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Nanoformulations for Antioxidants

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Extended Abstract

The development of nanoparticles for medical use has raised the question regarding the biocompatible impact of these materials. Indeed, nanoparticle induced inflammatory response and toxicity is inextricably linked to cellular oxidative stress, where inflammatory cells release a plethora of cytokines, and reactive oxygen and nitrogen species (ROS & RNS). Strategies which can suppress this localized oxidative toxicity can theoretically extend the biocompatibility window for a wide variety of nanomaterials. Studies have demonstrated that inclusion of small molecule antioxidants with materials can suppress biomaterial-induced inflammation and oxidative stress. However, this method suffers from instability, low loading extents and rapid release of the antioxidant. We have recently developed an antioxidant polymer platform that which allows incorporation of any phenolic antioxidant within the polymer backbone. We have successfully incorporated polyphenols, including quercetin, curcumin, apigenin, resveratrol and trolox, into poly(ester) and poly(B amino ester) chemistries. Degradation of these polymers results in the release of native drug molecules that can scavenge ROS to protect the local environment from oxidative stress. Through tuning of the loading and comonomer selection, it is possible to control the rate of degradation, and formulation potential. Here we demonstrate the potential utility of these polymers in vascular targeting of antioxidant nanoparticles in suppressing iron oxide nanoparticle induced cellular toxicity. Further, we demonstrate that these particles may also have use in suppression of vascular endothelial inflammation, thereby inhibiting metastatic cancer cell adhesion.The computational approaches described here serve as powerful tools to fine-tune nanocarrier design for further clinical consideration. Development of such models, coupled with experiments, is essential to gain useful insights that can be translated into the optimal design of nanocarriers for endothelial targeting in vascular drug delivery.

References

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