R & D of virus-like particle vaccine modality that is compatible with chemical synthesis

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In this study, we propose a 'chemically synthesizable virus-like particle modality vaccines' as a novel vaccine modality that combines the advantages of mRNA and virus-like particle (VLP) vaccines. COVID-19 pandemic has accelerated the development and social implementation of new vaccine modalities. mRNA vaccines can be manufactured solely through chemical synthesis without the use of culture cells or chicken eggs, offering an advantage in terms of CMC management in manufacturing. However, their application as a vaccine modality presents challenges due to the need for unique antigen structures to enhance immunogenicity, as the antigen proteins expressed within the cells in vivo are directly presented to the immune system. VLP vaccines are technically capable of presenting antigens uniformly on their particle surfaces and adding an adjuvant, leading to selective induction of antibodies against target epitopes. However, traditional VLP vaccines use cultured cells, presenting manufacturing challenges compared to mRNA vaccine platform. Therefore, in this study, we try to develop a new vaccine modality that combines the advantages of both. Moreover, we acquire non-clinical proof-of-concept of new vaccine modality that can selectively induce protective antibodies against a target epitope, which has been difficult to achieve in current vaccine modalities.

We focus on influenza virus as the target infectious disease, and advance the research and development of a vaccine that is highly effective against antigenically divergent virus strain. In this project, the research and development team has already identified the conserved epitope that have the potential to adapt to this vaccine modality, and is conducting non-clinical development of current modality influenza vaccines aimed at inducing cross-protective antibodies against the epitope. In this study, the principal investigator's group is advancing the design of vaccine antigens with improved antigenicity and immunogenicity through multi-disciplinary approaches utilizing information science, human B-cell immunology, and virology. The chemical synthesis of nanoparticles equipped with designed antigens and encapsulating TLR agonists with excellent immunostimulation activity will be conducted by Sumitomo Pharma, a co-research institution. With a multi-disciplinary team encompassing industry and academia, we aim to realize the development of 'chemically synthesizable influenza vaccine' presenting the target epitopes. The new modality would have a broad spectrum of applications for preventing infectious diseases, such as for priority infectious diseases like pandemic influenza virus and SARS-CoV-2, and for diseases like HIV and hepatitis C that still lack vaccines.