Dopamine used to prompt nerve tissue to regrow

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When Yadong Wang, a chemist by training, first ventured into nerve regeneration two years ago, he didn't know that his peers would have considered him crazy.

His idea was simple: Because neural circuits use electrical signals often conducted by neurotransmitters (chemical messengers) to communicate between the brain and the rest of the body, he could build neurotransmitters into the material used to repair a broken circuit. The neurotransmitters could coax the neurons in the damaged nerves to regrow and reconnect with their target organ.

Strange though his idea might have seemed to others in his field, Wang, an assistant professor in the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University, discovered that he could integrate dopamine, a type of neurotransmitter, into a polymer to stimulate nerve tissues to send out new connections. The discovery is the first step toward the eventual goal of implanting the new polymer into patients suffering from neurological disorders to help repair damaged nerves. The findings were published online the week of Oct. 30 in the *Proceedings of the National Academy of Sciences* (PNAS).

"We showed that you could use a neurotransmitter as a building block of a polymer," said Wang. "Once integrated into the polymer, the transmitter can still elicit a specific response from nerve tissues."

The "designer" polymer was recognized by the neurons when used on a

small piece of nerve tissue and stimulated extensive neural growth. The implanted polymer didn't cause any tissue scarring or nerve degeneration, allowing the nerve to grow in a hostile environment post injury.

When ready for clinical use, the polymer would be implanted at the damaged site to promote nerve regeneration. As the nerve tissue reforms, the polymer degrades.

Wang's team found that dopamine's structure, which contains two hydroxyl groups, is vital for the material's neuroactivity. Removing even one group caused a complete loss of the biological activity. They also determined that dopamine was more effective at differentiating nerve cells than the two most popular materials for culturing nerves -- polylysine and laminin. This ability means that the material with dopamine may have a better chance to successfully repair damaged nerves.

The success of dopamine has encouraged the team to set its sights on other neurotransmitters.

"Dopamine was a good starting point, but we are looking into other neurotransmitters as well," Wang said.

The team's next step is to verify findings that the material stimulates the reformation of synapses in addition to regrowth.

"A successful nerve regeneration will require the nerve to synapse with the target organ," Wang said. "Since we've written this paper, we've also been able to get the nerves to form extensive synapses, which is a step in the right direction."

Source: Georgia Institute of Technology