THINKING SMALL FOR BIG RESULTS

The Incredible World of NanoBiotechnology

Drs. Lajos Balogh and Mohamed Khan

by Jill Max

Scientists have long explored the realms of molecules and cells, but at RPCI's NanoBiotechnology Center, they are immersed in an other dimension: the world of nanoparticles and nanodevices.

With its multidisciplinary team of chemists, material scientists, engineers, biologists, and physicians, the NanoBiotechnology Center uses a collaborative approach to research, engineer and develop nanodevices that can be used to fight cancer. These devices, so small that they are measured on a molecular scale, are showing promising results in cancer research and treatment. "These nanodevices can move in and out of cells or into areas that other, larger devices can not easily access," explained Mohamed Khan, MD, PhD, Co-director of the Center and Director of Basic and Translational Radiation Research. "We think of these nanodevices as multi-functional."

Since it opened in June 2004, the NanoBiotechnology Center has focused on developing nanodevices for cancer detection, imaging and treatment. Much of the current research, which is largely funded by the National Institutes of Health, focuses on imaging tumors. Imaging techniques commonly used today, such as CT scans, are limited in that they can typically only detect tumors larger than about one centimeter, which is approximately one billion cells. But researchers at the Center are developing nanodevices that may be able to pick up microscopic disease by recognizing specific proteins or other markers on cancer cells. The nanodevices are composites made up of an organic molecule that serves as a kind of host that carries "guests," or other types of molecules that provide much better images. Once the nanocomposite recognizes the cancer marker and attaches to previously undetectable cancer cells, the guests emit a bright signal that could be picked up by several imaging devices.

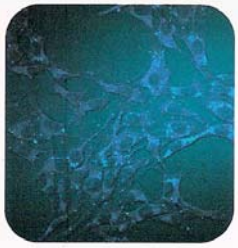
Lajos Balogh, PhD, Co-director of the NanoBiotechnology Center and Director of Nanotechnology Research, likens the process to an envelope being sent in the mail: the organic portion serves as the envelope, the guest is the contents, and the markers are the stamp, making sure that the bloodstream carries the nanodevices to their targets.

In addition to detecting and imaging cancer cells, the NanoBiotechnology Center is researching ways to treat cancer as well. By attaching radioactive molecules to nanocomposites, radiation could be delivered to cancer cells in very small doses without harming the surrounding healthy tissue. Likewise, chemotherapy could be directed at cancer cells, drastically reducing the side effects patients normally suffer with this type of treatment.

Because nanotechnology is an emerging science, researchers at RPCI and elsewhere are still trying to determine exactly how nanodevices operate and if they

cause any harmful effects. Before nanodevices can be used in humans, they must first be tested in the laboratory. "We're looking at nanodevices of different sizes, examining how they'll distribute, what their toxicity is, and what happens to the immune system if we add different molecules," said Khan, who is conducting basic research studies on these miniature wonders.

Although using nanodevices in humans probably won't be possible for at least another five years, RPCI's NanoBiotechnology Center stands at the forefront of nanodevice research and development. "We firmly believe that progress in medical nanodevice technology will come about by building on the scientific advancements of the last 20 years," said Balogh. "We now have the opportunity to approach issues in ways that we could only imagine before."



One out of twelve

One of Only a Dozen...

Roswell Park Cancer Institute has received one of only 12 National Cancer Institute (NCI) grants to establish Cancer Nanotechnology Platform Partnerships. RPCI has been awarded a $3.3 million five-year grant to study "Novel Cancer Nanotechnology Platforms for Photodynamic Therapy and Imaging."

Allan Oseroff, MD, PhD, Chair of the Department of Dermatology and Co-leader of the Biophysical Therapies Program, is principal investigator for the grant and will collaborate with researchers from the University at Buffalo (UB) and the University of Michigan. Oseroff also is Chair of UB's Department of Dermatology.

In making the announcement, Andrew von Eschenbach, MD, Director of the NCI said, "The future of oncology – and the opportunity to eliminate the suffering and death due to cancer – will hinge upon our ability to confront cancer at the molecular level."

Photodynamic therapy (PDT) pioneered at RPCI by Thomas J. Dougherty, PhD, has proven effective for many types of cancers. PDT uses a combination of photosensitizers and light to attack the cancer cells.

Dr. Oseroff and collaborators will develop targeted nanoparticles for delivering light-activated anticancer compounds. Researchers envision the development, characterization and validation of tumor-seeking nanoparticles that carry imaging agents as well as delivering therapeutic photosensitizers. The nanoparticles will allow detection and imaging of cancerous lesions. The images can guide the delivery of light that activates the photosensitizers which allows for selective destruction of cancers.

"Nanotechnology can provide innovative ways to diagnose and treat cancer," said Dr. Oseroff. "This 'see and treat' approach builds on our expertise with tumor-seeking agents that will make it possible to develop multifunctional devices for imaging and delivering localized therapy to malignant tumors."

The funding is part of the NCI's $144.3 million, five-year initiative for nanotechnology in cancer research. The NCI Cancer Nanotechnology Platform Partnerships are tightly focused programs designed to develop the technologies in six program areas which include molecular imaging and early detection, *in vivo* imaging, reporters of efficacy, multifunctional therapeutics, prevention and control and research enablers.

For more information on the NCI Alliance for Nanotechnology in Cancer, please visit **http://nano.cancer.gov**.