

A Simple Mathematical Model for a New Type of Cancer Cells

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Abstract

Recently new type of cancer cells has been observed. It is called Hybrid cells. A simple mathematical model is proposed to describe them. It implies that they will be near the tumor surface or circulating. Some comments about the possibility of their reaching brain are given.

Introduction

Hybrid tumor Cells

Recently [1,2,3,4] hybrid tumor cells have been discovered. They have the following properties:

- They circulate more than ordinary tumor cells.
- They have greater ability to migrate and invade other tumors.
- They have greater ability to form metastases.

Motivated by this the following simple model is presented:

Let N_1 , N_2 be the ordinary and hybrid tumor cells respectively. Let $N=N_1+N_2$ hence the tumor growth can be represented by

$$dN_1/dt = r_1 N_1^{2/3} - N, \quad dN_2/dt = r_2 N_2^{2/3} - N, \quad (1)$$

The equilibrium solution for the coexistence of both types is:

$$N_{1eq} = \left[r_1 / (1 + (r_1/r_2)^{3/2}) \right]^{3/2}$$

$$N_{2eq} = \left[(r_1/r_2)^{3/2} / (1 + (r_1/r_2)^{3/2}) \right]^{3/2} \quad (2)$$

It is unstable.

The single species solution is

$$N_1 = r_1^{3/2}, \quad N_2 = 0, \quad (3)$$

And it is stable if $r_1 > 2/3$.


Hence the following conclusion is reached: If $r_2 > r_1 > 2/3$ then most tumors consist of ordinary (non-hybrid) cells. Hybrid cells exist near tumor surface OR circulate.

Conclusion

Since hybrid cells have a greater ability to invade other cells, it is expected that they will invade brain cells. Hence brain diseases can be a good source for identifying them. Moreover, trying to attract them to less important sites can be a feasible strategy to deal with them. It will be difficult to test this idea experimentally, because the hybrid state will not be stable.

References

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