

Allergic asthma is a manifestation of the allergic inflammatory response in the lung. This response is well-characterized in terms of the cell types involved, but not in terms of its spatiotemporal behavior. We focus here on the observation that mice continually stimulated with antigen eventually have their allergic response resolve back toward baseline.

We propose that the allergic inflammatory response is a sequence of events that includes in its initiation both the onset of inflammation and its resolution. In particular, we hypothesize that the early responding cells of the allergic response become desensitized after continual stimulation by antigen, thereby inhibiting the inflammatory response.

To test the plausibility of this hypothesis, we must take the spatiotemporal dynamics of the underlying cells into account. Thus we created an *in silico* model of the allergic response in a capillary-alveolus interface in the lung using a computational method known as agent-based modeling. In our simulation of our proposed mechanism, we include major cell types such as mast cells, antigen-presenting cells (APCs) and helper T cells. The allergic inflammatory response is triggered once mast cells and APCs encounter particles in the alveolar space. After they encounter a certain number of particles (set by the user), they become inactive for a set desensitization period of time (also determined by the user).

By incorporating spatiotemporal dynamics of the cells of the immune system, we observe that continually stimulating our model with antigen results in oscillations in lung tissue damage and repair that are seemingly independent of the length of the desensitization period. This demonstrates how agent-based modeling can lead to testable predictions of biological behavior that may not be apparent until the spatial and temporal interactions of the many players involved are taken into account.