Scientists establish multiple primate models of SARS-CoV-2 airborne infection

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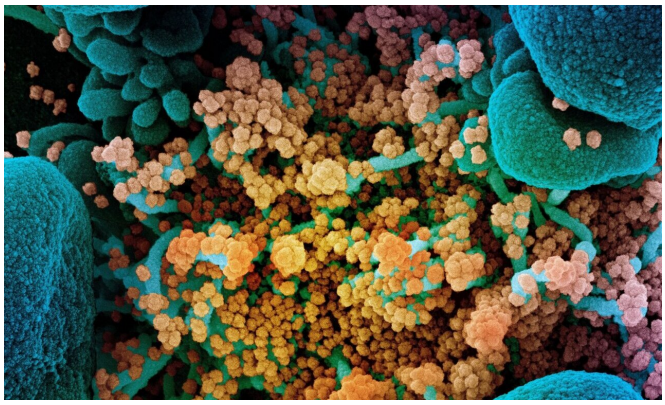

Colorized scanning electron micrograph of a dying cell (blue) heavily infected with SARS-CoV-2 (yellow), the virus that causes COVID-19. Credit: NIAID Integrated Research Facility, Fort Detrick, Maryland.

Army scientists evaluated three nonhuman primate species as potential models of SARS-CoV-2 airborne infection, according to results published online this week in *PLOS ONE*. Their work demonstrates that any of these species may be useful for testing vaccines and therapies in response to the COVID-19 pandemic, which has resulted in over 104 million cases and more than 2 million deaths worldwide in the past year.

Given the global impact of COVID-19, experts are working rapidly to develop medical countermeasures, and testing in animal models is critically important to evaluate the efficacy of these products. Recent studies suggest that aerosol transmission may be the most prevalent route of human exposure to SARS-CoV-2, the virus that causes COVID-19. Until now, however, the African green monkey was the only nonhuman primate model studied in efforts to replicate airborne transmission of the virus.

In this paper, first author Sara C. Johnston, Ph.D., and colleagues at the U.S. Army Medical Research Institute of Infectious Diseases analyzed two additional nonhuman primate species as potential models of COVID-19 in humans.

The team exposed cynomolgus macaques, rhesus macaques, and African green monkeys to SARS-CoV-2 using a model system invented at USAMRIID that generates a controlled dosage of highly respirable airborne particles within a sealed chamber. Scientists then monitored the animals for up to 18 days, documenting clinical disease findings and comparing them to human cases. All three species developed disease that resembled mild acute respiratory disease in human patients, and all had corresponding viral loads in nasal and throat swabs. Respiratory abnormalities and viral shedding also were observed for all animals.

"In general, the clinical disease characteristics we noted are similar to those described by others in the field," Johnston commented. "One exception is the presence of fever in all cynomolgus macaques on this study. This finding was exclusive to cynomolgus macaques and was detected only by using implanted body temperature-monitoring devices. Since fever is a hallmark of COVID-19 for human patients, this represents an important clinical finding."

Developing animal models is a complex process, according to Johnston. Variables include the species selected, the dose of virus used, and the route of exposure, with the goal being to combine these elements to create a model that replicates human disease as closely as possible.

Overall, the USAMRIID data indicate that macaques, in addition to African green monkeys, can be infected by airborne SARS-CoV-2, providing natural transmission models for evaluation of vaccines and treatments.

"In addition to determining critical disease

parameters associated with disease progression, and establishing correlations between primate and human COVID-19, this work directly contributes to the advancement of medical countermeasures against the virus," said USAMRIID senior author Aysegul Nalca, M.D., Ph.D. She said the team's next step is to demonstrate the utility of these primate models for the continuing evaluation of vaccine and therapeutic candidates. Having more than one viable model in place, she added, will help to facilitate a more rapid deployment of new medical products to mitigate the COVID-19 pandemic.

More information: Sara C. Johnston et al, Development of a coronavirus disease 2019 nonhuman primate model using airborne exposure, *PLOS ONE* (2021). DOI: 10.1371/journal.pone.0246366

Provided by US Army Medical Research Institute of Infectious Diseases

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