

Research Project

Name of Institution and department:

Hospital de la Santa Creu I Sant Pau

Diagnostic Imaging Department

Link to website:

City and Country of Institution: Barcelona, Spain

RESEARCH GROUP

Brief description of the research group and of its mission:

The advanced imaging and AI research group is part of the Diagnostic Imaging Department at Hospital de la Santa Creu i Sant Pau, a tertiary university hospital in Barcelona. Its mission is to advance the development, validation and clinical translation of advanced imaging biomarkers, quantitative imaging methods and artificial intelligence tools in radiology.

The aim of the research project is to develop and validate a framework for the extraction of opportunistic metabolic and systemic imaging biomarkers from acute cerebrovascular imaging studies, including non-contrast CT, CT angiography and MRI acquired during the acute phase of stroke or acute cerebrovascular disease.

TITLE OF PROPOSED RESEARCH PROJECT

Opportunistic Imaging Biomarkers from Acute Cerebrovascular Imaging: AI-Assisted Quantification of Metabolic and Systemic Risk in Stroke

OBJECTIVES

- To understand the clinical relevance of opportunistic imaging in patients with acute cerebrovascular disease.
- To learn the main imaging techniques used in the acute stroke pathway, including non-contrast CT, CT angiography, CT perfusion when available, and acute brain MRI.
- To understand how standard cerebrovascular imaging can provide additional information beyond the acute diagnosis, including systemic, metabolic, vascular and frailty-related biomarkers.
- To curate and structure a multimodal imaging database of patients with acute cerebrovascular disease, including CT, CT angiography and MRI studies acquired during the acute phase.

- To develop methods for the extraction of opportunistic imaging biomarkers from routinely acquired acute cerebrovascular imaging.
- To identify and quantify imaging-derived markers related to sarcopenia, fat distribution, vascular calcification and bone density.
- To explore anatomical regions available in acute stroke imaging that may be useful for opportunistic biomarker extraction, including cervical muscles, subcutaneous and visceral fat compartments, vascular calcifications, vertebral bone density and craniofacial or cervical structures visible on CT angiography.
- To compare opportunistic biomarkers obtained from CT-based and MRI-based acute cerebrovascular imaging.
- To analyze the relationship between opportunistic imaging biomarkers and clinical variables, including age, sex, cardiovascular risk factors, stroke subtype, disease severity and outcome when available.
- To explore radiomics and machine learning approaches for patient phenotyping and risk stratification based on opportunistic imaging biomarkers.
- To contribute to the creation of reproducible quantitative imaging biomarkers for systemic metabolic and vascular risk assessment in patients with acute cerebrovascular disease.

APPLICANT'S DUTIES

- o Curation and organization of a multimodal acute cerebrovascular imaging database including non-contrast CT, CT angiography and MRI studies.
- o Identification of suitable anatomical regions for opportunistic biomarker extraction in acute cerebrovascular imaging.
- o Segmentation of relevant structures, including skeletal muscle, adipose tissue compartments, vascular calcifications and bone structures, depending on the imaging modality and field of view.
- o Development and testing of semi-automatic and AI-assisted workflows for opportunistic imaging biomarker extraction.
- o Extraction of quantitative imaging features related to sarcopenia, fat distribution, vascular calcification and bone density.

- o Assessment of image quality, protocol variability and feasibility of biomarker extraction across different acute imaging modalities.

- o Correlation analysis between manual, semi-automatic and automatic quantification methods.

- o Analysis of the relationship between opportunistic imaging biomarkers and clinical variables, including cardiovascular risk factors, stroke subtype, acute severity and functional outcome when available.

- o Preparation of selected illustrative cases for multidisciplinary discussion, teaching files and research presentations.

- o Database curation, including anonymization, image quality assessment and structured entry of radiological and clinical variables.

- o Collaboration with radiologists, engineers and data scientists involved in advanced neuroimaging, vascular imaging, opportunistic imaging and artificial intelligence projects.

- o Contribution to the preparation of abstracts, oral presentations, posters and scientific manuscripts derived from the project.

APPLICANT'S BENEFITS

- o Participation in the scientific outcomes of the project, including presentations at congresses and publication of peer-reviewed papers.

- o Participation in a high-level advanced imaging and AI research project at a European reference hospital.

- o Access for study to a structured cohort of patients with acute cerebrovascular disease, many of them with multimodal imaging including non-contrast CT, CT angiography, CT perfusion when available and acute MRI.

o One-to-one mentoring by senior radiologists and engineers specialized in neurovascular imaging, advanced imaging biomarkers, quantitative image analysis and artificial intelligence.

o Specific training in opportunistic imaging and its application to acute cerebrovascular disease.

o Practical training in advanced post-processing tools, segmentation, quantitative image analysis and radiomics.

o Introduction to programming and artificial intelligence tools applied to medical image analysis.

o Training in the design of structured imaging databases and reproducible research workflows.

o Participation in the hospital's neurovascular disease committees during the fellowship period, including acute stroke, vascular risk and complex neurovascular case discussions.

o Exposure to a translational research environment integrating clinical neuroradiology, vascular imaging, metabolic imaging biomarkers and AI-assisted image analysis.

o Potential first authorship in scientific outputs directly derived from the fellow's specific study arm, according to contribution and project development.

- Project Leader: Josep Munuera
- Members: Lucía Borrego, Esther Granell, Ines del Val, Sara Castells, Alejandro Dominguez