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Nuclear data for production of novel medical radionuclides

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Nuclear data play an important role in optimisation of production routes of medical radionuclides. In general, the production data of all the commonly used diagnostic and therapeutic radionuclides are well known, except for some special applications, where improvements in data may be desired. Regarding research oriented radionuclides, great demands exist for non-standard positron emitters to study slow biological processes and to quantify dose distribution in internal radiotherapy. Some recent studies related to the development of the positron emitters 64Cu (T½ = 12.7 h) and 86Y (T½ = 14.7 h) will be described as typical examples. In general, the low-energy (p,n) reaction on a highly enriched target isotope is successfully utilized. However, for production of several other positron emitters, e.g. 73Se (T½ = 7.1 h), intermediate energy reactions are needed. Another area of increasing interest is internal radiotherapy and the choice lies on low-energy highly ionising radiation emitters, i.e. β-, α and Auger electron emitters. Cross section measurements to develop those novel therapeutic radionuclides are challenging, and interdisciplinary techniques are employed. This will be exemplified by studies on 67Cu (T½ = 2.6 d; Eß- = 577 keV), 193mPt (T½ = 4.3 d; Auger electrons) and 225Ac (T½ = 10.0 d; Eα = 5830 keV). The novel radionuclides are finding increasing applications in theranostics which involves the combination of a positron emitter and a therapeutic radionuclide of the same element. A few examples of such systems will be given.
Regarding future perspectives of medical radionuclide production, the potential of high energy protons and heavier mass projectiles will be discussed and the increasing efforts to utilize fast neutrons and high-energy photons will be briefly outlined. Furthermore, the prospects of combining PET with MRI for enhanced quality imaging, and of radioactivity with nanotechnology for effective internal radiotherapy, will be discussed. The relevant nuclear data needs will be considered.

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