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Gold nanoparticles as a part of a photothermal therapy system

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Introduction

Photothermal therapy (PTT) is attracting increased attention for the treatment of superficial localized tumors, relying on the induction of local hyperthermia of tumor cells upon their irradiation with light beams[1]. PTT efficacy depends, however, on the heat generated and, on the depth reached by the light. Some strategies to improve PTT efficacy includes the use of the near infrared (NIR, 650 to 900 nm) radiation to enhance the penetration depth of the light, combined with gold nanoparticles (AuNPs) to enhance the photothermal effect[2].

Experimental Methods

Core AuNPs were synthesized by a novel method using tetrachloroauric acid and a mixture of reducing agents, and subsequently coated with a combination of hyaluronic and oleic acids, for improving the NPs biocompatibility, biodegradability, and lifetime. This coating also promotes the binding of specific cell receptors of the tumor cells. The particles were physico-chemically characterized, and *in vitro* and *in vivo* tests were carried out in breast cancer models to assess their safety and efficacy, when applied alone or combined with NIR irradiation[3].

Results and Discussion

AuNPs presented a predominant spherical morphology with sizes under 350 nm, polydispersity index lower than 0.4 and enhanced absorbance in the NIR. The particles showed no toxicity *in vitro* and promising efficacy *in vivo* when administering the NPs *in situ* and later irradiating them externally. Histopathological analysis of tumors treated with both AuNPs and laser irradiation showed the presence of necrosis in most of the tumors and no effect or practically absence in healthy surrounding cells, which are very encouraging outcomes.

Conclusion

The results are promising, however, there is still room for improving the system, namely by reducing even more the invasiveness of the treatment through the combined use of aerogels structures. Aerogel's unique properties[4] make them ideal candidates to minimize the exposure of healthy tissues to laser radiation, acting as light and thermal insulators, as well as to incorporate the nanoparticles into their skeletal structure and thus potentiating a topical application of the particles. For these reasons, some exploratory methods were carried to produce and design aerogels structures for PTT applications.

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