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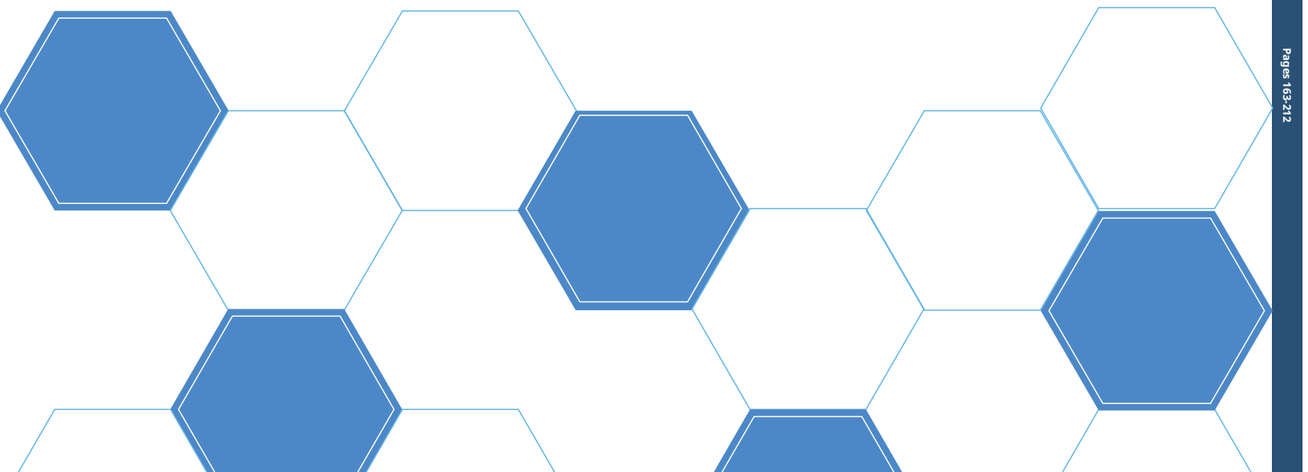

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About the journal

The *Annals of Clinical Nutrition and Metabolism* (ACNM, eISSN: 2799-8363) is a peer-reviewed, open-access, joint official journal of the Korean Society of Surgical Metabolism and Nutrition, the Korean Society for Parenteral and Enteral Nutrition, the Asian Society for Surgical Metabolism and Nutrition, and Japanese Society for Surgical Metabolism and Nutrition. This joint journal was launched in December 2021 after merging the Journal of Clinical Nutrition (pISSN: 2289-0203) from 2007 to 2021, published by the Korean Society for Parenteral and Enteral Nutrition, and the Surgical Metabolism and Nutrition (pISSN: 2233-5765) from 2010 to 2021, published Korean Society of Surgical Metabolism and Nutrition. Its abbreviated title is Ann Clin Nutr Metab.

Aims and scope

The *Annals of Clinical Nutrition and Metabolism* (ACNM) aims to contribute to health of human being by improving clinical nutrition practice through scientific research, including basic science and clinical studies related to nutrition and metabolism.

Scope: The journal's scope includes the following in the field of nutrition, metabolism, and medicine.
- Nutritional screening and assessment
- Nutritional planning
- Perioperative nutritional care
- Nutrition therapy in acute and chronic disease
- Critical care nutrition
- Optimizing enteral and parental therapy
- State-of-the-art diagnostic techniques for nutritional care
- Innovative surgical or interventional techniques for nutritional care
- Nationwide nutrition survey
- Scientific laboratory research

Regional scope: Its regional scope is mainly Asia, but it welcomes submissions from researchers all over the world.

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Editorial

Annals of Clinical Nutrition and Metabolism (ACNM): a new milestone toward global recognition

Suk-Kyung Hong

Division of Acute Care Surgery, Department of Surgery, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea

It is with great pleasure that I announce a major milestone in the journey of the *Annals of Clinical Nutrition and Metabolism* (*ACNM*)—our official inclusion in Scopus in 2025. Building upon our indexing in KoreaMed in 2022 and accreditation by the Korean Citation Index (KCI) in 2024, this achievement marks ACNM's transition from a regional publication to an internationally recognized scientific journal.

Since it was launched as the official journal of the Asian Society of Surgical Metabolism and Nutrition (ASSMN), ACNM has consistently pursued excellence in disseminating high-quality research in clinical nutrition and metabolism. Our mission has been clear: to contribute to the health of human beings by improving clinical nutrition practice through scientific research, including basic science and clinical studies related to nutrition and metabolism.

The journal's scope encompasses a wide range of topics, including nutritional screening and assessment, perioperative nutrition, nutrition therapy in both acute and chronic disease, critical care nutrition, optimization of enteral and parenteral therapy, and innovative diagnostic or interventional techniques for metabolic and nutritional management. We also welcome nationwide or regional nutrition surveys and laboratory-based investigations that connect fundamental science with clinical practice.

While ACNM's regional focus is primarily Asia, the journal has always been open to contributions from researchers worldwide. This inclusiveness reflects our commitment to cultivating an international academic community that values scientific collaboration and the advancement of nutritional care across diverse healthcare systems.

The indexing of ACNM in Scopus is not merely a recognition of past accomplishments but also marks a transition point where we must take on greater responsibility. It compels us to strengthen our editorial standards, uphold transparency and integrity in scientific publishing, and expand our global reach. Moving forward, we aim to improve the quality and expand the impact of the journal through rigorous peer review, editorial professionalism, and the publication of studies that influence both policy and practice in clinical nutrition.

On behalf of the editorial board, I would like to express my deepest gratitude to our authors, reviewers, and readers for their unwavering support. This achievement belongs to every member of our academic community who has contributed their time, expertise, and passion. Together, we will continue to advance the science and practice of clinical nutrition and metabolism for the benefit of patients and society more broadly.

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Authors' contribution

All work was done by Suk-Kyung Hong.

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Conflict of interest

Suk-Kyung Hong has served as the editor of the *Annals of Clinical Nutrition and Metabolism* since 2021. However, she was not involved in the peer review process or decision-making regarding publication. Otherwise, no potential conflict of interest relevant to this article was reported.

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Guideline

A practical guide for enteral nutrition from the Korean Society for Parenteral and Enteral Nutrition: Part II. selection and initiation of enteral feeding routes

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Abstract

Purpose: We developed evidence-based recommendations for selecting and initiating the enteral nutrition (EN) delivery route in adult and pediatric patients to improve safety and standardize practice in Korea.

Methods: Key questions covered feeding tube selection, methods to verify tube placement, confirmation in pediatric patients, and timing of EN following percutaneous endoscopic gastrostomy (PEG). Recommendations were drafted and refined through multidisciplinary expert consensus under the Korean Society for Parenteral and Enteral Nutrition (KSPEN).

Results: Feeding tube selection should be based on gastrointestinal anatomy, function, and expected EN duration. Short-term feeding is

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recommended with nasogastric or orogastric tubes, whereas long-term feeding should use percutaneous or surgical routes such as PEG. Tube position must always be verified before use, preferably with radiography or pH testing; auscultation alone is unreliable and should not be used. In pediatric patients, radiographic confirmation remains the gold standard, although pH testing and insertion-length assessment may be considered when imaging is not feasible. After PEG, EN can be initiated safely within 4 hours in both adults and children without increasing complications if trained staff monitor for leakage or infection.

Conclusion: This guideline offers a structured framework for safe and timely EN tailored to patient characteristics. Early verification and multidisciplinary collaboration help reduce complication, improving outcomes of EN therapy.

Keywords: Consensus; Delivery of health care; Enteral nutrition; Gastrostomy; Patient safety

Introduction

This chapter is a continuation of Part I, which addressed the prescription of enteral nutrition (EN) orders. Part II focuses on selecting feeding routes and initiating EN administration. Proper route selection and verification are essential to ensure safe and effective nutritional support. Misplacement or delayed initiation may lead to aspiration, infection, or inadequate nutrient delivery.

In clinical practice, the choice of feeding tube is influenced by the patient's anatomical and functional gastrointestinal condition, along with the expected duration of feeding. Radiographic or pH-based verification of tube position is necessary to prevent complications. Pediatric patients require additional caution because of anatomical differences and a higher risk of tube misplacement.

Furthermore, early initiation of EN after percutaneous endoscopic gastrostomy (PEG) has been shown to be safe in both adults and children, contributing to shorter hospital stays and improved outcomes. This chapter summarizes practical, evidence-based recommendations to guide healthcare professionals in selecting the appropriate delivery route, confirming tube placement, and determining optimal timing for EN initiation after PEG.

Methods

The methodology followed in Part II is identical to that described in Part I.

The Korean Society for Parenteral and Enteral Nutrition (KSPEN) Enteral Nutrition Committee identified key questions concerning: (1) factors to consider when selecting the feeding tube; (2) methods for verifying tube placement in adults; (3) methods for verifying tube placement in children; and (4) timing of EN initiation after PEG placement.

Each question was assigned to experts in surgery, nutrition, nursing, pediatrics, and gastroenterology. A comprehensive literature search was performed using databases such as PubMed, Embase, and the Cochrane Library. International guidelines from the European Society for Clinical Nutrition and Metabolism (ESPEN), the American Society for Parenteral and Enteral Nutrition (ASPEN), the Society of Critical Care Medicine (SCCM), and the American Gastroenterological Association (AGA) were also reviewed.

Draft recommendations were developed based on evidence strength and clinical applicability. These were peer-reviewed within each discipline and cross-reviewed by additional specialists. The final recommendations were approved by the KSPEN Guideline Committee to ensure validity and multidisciplinary consensus.

The structure of this part follows the same evidence-based practice format as Part I, including key questions, practice recommendations, and rationales, supported by international and domestic references.

Practice guide

Considerations when deciding on a feeding tube

Key question 1. What factors should be considered when deciding on a feeding tube?

Practice recommendation

- Feeding tubes should be selected based on the patient's specific circumstances.
  1. Anatomical changes in the gastrointestinal tract
  2. Changes in gastrointestinal function
  3. Duration of feeding
- For short-term feeding (4–6 weeks or less), nasogastric or orogastric tubes are recommended.
- For long-term tube feeding (4–6 weeks or more), invasive procedures such as PEG are recommended.

Rationale

Selecting an appropriate feeding tube requires careful

evaluation of the patient's disease status and gastrointestinal anatomy. The tip of the tube should be placed in either the stomach or the small intestine. In general, gastric placement is suitable for patients with a functional stomach and no delayed gastric emptying, obstruction, or fistula. Small-bowel feeding, such as via a nasojejunostomy or jejunostomy, is more appropriate for patients with gastric outlet obstruction, severe gastric atrophy, gastric reflux, or aspiration of gastric contents. A double-lumen gastric tube may be used when gastric decompression is required simultaneously with small-bowel feeding. Tubes inserted through the nose or mouth are typically intended for short-term use (4–6 weeks or less) in hospitalized patients, although nasal feeding can also be implemented in outpatient settings. For medium- to long-term EN, a gastrostomy is appropriate [1]. When long-term EN (4–6 weeks or more) is anticipated, gastrostomy placement should be planned based on treatment duration, long-term goals, and the condition of both the patient and caregiver. Two studies that randomly assigned adults with persistent dysphagia due to neurologic disease to either nasogastric or percutaneous endogastric tubes showed superior outcomes in weight gain and feeding volume in those receiving a percutaneous endogastric tube. These results appear related to the difficulties of managing tube feeding in patients using nasogastric tubes [2,3].

Enteral feeding in pediatric patients is determined according to the child's clinical status [4-6]. In children aged 1 year or older, inadequate oral intake and inability to meet 60%–80% of nutritional requirements for 5 days or longer are considered criteria for initiating tube feeding. In children under 1 year, the inability to meet 60%–80% of nutritional requirements for 3 days or more is considered a threshold for beginning tube feeding.

The following contraindications should be considered when selecting an enteral feeding tube (Table 1) [7].

How to confirm the feeding tube position

Key question 2. What is the best way to confirm the feeding tube position in an adult patient?

Practice recommendation

- When inserting a feeding tube, the correct placement should be confirmed using the following methods:
  1. Checking the pH of the tube aspirate
  2. Measurement of carbon dioxide using capnography
  3. Abdominal or chest radiograph
  4. Auscultation
- Auscultation alone should not be used to confirm tube position because it is inaccurate and difficult to distinguish from misplacement.
- After inserting a feeding tube, ensure correct positioning before starting nutrition or medication.
- The length of the feeding tube should be checked and recorded, and this measurement should be used periodically to monitor for changes in tube position.
- If a change in tube position is suspected, nutrition or medication should not be administered until the exact location is confirmed through X-ray or another reliable method.
- It is recommended not to use tubes for feeding other than those specifically designed for tube feeding (e.g., Levin tubes). However, due to legal limitations in Korea, the use of dedicated feeding tubes is restricted.

Rationale

Insertion of a feeding tube is an essential procedure for providing EN and is routinely performed in clinical practice. However, incorrect insertion into the trachea or lungs can lead to complications such as pneumothorax, atelectasis, and pneumonia [8]. In addition, failure to confirm safe positioning of the tube tip after insertion may result in the direct delivery of feeding solution into the lungs, leading to aspiration and potentially severe complications such as pneumonia [9].

Historically, the most common method for confirming tube placement was to inject air through the feeding tube and listen for air sounds in the upper abdomen. However, these methods have a very limited capacity to accurately determine tube position, and because they cannot detect misplacement during the insertion process, complications such as pneumothorax or lung injury may only be recognized after they occur [10]. Therefore, after inserting the tube, it is safest to confirm its position with an X-ray before initiating nutrition or medications [11]. In addition, after tube insertion, measuring the pH of aspirated contents to confirm whether the tube is located in the stomach can be helpful [12,13]. Typically, a pH of 5.5 or lower suggests gastric placement [14]. However, neither radiography nor pH testing can detect

Table 1. Contraindications for enteral tube placement

Absolute contraindications	Relative contraindications
Mechanical bowel obstruction	Gastrointestinal bleeding
Acute peritonitis	Hemodynamic instability
Uncorrected coagulopathy	Massive ascites
Intestinal ischemia or necrosis	Respiratory failure
	Ventriculoperitoneal shunt placement
	Morbid obesity

airway entry during the insertion itself. Recently, new devices using electromagnets or miniature cameras have been developed to more accurately guide and confirm tube placement [15]. Although effective, they are expensive and currently have limited availability in Korea. Several studies have reported that measuring carbon dioxide during tube insertion using capnography can help predict whether the tube has entered the trachea or lungs [16,17]. However, this method cannot differentiate between esophageal and gastric placement, so final confirmation must still rely on radiographs or other validated methods.

Even after nutrition or medication administration begins, the tube's position must be checked periodically. Patient movement or changes in body position may cause the tube to advance deeper, resulting in small-bowel feeding, or may cause it to retract into the esophagus, which significantly increases the risk of aspiration [18]. Because daily radiographic confirmation is not feasible, the external tube length should be measured and recorded. Any change in length should raise suspicion of tube displacement. In such cases, feeding should be stopped, and the actual tube location should be verified with radiographs or another reliable method before restarting nutrition.

When using a Levin tube for EN, the tube's side hole extends up to 20 cm from the distal end; therefore, the tube must be inserted deeply enough to prevent feeding solution from entering the esophagus.

How to confirm the feeding tube position in children

Key question 3. How can the feeding tube position be confirmed in children?

Practice recommendation

- Auscultation alone should not be used to confirm feeding tube position.
- If confirmation by abdominal X-ray is not possible, the exact insertion length may be measured, or 0.5–1 mL of fluid can be aspirated from the tube for pH measurement using a pH indicator.
- If accurate feeding tube position cannot be confirmed using non-radiological methods, abdominal X-ray is the most accurate method. Given radiation exposure concerns, X-ray use in children should be performed cautiously.

Rationale

Before administering nutrition or medications through a newly inserted tube, it is essential to confirm both tube patency and correct positioning. In 2012, the Child Health Patient Safety Organization recommended immediate discontinuation of relying solely on auscultation to verify nasogastric tube placement. Their report, based on more than 2,000 insertions, found that 1.3%–2.4% of tubes were misplaced outside the gastrointestinal tract and that over 20% led to pulmonary complications [19]. For these reasons, abdominal X-ray confirmation remains the gold standard until reliable non-imaging alternatives become available.

If abdominal X-ray is not feasible, measuring the accurate insertion length and aspirating gastric fluid for pH testing may be considered [19,20]. In neonates, children with neurological impairment, and those with a reduced gag reflex due to encephalitis or decreased consciousness—groups with a high risk of complications from tube misplacement—abdominal X-ray confirmation is essential [21,22].

A retrospective study by Ellett et al. [23] reported a 21% incidence of misplaced tubes, and in a prospective follow-up study, Ellett and Beckstrand [24] reported an even higher incidence in children, 22%–44%, which exceeds that observed in adults.

Even when placement is confirmed by abdominal X-ray, there is currently no consensus regarding the optimal position of the tube tip within the stomach [25].

Timing of initiation of tube feeding after PEG insertion

Key question 4. When can tube feedings be initiated after PEG?

Practice recommendation

- Enteral feeding via gastrostomy may begin within 4 hours post-procedure.
- Review the timing of PEG insertion and the sequence of procedures.
- Educate nurses administering tube feeding solutions regarding the appropriate timing for initiating tube use after PEG placement.

Rationale

In the absence of standardized protocols regarding the timing of post-PEG feeding and due to concerns about complications such as intraperitoneal leakage of feeding solutions, initiation of tube feeding has commonly been delayed until the following day or 12–24 hours after the procedure [26]. A 2011 web-based survey found that, despite reports since 2002 demonstrating the safety of initiating tube feeding 4 hours after gastrostomy, 59% of surveyed healthcare professionals

were unaware of standardized guidelines or updated evidence regarding this practice [27].

In five randomized controlled trials, there were no significant differences in mortality or gastric residual volume-related complications within 72 hours between groups that began early tube feeding within 3 hours of gastrostomy and those that began delayed feeding the following day [28].

In a retrospective comparative study involving 1,048 pediatric patients, early tube feeding initiated within 6 hours of gastrostomy was evaluated. The early-feeding group had a significantly shorter hospital stay, and there was no significant difference in complications—including gastrostomy infection, leakage, vomiting within 24 hours, aspiration, bleeding, peritonitis, or death—compared with the group for whom feeding was delayed beyond 6 hours [29].

Randomized controlled trials and retrospective studies consistently demonstrate that early tube feeding within 1–6 hours after PEG does not increase complication rates, including wound infection, melena, vomiting, leakage, aspiration pneumonia, mortality within 72 hours, or 30-day mortality. Meta-analyses similarly show no significant increase in complications associated with initiating tube feeding within 4 hours after gastrostomy in both adults and children [30-34].

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Authors' contribution

Conceptualization: all authors. Data curation: all authors. Formal analysis: all authors. Methodology: all authors. Project administration: all authors. Visualization: all authors. Writing–original draft: all authors. Writing–review & editing: all authors. All authors read and approved the final manuscript.

Conflict of interest

Ye Rim Chang has served as the editor of the *Annals of Clinical Nutrition and Metabolism* since 2024. However, she was not involved in the peer review process or decision-making regarding publication. Otherwise, no potential conflict of interest relevant to this article was reported.

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Supplementary materials

None.

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Guideline

The 2024 Korean Enhanced Recovery After Surgery guidelines for hepatobiliary and pancreatic surgery

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Abstract

Purpose: The Korean Enhanced Recovery After Surgery (ERAS) Committee within the Korean Society of Surgical Metabolism and Nutrition has developed comprehensive guidelines for hepatobiliary and pancreatic (HBP) surgery by adapting established international protocols. These guidelines provide evidence-based recommendations specifically tailored to the Korean healthcare system and address perioperative management for both pancreatoduodenectomy and hepatectomy.

Methods: The HBP subcommittee reviewed existing international ERAS guidelines and conducted an adaptation process. Key questions were identified based on national survey results from Korean HBP surgeons and were prioritized according to clinical relevance. The committee focused on elements supported by moderate- to high-quality evidence with strong recommendation grades. Literature searches were conducted through January 2025, and evidence quality was evaluated using GRADE methodology. Four key questions underwent formal assessment, and eight additional questions were adapted from international guidelines.

Results: Twelve key questions were selected and addressed, covering critical perioperative care domains: prehabilitation, preoperative nutritional assessment and support, anti-thrombotic prophylaxis, prophylactic abdominal drainage, preoperative biliary drainage, smoking and alcohol cessation, pre-anesthetic medication, minimally invasive surgical approaches, prophylactic nasogastric intubation, postoperative glycemic control, perianastomotic drainage management, and early mobilization protocols. Each recommendation was assigned specific evidence levels and graded for strength. High-quality evidence supported strong recommendations for the routine avoidance of prophylactic drainage in uncomplicated hepatectomy, early drain removal after pancreatoduodenectomy in low-risk patients, elimination of routine nasogastric decompression, and the implementation of early mobilization strategies.

Conclusion: These Korean-adapted ERAS guidelines for HBP surgery are expected to standardize perioperative care, reduce postoperative complications, shorten hospital stays, and enhance overall patient outcomes across Korean healthcare institutions.

Keywords: Clinical relevance; Enhanced Recovery After Surgery; Hepatectomy; Pancreatoduodenectomy; Perioperative care

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Introduction

Background

Despite major advancements in hepatobiliary and pancreatic (HBP) surgery, achieving early postoperative recovery and a timely return to daily life remains a significant challenge, particularly for complex procedures such as pancreatoduodenectomy and hepatectomy [1]. Although international Enhanced Recovery After Surgery (ERAS) guidelines have been developed and updated for these operations, there is increasing recognition of the need to adapt these protocols to the specific clinical environment and healthcare delivery system in Korea [2-5].

Objectives

In response, the Korean Society of Surgical Metabolism and Nutrition established an ERAS committee to develop Korean guidelines for HBP surgery. The primary objective of these guidelines is to support physicians by providing evidence-based recommendations that are both feasible and appropriate within Korean clinical practice. The guidelines seek to facilitate informed perioperative decision-making and to enhance the expectations and value perceived by both healthcare professionals and patients.

Methods

Ethics statement

Because this work did not involve human participants, neither institutional review board approval nor informed consent was required.

Assessment through adaptation by the committee

These guidelines were developed with an emphasis on practical clinical implementation. Unlike other surgical fields such as colorectal or gastric surgery, HBP surgery already has well-established and recently updated international guidelines. Therefore, the HBP subcommittee of the Korean ERAS Committee, under the Korean Society of Surgical Metabolism and Nutrition, elected to omit potentially redundant processes such as de novo literature searches and meta-analyses. Instead, the committee selected key elements considered most essential for implementation based on the results of a national survey. For all elements not included among these predefined priorities, the committee conducted evaluation through an adaptation process.

Review of existing guidelines

The head committee reviewed existing ERAS guidelines to identify common elements and areas of ongoing debate [2-7]. As a result, the head committee categorized the elements into two groups: common elements and other field-specific elements (Table 1). The HBP committee then examined the field-specific elements in international guidelines and assessed the degree of dissension associated with each.

Key question development

The HBP committee was subdivided into two groups, one focusing on hepatectomy and the other on pancreatoduodenectomy. Each subdivision identified pivotal but debated elements based on Korean survey findings [8]. In addition, another relevant survey conducted by the Korean Association of Liver Surgery (KALIS), though not yet published, also informed the process. Initially, the committee categorized all elements outside the common international elements according to whether their evidence level was at least moderate and their recommendation grade was strong. Through detailed discussions, the HBP committee then prioritized and finalized four key questions (KQs) for formal assessment and eight additional KQs to be adapted from international guidelines (Table 2).

Literature search and study selection

The authors met in August 2023 to agree upon the elements to be included and to assign responsibilities. A principal literature search was conducted through January 2025. All co-authors screened web-based databases and their personal archives for relevant articles. A non-systematic emphasis was placed on more recent publications and those demonstrating higher methodological quality.

Quality assessment and grading

The assessment of evidence levels followed the grading criteria established by the GRADE working group [9,10]. Assignment

Table 1. Common Enhanced Recovery After Surgery elements across surgical fields

Enhanced Recovery After Surgery items
Preoperative counseling
Preoperative fasting and treatment with carbohydrates
Epidural analgesia
Postoperative intravenous and oral analgesia
Wound catheter and transversus abdominis plane block
Postoperative nausea and vomiting prophylaxis
Avoiding hypothermia
Fluid balance
Postoperative artificial nutrition
Audit

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Table 2. Key questions

	Key questions
Assessed	Prehabilitation (PD)
	Preoperative nutrition (PD)
	Anti-thrombotic prophylaxis (L)
	Prophylactic abdominal drainage (L)
Adapted	Preoperative biliary drainage
	Preoperative smoking and alcohol cessation
	Pre-anesthetic medication
	Minimally invasive surgery
	Prophylactic nasogastric intubation
	Postoperative glycemic control
	Perianastomotic drainage
	Early and scheduled mobilization

PD, pancreatoduodenectomy; L, liver surgery.

of each level of evidence was based on outcome measures. When randomized and non-randomized studies contributed evidence for the same outcome measure, the evidence level derived from randomized studies was used as the reference. The final level of evidence assigned to each recommendation was determined by the evidence supporting the most critical primary outcome associated with that recommendation.

Results

KQ 1. Prehabilitation in pancreatoduodenectomy

A prehabilitation program consisting of moderate aerobic exercise and resistance training for 60 minutes per session, at least three times per week at home without supervision, has been recommended. This intervention has been associated with decreases in the incidence of severe bile leakage and reductions in the average length of hospital stay [11]. A recent systematic review on prehabilitation for pancreatic surgery also demonstrated improvements in patients' physical fitness and nutritional status, accompanied by reductions in postoperative complications and duration of hospitalization [12]. These findings support the integration of individualized prehabilitation programs, incorporating multidisciplinary components such as physical exercise, nutritional support, and psychological counseling, into the perioperative care pathway for pancreatic surgery.

Summary and recommendation: Prehabilitation for pancreatic surgery reduces postoperative complications, shortens the length of hospital stay, and supports overall patient recovery. (Evidence level: high, Grade of recommendation: conditionally in favor)

KQ 2. Preoperative nutrition in pancreatoduodenectomy

Appropriate patient selection and comprehensive nutritional assessment are fundamental to effective preoperative nutritional management. Early identification of patients at risk for malnutrition enables timely intervention and supports postoperative recovery. Assessment methods include anthropometric measurements (e.g., body weight, body mass index, waist circumference, body fat composition, and recent weight changes), laboratory parameters (e.g., serum albumin, transferrin, electrolytes, and vitamin levels), and validated screening tools such as the Malnutrition Universal Screening Tool (MUST), Nutrition Risk Screening 2002 (NRS-2002), and Patient-Generated Subjective Global Assessment (PG-SGA) [13-16]. Ideally, nutritional therapy should begin at least 7 days before surgery, particularly for patients with signs of or risk factors for malnutrition. Early intervention helps prevent acute nutritional deterioration and reduces postoperative complications such as infection, impaired wound healing, and muscle loss [13,17]. For patients with adequate oral intake and preserved gastrointestinal function, consumption of high-calorie, high-protein meals and oral nutritional supplements should be encouraged to optimize energy and nutrient intake. When oral intake is insufficient, enteral nutrition (EN) administered via feeding tubes is preferred to ensure delivery of nutrient-rich formulas tailored to the patient's metabolic requirements [18]. If EN cannot be implemented, parenteral nutrition (PN) should be considered, providing a complete intravenous nutritional solution that includes calories, amino acids, lipids, vitamins, and minerals [19]. Selection between EN and PN should be guided by the patient's clinical condition and gastrointestinal functional status. Early and adequate nutritional intervention is essential for optimizing surgical outcomes and postoperative recovery.

Summary and recommendation: Patients undergoing pancreatoduodenectomy should receive a thorough preoperative nutritional assessment. Preoperative nutritional support, through enteral or parenteral routes as appropriate, contributes to reduced postoperative complications and shorter hospital stays. (Evidence level: high, Grade of recommendation: conditionally in favor)

KQ 3. Anti-thrombotic prophylaxis in liver surgery

The use of pharmacological thromboprophylaxis in liver surgery is well established, and chemical prophylaxis with low-molecular-weight heparin (LMWH) or unfractionated heparin (UFH) has been shown to significantly reduce the incidence of postoperative venous thromboembolism

(VTE) without meaningfully increasing bleeding risk [20]. Comparative studies have further demonstrated that LMWH and UFH are similarly effective in lowering VTE rates, with no significant differences in bleeding complications [21]. A large Korean national study also reported lower overall VTE rates in Asian populations compared with Western populations, underscoring the need for individualized prophylaxis strategies [22]. Updated recommendations from the Asian Venous Thrombosis Forum emphasize the use of mechanical prophylaxis, such as intermittent pneumatic compression devices, particularly for patients with elevated bleeding risk. Combined use of pharmacologic and mechanical prophylaxis is recommended for individuals at high risk for VTE to achieve optimal outcomes [23].

Summary and recommendation: Postoperative administration of LMWH or UFH is recommended unless contraindicated. Intermittent pneumatic compression devices should also be used to minimize the risk of thromboembolic events. (Evidence level: moderate, Grade of recommendation: strong)

KQ 4. Prophylactic abdominal drainage in liver surgery

Abdominal drainage has traditionally been used following hepatic resections; however, emerging evidence has increasingly challenged its routine application. A 2022 meta-analysis of seven randomized controlled trials (RCTs) involving 1,064 patients reported that routine abdominal drainage after hepatectomy was associated with significantly higher rates of overall and wound-related complications. Importantly, no significant differences were observed between drainage and no-drainage groups with respect to bile leakage, intra-abdominal collections, or length of hospital stay [24]. Similarly, a systematic review and meta-analysis including 5,050 patients demonstrated that prophylactic drainage after major hepatectomy was associated with increased bile leakage, a higher need for interventional drainage, more postoperative complications, and longer hospitalization [25]. Although routine prophylactic drainage is unnecessary for most patients undergoing elective hepatectomy, selective drainage may benefit patients at high risk of bile leakage, including those undergoing biliary tract reconstruction or those with substantial liver damage [26].

The current consensus indicates that routine prophylactic abdominal drainage after hepatic resection offers no advantage in reducing bile leakage or intra-abdominal infections and may instead increase postoperative morbidity. Therefore, decisions regarding abdominal drain placement should be individualized based on surgical complexity and patient-specific risk factors.

Summary and recommendation: Routine abdominal drainage is not recommended in patients undergoing hepatectomy without biliary reconstruction. (Evidence level: high, Grade of recommendation: strong)

KQ 5. Preoperative biliary drainage

Prolonged preoperative jaundice is associated with increased postoperative morbidity, largely because severe cholestasis induces hepatic dysfunction [27,28]. To mitigate these risks, preoperative biliary drainage is often considered, particularly in patients with cholangitis, malnutrition, or coagulopathy [29]. However, biliary drainage also carries potential complications, including pancreatitis, biliary tract infection, and surgical site contamination.

Current evidence suggests that percutaneous transhepatic biliary drainage (PTBD) may be more effective than endoscopic biliary drainage (EBD) in achieving biliary decompression and reducing rates of post-procedural pancreatitis and infection among patients with perihilar cholangiocarcinoma [30,31]. In contrast, EBD has demonstrated superiority over PTBD with regard to minimizing seeding metastasis and improving overall survival in patients with resectable perihilar cholangiocarcinoma [32]. Most clinical guidelines recommend delaying surgery until serum bilirubin levels decrease to below 2–3 mg/dL [27,30,32,33].

For pancreatoduodenectomy, several meta-analyses have shown that preoperative biliary drainage is associated with increased postoperative complications and does not significantly affect mortality [27,34-36]. Neither percutaneous nor endoscopic techniques, including placement of plastic or metallic stents, appear to effectively mitigate this increased risk [35].

Summary and recommendation: For liver surgery, preoperative biliary drainage is recommended in patients with cholestatic liver disease (bilirubin >2–3 mg/dL). In perihilar cholangiocarcinoma, PTBD is preferred over EBD. Elective surgery should be postponed until bilirubin levels decrease to below 2–3 mg/dL. (Evidence level: moderate, Grade of recommendation: strong)

Summary and recommendation: For pancreatoduodenectomy, preoperative biliary drainage should be avoided unless clinically unavoidable (e.g., bilirubin >250 μmol/L, cholangitis, intractable pruritus, or prior to neoadjuvant therapy). (Evidence level: high, Grade of recommendation: strong)

KQ 6. Preoperative smoking and alcohol cessation

Cigarette smoking is an independent risk factor for postoperative complications following liver surgery, including respiratory and infectious complications [37-39]. Evidence from randomized trials and meta-analyses indicates that smoking cessation for at least 4 weeks prior to surgery significantly reduces pulmonary complications and promotes improved wound healing [38,40]. Similarly, chronic alcohol consumption negatively affects liver function and increases the risk of perioperative complications. Alcohol-induced hepatic inflammation and immune dysregulation contribute to higher postoperative infection rates and poorer surgical outcomes [41,42].

Summary and recommendation: Smoking cessation should begin at least 4 weeks before hepatic resection. Patients with high alcohol intake (>24 g/day for women, >36 g/day for men) should abstain for at least 4–8 weeks prior to surgery. (Evidence level: high, Grade of recommendation: strong)

KQ7. Pre-anesthetic medication

The routine use of nonsteroidal anti-inflammatory drugs (NSAIDs) in the preoperative period is not recommended due to the risk of acute kidney injury (AKI). NSAIDs may compromise renal perfusion and exacerbate kidney injury, particularly under physiological stress during major surgery. This risk is especially relevant in patients with preexisting renal impairment or other comorbidities [43-45]. Emerging evidence suggests that certain sedatives and antiemetics may offer protective effects against perioperative AKI. For example, dexmedetomidine possesses anti-inflammatory and antioxidant properties that may reduce the incidence of AKI. However, use of these agents should be individualized based on patient-specific profiles and potential contraindications [44,46].

Summary and recommendation: Routine preoperative NSAID use should be avoided due to concerns regarding renal function. Long-acting anxiolytics are discouraged, particularly in elderly patients. Transdermal scopolamine may be used for nausea prevention, but should be administered with caution in older adults. (Evidence level: moderate, Grade of recommendation: strong)

KQ 8. Minimally invasive approaches

Minimally invasive techniques, particularly laparoscopy, have advanced considerably in HBP surgery and demonstrate advantages such as reduced intraoperative blood loss, decreased morbidity, and shorter postoperative recovery. Numerous high-volume centers have reported favorable outcomes with laparoscopic HBP procedures. Although robust RCT evidence for robotic HBP surgery remains limited, emerging data support its feasibility and suggest that both laparoscopic and robotic approaches can expand the indications for minimally invasive HBP surgery [47-52].

Summary and recommendation: Laparoscopic liver resection and laparoscopic distal pancreatectomy are recommended when technically feasible, as they are associated with shorter hospital stays and fewer complications. Laparoscopic pancreatoduodenectomy should be performed only in high-volume centers with substantial expertise and within strict institutional protocols, given persistent concerns regarding its safety. (Evidence level: moderate, Grade of recommendation: strong)

KQ 9. Prophylactic nasogastric intubation

Historically, nasogastric tube (NGT) decompression has been used postoperatively to prevent ileus and aspiration. However, an RCT evaluating routine NGT use after elective hepatectomy found no significant differences in overall morbidity, pulmonary complications, postoperative emesis, time to oral intake, or hospital length of stay between patients with and without NGT placement. Importantly, patients in the NGT group reported greater discomfort [53]. A meta-analysis assessing routine nasogastric decompression (NGD) after pancreatoduodenectomy showed associations with increased delayed gastric emptying, higher rates of major complications, and prolonged hospitalization [54]. These findings indicate that routine NGD provides no clear clinical benefit and may instead contribute to adverse outcomes. Routine NGD after elective liver or pancreatic surgery does not improve postoperative recovery and may increase complications and patient discomfort. Current protocols therefore support early oral feeding and recommend selective NGT placement only in cases involving postoperative complications such as significant gastric distension or prolonged ileus.

Summary and recommendation: Routine postoperative NGT is not recommended. (Evidence level: high, Grade of recommendation: strong)

KQ 10. Postoperative glycemic control

Perioperative hyperglycemia is associated with an in-

creased risk of infections, reoperative interventions, and in-hospital mortality, regardless of whether patients have diabetes [55]. Surgical stress induces transient insulin resistance, which contributes to hyperglycemia and can impair immune function and wound healing. Maintaining normoglycemia through appropriate insulin therapy has been shown to reduce infection risk and support postoperative recovery [56]. Continuous glucose monitoring and individualized insulin regimens should be considered integral components of perioperative management in HBP surgery to optimize glycemic control [56,57].

Summary and recommendation: In pancreatoduodenectomy, elevated perioperative blood glucose levels are associated with adverse outcomes in both diabetic and non-diabetic patients, although the optimal perioperative glycemic target has yet to be clearly defined. In liver surgery, insulin therapy should be employed to maintain blood glucose levels below 150 mg/dL. (Evidence level: high, Grade of recommendation: strong)

KQ 11. Perianastomotic drainage in pancreatoduodenectomy

The utility of routine intra-abdominal drainage following pancreatoduodenectomy remains an area of debate. Multiple RCTs have reported conflicting results, with some demonstrating increased complications in patients with drains and others indicating higher morbidity in the no-drain groups [58-61]. The development of the Fistula Risk Score (FRS) has enabled a more refined, risk-stratified approach. Evidence suggests that routine drainage may be unnecessary—or potentially harmful—in low-risk patients, while offering possible benefit in those with moderate or high risk. Additionally, early drain removal (postoperative day 3) in patients with low drain amylase levels (<5,000 U/L on postoperative day 1) has been associated with lower complication rates [62-66]. Accordingly, a selective strategy based on FRS and early drain amylase levels is recommended, whereas routine omission of drains remains a matter of debate.

Summary and recommendation: In patients with a low FRS and drain amylase <5,000 U/L on postoperative day 1, early perianastomotic drain removal at 72 hours is recommended. (Evidence level: high, Grade of recommendation: strong)

KQ 12. Early and scheduled mobilization

Early postoperative mobilization is a core component of enhanced recovery pathways and offers benefits such as reduced pulmonary complications, prevention of VTE, and improved gastrointestinal function. Studies have shown that mobilizing patients within the first 24 hours after surgery accelerates gastrointestinal recovery and shortens hospital stays [67,68]. Although the ideal frequency and duration of mobilization remain undefined, structured ambulation programs should be incorporated into routine postoperative care.

Summary and recommendation: Patients should be encouraged to ambulate as early as the day of surgery to reduce postoperative complications. No specific recommendations can be made regarding the optimal duration or frequency of mobilization. (Evidence level: moderate, Grade of recommendation: strong)

Conclusion

These Korean ERAS guidelines for HBP surgery provide evidence-based, contextually adapted recommendations covering 12 essential perioperative elements. Implementation of these protocols is expected to standardize care, reduce postoperative complications, shorten hospital stays, and ultimately improve patient outcomes across Korean healthcare institutions performing major HBP procedures.

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Authors' contribution

Conceptualization: all authors. Data curation: all authors. Formal analysis: KH, DWH. Funding acquisition: DJP, SJP. Investigation: all authors. Methodology: KH, HK, HSK, DWH. Project administration: DWH, SJP. Resources: SJP. Supervision: DWH, DJP, SJP. Visualization: all authors. Writing–original draft: all authors. Writing–review & editing: all authors. All authors read and approved the final manuscript.

Conflict of interest

The authors of this manuscript have no conflicts of interest to disclose.

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Data availability

Not applicable.

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Supplementary materials

None.

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Original Article

Perioperative nutritional practices and pediatric nutrition support team implementation in Korea: a cross-sectional study

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Abstract

Purpose: Pediatric surgical patients are vulnerable to perioperative malnutrition, yet standardized nutritional care and structured nutrition support team (NST) involvement remain inconsistent across institutions. Although multidisciplinary nutritional support has gained increasing attention, data on pediatric NST practices within surgical settings in Korea are limited. This study examined the availability and composition of pediatric NSTs, perioperative nutritional practices, and barriers in hospitals performing pediatric surgery.

Methods: A nationwide cross-sectional survey was conducted among tertiary and secondary hospitals that perform pediatric surgery in Korea. The questionnaire assessed hospital characteristics, the presence and composition of pediatric NSTs, perioperative nutritional screening and support practices, monitoring protocols.

Results: A total of 12 hospitals participated. Although all were high-capacity institutions, only half reported having a pediatric NST. Routine preoperative nutritional screening was performed in 50% of hospitals, and validated tools such as Screening Tool for the Assessment of Malnutrition in Pediatrics (STAMP) and Pediatric Yorkhill Malnutrition Score (PYMS) were used in 41.7%. Hospitals with a pediatric NST more frequently had institutional protocols for nutritional evaluation (66.7% vs. 16.7%) and were more likely to administer central venous parenteral nutrition postoperatively (83.3% vs. 0%, P=0.015). Enhanced Recovery After Surgery protocols were implemented in only two hospitals (16.7%). Major barriers to pediatric NST operation included insufficient staffing and time constraints.

Conclusion: Pediatric NSTs and standardized perioperative nutrition protocols remain underutilized in Korean surgical centers. Institutions with a pediatric NST demonstrated more structured nutritional practices. Expanding NST infrastructure and establishing standardized perioperative protocols for pediatric surgical patients may enhance the quality and consistency of nutritional care.

Keywords: Enhanced Recovery After Surgery; Nutrition assessment; Nutritional support; Parenteral nutrition; Republic of Korea

Introduction

Background

Optimal nutritional support is crucial in the perioperative care of pediatric surgical patients, as pre- and postoperative malnutrition is strongly associated with higher rates of postoperative complications, prolonged hospitalization, and impaired wound healing in children undergoing gastrointestinal or congenital anomaly surgery [1]. Despite this recognized importance, standardized perioperative nutrition

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protocols and multidisciplinary collaboration remain inconsistently implemented across institutions.

Nutrition support teams (NSTs) have been shown to improve nutrition-related outcomes in pediatric settings. For example, an Iranian study involving neonatal surgical patients with congenital gastrointestinal disorders found that NST implementation significantly enhanced weight gain and caloric intake, while also increasing the rate of enteral feeding [2]. Similarly, studies conducted in Europe and pediatric intensive care units (PICUs) reported that NSTs improved the timing of enteral nutrition initiation and optimized the delivery of nutrition-focused care [3].

In Korea, the application of NSTs in general pediatric wards has demonstrated positive outcomes, including increased calorie and protein provision through NST-led consultations [4]. However, nationwide data in pediatric surgical contexts remain limited. A recent domestic study revealed that although over 30% of hospitalized patients are at risk for malnutrition, only about 4% are referred to NSTs [5]. These findings underscore a substantial gap between the recognized need for and actual utilization of NST services.

To address this gap, we conducted a cross-sectional nationwide survey of tertiary and secondary hospitals in Korea.

Objectives

This study aimed to assess (1) the presence and structure of pediatric NSTs, (2) perioperative nutritional practices—including parenteral nutrition (PN), oral nutrition advancement, and monitoring—and (3) whether the presence of a dedicated pediatric NST is associated with differences in practice. By comparing postoperative PN utilization, oral nutrition initiation, evaluation protocols, and reimbursement patterns, this study seeks to provide new insights into the organizational and clinical impacts of NST implementation in pediatric surgical care.

Methods

Ethics statement

Institutional review board approval was waived because no identifiable patient data were collected.

Study design

This study was a cross-sectional, questionnaire-based investigation designed to evaluate current nutritional support practices for pediatric surgical patients in Korea.

Setting

The final version of the survey was distributed via an online platform (Google Forms) between March and May 2025. All responses were collected anonymously.

Participants

The survey targeted tertiary and general hospitals in which pediatric surgery is actively performed, defined as university-affiliated hospitals employing full-time pediatric surgeons capable of performing pediatric operations. Pediatric surgeons affiliated with each institution were invited to complete the survey via email and were instructed to submit one response per hospital. A total of 12 out of 20 target hospitals submitted valid responses. No identifiable patient data were collected, and all responses were anonymized.

Variables

The survey included items addressing hospital characteristics, the composition and activities of pediatric NSTs, preoperative nutritional screening and assessment practices, and postoperative nutritional support approaches. These served as the variables analyzed in this study.

Data sources/measurement

The questionnaire was collaboratively developed by pediatric surgeons and clinical nutrition specialists to comprehensively assess nutritional practices in pediatric surgical care. It was designed to capture both structural and practical aspects of perioperative nutritional support across institutions. The survey comprised five key domains: (1) characteristics of participating hospitals, including type of institution, number of pediatric surgical patients, and annual surgical volume; (2) organization and activities of pediatric NSTs, including team composition, rounding practices, designated roles, and reimbursement status; (3) preoperative nutritional screening and assessment practices, including whether screening was routinely performed and what tools or methods were used; (4) postoperative nutritional support strategies, including PN use, approaches to initiating oral feeding, and criteria for assessing nutritional status; and (5) ongoing monitoring practices and the existence of institution-specific protocols for nutritional evaluation and management of pediatric surgical patients.

The questionnaire contained both single-answer and multiple-response items. Before dissemination, it was reviewed and refined based on feedback from two pediatric surgeons to enhance clarity, content validity, and usability. The full survey form is provided in Supplement 1.

Bias

Selection bias may have occurred, as only 12 of the 20 tar-

geted hospitals participated in the survey. The characteristics of the eight non-responding hospitals may differ from those of the responding institutions.

Study size

Since one pediatric surgeon from each of the 12 hospitals responded, no formal sample size estimation was performed.

Statistical methods

Categorical variables were summarized using frequencies and percentages. Comparative analyses were conducted between institutions with and without a dedicated pediatric NST. Associations between NST presence and clinical practices (e.g., frequency of PN use, presence of nutrition protocols) were assessed using the chi-square test or Fisher's exact test, as appropriate. A P-value < 0.05 was considered statistically significant. All statistical analyses were performed using R version 4.5.1 (R Foundation for Statistical Computing).

Results

Participating hospitals' characteristics

Demographic information for the pediatric surgeons who completed the survey on behalf of the 12 hospitals was not collected. The responses reflected institutional practices and the current status of pediatric nutritional support and NST implementation rather than personal opinions. The survey was distributed to 20 hospitals, and valid responses were received from 12 institutions, including both tertiary and secondary general hospitals across Korea. Most hospitals reported having more than 500 beds. Seven hospitals (58.3%) performed between 100 and 299 pediatric surgical procedures annually, while two institutions conducted over 1,000 cases per year. A dedicated pediatric NST was present in six of the 12 institutions (50.0%). Hospital characteristics are summarized in Table 1.

Composition and activities of pediatric NST

Among hospitals with a pediatric NST, the most common team members included pediatricians, nurses, and pharmacists (100.0%) (Table 2). NST rounds were conducted in 58.3% of institutions, most commonly on a weekly basis. The major responsibilities of pediatric NSTs included nutritional assessment and discussion of interventions for malnourished patients. In five of the 12 centers, NSTs were also involved in

Table 1. Characteristics of respondent hospitals

Variable	No. (%)
Hospital type	
Tertiary hospital	11 (91.7)
Secondary hospital	1 (8.3)
Number of beds	
≥1,000 beds	6 (50.0)
500–999 beds	6 (50.0)
Pediatric inpatients per day	
<10	2 (16.7)
10–30	3 (25.0)
>30	2 (16.7)
Not specified	5 (41.6)
Annual number of pediatric operations	
<100	2 (16.7)
100–299	7 (58.3)
300–499	0
500–999	1 (8.3)
≥1,000	2 (16.7)
Years of pediatric surgery experience	
<5 yr	2 (16.7)
5–9 yr	1 (8.3)
10–14 yr	2 (16.7)
15–19 yr	2 (16.7)
≥20 yr	5 (41.7)
Dedicated pediatric NST	
Yes	6 (50.0)
No	6 (50.0)

NST, nutrition support team.

Table 2. Composition of pediatric nutrition support teams

Hospital	Pediatric surgeon	Pediatrician	Nurse		Pharmacist		Dietitian	
			Dedicated	Shared	Dedicated	Shared	Dedicated	Shared
1	+	+	+	+	+	-	+	-
2	+	+	+	-	+	-	+	-
3	-	+	+	-	+	-	+	-
4	+	+	+	-	+	-	+	-
5	+	+	+	-	+	-	+	-
6	+	+	+	+	+	-	+	-

Symbols in cells: +, present; –, absent.

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providing education for patients and healthcare professionals (Table 3).

Preoperative nutritional screening and assessment

Half of the hospitals (50.0%) reported routinely performing preoperative nutritional screening, while the remaining institutions conducted screening only occasionally or rarely (Table 4). Common assessment methods included anthropometric measurements (91.7%), dietary intake evaluations (75.0%), and blood tests (66.7%). Validated screening tools such as the Screening Tool for the Assessment of Malnutrition in Pediatrics (STAMP) and the Screening Tool for Risk of Nutritional Status and Growth in Children (STRONGkids) were each used in 41.7% of hospitals. When stratified by NST presence, hospitals with a pediatric NST were more likely to use STAMP and STRONGkids, although the differences were not statistically significant (P=0.080). No significant difference was observed in the overall frequency of nutritional screening (P=0.402).

Table 3. Activities of pediatric nutrition support teams

Variable	No. (%)
Pediatric NST member composition (n=6)[a]	
Pediatric surgeon	5 (83.3)
Pediatrician	6 (100.0)
Nurse (dedicated or shared)	6 (100.0)
Dietitian	6 (100.0)
Pharmacist	6 (100.0)
NST rounding implementation (n=12)	
Performed	8 (66.7)
Not performed	2 (16.7)
Not sure	2 (16.7)
Frequency of rounding (n=12)	
2–3 times/wk	2 (16.7)
Weekly	4 (33.3)
Monthly	1 (8.3)
No response	5 (41.7)
Main roles of pediatric NST (n=12)[a]	
Nutritional assessment	9 (75.0)
Planning and adjusting nutritional intervention	7 (58.3)
Monitoring of nutritional status	8 (66.7)
Education of patients and healthcare professionals	2 (16.7)
Reimbursement of nutritional care	9 (75.0)
Not sure	3 (24.9)

NST, nutrition support team.
[a]Multiple responses were allowed.

Postoperative nutritional support practices

PN was occasionally or frequently used in most hospitals (Table 5). Central venous access was significantly more common in hospitals with a pediatric NST compared to those without (83.3% vs. 0.0%, P=0.015). The initiation of oral nutrition in children aged ≥2 years varied, with clear liquid diets being the most common approach (41.7%). Calculation of nutritional requirements was primarily based on kcal/kg/day (58.3%). Weight trends and physical examination findings were the most frequently used indicators of postoperative nutritional status. The presence of a pediatric NST was not associated with significant differences in the timing of oral nutrition initiation (P=0.753) or in the use of nutritional indicators (P=0.261).

Monitoring, protocols, and institutional differences

Only 41.7% of institutions reported having established protocols for nutritional evaluation and intervention, indicating a lack of standardization in perioperative nutritional care. Al-

Table 4. Preoperative nutritional screening and assessment practices

Variable	Total, No. (%)	Pediatric NST (+)	Pediatric NST (–)	P-value
Preoperative nutritional screening				0.402
Routinely performed	6 (50.0)	3	3	
Occasionally performed	2 (16.7)	1	1	
Rarely performed	2 (16.7)	0	2	
Not performed	1 (8.3)	1	0	
No response	1 (8.3)	1	0	
Assessment tools and methods used[a]				
Anthropometric measurements	11 (91.7)	5	6	0.455
Dietary intake assessment	9 (75.0)	5	4	0.080
Blood tests	8 (66.7)	3	5	0.080
STAMP, STRONGkids	5 (41.7)	4	1	0.080

NST, nutrition support team; STAMP, Screening Tool for the Assessment of Malnutrition in Pediatrics; STRONGkids, Screening Tool for Risk of Nutritional Status and Growth in Children.
[a]Multiple responses were allowed for assessment tools.

Table 5. Postoperative nutritional support practices

Variable	Total	Pediatric NST (+)	Pediatric NST (–)	P-value
Frequency of parenteral nutrition use				0.083
Occasionally used	6	2	4	
Frequently used	3	3	0	
Rarely used	2	0	2	
Case-by-case decision	1	1	0	
Route of parenteral nutrition				0.015
Central venous	5	5	0	
Case-dependent	7	1	6	
Type of oral nutrition started (≥2 yr)				0.753
Clear liquids (SFD)	5	3	2	
Regular diet immediately	3	1	2	
Liquid/puree diet	2	1	1	
Case-by-case decision	1	1	0	
No response	1	0	1	
Postoperative nutritional monitoring period				0.382
Not done	2	2	0	
Once a week	6	3	3	
2–3 times/week	4	1	3	
Presence of nutritional assessment protocol for perioperative children				0.242
Yes	6	4	2	
No	6	1	5	

NST, nutrition support team; SFD, soft fluid diet.

though hospitals with pediatric NSTs more frequently reported having such protocols (66.7% vs. 16.7%), the difference was not statistically significant (P=0.242).

Discussion

Key results

Twelve hospitals participated in the survey, six of which had dedicated pediatric NSTs. These NSTs typically comprised pediatricians, surgeons, nurses, pharmacists, and dietitians, and they conducted weekly rounds focused on nutritional assessment and intervention. Half of the hospitals routinely performed preoperative nutritional screening using anthropometric measurements, dietary evaluations, and blood tests. Validated tools such as STAMP and STRONGkids were utilized in 41.7% of institutions. PN was commonly administered postoperatively, with central venous access significantly more frequent in NST-equipped hospitals (83.3% vs. 0.0%, P=0.015). Only 41.7% of hospitals had established nutritional protocols. Institutions with NSTs demonstrated trends toward improved screening practices and protocol adoption, although the differences were not statistically significant.

Interpretation/comparison with previous studies

This nationwide survey is the first to investigate perioperative nutritional practices for pediatric surgical patients in Korea, focusing on the presence and structure of pediatric NSTs. Although the study included tertiary and secondary hospitals—most with more than 500 beds—only 50% had an established pediatric NST. This finding underscores a major opportunity to strengthen institutional frameworks for nutritional care.

Marked variability was observed among institutions regarding nutritional screening, monitoring, and postoperative PN practices. Notably, hospitals with pediatric NSTs showed significantly greater use of central venous PN (83.3% vs. 0.0%, P=0.015) and a trend toward more frequent PN utilization overall (P=0.083), suggesting a more proactive approach to perioperative nutrition. Pediatric NSTs face distinct challenges, including the limited availability of pediatric-specific PN formulations for children under 2 years, differences in institutional compounding capacity, and shortages of personnel dedicated to pediatric nutrition management.

The presence of a pediatric NST was also associated with higher utilization of validated screening tools such as STAMP and STRONGkids, as well as a greater likelihood of having formal nutrition protocols, although these trends did not

reach statistical significance. This aligns with prior evidence showing that multidisciplinary NSTs enhance the use of standardized nutrition screening tools. For instance, one PICU study reported that NST implementation increased the use of STAMP and STRONGkids from approximately 40% to over 80% (P<0.01). Similarly, a European systematic survey of 111 PICUs found substantially higher adoption rates (75%–90%) of validated screening tools in NST-equipped units compared to much lower rates (30%–50%) in units without NSTs [6,7]. Collectively, these findings support that pediatric NSTs facilitate more systematic and consistent nutritional risk screening.

In adult populations, national surveys have examined NST structure and performance, demonstrating associations with improved clinical outcomes and stronger adherence to nutritional guidelines [8]. However, comparable data for pediatric surgical populations—particularly in Korea—remain limited. The present study addresses this gap by characterizing current practices in large-capacity hospitals. Although all participating hospitals were tertiary or secondary institutions with over 500 beds, only half reported having a dedicated pediatric NST. Importantly, hospitals with an NST were more likely to have formal institutional protocols for perioperative nutritional evaluation and intervention (66.7% vs. 16.7%), suggesting that NST presence may promote the systematization and standardization of nutritional care processes.

Regarding Enhanced Recovery After Surgery (ERAS) protocols, only two of the 12 hospitals (16.7%) reported selective implementation for pediatric patients. ERAS represents a multidisciplinary, evidence-based approach to perioperative care designed to accelerate recovery by incorporating elements such as preoperative nutritional assessment, reduced fasting duration, early enteral feeding, and mitigation of surgical stress and catabolism [9,10]. Nutritional optimization forms a central component of ERAS, especially for pediatric patients, who are more susceptible to perioperative metabolic imbalance due to higher energy demands and limited reserves. Compared with the limited uptake observed in pediatric practice, ERAS has been far more widely adopted in adult surgery. For instance, a nationwide Italian survey reported that 50.6% of gastric surgeons routinely applied ERAS principles to gastrectomy, and that structured ERAS programs were present in approximately 65% of surgical centers [11]. For pediatric populations, expert recommendations similarly emphasize preoperative nutritional optimization, fasting minimization, carbohydrate loading, and early postoperative enteral feeding, yet real-world implementation remains scarce [12]. This disparity highlights a significant gap in the standardization of perioperative nutritional care between adult and pediatric surgical disciplines.

Qualitative feedback from respondents also offered insight into barriers to NST implementation. Among all participants, seven hospitals cited inadequate personnel—particularly a lack of pediatric-dedicated pharmacists and dietitians—while one noted time constraints related to clinical workload, and another cited insufficient professional training in pediatric nutrition. These findings suggest that implementation barriers are not solely infrastructural but also stem from limitations in human resources and specialized expertise.

Limitations

This study has several limitations. The sample size was small (n=12), and although institutions were nationally distributed, findings may not be generalizable to all hospital types. Because data were obtained from a single respondent per institution, response bias cannot be excluded. Furthermore, this study did not assess clinical outcomes such as length of stay, infection rates, or growth parameters, which should be incorporated into future analyses.

Suggestion for further studies

To better define the clinical impact of pediatric NSTs, future prospective multicenter studies should include objective patient outcomes. In addition, qualitative investigations into barriers to NST implementation and protocol adherence could inform national strategies for improving perioperative nutritional care in pediatric surgery.

Conclusion

In summary, despite sufficient institutional capacity, the integration of pediatric NSTs and standardized perioperative nutritional care remains limited in Korea. To optimize outcomes for pediatric surgical patients, future efforts should prioritize establishing dedicated pediatric NSTs, fostering multidisciplinary collaboration, and expanding institutional resources and professional training.

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Authors' contribution

Conceptualization: all authors. Data curation: DK, HH. Formal analysis: DK, HYK. Funding acquisition: DK, HH, JKY, HYK. Writing–original draft: DK. Writing–review & editing: all authors. All authors read and approved the final manuscript.

Conflict of interest

The authors of this manuscript have no conflicts of interest to disclose.

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Data availability

Contact the corresponding author for research data availability.

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Supplementary materials

Supplementary materials can be found via https://doi.org/10.15747/ACNM.25.0027

Supplement 1. Survey form used in this study.

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Original Article

A narrative inquiry into the disease adaptation experience of long-term follow-up patients with short bowel syndrome in Korea

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Abstract

Purpose: This study was conducted to describe the meaning of disease adaptation experience over a 5-year long-term follow-up of patients with short bowel syndrome.
Methods: Four patients were recruited from a tertiary hospital in Korea. This study was conducted through first and second interviews from January 2019 to July 2022. The transcribed data were analyzed using narrative methods.
Results: The mean age of the participants was 64 years, and the mean treatment period after small bowel resection was 100 months. The participants lost a mean of 19.3 kg body weight and all were receiving home total parenteral nutrition 2–7 days a week. The meaning of the experience of adapting to the disease for patients was found to be "extremely sensitive to the symptoms," "considering eating food as another effective treatment method," and "enduring the disease through family affection."
Conclusion: Patients are struggling alone to cope with physical symptoms and adapt to their disease. For this, they are doing their best to narrow the gap between normal and abnormal physical conditions by thoroughly implementing diet therapy according to their physical characteristics. This entire process is supported by their families.

Keywords: Adaptation, physiological; Intestinal failure; Qualitative research; Short bowel syndrome; Therapy

Introduction

Short bowel syndrome (SBS) refers to a group of metabolic disorders caused by congenital or acquired shortening of the small intestine, resulting in impaired digestion and nutrient absorption [1]. In essence, the shorter the remaining functional small intestine, or the longer the segment rendered nonfunctional, the less surface area and time available for nutrient absorption. This accelerates the transit of food, increasing the risk of malabsorption and a range of associated symptoms [1-3]. Removal of the distal ileum and the ileocecal (IC) valve further causes rapid intestinal transit, hypersecretion, and gastric dumping due to the loss of hormonal feedback mechanisms. Additionally, disruption of intestinal motility and IC valve function often leads to small intestinal bacterial overgrowth (SIBO), which exacerbates malabsorption and contributes to fat malabsorption. SIBO is commonly associated with abdominal distension, abdominal pain, and diarrhea [4,5].

The prevalence of SBS remains unclear; however, data from home intravenous nutrition programs estimate it at 5–80 per million in the United States and Europe, and approxi-

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mately 3.5 per million in Korea [6-10]. SBS is thus among the rarest diseases both in Korea and globally. Notably, appropriate diagnostic codes for intestinal failure and SBS were only incorporated into the ICD-11 in 2022. Regarding economic burden, direct medical costs for SBS average $44,500 in the first year following small bowel resection. Although these costs decline over time, they remain substantial—averaging at least $6,800 annually 5 years postoperatively [1,10]. These data underscore SBS as a lifelong condition with significant, persistent disease burden.

Meanwhile, dehydration is common in SBS due to greater secretion in the upper small intestine compared to absorption in the lower portion. In response, participants often increase water intake, which paradoxically worsens dehydration and perpetuates a vicious cycle. Bowel adaptation typically occurs over 6 months to 2 years, depending on the individual [11,12]. If symptoms do not respond to medical management and bowel adaptation is not achieved within the adaptation period, bowel transplantation may be considered, particularly in cases of life-threatening complications, severe dehydration, or recurrent central line–related issues [13]. For patients ineligible for intestinal transplantation, home intravenous nutrition becomes the primary nutritional strategy to compensate for intestinal function loss. In the United States, Europe, and other countries, home total parenteral nutrition (TPN) has demonstrated cost-effectiveness as part of bowel rehabilitation, with structured guidelines and educational support. However, in Korea, standardized protocols for home intravenous nutrition education remain lacking [3,7]. Home intravenous nutrition requires close attention to individualized nutritional and fluid–electrolyte needs, with rapid adjustments based on minor clinical changes. It also demands careful management to avoid under- or over-nutrition. Most individuals with SBS, along with their primary caregivers, manage their TPN and catheters—critical lifelines—with a persistent sense of urgency and anxiety. Previous research on SBS has largely focused on nutrient deficiencies associated with intravenous nutrition [14-16], case reports of specific instances [17,18], and studies examining pharmaceutical interventions or enteral rehabilitation programs in pediatric populations [19-23]. However, these investigations are predominantly limited to short-term analyses with small sample sizes. To date, only three qualitative studies have explored the lived experiences of individuals with SBS, highlighting a need for more comprehensive, patient-centered research [23-25].

Narrative research, a qualitative methodology, centers on each participant's life story and seeks to understand the individual's experience across past, present, and future to derive meaning and establish new values and directions [26]. In this study, we employed a narrative research approach to examine the lived experiences of patients with SBS as they adapt to their disease. The goal was to reconstruct the meaning embedded in their narratives to better address the challenges encountered during the adaptation process and to offer insights that can inform long-term clinical management through empirically grounded evidence.

Methods

Ethics statement

This study received approval from the Institutional Review Board of Seoul National University Hospital (IRB No. 1890/002-001). Prior to data collection, participants were informed of the study's purpose and procedures, including audio recording of interviews, and provided written informed consent. Participants were assured of their rights, including the option to pause or terminate the interview if they experienced physical or psychological discomfort and the ability to withdraw from the study at any time without consequence.

Study design

This qualitative study employed Clandinin and Connelly's narrative inquiry method to explore and describe the lived experiences of individuals with SBS as they adjusted to their illness [26]. Given that SBS is characterized by fluctuating symptoms and ongoing adaptation, a longitudinal narrative design was incorporated to capture the evolving nature of participants' interpretations and coping processes. Two interview phases were used to enhance narrative depth and ensure completeness of participants' accounts within their evolving illness trajectories.

Participants

Participants were individuals aged ≥19 years diagnosed with SBS at a university hospital in Seoul, Korea. Purposive sampling was used for efficient participant selection. Initially, six participants were recruited; however, two withdrew after the initial interview for personal reasons, leaving a final sample of four participants. Narrative inquiry focuses on individual life experiences and the meanings ascribed to them, and it may include more than one participant [27]. The mean age of participants was 64 years. They had been diagnosed with SBS following a mean of three bowel resections. The mean duration since the last bowel resection was 8 years and 4 months. All participants had a remaining bowel length of <100 cm and had lost a mean of 19.3 kg since diagnosis. All were receiving nutritional support via TPN. On mean, par-

ticipants received TPN 5 days per week and infused approximately 915 mL of fluid per day (Table 1).

Research team

The researchers had 18 and 23 years of clinical experience, respectively, at a tertiary hospital in Seoul and had served on the nutrition support team (NST) for approximately 10 years, caring for patients with SBS. They also participated in periodic outpatient multidisciplinary consultations post-discharge, allowing for the development of close, ongoing relationships with patients. Furthermore, both researchers completed at least two semesters of qualitative research methodology during their graduate nursing education and had experience conducting qualitative studies using diverse approaches.

Interview and procedure

Data collection occurred in two phases, from January 2019 to July 2022. The first phase spanned January to August 2019. Each interview lasted 40–70 minutes (mean: 50 minutes), with seven to eight sessions conducted per participant. Interviews were one-on-one between the researcher and participant; however, for two participants who experienced physical limitations, a caregiver was present with the participant's consent.

The interviews were held in a quiet hospital conference room. Interviews began with unstructured questions and transitioned to semi-structured ones. Key questions included: "What does it mean to live with SBS?," "How does living with SBS change your life?," "What are some of the most challenging experiences you've had?," "What gives you the strength to cope with your illness?," and "What are some of the things you've learned to live with?"

The second phase occurred from September 2019 to July 2022. During informed consent, participants were informed that the number of interviews could vary based on study needs. In this phase, participants completed seven to eight interviews, each lasting approximately 30 minutes. Follow-up questions addressed missing details, clarified emerging themes, and explored additional researcher concerns. Interviewers also observed participants' facial expressions and voice intensity to assess reactions.

Data analysis

Data were analyzed using Clandinin and Connelly's narrative inquiry framework, guided by the three-dimensional inquiry space of temporality, sociality, and place [26]. Analysis began with repeated readings of each transcript, after which we constructed individual narrative accounts by organizing participants' experiences across past events, present adaptation processes, and anticipated futures.

We then examined sociality by identifying both personal conditions (e.g., emotions, bodily reactions, coping strategies) and social conditions (e.g., family dynamics, caregiving roles, interactions with healthcare professionals). Attention to place allowed us to consider how settings—such as the hospital or home—shaped experiences and meanings.

In the next stage, reconstructed stories were compared across participants to identify recurring patterns, contrasts, and temporal flows of adaptation (e.g., early crisis, stabilization, long-term management). Throughout the process, we moved iteratively between transcripts, narrative accounts, and emerging interpretations to ensure that meanings remained grounded in participants' lived contexts. Themes were finalized by mapping how the three dimensions converged within and across stories, clarifying how participants' experiences gained meaning over time and within relational and situational contexts.

Rather than comparing the two interview phases as separate datasets, participants' experiences were interpreted as a continuous illness trajectory. Accordingly, temporal shifts were embedded within the holistic storyline, consistent with narrative inquiry principles.

Results

The qualitative analysis conducted to gain an understand-

Table 1. Participant's characteristics

Participant	Sex	Age (yr)	Underlying disease	No. of bowel resection	Period after last bowel resection	Remnant bowel	Body weight loss (kg)	Days of TPN (wk)	Fluid volume (mL/day)
A	M	68	Gastric cancer	3	9 yr	80 cm with IC valve	25	2	App. 210
B	F	45	Colon cancer	3	6 yr 10 mo	60 cm with IC valve	16	7 (cyclic TPN 10 hr off)	App. 1,400
C	M	69	Gastric cancer	5	8 yr 9 mo	70 cm with IC valve	19	7	App. 1,400
D	M	72	Gastric cancer	3	8 yr 8 mo	50 cm with IC valve	17	3	App. 650

TPN, total parenteral nutrition; M, male; F, female; IC, ileocecal; App., approximately.

ing of the experience of SBS patients, yielded themes and contents (Table 2). Additional information is provided in the Supplement 1.

Experiences of adjustment to illness in people with SBS

Participant A story

1) Story 1. The life you obsessively record to survive

Participant A, a businessman in the construction industry, had developed a lifelong habit of meticulous recordkeeping. Following his diagnosis with SBS, he continued this practice, maintaining computerized records of every meal—including type, calories, and ingredients—as well as detailed logs of bowel and bladder movements. He reviewed these data daily to objectively assess his condition and consulted with the NST when necessary.

2) Story 2. Commitment to disease-related information

SBS is among the rarest diseases, making information scarce. Unlike cancer, SBS lacks both peer networks and readily available, practical guidance. Determined to understand how to manage life with SBS, he turned to academic journals. He sought evidence on how healthcare professionals treat patients with SBS, what dietary restrictions are recommended, and which aspects of daily living require caution—all to construct an informed lifestyle plan.

3) Story 3. Hope with absolute trust in medical staff

For participant A, healthcare providers were akin to "the captain of a ship in the middle of a stormy sea." Most of his acquaintances who were living with other illnesses utilized folk remedies alongside hospital-based care, often recommending herbal medicines and nutritional supplements, and sending gifts. However, he strictly adhered to the medical team's directives, placing unwavering trust in them.

Table 2. Theme and contents

Participant	Theme	Contents	Overall theme
A	(1) The life you obsessively record to survive	"I have a notebook and I write down my weight every day... When I was in the hospital, I weighed myself at 6:00 a.m. before breakfast, so I do the same at home. (interruption) I do not just have one data sheet. I have many—one for each day, each month. Everything is organized by date, month, year. It is all saved on CDs and an external hard drive—over two terabytes of organized data."	Extreme sensitivity to symptoms
	(2) Commitment to disease-related information	"I was really stressful because there are limited resources for SBS. With cancer, if you search for resources, there is information. But for small bowel, there is nothing..."	Extreme sensitivity to symptoms
	(3) Hope with absolute trust in medical staff	"Code... I must now... match the code between the medical staff and me. (interruption) I am just going to focus on the doctor, the nurse, the nutritionist, and what they are saying, and I am not going to trust anything else."	Extreme sensitivity to symptoms
B	(1) Appreciation only found by comparing to other patients	"My dad has been in a nursing home for over 2 years with chronic obstructive pulmonary disease. He has not set foot on the ground once, and he is older now, so he cannot return home. I just think my illness is better than others. I am doing better among people with illnesses..."	Treat meals as another form of therapy
	(2) Reclaiming your life through work	"My job is my reason for living. I was crying in the hospital because I could not work; it was unbearable. So I need to go back—I feel brighter and more energetic when I work."	Treat meals as another form of therapy
C	(1) Appetite control learned through experience	"I just ate it all. Suddenly I felt blocked, then vomited, and had diarrhea four or five times. Eventually, I had a rupture. (interruption) I could not eat well for a while, then I ate again, thinking I could handle it. I should have stopped myself."	Treat meals as another form of therapy
	2) Total dependence on wife	"I have been very sick since I was admitted to the hospital, and if it were not for my wife—my caregiver—I believe I would already be dead. (interruption) I believe I am alive today because of my wife."	Endure with family love
D	(1) Voluntary isolation from relationships	"I feel more at ease at home with my family, where I do not have to resist the urge to eat or explain myself. I simply do not go. I feel better that way."	Endure with family love
	(2) Forcing yourself to eat a given amount of food per day	"To meet my nutritional goals, I set alarms on my phone and forced myself to eat small amounts at regular intervals, treating the process like a mandatory task."	Endure with family love

CD, compact disc; SBS, short bowel syndrome.

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Participant B story

1) Story 1. Appreciation only found by comparing to other patients

Participant B reflected on her father's condition: bedridden in a nursing home with a tracheostomy tube due to chronic obstructive pulmonary disease. His life was severely restricted. In contrast, Participant B could choose her meals and walk independently. Despite requiring daily TPN to survive and facing ongoing risks of TPN, she considered her life more autonomous than that of a bedridden patient.

2) Story 2. Reclaiming your life through work

Participant B had worked as a dental hygienist since age 24. Throughout her career, she experienced multiple small bowel obstructions and ruptures requiring emergency surgery. Despite these events, she tried to maintain her job. After adjusting to TPN, she prayed to switch to cyclic TPN. Although she could not return to full-time work, having a job restored her sense of autonomy and humanity beyond being a patient with illness.

Participant C story

1) Story 1. Appetite control learned through experience

Participant C had a voracious appetite even prior to his diagnosis with SBS. He described eating as his primary joy in life. However, following an intestinal perforation, five episodes of intestinal adhesions, and a small bowel resection due to obstruction, he was unable to eat by mouth for 1.5 years and depended entirely on TPN. Once he regained sufficient physical strength to eat orally, he consumed food uncontrollably, fearing he might soon lose the ability to eat again. He experienced severe complications from this behavior—once losing 7 kg overnight due to diarrhea and another time suffering severe abdominal pain and vomiting, which resulted in a 10-month hospitalization and several intensive care unit admissions.

2) Story 2. Total dependence on wife

Participant C explained that following five small bowel resections, he became unable to perform daily tasks independently because of severe, unrelenting pain. After 9 years of hospitalizations, repeated procedures, and surgeries, he began to rely entirely on his wife, gradually delegating all household decisions to her. Although healthcare providers advised him to eat, exercise, and rest within limits, he reported being unable to assess what constituted overexertion and routinely consulted his wife for guidance.

Participant D story

1) Story 1. Voluntary isolation from relationships

Participant D, previously an extroverted and socially active individual, had organized regular couple's gatherings with friends for over a decade. After being diagnosed with SBS, however, he began to avoid social interactions, finding it emotionally difficult to watch others eat freely while he was restricted. He also struggled with the contrast between his current state and the continued vibrant social lives of his friends.

2) Story 2. Forcing yourself to eat a given amount of food per day

Participant D underwent three small bowel resections and subsequently required TPN and intravenous fluids for approximately 7 months, due to persistent severe nausea and vomiting. Participant D was required to consume approximately 2,800 kcal and 100 g of protein per day—excluding calories from TPN, which were poorly absorbed due to his shortened bowel. Although he was motivated to eat more, his gastric capacity remained limited due to prolonged disuse. To meet his nutritional goals, he set alarms on his phone and forced himself to eat small amounts at regular intervals, treating the process like a mandatory task.

Implications of disease adaptation in patients with SBS

Extreme sensitivity to symptoms

Living with SBS has made participants highly sensitive and reactive to even minor symptoms. This heightened vigilance stems from repeated emergency room visits and intensive care admissions for complications such as catheter infections, sepsis, urinary tract stones, kidney stones, bloody stools, and impaired liver function. Consequently, participants exhibited extreme anxiety in response to any unusual symptoms and took immediate action to manage them. For instance, they decreased fluid intake when experiencing loose or frequent stools, increased food and fluid intake when noticing weight loss or excessive sweating, and closely monitored even minor physical discomfort. They paid attention to digestion time, the smell of flatulence, and the frequency of burping to assess their condition.

Treat meals as another form of therapy

Participants, who had minimal remaining small intestine had lost a mean of 19.3 kg since their SBS diagnosis. For them, eating was not simply for sustenance; it was a therapeutic strategy to minimize weight loss and reduce dependence on TPN, enabling a semblance of daily routine. Due to reduced gastric capacity, participants replaced the conventional three-meal structure with six smaller meals daily. They

continually sought strategies to increase oral calorie and nutrient intake through personal research and experimentation.

Drawing strength from family as a source of hope

For one participant who had lived with the condition for nearly 9 years, the love and support of family were central to enduring the disease and sustaining a sense of hope. Family members were often the only individuals capable of offering meaningful emotional support, and their understanding and encouragement provided essential physical, material, and emotional stability. For patients with SBS—whose condition is both uncommon and often misunderstood—this unwavering familial support became a crucial source of strength and hope.

Discussion

SBS is an extremely rare condition with limited epidemiological data, as its low prevalence hinders accurate determination of incidence. This study is significant in that it offers an in-depth understanding of the lived long-term experiences of individuals with SBS. Most prior research has focused primarily on the disease itself, rather than on the day-to-day lives of those affected. Furthermore, few qualitative studies have conducted in-depth interviews with patients with SBS, and none have examined their long-term adaptation to the illness. By focusing on extended illness trajectories rather than short-term episodes, this study provides meaningful insights into both the illness experience and the long-term adjustment process. In a systematic review by Rosland et al. [28], the participants' ability to maintain intestinal adaptation for nearly 8 years following diagnosis appeared to be closely linked to their sensitivity to even minor symptoms. This heightened symptom awareness contributed to successful adaptation but was also rooted in fear and anxiety regarding potential complications. Winkler et al. [29] analyzed data from 1,251 patients enrolled in the Sustain Registry across 29 U.S. sites from August 2011 to February 2014 and found SBS to be the most common indication for home parenteral nutrition (HPN). Although no studies have specifically reported the incidence of HPN-related complications among patients with SBS, the incidence of catheter-related infections during long-term HPN at 0.64–0.66 per 1,000 catheter days [30,31]. While this rate may appear low, it likely underrepresents the actual prevalence of catheter infections in clinical settings. Patients with SBS who are on long-term HPN and not under continuous medical supervision remain highly vulnerable to these complications. Therefore, ongoing education and consistent monitoring of catheter and intravenous nutrient management are essential for patients with SBS and their caregivers, particularly those requiring HPN for ≥2 years to facilitate intestinal adaptation. The study revealed that patients with SBS often lacked accessible support when experiencing unfamiliar symptoms or pain. In South Korea, only a limited number of large medical institutions and regional hub hospitals provide coordinated post-discharge home care through home nursing teams. Even in these settings, home visits are typically restricted to once weekly after the first week post-discharge. Consequently, patients with SBS who require prolonged HPN often lack a continuous support system bridging hospital and home, leaving them without reliable assistance when complications occur. As a result, participants reported financial strain related to emergency department visits and sought to manage symptoms at home whenever possible, either through self-care or by consulting a home health nurse. However, this often led to delays in addressing severe complications—such as systemic infections or catheter-related issues—that required urgent specialist intervention, sometimes resulting in life-threatening outcomes. In contrast, the United States has implemented center-based intestinal failure programs [31]. These programs utilize multidisciplinary teams—comprising physicians, pharmacists, dietitians, and nurses—to provide individualized HPN preparation and management. This model enables patients with intestinal failure to practice HPN safely and flexibly in out-of-hospital settings [31]. Previous qualitative studies reported that patients with SBS and their families identified the absence of parenteral nutrition at night as a factor positively influencing quality of life [32]. Accordingly, the principal aim of intestinal rehabilitation for SBS is to improve quality of life by addressing malnutrition and enabling patients to sustain themselves through oral feeding without intravenous nutritional support. Furthermore, 90% of patients with SBS and intestinal failure receiving HPN were cared for by family members, 61% of whom were identified as spouses or partners [32], and 77% of caregivers provided care daily, 7 days a week. Their responsibilities included housework, grocery shopping, companionship, emotional support, transportation to medical appointments, meal preparation, and HPN administration [7,32]. As the primary providers of direct care, family members represent a vital support system offering physical and emotional assistance to patients living with a severe chronic condition such as SBS. However, alongside the recognized burdens and fatigue experienced by family caregivers—including challenges with time management and professional responsibilities—depression among caregivers has been identified as the strongest predictor of poor illness adjustment in families managing chronic disease [33].

Establishing a robust care support framework within the healthcare and social welfare systems is an urgent priority to mitigate the burden on families managing long-term, severe conditions such as SBS.

Beyond the need for multidisciplinary management, this study shows that patients' adjustment to SBS involves ongoing meaning-making shaped through relationships with family and healthcare providers. Thus, clinical practice would benefit from a narrative-centered approach that emphasizes listening to patients' stories and supporting them in reconstructing their illness narratives alongside standardized biomedical care.

Limitations

This study has several limitations. First, the findings are based on a small sample from a single tertiary hospital, which may limit their broader transferability. Second, although the long-term follow-up design strengthened the depth of understanding, the narratives relied partly on participants' retrospective accounts and may be influenced by recall bias. Finally, because the study examined only patients' perspectives, the absence of caregiver and healthcare provider viewpoints may constrain the comprehensiveness of the findings. Future studies incorporating larger, multicenter samples and multiple stakeholder perspectives are warranted to enhance the applicability and robustness of the evidence.

Conclusions

This study aimed to describe and interpret the illness adjustment experiences of four participants with SBS using a narrative inquiry approach. For individuals with SBS, the process of adjustment involved coping with symptoms with heightened sensitivity, viewing food intake as a form of therapy, and enduring the illness through familial support. The findings indicate that participants with SBS often face the burden of self-managing their condition in isolation, relying primarily on family. They independently determine their dietary and exercise routines and respond sensitively to physical symptoms to maintain a state of relative comfort aligned with their physical conditions.

Based on the study findings, the following recommendations are proposed. First, multidisciplinary and individualized interventions are needed to address the comprehensive physical, psychological, and socioeconomic challenges faced by individuals with SBS during the adjustment process. Second, it is essential to develop clinical guidelines that provide accurate information about SBS and facilitate inter-institutional resource sharing to promote standardized treatment and management for this rare and incurable condition.

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Authors' contribution

Eun-Mi Seol and Eunjung Kim contributed equally to this work.

Conflict of interest

The authors of this manuscript have no conflicts of interest to disclose.

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Data availability

Contact the corresponding author for research data availability.

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Supplementary materials

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Supplement 1. Theme and contents.

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Original Article

Preprocedural prognostic nutritional index predicts early gastrointestinal symptoms after percutaneous endoscopic gastrostomy or percutaneous radiologic gastrostomy in Korea: a retrospective cohort study

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Abstract

Purpose: The prognostic nutritional index (PNI) reflects immunonutritional status and is a well-established predictor of surgical outcomes. Although its association with post-gastrostomy mortality has been documented, its relationship with early gastrointestinal (GI) symptoms remains unclear. This study aimed to evaluate whether the preprocedural PNI predicts early GI symptoms following percutaneous gastrostomy, including percutaneous endoscopic gastrostomy (PEG) and percutaneous radiologic gastrostomy (PRG).

Methods: This retrospective study included 71 adults who underwent PEG or PRG. Early GI symptoms, such as nausea, vomiting, and diarrhea, occurring within 7 days were recorded. The preprocedural PNI, neutrophil-to-lymphocyte ratio (NLR), and the C-reactive protein (CRP)-to-albumin ratio were analyzed using logistic regression to identify predictors. Receiver operating characteristic (ROC) analysis was performed to assess the PNI's discriminative performance.

Results: Early GI symptoms occurred in 21 of 71 patients (29.6%). In univariate analysis, the PNI (P=0.009) and CRP-to-albumin ratio (P=0.018) were significant predictors, whereas NLR was not (P=0.125). After adjustment for potential confounders, including age, sex, body mass index, and NLR, the PNI remained an independent predictor of early GI symptoms (adjusted odds ratio, 0.90; 95% confidence interval, 0.83–0.98; P=0.021). ROC analysis for the PNI produced an area under the curve of 0.696, with an optimal cutoff value of 41.3 (sensitivity 70.6%, specificity 66.7%).

Conclusion: A lower preprocedural PNI is independently associated with the development of early GI symptoms after gastrostomy. The PNI may serve as a practical screening tool to identify high-risk patients who could benefit from preemptive nutritional optimization.

Keywords: Area under curve; Gastrostomy; Logistic models; Nutrition assessment; Prognosis

Introduction

Background

Malnutrition and systemic inflammation are established risk factors for adverse clinical outcomes following gastrostomy, including perforation, infection, and delayed recovery [1]. The prognostic nutritional index (PNI), which is calculated from serum albumin and lymphocyte count, provides

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an integrated assessment of nutritional and immune status. Originally developed to predict postoperative complications in gastrointestinal (GI) surgery, the PNI has since been validated as a prognostic marker across various clinical scenarios, including GI and oncologic diseases and sepsis [2].

Percutaneous endoscopic gastrostomy (PEG) and percutaneous radiologic gastrostomy (PRG) are established methods for providing enteral nutrition to patients with prolonged swallowing impairment, commonly resulting from stroke, malignancy, or structural obstruction. Although major complications of PEG and PRG are relatively uncommon, early GI symptoms—including nausea, vomiting, bloating, and dyspepsia—are frequently observed and can lead to reduced oral intake, feeding intolerance, and, in severe cases, hospitalization [3,4]. Identifying preprocedural predictors of these symptoms may enable personalized nutritional strategies and reduce morbidity. Although the PNI has been studied as a prognostic factor for early mortality after PEG, with lower values (<37) associated with increased 30-day mortality [2], its role in predicting early GI symptoms independent of mortality has not yet been clarified. Because early GI symptoms may share underlying mechanisms related to impaired immune-nutritional status, it is reasonable to hypothesize that lower PNI values increase susceptibility to early GI complications.

Objectives

This study sought to determine whether the preprocedural PNI is an independent predictor of early GI symptoms following PEG or PRG. We also evaluated conventional inflammatory markers, including the neutrophil-to-lymphocyte ratio (NLR), to determine whether the PNI offers additional predictive value beyond established indices. We hypothesized that patients with PNI values below a clinically defined cutoff would face an increased risk of early GI symptoms and that the PNI would demonstrate satisfactory discriminative performance based on receiver operating characteristic (ROC) curve analysis.

Methods

Ethics statement

This study received approval from the Institutional Review Board (IRB) of Kosin University Gospel Hospital (No. KUGH-2025-07-016) and was conducted in accordance with the principles outlined in the Declaration of Helsinki. Because of the retrospective study design and the use of anonymized data, the IRB waived the requirement for informed consent.

Study design

This study is a retrospective observational analysis. It was described in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [5].

Setting

Electronic medical records were reviewed for patients treated between March 2023 and May 2025 at Kosin University Gospel Hospital in Busan, Korea.

Participants

The study population comprised adult patients (aged ≥18 years) who were evaluated by the nutrition support team for postprocedural nutritional care after undergoing PEG or PRG at Kosin University Gospel Hospital between March 2023 and May 2025.

The primary clinical indication for gastrostomy at our institution was the inability to maintain adequate oral nutritional intake. PEG was the preferred approach for gastrostomy placement, whereas PRG was chosen when endoscopic access to the stomach was technically difficult, such as in cases of severe pharyngeal or esophageal stenosis or complex head and neck anatomy. Eligibility criteria required complete preprocedural laboratory data and sufficient clinical follow-up to determine the presence of early GI symptoms. Early GI symptoms were defined as the onset of nausea, vomiting, diarrhea, or abdominal discomfort within 7 days following PEG or PRG, as documented in the electronic medical records. Patients were stratified into two groups based on whether early GI symptoms occurred.

Variables

The primary outcome (dependent variable) was the occurrence of early GI symptoms within seven days after gastrostomy. The primary exposure (predictor) was the PNI. Additional inflammatory and nutritional markers included the NLR, C-reactive protein (CRP)-to-albumin ratio, serum albumin, absolute lymphocyte count, and absolute neutrophil count. All variables were obtained from the same preprocedural laboratory panel. Demographic and clinical characteristics, including age, sex, and body mass index (BMI), were also collected.

Measurements

The PNI was calculated as follows:

PNI=[10×serum albumin (g/dL)] + [0.005×total lymphocyte count (/mm^3)].

Additional inflammatory indices included the NLR [6] as

well as the CRP-to-albumin ratio [7], both of which were derived from preprocedural laboratory parameters.

Bias

To minimize selection bias, all consecutive adult patients (≥18 years) evaluated for and undergoing PEG or PRG during the study period were included, irrespective of clinical indication. Eligibility criteria, specifically the requirement for complete preprocedural laboratory data and documentation sufficient to establish the outcome, were applied consistently. Basic demographics and procedure types were compared between included and excluded patients to assess potential differential inclusion.

Study size

This retrospective cohort included all eligible patients during the study period; therefore, no a priori sample size calculation was performed. The final analytic cohort consisted of 71 patients, of whom 21 (29.6%) developed early GI symptoms. Given this event count, we prespecified a parsimonious primary multivariable model to comply with events-per-variable recommendations and reduce the risk of overfitting. Model complexity was further limited by excluding collinear variables and performing sensitivity analyses with reduced covariate sets. Effect estimates are presented with 95% confidence intervals to convey precision and support cautious interpretation consistent with the available sample size.

Statistical methods

Patients were classified according to the presence or absence of early GI symptoms. Continuous variables are reported as mean±standard deviation, and comparisons were conducted using the Student t test. Categorical variables are presented as counts and percentages, and the chi-square test was used for group comparisons. Univariable and multivariable logistic regression analyses were performed to identify predictors of early GI symptoms. All clinically relevant variables (age, sex, BMI, PNI, and NLR) were included in the multivariable model regardless of univariable significance. ROC curve analysis was used to evaluate the predictive performance of the PNI, and the optimal cutoff value was identified using the Youden index. All statistical analyses were conducted using R software (version 4.2.2, The R Foundation for Statistical Computing). Statistical significance was defined as a P-value <0.05.

Results

Participants

A total of 71 patients who underwent gastrostomy were included in this retrospective study. Early GI symptoms developed in 21 patients (29.6%), while 50 patients (70.4%) showed no symptoms. Baseline demographic characteristics, including age (65.1±14.6 years vs. 68.0±11.0 years, P=0.356) and sex (male: 70.0% vs. 81.0%, P=0.369), did not differ significantly between the no GI symptoms and GI symptoms groups. Similarly, BMI was comparable between the two groups (19.6±2.7 kg/m^2 vs. 19.8±3.4 kg/m^2, P=0.814). However, the PNI was significantly lower in the GI symptoms group compared to the no GI symptoms group (40.3±7.9 vs. 45.6±6.9, P=0.011). Regarding clinical outcomes, patients who experienced early GI symptoms had a significantly longer post-procedure length of stay (LOS) than those without symptoms (35.8±5.1 days vs. 12.7±2.3 days, P<0.001) (Table 1).

Univariate and multivariate analyses for early GI symptoms

Table 2 presents the results of the univariable and multivariable logistic regression analyses identifying factors associated with early GI symptoms. In the univariable analysis, a lower PNI was significantly associated with an increased risk of early GI symptoms (odds ratio [OR], 0.90; 95% confidence interval [CI], 0.83–0.97; P=0.009). The CRP-to-albumin ratio also demonstrated a significant association with the outcome (OR, 1.40; 95% CI, 1.06–1.85; P=0.018). Other variables, including age, BMI, sex, and the NLR, were not significant predictors (P>0.05). In the multivariable analysis adjusted for age, BMI, sex, and NLR, the PNI remained an independent significant predictor of early GI symptoms (adjusted OR, 0.90; 95% CI, 0.83–0.98; P=0.021). The CRP-to-albumin ratio was excluded from the multivariable model to avoid potential multicollinearity. No other variables showed statistical significance in the multivariable model.

Component analysis of the PNI and NLR

To identify the specific components contributing to the observed associations, we performed separate univariate analyses of the constituent variables of the PNI and NLR. The results are presented in Table 3. This analysis showed that the significant univariate association of the PNI was primarily attributable to the serum albumin component (OR, 0.27; 95% CI, 0.09–0.76; P=0.014). The other components, including absolute lymphocyte count (P=0.083) and absolute neutrophil count (P=0.970), were not significantly associated with early GI symptoms.

Table 1. Baseline characteristics according to early GI symptoms

Variable	No GI symptoms (n=50)	GI symptoms (n=21)	P-value
Age (yr), mean±SD	65.1±14.6	68.0±11.0	0.356
BMI (kg/m^2), mean±SD	19.6±2.7	19.8±3.4	0.814
Male sex, No. (%)	35 (70.0)	17 (81.0)	0.369
Procedure type, No. (%)			0.944
PEG	36 (72.0)	16 (76.2)	
PRG	14 (28.0)	5 (23.8)	
LOS (day), mean±SD	29.0±3.9	57.0±11.3	<0.001
Preprocedural LOS (day), mean±SD	16.3±2.3	21.2±8.2	0.820
Postprocedural LOS (day), mean±SD	12.7±2.3	35.8±5.1	<0.001
PNI, mean±SD	45.6±6.9	40.3±7.9	0.011
NLR, mean±SD	6.5±5.1	9.8±10.9	0.187

Comparison of demographic and clinical characteristics between patients with and without early GI symptoms following PEG/PRG.
GI, gastrointestinal; SD, standard deviation; BMI, body mass index; PEG, percutaneous endoscopic gastrostomy; PRG, percutaneous radiologic gastrostomy; LOS, length of stay; PNI, prognostic nutritional index; NLR, neutrophil-to-lymphocyte ratio.
P-values were determined using Student t test or chi-square test, as applicable.

Table 2. Univariable and multivariable logistic regression analyses for predicting early gastrointestinal symptoms

Variable	Univariable analysis		Multivariable analysis	
	OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
Age	1.02 (0.98–1.06)	0.404	1.00 (0.96–1.05)	0.963
BMI	1.02 (0.86–1.22)	0.791	1.06 (0.86–1.30)	0.593
Sex	0.80 (0.25–2.61)	0.716	0.60 (0.16–2.23)	0.445
PNI	0.90 (0.83–0.97)	0.009	0.90 (0.83–0.98)	0.021
NLR	1.06 (0.98–1.15)	0.125	1.03 (0.95–1.12)	0.491
CRP-to-albumin ratio	1.40 (1.06–1.85)	0.018	-	-

The multivariate logistic regression model included variables considered clinically fundamental or those showing a strong trend in univariate analysis (e.g., age, BMI, PNI). Variables such as serum albumin, HS-CRP, and CRP-to-albumin ratio were excluded from the final multivariate model—despite their univariate significance—to avoid multicollinearity. This is because PNI and the CRP-to-albumin ratio are composite indices calculated from serum albumin and/or CRP, leading to statistical interference when included simultaneously. NLR was also excluded due to its lack of significant association in the univariate analysis.
OR, odds ratio; CI, confidence interval; BMI, body mass index; PNI, prognostic nutritional index; NLR, neutrophil-to-lymphocyte ratio; HS-CRP, high-sensitivity C-reactive protein.

Table 3. Univariate analysis of PNI and NLR components for GI symptoms

Variable	OR (95% CI)	P-value
Serum albumin	0.266 (0.093–0.763)	0.014
Absolute lymphocyte count	0.999 (0.998–1.000)	0.083
Absolute neutrophil count	1.000 (1.000–1.000)	0.970

Univariate logistic regression analysis for the individual components of PNI (serum albumin, absolute lymphocyte count) and NLR (absolute neutrophil count, absolute lymphocyte count) to identify the primary driver of the association with GI symptoms.
PNI, prognostic nutritional index; NLR, neutrophil-to-lymphocyte ratio; GI, gastrointestinal; OR, odds ratio; CI, confidence interval.

Predictive performance of the PNI for early GI symptoms

ROC curve analysis was conducted to determine the optimal PNI cutoff value for predicting early GI symptoms. Using the Youden index, the optimal cutoff was identified as 41.3. At this threshold, the PNI yielded an area under the curve (AUC) of 0.696, with a sensitivity of 70.6% and specificity of 66.7% (P=0.005) (Fig. 1).

Discussion

Key results

This retrospective analysis of patients who underwent percutaneous endoscopic or radiologic gastrostomy indicates that a lower preprocedural PNI is significantly associated with the development of early GI symptoms, such as nausea, vomiting, and abdominal discomfort, within 7 days of tube placement. Notably, after adjusting for potential confounders, including age, BMI, sex, and NLR, the PNI remained an

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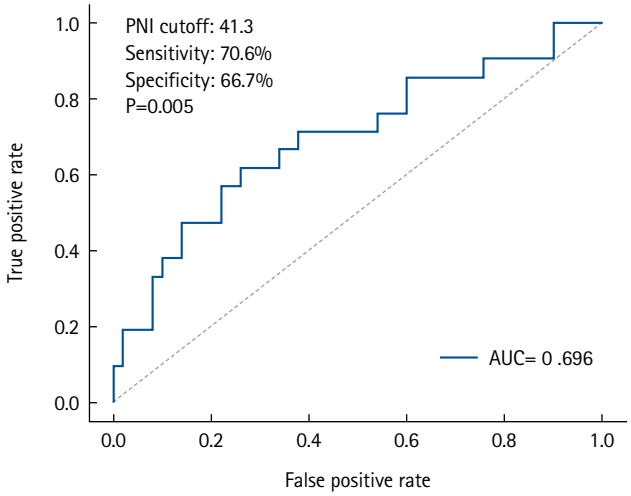

Fig. 1. Results of the receiver operating characteristic curve analysis for prognostic nutritional index. The optimal cutoff value was determined using the Youden index. AUC, area under the curve.

independent predictor of early GI intolerance (adjusted OR, 0.90; 95% CI, 0.83–0.98; P=0.021) (Table 2).

ROC curve analysis further supported this relationship, demonstrating fair discriminative performance (AUC=0.696) with an optimal cutoff value of 41.3 (Fig. 1). The clinical significance of early GI symptoms is underscored by their association with prolonged hospitalization. Our findings confirmed that patients who developed these symptoms experienced substantially longer post-procedure LOS.

Interpretation/comparison with previous studies

These results highlight that early GI symptoms represent more than mild postoperative discomfort; rather, they constitute a clinically meaningful complication that increases healthcare utilization. This also clarifies our methodological decision to treat LOS as an outcome secondary to the development of GI symptoms rather than as a baseline predictor. The PNI is a widely recognized composite score integrating serum albumin and lymphocyte count and was originally developed to predict surgical outcomes in GI cancer patients [8]. Since then, the PNI has gained broad acceptance as a prognostic biomarker across diverse clinical domains, including oncology, frailty assessment, and critical care [9-12]. Of particular relevance, Adachi et al. [2] demonstrated that a PNI below 37 was independently associated with 30-day mortality in patients receiving PEG. Building upon these findings, our study shows for the first time that the PNI also predicts early, non-fatal but clinically significant GI symptoms. This extends the utility of the PNI beyond long-term prognostication and highlights its role in assessing short-term procedural tolerance and immediate care quality.

The biological plausibility of this association is supported by known pathophysiological mechanisms. Malnutrition and impaired immune function, characteristic of lower PNI values, contribute to mucosal atrophy, delayed gastric emptying, and heightened visceral sensitivity—all factors that predispose patients to GI discomfort following gastrostomy [13]. Furthermore, hypoalbuminemia may affect fluid distribution and drug pharmacokinetics, potentially exacerbating GI intolerance [14].

Regarding systemic inflammatory markers, NLR did not demonstrate a significant association with early GI symptoms (P=0.170). In contrast, the CRP-to-albumin ratio showed a significant association with early GI symptoms (OR, 1.40; 95% CI, 1.06–1.85; P=0.018). These findings suggest that the integrated immunonutritional assessment captured by the PNI may provide superior predictive value compared with isolated inflammatory markers.

From a clinical perspective, routine evaluation of the PNI before PEG or PRG placement may assist in identifying patients at elevated risk. Individuals with a PNI ≤41.3 may benefit from tailored preprocedural strategies, including focused nutritional supplementation, albumin optimization, or preventive administration of prokinetic agents, to reduce symptom severity and enhance tolerance to enteral feeding. Such strategies may be especially valuable for older or chronically ill individuals who frequently exhibit compromised immunity and reduced GI resilience [15,16].

Limitations

Despite the importance of these findings, several limitations warrant consideration. First, as a retrospective single-center analysis, the results may not be widely generalizable and are vulnerable to potential selection or documentation biases. Second, early GI symptoms were identified through electronic medical records rather than standardized patient-reported outcome measures. This method may introduce subjectivity and could lead to underreporting or inconsistent documentation, as symptom identification depended on clinician documentation rather than structured assessment tools. Such variability may result in misclassification bias and may underestimate the true incidence of early GI symptoms. Third, the relatively small sample size limited our ability to conduct subgroup analyses according to gastrostomy type (PEG vs. PRG), procedural details, or underlying clinical comorbidities.

Suggestions for further studies

Future studies should include prospective, multicenter cohorts employing validated symptom assessment instruments to evaluate the predictive value of the PNI more precisely in this setting. Randomized controlled trials are also needed to determine whether PNI-guided nutritional interventions can effectively mitigate GI intolerance and improve post-procedure outcomes. Additionally, incorporating the PNI into comprehensive risk prediction models—potentially enhanced by artificial intelligence or machine learning—may further refine preprocedural planning and risk stratification for patients identified as high risk [17].

Conclusion

In conclusion, this study demonstrates that a low preprocedural PNI is a strong and independent predictor of early GI symptoms following gastrostomy. Because the PNI reflects both nutritional status and systemic inflammation, it serves as a simple and clinically valuable biomarker. Assessing the PNI prior to gastrostomy may help identify high-risk patients who could benefit from peri-procedural nutritional optimization to reduce complications.

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Authors' contribution

Conceptualization: JYL. Data curation: YK, YM. Methodology/formal analysis/validation: YM, SHL. Project administration: KHK. Writing–original draft: YK. JYL. Writing–review & editing: YM, SHL, KWS, KHK. All authors read and approved the final manuscript.

Conflict of interest

The authors of this manuscript have no conflicts of interest to disclose.

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Data availability

Contact the corresponding author for data availability.

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Supplementary materials

None.

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Original Article

Impact of tube feeding after pancreaticoduodenectomy on nutritional intake and status: a retrospective cohort study in Japan

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Abstract

Purpose: Pancreaticoduodenectomy (PD) is one of the most invasive procedures in gastrointestinal surgery. However, the clinical significance of postoperative tube feeding remains unclear. This study investigated the impact of enteral nutrition (EN) on the postoperative nutritional status of patients undergoing PD.

Methods: We retrospectively analyzed 129 patients who underwent PD at Tohoku University Hospital. Nutritional intake and status, evaluated using the Controlling Nutritional Status score, were compared between two groups: an EN group (97 patients) and a non-EN group (32 patients).

Results: There were no significant differences between the two groups in age, sex, body mass index, underlying diseases, operative duration, blood loss, postoperative pancreatic fistula, postoperative complications, delayed gastric emptying, or length of hospital stay. Although the EN group showed improvements in nutritional status both at discharge and compared with preoperative values, none of these changes reached statistical significance. Oral caloric intake was significantly higher in the non-EN group (P=0.01). In contrast, total energy intake was higher in the EN group, but this difference did not reach statistical significance (P=0.07).

Conclusion: Tube feeding after PD did not significantly influence postoperative nutritional status or overall nutritional intake. These findings suggest that EN offers no clear advantage over other approaches; however, further research is warranted to validate these results, refine existing guidelines, and optimize postoperative patient management.

Keywords: Enteral nutrition; Nutritional status; Pancreaticoduodenectomy; Postoperative complications; Treatment outcome

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Introduction

Background

Pancreaticoduodenectomy (PD) is regarded as one of the most invasive procedures in gastrointestinal surgery. Postoperative complications such as pancreatic fistula, intra-abdominal hemorrhage, abscess formation, delayed gastric emptying, bile leakage, cholangitis, and surgical site infection occur at a relatively high frequency, with an incidence rate of 40% to 60%, which exceeds that of most other gastrointestinal operations [1].

After PD, nutritional management via oral intake may become challenging due to complications such as pancreatic fistula, chylous ascites, or delayed gastric emptying [2-4]. Consequently, patients frequently experience a decline in postoperative nutritional status. Malnutrition has been associated with higher rates of postoperative complications [5] and poorer quality of life [6], underscoring the need for meticulous perioperative nutritional management to prevent or mitigate adverse outcomes.

When oral feeding is inadequate, enteral nutrition (EN) is generally preferred over parenteral nutrition. This preference is also supported by the guidelines of the Japanese Society for Clinical Nutrition and Metabolism [7]. EN is presumed beneficial for PD patients, who commonly experience postoperative difficulties with oral intake.

However, the 2019 edition of the Clinical Practice Guidelines for Pancreatic Cancer issued only a weak recommendation against the routine use of perioperative EN therapy [8]. Furthermore, the updated 2022 edition omitted any reference to EN, stating that "routine perioperative enteral nutrition therapy is no longer standard clinical practice" [9], reflecting an increasingly negative position toward the use of EN after PD.

Objectives

This study aimed to clarify the effects of EN on postoperative nutritional status and clinical outcomes in patients who underwent PD at our institution. We sought to determine the clinical relevance and potential benefits of EN following PD.

Methods

Ethics statement

This study was conducted as a subanalysis of the research project titled "Clinicopathological Factors and Treatment Outcomes in Pancreatic Diseases." The study was approved by the Tohoku University Ethics Committee (No. 2017-1-089). Informed consent was waived because this was a retrospective chart review.

Study design

This was a retrospective observational cohort study, described in accordance with the STROBE statement, available at: https://www.strobe-statement.org/.

Setting

We analyzed cases of PD performed at the Department of General Surgery, Tohoku University Hospital, between January 2014 and June 2017. During this period, PD was generally conducted as subtotal stomach-preserving PD with reconstruction by a modified Child method. Gastrojejunostomy was performed using the Billroth II approach. In principle, all cases involved intraoperative insertion of an EN tube via the afferent limb, which was then fixed using the Witzel method. Postoperative management followed a standardized critical pathway [3]. Water intake began on postoperative day 1, and meals were introduced from postoperative day 3. Additionally, beginning on postoperative day 3, 200 mL of elemental nutrition (1 kcal/mL) was administered through the EN tube, which was increased to 600 mL/day by postoperative day 5. Oral intake was prioritized for energy supply, with enteral or parenteral nutrition added as needed to meet individual caloric requirements. When oral intake was adequate, enteral and parenteral nutrition were gradually reduced. In cases presenting with symptoms suggestive of intolerance to enteral feeding, such as abdominal distension or diarrhea, EN was decreased, while oral or parenteral nutrition was increased accordingly.

Participants (subjects)

Patients with a history of gastric resection other than total gastrectomy (e.g., distal or proximal gastrectomy) and those experiencing difficulty with oral intake due to delayed gastric emptying were included. The exclusion criteria for this study were as follows: (1) cases with simultaneous major hepatectomy; (2) cases with total pancreatectomy due to PD; (3) cases with a history of total gastrectomy; (4) cases requiring reoperation after postoperative day 7; and (5) cases with a period of fasting due to postoperative complications such as aspiration pneumonia, anastomotic leakage, or chylous ascites.

Variables

For the included cases, data on age, sex, height, weight, diagnosis, operative procedure, operative time, blood loss, presence of pancreatic fistula, postoperative complications, length of hospital stay, and results of blood biochemical tests were extracted from departmental databases and electronic medical records. Additionally, oral intake during hospital-

ization, total energy intake (including EN and intravenous fluids), and the presence of vomiting were recorded.

Data sources and measurements

To compare patient demographics, perioperative outcomes, postoperative course, nutritional status, and compare EN use retrospectively, patients who received ≥600 mL/day of EN within 1 week after surgery were categorized into the EN group, while those who did not receive this amount were classified as the non-EN group.

Delayed gastric emptying was classified according to the definition proposed by Wente et al. [4]. Pancreatic fistula was defined using the International Study Group (ISGPF) grading system [10], with Grade B or higher considered a clinical pancreatic fistula. Postoperative complications were graded according to the Clavien-Dindo classification [11], with Grade IIIA or higher regarded as significant complications. Cases with complications of Grade IIIB or higher were excluded, as these patients required fasting management.

Nutritional status was assessed using the Controlling Nutritional Status (CONUT) score, which evaluates serum albumin, peripheral lymphocyte count, and serum cholesterol levels. The total CONUT score classifies nutritional status as normal (0–1), mild (2–4), moderate (5–8), or severe (9–12) [12]. We have previously demonstrated the usefulness of the CONUT score in evaluating nutritional status and predicting complications following pancreatic resection [5,13], and it is currently used at our institution for perioperative nutritional assessment.

Postoperative energy requirements were calculated by first determining basal energy expenditure using the Harris-Benedict equation based on standard body weight [14], which was then multiplied by an activity factor and a stress factor of 1.5. The postoperative energy fulfillment rate was derived by dividing the actual energy intake by the calculated postoperative energy requirement.

Bias

Confounding bias could not be fully excluded because decisions regarding the initiation or omission of EN were not randomized but based on clinical judgment and individual patient conditions. Although baseline demographics and operative factors were compared between groups, residual confounding due to unmeasured factors—such as comorbidities, perioperative inflammation, or functional status—may persist. Furthermore, survivorship bias may have been introduced, as patients with severe early postoperative complications were excluded, potentially underestimating both the risks and potential benefits of EN.

Study size

No formal sample size calculation was performed because all eligible patients during the study period were included in the analysis.

Statistical methods

Statistical analyses were performed using R (R Foundation for Statistical Computing). Continuous variables, including age, body mass index (BMI), blood loss, operative time, postoperative hospital stay, and CONUT score, were expressed as median (interquartile range). Energy intake was presented as mean (95% confidence interval). Comparisons between groups were conducted using the Wilcoxon test for continuous variables and Fisher exact test for categorical variables (sex, underlying disease, clinical pancreatic fistula, postoperative complications, and delayed gastric emptying). A two-sided P-value <0.05 was considered statistically significant.

Results

Participants

A total of 129 patients were included in the analysis, with a median age of 68 years (interquartile range, 61–74 years). The cohort comprised 83 men and 46 women. The underlying disease was pancreatic cancer in 55 cases. The EN group, defined as patients who received ≥600 mL/day of EN within 1 week postoperatively, included 97 cases, while the non-EN group comprised 32 cases. The cumulative energy intake via EN during the first postoperative week was significantly higher in the EN group (P<0.01). Clinical characteristics were compared between the two groups (Table 1).

Main results

No significant differences were observed between the EN and non-EN groups with respect to age, sex, BMI, underlying disease (pancreatic cancer), blood loss, or operative time (Table 1). Although the P-value for BMI was 0.05, the absolute difference between groups was small and not clinically meaningful.

A comparison of postoperative complications revealed no significant differences between the groups in the incidence of clinical pancreatic fistula, complications of Clavien-Dindo Grade IIIA or higher, or delayed gastric emptying. Likewise, there was no significant difference in postoperative hospital stay between the two groups.

We next examined differences in nutritional status during hospitalization and at discharge, as well as detailed patterns of energy intake, according to the presence or absence of EN.

Table 1. Patient factors, surgical factors, postoperative complications, and EN

Variable	EN group (n=97)	Non-EN group (n=32)	P-value
Cumulative EN (kcal)[a]	2,918	2,131	<0.01
Age (yr), median (IQR)	68 (62–74)	67 (59–72)	0.20
Sex, No. (%)			0.55
Male	61 (62.9)	22 (68.7)	
Female	36 (37.1)	10 (31.2)	
Body mass index (kg/m^2), median (IQR)	22 (20–25)	21 (19–23)	0.05
Primary disease, No. (%)			0.65
Pancreatic cancer	39 (40.2)	16 (50.0)	
Others	58 (59.8)	16 (50.0)	
Blood loss (mL), median (IQR)	1,065 (718–1,498)	1,010 (784–1,288)	0.34
Operative time (min), median (IQR)	551 (483–620)	537 (475–634)	0.84
Clinical pancreatic fistula, No. (%)	35 (36.1)	11 (34.4)	0.86
Postoperative complications, No. (%)	47 (48.5)	13 (40.6)	0.45
Delayed gastric emptying, No. (%)	58 (60.8)	15 (46.9)	0.20
Postoperative hospital stay (day), median (IQR)	33 (23–44)	31 (20–45)	0.48

EN, enteral nutrition; IQR, interquartile range.
[a]Cumulative EN was calculated as the total EN energy intake over the first postoperative week (days 1–7).

A comparison of CONUT scores at discharge showed no clear difference between the EN and non-EN groups (Fig. 1A). Furthermore, the change in CONUT score between admission and discharge (ΔCONUT) did not differ significantly between groups (Fig. 1B).

Energy intake during the first postoperative week was analyzed by route and compared between the EN and non-EN groups (Fig. 2). Oral energy intake was significantly higher in the non-EN group (EN group: 467 kcal and non-EN group: 711 kcal; P=0.01), indicating that patients in the non-EN group obtained more energy from meals. Total energy intake (parenteral plus enteral) showed no significant difference between the groups, although there was a trend toward higher intake in the EN group (EN group: 1,796 kcal and non-EN group: 1,617 kcal; P=0.07). The energy fulfillment rate was 93% in the EN group and 73% in the non-EN group, again showing a nonsignificant trend toward higher values in the EN group (P=0.06).

Discussion

Key results

In this study, EN after PD did not demonstrate a clear effect on postoperative nutritional status. This may be explained by the fact that patients with lower EN intake had higher oral intake or received supplemental parenteral nutrition, leading to minimal differences between groups, with total energy intake remaining similar at approximately 1,500 kcal in both. Moreover, the presence or absence of EN was not associated with postoperative complications or length of hospital stay. Therefore, a strong recommendation for routine EN after PD cannot be made. Nonetheless, in patients with limited postoperative oral intake, EN may help prevent deterioration in nutritional status.

Interpretation/comparison with previous studies

The role of EN after PD remains a matter of debate. The 2019 edition of the Clinical Practice Guidelines for Pancreatic Cancer issued only a weak recommendation against perioperative EN after pancreatic resection [8], while the most recent 2022 edition removed any mention of EN, stating that "routine perioperative enteral nutrition therapy is no longer standard clinical practice" [9]. The 2019 guideline's rationale for discouraging EN included the absence of significant differences in postoperative complications and, in one multicenter randomized controlled trial (RCT), an apparent increase in complications in the EN group [15]. However, that RCT reported a high-mortality rate of approximately 6%, compared with rates below 3% in other studies, raising concerns about the validity of uniform interpretation. When that high-mortality study was excluded, a meta-analysis performed for the 2019 guideline showed significantly fewer postoperative complications in the EN group (P=0.01).

A 2019 meta-analysis investigating early EN after PD reported no significant difference in postoperative complications but did show a shorter hospital stay in the EN group [16]. More recent systematic reviews have suggested that EN after PD may reduce hospital stay, though its impact on post-

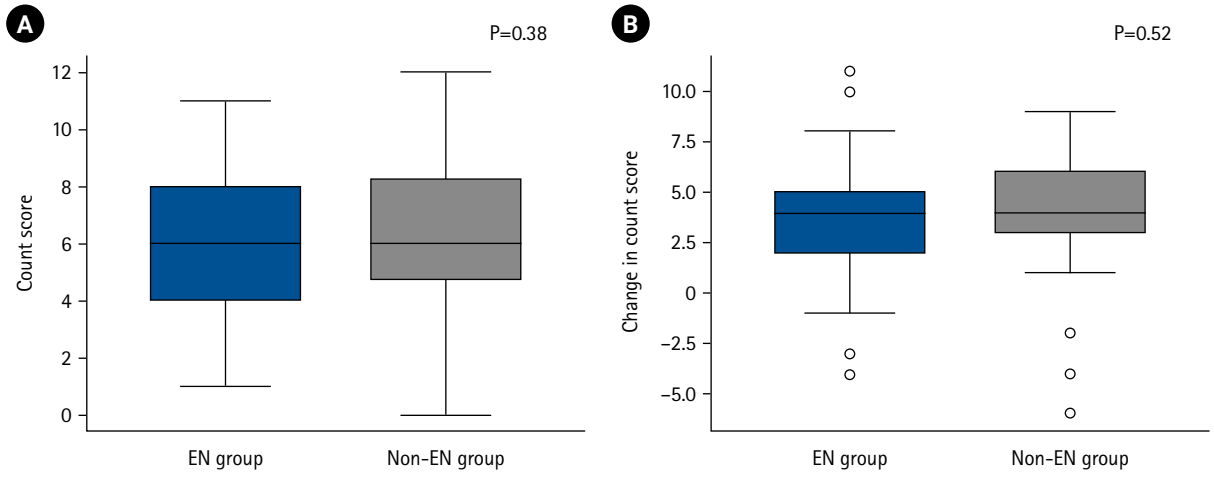

Fig. 1. Postoperative nutritional status and enteral nutrition. Nutritional status at discharge (A) and changes in nutritional status before and after hospitalization (B), assessed using the CONUT method, in the enteral nutrition group (EN group) and the non-enteral nutrition group (non-EN group). On the vertical axis, a higher CONUT score indicates poorer nutritional status (A), while a greater change in CONUT score represents a greater decline in nutritional status (B). No significant differences were observed between the two groups. CONUT, Controlling Nutritional Status.

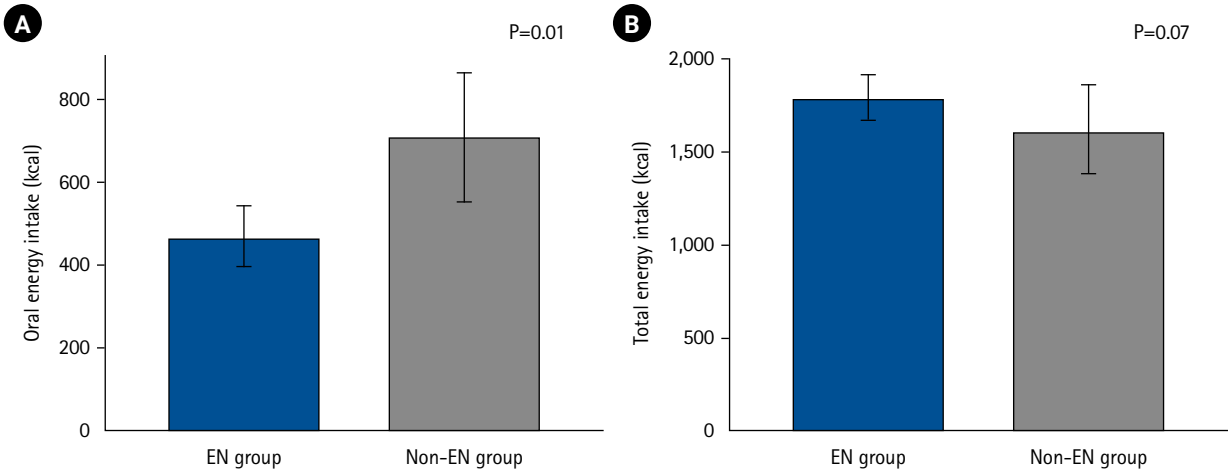

Fig. 2. Postoperative energy intake and enteral nutrition. Energy intake from oral sources (A) and total energy intake including enteral nutrition and parenteral nutrition (B) during the first postoperative week in the enteral nutrition group (EN group) and non-enteral nutrition group (non-EN group) are shown. Oral energy intake was significantly higher in the non-EN group, but there was no significant difference in total energy intake between the groups, with rather a trend toward higher intake in the EN group.

operative complications remains uncertain; hence, selective rather than routine use is recommended [17,18].

Although EN is expected to help maintain adequate nutritional status following PD—particularly when oral intake is limited due to delayed gastric emptying—this study did not identify any significant association between EN and postoperative nutritional outcomes. This finding may reflect the compensatory role of higher oral or parenteral intake among patients with reduced EN administration, resulting in comparable total energy intake and similar nutritional outcomes. These observations imply that even when EN is limited, adequate postoperative nutritional support can still be achieved through alternative oral or parenteral routes.

While EN after PD may not confer substantial nutritional advantages, it can still serve practical purposes. The enteral route allows for the administration of medications and fluids in patients who have difficulty with oral intake due to delayed gastric emptying or bowel obstruction. In such cases, drugs

that would otherwise be taken orally can sometimes be administered enterally, and fluids can be delivered via the feeding tube, thereby reducing the need for intravenous access. This may be particularly beneficial for patients with limited peripheral venous access.

Limitations

This study focused exclusively on postoperative nutritional status. Future research should also evaluate the benefits and drawbacks of EN after PD from the perspectives of drug and fluid administration. As a retrospective single-center study, it is inherently subject to selection bias, measurement bias due to the use of chart-based data, and residual confounding from unmeasured variables. Additionally, excluding patients with severe postoperative complications may have introduced survivorship bias. Therefore, these findings should be interpreted with caution, and further prospective, multicenter studies are needed for validation.

Conclusion

This study found no evidence supporting the benefit of EN in improving postoperative nutritional status or total nutritional intake after PD. These results may reflect compensatory energy intake via alternative routes—such as oral or parenteral nutrition—in patients with limited EN administration, thereby minimizing nutritional differences between groups.

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Authors' contribution

Conceptualization/Data curation/Formal analysis: all authors. Investigation/Methodology/Project administration/Resources: all authors. Supervision: MU. Validation: all authors. Writing–original draft: all authors. Writing–review: all authors. All authors read and approved the final manuscript.

Conflict of interest

The authors of this manuscript have no conflicts of interest to disclose.

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Data availability

Contact the corresponding author for research data availability.

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Supplementary materials

None.

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Interesting Image

Penetration of a nasogastric tube by a stylet during insertion

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Nasogastric tube insertion is a common medical procedure, with approximately 1.2 million performed annually in the United States [1]. However, complications can sometimes be fatal [2]. Herein, we report the case of an 82-year-old woman with a putaminal hemorrhage who required nasogastric tube insertion due to impaired consciousness. A feeding tube (Kangaroo, Cardinal Health) was initially inserted through the right nostril but encountered resistance at a depth of 10 cm. After reinsertion, the tube advanced smoothly to 50 cm. During auscultation, the stylet was found to be protruding approximately 10 cm beyond the proximal end of the tube and was reinserted. Chest radiography revealed that the stylet had punctured the tube 10 cm from its distal tip (Fig. 1). Both the tube and the stylet were subsequently removed, revealing stylet-induced damage but no structural defects (Fig. 2). The patient did not experience any adverse events. Although rare, feeding tube damage during insertion underscores the risk associated with stylet reinsertion, and this practice should be avoided to prevent potential complications. Written informed consent was obtained from the patient for the publication of the clinical information and related images.

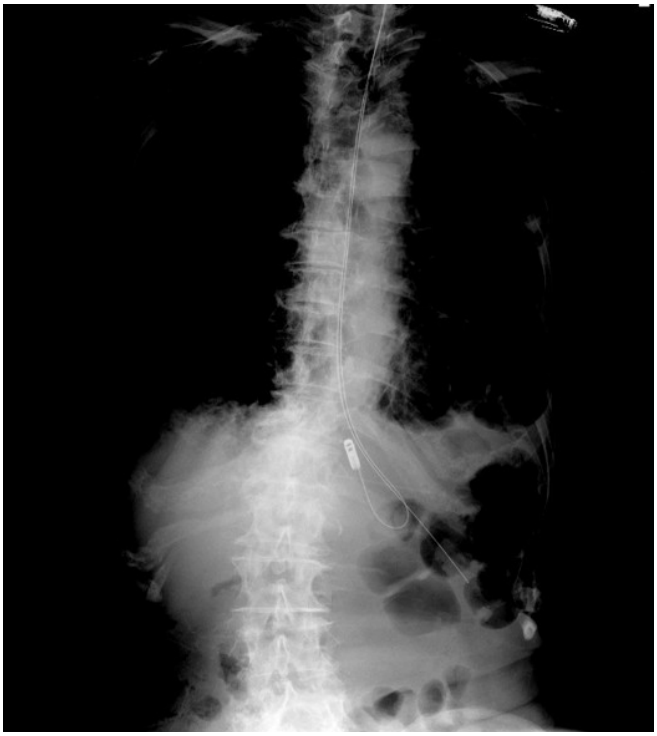

Fig. 1. Chest X-ray after nasogastric tube insertion. Chest radiography demonstrated that the stylet had perforated the nasogastric tube approximately 10 cm proximal to its distal tip.

Keywords: Enteral nutrition; Gastrointestinal intubation; Intestinal perforation

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Fig. 2. Gross appearance of stylet perforation of the nasogastric tube. The extracted nasogastric tube shows the stylet penetrating the tube wall approximately 10 cm proximal to its distal tip.

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Authors' contribution

Conceptualization: KO. Investigation: HT, KO. Project administration: KO. Supervision: HT, KO. Visualization: AT, KO. Writing–original draft: AT. Writing–review & editing: HT, KO. All authors read and approved the final manuscript.

Conflict of interest

The authors of this manuscript have no conflicts of interest to disclose.

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Data availability

No new data were created or analyzed in this study. Data sharing is not applicable to this article.

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None.

Supplementary materials

None.

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Correction

Correction: article type revision

Editorial Office, Annals of Clinical Nutrition and Metabolism

In the *Annals of Clinical Nutrition and Metabolism* (ACNM) articles listed below, the article type was incorrectly indicated at the time of publication. The correct article types are as follows:

1. A practical guide for enteral nutrition from the Korean Society for Parenteral and Enteral Nutrition: Part I. prescribing enteral nutrition orders

Published as Special Article; corrected to Guideline.
Annals of Clinical Nutrition and Metabolism 2025;17(1):3-8.
https://doi.org/10.15747/ACNM.25.0002

2. Kumamoto Earthquake NST activity report: food problems in evacuation shelters in comparison with convalescent facilities

Published as Special Article; corrected to Original Article.
Annals of Clinical Nutrition and Metabolism 2024;16(3):173-180.
https://doi.org/10.15747/ACNM.2024.16.3.173

3. Current practices and challenges in nutrition support team activities, 2025 in Korea: a multicenter cross-sectional descriptive study

Published as Special Article; corrected to Original Article.
Annals of Clinical Nutrition and Metabolism 2025;17(2):97-103.
https://doi.org/10.15747/ACNM.25.0026

4. Successful introduction of ERAS in pancreaticoduodenectomy: what is real minimally invasive surgery?

Published as Clinical Experience; corrected to Original Article.
Annals of Clinical Nutrition and Metabolism 2025;17(2):156-161.
https://doi.org/10.15747/ACNM.25.0014

Corrections have been made to the online versions of these articles.

email: journal@e-acnm.org

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Instructions for authors

Enacted: August 30, 2007
Recently revised on December 31, 2024

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- References should be identified in text with full-size Arabic numerals on the line and in square brackets [ ].

- Up to six authors may be listed. References with seven or more authors should list only the first six followed by "et al." Names should be separated by a comma and one space.
- Journals should be abbreviated according to the style used in the list of journals indexed in the NLM Journal Catalog (https://www.ncbi.nlm.nih.gov/nlmcatalog/journals/). Journal titles that are not listed in the NLM Journal Catalog should follow the ISO abbreviation as described in Access to the LTWA (List of Title Word Abbreviations; https://www.issn.org/services/online-services/access-to-the-ltwa).
- If not specified below, the references should follow the ICMJE reference style (https://www.nlm.nih.gov/bsd/uniform_requirements.html).

[Examples of reference style]

- Journal
  Lim CS, Kim H, Han IW, Yun WG, Go E, Lee J, et al. Incidence and risk factors of nonalcoholic fatty liver disease after pancreaticoduodenectomy in Korea: a multicenter retrospective cohort study. Ann Clin Nutr Metab 2024;16:125-33.
- Book
  DeVita VT Jr, Hellman S, Rosenberg SA, eds. Cancer: principles and practice of oncology. Vol 2. 4th ed. Lippincott; 1998.
- Chapter in book
  Ginberg RJ, Kris MG, Armstrong JG. Cancer of the lung. In: DeVita VT Jr, Hellman S, Rosenberg SA, eds. Cancer: principles and practice of oncology. Vol 2. 4th ed. Lippincott; 1993. 673-758.
- Electronic format
  Ang SW, Liew J, Dharmaratnam VM, Yik VY, Kok S, Aftab S, et al. Diagnostic performance of various radiological modalities in the detection of sarcopenia within Asian populations: a systematic review. Ann Coloproctol 2024 Dec 20 [Epub].
  https://doi.org/10.3393/ac.2024.00080.0011
- Web sites
  Sage Terapeutics. A study with SAGE-547 for super-refractory status epilepticus [Internet]. U.S. National Library of Medicine; 2022 [cited 2024 Nov 20]. Available from: https://clinicaltrials.gov/ct2/show/NCT02477618?term=NCT02477618&rank=1

Tables and figures

ACNM publishes in full color and encourages authors to use color to increase the clarity of figures. An individual should not be recognizable in photographs or X-ray films provided at the time of submission. Authors must submit figures and illustrations as electronic files. Images must be provided in PPT, JPG, TIF, or PDF format. Each figure must be of good quality, have a resolution higher than 600 dpi, and have good contrast and sharpness. Submit files of figures and photographs separately from the text of the paper. Number figures as "Figure Arabic numeral" in the order of their citation (e.g., Fig. 1). If a figure is divided into more than two images, mark each figure with Arabic numerals and a capital letter (e.g., Fig. 1A, Fig. 1B). Authors should submit line drawings in black and white. Figures should be explained briefly in the titles. Explain all nonstandard abbreviations in footnotes, and use the following symbols in sequence: a, b, c, d (e.g., Rad, radiation; Chemo, chemotherapy; NS, not significant. *P<0.001). The brief title of tables and figures should be described as the verse or phrase in the above line of tables and the section of figure legends, respectively. Only the first character of the title should be capitalized. The first character of each cell in tables is also capitalized. Figure legends must describe all abbreviations and acronyms used in the figure. This section should be typed on a separate page.

Case reports

Case reports describe unique and instructive cases that make an important teaching point or scientific observation, novel techniques, use of new equipment, or new information on diseases that are important to clinical nutrition and metabolism. The manuscripts for case reports should be organized in the following order: Introduction, Case report, Conclusion, and References.

Guidelines

The clinical practice guidelines are usually invited. Clinical practice guidelines are systematically developed statements or recommendations intended to help clinicians and patients make decisions about appropriate healthcare in specific clinical circumstances. A structured abstract is required. The main text is recommended to be described according to the AGREE statement at https://www.agreetrust.org/.

Reviews

Reviews are usually requested by the Editor in Chief. However, unrequested reviews could be considered after contacting the Editor in Chief by e-mail to determine the appropriateness of the review to ACNM. The abstract must have the following headings: Purpose, Current concept, and Conclusion. The main text comprises the Introduction, Main body, and Conclusion sections. Otherwise, it keeps the style and format of the original articles, but the details may be more flexible depending on the contents.

Interesting images

The "Interesting images" section presents clinically interesting or informative images regarding nutrition or metabolism. The section is intended to share experiences and relevant commentary rather than report a specific case or study. The section should include the title, authors' names and affiliations, main text, images, image legends, keywords, and references.

Editorials

Editorials provide invited perspectives on an area of clinical nutrition and metabolism, dealing with very active fields of research, current interests, fresh insights, and debates. An abstract is not required, and a brief unstructured text should be prepared. Although editorials are usually invited or written by an Editor, unsolicited editorials may be submitted.

Letter to the editor

Letters to the Editor should include brief constructive comments concerning a published article, a short, freestanding opinion, or a short, interesting case. Letters to the Editor should be submitted no more than 1 year after the relevant paper has been published. Responses from the author of the relevant paper may be provided. The responses should have the same format as Letters to the Editor.

Table 1 summarizes each publication type's key features and word count limit. The length of each article is negotiable with the editor-in-chief.

Table 1. Key features and word count limits of publication type

Type of article	Abstract (words)	Text (words)[a]	References	Tables and figures
Original article	Structured, 250	3,000	40	10
Review article	Structured, 250	5,000	50	10
Case report	200	1,500	20	10
Guidelines	Structured, 250	5,000	100	15
Interesting images	NR	800	10	5
Editorial	NR	1,500	10	5
Letter to the editor	NR	1,000	10	5

NR, not required.
[a]The length of each article is negotiable with the editor-in-chief.

Reporting guidelines

Authors should follow the relevant reporting guidelines for specific study designs, such as randomized controlled trials, diagnostic accuracy studies, meta-analyses, observational studies, and non-randomized studies. Recommended sources include the EQUATOR Network (https://www.equator-network.org/) and the National Library of Medicine (https://www.nlm.nih.gov/services/research_report_guide.html).

Annals of Clinical Nutrition and Metabolism requires compliance with the reporting guidelines summarized in Table 2 for the listed article types. For other study design and reporting guidelines, contact the editorial office at https://e-acnm.org/about/contact.php.

Table 2. Reporting guidelines for specific study designs

Initiative	Type of study	Source
CONSORT	Randomized controlled trials	https://www.equator-network.org/reporting-guidelines/consort/
TREND	Non-randomized controlled study	https://www.cdc.gov/trendstatement/index.html
STROBE	Observational studies	https://www.equator-network.org/reporting-guidelines/strobe/
STARD	Diagnostic/prognostic studies	https://www.equator-network.org/reporting-guidelines/stard/
PRISMA	Systematic reviews and meta-analyses	https://www.equator-network.org/reporting-guidelines/prisma/
CARE	Case reports	https://www.equator-network.org/reporting-guidelines/care/
AGREE	Clinical practice guidelines	https://www.equator-network.org/reporting-guidelines/the-agree-reporting-checklist-a-tool-to-improve-reporting-of-clinical-practice-guidelines/

PEER REVIEW AND EDITORIAL PROCESS OF ACCEPTED MANUSCRIPTS

It is available at: https://e-acnm.org/policy/publish_policy.php#1

ARTICLE PROCESSING CHARGE

It is available at https://e-acnm.org/authors/processing_charge.php.

CONTACT US

It is available at https://e-acnm.org/about/contact.php