ISSN: 2149-2018

Applied Medical Research, 2020
VOL 7, NO. 2, PAGE 1 – 2
DOI: doi.org/10.47363/AMR/2020(7)182

SHORT COMMUNICATION

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Immune Response and Immunity to SARS-CoV-2

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ARTICLE HISTORY

Received Dec 06, 2020
Accepted Dec 17, 2020
Published Dec 28, 2020

Introduction

Immune response to SARS-CoV-2 involves both innate immunity-pathogen non specific anti-microbial resistance, and adaptive immunity involves both cell-mediated immunity and antibody production [1,2]. Bats are important reservoirs of zoonotic viruses like SARS-CoV-2, that cause serious disease in humans and other animals with no visible clinical signs of disease in bats and they had mainly innate antiviral responses opposite to adaptive immune response. They have evolved to respond to RNA virus infections associated with a highly contracted IFN genome, and responses to DNA viruses are dampened and the adaptive immune response is not very important as it is in humans [3].

Pathophysiology

The cells of the innate immune system include myeloid cells (monocytes, macrophages, dendritic cells (DCs), and granulocytes) and innate lymphoid cells (ILCs) [1-3]. Then the antigen presenting cells (APCs) after the internalization of the virus present some peptides(the most important the Receptor binding domain of the spike-RBD) to activate T helper-CD4-cells that enable B cells to produce neutralizing antibodies as well as CD8 cytototoxic T cells that identify and destroy virus infected cells. Most of the CD8+ T cell responses were specific to viral internal proteins, rather than spike proteins [4,5]. On the other hand, the effectiveness of the innate immune response against viral infection depends mainly on IFN1 production and its downstream signaling that results in controlling viral replication and induction of an adequate adaptive immune response [4,5].

However the virus could avoid this attack due to the complex immune dysregulation caused by this infection. When the SARS-CoV-2 virus, which causes COVID-19, infects epithelial cells, such as those found in the airways, it replicates inside the cells, using the host cell's biochemical machinery. This causes the host cell to undergo programmed cell death, releasing molecules called damage-associated molecular patterns (e.g. nucleic acids and oligomers) that could lead to an abnormal CD4+ T cell response in acute SARS-CoV-2 infection, whether impaired, over-activated, or inappropriate [4,5].

These molecules are recognized by macrophages and neighbouring endothelial and epithelial cells, causing them to produce cytokine storm or Macrophage activation syndrome and ARDS and multiorgan dysfunction of the more severe cases [4,5].

High-grade chronic viral infections result in CD8+ T and NK cell exhaustion that lead to a decreased effector function and lower proliferative capacity. CD8+ T and NK cell exhaustion leads to over-expression of inhibitory receptors, including CD279 (PD-1) and PD-L1 among others [4,5].

Seroconversion and antibody production occurs by the first two weeks after infection . Like other infections, specific IgM is the first defense to appear, and disappears after a short time, but specific IgG remains a long-term defense against the virus. Therefore, neutralizing IgGs play a major role in the patient recovery and control of infection. IgGs reach their peak in the serum during the convalescent phase, and tend to wane after recovery, but memory B cells could still survive to offer long-term protection. The antibodies in people infected with SARS-CoV-2 dropped significantly within 2 to 3 months but SARS-CoV-2-specific memory T cells could elicit a strong response later [4,5].

Although COVID-19 has numerous manifestations, lung injury and severe respiratory failure (SRF) are more common than others. The cornerstone of this condition is MAS/sHLH or immune dysregulation. The cytokine storm (CS) is typical of macrophage activation syndrome (MAS) or secondary hemophagocytic lymphohistiocytosis (sHLH). Consequently, tissue damage, lung injury and acute respiratory distress syndrome (ARDS) could be expected.

Alveolar macrophages secret IL-6 that cause overproduction of pro-inflammatory cytokines by monocytes, and dysregulation of

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lymphocytes, characterized by CD4 lymphopenia and subsequently B cell lymphopenia. In parallel, the absolute natural killer (NK) cell count is depleted, probably as a result of the rapidly multiplying virus. Moreover, IL-6 decreases the expression of HLA-DR on the membrane and production of IFN-γ by CD4 cells [4,5].

It seems that innate and adaptive immunity, characterized by immune cells and proinflammatory cytokines in the format of the cytokine storm, is trying to limit the infection and overcome the virus; however, it leads to an excessive inflammatory response rather than harming the virus.

The clinical spectrum of COVID-19 varies from an asymptomatic form to severe respiratory failure (ARDS) that necessitates high-flow nasal cannula oxygen, extracorporeal membrane oxygenation (ECMO), mechanical ventilation and support measures in an intensive care unit (ICU) and can lead to multi-organ failure and long-COVID symptoms. Pneumonia is the most frequent acute serious manifestation of COVID-19, characterized primarily by fever, cough, sometimes hemoptysis and dyspnea. Other less common symptoms are headaches, sore throat,rhinorrhea and anosmia and dysgeusia . In addition to respiratory symptoms, gastrointestinal symptoms, myalgia, skin rashes,renal ,neurological involvement and Multisystem Inflammatory Syndrome in Children (MIS-C) have also been reported [4,5].

The progression of therapy according to severity/viral load may go from monoclonal antibodies/convalescent plasma,remdesivir or other anti-viral drug, and tocilizumab as an IL-6 inhibitor and/or glucocorticoids with thromboprophylaxis/anticoagulation everytime it is needed.

The COVID-19 promote age-induced immune cell polarization and gene expression related to inflammation and cellular senescence. The elderly and the very young has a loss of repertoire diversity in immune cells, sometimes increased clonality , and decreased naïve cells which could lead to the development of less memory cells and a deficient immune response [6].

Conclusion

A new era is approaching with the vaccines and we must prioritize the groups,identify the subgroups:pregnant, children, elderly,allergic, immunodepressed,oncological, with cardiovascular disease, already with some immunity against SARS-CoV-2,among other conditions.

We hope as Tureci and Sahin said: “these vaccines could save milliions of lifes beginning in this December 2020!

References

[1] Mantovani A, Mihai N. Trained Innate Immunity, Epigenetics, and Covid-19. N Engl J Med. 2020; 383: 1078-1080.

[2] Preliminary results of first seroepidemiological population studies in EU/EEA Member States and the UK from public sources, as of 30 June 2020- https://www.ecdc.europa.eu/en/covid-19.

[3] Banerjee A, Baker M, Kulcsar K, Misra V, Plowright R,Mossman K. Novel Insights Into Immune Systems of Bats .Front. Immunol., 24 January 2020 https://doi.org/10.3389/fimmu.2020.00026.

[4] Yingfeng Zheng, Xiuxing Liu, Wenqing Le, Lihui Xie, He Li, Wen Wen, et al. A human circulating immune cell landscape in aging and COVID-19, Protein Cell. 2020; 11: 740-770.

[5] Annette Plüddemann, Jeffrey K. Aronson. What is the role of T cells in COVID-19 infection? Why immunity is about more than antibodies. Evidence-Based Medicine, Nuffield Department of Primary Care Health Sciences University of Oxford;Oct/2020.

[6] Jamil Nehme, Michela Borghesan, Sebastian Mackedenski, Thomas G Bird, Marco Demaria. Cellular senescence as a potential mediator of COVID-19 severity in the elderly- aging cell; Sept 2020; https://doi.org/10.1111/acel.13237.