MITIGATION - SCIENCE AND TECHNOLOGY ADVANCES FOR CHEMICAL AND BIOLOGICAL HAZARD MITIGATION

Linear Peptide Micro Array Platform For Development Of Mucosal Immune Enhancers And Saliva-based Diagnostics

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The portal of entry and immediate place of residency for all respiratory viruses is the mucosal lining of the nasopharynx. Standard vaccines have been predominantly directed towards generating blood-sera circulating antibodies, or the IgG type and not IgA mucosal antibodies.The IgA2 antibody is the most effective and abundant mucosal antibody available to inhibit and neutralize any viral infection. This antibody, therefore, may be a target for determining initial viral infection for asymptomatic as well as symptomatic individuals and, with IgG, indicating immune response. Under a DTRA contract in response to SARS-Covid-2, a prototype platform was developed to analyze the IgA and IgG immune response to the target virus.

Utilizing a whole genome peptide microarray platform (slides printed in duplicate with whole genome SARS-CoV-2 peptides), we identified linear peptides of the SARS-CoV-2 spike protein that elicited high IgA or IgG binding activity. We compared the immunoreactivity of infected individuals to those who received recommended doses of either the Moderna mRNA-1273 or Pfizer BNT162b2 vaccines. Our results revealed peptide epitopes of significant IgG and IgA binding among recently infected individuals not present in vaccinated individuals.

The peptides were sequenced and produced. These were integrated within standard ELISA and Lateral Flow Assays. Methods for collection and testing saliva samples were evaluated. Over 1,000 saliva samples were evaluated with correlation observed for immune status (IgG) and recent infectivity (IgA).

This platform technology can be developed within 30 days and be applied to other virus by analyzing samples from infected individuals. The immune response regions and associated peptides would be useful in identifying targets for vaccine and therapeutic developmental strategies. Also, identification of specific peptides may serve to study the effect that variant mutations have on antibody binding involved in the viral escape mechanisms. Additionally, the peptides can be microencapsulated with a lectin tag, such as mannose binding lectin (MBL), for viral binding and IgA2 stimulation. Should a virus be present, the lectin assures the proper resonance time for IgA2 response to the peptide antigen. Such a complex could be used as a protective spray to allow for increased immune defense to limit viral binding and replication. Developing assays to screen saliva samples may be helpful with efforts to perform IgA epitope profiling and will aid in the development of saliva-based diagnostics and immunity determinations. This could also include detecting the immune response from the presence of a virus in the upper respiratory system within asymptomatic and pre-symptomatic individuals, possibly prior to detection by other methods. A MBL nasal spray stimulating natural IgA2 immune protection, could be used by personnel prior to deployment to high risk regions or for other mission specific needs.

The Micro Array system platform with associated peptides included in rapid saliva-mucosal tests, will enhance readiness as at risk individuals can be identified and proactive medical steps taken. The identification of immune regions of variant escape, will assist in rapid therapeutic/preventative developmental response in case of an emerging disease, further assisting in readiness posture and maximizing resources.

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