It makes you wonder …

The Deadly Beauty of Cancer

By Bartlomiej Waclaw & Martin Nowak

The research story

Cancerous tumours are not a uniform mass of identical cells but can be very heterogeneous [1]. Cells from different parts of the tumour harbour different genetic mutations. These mutations affect how fast cancer cells are able to grow, whether they can invade the surrounding healthy tissue, or how sensitive they are to chemotherapy. Heterogeneity not only makes tumours more difficult to eradicate but also to diagnose, because a small biopsy sample may not be representative of the entire tumour. We were interested in what biological processes determine how heterogeneous tumours are. We developed a computer model that simulated a population of cancer cells that replicate, die, migrate, and mutate. We varied the strength of these processes and measured the level of heterogeneity.

The image

The image shows a simulated tumour with a low level of migration. Cells are represented by small dots. The tumour shown in the foreground has about 10 million cells, smaller tumours in the background are snapshots of the same tumour from earlier times. Cells have been colour-coded depending on what mutations they carry in addition to the first cancer-initiating mutation. Cells with similar mutations have been assigned similar colours. A huge diversity of colours means that the tumour is genetically heterogeneous. This is typical for our simulation. Only when migration is very fast or cells rapidly die and are replaced by other cells, tumours become more homogeneous. The sequence of images has been created using a published computer algorithm [2].

References

[1] Gerlinger M et al., Intratumor heterogeneity and branched evolution revealed by multiregion sequencing, New England Journal of Medicine 366: 883–892, 2012.

[2] Waclaw B et al., A spatial model predicts that dispersal and cell turnover limit intratumour heterogeneity, Nature 525: 261–264, 2015.

F. Matthäus et al. (eds.), *The Art of Theoretical Biology*, https://doi.org/10.1007/978-3-030-33471-0_1