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A Mathematical Model of Innate and Adaptive Immune Responses Initiated by Superficial Burn Injury

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A Mathematical Model of Innate and Adaptive Immune Responses Initiated by Superficial Burn Injury,

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It is estimated that 1.1 million people in the United States suffer from burn injuries annually. Understanding the collective effects of burns is fundamental for gauging injury severity and predicting healing outcomes. To repair tissue damage, an overlapping, coordinated sequence of events involving highly specialized cells and their byproducts occurs. Pathological inflammation during this process impairs wound healing, increasing the likelihood of adverse health outcomes. Here, we introduce an immunophysiological model of local dermal wound healing following superficial burn injury. The model consists of a system of nonlinear ordinary differential equations that describe dynamics between various innate (neutrophils, macrophages) and adaptive (T lymphocytes) immune cells, as well as early fibroblast activity at the site of injury. A representative parameter set was extracted to establish baseline values. Using the time series predictions for the baseline values as the comparator, numerical simulations were performed, allowing us to further verify the biological plausibility of model's behaviors. We then utilize the model to explore the effect of different inflammatory profiles in promoting timely tissue healing and preventing secondary infection for burn injury.