New needle-free nasal vaccine shows promise for COVID-19

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New research shows that a needle-free mucosal bacteriophage (phage) T4-based COVID-19 vaccine is effective against SARS-CoV-2 infection. The findings were published in *mBio*, an open access journal of the American Society for Microbiology.

In recent years, the Food and Drug Administration authorized mRNA- and adenovirus-based SARS-CoV-2 vaccines. These vaccines are intramuscularly injected in 2 or more doses and are effective in preventing COVID-19, but they do not induce efficient mucosal

immunity or prevent viral transmission.

In the new study, senior study authors Venigalla B. Rao, Ph.D., from the Bacteriophage Medical Research Center, Department of Biology, The Catholic University of America, Washington, D.C., and Ashok K. Chopra, Ph.D., CSc, Department of Microbiology & Immunology, The University of Texas Medical Branch, Galveston, Texas, and their colleagues report the first non-infectious, bacteriophage T4-based, multicomponent, needle and adjuvant-free mucosal vaccine. Both of the senior authors are elected fellows of the American Academy of Microbiology.

In experiments conducted in mice, intranasal administration of 2 doses of the phage T4-COVID-19 vaccine 21-days apart induced robust mucosal immunity, in addition to strong systemic humoral and cellular immune responses. The intranasal vaccine induced broad virus neutralization antibody titers against multiple variants and triggered Th1-biased cytokine responses, strong CD4+ and CD8+ T cell immunity, and high secretory IgA titers in sera and bronchoalveolar lavage of vaccinated mice. All these responses were much stronger in intranasally vaccinated mice than that induced by the injected vaccine. Furthermore, the nasal vaccine provided complete protection and sterilizing immunity against the mouse-adapted SARS-CoV-2 MA10 strain, the ancestral WA-1/2020 strain, and the most lethal Delta variant in mouse models.

Additionally, the T4-COVID-19 vaccine elicited broad virus-neutralizing antibodies against SARS-CoV-2 variants in sera and bronchoalveolar lavage, did not affect the gut microbiota, exhibited minimal lung lesions in vaccinated and challenged mice and is stable at ambient temperature.

"This intranasally administered vaccine generates superior mucosal immunity in mice in addition to inducing robust humoral and cell-

mediated immune responses, and provides complete protection and sterilizing immunity against SARS-CoV-2 variants. The vaccine is stable, adjuvant-free and cost-effectively manufactured and distributed, making it a strategically important next-generation COVID-19 vaccine for ending this pandemic," said Drs. Rao and Chopra. "This modular, needle-free, phage T4 mucosal vaccine delivery platform is an excellent candidate to design efficacious mucosal vaccines against other respiratory infections and for emergency preparedness against emerging epidemic and pandemic pathogens."

More information: Jingen Zhu et al, A Bacteriophage-Based, Highly Efficacious, Needle- and Adjuvant-Free, Mucosal COVID-19 Vaccine, *mBio* (2022). DOI: 10.1128/mbio.01822-22

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