Quantum dots provide quantitative profile of pancreatic cancer biomarkers on single cells

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(Phys.org) -- With the aid of a novel set of lipid-coated, targeted quantum dots, researchers at Johns Hopkins University have developed a method for quantifying multiple specific biomarkers on the surfaces of individual cancer cells. This approach to quantitative biomarker detection stands to improve the histopathology methods used to diagnosis pancreatic and other cancers and enable the development of methods to spot cancer cells circulating in the blood stream.

Peter Searson, co-principal investigator of the Center for Cancer Nanotechnology Excellence at Johns Hopkins, led this study. He and his collaborators published their work in the journal *Nanomedicine*.

The key to the success of this project was developing a method for coating quantum dots, fluorescent nanoparticles that shine brightly at specific wavelengths of light, in such a way as to make the nanoparticles water soluble and to keep them from binding to anything but their targets. The solution was to develop a lipid bilayer, the same strategy that nature uses to create the highly stable cell membrane, which is hydrophilic on the outside and renders the coated particles soluble.

The bilayer coating came with another benefit – it enabled the researchers to attach a specific number of biomarker-binding antibodies in a way that each coated quantum dot would only bind to one biomarker protein on the surface of a single cancer cell. The investigators created a set of three quantum dots, each emitting light of distinct color and each targeted to a different well-characterized pancreatic cancer protein.

To determine the amount of each biomarker on a pancreatic cell surface, the investigators spread tumor cells across a plate and added the targeted quantum dots. In a series of experiments, they demonstrated that they could saturate the biomarker proteins on the cell surface, that is, they could ensure that every biomarker protein on the cell surface was binding one quantum dot.

Dr. Searson's team then used high-resolution quantitative fluorescence imaging to measure the amount of light each cell emitted and used that number to calculate the density of each biomarker on the surface of each cell. The researchers were able to make these measurements with sufficient resolution to determine that one of the biomarkers was not distributed uniformly over the surface of the cell. They also demonstrated that they could make simultaneous measurements of all three targeted biomarkers, a capability essential to the development of high-throughput diagnostic profiling assays.

This work, which is detailed in a paper titled, "Quantitative molecular profiling of biomarkers for pancreatic cancer with functionalized quantum dots," was supported in part by the NCI Alliance for Nanotechnology in Cancer, a comprehensive initiative designed to accelerate the application of nanotechnology to the prevention, diagnosis, and treatment of cancer.

More information: View abstract here.

Provided by National Cancer Institute

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