Light at the End of the Tunnel

By Noah Shachtman | Also by this reporter

02:00 AM Oct. 29, 2003 PT

On this much, scientists and doctors agree: Tiny flashes of infrared light can play a role in healing wounds, building muscle, turning back the worst effects of diabetes and repairing blinded eyes. But what they can't decide on is why all these seemingly miraculous effects happen in the first place.

For more than a decade, researchers have been studying how light-emitting diodes, or LEDs -- miniscule, ultra-efficient bulbs like the ones found in digital clocks and television remotes -- might aid in the recuperative process. NASA, the Pentagon and dozens of hospitals have participated in clinical trials. Businesses have sold commercial LED zappers to nursing homes and doctors' offices. Magazines and television crews have drooled on cue. Medicare has even approved some LED therapy.

Despite all that effort, "there's not a clear idea of how this works. There are just working hypotheses," said Marti Jett, chief of the molecular pathology department at the Walter Reed Army Institute of Research.

One possibility comes from Dr. Harry Whelan, a colleague of Jett's and a neurology professor at the Medical College of Wisconsin. In a 2002 study backed by the National Institutes of Health and the Persistence in Combat program from the Pentagon's research arm, Whelan used LEDs to restore the vision of blinded rats. Toxic doses of methanol damaged the rats' retinas. But after exposure to the flashes of infrared light, up to 95 percent of the injuries were repaired.

Human trials have been less dramatic, but still shockingly effective. Using a Food and Drug Administration-approved, handheld LED -- playfully called Warp 10 for its *Star Trek* style -- wound-healing time was cut in half on board the *USS Salt Lake City*, a nuclear sub. Diode flashes improved healing of Navy SEALs' training injuries by more than 40 percent. And a Warp 10 prototype was used by U.S. Special Forces units in Iraq, Whelan asserts.

These LEDs originally were developed by NASA to stimulate plant growth. Now, the agency wants to use the gadgets to build astronauts' muscles during weightlessness. DNA synthesis in muscle cells quintupled after a single application of LEDs flashing at the 680-, 730- and 880-nanometer wavelengths, according to Whelan.

How *exactly* all this happened remains a mystery, Jett said. She's identified more than 20 genes that typically are associated with retinal damage, for example, and "the LED alters all of them."

"Some increased, some decreased," she added. "But they were all brought back to normal."

Why? Whelan thinks that the LED pulses give the retinal cells extra energy, allowing them to heal more quickly. Ordinarily, mitochondria -- the engines of the cell -- turn sugars into energy. They do so with the help of an enzyme, cytochrome oxidase, which carries electrons during the energy-transfer process. Whelan's theory is that light particles from the LED give the cytochrome electrons it ordinarily would get from sugar. Light becomes a substitute for food, basically.

Dale Bertwell, the founder of Tampa, Florida-based Anodyne Therapy, a maker of LED medical devices, doesn't buy the explanation.

"Mitochondria in no way explains the effects" of the LEDs, he said. If Whelan is right, wounds could be healed just by "eating another candy bar."

What's more, Bertwell added, the $1.2 million the Pentagon's Defense Advanced Research Projects Agency just invested in Whelan's work is a waste.

"They're funding Harry's work to build something that's already in widespread use," Bertwell said.

That something, Bertwell said, is Anodyne's purse-sized, monochromatic, LED zapper. Life Care Centers of America, a nursing home chain, has bought nearly 200 of the devices, approved by Medicare last year. Gentiva Health Services, a home health-care provider, ordered another 25.

The devices are being marketed as an antidote -- maybe the first antidote -- to diabetic neuropathy, a deadening in the small nerve endings at the body's extremities. The syndrome is blamed for the vast majority of diabetic amputations.

Because of all the sugar in a diabetic's blood, the nerve endings can become brittle.

The diodes' flashes combat this by momentarily breaking nitric oxide away from hemoglobin, the protein in red blood cells that carries oxygen, Bertwell asserts. Nitric oxide is a vasodilator -- a substance that causes blood vessels to expand. That, in turn, stimulates blood flow, which can cause nerves to break their brittle nature, and grow again.

Dr. Joseph Prendergast, a Redwood City, California, endocrinologist, says he's used LED therapy on more than 200 patients with diabetic neuropathy. After about 10 treatments of 40 minutes each, 95 percent of those people reported having some feeling restored to their feet. Nearly two-thirds are completely back to normal, Prendergast said.

But, when asked why he's seen such startling results, Prendergast said, "It just goes up; that's all I know."

Dr. David Margolis, a pediatrics professor at the Medical College of Wisconsin, expressed similar sentiments. He and Whelan are part of a seven-hospital clinical test to see if LEDs can reduce one of the nastier side effects of chemotherapy, called mucositis. It's basically an inflammation of the gastrointestinal tract, which results in canker sores in the mouth and throat.

In an earlier study, mucositis in bone-marrow transplant recipients dropped to 58 percent from an expected 70 percent to 90 percent after daily treatment using a 670-nanometer LED array.

The trial Margolis is involved with started only recently, so he won't pronounce any definite conclusions.

"But it appears to those of us working in the ward -- the doctors, the nurses -- that patients getting the light treatment get significantly less sores," Margolis noted.

That being said, he had "absolutely no idea" why this was happening. "It's my first venture into the light," he said.