A Novel Mathematical Simulation to Study the Dynamics of CD4 Cells, CD8 Cells, and HIV Viral Load

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Human Immunodeficiency Virus (HIV), the virus that causes the acquired immune deficiency syndrome (AIDS), affects more than 1.7 million Americans. This infection results in progressive failure of the immune system and an increased susceptibility to opportunistic infections. HIV targets the T lymphocytes, specifically the CD4 (helper) cells and the CD8 (suppressor) cells, resulting in loss of function and eventually in the death of these cells. This study was undertaken to evaluate the effect of HIV viral load on CD4 T cells and CD8 T cells incorporating a population based model known as SIR model. The three compartments comprising this model were S (susceptible), I (infected), and R (removed i.e., immune or killed). Differential equations were established to study the interactions of HIV viral load, CD4 T cells, and CD8 T cells. These were solved using MATLAB ODE 45 module with a time step of 0.001 days and the results graphed and tabulated. The effect of medications on the HIV viral load and the CD4 T cells were also recorded. In the presence of CD4 T cells, the HIV viral load was 40,000 copies per mL at 180 days. However, in the presence of CD8 T cells or medications to treat HIV, the viral load remained suppressed and close to baseline at 180 days. Thus, by using a SIR model, the CD8 T cells and medications were found to play a crucial role in suppression of HIV viremia. This has important implications in devising strategies to combat this deadly disease.