Doctors use robotic assistant to detect source of girl's seizures

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David Hahne tosses daughter Gracin in the air. As an infant, Gracin began having seizures. She has been seizure-free since undergoing special procedures at Packard Children's Hospital. Credit: Courtesy of the Hahne family

Gracin Hahne was 3½ months old when she had her first seizure. "I was changing her diaper," said Heidi Hahne, Gracin's mom. "I also noticed something else: There were light patches, like abnormal pigmentations, on her skin."

Gracin's seizures were caused by benign tumors, called tubers, that develop in the brain as part of a condition called tuberous sclerosis complex. (In TSC, tubers also commonly form in the skin and other organs.) Seizures and the "ash-leaf" spots on Gracin's skin are some of the many symptoms TSC patients may have to varying degrees. Gracin was started on anti-seizure medication right away, which stopped her infantile spasms.

As Gracin grew, her medications were adjusted to continue preventing seizures; but by the time she turned 3, her seizures could no longer be controlled.

An overnight electroencephalogram study detected the frequency of the young girl's seizures and found she was experiencing nearly 30 while she slept. During the daytime, Gracin's seizures would cause her speech to regress so badly that her parents couldn't understand her at all.

Heidi and her husband, David, learned about two doctors at Lucile Packard Children's Hospital Stanford who might be able to help: Brenda Porter, MD, associate professor of neurology at the Stanford School of Medicine and a specialist in TSC; and Gerald Grant, MD, associate professor of neurosurgery. They also learned that Packard Children's was the only hospital in Northern California using an innovative technology called ROSA, short for Robotized Stereotactic Assistant, to help children suffering from prolific seizure disorders.

Computerized assistance

Guided by a surgeon, ROSA allows precise, minimally invasive movement and placement of tiny electrodes in the brain during surgery. The machine could help doctors detect seizures deep in Gracin's brain without having to open her skull or even shave her head, as other traditional methods require.

This technology is part of the Pediatric Center for Brain Engineering at Packard Children's, where multiple specialty groups are collaborating to focus on brain disorders and developing personalized treatments for those disorders.

In December 2016, Grant used ROSA to guide 13 electrodes through tiny openings deep into Gracin's brain, setting up a stereo electroencephalogram. "Each electrode has contacts along its entire length, so you can get a sampling going into the gray matter of the brain, then into the deep white matter, then into the tuber straight through and then out of the tuber," Grant said.

"With the surface EEG, we saw some seizures," Porter said. "But then, when we put the electrodes in, we saw hundreds." The majority of Gracin's seizures were coming from her left temporal lobe, where the brain normally stores language.

"Through the stereo EEG we were able to determine that seizure activity was not in her language center but adjacent to it," Porter said. This gave the team hope that they could remove the tubers without worsening—and possibly even improving—Gracin's language capability.

The road to recovery

In January 2017, Grant and his team successfully removed the tubers in her brain.

The Hahnes were advised by doctors that Gracin's recovery would take time. With a resection in the brain's left hemisphere, part of the procedure to remove the tubers, she might not be able to move the right side of her body, walk or talk for at least a few days.

But Gracin had recovery plans of her own. "After not seeing her for eight hours, we turn the corner, and there she is flailing and moving her arms and legs," said Heidi Hahne. "She sees us and says, 'Mommy, Daddy, I want juice!' Not only was she okay, but she was speaking in complete sentences and using all of her body parts. We started crying—and gave her juice!"

Gracin still needs continuous care for other aspects of her TSC, including monitoring and treating tubers in other parts of her body, and her neurologist will watch for any new seizure activity as she grows. But today, 4-year-old Gracin loves singing, reading books and chatting with her 1-year-old brother, Lucas. "We're celebrating each of these moments," said Heidi Hahne. "That's our goal."

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