

The outbreak of Coronavirus Disease 2019 (COVID-19) has posed a serious problem to global public health. COVID-19 is caused by a novel highly pathogenic coronavirus SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2) first reported in Wuhan City, China in December 2019. SARS-CoV-2 has now spread all over the world and become pandemic. The development of an effective antiviral treatments and vaccine to stop the spread of this deadly virus has become the most urgent goal in the scientific community.

In less than a year, several vaccines based on novel technologies, including mRNA and adenoviral vectors, have shown high efficacy in clinical trials and become available for large-scale vaccination. However, concern about vaccine efficacy has arisen with the emergence and spread of the SARS-CoV-2 variants, which carry multiple mutations in the spike (S) protein—the main target for the COVID-19 vaccines already rolled out or in development. So far, several studies showed a significant reduction in virus neutralization for some variants, which could have serious ramifications for the currently available vaccines. Therefore, the design of effective, widely applicable novel vaccines against SARS-CoV-2 targeting the conserved regions of the S protein could be beneficial in terms of newly arising variants.

Virus-like particle (VLP) based vaccines are an interesting tool in current vaccinology. VLPs are non-replicating recombinant protein structures morphologically similar to native virions. Due to the lack of viral genetic material, VLPs are safe and have been already tested as vaccine candidates. Hepatitis B virus small surface antigen (sHBsAg) has ability to self-assemble into non-infectious, highly immunogenic VLPs, which are currently used worldwide as the first commercial recombinant vaccine, licensed for human use since 1986. Because of its immunogenic potential, sHBsAg was also applied as an antigen carrier to deliver foreign sequences and induce anti-foreign immunological response.

In our previous studies we proposed an anti-HCV vaccine candidate in which selected epitopes derived from HCV were exposed on the small surface antigen of the Hepatitis B virus (sHBsAg) virus like particles (VLPs). Our approach became successful in eliciting specific and neutralizing antibody response against HCV. Building on our previous results, the objective of this project is to examine immunogenic properties of a selected conserved epitopes of spike protein exposed on the sHBsAg particles and evaluate their ability to induce neutralizing response against SARS-CoV-2 variants. The most promising vaccine candidate will be used in SARS-CoV-2 challenge studies in transgenic mouse model.

As outlined above, design of an effective, widely applicable and universal pan-SARS vaccine is still an open research field. We hope that our approach will contribute to understanding the immune response against potentially conserved epitopes derived from spike protein of SARS-CoV-2 and provide new insights into pan-SARS rationally designed vaccine.