



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

Electron microscopy of SARS-CoV-2: a challenging task

We read with interest the Correspondence by Zsuzsanna Varga and colleagues¹ on the possible infection of endothelial cells by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) using electron microscopic (EM) images as evidence. However, we believe the EM images in the Correspondence do not show coronavirus particles but instead show cross-sections of the rough endoplasmic reticulum (RER). These spherical structures are surrounded by dark dots, which might have been interpreted as spikes on coronavirus particles but are instead ribosomes. The purported particles are free within the cytoplasm, whereas within a coronavirus-infected cell, accumulations of virus particles would be found in membrane-bound

areas in the cisternae of the RER-Golgi area, where the spikes would be located on the inside of the cisternal space.² In addition, cross-sections through the viral nucleocapsid are not seen in the interior of these structures as would be found with coronavirus particles (figure).

Just recently, there have been two additional reports^{3,4} in which structures that can normally be found in the cytoplasm of a cell have been misinterpreted as viral particles.⁵ EM can be a powerful tool to show evidence of infection by a virus, but care must be taken when interpreting cytoplasmic structures to correctly identify virus particles.

We declare no competing interests. The findings and conclusions are those of the authors and do not necessarily represent the position of the US Centers for Disease Control and Prevention.

*Cynthia S Goldsmith, Sara E Miller, Rosecelis B Martines, Hannah A Bullock, Sherif R Zaki
csg1@cdc.gov

Infectious Diseases Pathology Branch, Centers for Disease Control and Prevention, Atlanta, GA 30329, USA (CSG, RBM, SRZ); Department of Pathology, Duke University Medical Center, Durham, NC, USA (SEM); and Synergy America, Atlanta, GA, USA (HAB)

- 1 Varga Z, Flammer AJ, Steiger P, et al. Endothelial cell infection and endotheliitis in COVID-19. *Lancet* 2020; **395**: 1417–18.
- 2 Goldsmith CS, Tatti KM, Ksiazek TG, et al. Ultrastructural characterization of SARS coronavirus. *Emerg Infect Dis* 2004; **10**: 320–26.
- 3 Su H, Yang M, Wan C, et al. Renal histopathological analysis of 26 postmortem findings of patients with COVID-19 in China. *Kidney Int* 2020; published online April 9. DOI:10.1016/j.kint.2020.04.003.
- 4 Kissling S, Rotman S, Gerber C, et al. Collapsing glomerulopathy in a COVID-19 patient. *Kidney Int* 2020; published online April 15. DOI:10.1016/j.kint.2020.04.006.
- 5 Miller SE, Brealey JK. Visualization of putative coronavirus in kidney. *Kidney Int* 2020; published online May 12. DOI:10.1016/j.kint.2020.05.004



Published Online
May 19, 2020
[https://doi.org/10.1016/S0140-6736\(20\)31188-0](https://doi.org/10.1016/S0140-6736(20)31188-0)

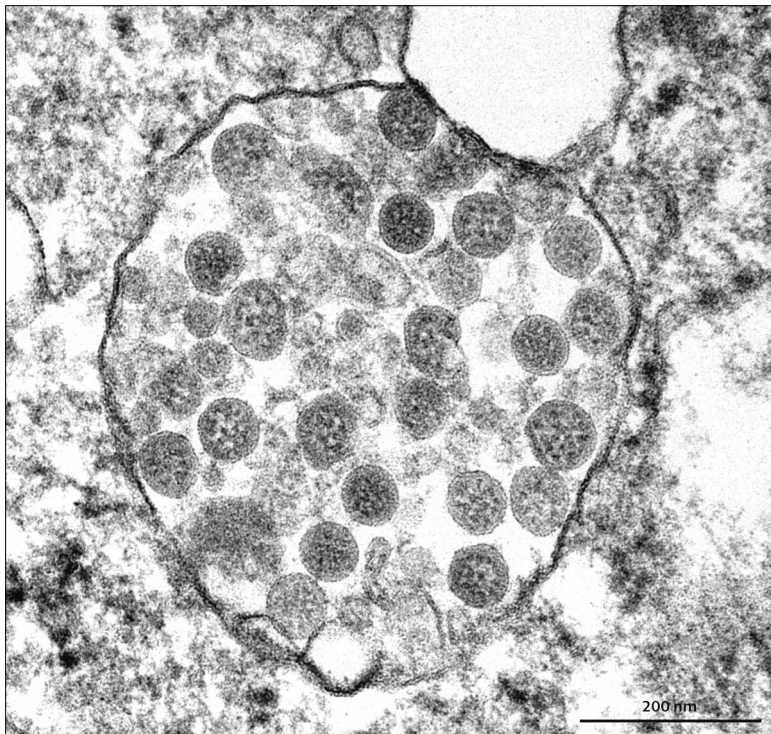


Figure: Viral isolate grown in cell culture

Spherical coronavirus particles with cross-sections through the nucleocapsid, seen as black dots, are clustered within a membrane which separates them from the cytoplasm.

Submissions should be made via our electronic submission system at <http://ees.elsevier.com/thelancet/>