

New imaging technology is transforming medicine

Revealing the Body's Deepest Secrets

by Dr. Francis S. Collins

FOR MORE THAN A CENTURY, X-rays have allowed doctors to observe the inner workings of the human body. Today a new generation of imaging devices is probing even deeper—and transforming medicine in the process.

Take the case of a 53-year-old woman rushed to the emergency room of Suburban Hospital in Bethesda, Md., with chest pains. Heart attack or just indigestion? It's a common dilemma. Every minute counts when treating heart attacks. Yet less than half the 6 million patients who end up in the ER with chest pains each year can be quickly diagnosed with standard tests.

Fortunately, Suburban was participating in a large clinical trial by the National Institutes of Health (NIH) exploring whether magnetic resonance imaging (MRI) might offer a faster, more accurate way to diagnose heart attacks. High-resolution images, obtained in about 40 minutes, showed that the patient was indeed experiencing a heart attack, so doctors performed a procedure to open an artery that was 99% blocked. A month later, the woman's heart was functioning normally.

Dozens of patients in the NIH trial had the same experience, laying the groundwork for what may be a shift in how heart attacks are diagnosed in the ER. Indeed, not only do MRIs provide the most detailed views of heart muscle, they may also be safer. The stan-

dard test—nuclear scan—uses a radioactive dye. Computed tomography (CT) angiography, another rapid approach, involves multiple X-rays of the heart. In contrast, MRIs use magnetic and radio waves, so patients aren't exposed to potentially damaging radiation.

Still, few ERs currently have MRI scanners, while most have CT machines. So, until MRIs become widely available, the decision facing many chest-pain patients and their doctors will be whether CT's potential for quick diagnosis outweighs its radiation risks.

Stroke victims may also benefit from the emergency use of advanced imaging technologies. Ischemic strokes—the most common type—are caused by blood clots, which can be dissolved if an individual receives the right drugs within three hours of onset. But that same therapy can prove fatal in patients with other types of strokes. An NIH Stroke Center study found that MRI was four times better than CT at identifying ischemic strokes.

Beyond the ER, new imaging technology is reducing or even eliminating surgical procedures. Just ask Sarah Perruccio, 26, of Denver. Diagnosed with epilepsy at 12, she struggled with the brain disorder throughout her teens. Even with medications, she experienced seizures that impaired her speech and memory.

Searching for relief, she underwent surgery to remove the seizure-causing tissue from her brain. Such surgery typically involves two seven-hour operations

One new device tells doctors how an organ or tissue would 'feel' if touched



A patient undergoes an MRE test to determine the elasticity of her liver

and the risk of damaging healthy tissue. But Perruccio was among the first to benefit from a new imaging system developed at Yale University that simultaneously maps blood flow, electrical activity, and biochemical activity, providing neurosurgeons with a clearer picture of what's wrong in a patient's brain so they can operate more swiftly and precisely. Researchers hope the system will someday allow epilepsy patients to undergo a single operation instead of two.

Perruccio suffered no loss of brain function as a result of her surgeries and remains seizure-free. She earned a degree in social work and now works with children with autism. Because surgeons gave her so much, she explains, she wants to give back to others.

DURING A PHYSICAL, DOCTORS often palpate, or feel, various parts of a patient's body. But how can organs deep within the body be "felt"? A new technology, magnetic resonance elastography (MRE)—a variation on MRI scanning—may hold the answer.


Researchers at the Mayo Clinic in Rochester, Minn., developed MRE to help detect diseases affecting the elasticity of the body's tissues. For instance, a liver damaged by alcohol feels much harder than a healthy liver. This hardening is called fibrosis. The standard test involves sticking a needle into the abdomen and removing a small piece of liver, which is examined under a microscope. Needle biopsies can be uncomfortable, even painful,

and pose a risk of bleeding.

In contrast, MRE involves no needle sticks. A patient is moved into an MRI machine with a small pad resembling the head of a drum strapped to the abdomen. The “drum” vibrates in different ways as the patient briefly holds his breath. The result is an elastogram—a detailed map of tissue elasticity. If fibrosis is detected early enough, treatment may halt the disease before it causes irreversible liver damage. Research is evaluating whether MRE can distinguish between other types of tissue, such as benign and cancerous lumps in the breast.

TWO IMAGING devices are innovative because of their small size. The optical coherence tomography (OCT) probe is aimed at improving detection of retinal diseases in children. Created at the University of California, Davis, the handheld device makes it easier to obtain high-resolution images of the retinas of youngsters who find it hard to sit still.

And a team at Rice University in Houston has developed a briefcase-size scanner to screen for oral cancer, using a fiberoptic probe to illuminate the inside of the mouth. Its portability and relative affordability could make it invaluable for cancer screening in remote clinics.

It's impossible to predict when these devices will move from research centers into local hospitals or clinics. What is certain is that scientists will develop even more precise imaging technologies to improve our health. 

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