Development of a model of the immune dynamics during a respiratory infection can aid pharmaceutical development

The mathematical model, which was able to replicate the dynamics of virus and inflammatory cells during a virus infection, can be used as a test module for further investigation of the mechanisms between the immunological defence and virus.

Imagine a future in which computerized models could be used to test pharmaceuticals. Today many patients have to elaborate with different combinations of tablets and doses in order to find the solution that works best for each individual. But with a computerized model of the body these tests could instead be performed on the model. Furthermore the model could be used as a complement during experimental testing and development of new pharmaceuticals.

In this master thesis a mathematical model of the interactions between the immune system and the common cold virus Human Rhinovirus (HRV) was developed. The model was aimed for and used to reproduce the dynamics of viral concentration sampled from the nose of humans infected with HRV. Surprisingly the model was simultaneously able to reproduce the dynamics of virus from the nose and the dynamics of inflammatory cells from the lower parts of the respiratory system i.e. the lungs. The respiratory system has complex immune dynamics and the accumulation of cells and molecules can differ between different parts of the organ. Therefore it is of interest to study how the production and accumulation can differ between the nose and the lungs.

With the model the author was also able to identify the production and clearance of virus, for example by coughing as important factors for the spread of the virus from the nose down to the lungs.

These results could give light into the problem of finding the answer on how HRV is able to fight the immune system during a respiratory infection. Furthermore such findings could be important in the process of understanding why patients with Chronic Obstructive Pulmonary Disease (COPD) have higher concentrations of virus in the lungs compared to controls during a HRV infection or why COPD patients experience symptoms for a longer period of time. The mathematical model of the dynamics between the immune system and HRV could be a helpful tool in the development of a treatment for HRV both for individuals with normal lung function and for patients with COPD.