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Dynamics of chronic myelogenous leukaemia cell population with logistic growth and cell division delay

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We develop a nonlinear delay differential equation model to study the dynamics of chronic myelogenous leukemia (CML) cell concentration in the resting phase. In our model, we assume that cells leave the resting phase and enter a proliferation phase of duration τ at a rate that is smoothly dependent on the present concentration and is modelled by a logistic function. We derive a formula for σ from the characteristic equation of the system, which determines the stability of the zero and positive steady states. The study shows that the delay τ can cause stability switches, and the model undergoes a Hopf bifurcation at certain threshold values of τ and exhibits symmetric patterns as the time delay increases. The model is shown to be permanent when a certain condition is met, and numerical simulations are presented to illustrate the model's rich dynamics. The study concludes that when the delay exceeds a certain threshold value, the positive equilibrium vanishes, resulting in the decay of the cancer cells. The graphical representation diagram of the model's dynamics makes it easier to understand and interpret the results. Overall, the model proposed in this article provides insight into the dynamics of CML cancer cell concentration in the resting phase and sheds light on the role of time delay in cancer growth or decay. Joint work with Attila Dénes and Gergely Röst.