Cells migrate collectively by intermittent bursts of activity

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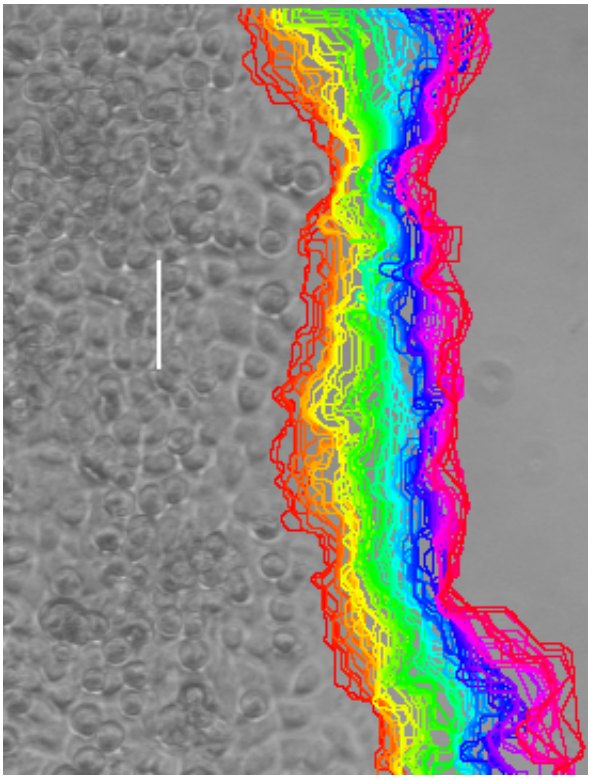

This is how cells are migrating. He-La cells - the oldest and most commonly used human cell line - on collagen substrate: time evolution of the front superimposed on the first frame of experiment. Credit: Oleksandr Chepizhko / Aalto University

Cell migration is a central process in the development and maintenance of multicellular organisms. Researchers of Aalto University and their

research partners have now discovered that this motion occurs by intermittent bursts of activity. It can be described by universal scaling laws similar to the ones observed in other driven systems outside of biology.

When you have got a wound and it starts healing, cells start to migrate in your body to the wound. They are driven by active internal forces to invade the available space. Cell migration doesn't only take place when you are getting better. In cancer invasion cells also migrate collectively. Tissue formation during embryonic development requires the orchestrated movement of cells to specific locations. In general, cell migration is a central process in the development and maintenance of multicellular organisms.

"Our results demonstrate that living systems display universal non-equilibrium critical fluctuations, induced by cell mutual interactions, that are usually associated to externally driven inanimate media," says Oleksandr Chepizhko, Postdoctoral Researcher at Aalto University.

Researchers substantiated the analogy between collective cell migration and depinning by revealing and characterizing widely distributed bursts of activity in the collective migration of different types cells over different substrates and experimental conditions. After that, they compared the experiments with simulations of a computational model of active particles. They found that in all these cases the statistical properties of the bursts follow universal scaling laws that are quantitatively similar to those observed in driven disordered systems.

Errors during cell migration may have serious consequences. For instance, errors may cause vascular disease, intellectual disability, metastasis or tumor formation. Increased understanding of the mechanism by which cells migrate may lead to the development of new therapeutic strategies for controlling, for example, invasive tumour cells.

More information: Oleksandr Chepizhko et al. Bursts of activity in collective cell migration, *Proceedings of the National Academy of Sciences* (2016). DOI: 10.1073/pnas.1600503113