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# Determining the impact of sarcopenia on postoperative complications after ventral hernia repair

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## KEYWORDS

Plastic surgery;  
Sarcopenia;  
Ventral hernia;  
Abdominal wall reconstruction;  
Component separation

**Summary Background:** Postoperative complication following ventral hernia repair (VHR) is a major clinical and financial burden. Preoperative risk assessment is necessary to minimize adverse outcomes following VHR. This study examines the ability of an independent parameter to predict postoperative morbidity following VHR.

**Methods:** A retrospective analysis of 58 patients who underwent VHR by component separation between January 2009 and December 2013 was performed. Preoperative abdominal CT scans were analyzed to assess sarcopenia. Sarcopenia was determined using the Hounsfield unit average calculation (HUAC), a measure of psoas muscle size and density. Sarcopenia was defined as an HUAC score of less than 19.6 HU calculated using receiver operating characteristic (ROC) analysis and the Youden index. Multivariate analysis was performed to analyze the association of sarcopenia and postoperative complications.

**Results:** Preoperative sarcopenia was associated with an increased risk for postoperative complications (odds ratio [OR] = 5.3;  $p = 0.04$ ). Preexisting gastrointestinal conditions such as ulcerative colitis or colon cancer were associated with an increased risk for postoperative complications (OR = 5.7;  $p = 0.05$ ). A significantly higher rate of hernia recurrence (33.3% vs. 10.8% [ $p = 0.04$ ]) and renal failure (19% vs. 2.7% [ $p = 0.03$ ]) was noted in patients with sarcopenia when compared to patients without sarcopenia.

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**Conclusions:** Sarcopenia is an independent risk factor for postoperative complications in patients who underwent VHR. Assessment of sarcopenia using the HUAC score provides an opportunity for the adjustment of perioperative care plans to minimize postoperative complication rates.

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## Introduction

Ventral hernia repair (VHR) is a commonly performed procedure in the United States with more than 300,000 repairs being performed annually.<sup>1</sup> In addition to the increasing number of VHRs, the comorbid burden of patients requiring VHR is also increasing. Thus, there is a significant morbidity associated with this procedure. This is particularly applicable to open repairs, which constitute the most common modality of surgical treatment.<sup>2,3</sup> Because VHRs are associated with significant morbidity as well as a distinct risk of mortality, preoperative risk assessment and proper patient selection are becoming increasingly important. Ventral hernia grading systems, therefore, have been developed for the purpose of facilitating clinical decision-making and to aid in choosing the appropriate technique of repair.<sup>4</sup> A variety of risk factors have been identified, which translate into an increased rate of morbidity and mortality following VHR, including advanced age, liver disease, renal failure, pulmonary disease, and other medical conditions.<sup>5-9</sup>

It is not surprising that the increasing number of comorbid conditions is associated with poorer outcomes following major surgery, as it correlates with an increased degree of patient frailty. This concept describes “a biological syndrome of decreased reserve and resistance to stressors, resulting from cumulative declines across multiple physiological systems and causing vulnerability to adverse outcomes”.<sup>10-12</sup> In fact, assessment of patient frailty has been recommended as an important parameter in preoperative risk assessment.<sup>13,14</sup>

Interestingly, sarcopenia has been reported to correlate highly with frailty and can be easily determined by computer tomography (CT).<sup>17,18</sup> Several studies have demonstrated a significant correlation of increased mortality with low core muscle area. While these associations have been demonstrated for vascular and gastrointestinal procedures, including solid organ transplantation and surgery for gastrointestinal malignancy,<sup>15,19-22</sup> the impact of sarcopenia on postoperative outcomes following VHR has not been investigated to date. The present study was conducted to investigate whether sarcopenia is an independent risk factor for poor outcomes following VHR. We hypothesized that sarcopenia would indeed be associated with poorer postoperative outcomes.

## Materials and methods

### Study design and patient population

The Stanford Translational Research Integrated Database Environment (STRIDE), which is a research and development

project at Stanford University to create a standard-based informatics platform supporting clinical and translational research,<sup>23</sup> was utilized to identify all patients who underwent VHR between January 1, 2009, and December 31, 2013, at Stanford University Medical Center. Institutional Review Board (IRB) approval was obtained before conducting the study. Only patients in whom component separation was part of the procedure were included for the final analysis. Patients were identified using relevant International Classification of Diseases-Clinical Modification (ICD-9-CM) and Current Procedural Terminology (CPT) codes. Patients without CT scans within 3 months before surgery and those under the age of 18 years were excluded.

Patients' medical records were queried for sociodemographic, preoperative and postoperative clinicopathologic, and CT image data. De-identified patient data were used for all subsequent assessments. Baseline characteristics included age, gender, body mass index (BMI), past medical history, and length of hospital stay (in days). The date of the last clinic visit was used to determine the length of follow-up. The primary outcome parameter was the rate of wound healing complications including delayed wound healing and surgical site/mesh infection. A secondary parameter of interest was the incidence of hernia recurrence. A full list of the parameters of interest is presented in [Table 1](#). Delayed wound healing was defined as a wound requiring debridement and healing by secondary intention.

The criteria for a readmission episode to be included as a parameter were as follows: Admission to the hospital due to (1) surgical complication (e.g., infection requiring intravenous antibiotics or drainage) or (2) surgical treatment for repair of ventral hernia recurrence. All other readmissions such as those for preplanned or unrelated procedures were excluded.

### Computed tomography scan analysis and determination of sarcopenia

Preoperative abdominal CT scans were analyzed to determine the presence of sarcopenia based on morphometric measurements. Using OsiriX v.7.0.1 32-bit (open-source software; [www.osirixviewer.com](http://www.osirixviewer.com)), cross-sectional psoas muscle area was measured in a semiautomated manner with manual outlining of the left and right psoas muscles at the superior border of the L4 vertebrae as previously reported ([Figure 1](#)).<sup>19,24-26</sup> The Hounsfield unit calculation (HUC), a measure of psoas muscle density and fatty infiltration, was determined for both left (LHUC) and right (RHUC) psoas muscles as previously described.<sup>27</sup> LHUC and RHUC measurements were averaged to determine the final

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