BRIGHAM AND WOMEN'S HOSPITAL

HARVARD MEDICAL SCHOOL

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Department of Medicine
Channing Division of Network Medicine

Channing Network Science Seminar

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Model for Breast Cancer Diversity and Heterogeneity

Abstract: A model of an avascular tumor growth that considers the basic biological principles of cell proliferation, motility, dead and genes mutations is proposed and analyzed. The role of tumor microenvironment is incorporated by assuming that nutrients spatial gradients influence cancer cell metabolism and thus the probability of acquiring new mutations. Two sets of genes were identified –a set of sixteen and six genes– that are believed to play an important role in tumor growth. Gene mutation dynamics was modeled as a stochastic process coupled to nutrients transport equations. For each representative tumor its diversity, represented by the Shannon index, and its spatial heterogeneity, measured by its fractal dimension were calculated. These quantities are important in the clinical diagnosis of tumor malignancy. A tumor malignancy diagram, obtained by plotting diversity versus fractal dimension, was calculated for different values of a parameter β, that modulates proliferation rate due to the occurrence of mutations. It is found that, when $\beta < 1$, tumors show greater diversity and more spatial heterogeneity as compared with $\beta > 1$. More importantly, it is found that the results and conclusions are similar when we use the six-gene set versus the sixteen-gene set.

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Bio: Guillermo Ramírez-Santiago earned a Ph.D. from Northeastern University (Boston) in Condensed Matter theory and a B. Sc. in physics from National Polytechnic Institute (Mexico City). He was a professor at the Institute of Physics at UNAM (Mexico City) for more than two decades and is now at the Institute of Mathematics at UNAM Campus Juriquilla, Querétaro in Mexico. He worked on the subjects of critical phenomena, superconductivity, and soft condensed matter. Recently he has applied his expertise in Statistical Mechanics to model some aspects of exocytosis of neurotransmitters, signal transduction, and evolution of tumors.

Hosted by Yang-Yu Liu