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Interaction of opportunistic pathogenic fungi and human phagocytes: A multi-agent-based modeling approach

The fungal pathogen *Aspergillus fumigatus* causes severe systemic diseases in immunocompromised patients [1,2]. Although this fungus is found worldwide and its small conidia are present in air and food [2] it is almost harmless to healthy people, since inhaled conidia are phagocytosed by macrophages and neutrophil granulocytes [1]. However, neither the cellular dynamics, the per-cell efficiency, the outcome of this interaction, nor the environmental impact on this process are known [3]. Live imaging shows that the interaction of phagocytes and fungal conidia is a dynamic process of touching, dragging and phagocytosis [3].

Using multi-agent-based modeling, the interactions of human neutrophil granulocytes and *Aspergillus fumigatus* are simulated to gain knowledge about different behavioral strategies by optimizing parameter settings such as velocity of cells, dragging and phagocytosis efficiency as well as movement directions. Behavior of simulated cells is compared to those of living cells in liquid cultures gained by live imaging data.

Implemented in the multi-agent modeling environment NetLogo [4], neutrophil granulocytes and conidia of *Aspergillus fumigatus* are modeled as distinct agents, whose individual behavior is determined by spatial settings, e. g., density of cells, communication between cells, individual states and is influenced by random effects. Moreover, chemotaxis and random movement of immune cells are compared to get insight into advantages in regard to phagocytosis efficiency.

References

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