Title: clinical decision-making tool for metastatic breast cancer using a data-driven approach combining clinical and imaging high-dimensional data

PhD, Axis 2 (computational medicine)

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Topic of the project:

Genomic profiling has demonstrated that breast cancer is made of heterogeneous biological entities with various evolutive profiles and chemosensivities.

In non-metastatic breast cancer, great progresses have been made toward precision medicine through the identification of biological oncogenic pathways that can be targeted with innovative drugs.

In the metastatic setting of breast cancer, precision medicine based on tumor biology alone is more challenging because the intra-patient biological heterogeneity of lesions cannot be captured by one single biopsy. Thus, the treatment sequence for metastatic breast cancer is currently based on few conventional clinical markers, far away from precision medicine. There is a strong need to develop innovative biomarkers of response to improve women’s care in this metastatic setting.

Using an artificial intelligence data-driven approach, this project aims to develop a non-invasive predictive signature of response/resistance to chemotherapy for an individual woman with metastatic breast cancer. In this purpose, we will use machine and deep learning algorithms integrating high-dimensional clinico-biological and imaging data.

Many informations can be obtained from the clinical records of these metastatic patients. Some of these clinical data are already known to individually carry a prognostic information (such as the delay from initial diagnosis to metastatic recurrence, patient’s age...). Moreover, medical imaging technologies offer key insights into multiple features of tumour morphology, biology and biomarker expression, that also carry major prognostic informations. Because these data are numerous and of heterogeneous natures, they are currently not exploited for the treatment strategy. Predictive solutions based on data gathering/integration and machine learning technologies may be the solution to promote personalised oncology and optimize patient’s management.
Data will be collected from:

- the clinical records (demographic characteristics, medical history, breast cancer evolutive pattern, tumour clinical and biological characteristics ....). A clinical database of patients with metastatic breast cancer is already available in the Centre Antoine-Lacassagne (CAL). In a next step, we will require the access to a larger available national database (Base Esmé, Unicancer) for algorithm optimization and external validation.

- The PET/CT exams (an hybrid imaging modality combining morphological and metabolic imaging data) will be retrospectively collected. We will use the images of 2 different hospitals. We will convert images into mineable data using processes for high-throughput extraction of quantitative features; this practice is termed radiomics. For this purpose, we will use innovative post-processing tools such as hand-crafted features extraction (LIFEx freeware) for a machine learning approach and CNN for deep-radiomics approach.

Mathematics support will be provided by the Maasai and Epione teams through the 3IA Cote d’Azur.

The aim of the project will be to develop a decisional algorithm for supporting clinical decisions and improve women’s care in the metastatic setting of breast cancer.