Probabilistic analysis of apoptosis and necrosis in cancer cells induced by natural killer cells

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Cytotoxic T lymphocytes and natural killer (NK) cells are the main cytotoxic killer cells of the human body to eliminate pathogen-infected or tumorigenic cells. They can kill target cells via the release of cytolytic molecules, which leads tonecrosis or apoptosis or induce apoptosis via binding to Fas receptors. Experimentally Backes et al. (unpublished) have observed, that the killing mechanism employed by a single NK cell varies in time andthe sequence of the killing mechanisms varies among different cellsof a population. Whether these variations indicate the existence of different NK cell phenotypes, or whether it is a purely probabilistic phenomenonis unknown. We rely on experimental data for these time sequences to modelthe observed sample of killing sequences as realizationsof one or more independent stochastic processes. Each process represents differentNK cell phenotype with different killing characteristics. In addition, we analyze how parameter variation of the model can optimize the killing efficiency of the killer cell population and discuss potential applications to enhance immune reactions.