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Case Report

Functional recovery following resection of an epileptogenic focus in the motor hand area

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Abstract

Despite recent technical advances, the surgical management of epileptic foci in the primary motor area, especially the motor hand area, continues to represent a significant challenge because of the risk of permanent neurological deficit. We describe the case of a 19-year-old woman with intractable epilepsy secondary to cortical dysplasia of the motor hand area who was treated with surgical resection. The patient showed immediate complete motor deficit, started improving at around 1 month of follow-up, and had a substantial recovery at 6 months, with only mild limitations of fine hand movements. At the latest follow-up (3 years), she remained seizure-free. This case demonstrates that, in selected cases, resections in the primary motor cortex can be performed and that the immediately observed motor deficit is transient. We discuss the proposed mechanisms for recovery based on available data from experimental animal and clinical human studies.

Keywords: Cortical dysplasia; Epilepsy surgery; Primary sensorimotor cortex; Motor hand area; Central resection; Cortical reorganization

1. Introduction

The surgical resection of epileptogenic foci involving the primary sensorimotor cortex continues to present a real neurosurgical challenge. The potential benefit of controlling the patient's seizures has to be balanced against the risk of neurological deficit that might result from such surgery. Recent advances in anatomical and functional neuroimaging and in intraoperative mapping techniques have allowed accurate preoperative assessment and better surgical planning.

On the other hand, not only the anatomical location, but also the nature of the lesion is a major factor determining the seizure and functional outcome. Some lesions appear to displace rather than invade eloquent structures, thus making their resection without functional deficit feasible. Other lesions, like cortical dysplasia, however, can in some patients involve the primary motor area per se, and functional activity can be demonstrated within the lesion [1–4], thus making the surgical decision more problematic.

In this article, we report a case of intractable epilepsy secondary to cortical dysplasia in which the epileptogenic focus matched exactly the motor hand area. Postoperatively, the patient was seizure free and had a transient neurological deficit. We discuss the postsurgical outcome and the proposed mechanisms for functional recovery.

2. Case description

D.K., a 19-year-old, right-handed, female patient, had been experiencing recurrent medically intractable seizures since age 3. Her seizures consistently started with tonic stiffening followed by clonic movements of the left hand,

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and then there was a Jacksonian march progression with occasional secondary generalization. Postictally, she usually had Todd's paralysis of the left upper extremity. Her physical exam was unremarkable, and strength in the left upper and lower extremities, including the left hand, was normal. The patient continued to have seizures approximately once per week despite several combinations of antiepileptic drugs (including carbamazepine, valproate, phenytoin, and lamotrigine). The EEG showed right central focal sharp waves, and high-resolution MRI of the brain (including FLAIR sequence) failed to show any abnormality or signal change (Fig. 1).

Noninvasive long-term video/EEG monitoring revealed electrographic seizure activity of rhythmic sharp theta in the parasagittal region. SPECT scan showed interictal right central hypoperfusion with ictal hyperperfusion in the same area. A right frontoparietal subdural grid centered over the central area was inserted, and the patient was monitored over 6 days in the Epilepsy Monitoring Unit (EMU); long-term video/EEG monitoring was performed, as was cortical mapping using the subdural electrodes. The results demonstrated that the irritative zone and the zone of ictal onset exactly matched the motor hand area and extended slightly into the arm area (Fig. 2). At that point, we explained to the family that resection of the primary motor hand area was necessary to remove the epileptogenic zone. We informed them that the surgery would result in an immediate severe motor deficit of the left hand, and that, although a certain degree of functional recovery may be expected based on available literature on cortical reorganization, the degree and extent of such recovery cannot be predicted. They were also informed that it is probable that the surgery would result in complete loss of fine motor control. The family elected to proceed with the surgical option despite the risk because of the frequency and intractability of the seizures. During the subsequent resective surgery, an awake craniotomy was performed, and the findings of the extraoperative mapping were verified using intraoperative cortical mapping and electrocorticography. Then the motor hand area, which was judged to coincide with the epileptogenic lesion based on the above findings, was resected (Fig. 3). Immediately after resection, the patient had complete paralysis of the left hand and 3/5 weakness of the left arm and forearm. Post-resection electrocorticography revealed no spikes, spike slow waves, or electrographic seizures. The pathology showed that the resected tissue consisted of cortical dysplasia without balloon cells.

On follow-up a month after surgery, the patient began to show some movements of the left hand. At 6 months of follow-up, she had substantial recovery of motor function of the hand and fingers. Her arm and forearm strength normalized at 1 month. At the latest follow-up (3 years), the patient remained seizure free, and her motor power in the left hand was nearly normal; she could use her fingers

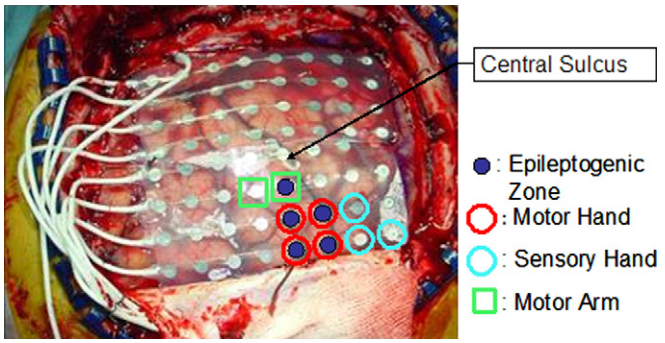

Fig. 2. View of the subdural grid over the central cortical area showing the results of cortical mapping. The epileptic focus matched the motor hand area and slightly extended into the arm area.

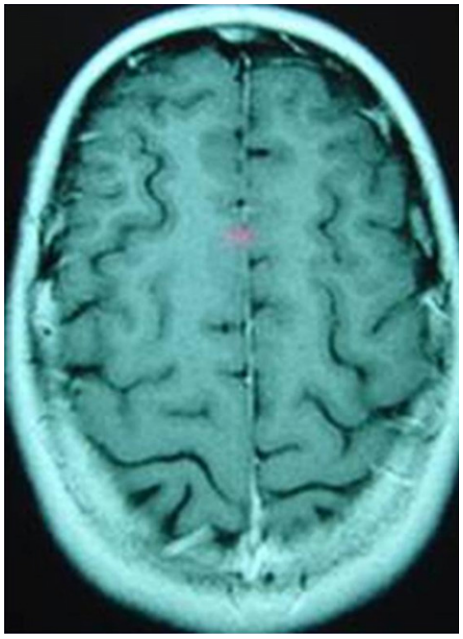

Fig. 1. Preoperative axial T1-weighted MRI brain scan. Normal: no detectable lesion and no abnormal signal.

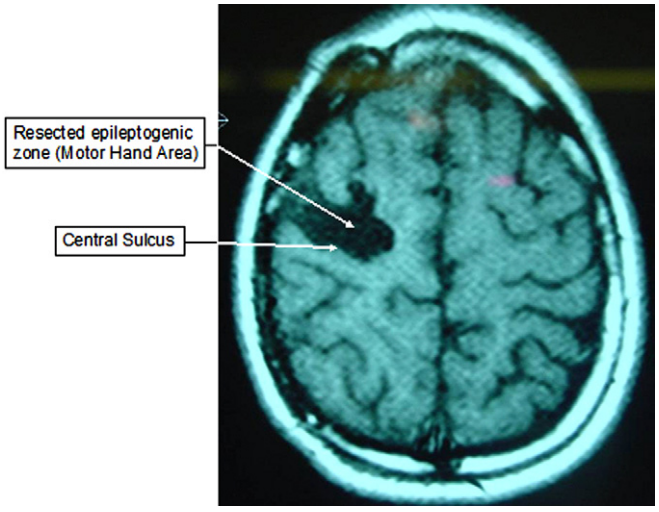

Fig. 3. Postoperative axial T1-weighted MRI scans showing resection of the primary motor hand area.