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Immune cells of aqueous Humour: Role in homeostasis and disease

Abstract:

The immune environment of the eye is unique due to its immune-privileged status, where immune responses are tightly regulated to maintain visual function. The aqueous humour, a clear fluid filling the anterior chamber of the eye, plays a key role in this regulation. While the presence of immune cells in inflamed or diseased eyes is well-documented, their composition in the healthy eye remains unclear. To characterize the immune cell populations in the aqueous humour under non-pathological conditions, we first performed flow cytometry analysis. We identified both CD45+ immune cells and CD45- non-immune cells. We utilized single-cell RNA sequencing on aqueous humour samples from postmortem donors. We found nine distinct clusters, including two T cell clusters, a monocyte/macrophage cluster, dendritic cells, microglia, B cells, and two unknown clusters. T cells were the most abundant, followed by microglia and monocyte/macrophages. T cells Cluster # 1 expressed markers of activation and tissue residency (CD44, CD69, JUND), along with transcription factors associated with less terminal differentiation (TCF7, GATA3). In contrast, T cells Cluster #2 displayed high expression of cytotoxicity markers (GNLY, GZMB, PRF1) and exhaustion molecules (HAVCR2, CD38), indicating a more differentiated, potentially exhausted phenotype. Pseudotime analysis confirmed that both T cells Cluster # 1 and Cluster # 2 formed a continuum of T cells differentiation from early stage of activation to cytotoxicity and exhaustion. CellChat analysis showed interaction between T cells and Monocytes/Macrophages and Microglia, that was mediated mainly by the CD44-SSP1 which is known to have a regulatory effect on T cells. Our results highlight the immune heterogeneity within the aqueous humour of the healthy eye, providing new insights into the immune landscape of this immune-privileged site. The detection of microglia and other tissue-resident immune cells indicates that the aqueous humour harbours a specialized immune environment.

Biography

Abdelilah Majdoubi has completed his PhD in Microbiology and Immunology from the University of Montreal and postdoctoral studies from British Columbia University and Yale University.