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Radionuclides for medical applications

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Ionizing radiation plays an important role in many medical applications. Not only the specialties radiology, radiotherapy and nuclear medicine rely on ionizing radiation, but also radioguided surgery, certain dermatology procedures, research and development of new pharmaceuticals, etc. Last but not least about half of all medical devices are sterilized by ionizing radiation before use. All these applications use different types of radiation (gamma, positron, beta-minus, alpha, conversion and Auger electrons), very different levels of dose, dose rate and activity respectively and different modes of exposure (external versus internal). The dominating radionuclides in diagnostic nuclear medicine are 99mTc for SPECT (single photon emission computed tomography) and 18F for PET (positron emission tomography). These work horses are complemented by other diagnostic radionuclides with shorter or longer half-lives or different chemical properties to cover a wide range of applications. Therapeutic applications of radiopharmaceuticals were so far restricted to very special diseases (e.g. thyroid cancer) but new targeted radionuclide therapies for more applications are now coming into clinical practice. The future holds large promise for Theranostics, a type of personalized medicine where a targeted radionuclide therapy is individually optimized based on imaging with a companion diagnostic radiopharmaceutical. Such applications are ideally performed with so-called “matched pairs” of diagnostic and therapeutic radionuclides of the same chemical element. The presentation will discuss medical applications of radionuclides and the respective production methods. A particular emphasis is made on synergies with nuclear physics research and research facilities.

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