135La for Auger-based therapy: preparation, imaging and emissions

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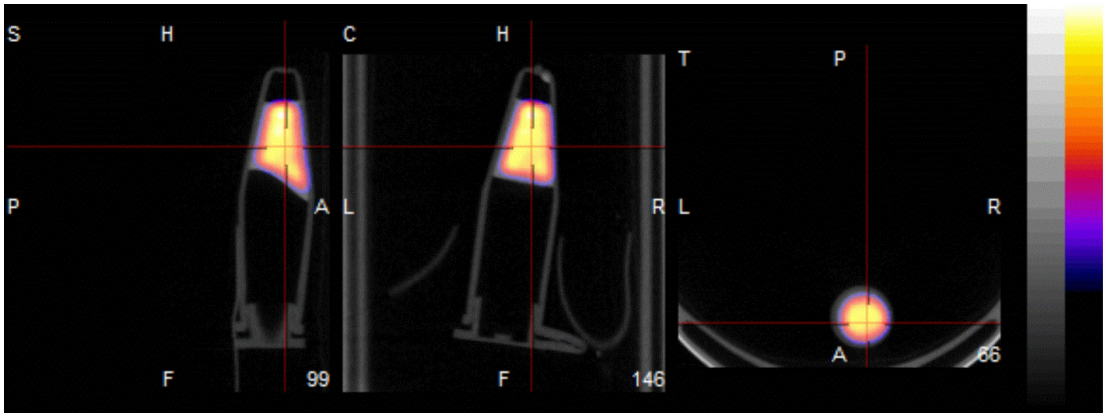
Objectives: Our aim was to determine the suitability of ^{135}La for Auger-based internal radiotherapy. We set out to produce and purify ^{135}La (EC, 19.5 h) from ^{nat}Ba, radiolabel DTPA-mAbs with high specific activity, test X-ray based SPECT/CT imaging capabilities, and calculate detailed X-ray and Auger emission spectra.

Methods: ^{135}La was produced by 16 MeV proton irradiation of ^{nat}Ba metal and purified by extraction from NH_4OAc (*aq.* 30 mM, pH 4.7) onto hydroxamate resin (see ^{44g}Sc from ^{nat}Ca[1]). A DTPA-functionalized-IgG_1 mAb, h11B6 [2], was labeled in NaOAc, pH 5.5, *RT*. X-ray emissions were used for SPECT/CT (BioScan) phantom imaging. X-ray and Auger spectra were determined by Monte-Carlo simulation of the atomic relaxation process[3].

Results: The saturation production yield of ^{135}La was 431 MBq/μA on the thick ^{nat}Ba target. At 13 h post-bombardment the radionuclidic purity was over 95%. The main impurities were the short-lived ^{136}La and ^{134}La (10 min, 6 min), and ^{133}La which is dosimetrically similar to ^{135}La but with a potentially useful 7% β^+ branch for PET imaging. The chemical separation was 96% efficient for La recovery, reducing the Ba content by a factor of ~10^4. DTPA-IgG_1 labeling reactivity was >70 GBq/μmol at 20 h post EOB. A phantom SPECT/CT image, **figure 1,** illustrates the promise of preclinical imaging. The Auger cascade from the isolated neutral atom was calculated to emit 7.7 e^- per decay, ranging in energy from 1 eV to 36 keV (E_{ave} = 0.8 keV).

Conclusions: ^{135}La production from ^{nat}Ba and its ultimate chemical and radionuclidic purity are appropriate to begin preclinical studies. These studies will be augmented by SPECT/CT. Dosimetry on both the cellular and organ level are now calculable using emissions from the entire Auger cascade.

References: [1] Severin GW, et al. (2012) AIP Conf Proc 125:125–128. [2] Tran T, et al Soc Nucl Med Annu Meet Abstr 55:1024. [3] Lee BQ, et al (2012) Comput Math Methods Med 2012:651475.



Phantom SPECT/CT (BioScan) image of 1-1.5 MBq 135La in an Eppendorf tube.