MedicalXpress

World's Most Powerful MRI for Humans Opens New Vistas in Diagnosis

September 14 2009

(PhysOrg.com) -- New images from the world's most powerful magnetic resonance imaging machine, the 9.4-Tesla MRI at the University of Illinois at Chicago, are opening radical new possibilities for the diagnosis and treatment of disease.

"We are using the 9.4-T to develop a toolbox that allows us to see perturbations of tissue health at the very first sign of disease," says Dr. Keith Thulborn, director of the UIC Center for Magnetic Resonance Research. These tools, Thulborn said, will allow clinicians to gauge the health of the brain by showing the metabolic functioning of its tissue.

Developing effective therapies for neurodegenerative diseases such as Alzheimer's and Parkinson's, which damage the brain years before the appearance of clinical symptoms, depends on recognizing the beginning of the disease process and then measuring whether a particular intervention is working.

"In medical practice today we have very sophisticated technology, but we are treating advanced disease," Thulborn said. "We are playing catch-up. The goal for medicine should be early intervention; to treat disease earlier.

"Think of treating hypertension at age 25 instead of performing a heart transplant at 65."

Working from 9.4-T images, Thulborn and his colleagues at the Center,

assistant professors Ian Atkinson and Aiming Lu, have developed a new metabolic-imaging toolbox has three components. Each measures a different "bioscale" -- a quantitative parameter that is measure of regional tissue health. (A bioscale is different from a biomarker, which is a yes/no indicator of disease.)

The first bioscale is sodium concentration, a measure of tissue viability. Sodium is pumped in and out of living cells -- a cell no longer pumping sodium is dead. The 9.4-T scanner provides a picture of tissue, such as a tumor during therapy, that indicates whether the cells are dying long before the mass begins to shrink in size, which is the usual indicator of treatment success.

"Clinical trials are often considered a success if, say, 60 percent of patients respond to a treatment," Thulborn said. "What if we could detect early in treatment, on an individual level, that 30 percent of patients show excellent response to treatment; 30 percent should perhaps combine this treatment with additional adjuvant therapy; and the non-responders should immediately receive other treatments?

"This personalized care has the potential to greatly improve outcome by avoiding wasting time and expense on ineffective treatments."

The second bioscale in the toolbox is oxygen consumption, a more dynamic measure of tissue health and viability than sodium, according to Thulborn.

The third measure, phosphocreatine, gives a dynamic view of energy stores within the cell, telling whether the cell is metabolically stressed.

The metabolic toolbox will offer a way to treat each person as an individual and intervene in brain diseases that are difficult or impossible to detect before decades of damage.

"Without this magnet we wouldn't have gotten this far so fast," Thulborn said of the 9.4-T. "It would have taken years and years to develop the insight and understanding to overcome the hurdles using the more widely available 3-T diagnostic MRI."

But right now there are only four 9.4-T MRI machines in the world, and Thulborn recognizes that not everyone can be screened with these powerful magnets.

"To have an impact on medicine our toolbox has to be widely available," he said. "We have used the 9.4-T's sensitivity to develop this new way to see the disease process. We will one day be able to interpret the less sharp images in more widely available diagnostic MRIs and extract the same information."

Provided by University of Illinois at Chicago (news : web)