Flu vaccine given in microneedle skin patches proves effective in mice

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Flu vaccine delivered through skin patches containing microneedles has proven just as effective at preventing influenza in mice as intramuscular, hypodermic flu immunization. A team of researchers at Emory University and the Georgia Institute of Technology believes the new microneedle skin patch method of delivering flu vaccine could improve overall seasonal vaccination coverage in people because of decreased pain, increased convenience, lower cost and simpler logistics over conventional hypodermic immunization.

The research will be published in the Proceedings of the National Academy of Sciences (PNAS). Another study by the research team on a different influenza strain was described in the journal PLoS ONE.

The patches used in the experiments contained an array of stainless steel microneedles coated with inactivated influenza virus. The patches were pressed manually into the skin and after a few minutes, the vaccine coating dissolved off within the skin. The coated microneedle immunizations were compared to conventional intramuscular hypodermic injections at the same dose in another group of mice.

The researchers found that the microneedle vaccinations induced strong immune responses against influenza virus that were comparable to immune responses induced by the intramuscular, hypodermic immunizations. One month after vaccination, the researchers infected both groups of mice with a high dose of influenza virus. While all mice in a control group of unvaccinated mice died of influenza, all mice in

both the hypodermic and the microneedle groups survived.

"Our findings show that microneedle patches are just as effective at protecting against influenza as conventional hypodermic immunizations," says Richard Compans, PhD, Emory professor of microbiology and immunology and one of the paper's senior authors. "In addition, vaccine delivery into the skin is desirable because of the skin's rich immune network."

Even though cutaneous immunization has been shown to induce a broad range of immune responses, and to be especially effective in individuals over age 60, this method has not been widely used because it has not been convenient and has required highly trained personnel.

"Unlike conventional hypodermic injections, microneedles are prepared in a patch for simple administration, possibly by patients themselves, and inserted painlessly onto the skin without specialized training," says Mark Prausnitz, PhD, professor in the Georgia Tech School of Chemical and Biomolecular Engineering and co-senior author. "These micron-scale needles can be mass produced using low-cost methods for distribution to doctors' office, pharmacies and, possibly, people's homes."

Other advantages of the microneedle patches could include more convenient storage, easier transportation and lower dosage requirements. Lower doses could be particularly important because flu vaccine production capacity sometimes is limited for seasonal vaccine, and a future influenza pandemic would require much greater production of vaccine.

Replacing a hypodermic needle with a microneedle patch also could significantly impact the way other vaccines are delivered, and could be particularly beneficial in developing countries. A microneedle patch could fit inside an envelope for delivery by the postal service and would

occupy much less storage space. Patches also would increase vaccine safety by reducing the dangers of accidental or intentional hypodermic needle re-use.

The project team plans future immunization studies in other animal models, including guinea pigs or ferrets, before initiating studies in humans. Also, more studies are needed to determine the minimum vaccine dose needed for full protection.

The Emory and Georgia Tech research team began developing the new microneedle vaccine patch technology in 2007 using grants from the National Institutes of Health (NIH). The project team has extensive experience in microneedle development, influenza vaccines, vaccine delivery systems, product development and interdisciplinary collaboration.

In 2007 the NIH awarded a $32.8 million, seven-year contract to Emory, along with the University of Georgia, to establish the Emory/UGA Influenza Pathogenesis and Immunology Research Center. The center is working to improve the effectiveness of flu vaccines through a number of different projects studying how influenza viruses attack their hosts, how they are transmitted, and what new immune targets might be identified for antiviral medicines.

Prausnitz and his colleagues have been working since the mid 1990s to develop microneedle technology for painless drug and vaccine delivery through the skin. The Georgia Tech team has also developed manufacturing processes for microneedle patches and tested the ability of the needles to deliver proteins, vaccines, nanoparticles, and other small and large molecules through the skin.

Source: Emory University (news : web)