

Case Report

Unexpected Aphasia following Right Temporal Lobectomy as Treatment of Recurrent Super-Refractory Status Epilepticus

Utku Uysal^a Patrick Landazuri^a Caleb Pearson^{a, b} Manoj Mittal^a
Nancy Hammond^a

^aDepartment of Neurology, University of Kansas Medical Center, Kansas City, KS, USA;

^bDepartment of Clinical Neuropsychology, University of Kansas Hospital, Kansas City, KS, USA

Keywords

Super-refractory status epilepticus · Crossed aphasia · Temporal lobectomy

Abstract

Background: Super-refractory status epilepticus (SRSE) is a critical neurological condition with a high mortality rate. There are only limited data to direct the treatment in SRSE, and surgery has been reported to successfully stop SRSE. We present a case of recurrent SRSE treated with urgent right temporal lobectomy in a right-handed woman which potentially saved her life but resulted in crossed sensory aphasia. **Case Description:** A 61-year-old woman with a recent episode of prolonged focal SRSE due to right frontotemporal meningioma and hyperkalemia was admitted for recurrence of seizures that evolved to SRSE despite aggressive treatment with multiple fosphenytoin antiepileptic drugs (AEDs) and anesthetics. The patient underwent a right temporal lobectomy to remove the encephalomalacic and gliotic tissue around the meningioma that had been resected during a previous admission.

Postoperatively the patient had a protracted course with modest improvement after stepwise reduction in her AEDs; however, her recovery unveiled a severe crossed aphasia. **Conclusion:** Resective surgery is an effective treatment option in the treatment of SRSE, although the recovery period can be protracted. Crossed aphasia after right temporal lobectomy should be considered in patients where it is not possible to complete a presurgical evaluation of higher cortical functions.

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Introduction

Super-refractory status epilepticus (SRSE) is a neurological condition operationally defined as status epilepticus (SE) that continues for at least 24 h after general anesthesia has been initiated or recurs once general anesthesia is reduced or stopped. It occurs in about 15% of all SE cases admitted to hospital, with a mortality rate of 50% [1, 2].

The guidelines of the Neurocritical Care Society and the European Federation of Neurological Societies outline the recommended treatment of early and established SE [3, 4]. However, data are limited to direct treatment for SRSE. Ketogenic diet, electroconvulsive treatment, hypothermia, steroids, vagus nerve stimulation, and resective surgery have all been reported as possible options [1, 5].

Including the following case, resection has been reported in 18 cases of SRSE [6–17]. The functional outcome is typically good, with hemiparesis being the most commonly reported postoperative complication [6, 10, 17]. Postoperative aphasia has not been reported. We report a case of recurrent SRSE treated with urgent and possibly life-saving right temporal lobectomy who developed postoperative aphasia.

Case Description

A previously healthy, 61-year-old right-handed woman without history of epilepsy was transferred to our hospital for further evaluation and treatment of hypokalemia, hypercalcemia, confusion, and a brief seizure. Initial magnetic resonance imaging (MRI) revealed a 3.5 × 3.3 × 2.8 cm right frontotemporal meningioma with an accompanying midline shift of 3 mm (Fig. 1a).

Upon arrival, her neurological exam was notable for confusion and otherwise was non-focal. Two clinical seizures with semiology of lip smacking, left head and eye deviation, and altered awareness were also observed. Both seizures ceased following intravenous lorazepam 2 mg without any improvement in mental status. Electroencephalography (EEG) revealed two right temporoparietal seizures with frequent T8/P4 sharp waves. She was treated with intravenous fosphenytoin 15 mg/kg. Continuous video-EEG monitoring showed nonconvulsive SE (NCSE). The patient was intubated and admitted to the neuro-intensive care unit. Stepwise treatment with propofol, midazolam, and ketamine was started, with burst suppression achieved in less than 24 h. Her antiepileptic drug (AED) management consisted of levetiracetam, lacosamide, and phenobarbital. Unfortunately NCSE recurred each time with weaning of general anesthesia. Three days after admission, she underwent

resection of the right frontotemporal mass which was consistent with a WHO grade I meningioma (Fig. 1b). During her hospital stay, she was also treated for hyperparathyroidism secondary to a parathyroid adenoma that was treated medically and then surgically. Postoperatively, she remained seizure free, but her mental status did not improve. Intermittent EEGs showed diffuse slowing with focal right hemispheric arrhythmic delta slowing and continued right T8/P4 sharp waves. She was discharged to a long-term care facility in a minimally responsive state with tracheostomy and percutaneous endoscopic gastrostomy. Her mental status improved after discharge, but she had persistent generalized weakness due to critical illness myopathy from her prolonged intensive care unit stay. At 2-month follow-up, she had normal memory, attention, and language functions.

Two weeks later, she presented with confusion and left face twitching. EEG showed continuous right hemispheric spike and wave activity consistent with focal NCSE. Her preadmission AEDs were continued with the addition of valproic acid without subsequent improvement. EEG burst suppression was achieved with propofol, ketamine, midazolam, and pentobarbital. Brain MRI showed right superior temporal encephalomalacia and gliosis (Fig. 1c). NCSE emerged each time anesthetic medication was lowered despite four antiepileptic medications. Due to her previous SRSE with prolonged recovery phase and current poor prognosis, the family agreed for recurrent surgical treatment. She underwent tailored right temporal lobectomy 8 days after admission with removal of the superior, middle, and inferior temporal gyri (6 cm from the tip). Hippocampectomy was guided by intraoperative electrocorticography with resultant cessation of epileptiform activity along the margin of the resections (Fig. 1d). Postoperative EEG continued to show frequent right posterior temporal periodic epileptiform discharges for another 15 days without clinical improvement. Topiramate was added to her AED regimen, and propofol and midazolam was again titrated to EEG burst suppression for 2 days. As general anesthesia was weaned, the EEG slowly improved to diffuse theta and delta range slowing. Surgical pathology showed nonspecific leptomeningeal necrotizing inflammation in medium-sized arteries, focal cortical neuronal loss, and gliosis. The patient received high-dose fosphenytoin steroids for 5 days for possible autoimmune encephalitis. Tests for autoimmune markers and paraneoplastic antibodies as well as imaging studies for neoplasia in any other part of the body were negative except for a nonspecific elevated antinuclear antibody. She was transferred to a long-term care facility on topiramate 400 mg/day, valproic acid 3,000 mg/day, phenobarbital 300 mg/day, lacosamide 400 mg/day, and levetiracetam 5,000 mg/day.

At 9-month follow-up, neuropsychological testing could not be performed due to somnolence and lack of cooperation. Over 3 years the patient gradually improved her interaction and alertness, with concomitant decrease in her AEDs. As her cognitive status improved, a clinical picture of sensory aphasia was revealed. This manifested as relatively fluent and articulate speech with notable paraphasic errors, verbal perseveration, word salad, and alexia. Neuropsychological testing 34 months postoperatively could not be completed due to her dense sensory aphasia. The Mississippi Aphasia Screening Test showed an improving Wernicke-type aphasia that was evolving into a transcortical sensory aphasia profile with relatively fluent and articulate speech, paraphasic errors, poor comprehension, inconsistent response to questions and command following, restricted repetition of single words only, agraphia, and inability to read complex sentences.

Discussion

We present a case of recurrent SRSE treated with urgent right temporal lobectomy and hippocampectomy guided by electrocorticography. The reasons for early surgical treatment were (a) recurrent SRSE not responsive to aggressive medical treatment, (b) presence of a structural MRI abnormality concordant with scalp EEG, (c) unclear data regarding best available treatment for SRSE, (d) previous episode of SRSE with protracted recovery phase, and (e) family preference. Surgery resulted in seizure control, although her subsequent functional recovery was slow.

One of the most notable aspect of this case was the emergence of sensory aphasia following surgery. Several cases of crossed aphasia have been described in the literature following right hemispheric damage, either transiently with cortical stimulation or permanently due to stroke [18, 19]. Risk factors for crossed aphasia are left-handedness and family history of right hemisphere language dominance. Our patient is right-handed and there is no family history of left-handedness. Although rare, right-handed individuals with late-onset epilepsy have been reported to have right-hemisphere language dominance [20], with at least one case of transient crossed aphasia following right anterior temporal lobectomy thought secondary to atypical bilateral representation of language in an individual with epilepsy [19]. This suggests that our patient had at least bilateral if not complete right-hemisphere language dominance. Additionally, while classically thought to be located in the posterior portion of the superior temporal gyrus, there is increasing evidence indicating the importance of the anterior superior temporal gyrus in word recognition and receptive language processing [21, 22]. This possibility could help explain her dense sensory aphasia.

There are 17 previously reported cases of resective surgery in the setting of SRSE, with 16 showing improvement in seizures after surgery; 7 became seizure free and 1 became free of disabling seizures (Engel class 1 [16]) (Table 1). Limited data from these cases suggest that surgery may be an effective method of treatment in appropriately selected cases. We believe that the cause for our patient's SRSE was encephalomalacia along the right superior temporal gyrus after her meningioma resection. However, pathology showed leptomenigeal necrotizing inflammation in medium-sized arteries. This raises the possibility of autoimmune epilepsy, although she did not have any clinical or laboratory finding suggestive of vasculitis or autoimmune disease, except for a positive antinuclear antibody. Nevertheless, limbic encephalitis and central nervous system vasculitis have been reported in surgically treated refractory SE patients, among other etiologies (Table 1). Therefore, it is possible that an autoimmune process contributed to the development of SRSE and that fosphenytoin steroid treatment contributed to her SRSE treatment.

Cognitive and functional impairment showed significant stepwise improvement with each AED taper. Cooper et al. [8] reported that survival with meaningful functional and cognitive recovery is possible even months after resolution of refractory SE. Therefore, we find it reasonable to consider controlled, early AED removal with maintained vigilance for breakthrough seizures as a mean for improved functional and cognitive recovery.

In summary, this case report and review of the literature supports the consideration of resective surgery in appropriate patients as an early treatment option for SRSE. Unexpected outcomes (e.g., crossed aphasia in a right-hand patient) should be considered as part of the

informed consent in comatose patients where presurgical evaluation of higher cortical functions is not possible.

Statement of Ethics

The power of attorney of the patient gave informed consent for her participation in the study and publication.

Disclosure Statement

Drs. Uysal, Landazuri, Mittal, and Pearson report no conflict of interest. Dr. Hammond receives a honorarium from Cyberonics, Inc. for speaking.

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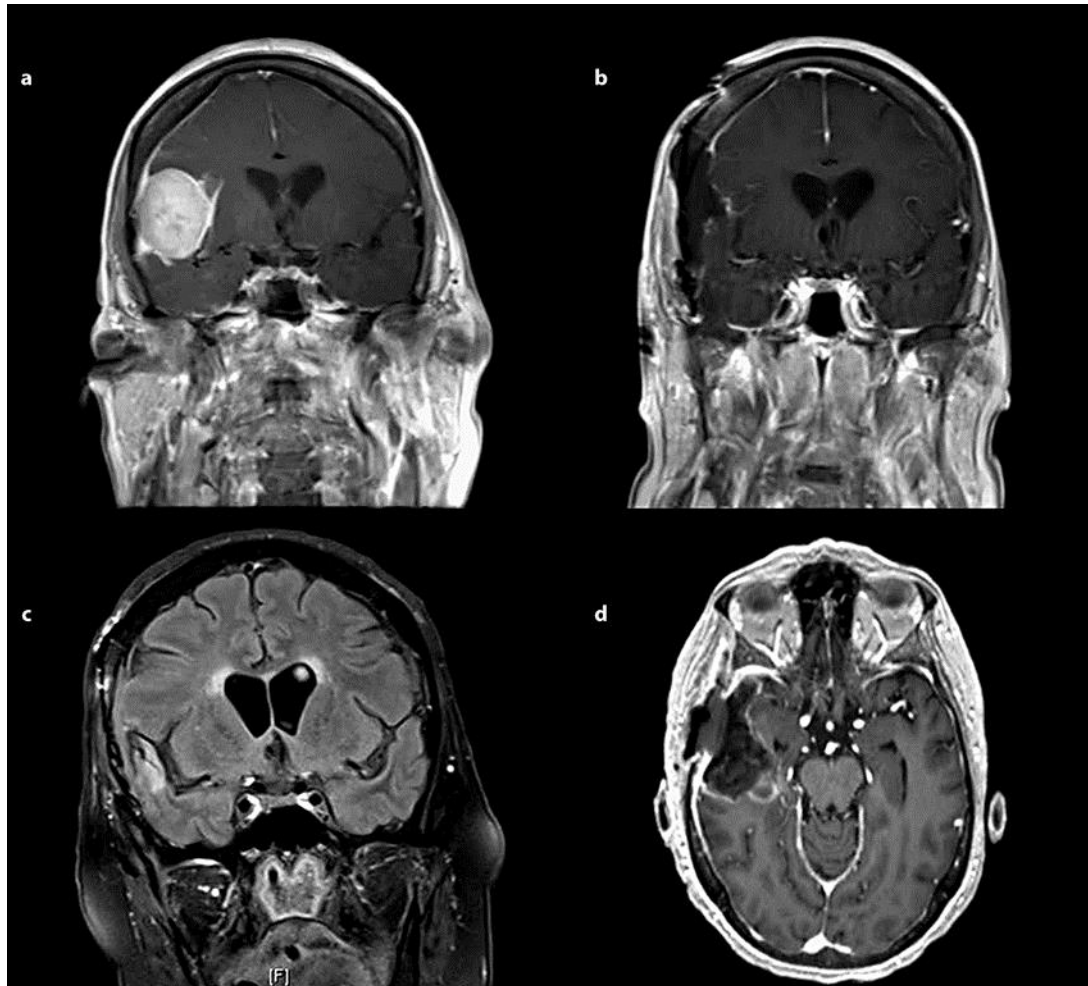


Fig. 1. Brain magnetic resonance imaging (MRI) of a patient with super-refractory status epilepticus (SRSE) treated with surgical resections. **a** T1-weighted MRI with contrast image showing right frontotemporal meningeoma with mild right to left midline shift. **b** Postoperative T1-weighted MRI with contrast image after meningeoma resection during the first SRSE. **c** Fluid-attenuated inversion recovery image showing encephalomalacia and gliosis along the right superior temporal gyrus noted during recurrent SRSE, 2 months after meningeoma resection. **d** Postoperative T1-weighted MRI with contrast image after temporal lobectomy and hippocampectomy.

Table 1. Summary of previously reported adult cases of SRSE treated with surgery

Reference	n	Age, years	Etiology	EEG	MRI	PET	SPECT	Surgery	Pathology	Outcome
Molyneux et al. [11], 1998	1	19	focal cortical dysplasia	L central seizures	normal	N/A	N/A	MST on L precentral and postcentral gyri with ECoG	focal cortical dysplasia	RSE stopped, no recurrence of EPC, wheelchair bound at 9 months
Ma et al. [10], 2001	1	22	N/A	R frontal seizures, bilateral PED, R frontal PLED	L parasagittal frontal cortex increased FLAIR intensity without contrast enhancement	N/A	R frontal, parietal, and posterior temporal increased ictal perfusion	R frontal resection and MST with ECoG on day 40	astrogliosis	occasional brief seizures, L hemiparesis
	1	25	generalized epilepsy	generalized fast activity for 1–2 s every 30 s	prior CC	N/A	N/A	CC on day 42	N/A	seizure-free, recovered to baseline functions
	1	31	focal epilepsy	diffuse attenuation for 1–2 s	R frontal T2 hyperintensity	N/A	R frontal, superior, temporal lobes and globus pallidus increased ictal perfusion	anterior 2/3 CC on day 23, then R frontal resection at 17th month	gliosis	seizure-free
Costello et al. [9], 2006	1	36	N/A	frequent and organized L frontal sharp and slow waves	L midfrontal thickening of cortical mantle	focal L frontal ictal hypermetabolism	N/A	L middle frontal gyrus resection and MST with ECoG on day 51	inconclusive	seizure-free, cognitive impairment first then independent in activities of daily living at 16 months
Ng et al. [13], 2007	1	48	astrocytoma	R frontal continuous seizure activity	previous R frontal biopsy with edema and contrast enhancement	N/A	N/A	grid placement on day 4, tumor resection and MST on day 10	astrocytoma with anaplastic transformation	seizure-free without residual deficit
Weimer et al. [14], 2008	1	45	limbic encephalitis	R temporal ictal activity	T2 hyperintensities: pons, cerebral white matter, and R temporal lobe	N/A	N/A	R temporal lobectomy on day 11	encephalitis	seizure-free, intact mental status, died at 6th month from metastatic lung cancer
Nahab et al. [12], 2008	1	57	limbic encephalitis	L frontocentral seizures	MRI: T2 hyperintensity in the L frontoparietal region	N/A	N/A	L frontal resection on day 22	chronic inflammation of leptomeninges, perivascular spaces of cortex, and white matter blood vessels	seizures resolved, patient remained comatose and died on day 54
Weimer et al. [15], 2012	1	43	N/A	R frontal seizures	MRI L temporal arachnoid cyst	N/A	N/A	R frontal resection and MST	N/A	seizure-free
Atkinson et al. [6], 2012	1	20	CNS vasculitis	R frontal seizures	MRI-increased T2 signal in R temporal, L insula, bilateral frontal lobes	N/A	N/A	R lateral frontal resection with ECoG at week 8	small-vessel vasculitis in cortex and leptomeninges	rare simple partial motor seizures, mild L hemiparesis, no cognitive impairment

Winkler [16], 2013 ^a	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1 Engel class I, 1 Engel class II, 2 Engel class III, 1 Engel class IV
Oderiz et al. [17], 2015	1	21	L hemispheric PMG	frequent L frontal paroxysmal fast activity	L hemispheric PMG, restricted diffusion in L frontal lobe	N/A	N/A	L functional hemispherectomy on day 20	focal cortical dysplasia type IIA	only 2 seizures, R hemiparesis
	1	18	Parry-Romberg syndrome, focal epilepsy	R frontotemporal epileptiform discharges and seizures	R parietal and occipital T2 hyperintensity	N/A	N/A	R hemispherectomy on day 39	reactive gliosis	seizure-free with moderate L hemiparesis

ECoG, electrocorticography; EEG, electroencephalography; RSE, refractory status epilepticus; SRSE, super-refractory status epilepticus; MRI, magnetic resonance imaging; PET, positron emission tomography; SPECT, single-photon emission computed tomography; N/A, not available; MST, multiple subpial transections; EPC, epilepsy partialis continua; R, right; L, left; PED, periodic epileptiform discharge; PLED, periodic lateralized epileptiform discharge; FLAIR, fluid-attenuated inversion recovery; CC, corpus callosotomy; CNS, central nervous system; PMG, polymicrogyria. ^a Five cases from the author's personal series. No further data available other than postoperative seizure outcome reported as Engel Epilepsy Surgery Outcome Scale.