

عنوان مقاله:

Calculation of Positron Distribution in the Presence of a Uniform Magnetic Field for the Improvement of Positron Emission Tomography (PET) Imaging Using GEANT4 Toolkit

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خلاصه مقاله:

Introduction Range and diffusion of positron-emitting radiopharmaceuticals are important parameters for image resolution in positron emission tomography (PET). In this study, GEANT4 toolkit was applied to study positron diffusion in soft tissues with and without a magnetic field for six commonly used isotopes in PET imaging including ^{11}C , ^{13}N , ^{15}O , ^{18}F , ^{68}Ga , and ^{82}Rb . Materials and Methods GEANT4 toolkit was used to simulate the transport and interactions of positrons. Calculations were performed for the soft tissue phantom (8 mm \times 8 mm \times 8 mm). Positrons were emitted isotropically from the center of the phantom. By the application of a magnetic field perpendicular to the path of positrons, lateral scattering of positrons could be prevented due to Lorentz force. When the positron energy was below the cut-off threshold (0.001 MeV), the simulation was terminated. Results The findings showed that the presence of a magnetic field increased the rate of positron annihilation. At magnetic field strengths of 3, 7, and 10 Tesla, ^{18}F with the lowest decay energy showed improvements in the ratio of full width at half maximum (FWHM) resolution to the peak of curve by 3.64%, 3.89%, and 5.96%, respectively. In addition, at magnetic field strengths of 3, 7 and 10 Tesla, ^{82}Rb with the highest decay energy showed improvements in resolution by 33%, 85%, and 99%, respectively. Conclusion Application of a magnetic field perpendicular to the positron diffusion plane prevented the scattering of positrons, and consequently, improved the intrinsic spatial resolution of PET imaging, caused by positron range effects.

کلمات کلیدی:

Positron, PET Image, Magnetic Field, Geant4 toolkit

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