Introduction

Malnutrition and sarcopenia are key features in life threatening gastrointestinal diseases such as liver cirrhosis (LC), chronic pancreatitis (CP) or short bowel syndrome (SBS). Approximately 30% of gastrointestinal inpatients are malnourished. Disease-related malnutrition is associated with a reduced life expectancy, an increased risk of complications, an impaired quality of life and higher expenses. Pathophysiologically, disease-related malnutrition is linked to a low-grade systemic inflammatory which in turn contributes to the reduction of muscle mass and subsequently sarcopenia (Figure 1).

In a multimodal approach, EnErGie addresses three project goals:
1. Understanding of the mechanistic interplay between malnutrition, sarcopenia and low-grade systemic inflammatory in the different gastrointestinal diseases,
2. Development of a set of methods for diagnosis and follow-up of malnourished patients with gastrointestinal diseases and
3. Enabling a better care of malnourished patients.

II - Cross-sectional study

- Study design: multicenter, prospective, controlled study
- Study sites: UMR, UMG and HSNB (FBN involved)
- Period: 10/2018 – 03/2022 (42 months)
- Study population:

<table>
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<tr>
<th>Group</th>
<th>Expected</th>
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<th>%</th>
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<tbody>
<tr>
<td>LC: 50 patients (50 % malnourished*)</td>
<td>20 (21)</td>
<td>80.0 (84.0)</td>
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<tr>
<td>CP: 50 patients (50 % malnourished*)</td>
<td>20 (19)</td>
<td>60.0 (62.0)</td>
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* ESPEN or GLIM criteria

III - Longitudinal study

- Study design: multicenter intervention study
- Study sites: UMR and UMG together with HSNB (FBN involved)
- Period: 06/2019 – 11/2021 (30 months)
- Study population: 80 malnourished patients

Methods

- Anthropometry (body weight, height, BMI, upper arm circumference, waist hip ratio, triceps skin fold thickness)
- Bioelectrical impedance analysis (FMII, FFMII, SMMII), TBW, ECW, phase angle
- Muscle strength and function (hand grip, walking speed)
- Questionnaires (food intake (SHIP-FQG, DEGS-FQG), physical activity (IPAQ) and mental health (depression, fatigue, loneliness))
- Clinical blood analyses and plasma metabolome
- Monocyte studies
- Intestinal barrier function (gene- and protein function of Claudins and transporters, zonulin and lactulose/mannitol ratio)
- Transcriptomics
- Dietary counseling (G-NCP-based, face-to-face & by phone)

The joint project EnErGie combines expertise of five project partners from the fields of nutritional sciences, nutritional medicine, gastroenterology and basic, experimental research to study mechanisms of malnutrition and sarcopenia and to improve the medical care of malnourished patients.

Table 2: Project consortium

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<thead>
<tr>
<th>Partner</th>
<th>Project Leader</th>
<th>Research Institution</th>
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<tbody>
<tr>
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<td>Prof. Georg Lambracht</td>
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<td>P2</td>
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<td>University Medical Center Greifswald, Clinic and Polyclinic for Internal Medicine A, Department for Gerontology, Endocrinology and Nutritional Medicine</td>
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<td>P3</td>
<td>Prof. Luca Valentini</td>
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<td>P4</td>
<td>Prof. Cornelis C. Metges</td>
<td>Leibniz Institute for Farm Animal Biology, Dummerstorf, Institute for Nutritional Physiology</td>
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<td>P5</td>
<td>Prof. Leif-Alexander Garbe</td>
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