Biocompatible Iron-Boron Nanoparticles Designed for Neutron Capture Therapy Guided by Magnetic Resonance Imaging

Abstract

The combination of multiple functions in a single nanoparticle (NP) represents a key advantage of nanomedicine compared to traditional medical approaches. This is well represented by radiotherapy in which the dose of ionizing radiation should be calibrated on sensitizers biodistribution. Ideally, this is possible when the drug acts both as radiation enhancer and imaging contrast agent. Here, an easy, one-step, laser-assisted synthetic procedure is used to generate iron-boron (Fe-B) NPs featuring the set of functions required to assist neutron capture therapy (NCT) with magnetic resonance imaging. The Fe-B NPs exceed by three orders of magnitude the payload of boron isotopes contained in clinical sensitizers. The Fe-B NPs have magnetic properties of interest also for magnetophoretic accumulation in tissues and magnetic hyperthermia to assist drug permeation in tissues. Besides, Fe-B NPs are biocompatible and undergo slow degradation in the lysosomal environment that facilitates in vivo clearance through the liver-spleen-kidneys pathway. Overall, the Fe-B NPs represent a new promising tool for future exploitation in magnetic resonance imaging-guided boron NCT at higher levels of efficacy and tolerability.