First responders haunted by 9/11 terrorism for 20 years to be treated with minute doses of electricity

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Credit: Nesos

Twenty years after the 9/11 terror attacks on the United States, survivors still suffer from posttraumatic stress disorder—PTSD—a condition that New York researchers will attempt to control through bioelectronic medicine, delivered as imperceptible pulses of electricity from "ear

buds" in patients' ears.

While the treatment may seem like science fiction, PTSD is one of several human disorders that a cadre of elite medical investigators believes can be treated via the emerging discipline of bioelectronic medicine. The 20th century introduced a vast array of pharmaceutical interventions for an imponderable number of medical disorders. The 21st century, these scientists say, could very well be the biolectronic era in which patients are treated with imperceptibly tiny pulses of electricity.

Researchers at the Feinstein Institutes for Medical Research in Manhasset, New York, are embarking on a clinical trial that will test an in-the-ear device that emits doses of electricity to banish symptoms of PTSD. The small trial will recruit 35 volunteers, all of whom were first responders following the World Trade Center attack in New York City on September 11, 2001.

On that day, members of the militant Islamic terrorist group known as al-Qaeda, hijacked U.S. commercial airliners and struck multiple targets. Hijackers flew two planes, 17 minutes apart, into the 110-story twin towers, causing each massive building to collapse. The terrorists also flew a hijacked plane into the Pentagon in Washington, D.C., and yet another terrorist-commandeered plane crashed into a field in Shanksville, Pennsylvania.

Death and severe injuries were seared into the memories of survivors. While the 9/11 attacks are events in history for most of the world, for many survivors, it's a day of mass casualties still vividly relived. Feinstein scientists hope to break new ground with a bioelectronic strategy that addresses patients' PTSD by directing tiny doses of electricity to a key nerve that emanates in the brain.

"PTSD is a psychiatric disorder that may occur in people who have

experienced or witnessed a traumatic event, such as a terrorist attack, war, natural disaster, sexual violence, or who have been threatened with death, violence or serious injury," said Dr. Rebecca Schwartz, an associate professor of occupational medicine, epidemiology and prevention. She is investigating PTSD and bioelectronic medicine at the Feinstein.

"Symptoms of PTSD may include having intense, disturbing thoughts or feelings related to their traumatic experience that continue long after the trauma has ended," added Schwartz, who is also a clinical research psychologist.

She said there are several treatments for PTSD that "have been empirically validated as effective therapies." These include several psychiatric medications and various forms of psychotherapy. Among them: cognitive processing therapy; prolonged exposure therapy, and eye movement desensitization reprocessing. In the latter, patients focus on a negative thought, memory or image as the therapist simultaneously asks the patient to make specific eye movements.

But researchers at the Feinstein are attempting to address PTSD in a different way, and are launching a randomized controlled trial of a bioelectronic treatment designed specifically for PTSD in World Trade Center first responders. The clinical study is supported by a two-year, $700,000 grant from the National Institutes of Health and Centers for Disease Control and Prevention. If successful—and scientists involved in the project have high hopes that it will be—the treatment will mark the first use of tiny pulses of electricity to treat PTSD.

Bioelectronic medicine is an emerging treatment strategy pioneered at the Feinstein Institutes for Medical Research, but studied by a growing number of investigators worldwide. Feinstein scientists theorize that infinitesimal pulses of electricity can be used to correct a vast number of

medical disorders, especially conditions that have inflammation at their core. Clinical studies conducted in Europe in recent years have shown, for example, that bioelectronic medicine can successfully treat rheumatoid arthritis and Crohn's disease. A study at the Feinstein a few years ago treated lupus—an autoimmune condition characterized by inflammation—using a bioelectronic protocol.

In each of those studies, whether conducted at home or abroad, doctors relied on minute doses of electrical stimuli to mitigate debilitating symptoms. All of the disorders were treated by stimulating the vagus nerve, which will be the target in the PTSD research, as well.

Dr. Kevin Tracey, president and chief executive of the Feinstein Institutes, and a global pioneer in bioelectronic medicine, theorized more than two decades ago that using bioelectronic medicine to stimulate the vagus nerve could help control a wide spectrum of human maladies.

The form of bioelectronic medicine designed to address PTSD among World Trade Center first responders is known as transcutaneous auricular vagus nerve stimulation (taVNS). This non-invasive therapy targets the vagus nerve through devices that fit in each ear.

"The vagus nerve is one of the major cranial nerves and connects the brain to the majority of our peripheral organs," explained Schwartz, who will collaborate with the staff at the Northwell Health Queens World Trade Center Health Program in Queens, N.Y., to conduct the PTSD research.

"Bioelectronic medicine and specifically vagus nerve stimulation—VNS—can potentially benefit treatment of psychiatric disorders, partly due to its projections [the vagus nerve] to brain areas that have been linked to the psychosomatic origins of anxiety," Schwartz said. "Brain areas such as the amygdala and hippocampus that have been

reported to be involved in the hardwired fear and stress response, are also anatomically connected to the vagus nerve."

Dr. Theodoros Zanos, an assistant professor in the Institute of Bioelectronic Medicine at the Feinstein, is an expert in the evolving class of devices that treat human medical conditions in an innovative way.

Going into the research Zanos said the aim was to focus the auricle, the outer part of the ear. "Specific parts of the auricle are innervated by the vagus nerve, providing a route to interact with it in a non-invasive way," Zanos said.

The system that will allow the world's first investigation of treating PTSD with extraordinarily low pulses of electricity was designed by Nesos Corporation, which started working on versions of the system in 2018, Zanos told Medical Xpress.

"The device has two "ear buds" that are personalized—molded—to fit both ears of the user optimally, much like custom ear monitors used by musicians. These ear buds are connected to a stimulator that provides the current to stimulate the auricle at a specific location.

"The patients will operate the device through a phone remotely connected to the device and they will turn the device on and off using the phone," Zanos said. "The amplitude—or level—of stimulation is also personalized to each patient, chosen to be right below what we call the sensory threshold, meaning enough electricity so that the user doesn't feel anything.

"This has been chosen in order to optimize the amount of electricity delivered to the auricle, while maintaining proper "blinding" of the participants, meaning each participant doesn't know if they are part of the treatment or control group," Zanos said.

Participants in the research won't be able to change the dosage of electricity being delivered, he added, but they will be able to turn the system on and off.

Schwartz noted: "They will have the device at home and will be instructed to use it twice a day for 15 minutes each time," she said of each stimulation in which electrical pulses will be delivered to the vagus nerve.

Scientists see this method of addressing psychiatric conditions as having great promise. Vagus nerve stimulation could potentially benefit psychiatric disorders by "downregulating activity in brain regions related to stress responses and hyperarousal," Schwartz said.

In addition, certain brain regions also play a major role in inflammation, both in the brain and periphery, mainly due to their direct and indirect connections to the vagus nerve. "Inflammation both in the body and brain have been shown to evoke neural responses in the vagus nerve, and are believed to elicit neural changes leading to various psychological difficulties, such as depression and anxiety, in addition to inflammatory diseases of the body as well as neurodegenerative disease.

"Finally, various studies have established a relationship between PTSD and systemic inflammation, suggesting that PTSD is underpinned by the presence of a systemic low-grade inflammatory state," Schwartz said.

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