**PROJECT**

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| **Supervisor:** | Prof. Francesco De Cobelli |
| Title: | Imaging-derived body composition for quantitative phenotyping: implications for pathophysiology, clinical outcomes and contrast media administration |
| *Curriculum*: | Clinical and Experimental Medicine |
| Link to the personal page of the University or relevant hospital site website: | https://research.hsr.it/en/education-and-careers/phd-program/experimental-and-clinical-medicine.html |

**Description of the Project (max 3,000 characters including spaces)**

**Background/gap of knowledge**

The assessment of body composition (BC) is a crucial determinant in metabolic disease management and in oncological and surgical outcomes. Sarcopenia and myosteatosis have been associated with increased perioperative complications and toxicity during chemotherapy as well as reduced survival. Extrapolating quantitative body composition parameters from radiological imaging (CT or MRI) could allow to obtain "real-time" patient-specific imaging data that aids in monitoring prehabilitation programs, systemic treatment toxicity and metabolic disease status. Incorporating body composition metrics may offer a more accurate and physiological strategy for optimizing contrast medium dose during contrast-enhanced CT scans, as supported by recent literature based on lean body mass (LBM) adjusted dose. However, the availability of this quantitative data is not readily evaluated in normal clinical practice due to the lack of automated systems.

**Rationale and hypothesis**

Since BC data is already present in routine imaging, automated framework which quantifies these parameters would support a tailored approach in patient management.

We hypothesize that imaging derived-BC combined with non-invasive tissue characterization is a reproducible quantitative phenotype which supports personalized medicine across multiple domains. Incorporating these metrics into contrast-enhanced CT (ceCT) protocols allows for more physiologically adapted contrast media administration, improving enhancement uniformity while reducing variability and potential toxicity.

**Objectives and specific aims:**

Objective 1: Standardization of body composition analyses on ceCT and MRI, using automated pipelines

Objective 2: Derive a CT-Based Lean body mass (CT-LBM) formula to optimize contrast dose

using multivariate regression and nonlinear model calibrated against bioelectrical impedance analysis (BIA) as a reference standard. Objective 3 (Metabolic): Longitudinal MRI analysis in patients with metabolic syndrome and diabetes and correlation of changes in BC with clinical, metabolic, and biochemical outcomes. Objective 4 (Prehabilitation): BC analysis in cohorts of patients undergoing surgery (with or without neoadjuvant chemotherapy) and correlation with postoperative complications and length of hospital stay. Objective 5 (Liver Regeneration): Volumetric assessment and quantitative MRI (steatosis, siderosis, fibrosis) in patients undergoing portal vein embolization.

**Expected outcomes**

The expected outcomes are: a)identify and validate a comprehensive framework for the multimodal assessment of BC on CT and MRI; b)Identify BC biomarkers predictive of response in metabolic disease and of changes induced by multimodal prehabilitation, c)develop a personalized CT-based contrast medium algorithm based on individual BC, and d)develop predictive models of liver regeneration based on BC and tissue characterization.

**Skills that the student should acquire** (max. 600 characters including spaces):

The Candidate will develop advanced expertise in MRI and CT interpretation and proficiency in quantitative body composition analysis tools, be able to identify and characterize imaging biomarkers in different diseases as well as in depth knowledge in clinical research methods, clinical study designs, expertise in biostatistics, regression modelling, ROC analysis, and survival analysis and work with gold-standard segmentation platforms. Scientific writing and proper, high-quality communication of results at national and international meetings is also envisaged.

**References** (max. 15)

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