Application of radioisotopes for medical diagnosis and therapy

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One of characteristics of metal elements is the existence of a lot of radionuclides. This characteristic has been leading to various applications of metallic elements in the clinical field. The clinical field using radionuclides calls nuclear medicine and contains diagnosis and therapy. Diagnostic nuclear medicine is a technique used gamma-emitted radionuclides with high permeability into the body (^{99m}Tc, ^{111}In, ^{201}Tl, ^{67}Ga and $^{62/64}$Cu) and can visualize changes in physiological and biochemical processes throughout the distributed and interrelated systems of the entire living tissues and organs. Therapeutic nuclear medicine is a technique used beta-emitted radionuclides with high radiation damage of to the cell (^{90}Y, $^{186/188}$Re, ^{89}Sr, ^{90}Y and $^{64/67}$Cu) and can do the internal radiation therapy. Drugs containing radioactive nuclide to be used in the nuclear medicine are called radiopharmaceuticals. Radiopharmaceuticals require the desired biological behavior with high radioactivity localization into target tissue and a high target/non-target tissue ratio for clear imaging or effective therapy.

However, those metallic radionuclides available for the nuclear medical field are not isotopes of constituent elements of bioactive molecules and drugs but of heterogeneous elements. Therefore, the great demand for biospecific compounds bid for rational design of radiometallic compounds to mimic the pharmacokinetics of bioactive molecules and drugs, and evolved into the generation of the so called, "bifunctional radiopharmaceuticals"; that is, a radiopharmaceutical containing a group for the selective targeting of diseased tissue together with a group with the ability to bind radiometallic nuclides. Research on bifuncitonal radiopharmaceuticals has been started from the development of radiolabeled macromolecules and used for the labeling of non-protein compounds such as peptides and small molecules. These results obtained can be put to the development of non-radioactive metallic compounds available for medical field.

This lecture will present recent progress in research on application of metallic radionuclides for medical diagnosis and therapy, including the drug design of bifunctional radiopharamceuticals.