Star Trek medical device uses ultrasound to seal punctured lungs

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A stretcher races through the entrance of a busy hospital. The car-accident victim lies on top and grimaces in pain. While surface injuries look gruesome, the real medical danger is invisible - internal organ damage caused by being crushed against the steering wheel.

This isn't a scene from Seattle Grace Hospital, the set of the popular television drama Grey's Anatomy, but from its real-life model, Harborview Medical Center. Engineers at the University of Washington are working with Harborview doctors to create new emergency treatments right out of Star Trek: a tricorder type device using high-intensity focused ultrasound rays. This summer, researchers published the first experiment using ultrasound to seal punctured lungs.

"No one has ever looked at treating lungs with ultrasound," said Shahram Vaezy, a UW associate professor of bioengineering. Physicists were skeptical it would work because a lung is essentially a collection of air sacs, and air blocks transmission of ultrasound. But the new experiments show that punctures on the lung's surface, where injuries usually occur, heal with ultrasound therapy.

"The results are really impressive," Vaezy said. He cautions that this is still in the early stages and the technique is not yet being tested on humans.

High-intensity focused ultrasound is now being investigated for a number of different treatments. It promises "bloodless surgery" with no

scalpels or sutures in sight. Doctors would pass a sensor over the patient and use invisible rays to heal the wound. Researchers are exploring the use of high-intensity focused ultrasound â€“ with beams tens of thousands of times more powerful than used in imaging â€“ for applications ranging from numbing pain to destroying cancerous tissue.

In this case, lenses focus the high-intensity ultrasound beams at a particular spot inside the body on the patient's lungs. Focusing the ultrasound beams, in a process similar to focusing sunlight with a magnifying glass, creates a tiny but extremely hot spot about the size and shape of a grain of rice. The rays heat the blood cells until they form a seal. Meanwhile the tissue between the device and the spot being treated does not get hot, as it would with a laser beam.

"You can penetrate deep into the body and deliver the energy to the bleeding very accurately," Vaezy said. Recent tests on pigs' lungs showed that high-intensity ultrasound sealed the leaks in one or two minutes. More than 95 percent of the 70 incisions were stable after two minutes of treatment, according to results published this summer in the Journal of Trauma.

The findings suggest that ultrasound might replace what is now a painful, invasive procedure. Lung injuries are relatively common because the chest is a big surface that's often exposed to crushing or puncture wounds, said Gregory Jurkovich, chief of trauma at Harborview Medical Center in Seattle and a UW professor of surgery. A busy trauma room like Harborview's, he said, admits about two patients with bleeding lungs per day.

Often the bleeding can be stopped simply by packing the wound and applying pressure. In other cases, doctors insert a straw and drain the blood and air so the wound can heal. But in about one in 10 cases neither of these methods is successful, and doctors must operate to stop the

bleeding. That means making a long incision and separating the ribs, and then either sewing up the organ or removing a section of the lung.

The new research shows that in these difficult cases, high-intensity focused ultrasound applied from outside could stop bleeding and air leaks. Vaezy and colleagues in the Center for Industrial and Medical Ultrasound in the UW's Applied Physics Laboratory have been developing ultrasound for surgery for more than a decade, concentrating on frequencies in the 1 million to 10 million hertz (cycles per second). The device producing the ultrasound rays, about the size of a golf ball, is inserted into a handle that doctors use to scan the outside of the body. Previous experiments used the tool to seal blood vessels and stop bleeding in the spleen.

Someday, Jurkovich predicts, this tool might be used for image-guided therapy.

"Doctors will scan the body from the outside, recognize where the injury is, focus the beam on the injury and use the beams to seal the wound," Jurkovich said. The futuristic medical technology's promise is substantial, he said. "It would be non-invasive and it would stop the bleeding from the outside. When it happens, that's going to revolutionize how we would care for some of these injuries."

Source: University of Washington

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