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Sarcopenia and sarcopenic obesity in patients with complex abdominal wall hernias

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Abstract

BACKGROUND: Chronic muscle wasting, or sarcopenia, has been associated with poor-health outcomes after major surgical procedures. Here, we explore the utility of CT-generated determinations of sarcopenia as markers of risk in patients undergoing evaluation for complex ventral hernia repair.

METHODS: In 148 successive patients being evaluated for complex ventral hernia repair, CT scans were analyzed retrospectively for attributes of the hernia and indices of core-muscle mass, correlating them with preoperative clinical/laboratory profiles and outcomes in 82 patients who had undergone surgery.

RESULTS: Prevalence of sarcopenia, and sarcopenia corrected for obesity, was 26% and 20% respectively. Sarcopenia was associated with age, some laboratory indicators, and increased hospital length of stay but not with a higher likelihood of surgical site occurrence.

CONCLUSIONS: Obesity may obscure the value of sarcopenia as a marker of metabolic disturbance and postoperative outcome. Image-based measurements of core-muscle mass should be used with caution as predictors of risk in similar surgical populations.

Originally described as a consequence of aging, sarcopenia has been defined as a loss of muscle mass associated with impairment of muscle functionality including alterations in strength, balance, exercise capacity, and efficiency of glucose metabolism.[1–3] The loss of muscle mass and its impact has been observed in catabolic states induced by cirrhosis, immunosuppressive agents, and advanced malignancies.[4–9] Moreover, it has been suggested that imaging modalities such as computerized tomography (CT) scanning may provide objective and independent measures of volume and density of core musculature.[10] In patients with specific malignancies or those undergoing major surgical procedures such as liver transplantation, open aneurysm repair, or major visceral resections, image-based measures of reduced muscle mass has been associated with increased morbidity, longer hospital stays, higher infection rates, and higher mortality.[4–9] Similarly, the metabolic burdens of

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general laparotomy and complex abdominal wall hernia repair may be substantial, suggesting that sarcopenia could potentially serve as a predictor of poor recovery and adverse outcomes in a population of patients undergoing complex abdominal hernia repair.[11–13]

Attention has recently been focused on sarcopenia associated with obesity, an association that is now referred to as an independent entity, "sarcopenic obesity." This condition, attributed to the infiltration of muscle with fat and associated with inflammatory states such as metabolic syndrome, has been linked with poor long-term health outcomes including poor survival after resection of cancer and mortality in cardiovascular disease.[14–17] Obesity itself is a well recognized but not entirely consistent risk factor for adverse outcomes after major abdominal operations.[18,19] A singular challenge of the patient group with large and recurrent ventral hernias is the overwhelming prevalence of obesity, a likely driver of many other operative comorbidities. Efforts to identify factors that disturb metabolism or influence surgical outcomes in patients with complex ventral hernias should not underplay the role of obesity.

To our knowledge, the prevalence and implications of sarcopenia in the formation and repair of abdominal wall hernias has not been reported. Given the substantial anabolic requirements for recovery after major abdominal operations, we initiated this study to evaluate the hypothesis that sarcopenia would be associated with adverse outcomes and delays in recovery within this medically complex patient group.[11,12] The main objective of this study was to use CT-based measurements to determine the prevalence of sarcopenia and sarcopenic obesity in this patient population. An additional objective was to determine whether these measurements would be associated with preoperative clinical and laboratory profiles or postoperative recovery and complications.

Methods

Patient cohort

Data were collated from a prospectively maintained database of 159 consecutive patients referred for evaluation of primary or recurrent complex ventral hernias by a single general surgeon from July 2011 to March 2013 at the Penn State Milton S. Hershey Medical Center. Routine patient assessment included detailed history and physical, and when indicated, an abdominal CT. Inclusion criteria included all the patients 18 years or more of age with a CT scan encompassing all abdominal wall defects and a body habitus that was adequately visualized within the confines of the scanning field. Patients were excluded from the study if clinical documentation was incomplete. Standardized laboratory evaluations including markers for stress, anemia, micronutrient imbalance, and organ functionality were performed in most patients, as described elsewhere.[20] These laboratory measures included white blood cell count, hemoglobin, mean corpuscular volume, red blood cell distribution width, blood urea nitrogen, creatinine, random glucose, C-reactive protein, albumin, total protein, calcium, zinc, alkaline phosphatase, alanine aminotransferase (ALT), and aspartate ALT. Eight common comorbidities were tracked, including: diabetes, obstructive sleep apnea or lung disease, chronic renal insufficiency, hepatitis or liver disease, hypertension, hyperlipidemia or statin use, gastroesophageal reflux disease, and anxiety or depression. CT image analysis was carried out with Aquarius iNtuition software (version 4.4.7, TeraRecon, Inc., San Mateo, CA).

Dimensions of the hernia defect and hernia contents

Attributes of the hernia provide perspective on comparability of patient cohorts and strategies of repair.[21–24] CT images were used to quantify the maximum dimensions of the hernia defect (transverse, longitudinal) and hernia sac (transverse, longitudinal, anterioposterior).[25] The hernia defect area was calculated using the formula for the area of an ellipsis (A):

$$A = (\pi)(a)(b)$$

where a and b are the largest transverse and longitudinal measurements divided by 2, respectively. Because different attributes of the hernia defect are potentially relevant to methods of repair and the biological stress placed on the patient, we analyzed images for (a) the area of the single largest defect if multiple defects were present, and reported as the largest defect area (cm^2); (b) the sum of the areas of all observable defects on CT, and reported as the summed defect area (cm^2); and (c) the total area of the abdominal wall containing all defects, reported as the abdominal defect area (cm^2), calculated as the product of the distance between the most lateral margins (maximum transverse) and the most superior aspect of the cranial to most inferior aspect of the caudal (maximum longitudinal) defects. Thus, the abdominal defect area represents the total area of potential weakness in the abdominal wall.

Hernia volume was estimated using the formula of an ellipsoid (V):

$$V = (4/3)(\pi)(r1)(\mathrm{r2})(\mathrm{r3})$$

with r1, r2, and r3 as the largest transverse, longitudinal, and anteroposterior distances divided by 2, respectively.[25] The established parameters to describe the hernia volume include both the largest hernia volume (cm^3) and the summed hernia volume (cm^3), with the latter used as a surrogate for the loss of domain (volume of tissue extending beyond the confines of the peritoneum).