# Quantitative imaging application to gut and ear cells

January 15 2012

From tracking activities within bacteria to creating images of molecules that make up human hair, several experiments have already demonstrated the unique abilities of the revolutionary imaging technique called multi-isotope imaging mass spectometry, or MIMS, developed by researchers at Brigham and Women's Hospital (BWH). MIMS can produce high-resolution, quantitative three-dimensional images of stable isotope tags within subcellular compartments in tissue sections or cells.

With its use of stable isotopes as tracers, MIMS has opened the door for biomedical researchers to answer various biological questions, as two new studies have demonstrated. These studies looked at the use of MIMS in tracking cell division in intestinal stem cells, lipid turnover in Drosophila flies, protein turnover in ear cells, and opened the way to human application by detecting the formation of new white blood cells. Both studies will be published in *Nature* online on January 15, 2012 and in print on January 26, 2012.

In the first study, researchers used MIMS to test the much debated "immortal strand hypothesis" which claims that as stem cells divide, the older template DNA remains together in a stem cell, as the newer DNA is passed to cells that differentiate forming the digestive lining of the small intestine.

By tagging DNA with stable isotope tracers, researchers tracked DNA replication as cells divided. They found that in any situation DNA segregation was random, thereby disproving the immortal strand hypothesis.

The research opened another door by studying lipid metabolism within single lipid droplets of the fat body and of the central nervous system of Drosophila larvae. The researchers were also able to translate their work to humans. In a pilot study, they used MIMS to successfully track the formation of new white blood cells after administering isotope tracers in a healthy human volunteer.

The second study demonstrated that protein turnover in stereocilia in the inner ear is extremely slow contrary to the prevalent belief in the field. Stereocilia are hair-like projections found in cells of the inner ear that are responsible for hearing and maintaining balance. Using MIMS, researchers saw that protein turnover was very slow throughout the stereocilia, except the tip at the location of the mechanoelectrical transduction apparatus.

MIMS was created by developing several tools—an ion microscope/secondary-ion mass spectrometer, labeling with stable isotopes, and quantitative image-analysis software. Unlike other imaging technologies, MIMS does not require staining or the use of radioactive labeling. MIMS enables researchers to conduct experiments with safe, non-toxic stable isotopes, which are naturally occurring components of all living matter.

Provided by Brigham and Women's Hospital