COVID-19 Immune Response Improves for Months After Vaccination

Researchers showed that B cells evolve after COVID-19 vaccination to help improve protection against SARS-CoV-2 over time.

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Vaccines are the best way to protect yourself against COVID-19. They elicit a strong defense against SARS-CoV-2, the virus that causes the disease. Vaccines activate your body's disease defense system, called the immune system. The response starts by engaging two kinds of immune cells: B cells, which produce antibodies that fight off the virus, and T cells, which destroy infected cells.

After this initial response, levels of antibodies in the bloodstream begin to fall. But some B and T cells stay around to keep a "memory" of the virus and fight off future infections. In order to optimize future COVID-19 vaccines and predict when booster shots are needed, researchers have been working to gain a better understanding of these memory cells.

In previous work, a research team led by Dr. Ali Ellebedy at Washington University in St. Louis showed that activated B cells can persist for months after COVID-19 vaccination in regions of the lymph nodes called germinal centers. Germinal centers are areas in which B cells can evolve to make more effective antibodies. Long-lasting memory B cells emerge from this process. Some long-lasting antibody-producing B cells may also move into the bone marrow.

In their new study, the researchers set out to track the evolution of B cells against the SARS-CoV-2 spike protein after COVID-19 vaccination. The spike protein was used to develop the COVID-19 vaccines because it allows the virus to latch onto and infect your body's cells.

The team analyzed B cells and antibodies from 43 healthy people who received two doses of the Pfizer-BioNTech vaccine (13 of whom had a past SARS-CoV-2 infection). Researchers collected blood samples both before and for six months after the study participants were vaccinated. They also collected bone marrow and lymph node samples from a subset of participants.

The study was funded primarily by NIH's National Institute of Allergy and Infectious Diseases (NIAID). Results appeared in Nature on February 15, 2022.

At six months after vaccination, the team found both antibodies and memory B cells against the

SARS-CoV-2 spike protein in all participants. Nine of 11 bone marrow samples also had spike-protein specific B cells.

To track the development of the B cells, the team compared B cells from the blood, lymph nodes, and bone marrow samples. They were able to trace the evolution of 1,540 B cell lineages.

The B cells in the blood peaked one week after the second vaccine dose and then quickly disappeared. In contrast, the B cells in the lymph nodes persisted for six months, during which they significantly changed. The antibodies made by these cells became better at binding to and neutralizing the virus. The B cells in bone marrow samples taken six months after the second vaccine dose were similarly improved, suggesting that they were derived from the lymph node B cells.

The study didn't look at whether the B cells or antibodies recognized different virus variants. However, other studies have found that germinal centers can evolve B cells to defend against a range of variants.

"When you look at antibodies, quantity should not be your only concern," Ellebedy explains. "The antibodies at six months might be less in quantity, but they are much better in quality. And that refinement of the antibody response happens on its own. You get your shot, maybe your arm hurts for a day, and then you forget about it. But six months later, your germinal centers are still working, and your antibodies are still getting better and better."

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