

T cells and COVID-19 Vaccines

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Since the life-changing 2020 COVID-19 lockdown, the biomedical field has not stopped working on the containment and prevention of COVID-19 through the mass production of vaccines. Scientists in the biomedical field have achieved a major milestone, breaking records for effective vaccines. However, their work is far from over as each new vaccine produced, scientists learn more about the disease's immune mechanisms, which drives their passion for long-term perfection. Right now, most COVID-19-related vaccines are very focused on naturalizing antibody (NAbs) responses. NAb are antibodies whose main goal is to prevent a pathogen from causing illness. It achieves prevention by neutralizing basic biological effects through blocking interaction with the host cell (1). In the case of this article, it prevents the entry of SARS-CoV-2. Moreover, there has been growing evidence regarding the correlation between T cells and COVID-19 vaccines. T cell response is crucial in protecting the body against viral variants that are able to evade NAb recognition.

In the case of SARS-CoV-2, T cells have a more protective role than antibodies. Antibodies, when fighting infection and dealing with vaccines, rely on human immunity and cellular immunity, allowing antibodies to prevent infection at high concentrations. However, these antibody levels will decrease rapidly over time, meaning cells will become more prone to infection with no real protection. In contrast, T cells cannot recognize a virus until it has penetrated the cell membrane and entered the host cell. However, T cells hold the ability to work rapidly under pressure to help reduce the virus's ability to colonize, replicate DNA, and spread to another cell. This aspect of the T cell has played a key role in the protection and the prevention of disease progression when antibody responses fail to neutralize new variants like SARS-CoV-2. (2)

It is found and researched that when COVID-19 vaccines were first given to patients, their antibody titers, the concentration of antibodies in blood, were extremely high. Meaning that a patient's immune system has a stronger defense against the pathogen it is fighting. This led to the idea that vaccines can completely prevent the infection and transmission of the initial pathogen. (2,3) However, follow-up studies months prior to the initial vaccination found that neutralizing antibodies decreased significantly within 4-6 months. Additionally, new viral variants, such as Omicron, now have the ability to escape antibody detection, further reducing vaccines' overall effectiveness against foreign pathogens.

Despite viruses' ability to adapt strains and overcome protective antibodies, there is still some sustained defense against hospitalization and death, thanks to cellular immunity. From the article, we see evidence supporting this idea comes from multiple different cases regarding T cell response. In the first case mentioned, cancer patients lacked B cells, crucial for producing antibodies, but possessed CD8+ T cells whose responses tended to experience a milder COVID-19. Taking a different perspective, an animal study found that macaques that did not have CD8+ T cells showed severely reduced protection from infection even with vaccination. (3) Moreover, during the Omicron surge, infection rates skyrocketed, but hospitalization did not increase proportionally. This finding suggests that T cells limit the severity of infection outcomes even when antibody protection fails.

Further research is now underway exploring how to enhance T cell immunity in future vaccines. Scientists are also investigating whether vaccine-induced T cells can form long-term immunity in the respiratory tract, where most infections are able to attach, grow, and spread. Current vaccines only target spike proteins, which are structural proteins found on the surface of a virus and help its entry into the cell. But in recent research, it was found that including viral

proteins like nucleocapsid and membrane proteins can expand cellular response, allowing vaccines to be more resilient to mutation and infection.

New bivalent mRNA booster vaccine shots have been created whose main aim is to target the original COVID-19 strain and the mutated Omicron strain. (3) These results showed only a small increase in antibody levels. Scientists are still puzzled by how exactly these booster shots are able to affect T cell responses. The next step in this development is figuring out which type of T cells, whether it's those in the lungs, nose, throat, or lungs, give the best protection to the body's health. This will be important for the development of future vaccines that have a better and longer-lasting effect.

In all, T cell immunity plays a key role in providing insight into long-lasting protection against COVID-19 and its mutated strains. While antibodies have proved to help stop initial infection, their levels vary over time and could compromise our immune system when they are unable to protect it from new strains. With that being said, future COVID-19 vaccines will have to focus on improving both antibody and T cell responses, targeting viral aspects, and helping T cells protect the body from initial sites.

References

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