



Perioperative Nutrition Management

ERAS Perioperative Pharmacy Services

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ERAS- Enhanced Recovery after Surgery

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Guidelines for Perioperative Care in Elective

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MDPI

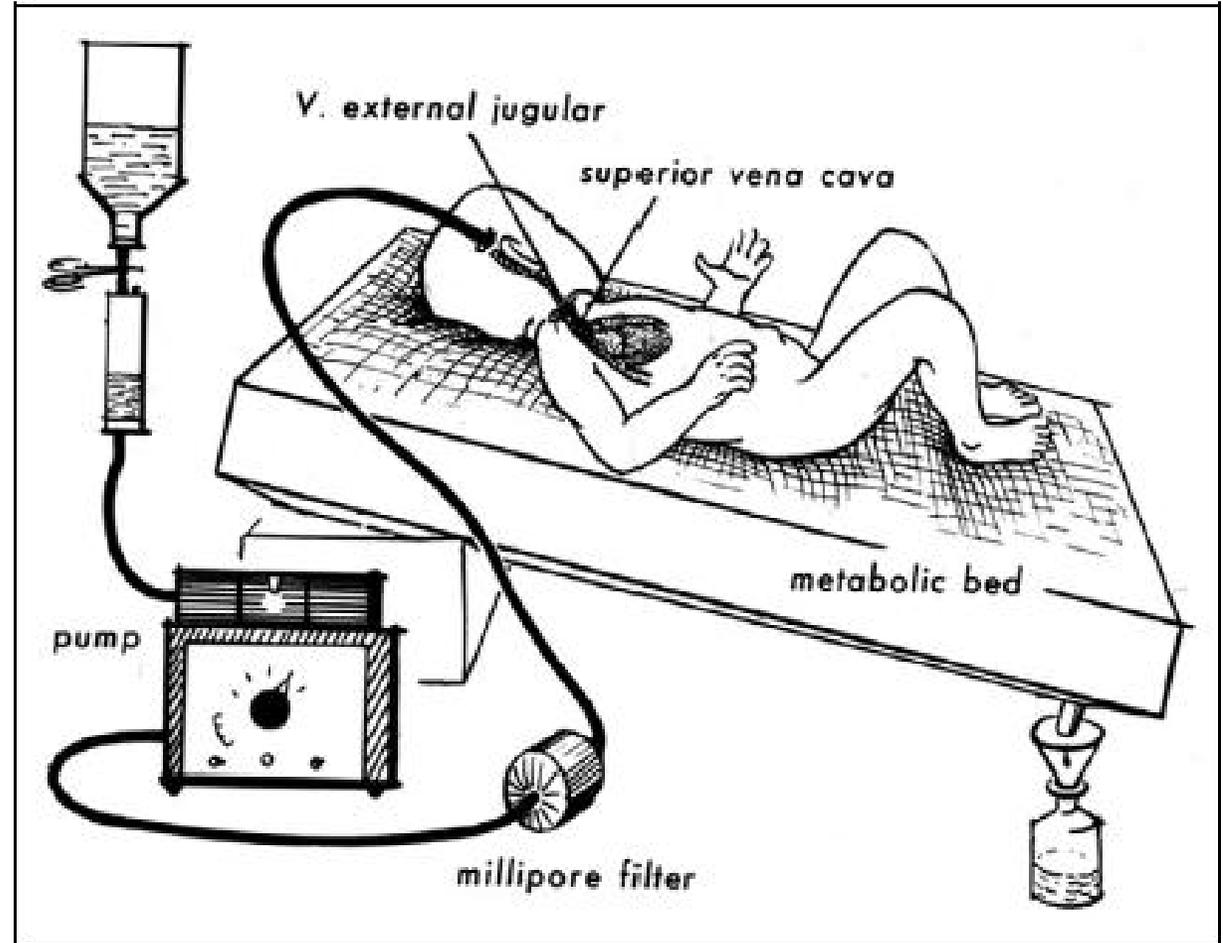
Review

Surgical Pharmacy for Optimizing Medication Therapy Management Services within Enhanced Recovery after Surgery (ERAS[®]) Programs

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Major achievements in medicine in the 20th century

- **Nutritional support**
- Antibiotics
- Blood transfusion techniques
- Intensive care and support
- Anesthesia techniques
- Immune regulation
- Extracorporeal circulation





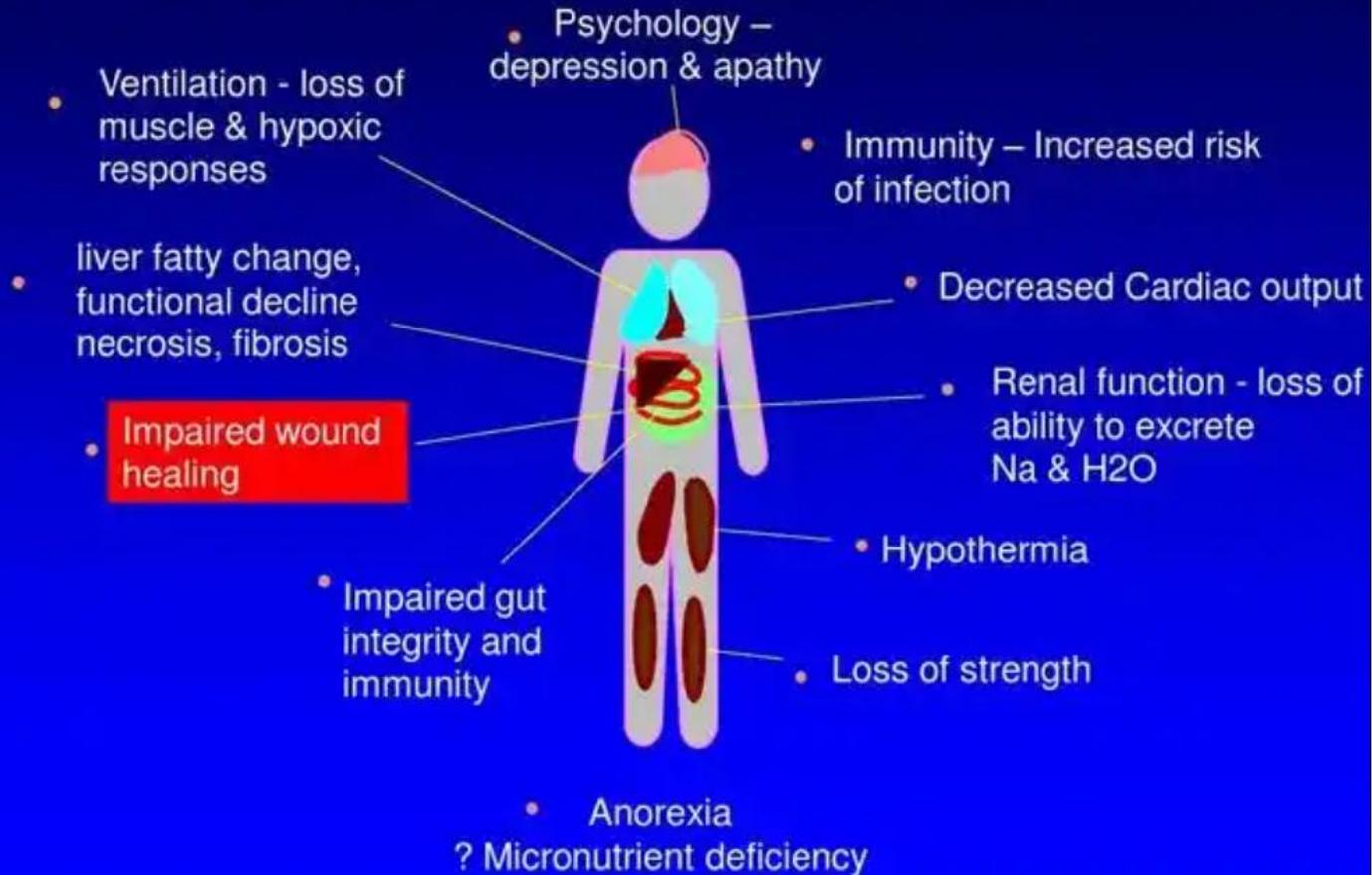
Malnutrition is a common clinical phenomenon among hospitalized patients worldwide.



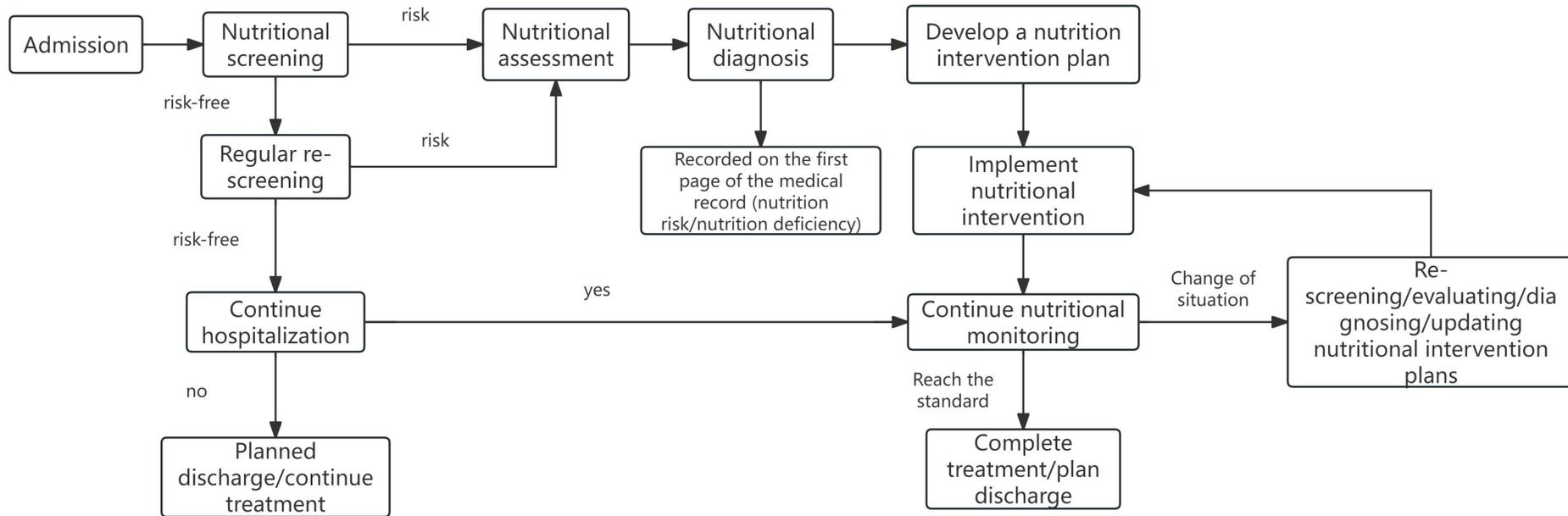
1. Russell CA and M Elia on behalf of BAPEN and collaborators. Nutrition screening survey in the UK and Republic of Ireland in 2011. 2. Meijers JM, Schols JM, van Bokhorst-de van der Schueren MA, et al. Br J Nutr. 2009 Feb; 101(3):417-23. 3. Charlton KE, Nichols C, Bowden S, et al. J Nutr Health Aging. 2010 Oct; 14(8):622-8. 4. Agarwal E, Ferguson M, Banks M, et al. Clin Nutr. 2012 Feb; 31(1):41-7. 5. Waitzberg DL, Caiaffa WT, Correia MI. Nutrition. 2001 Jul-Aug; 17(7-8):573-80. 6. Barreto Penié J, Cuban Group for the Study of Hospital Malnutrition. Nutrition. 2005 Apr; 21(4):487-97. 7. Liang X, Jiang ZM, Nolan MT, et al. Asia Pac J Clin Nutr. 2009; 18(1):54-62. 8. Zhang L, Wang X, Huang YI, et al. Asia Pac J Clin Nutr. 2013; 22(2):206-13

The dangers of malnutrition

Effects of Undernutrition



Nutritional support therapy - process





Common nutritional risk assessment methods

Currently, no single nutritional screening or assessment method can comprehensively evaluate the nutritional status of various patients.

It is recommended to use anthropometric indicators, laboratory indicators, and comprehensive evaluation methods to assess whether patients have malnutrition:

Anthropometric indicators: BMI, arm muscle circumference, triceps skinfold thickness, and body composition measurement

Laboratory indicators: serum ALB, pre-albumin, transferrin, etc.

Comprehensive evaluation methods: NR2002, PONS, SGA, etc.



Nutritional Risk Screening NRS - 2002

Preliminary Screening

Screening Items	Yes	No
BMI < 18.5 (kg/m ²)		
Has there been weight loss in the past 3 months?		
Has the food intake decreased in the past 1 month?		
Is the patient seriously ill (e.g., receiving intensive treatment)?		
If any of the above answers is "Yes", proceed to the second - stage screening; if all are "No", re - evaluate weekly. However, if the patient is scheduled for major surgery, a preventive nutrition treatment plan must be implemented.		



Nutritional Risk Screening NRS - 2002

Second - stage Screening

Nutritional Status Indicators	Score	Yes /No
Normal nutritional status	0	
Weight loss > 5% in 3 months or food intake reduction by 25 - 50% in the past 1 week	1	
Weight loss > 5% in 2 months or food intake reduction by 50 - 75% in the past 1 week	2	
Weight loss > 5% in 1 month (or > 15% in 3 months) or food intake reduction by 75 - 100% in the past 1 week or BMI < 18.5 or albumin < 30 g/L	3	
Normal nutritional status	0	

Disease Severity	Score	Yes/ No
Hip fracture, acute onset or complications of chronic diseases, COPD, hemodialysis, liver cirrhosis, general malignant tumor	1	
Major abdominal surgery, stroke, severe pneumonia, hematological system tumor	2	
Traumatic brain injury, bone marrow suppression, intensive care (APACHE \geq 10 points)	3	

NRS \geq 3 indicates that the patient has nutritional risk.



Advantages of NRS2002

- ✓ It is the first international nutritional risk screening tool developed using evidence-based medical data.
- ✓ Supported by RCTs, it offers better sensitivity and specificity. It facilitates doctor-patient communication and is easy to use, suitable for doctors, nutritionists, pharmacists, and nurses.
- ✓ Recommended by the European Society for Clinical Nutrition and Metabolism and the Chinese Medical Association's Branch of Clinical Nutrition and Metabolism, it is a valuable tool for standardizing clinical nutritional support operations in the future.
- ✓ It may become the standard for medical insurance payments for nutritional formulations.



Shortcomings of NRS2002

- ✓ When patients are bedridden and unable to measure their weight, or have conditions like edema or ascites that affect weight measurement, or are unconscious and unable to answer the assessor's questions, the use of this tool is limited.
- ✓ It cannot objectively distinguish between types of malnutrition. It also cannot determine specific nutritional support plans, such as nutrient requirements, delivery routes, gastrointestinal tolerance, renal function capacity, and methods for transitioning nutritional support.

GDPA



Common Nutritional Risk Screening and Assessment Tool

Nutritional Risk Assessment Scale	Notes
Nutritional Risk Screening, NRS 2002	Suitable for hospitalized patients
Subjective Globe Aessment, SGA	
Patient-generated Subjective Global Assessment, PG-SGA	Suitable for cancer patients
Mini Nutritional Screening Tools, MNA	Suitable for elderly people in the community
Malnutrition Screening Tool, MUST	Suitable for the general community population
The Royal Free Hospital-nutritional prioritizing tool, RFH-NPT	May be more suitable for patients with liver cirrhosis, especially those with fluid retention and ascites.
The Nutrition Risk Index, NRI	Suitable for major abdominal surgery and chest surgery



The impact of malnutrition on the risk of death

Nutritional Status and Mortality in the Critically Ill.

Mogensen KM¹, Robinson MK, Casey JD, Gunasekera NS, Moromizato T, Rawn JD, Christopher KB.

Author information

Abstract

OBJECTIVES: The association between nutritional status and mortality in critically ill patients is unclear based on the current literature. To clarify this relation, we analyzed the association between nutrition and mortality in a large population of critically ill patients and hypothesized that mortality would be impacted by nutritional status.

DESIGN: Retrospective observational study.

SETTING: Single academic medical center.

PATIENTS: Six thousand five hundred eighteen adults treated in medical and surgical ICUs between 2004 and 2011.

INTERVENTIONS: None.

MEASUREMENTS AND MAIN RESULTS: All cohort patients received a formal, in-person, standardized evaluation by a registered dietitian. The exposure of interest, malnutrition, was categorized as nonspecific malnutrition, protein-energy malnutrition, or well nourished and determined by data related to anthropometric measurements, biochemical indicators, clinical signs of malnutrition, malnutrition risk factors, and metabolic stress. The primary outcome was all-cause 30-day mortality determined by the Social Security Death Master File. Associations between nutrition groups and mortality were estimated by bivariable and multivariable logistic regression models. Adjusted odds ratios were estimated with inclusion of covariate terms thought to plausibly interact with both nutrition status and mortality. We used propensity score matching on baseline characteristics to reduce residual confounding of the nutrition status category assignment. In the cohort, nonspecific malnutrition was present in 56%, protein-energy malnutrition was present in 12%, and 32% were well nourished. The 30-day and 90-day mortality rates for the cohort were 19.1% and 26.6%, respectively. Nutritional status is a significant predictor of 30-day mortality following adjustment for age, gender, race, medical versus surgical patient type, Deyo-Charlson index, acute organ failure, vasopressor use, and sepsis: nonspecific malnutrition 30-day mortality odds ratio, 1.17 (95% CI, 1.01-1.37); protein-energy malnutrition 30-day mortality odds ratio, 2.10 (95% CI, 1.70-2.59), all relative to patients without malnutrition. In the matched cohort, the adjusted odds of 30-day mortality in the group of propensity score-matched patients with protein-energy malnutrition was two-fold greater than that of patients without malnutrition.

CONCLUSION: In a large population of critically ill adults, an association exists between nutrition status and mortality.

- Between 2004 and 2011, there were a total of 6,580 patients admitted to hospital and surgical ICUs.
- In the cohort, non-specific malnutrition accounted for 56%, protein-energy malnutrition for 12%, and 32% had good nutritional status.
- After adjusting for factors such as age, gender, race, and type of medical or surgical patient, nutritional status was found to be an important predictor of 30-day mortality: compared to patients with no malnutrition, those with non-specific malnutrition had an odds ratio of 1.17 (95% CI, 1.01-1.37) for 30-day mortality, while those with protein-energy malnutrition had an odds ratio of 2.10 (95% CI, 1.70-2.59).

Contemporary perioperative nutritional care

Annual Review of Nutrition

Contemporary Perioperative Nutritional Care

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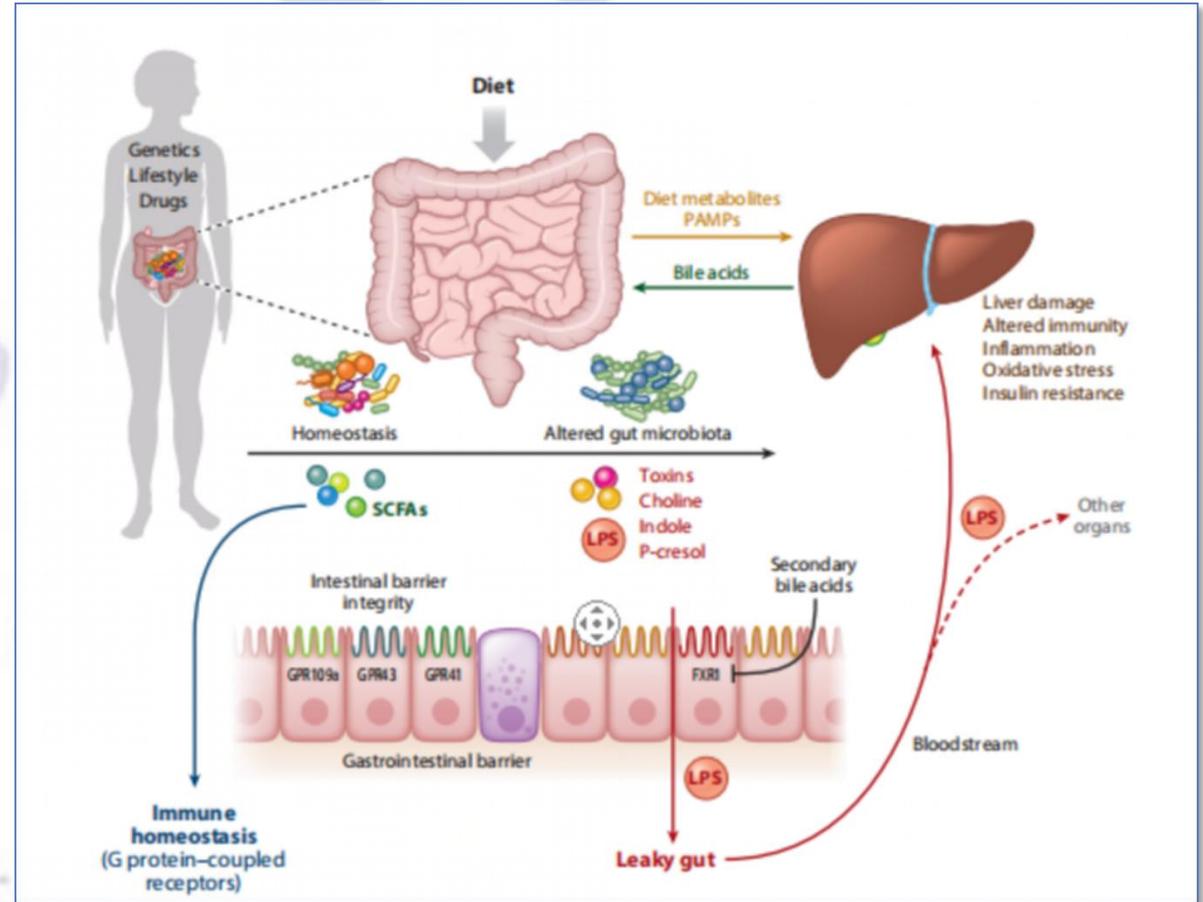
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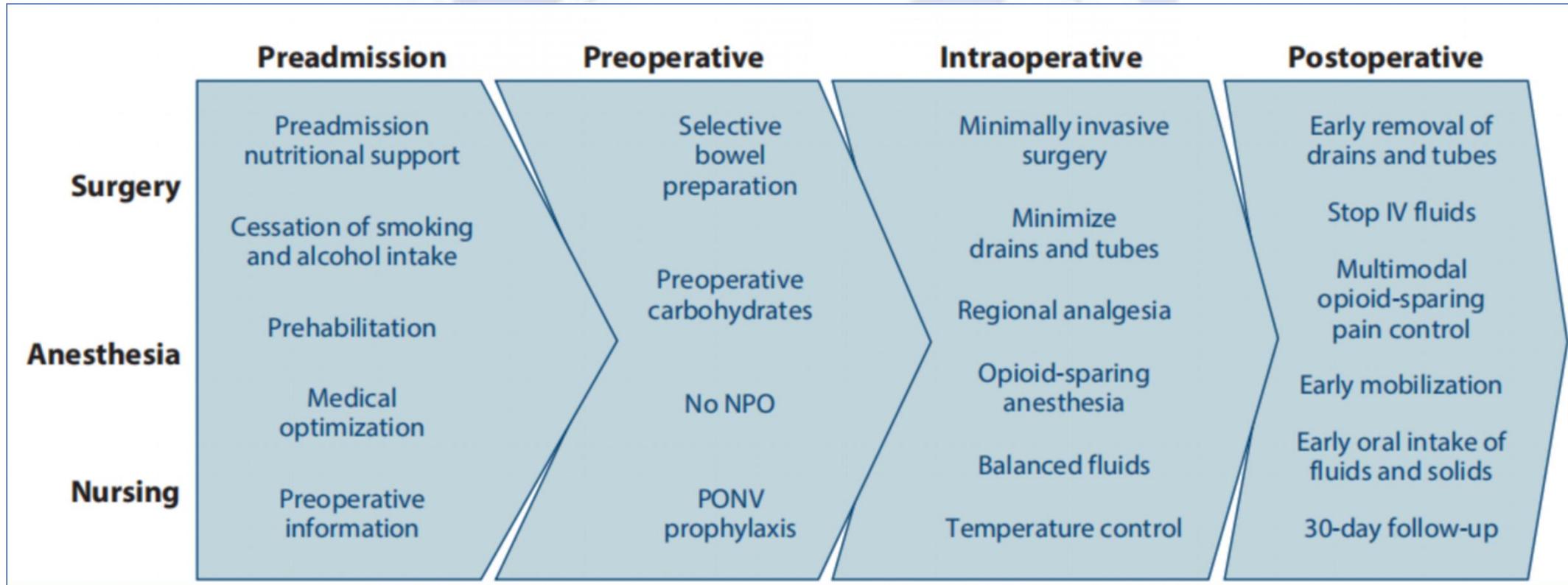
Critical variables for evaluating the nutritional and nonnutritional risks

Table 1 Critical nutritional and nonnutritional parameters implicated in increasing the risk of complications after major abdominal surgery

Nutritional parameters	Body mass index (both low and high)
	Unintentional body weight loss
	Low muscle mass and reduced muscle function (sarcopenia)
	Visceral obesity
	Sarcopenic obesity
	Reduced food intake
Nonnutritional parameters	Malignancy
	Age (>70 years)
	Sex (male)
	Ethnicity (non-Caucasian)
	Decompensated diabetes
	Chronic organ dysfunction (heart, lung, kidney, liver, pancreas, intestine, blood, etc.)
	Charlson Comorbidity Index
	Drug/alcohol dependency
	Chronic corticosteroid use
	American Society of Anesthesiologists physical status classification
	Bleeding disorders
	Active smoking
	Frailty
	Intraoperative blood loss
	Perioperative blood transfusion
	Duration and complexity of surgery
	Emergency operations
	Intravenous fluid overload
	Surgical field contamination
	Open surgery
Persistent postoperative hyperglycemia (> 180 mg/dl or 10 mmol/L.)	
Low phase angle at bioimpedance analysis	
Albumin (<30 g/L)	



Nutrition is one of the most crucial aspects of ERAS management





Nutrition is one of the most crucial aspects of ERAS management

Table 2 Basic care elements of ERAS and their role in management of nutritional care (based on the colorectal guidelines from the ERAS Society)

Timing	Basic care elements of ERAS	Aim(s) related to nutrition
Preadmission items	Preadmission information and counseling	Patient involvement
	Preoperative medical optimization	NA
	Prehabilitation	Nutrition and exercise
	Preoperative nutritional screening and care as needed	Nutrition for at-risk patients
	Anemia screening and treatment as needed	NA
Preoperative items	Prevention of PONV	Supporting oral intake
	Avoidance of long-acting sedatives	Reducing PONV
	Antimicrobial prophylaxis (IV) and skin preparation	NA
	Avoidance of oral bowel preparation in colonic surgery	Avoiding dehydration
	Preoperative carbohydrate loading	Reducing insulin resistance
Intraoperative items	Standard anesthetic protocol	Pain management
	Balanced fluid and electrolyte therapy	Keeping euvolemia and supporting GI function
	Minimally invasive surgery	Reducing pain and ileus
	Avoidance of surgical site drains	NA
	Maintaining temperature control	Avoiding protein losses
Postoperative items	Avoidance of nasogastric tubes	Allowing oral intake
	Multimodal standardized analgesia to minimize opioid use	Minimizing opioids and reducing PONV and ileus
	Thromboprophylaxis	NA
	Balanced fluid and electrolyte therapy	Keeping euvolemia and supporting GI function
	Early removal of urinary catheter	Supporting mobilization
	Prevention of postoperative ileus	Supporting GI function
	Postoperative nutritional care	Oral and IV support as needed
Early mobilization	Building strength/stimulating appetite	

Abbreviations: ERAS, Enhanced Recovery After Surgery; GI, gastrointestinal; IV, intravenous; NA, not applicable; PONV, postoperative nausea and vomiting.



Nutritional Support

Parenteral nutrition

PN



Via peripheral or
central venous route

Enteral nutrition,

EN



Via enteral feeding through
the gastrointestinal tract

Whenever gastrointestinal anatomy and function permit, EN should be the preferred option.

Surgical Pharmacy



Selection of enteral nutrition formulations

Protein-based formulation

Normal

Damaged

Peptide-based formulations

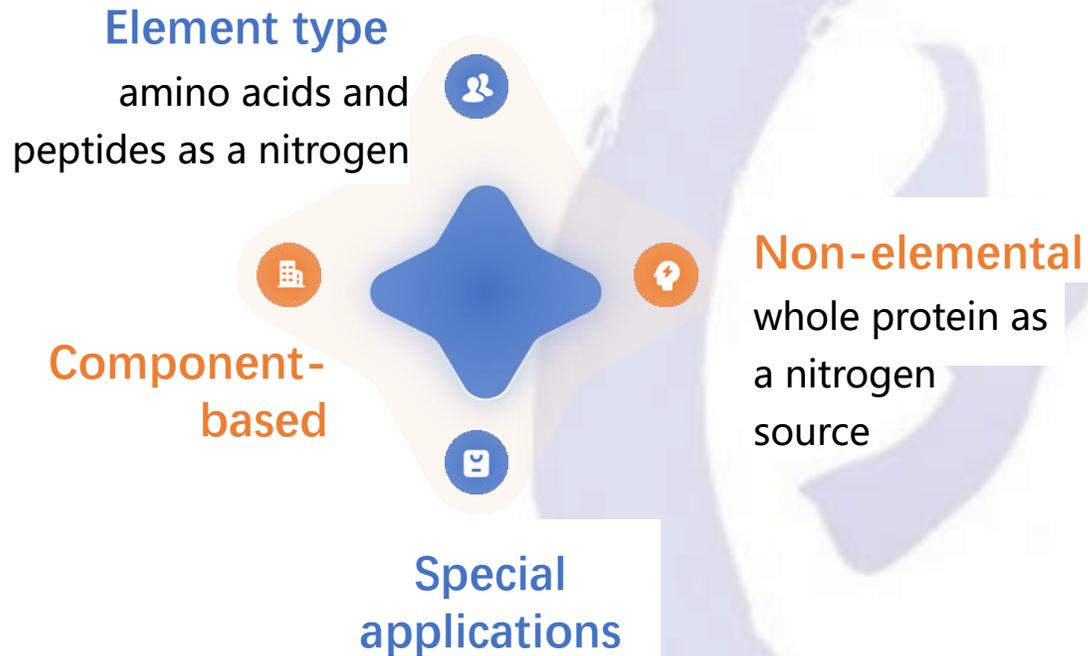
Individuals who have difficulty tolerating it can initially use EN plus PPN.

Gradually transition as the patient's gastrointestinal function recovers.

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Classification of enteral nutrition formulations



- ✓ Commonly used enteral nutrition formulations in clinical practice include powders, suspensions, and emulsions. Powders containing amino acid mixtures or hydrolyzed proteins, monosaccharides, disaccharides, or oligosaccharides, and low-fat content form solutions when mixed with water. Powders containing polysaccharide dextrans or soluble starch, poorly soluble calcium salts, and high-fat content form stable suspensions when mixed with water.



Key evaluation parameters for enteral nutrition formulations

Energy density

Energy density is related to the nutrient content and inversely proportional to the volume of the liquid formulation. Clinically used enteral nutrition formulations have energy densities ranging from 0.9 kcal·mL⁻¹ to 1.5 kcal·mL⁻¹;



Protein content

Protein content is expressed as the percentage of protein energy relative to total energy. The protein content in standard formulations is \leq standard level, while in high-nitrogen formulations, it exceeds 20%.



Feeding route



Protein sources

Protein sources, including amino acid mixtures, hydrolyzed proteins, and whole proteins.





Secondary evaluation parameters for enteral nutrition formulations

01

Osmolality. The osmolality of enteral nutrition formulations primarily depends on the content of free amino acids and electrolytes, Based on osmolality, enteral nutrition formulations can be categorized into isotonic (< 350 mOsm/kgH₂O), moderately hypertonic (350 ~ 550 mOsm/kgH₂O), and significantly hypertonic (> 550 mOsm/kgH₂O).

02

Fat content. Fat content is expressed as a percentage of total energy, and it is divided into standard type ($> 20\%$), low-fat type (5% ~ 20%), and very low-fat type ($< 5\%$). Patients with significant malabsorption, severe exocrine pancreatic insufficiency, or hyperlipidemia should choose very low-fat formulations.



Secondary evaluation parameters for enteral nutrition formulations

03

Fat source. This includes long-chain fatty acids, medium-chain fatty acids, or a mixture of both. Patients with malabsorption or long-chain fatty acid metabolic disorders should choose medium-chain fatty acids or a mixture of both.

04

Dietary fiber content. Some non-elemental formulations contain dietary fiber, whereas all elemental formulations do not contain dietary fiber. Dietary fiber is particularly important for long-term enteral nutrition support therapy or for individuals prone to constipation.

05

Lactose content. Individuals with lactose intolerance should choose formulations that do not contain lactose.

06

Electrolyte, mineral, and vitamin content. Most enteral nutrition formulations provide the full daily energy requirements, and their vitamin content typically meets recommended dietary standards.

07

Formulation and price.



Factors influencing the selection of enteral nutrition formulations

1 Patient's age. For infants who cannot tolerate hypertonic fluids, breast milk or a formula milk that closely resembles breast milk is preferred;

3 Protein allergy;

5 The patient's lactose tolerance;

7 Feeding route.

2 The patient's gastrointestinal status. For patients with normal gastrointestinal function, whole protein enteral nutrition formulations can be used, while for those with low gastrointestinal function, elemental enteral nutrition formulations are preferred;

4 The patient's fat absorption;

6 The patient's disease and nutritional status;

Contraindications for enteral nutrition

Paralytic bowel obstruction;

Failure of enteral nutrition in severe short bowel syndrome;

High-output proximal enterocutaneous fistula;

Severe malabsorption due to gastrointestinal dysfunction;



Nausea and vomiting uncontrolled by medication;



Persistent bowel obstruction after surgery;



Severe gastrointestinal bleeding;



Inability to place a gastroenteric feeding tube;



Mechanical Complications

Mechanical Complications	Causes	Prevention and Treatment Principles
Injury to the nose, pharynx, and esophagus	<ol style="list-style-type: none">1. The feeding tube is thick and hard.2. Long - term indwelling.3. The tube presses too tightly.	<ol style="list-style-type: none">1. Replace it with a thinner and softer feeding tube.2. Switch to gastrostomy or jejunostomy.3. Regularly check the local area and do a good job in nasal and oral care.
Feeding tube blockage	<ol style="list-style-type: none">1. Insufficient flushing.2. The diameter of the feeding tube is too small.3. Frequently administer inappropriate medications through the feeding tube.	<ol style="list-style-type: none">1. Flush with 20 - 50 mL of water after each infusion or every 2 - 8 hours.2. Select a feeding tube with a suitable diameter and use a feeding pump for continuous and uniform infusion.3. Use liquid medications as much as possible. Flush with about 30 mL of water before and after administration to prevent blockage. Suspend enteral nutrition (EN) during medication administration.
Difficulty in removing the feeding tube	<ol style="list-style-type: none">1. Long - term use.2. Improperly and overly tightened fixing of the stoma tube.3. The feeding tube is twisted.	<ol style="list-style-type: none">1. Switch to gastrostomy or jejunostomy.2. Cut the stoma tube so that its distal end is excreted through the intestine.3. Move the feeding tube to the pharynx and cut it at the twisted part. Remove the tube from the mouth at the twisted part or let its distal end be excreted through the intestine.
Stoma complications	<ol style="list-style-type: none">1. The stoma tube is not firmly fixed to the gastrointestinal wall, resulting in bleeding and extravasation of gastrointestinal fluid.2. The intestinal wall after the stoma and the tube are not fixed to the abdominal wall, causing the feeding tube to be dislodged.3. Inadequate disinfection and care of the skin near the stoma.	<ol style="list-style-type: none">1. Fix it properly.2. Pay attention to skin disinfection and care.



Gastrointestinal complications

Gastrointestinal Complications	Causes	Prevention and Treatment Principles
Abdominal distension and diarrhea (related to the formula)	<ol style="list-style-type: none"> 1. Insufficient dietary fiber intake. 2. Hyperosmolar formula. 3. Cold formula. 4. Rapid infusion. 5. Microbial infection. 6. Rapid gastric emptying. 7. Poor carbohydrate absorption. 8. Lactose intolerance. 9. Poor fat absorption. 	<ol style="list-style-type: none"> 1. Select formulas containing dietary fiber. 2. Use iso - osmotic formulas or adjust to iso - osmotic state. 3. Warm up the formula slightly. 4. Start with a small dose and low concentration, and increase according to tolerance. 5. Standardize operations. 6. Delay gastric emptying. 7. Select formulas with a high degree of hydrolysis. 8. Select lactose - free formulas. 9. Use low - fat formulas.
Abdominal distension and diarrhea (unrelated to the formula)	<ol style="list-style-type: none"> 1. Concurrent drug treatment, such as dysbiosis caused by antibiotics. 2. Hypoproteinemia causing intestinal mucosal atrophy. 3. Gastrointestinal dysfunction diseases, such as short - bowel syndrome, pancreatitis, etc. 	<ol style="list-style-type: none"> 1. Stop relevant drugs. 2. Intravenous supplementation of albumin to correct hypoproteinemia, and start enteral nutrition (EN) with a small dose and low concentration at the same time. 3. Supplement pancreatic enzymes when necessary; switch to elemental preparations; supplement parenteral nutrition as appropriate.
Nausea and vomiting	<ol style="list-style-type: none"> 1. Gastric retention. 2. Rapid infusion of hyperosmolar formula. 3. Odor of the formula. 4. Formula with high fat content. 5. Lactose intolerance. 	<ol style="list-style-type: none"> 1. Elevate the head of the bed, use prokinetic agents, and change the feeding route. 2. Select iso - osmotic formulas or adjust to iso - osmotic state. 3. Select formulas with a pleasant smell. 4. Use low - fat formulas. 5. Select lactose - free formulas.
Constipation	<ol style="list-style-type: none"> 1. Dehydration. 2. Insufficient dietary fiber intake. 3. Long - term bed rest. 	<ol style="list-style-type: none"> 1. Pay attention to fluid balance. 2. Select enteral nutrition (EN) preparations rich in dietary fiber. 3. Encourage the patient to be active.



Metabolic complications

Complications	Causes	Prevention and Treatment Principles
Hyperosmotic Dehydration	1. Hyperosmolar and high-protein formulas. 2. Mechanical ventilation, coma.	1. Use iso-osmotic formulas or adjust to iso-osmotic state as much as possible. 2. Monitor fluid intake and output, and appropriately increase fluid intake.
Liver Function Abnormality	Strict fasting	Monitor fluid intake and output, strictly restrict fluid intake, and adjust the EN formula by monitoring blood electrolyte levels.
Edema	Cardiac, renal, and hepatic insufficiency	Monitor fluid intake and output, strictly restrict fluid intake, and adjust the EN formula by monitoring blood electrolyte levels.
Hyperkalemia	1. High potassium content in the formula. 2. Renal insufficiency in patients.	Adjust the EN formula by monitoring blood potassium levels.
Hypokalemia	1. Limiting potassium intake due to cardiac and renal insufficiency. 2. Potassium shift not considered when using insulin.	Adjust the EN formula by monitoring blood potassium levels.

Complications	Causes	Prevention and Treatment Principles
Hypercapnia	Difficulty in carbon dioxide excretion in patients with limited lung function	Regulate carbohydrate intake, select special formulas for diabetic patients, and control insulin.
Hyperglycemia	1. High carbohydrate content in the formula. 2. Diabetic patients. 3. Stress state.	Slowly stop EN or stop it gradually.
Hypoglycemia	Abrupt termination of EN	Adjust the EN formula.
Trace Element Abnormality	Insufficient trace elements in the formula	Supplement essential fatty acids and fat-soluble vitamins as appropriate.
Vitamin and Essential Fatty Acid Deficiency	Long-term use of low-fat formulas	Liver function may recover after adjusting the diet.

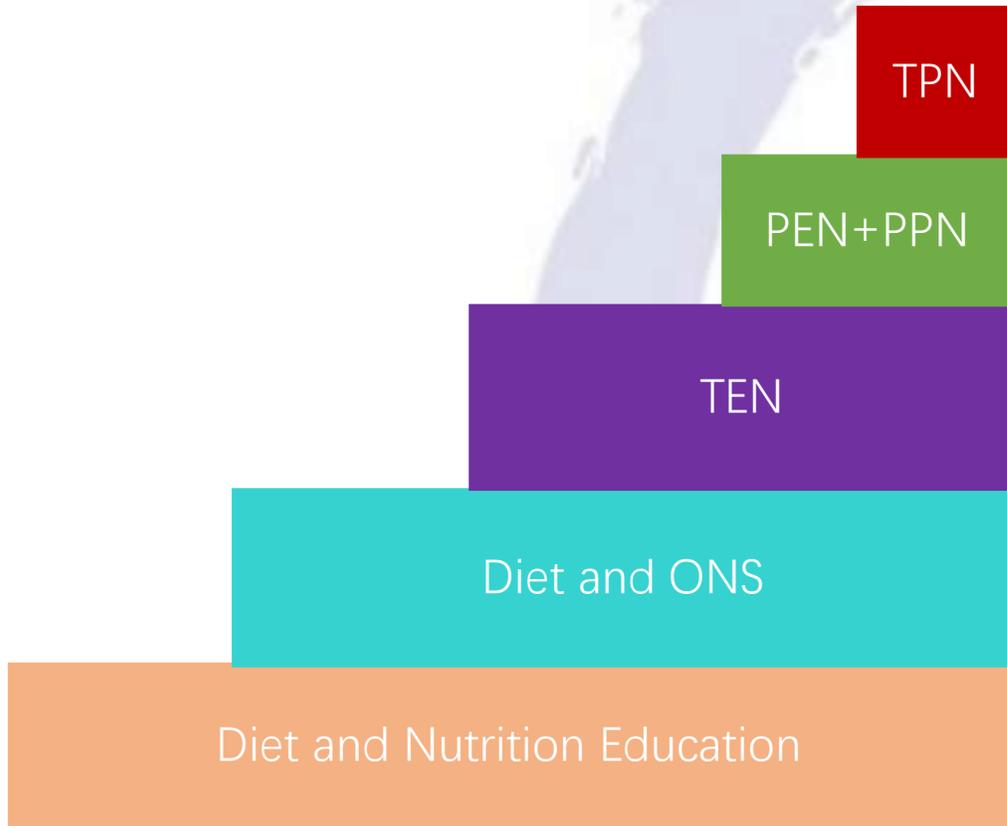


Infection complications

- Infection complications related to enteral nutrition primarily involve aspiration and contamination of the nutritional solution. Aspiration mainly manifests as aspiration pneumonia, caused by factors such as:
- (1) The head of the bed not being elevated;
 - (2) Incorrect placement of the feeding tube;
 - (3) The feeding tube being too large;
 - (4) Delayed gastric emptying or gastric retention;
 - (5) Patient risk factors (such as frailty, coma, neuromuscular disorders, etc.)



Five-step treatment model for malnutrition



The standard treatment for malnutrition should follow the five-step treatment principle:

- choose nutritional education, then progressively choose oral nutritional supplements (ONS), complete enteral nutrition (TEN), partial parenteral nutrition (PPN), and finally total parenteral nutrition (TPN).
- According to ESPEN guidelines, if the next step cannot meet 60% of the target energy requirement for 3 to 5 days, the previous step should be chosen.



Who is eligible for PN?

- ✓ PN is suitable for patients who cannot meet their nutritional needs through oral and/or enteral routes (Evidence A, strong recommendation, 99.3%).
- ✓ For patients requiring nutritional support, if EN provides less than 60% of the body's target energy and protein needs, supplemental PN (SPN) should be used to increase energy and protein intake, thereby reducing or avoiding underfeeding and improving clinical outcomes (Evidence A, strong recommendation, 98.6%).
- ✓ PN is recommended for patients with intestinal failure, short bowel syndrome, intestinal ischemia, high-output fistulas, and abdominal compartment syndrome (Evidence B, strong recommendation, 96.8%).
- ✓ PN can improve malnutrition in advanced cancer patients (Evidence C, weak recommendation, 96.8%).



How do you determine the right time to start the PN?

- For patients with high nutritional risk (NRS 2002 \geq 5 points, NUTRIC \geq 6 points), if enteral nutrition (EN) cannot meet at least 60% of the required energy and protein needs within 48 to 72 hours, parenteral nutrition (PN) is recommended; for severely malnourished patients with severe gastrointestinal dysfunction who cannot use EN, PN should be initiated as early as possible (evidence B, strong recommendation, 98.2%).
- For patients with low nutritional risk (3 points \leq NRS 2002 $<$ 5 points or NUTRIC $<$ 6 points), if enteral nutrition support therapy does not achieve 60% of the target feeding volume after 7 days, supplemental parenteral nutrition (SPN) should be provided (evidence A, strong recommendation, 99.3%).



Parenteral nutrition solutions

Component	Preparations
Glucose	Glucose Injection (10%, 50%).
Fat Emulsion	Soybean Oil Long Chain Fat Emulsion Injection (SO), Medium and Long Chain Fat Emulsion Injection (MCT/LCT), Structural Fat Emulsion Injection (STG), Olive Oil Long Chain Fat Emulsion Injection (OO), Fish Oil Long Chain Fat Emulsion Injection (FO), Multi - Oil Fat Emulsion Injection (SMOF).
Amino Acid	Compound Amino Acid Injection (3AA, 6AA, 9AA, 15AA, 18AA, 20AA, etc.), Pediatric Compound Amino Acid Injection, Propionyl Glutamine Injection.
Water	Sterile Water for Injection, 0.9% Sodium Chloride Injection, 5% Glucose Injection, Glucose and Sodium Chloride Injection.
Electrolytes	Concentrated Sodium Chloride Injection, Potassium Chloride Injection, Calcium Gluconate Injection, Calcium Chloride Injection, Magnesium Sulfate Injection, Potassium Magnesium Aspartate Injection, Sodium Glycerophosphate Injection, Compound Potassium Hydrogen Phosphate Injection.
Trace Elements	Multi - Trace Elements Injection.
Vitamins	Water - soluble Vitamins for Injection, Fat - soluble Vitamins for Injection, Compound Vitamins for Injection, 12 - component Compound Vitamins for Injection.
Premixed Type	Fat Emulsion Amino Acid Glucose Injection.



Rational use of parenteral nutrition

Prescription Review Content	Limit	Review Reason	Handling Measures
1. Monovalent Cations	≤150mmol/L	The stability of fat emulsion in TNA cannot be guaranteed.	It is recommended to reduce the supply of sodium or potassium. Calculate the boundary value with a calculator and then guide clinical practice.
2. Divalent Cations	≤10mmol/L	The stability of fat emulsion in TNA cannot be guaranteed.	It is recommended to reduce the supply of calcium or magnesium. Calculate the boundary value with a calculator and then guide clinical practice.
3. Amino Acids	>0g	The stability of fat emulsion in TNA cannot be guaranteed.	It is recommended to add amino acid injection or administer fat emulsion separately.
4. Vitamin C	Do not use with calcium agents	Vitamin C may degrade into oxalic acid in the nutrient bag and combine with calcium ions in TNA to form calcium oxalate precipitate.	It is recommended to administer vitamin C through other routes.
5. Potassium Ion Concentration	≤3g/L	The main adverse reactions of intravenous potassium infusion are phlebitis, arrhythmia, and hyperkalemia. When supplementing potassium via peripheral veins, the potassium content per liter of infusion should not exceed 40mmol (3g); when supplementing potassium via central veins, the potassium can be completely diluted in the blood, reducing the risk of extravasation, avoiding pain and phlebitis related to peripheral infusion. The maximum concentration of potassium supplementation via central veins is 400mmol/L (30g/L), and continuous electrocardiogram monitoring is required.	It is recommended to reduce the supply of potassium. Calculate the boundary value with a calculator and then guide clinical practice.
6. Glutamine	Use with compound amino acids, except for compound amino acid (9AA)	Glutamine is a non - essential amino acid and becomes a conditionally essential amino acid under special circumstances. There is no situation where the body only needs glutamine and no other amino acids. Therefore, glutamine must be used with compound amino acids. However, compound amino acid 9AA is an exception because 9AA is a preparation containing only essential amino acids, generally used for patients with chronic kidney disease who need high - quality low - protein diets. Such patients are not suitable for using glutamine.	Single use: It is recommended to use alanyl - glutamine in combination with compound amino acids. Use with 9AA: It is recommended to switch to other compound amino acid injections or discontinue alanyl - glutamine.

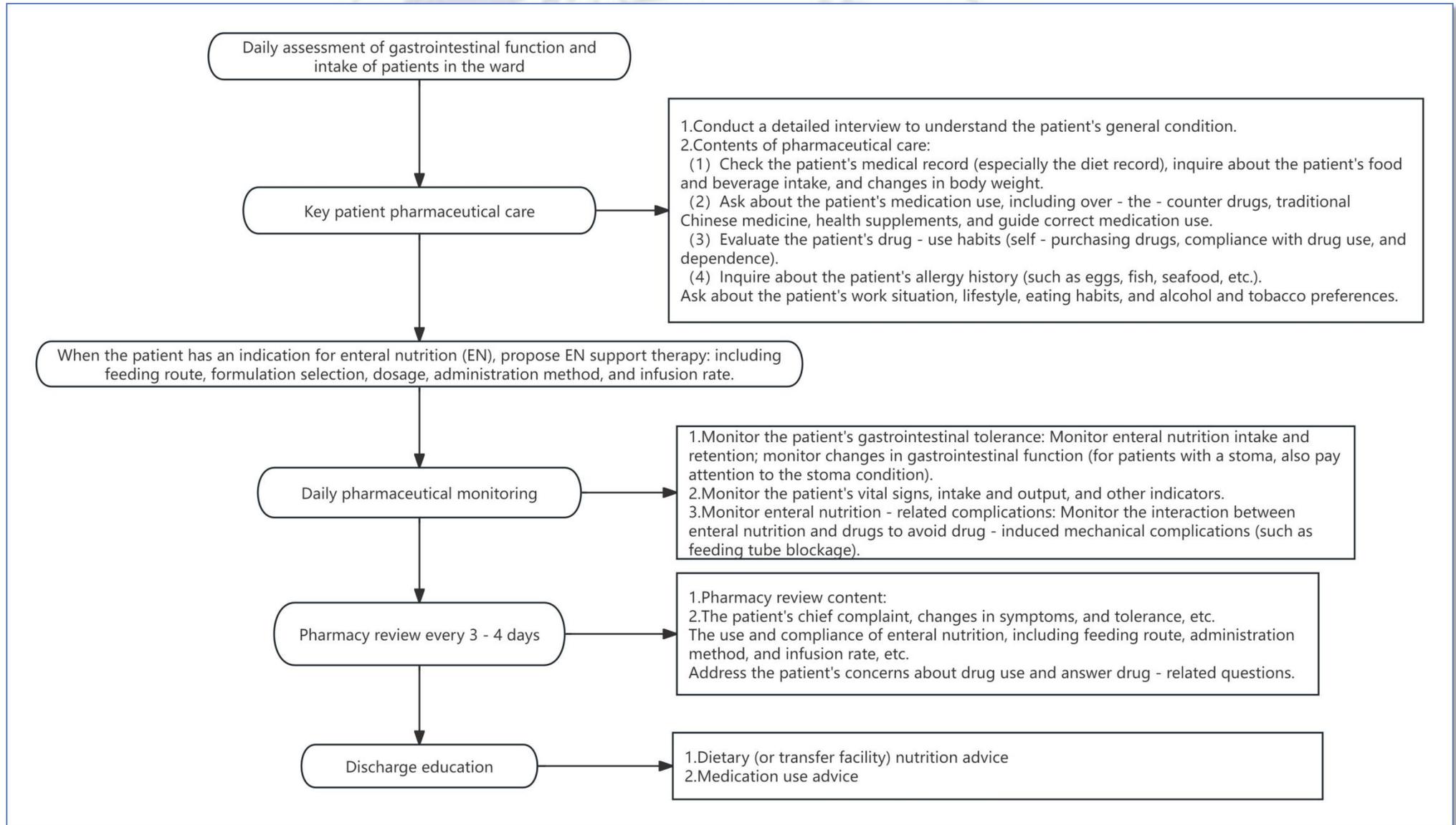


Rational use of parenteral nutrition

Prescription Review Content	Limit	Review Reason	Handling Measures
7. Glutamine Proportion	≤20%	According to the drug instruction manual.	The proportion of alanyl - glutamine in total amino acids should not exceed 20%. Calculate the boundary value with a calculator and then guide clinical practice.
8. Fish Oil	Use with fat emulsions rich in essential fatty acids (soybean oil)	The content of essential fatty acids in fish oil fat emulsion is very low. Single use is only applicable to patients with a clear allergy to soybean oil fat emulsion.	First, ask the patient if there is an allergy to soybean oil fat emulsion. If so, suggest that the doctor record the reason for single use in the medical record; if not, single use is not recommended (due to low essential fatty acid content).
9. Fish Oil Proportion	≤20%	According to the drug instruction manual.	The proportion of fish oil in total fat should not exceed 20%. Calculate the boundary value with a calculator and then guide clinical practice.
10. Proportion of Fat in Non - Protein Calories	≤60%	There is a high risk of fat clearance disorder. If clinically necessary, it is recommended to monitor blood triglycerides.	Remind the doctor that the fat proportion (in non - protein calories) of this nutrition prescription exceeds the normal maximum limit (60%), and the patient is prone to fat overload. It is recommended to adjust the ratio of carbohydrate to fat. Calculate the boundary value with a calculator and then guide clinical practice. If the doctor deems no adjustment necessary, record the intervention situation and suggest that the doctor monitor blood triglyceride levels.
11. 12 - component Compound Vitamins	Additional Vitamin K Supplementation	Does not contain vitamin K. Long - term use requires vigilance against vitamin K deficiency.	It is recommended to supplement vitamin K additionally or switch to a compound vitamin preparation containing vitamin K.



Clinical nutrition pharmacist work model





case

- ✓ A 79-year-old female patient was admitted to a hospital on March 4, 2024, due to abdominal pain, vomiting, and cessation of bowel movements for 2 days.
- ✓ In 2020, she underwent a rectal cancer resection and colorectal anastomosis at a tertiary hospital (pathological diagnosis: mucinous adenocarcinoma of the rectum). Postoperatively, she received regular chemotherapy.
- ✓ In 2021, the tumor recurred, and she had a sigmoid colostomy performed at a hospital.
- ✓ She has a history of hypertension for 10 years, which is managed with medication and is well-controlled. Physical examination revealed no significant abnormalities.
- ✓ Laboratory tests were mostly normal.
- ✓ Preoperative barium meal study showed obstruction at the distal jejunum and proximal ileum. Admission diagnosis: 1) adhesive intestinal obstruction; 2) radiation enteritis; 3) post-sigmoid colostomy; 4) post-rectal cancer resection; 5) hypertension.



case

- ✓ The NRS 2002 nutritional risk screening score is 6 points, indicating a risk of malnutrition.
Nutritional assessment: PG-SGA score of 21 (severe malnutrition).
- ✓ Gastrointestinal function evaluation AGI grade: Level III. Performance status ECOG score: 3 points.
- ✓ Laboratory tests showed red blood cells at $2.53 \times 10^{12}/L$, hemoglobin at 79 g/L, total protein at 56 g/L, albumin at 29.3 g/L, potassium at 3.18 mmol/L, sodium at 126 mmol/L, and chloride at 86 mmol/L.
- ✓ Preoperative barium meal examination of the entire digestive tract indicated an obstruction at the distal jejunum and proximal ileum.



case

- ✓ Upon admission, the patient experienced nausea and vomiting, and a gastric tube was placed for gastrointestinal decompression, draining approximately 1000 mL daily.
- ✓ After a comprehensive analysis of the condition, initial nutritional therapy was initiated: total fluid intake at 50 mL/(kg·day) (while also replenishing lost fluids and electrolytes), energy intake at 25-30 kcal/(kg·day) (1100 kcal), 1.2-1.5 g/(kg·day) of fat emulsion, 3 g/(kg·day) of glucose, a carbohydrate-to-fat ratio of 1:1, and 2 g/(kg·day) of protein, with a caloric-to-nitrogen ratio of 100-150 kcal:1g.
- ✓ According to the ESPEN guidelines on tumor nutrition, most patients with malignant tumors do not require additional glutamine or special nutrients in their short-term nutritional support plan.



case

- ✓ After one week of preoperative total parenteral nutrition, the patient's overall condition significantly improved.
- ✓ Laboratory tests showed: red blood cells $3.33 \times 10^{12}/L$, hemoglobin 107 g/L, hematocrit 0.315 L/L, total protein 59.1 g/L, albumin 30.5 g/L, potassium 2.3 mmol/L (significantly decreased), sodium 137 mmol/L, chloride 101 mmol/L, phosphorus 0.5 mmol/L (significantly decreased).
- ✓ The nutritional plan was adjusted: energy intake increased gradually from 10 kcal/(kg·d) to 15 kcal/(kg·d), with an increase of 200 kcal over 24 to 48 hours. Carbohydrates accounted for 50-60%, fats for 30-40%, and proteins for 15-20%. Measures were taken to prevent hypoglycemia and dehydration, assess tolerance for salt and fluid replacement, and prophylactically supplement vitamin B1 at 200 mg daily to correct hypophosphatemia and hypomagnesemia. Phosphorus supplementation was 0.5-0.8 mmol/(kg·d), potassium 1-3 mmol/(kg·d), and magnesium 0.3-0.4 mmol/(kg·d).



case

- ✓ On postoperative day 3, total parenteral nutrition was maintained.
- ✓ By postoperative day 4, enteral nutrition was initiated, starting with 250 mL of 5% glucose injection plus 0.9% sodium chloride injection infused at 20 mL/h, gradually transitioning to a combined parenteral and enteral nutrition regimen.
- ✓ On postoperative day 5, yellowish soft stool was observed from the stoma, and the amount of enteral nutrition was increased, allowing the patient to start moving around independently.
- ✓ On postoperative day 7, the patient was discharged with enteral nutrition formula.



Case study

- ✓ The patient had a high preoperative nutritional risk due to bowel obstruction, for which total parenteral nutrition was administered.
- ✓ Postoperatively, the patient developed refeeding syndrome, and potassium and phosphate ions were supplemented.
- ✓ The patient's condition stabilized, and nutrition transitioned gradually from parenteral to a combination of parenteral and enteral nutrition.
- ✓ The patient improved and was discharged, with a recommendation for home-based enteral nutrition support therapy.



ERAS- Perioperative Pharmacy Service

1

Aspects of Medication Management

- Antimicrobial therapy
- Anticoagulation
- Pain
- **Nutrition**
- Glycemic control
- Blood pressure
- Fluid management
- PONV

2

Pharmaceutical Care

- Therapeutic effects
- Adverse effects
- Drug-drug interaction
- Individualized medication
- Education

3

Work Pattern

- Pre-admission/Out-patient
- Pre-operation
- Intro-operation
- Post-operation
- Discharge



THANK YOU!

