An Effective Peptide Vaccine Against the Zika Virus

Kalavacherla, Sruthi (School: Amador Valley High School)

No effective vaccine against Zika, a positive, single-stranded RNA virus, has been developed. A major obstacle in the design of an antiviral peptide vaccine is the cross-reactivity between the Zika virus and the Dengue virus as both belong to the same family of Flaviviridae, and the Zika virus is emerging in areas where the Dengue virus is endemic. As a result of cross-reactivity between the two viruses, the accentuated immune response may be fatal. While previous studies have focused on the structural proteins of the virus, this study examines various short amino acid sequences of the nonstructural protein 3, NS3, (617 aa) for immunological competence to be CD8+ T cell epitopes. Using the Immune Epitope Database and Analysis Resource (IEDB), Net CTL Version 1.2, and VaxiJen, one novel CD8+ T cell epitope in the protease region of NS3 that is immunogenic, shows only 33 percent similarity with Dengue virus, has a large population coverage in areas affected by Zika, and is conserved in isolates of Zika from ten geographical regions is identified. In addition, through the tool PrediVac, I determined some potential CD4+ T cell epitopes based on MHC class II binding in 6 geographical regions. To know the validity of these procedures, as a control, the protein sequence of hemagglutinin of human Influenza virus A is put through the same analysis, and the results matched with the well-documented epitopes in the IEDB database. Furthermore, as the synthesis of a peptide vaccine can be difficult, I wrote a program in Python to evaluate a set of epitope sequences for the presence of any challenging amino acids that are not ideal for a peptide vaccine. This cost-effective vaccine can significantly improve the treatment of the Zika virus.

Awards Won:

Fourth Award of $500

U.S. Agency for International Development: USAID Science for Development Second Place Award of $3,000.