A novel technology using tiny “nanofibers” shows promise for helping the body repair and restore tissue damaged through injury or disease, including brain trauma, according to new research (Ellis-Beinhke RG et al. Proc Natl Acad Sci U S A. 2006; 103:5054-5059). The same material applied to a wound may also help surgeons staunch bleeding within seconds.

The nanoscale fibers are composed of peptides that self-assemble into a fibrous mesh that mimics the natural connective tissue of the body’s extracellular matrix. “The peptide nanofiber scaffold not only represents a previously undiscovered nanobiomedical technology for tissue repair and restoration but also raises the possibility of effective treatment of [central nervous system] and other tissue or organ trauma,” the researchers noted.

**NEURON REPAIR**

In a new report, researchers at the Massachusetts Institute of Technology, in Cambridge, and the University of Hong Kong, in China, describe the use of these nanofibers to support axon regeneration at sites of nerve injury in young and adult hamsters. After investigators injected nanofibers at the area of injury in animals deprived of vision due to a severed optic tract, regenerated axons reconnected to promote functional return of vision.

“Within the first 24 hours [of injecting the nanofibers], we saw that the brain already started to heal,” said Rutledge Ellis-Beinhke, PhD, of the Massachusetts Institute of Technology. By putting a colored tracer in the eye, Ellis-Beinhke and his colleagues “saw the axons going through the center of the cut and reconnecting,” said Ellis-Beinhke. Animals injected with a saline control experienced no such healing and remained blind.

Somehow, the nanofiber scaffold allowed axons at the site of the injury to knit the surrounding brain tissue together, resulting in at least partial restoration of vision, explained Ellis-Beinhke. While the details of how the nanofibers encouraged repair are not known, the findings indicate that peptide nanofiber scaffolds might have potential in humans for mending damage to the central nervous system—for example, due to stroke, injury, or surgery.

**HALTING BLOOD LOSS**

While Ellis-Beinhke and his colleagues were focused on repairing nerve damage in blinded hamsters, they also noticed that blood flow stopped in the area where they injected their nanofibers.

This serendipitous finding—like so many in laboratory research—led to an entirely new area of study for the scientists. Setting out to test their nanofiber scaffold’s potential as a means to halt blood loss during surgical procedures and after major trauma, the investigators recently applied their nanofibers directly to wounds in the brain, spinal cord, femoral artery, liver, and skin of hamsters. Complete hemostasis was successfully achieved through this treatment, a procedure that is unlike other techniques that stop bleeding, which use pressure, cauterization, vasoconstriction, coagulation, or cross-linked adhesives (Ellis-Beinhke RG et al. Nanomedicine. doi: 10.1016/j.nano.2006.08.001 [published online October 13, 2006]).

“We haven’t found exactly how it works yet,” said Ellis-Beinhke. “It could be a simple physical barrier or it could be a completely new way of stopping bleeding.”

Because applying nanofibers to a wound site stopped bleeding completely in less than 15 seconds, this approach has the potential to substantially reduce blood loss during surgery, or on the battlefield, thereby decreasing the amount of transfused blood needed. It could also reduce the length of time needed for surgery because as much as 50% of surgical time is spent working to control bleeding.

**FUTURE POTENTIAL**

Ellis-Beinhke is optimistic about the clinical potential of nanofiber scaffolds and the likelihood that regulators will find them acceptable for human use. “From a safety perspective, we’re at a pretty good spot—this material disappears and it’s biodegradable in 3 to 4 weeks.” The nanofibers typically pass through the urine or are taken up by surrounding tissue.

Ellis-Beinhke is now testing the nanofibers’ potential for repairing a wide variety of tissues and organs. “If you had something that was biocompatible, would break down and facilitate healing without any encumbrances, and would stop bleeding, we think that would be pretty powerful.”

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