Quantitative image analysis of cell colocalization in murine bone marrow.

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Details

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Abstract

Long-term antibody production is a key property of humoral immunity and is accomplished by long-lived plasma cells. They mainly reside in the bone marrow, whose importance as an organ hosting immunological memory is becoming increasingly evident. Signals provided by stromal cells and eosinophils may play an important role for plasma cell maintenance, constituting a survival microenvironment. In this joint study of experiment and theory, we investigated the spatial colocalization of plasma cells, eosinophils and B cells by applying an image-based systems biology approach. To this end, we generated confocal fluorescence microscopy images of histological sections from murine bone marrow that were subsequently analyzed in an automated fashion. This quantitative analysis was combined with computer simulations of the experimental system for hypothesis testing. In particular, we tested the observed spatial colocalization of cells in

the bone marrow against the hypothesis that cells are found within available areas at positions that were drawn from a uniform random number distribution. We find that B cells and plasma cells highly colocalize with stromal cells, to an extent larger than in the simulated random situation. While B cells are preferentially in contact with each other, i.e., form clusters among themselves, plasma cells seem to be solitary or organized in aggregates, i.e., loosely defined groups of cells that are not necessarily in direct contact. Our data suggest that the plasma cell bone marrow survival niche facilitates colocalization of plasma cells with stromal cells and eosinophils, respectively, promoting plasma cell longevity.

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