Clinical Nutrition ESPEN xxx (2017) e1–e5

Contents lists available at ScienceDirect

Clinical Nutrition ESPEN

journal homepage: http://www.clinicalnutritionespen.com

Original article

Thickness of the adductor pollicis muscle: Accuracy in predicting malnutrition and length of intensive care unit stay in critically ill surgical patients
Thickness of the adductor pollicis muscle in surgical critically patients

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ARTICLE INFO

Article history:
Received 27 October 2017
Accepted 28 October 2017

Keywords:
Anthropometry
Nutritional assessment
Thickness of the adductor pollicis muscle
Critical care
Mortality
Length of stay
Intensive care units

SUMMARY

Backgrounds & aims: new techniques for assessment of nutritional status of critically ill and surgical patients have been investigated to overcome inherent limitations of conventional method. The current study aimed to evaluate the ability of thickness of the adductor pollicis muscle (TAPM) in detecting malnutrition and predicting morbidity and mortality in critically ill surgical patients.
Methods: cohort study of adult patients, assessed within the 48 h of admission to the surgical intensive care unit (ICU) of a public hospital. TAPM measurements of the non-dominant hand were performed with patients lying supine. TAPM values lower than the 5th percentile for age and sex were adopted to identify malnutrition. Patients were followed up until discharge for measurement of the following parameters: length of ICU stay, time on mechanical ventilation, length of hospital stay, and hospital mortality.
Results: fifty-nine surgical ICU patients, with mean age of 60.0 ± 17.4 years were included in the current study. There was a positive, weak-to-moderate correlation between TAPM and anthropometric indicators ($r = 0.338$ to $r = 0.579$; $p < 0.01$). The ability of TAPM in identifying patients with malnutrition (diagnosed by global subjective assessment) was assessed by ROC curve analysis, and an area under the ROC curve of 0.611 (95%CI: 0.459–0.762; $p = 0.151$) was found. TAPM < p5 increased the risk of ICU length of stay >3 days (RR = 2.92; 95%CI 1.09–7.81; $p = 0.032$). Relative frequencies of malnourished and well-nourished patients according to TAPM were not different between survivors and non-survivors ($p = 0.814$).
Conclusion: TAPM showed unsatisfactory accuracy in predicting malnutrition. Although TAPM was not a good mortality predictor, reduced TAPM (< p5) values increased the risk of a prolonged ICU stay (>3 days).

1. Introduction

Malnutrition is highly prevalent in hospitalized patients (40–60%) and has been reported as a predictor of hospital morbidity and mortality, leading to increased hospital stay, readmission rates and hospital costs [1–4]. At intensive care units (ICUs), the prevalence of malnutrition varies from 38% to 78% and has been associated with a worse clinical outcome including longer ICU stay, higher mortality rates and higher incidence of infection [5,6].

Malnutrition has been associated with higher infection rates and postoperative complications also in surgical patients. Early identification of malnutrition in these patients is crucial for the establishment of early nutrition therapy [7,8]. However, nutritional assessment methods usually used in hospitalized patients have limited applicability in ICUs. In fact, a recent systematic review [9]

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https://doi.org/10.1016/j.clnesp.2017.10.013
2405-4577/

suggests that commonly used methods for nutritional assessment of hospitalized patients have little accuracy in diagnosing malnutrition in critically ill patients [9], which has been also highlighted by the ASPEN [8]. In light of this, new techniques for assessment of nutritional status of critically ill and surgical patients have been investigated to overcome inherent limitations of conventional methods.

Thickness of the adductor pollicis muscle (TAPM) was proposed by Lameu et al. [10] as a new anthropometric parameter in a study published in 2004 with 421 Brazilian healthy adults. In this study, the authors determined TAPM cutoffs by sex and since then, this parameter has been investigated as a predictor of nutritional status in critically ill and surgical patients [11–19]. Some studies [11–13] have been demonstrating a good performance of TAMP in identifying malnutrition, while in another studies theses results could not be confirmed [14]. The role of TAPM as a prognostic indicator and mortality predictor has also been recently investigated among critically ill and surgical patients, and results have been controversial [12,17–20]. Therefore, the aim of the present study was to evaluate the value of TAPM in detecting malnutrition and predicting morbidity and mortality in critically ill surgical patients.

2. Methods

2.1. Subjects and study design

This was a cohort study performed in a surgical ICU of a public hospital in Porto Alegre (state of Rio Grande do Sul, Brazil). The Ethical Committee of Hospital approved the protocol (Number 967.938).

Patients were assessed within the first 48 h of admission in the ICU and followed up until discharge. Adult patients of both sexes, admitted to the ICU were included in the study. Patients with water and electrolyte disturbances, limb amputation that would make nutritional assessment difficult, and patients (and family members) unable to provide detailed information during nutritional anamnesis were excluded from the study.

Sample size was calculated based on the study by Bragagnolo et al. [12], which showed a significant difference in TAPM between no survivors and survivors (11.4 ± 4.1 mm *vs*. 14.5 ± 4.2 mm). Based on this difference, and considering a statistical power of 80%, a level of significance of 5%, we estimated a sample size of 60 patients, which was increased by 10% to account for potential dropouts and loss-to-follow-up.

2.2. Data collection protocol

All patients underwent clinical, laboratory and nutritional assessment. Sociodemographic data (age, sex, ethnics, place of origin), cause of hospitalization, type of surgery, length of hospital stay before surgery, past medical history and laboratory data – C-reactive protein, albumin, complete blood count and electrolytes were obtained from medical records. The C-reactive protein/albumin ratio was calculated and used as mortality predictor. Patients were classified for illness severity at baseline assessment using the APACHE II score.

Nutritional assessment included anthropometry, in which weight and height were estimated from knee height (KH) and arm circumference (AC) using the prediction equations proposed by Chumlea et al. [21,22]. KH was defined as the distance between the base of the heel and the suprapatelar point. It was measured using an inelastic tape, with the knee and ankle flexed to a 90° angle. AC was measured using an inelastic tape at the midpoint between the olecranon and acromion processes on the posterior surface of the arm. Body mass index (BMI) was calculated, and TAPM of the non-dominant hand was measured using a Lange® caliper, with the patient lying supine, as described by Caprossi et al. [12]. Patients with a TAPM below the p5 for age and sex, as proposed by Gonzales et al. [23], were considered malnourished. In addition, TAPM values below the mean obtained from the sample were considered abnormal.

Subjective global assessment (SGA) was administered to patients' family members, since all patients were under mechanical ventilation. Patients were classified as well-nourished (SGA-A), moderately malnourished or at risk of malnutrition (SGA-B), or severely malnourished (SGA-C) [24].

Patients were followed up until hospital discharge for measurement of the following parameters: length of ICU stay, time on mechanical ventilation, length of hospital stay, and hospital mortality.

2.3. Data analysis

Continuous variables were expressed as mean and standard deviation (parametric variables) and interquartile range (non-parametric variables), and qualitative variables were expressed as absolute and relative frequencies. The normality of quantitative variables was tested by Kolgomorov–Smirnov test.

Correlation between TAPM and anthropometric indicators was assessed by Pearson's correlation coefficient, based on normality of the variables. Comparisons of nutritional indicators between patients with and without malnutrition according to TAPM values were performed by the Student's t-test or the chi-square test, and TAPM values were compared between nutritional status categories according to the SGA by ANOVA test. Cohen's kappa coefficient was calculated to measure the agreement between SGA and TAPM for diagnosis of malnutrition. A ROC curve was constructed to evaluate the role of TAPM in predicting malnutrition, and an area under the ROC curve of 0.50 was considered adequate. Poisson regression was used to assess the association between TAPM < p5 or TAPM ≤ median (15 mm) and malnutrition (SGA B or C) adjusted for sex. The Hosmer & Lemeshow was performed to evaluate the model' s quality of fit.

Correlation between TAPM and morbidity indicators was analyzed using the Spearman correlation coefficient, based on normality of the variables. Comparisons of TAPM values between survivors and non-survivors and between the patients grouped by length of ICU stay were performed by the Student's t-test. The chi-square test was used to evaluate the association between malnutrition according to TAPM and mortality. In addition, Poisson logistic regression was used, with length of ICU stay (> or < median of 3 days) as the dependent variable, TAPM (> or < mean of 15 mm or > or < p5) as the independent variable, and the APACHE II as confounding variable. The Hosmer & Lemeshow was performed to evaluate the model' s quality of fit.

Significance level was set at $p < 0.05$ and all analyzes were performed using SPSS version 20.0.

3. Results

3.1. General characteristics of the sample

Fifty-nine surgical ICU patients were included in the study. Patients were aged 60.0 ± 17.4 years, 65% were men, and 94.9% were white. Most patients underwent elective surgeries (n = 38; 64.4%), most of them related to the digestive (n = 26; 44.1%) and cardiovascular systems (n = 18; 30.5%). Mortality rate was 10.2% (n = 6) and patients had a mean APACHE score of 9.9 ± 3.9. Median hospital stay was 30.0 (19.0–50.0) days and the median ICU stay was 3.0 (2.0–6.0) days. Two patients were receiving kidney replacement

Please cite this article in press as: Pereira TG, et al., Thickness of the adductor pollicis muscle: Accuracy in predicting malnutrition and length of intensive care unit stay in critically ill surgical patients, Clinical Nutrition ESPEN (2017), https://doi.org/10.1016/j.clnesp.2017.10.013