e-SPEN, the European e-Journal of Clinical Nutrition and Metabolism 6 (2011) e21–e26

Contents lists available at ScienceDirect

e-SPEN, the European e-Journal of Clinical Nutrition and Metabolism

journal homepage: http://www.elsevier.com/locate/clnu

Original Article

Handgrip strength and adductor pollicis muscle thickness as predictors of postoperative complications after major operations of the gastrointestinal tract

Rosalia Bragagnolo [a], Fernanda Stephan Caporossi [a], Diana Borges Dock-Nascimento [b], José Eduardo de Aguilar-Nascimento [c,*]

Multidisciplinary Nutrition Team of the Julio Muller University Hospital, Federal University of Mato Grosso, Cuiabá, Brazil

ARTICLE INFO

Article history:
Received 19 July 2010
Accepted 17 November 2010

Keywords:
Malnutrition
Nutritional assessment
Adductor pollicis muscle
Dynamometry
Postoperative complications
Surgery

SUMMARY

Background & Aims: Malnutrition increases the risk of postoperative complications. We investigated whether handgrip strength (HGS) and adductor pollicis muscle (TAPM) thickness are reliable indicators of postoperative outcome in patients undergoing major abdominal operations.

Methods: A prospective cohort study was conducted that involved 90 patients who underwent major digestive tract surgery. All patients were subjected to anthropometric measurements and subjective global assessment. Both HGS and TAPM were analyzed as potential risk factors for postoperative outcome.

Results: TAPM was significantly correlated with all anthropometric measurements ($p < 0.001$). Multivariate linear regression analysis indicated that both HGS and TAPM were significantly greater in male, nourished, and younger patients. The relative risk (RR) of postoperative death was approximately five-fold higher (RR = 5.01; 95% confidence interval [CI]: 1.79–14.03; $p < 0.001$) in patients with abnormal HGS and approximately 25% greater in patients with abnormal TAPM (RR = 1.26; 95% CI: 1.03–1.55; $p = 0.02$). Abnormal HGS increased the risk of either infectious (RR = 1.53; 95% CI: 1.06–2.21; $p = 0.01$) or noninfectious (RR = 1.45; 95% CI: 1.02–2.06; $p = 0.02$) complications by 50%. Abnormal TAPM was associated with an increased number of complications. The length of postoperative hospital stay was greater in patients with abnormal HGS ($p = 0.02$).

Conclusions: Both the TAPM and HGS are excellent tools for evaluating nutritional status and predicting the outcome of surgical patients.

1. Introduction

Malnutrition is prevalent in patients who undergo surgical procedures involving resection and anastomosis of the digestive tract and is associated with an increased risk of postoperative complications.[1,2] Consequently, the length of hospital stay (LOS), mortality rate, and hospital costs are frequently augmented in this subset of surgical patients.[3–7] Early recognition of malnutrition is therefore crucial for establishing a good prognosis and initiating immediate preoperative nutritional support.[1–7]

The measurement of handgrip strength (HGS) is useful for assessing functional changes in the muscle compartment. The rationale for the use of HGS in determining malnutrition lies in the fact that functional changes may be evident before modifications of both anthropometry and laboratory variables occur. Unfortunately, only a few studies have focused on the value of HGS in predicting postoperative complications.[8,9] Recently, a new technique for evaluating the muscular compartment has been developed. Measuring the thickness of the adductor pollicis muscle (TAPM) is a potential tool for estimating muscle loss because it is easy and rapid to obtain, makes the use of formulas to calculate the muscle compartment unnecessary, is noninvasive, and is inexpensive.[10] A few papers have reported the usefulness of the TAPM in assessing the nutritional status of healthy and hospitalized individuals.[11–13] Recently, we showed that the TAPM correlates with all anthropometric techniques in surgical patients.[14] However, no study has investigated the value of this technique for predicting clinical outcome after major operations of the digestive tract. Thus, the aim of the present study was to assess whether the TAPM and

* Corresponding author. Federal University of Mato Grosso, Department of Surgery, Rua Estevao de Mendonca 81 apto 801, 78043-300, Cuiaba, Brazil. Tel./fax: +55 65 36234020.
E-mail address: aguilar@terra.com.br (J.E. de Aguilar-Nascimento).
[a] Medical Sciences School, Federal University of Mato Grosso, Cuiaba, Brazil.
[b] Food and Nutrition Department, Nutrition School, Federal University of Mato Grosso, Cuiaba, Brazil.
[c] Department of Surgery, Federal University of Mato Grosso, Cuiaba, Brazil.

1751-4991/$36.00
doi:10.1016/j.eclnm.2010.11.001

HGS are reliable prognostic indicators of postoperative outcome in patients undergoing major operations of the gastrointestinal tract.

2. Materials and methods

This study was approved by the Research Ethical Committee of the Julio Muller University Hospital. Patients were included in the study after giving informed consent.

2.1. Patients

This was a prospective clinical cohort study involving patients admitted to the infirmary of the Department of Surgery, Julio Müller University Hospital, between March 2008 and July 2009. Patients of both sexes who were candidates for elective major surgery of the gastrointestinal tract were eligible as participants in the study. Patients who either refused to participate or did not have an operation were excluded.

2.2. Nutritional assessment

All patients underwent nutritional evaluation by subjective global assessment (SGA)[15] at least 24 h after admission. Various other conventional anthropometric measurements, such as body mass index (BMI), arm muscle circumference (AMC), arm circumference (AC), and triceps skin fold (TSF), were also collected according to classic methods described in the literature.[16] Additionally, measurements of both HGS and the TAPM were obtained. The TAPM was assessed in both hands while the subject was seated with the hand lying on the knee and with the elbow at an angle of approximately 90° over the homolateral lower limb. The average of three consecutive measurements was considered to be the TAPM for each individual. A caliper (Cescorf®, Porto Alegre, Brazil) was used with a continuous pressure of 10 g/mm^2 to pinch the adductor muscle in the vertex of an imaginary triangle formed by the extensions of the thumb and index finger. For HGS evaluation, subjects were seated with their elbows flexed at a 90° angle and supported at the time of the measurement. We collected three measurements of both hands and chose the highest value as representing each case. During HGS measurement, the patient was instructed to grip the dynamometer (Baseline TBW, New York, NY, USA) with the maximum possible strength and hold the grip for 3 s.[14] For statistical comparisons, we chose the value from the nondominant hand for the TAPM measurement and the value from the dominant hand for the HGS measurement to represent each individual. This decision was based on the facts that most anthropometric references are from the nondominant limb and that grip strength is most pronounced in the dominant hand.

2.3. Perioperative treatment

Artificial preoperative nutrition for 7–10 days was prescribed to patients considered severely malnourished by SGA, with the exception of four patients because of the surgeons' judgments. All patients received antibiotics and thrombosis prophylaxis according to international guidelines.[17,18] Preoperative fasting, unless contraindicated, was set to 2 h, and patients received 400 and 200 mL of 12.5% maltodextrine 6 h and 2 h before anesthesia was induced. Postoperative re-feeding by either the oral or enteral route was initiated on either the same day as the surgery or the day after surgery.

2.4. Main outcome endpoints

The main endpoints of clinical outcome prognosis for which associations with TAPM and HGS were assessed were mortality, postoperative complications, and length of hospital stay (LOS). Postoperative complications were divided into infectious and noninfectious categories. Other potential risk factors associated with postoperative outcome, such as age, cancer, duration of surgery, and ASA score, were also analyzed. The definitions adopted for postoperative complications are shown in Table 1.

2.5. Statistical analysis

The *chi-square* or Fisher's exact test was used to compare categorical variables. Comparisons between TAPM and HGS values and all other variables were performed using Student's *t*-test or the Mann–Whitney test. Linear regression analysis was used to identify possible confounding factors associated with the measurement of both TAPM and HGS, such as age and sex. The cutoff points for TAPM and HGS of both hands were determined by receiver-operating characteristic (ROC) curves according to sex and age, with mortality as the outcome. The values established for cutoff are presented in Table 2. Patients who had values equal to or less than the cutoff were classified as abnormal. Logistic multivariate analysis was used to determine the strength of the association between the independent variables and the main endpoints. Continuous or ordinal variables, such as age (less or more than 60 years old), duration of surgery (less or more than 3 h), ASA score (less or more than 2), and LOS (less or more than 7 days), were categorized for both univariate and multivariate analyses. We established a level of 5% to reject the null hypothesis ($p < 0.05$). All analyses were performed with the Statistical Package for the Social Sciences (SPSS) version 8.0 for Windows. For the ROC curve analysis, we used MedCalc® software.

3. Results

We evaluated 124 patients (62 [50%] females and 62 [50%] males) with a median age of 58 year (range 18–82 years). Ninety

Table 1
Definitions adopted for postoperative complications.

Postoperative complications	Definitions
Abdominal abscess	Deep collection of pus revealed by computed tomography scan or surgery
Acute renal insufficiency	Serum creatinine > 2 mg/dL
Anastomotic leak	Any dehiscence of anastomosis with clinical symptoms
Atelectasis	Collapse of the lung tissue revealed by chest X-ray
Bacteremia	Positive blood culture
Bleeding	Hemorrhage requiring a blood transfusion
Circulatory insufficiency	Unstable blood pressure requiring the use of extra fluids or cardiac stimulants
Deep vein thrombosis	Any thrombus in the deep vein system revealed by Doppler
Myocardial infarction	Revealed by electrocardiogram and elevated serum creatine kinase isoenzyme-MB or troponine
Pleural effusion	Revealed by chest X-ray of excess fluid accumulation in the pleural cavity
Pneumonia	Presence of new or progressive infiltrate, consolidation, or cavitation in chest X-ray in addition to clinical manifestation
Respiratory failure	Presence of dyspnea and respiratory rate > 30/min or PaO_2 < 70 mm Hg
Sepsis	SIRS plus bacteria isolated from any site
Systemic Inflammatory Response Syndrome (SIRS)	Presence of two or more of the following: white blood count > 12.000 (or < 4000), body temperature > 38 °C (or < 36 °C), heart rate > 90 beats/min, respiratory rate > 20 breaths/min, and $PaCO_2$ < 32 mm Hg
Wound dehiscence	Any dehiscence of the abdominal wall suture
Wound infection	Any redness or tenderness of the wound with purulent drainage through the incision