Creating nanodevices for delivery of vaccines

October 27 2006

A team of Yale biomedical engineers and cell biologists received a $1-million award from the National Science Foundation to develop "smart nanoparticles" for the delivery of vaccines.

Led by Tarek Fahmy, assistant professor of biomedical engineering, the team will apply the two-year, Nanoscale Interdisciplinary Research Team (NIRT) funding to develop a new class of nanomaterials with properties that mimic biological vectors like bacteria and viruses.

"While previous research has shown that safe, biocompatible materials can be engineered into nanoparticles that contain drugs or vaccines, we will develop new materials for vectors that interact specifically and predictably with cells," said Fahmy. "Our nanosystems will be designed to evade the normal barriers and stimulate antigen-presenting cells of the immune system."

The researchers propose to construct the "smart nanoparticle" vaccine delivery system using a simple, modular approach that can be easily modified to meet the requirements of any particular vaccine. They expect this approach to be safer and more effective than current methods of co-administering an adjuvant or delivering live attenuated or killed bacteria or viruses to amplify the immune response.

"We will specifically target antigen-presenting cells such as the dendritic cells that are uniquely responsible for initiating immune responses," said Ira Mellman, chair and Sterling Professor of Cell Biology. "Targeting antigens to dendritic cells is emerging as a powerful novel strategy for

vaccination."

The researchers will also track the fate and biological activity of the "smart nanoparticles" in cultured dendritic cells (DCs), to optimize the fate of the internalized nanoparticles and the release of the encapsulated antigen.

Their approach promises flexibility for integrating different DC surface proteins, enabling optimal DC population targeting and priming, delivery of a wide variety of antigens of clinical importance, and assembly of different combinations of recognition and antigen modules for a broad-spectrum potent vaccine response.

Source: Yale University