Ultrasound reveals sickle-cell stroke risk

A new ultrasound method may help identify children and teenagers with sickle cell anemia who run a high risk of stroke, alerting physicians in time to begin preventive treatment.

Sickle cell anemia is a genetic disorder in which the normally round, puffy red blood cells contain defective oxygen-carrying molecules and sometimes become rigid and crescent-shaped. The disease causes frequent painful episodes when the distorted red blood cells block blood flow through tiny capillaries.

But an even greater threat lurks for sickle-celled children and teens if the arteries carrying blood to the brain become narrowed with a buildup of scar tissue. Researchers don't know what triggers the deposits, but they do know that these youngsters risk suffering a stroke — which can cause potentially lethal brain damage — when their abnormal red cells pile up in the already narrowed arteries, reducing the blood flow to the brain.

Physicians caring for sickle cell patients have had no way to tell which individuals possessed this added vulnerability until after signs of blood-flow restriction appeared. By that time, irreversible brain damage may already have occurred. Strokes can cause mental retardation, paralysis, coma and even death.

Scientists at the Medical College of Georgia in Augusta have now developed an ultrasound method, called transcranial Doppler, that uses sound waves to gauge the speed of blood flow to the brain. Neurologist Robert J. Adams and his colleagues reasoned that blood would travel at a higher velocity in narrowed arteries than in healthy ones, providing an early warning of impending stroke.

Their preliminary findings suggest the technique holds promise as a screening tool, Adams reported last week at the American Heart Association's annual science writers forum in Savannah, Ga. His team studied 250 children and teens with sickle cell anemia, using transcranial Dopper imaging to identify 40 individuals with higher-than-normal blood velocities (more than 160 centimeters per second). Six patients in that high-risk group suffered strokes within months of the ultrasound test, while only one stroke occurred among the 210 children with normal blood velocities, Adams says, suggesting that blood velocity can indeed foreshadow vessel occlusion.

The team then focused on seven of the youngsters who showed no discernible symptoms of stroke but whose ultrasound tests had indicated abnormally high blood velocities. Adams says such children may experience slight reductions in blood flow to the brain, which could lead to subtle brain damage that goes undetected during clinical examination. Using a magnetic resonance imaging device to visualize damaged tissue, the researchers discovered abnormal brain areas in three of the seven, whereas a group of 17 other youngsters who had normal ultrasound test values showed no brain injuries in the same type of images. Only further research will tell whether the three with brain abnormalities had suffered a "silent stroke," Adams says.

"This test may predict [sickle cell] patients at risk for stroke," says neurologist Steven G. Pavlakis at the Cornell University Medical College in New York City. If additional evidence confirms its predictive power, physicians might reduce these children's stroke threat by giving them blood transfusions every three to four weeks, he adds. Such transfusions would help prevent stroke by substituting normal blood cells for the sickling cells, Pavlakis says.

It's unclear whether the ultrasound method can uncover stroke jeopardy in a wider population, says John R. Marler at the National Institute of Neurological Disorders and Stroke in Bethesda, Md. Adams says he believes the technique holds promise for detecting stroke risk in the general population, but agrees that additional studies must establish its range of usefulness. — *K.A. Fackelmann*

Climate test: Hum heard 'round the world

From remote Heard Island far off the Antarctic coast, scientists next week will send sound waves throughout the world's oceans as part of an experiment to determine whether greenhouse gases are indeed warming the planet.

A simple physical fact underlies their technique: Sound travels faster through warm water than through cold water. By measuring changes in the speed of sound over a decade, scientists hope to obtain a clear answer about global warming.

Investigators will test the feasibility of this idea into early February. A dozen listening stations scattered around the globe will monitor the Heard Island transmissions in an attempt to measure the time it takes for the sound to cross the seas. If the experiment proves successful, scientists plan to begin routinely measuring sound speed in the ocean within the next few years. Walter H. Munk of the Scripps Institution of Oceanography in La Jolla, Calif., organized the Heard Island experiment.

This is the first attempt to establish a monitoring program over such vast distances, says Ted Birdsall of the University of Michigan in Ann Arbor, a principal investigator in the experiment. Researchers have used similar techniques to measure the speed of sound along a 4,000-kilometer stretch between Hawaii and North America, but next week's experiment will seek to more than quadruple that length. Sites on the east and west coasts of North America lie about 18,000 km — nearly halfway around the world — from Heard Island.

The experimenters will make their signal heard in such far-off places by exploiting a natural sound channel in the oceans. The channel exists in the region where sound travels the slowest — a layer sandwiched between the warm surface waters and the extremely dense layer below. When acoustic waves traveling through the sound channel begin to stray into the "faster" adjacent layers, refraction sends them back into the channel. In a 1960 experiment, sound waves from a single explosion off western Australia traveled through the sound channel and were clearly recorded at Bermuda.

In the Heard Island experiment, a transmitter lowered from a ship to a depth of 200 meters will create a low-frequency hum of about 57 hertz. The signal will be extremely faint by the time it reaches listening stations, so investigators will use complex processing techniques to isolate it from other noises.

Because marine mammals can hear sounds of that frequency, the experiment also involves biologists, who will observe the behavior of whales around the ship.

Computer climate models estimate that greenhouse gases should cause the world's oceans to warm by about 0.005°C per year at a depth of 1,000 meters. Direct measurements of ocean temperatures would not reveal such a small rise within a few years, but a program monitoring the speed of sound could detect clear signs of a greenhouse warming over five to 10 years, says project coordinator Robert Spindel of the University of Washington in Seattle. Over 10 years, the estimated warming would cut a few seconds off the signal's 3.5-hour trip from Heard Island to the Pacific coast of North America, he says.

In the past few years, climate experts have vigorously debated the meaning of a global warming trend apparent in records of continental and sea-surface temperatures. Because the planet's surface climate can fluctuate naturally, most scientists say they cannot tell whether the buildup of greenhouse pollutants in the atmosphere has indeed caused the observed warming trend.

The deep ocean, with its naturally stable climate, provides a means of sidestepping those problems, says Albert J. Semtner Jr. of the Naval Postgraduate School in Monterey, Calif., an oceanographer involved in the Heard Island experiment. "We think this is a clean way, an experimentally simple and clear way, to look for global warming," he says.

— *R. Monastersky*