MRI Guided Interventions needs new materials and contrast agents

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Abstract

Magnetic resonance imaging (MRI) is primary a diagnostic tool, with or without the use of contrast agents. To enable the use of MRI for interventional purposes, devices are needed that are non-magnetic and non-conductive and visible in MRI. Fiber-composite materials provide enough strength to replace classic metal-based devices, and at the same time provide opportunity to include contrast agents as part of the matrix. Gadolinium chelates are clinically being used ad contrast agents by delivery into the vascular space, and then diffusing into the site (tumor, scar, vessel) of interest, Apart from incomplete diffusion, they are rapidly washed out of the site, and some gadolinium chelates cause specific renal toxicity [1]. With the gradual elimination of commercially available paramagnetic iron oxides from the market, a need for new contrast agents is becoming apparent.

Porphyrins are potential MR contrast agents, considering their stable form within chelate complexes that comprises paramagnetic metal ions and their retention by the site selectively [2]. Hemin, is a protoporphyrin structure that contains a ferric iron ion with a chloride ligand. Hemin occurs in organisms as a prosthetic group of which refers to the ability of use as a biomaterial to perform its imaging function with respect to a medical diagnosis.

The present study aims to evaluate the site enhancing imaging characteristics of novel metalloporphyrin derivatives. In this project we investigate the MRI characteristics of metalloporphyrin derivatives as potential biocompatible MR contrast agent. However, to enable this several technical issues have to be resolved. Hemin is sparingly soluble in aqueous media. Therefore, derivatives of Hemin have been processed for enhancing the solubility as PEGylated Hemin, Hemin Arginate or Hemin Lysinate. This new contrast agent has achieved a high molar Relaxivity in MRI allowing decrease of the required dose for in vivo applications. These derivatives suggest that the size, geometry, and polarity of hemin can be modified to optimize their relaxivities ,pharmacokinetic properties, and biocompatibility.

References

[1] Penfield JG, Reilly RF Jr., Nat Clin Pract Nephrol. Dec 3/12, (2007), 654-68.

[2] Mathew T, Kuriakose S, J. Porphyrins Phthalocyanines **3**, (1999), 316–321.