Numerical study on the proliferation cells fraction of a tumour cord model

L. M. Abia, O. Angulo, J.C. López-Marcos

Departamento de Matemática Aplicada, Universidad de Valladolid, Valladolid, Spain
abia@mac.cie.uva.es; oscar@mac.uva.es; lopezmar@mac.uva.es

ABSTRACT

The proliferative behaviour at the stationary state of a cell population within a tumour cord has been described by a non-classical boundary value problem for a hyperbolic first order integro-partial differential equation [2]. The model was theoretically analyzed in [5], where sufficient conditions are given on the fraction of cells which enter proliferation to assure the existence of a unique steady state. Also, a more complex model, where cells are distinguished by maturity, had been studied in [4]. In later works, models with variable cell-cycle length [1] or with the effects of drugs and radiation [3] has been developed. From a numerical point of view, there is only an algorithm proposed in [3] in order to make extensive simulations.

In this work, we are going to develop a numerical method for this kind of problem. The numerical scheme we will introduce take into account that the straightforward discretization of the integro-partial differential equation by a finite differences method needs of additional data on the characteristic curve representing the wall of the blood vessel and also that the coupling of the boundary conditions involves the solution of a nonlinear system of equations.

The numerical simulations with the method are used to make a quantitative study of the best functional form (within several classes of functions) for the radial dependency of the function that describes the fraction of newborn cells which become quiescent in the model [3], when compared with experimental field data. The goal of this study is to validate the model under study.

References