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Mathematical model of the mechanism of the activation killer cells after the BCG treatment in bladder cancer

Bladder cancer (BC) is the most frequently occurring urological cancer and the fifth most common cancer among men, accounting for approximately 200,000 new cases worldwide annually. I would like to present a new mathematical model that describes the growth of superficial bladder cancer and the effect thereupon of immunotherapy based on the administration of Bacillus Calmette-Guerin (BCG) combined or not with interleukin-2 (IL-2). Intravesical instillations of BCG performed after surgical removal of tumors represents an established treatment with approximately 50% success rate. So far, attempts to improve this efficiency have not led to essential changes. However, convincing clinical results have been reported on the combination of IL-2 to BCG, even though this is still not applied in current practice. The present model provides insights into the dynamical outcomes arising in the bladder from the interactions of immune cells with tumor cells in the course of BCG therapy associated or not with IL-2. Specifically, from the simulations performed using nine ordinary and non-linear differential equations we obtained indications on the conditions that would result in successful bladder cancer treatment. We show that immune cells effector lymphocytes, natural killer cells and antigen-presenting cells expand and reach a sustainable plateau under BCG treatment, which may account for its beneficial effect, resulting from inflammatory "side-effects" which eliminate residual or eventual newly arising tumor cells, providing thus protection from further cancer development.