Eur J Nucl Med Mol Imaging (2015) 42 (Suppl 1):S1–S924
DOI 10.1007/s00259-015-3198-z

EANM'15

Annual Congress of the European Association of Nuclear Medicine

October 10 - 14, 2015

Hamburg, Germany

Abstracts

European Journal of Nuclear Medicine and Molecular Imaging
Volume 42, Supplement 1
10.1007/s00259-015-3198-z

This supplement was not sponsored by outside commercial interests. It was funded entirely by the association's own resources.

Springer

Aim: The ^{43}Sc ($t_{1/2}$ = 3.89 h) is an ideal β^+-emitter in PET diagnosis. It can be used as an alternative to ^{68}Ga, because ^{43}Sc has longer half-life and forms stable radiobioconjugates with a structure similar to ^{90}Y and ^{177}Lu, that is important in planning radionuclide therapy. In comparison with ^{44}Sc -other proposed isotope of scandium - ^{43}Sc has half-life and beta plus radiation similar to ^{44}Sc, moreover gamma-ray energy emission and intensity is much lower (372 keV, 23%) than in case of ^{44}Sc (1157 keV, 99%) what is not negligible for patient and medical personnel. ^{43}Sc can be produced via the $^{nat}Ca(\alpha,x)^{43}Sc$ reaction in medium size cyclotrons or in reactions $^{43}Ca(p,n)^{43}Sc$ and $^{42}Ca(d,n)^{43}Sc$ carried in small medical cyclotrons. The aim of our work was to find optimal parameters for target irradiations in order to maximize the production of ^{43}Sc with minimal impurities and to develop a simple chemical procedure for separation of ^{44}Sc from the calcium target. Materials and methods: In the present work, we used either high purity natural $CaCO_3$ or enriched $^{42}CaCO_3$ and $^{43}CaCO_3$ targets (Isoflex, Russia). The irradiations have been performed with the Scanditronix MC 40 Cyclotron of the Joint Research Centre (Ispra, Italy), or U-200P and GE-PETtrace cyclotrons of the Heavy Ion Laboratory, University of Warsaw. Target materials for irradiation were compacted into the specially designed aluminum capsules or were pressed into a rectangular pellet wrapped in the pre-formed aluminum foil and fixed to a water cooled target holders. The activities of the samples were measured with high resolution γ-ray spectrometry. $CaCO_3$ targets were dissolved in 0.2 M HCl and an ion exchange resin Chelex 100 was used to separate ^{43}Sc from target material.^{43}Sc-DOTATATE was synthesised with different amounts of the peptide and at various pH. Results: The three proposed methods of ^{43}Sc production allow obtaining the high activity of the radionuclide. ^{43}Sc was separated from the targets on iminodiacetic resin with efficiency higher than 95% and eluted in volume of 0.3 ml. The recovery of the calcium material is also very high (~90 %). The level of Ca^{2+} in ^{43}Sc fraction is less than 3 μg/ml. Conclusions: The ^{43}Sc radionuclide can be produced in amount of several GBq. The proposed production procedures are simple and fast. The synthesis and purification procedure can be simplified using C18 Sep-Pak® columns.

OP479

Production of High Specific Activity 186Re for Cancer Therapy Using WO3 Targets in a Proton Beam

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Rhenium-186 is a β-γ emitter with a half-life of 90.64 h and a β− end-point energy of 1.07 MeV. The isotope is suitable to treat cancers of small dimensions (mm range). Moreover, its γ-emission at 137.15 keV is in the energy range favorable for both γ-camera and SPECT imaging. Current production methods rely on the neutron capture induced reaction 185Re(n,γ) in a reactor and are associated with low specific activities (0.6 kCi/mmol), thereby limiting the application of the isotope to palliative treatments. Production via charged particle irradiation of enriched 186W results in a 186Re product with a much higher specific activity; allowing its use in therapeutic nuclear medicine. Test targets of both sintered and pressed natWO3 powder were proton irradiated at the Los Alamos Isotope Production Facility (LANL-IPF) to evaluate radionuclide product yields, impurities, irradiation parameters and wet chemical Re recovery for a bulk production. We demonstrated that 186gRe can be isolated in 97% yield from irradiated natWO3 targets within 12 h of end of bombardment (EOB) via an alkaline dissolution followed by anion exchange. Tungsten (VI) oxide can be easily recycled for recurrent irradiations. Using a sintered target, 186Re batch yields of 42.7 +/- 2.2 μCi/μAh (439 +/- 23 MBq/C) (with respect to 186W content) were obtained after 24 h of irradiation in proton beams. The target entrance energy of the proton beam was determined to be 15.6 MeV. The specific activity of 186gRe at EOB was measured to be 1.9 kCi (70.3 TBq)/mmol. Based upon our studies of natWO3, a target of enriched 186WO3 irradiated in a proton beam of 250 μA for 24h can provide batch volumes of roughly 250 mCi (9.25 GBq) of 186gRe at EOB with a specific activity approaching the theoretical value of 35kCi/mmol (1295 TBq/mmol).

OP480

Direct production of 99mTc-Technetium using low energy cyclotrons and radionuclidic purity: our results so far using natMo-Molybdenum

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Introduction: Despite the global crisis concerning 99mTc delivering to Nuclear Medicine Departments there isn't yet a reliable solution. The cyclotron direct production of 99mTc, using the 100Mo(p,2n)99mTc nuclear reaction is our attempt to approach the problem, aiming to become efficient, reliable and sustainable from points of view as reducing drastically the radioactive waste being produced and becoming beneficial for all the involved parts. Between several critical factors, radionuclidic purity of cyclotron-produced 99mTc is being pointed as an issue of concern. Aim: This paper aims to disseminate the results being obtained so far in what concerns radionuclidic purity of the 99mTc already produced from natMo and some extrapolation calculi for the use of high-level of purity 100Mo. Material and Methods: natMo foils were stacked into a solid target of aluminum and short irradiations (with ~1-2 to 20 μA proton beams, during 2 to 20 seconds) were performed, using our in-house developed targets and target holder systems, on three different cyclotrons (IBA Cyclone-18, ACSI TR19 and GE PETtrace). Beam energy degraders based on aluminum were developed in-house with thicknesses calculated using SRIM/TRIM, allowing irradiations with 15 MeV in the IBA and GE machines. Produced activity was quantified using HPGe gamma spectroscopy to obtain the overall amount of 99mTc produced, as well as the different contaminants (such as 93Tc, 93mTc, 94Tc, 94mTc, 95Tc, 95mTc, 96Tc, 96mTc, 99Mo and 96Nb) whose activity was analyzed in terms of ratios in order to 99mTc activity. Novel ratios were extrapolated from our experimental data to an ideal case of irradiations using 100Mo enriched targets (with purities of 97,42% and 99,5%). Results: It has been observed, that 19 and 18 MeV irradiations of natMo lead to an higher level of contaminants, with produced yields of some contaminants much higher than those of 99mTc being produced (e.g.: 93Tc, 94Tc and 95Tc), however, extrapolated contaminant ratios for enriched targets suffer a reduction, even considering values deserving attention (e.g.: 94Tc/99mTc ≥ 1% or 93Tc/99mTc ≥ 3%). On other hand, our results confirm our hypothesis that 15 MeV irradiations could maintain considerable production yields, with a significant decrease of contaminants, with almost all extrapolated ratios reaching values ≤ 1%. Conclusion: Radionuclidic purity is a critical issue for the implementation of alternative routes for 99mTc production and our actual data points that 15 MeV proton beams could be considered, since drastically reducing contaminants while easing production and purification processes.

OP481

Extremely rapid, kit-based biomolecule labelling and molecular imaging with gallium-68: tris(hydroxypyridinone) chelators

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The gallium-68 (68Ga) generator offers PET molecular imaging to hospitals without a cyclotron if simple labelling methods are devised. Current 68Ga clinical radiopharmaceutical syntheses require high temperatures (greater than 90 °C), and extended reaction times (5 - 20 min). We have previously shown that tris(hydroxypyridinone) (THP) ligands rapidly label with 68Ga quantitatively under mild conditions (Chem Commun, 2011; 47:7068). We now report the development of one-step labelling methods equivalent to kit formulation protocols, and the ability of 68Ga-THP peptide conjugates to image expression of peptide receptors in tumours in vivo. The THP-Ac chelator was labelled with 68Ga-generator eluate under a range of THP-Ac concentrations (0.1-1000 μM), pH values (4 - 7), buffers, and trace metal concentrations (Mg(II), Fe(III), Zn(II)). At 10 μM, 20 °C and all pH values and times, labelling efficiency of THP-Ac reached greater than 95% in under 2 min, and was unaffected by contaminating Mg(II), Zn(II) and Fe(III) at 30, 20, 0.3 mg/L, respectively. Vials containing lyophilised THP-Ac and buffer salts gave quantitative radiolabelling with unprocessed eluate in less than 5 min. New bifunctional chelator isothiocyanate and carboxylate derivatives of THP were synthesised and conjugated to (i) cyclic(RGDfK) peptides for targeting αvβ3 integrin expression, (ii) Tyr3-octreotate (TATE) peptide for targeting SSTR2 expression in neuroendocrine tumours, (iii) a urea-containing peptide targeting PSMA receptors for prostate tumours, and (iv) the monoclonal antibody, trastuzumab for HER2 receptors. All conjugates were labelled with 68Ga in greater than 95% radiochemical yield and high specific activity (up to 80 MBq/nmol at the point of administration) at 25 °C and formulated to pH 6 - 7 in 2 - 5 min. Biodistribution of tested αvβ3- and SSTR-targeting conjugates showed tumour-specific uptake and retention of target receptor affinity. Excretion was rapid and predominantly renal. Serum stability and biodistribution experiments point to excellent in vivo stability of the new radiotracers with respect to the 68Ga-THP complex. Notably, in vivo tumour uptake and biodistribution of 68Ga-THP-TATE was comparable to that of the clinical radiopharmaceutical, 68Ga-DOTA-TATE.The new tris(hydroxypyridinone) chelator and its conjugates enable