University of Michigan
Hospitals and Health Centers

Pediatric Epilepsy Surgery Evaluation

This handout is meant to help you understand the different tests that your child may have as we determine whether he or she is a candidate for epilepsy surgery. Because you are considering epilepsy surgery, your child will have some of these tests, but he or she might not need all of them.

After your child has all of the tests that your doctor recommends, he or she will be discussed in our Refractory Epilepsy Conference. This conference is held on Thursday afternoons and the epileptologists, neurosurgeon, neuropsychologist, radiologist, social worker, and epilepsy coordinator are present. We review the child's history and test results and provide a recommendation for the type of surgery we feel would most benefit the individual child. If you have not already been seen by our neurosurgeons, and surgery is recommended, you will then be referred for evaluation in the Pediatric Neurosurgery Clinic.

What are the tests that may be part of the epilepsy surgery evaluation?

Remember, not all tests are needed for every child

1. **Video-EEG monitoring**: Your child will be admitted to Mott Children's Hospital for EEG monitoring. The goal of the admission is to capture his or her typical seizures on EEG. This helps the doctors to figure out where in the brain the seizures are coming from. Sometimes the results of this tests show that a child is not a good candidate for epilepsy surgery (for example if seizures come from more than one place in the brain).

If your child does not have seizures very often, we might decrease the medication doses before or during this admission so that we capture some seizures while he or she is in the hospital. We ask that a family member be present at the bedside during the hospitalization.

2. **Epilepsy protocol brain MRI**: If your child has not recently had a brain MRI, this test will be requested. The MRI can show us areas of abnormality that may be causing the seizures. An MRI requires your child to hold relatively still for up to an hour. Younger children usually need sedation for this test.

3. **SPECT scan (Single Photon Emission Computed Tomography):** This test permits your doctors to see how blood is flowing through different areas of the brain. The area with the most blood flow during a seizure is the area where the seizure probably starts. Your child will be admitted to the hospital for this test. This test is combined with long-term video EEG monitoring, usually lasting 5 days.

An EEG technician will be at your child's bedside during the day, watching your child and the EEG. As soon as a seizure starts, the technician will inject a special tracer through your child's IV. This tracer is taken up in the area of the brain with the most blood flow. You child will then receive medication to prevent more seizures from happening and will be taken to the nuclear medicine suite for the scan. We will arrange sedation for the scan if necessary. Note that two scans will be ordered. The first happens right after a seizure occurs and the second happens between seizures (on a different day from the first). A neuroradiologist will compare the two scans to determine which area of the brain has the highest blood flow during the seizure. Scans can only occur on weekdays and only during certain hours.

4. **PET Scan**: A PET scan is another imaging study that can identify the possible starting point for your child's seizures. When the brain is not seizing, places where seizures start often have slower metabolism than the rest of the brain. This means that these areas use less glucose (sugar) than normal. These areas of low metabolism (called hypometabolism) are detected by injecting a small amount of radioactive material known as a tracer (we use a substance called 2-[18F] fluoro-deoxyglucose, or FDG) into a patient's vein. The more glucose an area of the brain is using, the more FDG it will take up. Although PET studies depend on the injection of a radioactive molecule into your child, it is a safe test because such a small amount of FDG is used. An EEG will be recorded before and after the FDG is injected, to make sure your child is not having a seizure during the test.

5. **Neuropsychometric testing**: A full day of testing will be ordered, to evaluate your child's intelligence (IQ testing), language abilities, ability to visualize objects, memory, fine motor skills, ability to pay attention, academic achievement, and behavior. The pattern of strengths and weaknesses may indicate that a particular area of your child's brain does not work as well, and could be responsible for the seizures. We will repeat the testing several months after surgery to see if, or how, your child's abilities have changed. Even if your child does not have epilepsy surgery, this information may be useful in developing an educational program for your child (e.g. Individualized Educational Program).

6. **Speech and Language evaluation**: This testing complements the neuropsychometric testing and focuses on your child's abilities in speech and language. This testing will not occur on the same day as the neuropsychometric testing.

7. **Wada test**: This test is done to determine whether the left or right side of your child's brain controls his or her ability to speak and understand language. It also can determine how important the left and right sides of the brain are for memory. If the speech or memory centers are on the same side as the seizures start, your child's surgery may be slightly altered to avoid damaging or removing the speech/memory area of the brain.

   The Wada test involves putting one side of the brain to sleep at a time with a medication called sodium amobarbital. A neuroradiologist will insert a catheter (like a big IV) into a blood vessel in the groin and then use this to inject one internal carotid artery, the major blood vessel feeding each side of the brain, at a time. After each injection, a neuropsychologist will test your child's ability to speak, understand, and remember things. If these abilities are impaired, then the side of the brain that is asleep must be important for these functions. An EEG recorded during the study helps your child's neuropsychologist determine if the injection worked. Although we have been able to perform this study on children as young as 7 years, it does require significant cooperation from the child and not all patients are eligible.

8. **Functional MRI**: This is a special MRI test which can look for areas of the brain which have increased blood flow. Your child will be asked to listen, speak, and do some small movements such as finger or toe-tapping. The results can help us to tell which areas of the brain control these functions. Functional MRI is a noninvasive and safe test which is done on the same machine as a regular brain MRI. Just like for the Wada test, only children who can cooperate fully and are able to have MRI tests without sedation are eligible to have this test.

9. **Intracranial EEG monitoring**: After an initial round of tests, including many of the ones listed above, your epileptologist may have a good idea of where your child's seizures are coming from. However, in order to for an epilepsy surgery to be successful, the seizure onset must be precisely localized. Sometimes, this requires placement of EEG electrodes directly on the surface of the brain, where the epileptologists suspect the seizures start. This is also called invasive monitoring because it requires surgery to place the EEG electrodes, also called "grids", into position.

   Once the electrodes are placed, your child will have an MRI and/or head CT scan to create a precise map showing the electrodes on the brain surface. Your child will then be admitted to the pediatric intensive care unit (ICU) for at least one day, before moving to the general care floor. The electrodes will be hooked up to the EEG machine and we will monitor to see exactly where the seizures start. Usually, we decrease antiseizure medications so that the child will have seizures. Depending on the EEG results and the number of seizures your child has, the invasive monitoring will usually continue for between 7 and 14 days.

   If the area where the seizures start is clear and it is far away from brain areas involved with critical functions such as language, vision, or movement, the epileptologist and neurosurgeon will likely recommend removal of this area. If the area is likely to overlap with a critical function, we will probably recommend cortical mapping with the EEG grids in place (see below). Then, the team will compare the cortical mapping results with the area where the seizures start. If the area where the seizures start does not overlap with an area responsible for an important function, they will likely recommend surgery to remove the area where the seizures start. If the area where the seizures start overlaps with an area controlling an important function, the epilepsy surgery team may recommend removing a smaller area (to give some

chance of helping seizures with a smaller chance of causing problems with a critical function) or they may recommend against a resection.

Regardless of the recommendations for treatment of the epilepsy, a second surgery is required to remove the intracranial EEG grids. In most, but not all, cases we are able to recommend a specific surgical resection to treat the epilepsy, which is performed at the time the intracranial EEG grids are removed. Not all patients who are candidates for epilepsy surgery require intracranial EEG electrode monitoring.

10. **Cortical mapping**: The goal of cortical mapping is to understand the function of the areas of brain underneath intracranial EEG electrodes. This is done by passing a small electrical current ("stimulation") through pairs of electrodes to temporarily alter the function of the part of the brain immediately beneath them. For example, stimulating the area of the brain controlling hand movement will cause the hand to move. Stimulating the area controlling speech will disrupt speech. Thus, an epileptologist can determine the function of the brain underneath the electrodes by observing your child's behavior during the stimulation. In some cases, your child will need to perform a task while in others he/she will only have to lie still. Usually, the goal of cortical mapping is to identify areas which are needed for movement and/or language function in order to protect these areas during a surgical resection. The procedure will take place while your child is lying comfortably in bed.