Rheumatoid arthritis: a mathematical model

Avner Friedman
Ohio State University, USA

A joint is a structure that connects two parts of the skeleton; in particular, the synovial joint is a joint where two bones are connected. This joint consists of cartilage (as cushion) at each bone-end, synovial fluid (as shock absorber when bones are rotated) and synovial membranes between the cartilages and the fluid. Rheumatoid arthritis (RA) is an autoimmune inflammatory degenerative disease of the synovial joints. The inflammations begins in the synovial membrane by immune cells, and it leads to the destruction of the cartilage. There are two million Americans with RA.

In this talk, I will present a novel mathematical model of RA. The model is presented as a system of PDEs in the three compartments of the synovial joint. As the cartilage layer degrades it becomes thinner, and its boundary that is in contact with the synovial membrane is moving in time as a "free boundary". There is no cure to RA, but drugs are used to try slow the progression of the disease. I shall use the model to evaluate the efficacy of several approved drugs, combination of drugs, and experimental drugs. This a joint work with Nicola Moise from the medical school in Bucharest, Romania.

Finally, I will present rigorous mathematical results, joint with K. Y. Lam, for a simplified model, on the behavior of the free boundary, which is the interface the synovial membrane and the cartilage.