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CASE SERIES

# The Conservative Treatment of a Rare Postoperative Complication of DBS—Brain Abscess: Case Series

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**Background:** Deep Brain Stimulation (DBS) is an established treatment option for movement disorders such as Parkinson's disease and dystonia, so more and more patients (over 160,000 patients till 2019) worldwide have undergone DBS for a variety of neurological and non-neurological conditions, with numbers increasing each year. This case series primarily discusses a very rare complication following DBS surgery —— brain abscess.

**Case Presentation:** We administered vancomycin and metronidazole to patients who developed brain abscesses after undergoing DBS surgery based on previous literature. After treatment, the abscess lesions and infection symptoms completely resolved, resulting in a good therapeutic outcome without the removal of the DBS system.

**Conclusion:** In previous studies, similar cases always involved surgical intervention to drain the pus while also removing the DBS system; however, in our cases, the patient did not have the DBS system removed and achieved a good prognosis. To our knowledge, our two cases are among the few where a conservative treatment approach has been used for brain abscesses after DBS surgery.

**Keywords:** DBS, brain abscess, STN, GPI, dyskinesia

## Introduction

Deep brain stimulation (DBS) is an effective treatment for movement disorders such as dystonia, Parkinson's disease, and essential tremor,[1,2] as well as for certain psychiatric conditions, like depression, obsessive-compulsive disorder and substance dependence,[3–5] so more and more patients (over 160,000 patients till 2019) worldwide have undergone DBS for a variety of neurological and non-neurological conditions, with numbers increasing each year.[6] Common complications associated with DBS include bleeding, infections (such as wound infections, hardware-related infections, and meningitis), cerebrospinal fluid leaks, and various device-related issues. Among these, hardware-related infections are the most prevalent.[7,8] The reported infection rates for DBS vary significantly in the literature, ranging from 1.24% to 9.7%.[8–11] However, the formation of abscesses within brain tissue remains exceedingly rare.[12]

Routine management of DBS infections typically involves systemic antibiotic therapy and the complete removal of the implanted DBS system through incision and debridement of the wound. We present two cases involving the formation of brain abscesses surrounding DBS leads. The first case involved the development of dual-cavity brain abscesses in the right frontal lobe and basal ganglia following DBS treatment for generalized dystonia in the bilateral globus pallidus internus (GPI). The second case resulted in a left frontal lobe brain abscess after DBS treatment for Parkinson's disease in the bilateral subthalamic nucleus (STN). The MRI images of two patients in the early stages are shown in Figure 1. Panels a-d correspond to Patient 1, with a representingDWI, b representing coronal T1+C, c representing sagittal T1+C, and d representing T2 propeller. Panels e-h correspond to Patient 2, with the specific sequences as described above.

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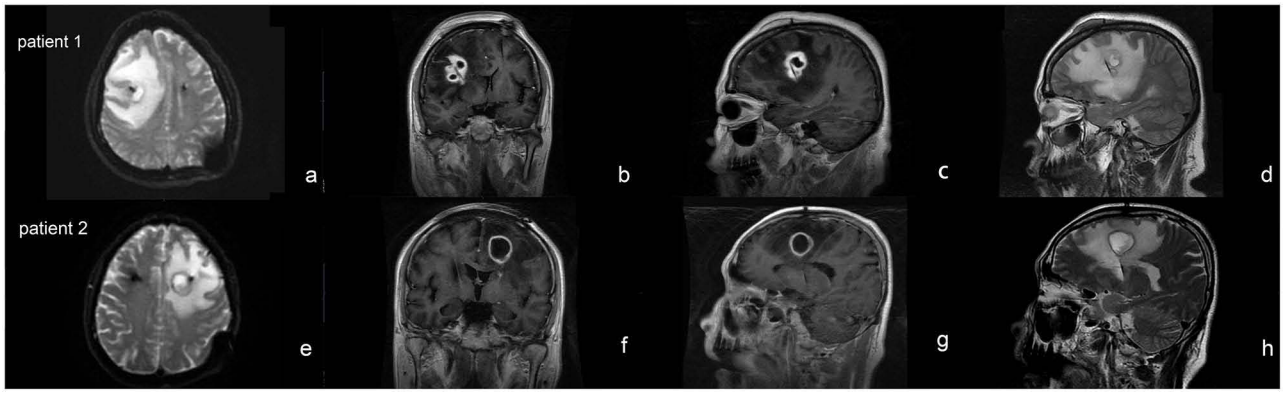


**Figure 1** Panels (**a**–**d**) correspond to Patient 1, with a representingDWI, b representing coronal T1+C, (**c**) representing sagittal T1+C, and (**d**) representing T2 propeller. Panels (**e**–**h**) correspond to Patient 2, with the specific sequences as described above.

# Case Presentation

## Patient 1

A 41-year-old female patient presented with involuntary rightward rotation of the head and neck for over 20 years, diagnosed with spasmodic torticollis. Due to the involuntary rightward twisting of the neck and inadequate response to conservative treatments including tizanidine and clonazepam, which significantly affected her daily life, she underwent bilateral deep brain stimulation (DBS) on June 5, 2023, with electrodes implanted in both globus pallidus internus (GPI). Postoperatively, the amplitude of her neck involuntary movements decreased.

Three months after surgery, the patient exhibited left-sided facial droop, slurred speech, and weakness in the left limbs, with these symptoms persisting without significant relief. Physical examination revealed a shallow left nasolabial fold and left limb muscle strength at grade 4. A cranial CT scan showed a low-density lesion in the right frontal-temporal -basal ganglia region, initially suggestive of a cerebral infarct. Subsequent MRI revealed cerebral abscesses in the right frontal lobe and basal ganglia. We took conservative treatment at the first time.

Treatment included intravenous mannitol to reduce intracranial edema, as well as vancomycin and metronidazole for infection control. Given the positive response to medication and no obvious clinical manifestations, we opted not to remove the DBS devices and continued with conservative treatment. The specific medication regimen included:

- Vancomycin (Eton Pharmaceuticals Wankexin shanghai China) 0.5g intravenous infusion (IV) every 12 hours for 12 weeks.
- Metronidazole sodium chloride injection (Liaoning Minkan Dalian Liaoning China) 100mL IV for 12 weeks.
- 20% mannitol injection 100mL IV for 12 weeks.

Ultimately, follow-up MRI indicated stability of the brain abscesses. The detailed MRI progression is illustrated in Figure 2. Panels a-d present T2 propeller images captured from August 18, 2023, to November 17, 2023, which provide enhanced visibility of the edema surrounding the abscesses. Additionally, panels e-h display T1-weighted images with contrast enhancement (T1+C), emphasizing the presence of dual cavities in the right frontal lobe and basal ganglia, as well as highlighting the progression of the disease over the three-month period. Throughout the course of the illness, the patient did not exhibit significant fever, and the blood infection markers were not markedly elevated. We followed up with the patient for another six months, and there was no recurrence of brain abscess. We also reviewed the patient's MRI in January 8 2024, and compared to previous scans, there is no progression.

## Patient 2

A 61-year-old male patient presented with involuntary trembling of the right upper limb without any obvious trigger eight years ago. This gradually progressed to tremors and rigidity in all four limbs, accompanied by bradykinesia,

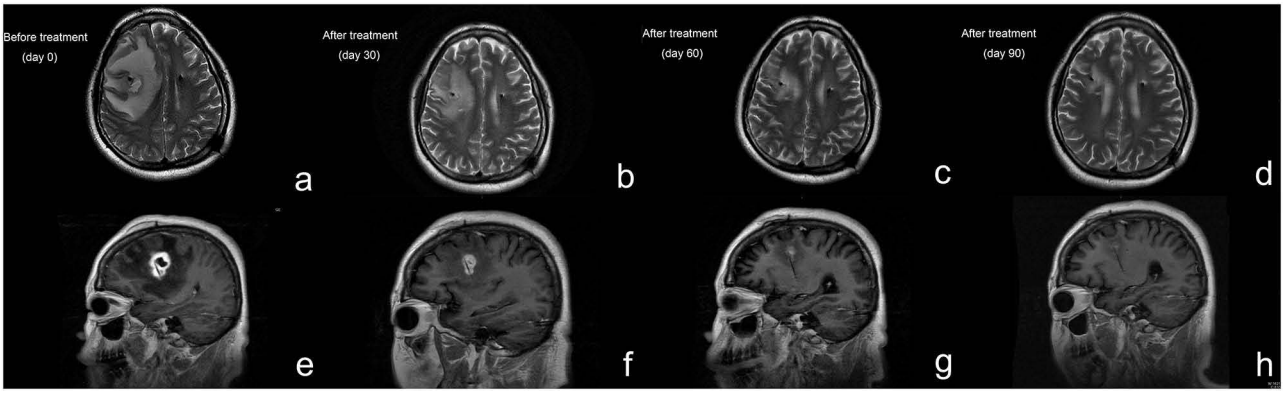


**Figure 2** Panels (**a–d**) present T2 propeller images captured from August 18, 2023, to November 17, 2023, panels (**e–h**) display T1-weighted images with contrast enhancement (T1+C).

a marked reduction in voluntary movements, hyposmia, diminished speech fluency, a masked face, and slowed thumb-index finger opposition. Treatment with levodopa was effective, leading to a diagnosis of Parkinson's disease.

On January 8, 2024, the patient underwent bilateral deep brain stimulation (DBS) surgery after an enhanced response to the test indicated a positive rate of over 30%, with electrodes implanted in both subthalamic nuclei (STN). Postoperatively, the patient experienced a stable recovery with significant symptom improvement.

However, four months post-surgery, the family reported that the patient was speaking less, appeared apathetic, occasionally depressed, and expressed a sense of disappointment regarding his current health status. The patient also showed increased instability during walking. MRI revealed a brain abscess in the left frontal lobe. A CT scan on May 8 first identified the low-density lesion located in the left frontal and parietal lobes adjacent to the lateral ventricle, and on May 9, MRI T2 FSE images confirmed the presence of the abscess and surrounding edema.

For this patient, we similarly chose not to remove the DBS devices and opted for conservative management due to the successful precedent. The medication treatment approach is the same as that of the previous patient. The specific medication regimen consisted of:

- Vancomycin (Eton Pharmaceuticals Wankexin shanghai China) 0.5g IV every 12 hours for 8 weeks,
- Metronidazole sodium chloride injection (Liaoning Minkan Dalian Liaoning China) 100mL IV for 8 weeks,
- 20% mannitol injection 100mL IV for 8 weeks.

Currently, the patient's symptoms are well-controlled, and there has been a significant reduction in the brain abscess. Two weeks after discontinuing antibiotics, the abscess showed continued shrinkage without enlargement. Detailed MRI progression is presented in Figure 3. Panel a shows that the initial MRI taken on May 9 revealed a cystic lesion in the left frontal lobe, which, based on the clinical history, was diagnosed as a cerebral abscess. T1-weighted images with contrast (T1+C) indicated that the long axis of the abscess measured 22.83 mm. Panel b presents a follow-up MRI conducted on June 14 using the same method, which demonstrated that the long axis of the abscess had reduced to 13.11 mm. This reflects an almost 50% reduction in abscess diameter during the first month of conservative treatment. Panels c-f depict the progression of the abscess on T1-weighted images with contrast, illustrating that after 12 weeks of conservative therapy, the abscess nearly resolved.

Throughout the patient's course of illness, there was no significant fever. However, there were transient elevations in absolute neutrophil counts and C-reactive protein (CRP). The absolute neutrophil count peaked at $8.93 \times 10^9$/L on May 22, and CRP reached 11.73 mg/L on June 2.


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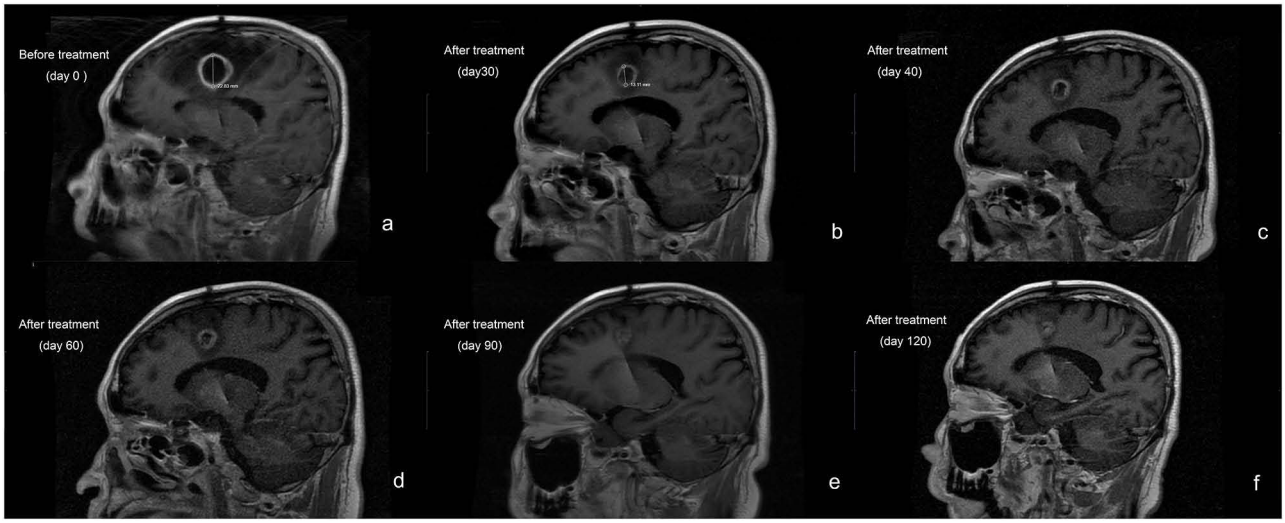


**Figure 3** Panel (**a**) shows that the initial MRI taken on May 9 revealed a cystic lesion in the left frontal lobe, T1-weighted images with contrast (T1+C) indicated that the long axis of the abscess measured 22.83 mm. Panel (**b**) presents a follow-up MRI conducted on June 14 using the same method, which demonstrated that the long axis of the abscess had reduced to 13.11 mm. Panels (**c–f**) depict the progression of the abscess on T1-weighted images with contrast, illustrating that after 12 weeks of conservative therapy, the abscess nearly resolved.

## Discussion

Although both patients lacked microbiological evidence, we have imaging evidence that can indirectly support the presence of brain abscesses. Combined with clinical symptoms, we can make an appropriate diagnosis. The occurrence of brain abscesses as a complication of deep brain stimulation (DBS) is indeed relatively rare, but the potential risks and impacts should not be overlooked. According to a retrospective analysis by van Kroonenburgh et al of neurostimulation cases at the University Hospital of Cologne in Germany,[13] over the past eight years, a total of 1,250 DBS surgeries, 1,835 spinal cord stimulation (SCS) surgeries, and 731 peripheral nerve stimulation (PNFS) surgeries were performed. Among these cases, only one brain abscess caused by DBS was documented; however, specific details regarding that case have not been disclosed. This suggests that while the occurrence of brain abscesses is exceedingly rare, it can still arise under certain special circumstances.

In the existing literature, we found only five case reports detailing eight instances of intracranial infections following DBS procedures,[12,14–17] all of which necessitated the removal of the DBS system. In these cases, all patients had to undergo multiple surgeries to remove the DBS system, with some enduring up to five surgical interventions.[12] The process was also fraught with different complications. Notably, in one case, the intracranial electrode was so tightly adhered to the brain tissue that its removal was ultimately abandoned and finally removed the intracranial electrode due to intracranial infection ten years later, significantly increasing the patient's suffering. In this case,[15] the doctor initially decided to remove the deep brain stimulation (DBS) system due to signs of infection from the IPG implantation site in the chest to the intracranial DBS lead. However, due to the difficulties associated with the removal process, they ultimately abandoned the decision, which led to the development of a brain abscess because of the exposure of the cut end of the external lead on the skin, so they had to continue removing the left intracranial electrodes. Therefore, the risks associated with the removal of the DBS system are very high, as they involve not only common postoperative complications but also additional challenges.

It is important to note that the removal of the DBS system not only poses a significant risk to the patient's physical health but can also worsen the conditions for which DBS was initially prescribed (eg, Parkinson's disease, dystonia). Patients often find themselves needing to have the DBS system re-implanted due to the unbearable return of symptoms. This turns a procedure intended to enhance quality of life into a counterproductive endeavor. For example, during the postoperative MRI review, Patient 2 developed severe rest tremor after the DBS system was turned off, which prevented the completion of the MRI scan due to excessive artifacts. Ultimately, we had to administer intravenous sedatives to resolve this issue. If we decided to remove this patient's DBS system under this circumstance, we think that the patient would likely undergo surgery again in the future due to the inability to tolerate the symptoms of Parkinson's disease. Therefore, when addressing the issue of

brain abscesses following DBS, conservative treatment emerges as a feasible new option. In our cases, successful conservative treatment not only mitigated the risks associated with further surgical intervention but also preserved the functionality of the DBS system even in the course of brain abscess, continuing to provide effective treatment for the patient's primary disease (such as Parkinson's disease and dystonia), alleviating symptoms, and improving the patient's quality of life. Of course, conservative drug treatment has its drawbacks. For example, the long-term use of antibiotics can lead to resistance, dysbiosis, liver and kidney damage, and allergic reactions. Therefore, we need to closely monitor the changes in these indicators for the patients. Despite our caution, Patient 1 still experienced a transient liver function abnormality. After implementing liver protection therapy, the patient's indicators returned to normal. We also reviewed the literature[18,19] indicating that in patients with brain abscesses receiving antibiotic treatment, the use of dexamethasone is not associated with an increased mortality rate. Therefore, in conservative treatment, we also attempted intermittent use of glucocorticoids to alleviate cerebral edema and inflammatory responses, ultimately achieving good results.

Despite the low incidence of brain abscesses after DBS surgery, we must remain vigilant and actively explore effective prevention and treatment strategies to minimize the damage these abscesses can inflict on patients. Although there has been research focused on the way to minimize infection during DBS implantation, studies targeting the treatment of infections, especially severe complications like intracranial infections, are still lacking. The existing research only indicates that brain abscesses should have pus drained within 24 hours of diagnosis,[20,21] but it does not take into account that for patients post-DBS surgery, draining the pus requires the removal of the DBS system, which is a very unfavorable option for the patients. Therefore, we need to further investigate which treatment approach, conservative treatment or surgical intervention, is more beneficial for patients with brain abscess cases caused by complications after DBS surgery.

## Conclusion

A brain abscess following DBS lead placement, although rare, can be a life-threatening complication. If appropriate conservative measures are taken, the abscess may gradually resolve. Therefore, conservative treatment and follow-up observation should be considered viable options. If conservative treatment is ineffective, we will then consider surgical intervention. Further research is needed to determine the benefits of each option for the patient.

## Data Sharing Statement

All the data that support the findings of the case series have been provided in the article, and are available from the corresponding author upon reasonable request.

## Ethics Statement

Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article. Additionally, institutional consent for case publication was granted by Nanjing Brain Hospital.

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## Disclosure

The authors declare no conflicts of interest in this work.

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