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Production of Theranostic 153Samarium-labelled Polystyrene Microspheres for Hepatic Radioembolization

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Introduction: Hepatic radioembolization is a minimally invasive procedure involving intrarterial administration of radioembolic microparticles for the treatment of liver tumours. A biocompatible polystyrene (PS) microparticles containing Samarium-153 (153Sm) were developed for hepatic radioembolization therapy. The incorporation of 153Sm that possessed both diagnostic gamma energy and therapeutic beta radiation has made it a theranostic radioembolic agent for hepatic radioembolization.

Methods: The 152Sm-labelled PS microparticles were prepared using solid-in-oil-in-water solvent evaporation method. The 152Sm-labelled PS microparticles were neutron activated to 153Sm(Eβmax = 807.6 keV, half-life= 46.3 hours) through 152Sm(n,γ)153Sm reaction in a nuclear reactor with a neutron flux of 2.0 × 10^12 n.cm-2.s-1. Physicochemical characterization of the microparticles, gamma spectrometry and in vitro radiolabeling studies were performed to study the performance and stability of the microparticles before and after neutron activation.

Results: The 153Sm-labelled PS microparticles achieved a nominal activity of 4.0 Gbq.g-1 after 6 hours neutron activation. Scanning electron microscope and particle size analysis suggest the microparticles remained spherical with the diameter within 15–60 μm after neutron activation. No long half-life radioimpuirties were found in the samples as indicated by gamma spectrum of the microparticles. The 153Sm-labelled PS microparticles was found to have a radiolabeling efficiency of more than 95% in saline and blood plasma over 480 hours.

Conclusion: The favorable microparticles and radiation characteristics along with excellent radiolabeling efficiency have rendered the 153Sm-labelled PS microparticles as potentially theranostic agent for hepatic radioembolization. This study described a safer method to prepare the microparticles for hepatic radioembolization as the preparation does not involve any harmful ionizing radiation.

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