DOI: 10.1590/0100-69912016003006

Reliability of nutritional assessment in patients with gastrointestinal tumors

Confiabilidade da avaliação nutricional em pacientes com tumores gastrointestinais

Aline Kirjner Poziomyck[1]; Ana Valeria Gonçalves Fruchtenicht[1]; Georgia Brum Kabke[1]; Bernardo Silveira Volkweis, ACBC-RS[1,2]; Jorge Luiz Antoniazzi[3]; Luis Fernando Moreira, TCBC-RS[1].

A B S T R A C T

Patients with gastrointestinal cancer and malnutrition are less likely to tolerate major surgical procedures, radiotherapy or chemotherapy. In general, they display a higher incidence of complications such as infection, dehiscence and sepsis, which increases the length of stay and risk of death, and reduces quality of life. The aim of this review is to discuss the pros and cons of different points of view to assess nutritional risk in patients with gastrointestinal tract (GIT) tumors and their viability, considering the current understanding and screening approaches in the field. A better combination of anthropometric, laboratory and subjective evaluations is needed in patients with GIT cancer, since malnutrition in these patients is usually much more severe than in those patients with tumors at sites other than the GIT.

Keywords: Nutrition Assessment. Gastrointestinal Tract. Malnutrition. Prognosis. Morbidity.

INTRODUCTION

Currently, cancer is a major public health problem worldwide[1]. In addition, malnutrition and subsequent weight loss have long been among the leading causes of morbidity and mortality, as well as increased costs with other organs dysfunction associated to cancer patients undergoing surgery[2]. Malnutrition is defined as the energy, protein and other specific nutrients deficient state, which significantly modifies organic functions[3].

Patients with gastrointestinal malignancy undergoing major elective procedures have a higher risk of postoperative complications and alterations resulting from their pre and post-admission nutritional status, particularly related to surgical stress, immune suppression induced by cancer or by blood transfusion. Among these factors, malnutrition is the most important due to its high prevalence and negative impact on clinical outcomes such as longer hospital stay[3] and mortality. The latter is much more related to malnutrition than cancer alone and can occur in 20% of cases[4]. Approximately half of the patients with malignancies has malnutrition, and in the case of gastrointestinal tract (GIT) tumors, the mortality rate varies from 30% to 50%, reaching 80% in cases of advanced pancreatic cancer[4,5].

Several nutritional assessment methods can be used[5], and must be sensitive enough to early identify changes according to specific nutritional imbalances. The method choice depends on the purpose of the assessment, prognosis or even on the response to nutritional interventions[2,4].

However, health professionals find it difficult to use most of the currently validated tools for nutritional assessment, due to limited time, method reproducibility, organization or cost[6-8]. Thus, all currently considered parameters show some sort of limitation to accurately assess the state nutritional[6]. In the absence of a gold standard, the option for the assessment tool and nutritional classification will depend on the institution and the target population in question, as well as on the resources available[8-10]. Although the use of indices and multivariate scores is often regarded as the solution to the lack of standardized and reliable evaluation, this is only a possibility[10].

1 - Programa de Pós-Graduação em Ciências Cirúrgicas, Faculdade de Medicina, Universidade Federal do Rio Grande do Sul (UFRGS). Porto Alegre, RS, Brasil; 2 - Serviço de Cirurgia do Hospital de Clínicas de Porto Alegre (HCPA), Porto Alegre, RS, Brasil; 3 - Faculdade de Medicina, Universidade Federal do Rio Grande do Sul (UFRGS), Porto Alegre, RS, Brasil.

Therefore, in the daily practice of oncology, the definition of an appreciable and simple to apply nutritional assessment tool is necessary to identify nutritional risk patients and thus determine the best approach and appropriate nutritional support[8]. The objective of this review is to present an overview of the methods and tools used to determine nutritional risk, considering the pros and cons when applied to patients with GIT cancer.

METHODS

We systematically identified studies on nutritional status of patients with GIT cancer through the PubMed and MEDLINE databases. We researched articles published in the last ten years by combining the terms "nutritional assessment", "GI cancer", "gastrointestinal tract", "gastric cancer", "oesophageal cancer" and "pancreatic cancer". We considered for evaluation only complete articles with those terms in English or Portuguese. We identified additional articles from citations in the articles evaluated.

RESULTS AND DISCUSSION

General review of nutritional assessment

It was in the 1950s that authors first published research related to nutritional assessment procedures. Between 1960 and 1980, malnutrition markers have emerged to evaluate surgical patients and new concepts and nutritional assessment methods have been developed[11]. In the following decades, the researchers analyzed the relevance of functional indices and combinations of clinical and laboratory parameters existing in an attempt to better predict nutritional risk. A new concept of body composition was defined from the use of new and more complex equipment and methods of assessment, but still considering subjective concepts[7]. From the beginning of this century, attempts have been made to demonstrate the nutritional assessment method that would be more accurate and reliable for certain types of patients or specific clinical conditions[3,8].

Subjective methods

In 1980, Detsky et al. described the Subjective Global Assessment (SGA) used to assess preoperative patients with GIT tumors (n = 202) undergoing major surgical procedures; They have shown that SGA could be easily applied and considered it a valid and reliable method to estimate the surgical patients' nutritional status[12].

Other authors have published several articles supporting the SGA in determining nutritional status, which differed from other methods in considering not only changes in body composition, but also functional changes. In addition, SGA is a simple, inexpensive, non-invasive method and can be performed at bedside. Correct guidance on the SGA application is essential, since its accuracy depends on the observer's ability to detect subjectively significant nutritional changes[8,13,14].

Subsequently, the SGA has undergone modifications and adaptations developed specifically to meet the oncological patient characteristics. Questions about symptoms of nutritional impact and resulting from the tumor itself or from the imposed treatment[8] were included and answered by the patient, becoming known as the Patient-generated SGA (PG-SGA). The main introduced difference was a numerical score that allows to better identify patients at nutritional risk and estimate the time required for re-evaluation.

In some multi-center studies on nutritional assessment of hospitalized patients using SGA, different results have been reported, particularly in patients with GIT cancer. Poziomyck et al. found 66% of malnourished patients in surgical cases of upper GIT tumors[8], while Bragagnolo et al. showed 77% of malnourished patients in a similar sample[15].

In another study involving 80 patients with GIT tumors, mainly colorectal, Cid Conde et al. found 50% of malnutrition by SGA[16], a result that were higher (70%) in another study with a similar sample[17].

Wu et al. had higher incidence of complications and longer hospital stay the worse the level of SGA in patients undergoing major procedures for GIT cancer (mainly gastric)[18]. These results were also supported by our series of patients with esophageal, stomach and pan-

Table 1. *Main objective and subjective methods used for nutritional assessment.*

Objective	
Anthropometrics	Body mass index, weight loss, skin-fold thickness and circumferences, adductor pollicis muscle thickness
Biochemical tests	Albumin, prealbumin, transferring, retinol-binding protein, nitrogen balance, creatinine-height index
Body composition	Bioelectrical impedance analysis
Functional tests	Hand grip strength, phase angle
Subjective	Subjective global assessment (SGA) and Patient-generated subjective global assessment (PG-SGA)

creas tumors[8]. Moreover, in patients with esophageal or stomach cancer, SGA appears to be associated with the Glasgow Prognostic score (GPS)[19]. A study comparing PG-SGA with the Mini Nutritional Assessment (MNA) revealed that these tools seem appropriate to define elderly patients as malnourished[10]. GPS and MNA concepts are described in Score Methods later in the text.

Anthropometric methods

The accuracy and reproducibility of anthropometric measurements may be affected by the equipment calibration, examiner and parameters used for the predictive equations[20]. Several essentially objective nutritional assessment tools have been used in clinical practice, each with its own characteristics[13].

Body weight is as simple and commonly used measure in clinical practice. However, it does not discriminate mass from fat, muscle, bone or extracellular fluids. Thus, it must be used with caution, since sharp alterations may reflect changes in hydration status, and not necessarily change in cell mass[21].

Renehan et al. demonstrated that increased body mass index (BMI) on the order of 5 kg/m^2 in both genders was strongly associated with esophageal adenocarcinoma[22]. Excess weight, visceral fat and abdominal obesity appears to be more disturbing than subcutaneous fat, and any further increase in BMI confers increased risk of developing colorectal cancer[19], which, however, has not been confirmed in other studies with this tool[8,15].

Functional markers are of particular importance, since they correlate well with clinical complications[20]. They may be more sensitive and relevant indicators of changes in nutritional state or response to additional support in the short term than conventional methods[8]. Loss of muscle function is indicative of malnutrition, particularly the loss of lean body mass. Usually expressed by the handgrip strength, it is important to determine the function and the ability of skeletal muscle. The authors consider this as evidence of compromised nutritional status as responsible for the loss of skeletal muscle function and, consequently, loss of

Table 2. *Advantages and disadvantages of subjective methods and nutritional assessment.*

Method	Advantage	Disadvantage
Subjective global assessment (SGA)	Simple Inexpensive Non-invasive Bedside use	Observer dependable Non-disease specific
Patient-generated subjective global assessment (PG-SGA)	Simple Inexpensive Non-invasive Bedside use Reproducible	Provides a good training for observers Unspecific to different types of cancer

Table 3. *Advantages and disadvantages of anthropometric methods.*

Method	Advantage	Disadvantage
Body Mass Index (BMI)	Simple Inexpensive Non-invasive Bedside use	Does not distinguish fat mass and lean mass Does not reflect body composition
Skinfold Thickness	Simple Inexpensive Non-invasive Bedside use	Database limited Insufficient correction factors (age, hydration status, physical activity, disease state) No standard for oncology
Bioimpedance	Simple Non-invasive Easy application / Shortly Accurate measurements	Requires several previous care (4h fasting, use of diuretics, exercise, alcohol intake)
Adductor Muscle Pollicis Thickness (APM) / Dinamometry	Simple Non-invasive Easy application/Shortly Accurate measurements	Does not evaluate the acute effects of cancer malnutrition Requires the evaluator training

handgrip strength[8,15,20]. Recently, the measurement of the thickness of the *adductor pollicis* muscle (APM) was standardized to anthropometric parameters relating to age, gender and physique[8]. APM has been used to indirectly determine the nutritional status[14,20,23], being considered as one of the best single predictors of mortality in a recent study with patients undergoing resection of upper GIT tumor[8].

The bioimpedance analysis (BIA) uses the measured phase angle, which is the result of the electric current stored in cell membranes. However, more accurate results depend on regression equations and lower values indicate reduction in cell integrity or cellular death[24].

Some authors also use weight loss as a nutritional screening marker. In a study of patients with esophageal cancer, Van der Schaaf et al. found that preoperative loss weight exceeding 10% was associated with a reduction of the overall five-year survival after resection, but not with increased risk of postoperative complications[25].

Laboratory Methods

Albumin and other proteins used as nutritional markers can be affected by many factors and clinical conditions such as inflammation, malnutrition, diabetes, liver disease or surgical trauma. But they also have been used to assess overall nutritional status, severity, progression and prognosis of the disease[26], assuming that plasma levels indeed reflect the rate of synthesis[27-29.] However, other factors such as liver function, inflammation markers and endocrine stress result in increased levels of cortisol, which also affects albumin regulation[27].

Serum albumin has also been described as an independent survival prognostic factor in many tumors, displaying an inverse relation to complications and length of postoperative hospitalization or intensive care, mortality, and resumption of oral intake[26,27]. Decreased serum albumin also proved to be an independent prognostic factor for cancer patients with unknown primary site[26], but further clinical trials are needed to better define the baseline risks in patients with cancer[26-29.]

Recently, a significant association between increased C-reactive protein (CRP) and poor clinical outcome has been demonstrated in patients with pancreatic cancer[30]. CRP has also been shown to be an independent prognostic indicator in colorectal carcinoma[31].

Score Methods

A number of studies have consistently shown that no method or tool alone is enough to predict nutritional status[3]. The mini nutritional assessment (MNA) classified as normal, borderline or malnutrition in the elderly involves anthropometric measurements, overall evaluation, dietary questionnaire and subjective evaluation[32]. A cross-sectional study with elderly patients (n = 109) observed that combined arm circumference (AC) and BMI allowed to predict the MNA classification[33]. In another study evaluating elderly patients with hepatocellular carcinoma, the results suggested that MNA was adequate to identify the risk of deterioration in the quality of life and functional status, and to determine the risk of malnutrition[23].

The Nutritional Risk Index (NRI) is calculated by the equation of serum albumin and weight ratio[3,34]; the levels of serum protein and albumin significantly correlated with malnutrition, but not with subgroups of SGA or Nutritional Risk Screening 2002 (NRS-2002)[34].

The Glasgow Prognostic Score (GPS) has been used to determine long-term outcome (survival) in cases of curable gastric cancer[34], according to the degree of inflammation inferred by the CRP and albumin levels,with scores ranging from from 0 to 2[35]. It may be useful in determining the nutritional status, since inflammation is a relevant factor in the development of cachexia, though not yet evaluated in the short term[34].

In a study with 74 patients, 54 (72%) with GIT tumors, the Nutrition Inflammatory Index (NII) was an alternative method for biochemical nutritional assessment and monitoring of patients with cancer and systemic inflammation[36,37].

The NRS-2002 is a nutritional and disease severity score, being the preferred method for evaluating patients at risk or malnourished and for selecting those that could benefit from nutritional support[3]. This nutritional screening was directly related to tumor stage in 100 newly diagnosed patients with stomach cancer, and inversely correlated with quality of life, making it a useful tool to identify patients in need of nutritional support throughout treatment[38].

Table 4. *Advantages and disadvantages of laboratory methods.*

Method	Advantage	Disadvantage
Albumin	Simple Inexpensive Independent indicator of survival in many cancers	Unreliable Affected by many factors and conditions Need better definition of baseline risk in cancer patients Reflects more on the severity of the disease than the nutritional status per se
C-Reactive Protein (CRP)	Independent prognostic indicator for some types of carcinoma Good correlation with other methods of nutritional assessment	Higher costs Alone is not cancer-specific
Pre-albumin	Sensitive stress level Good marker for visceral protein	Higher costs Non-disease specific Can be affected by non-nutritional factors (reduction in inflammation)
Retinol Binding Protein (RBP)	High sensitivity to protein and caloric restriction	Higher costs Few studies in cancer patients Potential confounder in vitamin A deficiency
Total Lymphocyte Count (TLC)	Associated with weight loss and visceral protein loss	May be affected by tumor type and use of chemotherapeutic drug

In 2011, Argiles et al. presented a new tool called "The Cachexia Score" (CASCO), which considers weight and loss of lean body mass, anorexia, inflammatory, immunologic and metabolic disorders, physical performance and quality of life. The score (up to 100) appears to be adequate, although further prospective studies are needed to better define its sensitivity and specificity in different types of cancers, including GIT tumors[39].

FINAL CONSIDERATIONS

Various methods have allowed measurements of body composition, protein and lipid reserves by traditional anthropometry with the use of more sophisticated equipment. Currently, the most accurate techniques for assessment of nutritional status are more expensive, less available and inappropriate for repetitive measures[2].

Many studies have also revealed the inadequacy of any tool or method used alone in safely predicting the nutritional status of patients with cancer, which clearly demonstrates the lack of a specific measure as the gold standard[3,8], although the real need for a specific pattern is questionable. Still, this led to the attempt to combine evaluation measures, such as anthropometric and laboratory data, in order to increase sensitivity and specificity[30], and thus to more adequately evaluate oncology and surgical patients. Overall, the assessment instruments routinely used do not consider the risk and complications of ongoing cancer treatment, such as chemotherapy and radiation, their side effects in the gastrointestinal tract or post-operative implications of the inflammatory response in cancer patients in general.

This is even more relevant when considering patients with GIT tumors, for whom there is no consensus on the best tool or method to assess nutritional status, especially those with upper GIT tumors, most severely affected by nutritional and immune deficiency, and by the effect of major surgical procedures and complications in the immediate postoperative period when compared with lower GIT tumors cases. Probably the course of nutritional depletion between the two tumor locations is very different, as are quite distinct the nutritional support requirements. Thus, attempts to develop new protocols, trials, scores or new combinations of more specific approaches are necessary to better assess the nutritional status in patients with GIT tumors, especially considering those patients with upper GIT tumors, who are more malnourished, more immunocompromised and at increased risk of morbidity and mortality, as recently demonstrated in our series[8]. To date, as far as we know, there is insufficient data to establish a consensus for this group of patients. Therefore, it would be interesting to simulate, add or combine features already validated with objective variables to test a single questionnaire specifically designed

Table 5. *Advantages and disadvantages of nutritional scores.*

Method	Advantage	Disadvantage
Glasgow Prognostic Score (GPS)	Powerful method for diagnosis of nutritional status Long-term survival in some cancer surgery	Not assessed for short-term outcomes
Reilly Nutrition Risk Score	Mix of different approaches in nutritional methods	Adults and children in the same group Different types of cancer altogether
Prognostic nutritional index (PNI)	Good and accurate	Difficult to obtain the hypersensitivity skin tests
NUTRA*	Anthropometric, Subjective and Laboratory data targeting GIT cancer patients	Ongoing trial

**Developed by SSORG (Southern Surgical Oncology Research Group)*

to better predict postoperative morbidity and mortality in patients with gastrointestinal cancer.

In summary, the GPS score, the PG-SGA and some anthropometric parameters are considered suitable for chronic and cancer patients in general. However, a better combination of laboratory, anthropometric and subjective evaluations is required, considering an instrument more focused in GIT cancer patients, since malnutrition in these patients is much more severe compared with the one in patients with tumors in other locations.

R E S U M O

Pacientes com neoplasia gastrointestinal e desnutridos são menos propensos a tolerar procedimentos cirúrgicos de grande porte, radioterapia ou quimioterapia. Em geral, apresentam maior incidência de complicações, como infecção, deiscência e sepse, o que aumenta o tempo de internação e o risco de morte, e reduz a qualidade de vida. O objetivo desta revisão é abordar os prós e contras de diferentes pontos de vista que avaliam risco nutricional em pacientes com tumores do Trato Gastrointestinal (TGI) e sua viabilidade, considerando o atual entendimento e abordagens de triagem neste campo. Melhor combinação de avaliações antropométricas, laboratoriais e subjetivas se faz necessária em pacientes com câncer do TGI, uma vez que a desnutrição nestes pacientes costuma ser muito mais grave do que naqueles indivíduos com tumores em outros sítios que não o TGI.

Descritores: *Avaliação Nutricional. Trato Gastrointestinal. Desnutrição. Prognóstico. Morbidade.*

REFERENCES

1. Bray F, Ren JS, Masuyer E, Ferlay J. Global estimates of cancer prevalence for 27 sites in the adult population in 2008. Int J Cancer. 2013;132(5):1133-45.
2. Van Cutsem E, Arends J. The causes and consequences of cancer-associated malnutrition. Eur J Oncol Nur. 2005;9 Suppl 2:S51-63.
3. Ryu SW, Kim IH. Comparison of different nutritional assessment in detecting malnutrition among gastric cancer patients. World J Gastroenterol. 2010;16(26):3310-7.
4. Sungurtekin H, Sungurtekin U, Balci C, Zencir M. Erdem E. The influence of nutritional status on complications after major intraabdominal surgery. J Am Coll Nutr. 2004;23(3):227-32.
5. Petroniau A, Alberti LR, Zac RI, Andrade Júnior JCCG. Influência do trauma cirúrgico na concentração sérica de albumina no pós-operatório imediato. Rev Col Bras Cir. 2004;31(3):194-9.
6. Ottery FD. Definition of standardized nutritional assessment and interventional pathways in oncology. Nutrition. 1996;12(1 Suppl):S15-9.
7. Barbosa-Silva MCG, Barros AJD. Avaliação nutricional subjetic a: Parte 2 - Revisão de suas adaptações e utilizações nas diverss especialidade clínicas. Arq Gastroenterol. 2002;39(4):248-52.
8. Poziomyck AK, Weston AC, Lameu EB, Cassol OS, Coelho LJ, Moreira LF. Preoperative nutritional assessment and prognosis in patients with foregut tumors. Nutr Cancer. 2012;64(8):1174-81.
9. Kyle UG, Bosaeus I, De Lorenzo AD, Deurenbergd P, Elia M, Gómez JM, et al. Bioelectrical impedance analysis--part I: review of principles and methods. Clin Nutr. 2004;23(5):1226-43.
10. Hall JC. Nutritional assessment of surgery patients. J Am Coll Surg. 2006;202(5):837-43.
11. Sando K, Okada A. History of progress in nutritional assessment. Nihon Geka Gakkai Zasshi. 1998;99(3):144-53.
12. Detsky AS, McLaughlin JR, Baker JP, Johnston N, Whittaker S, Mendelson RA, et al. What is subjective global assessment of nutritional status? JPEN J Parenter Enteral Nutr. 1987;11(1):8-13.
13. Barbosa-Silva MC, Barros AJ. Indications and limitations of the use of subjective global assessment in clinical practice: an update. Curr Opin Clin Nutr Metab Care. 2006;9(3):263-9.
14. Lameu EB, Poziomyck AK, Moreira LF, Consequences of malnutrition in the surgical patient. In: Campos ACL, editor. The Treaty of Nutrition and Metabolism in Surgery. Rio de Janeiro: Rubio; 2013. p. 55-64.
15. Bragagnolo R, Caporossi FS, Dock-Nascimento DB, Aguilar-Nascimento JE. Espessura do músculo adutor

do polegar: um método rápido e confiável na avaliação nutricional de pacients cirúrgicos. Rev Col Bras Cir. 2009;36(5):371-6.

16. Cid Conde L, Fernández López T, Neira Blanco P, Arias Delgado J, Varela Correa JJ, Gómez Lorenzo FF. Hyponutrition prevalence among patients with digestive neoplasm before surgery. Nutr Hosp. 2008;23(1):46-53.
17. Read JA, Crockett N, Volker DH, MacLennan P, Choy ST, Beale P, et al. Nutritional assessment in cancer: comparing the Mini-Nutritional Assessment (MNA) with the scored Patient-Generated Subjective Global Assessment (PGSGA). Nutr Cancer. 2005;53(1):51-6.
18. Wu BW, Yin T, Cao WX, Gu ZD, Wang XJ, Yan M, et al. Clinical application of subjective global assessment in Chinese patients with gastrintestinal cancer. World J Gastroenterol. 2009;15(28):3542-9.
19. Maurício SF, da Silva JB, Bering T, Correia MI. Relationship between nutritional status and the Glasgow Prognostic Score in patients with colorectal cancer. Nutrition. 2013;29(4):625-9.
20. Lameu EB, Gerude MF, Corrêa RC, Lima KA. Adductor policis muscle: a new anthropometric parameter. Rev Hosp Clin. 2004;59(2):57-62.
21. Barbosa-Silva MC. Subjective and objective nutritional assessment methods: what do they really assess? Curr Opin Clin Nutr Metab Care. 2008;11(3):248-54.
22. Renehan AG, Tyson M, Egger M, Heller RF, Zwahlen M. Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. Lancet. 2008;371(9612):569-78.
23. Schlüssel MM, Anjos LA, Kac G. A dinamometria manual e seu uso na avaliação nutricional. Rev Nutr. 2008;21(2):223-35.
24. Barbosa-Silva MC, Barros AJ. Bioelectrical impedance analysis in clinical practice: a new perspective on its use beyond body composition equations. Curr Opin Clin Nutr Metab Care. 2005;8(3):311-7.
25. van der Schaaf MK, Tilanus HW, van Lanschot JJ, Johar AM, Lagergren P, Lagergren J, et al. The influence of preoperative weight loss on the postoperative course after esophageal cancer resection. J Thorac Cardiovasc Surg. 2013;20(13):490-5.
26. Gupta D, Lis CG. Pretreatment serum albumin as a predictor of cancer survival: a systematic review of the epidemiological literature. Nutr J. 2010;9:69.
27. Hülshoff A, Schricker T, Elgendy H, Hatzakorzian R, Lattermann R. Albumin synthesis in surgical patients. Nutrition. 2013;29(5):703-7.
28. Gibbs J, Cull W, Henderson W, Daley J, Hur K, Khuri SF. Preoperative serum albumin level as a predictor of operative mortality and morbidity: results from the National VA Surgical Risk Study. Arch Surg. 1999;134(1):36-42.
29. Kudsk KA, Tolley EA, DeWitt RC, Janu PG, Blackwell AP, Yeary S, et al. Preoperative albumin and surgical site identify surgical risk for major postoperative complications. JPEN J Parenter Enteral Nutr. 2003;27(1):1-9.
30. Szkandera J, Stotz M, Absenger G, Stojakovic T, Samonigg H, Kornprat P, et al. Validation of C-reactive protein levels as a prognostic indicator for survival in a large cohort of pancreatic cancer patients. Br J Cancer. 2013;110(1):183-8.
31. Takasu C, Shimada M, Kurita N, Iwata T, Nishioka M, Morimoto S, et al. Impact of C-reactive protein on prognosis of patients with colorectal carcinoma. Hepatogastroenterology. 2013;60(123):507-11.
32. Guigoz Y, Vellas B, Garry PJ. Assessing the nutritional status of the elderly: The Mini Nutritional Assessment as part of the geriatric evaluation. Nutr Rev. 1996;54(1 Pt 2):S59-65.
33. Leandro-Merhi VA, Aquino JLB, Camargo JGT, Frenhani PB, Bernardi JLD, McLellan KCP. Clinical and nutritional status of surgical patients with and without malignant diseases: cross-sectional study. Arq Gastroenterol. 2011;48(1):58-61.
34. Hsu WC, Tsai AC, Chan SC, Wang PM, Chung NN. Mini-nutritional assessment predicts functional status and quality of life of patients with hepatocellular carcinoma in Taiwan. Nutr Cancer. 2012;64(4):543-9.
35. Kubota T, Hiki N, Nunobe S, Kumagai K, Aikou S, Watanabe R, et al, Significance of the inflammation-based Glasgow prognostic score for short- and long-term outcomes after curative resection of gastric cancer. J Gastrointest Surg. 2012;16(11):2037-44.

36.McMillan DC. Systemic inflammation, nutritional status and survival in patients with cancer. Curr Opin Clin Nutr Metab Care. 2009;12(3):223-6.

37.Alberici PC, Paiva OS, González MC. Association between an inflammatory-nutritional index and nutritional status in cancer patients. Nutr Hosp. 2013;28(1):188-93.

38.Gavazzi C, Colatruglio S, Sironi A, Mazzaferro V, Miceli R. Importance of early nutritional screening in patients with gastric cancer. Br J Nutr. 2011;106(12):1773-8.

39.Argilés JM, López-Soriano FJ, Toledo M, Betancourt A, Serpe R, Busquets S. The cachexia score (CASCO): a new tool for staging cachectic cancer patients. J Cachexia Sarcopenia Muscle. 2011;2(2):87-93.

Recebido em: 28/01/2016
Aceito para publicação em: 12/04/2016
Conflito de interesse: nenhum.
Fonte de financiamento: nenhuma.

Endereço para correspondência:
Luís Fernando Moreira
E-mail: lufmoreira@hcpa.ufrgs.br