Predicting cancer's growth from few clues

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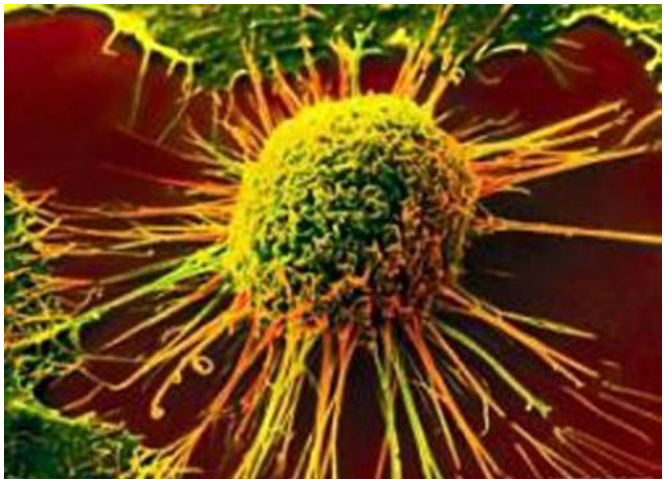

Mathematicians at Duke University are developing ways to help doctors predict how different cancers are likely to progress when actual measurements of tumor growth are hard to come by.

More than one in three people in the United States will be diagnosed with cancer at some point in their lives. Accurate predictions of tumor growth are key to determining the right dose of radiation and chemotherapy, how often patients should undergo screening, and whether a treatment is effective.

"Mathematical models can help inform a whole host of cancer treatment decisions, but you need an accurate model," said Duke mathematics professor Richard Durrett, who is leading the research.

Numerous mathematical models of tumor growth have been proposed, but which ones are most appropriate for different types of cancer remains an open question.

"Some tumors stop or slow down once they reach a certain size, while others continue to grow," said co-author and Duke undergraduate Anne Talkington.

Part of the difficulty comes from the fact that most tumor growth models are calibrated using serial measurements of tumors growing in mice or in the lab, where the supply of oxygen and nutrients isn't the same as tumors growing in a person. But because most cancer patients begin treatment—including surgery—as soon as possible after diagnosis, similar growth data for tumors in humans are hard to come by.

In a study published online in the *Bulletin of Mathematical Biology*, Durrett and Talkington describe a way to compare common mathematical models of tumor growth, using only two time-point measurements of tumor size—often the maximum number of size measurements available before patients begin treatment.

"Working with data from actual patients forces us to work with only two time points," Durrett said. "At first it may seem that two points is not enough, since any model can be made to go through two data points. However, by examining trends in the growth rates when the models are fit to tumors of different sizes, we are able to figure out what the best model is."

To test their method, the authors scoured the literature for previously published data from cancer patients whose tumors were measured at two time points before treatment via repeat mammograms, CT scans or MRIs.

The results suggest that breast and liver tumors grow exponentially, at least when the tumors are still small.

"Like money in a savings account that earns a fixed interest rate," Durrett said.

Two types of neurological tumors, on the other hand, grew according to the two-thirds power law, consistent with the idea that only cells on the surface of the tumor can divide.

"Some bias has been introduced by the way the data were obtained, but our results indicate that the method is useful for determining which tumor growth models work best for different types of cancer," Talkington said.

More information: Anne Talkington et al. Estimating Tumor Growth Rates In Vivo, *Bulletin of Mathematical Biology* (2015). DOI: 10.1007/s11538-015-0110-8

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