Impact of preoperative nutritional support on patients with gastric cancer surgery

Abou-Ashour H.S.[a], Ahmed Farag El Kased[a], Alaa Abdel-Azeem Elsisi[a], Eman Abdelrazek[b], Fatma I. Youssef[a], Mahmoud Ahmed Shahin[a]

Departments of, [a]General Surgery, [b]Medical Oncology, Menoufia University, Menoufia, [c]Department of Medical Nutrition, Tanta University, Tanta, Egypt

Correspondence to Abou-Ashour H. Hady Saleh, MD, MRCS, Associate Professor of General Surgery, General and Gastrointestinal Surgery, Department of General Surgery, Menoufia Faculty of Medicine, Menoufia University Hospital, Menoufia 32951, Egypt.
e-mail: drhadyabouashour@gmail.com

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Background
Gastric cancer is the fifth most common cancer and the fourth leading cause of cancer deaths worldwide. Optimizations of the nutritional and metabolic condition before major surgeries seemed to result in better operative outcome, and it is progressively believed to be a significant portion of decreasing postoperative surgical complications.
Aim and objectives
The current work aimed to assess the impact of preoperative nutritional support on operative and postoperative complications in patients with gastric cancer surgery.
Patients and methods
This was a prospective randomized study in Menoufia University Hospital, General Surgery Department. It was conducted from December 2016 to August 2021. It was accomplished on 80 cases, who were proved to have gastric cancer and planned for surgery and were malnourished or at risk of malnutrition. Participants were allocated randomly into two equal groups. Group A (40 patients) were those who underwent ordinary preoperative evaluation as regards fitness for anesthesia in addition to nutritional screening and support and group B included those who were fit for anesthesia according to the ordinary institution standards.
Results
A highly significant difference was found among the study groups as regards ICU admission, time for bowel movement, length of hospital stay, wound healing, and wound infection, *P* value less than 0.001. A significant difference was also found among the study groups as regards anastomotic leak and mortality, *P* value less than 0.05.
Conclusion
The operative and postoperative complications in gastric cancer patients were significantly lesser in those who underwent nutritional screening and support among the malnourished patients.

Keywords:
gastric cancer, malnutrition, nutrition in cancer patients, postgastrectomy complications

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Introduction

Gastric cancer is the fifth most common cancer and the fourth leading cause of cancer deaths worldwide [1].

Since gastric cancer surgery is one of the high-risk major procedures for nutritional derangement, the benefit from nutrition therapy has been documented in the field of gastric cancer surgery [2].

Drug toxicity, insufficient food intakes, decrease of physical functions, depression, and mechanical obstruction put cancer patients at high risk of malnutrition [3,4]. Various factors such as gastrointestinal tract obstruction, anorexia, oral ulcer, and chemotherapeutic agents can decrease dietary intake in patients with gastric cancer.

Malnutrition is defined as a clinical condition resulting from the lack of nutrient intake/assimilation, leading to weight loss and/or altered body composition and impaired clinical outcome [Global Leadership Initiative on Malnutrition (GLIM) 2018]. It was valued that from 20% up to greater than 70% of cancer cases universally suffer from malnutrition, and the percent varies between different types of tumors and cases' ages [5].

Gastric cancer is frequently associated with pain, nutritional restrictions, malabsorption, and chronic

bleeding owing to its invasive, repressive, and metastatic features. Consequently, most cases with newly discovered gastric cancers have poor nutritional status [6].

Malnutrition, in turn, deeply affects treatment outcomes: it reduces overall survival, disease-free survival, treatment tolerance, and increases the frequency and severity of postoperative surgical complications and treatment-related adverse events [7].

It is a vicious circle: cancer increases the risk of malnutrition, whereas malnutrition enhances the risk of treatment side effects, possibly resulting in treatment discontinuation with poorer outcomes [8].

The present study assesses the impact of preoperative nutritional support to malnourished gastric cancer patients on operative and postoperative complications.

Patients and methods

This was a prospective randomized study, which was accomplished on 80 patients with gastric cancer and planned for surgery in the Menoufia University Hospitals from December 2016 to August 2021.

The study was approved by the Institution Review Board. The closed envelope method was used for randomization. Participants have been allocated randomly into two equal groups: 40 patients each; group A were cases who underwent nutritional monitoring and support for 10–15 days. Group B: patients who underwent conventional preoperative assessment and considered fit for anesthesia.

Aim and objectives

The current work aimed to assess the impact of preoperative nutritional support on the surgical outcomes as regards complications in the malnourished or at risk of malnutrition with gastric cancer, who were planned for surgery and to report any difference between those who received nutritional support and those who did not.

Informed written consent was attained from all patients to be enrolled in this work.

Case characteristics such as sex, age, socioeconomic status, tumor type, location, and stage were obtained.

(1) Both groups A and B were evaluated according to the institution standards for anesthesia and were fit for surgery.
(2) An interval of nutritional monitoring and support for 10–15 days before surgery was provided to group A.
(3) On the contrary, group B was evaluated according to the standard institution preoperative evaluation for anesthesia.

Nutritional screening of patients was performed as follows:

Measurements were made of anthropometrics, such as weight, height, and mid-upper arm circumference (MUAC). The left MUAC of the cases has been determined with cutoff points of 22 and 23 cm for females and males, respectively.

The nutritional status was assessed by patient-generated subjective global assessment (PG-SGA), 24 h dietary intake before surgery, albumin, and hemoglobin blood before surgery.

(1) Serum albumin: in adults: normal: 35–50 g/l, mildly undernourished: 28–less than 35 g/l, moderately undernourished: 21–less than 28 g/l and severely undernourished: less than 21 g/l.
(2) Serum prealbumin: normal: 20–40 mg/dl, mildly undernourished: 17–less than 20 mg/dl, moderately undernourished 10–less than 17 mg/dl, and severely undernourished less than 10 mg/l.
(3) Total lymphocyte count: normal: more than 1800/mm^3, mild malnutrition: 1500–1800/mm^3, moderate malnutrition: 900–less than 1500/mm^3, and severe malnutrition: less than 900 mm^3.
(4) Hemoglobin: diagnosis as anemia when hemoglobin was less than 130 g/l in men and was less than 120 g/l in women.

The following nutritional plans were performed to group A patients:

(1) An initial screening was performed using PG-SGA, which is recommended by international guidelines of the European Society for Clinical Nutrition and Metabolism for cancer patients [7].
(2) In case of malnutrition or malnutrition risk, assessment was done.
The PG-SGA scores consisted of three sections. The first section, which was completed by the patients, comprised the following components: weight, food intake, symptoms, and activities and function. The physician completed the professional component part including metabolic stress, physical examination, nutritional requirements, and weight loss scoring. In the global assessment section, the PG-SGA scores [9] were categorized as (a) well

nourished, (b) mild/moderately malnourished, and (c) severely malnourished.

(3) Personalized nutritional intervention.
   (a) Different types of nutritional intervention were as follows:
      (1) Dietetic counseling to promote a personalized diet, with the possible integration of oral nutritional supplements (ensure intake of sufficient food and calories).
      (2) Enteral nutrition: through naso-enteral tube feeding with blended food.
      (3) Enteral nutrition with supplemented parenteral nutrition.
      (4) Parenteral nutrition (hydration, dextrose, lipids, proteins, vitamins, and minerals).
   (b) The chosen plan was related to the patient's nutritional status, the patients gastrointestinal tract symptoms, the integrity of the gastrointestinal tract, the type of surgery, the expected side effects, and the prognosis.
   (c) We aimed to provide patients with 35–45 kcal/kg/day according to the severity of malnutrition, and twice weekly reassessment was performed until the day of surgery.
   (d) We included patients who were fit for anesthesia, patients less than 65 years old, nondiabetic, operable, nonmetastatic cancer cases of gastric cancer.
      (a) All the participants had histologically confirmed diagnosis. Preoperative staging was performed with gastrointestinal endoscopy and biopsy and computed tomography abdomen. Physiological status of the patients was assessed in all patients by routine blood tests, ECG, echocardiography, and chest radiography. According to the results of preoperative staging, all patients were legible for surgical treatment except those with distant metastases or peritoneal carcinomatosis. Surgery included: total, subtotal, and distal gastrectomy according to the localization of the tumor; a Roux-en-Y anastomosis was used for reconstruction.
      (b) Gastrojejunostomy was performed for distal and subtotal gastrectomy and esophagojejunostomy for total gastrectomy. We used Roux-en-Y in reconstruction in both total, subtotal, or distal gastrectomy to avoid alkaline reflux.

Patients were followed up for 60 days after surgery for monitoring the operative and postoperative complications.

Patients were watched for:

(1) Operative time, blood loss, ICU admission, time to tolerating the first meal, time for bowel movement, ambulation tolerance time, drain removal time, wound infection, postoperative anastomotic leak, intra-abdominal collection or abscesses, time for wound healing, pancreatitis, and mortality.
(2) Systemic side-effects involved, renal, pulmonary, urinary, hepatic, cardiac, and endocrine conditions, whereas infectious side-effects have been described as pneumonia, urinary tract infections, or any surgical site infection (e.g. surface, deep, and/or organ cavity) [10].
(3) Postoperative side-effects have been classified in accordance to the Clavien–Dindo sorting system. Complications more than that of grade III were described as major side-effects that were possibly deadly [11].

Statistical analysis

Gathered data were analyzed via SPSS-22.0 (IBM Inc., Chicago, Illinois, USA). Data was judged significant at *P* value less than or equal to 0.05 and high significance at *P* value less than 0.001 and, *P* value more than 0.05 was not significant.

Results

No significant difference was found among the study groups regarding demographic data (Table 1).

A highly significant difference was found among the study groups regarding hospital stay, ICU admission, bowel movement time, and tolerating the first meal, *P* value less than 0.01. There was also significant difference between the two groups as regards anastomotic leak and mortality, *P* value less than 0.05.

A significant difference was found among the study groups as regards wound infection.

No significant difference was found between the two groups as regards the amount of blood loss, operative time, pancreatitis, or splenectomy.

(1) Complications are illustrated in Table 4.
During the screening of group A, 22 (55%) patients were found to receive less than 50% of their daily caloric requirements and 18 (40%) patients were found to receive 50–75% of their daily caloric requirements and two (5%) patients receive 75–100% of their daily requirements (Table 2).

Table 1 Comparison between the study groups as regards basic data

	Group A *N*=40)	Group B (*N*=40)	Test	*P*
Age (years)				
Range	44–65	47–65	*t*=1.510	0.133
Mean±SD	50.25±8.03	51.37±7.2		
Sex	*n* (%)	*n* (%)		
Female	11 (27.5)	16 (40)	χ^2=2.116	0.13
Male	29 (72.5)	24 (60)		
Smoking				
No	19 (47.5)	22 (55)	χ^2=0.667	0.414
Yes	21 (52.5)	18 (45)		
BMI (kg/m^2)				
Range	17.3–28.4	17.1–28	*t*=1.132	0.260
Mean±SD	22.43±3.41	21±3.15		
Pathologic staging				
I	2 (5)	3 (7.5)	*t*=1.65	0.362
II	25 (62.5)	26 (65)	*t*=1.53	0.354
III	13 (32.5)	11 (27.5)	*t*=1.286	0.237
Preoperative neoadjuvant treatment	37 (92.5)	36 (90)	*t*=1.62	0.332

t, Student's *t* testing. χ^2, χ^2 testing. *P*, *P* value for comparison among various groups.

Table 2 Nutritional intake of the daily requirement in group A

Nutritional intake/required daily nutritional requirements	*n* (%)
<50% of the daily requirements	22 (55)
50–75% of the daily requirements	16 (40)
75–100% of the daily requirements	2 (5)

Table 3 Degree of malnutrition among the two groups

	Group A	%	Group B	%	*P*
Preoperative malnourished patients in each group					
Mild	2	5	3	7.5	NS
Moderate	16	40	17	42.5	NS
Severe	22	55	20	50	NS

(2) Among group A, there were two (5%) patients with mild malnutrition and 16 (40%) patients were moderately malnourished, and 22 (55%) patients were severely malnourished (Table 3).
(3) Among group A, 11 (27.5%) patients required oral nutritional support and nine (22.5%) patients required naso-enteral tube feeding with blended food. Eight (20%) patients required total parenteral nutrition infusion in the form of hydration, dextrose, proteins, lipids, vitamins, and minerals. Twelve (30%) patients required parenteral supplementation with enteral nutrition (Table 4).
(4) One patient was inoperable in each group.

Discussion

Many surgeons may pay little attention to the preoperative nutritional status of patients with gastric cancer. A considerable number of surgeons and anesthetists only depend on the hematological and biochemical values before surgical intervention.

Table 4 Mthod of nutritional support

Type of feeding support in group A	*n* (%)
Oral nutritional support	11 (27.5)
Enteral nutrition in the form of naso-enteral feeding	9 (22.5)
Parenteral	8 (20)
Enteral nutrition with supplemented parenteral nutrition	12 (30)

A significant weight loss (above 10% of the usual weight) is considered to be an indicator of severe malnutrition, and it can be encountered in up to one-third of the newly diagnosed gastric cancer patients [12].

Weimann *et al.* [13] reported that parenteral nutrition should be considered when energy intake cannot be met due to caloric requirement through the enteral route. For severely malnourished patients, surgery should be delayed and nutritional intervention must be started immediately and continued preoperatively for at least 7–10 days. Similarly in the present study nutritional screening of group A found that 50% of them required parenteral or additional parenteral support to enteral feeding to reach the required caloric intake (Table 4). Again, Weimann aand colleagues recommended to provide parenteral nutrition and immune-modulating substrates (arginine, glutamine, ω-3 fatty acid, nucleotides, and antioxidant micronutrients) for 5–7 days in cancer patients undergoing upper major abdominal surgery.

(1) In the present study, we reported highly significant differences among the study groups as regards hospital stay, bowel movement time, time for ambulation tolerance, time to tolerate the first meal, and time for drain removal, *P* value less than 0.001. Again, there was also significant difference between the two groups such as anastomotic leak and postoperative mortality, *P* value less than 0.05.

There was no significant difference between the two groups as regards, operative time, amount of blood loss, and postoperative pancreatitis, *P* value more than 0.05 (Tables 5–7). There were two inoperable cases, one in each group.

In the current study, it is worth mentioning that despite acceptable laboratory values of routine preoperative anesthesia evaluation of group B, there was negative impact on the surgical outcome as regards the incidence and severity of complications due to lack of nutritional monitoring and support (Tables 6 and 7).

Table 5 Comparison between the study groups as regards operation data

	Group A (*N*=40) [*n* (%)]	Group B (*N*=40) [*n* (%)]	Test	*P*
Inoperable	1 (2.5)	1 (2.5)	–	–
Operative time (min)				
Range	177–278	183–286	*t*=2.236	0.2
Mean±SD	223.08±31.48	222.21±29.48		
Blood loss (ml)				
Range	120–570	200–570	*t*=3.324	0.32
Mean±SD	361.2±121.12	381.27±111.07		
Operation performed				
Total gastrectomy	21	17	–	NS
Distal gastrectomy	9	11		
Subtotal gastrectomy	9	11		
Associated splenectomy	6	8	*t*=4.322	NS
Postoperative hospital stay(days)				
Range	9–15	12–22	*t*=4.708	<0.001*
Mean±SD	10.5±2.29	14.43±1.28		
Early ambulation time (h)				
Range	24–192	48–348	*t*=4.605	<0.001*
Mean±SD	31.84±10.72	40.72±18.02		
Bowel time (h)				
Range	34–68	35–97	*t*=5.554	<0.001*
Mean±SD	49.45±9.341	61.92±17.05		
Tolerating the first meal (h)				
	72–148	72–220	*t*=4.324	<0.001*
	98±9.341	128.45±11.714		
Drain removal time	5–10 days	6–19 days	*t*=1.12	0.03*
	5±1.7	6±2.4		

t, Student's *t* testing. *P*, *P* value for comparison among various groups. *Significance at *P* value less than or equal to 0.05.

Table 6 Comparison among the study groups as regards complications and mortality

Complications	Group A (*N*=40) [*n* (%)]	Group B (*N*=40) [*n* (%)]	Test	*P*
Postoperative ICU admission	9 (22.5)	17 (42.5)	χ^2=13.03	<0.001*
Pneumonia	5 (12.5)	6 (15)	χ^2=0.498	0.480
Arrhythmia	3 (7.5)	5 (12.5)	χ^2=1.659	0.198
Wound infection	1 (2.5)	6 (15)	χ^2=4.754	0.029*
Leakage from anastomosis	1 (2.5)	4 (10)	χ^2=3.542	0.031*
Pancreatitis	1 (2.5)	1 (2.5)	–	NS
Deaths	1 (2.5)	3 (7.5)	χ^2=4.73	0.028*

χ^2, χ^2 testing. *P*, *P* value for comparison among various groups. *Significance at *P* value less than or equal to 0.05.

Table 7 Complications between the two groups according to Clavien–Dindo sorting system

	Group A	Group B	*P*
Grade I	2	7	0.026*
Grade II	3	6	0.032*
Grade III	3	11	<0.001*
Grade IV	0	3	<0.001*

χ^2, χ^2 testing. *P*, *P* value for comparison among various groups. *Significance at *P* value less than or equal to 0.05.

Frailty of patients and lack of physiological reserve due to malnutrition could be found despite suitable laboratory results.

The present study results address the strong correlation between preoperative nutritional status and operative and postoperative morbidities.

Mortensen *et al.* [14] illustrated that preoperative intake of immuno-nutrients such as amino acids and essential fatty acids reduces postoperative complications such as infection and length of hospital stay after surgery, particularly in undernourished patients.

Again, Smyth and colleagues reported that the clinical influence of malnutrition on cancer patients may have significance as regards operative resectability rates, response rates to chemotherapy, hospitalization period, and survival.

Similarly, Smyth *et al.* [15] illustrated that significant weight loss previous to surgical operation was associated with high postoperative infections due to impaired immunity as well as higher death rates.

Again, Barrea *et al.* [16] reported that nutritional support in malnourished cancer patients suppresses gluconeogenesis, cancer cachexia, and catabolism

and revealed that it positively influences the clinical outcome, tolerance to treatment, reduction of hospitalization rate, better senses of well-being, and decrease in surgical morbidities and mortalities.

Malnutrition is associated with increased morbidity and mortality after major gastric surgery, and a thorough nutritional screening of potential surgical candidates for gastrectomy should be mandatory as intervention before surgery can improve the nutritional status and surgical outcomes.

From the present study, we recommend that surgeons and residents should widen their scope of preoperative evaluation and more attention should be given to the nutritional status of gastric cancer patients.

Surgeons as well as young clinicians can easily detect features of malnutrition risk from history, prominence of facial bones, muscle wasting (temporalis muscle), prominent clavicle, rib bones, frailty, scaphoid abdomen, and decreased left MUAC (left MUAC), less than 22 and 23 cm for females and males, respectively.Also, anemia, leukopenia, and hypoalbuminemia are indicators of malnutrition. Any patient who seems to be malnourished should be nutritionally evaluated with objective measures such as the PG-SGA score and should be properly supported before surgery.

DeLegge and Drake [17] illustrated that body weight is the simplest and the most frequently used parameter in a clinical setting. A very sensitive indicator of malnutrition is unintended weight loss. More than 5% weight loss in 1 month or 10% in 6 months before hospital admission is shown to be clinically significant.

In the present study, we agreed with Son *et al.* [18] that earlier detection of nutritional risk with proper support can significantly reduce patient's morbidity and mortality after surgery. As long as there is no gold standard method, it is recommended that the most appropriate tool depending on the surgeons 's hospital is applied to all patients before surgery for nutritional assessment.

According to the Clavien–Dindo sorting system, we found that there was significant difference between groups A and B as regards minor and major complications, which in turn reflects the impact of preoperative nutritional support on reduction of postoperative complications after gastric cancer surgery (Table 7).

In the present study, we found that addressing a short interval of 2 weeks positively affects the surgical outcome and reduces postoperative complications. This interval should be concurrent with the preoperative neoadjuvant treatment or during the preoperative schedule.

The present study encourages preoperative nutritional evaluation and support among surgeons to decrease surgery-related morbidities in the malnourished gastric cancer patients.

Conclusion

Nutritional evaluation and preoperative nutritional support positively impact the surgical outcome. Healthy nutritional status was associated with less surgery-related complications; a continuous side-by-side teamwork between the surgeons and the nutrition specialist is highly encouraged to guarantee good surgical outcomes.

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Conflict of interest

There are no conflicts of interest.

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