Mathematical model of adipocyte size dynamics

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Résumé

Adipocytes are the main component of adipose tissue. They are the cells with the ability to store and release lipids by adapting their size. Furthermore, they satisfy a property which is rare among cell populations: they have two orders of magnitude of sizes, not only one (1). The dynamics of adipocyte size remains, however, to be clarified. In the light of the obesity pandemic (3), the understanding of this phenomenon becomes crucial. We study here a mathematical model of adipocyte size dynamics (2), which can take into account this significant size variation. The model describes cells radii and is based on a coupled system of ordinary differential equations.
At the beginning, we prove that the problem is well posed. We then investigate analytic (semi- explicit) solutions, in order to perform numerical validations of our discretization. To explore possible dynamics of solutions, we start with a one-cell system and gradually add more cells, which leads to more intricated trajectories of solutions.

We focus on two cases: with constant or smooth, periodic total lipid amount in the system. In the case of constant total lipid amount, depending on model parameters, we exhibit one or two stable steady states. By carefully choosing the parameters, we can reach stable steady states corresponding to experimentally observed cell sizes. In the periodic case, with certain parameter values, we obtain periodic dynamics of cell radii.

References

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Mots-Clés: coupled system of ODEs, adipocyte size dynamics, numerical simulations

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