Offer for a PhD preparation

Radiomics and deep learning to improve characterization and prediction of breast cancer outcome

U1288 Inserm, Institut Curie
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Context

In vivo positron emission tomography (PET) images have already demonstrated their usefulness in characterizing breast cancers and predicting their prognosis. In particular, biomarkers such as the total metabolic tumor volume measurable from whole-body 18F-Fluorodeoxyglucose (FDG) PET scans have been identified as prognostic biomarkers (1-2), as has disease dissemination (3). Nevertheless, current predictive models are not yet efficient enough to be widely deployed in clinical routine.

The hypothesis of this PhD project is that PET images are still insufficiently exploited, and that they contain more information than is currently used. In particular, the metabolic activity of non-tumoral regions, which interact with tumoral regions, is not taken into account in current models. Nor is body composition, reflected by the computed tomography (CT) scan systematically performed with PET, or the characteristics of the tumor microenvironment revealed by radiotracers other than FDG.

Objectives

The aim of this PhD project is to propose to enrich characterization or prediction models exploiting PET images in breast cancer by extracting more biomarker candidates from PET/CT images, and/or by directly analyzing the whole-body phenotype of the disease using deep learning methods.

Methods

Thanks to several recently-funded projects concerning the contribution of PET imaging in breast cancer (ANR NEMO-PET, ANR Inter-Organ PET, RHU Cassiopeia, IHU Cancers de femmes) and the huge expertise of Institut Curie in breast cancer, we have collected large databases integrating PET images of breast cancer patients before treatment, during treatment, and at the end of treatment, combined with already structured clinical and biological data.

The laboratory also has extensive experience in radiomic analysis and in the development and use of artificial intelligence models for the analysis of whole-body PET images (4-7).

Using these cohorts, the PhD project will involve:

- Studying the relevance of new radiomic features derived from FDG PET/CT images to improve patient stratification.
- Studying the added value of taking into account dual-tracer information (FDG and FAPI, FDG and FES) to predict patients' response to treatment and their evolution after treatment.
- Developing prognostic and predictive models integrating not only radiomic information, but also clinical and biological information.

Supervision

Day-to-day supervision will be provided by Irène Buvat (DR CNRS), thesis supervisor, and Fanny Orlhac (CR Inserm), co-supervisor. The work will be carried out in interaction with those involved in the laboratory's breast cancer projects, including a PhD student, nuclear physicians and experts in the molecular biology of breast cancer.

The student will take part in weekly team meetings to follow the progress of work carried out in the lab on related topics, and will be expected to present his/her results on a regular basis. He/she will also take part in the laboratory's journal club.

Funding and logistics

The PhD student will work on the computing servers of the LITO laboratory and the Institut Curie. Funding will be provided by the ANR IOP Inter-Organ grant, and the employer will be the Institut

Curie Research Center. The laboratory is located in Orsay (91) and will move to Saint-Cloud (92) in 2026.

Dissemination

The PhD student will present his/her work at national and international conferences in the fields of medical imaging (SNMMI, EANM, RSNA) and data science (eg, MICCAI). He/she will publish results in international journals.

Collaborations

The Unit collaborates on breast cancer research with the Princess Grace Hospital of Monaco and the Institut Roche, and the PhD student will have the opportunity to get involved in these collaborations as well.

Contact

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References

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