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Original Article

NUTRITIONAL RISK INDEX IS PREDICTOR OF POSTOPERATIVE COMPLICATIONS IN OPERATIONS OF DIGESTIVE SYSTEM OR ABDOMINAL WALL?

O índice de risco nutricional (nutritional risk index) é preditor de complicação pós-operatória em operações do aparelho digestivo ou parede abdominal?

Rubia Daniela **THIEME**[1], Gislaine **CUTCHMA**[1],
Maria Eliana Madalozzo **CHIEFERDECKER**[1], Antônio Carlos Ligocki **CAMPOS**[1,2]

From the [1]Departamento de Nutrição and [2]Departamento de Cirurgia, Setor de Ciências da Saúde, Universidade Federal do Paraná, Curitiba, PR, Brazil.

ABSTRACT – ***Background:*** Malnutrition can be considered the most common disease in hospitals due to its high prevalence. ***Aim*:** To investigate the methods of evaluation of the nutritional status that better correlate with postoperative complications and the length of hospital stay in patients submitted to gastrointestinal or abdominal wall surgeries. ***Methods*:** This is a retrospective evaluation of 215 nutritional assessment records. All were submitted to traditional anthropometry (weight, height, BMI, arm circumference, triceps skinfold thickness and mid-arm muscle circumference), subjective global assessment, serum albumin and lymphocyte count. Nutritional risk index was also calculated. ***Results*:** A total of 125 patients were included. Malnutrition was diagnosed by mid-arm muscle circumference, nutritional risk index and subjective global assessment in 46%, 88% and 66%, respectively. Severe malnutrition was found in 17,6% if considered subjective global assessment and in 42% by the nutritional risk index. Oncologic patients had a worst nutritional status according to this index (5,42 less units). There was a negative correlation between occurrence the noninfectious postoperative complications with the nutritional risk index (p=0,0016). Similarly, lower serum albumin levels were associated with higher non infectious complications (p=0,0015). The length of hospital stay was, in average, 14,24 days less in patients without complications as compared with non infectious postoperative complications (p<0,05). ***Conclusion*:** Nutritional risk index and serum albumin are the parameters with the best capacity to predict the occurrence of non infectious postoperative complications and the length of hospital stay was higher to this patients.

HEADINGS - Malnutrition. Nutrition assessment. Digestive system. Abdominal wall. Postoperative complications.

Correspondence:
Rubia Daniela Thieme
E-mail: rubiathieme@gmail.com

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RESUMO – *Racional* : Pode-se considerar a desnutrição como doença mais comum no ambiente hospitalar, devido à sua alta prevalência. ***Objetivo*:** Verificar os indicadores de estado nutricional que melhor se correlacionam com as complicações pós-operatórias e o tempo de permanência hospitalar de pacientes submetidos à operações do aparelho digestivo ou parede abdominal de médio e grande porte. ***Método*:** Estudo retrospectivo, com análise de 215 fichas de avaliação nutricional de pacientes cirúrgicos que foram submetidos à avaliação nutricional por meio de dados antropométricos (peso, altura, IMC, circunferência do braço, prega cutânea tricipital, circunferência muscular do braço), avaliação subjetiva global e dados bioquímicos (contagem total de linfócitos e albumina sérica). Em adição, posteriormente foi calculado o índice de risco nutricional. ***Resultados*:** Foram incluídos 125 indivíduos. Diagnóstico de desnutrição de acordo com circunferência muscular do braço, índice de risco nutricional e avaliação subjetiva global foi de 46%, 88% e 66%, respectivamente. A classificação como gravemente desnutridos foi de 17,6% dos pacientes de acordo com a avaliação subjetiva global, enquanto que com o índice de risco nutricional foi de 42%. Os pacientes com câncer são mais desnutridos (5,42 unidades do índice de risco nutricional a menos). Houve correlação significativa entre ocorrência de complicações pós-operatórias não infecciosas quando analisado o índice de risco nutricional, considerando que seus menores complicaram mais (p=0,0016). O mesmo resultado foi obtido para albumina sérica (p=0,0015). Os pacientes sem complicações permaneceram, em média, 14,24 dias internados a menos do que os pacientes com complicações não infecciosas (p<0,05). ***Conclusão*:** O índice de risco nutricional e a albumina sérica são os parâmetros com melhor capacidade em predizer ocorrência de complicações pós-operatórias não infecciosas.

DESCRITORES - Desnutrição. Avaliação nutricional. Sistema digestório. Parede abdominal. Complicações pós-operatórias.

INTRODUCTION

Malnutrition is considered one of most prevalent diseases in the hospital setting. Studies have indicated that 30% and 50% of hospitalized patients present some degree of malnutrition. The prevalence of malnutrition was 50.2% in the Latin American Nutrition Study (ELAN). The Brazilian National Survey on Hospital Nutritional Assessment (IBRANUTRI) indicated that 48.1% of hospitalized patients in the public healthcare system are malnourished. Severe malnutrition was reported in 12%. Of the patients with gastrointestinal disorders, more than 60% of the patients present malnutrition[11,16,18,26,28,29].

Patients submitted to digestive system surgery often present poor nutritional status related to the presence of malignancy or chronic disease, older age, lower caloric intake, malabsorption, gastrointestinal obstruction, and higher resting energy expenditure[4,9,28,29]. Surgical trauma increases the resting energy expenditure and the metabolic demand. Malnutrition risk also increases in the presence of inflammation and infection. The consequences of poor nutritional status in hospitalized patients, generally, include decreased muscle function, respiratory function, immune function and to a high rate of morbidity, such as infectious complications, postoperative complications, and slower wound healing, reoperation, increased length of stay and hospital costs, and increased mortality rates[20,27,29].

Postoperative complications are multifactorial and they frustrate the surgeon, the multidisciplinary team and the patient. Even well-nourished subjects may present post-surgical complications, mainly if they had previous disease, such as cardiac and pulmonary illness. However, the risk of complications in malnourished patients with decreased functional status has been showed to be higher. Frequently, surgeon and dietitian investigate recent body weight loss, because there is a positive correlation between body weight loss and postoperative complication[6,16,29].

Malnutrition is defined as a continuous nutritional reserve expenditure because of inadequate energy and nutrients intake to support daily metabolic requirements, or because there is a impairment in normal metabolism, such as digestion and absorption. Malnourished subjects frequently present altered body composition and metabolism and diminished biological function[8,12].

Because the nutritional status impact on postoperative clinical outcome, early recognition of malnutrition or risk to malnutrition must be investigated. Early malnutrition recognition allows to an appropriate nutritional therapy planning, which might be able to prevent, interrupt or reverse the inadequate nutritional status and to avoid post-surgical complications.[2,11,6]

Nutritional assessment should be capable to predict clinical outcome or prognosis, and, at the same time, must be low-cost and fast to perform. An adequate method for assessing the nutritional status of hospitalized subjects includes dietary intake, nutritional requirements, functional status and body composition, such as anthropometric and laboratory parameters. Among the classical parameters some should be mentioned: usual and actual body weight, percentage of recent body weight loss, height, Body Mass Index (BMI), Mid-arm Circumference, Mid-arm Muscle Mass, Triceps Skinfold Thickness, total lymphocyte count and serum albumin.[2] Subjective methods, such as Subjective Global Assessment, and other indexes, such as Nutritional Risk Index, might help in nutritional diagnosis[8,12].

The need to detect malnutrition as early as possible to allow adequate nutritional therapy justifies the search for an accurate nutritional assessment method to detect malnutrition and to predict postoperative outcome in surgical patients, such as postoperative complications and hospital length of stay.

Studies have shown that assessing a nutritional parameter alone, even a well-accepted method of nutritional assessment, such as the Subjective Global Assessment[12], might fail to determine the nutritional status accurately[6]. Researchers have been tried to detect new methods able of accurate diagnose malnutrition, a method which might be considered as a "gold-standard" for diagnosing hospital malnutrition and clinical outcome[25].

The aim the present study was to investigate the correlation between nutritional status assessed by different parameters and postoperative outcomes in patients submitted to digestive system or abdominal wall surgery.

METHODS

This is a retrospective study performed in a public teaching hospital in southern Brazil at two surgical settings. The study subjects were patients who underwent digestive system or abdominal wall surgery due to benign or malignant disease. The study included adult subjects assessed before the surgical procedure. Patient inclusion lasted from January 2010 to October 2011.

The ethics committee of Universidade Federal do Paraná, Hospital de Clínicas, approved this study (CAAE: 04125312.8.0000.0096). It was designed following the guidelines of the Declaration of Helsinki.

Baseline characteristics, clinical variables and nutritional status assessments were collected during the period that the patients remained hospitalized. For ensuring the reliability of the nutritional status assessment and data collection, dieticians were previously trained. The dieticians wrote all the information or measurements onto a data collection

sheet.

Patient aged >18 years who were admitted in surgical settings with digestive system or abdominal wall illness, either benign and malignant, who were submitted to surgery, were selected to participate if they had complete nutritional assessment prior to surgery. After to analysis inclusion criteria, 125 patient's data collection sheets were selected.

Patient data (sex, age, hospital register number) and nutritional assessment parameters were accessed. Nutritional assessment was performed with the following anthropometric indicators: body weight (usual and actual), height, Mid-arm Circumference, and Triceps Skinfold Thickness. From these measurements the body mass index (BMI), percentage of body weight loss, Mid-arm Muscle Circumference were calculated and classified according to the classic methods described in the literature. Patient who could not stand up had height estimated by validated equations[20]. Other nutritional status indicators (Subjective Global Assessment, Serum Albumin, and Total Lymphocytes Count. Nutritional Risk Index) was then calculated.

Clinical diagnosis (presence of malignancy, indication for surgery) operation, hospital length of stay, 30-day postoperative outcome, and 30-day mortality rate, were collected from medical records. Postoperative complications were considered as any abnormal result after operation, both infectious and non-infectious complications after surgery. Infectious complication included wound complication, Intra-abdominal fluid collection/abscess, anastomosis leakage, fistulas, cholangitis, pneumonia, urinary tract infection, bacteremia and sepsis. Chronic disease exacerbation, bleeding, intestinal obstruction, ileus, anastomosis stenosis, endocrine complications, neurovascular disorders, pulmonary atelectasis, organs failure (pulmonary, renal, hepatic, cardiac) and reoperation were classified as non-infectious complications[10]. In patient with more than one complication, the most severe or the infectious one was considered for the analyses. All the data were collected from the computerized Hospital Information System.

Subjective global assessment

Subjective nutritional evaluation of the patients was carried out using the Subjective Global Assessment, recommended by Detsky and coworkers (1987)[12]. Subjective Global Assessment is a validated nutritional assessment tool, considered as a gold-standard method, using a range of medical factors including body weight, body weight change, dietary intake and change, gastrointestinal symptoms and functionality; along with a physical examination of sites related to subcutaneous fat and muscle mass. This method was performed by an experienced dietician previously trained in the technique. The patients were classified as A (well nourished); B (moderately or possibly malnourished); and C (severely malnourished)[12].

Anthropometric measures

Height was measured with a portable stadiometer. When height was not possible to measure, stature was calculated from knee height or arm span and estimated by validated equations.Body weight was measured with digital scales (BC 548 Ironman - Tanita®, Arlington Heights, Illinois, United States) determining body weight in kilograms to the nearest 0.1 kg (maximum load 150 kg). Patients were in light day clothing. Height and weight were used to determine body mass index (BMI)[8,25].

BMI was obtained by dividing body weight by the square of the height and classified for adults: underweight if BMI ≤18.4 kg/m^2; normal weight if 18.5 ≤BMI ≤24.9 kg/m^2; pre-obese if 25.0 ≤BMI ≤29.9 kg/m^2 and obese if BMI ≥30.0 kg/m^2.[17] For the elderly (≥60 years of age), BMI was classified: underweight if BMI ≤22 kg/m^2; normal weight if 22 <BMI <27 kg/m^2; and overweight if BMI ≥27 kg/m^2.

Subjects were asked about their history of weight change in the past six months. Percentage of weight loss over the six months before hospital admission was estimated by the equation: usual weight (kg) – actual weight (kg) x 100/usual weight (kg). Unintentional body weight loss of more than 10% was considered as evidence of malnutrition.

Mid-arm Circumference (cm) was measured with an inelastic tape, midway between the tip of the acromion and olecranon process, with the right arm hanging relaxed at the subject's side. Triceps Skinfold Thickness (mm) was measured in a vertical fold midway at the same level as the Mid-arm Circumference, on the posterior aspect of the arm, with the right arm held vertically, with Cescorf® (Porto Alegre - Brazil) skinfold caliper, which applies 10 g/mm^2 pressure to the applied surface. These values were used to calculate Mid-arm Muscle Mass (Mid-arm Muscle Mass (cm)=Mid-arm Circumference - (Triceps Skinfold Thickness (mm)X0.314). Values were compared with normal values for Triceps Skinfold Thickness and Mid-arm Circumference measurements standardized for sex and age and percentage of adequacy was calculated, considering well-nourished >90%, mild malnourished 80 - 90%, moderately malnourished 70 - 80% and <70% severely malnourished.[19]

Laboratory parameters

A fasting blood sample was obtained to measure complete blood count, serum albumin, and lymphocyte count. Total Lymphocyte Count was calculated from the total, and the differential white count was obtained by an automated analyzer. To serum albumin, normal values were considered >3.5

g/dL and depletion was considered mild between 3-3.5g/dL, moderate 2.4-2.9g/dL, and severe <2.4g/dL. Total Lymphocyte Count was considered adequate when >2000mm^3, and mild depletion between 1200-2000mm^3, moderate depletion between 800-1199mm^3, and severe depletion <800mm^3. [19,20]

Nutritional Risk Index

It was calculated by a simple equation that uses serum albumin and recent body weight loss. Nutritional Risk Index=(1.519 X serum albumin, g/L) + 0.417 X (present weight/usual weight x 100). A Nutritional Risk Index>100 indicates that the patient is not malnourished, 97.5–100 indicates mild malnourishment, 83.5-<97.5 indicates moderate malnourishment and <83.5 indicates severe malnourishment. [13,14]

Statistical analysis

The data were analyzed using the Software R 2.14.0. Descriptive statistics were expressed as mean plus minus (±) standard deviation (SD). Comparison between two categorical variables was performed with Chi-square test. ANOVA test was executed when the dependent variable or explanatory variable were categorical, using Tukey's post hoc analysis, Kruskal-Wallis, and multiple comparisons to find differences between groups. As alternative to ANOVA, Mann-Whitney test was performed. Pearson's or Spearman Correlations were used to verify the association between quantitative variables, with normal or non-normal distribution, respectively. Statistical significance was set at 95% confidence interval (considered to be significant when $p < 0.05$).

RESULTS

One hundred twenty-five subjects who underwent digestive system or abdominal wall surgery were included in the study. Patient characteristics are summarized in Table 1. The mean age for the group as a whole was 58.5±14.9 years, 49% (n=61) were older than 60 years of age and 61.6% (n=77) of patients were male. The mean BMI was 23.14±4.70Kg/m^2 (min=15.03 and max=38.57). Sixty patients reported no body weight loss six months before the interview. Among subjects who lost weight, 43.2% (n=54) lost between 0.1 and 9.9% of their usual body weight and 44% (n=55) reported higher than 10% of their usual body weight. The prevalence of malnutrition varied according to the nutritional assessment parameter (Figure 1 and Table 2).

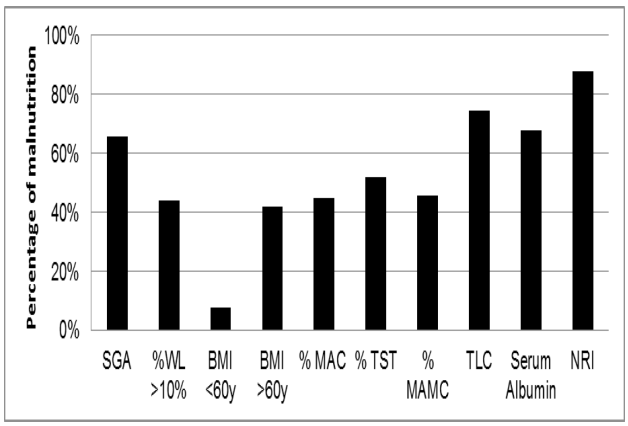
The primary clinical diagnosis was a malignant disease in 49.6% (n=62), 51.6% (n=32) were colorectal, and 37.1% (n=23) were esophageal or gastric cancer. The prevalence of malignancy was higher in elderly (59.7%). Benign diseases, higher prevalence was observed also in bowel (14.4%, n=18), biliary (12.8%, n=16) and esophagus and stomach (11.2%, n=14) (Table 1).

TABLE 1 – Demographics and clinical characteristics

Variables	Male n=77	Female n=48	Total n=125
Age (years)	58.7±15	58.1±14.9	58.5±14.9
Non-oncological disease (%) Esophagus and stomach (%) Liver (%) Biliary (%) Pancreatic (%) Bowel (%) Complicated hernias (%) Enterocutaneous fistulas (%) Biliary fistula (%)	 45.5 9.1 3.9 14.3 5.2 11.7 3.9 3.9 1.3	 58.3 14.6 2.1 10.4 2.1 14.6 6.2 2.1 0	 50.4 11.2 4.0 12.8 4.0 14.4 4.8 3.2 0.8
Oncological disease (%) Esophagus and Stomach (%) Liver (%) Biliary (%) Pancreatic (%) Bowel (%)	 54.5 20.8 5.2 1.3 1.3 28.6	 41.7 14.6 0 0 4.2 20.8	 49.6 18.4 3.0 0.8 2.0 25.6
Hypertension (%)	37.7	35.4	36.8
Diabetes mellitus (%)	22.1	14.6	19.2
Fasting glucose (mg/dl) (±SD)	107±37.6	100.5±28.5	104.5±34.4
Weight loss in six month (±SD) (%)	9.1±9.1	10.8±12.5	9.7±10.5
Total Lymphocytes Count (mm3) (±SD)	1,535±989.8	1,824.3±1,192.5	1,642.6±1,076.8
Serum Albumin (g/dL) (±SD)	3.06±0.73	3.22±0.66	3.12±0.70
Nutritional Risk Index (units) (±SD)	84±13	86.1±13.3	84.1±13.1
Postoperative complications (%) Infectious (%) Non-infectious (%) Reoperation (%)	55.9 26.0 29.9 10.4	41.7 27.1 14.6 6.3	50.4 26.4 24.0 8.8
Hospital length of stay (days) (±DP)	21.9±25.4	16.7±21.1	19.9±23.9
Mortality (%)	14.3	12.5	14.4

SD: Standard Deviation

Postoperative complications were observed in 50.4% (n=63) of the patients. Infectious complications were presented in 26.4% (n=33) of the subjects and 24% (n=30) had non-infectious complications. Fistulas were observed in 14.4% (n=18) of the patients, non-infectious pulmonary complication in 8.8% (n=11) subjects, and lower number of patients had herniation, dehiscence, wound infection, collection/abscess, sepsis, pneumonia, organs failure (cardiac insufficiency). Among patients with complications, 17.5% (n=11) needed reoperation. The mortality rate was 14.4% (n=18) (Table 1).



SGA: Subjective Global Assessment; %WL: Weight Loss in 6 month in percentage; BMI<60y: Body Mass Index to adults patients; BMI>60y: Body Mass Index to old adults patients %MAC: Mid-Arm Adequacy Percentage; %TST: Triceps Skinfold Thickness Adequacy Percentage; %MAMC: Mid-Arm Circumference Adequacy Percentage; TLC: Total Lymphocytes Count; NRI: Nutritional Risk Index.

FIGURE 1 – Prevalence and degree of malnutrition according to different nutritional assessment methods

TABLE 2 – Prevalence of malnutrition according to different nutritional assessment methods

Nutritional parameter / Nutritional status	SGA	%MAC	%TST	%MAMC	TCL	Serum Albumin	NRI
Severe malnutrition (%)	17,6%	8%	31,2%	6,4%	15,2%	15%	42%
Moderate malnutrition (%)	48%	12,8%	11%	10%	23,2%	22%	39%
Mild malnutrition (%)	*	24%	10%	30%	36%	31%	7%
Well-nourished (%)	34,4%	55,2%	48%	54%	25,6%	32%	12%

SGA: Subjective Global Assessment; %MAC: Mid-Arm Adequacy Percentage; %TST: Triceps Skinfold Thickness Adequacy Percentage; %MAMC: Mid-Arm Circumference Adequacy Percentage; TLC: Total Lymphocytes Count; NRI: Nutritional Risk Index; *: There is no mild malnutrition to this nutritional parameter

Subjective Global Assessment and Nutritional Risk Index

According to the Subjective Global Assessment, 65.6% (n=82) of the patients were malnourished, while according to the Nutritional Risk Index 88.0% (n=110) were malnourished. Severe malnutrition was diagnoses in 17.6% (n=22) and 42.4% (n=53), respectively. Subjective Global Assessment malnutrition classification was not associated to postoperative complications (p=0.6471), reoperation (p=0.4361), malignancy (p=0.3854), and 30-day mortality rate (p=0.0719). Correlation was found between low Nutritional Risk Index and non-infectious postoperative complications (p=0.0016). Patients with non-infectious complications had 9.52±6.73 units lower compared to subjects that did not present complications (p=0.001) (Table 3). However, there was no positive statistical correlation between low Nutritional Risk Index and infectious complications, reoperation and 30-day mortality rate (p>0.05). Patients with oncologic diseases had Nutritional Risk Index 5.42±3.45 units less than non-oncologic patients (82.35±11.73 and 87.25±14.0 units, respectively, p=0.016) suggesting that malnutrition was more prevalent in subjects with malignancy. Patients with oncologic illness and non-infection complications presented lower Nutritional Risk Index as compared with non-oncologic patients without postoperative complications (p=0.0053) (Table 4).

TABLE 3 – Nutritional Risk Index and Serum Albumin comparison in different postoperative outcomes

Postoperative outcome	NRI (units)	Serum albumin (g/dl)
No complications (±SD) (n=62)	88.43[a]±11.05	3.30b±0.63
Infectious complications (±SD) (n=33)	84.38±13.39	3.11±0.67
Non-infection complications (±SD) (n=30)	78.91[a]±12.76	2.77b±0.77

NRI: Nutritional Risk Index [a] Statistically Significant Difference: p=0.0016 (ANOVA, Tukey's post hoc analysis) [b] Statistically Significant Difference: p=0.0015 (ANOVA, Tukey's post hoc analysis); SD: Standard Deviation

TABLE 4 – Nutritional Risk Index in different diseases and postoperative outcomes

Disease	Nutritional Risk Index in different postoperative outcomes		
	No complications	Infectious complications	Non-infectious complications
Oncological ±SD (n)	85,84	81,29	78,99*
Non-oncological ±SD (n)	89,96*	90,57	78,82

* Statistically Significant Difference: p=0.0053 (ANOVA, Tukey's post hoc analysis); SD: Standard Deviation

Anthropometric measures

According to the BMI, malnutrition was found in 19.0% (n=12) of adult subjects and 41.9% (n=26) of the older patients. There was not statistical difference between BMI nutritional status groups and postoperative complications, both in adults (p=0.7324) and elders (p=0.4422).

The evaluation of subcutaneous muscle depletion and subcutaneous fat depletion, by the Mid-arm Muscle Mass adequacy indicated 46.4% (n=58) of malnourished patients, with 6.4% (n=8) with severe depletion, and Triceps Skinfold Thickness adequacy, 52.2% (n=65) of malnourished patients, with 31.2% (n=39) with severe malnutrition (Figure 1 and Table 2). Malnutrition as diagnosed by Mid-arm Muscle Mass and Triceps Skinfold Thickness had no statistical correlation with the presence of postoperative complications (p=0.8471 and p=0.2205, respectively).

Laboratory parameters

Laboratory mean values showed nutritional depletion (Table 1). Total Lymphocytes Count

demonstrated immunological depletion in 74.4% (n=93) of the subjects, severe in 25.6% (n=32). Low levels of serum albumin were found in 68.0% (n=85), severe depletion to 15.2% (n=19) (Figure 1 and Table 2). Total Lymphocytes Count values had no correlation with infectious postoperative complications (p=0.9105). Lower serum albumin level had a positive correlation with non-infectious complication (p=0.0015), compared with those who did not present postoperative complications (Table 3).

DISCUSSION

Many factors may affect postoperative outcome. Studies have shown that nutritional status might influence postoperative results and they suggested that malnourished subjects present more complications. Because other factors may influence postoperative outcome, as age and disease severity, studies associating nutritional status and surgical complications are important.

The results of the present study suggest greater impairment of nutritional status in patients with malignant diseases when assessed by the Nutritional Risk Index. Schiesser[28], verified high nutritional risk prevalence in subjects with cancer (40%) as compared to benign illness (8%)[25] and Pablo[23] demonstrated that patients with cancer had significantly higher body weight loss. In the present study, body weight loss six month before surgery was not significantly higher in oncologic patients, as compared to non-oncologic patients[25,28].

The Subjective Global Assessment demonstrated a high number of malnourished patients. According to the Subjective Global Assessment, 65.6% of the patients were malnourished and 17.6% of the patients were severely malnourished. This results are similar to the study by Pablo[23] that observed malnutrition in 63.3% of the patients and 8.3% of patients were classified as suffering severe malnutrition according to the Subjective Global Assessment. Ryu and Kim [25]observed malnutrition in 31% of subjects with gastric cancer submitted to surgery and the IBRANUTRI study showed 39% of malnutrition in surgical patients in Brazil according to Subjective Global Assessment[25,28].

The Nutritional Risk Index demonstrated 42% of severely malnourished subjects, a higher percentage as compared to other nutritional parameters. Pablo [23] observed severe malnutrition in 23% of the patients according to the Nutritional Risk Index.

Nutritional assessment methods, including objective and subjective parameters and screenings, might predict postoperative complications. Nutritional screenings have been able to show that postoperative complications and need for reoperation after gastrointestinal operations are more severe and frequent in malnourished patients and that nutritional therapy should be established from this diagnosis to decrease or to prevent possible complications. In the present study, patients with postoperative non-infectious complications had significantly lower Nutritional Risk Index as compared to subjects without complications. Malnutrition detected by Subjective Global Assessment did not demonstrate to be associated to postoperative complications. Pablo[23] and Almeida [1] found a low correlation between Subjective Global Assessment and Nutritional Risk Index. [21,23] In the same study, Almeida [1] suggested that the Nutritional Risk Index has a lower sensitivity and specificity to assess malnutrition risk as compared to Subjective Global Assessment.

Some postoperative complications are related to the wound healing process. According to Campos[9] , several factors affect post-surgical wound healing such as protein malnutrition, than can adversely affect wound healing. Collagen is the most abundant protein in human body and provides strength, integrity and structure. Besides protein, wound healing is stimulated by an adequate amount of energy, vitamins A, C, E and B complex, zinc, cooper, and selenium. Malnutrition influence in wound healing quality and duration and serum proteins, such as albumin, are important to this process.

Serum albumin level is necessary to calculate the Nutritional Risk Index. Oh[22] observed that 94% of the patients with gastric cancer and with wound healing complications were malnourished according to Nutritional Risk Index.[24] Serum albumin is a classic method to predict postoperative complications, hospital length of stay, morbidity and mortality, and might to be associate to nutritional status and disease severity.

Lohsiriwat[19] studied postoperative complications in surgery for rectal cancer and verified complications in 37.5% of the patients with low serum albumin and 21.3% to patients with adequate serum albumin level. [25] Similar results were obtained in the present study, regarding non-infectious complications.

Mortality is higher in subjects with lower serum albumin level[21]. Gregg [15] assessed several mortality predictors and found that serum albumin had a positive association with mortality in patients submitted to cystectomy[21]. Another study showed no association between mortality and low serum albumin level to patients submitted for surgery for esophageal cancer tratament[21].The present study found a significant association between low serum albumin and non-infectious complications.

Many studies have demonstrated lower mortality in patients with lower body weight loss, despite in some cases, as in a study with surgical patients with esophagus cancer, this was not observed[21]. Considering that to calculate the Nutritional Risk Index both serum albumin and body weight loss are needed, the Nutritional Risk Index result might overestimate malnutrition, because, albumin level might be related with disease severity and body weight loss estimation depends on subjective usual body weight value informed by the patient. Recognizing these limitations

to use Nutritional Risk Index to assess nutritional status, in the present study the Nutritional Risk Index was a satisfactory non-infectious postoperative complication predictor.

The BMI, one of most used indices to assess nutritional status in the community, demonstrated to be fragile when used in hospitalized subjects in order to evaluate the association between malnutrition and postoperative outcome, mainly because BMI seems to underestimate malnutrition in this case. Garth[14], Marin[21] and Pacelli [24] also suggested that BMI assessed in hospital admission was not correlated to postoperative complications.

Regardless which method is used to assess malnutrition, studies have shown that higher hospital length of stay is associated to impaired nutritional status and the probability of malnourished patients stay in hospital fifteen days or more is three times higher as compared to nourished subjects.[7,14,29,28]

The immunologic status, analysed by Total Lymphocytes Count was not correlated to postoperative outcomes, suggesting that this is not an adequate parameter to predict postoperative complications. A limitation of the present study is that some postoperative complications might manifest later, after hospital discharge, and these data were not evaluated.

CONCLUSION

The Nutritional Risk Index and the Serum Albumin level were the parameters with the best capacity to predict the occurrence of non-infectious postoperative complications.

REFERENCES

1. Almeida AI, Correia M, Camilo M, Ravasco P. Nutritional risk screening in surgery: valid, feasible, easy! Clin Nutr. 2012;31(2):206-11.
2. Blackburn GL, Bistrian BR, Maini BS, Schlamm HT, Smith MF. Nutritional and metabolic assessment of the hospitalized patient. J Parenter Enteral Nutr. 1977; 1(1):11-21.
3. Blackburn GL, Thornton PA. Nutritional assessment of the hospitalized patient. Med Clin North Am. 1979; 63(5):11103-15.
4. Blackburn GL. Metabolic considerations in management of surgical patients. Surg Clin N Am. 2011; 91(3):467-80.
5. Bottoni A, Oliveira GPC, Ferrini MT, Waitzberg DL. Avaliação nutricional: exames laboratoriais. In: Waitzberg, DL. Nutrição oral, enteral e parenteral na prática clínica. 3a ed. São Paulo: Atheneu; 2000. 279-294 p.
6. Bragagnolo R, Caporossi FS, Dock-Nascimento DB, Aguiliar-Nascimento JEA. Espessura do músculo adutor do polegar: um método rápido e confiável na avaliação nutricional de pacientes cirúrgicos. Rev Col Bras Cir. 2009; 36(5):371-76.
7. Burden ST, Hill J, Shaffer JL, Todd C. The British Dietetic Association. Nutritional status of preoperative colorectal cancer patients. J Hum Nutr Diet. 2010; 23(4):402–7.
8. Buzby GP, Williford WO, Peterson OL, Crosby LO, Page CP, Reinhardt GF, et al. A randomized clinical trial of total parenteral nutrition in malnourished surgical patients: the rationale and impact of previous clinical trials and pilot study on protocol design. Am J Clin Nutr. 1988; 47(Suppl 2):357-65.
9. Campos AC, Groth AK, Branco AB. Assessment and nutritional aspects of wound healing. Curr Opin Clin Nutr Metab Care. 2008;11: 281–8.
10. Chumlea WC, Roche AF, Steinbaugh ML. Estimating stature from knee height for persons 60 to 90 years of age. J Am Geriatr Soc. 1985; 33(2):116-20.
11. Correia MITD, Campos ACL. Prevalence of Hospital Malnutrition in Latin America: The Multicenter ELAN Study. Nutrition. 2003; 19(10):823-5.
12. Detsky AS, McLaughlin JR, Baker JP, Johnston N, Whittaker S, Mendelson RA, Jeejeebhoy, KN. What is subjective global assessment of nutritional status? J Parenter. Enteral Nutr. 1987; 11(1):8-13.
13. Frisancho AR. New norms of upper limb fat and muscle areas for assessment of nutritional status. Am J Clin Nutr November. 1981; 34(11): 2540-5.
14. Garth AK, Newsome CM, Simmance N, Crowe TC. The British Dietetic Association Ltd. Nutritional status, nutrition practices and post-operative complications in patients with gastrointestinal cancer. J Hum Nutr Diet. 2010; 23(4): 393–401.
15. Gregg JR, Cookson MS, Phillips S, Salem S, Chang SS, Clark PE, Davis R, Stimson Jr CJ, Aghazadeh M, Smith Jr JA, Barocas AD. Effect of preoperative nutritional deficiency on mortality after radical cystectomy for bladder cancer. J Urol. 2011; 185(1):90-6.
16. Jensen GL, Mirtillo J, Compher C, Dhaliwal R, Forbes A, Figueredo Grijalba R, Ardí G, Kondrup J, Labadarios D, Nyulasi I, Castillo Pineda JC, Waitzberg D. Adult starvation and disease-related malnutrition: A proposal for etiology – based diagnosis in the clinical practice setting from the International Consensus Guidelines Comité. JPEN 2010; 34(2):156-159.
17. Jie B, Jiang ZM, Nolan MT, Efron DT, Zhu SN, Yu K, Kondrup J. Impact of nutritional support on clinical outcome in patients at nutritional risk: A multicenter, prospective cohort study in Baltimore and Beijing teaching hospitals. Nutrition. 2010; 26(11):1088-93.
18. Leandro-Merhi VA, Aquino JLB, Chagas JFS. Risco nutricional no período pré-operatório. Arq Bras Cir Dig. 2009; 22(3):143-6.
19. Lohsiriwat V, Lohsiriwat D, Boonnuch W, Chinswangwatanakul V, Akaraviputh T, Lert-akayamanee N. Pre-operative hypoalbuminemia is a major risk factor for postoperative complications following rectal cancer surgery. World J Gastroenterol. 2008; 14(8):1248-51.
20. Mahmound MK, Merril TD. Surgical Complications. In: Sabinston, Textbook of Surgery, 18a ed. New Delhi: Elsevier; 2007. cap. 15.
21. Marin FA, Lamônica-Garcia VC, Henry MACA, Burini RC. Grade of esophageal cancer and nutritional status impact on postsurgery outcomes. Arq Gastroenterol. 2010;47(4):348-53.
22. Oh AC, Kim DH, Oh SJ, Choi MG, Noh JH, Sohn TS, Bae JM, Kim S. Nutritional risk index as a predictor of postoperative wound complications after gastrectomy. World J Gastroenterol. 2012;18(7):673-8.
23. Pablo AMR, Izaga MA, Alday LA. Assessment of nutritional status on hospital admission: nutritional scores. Eur J Clin Nutr. 2003; 57:824-31.
24. Pacelli F, Bossola M, Rosa F, Tortorelli AP, Papa V, Doglietto GB. Is malnutrition still a risk factor of postoperative complications in gastric cancer surgery? Clin Nutr. 2008; 27(3):398-407.
25. Ryu SW, Kim IH. Comparison of different nutritional assessments in detecting malnutrition among gastric cancer patients. World J Gastroenterol. 2010; 16(26):3310-17.
26. Schiesser M, Müller S, Kirchhoff P, Breitenstein S, Schäfer M, Clavien PA. Assessment of a novel screening score for nutritional risk in predicting complications in gastro-intestinal surgery. Clin Nutr. 2008; 27(4):565-70.
27. Stratton RJ, Green CJ, Elia M. Scientific criteria for defining malnutrition. In: Stratton RJ, Green CJ, Elia M. Disease-related malnutrition: an evidence based approach to treatment. Wallingford, Oxon: CABI Publishing, 2003. p. 1–34.
28. Waitzberg DL, Caiaffa WT, Correia MITD. Hospital malnutrition: the Brazilian national survey (IBRANUTRI): a study of 4000 patients. Nutrition. 2001; 17 (7):573-80.
29. Waitzberg DL, Correia MITD. Nutritional assessment in the hospitalized patient. Curr Opin Clin Nutr Metab Care. 2003; 6(5):531–38.
30. World and health organization (WHO). BMI classification. [2005?] [acesso em 2012 set 19]; Disponível em: http://www.who.int/bmi/index.jsp?introPage=intro_3.html.