Editorial

Scientific Understanding of COVID-19: The First Step to Vanquishing the Current Pandemic

Eui-Cheol Shin[1,2,*]

[1]Laboratory of Immunology and Infectious Diseases, Graduate School of Medical Science and Engineering, Korea Advanced Institute of Science and Technology (KAIST), Daejeon 34141, Korea, [2]The Center for Epidemic Preparedness, KAIST, Daejeon 34141, Korea
*Correspondence: ecshin@kaist.ac.kr
https://doi.org/10.14348/molcells.2021.0146
www.molcells.org

Coronavirus disease 2019 (COVID-19) is caused by infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and manifests in various clinical forms, from asymptomatic or mild disease to severe disease. Since its emergence in Wuhan, China, in late December 2019, SARS-CoV-2 has spread rapidly worldwide and was declared a pandemic by the World Health Organization (Carvalho et al., 2021). As of June 8, 2021, more than 170 million people have been diagnosed worldwide, and more than 3.5 million people have died of COVID-19 (World Health Organization, 2021). The ongoing COVID-19 pandemic has had devastating impacts on not only public health, but also the economy and society.

In response to the rapid spread of COVID-19, prophylactic vaccines have been developed at an unprecedented pace using diverse platform technologies, including mRNA, viral vector, and inactivated virus (Excler et al., 2021). As of June 8, 2021, more than two billion vaccine doses have been administered worldwide (World Health Organization, 2021). However, variant viruses have been emerging, and neutralizing antibodies elicited by infection or vaccination have reduced activity against some of the variants (Noh et al., 2021). The emergence of SARS-CoV-2 variants that evade neutralizing antibodies makes us concerned about the effectiveness of COVID-19 vaccines.

In preparedness for a newly emerging virus, the first step is scientifically understanding the virus and the host immune responses to the virus. Since the emergence of COVID-19, a lot of studies have been conducted to understand SARS-CoV-2, immune responses to SARS-CoV-2, and the pathogenesis of COVID-19, and these results were immediately published in not only established journals, but also preprint websites. Scientific understanding of SARS-CoV-2 and COVID-19 has enabled us to control the spread of SARS-CoV-2, treat patients with COVID-19, and develop COVID-19 vaccines. This scientific endeavor should be continued until the current pandemic is vanquished.

The current issue of *Molecules and Cells* includes five review articles regarding COVID-19. First, Dr. Young Seok Ju and colleagues review infection models for SARS-CoV-2 (Kim et al., 2021). They describe various infection models, including cell lines, organoids, and animals, and discuss the advantages and disadvantages of each model. This knowledge will be required to develop effective antivirals, as well as understanding the biology of SARS-CoV-2 infection.

Dr. Sung Ho Park reviews the innate immune responses and inflammation in COVID-19 (Park, 2021). He summarizes current knowledge of the innate immune responses elicited by SARS-CoV-2 infection. In addition, he describes mechanisms of hyper-inflammation that cause severe COVID-19 and discusses immunological determinants of the severity of COVID-19.

Dr. Ji Eun Oh and colleague review humoral immunity against SARS-CoV-2 (Lee and Oh, 2021). They describe current knowledge of the humoral immune responses in

COVID-19, including the dynamics of antibody responses, the relationship with disease severity, neutralizing antibodies, cross-reactivity of antibodies, the longevity of humoral immunity, and autoreactive antibodies found in COVID-19 patients. They also discuss the efficacy of therapeutic antibodies and vaccines against SARS-CoV-2 variants of concern.

Dr. Eui-Cheol Shin and colleague review cellular immunity against SARS-CoV-2 (Jung and Shin, 2021). They describe phenotypes and functions of SARS-CoV-2-specific T cells in COVID-19 patients and the relationship with disease severity. In addition, they discuss SARS-CoV-2-specific memory T cells in convalescent patients and unexposed individuals (Rha et al., 2021). They also describe the SARS-CoV-2-specific T-cell responses elicited by COVID-19 vaccines.

Dr. Hyun Goo Woo and colleague review the molecular perspectives of SARS-CoV-2 in terms of pathogenesis, immune evasion, and therapeutic interventions (Shah and Woo, 2021). In particular, they describe immuno modulating interventions for the treatment of COVID-19 and discuss the molecular aspects of immune evasion by SARS-CoV-2. This knowledge will provide insights for the development of more effective therapeutics and for better management of COVID-19 patients.

Currently, we cannot predict the future of the COVID-19 pandemic. What is certain is that an exact understanding of COVID-19 is required to end the current pandemic. Our experience of vanquishing the COVID-19 pandemic by scientific endeavor will bequeath a memory of how to prepare for the next pandemic, like a vaccination for human beings.

CONFLICT OF INTEREST

The author has no potential conflicts of interest to disclose.

ORCID

Eui-Cheol Shin   https://orcid.org/0000-0002-6308-9503

REFERENCES

Carvalho, T., Krammer, F., and Iwasaki, A. (2021). The first 12 months of COVID-19: a timeline of immunological insights. Nat. Rev. Immunol. *21*, 245-256.

Excler, J.L., Saville, M., Berkley, S., and Kim, J.H. (2021). Vaccine development for emerging infectious diseases. Nat. Med. *27*, 591-600.

Jung, M.K. and Shin, E.C. (2021). Phenotypes and functions of SARS-CoV-2-reactive T cells. Mol. Cells *44*, 401-407.

Kim, T., Lee, J.S., and Ju, Y.S. (2021). Experimental models for SARS-CoV-2 infection. Mol. Cells *44*, 377-383.

Lee, E. and Oh, J.E. (2021). Humoral immunity against SARS-CoV-2 and the impact on COVID-19 pathogenesis. Mol. Cells *44*, 392-400.

Noh, J.Y., Jeong, H.W., and Shin, E.C. (2021). SARS-CoV-2 mutations, vaccines, and immunity: implication of variants of concern. Signal Transduct. Target. Ther. *6*, 203.

Park, S.H. (2021). An impaired inflammatory and innate immune response in COVID-19. Mol. Cells *44*, 384-391.

Rha, M.S., Kim, A.R., and Shin, E.C. (2021). SARS-CoV-2-specific T cell responses in patients with COVID-19 and unexposed individuals. Immune Netw. *21*, e2.

Shah, M. and Woo, H.G. (2021). Molecular perspectives of SARS-CoV-2: pathology, immune evasion, and therapeutic interventions. Mol. Cells *44*, 408-421.

World Health Organization (2021). COVID-19 Weekly Epidemiological Update (43rd Edition) (Geneva: World Health Organization).