Original Article

Expert Consensus on Perioperative Nutritional Care and Muscle Loss Prevention: A Multidisciplinary Approach Tailored to Taiwan's Healthcare System

Wan-Hsuan Huang[1], Shih-Chang Chang[2]
Jaw-Yuan Wang[3], I-Shu Chen[4]
Ke-Chen Hung[5], Pei-Rong Li[6]
Hung-Hsing Chiang[7], Fan-Wei Yan[8]
Po-Li Tsai[9], Ya-Ling Chen[10]
Shau-Huai Fu[11], Feng-Fan Chiang[12]
Shuenn-Wen Kuo[13], Shu-Lin Guo[1,14]

[1]*Department of Anesthesiology, Cathay General Hospital,*
[2]*Department of Colorectal Surgery, Division of Surgery, Cathay General Hospital, Taipei,*
[3]*Division of Colorectal Surgery, Department of Surgery, Kaohsiung Medical University Hospital, Kaohsiung Medical University,*
[4]*Department of Surgery, Kaohsiung Veterans General Hospital, Kaohsiung,*
[5]*Division of Dietetics, Cathay General Hospital, Taipei,*
[6]*Department of Nutrition Therapy, Tungs' Taichung MetroHarbor Hospital, Taichung,*
[7]*Division of Chest Surgery, Department of Surgery, Kaohsiung Medical University Hospital, Kaohsiung Medical University, Kaohsiung,*
[8]*Division of Chest Surgery, Pingtung Hospital of the Ministry of Health and Welfare, Pingtung,*
[9]*Division of Colorectal Surgery, MacKay Memorial Hospital,*
[10]*Department of Rehabilitation, Cathay General Hospital, Taipei,*
[11]*Department of Orthopedics, National Taiwan University Hospital Yunlin Branch, Yunlin,*
[12]*Division of Colon and Rectal Surgery, Taichung Veterans General Hospital, Taichung,*
[13]*Department of Surgery, National Taiwan University Hospital and National Taiwan University College of Medicine, Taipei,*
[14]*School of Medicine, Fu Jen Catholic University, New Taipei City, Taiwan*

Purpose. This expert consensus aimed to provide a practical reference on perioperative evaluation, nutrition, and muscle loss prevention to address the lack of awareness of perioperative nutritional care and rehabilitation strategies.

Methods. A panel of Taiwan experts from the Taiwan Chapter, Enhanced Recovery After Surgery (ERAS) Society, Taiwan Society for Parenteral and Enteral Nutrition (TSPEN), Taiwan Society of Thoracic Surgeons (TSTS), Taiwan Society of Colon and Rectal Surgeons (TSCRS) established a working group, the Taiwan Panel on Perioperative Care (TPPC). The TPCC reviewed research articles, including evidence-based guidelines from the European Society for Clinical Nutrition and Metabolism (ESPEN), the American Society for Enhanced Recovery (ASER), the Asian Working Group for Sarcopenia (AWGS), and the Taiwan Advisory Panel for Sarcopenia (TAPS), and subsequently synthesized these to develop expert consensus statements.

Results. The TPPC formulated consensus statements on perioperative nutritional care and muscle loss prevention, tailored to Taiwan's healthcare system and following the ERAS protocol. The expert panel emphasized that preoperative screening and early nutritional intervention can help reduce infections and other complications, accelerate recovery, improve prognosis, and enhance the quality of care. Additionally, early nutritional interventions, such as high-protein supplementation and enteral nutrition, can help preserve muscle mass, and postoperative rehabilitation and structured nutritional plans can mitigate muscle loss.

Conclusions. This expert consensus highlights the need to increase awareness and implementation of perioperative nutritional screening, timely nutritional intervention, and rehabilitation strategies. This consensus serves as a structured guide for surgeons and other healthcare professionals involved in perioperative patient care.

Key Words
ERAS;
Muscle loss;
Perioperative nutrition;
Sarcopenia;
Prehabilitation

[*J Soc Colon Rectal Surgeon* (*Taiwan*) *2025;36:288-299*]

Received: June 10, 2025. Accepted: July 31, 2025.
Correspondence to: Dr. Shu-Lin Guo, Department of Anesthesiology, Cathay General Hospital, No. 280, Sec. 4, Ren-Ai Rd., Taipei, Taiwan. Tel: 886-983-701446; E-mail: pjdadsl@gmail.com

The nutritional status of patients plays a crucial role in surgical outcomes, especially in those undergoing major surgeries, including gastrointestinal surgery, major tumor resection, and organ transplantation.[1] Given the extent and complexity of the procedure, major surgeries are typically performed under general anesthesia and accompanied by significant pathophysiological changes.[1] Adequate perioperative nutrition is essential as situations of acute stress, such as surgery, increase the requirements for protein. Moreover, malnutrition can lead to inadequate immune response, delayed wound healing, and increased risk of infection, consequently negatively impacting surgical outcomes and prognosis.[2]

Muscle loss is increasingly recognized as one of the critical issues in perioperative patients. Major surgeries have been associated with a high risk of muscle loss, with previous studies demonstrating a prevalence of 16-50%, particularly in patients undergoing gastrointestinal or orthopedic procedures.[3-5] Traditionally, age has been used as a predictor of postoperative outcomes. However, studies have demonstrated that muscle loss is a more reliable predictor of poorer outcomes in surgical patients including higher complication rates, longer hospital stays, and higher postoperative mortality compared to patients without muscle loss.[5,6] Previously, muscle loss was only considered a result of the normal aging process, which led to missed opportunities for early diagnosis of muscle loss or sarcopenia. Systematic reviews and meta-analyses have emphasized the early preoperative detection of risk factors for muscle loss in surgical patients and the formulation of comprehensive surgical and rehabilitation plans to optimize outcomes in surgical patients. These data highlight the need for standardized tests for evaluating muscle health, particularly in the preoperative phase, which currently are lacking.[5]

For surgical patients, preoperative nutritional assessments, muscle health evaluations, and nutritional care can contribute to accelerating postoperative recovery. As a component of the Enhanced Recovery After Surgery (ERAS) protocol, early mobilization can also reduce postoperative complications, improve physical function, and reduce hospital stays, which consequently can lower healthcare costs. Combined with appropriate perioperative nutritional care, patients can preserve and increase their muscle mass and reduce their risk of falls and other complications. Research has shown that patients with higher muscle strength after surgery are more likely to mobilize early and have a lower risk of complications.[5]

With these data, the European Society for Clinical Nutrition and Metabolism (ESPEN)[7] has published guidelines on clinical nutrition in surgery, emphasizing the importance of perioperative nutritional care in patient recovery and prognosis. Furthermore, the American Society for Enhanced Recovery (ASER)[2] has introduced the Perioperative Nutrition Screen (PONS) to facilitate rapid assessment of the need for nutritional interventions. Similarly, the Asian Working Group for Sarcopenia (AWGS)[8] has provided updated diagnostic criteria and treatment recommendations for sarcopenia, specifically tailored to Asian populations. Additionally, the Taiwan Advisory Panel for Sarcopenia (TAPS)[9] has underscored the importance of early detection and intervention to mitigate the adverse effects of sarcopenia on health outcomes. The TAPS has also highlighted the supplementation of β-hydroxy β-methylbutyric acid (HMB) for individuals with sarcopenia or at risk for sarcopenia.

Despite the availability of international and local guidelines, awareness of perioperative nutrition and muscle health remains inadequate in Taiwan, even among colorectal, thoracic, and orthopedic surgeons. Thus, there is a need for clear and comprehensive guidance aligned with the ERAS protocol to address the perioperative nutritional care needs of surgical patients and reduce their risk of perioperative muscle loss.

Methods

To address the need for a comprehensive reference on perioperative nutrition that aligns with global standards and the ERAS protocol, an expert consensus was initiated to develop a clinical reference for surgical patients on nutritional assessment, muscle health evaluation, perioperative nutritional care strategies, and prehabilitation and rehabilitation to enhance recovery. To meet these goals, four key Taiwan-

ese medical societies, including the Taiwan Chapter, ERAS Society, Taiwan Society for Parenteral and Enteral Nutrition (TSPEN), Taiwan Society of Thoracic Surgeons (TSTS), and Taiwan Society of Colon and Rectal Surgeons (TSCRS) established an expert panel referred to as the Taiwan Panel on Perioperative Care (TPPC).

The TPPC comprised two anesthesiologists, three thoracic surgeons, four colorectal surgeons, one general surgeon, one orthopedic surgeon, two nutritionists, and one physical therapist. The TPCC searched the literature for the latest evidence-based medicine on perioperative nutritional care and muscle loss prevention. The search also included the latest recommendations from the ASER, ESPEN, AWGS, and TAPS. During the consensus meeting, each group of experts synthesized these recommendations and other scientific data and contributed clinical insights and opinions according to their respective areas of specialty to ensure that all aspects of perioperative care, including nutrition, muscle health, surgical risks, and rehabilitation, are covered. Consensus statements were formulated through expert discussion, with each statement modified in real time until unanimous agreement was reached. These consensus statements were then sent to the four Taiwanese medical societies for review and validation. The TPPC revised and finalized the consensus statements, with unanimous agreement, ensuring that the final version is adapted to the unique healthcare landscape of Taiwan.

Results and Discussion

The finalized consensus statements present a comprehensive and structured framework adapted from the recommendations of the ASER, ESPEN, AWGS, and TAPS (Table 1). The TPPC developed 16 consensus statements on perioperative nutritional care and rehabilitation. The nutritional and rehabilitation strategy is divided into three key phases: preoperative (2-3 weeks before surgery), the day of surgery, and postoperative (Fig. 1).

Preoperative period: 2-3 weeks before surgery to the day of surgery

Consensus statement 1

Patients scheduled for major surgery, such as major gastrointestinal surgery, major tumor resection, or organ transplantation, should undergo preoperative evaluation and treatment planning by a multidisciplinary care team consisting of surgeons, anesthesiologists, case managers, dietitians, physical

Table 1. Published guidelines on perioperative nutrition and muscle loss

Society/Group/Panel	Year	Topic	Summary
American Society for Enhanced Recovery (ASER)	2018	Nutrition screening and therapy within a surgical enhanced recovery pathway	• Screening of nutritional status • Optimal methods of providing nutritional support • When and how to optimize nutrition delivery
European Society for Clinical Nutrition and Metabolism (ESPEN)	2021	Clinical nutrition in surgery	Nutritional aspects of the ERAS concept and the special nutritional needs of patients undergoing major surgery
European Society for Clinical Nutrition and Metabolism (ESPEN)	2020	Perioperative nutrition	• Perioperative fluid therapy • Glycemic control • Protein nutrition and muscle strength
Asian Working Group for Sarcopenia (AWGS)	2019	Sarcopenia diagnosis and treatment	Low muscle strength and low physical performance definitions
Taiwan Advisory Panel for Sarcopenia (TAPS)	2024	Advancing sarcopenia diagnosis and treatment	Supplementation of HMB, in light of superior empirically substantiated benefits, for older people with or at risk for sarcopenia

ERAS, enhanced recovery after surgery; HMB, β-Hydroxy-β-methylbutyrate.

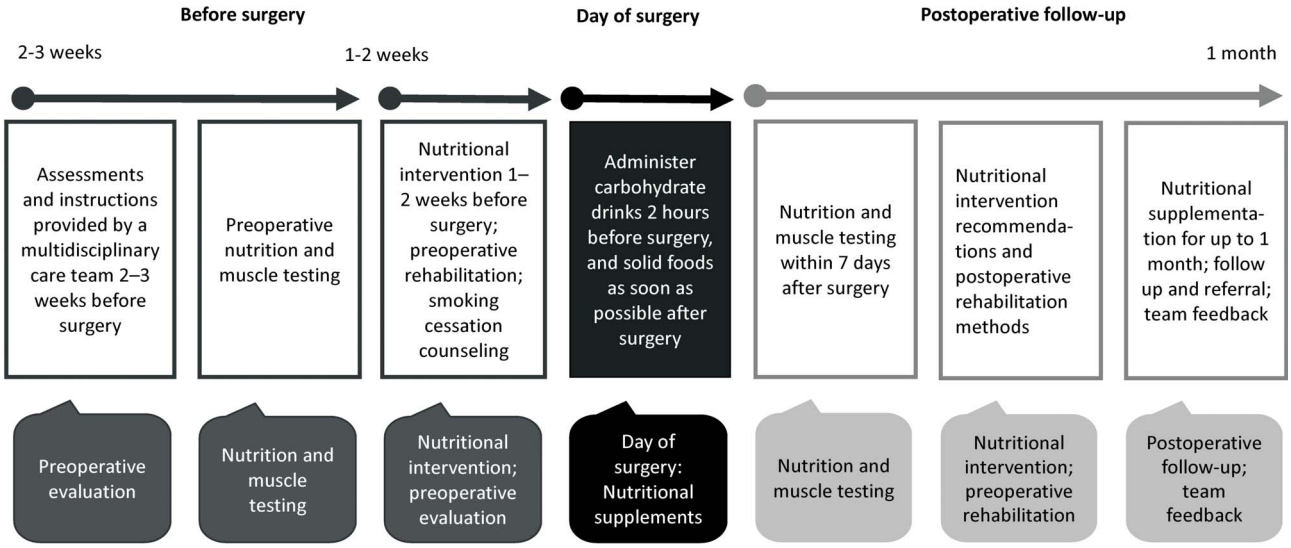

Fig. 1. Perioperative nutritional and rehabilitation strategy. The preoperative phase (2-3 weeks before surgery) focuses on nutritional and muscle health assessments and nutritional intervention; the day of surgery emphasizes metabolic preparation; and the postoperative phase underscores continued nutritional support, rehabilitation, and exercise to promote recovery and prevent muscle loss.

therapists, pharmacists, and other healthcare professionals as appropriate. Through comprehensive nutritional assessment and muscle health assessment, high-risk patients can be provided with enhanced perioperative nutritional care and appropriate intervention or delayed surgery.

Identifying perioperative malnutrition and muscle loss can help identify high-risk patients who can benefit from perioperative nutritional intervention and rehabilitation.[2,5] A multidisciplinary care team plays a crucial role in identifying patients who can benefit from interventions and ensuring the timely implementation of appropriate interventions. Apart from the surgeon and anesthesiologist who have direct roles during surgery, other experts such as dietitians, physical therapists, pharmacists, and case managers contribute specialized expertise to ensure comprehensive preoperative evaluation and intervention. Dietitians assess the patient's nutritional status and recommend personalized dietary interventions (e.g., oral or enteral nutrition),[2,10] and supplementation to address deficiencies and support recovery. On the other hand, physical therapists provide appropriate prehabilitation exercises to improve physical function and reduce the risk of postoperative complications, particularly in patients with muscle loss.[5] Pharmacists review prescriptions to identify drug interactions and ensure appropriate dosing. Case managers coordinate the patient's care plan to ascertain that all relevant specialists are involved and assist in navigating the healthcare system to access necessary resources and support throughout the perioperative process. Through the collaborative efforts of the team, high-risk patients are given appropriate nutritional care and intervention, and even delayed surgery when necessary.

Consensus statement 2

A nutritional assessment should be conducted before surgery and integrated into the electronic medical record system. Patients meeting any of the following criteria and classified as having severe malnutrition should receive 7-14 days of nutritional intervention, prioritizing oral nutritional supplements (ONS) to prevent unnecessary hospitalization or hospital-acquired infections.

The following criteria are used to assess nutritional risk, with the first three derived from the PONS:

- *Weight loss > 10% within six months or > 5% within three months*
- *Body mass index (BMI) < 18.5 kg/m^2 or < 20 kg/m^2 in adults > 65 years*
- *Food intake of < 50% of the regular diet*

- *Serum albumin < 3.0 g/dL*
- *Subjective Global Assessment (SGA) grade C or Nutritional Risk Screening 2002 (NRS-2002) score > 5*

The use of PONS from the ASER[2] helps assess the nutritional status of patients and identify those at risk of poor surgical outcomes due to malnutrition. Alternatively, SGA[11] or NRS (2002)[12] may also be used. Following nutritional assessment, patients should then be referred to a dietitian for further nutritional counseling and intervention. If necessary, ONS may be recommended to improve their nutritional status before surgery. Additionally, the ESPEN[13] advised that patients who meet certain criteria be considered severely malnourished and receive 7-14 days of nutritional intervention (Fig. 2).

Consensus statement 3

Muscle health assessments should be conducted before surgery in all presurgical patients (Table 2). One of the following muscle health evaluations may be used:

- *Handgrip strength test*
- *5-time sit-to-stand test*
- *Walking speed*
- *Computed tomography (CT)*

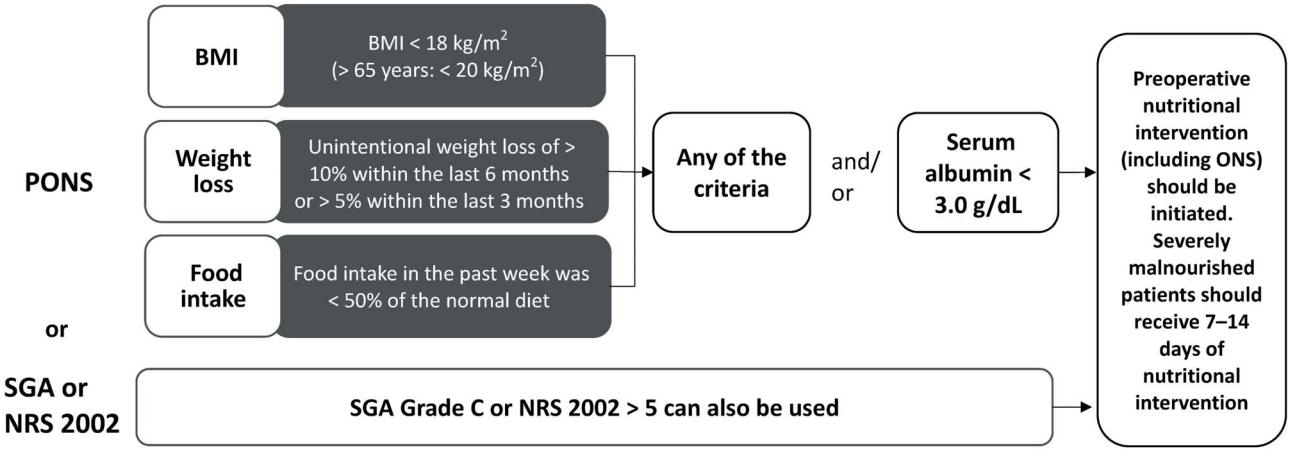

Fig. 2. Nutritional screening tools for presurgical patients. The PONS from ASER serves as a convenient method of evaluating nutritional status. SGA and NRS (2002) are alternative validated methods. Following nutritional screening, patients are referred to a dietitian for nutritional intervention as necessary. BMI, body mass index; NRS, nutritional risk screening; ONS, oral nutritional supplements; PONS, perioperative nutrition screen; SGA, subjective global assessment.

Table 2. Perioperative muscle health assessments and interventions

Preoperative		Postoperative	Intervention recommendations
Handgrip strength test	Grip strength for men < 28 kg Grip strength for women < 18 kg	Grip strength test: • For men, grip strength < 28 kg • For women, grip strength < 18 kg	Aggressive preoperative nutritional intervention for ≥ 7 days, along with high-protein ONS (2-3 times/day), complemented with BCAA, HMB, and other supplements that support muscle health. A carbohydrate drink should be administered 2 hours before surgery. Postoperative nutrition should prioritize adequate protein intake, and immune-modulating formulas may be considered to support immune function and healing.
Five-time sit-to-stand test	5 times, sit-to-stand ≥ 12 s		
Walking speed	6-meter walking time > 6 seconds, < 1.0 m/s		
CT	Analysis of body composition at the level of the third lumbar vertebra (L3) on a cross-sectional CT scan		

BCAA, branched chain amino acid; CT, computed tomography; HMB, β-Hydroxy-β-methylbutyrate; ONS, oral nutritional supplements.

As recommended by the AWGS[8] and ESPEN[13] guidelines, muscle health assessment may be conducted using one of the several above-mentioned methods, depending on the availability of facilities (Table 2). Muscle strength can be evaluated using the handgrip strength test, with values < 28 kg for men and < 18 kg for women indicating low strength.[8] Physical performance may be assessed using the 5-time sit-to-stand test, where a time of ≥ 12 seconds suggests reduced function, or the 6-meter walk test, with speeds < 1.0 m/s indicating impaired performance.[8] Additionally, CT imaging, if available, offers a detailed analysis of body composition.[2,14] Cross-sectional images at the third lumbar vertebral level analyze body composition, which is then indexed to the patient's height to calculate muscle volume.[16] CT imaging also provides the mean radiodensity in Hounsfield Units (HU) as an indicator of muscle quality and detects the presence of myosteatosis.[16] Although CT provides quantitative measurements of muscle mass, it is not always available in all hospitals or healthcare facilities, limiting its routine use in preoperative assessments.

Consensus statement 4

After evaluation by the nutrition team, surgical patients are recommended to receive > 1.2 g/kg of protein and ≥ 25 kcal/kg of calories per day.

For patients identified as severely malnourished or experiencing significant muscle loss, a nutritional intervention lasting 7-14 days is recommended. This approach should include high-protein ONS administered two to three times daily, with each serving providing at least 18 grams of protein.[2] Protein sources may include dietary protein, branched-chain amino acids (BCAA), and HMB to support muscle synthesis and maintenance[9,15] (see Table 2). HMB is a metabolite of leucine, one of the BCAAs, and plays several roles in the human body, including muscle hypertrophy.[16] Several mechanisms have been proposed explaining the muscle hypertrophic effects of HMB. These include the stimulation of growth hormone/insulin-like growth factor-1 and the enhancement of muscle stem cell proliferation and differentiation.[16] The ergogenic effects of HMB have been demonstrated in several human studies involving surgical patients. A multimodal prehabilitation strategy combining high-protein ONS and HMB has been shown to enhance muscle quality and functional outcomes in sarcopenic surgical patients.[17] Another study has shown that the supplementation of HMB combined with a prehabilitation strategy significantly improved gait speed and 6-meter walking performance before and after surgery in older cardiac surgery patients compared to the control group.[18] Additionally, the patients receiving HMB had a significantly shorter hospital length of stay (LOS) with no reported adverse events.[17,18]

Consensus statement 5

Preoperative physical therapy assessments and rehabilitation exercises benefit surgical patients, especially those at risk of malnutrition or muscle loss. Under the guidance of a physical therapist, strength and cardiopulmonary training should be conducted to improve muscle strength and mobility, reduce postoperative complications, and accelerate recovery. Recommended preoperative exercise program with a frequency of 3 times per week, each session lasting 1 hour:

- *Aerobic exercise: Based on the patient's preference and ability, including walking, stair climbing, aquatic exercises, or cycling*
- *Resistance training: Strength training for major muscle groups, using exercise machines, resistance bands, or dumbbells*
- *Balance training: Includes static and dynamic balance exercises*

Before surgery, patients at risk for malnutrition or muscle loss should undergo a prehabilitation program, involving three sessions per week that combine aerobic exercise, resistance strength training, and balance training, each lasting about one hour.[19,20] Aerobic and strength training components are essential for improving cardiovascular fitness and muscle strength, while balance training helps enhance stability and reduce fall risk. Evidence from the PREHAB trial has demonstrated that compared to the standard of care, a multimodal prehabilitation program before colorectal cancer surgery can reduce postoperative complications and optimize postoperative recovery.[19] Preha-

bilitation can also reduce 30-day readmission and 30-day emergency visits.[20] Given these benefits, initiating prehabilitation from the first outpatient visit is encouraged to enhance the patient's physical condition and improve surgical outcomes.[19,20]

Consensus statement 6

Patients should receive comprehensive smoking cessation counseling and intervention before hospitalization.

Smoking is a significant risk factor for sarcopenia.[22] Studies have shown that compared to non-smokers, smokers are more likely to develop sarcopenia.[22] Smoking contributes to muscle fatigue and protein catabolism, which can reduce muscle mass and function.[21] Furthermore, smoking increases the risk of perioperative complications, infections, and impaired wound healing, which can worsen the effects of sarcopenia and impede recovery, particularly in individuals with other health challenges.[21,22] These data underscore the importance of addressing smoking as a modifiable risk factor in surgical patients. Thus, patients should receive comprehensive smoking cessation counseling and intervention before hospitalization to decrease the likelihood of perioperative complications and outcomes.

Preoperative period (the day of surgery)

Consensus statement 7

Patients with no or little aspiration risk (e.g., patients without neurological disorders) may eat up to 6 hours before anesthesia and drink clear liquids up to 2 hours before surgery to avoid preoperative fluid depletion.

Studies and recommendations support the safety and benefits of allowing patients to ingest solid foods up to 6 hours before surgery and drink clear fluids up to two hours before anesthesia, in contrast to the traditional practice of fasting from midnight.[13,14,23-25] A systematic review has indicated that a shortened fluid fast does not increase the risk of aspiration, regurgitation, or related complications compared to traditional fasting protocols.[23] On the contrary, preoperative water intake has resulted in reduced gastric volumes.[23] A study also confirmed that clear liquids, including those containing carbohydrates but no protein or fat, are emptied from the stomach within approximately 90 minutes, which reinforces the safety of consuming clear fluids up to two hours before anesthesia.[25] These findings support a more patient-centered approach to preoperative fasting, reducing unnecessary discomfort while maintaining safety.

Consensus statement 8

Patients should consume clear liquids containing 50 g of carbohydrates 2 hours before surgery, finishing the drink within 5-10 minutes to increase insulin secretion and induce a fed metabolic state. Patients with type 1 diabetes or gastroparesis are exceptions to this recommendation.

Preoperative carbohydrate loading is an effective strategy to promote a metabolically fed state before surgery. Additionally, it can enhance nitrogen balance and insulin sensitivity, which can reduce the postoperative hospital LOS. Consuming 50 g of carbohydrates in a clear liquid 2-3 hours before anesthesia has been shown to enhance insulin secretion and reduce perioperative catabolic stress.[2] This strategy may be particularly relevant in patients with severe muscle loss, given its potential to attenuate catabolic responses and support muscle preservation mechanisms (see Table 2). Some protocols also include an additional 100 g of carbohydrates the evening before surgery to optimize metabolic preparation.[2] This approach has been associated with a modest reduction in hospital stay duration compared to fasting or placebo, without increasing postoperative complications.[26] However, patients with type 1 diabetes or gastroparesis should be excluded from this recommendation due to altered gastric emptying and glucose regulation concerns.

Postoperative phase (from the day of surgery to discharge)

Consensus statement 9

Early postoperative oral intake can promote gastrointestinal function recovery, shorten hospital stays, and reduce the occurrence of complications. Oral nutrition is the preferred method for postoperative nutritional intake. If oral intake is insufficient, en-

teral or parenteral nutrition may be considered.

Once a patient successfully resumes oral intake of food and achieves fluid and electrolyte balance, intravenous fluids should be discontinued to prevent unnecessary fluid administration.[14] Early oral nutrition is particularly beneficial in abdominal and pelvic surgeries since it promotes gut motility, reduces the risk of postoperative ileus, and shortens hospital stays.[14] For patients unable to ingest food or those expected to consume < 50% of their nutritional requirements for more than seven days, enteral nutrition should be initiated within 24 hours.[13] This is especially important for individuals undergoing major head and neck or gastrointestinal surgeries, those with severe trauma, including head injuries, and those with significant nutritional deficiencies identified during surgery.

Consensus statement 10

A nutritional and muscle health assessment should be performed within 7 days after surgery to provide appropriate nutritional interventions or rehabilitation (Table 2 and Fig. 1).

Following surgery, patients may experience a decline in body weight, muscle mass, and BMI, regardless of preoperative nutritional interventions.[27] These changes can negatively impact recovery, increase the risk of postoperative complications, and prolong hospital stays. Thus, it is essential to conduct a thorough nutritional and muscle health assessment within 7 days after surgery. This early evaluation allows healthcare providers to identify patients at risk of malnutrition and muscle loss, enabling timely interventions such as targeted nutritional support, supplementation, or rehabilitation programs. If muscle health assessments are difficult to perform, depending on the postoperative status of the patient, a handgrip strength test may be conducted once the patient's pain is adequately controlled.[28,29]

Consensus statement 11

Meeting the recommended protein intake should be prioritized over meeting the caloric intake in postoperative patients.

Adequate protein intake is an essential requirement of muscle protein synthesis, with studies showing that 30 g of protein per meal stimulates synthesis in young and elderly subjects.[30] In patients who underwent hip fracture surgeries, high-protein ONS containing HMB and vitamin D has been shown to accelerate wound healing, shorten the immobilization period, enhance muscle mass, and prevent sarcopenia.[31-33] In patients with multiple comorbidities, nutritional supplements containing amino acids such as arginine, glutamine, and HMB may accelerate wound healing and recovery.[7] In addition, immune-modulating formulas may also be considered within the first seven days after surgery to support immune function and healing.[2]

Consensus statement 12

Patients should be encouraged to sit up or stand within 24 hours of post-surgery and maintain proper positioning under the guidance of the healthcare team. If getting out of bed is not feasible, in-bed physical rehabilitation exercises are recommended, including patient-driven or caregiver-assisted limb movements.

Early mobilization is one of the key components of the ERAS protocol, which counteracts the negative effects of surgical stress and prolonged immobilization.[34] In patients undergoing curative-intent colorectal cancer surgery, early postoperative exercise has been associated with faster recovery and earlier hospital discharge.[35] Additionally, early mobilization maintains muscle mass, enhances walking capacity, improves patient-reported outcomes, and shortens hospital stays, leading to reduced healthcare costs.[34,35] The patient should be under the guidance of the healthcare team to ensure proper positioning and movement. In instances where it is impossible or inconvenient for the patient to get out of bed, in-bed exercises that are patient-driven or caregiver-assisted are recommended.[35]

Discharge and follow-up period

Consensus statement 13

Malnourished, elderly, or patients with sarcopenia before surgery should continue supplementation with high-protein ONS for at least 1 month after discharge.

Despite preoperative nutritional intervention, patients may still experience significant losses in weight, BMI, and muscle mass following surgery.[27] Patients with complications face a higher risk, especially those with lower preoperative lean body mass.[27] Additionally, postoperative patients may not be able to consume enough calories and proteins to support recovery. This challenge is particularly compounded in elderly patients who may experience a lack of appetite, nausea, or constipation from medications.[36] In a study, patients who received ONS containing HMB, vitamin D, and protein products in addition to a postoperative nutritional plan containing a total of 1900 kcal/day experienced significantly faster wound healing and higher muscle strength compared to patients who did not receive the supplement.[31] Recommendations from the ASER include that elderly, malnourished, and patients with sarcopenia should continue with ONS for at least 1 month after surgery.[2]

Consensus statement 14

During outpatient follow-up, patients should be referred to the nutrition or rehabilitation team as needed. Elderly patients may be referred to geriatrics for continued care and postoperative management.

A multidisciplinary approach is essential for optimizing postoperative recovery, particularly in older and high-risk patients. Referral to nutrition and rehabilitation teams ensures adequate dietary counseling, weight monitoring, and prevention of deficiencies, including key nutrients like vitamin D and calcium for bone health.[13] Involving geriatrics further enhances care by addressing the complex needs of older patients, promoting functional recovery, and reducing complications.

The clinical care team

Consensus statement 15

A designated individual may be assigned to collect various clinical parameters of patients throughout the perioperative period for long-term trend analysis and statistical evaluation.

Systematic data collection throughout the perioperative period is essential for evaluating and improving patient outcomes. Assigning a designated individual to track key clinical parameters, including compliance with ERAS elements, postoperative LOS, complication rates, and 30-day readmissions, allows for comprehensive trend analysis and statistical evaluation. This approach helps identify areas for optimization in perioperative care, enhances adherence to best practices, and leads to evidence-based improvements in surgical recovery and patient management.

Consensus statement 16

The healthcare team should hold regular meetings at least quarterly to review past patient care clinical indicators and compliance with the ERAS protocol.

Regular meetings of the healthcare team are essential for assessing the quality of patient care and adherence to ERAS protocols. Discussions during the meeting provide an opportunity to review past patient clinical indicators, identify gaps in ERAS implementation, and establish clinical consensus on pending issues or issues that may arise during ERAS implementation. By formulating targeted action plans and addressing unimplemented ERAS elements, the care team can enhance perioperative outcomes. Additionally, providing annual feedback to the hospital team ensures continuous improvement of care processes and identifies best practices.

Conclusion

This expert consensus addresses the need for a comprehensive reference on perioperative nutrition and rehabilitation, specifically tailored to the healthcare landscape of Taiwan. Here, we outline points of consensus to serve as guidance for the relevant healthcare practitioner spanning from the preoperative to the postoperative stage in an easy-to-follow manner, followed by a brief commentary explaining the rationale behind each consensus statement. To further enhance usability and convenience, we also constructed an infographic (Fig. 1) that illustrates the recommended timing of perioperative nutritional and rehabilitation strategies.

In this consensus, we highlight that early nutritional intervention, including high-protein supple-

ments or enteral nutrition, helps improve muscle health, reduces complications, and shortens LOS. Preoperative muscle health assessments, such as handgrip strength tests, are necessary for tailoring nutritional strategies, while postoperative nutrition and rehabilitation, including resistance training and supplementation, are key for enhancing recovery and preventing muscle loss. We also underscore that implementing the ERAS protocol requires the cooperation of various hospital departments to achieve patient safety goals, which is central to the ERAS protocol. This aligns with Taiwan's Ministry of Health and Welfare's objectives for quality medical practice and patient safety. In the future, ERAS implementation can be further strengthened by incorporating preoperative muscle health assessments, body composition analysis, and standardized postoperative nutrition referral protocols to optimize patient outcomes.

Acknowledgements

We would like to thank the Taiwan Chapter, ERAS Society, the Taiwan Society for Parenteral and Enteral Nutrition (TSPEN), the Taiwan Society of Thoracic Surgeons (TSTS), and the Taiwan Society of Colon and Rectal Surgeons (TSCRS) for their collaboration and support for this project. We also thank the EMD Scientific Communication (Taiwan Branch) Co. Ltd., for medical writing support.

Funding

The Taiwan Chapter, ERAS Society, TSPEN, TSTS, and TSCRS initiated the panel meetings and related activities, which Abbott Nutrition Taiwan and the Taiwan Association for Integrated Care funded. Funding agencies had no role in the formulation of the consensus statements.

References

1. Martin D, Mantziari S, Demartines N, Hübner M. Defining major surgery: a Delphi consensus among European Surgical Association (ESA) members. *World J Surg* 2020;44:2211-9.
2. Wischmeyer PE, Carli F, Evans DC, Guilbert S, Kozar R, Pryor A, et al. American Society for Enhanced Recovery and perioperative quality initiative joint consensus statement on nutrition screening and therapy within a surgical enhanced recovery pathway. *Anesth Analg* 2018;126:1883-95.
3. Elliott JA, Doyle SL, Murphy CF, King S, Guinan EM, Beddy P, et al. Sarcopenia: prevalence, and impact on operative and oncologic outcomes in the multimodal management of locally advanced esophageal cancer. *Ann Surg* 2017;266:822-30.
4. Terayama M, Ohashi M, Ri M, Makuuchi R, Hayami M, Ida S, et al. Long-term impact of sarcopenia in older patients undergoing gastrectomy for gastric cancer: a systematic review and meta-analysis. *Transl Gastroenterol Hepatol* 2023;8:35.
5. Knoedler S, Schliermann R, Knoedler L, Wu M, Hansen FJ, Matar DY, et al. Impact of sarcopenia on outcomes in surgical patients: a systematic review and meta-analysis. *Int J Surg* 2023;109:4238-62.
6. Yang TR, Luo K, Deng X, Xu L, Wang RR, Ji P. Effect of sarcopenia in predicting postoperative mortality in emergency laparotomy: a systematic review and meta-analysis. *World J Emerg Surg* 2022;17:36.
7. Wunderle C, Gomes F, Schuetz P, Stumpf F, Austin P, Ballesteros-Pomar MD, et al. ESPEN practical guideline: nutritional support for polymorbid medical inpatients. *Clin Nutr* 2024;43:674-91.
8. Chen LK, Woo J, Assantachai P, Auyeung TW, Chou MY, Iijima K, et al. Asian Working Group for Sarcopenia: 2019 consensus update on sarcopenia diagnosis and treatment. *J Am Med Dir Assoc* 2020;21:300-7. e302.
9. Peng LN, Chan D, Han D, Lee C, Lei H, Lin W, et al. Advancing sarcopenia diagnosis and treatment: recommendations from the Taiwan Advisory Panel for Sarcopenia. *Aging Med Healthc* 2024;15:8-14.
10. Williams DG, Molinger J, Wischmeyer PE. The malnourished surgery patient: a silent epidemic in perioperative outcomes? *Curr Opin Anaesthesiol* 2019;32:405-11.
11. Detsky AS, JR M, Baker JP, Johnston N, Whittaker S, Mendelson R, Jeejeebhoy K. What is subjective global assessment of nutritional status? *J Parenter Enteral Nutr* 1987;11:8-13.
12. Kondrup J, Rasmussen HH, Hamberg O, Stanga Z, Ad hoc ESPEN Working Group. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials. *Clin Nutr* 2003;22:321-36.
13. Weimann A, Braga M, Carli F, Higashiguchi T, Hübner M, Klek S, et al. ESPEN practical guideline: clinical nutrition in surgery. *Clin Nutr* 2021;40:4745-61.
14. Lobo DN, Gianotti L, Adiamah A, Barazzoni R, Deutz NE, Dhatariya K, et al. Perioperative nutrition: recommendations from the ESPEN expert group. *Clin Nutr* 2020;39:3211-27.
15. Molfino A, Gioia G, Rossi Fanelli F, Muscaritoli M. Beta-hydroxy-beta-methylbutyrate supplementation in health and

disease: a systematic review of randomized trials. *Amino Acids* 2013;45:1273-92.
16. Kaczka P, Michalczyk MM, Jastrząb R, Gawelczyk M, Kubicka K. Mechanism of action and the effect of beta-hydroxy-beta-methylbutyrate (HMB) supplementation on different types of physical performance - a systematic review. *J Hum Kinet* 2019;68:211-22.
17. Koh FHX, Yik V, Chin SE, Kok SSX, Lee HB, Tong C, et al. Evaluating the impact of multimodal prehabilitation with high protein oral nutritional supplementation (HP ONS) with beta-hydroxy beta-methylbutyrate (HMB) on sarcopenic surgical patients—interim analysis of the HEROS study. *Nutrients* 2024;16:4351.
18. Ogawa M, Satomi-Kobayashi S, Yoshida N, Komaki K, Hirabayashi T, Wakida K, et al. Effects of preoperative beta-hydroxy-beta-methylbutyrate, arginine, and glutamine supplementation on cardiac surgery: a randomized controlled trial. *Clin Nutr* 2025;45:91-100.
19. Molenaar CJL, Minnella EM, Coca-Martinez M, Ten Cate DWG, Regis M, Awasthi R, et al. Effect of multimodal prehabilitation on reducing postoperative complications and enhancing functional capacity following colorectal cancer surgery: the PREHAB randomized clinical trial. *JAMA Surg* 2023;158:572-81.
20. Yadav Y, Gupta A, Singh A, Kapoor D, Bisht SS, Chaudhary R, et al. Effect of multimodal prehabilitation on muscle mass in rectal cancer patients receiving neoadjuvant treatment. *Indian J Surg Oncol* 2024;15:931-7.
21. Locquet M, Bruyère O, Lengelé L, Reginster JY, Beaudart C. Relationship between smoking and the incidence of sarcopenia: the SarcoPhAge cohort. *Public Health* 2021;193:101-8.
22. Gao Q, Hu K, Yan C, Zhao B, Mei F, Chen F, et al. Associated factors of sarcopenia in community-dwelling older adults: a systematic review and meta-analysis. *Nutrients* 2021;13:4291.
23. Brady MC, Kinn S, Stuart P, Ness V, Cochrane Wounds Group. Preoperative fasting for adults to prevent perioperative complications. *Cochrane Database Syst Rev* 1996;2010.
24. Lambert E, Carey S. Practice guideline recommendations on perioperative fasting: a systematic review. *J Parenter Enteral Nutr* 2016;40:1158-65.
25. Lobo DN, Hendry PO, Rodrigues G, Marciani L, Totman JJ, Wright JW, et al. Gastric emptying of three liquid oral preoperative metabolic preconditioning regimens measured by magnetic resonance imaging in healthy adult volunteers: a randomised double-blind, crossover study. *Clin Nutr* 2009; 28:636-41.
26. Smith MD, McCall J, Plank L, Herbison GP, Soop M, Nygren J. Preoperative carbohydrate treatment for enhancing recovery after elective surgery. *Cochrane Database Syst Rev* 2014.
27. Grass F, Benoit M, Coti Bertrand P, Sola J, Schäfer M, Demartines N, Hübner M. Nutritional status deteriorates postoperatively despite preoperative nutritional support. *Ann Nutr Metab* 2016;68:291-7.
28. Chang CM, Lee CH, Shih CM, Wang SP, Chiu YC, Hsu CE. Handgrip strength: a reliable predictor of postoperative early ambulation capacity for the elderly with hip fracture. *BMC Musculoskelet Disord* 2021;22:1-6.
29. Zhou J, Liu X, Guo X, Yang X, Ma X, Liu W. Grip strength is an important predictor for nutritional risk and early postoperative ambulation in gastrointestinal tumors undergoing laparoscopic surgery: a prospective multicenter clinical study. *World J Surg Oncol* 2023;21:273.
30. Symons TB, Sheffield-Moore M, Wolfe RR, Paddon-Jones D. A moderate serving of high-quality protein maximally stimulates skeletal muscle protein synthesis in young and elderly subjects. *J Am Diet Assoc* 2009;109:1582-6.
31. Ekinci O, Yanık S, Terzioğlu Bebitoğlu B, Yılmaz Akyüz E, Dokuyucu A, Erdem Ş. Effect of calcium β-hydroxy-β-methylbutyrate (CAHMB), vitamin D, and protein supplementation on postoperative immobilization in malnourished older adult patients with hip fracture: a randomized controlled study. *Nutr Clin Pract* 2016;31:829-35.
32. Malafarina V, Uriz-Otano F, Malafarina C, Martinez JA, Zulet MA. Effectiveness of nutritional supplementation on sarcopenia and recovery in hip fracture patients. A multicentre randomized trial. *Maturitas* 2017;101:42-50.
33. Rempel AN, Rigassio Radler DL, Zelig RS. Effects of the use of oral nutrition supplements on clinical outcomes among patients who have undergone surgery for hip fracture: a literature review. *Nutr Clin Pract* 2023;38:775-89.
34. Tazreean R, Nelson G, Twomey R. Early mobilization in enhanced recovery after surgery pathways: current evidence and recent advancements. *J Comp Eff Res* 2021;11:121-9.
35. Min J, An KY, Park H, Cho W, Jung HJ, Chu SH, et al. Postoperative inpatient exercise facilitates recovery after laparoscopic surgery in colorectal cancer patients: a randomized controlled trial. *BMC Gastroenterol* 2023;23:127.
36. Wischmeyer PE. Are we creating survivors… or victims in critical care? Delivering targeted nutrition to improve outcomes. *Curr Opin Crit Care* 2016;22:279-84.

原　著

圍手術期營養照護及減少肌肉流失專家建議：適合台灣醫療體系的多專科方法

黃琬瑄[1]　張世昌[2]　王照元[3]　陳以書[4]　洪可珮[5]　李沛融[6]　姜宏興[7]
顏凡偉[8]　蔡柏立[9]　陳雅玲[10]　傅紹懷[11]　蔣鋒帆[12]　郭順文[13]　郭書麟[1, 14]

[1]國泰綜合醫院 麻醉科；[2]國泰綜合醫院 大腸直腸外科
[3]高雄醫學大學附設中和紀念醫院 大腸直腸外科；[4]高雄榮民總醫院 一般外科
[5]國泰綜合醫院 營養組；[6]童綜合醫院 營養治療科
[7]高雄醫學大學附設高醫岡山醫院 胸腔外科；[8]屏東醫院 胸腔外科
[9]馬偕紀念醫院 大腸直腸外科；[10]國泰綜合醫院 復健科
[11]台大醫院 雲林分院 骨科；[12]台中榮民總醫院 大腸直腸外科
[13]台大醫院 胸腔外科；[14]輔仁大學 醫學系

目的　本專家共識旨在提供圍手術期營養評估與預防肌肉流失的臨床參考依據，以解決目前對圍手術期營養照護與復健策略認知不足的問題。

方法　由台灣術後加速康復學會 (ERAS Society Taiwan Chapter)、台灣靜脈暨腸道營養醫學會 (Taiwan Society for Parenteral and Enteral Nutrition, TSPEN)、台灣胸腔外科醫學會 (Taiwan Society of Thoracic Surgeons, TSTS)、中華民國大腸直腸外科醫學會 (Taiwan Society of Colon and Rectal Surgeons, TSCRS) 之專家組成工作小組 — 台灣圍手術期照護專家小組 (Taiwan Panel on Perioperative Care, TPPC)。TPPC 參酌多篇研究文獻，包括 European Society for Clinical Nutrition and Metabolism (ESPEN)、American Society for Enhanced Recovery (ASER)、Asian Working Group for Sarcopenia (AWGS)、以及 Taiwan Advisory Panel for Sarcopenia (TAPS) 所發布之診療指引，據此彙整並制定專家共識。

結果　TPPC 依據 ERAS 術後加速康復計畫，並考量台灣醫療體系現況，提出圍手術期營養照護與肌肉流失預防之共識建議。專家小組強調，術前篩檢與早期營養介入有助於降低感染與其他併發症，加速病人康復及改善預後，並提升整體照護品質。此外，早期營養介入 (例如高蛋白口服營養補充品與腸道營養)，有助於維持肌肉量，而術後復健與結構化的營養計畫則可進一步減緩肌肉流失。

結論　本專家共識強調提升圍手術期營養篩檢、及時營養介入與復健策略的認知與落實之必要性。希望本專家共識能成為外科醫師以及圍手術期相關醫療照護人員在臨床操作上的實用依據。

關鍵詞　ERAS、肌肉流失、圍手術期營養、肌少症、術前復健。