Project title: Spatial Determinants of Response to Chemoimmunotherapy in Triple-Negative Breast Cancer

Project Summary:

Breast cancer therapy is not tailored to the profile of individual tumours. As a result, many patients receive ineffective or excessive treatment. This is particularly true in triple-negative breast cancer (TNBC) where response to neoadjuvant chemo-immunotherapy is highly variable and cannot be predicted.

In this project, we will define histopathological spatial determinants of therapeutic response in TNBC using samples acquired from the BELIEVE (NCT06681064) translational programme. In this study, serial tumour and blood samples are acquired during neoadjuvant therapy to understand how tumours evolve and change during treatment and how these evolutionary trajectories associate with response. By facilitating real-time treatment adaptation and identifying novel therapeutic targets, the BELIEVE study aims to transition TNBC management from a 'one-size-fits many' approach to one that is truly personalised, improving patient outcomes.

We will apply established computer vision techniques to extract human interpretable features from H&E and multiplex immunofluorescence (mIF) slides to characterise the tumour microenvironment in TNBC. Spatial metrics, such as immune cell identity, activation state, proximity to tumour cells, and tissue neighbourhood structure, will be derived from mIF data to investigate histopathological spatial determinants of response to neoadjuvant chemo-immunotherapy in TNBC.

To enhance biological resolution, we will integrate spatial imaging features with single-cell RNA sequencing data using advanced machine learning approaches. This integrative analysis aims to uncover robust, multimodal predictors of response, with the potential to inform stratified therapeutic strategies and clinical trial design.

This project offers training in spatial biology, computational pathology, machine learning, multi-modal data integration and translational oncology.

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