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NEWS

RSNA Press Release

Radiology's Role in Gene Therapy: Image and Deliver

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At A Glance

- Radiologists are addressing a great challenge in gene therapy: delivering genes and imaging their subsequent function.
- A safer alternative to delivering genes through viruses are liposomes, which can be imploded with ultrasound.
- "Suicide genes" injected into a tumor cause an inactive drug to become toxic after coming in contact with the gene's proteins.

NEW YORK - Radiologists are at the forefront in developing new technologies for delivering genes into targeted tumors or cells, and imaging their subsequent functions at these sites. Radiologists are also collaborating with oncologists and molecular scientists on such cutting-edge therapies as replacing defective genes and injecting "suicide genes" to help destroy cancerous cells.

"There is a whole new radiological specialty emerging in delivering and imaging genes," said Jonathan B. Kruskal, M.D., Ph.D., section chief of abdominal imaging at Beth Israel Deaconess Medical Center and associate professor of radiology at Harvard Medical School in Boston.

Dr. Kruskal discussed gene therapy today at a Radiological Society of North America (RSNA) media briefing on image-guided therapies.

Gene therapy evolved from the Human Genome Project, a 13-year endeavor by the U.S. Department of Energy and the National Institutes of Health (NIH) to identify and sequence the roughly 30,000 genes in human DNA. A gene is a structure within a chromosome that dictates hereditary characteristics. By altering the gene, researchers are hoping to correct the resulting physical manifestation.

A major challenge in gene therapy is delivering genes to specific sites. Currently, there are two ways for genes to be delivered in the blood system: through viruses and using fat vesicles called liposomes. Viruses attach to specific cells and deploy their contents into the cells, including any genes they might be carrying. But viruses might also attack the cells. An alternative and safer delivery method is via liposomes, which are commonly used to deliver medicines to the body.

"Radiologists use image guidance for delivering these liposomes to specific sites, such as tumors," Dr. Kruskal said. "This delivery can also be enhanced using imaging techniques.

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Focused ultrasound can implode the liposomes, causing them to release their contents, including DNA or genes. Ultrasound also enhances the absorption of the genes into tumor cells, incorporating DNA in the host cell."

Replacement gene therapy delivers a healthy gene to supplant a defective or absent one. According to Dr. Kruskal, certain genes may be absent from tumors. By reinserting or replacing these genes, tumors are made more susceptible to chemotherapies or radiation therapy. Image guidance is typically required for delivering these genes into tumors.

Targeted gene therapy is also being studied in the prevention of vascular disease, he said. Genes directed into the heart and legs can increase angiogenesis, the formation of new blood vessels. Genes directed into the eyes can prevent diabetic retinopathy, a condition of deteriorating blood vessels to the retina.

In the area of cancer research, studies are underway on "suicide genes," which make a tumor more susceptible to radiation treatment and chemotherapy. An inactive drug becomes toxic only when it comes in contact with proteins produced by the suicide genes injected into the tumor, Dr. Kruskal said.

"Targeting delivery of genes to a specific area limits potential patient side effects from the toxicity of the drugs," he said.

Interventional radiologists are studying ways to improve gene delivery to malignant tumors. One method uses a catheter to inject drugs that enhance the porosity, or leakiness, of the vessels around the tumor. This way, the new genes can "leak" into the tumor more effectively. Imaging methods, such as ultrasound and computed tomography (CT), are also used to guide the needle into a tumor and precisely deliver the genes to the targeted area.

Radiologists are also leading the field in developing strategies for imaging successful delivery and function of desired genes. These include new molecular imaging technology and contrast agents.

"Currently, after we deliver the genes we can only measure the tumor," Dr. Kruskal said. "Emerging therapies will enable us to develop imaging techniques that immediately confirm the genes have been delivered to the area and are functioning at that site."

The RSNA is an association of more than 33,000 radiologists, radiation oncologists and related scientists committed to promoting excellence through education and by fostering research, with the ultimate goal of improving patient care. The Society's headquarters are located at 820 Jorie Blvd., Oak Brook, Ill. 60523-2251. (http://www.rsna.org)

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