Dr. Rachela Popovtzer

A Golden Opportunity for Cancer Treatment

CT imaging combines special x-ray equipment with sophisticated computers to produce pictures of the body's internal tissues. When interpreted by a trained radiologist, these fuzzy black-and-white images are an important factor in cancer diagnosis. But what if CT imaging could highlight cancer cells throughout the body, with an unmistakable signal that anyone could read? That's the diagnostic future envisioned by Dr. Rachela Popovtzer, a newly-recruited scientist at Bar-Ilan's School of Engineering.

"Every cancer type is characterized by certain molecular markers," explains Dr. Popovtzer, an expert on electrochemistry and nanotechnology who recently returned to Israel after completing a post-doctoral fellowship at the University of Michigan. "In our lab, we synthesize gold nanoparticles that are covered with antigens – special molecules that link to cancer markers like a lock fitting into a key. When administered to the patient by IV, the nanoparticles travel directly to the cancer cells, covering the membrane with gold. This, in turn, creates an unmistakable signal on the CT image – that these cells are cancerous."

According to Dr. Popovtzer, her technique is not simply an improvement of CT technology. Rather, it represents

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an entirely different way to read CT data. "Some 10 billion markers are found on the surface of each cancer cell, and that means that a huge concentration of the gold nanoparticles adhere to the cellular membrane. The scan can therefore be read, not based on a radiologists' intuition, but on the concentration of gold found in a single pixel of the computerized image."

Another advantage of Dr. Popovtzer's technique is its ability to reveal – early on – whether cancer has spread to other tissues. "The best course of treatment is based on the stage of the cancer," she says. "With this method, it's possible to identify cancer cells all over the body."

In another area of her research, Dr. Popovtzer has designed gold nanorods that form the basis of a new method for targeted, light-activated cancer therapy. "Our nano-structures that can be 'tuned' so they heat up when exposed to near-infrared light," she explains. "When this light penetrates the tissue, the heat from the nanorods destroys the cancer cells, while leaving non-cancerous tissue unharmed."

Dr. Popovtzer's cancer-related research draws on her extensive experience using cutting-edge nanotechnology to solve biological problems. In her PhD studies, she developed an innovative "lab-on-a-chip" that integrated living organisms – genetically-engineered bacteria – into an electronic device used for identifying toxins in water. "With this device, it takes just a minute to determine whether water is safe to drink because thousands of recombinant bacteria – each one sensitive to a different toxin – are mounted into separate cells. When any of these toxins is present, the chip registers an electrical signal. It's the equivalent of screening for thousands of chemicals at one time."

An alumna of Bar-Ilan, where she studied physics and philosophy as an undergraduate before moving to Tel Aviv University for graduate work in biomedical and electrical engineering, Dr. Popovtzer has won numerous Israeli and international prizes for her innovative approaches. She has submitted two patents, and participates in scientific conferences around the world. Still, she's delighted to be home in Israel, and at Bar-Ilan.

"Bar-Ilan University's Engineering School is new, and it's exciting to be part of a community of scientists that's still in formation," she says.

And if her past achievements are any indication, Dr. Popovtzer's scientific potential is as good as gold.