Control of cell migration and colony growth by contact inhibition

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【はじめに】The collective motion and proliferation of cells are behaviors which are central to biological processes such as the formation of embryos, the closure of wounds, and metastasis of tumor cells. Essential for the regulation of these processes is contact inhibition, which describes the tendency of cells to stop migration, or change direction, or stop cell divisions, when coming into contact with other cells. In order to reduce the complexity of the systems under study, it is valuable to investigate well controlled model systems.

【結果と考察】 We developed a minimal model for cells which proliferate and crawl on a substrate. Each cell consists of two disks, modeling the cell body and a protrusion such as a pseudopod. The disks are connected by a finitely extensible string and the motility of the cell is proportional to the spring's extension. The model naturally exhibits contact inhibition of locomotion and proliferation.

Despite the model's simplicity, the collective migration behavior of the cells is non-trivial and depends on the shape of the cells and whether contact inhibition is enabled. Cells with a small, i.e. weakly repelling, pseudopod tend to cluster, while cells with a large, i.e. strongly repelling, pseudopod tend to collectively align [1]. The cells naturally arrest at a high density. At intermediate to high density, the cells develop strong density waves [1-2], analogous to traffic jams in traffic models. The model also reproduces the typical growth characteristics of cell colonies [3], see figure. At early times, the colonies grow exponentially in time. At long times, the colony boundary moves at a constant speed, determined only by the maximum migration speed of a single cell and independent of the proliferation rate.

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【参考文献】

(1) S.K. Schnyder, Y. Tanaka, J.J. Molina, and R. Yamamoto, Scientific Reports 7, 5163 (2017).
(2) M. Campo, S.K. Schnyder, J.J. Molina, T. Speck, and R. Yamamoto, Soft Matter 15, 4939–4946 (2019).
(3)S.K. Schnyder, J.J. Molina, and R. Yamamoto, arXiv:1810.00546.