The promise of nanomaterials for photodynamic therapy in cancer

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Photodynamic therapy (PDT) is a challenging therapeutic strategy in solid tumors that is based on the cytotoxic potential of reactive oxygen species (ROS), acting much in the same way as radiotherapy does. Briefly, a photosensitizer (PS) which is more or less preferentially accumulated in tumors, is precisely activated in the tumor area by light of particular wavelength. PS will consequently generate cytotoxic singlet oxygen, hence triggering tumor cells death by local and intense oxidative burst.

Drawbacks of conventional PDT may be overcome by nanoformulations, mainly those related to the low solubility and unwanted self-aggregability of PS in biological water-based media. Nanoformulations can also increase PDT efficacy by concentrating PS into tumors, and by providing a useful tool for imagistic guidance of the PS-activating light beam towards the tumor. Moreover, co-therapies that modulate the redox status of target cancer cells and hence increase PDT efficacy may be simultaneously delivered with PS in nanoformulations.

Carbon nanosystems show promise for new theranostic approaches in cancer, due to: a) high capacity to encapsulate drugs; b) excellent suitability for surface modifications; c) imagistic power due to hyperechogenicity; c) intrinsic anti-tumor action by photothermal effects. As such, carbon nanomaterials are valuable candidates for simultaneous imagistic diagnosis and multi-component therapy of tumors. Major limitation in using carbon nanosystems in medicine resides in their toxicity (such as blood clotting and inflammatory reactions) albeit it is lower than the toxicity of metal-based nanoparticles.

What is our group expecting from MultiComp: nanosolutions for PDT or other cancer therapies (endoradiotherapy). What is our group offering to MultiComp: advanced biomedical investigations for assessing the efficacy and toxicological profile of carbon-based nanomaterials for targeted therapy in major diseases.