$^{nat}Cr(p,x)$ or $^{nat}V(\alpha,x)$? Dosimetric assessments at comparison for high-purity ^{52g}Mn PET tracer production.

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Aim

^{52g}Mn appears as promising tracer for positron emission tomography (PET) thanks to its decay properties (β^+ = 29.4%, E(β^+) avg = 242 keV) and its quite long half-life ($t_{1/2}$ = 5.6 day)[1]. Potential nuclear-medicine applications in imaging require a sufficiently quantity and high quality production in compliance with the European Pharmacopoeia requirements. Focus of this work is to develop precise simulations and models to compare the standard $^{nat}Cr(p,x)^{52g}Mn$ production route and the alternative $^{nat}V(\alpha,x)^{52g}Mn$ one here proposed[2,3]. To this aim the radionuclidic purity and dose increase, due to the co-produced radioactive contaminants, have been evaluated.

Methods

The nuclear code Talys has been employed to optimize the $^{nat}V(\alpha,x)^{52g}Mn$ cross section by tuning the parameters of the microscopic level densities[4]. Thick-target yields have been calculated from the expression of the rates as energy convolution of cross sections and stopping powers, and finally integrating over the time evolution of the relevant decay chains. Dosimetric evaluations have been accomplished by means of the OLINDA software considering the injection of $[^{xx}Mn]Cl_2$ in female and male phantoms[5,6]. Finally, the dose increase has been calculated by combining the yield of ^{xx}Mn radioisotopes estimated for both reactions with the dosimetric outcomes.

Results

Good agreement was obtained between cross sections calculations and measurements. With the $^{nat}V(\alpha,x)$ route, the dose increase shows a less harmful impact on patients' health due to a reduced contamination by other Mn radioisotopes.

Conclusions

Both $^{nat}V(\alpha,x)$ and $^{nat}Cr(p,x)$ reactions are suitable for a clinically acceptable production of ^{52g}Mn. If we consider a thick-target production (200 µm), the Vanadium target requires a α beam with 48 MeV, while the Chromium target implies a 17 MeV proton beam. Compared to $^{nat}Cr(p,x)^{52g}Mn$, the $^{nat}V(\alpha,x)^{52g}Mn$ reaction produces larger quantity of the PET tracer, a longer time with radionuclidic purity higher than 99%, and finally, considering the injection of the $[^{52g}Mn]Cl_2$ compound, a systematically lower dose increase.

References

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