Quantum Dots Probe Cell Death

September 5 2006

Aiming to help researchers get a better handle on how – and if – anticancer agents are triggering cell death, investigators at the University of Twente in The Netherlands have developed a quantum dot nanodevice that can detect and image apoptosis, also known as programmed cell death. These results have been published in the journal *Nano Letters*.

Albert van den Berg, Ph.D., and colleagues created their apoptosis nanoprobe using quantum dots that will bind tightly to the naturally occurring protein Annexin V. Annexin V binds to a molecule called phosphatidylserine, a component of cell membranes that becomes exposed to the extracellular environment early in apoptosis.

The investigators found that when linked to Annexin V, quantum dots accumulate on the surfaces of cells that are undergoing apoptosis. However, these Annexin V-coated cells were difficult to work with because they clumped together in solution. The researchers did note that the use of quantum dots coated with poly(ethylene glycol), also known as PEG, might alleviate this clumping problem. However, the researchers chose a different tack, which was to use a pair of linking molecules to bring together Annexin V and the quantum dots after Annexin V had bound to apoptotic cells.

To carry out this strategy, the investigators used streptavidin and biotin, two biomolecules that bind to one another with an unparalleled specificity and avidity. They attached streptavidin to the quantum dots and biotin to Annexin V.

The researchers tested this approach by first treating cells with the anticancer agent camptothecin, which is known to trigger apoptosis. They then added biotin-labeled Annexin V to the cells and, after a suitable delay to allow Annexin V to bind to any phosphatidylserine present on the cells, added the streptavidin-labeled quantum dots. Sixty minutes later, the investigators imaged the cells and showed conclusively that quantum dots were marking those cells undergoing apoptosis.

The researchers then showed that because quantum dots, unlike other dyes, do not bleach over time, these nanoscale monitors could track apoptosis as it was occurring in living cells. This characteristic could prove valuable in real-time studies aimed at discovering new apoptosis-inducing anticancer agents.

This work is detailed in a paper titled, “Quantum dots based probes conjugated to Annexin V for photostable apoptosis detection and imaging.” This paper was published online in advance of print publication. An abstract is available at the journal’s website.

Source: National Cancer Institute