

Study shows SARS-CoV-2 can infect heart cells in lab dish

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Clive Svendsen, PhD, director of the Cedars-Sinai Board of Governors Regenerative Medicine Institute, at work in his laboratory. Credit: Cedars-Sinai

A new study shows that SARS-CoV-2, the virus that causes COVID-19 (coronavirus), can infect heart cells in a lab dish, indicating it may be

possible for heart cells in COVID-19 patients to be directly infected by the virus. The discovery, published today in the journal *Cell Reports Medicine*, was made using heart muscle cells that were produced by stem cell technology.

Although many COVID-19 patients experience heart problems, the reasons are not entirely clear. Pre-existing [cardiac conditions](#) or inflammation and oxygen deprivation that result from the infection have all been implicated. But until now, there has been only limited evidence that the SARS-CoV-2 [virus](#) directly infects the individual muscle [cells](#) of the heart.

"We not only uncovered that these stem cell-derived [heart cells](#) are susceptible to infection by novel coronavirus, but that the virus can also quickly divide within the [heart muscle cells](#)," said Arun Sharma, Ph.D., a research fellow at the Cedars-Sinai Board of Governors Regenerative Medicine Institute and first and co-corresponding author of the study. "Even more significant, the infected heart cells showed changes in their ability to beat after 72 hours of infection."

The study also demonstrated that human stem cell-derived heart cells infected by SARS-CoV-2 change their gene expression profile, further confirming that the cells can be actively infected by the virus and activate innate cellular "defense mechanisms" in an effort to help clear out the virus.

While these findings are not a perfect replicate of what is happening in the [human body](#), this knowledge may help investigators use stem cell-derived heart cells as a screening platform to identify new antiviral compounds that could alleviate viral infection of the heart, according to senior and co-corresponding author Clive Svendsen, Ph.D..

"This viral pandemic is predominately defined by respiratory symptoms,

but there are also cardiac complications, including arrhythmias, heart failure and viral myocarditis," said Svendsen, director of the Regenerative Medicine Institute and professor of Biomedical Sciences and Medicine. "While this could be the result of massive inflammation in response to the virus, our data suggest that the heart could also be directly affected by the virus in COVID-19."

Researchers also found that treatment with an ACE2 antibody was able to blunt viral replication on stem cell-derived heart cells, suggesting that the ACE2 receptor could be used by SARS-CoV-2 to enter human heart muscle cells.

"By blocking the ACE2 protein with an antibody, the virus is not as easily able to bind to the ACE2 protein, and thus cannot easily enter the cell," said Sharma. "This not only helps us understand the mechanisms of how this virus functions, but also suggests therapeutic approaches that could be used as a potential treatment for SARS-CoV-2 infection."

The study used human induced pluripotent [stem cells](#) (iPSCs), a type of stem cell that is created in the lab from a person's blood or skin cells. iPSCs can make any cell type found in the body, each one carrying the DNA of the individual. Tissue-specific cells created in this way are used for research and for creating and testing potential disease treatments.

"This work illustrates the power of being able to study human tissue in a dish," said Eduardo Marbán, MD, Ph.D., executive director of the Smidt Heart Institute, who collaborated with Sharma and Svendsen on the study. "It is plausible that direct infection of cardiac muscle cells may contribute to COVID-related heart disease."

The investigators also collaborated with co-corresponding author Vaithilingaraja Arumugaswami, DVM, Ph.D., an associate professor of molecular and medical pharmacology at the David Geffen School of

Medicine at UCLA and member of the Eli and Edythe Broad Center of Regenerative Medicine and Stem Cell Research. Arumugaswami provided the novel coronavirus that was added to the heart cells, and UCLA researcher Gustavo Garcia Jr. contributed essential [heart](#) cell infection experiments.

"This key experimental system could be useful to understand the differences in disease processes of related coronaviral pathogens, SARS and MERS," Arumugaswami said.

More information: Arun Sharma et al, Human iPSC-Derived Cardiomyocytes , are Susceptible to SARS-CoV-2 Infection, *Cell Reports Medicine* (2020). [DOI: 10.1016/j.xcrm.2020.100052](https://doi.org/10.1016/j.xcrm.2020.100052)

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