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Nanomaterials for Anti-Cancer Drug Delivery

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During the last decade, nanoparticles have attracted special attention as drug carriers with multiple functionalities. Oncology is the field of medicine that benefits most from nanoparticle application by allowing drug targeting to cancerous tumors. Various chemotherapeutic drugs, imaging agents, and targeting moieties may be encapsulated in the same “teranostic” nanocontainer. The ability to combine chemotherapeutic and imaging agents is especially important because imaging can provide for precise determination of nanoparticle localization, early assessment of response to treatment, and allow personalized therapy. Among various suggested drug carriers, three types, namely liposomes, polymeric micelles, and emulsions are the most extensively studied and developed drug carriers. Pro and contra of their applications will be discussed in detail. Drug encapsulation in nanoparticles allows for active and/or passive drug targeting to tumors. Active targeting is based on ligand/receptor interaction while passive targeting is based on the Achilles heels of cancerous tumors - their defective and poorly organized vascular architecture that allows extravasation of drug-loaded nanoparticles through large inter-endothelial gaps. In contrast to tumors, blood vessels in normal tissues have tight inter-endothelial junctions which do not allow extravasation of nanoparticles. For effective therapeutic action, drugs should be released from nanocarriers at the site of action. This can be provided by developing stimuli responsive drug carriers that release their drug load only in response to environmental or physical stimuli, such as pH, hyperthermia, light, or ultrasound. The interaction of nanoparticles with directed energy is a novel application in targeted drug delivery that actively alters nanoparticle bio-environment for enhancing drug transport through various biological barriers to sites of action, which significantly enhances therapeutic outcome. The state of the art in the application of various nanoparticles for drug targeting to tumors will be discussed, with first in the art demonstrations of nanoparticle circulation and biodistribution in live animals.

Biography

Natalya Rapoport, Ph.D., D.Sc. has completed her PhD from the Karpov Institute of Physical Chemistry and D.Sc. degree from the Institute of Chemical Physics, Russian Academy of Sciences, Moscow, Russia. In 1990 she immigrated into the United States at the invitation of the University of Utah where she held a position of a Research Professor. She is currently a Research Professor Emerita at the Department of Bioengineering, the University of Utah. She has been awarded a number of prestigious awards and several patents in the nanomaterial field. She published more than 100 papers in high-rank journals and served as an editorial board member of reputable journals.

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