



EPILEPSY & The Facts

Surgery and Epilepsy

Why surgery for epilepsy?

The adult human brain weighs 1.4 kilograms and contains approximately one hundred billion nerve cells or neurons. The abnormal excessive and synchronous discharge of a group of neurons is the basis for epilepsy. In this respect, epilepsy is very much like a thunderstorm inside the brain. The location of this disturbance, its duration and spread to neighbouring areas determine the clinical features of seizures.

One per cent of the population has a tendency for recurrent seizures, making epilepsy a common disorder. Anticonvulsant drugs suppress abnormal neuronal discharges and limit the spread of seizure activity in the brain. Sixty per cent of patients are well controlled with these medications. This leaves 40 per cent of patients who are not adequately controlled for whom alternate treatments need to be considered.

Have there been recent advances in epilepsy surgery?

There is an increasing awareness of the benefits of surgery in the treatment of certain patients who continue to have seizures despite of the best treatment with anticonvulsants. The last decade has seen significant advances in the surgical treatment of epilepsy. This has come about with the development of better imaging techniques such as magnetic resonance imaging (MRI) and better seizure localization with increasing sophistication of electroencephalographic (EEG) technology, single photon emission computed tomography (SPECT) and positron emission tomography (PET).

These advances together with improvements in surgical techniques have increased the safety and efficacy of operations for the treatment of epilepsy.

How does surgery work?

Although epilepsy surgery is complex, the treating team of neurologists and neurosurgeons follow a straightforward set of principles. The strategy is to identify the area of abnormally discharging neurons (the “seizure focus”) and to remove it when possible. In certain patients without a well defined epilepsy focus, surgery can sometimes help, by disconnecting or isolating the abnormal area so that seizures no longer spread to the neighbouring normal brain.

How common is epilepsy surgery?

There are currently approximately 500 operations performed each year in North America for epilepsy. Investigators feel that 2,000 to 5,000 new patients might be suitable for operations each year.



Which patients are candidates for epilepsy surgery?

Only patients whose seizures are not well controlled on medical treatment are considered for surgery. Before seizures are considered medically intractable, the physicians must ensure that the correct seizure diagnosis has been made and that the correct drugs have been used in the appropriate amounts. Even then, however, there is no clear definition of when to move to surgery. Among the factors to consider are seizure type, frequency and severity, the length of time since the diagnosis and the impact of the epilepsy on the patient's quality of life. There are also other reasons to consider surgical therapy. For instance, repeated seizures may lead to neurological deterioration and certain patients may have intolerable side effects to anticonvulsant medications.

It is important to stress that not all patients with medically refractory epilepsy can be helped with surgery. The best surgical candidates have seizures arising from a single location and from an area of the brain that is relatively silent meaning that the seizure focus can be safely and completely removed.

Which patients cannot be helped by epilepsy surgery?

Patients with seizures arising from many sites (multifocal epilepsy) and most patients with generalized seizures without a clear focus of onset are usually not helped by surgery and are at the present time, not candidates for operations.

What investigations are required for surgery?

Patients considered for surgery must be well motivated to undergo the extensive series of tests required to localize the seizure focus and determine whether it can be safely surgically removed. A neurological history and physical examination is the first step in evaluating a patient with seizures. This gives important clues into the many causes of the seizures and can identify the part of the brain from which the seizures are likely to be originating. Next, imaging the brain is important to identify any abnormalities which may cause seizures. The findings of the imaging studies may show a lesion or may show subtle abnormalities such as an area of the brain involved in the seizure which is slightly smaller than usual.

What other tests are performed on the surgery patient?

Perhaps the most important investigation in the evaluation of patients for surgical treatment of their epilepsy is the EEG. This test measures the electrical activity of the brain and can identify the location of the abnormally firing neurons. It is sometimes necessary to activate electrical activity at the seizure focus by withdrawing anticonvulsants, by depriving the patients of sleep or by administering certain drugs to bring out seizure activity. When the standard EEGs do not give the location of the seizure focus, patients are often admitted to hospital for 24 hours round-the-clock EEG and video monitoring. In this way the clinical manifestations of the seizure as recorded by the video camera can be correlated with abnormalities in the EEG to identify the area of the brain responsible for the seizure. A minority of patients with particularly complicated seizures require more extensive investigations for added resolution and accuracy of seizure localization. These patients require electrodes implanted on the surface of the brain or directly within the brain tissue suspected of harbouring the seizure focus.

What is the neuropsychological assessment for surgery?

An important aspect of the evaluation is the neuropsychological assessment. These tests document the consequences of the seizures on brain function. Since each part of the brain subserves a specific function, each identified neuropsychological finding can be matched to precise brain areas to give important clues about seizure localization. In addition, as a preoperative tool, neuropsychological tests can identify which hemisphere is dominant for speech and memory and can, by predicting the neurological consequences of the proposed operation, help in the safety of the surgery. It is interesting that after successful operations, the neuropsychological tests often document improvements in brain function associated with improved seizure control.

How is the surgery performed?

After collection of the necessary data a decision regarding surgery is made. The largest group of surgical candidates are patients with seizures that have a single seizure focus. Operations can be done under general anaesthesia but when seizures arise near areas of the brain involved in important functions such as speech, motor control or sensations, many epilepsy operations are performed under local anaesthesia with the patient awake and fully cooperative. The surgical team performs an EEG in the operating room and stimulates the brain electrically to establish the relation between the seizure focus and essential brain areas. This technique gives the surgeon a detailed account of where the seizures are originating and tells when it is safe to proceed with the resection and when it is necessary to back-off. Operating with the patients awake, thus increases the safety of the surgery and increases the chances of removing the neurons responsible for the seizures when it might otherwise be considered to be too dangerous.

What is the “callosotomy” surgery for epilepsy?

Another surgical technique used is that of disconnecting the seizure focus from the normal brain. The best example of this is an operation called a “callosotomy”. This operation done in patents with generalized seizures, interrupts the connections from one half of the brain to the other. The end result is that seizures no longer spread from the epileptic to the more normal half of the brain. This operation does not cure the patients of epilepsy but can help with the frequency and severity of attacks. It is particularly effective for patients with “drop attacks”. These are seizures characterized by sudden failing and without any warning.

What are the risks and benefits of epilepsy surgery?

As with any operation, there are risks to surgery for epilepsy. The risks depend on the area being operated and are those of producing a disturbance in motor strength, in sensation, in vision or speech. There have also been rare cases of surgical mortality. Fortunately, with continuing refinement in neurosurgery, the chances of long lasting complications are small at approximately two per cent.

In patients with an identified focal seizure focus, the success rate of surgery is up to 80 per cent. This is the number of patients that will be seizure free for five years after surgery with some patients experiencing occasional auras and some still taking anticonvulsant medication. For patients with generalized seizures without a focal onset the results are still not as good. These patients may nevertheless obtain a worthwhile improvement with an operation.

What does the future hold for the surgical treatment of epilepsy?

We have made important progress in the treatment of epilepsy with an increasing understanding of the disorder, the developments of new medications, improved diagnostic tests and the refinements in surgical procedures. There is still much work to be done. Further progress will depend on gaining a better understanding of the changes in the brain leading to seizures and on greater accessibility to specialized centres for epilepsy research and treatment. These are the challenges that lie ahead.

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