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Case Report

Stereotactic laser ablation of the splenium for intractable epilepsy☆

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ABSTRACT

Partial or complete corpus callosotomies have been applied, traditionally via open surgical or radiosurgical approaches, for the treatment of epilepsy in patients with multifocal tonic, atonic, or myoclonic seizures. Minimally invasive methods, such as MRI-guided laser interstitial thermal ablation (MTLA), are being employed to functionally remove or ablate seizure foci in the treatment of epilepsy. This therapy can achieve effectiveness similar to that of traditional resection, but with reduced morbidity compared with open surgery. Here, we present a patient with a history of prior partial corpus callosotomy who continued to suffer from medically refractory epilepsy with bisynchronous onset. We report on the utilization of laser ablation of the splenium in this patient to achieve full corpus callosotomy. Adequate ablation of the splenial remnant was confirmed by postoperative MRI imaging, and at four-month follow-up, the patient's seizure frequency had dropped more than 50%. This is the first reported instance of laser ablation of the splenium to achieve full corpus callosotomy following a previous unsuccessful anterior callosotomy in a patient with intractable generalized epilepsy.

1. Introduction

Surgical intervention is an option for a subset of the 30% of people with epilepsy whose seizures are resistant to antiseizure drugs [1]. Some patients with multifocal tonic, atonic, or myoclonic seizures may benefit from partial or complete corpus callosotomy [2,3]. Partial callosotomy involves sectioning the anterior half to two-thirds of the corpus callosum. Complete callosotomy also includes the splenium (Fig. 1). When reduction in symptoms has been unsatisfactory following partial callosal resection, complete callosotomy can be beneficial [4].

Minimally invasive methods, such as MRI-guided laser interstitial thermal ablation (MTLA), are being employed to functionally remove or ablate seizure foci. This therapy can achieve effectiveness similar to that of traditional resection [5], but with reduced morbidity compared with open surgery. Laser ablation for epilepsy has been applied to the periventricular region for heterotopia [6] and the hypothalamus for removal of seizure-inducing hamartomas [7]. Here, we present the first reported instance of laser ablation of the splenium following a previous unsuccessful anterior callosotomy in a patient with intractable generalized epilepsy.

2. Case presentation

2.1. Case history

The patient is a 30-year-old ambidextrous male with a history of developmental delay, hypothyroidism, and symptomatic generalized epilepsy. Onset of poor feeding and limb jerking episodes began at 9 months in an otherwise normal infancy. Electroencephalogram monitoring at two years showed myoclonic seizures. Seizures worsened throughout childhood and adolescence, despite the introduction of numerous antiseizure medications, including carbamazepine, vigabatrin, gabapentin, lamotrigine, clobazam, clonazepam, diazepam, pyridoxine, valproate, corticosteroids, and topiramate. Magnetic resonance imaging in 2004 was unable to identify any structural correlate of the seizures. Electroencephalogram monitoring in January of 2005 demonstrated multifocal epileptiform discharges and slow spike–waves emanating from the right frontal lobe. A subsequent routine EEG captured a seizure with clonic activity beginning over the left hemisphere. In June of 2005, at another hospital, the patient underwent an anterior two-thirds corpus callosotomy via a right anterior craniotomy. This procedure provided roughly three months of seizure freedom before the patient relapsed with atonic seizures.

Upon first presentation to our institution in 2006, the patient was experiencing roughly 4-5 generalized tonic-clonic and 1-2 myoclonic

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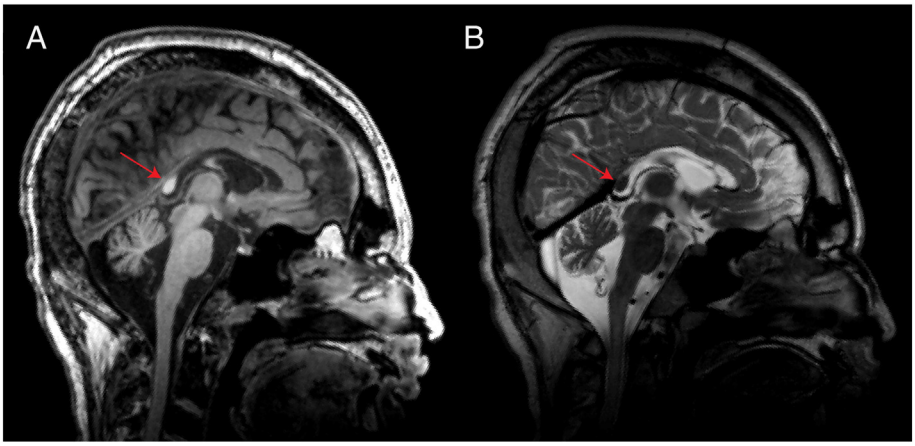

Fig. 1. Splenial remnant. Saggital T1W (A) and T2W (B) MRI images of the patient's remaining splenium remnant status-postpartial corpus callosotomy. This remaining anatomic remnant of the corpus callosum was the anatomic target of our MRI-guided stereotactic laser interstitial thermal ablation of the splenium.

seizures each day, and weekly atonic seizures. An Athena screen for commonly identified seizure genes was negative. Additional therapies included felbamate, phenobarbital, rufinamide, and levetiracetam, in combination with a ketogenic diet and combinations of previously used medications. In May of 2013, a 24-hour continuous EEG captured at least 3 different types of seizures: focal left hemisphere seizures, myoclonic–atonic seizures, and tonic–clonic seizures. Both the myoclonic–atonic and tonic–clonic seizures appeared to have bisynchronous onset, suggesting a possible justification for completing the callosotomy. Epileptiform spikes and polyspikes also showed bilateral synchrony (Fig. 2).

Preoperatively, the patient was having 15–25 seizures per day, including 1–2 drop attacks per day. Functional status and wakefulness were compromised by the frequent seizures and the side effects of medications. In April of 2015, a stereotactic laser interstitial thermal ablation of the splenium was performed to complete his corpus callosotomy.

2.2. Operative details

The operation utilized standard technique for laser-induced thermal therapy [8], which is a minimally invasive approach for frameless stereotactic placement of a laser fiber at an intracranial target, in this case, the splenium (Fig. 1), utilizing the Medtronic Visualase® system. A unilateral trajectory was first mapped from the right parietal region down to the splenium on preoperative MRI scans (Fig. 3a) that were merged with a preoperative CT scan and then coregistered to an intraoperative CT with skull fiducials, a Medtronic O-arm®, and the StealthStation® Navigation System. The patient was placed in Mayfield pin fixation and turned prone. Five skull fiducials were used for registration with an error of less than 0.2 mm, and the target was acquired with an alignment error of less than 0.4 mm. The periosteum was exposed, a twist-drill burr hole was made, and the trajectory was rechecked prior to passing the guide cannula and advancing the laser fiber down the

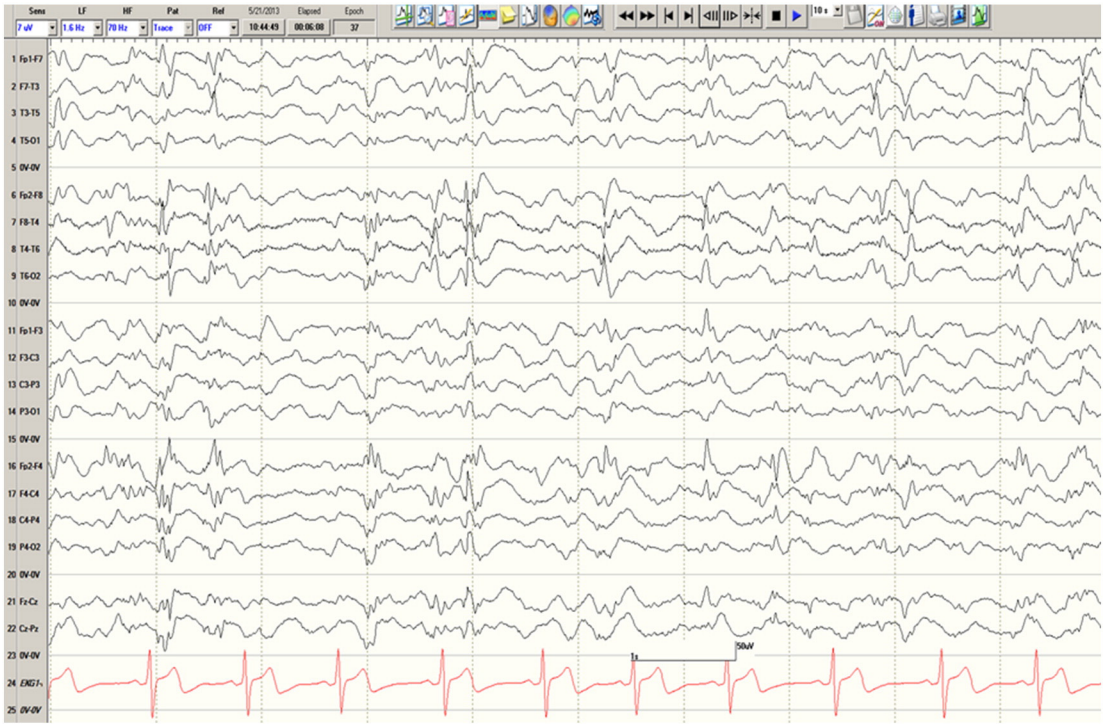

Fig. 2. EEG. Ten seconds of interictal EEG showing bilateral, sometimes synchronous spikes.