Supplment 1. The frequency analysis results of each case report form item for the development of the preliminary draft of the pre- and re-habilitation protocol

I. Diagnostic Exam and Assessment Tool for Pre- and Postoperative Rehabilitation

1-1. Exclusion Criteria

Rank	Item	Frequency
1	Illiteracy/Dementia/Cognitive Impairment	16
2	Inability to move/Exercise	12
3	Underlying disease (heart, lung, liver, kidney)	7–12
4	Not possible for dietary intake	8
5	Accompanied by distant metastases that cannot be surgically resected	8

Recommendation

If any of the following applies, you are excluded from this prehabilitation protocol.

- Illiteracy/Dementia/Cognitive Impairment
- Inability to move/Exercise
- Not possible for dietary intake
- Accompanied by distant metastases that cannot be surgically resected

1-2. Nutrition Screening & Assessment (Tool for Screening/Advanced Test)

Rank	Item	Frequency
1	PG-SGA (Patient-Generated Subjective Global Assessment)	10
2	NRS 2002 (Nutritional Risk Screening)	6
3	MNA (Mini Nutritional Assessment)	4

Recommendation

- Use the NRS as a nutritional evaluation screening, and if the score is 3 or higher, refer to a clinical nutritionist.
- Clinical nutritionists determine nutritional status through PG-SGA and consider nutritional intervention.
- Depending on the malnutrition status,

if the nutritional status is good (NRS ≥3, PG-SGA A), standard care,

if the nutritional status is poor (NRS ≥3, PG-SGA B, C), follow the Pre-rehabilitation protocol according to the

1-3. Nutritional Assessment (Food Intake Record)

Rank	Item	Frequency
1	3-day record	9
2	24-hr recall	3

Recommendation

- Before and after surgery, if necessary, it may be necessary to assess typical intake through a 3-day meal record or 24-hour recall method for nutritional management intervention and goal setting/evaluation of intervention effectiveness.
- However, since it is not required, it can be omitted.

1-4. Nutritional Assessment (Laboratory Tool)

Rank	Item	Frequency
1	Albumin	16
2	Hemoglobin	12
3	CRP (C-reactive protein)	7–12
4	Pre-albumin	8
5	TLC (total lymphocyte count)	6

Recommendation

- Before and after surgery, blood tests (albumin, pre-albumin, hemoglobin, CRP) are measured.
- If possible, TLC, transferrin, and vitamin D are also measured.

1-5. Nutritional Assessment (Anthropometric)

Rank	Item	Frequency
1	BMI (body mass index)	15
2	Weight loss	9
3	FM (fat mass)	6
4	LBM (lean body mass)	5

Recommendation

- Before and after surgery, changes in weight and body mass index (BMI) are checked to determine nutritional status and evaluate nutritional status.
- Body composition assessment for the diagnosis of Sarcopenia is a key factor for patients, and if possible, it is assessed by measuring FM and LBM.

1-6. Nutritional Assessment (Timing)

Rank	Item	Frequency
1	Preoperative	8
2	Pre-, Postoperative	7
3	Postoperative	3

Recommendation

- Nutritional assessment is performed both before and after surgery.
- In the case of pre-surgery, it is performed at least 1 week before and with diagnosis.

- It is performed after surgery, before discharge or 1 week after surgery, and for patients who underwent intervention due to malnutrition, it is performed 2 months after surgery.
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1-7. Sarcopenia Evaluation (Muscle Strength Test)

Rank	Item	Frequency
1	Handgrip strength	17
2	Not used	6
3	Quadriceps strength	3

Recommendation

- Muscle strength for evaluation of Sarcopenia is assessed using the Handgrip Strength test.
- Measure a total of three times and calculate and evaluate the average value.
- Standard: Male <28 kg, Female <18 kg (Asian Sarcopenia Guideline)

1-8. Sarcopenia Evaluation (Muscle Mass)

Rank	Item	Frequency
1	Not used	14
2	Bioelectrical impedance analysis	3
3	Abdomen CT (computed tomography; L3 level) DEXA (dual energy X-ray absorptiometry)	2

Recommendation

- Muscle mass evaluation for the evaluation of sarcopenia is done through DEXA, BIA, or CT scan.
- Standard value (Asian Sarcopenia Guideline)

→ DEXA: Skeletal Muscle Index (SMI); male <7.0 kg/m^2, female <5.4 kg/m^2

→ BIA: SMI; male <7.0 kg/m^2, female <5.7 kg/m^2

1-9. Sarcopenia Evaluation (Physical Function Test)

Rank	Item	Frequency
1	6-min walk test	16
2	CPET (cardiopulmonary exercise test)	5
3	Five-time-sit-to-stand test	4
4	Timed up and go test	3

Recommendation

- Physical function evaluation for the evaluation of sarcopenia is done through a 6-minute walk test.
- CPET can comprehensively evaluate exercise capacity and corresponding cardiopulmonary capacity, so it should be performed whenever possible.

1-10. Sarcopenia Evaluation (Questionnaire)

Rank	Item	Frequency
1	No	17
2	SF-36	6
3	EORTC QLQ-C30	3

Recommendation

- As a quality of life survey to evaluate sarcopenia, SF-36 and EORTC QLQ-C30 can be considered, but are not required.

II. Nutritional Rehabilitation Program in Pre- and Postoperative Period

2-1. Energy Requirements

Rank	Item	Frequency
1	Not use	21
2	Harris and Benedict equation	1

3	Mifflin-St. Jeor equation	1

Recommendation

- After assessing the patient's nutritional status, individual energy requirements are determined to establish a nutritional intervention plan.
- Energy requirements can be calculated simply using the energy requirements per unit body weight (kg), and for adults scheduled for surgery, a range of 25 to 30 kcal is considered.
- Nutrient requirements vary depending on nutritional status, level of physical activity, disease and metabolic status and may require individual adjustment.

2-2. Protein Requirements

Rank	Item	Frequency
1	Not use	11
2	1.5 g/kg/day	5
3	1.2 g/kg/day, 1.2–1.5 g/kg/day	2

Recommendation

- Protein requirements are at least 1.0 to 1.5 g/kg before and after surgery. Depending on the patient's condition, up to 2.0 g/kg can be considered.
- For the elderly, the recommended protein intake is at least 1.2 g/kg/day to prevent and manage sarcopenia.
- However, protein requirements may vary depending on the patient's condition and treatment methods such as metabolic stress, trauma, surgery, or dialysis. For patients with acute or chronic diseases, an individualized, customized approach is recommended, so follow expert opinion.

2-3. Insufficient Intake Criteria

Rank	Item	Frequency

1	Not use	15
2	75% of estimated	2

Recommendation

- If it is determined by the medical staff or a clinical nutritionist that calories and protein are insufficient compared to the required amount, a plan is established to provide nutritional supplement drinks and various supplements through nutritional intervention.

2-4. Nutrition Supplement: ONS (Oral Nutritional Supplement)

Rank	Item	Frequency
1	Yes	17
2	No	4

Recommendation

- Preoperatively, ONS shall be given to all malnourished cancer and high-risk patients undergoing major abdominal surgery. A special group of high-risk patients are the elderly people with sarcopenia.

2-5. Volume of Oral Nutritional Supplements (ONS)

Rank	Item	Frequency
1	400	5
2	700–750	2

Recommendation

- Oral nutritional supplements (ONS) should provide at least 400 kcal/day.

2-6. Frequency of Oral Nutritional Supplements (ONS)

Rank	Item	Frequency
1	2 times per day	5
2	3 times per day	3
3	1-4 times per day	2

Recommendation

- ONS should be administered in two or more divided doses per day.

2-7. Specific Formula in Supplement

Rank	Item	Frequency
1	Omega-3, arginine	6
2	Protein powder, vitamin, etc.	3

Recommendation

- If necessary, select ONS containing omega-3 or arginine.

2-8. Parenteral Nutrition (PN)

Rank	Item	Frequency
1	No	8
2	Yes	3

Recommendation

- In cases of insufficient oral intake in the pre- and postoperative periods, PN should be applied as needed.
- If oral intake or enteral feeding is difficult before and after surgery, PN is applied if necessary.

- If PN is planned within the pre/post-operative hospitalization period, request the Nutrition Support Team (NST) to plan PN application, timing, duration, amount, frequency, composition, etc.

2-9. Dietary Counseling

Rank	Item	Frequency
1	Individual dietary counseling	8
2	Dietary advice	5
3	Others	2

Recommendation

- Depending on the medical staff's judgment, if necessary, a clinical nutritionist is referred to provide nutritional management through nutritional counseling and education.

III. Exercise Rehabilitation Program in Pre- and Postoperative Period

3-1. Component/Intensity of Intervention

Rank	Item	Frequency
1	Aerobic	17
2	Resistance	15
3	Respiratory	6

Rank	Item	Frequency
1	Yes (moderate 6, moderate to high 2)	13
2	No	7

Recommendation

- For healthy cancer patients, the exercise prescription includes 150 minutes of moderate-intensity aerobic exercise or 75 minutes of high-intensity aerobic exercise per week (3–5 days per week), along with resistance exercises twice a week involving 8–10 muscle groups with

8–10 repetitions for at least 2 sets. Breathing exercises are also recommended to reduce postoperative complications.

3-2. Supervising/Place of Intervention

Rank	Item	Frequency
1	Supervised	8
2	Both	7
3	Non-supervised	6

Rank	Item	Frequency
1	Home	13
2	Hospital	10
3	Local PT	2

Recommendation

- For patients with comorbidities, stomas, lymphedema, severe sarcopenia (frailty), or severe malnutrition, a medical pre-evaluation must be conducted. Exercise should only be initiated after medical safety confirmation by healthcare providers and performed under the supervision of rehabilitation specialists.
- Patients with a low risk of exercise-related complications may transition from a hospital-based exercise program to a home-based exercise program. However, for patients with a high risk of exercise-related complications, a supervised exercise program is required.

3-3. Structuring of Intervention

Rank	Item	Frequency
1	Structured	18
2	Non-structured	1

Recommendation

- For elderly patients or those with sarcopenia, a comprehensive assessment of the patient's medical condition should be conducted, and a structured exercise program tailored to the individual's physical status—including the type and intensity of exercises—should be provided.