BIOMATH SEMINAR

Friday, September 26, 1-2 pm

Harris 4119

Dr. Julia Arciero

Dept. of Mathematical Sciences, IUPUI

Using a mathematical model to assess the roles of T cells and cytokines in transplant rejection

Organ transplantation is a life-saving surgical procedure through which the functionality of a failing organ system can be restored. However, without the life-long administration of immunosuppressive drugs, the recipient's immune system will launch a massive immune attack that will ultimately destroy the graft. Long-term use of immunosuppressive drugs leads to an increased risk of infection, cardiovascular disease, and cancer, and thus there is currently a great medical need to identify new strategies of intervention to induce transplant acceptance while preserving the functionality of the immune system. This study introduces an experimentally-based mathematical model to examine the complexities of the dynamic interactions between key elements of the immune system and the transplant and to predict how alterations in the immune response influence the rejection of the transplant. The assumptions and elements of the mathematical model are based on literature data inherent to mouse models of heart transplant rejection and on accepted principles of the activity of the immune system. The model predicts that decreasing the translocation rate of effector cells from the lymph node to the graft generally delays transplant rejection. Interestingly, the model also predicts that this latter relation is not monotonic and instead depends on the relative concentrations of cytokines and the ratio of regulatory T cells to effector cells. In particular, increasing the translocation rate from 0.001/s to 0.067/s doubles the time until graft rejection, while a 25% decrease in pro-inflammatory cytokines and significant increase in the regulatory T cell to effector cell ratio is also observed. This unexpected behavior of the system suggests possible key points of intervention for effective modulation of the rejection response.