

Neuroscience PHD

Research project for a PhD curriculum in Neuroscience

Tutor: Prof. Iaccarino

Co-tutor: Prof. Pavesi

Proposed Title of the research:

Quantitative Haemoglobin Degradation Analysis in Aneurysmal Subarachnoid Haemorrhage: Clipping vs Coiling — Radiomics, AI, Vasospasm and DCI Correlation Study

Keywords: (5)

Aneurysmal Subarachnoid Haemorrhage

Cerebral Vasospasm

Delayed Cerebral Ischemia

Radiomics

Volume/Treatment

Research objectives: --(max 5 rows preferably bullet points)

- Quantitative Hb degradation (HU variation) on serial CT: clipping vs endovascular treatment
- Correlate Degradation Index (DI) with angiographic vasospasm (day 7–10) and confirmed DCI
- Compare predictive power: radiomic DI vs Hijdra Sum Score (AUC-ROC, DeLong)
- Verify whether equal cisternal volume reflects true biological equivalence (HU/texture analysis)
- U-Net automated subarachnoid blood segmentation: development and validation (Dice ≥ 0.80)

Proposed research activity -- (max 10 rows)

Aim: Validate the Degradation Index (DI) — HU variation on serial CT — as an early radiomic biomarker for vasospasm and DCI risk stratification.

Tools: Standardised inter-centre serial CT protocol (CT-0 ≤ 6 h, CT-1 24h, CT-2 72h); automated AI pipeline for real-time DI calculation; U-Net segmentation model (U-Net++/ResNet-based) for subarachnoid blood detection on non-contrast CT, benchmarked on Chen et al. 2025 (Dice 0.731–0.741), targeting Dice ≥ 0.80 .

Expected Outcomes: DI at 24h identifies high-risk patients within 48h, guiding TCD monitoring intensity, early CTA timing, and preventive hypertensive therapy — translating radiomic analysis into direct, actionable clinical decisions.

Supporting research projects (and Department)

The study involves a PhD candidate, under the supervision of Prof. Giacomo Pavesi (PI, Vascular Neurosurgeon) and Prof. Corrado Iaccarino (Senior Neurosurgeon). Direct clinical support is provided by Dr. Stavros Dimitriadis (Staff Neurosurgeon) and Dr. Stefano Vallone (Senior Neuroradiologist). The neuroradiology component is further supported by an Interventional Neuroradiologist. The technical and analytical pipeline is managed by a dedicated AI Engineering Team, a Biostatistician, and a Radiology Technician. Research coordination and administrative support are provided by a dedicated Research Nurse and Administrative Officer.

The study will be conducted within the Neurosurgery and Neuroradiology Units of the host institution, equipped with a multi-slice CT scanner and a PACS system providing full access to retrospective imaging archives. Angiographic facilities (DSA) and a Neurocritical Care Unit are

available on-site, ensuring comprehensive clinical and imaging data collection. A dedicated AI software pipeline and radiomic analysis tools will be developed as part of the project, leveraging existing institutional computational resources. A prospective clinical database will be established during the study using a validated data management platform. Retrospective CT imaging data are accessible through the institutional PACS archive and will constitute the training and validation dataset for the U-Net segmentation model.

Possible external connections (research groups, companies, universities).

Department of engineering “Enzo Ferrari”