Perspective

CLINICAL INVESTIGATION

Response of Immune system towards SARS-CoV-2 Infection

Submitted: 28 November 2021; Accepted: 12 December 2021; Published online: 20 December 2021

Chritiana William*

Editorial Office, Journal of Clinical Investigation, London

*Author for correspondence: clinicalinvestigation313@gmail.com

Abstract

Following the 1918 influenza pandemic, the world is once again confronted with a similar dilemma. However, advances in medical science have allowed researchers to determine that the new infectious agent belongs to the coronavirus family. The structure and function of the virus, as well as its immunogenicity in different populations and potential preventive treatments, were all identified thanks to rapid genome sequencing by several organizations. Coronavirus infects the lungs, causing pneumonia and lymphopenia in those who are affected. Viral components such as spike and nucleocapsid proteins activate the host's immune system, causing the virus to be eliminated. In the acute phase of infection, these viral antigens can be identified by B cells or presented to T cells via MHC complexes, resulting in antibody formation, enhanced cytokine secretion, and cytolytic activity. MHC genetic variability allows it to present some T cell epitopes more effectively than other MHC alleles. The relationship between MHC alleles and their downregulated expression has been linked to the severity of sickness caused by influenza and coronaviruses. Infected individuals can produce substantial protective responses after recovery by creating a memory T-cell pool against SARS-CoV and MERS-CoV, according to studies. These memory T cells were not long-lasting and caused local harm when reactivated due to cross-reactivity. According to reports so far, SARS-CoV-2, which is extremely contagious, exhibits similar symptoms in three stages and develops an extensive T-cell pool at higher viral loads. Because there are no particular treatments for this unique coronavirus, COVID-19 patients are given a variety of tiny molecular medications that are used to treat diseases including SARS, MERS, HIV, ebola, malaria, and tuberculosis, and clinical studies for several of these drugs have already begun. For the neutralization of viremia in terminally ill COVID-19 patients, a traditional immunotherapy of convalescent plasma transfusion from recovered patients has also been started. Due to the limits of plasma transfusion, researchers are now concentrating on producing virus-neutralizing antibodies as well as immuno-modulation of cytokines such as IL-6, Type I interferons (IFNs), and TNFs, which could aid in the fight against infection. The similarities between the coronaviruses that caused SARS and MERS and the novel SARS-CoV-2 in terms of pathogenicity and immunogenicity are highlighted in this review, as well as possible therapeutic options that could be used to cure COVID-19.

Introduction

The entire world is currently dealing with a problem that began in late December 2019 with a few cases of pneumonia in Wuhan, China. Fever, dry cough, sore throat, dyspnea, and weariness were all typical complaints among the patients. Swabs from the oral cavity and anal region, as well as blood and Bronchoalveolar Lavage Fluid (BALF), were taken from all seven patients, regardless of their age or gender, and forwarded to the Wuhan Institute of Virology for additional analysis. The scientists used pan-CoV qPCR primers to screen the samples because the outbreak started at a seafood market with the arrival of winter, similar to the previous Severe Acute Respiratory Syndrome (SARS) illness. Surprisingly, coronavirus was found in five of the samples. The causative agent of this respiratory ailment, a novel coronavirus, was identified after a thorough research using next-generation sequencing and phylogenetic analysis (2019-nCoV). As more instances emerged around the world, the World Health Organization named the ailment COrona VIrus Disease 2019 or COVID-19 on February 11, 2020, and declared it a pandemic on March 11, 2020. On the basis of its genetic similarities to a previously known coronavirus, Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV), the virus was renamed from 2019-nCoV to SARS-CoV-2 by the International Committee

on Taxonomy of Viruses. When a healthy person inhales or comes into touch with respiratory droplets from an infected person, SARS-CoV-2 is transmitted. The average incubation period between the onset of disease symptoms and the onset of symptoms is 2 to 14 days. SARS, a zoonotic coronavirus, and Middle East Respiratory Disease (MERS), both caused by a new coronavirus of zoonotic origin and attributed to the genus Betacoronavirus, arose as epidemics in 2003 and 2012, respectively, before the introduction of COVID-19. As of June 15, 2020, the global outbreak of SARS-CoV-2 has put life on pause, wreaking havoc on the global economy and claiming 436,167 lives. Unlike past outbreaks of coronavirus, when it took months to identify the source of infection and sequence the genome, advances in science and technology allowed for a rapid identification of the culprit organism. These quick scientific contributions aided in the development of diagnostic kits and treatment strategies for effective prognosis and prevention. The study emphasise the immunological element of SARS-CoV-2 pathogenesis in this study, taking into account past experimental and clinical insights gained from the coronaviruses that caused SARS and MERS. This method will aid in the more effective use of immunotherapies, the repurposing of existing licensed antiviral medicines, and the development of therapeutic vaccines specific to novel coronaviruses.

Immune Response to SARS-CoV-2

The host immune system detects the complete virus or its surface epitopes once the virus has gained access inside the target cell, provoking an innate or adaptive immune response. Pathogen Recognition Receptors (PRRs), primarily Toll-like receptors 3, 7, and 8, on immune cells are the first to recognize the virus, resulting in increased Interferon (IFN) production. The non-structural proteins of SARS-CoV and MERS-CoV infection impact the function of host innate immune cells, affecting total cytokine output. The humoral response to SARS-CoV-2 was shown to be comparable to that of previous coronavirus infections, with the development of the typical IgG and IgM antibodies. B cells generate an early response against the N protein when infected with SARS-CoV, but antibodies against the S protein were found 4 days-8 days after the onset of symptoms. Despite being smaller than S protein, N protein is highly immunogenic, and the lack of glycosylation sites on it results in the formation of N-specific neutralizing antibodies early in the course of acute infection. SARS-CoV-specific IgA, IgG, and IgM antibodies were found in infected patients at various time points after the beginning of symptoms. IgG levels were stable for a longer time. However IgM levels began to fall after three months. Anti-S-RBD IgG was found in all 16 SARS-CoV-2 patients in an observational case study, whereas anti-N IgG and anti-S-RBD IgM were found in 15 patients and anti-N IgM in 14 patients. The patients developed IgM and IgG antibodies that did not cross-react with other human coronaviruses accept SARS-CoV, according to an ELISA-based temporal kinetics analysis to detect the COVID-19 specific humoral immune response. IgM and IgA antibodies were found 5 days after the onset of symptoms, while IgG was found 14 days later. Another preprint reported the existence of greater IgG and IgM antibody titers in severe patients in a kinetic analysis of viral shedding and antibody detection. They also discovered that weak IgG antibody responders had higher viral clearance than strong IgG antibody responders. This finding suggests that a strong antibody response is linked to disease severity, whereas a weak response is linked to virus eradication. In a case study of paediatric patients, neutralising IgG and IgM antibodies targeting the N and S-RBD proteins of SARS-CoV-2 were found in 5 out of 6 children, indicating that they had a protective humoral response. These results suggest that IgM-based ELISA can be utilised for early patient diagnosis in conjunction with qPCR techniques to improve the technique's sensitivity and specificity.