

Two Dimensional Stochastic Model for Atherosclerosis

Jason Pfister Phil Zhang

31 July 2006

Abstract

Atherosclerosis is an inflammatory disease of the arteries caused by a series of biological as well as chemical interactions in the arterial wall that eventually leads to inhibition of blood flow and possibly heart attack. Although initiation of atherosclerosis is unclear, once a lesion appears in the arterial wall, the immune response perpetuates its growth. Existing regions of oxidized low density lipoprotein as well as dead immune cells produce chemicals that attract live immune cells, called macrophages, to dispose of the debris. However, when a macrophage eats an oxidized LDL, it dies and turns into a large dead cell known as a foam cell. These foam cells create more chemoattractants for more immune cells, thus perpetuating the process. It is the accumulation of these foam cells that contributes to the large majority of the growing lesion. In our two-dimensional stochastic model of this inflammatory process, we examine the interaction of four random variables: immune cell population, foam cell population, chemoattractants, as well as oxidized LDL.