Quantification of T-cell Migration in Confined and 3D Conditions

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Summary

Migration is one of the immune system's fundamental processes in order to carry out its function of defense against pathogens and aberrant cells. Therefore, a novel microfluidic-based approach was adopted to comprehend the immune response. We found that T lymphocytes show higher velocity under confinement in comparison to 3D migration.

Introduction

The immune system plays a crucial role in the defense against pathogens and aberrant cells, such as tumoral cells. In order to carry out its function of immune surveillance, migration is one of the fundamental processes required. Therefore, it is essential to characterize this mechanism in physiologically and pathologically relevant scenarios to comprehend the immune response.

In this context, we have adopted a novel microfluidic-based approach that recreates the biomechanical aspects of solid tumors [1],[2]. Two different microfluidic geometries were employed: one of them based on a central chamber which allowed hydrogel polymerization [3], while the other one on microstructures of confined channels with varying widths [4].

Materials and Methods

The microfluidic devices were fabricated with polydimethylsiloxane (PDMS) owing to its many advantages, including biocompatibility, transparency, flexibility and gas permeability. Then, T cells were seeded on the microchips and were visualized via time-lapse microscopy under controlled conditions of temperature, humidity and CO_2 concentration. The resulting images were processed with ImageJ and Matlab to quantify cell migration.

Results and Conclusions

We found that T lymphocytes display higher velocity under confinement compared to 3D migration. This is consistent because in 3D hydrogel matrices cells must squeeze through different pores in three possible dimensions, leading to an irregular track and slower migratory speed. These results demonstrate that confinement is a key factor in immune migration and its characterization can provide a better understanding of the infiltrating capacity of immune cells in solid tumors, as well as in wounds or other pathological conditions.

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