Internship Proposition
(one page max)

Master 2 GP Immunology & ImmunoIntervention (I^3)
2025-2026

Lab: CRHMR (Centre de Recherche de l'Hôpital Maison Neuve Rosemont)

Team: Laboratoire de génomique fonctionnelle et bio-informatique

Name and position of the supervisor: Yoshiaki Tanaka, Christopher Rudd

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Candidate (if internship filled): Marie Balohe-Laccourège

Title of the internship: Boosting CAR-T Cell Efficacy against Solid Tumors

Summary of the internship proposal:

Cancer is the most leading cause of death (~30%), and devastate lives of over 20 million patients every year worldwide. Chimeric Antigen Receptor (CAR)-T cell therapy is a promising personalized medicine that engineers patients' immune cells to fight against cancer cells. Recently, CAT-T cell therapy has demonstrated remarkable success in the treatment of hematopoietic cancers, in particular, leukemia and lymphoma. In contrast, CAR-T cell therapy is still less effective against solid tumors, such as brain tumors, due to unexpected inactivation and limited tumor infiltration of CAR-T cells. Despite a recent growing number of clinical trials of CAR-T cell therapy, there is no solution to improve efficacy for the solid tumors and none of CAR-T cell therapies is not approved yet. To counter this limitation, our teams recently have performed huge scale comprehensive analysis of single-cell transcriptomics of CAR-T cells, and applied artificial intelligence-based inference to identify molecular characteristics of CAR-T cells associated with the solid tumors. Notably, we found that CAR-T cells in solid tumors elevated **GTPase activating proteins (GAPs)** and suppressed **canonical NF-κB signaling**. In addition, we also identified that the solid tumors enhance derivation of unique $CD4^+$ CAR-T cell subpopulations that are characterized by high expression of **TGFβ/SMAD** and **glutamate signaling**. Here, we hypothesize that these aberrantly-changed signaling pathways lead to inactivation of CAR-T cells, and address whether the modulation of these signaling pathways can ameliorate efficacy of CAR-T cell therapy. Collectively, the proposed research will open a new avenue for immunotherapy against solid tumors and give strong impact on cancer treatment.

Option(s) linked to the project:

☐ Clinical Research Profile (Recherche Clinique)
■ Data Analyst Profile (Recherche et Analyse de Données Omiques)
☐ Experimental Biology Profile (Recherche Expérimentale)

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