

## Radioisotopes for Diagnosis and Therapy in Nuclear Medicine/核医学における診断・治療用放射性同位体

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The use of radioactive isotopes (RIs) in medicine enables both the diagnosis and treatment of diseases, referred to as nuclear medicine imaging and nuclear medicine therapy, respectively. For example, drugs labeled with RIs can be administered to visualize or destroy cancer cells that selectively accumulate the compound. The physical and chemical properties required for RIs differ between diagnostic and therapeutic applications. In each case, the energy of the emitted radiation and the half-life of the isotope must be carefully optimized. Furthermore, since many diseases progress rapidly and cannot wait for isotope production, a stable and reliable supply of the required RI is essential. Because the amount of radiopharmaceutical administered to patients is extremely small, there are few elemental restrictions on the composition of the compound.

In nuclear medicine imaging, the radiation emitted from the administered radiopharmaceutical must be detected externally. Therefore, isotopes emitting  $\gamma$ -rays or X-rays with sufficient tissue penetration are used. For therapeutic applications, particle-emitting isotopes are employed. Traditionally,  $\beta^-$ -emitters have been widely used due to their relatively long range and established production routes. However, in recent years,  $\alpha$ -emitting isotopes with high linear energy transfer (LET) have attracted significant attention. In addition, isotopes that emit Auger electrons are now being investigated for achieving even more localized irradiation at the nanometer scale.

A variety of diagnostic and therapeutic RIs are currently used in clinical practice. Nonetheless, the discovery or production of new isotopes with more favorable properties would further advance the field. Hopefully, three-body nuclear forces could lead to the creation of new nuclear data that are directly useful for medical applications.

**Primary author:** OGAWA/小川, Mikako/ミカコ (Faculty of Pharmaceutical Sciences, Hokkaido University/北海道大学大学院薬学研究院)

**Presenter:** OGAWA/小川, Mikako/ミカコ (Faculty of Pharmaceutical Sciences, Hokkaido University/北海道大学大学院薬学研究院)

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