

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 multimodal framework for the AI-assisted extraction and characterization of cerebral venous imaging biomarkers using CT angiography, MR angiography and digital subtraction angiography, and to train the ESOR research fellow in advanced neurovascular imaging research, quantitative image analysis and radiology-oriented artificial intelligence methodology.

TITLE OF PROPOSED RESEARCH PROJECT

Cerebral Venous Imaging Biomarkers: AI-Assisted Multimodal Analysis of Venous Patterns in Neurovascular Disease

OBJECTIVES

- To understand the anatomy, physiology and clinical relevance of the cerebral venous system in neurovascular disease.
- To learn the main imaging techniques used for cerebral venous assessment, including CT angiography, MR angiography, susceptibility-weighted imaging, contrast-enhanced MRI, perfusion imaging and digital subtraction angiography.
- To curate and structure a multimodal neurovascular imaging database including more than 400 adult and pediatric patients with cerebrovascular disease.

- To develop methods for venous segmentation from CT angiography, MR angiography and angiographic image datasets.
- To extract quantitative features from cerebral venous structures, including venous density, caliber, tortuosity, asymmetry, drainage territories and relationships with arterial and parenchymal lesions.
- To compare venous features across imaging modalities and assess the degree of agreement between CT angiography, MR angiography and digital subtraction angiography.
- To explore radiomics and machine learning approaches for classifying venous vascular patterns in different cerebrovascular diseases.
- To contribute to the creation of reproducible imaging biomarkers for venous involvement in ischemic stroke, subarachnoid hemorrhage, vascular malformations, arteriovenous fistulas and other neurovascular diseases.

APPLICANT'S DUTIES

- o Vascular segmentation of cerebral venous structures from CT angiography, MR angiography and digital subtraction angiography datasets.
- o Curation and organization of a multimodal neurovascular imaging database including conventional and advanced imaging studies.
- o Identification and classification of cerebral venous structures using standard anatomical and radiological criteria.
- o Development and testing of semi-automatic and AI-assisted workflows for venous structure extraction.
- o Correlation analysis between manual, semi-automatic and automatic segmentation methods.
- o Extraction of quantitative venous imaging features, including venous caliber, venous density, venous asymmetry, tortuosity and drainage patterns.
- o Analysis of the relationship between venous patterns and underlying neurovascular diseases, including ischemic stroke, subarachnoid hemorrhage, vascular malformations, arteriovenous fistulas, MoyaMoya disease and vasculitis.
- o Preparation of selected complex or illustrative cases for multidisciplinary discussion, teaching files and research presentations.
- o Classification of venous and vascular patterns according to current qualitative radiological classifications where applicable.
- o Database curation, including anonymization, image quality assessment and structured entry of radiological variables.
- o Collaboration with radiologists, engineers and data scientists involved in advanced neuroimaging, vascular 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 on scientific outcomes of the project i.e. presentations to congresses or publications of papers

 - o Participation in a high-level neurovascular imaging research project at a European reference hospital.

 - o Access for study to a database of more than 400 adult and pediatric patients diagnosed with neurovascular disease, many of them with multimodal imaging including CT angiography, MR angiography, digital subtraction angiography, perfusion imaging, vessel wall imaging and advanced MRI sequences.

 - o One-to-one mentoring by senior radiologists and engineers specialized in neurovascular imaging and cerebrovascular disease and AI.

 - o Specific training in cerebral venous anatomy, venous pathophysiology and multimodal neurovascular imaging interpretation.

 - o Practical training in advanced post-processing tools, vascular 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 stroke, subarachnoid hemorrhage, vascular malformations and complex neurovascular case discussions.
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- Project Leader: Josep Munuera
 - Members: Lucía Borrego, Esther Granell, Ines del Val, Sara Castells