Nonlinear Dynamics and Systems Theory, **13** (1) (2013) 79–92

Asymptotic Stability for a Model of Cell Dynamics after Allogeneic Bone Marrow Transplantation

R. Precup *, M-A. Şerban and D. Trif

Department of Mathematics, Babeş–Bolyai University, 400084 Cluj-Napoca, Romania

Received: March 13, 2012; Revised: January 18, 2013

Abstract: The paper presents stability analysis of steady-states of a dynamic system modeling cell evolution after stem cell transplantation. The border of the basins of attraction of the stable equilibria is found providing the theoretical basis for post-transplant correction therapies.

Keywords: *stability; dynamical system; numerical simulation; mathematical modeling.*

Mathematics Subject Classification (2010): 37C75, 37N25, 34D23.

1 Introduction

In [1] a mathematical model essentially owed to Dingli and Michor [2] was used in order to characterize normal and leukemic states and to explain basic pathways through which the robustness of the hematopoietic system can fail leading to leukemia.

Assume that at each time t, the cell population divides into two: the normal population $x(t)$ and the leukemic population $y(t)$. By x_0, y_0 we denote the normal and leukemic populations at a fixed moment of time $t = 0$. Denote by a, b, c and A, B, C (model parameters) the intrinsic (i.e., in the absence of any constraints) growth, microenvironment sensitivity and death rates of normal and leukemic cells, respectively. The conservation laws for normal and leukemic cells can be expressed as a system of two differential equations:

$$\begin{cases} x' = \frac{a}{1+b(x+y)}x - cx, \\ \\ y' = \frac{A}{1+B(x+y)}y - Cy. \end{cases} \tag{1}$$

* Corresponding author: mailto:r.precup@math.ubbcluj.ro

