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Original article

Nutrition practices with a focus on parenteral nutrition in the context of enhanced recovery programs: An exploratory survey of gastrointestinal surgeons

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SUMMARY

Background & aims: Ensuring patients have adequate physiological reserves to meet the demands of major surgery may necessitate nutritional prehabilitation and perioperative medical nutrition therapy (MNT). Parenteral nutrition (PN) via central or peripheral routes is indicated when requirements cannot be met orally or enterally. While patients undergoing major gastrointestinal (GI) surgery are at high nutritional and catabolic risk, guidance on PN is limited in Enhanced Recovery After Surgery (ERAS) protocols. This survey-based study characterized MNT practices among GI surgeons, and the challenges and opportunities for MNT within the context of ERAS.
Methods: This on-line survey comprised questions and attitudinal statements centred on MNT, particularly PN, for major GI surgery patients, and encompassed the spectrum of the surgical pathway (prehabilitation to postoperative care). GI surgeons in Europe were invited to complete the survey. Respondents described their current clinical practices, while their perceptions, unmet needs, and opportunities to improve nutritional management were explored via Likert-scale responses to statements.
Results: GI surgeons (N = 130) from different centres in France, Germany, Italy, Poland, and Spain completed the survey. Enhanced recovery protocols (75%) and multidisciplinary nutritional care teams (72%) were established in the centres of most respondents; surgeons, dieticians/nutritionists, and nurses were most frequently involved in MNT. Nutritional risk screening was common in the centres surveyed prior to surgery (range: 62% in Italy to 96% in Poland) and undertaken less frequently postoperatively (range: 19% in Poland to 54% in Germany) with varied screening methods. Enteral nutrition insufficiency was the most common reason for prescribing PN (83%) and 56% of surgeons prescribed PN when enteral nutrition (EN) was not feasible. Overall, 71% of respondents agreed that peripherally administered PN (PPN), which does not require a central access route, lessens invasive procedures and benefits selected patients who are in a catabolic state, malnourished, or at nutritional/metabolic risk when oral intake/EN is insufficient. However, only 35% of surgeons used PPN in this scenario and only 47% utilized PPN when a central venous catheter is not available. Most surgeons (69%) agreed that PPN is in line with the ERAS concept of using minimally invasive approaches. The respondents raised a need for increasing awareness

Abbreviations: AIOM, Italian Association of Medical Oncology; BMI, body mass index; CVC, central venous catheter; DGEM, German Society for Nutritional Medicine; DRG, Diagnosis-Related Group; ERAS, Enhanced Recovery After Surgery; ESOMAR, European Society for Opinion and Marketing Research; ESPEN, European Society for Clinical Nutrition and Metabolism; GI, gastrointestinal; GDPR, General Data Protection Regulation; GLIM, Global Leadership Initiative on Malnutrition; HCP, healthcare provider; ICD, International Classification of Disease; MNA, Mini Nutritional Assessment; MNT, medical nutritional therapy; MUST, Malnutrition Universal Screening Tool; NST, nutritional support team; PN, parenteral nutrition; POLSPEN, Polish Society for Parenteral, Enteral Nutrition and Metabolism; PPN, peripheral parenteral nutrition; SGA, Subjective Global Assessment; SENPE, Spanish Society of Enteral and Parenteral Nutrition; SINPE, Italian Society of Artificial Nutrition and Metabolism.

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of PPN indications (81%), inclusion of PPN recommendations in clinical guidelines (79%), implementation of nutritional support teams (79%), and increased PPN-trained personnel (78%) to improve PPN delivery. *Conclusions:* PPN is perceived by surgeons (with ≥10 patients per month who receive PN) as a favourable strategy to support timely nutritional support in selected patients undergoing major GI surgery. However, from this clinical practice survey it seems PPN is underutilized in nutritional care practices. Findings from this survey of GI surgeons in Europe emphasize the need to improve early identification of patients who are malnourished or at nutritional/metabolic risk and integrate PPN into ERAS GI surgical pathways, within the framework of minimally invasive approaches.

1. Introduction

Major surgery triggers the release of pro-inflammatory cytokines and activation of the hypothalamic–pituitary–adrenal axis. This surgical stress response causes metabolic changes which result in catabolism of glycogen, protein, and lipid to facilitate healing [1,2]. Altered glucose homeostasis and insulin resistance associated with the surgical stress response can also contribute to muscle loss which impedes recovery and increases the likelihood of postoperative complications and mortality [1–4]. Consequently, it is essential that patients have adequate preoperative physiological reserves to meet the demands of major surgery. This may necessitate nutritional prehabilitation, to enhance functional reserves prior to surgery, and supporting nutritional intake during the perioperative period to facilitate recovery [5,6]. Patients undergoing major gastrointestinal (GI) surgery have particularly high nutritional and catabolic risk. In addition to underlying GI disease impacting food intake and absorption of nutrients, procedures such as gastrectomy and pancreatoduodenectomy can impair oral intake during the early postoperative period [7–9].

European Society of Clinical Nutrition and Metabolism (ESPEN) guidelines on clinical nutrition in surgery recommend assessing nutritional status in all patients before and after major surgery, and providing medical nutritional therapy (MNT) to patients with malnutrition, at nutritional risk, or anticipated to be unable to eat for >5 days [6]. MNT is also indicated without delay in patients in whom oral intake will be inadequate (<50% of recommended intake) for >7 days [6].

Parenteral nutrition (PN), which provides nutrients intravenously, is indicated when nutritional needs cannot be met by oral or enteral routes. PN can be delivered via a central venous catheter (CVC) or by peripheral venous access. Peripheral parenteral nutrition (PPN) enables immediate support to supplement oral and enteral nutrition (EN) or to prevent nutritional gaps until a CVC for central PN is available [10].

Enhanced recovery programs such as ERAS (Enhanced Recovery After Surgery) aim to optimize the outcomes of patients undergoing major surgery and are available across a range of surgical settings including GI procedures [11–16]. A key focus of ERAS recommendations, which advocate for minimally invasive procedures, is to minimize the adverse metabolic and catabolic consequences of surgery [11–17]. Despite PPN offering a less invasive approach than centrally delivered PN to support ERAS nutritional strategies when oral and/or EN are insufficient or not feasible, ERAS guidance on the use of PN, and particularly on PPN in the perioperative period including prehabilitation, are lacking [18,19].

We report the results of a European survey of GI surgeons, conducted to obtain insight on day-to-day clinical practices and perceptions of surgeons regarding MNT for patients in the perioperative setting, with a focus on PN. The survey sought to identify the unmet needs of healthcare providers (HCPs) in this setting, and opportunities to improve MNT for patients undergoing major GI surgery.

2. Materials and methods

2.1. Study design

The survey was developed by a panel of experts with extensive clinical experience in GI surgery and clinical nutritional support, including PPN (the study sponsor did not input into the survey questions). This included (but was not limited to) members of the Italian Association of Medical Oncology (AIOM), German Society for Nutritional Medicine (DGEM), ESPEN, Polish Society for Parenteral, Enteral Nutrition and Metabolism (POLSPEN), Spanish Society of Enteral and Parenteral Nutrition (SENPE), and Italian Society of Artificial Nutrition and Metabolism (SINPE).

The survey comprised 95 pre-coded questions (see supplementary appendix) that were translated into local languages and delivered using an on-line platform. The questions encompassed the spectrum of the surgical pathway, from prehabilitation to postoperative care. This survey included general questions about the respondents' clinical practice and patient population treated, roles of different HCPs at their centre in the provision of pre-to postoperative MNT, nutritional risk screening practices, use of PN, and considerations for PPN. Perceptions regarding MNT during prehabilitation and perioperative care, unmet needs and opportunities to improve the provision of PN for GI surgery patients were also explored, via statements assessed on a 9-point Likert scale (1 = 'strongly disagree' to 9 = 'strongly agree'). Respondents were encouraged to answer the questions based on their regular clinical practice, outside of the impact of COVID-19.

The survey complied with all national laws protecting personal data and relevant national codes of practice including guidelines associated with the General Data Protection Regulation (GDPR), the European Society for Opinion and Marketing Research (ESOMAR), and all relevant national codes of practice. Respondents provided informed consent in accordance with Institutional Review Board/Institutional Ethics Committee regulations.

2.2. Survey participants

Practicing GI surgeons from hospitals (one surgeon per institute) in France, Germany, Italy, Poland, and Spain with a diverse geographical spread across each country were identified by Kantar.com (from a previously established proprietary panel of healthcare professionals) and asked to complete the on-line survey. All surgeons from France, Germany, Italy, and Spain, who had previously expressed interest in participating in a range of market-research survey-based studies, were emailed a link to the survey. Surgeons in Poland were contacted by telephone and a link to the survey was emailed to individuals who expressed interest. Surveys

from surgeons who did not meet the following prespecified inclusion criteria were excluded: specialist in adult upper GI (oesophageal, stomach, small bowel, pancreatic, liver, biliary system) and/or lower GI (colon, rectal, anal) surgery, been in surgical practice for ≥3 years, be involved in prescribing PN, and have on average ≥ 10 patients per month who receive PN.

2.3. Survey analysis

Surgeons reported the regional location of their hospital (from 28 regions in France, 20 regions in Italy, 16 regions in both Germany and Poland, and 9 regions in Spain) in the screening questions. A maximum of 2 surgeons (France and Italy), 3 surgeons (Germany and Poland), or 4 surgeons (Spain) per region were analysed, up to a maximum of 26 respondents per country. Surveys were not analysed from participants once the regional or country quota of respondents was reached. In similar opinion-based studies, a sample population of ≤17 is considered adequate, when relative homogeneity of viewpoints is anticipated, to detect differences in practices and viewpoints [20,21]. A sample of 26 participants per country (N = 130 in total) was selected to provide confidence that the insight into current clinical practices, perceptions and unmet needs regarding PN provision was robust.

Responses to statements were assessed on a 9-point Likert scale (1 = 'strongly disagree' to 9 = 'strongly agree'). 'Agreement' was considered as ≥ 7 points. Data were analysed using descriptive statistics (Microsoft Excel). Due to the exploratory nature of this study which focussed on the description of clinical practices and perceptions, statistical comparisons to identify response patterns were not performed (mean data are reported).

3. Results

3.1. Clinical practice overview

Overall, the survey was completed by 391 of 425 surgeons who accessed it (response rate of 92%). Of the 391 questionnaires screened between November 2020 and January 2021, 31 incomplete questionnaires and 185 questionnaires that did not meet the inclusion criteria were excluded. An additional 45 questionnaires were not analysed that were completed after region/country quotas were filled (Supplementary Fig. 1). Overall, 130 questionnaires were included in this analysis (26 respondents per country: France, Germany, Italy, Poland, and Spain). Over 20 patients underwent GI surgery each month in the hospital departments of most surgeons (69%). The GI surgeon (N = 130) specialties included stomach (92%), small bowel (75%), colon (88%), and rectal (64%) surgery (multiple answers could be selected). Cancer was the most frequent reason for GI surgery, with partial resection of the liver (49%) and colon (47%), and total resection of the rectum (46%), anus (45%), oesophagus (42%), stomach (41%), and pancreas (38%) being the most frequent surgery types (multiple answers could be selected). Infection (29%) was the predominant reason for biliary system surgeries.

Enhanced recovery protocols according to ERAS guidelines were in place in most surgical departments (75%), while 7% used national, regional or hospital protocols. Overall, 18% of surgeons reported enhanced recovery protocols were not used in their department.

Except for surgeons from Poland, most respondents (61%) described their experience of using PN as 'extensive' (31% and 9% reported 'sufficient' and 'basic' experience of PN, respectively). In contrast, most of the surgeons in Poland (73%) reported 'sufficient' experience of PN use (8% and 19% reported 'extensive' and 'basic' experience of PN, respectively). This difference may, in part, reflect that Polish respondents had a shorter duration as practicing surgeons (3–10 years: 92%) compared with respondents from the other countries (11–30 years: 89%).

3.1.1. HCP roles in the nutritional care of GI surgery patients

Overall, 72% of respondents indicated specific multidisciplinary nutrition support teams (NST) were in place to manage MNT of patients undergoing GI surgery, most frequently involving surgeons (62%), dieticians/nutritionists (59%), and nurses (56%). Pharmacists were also listed as NST participants by surgeons in France (50%), Italy (46%) and Spain (46%), while intensive care physicians (46%) and endocrinologists (69%) also played a prominent role in France and Spain, respectively.

Regarding discussions and decisions on MNT in both prehabilitation and postoperative setting, surgeons were the most frequent HCP involved (Fig. 1). Dieticians/nutritionists also had a substantial role (reported by ≥ 50% of surgeons) in MNT discussions and decisions in all countries except Poland. Intensive care physicians had a larger role in MNT discussions and decisions in the postoperative versus prehabilitation setting across all countries, while endocrinologists were reported to have a substantial role in MNT discussions and decisions in Spain only (Fig. 1).

Surgeons were also the most frequent type of HCP to prescribe PN in all countries, with their prescriber role being particularly prominent in Poland due to a requirement for surgeons to sign prescriptions for patients in surgical units in this country (Fig. 1). Involvement of other HCPs in prescribing PN differed across the countries, with dieticians/nutritionists, intensive care physicians, endocrinologists and anaesthesiologists having substantial prescriber roles in Italy, Germany, Spain, and France, respectively (Fig. 1).

3.1.2. Screening for nutritional risk

Screening for nutritional risk at hospital admission was performed by nearly all surgeons in Poland (96%) reflecting policy in this country, and was frequently undertaken in France (73%), Germany (69%), and Italy (62%) while in Spain most patients were screened preoperatively (77%). Postoperative nutritional screening was less frequent, ranging from 54% in Germany to 19% in Poland. Overall, 56% of surgeons reported that all patients undergoing GI surgery were screened for nutritional risk, being highest in Poland (85%) and lowest in Germany (35%) where screening was more focussed on patient subgroups undergoing major GI surgery and/or with frailty, cachexia and/or sarcopenia.

The respondents utilized a range of tools to assess nutritional risk, with standard screening tools such as Nutrition Risk Screening-2002 (NRS-2002), Subjective Global Assessment (SGA), Malnutrition Universal Screening Tool (MUST), and Mini Nutritional Assessment (MNA) (72%), as well as BMI, weight loss or anthropometric parameters (72%), and laboratory parameters (68%) being most frequently used. Evaluating malnutrition according to Global Leadership Initiative on Malnutrition (GLIM) criteria was less common, ranging from 27% in Italy to 0 in Poland, where NRS-2002 and SGA are the mandated screening tools. Also, while most of the surgeons surveyed in Germany (77%), Spain (77%), Italy (73%) and France (54%) used International Classification of Disease (ICD) or Diagnosis-Related Group (DRG) codes to verify a diagnosis of malnutrition, this was less frequently reported by the surgeons from Poland (35%).

	Surgeons (N=130) reporting HCP involvement, %					
	Total	France	Germany	Italy	Poland	Spain
Preoperative setting						
Surgeon	87	88	81	88	100	77
Nurse	39	31	38	38	23	65
Dietician/Nutritionist	59	69	50	81	19	77
Anaesthesiologist	35	46	23	58	27	23
Intensive care physician	22	27	27	35	8	15
Oncologist	31	46	35	35	15	23
Endocrinologist	22	23	8	19	0	58
Other	3	4	4	0	0	8
Postoperative setting						
Surgeon	88	77	88	81	100	92
Nurse	48	35	62	58	27	62
Dietician/Nutritionist	62	85	62	73	15	77
Anaesthesiologist	27	46	23	35	15	15
Intensive care physician	45	50	58	58	27	31
Oncologist	31	46	35	42	12	19
Endocrinologist	23	12	12	23	0	69
Other	3	4	4	0	0	8
Prescribers of parenteral nutrition						
Surgeon	83	85	69	85	100	77
Nurse	12	19	12	19	0	8
Dietician/Nutritionist	38	42	42	65	0	38
Anaesthesiologist	19	50	23	15	4	4
Intensive care physician	25	31	54	23	0	15
Oncologist	25	46	38	27	0	12
Endocrinologist	18	19	12	12	0	50
Other	1	0	0	0	0	4

Fig. 1. HCPs (healthcare provider) involved in nutritional therapy discussions and treatment decisions.

3.1.3. Use of parenteral nutrition in the perioperative setting

Overall, perioperative PN was most likely to be prescribed for patients undergoing stomach (reported by 85% of surgeons), small bowel (63%), oesophageal (62%), colon (62%), and pancreatic (53%) surgery. There was consensus across the surgeons from different countries that most (83%) would prescribe PN if enteral intake was insufficient, and over half (56%) would prescribe PN due to enteral intake being unfeasible. The surgeons indicated a broad range of clinical cases in which PPN is used during their clinical practice, with 'short duration of PN required', 'less invasive procedure versus central infusion', and 'CVC not available' being key drivers (Fig. 2). Few surgeons (5%) indicated PPN was not used in their clinical practice.

Overall, most surgeons would initiate PN, either as total or supplemental nutrition, within the first 48 h post surgery; similar results were observed for PN delivered via central and peripheral routes. Country-specific differences in the timing of PN delivery were observed, including fewer surgeons in France initiating supplemental centrally delivered PN, and PPN as both total and supplemental nutrition within 24 h (Fig. 3).

3.2. Surgeons' perspectives on nutritional status and therapy

As detailed below, across the countries, the survey respondents were broadly aligned in their perceptions regarding the importance of nutritional status and MNT of patients undergoing major GI surgery.

3.2.1. Nutritional status in the perioperative setting

Most surgeons (79%) agreed/strongly agreed (7–9 on a 9-point Likert scale) that surgery represents a significant trauma, resulting in a catabolic state, and 84% agreed that impaired nutritional status in the perioperative setting is highly predictive of adverse postoperative outcomes. There was 80% agreement that preoperative serum albumin is associated with poor nutritional status and is prognostic for postoperative complications (Table 1).

3.2.2. Prehabilitation and perioperative MNT

Approximately 80% of surgeons agreed/strongly agreed that patients need adequate preoperative physiological reserves to meet the demands of surgery, optimizing the nutritional status is an important goal during prehabilitation, and early interaction

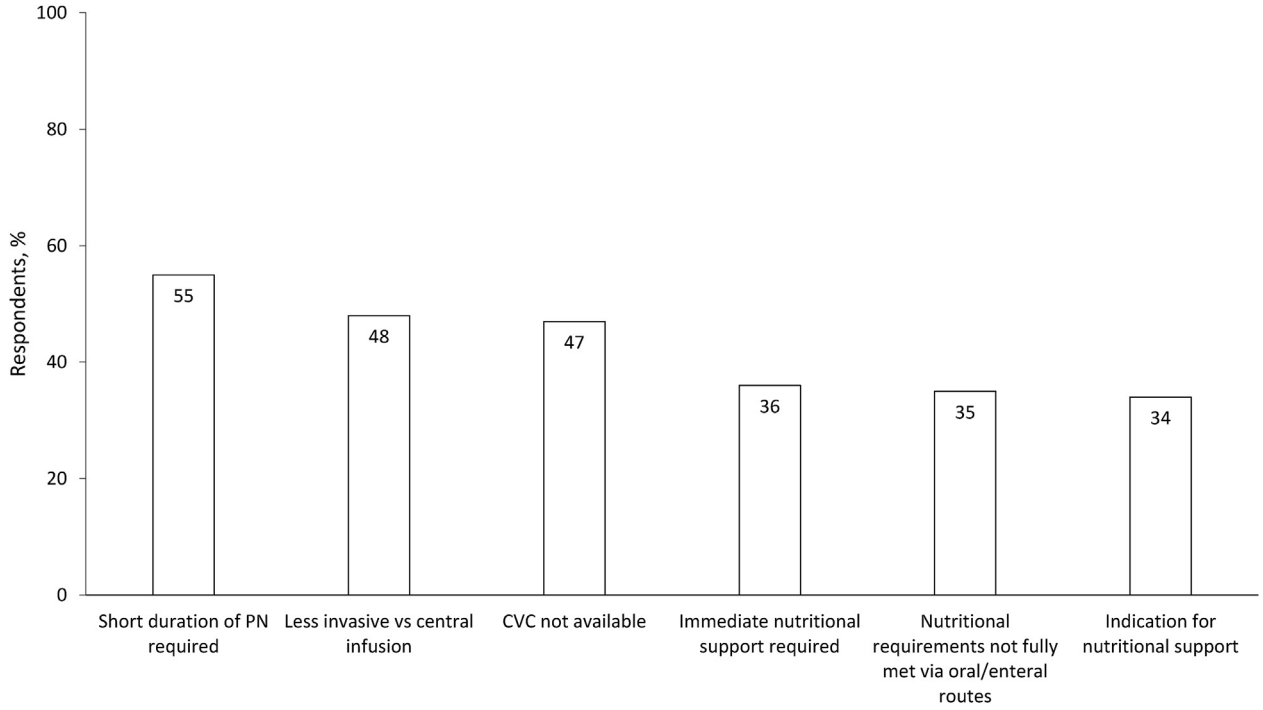

Fig. 2. Scenarios in which GI surgeons (N = 130) use PPN in their clinical practice. CVC, central venous catheter; GI, gastrointestinal; PN, parenteral nutrition; PPN, peripheral parenteral nutrition.

between physicians and patients is needed to ensure patients are fit for surgery. There was also wide agreement (81%) that prehabilitation can have both short-term and long-term clinical benefits (Table 1).

Most surgeons agreed/strongly agreed that nutritional intervention should start early i.e., when surgery is planned, involve the patient in treatment decisions and extend through the perioperative and postoperative periods (86%), and that provision of nutritional therapy is optimized by involvement of a multidisciplinary team (83%). There was also agreement that patients should receive immediate supplementary PPN for up to 14 days as an adjunct to insufficient oral or EN in order to meet nutritional goals (70%), to close nutritional gaps (74%), and if a CVC is not available (64%, Table 1).

There was concordance among the respondents that poor nutritional status increases the risk of impaired wound healing (agreed or strongly agreed: 92%), postoperative complications (88%), prolonged hospitalization (91%), and more frequent hospital readmissions (88%). Furthermore, most respondents (agreed or strongly agreed: 84%) considered nutrition therapy important in reducing the catabolic impact of the surgical stress response and promoting postoperative recovery, and that some surgeries can impair the ability to receive oral nutrition during the early postoperative period contributing to physiological insufficiency and metabolic risk (89%). Most surgeons also agreed or strongly agreed that PPN can bridge the nutritional gap if patients cannot receive adequate oral intake/EN during the postoperative period (81%).

3.2.3. PPN and ERAS

Most surgeons agreed/strongly agreed (84%) that implementing enhanced recovery recommendations reduces nutritional risk and helps to optimize patient outcomes. A high level of agreement was also seen with PPN being aligned with the ERAS concept of using minimally invasive approaches where possible (69%), which benefits selected patient populations (e.g., those in a catabolic state, malnourished or at high nutritional risk) when oral intake/EN is insufficient (71%) (Table 1). Approximately 80% of surgeons agreed/strongly agreed with case examples of high nutritional risk patients who may benefit from PPN. These included patients receiving neoadjuvant radio/chemotherapy for oesophageal cancer; pancreatic cancer patients with altered glucose homeostasis, abdominal pain, and vomiting; patients with dysphagia and low physiological reserves undergoing major upper GI surgery; and patients anticipated to experience delayed gastric emptying or paralytic ileus following gastrectomy (Fig. 4).

3.2.4. Unmet needs regarding PN and PPN

When asked how the delivery of PPN can be better supported, most surgeons agreed/strongly agreed that implementing a nutrition support team (79%), increasing the number of personnel trained to deliver PPN (78%), increasing awareness of patient eligibility for PPN (81%), and inclusion of PPN in clinical guideline/protocol guidelines (79%) were important considerations (Fig. 5). Indeed, two-thirds (65%) of respondents indicated that current guidelines/protocols provide insufficient direction on the use of PPN during routine clinical practice. Most surgeons also agreed that catheter-related infections can be minimized by implementing catheter care protocols and providing HCPs with appropriate training (84%), and that products with low osmolarity can improve venous tolerability (77%). Suggestions to support the delivery of centrally administered PN during routine clinical practice was very similar (see Supplementary Fig. 2).

4. Discussion

This survey-based study provides insight into clinical practices and perceptions of surgeons in Europe (N = 130; 5 countries) regarding MNT for patients undergoing major GI surgery. High catabolic risk due to underlying disease and a short-term impact of

Hours post surgery	Surgeons (N=130) reporting PN initiation timing, %					
	Total	France	Germany	Italy	Poland	Spain
Total PN: centrally delivered						
<24 h	38	27	27	58	54	23
24–48 h	45	54	35	31	42	62
49–72 h	15	15	31	12	0	15
>72 h	2	4	8	0	0	0
Other	1	0	0	0	4	0
Supplemental PN: centrally delivered						
<24 h	26	15	27	35	31	23
24–48 h	44	54	35	46	35	50
49–72 h	21	15	27	15	19	27
>72 h	8	15	12	4	8	0
Other	2	0	0	0	8	0
Total PPN						
<24 h	29	15	23	35	46	27
24–48 h	38	38	38	38	42	35
49–72 h	25	31	23	23	12	38
>72 h	5	12	12	4	0	0
Other	2	4	4	0	0	0
Supplemental PPN						
<24 h	27	12	23	38	31	31
24–48 h	42	46	35	38	46	46
49–72 h	23	35	31	23	8	19
>72 h	5	4	8	0	8	4
Other	3	4	4	0	8	0

Fig. 3. Timing for initiating centrally delivered PN and PPN after surgery. PN, parenteral nutrition; PPN, peripheral parenteral nutrition.

surgical procedures may affect the ability of these patients to obtain adequate perioperative nutrition via oral and/or enteral routes.

Multidisciplinary NSTs were established at the centres of 72% of respondents. Except for Poland (where surgeons had a particularly dominant role), surgeons, dieticians/nutritionists, nurses, and anaesthesiologists were frequently involved in MNT discussions and treatment decisions for patients undergoing major GI surgery. These findings are supported by a survey of HCPs in Spain (GI cancer specialists: 41%) in which a variety of specialties conducted nutritional screening of advanced cancer patients, most frequently from nutrition (52.3%), medical oncology (50%), and radiotherapy (45.5%) departments [22]. However, the quality of nutritional care was rated as medium–low by 67.3% of respondents, due in part to infrequent presence of a NST and late/absent MNT [22]. Multidisciplinary care, combining the specialist skills of different HCPs, is best placed to optimize perioperative nutrition support [18,23]. The findings from this study indicate there is a lack of multidisciplinary NSTs across several countries in Europe, particularly in Poland.

Monitoring nutritional status prior to surgery and perioperatively enables prompt detection and management of poor nutritional status. While ICD and DRG codes to verify a diagnosis of malnutrition were used less frequently by surgeons in Poland compared with the other countries surveyed, this likely reflects reimbursement differences (in Poland, malnutrition is reimbursed as a primary diagnosis, otherwise malnutrition is recorded as a comorbidity). Screening for nutritional risk prior to surgery was common practice (ranging from 62% of respondents in Italy to 96% in Poland), however, postoperative nutritional screening was less frequent (19%–54% of respondents). In contrast, ESPEN guidelines recommend nutritional status assessment before and after major surgery, and in every patient undergoing cancer-related surgery, the most frequent reason for GI surgery in this survey [6,24]. Underutilization of nutritional screening has been reported in other surgeon surveys [25,26]. For example, many general surgeons in Turkey only conducted nutritional screening in patients who looked malnourished (41.1%), with just 24.6% screening all individuals [27]. Our survey revealed anthropometric (72%) and standard screening tools (72%) as the predominant nutritional screening approaches used. GLIM criteria, based on global expert consensus on diagnostic criteria for malnutrition, was used by only 15% of respondents [28,29]. Together, these findings underscore the need for improved nutritional screening for major GI surgery patients, particularly following surgery, and standardization of nutritional risk screening approaches to ensure all patients who may benefit from MNT are identified promptly.

Nutritional prehabilitation (supplementing nutritional intake to improve physical reserves prior to surgery in order to improve postoperative outcomes) helps ensure patients at nutritional risk can withstand the stresses of surgery. While oral supplementation is the mainstay of nutritional prehabilitation, short-term PN

Table 1
Surgeon perceptions regarding nutritional status and nutritional care of patients undergoing major GI surgery.

	Surgeon (N = 130) responses[a], %			
	Disagree	Neutral	Agree	Strongly agree
Nutritional status				
Major surgery represents a significant trauma to patients, eliciting the release of stress hormones and inflammatory mediators which result in the catabolism of glycogen, protein, and lipid to facilitate healing	0	21	49	30
Impaired nutritional status during the preoperative, postoperative or rehabilitation period is a strong independent predictor of adverse postoperative outcomes	0	16	46	38
Preoperative serum albumin is a prognostic factor for complications after surgery and is also associated with impaired nutritional status	1	19	62	18
Prehabilitation and preoperative care				
Patients require adequate preoperative physiological reserves to meet the demands of the surgical stress response	0	21	53	26
Optimizing patient nutritional status is an important goal during prehabilitation	0	15	55	30
Early interaction with patients prior to surgery improves patient care to ensure individuals are fit for surgery	0	17	55	28
Multimodal prehabilitation can benefit short-term and long-term clinical outcomes for many patients	0	19	59	22
Perioperative care				
Nutritional care should start at planning for surgery to ensure early patient involvement, and extend into the perioperative and postoperative periods	0	14	57	29
A multidisciplinary group of HCPs caring for patients during the perioperative period is best placed to optimize the provision of nutritional therapy	1	16	55	28
Patients should receive PPN for up to 14 days:				
When a CVC is not available	4	32	49	15
To provide immediate nutritional support if nutritional targets cannot be met by oral or enteral routes	2	28	56	14
To close nutritional gaps	3	23	62	12
Postoperative care and rehabilitation				
Poor nutritional status increases the risk of:				
Postoperative complications	0	12	38	50
Impaired wound healing	0	8	46	46
Prolonged hospitalization	0	9	45	46
More frequent hospital readmissions	0	12	53	35
Nutrition therapy is an important component of patient management to reduce the catabolic impact of the surgical stress response, mitigate complications associated with poor nutritional status, and promote postoperative recovery	0	16	51	33
Some surgical procedures impair a patient's ability to receive oral nutrition during the early postoperative period, thereby contributing to physiological insufficiency and metabolic risk	0	11	56	33
Patients who experience postoperative complications and cannot be nourished adequately orally and/or enterally benefit from PPN to bridge the nutritional gap	1	18	52	29
ERAS and PPN				
Implementing enhanced recovery recommendations for perioperative nutritional support helps to optimize patient outcomes	0	16	63	21
Adherence to enhanced recovery programs, which include nutritional risk screening, preoperative carbohydrate loading and early postoperative feeding, significantly reduce nutritional risk	0	16	69	15
PPN does not require a central access route, lessening invasive procedures and can benefit selected patients who are in a catabolic state, malnourished or at nutritional/metabolic risk when enteral or oral nutrition is insufficient or contraindicated	2	27	56	15
Use of a peripheral catheter to deliver PPN is aligned with the concept of enhanced recovery pathways which advocate less invasive interventions (versus central PN) where possible	2	29	57	12

CVC, central venous catheter; HCP, healthcare provider; PN, parenteral nutrition; PPN, peripheral parenteral nutrition.
[a] Strongly agree = 9, agree = 7–8, neutral = 4–6, disagree = 1–3 on 9-point Likert scale (1 = 'strongly disagree' to 9 = 'strongly agree').

(potentially provided in an outpatient setting or at home if longer-term support is required) is warranted for malnourished patients in whom adequate EN is not feasible [11,12,15]. Indeed, preoperative PN, to supplement inadequate oral and EN, and replenish energy, protein, micronutrient, and glycogen stores, has been shown to reduce postoperative complications and length of hospital stay [30]. In this survey, enteral insufficiency was the most common reason GI surgeons prescribed PN (83%), and most would initiate total or supplemental PN within 48 h post surgery. Using PN to close nutritional deficits aligns with ESPEN and ERAS guidelines [6,12,13]. These guidelines advocate PN for patients in whom oral or

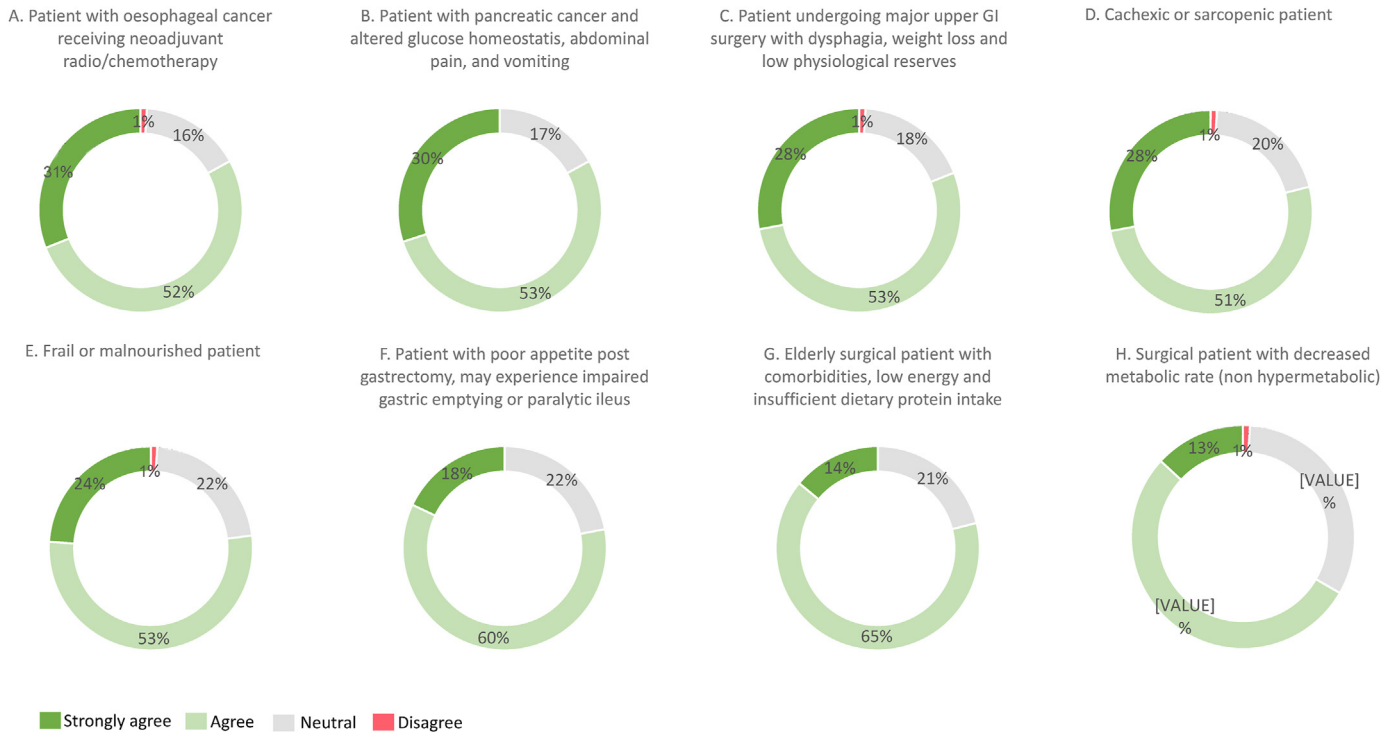

Fig. 4. Surgeon perceptions of potential patients at nutritional risk who may benefit from PPN. GI, gastrointestinal; PPN, peripheral parenteral nutrition. Strongly agree = 9; Agree = 7–8, neutral = 4–6, disagree = 1–3 on 9-point Likert scale (1 = 'strongly disagree' to 9 = 'strongly agree').

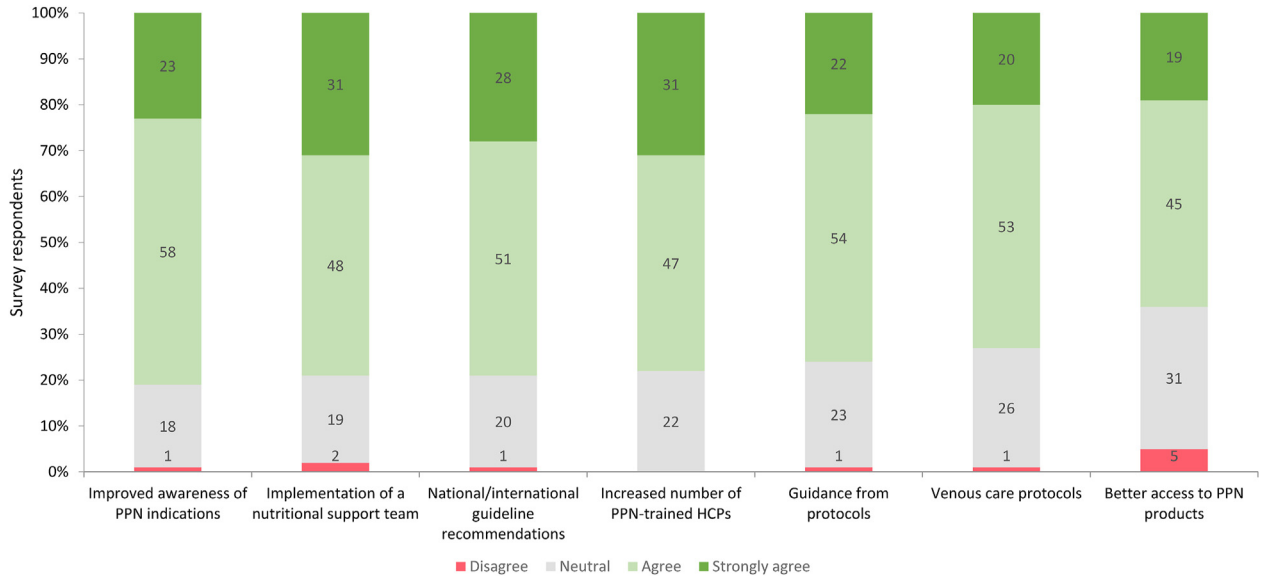

Fig. 5. Opportunities to improve the delivery of PPN for GI surgery patients. GI, gastrointestinal; HCP, healthcare professional; PPN, peripheral parenteral nutrition, Strongly agree = 9; Agree = 7–8, neutral = 4–6, disagree = 1–3 on 9-point Likert scale (1 = 'strongly disagree' to 9 = 'strongly agree').

EN therapy is insufficient or unfeasible, and state PN should be initiated without delay when EN is contraindicated [6,12,13]. However, only 56% of surgeons in this study indicated they would prescribe PN to patients requiring MNT in whom EN is unfeasible, suggesting PN may currently be underutilized.

Most surgeons recognized the importance of adequate perioperative nutritional status in optimizing patient outcomes. There was strong acknowledgement that malnutrition and the catabolic impact of the surgical stress response negatively impact postoperative recovery, as has been reported in observational studies of patients undergoing major GI surgery [3,4,31]. The surgeons also agreed that the preoperative phase provides an important window to ensure patients are fit to undergo surgery, with optimizing nutritional status being key to reducing risks associated with the surgical stress response. Nutritional prehabilitation to avoid malnutrition and support anabolism prior to surgery is aligned with the tenets of ERAS [19,32,33]. Preoperative PN has utility when oral nutritional support is not feasible which may, for

example, include individuals with intestinal obstruction [32]. The surgeons also agreed that MNT should extend throughout the perioperative and postoperative phases, if required. Together, these perceptions align with ERAS recommendations, which advocate nutritional prehabilitation and perioperative nutritional support, focussed on oral supplements and EN, for malnourished GI surgery patients to promote postoperative recovery and optimize outcomes [11–15,17]. Indeed, the benefits of ERAS perioperative nutritional support recommendations were demonstrated in a study of colorectal surgery patients: nutritional risk screening and providing MNT per ERAS guidance reduced the length of hospital stay and improved mobilization and activities of daily living, while poor compliance with ERAS nutritional recommendations was associated with postoperative complications and greater 30-day mortality [34]. Studies in other major GI surgery settings are needed to further inform the impact of providing MNT in accordance with ERAS guidance on patient outcomes. Nevertheless, studies to date point to a need for greater awareness and practical guidance on how to identify patients at nutritional risk, and provide nutritional prehabilitation and perioperative nutritional support, to address malnutrition as a modifiable risk factor for poor postoperative outcomes [35,36].

When oral and EN support is insufficient, PPN – which does not require insertion of a central line – facilitates timely MNT in patients who are catabolic or at nutritional/metabolic risk, thereby bridging the nutritional gap [18]. This aligns with the ERAS concept of using minimally invasive approaches where possible [18]. Over two-thirds of surgeons (71%) agreed PPN provides less invasive MNT versus centrally delivered PN and benefits selected patients when oral/EN is insufficient. However, only 35% of surgeons used PPN in this scenario. Similarly, fewer than half of surgeons utilized PPN when a CVC is not available (47%), and when immediate MNT is required (36%), further suggesting many patients who may benefit from PPN do not receive it. These observations are aligned with a study in France, Germany, and Italy which concluded current MNT practices for cancer patients might not support optimal therapeutic outcomes, and greater awareness of MNT is needed [37].

Most surgeons indicated improved awareness of PPN indications (81%) and including PPN in clinical guidelines (79%) would better support HCPs to deliver PPN. PPN is currently lacking in ERAS guidelines on the care of GI surgical patients, with the few recommendations on PN not specifying central or peripheral delivery [18]. The need for major GI surgery nutritional care protocols highlighted by this study aligns with a survey of US GI oncology surgeons (PN was used by only 22%) which found most respondents (81%) believed a standardized protocol would greatly improve nutritional practices [25]. Other surveys also indicate surgeons and medical oncologists often lack expertise regarding MNT, including PPN [38–40]. While an algorithm to identify patients at nutritional risk and deliver PPN within the context of ERAS has been proposed, guidelines to identify GI surgery patients in nutritional need and inform appropriate MNT are required [18]. Other opportunities identified to facilitate perioperative care included increased numbers of HCPs trained in PPN provision. This, in part, reflects an Italian survey of oesophageal surgery specialists, in which insufficient numbers of nurses and physical therapists, and opposing attitudes were among the barriers to ERAS protocol implementation [41].

While this survey was designed for GI surgeons, adaptation for other HCPs could provide wider insight into nutritional support practices, perceptions, and unmet needs. Other limitations of our study include the limited number of GI surgeons (n = 26) in each country; while the surveys analysed reflected broad geographical locations within each country, the individual practices and perceptions reported may not fully reflect national viewpoints and precluded comparison of nutritional care practices across settings (e.g. general hospitals versus specialised oncology centres). Indeed, having an average of ≥10 patients receiving PN per month was an inclusion criterium for this survey, in order to assess insights on MNT from surgeons with appropriate experience; it is possible that the surgeons in this survey may be more supportive of PN than a wider population. Moreover, more detailed insight into the MNT expertise of each participant was not available and may have impacted the survey findings. The information reported was subjective and may have been affected by recall imprecision. Furthermore, definitions of malnutrition may have varied across centres, and nutritional risk considerations may not include underlying disease or impact of neoadjuvant treatment [42,43]. Finally, responses were based on clinical practice outside the impact of COVID-19 on clinical practice [44].

In conclusion, PN-experienced GI surgeons recognize the importance of perioperative nutritional status and MNT in optimizing patient outcomes. They perceive PPN as a favourable strategy to provide timely nutritional support in selected patients undergoing major GI surgery. However, from this clinical practice survey, it seems PPN is underutilized in nutritional care. This survey suggests there are barriers to the provision of MNT for patients undergoing major GI surgery, and a need to improve access to PPN for malnourished patients and those at nutritional/metabolic risk. While there are guidelines for perioperative MNT and studies demonstrate its positive impact on surgical outcomes, practical guidance on the use of PPN in this setting may help inform MNT decisions. These findings may open dialogue to enhance the current nutritional practices.

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Author contribution

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Declaration of competing interest

All authors report no conflicts of interest in relation to the submitted work.

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Appendix A. Supplementary data

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