New technique developed for tracking cells in the body

March 20 2007

Scientists' inability to follow the whereabouts of cells injected into the human body has long been a major drawback in developing effective medical therapies. Now, researchers at Johns Hopkins have developed a promising new technique for noninvasively tracking where living cells go after they are put into the body. The new technique, which uses genetically encoded cells producing a natural contrast that can be viewed using magnetic resonance imaging (MRI), appears much more effective than present methods used to detect injected biomaterials.

Described in the February edition of *Nature Biotechnology*, the method was developed by a team of researchers from Johns Hopkins' Russell H. Morgan Department of Radiology and Radiological Science, the Hopkins Institute for Cell Engineering, and the F.M. Kirby Research Center for Functional Brain Imaging at the Kennedy Krieger Institute in Baltimore.

In their study, the researchers used a synthetic gene, called a reporter gene, which was engineered to have a high proportion of the amino acid lysine, which is especially rich in accessible hydrogen atoms. Because MRI detects energy-produced shifts in hydrogen atoms, when the "new" gene was introduced into animal cells and then "pelted" with radiofrequency waves from the MRI, it became readily visible. Using the technique as a proof of principle, the researchers were able to detect transplanted tumor cells in animal brains.

"This prototype paves the way for constructing a family of reporter

genes, each with proteins tailored to have a specific radiofrequency response," says MRI researcher Assaf Gilad, Ph.D., lead author of the study.

"The specific frequencies can be processed to show up as colors in the MRI image," adds collaborator Mike McMahon, Ph.D., an assistant professor of radiology at the Johns Hopkins School of Medicine "In a way, it's the MRI equivalent of the green and red fluorescent proteins found in nature and used by labs everywhere in the world for multiple labeling of cells."

The problem with using fluorescent proteins, however, is that tissue must be removed from the body for examination under a microscope, which means that the method isn't suitable for use in patients. "In contrast," says Hopkins radiology professor Jeff Bulte, Ph.D., "MRI is noninvasive, allowing serial imaging of cells and cellular therapies with a high resolution unmatched by any other clinical whole-body imaging technique."

Current MRI contrast agents also have several disadvantages. "Their concentration becomes lower every time cells divide," says Peter van Zijl, Ph.D., founding director of the Kirby Research Center for Functional Brain Imaging, "so our ability to see them diminishes.. Also, using magnetic metal allows us to detect only one type of labeled cell at a time." The new approach is not hampered by these limitations.

Source: Johns Hopkins Medical Institutions