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Metabolic Interaction of Nigari and Various Trace Elements on Mice by Using the Multitracer Technology and the Gamma-Ray Emission Imaging System (GREI) as a New Modality of Multiple Molecular Imaging

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Summary

Recently, biotrace elements (elements that are essential to our bodies in minute amounts) have caught our attention, as health has become an important issue to many peoples' lives. The metabolism and dispersion of many biotrace elements may be analyzed using the multitracer technology. The multitracer technology allows simultaneous tracing of various radioactive isotopes (RI). By administrating a multitracer solution containing various RI into a living organism, the activity of these RI can be detected using a high purity Ge detector or Gamma-ray Emission Imaging (GREI). In the first experiment, the multitracer technology was applied to insulin dependent diabetes mellitus (IDDM) model mouse. To one group of this IDDM model mouse, nigari (bittern) was fed each day from one week before the administration of the multitracer solution to investigate whether nigari has a beneficial effect in lowering body weight and blood glucose levels in IDDM model mouse. The uptake rate of various trace elements on the IDDM model mice are slightly decreased those on the normal group mice. Multitracer administration results showed that nigari had effects to accumulation of Mn, Zn in liver and Se in kidney on 3 and 6 hours after administration in IDDM model mouse. These results suggested that accumulations of these elements are closely related to homeostasis and biotrace elements interaction change by occurring high Mg treatments as a nigari administration. In the second experiment, the multitracer technology and the molecular imaging technology were applied to Mg deficient model mouse.

In these studies, we have demonstrated the multiple molecular imaging as include in bittern elements by use of semiconductor Compton cameras. The Compton camera used in this work comprises two double-sided orthogonal-strip germanium detectors, and their excellent energy resolution enables discrimination of the nuclides and accurate determination of the scattering angle especially for sub-MeV to MeV-range gamma rays. Three radioactive tracers of ^{28}Mg, ^{43}V, ^{24}Na, ^{47}Ca and ^{48}V were injected to living mice and were simultaneously measured in the live-mice metabolic dynamics. The world's first real-time metabolic images of the three tracers were successfully obtained, which showed the different behavior in the living organism. We were able to obtain quite encouraging results for multiple molecular imaging by use of semiconductor Compton cameras.