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Nanoscale structures as drug carriers for pharmaceutical reformulation

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Nanotechnology is to utilize matter smaller than 100 nanometers and taking advantages of properties that are only presented at this nano-level. Recent advances in nanotechnology have provided various new tools for biomedical research and clinical applications. Nanopharmaceutics is one of the disciplines that will benefit from this technology the most. Nanomaterials, with their unique size-dependent physical and chemical properties, have showed promising advantages as drug and gene delivery vehicles, ultra-sensitive and controllable intracellular payload release, and precisely silence of targeted genes. However, to develop nucleic acids, peptides or chemicals-based pharmaceuticals along with these promising progresses, the high transfection and low toxicology of engineered nanomaterials as carriers exist as a potential barrier and has caught much attention. Therefore, designing nanopharmaceutics for effectively expected bioeffects without significant toxicity has become an important issue for clinical application of novel nanomaterials. Nanotechnology will have a revolutionary impact on clinically based therapy due to the exceptional characteristics of nanopharmaceutics. It is critical to screen and identify novel nanopharmaceutics with an exclusive biological function *in vitro* and *in vivo*. Recently, innovative nanomaterials for pharmaceutics have been discovered as a potential competent drug with negligible cytotoxicity in tissue culture and without detectable side effects *in vivo*. Nanostructures can specifically inhibit the growth of solid malignant tumors in nude mice by direct injection into the neoplasm. The mechanism of how these nanostructures seeking for and docking into tumor after i.v. injection in patient is unknown and still needs further study. This finding may inspire researchers to develop a new generation of nanomaterials with inventive non-traditional approach for disease treatement. The development of nanomaterials will allow for more precise efficiently targeted treatment with less toxicity of clinical therapy.

Biography

Xing-Jie Liang finished his postdoc with Dr. Michael M. Gottesman at Laboratory of Cell Biology, Center for Cancer Research, National Cancer Institute and worked as a research fellow at Surgical Neurology Branch, NINDS. Dr. Liang currently is Deputy Director of Key Laboratory for Biomedical Effects of Nanomaterials and Nanosafety. He is current editorial board member of Acta Biophysica Sinica, Advances in Nano Research, Current Nanoscience and guest editor of Biotechnology Advances. Improved drug delivery efficiency for prevention/treatment of AIDS and cancers are under investigation in Dr. Liang's lab based on understanding of basic physio-chemical and biological processes of nanomedicine. Most protocols are employed for delivering therapeutic compounds to actively target cells or tissues *in vivo* to enhance drug safety and efficacy.

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Magnesium-based biomaterials for mini-implant applications

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Bone fractures often require surgical repair using mini-implants such as screws and plates. Current practice limits these implants primarily to non-degradable metallic materials such as stainless steel, titanium alloys and chromium-cobalt alloys. However, the long-term exposure of these implants greatly increases the risk of complications such as foreign body reactions and inflammation due to the release of ions or particles. This leads to the necessity of a secondary surgery to remove the implant after sufficient tissue healing. Hence, the current research focus is towards developing biodegradable biomaterials, which are expected to dissolve completely after the healing of the tissues.

Metallic magnesium is a potential candidate for more widespread use as a biodegradable implant material. It is biocompatible and degrades naturally in the physiological environment. In fact, magnesium is an essential element in the body and also a co-factor for many enzymes. However, the major issue of using magnesium as a biodegradable implant is that the degradation rate of pure magnesium in physiological conditions is extremely high. This would cause magnesium implants to lose their structural integrity before complete bone healing. In this talk, the developments made to tailor the degradation rate of magnesium will be discussed.

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