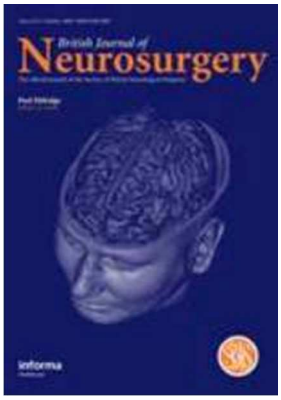

Functional preservation of deep brain stimulation electrodes after brain shift induced by traumatic subdural hematoma - case report

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SHORT REPORT

Functional preservation of deep brain stimulation electrodes after brain shift induced by traumatic subdural hematoma - case report

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Running Title: DBS Preservation after Brain Shift

Abstract

A Parkinson's disease patient with deep brain stimulation (DBS) implantation experienced an acute subdural hematoma (SDH) after a fall. The DBS electrodes and brain parenchyma were shifted. Fortunately, the patient recovered after craniectomy and removal of SDH, and the DBS was re-activated with the same parameters. Patients with DBS implants who suffer a traumatic brain injury do not necessarily incur permanent implant failure; there is every chance the DBS may continue to work as reported here.

Key words: *Brain shift, deep brain stimulation, traumatic subdural hemorrhage, parkinsonism*

Introduction

Deep brain stimulation (DBS) is an effective modality for treating movement and psychiatric disorders including advanced Parkinson's disease (PD). Even the high cost and requirement for precision have not prevented this procedure from becoming popular. Accurately placing the DBS leads into the targeted deep nuclei is an essential step for successful DBS therapy in patients with PD. Awareness about the tendency of the brain to shift is very important for accurate implantation of a DBS electrode when the prediction of therapeutic and adverse effects in stereotactic surgery is being studied.[1]

However, electrode displacement after head injury due to acute subdural hematoma (SDH) may be assumed to cause an irreversible DBS failure. Here, we report the case of a patient who underwent bilateral subthalamic-nucleus (STN) DBS implantation for PD and who experienced left acute SDH after a fall. The DBS electrode function returned to normal after the brain swelling and shifting subsided.

Clinical details

The patient was a 67-year-old woman, who was in good health until 2002. She presented with an intermittent tremor in her left hand and a vague discomfort in the left arm. Because of the progression of symptoms and poor response to medication,

she underwent DBS surgery in December 2005. The clinical improvement following the surgery was satisfactory. In June 2008, she was brought to the emergency department because of a fall. The Glasgow Coma Scale (GCS) score was E1M1V1. A computed tomography (CT) scan of the brain showed a left-sided acute SDH with brain and DBS electrodes shifting (**Figure 1**). The DBS was turned off and craniectomy was performed for removal of the SDH.

The patient received Parkinson's medication madopar (250 mg/tablet; 4 times/day) after craniectomy. We turned on the DBS after follow-up brain CT scan on postoperative day 16 (**Figure 2**). Three days later, we were able to extubate the patient and decrease the dose of madopar (250 mg/tablet; 3 times/day). The DBS electrodes seemed to shift back in place, and the patient was successfully weaned off the ventilator. Cranioplasty was performed on postoperative day 35. The patient was discharged on postoperative day 44 with a GCS score of E4M6V4. At the latest follow-up at our out-patient department, the patient was completely ambulatory and had a GCS score of E4M6V5.

Discussion

DBS is now a well-established treatment modality for medically uncontrollable PD. Good clinical results are acquired by precise positioning and implantation of the

electrodes; the locations of the electrodes were calculated and repeatedly tested before and during DBS surgery. Migration or displacement of the electrodes without contact with STN would surely mean loss of implant function. However, the cause of lead migration is poorly understood. The risk of seizures associated with DBS placement is probably less than 2.4% (95% CI: 1.7 – 3.3%).[2] Although electrode displacement may not induce seizures, it is better to turn off the DBS under such situations. Gliosis formed near the electrode tracks may appear as a potential space for some time after the electrodes have been displaced.[2] In addition, a migrated electrode may slip back in place over this space if the gliosis track has not been ruptured or closed. This may have been the scenario in our patient. After craniectomy and removal of the hematoma, the brain swelling gradually subsided and the electrodes shifted back to their original positions. Though there is another possibility that the electrodes moved along with the brain parenchyma without ever losing their target points. We did not have to change the implanted pulse generator (IPG) parameters to achieve the same initial result.

In the pre-operation status, the patient's daily life was obviously improved after DBS operation. The patient needs the DBS to improve her daily life from her past history. However, the patient's condition was worse after head injury with acute subdural hematoma because of brain shift and improper location of electrodes. Thus, her ventilator dependent was the sequelae of PD s/s because of DBS off and resulted

in bad response to medication. The complication might be related to PD severity itself rather than the reversal of anaesthesia. It was difficult to wean the patient from the ventilator because of cogwheel rigidity. Though intermittent apomorpine injection might be a reasonable option in this situation.[3] Other strategies around restoring dopamine agonists may also be used to reverse a PD state preventing reversal of the patient.

In summary, permanent implant failure need not occur in every patient with DBS implants who have suffered a traumatic brain injury (TBI). The electrodes may shift back in place via the gliotic tracks or shift along with brain parenchyma. Although the risk of seizures is low, we suggest the DBS be turned off after severe TBI. Above all, every effort should be made to preserve the leads and extension wires confirmed by plain X-ray film, from the design of the trauma flaps to manipulation of the exposed wires. The DBS pulse generator should be turned on again only after the position of the electrodes was confirmed and the impedance of the wires were measured.

Acknowledgements

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Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

FIGURE LEGENDS

Figure 1. CT images. Thick left SDH with severe midline shift and shifting of left electrode to the right side of midline.

Figure 2. Midline was back to normal position and electrodes were back in place.

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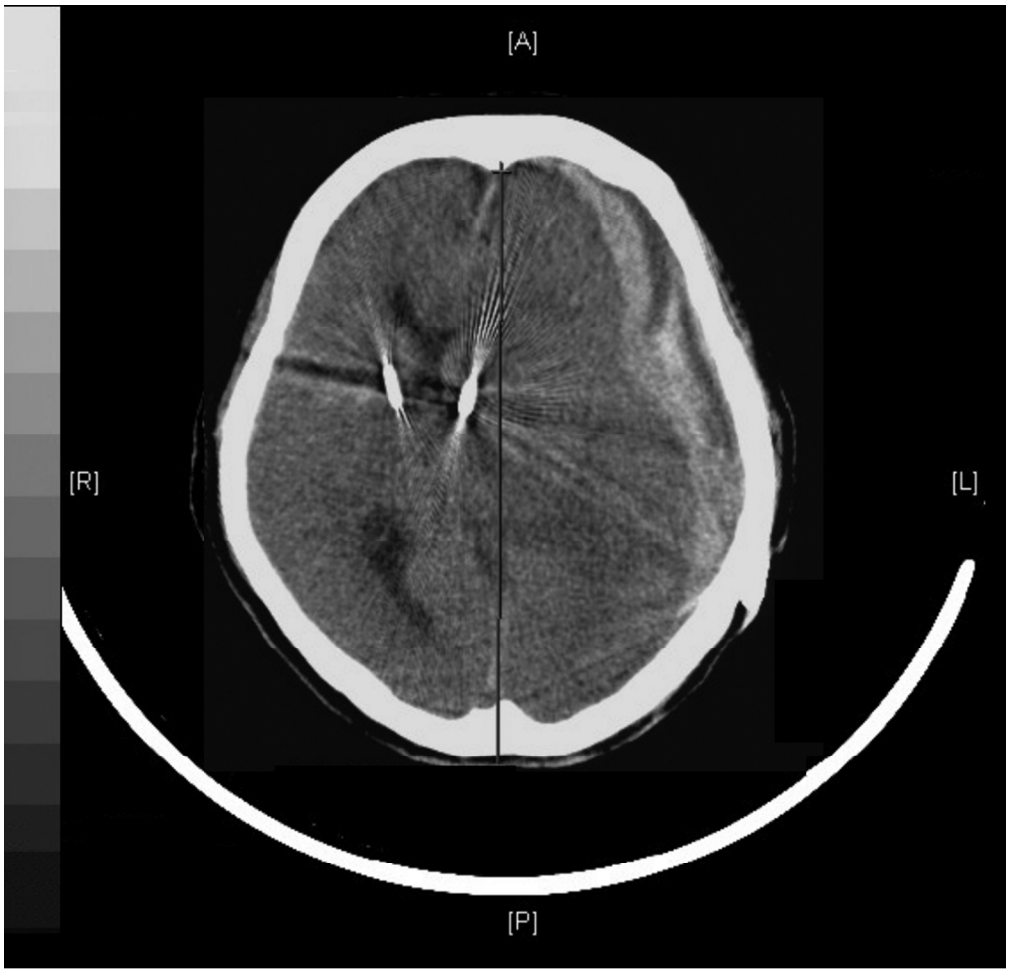

CT images. Thick left SDH with severe midline shift and shifting of left electrode to the right side of midline.
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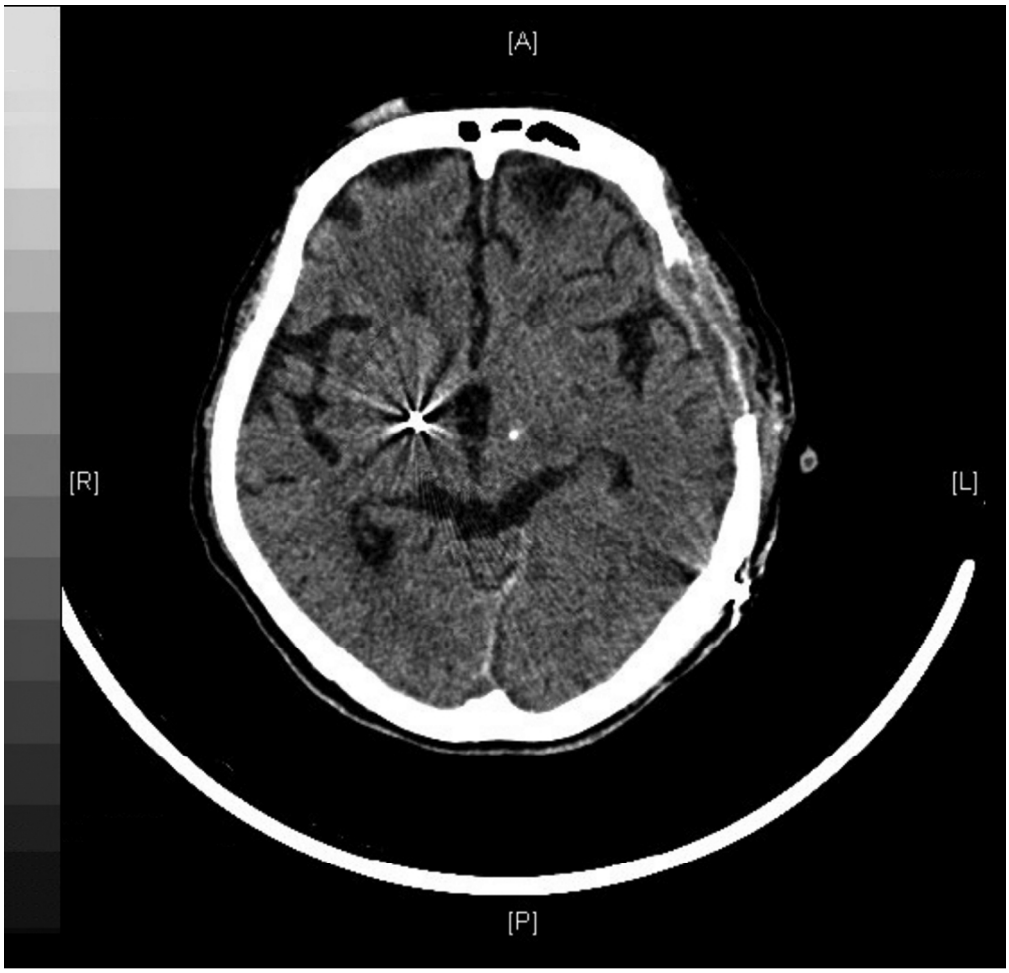

Midline was back to normal position and electrodes were back in place.
88x85mm (300 x 300 DPI)

To: Professor Paul Eldridge

Editor in Chief

British Journal of Neurosurgery

E-mail: paul.eldridge@thewaltoncentre.nhs.uk

Dear Professor Eldridge,

Thank you for your letter dated on Jun. 7, 2012 regarding to our manuscript entitled "**Functional preservation of deep brain stimulation electrodes after brain shift induced by traumatic subdural hematoma - case report (Manuscript ID: CBJN-2012-0054.R1)**". Thanks for the Editors and Reviewers' valuable comments. We have tried to revise our manuscript in response to the comments as attachment.

Your further editorial consideration will be very much appreciated.

Best regards,

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Reviewer(s)' Comments to the Author:

It's improved vastly, and only needs some very minor revisions after which it will be ready for publication.

Response:

Thank you so much for the comment.

Pre- op status - can you comment on the patient's status regarding Parkinson's disease as this time - a statement about on-off state is important for the later reversal of analgesia.

Response:

Yes, we have added the comment on the patient's status regarding Parkinson's disease in the pre-operation status. Thanks for your suggestion.

The apomorphine statement is fine but I would put it in the section of the discussion where you talk about strategies for waking the patient, but add in the other strategies around restoring dopa agonists to reverse a PD state preventing reversal of the patient.

Response:

Thanks for the comment. We have moved the apomorphine statement in the discussion and add in the statement of strategies around restoring dopamine agonists to reverse a PD state preventing reversal of the patient.

Thank you so much for your valuable comments. Your further consideration will be very much appreciated.