HOW TO CREATE A VACCINE AGAINST SARS-CoV-2

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Background: SARS-CoV-2 has caused a pandemic, overwhelming health care systems worldwide. Clinical manifestations of COVID-19 vary broadly, ranging from asymptomatic infection to acute respiratory failure and death, yet the underlying mechanisms for this high variability are still unknown. Vaccination is one of the most efficient preventive measures taken against life-threatening infectious diseases. Currently, there are no effective vaccines or treatments available for this virus.

Aim: The aim of the proposal is the knowledge-based development of next-generation novel vaccine prototype for preventive therapy of coronavirus SARS-CoV-2.

Material and Methods: We performed *in silico* analysis of the coronavirus sequence to identify immunogenic coronavirus B and T cell epitopes; peptide epitope synthesis; virus-like particle assembling. The model of humanized ACE2-transgenic C57B6 mice was developed to study the administration of constructed virus-like delivery particles.

Results: The HLA binding affinities of the peptides originating from the four structural SARS-CoV-2 proteins, were predicted by the servers EpiJen, EpiTOP and EpiDOCK. Then, the synthesized peptides comprising immunogenic T- or B-cell immunodominant coronavirus epitopes were attached to the surface of the delivery nanoparticles to form virus-like particles. This treatment with vaccine prototype is expected to generate virus-specific T and/or B-cell immune response and to serve as *in vivo* validation of the protective properties of a nanoparticle-based multi-epitope vaccine in hACE2 transgenic mouse model and to generate strong SARS-CoV-2-specific CTL response.

Conclusion: The engineered virus-like particles bind selectively to TLRs on APCs, and induce in these cells strong activating signal via their surface receptors. The mechanism is involved in antigen presentation which can be translated to stronger B and CD8+T immune responses.