molecular pharmaceutics

editorial

Nanoparticles for Imaging, Diagnosis, and Therapeutics

We are pleased to bring you a special issue on "Nanoparticles for Imaging, Diagnosis, and Therapeutics," the theme of the 2008 NanoMedicine Summit, held in Cleveland, Ohio, on September 25−26, 2008. The summit was organized by a team from Cleveland Clinic, Case Western Reserve University, and the Nano-Network (a consortium of nanotechnology researchers and industry professionals in Northeast Ohio). The gathering featured prominent internationally known scientists, physicians, and business experts, discussing the latest research, development, and commercialization of nanomedicine. In his opening remarks at the Summit, Paul DiCorleto, Ph.D., Chairman of Cleveland Clinic's Lerner Research Institute and an expert in cell biology, emphasized the significance of nanomedicine as the next wave of medical innovation. Recognizing plans by the National Institutes of Health to invest in efforts exploring nanotechnology, he noted that all research/medical institutions are striving to find ways to translate laboratory-based research into novel therapies and treatments that will improve patient care. In his overview, Piotr Grodzinski, Ph.D., Director, Nanotechnology for Cancer Programs at the National Cancer Institute's Alliance for Nanotechnology in Cancer, highlighted the vision and goals of the Alliance's cancer nanotechnology programs, aimed at disease prevention, detection, and rapid translational applications of new technologies. This special issue includes contributions primarily by the presenters at the summit with additional invited articles from other experts.

Nanomedicine, which explores medical applications of nanotechnology, is poised to make a significant transition from basic to translational research and commercialization, particularly in the areas of imaging, diagnostics, and drug therapy. The field of nanomedicine may dramatically change the ways different diseases are detected and treated. By virtue of their small size, nanoparticles can overcome cellular, anatomical, and physiological barriers—including even the blood-brain barrier—as well as afford properties that are suitable for imaging and diagnostic applications to detect changes at cellular and molecular levels. Development of multifunctional nanomaterials that can play complementary roles in molecular detection and then respond to detected changes will redefine this paradigm in the future. Modern therapeutics, particularly protein- and nucleic acid-based drugs, as well as water-insoluble drugs, require development of specialized delivery systems to maximize their therapeutic efficacy. Similarly, various nanoscale delivery systems are being developed to achieve precision in targeted drug therapy and to improve drug bioavailability.

This special issue touches on various aspects of nanomedicine. It includes articles and reviews focused on basic research such as biophysical interactions of nanomaterials with lipid model membranes to design and develop effective nanomaterials for drug delivery applications, synthesis of specialized polymeric systems that can deliver anticancer drugs more precisely to tumors, and designing of magnetic nanoparticles to monitor circulating tumor cells, a tool that can effectively be used to monitor the response of the therapy to cancer progression.

This issue also includes articles on novel methods of making nucleic acid-based drug delivery systems using polymers and lipids, formulation of nanomaterials with optical imaging properties to monitor their biodistribution in real time, liposomes that can target the central nervous system in neuroinflammatory disorders, use of silver nanoparticles as an antibacterial agent, and synthesis of novel nanomaterials for imaging applications. Approaches such as achieving drug delivery with magnetic nanoparticles in response to an external magnetic field and refinement of magnetic materials to improve their drug targeting to the diseased area are also covered in this issue. One can see from the scope of these articles the diverse nature of applications of nanotechnology.

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Over the past few decades, collaborative and multidisciplinary research has matured the field of nanomedicine. Polymer and material scientists, physicists and engineers, biologists and clinicians, and pharmaceutical scientists have all contributed to the progression of nanomedicine. The rapid progress in the field is evident from the wide range of different nanotechnologies that have been designed and investigated, and are now at different stages of preclinical and clinical development. As these applications of nanotechnology are being explored, the critical issue of their safety to the patient is also being debated and investigated. How to ensure large-scale manufacturing of nanomedicine is another issue that engineers and pharmaceutical scientists are facing. Despite such challenges, from the pace at which the field is expanding and progressing, one can anticipate many nanomedicine-based therapies in the future.

Advances in nanomedicine will continue as investigators expand their horizon of imagination and design and construct sophisticated systems at the nanoscale level, such as nanomotors, nanomachines, nanorobots, and molecular "tweezers" that may eventually be used to control cellular and biological functions. What may sound like science fiction today could soon become a new generation of nanomedicine.

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