Nanomedicine, bioimaging and biological microenvironment monitoring

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Nanomedicine have gained increasing attention in recent years. Compared to small molecules, nanoparticles have many advantages in biomedical applications such as controlled drug delivery and therapy (by taking advantage of EPR effect). As a collection of atoms/molecules, nanoparticles exhibit much stronger absorbance and emissions compared to small molecular probes, which can provide improved local contrast in biological imaging and sensing applications. However, the toxicity of nanoparticles is a concern for clinical application. Nanosystems that can simultaneously combine diagnosis, therapy, and toxicity evaluation would be highly promising for future clinical applications.

Monitoring of biological microenvironment can provide valuable information for diagnosis and study of complicated biological processes. For examples, the hypoxia, concentrations of reactive oxygen species (ROS) or reactive nitrogen species (RNS), as well as local pH value and temperature change are highly related to many diseases such as cancer, Alzheimer's disease, and some metabolic diseases. However, the in vivo monitoring is difficult because many factors can interfere the measurements in complicated biological environment. In addition, many ROS and RNS species have very short lifetimes, which make the measurements even challenging. Local temperature measurement is important not only for the study of biological processes and metabolism but also for thermotherapy. For example, the temperature in thermotherapy process should be well controlled, i.e. high enough to kill cancer cells while keep healthy cells alive. Therefore, biocompatible nanothermometers (do not cause local inflammations) that can report local temperature are highly desirable for thermotherapy.

Controlled drug delivery using nanoscale capsules with specific targeting can largely improve the drug efficiency and reduce side effects. Nanoparticles assembled from smart biocompatible polymers have great potentials for triggered release upon stimulation of ROS/RNS, local pH value, or temperature change. For example, amphiphilic polymers pre-functionalized with hydrophobic side chains can form nanoparticles by self-assembly, which can encapsulate drugs. After the hydrophobic chain removed by reacting with ROS/RNS or other factors, the particles become loose due to improved solubility in water, which results in the release of encapsulated drugs.

Optical imaging is powerful for drug tracking, monitoring of microenvironment, and evaluating the toxicity of nanoparticles. Among them, fluorescence imaging is widely used for study of the structures and functions of biological systems without perturbing them. However, the poor penetration limits in vivo applications. Two-photon fluorescence (TPF) imaging and photoacoustic (PA) imaging can overcome this limitation, which allow imaging of living tissue up to about one millimeter in depth. Such approaches have great potentials to track biological processes and interactions of chemicals with living subjects. Molecular probes and theranostic nanoprobes with specific targeting are highly desirable for this purpose.

The aim of journal of Clinical Pharmacology and Toxicology Research is to publish original and overview articles that range from drug development, therapy, to design of molecular probes and nanoprobes for biomedical imaging and sensing. We believe that selected articles in this journal match diverse readership.

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