Study uncovers how electromagnetic fields can amplify pain

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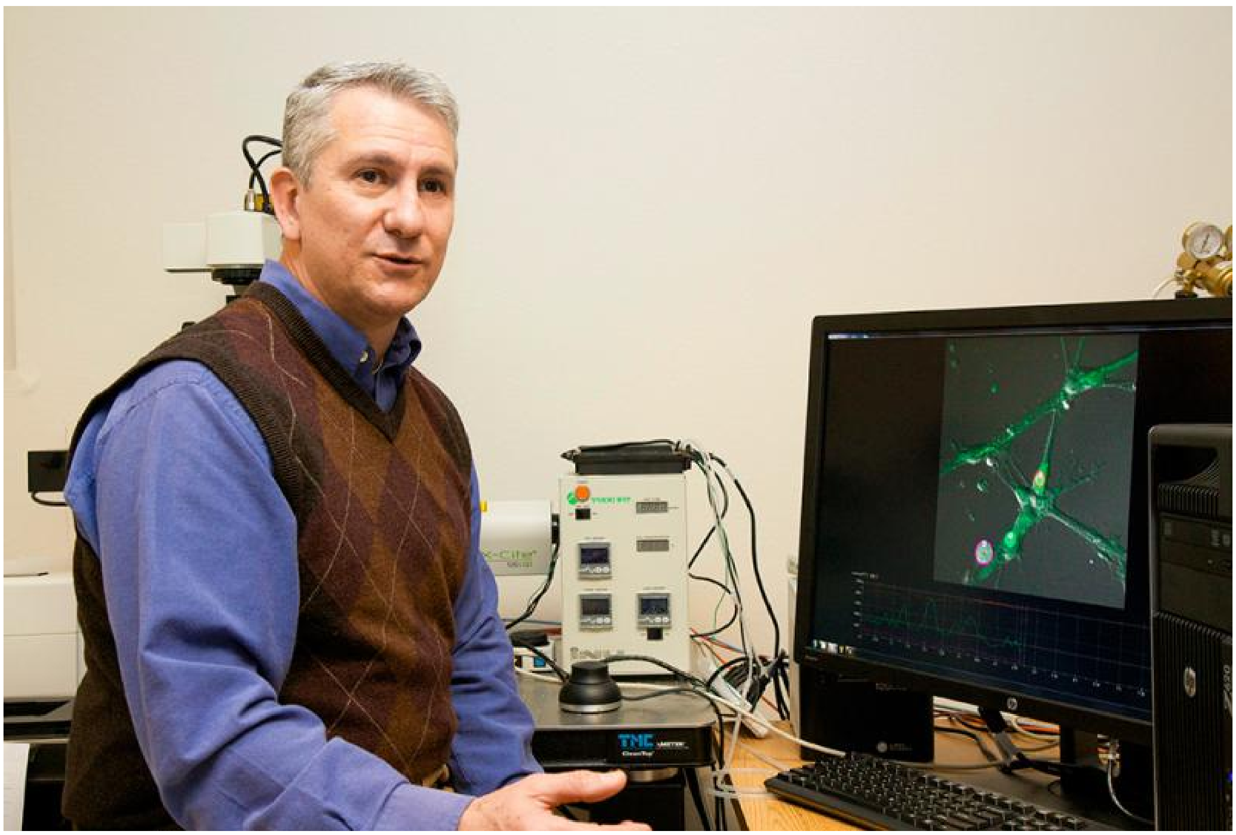

Dr. Mario Romero-Ortega

For years, retired Maj. David Underwood has noticed that whenever he drove under power lines and around other electromagnetic fields, he would feel a buzz in what remained of his arm. When traveling by car through Texas' open spaces, the buzz often became more powerful.

"When roaming on a cellphone in the car kicked in, the pain almost felt like having my arm blown off again," said Underwood, an Iraq War veteran who was injured by an improvised explosive device (IED). His injuries have resulted in 35 surgeries and the amputation of his left arm. Shrapnel from the IED also tore part of his leg and left him with more than 100 smaller wounds. "I didn't notice the power lines, cellphones on roam or other electromagnetic fields until I first felt them in my arm."

Until a recent study led by researchers at The University of Texas at Dallas was published online last month in *PLOS ONE*, there was no scientific evidence to back up the anecdotal stories of people, such as Underwood, who reported aberrant sensations and neuropathic pain around cellphone towers and other technology that produce radio-frequency electromagnetic fields.

"Our study provides evidence, for the first time, that subjects exposed to cellphone towers at low, regular levels can actually perceive pain," said Dr. Mario Romero-Ortega, senior author of the study and an associate professor of bioengineering in the University's Erik Jonsson School of Engineering and Computer Science. "Our study also points to a specific nerve pathway that may contribute to our main finding."

Most of the research into the possible effects of cellphone towers on humans has been conducted on individuals with no diagnosed, pre-existing conditions. This is one of the first studies to look at the effects of electromagnetic fields (EMFs) in a nerve-injury model, said Romero-Ortega, who researches nerve regeneration and builds neural interfaces—technology that connects bionic or robotic devices to the peripheral nerve. There are nearly 2 million amputees in the United States, according to the Centers for Disease Control and Prevention, and many suffer from chronic pain.

After interacting with Underwood, Romero-Ortega decided to study the phenomena that Underwood described.

The team hypothesized that the formation of neuromas—inflamed peripheral nerve bundles that often form due to injury—created an environment that may be sensitive to EMF-tissue interactions. To test this, the team randomly assigned 20 rats into two groups—one receiving a nerve injury that simulated amputation, and the other group receiving a sham treatment. Researchers then exposed the subjects to a radiofrequency electromagnetic antenna for 10 minutes, once per week for eight weeks. The antenna delivered a power density equal to that measured at 39 meters from a local cellphone tower—a power density that a person might encounter outside of occupational settings.

Researchers found that by the fourth week, 88 percent of subjects in the nerve-injured group demonstrated a behavioral pain response, while only one subject in the sham group exhibited pain at a single time point, and that was during the first week. After growth of neuroma and resection—the typical treatment in humans with neuromas who are experiencing pain—the pain responses persisted.

"Many believe that a neuroma has to be present in order to evoke pain. Our model found that electromagnetic fields evoked pain that is perceived before neuroma formation; subjects felt pain almost immediately," Romero-Ortega said. "My hope is that this study will highlight the importance of developing clinical options to prevent neuromas, instead of the current partially effective surgery alternatives for neuroma resection to treat pain."

Researchers also performed experiments at the cellular level to explain the behavioral response. That led researchers to explore the protein TRPV4, which is known to be a factor in heat sensitivity and the development of allodynia, which some subjects displayed.

"It is highly likely that TRPV4 is a mediator in the pain response for these subjects," Romero-Ortega said. "Our calcium imaging experiments were a good indicator that TRPV4 is worth further exploration."

Romero-Ortega said since the research produced pain responses similar to those in anecdotal reports and a specific human case, the results "are very likely" generalizable to humans.

"There are commercially available products to block radio frequency electromagnetic energy. There are people who live in caves because they report to be hypersensitive to radiomagnetism, yet the rest of the world uses cellphones and does not have a problem. The polarization may allow people to disregard the complaints of the few as psychosomatic," he said. "In our study, the subjects with nerve injury were not capable of complex psychosomatic behavior. Their pain was a direct response to man-made radiofrequency electromagnetic energy."

At one point in the study, members of the research group showed Underwood video of subjects in the experiment and their response to radiofrequency electromagnetic fields.

"It was exactly the same type of movements I would have around cellphones on roam, power lines and other electromagnetic fields," said Underwood, who has served on congressional medical committees and been exposed to some of the best doctors in the world. "It is pretty amazing that a few short conversations with this team led to validation of what I, and many others, experience."

Researchers said that the next step is to develop devices that block neuropathic pain from radiofrequency electromagnetic energy.

More information: Bryan Black et al. Anthropogenic Radio-Frequency Electromagnetic Fields Elicit Neuropathic Pain in an

Amputation Model, *PLOS ONE* (2016). DOI: 10.1371/journal.pone.0144268

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