Nanoprobes hit targets in tumors, could lessen chemo side effects

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(PhysOrg.com) -- Tiny nanoprobes have shown to be effective in delivering cancer drugs more directly to tumor cells - mitigating the damage to nearby healthy cells - and Purdue University research has shown that the nanoprobes are getting the drugs to right cellular compartments.

Professor Joseph Irudayaraj and graduate student Jiji Chen, both in the Department of Agricultural and Biological Engineering, have found that the nanoprobes, or nanorods, when coated with the breast cancer drug Herceptin, are reaching the endosomes of cells, mimicking the delivery of the drug on its own. Endosomes perform a sorting function to deliver drugs and other substances to the appropriate locations.

"We have demonstrated the ability to track these nanoparticles in different cellular compartments of live cells and show where they collect quantitatively," said Irudayaraj, whose results were published early online in the journal *ACS Nano*. "Our methods will allow us to calculate the quantities of a drug needed to treat a cancer cell because now we know how these nanoparticles are being distributed to different parts of the cell."

The nanoprobes, which are about 1,000 times smaller than the diameter of a human hair, are made from gold and magnetic particles. An MRI machine can track the magnetic portions of the nanoprobes while a more sensitive microscopy process can detect the gold.

The nanoprobes were inserted into live human tumor cells during laboratory testing. Using fluorescent markers to differentiate organelles, or sub-units of cells, Irudayaraj's group was able to determine the number of nanoprobes accumulating in the endosomes, lysosomes and membranes of those cells.

Cancer treatments often use high drug concentrations that damage healthy cells near a tumor. While Herceptin is attracted to and attaches to the proteins on the surface of breast cancer cells, healthy surrounding cells absorb some of the chemotherapy drugs through normal fluidic intake.

Irudayaraj said targeting only tumor cells with nanoprobes would require less drugs and mitigate the side effects of cancer chemotherapy drugs.

"Each nanoparticle acts like a deliverer of a mail package, or dose, of the drug directly to the appropriate location," Irudayaraj said.

In Irudayaraj's laboratory tests, endosomes received a major portion of the nanorods containing Herceptin. Lysosomes, which act like garbage collection units in cells and hinder a drug's effectiveness, received a lower concentration of nanorods.

Irudayaraj said those percentages are similar to how cells distribute drugs through traditional treatments.

Irudayaraj will next try to attach multiple drugs to a nanoparticle and track their distribution within cells. He also wants to determine the timing of a drug's release from the nanoprobes after attaching to the tumor cells.

More information: Quantitative Investigation of Compartmentalized Dynamics of ErbB2 Targeting Gold Nanorods in Live Cells by Single

Molecule Spectroscopy, Jiji Chen and Joseph Irudayaraj, *ACS Nano*.

Source: Purdue University (news : web)