Manufacturing and Applications of Sn-117m in Nuclear Medicine

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Sn-117m has unique characteristics that make it ideal for a variety of nuclear medicine applications. The $t_{1/2}$=14d isotope emits a primary 159 keV imaging photon (86%) that is easily detectable with any SPECT camera system. The accompanying mono-energetic conversion electrons (~140 keV; 110%) have a therapeutic effect limited to a range of ~300 μm which also minimizes any shipping and handling issues. Together these characteristics make this theranostic isotope a prime candidate for several personalized nuclear medicine applications.

This isotope can be produced in large quantities as a low specific activity (up to 21 Ci/g) product in reactors via the Sn-116(n,γ) or Sn-117(n,n'γ) reactions. A carrier-free, high specific activity (up to 20,000 Ci/g) isotope can be manufactured with ~50 MeV cyclotrons employing either Sb(p,x) or Cd-116(α,3n). Methods for extracting and purifying the Sn-117m from Sb or Cd have been developed.

Sn-117m has been used to label a wide variety of targets including proteins, anti-bodies and small molecules. In recent animal and human Phase I/II cardiovascular trials to detect and treat vulnerable plaque, the Sn-117m was chelated to aminobenzyl DOTA before being conjugated to annexin V. Results demonstrated the ability of this molecule to both target and image the plaques. Additionally, a remarkable therapeutic effect was observed at very low doses (~10 cGy).

In oncology, Sn-117m (chelated to DTPA) has been successfully used in over 120 humans for bone pain palliation in a Phase I/II trial. Labeling of neuroendocrine cancer targeting molecules has also been demonstrated. The isotope, in low specific activity form, has been electroplated onto stents and implanted into several animal models to demonstrate the efficacy and finite range of the conversion electrons.

Rheumatological applications include a homogeneous Sn-117m colloid that is being used to treat (radiosynoviorthesis) canine osteoarthritis (OA). Future veterinary applications include treating equine OA and human rheumatoid arthritis (RA). Labeled compounds are also being developed to image and treat RA systemically.

Additional future applications being explored take advantage of the limited irradiation of normal tissue in immune and inflammatory CNS conditions that could provide new therapeutic advantages to this immunologically privileged system. In conclusion, the novel isotope Sn-117m is successfully finding application in several aspects of human nuclear medicine and is now also creating new opportunities in the emerging field of veterinary nuclear medicine.

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