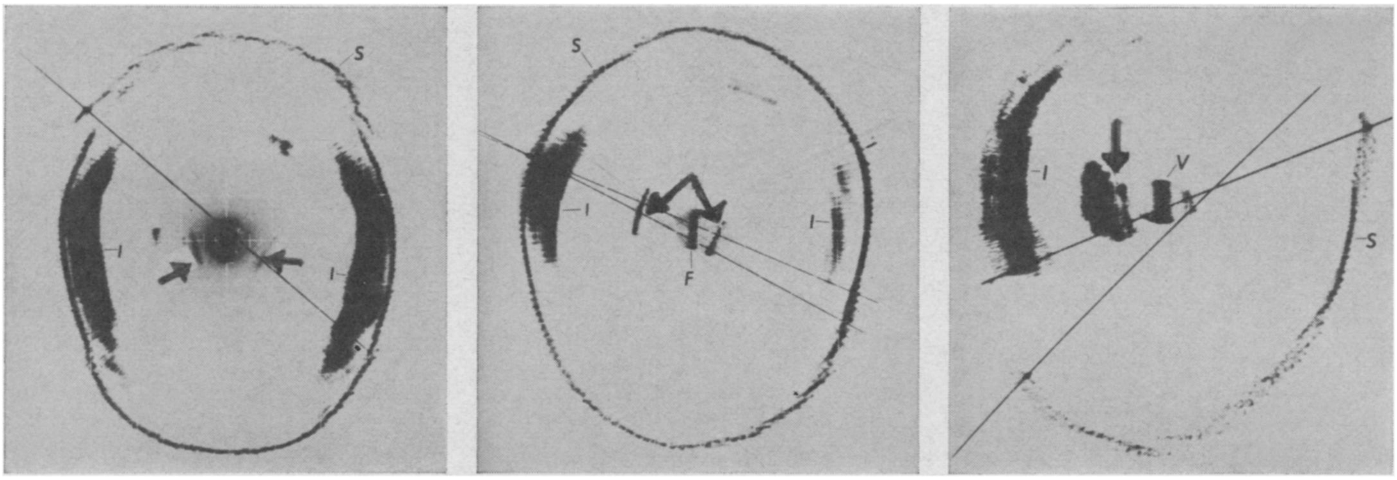

National Research Council

Lateral ventricles (arrows) shown by ultrasound to be (1) normal, (2) distorted, (3) enlarged, in different brains.

Brain Scans by Ultrasound

No part of the human anatomy is more difficult to examine than the brain, and no area is better at hiding tumors. The problem facing researchers is one of what industry calls non-destructive testing: the examination of closed systems without violating them.

Since soft brain tissue cannot be photographed, the only way to directly visualize a tumor, short of cutting open the head, is through a complicated radio isotope procedure.

Otherwise, the brain may be X-rayed though its ventricles (fluid-filled spaces) first must be drained and pumped full of air. Though accurate enough in indicating a tumor's presence, brain X-rays are both painful and slow, and before anyone in his right mind would go through one, he often has a tumor big enough to cripple some function—whether writing, walking or thinking. That means golfball size or bigger.

Consequently, a handful of medical scientists have looked to silent sound or ultrasonics for a simple, painless method of screening the brain for abnormality. Dr. David Makow, a Canadian physicist with the National Research Council in Ottawa, believes he has just that.

His new machine was highly successful in distinguishing the good brains from abnormal ones in a recent examination of 26 people, said Dr. Makow. He said the ultrasonic test agreed with X-rays and other examinations more than 90 percent of the time.

If his 90-plus agreement figure holds, Dr. Makow will have out-done U.S. scientists in the search for a reliable ultrasonic brain scan. No other machine can claim such success.

The main trouble with sound waves are their length. They are far too long to give any kind of detailed image. The resolution, in fact, is so bad that only a few brain structures even show up and those are blurs on the page.

But the Makow scanner will determine when the brain is grossly distorted—in particular, when its ventricles (spaces) are enlarged or pulled out of shape by a tumor or some trouble elsewhere in the brain.

The ventricles shift readily with bleeding, tumors, or atrophy, he said. Being fluid, they send back different echos than do the tissues and their position can be traced with sound.

Dr. Makow's innovation was to beam the sound through water. The patient lies on his back and immerses his head to the eyebrows in a tub of water, while tranducers move around a ring, beaming sound in at every possible angle. The water not only propagates sound very well, but because the examiner does not touch the patient's skull, he cannot inadvertently bias the results, said Dr. Makow.

Freedom from operator bias may explain Dr. Makow's success, since many ultrasonic scanners are of the direct contact variety.

Despite the new machine, however, one radiologist, who daily examines brains for tumors, is less than enthusiastic about the utility of ultrasonics.

Dr. D. L. McRae of the Montreal Neurological Institute collaborated with Dr. Makow in testing the machine on humans. He said that though the machine could pick out normal and grossly distorted brains, it has yet to prove itself in day-to-day work.

He has one ultrasonic machine he uses five times a day, said Dr. McRae, and five rooms of X-ray equipment he uses 30 times a day.

When a neurologist comes in to him and says "I think this patient has a tumor in the right frontal lobe," he needs equipment which will confirm or deny that diagnosis, said Dr. McRae. So far ultrasonics cannot.

"Personally," said the radiologist, "I don't think it ever will."

Nevertheless, he is continuing work with Dr. Makow, hoping to develop more detailed ultrasonics which could replace X-rays altogether.

Dr. Makow agrees that ultrasonics is not yet good enough to act in place of X-rays. If any distortion is found, the patient must still be examined by X-ray. But, if the brain turns out to be normal with an ultrasonic scan, then the patient need not go through the two-day long X-ray procedure.

U.S. radiologist Ray Brinker, an ultrasound enthusiast, not only disagrees with the McRae pessimism, but believes that sound waves will eventually be capable of drawing a profile of all the brain structures.

Dr. Brinker, who is working on both water and contact ultrasonics at Washington University's Mallinckrodt Institute of Radiology, said that many adjacent brain structures have different acoustic properties. Similarly, abnormal tissue differs from normal tissue. The task is to develop a means of tuning in on the slight differences.

"From the physics of ultrasound, we should be able to do it," he said. "I've got an entire lab set up in the hope we will."

According to Dr. Makow, one way of achieving greater resolution is to increase the number of sound pulses per second. Then, there are ways of electronically processing the signals to give satisfactory depth.