



Case Report

Rehabilitation Assists in Recovery After Complicated Intracerebral Hemorrhage Related to Deep Brain Stimulation

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Abstract

Bilateral subthalamic nuclei deep brain stimulation (DBS) has been shown to be effective in treating motor symptoms of Parkinson's disease. Numerous studies confirm the safety and efficacy of DBS. Complications of subthalamic nuclei DBS show a 1.2% risk of symptomatic intracerebral hemorrhage. There are few studies concerning the benefits of rehabilitation after occurrence of intracerebral hemorrhage related to DBS. We report a patient who underwent an inpatient rehabilitation program because of complicated intracerebral hemorrhage after a DBS procedure. We observed significant improvement in locomotion and independence of daily activities after the program. We also review the current literature reporting complications following DBS. (*Tzu Chi Med J* 2010;22(1):61–64)

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1. Introduction

Parkinson's disease (PD) is a neurodegenerative disorder characterized by tremors, rigidity, and akinesia (1). In addition to medication, neurosurgery is an option to alleviate the Parkinsonian symptoms. Ablative stereotactic surgery for a variety of movement disorders was adopted in the 1960s. Classical lesioning methods were mostly cast aside after highly effective drugs, such as levodopa (L-dopa), became available. L-dopa remains the gold standard for symptomatic treatment

of PD. Nonetheless, patients with chronic L-dopa therapy develop motor complications such as dyskinesias or motor fluctuations (2). In the early 1990s, deep brain stimulation (DBS) began to be used to treat tremors. Owing to its adjustability, reversibility, and specificity, high frequency DBS of specific target areas is now accepted by clinicians as an established treatment for medication-refractory PD patients (3,4). Previous studies have suggested that bilateral subthalamic DBS (STN-DBS) can improve all cardinal motor symptoms of PD including axial symptomatology (5–7).

Although the procedure is relatively safe for all indicated patients with PD, several centers have reported complications related to DBS procedures (8). The risk of hemorrhage following stereotactic surgery ranges from 0.6% to 2.1% in previous reports (8–11). However, few studies have investigated the outcome and benefits of rehabilitation for complicated intracranial hemorrhage related to the operation of STN-DBS. We report, for the first time, a patient's rehabilitative gains after complicated intracranial hemorrhage related to the DBS procedure in Taiwan, and review reports in the current literature on complications and prognosis after the procedure.

2. Case report

A 62-year-old man was diagnosed with PD 12 years ago. He also suffered ischemic heart disease and underwent percutaneous coronary angioplasty in 2002. No antiplatelet or anticoagulation agents were given for his ischemic heart disease. He did not have a history of diabetes mellitus or hypertension. The initial presentation of PD included right hand clumsiness, micrographia, resting tremor, rigidity and bradykinesia. These symptoms had involved both hands for the past 9 years. For the past 8 years, it had been difficult for the patient to swallow solid food. He also had obvious amnesia demonstrated by memory loss in the previous 1–2 years.

Because the patient suffered these typical PD symptoms, he had taken L-dopa for the past 10 years. Initially, he benefited from a low dosage of L-dopa therapy, and the long duration of therapy allowed him to perform his daily activities independently. However, his disease progressed, and the L-dopa dose was progressively increased to control his symptoms. Unfortunately, he demonstrated a marked "wearing-off" phenomenon, and the effect of the anti-Parkinsonian medication was not maintained for more than 3 hours. Side effects of L-dopa, including auditory hallucinations and constipation, were reported by the patient. He also had obvious difficulty in performing his daily activities and ambulation, which was caused by the progression of the PD. For example, he could only perform daily activities for 30 minutes after taking his medicine every morning. Owing to the progression of his PD and his intolerance to the side effects of current pharmacological therapy, he was admitted to our neurosurgical ward for DBS implantation. Three days later, preoperative brain computed tomography for navigation showed no active lesion. STN-DBS insertion was performed and 7 hours later, the patient's score on the Glasgow Coma Scale progressed from E1VtM4 to E3VtM6. Right hemiparesis in the patient was found by a neurosurgeon 7 hours after this operation. Manual muscle tests of both the right upper and

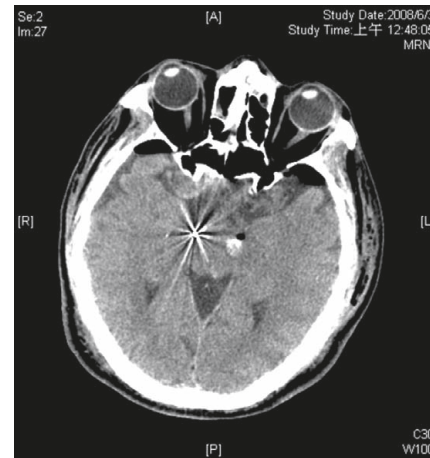


Fig. 1 — Axial computed tomography of the brain shows acute bleeding in the left cerebral peduncle.

lower limbs were graded 2. Emergency brain computed tomography showed hemorrhage at the tip of the left electrode in the left cerebral peduncle (Fig. 1). The neurosurgeon prescribed mannitol to reduce intracranial pressure. Because of the right hemiparesis, an inpatient rehabilitation program, including passive range of motion, stretch exercises, posture training, and muscle strengthening exercises, was started 1 week later.

Approximately 1 month later, the patient was transferred to our rehabilitation ward. Initially, he needed minimal assistance to stand up and transfer from the bed to the wheelchair. Poor standing balance and endurance were also noted. His inpatient rehabilitation program included daily physical therapy and occupational therapy. The rehabilitation focused on improvement of his muscle strength, ambulatory endurance, and stair climbing. The initial evaluation of his Barthel index score was 45. DBS remained turned off during this hospitalization. After 2 weeks of rehabilitation, the patient's Barthel index score advanced to 55, and manual muscle tests of both the right upper and lower limbs were graded 4. At discharge from our rehabilitation ward, he could walk more than 10 meters with his walker. He could also climb two flights of stairs independently with supervision. He was discharged from the inpatient rehabilitation program after 15 days, when he had almost reached his initial rehabilitation goals. After his condition became stable, approximately 1 month later, he returned to our neurosurgical ward for a battery implantation and modification of his medication regimen and stimulator programming.

3. Discussion

DBS subthalamic nuclei surgery performed by experienced teams has a low risk of severe complications.

The mortality rate in this type of surgery can reach up to 1.8% (12). This mortality rate might be related to bleeding and the number of tracts made during the neurological exploration (13).

Complications of DBS include perioperative mortality (1.8%), permanent neurological deficits (0.6–6%), infections (3.6–5%), hardware complications (20.5%) and other complications (26.2%) (8,12,14–17). Surgical complications of STN-DBS can be divided into those that are related to the surgical procedure and those that are hardware related. The most frequently reported hardware-related complications are lead fracture in the extracranial location, system infection, battery or connector problems, and lead migration (14). Surgical complications include aborted procedures, postoperative seizures, infections, and misplaced leads (8). Our patient had intracerebral hemorrhage without evidence of hardware failure, according to a postoperative image study. His complications may have been related to the surgical procedure.

Seijo and colleagues reported that 62% of their patients had no complications, 30% had one complication, and 8% had more than one complication (15). Procedures were aborted in 5.14% of all cases, and there were misplaced leads in 2.2%, intracranial hemorrhage in 3.3%, seizures in 4.7%, hardware complications in 1.8% and other complications in 5.1% (15). The infection rate varies from 2.5% to 5.5% (8,16). Vesper et al found that infections were significantly more frequent in older patients than in younger ones ($p < 0.05$) (17). Based on a large-scale study of new DBS hardware implantations, the incidence of postoperative hardware-related infection requiring further surgery was 4.5% (18).

A previous study showed that intracranial hemorrhage was present in nine patients, which equates to 6.92% of all patients who received the stereotactic surgery (15). The incidence of complicated intracranial hemorrhage was 3.3% of all the DBS procedures. Among these nine patients, five patients had convulsions, two were asymptomatic, and one required urgent surgery. The last of the nine patients had an aborted procedure. Only one patient had long-term sequelae representing 0.36% of the DBS procedures (15).

The risk of symptomatic hemorrhage has been shown to be 1.2% and the risk of symptomatic hemorrhage resulting in permanent neurological deficit is 0.6% (10). There is still debate about the risk factors of hemorrhage during DBS. The patient's age, diagnosis, sex, and number of microelectrode recording penetrations do not show a significant correlation with occurrence of hematoma (10,15).

Sansur et al reported that hypertension, age, sex, and PD are risk factors for cerebral hemorrhage after DBS. A patient history of hypertension is the most significant factor associated with symptomatic hemorrhage ($p = 0.007$) (19). This finding was also confirmed

by other studies (20,21). In addition, Sansur et al found that five (8.6%) of the 58 patients with hypertension experienced symptomatic hemorrhages (19). In contrast, only two (1.0%) of 201 non-hypertensive patients had hemorrhages. PD was also significantly associated ($p = 0.007$) with hemorrhage, as five of the seven patients with symptomatic hemorrhaging were being treated for PD. Age was also significantly associated with hemorrhage ($p = 0.01$). The mean age of patients with symptomatic hemorrhage was 65 years, while the mean age of the remaining patients was 41 years. However, in a subset analysis in which young patients with epilepsy were excluded from the calculation, age was no longer predictive of an increased risk of hemorrhage in adult patients undergoing DBS. Sex was also significantly associated with hemorrhage, as all seven patients with hemorrhages were men ($p = 0.04$).

With regard to the prognosis of hemorrhage after DBS, Seijo et al reported only one patient who presented with persistent neurological sequelae (0.76%), consisting of a mild right hemiparesis secondary to intracerebral bleeding, which required emergency surgery (15). In another study, patients with symptomatic hemorrhage had significantly longer hospital stays (8.2 days *vs.* 2.7 days for other patients, $p = 0.0001$) and were more likely to be discharged to a rehabilitation center or skilled nursing facility (19). Therefore, a complicated hemorrhage indicated a worse outcome than an uncomplicated DBS procedure. On the other hand, the majority of cases with spontaneous midbrain hemorrhage in the literature (35 patients, 53% of 66 reported cases) had minor neurological deficits, involving mainly cranial nerve III or IV or both (22). In 10 cases (15%), moderate neurological deficits persisted and the patients required long-term care. Three patients (5%) died from spontaneous midbrain hemorrhage. The neurological findings were normal at follow-up in 16 (24%) of the 66 reported cases.

There are many studies examining the outcome of inpatient rehabilitation following complicated intracerebral hemorrhage related to DBS procedures. Our patient did not have a history of hypertension, which, as previously mentioned, may be the most significant risk factor for hemorrhage. However, he received DBS because of PD, and his sex increased the possibility of intracranial hemorrhage related to DBS. The rehabilitation program was customized for our patient, and was based on the severity and nature of the impairments. Even with his obvious disabilities after complicated hemorrhage, he showed great improvement in locomotion and activities of daily living after an inpatient rehabilitation program.

In conclusion, intracerebral hemorrhage is one of the most significant complications associated with the application of DBS. According to previous reports,

hypertension, age, male sex, and PD are possible risk factors for cerebral hemorrhage after DBS. Thus the risk of this major complication may be reduced by intensively controlling and monitoring the patient's blood pressure. The incidence of persistent neurological sequelae after complicated intracerebral hemorrhage is relatively low compared with that after spontaneous midbrain hemorrhage. Because of early rehabilitative therapy, the patient avoided being bedridden and gained more independence in daily activities. We therefore believe that rehabilitative programs increase the chance of a favorable outcome after complicated intracerebral hemorrhage related to STN-DBS, similar to cerebrovascular attack and traumatic brain injury.

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