

# Non-invasive MRI tracking of labeled stem cells and its application to regenerative medicine

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## 【 Outline of survey 】

Since The Human Genome Project succeeded in sequencing a "working draft" of the human genome at the turn of century, sequencing of the human genome signifies the beginning of a new era in medicine. Although genes get a lot of attention, it is the proteins that perform most life functions and even make up the majority of cellular structures. Therefore, Cells are the fundamental working units of every living system. It is important to characterize the cells in a living system. In order to do this, we are developing a non-invasive technique to track implanted stem cells in living systems.

Among many methods to analyze cells, MRI is particularly unique in that the subjects are not tormented by medium or drugs, therefore it is non-invasive to human. However, MR is notoriously insensitive to detect signals from small targeted cells, therefore it is needed to introduce tags to the interested cells. To circumvent the limitations associated with MR sensitivity, we found a convenient vehicle to transport efficient MR tags into cells, that is the envelope of Sendai virus (Hemagglutinating Virus of Japan : HVJ), having an excellent ability of cell fusion. Incorporate MR marker, superparamagnetic iron oxide, can be detected inside body by MRI in non-invasive fashion. Not only ES cells are labeled, but also a wide range of cells, such as neuron, glia cell, and some killer cells in immuno-therapies. Here, we are seeking more efficient probe for cell tracking and also better sensitivity to detect targeted cells *in vivo* in the current project. At the end of this project we are hoping to propose a new non-invasive method to track the transplanted stem cells during the course of the treatment with regenerative medicine.

## 【 Expected results 】

The goal of this project is to overcome current boundaries of conventional diagnostic imaging and develop techniques to image targets at cellular and molecular levels *in vivo*. " Cell Labeling and Tracking *In Vivo* " is an important capability for practice, as well as for research in regenerative medicine, immunology and gene therapy. Magnetic cell labeling and MRI tracking techniques are useful to gather data on this important problem. Besides the cellular tracking, this technique bears wide applicability in a medical area. One of the area is the drug delivery, where drugs and MR-labels are co-encapsulated into liposomes, vesicles and macromolecules, which might be traced by the MRI cellular tracking method. Similarly, MRI hireling above tracking techniques will locate medical devices in nano-medicine, which may realize in near future. We are hoping to develop a number of key technologies, labeling-reagents and techniques for bio-imaging in this research project.

## 【 References by the principal researcher 】

1. Toyoda K, Tooyama I, Kato M, Sato H, Morikawa S, Hisa Y, Inubushi T. Effective magnetic labeling of transplanted cells with HVJ-E for magnetic resonance imaging. *Neuroreport*. 15:589-93, 2004.
2. Morikawa S, Inubushi T, Kurumi Y, Naka S, Sato K, Tani T, Haque HA, Tokuda J, Hata N. New assistive devices for MR-guided microwave thermocoagulation of liver tumors. *Acad Radiol*. 10:180-8, 2003.

【 Term of project 】 F Y 2004 - 2008

【 Budget allocation 】 86,100,000 yen

【 Homepage address 】

<http://www.shiga-med.ac.jp/hqbioph/index.htm>