Nanotechnology for fighting cancer

September 20 2004

The National Cancer Institute (NCI) announced today at a media briefing a new $144.3 million, five-year initiative to develop and apply nanotechnology to cancer. Nanotechnology, the development and engineering of devices so small that they are measured on a molecular scale, has already demonstrated promising results in cancer research and treatment

"Nanotechnology has the potential to radically increase our options for prevention, diagnosis, and treatment of cancer," said Andrew von Eschenbach, M.D., director of the National Cancer Institute. "NCI's commitment to this cancer initiative comes at a critical time. Nanotechnology supports and expands the scientific advances in genomics and proteomics and builds on our understanding of the molecular underpinnings of cancer. These are the pillars which will support progress in cancer."

To carry out this initiative, the NCI, part of the National Institutes of Health, is forming the NCI Alliance for Nanotechnology in Cancer, a comprehensive, integrated initiative encompassing researchers, clinicians, and public and private organizations that have joined forces to develop and translate cancer-related nanotechnology research into clinical practice.

"The Alliance lays out a process to safely accelerate the application of nanotechnology to cancer research," said NCI Deputy Director Anna Barker, Ph.D. "Central to this initiative will be multidisciplinary partnerships involving physicists, biologists, clinicians, engineers, and

other experts that can translate knowledge on cancer and nanotechnology into clinically useful products."

The new NCI Alliance for Nanotechnology in Cancer is one of the first steps in implementing the Cancer Nanotechnology Plan, which was developed over the past 18 months with the input of a broad cross-section of the cancer research and clinical oncology communities. The NCI Alliance consists of four major program activities:

• Centers of Cancer Nanotechnology Excellence (CCNEs): The primary goal of the CCNEs is to integrate nanotechnology development into basic and applied cancer research. Each center will be affiliated with a NCI Comprehensive Cancer Center, university, or research center of engineering and physical science. By leveraging existing NCI resources, these centers will bridge gaps in the development pipeline from materials discovery to preclinical testing.

• Multidisciplinary research teams: Given the multidisciplinary nature of nanotechnology research, investigators with basic science and clinical backgrounds will require training to optimize the development and translation of nanotechnologies toward clinical oncology applications. The NCI will initially use existing career development mechanisms to direct talent to this area, create incentives for cross-disciplinary research, and foster collaboration through training.

• Nanotechnology platforms for cancer research: Over the next five years, investigator-initiated and directed project research will be supported in six key programmatic areas: molecular imaging and early detection, in vivo imaging, reporters of efficacy (e.g., real-time assessment of treatment), multifunctional therapeutics, prevention and control, and research enablers (opening new pathways for research).

• Nanotechnology Characterization Laboratory (NCL): The NCL will

perform and standardize the pre-clinical characterization of nanomaterials developed by researchers from academia, government, and industry. The NCL will serve as a national resource and knowledge base for cancer researchers, and facilitate the accelerated regulatory review and translation of nanomaterials and devices into the clinical realm.

The NCI recently signed a memorandum of understanding and an interagency agreement with the National Institute of Standards and Technology to partner with the NCI in this characterization and standardization effort. The NCI will also be working to expand collaborations with the U.S. Food and Drug Administration (FDA) to help define the critical pathway for nanotechnologies to reach the clinic.

Among the key components of the Cancer Nanotechnology Plan are milestones to measure success over two time periods. Within the first three years, the plan calls for acceleration of projects that hold promise for near-term clinical application. After three years, the Alliance will focus on developing solutions to address more difficult technological and biological problems that have the potential to impact detection and treatment.

"We are already seeing how nanotechnology is transforming our ability to translate research advances into clinical advances," said Samuel Wickline, M.D., Professor of Medicine, Physics and Biomedical Engineering at Washington University, St. Louis, Mo., and NCI grantee for nanotechnology research. "The possibilities are enormous for finding very small cancers far earlier than ever before and treating them with powerful drugs at the tumor site alone, while at the same time reducing any harmful side effects. This initiative will allow us to explore using this technology to its full potential."

Recent advances in cancer treatment involving nanotechnology include:

Liposomes, the "first generation" of nanoscale drug delivery devices, were developed to deliver anticancer therapeutics directly at tumors. Specifically, liposomal doxorubicin is being used to treat certain forms of cancer, while liposomal amphotericin B treats fungal infections often associated with aggressive anticancer treatments.

Recently, a nanoparticulate formulation of the well-known anticancer compound taxol was submitted to the FDA as a new treatment for advanced-stage breast cancer.

Other clinical applications of nanotechnology have focused on identifying cancer in its earliest stages, visualizing development of the disease, delivering improved therapy to increase the effectiveness and reduce side effects of drugs, and capturing early signals of drug efficacy.