Scientists find new way to improve MERS vaccines

November 23 2016

Credit: University of Minnesota/NIAID/CC 2.0

Since the Middle East Respiratory Syndrome (MERS) was identified in 2012, more than 1,800 people have been infected with the virus that causes MERS, and the fatality rate is a concerning 36 percent. There's

still no approved MERS vaccine for humans. However, promising new research reported in *Nature Communications* this week may help pave the way for a human vaccine – and give hope for a new era of protection against similar viral infections.

The study was led by Fang Li, associate professor in the Department of Pharmacology at the University of Minnesota Medical School, in collaboration with Lanying Du and Shibo Jiang from New York Blood Center; Yusen Zhou from Beijing Institute of Microbiology and Epidemiology; Chien-Te Tseng from the University of Texas; and Stanley Perlman from the University of Iowa.

Professor Li and colleagues identified a region on an existing MERS vaccine that causes the body's immune system to generate ineffective antibodies, which distract it from generating effective antibodies. In mouse models, this prevented the vaccine from working well. But, by blocking that region and stopping the distraction, the researchers could be one step closer to making a MERS vaccine viable for humans.

There are two types of commonly used viral vaccines. The first type uses whole particles of the virus that have been inactivated or attenuated to nearly harmless levels, which then spark an immune response when injected into a person or animal. By exposing the immune system to those particles, the body builds up virus-specific antibodies to prevent infection.

Another common type of vaccine is called a subunit vaccine. As the name suggests, this type only uses bits of virus proteins – not whole particles of the virus – to prompt the best response after injection. Because this type of vaccine uses only small bits of the virus, there's no chance of infecting the host.

"Subunit vaccines are a compelling method to protect humans from virus

infections because there's no chance for inadvertent infections and they can be made and transported with relative ease." said Li, "But they have shortcomings, too, and don't always work as well as we want them to."

Li and colleagues observed for the first time that when subunit vaccines are taken out of the context of the whole virus particles, these vaccine molecules created large exposed surface areas of the virus structure that were previously buried. These exposed areas on the subunit vaccines appeared to cause a reaction that distracted the immune system from leveraging the effective parts of the vaccines.

To reduce this unintended immune system response, Li and colleagues identified and then masked one of the most unfavorable regions of the vaccine that distracted the immune system. They then measured the resulting immune response in mice and noted significantly enhanced efficacy of vaccination. By masking this unfavorable region, the immune system could focus on producing large amounts of effective antibodies. They believe this concept can be replicated in other subunit vaccines to boost efficacy, improving protection against diseases like HIV, Ebola and influenza.

"The finding can potentially facilitate the design and development of vaccines against other life-threatening viruses," said Li. "In a world where new viruses keep emerging and re-emerging, this study holds the promise to making subunit vaccines a valuable tool to combat virus infections."

More information: Lanying Du et al. Introduction of neutralizing immunogenicity index to the rational design of MERS coronavirus subunit vaccines, *Nature Communications* (2016). DOI: 10.1038/ncomms13473