Surgery for Medically Refractory Focal Epilepsy

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Surgery for medically refractory epilepsy

Patients with uncontrolled epilepsy are much more susceptible to accident, injury and death.

Patients with uncontrolled epilepsy receive 4-9x as much health care as those with well-controlled epilepsy.

In 30-40% of patients, epilepsy is pharmacoresistant.

Surgery is often considered a last resort:
Mean duration of epilepsy prior to surgery is greater than 20y (requires highly specialized pre-surgical and surgical techniques).
Surgery for medically refractory epilepsy

Goal: identify an area in the brain that causes seizures and determine whether this area can be removed safely

Noninvasive workup +/- invasive recording → craniotomy for resection vs. minimally invasive ablation

Other options are available when:
• a specific area of seizure onset is not identified
• multiple areas of seizure onset are identified
• resection/ablation is not possible without causing new neurologic problems

(responsive neurostimulation, vagus nerve stimulation)
Cost-effectiveness analysis of epilepsy surgery in a controlled cohort of adult patients with intractable partial epilepsy: A 5-year follow-up study


Epilepsia, 57(10):1669–1679, 2016
doi: 10.1111/epi.13492

Epilepsy surgery is cost effective at 9-10 years (direct medical costs)
Resective surgery for medically refractory epilepsy: The best chance for a surgical cure for seizures
Resective surgery for medically refractory epilepsy: The best chance for a surgical cure for seizures

Wiebe et al., 2001 NEJM
Surgical evaluation for medically refractory epilepsy

*Subdural grid placement:* improved spatial resolution of the brain surface compared to scalp EEG
Surgical evaluation for medically refractory epilepsy

*Stereo EEG*: multiple depth electrodes placed to monitor superficial and deep structures
Risks
This is *elective* brain surgery
Risk vs benefit analysis

Tebo et al. 2014 JNS
Case example: intracranial monitoring then resection

Otherwise healthy 29 yo F with 6 years of frequent uncontrolled seizures despite 3 seizure medications (4 prior medication trials). Unable to continue college, difficulty caring for her children.

Workup:

*MRI:* normal.
*PET/CT:* normal
*Ambulatory EEG:* paroxysmal bifrontal slowing, consistent with idiopathic generalized epilepsy.
*Neuropsych:* IQ 106, visuospatial worse than verbal memory

EMU: right temporal epilepsy, poorly localized...
Intracranial electrode implantation: grids, strips, depths
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Intracranial monitoring: seizure activity isolated to HD4-8

7 seizures were recorded, all very similar: onset in HD 4-8, with minimal spread to other electrodes
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Wada testing: good contralateral memory

Bilateral language dominance: dysphasic but not aphasic with left injection
Bilateral independent memory: 11/12 recall with left injection (testing R hemisphere), 12/12 with right injection (testing left hemisphere)
R craniotomy for electrode removal, selective anterior temporal lobectomy and amygdalohippocampectomy

Discharged home postop day 3
Continue home AED regimen for at least several months
No seizures since surgery in 3/2018
Case example: intracranial monitoring x2 then resection

Otherwise healthy 23 yo M with multiple seizures/week despite 3 AEDs characterized by racing thoughts or déjà vu that can progress to generalized seizures. Many events are subtle, but 3-4 hospitalizations/year for more severe seizures.

Workup:

*MRI*: normal.

*PET/CT*: Asymmetric decreased metabolic activity in the left inferior lateral temporal lobe

*Ambulatory EEG*: left frontotemporal irritability

*Neuropsych*: normal memory, mild difficulty with phonemic verbal fluency and auditory naming

EMU: focal epilepsy arising from the left frontotemporal region, no generalized seizures recorded
Wada testing: bilateral memory

Language: left side dominant (dense aphasia with left injection)
Memory:
9/12 recall with left side injection (testing right side function)
11/12 recall with right side injection (testing left side function).
This suggests possible memory deficit with surgical resection of left mesial structures
Intracranial electrode implantation: stereoEEG

13 seizures arising nearest to the anterior lateral contacts, *not involving the medial structures*

However: global attenuation followed by abrupt onset at multiple contacts simultaneously
Intracranial electrode implantation: grid plus strips

3 months later...

Widespread temporal and frontal coverage

11 seizures with onset in the basal temporal lobe contacts

Just inferior and anterior to prior depth electrodes
Left selective anterior/basal temporal lobectomy
Sparing the mesial structures

Discharged home postop day 2
No seizures since surgery in 10/2018
Mild subjective reduction in verbal fluency, no change in memory
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*Stereotactic laser ablation*: minimally invasive epilepsy surgery
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*Stereotactic laser ablation*

MRI-guided ablation
Case example: stereotactic laser ablation for amygdala dysplasia

38 yo healthy M with a history of epilepsy that was well-controlled for several years, however the past 6 mos he had frequent seizures despite increasing dosages of medication with increasing side effects. He now has seizures every 1-2 days, which are characterized by speech arrest, lipsmacking, right-sided tonic posturing followed by confusion and lethargy.

Workup:

MRI: Cystic lesion in the left mesiotemporal lobe
EEG and EMU: diffuse left frontotemporal ictal onset, rare interictal abnormalities over the left frontotemporal region
Wada:
Language: bilateral representation, left greater than right.
Memory:
left injection showed a significant reduction from baseline.
right injection was similar to baseline testing.

*If left mesial temporal structures are removed this may result in a decrease in verbal memory.*
Case example: stereotactic laser ablation for amygdala dysplasia
Post ablation

Path: Reactive changes, nondiagnostic of neoplasm or cortical dysplasia
Postop course:
postop headache and neck pain, neuro intact
No memory or speech issues
Discharged home on POD2

Steroid taper over 1 week
Continue home AED regimen for several months (reduced early due to intolerable side effects)
No seizures since 5/2018
Returned to work
Case example: stereotactic laser ablation for MTS

56-year-old healthy F with epilepsy that began in her mid 20s. She has tried at least 7 anticonvulsants, currently on keppra and tegretol. She has seizures that occur 1-2 times/week characterized by staring +/- loss of awareness and disorientation, with aura of a strange feeling in her stomach prior. She has had rare generalized tonic-clonic seizures

Workup:

**MRI:** right hippocampal atrophy and abnormal signal, consistent with mesial temporal sclerosis

**PET/CT:** decreased FDG uptake in the right mesial temporal lobe

**EEG and EMU:** right fronto-temporal ictal pattern during stereotyped seizures, interictal right temporal slowing and right fronto-temporal sharps

**Neuropsych:** poor performance on multiple verbal measures
Case example: stereotactic laser ablation for MTS

MRI shows typical right MTS
Postop course:
Minimal postop headache, neuro intact
Good memory on bedside testing
No visual field disturbance
Discharged home on POD1

Steroid taper over 1 week
Continue home AED regimen for several months
No seizures since 6/2018
Surgery for medically refractory epilepsy

Treatment Algorithm for Refractory Partial Onset Seizures

1. Confident localization to one focus
   - Safe to resect?
     - NO
     - Low cognitive risks?
       - NO
         - Not localizable
       - YES
         - Seizure freedom likely?
           - NO
             - Vagus nerve stimulation or alternative treatments
           - YES
             - Responsive neurostimulation
     - YES
       - Responsive neurostimulation
       - Resective surgery or ablation

2. # OF SEIZURE ONSET AREAS IDENTIFIED
   - Not localizable
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*Responsive neurostimulation:* detects epileptiform discharges and delivers therapeutic stimulation.
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Responsive neurostimulation

73% median seizure reduction at year 8

- 66% achieved >50% seizure reduction at year 8
- 30% achieved >90% seizure reduction in most recent 3 months*
- 29% had at least 1 period of ≥6 months without seizures
Summary

For highly selected patients, epilepsy surgery can be curative.

The workup for epilepsy surgery is complex, ultimately requires multiple specialists.

Complication rates are low, but not zero: benefit must outweigh the risk.

Several surgical options are available, surgery is highly tailored to each individual patient.
Thank You