardware removal may not be successful, and must be carefully considered in continuing treatment.

Competing interests None.

Patient consent Obtained.

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REFERENCES

- 1 Benabid AL, Koudsie A, Benazzouz A, *et al*. Subthalamic nucleus deep brain stimulation. In: Lozano AM, ed *Movement disorder surgery*. Basel: Karger, 2000:196–226.
- 2 Bendok B, Levy R. Brain stimulation for persistent pain and management. In: Gildenberg PL, Tasker RR, eds *Textbook of stereotactic and functional neurosurgery*. New York: McGraw-Hill, 1998:1539–46.
- 3 Beric A, Kelly PJ, Rezai A, *et al*. Complications of deep brain stimulation surgery. *Stereotact Funct Neurosurg* 2001;77:73–8.
- 4 Blomstedt P, Hariz MI. Hardware-related complications of deep brain stimulation: a ten year experience. *Acta Neurochir (Wien)* 2005;147:1061–4.
- 5 Constantoyannis C, Berk C, Honey CR, *et al*. Reducing hardware-related complications of deep brain stimulation. *Can J Neurol Sci* 2005;32:194–200.
- 6 Joint C, Nandi D, Parkin S, *et al*. Hardware-related problems of deep brain stimulation. *Mov Disord* 2002;17(Suppl 3):175–S180.
- 7 Koller W, Pahwa R, Busenbark K, *et al*. High-frequency unilateral thalamic stimulation in the treatment of essential and parkinsonian tremor. *Ann Neurol* 1997;42:292–9.
- 8 Kondziolka D, Whiting D, Germanwala A, *et al*. Hardware-related complications after placement of thalamic deep brain stimulator systems. *Stereotact Funct Neurosurg* 2002;79:228–33.
- 9 Kumar K, Toth C, Nath RK. Deep brain stimulation for intractable pain: a 15-year experience. *Neurosurgery* 1997;40:736–47.
- 10 Levy RM, Lamb S, Adams JE. Treatment of chronic pain by deep brain stimulation: long term follow-up and review of the literature. *Neurosurgery* 1987;21:885–93.
- 11 Limousin P, Speelman JD, Gielen F, *et al*. Multicentre European study of thalamic stimulation in parkinsonian and essential tremor. *J Neurol Neurosurg Psychiatry* 1999;66:289–96.
- 12 Lyons KE, Koller WC, Wilkinson SB, *et al*. Surgical and device-related events with deep brain stimulation (abstract). *Neurology* 2001;56:A146.
- 13 Lyons KE, Wilkinson SB, Overman J, *et al*. Surgical and hardware complications of subthalamic stimulation: a series of 160 procedures. *Neurology* 2004;63:612–16.
- 14 Umemura A, Jaggi JL, Hurtig HI, *et al*. Deep brain stimulation for movement disorders: morbidity and mortality in 109 patients. *J Neurosurg* 2003;98:779–84.
- 15 Vingerhoets FJ, Russmann H, Pollo C, *et al*. Results and adverse events in 50 consecutive patients treated by STN-DBS. *Mov Disord* 2002;17:P666.
- 16 Voges J, Waerzeggers Y, Maarouf M, *et al*. Deep-brain stimulation: long-term analysis of complications caused by hardware and surgery—experiences from a single centre. *J Neurol Neurosurg Psychiatry* 2006;77:868–72.
- 17 Oh MY, Abosch A, Kim SH, *et al*. Long-term hardware-related complications of deep brain stimulation. *Neurosurgery* 2002;50:1268–76.
- 18 Pollak P, Fraix V, Krack P, *et al*. Treatment results: Parkinson's disease. *Mov Disord* 2002;17(Suppl 3):S75–83.
- 19 Schuurman PR, Bosch DA, Bossuyt PM, *et al*. A comparison of continuous thalamic stimulation and thalamotomy for suppression of severe tremor. *N Engl J Med* 2000;342:461–8.
- 20 Temel Y, Ackermans L, Celik H, *et al*. Management of hardware infections following deep brain stimulation. *Acta Neurochir (Wien)* 2004;146:355–61.
- 21 Merello M, Cammarota A, Leiguarda R, *et al*. Delayed intracerebral electrode infection after bilateral STN implantation for Parkinson's disease. *Mov Disord* 2001;16:164–82.
- 22 Fily F, Haegelen C, Tattevin P, *et al*. Deep brain stimulation hardware-related infections: a report of 12 cases and review of the literature. *Clin Infect Dis* 2011;52:1020–3.
- 23 Consky ES, Lang AE. Clinical assessments of patients with cervical dystonia. In: Jankovic J, Hallett M, eds *Therapy with botulinum toxin*. New York, NY: Marcel Dekker, Inc., 1994:211–37.
- 24 Sillay KA, Larson PS, Starr PA. Deep brain stimulator hardware-related infections: incidence and management in a large series. *Neurosurgery* 2008;62:360–7.
- 25 Bhatia S, Zhang K, Oh M, *et al*. Infectious and hardware salvage after deep brain stimulation surgery: a single-center study and review of the literature. *Stereotact Funct Neurosurg* 2010;88:147–55.
- 26 Darouiche RO. Treatment of infections associated with surgical implants. *N Engl J Med* 2004;350:1422–9.

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