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Original article

Different nutritional assessment tools as predictors of postoperative complications in patients undergoing colorectal cancer resection

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SUMMARY

Background & aims: Malnutrition in patients with colorectal cancer contributes to increased postoperative complications. The aim of the study was to evaluate the prognostic value of several nutritional assessment parameters: body mass index versus percentage of weight loss grading system (BMI/%WL); Patient-Generated Subjective Global Assessment (PG-SGA); standardized phase angle (SPA) by BIA; muscle strength by handgrip strength; muscle mass by computerized tomography; and the combination of muscle mass and strength in patients undergoing resection surgery.

Methods: Patients diagnosed with cancer of the colon or rectum, who were over 18 years old and were scheduled to undergo surgical treatment were invited to participate. Postoperative complications were assessed from the first day post-surgery until discharge. Complications classified as Grade II or above according to the Clavien–Dindo classification were considered. Chi-square test or Fisher's exact test, bivariate analysis, Poisson regression and receiver operator characteristic (ROC) curve were utilized and $p < 0.05$ was considered significant.

Results: 84 patients were evaluated, with 28 (33.3%) presenting with Grade II postoperative complications. SPA showed no association with postoperative complications ($p = 0.199$). In multivariate analysis, low skeletal muscle mass showed a relative risk (RR) of 1.80 (CI: 1.02–3.17), BMI/%WL equal or higher than grade 3 had a RR of 1.90 (95% CI: 1.22–3.39). PG-SGA classified as malnutrition showed a RR of 2.08 (95% CI: 1.06–4.06); and low muscle mass plus low muscle strength showed a RR 2.13 (95% CI: 1.23–3.69). Low strength alone was not associated with postoperative complications after controlling for confounding factors ($p = 0.16$; 95% CI: 0.83–2.77). Low muscle mass in combination with low strength showed the highest predictive power for postoperative complications (AUC: 0.68; CI: 0.56–0.80).

Conclusions: BMI/%WL > grade 3, PG-SGA defined malnutrition, low muscle mass and low muscle mass plus low strength were independent risk factors for complications controlling for confounding factors. However, low muscle mass in combination with low muscle strength were the strongest variables associated with complications.

Clinical Trials identification number: NCT02901132 (www.clinicaltrials.gov).

1. Introduction

Malnutrition is a frequent condition among colorectal cancer and an independent prognostic factor for increased risk of postoperative complications, reduced response to anticancer treatment, and ultimately shorter survival [1,2]. Malnutrition contributes to approximate 20–40% of colorectal surgical complication rates and therefore incurs an important economic and social burden [3]. In this regards, early diagnosis of malnutrition is extremely important, since preoperative nutritional intervention may contribute to lower post-surgical morbidity and mortality rates [3]. However, in many cancer centers, preoperative nutritional assessment is not routinely performed due to either limited

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availability of nutrition experts or lack of protocols, although accessible assessment tools are available in most settings. Tools such as patient generated subjective global assessment (PGSGA), body mass index (BMI) and weight loss system grading, standardized phase angle and muscle mass evaluate different dimensions of nutritional status including function and body composition.

Among nutrition variables, percentage of weight loss is a simple parameter that has historically been considered as a hallmark in the diagnosis of malnutrition in cancer, and a predictor of worse clinical outcomes in several types of tumor [4,5]. There is still controversy regarding the percentage of weight loss that should be considered clinically important, with cutoff values varying from 5% to 20% [6–8]. Recently, a classification system incorporating both the prognostic significance of BMI and percentage of weight loss in cancer patients was created [9]. These variables combined were associated with survival independent of cancer site, stage and performance status. Five classification grades (0–4) were described based on longest (grade 0) and shortest (grade 4) survival [9]. This classification system may be useful to predict postoperative complications after colorectal cancer surgery, although no previous study has investigated its prognostic value.

A more established tool to estimate nutritional status is the PG-SGA developed and validated by Ottery et al. [10]. This tool is an adaptation of the Subjective Global Assessment (SGA), an essential clinical assessment method proposed by Detsky et al. [11]. The PG-SGA tool is endorsed by the Oncology Nutrition Dietetic Practice Group of the American Dietetic Association as the standard for nutrition assessment in cancer patients [12] and is a rapid, cost-effective and feasible tool, which can be easily implemented in clinical settings.

Bioelectrical impedance analysis (BIA) has also been used as a tool to assess nutritional status [13,14]. The phase angle generated from BIA has been used as a prognostic marker in several clinical situations [15–17]. Reduced phase angle values are associated with adverse outcomes in patients with cancer [18]. Standardized phase angle (SPA) has been proposed by adjusting phase angle to reference values, which are sex and age specific [19]. However, to our knowledge, no studies have investigated the prognostic value of SPA for postoperative complications in patients undergoing colorectal cancer resection surgery.

An additional body composition tool used to assess low muscle mass (sarcopenia) as a marker of nutritional status is computerized tomography (CT) [20]. Low muscle mass has been associated with negative prognosis after colorectal surgery [21,22]. The use of CT scans to diagnose sarcopenia has increased due to the accuracy, reliability and availability of the images in clinical scenarios [23]. Although the international consensus on cancer cachexia recognizes muscle mass as sufficient marker to diagnose sarcopenia in cancer [24], several other working groups have endorsed the measurement of function and strength in addition to muscle mass [25,26]. This include the European Working Group on Sarcopenia in Older People (EWGSOP) [20], the European Society for Clinical Nutrition and Metabolism Special Interest Groups (ESPEN-SIG) [27] and the International Working Group on Sarcopenia (IWGS) [28]. The use of muscle function in the context of sarcopenia diagnosis/prognosis in cancer has not been previously explored. Muscle function (strength) may be a complementary marker for the diagnosis of sarcopenia in these patients, potentially improving the relationship between sarcopenia and cancer prognosis.

The method of choice for the assessment of nutritional status depends on its availability, the expertise of the health care team, and reliability in predicting outcomes. When evaluated separately, some of these measurements have been found to be associated with postoperative complications in various patient cohorts [25,29]. However, to our knowledge, these nutritional assessment tools have not been previously compared regarding their predictive value for postoperative complications in patients with colorectal cancer. Thus, the aim of the current study was to evaluate the prognostic value of several different nutritional assessment tools: BMI-Adjusted Weight Loss Grading System (BMI/%WL); PG-SGA; SPA by BIA; muscle strength by handgrip strength (HGS), muscle mass assessment by CT and the combination of muscle mass and strength.

2. Methods

This was a prospective cohort study carried out at Hospital das Clínicas/Universidade Federal de Minas Gerais (UFMG), Minas Gerais, Brazil. The research protocol was reviewed and approved by the Ethics Committee in Research of the UFMG (ETIC 10726513.0.0000.5149) and the University of Alberta Research Ethics Board (Pro00062774) and all subjects gave written informed consent. The ClinicalTrial.gov identification number is NCT02901132.

2.1. Patients

Patients diagnosed with cancer of the colon or rectum who were over 18 years old and scheduled to undergo surgical treatment from 2013 to 2016 were invited to participate in the study. Exclusion criteria were as follows: non-cancer inflammatory disease, re-operation due to disease recurrence (or otherwise), inability to complete any of the assessment methods and those who refused to sign the consent form. A standardized questionnaire was used to collect data, including identification number, age, sex, type of treatment, surgical approach, smoking, blood transfusion and cancer staging. The Tumor Nodes Metastasis staging system (TNM) was used to describe disease staging. Preoperative systemic inflammatory response was evaluated by the modified Glasgow Prognostic Score (mGPS). Information on albumin and C reactive protein (CRP) were collected from the medical records. The mGPS was scored as 0, 1, or 2 based on CRP (>10 mg/L) and albumin (<35 g/L) [30]. Data were collected one day before the operation.

2.2. Procedures

Anthropometric measurements were performed by two trained evaluators, with an interobserver coefficient of variation of 1.9%. Height and weight were measured according to international standards and the BMI was calculated. Patients were classified according to the BMI/%WL [9] and divided into two groups: below grade 3 (life expectancy longer than 10 months) and equal or above grade 3 (life expectancy less than 10 months).

The PG-SGA was completed as described by Ottery [31]. Each patient was classified as well-nourished (PG-SGA A), suspected or moderately malnourished (PG-SGA B) or severely malnourished (PG-SGA C). In this study, patients classified as PG-SGA B and C were grouped and classified as malnourished.

BIA was conducted with the Quantum X model (RJL Systems, Michigan, USA) following international guidelines [32,33]. The phase angle was calculated as the arc tangent of the ratio of reactance to resistance in degrees. The phase angle was converted into a SPA according to Barbosa-Silva et al. (2008) [19] who used a Brazilian large sample to develop this standard. The cutoff −1.65 represents the 5th percentile of the population and can be regarded as the lowest limit accepted for healthy subjects [19].

Muscle mass was assessed by diagnostic CT. All CT images were generated within 60 days prior the analysis. To minimize assessment bias, a single trained expert quantified skeletal muscle cross-sectional area at the level of the third lumbar vertebra (L3), based

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