Some scum! Microbe in pond scum enlisted in new cancer test

March 25 2012

Scientists are enlisting the living, self-propelled microbes found in pond scum -- the pea-green surface slicks that form on ponds -- in the development of a long-awaited new test to detect the cells that spread cancer through the bloodstream from the original tumor to new sites in the body.

In a report here today at the 243rd National Meeting & Exposition of the American Chemical Society (ACS), the world's largest scientific society, they described how the test is intended to not only identify the spreading of cells, but allow lab analysis of those cells so that doctors can decide on the most effective treatment.

Yoshinobu Baba, Ph.D., a renowned scientist who led the research using the pond scum microbe called *Euglena*, also discussed promising results with new agents that can both produce images of diseased tissue and deliver treatments.

Baba's team turned to *Euglena* in an effort to solve the medical problem of detecting the minute number of cancer cells that break off from the original, or primary, tumor site and travel through the bloodstream. Those cells, termed circulating tumor cells (CTCs), enable cancer to spread, or metastasize, and start growing at distant sites in the body. Metastasis is the main reason why cancer can be such a difficult disease to treat. Detecting those cells would raise a red flag so that doctors could treat or more intensively monitor patients. Baba pointed out, however, that the small numbers of CTCs make that goal very difficult.

"In every 20 drops of blood, there are over 5 million white blood cells and 4 billion red blood cells, but there may be only one CTC," explained Baba, who is with Nagoya University in Japan. "It is very hard to separate such small numbers of CTCs from the huge numbers of blood cells. After separation, we must also get information about the CTCs, such as the DNA sequence. That DNA sequence can provide further confirmation that that cancer has spread, lowering the risk of false alarms and perhaps help with decisions about treatment."

Baba's solution is a test that takes place in a lab-on-a-chip, a small device made up of microchambers and channels for the *Euglena*, which are single-celled organisms with features of both plants and animals. Historians think *Euglena* are the organisms that Dutch microscope pioneer Anton van Leeuwenhoek saw in 1674 in a sample of pond water. They have chlorophyll to produce food from sunlight, for instance, and also can ingest food. They have a primitive "eye" and a long tail or flagellum that moves like a whip to propel them through the water.

The scientists decided to use *Euglena* as a natural cargo carrier. Baba's team attaches an antibody onto the *Euglena*. That antibody can specifically bind to CTCs. The microbe (with antibody attached) is then placed into a microchamber that contains normal cells and a single CTC, simulating the very low concentration of CTCs that would be in a real cancer patient's blood sample. The antibody on the microbe binds to the cancer cell. When the researchers shine a light on the microchamber, the *Euglena*, with CTC in tow, moves to a neighboring microchamber to escape from the light. Afterwards, the CTC could be removed from the microbe and tested further.

They are working on improvements so that the test will reliably detect very small concentrations of CTCs in real blood samples. They plan to couple the microchamber to a so-called nanopore, which can sequence the CTC's DNA after the separation to positively confirm cancer metastasis.

Baba also is developing "theranostics," which combine therapy or treatment of disease with diagnostic imaging. One of Baba's theranostics involves therapeutic stem cells that are combined with imaging agents called "quantum dots," which are semiconductor crystals that light up when exposed to a special type of light.

"One of the medical doctors in our university hospital injected stem cells into a mouse with liver failure, and the mouse improved," said Baba. "But he didn't know how this improvement happened. To determine the mechanism, we made a new type of quantum dot that would be placed inside the stem cells."

The new quantum dots are biocompatible and are safe for use with living cells, unlike many currently available versions. The quantum dots allowed the researchers to see where the therapeutic stem cells went after they were injected into a mouse.

Baba is now working with medical device companies to commercialize these new tools.

More information:

Abstract

Nanobiodevice is a piece of contrivance, equipment, machine, or component, which is created by the overlapping multidisciplinary activities associated with nanotechnology and biotechnology, intended for biological, medical, and clinical purposes. During the past decade, nanobiodevice has progressively begun to focus on the establishment of main four fields of biomedical applications of nanotechnology, including 1) diagnostic devices, 2) molecular imaging, 3) regenerative medicine, and 4) drug delivery systems. In this lecture, I will describe the development of nanobiodevices to analyze biomolecules and cells

towards biomedical applications.[1-7] I developed nanopillar device for the ultra fast separation of DNA and nanoball materials for the ultrafast separation of wide range of DNA fragments in single molecular level. These devices are also applicable to fast and low invasive blood marker detection of cancer with fM detection sensitivity. Additionally, I developed new synthetic method of quantum dots (QDs) based on the appropriate cluster confirmation by the ab initio molecular orbital calculation. QDs are applied to the development of nanobiodevice for single cancer cell diagnosis, single molecular epigenetic analysis, in vivo imaging for stem cell therapy and theranostic device for cancer diagnosis and therapy.

Provided by American Chemical Society