Towards a universal vaccine against all coronaviruses

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According to several scientists, it is imperative to develop broad-spectrum vaccines now, capable of protecting against all coronaviruses, to avoid a recurrence of the COVID-19 pandemic in the near future.

The rapid development and production of highly effective COVID-19 vaccines less than a year after the disease emerged will be forever remembered as a milestone in the history of science.

The rapid design of these vaccines was largely made possible by certain biochemical properties unique to the SARS-CoV-2 coronavirus, notably the presence of spicules on its surface essential for its infectivity.

We were lucky in our bad luck: these spicules are very immunogenic and the strong immune response they elicit allows the generation of antibodies capable of neutralizing the virus very effectively.

It is for this reason that the majority of people affected by the coronavirus survive the disease and that the vaccines produced so far provide great protection against the virus, reaching almost 95% for some of them.

AVOID THE WORST

Despite this good immunity and the extremely rapid development of vaccines, the fact remains that COVID-19 has already caused more than 2.3 million deaths in the past year, to which will be added many lives lost by the time that vaccines can be administered to the entire population of the planet. We must therefore remain humble: if we were to face a more virulent strain of coronavirus, even such a rapid response from the scientific community could not prevent a death toll of a similar magnitude to certain epidemics of the past, for example the Spanish flu in 1918 (about 50 million deaths).

On the other hand, a coronavirus quite similar to the one currently raging, the SARS-CoV-1 responsible for the 2002 SARS epidemic, had a mortality rate of 10%, compared to just under 1% for the Current SARS-CoV-2. Another coronavirus, the Middle East respiratory syndrome coronavirus (MERS-CoV), was even worse, with a death rate of 34%.

Fortunately, these two viruses were much less contagious than SARS-CoV-2 and these outbreaks were neutralized fairly quickly. However, we can imagine how the already difficult situation we are currently living could have become really catastrophic with a contagious virus having a lethality of this order.

LATENT CORONAVIRUS

This potential threat must be taken into account, as coronaviruses are a family of viruses that are extremely widespread and endemic to bats and some wildlife.

Normally, these animals are not in contact with humans and there is little risk that these viruses can infect us; however, ecosystem disruption caused by deforestation, large-scale agriculture and urban sprawl have in many cases destroyed their natural habitats and increased the risk of direct contact with humans.

All experts agree that there will be other coronavirus epidemics one day or another and, without being too alarmist, we must prepare for the next coronavirus to emerge and trigger a pandemic that may be less accommodating and that may require more time to develop a vaccine.

PANVIRUS VACCINE

It is in this context that two articles recently published in the prestigious *Nature* and *Science* call for an immediate mobilization of governments, industry and the university community to develop as soon as possible vaccines capable of neutralizing all coronaviruses (1, 2).

The data collected so far suggests that this approach is feasible: for example, several antibodies neutralizing both SARS-CoV-1 and SARS-CoV-2 have been isolated from the blood of people infected with one or the other. Another of these viruses and antibodies could serve as a starting point for developing vaccines against the SARS-like coronavirus subgenus (sarbecovirus) (3).

Antibodies neutralizing a broad spectrum of coronaviruses, including SARS, MERS and those responsible for seasonal colds, have also been identified and are very interesting candidates for developing a universal vaccine against these viruses (4).

A study showed that nanoparticles containing the RBD domains (essential for infection) of eight different types of coronavirus induce a broad-spectrum immune response that neutralizes not only the coronaviruses present in the particles, but also other unrelated coronavirus (5).

Another advantage of this approach is that it would make it possible to eliminate the risk posed by the continual evolution of coronaviruses to escape the immune system: we can already see it now, certain mutations (that coming from South Africa, in particular) tend to make the COVID-19 coronavirus more resistant to immunity and it is possible that over time the accumulation of these mutations will render current vaccines ineffective.

The scientific means to develop these universal vaccines therefore exist and one can be optimistic about the chances of success of this approach,

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with sustained investments on the part of governments, industry and philanthropic organizations over the next few years.

A very profitable investment since the estimated cost of this type of vaccine is around 150 million dollars to reach Phase 1 (1), which is only a tiny fraction of the loss in trillions of dollars involved by the current pandemic.

(1) Burton DR and EJ Topol. Variant-proof vaccines - invest now for the next pandemic. Nature 2021 ; 590 : 386-388.

(2) Koff WC and SF. Berkley. A universal coronavirus vaccine. Science 2021 ; 371 : 759.

(3) Wec AZ et al. Broad neutralization of SARS-related viruses by human monoclonal antibodies. Science 2020 ; 369 : 731-736.

(4) Wang C et al. Isolation of cross-reactive monoclonal antibodies against divergent human coronaviruses that delineate a conserved and vulnerable site on the spike protein. bioRxiv (Published on-line, October 20th).

(5) Cohen AA et al. Mosaic nanoparticles elicit cross-reactive immune responses to zoonotic coronaviruses in mice. Science 2021 ; 371 : 735-741.

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