Nanoparticle-based method shows promise in DNA vaccine delivery

December 19 2016

Scientists at Brigham and Women's Hospital have developed a novel method for delivering therapeutic molecules into cells. The method harnesses gold nanoparticles that are electrically activated, causing them to oscillate and bore holes in cells' outer membranes and allowing key molecules—such as DNA, RNA, and proteins—to gain entry. Unlike other approaches, the nanoparticles are not tethered to their biological cargo, a refinement that can boost therapeutic potency and effectiveness.

The research team, led by Hadi Shafiee, PhD, assistant professor at Brigham and Women's Hospital, together with first author Mohamed Shehata Draz, PhD, evaluated the technique's ability to deliver a DNA vaccine—specifically, one against the hepatitis C virus (HCV)—into mice. They found that it induced a strong immune response, reflected by high levels of anti-HCV antibodies and immune cells that secrete specific inflammatory hormones. Importantly, Shafiee and his colleagues detected no signs of toxicity in the mice throughout the study period, which lasted nearly 3 months.

"Our concept is unique," says Draz. "Both the electric field parameters and the nanoparticle properties can be augmented to perform other important functions, such as precisely removing cells or blood clots."

There is growing interest in DNA vaccines. First, they offer a potential alternative to conventional vaccines, which are sometimes constructed using weakened microbes—either whole or specific parts. These foreign substances can pose risks to patients, which could potentially be

minimized if DNA—now readily synthesized in the laboratory—is used instead. DNA vaccines also show promise as a tool for taming cancer growth.

Although Draz, Shafiee, and their colleagues began by applying their novel nanoparticle method to DNA vaccines, they underscore its wide-ranging applications.

"One of the really exciting aspects of this new method is that it enables drug delivery into tissues or cells in a universal way," says Shafiee. "We are eager to explore its use for other important biological molecules, including RNA."

More information: Mohamed Shehata Draz et al, Electrically Oscillating Plasmonic Nanoparticles for Enhanced DNA Vaccination against Hepatitis C Virus, *Advanced Functional Materials* (2016). DOI: 10.1002/adfm.201604139

Provided by Brigham and Women's Hospital