Molecular Imaging for Bio-medical Research with Mice

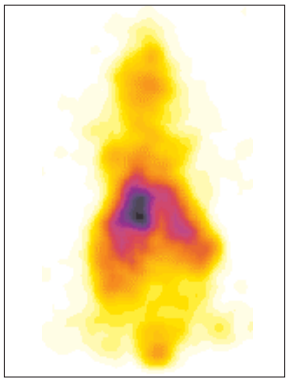
Molecular Imaging

Researchers at the Department of Energy's Thomas Jefferson National Accelerator Facility (Jefferson Lab) are collaborating with the College of William and Mary on the implementation of a detector system ideally suited for biomedical research with live small animals.

A detector system developed by the collaboration is being used and optimized for detection of the emission of iodine-125. Iodine-125 is the isotope that can be used with certain molecular biology techniques to probe for certain gene products in a live animal. The ability to image gene expression in live animals provides a valuable tool for molecular biology and disease research.

Advantages

Current gene expression techniques take snapshots of the state of expression of the gene of interest. In order to get an actual measurement of the animal's state of expression of the gene of interest, for instance in the brain or endocrine system, the animal's life must be terminated. The technology developed by the collaboration offers neural scientists and endocrinologists the opportunity to understand processes in real-time and over an extended period of time allowing for more complete study of the genetic processes.

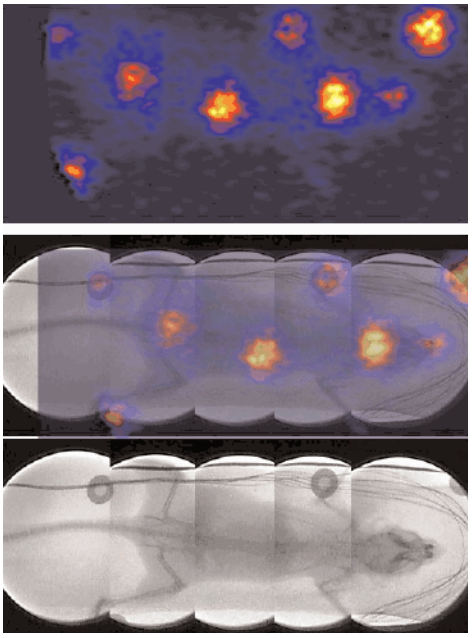


Distribution of a cocaine-like compound (RTI-55) in a live mouse.

Iodine-125 is unique since commercially available gene probes already exist for this isotope. The iodine-labeled probe attaches to the gene marker of interest and the gamma and x-rays emitted from the isotope decay process are used to image the gene product to millimeter resolution.

Current Status

The College of William and Mary, with funding from the American Diabetes Association (ADA) and technical assistance from Jefferson Lab, has incorporated x-ray imaging with the iodine-125 imaging system. The x-ray images provide anatomical information to aid in the localization of the iodine-125 labeled molecules. The system is now being used to aid diabetes research in the William and Mary Biology Department. Modifications to this system are underway to permit three-dimensional imaging of the labeled molecules in a live mouse by applying a medical imaging technique called Single Photon Emission Computer Tomography.



Diabetes study: (top) biodistribution of iodine-125 labeled insulin binding in a live mouse, (middle) image co-registration of insulin binding with a digital x-ray radiograph of the mouse, (bottom) digital x-ray radiograph of mouse under study.

Partners

Research was done in collaboration with the Department of Biology at the College of William and Mary which obtained grants from NSF and the ADA; and with the support of the Department of Energy's Division of Nuclear Physics.

Nuclear Physics Spin-off

This medical application spin-off came from research conducted by physicists at Jefferson Lab to develop new high energy particle detector components. These components are called crystal scintillators and position sensitive photo multiplier tubes. This project began in 1996 and is ongoing.