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Role of the mononuclear phagocyte system in the uptake and accumulation of nanoparticles designed for biomedical applications.

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Abstract

The unique physical-chemical properties of Nanoparticles (NPs) make them suitable for many biomedical applications (drug delivery, imaging, cell tacking) (Yildirimer et al, 2011). However, the design of nanoparticle-based platforms for nanomedicine is extremely challenging and must overcome a number of physiologically constraints, including the Mononuclear Phagocyte System (MPS) (Dawidczyk et al, 2014).

The aim of this study was to assess the role of MPS in the biodistribution and accumulation of metallic NPs [iron-oxide NPS and silver NPs (AgNPs)] after single intravenous administration in mice. 24 hours after the treatment mice were sacrificed and underwent complete necropsy. Liver, kidney, spleen and lung were collected, stained with hematoxylin and eosin (HE), Perls stain (for iron-oxide NPs) or autometallography (for AgNPs), and evaluated under a light microscope. Immunostaining for Iba-1 (pan macrophage marker) was applied to localize the NPs aggregates within MPS cells.

Histologically, in all treated mice, intracytoplasmic brown granular material (consistent with iron or silver pigment, as confirmed by Perls iron stain and autometallography) was found in stained sections of the liver (within Kupffer cells), spleen (MPS of marginal zone and red pulp) and lung (MPS within alveolar septa). Iron/silver deposits were mainly found in the cytoplasm of MPS cells (Iba1 immunostaining), indicating that most of injected particles were removed from blood circulation by phagocytic cells. These findings indicate that MPS greatly influence NPs biodistribution. For this reason, strategies able to increase bioavailability of NPs by minimizing MPS-mediated clearance are needed. Moreover, the potential toxic effects due to the persistence of NPs in MPS should be further investigated.

References

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