Scientists develop mathematical model to predict the immune response to influenza

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Researchers at the University of Rochester have developed a mathematical model to predict immune responses to infection with influenza A viruses, including novel viruses such as the emergent 2009 influenza A (H1N1). This model examines the contributions of specific sets of immune cells in fighting influenza A virus. The model also helps predict when during the immune response to viral infection antiviral therapy would be most effective.

The project was conducted by investigators funded through the Modeling Immunity for Biodefense program, a program established in 2005 by the National Institute of Allergy and Infectious Diseases (NIAID), part of the National Institutes of Health, to improve preparedness for emerging and re-emerging pathogens.

When an individual is infected by a virus, a network of immune cells becomes immediately engaged, taking up viral particles and presenting pieces of the virus—antigens—to specialized white blood cells, thereby initiating a virus-specific response. The responding cells include T cells—which either directly attack and eliminate virus-infected cells or help other immune cells fight the virus—as well as B cells, which produce antibodies that bind and neutralize the virus.

The mathematical model developed by the research team generates immune response scenarios reflecting multiple variables, including the pathogenicity of the virus, numbers of responding B and T cells and function of antigen-presenting cells, in the lungs and lymph nodes. Their

model suggests that prolonged viral infection limits the production of T cells and inhibits antigen presentation to immune cells. Confirming previous findings, the mathematical model predicts that antiviral therapy is most effective in reducing the spread of the virus when given within two days after infection.

The research team tested the accuracy of their model in mice infected with influenza A virus. They next plan to apply the model to human populations and continue to improve the model as more data become available.

In addition to the investigators in Rochester, NIAID supports three additional laboratories across the United States as part of the Modeling Immunity for Biodefense program. These scientists are conducting immune modeling research with the goal of developing models to simulate host immune responses to infections or vaccination in order to better treat and prevent diseases affecting millions of people, such as seasonal flu and tuberculosis.

More information: HY Lee et al. Simulation and prediction of the adaptive immune response to influenza A virus infection. Journal of Virology. DOI: 10.1128/JVI.00098-09.

Source: NIH/National Institute of Allergy and Infectious Diseases (news : web)