PROJECT

Supervisor:	PALUMBO DIEGO
Title:	Non invasive characterization of liver parenchyma texture and body composition parameters dynamic changes during chemotherapy
Curriculum:	CLINICAL AND EXPERIMENTAL MEDICINE
Link to the personal page of the University or relevant hospital site website:	https://unifind.unisr.it/resource/person/12958

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

Background/gap of knowledge

Chemotherapy for gastrointestinal tumors remains a cornerstone in the treatment of gastrointestinal cancers [1-2], yet its effectiveness is often limited by systemic and organ-specific toxicities [3-4]. These are further exacerbated by the patient's already compromised condition, commonly due to the underlying malignancy and its impact on nutritional status [5].

While standard laboratory tests frequently fail to detect subclinical changes, chemotherapy-induced hepatic toxicity (e.g., steatosis, sinusoidal injury) [6-8] and alterations in body composition (e.g., sarcopenia, fat redistribution) [9-11] are increasingly recognized as early predictors of treatment intolerance and poor prognosis, even in the absence of overt clinical symptoms.

Rationale and hypothesis

We hypothesize that quantitative imaging techniques can provide early, reliable indicators of chemotherapy-induced hepatic and systemic toxicity, undetectable by conventional clinical or laboratory parameters. In particular, while MRI-based fat quantification and quantitative ultrasound may detect early hepatic steatosis or parenchymal changes [12-13], CT-based body composition analysis can identify trends in muscle mass loss, fat redistribution or sarcopenic obesity, predicting clinical decline [9-11]. The rationale is to create a multimodal imaging strategy to characterize liver parenchyma and body composition potentially providing personalized treatment strategies.

Objectives and specific aims

This project aims to develop and validate a multimodality imaging approach for early detection and monitoring of chemotherapy-induced hepatic and systemic toxicity.

I. To quantify liver alterations, including steatosis and parenchymal changes, using MRI-based analysis as gold standard and compare it with other imaging methods.

II. To analyse body composition changes — such as skeletal muscle mass, visceral fat and subcutaneous fat—through automated CT segmentation across chemotherapy cycles.

III. To correlate multimodal imaging findings with clinical parameters, chemotherapy regimens, and laboratory markers in order to identify predictive imaging biomarkers of treatment-related toxicity.

IV. To compare hepatic parenchymal changes identified through multi-modality imaging (MRI/photon counting CT fat quantification, quantitative ultrasound, CT texture analysis) with histopathological findings, validating imaging-based assessments of chemotherapy-induced liver injury.

Expected outcomes

- Identify early imaging biomarkers of hepatic toxicity before clinical/laboratory manifestations and correlate them with liver histopathology.

- Define quantitative imaging metrics that correlate with specific chemotherapy regimens and toxicity profiles, through integrated analysis of liver parenchymal changes and body composition (e.g., muscle mass, fat distribution).

- Support personalized oncologic care by integrating imaging biomarkers into risk stratification models and clinical decision-making.

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

- Proficiency in advanced imaging interpretation (MRI, CT, ultrasound) and quantitative analysis software.

- Knowledge of chemotherapy pharmacology and toxicity profiles in gastrointestinal oncology.

- Competence in clinical research methodology, including imaging biomarkers, biostatistics, and data correlation.

- Familiarity with 3D segmentation tools and possibly AI-based imaging analysis platforms.

- Scientific writing and presentation skills for dissemination of research findings.

References (max. 15)

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