הטכניון - מכון טכנולוגי לישראל

TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

הפקולטה להנדסה כימית
ע״ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar
Lecture Hall 6, Wolfson Department of Chemical Engineering,
Wednesday June 26th at 1:30pm

Modeling Tumor Populations: Zebrafish Melanoma, Mouse Breast Cancer and a Plausible Mechanism for Tumor Dormancy and Recurrence

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Certain types of cancer including breast cancer and melanoma can recur many years after apparently successful treatment. It is a mystery how tumor cells can remain dormant for many years, avoid eradication by the immune system and then reactivate after many years of apparent dormancy. We present a mathematical population balance model to describe how the size distribution of an ensemble of tumors from many patients evolves in time due to mitosis, cell death and metastasis. A transformation recasts the dynamic interplay between tumor growth and shrinkage in these equations into the form of an advective-diffusion equation in tumor size space. These new equations predict and thus provide a plausible mechanism for tumor apparent dormancy and recurrence for certain relationships amongst the three model parameters. After showing that our model easily fits data sets on tumor size distributions in the literature, we present new, far more refined gender- and immune status-segregated data on the zebrafish melanoma. We show that our model also describes these data very well. Study of gender-segregated cohorts shows that gender-dependence only appears in the host-dependent parameter describing tumor shrinkage; it is far more size-dependent in females than in males, which may be relevant for gender differences in human melanoma outcomes. Fortunately for the fish, if not for us, our model with the fish melanoma parameters that we extract from our data do not predict recurrence over fish lifetimes. However, the model guides our current experiments by instructing us on how to try to perturb the fish's immunity to bring fish parameters into the range where we should be able to observe fish melanoma dormancy and recurrence. Interesting there are claims in the literature that a mouse model of breast cancer can show dormancy and recurrence. We have recently begun collaborating with Dr. Yuval Shaked and his student Madeleine Benguigui at the Technion Rambam using these mouse models and murine breast cancer cell lines. We are following the change with time of these tumor populations (using IVIS and microCT) after orthotopic injection. We will compare the results with our mathematical model to see if it fits well, then extract corresponding parameters and see if there are conditions under which the model predicts dormancy and recurrence. In such case the theory will guide experiment in attempts to observe such phenomena unambiguously for the first time in an animal cancer model.

Refreshments will be served at 1:15pm