Cancer: Killing It Softly

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Ultrasound is a familiar term for mothers-to-be, whose doctors use the technology to view a fetus in the womb. But ultrasound as a surgical tool -- where focused beams of high-intensity sound waves are used to kill tumors and cauterize sites of internal bleeding -- is a new and promising application in the burgeoning field of "acoustic medicine."

This week, at the annual meeting of the Acoustical Society of America, several teams of scientists are presenting their research on using high-intensity focused ultrasound, or HIFU, to combat prostate cancer, liver cancer and internal bleeding -- without anesthesia, chemotherapy, radiation or incisions.

Companies and researchers are still testing HIFU therapy, hoping for FDA approval in the United States, but this past summer Japan and Europe OK'd its use as a method of reducing swollen prostate glands in older men. On the other hand, China -- whose medical approval process is less stringent

than the FDA's -- has been using HIFU therapy in cancer patients since 1997.

According to a paper delivered Tuesday morning, doctors at Chongqing Medical University have reported "satisfactory results from more than 400 cases" of certain types of breast, bone and liver cancers.

Larry Crum, a University of Washington researcher, remains skeptical. Nevertheless, he said, "I would like to see this technology in the United States -- and if we had half the success they're claiming, we would be saving tens of thousands of lives per year."

Crum and his colleagues have been working for seven years to develop acoustic surgery technology that would enable medics on the battlefield and paramedics at an accident site to save lives during the "golden hour," that crucial period after a major injury when many casualties die from internal bleeding.

"Forty percent of the people on the battlefield who die within the first hour (after being wounded) bleed to death internally," Crum said. "Also, this happens in remote areas in the U.S. when you have automobile accidents."

Princess Diana, like many traffic fatalities, died of internal bleeding. "Her life might have been saved, however, had paramedics been able to treat her hidden wounds at the scene of the accident," Crum writes in an August article in *Physics World*. "Indeed, internal bleeding is the real killer in many accidents."

Crum and his colleagues, Shahram Vaezy and Roy W. Martin, have developed a

technique in which low-intensity ultrasound is used to capture an image of the area around an internal injury. Then a beam of ultrasound waves -- some 1,000 to 100,000 times more intense than the sonic pulses used for imaging -- are focused on the internal hemorrhage.

Like a magnifying glass focusing the sun's light onto a piece of paper, only the focal point of the converging ultrasonic beams feels any heat. In seconds, the tissue in the HIFU's crosshairs heats up and solidifies like a boiled egg, cauterizing the wound and stopping the bleeding. Most important, undamaged tissue surrounding the trauma site remains unaffected.

This, at least, is how a HIFU unit should work in theory. Crum says his team is still working on animal trials at the moment. He expects human trials will begin in two years.

According to Junru Wu of the University of Vermont, the toughest part of making any HIFU surgery system would be ensuring accurate imaging -- on the order of millimeters -- and accurate targeting of the focused beam.

"You have to design a very precise mechanical system," he said. "You have somehow to get the signal from the imaging system and then use it to direct the motion of the surgery system. Also, you have to establish some kind of feedback loop to make sure the tissue you want to perform surgery on is the tissue you see on screen."

Narendra Sanghvi is the president and CEO of Focus Surgery, an Indianapolis HIFU

surgery company. Sanghvi and his team presented a paper Tuesday morning on their development of an ultrasound system that treats prostate cancer.

He reports promising success rates in the 50 trial patients that Focus Surgery has worked with to date -- at several sites in Japan as well as Indiana University and Case Western Reserve University. The ultrasound system Focus Surgery has developed -- called the Sonablate 500 -- is still undergoing clinical trials and awaiting FDA approval.

"This does not involve any radiation, no ionization, no poking of needles inside the prostate or lacing any radiation seeds inside the prostate like other therapies require," he said. "This is a minimally invasive or non-invasive therapy."

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