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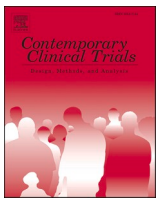

Prehabilitation in oncological patients undergoing major gastrointestinal surgery: rationale and design of the PROGRESS trial

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ABSTRACT

Background: Preliminary evidence suggests that multimodal prehabilitation may reduce postoperative complications in patients undergoing cancer surgery. However, its true effectiveness has yet to be fully demonstrated, and there are still significant gaps in knowledge that need to be addressed.
Methods: This is a two-arm, multicenter, randomized controlled trial including 400 adult oncological patients undergoing major gastrointestinal surgery. Patients are randomized with a 1:1 allocation ratio either to receive a multimodal prehabilitation program in addition to standard care or standard care alone. The prehabilitation program consists of four weeks of intervention including exercise training, nutritional support, and psychological counseling. The standard of care is delivered in accordance with the Enhanced Recovery After Surgery (ERAS) pathways.
Results: The trial is ongoing and currently recruiting. The primary outcome is the rate of patients experiencing major postoperative complications within 30 days after surgery. We hypothesize that prehabilitation will reduce this rate from 40% to 25%. Secondary outcomes include the time of functional recovery, length of hospital stay, and complication severity.
Conclusion: The PROGRESS trial will provide data to assess whether a prehabilitation program can reduce major postoperative complications and facilitate recovery in patients undergoing major oncological gastrointestinal surgery.
Trial registration: This trial was registered on ClinicalTrials.gov with the trial identification NCT06404489.

1. Introduction

Surgical resection remains a cornerstone in the management of solid tumors, particularly in gastrointestinal cancers. While advances in perioperative and oncologic care have significantly improved survival rates, cancer surgery is still a physically demanding procedure, particularly for older patients or those with comorbidities. Patients frequently enter the perioperative period with impaired physiological reserves due to disease-related malnutrition, muscle wasting, and emotional distress. [1–3] These factors not only hinder recovery but can also compromise surgical outcomes and reduce adherence to adjuvant therapies.

While the importance of postoperative rehabilitation on physical performance and recovery is well-recognized, [4,5] there is growing interest in strategies that optimize patient condition before surgery. [6] The concept of prehabilitation, a proactive, multidisciplinary approach aimed at enhancing a patient's functional capacity prior to a major stressor like surgery, has emerged as a promising solution.

Multimodal prehabilitation, delivered by a multidisciplinary team, combines exercise training, nutritional support, and psychological counseling to address the complex needs of cancer patients. Despite the strong rationale and encouraging clinical evidence in specific clinical settings, [6–8] the effectiveness of such interventions remains insufficiently defined.

This multicenter randomized study aims to evaluate the efficacy of a structured multimodal prehabilitation program in patients undergoing major gastrointestinal cancer surgery. The hypothesis is that prehabilitation will result in a significant reduction of major postoperative complications and promote faster functional recovery when compared to standard care alone.

2. Methods

2.1. Study design

This study is a multicenter, open label randomized controlled trial to assess the efficacy of a multimodal prehabilitation program in patients undergoing major oncological gastrointestinal surgery on postoperative complications (Fig. 1).

2.2. Study registration

This trial will be approved by Ethical Committees of all participating centers and conducted in compliance with the principles of the Declaration of Helsinki. The trial was registered on ClinicalTrials.gov in May 2024 with trial identification number NCT06404489.

2.3. Study population

The trial aims to enroll 400 adult patients (age > 18 years) scheduled for elective major gastrointestinal surgery for cancer, including

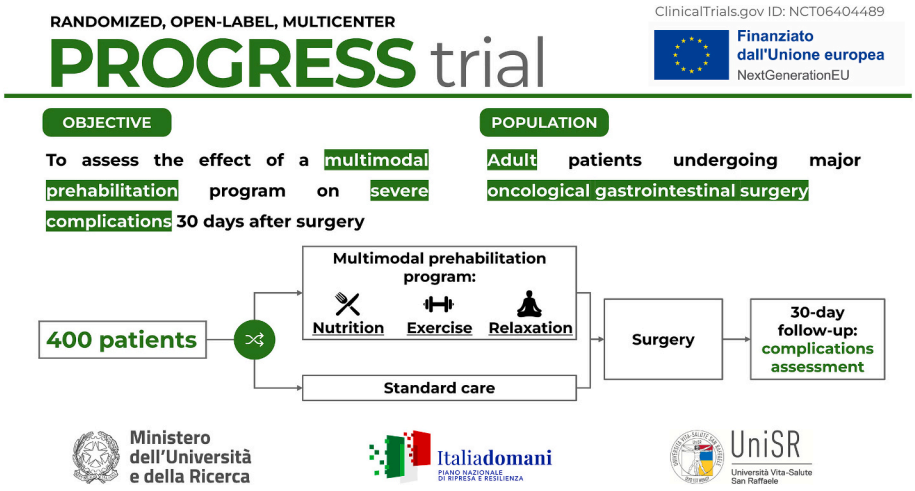

Fig. 1. Visual abstract.

resections of the colon, rectum, stomach, esophagus, pancreas, and liver.

The exclusion criteria include all medical, physical, and mental conditions interfering with the ability to complete study procedures, such as:

- acute or unstable cardio-respiratory conditions (e.g., unstable angina or symptomatic severe aortic stenosis);
- severe/end-stage organ diseases (e.g., cardiac failure NYHA functional classes III-IV, COPD FEV1 < 50% pred, end-stage kidney or liver disease);
- American Society of Anesthesiologists (ASA) physical status classes 4–5;
- disabling orthopedic and neuromuscular disease;
- psychosis, dementia;
- symptomatic anemia.

2.4. Recruitment and randomization

All patients who meet the inclusion and exclusion criteria and provide informed consent will be randomized four weeks before surgery to receive either a multimodal prehabilitation program in addition to standard care or standard care alone. Although the intended duration of prehabilitation is four weeks, this period may be shortened to accommodate surgical scheduling constraints, as previous studies have demonstrated that a three-week program is sufficient to improve functional recovery and relevant clinical outcomes. [9] Informed consent will be obtained in accordance with local ethics committee guidelines and legal regulations. Patients will be randomized with a 1:1 allocation ratio using a web-based system, employing a computer-generated permuted block design list. Randomization will be stratified according to the center. The group assignment will be concealed until the required information (sex and date of birth) is entered in the randomization system. Due to the nature of the intervention, the study will be

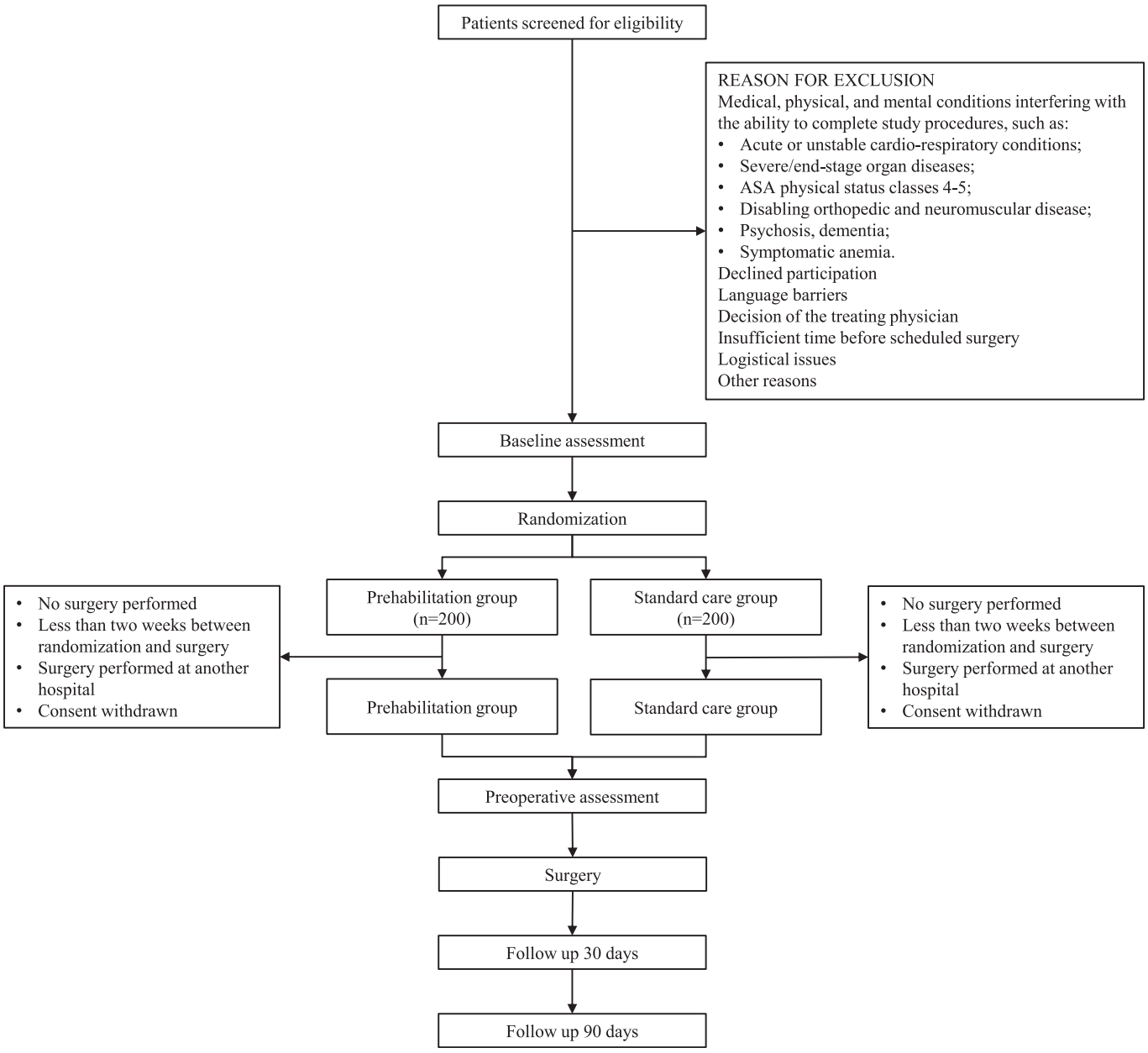

Fig. 2. Study flowchart.
Abbreviations: ASA = American Society of Anesthesiologists.

conducted in an open-label manner: participants and investigators will be aware of group assignments. Outcome assessors and statisticians will be blinded.

2.5. Patient assessment

All patients included in the study will be assessed for physical, nutritional, and psychological status prior to randomization, the day before surgery, at 30 days and 90 days after surgery (Fig. 2). The assessment includes the following tests and questionnaires:

- Physical performance assessment
  - o 6-min walk test (6MWT) [10]
  - o Short physical performance battery (SPPB) [11]
  - o Handgrip strength test
- Body composition and nutritional status
  - o Bioimpedance analysis (BIA) [12]
  - o Patient-Generated Subjective Global Assessment (PG-SGA) [13]
- Psychological assessment
  - o Hospital Anxiety and Depression Scale (HADS) [14]
- Self-Reported Functional Status and Physical Activity
  - o Duke Activity Status Index (DASI) [15]

All tests will be performed following international guidelines and standardized verbal instructions. Additional site-specific assessments will include cardiopulmonary exercise testing (CPET) to evaluate functional capacity and abdominal CT scans to assess body composition.

2.6. Intervention

Participants randomized to the intervention arm will undergo a structured multimodal prehabilitation program starting after randomization and continuing up to the time of surgery. The program will include three components: physical exercise, nutritional optimization and psychological support. The intervention will be tailored based on the specific impairments identified during the patient's assessment phase. The prehabilitation program will be primarily home-based. To ensure safety and adherence, compliance with the program will be regularly monitored through weekly phone calls. Furthermore, patients will be asked to complete a logbook to track their activities and progress. Hospital supervised prehabilitation will be permitted if preferred by a participating center.

2.6.1. Physical exercise training

The exercise program will be delivered by certified physiotherapists or kinesiologists and may be performed either at home or in a hospital-based setting, according to local organization and patient needs. Exercise prescription will be individualized following the baseline physical assessment, with patients engaging in endurance and resistance training three times per week or more, with modalities tailored to baseline functional capacity and personal preferences.

Two main aerobic exercise methods will be used: High-Intensity Interval Training (HIIT) or Moderate Intensity Continuous Training (MICT).

- HIIT involves alternating short bouts of high-intensity exercise at 85–90% peak power output with recovery periods of light activity. If CPET is unavailable, high-intensity exercise will be based on Borg Rating of Perceived Exertion Scale (RPE) 17, or 90% of maximum heart rate (HRmax).
- MICT consists of continuous exercise performed at moderate intensity (80–85% workload at VO_2 at, or Borg RPE 11–13, or 55–70% HRmax if CPET is unavailable).

Duration of training will be 30 min for HIIT and 40 min for MICT. Each modality will include a 5-min warm-up and 5-min cool-down at light intensity.

The resistance program will include exercises focusing on major muscle groups (upper limbs, trunk, and lower limbs). Patients will perform 2–4 sets of 6–12 repetitions, with intensity set at a moderate level based on the OMNI Resistance Exercise Scale of perceived exertion. Bodyweight exercises and elastic bands will be the preferred modalities. During the intervention, patients' responses to exercise will be monitored through weekly telephone contacts and self-reporting, allowing review of exercises, discussion of difficulties, provision of guidance, and reinforcement of motivation. Participants will also receive a PROGRESS Trial exercise guidebook, including a detailed program description, the Borg scale, and a diary to record exercise type, duration, maximum heart rate, and perceived intensity. The diary will be returned before surgery to assess adherence to the program. Further details are provided in the Supplementary materials.

2.6.2. Nutritional support

At enrollment, a qualified healthcare professional will conduct an initial nutritional assessment, including evaluation of habitual dietary intake, anthropometric measurements (e.g. body weight and body mass index), and review of medical history and comorbidities, with additional BIA and biochemical markers when available, to develop an individualized nutrition plan. Daily caloric intake will be individualized, with a target protein intake of 1.5 g/kg ideal body weight, following surgical oncology guidelines. Protein-energy supplements will be prescribed if needed, with patients advised to consume 20 g of whey protein immediately after each resistance training session. Nutritional education will be provided on macronutrient distribution, portion sizes, meal timing, and food choices. Patients will complete a food diary documenting foods and beverages consumed, including portions and mealtimes. Diaries will be reviewed to assess adherence to the nutrition plan and identify areas needing support or adjustment. Further details are provided in the Supplementary materials.

2.6.3. Psychological support

Counseling sessions will focus on reducing anxiety and enhancing coping strategies in preparation for surgery. An initial psychological assessment will be conducted by qualified psychologists via video or phone to evaluate psychological baseline, stress, coping strategies, mental health history, and psychosocial factors affecting prehabilitation and recovery. Trained psychology staff will deliver brief interventions including relaxation techniques such as guided imagery, visualization, and deep breathing exercises. Motivational interviewing and cognitive-behavioral strategies may also be applied to address unhelpful thoughts and strengthen coping skills, with structured guidance for independent practice. Sessions will be documented to monitor progress, with regular phone or video follow-ups to address challenges and adjust interventions as needed. Further details are provided in the Supplementary materials.

2.7. Standard care group

Participants randomized to the control arm will receive standard preoperative care according to the institutional protocols at each participating center. This typically includes basic preoperative counseling and optimization but without a structured or multimodal prehabilitation program. All patients in both groups will be managed following the ERAS Society guidelines for perioperative care [16] (see Supplementary materials).

2.8. Study outcomes

2.8.1. Primary outcome

The primary outcome of the study is the incidence of major postoperative complications within 30 days after surgery, defined as Grade III or higher according to the Clavien-Dindo classification. [17]

2.8.2. Secondary outcomes

The secondary outcomes are time to functional recovery (TFR) in postoperative days, [18–20] post-operative length of hospital stay, complication severity as measured by the Comprehensive Complication Index (CCI), [21] proportion of patients returning to preoperative functional walking capacity at 30 days after surgery, self-reported physical activity and generic health-related quality of life at 30 days after surgery. TFR is defined as the first postoperative day on which all of the following criteria are simultaneously met: adequate pain control with oral analgesics only, independent mobility, ability to maintain at least 50% of the estimated daily caloric requirements, no need for intravenous fluid administration, and absence of clinical signs of infection (body temperature $< 38.5\ ^{\circ}C$). [18–20].

2.9. Data collection

All data will be prospectively collected and stored in secure, electronic Case Report Forms (eCRFs). Data collection will comply with Good Clinical Practice (GCP) guidelines and applicable data protection regulations (e.g., General Data Protection Regulation). Participants will be assigned unique study identification numbers to ensure confidentiality. Only authorized study personnel will have access to identifiable participant information.

Data collected will include demographic information, medical history, comorbidities and concurrent conditions, details of the intervention, surgical and postoperative data, as well as physical, nutritional, and physiological status (Table 1).

Table 1
Study procedures.

	Screening	Study	Revaluation	Follow-up (after surgery)	
		>3 weeks	Day before surgery	30 days	90 days
Inclusion/exclusion criteria	✓				
Randomization	✓				
Clinical evaluation	✓		✓	✓	✓
6MWT	✓		✓	✓	
SPPB	✓		✓	✓	
Strength test	✓		✓	✓	
Weight	✓		✓	✓	✓
Height	✓		✓	✓	✓
BMI	✓		✓	✓	✓
Circumferences	✓		✓	✓	
BIA	✓		✓	✓	
Blood examinations	✓		✓	✓	
DASI	✓		✓	✓	✓
PG-SGA	✓		✓	✓	✓
HADS	✓		✓	✓	✓
EQ-5D-5L				✓	✓
Additional procedures only for treatment group					
Physical exercise training		✓			
Nutritional support		✓			
Psychological support		✓			
SAFETY					
Adverse events	✓	✓	✓	✓	✓

Abbreviations: 6MWD = 6-min walk distance; BIA = Bioimpedance analysis; BMI = Body mass index; DASI = Duke Activity Status Index; EQ-5D-5L = EuroQol 5-Dimensions 5-Levels; HADS = Hospital Anxiety and Depression Scale; PG-SGA = Patient-Generated Subjective Global Assessment; SPPB = short physical performance battery.

2.10. Safety monitoring

During the entire study period, clinical and study staff will work together to guarantee protocol adherence and patient safety. Patients enrolled in treatment group will not receive any additional medication but only a multimodal program to optimize their preoperative functional capacity. All safety data will be collected, reviewed, and reported according to GCP standards and applicable regulatory requirements.

2.11. Sample size calculation

Among high-risk patients, approximately 40% experience major postoperative complications within 30 days after major cancer surgery. [22–25] We anticipated that patients in the treatment group would have a 15% absolute reduction in this rate (corresponding to a risk ratio of $0.25/0.40 = 0.63$). Using a two-tailed test with a significance level of $\alpha = 0.05$ and a statistical power of 80%, and accounting for continuity correction and an interim analysis, the required sample size was estimated at 180 patients per group. To accommodate an anticipated 10% attrition due to dropouts and missing data, the target enrollment was increased to 200 patients per group, resulting in a total sample size of 400 participants.

2.12. Data analysis

The primary analysis will be conducted according to a modified intention-to-treat principle, including all randomized patients who underwent surgery, who had a time-window of at least two weeks between randomization and surgery, [26] did not withdraw consent, and did not undergo surgery at another hospital. A per-protocol analysis will also be conducted. Baseline demographic and clinical characteristics will be summarized using descriptive statistics. Categorical variables will be presented as frequencies and percentages and compared with the two-tailed chi-square test or Fisher's exact test when appropriate. The normality of continuous variables will be assessed using the Shapiro–Wilk test. Continuous variables with a skewed distribution will be reported as medians and interquartile ranges (IQR), while those with a symmetric distribution will be expressed as means and standard deviations (SD). Continuous variables will be compared using Student's *t*-test or the Wilcoxon rank-sum test, as appropriate based on data distribution. Between-group differences for the primary and secondary outcomes will be reported as relative risks (RR) or mean differences with their 95% confidence intervals (CI), for dichotomous and continuous variables respectively. The significance level will be set at a two-tailed *P* value of <0.05. Statistical analysis will be performed using STATA® version 19 software (StataCorp, College Station, TX, USA). Pre-specified subgroup analyses will be conducted according to type of surgical procedure.

An independent safety committee will conduct an interim analysis at 50% ($n = 200$) of enrolled patients. The interim analysis will be carried out on the alpha spending models, according to Lan and De Mets, and will employ O'Brien- Fleming *Z*-test boundaries. [27] The efficacy stopping rules will require a low P value ($P < 0.003$). Investigators will not be informed of the results of the interim analysis.

3. Discussion

3.1. Significance

The findings of this study are expected to contribute significantly to the developing field of perioperative oncology care. Postoperative complications are associated with prolonged hospital stay, increased costs, and increased morbidity and mortality.

Prehabilitation represents a paradigm shift—from reactive postoperative rehabilitation to proactive preoperative optimization. The rationale is grounded in the understanding that cancer patients often

face diminished functional reserves due to chronic inflammation, malnutrition, and functional decline induced by both the disease and its treatment. [28] Early tailored physical, nutritional, and psychological interventions might be a valuable approach to reduce the risk of perioperative morbidity and enhance recovery. Nonetheless, optimal strategies to preserve functional status have yet to be defined. Our clinical and research interest is meant to fulfill this gap. In patients undergoing elective cancer surgery, the preoperative period represents a unique opportunity to address comorbidities and modifiable risk factors, improve functional capacity and address deficiencies, which might otherwise hinder surgery and recovery.

Poor nutritional status is a significant concern throughout the continuum of cancer care [29] with a high incidence of unintended weight loss (>70%) and sarcopenia (26–75%) at diagnosis, worsened by anticancer therapies. Unmanaged nutritional deficits during the preoperative period can result in a worsening of body composition, physiological reserves, short and long-term functional status and quality of life. [30,31] Moreover, surgery itself represents a significant physiological stress requiring increased energy and nutritional intake to facilitate healing.

Loss of muscle mass often leads to deconditioning increasing the risk of dose-limiting toxicities and surgical morbidity. [32,33] These findings emphasize the role of physical fitness as critical determinant of cancer care. As disease and therapies affect different aspects of health and well-being, the importance for appropriate screening of patient's psychological status cannot be understated. Disease-related symptoms, functional decline and poor prognosis frequently result in manifestations of anxiety and depression following diagnosis, which are often exacerbated by the side-effects of neoadjuvant therapies. [32] Multimodal and multidisciplinary prehabilitation aims to address all the determinants of increased perioperative risk in this clinical setting. Enrollment in the PROGRESS trial, in addition, will not cause any delay in planned cancer surgery, since four weeks is the average length of the surgical waiting list [8] for most gastrointestinal procedures. If this trial shows a positive impact on the study outcomes, it could provide a foundation for incorporating structured prehabilitation into standard surgical procedures. This would not only improve patient outcomes but also set a new standard in perioperative care for cancer patients, while potentially lowering healthcare costs at the national level.

3.2. Strengths and limitations

The selection of a very specific and homogeneous population (patients undergoing gastrointestinal cancer surgery) is in line with previous existing randomized trials [7] and gives strength to the results and their interpretation. At the same time, it could limit the enrollment speed; furthermore, the results obtained in this population cannot be immediately transferred to all cancer surgery patients. The use of validated tools like the 6-min walk test, PG-SGA, HADS and BIA aims to detect specific deficits in cardiorespiratory fitness, nutritional status, and psychological well-being. This thorough evaluation ensures that interventions are both comprehensive and personalized, potentially maximizing their impact. Emphasis on individualized care is a key strength.

Unlike most previous prehabilitation studies, PROGRESS is designed as a multicenter trial with a large sample size, adequately powered to detect the effect of prehabilitation on clinically relevant outcomes. Among prior large randomized controlled trials, the PREHAB study enrolled 251 patients undergoing colorectal cancer surgery and provided a hospital-supervised prehabilitation program. [8] However, it failed to achieve the preplanned sample size of 714 patients due to disruptions caused by the COVID-19 pandemic. More recently, the PREPARE trial randomized 847 frail patients to either a home-based prehabilitation program or standard care, without focusing on a specific surgical population, with gastrointestinal surgery accounting for approximately 40% of the study cohort. [34]

Nonetheless, challenges remain and might influence the results of the study. Patient's adherence to home-based prehabilitation protocols, variability in baseline functional status, and other confounding perioperative factors must be carefully considered in the interpretation of results. Prehabilitation should not be evaluated only in terms of efficacy, but also in terms of sustainability and cost-effectiveness, which goes beyond the aim of this paper.

Consent to participate and study approval

The trial has been approved by the Comitato Etico Lombardia 1 at IRCCS San Raffaele Scientific Institute, Milan, Italy (CET 191–2023) and each participating center.

All patients who fulfill the study criteria will be informed about the rationale of the study and any aspect concerning intervention, data collection, storage, management, and about follow-up strategies. Written informed consent will be obtained from all the patients that are recruited for the trial by study staff.

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Trial status

The study is currently ongoing with 57 patients recruited in 3 centers as of October 10th, 2025.

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Declaration of competing interest

Given their role as members of the Editorial Board, Laura Pasin and Giovanni Landoni had no involvement in the peer-review of this article and had no access to information regarding its peer-review. Full responsibility for the editorial process for this article was delegated to another journal editor.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cct.2026.108249.

Data availability

No data was used for the research described in the article.

References

[1] J.P. Desborough, The stress response to trauma and surgery, Br. J. Anaesth. 85 (2000) 109–117, https://doi.org/10.1093/bja/85.1.109.
[2] I. Bautmans, R. Njemini, J. De Backer, E. De Waele, T. Mets, Surgery-induced inflammation in relation to age, muscle endurance, and self-perceived fatigue, J. Gerontol. A Biol. Sci. Med. Sci. 65 (2010) 266–273, https://doi.org/10.1093/gerona/glp145.
[3] F. Carli, Physiologic considerations of enhanced recovery after surgery (ERAS) programs: implications of the stress response, Can. J. Anaesth. J. Can. Anesth. 62 (2015) 110–119, https://doi.org/10.1007/s12630-014-0264-0.
[4] K.S. Courneya, J.L. Vardy, C.J. O'Callaghan, S. Gill, C.M. Friedenreich, R.K. S. Wong, H.M. Dhillon, V. Coyle, N.S. Chua, D.J. Jonker, P.J. Beale, K. Haider, P. A. Tang, T. Bonaventura, R. Wong, H.J. Lim, M.E. Burge, S. Hubay, M. Sanatani, K. L. Campbell, F.Z. Arthuso, J. Turner, R.M. Meyer, M. Brundage, P. O'Brien, D. Tu, C.M. Booth, CHALLENGE investigators, structured exercise after adjuvant chemotherapy for colon cancer, N. Engl. J. Med. (2025), https://doi.org/10.1056/NEJMoa2502760.
[5] D. Lemanne, B. Cassileth, J. Gubili, The role of physical activity in cancer prevention, treatment, recovery, and survivorship, Oncol. Williston Park N 27 (2013) 580–585.
[6] J.K. Silver, J. Baima, Cancer prehabilitation: an opportunity to decrease treatment-related morbidity, increase cancer treatment options, and improve physical and psychological health outcomes, Am. J. Phys. Med. Rehabil. 92 (2013) 715–727, https://doi.org/10.1097/PHM.0b013e31829b4afe.
[7] F. D'Amico, S. Dormio, G. Veronesi, F. Guarracino, K. Donadello, G. Cinnella, R. Rosati, N. Pecorelli, G. Baldini, M. Pieri, G. Landoni, S. Turi, PREHAB study group, Home-based prehabilitation: a systematic review and meta-analysis of randomised trials, Br. J. Anaesth. 134 (2025) 1018–1028, https://doi.org/10.1016/j.bja.2025.01.010.
[8] C.J.L. Molenaar, E.M. Minnella, M. Coca-Martinez, D.W.G. Ten Cate, M. Regis, R. Awasthi, G. Martínez-Palli, M. López-Baamonde, R. Sebio-Garcia, C.V. Feo, S. J. van Rooijen, J.M.J. Schreinemakers, R.D. Bojesen, I. Gögenur, E.R. van den Heuvel, F. Carli, G.D. Slooter, PREHAB study group, Effect of multimodal prehabilitation on reducing postoperative complications and enhancing functional capacity following colorectal cancer surgery: the PREHAB randomized clinical trial, JAMA Surg. 158 (2023) 572–581, https://doi.org/10.1001/jamasurg.2023.0198.
[9] J. Chen, C. Hong, R. Chen, M. Zhou, S. Lin, Prognostic impact of a 3-week multimodal prehabilitation program on frail elderly patients undergoing elective gastric cancer surgery: a randomized trial, BMC Gastroenterol. 24 (2024) 403, https://doi.org/10.1186/s12876-024-03490-7.
[10] ATS Committee on proficiency standards for clinical pulmonary function laboratories, ATS statement: guidelines for the six-minute walk test, Am. J. Respir. Crit. Care Med. 166 (2002) 111–117, https://doi.org/10.1164/ajrccm.166.1.at1102.
[11] J.M. Guralnik, E.M. Simonsick, L. Ferrucci, R.J. Glynn, L.F. Berkman, D.G. Blazer, P.A. Scherr, R.B. Wallace, A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission, J. Gerontol. 49 (1994) M85–M94, https://doi.org/10.1093/geronj/49.2.m85.
[12] P.R. Boshier, R. Heneghan, S.R. Markar, V.E. Baracos, D.E. Low, Assessment of body composition and sarcopenia in patients with esophageal cancer: a systematic review and meta-analysis, Dis. Esophagus 31 (2018), https://doi.org/10.1093/dote/doy047.
[13] J. Bauer, S. Capra, M. Ferguson, Use of the scored patient-generated subjective global assessment (PG-SGA) as a nutrition assessment tool in patients with cancer, Eur. J. Clin. Nutr. 56 (2002) 779–785, https://doi.org/10.1038/sj.ejcn.1601412.
[14] A.S. Zigmond, R.P. Snaith, The hospital anxiety and depression scale, Acta Psychiatr. Scand. 67 (1983) 361–370, https://doi.org/10.1111/j.1600-0447.1983.tb09716.x.
[15] M.A. Hlatky, R.E. Boineau, M.B. Higginbotham, K.L. Lee, D.B. Mark, R.M. Califf, F. R. Cobb, D.B. Pryor, A brief self-administered questionnaire to determine functional capacity (the Duke activity status index), Am. J. Cardiol. 64 (1989) 651–654, https://doi.org/10.1016/0002-9149(89)90496-7.
[16] O. Ljungqvist, M. Scott, K.C. Fearon, Enhanced recovery after surgery: a review, JAMA Surg. 152 (2017) 292–298, https://doi.org/10.1001/jamasurg.2016.4952.
[17] D. Dindo, N. Demartines, P.-A. Clavien, Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey, Ann. Surg. 240 (2004) 205–213, https://doi.org/10.1097/01.sla.0000133083.54934.ae.
[18] E.M. Wong-Lun-Hing, R.M. van Dam, G.J.P. van Breukelen, P.J. Tanis, F. Ratti, R. van Hillegersberg, G.D. Slooter, J.H.W. de Wilt, M.S.L. Liem, M.T. de Boer, J. M. Klaase, U.P. Neumann, L.A. Aldrighetti, C.H.C. Dejong, ORANGE II collaborative group, randomized clinical trial of open versus laparoscopic left lateral hepatic sectionectomy within an enhanced recovery after surgery programme (ORANGE II study), Br. J. Surg. 104 (2017) 525–535, https://doi.org/10.1002/bjs.10438.
[19] J. van Hilst, T. de Rooij, K. Bosscha, D.J. Brinkman, S. van Dieren, M.G. Dijkgraaf, M.F. Gerhards, I.H. de Hingh, T.M. Karsten, D.J. Lips, M.D. Luyer, O.R. Busch, S. Festen, M.G. Besselink, Dutch Pancreatic Cancer Group, Laparoscopic versus open pancreatoduodenectomy for pancreatic or periampullary tumours (LEOPARD-2): a multicentre, patient-blinded, randomised controlled phase 2/3 trial, Lancet Gastroenterol. Hepatol. 4 (2019) 199–207, https://doi.org/10.1016/S2468-1253(19)30004-4.
[20] T. De Rooij, J. Van Hilst, H. Van Santvoort, D. Boerma, P. Van Den Boezem, F. Daams, R. Van Dam, C. Dejong, E. Van Duyn, M. Dijkgraaf, C. Van Eijck, S. Festen, M. Gerhards, B. Groot Koerkamp, I. De Hingh, G. Kazemier, J. Klaase, R. De Kleine, C. Van Laarhoven, M. Luyer, G. Patijn, P. Steenvoorde, M. Suker, M. Abu Hilal, O. Busch, M. Besselink, Dutch Pancreatic Cancer Group, Minimally invasive versus open distal pancreatectomy (LEOPARD): a multicenter patient-blinded randomized controlled trial, Ann. Surg. 269 (2019) 2–9, https://doi.org/10.1097/SLA.0000000000002979.
[21] K. Slankamenac, R. Graf, J. Barkun, M.A. Puhan, P.-A. Clavien, The comprehensive complication index: a novel continuous scale to measure surgical morbidity, Ann. Surg. 258 (2013) 1–7, https://doi.org/10.1097/SLA.0b013e318296c732.
[22] T. Jakobson, J. Karjagin, L. Vipp, M. Padar, A.-H. Parik, L. Starkopf, H. Kern, O. Tammik, J. Starkopf, Postoperative complications and mortality after major gastrointestinal surgery, Med. Kaunas Lith. 50 (2014) 111–117, https://doi.org/10.1016/j.medici.2014.06.002.
[23] M.S. Morris, R.J. Deierhoi, J.S. Richman, L.K. Altom, M.T. Hawn, The relationship between timing of surgical complications and hospital readmission, JAMA Surg. 149 (2014) 348–354, https://doi.org/10.1001/jamasurg.2013.4064.
[24] T. Szakmany, J. Ditai, M. Kirov, D. Protsenko, B. Osinaike, A. Venara, N. Demartines, M. Hubner, R.M. Pearse, J.R. Prowle, International Surgical outcomes study (ISOS) group, in-hospital clinical outcomes after upper gastrointestinal surgery: data from an international observational study, Eur. J. Surg. Oncol. J. Eur. Soc. Surg. Oncol. Br. Assoc. Surg. Oncol. 43 (2017) 2324–2332, https://doi.org/10.1016/j.ejso.2017.08.002.
[25] A.K. Warps, R.A.E.M. Tollenaar, P.J. Tanis, J.W.T. Dekker, Dutch ColoRectal audit, Postoperative complications after colorectal cancer surgery and the association with long-term survival, Eur. J. Surg. Oncol. J. Eur. Soc. Surg. Oncol. Br. Assoc. Surg. Oncol. 48 (2022) 873–882, https://doi.org/10.1016/j.ejso.2021.10.035.
[26] C. Gillis, L. Hasil, C. Keane, D. Brassard, F. Kiernan, N.T. Bellafronte, S.N. Culos-Reed, L. Gramlich, O. Ljungqvist, T.R. Fenton, A multimodal prehabilitation class for enhanced recovery after surgery: a pragmatic randomised type 1 hybrid effectiveness-implementation trial, Br. J. Anaesth. S0007-0912 (25) (2025) 00153–00159, https://doi.org/10.1016/j.bja.2025.03.001.
[27] P.C. O'Brien, T.R. Fleming, A multiple testing procedure for clinical trials, Biometrics 35 (1979) 549–556.

[28] J. Muhandiramge, S.G. Orchard, E.T. Warner, G.J. van Londen, J.R. Zalcberg, Functional decline in the cancer patient: a review, Cancers 14 (2022) 1368, https://doi.org/10.3390/cancers14061368.
[29] J. Arends, P. Bachmann, V. Baracos, N. Barthelemy, H. Bertz, F. Bozzetti, K. Fearon, E. Hütterer, E. Isenring, S. Kaasa, Z. Krznaric, B. Laird, M. Larsson, A. Laviano, S. Mühlebach, M. Muscaritoli, L. Oldervoll, P. Ravasco, T. Solheim, F. Strasser, M. Schueren, J.-C. Preiser, ESPEN guidelines on nutrition in cancer patients, Clin. Nutr. Edinb. Scotl. 36 (2017) 11–48, https://doi.org/10.1016/j.clnu.2016.07.015.
[30] Y. Shen, Q. Hao, J. Zhou, B. Dong, The impact of frailty and sarcopenia on postoperative outcomes in older patients undergoing gastrectomy surgery: a systematic review and meta-analysis, BMC Geriatr. 17 (2017) 188, https://doi.org/10.1186/s12877-017-0569-2.
[31] J. Sun, C. Zhang, Z. Liu, M. Cai, J. Miao, X. Yao, Impact of preoperative frailty on choice of anesthesia modality and outcomes in elderly total joint replacement patients, Signa Vitae 20 (2024) 106–114, https://doi.org/10.22514/sv.2024.047.
[32] S. Jack, M.A. West, D. Raw, S. Marwood, G. Ambler, T.M. Cope, M. Shrotri, R. P. Sturgess, P.M.A. Calverley, C.H. Ottensmeier, M.P.W. Grocott, The effect of neoadjuvant chemotherapy on physical fitness and survival in patients undergoing oesophagogastric cancer surgery, Eur. J. Surg. Oncol. J. Eur. Soc. Surg. Oncol. Br. Assoc. Surg. Oncol. 40 (2014) 1313–1320, https://doi.org/10.1016/j.ejso.2014.03.010.
[33] M.C. Goktekin, E. Gul, F. Aksu, PRISMA-7 (for frailty assessment) and SARC-F (for evaluation of sarcopenia risk) in predicting emergency department readmission and mortality, Signa Vitae 21 (2025) 97–105, https://doi.org/10.22514/sv.2025.012.
[34] D.I. McIsaac, S. Lee, D. Fergusson, C. Gillis, R.G. Khadaroo, A. Meliambro, J. Muscedere, A. Eskander, H. Moloo, G. Nelson, T. Saha, R. Chun, P.E. Serrano, D. N. Wijeysundera, M. Taljaard, PREPARE Trial Investigator Group, K. Barnes, S. Boet, L. Boland, K. Branje, R. Breau, G.L. Bryson, I. Dhalla, E. Dixon, G. Dobson, M. Farnand, A. Forster, S. Gagne, E. Hladkowicz, J. Holroyd-Leduc, A. Huang, J. Hutton, E. Jacobsohn, J. Joanisse, A. Johnson, S. Johnson, N. Khalil, G. Kidd, M. Lalu, L.T. Lavallée, T. Le, M. Levine, C. Love, C. McCartney, M. McMullen, L. M. Bergamascki, R. Moore, M. Mozel, S. Nagpal, J. Nantel, B. Power, C. Scheede-Bergdahl, L. Tamblyn-Watts, K. Thavorn, D. Trottier, C. van Walraven, I. Yang, Home-based prehabilitation for older surgical patients with frailty: a randomized clinical trial, JAMA Surg. (2025) e255288, https://doi.org/10.1001/jamasurg.2025.5288.