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

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

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Objectives: Our aim was to determine the suitability of 135La for Auger-based internal radiotherapy. We set out to produce and purify 135La (EC, 19.5 h) from natBa, 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: 135La was produced by 16 MeV proton irradiation of natBa metal and purified by extraction from NH4OAc (aq. 30 mM, pH 4.7) onto hydroxamate resin (see 44Sc from natCa[1]). A DTPA-functionalized-IgG1 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 135La was 431 MBq/µA on the thick natBa target. At 13 h post bombardment the radionuclidic purity was over 95%. The main impurities were the short-lived 136La and 134La (10 min, 6 min), and 133La which is dosimetrically similar to 135La 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-IgG1 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: 135La production from natBa 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.

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