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Preoperative Nutritional Assessment and Prognosis in Patients with Foregut Tumors

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Malnourished patients with gastrointestinal tumours are at risk for postoperative complications and death. The aim of this study was to determine which nutritional assessment method better predicts outcome. Seventy-four patients, 45 men and 29 women; mean (SD) age of 63 (102) yr (range = 34 to 83), undergoing surgical resections for esophageal ($n = 19$) gastric ($n = 43$) and pancreatic ($n = 12$) tumors were preoperatively assessed by Patient Generated Subjective Global Assessment, anthropometry, and by laboratory sampling. Forty-three (58%) of them were unnourished; 25 Subjective Global Assessment (SGA)-A, 34 SGA-B, and 15 SGA-C cases. Mean (SD) of dominant hand adductor pollicis muscle thickness (DAPM) was 13 (3.5) mm and mean (SD) serum albumin was 3.8 (0.5) g/dL. Mean (SD) hospital staying for patients who complicated and died was 34 (29) days and 23 (13) days for survivors (not significant); SGA-B cases were significantly associated with higher mortality ($n = 12$, $P<0.001$). Patients with a mean (SD) DAPM below 10.8 (3.7) mm died more frequently than those with a mean (SD) greater than 14 (3) mm ($P < 0.001$). None of the methods was significantly related to hospital stay, but receiver operating characteristic curves (95% confidence interval) for PG-SGA and DAPM thickness (0.75 and 0.74) reliably predicted mortality ($P<0.001$) and these methods may be used as preoperative parameter.

Currently, cancer has been considered as a major public health problem worldwide (1). Moreover, malnutrition and the subsequent weight loss have been known for quite long as a major cause of morbidity and mortality in cancer patients (2-5). Malnourished patients are less likely to tolerate major surgical procedures, radiotherapy and chemotherapy as do their counterparts and generally tend to have more serious complications from poor wound healing to infection and dehiscence, besides increasing length of hospital stay and decreasing survival and quality of life (4,6–8).

Malnutrition defined as a status disordered from reduced food intake or decreased metabolism (9), affects cancer patients

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often due to systemic and local tumour behaviour, psychological impairment and treatment side-effects, as well as changes in nutrient metabolism and energy expenditure at rest (4). The diagnosis of malnutrition is generally based on objective measures of nutritional status, including assessment of oral intake, weight loss, anthropometric data, cell-mediated immunity, biochemical parameters, and body composition analysis. Although these indicators are epidemiologically useful, none of them either isolated or in combination are truly predicable, often leading to a mistaken or overlooked deficiency (8,9).

The incidence of malnutrition in cancer patients ranges from 40% to 80% (6); especially in those patients with head and neck tumors, lungs or hindgut tumors such as colorectal ones or foregut ones, such as esophageal, gastric, or pancreatic cancer patients that show significant losses, increasing the risk of malnutrition by eightfold or as much as 16-fold when tumors located in the upper gastrointestinal tract (GIT) (10,11).

The nutritional assessment provides an estimate of body composition that can help to identify patients at risk for cancer-induced malnutrition and to assess the degree of nutritional depletion in those patients who are already malnourished as well. There are quite a great number of variables to indicate such nutritional status (12) and the most current used techniques and methods to assess nutrition are based on their predictive value for clinical outcome (3). Different criteria and methods, such as anthropometric, laboratorial, and subjective ones, have been widely used in a number of studies, because a universal concept of malnutrition is still lacking. All criteria or methods have limitations and can be affected by factors unrelated to nutritional status (13). The Brazilian Survey of Hospital Nutritional Assessment (IBRANUTRI) conducted with 4000 inpatients, identified malnutrition in 57% of them. In cancer patients, the rate of malnutrition was almost threefold higher, considering this disease as a risk factor (14).

By assessing the nutritional status at an early stage or correcting nutrient depletions one can attempt to reduce or virtually eliminate nutrition-related morbidity and mortality. For instance, nutritional assessment shall focus on identifying patients who have or are at risk of malnutrition, quantifying those at risk for developing nutrition-related complications and determining adequacy of nutritional support (15).

Despite the clinical relevance of malnutrition in a hospital setting, none of the techniques currently used in nutritional assessment can be considered as a gold standard, indeed. In other words, none of the available tests are reliable enough to demonstrate nutritional status exclusively, and other features, such as type and severity of disease or age at presentation may overestimate the predictive value of nutritional variables (16). Moreover, it is difficult to distinguish the effects of malnutrition from those resulting from tumor progression as well as it is still unclear which method among those ones commonly used would be more reliable, because comparative data is unavailable yet (13–16].

In addition, proper identification of those patients at high risk for postoperative complications is essential for decision-making and treatment plan, if decreasing the potential morbidity and mortality of the surgical procedures is attempted. Therefore, the aim of this study was to preoperatively assess the nutritional status by subjective, anthropometric, and laboratory sampling of patients with foregut tumors undergoing curative resection to prospectively determine which parameters, methods either isolated or combined better predict hospital staying and mortality.

PATIENTS AND METHODS

This is a prospective study, based on a convenience sample, selected in a consecutive manner and including 74 patients (45 male 29 female), mean (SD) age of 63 (10.2) yr (range = 34 to 83) who underwent resection of foregut tumors (esophageal, gastric, and pancreatic) at Santa Rita Hospital, Santa Casa de Misericórdia Centre, Porto Alegre, RS, Southern Brazil), from March 2009 to November 2010, who agreed to participate and signed written informed consent. This project was carried out by the Southern Surgical Oncology Research Group and was approved by the Institutional Review Board, under IRB #2041/08.

Patients were nutritionally assessed, by the same protocol up to 72 h of admission by the Patient Generated Subjective Global Assessment (PG-SGA), classical anthropometry including current weight and height, percentage of weight loss (%WL), body mass index (BMI), arm circumference (AC) and arm muscle circumference (AMC), triceps skinfold (TSF), the adductor pollicis muscle thicknesses on both, dominant (DAPM) and non-dominant hand and laboratory profile (NDAPM) including serum levels of albumin, erythrocytes, hemoglobin, hematocrit, leukocytes, and total lymphocyte count (TLC).

In this study, we used the PG-SGA version validated into Portuguese language, considering the 3 levels of nourishment as category A (well nourished), B (risk of malnutrition or moderate malnourished), and C (severely malnourished), and the sum of the scores was used to determine specific nutritional approaches.

To determine current weight and height, a digital scale Welmy® (Welmy Inc., São Paulo, SP, Brazil) platform type graduated in 100 g was used and the BMI was calculated to adult and elderly patients as previously reported (17,18). The usual weight as referred by patients was considered to determine the percentage of weight loss (19).

The AC was measured by a nonextendable plastic tape in the nondominant arm and TSF was measured by a Lange calliper® (Lange Co, São Paulo, SP, Brazil). These measurements were performed in triplicates and results presented as the average of the 3 measures.

The APM thickness was also measured in triplicates with the patient in the sitting position, hands lying on knees, and elbows at an angle of 90° over the homolateral lower limb, also by a Lange® calliper to pinch the adductor pollicis muscle in the vertex of an imaginary triangle formed by the extension of the thumb and index finger. All assessments were performed by the same observer (Aline Kirjner Poziomyck) after a trial training attempting to reduce biases. Serum levels of albumin and hemoglobin, hematocrit, and TLC were obtained through routine lab tests and noted from patients records.

For statistical analysis, counts and relative frequencies, as well as measures of central tendency (mean and median) and variability (standard deviation and interquartile range), were used where appropriate. To assess distribution symmetry the Kolmogorov-Smirnov test was used, and comparison of categorical data was performed by the Fisher exact test or Monte Carlo simulation for alternative outcomes when needed. In bivariate analysis, comparison of continuous variables between 2 independent groups was performed by student's *t*-test or Mann-Whitney test.

The linear relationship between parametric and nonparametric continuous variables was determined by Pearson's correlation or Spearman's test, respectively.

Receiver operating characteristic (ROC) curves to determine whether anthropometric and laboratory variables correlate to length of hospital staying or mortality were considered; and a *P* level of less than 0.05 with a 95% confidence interval was regarded as significant. Statistical analysis was performed using the SPSS 15.0 (Statistical Package for Social Sciences to Windows Inc., Chicago, IL).

RESULTS

Overall a total of 74 patients who were submitted to esophagectomy ($n = 19$), gastrectomy ($n = 43$) and Whipple ($n = 12$), were included in the study; all of them were diagnosed as AJCC 2010 pathological stage II or III.

A greater proportion of patients ($n = 43$; 58%) significantly lost more than 10% of their usual weight within 6 mo prior admission ($\chi^2 = 70.054$, $P < 0.001$). All (98%) but 1 patient needed to improve symptom management and nutritional support (score ≥9).

PG-SGA was significantly increased ($\chi^2 = 7.32$, $P = 0.026$) for SGA-B patients ($n = 34$; 46%), followed by SGA-A ($n = 25$; 34%) and SGA-C ($n = 15$; 20%). Mean BMI (SD) was 22.9 (4.4) Kg/m^2, ranging from 14.1 to 35.6 Kg/m^2. Mean (SD) TSF and AMC was 13.7 (6.6) mm and 24.1 (3.9) mm, respectively. No significant differences were observed in APM measures between dominant and nondominant hand. These subjective and anthropometric results are shown in Table 1.

The mean (SD) of serum albumin, hemoglobin, and hematocrit were 3.8 (0.5), 12.5 (1.8), and 36.6 (5.7) g/dL, respectively; and mean (SD) TLC was 1.421 (551). Table 2 depicts the median values and ranges of these laboratory samplings.

Median hospital stay was 21.5 days (1st–3rd quartile: 120 to 36.3) ranging from 4 to 130 days. Death occurred in 24 (32%) out of 74 patients, being septicemia and acute respiratory failure the most frequent causes (Table 3). Nevertheless, no significant difference between length of hospital staying and mortality was observed as shown in Table 4. In contrary, a significant difference between mortality and anthropometric or subjective

TABLE 1
Subjective and anthropometric parameters

Variables	$N = 74$ (%)
Subjective parameter PG-SGA*	
A	25 (34)
B	34 (46)
C	15 (20)
Anthropometric parameters	
%WL (6 mo) †	
Mean (DP); range	14 (13); -6.7–45.3
Median (Q_1–Q_3) ∇	12 (4.6–17.6)
Classification of%WL	
WL<10,0	31 (42)
WL≥10,0	43 (58)
Body mass index (Kg/m^2)	
Mean (SD); range	23.9 (4.4); 14.1–35.6
Triceps skinfold (mm)	
Mean (SD); range	13.7 (6.6); 3.0–30.0
Median (Q1–Q3) ∇	13.0 (8.9–18.3)
Arm muscle circumference (cm)	
Mean (SD); range	24.1 (4.3); 14.6–34.6
Median (Q_1–Q_3) ∇	23.9 (21.1–25.8)
DAPM (mm)	
Mean (SD); Range	12.9 (3.5); 4.3–22.0
Median (Q_1–Q_3) ∇	12.8 (10.9–16.0)
NDAPM (mm)	
Mean (SD); range	12.0 (3.6); 4.0–20.3
Median (Q_1–Q_3) ∇	12.0 (9.0–15.0)

Values n parentheses are percentages, except if otherwise stated; PG-SGA = Patient Generated Subjective Global Assessment;%WL = percentage of weight loss; DAPM = dominant adductor pollicis muscle; NDAPM = nondominant adductor pollicis muscle.

TABLE 2
Laboratory parameters

Laboratory	$N = 74$
Albumin (g/dL)	
Mean (SD); range	3.8 (0.5); 2.4–5.0
Median (Q_1–Q_3) ∇	3.9 (3.5–4.2)
Hemoglobin (g/dL)	
Mean (SD); range	12.5 (1.8); 6.8–16.3
Median (Q_1–Q_3) ∇	12.6 (11.9–13.4)
Hematocrit (g/dL)	
Mean (SD); range	36.6 (5.7); 11.0–48.0
Median (Q_1–Q_3) ∇	37.9 (34.7–39.8)
Total lymphocyte count (g/dL) *	
Mean (SD); range	1421 (551); 576.0–3093
Median (Q_1–Q_3) ∇	1286 (1002–1839)

Asymmetrical variables; values in parentheses are percentages, except if otherwise stated.

TABLE 3
Clinical characteristics and outcome

Variables	$N = 74$ (%)
Surgical procedures	
Esophagectomy	19 (26)
Gastrectomy	43 (58)
Whipple	12 (16)
Hospital stay (days)*	
Mean (SD)	27 (20)
Median (Q_1–Q_3) ∇; Minimum–maximum	21.5 (12–36); 4–130
Mortality	
No	50 (68)
Yes	24 (32)
Causes of death	
Acute renal failure	2 (8)
Acute respiratory failure	5 (21)
Sepsis	13 (54)
Multiple organ failure	4 (17)

*Asymmetrical values; Values in parentheses are percentages, except if otherwise stated.

assessment by PG-SGA was observed ($P < 0.001$), indicating that grade SGA-C patients are at higher risk, as compared to grade SGA-A, because all but 2 patients died.

As for APM thickness, there was also a significant difference by comparing dominant ($P < 0.001$) and nondominant hand and those who are alive or died ($P < 0.001$). For remaining anthropometric variables, no statistically significant differences were observed (Table 5) as well as for laboratory profile in relation to mortality. Despite statistical significance for albumin (3.9 vs. 3.5) other measures, such as hemoglobin (12 vs. 11.9); hematocrit (37 vs. 36), and TLC (1.473 vs. 1.312) did not differ between complicated patients who lived or died (not significant).

TABLE 4
Comparison of admission and mortality

	Death		
Length of stay	No ($n = 50$)	Yes ($n = 24$)	P
Length of stay (days)*			0.080†
Mean (SD)	23.0 (13)	34.5 (30)	
Median (Q_1–Q_3) ∇; Range	21.0 (12.0–34.0); 4–61	27 (11–46); 5–130	
Length of Stay*			0.456‡
Up to 21 days	27 (54)	10 (42)	
Over 21 days	23 (46)	14 (58)	

*Varies with asymmetrical; †Mann Whitney test; ‡Chi-square test with continuity correction; values in parentheses represent the percentage, except as otherwise stated.

TABLE 5
Subjective and anthropometric parameters in relation to mortality

	Mortality		
Parameters	No ($n = 50$)	Yes ($n = 24$)	P
Subjective parameter PG-SGA			<0.001§
A	23 (46)	2 (8)	
B	22 (44)	12 (50)	
C	5 (10)	10 (42)	
Anthropometric parameters %WL (6 Mo) *			0.023†
Mean (SD); Range	10.9 (10.6); −6.7–44.8	21.5 (20.3); 0.0–45.28	
Median (Q_1–Q_3) ∇	10.3 (3.5–15.6)	16.6 (10.3–26.2)	
Body mass index (Kg/m^2)			0.438
Mean (SD); Range	24.1 (4.0); 16.3–35.6	23.2 (5.1); 14.1–31.3	
Mean (SD); Range	25.3 (4.1); 18.3–35.6	24.3 (3.9); 17.3–31.3	
Triceps skinfold (mm) (mm)			0.548
Mean (SD); Range	13.9 (6.7); 4.0–30.0	12.9 (6.2); 3.0–24.7	
Arm muscle circumference (cm)			0.377**
Mean (SD); Range	24.4 (3.7); 17.1–34.6	23.4 (5.2); 14.6–34.5	
DAPM (mm)			<0.001**
Mean (SD); Range	13.9 (2.9); 8.0–22.0	10.8 (3.7); 4.3–17.7	
NDAPM (mm)			0.006**
Mean (SD); Range	13.5 (5.1); 6.7–41.0	10.1 (3.8); 4.0–16.7	

*Asymmetrical variables; † Mann Whitney; § Fisher's exact test by Monte Carlo simulation;

t-student test for independent groups assuming homogeneity of variance, ***t*-student test for independent groups assuming heterogeneity of variance; values in parentheses are percentages, except if otherwise stated. PG-SGA = Patient Generated Subjective Global Assessment; %WL = percentage of weight loss; DAPM = dominant adductor pollicis muscle; NDAPM = nondominant adductor pollicis muscle.

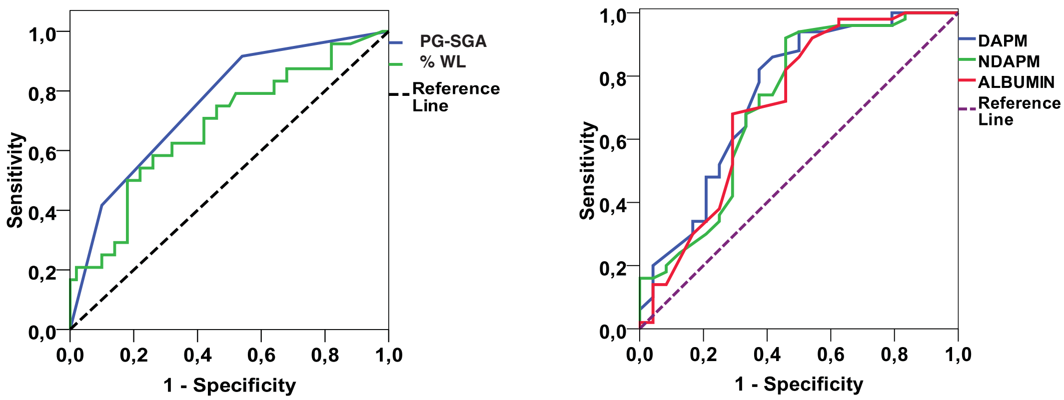

FIG. 1. Receiver operating characteristic curves of parameters predictive of mortality. PG-SGA = patient generated subjective global assessment;% WL = percentage of weight loss; DAPM = dominant hand adductor pollicis muscle thickness; NDAPM = nondominant hand adductor pollicis muscle thickness. (Color figure available online).

The AUCs for those variables predictive of mortality, PG-SGA, weight loss, APM, and albumin proved to be around 0.70 (Figure 1), appearing PG-SGA classification to be the variable with the greatest discriminating power (0.75), followed by the APM on both, dominant (0.74) and non-dominant (0.71) hand as demonstrated in Table 6.

Anthropometric and laboratory profiles were significantly correlated with hospital staying longer than 3 weeks, but weakly positive to%WL (r = 0.278, *P* = 0.016) and inversely correlated with serum albumin (r = −0.277, *P* = 0.017) as shown in Table 7. However, these 2 variables did not appear to be adequate predictors as determined by their ROC curves; 0.54 (0.41–0.67) and 0.63 (0.50–0.75), respectively (not significant; Figure 1).

TABLE 6
Receiver operating characteristic (ROC) curves and cutoffs on predictor parameters for mortality

	ROC curves–mortality		
Parameters	AUC (CI 95%)	*P*	Cutoff points
Subjective			
PG-SGA	0.75 (0.64–0.87)	0.001	B
Anthropometric			
%WL	0.68 (0.55–0.81)	0.012	≥9.66
DAPM	0.74 (0.61–0.87)	0.001	≤10.2
NDAPM	0.71 (0.57–0.85)	0.003	≤8.8
Laboratorial			
Albumin	0.71 (0.57–0.85)	0.004	≤3.5

AUC = area under the curve; PG-SGA = Patient Generated Subjective Global Assessment; %WL = percentage of weight loss; DAPM = dominant adductor pollicis muscle; NDAPM = nondominant adductor pollicis muscle.

DISCUSSION

In some multicentric studies on nutritional assessment of in-patients a reduced incidence of malnutrition as assessed by SGA has been reported (14,20). In the Brazilian study IBRANUTRI (19) and in Latin America in general, as much as 88% of patients had some degree of malnutrition as reported by Bragagnolo et al. (20). In our study, using the same methods for nutritional assessment, the percentage of malnourished patients was 66%, which seems reasonable, because most cancer patients had larger tumors at presentation. Other studies including surgical patients, malnutrition was also quite significant and accounted for an overall prevalence of 77%; being 44% and 67% of them

TABLE 7
Hospital stay and nutritional assessment

	Correlation–hospital Stay	
Parameters	R	*P*
Subjective		
PG-SGA	0.13	0.27
Anthropometric		
% of weight loss	0.28	0.016*
Body mass index	−0.09	0.44
Triceps skinfold	−0.18	0.12
Arm muscle circumference	−0.06	0.59
DAPM	−0.09	0.42
NDAPM	−0.09	0.43
Laboratorial		
Albumin	−0.27	0.017*
Hemoglobin	−0.21	0.06
Hematocrit	−0.07	0.51
Total lymphocyte count	−0.08	0.47

*Correlation significant at 5%. DAPM = dominant adductor pollicis muscle; NDAPM = nondominant adductor pollicis muscle.

malnourished on admission and at discharge, respectively (3,21). In a study on GIT tumors including 23 gastric and 6 pancreatic cancers, 40 (53%) patients lost preoperatively up to 5% of their usual weight within 3 mo. Moreover, prevalence of malnutrition was consistent with PG-SGA assessment demonstrating that 21% of the patients were severely malnourished (22).

Because the APM is a single muscle located between 2 bones, it exhibits a well-defined and easily accessible anatomical site, therefore allowing a direct and adequate thickness evaluation. However, only recently few reports have included APM thickness assessment as a parameter to determine nutritional status as suggested by Lameu et al. (23), and therefore not so many studies have compared APM thickness with other criteria for nutritional assessment (20,23–27).

The DAPM in our study is thinner than those presented by Gonzalez et al. (25), probably because surgical procedures and other treatments unrelated to GIT tumors, which accounted for only one third of the cases, were considered. It is also thinner, though closer, to the thickness of clinical patients and slightly thicker than those data found in health volunteers at a university hospital (23–26_. This difference may be also related to the admission type, either surgical or internal medicine patients, or occupation (20). Results from the APM thickness closer than those demonstrated in this study were published by Bragagnolo et al. (20), probably because their sample was similar to our sample and included more patients with major surgical procedures of GIT tumours (52%) as compared to other studies (23–27). Thinner APM in these cases may be easily explained, once tumor-related malnutrition and decreased labor activity leads to protein loss and, as a result, muscle depletion.

A significant association of APM measures with length of stay and postoperative complications, but not with mortality (probably due to a type II error), was demonstrated by Andrade and Lameu (26).

Bragagnolo et al. (20) evaluated 87 patients scheduled for major GIT procedures by SGA and APM thickness and found significantly thicker measures among well-nourished (SGA-A) patients than moderately (SGA-B) or severely malnourished (SGA-C) ones. These findings are in agreement with those reported by Gonzalez et al. (25) as well; that is, the worse the nutritional status, the lower the measures of APM thickness as shown by a negative association either for DAPM or NDAPM measures in our SGA-C patients ($r = -0.61$ and -0.60, respectively).

In patients scheduled to cardiac procedures, Andrade et al. (27) showed that preoperative weight loss, TLC, total protein, and APM thickness were all significantly associated with length of hospital staying. Unlikely, in our study only weight loss and serum albumin levels were weakly associated with length of stay, but, as expected, the greater the malnourishment the longer the staying. In that study (27), like ours, the APM thickness showed a significant inverse association with weight loss.

Furthermore, surgical patients were prospectively assessed, where most of them were classified as SGA-A, and normal grip strength was observed. However, most patients classified as SGA-B or SGA-C had also anthropometric parameters within normal range, and even patients with low BMI also had normal grip strength, indicating that general thickness measurements other than APM thickness may not reliably discriminate nutritional features indeed (21).

In a systematic review including 29 articles about cancer of the GIT, Gupta and Lis (28) advocated the potential of serum albumin as a pretreatment prognostic factor in cancer patients because it is inexpensive, reproducible, and consistent. However, among the main disadvantages, the serum albumin reading is often difficult because of factors, such as dehydration, inflammation and disease process, that do not related to nutrition and may hinder the real effect of nutrient deprivation. In addition, serum albumin levels have relatively long half-life, and therefore to evaluate changes in nutritional status over a short time is still a challenge. Moreover, though serum albumin has been described as an independent prognostic factor of survival in cancer patients in general, great differences were noted regarding study population and study design, sample size, serum level cut-offs, and adjustments for cofactors as well as avoidance of biases used in that analysis (28). Although, albumin levels below 3 g/dL were related to longer admissions, albumin fails to predict mortality (29).

The scoring system proposed by Ottery was the most sensitive among the clinical parameters, and weight loss was significantly associated with survival (29). In our study, setting the cut-off point for weight loss as 9.66 in 6 mo, there was a weak association with mortality but not with length of stay, which shows that weight loss does not allow clear definition of risk.

In a retrospective study in patients with pancreatic cancer ($n = 69$), low serum albumin levels (<3.5 g/dL) and leukocytosis were independent predictors of decreased survival in multivariate analysis (30). Nutritionally assessing patients undergoing gastric cancer resection, Pacelli et al. (31) identified similar rates of postoperative complications in patients with different degrees of weight loss, albumin levels, and BMI as in our study. However, no difference in the incidence of anastomotic leakage, higher in patients with weight loss exceeding 10%, albumin serum <3.0 g/dL, or BMI <18.5 kg/m^2 was noted (not significant).

Low levels of albumin, prealbumin, and TLC were useful preoperatively indicators for predicting risk of pulmonary complications and infections in patients undergoing resection for gastric cancer (32). In contrary, Wakahara et al. (33) evaluating 262 patients with GIT diseases (110 cancer cases) observed that the SGA was the best predictor of length of stay than serum albumin levels, skinfold thickness, or AMC similar to results obtained in our study, where albumin also proved unreliable for length of stay and has not been linked with mortality when a cut-off of less than 3.5 g/dL was used. These figures showed a weaker discriminating power than PG-SGA and DAPM, which suggests albumin as a prognostic factor for complications and mortality, rather than a proper indicator of nutritional status (34).

In addition, the length of stay for patients classified as SGA-B and SGA-C was increased twofold (CI = 1.2 to 3.2×) or fourfold (CI = 2.0 to 7.2×), respectively (35) and performance scores of the PG-SGA showed 98% sensitivity and specificity of 82% appropriately correlating to the weight loss in the past 6 mo (36). Although these studies have not demonstrated increased mortality for the malnourished, these patients had significantly higher admission period, and increased risk of postoperative complications as previously shown (3,26,28,32,36).

Also, assessing 751 Chinese patients diagnosed with GIT cancer (51% gastric cancer), Wu et al. (34) found a higher incidence of complications and longer length of stay according to the increasing level of SGA in both patients undergoing surgery or receiving chemotherapy/radiotherapy.

Although malnutrition is recognized as a worse predictor of prognosis after surgery in many studies, it is still poorly understood by many health professionals (37). The goal of nutritional assessment in cancer patients is early identification of patients at imminent risk of malnutrition as a possible predictor of survival and prognosis. There is wide variety of different methods and nutritional indices, and when isolated or combined measures for nutritional assessment and risk results are inadequate, a consensus on the best method or combination of methods to assess the nutritional status of admitted patients as a whole has not yet been established.

Therefore, it is important to develop new comparative studies between different methods and combinations of methods for nutritional assessment in different populations to elucidate which approach better demonstrates the clinical condition and nutritional risk of the patients.

The present study indicates that APM thickness and PG-SGA are reliable parameters predictive of mortality in patients undergoing resection of tumors of the upper GIT and can be easily used in daily clinical practice. Albumin and percentage of weight loss can be used as associated parameters though less reliable, indeed.

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