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Medicine intended Technetium ^{99m}Tc isotope production technology under C18 cyclotron beam

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The isotope ^{99m}Tc has broad application in nuclear medicine for diagnostic purposes. Due to its short life time of about 6h favoring low radiation dose for the patient, high demands are put on the infrastructure for production and distribution of the isotopes involved. Currently, this isotope is produced by a couple of fission reactors in the world which are ageing machines without guaranteed uptime. This is a dangerous situation for the supply-chain and thus numerous scientists work on alternatives. In addition, these fission reactors are operated with weapons-grade Uranium-235 a fact that should be avoided for numerous reasons. The proposal to produce ^{99m}Tc using cyclotron accelerators generating a proton beam of that impinges on a molybdenum target (100Mo) is one the promising solutions. It can ensure the local supply of technetium and reduces nuclear proliferation since no uranium is needed. Last decade many scientific centers are working hard to find alternative technologies of Mo/Tc production, in particular using charged particles accelerators. In general the focus is on the direct production of ^{99m}Tc from proton bombardment of enriched molybdenum and although other accelerator based technologies are feasible. Usable quantities of ^{99m}Tc can be produced by the 100Mo (p, 2n) ^{99m}Tc reaction, well within the reach of many commercial medical cyclotrons. Many hundreds of cyclotrons are working around the world for PET isotope production, and they can produce ^{99m}Tc in parallel without serious investment. This technology is close to create full scale domestic production covering whole demand of clinics.

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18F-DOPA PET for proton therapy treatment planning in high-grade gliomas

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In high-grade gliomas (HGG), treatment planning and evaluation of local response to therapy are usually based on magnetic resonance imaging (MRI) and computed tomography. Although these investigations show the anatomy of the brain with high accuracy they seem insufficient for proper tumor visualization. At the same time, recent technical advances in radiation therapy such as intensity-modulated radiation therapy and proton therapy (PT) provide the ability to deliver higher radiation doses to the most resistant tumor regions as well as reduce the dose delivered to the surrounding normal structures. Therefore, there is an urgent need for new imaging approaches to increase accuracy in tumor delineation for high precision radiotherapy. Imaging the biological and molecular characteristics of tumor tissue by positron emission tomography (PET) is an interesting approach to improve treatment planning for high precision radiotherapy as well as to evaluate tumor response after treatment. In fact, amino acid transport is generally increased in malignant transformation due to high income of the amino acid to the tissue, the intrinsic activity of the amino acid transporter and the rate of the intracellular amino acid metabolism. From this standpoint the amino acid tracer 18F-DOPA (3, 4-dihydroxy-6-[18F] fluoro-L-phenylalanine) has a high tumor-to-background signal and high sensitivity for glioma imaging. For these reasons we routinely integrate our planning with 18F-DOPA PET in patients with HGG treated with PT post-operatively or at progression/relapse (re-irradiation). 18F-DOPA PET imaging may more accurately identify regions of tumor extension and change the expected planning, as determined just by MRI, in many cases. Even though data are not definitive effective chemotherapy combined with highly conformal radiotherapy targeted to areas at highest risk for tumor recurrence may allow us to improve the therapeutic index.

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