RESECTIVE SURGERY FOR REFRACTORY EPILEPSY
MEMORIAL HERMANN TEXAS MEDICAL CENTER, HOUSTON, TEXAS
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NARRATOR: Approximately 25% of patients who suffer from epilepsy do not respond well to pharmacologic therapy. For many of these patients, surgery may offer a positive outcome. Today, neurosurgeons from Memorial Hermann Hospital and the Texas Medical Center in Houston will perform, live, a resective surgery for refractory epilepsy. This procedure targets a specific, localized part of the brain where the seizures are thought to originate. Half of the patients who have resective surgery remain completely seizure-free and 85% of all patients report a marked decrease in number of seizures and in severity. Todayís program is part of Memorial Hermann Hospitalís ongoing educational efforts to bring the latest information in healthcare to patients and physicians. During the program, you may send your questions to the OR surgeons at any time. Just click the MDirectAccess button on the screen.
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DENNIS VOLLMER MD: Good afternoon. Weíre here, live, at Memorial Hermann Hospital in Houston, Texas. Iím Dr. Dennis Vollmer. Iím Chairman of Neurosurgery at UT Medical School at Houston and Chief of Neurosurgery at Memorial Hermann Hospital. Iím here today to present a live webcast of resective neurosurgery for refractory epilepsy. Today Iím joined by Dr. Jeremy Slater, who is Director of the University of Texas Comprehensive Epilepsy Program and Director of the Epilepsy Monitoring Unit at Memorial Hermann Hospital.
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JEREMY SLATER MD: Good afternoon.
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DENNIS VOLLMER MD: Weíre also joined today by Dr. Nitin Tandon, who is carrying out a neurosurgical procedure for refractory epilepsy as we speak. We will be joining him momentarily. Let me point out that during the course of this webcast, we welcome those of you who are watching to submit email questions or commentary, which we will make some attempt to address during the next hour or so. Just to set the stage, let me just begin by asking Dr. Slater a few questions. First of all, Dr. Slater, could you give us a brief understanding of what weíre talking about when we speak of epilepsy? What is the disorder and how does it affect people?
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JEREMY SLATER MD: Certainly. First you start with the basic idea of what is a seizure. When I say the word seizure to you, the average person, you picture someone falling to the ground, their arms and limbs shaking. Theyíre unresponsive. But a seizure, to a physician, is also a very specific kind of event. You can think of it as a short circuit within the brain, where excessive numbers of brain cells are all firing at the same time, which is actually an abnormal situation. If the brain has been changed in such a way that it will now generate repeated seizures without anything else happening to it, that condition is called epilepsy.
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DENNIS VOLLMER MD: Thank you. Can you tell me a little bit about how big a problem this is nationally? What are the statistics regarding epilepsy in America?
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JEREMY SLATER MD: Itís actually the second most common neurologic disease, behind stroke. Itís about as common as diabetes, affecting approximately 1% of the population. Weíre talking about 3 million people within the United States.
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DENNIS VOLLMER MD: Thatís quite a few. How many of those people could be helped by surgeries like what weíre talking about today?

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JEREMY SLATER MD: Well, as with a lot of illnesses, the first treatment for patients with epilepsy is medication. Approximately 60-70% of those patients are going to respond to medical intervention, leaving 30% of them considered medically refractory, or patients who wonít respond to the routine medications. Of that 30%, perhaps half of those would potentially be candidates for surgery.
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DENNIS VOLLMER MD: So thatís still a large number in the United States.
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JEREMY SLATER MD: Thatís correct.
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DENNIS VOLLMER MD: Can you give us a number as to approximately how many surgeries are actually done on an annual basis?
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JEREMY SLATER MD: Even in the world as a whole, thereís about 5,000 surgeries that are performed and 3,000 within the United States. When you consider that 1 million patients, out of the 3 million, are considered refractory and somewhere between 1 and 1.5 million are potentially candidates for this surgery, there are a lot of patients who could potentially benefit from this intervention that so far we have not been able to reach.
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DENNIS VOLLMER MD: Epilepsy is a group of conditions, is it not? Arenít there many different types of epilepsy and different manifestations of this disorder?
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JEREMY SLATER MD: Certainly. The primary distinctions that we make are between focal and generalized epilepsy. Generalized epilepsies, you can think of this abnormal electrical activity or the short circuit affecting the entire brain at the same time. Focal epilepsies are thought to begin in one particular area of the brain. They may spread quite rapidly and produce the sort of convulsion that people are used to seeing, but the focal epilepsies are considered to be more likely amenable to resective surgery or surgery where youíre actually attempting to remove a specific part of the brain. The generalized epilepsies, we have other types of surgical interventions, but not actually attempting to remove a specific part of the brain.
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DENNIS VOLLMER MD: Letís set the stage for our viewers and talk a little bit about the patient that Dr. Tandon is operating on today. Obviously you had conducted a presurgical evaluation and found this patient to be a candidate. Could you tell us a little bit more about how this transpired?
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JEREMY SLATER MD: The woman who is undergoing the procedure today was initially seen in the outpatient epilepsy clinic. I believe sheís in her early 60s. She has had epilepsy since the age of 17. She has been tried on multiple medications. At least 7 different anticonvulsant medications have been tried. She also underwent an intervention with a device called a vagal nerve stimulator, which is actually a sort of brain pacemaker that acts through the vagus nerve to attempt to reduce her seizure frequency. This was also ineffective and it was subsequently removed. She has seizures quite frequently. These consist, in some instances, of generalized convulsions, but she also has sudden episodes where she loses consciousness, will fall to the ground, and frequently injures herself.
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DENNIS VOLLMER MD: Okay. So this is a major life-altering condition for her.
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JEREMY SLATER MD: That is correct.
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DENNIS VOLLMER MD: And therefore the risk for her thatís obviously involved in having a surgical procedure was an acceptable one, given the potential benefit.
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JEREMY SLATER MD: Thatís correct. The impact on the quality of life for an epilepsy patient where the seizures are not controlled cannot be overestimated. Besides the risk of personal injury, it affects their ability to drive. It

affects their ability to hold down employment. It affects all of their social and work relationships. The unpredictability of the seizures is probably the most frightening aspect.
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DENNIS VOLLMER MD: With that as a background, maybe itís a good time to introduce Dr. Nitin Tandon, who is currently conducting the surgery. Dr. Tandon, can you hear me?
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NITIN TANDON MD: Yes I can, Dr. Vollmer.
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DENNIS VOLLMER MD: Would you like to tell us where you are in this procedure?
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NITIN TANDON MD: Sure. Letís just orient our viewers here a little bit. This is the left side of this patientís head. The ear is down here and the top of the head is about here. The front of the head is here and the back of the head is toward this side of your screen. This is what we call the left temporal lobe. This vessel here is a vessel in the sylvian fissure. Itís what we call the sylvian vein. This is the lateral temporal lobe. You will see here that we have some little markers, little numbers there, and what those relate to is some of the areas where language was found, in her case, based on some noninvasive language mapping. The language mapping in her case was the MEG scan. As you can see here, we have a little device which is a frameless stereotactic navigation system which, if you look up at the screen there, shows you that there are these multiple white spots on her MRI scan that relate to the areas for language. This is where, at least according to this noninvasive study, her language was, which is not to say that this is necessarily as precise a measure as doing language mapping in an awake patient or doing language mapping with implanted electrodes, but given that this lady has a disease process that will allow us to target her temporal lobe, we feel fairly comfortable proceeding with the temporal dissection based on that information. Interestingly, this lady speaks two languages and both languages, English and Spanish, cluster tightly in this area, which is the superior temporal gyrus, which is where we would expect language to be.
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This little cut that we have made in the brain is in the lateral temporal lobe. This little cut is approximately 3.5 cm from the tip of the temporal lobe. We know, based on multiple anatomical as well as mapping studies, that most language lives about 4 cm behind the temporal tip, so this gives us reasonable security in saying that we could do this resection without affecting her language. So what weíve done so far is weíve separated the superior temporal gyrus away from this structure here, which is the pia overlying the sylvian fissure and the insula. I donít know if you can see this on your screen on the computer, but this is called the middle cerebellar artery, or branch of the middle cerebellar artery, which is one of the major arteries that supplies the temporal lobe. Also, this is a remnant of a portion of the superior temporal gyrus, which Iím aspirating right now. This superior temporal gyrus ends or is attached to what we call the inferior circular sulcus. All these fancy names in neuroanatomy keep the uninitiated at bay. As we keep aspirating this superior temporal gyrus, we end up in whatís called the inferior circular sulcus. That gives us one starting point for our removal of the temporal lobe. In addition, what weíve also done is weíve found the temporal horn, which is the ventricle in the temporal lobe, which is right about here, and thereís a little piece of material weíve used to mark it, which weíll just remove right now. That is the temporal horn. Right next to that is the hippocampus. So weíre going to proceed now and take out this lateral temporal near cortex, as we call it, near cortex as distinguished from the outer cortex, which forms the limbic structures, which are most responsible for the epilepsy. This gives us a gateway to removing the remaining abnormal structures in the brain.
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DENNIS VOLLMER MD: Dr. Tandon, you mentioned the term limbic structures. Do you want to just clarify what those structures do in a normal circumstance?
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NITIN TANDON MD: Sure. The word limbic, itís a Greek word, I believe, which means circular. There are multiple circular structures around the center of the brain which relate to memory function and also, in a pathological state, the production of epilepsy. What we are targeting right now is the hippocampus and the amygdala. There are other limbic structures, but those are the ones that are most responsible for the epilepsy problem. So thatís where we are headed now, to complete this disconnection so we can get out the hippocampus and the amygdala and that will complete our resection. The first step is this lateral resection, resection of temporal neocortex, after which we will proceed with our medial resection.

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DENNIS VOLLMER MD: Let me just ask Dr. Slater a question to follow up on your discussion of the limbic structures. If these structures are involved in such important functions as memory, how do we know that weíre going to be able to perform this surgery in this patient without causing a significant deficit?
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JEREMY SLATER MD: Thatís an excellent question. Itís absolutely crucial not only to identify the area of the brain that the seizures are coming from, but to make sure that when the resection is completed, the patient isnít going to lose any function. These are structures that are critically involved in memory and there are two ways right now that we approach this. One is utilizing a test called a Wada test, where we actually have a radiologist perform an arteriogram. We have them place a small catheter into the internal carotid artery on the side that weíre interested in and we inject a short-acting anesthetic so that half of the patientís brain goes to sleep temporarily. During that period of time, the patient is shown a series of objects. Then, after the medication wears off, we see if they can remember the objects so that, in effect, we can test the memory abilities of each half of the brain separately. Generally when the patient has the kind of pathology that this particular patient is suffering from, what we call mesial temporal sclerosis, those structures are not contributing very much to actual memory function, as was the case for this patient.
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DENNIS VOLLMER MD: I see. So, to paraphrase your explanation, essentially when you put the patientís left side of the brain to sleep, it didnít adversely affect her memory, so you knew from that that most of her memory function was actually on the right side, away from the surgery. Okay, Dr. Tandon, youíre now doingÖ?
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NITIN TANDON MD: What weíre doing right now is we keep covering things up, just to make sure we donít damage anything we donít need to take out, at this point anyway. We just made a cut. I donít know if you can see this again. This is the incision we made in what we call the lateral ventricular sulcus, which is a groove between the collateral eminence and the hippocampus in the floor of the lateral ventricle. This incision has taken us all the way down to the basal pia arachnoid of the temporal lobe, so if you imagine the temporal lobe to be a hemispherical structure, we have disconnected its posterior, its inferior, and its superior connections. Now weíre just joining the dots a little bit to allow the lateral temporal lobe to be removed.
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DENNIS VOLLMER MD: Iím showing a slide right now on the webcast that kind of shows the amount of temporal lobe that youíre removing in this patient, in orange on the picture of the brain, just so the viewers have some perspective of where youíre working. Dr. Slater, while Dr. Tandon is working here, can you tell us a little bit about the kinds of outcomes that people have when they have this sort of surgery for mesial temporal sclerosis, as in this case?
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JEREMY SLATER MD: Depending on the particular patient, the hemisphere, whether thereís involvement of the opposite side, published statistics indicate on average about a 60% or better rate of response to the surgery in terms of the patient becoming completely seizure-free. Thereís going to be some variation from one surgical center to the other because some surgical centers are going to be more conservative and only operate on those patients they consider absolutely ideal. As a result, theyíre going to see fewer patients. Some surgical centers are going to be a little bit more liberal in the types of patients that they might operate on and they are able to help many more patients, but their success rate isnít going to be as high, so youíre going to be published results that vary anywhere from 60% to as high as 80-90% in terms of seizure freedom.
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DENNIS VOLLMER MD: This might be a good time for us to address a couple of the emails that have been forwarded to us during the webcast. Dr. Slater, one of our webcast viewers has asked the question if your EEG shows epilepsy-like patterns in between seizures, does that rule you out as a candidate for surgery? In other words, thereís inter-ictal discharges, but an actual seizure has not been caught on the EEG.
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JEREMY SLATER MD: Itís an excellent question. The presence of inter-ictal discharges, or visible discharges in between seizures, is actually a good thing in terms of helping us with localization. When we are considering a patient for surgery, one of the first steps is to place them in the epilepsy monitoring unit for what we call a Phase I recording. The patient is brought into a special hospital room where they are under continuous video

surveillance and have an EEG that is also attached and running continuously. We reduce their medications to the point where ideally they have several seizures during their hospital stay and we can actually see what the seizures look like clinically and see the electrical activity so that even in patients where their EEG has not shown anything in between seizures, thereís still a possibility that theyíre going to be a good surgical candidate.
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DENNIS VOLLMER MD:
I put up on the monitor there some other aspects of the Phase I evaluation, some of which, again, were used in our patient today, the MEG scan and the MRI, as well as other means of localizing seizure onset. Do you want to talk a little big about the magnetoencephalography that we have here?
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JEREMY SLATER MD: Certainly. This is something thatís in some ways one of the prides of our institution. There are currently 8 magnetoencephalography centers across the country and Iím very proud to be able to work with our magnetoencephalography (MEG) lab because this is truly cutting edge technology. It involves using very sophisticated equipment to be able to track tiny, tiny changes in magnetic fields that are detectable over the surface of the brain. It reflects the electrical activity, but unlike routine EEG, which is affected by the skull and the scalp and the skin and the blood vessels, the magnetoencephalography essentially sees through all of this as though it was transparent and in some difficult to localize cases, it can detect activity we might not be able to see with a routine EEG. It can localize better than a routine EEG may be able to for certain types of epilepsies. Beyond this, it allows us to perform language localization, as was done in this case, and this is absolutely crucial if you want to avoid producing deficits in language or motor or sensory deficits after the surgery has been completed.
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DENNIS VOLLMER MD:
One more email question. Dr. Slater, can you please tell one of our viewers whether or not you can grow out of epilepsy. This individual states they havenít had a seizure in six years.
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JEREMY SLATER MD: Thatís excellent. There are certain types of epilepsies that are usually in the class of what we call idiopathic epilepsies, thought to be genetic in origin. Some of these epilepsies we, in fact, expect patients to grow out of. Other times, if the epilepsy can be controlled or the seizures can be controlled with medication for 4, 5, 6 years, the patient has had no seizures whatsoever, it is possible under those circumstances that the patient may be able to come off medication and not have the seizures return, so after 6 years, itís going to vary according to your physician and your treating epileptologist and the specifics of your condition, but it is at least a possibility that an EEG could be repeated and if it was normal, the medication, you might be able to discontinue it.
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DENNIS VOLLMER MD:
Thank you. Let me remind everyone, weíre live. Weíre watching live resective surgery, in this case a left temporal lobectomy for refractory seizures. Just to remind those of you again that we are accepting email queries and so forth that viewers might want to direct our way. The directions can be found on the website, clicking the MDirectAccess button. Dr. Tandon, letís go back to you and just update us as to where you stand right now.
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NITIN TANDON MD: Weíre almost done with removing the lateral temporal lobe. Weíre doing the neocortical resection and we are in the process, as I said, of joining our little cuts. I donít know again if you can see this well, but right now Iím looking in the middle cranial fossa floor, which is where our basal cuts and our anterior cuts join up, so we are very close, actually, to getting this lateral neocortex out of the way to allow us to proceed with the medial resection. One of the key things, I donít know if you can see this shiny material down here, is the dura of the middle cranial fossa floor. Itís important for us to actually stay away from the edge of the tentorium during this portion of the case. Of course, we will be closer to the edge in just a little while. This prevents us from injuring any of the small vessels and cranial nerves that run medial to the tentorium. This lateral disconnection is almost at its completion.
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DENNIS VOLLMER MD:

Great, and Iíve shown a slide, Dr. Tandon, showing the lateral resection schematically on a diagram. Now, let me direct you again to one of the emails. The question was emailed in, Dr. Slater, how often is this procedure done in the pediatric population and how young of a patient can be accepted for surgery if they qualify? Can you comment on that for us?
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JEREMY SLATER MD: The types of epilepsies that you see in the pediatric population can be substantially different from those in the adult population. Some of these epilepsies are amenable or will respond to a surgical intervention. In some cases, youíre not actually doing a resection, but you may be doing a surgery called a corpus callosotomy, where the thick fiber tracks that connect the two sides of the brain are partially separated in order to prevent the rapid spread of the abnormal electrical activity. There is no lower limit on age that Iím aware of. It really depends on how appropriate the patient is for surgery. For example, in this institution, going back in the last few years, anywhere from 50 to 100 epilepsy surgeries were done specifically on children, so it can be done as commonly as it is in adults.
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DENNIS VOLLMER MD: And t
The epilepsy monitoring unit here at Memorial Hermann does monitor both adults and children for their epilepsy.
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JEREMY SLATER MD: That is correct.
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DENNIS VOLLMER MD:
Okay. Hereís a little more specific question, actually from the UK. This is a patientís family. The patientís mother writes that her daughter is 18. She has Lenox-Gasteau syndrome, which was diagnosed as an infant, and she continues to have uncontrolled seizures. The person asks is there any beneficial surgery that is available?
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JEREMY SLATER MD: Lenox-Gasteau, as Iím sure these parents are already well aware, is an exceedingly difficult childhood epilepsy to control. It responds poorly to almost every medication. In some cases, if the patients are having as part of their presentation the kind of drop attacks I was talking about before, they might be candidates for corpus callosotomy. In some patients, though certainly not the majority, they may have the majority of their seizures being generated, or their worst clinical seizures being generated from a single area in the brain. Under those circumstances, they might potentially benefit from surgery. As an alternative, these patients are also potentially candidates for implantation of a vagal nerve stimulator, which, while it is not resective surgery and usually not curative, may have a significant beneficial effect and it doesnít matter where in the brain the seizures are coming from for that particular device.
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DENNIS VOLLMER MD:
Thank you for that. You can see, I think, on the monitor in the operating room that Dr. Tandon is continuing to work on the lateral resection. We will go back to that in just a minute. Let me just get through a couple more emails. Hereís a question that kind of relates to the surgery being done today. If your MRI shows scar tissue on the temporal lobe, how do you keep new scar tissue from forming after the surgery?
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JEREMY SLATER MD: This is actually something that Dr. Vollmer and Dr. Tandon can probably address in some ways better than I can, but the scarring that is produced by the actual surgical procedure is remarkably different from the scarring that is pre-existing that triggers the seizures in the first place. For one, not all areas of the brain are equally epileptogenic or capable of producing seizures. The surgery specifically is designed to reduce that seizure-generating area. At the same time, and this again is probably something that you can address better than I can, the technique for surgery is designed to minimize the chance of producing an epileptic scar by following the tissue planes.
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DENNIS VOLLMER MD: Correct and I thinkÖIíll put in my 2 cents as a surgeonÖI think also by minimizing the amount of blood clot along the resection and achieving a nice clean surgical incision in the cortex, youíre going to reduce the disruption to nearby tissue and therefore hopefully minimize recurrence of seizures.
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NITIN TANDON MD: Dr. Vollmer, weíre ready now to actually remove the temporal neocortex. Itís all been separated, so here it comes. Weíre going to hand this off as a separate specimen. I can put this under the camera here. Thatís what it looks like. Itís a little piece of temporal lobe that has been removed. As you can see here, we still have a little bit of work to do with removing some of what we call the parahippocampus and the parahippocampal gyrus. Just a little bit of hemostasis that we need to accomplish as well. With that out, we will soon move under the microscope and do the resection of the hippocampus and the amygdala under the microscope. You can see here, this is a good view to actually see. Here you can see the hippocampus right here. This is a little piece of material that weÖ
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DENNIS VOLLMER MD: Weíre seeing your fingers. Please make an adjustment.
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NITIN TANDON MD: Okay, let me use something different here. Hereís the lateral ventricle and hereís the hippocampus. Here is what we call the choroid plexus. Right next to the hippocampus here is this structure, the amygdala. Weíre going to take out the amygdala now and then the hippocampus and that will actually complete our resection. As I said earlier, this is sort of a finesse surgery. Weíre going to do this under the microscope so we can see better.

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DENNIS VOLLMER MD: Do you always do it under the microscope?
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NITIN TANDON MD: If weíre doing a very extensive lateral temporal resection, where the view is really nice, which is typically more on the right side, then we donít really necessarily have to use the microscope, but as you can tell, weíve taken out barely 3, maybe 3.5 cm of the lateral temporal lobe here. It gives us a small view, a good enough view to get the job done, but obviously this is her dominant side for language, so we canít expose things any further. It just gives us a better handle on things, using the microscope.
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DENNIS VOLLMER MD: Dr. Tandon, while youíre working there, Iím showing a slide of an MRI image of the brain in whatís called coronal section. Thereís a red line showing the lateral resection that youíve just done. I think the viewers can then see a slightly darker gray area toward the midline, slightly, that represents the hippocampus. Thatís the part that youíre about to start working on here under the microscope.
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NITIN TANDON MD: Right. What Iím doing right now is resecting some of the parahippocampal gyrus. Weíre going to do some of that first. It allows us to remove the hippocampus without retracting too much on it. Iíll just roll it out. Weíre going to start anteriorly and work our way backwards and separate the parahippocampal gyrus.
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DENNIS VOLLMER MD: Dr. Tandon, Iím going to ask you one of the email questions, if I may, while youíre working. A viewer emailed in to ask how vital is the posterior third of the hippocampus, as opposed to the anterior two-thirds?
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NITIN TANDON MD: Thatís a great question. People have tried to do studies to show the difference in resecting all of the hippocampus versus some of it because obviously you can only find that out if you leave some of the hippocampus behind, what function lives there and what doesnít. There is some evidence to say that if you can get away with not removing the entire hippocampus, you have a lower chance of having some of the memory difficulties that patients can have after a hippocampal operation, but on the flip side, there are also studies showing that there is a correlation, if you will, between the completeness of the hippocampal resection and the seizure-free rates, so itís a bit of decision-making thatís tailored to each patient. As you can see here, Iím holding up the pia. The pia is the innermost lining of the membranes that cover the brain. Weíre aspirating. This technique is typical for epilepsy surgery. Itís called the subpial technique. Weíre removing some of the parahippocampal gyrus that will allow us to remove the hippocampus with more ease in just a little while. Weíre actually going to switch for a couple of moments. Not much is going to happen here. Weíre going to go under the microscope.
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DENNIS VOLLMER MD: Thanks, Dr. Tandon. Weíll be back with you in a short while. Again, letís remind everyone, weíre live here at Memorial Hermann Hospital in Houston, Texas. Weíre part of a webcast to describe a temporal lobectomy procedure for refractory epilepsy. Iím here with Dr. Jeremy Slater, our chief epileptologist, who is here to answer some of your email questions, if you care to write in. Right now, while Dr. Tandon is getting ready to do the microsurgical part of the case, weíll take a couple more email questions for you. Dr. Slater, what kinds of deficits would you expect with the kind of surgery that weíre doing today? If one were to occur, I guess I should say.
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JEREMY SLATER MD: Obviously everyoneís hope is that after this type of surgery, there will be no deficits at all. A lot of this is related to how much scarring and how functional tissue is around the area of scarring that was producing the seizures in the first place. If there was extensive scarring and the temporal lobe in that area was essentially nonfunctional, it can frequently be resected and there are no new deficits produced at all. Sometimes, when a more aggressive resection is required, there can be an impact on part of the vision, what we refer to as the visual field, but itís usually in an area that the patients themselves donít notice and has very little impact on their ability to function. For example, they can still drive and read and do all of the normal things that they would expect to be able to do. When careful testing is done, sometimes subtle memory deficits or subtle attentional deficits can be discovered after surgery that the patient may well not be aware of. These are reflective of the fact that sometimes small amounts of healthy tissue are resected along with the scarring around it and unfortunately that is inevitably a possibility. One of the things that we make great efforts for is to try to provide the surgeon with as much information in advance as possible concerning localization of absolutely critical functions, such as language, and this case was a very nice example. With the magnetoencephalography performed, you could actually see the surface of the brain marked in such a wayÖas the slide here illustrates, the small triangles illustrate the areas where motor function was localized and language function was localized. When the surgeon has this information, it makes it a whole lot easier to simply say, okay, these are parts of the brain that weíre not going anywhere near and that reduces the chance of a complication.
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DENNIS VOLLMER MD: One of the viewers also asked about other mapping techniques. As you said, magnetoencephalography may not be available in many centers and in other cases it may not be an appropriate modality. Can you describe some other ways that you can map functional cortex preoperatively in these patients or perhaps intraoperatively?
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JEREMY SLATER MD: There are a wide variety of techniques available, some research, some relatively standard. Sort of a complement to magnetoencephalography is the idea of functional MRI. That, again, is a relatively new technique. Itís not available in every center and in many instances the applications are considered research, rather than a standard clinical operation. Probably the most direct approach that we have is to actually place electrodes along the surface of the brain itself. This is obviously done as part of a surgical procedure prior to a resection, like the one that weíre doing today. In that instance, with the electrodes in place, we can actually use them in addition to recording the electrical activity from the surface of the brain. We can pass small currents through pairs of electrodes and temporarily paralyze the brain underneath so that when we take an electrode pair and pass a current through it, if the patient at that point briefly loses the ability to speak or briefly loses the ability to understand language, we know thatís a vital language center. When we pass it through a motor area, we may see their face twitch or their hand twitch. If weíre doing this at the bedside, for example, if this is a chronically implanted electrode, so we have the patient up in the epilepsy monitoring unit at the time weíre doing it, theyíre awake and alert and they can answer questions. We may pass the current through and theyíll tell us they feel a sensation in a certain part of their body, which tells us that that part of the brain is critically involved in sensation.
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DENNIS VOLLMER MD: So just to further elaborate on that point, I put up a slide that shows a couple of photographs related to a very similar case of medial temporal sclerosis, in which there was some ambiguity about seizure onset because there were also some abnormalities of the lateral temporal lobe. This slide just illustrates

those cortical electrodes you were talking about. Correct me if Iím wrong, but this is something that can be done both intraoperatively, as well as extraoperatively in the monitoring unit.
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JEREMY SLATER MD: Thatís absolutely right. Depending on the particular case and whatís appropriate, the patient may have the electrodes, like youíre seeing there, implanted in one surgery and then everything is basically closed up. The patient then recovers and is brought to the epilepsy monitoring unit. To get more accurate localization, weíll do the same thing as we would do during a phase 1 recording, but rather than having the electrodes on the surface of the scalp, the same way we would do for a routine EEG, the electrodes, as you can see in the illustration, are now actually on the brain surface. This allows for very, very accurate localization of seizure onset. At the same time, once the seizures have been localized and we know where theyíre coming from, we can then go through the mapping that I was describing earlier.
00:39:27.000

DENNIS VOLLMER MD: Iím getting word that Dr. Tandon may be ready for us to rejoin him. Is that right, Nitin? Are you at a point in the operation where we can see under the scope?
00:39:36.000

NITIN TANDON MD: Yeah, weíre under the scope. Weíre just sort of getting situated. I really wish we had the luxury of a long time with our audience today so we could take them through the entire operation, but theyíre going to see a fair amount of it, I hope. Here is the lateral ventricle, which we showed earlier without the microscope. Here is this little bulge called the amygdala, right there, what Iím pointing to, and thatís the hippocampus. Weíre going to remove some more neocortical structures here, which is just a little remnant of the lateral temporal lobe, and then we will proceed with the medial resection in just a moment. Again, we use the same techniques we talked about, subpial aspiration. Weíll open the temporal horn some more. You can see how it has this little wall. The interesting thing is right here the amygdala and the hippocampus are joined. They have a little connection here, a little bridge, which we will come through in just a little while, right there, weíre coming through that little bridge. Weíre going to aspirate some more.
00:40:57.000

DENNIS VOLLMER MD: Just to, again, give the viewers a little bit of a sense of time here, theyíve been watching you work on and off for about 40 minutes. How long before the webcast did you actually get started with the earlier parts of the operation?
00:41:12.000

NITIN TANDON MD: I think we started probably an hour and a half before we went live, maybe an hour, somewhere in that time range.
00:41:23.000

DENNIS VOLLMER MD: And the typical length of this operation from start to finish, when the patient is ready to leave the operating room, is about how long?
00:41:32.000

NITIN TANDON MD: I would say itís about 4 hours, maybe 4Ω hours, somewhere in that range, because after we do our resection, we will also be doing some post-resection electrocorticography, or EEG, on the surface of the brain. That EEG is designed to give us an idea if there is any remnant epileptiform activity. Here you can see thereís a little piece of Telfa strip there, which is protecting the choroid plexus. You can see that pink thing there. Thatís the choroid plexus. We want to stay below the choroid plexus. This is below the hippocampus, which we will start working on removing in just a moment. So weíll just remove some more parahippocampal gyrus. I donít know if you all can see this okay.
00:42:34.000

DENNIS VOLLMER MD: The focus could be a little tighter.

00:42:34.000

NITIN TANDON MD: One second. Iím going to move the camera. Letís take out a little more hippocampus. Now we are getting closer toward the edge of the tentorium and actually a little bit into the ambien cistern, which is where the parahippocampal gyrus becomes the uncus. Thereís a whole bunch of Latin names to this as well, the prosubiculum and the subiculum, which is also what we are aspirating, trying to leave the pia, or the membrane, intact because it gives us a barrier of protection against all of the structures that we want to save.
00:43:46.000

DENNIS VOLLMER MD: The structures that are just on the other side of that pial membrane are what, Dr. Tandon?
00:43:52.000

NITIN TANDON MD: We will see them, hopefully, in just a little bit here. We have the posterior cerebellar artery, the third nerve. We will hopefully see all of them in just a little while. Then the perimesencephalic vein. All of these are important structures that supply the brain stem and come out of the brain stem. The third nerve goes to the eye and helps with eye movement. The posterior cerebellar artery supplies a large amount of the brain stem and some of the occipital lobe. In addition, there are a whole bunch of little arteries and little branches called perforating branches, one of which actually has a name. Itís called the anterior choroidal artery, which sends a whole bunch of little blood supply to the structures in the ambient cistern, including the brain stem and the cranial nerves. We want to save all of those structures. Part of the reasonÖyou asked earlier, Dr. Vollmer, do you absolutely have to use the microscope? Part of the reason, quite honestly, is to be able to see those vessels better. Weíre going to take a little cottonoid now and just protect our little pial that weíve saved so it doesnít keep moving. As you see, as I try to aspirate the parahippocampus here, it wants to come up into my sucker. Itís a very fragile and thin membrane and itís important, if we can, to try to preserve it, to prevent yourself from looking at all of the little structures that we talked about too closely. If you donít see them too closely, they usually are doing alright. You want to see them well enough to know that you got the job done, but you donít want to see them really up close.
00:45:39.000

DENNIS VOLLMER MD: Let me take a break here and just remind the viewers that weíre watching a live surgical webcast of a temporal lobectomy. Weíre here at Memorial Hermann Hospital in Houston, Texas, and we are available to receive your email questions regarding the surgery. We would be happy to answer them. I have Dr. Jeremy Slater here, the chief epileptologist at Memorial Hermann, and Dr. Nitin Tandon, epilepsy surgeon, who is carrying out the surgery.
00:46:08.000
NITIN TANDON MD: Now we have a little retractor thatís retracting the hippocampus laterally. You can really get a nice view into the lateral ventricle. Iím going to remove this little cotton pledget. You can see now the amygdala, which is this structure, and you can see the choroid plexus. Now, the choroidal fissure, which is where the choroid plexus lives, is a good landmark for us to know how much amygdala to take. The amygdala, which is this structure here, is involved in the epilepsy process in most of these patients. Some epileptologists have very strong opinions that the amygdala absolutely needs to be removed. Weíre going to enter the amygdala now. Can you all see okay, Dr. Vollmer? Let me adjust the microscope.
00:47:54.000
DENNIS VOLLMER MD: Very nice. I can see you using your suction to remove a portion of the amygdala there.
00:47:58.000
NITIN TANDON MD: Yes. Weíre just making a little trough in the amygdala. The amygdala is part of the basal ganglia structures of the brain, so you can see these little vessels in the amygdala. I donít know if you can see these on your microscope. Theyíre like tiny little vessels, which is typical for the basal ganglia. They bleed just a little bit. They donít bleed too much, but they give us a proof positive feeling that we are in the amygdala. This little bit of neocortex that we left behind, weíll take it out at the same time, so itíll all come out together.
00:48:34.000

DENNIS VOLLMER MD: Iím going to go to another emailed in question for Dr. Slater and Dr. Tandon, both, I think. Do you always resect the hippocampus and the amygdala during a temporal lobectomy?
00:48:50.000
NITIN TANDON MD: No, we donít always. Really, the reasons we donít depend on what the patient has or what problems the patient has. This is an operation for medial temporal lobe sclerosis and medial temporal lobe epilepsy without hippocampal sclerosis, so either we have to prove the fact that the patient has scarring on the hippocampus, or what we call hippocampal sclerosis, or we have to prove that they have seizures coming from the hippocampus. Now, that second thing is always done in the context of a phase 2 evaluation or an invasive evaluation. Once again, see these little vessels, these tiny little vessels that are coming under my sucker, the typical vessels of the amygdala. We never take out the entire amygdala. We take out about 2/3 of the amygdala and maybe about 80% in some cases. It depends on the structure of the amygdala. As we keep going, weíll come down to the medial field boundary. So the answer is not always. In fact, many times, as Iíll show you or have already pointed out to our audience, we donít even take out the temporal lobe. Weíre taking out other parts of the brain. The other situation of the same sort, where we donít take out the mesial structures, is if someone has a tumor or a vascular malformation of the temporal lobe. I donít know if Dr. Slater wants to add anything more to that.
00:50:13.000
JEREMY SLATER MD: No. I think you covered that pretty well.
00:50:19.000
DENNIS VOLLMER MD: Maybe I can ask Dr. Slater to comment a little bit on surgical resections in other parts of the brain. Obviously temporal lobectomy and medial temporal sclerosis are very common scenarios for the epilepsy surgery programs. Are there other sites that seem to be commonly epileptogenic that require surgery?
00:50:44.000
JEREMY SLATER MD: Well, the mesial temporal sclerosis in the adult population is the single most common cause for refractory epilepsy. If we have the appearance of a tumor or scarring from a prior stroke or closed head injury, particularly if itís evident on an imaging study, that has the potential to be extremely epileptogenic and that can occur virtually anywhere. It could occur within the frontal lobe and probably most commonly the frontal lobe after the temporal lobe, simply because the frontal lobes cover a relatively large area of the brain. Theyíre positioned in such a way that theyíre fairly susceptible to the occurrence of closed head injuries, but any of the lobes can be involved. You can have a parietal lobe focus. You can have an occipital lobe focus. How readily you can perform surgery in a case like that is going to be heavily dependent on how close the onset of the seizures are to a place that is vitally important. For example, if you have an occipital lobe focus, is it located so close to the patientís primary visual areas that you know that if youíre going to do a resection there that might actually be successful, youíre going to have some negative impact on their ability to see. So itís certainly possible. We do resections in other areas. Itís a much more complicated process in terms of the prior workup. It involves a lot more additional evidence in terms of ancillary testing, the magnetoencephalography, positron emission tomography, single photon emission computerized tomography, or PET and SPECT, as theyíre called.
00:52:38.000
DENNIS VOLLMER MD: Hereís another question that came in on the email. What kinds of personality changes can be expected, especially when thereís resection of the amygdala and hippocampus?
00:52:48.000
JEREMY SLATER MD: Thereís approximately an 8% incidence of postoperative depression, but thatís a broad figure and a broad statement. Iíll explain why. Chronic epilepsy, medically refractory epilepsy, or epilepsy thatís not responding to medication, carries with it a fairly significant incidence of depression. It may be as high as 20% or more. If you think about it for a minute, itís not hard to see why. If you have poorly controlled seizures and itís having all of the negative impacts on quality of life that we previously described, that can lead to a condition of depression. The structures in the brain that are affected by the seizures can produce some depression. At the same time, for some patients, for a small number of these patients, the seizures themselves are actingÖIím sure many in the viewing audience have heard of electroconvulsive therapy or ECT or electroshock therapyÖfor some patients, the seizures themselves are acting as sort of a miniature form of ECT and having an actual antidepressant effect so that when the seizures are removed and eliminated by the surgery, the depression that may have been there the entire time may recur or worsen. It gets even more complicated than that. Patients, once the epilepsy has been removed, have to go back to their day to day lives and many aspects of their lives

that had been limited due to the presence of the epilepsy donít automatically disappear and improve. Their work situation, their social situation, their family situation isnít automatically cured at the same time that the epilepsy is.
00:54:34.000
DENNIS VOLLMER MD: So itís obviously a complicated process of recovering from longstanding epilepsy. Itís not just an operation to solve the patientís problems, in some cases.
00:54:42.000
NITIN TANDON MD: Hereís our amygdala specimen. Itís a pretty small specimen, about 1 cubic cc or so in volume, which is typically what it is. As you can see now, you can see some of the medial pia. Thereís still a little bit of material left there. The surgery really depends a little bit on an intangible, which is what the pia of each patient is like. As you get older, the pia tends to be a little bit, as you can imagine, a little bit not quite as firm as youíd like it, in some cases, and also more scarring and adhesions. In some patients, like this one, that had multiple falls, there tends to be a lot of scars. Now you can actually see, thereís the edge of the tentorium. Again, I donít know how well you can see this at your homes or wherever youíre watching us, but here is the ambien cistern and we shall soon see, hopefully, some of the structures in the ambien cistern.
00:55:50.000
DENNIS VOLLMER MD: The ambien cistern is a fluid-filled space that surrounds the brain stem.
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NITIN TANDON MD: This now is the beginning of the uncus. The uncus is the part of the medial structure, the parahippocampal gyrus, that is right adjacent to the brain stem, so this is one window into this region. Now weíre going to actually work on the hippocampus itself and take out the hippocampus.
00:56:17.000
DENNIS VOLLMER MD: Iím showing a slide on the screen that shows in yellow the area that youíre currently working on, Dr. Tandon. It involves the hippocampus and medial structures. I think the viewers can look at that and see that this yellow area is right adjacent to the brain stem, just as Dr. Tandon is showing us under the microscope.
00:56:37.000
NITIN TANDON MD: Weíre just adjusting the microscope now to get a better angle of the hippocampus itself. Weíll start working on the hippocampus in just a moment.
00:56:47.000
DENNIS VOLLMER MD: So now youíre about to begin removing the hippocampus. Is this then where this patientís epilepsy is thought to arise from, primarily?
00:56:59.000
NITIN TANDON MD: Yes. This patient hasÖwell, Dr. Slater can maybe answer that.
00:57:05.000
JEREMY SLATER MD: This patient has a condition called mesial temporal sclerosis, which is actually scarring of the structures within the hippocampus. Frequently these patients will have a history in childhood of seizures associated with high fevers, though that in and of itself doesnít mean that youíre going to develop epilepsy. What are called febrile seizures are probably the single most common epilepsy syndrome and are generally benign and donít recur, but if you only look at the group of patients who have refractory epilepsy when they become adults, a significant number of them actually have that history of febrile seizures. Whether this is the cause of the eventual scarring in the hippocampus or whether this is an effect, that the hippocampus is already ready to become scarred because of some genetic predisposition and the seizures occurring during fevers are simply a reflection of this has never been clearly demonstrated, but it is the heart of the generation of the seizure activity. In those patients where electrodes are actually placed within the hippocampus itself during a preoperative recording, we can very neatly see the seizures begin within that structure before spreading to the rest of the temporal lobe.
00:58:28.000
DENNIS VOLLMER MD: Okay. Again, weíre looking now as Dr. Tandon carries out the hippocampectomy. I wanted to just, again, touch on some of the outcomes. I put up a slide to kind of reiterate some of those numbers weíve covered earlier in the webcast. Basically when the diagnostic work that you do, Dr. Slater, is correct and the seizures are localized to these structures, the outcomes can actually be quite good, with relatively low complications. Is that correct?

00:59:03.000
JEREMY SLATER MD: Thatís correct. As you can see on the slide, 60-70% of these patients become seizure-free, which is the ideal outcome, but even in those patients who donít become seizure-free, another 20-25% have a marked reduction in their seizure frequency and this can produce a very large improvement in their quality of life. Only 5-10% are seeing essentially minimal or no improvement.
00:59:29.000
DENNIS VOLLMER MD: Iíd like to take a little time, if we can, while Dr. Tandon is working hereÖ
00:59:33.000
NITIN TANDON MD: One second, Dr. Vollmer, if I can show our audience, this is what we call the choroidal point. I donít know if you can see this. Let me just focus. This is the choroidal point. You can see that little bluish point. Thatís where the anterior choroidal artery enters the ventricle and then supplies this little pinkish structure, which is the choroid plexus, so weíre going to start our work right here because this is a good point to find what we call the hippocampal sulcus, which is the structure where the hippocampus gets its blood supply from.
01:00:23.000
DENNIS VOLLMER MD: Iím going to take a second to answer one question that was just emailed in. A viewer asked if the patient is awake. By way of background, we certainly have done and continue to do a number of awake surgeries for epilepsy here at Memorial Hermann Hospital, but in this particular case, the preoperative evaluation and the surgical decision-making dictated that this patientís surgery could be done with her asleep because of the ability to localize some of the important cortical functions, such as speech, with the magnetoencephalography. Dr. Slater, any more comments on why the decision was to do this particular patient asleep?
01:01:09.000
JEREMY SLATER MD: Well, as youíre alluding to, if weíre doing the patient awake, it is usually a fairly specific reason. While the brain itself does not have sensory nerve endings, so the patient doesnít actually feel anything when youíre working inside, as you can imagine, itís fairly anxiety-provoking to be in that situation and itís much easier to keep control of blood pressure, blood supply, everything that the surgeon needs in order to have an uncomplicated surgery when the patient is under general anesthesia. The anesthesia itself is also, to some degree, neuroprotective, so if we have a situation where we canít get an accurate localization with preoperative monitoring of any kind, if the magnetoencephalography is insufficient and the patient is not a good candidate for placement of long-term implanted electrodes, then the patient can be done awake and we can do live language mapping or live motor mapping and we do that not uncommonly, but in this instance, as you said, the magnetoencephalography provided very nice language localization. In fact, for both of the patientís primary languages, English and Spanish, it provided a nice, tightly well-defined area that we demarcated on the MEG pictures that were shown previously. That provides a nice Do Not Approach sign for the surgeon, if you will.
01:02:47.000
NITIN TANDON MD: Iíd also like to take a moment here, if I may, to introduce our viewers to our OR team who are helping us today. It does take a team. Iím Dr. Tandon. This is Cindy Richardson, my PA, right here. Over there is John Hogan, who is our scrub tech. Across the blue curtain there, smiling, as always, you can see the twinkle in her eyes, is Dr. Hagberg, wearing her pink cap and mask. This is the second to none circulator right behind me, David Sawitana, who really keeps us going and gets our supplies, everything ship-shape before we ever have to ask for it. So, having said that, let me take out viewers back to where weíre working. Weíre separating the hippocampus now from its blood supply, which is really the last thing that remains here. The hippocampus is going to be separated from the amygdala. Thereís a little bit of amygdala there that we probably still need to take out, more superior. The hippocampus does start to get a little bit bruised by the end of the day here and thatís okay. Itís coming out and going into a bucket. So that is one of the hippocampal veins. I just aspirated some of the white matter on top of that. That is the fimbria of the hippocampus, which then leads to formation of the fornix. Iím going to keep aspirating that, and a little bit of coagulation to facilitate its removal, right here. Now you can see this very nicely. This is the hippocampal hilus. This is the sulcus that leads into the blood supply of the hippocampus. This is really the key to the whole operation, this fanning our structure of the blood vessels, which we will follow out on both sides. Really, we want to try and take these blood vessels as close to the hippocampus as possible, as close to the hilus of the hippocampus and as far away from the beginning of the hippocampus sulcus as possible. We will join this cut here with our cuts from here. That will allow us to completely disconnect the hippocampus from the parahippocampal gyrus and then we will come across all of

these little vessels that supply the hippocampus and take the hippocampus out. I hope we have time to show the viewers everything, but I donít know if we do. If we donít, you know, maybe we can save it some other way and they can look at it later.
01:05:47.000
DENNIS VOLLMER MD: While youíre working there, Dr. Tandon, Iím going to address a couple more email questions. I think I can direct this one to Dr. Slater. Dr. Slater, are there specific symptoms that suggest the presence of medial temporal sclerosis, as opposed to other pathological substrates for epilepsy?
01:06:05.000
JEREMY SLATER MD: There are. We use the term seizure semiology to describe the clinical appearance of the seizure. In some instances, patients will describe an aura or the warning that they get before what they consider the seizure actually occurs. Patients with mesial temporal sclerosis donít always have these auras, but quite frequently they may occur. They may have the feeling of a rising sensation or abnormal sensation in their abdomen that rises up in their chest. The seizures themselves are frequently a period of impaired consciousness, what we call a complex partial seizure, that may be accompanied by some abnormal hand movements, picking at their clothes, staring off into space, appearing confused. That will stand in distinction from seizures that are coming from, say, the occipital lobe, where they may have an abnormal visual manifestation, or seizures coming from the parietal lobe, where they may have some odd sensation. The pattern suggests the possibility of mesial temporal sclerosis, along with the history, like I mentioned before, the presence of febrile seizures as a history, but the real answer for us comes with the imaging study because mesial temporal sclerosis is something which, fortunately, frequently will be detectable with a routine magnetic resonance imaging, or MRI, of the brain and the appearance of epileptiform discharges over specifically that area of the brain with the EEG.
01:07:50.000
NITIN TANDON MD: Here is some of the ambien cistern. You can see the pia right over where the brain stem would be. Weíre just aspirating the last little bits of amygdala here and some of the anterior parahippocampal gyrus. We can see in her case that the pia is pretty adherent to the brain, which makes this process a little more tedious and time consuming. Weíre going to move backward again toward the hippocampal sulcus and start dissecting out these blood vessels now and separating them off from the hippocampus.
01:08:24.000
DENNIS VOLLMER MD: Iím going to go back to another email query. This is an excellent question. Weíve touched on it a little bit, but I think we can clear it up a little more. What is the risk of aphasia after this procedure? I think the viewer is really asking the question because we are on the dominant temporal lobe and we know that most people have some speech representation in their left temporal lobe. What is the risk of aphasia with this kind of surgery and how can the risk be reduced?
01:08:53.000
JEREMY SLATER MD: I think as far as the specific surgical risk, I will follow up on that. I will allow Dr. Tandon to address it initially.
01:09:03.000
NITIN TANDON MD: You can have aphasia from two sorts of situations. One is a postoperative hemorrhage, bleeding, or stroke. That can produce that, which is rare, but it can happen. The second scenario is when, due to either retraction or getting too close to some of the language sites, we have a problem with having affected some of these language areas. Now, in the second case, if itís just a retraction-induced speech dysfunction, that usually gets better. The time taken for that recovery really depends on how close you were and how much of that structure was actually damaged or removed. In some cases, actually, we are compelled to get very close to language sites and we have had patients with transient language difficulties, but those almost always by 4-6 weeks after surgery are improved and significantly better.
01:10:03.000
DENNIS VOLLMER MD: Can I follow on with another email directed to both of you? A viewer writes, what is the expected recovery time after this surgery? We can talk about this as weíre winding down here. At what point will normal cognitive function return?
01:10:20.000
NITIN TANDON MD: Patients are cognitively normal right after the surgery. They may be a little sedated from the anesthetic and they may be a little bit affected by discomfort from the surgery itself, but they usually are pretty

well right afterward. In our program, we usually tell patients to wait about 6 weeks before they get back to work or their usual activities. Thatís usually our recovery period for most of our epilepsy operations.
01:10:59.000
JEREMY SLATER MD: I can comment on that a little further. When we do postoperative detailed neuropsychological testing, and this has been done in other centers besides ours as well, you can continue to see some improvements, even going out 6 months after the surgery. Now, these are relatively subtle and not something that the patient or the family members are going to notice, but you can see gradual improvements. If there were even very subtle deficits, problems with language function after the surgery, you can see progressive improvements for quite some time after surgery.
01:11:36.000
DENNIS VOLLMER MD: This is a related question. Can you tell simply from the way the procedure went what the prognosis will be for the patient after the surgery. Is there any way to tell from what weíre seeing right now?
01:11:53.000
JEREMY SLATER MD: Unfortunately not. I mean, we can see that a very nice and well-explained resection is going on and the structures that we believe are responsible for the patientís epilepsy are clearly being removed and the parts of the brain that we want to avoid are being spared, but we canít tell simply from looking at the surgery the chances that itís going to be successful. Now, once the resection has been completed, there will be some post-resection corticography, or monitoring of the remaining brain surfaces, to look for evidence of epileptic discharges.
01:12:35.000
DENNIS VOLLMER MD: Youíre going in, as a matter of fact, after the webcast to help Dr. Tandon with that phase of surgery, is that right? Youíre going to do the electrocorticography to evaluate that in a few minutes?
01:12:47.000
JEREMY SLATER MD: Thatís correct. In some instances, if we find residual epileptic discharges and it is in an area of tissue that we feel can be safely removed, there might be a slightly more extended resection than is originally done.
01:13:04.000
DENNIS VOLLMER MD: Another viewer asked, to paraphrase the question, will they be able to observe the closure of the operation? Unfortunately, due to the constraints of time on the webcast, weíre looking at what really is a 4+ hour operation, in many cases, so we donít actually have time today to watch the closing portion of the operation, but the person who emailed in commented that his wife had a similar operation on the other side and was doing well and was actually, I think, curious to see how the closure went. Dr. Tandon, back to you.
01:13:45.000
NITIN TANDON MD: Weíve mobilized a lot of the hippocampus. We still have some of the vessels to take care of. Weíve actually oriented our microscope now to look back into the hippocampus to do the next step on this, which is to cut the tail of the hippocampus. We can either do that after the vessels have been separated or before, but Iím just sort of doing it now because itís another step for our viewers to watch. As you can see here, the hippocampus is all free in its anterior portion here. Thereís a couple of arachnoid and pial bands which relate to the hippocampal sulcus that are still holding it in place.
01:14:39.000
DENNIS VOLLMER MD: Again, to remind people watching, this is a live surgical webcast showing a left temporal lobectomy for refractory epilepsy, coming from Memorial Hermann Hospital here in the Texas Medical Center. Weíre watching Dr. Nitin Tandon, the surgical member of the Texas Comprehensive Epilepsy Program, carry out the surgery. Dr. Slater, while Dr. Tandon is working here on the back part of the hippocampus, I put up a slide sort of summarizing some aspects of the comprehensive epilepsy program here at UT and Memorial Hermann. Would you like to just tell our viewers a little bit about that as we wind down our webcast?
01:15:28.000
JEREMY SLATER MD: The Comprehensive Epilepsy Program is obviously made up of many different team members. Youíve met several of them today. Dr. Nitin Tandon is obviously a critically important member as the subspecialty trained epilepsy surgeon. Myself, as the epileptologist. There are nurses within the epilepsy monitoring unit. The technicians who supervise the placement of the electrodes and the monitoring of the seizure activity, and many other subspecialties that also participate in the evaluation of the epilepsy patients. Neuroradiology is absolutely crucial and we rely on their assistance for performing and interpreting the magnetic

resonance imaging studies. The magnetoencephalography group, under the leadership of Dr. Andrew Papaniculou, is crucial. Nuclear medicine, with the performance of PET and SPECT studies, looking at the blood supply to the brain, which in the area of the seizure focus is frequently altered in these patients, plus all of the administrative staff, secretarial staff. We get a great deal of assistance from the neurology residents, epilepsy fellows, neurophysiology fellows. It is absolutely a group effort.
01:16:54.000
DENNIS VOLLMER MD: What youíre really telling me is that what weíre seeing today is kind of the culmination of a large project, if you will, a number of people working to benefit individual patients with epilepsy and get to this stage, where we can do something hopefully definitive in this patientís case to relieve her of her seizure disorder.
01:17:18.000
JEREMY SLATER MD: Thatís absolutely correct. For all of the patients who are referred into the epilepsy program, for example, the patient who presents with a new diagnosis of seizures, at least half the time that patient will respond to the first medication thatís tried and will become seizure-free on that medication alone. We go through several trials of medications. We have experimental protocols, both with existing medications and medications that are being newly developed. We are active in the implantation of the vagal nerve stimulator. This is a pacemaker-like device for the control of epilepsy, in addition to doing the surgical resections, and there is always ongoing research, both related to the diagnosis and the therapy for epilepsy. One of the really nice parts about this program is the fact that all of these things are taking place at the same time.
01:18:11.000
DENNIS VOLLMER MD: I notice, looking at the feed from the OR, Dr. Tandon is about to use an ultrasonic aspirator to facilitate the posterior resection. Nitin, do you want to comment?
01:18:23.000

NITIN TANDON MD: Yeah, this is a CUSA, or Cavitron ultrasonic aspirator. Iím not sure if itís on. Okay, itís just going through its steps with completely being on. Itís going to irrigate the field a little bit, which always helps us, keeps things nice and noise. What it does is allows us to deliver a nicely focused field of ultrasonic wave that helps disrupt the tissue that we can then remove and aspirate.
01:18:56.000

DENNIS VOLLMER MD: What weíre seeing here, then, is the latter part of the hippocampectomy here as we go on to the final stages of the resective part of the epilepsy procedure.
01:19:16.000

NITIN TANDON MD: Correct. Again, the reason we havenít used this tool yet is because there is a significant amount of force that it exerts and it can aspirate pia, so it depends on the patient. If the patient has a very nice pial boundary, we can use the CUSA even more than we have so far today, but in her case, I think so far the regular suction and bipolars have worked well. Here we are cutting the body of the hippocampus from its tail. There you can see the back end of the hippocampal sulcus.
01:20:43.000

DENNIS VOLLMER MD: Again, weíre watching Dr. Nitin Tandon perform resection of a hippocampal structure as part of a left temporal lobectomy for medically refractory epilepsy here in Houston, TX. Dr. Slater, just a couple of more questions for you. In patients who undergo this kind of surgery for the most part, could you just reiterate, I know we talked about it earlier, but the kind of complications that we generally are concerned about in weighing surgery of this nature. Can you just briefly again remind our viewers?
01:21:34.000

JEREMY SLATER MD: Well, we have to be concerned about the possible complications that are associated with any surgery with general anesthesia, the possibility of bleeding or stroke at the time that youíre operating on a tissue as delicate as the brain. With the resection of brain tissue, everything is done to try to delineate the areas that are actually producing the seizures and to identify as clearly as possible those parts of the brain that are responsible for language function, motor function, sensory function. The closer we get to those areas, what we call eloquent cortex or cortex that is clearly being used for critical functions, the greater the possibility that there

may be some postoperative complication that involves impairment of language. Obviously in the case of those rare instances where there is some type of complication, such as hemorrhage or stroke, there can be deficits that are produced that are related to that particular complication. As with any surgical procedure, thereís always the possibility of infection, but everything is done thatís possible to minimize that. For the most part, the patients do quite well. With the swelling of brain tissue, the effects of retraction, there may be some temporary deficits. The patients may emerge from surgery, may have some word-finding difficulties or sometimes the visual field problems and deficits that I talked about before that even within 1-2 days begin to get better. Generally by 6 weeks out, most of these things have completely disappeared.
01:23:15.000

NITIN TANDON MD: Now weíre going to come across the hippocampal sulcus at the level of the hilus of the hippocampus. Weíve cut off most of the tail of the hippocampus. We feel fairly comfortable that whatever weíre seeing here now are just vessels supplying the hippocampus and the parahippocampal structures. As you can see, thereís this nice wide view of the hippocampal sulcus.
01:23:39.000

DENNIS VOLLMER MD: Just to clarify, youíre using a bipolar cautery.
01:23:44.000

NITIN TANDON MD: Yes. The instrument thatís moving right now is a bipolar forceps and this is a sucker. Cindyís holding this little retractor, just to give us a better view of things.
01:24:33.000
DENNIS VOLLMER MD: Again, weíre looking at live surgery. This is a left temporal lobectomy. Weíre watching Dr. Nitin Tandon remove the hippocampus, which is a medial structure in the temporal lobe. This is associated with epilepsy in this patient and Dr. Tandon right now is just dividing the last small vessels along the hippocampal hilus to complete the resection here, again, as we wind down on the resective part of this surgery. In the foreground of the picture, you can see in the lower left corner, that is the cortex of the temporal lobe behind the resection.
01:25:29.000
NITIN TANDON MD: Here is the hippocampus. As you can see, itís freed posteriorly and itís only attached a little bit medially. Weíre going to keep working on that as long as it takes.
01:25:49.000
DENNIS VOLLMER MD: This is under a microscope, for those of you who just joined us, so itís under fairly high magnification. Again, you can see the cortex in the left side of the image. Some of the very small vessels on the brain cortex are just in the field of view there. This is a temporal lobectomy. If you make reference to the slide also displayed on the screen, Dr. Tandon is currently working on the part of the brain marked yellow, which is the hippocampus. He has previously resected a portion of the anterior temporal lobe, which would correlate with the orange area on the slide.
01:26:26.000
NITIN TANDON MD: Now, having gone through the hippocampal sulcus there, weíre just removing the remnants of the parahippocampal gyrus that are really the most medial portions of this. Theyíre not connected to anything else, but we donít like seeing them there, so weíre just going to aspirate them out. There you go. Now you can actually see the pia arachnoid over the ambien cistern.
01:26:50.000
JEREMY SLATER MD: Iíve got a question for you, Dr. Tandon. This isnít something thatís really transmitted by the camera, but is there a typical consistency to the structures that youíre taking out and does that tell you anything about the state of the hippocampus?
01:27:07.000
NITIN TANDON MD: Thatís a great question. Iím glad you asked. This hippocampus does seem a little scarred, a little firmer. We do, of course, have a lot of hippocampi in situations where, in the context of the phase 2 evaluation, for example, where the hippocampus does not have scarring, where the hippocampus is softer. That brings up a technical note as well. A hippocampus thatís former is usually a little bit easier to remove because itís easier to handle. A hippocampus that does not have the scarring and is a little bit harder, just from a purely

technical standpoint, it can be, but not always, but a smaller, shriveled up hippocampus tends to be the one that comes out the easiest.
01:27:50.000
DENNIS VOLLMER MD: Dr. Tandon, let me ask another follow-up question. Obviously youíre taking great pains to remove the hippocampus in more or less an en bloc fashion. Certainly it would have been possible to simply aspirate it piecemeal, but youíre choosing in this case to remove it more or less in a single large piece. Can you explain why that is?
01:28:16.000
NITIN TANDON MD: Sure. Let me move the microscope, so we can keep working as we talk. The hippocampus can be removed in a subpial manner by just aspirating it. Now weíre going to tilt back and look at the back end of the hippocampus. We donít like doing that for two reasons. The first is, as I said, one of the key things in this operation is to protect the little vessels that run in the ambien cistern. To delineate those vessels, you really have to delineate the hippocampal sulcus well. By the time youíve done that, the hippocampus is essentially capable of being removed en bloc. The second thing is the pathologists need to look at this tissue. They need to look at it because of two reasons. First, it corroborates the MRI diagnosis and the diagnosis that led to us to get to this point of trying to take out this structure. The second thing that it does is it rules out the possibility that something else was going on in the patient, like a low grade tumor or something else of the sort, which is less of a concern in this day and age because we have much better imaging techniques than people had about 20 years ago. So now you see, this is the last remaining vessel in the hilus of the hippocampus. Iím going to come across this and join it with the tail. Let me focus for you.
01:30:19.000
DENNIS VOLLMER MD: While you were talking, I decided to throw up a slide showing some MRIs, just of some various imaging abnormalities, just to kind of expand on what you were saying. Certainly with todayís imaging, as this slide exemplifies, we can see a number of different things and identify them for what they are on an MRI, although obviously a pathologist can confirm the diagnosis for us, which not only helps this particular patient, but helps us in understanding the disease process so we can treat other patients more effectively as well. Again, weíre seeing removal of the mesial hippocampal structures. Dr. Tandon is using a bipolar to cauterize small vessels entering the hippocampus and then he can use microsurgical scissors to divide them to aid in the removal of this very critical structure.
01:31:24.000
NITIN TANDON MD: Most of the hippocampus is now separate. Thereís a little bit of parahippocampus thatís left here that weíre going to aspirate out. This is the hippocampal specimen thatís now coming out of the field. Iíll get a green towel and the lateral temporal lobe specimen. I donít know if we can focus in on this. Here are our surgical specimens. This is what we send off to the pathologists. Here is the amygdala, so here are our three surgical specimens so far, which will really be the end of our resection. We will now remove any remaining portions of the hippocampus and parahippocampus that are still in there that havenít been removed en bloc. We will do that in a subpial fashion and you can watch that as we do it.
01:33:03.000
DENNIS VOLLMER MD: I think weíre going to wrap up here, Nitin, and weíll move along. Youíve been watching a live surgical webcast of a left temporal lobectomy done for refractory epilepsy by Dr. Nitin Tandon of the Department of Neurosurgery at the University of Texas Medial School, Houston. Weíve been talking today with Dr. Jeremy Slater, who is the Director of the Texas Comprehensive Epilepsy Program here at Memorial Hermann Hospital as well. I have one last email question that Iíd like to address before we leave you and then I would also want to remind you, before we sign off today, that this webcast will be archived. You can access the archived webcast using the same web address that you used to view todayís live study. We will have a forum available. Youíll be able to follow that through the appropriate links and access that, so you can submit questions that may come up in the future. We will maintain a forum and we will see that those questions are answered by one of the folks that youíve been watching today. One last question, though, before we sign off today. A viewer writes in a very good question. After the surgery, can you just stop taking your antiepileptic medications, Dr. Slater?
01:34:30.000
JEREMY SLATER MD: The answer to that in most centers and with most surgeries is generally no. We will usually continue the patient on the antiepileptic medications they were taking prior to surgery for at least a year and try not to make any changes. During the postoperative period, thereís a lot of healing thatís going on, a lot of tissue

swelling thatís going away, and structures essentially forgettingÖthe remaining brain that may have partially learned how to have seizures is, if you will, forgetting how to do so, now that the heart of the seizure generation has been removed. After a year, depending on the patientís particular circumstances and the particular case, we may consider discontinuing medication. Frequently if the patient has been on multiple medications prior to surgery, after a year weíll try to get them down to a single medication. If the postoperative EEGs are normal and the patient has been seizure-free for that period of time and we discontinue medication, approximately 60% of the patients will remain seizure-free off of medication. The good news is that even if seizures recur, the majority of the patients, over 90%, will come immediately back under control once the medications have been reinstituted.
01:35:50.000
DENNIS VOLLMER MD: Thank you very much, Dr. Slater. I want to thank you for your participation in todayís live webcast.
01:35:56.000
NITIN TANDON MD: Dr. Vollmer, right before we go here, just so the people watching this can see, we have the entire hippocampus out. Now you can see these pulsating vessels, which are right on the other side of the pia. This is what really the microscope is used to protect, all of these little vessels in the ambien cistern in the vicinity of the brain stem. Weíre going to take out a little bit more remaining tissue here, so we wrap around the back of the brain stem, which is where the hippocampal tail ends and becomes the fornix, and a little bit here around the ambien cistern more anteriorly and thatís really it, so weíre pretty much done with our resection. Thank you for being with us.
01:36:55.000
DENNIS VOLLMER MD: Thank you, Dr. Tandon. Again, youíve been watching live neurosurgery here at Memorial Hermann Hospital. Iím Dr. Dennis Vollmer and I hope youíve enjoyed watching this as much as I have. Weíve been joined, again, by Dr. Slater. Thank you for your time. Thanks certainly to the OR staff that helped make this webcast possible. Again, as I said a few moments ago, this broadcast will be archived, so those of you who came in partway through can access it through the same web address as you are currently watching it at the moment and catch the beginning. Again, thank you very much for joining us today in our webcast.
01:37:35.000
NARRATOR: Thank you for watching the live resective surgery for refractory epilepsy from Memorial Hermann Hospital at the gateway to the Texas Medical Center in Houston, Texas. For more information, to make an appointment or make a referral, please click the buttons below.