THE BRAIN BRIEFING
Podcast

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Credits:

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Maria Perrone:

Welcome to the Brain Briefing, brief conversations with neurology experts with information for everyday people. With us today is Dr. Matt Luedke, a neurologist who specializes in the care of seizures and hospital patients. And today, he'll be explaining seizure basics.

It can be hard to understand what doctors mean when they say someone has had a seizure. What does a seizure mean and how can a patient begin to understand it?

Dr. Matt Luedke:

I think it's interesting when you hear the word seizure, there's an implication to the term, and that is that there's a loss of control, control has been taken away from you, it has been seized from you. This comes from a historical understanding that maybe a spirit or something like that took away control from you. But it still bears out in the modern era that seizures imply a loss of conscious control of something happening with your body. And the big question is, why? And when we talk about electrical seizures or epileptic seizures, that's because the normal electrical rhythms of your brain, the normal patterns of electrical firing of the nerves in your brain have been hijacked by a power surge.

There are a number of different analogies you could use to describe this, but the one I like is thinking of your brain as a computer. Admittedly, a wet and soggy computer, but a computer nonetheless. And just like the computer that you have plugged into the charger in your house, if there's a power surge, it can get knocked down. So say you have a computer at your home and the plug is plugged directly into the wall outlet and your house gets struck by lightning, there's going to be a surge of electricity that overwhelms the normal function of that computer and puts it on the fritz and it will shut off. And hopefully you can reboot it and comes back online.

Our brains are different. Again, they're soggier, they're wetter, but also, unlike a computer, our brain doesn't depend on external electrical sources. It generates its own internal electrical rhythms. And if there's a dysfunction in the brain that causes those rhythms to be unopposed in the ON direction, they become overwhelmingly high voltage and high frequency that can drive your brain to shut off or parts of your brain to shut off or become overactive. And that's essentially what a seizure is. It's a power surge in your brain.

The how of it can get interesting and can get complicated, but that's what we're trying to address when we're treating seizures, we're trying to treat that overwhelming burst of excessive electrical activity in your brain to tamp it down so that it falls back into its normal rhythms and functions.

Maria Perrone:

And what causes a seizure?

Dr. Matt Luedke:

So, your brain is a series of regions that are networked tightly together. You can think of an office that has a bunch of computers and each workstation has its site data and information that it's dealing with. And then you have a hub in the network, and it connects that information and passes it from one station to another. Your brain has similar structures. It has regions that work independently over the other, but they get tied together in these networks.

And, depending on which area of the brain you're in, there are various systems that have “on” and “off” activity. You can think of it a little bit like a gas pedal and the brake pedal in a car. There are certain structures that tell a region of your brain to have more activity – to push on the gas pedal, and there are structures that tell your brain to have less activity – to push on the brake pedal. Fundamentally, the seizure is an imbalance between the gas pedal and the brake pedal. Too much gas, too little brake. So it's an unopposed “on” activity. And that can happen for innumerable reasons.

And that's why, in some sense, it's a little bit silly to talk of something like epilepsy as a single entity. There are almost as many reasons to have seizures as there are people. Anything that causes that imbalance in the “on” and “off” activity of the region of a brain or the whole brain will cause a seizure disorder. That can happen because you've had an injury to your brain, let's say an accident, and the “off” structures become disconnected from the “on” structures. And so, all of a sudden a portion of your brain just has gas pedal in the brake pedal goes away. It could happen because there are things that occur between neurons that just make the gas pedal go, and go, and go and sort of stick. And unfortunately, no matter how much brake pedal there is, it will overwhelm it.

It can happen because you maybe take a medicine that causes you to have it at normal levels too much brake, and so, your brain decides, I don't need to use the brake anymore, it's coming from outside of me. And then those medications go away and your brain doesn't remember how to use the brake pedal until it's too late.

So there are a variety of things that can cause these seizures, but they all, again, fundamentally go back to that imbalance of on, on, on, and not enough off, off, off.

Maria Perrone:

Okay, so we've talked about what a seizure is and what some of the causes are. So in that framework then, what would we say – what is epilepsy?

Dr. Matt Luedke:

The definition of epilepsy, broadly speaking, is either a single seizure with risk factors in your brain that would indicate that you have a really high risk of having more seizures, or someone who's had two or more seizures, not within a 24-hour period, but spread out beyond 24 hours would also be diagnosed with having epilepsy. And that's just because the recurrent seizures demonstrate a high risk of having more.

Or there are things called epileptic syndromes. These are our characteristic patterns of seizures and sometimes other neurological findings that fit in a pre-specified syndrome that we know to be epileptic too. So those are really the three definitions. A single seizure, again, with a high risk of recurrence, recurrence seizures, or a specific pattern that we call an epileptic syndrome.

That's all fine and dandy, but fundamentally, when we're saying someone has epilepsy, is we're saying that because of the way their brain is structured, whether it's born that way or whether it was acquired during lifetime from an injury or something like that, that their brain is vulnerable to too much gas and too little brake, to use the previous metaphor, to have too much electrical activity with not enough opposition to that electrical activity. And that just makes you vulnerable to more seizures.

There's a concept that sometimes we talk about called the seizure threshold. I think it's a useful term. It's not something we can measure – there's no seizure threshold number. You can't look at someone and say, you have a seizure threshold of seven, but it's a concept, and that is there's a level of stress that your brain can undergo. And if it goes above that level, then you're going to have a seizure. If it goes below that level, you're not going to have a seizure. And even the most neurotypical of brains, the most resistant to seizures of brains, if you stress them out enough with disease or sleep deprivation or chemicals or injury, will eventually cross that threshold. That's that threshold where the excess activity overwhelms the braking mechanisms of the brain and you have that burst of electrical activity that takes the system down.

Fundamentally, epilepsy is, for whatever reason, something that happens to a person when their seizure threshold is low enough for day-to-day life, to push them beyond that threshold, to push them beyond that imaginary line that if you cross it, a seizure will happen. And again, that varies from person to person, from cause to cause, but that fundamentally is what epilepsy is. It's a vulnerability to seizures such that day-to-day life can bring them on. And what we do is we treat it with medications and other tools, but in the end, the goal with medications and those other tools is to either remove the source if it's a surgery or modulate the brain or modulate the chemicals in the brain to increase your brain's braking activity or decrease its excitability. More brake, less gas.

Maria Perrone:

And are there ways that you can break down seizures into different types? Are there ways that we can make it a little bit easier to understand the different kinds of seizures?

Dr. Matt Luedke:

Yeah, there are a few ways of breaking it down. And how we've discussed these has changed over the course of history. There's a series of terms that are no longer en vogue in medicine but are still used to this day, the terms grand mal and petit mal. And they describe big convulsive seizures, grand mal or petit mal steering seizures. Those terms are no longer used one because they're a little silly. Grand mal is from French and it basically means “big bad”. And I would have trouble looking at a patient with a straight face and saying, “Ma’am, you just had a big bad”, I think that would be a little silly, or “you just had a little bad”. That would also be silly.

But also, there's a value judgment in implicit in those old terminologies. Why is one a “big bad” and one a “little bad”. A little bad seizure, a staring seizure where you briefly lose awareness of the world around you can be very impairing. It can keep you from driving, it can make it hard to focus in school, it can make it hard to keep down a job. So that's not a “little bad” thing in the context of your life. And if you've had one “big bad” in your life and you've had many “little bads”, which is worse for you? I think the value judgment implicit in that is a little silly. So I don't use those, most neurologists don't use those anymore, but those are still kicking around in the community, and to some degree in the medical field.

The next set of terms, which are essentially in a different guise still used today, are the idea of a partial or a generalized seizure. Now we use the term focal or generalized onset seizure. And what those imply is that a seizure either starts focal, in a spot in your brain on one side or the other that you could point

to essentially, and it may or may not spread out from there. Or generalized onset, meaning it starts on both sides of your brain through a very distributed network. And again, going back to an analogy we used, if you had a computer network at work, a focal seizure could be a seizure that starts in one computer in that network and may go from that computer to the network hub and then spread throughout all the other networks on the system, or it may just stay in that one computer. Generalized seizure starts in the hub and very rapidly goes everywhere all at once and hits all the other computers in the network. And that's the modern conception of it.

These are useful because, one, it helps define how we treat people. We have a broader selection of choices of medications for focal seizures than we do for generalized seizures. And a lot of our surgical tools are more geared towards focal seizures than generalized seizures. So there are some treatment implications and some workup implications of that. It's also important to note that focal seizures can happen because there is a structural problem that may be an issue in itself. Seizures, in the end, are a problem, but they're also a symptom of a brain dysfunction. It's a signal that something's going on in your brain. And a focal seizure may be due to an old stroke, it may be due to an injury, it may be due to a region of your brain that didn't develop appropriately when you were in your womb. It also may be related to an acquired problem like a tumor or something like that.

And so, when a doctor identifies a person who's had a focal seizure, we tend to look for where the focus might be and what might be causing it. And so, we do things like get MRIs to see if we can find a problem that's causing it. Oftentimes, more often than not, we don't find anything. And in the end, that's a good thing. You don't want to find a spot that's a problem if you can control it otherwise with medications. But sometimes finding that spot can be useful if the medicines aren't helping, and then you can potentially do something like surgery on a patient to help out.

Generalized seizures are a little bit, again, harder to understand because, how does something start everywhere at once? And again, I think the easiest way to think about it is think about that network hub being involved with the seizure and it's not that it starts everywhere, but it spreads out so rapidly throughout the whole network, it might as well already have been on both sides at once. Again, we have some great medications for that, a little bit fewer than we do for focal seizures. And now in the 21st century, we have some tools even surgically to deal with generalized seizure disorders that we didn't used to have. And it's an exciting time to be able to care for patients with medically resistant generalized epilepsies. But again, the causes of generalized epilepsies tend to be very different than focal epilepsies, and that's going to lead to different patterns of workup by your providers.

Maria Perrone:

If people want to learn more about seizures either for themselves or if they've had a loved one who's had a seizure, what might you suggest?

Dr. Matt Luedke:

I always encourage people to start with their physician. It's important to have a good working relationship with your doctor. In the end, I think of the doctor-patient relationship as the relationship on a football team between the coach and the quarterback. The coach has a lot of experience and understands the mechanics of the game, but the quarterback's the person on the field. And in the end, you have to have a good working relationship if you're going to win games and if you're going to move the ball down the field. Sometimes the players sees something on the field though that the coach doesn't see and they have to call an audible. They have to make a change on the fly. But then, after the

play, they let the coach know what was going on and why they made that decision so that the coach can adapt. So having that good working relationship between a physician and a patient is critical.

So if you have questions and you have a doctor who you trust, go to that doctor, ask, have that back and forth that a good coach and a good quarterback has. Outside of a physician, there are some great resources. The Epilepsy Foundation website has a lot of information, often geared more towards providers, but there's a lot of good information there. And using those society-based routes online I think can be really good tools. Community groups can also be very useful, and it certainly can provide an environment where you can share experiences.

There's an old saying in medicine, anecdote is not the plural data, but anecdotes are still important. Individual life and experiences are still important. And being able to share that in a community can be very uplifting.

And then, finally, if you or a loved one has seizures and they've had their seizures cared for and maybe they've tried a couple of medications and haven't gotten any traction, or they just have questions that aren't getting answered – there are comprehensive epilepsy centers scattered throughout the country where you have experts who focus their medical careers on treating people with seizures and epilepsy. And those become great resources to go to. Again, they're dotted all over the place. There are a bunch of centers scattered across the country, probably one close to you. And if you feel you need more questions answered than you're getting or you're not making progress in the care of your seizure disorders, comprehensive epilepsy centers are a great place to look for. The NAEC, the National Association of Epilepsy Centers is a great resource and a comprehensive epilepsy center is a level three or a level four facility. If you can look that up, that's a great place to find one near you.

Maria Perrone:

Thanks to Dr. Luedke for talking to us today. Thanks to our audio engineer Stephanie Perez. And thanks to you for listening to this episode of The Brain Briefing. You can find more info about the Duke Comprehensive Epilepsy Center at https://neurology.duke.edu/DCEC.