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Sarcopenia is a risk factor for complications and an independent predictor of hospital length of stay in trauma patients



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ABSTRACT

Background: Sarcopenia is an independent risk factor for adverse outcomes in critically ill patients. The impact of sarcopenia on morbidity and length of stay in a trauma population has not been completely defined. This project evaluated the influence of sarcopenia on patients admitted to the trauma service.

Materials and methods: A retrospective review of 778 patients presenting as a trauma alert at a single institution from 2012–2014 was completed. Records were abstracted for comorbidities and hospital complications. The Hounsfield Unit Area Calculation was collected from admission computed tomography scans. Criteria for sarcopenia were based on the lowest 25th percentile of muscle density measurements. Relationships to patient outcomes were evaluated by univariate and multivariable regression or analyses of variance, when applicable.

Results: A total of 432 (55.6%) patients suffered a complication. Sarcopenia was associated with overall complications ($P < 0.0001$, relative risk 2.54, confidence interval 1.78–3.61) and was an independent risk factor for catheter-associated urinary tract infections ($P = 0.011$), wound infections ($P = 0.011$), need for reintubation ($P = 0.0062$), and length of hospitalization ($P = 0.0007$). Incorporating sarcopenia into a novel length of stay calculator showed increased prognostic ability for prolonged length of stay over Abbreviated Injury Scale alone ($P = 0.0002$).

Conclusions: Sarcopenia is an independent risk factor for adverse outcomes and increased length of stay in trauma patients. Prognostic algorithms incorporating sarcopenia better predict hospital length of stay. Identification of patients at risk may allow for targeted interventions early in the patient's hospital course.

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Introduction

Sarcopenia is the quantifiable loss of muscle mass that accompanies a deconditioned state of health.¹ Often characterized as a progressive syndrome that accompanies aging and catabolism, the relevance of sarcopenia is not limited to

medical outcomes in cachectic elderly cohorts. In fact, sarcopenia is often an insidious process with few outward indicators of the disease.^{2–4}

Sarcopenia correlates with adverse outcomes in several populations including patients with cancer, the critically ill, and those undergoing a diversity of surgical procedures.^{5–7}

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After elective operations, sarcopenic patients are more likely to incur higher payer costs even after adjusting for patient and procedural factors.⁶ While less well defined, sarcopenia appears to play an important role in the outcomes of patients who suffer traumatic injuries or require emergent surgery. In elderly trauma patients, sarcopenia is a strong risk factor for loss of independence upon hospital discharge. One study noted that each additional 1 cm² of psoas area predicted a 20% increase in functional independence.⁸ It is hypothesized that there is a pathologic sarcopenia distinct from that which is seen with aging alone and that this state is predictive of post-trauma morbidity. Furthermore, due to the significance of this finding on a patient's overall wellbeing, it is postulated that sarcopenia is predictive of length of stay in this population.

Methods

Patients and sarcopenia quantification

A retrospective study of hospital charts of 778 patients presenting as a trauma alert at a single institution from 2012–2014 who underwent abdominal computed tomography (CT) scans was completed. CT scan measurements were recorded, and sarcopenia quantification was done using the validated method described by Joglekar *et al.*⁵ In short, sarcopenia was defined using a mean Hounsfield Unit Area Calculation within the lowest gender quartile as measured at the third lumbar vertebrae. Patient charts were also reviewed for clinical assessment data and complications. Appropriate approval from the University of Iowa Hospitals and Clinics (UIHC) institutional review board was obtained. A waiver of informed consent was obtained due to the retrospective nature of this research.

Statistical analysis

Univariate logistic regression was used for categorical outcome variables and linear regression was used for continuous outcome variables to determine which predictor variables were significantly associated with complications. Patient variables abstracted as potential predictors for poor outcomes included the following factors: age, body mass index, comorbid conditions, smoking status, history of venous thrombosis, abdominal wall fat, hip girdle fat, visceral fat, and admission laboratory values including complete blood count, blood urea nitrogen, liver function tests, albumin, pre-albumin, and international normalized ratio. Trauma-related characteristics collected included Glasgow Coma Scale and the injury severity score. In addition, head, chest, abdomen, and extremity abbreviated injury scale (AIS) scores were recorded. The maximum AIS score was noted as its own variable. Additional variables included receipt of transfusion of any kind, total products transfused, total red blood cell transfusion, receipt of platelets, total platelet transfusion, receipt of fresh frozen plasma, and total fresh frozen plasma transfusion. Complications abstracted from records included the following factors: time in intensive care unit (ICU), length of stay, readmission, organ space infection, central line–associated blood stream infections (CLABSIs), catheter-associated urinary tract infections (CAUTIs), hospital-acquired pneumonia, sepsis, venous thrombosis requiring treatment,

discharge disposition, death while hospitalized, death within 30 d, death within 90 d, and total mortality. Multivariable logistic and linear regression models were constructed using all predictor variables found to be significantly associated with complications.

Length-of-stay prediction

The finding of sarcopenia as a predictor of morbidity in a trauma cohort is not unexpected, given the available data in surgical populations. To date, its roll in a nongeriatric trauma population has not been completely defined. Having established the significance of sarcopenia in this group, it was thought to be critical to develop a scoring system that would evaluate the predictive capacity of sarcopenia on length of stay. To do this, the variables significantly associated with prolonged length of stay from the multivariate analysis were aggregated with the presence of sarcopenia. These variables included admission white blood cell count, maximum AIS value, and a diagnosis of congestive heart failure and hypertension. When linear regression was performed on these variables, an aspect of the data produced was the parameter estimate of the coefficients for these variables. These parameter estimates of coefficients served as the relative weights of each variable when creating the final calculator predicting the length of stay. In this way, each variable would have the appropriately weighted influence on the length of stay estimate. For continuous variables, the result that gave the greatest sensitivity for prolonged length of stay (>10 d) on the receiver operating characteristic (ROC) analysis was used as a cutoff point. Patient data for said variable, which was above and below this set point was assigned a number. In this way, a continuous variable such as white blood cell (WBC) count was translated into a categorical variable. A score was derived from this value multiplied by the respective linear regression coefficient parameter estimates to achieve the variable's contribution to the composite score. For categorical variables, no translation was necessary. In this case, the calculation was derived from the weight defined by the linear regression analysis multiplied by the categorical value. Each of these results were then combined into a composite score predicting the length of stay. This final score did not include the injury severity score, as it was noted to be redundant with a patient's maximum AIS score and did not add any significant prognostic power. These scores and the overall composite scoring system were developed using a random sampling of half of the patient population and then tested for prognostic power using the entire population. This assessment of prognostic power was done through ROC analysis of the scoring system for discrete lengths of stay.

Results

A total of 978 patients presented as a trauma alert and also underwent CT imaging from 2012–2014 at the UIHC. Two hundred patients were excluded from the analysis due to missing data points for a total of 778 enrolled. Seventy-one percent of patients were male. The average age of those with sarcopenia was older than those without (63 versus 42 years). Sarcopenic patients were more likely to suffer from numerous medical comorbidities including obesity (Table 1).

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