Venous Infarct after Sacrifice of Single Cortical Vein during Deep-Brain Stimulation Surgery

Abstract

Intracerebral hemorrhage (ICH) is the most feared and dreadful complication related to deep-brain stimulation (DBS). Bleeding may originate from arterial or venous damage. Commonly, hemorrhage is detected by postoperative imaging performed to assess lead positioning in asymptomatic patients. Rarely, hemorrhage leads to stroke, coma, or even death. We present the case of a patient who suffered a severe ICH of venous origins after bilateral DBS. Deep-brain hemorrhages are the most difficult to be predicted and to be prevented because they are caused by small vessels. As superficial hemorrhages are secondary to venous coagulation or sulcal hemorrhage, neurosurgeons must drive all efforts to minimize their occurrence.

Keywords: *Complications, deep-brain stimulation, hemorrhage, safety*

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Introduction

Since its renaissance in 1987, deep-brain stimulation (DBS) is applied for pharmacological refractory movement disorders such as Parkinson's disease (PD), essential tremor, and dystonia[1-4] and since 1999 for psychiatric disorders.[5] Surgical procedure consists in the unilateral or bilateral placement of DBS leads in basal ganglia structures. DBS is considered a relatively safe procedure. However, the most feared complication of DBS is intracerebral hemorrhage (ICH).[6] Incidence rates range between 0.5% and 5%, with 1.1% of cases resulting in permanent deficit or death.[7,8] Venous infarction following DBS is rare.[9] We report and discuss a case of severe ICH secondary to venous infarction after DBS.

Case Report

A 75-year-old woman with PD of 5 years' duration presented with right-sided arm and leg rigidity, right Pisa syndrome, and urinary urgency. After 3 years of symptom control by dopamine and dopaminergic therapy, she developed nocturnal motor blocks, dyskinesia, and progressive mental deterioration. In light of disease progression in spite of medical therapy, DBS of the subthalamic nucleus was considered.

During the surgical procedure, performed with the patient awake, a cortical vein on the left side, which was at the borders of the burr hole, was sacrificed as it started bleeding [Figures 1 and 2]. The patient had no intraoperative symptoms. Postinterventional computed tomography (CT) scan showed correct lead positioning. Eight hours after the procedure, the patient developed aphasia and right hemiplegia. A brain CT scan showed a venous infarct with hemorrhagic conversion in the left frontal region with a large hypodense frontal area [Figure 3]. In cardiorespiratory stable state, the patient was transferred to the Intensive Care Unit for observation. The morning after, she deteriorated further with the Glasgow Coma Scale score dropping from 12 to 7. Prompt CT scan [Figure 4] evidenced a further enlargement of the hemorrhage with mass effect and midline shift not present on the previous scan. An emergency hemorrhage evacuation with left lead removal was performed. The postoperative CT scan showed a complete clot removal and reduced mass effect [Figure 5]. Clinical status remained however unchanged for the severe right-sided hemiparesis and aphasia. Subsequent rehabilitation helped to improve foremost the lower limb, and aphasia persisted.

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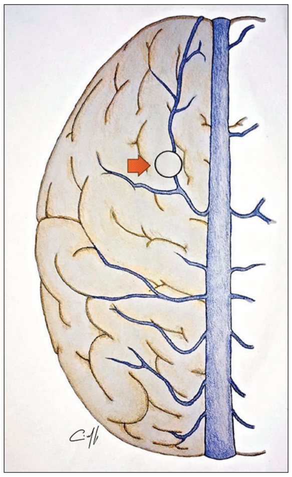

Figure 1: Schematic drawing of patient's cortical venous anatomy. The red arrow indicates the cortical projection of the burr hole

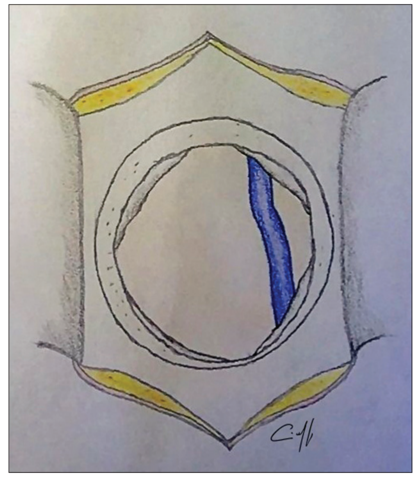

Figure 2: Operative view of the burr hole overlying the large frontal draining vein

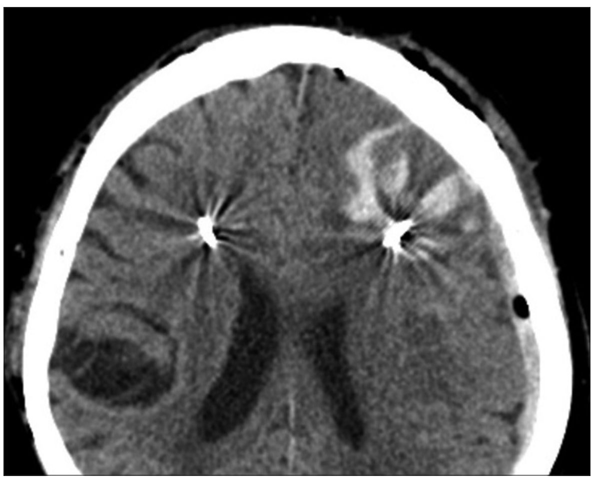

Figure 3: Hypodensity with hemorrhagic conversion in the left frontal lobe

Figure 4: Massive frontal hemorrhagic conversion with mass effect

Discussion

Since the pioneering work of Benabid *et al*.[1] in the late 1980s, DBS has become a widely applied therapy for pharmacological refractory motor disorders worldwide. Rapid technological development has allowed to reduce the complication rate. However, as any surgical intervention, DBS is associated with reported adverse effects, the most fearsome being hemorrhage.[6] Hemorrhage is classified as deep or superficial brain bleeds. Deep hemorrhagic lesions are usually secondary to damage of tiny vessels, thus more difficult to avoid. It seems that the number of micro-recording traces used increases the risk of this type of hemorrhage.[10] Superficial hemorrhages may be secondary to arteriosus origin like sulcal arterial bleeding or secondary to venous infarction after cortical vein coagulation. In order to reduce the incidence of hemorrhage during DBS, lead trajectory has to avoid cortical sulci, superficial cerebral veins, and ventricles.[11] In some cases, small superficial cerebral veins are sacrificed and if venous drainage is sufficient, there are no sequelae; however, venous infarction represents a serious hazard.[9] Morishita *et al*.[9] reported four symptomatic cases of venous infarction in a series of 500 patients (0.8% per lead and 1.3% per patient). Our patient developed a major venous hemorrhagic infarct following coagulation of a superficial convexity vein. The lead trajectory avoided sulci, ventricles, and the vein which was at the margins of the burr hole. Unfortunately, the vein started bleeding during the procedure, thus it was necessary to coagulate it. As described, the patient developed an important venous hemorrhagic infarct which required an urgent surgical intervention of hematoma evacuation. We analyzed the presurgical T1-volumetric contrast-enhanced magnetic resonance images and identified the course of the coagulated vein. It was noted that the vein originated from the anterior frontal lobe and had a long trajectory posteriorly to enter into the middle part of the sagittal sinus. On the left cerebral hemisphere, we noticed a fewer number of cortical veins with respect to the contralateral side. These findings explain the severity of venous infarct after sacrification of a single venous vessel.

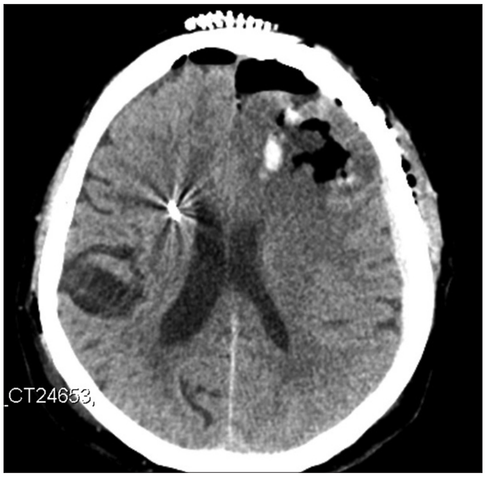

Figure 5: Postsurgical image shows hemorrhage evacuation with reduction in mass effect

Conclusion

Functional surgeons should be aware that superficial venous sacrifice needs to be strictly avoided as severe complication such as a venous infarct may result. This complication is more serious if cerebral venous circulation is less pronounced consequently with a less likely efficient venous collateral circulation.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given her consent for her images and other clinical information to be reported in the journal. The patient understands that her name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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