

Agent-based modeling approach of immune defense against spores of opportunistic human pathogenic fungi.

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Abstract

Opportunistic human pathogenic fungi like the ubiquitous fungus *Aspergillus fumigatus* are a major threat to immunocompromised patients. An impaired immune system renders the body vulnerable to invasive mycoses that often lead to the death of the patient. While the number of immunocompromised patients is rising with medical progress, the process, and dynamics of defense against invaded and ready to germinate fungal conidia are still insufficiently understood. Besides macrophages, neutrophil granulocytes form an important line of defense in that they clear conidia. Live imaging shows the interaction of those phagocytes and conidia as a dynamic process of touching, dragging, and phagocytosis. To unravel strategies of phagocytes on the hunt for conidia an agent-based modeling approach is used, implemented in NetLogo. Different modes of movement of phagocytes are tested regarding their clearing efficiency: random walk, short-term persistence in their recent direction, chemotaxis of chemokines excreted by conidia, and communication between phagocytes. While the short-term persistence hunting strategy turned out

to be superior to the simple random walk, following a gradient of chemokines released by conidial agents is even better. The advantage of communication between neutrophilic agents showed a strong dependency on the spatial scale of the focused area and the distribution of the pathogens.

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