Can the Nervous System Be Hacked?

Mirela Mustacevic, who suffers from rheumatoid arthritis, had a nerve stimulator implanted as part of a medical trial. Her symptoms have lessened significantly.

SARAH WONG FOR THE NEW YORK TIMES

By MICHAEL BEHAR
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One morning in May 1998, Kevin Tracey converted a room in his lab at the Feinstein Institute for Medical Research in Manhasset, N.Y., into a makeshift operating theater and then prepped his patient — a rat — for surgery. A neurosurgeon, and also Feinstein Institute's president, Tracey had spent more than a decade searching for a link between nerves and the immune system. His work led him to hypothesize that stimulating the vagus nerve with electricity would alleviate harmful inflammation. "The vagus nerve is behind the artery where you feel your pulse," he told me recently, pressing his right index finger to his neck.

The vagus nerve and its branches conduct nerve impulses — called action potentials — to every major organ. But communication between nerves and the immune system was considered impossible, according to the scientific consensus in 1998. Textbooks from the era taught, he said, "that the immune system was just cells floating around.

Nerves don’t float anywhere. Nerves are fixed in tissues.” It would have been “inconceivable,” he added, to propose that nerves were directly interacting with immune cells.

Nonetheless, Tracey was certain that an interface existed, and that his rat would prove it. After anesthetizing the animal, Tracey cut an incision in its neck, using a surgical microscope to find his way around his patient’s anatomy. With a hand-held nerve stimulator, he delivered several one-second electrical pulses to the rat’s exposed vagus nerve. He stitched the cut closed and gave the rat a bacterial toxin known to promote the production of tumor necrosis factor, or T.N.F., a protein that triggers inflammation in animals, including humans.

“We let it sleep for an hour, then took blood tests,” he said. The bacterial toxin should have triggered rampant inflammation, but instead the production of tumor necrosis factor was blocked by 75 percent. “For me, it was a life-changing moment,” Tracey said. What he had demonstrated was that the nervous system was like a computer terminal through which you could deliver commands to stop a problem, like acute inflammation, before it starts, or repair a body after it gets sick. “All the information is coming and going as electrical signals,” Tracey said. For months, he’d been arguing with his staff, whose members considered this rat project of his harebrained. “Half of them were in the hallway betting against me,” Tracey said.